# WSM

## WORKSHOP MANUAL
# KUBOTA EXCAVATOR

# KX027-4

Kubota

KiSC issued 12, 2017 A

# TO THE READER

This workshop manual provides safety information for service activity, general information such as specifications and dimensions of the machine, mechanisms and structure descriptions of the machine, and service procedures with setting values.

**Information**
- Information section contains safety service descriptions and safety label information.

**General**
- General section contains specifications for the machine, identification for the machine and the engine, general maintenance information.

**Mechanism**
- Mechanism section contains the structures of mechanisms and explains their functions.

**Servicing**
- Servicing section contains information and procedures for troubleshooting and repair works with service specifications and limit tables, torque specifications, items to be inspected and adjusted. The reader should follow these instructions to complete any servicing safely, correctly and quickly.
- In this WSM, value of the service specifications and limits are defined as followings.
  - **Service specifications:**
    It is the new machine's specification ex-factory. It is mainly based on quality standard, drawings, or actual measurements conducted by KUBOTA. This value is used to judge if a machine has a problem when testing and troubleshooting. Still, normal wear-related deterioration of the service specification must be taken in account based on machine's operating hours, application or maintenance.
    Service specifications are based on the machine which attached the specified bucket.
  - **Service limits:**
    Specification which corresponds to the recommended performance limit taking in account long term wear. The machine is supposed to have insufficient performance for proper and safe work and a repair or overhaul would be required.

All of the illustrations, photographs, specifications and other information in this manual were created based on the latest model at the time of publication.
KUBOTA reserves the right to change all information at any time without notice.
If the engine servicing information is necessary, please refer to the following engine WSM.

**KX027-4**

| Engine model | WSM title | WSM PDF No. |
|---|---|---|
| V1505-E4-BH-2 | 05-E4B SERIES,05-E4BG SERIES | 9Y111-07841 (English)<br>9Y111-14261 (Standard German)<br>9Y111-14251 (French)<br>9Y111-14251 (Italian)<br>9Y111-14271 (Spanish) |

**February, 2017**

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# REVISION HISTORY

| Revision number | Date (YYYY/MM) | Revision description | Pages | Author |
|---|---|---|---|---|
| 1 | 2017/12 | Corrected contents for the Hi-spec. | - | P.S. |
| | | Added contents for bleeding the air from the hydraulic cylinder. | 2-10 | |
| | | Added contents for jacking up the machine. | 2-11 | |
| | | Added contents for the maintenance. | 2-29 | |
| | | Added contents for the short arm (1050 mm) specification. | - | |
| | | Added contents for the sprocket dimensions. | 3-10 | |
| | | Corrected values in the service specifications for machine body.<br>Added service specifications for the clearance of swing bracket and front attachment pins. | 3-17 | |
| | | Added contents for the swing bracket vertical clearance. | 3-21 | |
| | | Added contents for front idler and track roller components. | 3-42<br>3-47 | |
| | | Corrected the combustion chamber type to swirl combustion chamber. | 4-3 | |
| | | Added contents for cylinder, pilot control valve, and unload valve components. | 5-130<br>5-139<br>5-151 | |
| | | Added contents for removing and installing the pilot control valve. | 5-137 | |
| | | Corrected the front hose routing and pilot hose routing (Hi-spec). | 5-166 | |
| | | Corrected the error warning table. | 6-27 | |

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# ABBREVIATIONS

| Abbreviations | Definitions | Abbreviations | Definitions |
|---|---|---|---|
| A/C | Air conditioning | ID | Inner diameter |
| AC | Alternating Current | ISO | International Standards Organization |
| ACC | Accessory | J/C | Joint Connector |
| AI | Auto Idle | JIS | Japanese Industry Standard |
| API | American Petroleum Institute | LED | Light Emitting Diode |
| Approx. | Approximately | LH | Left Hand side |
| AS | Auto Stop | MAX | Maximum |
| ASSY. | Assembly | MIL | Military Standards |
| ASTM | American Society for Testing and Materials | MIN | Minimum |
| AUX | Auxiliary | NC | Normally Closed |
| C/V | Control Valve | NO | Normally Opened |
| CAB | Cabin | OD | Outer diameter |
| CAN | Controller Area Network | P/V | Pilot Valve |
| CECE | Committee for European Construction Equipment | RH | Right Hand side |
| CNP | Canopy | RMS | Root Mean Square |
| CRS | Common Rail System | SAE | Society of Automotive Engineers |
| DIN | Deutsches Institut für Normung (German Institute for Standards) | SBF | Slow Blow Fuse |
| DOC | Diesel Oxidation Catalysts | SCV | Suction Control Valve |
| DPF | Diesel Particulate Filters | SI | Système Internationale |
| ECU | Electronic Control Unit | S/J | Swivel joint |
| EGR | Exhaust Gas Recirculation | SOL | Solenoid |
| e.g. | exempli gratia | spec. | Specification |
| EN | Europäische Norm (European standard) | SW | Switch |
| Eng | Engine | TPSS | Two Pattern Selection System |
| etc. | et cetera | WSM | Work Shop Manual |
| GND | Ground | | - |

# 1. INFORMATION

# SAFETY FIRST

Read the safety instructions in the manual and on the safety labels very carefully to avoid personal injury.
The safety symbols, precautions and safety labels offer instructions regarding safety regulations for machine operation.
It is essential that you read and follow them.

