RECOGNIZE SAFETY INFORMATION

- This is the **SAFETY ALERT SYMBOL**.
  - When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.
  - Follow recommended precautions and safe operating practices.

001-E01A-0001

SA-001

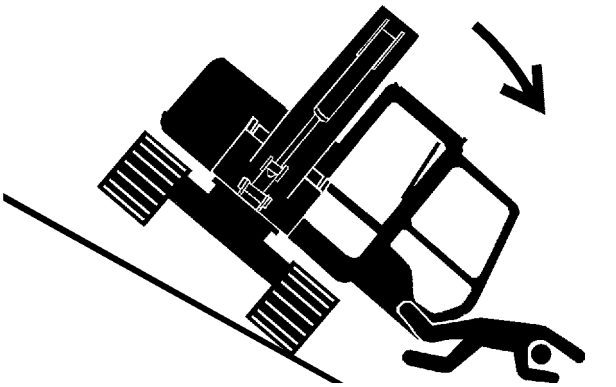
UNDERSTAND SIGNAL WORDS

- On machine safety signs, signal words designating the degree or level of hazard - DANGER, WARNING, or CAUTION - are used with the safety alert symbol.
  - **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
  - **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
  - **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
  - **DANGER or WARNING safety signs** are located near specific hazards. General precautions are listed on **CAUTION safety signs**.
- **CAUTION** also calls attention to safety messages in this manual.
- To avoid confusing machine protection with personal safety messages, a signal word **IMPORTANT** indicates a situation which, if not avoided, could result in damage to the machine.
- ***NOTE*** indicates an additional explanation for an element of information.

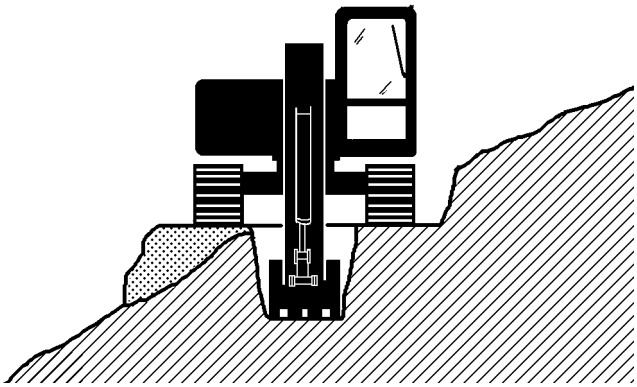
SA-1223

002-E01A-1223

AVOID TIPPING



SA-012



SA-440

- The danger of tipping is always present when operating on a grade, possibly resulting in serious injury or death.

  To avoid tipping:
- Be extra careful before operating on a grade.

  - Prepare machine operating area flat.
  - Keep the bucket low to the ground and close to the machine.
  - Reduce operating speeds to avoid tipping or slipping.
  - Avoid changing direction when traveling on grades.
  - NEVER attempt to travel across a grade steeper than 15 degrees if crossing the grade is unavoidable.
  - Reduce swing speed as necessary when swinging loads.

- Be careful when working on frozen ground.

  - Temperature increases will cause the ground to become soft and make ground travel unstable.

S025-E02B-0495

Check Emergency Engine Stop Switch:

- If a fire breaks out, failure to stop the engine will escalate fire, hampering fire fighting.

  - Check the emergency engine stop switch function every 250 hours:
    1) Start the engine and run it at slow Idle.
    2) Turn the emergency engine stop switch to the EMERG. STOP position.
    3) Confirm that the engine(s) stop.

  - If any abnormalities are found, be sure to repair them before operating the machine.

Check Heat Shields:

- Damaged or missing heat shields may lead to fires.

  - Damaged or missing heat shields must be repaired or replaced before operating the machine.

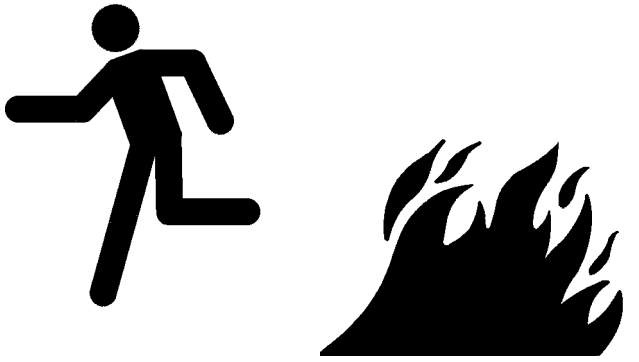
S508-E05B-0019

EVACUATING IN CASE OF FIRE

Evacuating in Case of Fire:

- If a fire breaks out, evacuate the machine in the following way:

  - Stop the engine by turning the emergency engine stop switch to the EMERG. STOP position if there is time.
  - Use a fire extinguisher if there is time.
  - Exit the machine. Refer to the section “HANDLING LADDER/EMERGENCY ROPE” or “EMERGENCY ROPE” in the operator’s manual for details on the procedures for emergency exits from the machine.



SA-393

S518-E01A-0393

ENGINE SPEED

Performance Test Conditions:
Oil Temperature :50±5 °C
Ground Conditions :Solid, level ground

Measurement:
1. Turn the key switch to the OFF position to stop the engine.

2. Disconnect the engine speed sensor connector (Lower side: For EC and MC). Connect the pulse counter harness to engine speed sensor harness.

3. Start the engine, run it at the specified speeds, and read the pulse counter.
   Calculate the engine speed using the following formula:

   Engine speed (min^{-1}) = Pulse Number×60/142

Evaluation:
Refer to T4-5 Operational Performance Standard.

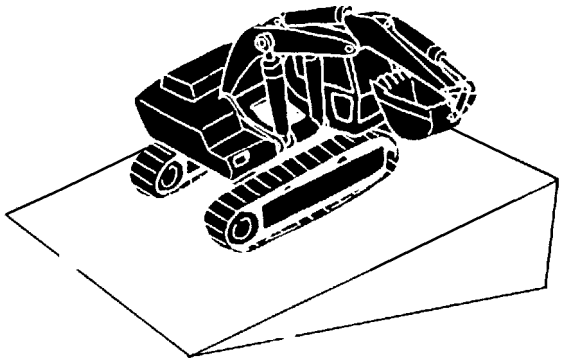
MAXIMUM SWINGABLE SLANT ANGLE

Summary:

1. With the upperstructure swung 90° to the slope, check the maximum slant angle on which the upperstructure can swing to the uphill side.

Preparation:

1. Check that the swing gear and bearing are well lubricated.
2. Load bucket fully. In lieu of loading the bucket, weight (W) of the following specification can be used.
   W = 18300 kg (40340 lb): Backhoe
   21000 kg (46300 lb): Loading Shovel
3. Position the front attachment as described in the following.
   Loading shovel: With the arm cylinder fully extended and the bucket cylinders fully extended, position the arm top pin height flush with the boom foot pin height.
   Backhoe: With the arm cylinders fully retracted and the bucket cylinders fully extended, position the arm top pin height flush with the boom foot pin height.
4. Climb a slope and swing the upperstructure 90° to the slope.
5. Maintain the hydraulic oil temperature at 50±5 °C (122±9 °F).



T142-05-03-004

Measurement:

1. Engine Control Lever: Maximum Position
   Auto Idle Switch: OFF
2. Operate the swing lever to full stroke to swing the upperstructure to the uphill side.
3. If the machine can swing, measure the cab floor slant angle.
4. When the machine can swing, increase the slant angle. Then, repeat the test until the maximum swingable angle is obtained. Check in both clockwise and counterclockwise directions.
5. Perform the measurement three times in each direction and calculate the average values.

Evaluation:

Refer to T4-5 Operational Performance Standard.

Solution:

Refer to T5-4 Troubleshooting B.

PILOT PRIMARY PRESSURE

Preparation

1. Stop the engine.

CAUTION: The breather cap may pop off if turned quickly. Slowly turn it to release internal pressure before removing it.

2. Release air from the hydraulic oil tank by loosen the air breather cap.

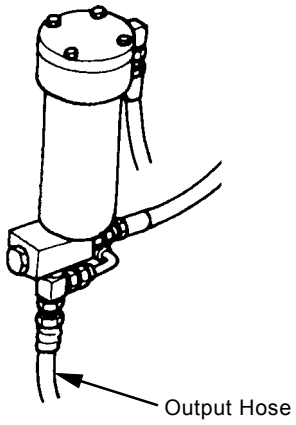
   : 4 mm

3. Disconnect the output hose from the pilot filter, then install the pressure gauge at the disconncted port in the pilot filter.

   : 36 mm

4. Start the engine and check for oil leakage from the connections.

5. Maintain the hydraulic oil temperature at 50±5 °C (122±9 °F).



T117-05-04-001

Measurement

1. Measure the primary pilot pressure in both the fast idle and the slow idle.

2. Repeat step (1) three times and calculate the average values.

Evaluation

Refer to T4-5 Operational Performance Standard.

Measurement:

1. Measure the maximum flow rate.
2. Auto-idle switch : OFF
   Engine speed control lever : Fast Idle
3. Measure the pump flow rate and engine speed at the pressure (referring to the table below) while gradually throttling the loading valve of the hydraulic tester.
4. Measure each pressure three times and take the average as the measured figure.

Evolution:

Connect the measurement results to the date of the pump with the specked speed.

QC : Converted Flow Rate
Q : Measured Flow Rate
I : Pump Speed Ratio (0.86)
Np : Pump Specified Speed (1547 min^{-1})
Ne : Measured Engine Speed

$$Ne = \frac{\text{Pulse Number}}{2.36} \qquad QC = \frac{Np}{i \times Ne} \times Q$$

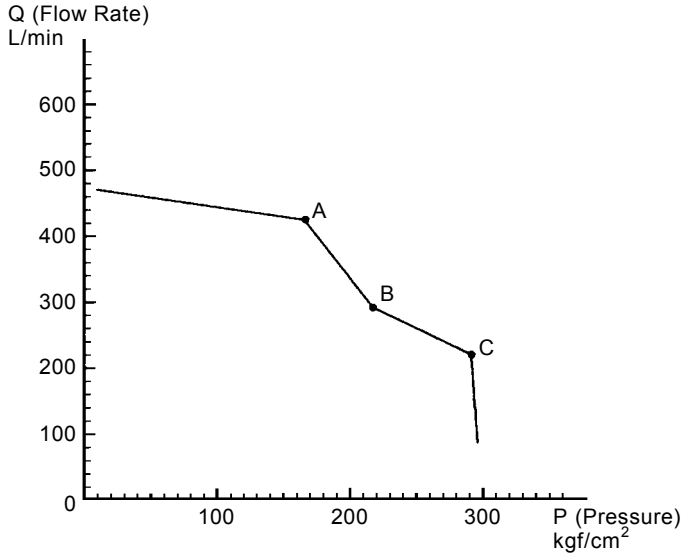
NOTE: 1 kgf/cm^2=98.07 kPa

Main Pump {1to4} P–Q Diagram

Point	Q (L/min)	P (kgf/cm^2)
A	358	191
B	290	223
C	221	292

Main Pump {5 and 6} P–Q Diagram

Point	Q (L/min)	P (kgf/cm^2)
A	441	166
B	290	223
C	221	292



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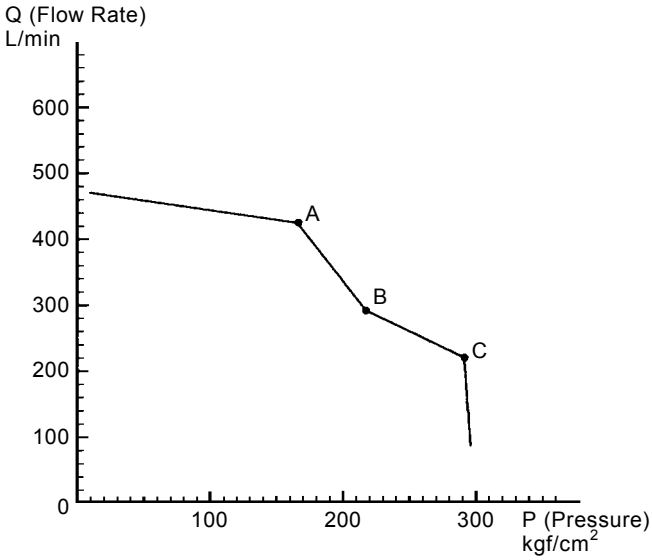
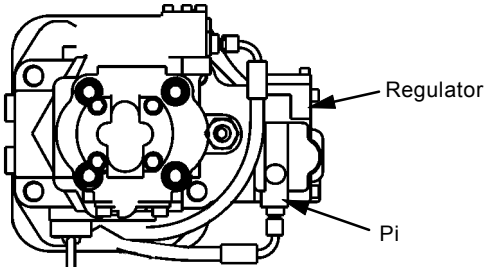


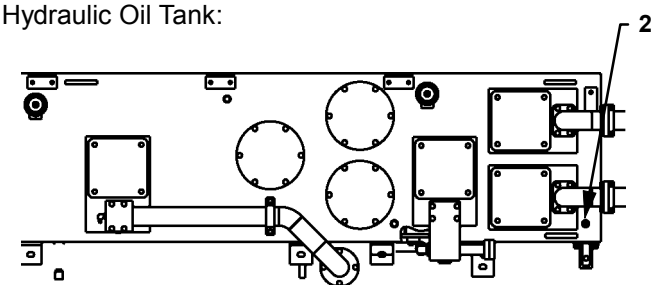
T117-05-04-004

Oil Cooler Fan Pump:



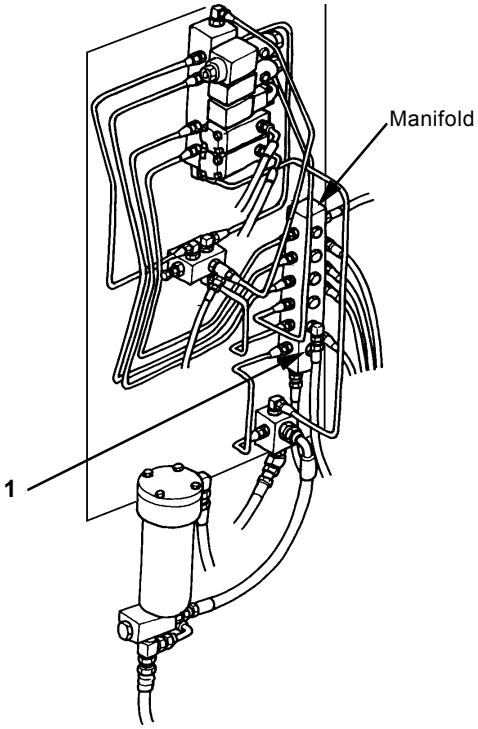
T118-05-02-026

Hydraulic Oil Tank:

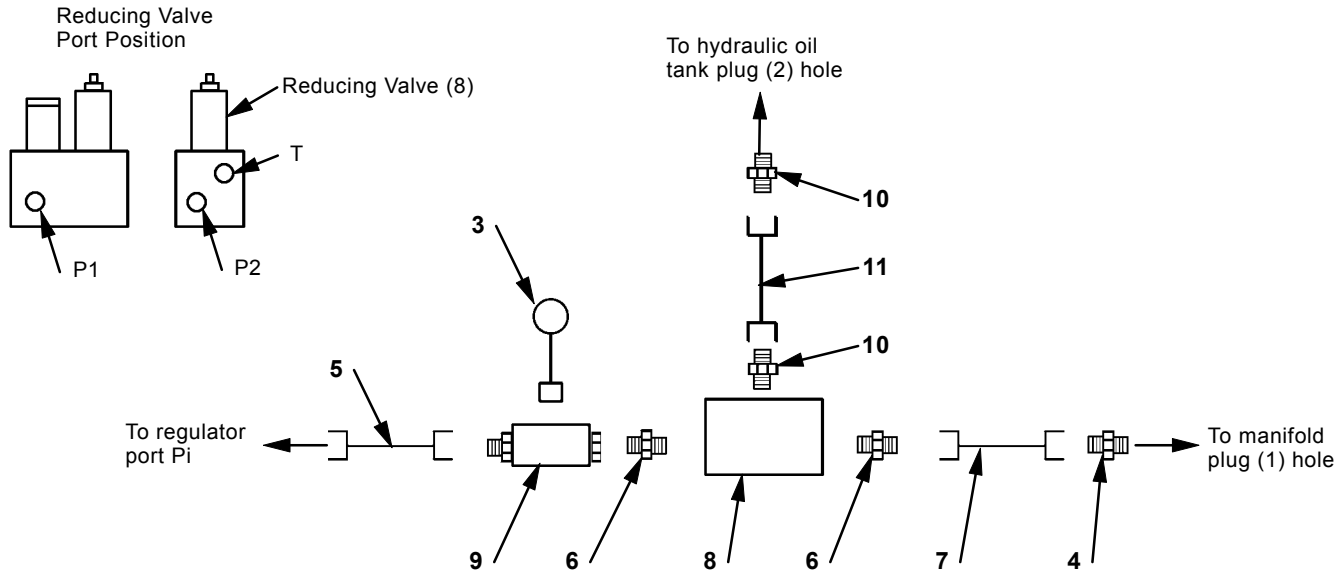


T117-05-04-009

Pump Control Panel:



T117-05-04-010



T118-04-04-014

1 - Plug PF1/4
2 - Plug PF1/4
3 - Pressure Gauge (ST 6931)
4 - Adapter UNF7/16×PF1/4 (4042037)
5 - Hose UNF7/16×UNF7/16
6 - Adapter PF3/8×UNF7/16 (4200465)
7 - Hose UNF7/16×UNF7/16
8 - Reducing (4325439)
9 - Tee UNF7/16×UNF7/16 ×PF1/4 (ST 6451)
10 - Adapter PF3/8×PF3/8 (4042031)
11 - Hose PF3/8×PF3/8 (ST 6961)

OPERATIONAL PERFORMANCE TEST / Standard

Performance Test Designation	EX2500 (Performance Standard)	Remarks
HYDRAULIC CYLINDER CYCLE TIME (sec)		
Backhoe		
Boom Raise	7.7±0.7	
Boom Lower	4.7±0.5	
Arm Roll-In	7.1±0.5	
Arm Roll-Out	6.0±0.5	
Bucket Roll-In	5.3±0.5	
Bucket Roll-Out	3.9±0.5	
Loading Shovel		
Boom Raise	8.2±0.7	
Boom Lower	5.0±0.5	
Arm Extend	3.4±0.5	
Arm Retract	4.2±0.5	
Bucket Tilt-In	4.0±0.5	
Bucket Tilt-Out	2.9±0.4	
Bucket Open	2.1±0.4	
Bucket Close	2.5±0.4	
DIG FUNCTION DRIFT CHECK (mm/5 min)		
Backhoe		
Boom Cylinder	25 or less	
Arm Cylinder	40 or less	
Bucket Cylinder	20 or less	
Bucket Bottom	200 or less	
Loading Shovel		
Boom Cylinder	25 or less	
Arm Cylinder	25 or less	
Bucket Cylinder	20 or less	
Bucket Bottom	300 or less	
CONTROL LEVER OPERATING FORCE (kgf) (Hitachi Lever Pattern)		
Boom Lever	1.2 or less	
Arm Lever	1.2 or less	ISO Lever Pattern: Swing
Bucket Lever (Roll In / Out)	1.2 / 0.7 or less	
Swing Lever (Right / Left)	1.2 / 0.7 or less	ISO Lever Pattern: Arm
Travel Lever	2.0 or less	
Bucket Open-Close Pedal	5.0 or less	

