VEBM450104

Shop Manual

WA320-3

Wheel Loader

Serial Number

WA320H20051 and up

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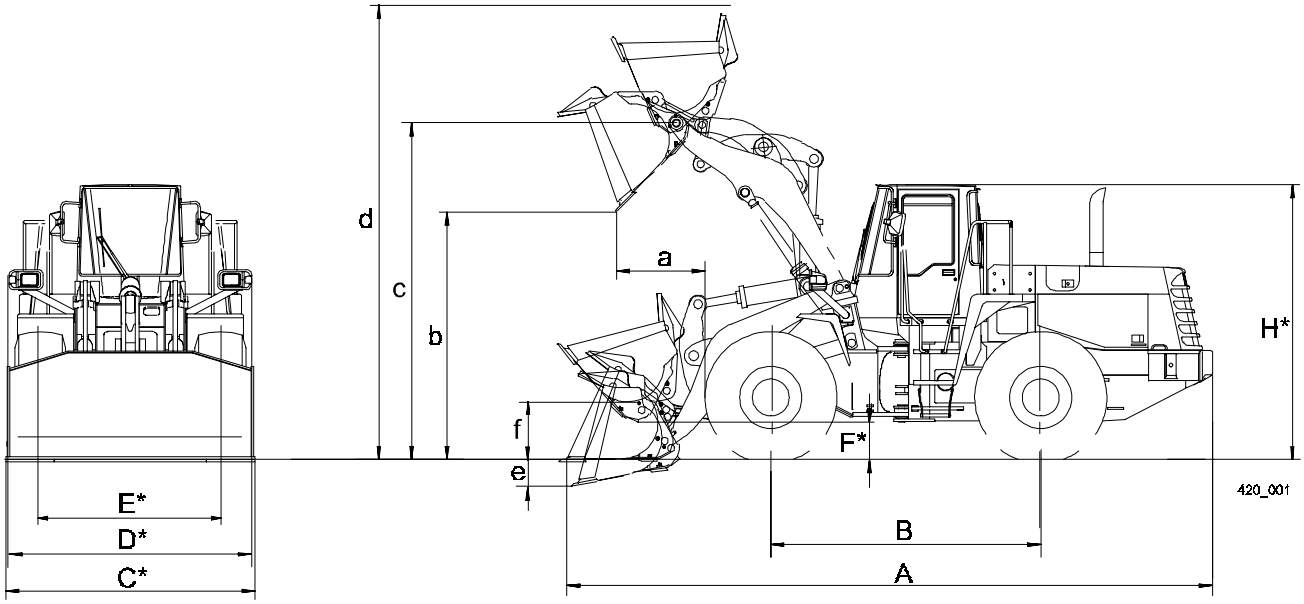
Up to SN WA320H20560

DIMENSIONS, WEIGHTS AND OPERATING DATA



Buckets (capacities in accordance to ISO 7546) m^3		**2,6**	**2,9**
Specific density	t/m^3	1.75	1.6
Bucket weight w/o teeth	kg	1.185	1.230
Stat. tipping weights, straight	kg	11.730	11.430
Stat. tipping weights, articulated 40°	kg	10.100	9.820
Breakout force hydraulic	kN	129	124
Hydraulic lifting capacity, on ground	kN	145	144
Operating weight	kg	13.740	13.785
a Reach at full lift 45°	mm	1.032	1.067
b Dumping height 45°	mm	2.820	2.785
c Lift height, hinge pin	mm	3.814	3.814
d Bucket to edge height	mm	5.162	5.162
e Digging depth	mm	58	58
f Carry height, hinge pin	mm	442	442
A Overall length	mm	7.257	7.307
B Wheelbase	mm	3.030	3.030
C Bucket width	mm	2.740	2.740
D Width less bucket	mm	2.598	2.598
E Track width	mm	2.050	2.050
F Ground clearance	mm	380	380
H Overall height	mm	3.315	3.315

Modified space due to:

	Additional Counter-weight	Solid tyres
Weight	+ 325kg	+ 820kg
Dump load		
0°	+ 865kg	+ 1345kg
45°	+ 720kg	+ 1180kg
Overall length	+ 175mm	

Special buckets:
3,8 m^3 - light material bucket

The 2,6/2,9 m^3 standard buckets shown in the table can be supplied with bold on cutting edge.

Material	Bucket contents %	Density t/m^3
Earth	100-115	1.5-1.6
Clay	110-120	1.5-1.7
Sand	100-110	1.4-1.8
Gravel	100-110	1.5-2.0
Rock	75-100	1.6-2.0

LIST OF LUBRICANT AND WATER

WA320-3	LUBRICANTS, FUEL ETC. AND FILLING CAPACITIES					
	Lubricants, fuel etc.	**BI code ****)**	**Quality grades**	**Temperature ranges**	**Viscosity ranges**	**Approx. filling capacity in litres**
Engine	Engine oil EO	EO 1540 A EO 1030 A NRS	CCMC D4 or, if not available, API CE or API CF -4 [2])	-10° to 50° C -25° to 20° C -40° to 20° C	SAE 15W-40 *) SAE 10W-30 SAE 05W-30	22,5 (19 **)
Transmission	Engine oil EO	EO 10	CCMC D4 or, if not available, API CD	-	SAE 10W	42 (40**)
Axles with standard locking differentials type KWA 012 W-1 KWA 012 W-2	Universal transmission and hydraulic oil	NRS	Fuchs: RENOGEAR HYDRA ZF 20W-40*) Komatsu: AXO 75 Caltex: RPM TRACTOR HYDRAULIC FLUID Chevron: TRACTOR HYDRAULIC FLUID Texaco: TDH OIL Mobil: MOBILAND SUPER UNIVERSAL			2x25
	or engine oil EO	EO 30	CCMC D4 or, if not available, API CD	-	SAE 30	
Axles with multi-disc locking differentials type KWA 012 W-3 KWA 012 W-4	Universal transmission and hydraulic oil	NRS	Fuchs: RENOGEAR HYDRA ZF 20W-40*)			
Hydraulic system, steering, brakes	Hydraulic oil HYD	HYD 0530	HVLP, HVLP D	-35° to 50° C	ISO VG 46 *)	165 (116**)
	or engine oil EO	EO 10	CCMC D4 or, if not available, API CD	-35° to 40° C	SAE 10W	
	or hydraulic oil BIO-E-HYD	BIO-E-HYD 0530	HEES (to VDMA fluid technology)	-35° to 50° C	ISO VG 46	
Cooling system	Long-life coolant with anti-frost and rust prevention SP-C	SP-C	Anti-frost and rust prevention			30
Fuel tank	Diesel fuel [3])	CFPP class B CFPP class D CFPP class E CFPP class F	DIN-EN 590	up to 0°C up to -10°C up to -15°C up to -20°C		221
Grease nipples, central lubrication	Multi-purpose grease MPG on a lithium base	MPG-A	KP2N-20	-10° to 50° C -35° to -10° C	NLGI 2 *) NLGI 0	
Air conditioning	Coolant Refrigerating machine oil	NRS NRS	R134a (CFC-free) PAG (polyalkylglycol oil)			1500 g 150 cm [3]

The specified filling capacities are approximate guidelines; test specifications are binding. The selection of the viscosity class depends on the predominantly existing outside temperature. The temperature limits are to be regarded as guidelines which can be exceeded up or down for a brief period.

*) Works filling **) Top-up quantity

[2]) If no engine oil of the API CE or API CF-4 specification is available, API CC or API CD-classified engine oil can be used alternatively. The oil change intervals must be split in half in this case, however.

[3]) If the fuel sulphur content is between 0.5 and 1.0 %, the oil change interval must be 1/2 normal. With a sulphur content of more than 1.0 %, the oil change interval must be 1/4 normal.

****) BI codes are the "standard lubricants" for construction machinery and vehicles of the Hauptverband der Deutschen Bauindustrie e.V. (BI). The brochure "Regelschmierstoffe für Baumaschinen- und Fahrzeuge" (Standard Lubricants for Construction Machinery and Vehicles" can be obtained from bookstores or Bauverlag GmbH, Wiesbaden and Berlin, under the ISBN no. 3-7625-3102-1.

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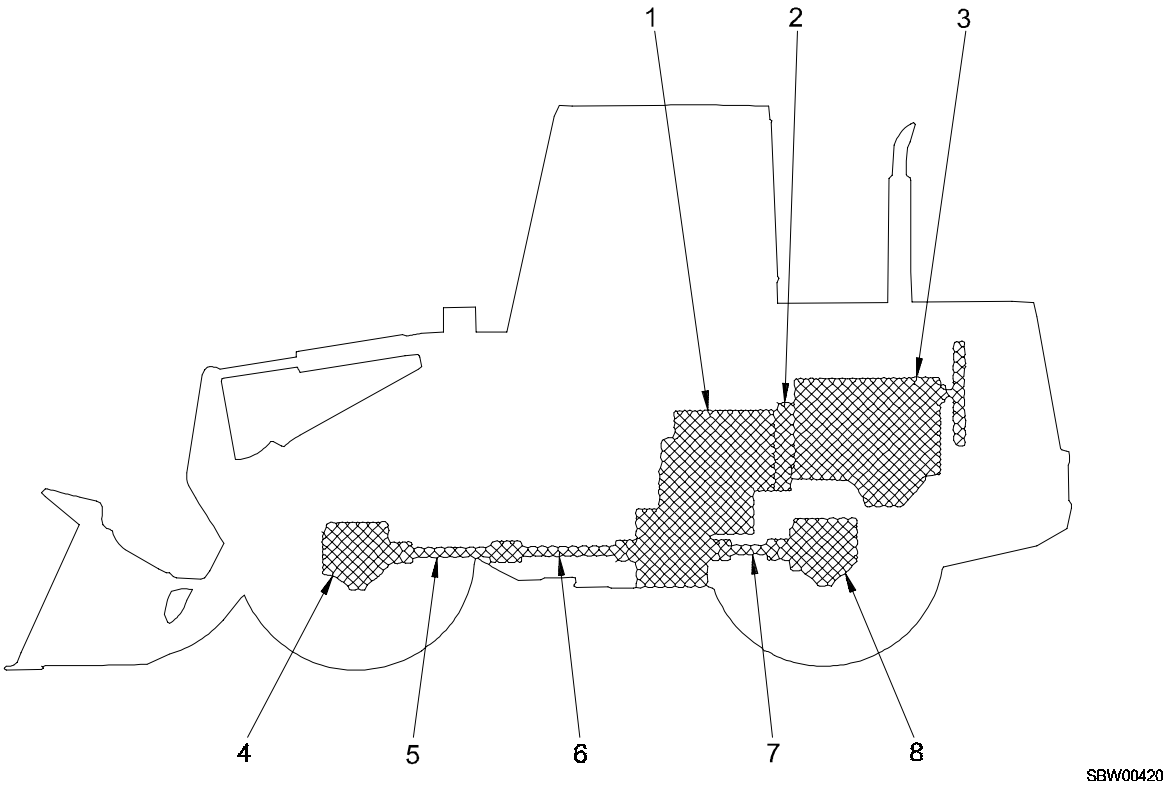
POWER TRAIN

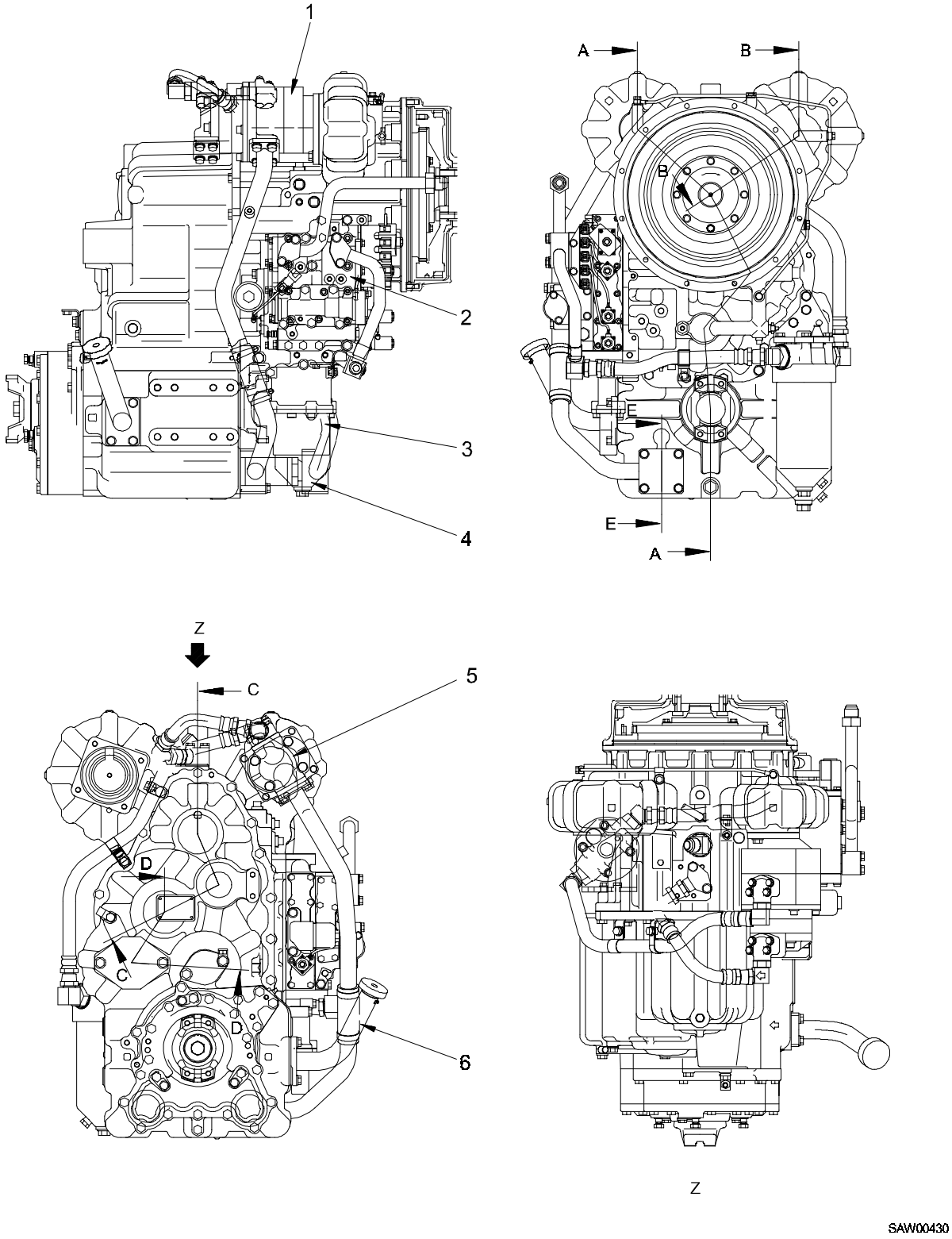


1. Transmission
2. Torque converter
3. Engine
4. Front axle
5. Front drive shaft
6. Center drive shaft
7. Rear drive shaft
8. Rear axle

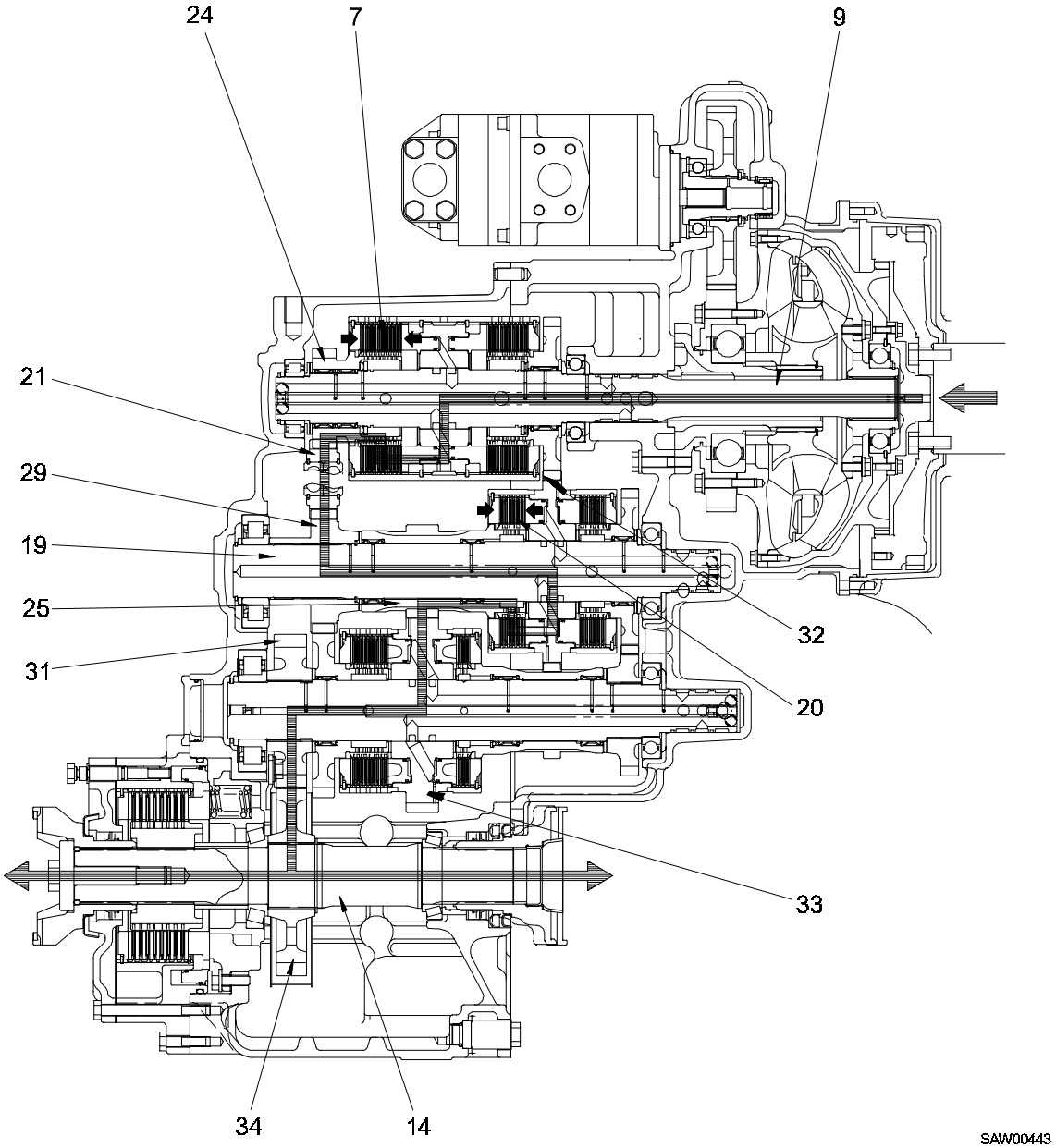
Outline

- The motive force from engine (3) passes through the engine flywheel and is transmitted to torque converter (2), which is connected to the input shaft of transmission (1).
- The transmission has six hydraulically actuated clutches, and these provide four speed ranges for both FORWARD and REVERSE. The transmission speed ranges are selected manually.
- The motive force from the output shaft of the transmission passes through center drive shaft (6), front drive shaft (5) and rear drive shaft (7), and is then transmitted to front axle (4) and rear axle (8) to drive the wheels.

TRANSMISSION



REVERSE 1ST



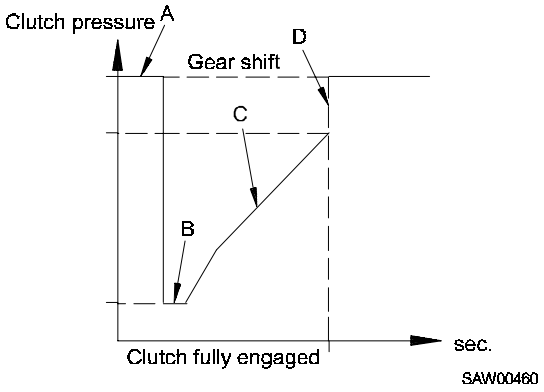
Operation

- In reverse 1st, reverse clutch (7) and 1st clutch (20) are engaged. The motive force from the torque converter transmitted to input shaft (9) is transmitted to output shaft (14).
- The clutch discs of reverse clutch (7) and 1st clutch (20) are held by the hydraulic pressure applied to the piston.
- The motive force from the torque converter is transmitted from input shaft (9) via reverse clutch (7) to reverse gear (24). The direction of rotation is reversed by idler gear (21), and the motive force is then transmitted to 1st and 3rd cylinder gear (32) via idler gear (29) and 1st and 3rd shaft (19). Since the 1st clutch is engaged, the motive force transmitted to 1st and 3rd cylinder gear (32) is transmitted from 1st gear (25) via the 1st clutch to 2nd and 4th cylinder gear (33), then transmitted to output shaft (14) via the 2nd and 4th shaft, idler gear (31) and output gear (34).

QUICK RETURN VALVE

Function

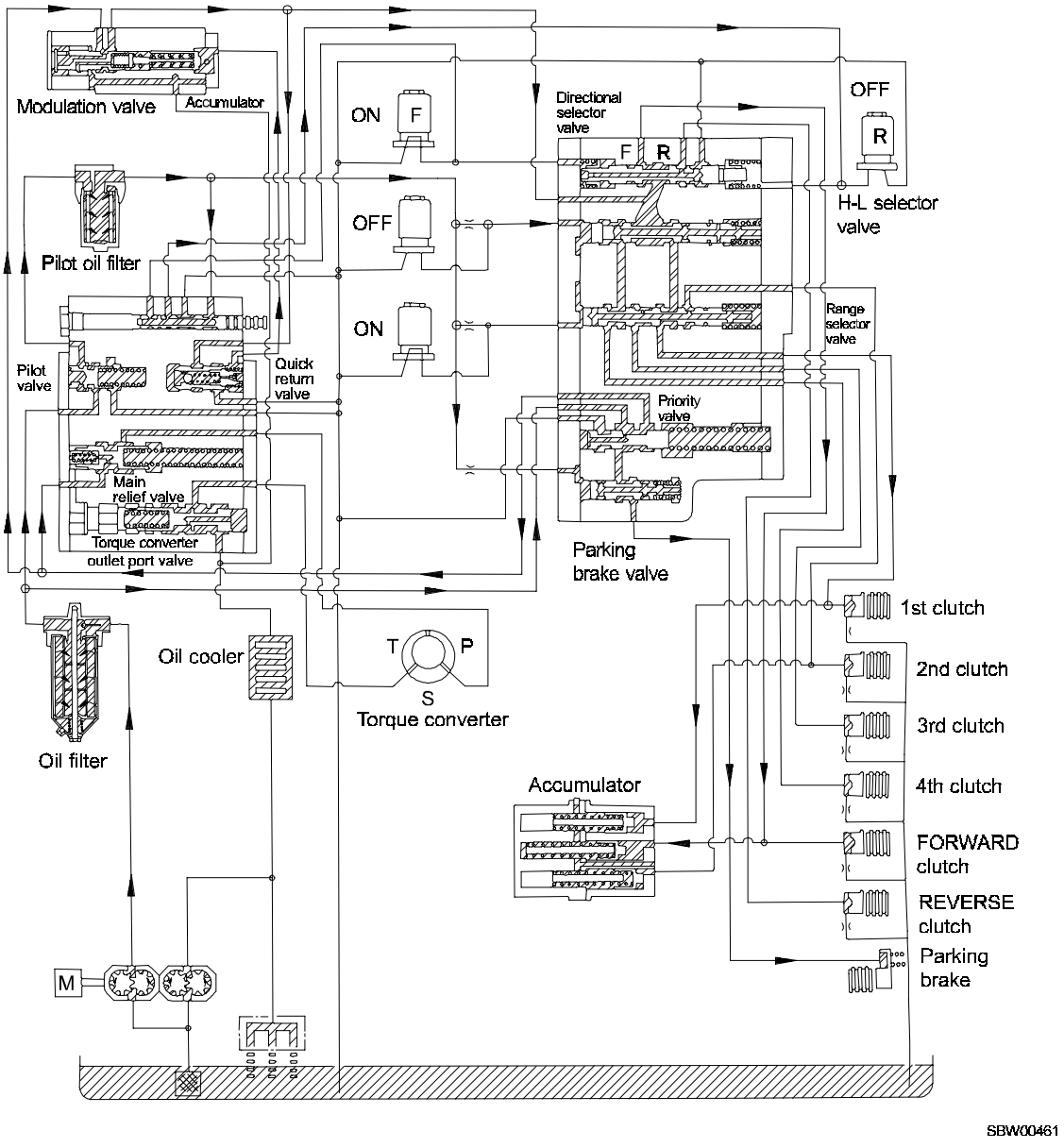
- To allow the modulation valve to raise the clutch pressure smoothly, the quick return valve sends the pressure in the accumulator acting on the modulation valve spool momentarily to the drain circuit when the transmission is shifted.



Operation

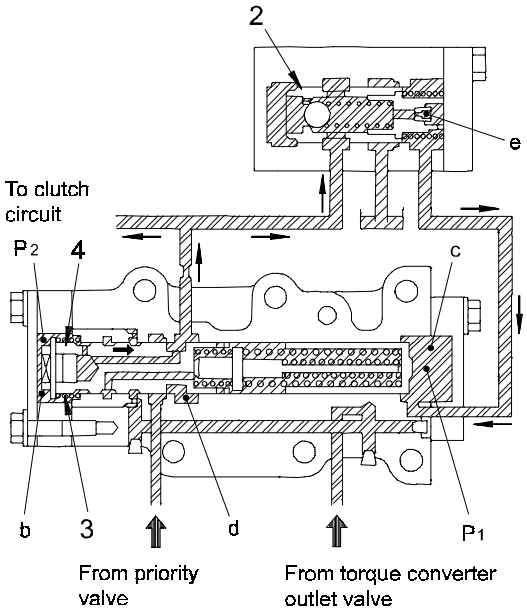
1. After engine is started, clutch completely engaged (clutch pressure at point A)

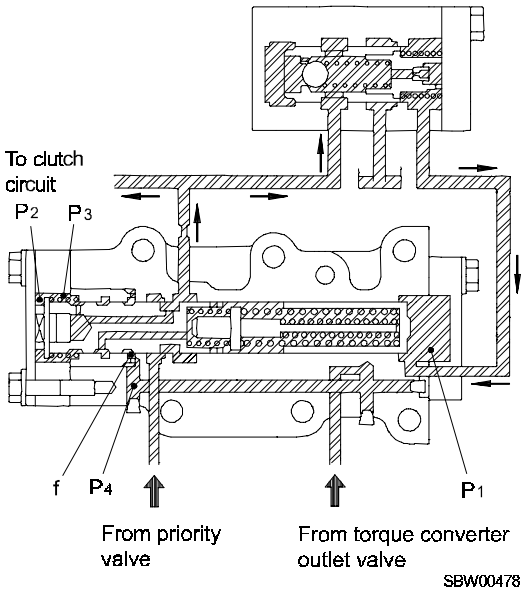
(FORWARD 1st)



3. Beginning of rise in clutch pressure (point C to point D)

- The pressure in the clutch circuit begins to rise when the oil from the priority valve fills the clutch piston.
  Quick return valve (2) moves to the right, and the drain circuit in the accumulator is closed.
- When the quick return valve's drain circuit closes, the oil which has passed through port d passes through fill valve (4) and enters port b, and the pressure P2 of chamber b begins to rise. At this time, the relationship between pressures P1 and P2 of the accumulator section is P2 > P1 + P3 (oil pressure equivalent to spring (3) tension). Fill valve (4) moves to the right, shutting off port d and preventing the clutch pressure from rising suddenly.
- The oil at port d flows into the clutch circuit, and since P2 > P1 + P3 it simultaneously passes through quick return valve (2) orifice e and flows into accumulator chamber c. Both pressures P1 and P2 increase. This action is repeated, while maintaining the relationship P2 = P1 + P3 (oil pressure equivalent to spring (3) tension), and the clutch pressure gradually rises.
- The pressure at the torque converter outlet is released to fill valve port f. The pressure at the torque converter outlet changes according to the engine speed.
- Thus, because of the relationship P2 = P1 + P3 + P4 (the pressure at port f which varies according to the engine speed), pressure P2 changes by the same amount as pressure P4. Since pressure P2 increases by the amount of increase of pressure P4, it is possible to create oil pressure characteristics corresponding to the engine speed.





TORQUE PROPORTIONING DIFFERENTIAL

Function

- Because of the nature of their work, 4-wheel-drive loaders have to work in places where the road surface is bad. In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced. The torque proportioning differential is installed to overcome this problem.
- In structure it resembles the differential of an automobile, but differential pinion gear (4) has an odd number of teeth. Because of the difference in the resistance from the road surface, the position of meshing of pinion gear (4) and side gear (3) changes, and this changes the traction of the left and right tires.

Operation

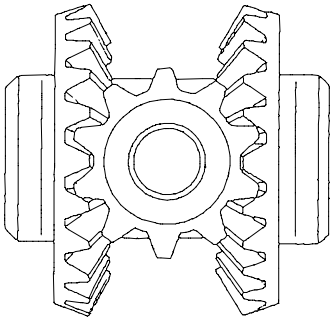
When traveling straight (equal resistance from road surface to left and right tires)

- If the resistance from the road surface to the left and right wheels is the same, the distance between pinion gear (4) and meshing point “a” of left side gear (7) is the same as the distance between pinion gear (4) and meshing point “b” of right side gear (3).
- Therefore the left side traction TL and the right side traction TR are balanced.

When traveling on soft ground (resistance from road surface to left and right tires is different)

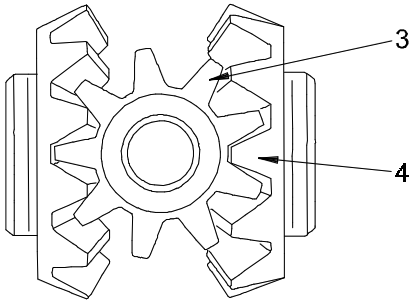
- On soft ground, if the tire on one side slips, the side gear of the tire on the side which has least resistance from the road surface tries to rotate forward. Because of this rotation, the meshing of pinion gear (4) and side gear changes.
- If left side gear (7) rotates slightly forward, the distance between the pinion gear and the meshing point “a” of the left side gear becomes longer than the distance between the pinion gear and the meshing port “b” of the right side gear. The position is balanced as follows.
  a x TL = b x TR
  The ratio between the distances to “a” and “b” can change to 1 : 1.38.
- Therefore when the ratio of the distances to “a” and “b” is less than 1 : 1.38 (that is, the difference between the resistance from the road surface to the left and right tires is less than 38%), the pinion gear will not rotate freely, so drive force will be given to both side gears, and the tires will not slip.
  Because of this effect, the tire life can be increased by 20 – 30%, and at the same the operating efficiency is also increased.

Ordinary differential



SEW00080

Torque proportioning differential



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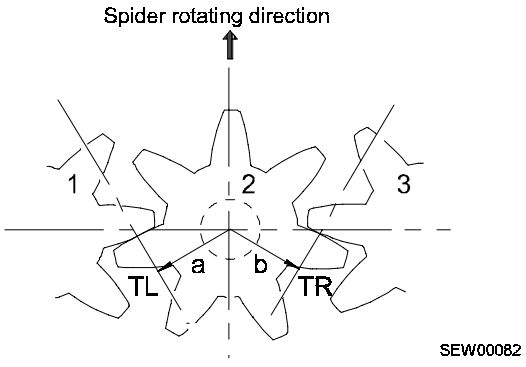
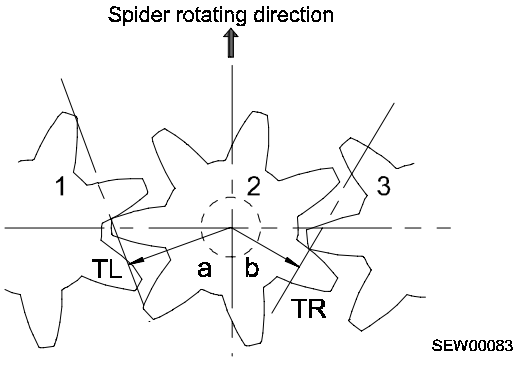


SEW00082



SEW00083

Operation

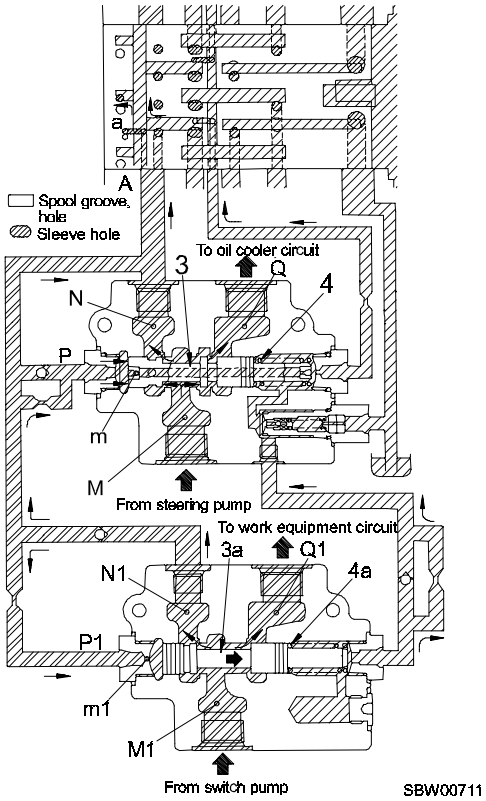
1. Steering wheel at neutral

When the engine is stopped, spools (3) and (3a) are pushed fully to the left by the tension of springs (4) and (4a). In this condition, the circuits between ports M and N and between ports M1 and N1 are fully open, while the circuits between ports M and Q and between ports M1 and Q1 are fully closed.

If the engine is started and the steering pump and switch pump start to turn, the oil from the pumps goes from port M to port N and from port M1 to port N1, and then enters port A of the steering valve.

The oil entering port A is throttled by orifice a, so the pressure in the circuit rises.

When this happens, the oil passing through orifices m and m1 in spools (3) and (3a) enters ports P and P1. It then compresses springs (4) and (4a), and moves spools (3) and (3a) to the right in the direction of the arrow. This stabilizes the condition so that the circuits between ports M and Q and between ports M1 and Q1 are almost fully open and the circuits between ports M and N and between ports M1 and N1 are almost fully closed. Therefore, the oil from the steering pump almost all flows to the oil cooler circuit, and the oil from the switch pump flows to the work equipment circuit.



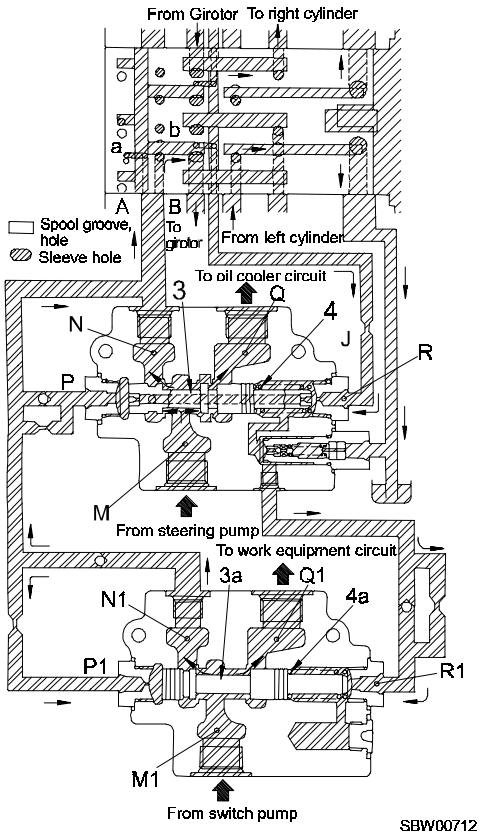
2. Steering wheel turned to left

When the steering wheel is turned to the left, an angle variation is generated between the spool and sleeve of the steering valve, and the oil flow is switched. (For details, see STEERING VALVE.)

