TTLA-0596-EX

HITACHI

Training Text

EX1900-5

PERFORMANCE TEST & TROUBLESHOOTING

Technical Training Center

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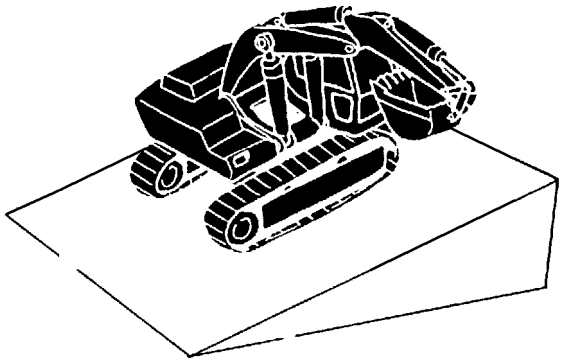
SWING MOTOR LEAKAGE

Summary:

Check for upperstructure drift while suspending a load on a slope.



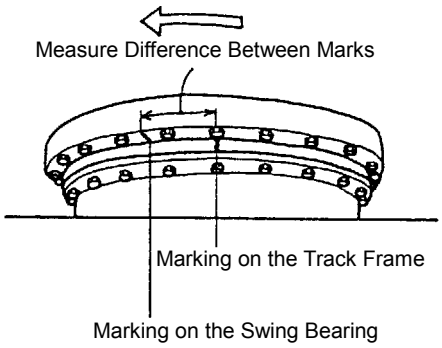
T142-05-03-004

Preparation:

1. Check the lubrication of the swing gear and swing bearing.
2. Load bucket fully. In lieu of loading the bucket, weight (W) of the follwing specification can be used.
   W = 15900 kg (35060 lb): BE Backhoe
   16500 kg (36380 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. Park the machine on a smooth slope with a gradient of 26.8 % (15°),
5. Swing the upperstructure to position it 90° to the slope. Make aligning marks on the swing bearing periphery and track frame using tape, as illustrated.
6. Maintain the hydraulic oil temperature at 50±5 °C (122±9 °F).

Measurement:

1. Stop the engine. After five minutes, measure the difference between the marks along the swing bearing periphery and the track frame.
2. Perform the measurement in both right and left swing directions.
3. Perform the measurement three times in each direction and calculate the average values.



T105-06-03-010

Evaluation:

Refer to T4-2 Operational Performance Standard.

Solution:

Refer to T5-4 Troubleshooting B.

BOOM RAISE/SWING COMBINED OPERATION CHECK

Summary:

1. Check the combined operation performance while operating the boom raise and swing simultaneously.
2. Run the engine at full speed and check if the boom cylinders move without hesitating.

NOTE: When the bucket weight is increased by welding wear-resist plates, boom may become lower.

Preparation:

1. Empty the bucket and position the machine with front attachment positioned as illustrated.
2. Maintain the hydraulic oil temperature at 50 ± 5 °C (122 ± 9 °F).

CAUTION: Prevent personal injury. Always make sure that the area is clear and that coworkers are out of the swing area before starting the measurement.

Measurement:

1. Run the engine at the maximum speed with the auto idle switch OFF.
2. Operate the boom raise and swing levers full stroke. Measure the time required for the machine to swing 90 ° and bucket tooth tip height H raised while swinging.
3. Repeat the measurement in both directions three times and calculate the average values.

Evaluation:

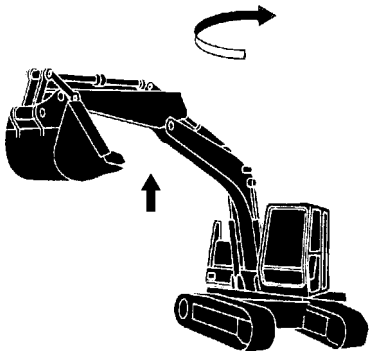
Refer to T4-2 Operational Performance Standard.

Solution:

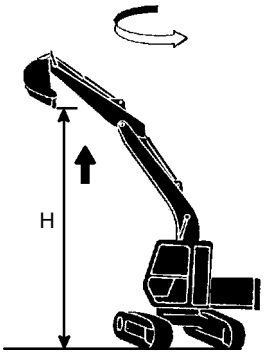
Refer to T5-4 Troubleshooting B.

T142-05-03-007

T142-05-03-008



T142-05-03-009



T142-05-03-010

MAIN PUMP FLOW RATE MEASUREMENT

- P-Q Line (Torque Adjustment)

Summary:

In order to check performance of the main pump, measure the main pump flow rate by connecting a hydraulic tester to the delivery hose of the main pump.

Measurement Preparation:

1. Stop the engine.

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

2. Release air from the hydraulic oil tank by loosening the air breather cap at the oil supply port on the hydraulic oil tank.

   : 4 mm

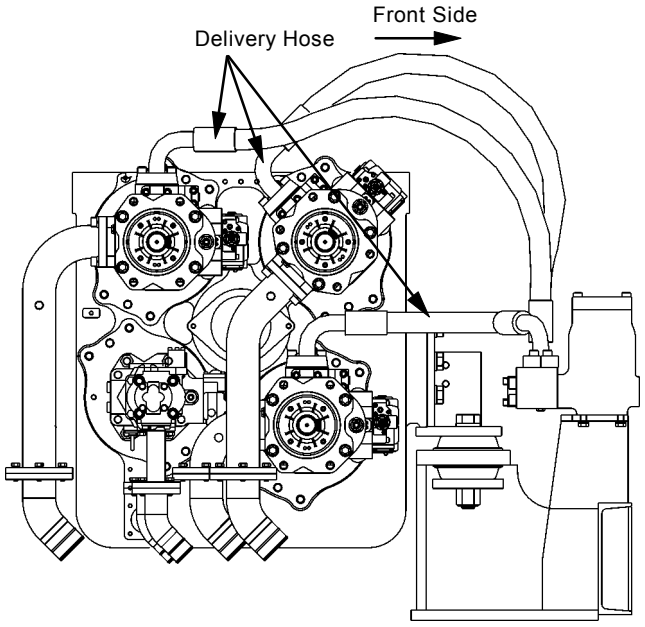
3. Connect a hydraulic tester to the delivery hose. Necessary components and parts are as follows:
   - Hydraulic tester (ST 6299)
   - Adapter (ST 6146)
   - Test hose (ST6145))
   - Bolt (M 341650, M341660)
   - Pipe (ST 6139)
   - Flange (ST 6141)
   - Split flange (4075854)

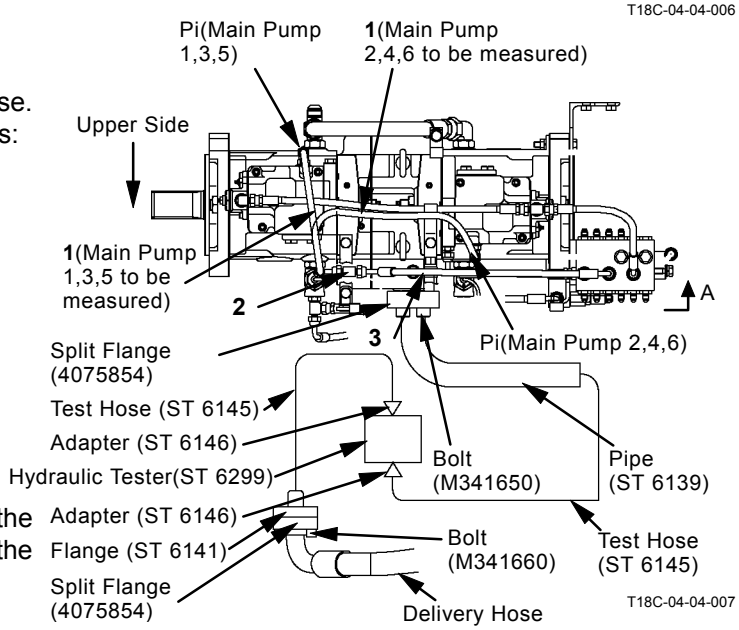
   : 17 mm, 19 mm, 41 mm)
   : 14 mm

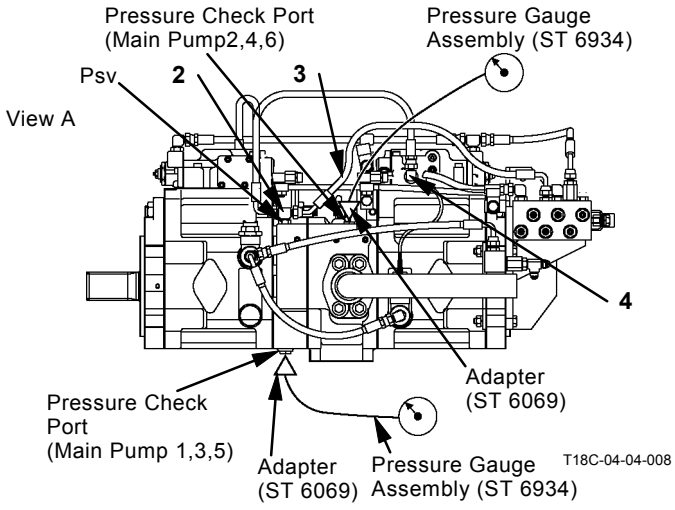
4. Remove plug from the pressure check port on the main pump to be measured, then install the adapter and pressure gauge assembly.
   - Adapter
   - Pressure gauge assembly (ST 6934)

   : 19 mm

5. Purge air from the main pump.







- Pi-Q Control by Pump Control Pilot Pressure Signal (Pilot Pressure Characteristics)

Summary:
In order to check performance of the oil cooler fan motor drive pump, measure the main pump flow rate by connecting a hydraulic tester to the delivery hose of the oil cooler fan pump.

Preparation:
1. Refer to steps 1 to 3 on page T4-5-18, connect a portable tester to the oil cooler fan motor drive pump to be measured.

2. Disconnect hose from regulator port Pi, and attach plug in the disconnected hose.
   Connect hose (5) on regulator port Pi.

3. Connect adapters (6) (2 used) and adapter (10) to reducing valve (8).
   Remove plug (1) located on the manifold (13). Connect adapter (4) to the removed plug port. Connect hose (7) between adapter (4) and adapter (6) to port P1 on reducing valve (8).
   : 19 mm : 6 mm

4. Connect tee (9) to port P2 on reducing valve (8). Connect pressure gauge (3) and hose (5) to tee (9).
   : 19 mm

5. Connect hose (5) to port T on reducing valve (8). Remove plug (2) from hydraulic oil tank, and connect adapter (10) and hose (11) to the removed plug (2) hole.
   : 19 mm, 22 mm

6. Purge air from the main pump.

7. Fully open the loading valve on the portable tester.

8. Start the engine. Check the pressure gauge connection for any oil leakage.

Measurement:
1. Measure the oil cooler fan motor drive pump flow rate controlled by the pump control pilot pressure signal.