NOTE: 1 kgf/cm^2 = 98.07 kPa

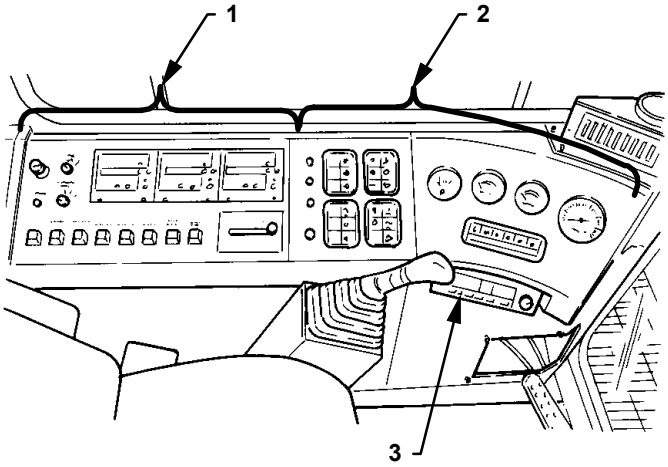
BH: Backhoe (9.0 m Boom, 4.2 m Arm, 13.8 m^3 (PCSA heaped) Bucket)

LD: Loading Shovel

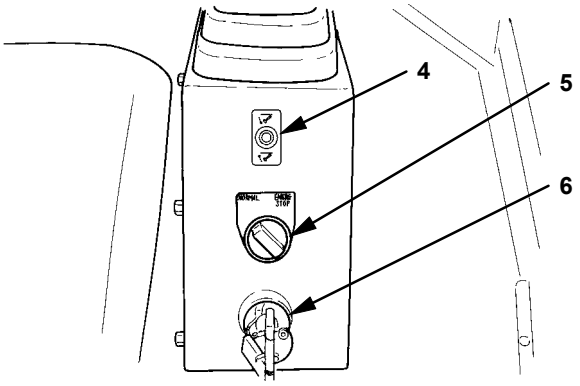
EC-RELATED FAULT CODES

Fault Code	Trouble	Corrective Action
01 02 03	Faulty FC (Hard Ware)	1) Retry A 2) Even if the message for abnormal engine speed control is displayed, when pump control (spped sensing) or auto-idle control operates normally, no remedy is requires. 3) Replace the EC.
04	Faulty EC (Faulty RAM)	1) Retry 2) Abnormal engine speed control system. If 8 or more selfdiagnostic fault codes are displayed, replace the EC.
05	Interrupted communication between the MC and EC	1) Retry B 2) Check for the harness. 4) Even if the message for abnormal auto-idle control is displayed, when pump control (speed sensing) control operates normally, no remedy is required. 3) Replace the MC or EC.
06	Faulty EC (Faulty AD Conversion)	1) Retry B 2) Even if the message for abnormal engine speed control is displayed, no remedy is required. 3) Replace the EC.
13	Faulty Engine Speed Sensor	1) Retry B 2) Check for the harness. 3) Replace the engine speed sensor.

ELECTRICAL COMPONENT LAYOUT IN THE CAB

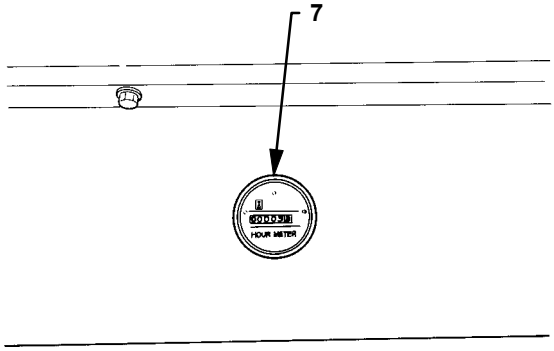


M117-01-017



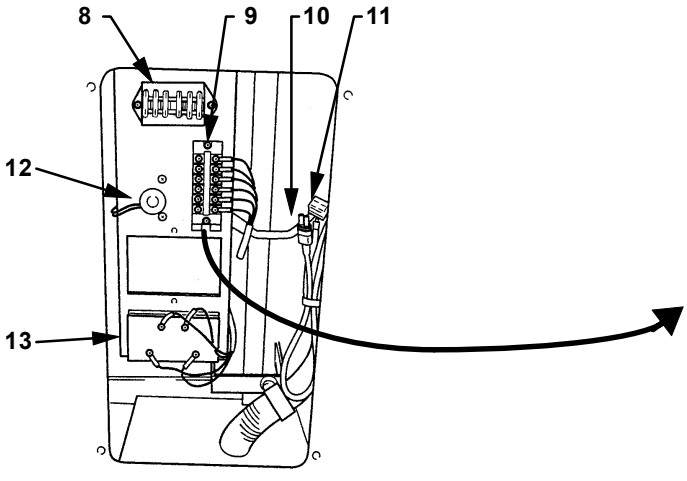
T117-01-02-011

Right Lever Stand



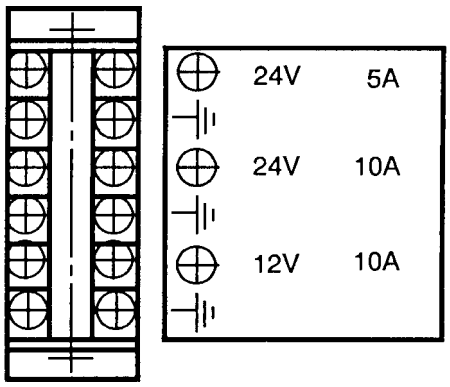
M117-01-019

On the front upper panel in the cab



M117-07-174

On the left side
behind the operator's seat

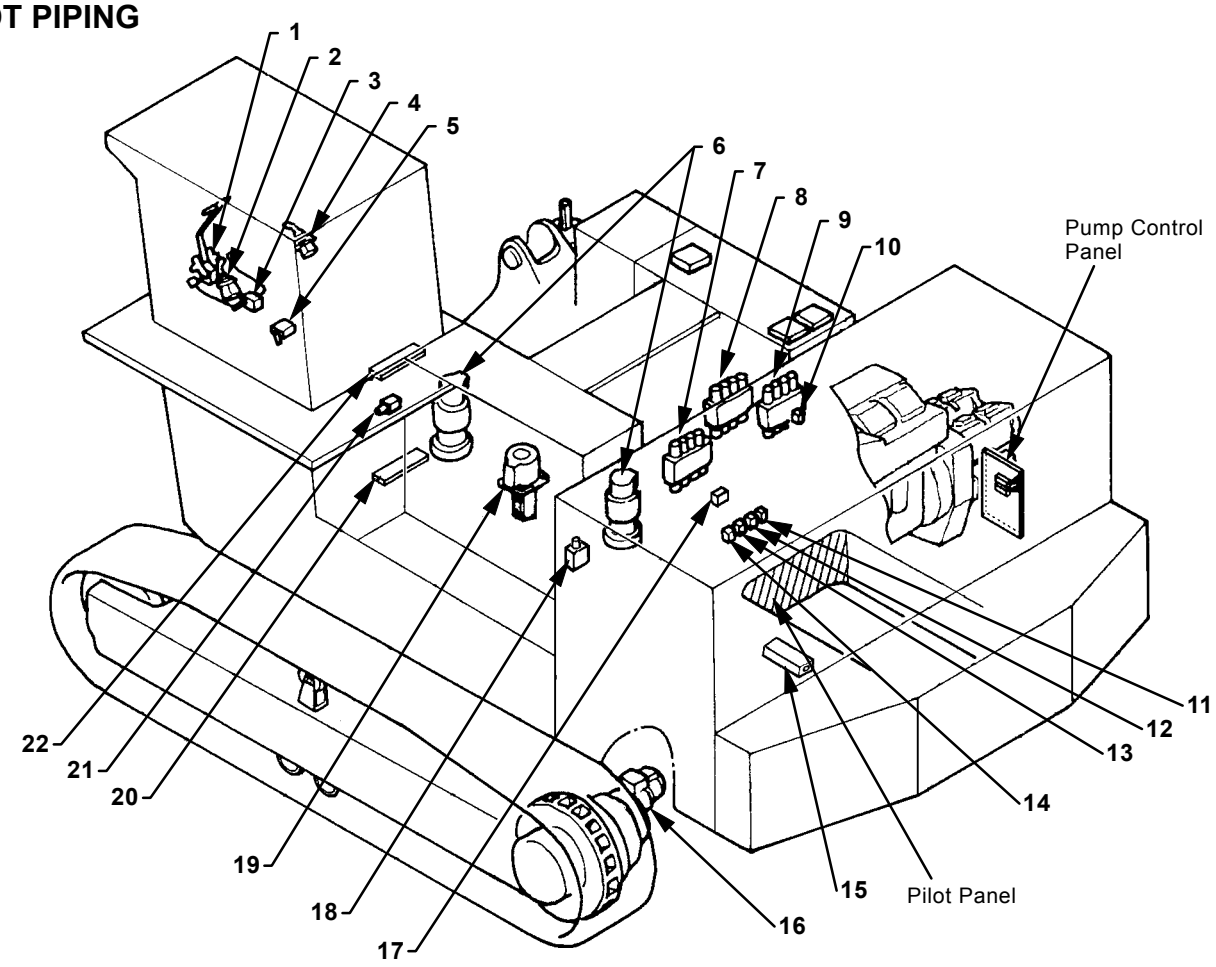


M117-07-172

Layout of power
Source terminal

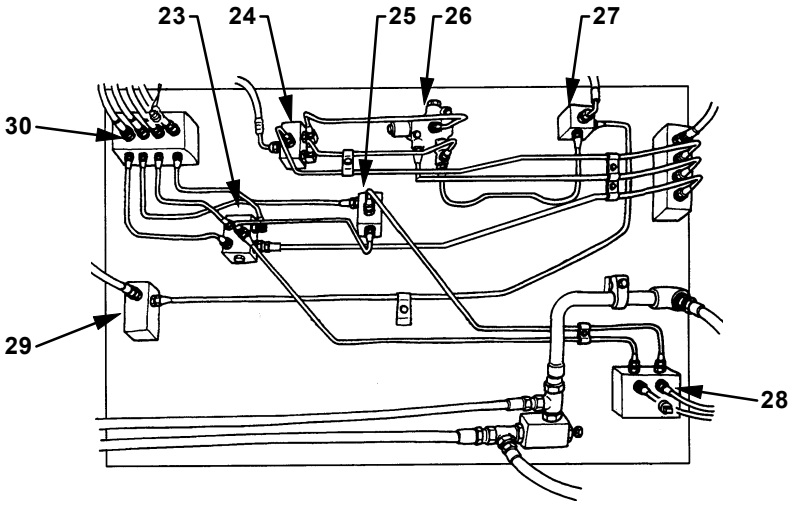
1 - Switch Panel
2 - Monitor Panel and Switch Panel
3 - Radio
4 - Fast Filling System Switch
5 - Emergency Engine Stop Switch
6 - Key Switch
7 - Hour Meter
8 - Fuse Box 2
9 - Power Source Terminal
10 - E Checker Connector
11 - Dr.EX Connector
12 - Buzzer
13 - Transformer (24V to 12V)

PILOT PIPING



T117-06-02-041

Pilot Panel:



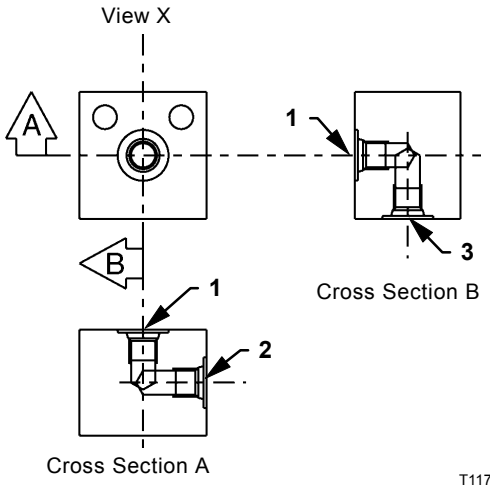
T117-01-02-003

Manifold 7

This manifold is a pilot line connection block from manifold 5 to swing motor and travel mode change solenoid valve.

No.	Connecting Point	Remarks
1	Swing Motor	Pilot pressure for swing parking brake release
2	Manifold 5 (2)	Pilot pressure for swing parking brake release
3	Travel Mode Change Solenoid Valve (3)	Travel parking brake release pressure/Travel speed change pressure

T117-06-02-012



T117-06-02-028

Control Valve

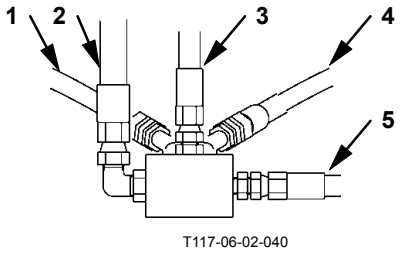
Loading Shovel:

No.	Connecting Point	Remarks
1	Manifold 3 (1)	Pilot pressure for bucket tilt-in
2	Manifold 3 (3)	Pilot pressure for boom raise
3	Manifold 3 (8)	Pilot pressure for arm extend
4	Shuttle Valve 3 (1)	Pilot pressure for travel reverse left
5	Manifold 3 (6)	Pilot pressure for arm extend
6	Shuttle Valve 4 (2)	Pilot pressure for bucket open
7	Manifold 3 (4)	Pilot pressure for boom raise
8	Shuttle Valve 3 (4)	Pilot pressure for travel forward right
9	Shuttle Valve 4 (3)	Pilot pressure for right swing
10	Manifold 3 (7)	Pilot pressure for arm extend
11	Manifold 3 (2)	Pilot pressure for bucket tilt-in
12	Manifold 3 (5)	Pilot pressure for boom raise
13	Left Control Valve (25)	Pilot pressure for boom lower
14	Left Control Valve (27)	Pilot pressure for bucket tilt-out
15	Hydraulic oil tank	Return oil to hydraulic oil tank
16	Shuttle Valve 4 (4)	Pilot pressure for left swing
17	Shuttle Valve 3 (3)	Pilot pressure for travel reverse right
18	Boom Priority Switch Valve (2)	Pilot pressure for bucket roll-in
19	Shuttle Valve 4 (1)	Pilot pressure for bucket close
20	Left Control Valve (23)	Pilot pressure for arm retract
22	Shuttle Valve 3 (2)	Pilot pressure for travel forward left
23	Center Control Valve (20)	Pilot pressure for arm retract
24	Shuttle Valve 2 (2)	Pilot pressure for arm retract
25	Right Control Valve (12)	Pilot pressure for boom lower
26	Shuttle Valve 1 (4)	Pilot pressure for boom lower
27	Right Control Valve (14)	Pilot pressure for bucket tilt-out
28	Shuttle Valve 1 (2)	Pilot pressure for bucket tilt-out

Pilot Pressure Selector Valve
(Serial No.145 and up)

Pilot pressure selector valve is activated by the pressure from the adjuster cylinder, supplying changeover pressure to the travel pilot pressure cut-off valve.

No.	Connecting Point	Remarks
1	Adjuster Cylinder (L)	Pilot pressure selector valve changeover pressure
2	Center Joint	Return to hydraulic oil tank
3	Center Joint → Travel Pilot Pressure Cut-Off Valve (1)	Travel pilot pressure cut-off valve changeover
4	Adjuster Cylinder (R)	Pilot pressure selector valve changeover pressure
5	Center Joint	Return to hydraulic oil tank



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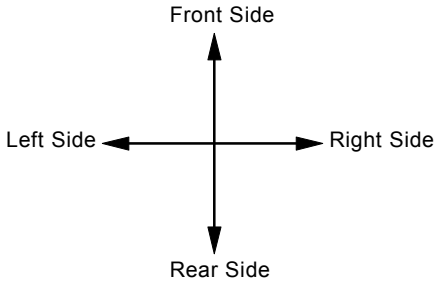


Fault Code List

Fault Code	Remarks	Fault Code	Remarks
111	Cannot be detected by Echeck™	432	
113		441	
114		442	
115		443	
121		444	
131		445	
132		451	
234		452	
254		455	
255		511	
341		514	
342		523	
353	Cannot be detected by Echeck™	524	
412	Can be detected by Echeck™ only	525	
414	Can be detected by Echeck™ only	552	
431		554	

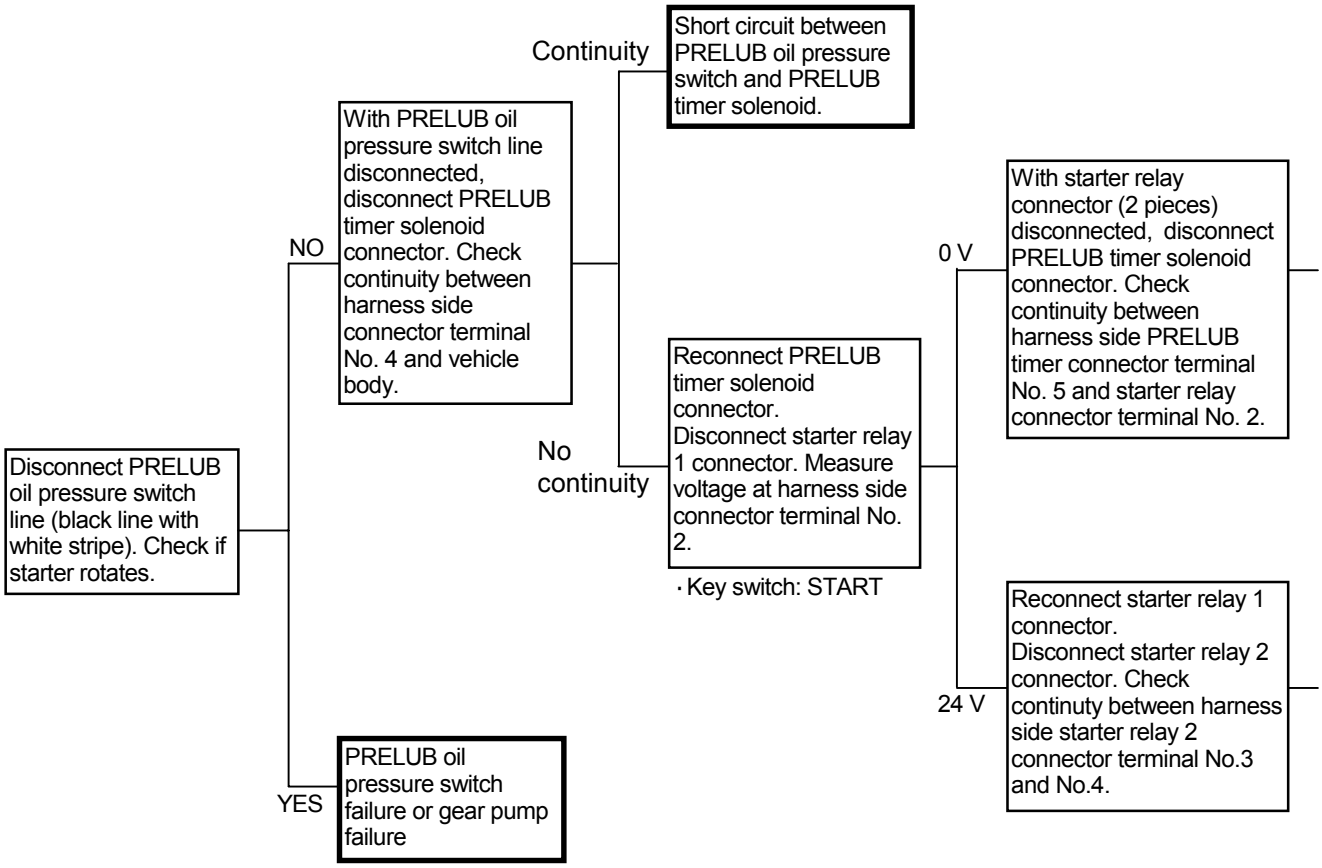
NOTE: For details, refer to the Cummins manuals below:

- *Troubleshooting and Repair Manual CENTRY™ System*
  Hitachi Part No. : 4380900
- *Operation and Maintenance Manual CENTRY™ System*
  Hitachi Part No. : 4380899

ENGINE SYSTEM

PRELUB mechanism functions, but starter does not rotate.

