Printed in Japan (K)
（アメリカ用）

65TMV-2 SHOP MANUAL General Information & Structure

93207-00871

93207-00871
November 2014

SHOP MANUAL

WHEEL LOADER

65TMV-2

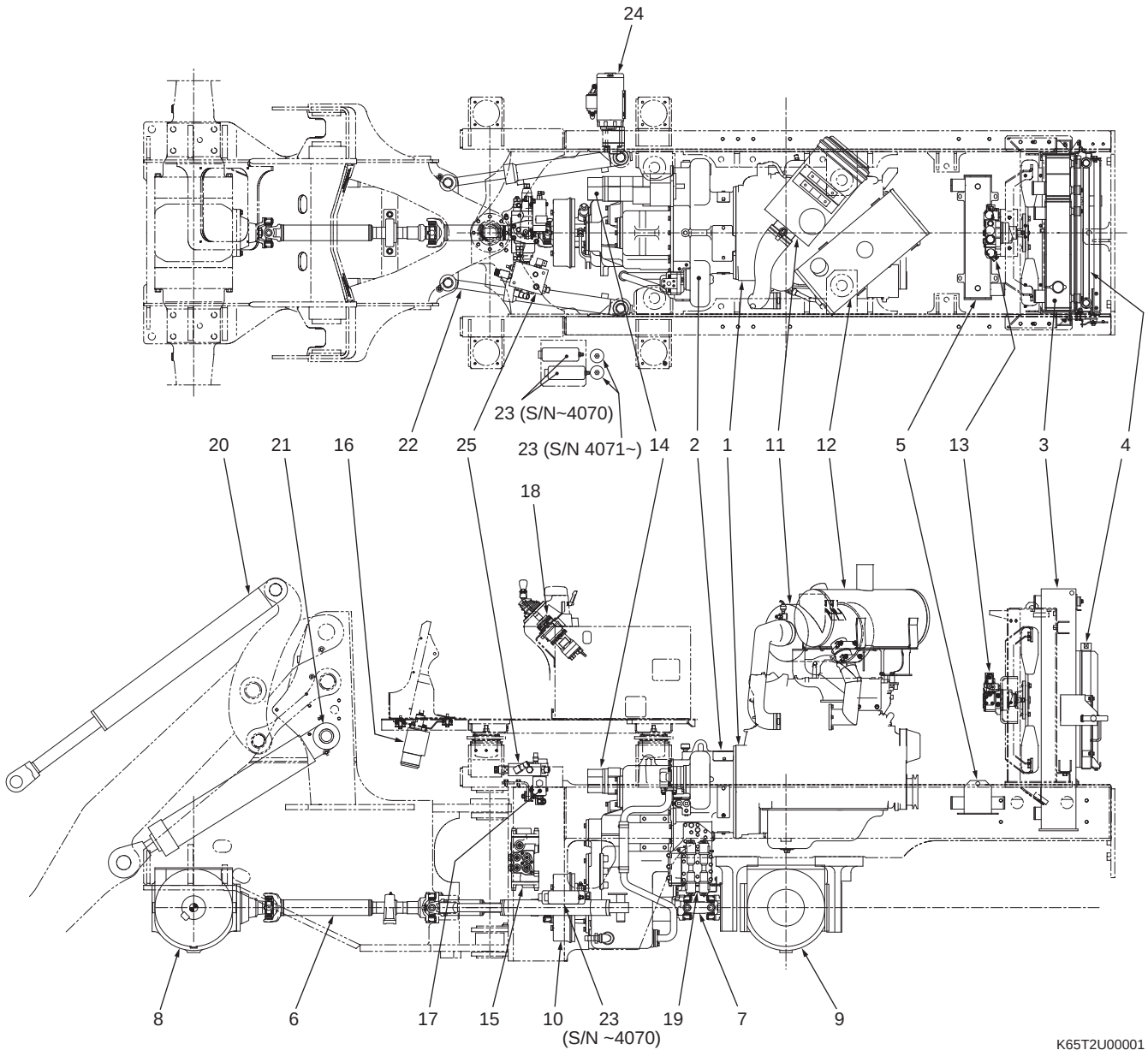
General Information
Standard Measurement Values for Performance Check
Function & Structure
Check & Adjustment

Powered by Isuzu 4HK1X Engine

Serial No. 65J4-4001 and up

Outline

Layout of main components



1. Engine assembly (Isuzu 4HK1X)
2. Transmission/Torque converter assy
3. Radiator assembly (including air cooler)
4. Hydraulic oil cooler (air-to-oil type)
5. T/C oil cooler
6. 2nd propeller shaft
7. 3rd propeller shaft
8. Front axle assembly
9. Rear axle assembly
10. Parking brake
11. Air cleaner
12. Muffler
13. Fan motor
14. Hydraulic pump
15. Multiple (loader) control valve
16. Orbitrol®
17. Priority valve
18. Pilot valve (for loading)
19. Transmission control valve
20. Bucket cylinder
21. Hoist cylinder
22. Steering cylinder
23. Accumulator (for steering)
24. Pump unit (for secondary steering) (OPT)
25. ELS (OPT)

(kgf-m)

Type	Bolt size			Bolt strength	
	Nominal dimension	Nominal diameter	Pitch	8.8 (8T)	10.9 (11T)
Metric thread	M8	8	(C) 1.25	2.7	3.9
	M10	10	(C) 1.5	5.4	7.8
			(F) 1.25	5.6	8.2
	M12	12	(C) 1.75	9.2	13.5
			(F) 1.25	9.8	14.5
	M14	14	(C) 2.0	14.5	21.0
			(F) 1.5	15.5	22.5
	M16	16	(C) 2.0	22.0	32.0
			(F) 1.5	23.0	33.7
	M18	18	(C) 2.5	30.5	44.5
			(F) 1.5	33.0	48.5
	M20	20	(C) 2.5	42.5	62.0
			(F) 1.5	46.0	67.5
	M22	22	(C) 2.5	57.0	83.0
			(F) 1.5	61.0	89.5
	M24	24	(C) 3.0	73.5	105.0
			(F) 2.0	78.5	115.0
	M27	27	(C) 3.0	105.0	155.0
			(F) 2.0	115.0	165.0
	M30	30	(C) 3.5	145.0	215.0
			(F) 2.0	160.0	230.0
	M33	33	(C) 3.5	195.0	290.0
			(F) 2.0	210.0	310.0
Unified thread	5/16	05	18 UNC	2.5	3.6
	3/8	06	16 UNC	4.5	6.6
	7/16	07	14 UNC	7.2	10.5
	1/2	08	13 UNC	10.5	15.0
	9/16	09	12 UNC	15.0	22.0
	5/8	10	11 UNC	20.5	30.0
	3/4	12	10 UNC	36.5	53.5
	7/8	14	9 UNC	56.5	82.5
	1	16	8 UNC	88.5	130.0

Note: Tighten the bolts according to the above list, unless otherwise specified.

Cautions on Safety

⚠ WARNING

Unexpected movement of the machine may cause an accident resulting in injury or death.
Therefore, to provide repair service with the engine running, be sure to observe the following items:

- Park the machine on level ground.
- Apply the parking brake.
- Block the tires with chocks to prevent the tires from moving.
- Determine the signals between the service man.
- Prohibit any person from walking into dangerous areas.
    - Near articulation areas of the machine
    - Under the machine
    - Around the engine
    - In front of or behind the machine

⚠ WARNING

Operation under the boom or the bucket may lead to severe accidents.
Make sure to apply the safety lock of the boom and the bucket control lever provided in the cab, remove the starter key, and attach a "DO NOT OPERATE!" tag to the cab.

⚠ CAUTION

Be careful not to be burnt by bursting high pressure oil.
Release the pressure remaining inside the circuit and open the cap of the hydraulic tank before removing the plug from the pressure measurement port so that the internal pressure of the hydraulic tank is released and burst of the high pressure oil can be prevented.

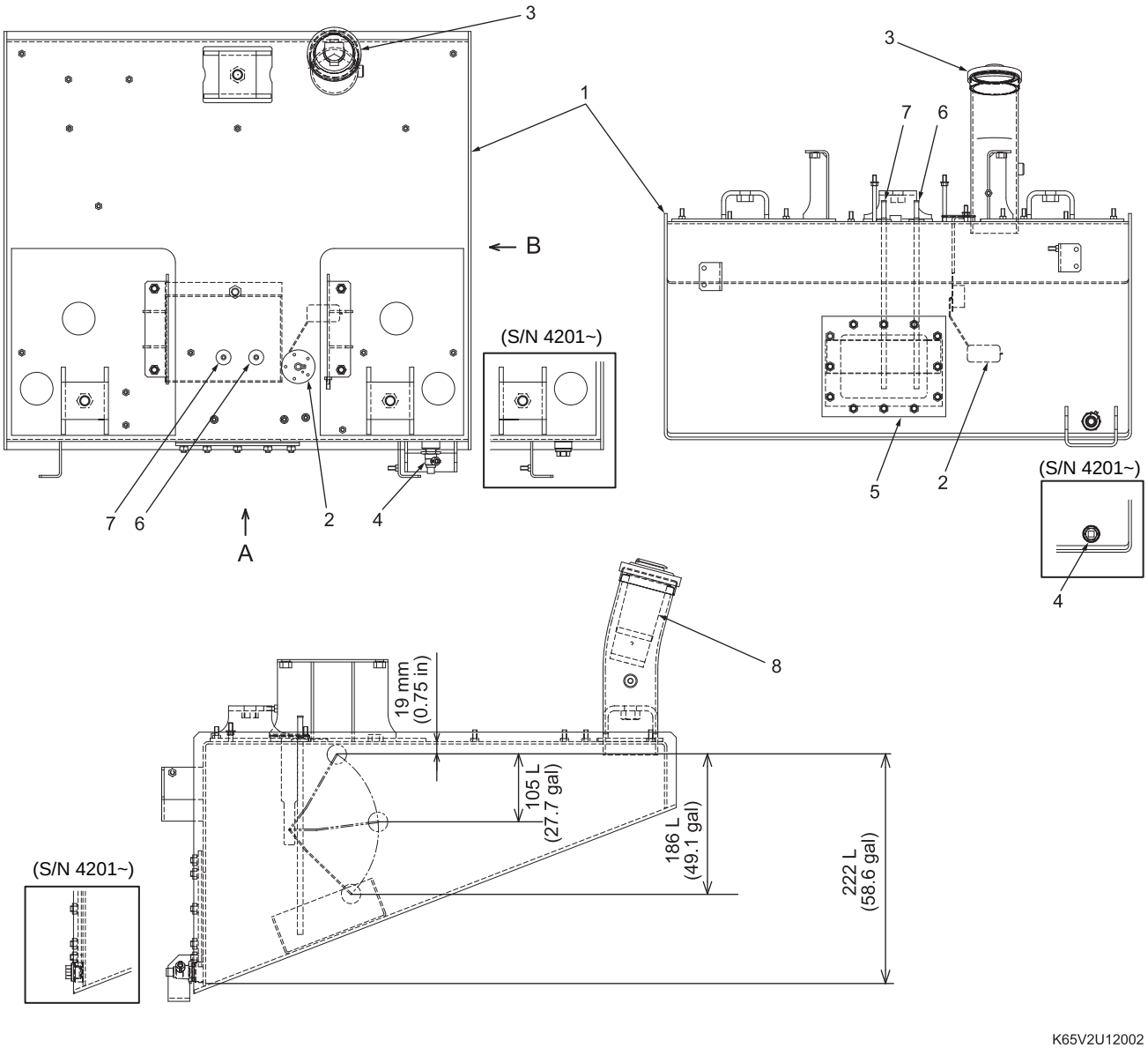
⚠ WARNING

Entering the articulation area of the machine body while the engine is running may cause severe accidents.
Make sure to stop the engine, pull out the starter key, and attach a "DO NOT OPERATE!" tag to the cab before entering the articulation area.

⚠ CAUTION

Touching the fan or the V belt of the engine or the hot area while the engine is running may cause severe accidents.
Make sure to stop the engine before opening the engine room access panel.

Fuel tank (S/N 4065~)

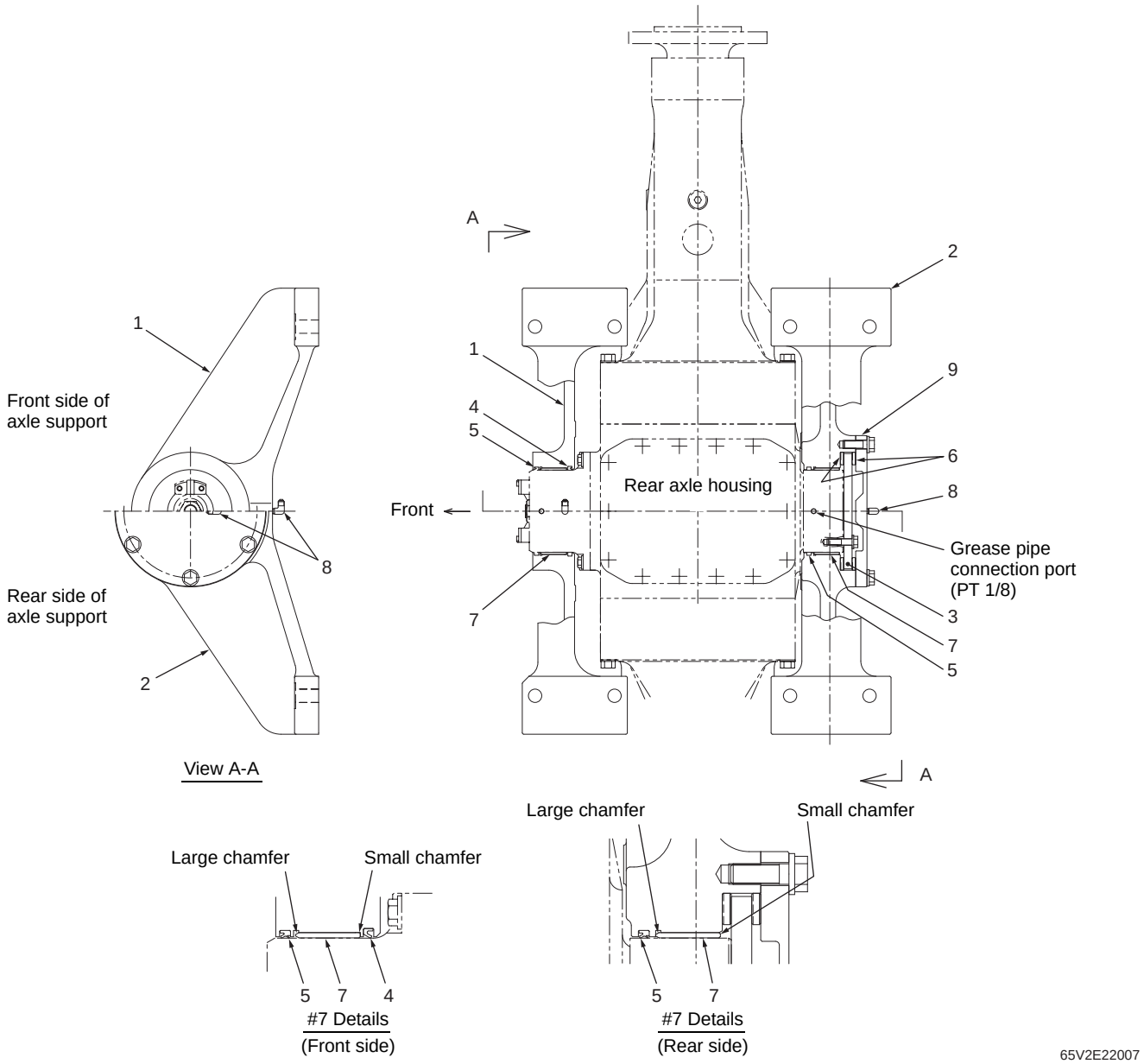


K65V2U12002

1. Fuel tank
2. Fuel level sensor
3. Fuel tank filler assembly
4. Drain valve (S/N 4201~ square socket head)
5. Inspection hole cover
6. Suction pipe
7. Fuel return pipe
8. Filter

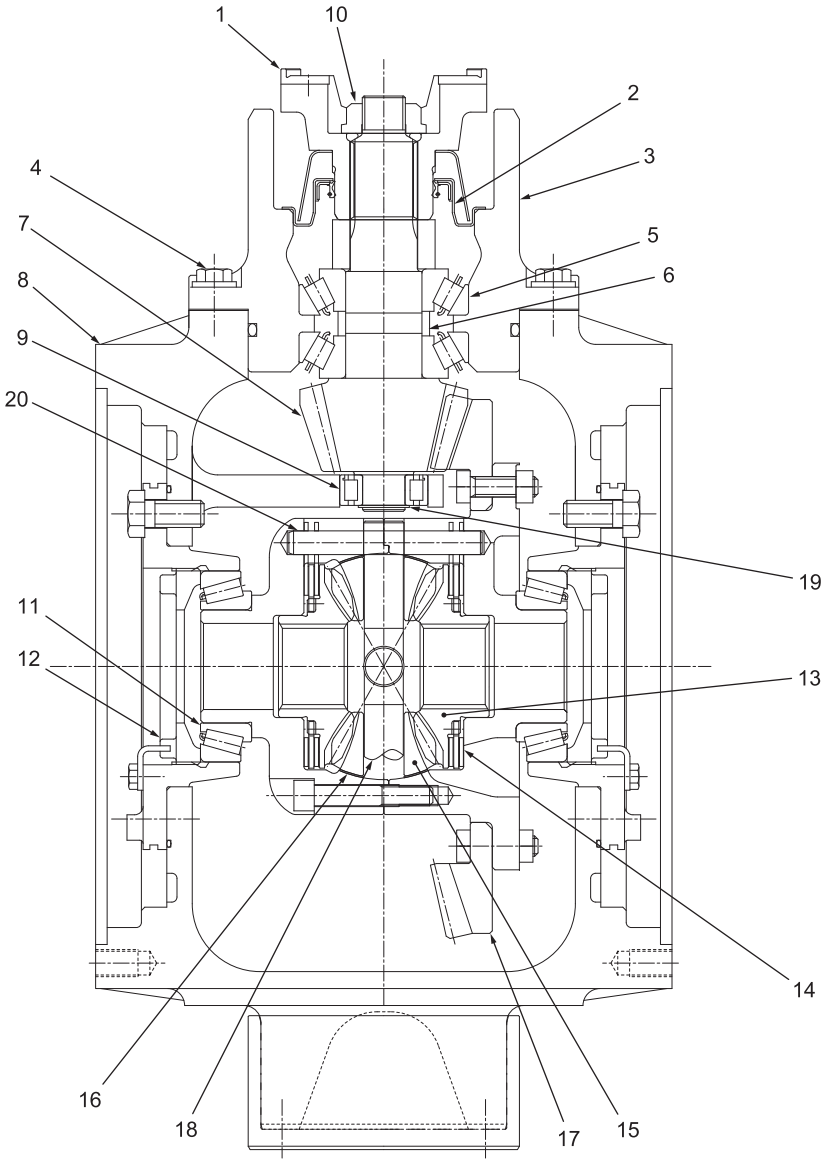
MEMO

Axle Support



1. Axle support (front)
2. Axle support (rear)
3. Plate
4. Lip seal
5. Lip seal
6. Wear ring
7. Bushing
8. Elbow
9. Plate

Rear differential gear



K65V2U22005

1. Flange
2. Oil seal
3. Cage
4. Shim
5. Taper roller bearing
6. Collar
7. Drive pinion
8. Carrier
9. Pilot bearing
10. Nut
11. Taper roller bearing
12. Adjusting nut
13. Side gear
14. Clutch assembly
15. Differential pinion
16. Thrust washer (pinion gear)
17. Ring gear
18. Spider (cross shaft)
19. Snap ring
20. Pin

Transmission

Clutch combination

Clutch / Speed range	F	R	1	2	3	4
F1	◯		◯			
F2	◯			◯		
F3	◯				◯	
F4	◯					◯
N			*	*	*	
R1		◯	◯			
R2		◯		◯		
R3		◯			◯	
R4		◯				◯

(Either 1st or 2nd or 3rd)

The transmission is equipped with six clutches:

Forward range, reverse, and 1st, 2nd, 3rd and 4th speeds. Combining the clutches as shown in the table here provides four forward speeds, and four reverse speeds for a total of eight speeds. Two clutches must be engaged at the same time to move the machine.