**⚠ DANGER**
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

**⚠ WARNING**
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

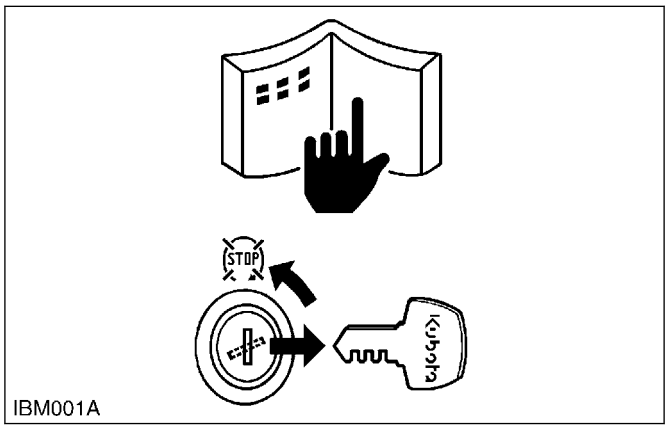
**⚠ CAUTION**
- **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

**■ IMPORTANT**
- **Indicates that equipment or property damage could result if instructions are not followed.**

**■ NOTE**
- **Gives helpful information.**

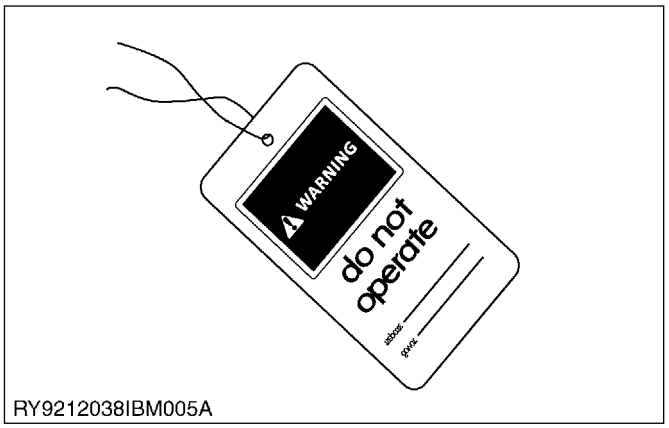
## 1. For working safety

### 1.1 Working precautions



IBM001A

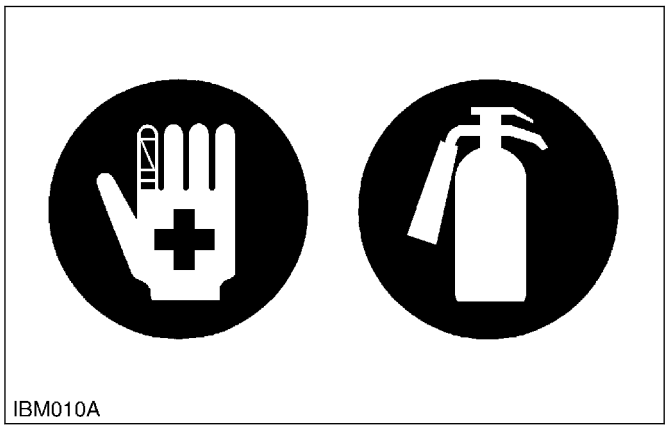
- Please understand all safety instructions and safety labels in this manual.
- Stop the engine when leaving the operator's seat for cleaning, checking, and adjusting the machine.
- Park the machine on a firm and level ground to check the machine safely.

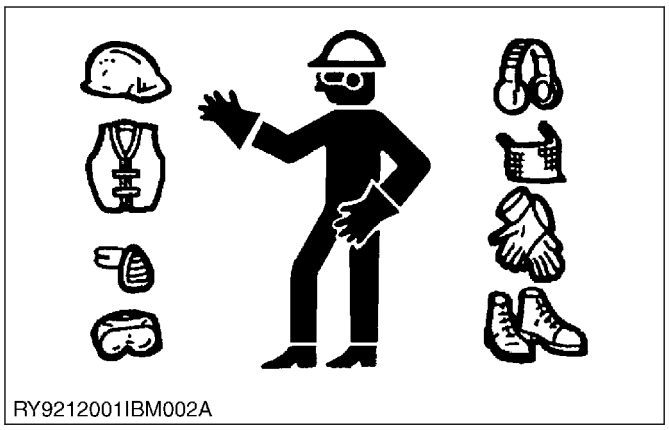


RY9212038IBM005A

- Hang a **DO NOT OPERATE** tag near the operator's seat.
- When doing maintenance and repairing, lower the front attachment to the ground, stop the engine, and attach the warning sign so it is clearly visible.
- Do not use worn or cracked tools. Use tools in a proper way with enough strength.