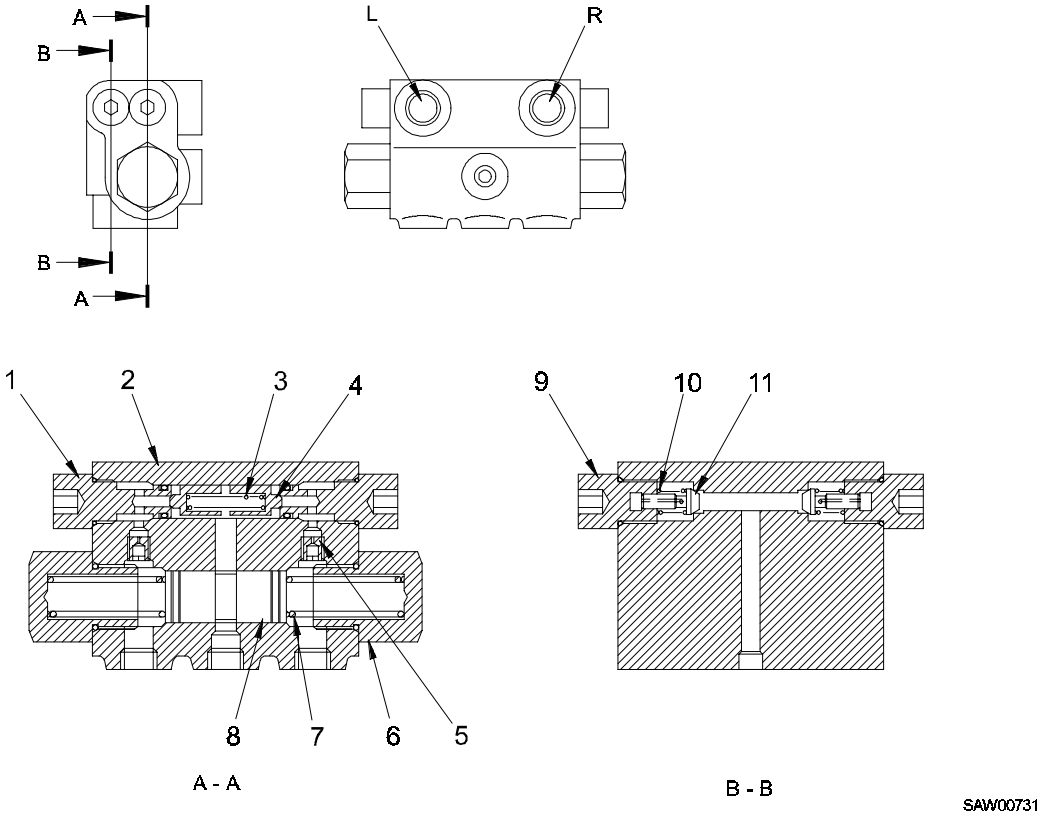
The oil from the pump flows from port M to port N and from port M1 to port N1, and enters port A. The degree of opening of the sleeve (port A) and spool (port B) of the steering pump creates a difference between the pressure up to port A and the pressure beyond port B. Some of the oil from port B flows to the Girotor, and then goes to the front right cylinder. The remaining oil passes through orifice b, flows to port J, and then enters ports R and R1.

When this happens, spool (3) stabilizes at a position where the differential pressure between the circuit up to port A and circuit beyond port B (pressure of port P – pressure of port R) and the load of spring (4) are balanced. It adjusts the degree of opening from port M to ports N and Q, and distributes the flow to both circuits.

At the same time, spool (3a) stabilizes at a position where the differential pressure between the circuit up to port A and circuit beyond port B (pressure of port P1 – pressure of port R1) and the load of spring (4a) are balanced. It adjusts the degree of opening from port M1 to ports N1 and Q1, and distributes the flow to both circuits.



CUSHION VALVE



1. Valve seat
2. Valve body
3. Spring
4. Poppet
5. Orifice
6. Plug
7. Spring
8. Spool
9. Plug
10. Spring
11. Poppet

L. Steering cylinder port
R. Steering cylinder port

Outline

- When there is a reaction to the sudden rise in the pressure of the steering cylinder, the cushion valve acts to prevent shock by relieving the momentary high pressure oil to another line.

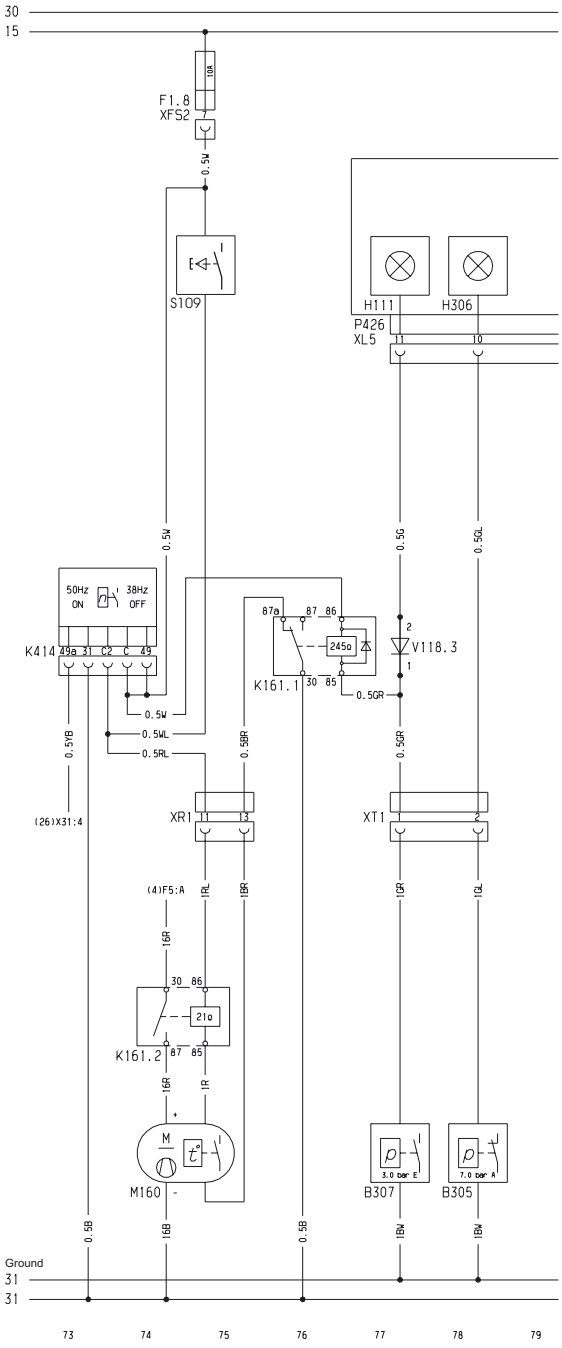
Function

- If high pressure oil suddenly enters from port R, the high pressure oil compresses spring (3), and pushes open poppet (4). It then passes through the center groove of spool (8), goes through poppet (11) of port L, and flows to port L.
- At the same time, the high pressure oil passes through orifice (5) and goes to the pressure chamber of plug (6). When it becomes greater than the pressure at port L and the force of spring (7), it pushes spool (8) fully to the left. This shuts off the flow of high pressure oil from port R through poppet (4) to port L. This temporary flow of oil has a cushion effect. The valve is not actuated any further, so there is no effect on the steering, and the steering operates as normal.
- When the pressure rises slowly and there is no need for any cushion effect, spool (8) closes more quickly than poppet (4) opens, so there is no unnecessary cushion action.

WIRING DIAGRAM EMERGENCY STEERING

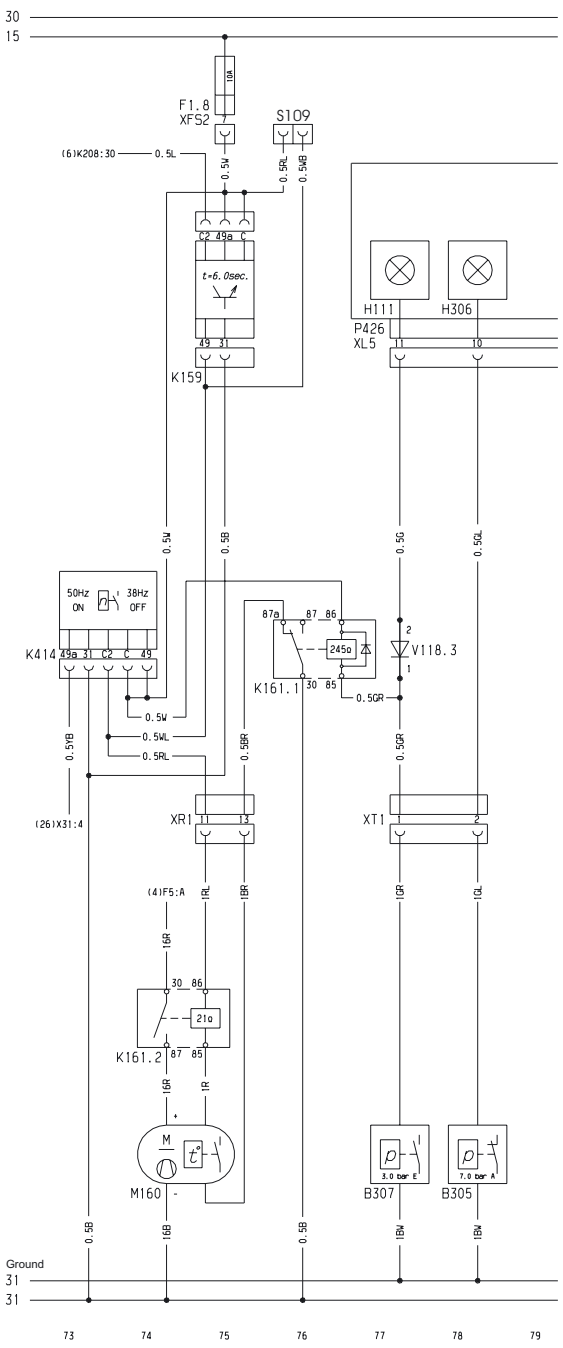
SN WA320H20711 and up

Operating mode with test switch (up to WA320H20782)

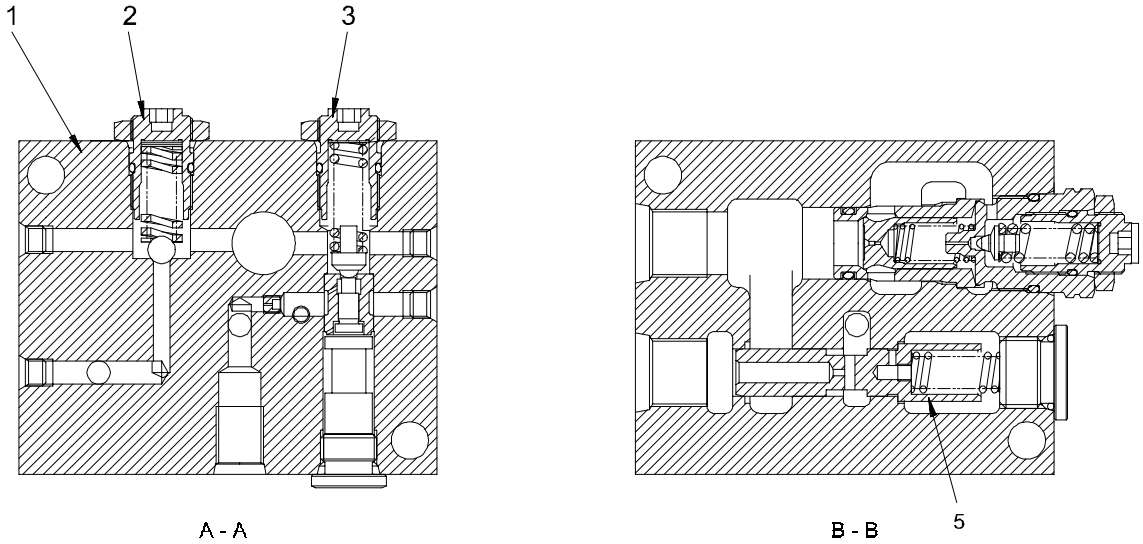


	Description
H111	Lamp steering oil pressure
H306	Lamp energency steering
S109	Switch test emergency steering pump
V118	Diode
XFS	Connector fuses
XL	Connector platform
XR	Connector rear frame

Operating mode with timer relay (WA320H20783 and up)



	Description
B305	Flow indicator emergency steering pump
B307	Sender air pressure
K159	Relay test emergency steering pump
K161	Relay emergency steering pump
K414	Rpm sensor emergency steering pump
P426	Main Monitor
M160	Emergency steering pump



1. Valve body
2. Safety relief valve (R_3)
3. Relief valve (R_1)
4. PPC relief valve (R_2)
5. Relief valve (H_1)

SDW00115

BRAKE VALVE (DUAL CIRCUIT)

Serial Number: WA320H20483 and up

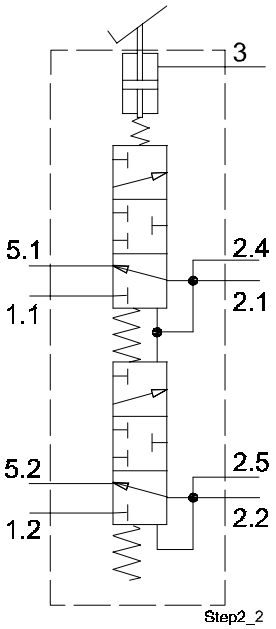
Function:

- The purpose of the brake valve is to allow a controlled increase or decrease of brake pressure when the brake pedal is operated.

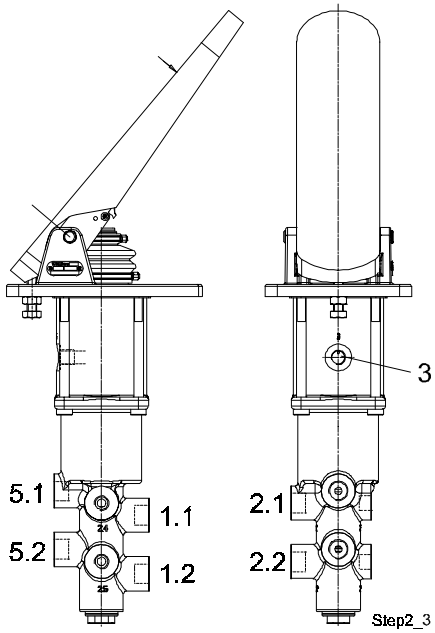
Operation:

Brakes released:

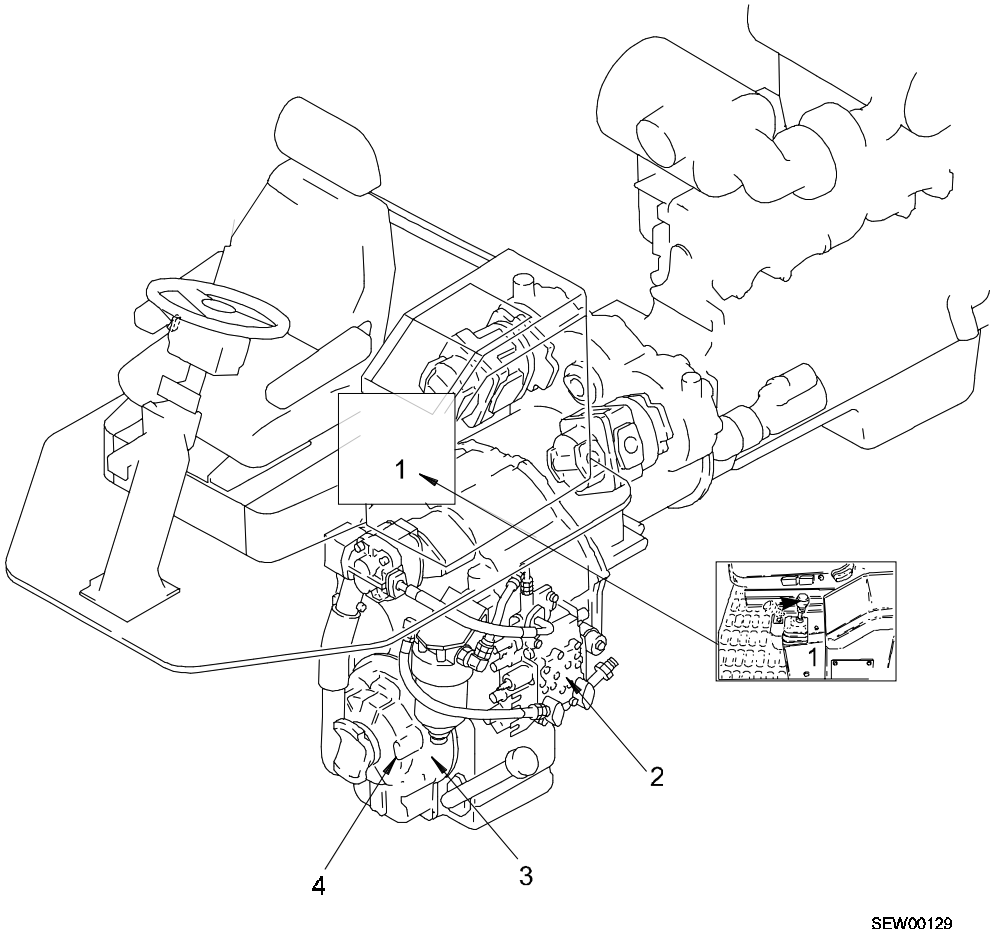
- Accumulator pressure is available at inlet ports 1.1 / 1.2 of the brake valve. Ports 2.1 / 2.2 are connected to the return ports 5.1 / 5.2 and the wheel brake pressure is released.



1.1 / 1.2	From the brake accumulators
2.1 / 2.2	To the wheel brakes
2.4 / 2.5	Pressure check points
5.1 / 5.2	Return ports to the tank
A	Pilot pressure from left brake pedal



PARKING BRAKE CONTROL



1. Parking brake switch and valve
2. Transmission control valve
3. Transmission (built-in parking brake)
4. Parking brake emergency release switch

Outline

- The parking brake is a wet-type multiple-disc brake built into the transmission. It is installed to the output shaft bearing, and uses the pushing force of a spring to apply the brake mechanically and hydraulic power to release the brake.
- When parking brake switch (1) installed in the operator's compartment is switched ON, parking brake solenoid valve shuts off the oil pressure and applies the parking brake. When the parking brake switch is turned OFF, the oil pressure in the cylinder releases the parking brake.
- When the parking brake is applied, the neutralizer relay shuts off the electric current to the transmission solenoid valve and keeps the transmission at neutral.
- Emergency release switch for the parking brake is installed for use when moving the machine if the machine has stopped (the parking brake is automatically applied) because of trouble in the engine or drive system.

WORK EQUIPMENT HYDRAULIC DIAGRAM

From Serial Number: WA320H20561

up to Serial Number: WA320H20710

1. Hydraulic tank
2. Oil filter
3. Breather
4. Hydraulic pump
5. Steering pump
6. Switch pump
7. PPC, brake pump
8. Priority valve (Switch pump)
9. Priority valve (Steering pump)
10. Steering valve (Orbit-roll)
    - 10A. Safety and suction valve
11. Restrictor valve
12. Cushion valve
13. Steering cylinder
14. Filter
15. Accumulator charge valve
    - 15A. Safety relief valve
    - 15B. PPC relief valve
16. Accumulator

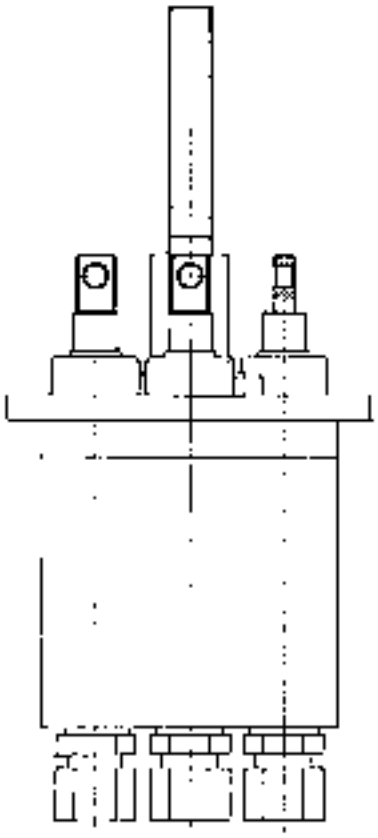
17A. PPC valve

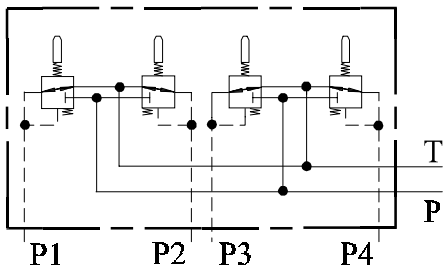
17B. PPC valve attachment spool

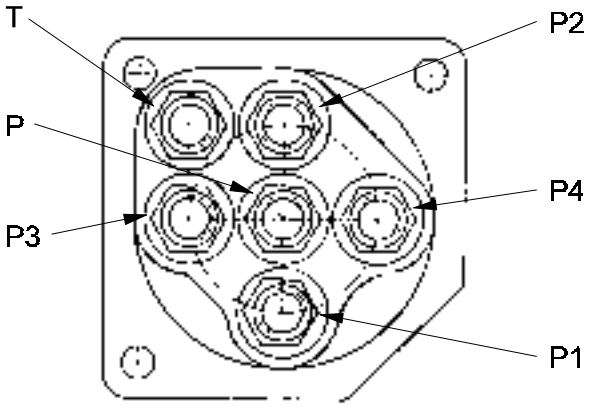
18. Oil cooler
19. Brake circuit
20. Main control valve
    - 20A. Boom spool
    - 20B. Bucket spool
    - 20C. Attachem. spool (Opt.)
    - 20D. Main relief valve
    - 20E. Suction valve
    - 20F. Shock and suction valve
    - 20G. Cut-off valve
21. Boom cylinder
22. Bucket cylinder
23. Emergency steering pump
24. Flow valve
25. Divider valve
26. Float valve
27. Safety valve
28. Attachm. cylinder (Opt.)

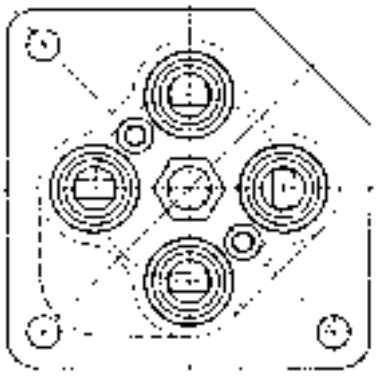
PPC VALVE

Serial Number: WA320H20344 up to
Serial Number: WA320H20560







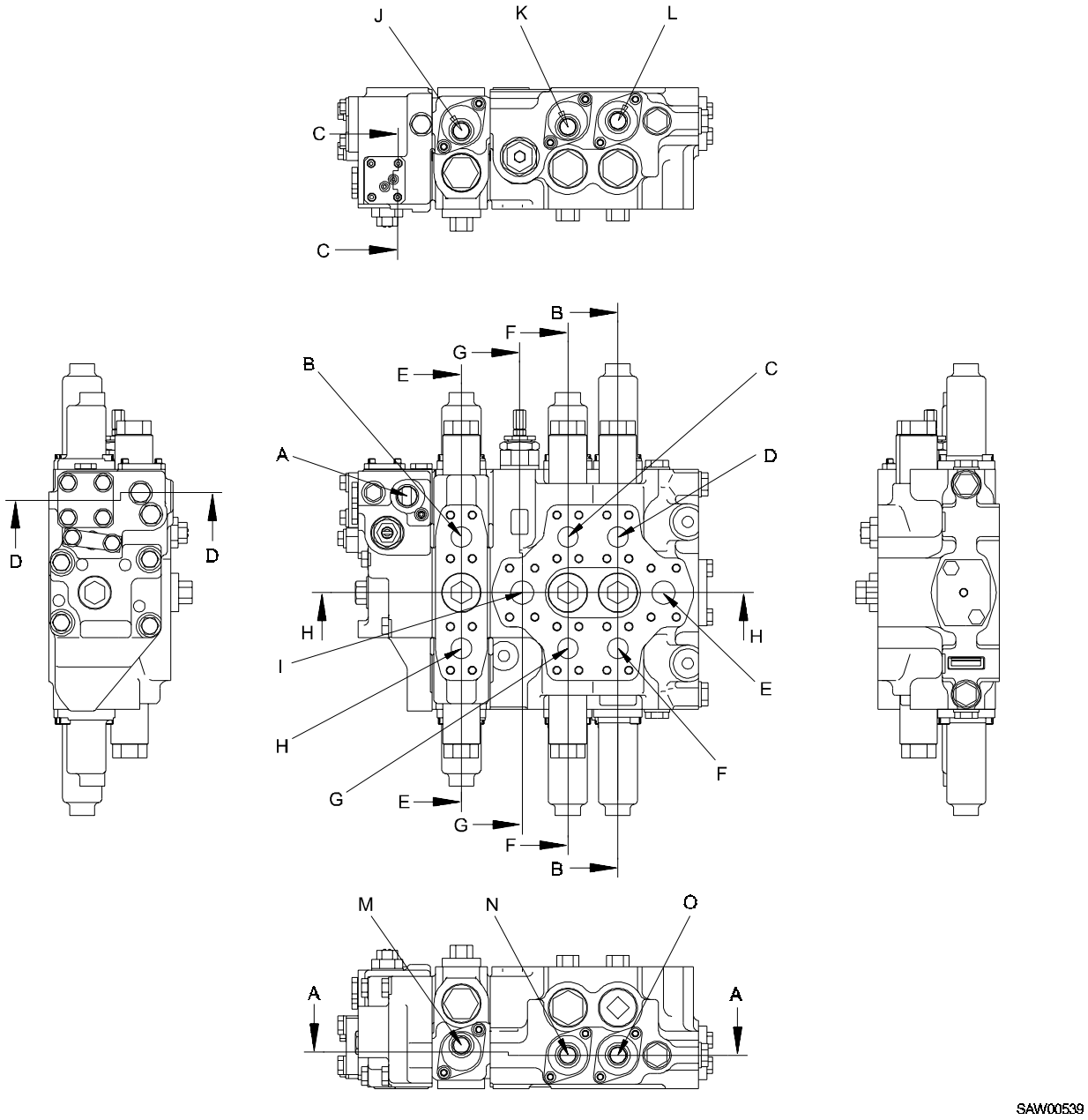


P. From PPC pump
P_1. To bucket cylinder bottom end
P_2. To boom cylinder head end
P_3. To boom cylinder bottom end
P_4. To bucket cylinder head end
T. Drain

For details, see PPC valce up to
SN WA320H20343

3-SPOOL

Up to Serial Number: WA320H20343

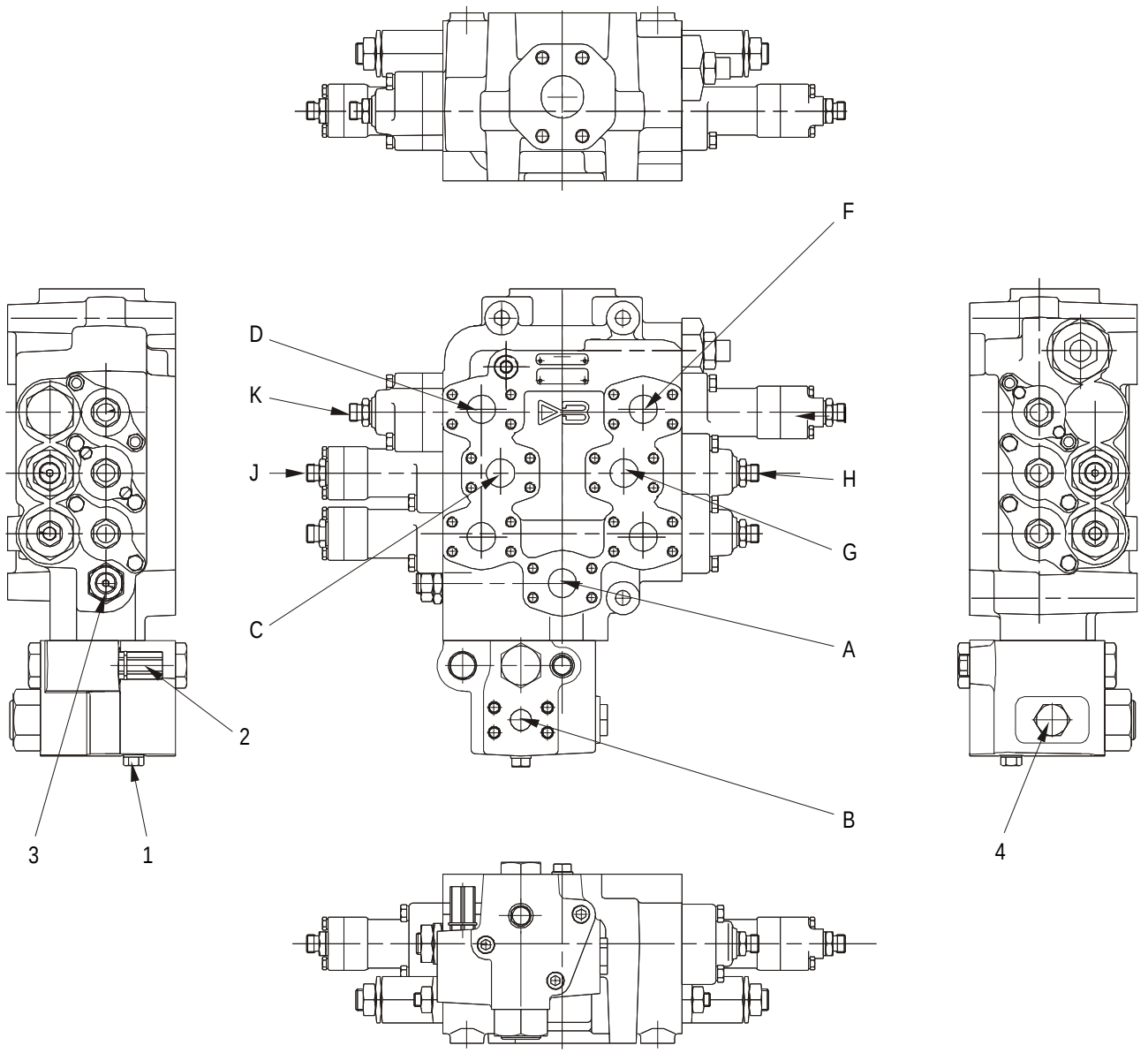


A. From switch pump (via steering valve)
B. To attachment cylinder
C. To bucket cylinder rod side
D. To boom cylinder rod side
E. Drain port (to tank)
F. To boom cylinder bottom side
G. To bucket cylinder bottom side
H. To attachment cylinder
I. From work equipment pump
J. From attachment PPC valve
K. From PPC valve port P1
L. From PPC valve port P3
M. From attachment PPC valve
N. From PPC valve port P4
O. From PPC valve port P2

MAIN CONTROL VALVE

3-SPOOL

Serial Number: WA320H20711 and up



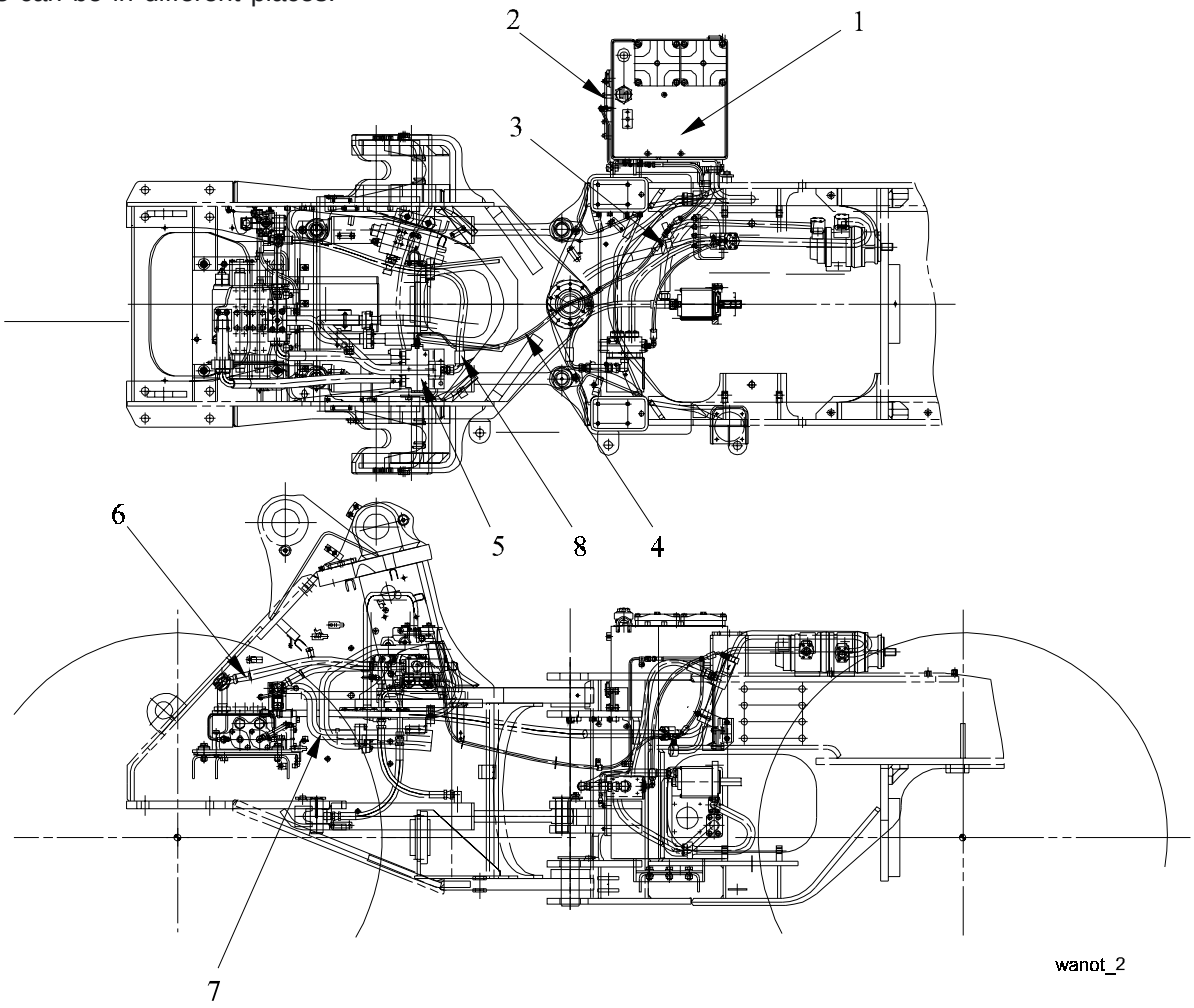
A. From work equipment pump
B. From switch pump (via steering valve)
C. To bucket cylinder rod side
D. To boom cylinder rod side
F. To boom cylinder bottom side
G. To bucket cylinder bottom side
H. From PPC valve port P1
I. From PPC valve port P3
J. From PPC valve port P4
K. From PPC valve port P2

1. Checkpoint cut-off pressure (M10x1)
2. Cut-off pressure valve
3. Main relief valve
4. To safety valve

HYDRAULIC SAFETY SYSTEM LOCATION

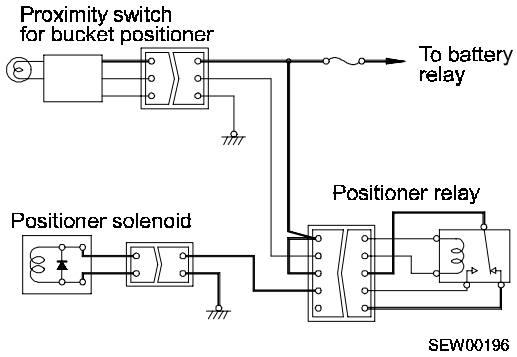
Up to Serial Number: WA320H20710

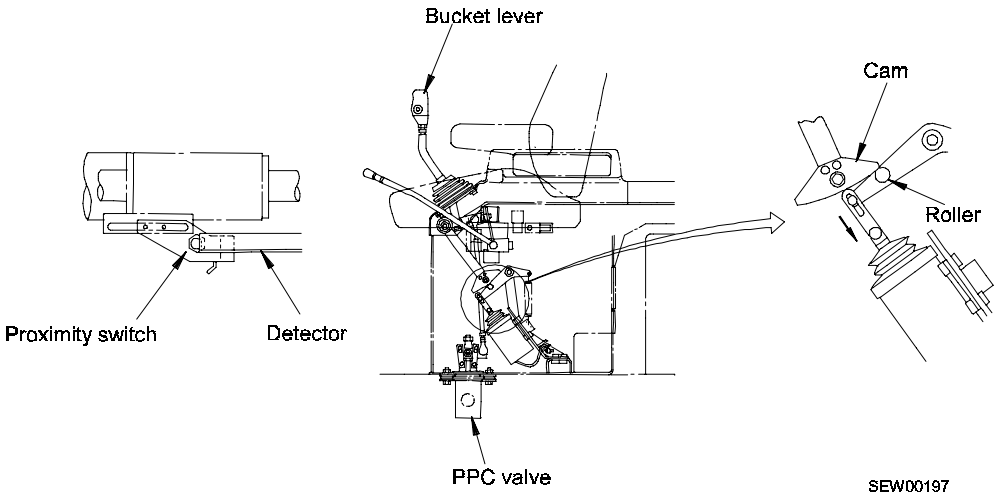
Schematic sketch only!
Ports can be in different places!



