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## Fire and Explosion Prevention

All fuels, most lubricants and some coolant mixtures are flammable and can cause a fire resulting in death or serious injury, and property damage. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause fire.

Inspect for and remove all flammable materials such as spilled fuel and oil, and debris from machine. Do not allow any flammable materials to accumulate on machine.

Always observe the following:

- Add fuel, oil, antifreeze and hydraulic fluid to machine only in a well ventilated area. Machine must be parked with controls, lights and switches turned "OFF". Engine must be "OFF" and any flames, glowing embers, auxiliary heating units or spark causing equipment must be extinguished, or turned "OFF" and kept well clear of machine.
- Dust that is generated from repairing or grinding nonmetallic hoods or nonmetallic fenders can be toxic, flammable and explosive. Repair these components in a well ventilated area away from flames or sparks and wear dust mask when grinding painted parts.

### Maintenance

The machine and some attachments have components that are at high temperatures under normal operating conditions. The primary source of high temperatures are the engine and exhaust system. If damaged or incorrectly maintained, the electrical system can be a source of arcs or sparks.

Flammable debris (leaves, straw, etc.) must be removed regularly. If flammable debris is allowed to accumulate, it can cause a fire hazard. Clean machine often to avoid this accumulation. Flammable debris in an engine compartment is a potential fire hazard.

The operator's area, engine compartment and engine cooling system must be inspected every day and cleaned. This is necessary to prevent fire hazards and overheating.

### Operation

Do not use machine where exhaust, arcs, sparks or hot components can contact flammable material, explosive dust or gases.

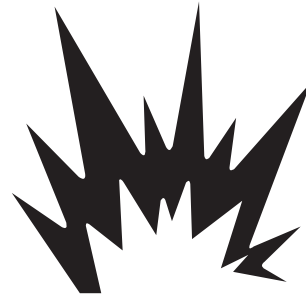
Do not operate machine near any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil spray or fuel spray in case of a break in a line, hose, or seal. Exhaust shields must be correctly installed.



HDO1015I

Figure 8



FG018458

Figure 9

## Cleaning

Remove all straw, wood chips, leaves, grass, paper and other flammable debris accumulated in engine compartment, mufflers and around battery. Remove any dirt from window glass, mirrors, handrails, and steps.

Do not leave tools or spare parts in operator's cabin. Vibration of machine during operation can cause tools or spare parts to fall and damage or break control levers or switches. Tools and spare parts can also get caught in spaces between control levers and cause accidental movement of work equipment causing death or serious injury.

When entering operator's cabin, always remove all mud and oil from your shoes. If you operate travel pedal with mud or oil stuck to your shoes, your foot could slip off the control, or dirt and debris may interfere with proper operation of control levers.

After using ashtray, make sure that any matches or cigarettes are properly extinguished, and be sure to close ashtray.

Clean window glass and working lights for good visibility.

Do not stick suction pads to window glass. Suction pads act as a lens and can cause fire.

Never bring flammable or explosive items into operator's cabin. Do not leave cigarette lighters laying around operator's cabin. If temperature inside operator's cabin becomes too high, there is a potential hazard that lighter could explode.

Secure all loose items such as lunch boxes, and other items that are not a part of equipment.

## Operator Station

Inspect condition of seat belt and mounting hardware. Replace any parts that are worn or damaged. Do not use a seat belt extension on a retractable seat belt.

Adjust seat so full pedal travel can be achieved with operator's back against back of seat.

Keep all windows and doors closed on machine.

Adjust operator's seat to a position where it is easy to perform operations, and check that there is no damage or excessive wear to seat belt or mounting clamps.

Adjust and clean mirrors so area to rear of machine can be seen clearly from operator's seat.

When standing up from operator's seat, always place safety lever securely in "LOCK" position. If you accidentally move work equipment levers when they are not locked, the machine could suddenly move and cause damage, death or serious injury.

## Engine Stop

Turn engine starter switch to "O" (OFF) position and remove engine starter switch key.

Before lowering any equipment with engine stopped, clear area around equipment of all personnel and bystanders. This procedure will cause high-pressure air or hydraulic pressure to be released to lower equipment.

Do not stop engine immediately after the machine has been operated under load. This can cause overheating and accelerated wear of engine components.

After the machine is parked, allow engine to run for five minutes before stopping the engine. This allows hot areas of engine to cool gradually.

- Do not leave operator's seat when there is a raised load.

## Parking Machine

Avoid making sudden stops, or parking machine wherever it happens to be at end of workday. Park machine on firm and level ground away from traffic and away from high walls, drop-offs and any area of potential water accumulation or runoff. If parking on inclines is unavoidable, block crawler tracks to prevent movement. Lower other working attachment completely to ground, or to an overnight support saddle. To prevent unintended or accidental movement.

When parking on public roads, provide fences, signs, flags, or lights, and put up any other necessary signs to ensure that passing traffic can see machine clearly. Park machine so machine, flags, signs and fences do not obstruct traffic.

After front attachment has been lowered to an overnight storage position and all switches and operating controls are in "OFF" position, safety lever must be moved to "LOCK" position. This will disable all pilot control functions.

Always close door of operator's cabin and lock all equipment to prevent any unauthorized person from operating the machine.

The hydraulic system remains pressurized, provided accumulator, is charged even when engine is not running. Accumulator pressure should decrease in a short time (approximately one minute). While hydraulic system maintains a charge, hydraulic work tools and machine controls remain functional.

Machine movement will occur if any controls are moved. This can result in death or serious injury.

Always move safety lever to "LOCK" position before stopping off engine or immediately after engine stops running.

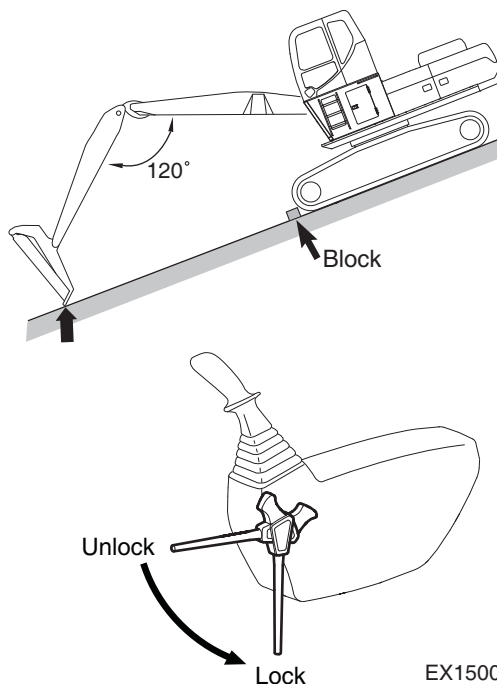


Figure 29

EX1500888

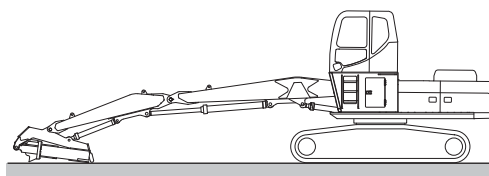


Figure 30

EX1300554

## Welding Repairs

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# IMPORTANT

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**When disconnecting or connecting connectors between ECU/DCU and engine, or connector between ECU/DCU and the machine, always disconnect the battery to prevent damage to ECU/DCU.**

**If you do not follow this procedure, the ECU/DCU will be damaged and/or the engine will not operate properly.**

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When performing welding repairs, perform welding in a properly equipped place. Repairs must be performed by a qualified welder. Welding operations, can create potential hazards, including generation of gas, fire, or electric shock. Never let an unqualified welder do welding.

A qualified welder must do the following:

- To prevent battery explosion, turn battery disconnect switch to "OFF" position.
- Disconnect the connector between ECU/DCU and machine, and the connector between ECU/DCU and engine.
- Disconnect the negative (-) cable of battery.
- To prevent generation of gas, remove paint from location of the weld.
- If hydraulic equipment, piping or component ports close to them are heated, a flammable gas or mist could result in an explosion or fire. To prevent this, protect and insulate components from excessive heat.
- Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut pipes or tubes that contain flammable fluids. Before welding on pipes or tubes, or before flaming cut pipes or tubes, clean them thoroughly with a nonflammable solvent. Make sure pressure inside pipes or tubes does not cause a rupture of the component parts.
- If heat is applied directly to rubber hoses or piping under pressure, they may suddenly break, so cover and insulate them with a fireproof covering.
- Wear protective clothing.
- Make sure there is good ventilation.
- Remove all flammable objects and make sure a fire extinguisher is available.



## WARNING

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### AVOID DEATH OR SERIOUS INJURY

**Explosion of the battery can cause death or serious injury. Never attempt to directly heat the battery with open fire.**

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2. Keep engine in good mechanical condition for easy starting and good performance during adverse weather.
  3. Use engine oil with proper specifications for expected temperatures. Refer to Operation & Maintenance Manual, in this manual or Shop Manual for details.
  4. Always keep the fuel tank fully filled after completion of the operation. Always drain water from the fuel tank before and after the operation. In addition, check the water separator, and drain it if required. The fuel filter, if frozen, may interrupt the flow of fuel. Periodically remove water from the fuel tank, drain water from the filter, and replace the filter upon regular basis. To prevent fuel from being clogged because of formation of wax in fuel, make sure that wax formation point of fuel is lower than atmospheric temperature.
- 



## WARNING

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### AVOID DEATH OR SERIOUS INJURY

**Explosion of the fuel tank can cause serious injury or death. Never attempt to directly heat the fuel tank with open fire.**

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5. Lubricate entire machine according to Operation & Maintenance Manual, in this manual or lubrication chart on machine.
6. Start engine and allow it to reach normal operating temperature before operating.
  - If mud and ice collects and freezes on any of moving parts while machine is idle, apply heat to thaw frozen material before attempting to operate machine.
  - Operate hydraulic units with care until they have reached a temperature which enable them to operate normally.
  - Check all machine controls and functions to be sure they are operating correctly.
7. An extra outer air filter must be kept in operator's cabin to replace element that could become iced and cause restricted airflow to engine.

# GENERAL DESCRIPTION

The forestry machine has three main component sections:

- The Upper Structure
- The Lower Undercarriage and Track Frames
- The Forestry Machine Front-end Attachment

The following illustration identifies main components and their locations. (See Figure 1 on page -4.)

# PERFORMANCE TESTS

Use operational performance test procedure to quantitatively check all system and functions on the machine.

## Purpose of Performance Tests

1. To comprehensively evaluate each operational function by comparing the performance test data with the standard values.
2. According to the evaluation results, repair, adjust, or replace parts or components as necessary to restore the machine's performance to the desired standard.
3. To economically operate the machine under optimal conditions.

## Kinds of Tests

1. Base machine performance test is to check the operational performance of each system such as engine, travel, swing, and hydraulic cylinders.
2. Hydraulic component unit test is to check the operational performance of each component such as hydraulic pump, motor, and various kinds of valves.

## Performance Standards

"Performance Standard" is shown in tables to evaluate the performance test data.

## Precautions for Evaluation of Test Data

1. To evaluate not only that test data is correct, but also in what range the test data is.
2. Be sure to evaluate the test data based on the machine operation hours, kinds and state of work loads, and machine maintenance conditions.

The machine performance does not always deteriorate as the working hours increase. However, the machine performance is normally considered to reduce in proportion to the increase of the operation hours. Accordingly, restoring the machine performance by repair, adjustment, or replacement shall consider the number of the machine's working hours.

## Definition of "Performance Standard"

1. Operation speed values and dimensions of the new machine.
2. Operational performance of new components adjusted to specifications. Allowable errors will be indicated as necessary.

# Mistrack Check

## Summary

1. Allow the machine to travel 20 m (65.6 ft). Measure the maximum tread deviation from the tread chord line drawn between the travel start and end points to check the performance equilibrium between both sides of the travel device systems (from the main pump to the travel motor).
2. If measured on a concrete surface, the tread deviation has a trend to decrease.

## Preparation

1. Adjust the track sag of both tracks to be equal.
2. Provide a flat, solid test yard 20 m (65.6 ft) in length, with extra length of 3 - 5 m (9.8 - 16 ft) on both ends for machine acceleration and deceleration.

# IMPORTANT

**The end of heel will hit the boom if the heel is rolled-in with the arm fully rolled-in.**

**As for this condition: arm fully rolled-in + heel fully rolled-in, set the heel at fully rolled-in and a perform arm roll-in operation.**

3. Hold the heel 0.3 - 0.5 m (12 - 20 in) above the ground the arm and heel rolled-in.
4. Maintain the hydraulic oil temperature at  $50 \pm 5^\circ\text{C}$  ( $122 \pm 41^\circ\text{C}$ ).

## Measurement

1. Measure the amount of mistracking in both fast, and slow travel speeds.
2. Measurement conditions are as below.

Travel Mode Switch	Engine Control Dial	Power Mode Switch	Work Mode	Auto-idle Switch
Low Mode	High Idle	Power Plus Mode	Working Mode	OFF
High Mode	High Idle	Power Plus Mode	Working Mode	OFF

3. Start traveling the machine in the acceleration zone with the travel levers al full stroke.

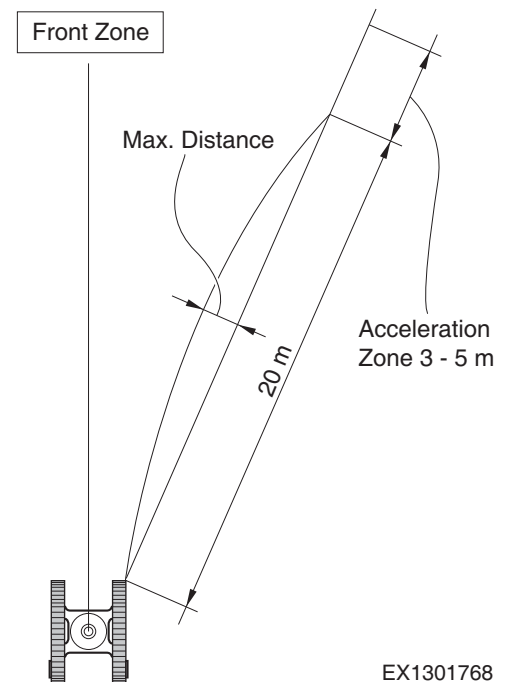


Figure 13

EX1301768

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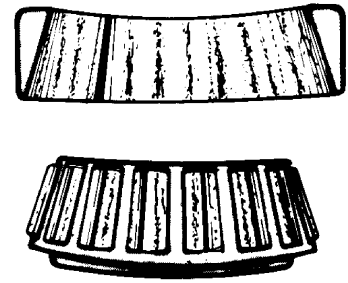
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### Etching

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.

Replace bearings - check seals and check for proper lubrication.



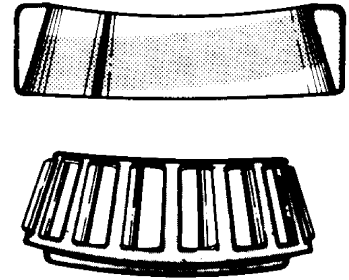
HASA500S

Figure 7

### Misalignment

Outer race misalignment because of foreign object.

Clean related parts and replace bearing. Make sure races are properly seated.



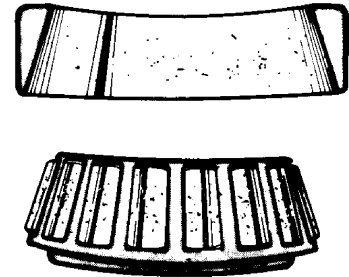
HASA510S

Figure 8

### Indentations

Surface depressions on race and rollers caused by hard particles of foreign materials.

Clean all parts and housings, check seals and replace bearings if rough or noisy.



HASA520S

Figure 9

# TORQUE VALUES FOR SPLIT FLANGES

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Split flanges and shoulders should install squarely. Install all bolts, finger tight and then torque evenly.

**NOTE:** *Over torquing bolts will damage the flanges and/or bolts, which can cause leakage.*

Flange Size (*)	Bolt Size	Bolt Torque	
		Kilogram.meter (kg.m)	Foot-pounds (ft lb)
1/2"	5/16"	2.1 - 2.5	15 - 18
3/4"	3/8"	3.0 - 3.7	22 - 27
1"	3/8"	3.7 - 4.8	27 - 35
1 - 1/4"	7/16"	4.8 - 6.2	35 - 45
1 - 1/2"	1/2"	6.4 - 8.0	46 - 58
2"	1/2"	7.6 - 9.0	55 - 65
2 - 1/2"	1/2"	10.9 - 12.6	79 - 91
3"	5/8"	19.1 - 20.7	138 - 150
3 - 1/2"	5/8"	16.2 - 18.4	117 - 133

(\*) - Inside diameter of flange on end of hydraulic tube or hose fitting.

**NOTE:** *Values stated in chart are for Standard Pressure Series (Code 61) Split Flanges.*

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# ENGINE IDENTIFICATION

## Engine Data Plate

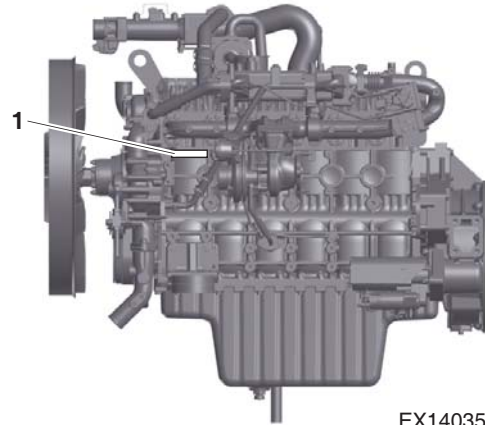


Figure 2

EX1403503

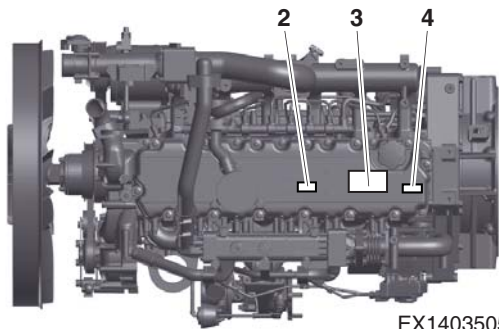


Figure 3

EX1403505

### 1. Engine Numbering

This decal indicates the model name and suffixes that contain the engine's information.

See Figure 2 for information on each set of numbers.

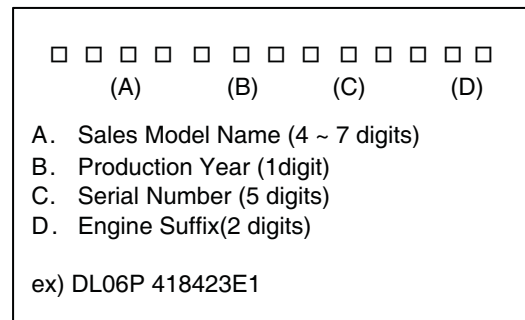


Figure 4

EX1403504

## Tightening Torque of Plug Screw

M10	M12	M14	M16	M18	M22	M24	M26	M30
5.0	5.0	8.0	8.0	10.0	10.0	12.0	12.0	15.0

## Hollow Screw (4-Hole) Tightening Torque

M8	M10	M12	M14	M16	M18	M22	M26	M30	M38
0.8	1.8	3.0	4.0	5.5	6.5	11.0	16.0	20.0	35.0



## CAUTION

### AVOID INJURY

**Be careful not to damage the mating surface.**

- F. Unscrew the mounting bolt of the lifting hook from the cylinder head to remove the lifting hook.
32. Remove the valve and valve stem seal.
- A. Press the valve spring and retainer with the valve spring compressor to remove the valve cotter.
  - B. Remove the valve spring and retainer.
  - C. Remove the calipers.
  - D. Use a general service tool to remove the valve stem seal.



## CAUTION

### AVOID INJURY

**Do not reuse the valve stem seal.**

- E. Remove valve.
  - F. Unscrew the mounting bolt of the lifting hook from the cylinder block to remove the lifting hook.
33. Remove the oil cooler.
- A. Unscrew the oil cooler mounting bolts to remove the oil cooler.

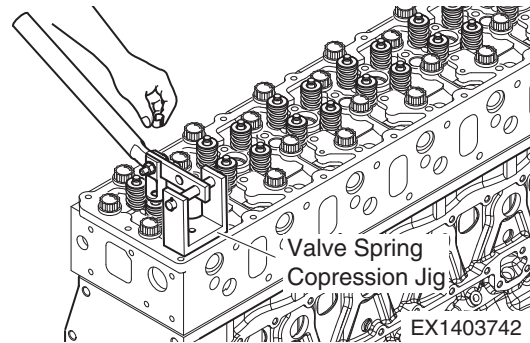


Figure 41

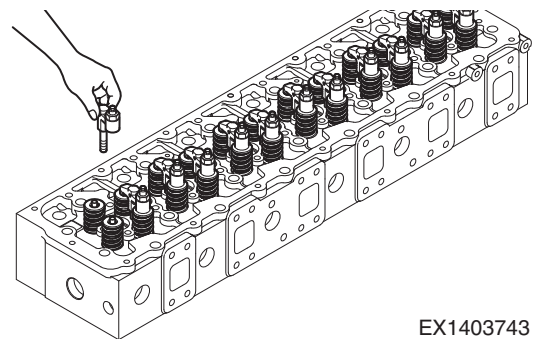


Figure 42

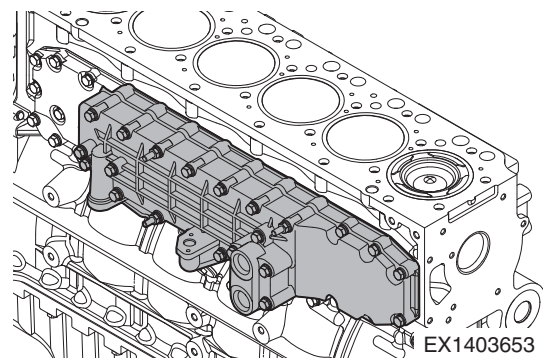


Figure 43

- End play

Measuring Position	Standard (mm)
Camshaft Gear	0.280 ~ 0.430
Step Idle Gear	0.107 ~ 0.183
Fuel High-pressure Pump Idle Gear	0.078 ~ 0.140

9. Install the flywheel housing.
  - A. Install a guide bar to the cylinder block temporarily.
  - B. Install the gasket to the cylinder block.
  - C. Use a dowel pin and guide bar to install the flywheel housing.
  - D. Tighten the mounting bolts to 109.8 N.m (11.2 kg.m, 81 ft lb) in the specified order.
  - E. Remove the guide bar.
  - F. Apply a thin film of engine oil to the outer surface of the oil seal and fit this seal into the flywheel housing.
10. Install the rear oil seal.
  - A. Align the oil seal with the crankshaft.
  - B. Install the oil seal using its jig.

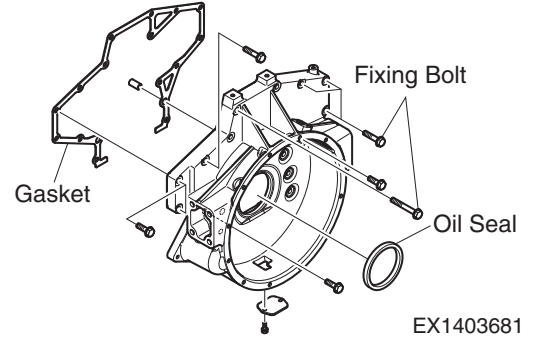


Figure 75

EX1403681

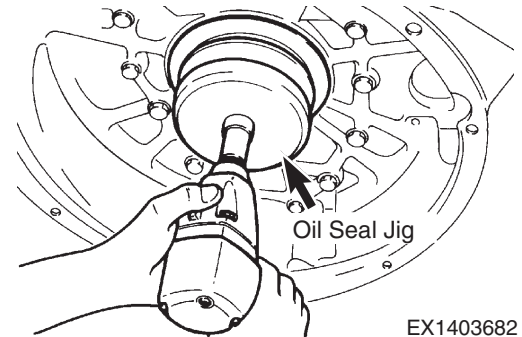


Figure 76

EX1403682

11. Install the flywheel.
  - A. Heat the ring gear with a gas burner evenly to expand it. Then, install it with a hammer.



## CAUTION

### AVOID INJURY

- Make sure that the temperature of the ring gear does not exceed 200°C.
- When installing the ring gear, heat it to 150°C with a heater, and apply loctite #262 to it, and use an assembly jig to install it.

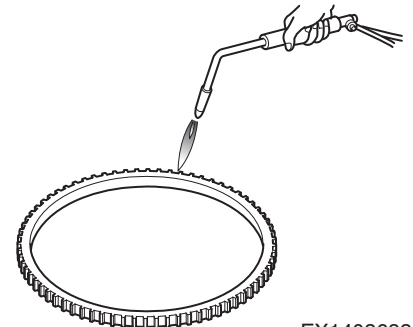


Figure 77

EX1403683

24. Install the oil cooler.
- A. Install the oil cooler and gasket to the cylinder block.

---

 **CAUTION**

**AVOID INJURY**

**Make sure to install the gasket in the correct direction.**

---

- B. Tighten the bolt to 21.6 N.m (2.2 kg.m, 15.9 ft lb).

25. Install the oil filter.
- A. Install the oil filter cartridge using a special service tool.

---

 **CAUTION**

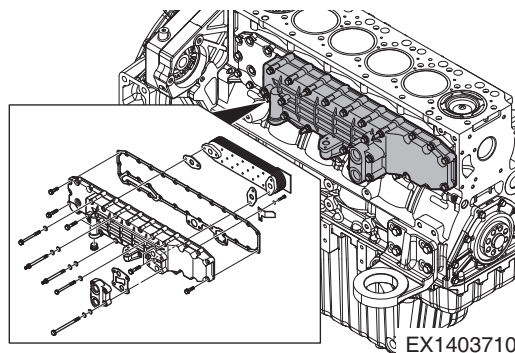
**AVOID INJURY**

**The oil filter should be installed to the engine without oil in it. Never fill the new oil filter with oil drained from the used oil filter.**

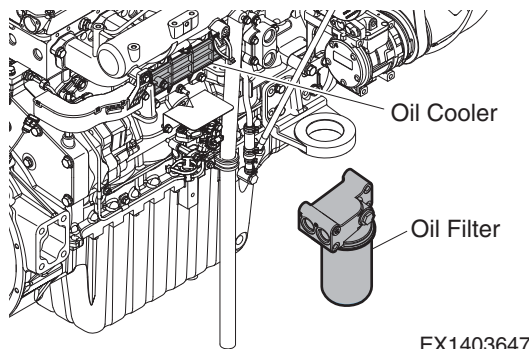
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26. Install the coolant pump.
- A. Install the coolant pump cover and coolant pump gasket.