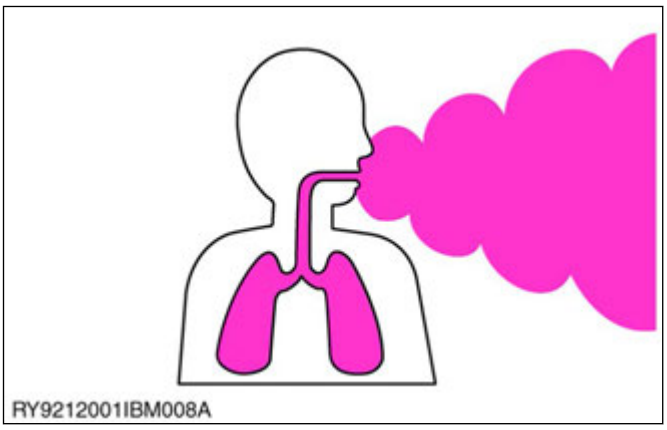
## 1.2 Preparing for emergencies


IBM010A


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- Keep a first aid kit and fire extinguisher ready at all times.
- Keep the emergency contact telephone numbers near your telephone.
- Wear the uniform suited for service working. Do not wear loose clothes as they could get caught on the control lever.
- When checking the machine, use proper protective equipment (for example helmet, eye protector, and protective shoes).
- Do not check the machine after you have consumed alcohol or drugs or when you are tired.

## 1.3 Working cautions


RY9212001IBM008A

- Park the machine on a stable and level ground. Keep the machine away from obstacles and hazardous materials.
- In cases of working indoors, make sure to ventilate the work area.
- Do not allow third parties to come near the machine.
- Maintain machine clean. Remove dirt, debris, and oil attached to the machine.


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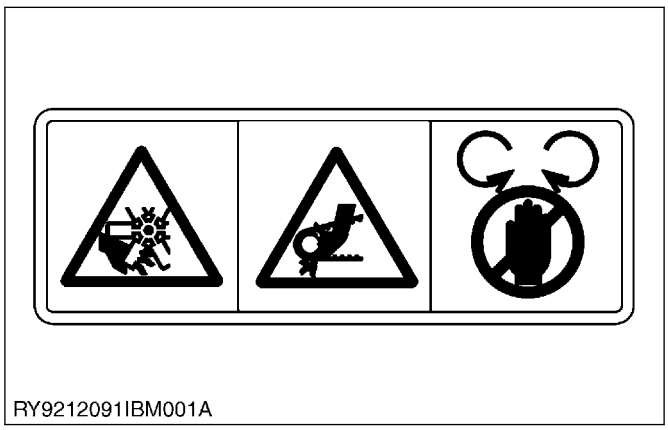
- Make sure you have the support of 3 points (both hands and one foot) to get on or off the machine.

## 1.4 Starting the machine safely



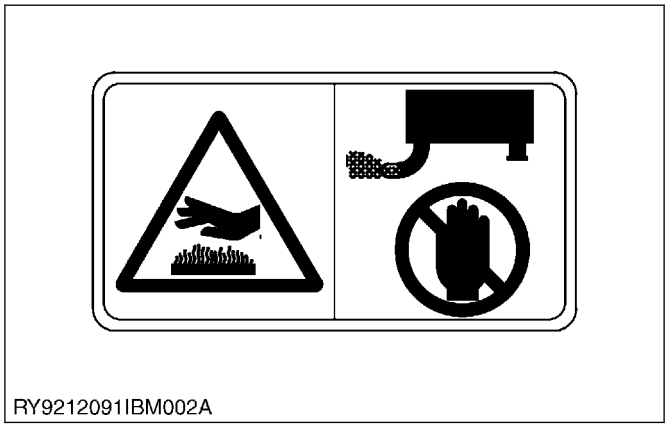
RY9212001IBM004A

- Confirm if it is safe around the machine from the operator's seat before starting the engine.
- Do not start the engine if not seated in the operator's seat.
- Confirm that the pilot levers are in neutral before starting the engine.