1. Hydraulic oil tank
2. Float valve
3. Restricted connection
4. Pilot pipe
5. Safety valve
6. Main working hydraulic pipe
7. Oil return pipe
8. Switch pump pressure pipe

- When the bucket tilts and reaches the set position for the bucket leveler, in other words, the detector (steel plate) separates from the detection surface of the proximity switch, electric current is sent to the solenoid by the action of the proximity switch and relay circuit.
  As a result, the solenoid is actuated, and the cam is pulled away from the cam detent, so the bucket spool is returned to the HOLD position by the return spring.





Action of proximity switch

Position	When detector is in position at detection surface of proximity switch	When detector is separated from detection surface of proximity switch
Proximity switch actuation display	Lights up	Goes out
Proximity switch load circuit (relay switch circuit)	Current flows	Current is shut off
Relay switch load circuit (solenoid circuit)	Current flows	Current is shut off

SHIFT CONTROL SYSTEM FUNCTION

INPUT SIGNALS

1. Directional lever
   This selects F (FORWARD), R (REVERSE), and N (Neutral).
2. Speed lever
   This selects the optimum speed range when using auto-shift FORWARD or REVERSE. Normally, if the speed lever is at position 2 or above, the transmission will be set to 2nd when the machine starts.
   When the auto shift used, and the gear shift lever is moved 4 → 3 → 2 → 1 when the machine is traveling with the transmission in force, the transmission will also shift down immediately 4 → 3 → 2 → 1. **(Priority given to speed lever!)**
3. Engine speed sensor
   When the engine is running at low speed (less than 1450 rpm), the auto shift is stopped. When shifting between forward and reverse or when coasting, the present speed range is maintained and the shift shock is reduced.
   When the machine is traveling in 2nd, and the engine speed changes from low speed (less than 1450 rpm) to high speed (more than 1450 rpm), the speed range is kept at 2nd to allow the machine to accelerate more easily.
4. Travel speed sensor
   The speed range is determined according to the travel speed. In addition, the change in speed is determined from the pulse count to decide whether to shift up or down.
5. Neutralizer
   The parking brake actuation signal is input to the controller and the transmission is shifted to neutral.
6. Transmission cut-off signal
   When the controller receives the transmission cut-off signal, it shifts the transmission to neutral. After the signal is canceled, it selects a speed range that matches the travel speed at that point.

OUTPUT SIGNALS

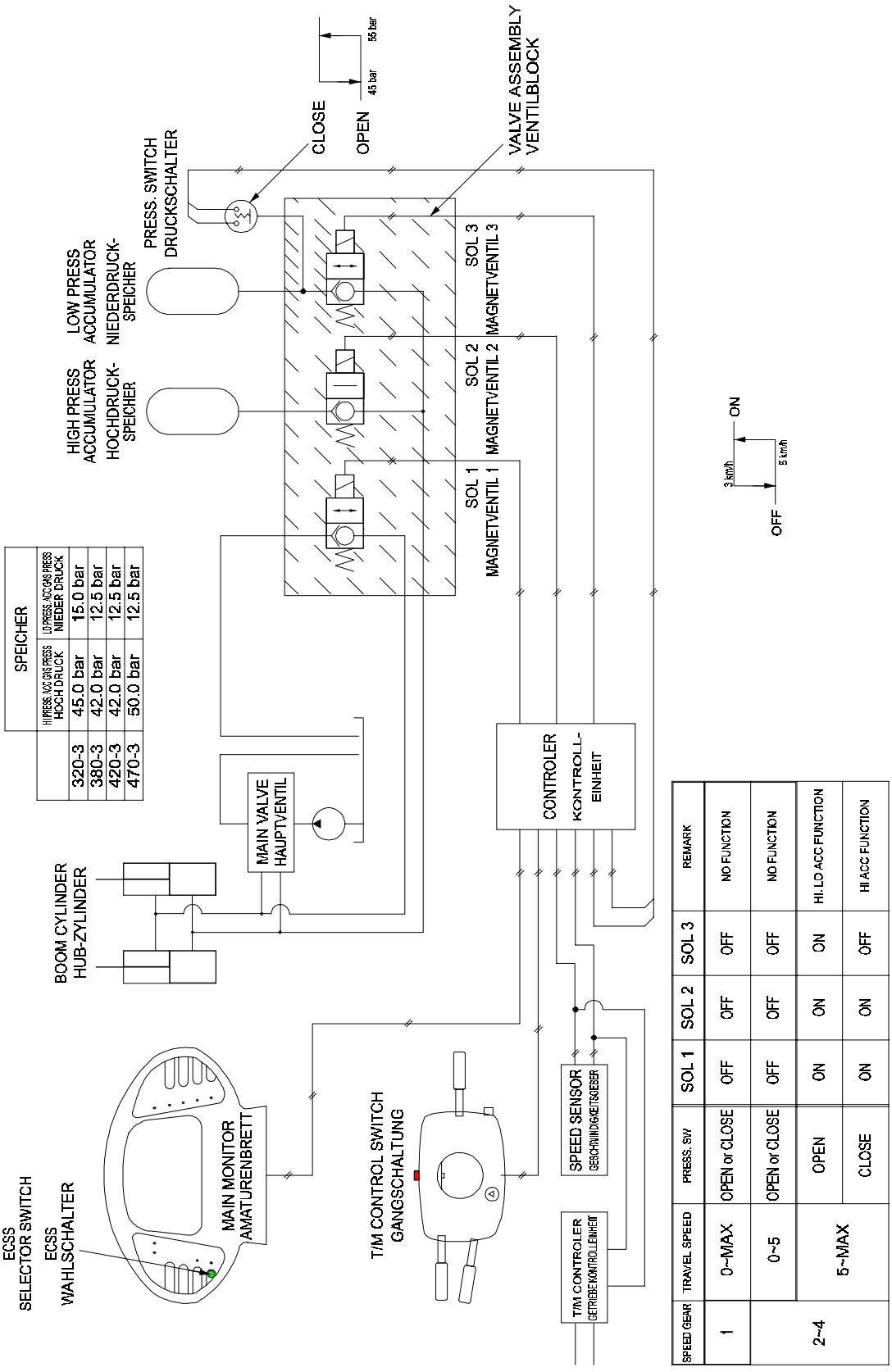
1. Transmission solenoid output
   The F and R solenoids correspond to the F and R positions of the directional lever.
   Positions 1 to 4 of the speed lever actuate the H-L solenoid and speed solenoid to select the clutches to give the 1st to 4th transmission speeds. This combination is then output to the transmission. (See Table 1)

Speed range	Solenoid				Clutch					
	F	R	HL	SP	F	R	1	2	3	4
N								○		
F1	○			○	○		○			
F2	○				○			○		
F3	○		○		○				○	
F4	○		○	○	○					○
R1		○		○		○	○			
R2		○				○		○		
R3		○	○			○			○	
R4		○	○	○		○				○

3. Hold function (maintaining present speed range)
   When the hold switch is turned ON, the existing speed range is held, and even if the travel speed goes down, the transmission does not shift down. However, if the direction of travel is shifted between forward and reverse, the transmission shifts down, and then it shifts up to the speed range according to the change in the conditions. (This prevents any unnecessary shift down on level ground or unnecessary shift up when traveling downhill.) (See Table 2, Item 4)

E.C.S.S.-SYSTEM STRUCTURE DIAGRAM

Up to Serial Number: WA320H20343



SPEICHER	HI PRESS. ACCU GAS PRESS HOCH DRUCK	LO PRESS. ACCU GAS PRESS NIEDER DRUCK
320-3	45.0 bar	15.0 bar
380-3	42.0 bar	12.5 bar
420-3	42.0 bar	12.5 bar
470-3	50.0 bar	12.5 bar

SPEED GEAR	TRAVEL SPEED	PRESS. SW	SOL 1	SOL 2	SOL 3	REMARK
1	0~MAX	OPEN or CLOSE	OFF	OFF	OFF	NO FUNCTION
2~4	0~5	OPEN or CLOSE	OFF	OFF	OFF	NO FUNCTION
	5~MAX	OPEN	ON	ON	ON	HI-LO ACC FUNCTION
		CLOSE	ON	ON	OFF	HI ACC FUNCTION

Fitting a new inductive rpm sender unit

All gear boxes for WA-3H, Cummins - engines in WA 320/420

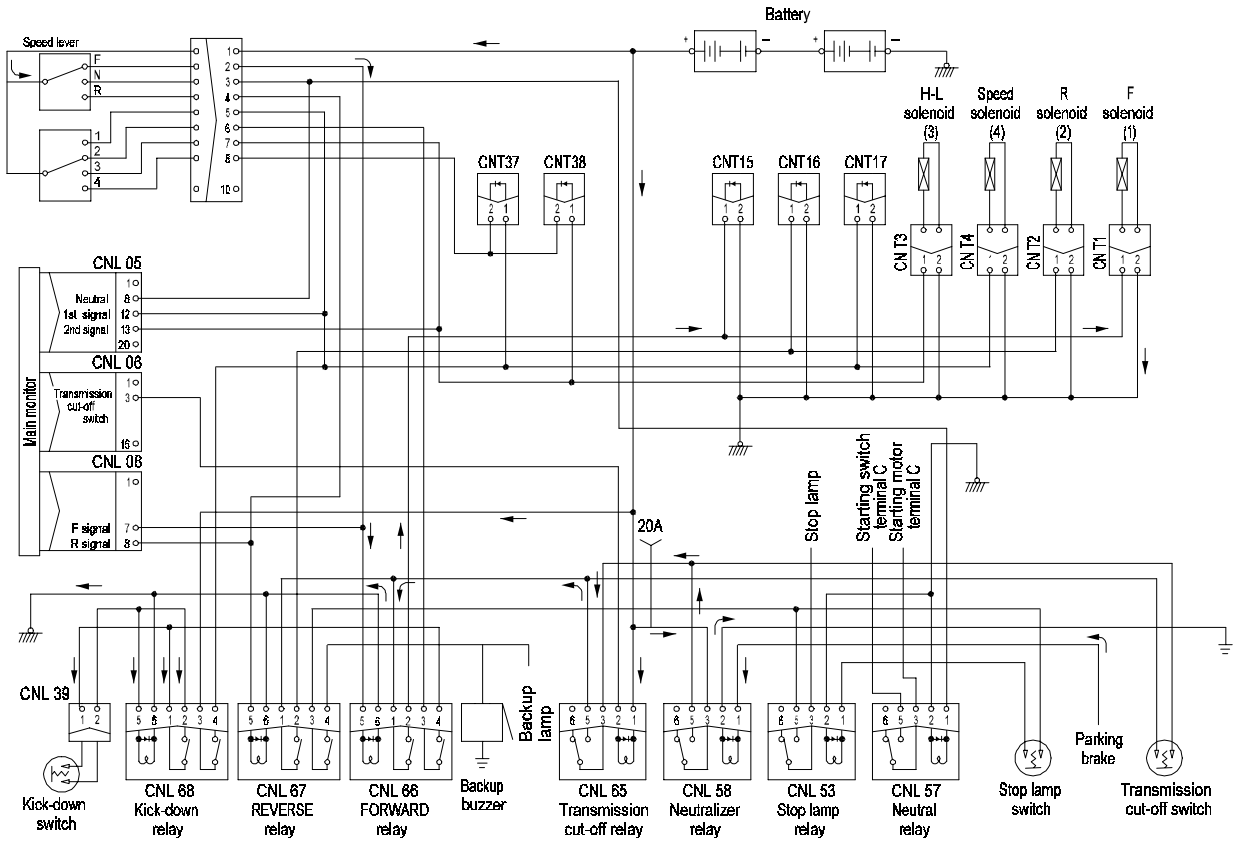
- Check that one gear tooth is in the centre of the sender mounting opening.
- Screw in the new sender (hand tight) until it just touches the gear tooth.
- Screw out 1 - 1.5 turns and lock.

Komatsu - engines S6 D125 and S6 D108 (WA380/470)

- The fly wheel of the Komatsu engine have 6 pins fitted on the flywheel side around the circumfrence, on the side of the flywheel seen from the starter motor side. These are used to give the rpm signal to the inductive rpm sender unit.
- To fit a new sender check that one of the pins is in the middle of the sender unit mounting hole. Screw in the new sender unit hand tight until it just touches the pin.
- Screw out 1 - 1.5 turns and lock.

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM (NORMAL)

Normal operation
(directional lever at F, speed lever at 2)



Directional lever set to F

- When the directional lever is set to the F position, electric current flows from the battery ⊕ → directional lever switch terminal 1 – 2 → FORWARD relay terminal 5 – 6 → ground.
  As a result, the FORWARD relay is actuated and terminals 1 and 2 and terminals 3 and 4 are connected.
- Next, the current flows from the battery ⊕→parking brake safety relay terminal 5 – 3 →parking brake switch terminal 3 – 2 → neutralizer relay terminal 1 – 2 → ground, and neutralizer relay terminal 3 – 5 are connected. In addition, electric current flows from the battery ⊕ → transmission cut-off relay terminal 1 – 2 →monitor, and transmission cut-off relay terminals 3 – 5 are connected.
- Electric current flows from the battery ⊕ → neutralizer terminal 3 – 5 → transmission cut-off relay terminal 3 – 5 → FORWARD relay terminal 1 – 2 → solenoid 1 → ground, and solenoid (1) is actuated.

Speed lever set to 2

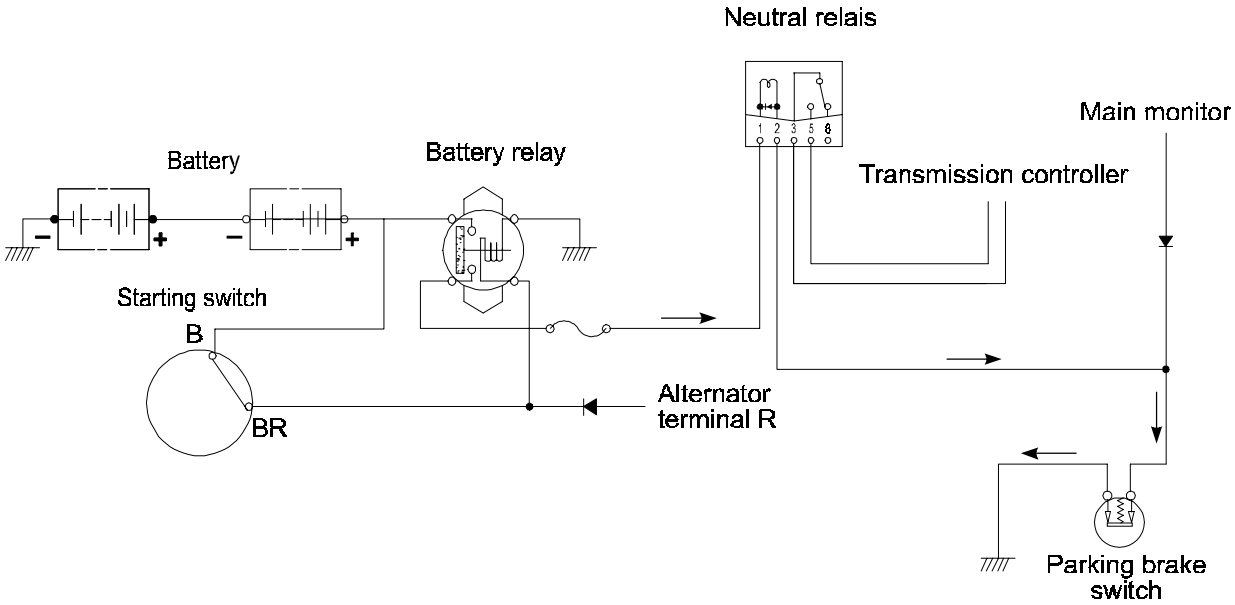
- When the speed lever is at position 2, no electric current flows to solenoids (2), (3), or (4). In this condition, the transmission valve is set to F2 by the action of solenoid (1).
  No current flows to the coil (relay terminals 5 – 6) of the kick-down relay if the kick-down is not pressed. Therefore, the kick-down relay is not actuated, and the transmission is held in F2.

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	O	●	O	O					
REVERSE	(2)						O	O	O	O
H-L select	(3)			O	O				O	O
Speed select	(4)	O			O		O			O

ELECTRIC PARKING BRAKE CONTROL

Parking brake: Transmission neutralizer

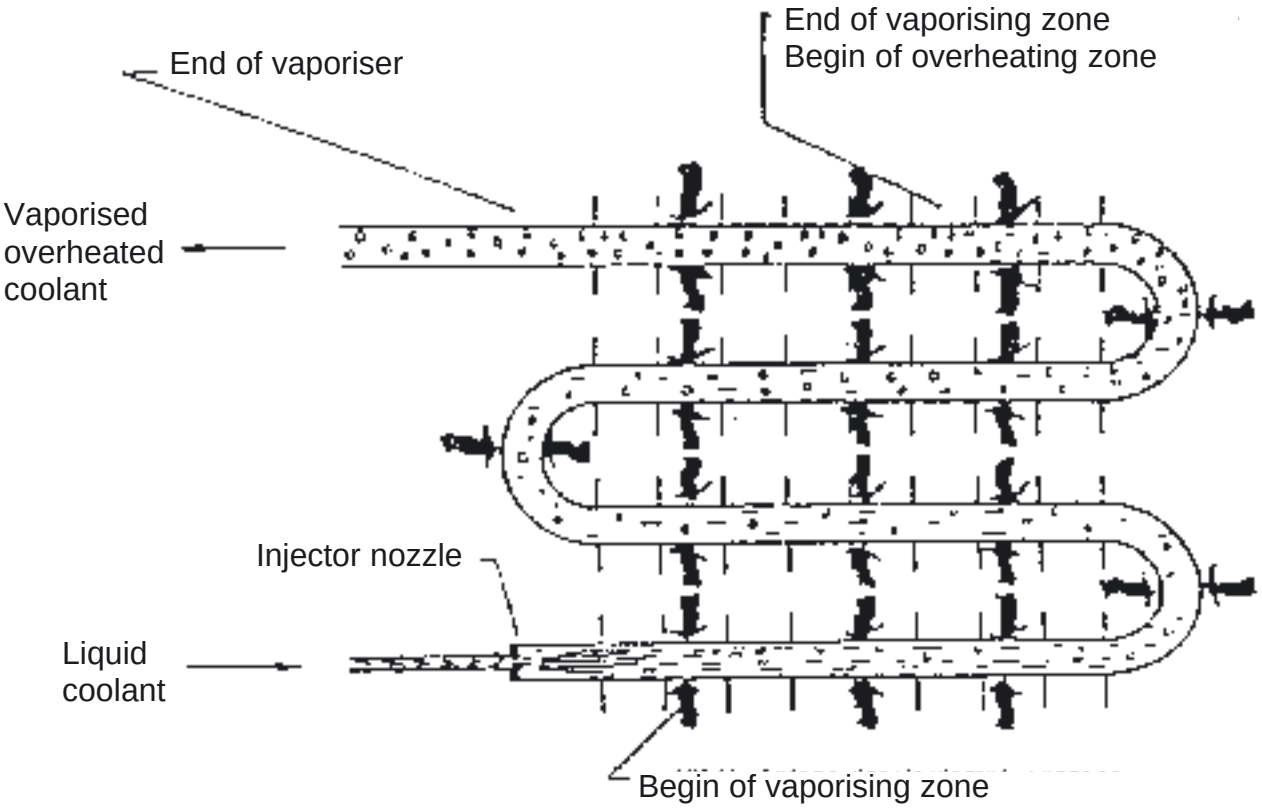


Outline

- When the starting switch is turned ON and the parking brake is applied, current flows from the main battery relay through the neutralizer relay, contacts 1. to 2. and over the parking brake switch to chassis.
- The neutralizer relay is now operated, contacts 3. to 5. open and the transmission control unit puts the transmission in neutral.
- At the same time the parking brake warning light, in the main monitor, is connected to chassis through the parking brake switch and is switched ON.

The vaporiser

Liquid coolant is sprayed into the vaporiser and converted to a gaseous state. During this process, the coolant boils in the vaporiser. The temperature of the coolant can fall well below the freezing point during boiling. The coolant adopts a very similar behaviour to boiling water in the vaporiser. The warmth which the coolant requires to evaporate is withdrawn from its environment. At the end of the vaporising process, the coolant emerges as steam. The actual vaporiser has been lengthened in order to allow any liquid bubbles which may possibly have been carried along as a result of the turbulence time to evaporate as well. This extension is called the after-vaporiser.



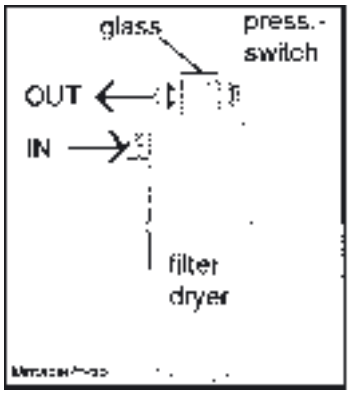
There are two fundamental methods of operation for vaporisers:
- Inundated vaporisers (disc vaporisers)
- Dry expansion vaporisers (round pipe and serpentine vaporisers)

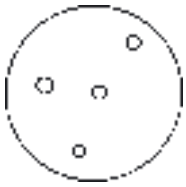
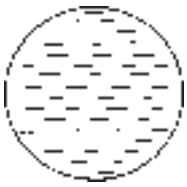
While inundated vaporisers are generally bound to upright installation and coolant flow and require special measures for ensuring oil return and avoiding cavitation, dry expansion vaporisers where overheated steam is fundamentally present at the outlet can be installed in virtually any position without any special measures having to be taken.

OPERATION

CHECKING COOLANT LEVEL

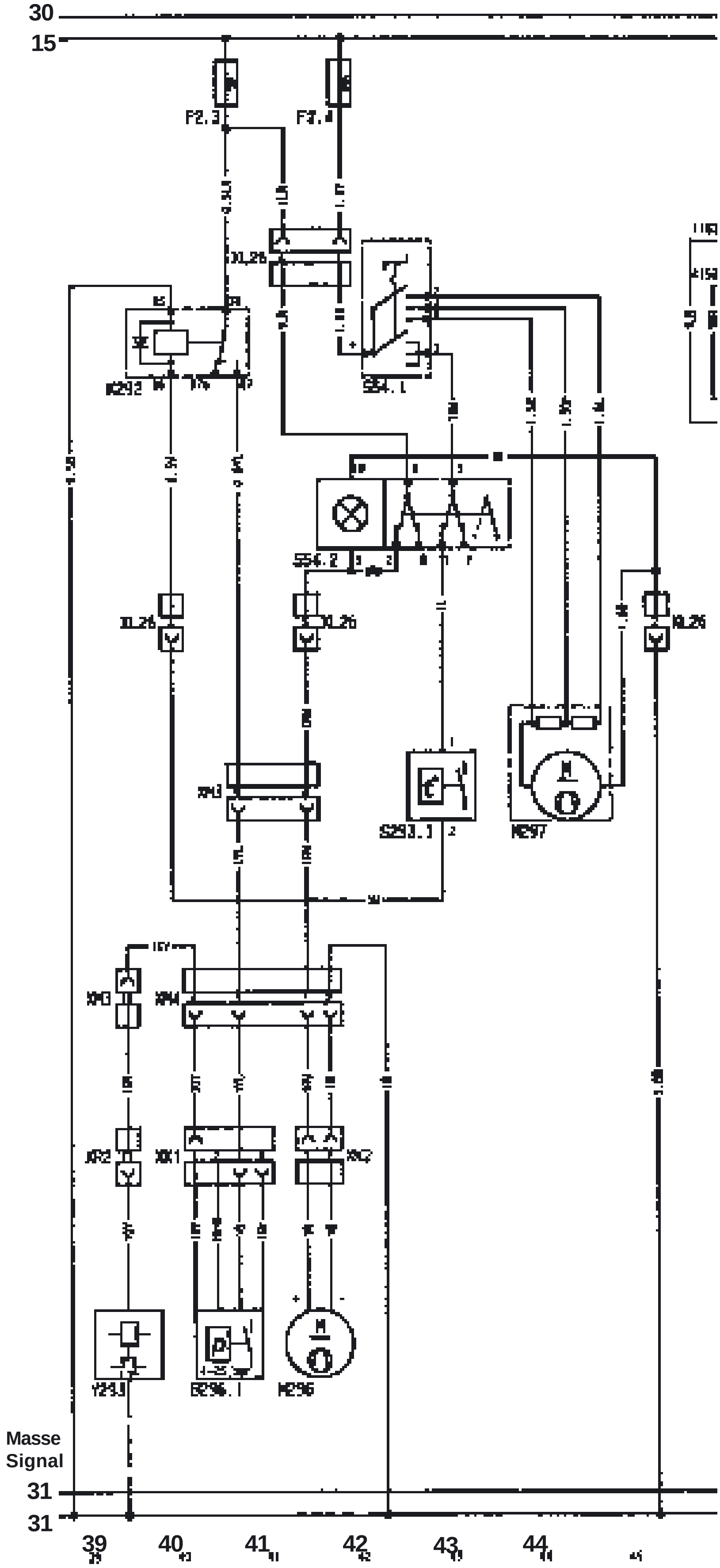
- Run the air conditioning system at maximum output for 5 - 10 minutes. Touch the high pressure section and the low pressure section of the compressor or the high pressure pipe and the low pressure pipe connecting element with your hand. At the same time, check the flow of coolant (R134a) through the inspection glass for correct level of coolant.



Cooler condition	Normal	Abnormal	
Temperature of high and low pressures pipes	High pressure pipie is hot. Low pressure pipe is cold. Clear difference in temperature	High pressure pipe is warm. Low pressure pipe is cold. Little difference in temperature	Amost no difference in temperature between high and low pressure pipes.
Sight glass	Almost transparent. All bubbles disappear if the engine speed is increased or reduced. 	Bubbles are always visible. Sometimes becomes transparent, or white bubbles appear. 	Opaque substance is visible in the fluid. 
Pipe connections	Properly connected	Some parts contaminated with oil.	Some parts heavily stained with oil.
General condition of cooler	Coolant level correct, no abnormalities. Ready for use.	There may be a leak somewhere. Call service repair shop for inspection.	Almost all coolant has leaked out. Contact service repair shop immediately.

CHECKING THE COMPRESSOR OIL LEVEL

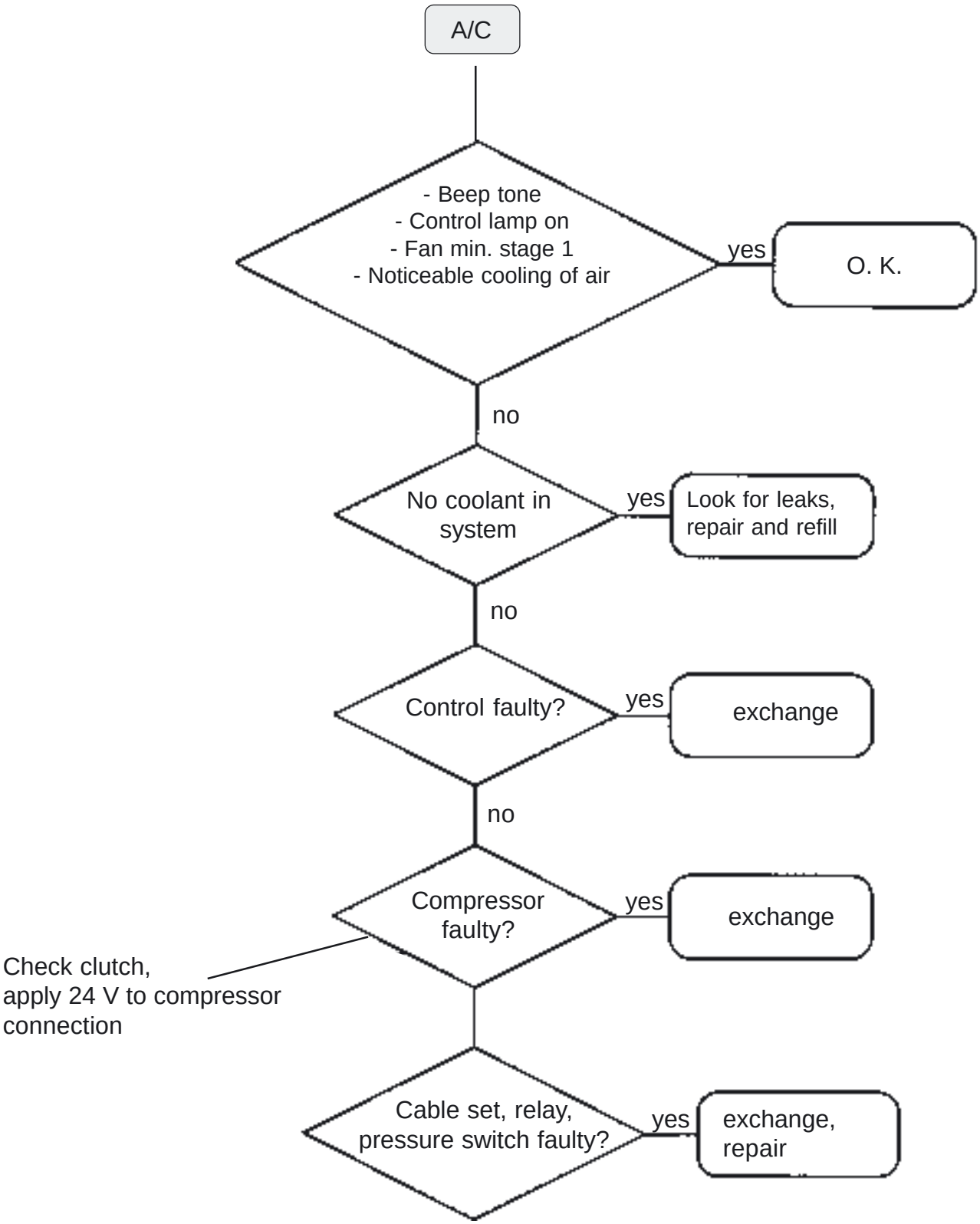
- Check, top up or change if:
  - Compressor, vaporizer, condenser or drier have to be changed.
  - Coolant leaks from coolant circuit.
  - Problems occur with the oil in the coolant circuit.
  - The connectors from compressor or dryer was opened.



Wiring Diagram Air Conditioner

WA 270-3 / WA 320-3 SN H20561 and up

AIR CONDITIONING MODE



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Wiring Diagrams

From SN WA320H20711
up to SN WA320H20854

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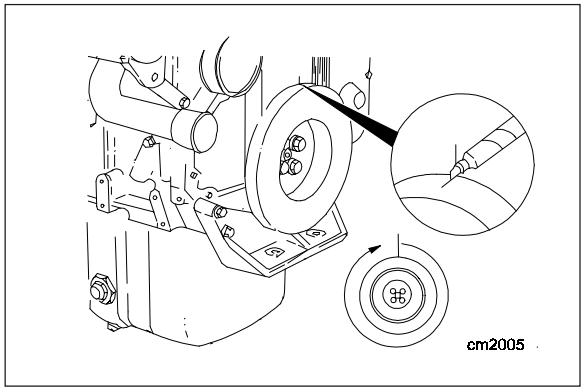
WA320-3 active plus	Wiring diagram Fig. 4				
Sect.	**Description**		**Sect.**	**Description**	
105	S 70	Switch brake light	85	E 243	Turning signal left
88	S 101	Switch waring lamp	91	E 244	Turning signal right
99	S 331.1	Switch headlights	96	K 67.1	Indicator relay 2+1
88	S 331.2	Switch turning signal	94	K 67.2	Indicator relay 3+1
110	B 279	Horn back off alarm	93	K 101	Relay waring lamp
	V 118..	Diode	91,93	K 163...	Relay turning signal
100	H 29	Lamp main head light	109	K 385	Relay back off alarm
89	H 31.1	Lamp turning signal right			
86	H 31.2	Lamp turning signal left			
94	E 1	Headlight left			
97	E 2	Headlight right			
85	E 5	Turning signal front left			
91	E 6	Turning signal front right			
101	E 68.1	Rear light left			
100	E 69.1	Rear light right			
86	E 68.2	Turning signal rear left			
89	E 69.2	Turning signal rear right			
105	E 68.3	Brake light left			
106	E 69.3	Brake light right			
108	E 68.4	Reversing light left			
109	E 69.4	Reversing light right			
103	E 71	Number plate light left			
104	E 72	Number plate light right			
Connectors					
X L		Connector platform	X M		Connector engine
X C		Connector cab	X R		Connector transmission
X F		Connector front frame	X H		Connector engine hood
Fuses					
F...		Fuse			
					320EL4b.tbl

Category	Item		Measurement conditions	Unit	Standard value	Permissible value
Work equipment	Hydraulic drift	Retraction of boom cylinder rod	• Hydraulic oil temperature: 45 – 55°C • Leave for 5 minutes after stopping engine then measure for next 15 minutes • Bucket empty, boom, bucket horizontal • No load	mm	Max. 13.0	15
		Retraction of bucket cylinder rod			Max. 37.0	37
Proximity switch	Clearance of bucket positioner switch		• Hydraulic oil temperature: 45 – 55°C	mm	3 – 5	—
	Clearance of boom kick-out switch				3 – 5	—
ALS	Accumulator		• Hydraulic oil temperature: 45 – 55°C	bar	20	14
	Working pressure				98 $^{+5}$	103

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions
Main monitor	Alternator	Between alternator terminal R and chassis	Measure voltage	When engine is running (half throttle or above) → 27.5 – 29.5 V ※ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.	1) Start engine.
	Engine water temperature sensor Pre-heating	XB14	Measure resistance	If the condition is as shown in the table below, it is normal. Normal temperature (25°C) / Between XB14 (male) – GND / Approx. 2 kΩ 5°C / Between XB14 (male) – GND / Approx. 4 kΩ	1) Turn starting switch OFF. 2) Disconnect XB14.
	Speed sensor	XT06	Measure resistance	If the condition is as shown in the table below, it is normal. Between (1) – (2): 500 – 1000 Ω	1) Turn starting switch OFF. 2) Disconnect XT06.
Transmission controller	F solenoid	XT01	Measure resistance	If the condition is within the range shown in the table below, it is normal. Between (1) – (2): 46 – 58 kΩ Between (1) – chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.
	R solenoid	XT02	Measure resistance	If the condition is within the range shown in the table below, it is normal. Between (1) – (2): 46 – 58 kΩ Between (1) – chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.
	H-L solenoid	XT03	Measure resistance	If the condition is within the range shown in the table below, it is normal. Between (1) – (2): 46 – 58 kΩ Between (1) – chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.
	Speed solenoid	XT04	Measure resistance	If the condition is within the range shown in the table below, it is normal. Between (1) – (2): 46 – 58 kΩ Between (1) – chassis: Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.