Shift lever position

Position of shift lever	Function
1	Held in 1st speed range for both forward and reverse.
2	Held in 2nd speed range for both forward and reverse. Downshift button operation.
3	Held in 3rd speed range for both forward and reverse.
A	Automatic speed change according to shift map (computer) for 2nd through 4th speeds forward and reverse. Downshift button operation.

Automatic or manual speed change is available depending on the position of the shift lever, as shown in the table.

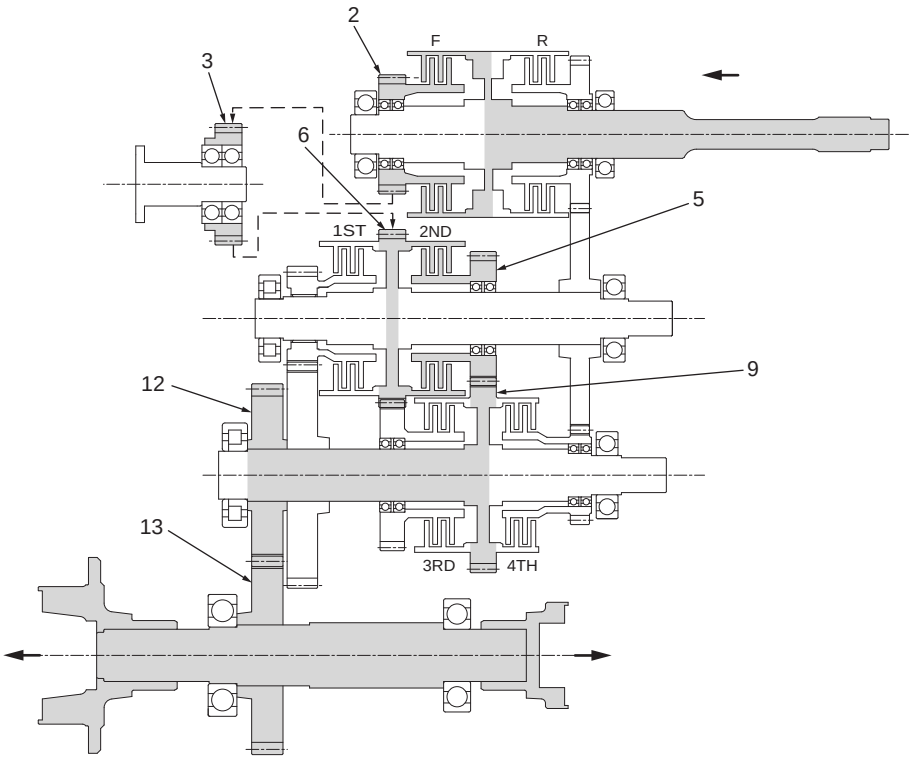
Automatic speed change refers to one where the best speed range is determined by a computer according to the machine speed detected.

Downshift button operation

This feature permits quick up and down shifting when in 2nd and Automatic.

It operates from 2nd to 1st, and 1st to 2nd.

Forward 2nd speed power flow path



65V2E32010

The power from the torque converter is transmitted to;

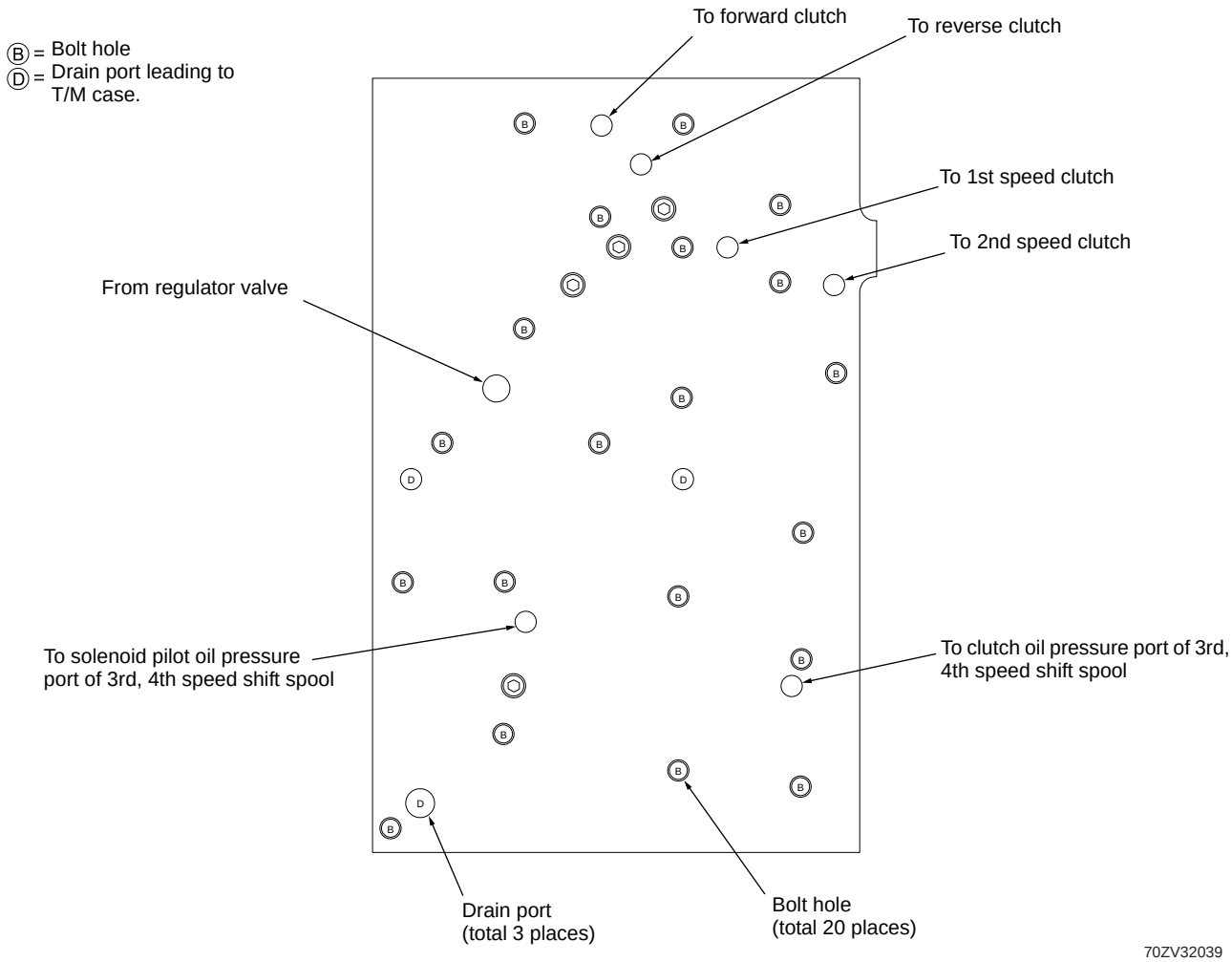
F-clutch
↓
2. Gear
↓
3. Gear
↓
6. Gear
↓
2nd speed clutch
↓
5. Gear
↓
9. Gear
↓
12. Gear
↓
13. Gear

then the power is finally transmitted to the output shaft.

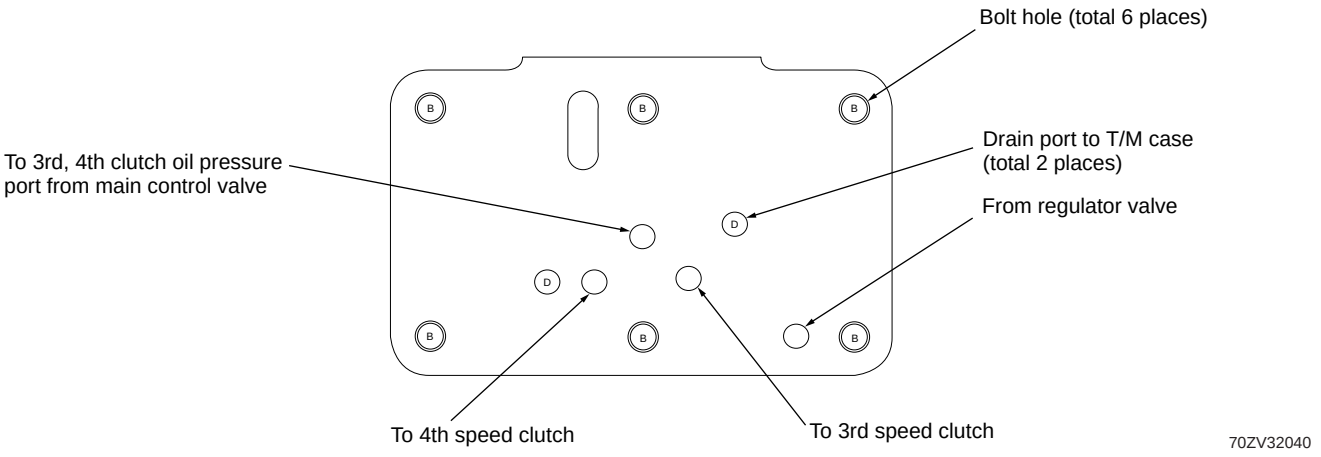
Oil port layout

Layout of ports on mounting surface of control valve (at T/M case side)

Main control valve



3rd, 4th speed control valve



Clutch Oil Pressure

Measuring clutch oil pressure

⚠ WARNING

Unexpected movement of the machine may cause an accident resulting in injury or death.
Therefore, to provide repair service with the engine running, be sure to observe the following items:

- Park the machine on level ground.
- Apply the parking brake.
- Block the tires with chocks to prevent the tires from moving.
- Determine the signals between the service men.
- Prohibit any person from walking into dangerous areas.
    - Near articulation area of the machine
    - Under the machine
    - Around the engine.
    - In front of or behind the machine

Hydraulic System Operation

Hydraulic system operation outline

The hydraulic system consists of the following systems:

- Loading system
- Steering system
- Fan motor system
- Ride control system (OPT)
- Secondary steering (OPT)

Loading system

The loading system consists of the following components. All numbers base on page 92-5.

- Hydraulic pump (1)
- Unloader valve (22)
- Line filter (39)
- Check valve (32)
- Reducing valve (38)
- Pilot valve (16)
- Multiple control valve (3)
- Boom cylinders (5)
- Bucket cylinders (6)(7)

Oil from pump (1) flows to pilot valve (16) through unloader valve (22), line filter (39), check valve (32) and reducing valve (38). Oil to pilot valve (16) is reduced to 3.5 MPa (36 kgf/cm^2) (512 psi) by reducing valve (38).

When the pilot control lever is operated, the pilot valve line is opened, and the oil pressure is generated depending on the position of the pilot control lever.

The pilot pressure entering the oil pack to multiple control valve (3) moves the spool against its return spring.

The spool press-in distance (displacement) depends on the pilot valve pressure.

Oil from the loader pump is then directed through multiple control valve (3) to boom cylinders (5) and bucket cylinders (6)(7).

Return oil from the cylinders flows through the valve to the oil cooler, return filter (12) and into the hydraulic tank.

Even if no hydraulic pump supplies oil to the loading and pilot control circuits due to trouble, or if the engine is shut off, the boom can be lowered to the ground by the pressure in accumulator (33) in the brake circuit in case of an emergency.

Steering system

The steering system consists of the following components.

- Hydraulic pump (1)
- Priority valve (15)
- Orbitrol® (14)
- Accumulator (34)
- Steering cylinder (8)

Oil from pump (1) flows to Orbitrol® (14) through priority valve (15).

When the steering wheel is turned, an amount of oil proportional to the turning speed is sent from pump (1) to steering cylinder (8) through priority valve (15) and Orbitrol® (14).

When the steering wheel is not operated, almost all of the hydraulic oil discharged from pump (1) is supplied to the loading circuit.

Priority valve (15) detects the resistance of the hydraulic oil passing through Orbitrol® (14), namely the speed of the steering wheel's rotation and the amount of oil, and then distributes oil to the loading and steering circuits.

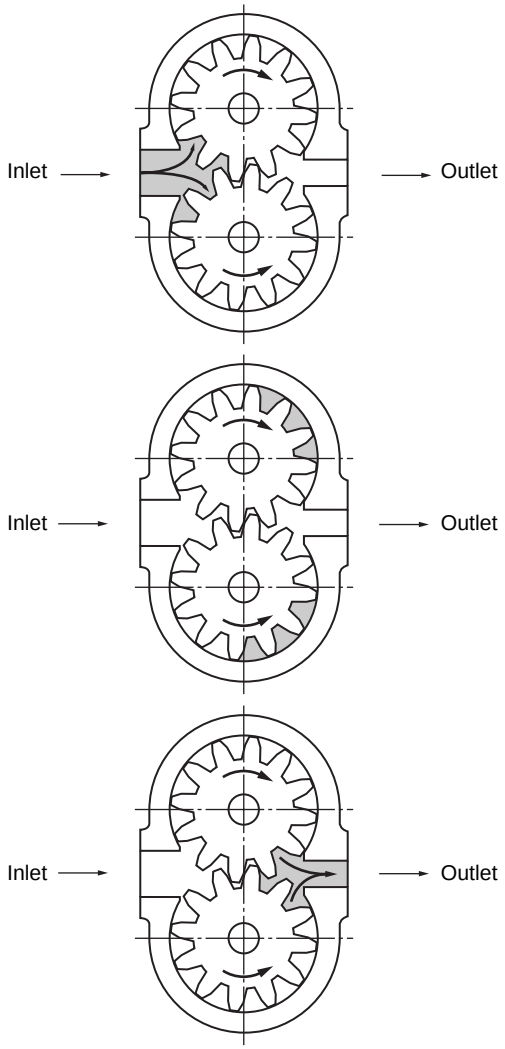
Accumulator (34) is provided to prevent shock at the time of starting and stopping the steering wheel.

While the steering wheel is not turned, almost all hydraulic oil from steering pump (1) is sent to the loading line by the action of the flow control spool in priority valve (15).

Oil returns from steering cylinders (8) flows through orbitrol® (14) and returns to the hydraulic tank.

Finally it returns to the tank through return filter (12).

Hydraulic pump principle

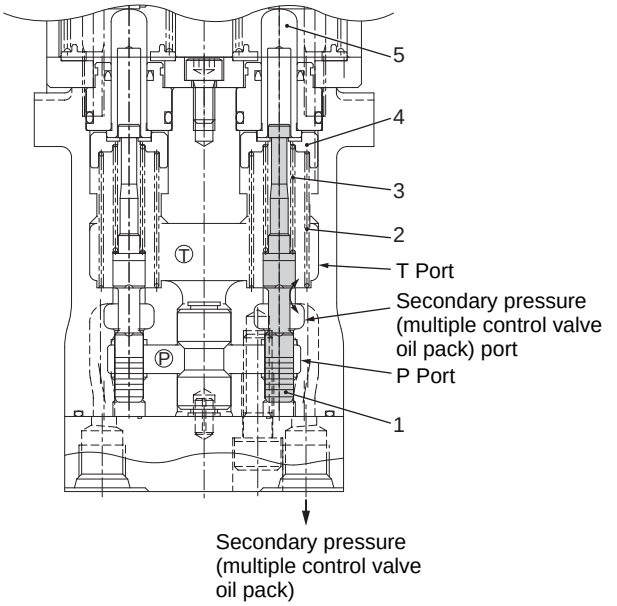


95ZV42040

The oil at the inlet area is taken in the cavities between the gear teeth right after disengagement and transferred towards the outlet area enclosed in between the teeth and the gear casing.

When the gear teeth mesh again, the oil is extruded out of the tooth cavities and forwarded to the outlet.

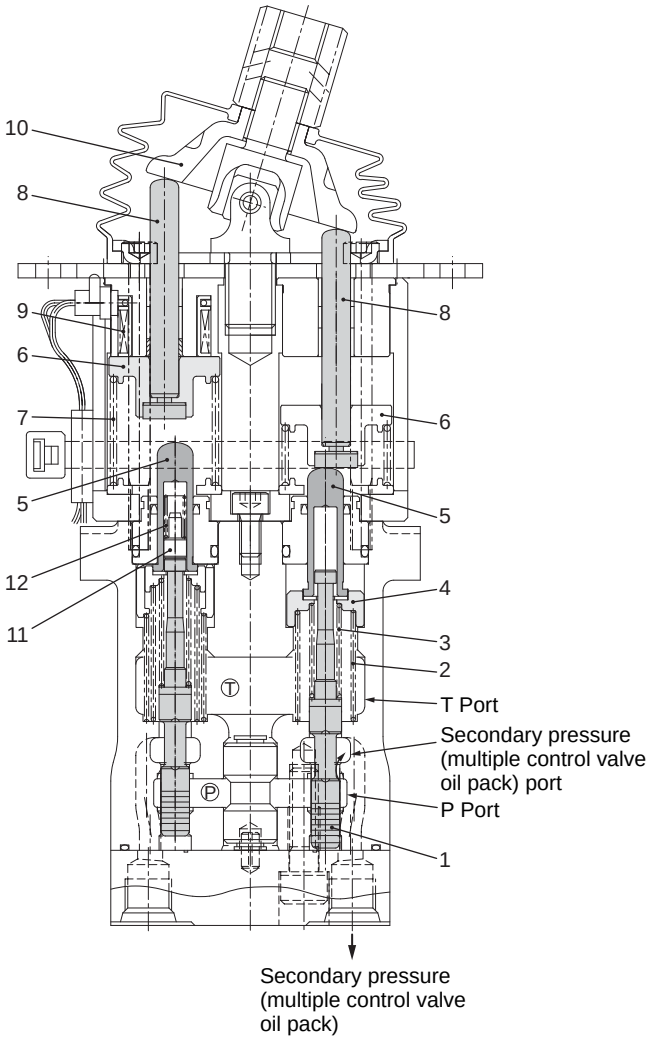
Pilot valve operation



50ZV42016

- When the lever is in the neutral position

  When the lever [disk (10)] is in the neutral position, spool (1) closes the pump port, and the secondary pressure (multiple control valve oil pack) port is opened to the tank port. Therefore the multiple control valve is held in neutral.
  At this time, inner pressure 78.5 kPa (0.8 kgf/cm^2) (11.4 psi) in the hydraulic tank is applied to the multiple control valve oil pack, but the spool does not move because the operating starting pressure for the multiple spool is 0.32 MPa (3.26 kgf/cm^2) (47 psi).