2. Turn the auto-idle switch is OFF position. Operate the engine control lever to fast idle position.

3. Adjust the reducing valve (8) set pressure to the specified pressure shown on the Pi-Q diagram of the oil cooler fan motor drive pump (Pilot Pressure Characteristics).
   Measure the flow rate and engine speed at each specified pressure shown on the Pi-Q diagram. (Refer to T4-2-5)

4. Repeat the measurement three times and calculate the average values.

Evaluation:
Convert the measurement results to the flow rate at the specified pump speed by the following formulas:
$QC = (Np \times Q)/(i \times Ne)$

Where:
QC : Converted Flow Rate
Q : Measured Flow Rate
Np : Specified Pump Speed (2178 min^{-1})
i : Pump Drive Gear Speed Ratio (1.088)
Ne : Measure Engine Speed

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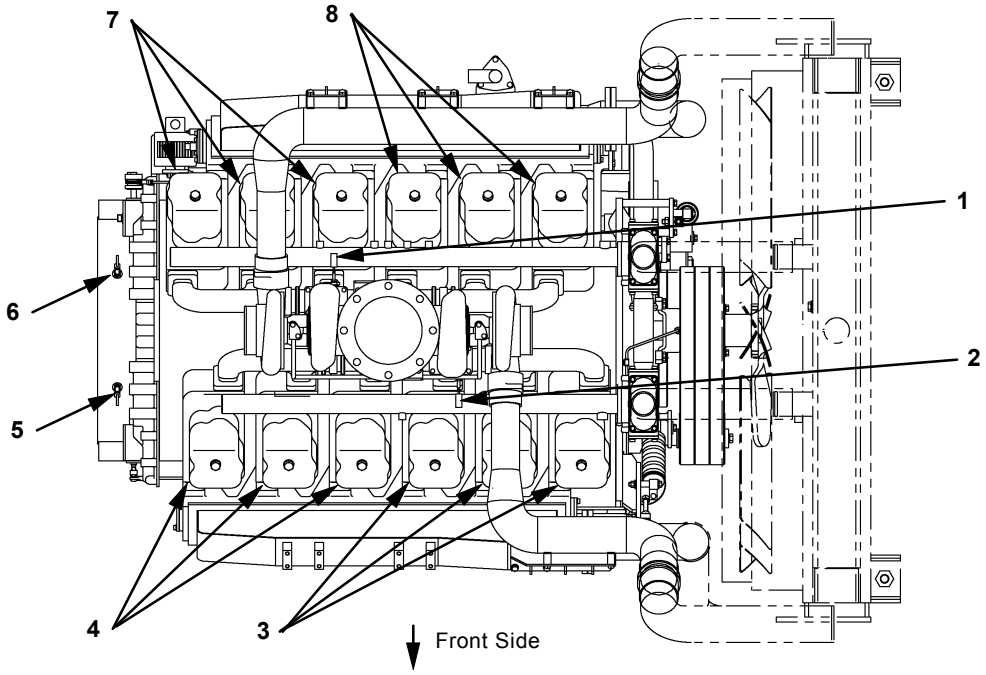
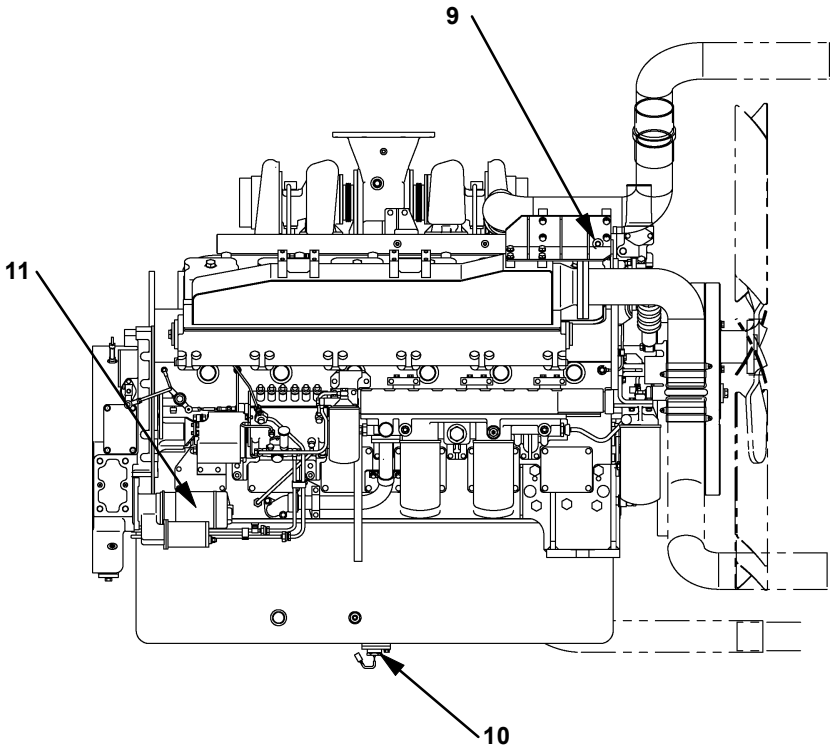
ELECTRICAL COMPONENTS (Engine)

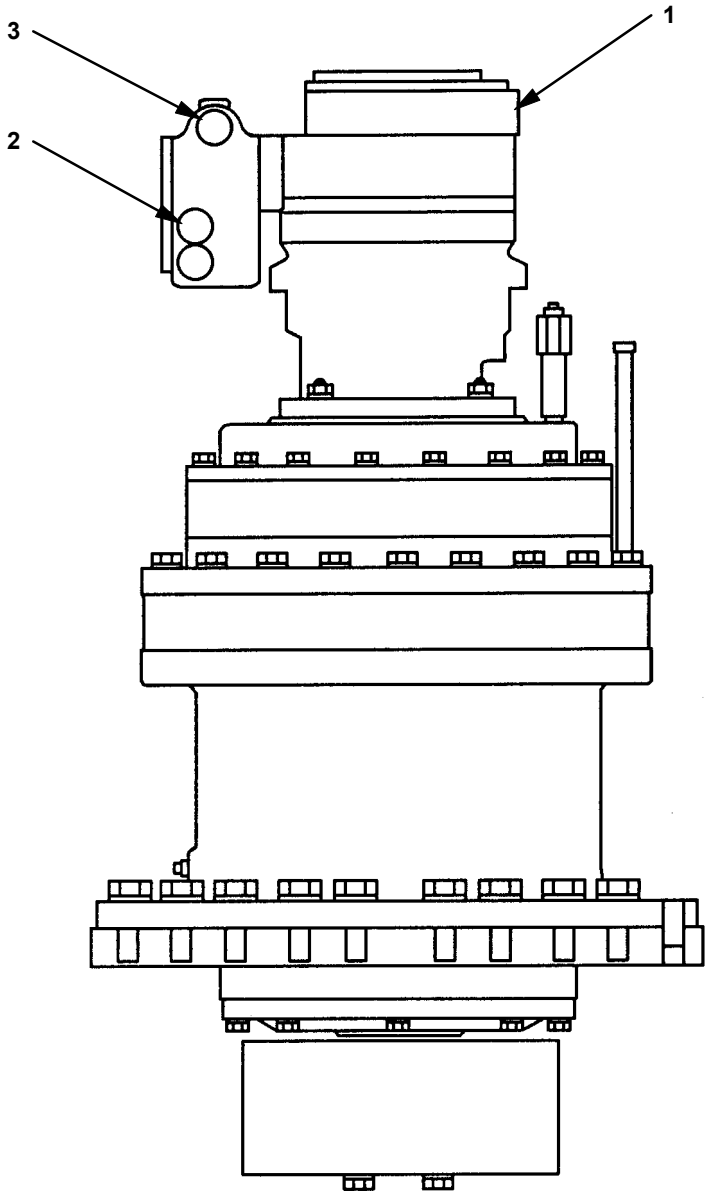


T18C-01-02-001



T18C-01-02-002

SWING DEVICE

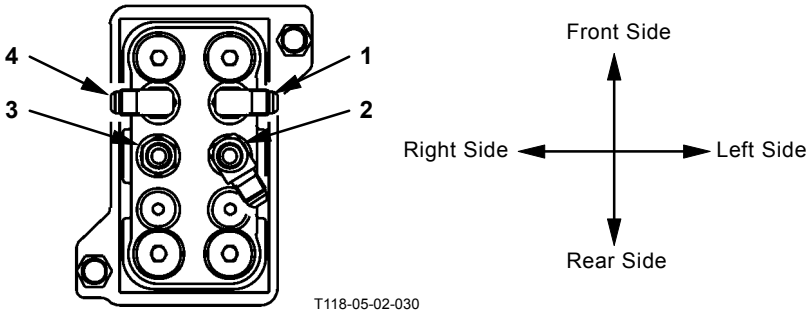


T 144-03-02-001

1 - Swing Motor
3 - Relief Valve
5 - Make-Up Valve

Bucket Open/Close Pilot Valve
(Loading shovel only)
This valve controls the pilot pressure to the bucket open/close control valve.

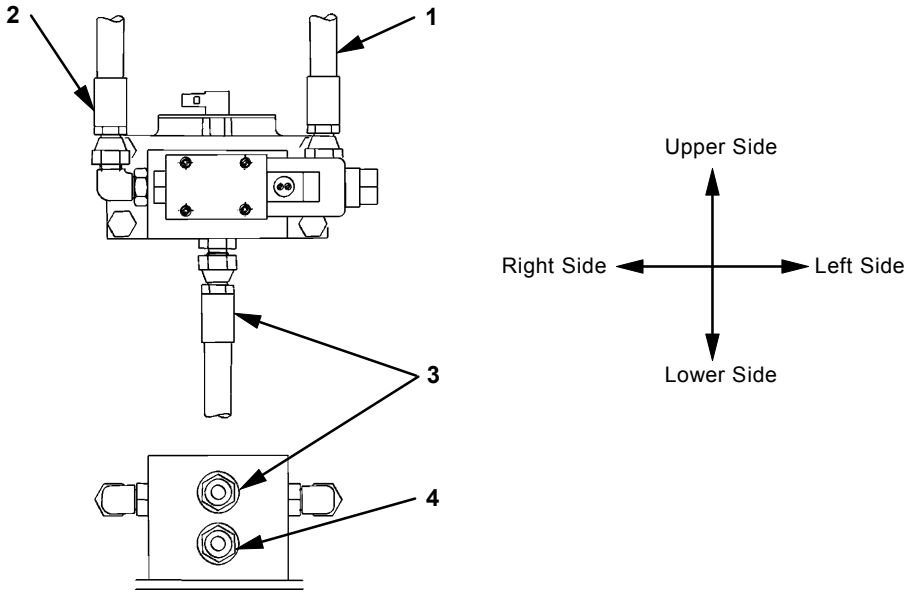
No.	Connecting Point	Remarks
1	Shuttle Valve 2 (6)	Pilot pressure for bucket close
2	Travel Pilot Valve (2) Manifold 9 (3)	Pilot Pressure Pilot pressure for parking brake release
3	Travel Pilot Valve (5)	Return oil to hydraulic oil tank
4	Shuttle Valve 2 (7)	Pilot pressure for bucket open



T118-05-02-030

Swing Stop Solenoid Valve
Blocks the swing pilot pressure to deactivate the swing function when either the ladder or the fast filling panel (Option) is lowered.

