SAFETY ALERT SYMBOL AND HEADLINE NOTATIONS

In this manual, the following safety alert symbol and signal words are used to alert the reader to the potential for personal injury or machine damage.

⚠ This is the safety alert symbol. When you see this symbol, be alert to the potential for personal injury.
Never fail to follow the safety instructions prescribed along with the safety alert symbol.
The safety alert symbol is also used to draw attention to component/part weights.
To avoid injury and damage, be sure to use appropriate lifting techniques and equipment when lifting heavy parts.

- ⚠ **CAUTION:** indicated a potentially hazardous situation which could, if not avoided, result in personal injury or death.
- **IMPORTANT:** indicates a situation which, if not avoided, could result in damage to the machine.
- *NOTE:* indicates supplementary technical information or know-how.

UNITS USED

- SI Units (International System of Units) are used in this manual.
  MKSA system units and English units are also indicated in parentheses just behind SI units.

  Example: 24.5 MPa (250 kgf/cm^2, 3 560 psi)

  A table for conversion from SI units to other system units is shown below for reference purposes.

Quantity	To Convert From	Into	Multiply By	Quantity	To Convert From	Into	Multiply By
Length	mm	in	0.039 37	Pressure	MPa	kgf/cm^2	10.197
	mm	ft	0.003 281		MPa	psi	145.0
Volume	L	US gal	0.264 2	Power	kW	PS	1.360
	L	US qt	1.057		kW	HP	1.341
	m^3	yd^3	1.308	Temperature	°C	°F	°C×1.8+32
Weight	kg	lb	2.205	Velocity	km/h	mph	0.621 4
Force	N	kgf	0.101 97		min^{-1}	rpm	1.0
	N	lbf	0.224 8	Flow rate	L/min	US gpm	0.264 2
Torque	N·m	kgf·m	1.019 7		mL/rev	cc/rev	1.0
	N·m	lbf·ft	0.737 5				

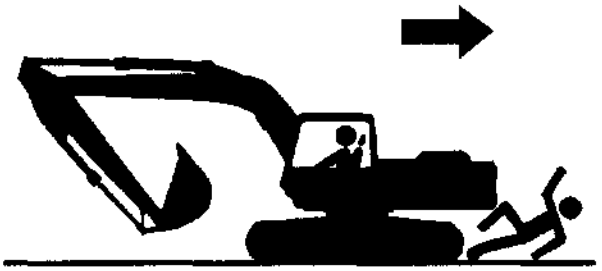
USE HANDHOLDS AND STEPS

- Falling is one of the major causes of personal injury.
  - When getting on and off the machine, always maintain a three-point contact with the steps and handrails, and face the machine.
  - Do not use any controls as handholds.
  - Never jump on or off the machine. Never mount or dismount a moving machine.
  - Be careful of slippery conditions on platforms, steps, and handrails when getting on or off the machine.

SA-006

PRECAUTIONS FOR MACHINE OPERATION

- Never lubricate or service the machine while it is moving.
- If a maintenance procedure must be performed with the engine running, do not leave the machine unattended.
- Take precautions when operating the machine
  - Be sure to start the engine only while seated in the operator's seat.
  - Always be alert for bystanders moving into the work area. Use the horn or other signal to warn bystanders before starting the engine and before moving the machine.
  - Machines experiencing trouble may move in unexpected ways. Be sure to operate the machine slowly while observing machine movements closely.
  - Use a signal person when backing up, if your view is obstructed. Always keep the signal person in view.
  - Learn the meaning of all flags, signs, and markings used on the job, and confirm who has the responsibility for signaling.
- Be sure to remain seated in the operator's seat while operating the machine.
- Keep riders off the machine. Only allow the operator on the machine.