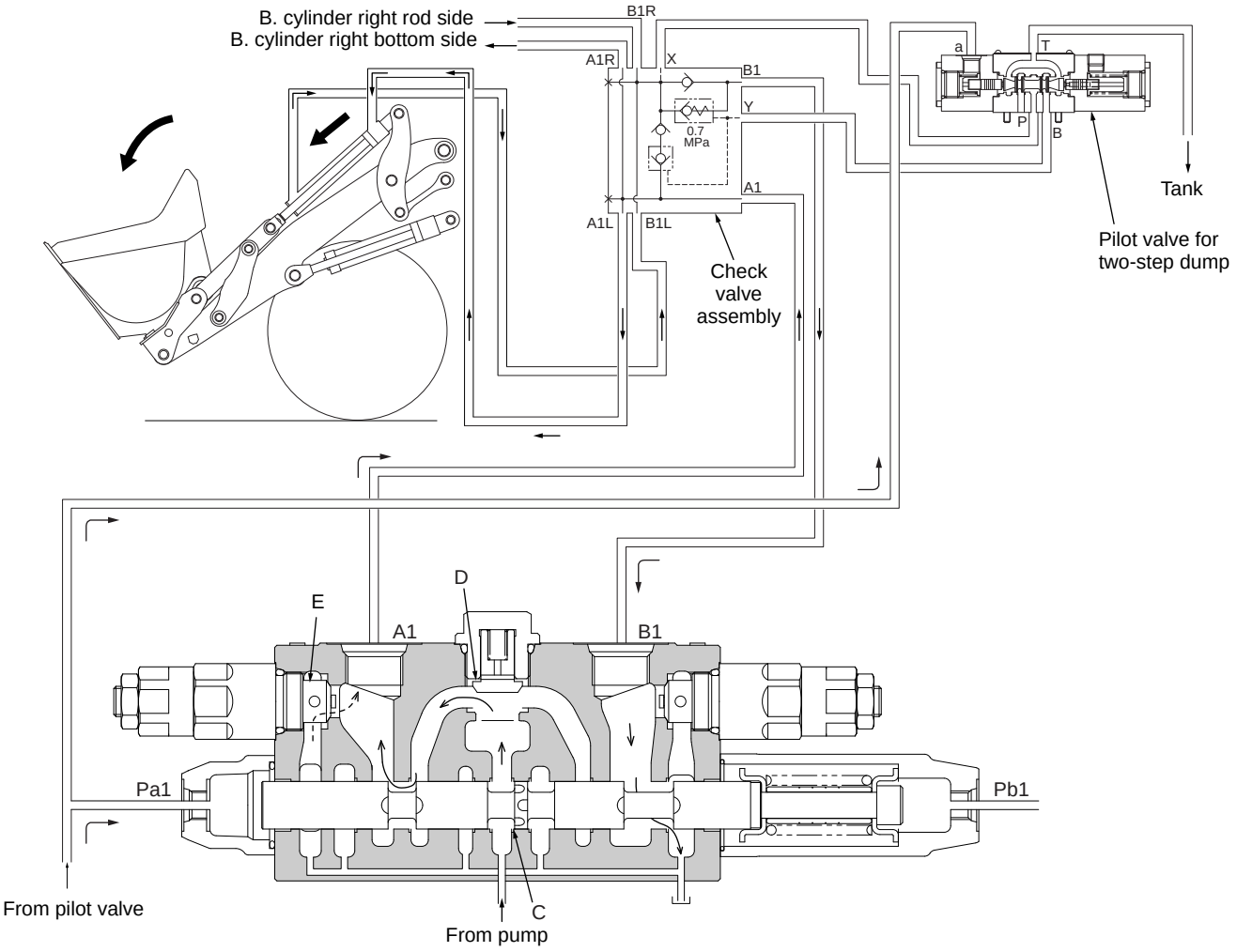


50ZV42017

- When the lever is operated

  When the lever is moved from the neutral, push rod (8) in the detent magnet unit, push rod (5) in the reducing valve unit and spring seat (4) are forced down by disc (10).
  Spool (1) is forced down by spring (3). Then, the tank port is closed and the pump port is opened.
  As a result, the pressurized oil from the pump flows into the secondary pressure (multiple control valve oil pressure) port. Then, the spool of the multiple control valve is moved.

2. "Bucket Dump" position



65T2U42005

- When the control lever is set to the "Bucket Dump" position, the pilot pressure is applied on left oil pack (Pa1), the spool moves to the right, and spool shoulder (C) closes the center bypass line. As a result, the oil from the pump opens load check valve (D), flows from the A1 port, through the check valve assembly, into the bottom side of the bucket cylinder, and finally dumps the bucket.

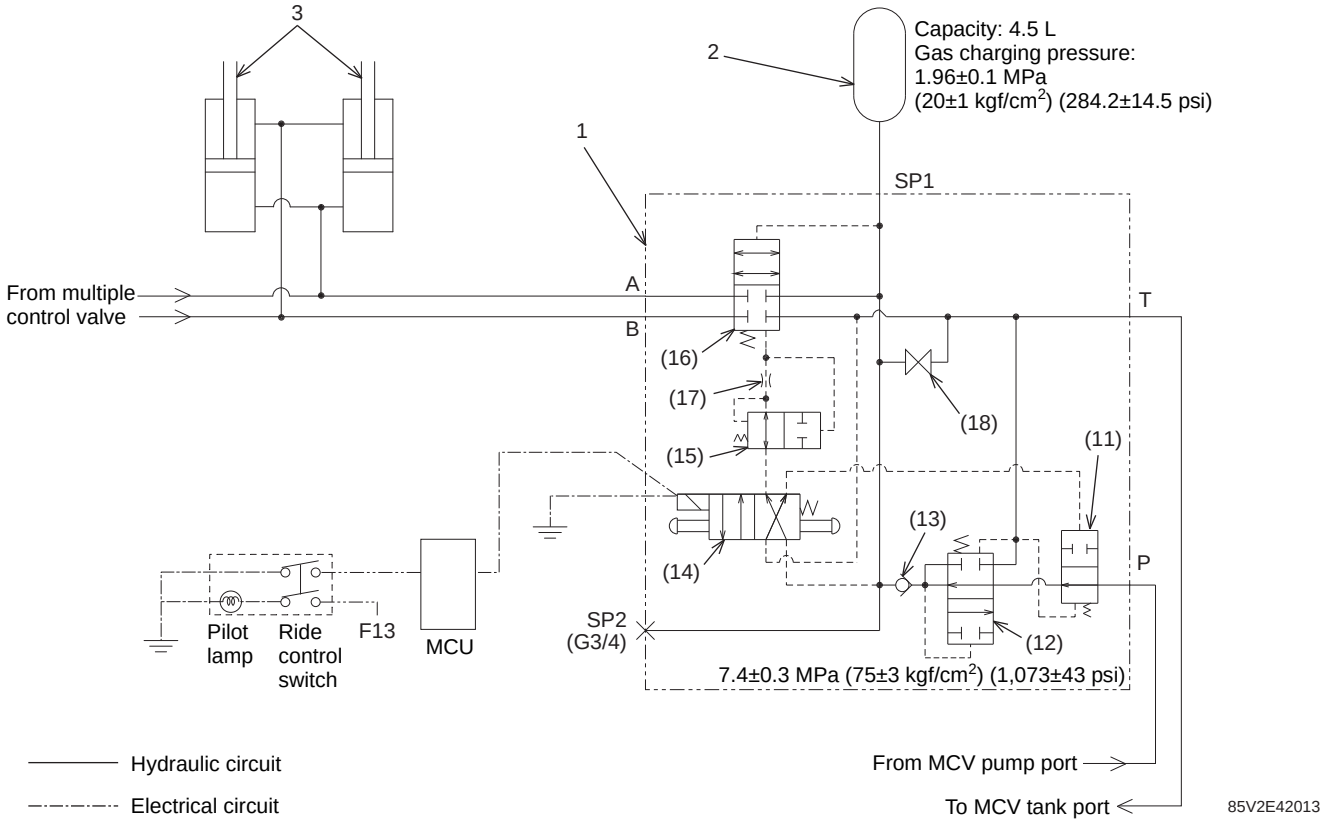
- On the other hand, the oil on the rod side of the bucket cylinder returns from the B1 port, through the check valve assembly, to the tank.

- When the pilot pressure is more than 2.0 MPa (284 psi) by operation of the control lever, the spool of the pilot valve for two-step dump is switched. As a result, the return oil on the rod side flows into the bottom side through the check valve assembly, and dump speed increases.

- Extremely quick dumping generates negative pressure (or a void) on the bottom side. To prevent generation of negative pressure (or a void), make-up valve (E) of the overload relief valve opens so that the oil in the tank port flows into the bottom side of the cylinder.

Ride control operation

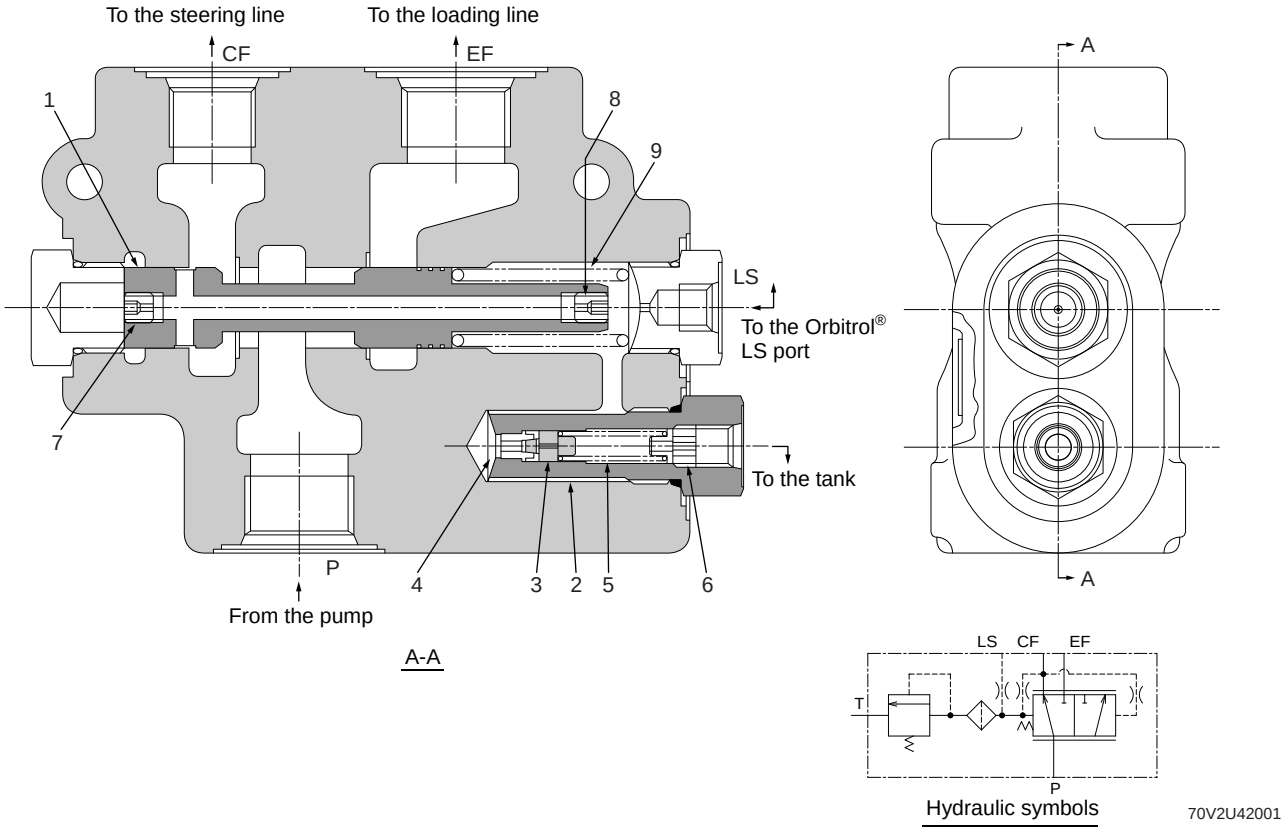
Preparation mode (ride control switch is OFF)



The oil from the pump is reduced to 7.4 MPa (75 kgf/cm^2) (1,073 psi) by reducing valve (12) through charge switching spool (11). The oil flows into accumulator (2) through check valve (13), and also flows into the lower part of main spool (16) through solenoid valve (14), flow control spool (15) and orifice (17).

Although the accumulator pressure applies to the upper part of main spool (16), the main spool is being kept by spring force at the lower part. In this condition, the ride control does not work because the both ports of the boom cylinder are closed.

Priority Valve



A-A

Hydraulic symbols

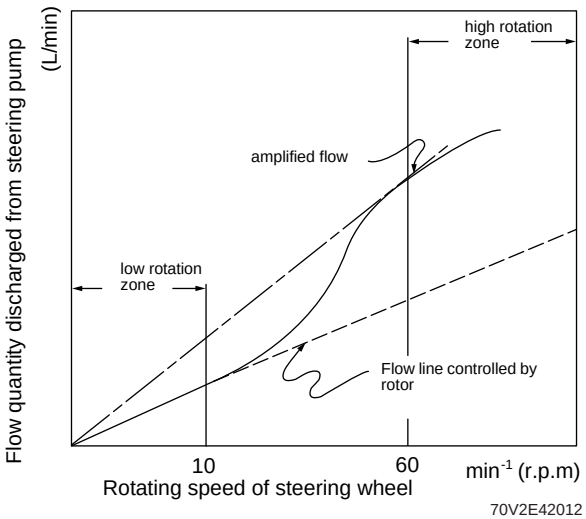
1. Spool
2. Relief valve assy
3. Poppet
4. Screen
5. Spring
6. Adjusting screw
7. Orifice
8. Orifice
9. Spring

Model	VLE61C210DPB
Maximum input pressure	20.6 MPa (210 kgf/cm^2) (2,986 psi)
Rated flow	150 L/min
Control pressure	1.0 MPa (10.3 kgf/cm^2) (142 psi)
Steering relief pressure	20.6 MPa (210 kgf/cm^2) (2,986 psi)

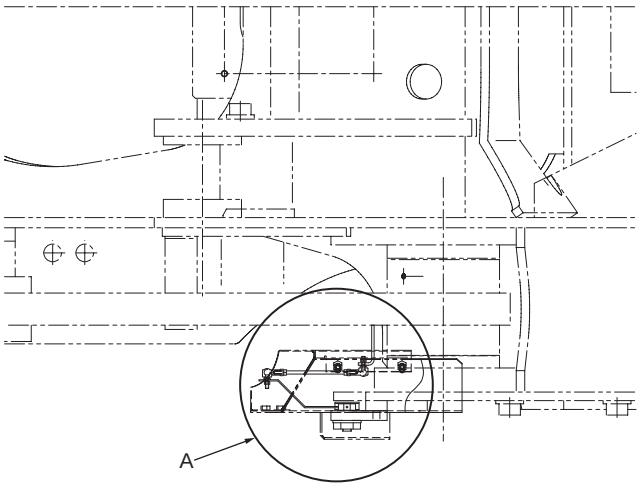
Oil flow change when Q/Amp. is operated

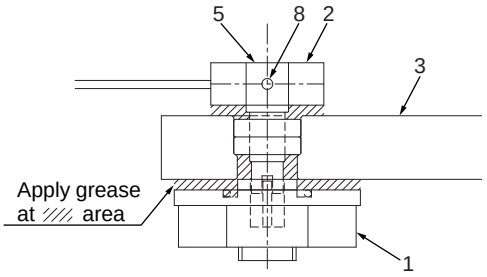
- When the rotating speed of steering wheel is 10 min^{-1} or less at the low rotation zone as we say, the discharge of this Orbitrol® is largely similar to conventional one. But when the rotating speed exceeds 10 min^{-1} until 60 min^{-1}, the oil flow is amplified in proportion to the rotating speed of the steering wheel.

- When it exceeds 60 min^{-1} at the high rotation zone as we say, the flow is amplified and increase to twice its amount.

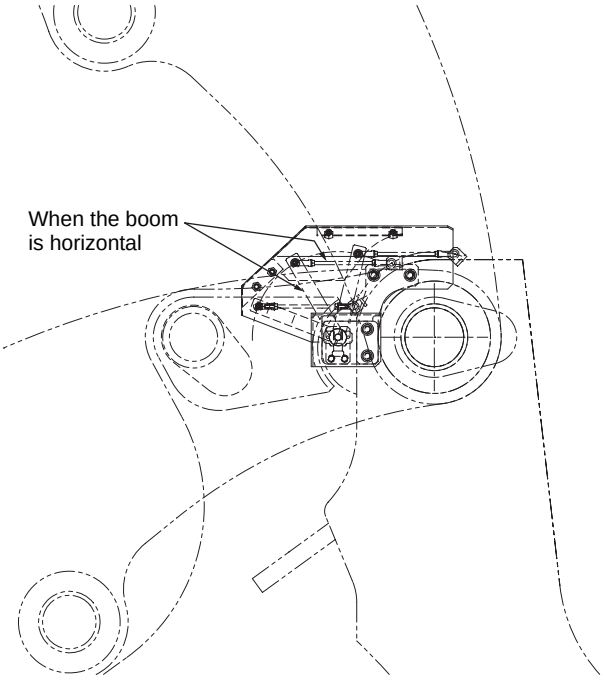


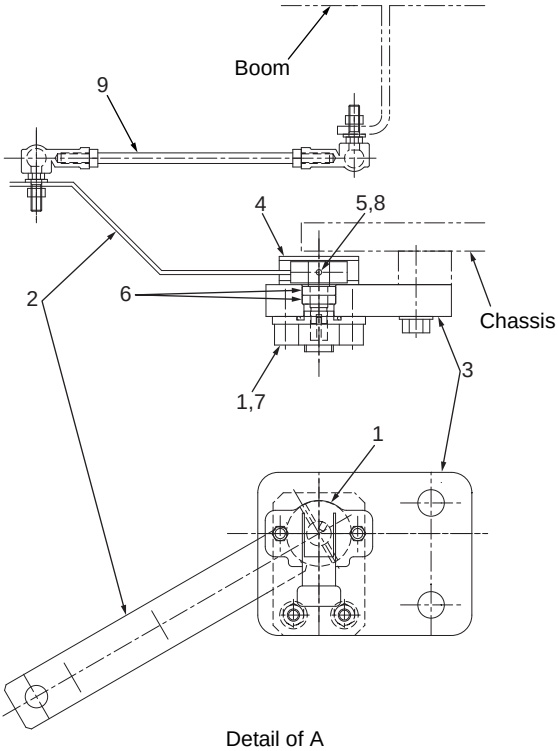
Mounting of the variable kickout sensor





Detail of grease applying



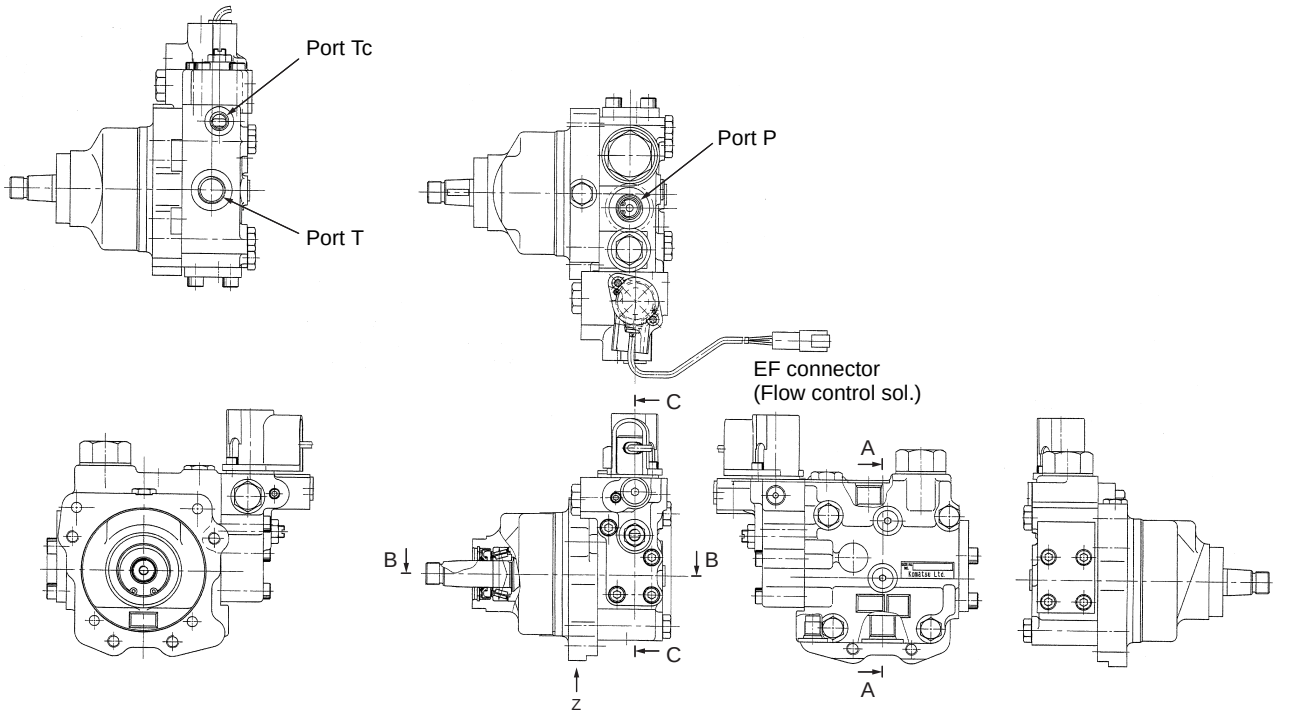


Detail of A

85V2E42056

1. The variable kickout sensor
2. Link
3. Plate
4. Plate
5. Shaft
6. Ball bearing
7. O-ring
8. Spring pin
9. Rod

Fan motor (S/N 4001~4030)