Mark the vibration damper and rotate the crankshaft 360 degrees.

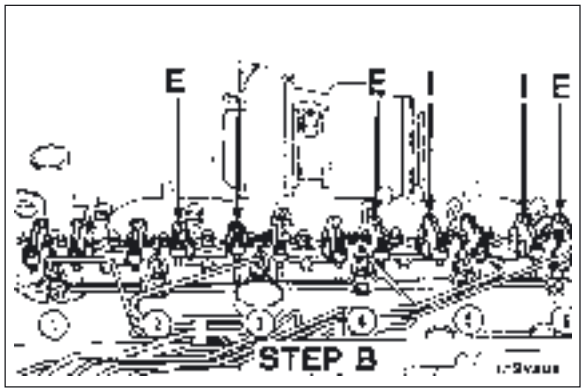
⚠ Be sure the engine timing pin is disengaged to prevent damage to the engine timing pin.



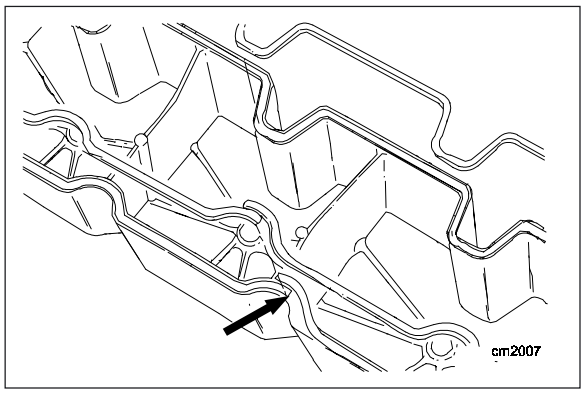
Set the valves indicated for STEP B.

After tightening the rocker lever lock nut, check the valve clearance to make sure the valve clearance has not changed.

kgm Torque Value: 24 Nm



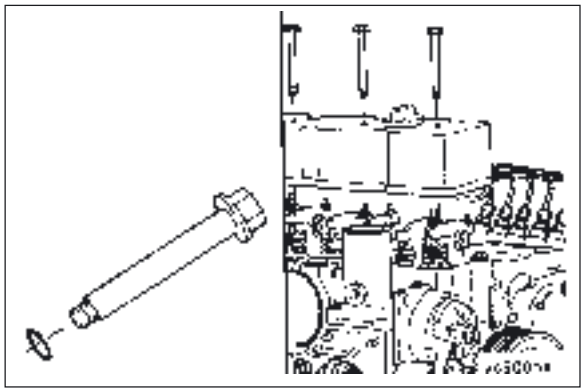
Install the rubber seal into the groove in the valve cover. Start the installation at the overlap area shown in the illustration. Do not stretch the rubber seal.



Install new sealing o-rings on the capscrews.

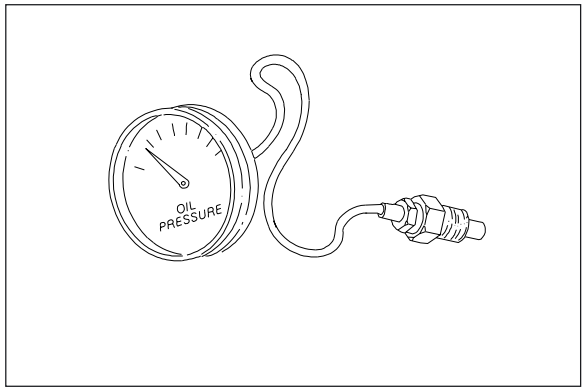
Install the valve cover and wastegate sensing tube.

kgm Torque Value: 24 Nm



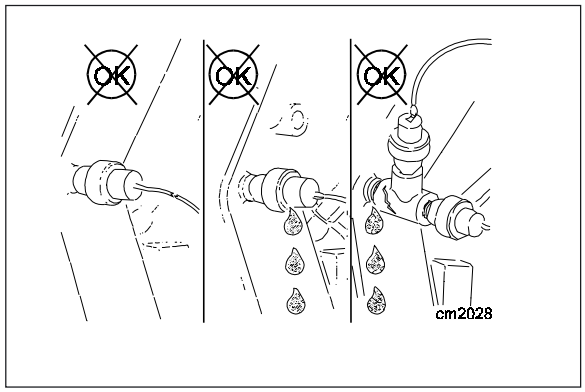
MEASURING ENGINE OIL PRESSURE

Check the oil gauge and sending unit to make sure they are operating correctly by verifying the pressure with a manual gage.



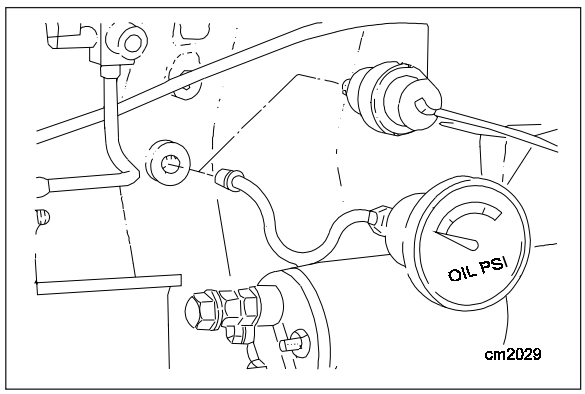
Check the following for defects:

- Electrical wiring broken
- Sending unit malfunction
- Plumbing loose or broken



If a sending unit malfunction is found:

- Use a master gauge of known accuracy to verify the reading of the suspect gauge.
- Connect the line from the master gauge to the main oil rifle on the fuel pump side of the engine.
- Replace the sending unit if it is defective.



NORMAL TRANSMISSION

Measuring procedure

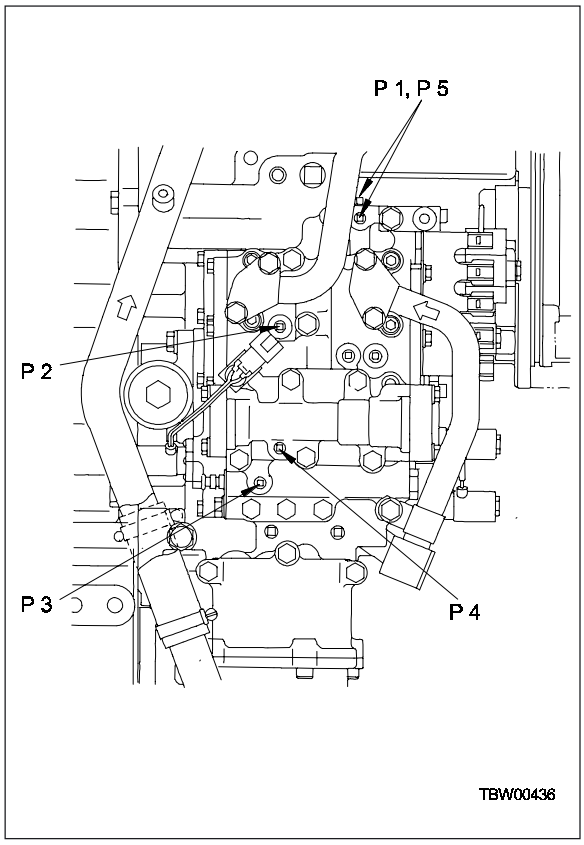
1. Priority pressure
   1) Measuring port (P1, PT1/8)
   2) Start the engine and measure the pressure at low and high idle.

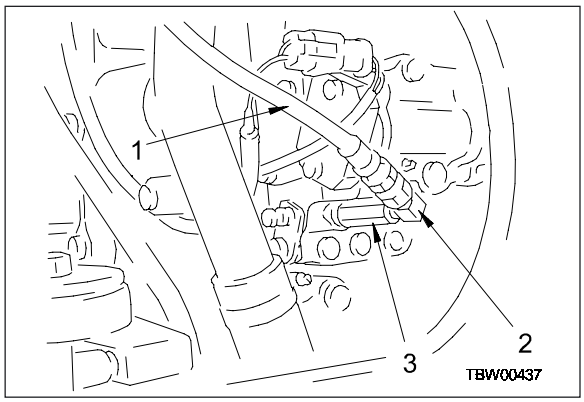
2. Torque converter output pressure
   1) Measuring port (P2, PT1/8)
   2) Start the engine and measure the pressure at low and high idle.

3. Pilot pressure
   1) Measuring port (P3, PT1/8)
   2) Start the engine and measure the pressure.
      ★ Remove hose (1) and elbow (2) and attach the hydraulic test kit to nipple (3).

4. Clutch pressure
   1) Measuring port (P4, PT1/8)
   2) Start the engine, set the forward/reverse lever to neutral, and measure the pressure when the gear shift lever is operated.

5. Parking brake pressure
   1) Measuring port (P5, PT1/8)
   2) Start the engine and measure the pressure when the parking brake is released.



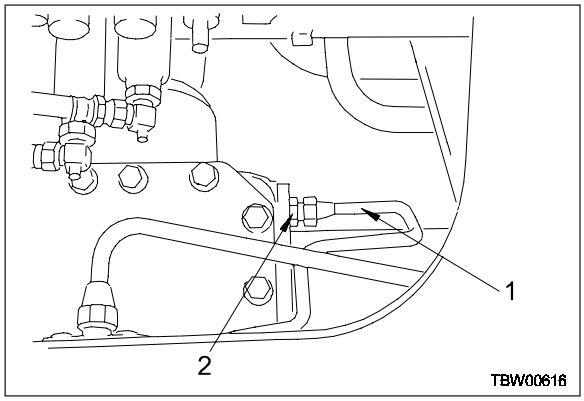


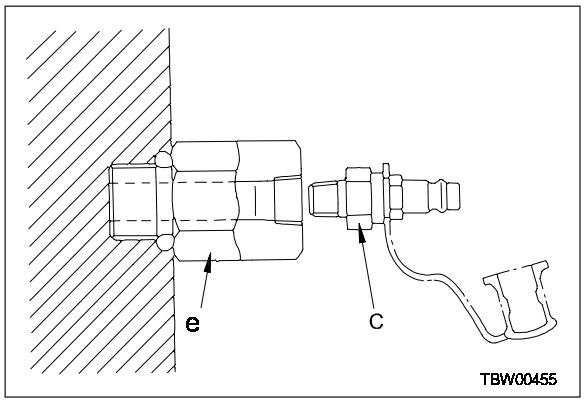
TESTING BRAKE OIL PRESSURE

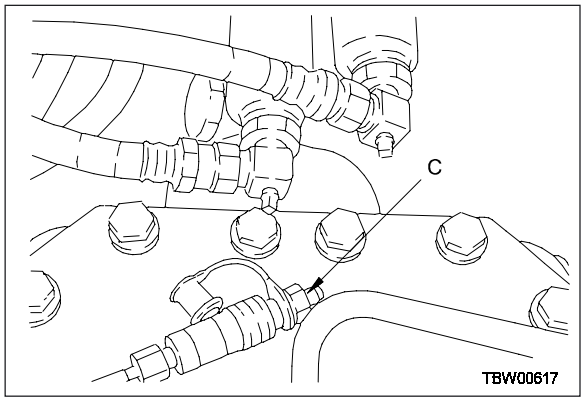
★ Measurement conditions
- Engine water temperature: Within engine water temperature gauge green range
- Testing pressure: 4.9 MPa (50 bar)

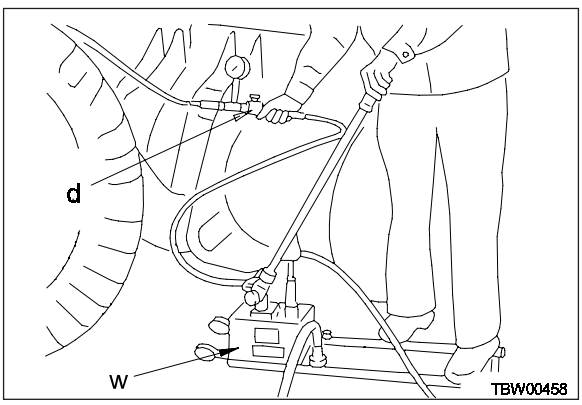
⚠ Apply the parking brake and chocks the tires.

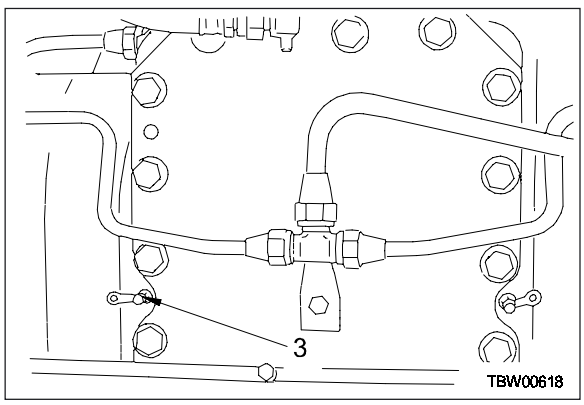
Measuring procedure
1. Stop the engine.
2. Disconnect brake tube (1) on the side to be measured.
3. Disconnect union (2), install joint e and attach hydraulic test kit C
.
   ★ Use the O-ring installed on the union. (O- ring: 07002-02034)
   ★ Connect the hydraulic test kit quick coupler.
4. Loosen bleeder screw (3) and bleed the air.
   ★ Bleed the air by activating pump w.
5. Tighten bleeder screw (3), activate pump w, increase the pressure to 4.9 MPa (50 bar), then tighten stop valve d.
6. Let sit for five minutes with pressure applied and check the pressure decrease.
   * Do not move the hose while the pressure is being measured, as this will cause pressure fluctuations.
   * After testing, activate pump w and lower the pressure of hydraulic test kit C before removing the test kit.
   * When testing is completed, install the brake tube and bleed the air from the brake circuit.











MEASURING PPC VALVE PRESSURE

Up to serial number: WA320H20482

★ Measurement conditions
- Engine water temperature : Within engine water temperature gauge green range
- Hydraulic oil temperature : 45 to 55°C
- Engine speed : High idle

⚠ Apply the parking brake and blocks the tires.

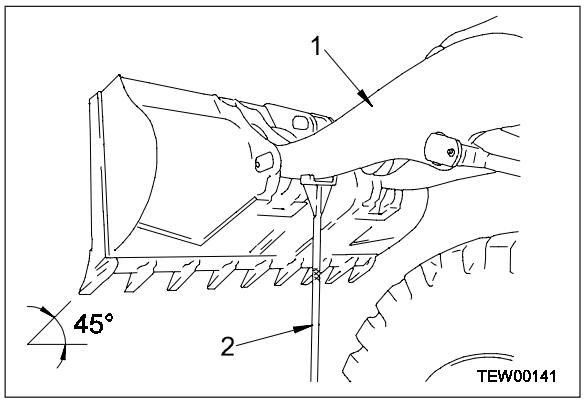
Measuring

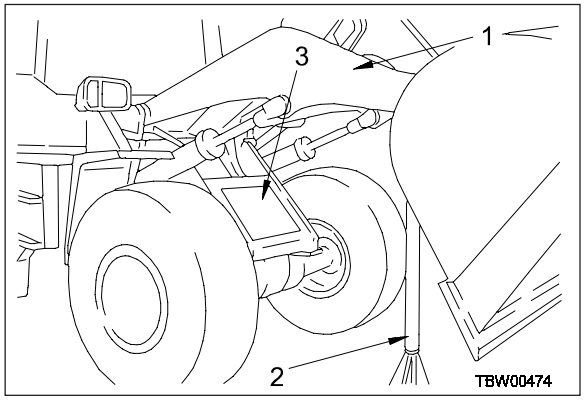
1. Raise boom (1), set boom prop (2), set the bucket to an angle of approximately 45° (not to the maximum dump position) and remove front cover (3).

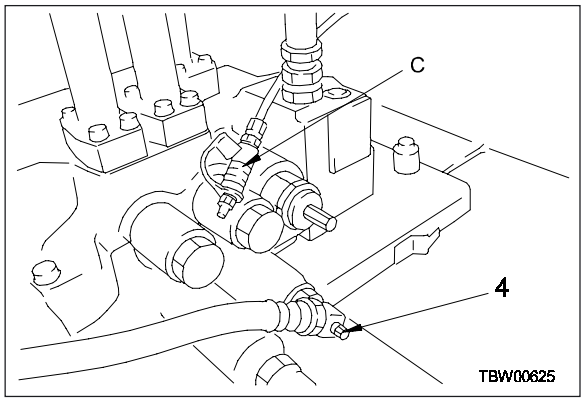
⚠ Set the prop securely.

2. Stop the engine, loosen the oil supply cap, release the pressure inside the hydraulic oil tank, then stroke the bucket control lever between the tilt and neutral positions at least 40 times to completely release the accumulator pressure.
   - ★ Be sure to stop the engine before operating the lever.
   - ★ After the accumulator pressure is completely released, set the bucket lever to the dump position and check that the bucket does not dump.
3. Remove the work equipment dump cylinder circuit pressure measurement plug (4).
4. Install hydraulic test kit to the measuring port.
   - Connect the hose after installing the hydraulic test kit 90° elbow to the measuring port.
   - Check that there is no oil leakage from any joints.
   - Use a hose which is long enough to reach the operator's seat.
5. Start the engine, raise the boom about 400 mm, tilt back the bucket using the control lever, and measure the pressure when the relief valve is activated.
   - Be careful not to apply any sudden pressure to the pressure gauge.

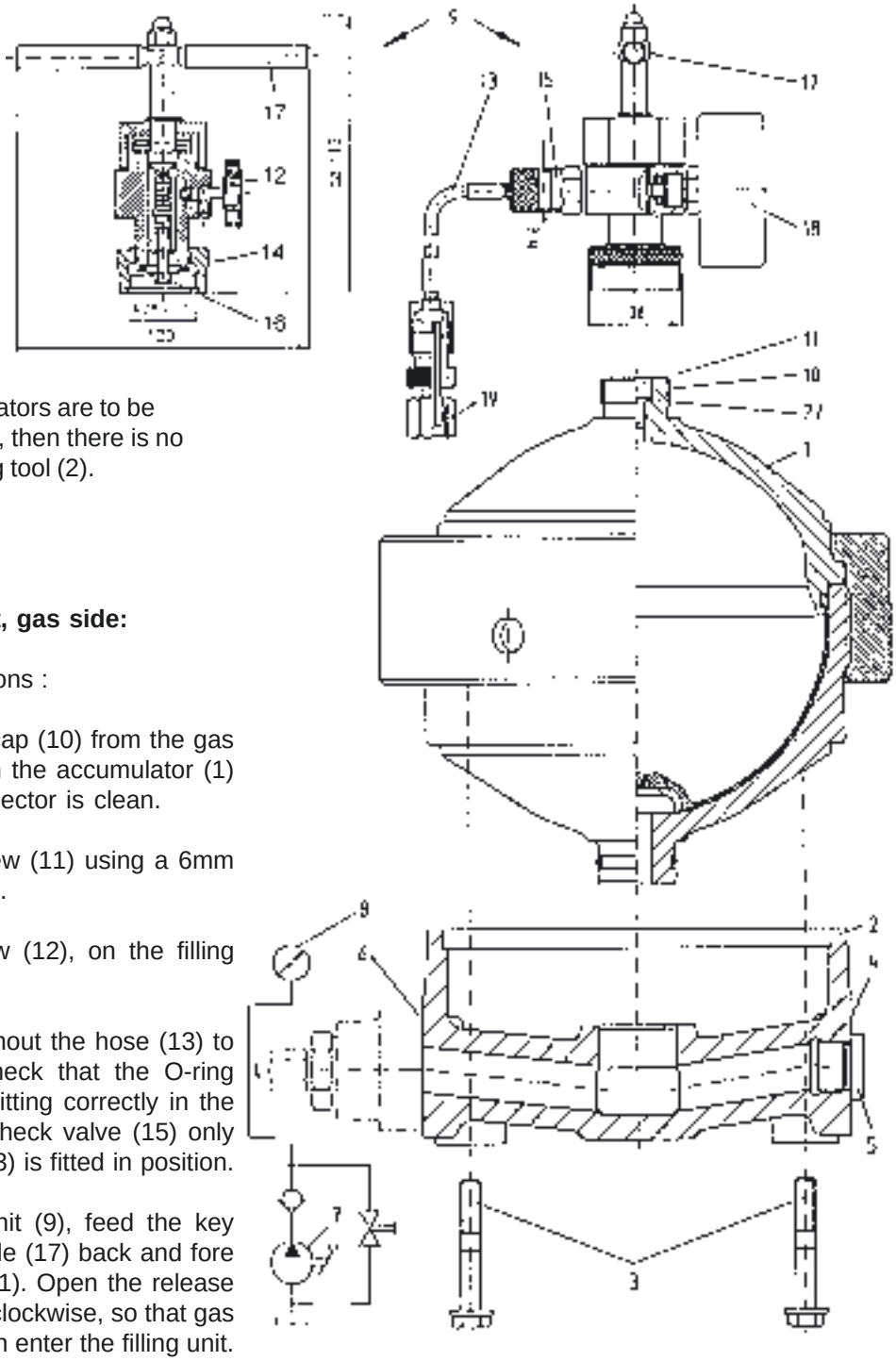
⚠ When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when it was installed.







GAS SIDE TEST AND TOPPING UP THE GAS PRESSURE



Note:

If a filling unit, as shown , DFM (9), and a pressure table are available, then the test can be carried out in the machine. To carry out this care must be taken to check that there is no hydraulic pressure on the hydraulic side of the accumulators. If the accumulators are to be checked out off the machine , then there is no need for the special mounting tool (2).

Accumulator pressure test, gas side:

Follow the following instructions :

a) Remove the protection cap (10) from the gas connector M28 X 1.5 on the accumulator (1) and check that the connector is clean.

b) Release the gas fill screw (11) using a 6mm allen key approx. ¼ turn.

c) Close the release screw (12), on the filling unit, fully.

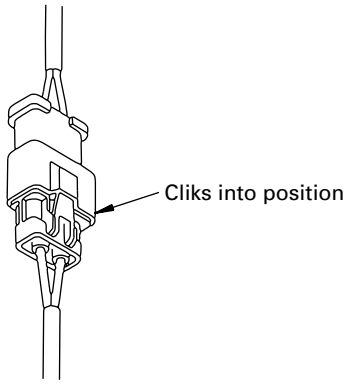
d) Fit the filling unit (9) without the hose (13) to the gas connection. Check that the O-ring (14) is in position and sitting correctly in the grove. Attention ! The check valve (15) only works when the hose (13) is fitted in position.

e) After fitting the filling unit (9), feed the key (16) by turning the handle (17) back and fore into the gas fill screw (11). Open the release screw slowly by turning clockwise, so that gas from the accumulator can enter the filling unit. The gas pressure can be read on the pressure gauge. At ambient temp, the pressure read is the gas pressure.

f) If the pressure, read at ambient temp., is more than 17 bar, close the gas fill screw (11) using the handle (17) and the key (16). Open the release screw (12) and release the gas pressure in the fill unit.

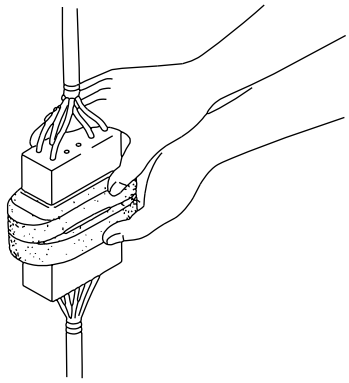
g) Remove the filling unit (9) from the accumulator. Tighten the gas filling screw (11) using an allen key to 20 +5 Nm.. Fit the protection cap back on the gas connector (10) M28 x 1.5mm.

(2) Fix the connector securely.
Align the position of the connector cor-rectly, then insert it securely.
For connectors with lock stopper
Push in the connector until the stopper clicks into position.



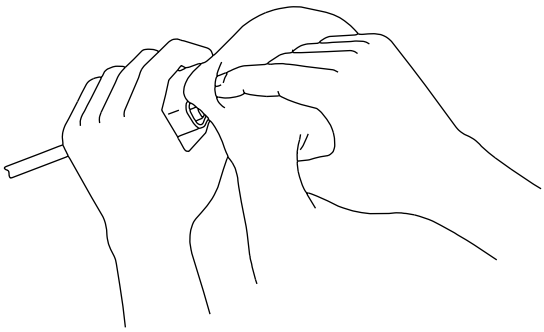
TEW00199

(3) Correct any protrusion of the boot and any misalignment of the wiring harness
For connectors fitted with boots, correct any protrusion or the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.
★ When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with air from which all the water and oil has been removed.

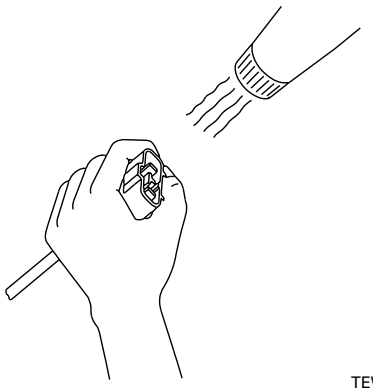

TEW00200

Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connec-tor must be washed in water, do not use high pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.

(1) Disconnect the connector and wipe off the water with a dry cloth.
★ If the connector is blown dry with air, there is the risk that oil in the air may cause defective contact, so avoid blowing with air.


TEW00196

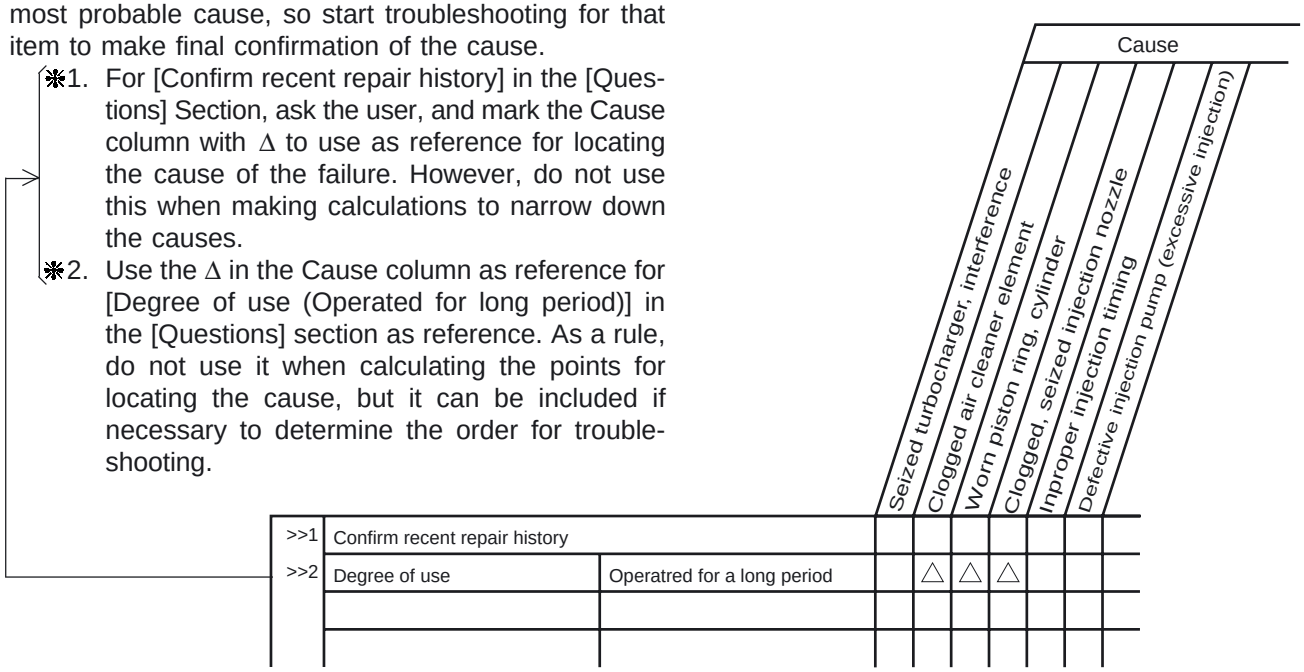
(2) Dry the inside of the connector with a dryer.
If water gets inside the connector, use a dryer to dry the connector.
★ Hot air from the dryer can be used, but be careful not to make the con-nector or related parts too hot, as this will cause deformation or damage to the connector.


TEW00202

The basic method of using the troubleshooting chart is as follows.
Items listed for [Questions] and [Check items] that have a relationship with the Cause items are marked with ○, and of these, causes that have a high probability are marked with ◎ .
Check each of the [Questions] and [Check items] in turn, and marked the ○ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

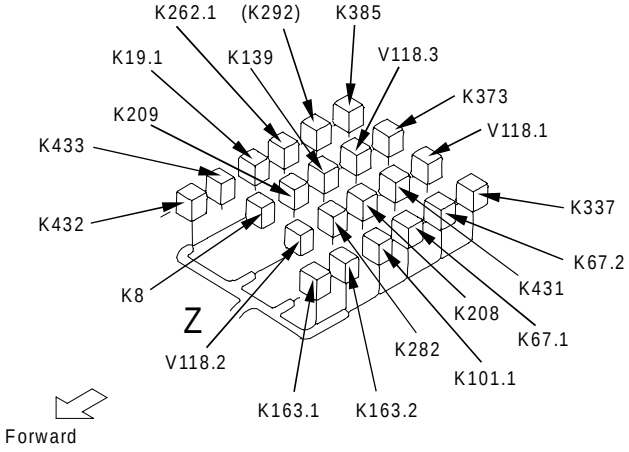
❋1. For [Confirm recent repair history] in the [Questions] Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

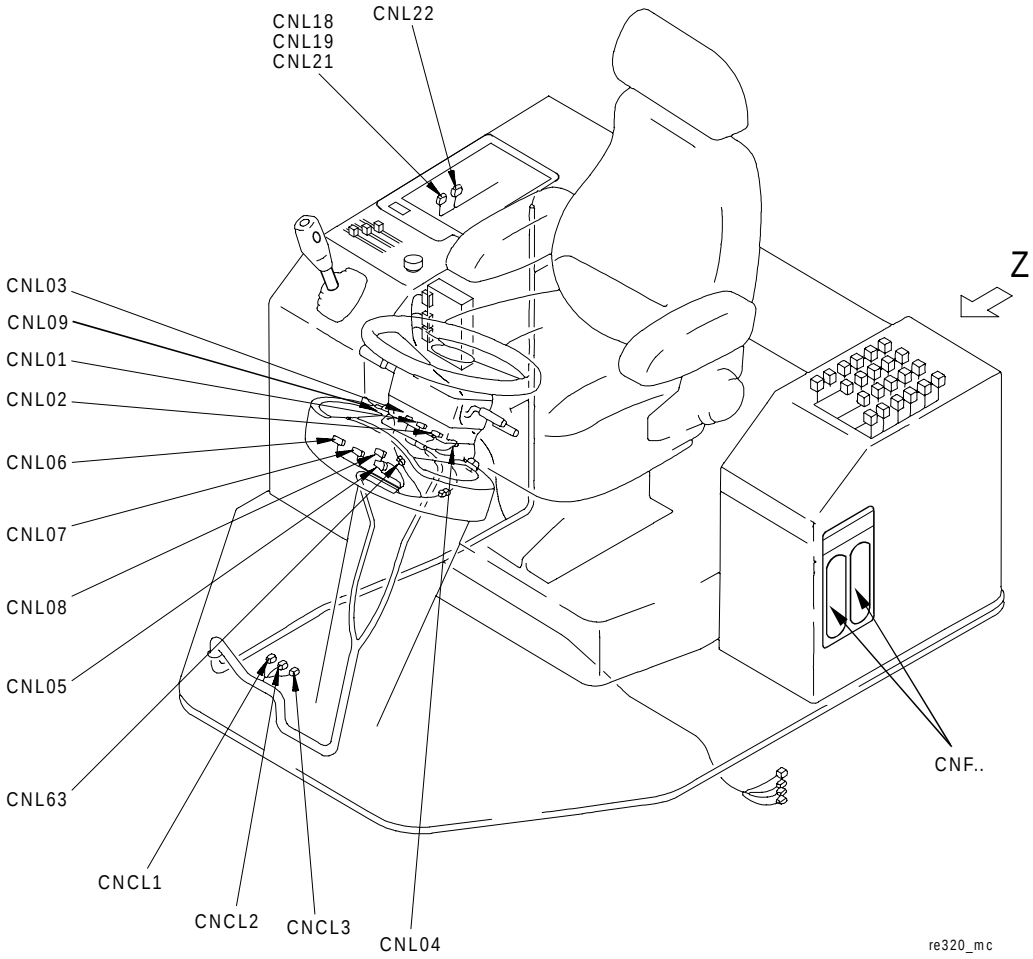
❋2. Use the △ in the Cause column as reference for [Degree of use (Operated for long period)] in the [Questions] section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

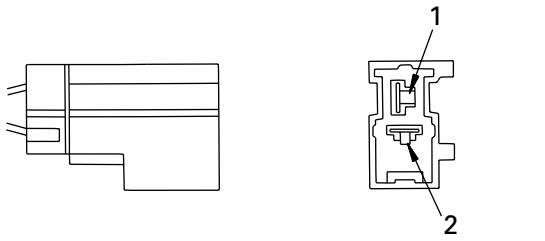
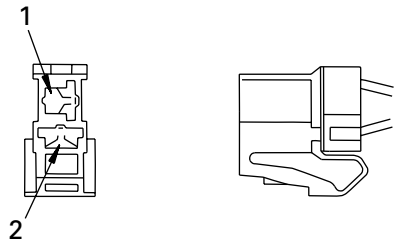
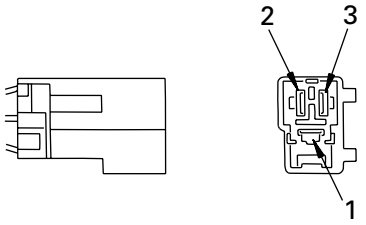
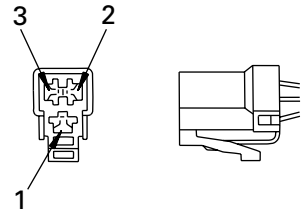
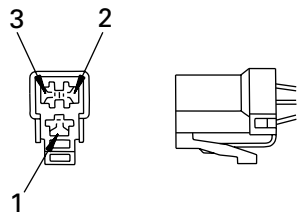
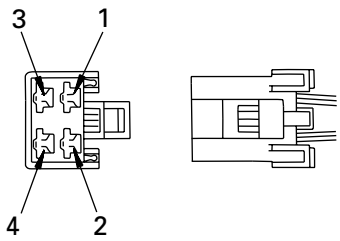
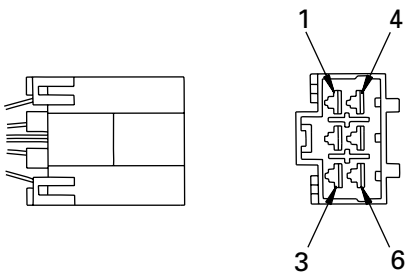
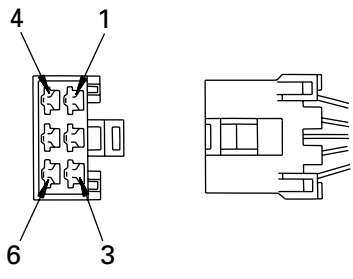


From SN WA320H20561
up to SN WA320H20710

WA 320-3H Automatic





No. of pins	M type connector	
	Male (female housing)	Female (male housing)
2	 TEW00241	 TEW00242
3	 TEW00243	 TEW00244
4	 TEW00244	 TEW00246
6	 TEW00247	 TEW00248

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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
- Improper condition of fuel injection
- Improper fuel used

Legend
◯ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

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

S-13 Oil level rises

★ If there is oil in the cooling water, carry out troubleshooting for “Oil is in cooling water”.