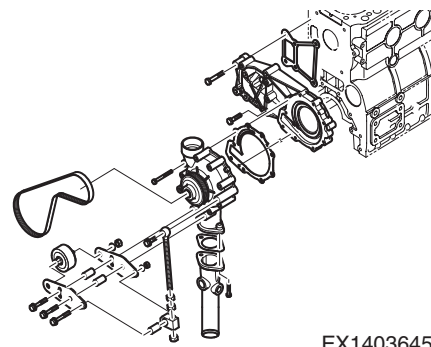
- B. Install the coolant pump to the cylinder block.
- C. Tighten the mounting bolt to 21.6 N.m (2.2 kg.m, 15.9 ft lb).
- D. Install the idle pulley bracket.



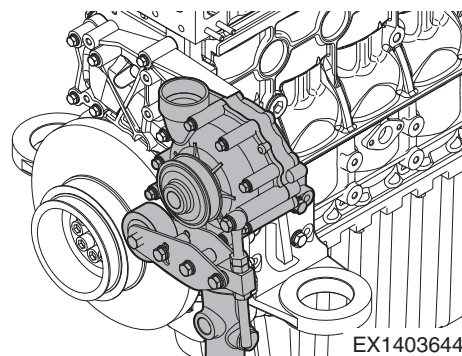
**Figure 111**



**Figure 112**



**Figure 113**



**Figure 114**



## Rocker Arm Shaft Inspection

### Deflection of Rocker Arm Shaft

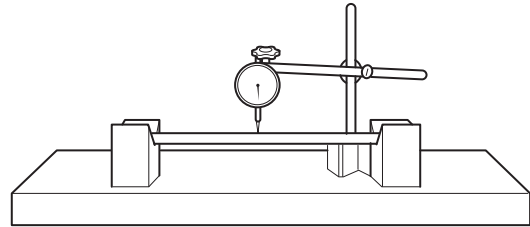
1. Place the rocker arm shaft on two V-blocks and use a dial gauge to measure the deflection of the shaft.
2. If its deflection is minute, use a press to straighten it. If its deflection is over the allowable limit, replace it.

Allowable Limit	0.1 mm
-----------------	--------

### Rocker Arm Shaft O.D.

1. Use a O.D. micrometer to measure the outside diameter of the rocker arm shaft at the location where the rocker arm was installed.
2. If the measurement is over the allowable limit, replace the rocker arm shaft.

Standard	Allowable Limit
ø24.939 ~ ø24.960 mm	ø25.90 mm



EX1403760

Figure 157

## Valve Tappet Inspection

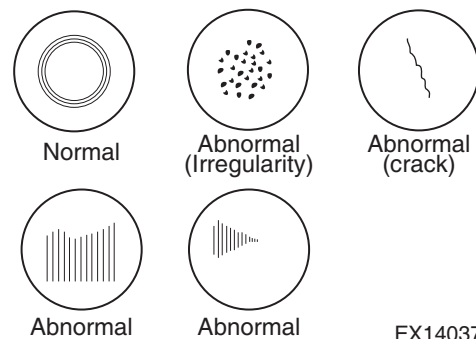
### Tappet Clearance

1. Measure the outside diameter of the tappet and the inside diameter of the tappet hole of the cylinder block.
2. If the measurement is over the allowable limit, replace the tappet.

Standard	Allowable Limit
0.028 ~ 0.069 mm	0.13 mm

### Visual Inspection of Tappet

1. Visually check the surface of the tappet which moves in contact with the camshaft. Check if the surface is cracked, scratched or damaged.
2. If such damage is minute, grind the surface with an oily whetstone or fine sandpaper. If its surface has severely damaged, replace it.



EX1403761

Figure 158

## Inspection

### Distortion

1. Check the distortion of the connecting rod.
2. Fit the connecting rod to its measuring device and use a feeler gauge to check its distortion.
3. If the connecting rod is distorted, do not reuse it, but replace it with a new one.

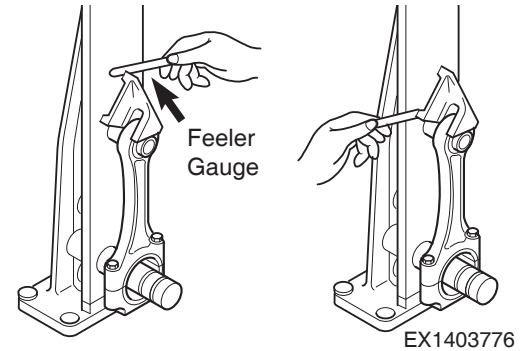


Figure 177

### Hole Parallelization

1. Measure the parallelization of the small end bushing hole and big end bearing hole of the connecting rod.

**NOTE:** Use the connecting rod measuring device and feeler gauge for this measurement.

Standard	Allowable Limit
0.02 mm	0.1 mm or below

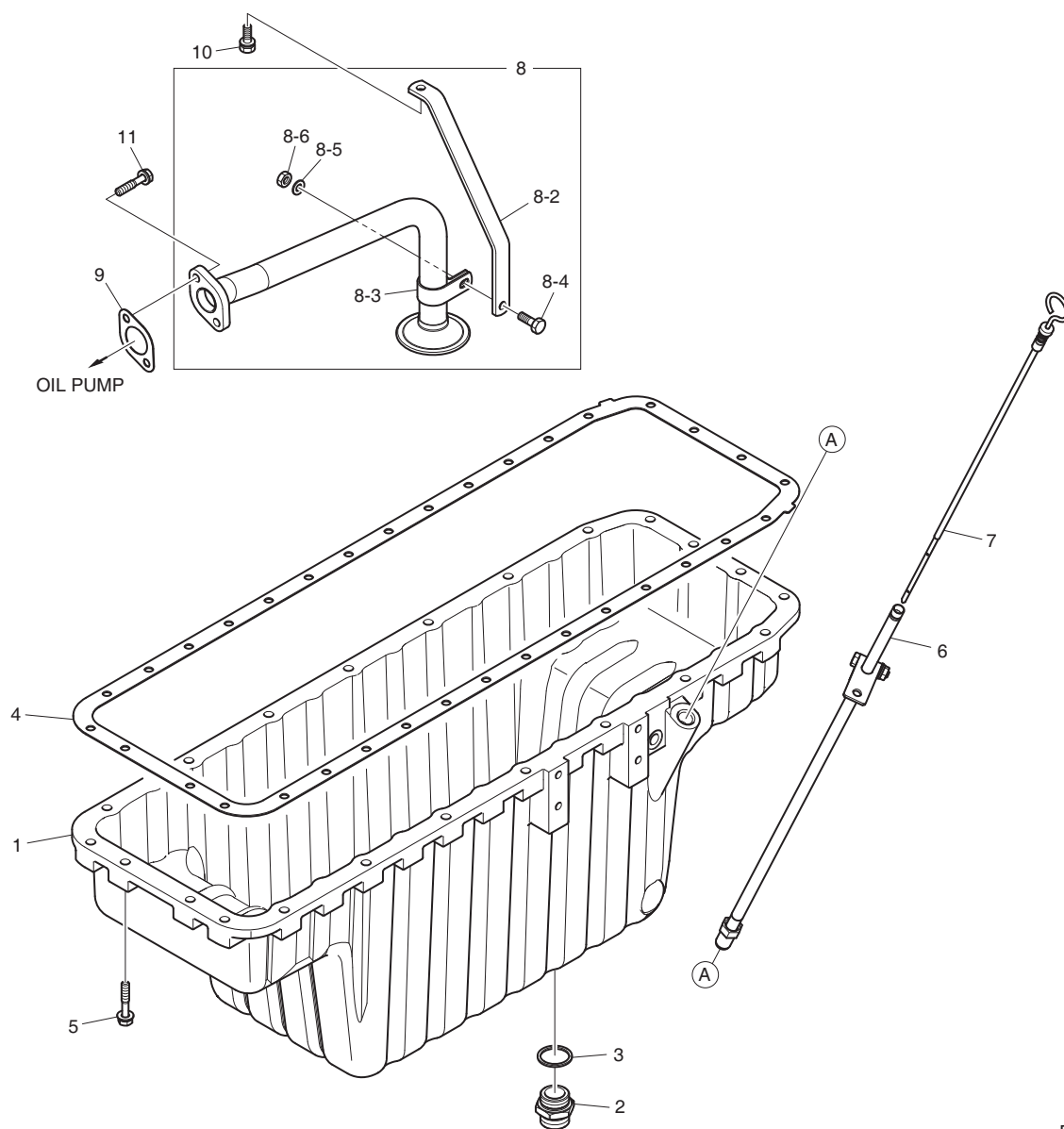
### Wear

1. Install the connecting rod to the crankshaft.
2. Use a feeler gauge to measure the side clearance at the big end of the connecting rod.
3. Install the connecting rod to the piston.
4. Measure the side clearance at the small end of the connecting rod.
5. If the measurement is over the allowable limit, replace the connecting rod.

Standard	Allowable Limit
0.17 ~ 0.30 mm	0.50 mm

# Oil Pan

## Parts List



EX1403607

Figure 195

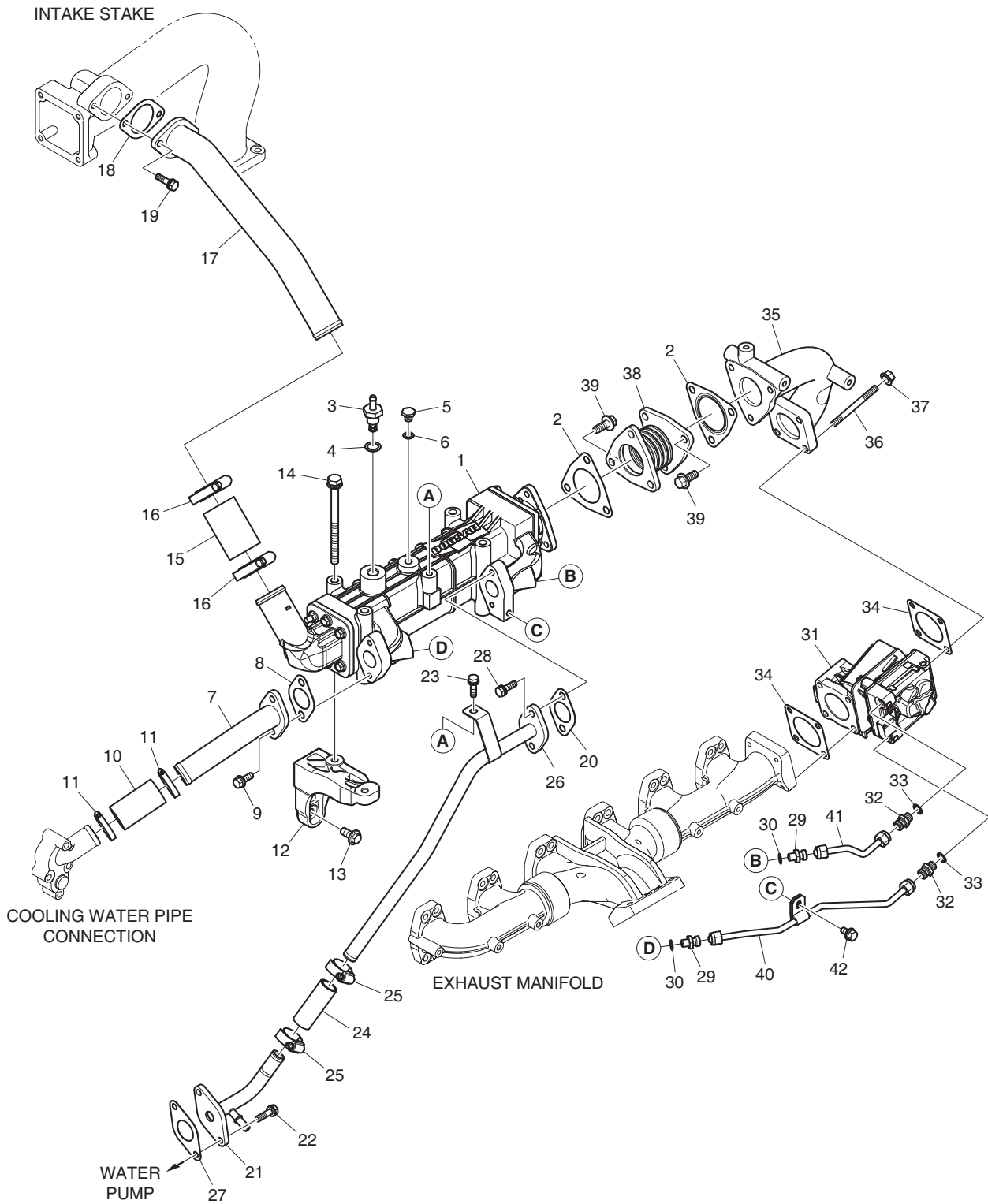
Reference Number	Description
1	Pan, Oil
2	Joint; Drain
3	Seal; Ring
4	Gasket, Oil Pan
5	Bolt Assembly M8 x 45
6	Tube; Oil Level Gauge
7	Gauge; Oil Level
8	Oil Pipe Assembly

Reference Number	Description
8-2	Bracket; Oil Suct. Pipe
8-3	Clip; Pipe
8-4	Bolt M8 x 25
8-5	Washer
8-6	Nut
9	Gasket
10	Bolt Assembly M8 x 25
11	Bolt Assembly M8 x 40

## Troubleshooting

Phenomenon	Causes	Troubleshooting
Noise or Vibration	Rotating part is contacted	Repair or replace it
	Unbalanced rotation of a rotor	Repair or replace it
	Burn	Repair or replace it
	Loose joint	Check or repair it
	Deformed or damaged intake unit hose	Replace it
	Poor clamping state	Adjust and tighten the clamp
	Contaminated or damaged air filter	Replace and check if the impeller of the turbocharger is damaged
	Leakage of coolant from the turbocharger or oil from the oil hose	Replace the hose and the gasket
	Leakage of gas from the exhaust manifold	Replace the gasket or tighten the fixing nut
	Poor turbo actuator operation	Replace the turbocharger
	Leakage from the engine block and the exhaust manifold	Check the engine
	Contaminated blowby gas and abnormal oil amount	Check the turbo impeller and the turbo intake and outlet
	Large gap of the turbocharger wheel, causing interference with the wall	Check if there is any sand or metallic foreign substance
	Damaged turbocharger wheel	Check if there is any sand or metallic foreign substance
	Damaged wheel and shaft of the turbocharger	Check if there is any sand or metallic foreign substance
Poor rotating force of the turbocharger wheel	Check if there is any sand or metallic foreign substance	

**Parts List**



EX1403726

**Figure 210**

## Dosing Module

The dosing module is attached to the exhaust manifold in front of the SCR system to receive DEF from the supply module and spray it into the exhaust manifold.

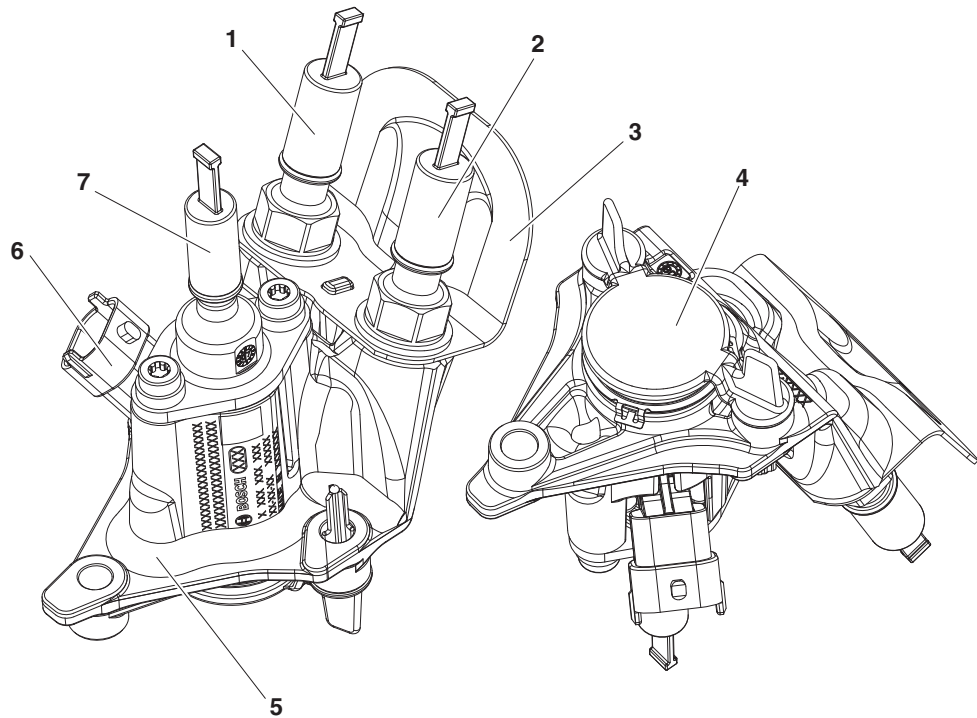


Figure 226

EX1403807

Reference Number	Description
1	Coolant Outlet
2	Coolant Inlet
3	Head Shield
4	Protective Cap

Reference Number	Description
5	Cooling Adapter
6	Dosing Valve
7	Adblue Inlet

## Fuel High-pressure System Components

The common rail fuel injection system consist of the low-pressure stage for low-pressure fuel delivery, high-pressure stage for high-pressure fuel delivery, and electronic control unit.

### 1. Fuel high-pressure pump

The fuel high-pressure pump pressurizes fuel up to approximately  $1,835.5 \text{ kg/cm}^2$  (1,800 bar, 26,106.8 psi) and sends this pressurized fuel to the common rail (pipe shape) through the high-pressure line.

### 2. Common rail

Even after the injector uses fuel from the common rail to inject fuel, the fuel pressure in the common rail is still maintained at a constant level. The common rail pressure sensor detects the fuel pressure while the pressure control valve maintains the fuel pressure at the desired level. The fuel pressure in the common rail is controlled to max.  $1,835.5 \text{ kg/cm}^2$  (1,800 bar, 26,106.8 psi) by the pressure control valve.

### 3. Injector

As the solenoid valve is operated, fuel flows to the injector nozzle which then sprays fuel directly into the combustion chamber. When the injector nozzle opens and sprays the commanded amount of fuel, the excess fuel is returned to the tank through the return line. Also, fuel returned from the fuel pressure control valve and low-pressure stage and fuel used to lubricate the high-pressure pump are returned back to the fuel tank through the return line as well.

### 4. Fuel high-pressure pipe

The fuel high-pressure pipe carries high-pressure fuel at  $1,835.5 \text{ kg/cm}^2$  (1,800 bar, 26,106.8 psi). Therefore, this pipe is made of special material to be able to withstand the maximum pressure of the system and fluctuation of high pressure occurred during fuel injection. The high-pressure pipe has 8.0 mm of outside diameter and 3.5 mm of inside diameter. Also, the fuel high-pressure pipes installed between the common rail and injectors should be in the same length and they are installed as short as possible.

Also, it supplies a proper amount of fuel to the common rail to handle any harsh condition, such as abrupt vehicle start or rapid change of pressure in the common rail. The fuel high-pressure pump produces the system pressure required in the common rail constantly.

### Structure Fuel High-pressure Pump

The fuel high-pressure pump has three pump pistons set 120° apart from each other in it to compress fuel in the circumferential direction. As every rotation creates three compression strokes, the pump drive system's stress is maintained steadily and it needs low driving force. The common rail needs low pump driving force which is only approximately 1/9 of force required for the conventional pump system.

### Operation

The fuel feed pump supplies fuel to the high-pressure pump through the fuel inlet and safety valve. Then, this fuel is transferred to the high-pressure pump's lubrication and cooling circuits through the safety valve. The drive shaft is equipped with the eccentric cam to move the pump's piston up and down according to the shape of the cam.

If the fuel pressure delivered from the fuel feed pump exceeds the fully open pressure of the safety valve, fuel moves the pump piston downwards through the intake valve of the fuel high-pressure valve to the intake stroke position of the pumping chamber. When the pump piston passes the B.D.C., the valve is closed. Then, as fuel cannot escape the pumping chamber, it is compressed further over the delivered pressure.

As soon as the fuel pressure reaches the common rail pressure, it opens the exhaust valve. Then, this compressed fuel enters the high-pressure circuit. The pump piston continues to carry fuel until it reaches the T.D.C. Then, as soon as the pressure drops, the exhaust valve is closed. Then, fuel left in the pumping chamber is depressurized and the pump piston moves downwards again. When the pressure in the pumping chamber drops below the pressure of the fuel feed pump, the intake valve opens and the above steps are repeated.

### Fuel Return

The fuel high-pressure pump is designed to supply a large amount of fuel. While the engine is running at an idle speed or with partial load, excess fuel is returned to the tank through the pressure control valve.

### Fuel High-pressure Pumping Cut-off Valve

When the switch of the fuel high-pressure pumping cut-off valve is turned off, the fuel amount delivered to the common rail is increased. When the switch is turned off, the fuel pumping solenoid valve is pulled, so the pin attached to an electric magnet keeps the valve open. Therefore, fuel led into the

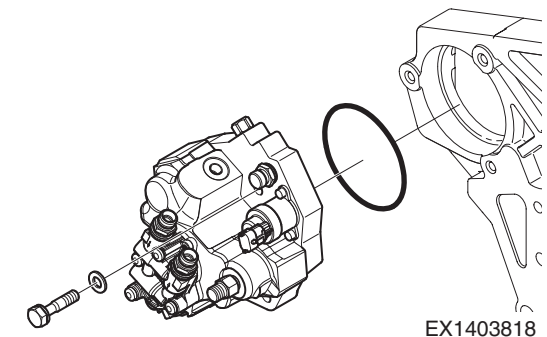


Figure 242

# Exhaust Gas Reduction

## General Description

### Connector

1. Mark by connector part

Reference Number	Description
1	Wire Cover
2	Cable Tie
3	C/Tube
4	Tube (White)

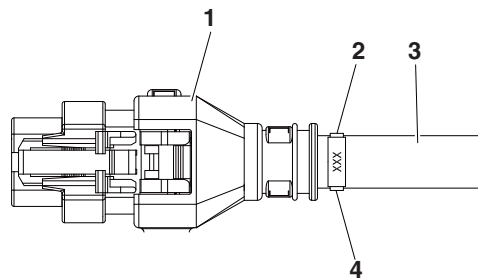


Figure 250

EX1403838

2. If the connector has no cover, wrap end of the connector with plastic tape.

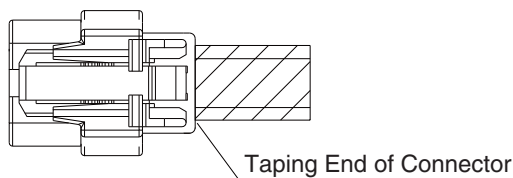


Figure 251

EX1403839

### Tolerance for Allowable Wiring Distance

1. Between fixed points: +5 mm
2. Between fixed points before junction: +5 mm
3. Connector end or fixed point or junction of terminal type: +10 mm

**NOTE:** End of injector junction: +5 mm

	Symbol	Description
1		Apply Aluminum Tape
2		Apply Manifold
3		Apply Cross Taping
4		Apply Heat Resisting Transparent Tape (125 or Higher)
5		Apply Corrugate Tube

# Engine Coolant Heater (Option)

## SAFETY INSTRUCTIONS

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### WARNING

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#### AVOID DEATH OR SERIOUS INJURY

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs or service. Untrained operators and failure to follow instructions can cause death or serious injury.

---

# Changing the Burner Head

## Removal

1. Remove heater.
2. Remove combustion air fan.
3. Remove burner, flame monitor and glow plug.
4. Remove mounting screw of the V-clamping collar (2, Figure 6) and pull off the clamping collar.
5. Pull out and remove burner head (1, Figure 6) from the heat exchanger (3, Figure 6).
6. Complete the work on stripped-down components.

## Installation

**NOTE:** *The burner head and exhaust outlet port can also be aligned during installation in the machine.*

1. Guide the burner head (1, Figure 6) into the heat exchanger (3, Figure 6), align it if necessary and secure with the V-clamping collar (2, Figure 6).
2. If necessary, tighten the mounting screw of the V-clamping collar to 3 N.m  $\pm$ 10%.
3. Install the burner, flame monitor and glow plug.
4. Attach the combustion air fan.
5. Install the heater.