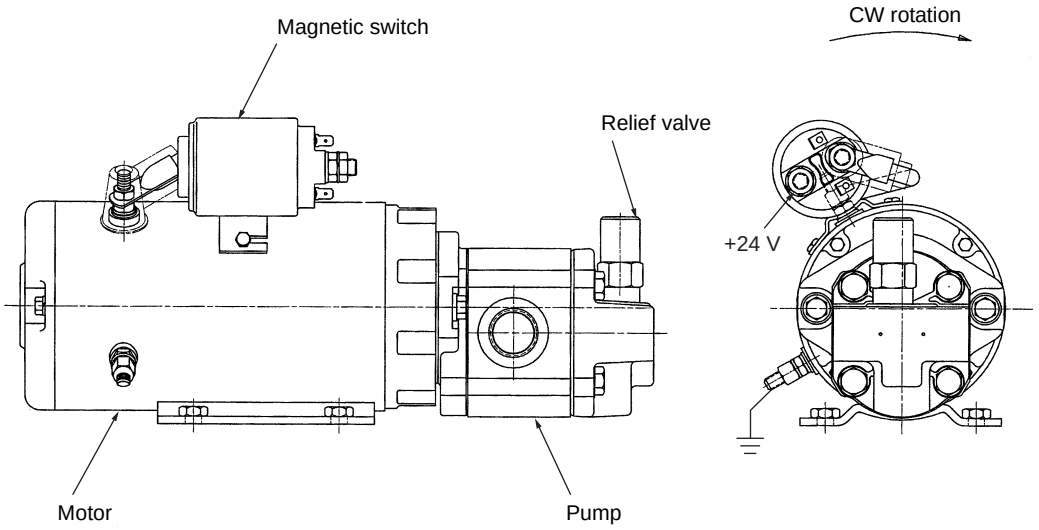


Note
For normal rotation only.

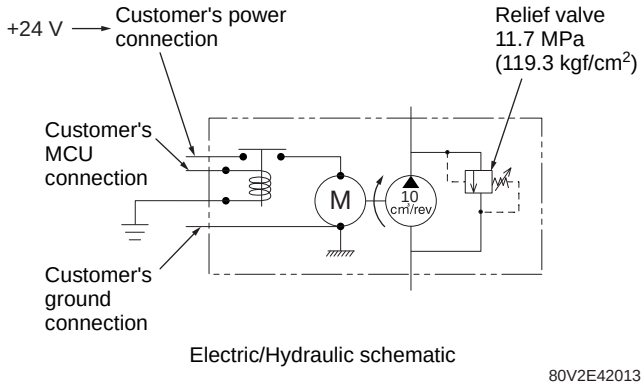
Fan motor specifications

Displacement capacity		16±1 cm^3/rev (1.0 in^3/rev)
Rating	Pressure	14.2 MPa (145 kgf/cm^2) (2,060 psi)
	Speed	1,600 min^{-1}
	Flow	25.6 L/min (6.7 gal/min)
Speed control	Control method	Continuous variable control with solenoid valve

Secondary steering motor and pump



85V2E42052



Electric/Hydraulic schematic

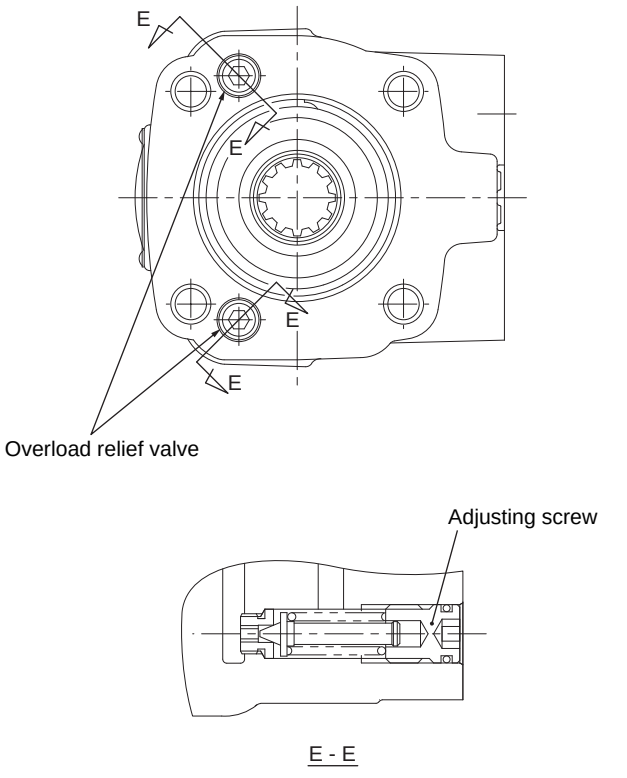
80V2E42013

Secondary steering motor and pump

Model	Haldex 11183G00
Discharge (cm^3/rev)	10
Relief valve setting pressure MPa (kgf/cm^2) (psi)	11.7 (119.3) (1,696)

Measuring steering circuit overload relief pressure

Orbitrol®



1. Attach the pressure gauge to the port ((1) for the left turn, (2) for the right turn).

2. Adjust the main relief valve pressure to 25.5 MPa (260 kgf/cm^2) (3,697 psi) + 1/4 additional turn, so the pressure is above the overload relief pressure.

3. Steer the machine until the front and rear chassis contact each other. Continue to hold the steering wheel fully turned.

4. Keep the engine speed at low idle, and measure and record the pressure.
   Raise the engine speed to 1,000 min^{-1} if fail to do.

Adjusting overload relief pressure

The pressure is adjusted by the overload relief valve on the orbitrol®.
Turn clockwise the adjusting screw to raise the steering line overload relief pressure.

Note
It is not possible to adjust the overload relief pressure if the orbitrol® is removed.

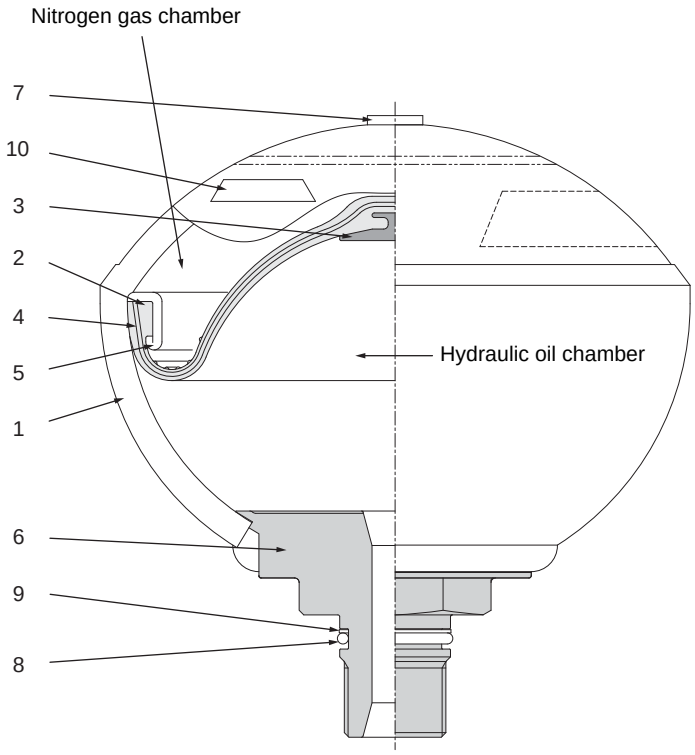
⚠ WARNING

If the machine begins to move with the articulation stopper applied, it may cause an accident resulting in injury or death.
After the measurement, be sure to disconnect and store the articulation stopper.

IMPORTANT

At the completion of check and adjustment of overload relief valve pressure, be sure to reset the main relief valve to the original condition.

Accumulator



65ZV52005

1. Shell
2. Bladder
3. Poppet
4. Film
5. Holder
6. Oil port
7. Gas plug
8. O-ring
9. Back-up ring
10. Label

The accumulator holds a reserve of pressurized oil for the brake circuit prevent disability of the brakes caused by a problem with the pump, etc. Two accumulators are provided in the service brake line. Nitrogen gas at 2.94 MPa (30 kgf/cm^2) (427 psi) is charged in the gas chamber.

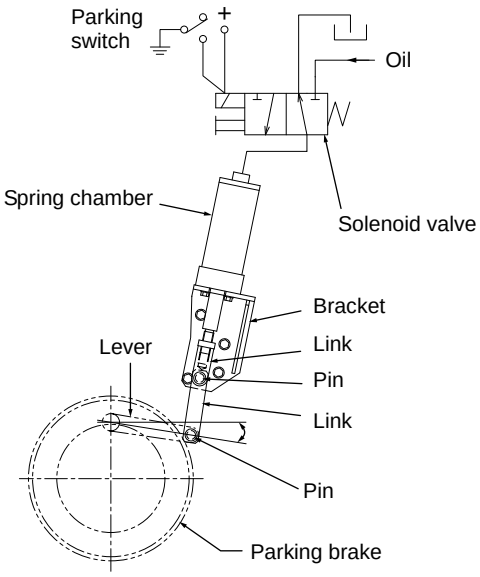
⚠ WARNING

Never weld on or near gas charged accumulator. Serious injury may result.
When disposing, wear protective glasses and loosen plug to release gas in the accumulator completely. Do not remove plug.

Accumulator specifications

Maximum operating pressure MPa (kgf/cm^2) (psi)	11.8±0.5 (120±5) (1,706±71)
Nitrogen gas charging pressure MPa (kgf/cm^2) (psi)	2.94±0.1 (30±1) (427±14)
Nitrogen gas capacity L (gal)	0.5 (0.132)

Parking brake operation



70ZV52018

Turning on (pulling out) the parking switch turns off the power of the solenoid valve (shown in the figure). Oil is discharged from the spring chamber to the tank, and the spring in the spring chamber pulls parking brake lever (6).

Since lever (6) is connected to cam shaft (5), the cam shaft rotates when the lever is pulled up. The rotation of the cam shaft causes the shoes on both sides of the cam to expand. As a result, the rotating brake drum is stopped.

Operation chart parking brake

Parking switch	ON	OFF
Solenoid valve	Power-off	Power-on
Spring chamber	Oil discharge	Oil feeding
Parking brake	Braking	Released

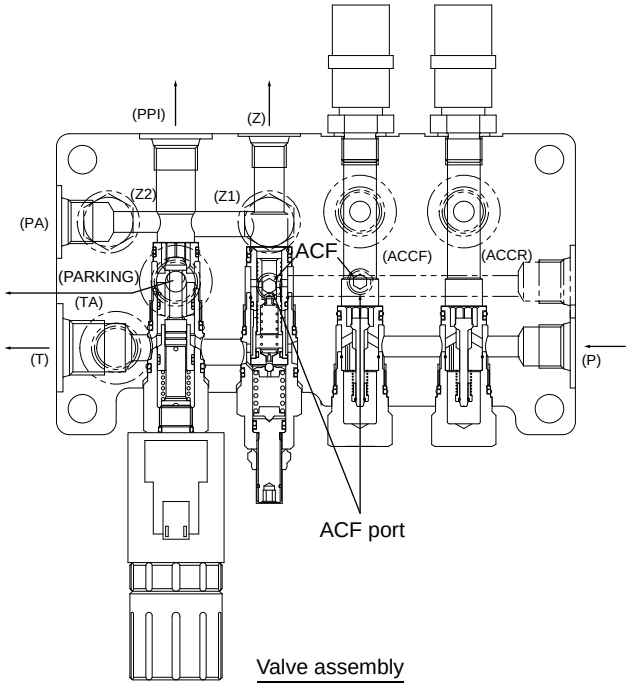
Brake Circuit Oil Pressure

⚠ WARNING

Unexpected movement of the machine may cause an accident resulting in injury or death. Therefore, to provide repair service with the engine running, be sure to observe the following items:

- Park the machine on level ground.
- Apply the parking brake.
- Block the tires with chocks to prevent the tires from moving.
- Determine the signals between the service men.

Unloader valve setting pressure



85V2E53001

⚠WARNING

Injection Hazard
Depress brake pedal 80~100 times to completely discharge the brake accumulators prior to removing these test plugs.

135ZV52035

Brake line main pressure is regulated by the unloader valve.

MEMO

Neutral starter

To prevent the machine from unexpected movement at engine start up, the machine is so designed that the engine can start only while the shift lever is in the neutral (N) position.

Shift lever neutral (N) position

When the starter switch is turned to the ON position while the shift lever is located in the N position, the coil actuation circuit of the neutral relay is connected to the ground of the MCU unit and the contact of the neutral relay is switched over to ON.

When the starter switch is turned to the START position, the start command current flows from the starter switch terminal C to the safety relay via the neutral relay. As a result, the starting current flows in the starter motor, and the engine starts.

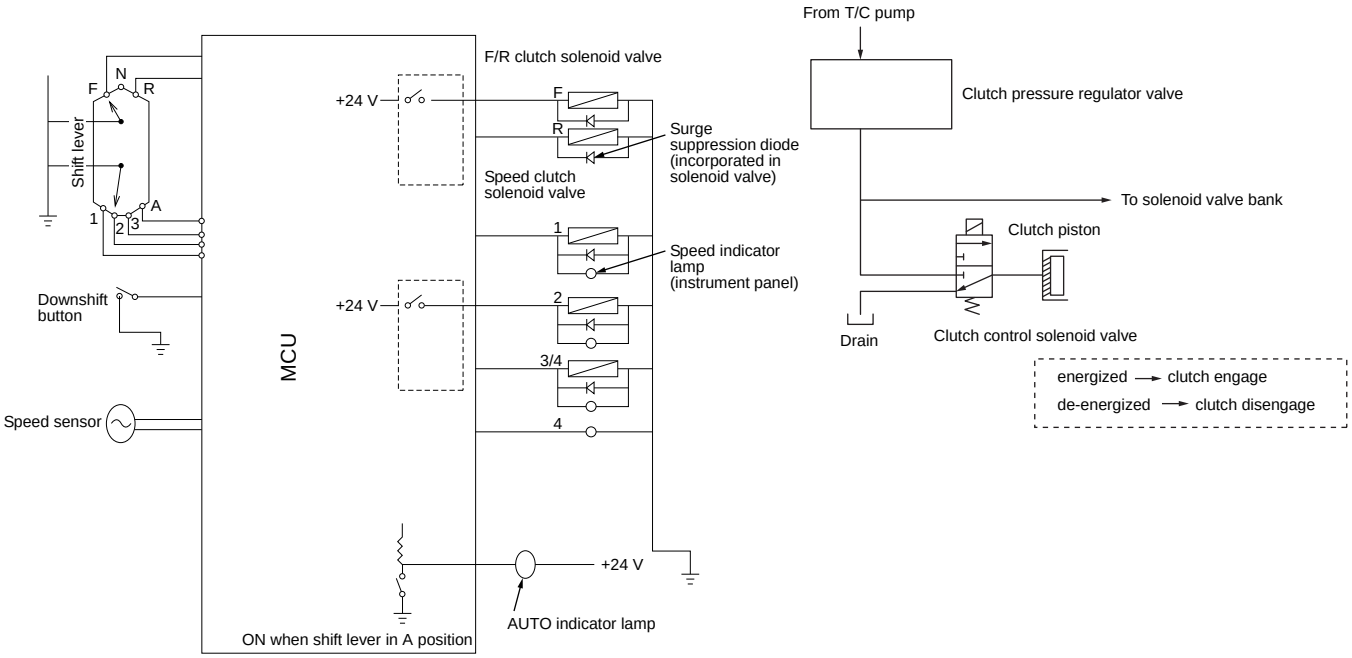
Shift lever forward/reverse (F/R) position

While the shift lever is located in the F or R position, the power is not supplied to the neutral relay coil, and the main contact is OFF. As a result, the starting current from the starter switch terminal C does not flow in the safety relay, and the engine does not start.

DTC LAMP	Error
336 Red	Crank sensor fault
340 Red	Cam sensor (G sensor) fault
341 Red	Cam sensor (G sensor) fault
380 Red	Glow relay fault
381 Red	Glow plug lamp circuit fault
487 Red	EGR position fault (Brushless specification)
488 Red	EGR valve control fault
522 Red	Engine oil pressure sensor fault (low voltage fault)
523 Red	Engine oil pressure sensor fault (high voltage fault)
601 Red	ROM fault
603 Red	EEPROM fault
606 Red	CPU fault
611 Red	Charge circuit fault (bank 1)
612 Red	Charge circuit fault (bank 2)
650 Red	Diag. lamp circuit fault
1093 Red	No pump pressure feed (fuel leakage)
1095 Red	Pressure limiter is opened
1112 Red	Boost temperature sensor fault (low voltage fault)
1113 Red	Boost temperature sensor fault (high voltage fault)
1173 Red	Overheat
1261 Red	Injection nozzle common 1 drive system fault
1262 Red	Injection nozzle common 2 drive system fault
1271	Accelerator sensor 1-2 comparison fault
1277	Accelerator sensor 1 fault (low voltage fault)
1278	Accelerator sensor 1 fault (high voltage fault)
1282	Accelerator sensor 2 fault (low voltage fault)
1283	Accelerator sensor 2 fault (high voltage fault)
1294 Red	Fuel filter sensor fault (high voltage fault, short circuit, ground disconnection)
1345 Red	Cam sensor out of phase

Machine control unit (MCU) function

Forward/reverse (F/R) shifting and speed change



65V2E62007

Each clutch has one solenoid valve for transmission control. When electric current flows through the solenoid valve, the clutch oil is fed into the clutch piston chamber. When the piston operates, the clutch is engaged. When the current stops flowing through the solenoid valve, the oil is drained from the clutch piston chamber, and the clutch is disengaged.