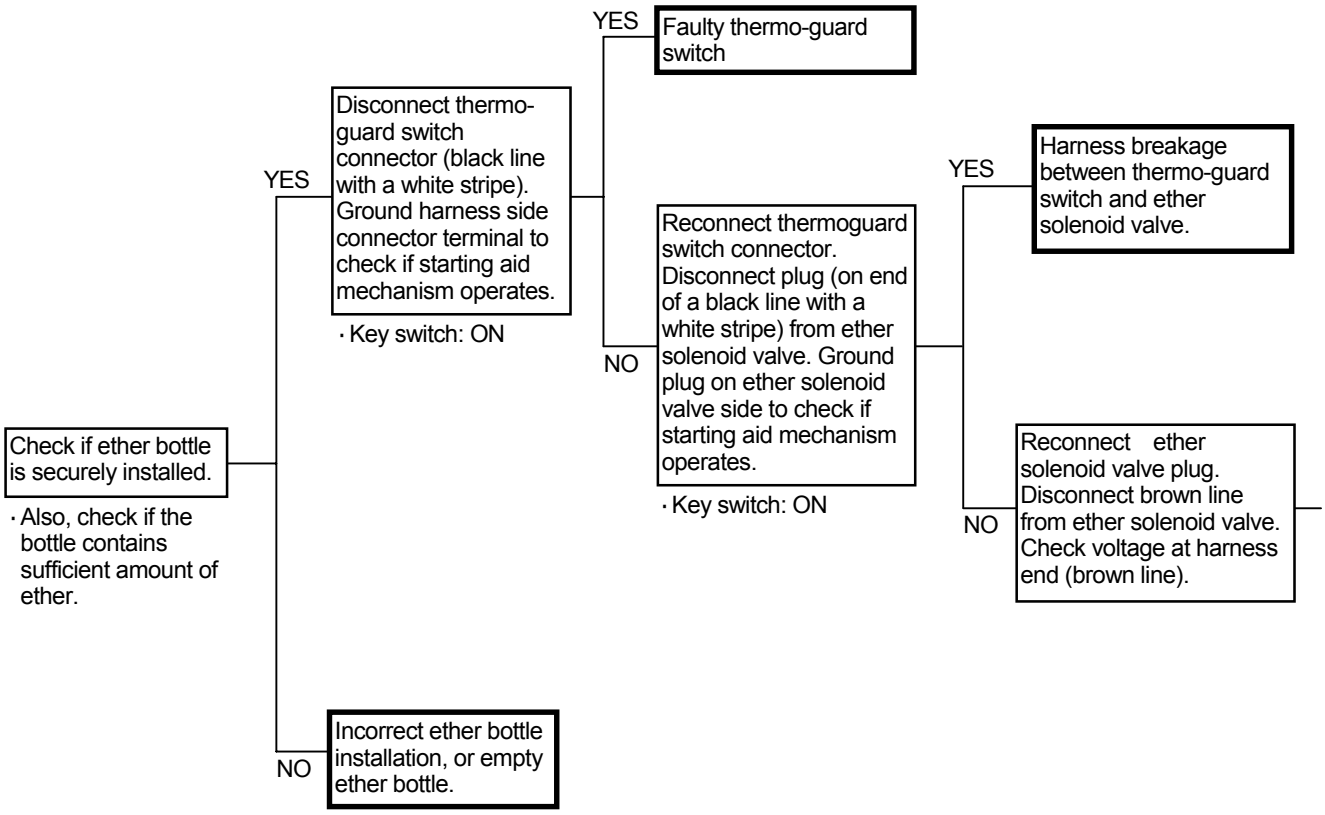
- Engine oil is sufficient.
- Check for loose harness connections beforehand.



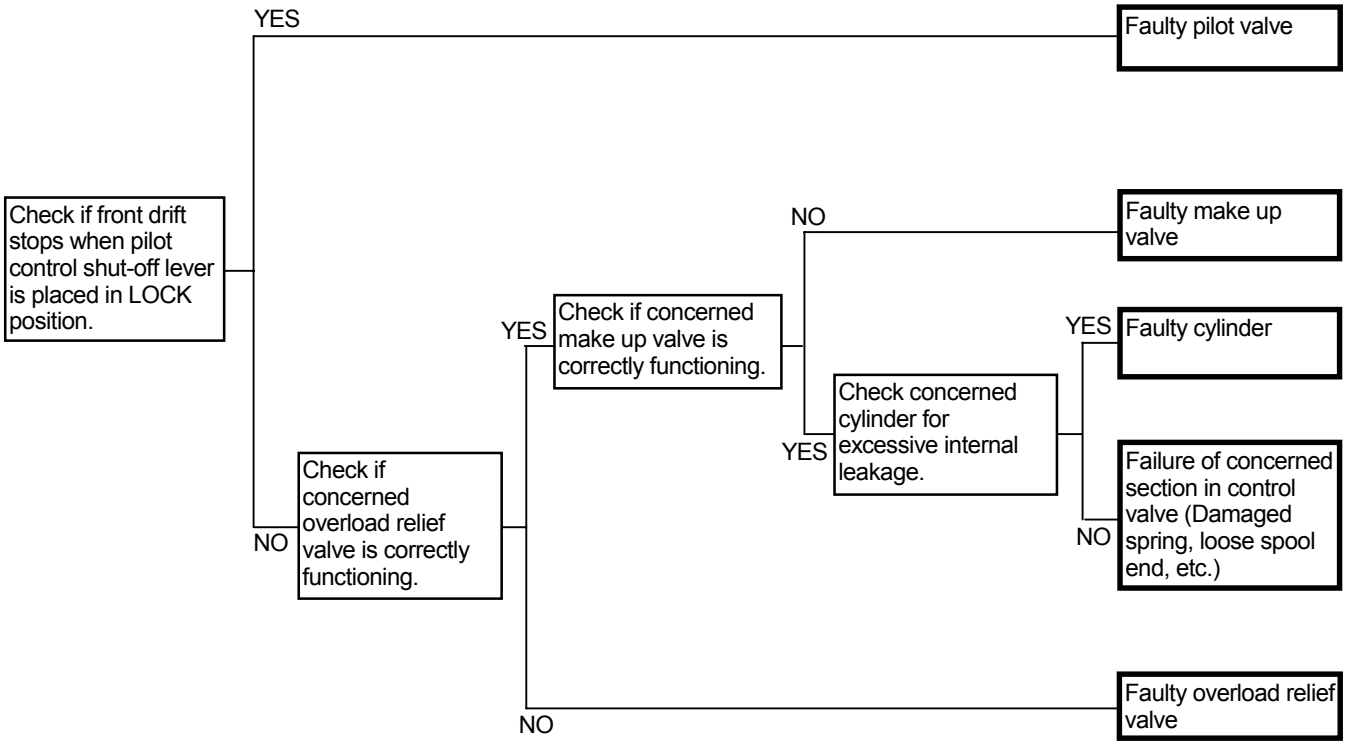
Starting aid mechanism does not function.

- Check for loose harness connections beforehand.

NOTE: When the coolant temperature is 38 °C (100 °F) or higher, the starting aid solenoid valve is not activated.



Front attachment drifts excessively.

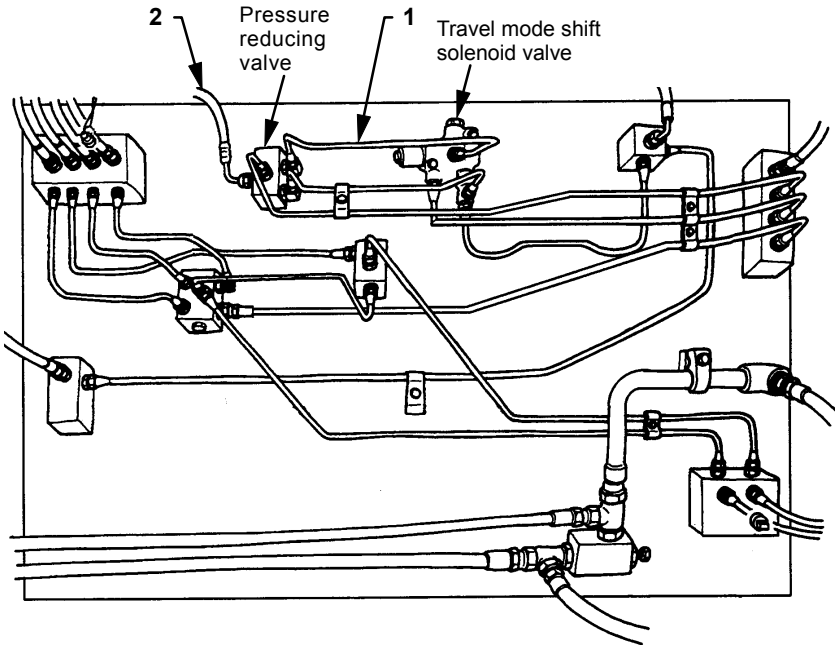


Travel mode does not shift to the slow speed mode.

- Check for loose harness connections beforehand.

Disconnect line (1) to travel mode shift solenoid valve. Attach a pressure gauge into solenoid valve port. Measure pressure reducing valve shift pressure.
· Travel speed (mode) change switch: OFF

- 40 kgf/cm^2 → Disconnect blue line plug from travel mode shift solenoid valve. Check if pressure reducing valve shift pressure becomes 40 kgf/cm^2.
  · Travel speed (mode) change switch: ON
  - 40 kgf/cm^2 → Faulty travel mode shift solenoid valve
  - 0 kgf/cm^2 → Reconnect travel mode shift solenoid valve plug. Disconnect travel mode shift relay connector. Check if pressure reducing valve shift pressure becomes 40 kgf/cm^2 .
    · Travel speed (mode) change switch: ON
- 0 kgf/cm^2 → Disconnect hose (2) from pressure reducing valve. Attach a pressure gauge into hose port to measure pressure.
  · Travel speed (mode) change switch: ON
  - 32 kgf/cm^2 or lower → Failure of travel motor displacement mechanism.
  - 33 kgf/cm^2 or higher → Faulty pressure reducing valve

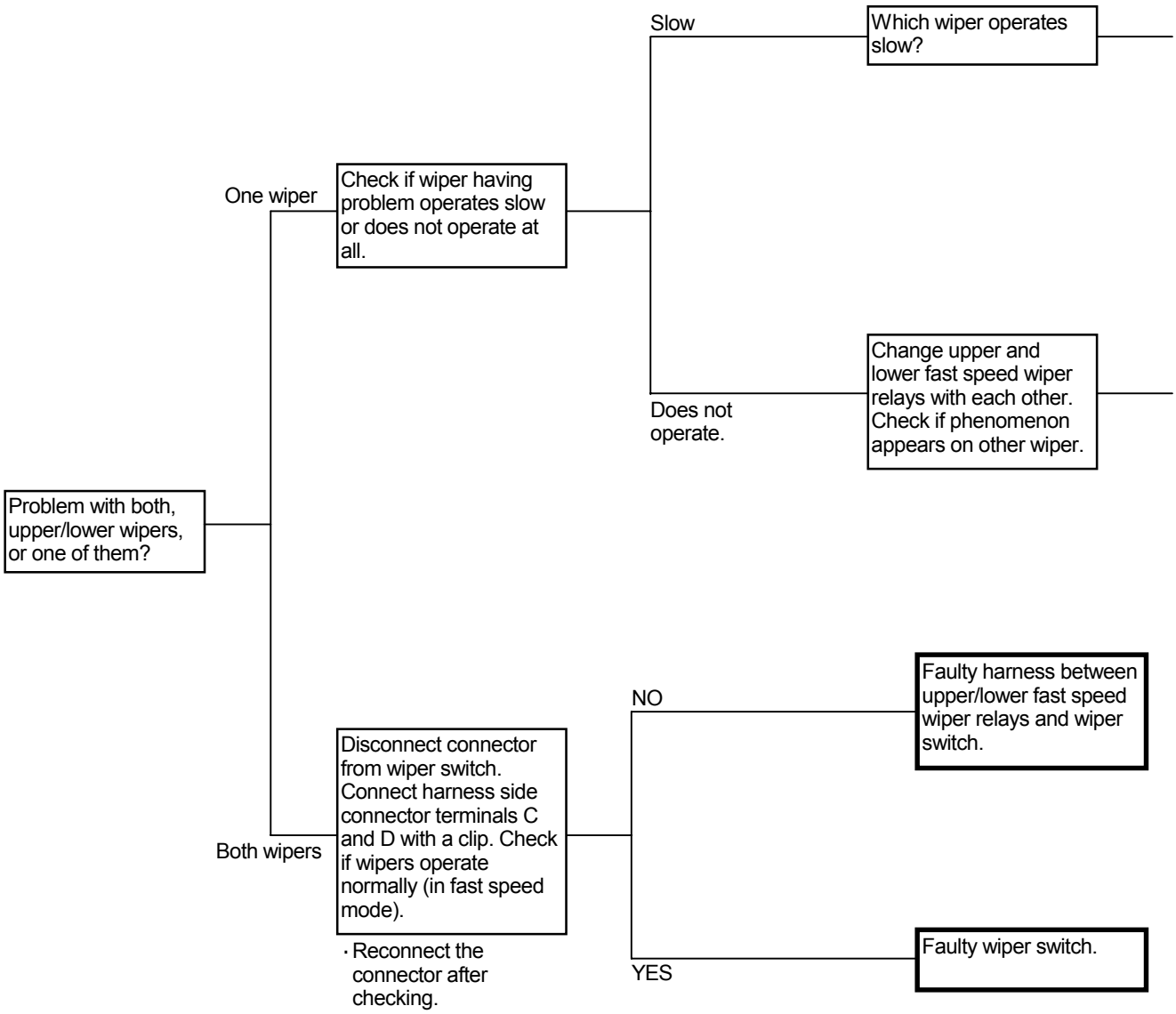


T117-01-02-003

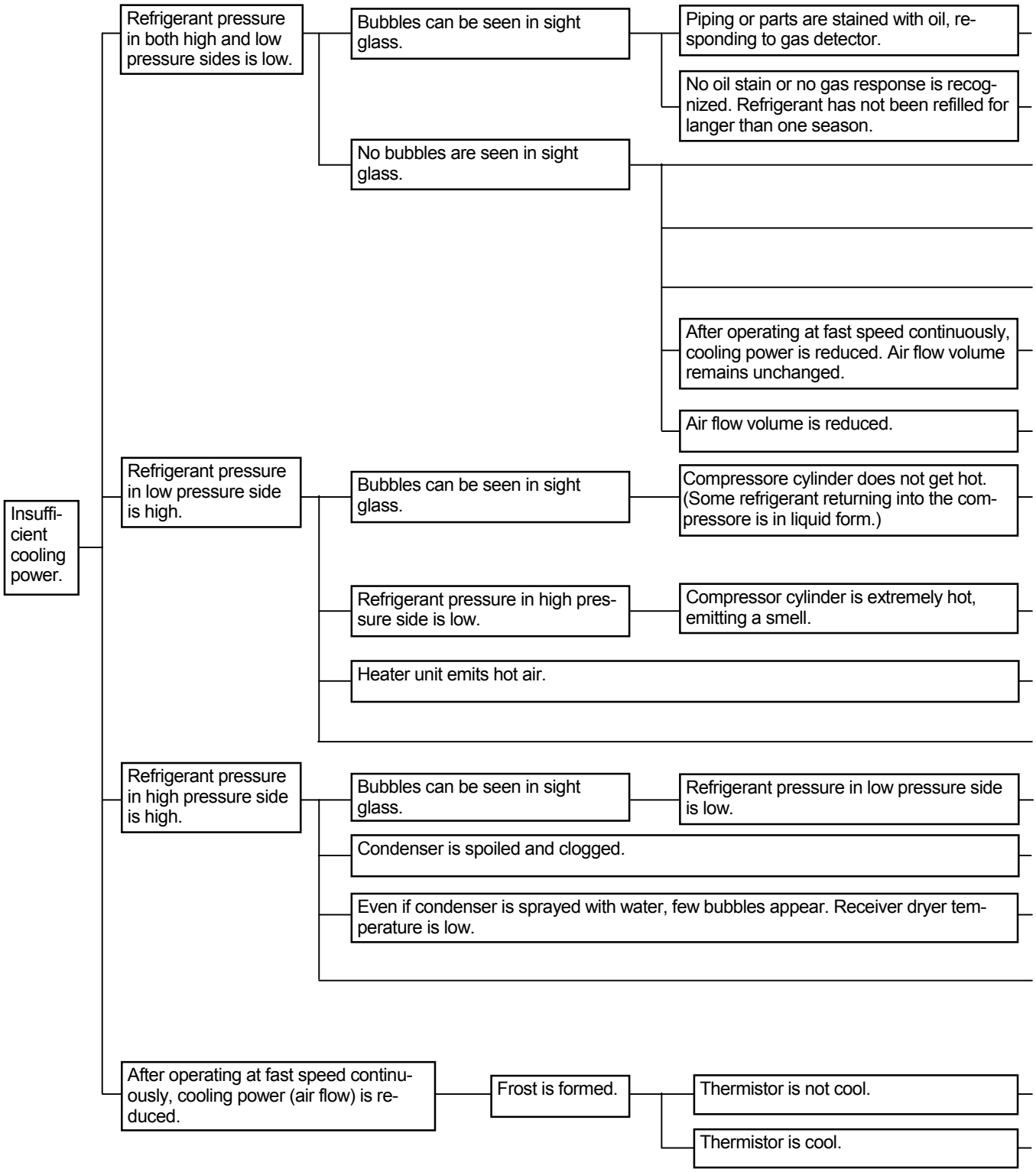
WIPER OPERATING SYSTEM

Wiper does not operate in fast speed mode.