17. Remove all bolts (1, Figure 13) (17 ea) with brackets (2 thru 4) from body of operator cabin.

- Tool: 13 mm (🔧)
- Torque: 19.6 N.m (2 kg.m, 14.5 ft lb)

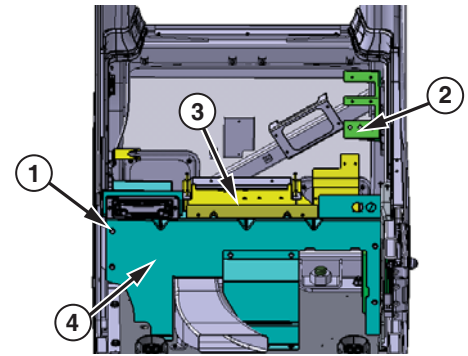


Figure 13

WE1400440

18. Disconnect connectors of interior lights, speakers and antenna.

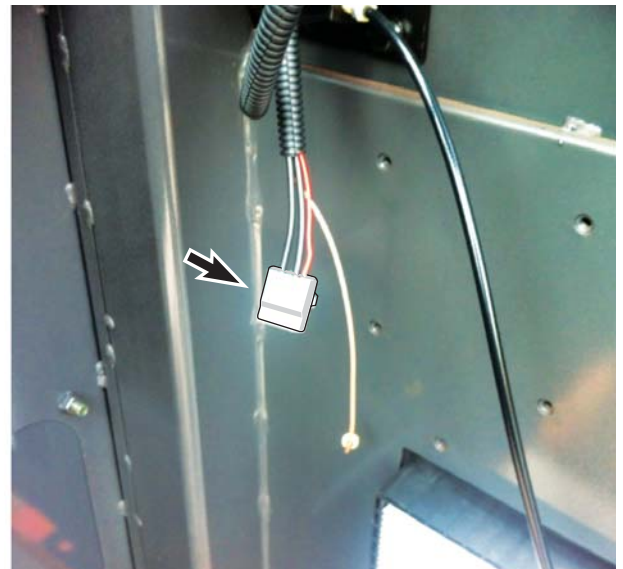


Figure 14

WE1400441

19. Using a suitable lifting device, attach slings to four lift points on top of cabin (Figure 15)

- Lifting hole size: M12 x 1.75, depth: 15 mm
- Cabin weight: about 400 kg (882 lb)

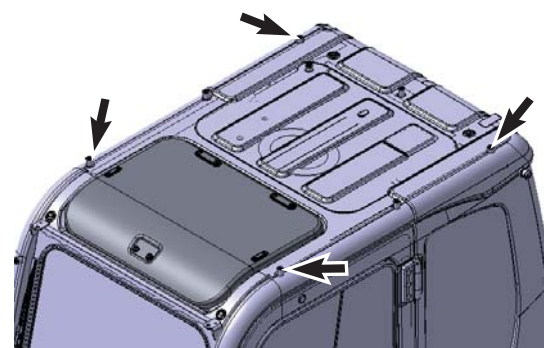
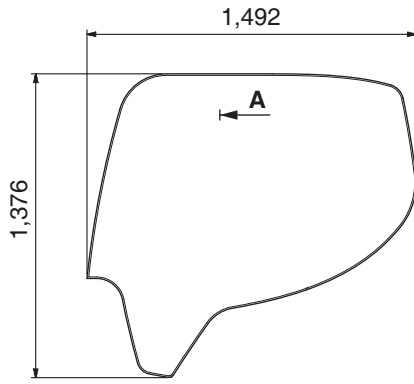


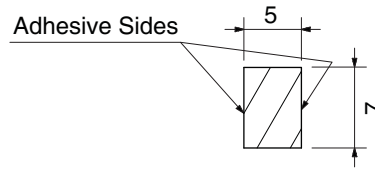
Figure 15

WE1400442

### Damper - Right-hand Glass



Length: about 4,712 mm

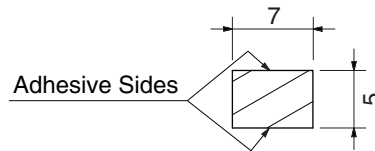
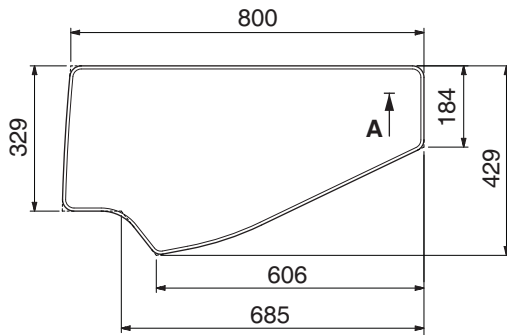


Section A - A

EX1301356

Figure 34

### Damper - Lower Glass of Door

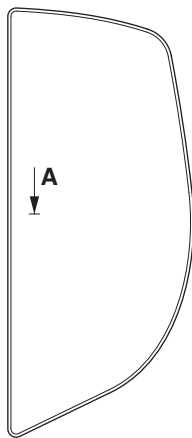


Section A - A

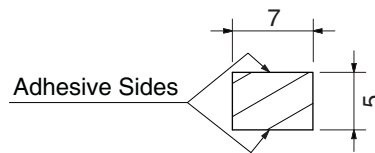
EX1301357

Figure 35

### Damper - Rear Left-hand Glass



Length: about 2,400 mm



Section A - A

EX1301358

Figure 36

NOTE: Unit: mm (1 mm = 0.039 in)

# Hydraulic Oil Tank

## SAFETY INSTRUCTIONS

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### WARNING

---

#### AVOID DEATH OR SERIOUS INJURY

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs or service. Untrained operators and failure to follow instructions can cause death or serious injury.

---

22. Remove oil tank mounting bolts and spacers (1, Figure 19) (6 ea) from the main frame.

- Tool: 24 mm (🔩)
- Torque: 264.6 N.m (27 kg.m, 195.2 ft lb)

23. Remove bolts (2, Figure 19) (6 ea) of suction pipe from the oil tank.

- Tool: 17 mm (🔩)
- Torque: 63.7 N.m (6.5 kg.m, 47 ft lb)

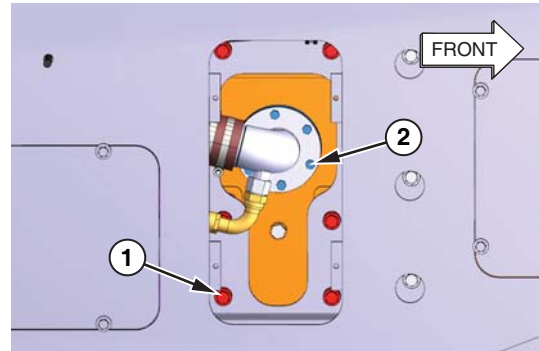


Figure 19 Bottom of Main Frame DS1602638

24. Disconnect the connector of oil temperature sensor (1, Figure 20) and pressure switch (2).

**NOTE:** *Be careful not to let water get into electrical components (sensor, connectors). If water gets into electrical system, this will cause an electrical short circuit and result in improper machine operation.*

25. Remove bolts (3, Figure 20) (2 ea) and clips with harness.

- Tool: 12 mm (🔩)
- Torque: 29.4 N.m (3 kg.m, 21.7 ft lb)

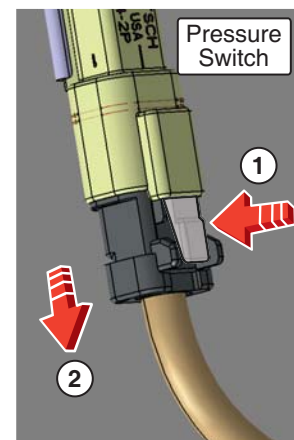
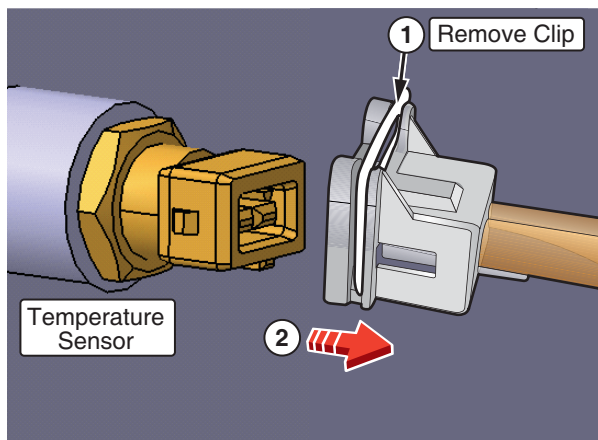
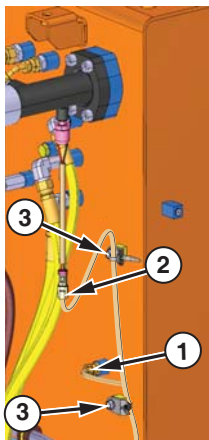


Figure 20

DS1602837

26. When disconnecting the hose, oil left in the hose may flow out. Therefore, place the end of the hose into a suitable container to prevent contamination of the ground and environment.

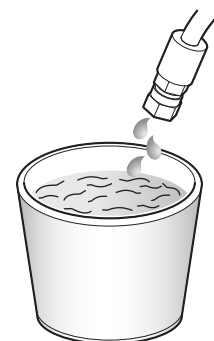


Figure 21

EX1504170

Reference Number	Description
1	Tank, Fuel
2	Cover, Tank
3	O-ring
4	Filter, Fuel Strainer
5	Cap, Fuel
5-1	Element, Fuel Cap
6	Gauge, Level
10	Bolt
11	Washer
13	Bolt
14	Shim
15	Shim

Reference Number	Description
16	Spacer
20	Spacer
21	Bolt
22	Plate, Front
23	Bolt
24	Plate
25	Cover
26	Foam
27	Foam
31	Bracket
32	Bolt

11. Turn battery disconnect switch to "OFF" position.  
(Figure 31)

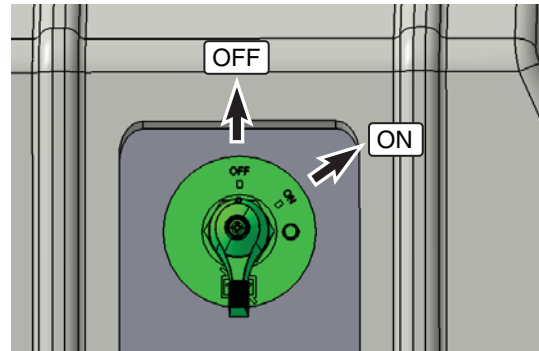


Figure 31

WE1500101

**NOTE:** Removal (installation) procedure of the bolts.

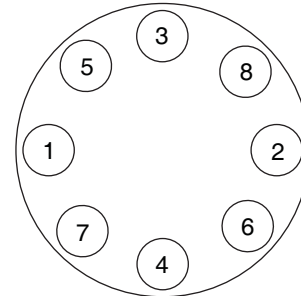


Figure 32

EX1401809

12. Clean area around fuel tank fill cap. Open fuel cap.

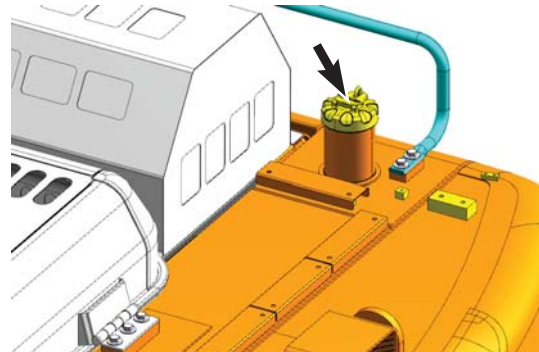


Figure 33

DS1602817

13. Open drain valve (Figure 34) right side door and carefully drain.

- Fuel tank capacity: 606 L (160 U.S. gal)

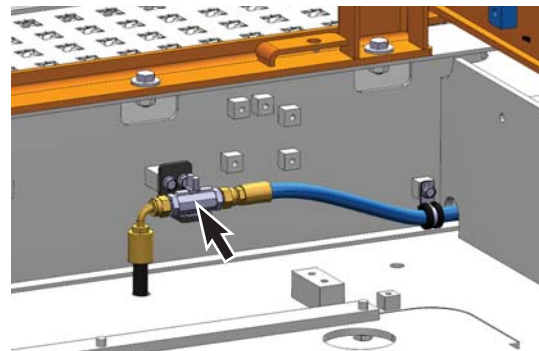


Figure 34 Pump Room

DS1602818

# GENERAL

## Specifications

Input Power	(P)	126 kW (171 PS) @ 1,800 rpm
Rated Speed	(N)	1,800 rpm
High Idle	(N)	2,200 rpm
Max. Flow	(Q max.)	2 x 214 L/min @ 1,800 rpm & 350 bar (356.9 kg/cm <sup>2</sup> , 5,076.3 psi)
Min. Flow	(Q min.)	104 L/min @ 1,800 rpm
Max. Displacement	(V g max.)	120 cc/rev x 2
Weight		120 kg (265 lb)

### Control Pressure

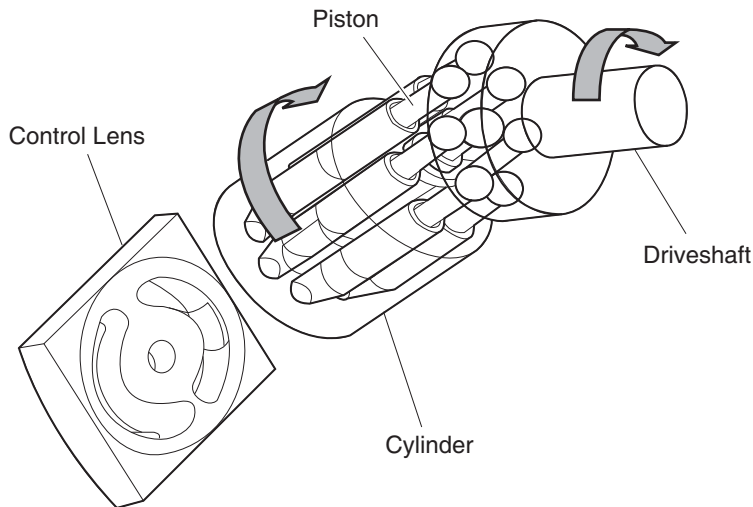
Beginning of Regulation	(P)	10 bar (10 kg/cm <sup>2</sup> , 145 psi)
End of Regulation	(P)	24.3 bar (24.7 kg/cm <sup>2</sup> , 352 psi) @ 50 L/min

### Pilot Pressure Pump Relief Valve

Pilot Pressure	(P)	39 ±2 bar (40 ±2 kg/cm <sup>2</sup> , 569 ±28 psi) @ 1,800 rpm
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Engine torque is transferred to the shaft and the seven plungers, causes the cylinder block to rotate while sliding along the valve plate surface.

The plunger oscillates in the cylinder block bores and alternately hydraulic oil is drawn and delivered.



EX1400245

**Figure 8**

**Increasing and Decreasing Flow Rate**

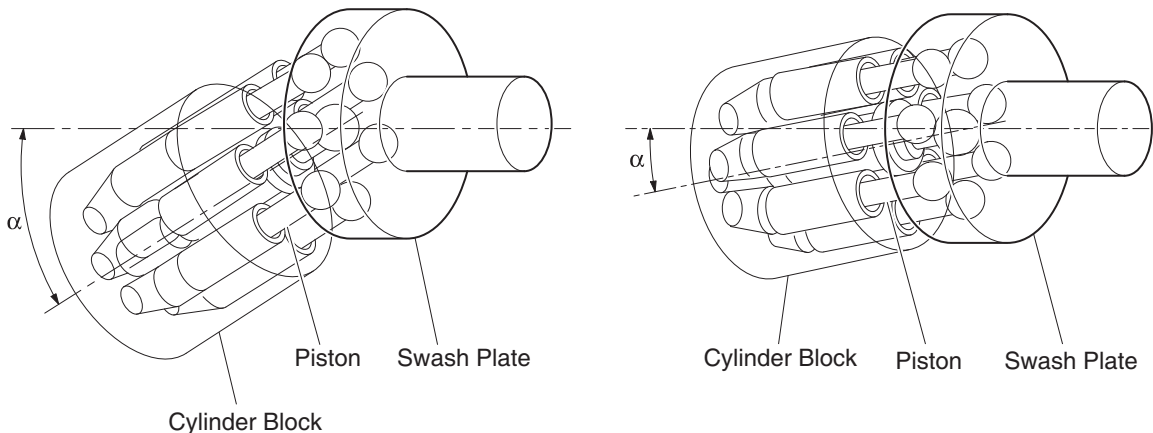
Changing inclination of cylinder (4, Figure 7) causes the piston (3, Figure 7) stroke to increase or decrease depending on the slant angle in order to control the main pump flow rate.

Up-down movement of positioning piston (7, Figure 7) changes inclination of cylinder (4, Figure 7). Positioning piston (7, Figure 7) is interlocked with control lens (5, Figure 7) positioning trunnion (8, Figure 7).

The one end of cylinder (4, Figure 7) is kept in contact with the surface of control lens (5, Figure 7) and slides along it.

Maximum Displacement Angle:

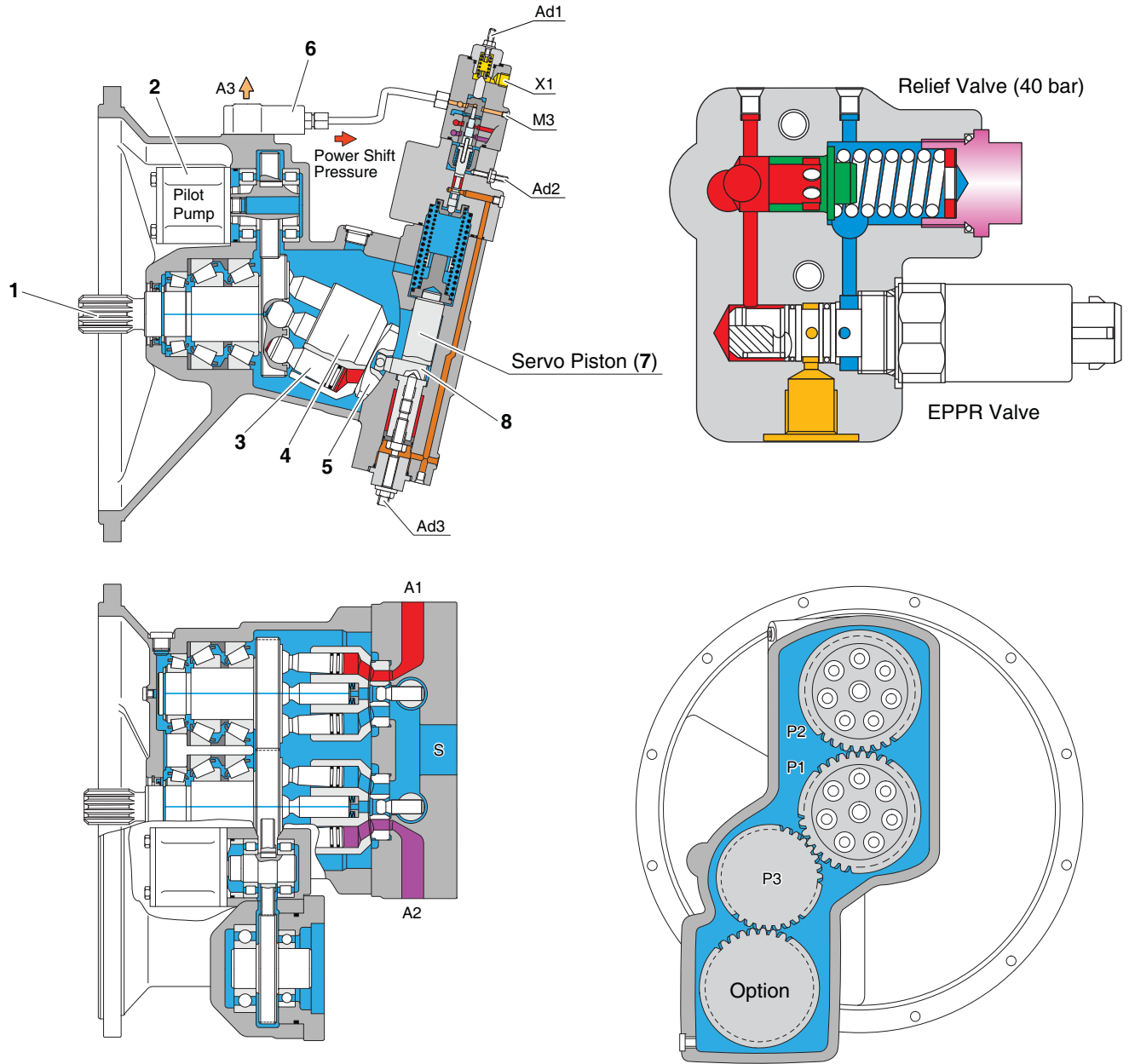
Minimum Displacement Angle (Operable Limit Angle):



EX1400646

**Figure 9**

# SECTION VIEW



EX1403146

Figure 20

Reference Number	Description
1	Drive Shaft
2	Gear Pump (Pilot)
3	Piston
4	Cylinder

Reference Number	Description
5	Control Lens
6	EPPR Valve
7	Positioning Piston
8	Positioning Trunnion

33. Lift the pump from engine slowly and carefully.

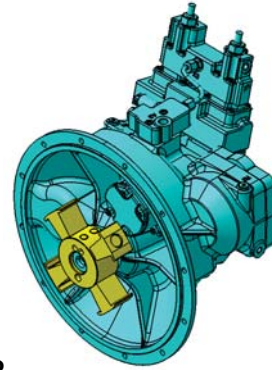


Figure 52

EX1403069

## INSTALLATION



### WARNING


**INCORRECT INSTALLATION CAN CAUSE DEATH OR SERIOUS INJURY**

Any change in the connections will lead to malfunctions (e.g. lift instead of lower).

- When connecting hydraulic components, observe the specified piping according to the hydraulic schematic diagram of the machine.
1. Perform installation in the reverse order to removal.
  2. When installing the pump to engine, be careful assembling pump shaft and drive coupling. Refer to drive coupling installation.

## COMPLETING WORK

**NOTE:** *If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.*

1. With the engine stopped, remove vent plug (Figure 53) to see if any oil is present.
2. If oil is not present, fill oil tank with oil.
3. Install vent plug (Figure 53) first.
4. Slowly loosen vent plug (Figure 53) several turns, until hydraulic oil flows out of plug. This shows that air has been released.
5. Tighten the plug (Figure 53).
  - Tool: 6 mm (  )
  - Torque: 30 N.m (3.1 kg.m, 22 ft lb)

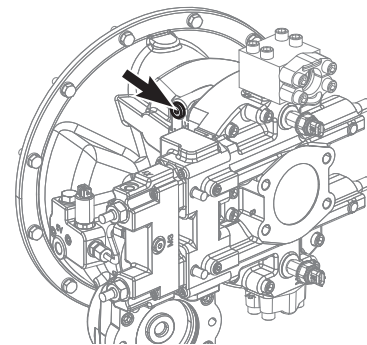
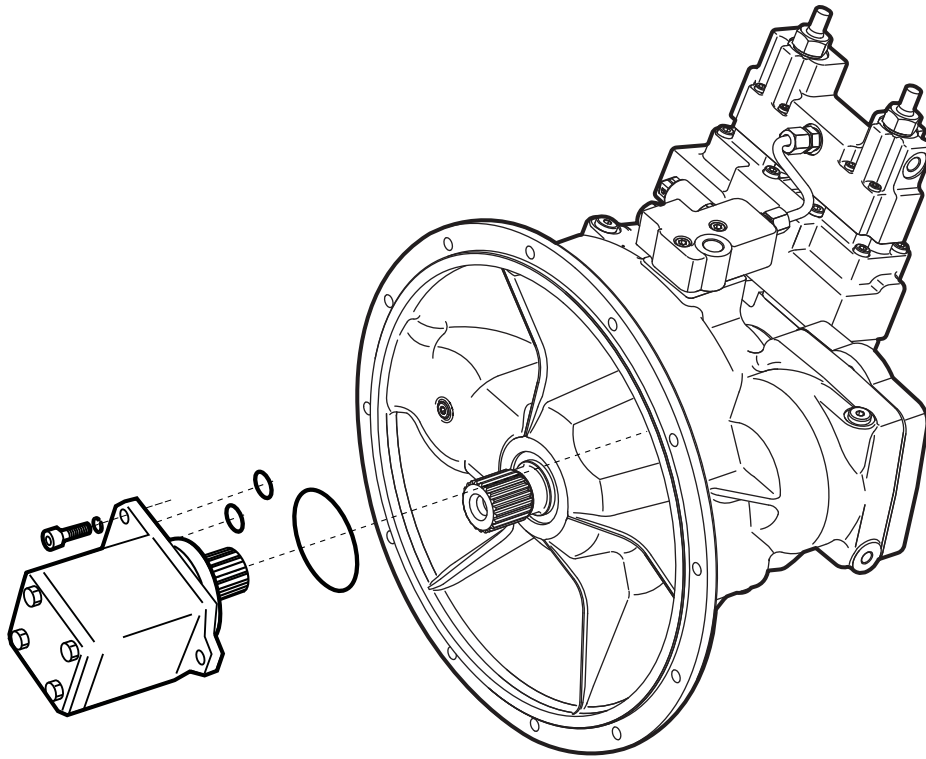


Figure 53

DS1602721

# Gear Pump Sealing



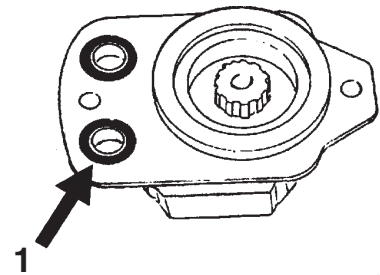
**Figure 80**

EX1403156

Remove gear pump.

Visually check

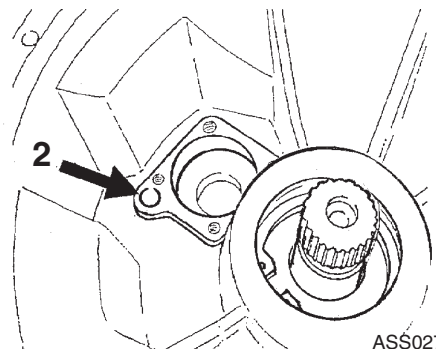
1. O-ring (1, Figure 81).



