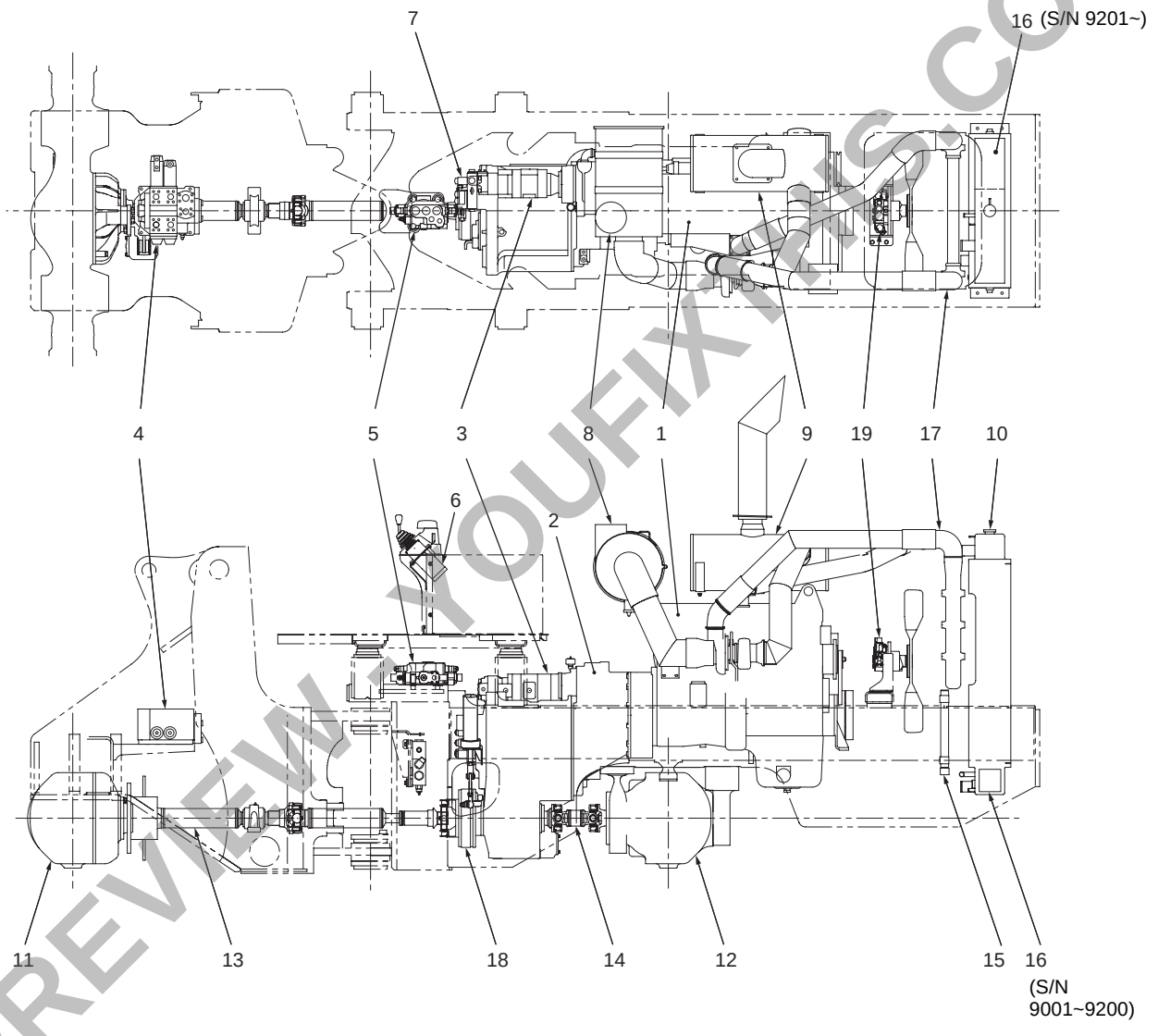
Outline

Layout of main components



1. Engine assembly (Cummins QSM11)
2. Transmission/Torque converter assy
3. Hydraulic pump
4. Multiple (loader) control valve
5. Steering valve
6. Pilot valve (for loading)
7. Transmission control valve
8. Air cleaner
9. Muffler
10. Radiator
11. Front axle assembly
12. Rear axle assembly
13. 2nd propeller shaft
14. 3rd propeller shaft
15. Hydraulic oil cooler (air-to-oil type)
16. T/C oil cooler
17. Air charge cooler
18. Parking brake
19. Fan motor

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Standard Measurement Values for Performance Check

Measurement conditions
Temperature of torque converter oil : 50~80°C (120~180°F)
Temperature of hydraulic oil : 50~80°C (120~180°F)
Temperature of engine coolant : 50~80°C (120~180°F)

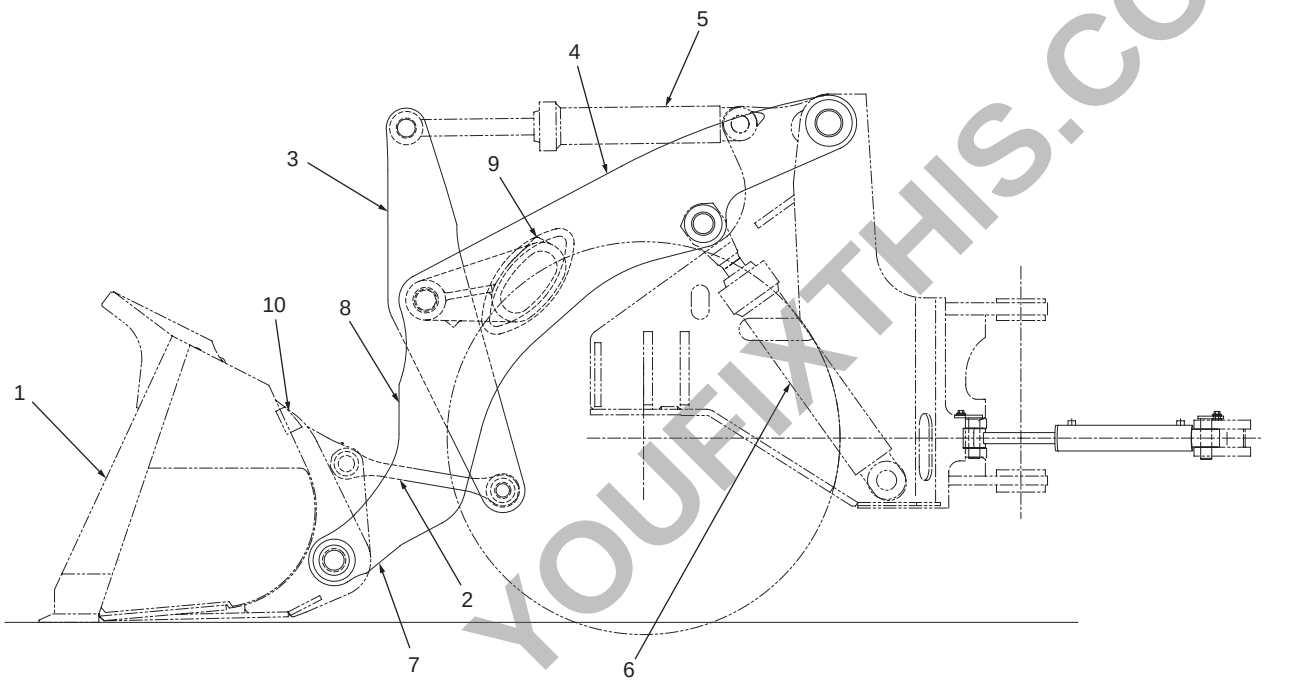
Item				Standard measurement values for performance check		Remarks
System	Measurement item			Normal	Fuel efficient mode	
Engine	Engine speed (min^{-1}) (rpm) (S/N 9001~9350)	Minimum no-load speed, Low Idle (LI)		800±50		725 in hibernate mode
		Maximum no-load speed, High Idle (HI)		2,250±50		
		Maximum speed in torque converter stall mode		2,180±100	2,015±100	
		Maximum speed in multiple control valve relief mode		2,155±100	1,890±100	
		Maximum speed in torque converter stall plus multiple control valve relief mode		1,865 $^{+150}_{-100}$	1,650 $^{+150}_{-100}$	
	Engine speed (min^{-1}) (rpm) (S/N 9351~)	Minimum no-load speed, Low Idle (LI)		800±50		725 in hibernate mode
		Maximum no-load speed, High Idle (HI)		2,250±50	2,000±50	
		Maximum speed in torque converter stall mode		2,180±100	2,000±100	
		Maximum speed in multiple control valve relief mode		2,155±100	2,155±100	
		Maximum speed in torque converter stall plus multiple control valve relief mode		1,865 $^{+150}_{-100}$	1,650 $^{+150}_{-100}$	
Transmission	Clutch pressure MPa (kgf/cm^2) (psi)	Engine speed	Idling (LI)	1.3±0.2 (13±2) (185±28)		
			Maximum (HI)	1.5±0.2 (15±2) (213±28)		
	Clutch time lag (sec)	Neutral→Forward 1st speed (engine speed: 1,500 min^{-1} (rpm))		0.3±0.1		Before wheels move