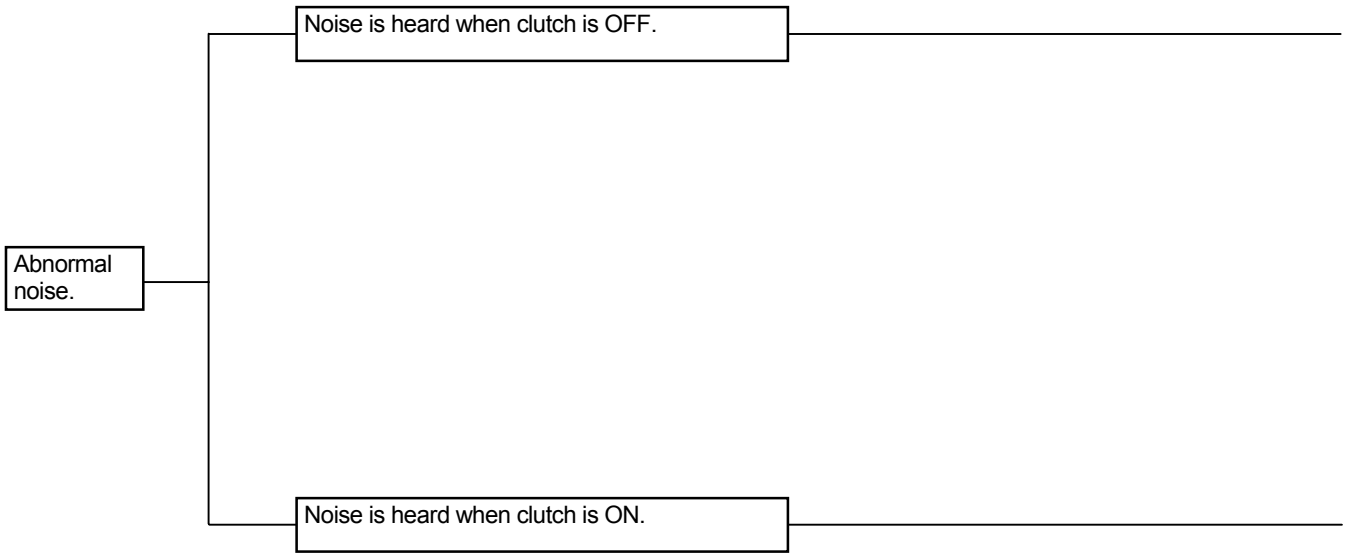
- Check for loose harness connections beforehand.



Refrigeration Circuit



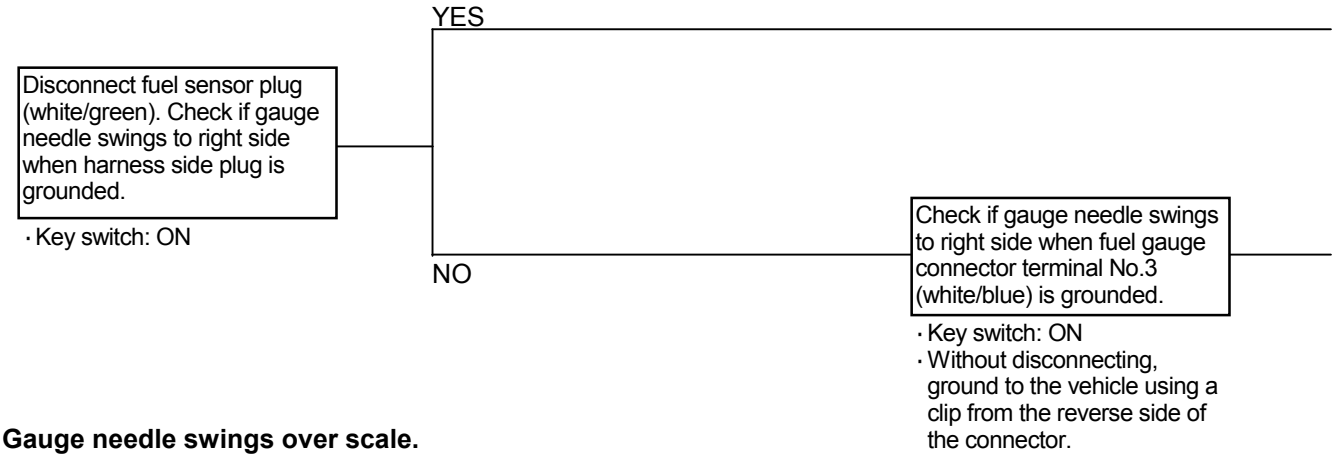
Compressor


Abnormal noise.
Noise is heard when clutch is OFF.
Noise is heard when clutch is ON.

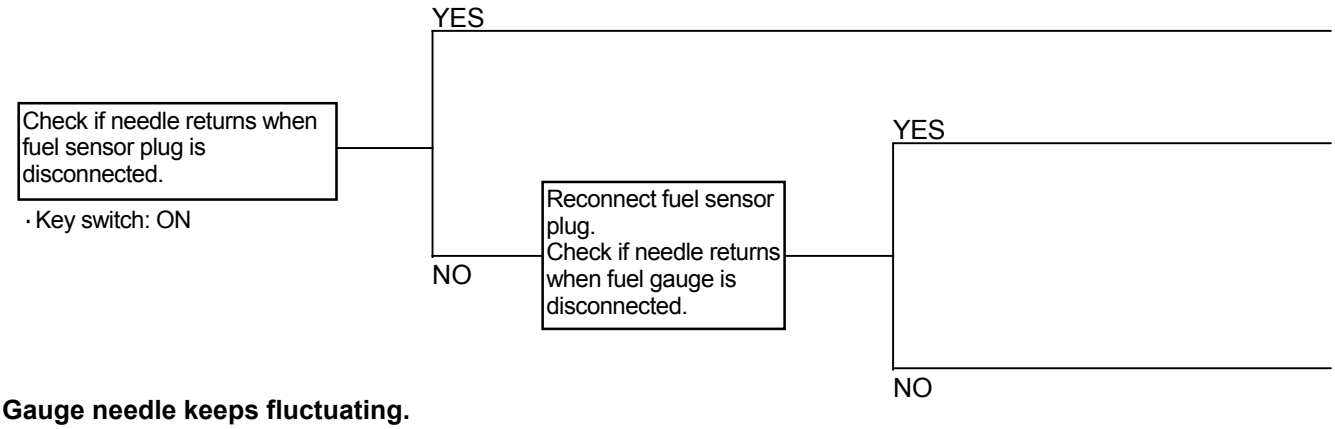
FUEL GAUGE DOES NOT WORK CORRECTLY

- Providing that other meters are working correctly.
- Check for loose harness connections beforehand.

Gauge needle does not move at all.



Gauge needle swings over scale.



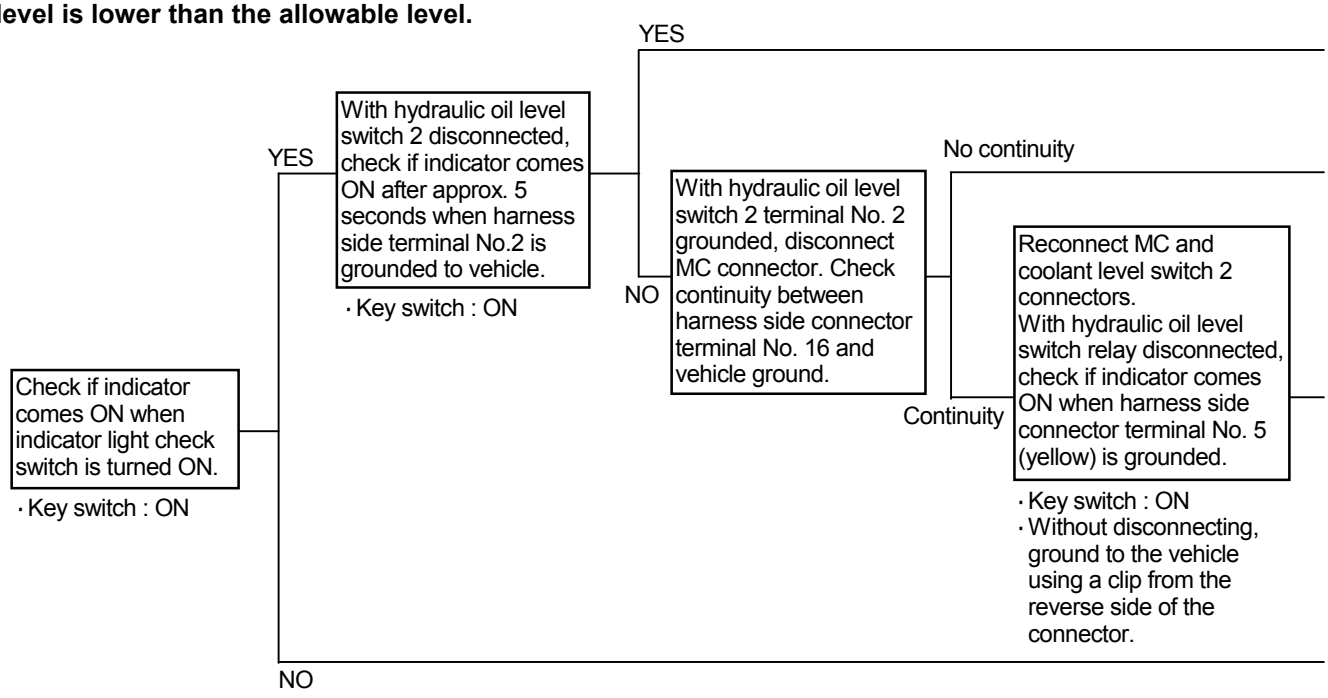
Gauge needle keeps fluctuating.

MALFUNCTION OF HYDRAULIC OIL LEVEL WARNING INDICATOR

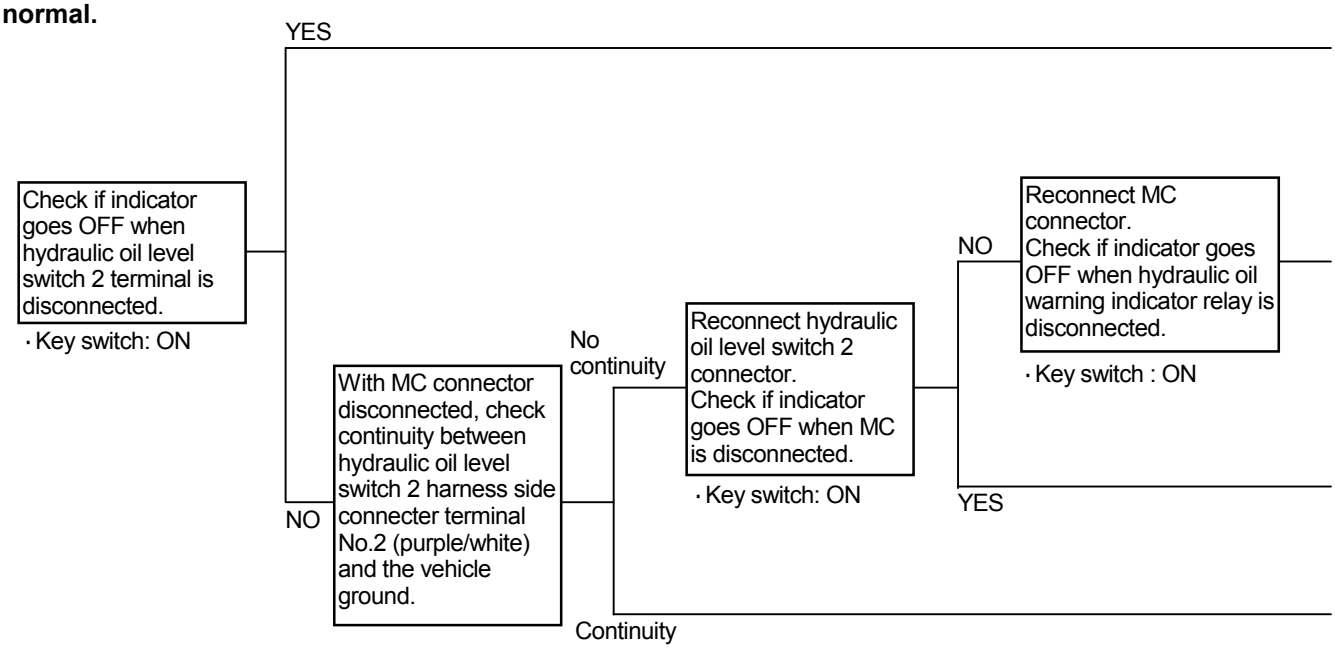
- Check for loose harness connections beforehand.

NOTE: Hydraulic oil level switch 2 activation level. 58 US gal (220 L) or less

Indicator does not come ON even if hydraulic oil level is lower than the allowable level.



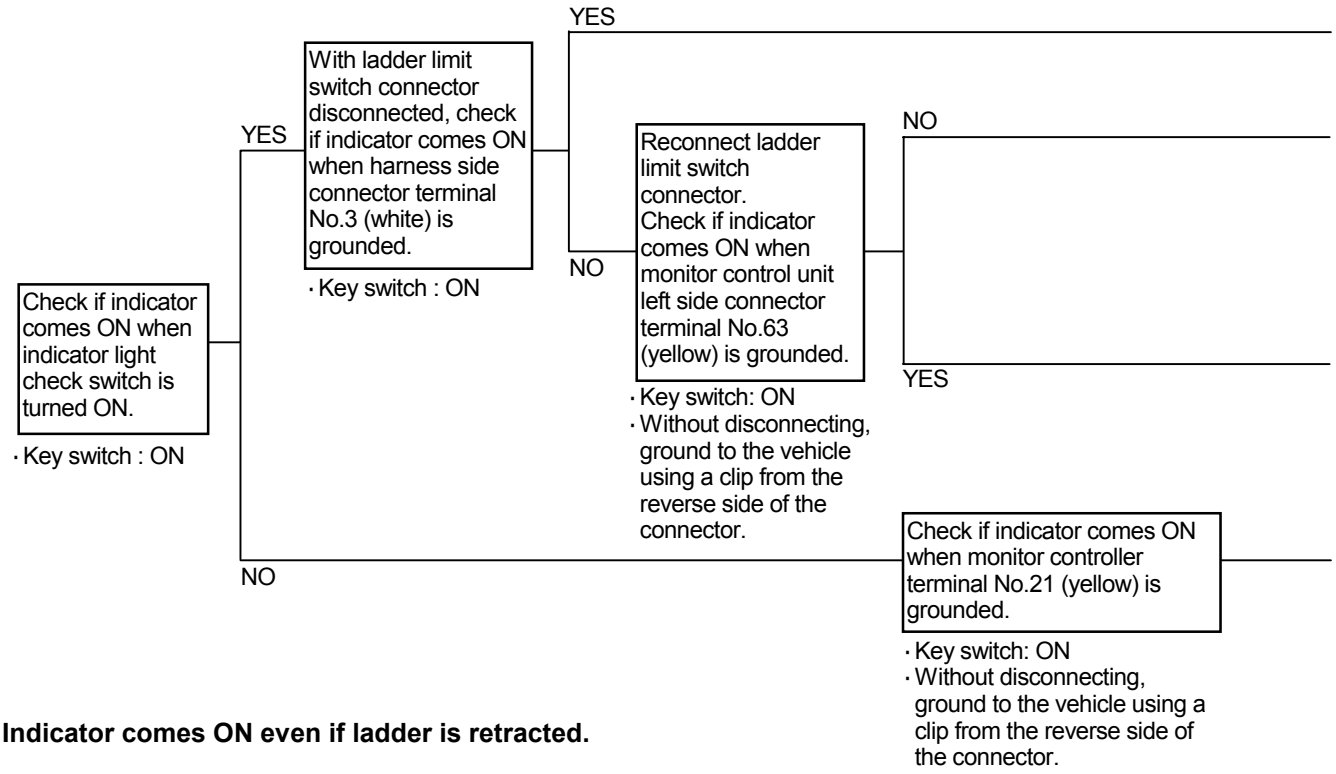
Indicator comes ON even if hydraulic oil level is normal.



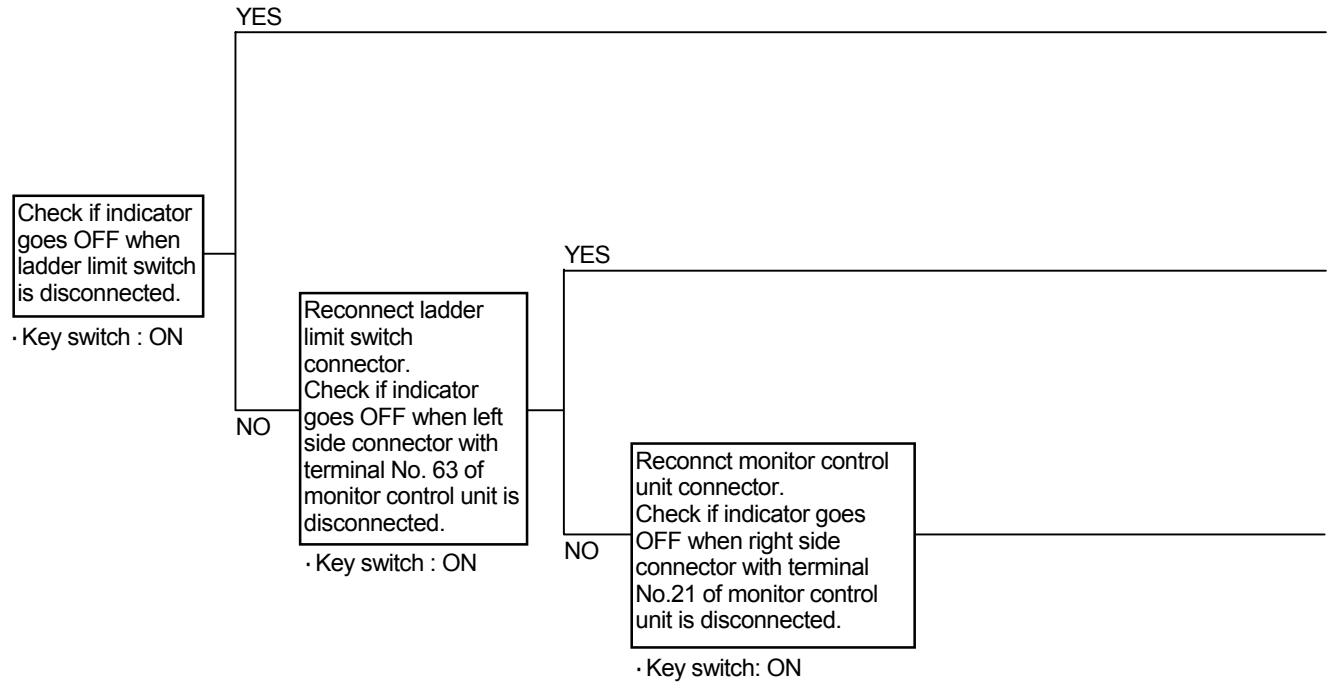
MALFUNCTION OF LADDER INDICATOR

- Check for loose harness connections beforehand.