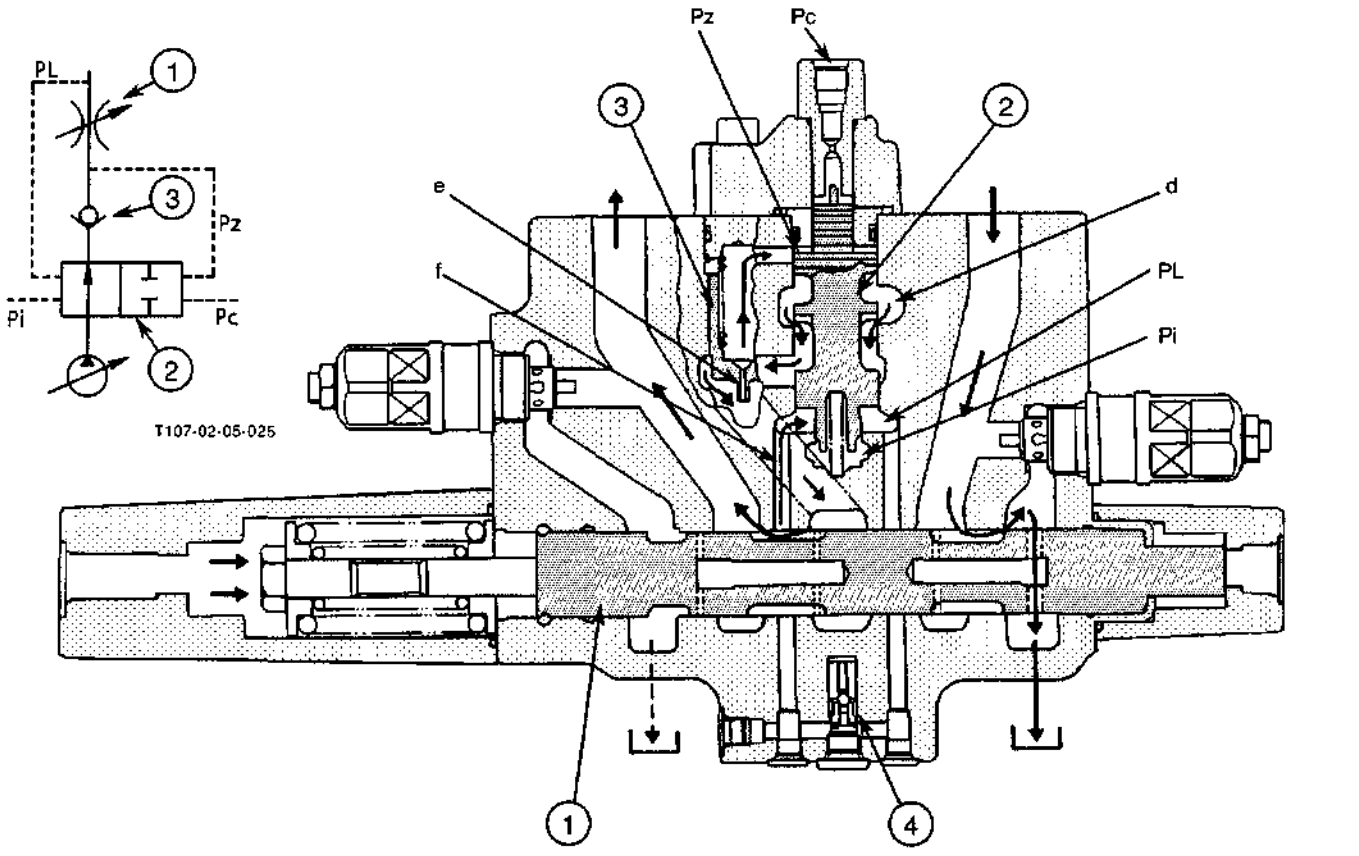


SA-007

VARIABLE PRESSURE COMPENSATED VALVE (VPCV)

The VPCV is an oil flow regulator valve which functions to properly deliver the pump oil flow to each actuator. This valve is located on the upstream side of control valve spool (1) in the control valve.
The VPCV reduces pump oil flow when receiving pilot oil pressures Pz and Pc, and increases it when receiving pilot oil pressures PL and Pi at notch section (d).

- Pilot oil pressure Pz is routed to VPCV (2) after passing load check valve (3) via passage (e) to reduce the pump oil flow.
- Pilot oil pressure PL is routed to VPCV (2) through passage (f) when control valve spool (1) is operated to increase the pump oil flow. At the same time, pilot oil pressure PL is routed to the differential pressure sensor (DP sensor), unloading valve, and unloading relief valve via shuttle valve (4). When a combined operation, bucket and arm for example, is made, and load pressure in the arm cylinder is lower than that in the bucket cylinder, a larger quantity of pressure oil passes the VPCV in the arm circuit.
  Then differential oil pressure between PZ and PL in the arm circuit becomes greater than in the bucket circuit, closing the VPCV in the arm circuit until differential oil pressures between PZ and PL in both arm and bucket circuits become equal. Accordingly, pressure oil can be supplied equally to both arm and bucket cylinders.
- Pilot oil pressure Pc is routed to VPCV (2) from the proportional solenoid valve in the solenoid valve assembly to reduce the pump oil flow. The Pc pressure is controlled by signals sent out from the PVC so as to meet the selected work mode, or working conditions of the combined operation at hand.
- Constant pilot oil pressure Pi is routed to VPCV (2) from the reducing valve in the solenoid valve assembly to increase the pump oil flow.



1— Control Valve Spool
2— Variable Pressure Compensated Valve
3— Load Check Valve
4— Shuttle Valve

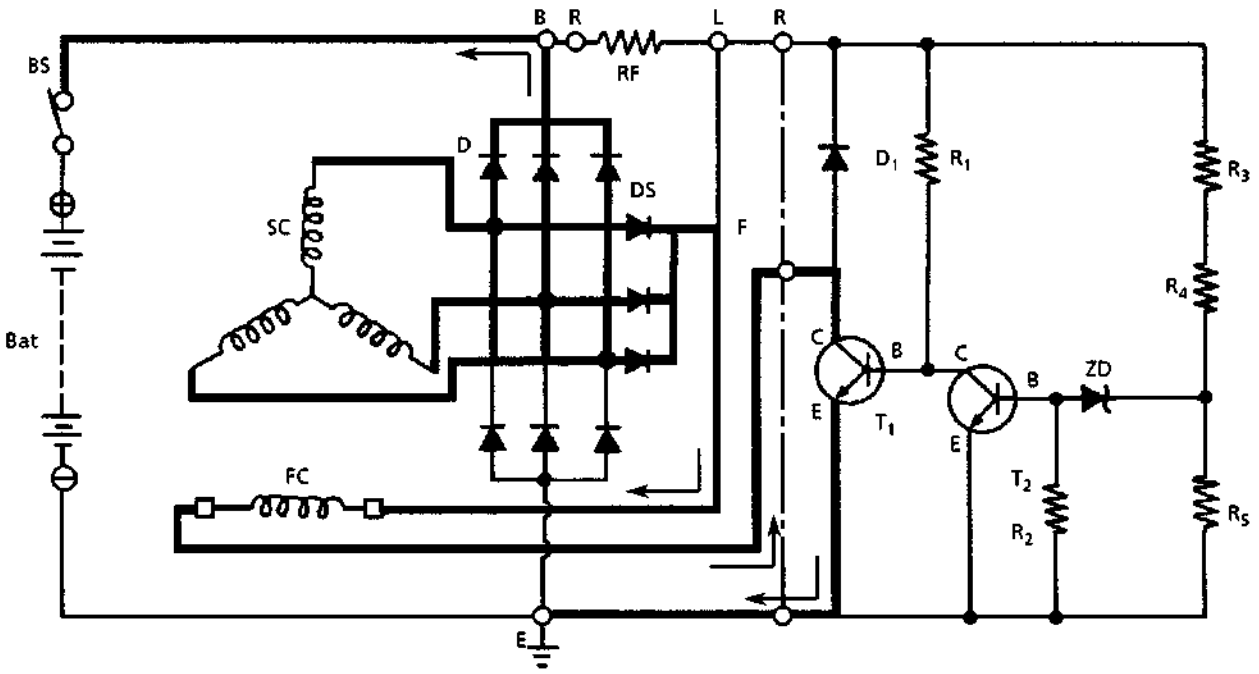
OPERATION OF THE REGULATOR

The figure below illustrates the circuitry between the alternator and the regulator.
The alternator incorporates a field coil (FC / rotor coil), a stator coil (SC) and a diode (D).
The regulator contains a transistor (T), a diode (D), and zener diode (ZD). Terminal B of the alternator sends current from the alternator to the regulator in this way:
B →RF →R →R1 →Base (B) of Transistor T1
B →RF →FC →F →Collector (C) of Transistor T1