The solenoid valve for the 4th speed clutch is not installed on the transmission.
When the current stops flowing to all solenoid valve for the 1st, 2nd and 3rd clutches, the transmission is automatically engaged to the 4th speed.

Input detection

When the shift lever is set to the F (forward) position, electric current for input detection signal is sent from the MCU to the grounding circuit via shift lever contact F. The MCU, therefore, judges that the shift lever is set to the F (forward) position. On the other hand, there is no shift lever contact for the R (reverse) input circuit and no electric current will flow to the ground circuit.

For the speed change, the MCU judges the set speed position of the shift lever in the same way as described above.

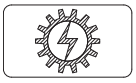
Operation error preventive function (Simultaneous input of two or more commands)

If both the forward and reverse commands are input at the same time due to a problem, the forward and reverse clutches will not function. In addition, if two or more speed commands are input at the same time, the machine will stay engage in the gear just before the shift lever stuck and still move with it's gear selection.

When the starter switch is at OFF position, if both the forward and reverse commands are input at the same time due to a problem, the engine does not start even if the starter switch is placed in the start position. This is because the neutral relay does not work.

Machine control unit (MCU) failure warning

Should the MCU stop working due to the following cause, a dash mounted monitor lamp lights up to give warning.

MCU failure monitor lamp 

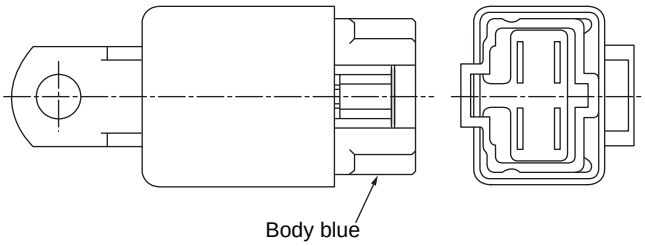
If a warning is given as a result of self-diagnosis of the MCU

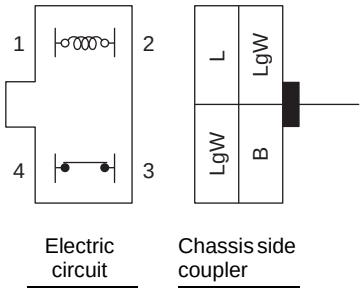
The MCU has a self-diagnosis function incorporated in it, and if the computer program becomes abnormal due to abuse or defect, a dangerous condition may occur, the monitor lamp lights up and all the outputs from the MCU are turned OFF.

MCU replacement

If the monitor lamp lights up under the cause above, it is an indication that the MCU's program has malfunctioned and the MCU assembly must be replaced.

When installing a new MCU on the machine, all specifications must be registered into the MCU through the MODM.





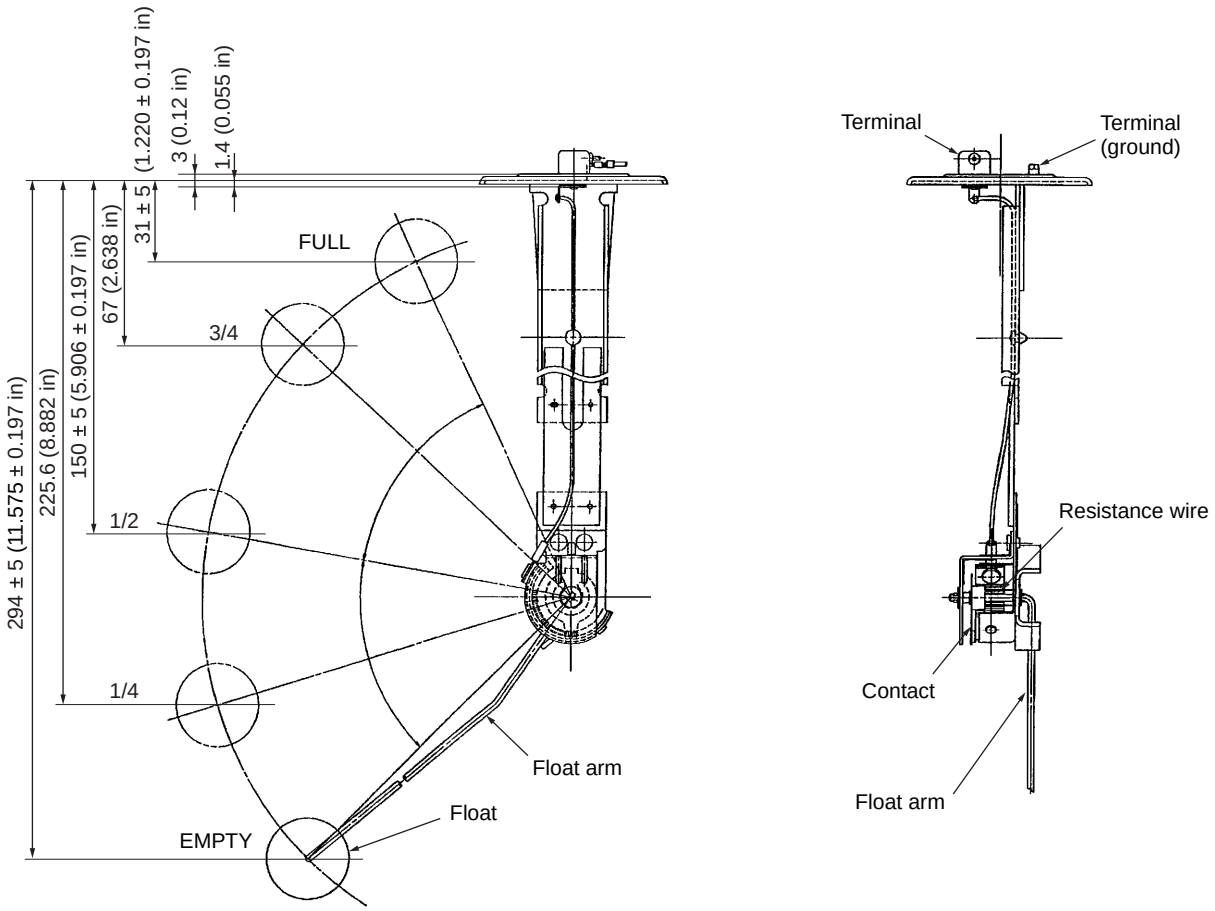
85V2E62030

Rating	DC 24 V
Operation voltage	16 V or less
Reset voltage	2.4 V or more
Coil resistance	320 Ω

MCU fault relay (Normally closed)

Fuel level sensor

(S/N 4001~4030)



65ZV62023

Replacement Monitor

(Refer to page 92-62)

Replacement time check

1. Engine oil filter

Press both the [(step forward)] and [(step back)] buttons simultaneously to change over the screen from the information monitor to the replacement monitor.

90ZV-262034

You will now be at the screen shown above.

The display window first displays the remaining time until next replacement of the engine oil filter cartridge.

This interval is based on using low sulfur fuel and when engine oil sulfur content is less than 0.5 %. If engine oil sulfur content exceeds 0.5 %, this interval must be cut in half.

Note
If an exclamation mark shows before the numbers that indicate hours, this shows how many hours overdue the filter is.

Ex. **"!12 h"** indicates that it is 12 hours overdue.

80V2U62079

Note
Make sure to set the replacement interval (timer reset) whenever the engine oil filter is replaced.

2. Fuel filter

Press the [(step forward)] button and release.

80V2U62010

You will now be at the screen shown above.

The display window displays remaining time until next replacement of fuel filter cartridge.

Note
If an exclamation mark shows before the numbers that indicate hours, this shows how many hours overdue the filter is.

Ex. **"!12 h"** indicates that it is 12 hours overdue.

70V2U62018

Note
Make sure to set the replacement interval (timer reset) whenever the fuel filter is replaced.

It may be necessary to change this filter more frequently, depending on fuel cleanness.

Failure code (Input side)

Code	Failure	Detection condition (In case of)
CN121	Shift lever F & R switch malfunction	Shift lever F & R contact ON at the same time Failure continues for more than 3 seconds
CN122	Shift lever 1•2•3•A switch malfunction (1)	Shift lever any of more than two 1•2•3•A contact ON at the same time Failure continues for more than 3 seconds (30 seconds from program ver. 100915).
CN123	Shift lever 1•2•3•A switch malfunction (2)	All 1•2•3•A signal OFF continues for more than 3 seconds (30 seconds from program ver. 100915).
CN141	Shift-up switch malfunction	Switch is ON for more than 10 seconds
CN142	Shift-down switch malfunction	Switch is ON for more than 10 seconds
CN143	Shift-up switch & shift-down switch malfunction	Shift-up switch & shift-down switch contact ON at the same time Failure continues for more than 3 seconds
CN145	Kick-down switch malfunction	Switch is ON for more than 10 seconds
CN146	Shift hold switch malfunction	Switch is ON for more than 10 seconds
CN151	T/M oil pressure switch malfunction (This applies to the model 115ZV-2/135ZV-2 only)	Signal OFF continues for more than 10 seconds during engine running
CN152	T/M oil pressure sensor malfunction (This applies to the model 95ZV-2 only)	T/M pressure below 294 kPa (3.0 kgf/cm^2) (43 psi) continues for more than 10 seconds during engine running
CN161	Machine speed sensor malfunction (1)	Input circuit is disconnected for more than 3 seconds
CN162	Machine speed sensor malfunction (2)	Input value is over 70 km/h (44 mile/h) for more than 3 seconds
CN163	E/G speed sensor 1 (ECM output) malfunction (1)	No E/G speed sensor input for more than 3 seconds when E/G speed sensor selection is OFF (Input circuit is disconnected)
CN164	E/G speed sensor 1 (ECM output) malfunction (2)	Input value is more than 3,000 min^{-1} for more than 3 seconds when E/G speed sensor selection is OFF
CN165	E/G speed sensor 2 (Sensor output) malfunction (1)	No E/G speed sensor input for more than 3 seconds when E/G speed sensor selection is ON (Input circuit is disconnected)
CN167	E/G speed sensor 2 (Sensor output) malfunction (2)	Input value is more than 3,000 min^{-1} for more than 3 seconds when E/G speed sensor selection is ON
CN213	Inching sensor malfunction (1)	Voltage is lower than 0.2 V for more than 3 seconds
CN214	Inching sensor malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN232	S/S potentiometer malfunction (1)	Voltage is lower than 0.1 V for more than 3 seconds
CN234	S/S potentiometer malfunction (2)	Voltage is larger than 4.9 V for more than 3 seconds
CN236	S/S shift switch (F & R contact) malfunction	Failure continues for more than 3 seconds
CN251	Secondary steering oil pressure sensor malfunction(1)	Voltage is lower than 0.2 V for more than 3 seconds
CN252	Secondary steering oil pressure sensor malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN254	Low secondary steering oil pressure	Oil pressure sensor detects secondary steering oil pressure below 306 kPa (3.1 kgf/cm^2) (44 psi) for more than 3 seconds during engine running
CN262	Kickout potentiometer malfunction (1)	Voltage is lower than 0.2 V for more than 3 seconds
CN263	Kickout potentiometer malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN271	Efficient loading system hydraulic oil pressure sensor malfunction (1)	Voltage is lower than 0.2 V for more than 3 seconds
CN272	Efficient loading system hydraulic oil pressure sensor malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN312	Brake oil pressure sensor 1 malfunction (1)	Voltage is lower than 0.2 V for more than 3 seconds
CN313	Brake oil pressure sensor 1 malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN315	Brake oil pressure sensor 2 malfunction (1)	Voltage is lower than 0.2 V for more than 3 seconds
CN316	Brake oil pressure sensor 2 malfunction (2)	Voltage is larger than 4.6 V for more than 3 seconds
CN321	E/G coolant temperature sensor malfunction (1)	Input voltage is larger than 3.56 V for more than 3 seconds
CN323	E/G coolant temperature sensor malfunction (2)	Input voltage is lower than 0.263 V for more than 3 seconds
CN341	T/M oil temperature sensor malfunction (1)	Input voltage is larger than 3.56 V for more than 3 seconds
CN342	T/M oil temperature sensor malfunction (2)	Input voltage is lower than 0.263 V for more than 3 seconds

6. K-Lever (stick steering) (80ZV-2 ~ 115ZV-2)

Next, by pressing the [⩥ (step forward)] button, the following screen is seen.

80V2U62052

The screen should appear similar to what is shown and indicates the K-Lever voltage.

Note
The default setting for K-Lever is to the "A" type.

The voltage settings are displayed in the MODM monitor display.

Review the following screens that are able to be seen by pressing the [⩥ (step forward)] button. (A setting shown.)

80V2U62053

80V2U62054

V=Voltage

The screen should appear similar to what is shown and indicates the K-Lever mA signal strength or intensity.

Note
The default setting for K-Lever is to the "A" type.

The voltage settings are displayed in the MODM monitor display.

Review the following screens that are able to be seen by pressing the [⩥ (step forward)] button. (A setting shown.)

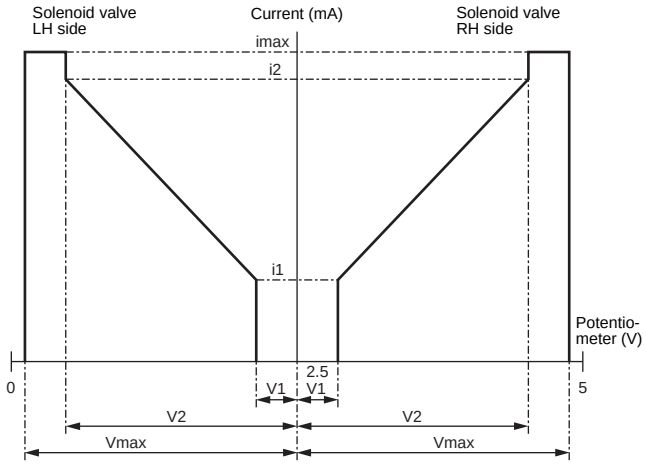
80V2U62055

80V2U62056

80V2U62057

i=Signal intensity (or mA)

A Type



80V2U62077

Initial set values

K-LEVER V1	0.25 V
K-LEVER V2	2.0 V
K-LEVER Vmax	2.4 V
K-LEVER i1	290 mA
K-LEVER i2	450 mA
K-LEVER imax	470 mA

All setting reset procedure (Start at screen shown)

80V2U62075

Press and hold the [◎] button for 2 seconds or more to display the all setting reset execution screen.

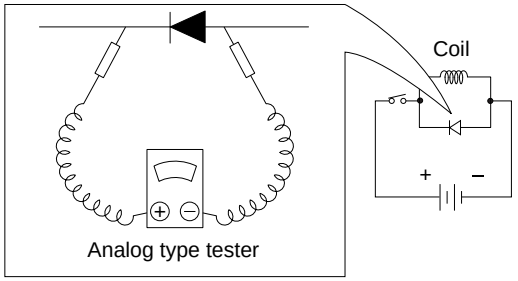
See example below.

80V2U62076

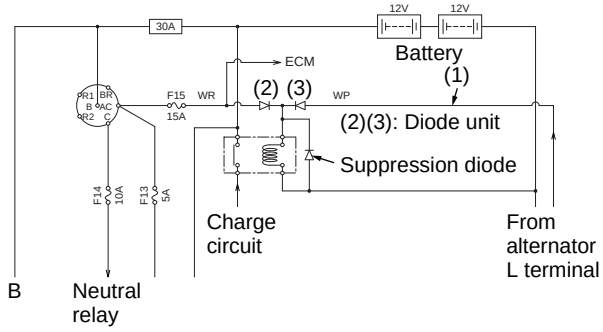
When executing the all setting reset function, press and hold the [◎] button for 2 seconds or more. Then, the all setting reset function is executed, and the specification setting screen appears again.

Press the [✕] button to return to the specification setting screen without executing the all setting reset function.

Diode check method



95ZV62129



65V2E62017

Normal	Continuity is detected in the status shown in the figure. Continuity is not detected when tester terminals are connected in opposite way.	
Abnormal	Continuity is not detected in either way	Disconnection
	Continuity is detected in either way	Short-circuit

Note
When the circuit tester is the digital (number indication) type, exchange the positions of the terminals of the tester during the check. Some solenoid coils contain diodes inside the solenoid coil pack.

Caution for diode check method

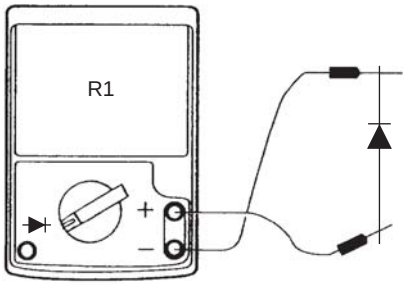
Continuity check mode

When checking the continuity by continuity check mode of volt-ohm-ammeter, only in case that the resistance is about 300 Ω or smaller, the continuity is detected.

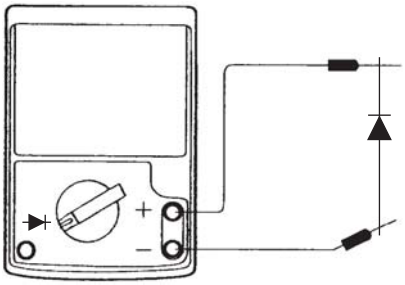
If the continuity check mode of volt-ohm-ammeter is used to check the continuity of diode with 500~600 Ω, no continuity is detected both ways.

Use a volt-ohm-ammeter with diode mode for checking diode continuity.

Diode check mode



Forward check

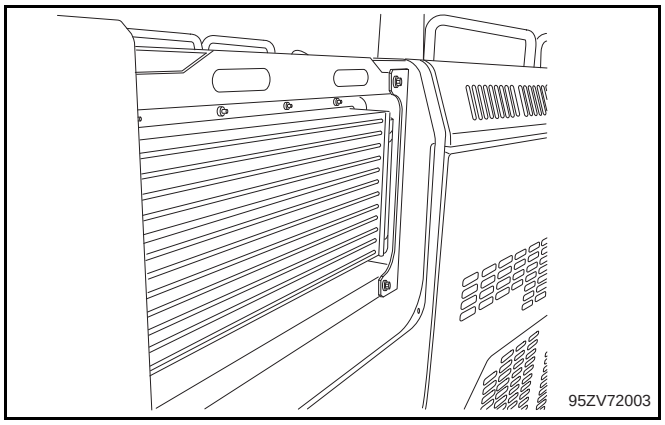


Backward check

85V2E62036

Forward check	Backward check	Judgement
Continuity (voltage value)	Over level	Normal
Over level	Over level	Open circuit
0 volt	0 volt	Short-circuit

Condenser



The condenser transfers heat from hot refrigerant to outside air.