**Figure 81**

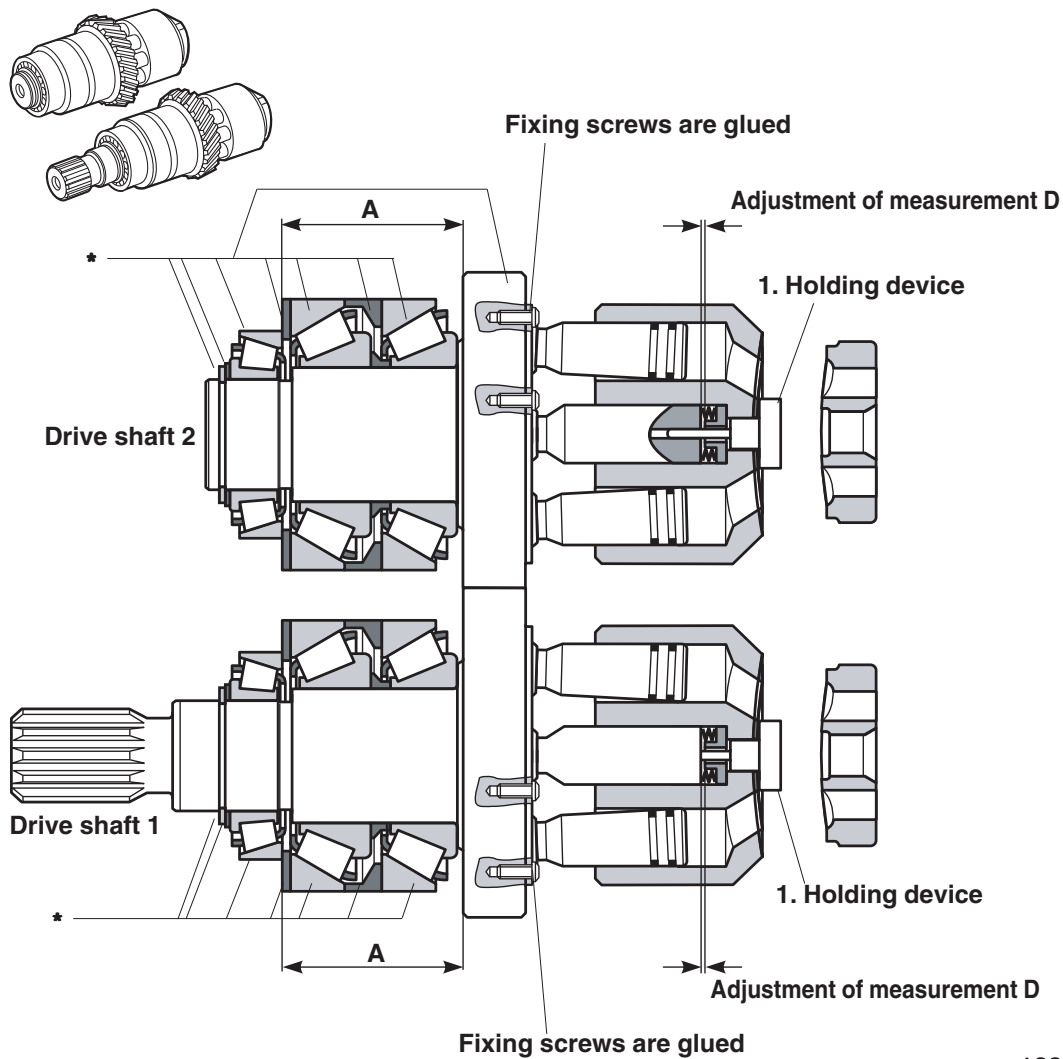
ASS0260L

2. Sealing surface of housing (2, Figure 82).



**Figure 82**

ASS0270L



ASS0510L

Figure 105

- NOTE:**
- 1) Position (\*) driveshafts with bearing set are the smallest assembly group.
  - 2) The assembly group is adjusted to measurement A.
  - 3) The tapered roller bearings are adjusted to the specified through-torque.

- NOTE:**
- 1) Fixing screw - Retaining device.
  - 2) Removal of screws is only possible if driveshaft is warmed up to a temperature of approximately 120°C for 1/2 hour in an oil bath or heat air furnace.
  - 3) Remove screw quickly.

## Assembling the Rotary Group

1. Threads must be free of oil, grease, dust or any other contaminants which may impair locking of screws.

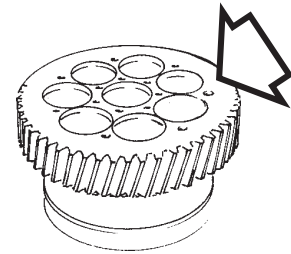


Figure 132

ASS0780L

2. Assemble retaining plate with pistons and center pin in position. Use screws that have a precoat coating.

**NOTE:** For tightening torques, see service information.

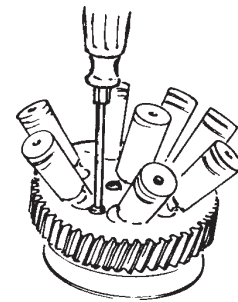


Figure 133

ASS0790L

3. Insert spring plate (1, Figure 134) and cup springs (2, Figure 134) into their correct position (and orientation) using grease to hold them into place.

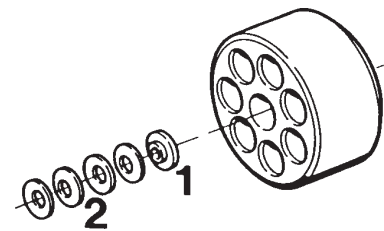


Figure 134

ASS0800L

4. Ensure that all parts are assembled in correct order and orientation.

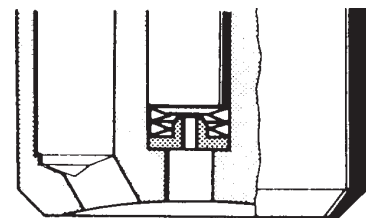


Figure 135

ASS0810L

## Assembly of Intermediate Wheel

1. Press bearing (1, Figure 156) into housing.
2. After assembly key (3, Figure 156) to the shaft (5) and install the gear (2).
3. Assemble the bearing (4, Figure 156).

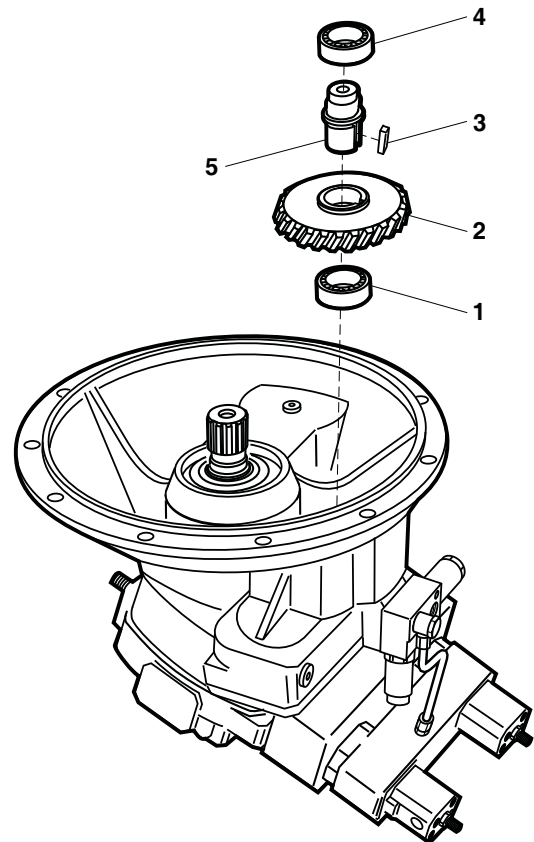


Figure 156

DS1600888

4. Press bearing (4, Figure 156) into housing.

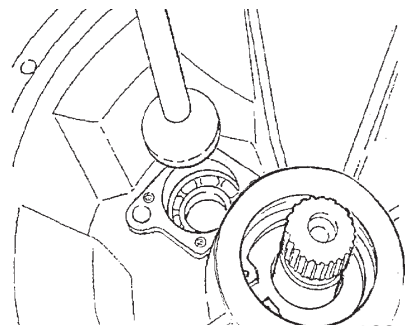


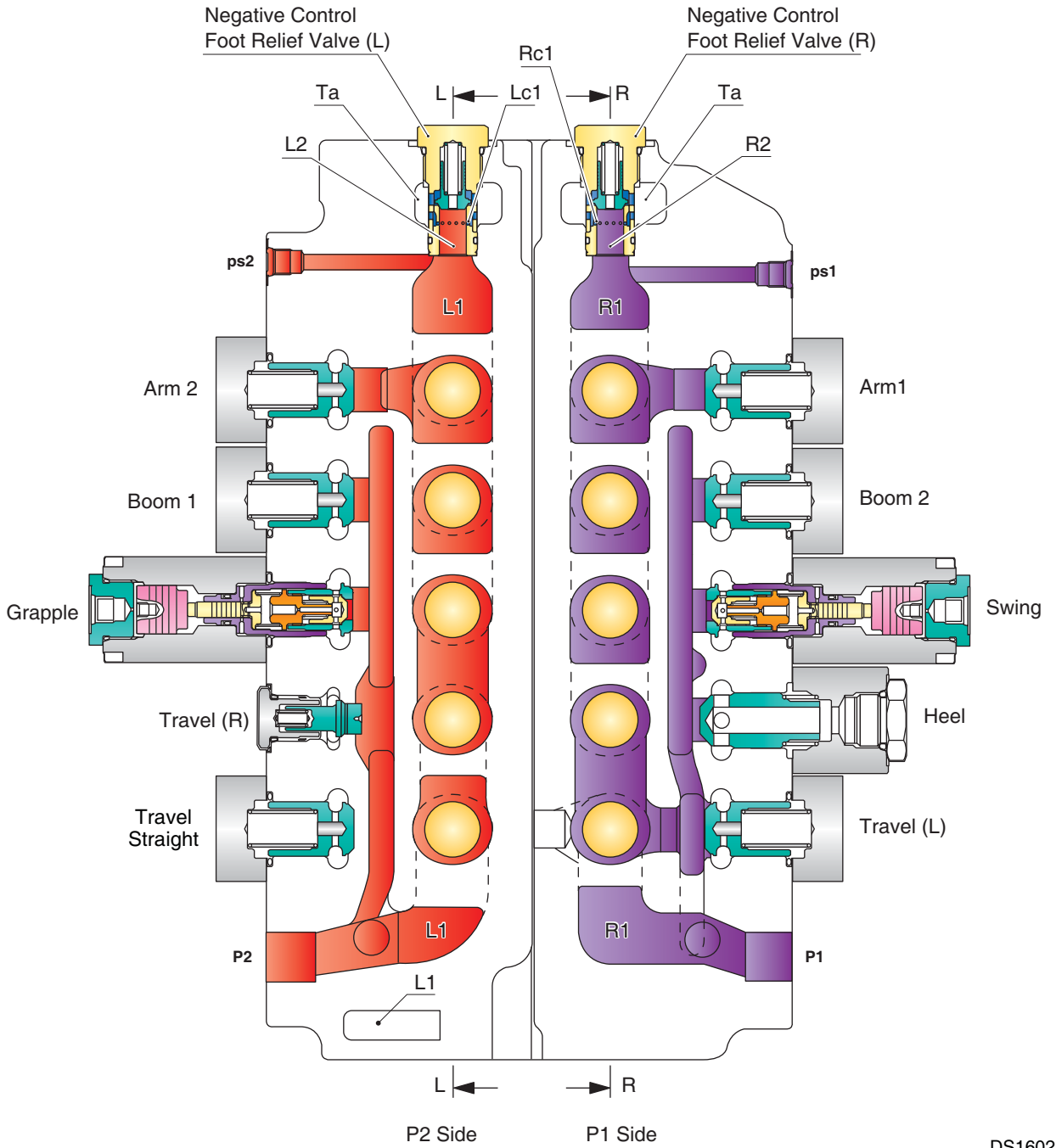
Figure 157

ASS1070L

<b>Reference Number</b>	<b>Description</b>
1	Pump, Main
2	Coupling, Pump
2-1	Hub
2-2	Element
2-3	Insert (A)
2-4	Insert (R)
2-5	Socket Bolt Set (8 ea)
2-6	Bolt

<b>Reference Number</b>	<b>Description</b>
2-7	Pin, Spring
2-8	Element Kit
3	Sensor, Pressure
4	Adatper, Reducing
5	Bolt
7	Washer
8	O-ring

<b>Port</b>	<b>Name</b>	<b>Size</b>
pa1	Travel Backward Pilot (LH)	PF 3/8"
pa2	Heel Rack OUT Pilot	
pa3	Swing Left Pilot	
pa4	Drain (Boom 2)	
pa5	Arm 1 Crowd Pilot	
pa6	Travel Backward Pilot (RH)	
pa7	Grapple Cylinder Head	
pa8	Boom 1 Up Pilot	
pa9	Arm 2 Crowd Pilot	
pb1	Travel Forward Pilot (LH)	
pb2	Heel Rack IN Pilot	
pb3	Swing Right Pilot	
pb4	Boom 2 Up Pilot (pb8)	
pb5	Arm 1 Dump Pilot	
pb6	Travel Forward Pilot (RH)	
pb7	Grapple Cylinder Rod	
pb8	Boom 1 Down Pilot	
pb9	Arm 2 Dump Pilot (pb5)	
DR1	Drain Port 1	
pr	Plugged	



DS1602568

Figure 7

2. Boom up (2-pump confluence)

When boom 1 spool is shifted by increasing pressure of boom 1 pilot port (Pa8), neutral passage (L1) is closed. Oil supplied to port (P2) flows through parallel passage (L3) and load check valve (S8-2) to spool and flows into port (A8). When boom 2 spool is shifted by increasing pressure of boom 2 pilot port (Pb4), neutral passage (R1) is closed. Oil supplied to port (P1) flows through parallel passage (R3), load check valve (S4-2), spool, and to passage (6) and joins at port (A8). Return oil flows from port (B8) to spool and returns to tank passage (Ta).

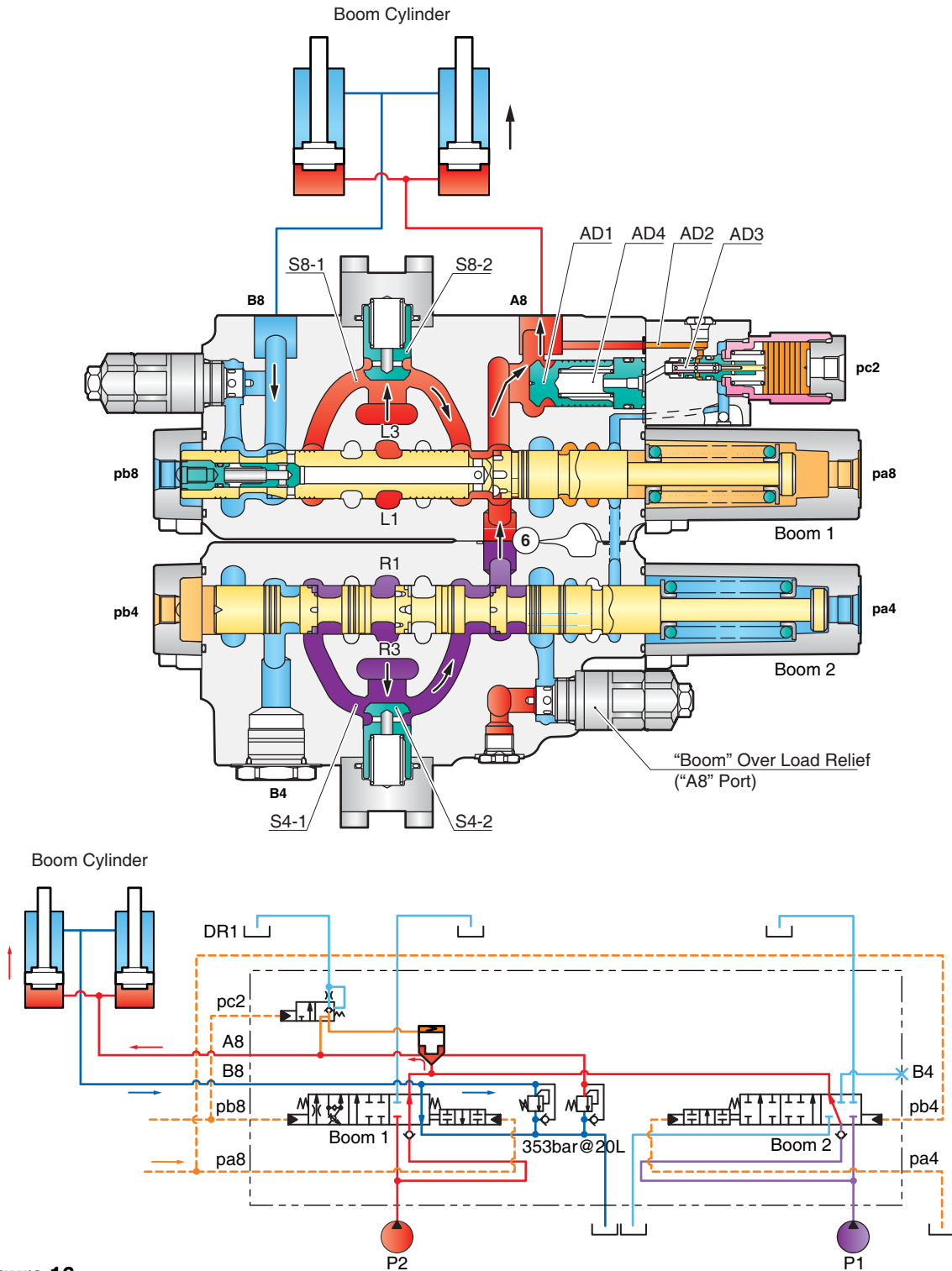


Figure 16

EX1404110

## Swing Compound Operation

The valve's swing section is equipped with the control valve that adjusts the flux that flows into the swing when combined operating with the section (travel, boom 2, arm 1) of P1.

If port (Pi3) is pressurized when operating swing function, piston (S3-6) is pushed to have the poppet assembly (S3-2) to be pressed under the seat part of the valve housing through the piston (S3-5) and plug (S3-4). In this way, the oil in the parallel passage (R3) is flowing into the passage (S3-1) by pushing up the poppet (S3-3) inside the poppet assembly.

As a result, the passage at the time of compound operation is tightened more than when single operation that flux flowing into A3 (B3) is reduced, and the surplus flux is advanced to the section that P1 is simultaneously operated through the parallel passage (R3).

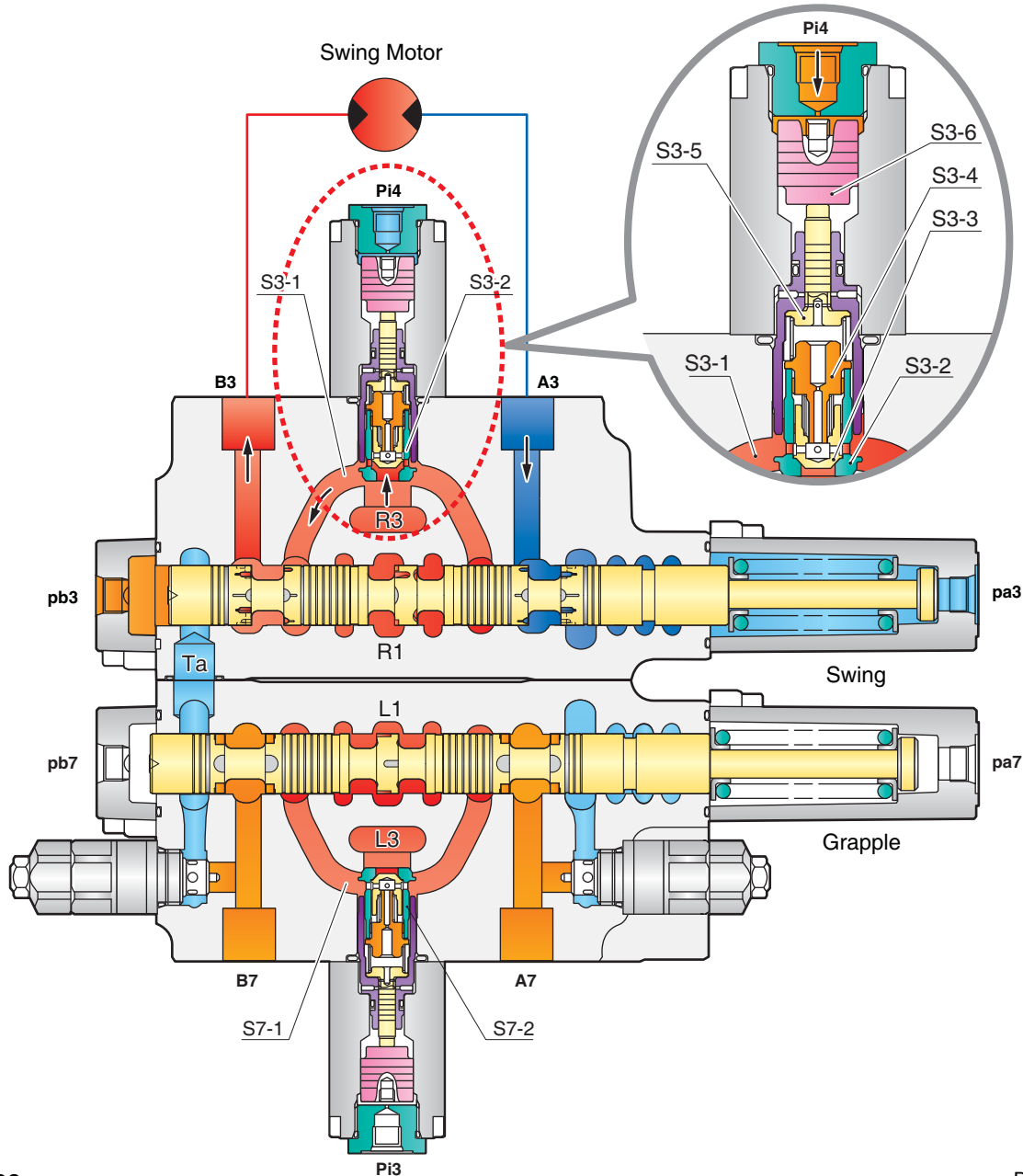


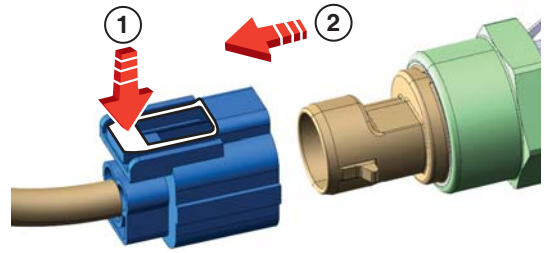
Figure 26

DS1602594

15. Disconnect the harness connector (2 ea).

**NOTE:** *Be careful not to let water get into electrical components (sensor, connectors). If water gets into electrical system, this will cause an electrical short circuit and result in improper machine operation.*

Port	Location
PT, PA	Left Side



DS1601120

Figure 53

16. When disconnecting the hose, oil left in the hose may flow out. Therefore, place the end of the hose into a suitable container to prevent contamination of the ground and environment.

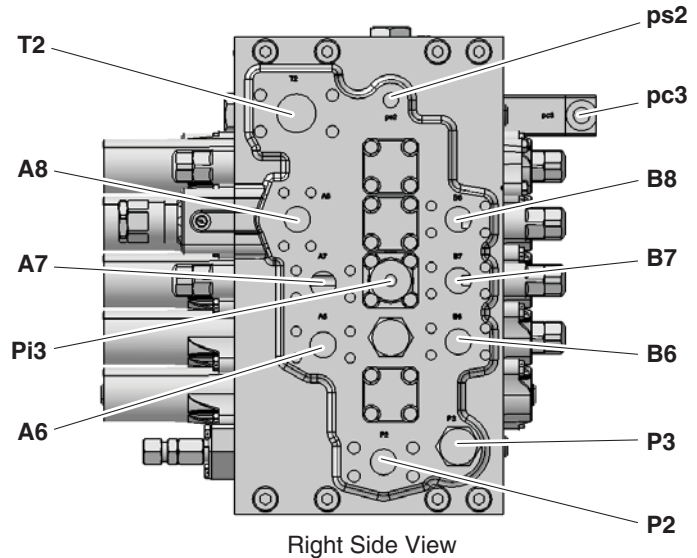
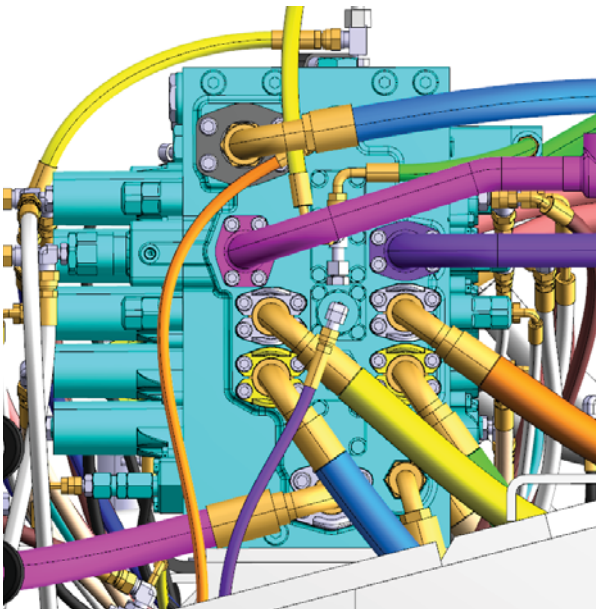


EX1504170

Figure 54

17. Remove hoses, pipes and adapters from control valve.

**NOTE:** *Attach identification tags to the removed hoses for reassembling. After disconnecting hoses from main control valve, plug them to prevent dirt or dust from entering. Disconnect the hoses from the bottom to top of control valve.*



DS1602840

Figure 55

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# DISASSEMBLY

## Caution on Disassembly

1. Stop engine when pressure of actuator is not indicated.

It is dangerous to disassemble control valve while it is under pressure. High-pressure oil can squirt out or components can spring out. When partially disassembling control valve that is on machine, be careful to follow the following caution.



## WARNING

---

### AVOID DEATH OR SERIOUS INJURY

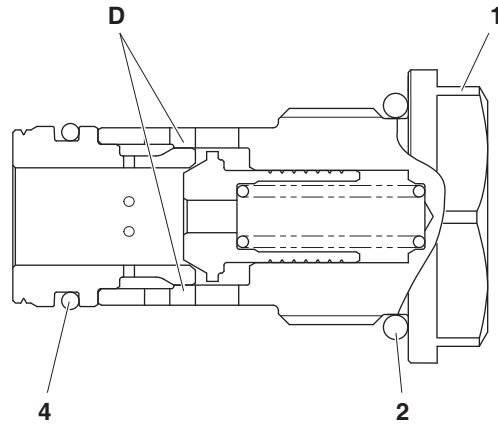
**Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.**

---

2. Vent pressurized air from hydraulic oil tank.
3. Clean all exterior surfaces of valve before to disassembly and protect it from dirt and foreign materials.
4. Match mark the disassembled parts to make sure of proper reassembling position.
5. Replace all sealing parts such as O-rings and backup rings with a new ones.
6. Do not replace spools, they are matched with valve housing and sleeve.