By turning the key switch ON, current flows to the base (B) of transistor T1, electrifying the collector (C) and the emitter (E) of transistor T1, and then the current passes to the field coil (FC). In this condition, the rotation of the alternator generates voltage.

Power Generation

Electrical power is generated as follows:
When the alternator starts rotation, the voltage between R-E is increased from the initial excitation level, increasing the flow of current to the field coil. This further raises the voltage between R-E, which changes from battery excitation to self-excitation, and begins charging the battery.



T107-04-04-006

LIST OF PVC RELATING FAULT CODES

Fault Code	Trouble	Corrective Action
17 18 19	Failure (type-17) of PVC Failure (type-18) of PVC Failure (type-19) of PVC	1) Retry diagnostic procedure A 2) Replace PVC if engine stops or working speed is abnormal
20	Signal from EC is not transmitted to PVC	1) Retry diagnostic procedure B 2) Check harness 3) Replace PVC or EC if abnormal speed sensing operation is found
21	Failure (type-21) of PVC	1) Retry diagnostic procedure B 2) Replace PVC
22	Abnormal pump control	1) Retry diagnostic procedure B 2) Harness check 3) Check pump displacement solenoid valve 4) Check pump displacement angle sensor 5) Check PVC
25 26	Short-circuit of DP sensor and/or harness Disconnected DP sensor and/or harness	1) Retry diagnostic procedure B 2) Check DP sensor harness 3) Replace DP sensor
27 28	Short-circuit of P sensor and/or harness Disconnected P sensor and/or harness	1) Retry diagnostic procedure B 2) Check P sensor harness 3) Replace P sensor
29 30	Short-circuit of A sensor and/or harness Disconnected A sensor and/or harness	1) Retry diagnostic procedure B 2) Check A sensor harness 3) Replace A sensor
31 32	Disconnected T sensor and/or harness Short-circuit of T sensor and/or harness	1) Retry diagnostic procedure B 2) Check T sensor harness 3) Replace T sensor
33 34	Disconnected BpiP sensor and/or harness Short-circuit of BpiP sensor and/or harness	1) Retry diagnostic procedure B 2) Check BpiP sensor harness 3) Replace BpiP sensor
35 36	Disconnected ABP sensor and/or harness Short-circuit of ABP sensor and/or harness	1) Retry diagnostic procedure B 2) Check ABP sensor harness 3) Replace ABP sensor

BpiP: Boom raise pilot pressure sensor ABP: Arm bottom pressure sensor

Check points

This travel and arm roll-in combined operation is a simulation of soft ground extrication. The arm cylinder force while the tracks spin is decided by the pump delivery pressure. However, measured values are liable to be changed by the hydraulic oil temperature.

If any measured value does not meet standards, refer to the table below for corrective action.

Problems	Causes	Check and repair
Traveling movement is unstable.	1-1 Aerated pipings between solenoid valve and control valve.	Loosen pipings to release air.
Althrough travel PC pressure raises to its standard, pump delivery pressure is too low.	2-1 Travel PC pressure (SE port output) too low.	Adjust or replace solenoid valve.
	2-2 Travel variable pressure compensated valve is failed so that flow rate for travel cannot be decreased.	Disassemble to clean or replace variable pressure compensated valve.
Travel PC pressure does raise to its standard.	3-1 When pump differential pressure is larger than standard, travel PC pressure cannot be raised.	Replace unloading valve. Disassemble and clean travel shuttle valve. Replace DP sensor.
Travel motor cannot changeover to its maximum angle position so that travel speed cannot be decreased.	4-1 Travel changeover pressure setting too high.	Replace unloading valve. Disassemble and clean travel shuttle valve. Replace DP sensor.
	4-2 Travel changeover pressure setting normal.	Measure changeover signal at travel motor. Replace or adjust solenoid valve.

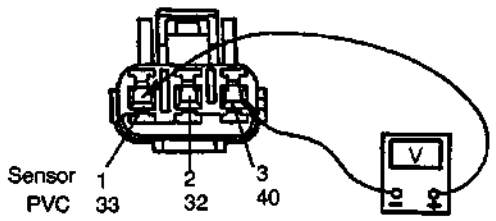
Harness Check Between PVC and A Sensor

1. Turn the key switch OFF, and remove the connector of the A sensor.

2. Turn the key switch ON and measure the voltage between terminal No. 1 (+ side) and terminal No. 3 (− side) of the harness side connector.

   Normal value : 5 ± 0.5 V

   If the voltage is within the normal value range, both harnesses between terminal No. 33 of the PVC and terminal No. 1 of the A sensor and between terminal No. 40 of the PVC and terminal No. 3 of the A sensor are normal.



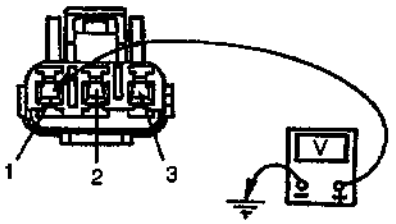
T107-07-03-010

3. When the above mentioned voltage is not normal, check which harness is defective.

3-1. Turn the key switch ON and measure the voltage between terminal No.1 of the harness side connector and vehicle (ground).