Condenser fans cause the air to flow across the condenser, thus increasing the transfer of heat from the condenser to outside air.

(Drawing above is from the model 95ZV-2. Other models may vary, but are similar in appearance.)

Means by which heat energy changes refrigerant vapor to liquid. The condenser must radiate sufficient heat energy to do this. If obstructed, or not able to transfer heat properly, can cause a buildup of compressor "head pressure" on high side, and pressure sensing switches will disengage the compressor clutch. (Refer to high and low pressure switches later on).

Obstructions to efficiency of condenser are.

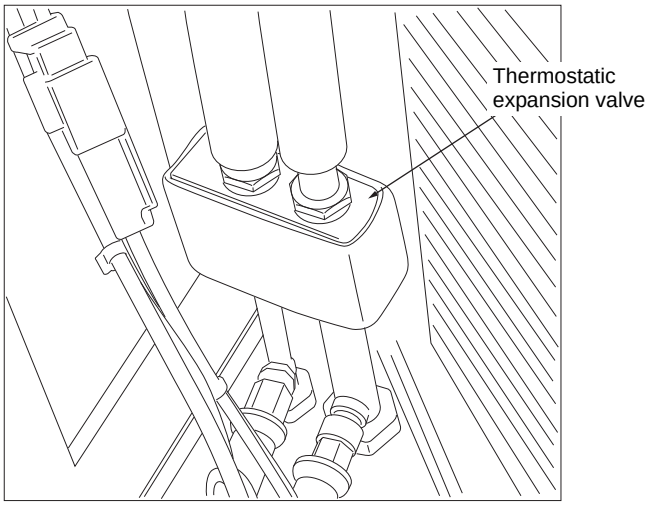
1. Bad fan motors, blades, or connections between these.

2. Obstructions to air flow. Should be free from airflow obstructions and permit a large volume of heat to escape from system. (Leaves, sticks, dirt, etc. Appropriate tooling may be used to remove debris, as a comb tool, or a 90º bent air blower device to clear debris from fins. If a pressure washer is used, care should be taken not to damage condenser fins.)

3. Bent cooling fins. (A comb tool may be used to maintain fins. If a pressure washer is used, care should be taken not to damage condenser fins.)

4. Unclean surfaces cut effectiveness of condenser.

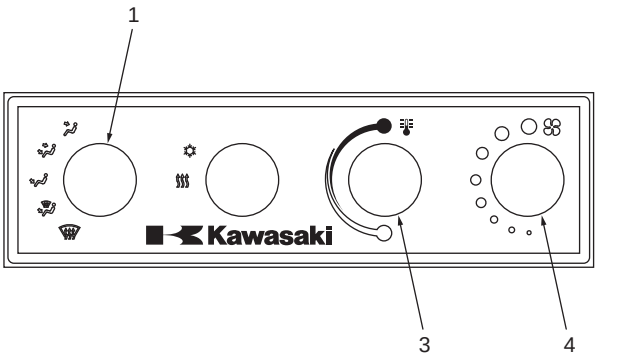
Thermostatic expansion valve



Lowers pressure before the refrigerant enters evaporator. Pressure is reduced by passing refrigerant through orifice. Orifice size is variable, and is controlled to compensate for changes in pressure and temperature. Temperature of the refrigerant at the outlet of the evaporator determines orifice size, and is varied by a gas expansion bulb assembly that moves the orifice valve seat by way of a diaphragm and pin arrangement.

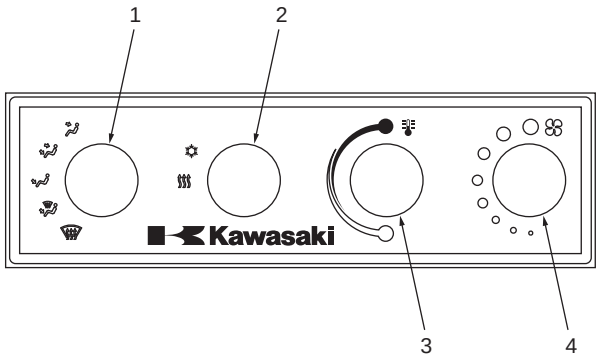
Panel switches

Manual heater control (Heat only)



K95V2U72013

Manual combo control (A/C and Heat)



K90ZV72002

1. Mode control switch

Provides the signal to adjust the mode doors to direct the air flow.

Mode \ Ventilator	Upper	Lower	Window (Defrost)
Panel Mode	Open	Close	Close
Bi-Level Mode	Open	Open	Close
Floor Mode	Close	Open	Close
Mix Mode	Close	Open	Open
Defrost Mode	Close	Close	Open

2. Heat/AC control switch

On the Combo control, it enables/disables the AC function.

- Air conditioner on
- Air conditioner off

3. Temperature control switch

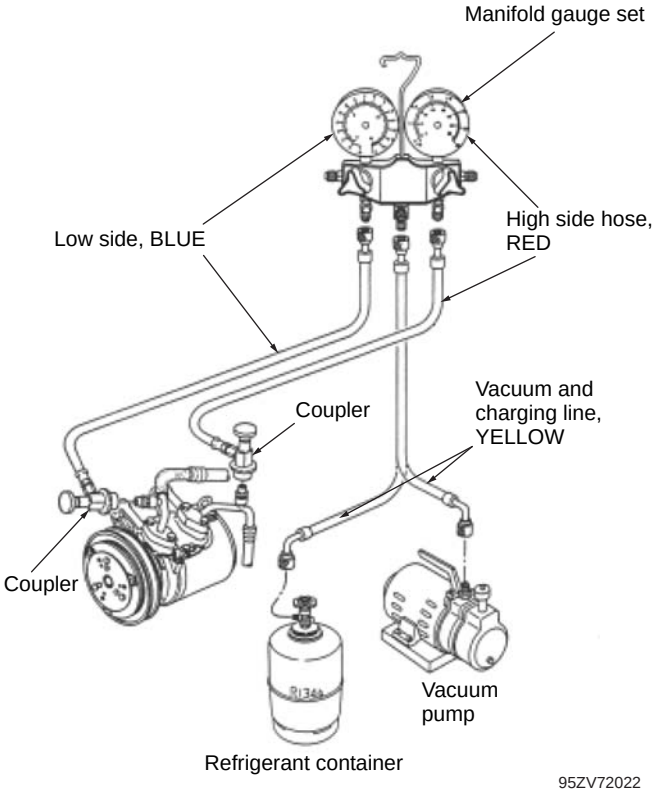
Adjusts the output temperature. This output is used to control the position of the water valve.

4. Blower control switch

Turn the control fully counter clockwise to turn off the blower, or adjust the blower to the desired speed.

Basic tools needed to work on air conditioning

Note that all tools must be compatible with the refrigerant being used. R134a, and R12 tools are NOT interchangeable.
NEVER MIX REFRIGERANTS!

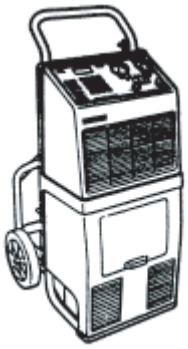


95ZV72022

1. Manifold gauge set.

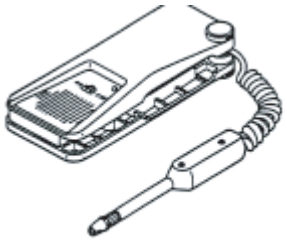
95ZV72023

2. Scale, (capable of accurately measuring an ounce).



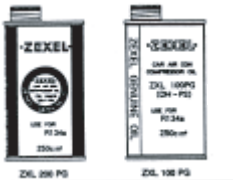
95ZV72024

3. Refrigerant recovery and vacuum unit (must be EPA certified, and refrigerants must not be mixed).



95ZV72025

4. Leak detector for R134a and R-12 gas.

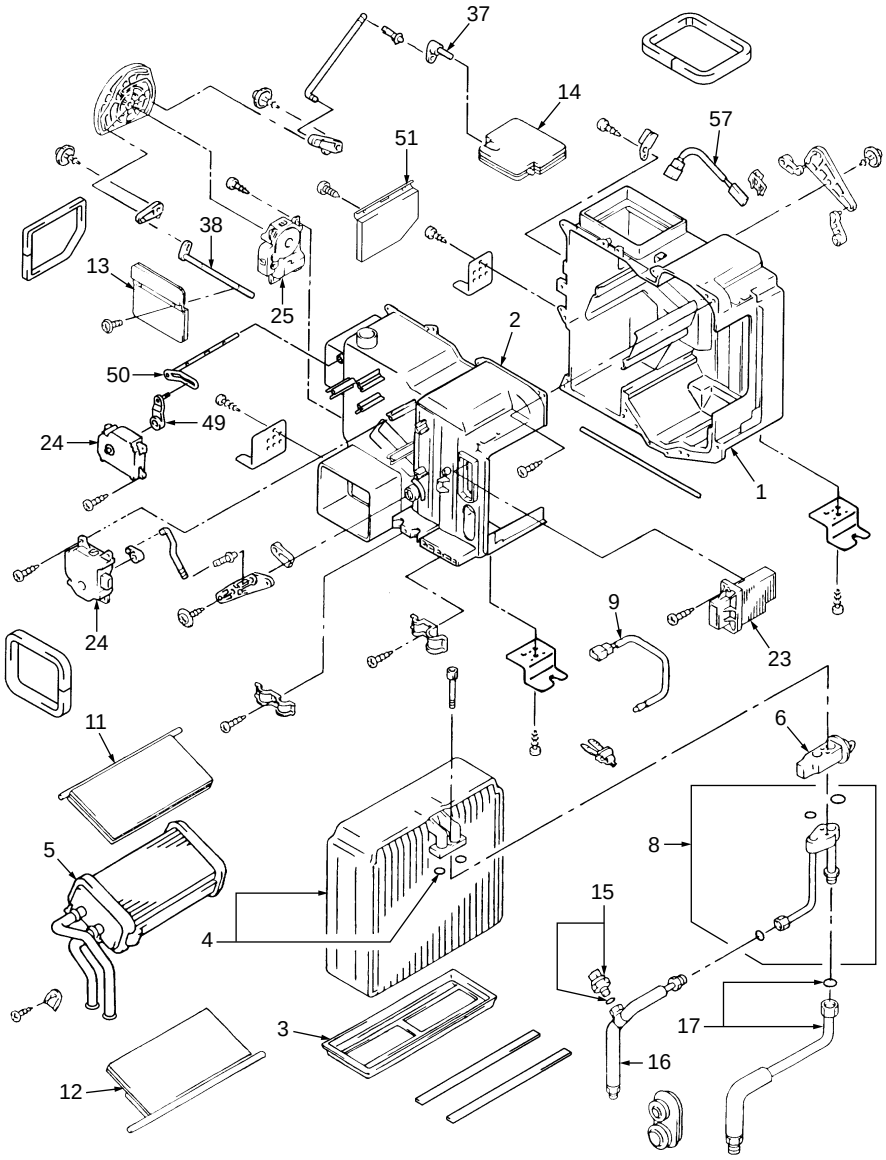


95ZV72026

5. Lubricating oils; Use mineral oil for R-12, PAG oil for R134a.

Denso air conditioner structure

Cooling unit

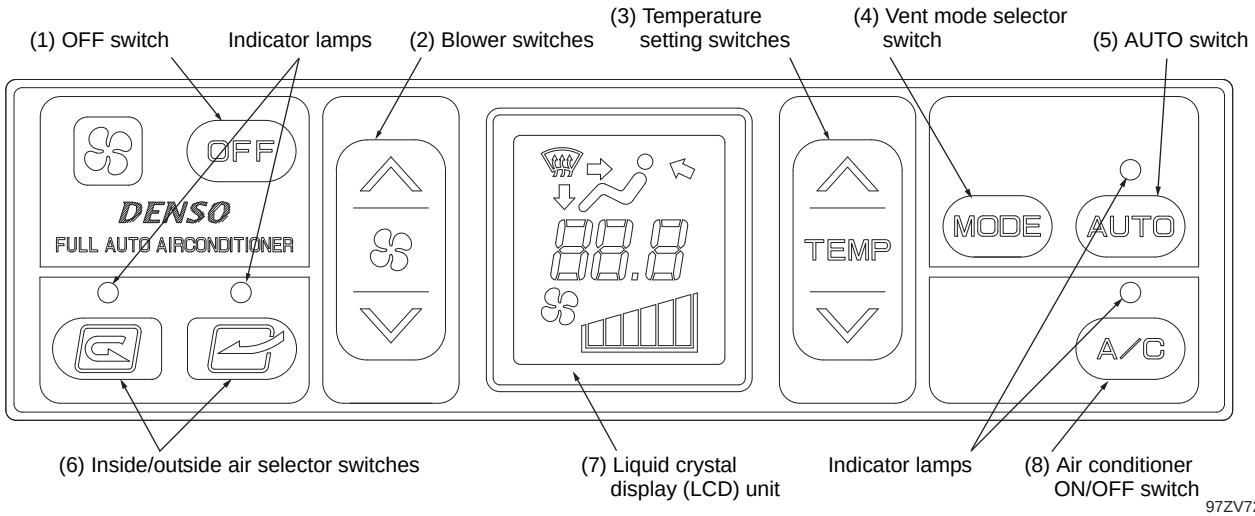


97ZV72021

Air conditioner functions of components

Control panel

Name and function of each part on control panel



- (1) OFF switch

  This switch stops the operation of the blower and the air conditioner.
  When OFF switch (1) is pressed, the set temperature and the air blow quantity displayed on LCD unit (7) as well as the indicator lamps above AUTO switch (5) and air conditioner ON/OFF switch (8) turned "off", and operation is stopped.

- (2) Blower switches

  These switches change over the air flow quantity in six steps.
  The air flow quantity is displayed on the LCD unit.
  When the ∧ switch is pressed, the air flow quantity increases.
  When the ∨ switch is pressed, the air flow quantity decreases.
  In the automatic mode, the air flow quantity is automatically changed over.

Display on the LCD unit and the air blow quantity

Display on LCD unit	Air blow quantity
	Air quantity "low"
	Air quantity "medium 1"
	Air quantity "medium 2"
	Air quantity "medium 3"
	Air quantity "medium 4"
	Air quantity "high"

Troubleshooting the expansion valve

Item	Symptom	Cause	Action
Blocked expansion valve or defective adjustment (too closed)	Both high pressure and low pressure are low, and air bubbles cannot be seen through sight glass.	- Expansion valve	- Cleaning/adjustment or replacement
Defective adjustment (too open)	Low pressure is too high, and compressor head is cold.	- Expansion valve	- Adjustment or replacement
Freezing caused by moisture	Cooling is disabled during operation. Frosting is not detected in evaporator. Both high pressure and low pressure are low, and air bubbles cannot be seen through sight glass.	- Expansion valve	- Replace receiver tank, evacuate air, then charge gas again.

Resistor

The resistor controls rotation of the condenser fan motor in two steps in accordance with a command given by the fan control pressure switch (medium pressure switch).

Resistor specifications

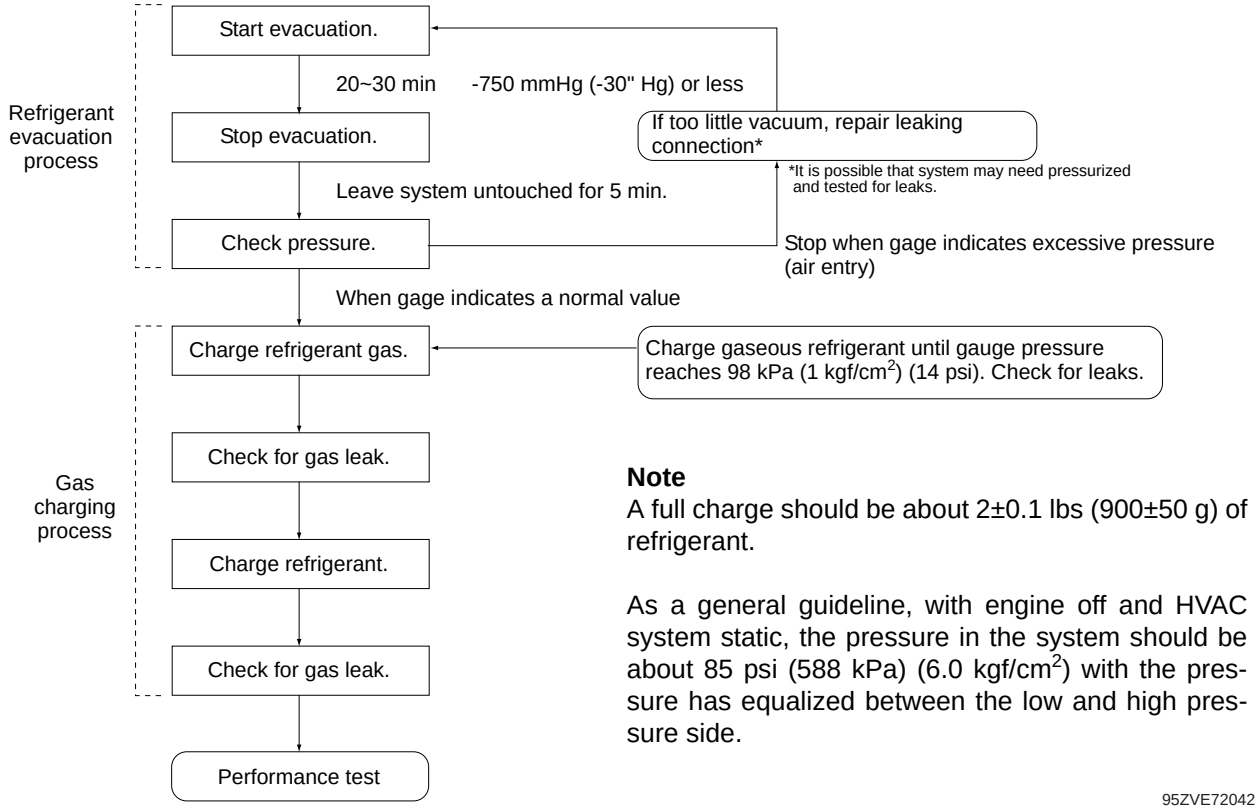
Resistance	4.0 Ω

Troubleshooting the condenser unit

Item	Symptom	Cause	Action
Heat radiation quantity is insufficient due to blockage*.	Both high pressure and low pressure are abnormally high, and air does not become cool enough.	- Blockage or crushed fins	- Clean or replace condenser
Rotation of condenser fan motor is defective.		- Fan motor	- Repair or replace motor
Blockage / condenser airflow	High pressure is abnormally high, low pressure is abnormally low, and air does not become cool enough. Air bubbles can be seen through sight glass.	- Internal to condenser fins	- Clean or replace condenser
Gas leak	Both high pressure and low pressure are abnormally low, and air bubbles can be seen through sight glass.	- Leaks at joints - Cracks in main body	- Tightening - Repair or replacement

* It is important to check the fan blades also as these can become bent or packed with dirt, making them ineffective.

Charging procedure chart



Note
A full charge should be about 2±0.1 lbs (900±50 g) of refrigerant.

As a general guideline, with engine off and HVAC system static, the pressure in the system should be about 85 psi (588 kPa) (6.0 kgf/cm^2) with the pressure has equalized between the low and high pressure side.