No.	Connecting Point	Remarks
1	Left Pilot Valve (4)	Pilot pressure for right swing
2	Left Pilot Valve (1)	Pilot pressure for left swing
3	Shuttle Valve 4 (7)	Pilot pressure for left swing
4	Shuttle Valve 4 (6)	Pilot pressure for right swing

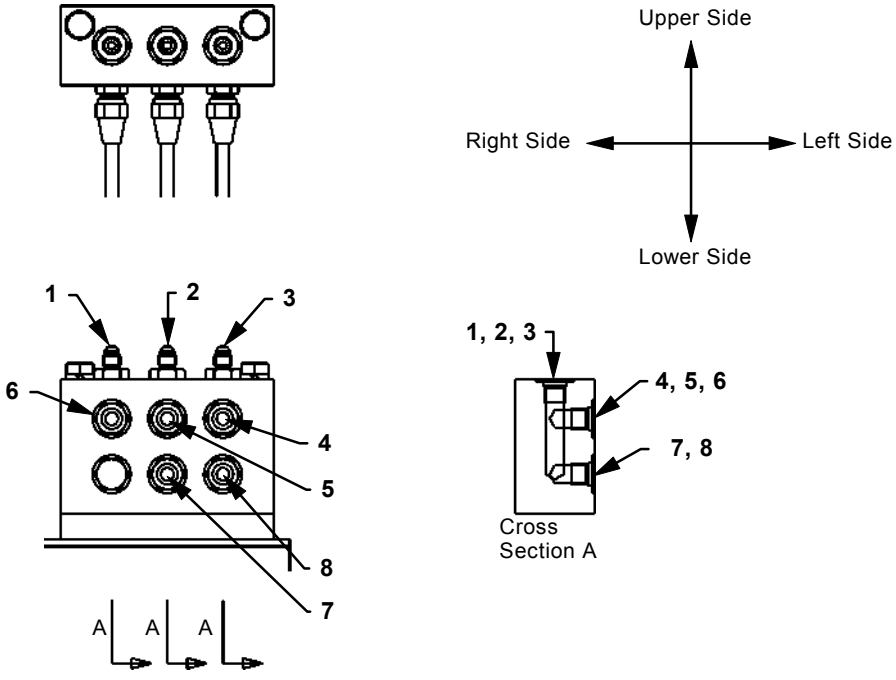


T18C-05-02-001

Manifold 11

This manifold is a pilot line connection block from manifold 7 and shuttle valve 6, 7, 8.

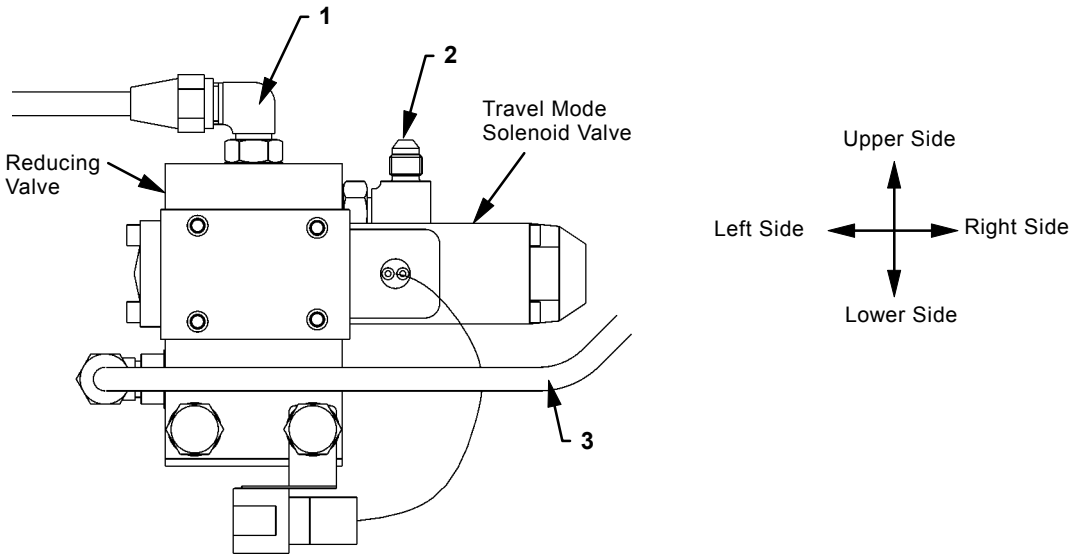
No.	Connecting Point	Remarks
1	Manifold 7 (3)	Flow rate control pressure Pi (Main Pump 5)
2	Manifold 7 (4)	Flow rate control pressure Pi (Main Pump 2, 3, 4, 6): Backhoe, (Main Pump 3, 4, 6): Loading shovel
3	Manifold 7 (5)	Flow rate control pressure Pi (Main Pump 1): Backhoe, (Main Pump 1, 2): Loading shovel
4	Shuttle Valve 8 (2)	Flow rate control pressure Pi (Main Pump 2, 3, 4, 6): Backhoe, (Main Pump 3, 4, 6): Loading shovel
5	Shuttle Valve 7 (3)	Flow rate control pressure Pi (Main Pump 5)
6	Shuttle Valve 7 (2)	Flow rate control pressure Pi (Main Pump 5)
7	Shuttle Valve 6 (2)	Flow rate control pressure Pi (Main Pump 1): Backhoe, (Main Pump 1, 2): Loading shovel
8	Shuttle Valve 6 (3)	Flow rate control pressure Pi (Main Pump 1): Backhoe, (Main Pump 1, 2): Loading shovel



T18C-05-02-033

Travel Mode Solenoid Valve, Reducing Valve (Travel Mode Selection)

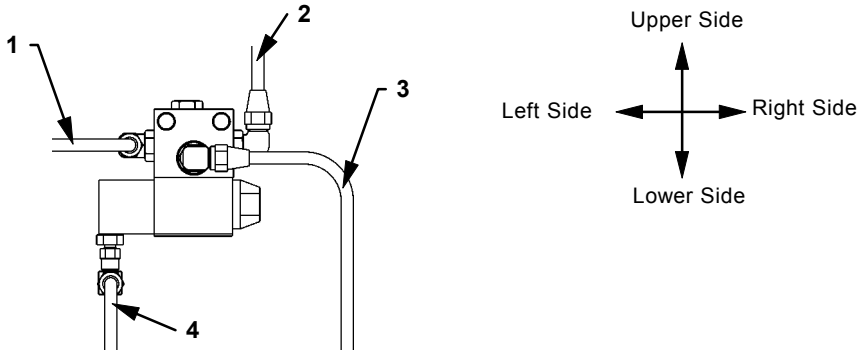
No.	Connecting Point	Remarks
1	Manifold 9 (2)	Parking brake release pressure
2	Center Joint → Travel Motor	Travel parking brake release pressure/Travel speed change pressure
3	Manifold 8 (2)	Return oil to hydraulic oil tank



T18C-05-04-005

Boom Priority Switch Valve (Loading Shovel Only)

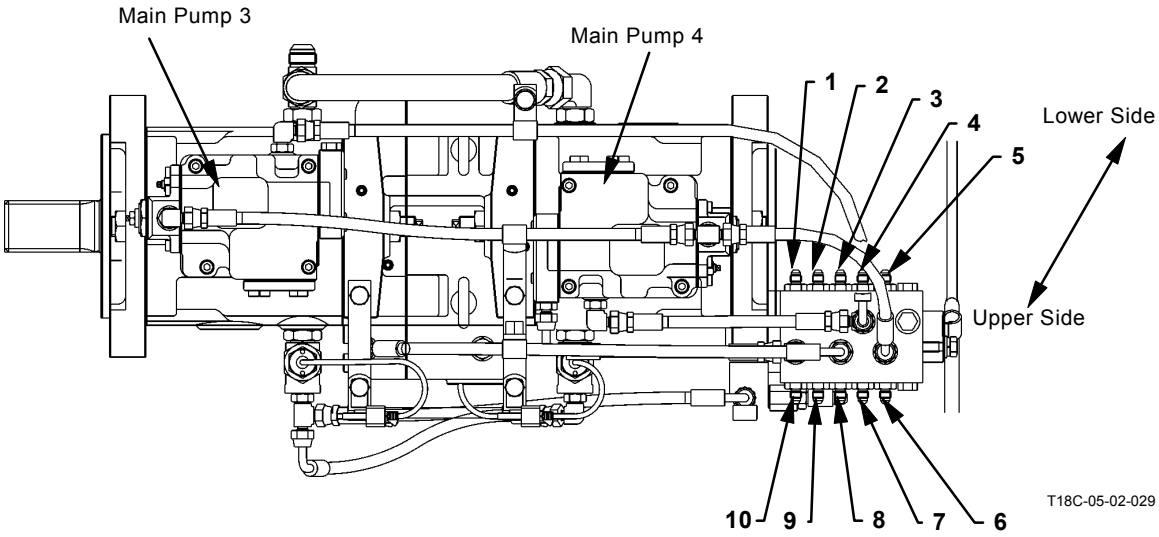
No.	Connecting Point	Remarks
1	Control Valve (22)	Pilot pressure for bucket tilt-in
2	Manifold 3 (7)	Pilot pressure for bucket tilt-in
3	Manifold 4 (6)	Return oil to hydraulic oil tank
4	Manifold 2 (6)	Pilot pressure for boom raise

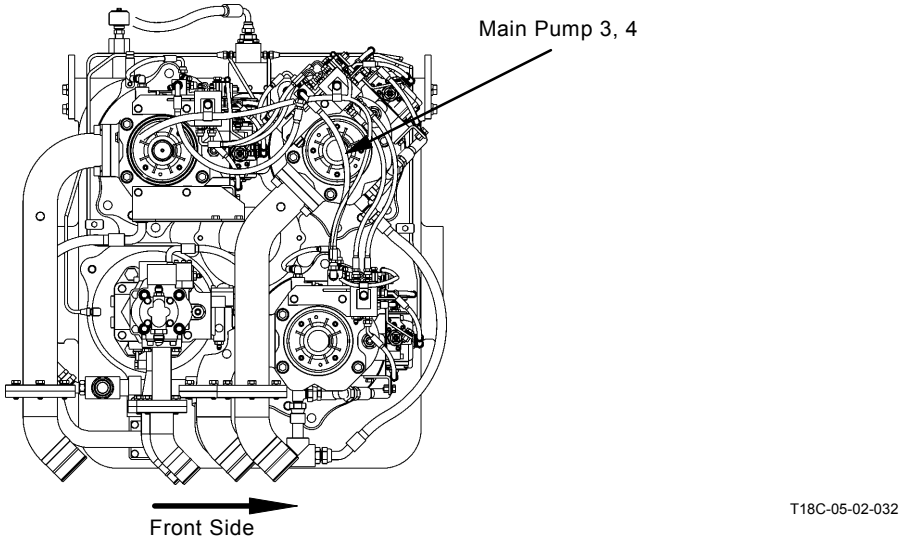


T18C-05-02-026

Main Pump 3, 4

No.	Connecting Point	Remarks
1	Main Pump 5, 6 (1)	Horsepower reducing pressure Pf
2	Main Pump 5, 6 (2)	Flow rate control pressure Pi (Main Pump 5)
3	Main Pump 5, 6 (3)	Pump servo assist pressure Psv
4	Main Pump 5, 6 (4)	Flow rate control pressure Pi (Main Pump 6)
5	Main Pump 5, 6 (5)	Horsepower increase pressure Pz
6	Main Pump 1, 2 (5)	Horsepower increase pressure Pz
7	Main Pump 1, 2 (4)	Flow rate control pressure Pi (Main Pump 3, 4, 6)
8	Main Pump 1, 2 (3)	Pump servo assist pressure Psv
9	Main Pump 1, 2 (2)	Flow rate control pressure Pi (Main Pump 5)
10	Main Pump 1, 2 (1)	Horsepower reducing pressure Pf





RELATIONSHIP BETWEEN MACHINE TROUBLE AND POTENTIAL PROBLEM PARTS WHICH MAY CAUSE TROUBLE IF FAILED

Engine System

Trouble Symptom \ Parts	Controller		Engine Control Component								
	Main Controller (MC) B	ECM	Acceleration Sensor	Pilot Pressure Sensor	Auto-Idle Switch	Battery Relay	Starter Relay 1	Starter Relay 2	Engine Stop Solenoid	Engine Stop Solenoid Relay	Engine Stop Relay
E-1 Although key switch is turned to START position, starter doesn't rotate.						●	●	●			
E-2 Although starter rotates, engine doesn't start.		●							●	●	●
E-3 Even if fuel lever is operated, engine speed doesn't change.	●	●	●								
E-4 Even if key switch is turned OFF, engine doesn't stop.									●	○	●
E-5 Engine speed doesn't decrease with control levers in neutral (with auto-idle system ON).	●			●	●						
E-6 Even if control levers are operated, engine speed doesn't increase(with auto-idle system ON).	●			●							
E-7 Engine speed doesn't increase only when particular function is operated (with auto-idle system ON).											
E-8 Engine stalls during operation (malfunction of power decrease control).	●										
E-9 Even if pre-heat switch is pressed, air heater doesn't operate (difficult to start engine).		●									

All Actuator System

Trouble Symptom \ Parts	Controller	Pump Control				Pump
	Main Controller (MC) B	Power Decrease Solenoid Valve	Power Increase Solenoid Valve	Power Decrease Solenoid Valve Relay	Engine Speed Sensor 1	Main Pump
A-1 All actuators are inoperable or slow.	●	●		●	●	●
A-2 Malfunction of power increases control.	●		●		●	●
A-3 Even after control lever is returned to neutral, actuator doesn't stop.						