General causes why oil level rises

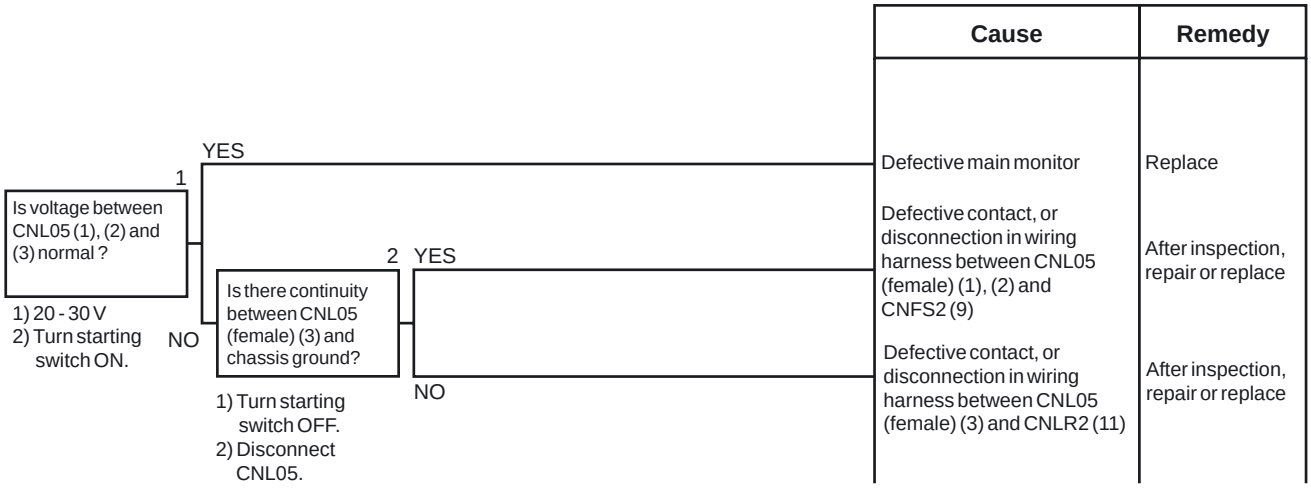
- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

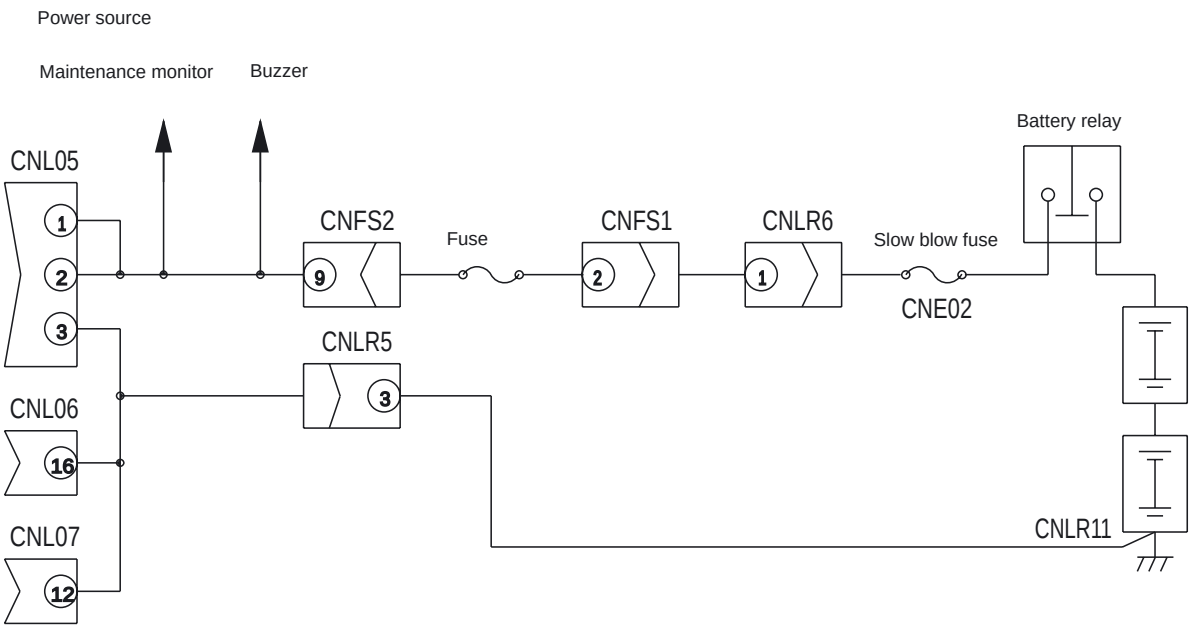
Legend
◯ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Cause: Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken head, head gasket (including precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump or auxiliary equipment	Leakage of fuel from piping inside head cover	Defective inside injection pump (flange type)	Defective thermostat seat	Damaged liner O-ring, holes made by pitting	Cracks inside cylinder block
Questions	Confirm recent repair history											
	Degree of use: Operated for long period		△		△	△	△				△	
	There is oil in radiator cooling water	◎	◯	◯							◯	◯
	Exhaust gas is white		◎					◯		◯		
	When engine is first started, drops of water come from muffler		◎									
Check items	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎							◯	
	Water pump breather hole is clogged with mud				◎							
	When water pump breather hole is clean, water comes out				◎							
	Oil level goes down in clutch, TORQFLOW transmission, or damper chamber					◎						
	Oil level goes down in hydraulic tank						◎					
	Engine oil smells of diesel fuel							◎	◎	◎		
	Fuel is added more frequently							◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●										
	Pressure-tightness test of cylinder head shows there is leakage		●									
	When compression pressure is measured, it is found to be low			●								
	Remove water pump and check directly				●							
	Check rear seal directly					●						
	When pump auxiliary equipment is removed, seal is found to be broken						●					
	Remove head cover and check directly							●				
	Remove injection pump and check directly								●			
	There is improper contact of thermostat seat valve									●		
	Remove oil pan and check directly										●	●
	Remedy	Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace	Replace

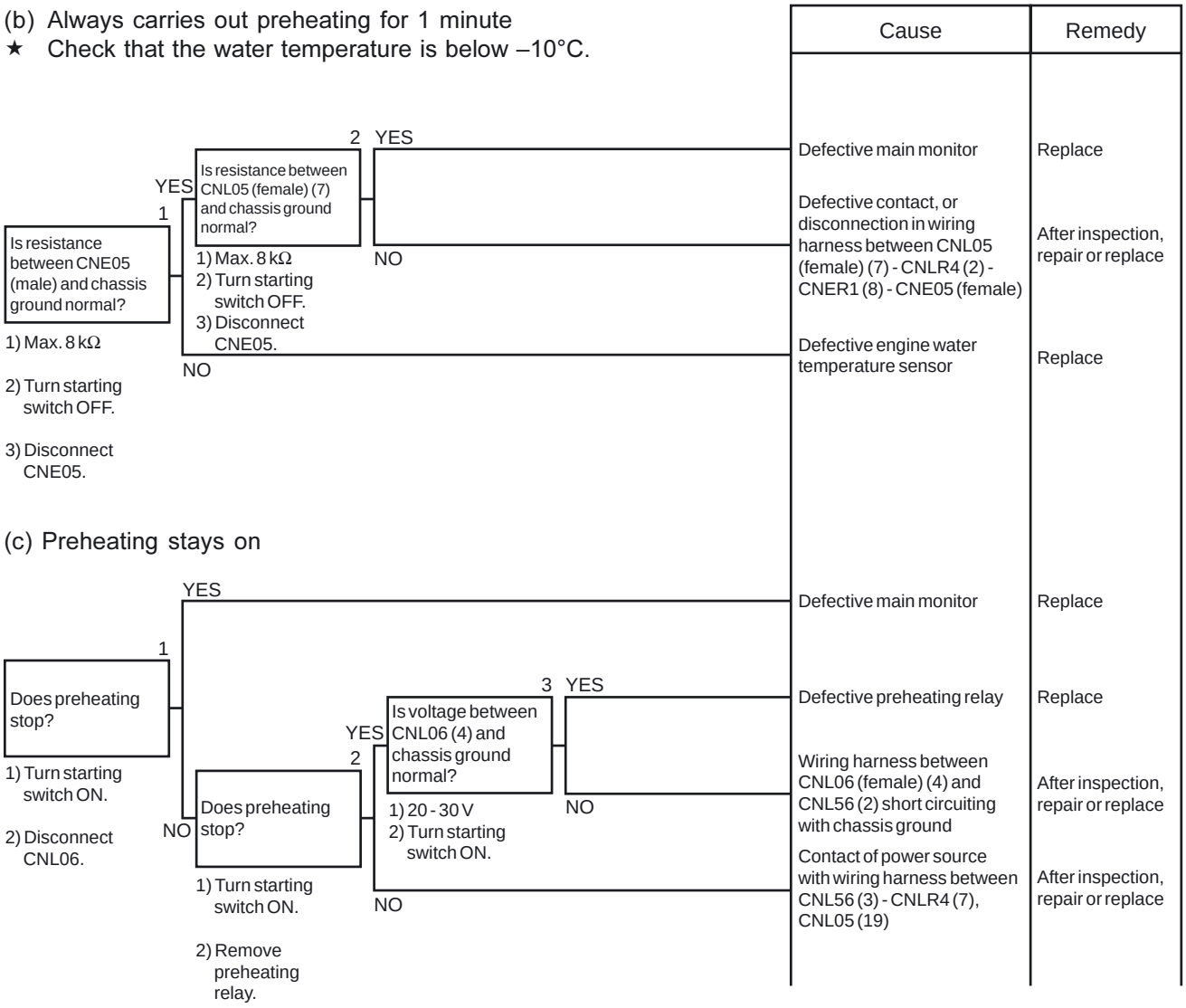
M-1 Main monitor does not work

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





(b) Always carries out preheating for 1 minute
★ Check that the water temperature is below –10°C.

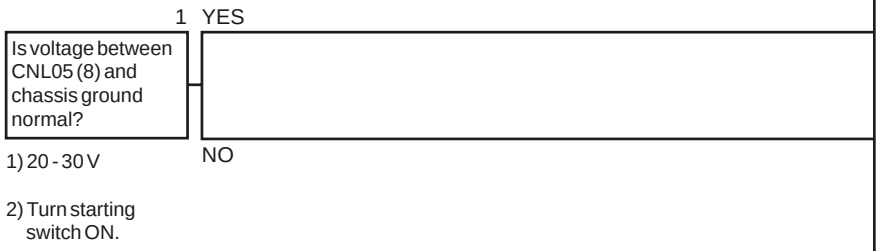


(c) Preheating stays on

M-13 Abnormality in parking brake dragging warning

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

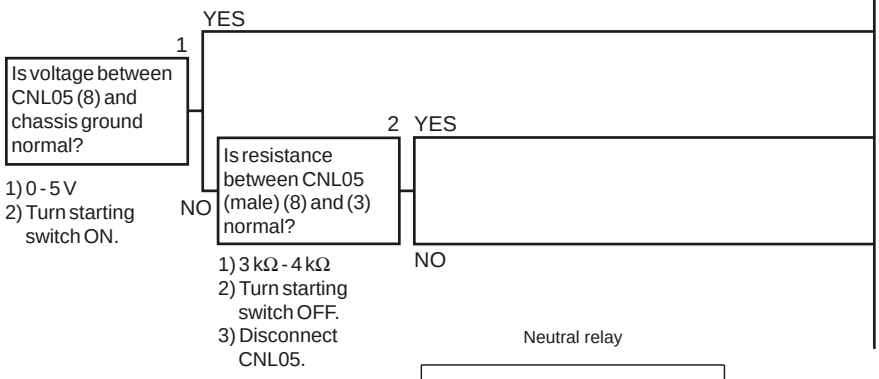
(a) When parking brake is applied, buzzer sounds (intermittently) even when directional lever is at N, and caution lamp flashes



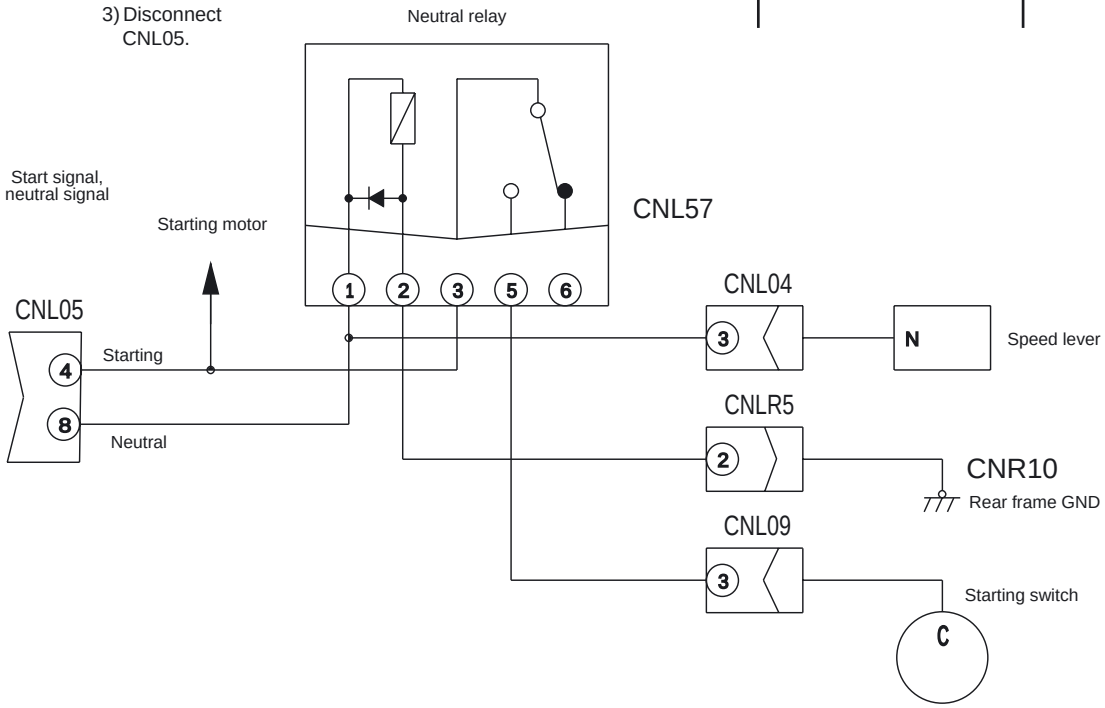
Cause	Remedy
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL05 (female) (8) and CNL04 (3)	After inspection, repair or replace

(b) When parking brake is applied, buzzer does not sound and caution lamp does not light up even when directional lever is at position other than N

★ Check that the synchronous flash signal is normal.

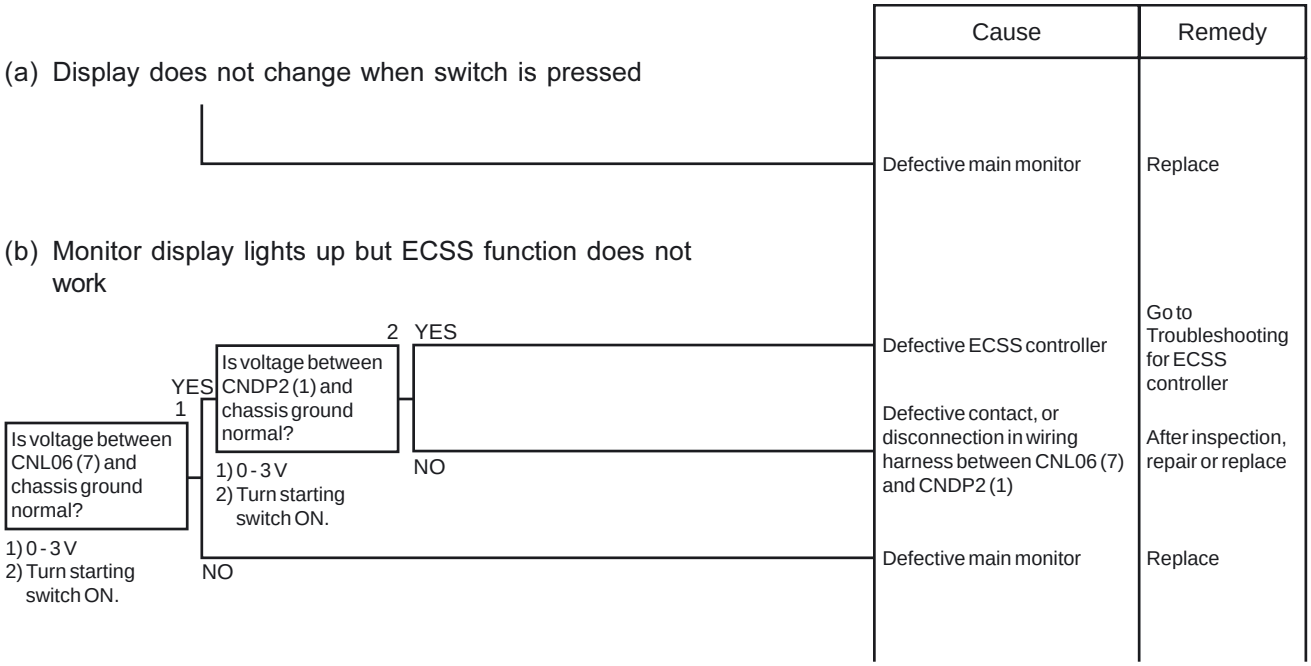


Cause	Remedy
Defective main monitor	Replace
Contact of power source with wiring harness between CNL05 (female) (8) and CNL04 (female) (3)	After inspection, repair or replace
Defective main monitor	Replace

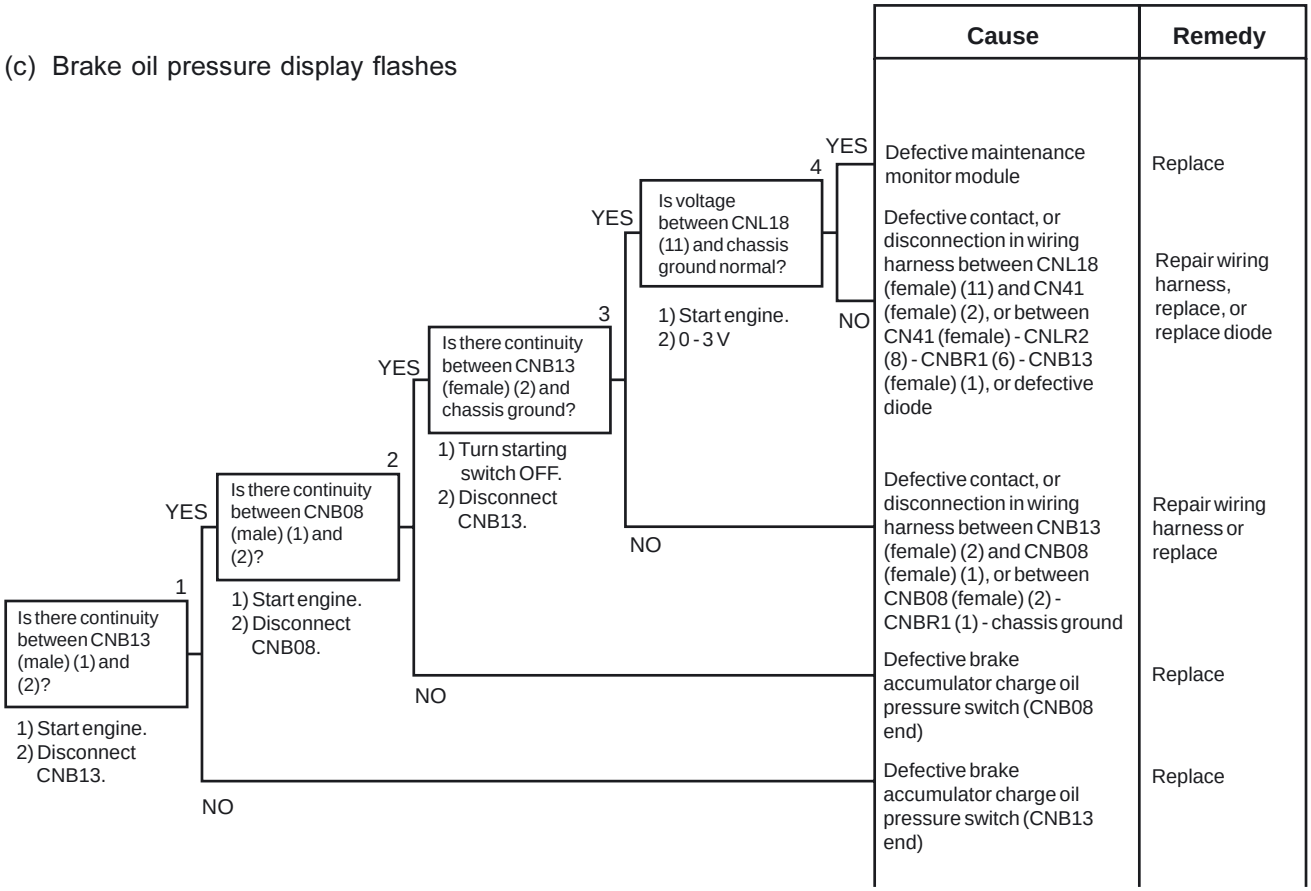


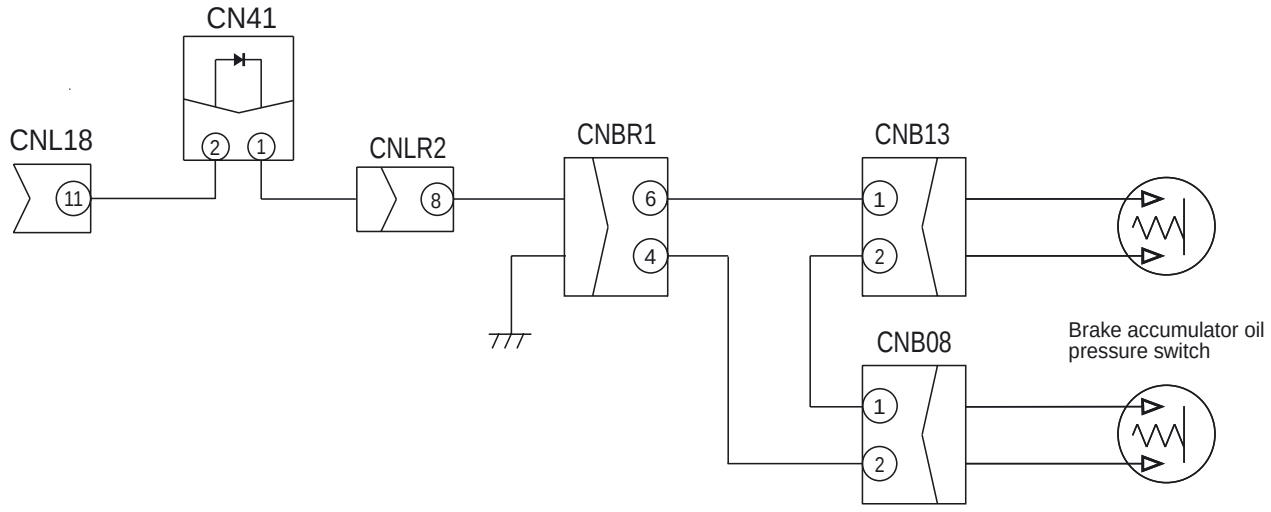
M-24 Abnormality in ECSS system

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



(c) Brake oil pressure display flashes

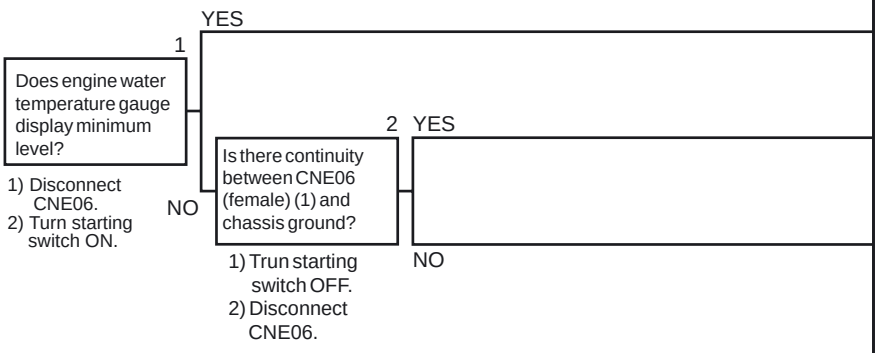




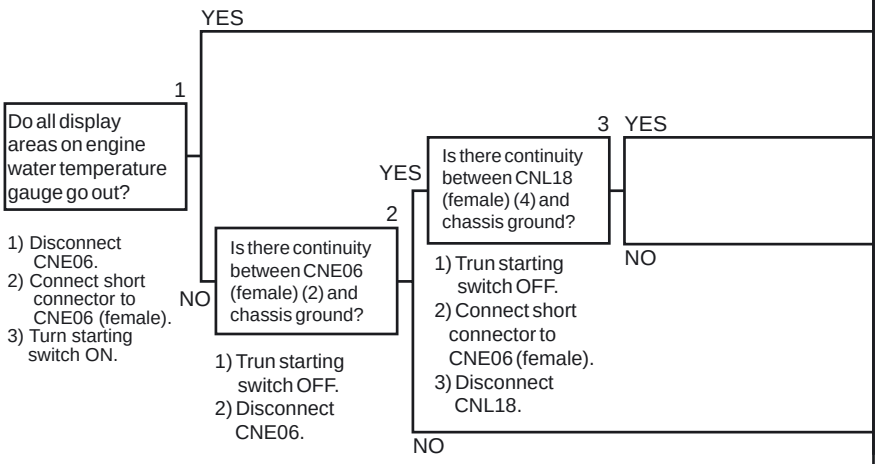
(b) Abnormality in engine water temperature gauge

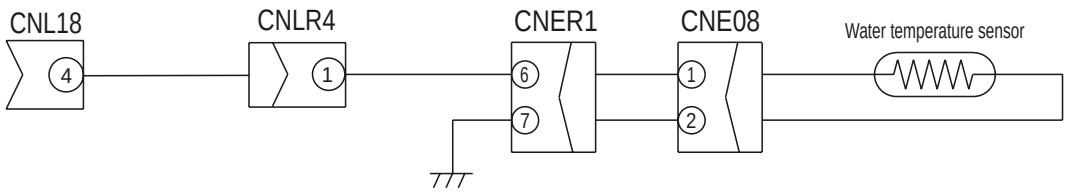
Cause	Remedy
Defective engine water temperatur sensor	Replace
Contact of chassis ground with wiring harness between CNE06 (female) (1) - CNER1 (6) - CNLR4 (1) - CNL18 (female) (4)	Repair wiring harness or replace
Defective maintenance monitor module	Replace
Defective engine water temperatur sensor	Replace
Defective maintenance monitor module	Replace
Defective contact, or disconnection in wiring harness between CNE06 (female) (1) - CNER1 (6) - CNLR4 (1) - CNL18 (female) (4)	Repair wiring harness or replace
Defective contact, or disconnection in wiring harness between CNE06 (female) (2) - CNER1 (7) - chassis ground	Repair wiring harness or replace

(1) Nothing is displayed in the display area



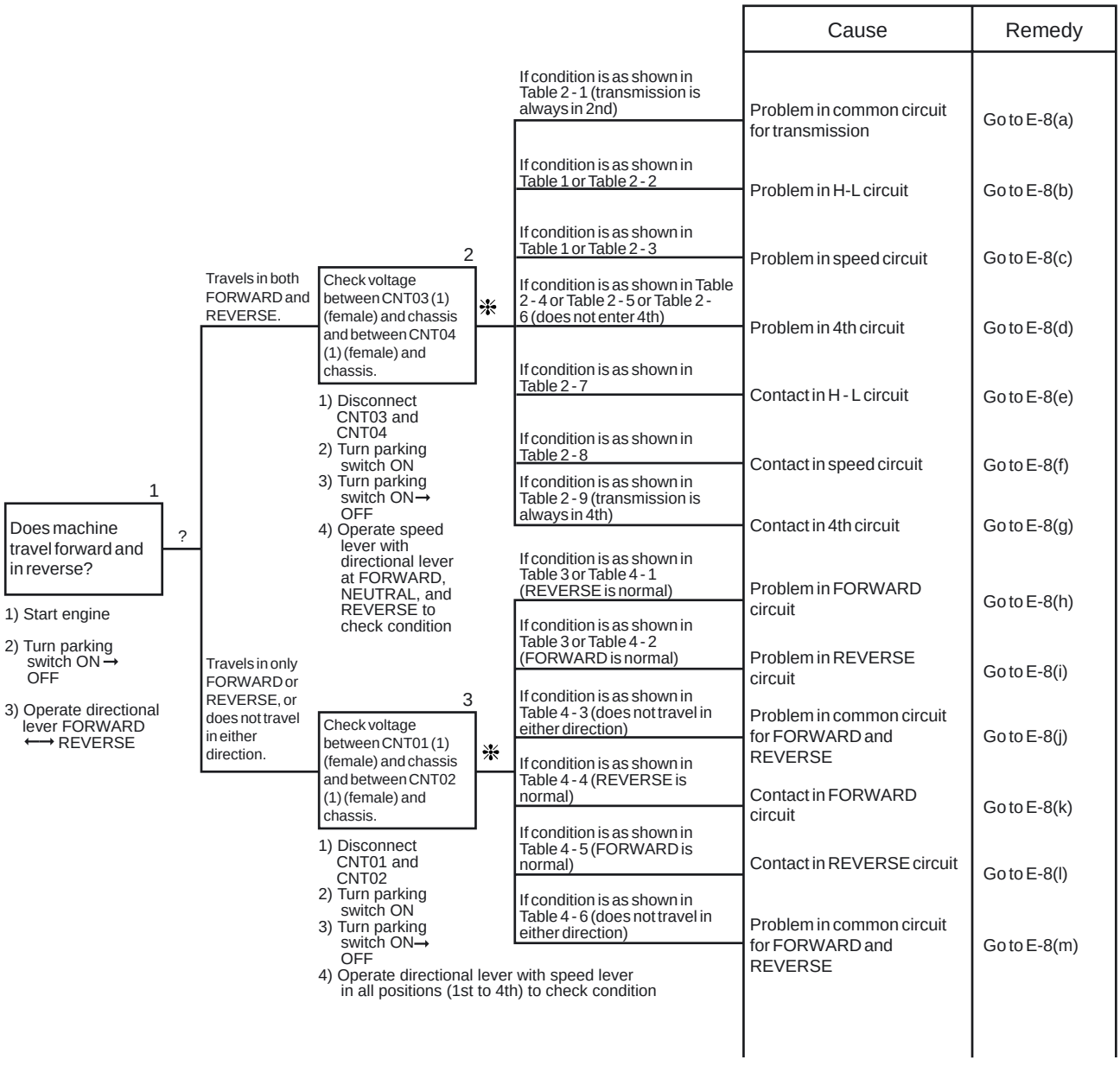
(2) Display shows lowest level and does not move





E-8 Transmission does not work normally
(WA320-3H manual gear shift)

★ When carrying out troubleshooting of the transmission system, stop the machine on flat ground.
★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△( ).
★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



Cause	Remedy
Problem in common circuit for transmission	Go to E-8(a)
Problem in H-L circuit	Go to E-8(b)
Problem in speed circuit	Go to E-8(c)
Problem in 4th circuit	Go to E-8(d)
Contact in H - L circuit	Go to E-8(e)
Contact in speed circuit	Go to E-8(f)
Contact in 4th circuit	Go to E-8(g)
Problem in FORWARD circuit	Go to E-8(h)
Problem in REVERSE circuit	Go to E-8(i)
Problem in common circuit for FORWARD and REVERSE	Go to E-8(j)
Contact in FORWARD circuit	Go to E-8(k)
Contact in REVERSE circuit	Go to E-8(l)
Problem in common circuit for FORWARD and REVERSE	Go to E-8(m)

※ Go to applicable item.

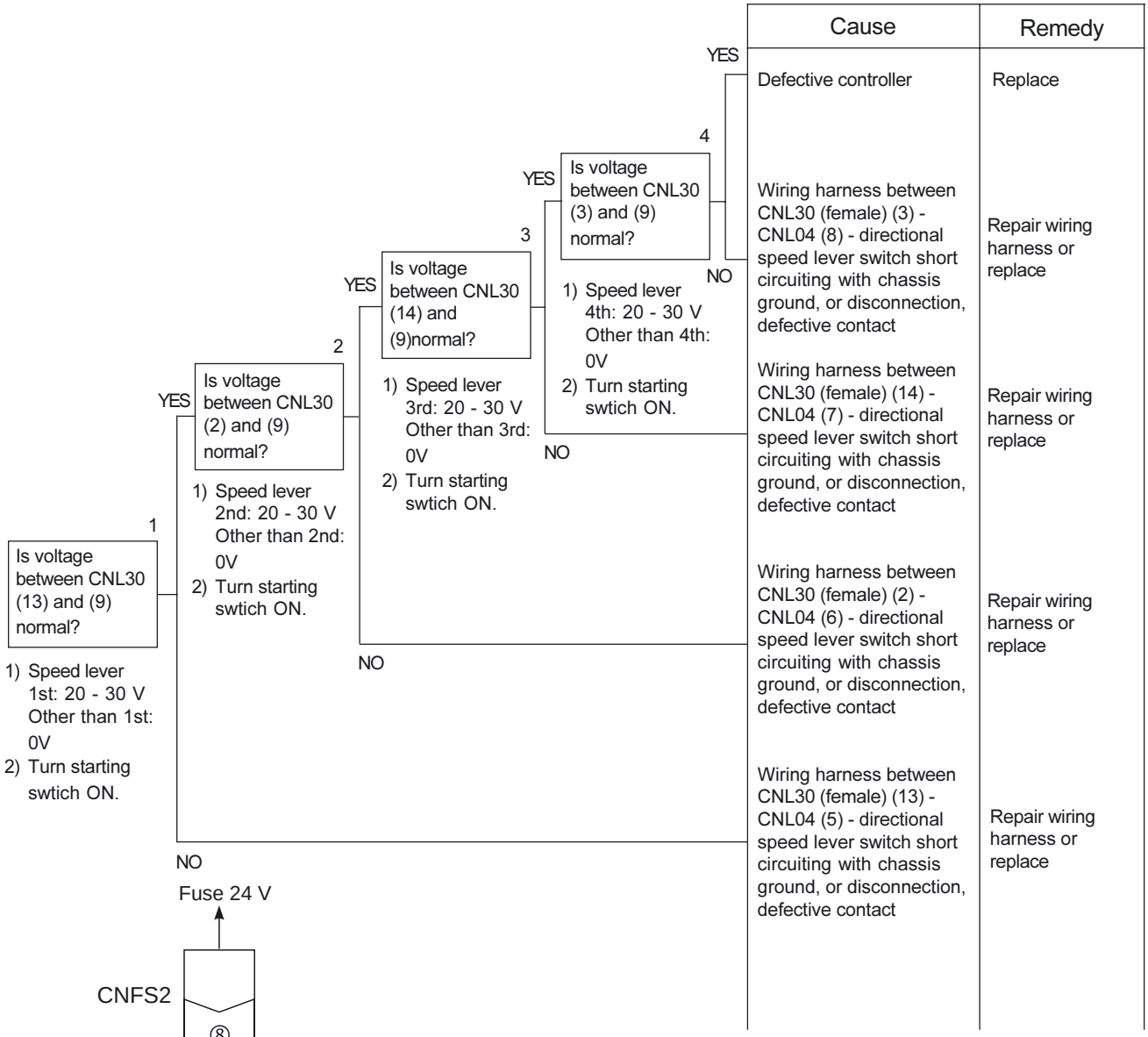
(WA320-3H manual gear shift)

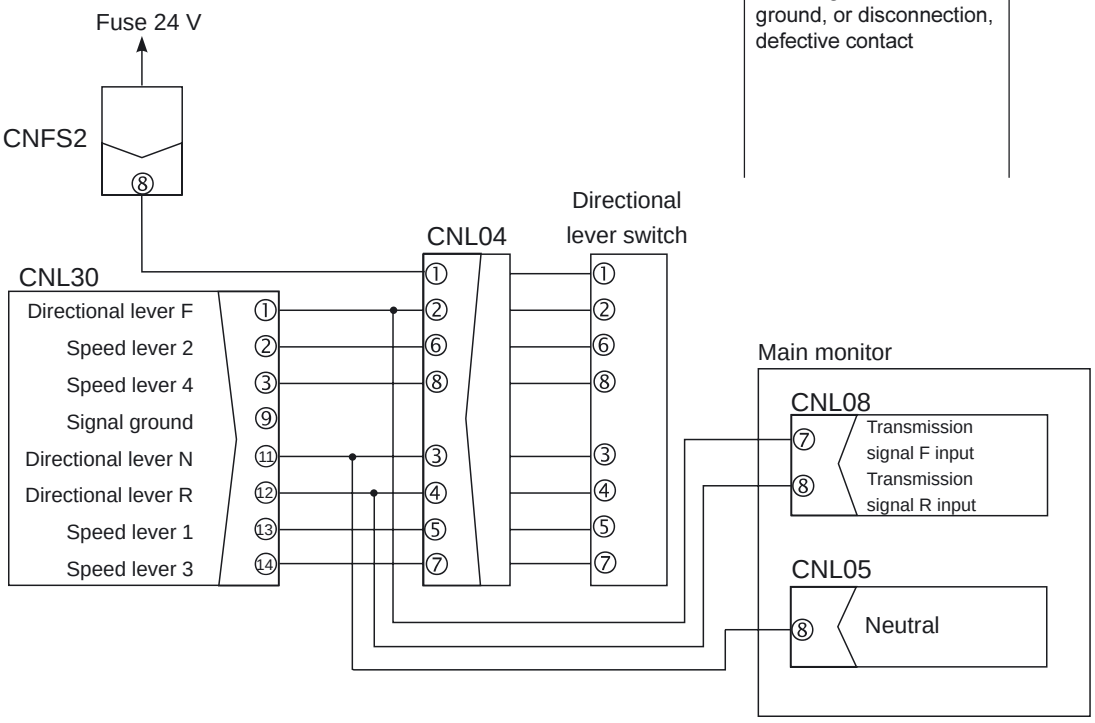
Cause	Remedy
Defective REVERSE relay	Replace
Abnormal contact of wiring harness between CNT02 (female) (1) and CNTL1 (female) (4) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (female) (4) and CNT02 (female) (1) with wiring harn. between CNTL1 (female) (3) - CNT01 (female) (1), CNTL1 (female) (5) - CNT03 (female) (1), CNTL1 (female) (6) - CNT04 (female) (1)	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (female) (4) and CNL67 (female) (2) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (male) (4) and CNL67 (female) (2) with wiring harness between CNTL1 (male) (3) - CNL66 (female) (2),CNTL1 (male) (6) - CNL04 (female) (5)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (female) (4) and CNL67 (female) (5) with wiring harn. between CNL04 (female) (1) - CNFS2 (female) (8), CNL04 (female) (3) - CNL57 (female) (1), CNL04 (female) (2) - CNL66 (female) (5), CNL04 (female) (5) - CNTL1 (male) (6), CNL04 (female) (6) - CNL66 (female) (3), CNL04 (female) (7) - CNTL1 (male) (5), CNL04 (female) (6) - CN37 (2) or CN38 (2)	After inspection, repair or replace
Defective transmission control switch	Replace

TROUBLESHOOTING OF TRANSMISSION CONTROLLER SYSTEM

(A MODE)

A-9 Troubleshooting code [21] Abnormality in speed lever signal system





TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (CHASSIS RELATED) (T MODE)

Explanation of symbols in Table

The following symbols are used on the Cause column to show the action to be taken to remove the cause.