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Front Chassis

Loading linkage



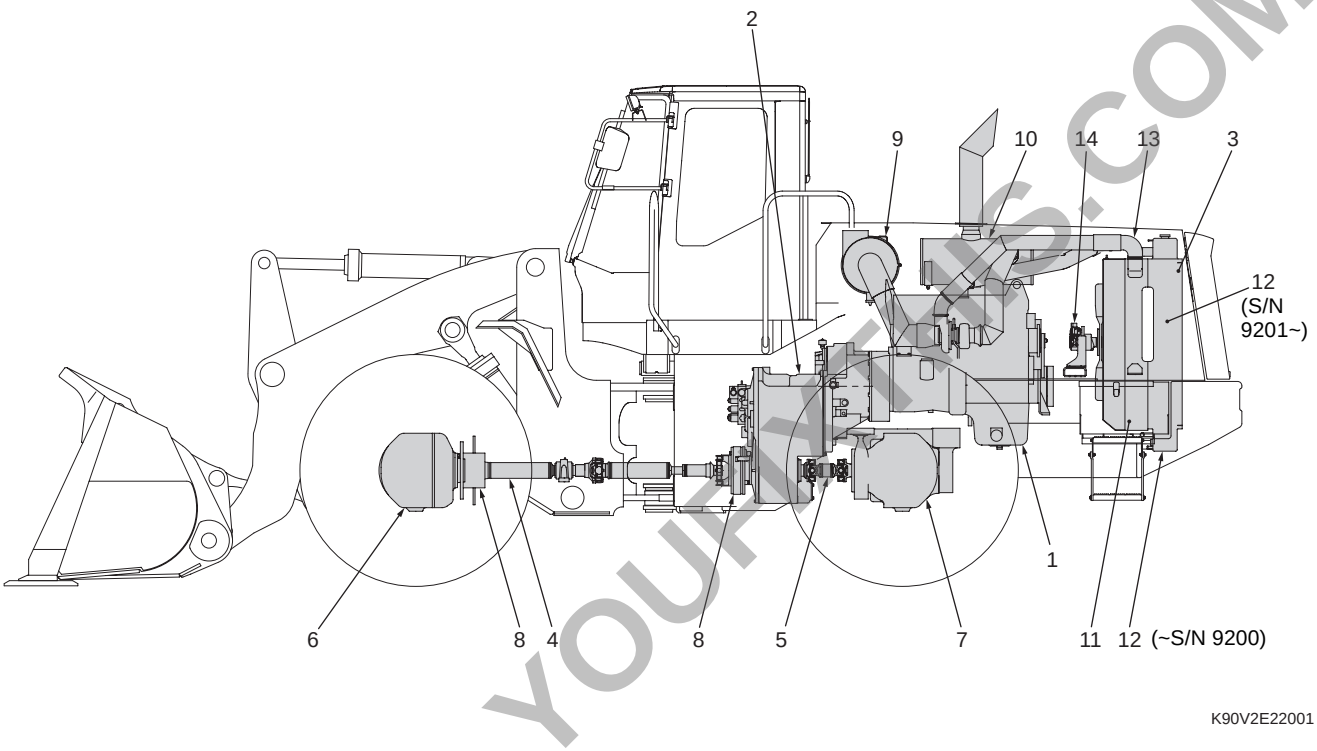
90ZVE12001

1. Bucket
2. Link
3. Lever
4. Boom
5. Bucket cylinder
6. Boom cylinder
7. Dump stopper surface
8. Roll-back stopper surface
9. Lever stopper surface
10. Bucket stop plate
    (Design differs by manufacturer of the attachment)

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Power Line



K90V2E22001

1. Engine
2. Torque converter and transmission
3. Radiator
4. 2nd propeller shaft
5. 3rd propeller shaft
6. Front axle differential gear
7. Rear axle differential gear
8. Parking brake
9. Air cleaner
10. Muffler
11. Hydraulic oil cooler
12. Torque converter oil cooler
13. Air charge cooler
14. Fan motor

The power output from the engine is transmitted to the transmission through the torque converter (combined with the transmission). The speed and direction are changed according to the engagement of the transmission clutches. The power is then transmitted through the second and third propeller shafts to the differential gears of front and rear axles.

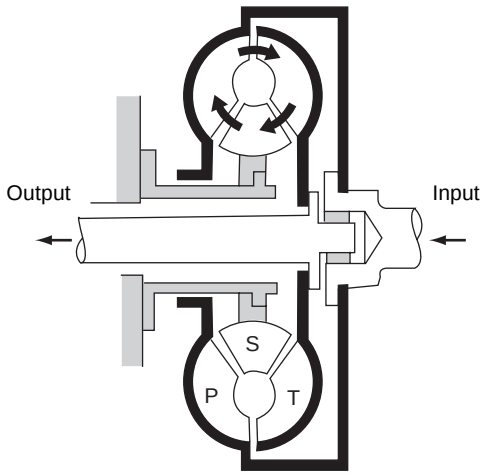
Finally the power is transmitted through the axles to the planetary gears, and tires to move the machine.

On the back side of the engine, there is a radiator. The radiator incorporates engine coolant, torque converter oil cooler, air charge cooler and an external air type hydraulic oil cooler. On the second propeller shaft side of the transmission, a parking brake is installed.

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Torque Converter



95ZV32002

Torque converter structure

The torque converter is between the engine and transmission, and consists of three impellers as shown in the figure. The three impellers are pump (P), turbine (T), and stator (S) impellers.

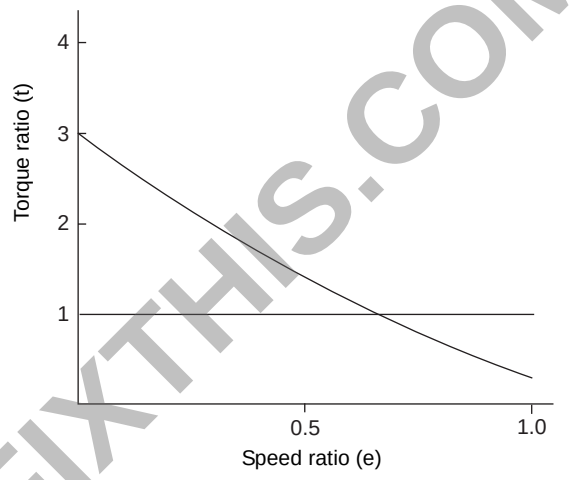
Power flow path

The pump is connected to the engine flywheel, and rotates together with the engine.

The turbine is connected to the torque converter output shaft to transmit the power to the transmission.

The stator is fixed to the torque converter case. The area of the impellers is filled with oil. When the engine is started, the pump impeller rotates, therefore the oil will circulate to rotate the turbine impeller (circulation order: pump→turbine→stator→pump). Oil is redirected by the fixed stator impeller back to the pump impeller. When the turbine impeller rotates, the power will be transmitted to the output shaft.

Torque multiplication



95ZV32003

If the engine speed/pump impeller speed stays the same but the turbine impeller speed is reduced due to the transmission load-output torque is increased. This is "torque multiplication". Heat is also generated.

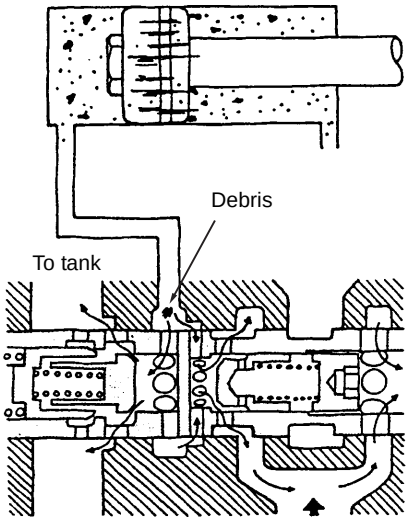
$$\text{Speed ratio(e)} = \frac{\text{Turbine impeller speed } (\text{min}^{-1}) \text{ (rpm)}}{\text{Pump impeller speed } (\text{min}^{-1}) \text{ (rpm)}}$$

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Flushing Hydraulic Circuit

Purpose of flushing



95ZV42001

If the inside of a cylinder, pump, or a valve of the hydraulic system is broken, the debris will be sent into the hydraulic line together with the oil. Most of the debris will flow into the return filter or hydraulic tank.

However, there are some debris that will remain in the valves, cylinders, or pipes. Therefore, even if the damaged cylinder or valve is replaced, the debris sticking in other valves, cylinders, or pipes will break loose and then is fed into the cylinders, where the debris may damage the inside of the cylinders, or stick into the valve spools or relief valves, and cause another malfunction. To prevent such problems, be sure to remove all the debris from the system.

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Brake System Outline

The brake system is the all-hydraulic type, and has two independent systems consisting of the front system and the rear system for enhancing safety. The service brake is the wet disc type. The parking brake is the internal expansion drum type.

Service brake

Oil from the pump is regulated in a range from 6.9~11.8 MPa (70~120 kgf/cm^2) (995~1,706 psi) by unloader valve (22), and accumulated in accumulator (33) provided for the front and rear wheels.

When brake valve (23) is depressed, the pressure oil in the accumulator enters the disc brake piston chamber for the front and rear wheels, pushes the piston, and generates braking power.

Parking brake

The internal expansion type drum brake for parking is applied by spring chamber (55).
Spring chamber (55) operates when the pressure oil inside the spring chamber returns to the tank while the power is not supplied to solenoid valve (35) (that is, while the parking switch is ON).

Adjustment of axle internal pressure

While the brake pedal is not pressed, the internal pressure of the hydraulic tank is always applied on the brake piston chamber, and there is a possibility that the brake may drag.