E-2 Although starter rotates, engine doesn't start.

- Check for loose harness connections beforehand.

Turn key switch ON. Check if engine stop solenoid is shifted.
- Visual inspection
- Key switch: ON

YES → Check if governor moves fuel injection pump rack to engine start position.
- Visual inspection
- Key switch: ON

YES → Faulty engine unit (Refer to the engine service manual.).

NO → Check if any fault code in governor system is displayed when ECM is diagnosed.
- Refer to Troubleshooting A.

YES → Proceed troubleshooting further by following the displayed fault code.

NO → Disconnect ECM J1 connector. Check if voltage at ECM J1 connector terminal #23 is 24 V.
- Key switch: ON

YES → Faulty ECM.

NO → Check if voltage at ECM relay connector 1 terminal #5 is 24 V.
- Key switch: ON
- Measure from the connector reverse side using a clip without disconnecting.

NO → Check if voltage at engine stop solenoid plus-side terminal (white) is 24 V.
- Key switch: ON

YES → Check for continuity between engine stop solenoid minus-side terminal (black) and vehicle frame.

YES → Faulty engine stop solenoid.

NO → Faulty ground line of engine stop solenoid.

NO → Check if voltage at engine stop solenoid relay connector 1 terminal #5 is 24 V.
- Key switch: ON
- Measure from the connector reverse side using a clip without disconnecting.

YES → Broken harness between engine stop solenoid relay and engine stop solenoid.

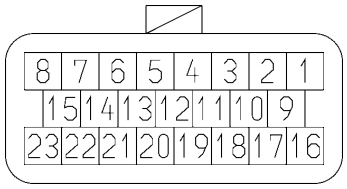
NO → Check if voltage at engine stop solenoid relay connector 1 terminal #3 is 24 V.
- Key switch: ON
- Measure from the connector reverse side using a clip without disconnecting.

YES → Blown fusible link #7 or broken harness between battery and engine stop solenoid relay.

NO

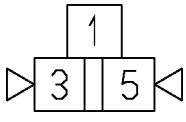
Connector

ECM J1 Connector (Black)



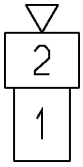
T146-05-03-004

Engine Stop Solenoid Relay Connector 1 / ECM Relay Connector 1



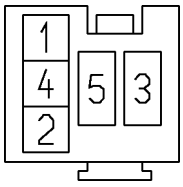
T146-05-04-010

Engine Stop Solenoid Relay Connector 2 / ECM Relay Connector 2



T146-05-04-009

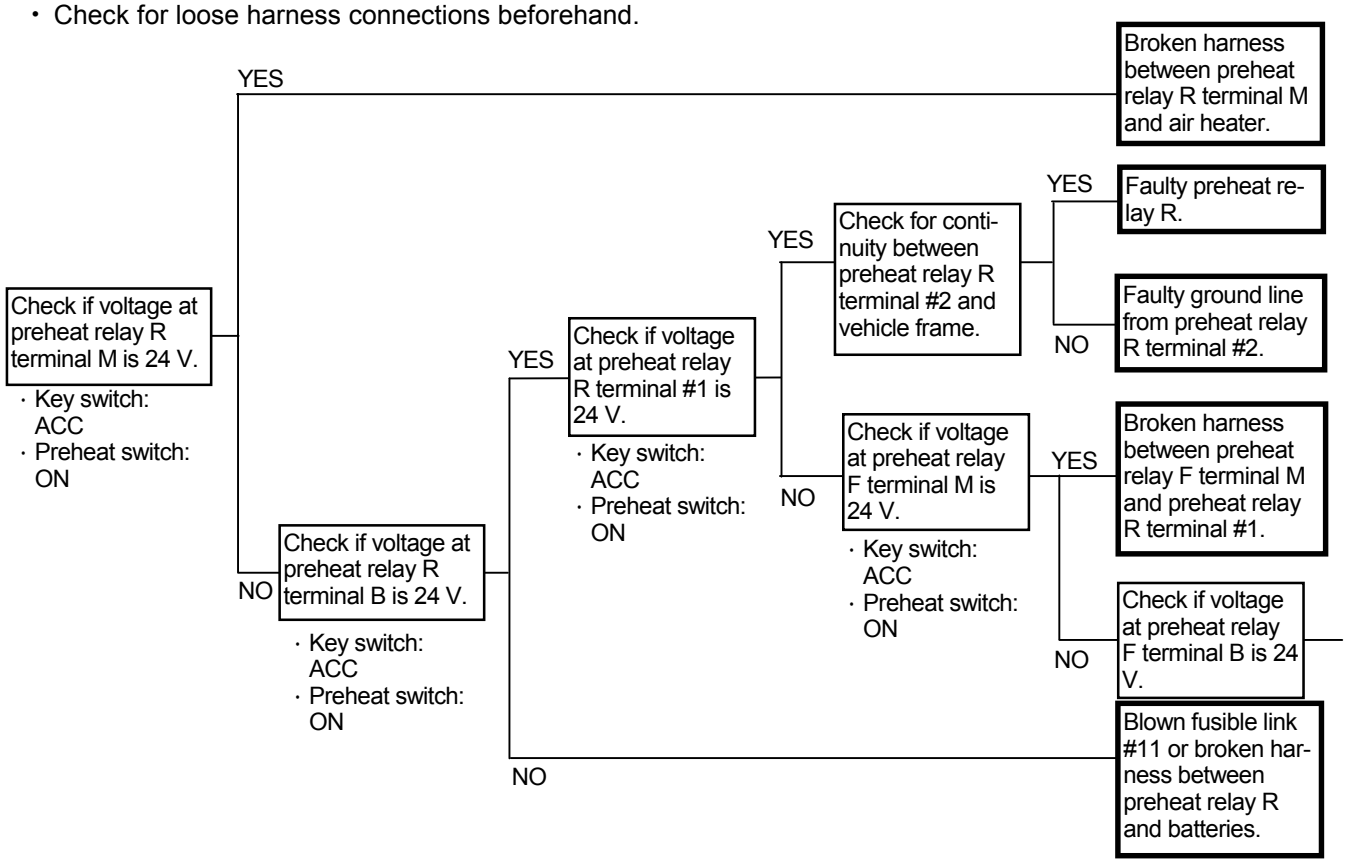
Engine Stop Relay



T146-05-04-003

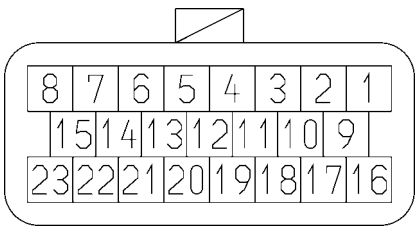
E-9 Even if preheat switch is pressed, air heater doesn't operate (difficult to start engine).

- This troubleshooting should be applied only when the air heater in the engine doesn't operate. In case the preheat indicator only doesn't light, refer to Troubleshooting C.
- When the preheat switch is pressed, the air heater is heated by electricity for 60 seconds. When measuring voltages in the circuit, check the voltage within 60 seconds after pressing the preheat switch, or turn the preheat switch OFF and wait for more than 60 seconds. Then, press the preheat switch again.
- Check for loose harness connections beforehand.



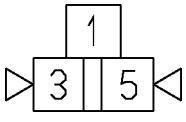
Connector

ECM J2 Connector (White)



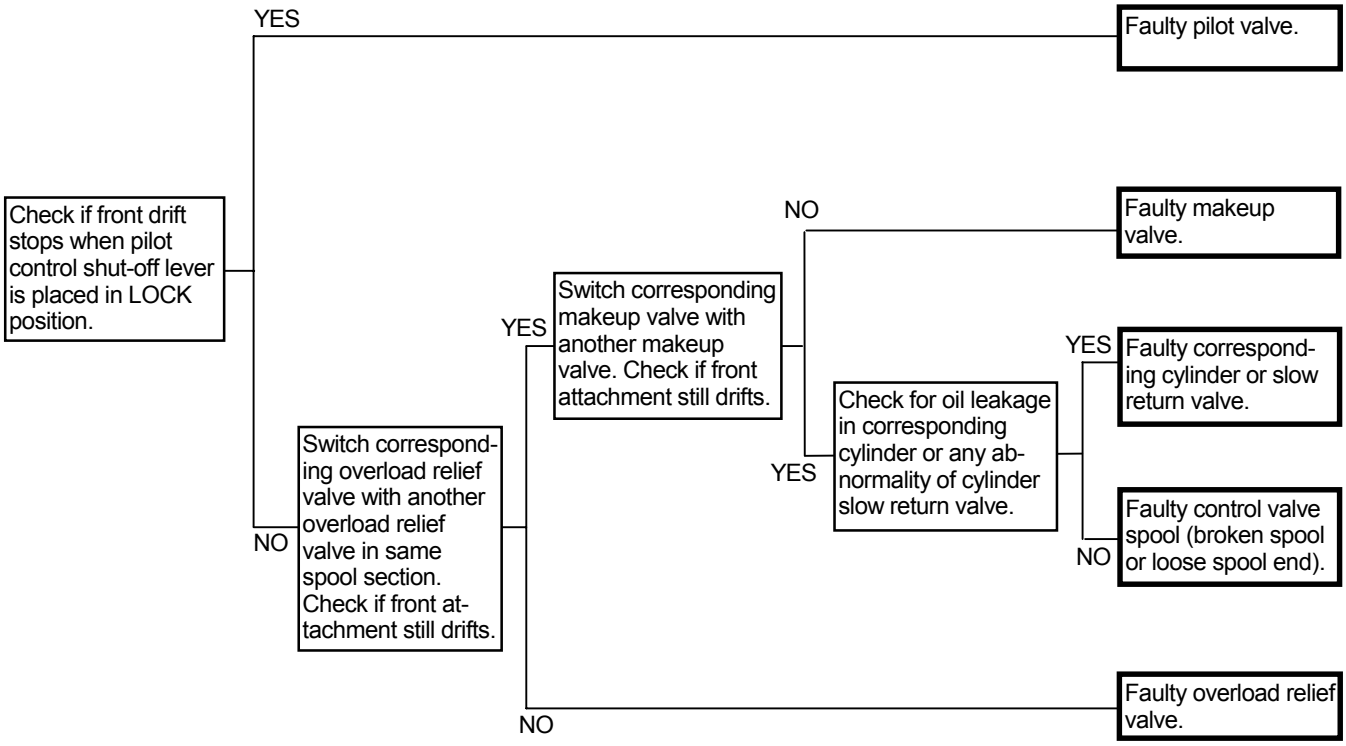
T146-05-03-004

ECM Relay



T146-05-04-010

F-2 Front attachment drifts excessively.



T-3 Slow travel mode is not selected.

- Check for loose harness connections beforehand.