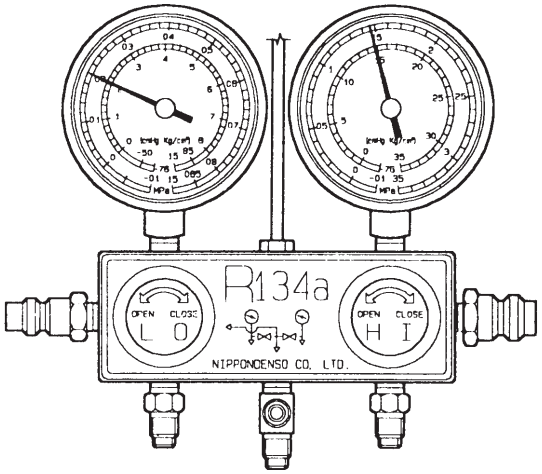
95ZVE72042

Troubleshooting using the gauge manifold

Normal status

<Low pressure side>
215~275 kPa
(2.2~2.8 kgf/cm^2)
(31~40 psi)

<High pressure side>
1,470~1,765 kPa
(15~18 kgf/cm^2)
(213~255 psi)



97ZV72091

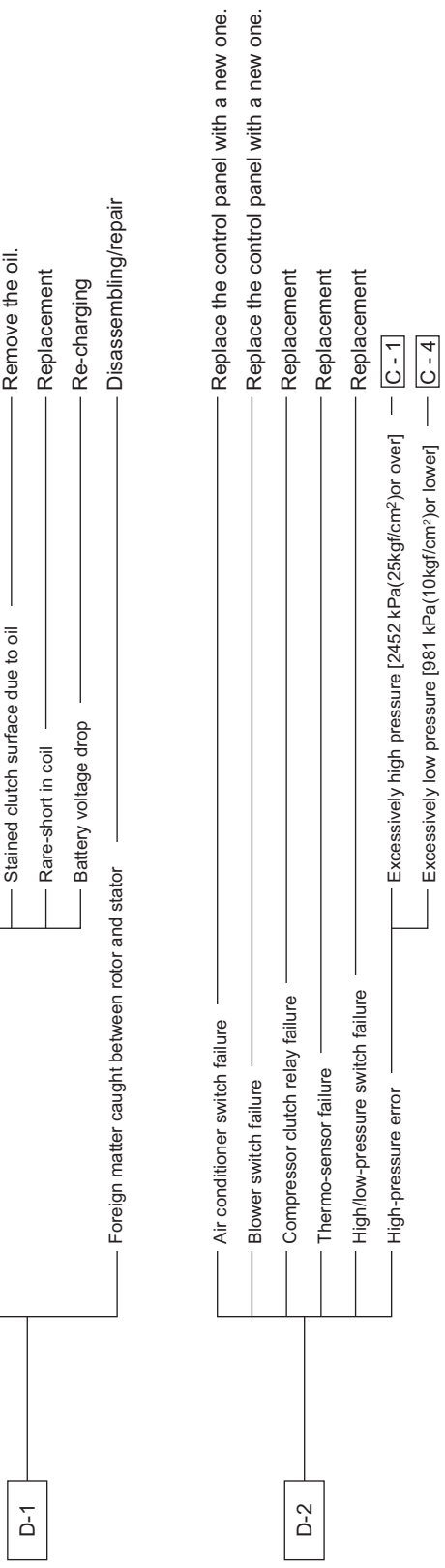
Condition

After warming up the engine, check the pressure under the following condition.

- Doors
  Completely open
- Inside/outside air selection
  Inside air
- Number of rotations of engine
  1,500 min^{-1}
- Temperature at suction port of air conditioner
  30~35ºC (86~95ºF)
- Blower speed
  High
- Temperature control switches
  Maximum cooling

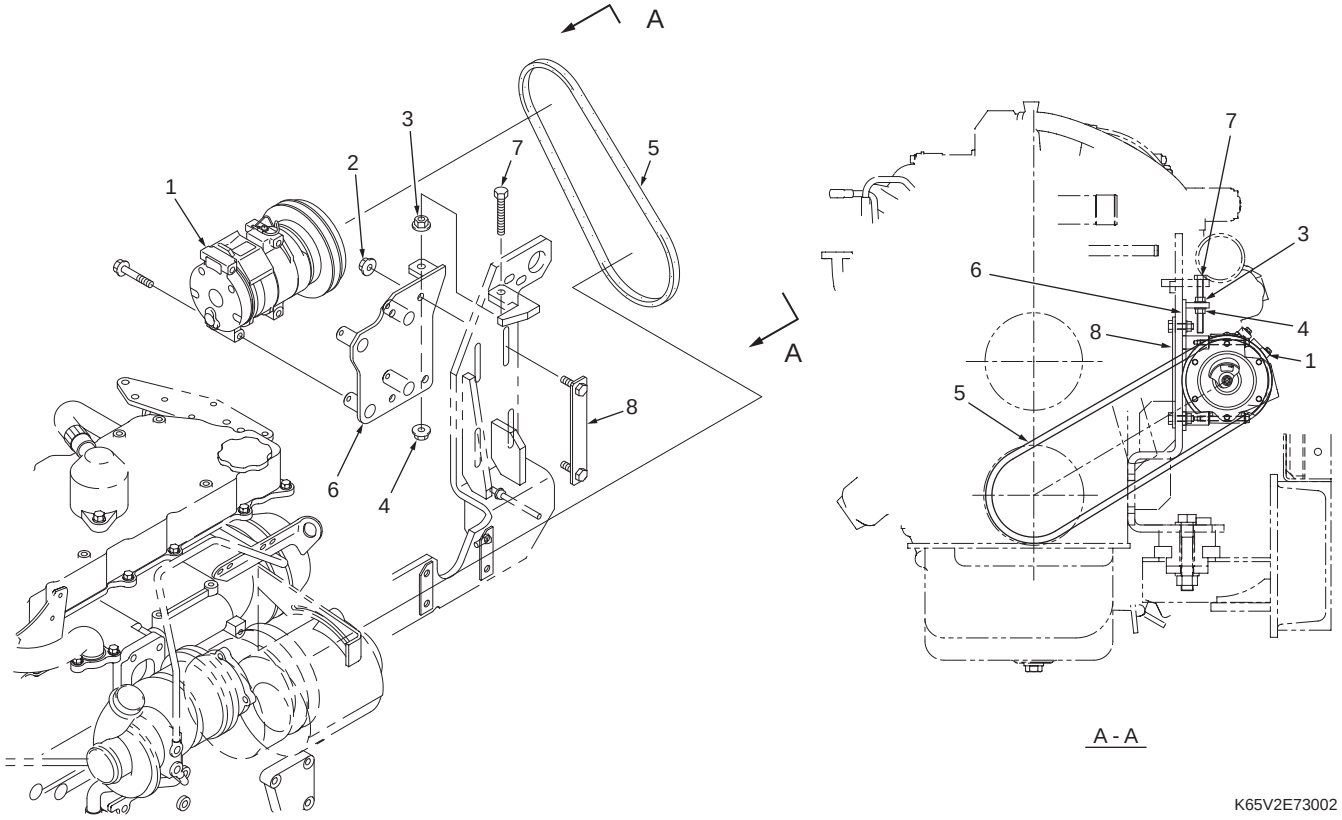
Pressure values indicated by gauges in the normal status

A/C suction port temperature	Pressure	Pressure value by gauge
20~25ºC (68~77ºF)	High pressure side	1,000~1,215 kPa (10.2~12.4 kgf/cm^2) (145~176 psi)
	Low pressure side	127~167 kPa (1.3~1.7 kgf/cm^2) (18~24 psi)
25~30ºC (77~86ºF)	High pressure side	1,215~1,470 kPa (12.4~15.0 kgf/cm^2) (176~213 psi)
	Low pressure side	167~215 kPa (1.7~2.2 kgf/cm^2) (24~31 psi)
30~35ºC (86~95ºF)	High pressure side	1,470~1,784 kPa (15.0~18.2 kgf/cm^2) (213~258 psi)
	Low pressure side	215~275 kPa (2.2~2.8 kgf/cm^2) (31~40 psi)
35~40ºC (95~104ºF)	High pressure side	1,784~2,146 kPa (18.2~21.9 kgf/cm^2) (258~310 psi)
	Low pressure side	275~353 kPa (2.8~3.6 kgf/cm^2) (40~51 psi)


D-1
Disconnected stator coil
Replacement
Excessive air gap between rotor and stator
Repair or replacement
Slipped clutch
Slippage due to broken key or key insertion failure
Replace the key with a new one.
Stained clutch surface due to oil
Remove the oil.
Rare-short in coil
Replacement
Battery voltage drop
Re-charging
Foreign matter caught between rotor and stator
Disassembling/repair
D-2
Air conditioner switch failure
Replace the control panel with a new one.
Blower switch failure
Replace the control panel with a new one.
Compressor clutch relay failure
Replacement
Thermo-sensor failure
Replacement
High/low-pressure switch failure
Replacement
High-pressure error
Excessively high pressure [2452 kPa(25kgf/cm2)or over]
C - 1
Excessively low pressure [981 kPa(10kgf/cm2)or lower]
C - 4

80V2E01016

Compressor V-belt adjustment (S/N 4031~) (DENSO)

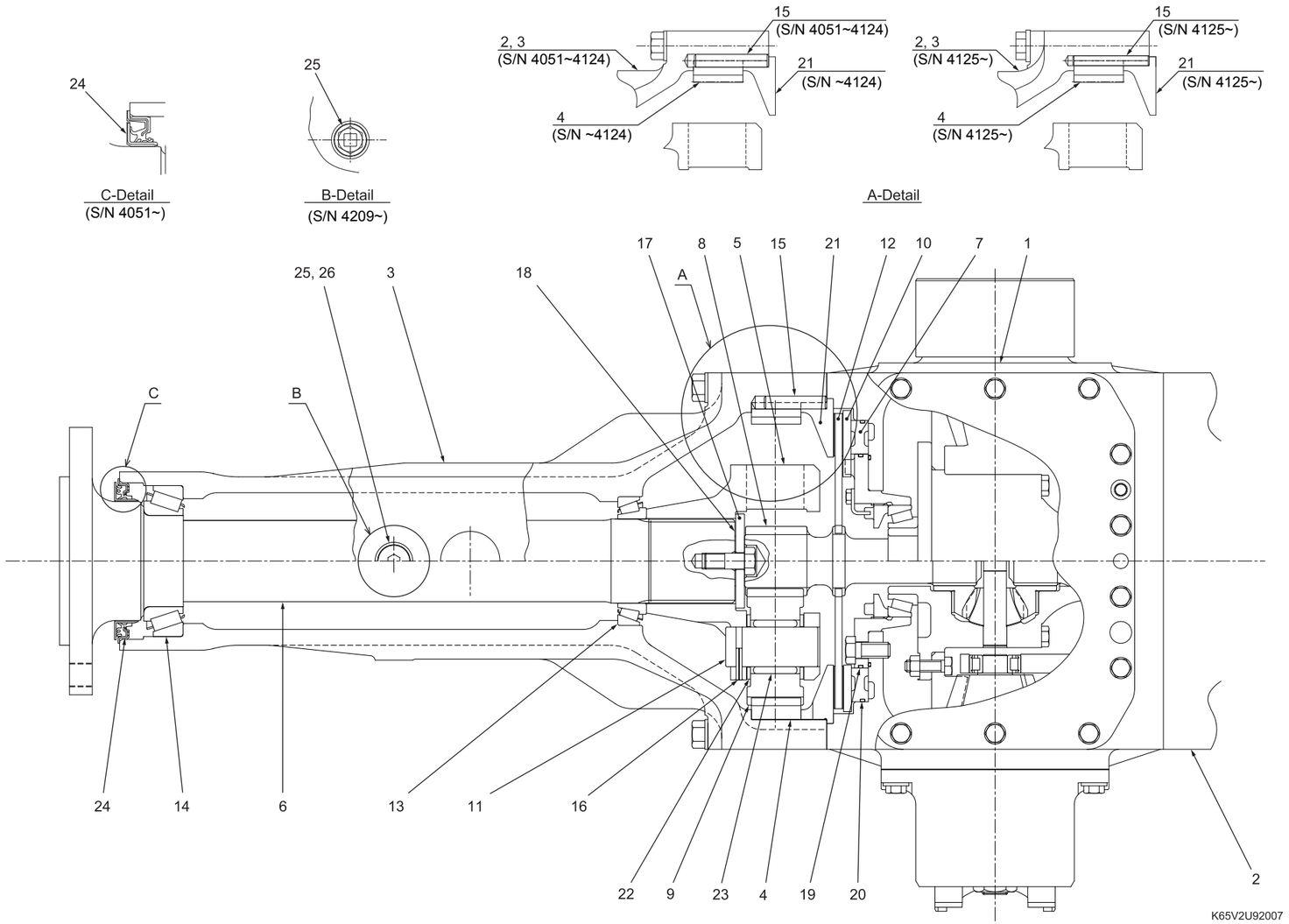


1. Compressor
2. Bracket mounting nut
3. Lock nut
4. Adjusting nut
5. V-belt
6. Bracket
7. Bolt
8. Plate

Maintenance Log

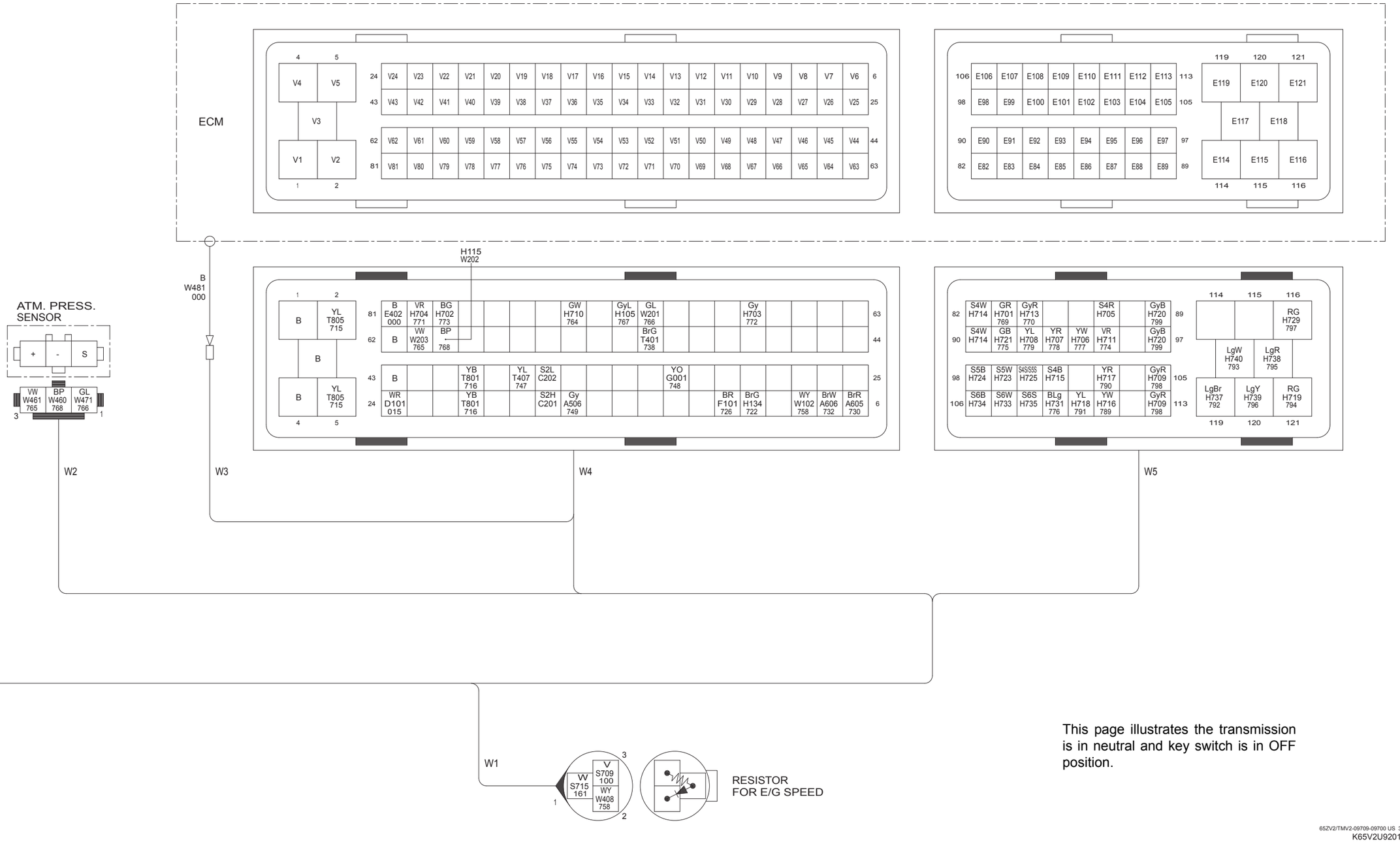
Date	Machine hours	Service performed

Rear axle assembly



1. Differential assembly
2. Axle housing
3. Axle housing
4. Internal gear
5. Spider
6. Axle shaft
7. Piston
8. Sun gear
9. Planetary gear
10. Separation disc
11. Pin
12. Friction disc
13. Taper roller bearing
14. Taper roller bearing
15. Straight pin
16. Spring pin
17. Plane washer
18. Shim
19. O-ring
20. O-ring
21. Brake backing plate
22. Wear ring
23. Needle cage
24. Oil seal
25. Plug
26. Seal washer

Electrical Wiring Diagram (3/4) (S/N 4031~4050)

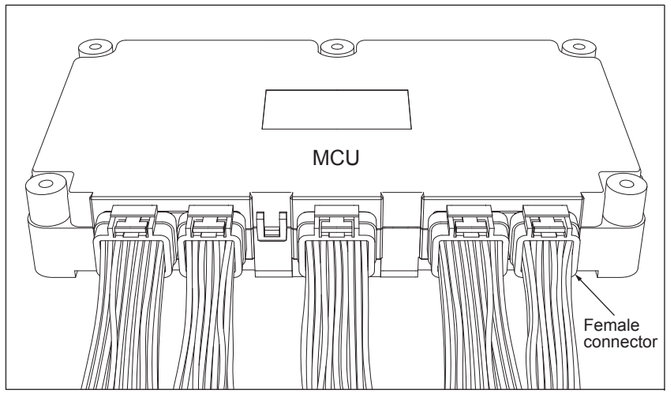


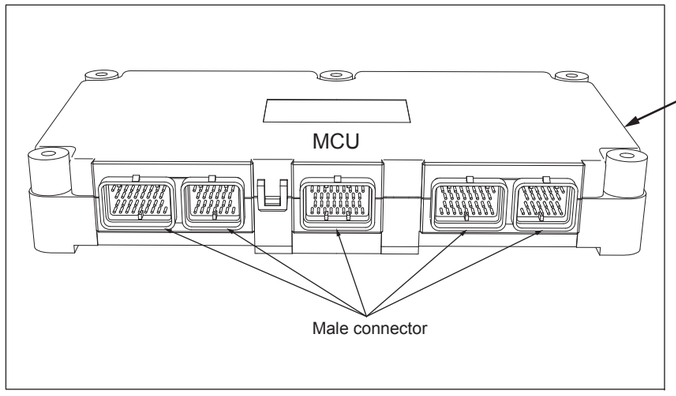
This page illustrates the transmission is in neutral and key switch is in OFF position.