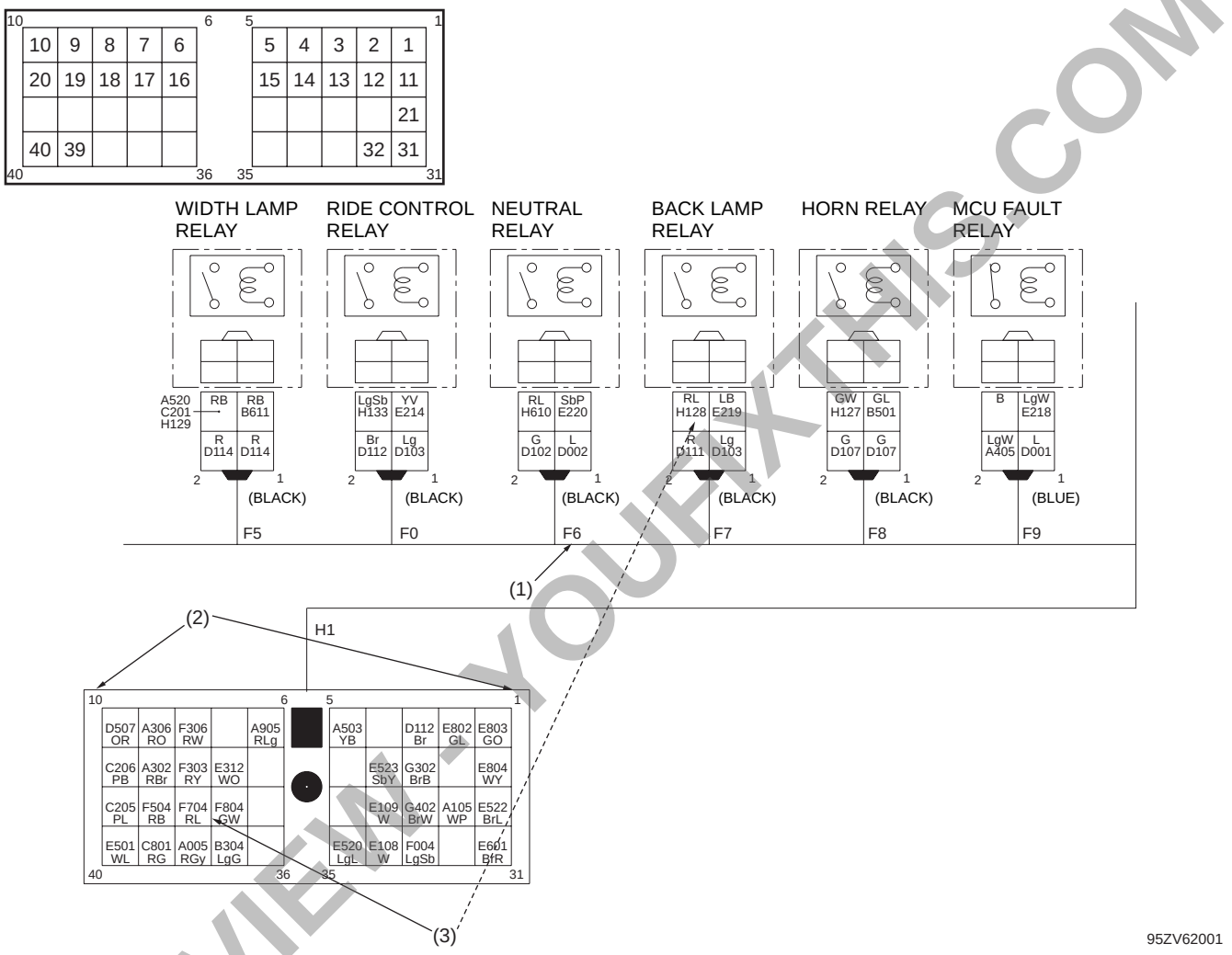
To prevent the brake from dragging, the axle housing air chamber is connected to the hydraulic tank air chamber so that the pressure inside the axle housing becomes equivalent to the pressure inside the hydraulic tank.

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How to Use Electrical Wiring Diagram

Example



95ZV62001

The address method is used for electrical wiring diagrams. For this method, a symbol is attached to each connector and connector terminal in order to easily locate the other terminal where the other end of the cable is connected.

Example 1
Symbol under (or above) connector, such as F6:
Shows the address of the connector.

Example 2
Symbol at the multi-terminal connector, such as 1 and 10:
Shows the terminal number and the numbering direction.

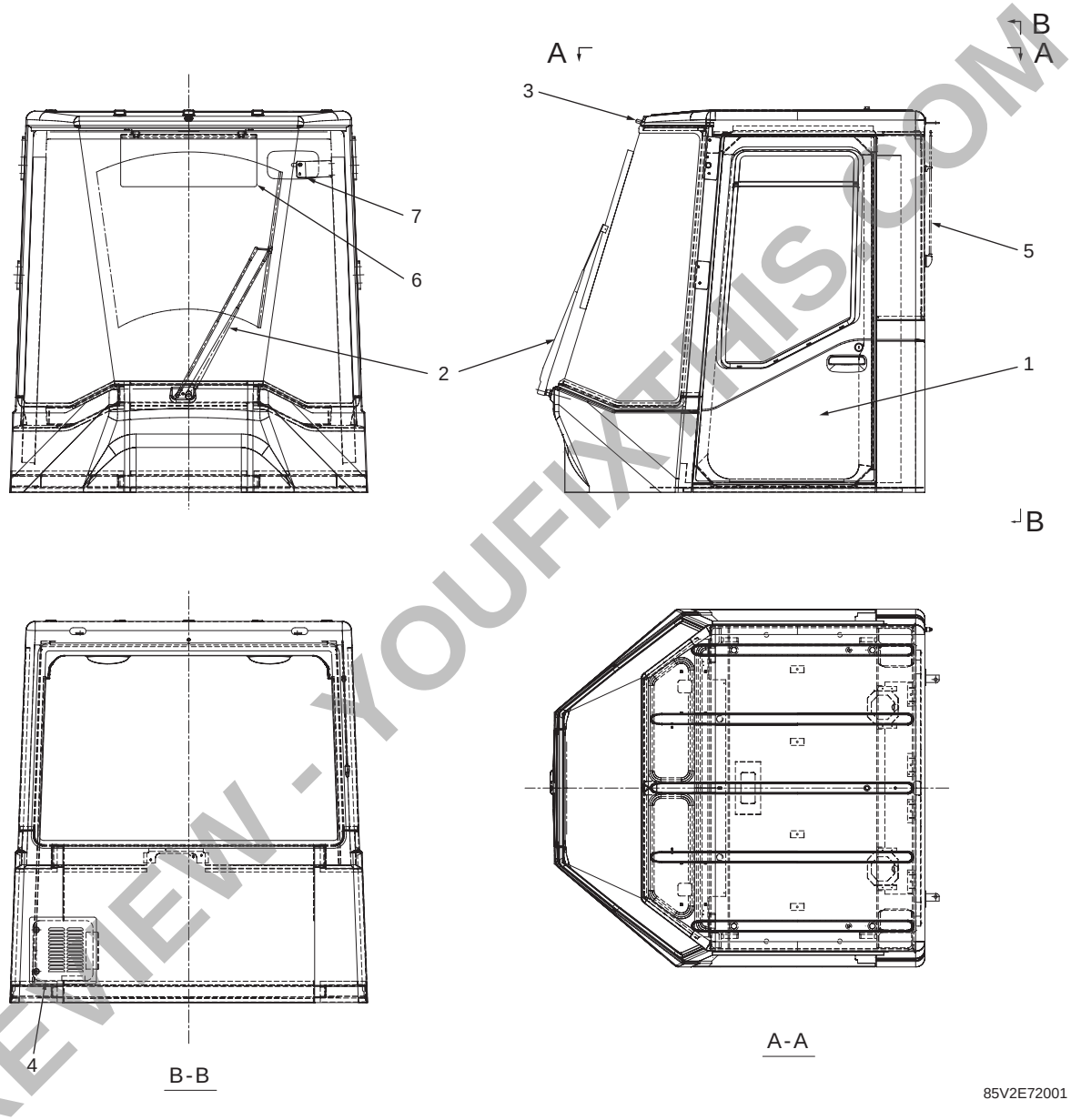
Example 3
Checking the other connector terminal where F704 RL (item (3)) is connected:

1. F704
   Shows that the terminal is connected to the 4th terminal of the F7 connector.
   Check the description in the 4th terminal of the F7 connector (F704), it shows that the F704 terminal is connected to H128. This means that the 4th terminal of the F7 connector is connected to the 28th terminal of the H1 connector.
2. RL
   Shows the color of the wire "RL" represents that the insulation color is red, and "L" represents a blue stripe is on the red insulation.