**NOTE:** *The further part numbers of an assembly part are shown as (assembly part number - further part number).*

## Instruction of Disassembly and Assembly of Low-pressure Relief Valve



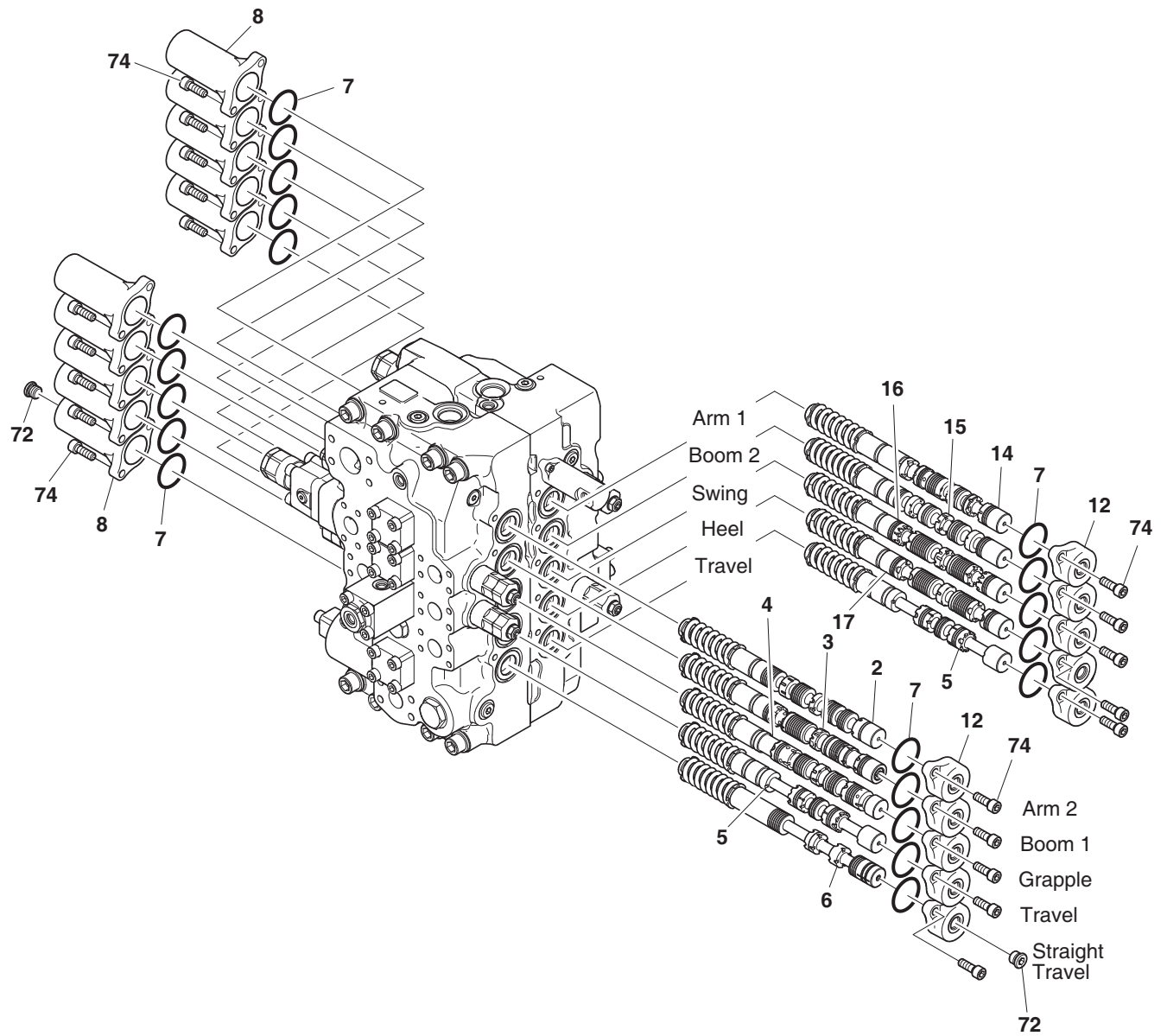
EX1401504

Figure 79

No.	Item	Tool	Torque
1	Plug	Wrench 32	8.8 kg.m
2	O-ring		
4	O-ring		

1. This unit has press install portion (D) and it must be replaced as a complete assembly.

## Assembly of Main Spool



**Figure 91**

DS1602593

1. Install O-ring (7, twenty places) on mating surface of valve housing cap.
2. Install spool of subassembly condition (2-6 and 14-17) in same positions that they were remove from during disassembly



# Theory of Operation

## Hydraulic Motor

As shown in the figure below, the high-pressure oil entering the cylinder block through valve plate (112) inlet side port exerts pressure on the piston, generating axial force  $F$ . The force  $F$  is divided into the two vectors of force  $F_1$  which is perpendicular to the swash plate (103) and  $F_2$  which is perpendicular to the shaft, with the shoe (104-1) as the medium. With the piston and the medium, the force  $F_2$  is transmitted to the cylinder block (108) and generates rotational torque to the output shaft. On the cylinder block, 9 pistons are arranged equidistantly, and rotational torque is transmitted to the output shaft by the multiple pistons connected to the inlet side of the high-pressure oil in consequences.

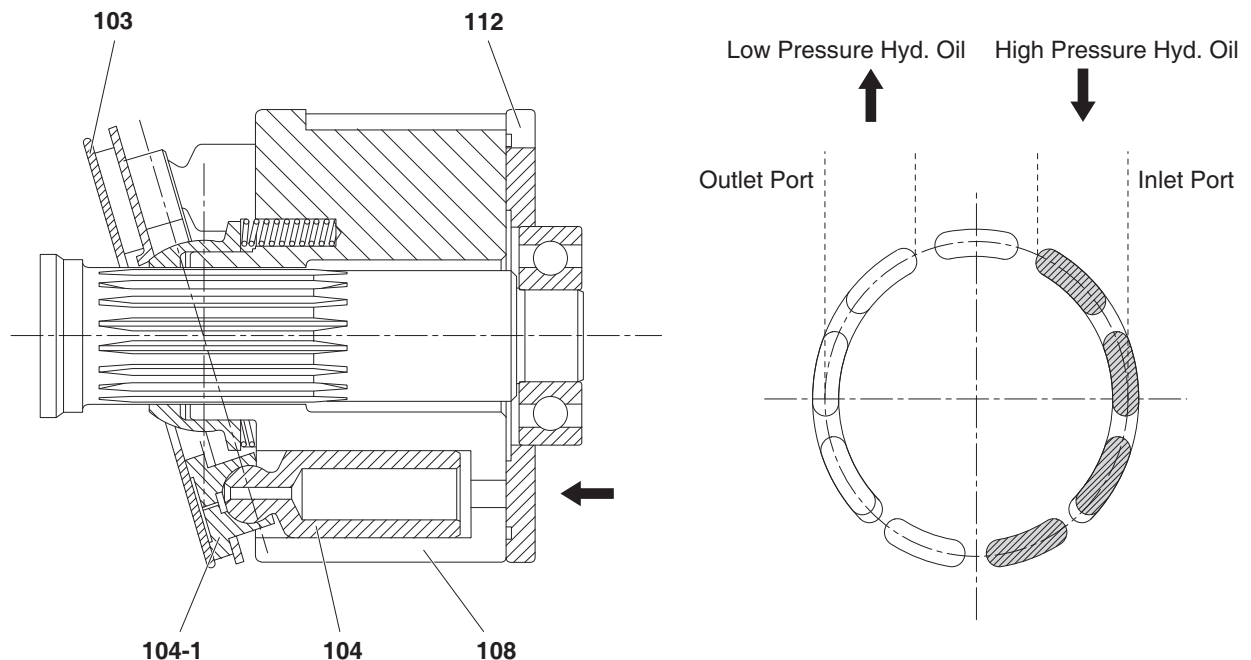
Reversing the direction of oil flow will reverse the direction of rotation of the output shaft.

Theoretical output torque  $T$  is calculated with the formula below;

$$T = \frac{P \times q}{2 \times \pi}$$

$P$ : effective differential pressure ( $\text{kg}/\text{cm}^2$ )

$q$ : volume per rotation ( $\text{cc}/\text{rev}$ )



EX1301620

**Figure 6** Operation Diagram of Motor

# REMOVAL

---



## WARNING

---

### AVOID DEATH OR SERIOUS INJURY

Contact with hydraulic fluid can harm your health. (e.g. eye injuries, skin damage or poisoning, if inhaled).

- While performing removal and installation, wear safety gloves, safety glasses and suitable working clothes.
  - If hydraulic fluid should come into contact with your eyes or penetrate your skin, consult a doctor immediately.
- 
- 



## WARNING

---

### FIRE CAN CAUSE SERIOUS INJURY OR DEATH

Hydraulic fluid is highly flammable.

- Keep open flames and ignition sources away from the workplace.
- 
- 

## IMPORTANT

---

Fluid such as engine oil, hydraulic fluid, coolants, grease, etc. must be disposed of in an environmentally safe manner. Some regulations require that certain spills and leaks on the ground must be cleaned in a specific manner. See local, state and federal regulations for the correct disposal.

---

1. Park the machine on flat level ground.
2. Extend the boom and arm, as shown in Figure 21 and lower the boom until the attachment is 10 cm above the ground.
3. Stop the engine.

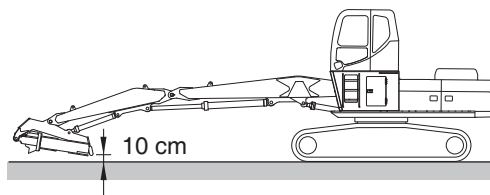
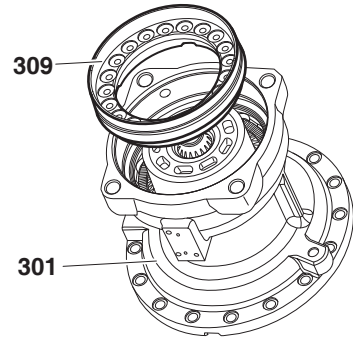


Figure 21

EX1505045

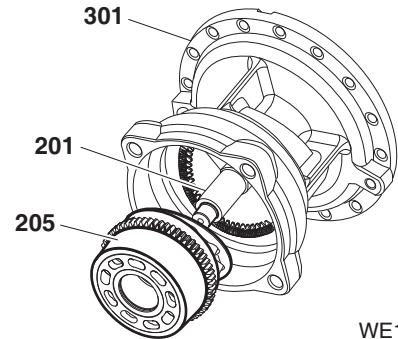
10. Disassemble brake piston (309) from casing (301) by using the special tool for removing the brake piston.  
Lift it up straight by using the bolt hole in the brake piston.



**Figure 43**

FG022409

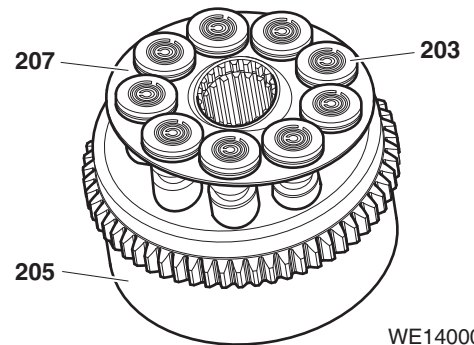
11. After placing the motor horizontally, take out cylinder block (205) from casing (301).



**Figure 44**

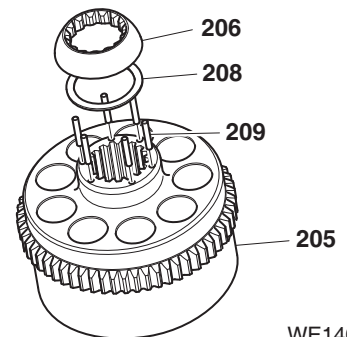
WE1400019

12. Remove piston assembly (203), retainer (207), thrust ball (206). When taking out the cylinder block, be careful not to pull out roller (209). Be careful not to damage the sliding parts of the cylinder block, thrust ball and shoe.



**Figure 45**

WE1400020

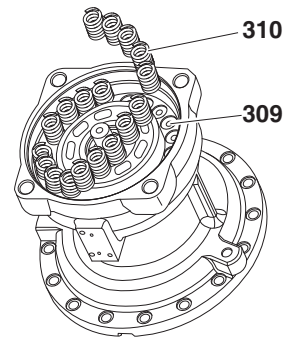


**Figure 46**

WE1400021

13. Assemble brake springs (310) into brake piston (309).

Confirm the springs are fitted to the brake piston completely.



FG022408

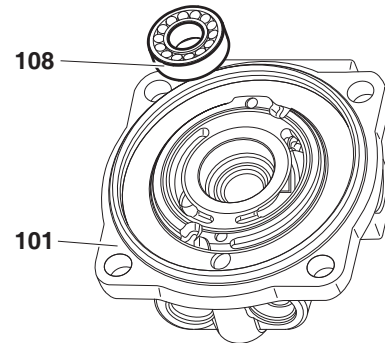
Figure 81

14. (This procedure applies when ball bearing (108) was disassembled from the valve casing.)

Assemble of ball bearing (108). Insert it to valve casing (101) while tapping it lightly.

Tap evenly on the outer diameter of the outer race with a brass drift until it completely stops.

Do not use a steel punch or bar on the bearing since it can chip or crack the race.



FG022417

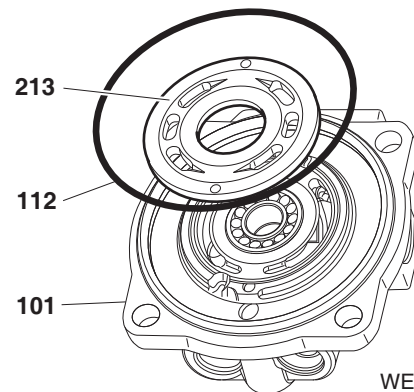
Figure 82

15. Assemble valve plate (213) to valve casing (101) and install O-ring (112).

Be careful to note the direction of the valve plate.

Mount the valve plate with its round part toward the opposite side of the flange.

Coat lightly with grease.



WE1400024


Figure 83

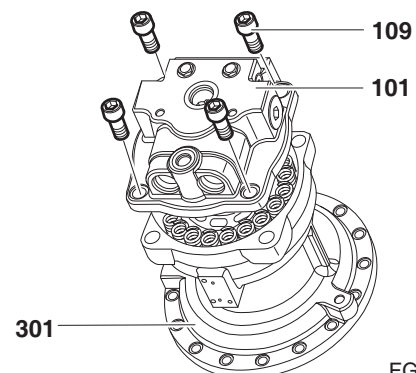
16. Mount valve casing (101) to casing (301) and tighten hex socket bolts (109) to specification.

Be careful to note the mounting direction of the valve casing. (Reference to the drawing)

Be careful not to drop the valve plate or let the brake springs pop out.

Tighten the bolts evenly.

- Tool: 17 mm (  )
- Torque: 431.5 N.m (44 kg.m, 318.3 ft lb)



FG022426

Figure 84

## Troubleshooting

### 1. Hydraulic motor fails to rotate

Symptom	Possible Cause	Corrective Action
Pressure does not rise	<ol style="list-style-type: none"> <li>1. The setting of the relief valve in the circuit is incorrect.</li> <li>2. Relief valve malfunction.               <ol style="list-style-type: none"> <li>1) Plunger sticks</li> <li>2) Plunger orifice clogged.</li> </ol> </li> <li>3. Plunger seat failure</li> </ol>	<ol style="list-style-type: none"> <li>1. Set up with correct value</li> <li>2.               <ol style="list-style-type: none"> <li>1) Plunger sticks</li> <li>2) Plunger orifice clogged.</li> </ol> </li> <li>3. Check the seat and replace it if damaged.</li> </ol>
Pressure rises up to normal level	<ol style="list-style-type: none"> <li>1. Overloaded.</li> <li>2. Sticking of moving parts</li> <li>3. Brake release pressure is not applied.</li> <li>4. Brake piston is sticking.</li> <li>5. Friction plate is sticking.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove load.</li> <li>2. Check/repair piston, shoe, cylinder block, and valve plate.</li> <li>3.               <ol style="list-style-type: none"> <li>1) Check/repair the circuit.</li> <li>2) Check the brake switching valve.</li> </ol> </li> <li>4. Disassemble and check</li> <li>5. Disassemble and check Replace the sticking part.</li> </ol>

### 2. The direction of rotation is reverse.

Symptom	Possible Cause	Corrective Action
Direction of rotation is reverse	<ol style="list-style-type: none"> <li>1. Motor rotates in reverse direction.</li> <li>2. The inlet and outlet of pipeline are reverse.</li> </ol>	<ol style="list-style-type: none"> <li>1. Referring to Figure 12, assemble correctly.</li> <li>2. Correct the pipeline.</li> </ol>

# Theory of Operation

## Structure

The joystick valve contains four push rods, spring seat, spools and return springs, which are in the valve casing. Moves the spool of the main control valve by reducing the pressure of the pilot pump from a first pressure to a second pressure.

The housing has six ports, which include input port P, tank port T, and four secondary pressure ports.

The electric horn button is installed in the valve handle.

Gear pump pressure is used for operating control spools.

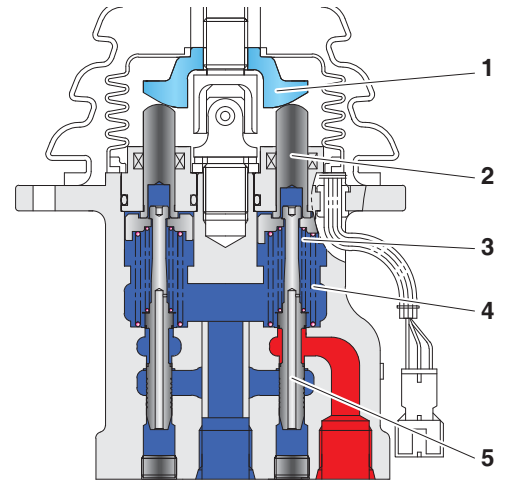
## Function

### 1. Neutral position

When the joystick lever is in the neutral state, the spool is pressed upward by the return spring and the spring seat.

The P-port is blocked by the lower part of the spool, and the 4 operation ports are connected to the T-port by the upper part of the spool.

Reference Number	Description
1	Swash Plate
2	Push Rod
3	Balance Spring
4	Return Spring
5	Spool



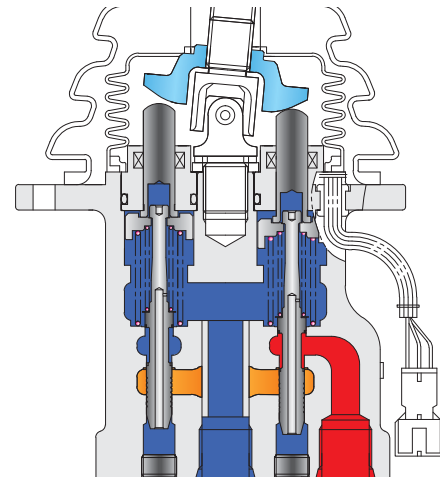
DS1602148

Figure 7

### 2. Half-operated state

When the joystick lever is moved, the push rod moves downward, and the force thereof is transferred to the spool through the spring seat and the control spring. When the spool moves, the first pressure is transferred to the operation ports through the spool.

When the lever spring stops in the halfway position, the force of the compressed spring and the hydraulic pressure caused by the second pressure applied upward because of the difference in area of the upper and lower ends of the spool create a state of equilibrium, and this pressure is transferred to the spool of the control valve. That is, the first pressure is transferred to the operation ports through the spool as a hydraulic pressure (second pressure) corresponding to the force of the compressed control spring.

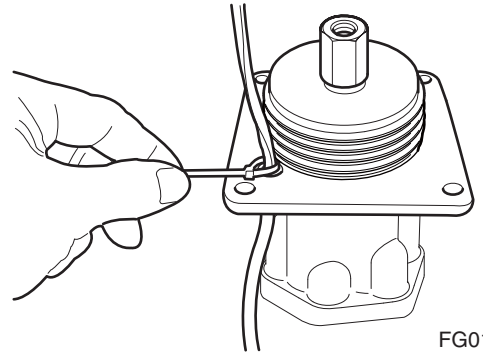


DS1602149

Figure 8

# DISASSEMBLY

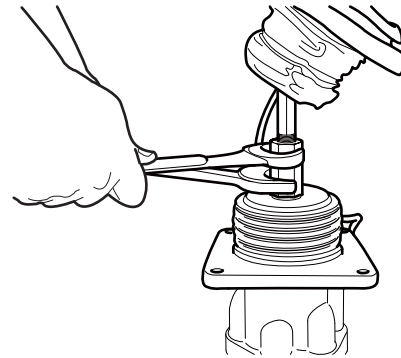
1. Remove lead wire from bushing (29).



FG013494

**Figure 28**

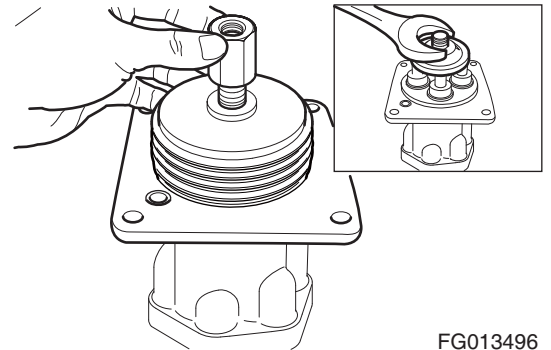
2. Remove lever assembly from case (1).



FG013495

**Figure 29**

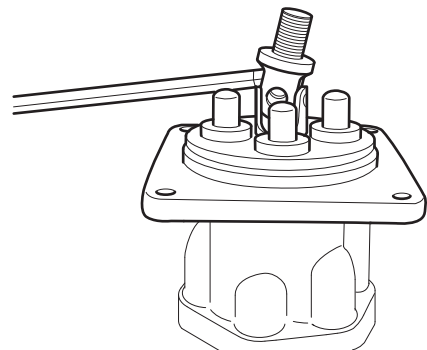
3. Remove hex nut (23) and swash plate (22) from case (1).



FG013496

**Figure 30**

4. Remove joint assembly (21) from case (1).



FG013497

**Figure 31**

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## WARNING

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### AVOID DEATH OR SERIOUS INJURY

Release any pressure in the hydraulic oil tank before doing any work.

---

- Loosen the oil tank air breather slowly to release the pressure inside the hydraulic oil tank. Pulling the breather cap upward, the check valve (0.45 bar) opens, and the air is discharged to the atmosphere from the top of the hydraulic oil tank.
- Open the cabin riser cover (Figure 12).



Figure 11

EX1404054

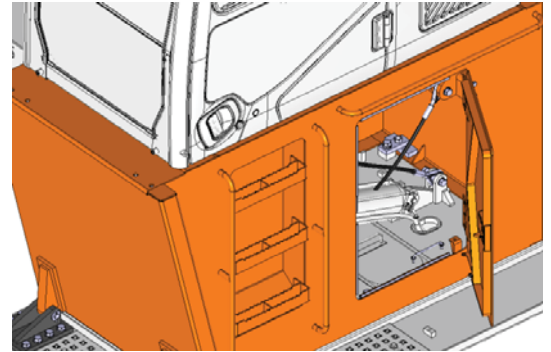
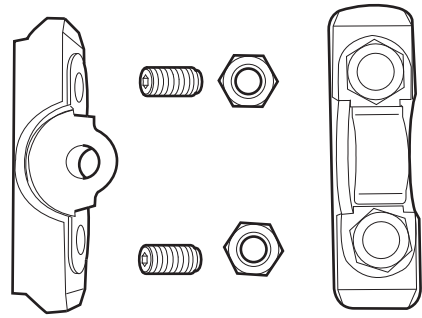


Figure 12

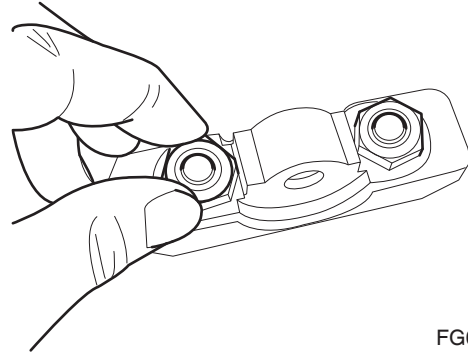
EX1505075

11. Install set screws (30) and hex nut (31) into cam (26) and tighten it.



FG013555

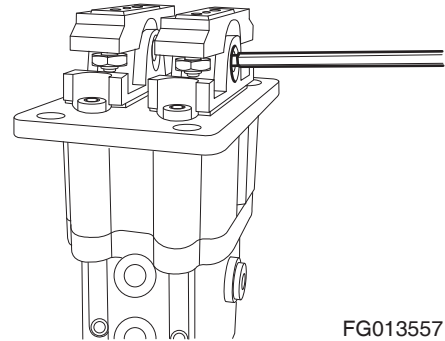
**Figure 44**



FG013556

**Figure 45**

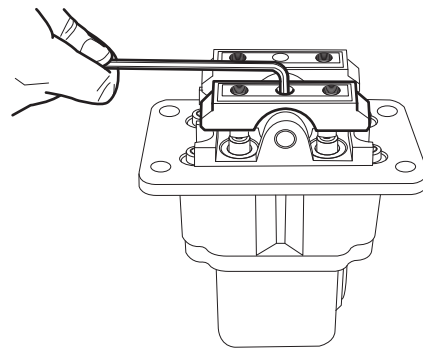
12. Position cam (26) on cover (24) and insert camshaft (29) using hammer.