2.7 ± 0.15 MPa (27.5 ± 1.5 kgf/cm^2, 391 ± 21 psi) or lower → Faulty travel motor swash angle control system

Disconnect hose 1 with adapter from reducing valve (travel mode selection). Install pressure gauge to reducing valve (travel mode selection) port. Check pressure.
- Travel speed switch: OFF
- Reducing valve port Size: PF 1/4

2.7 ± 0.15 MPa (27.5 ± 1.5 kgf/cm^2, 391 ± 21 psi) or more

Check if pressure is 2.7 ± 0.15 MPa (27.5 ± 1.5 kgf/cm^2, 391 ± 21 psi) or lower when travel mode solenoid valve is disconnected.
- Travel speed switch: OFF

YES

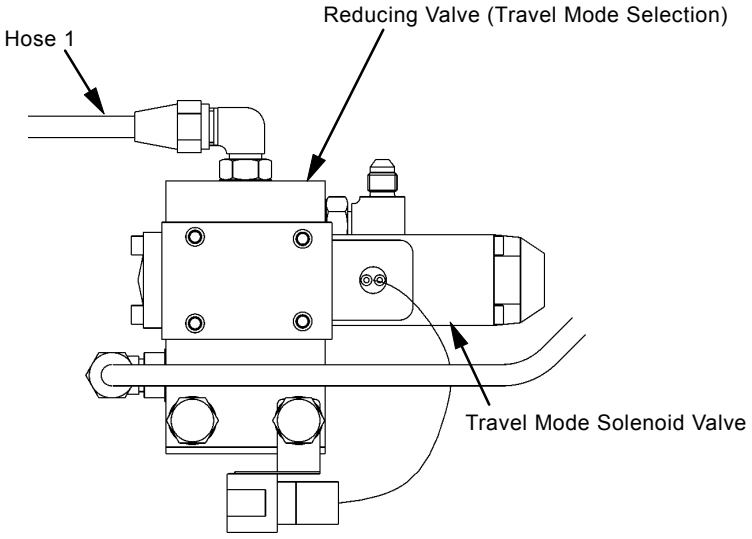
Remove pressure gauge from reducing valve (travel mode selection). Disconnect travel mode solenoid valve. Check for continuity between harness end connector terminal #2 and vehicle frame.
- Travel speed switch: OFF
- Key switch: OFF

No Continuity → Reconnect travel mode solenoid valve. Disconnect hose 1 from reducing valve (travel mode selection). Install pressure gauge to reducing valve (travel mode selection) port. Replace travel mode relay with hour meter relay. Check if pressure is 2.7 ± 0.15 MPa (27.5 ± 1.5 kgf/cm^2, 391 ± 21 psi) or lower.
- Reducing valve port size: PF 1/4
- Travel mode switch: OFF

NOTE: Check that hour meter operates normally before replacing.

Continuity → Short-circuited harness between travel mode solenoid valve and travel mode relay.

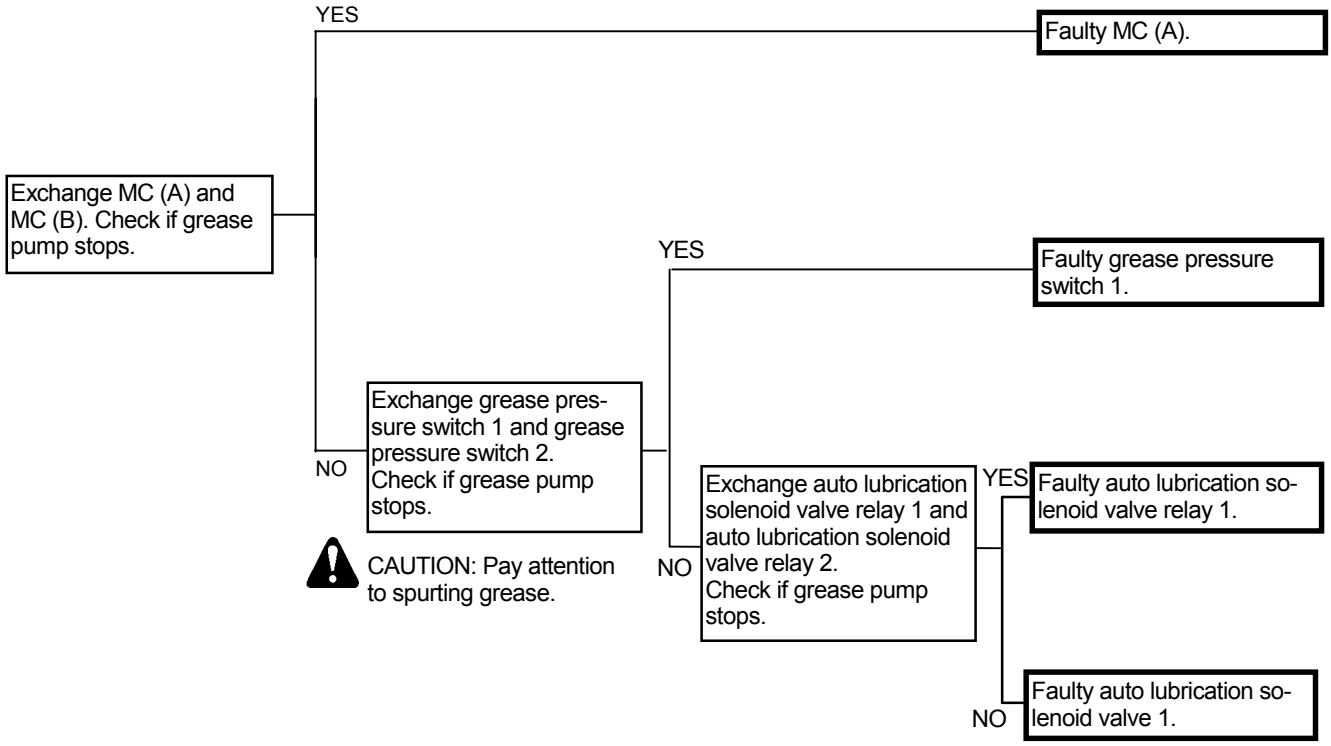
NO → Bound travel mode solenoid valve



T18C-05-04-005

O-4 Auto lubrication mode (Front lubrication circuit) does not stop.

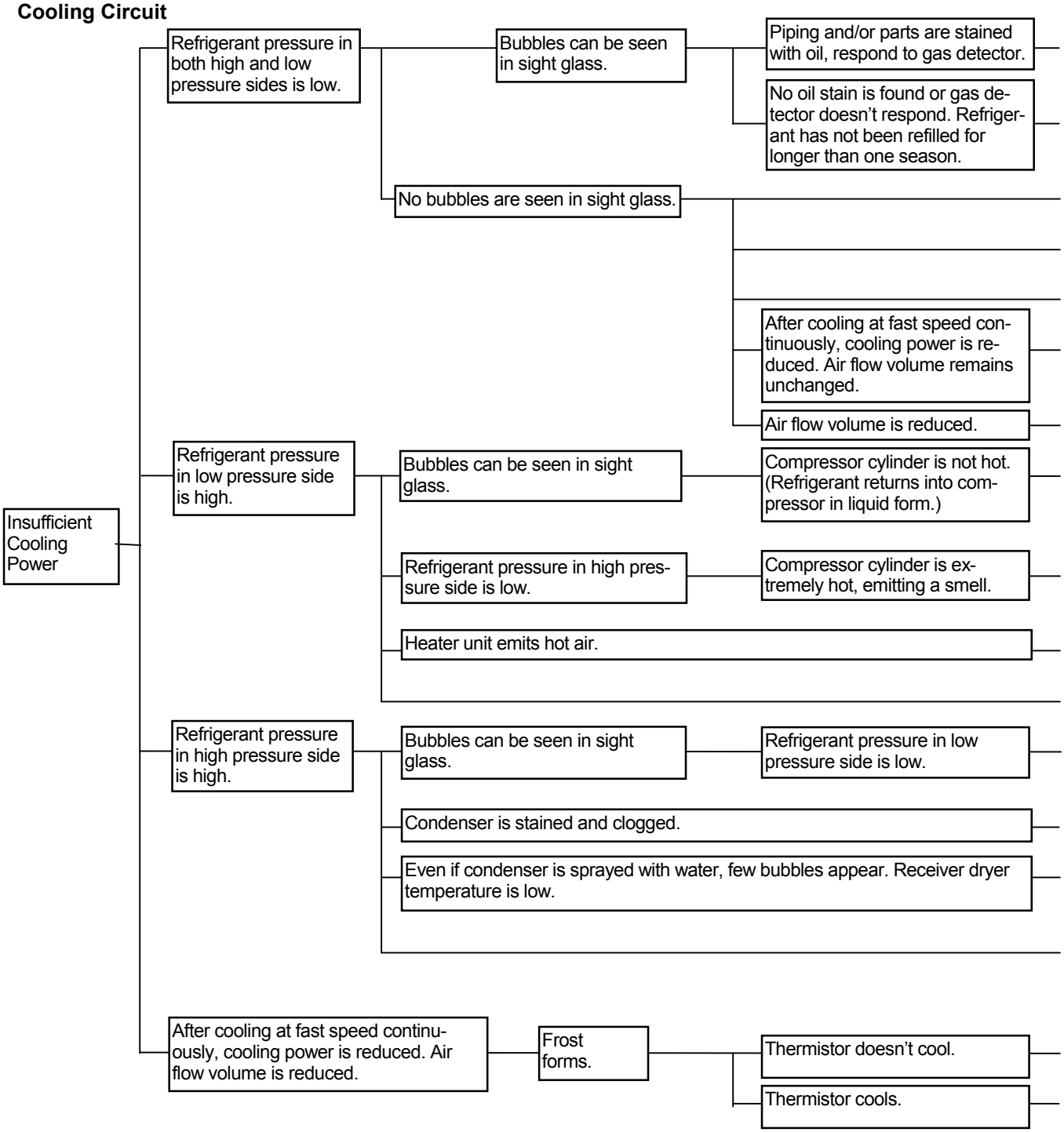
- When grease pressure becomes more than 17.7±0.5 MPa (180±5 kgf/cm^2, 2560±71 psi), auto-lubrication mode stops. Check for grease pressure.
- If auto-lubrication in center joint and swing bearing circuits does not stop , MC(A) may be faulty.
- If interval of auto-lubrication mode is fast, auto-lubrication interval switch may be faulty.
- Measured port of pressure sensor 1 may be clogged. Check measured port beforehand.
- Check for loose harness connections beforehand.



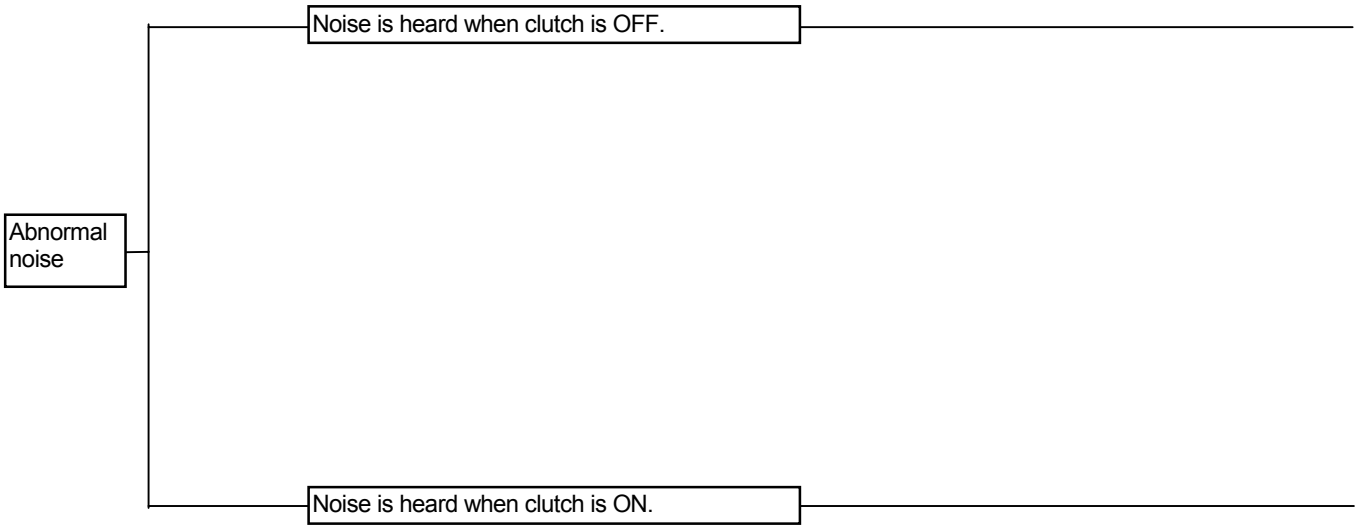
O-10 Air conditioner malfunction.