X: Replace, Δ: Correct, A: Adjust, C: Clean

T-8 Steering wheel shakes or there is excessive shock

Checks before troubleshooting
- Is the hydraulic oil level correct?
  Is the type of oil correct?
- Is there any abnormality in the steering gear box mount, column, or linkage?
- Is there any play in the center hinge pin bearing or steering cylinder pin or bushing?
- Is there any variation in the tire inflation pressure?
- Is the steering wheel play correct?

Checking for abnormalities
- Operate at a safe place and check how the steering wheel shakes and under what conditions.
  ❊ In cases where the steering wheel is heavy but does not shake, go to "T-7 Steering is heavy."

No.	Problems	Remedy / Causes: Saftey valve (Valves a)	Wrong position of steering valve selector spool (Valves b)	Defective steering valve	Defect inside steering cylinder (inside surface of cylinder, piston seal, nut, bolt) (Cylinder d)
		△A ✕	△ ✕	✕	△ ✕
1	Chassis shakes when traveling on rough road surface	○	○		○
2	Shakes when steering is suddenly turned during operation travel			○	○
3		○	○		○
4	Chassis shakes when engine is started		○		

T-9 Machine deviates to one side when traveling

Cause : Defective steering valve
- Wrong position of spool

: Leakage of oil inside steering cylinder
: Variation in tire inflation pressure

T-10 Turning radius is different between left and right

Cause : Defective adjustment of steering linkage
Distribution to left and right, stopper lock position
(relief sound can be heard from valve when turning is completed)

T-23 Bucket movement becomes slow during tilt-back operation

Checks before troubleshooting
- Can any deformation be seen in the bucket cylinder?

Cause
- Swelling or internal damage to bucket cylinder tube
- For other abnormalities when the bucket is operated, go to "T- 22 Bucket movement is slow or tilt back lacks power."

T-24 Bucket cannot be pushed with bucket cylinder

See "T-22 Bucket movement is slow or tilt back lacks power."

Checks before troubleshooting
- Is the stroke of the bucket spool in the main control valve properly adjusted?

Cause
- Defective seating of safety valve (with suction valve) at bucket cylinder rod end of main control valve
- Oil leakage from bucket cylinder piston seal

T-25 Excessive hydraulic drift of bucket

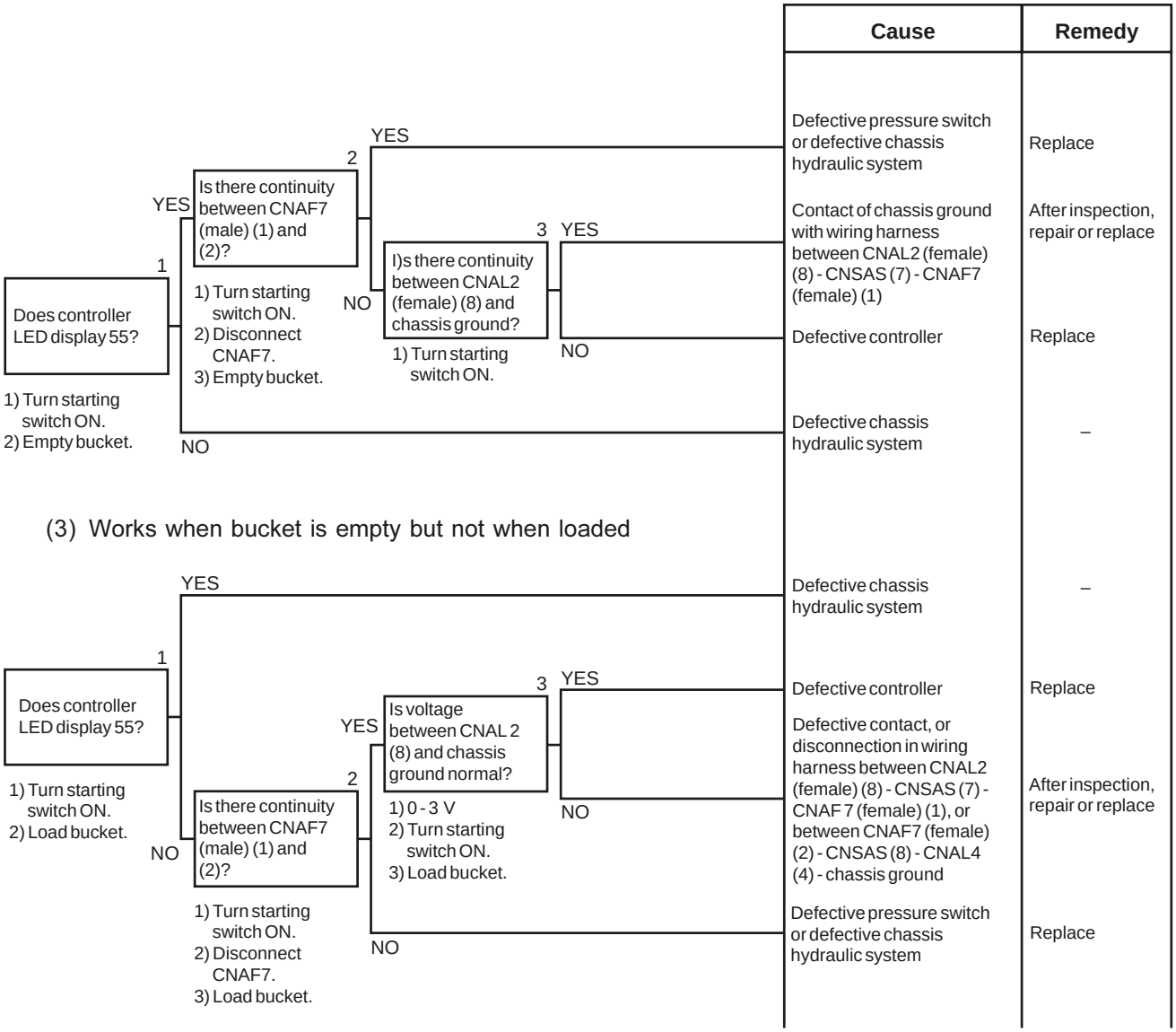
Ask the operator the following questions.
- Did the problem suddenly start?
  Yes = Dirt caught in valve, broken part
- Did the problem gradually appear?
  Yes = Worn parts

Checks before troubleshooting
- Is the bucket spool at the neutral position?
  Yes = Seized link bushing, defect in spool detent

Checking for abnormalities
- Use the Standard Value Table to check if the hydraulic drift of the bucket is actually excessive.

Cause
- Oil leakage inside bucket cylinder
- Defective seating of safety valve (with suction valve) at bottom end
- Defective oil tightness of bucket spool

(2) Works when bucket is loaded but not when empty



(3) Works when bucket is empty but not when loaded

METHOD OF USING MANUAL

1. When removing or installing unit assemblies

   (1) When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.
   (2) Any special techniques applying only to the installation procedure are marked ✻1 , and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

   (Example)

   REMOVAL OF O O O ASSEMBLY ..... Title of operation

   ⚠ ..... Precautions related to safety when carrying out the operation

   1. XXXX (1) ..... Step in operation

      ★ ..... Technique or important point to remember when removing XXXX (1).

   2. Δ Δ Δ (2): ..... ✻1 Indicates that a technique is listed for use during installation

   3. □□□□ assembly (3)

       ..... See Lubricant and Coolant Table

   INSTALLATION OF O O O ASSEMBLY ..... Title of operation

   - Carry out installation in the reverse order to removal.

     ✻1 ..... Technique used during installation

     ★ ..... Technique or important point to remember when installing Δ Δ Δ (2).

   - Adding water, oil ..... Step in operation

     ★ ..... Point to remember when adding water or oil

      ..... Quantity of filling oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTION WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

   (1) For details of the description, part number, and quantity of any tools (A1, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

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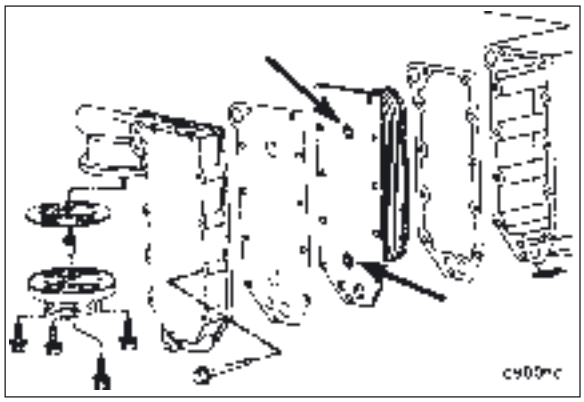
INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

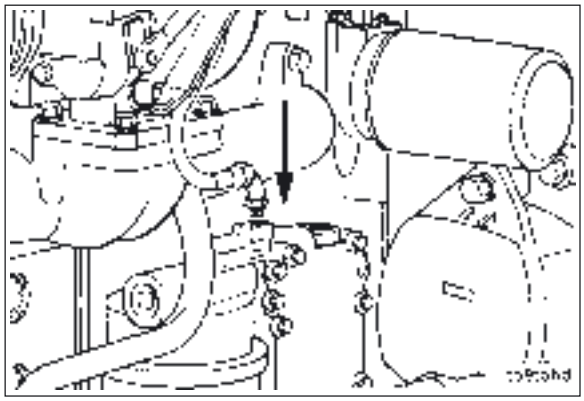
Assemble the oil cooler gasket, element, cooler cover gasket, oil temperature thermostat and cooler cover to the cylinder block.
Install the filter head and gasket if removed.



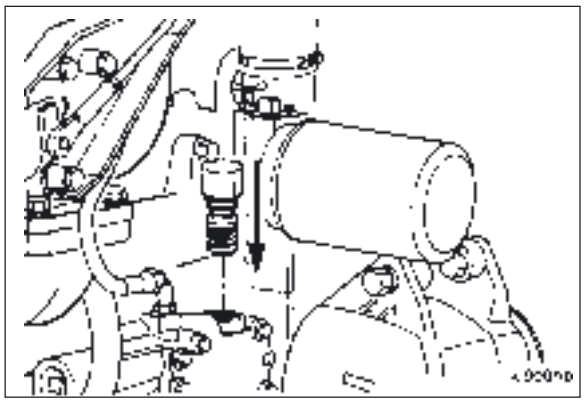
NOTE: Be sure to remove the shipping plugs from the new cooler element.

Torque Value:

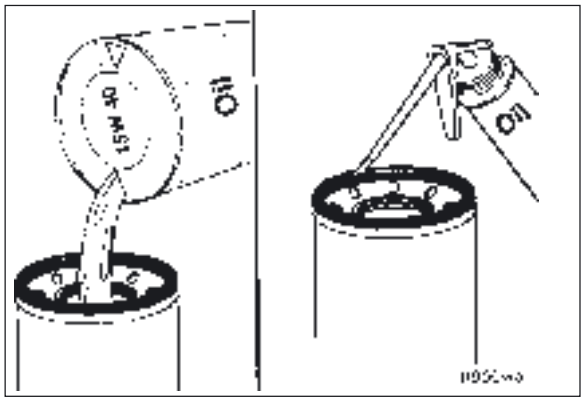
Oil Cooler Cover Capscrew	24 Nm
Oil Filter Head Capscrews	24 Nm



Connect the turbocharger oil supply line.
Torque Value: 17 Nm



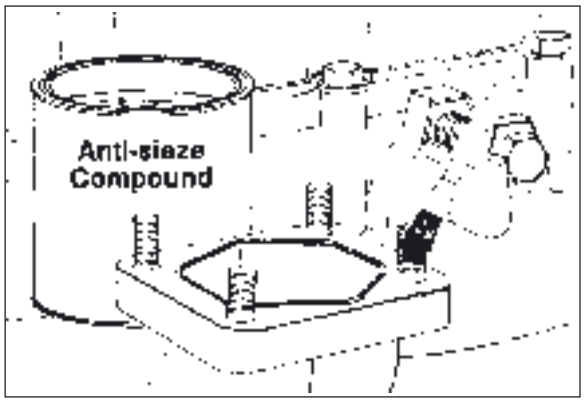
Install the lubricating oil temperature thermostat.
Torque Value: 50 Nm



NOTE: Fill the filters with clean lubricating oil before installation.
Install a new oil filter.
Follow the manufacturer`s instructions for tightening.

INSTALLATION OF TURBOCHARGER ASSEMBLY

Install a new gasket and apply a high temperature seize compound to the mounting studs.



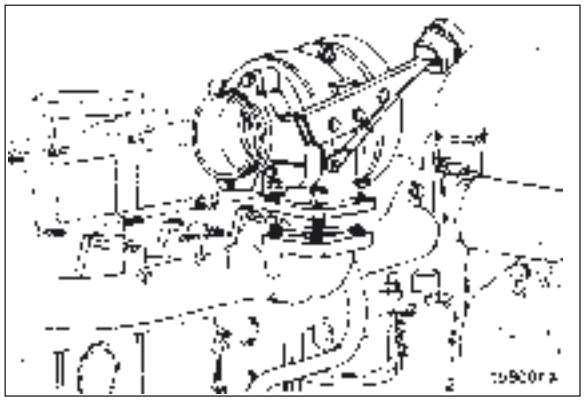
Install the turbocharger.

Torque Value: 45 Nm

Use a new gasket and connect the oil drain tube.

Torque Value:

(Exhaust Clamp)	8 Nm
(Drain Tube)	24 Nm

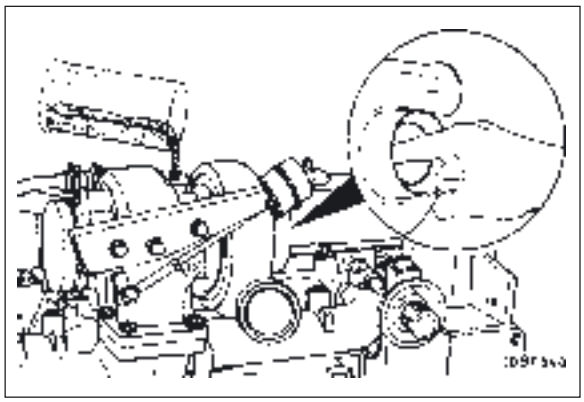


NOTE: New turbochargers **must** be pre-lubricated before start-up.

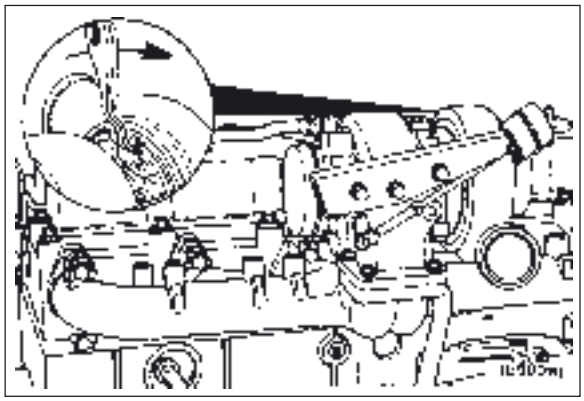
Pour 50 to 60 cc [2 to 3 ounces] of clean engine oil into the oil supply fitting. Rotate the turbine wheel to allow the oil to enter the bearing housing.

Connect the oil supply line.

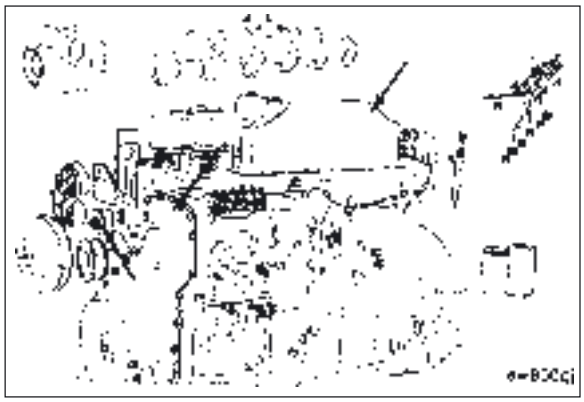
Torque Value: 15 Nm



Loosen the snap ring and align the compressor housing with the turbocharger air outlet connection.



Removal



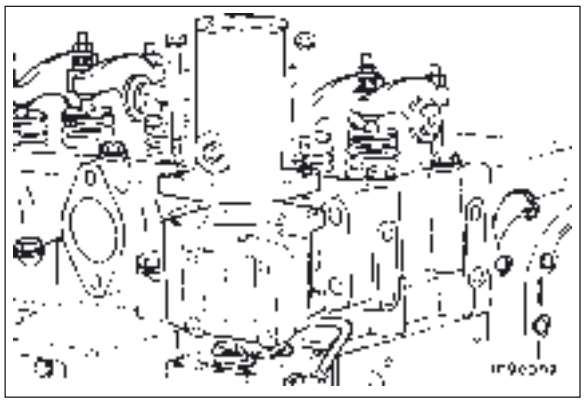
Drain the cooling system.

- Remove the turbocharger.
- Remove the aftercooler or intake cover.
- Remove the exhaust manifold.
- Remove the fuel lines and injector nozzles.
- Remove the valve cover, rocker lever assemblies and push rods.
- Remove the fuel filters.
- Remove the fan hub.
- Remove the alternator.
- Remove the belt tensioner.

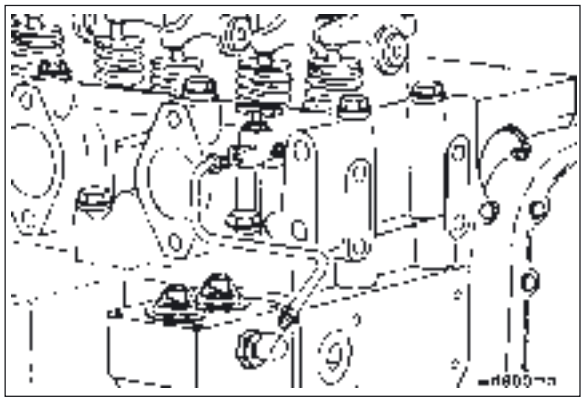
For details refer to CUMMINS Troubleshooting and Repair Manual. P/N. 36 66 003-01

NOTE: Insome applications it may be easier to remove the thermostat housing to gain access to the exhaust manifold capscrew for No. 1 cylinder.

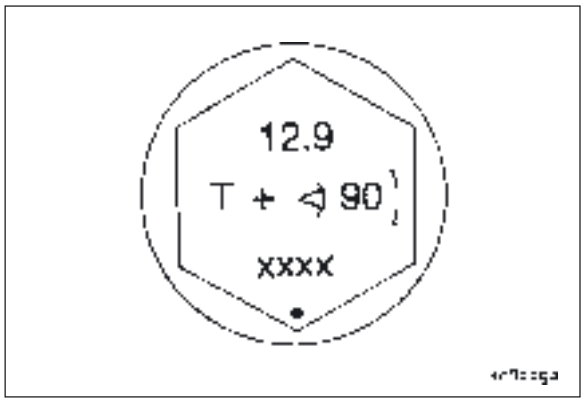
Remove the thermostat housing/coolant outlet assembly.



Disconnect the coolant vent tube.



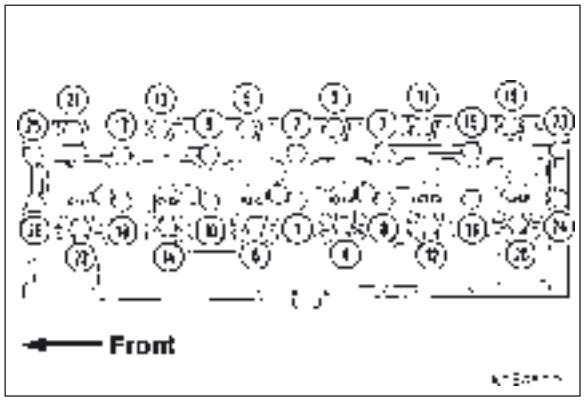
NOTE: The top of the cylinder head capscrew is identified with an angle marking. The cylinder head capscrews **must** be tightened by using the three-step "torque plus angle" method, described as follows:



1. Follow the numbered sequence and tighten all capscrews:

Torque Value: (Step One) 70 Nm

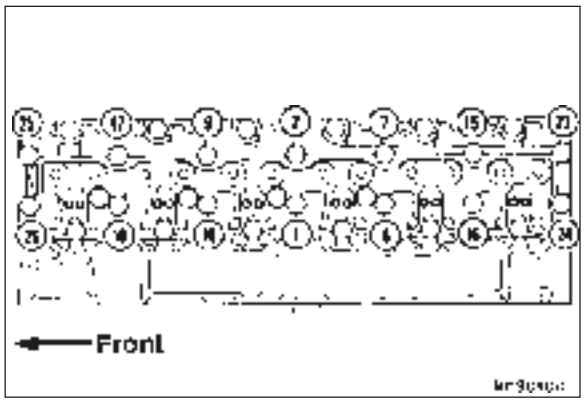
Follow the numbered sequence and check the torque on all capscrews again.



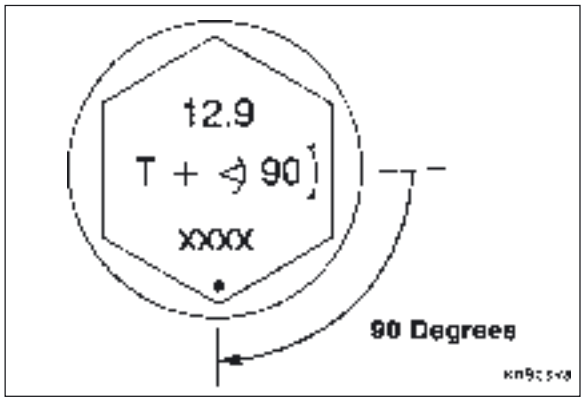
2. Follow the numbered sequence and tighten only the 12 long capscrews:

Torque Value: (Step Two) 145 Nm

Follow the numbered sequence and check the torque on all long capscrews again.



3. **Torque Value:** (Step Three)
Follow the numbered sequence and turn all the capscrews 90 degrees as indicated on the capscrew head.



INSTALLATION OF RADIATOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※1
★ Adjust the alternator V-belt.
For details, see TESTING AND ADJUSTING FAN BELT.

※2 ※3 ※4
★ Connect the wiring connectors securely.

※5
★ To prevent the hose from twisting, hold the hose securely with 2 wrenches when tightening.
kgm Air conditioner hose :
22 ± 2.5 Nm (2.25 ± 0.25 kgm)

※6
kgm Dry receiver hose bolt :
5.4 ± 1.5 Nm (0.55 ± 0.15 kgm)

※7
★ The space inside the hood is confined, so lower slowly and be careful not to hit any internal parts.

※8
★ Install the fan guard so that the clearance from the fan is uniform.

※9
★ Install the hoses without twisting or interference.
kgm Joint nut : 196 ± 49 Nm (20.0 ± 5.0 kgm)
(width across flats: 41 mm)

※10
★ Make sure that the clearance from the fan is uniform when installing.
★ Be careful not to damage the radiator core.
★ Insert the radiator carefully from the counterweight end.

- Refilling with water Add water through water filler to the specified level.
★ Run the engine to circulate the water through the system. Then check the water level again.
Coolant : 33 l

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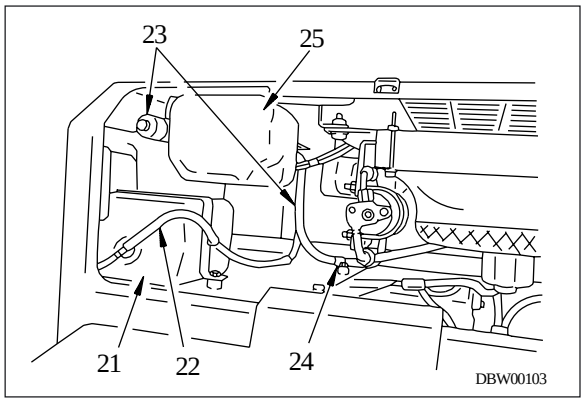
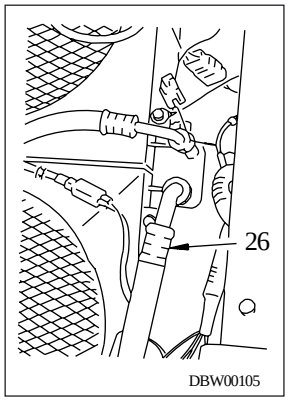
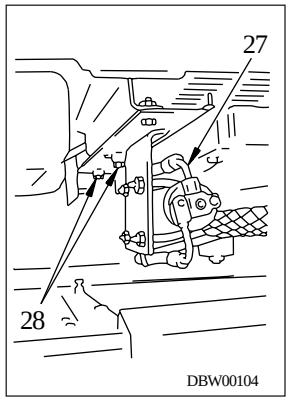
3) Disconnect hose (22) from radiator sub-tank (21).
   ★ Loosen the hose clamp.
4) Remove transmission breather hose assembly (23).
   ★ Remove clamp (24) from the hood.
   ★ Remove window washer tank (25), then remove transmission breather hose assembly and install the tank temporarily to the hood.



8. Air conditioner piping
   1) Disconnect air conditioner hose (26) from condenser.
      ★ Disconnect the band.
      ★ After disconnecting the hose, fit a cover to the joint.
   2) Disconnect air conditioner hose (27) from dry receiver.
      ★ Remove clamp (28) from the condenser bracket.
      ★ After disconnecting the hose, fit a cover to the joint. ❋6





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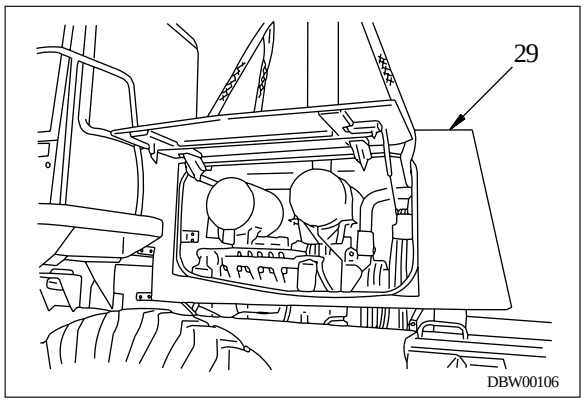
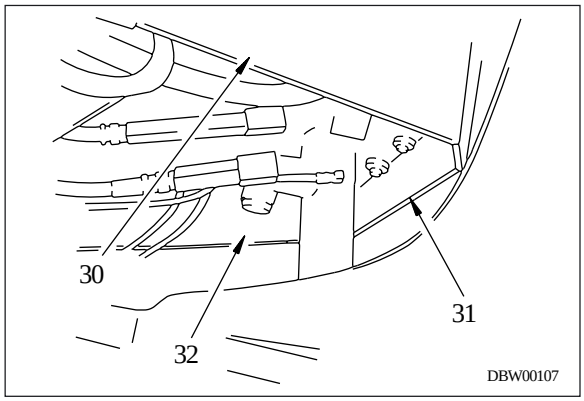
9. Hood
   Sling hood assembly (29), then remove mounting bolts and lift off.
   ★ Install eyebolts to the top of the hood.
   ★ The space inside the hood is confined, so lift off slowly and be careful not to hit any internal parts. ❋7

kg Hood assembly : 165 kg



10. Covers
    Remove covers (30), (31), and (32) at bottom of cab.



INSTALLATION OF TORQUE CONVERTER, TRANSMISSION ASSEMBLY

- Carry out installation in the reverse order to removal.

[*1]
- Install hydraulic tank.
  For details, see INSTALLATION OF HYDRAULIC TANK ASSEMBLY.
- Refilling with oil
  Tighten the drain valve and add transmission oil through the oil filler to the specified level.
  ★ Run the engine to circulate the oil through the system. Then check the oil level again.

Transmission oil : 35 l

[*2]
★ Connect the wiring connectors securely.

[*3]
★ Adjust the alternator V-belt.
For details, see TESTING AND ADJUSTING FAN BELT.

[*4] [*5]
★ Connect the wiring connectors securely.

[*6]
★ To prevent the hose from twisting, hold the hose securely with 2 wrenches when tightening.

kgm Air conditioner hose :
22 ± 2.5 Nm (2.25 ± 0.25 kgm)

kgm Dry receiver hose bolt :
5.4 ± 1.5 Nm (0.55 ± 0.15 kgm)

[*7]
★ The space inside the hood is confined, so lower slowly and be careful not to hit any internal parts.

[*8]
★ Connect the wiring connectors securely.

[*9]
★ Do not remove the cover from the hose until immediately before installation.
★ To prevent the hose from twisting, hold the hose securely with 2 wrenches when tightening.

kgm Hose joint:
13.2 ± 1.5 Nm (1.35 ± 0.15 kgm)

kgm Hose joint:
31.9 ± 2.5 Nm (3.25 ± 0.25 kgm)

Thread of hose joint: Compressor oil

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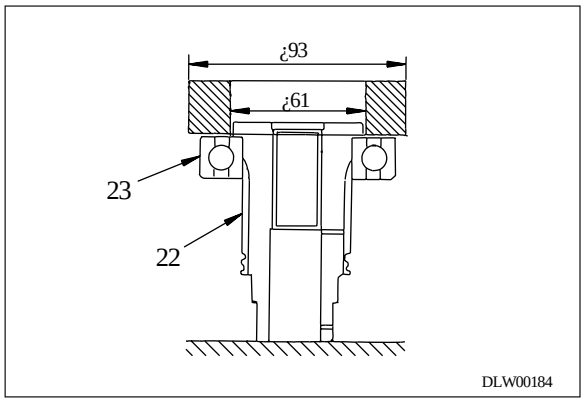
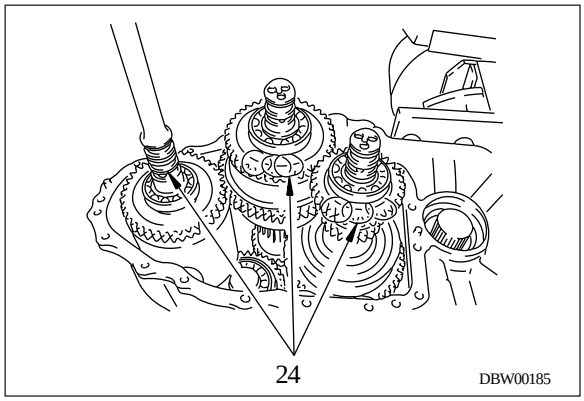
4) Remove bearing (23) from shaft (22).
   ★ Carry out the same procedure at the loader pump end.



10. Seal ring
    Remove seal rings (24) from each clutch shaft.



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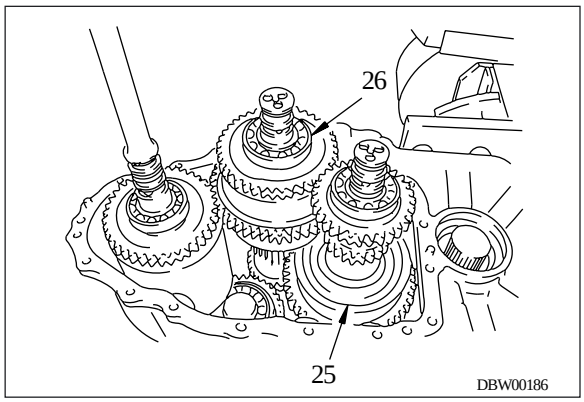
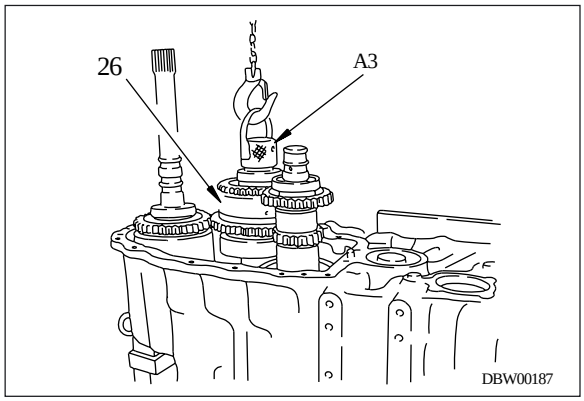
11. 2nd, 4th, and 1st, 3rd clutch
    1) Remove 2nd, 4th clutch (25) and 1st, 3rd clutch (26) together from housing bearing, then move towards 2nd, 4th clutch output shaft.
       ★ Remove 1st, 3rd clutch from bearing, then move towards FORWARD, REVERSE side.