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Cabin



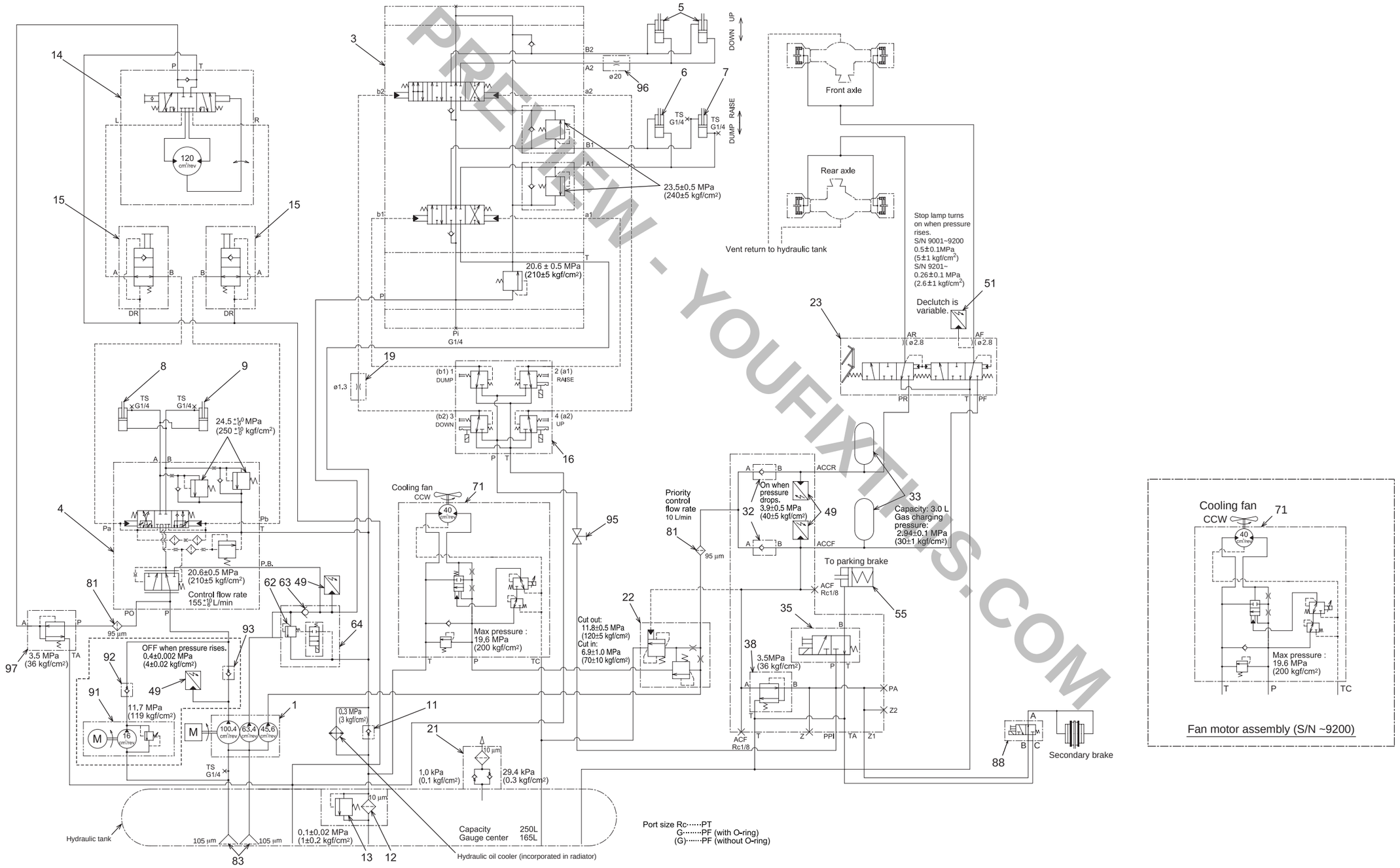
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The cabin equipped with the ROPS (Roll Over Protective Structure) is provided as standard.

1. Door (left side)
2. Front wiper
3. Window washer jet nozzle
4. Outside air suction port (air conditioner)
5. Antenna
6. Sun visor
7. Rear view mirror

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Hydraulic & Brake Circuit



Port size Rc·····PT
G·····PF (with O-ring)
(G)·····PF (without O-ring)

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Weight of Main Components

Item			Approx. weight (kg)	Approx. weight (lb)	Remarks
Unit name	Part name				
Chassis	Bucket		2,070	4,565	GSC bucket
	Boom		1,675	3,695	
	Lever		223/pc	495	
	Link (Bucket to Lever)		37/pc	85	
	Hinge pin		36/pc	80	
	Screen board		115	255	
	Roof		25	55	
	Engine room access panel		26	60	
	Radiator guard		88	195	
	Hydraulic tank		173	385	Excluding oil
	Fuel tank		184	410	Excluding fuel
	Deck	Left side	63	140	With handrail
		Right side	67	150	With handrail
	Cab (ROPS)		500	1,105	
	Floor board		230	510	
	Front chassis		1,890	4,170	
	Rear chassis		1,760	3,880	
	Counter weight		1,880	4,145	
Power line	Engine		940	2,075	Excluding oil
	Transmission		910	2,010	Excluding oil
	Second propeller shaft		72	160	
	Third propeller shaft		13	30	
	Radiator assembly	(S/N 9001~9200)	365	805	Excluding water and oil
		(S/N 9201~)	230	510	
	Air cooler		23	50	
	Air cleaner		25	55	
	Muffler		23	50	
	Front axle assembly		1,230	2,715	Excluding tires and oil
	Rear axle assembly		1,470	3,245	Excluding tires and oil (Including axle support)
	Axle support (Front)		90	200	
	Axle support (Rear)		110	245	
	Differential		185	410	
Hydraulic system	Multiple control valve		91	205	
	Steering valve		23	50	
	Valve assembly		8	20	For brake
	Valve assembly		16	35	For efficient loading system
	Hydraulic pump		46	105	
	Accumulator assembly		48	110	Two accumulators and bracket
	Fan motor		15	35	
	Boom cylinder		207/pc	460/pc	
	Bucket cylinder		130/pc	290/pc	
	Steering cylinder		42/pc	95/pc	
Other	Tire		670/pc	1,480/pc	With rim (26.5R25☆)
	Battery		36/pc	80/pc	

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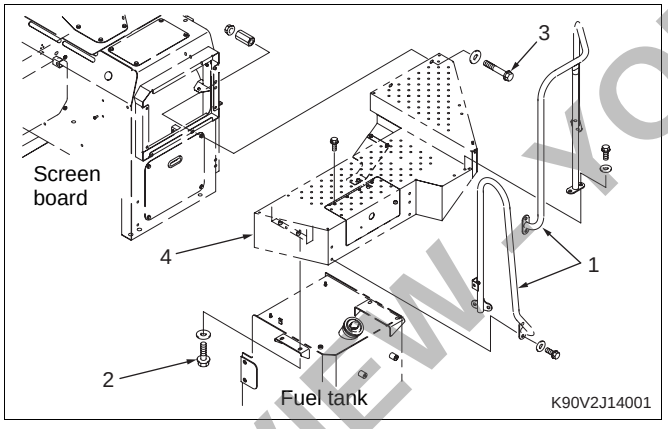
Deck

Deck removing and installing

Deck removing

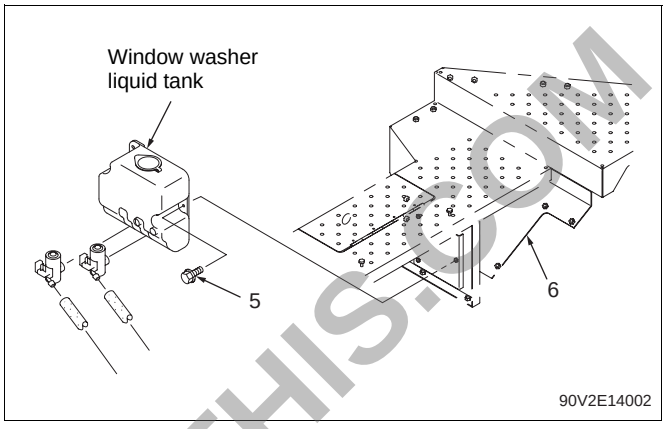
⚠ WARNING

Unexpected movement of the machine could cause an accident resulting in injury or death. Be sure to observe the following items before starting deck removal:
- Position the machine on level ground, and apply the parking brake.
- Lower the attachment onto the ground, and block the tires with chocks, etc. to prevent them from moving.
- Remove the engine key, and hang a "DO NOT START ENGINE!" tag on the steering wheel.

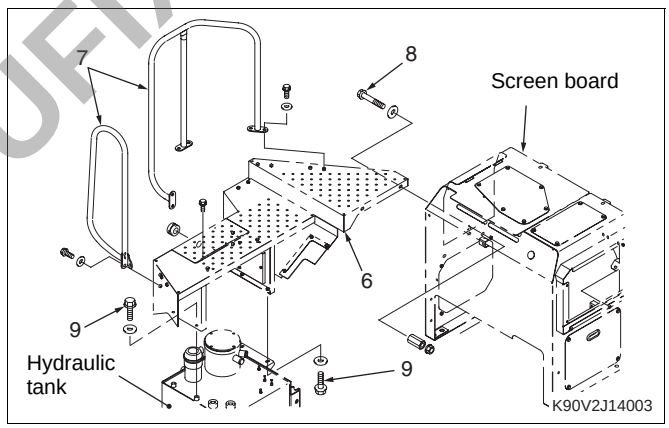


1. Apply a sling to handrail (1) and deck (4), then remove bolts (2)(3).

   : Deck (4) (with handrails): 65 kg (145 lbs)



2. Remove bolt (5) to remove the window washer liquid tank from deck (6).



3. Apply a sling to handrail (7) and deck (6), then remove bolts (8)(9).

   : Deck (6) (with handrails): 68 kg (150 lbs)