- When the air conditioner system control panel indicator flashes, see T5-4-74.
- When reporting the malfunction of the air conditioner to HITACHI, use the Air Conditioner Trouble Report form shown on page T5-4-75.

Cooling Circuit



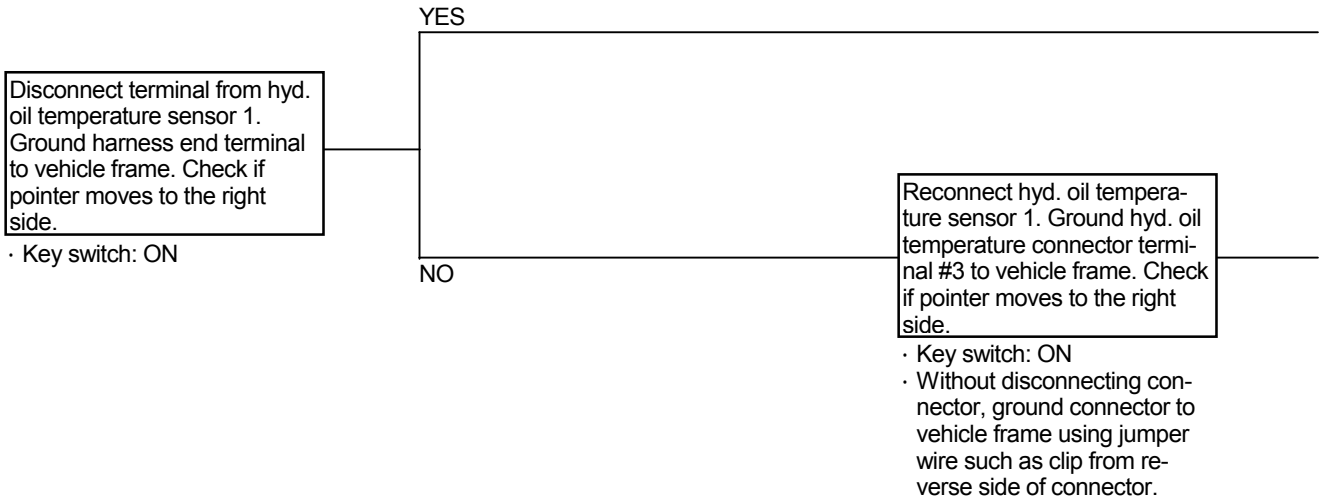
Compressor


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

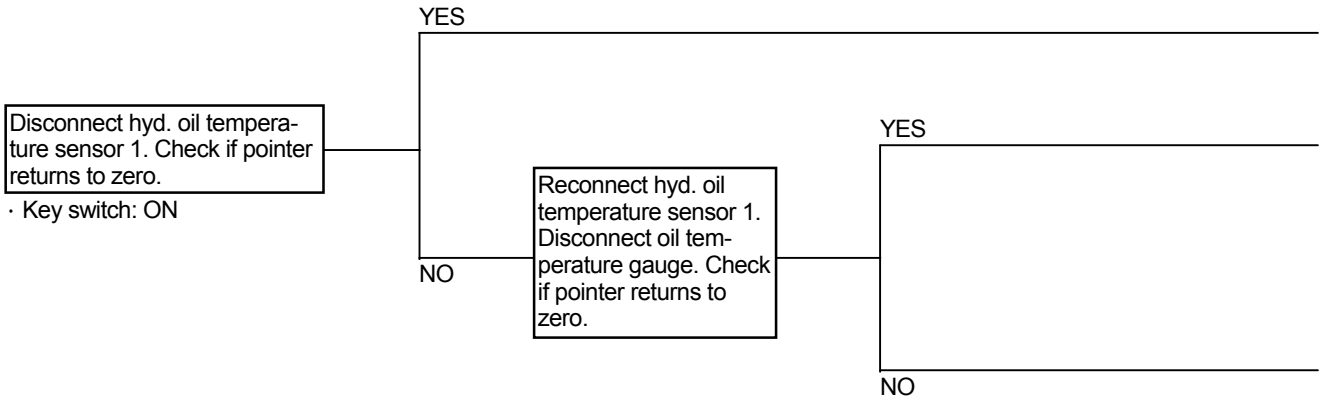
MALFUNCTION OF HYDRAULIC OIL TEMPERATURE GAUGE

- Check under the condition that all other gauges and meters operate normally.
- Check for loose harness connections beforehand.

Gauge pointer doesn't move at all.



Gauge pointer swings over scale.



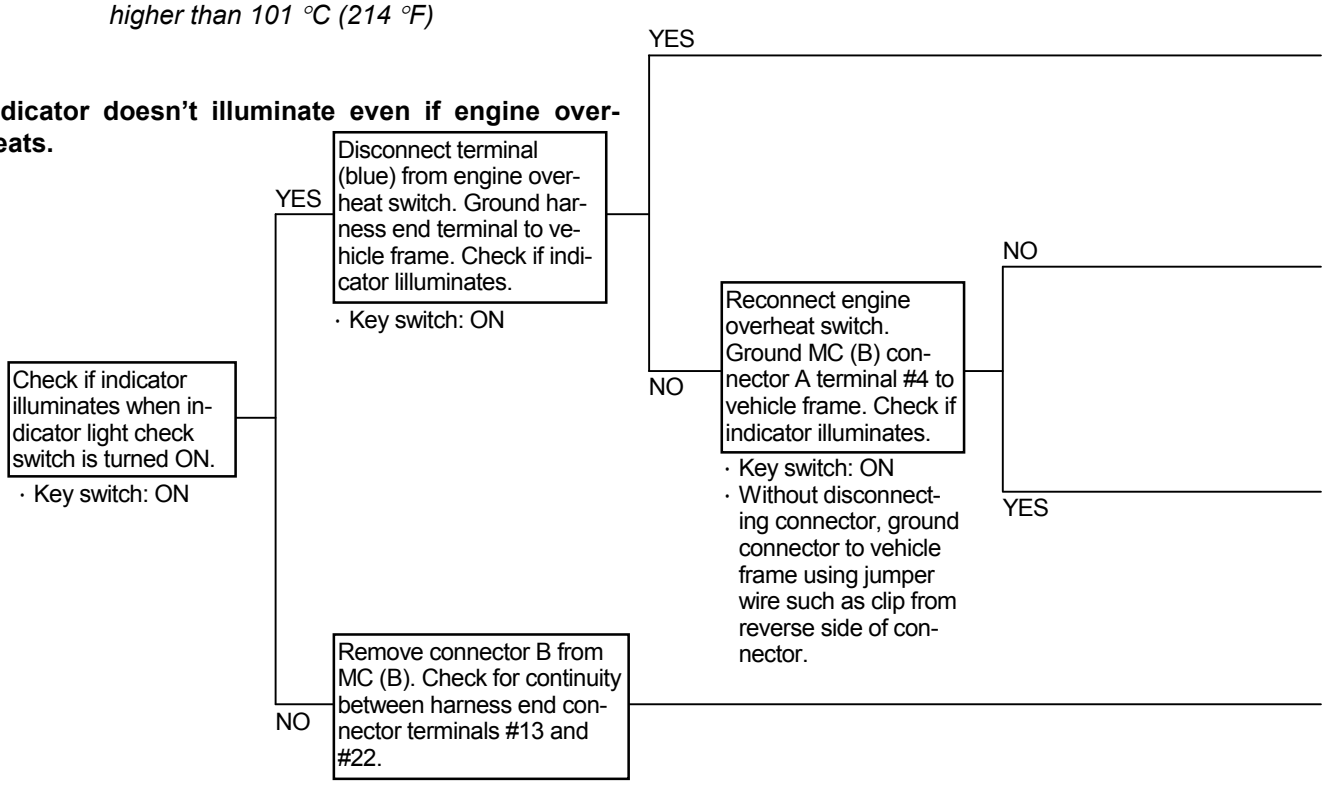
Gauge pointer keeps moving unstably.

MALFUNCTION OF OVERHEAT INDICATOR

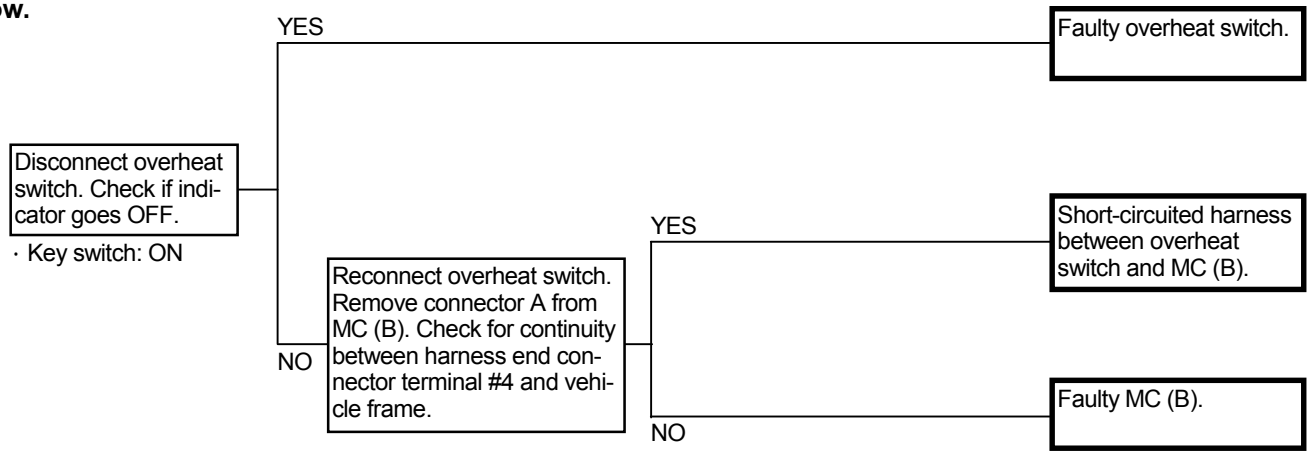
- Check for loose harness connections beforehand.

NOTE: Overheat Switch Operating Temperature: higher than 101 °C (214 °F)

Indicator doesn't illuminate even if engine overheats.