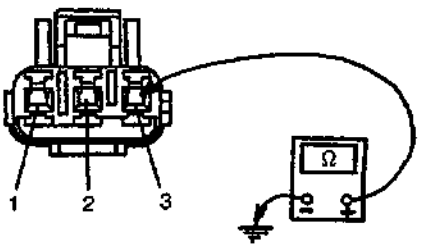
   Normal value : 5 ± 0.5 V

   If the voltage is within the normal value range, the harness between terminal No. 33 of the PVC and terminal No. 1 of the A sensor is normal.



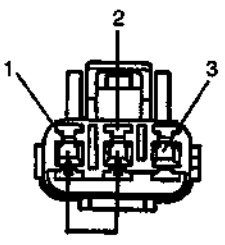
T107-07-03-011

3-2. If the voltage measured in the step 3-1 is normal, check the continuity between terminal No. 3 of the harness side connector and vehicle (ground).
   If continuity exists, the harness between terminal No. 40 of the PVC and terminal No. 3 of the A sensor is normal.



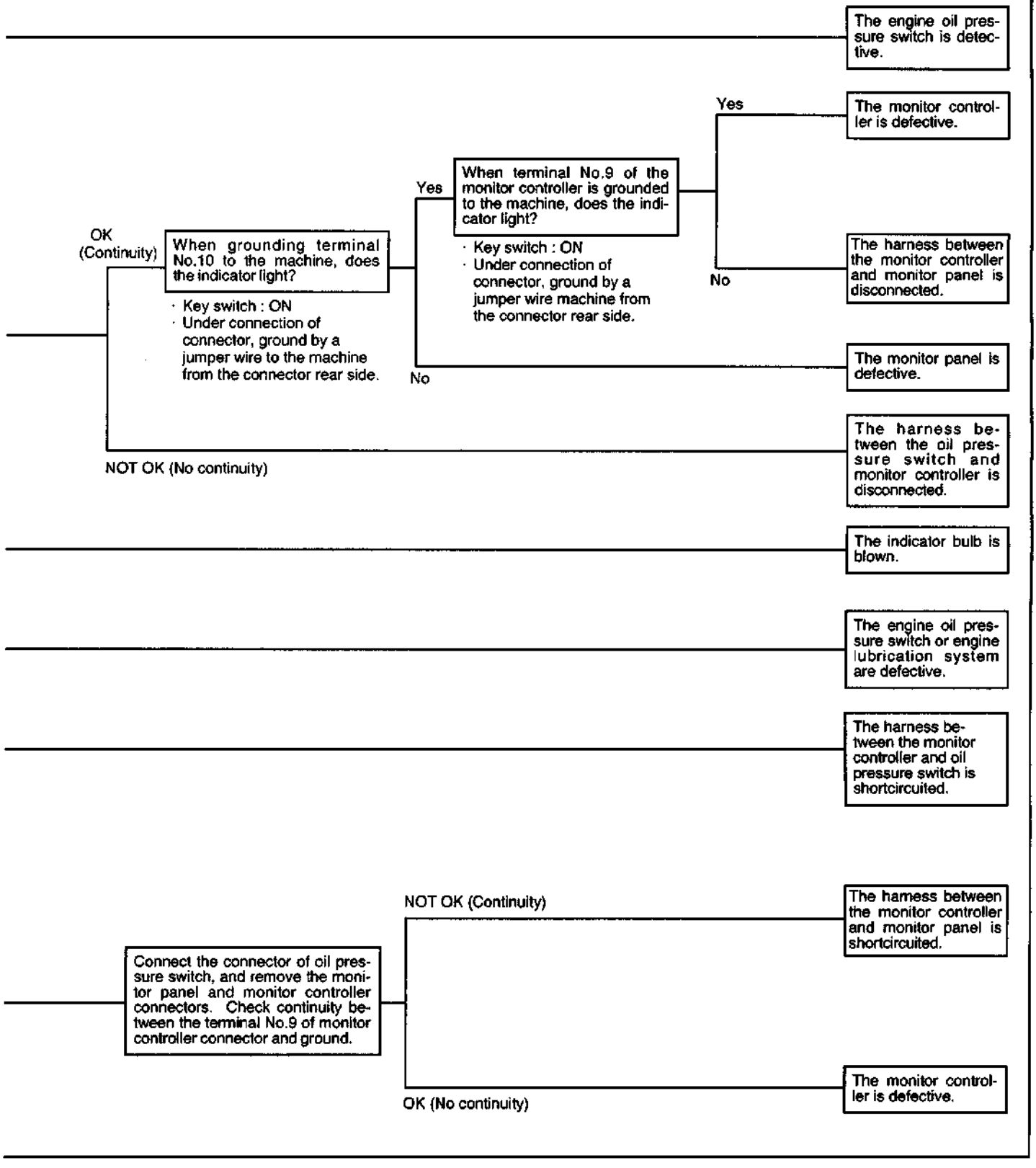
T107-07-03-012

4. Attach the Dr. EX to the machine and short-circuit terminals No. 1 and No. 2 of the harness side connector with a clip, or jumper wire.
   At that time, if the monitor display of the A sensor indicates the maximum value (24 deg.), the harness between terminal No. 32 of the PVC and terminal No. 2 of the A sensor is normal .



T107-07-03-013

IMPORTANT: When short-circuiting terminals No. 1 and No. 2, a care shall be taken not to short-circuit the clip to the machine body.