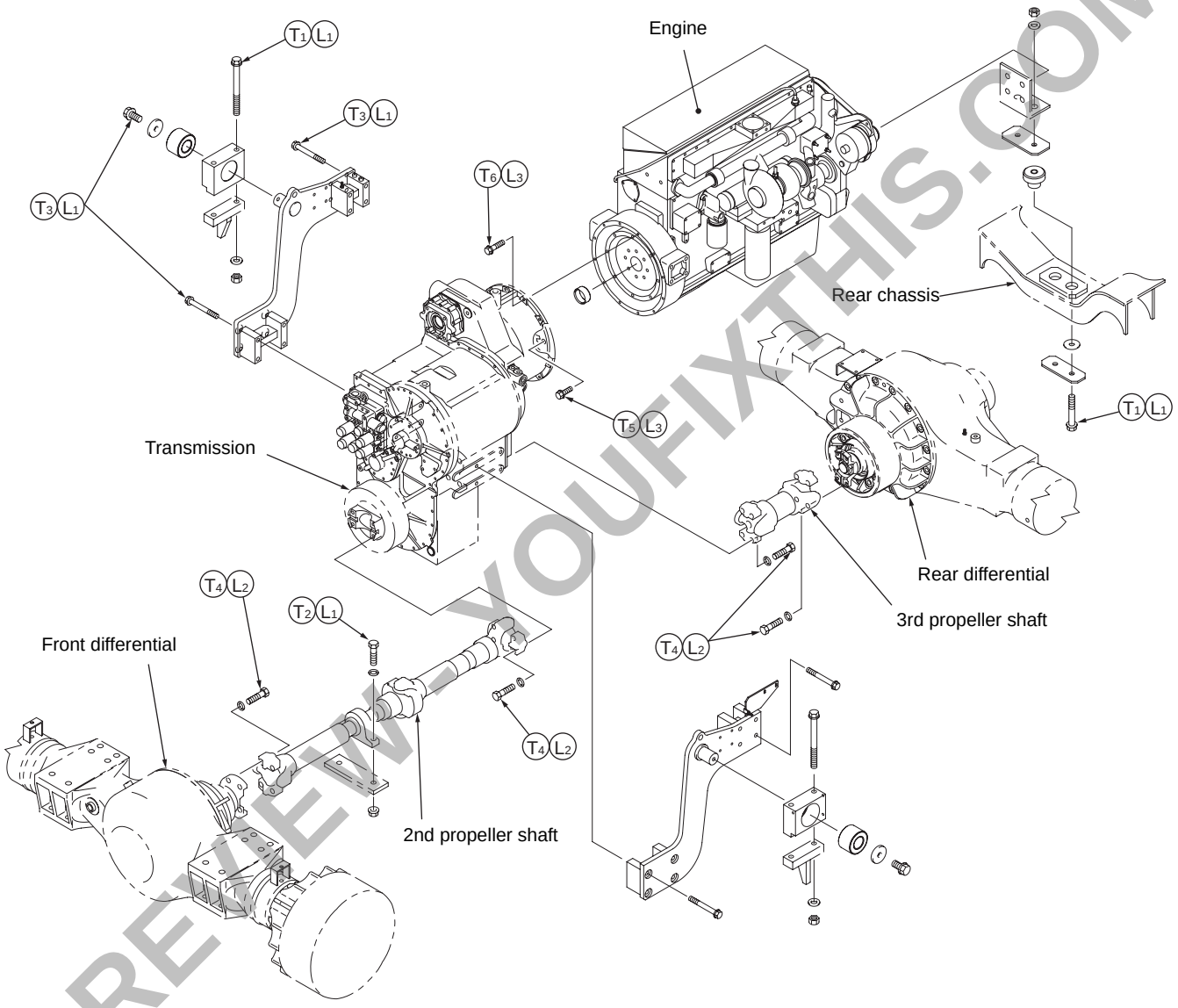
4. While considering the balance, remove decks (4)(6) together with the handrails.

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Power Line

Power line tightening torque



K90V2J24001

:
T_1: 441 N-m (45 kgf-m) (325 lb-ft)
T_2: 417 N-m (42.5 kgf-m) (307 lb-ft)
T_3: 230 N-m (23.5 kgf-m) (170 lb-ft)
T_4: 142 N-m (14.5 kgf-m) (105 lb-ft)
T_5: 67 N-m (6.8 kgf-m) (49 lb-ft)
T_6: 53 N-m (5.4 kgf-m) (39 lb-ft)

L_1: Screw lock agent (Loctite® 262)
L_2: Screw lock agent (Three Bond 1327)
L_3: With lubrication oil (Engine oil or gear oil)

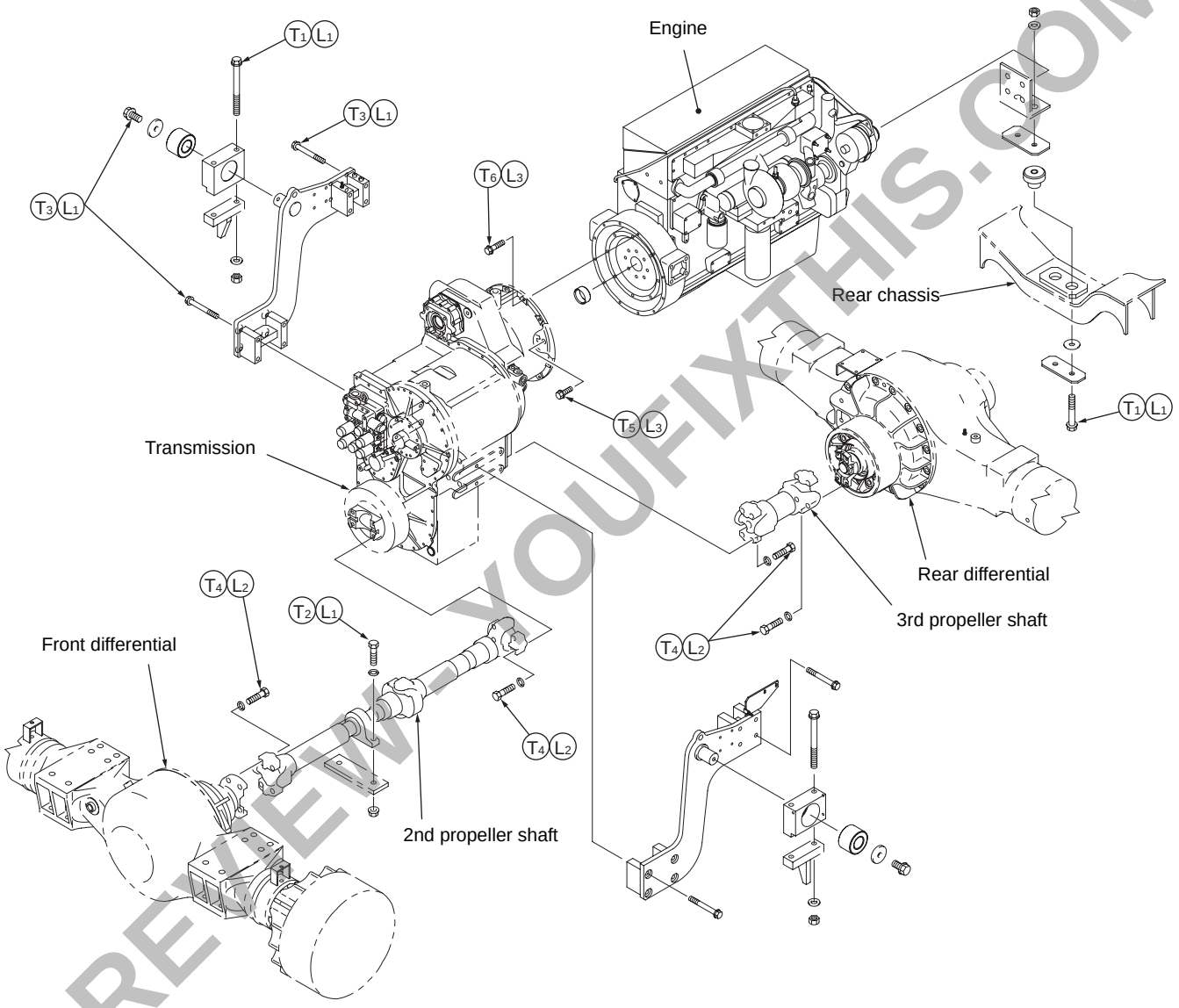
Always replace drive shaft bolts with new ones - never reuse them.

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Torque Converter and Transmission Assembly

Torque converter and transmission assembly tightening torque



K90V2J24001

:
T_1: 441 N-m (45 kgf-m) (325 lb-ft)
T_2: 417 N-m (42.5 kgf-m) (307 lb-ft)
T_3: 230 N-m (23.5 kgf-m) (170 lb-ft)
T_4: 142 N-m (14.5 kgf-m) (105 lb-ft)
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L_1: Screw lock agent (Loctite® 262)
L_2: Screw lock agent (Three Bond 1327)
L_3: With lubrication oil (Engine oil or gear oil)

Always replace drive shaft bolts with new ones - never reuse them.

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Hydraulic Pump Assembly

Hydraulic pump assembly removing and installing

Hydraulic pump assembly removing

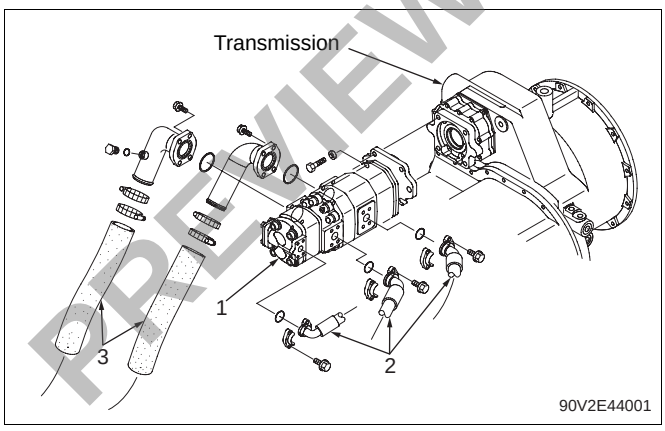
⚠ DANGER

Entering the articulation area while engine is running may cause serious injury or death.
So, when entering the area, stop the engine and place "DO NOT START" or "DO NOT OPERATE" tag on steering wheel.

⚠ CAUTION

Removing hoses and plugs without bleeding residual pressure could cause injuries or burns from hot oil under pressure.
Before removing hoses and plugs, relieve residual pressure. Relieve internal pressure from hydraulic tank to prevent oil from spraying.

Before starting work:
- Remove the cab and the floor board by referring to Section 14.
- Clean the area around the hydraulic pump.



1. Disconnect outlet hose (2) and suction hose (3) from hydraulic pump (1).

Note
Cover the hoses with plastic, plugs or caps to protect from dust and dirt.

2. Remove the hydraulic pump retainer bolts.

   : Bolt: 142 N-m (14.5 kgf-m) (105 lb-ft)

3. Remove hydraulic pump (1).

   : Hydraulic pump: 46 kg (105 lbs)

Hydraulic pump assembly installing

To reinstall the hydraulic pump assembly, follow the above removal procedure in reverse order.