FG013557

**Figure 46**

13. Install set screw (29) in cam (26) and tighten it using torque wrench.



FG013558

**Figure 47**

# TROUBLESHOOTING

Symptoms	Causes	How to Check	Solutions
Malfunction of solenoid valve	Foreign substance, dirt and dust in solenoid valve.	Disassemble the solenoid valve and check if there is any contamination such as a foreign substance and sludge between the case and the spool.	Remove contaminant, wash, and assemble components.
	Tube or retainer of solenoid valve damaged.	Disassemble the solenoid valve and check if there is any deformation (bending or reduction) in the tube or the retainer.	Replace solenoid valve.
	Coil broken, short, or burned.	Disassemble the solenoid valve and check the coil resistance. Spec: 26.7Ω @ 20°C Disconnection: ∞ Short: Low or excessive resistance Disassemble the solenoid valve and check the outside of the coil to see if its casing is burned and melted.	Replace coil.
	Connector terminal ground defect.	Check if the connector (valve side) and housing (where harness is attached) are grounded properly.	Replace coil or housing.
Pilot pressure fails to generate;	Pilot pressure.	Remove plug of the "P5" port, install a pressure gauge, and check the pilot pressure discharged from the pilot pump when operating the pilot cut-off valve (C1).	Refer to "Causes" and "How to Check" of the solenoid valve above.
	Pilot relief valve.	Check if the relief valve installed in the pilot line operates properly. <ul style="list-style-type: none"><li>Check if pressure is bypassing because of the presence of foreign substance.</li></ul>	Remove foreign substance, reassemble, and replace the relief valve.
	Pilot pump.	Check if the pilot pump works properly.	Replace the pilot pump.
Poor Actuator Performance	Pilot system.	Check any defect of the pilot system considering findings from "Pilot pressure fails to generate;" category.	Repair defect(s) accordingly.
	Solenoid valve.	Install a pressure gauge at each outlet port of the solenoid valve (H0, TR2, PH, and BS ports) and check the pressure value discharged from the pilot pump when operating the solenoid valve.	Refer to "Causes" and "How to Check" of the solenoid valve above.
	Main control valve.	Check if main control valve of each component works properly.	Repair according to findings.
	Other components.	Check if each component works properly.	Repair according to findings.

*button on the bottom of the diaphragm eventually seals off the lower oil passage. Just after the needle on the gauge reaches its highest point (when there is 0 bar (0 psi) resistance from hydraulic system pressure) pressure on the gauge will drop sharply to zero, as the accumulator is completely emptied of oil and the diaphragm button closes.*

Record the highest gauge reading and compare to "P1" rated precharge pressure on the accumulator manufacturer's data label. Repeat this test at least once a year to verify proper functioning of the accumulator.

3. As hydraulic system pressure overcomes accumulator precharge pressure, the flexible diaphragm begins to retract upward.
4. When system oil is at highest working pressure and the accumulator fills to maximum reserve capacity, the flexible diaphragm is pushed up into the top of the upper chamber.

The highest working pressure is sometimes referred to as the "P3" pressure and can also be referenced on the manufacturer's data label on the exterior of the accumulator.

5. If system oil pressure begins to fall off or is momentarily checked or interrupted, the energy stored on the other side of the diaphragm, in the form of compressed gas, pushes oil back out of the lower chamber, maintaining oil pressure of the circuit.
6. With minimal system pressure, an equilibrium point may be reached in which accumulator precharge pressure and hydraulic system oil pressure achieve a rough balance. In this condition a minimal amount of oil is stored in the accumulator.

## Specifications

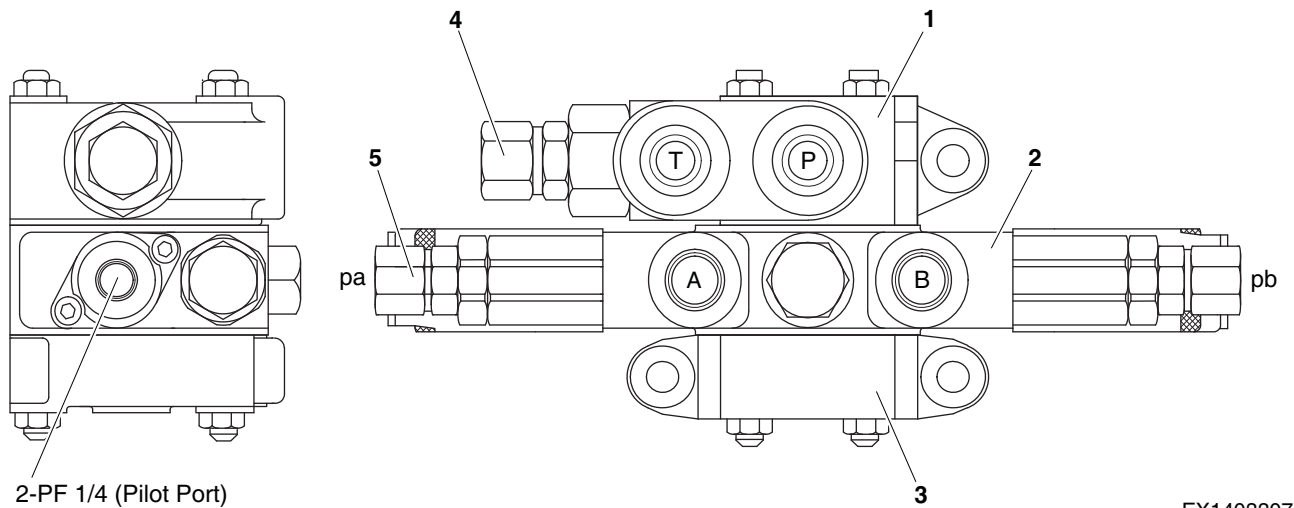
System	Charge Pressure	Volume
Pilot	9.8 bar (10 kg/cm <sup>2</sup> , 142 psi)	320 cc (19.53 in <sup>3</sup> )

# GENERAL

## Specification

Rated Pressure	83 bar (85 kg/cm <sup>2</sup> , 1,209 psi)
Rated Flow	50 L/min (13 U.S. gal)
Internal Leakage	100 cc/min at 68 bar (69 kg/cm <sup>2</sup> , 986 psi)
Main Relief Pressure Setting	78 bar (80 kg/cm <sup>2</sup> , 1,131 psi)
Overload Relief Pressure Setting	98 bar (100 kg/cm <sup>2</sup> , 1,421 psi)

## Overview



EX1403307

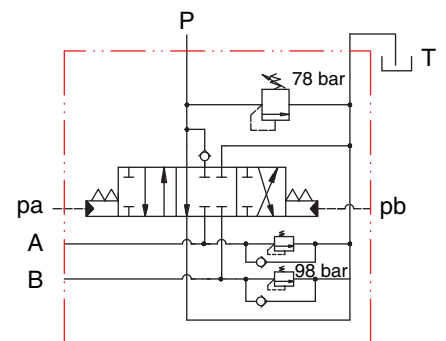
Figure 1

Reference Number	Description
1	Inlet Block
2	Work Block
3	T Block

Reference Number	Description
4	Main Relief Valve
5	Overload Relief Valve

## Port and Hydraulic Circuit

Port	Name	Size
P	Pressure Input	PF 1/2"
T	Drain	
A	Attach Pressure In/Out	PF 3/8"
B	Attach Pressure In/Out	
Pa	Pilot Pressure	PF 1/4"
Pb	Pilot Pressure	



EX1403308

Figure 2

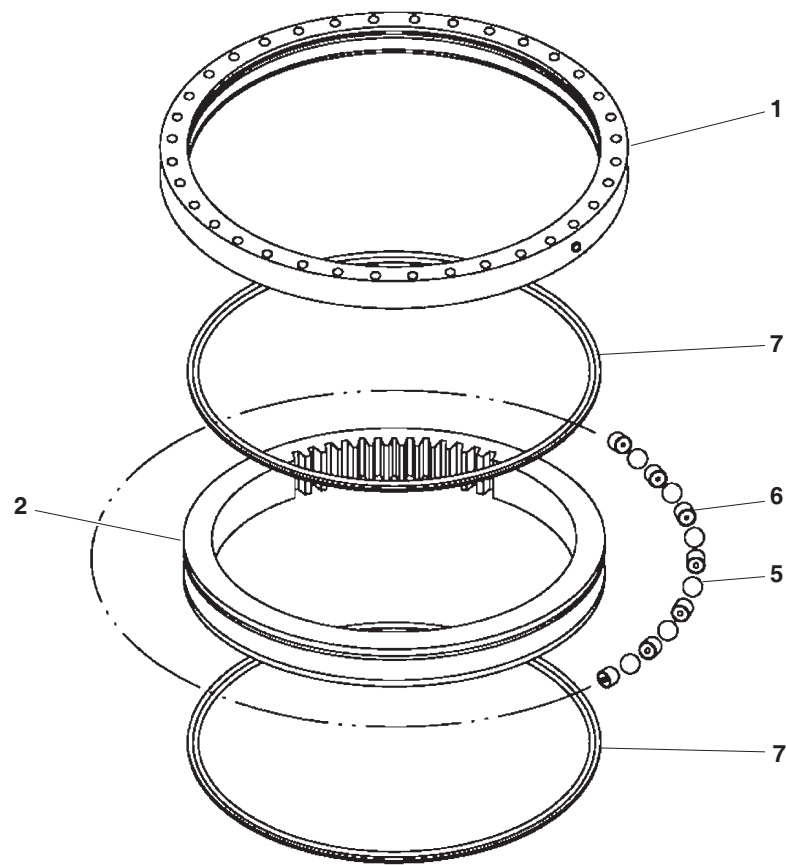


# GENERAL

## General Description

The swing bearing, which connects the upper structure with the lower structure, consists of a inner ring, outer ring and ball bearings. During swing movement, power from the swing motor is transferred to the pinion by planetary gears connected to gears on the inner ring, which is fixed in the undercarriage. Ball bearings turn the outer ring.

## Parts List



FG1301305

Figure 1

Reference Number	Description
1	Outer Ring
2	Inner Ring
3	Tapered Pin
4	Plug

Reference Number	Description
5	Ball
6	Retainer
7	Seal

# REMOVAL

---



## WARNING

---

### AVOID DEATH OR SERIOUS INJURY

Contact with hydraulic fluid can harm your health. (e.g. eye injuries, skin damage or poisoning, if inhaled).

- While performing removal and installation, wear safety gloves, safety glasses and suitable working clothes.
  - If hydraulic fluid should come into contact with your eyes or penetrate your skin, consult a doctor immediately.
- 
- 



## WARNING

---

### FIRE CAN CAUSE SERIOUS INJURY OR DEATH

Hydraulic fluid is highly flammable.

- Keep open flames and ignition sources away from the workplace.
- 
- 

## IMPORTANT

---

Fluid such as engine oil, hydraulic fluid, coolants, grease, etc. must be disposed of in an environmentally safe manner. Some regulations require that certain spills and leaks on the ground must be cleaned in a specific manner. See local, state and federal regulations for the correct disposal.

---

1. Park the machine on flat level ground.
2. Extend the boom and arm, as shown in Figure 4 and lower the boom until the attachment is 10 cm above the ground.
3. Stop the engine.

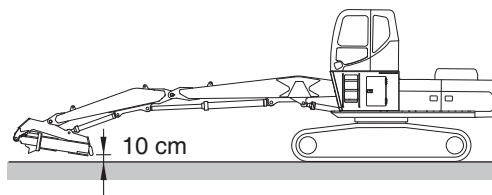


Figure 4

EX1505045

4. Assemble the shim (11, Figure 25), spacer (4) and install the retaining ring (5).

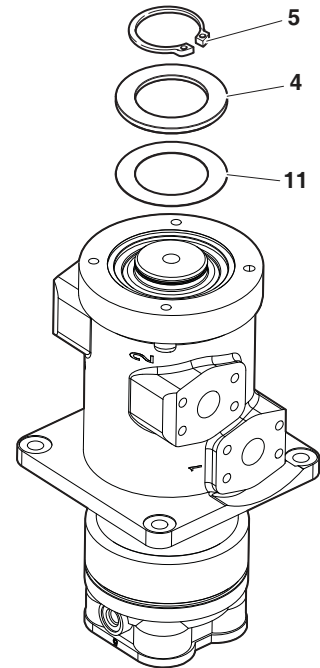


Figure 25

EX1402522

5. Apply the grease inner surface of cover (3, Figure 26) to fix the shim (12). And install the O-ring (9) to hub.

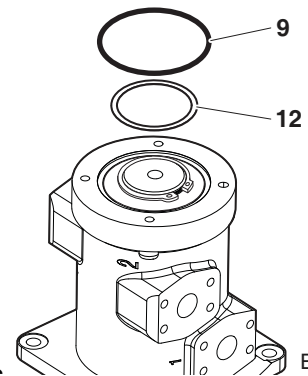



Figure 26

EX1402521

6. Install the bolts and washers (13 and 14, Figure 27) with cover (3) to hub.

- Tool: 19 mm ()
- Torque: 107.9 N.m (11 kg.m, 79.6 ft lb)

7. Prefill the center swivel with clean hydraulic fluid before reassembly of high-pressure and drain line piping. Clean and prefill piping line ends to reduce the amount of air in the system. Bleed air from the hydraulic system and check hydraulic tank fluid level.

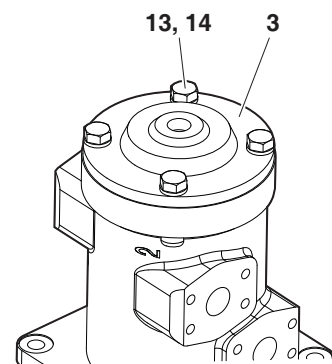


Figure 27

EX1402520

---

## IMPORTANT

---

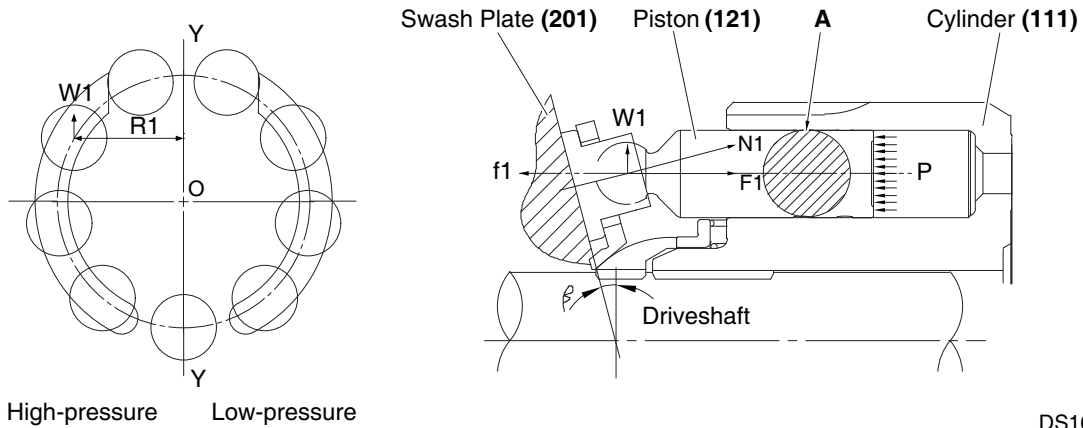
After the completion of the assembly, a start-up and a rotation torque test must be performed for the slipper seal to seat in its place properly.

---

# Theory of Operation

## Hydraulic Motor

1. Generation of rotational force.



DS1602582

**Figure 5**

High pressure oil supplied from the hydraulic pump flows through valve casing (303) and valve plate (131) into cylinder block (111). (Refer to Figure 3 for indication numbers).

The internal design allows the high pressure oil to flow to one side of the center line "Y-Y" at the top and the bottom dead center piston (121).

The high pressure oil acts upon pistons and generates force "F1" ( $F1 = P \times A$  (P: Supply pressure, A: Pressure area)). The force "F1" generates perpendicular force "N1" and radial force "W1" against swash plate (201), which has a tilting angle of "β." "W1" generates torque "T" ( $T = W1 \times R1$ ) against the line "Y-Y" of bottom and top dead center of piston.

The resultant ( $\sum W1 \times R1$ ) of torques which are generated from pistons (4 ~ 5 ea.) of high pressure side by high pressure oil generates rotating force. This torque is transmitted to cylinder block (111) through piston, and then rotating force is transmitted to drive shaft because cylinder block is combined with drive shaft by spline.

## Maintenance/Service

Check the following items while operating the travel motor.

1. Stop the product before service or inspection except when checking the noise level of clause 3 below. Otherwise, you may get physical injury including burn.
  - A. Oil leak (hydraulic oil, gear oil)
  - B. Loose bolt
  - C. Abnormal noise
  - D. Abnormally high case temperature  
(Standard external surface temperature of case during continuous operation: 80°C max.)
  - E. Replacement period of gear oil (See "Lubricant" on page -20.)
  - F. Hydraulic motor allowable drain: 0.5 lpm (pressure 5 bar (5 kg/cm<sup>2</sup>) max., at 25 rpm)
2. The case may be very hot right after operation. Measure the temperature with a contact type thermometer.

# Checkup After Assembly

## Air Test for Reduction Gear

Remove one plug (32) from reduction gear section and apply compressed air 0.3 bar (0.3 kg/cm<sup>2</sup>) through threaded hole for 2 minutes under water. No air bubbles should be generated.

## Air Test for Motor

Seal tightly all ports, except one location, of piping port of motor and apply compressed air 3 bar (3 kg/cm<sup>2</sup>) from opened port for 2 minutes under water. Air bubble should not be generated.

**NOTE:** Working oil volume: 1.5 L

# PERFORMANCE TEST

Be sure to add a sufficient amount of working oil into motor case before carrying out performance test. Be sure to carry out performance test below after finishing servicing of TM motor.

## If Test Equipment Is Available

If any built-in part has been replaced, be sure to carry out performance test after conducting test operation in accordance with following conditions:

1. Conditions for test operation
  - A. Rotating it right and left for 1 minute at no-load pressure of 20 rpm.
  - B. Rotating it right and left for 1 minute at no-load pressure of 10 rpm, 196 bar (200 kg/cm<sup>2</sup>).
  - C. Rotating it right and left for 1 minute on no-load pressure of 20 rpm.
2. Test conditions
  - A. Working oil: Wear-resistant working oil equivalent to ISO VG #46
  - B. Lube oil: Gear oil
  - C. Temperature
    - 1) Ambient temperature - Room temperature
    - 2) Working oil service temperature - 50 ±5°C
    - 3) Reduction gear case temperature - 40 ~ 80°C
  - D. Oil drain pressure: 0.8 bar (0.8 kg/cm<sup>2</sup>) or less

15. Remove floating seal (34) from housing (2). Do not damage it.

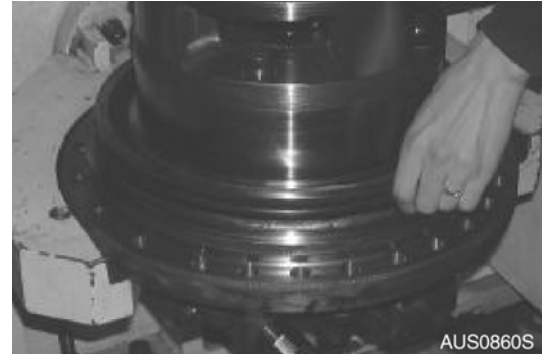
**NOTE:** *Be careful not to damage O-ring surface and seat.*



**Figure 55**

16. Remove floating seal (34) from shaft casing (272). Do not damage it.

**NOTE:** *Be careful not to damage O-ring surface and seat.*



**Figure 56**

17. Remove angular bearing (33) from housing (2).

**NOTE:** *After disassembling bearing, it should be replaced.*



**Figure 57**

### Assembly of Cylinder Subassembly

1. Assemble cylinder spring (114) and spherical bushing (113) onto cylinder block (111).

**NOTE:** *Align cylinder with spline of spherical bushing.*

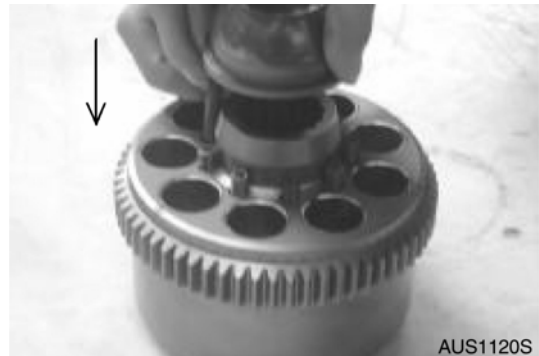


Figure 91

2. Insert piston (121) and shoe (122) assembly into plate (123) and assemble it on cylinder block.

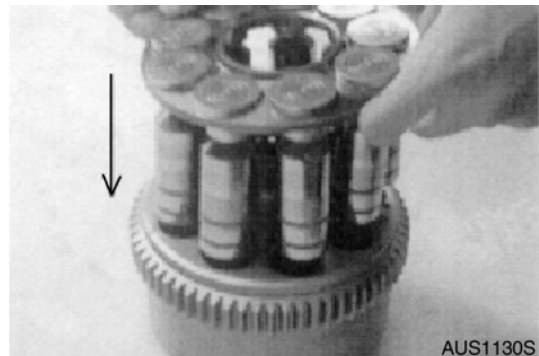


Figure 92

3. Assemble plug (461) and orifices (545 and 546) on shaft casing (272) to specified tightening torque.

- Torque:
  - Plug (461): 8.8 N.m (0.9 kg.m, 6.5 ft lb)
  - Orifices (545 and 546): 7 N.m (0.7 kg.m, 5 ft lb)



Figure 93



Figure 94

17. Position No. 1 sun gear (9) on motor shaft splines and engage No. 1 planetary gears.



Figure 134

18. Using ring gear (1) as a measuring surface, measure distance from it to top side of No. 1 sun gear.
  - The dimension: A (the value after subtracting thickness of jig)



Figure 135

19. Using surface (P.C.I.D. 342) of side cover as measuring surface, measure depth from it to hole surface of P.C.S. 60.2.



Figure 136

- The dimension: B (the value after subtracting thickness of jig)
20. Select a thickness of washer (53) according to following formula:
    - $1.5 \sim 2.0 = (B + A) - (\text{thickness of thrust} + \text{thickness of washer})$

**NOTE:** Maintain a clearance of 1.5 ~ 2.0 mm in shaft direction for No. 1 sun gear.

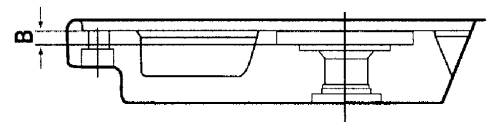


Figure 137

AUS1420S

# TRACK SHOES AND LINKS

## Parts List

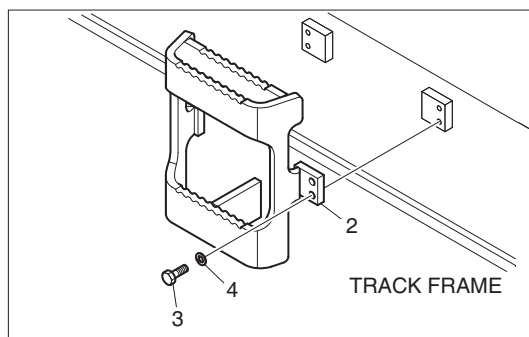
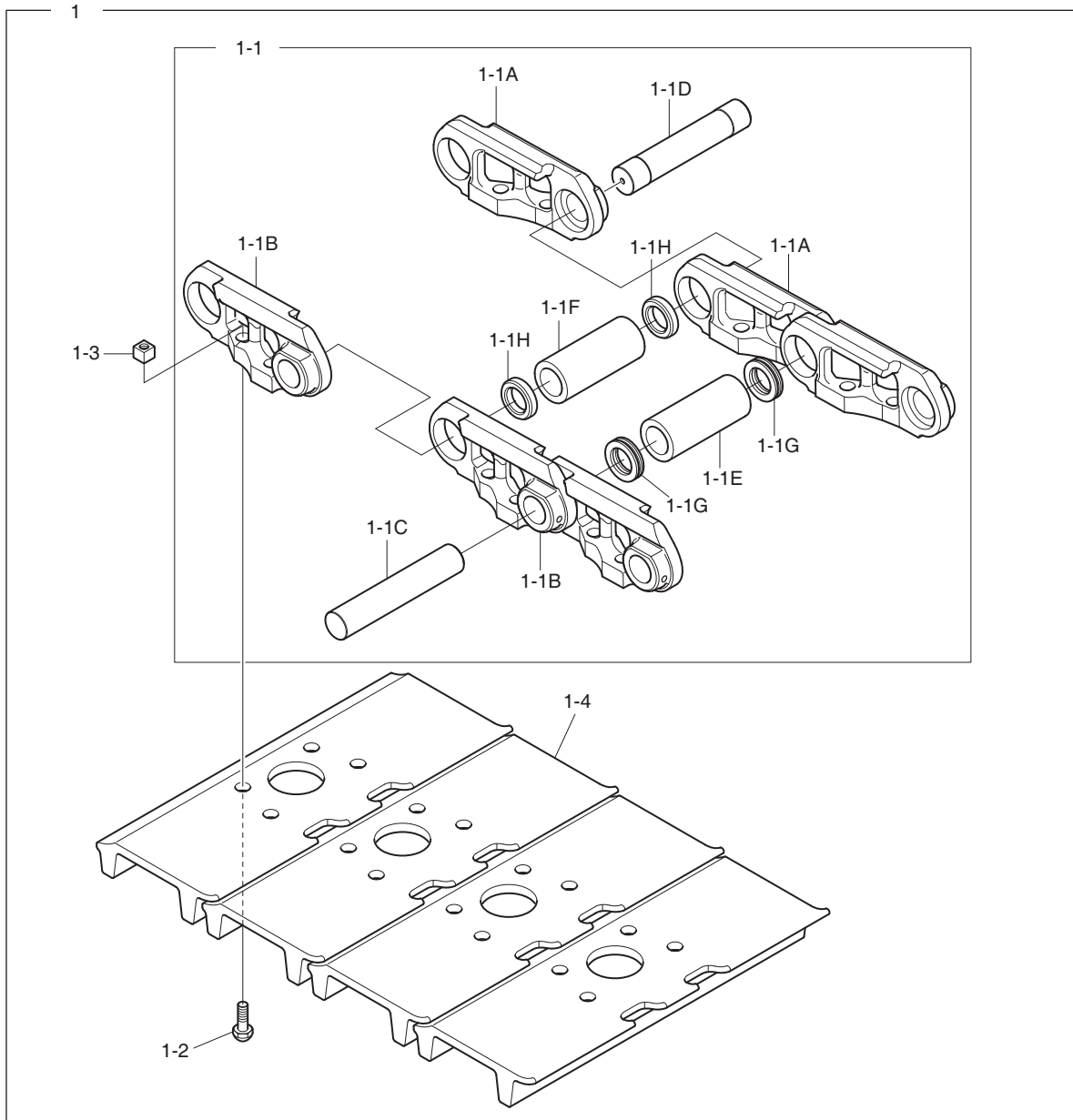