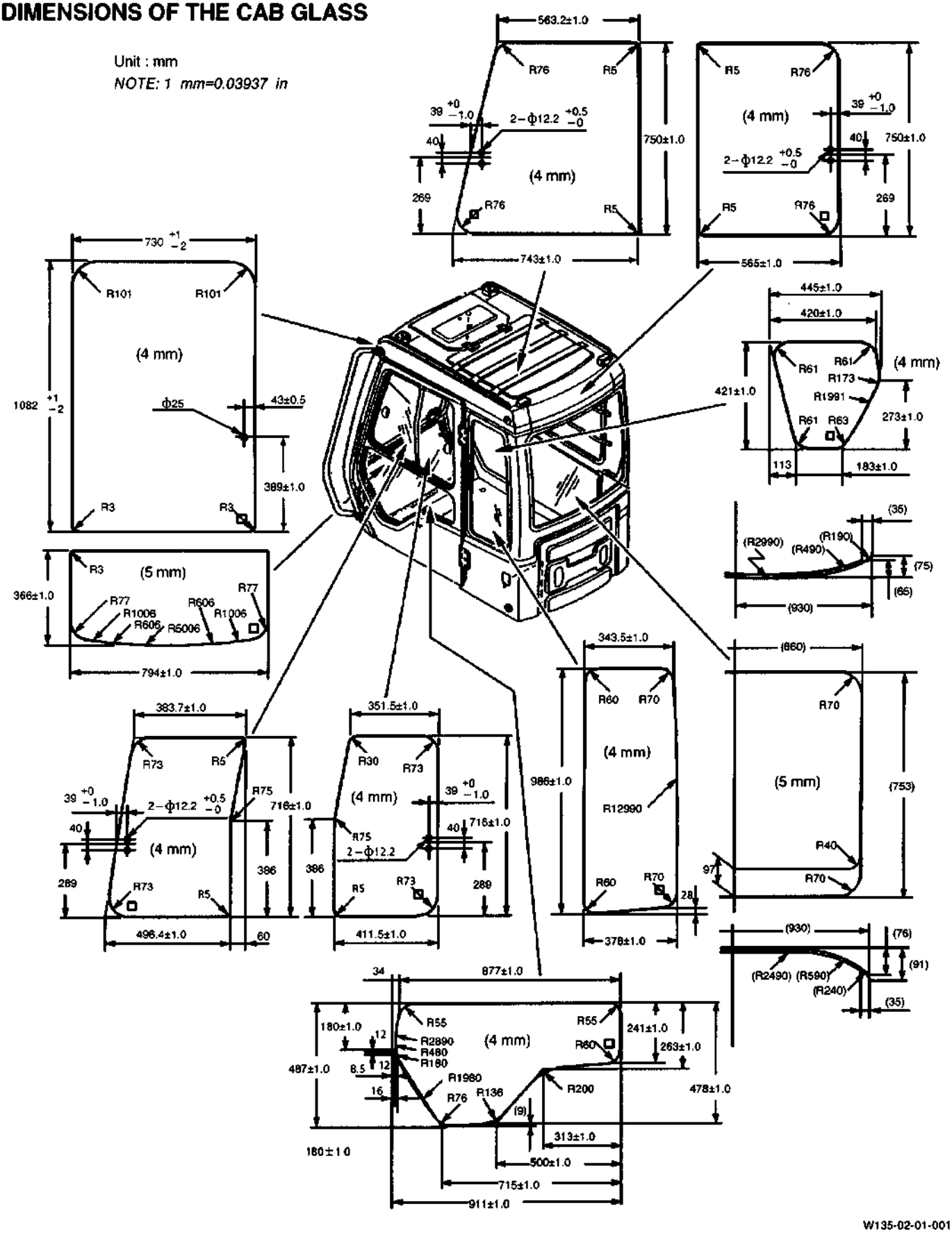

The engine oil pressure switch is detective.
Yes
The monitor controller is defective.
When terminal No.9 of the monitor controller is grounded to the machine, does the indicator light?
· Key switch : ON
· Under connection of connector, ground by a jumper wire machine from the connector rear side.
No
The harness between the monitor controller and monitor panel is disconnected.
Yes
OK (Continuity)
When grounding terminal No.10 to the machine, does the indicator light?
· Key switch : ON
· Under connection of connector, ground by a jumper wire to the machine from the connector rear side.
No
The monitor panel is defective.
The harness between the oil pressure switch and monitor controller is disconnected.
NOT OK (No continuity)
The indicator bulb is blown.
The engine oil pressure switch or engine lubrication system are defective.
The harness between the monitor controller and oil pressure switch is shortcircuited.
NOT OK (Continuity)
The harness between the monitor controller and monitor panel is shortcircuited.
Connect the connector of oil pressure switch, and remove the monitor panel and monitor controller connectors. Check continuity between the terminal No.9 of monitor controller connector and ground.
OK (No continuity)
The monitor controller is defective.

T07-04-17

DIMENSIONS OF THE CAB GLASS

Unit : mm

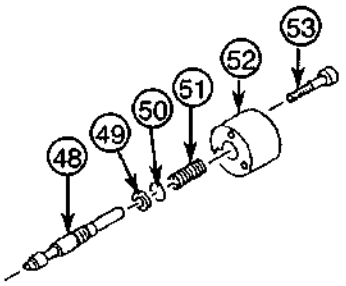
NOTE: 1 mm=0.03937 in



W135-02-01-001

- **System Pressure Regulator (Unloading Valve)**

17. Install spring seat (49) and spring (51) onto spool (48).
    Apply a film of grease to O-ring (50), then install it to cap (52).