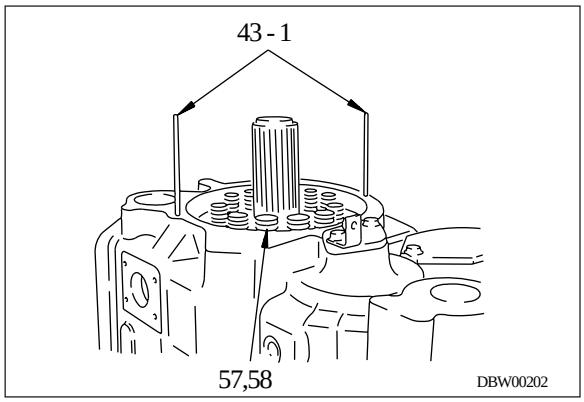


    2) Using tool A3, lift off 1st, 3rd clutch (26).
       ★ Remove slowly and take care not to hit any other gear.

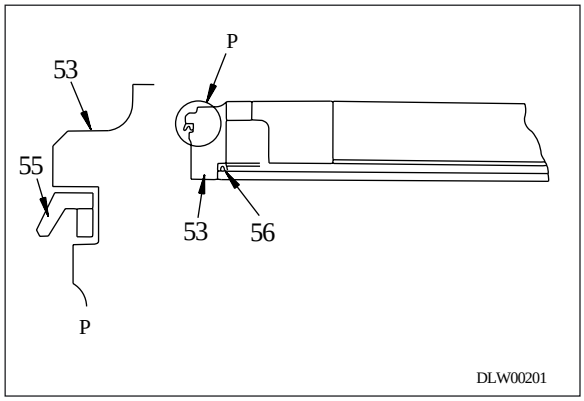
       kg 1st, 3rd clutch : 47 kg



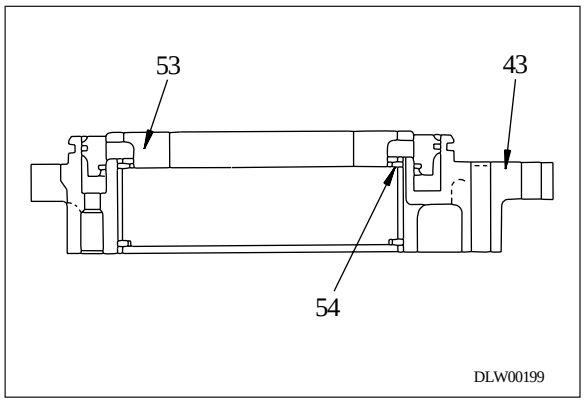
4. Parking brake assembly
   1) Assemble springs (57) and (58) to parking brake retainer.
      ★ Keep the inner and outer springs in sets.
      ★ Set guide bolts (43-1) in position.
      Guide bolt : (12 mm, pitch: 1.75 mm, length: 130 mm)



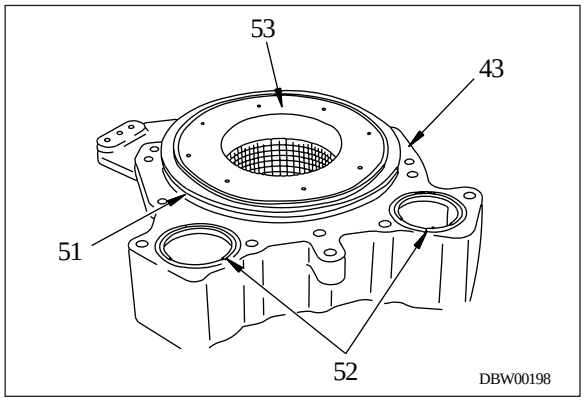
   2) Install seal rings (55) and (56) to piston (53).
      ★ Be sure to assemble the piston seal facing in the correct direction and without twisting.



   3) Assemble snap ring (54) to parking brake housing (43), and install piston (53).
      ★ Check that the snap ring is fitted securely in the groove.
      ★ Knock in the piston uniformly a little at a time with a plastic hammer.
      Outside circumference of seal ring, sliding surface : Transmission oil



   4) Assemble O-rings (51) and (52) to parking brake housing (43).
      ★ Fit the O-rings securely in the grooves.
      ★ Coat the O-rings thinly with grease and stick them on to prevent them from falling out.
      Outside circumference of O-ring : Grease (G2-LI)



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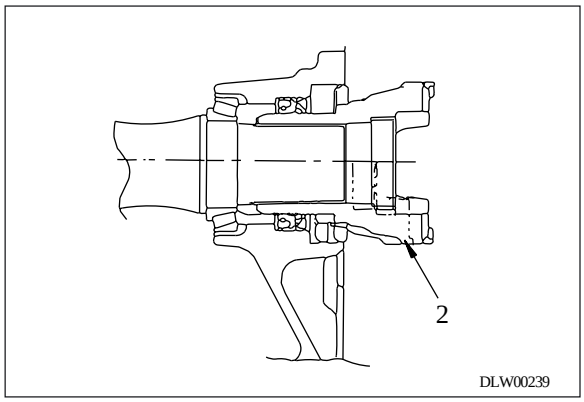
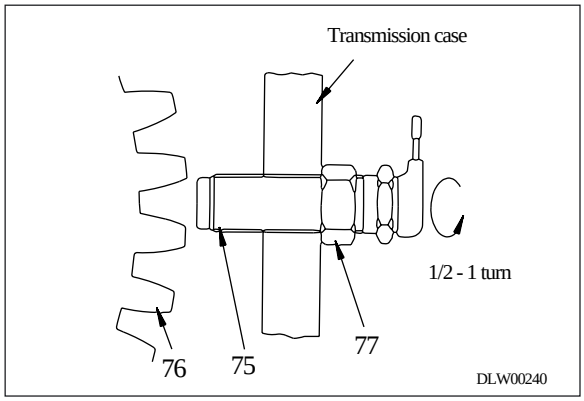
3) Assemble so that rear coupling (2) and front coupling face in same direction.



20. Adjusting speedometer sensor
    1) Screw in sensor (75) until it contacts outermost surface of gear (76).
       ★ Before installing the sensor, check that the gear is at the outermost circumference in relation to the mounting surface.
       ★ When screwing in the sensor with a wrench, stop before it contacts the gear, and finally tighten by hand until it is lightly in contact.
    2) After sensor (75) contacts gear (76), turn it back 1/2 – 1 turn, and secure it in position with locknut (77).
       ★ When securing with the locknut, hold the nut with a wrench when tightening.
       Sensor thread portion : Gasket sealant (LG-5)
       kgm Sensor locknut : 58.8 ± 9.8 Nm (6.0 ± 1.0 kgm)
       ★ Install the transmission bracket.



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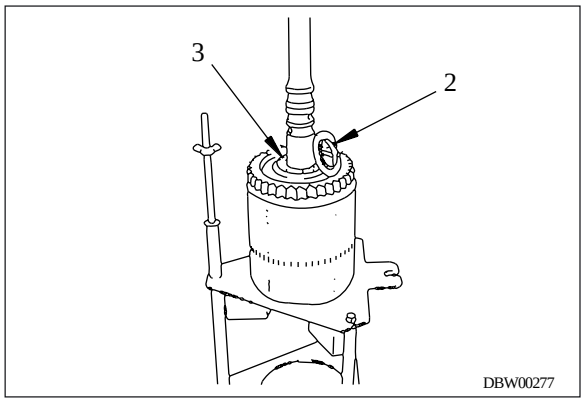
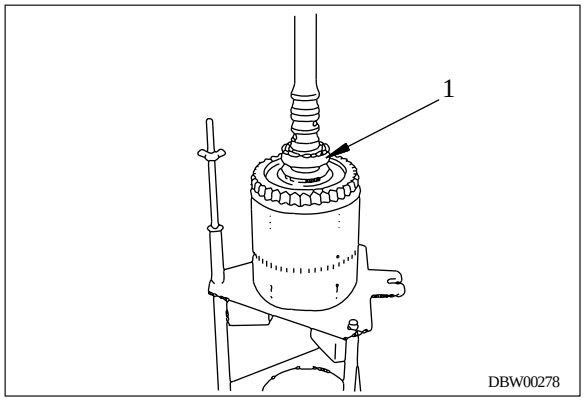
17. Spacer
Assemble thrust washer (3), then assemble spacer (2).
★ Check that the end face of the thrust race of the thrust washer is below the surface of the stepped portion of the shaft.
Thrust washer : Transmission oil



18. Bearing
Press fit bearing (1).
★ Press fit completely so that the spacer is in tight contact with bearing (1) at the stepped portion of the shaft.



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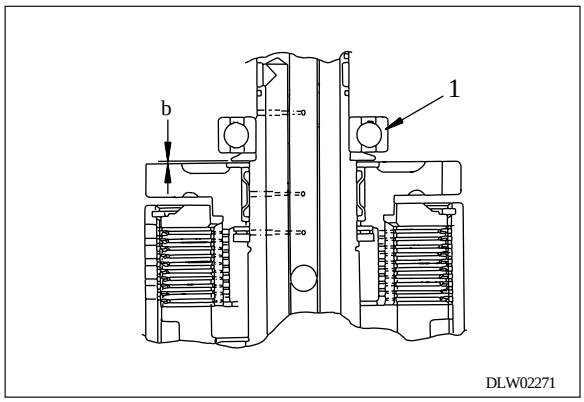
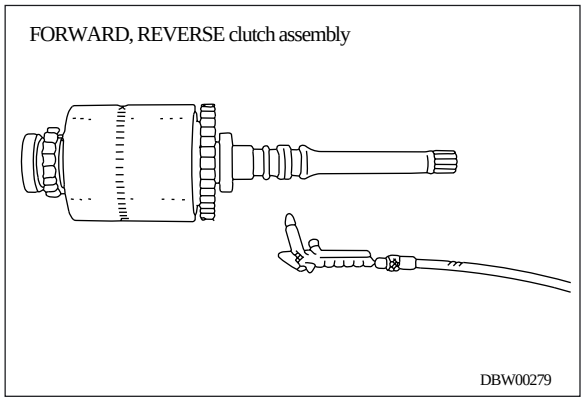
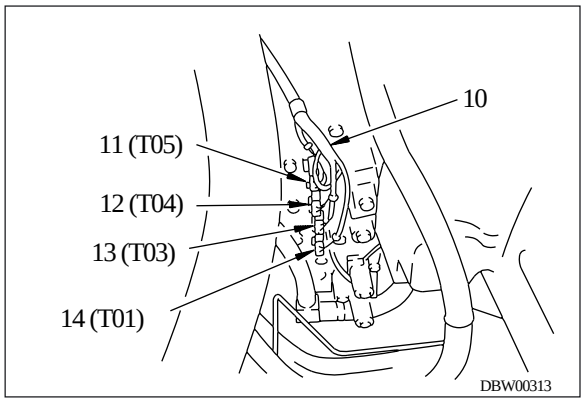
★ After press fitting bearing (1), check that clearance "b" between the thrust washer and the spacer is within the standard value.
★ b = 0.106 – 0.991 mm



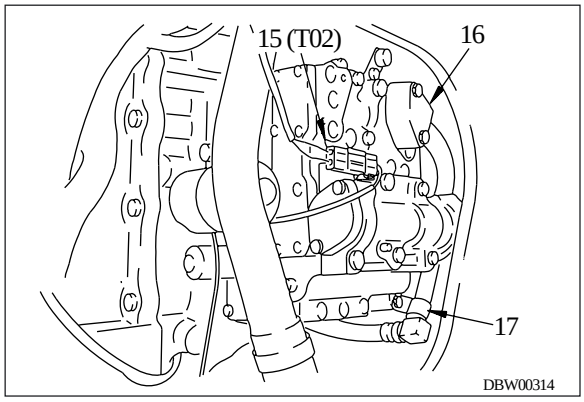
19. Clutch pack operation test
Blow in compressed air through oil hole in shaft and check that each clutch works properly.
★ If the gear where the air is blown in is held in position, the clutch is working properly.



5. Electric wiring
   1) Disconnect clamp of transmission wiring (10) from transmission valve.
   2) Disconnect transmission wiring (11), (12), (13), (14), and (15) from transmission valve. ✻ 3
      ★ Fit tags to distinguish the wiring.



6. Disconnect tube (16) between transmission filters from transmission valve. ✻ 4
   ★ Remove the valve mounting bolts, then remove clamp (17).



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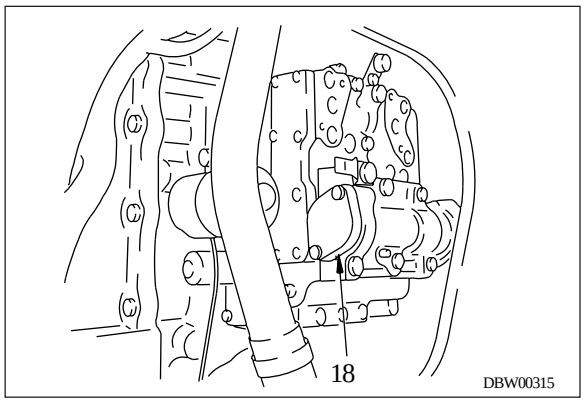
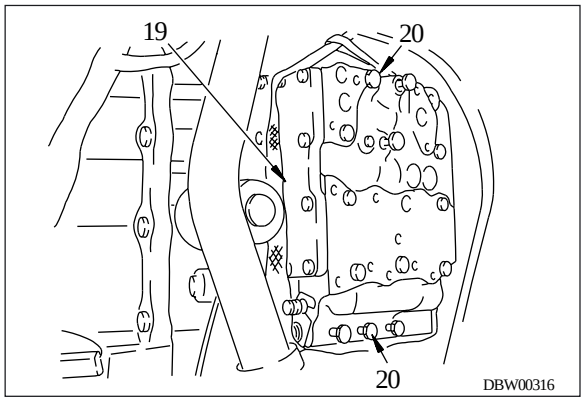
7. Remove modulating valve (18). ✻ 5

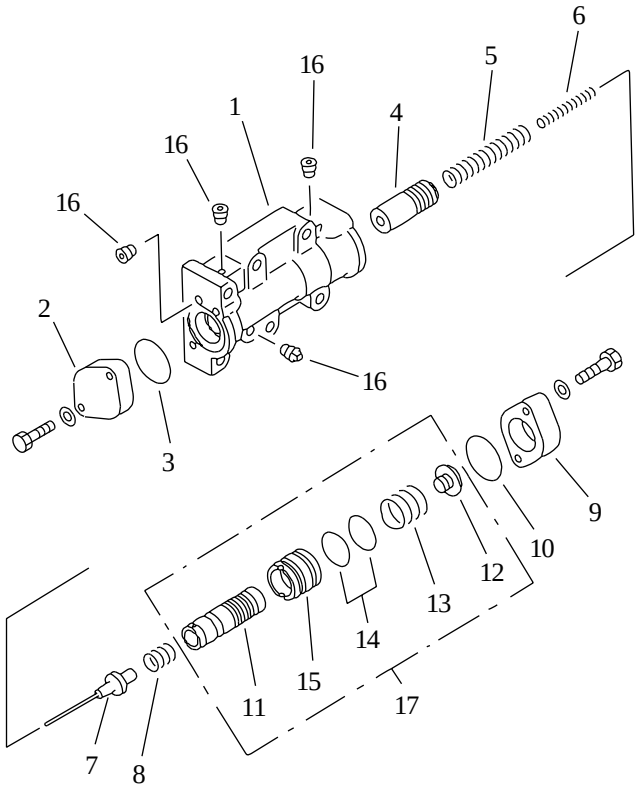


8. Sling transmission valve assembly (19), then remove mounting bolts, and lower assembly under chassis.
   ★ Leave upper and lower valve mounting bolts (20) installed. ✻ 6
   ★ Remove together with the wiring bracket.
   ⚠ The working space is confined, so be extremely careful when carrying out this operation.
   ★ When fitting the lifting tool, avoid the connectors, fit securely to the valve body, and be careful to maintain the balance.

   kg Transmission valve : 46 kg
   ★ The valve mounting bolts for the WA350-3S and WA350-3H are different, so record the mounting position of the mounting bolts.



DISASSEMBLY OF TRANSMISSION MODULATING VALVE ASSEMBLY



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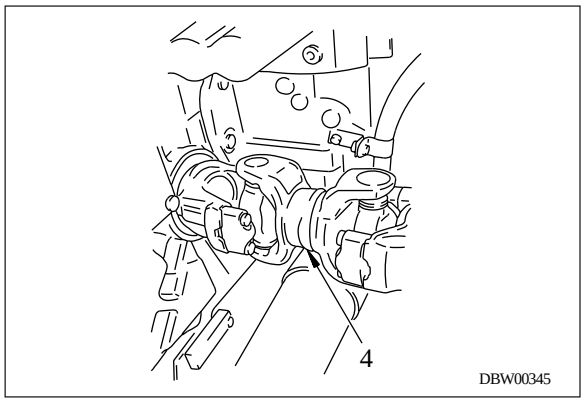
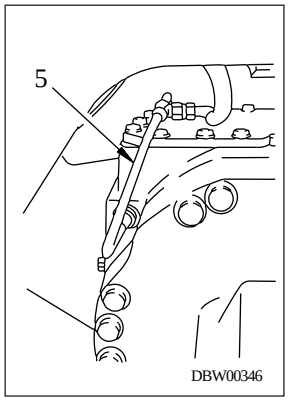
1. Remove mounting bolts from modulating valve assembly (1), remove cover (2) and O-ring (3), then remove ACC valve (4), outer spring (5), inner spring (6), stopper (7), and spring (8).
2. Remove mounting bolts, remove cover (9) and O-ring (10), then remove fill valve assembly (17).
3. Remove plug (12), fill spring (13), O-ring (14), and sleeve (15) from fill valve (11).
4. Remove plug (16) from modulating valve assembly (1).

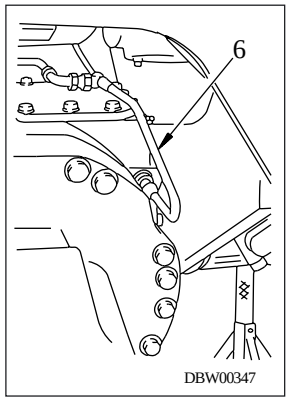
5. Rear drive shaft
   Remove rear drive shaft (4).
   ★ Make match marks to show the mounting position. ✻2

   kg Rear drive shaft : 8 kg



6. Brake, grease tubes ✻3
   1) Disconnect brake tubes (5) and (6).
      ★ Remove the differential cover bolts and the brake tube T-joint mount.





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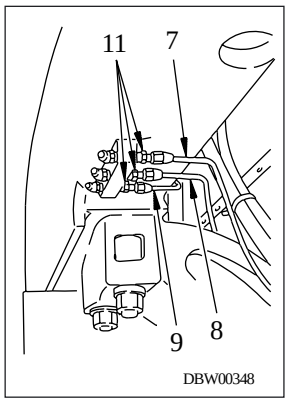
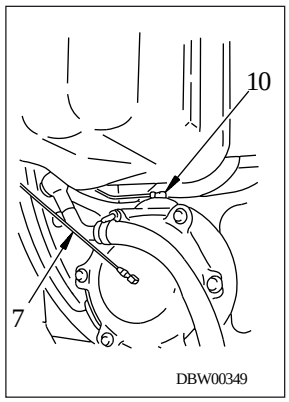
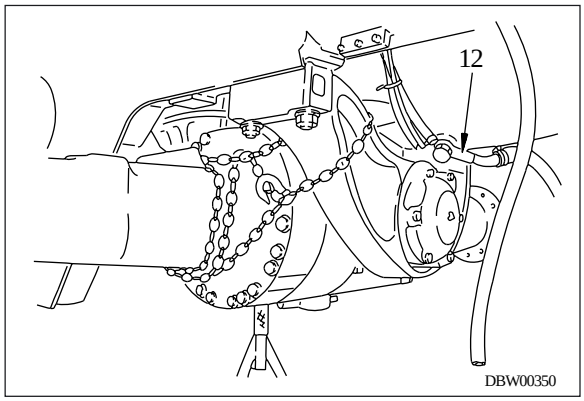
   2) Remove grease tubes (7) and (8), then remove grease tube (9).
      ★ Remove elbow (10) and nipples (11).

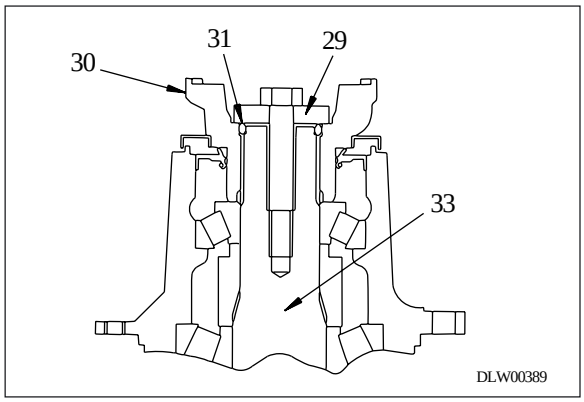




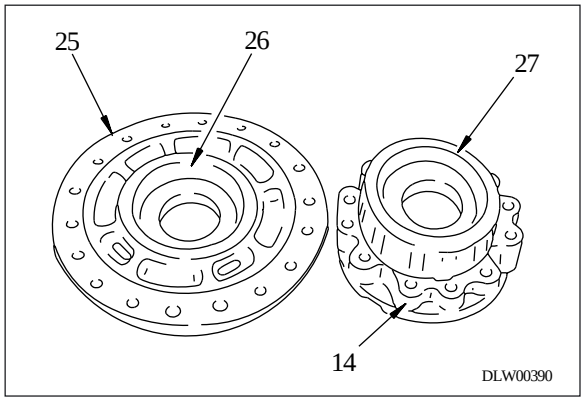
7. Axle
   1) Secure pivot to axle with wire.
      ★ Fix the pivot securely so that it does not move.
   2) Remove engine drain hose and tube (12) from engine oil pan.

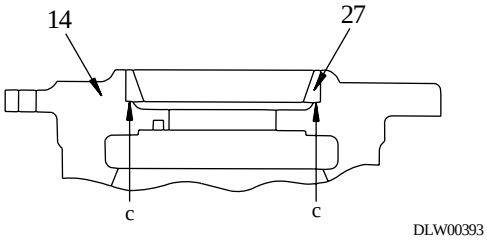


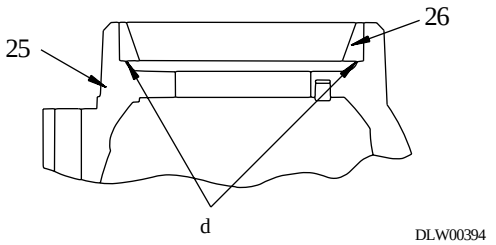
3. Coupling
   Install coupling (30), O-ring (31), and holder (29) to pinion gear (33), and tighten mounting bolts.
   ★ Tighten the mounting bolts temporarily, and tighten fully after assembling.
   ★ When inserting the coupling, be extremely careful not to damage the seal.
   Mounting bolt : Thread tightener (LT-2)
   (When tightening fully)
   kgm Mounting bolt :
   279 ± 29 Nm (28.5 ± 3.0 kgm)

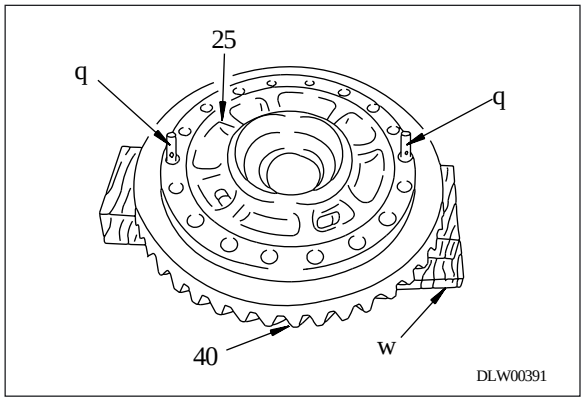


4. Differential carrier assembly
   1) Press fit bearing cups (27) and (26) to plain half (14) and flange half (25).
      ★ After press fitting the cups, check that there is no clearance at portions c and d.
      Bearing cup press-fitting portion :
      Oil (axle oil)

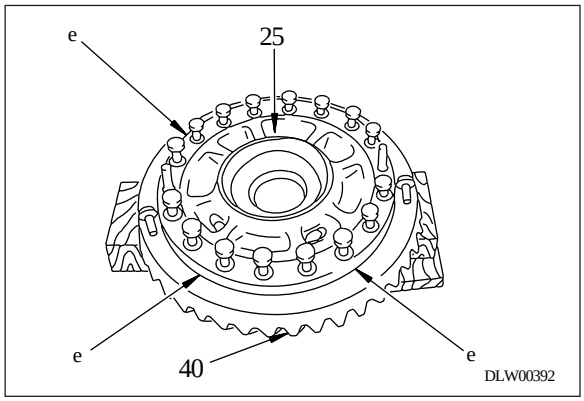








   2) Set bevel gear (40) on block ② with gear side at bottom, then install guide bolts ① (Thread dia. = 12mm, Pitch = 1.75mm, Length = 55mm).
      ★ Check that there is no clearance at mating portion e of flange half (25) and bevel gear (40).
      ★ Wash and remove all oil and grease from the threaded hole of the bevel gear.
      ★ Tighten the mounting bolts on diametrically opposite sides.
      Mounting bolt :
      Thread tightener (LT-2)
      kgm Mounting bolt :
      110 ± 12.3 Nm (11.25 ± 1.25 kgm)



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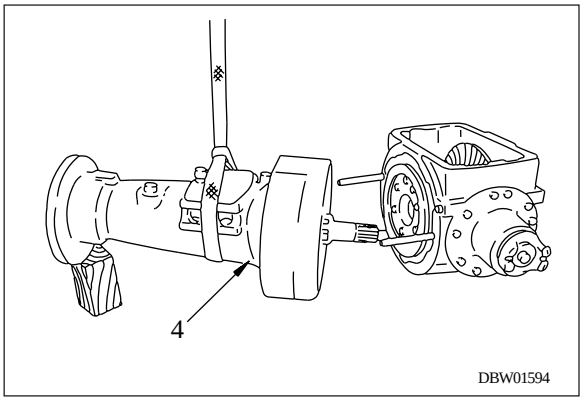
2) Lift off axle housing assembly (4).

kg Axle housing assembly : 250 kg (front)

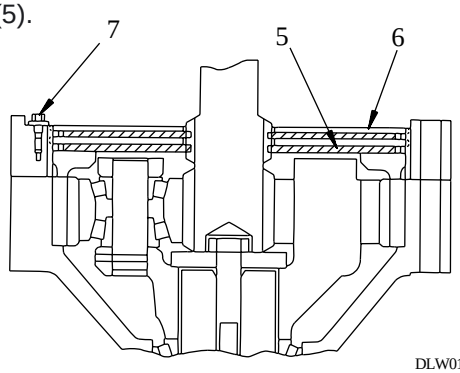
kg Axle housing assembly : 220 kg (rear)

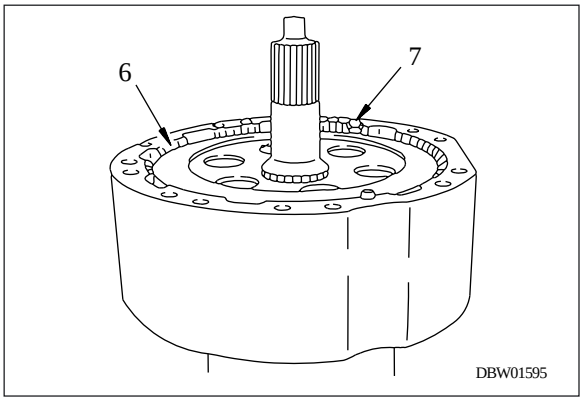
★ Change the place for the axle housing lifting tool, and stand the axle housing assembly upright.



4. Brake disc, plate

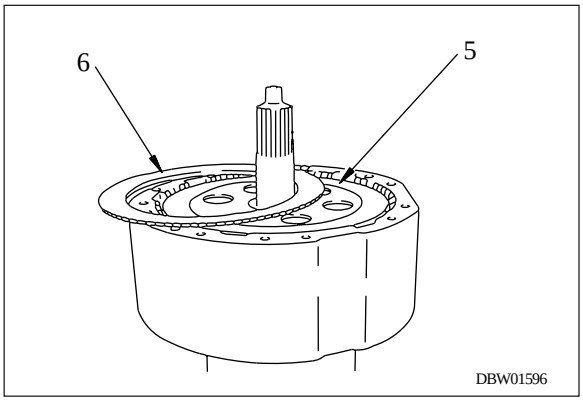
1) Remove lock bolts (7) of plate (6) and brake disc (5).





2) Remove plate (6) and brake disc (5).

★ Be careful not to damage the front face of the disc.



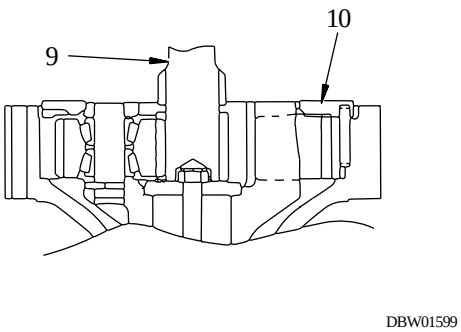
3) Remove wave spring (8).

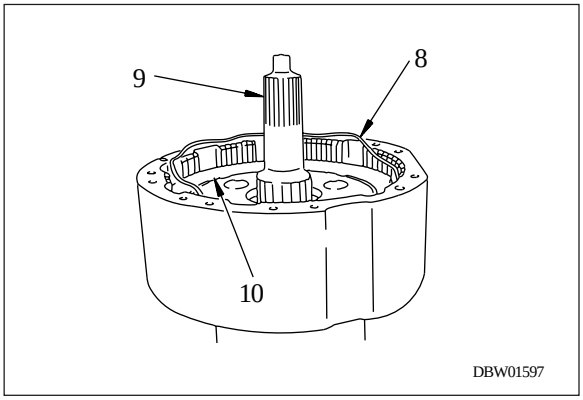
5. Sun gear shaft, outer ring

1) Remove shaft (9).

2) Remove outer ring (10).

★ Be careful not to damage face in contact with the brake disc.





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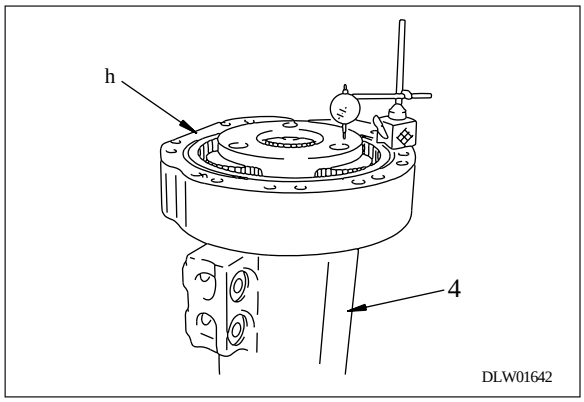
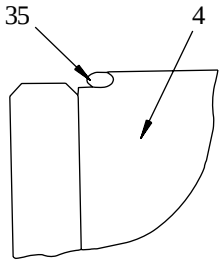
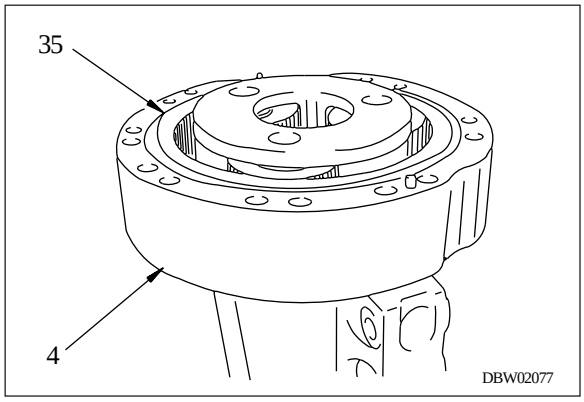
2) Make sure that bearing is fully settled, then check turning force "X" at axle housing assembly (4) and drill hole (h).
   ★ Reference value
      • Starting turning force X:
        20.6 – 59.8 N (2.1 – 6.1 kg)
3) Install stand of dial gauge to axle housing (4), and measure end play of planetary carrier at end face of planetary carrier.
   ★ Reference value
      • End play of planetary carrier :
        0 – 0.1 mm

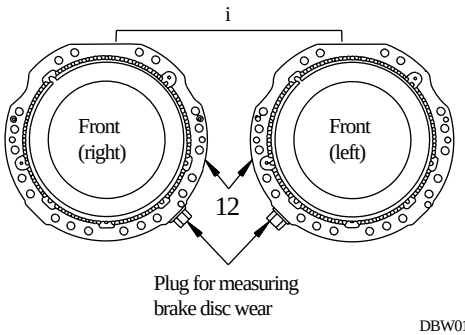


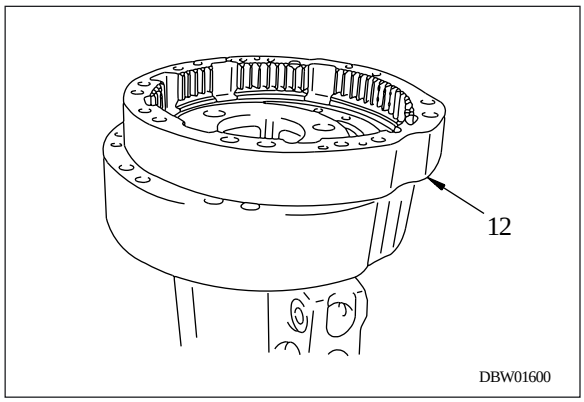
8. Brake housing (Front)
   1) Assemble O-ring (35) in groove of axle housing (4).
      ★ Coat the O-ring thinly with grease.
      O-ring : Grease (G2-LI)



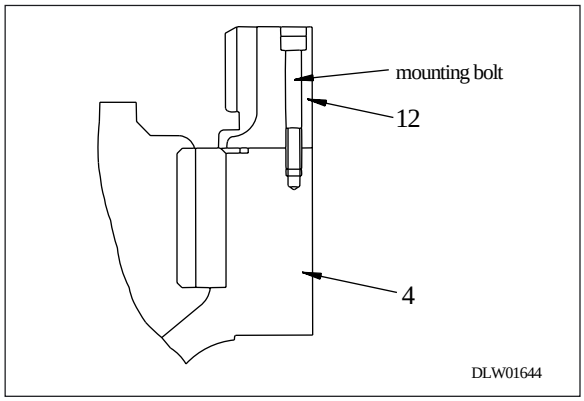


   2) Align axle housing (4) and portion i, and install brake housing (12).
      ★ Be careful that the O-ring is not twisted or caught when installing.





      ★ Assemble the axle housing so that the plug for measuring the brake disc wear is facing the rear.
      ★ Axle housing
         • Front (left) } Oil filter
         • Rear (right) }
         • Front (left) } No oil filter
         • Rear (right) }



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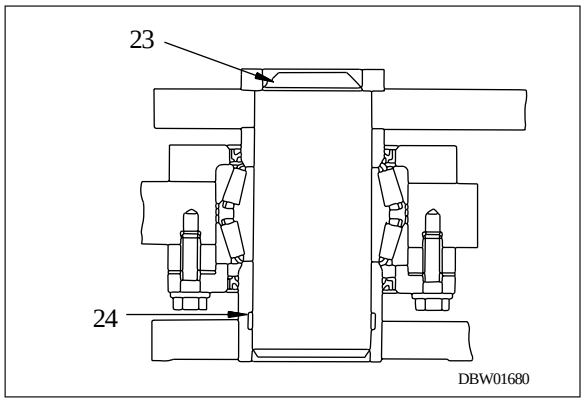
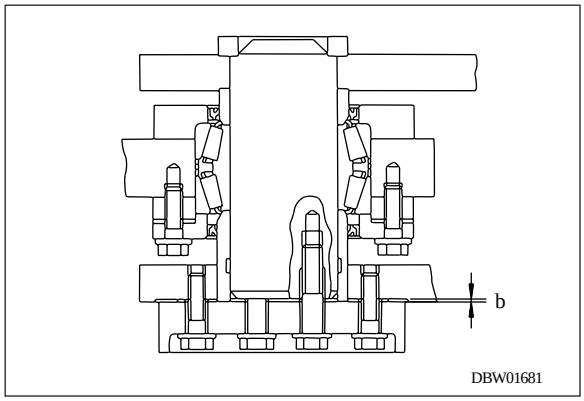
※ 5

Lower hinge pin

1) Insert lower hinge pin (23), and assemble spacer (24).
   Outside circumference of hinge pin : Grease (G2-LI)

2) Install retainer to lower hinge pin, tighten 3 bolts, select shims to make clearance b between hinge and retainer 0.1 mm or less, then assemble.
   ★ When adjusting the shims, tighten the retainer mounting bolts temporarily to prevent turning.
   kgm Pin mounting bolt : 206 ± 19.6 Nm (21.0 ± 2.0 kgm) (When adjusting shim)
   Pin mounting bolt : Thread tightener (LT-2)
   kgm Pin mounting bolt : 206 ± 19.6 Nm (21.0 ± 2.0 kgm)
   kgm Retainer mounting bolt : 113 ± 10 Nm (11.5 ± 1.0 kgm)
   ★ When tightening the mounting bolts, tighten the retainer mounting bolts to the specified torque, then tighten the pin mounting bolts.