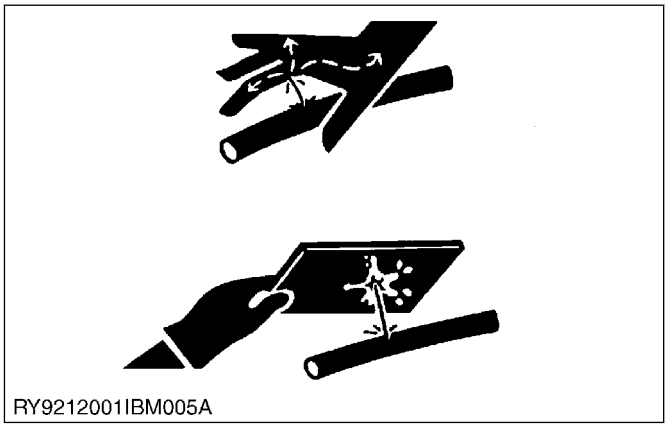
RY9212091IBM001A

- Lock the cover and bonnet when starting the machine with cover and bonnet opened.
- Keep away from rotating and moving objects.
- Keep tools and waste cloth away from the rotating and moving objects.



RY9212091IBM002A

- Do not work immediately after has stopping the engine. The engine, muffler, radiator, and hydraulic devises are extremely hot.
- Do not remove caps and plugs soon after has stopping the engine. Since, the temperature and pressure of coolant, hydraulic oil, and the fuel are still high.

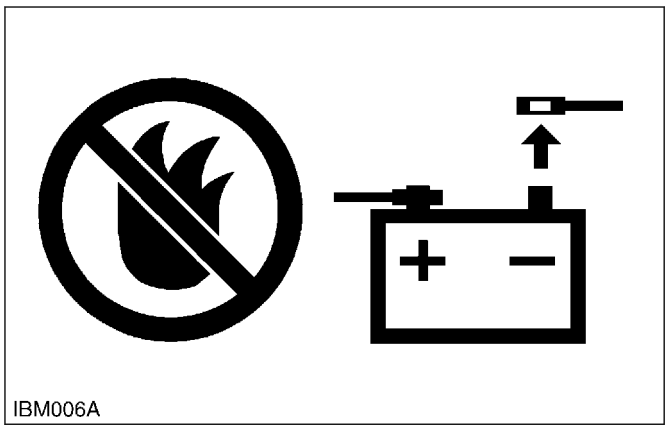


RY9212001IBM005A

- Do not short starter circuit to start the engine. This is dangerous and might damage the machine.
- When opening the radiator cap, confirm coolant temperature and release pressure.
- Release residual pressure of the hydraulic circuit before removing the hydraulic devices.
- Pay attention when releasing pressure of hydraulic circuit, as the machine or front attachment might move unexpectedly.
- Wear safety glasses and gloves when checking for oil leakage.

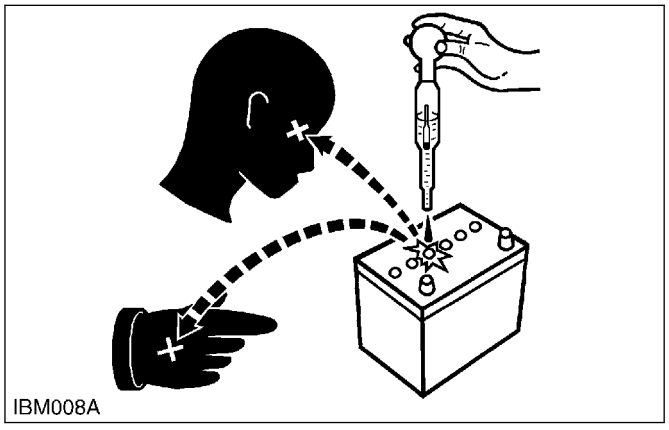
## 1.5 Preventing fires


RY9212001IBM006A


IBM006A

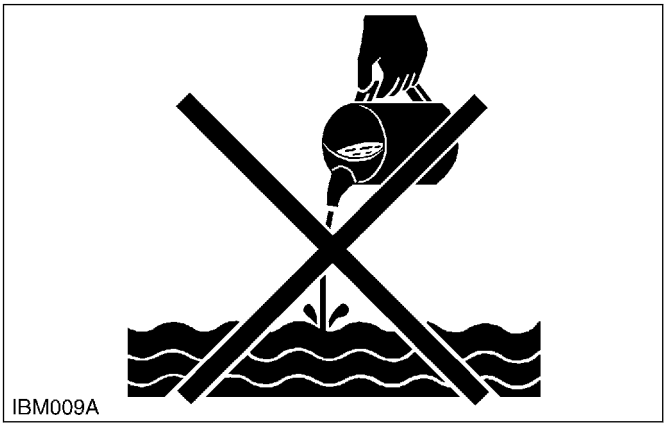
- Keep fire (welding sparks, grinding sparks, cigarettes) away from fuel.
- Wipe off the fuel off when spilled.
- Keep fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.
- When disconnecting the battery cable, make sure to disconnect the negative (-) terminal first.
- When connecting the battery cable, make sure to connect the positive (+) terminal first.

## 1.6 Preventing acid burns


IBM008A

- Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water and get medical aid immediately.