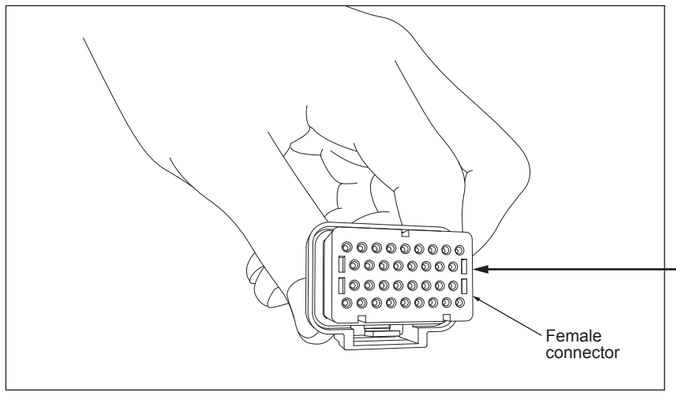
Electrical Wiring Diagram

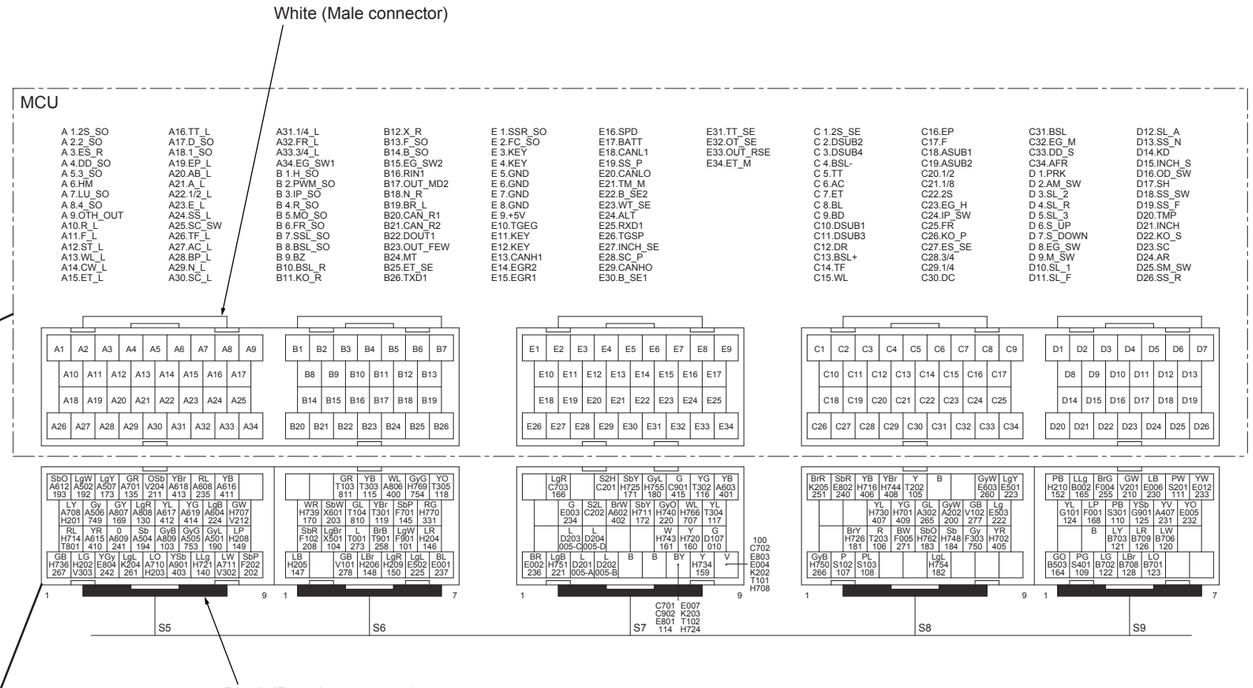
Way of looking at connectors

Machine control unit (MCU)

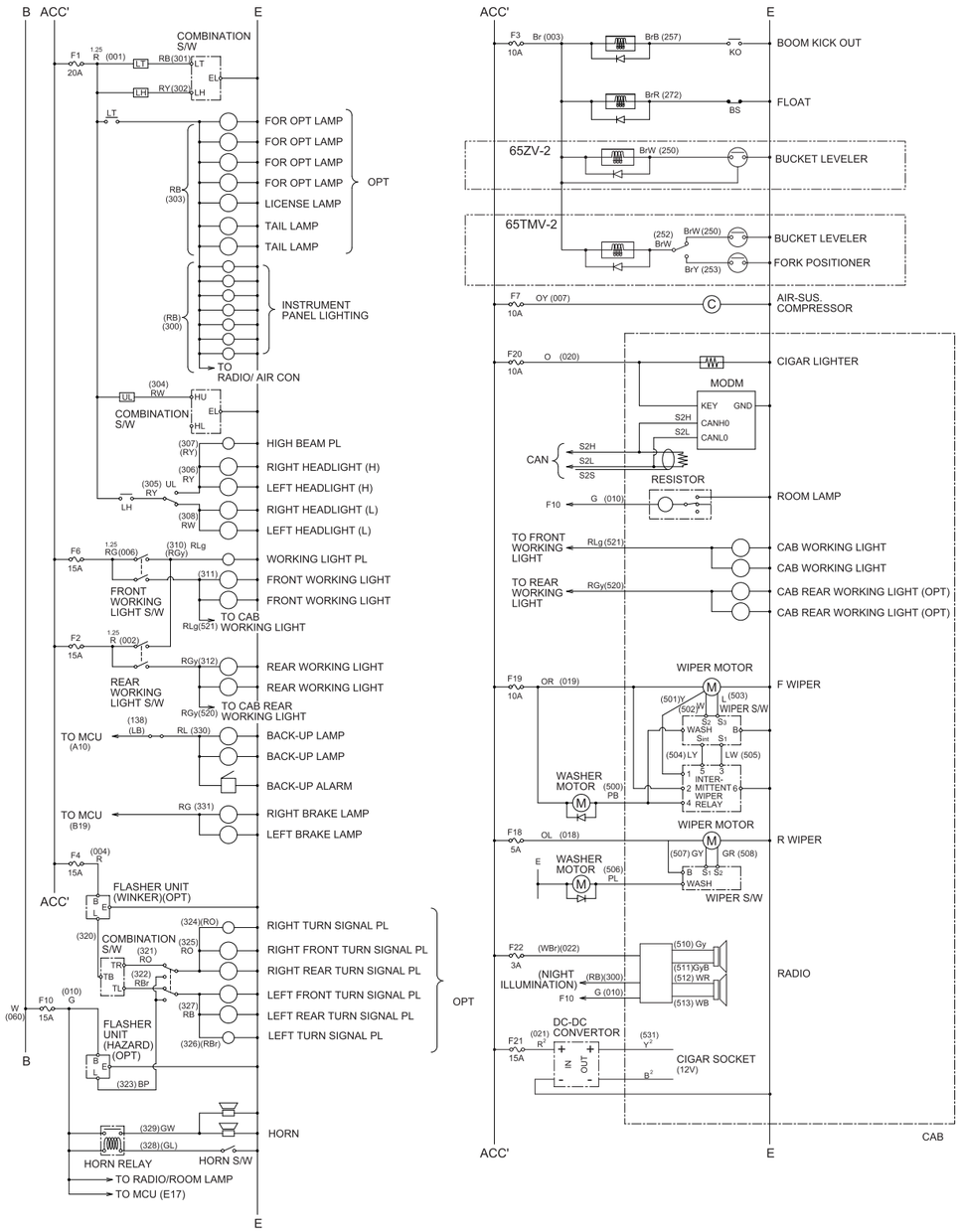


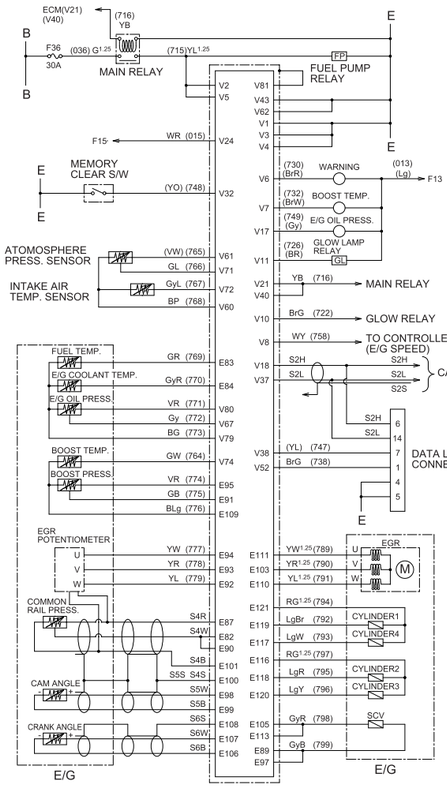




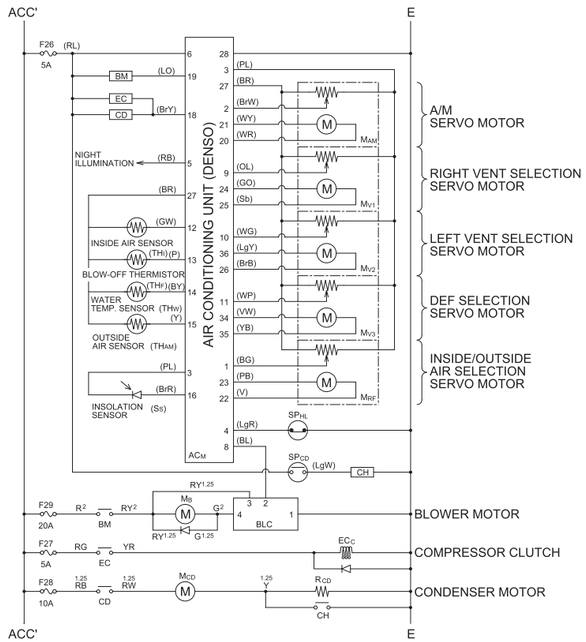


Electrical Connection Diagram (2/2) (S/N 4031~4050)





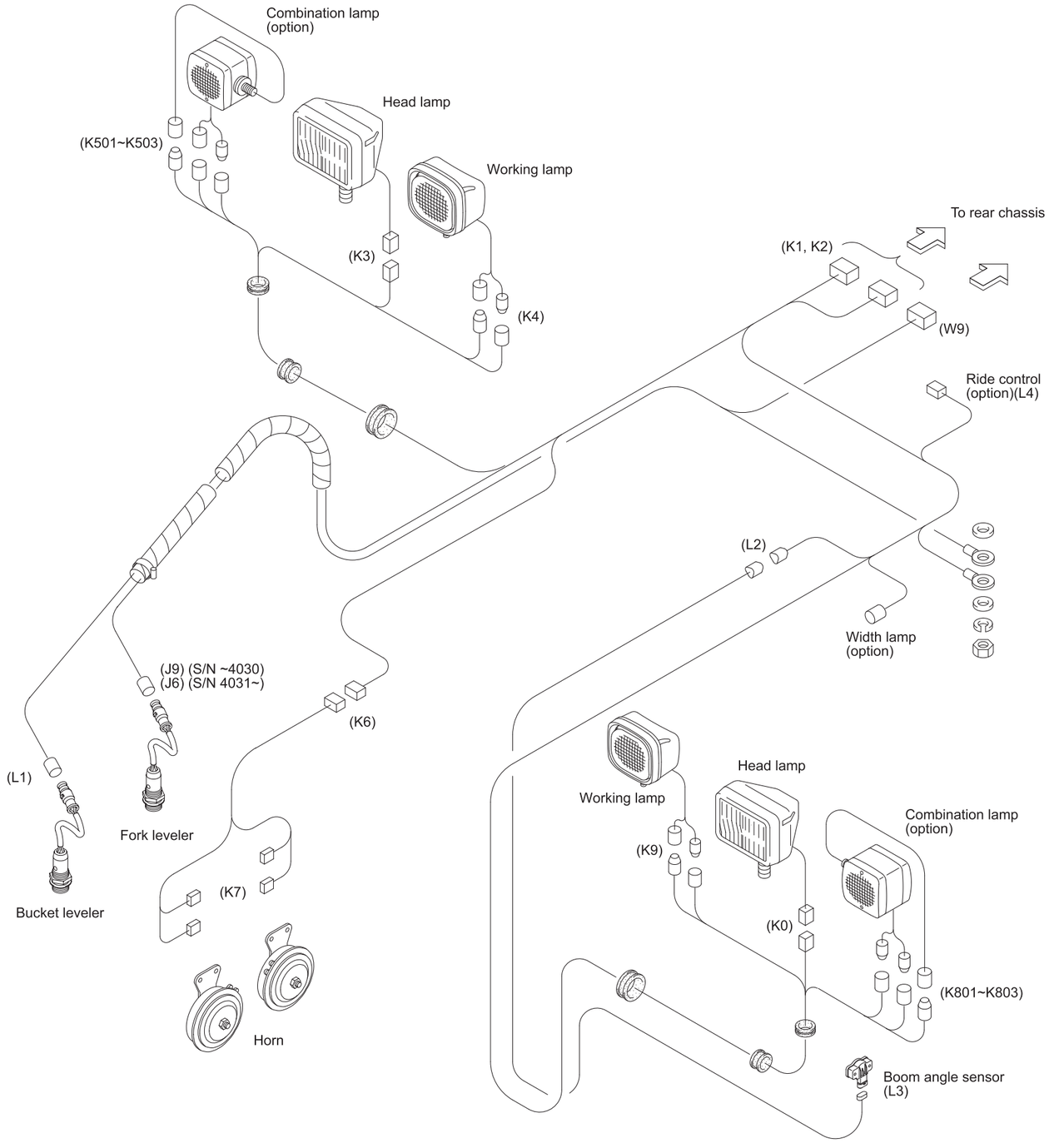
E/G ECM Connection Diagram



Air Conditioning Unit Connection Diagram

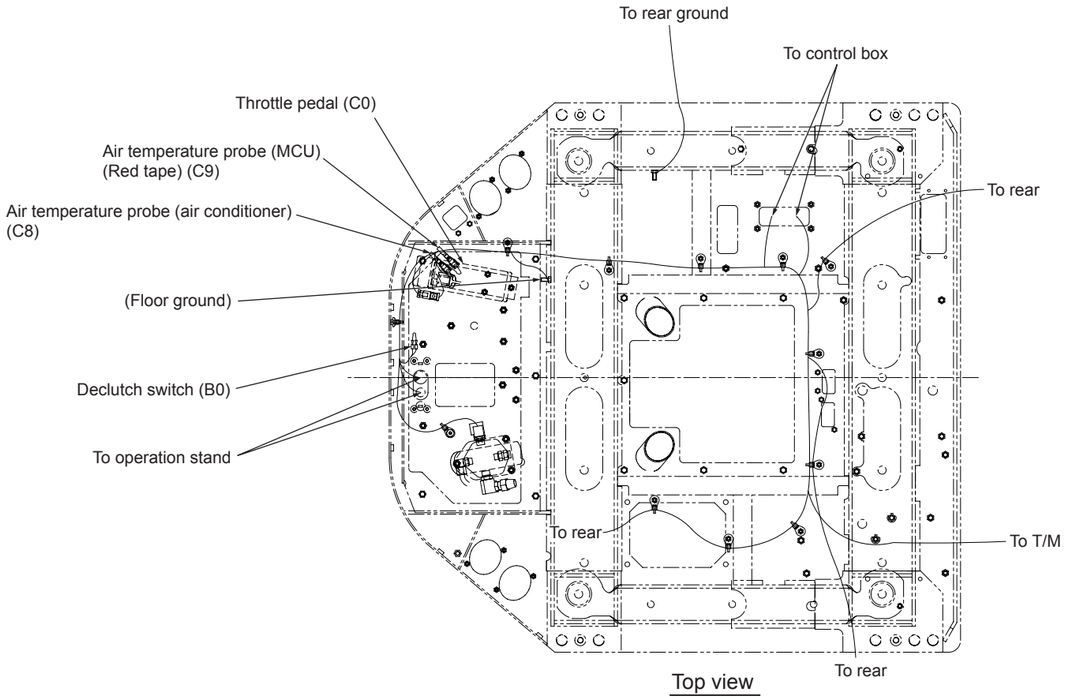
This page illustrates the transmission is in neutral and key switch is in OFF position.

Front chassis

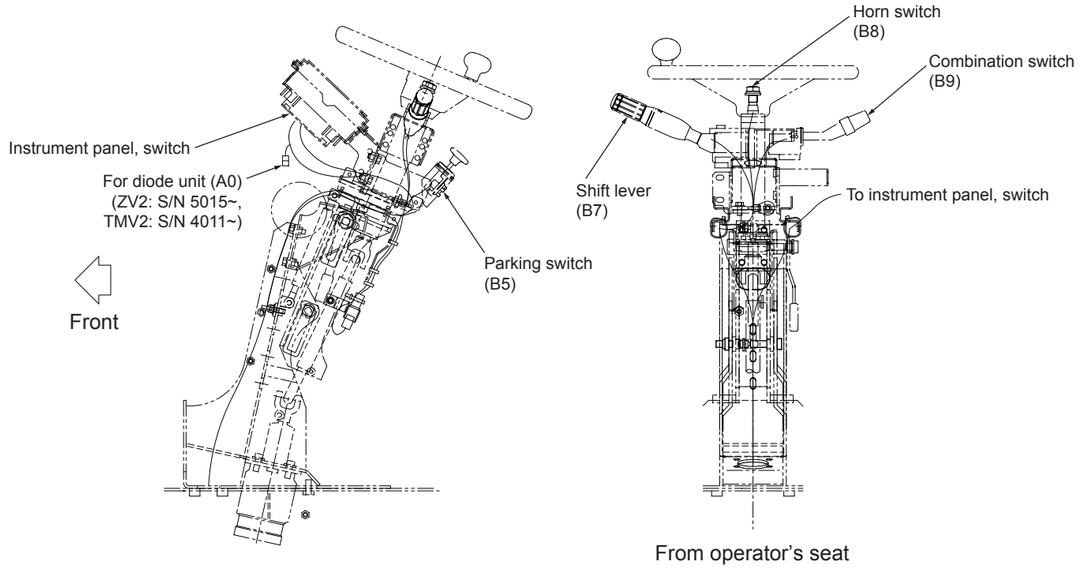


K65T2U92001

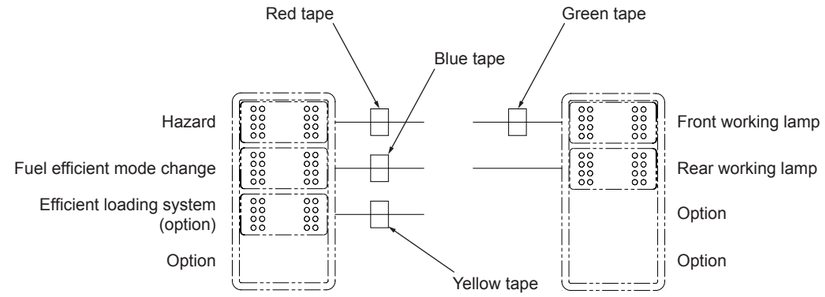
Floor board (S/N 4001~4030)



Top view



From operator's seat



Operation switch connection