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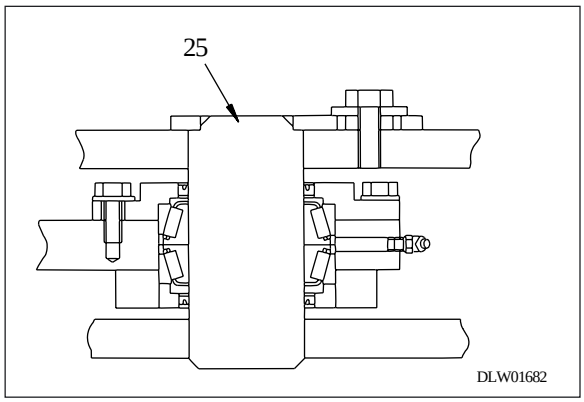
※ 6

Upper hinge pin

Insert upper hinge pin (25) and secure with lock bolt.
Outside circumference of hinge pin : Grease (G2-LI)



※ 7

Joining frame

Move front frame towards rear frame and align pin holes.

⚠ When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.
★ Align the pin holes exactly.
★ Install the safety bar.

ASSEMBLY OF STEERING VALVE

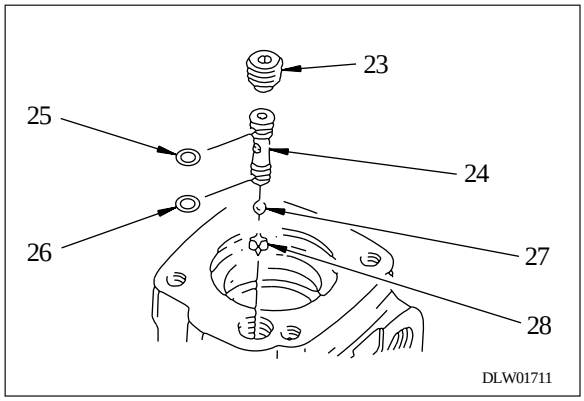
- ★ Check all parts for damage or burrs.
- ★ Wash all metal parts in clean solvent and blow dry with air.
- ★ Do not use a file or polish any part with rough sandpaper.
- ★ Coat the O-rings with clean grease. (No need to put grease on new X-ring seals)
- ★ Coat the O-ring for the rotor set with a small amount of grease.

ASSEMBLY OF CONTROL SIDE

1. Insert retainer (28) in housing with tweezers.
   - ★ Check that the retainer is not inserted at an angle.
2. Insert ball (27).
3. Fit O-rings (26) and (25) in check sheet (24), and push check sheet (24) into housing.
   - ★ Be careful to set the top and bottom of the check sheet facing in the correct direction.
4. Install set screw (23).
   - ★ Check that the set screw is set in slightly from the end face of the housing.

   kgm Set screw : 11.8 Nm (1.2 kgm)

   Set screw : adhesive (LT-2)



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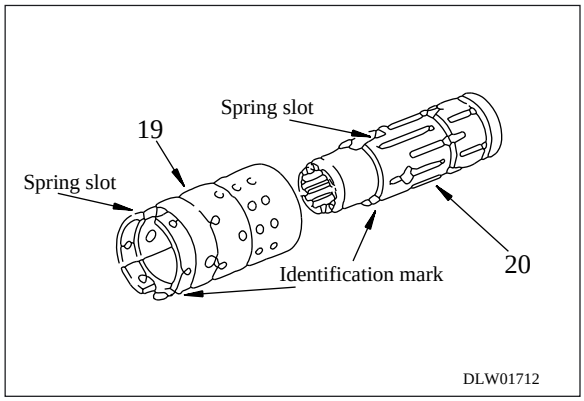
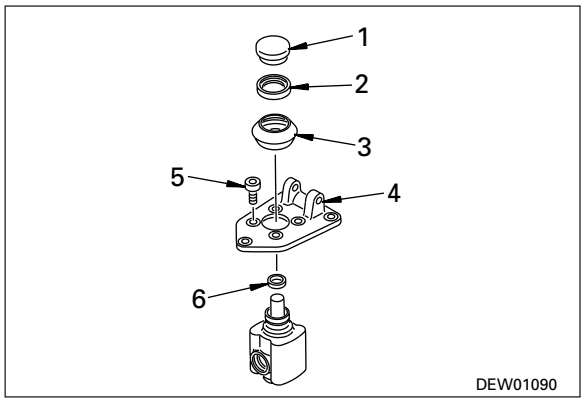
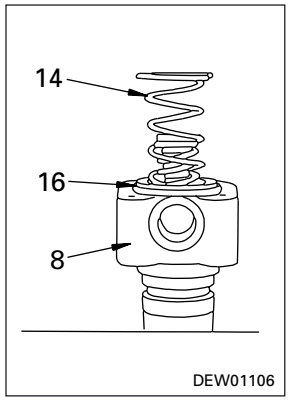
5. Assemble spool (20) and sleeve (19) so that spring groove is on same side.
   - ★ Rotate the spool and slide it in.
   - ★ Grip the splined portion of the spool lightly and check that the spool rotates smoothly inside the sleeve.
   - ★ If there are match marks, check that the match marks are aligned.

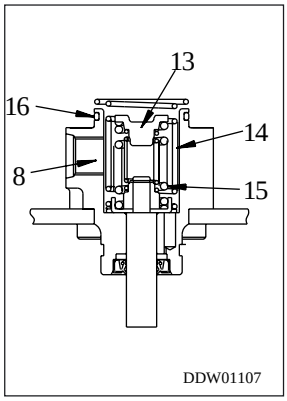


ASSEMBLY OF LEFT BRAKE VALVE ASSEMBLY (SINGLE)

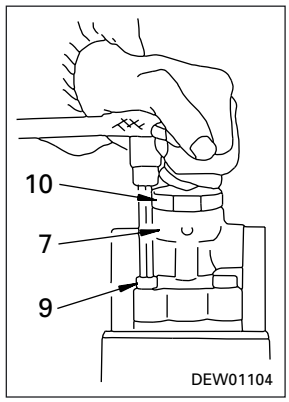


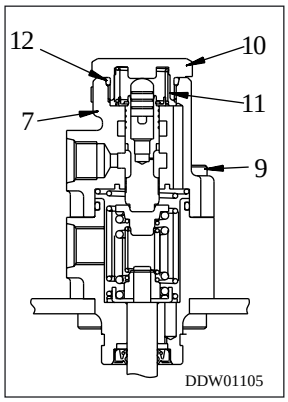
1. Valve
   Install S flange assembly (8) to jig ① with bolts (5), and hold jig ① in vice.
   1) Install springs (14) and (15) to S flange assembly (8), then install holder (13) on top of spring.
   2) Install O-ring (16) to S flange assembly (8).
      ★ Use a new part for the O-ring.
      O-ring: Lithium grease
   3) Set S cylinder assembly (7) to S flange assembly (8), and tighten with mounting bolts (9).
      ★ When setting the S cylinder assembly in position, align the match marks.
      kgm Mounting bolt:
      58.8 – 73.6 Nm (6.0 – 7.5 kgm)
   4) Install spring (11) and O-ring (12) to S cylinder assembly (7), and tighten with plug (10).
      ★ Use a new part for the O-ring.
      O-ring: Lithium grease
      Thread of plug: Thread tightener
      (Thread lock 1303B)
      kgm Plug:
      152.0 ± 24.5 Nm (15.5 ± 2.5 kgm)





2. Bracket assembly
   Remove valve from jig ①.
   1) Set S flange assembly facing up, and install oil seal (6).
      ★ Use a new part for the oil seal.
      Lip of oil seal: Lithium grease
   2) Install bracket assembly (4), and tighten with mounting bolts (5).
      kgm Mounting bolt:
      58.8 – 73.6 Nm (6.0 – 7.5 kgm)
   3) Install seat (1), pedal stopper (2), and boot (3) to valve.





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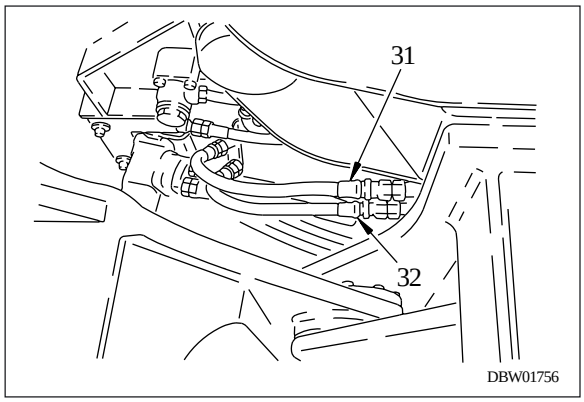
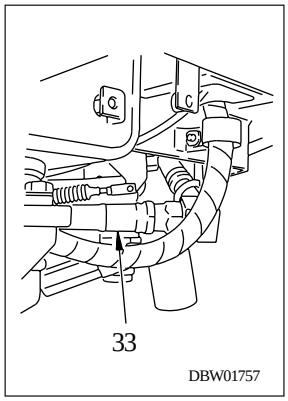
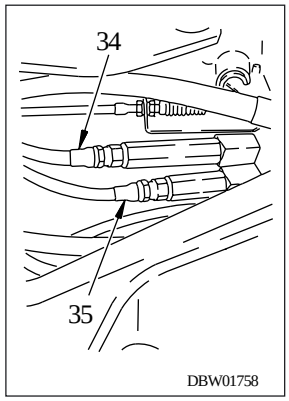
8. Brake valve piping
   1) Disconnect hoses (31) and (32) between right brake valve and block at top of left frame from block end.



   2) Disconnect hose (33) between right brake valve and block at top of right frame from right brake valve tube end. ✻ 3

   3) Disconnect hoses (34) and (35) between right brake valve and accumulator from brake valve.





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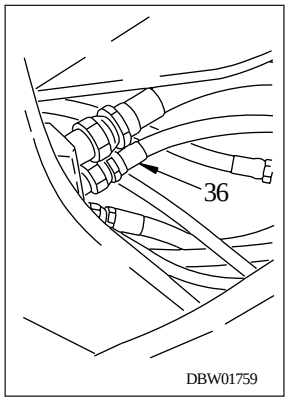
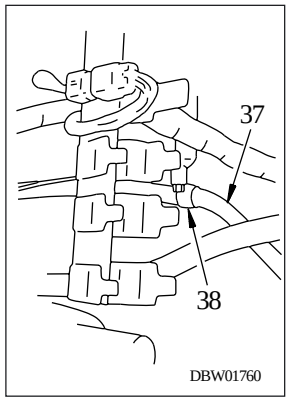
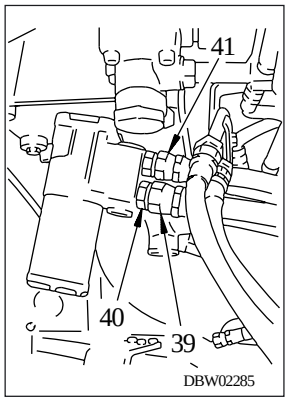
   4) Disconnect hose (36) between left brake valve and block at top of right frame from block end.

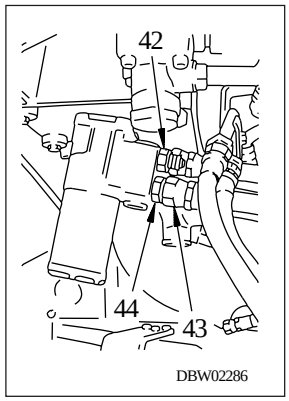
   5) Disconnect hose (37) between left brake valve and accumulator from brake valve.
      ★ Remove clamp (38) from the floor frame.





9. Steering valve piping
   - Disconnect hose (39) between steering valve and priority valve tube from steering valve end, then remove nipple (40).
   - Disconnect hose (41) between steering valve and hydraulic tank tube from steering valve end, then remove nipple (42).
   - Disconnect hose (43) between steering valve and steering cylinder tube, then remove nipple (44).





1. Cut-off valve assembly
   1) Fit O-rings to plugs (43), (42), and (41) and install.
      kgm Plug (41) :
      275 ± 29.4 Nm (28.0 ± 3.0 kgm)
   2) Assemble valve (40), spring (39), and seat (38) to valve body (2), then install O-ring to bar (37) and install.
      kgm Mounting bolt :
      66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)
   3) Assemble valve (36), spring (35), and piston (34) to valve body (2), then fit O-ring to flange (33) and install.
      kgm Mounting bolt :
      66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)
   4) Install screen (32) and pilot valve (31).
      kgm Screen :
      34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)
      kgm Pilot valve :
      147 ± 9.8 Nm (15.0 ± 1.0 kgm)

2. Check valve assembly, flange, plugs
   1) Install plugs (45) and (44) and install to body (1).
      kgm Plug (44) :
      152 ± 24.5 Nm (15.5 ± 2.5 kgm)
   2) Install flange (30).
      kgm Mounting bolt :
      66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)
   3) Assemble valve (29) and spring (28) to body (1), then fit O-ring to plug (27) and install.
      kgm Plug : 466 ± 24.5 Nm (47.5 ± 2.5 kgm)

3. Suction valve assembly
   Install suction valve (26).
   kgm Suction valve assembly :
   226 ± 9.8 Nm (23.0 ± 1.0 kgm)

4. Safety valve assembly with suction
   Install safety valve assembly (25).
   kgm Safety valve assembly :
   226 ± 9.8 Nm (23.0 ± 1.0 kgm)

5. Main relief valve assembly
   Install main relief valve assembly (24).
   kgm Main relief valve assembly :
   152 ± 24.5 m (15.5 ± 2.5 kgm)

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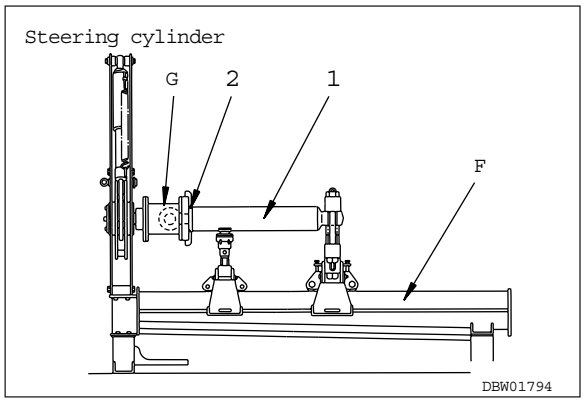
DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

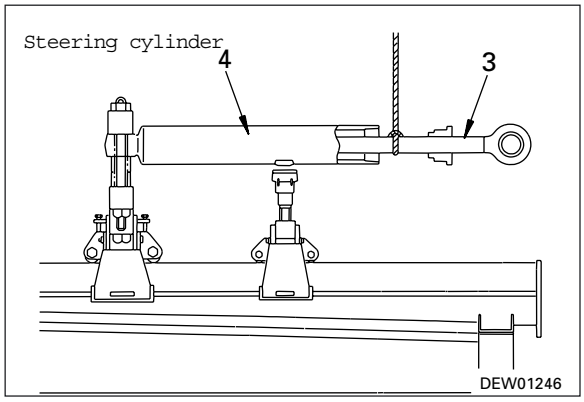
(STEERING, BOOM, BUCKET CYLINDER ASSEMBLY)

1. Set cylinder assembly (1) to tool F.

2. Cylinder head, piston rod assembly
   - Steering cylinder assembly
   1) Using tool G, remove cylinder head (2) from cylinder.



   2) Pull out cylinder head and piston rod assembly (3) from cylinder (4), and lift off.
      ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.



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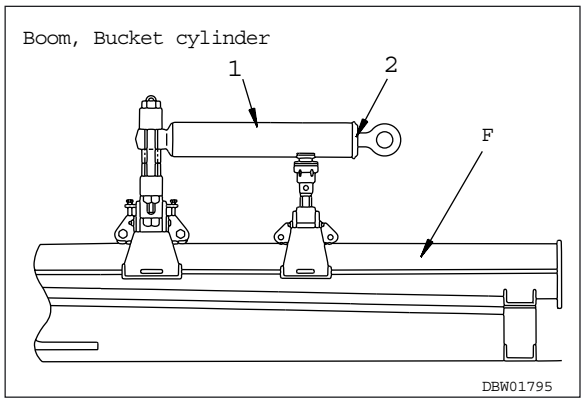
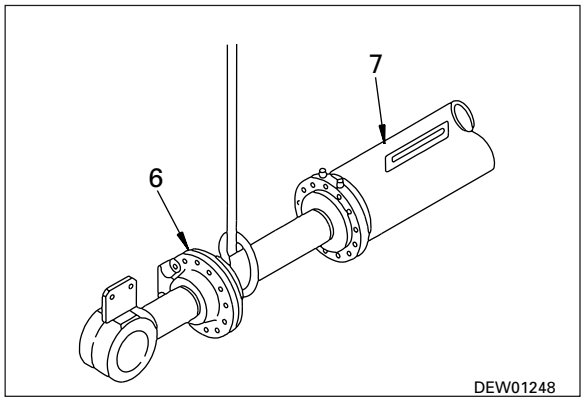
   - Boom, bucket cylinder assembly
   1) Remove mounting bolts of cylinder head (2).

Cylinder	Width across flats of bolt (mm)
Boom cylinder	24
Bucket cylinder	22



   2) Pull out cylinder head and piston rod assembly (6) from cylinder (7), and lift off.
      ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.



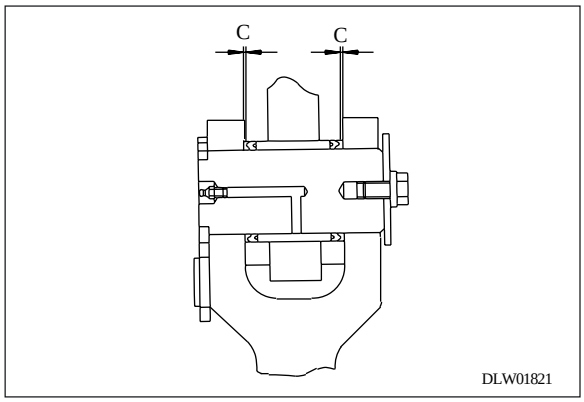
✻ 4

- Boom cylinder

  ⚠ Before starting the engine, check that the directional lever is at neutral and the parking brake is applied.

  ⚠ When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

  ★ Clearance c : Max. 1.5 mm



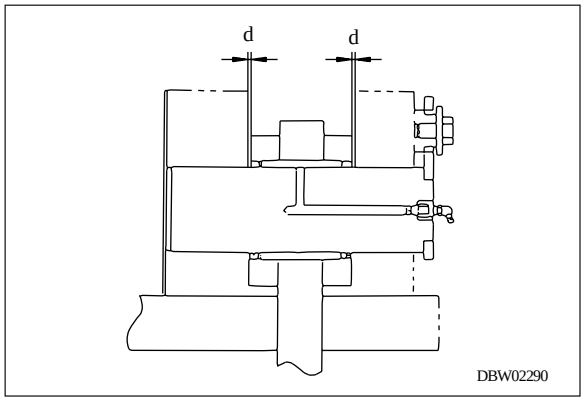
✻ 5

Check the operation of the boom kick-out.
For details, see TESTING AND ADJUSTING, TESTING AND ADJUSTING BOOM KICK-OUT.

✻ 6

⚠ When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

★ Clearance d : Max. 1.5 mm



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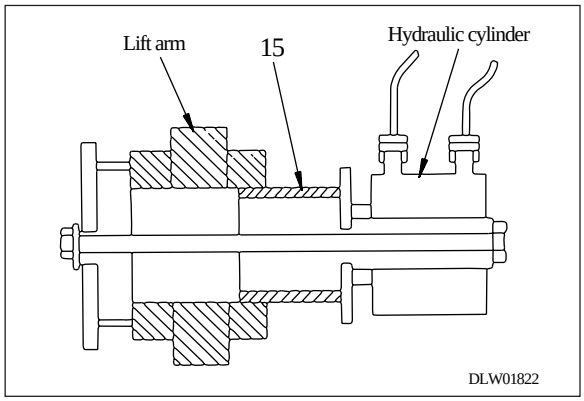
✻ 7

★ Secure the bucket link to the bellcrank with wire.
★ Be careful not to get the cord ring caught.

✻ 8

- Dust seal, bushing
  Using a press, press fit bushing (15) to bucket link, bellcrank, and boom, then assemble dust seal.
  Bushing : Grease (G2-LI)

- Greasing
  ★ Grease each pin well.



REMOVAL OF AIR CONDITIONER UNIT ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Disconnect the cable from the negative (–) terminal of the battery.

- Remove the cover under the cab.
- Carry out the oil return operation for the compressor, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.
- When carrying out the oil return operation, set the fan switch to the maximum position, run the engine at low idling, and operate the air conditioner for 5 minutes.

⚠ If the refrigerant gets in your eyes, there is danger of losing your sight, so always wear protective goggles.

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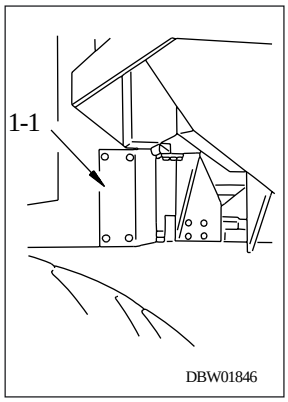
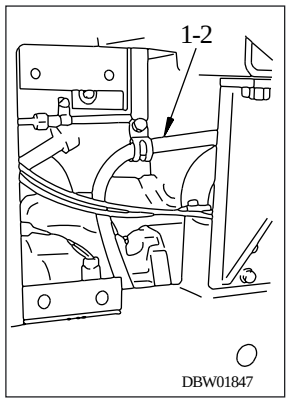
1. Remove hood cover (1-1), then disconnect heater hose (1-2) from intermediate joint.

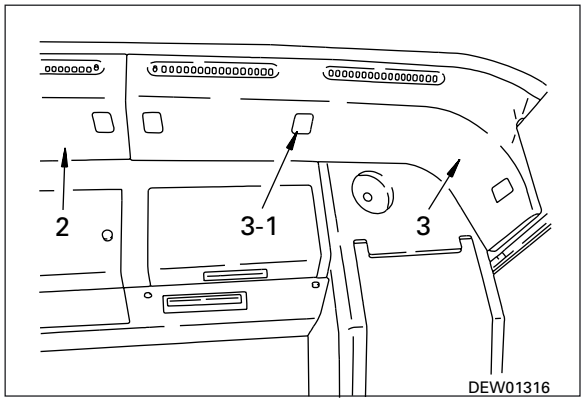
2. Remove covers (2) and (3) at rear of cab.
   - ★ Slide the operator's seat to the front, then tip it over.
   - ★ Remove blind cap (3-1).
   - ★ Remove 2 bolts and loosen 6 bolts.

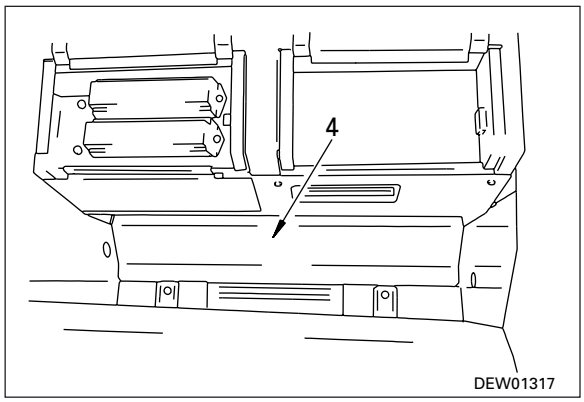
3. Remove 5 mounting bolts of cover (4), remove cover.

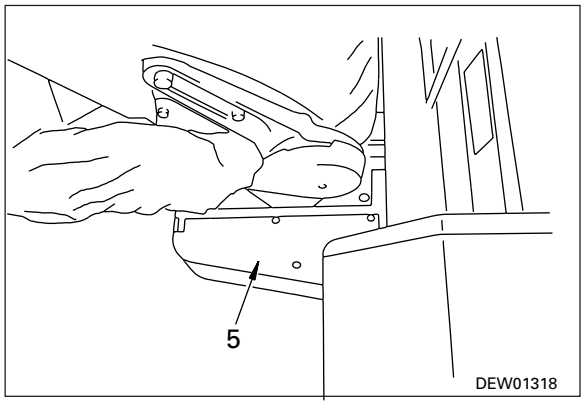
4. Remove seat support cover (5).











INSTALLATION OF AIR CONDITIONER COMPRESSOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Connect the wiring connectors securely.

※ 2

★ Adjust the alternator V-belt. For details, see TESTING AND ADJUSTING FAN BELT.
★ To prevent dirt or water from entering, do not remove the cover from the hose until immediately before installing.

Hose joint, O-ring portion : Compressor oil

kgm Hose mounting bolt : 9.8 ± 2.0 Nm (1.0 ± 0.2 kgm)

※ 3

Procedure for adjusting V-belt

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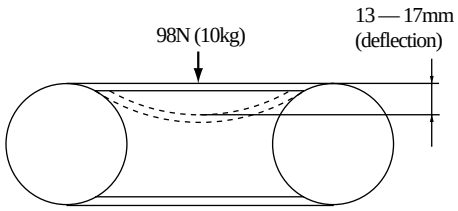

SBW02294

- Filling with gas
  ★ Fill the air conditioner with gas. (R134a)
  ★ Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.
  ★ Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
  ★ Do not operate the compressor before charging with refrigerant.
  ★ Check that the refrigerant level is correct.
  ★ Check the oil level in the compressor. (Specified oil level: 150 $^{+14}_{0}$ cc ND-OIL8)

★ Checks after assembly

	Amount of bubbles in receiver sight glass	Remedy
Correct	Almost completely transparent; even if there are bubbles, becomes transparent when engine speed is raised or lowered	———
Low	Continuous stream of bubbles passes	Connect charging hose to compressor, then add refrigerant until condition becomes normal

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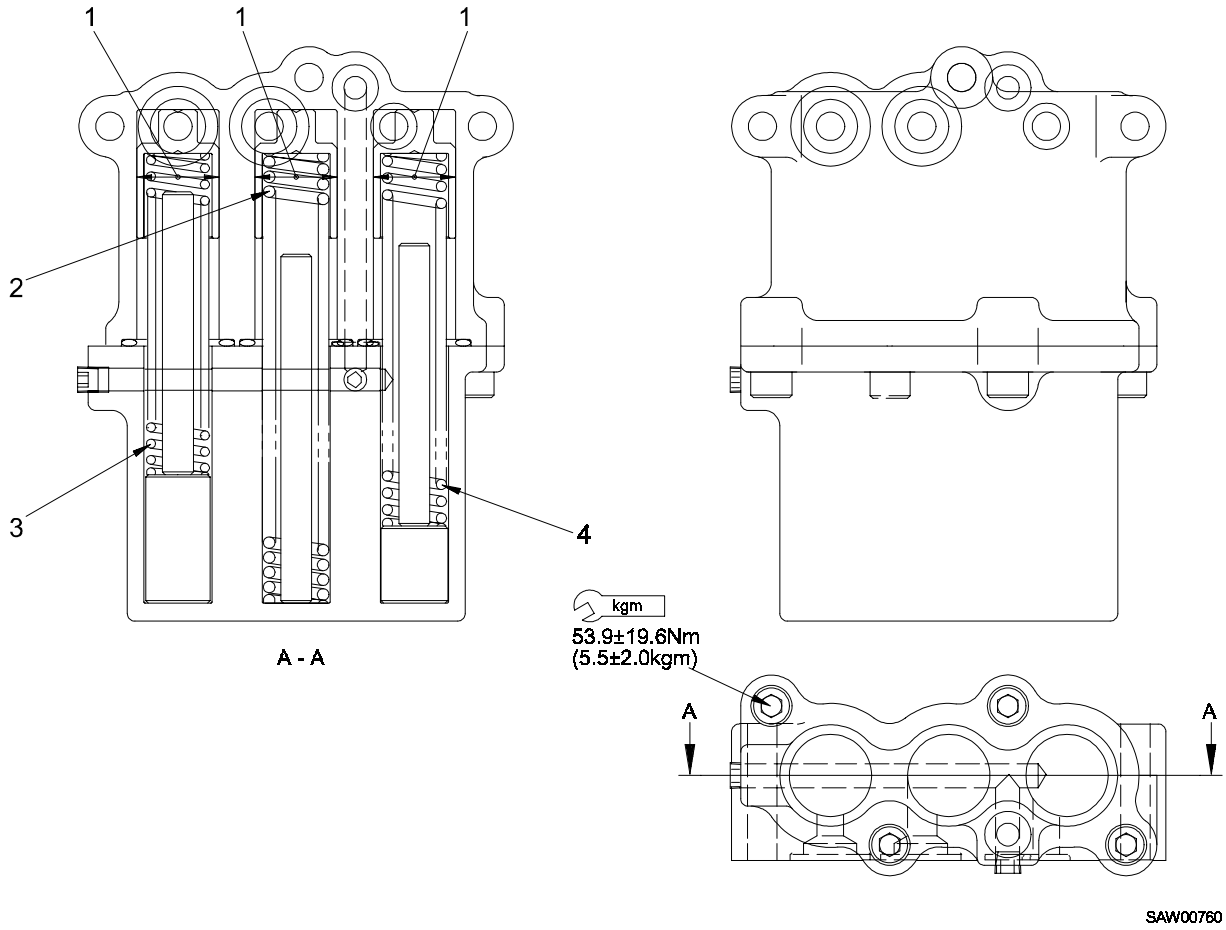
Blank

ACCUMULATOR VALVE



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Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between piston and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		32	–0.035 –0.045	+0.025 0	0.035 – 0.070	0.08	
2	Forward clutch accumulator spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		184.8	175	158N (16.1kg)	177.4	—	
3	1st clutch accumulator spring	157.7	125	404N (41.2kg)	151.4	—	
4	2nd clutch accumulator spring	157.7	145	155N (15.8kg)	151.4	—	

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between lower hinge pin and rear frame	75	–0.030 –0.076	–0.046 0	+0.030 – 0.122	—	Replace
2	Clearance between lower hinge pin and spacer (small)	75	–0.030 –0.076	+0.25 0	+0.030 – +0.326	—	
3	Clearance between lower hinge pin and bearing	75	–0.030 –0.076	0 –0.015	+0.015 – +0.076	—	
4	Clearance between lower hinge pin and spacer (large)	75	–0.030 –0.076	+0.026 –0.020	+0.010 – +0.102	—	
5	Clearance between rear frame and spacer (large)	90	–0.010 –0.040	+0.054 0	+0.010 – +0.094	—	
6	Clearance between front frame and lower hinge bearing	120	0 –0.020	–0.030 –0.076	+0.010 – +0.076	—	
7	Clearance between upper hinge pin and rear frame	75	–0.030 –0.076	+0.046 0	+0.030 – +0.122	—	
8	Clearance between upper hinge pin and bearing	75	–0.030 –0.076	0 –0.015	+0.015 – +0.076	—	
9	Clearance between front frame and upper hinge bearing	115	0 –0.015	–0.041 –0.076	–0.076 – –0.026	—	
10	Clearance between upper hinge pin oil seal and front frame boss	90	+0.280 +0.180	+0.054 0	+0.280 – +0.360	—	
11	Height of lower hinge pin spacer (small)	24.5	—	—	—	—	
12	Height of lower hinge pin spacer (large)	63.5	—	—	—	—	
13	Tightening torque of lower hinge retainer mounting bolt	(When adjusting shim) 20.6±2.0 Nm (2±0.2 kgm)					Tighten
		(Final value) 113±10 Nm (11.5±1.0kgm)					
14	Tightening torque of lower hinge retainer mounting bolt	(Final value) 113±10 Nm (11.5±1.0kgm)					
15	Clearance between lower hinge pin retainer and front frame	Max. 0.1					Adjust
16	Clearance between lower hinge pin bearing retainer and rear frame	Max. 0.1					
17	Clearance between upper hinge pin bearing retainer and front frame	Max. 0.1					

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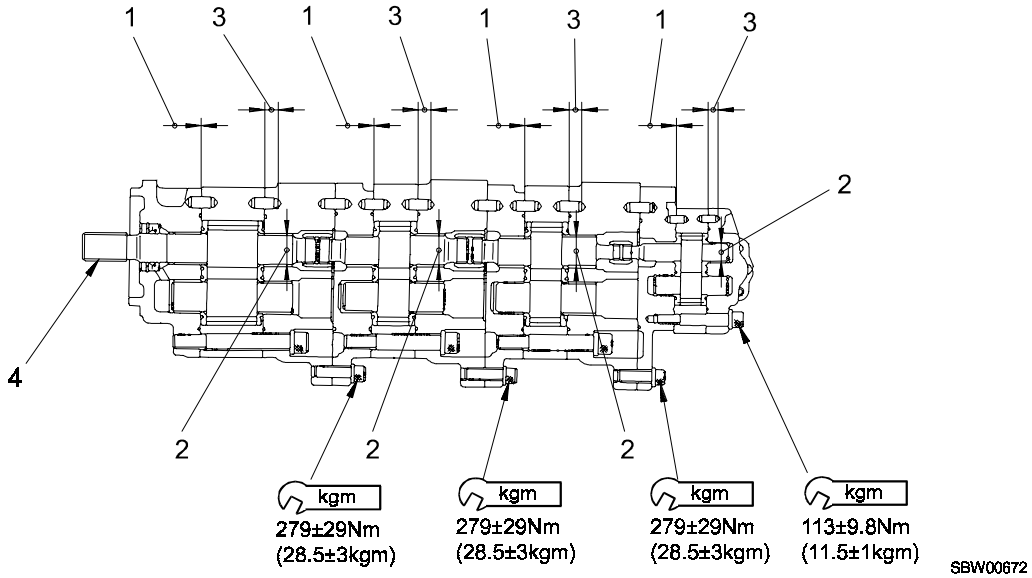
HYDRAULIC PUMP (Hydraulic, steering, switch, PPC pump)

(SAL(3)71+32+32+(1)20)



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Unit: mm

No.	Check item	Criteria			Remedy
1	Side clearance	Model	Standard clearance	Clearance limit	Replace
		SAL(3)71	0.10 – 0.15	0.19	
		SAL(3)32			
		SAL(1)20			
2	Clearance between inside diameter of plain bearing and outside of diameter of gear shaft	SAL(3)71	0.060 – 0.149	0.20	
		SAL(3)32			
		SAL(1)20	0.060 – 0.119		
3	Depth for knocking in pin	Model	Standard size	Tolerance	
		SAL(3)71	14	0 –0.5	
		SAL(3)32			
		SAL(1)20	10		
4	Rotating torque of spline shaft	22.6 – 40.2Nm (2.3 – 4.1kgm)			

—	Discharge amount Oil: EO10-CD Oil temperature: 45 – 55°C	Model	Rotating speed	Delivery pressure	Standard delivery amount	Delivery amount limit	—
		SAL(3)71	2,500rpm	20.6Mpa (210kg/cm^2)	158 l/min	146 l/min	
		SAL(3)32			73 l/min	68 l/min	
		SAL(1)20		2.9Mpa (30kg/cm^2)	68 l/min	63 l/min	

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