Figure 5

DS1602748

# UPPER/LOWER ROLLER

## Overview

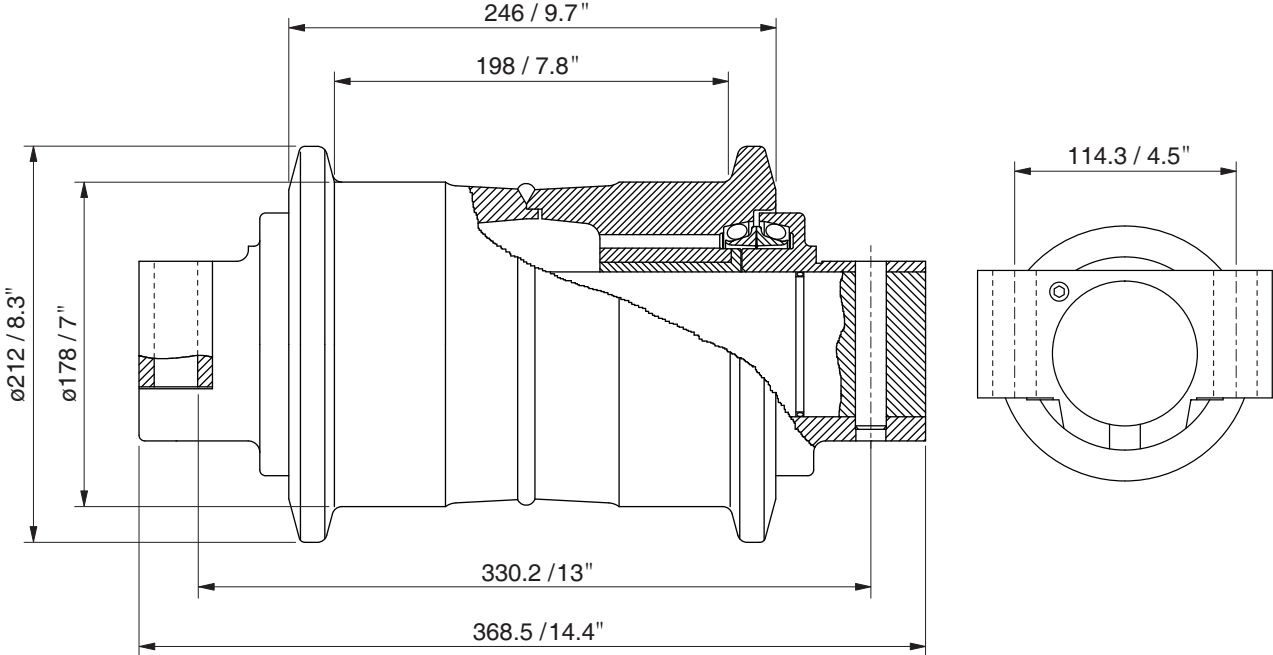


Figure 25


DS1602595

**NOTE:** Unit: mm (1 mm = 0.039 in)

- Weight: 52 kg (114.6 lb)

8. After the setting of spring (6, Figure 48), install lock plate (8), spring washer (11) and bolt (9).

**NOTE:** Apply loctite on bolt (9, Figure 48).

- Tool: 19 mm (  )
- Torque: 107.9 N.m (11 kg.m, 79.6 ft lb)

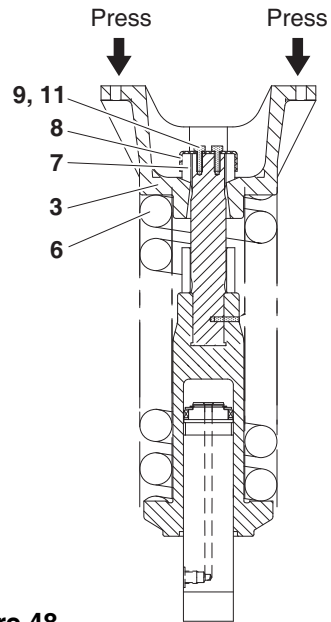



Figure 48

EX1400069

9. Install the bolt (3, Figure 49) and washer (4).

- Tool: 24 mm (  )
- Torque: 264 N.m (27 kg.m, 195 ft lb)

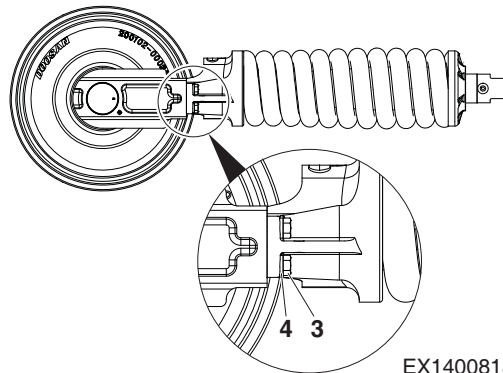


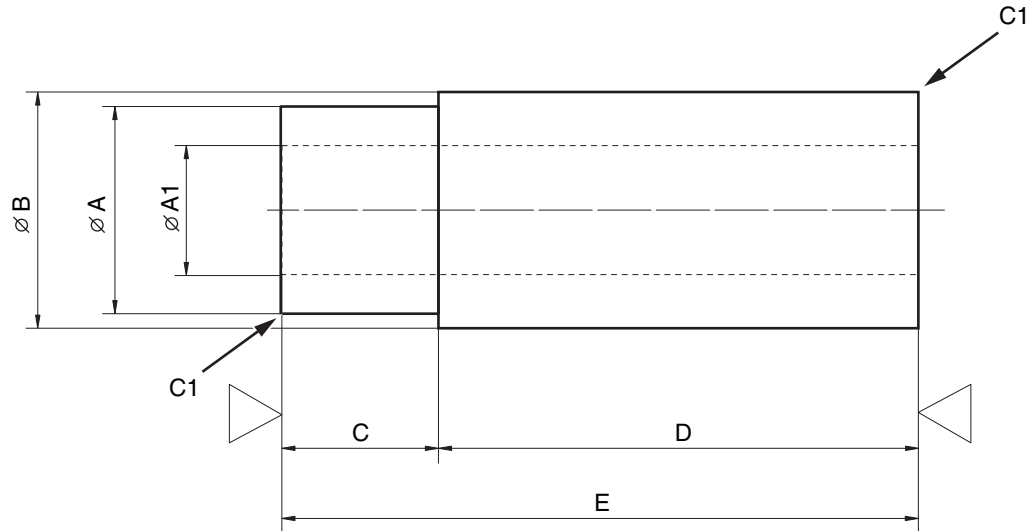
Figure 49

EX1400813





# Rod Bushing (DD-bushing) Pushing-in Jig



EX1301743

**Figure 17**

Inner diameter (A1): "A"-20 (no machining required on the inner diameter)

Cylinder	$\varnothing A^{+0.2}_{-0.1}$	$\varnothing B (\pm 0.1)$	C	D	E
Boom	94 mm (3.70 in)	99.8 mm (3.93 in)	30 mm (1.18 in)	75 mm (2.95 in)	105 mm (4.13 in)
Arm (Stick)	114 mm (4.49 in)	119.8 mm (4.72 in)	45 mm (1.77 in)	80 mm (3.15 in)	125 mm (4.92 in)
Heel	74 mm (2.91 in)	79.8 mm (3.14 in)	30 mm (1.18 in)	65 mm (2.56 in)	95 mm (3.74 in)

- Assemble the rod bushing with the exclusive jig (if disassembled).  
Push in the rod bushing in true vertical direction to prevent inclining of the bushing.  
Apply small volume of operating oil on inner surface of the rod cover for facilitating pushing in.
- Remove all of pushing-in residues generated during the pushing-in process.
- Mount the retaining ring on the rod cover groove at the end of the rod bushing after cleaning to prevent disengagement of the rod bushing.  
(Mount the retaining ring manually with pliers, and check if the ring is securely mounted.)

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
Cylinder drops from pull of gravity.	Scratches in U-packing.	Replace U-packing.
	Damage to U-packing.	Replace U-packing.
	Wear rings twisted.	Replace wear rings.
	Wear rings scratched.	Replace wear rings.
	Wear rings have other damage.	Replace wear rings.
Slow bucket and boom movements.	Reduced oil flow due to dirty filter or dirty intake line.	Disassemble and clean parts.
	Air drawn into circuit through loose connections.	Tighten intake connections.
	Reservoir oil level too low.	Fill reservoir to correct level.
	Relief valve pressure setting incorrect.	Adjust relief valve pressure.
	Damaged pump shaft or pump drive sleeve.	Replace damaged parts.
	Pump worn or damaged internally.	Replace worn or damaged parts.
	Relief valve sticking.	Disassemble and inspect cartridge. Clean or replace cartridge.
	Air in pressure line.	Perform cylinder bleeding procedure to remove air. Tighten or replace pressure line.
	Damaged pipe or hose.	Replace pipe or hose.
Worn cylinder seals.	Replace worn parts.	
Low-pressure, shown by weak upward movement of boom and bucket.	Reduced oil flow due to dirty filter or dirty intake line.	Disassemble and clean parts.
	Reservoir oil level too low.	Fill reservoir to correct level.
	Relief valve pressure setting incorrect.	Adjust relief valve pressure.
	Pump worn or damaged internally.	Replace worn or damaged parts.
	Relief valve sticking.	Disassemble and inspect cartridge. Clean or replace cartridge.
	Worn cylinder seals.	Replace worn parts.
	Low pump output due to dirty discharge pipes.	Remove and clean pump discharge pipes.
Relief valve spring is weak. Relief valve poppet worn.	Replace worn parts.	
Cylinder drops when control valve is in neutral	Worn plunger in control valve.	Replace plunger.
	Stuck overload relief valve due to worn seat surface.	Replace worn parts.
	Loose pipes or joints.	Tighten parts.
	Worn piston seal on hydraulic cylinder.	Replace piston seal.
Vibration or excessive noise.	Excessive resistance in pump intake line.	Inspect intake line and clean or replace as necessary.
	Air being drawn into intake line.	Inspect pipe joints and tighten.
	Chattering relief valve.	Change oil, replace valve.
Air bubbles in oil.	Wrong type of operating oil.	Drain and fill with proper type of oil.
	Oil level too low.	Raise to proper level.
	Air trapped in system	Perform cylinder bleeding procedure to remove air.
Frequent rubber hose damage.	System pressure too high.	Adjust relief valve pressure.
	Hoses breaking due to contact with another machine parts.	Restrain hoses to prevent contact.



# BOOM DOWN OPERATION

Oil supplied from hydraulic tank (22) passes through pilot pump connected to main pump (1) and pilot filter (2) and is supplied to solenoid package valve (5) after accumulator (4) is first filled with the oil.

If the pilot oil is supplied to boom spool of main control valve (10) by the operation of joystick valve (7), the spool is moved and oil passage of main pump and the one on the boom cylinder (11) rod side open.

Oil passage supplied from main pump (1) is supplied to boom cylinder (11) rod side after passing through boom holding valve (G), causing the moving to take place.

Rapidly occurring boom down causes short supply of oil in the cylinder rod side, in which case the oil in cylinder head side is supplied to rod side so oil cavitation may be prevented.

If boom down operation is stopped, the oil in boom cylinder is obstructed by check of boom holding valve (G) and the moving of boom is blocked.

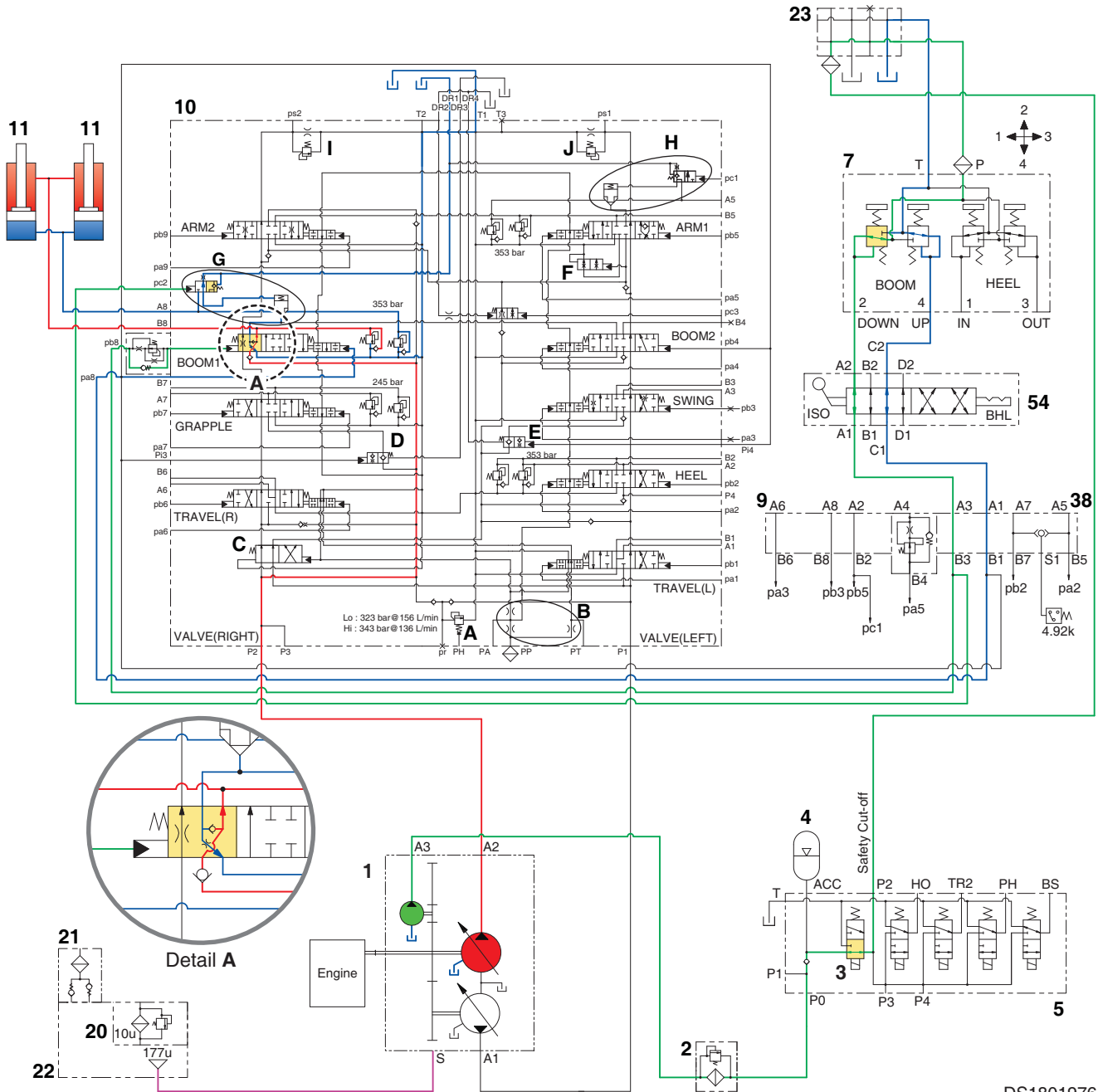


Figure 15

DS1801976

# Hydraulic System Testing and Adjustment

## SAFETY INSTRUCTIONS

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### WARNING

---

#### AVOID DEATH OR SERIOUS INJURY

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs or service. Untrained operators and failure to follow instructions can cause death or serious injury.

---

# FLOW METER AND FLOW METER KIT INSTALLATION AND TESTING

Checking regulator and pump output, to assess the output balance between the front and rear pumps and to verify operating adjustment of each regulator, will require installation of a flow meter.

The After Sales Service department of the nearest local DOOSAN dealer can assist you with these tests or, if you prefer performing your own testing, they must be able to help in putting together a hose and fitting kit (or the required dimensions and specifications for hoses and fittings) to allow you to install a flow meter downstream from the main pump assembly.

## Installation and Testing Procedure

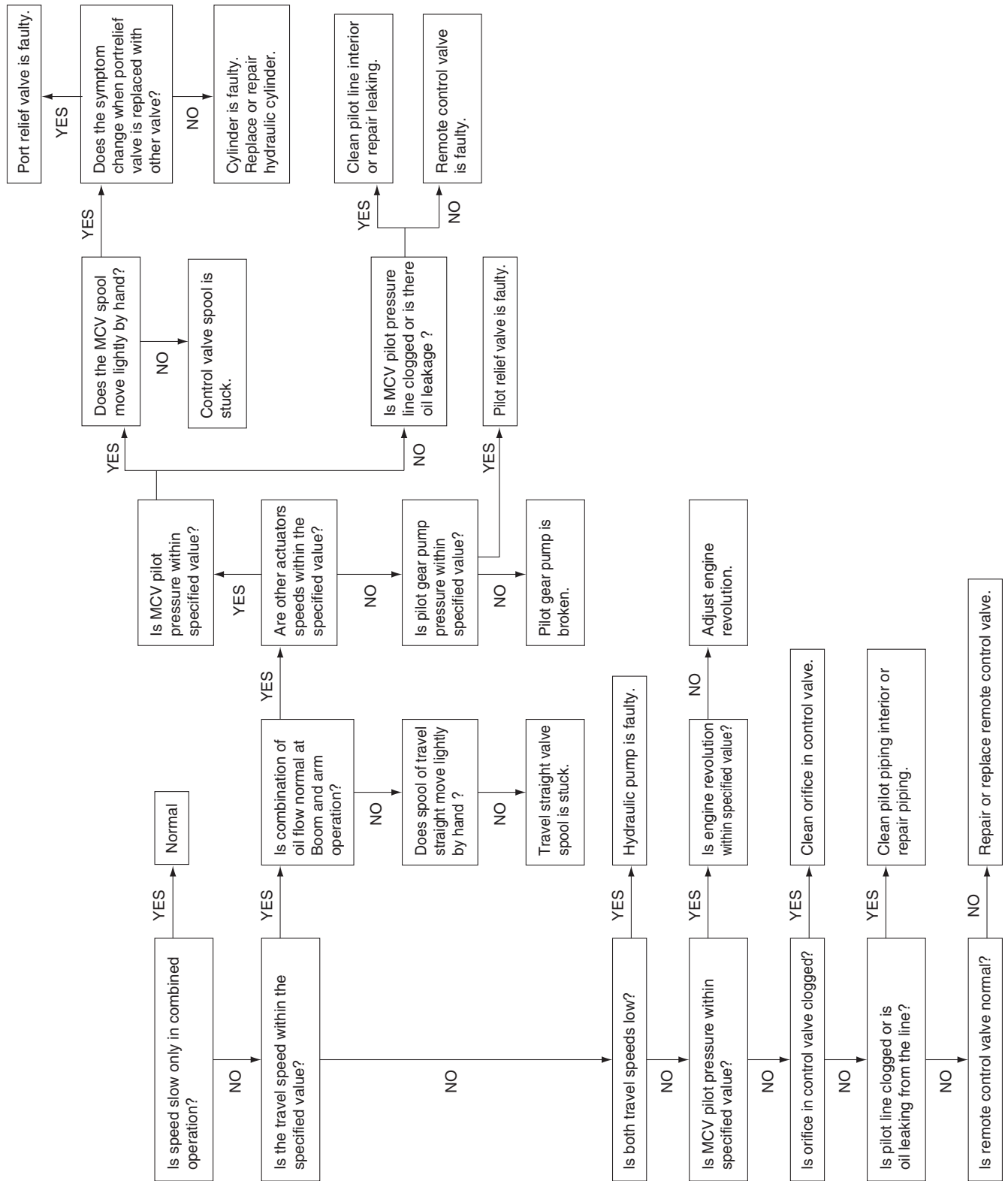
- Stop engine and operate controls to release hydraulic pressure from the accumulator.
- Vent the reservoir to release all pressure from the hydraulic system.
- Remove guard panels from around the main pump assembly.
- Disconnect the main pump discharge output line. Install the input flange of the flow meter on the pump end of the output line.
- Cap off the unused (input) end of the pump discharge line with a blocking flange.
- Connect a premeasured length of hydraulic hose, between the output end of the flow meter assembly and the top of the reservoir. Use appropriate fittings and adapter flanges to guarantee a pressure tight seal.

**NOTE:** *Be sure to maintain even tightening torque on all flange fittings. Use Loctite brand "PST 545" (or an alternate manufacturer's hydraulic system joint seal) if required, to give an airtight seal.*

- An assistant – who must remain at the operator's control station always – should restart the engine and run it long enough (at minimum rpm) to deaerate the system and warm up the engine and hydraulic system to operating temperature.

Record the values of all test results in three columns, comparing 1) pump pressure (from the instrument panel display) with 2) measured flow, in gallons or liters per minute, from the installed flow meter. The third column of test results should provide a record of engine rpm measured during each of the following tests – with the engine speed control dial set at maximum, the power mode selector at Power Mode and the work mode selector at digging mode:

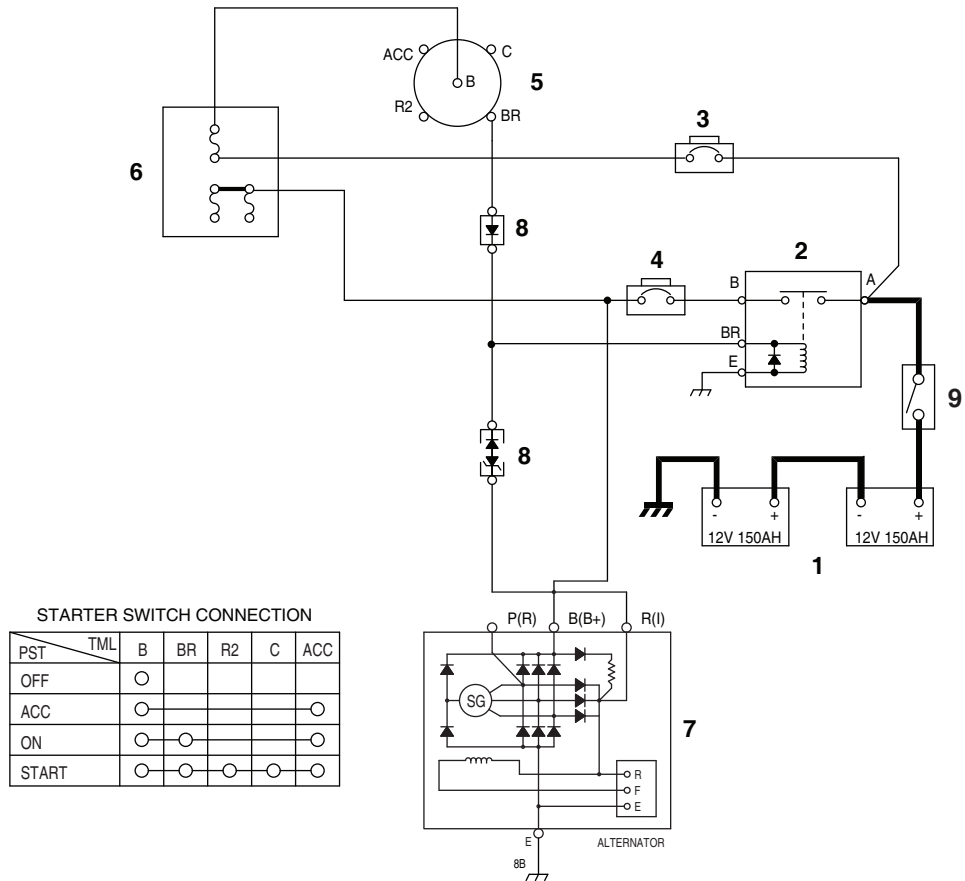
# Boom, Arm, Heel Speed is Slow



# TROUBLESHOOTING – CONTROL VALVE

Check control valve problems only after other hydraulic circuit operational tests have been made. Refer to "Troubleshooting Baseline Recommendations" procedure. Pump flow, pilot pressure, Negacon pressure, main relief pressure, and port relief pressure should all be checked before starting to work on the control valve. Make sure the hydraulic system is refilled up to the required level and free of oil leaks or air in the system that could cause cavitation problems.

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
Main relief valve.	Particulate contamination.	Disassemble, clean main poppet.
	Broken or damaged spring.	Replace.
	Adjusting screw loose.	Readjust.
	Main poppet sticking.	Repair/replace.
	Clogged orifice in pilot passage to control valve.	Clean/replace.
Cylinder goes down in spool neutral.	Excessive clearance between casing and spool.	Replace spool or casing.
	Spool does not return to neutral/ sticking spool.	Check secondary pilot pressure.
	Spool does not return to neutral because of dirt or other contaminants.	Clean.
	Broken or damaged spring.	Replace.
	Main relief or port relief not operating properly.	See above.
	Impurities in pilot circuit.	Clean.
Cylinder drops before start at boom up operation.	Rod check valve damaged or clogged.	Clean/replace.
	Poppet sticking.	Clean/replace.
	Broken or damaged spring.	Replace.
Slow operation or response.	Excessive clearance between spool or casing.	Check pilot pressure and/or replace spool or casing.
	Sticking spool.	Clean/replace.
	Broken or damaged spring.	Replace.
	Main or port relief valve damaged.	Check pressure/replace.
Boom and arm cylinders do not perform normally in combined operation.	Priority valve faulty or spool sticking.	Check pilot pressure.
	Broken or deformed spring.	Replace.
	Excess clearance between right and left casing and valve spool.	Clean/replace.
	Clogged spool passage.	Clean/replace, replace filter.
Relief valve malfunctions:		
Pressure does not increase at all.	Main poppet or pilot poppet stuck open.	Clean/replace.