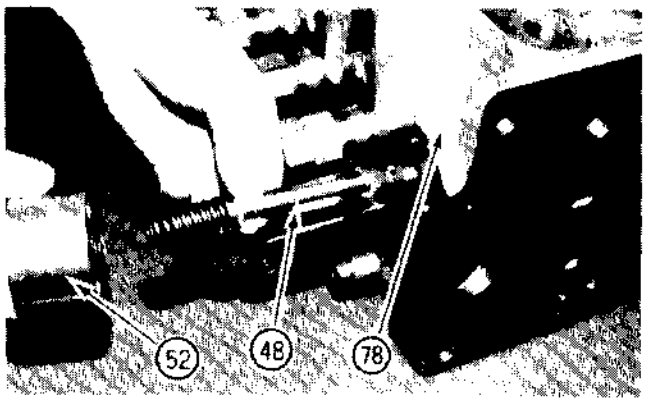


W107-02-05-106

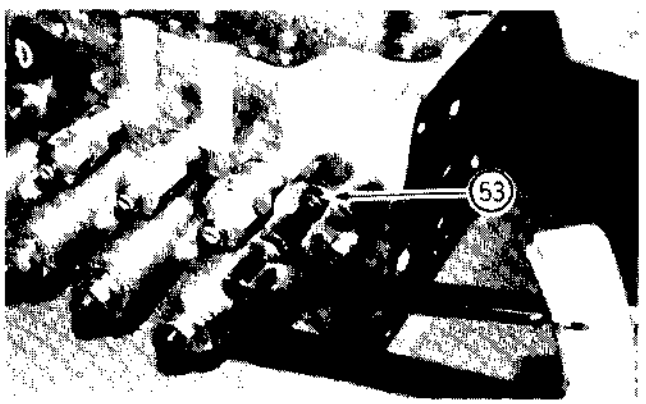
18. Apply a film of hydraulic oil to spool (48), then install it into housing (78).
    Tighten cap (52) with bolts (53).

    : 8 mm

    : 61 N·m (6.2 kgf·m, 45 lbf·ft)



W107-02-05-107



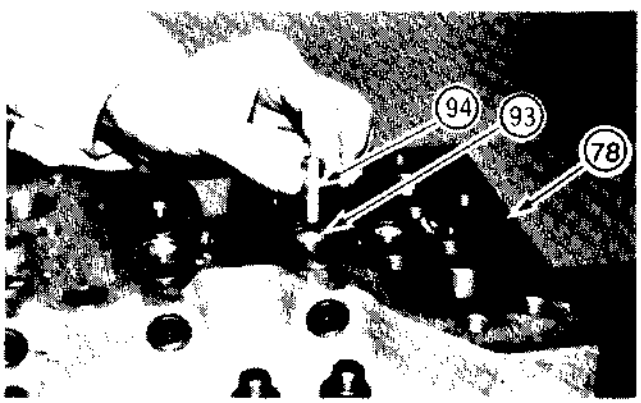
W107-02-05-108

- **Shuttle Valve**

19. Install O-ring to plug (93), then install it into housing (78).
    Apply a film of hydraulic oil to shuttle (94), then install it into housing (78).

    : 5 mm

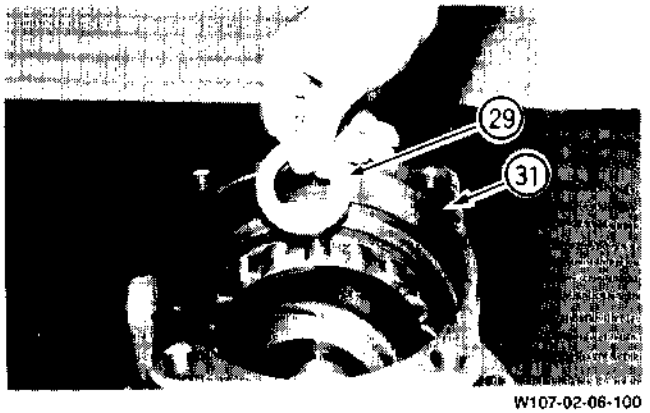
    : 14.5 N·m (1.5 kgf·m, 11 lbf·ft)



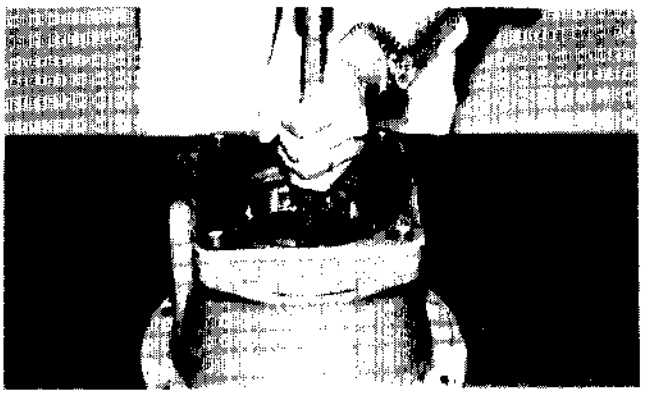
W107-02-05-109

3. Turn over casing (31) and put plate (29) in it. Install oil seal (30) into casing (31) using tool (ST 2564).

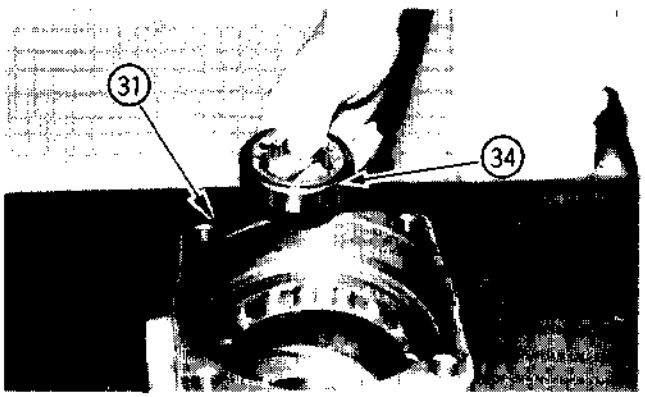
IMPORTANT: Take care of the fitting direction of the oil seal.