Hydraulic pump installation cautions

- Replace all gaskets and O-rings during reinstallation.
- When replacing hydraulic pumps or when draining hydraulic oil for extended periods, it is important to prime the hydraulic system properly.
  Air will be in the lines that go to and come from the pump. After a pump has been installed, or when the hydraulic oil has been drained for extended time periods, air will not purge easily from the lines, and this could lead to pump damage.

⚠ WARNING

Oil injection hazard!
Hydraulic oil can penetrate skin. When performing this procedure:
- Release all trapped circuit pressure prior to starting any procedure involving hydraulic oil.
- Wear protective gloves.
- Wear eye and face protection.
- Stay clear of areas where air may be purged.
- Route oil into a receiving canister [such as a 5 gallon bucket] by use of an additional hose.
- Rotate pump at a low RPM.

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Unloader Valve

Unloader valve removing and installing

Unloader valve removing

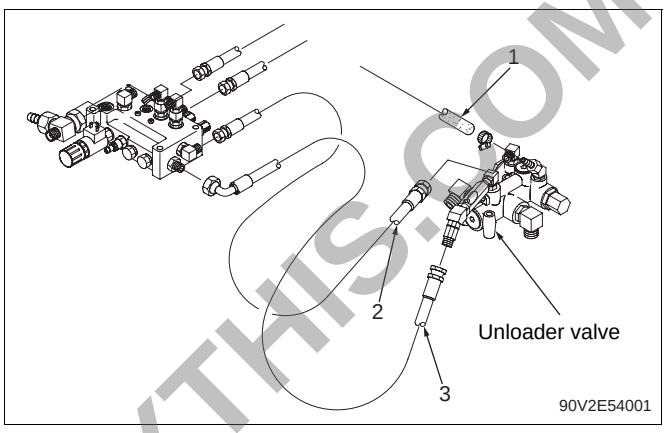
⚠ WARNING

Unexpected movement of machine could cause an accident resulting in injury or death. To prevent such an accident, observe the following items:
- Park the machine on level ground.
- Block the front wheels with chocks to prevent wheels from moving.
- Before starting work, be sure to remove the engine key, and hang a "DO NOT START!" tag on the steering wheel or the operator's seat, or disconnect the negative side of the battery.

IMPORTANT

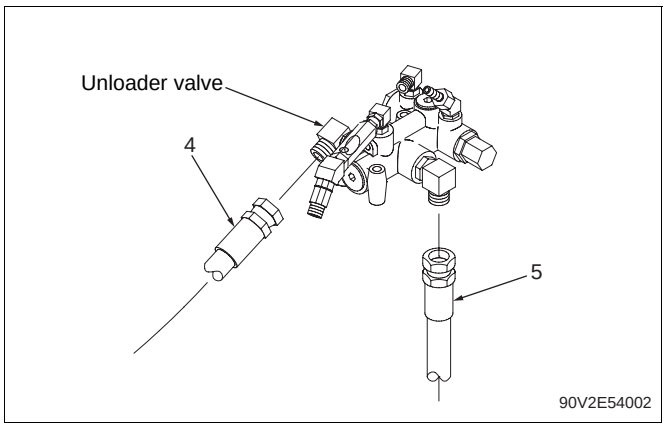
If a battery terminal is removed from a machine in less than 30 seconds after the key is put into the “OFF” position, it can corrupt the ECM program, which can disable the engine. Always wait 1 full minute to be sure to be past this “write to memory function” prior to removing battery terminals.

Before starting work:
- Stop the engine. Depress the brake pedal many times until there is no brake pressure.
- Press the hydraulic tank cap, and relieve the internal pressure from the hydraulic tank.
- Prepare a container to catch drained oil.



1. Remove hoses (1)~(3) from the unloader valve.

Note
Cover the disconnected hoses with plastic, plugs or caps to protect them from dust and dirt.



2. Remove hoses (4)(5) from the unloader valve.

Note
Cover the disconnected hoses with plastic, plugs or caps to protect them from dust and dirt.

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Air Conditioner

Air conditioner removing and installing

Air conditioner removing

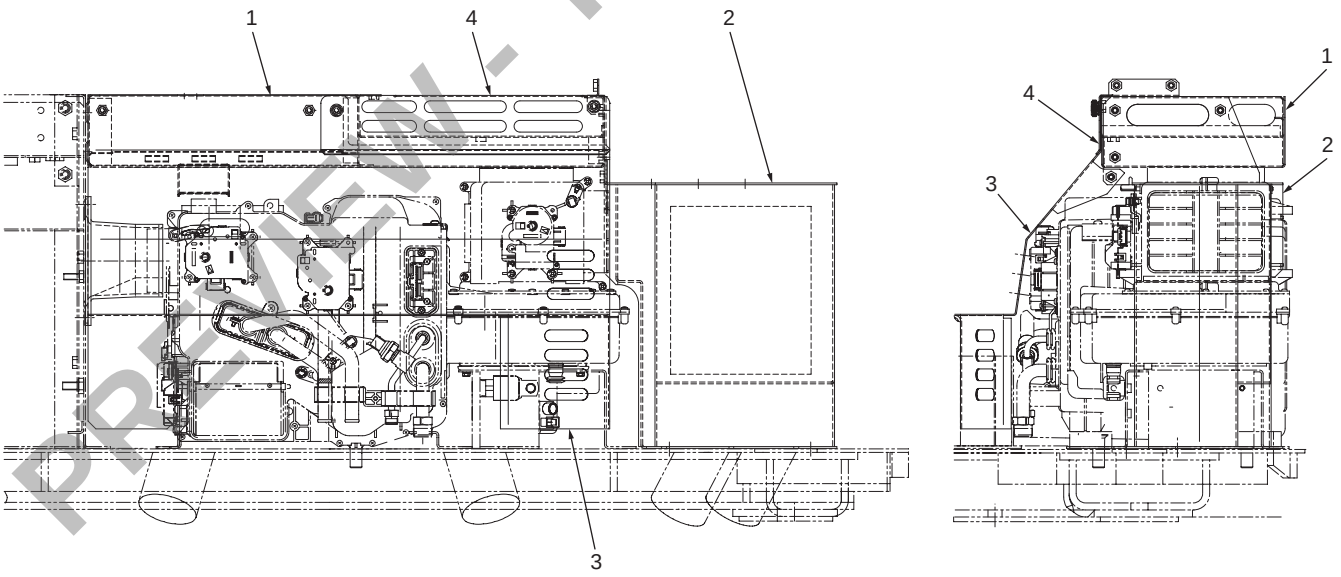
IMPORTANT

In case that it is necessary to replace the air conditioner parts, be sure to set the air conditioner mode as below before removing the air conditioner unit from the machine.

Temperature control: Max cool
Ventilation mode: Foot
Air intake control: Inside air circulation

Before starting work:

- Remover the seat in the cab.
- Collect the air conditioner refrigerant using the proper recovery method.
- Remove the floor mat in the cab.



View from operator's seat

95ZVE74001

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Torque Converter and Transmission Group

1. Machine dose not move in any shift lever position.

Check before starting work.

1. Check that the parking brake is released.
2. Check the error code No. shown on the MODM.
3. Check the transmission oil level.
4. Check the fuses of the MCU system.
5. Check the 70 A fusible link.
   (If the 70 A fusible link is off, no electrical circuits will operate except horn circuit and hazard flasher [opt.].)

Possible cause	Low clutch oil pressure at all the shift lever positions.	Torque converter oil becomes milky and cloudy in color.	Temperature of the torque converter oil is too high.	Filter of the torque converter is clogged.	Setting the declutch ON/OFF switch to OFF allows normal operation.	F5 fuse blows.	Pump is extremely heated.	Pump produces an abnormal (shrieking) noise.					Solution
Air drawn into suction line of the torque converter pump	○	○	○				○	○					Tightening hose band
Defective torque converter pump	○		○				○						Pump replacement
Damaged torque converter			○	○									Disassembly & repair
Sticking clutch pressure regulator valve	○												Disassembly & repair
Malfunctioning inching pressure switch					○								Switch replacement
Defective controller	○												Controller replacement
Neutral relay, controller fault relay, lift kickout and lower kickout relay, parking switch wirings short circuited						○							Repairing wiring
Restricted suction line - pinched, plugged, or internally defective.							○	○					Replace hose

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Standard Measurement Values for Performance Check (S/N 9001~9350)

Measurement conditions
Temperature of torque converter oil : 50~80ºC (120~180ºF)
Temperature of hydraulic oil : 50~80ºC (120~180ºF)
Temperature of engine coolant : 50~80ºC (120~180ºF)

Item				Standard measurement values for performance check		Remarks
System	Measurement item			Normal	Fuel efficient mode	
Engine	Engine speed (min^{-1}) (rpm)	Minimum no-load speed, Low Idle (LI)		800±50		
		Maximum no-load speed, High Idle (HI)		2,250±50		
		Maximum speed in torque converter stall mode		2,210±100	2,065±100	
		Maximum speed in multiple control valve relief mode		2,170±100	1,895±100	
		Maximum speed in torque converter stall plus multiple control valve relief mode		$1,870^{+150}_{-100}$	$1,655^{+150}_{-100}$	
Transmission	Clutch pressure MPa (kgf/cm^2) (psi)	Engine speed	Idling (LI)	1.3±0.2 (13±2) (185±28)		
			Maximum (HI)	1.5±0.2 (15±2) (213±28)		
	Clutch time lag (sec)	Neutral→Forward 1st speed (engine speed: 1,500 min^{-1} (rpm))		0.3±0.1		Before wheels move