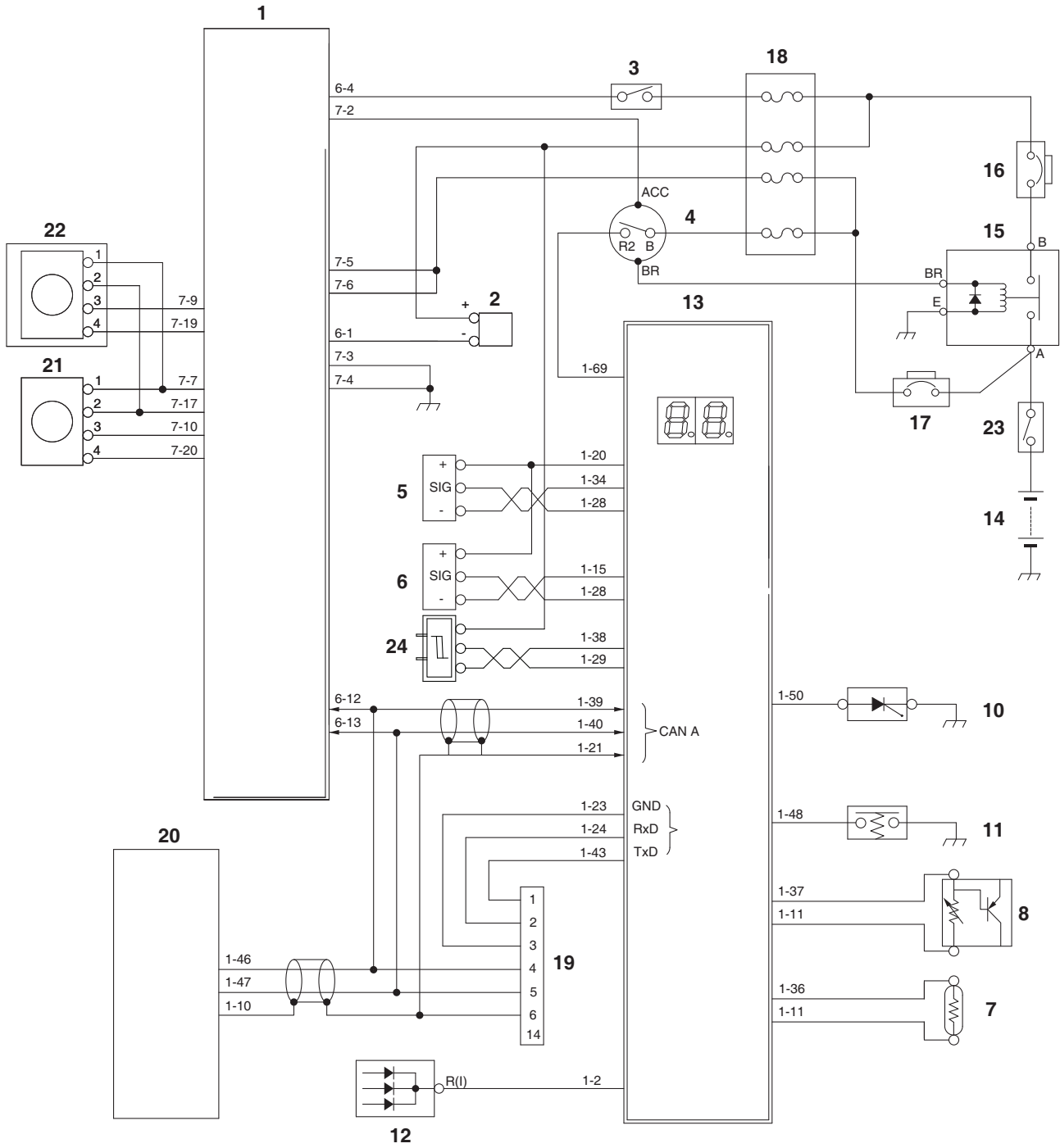
**Figure 1** Electric Power Circuit Diagram

WE1501263

Reference Number	Description
1	Battery
2	Battery Relay
3	Circuit Breaker 1
4	Circuit Breaker 2
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Alternator
8	Diode
9	Master Switch

# Monitoring System Schematic



DS1801982

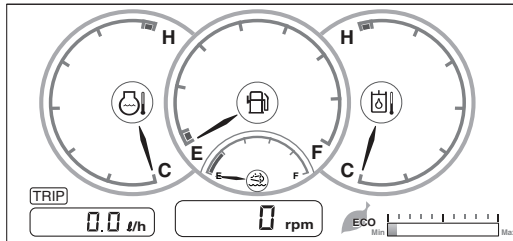
Figure 10

# USER MENU

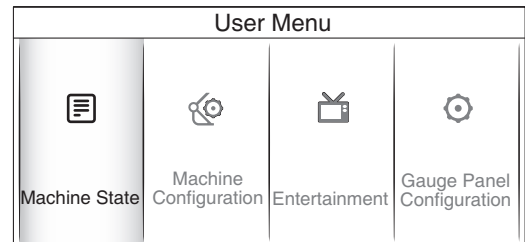
## User Menu - Access and Escape Methods

### Access Method

1. On the normal display screen, click on the jog switch to access the user menu screen.
2. Proceed to the user menu using the menu/esc button on the front of the dashboard.
3. Select the user menu from the launch menu.



<Normal Indication Monitor>



<Main Menu Monitor>

DS1601342

Figure 12

### Escape Method

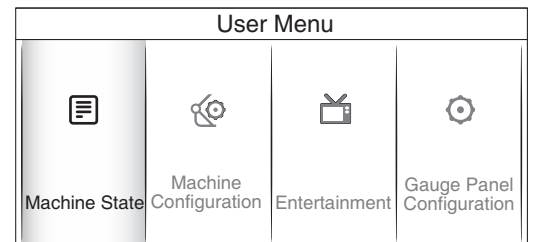
1. Press the ESC button to move to the normal display screen.
2. If 20 seconds have passed without the operation of the button, the normal display screen will be displayed.
3. Turning "OFF" the starter switch to cut off power, you will move to the normal display screen.

### User Menu

Turn the jog switch and move the cursor to see a reversed display on the desired menu. Then, click on the jog switch to select the menu.

**Machine State ↔ Machine Configuration ↔ Entertainment ↔ Gauge Panel Configuration**

Press the ESC button to return to the previous screen.



DS1601343

Figure 13



**WARNING**

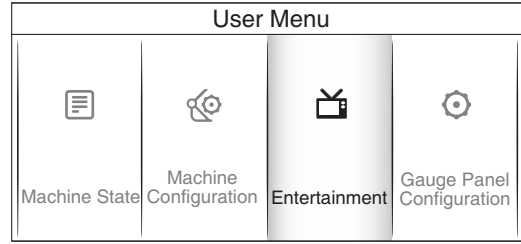
**AVOID DEATH OR SERIOUS INJURY**

**Do not use machine state menu when traveling or operating.**

### 3. Entertainment

This menu is used to replay videos and MP3.

Turn the jog switch and move the cursor to see a reversed display on the desired menu. Then, click on the jog switch to select the menu.

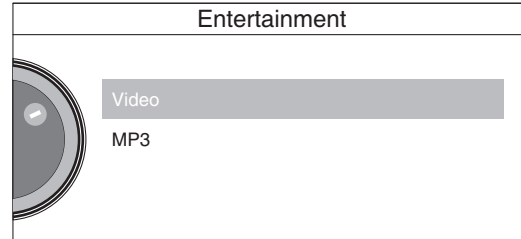


DS1601367

Figure 48

#### Video ↔ MP3

Press the ESC button to return to the previous screen.



DS1601368

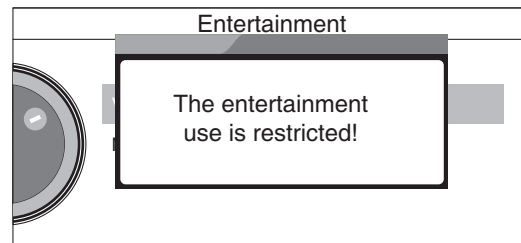
Figure 49

If the use of entertainment is limited, this pop-up window will be created.

To lift the use limits, you should change the limit setup in the Gauge Panel configuration.

The pop-up window will automatically disappear in 3 seconds. Press the ESC button or the jog switch to remove pop-up window.

For details, See [?\\$paratext>?](#) on page -4-.

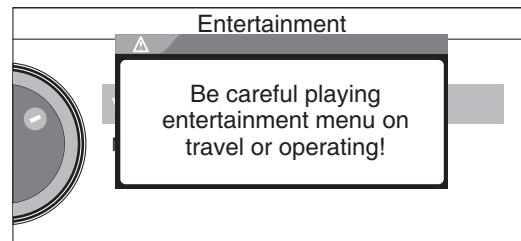


DS1601369

Figure 50

If the use of entertainment is not limited, this pop-up window will be created. The pop-up window will automatically disappear in 3 seconds.

Press the ESC button or the jog switch to remove pop-up window.



DS1601370

Figure 51



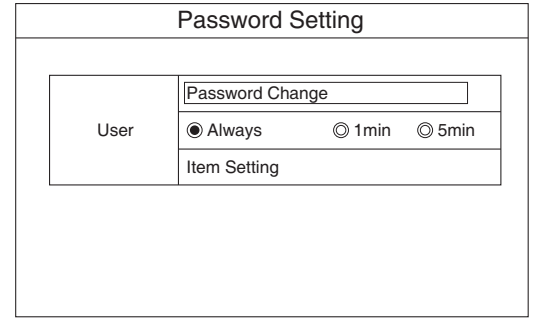
## WARNING

### AVOID DEATH OR SERIOUS INJURY

Listening to entertainment clips, such as video, music, etc., can cause an accident, resulting in death or serious injury. Do not play entertainment files when operating the machine.

3) Structure

User password settings include password change, start-up restriction settings, and function item settings.

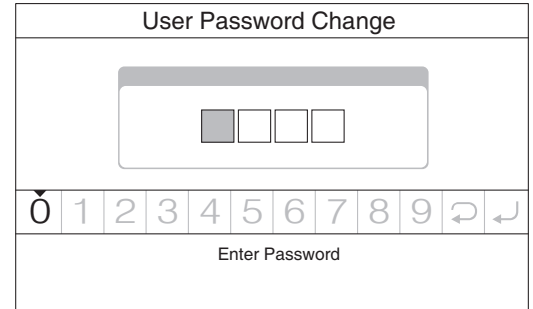


EX1301441

Figure 88

**Password change**

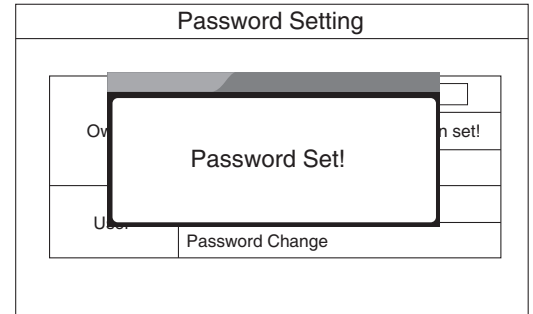
To change the user password, select password change, and change the user password using the jog switch (or keypad).



EX1301442

Figure 89

When the user password is changed, "Password Set!" will pop-up.



EX1301436

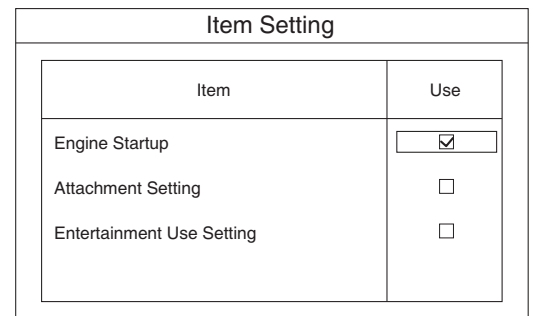
Figure 90

**Item setting**

Use of engine start-up, attachment setting, and entertainment use setting can be set.

**NOTE:** *This is only possible when permitted by the owner.*

- a) Engine startup  
Setting of password input upon operation of equipment.
- b) Attachment setting  
Setting of password input for attachment setting.



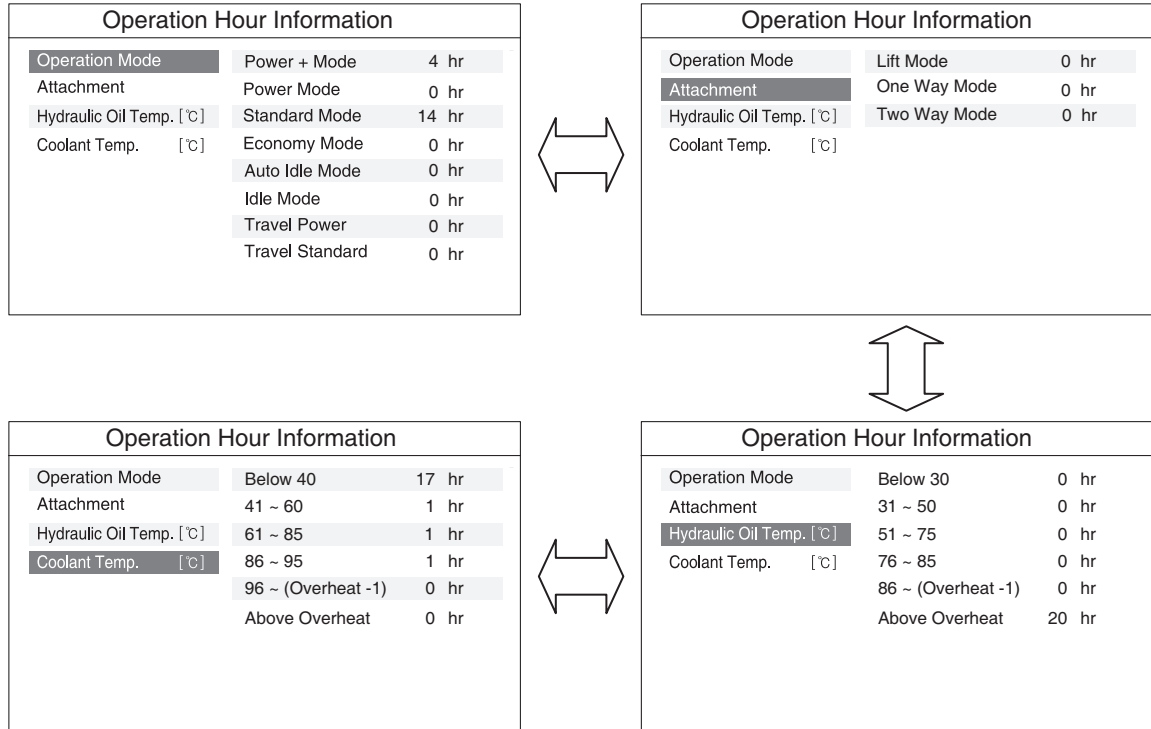
EX1301443

Figure 91

## **Vehicle Analog Description**

<b>Analog Items</b>	<b>Display</b>	<b>Remark</b>
1. Front Pump Pressure	bar	Front pump pressure
2. Rear Pump Pressure	bar	Rear pump pressure
3. Boom Cylinder Pressure	bar	Boom cylinder head pressure
4. Px Pressure	bar	Px pressure
5. Py Pressure	bar	Py pressure
6. Alternator Voltage	V	Indicating alternator voltage.
7. Battery Voltage	V	Indicating battery voltage.
8. Engine Speed Control Dial Voltage	mV	Indicating dial voltage.
9. WIF Sensor Voltage	mV	Current in WIF
10. Flow Control Lever LH Voltage	mV	Indicating LH joystick thumb wheel switch voltage
11. Flow Control Lever RH Voltage	mV	Indicating RH joystick thumb wheel switch voltage
12. Fuel Level	%	Fuel residual quantity ratio of fuel tank
13. Hydraulic Oil Temperature	°C	Hydraulic oil temperature
14. Boom Up Pressure	bar	Boom up pilot pressure
15. Arm in Pressure	bar	Arm in pilot pressure
16. Power Shift P/V 1	mA	Current in pump proportional valve.
17. Flow Control P/V	mA	Current in flow control proportional valve.
18. 2 Way P/V (Open)	mA	Current in two-way (open) flow control proportional valve.
19. 2 Way P/V (Close)	mA	Current in two-way (close) flow control proportional valve.
20. Rotating P/V (CW)	mA	Current in rotating (CW) flow control proportional valve.
21. Rotating P/V (CCW)	mA	Current in rotating (CCW) flow control proportional valve.
22. Pressure Control P/V 1	mA	Current in 1 way pressure proportional valve.
23. Pressure Control P/V 2	mA	Current in 2 way pressure proportional valve.

## Example of Machine Operation Info Screen



DS1602680

Figure 137

GP Display Code	P Code DTC	DTC Code		FMI	GP Display Description	Severity	Remarks
		HEX	DEC				
E001323-12	301	52B	1323	12	Injection misfire detection cylinder 1: Injection misfire detection cylinder 1	2	
E001324-12	302	52C	1324	12	Injection misfire detection cylinder 5: Injection misfire detection cylinder 5 - (P302)	2	
E001325-12	303	52D	1325	12	Injection misfire detection cylinder 3: Injection misfire detection cylinder 3 - (P303)	2	
E001326-12	304	52E	1326	12	Injection misfire detection cylinder 6: Injection misfire detection cylinder 6 - (P304)	2	
E001327-12	305	52F	1327	12	Injection misfire detection cylinder 2: Injection misfire detection cylinder 2 - (P305)	2	
E001328-12	306	530	1328	12	Injection misfire detection cylinder 4: Injection misfire detection cylinder 4 - (P306)	2	
E001482-12	D121	5CA	1482	12	Timeout error of CAN receive frame TCU: Timeout error of CAN-Receive-Frame TSC1TE	1	
E001639-03	527	667	1639	03	Auto fan clutch speed: Fan speed above maximum threshold	2	
E001639-04	528	667	1639	04	Auto fan clutch speed: Fan speed below minimum threshold	2	
E001639-12	526	667	1639	12	Auto fan clutch speed: Fan speed signal long period fault path	2	
E001761-00	103B	6E1	1761	00	Urea tank level sensor: Error of urea tank level sensor evaluation with physical range check high	1	
E001761-01	203B	6E1	1761	01	Urea tank level sensor: Error of urea tank level sensor evaluation with physical range check low	1	
E001761-03	203D	6E1	1761	03	Urea tank level sensor: DFC for SRC high error of the urea tank level sensor	3	
E001761-04	203C	6E1	1761	04	Urea tank level sensor: DFC for SRC low error of the urea tank level sensor	3	
E001761-12	103C	6E1	1761	12	Urea tank level sensor: Status of tank level	3	
E003031-00	205B	BD7	3031	00	Urea temperature sensor: Physical range check high for urea temperature sensor	2	
E003031-01	105B	BD7	3031	01	Urea temperature sensor: Physical range check low for urea temperature sensor	1	
E003031-02	115B	BD7	3031	02	Urea temperature sensor: Error tank temperature sensor plausibility max threshold	1	
E003031-03	205D	BD7	3031	03	Urea temperature sensor: SRC high for urea temperature sensor	3	
E003031-04	205C	BD7	3031	04	Urea temperature sensor: SRC low for urea temperature sensor	3	
E003031-12	115A	BD7	3031	12	Urea temperature sensor: Error tank temperature sensor plausibility min threshold	1	
E003031-31	115C	BD7	3031	31	Urea temperature sensor: Error urea tank temperature is overheated	2	
E003363-03	20B4	D23	3363	03	Urea tank heating valve (coolant valve): Short circuit to battery error for urea tank heating valve	3	
E003363-04	20B3	D23	3363	04	Urea tank heating valve (coolant valve): Short circuit to ground error for urea tank heating valve	3	
E003363-12	20B1	D23	3363	12	Urea tank heating valve (coolant valve): No load error for urea tank heating valve	3	
E003363-31	10B1	D23	3363	31	Urea tank heating valve (coolant valve): Over temperature error for urea tank heating valve	3	
E003464-00	12E1	D88	3464	00	Throttle valve control: Permanent governor deviation max for throttle valve	2	
E003464-01	12E2	D88	3464	01	Throttle valve control: Permanent governor deviation min for throttle valve	2	

GP Display Code	P Code DTC	DTC Code		FMI	GP Display Description	Severity	Remarks
		HEX	DEC				
E520761-31	1708	7F239	520761	31	Supply module monitoring (pressure reduction error): Monitoring of underpressure error in afterrun state (supply module monitoring)	3	
E520762-12	170A	7F23A	520762	12	SCR catalyst downstream temperature sensor static plausibility: Error for SCR catalyst downstream temperature sensor static plausibility	1	
E520763-00	170B	7F23B	520763	00	Urea tank level plausibility error: Urea tank sensor indicates too high fill level	1	
E520763-01	170C	7F23B	520763	01	Urea tank level plausibility error: Urea tank sensor indicates too low fill level	1	
E520764-12	1711	7F23C	520764	12	Detection of SCR wrong temperature value: Detection of SCR wrong temperature value	1	
E520765-03	1715	7F23D	520765	03	Low side switch error of urea dosing valve: Short circuit to battery error in powerstage of urea dosing valve actuator	3	
E520765-06	1716	7F23D	520765	06	Low side switch error of urea dosing valve: Short circuit to ground error in powerstage of urea dosing valve actuator	3	
E520766-03	1717	7F23E	520766	03	High side switch error of urea dosing valve: Short circuit to battery error in high side powerstage of urea dosing valve actuator	3	
E520766-06	1718	7F23E	520766	06	High side switch error of urea dosing valve: Short circuit error in high side powerstage of urea dosing valve actuator	3	
E520767-12	1719	7F23F	520767	12	Supply module heater plausibility error 1: Error supply module heater plausibility	3	
E520768-12	171A	7F240	520768	12	Supply module heater plausibility error 2: Error urea supply module heater temperature sensor dynamic plausibility	3	
E520768-31	171B	7F240	520768	31	Supply module heater plausibility error 2: Error urea supply module heater temperature sensor cold start plausibility	1	
E520769-12	171C	7F241	520769	12	Supply module temperature sensor plausibility error: Error urea supply module temperature sensor dynamic plausibility	3	
E520769-31	171D	7F241	520769	31	Supply module temperature sensor plausibility error: Error urea supply module temperature sensor cold start plausibility	1	
E520770-12	171E	7F242	520770	12	Urea catalyst upstream temperature plausibility error: Error for SCR catalyst upstream temperature sensor plausibility max threshold	3	
E520770-31	1720	7F242	520770	31	Urea catalyst upstream temperature plausibility error: Error for SCR catalyst upstream temperature sensor plausibility min threshold	1	
E520771-12	1723	7F243	520771	12	Urea pump motor 2: Pump motor not available for actuation	1	
E520772-03	208D	7F244	520772	03	Urea pump motor 3: Short circuit to battery error on powerstage for urea pump motor	3	
E520772-05	208A	7F244	520772	05	Urea pump motor 3: No load error on powerstage for urea pump motor	3	
E520772-06	208C	7F244	520772	06	Urea pump motor 3: Short circuit to ground error on powerstage for urea pump motor	3	
E520772-12	1724	7F244	520772	12	Urea pump motor 3: Over temperature error on powerstage for urea pump motor	3	

# Operation

## 1. Power Plus Mode

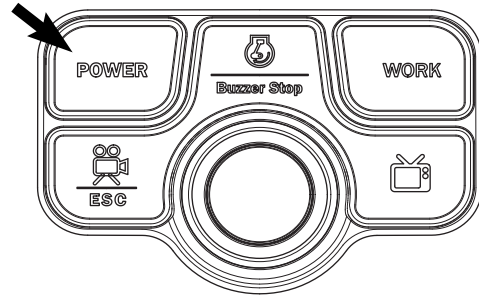
This mode must be selected for high-speed work. In this mode the engine output is most efficiently utilized because of the discharged oil volume being controlled based on the equivalent horsepower curve at various loaded pressures. The EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the EPPR (Electromagnetic Proportional Pressure Reducing) valve which in turn varies the pump output quantity.

If the load increases, the engine speed will fall below the rated speed. When this occurs, the controller senses this decrease and immediately reduces the pump discharge volume to maintain the engine speed at the rated level.

On the other hand, if the load is decreased the controller increases the discharge volume of the pump to maintain the engine speed at the rated level.

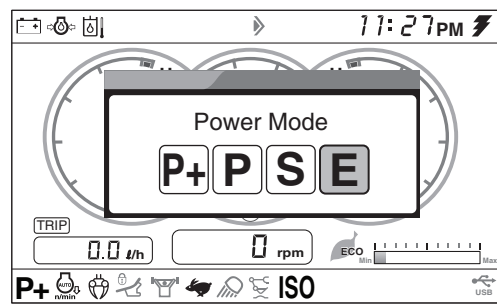
By repeating these control operations, the engine speed is maintained at the rated speed so maximum power can be generated.

In Power Mode, the EPOS controller receives engine speed signals from the engine control dial and the engine controller (ECU) and converts it to an operating signal current and is then transferred to the pump's EPPR valve. Now the EPPR valve converts the electric signal to the corresponding control pressure and sends it to the two pumps, adjusting the pump discharge volume to the desired level.



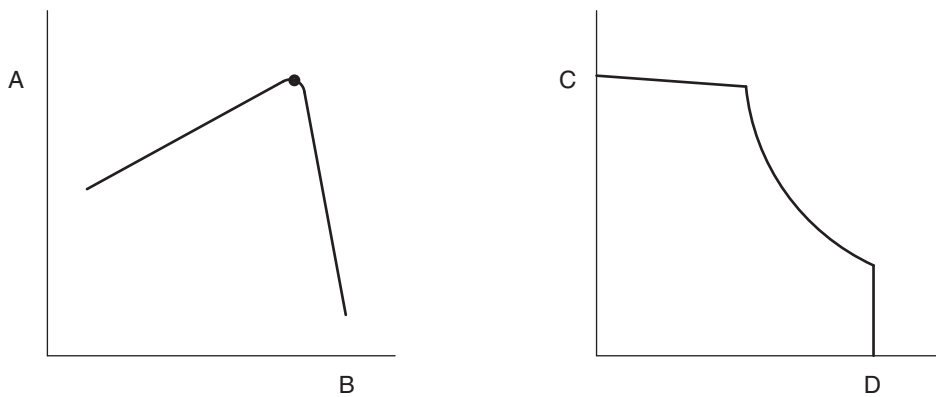
FG018900

Figure 153



DS1601534

Figure 154



FG000580

Figure 155

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)
C	Pump Discharge Volume (lpm)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm <sup>2</sup> )

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