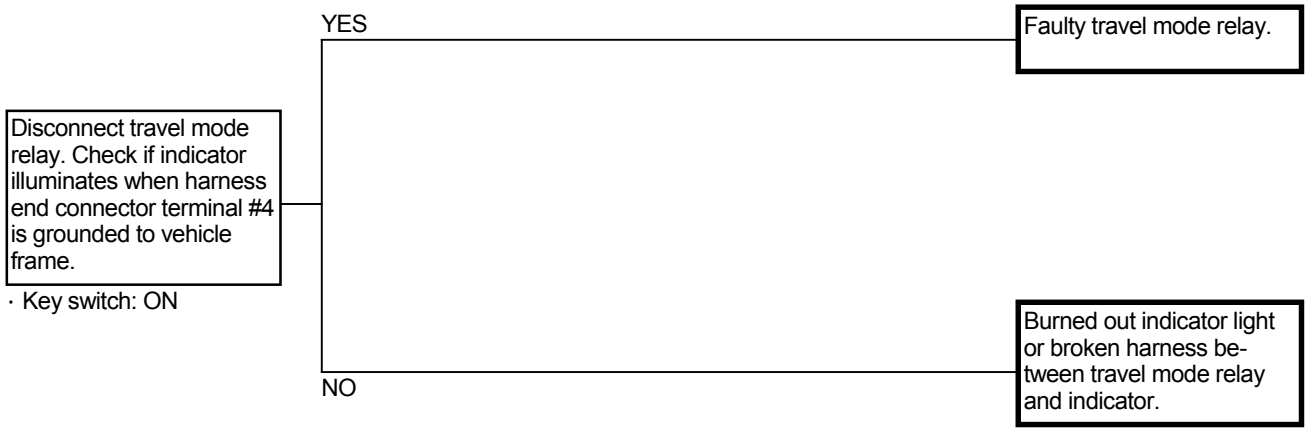
Indicator illuminates even if coolant temperature is low.



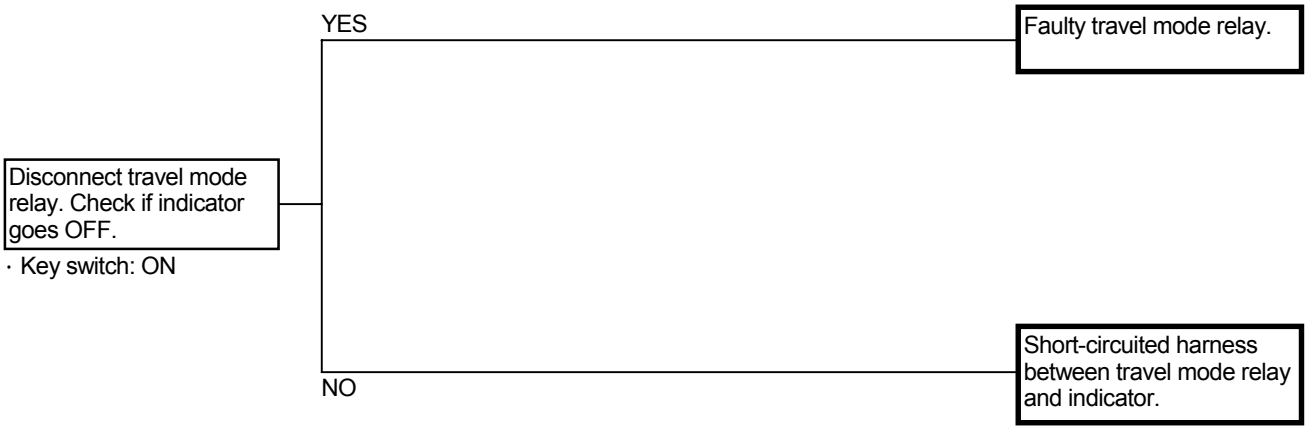
MALFUNCTION OF SLOW TRAVEL MODE INDICATOR

- Check under the condition that all other gauges and meters operate normally.
- Check for loose harness connections beforehand.

Indicator doesn't illuminate even though travel mode switch is turned OFF (slow).

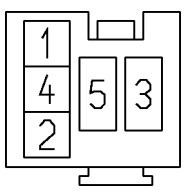


Indicator illuminates even if travel mode switch is turned OFF (slow).



Connector

Travel Mode Relay

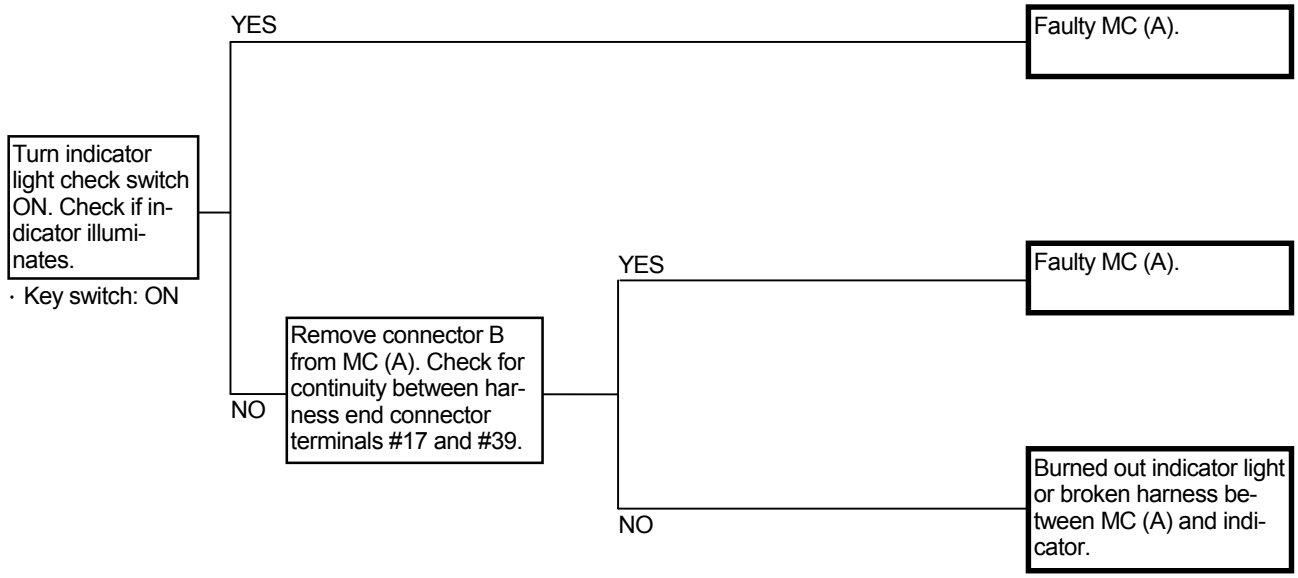


T146-05-04-003

MALFUNCTION OF AUTO-LUBRICATION INDICATOR

- Check for loose harness connections beforehand.

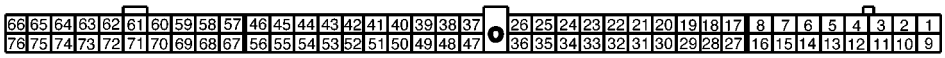
Indicator doesn't illuminate when auto-lubrication switch is set in the manual mode (although it normally operates in the automatic mode).



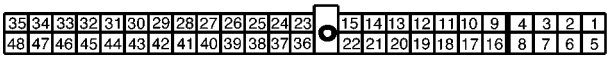
Connector

MC(A)

A



B

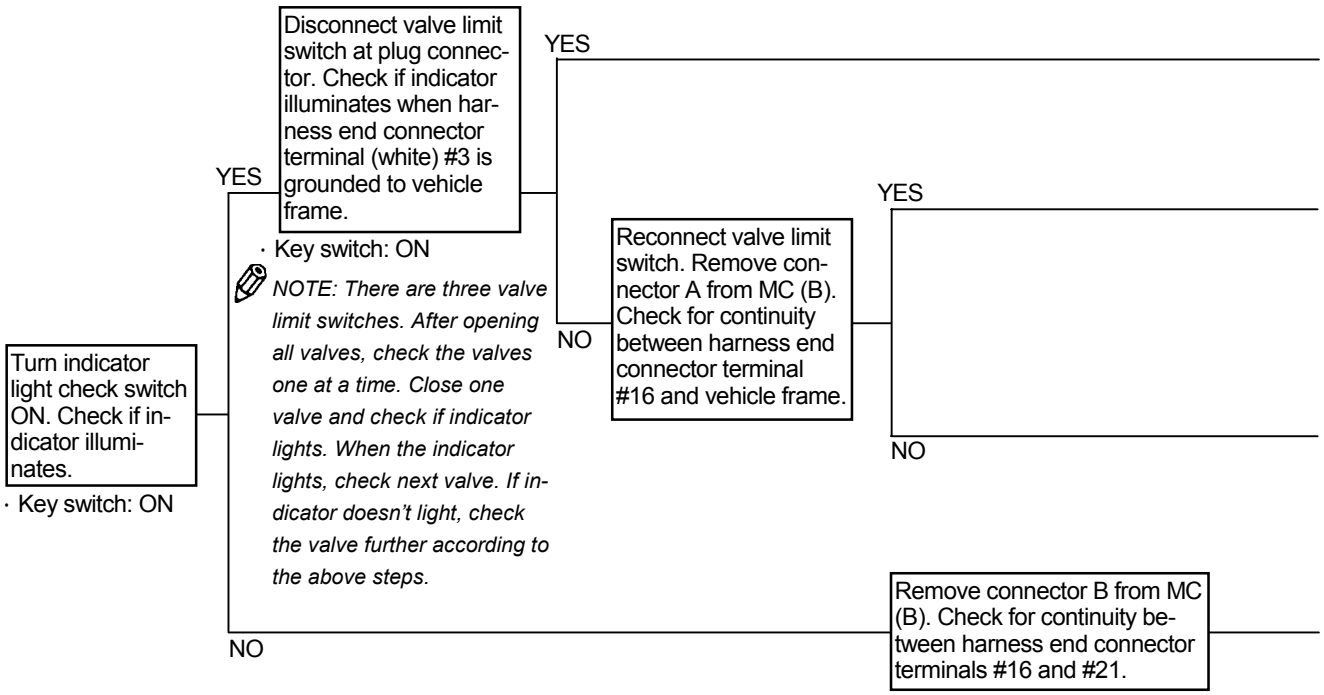


T118-05-04-002

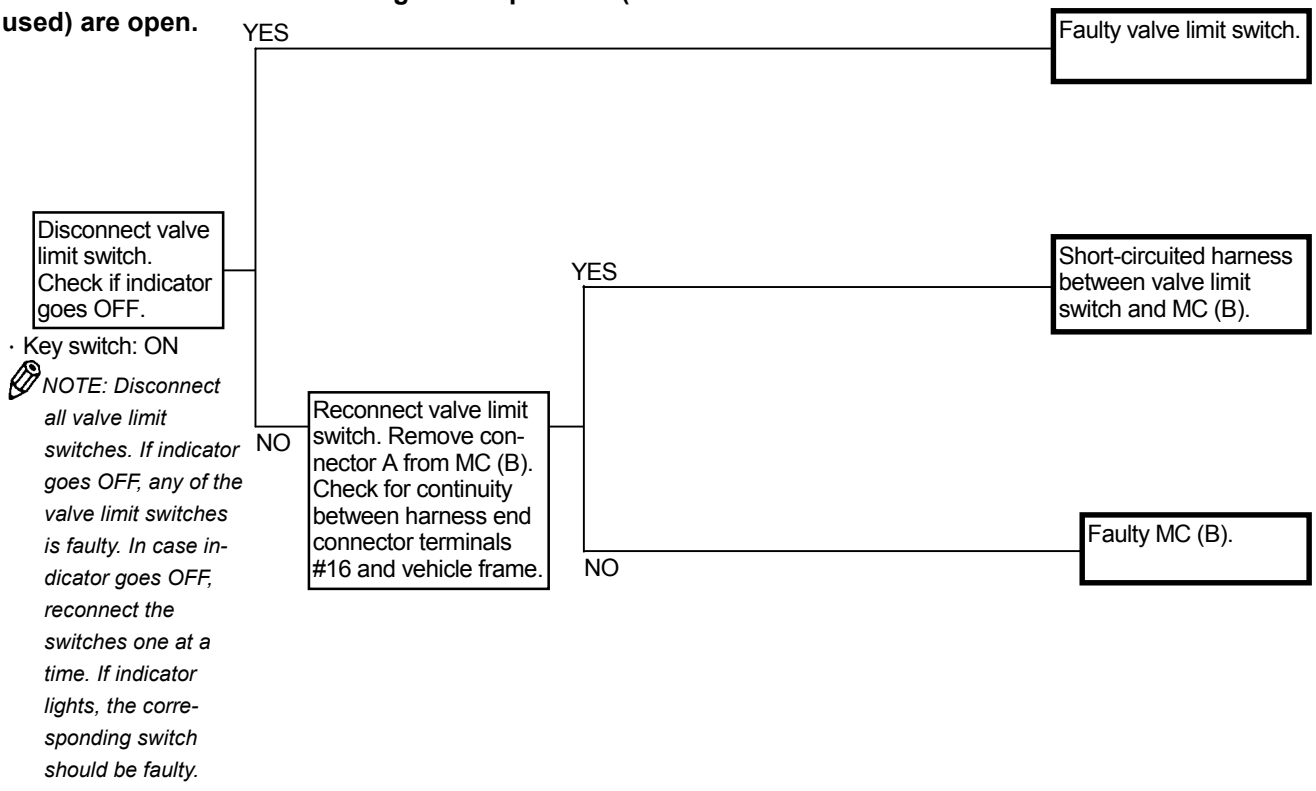
MALFUNCTION OF STOP VALVE INDICATOR

- Check for loose harness connections beforehand.