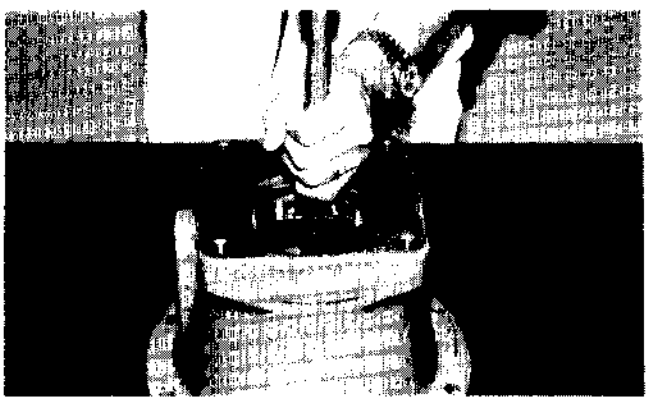
W107-02-06-100


W107-02-06-101

4. Install the outer race of bearing (34) to casing (31) using tool (ST 2565).



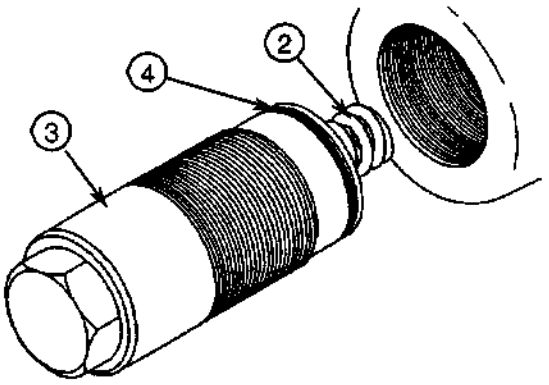
W107-02-06-102


W107-02-06-103

Disassemble Reducing Valve

1. Loosen plug (3) and remove shim (1), spring (2) and O-ring (4).

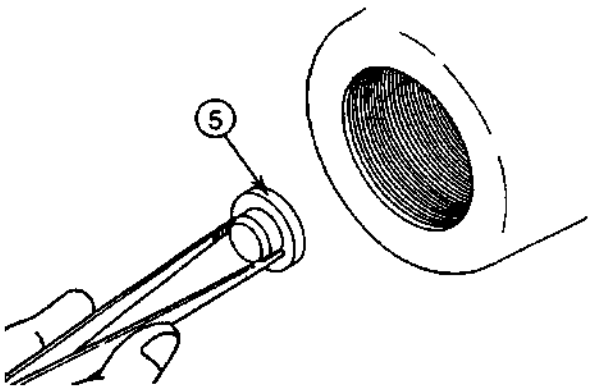
IMPORTANT: When removing plug (3), hold spring (2) with finger to prevent shim (1) and spring (2) from coming out.



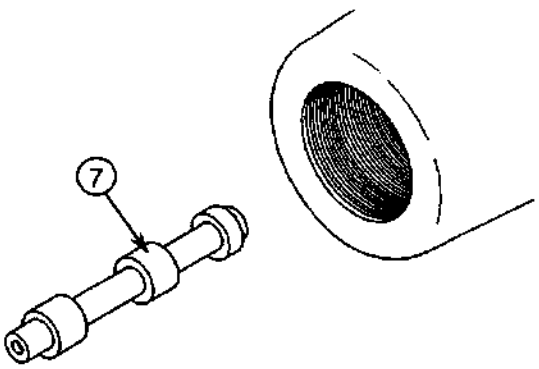
W107-02-11-059

2. Remove plug (5) and take spool (7) slowly out of sleeve (10).

IMPORTANT: Be careful not to damage the corner edge inside sleeve (10) when removing spool (7).



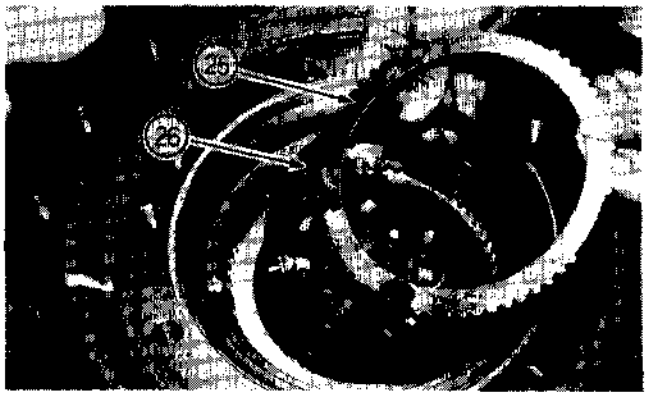
W107-02-11-061



W107-02-11-062

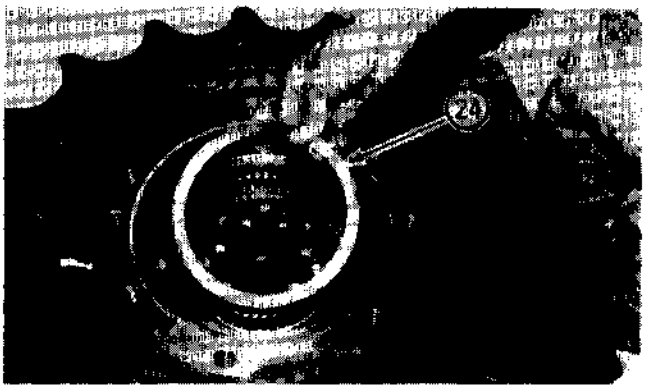
14. Remove plates (25) and friction plates (26) from housing (23).

NOTE: Turn over housing (23), then tap with plastic hammer to remove spacer (24), plates (25), and friction plates (26) from housing (23).



W107-03-02-111

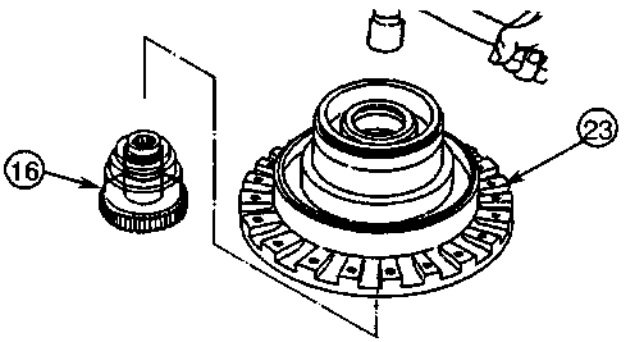
15. Remove spacer (24).