Indicator does not come ON even if ladder is lowered.



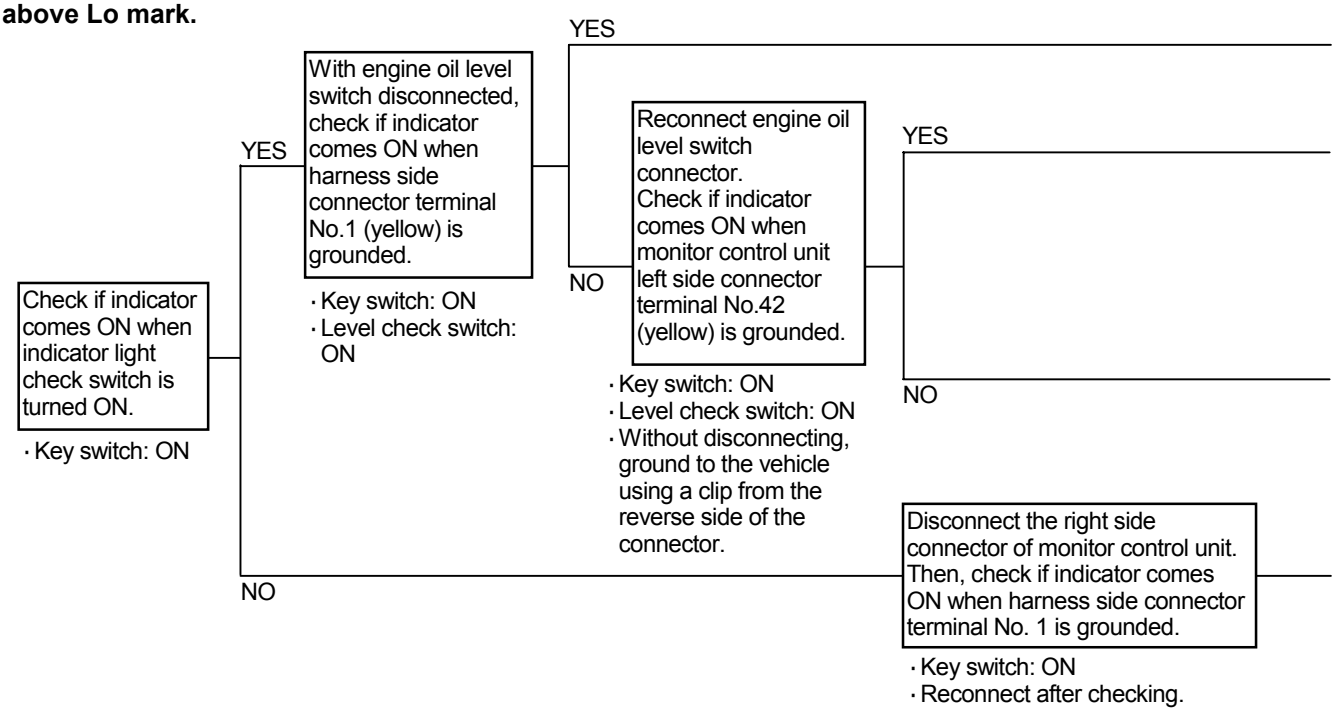
Indicator comes ON even if ladder is retracted.



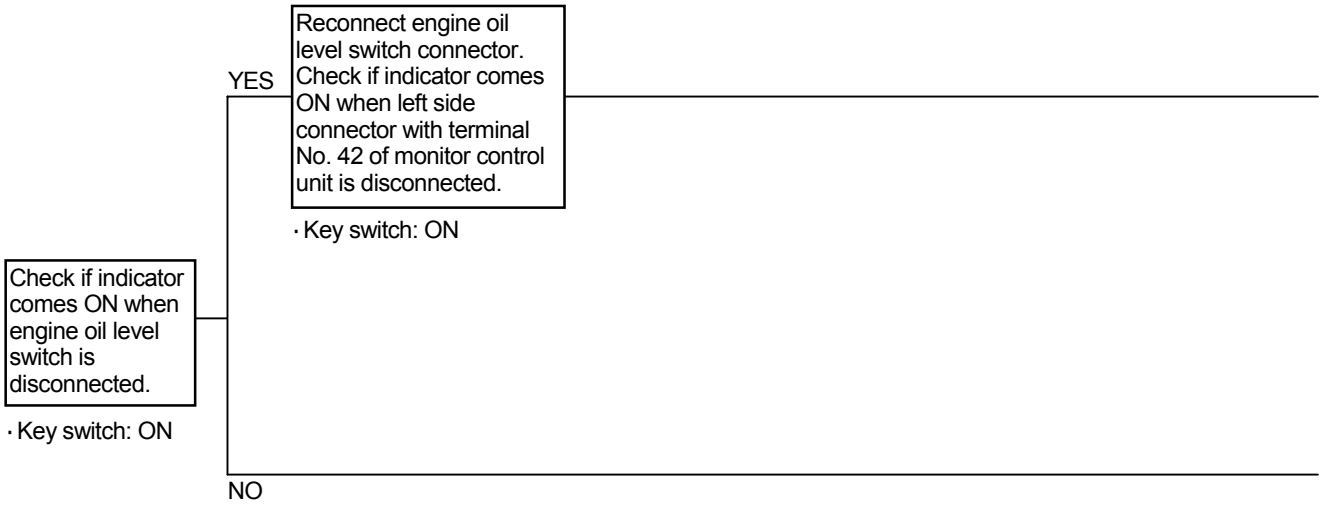
MALFUNCTION OF ENGINE OIL LEVEL INDICATION

- Check for loose harness connections beforehand.

Indicator does not come ON even if oil level is above Lo mark.



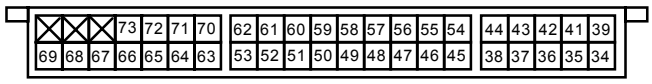
Indicator comes ON even if oil level is below Lo mark.



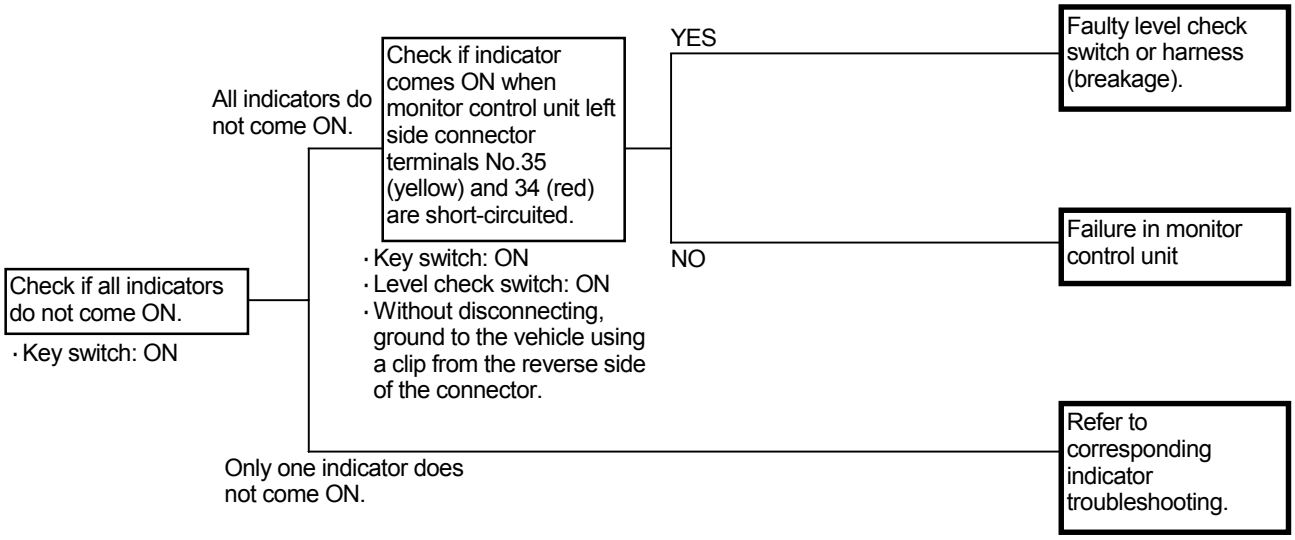
MALFUNCTION OF LEVEL CHECK SWITCH

- Other indicators light correctly.
- Check that oil and coolant levels are correct.
- Check for loose harness connections beforehand.

Connector
Monitor Control Unit (Left Side)



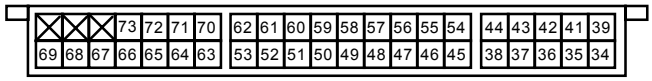
Oil and coolant levels are correct. But, indicator does not come ON when level check switch is depressed

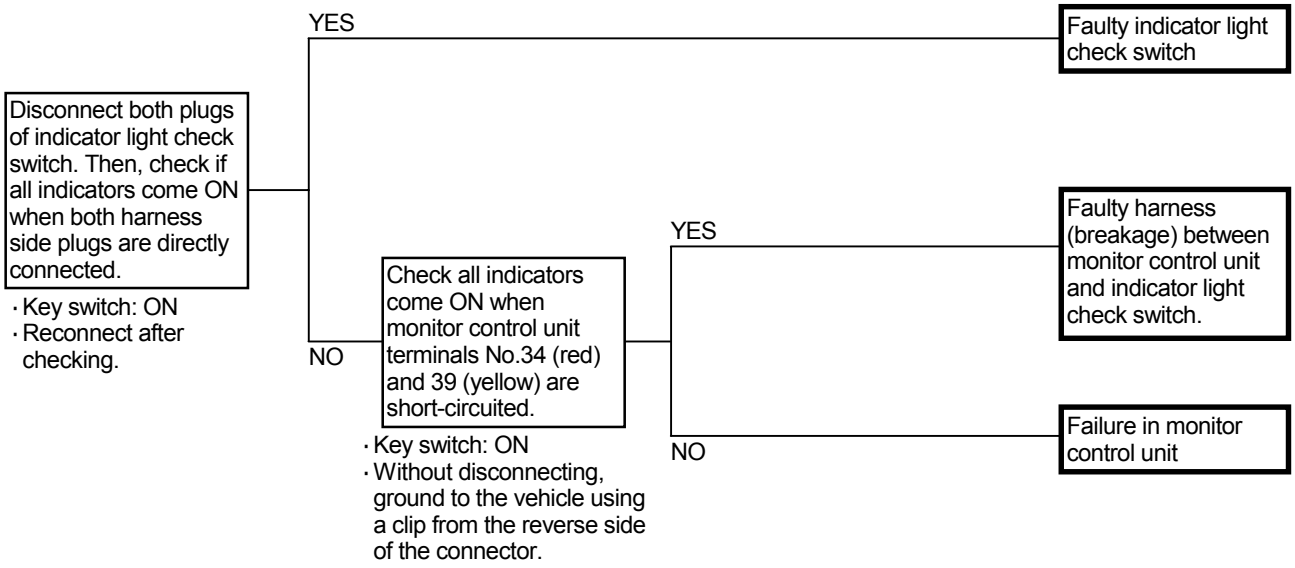


MALFUNCTION OF INDICATOR LIGHT CHECK SWITCH

All indicators do not come ON when indicator light check switch is depressed.

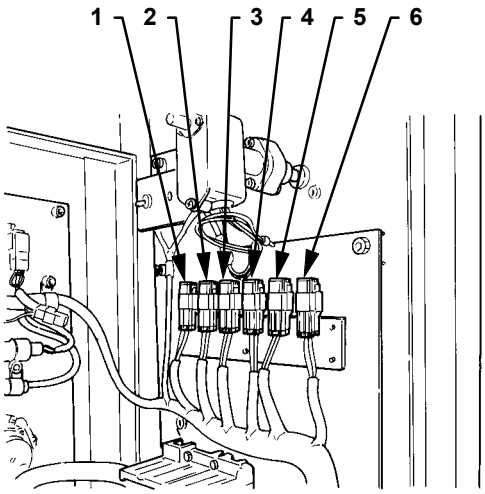
Connector
Monitor Control Unit (Left Side)





SLOW BLOW FUSE INSPECTION

1. Disconnect slow blow fuse. Inspect visually.

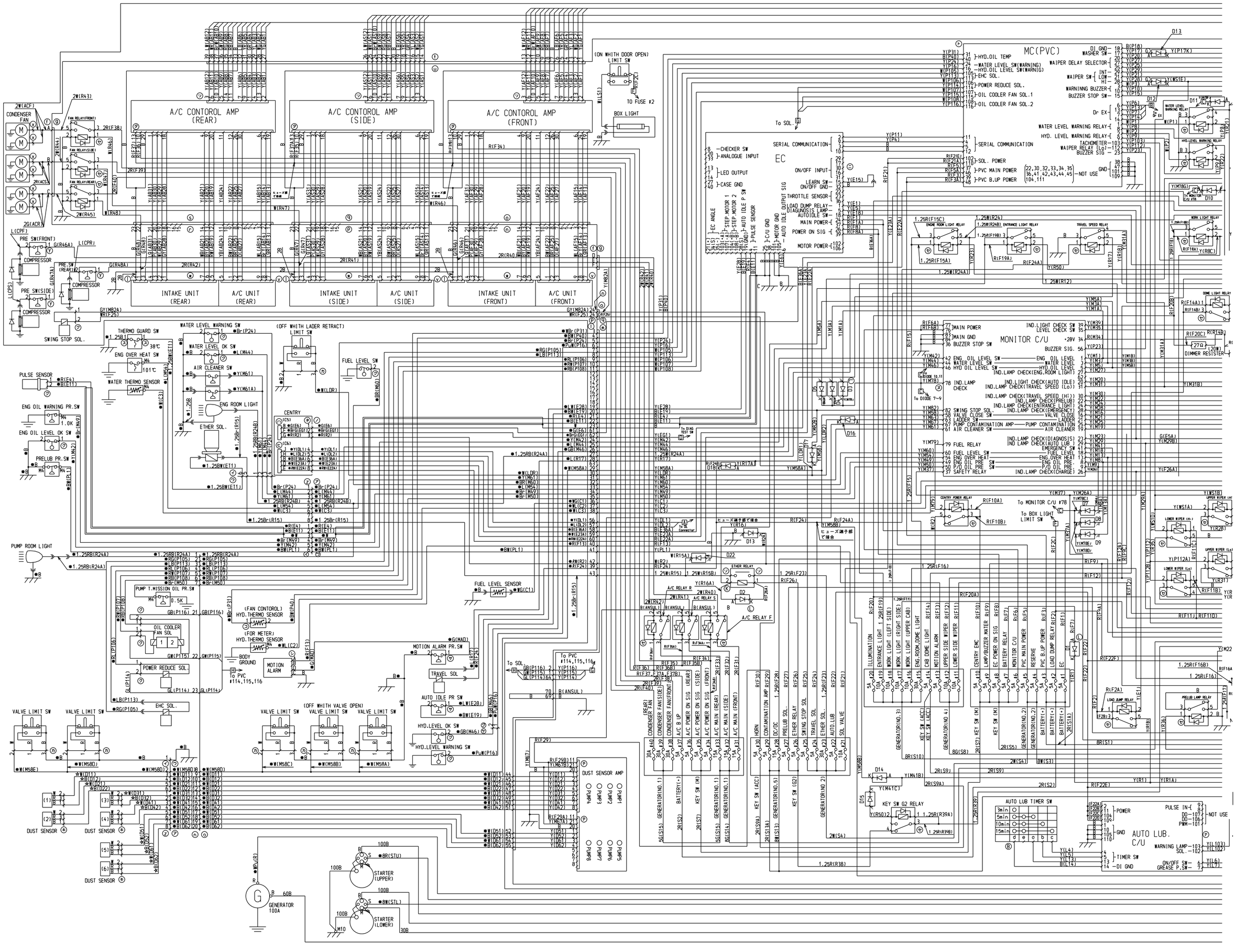


M117-07-073

Slow Blow Fuse No.	Capacity	Connected to	Remarks
1	75 A	Fuse Box 1 (#31 to #33, #38 to #40)	
2	75 A	Fuse Box 1 (#4, #5, #21 to #25), Starter Relay	
3	75 A	Fuse Box 1 (#15 to #20)	
4	75 A	Fuse Box 1 (#11 to #13)	
5	45 A	Fuse Box 1 (#28, #29), Fuse Box 2 (#5)	
6	45 A	Fuse Box 1 (#1 to #3, #37), Fuse Box 2 (#1), Key Switch (Terminal M)	

Attach to Techinical Manual Vol. No.: TT117E-03

EX2500 ELECTRICAL CIRCUIT 1/2: Up to Serial No.132



SECTION 1
GENERAL IMFORMATION

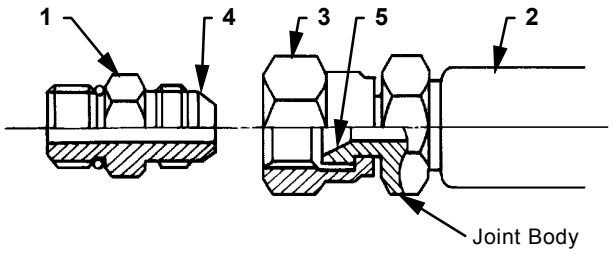
—CONTENTS—

PIPING JOINT

Pipe Thread Connection/Union Joint Tightening Torque Specifications

Union Joint

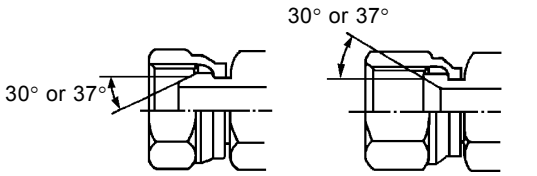
Metal sealing faces (4) and (5) of adaptor (1) and hose (2) fit together to seal pressure oil. Union joints are used to join small-diameter lines.



M202-07-051

IMPORTANT: (1) Do not over-tighten union nut (3). Excessive force will be applied to metal sealing surfaces (4) and (5), possibly cracking adaptor (1). Be sure to tighten union nut (3) to specifications.

(2) Scratches or other damage to sealing surfaces (4) or (5) will cause oil leakage at the joint. Take care not to damage them when connecting /disconnecting.