## 1.7 Discarding waste fluid

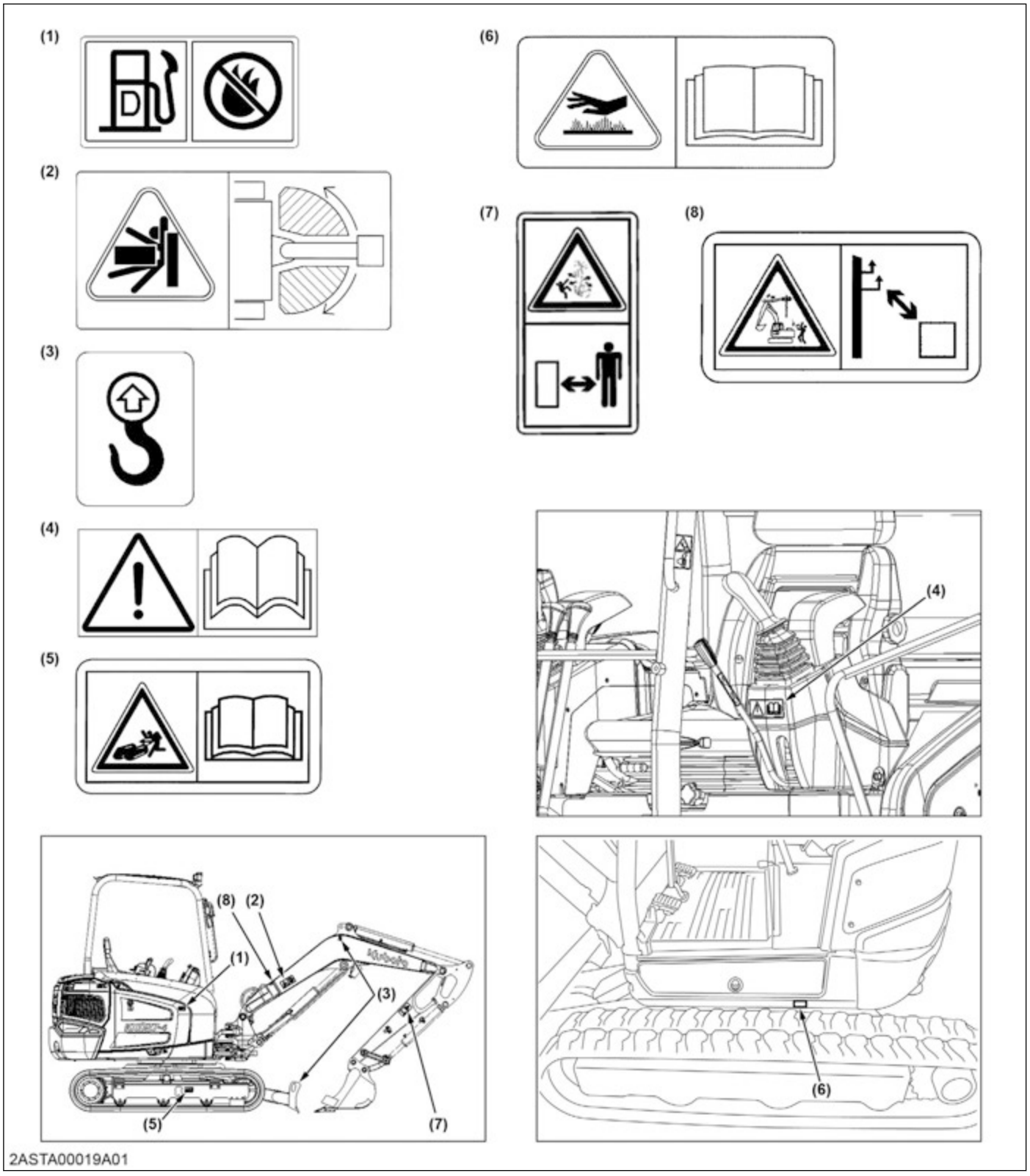

IBM009A

- Do not discard fluids to the ground, down the drain, into a stream, pond, or lake.
- Obey related environmental protection regulations when you discard oil, fuel, coolant, electrolyte and other hazardous wastes.