Even if stop valve is closed, indicator doesn't illuminate.

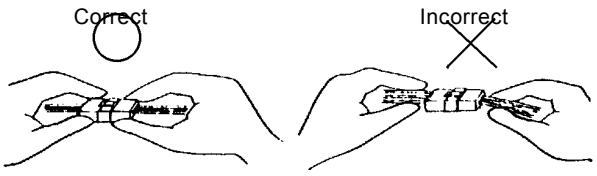


Indicator illuminates even though all stop valves (3 used) are open.

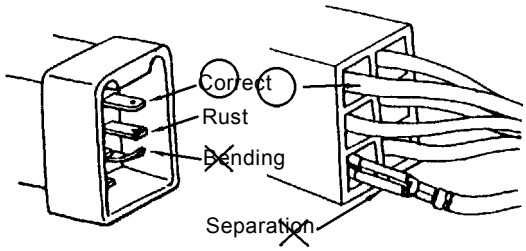


3. Precautions for Connecting and Disconnecting Terminal Connectors

1) When disconnecting harnesses, grasp them by their connectors. Do not pull on the wire itself. Be sure to release the lock first before attempting to separate connectors, if a lock is provided.
2) Water-resistant connectors keep water out so that if water enters the connector, water will not easily drain. When checking water-resistant connectors, take extra care not to allow water to enter these types of connectors. In case water should enter this connector, reconnect only after thoroughly drying the connector.
3) Before connecting terminal connectors, check that no terminals are bent or missing. In addition, as most connectors are made of brass, check that no terminals are corroding.
4) When connecting terminal connectors provided with a lock, be sure to insert them together until the lock “clicks.”



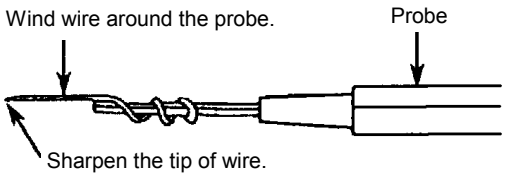
T107-07-06-001



T107-07-06-002

4. Precaution for Using a Circuit Tester

1) Before using a circuit tester, refer to the instructions in the circuit tester manual.
   Then, set the circuit tester to meet the object to be measured, voltage range and current polarity .
2) Before starting the connector test, always check the connector terminal numbers, referring to the circuit diagram. When the connector size is very small, and the standard probe size is too large to be used for testing, wind a fine piece of sharpened wire or a pin around the probe to make the test easier.



T107-07-06-003

VOLTAGE CHECK

The voltage check is performed not only for determination of the voltage values at the measurement point, but also for the confirmation of the electrical validity between the measurement point and power supply.

24 Volt Circuit

Before voltage check, turn appropriate switch ON to apply voltage at the measurement line.

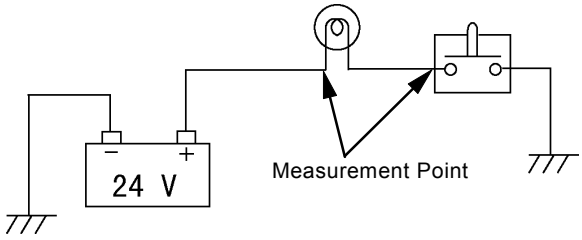
Black Negative (-) Probe: Vehicle Frame
Red Positive (+) Probe: Each Measurement Point

If the rated voltage (battery voltage) is measured, probably the circuit from the battery (alternator) to the measurement point is in good condition. However, if the current flowing through the circuit, the voltage may not be reached the rated value (this voltage drop is caused by resistance of electrical components).

If the rated voltage is not measured, faulty power supply, short-circuited circuit and/or broken line on circuit may be suspected. In this case, the faulty parts in the circuit can be found out by checking each parts in order of the circuit from the upstream (or downstream).

Rated Voltage (with normal power source):
When engine is not running: Battery voltage
approx. 25.5 V
When engine is running: Alternator generated voltage
approx. 28 V

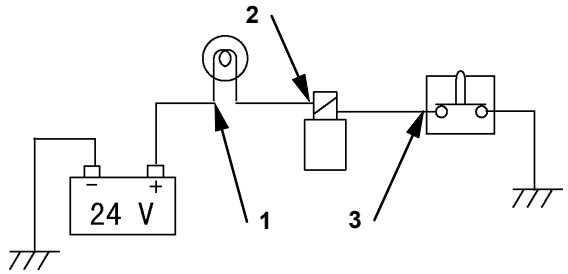
Measurement Example 1: When current is not flowing



T141-05-06-002

Measured Voltage
24 V: The circuit from power source to the measurement point is normal.
0 V: There is open or short circuit between power supply and the measurement point.

Measurement Example 2: When power flows



T141-05-06-003

Measurement Point	Measured Value
1	24 V
2	20 V
3	0 V

The measurement voltage does not become same to the power supply value because of voltage drops by resistance of the electrical components.
However, if the voltage is measured, it can be decided that there are no open wires in the upstream circuit from measurement point.

CONTINUITY CHECK

Single-line continuity check

Disconnect both end connectors of the harness and check continuity between both ends:
If the ohm-meter reading is:
0 Ω = Continuity
∞ Ω = Discontinuity

NOTE: When the one end connector is far apart from the other, connect one end of connector (A) to the machine chassis using a clip. Then, check continuity of the harness through the vehicle frame as illustrated.

If the ohm-meter reading is:
0 Ω = Continuity
∞ Ω = Discontinuity

Single-line short-circuit check

Disconnect both end connectors of the harness and check continuity between one end connector of the harness and the vehicle frame:
If the ohm-meter reading is:
0 Ω = Short circuit is present.
∞ Ω = No short circuit is present.

Multi-line continuity check

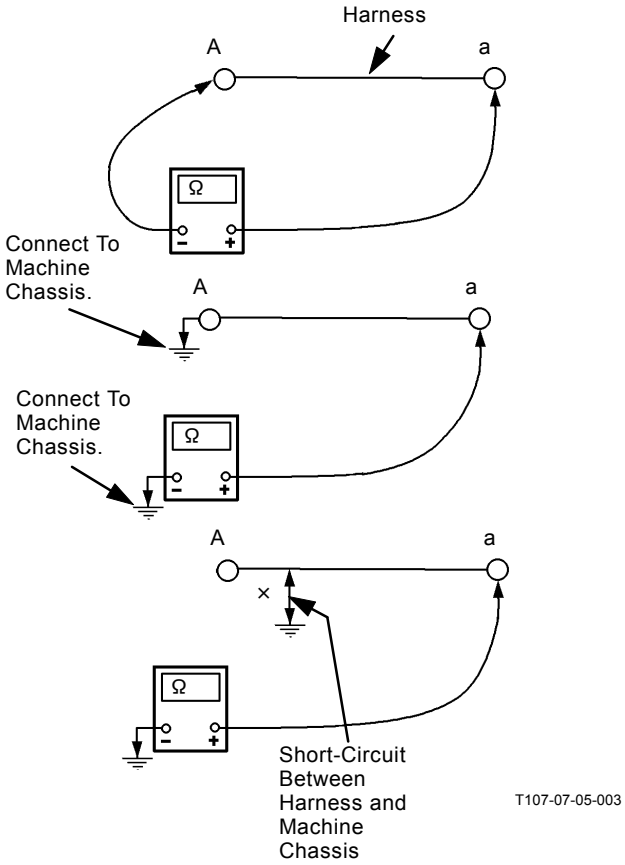
Disconnect both end connectors of the harness, and connect two terminals, (A) and (B), at one end connector, as illustrated. Then, check continuity between terminals (a) and (b) at the other connector. If the ohm-meter reading is ∞ Ω, either line (A)-(a), or (B)-(b) is in discontinuity. To find out which line is discontinued, conduct the single line continuity check on both lines individually, or, after changing the short-circuit terminals from (A)-(B) to (A)-(C), check continuity once more between terminals (a) and (c).

NOTE: By conducting the multi-line continuity check twice, it is possible to find out which line is discontinued. With terminals (A) and (C) connected, check continuity between terminals (a) and (c).

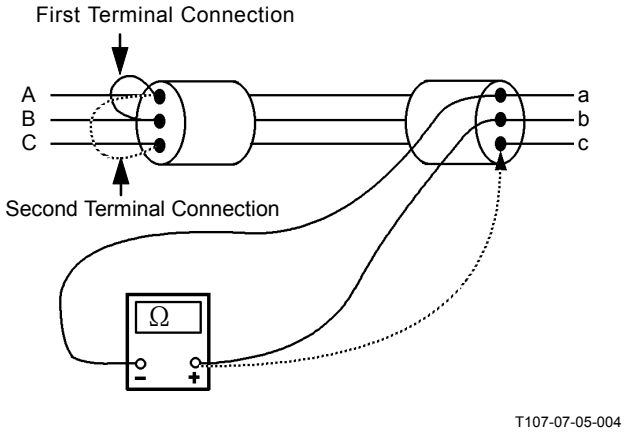
If the ohm-meter reading is:
0 Ω = Line (B)-(b) has discontinuity.
∞ Ω = Line (A)-(a) has discontinuity.

Multi-line short-circuit check

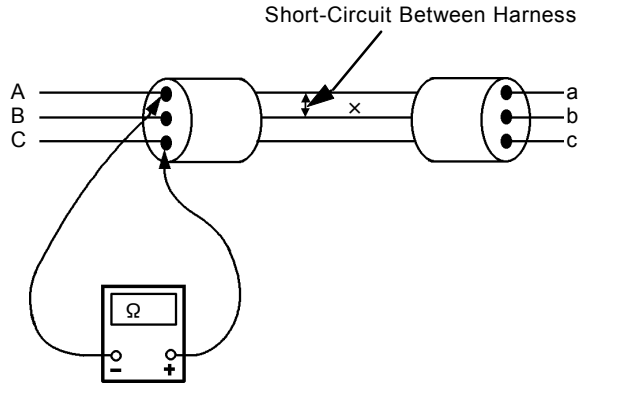
Disconnect both end connectors of the harness, and check continuity between terminals (A) and (B) or (C).
If the ohm-meter reading is:
0 Ω = Short-circuit exists between the lines.
∞ Ω = No short-circuit exists between the lines.



T107-07-05-003



T107-07-05-004



T107-07-05-005