W105-01-01-017

Wrench Size mm	Tightening Torque		
	N·m	(kgf·m)	(lbf·ft)
19	29	(3.0)	(22)
22	39	(4.0)	(29)
27	93	(9.5)	(69)
32	137	(14)	(101)
36	175	(18)	(130)
41	205	(21)	(152)
50	255	(26)	(188)

O-Ring Seal Joint

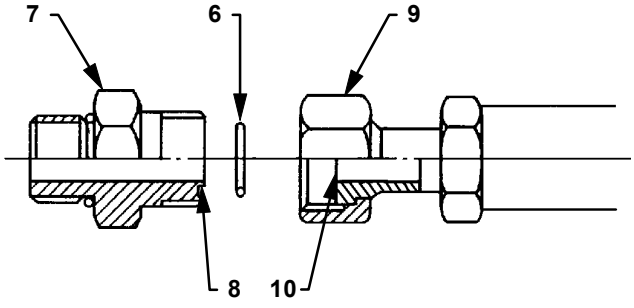
O-ring (6) seats against the end face of adaptor (7) to seal pressure oil.

IMPORTANT: (1) Be sure to replace O-ring (6) with a new one when reconnecting.

(2) Before tightening union nut (9), confirm that O-ring (6) is seated correctly in O-ring groove (8). Tightening union nut (9) with O-ring (6) displaced will damage O-ring (6), resulting in oil leakage.

(3) Take care not to damage O-ring groove (8) or sealing face (10). Damage to O-ring (6) will cause oil leakage.

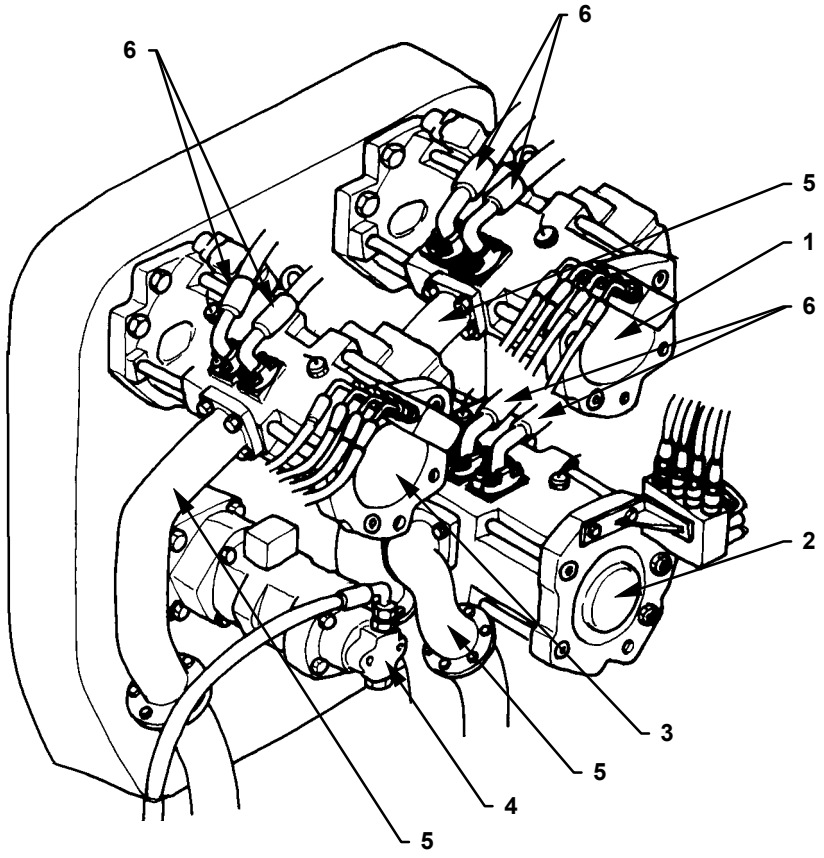
(4) If union nut (9) is found to be loose, causing oil leakage, do not tighten it to stop the leak. Instead, replace O-ring (6) with a new one, then tighten union nut (9) after confirming that O-ring (6) is securely seated in place.



M104-07-033

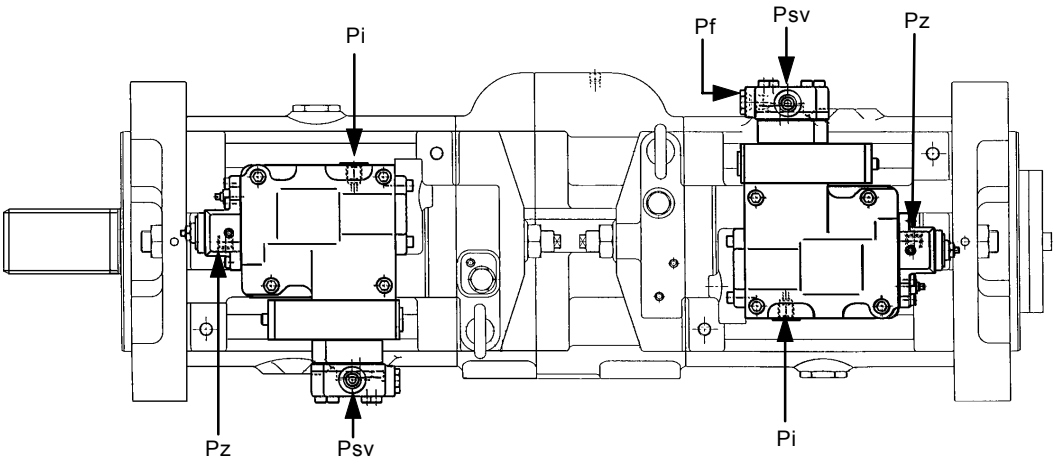
Wrench Size mm	Tightening Torque		
	N·m	(kgf·m)	(lbf·ft)
27	93	(9.5)	(69)
32	137	(14)	(101)
36	175	(18)	(130)
41, 46	205	(21)	(152)

PUMP DEVICE LINE CONNECTION



T117-02-01-001

1 - Main Pump 3 (Transmission Side)
Main Pump 4 (Tip Side)
2 - Main Pump 5 (Transmission Side)
Main Pump 6 (Tip Side)
3 - Main Pump 1 (Transmission Side)
Main Pump 2 (Tip Side)
4 - Quadruple Pump
5 - Suction Line
6 - Delivery Line



T117-02-01-004

Psv - Pump Servo Assist Pressure (From the pilot pump)

Pi - Flow Rate Control Pressure
(Switch Valves 1 and 2, Pressure Reducing Valve)

Pf - Horsepower Reducing Control Pressure
(Horsepower Reducing Solenoid Valve)

Pz - Horsepower Increasing Control Pressure
(EHC Valve)

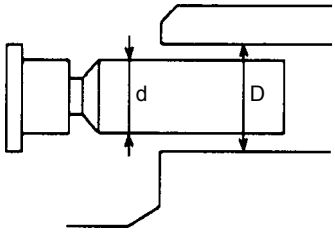
MAINTENANCE STANDARDS

NOTE: 1 mm= 0.03937 in

1. Clearance between plunger (47) diameter (d) and cylinder block (42) bore (D).

D-d — Unit : mm

Standard	Allowable Limit
0.047	0.094

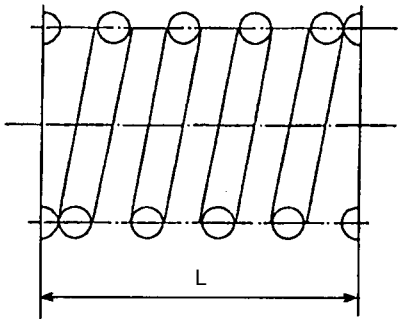


W117-02-02-009

2. Spring (43) free length (L)

Unit : mm

Standard	Allowable Limit
49.5	48.0



W117-02-02-010

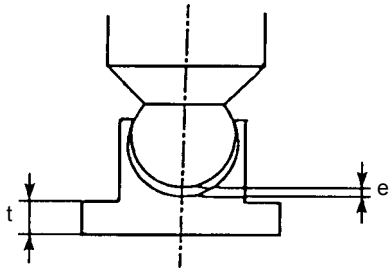
3. Clearance between plunger and shoe: (e), and shoe thickness (t)

e — Unit : mm

Standard	Allowable Limit
0~0.1	0.35

t — Unit : mm

Standard	Allowable Limit
6.5	6.3

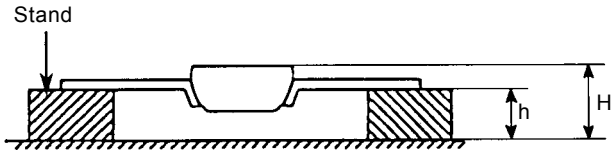


W117-02-02-011

4. Distance between retainer (46) bottom and spherical bushing (45) top.

H-h — Unit : mm

Standard	Allowable Limit
16.5	15.5



W117-02-02-012

Assemble Regulator

1. Install compensating rod (7) into casing (80).

2. Attach pin (21) into the designated hole on lever (22). Install lever (22) by inserting pin (21) into the groove on compensating rod (7) and, at the same time, by inserting pin (81), which is already attached on lever (22), into the designated hole on casing (80).

3. Insert sleeve (19) and spool (20) into casing (80).

NOTE: Before inserting, be sure that the correct end of spool (20) is facing the casing. Also, confirm that spool (20) moves smoothly in the casing.

4. Install feedback lever (23), aligning its pin hole with that on spool (20). Insert pin (24) into the pin hole.

NOTE: Be sure that the correct end of feedback lever (23) is inserted into casing (80).

5. Insert pilot piston (28) into casing (80).

NOTE: Confirm that pilot piston (28) moves smoothly in casing (80).

6. Install lever (26) so that the lever attached pin (27) fits in the groove on pilot piston (28). Install support plug (86) so that pin (85) on the support plug fits into the hole on lever (26). Install O-ring (87) and lock ring (88) onto support plug (86).

7. Install adjusting plug (82), O-ring (83), and lock ring (84) onto casing (80).

8. Install spring (17), spring (16), spring seat (15), and retaining ring (14) onto spool (20).

9. Install compensating piston (6), sleeve (5), O-ring (4), O-ring (3), sleeve (2), and pin (1) into casing (80).

10. Install O-rings (95), (96), and (97) onto casing (80). Install cover (64) using socket bolts (65) and (66).

: 5 mm
: 11.8 N·m (1.2 kgf·m, 8.7 lbf·ft)

Assemble Fan Drive Pump

1. Install displacement angle shift pin (19), servo piston (25), stopper (22) and stopper (15) into housing (18).

2. If displacement angle shift pin (19) has been separated from servo piston (25), apply LOCTITE to the threaded part of servo piston (25).

3. Place housing (18) on a workbench with the regulator mounting side on the bottom. Attach the shoe plate (30) attached swash plate (30) to displacement angle shift pin (19).

NOTE: Check if swash plate (30) moves smoothly after installing.

4. Install spacer (6), bearing (7), spacer (8), and retaining ring (9) onto shaft (5). Install shaft (5) into cover (11).

5. Install O-ring (3) onto cover (2). Install oil seal (4) and cover (2) onto cover (10) using socket bolts (1).

: 6 mm
: 29 N·m (3 kgf·m, 22 lbf·ft)

6. Install spring (38), spacer (37), spherical bushing (36), retainer (35), plungers (34) and shoes (33) into cylinder block (39). Install cylinder block (39) onto shaft (5), aligning splines.

7. Install pin (62), valve plate (40), O-ring (42), pin (61), stopper (43), steel ball (44), seat (45), stopper (54), steel ball (55), and seat (56) onto valve cover (46). Install cover (57) onto valve cover (46) using socket bolts (58).

8. Install valve cover (46) onto housing (18) using socket bolts (29).

: 17 mm
: 430 N·m (44 kgf·m, 318 lbf·ft)

9. Install coupling (52) onto shaft (5). Install O-ring (51) and plate (49) onto valve cover (46).

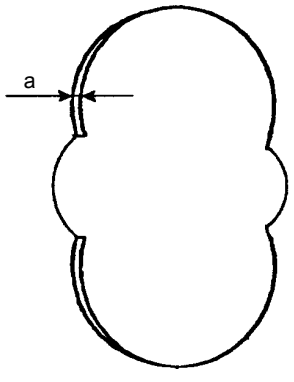
: 19 mm
: 98 N·m (10 kgf·m, 72 lbf·ft)

10. Install regulator (20) using socket bolts (21).

Part Name	Q'ty	Torque			Remarks
		N·m	kgf·m	lbf·ft	
1 - Cover	1				
2 - Dowel Pin	2				
3 - O-Ring	1				
4 - Driven Gear	1				
5 - Plate	1				
6 - O-Ring	1				
7 - Dowel Pin	2				
8 - Center Plate	1				
9 - Dowel Pin	2				
10 - O-Ring	1				
11 - Driven Gear	1				
12 - Plate	1				
13 - O-Ring	1				
14 - Dowel Pin	2				
15 - Flange	1				
16 - Snap Ring	1				
17 - Oil Seal	1				
18 - Pressure Plate	1				
19 - Drive Gear	1				
20 - Pressure Plate	1				
21 - Coupling	1				
22 - Pressure Plate	1				
23 - Drive Gear	1				
24 - Pressure Plate	1				
25 - Coupling	1				
26 - O-Ring	1				
27 - Stud Bolt	4				
28 - Nut	4	24 to 26	2.35 to 2.55	17 to 18.4	
29 - Spring Washer	4				
30 - Stabilizer	4				
31 - Seal Plate	2				
32 - Back Up Ring	2				
33 - Isolation Plate	2				
34 - Isolation Plate	2				
35 - Back Up Ring	2				
36 - Seal Plate	2				
37 - Cover	1				
38 - Socket Bolt	2	49 to 53	5.0 to 5.4	36 to 39	
39 - O-Ring	1				

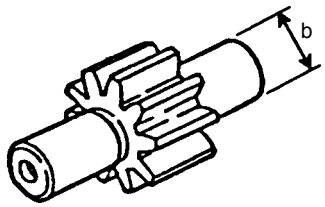
Maintenance Standard

Plates (5) and (12)
$a \geq 0.15$ mm



W117-02-02-021

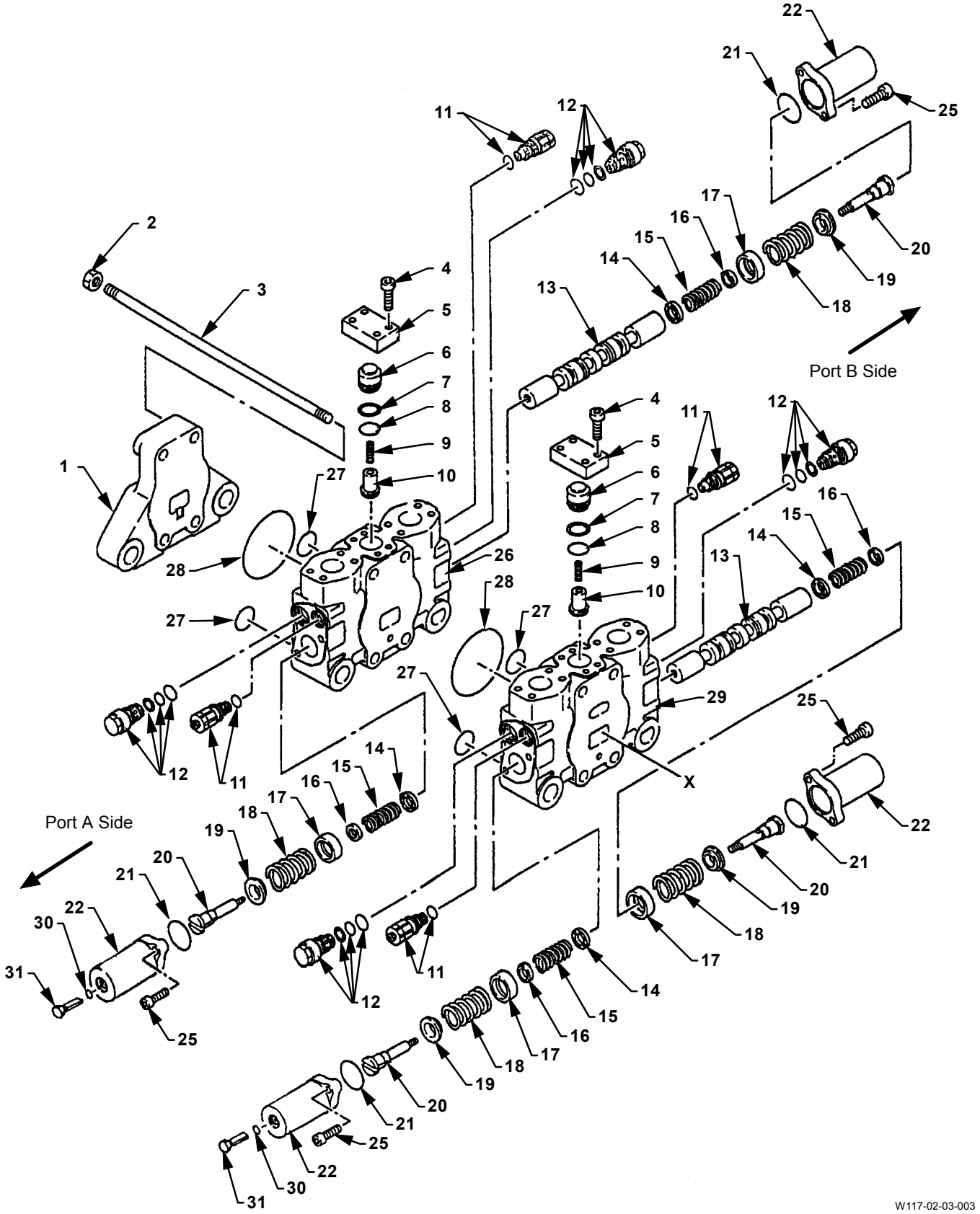
Drive Gears (19) and (23), Driven Gears (4) and (11)
$\phi b < \phi 27.48$ mm



W117-02-02-022

NOTE: 1 mm= 0.03937 in

Left Control Valve



Disassemble First Stage Carrier (9) Assembly

10. Unbend lock washers (18). Remove bolts (17), lock washers (18), lock plates (19), pin (20), and first stage planetary gear (24) assemblies.

    : 24 mm

11. Remove bearings (21), spacers (22), and retaining ring (23) from first stage planetary gear (24).

CAUTION: First Stage Carrier (9) Weight: 59 kg (130 lb)

12. Remove retaining ring (8) to remove first stage carrier (9).

Disassemble Second Stage Carrier (13) Assembly

CAUTION: Second Stage Carrier (13) Assembly Weight: Approximately 230 kg (507 lb)

13. Turn over second stage carrier (13) assembly.

14. Unbend lock washers (31). Remove bolts (32), lock washers (31), lock plates (30), pins (29) and second stage planetary gear (28) assemblies.

    : 24 mm

15. Remove bearings (25), spacers (26), and retaining ring (27) from first stage planetary gear (28).

1. Install spacer (22) and retaining ring (21) onto shaft (27). Heat bearing (23). Install it onto shaft (27) using a press. Install spacer (25) and retaining ring (26).