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CONTENTS

90ZV-2 General Information 00-1
How to Use Manual 00-2
Safety precautions 00-2
Symbols 00-3
Outline 00-4
Layout of main components 00-4
Inspection and maintenance table 00-5
Recommended Lubricants 00-8
Coolant 00-9
Lubrication chart 00-10
Weight of main components 00-11
Bolt tightening torque 00-12
Hose band tightening torque 00-16
Liquid gasket and screw lock agent 00-17
Cautions regarding welding repair service 00-19

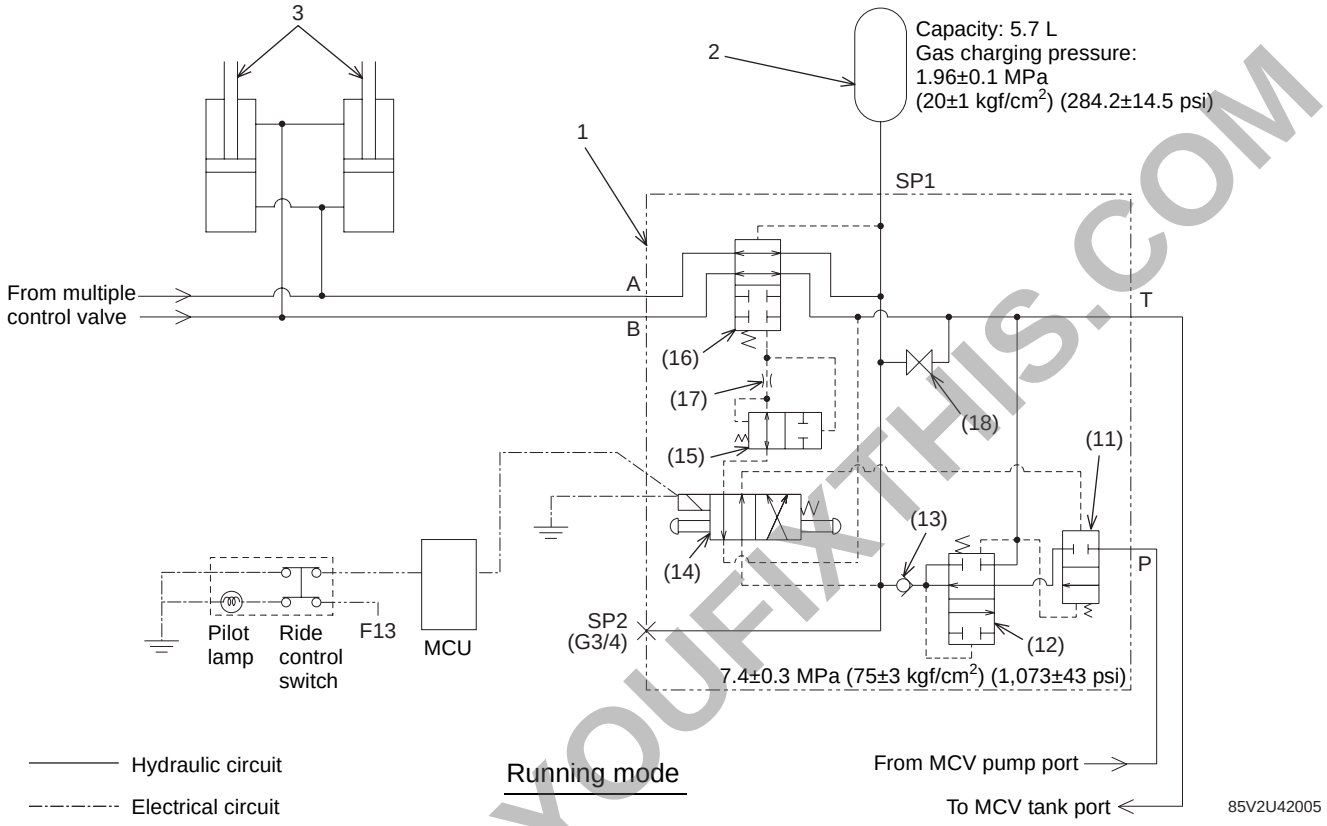
90ZV-2 Measurement for Performance Check 03-1
Cautions on Safety 03-2
Standard Measurement Values for Performance Check 03-3

90ZV-2 Function & Structure Chassis Group 12-1
Front Chassis 12-2
Loading linkage 12-2
Loading linkage pin 12-4
Rear Chassis 12-5
Floor board mount 12-5
Fuel tank (S/N 9001~9450) 12-6
Fuel tank (S/N 9451~) 12-7
Center Pin 12-8
Upper center pin 12-8
Lower center pin 12-8
Dust seal 12-9

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Running mode (ride control switch is ON)



The ride control switch is ON, and when the machine travelling speed reaches more than 7 km/h (4.3 mph) solenoid valve (14) comes to ON by a signal from the MCU.

When solenoid valve (14) is switched, the accumulator pressure applies to the upper part of charge switching spool (11) and the pump port is closed by pressing the spool down.

Pressurized oil in the lower part of main spool (16) is drained to the tank through solenoid valve (14). As a result, main spool (16) is switched by the accumulator pressure, and the hydraulic line between the boom cylinder bottom side and the accumulator is connected. Then the accumulator absorbs the oil pressure fluctuations in the boom cylinder bottom side.

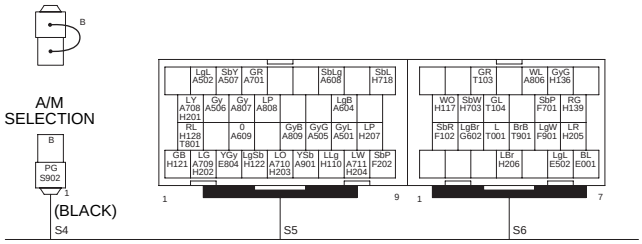
On the other hand, the hydraulic line between the boom cylinder rod side and tank port is connected.

Flow control spool (15) and orifice (17) control the switching speed of main spool (16), and reduce the momentary motion of the boom cylinder by switching the main spool when there is pressure difference in the hydraulic circuit between the accumulator and boom cylinder bottom side.

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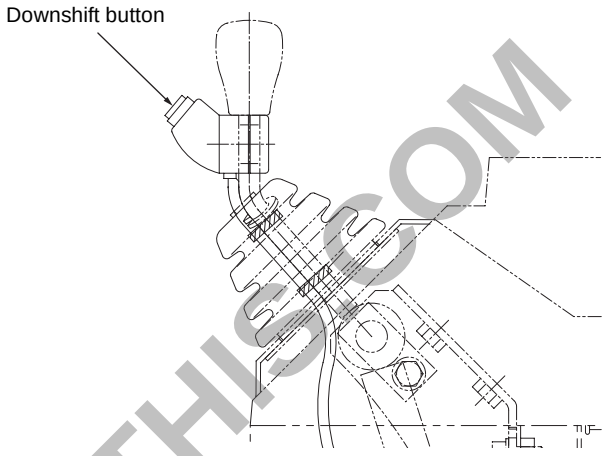
Switching from automatic to manual



85V2E62025

The machine has automatic shift cancellation function for troubleshooting. Connect the coupler (OPT) to S4 coupler to cancel the automatic shift function. The mode will be switched from automatic to manual. Position "A" of the shift lever, therefore, is fixed to the 4th speed.

Downshift button operation



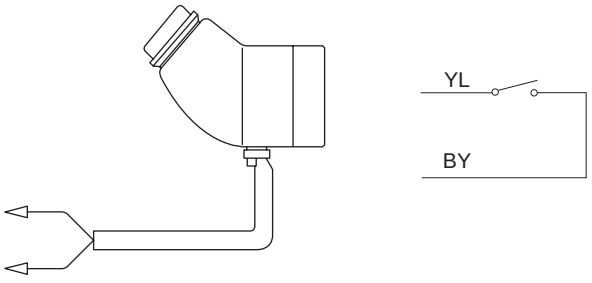
80ZVE62017

The downshift button is attached to the boom control lever.

In any operation mode, pressing the downshift button during 2nd speed operation shifts the 2nd speed to the 1st speed. After that, if the downshift button is pressed again, the speed is changed from the 1st to the 2nd, or to move the shift lever to neutral or to the opposite direction, the speed will be changed to the 2nd again.

Note that when the speed is shifted, the transmission status monitor lamp on the instrument panel changes from the 2nd gear to the 1st gear or from the 1st gear to the 2nd gear.