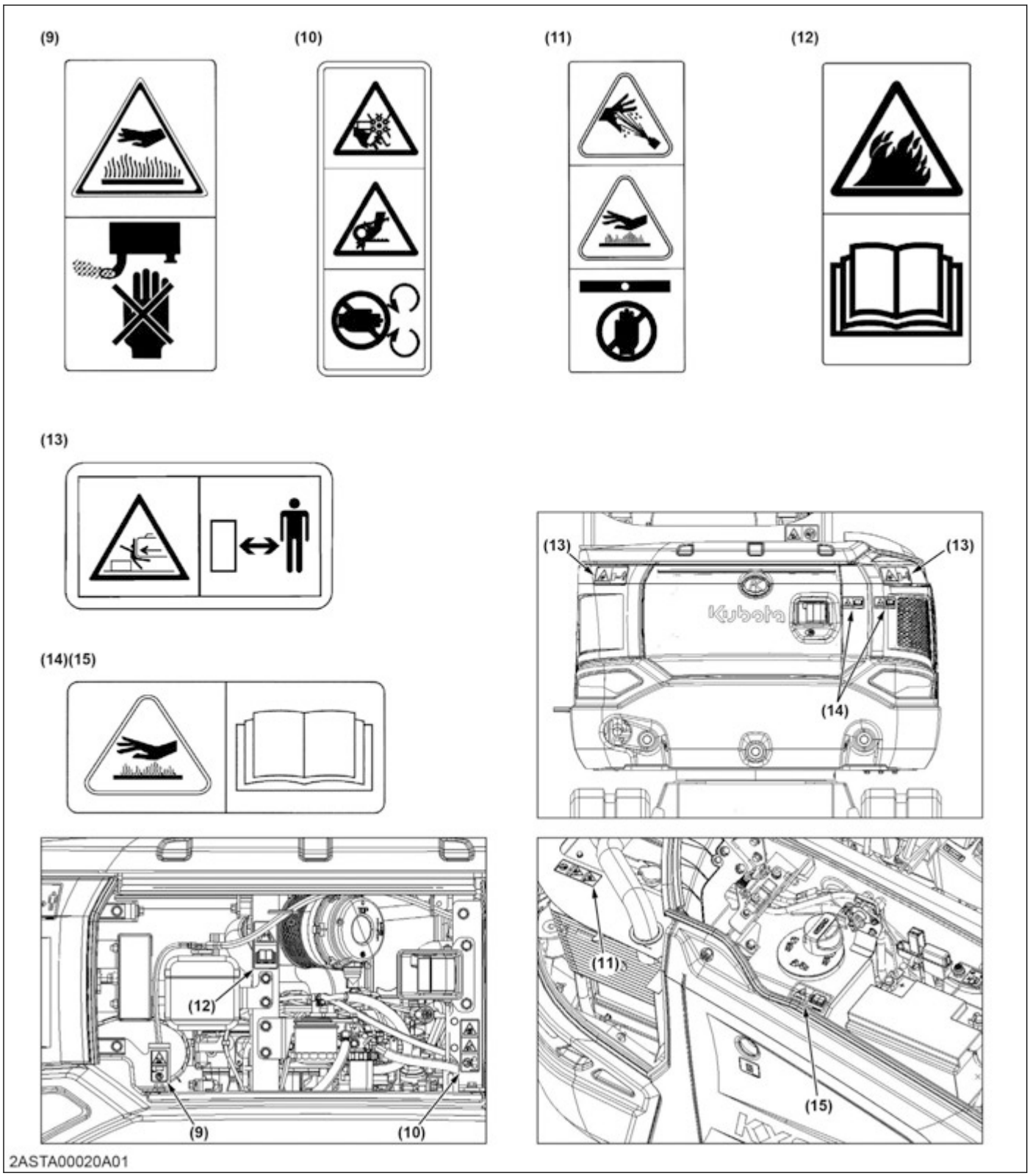
# 2. Safety labels

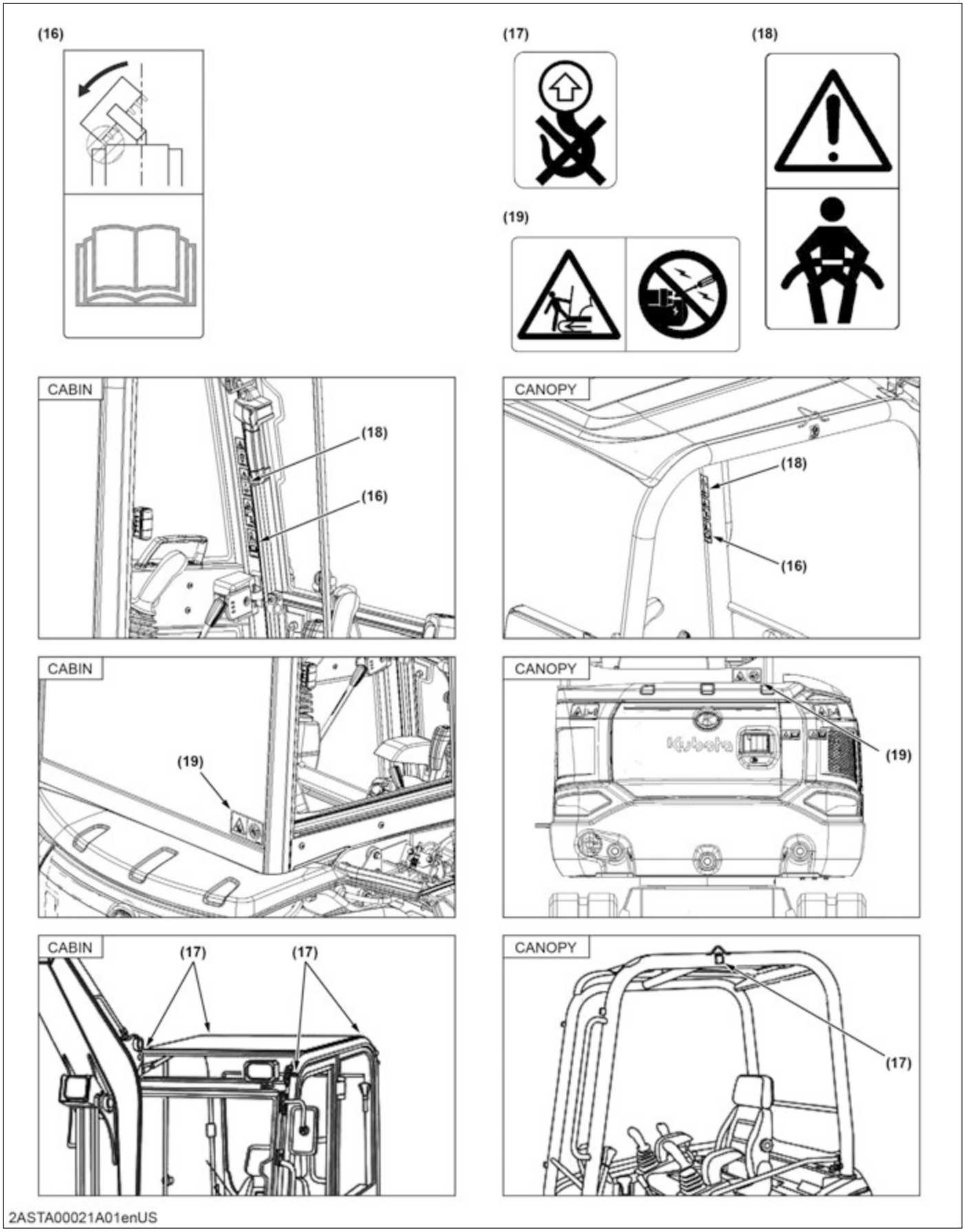
## 2.1 Safety labels placement

Read the safety instructions on safety label