2. Install shaft (27) into casing (17) using a press.

3. Install oil seal (28) and O-ring (24) onto cover (29). Install cover (29) onto casing (17) using socket bolts (30).

   : 8 mm
   : 57 N·m (5.8 kgf·m, 42 lbf·ft)

4. Install disk spring (18), shim (19), spherical bushing (20), plungers (34), retainer (33) and shoes (32) into rotor (37).

5. Install shoe plate (31) onto casing (17). Insert rotor (37) assembly onto shaft (27).

6. Place valve plate (16) on rotor (37). Measure the distance (ℓ) between the end face of casing (17) and the end face of valve plate (16). Also, measure cover (43) dimension (L).
   Deduct distance (ℓ) from distance (L).
   If the solution (L-ℓ) is less than the allowable limit value, replace disk spring (18) with a new one.

L-ℓ

Standard		Allowable Limit	
mm	in	mm	in
7.8	0.31	7.4	0.29

7. Install O-ring (14), guide ring (39) and valve plate (16) onto cover (43), then install cover (43) on casing (17) using socket bolts (1, 13).

   : 14 mm
   : 235 N·m (24 kgf·m, 175 lbf·ft)

NOTE: Be sure to apply grease to valve plate (16) before installing it on cover (43). Install valve plate (16) on cover (43) so that the hole (38) provided side of valve plate (16) is positioned on the BDC plunger side of the rotor when cover (43) is installed, as illustrated.

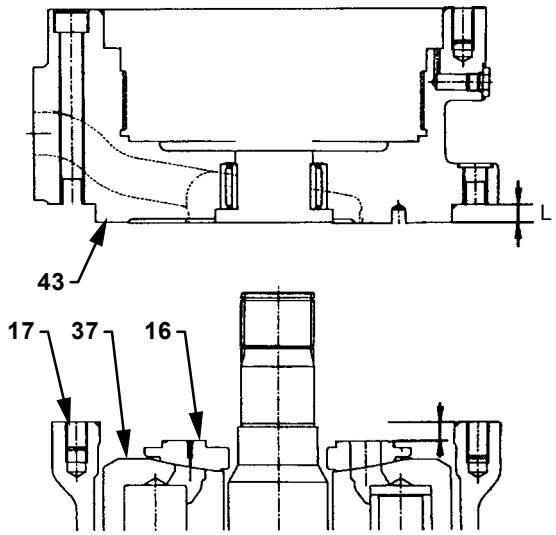
8. Install retaining ring (4), coupling (7) and retaining ring (5) onto shaft (27).

9. Install spring (41) and shim (42) onto cover (43). Install plates (11) and friction plates (12) one by one alternately.

10. Install piston rings (9, 16) onto piston (44), then install it onto cover (43). Put springs (3) on piston (44).

11. Install O-ring (2) onto cover (6), then install it onto cover (43) using bolts (8).

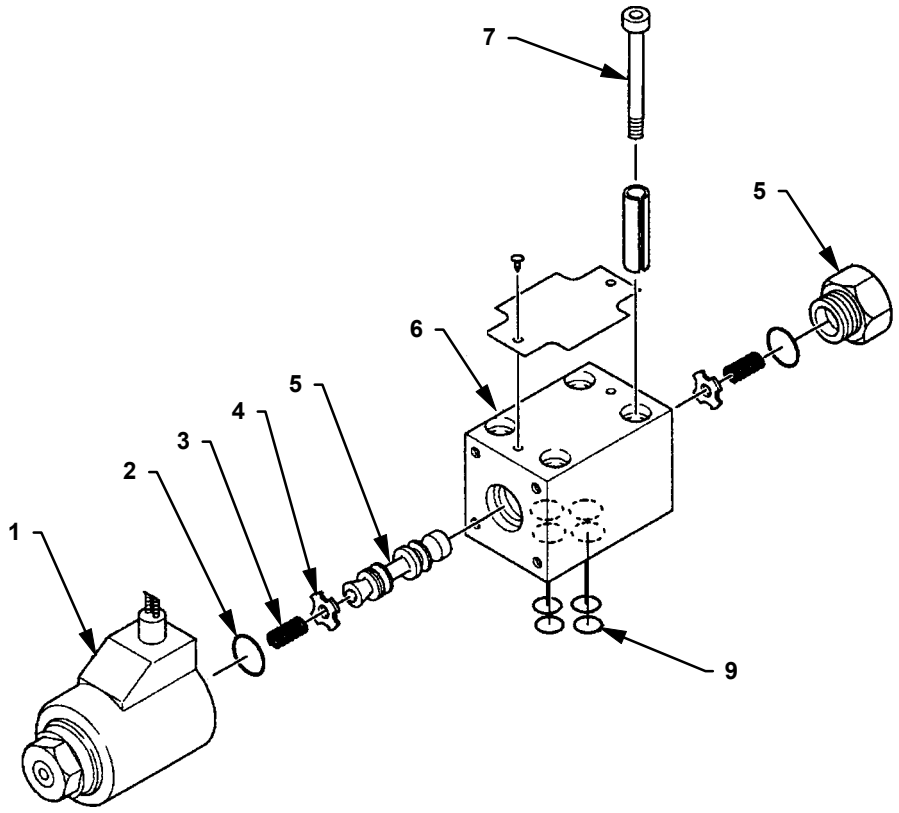
    : 24 mm
    : 235 N·m (24 kgf·m, 175 lbf·ft)



W117-02-04-006

Part Name	Q'ty	Wrench Size	Tightening Torque			Remarks
			N·m	(kgf·m)	(lbf·ft)	
1 - Nut	1					
2 - Lock Nut	1					
3 - Joint	1					
4 - Plate	1					
5 - Plunger	4					
6 - Plate	1					
7 - Seal	4					
8 - O-Ring	4					
9 - Cap	4					
10 - Spring Seat	4					
11 - Collar	4					
12 - Spring Seat	4					
13 - Inner Spring	4					
14 - Outer Spring	4					
15 - Spring Seat	4					
16 - Plug	5					
17 - Body	1					
18 - Spool	4					
19 - Piston	4					
20 - O-Ring	6					
21 - O-Ring	1					
22 - Body	1					
23 - O-Ring	1					
24 - Socket Bolt	1					

DISASSEMBLE AND ASSEMBLE HORSEPOWER REDUCING SOLENOID VALVE



W117-02-07-003

Part Name	Q'ty	Wrench Size	Tightening Torque			Remarks
			N·m	(kgf·m)	(lbf·ft)	
1 - Solenoid	1					
2 - O-Ring	2					
3 - Spring	2					
4 - Spring Seat	2					
5 - Spool	1					
6 - Casing	1					
7 - Socket Bolt	4	: 4 mm	7	(0.7)	(5)	
8 - Plug	1		49	(5)	(36)	
9 - Square Section Bearing	4					

1. Install retaining ring (29) onto shaft (28). Heat bearing (30) to approximately 60 °C (140 °F) and install it onto shaft (28) using a press. Install retaining ring (31).

2. Heat bearing inner race (27) to approximately 60 °C (140 °F) and install it onto shaft (28) using a press. Install retaining ring (26).

3. Position shaft (28) in housing (24). Install bearing (30) outer race by evenly tapping with a steel bar.

4. Install oil seal (32) onto cover (34).

NOTE: Be sure to install oil seal (32) so that the seal lip faces the inner side.

5. Install O-ring (33) and cover (34) onto housing (24). Install retaining ring (35).

6. Install spacer (15), spring (14), and spacer (13) into rotor (16). Install retaining ring (12).

7. Insert push rods (17) into rotor (16). Install spacer (18) and spherical bushing (19).

NOTE: Be sure to insert two push rods (17) for each hole.

8. Install shoe (22) onto plunger (21). Install them onto retainer (20). Install plunger (21) assembly into rotor (16).

9. Install shoe plate (23) onto housing (24) with the chamfered side facing downward.
Install rotor (16) assembly onto shaft (28), aligning splines.

NOTE: Align splines of spherical bushing (19) and rotor (16) for easier installation.

10. Install bearing outer race (5) into valve housing (2) by evenly tapping with a steel bar.

11. Install valve plate (6) and O-ring (3) onto valve housing (2). Install valve housing (2) onto housing (24) using socket bolts (1).

: 14 mm
: 235 ± 35 N·m
(24 ± 3.6 kgf·m, 174 ± 26 lbf·ft)

12. Install poppet (7) and spring (8) into valve housing (2). Install O-ring (9) and plug (10) onto valve housing (2).

: 10 mm
: 108 ± 9.8 N·m
(11 ± 1 kgf·m, 80 ± 7 lbf·ft)

13. Install relief valve (11) onto valve housing (2).

: 36 mm
: 147 ± 15 N·m
(15 ± 1.5 kgf·m, 109 ± 11 lbf·ft)

WORK AFTER COMPONENT REPLACEMENT

The following work is required after replacing compressor, high pressure hose, low pressure hose, condenser, receiver tank, liquid hose, and air conditioner unit.
The same work is required when gas leakage is found.

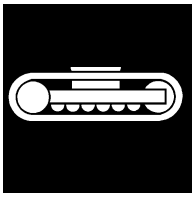
1. Add compressor oil

2. Charge air conditioner with refrigerant
   - Purging
   - Charge air conditioner with refrigerant
   - Worm up operation
   - Inspection

ADD COMPRESSOR OIL

Compressor oil quantity to be added after component replacement:
- 220 cm^3 (0.23 US qt) :
  After replacement of the compressor, high pressure hose, condenser, receiver tank, liquid hose, or air conditioner unit.
- 100 cm^3 (0.11 US qt) :
  After replacement of the low pressure hose.

SECTION 3
UNDERCARRIAGE



—CONTENTS—

Assemble Travel Reduction Gear

IMPORTANT: Be sure to insert seat (3) with the oil groove facing upwards.

1. Insert seat (3) into the center hole on plate (2). Set seat (3) into plate (2) by mushrooming symmetrical two points between the seat (3) and plate (2) using a punch and hammer. Install plate (2) onto second stage carrier (40).

IMPORTANT: Be sure to align the matching marks when installing bearings (42) into second stage planetary gear (41). When replacing bearings (42), be sure to replace them as a pair, with "A" mark stamped end facing each other.
Bend lock washers (47) to secure bolts (48).

2. Install retaining ring (44), spacers (43) (2 used), and bearings (42) (2 used) into each second stage planetary gear (41) (4 used). Install second stage planetary gears (41) (4 used) into second stage carrier (40) using pins (45) (4 used). Install lock plates (46) (4 used), lock washers (47) (4 used), and bolts (48) (8 used).

: 30 mm
: 390 N·m (40 kgf·m, 290 lbf·ft)

CAUTION: Approximate First Stage Carrier (5) Weight: 190 kg (419 lb)

3. Install ball bearing (7) and retaining ring (8) onto second stage sun gear (4). Drive stopper pin (9) into ball bearing (7). Lift and install first stage carrier (5) onto second stage sun gear (4) using a crane. Install retaining ring (6).

IMPORTANT: Be sure to align the matching marks when installing roller bearings (12) into first stage planetary gear (15). When replacing bearings (12), be sure to replace them as a pair, with "A" mark stamped end facing each other.

4. Install retaining ring (14), spacers (13) (2 used), and roller bearings (12) (2 used) into each first stage planetary gear (15) (3 used). Install first stage planetary gears (15) (3 used) into first stage carrier (5) using pins (11) (3 used). Install retaining rings (16) (3 used).

IMPORTANT: Be sure to align the matching marks when installing roller bearings (24) into pinion gear (25). When replacement of bearing (12) is required, be sure to replace both of them.

5. Install roller bearings (24) (2 used) into pinion gear (25). Install pinion gear (25) into case (17).

CAUTION: Approximate Gear (23) Assembly Weight: 150 kg (330 lb)

6. Install ball bearings (18) (2 used) into gear (23). Lift and install gear (23) onto case (17) using a crane.

9. Install plungers (13) into rotor (9). Install them onto drive shaft (5) as an assembly.

IMPORTANT: Do not remove roller bearing (32) unless necessary.
(If removed, be sure not to reuse it. Replace with a new one. Be sure to install roller bearing (32) onto valve cover (30) using a steel bar.)
Be sure to apply a coat of grease to the mating surfaces between valve plate (8) and valve cover (30).

10. Install knock pin (34) and valve plate (8) onto valve cover (30).

CAUTION: Approximate Valve Cover (30) Weight: 41 kg (90 lb)

11. Install O-ring (31) on casing (40). Install O-ring (28) on valve cover (30).

12. Lift and install valve cover (30) onto casing (40). Tighten socket bolts (29) (9 used) and (39) (3 used).

: 14 mm
: 235±35 N·m
(24±3.6 kgf·m, 174±26 lbf·ft)

13. Install spacer (56), coupling (26), and retaining ring (23) onto drive shaft (5).

14. Install shim (27) into valve cover (30). Install plates (25) (9 used) and friction plates (24) (8 used) on coupling (26), one by one alternately.

15. Install O-rings (20) and (21) onto brake casing (22). Install O-ring (17) onto cover (16).

16. Insert brake piston into brake casing (22).

17. Install springs (18) (10 used) in brake piston (19).

18. Install cover (16) onto brake casing (22).

19. Install brake casing (22) onto valve cover (30) using socket bolts (14) (12 used).

: 10 mm
: 98±15 N·m
(10±1.5 kgf·m, 72±11 lbf·ft)

20. Install pistons (50) and shoes (47) into the front casing side of casing (40).
Install O-ring (45) and O-ring (52) onto stoppers (46).

21. Install stoppers (46) and covers (44) using socket bolts (43) (4 used).

: 14 mm
: 235±35 N·m
(24±3.6 kgf·m, 174±26 lbf·ft)

Disassemble Drive Tumbler

- Be sure to thoroughly read “Precautions for Disassembly and Assembly” on page W1-1-1 before starting disassembly work.

CAUTION: Cover (20) weight: 80 kg (176 lb)

1. Remove bolts (1) to remove cover (20). Remove washers (2), O-ring (17) and shims (18) and (19).

   : 41 mm

CAUTION: Plate (16) weight: 24 kg (53 lb)

2. Remove bolts (22) to remove plate (16). Remove washers (21) and shims (14) (15).

   : 41 mm

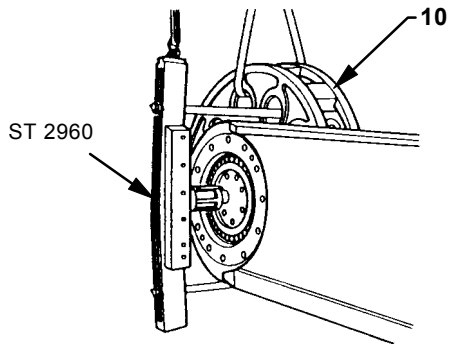
CAUTION: Cover (3) weight: 45 kg (99 lb)

3. Remove bolts (1) from the inner side of the side frame to remove cover (3). Remove washers (2).

   : 41 mm

4. Securely hold drive tumbler (10) using a crane. Attach a hydraulic jack and special tool (ST 2906) to drive tumbler (10) from the outer side of the drive tumbler.

   Hydraulic Jack Capacity: 50 tons



W115-03-06-010

CAUTION: Bearing (6) and shaft (7) combined weight: 617 kg (1360 lb)

5. Remove bearing (6) and shaft (7) using the hydraulic jack.

NOTE: If shaft (7) does not come out, cut bearing (13) using a gas torch.

CAUTION: Cartridge (12) and bearing (13) combined weight: 192 kg (432 lb)

6. Remove cartridge (12) and spacer (11) using two bolts (M27×P3.0).

   : 41 mm

7. Remove cartridge (4) using two bolts (M27×P3.0). Remove O-ring (5).

CAUTION: Drive tumbler (10) weight: 1220 kg (2690 lb)

8. Remove drive tumbler (10). Remove one half of floating seal (9) from both ends of drive tumbler (10). (The other half of floating seals (9) are located on cartridges (12) and (4).)

CAUTION: Bearing (13) weight: 72 kg (159 lb)

9. Remove bearing (13) from cartridge (12).

10. Remove the other half of floating seals (9) from cartridges (12) and (4).

CAUTION: Bearing (6) weight: 104 kg (229 lb)

11. Remove bearing (6) and spacer (8) from shaft (7) using a hydraulic press.

Disassemble Center Joint

- Be sure to thoroughly read “Precautions for Disassembly and Assembly” on page W1-1-1 before disassembling or assembling.

1. Remove bolts (14) (6 used) and spring washers (15) (6 used), then remove cover (11) from body (3) by installing removal bolts (14) in the screw hole on cover (11).

   : 24 mm

2. Remove bolts (9) (8 used), spring washers (10) (8 used) and plate (7) from housing (3), then remove balls (2) (36 used).

   : 19 mm

3. Install jigs (A) to spindle (1) and body (3), then remove spindle (1) from body (3) using jigs.

   No. list of jigs (A) : ST 2440, ST 2441, ST 2442, ST 2443, ST 2444, ST 2445, J901625, J901620

4. Remove seals (4) (5 used) and O-ring (5) from body (3).

5. Remove balls (6) (36 used) and ring plate (8) from spindle (1).

Assemble Center Joint

1. Install balls (6) (39 used) and ring plate (8) onto spindle (1).

2. Install seals (4) (5 used) and O-ring (5) onto body (3).

3. Install spindle (1) into body (3) using jigs (A).

   No. list of jigs (A) : ST 2440, ST 2441, ST 2442, ST 2443, ST 2444, ST 2445

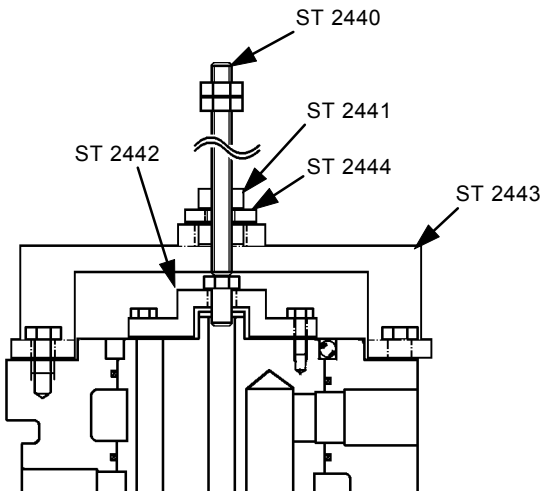
4. Install balls (2) (36 used) in the groove between spindle (1) and body (3).

5. Install plate (7) on balls (2), then tighten bolts (9) (8 used) and spring washers (10) (8 used) to push balls (2) into the groove.

   : 19 mm
   : 88 N·m (9 kgf·m, 65 lbf·ft)

6. Install O-rings (12) and (13) into cover (11), then install cover (11) to body (3) with bolts (14) (6 used) and spring washers (15) (6 used).