Downshift button



70ZV62031

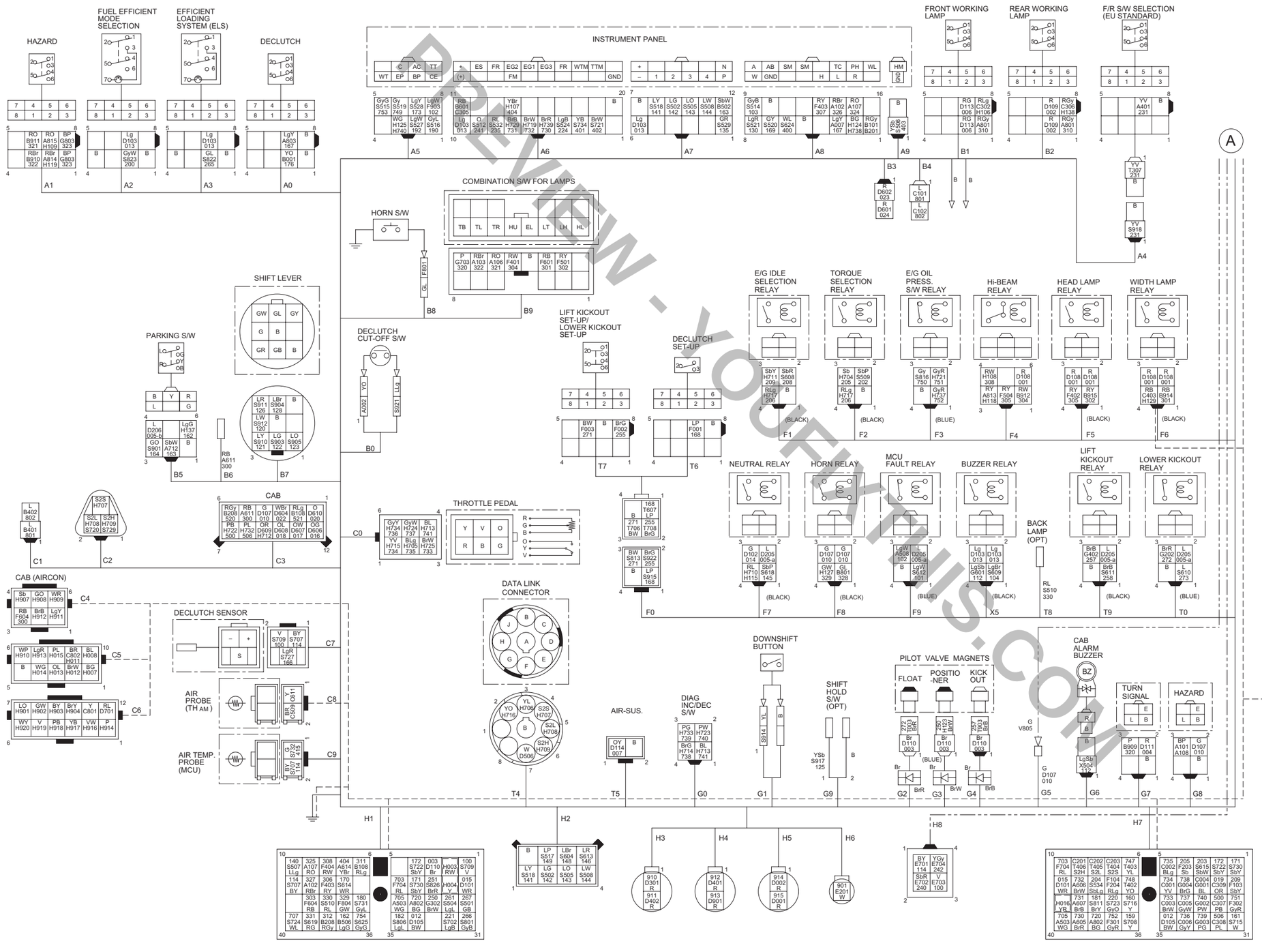
Allowable value	Max. voltage	DC 24 V
	Current	10 mA

The downshift button is of the momentary type. It is spring loaded to the "OFF" position.

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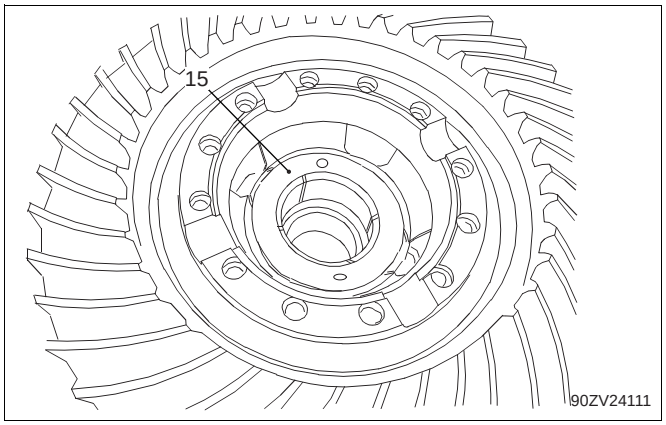
Electrical Wiring Diagram (1/3) (S/N 9001~9070)



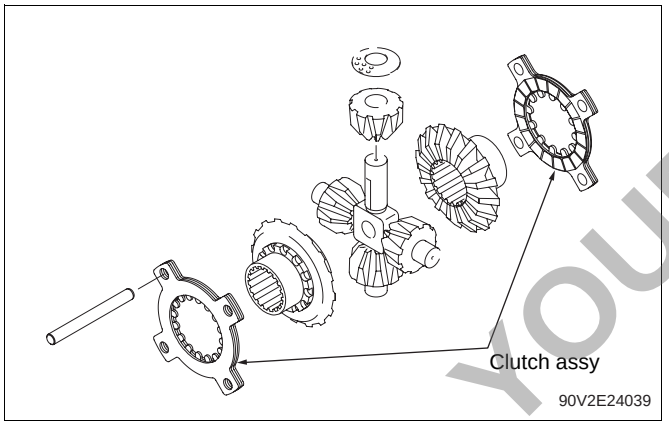
This page illustrates the transmission is in neutral and key switch is in OFF position.

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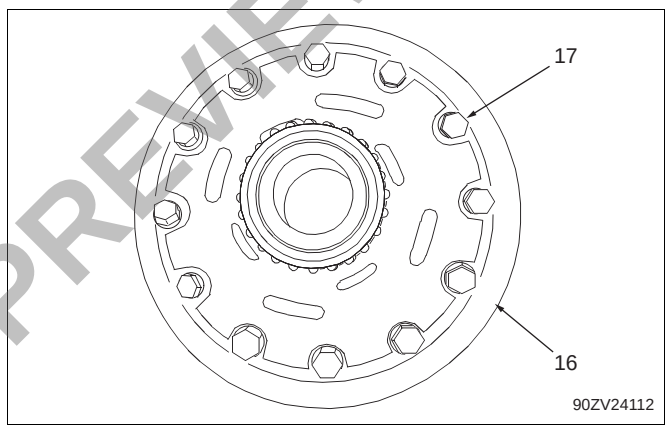
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8. Remove thrust washer (15).

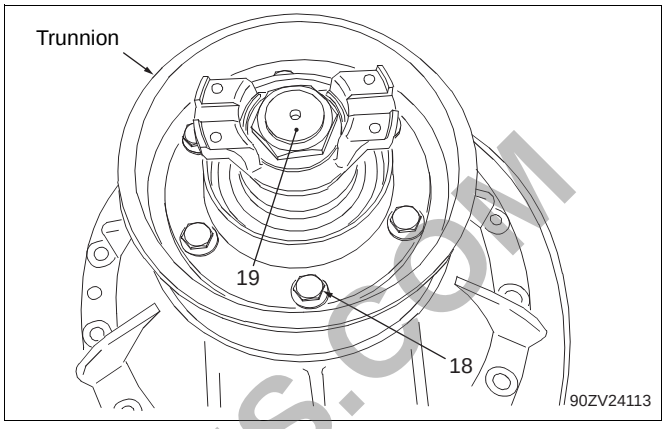


Note
For the limited slip differential, remove the clutch assy, which is assembled instead of thrust washer (15).



9. Turn the differential upside down. Remove bolts (17) from bevel gear (16) to separate the gear.

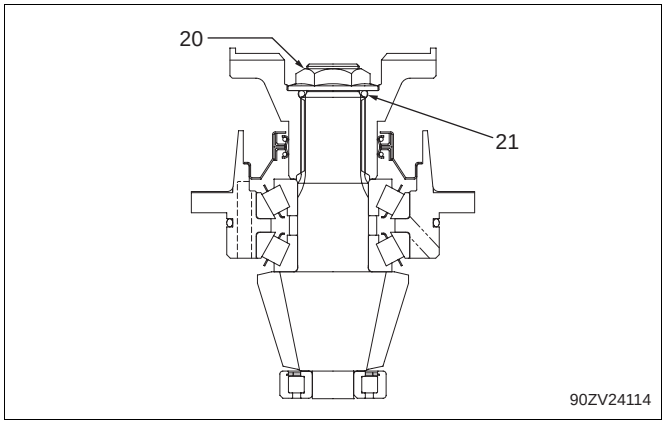
: Bolt (17): 330 N-m (33.7 kgf-m) (244 lb-ft)
: Screw lock agent application
(Three Bond 1327)



10. Remove bolts (18) to remove pinion (19). At the same time, remove the shim.

: Bolt (18): 314 N-m (32.0 kgf-m) (232 lb-ft)
: Screw lock agent application
(Three Bond 1327)

Note
The rear differential assembly has the trunnion installed with bolts (18) as shown.



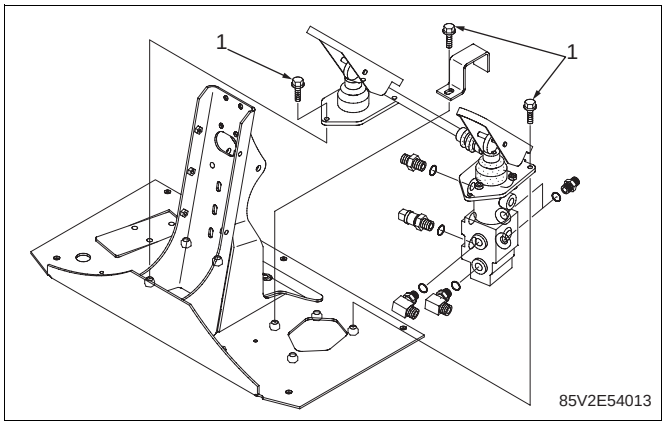
11. Remove nut (20) and O-ring (21).

: Nut: 883 N-m (90.0 kgf-m) (651 lb-ft)
: Screw lock agent application
(Three Bond 1327)

Note
Nut width across flat: 57.1 mm (2.25 in)

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3. Remove bolt (1) and then remove the brake valve.

: Bolt: 53 N-m (5.4 kgf-m) (39 lb-ft)

Brake valve installing

To reinstall the brake valve, follow the above removal procedure in reverse order.

Brake valve installation cautions

After reinstallation, completely bleed the brake line of air, and check all the pipe-joints for oil leakage.
To check or adjust the brake valve, refer to 90ZV-2 Shop Manual, Function and Structure, Section 53.

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