W107-03-02-113

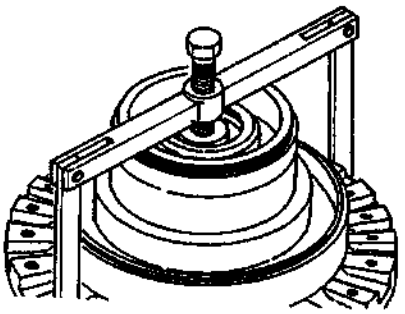
(When disassemble reduction gear)

16. Turn over housing (23), then tap with plastic hammer to remove drive disc (16) assembly.



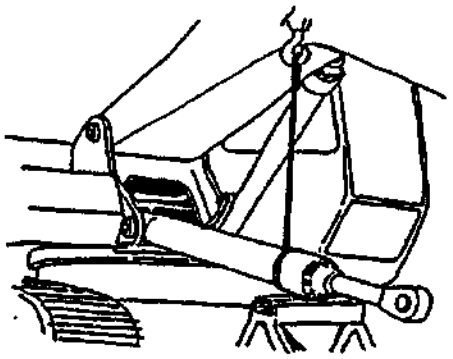
W107-03-02-114

If necessary, put a plate onto spline shaft, then pull out drive disc (16) assembly, using a puller, as illustrated.



W107-03-02-115

5. Lower right boom cylinder to put it on stand.
   Remove other boom cylinder following the same procedure.



W105-04-01-005

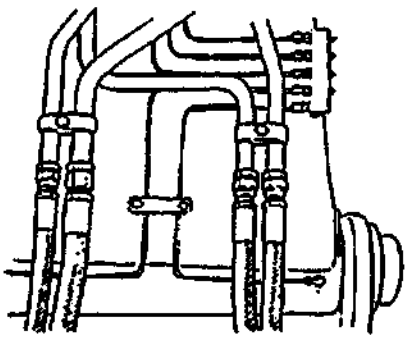
CAUTION: Escaping fluid under pressure can penetrate the skin, causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines.

Hydraulic oil may be hot just after operation. Hot hydraulic oil may spout, possibly causing severe burns. Be sure to wait for oil to cool before starting work.

6. Stop the engine. Move all control levers to release pressure remaining in the system. Push the air release valve on top of the hydraulic oil tank to release any remaining pressure.

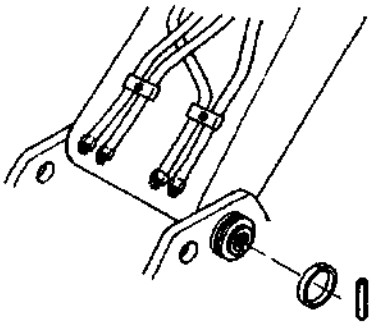
7. Disconnect 4 hoses of arm cylinder and bucket cylinder.
   Close all openings with plug to keep clean.

: 36 mm, 41 mm



W105-04-01-006

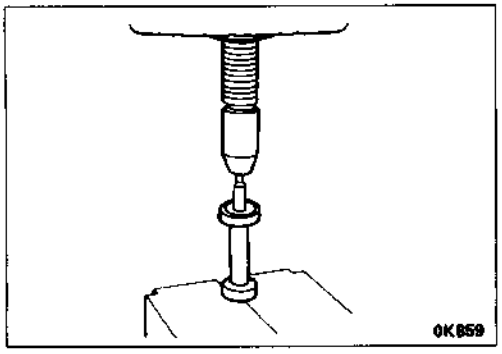
8. Remove ring and pin from the boom foot pin.



W105-04-01-021

INSPECTION AND REPAIR

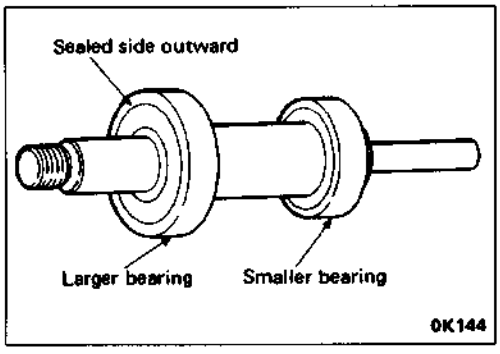
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Bearing Replacement

Removal:

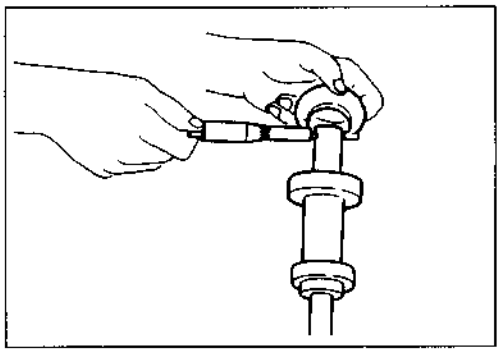
Use a bench press to remove two bearings and the spacer.



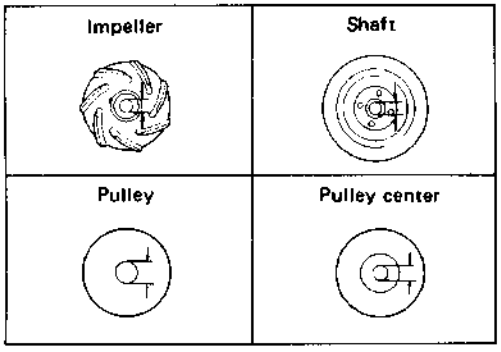
Installation:

Use a bench press to install two bearings and the spacer.

Single bearing is used for 4BD1 and 4BD1T.



Use a micrometer to check the fitness at the three points shown in the illustrations.



mm(in)

Fitness	Shaft to Pulley Center Fitness	0.02 — 0.06 (0.0008 — 0.0024)
	Shaft to Impeller Fitness	0.07 — 0.11 (0.0028 — 0.0043)
	Pulley Center to Pulley Fitness	0.14 (0.0055) or less