very carefully to avoid personal injury.

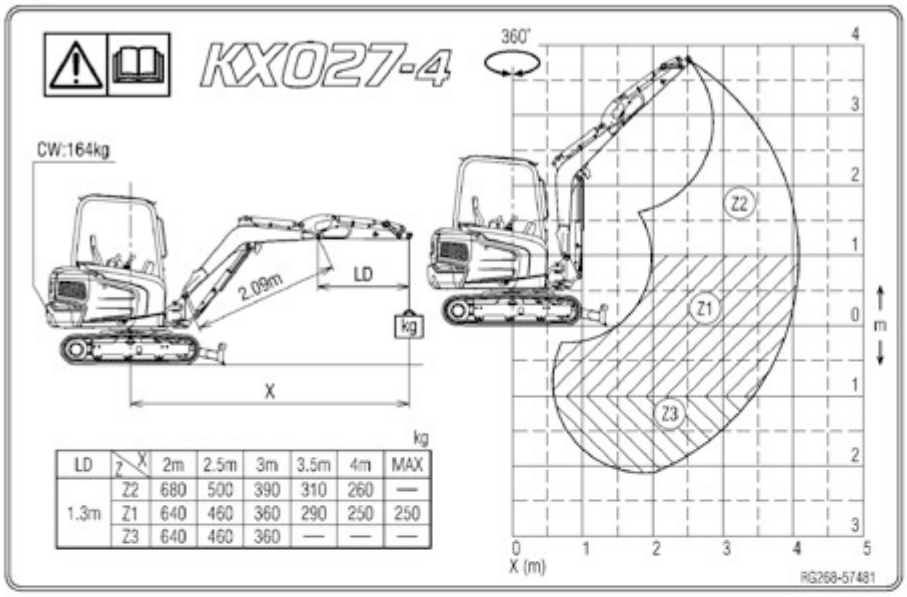



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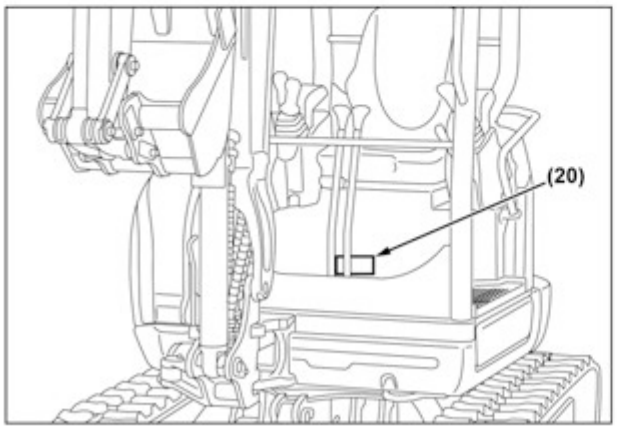