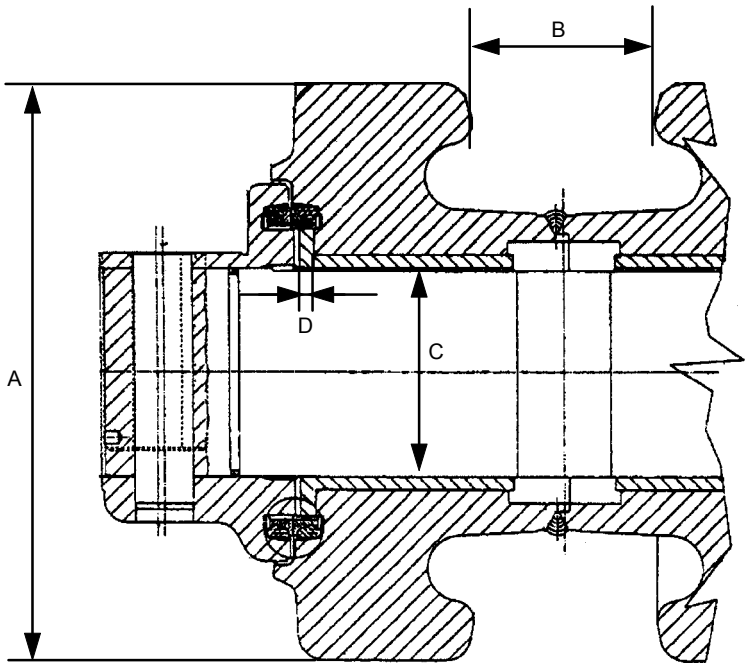
   : 24 mm
   : 206 N·m (21 kgf·m, 150 lbf·ft)



W145-03-04-002

(Blank)

Lower Roller



W117-03-07-008

NOTE: 1 mm=0.03937 in

Unit: mm

Key Letter and Part Name	Standard Dimensions	Allowable Wear Limit	Corrective Measure
A : Roller (Outer Diameter)	440	410	Repair or Replace
B : Tread Clearance	148	108	Repair or Replace
C : Axle (Outer Diameter)	$160^{-0.125}_{-0.085}$	158	Replace
C' : Bushing (Inner Diameter)	$160^{+0.063}_{+0.580}$	163	Replace
(Outer Diameter)	$180^{+0.320}_{+0.280}$	-	Replace
D : Bushing (Flange Thickness)	$15^{+0}_{-0.1}$	13.5	Replace

NOTE: If repair welding is required, refer to the Welding Repair Procedure at the end of this section and to the pattern drawings attached in the back of this book.

Assemble Accumulator

1. Before assembling, thoroughly clean and dry all components and parts, and apply a thin film of hydraulic oil to all surfaces.
   Use new O-rings and backup rings when assembling.

2. Insert bladder (7) into shell (8) via the oil port side opening.
   In order to install bladder (7) in the correct position, use a chain, as illustrated.

3. Pull valve stem (18) out of shell (8) using a chain. Install washer (27), O-ring (26) and backup ring (25) in the groove.
   Install spacer (11), and tighten locknut (12) with a hook spanner wrench.

4. Turn shell (8) over 180 degrees. Install oil port assembly (3) on shell (8).

5. Pick up and install retaining ring (6) into shell (8) using fingers.

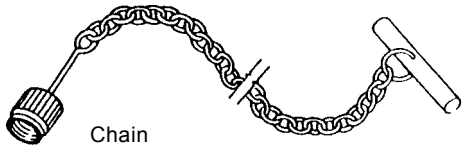
6. Pull oil port assembly (3) and align it with retaining ring (6).
   Install washer (20), O-ring (21) and backup ring (22) in the groove.

7. Install spacer (5) and locknut (4) onto oil port assembly (3).
   Tighten locknut (4) using a hook spanner wrench or a copper bar and hammer.

8. Turn shell (8) over 180 degrees. Install O-ring (17) onto gas valve (16). Install gas valve (16) on valve stem (18). Charge bladder (7) with nitrogen gas using the charge valve.

9. Check gas valve (16) for gas leakage by leak test method.
   Install cap (15) on valve stem (18).

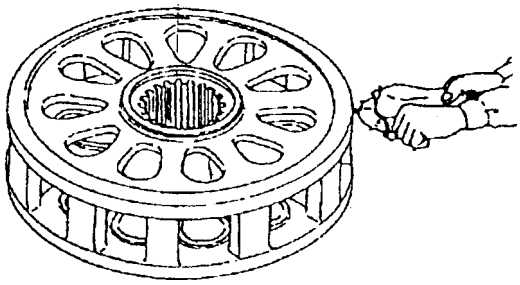
10. Install valve guard (14) on valve stem (18). Tighten valve guard (14). Connect wire (13) to valve guard (14) and locknut (12).



W145-03-09-003

Repair Drive Tumbler

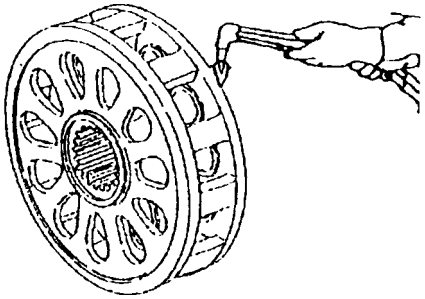
1. Before welding, clean the drive tumbler to remove mud and sand.
   Remove rust and surface unevenness using a grinder.



W115-03-11-024

2. Preheat the drive tumbler to 250 to 300 °C (482 to 572 °F) using a touch.

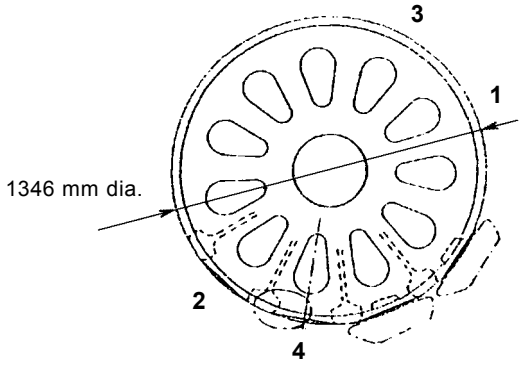
NOTE: Correctly measure the preheating temperature with thermal chalk.



W115-03-11-025

3. Perform underlaying with LB-26 or other equivalent welding rod.
   To maintain the temperature balance while welding, the succeeding welding spot should be on a diagonal line, as illustrated.

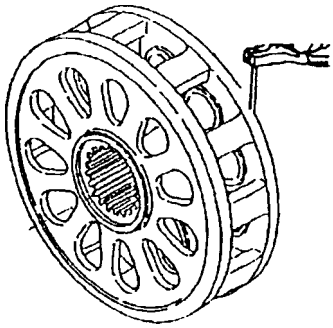
NOTE: Visually check that the welding beads are free from cracks.



W115-03-11-026

The minimum thickness of one layer of underlaying is 5 to 6 mm (0.2 to 0.23 in) even if the wear amount is less than 5 to 6 mm (0.2 to 0.23 in). Perform second and third layers of underlaying.

NOTE: Keep the temperature between welding paths of the drive tumbler at 200 to 250 °C (392 to 482 °F) while performing underlaying.



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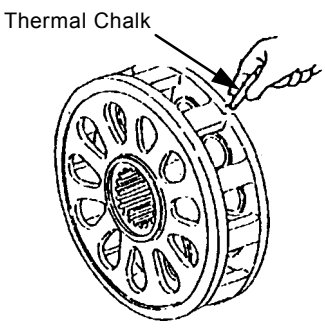


W115-03-11-028

Install Boom Cylinder

CAUTION: Boom cylinder weight
LD: 2970 kg (6550 lb)
BH: 3120 kg (6880 lb)
Pin weight
LD: 145 kg (320 lb)
BH: 148 kg (326 lb)

1. Install spacer (2) on the cylinder bottom end. Lift the boom cylinder and align the bottom end pin holes using a crane. Insert pin (1) into the bottom end pin hole. Secure the connection with bolts (4) (2 used), spring washers (5) (2 used), and plate (3).

   : 36 mm
   : 690 N·m (70 kgf·m, 510 lbf·ft)

2. Connect the bottom side lubrication hose and hydraulic hose.

   : 17 mm
   : 540 N·m (55 kgf·m, 400 lbf·ft)

   : 19 mm
   : 29.5 N·m (3 kgf·m, 21.5 lbf·ft)

3. Install bushings (10) (2 used) on the boom cylinder rod mounting part of the main frame.

4. Lift the rod side of the cylinder using a crane. Connect the hydraulic hose to the rod side. Remove the wire from the rod end. Start the engine. Extend the rod to align the rod pin hole with that on the main frame bracket.

   : 14 mm
   : 265 N·m (27 kgf·m, 195 lbf·ft)

CAUTION: Pin weight
145 kg (320 lb)

5. Insert pin (6) into the pin hole on the rod end. Secure the connection with bolts (8) (2 used), spring washers (9) (2 used) and plate (7).

   : 36 mm
   : 690 N·m (70 kgf·m, 510 lbf·ft)

6. Connect the lubrication hose to the rod side.

   : 19 mm
   : 29.5 N·m (3 kgf·m, 21.5 lbf·ft)

7. Remove the air bleed plug to bleed air from the cylinder. (Refer to page W4-1-34.)

8. Install the other boom cylinder referring to the procedure above.

Remove Level Cylinder

NOTE: Be sure to remove the arm cylinder before removing the level cylinder.

1. Disconnect the lubrication hose from the level cylinder.

   : 19 mm

CAUTION: Level cylinder weight: 1880 kg (4145 lb) Pin weight: 127 kg (280 lb)

2. Securely hold the level cylinder using a chain block. Remove bolts (4), spring washers (3), and plate (2) from the rod side. Remove pin (1).

   : 36 mm

3. Start the engine. Fully retract the cylinder. Reeve a wire through the rod hole around the cylinder to prevent the cylinder from extending.

CAUTION: Do not quickly loosen the cap on the hydraulic oil tank. The cap may fly off due to internal pressure. Always turn the cap slowly to release any remaining pressure before removing it.

4. Stop the engine. Release pressure from the level cylinder lines and purge air from the hydraulic oil tank. Disconnect the rod side hose and lower the cylinder rod end to the ground.

   : 17 mm
   : 19 mm

5. Disconnect the lubrication hose and hydraulic hose from the cylinder bottom.

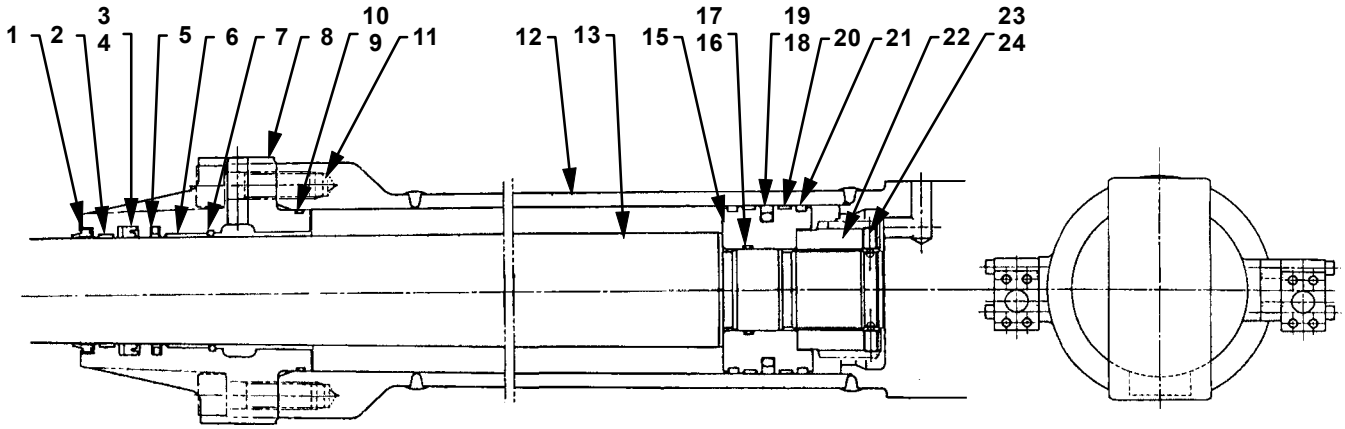
   : 17 mm
   : 19 mm

CAUTION: Pin weight: 127 kg (280 lb)

6. Securely hold the bottom side of the cylinder using a chain block. Remove bolts (4), spring washers (3) and plate (2) from the cylinder bottom. Remove pin (1). Disconnect the bottom end.

   : 36 mm

Level Cylinder (Loading Shovel)



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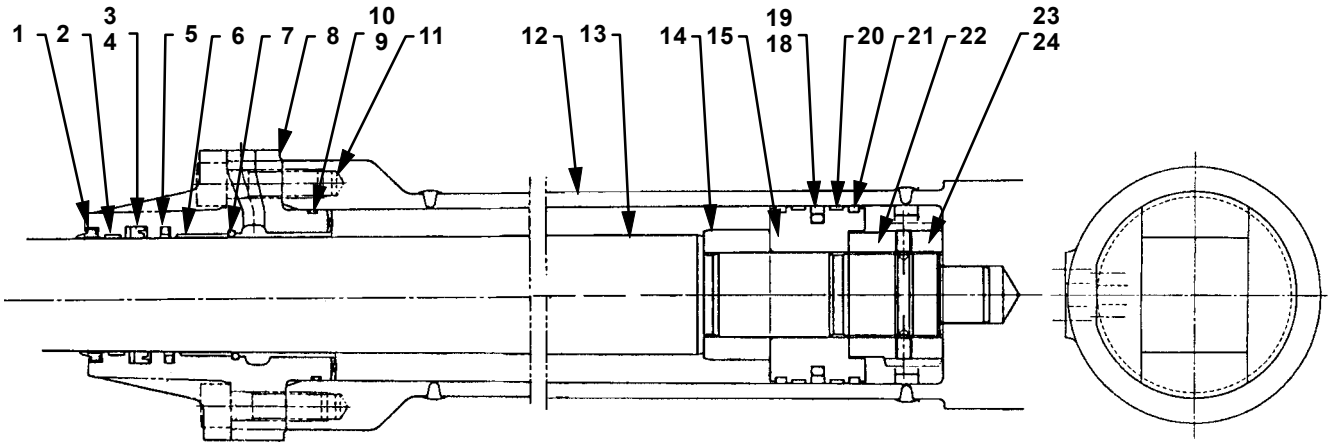
Dump Cylinder (Loading Shovel)



W117-04-02-004

1 - Wiper Ring	1 - Retaining Ring	1 - Cylinder Rod	1 - O-Ring
2 - Slide Ring	2 - Cylinder Head	2 - Cushion Ring	2 - Slide Ring (2 Used)
3 - U-Ring	3 - O-Ring	3 - Piston	3 - Slide Ring (2 Used)
4 - Backup Ring	4 - Backup Ring	4 - O-Ring	4 - Nut
5 - Buffer Ring	5 - Socket Bolt (8 or 17 Used)	5 - Backup Ring (2 Used)	5 - Set Screw
6 - Bushing	6 - Cylinder Tube	6 - Seal Ring	6 - Steel Ball

NOTE: Eight socket bolts (11) are used on the dump cylinder while 17 socket bolts (11) are used on the level cylinder.

8. Install steel ball (24) into the hole on nut (22). Install set screw (23).

IMPORTANT: After tightening set screw (23), mushroom the head of set screw (23) at two points.

: 14 mm (Dump)
: 96.6 ± 18 N·m
(9.8 ± 1.86 kgf·m, 71 ± 13 lbf·ft)
: 17 mm (Arm, Bucket)
: 180 ± 36 N·m
(18.4 ± 3.7 kgf·m, 133 ± 27 lbf·ft)
: 19 mm (Boom, Level)
: 471 ± 83 N·m
(48 ± 9.0 kgf·m, 350 ± 65 lbf·ft)

CAUTION: Cylinder rod (13) assembly weight:

Loading shovel

Boom	**: 1600 kg (3530 lb)**
Arm	**: 1090 kg (2405 lb)**
Bucket	**: 795 kg (1753 lb)**
Level	**: 930 kg (2050 lb)**
Dump	**: 226 kg (498 lb)**

Backhoe

Boom	**: 1555 kg (3430 lb)**
Arm	**: 1040 kg (2295 lb)**
Bucket	**: 630 kg (1390 lb)**

IMPORTANT: When installing cylinder head onto the cylinder tube, take care not to damage seal (9) and seal ring (18).

9. Install cylinder rod (13) assembly into cylinder tube (12) using socket bolts (11).

: Boom
: 24 mm (Socket Bolt: 17 used)
: 1910 ± 353 N·m
(195 ± 36 kgf·m, 1410 ± 260 lbf·ft)

: Arm
: 27 mm (Socket Bolt: 11 used)
: 2460 ± 461 N·m
(251 ± 47 kgf·m, 1815 ± 340 lbf·ft)

: Bucket (Loading Shovel)
: 24 mm (Socket Bolt: 10 used)
: 1910 ± 353 N·m
(195 ± 36 kgf·m, 1410 ± 260 lbf·ft)
: Bucket (Backhoe)
: 27 mm (Socket Bolt: 8 used)
: 2460 ± 461 N·m
(251 ± 47 kgf·m, 1815 ± 340 lbf·ft)

: Level (Loading Shovel)
: 24 mm (Socket Bolt: 17 used)
: 1910 ± 353 N·m
(195 ± 36 kgf·m, 1410 ± 260 lbf·ft)

: Dump (Loading Shovel)
: 24 mm (Socket Bolt: 8 used)
: 1910 ± 353 N·m
(195 ± 36 kgf·m, 1410 ± 260 lbf·ft)

10. Install the hydraulic lines to cylinder tube (12) using the socket bolts.

: Boom: 17 mm, 14 mm
: 443 ± 82.4 N·m
(45.1 ± 8.4 kgf·m, 326 ± 61 lbf·ft)
: 265 N·m (27 kgf·m, 195 lbf·ft)

: Arm: 17 mm
: 24 mm
: 443 ± 82.4 N·m
(45.1 ± 8.4 kgf·m, 326 ± 61 lbf·ft)
: 96.8 N·m (9.85 kgf·m, 71 lbf·ft)

: Bucket: 17 mm
: 12 mm
: 443 ± 82.4 N·m
(45.1 ± 8.4 kgf·m, 326 ± 61 lbf·ft)
: 89.3 ± 16.7 N·m
(9.11 ± 1.7 kgf·m, 66 ± 12 lbf·ft)

: Level (Loading Shovel): 17 mm
: 443 ± 82.4 N·m
(45.1 ± 8.4 kgf·m, 326 ± 61 lbf·ft)

: Dump (Loading Shovel): 12 mm, 10 mm
: 443 ± 82.4 N·m
(45.1 ± 38.4 kgf·m, 326 ± 61 lbf·ft)
: 64 ± 12 N·m
(6.5 ± 1.2 kgf·m, 47 ± 9 lbf·ft)