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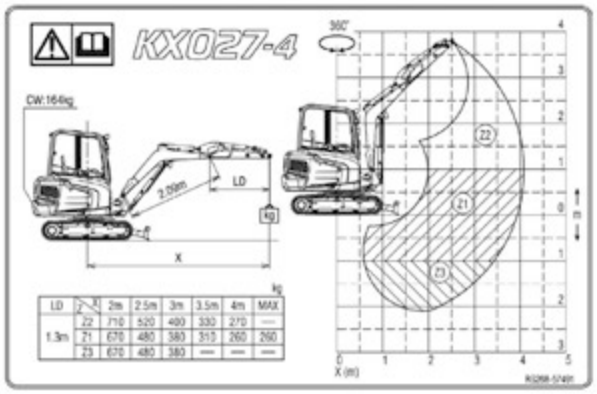

kg

| LD | Z \ X | 2m | 2.5m | 3m | 3.5m | 4m | MAX |
|---|---|---|---|---|---|---|---|
| 1.3m | Z2 | 680 | 500 | 390 | 310 | 260 | — |
| | Z1 | 640 | 460 | 360 | 290 | 250 | 250 |
| | Z3 | 640 | 460 | 360 | — | — | — |




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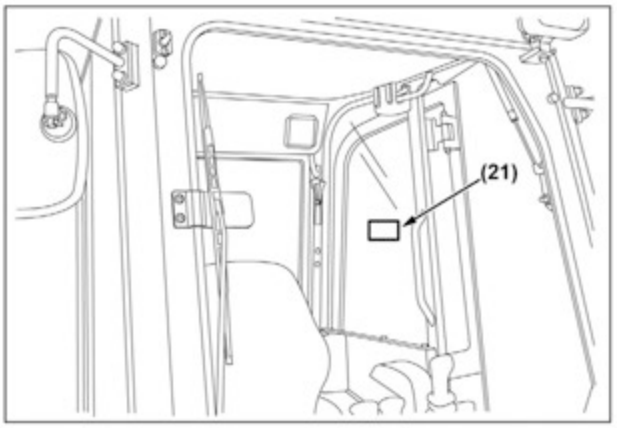


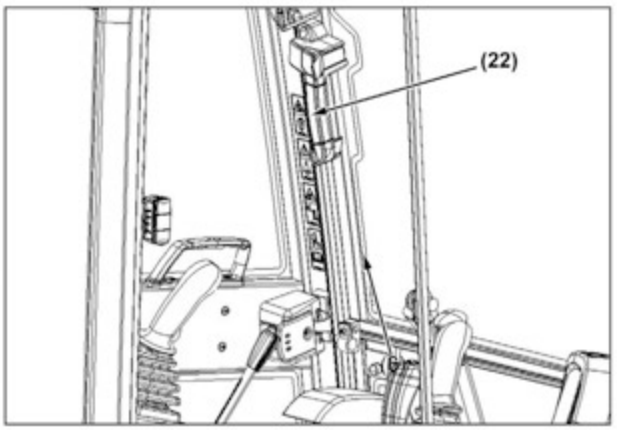

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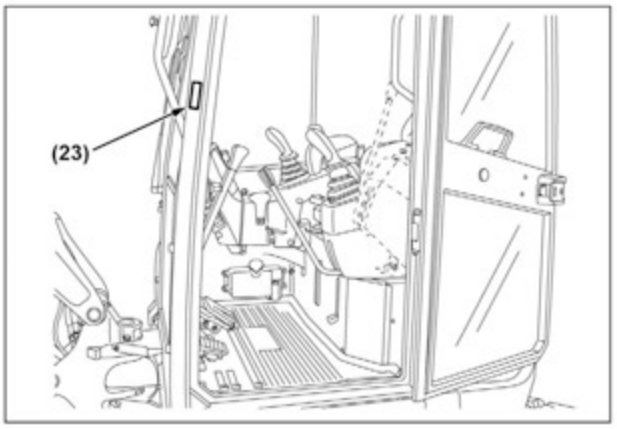


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## 2.2 Safety labels maintenance

- Keep safety labels clean and free from obstructing material.
- Clean safety labels with soap and water, and soft cloth.
- Replace damaged or missing safety labels with new labels.
- If a component with safety labels affixed is replaced with new part, make sure new labels are attached in the same locations as the replaced components.
- Mount new safety labels by applying on a clean dry surface and pressing any bubbles to the outside edge.

# 2. GENERAL

# GENERAL WORKING INSTRUCTIONS

## 1. General working precautions

- When servicing, observe the safety regulations in operator's manual and workshop manual.
- Clean the machine before maintenance.
- Before working, remove the negative (-) terminal from the battery, or turn off the battery isolator switch.
- Disassemble the machine at a clean location.
- Whenever a special tool is required, use the special tool that KUBOTA recommends. Make any special tools which are used occasionally according to the illustrations in this manual.
- Use genuine KUBOTA parts to ensure safety and machine performance.

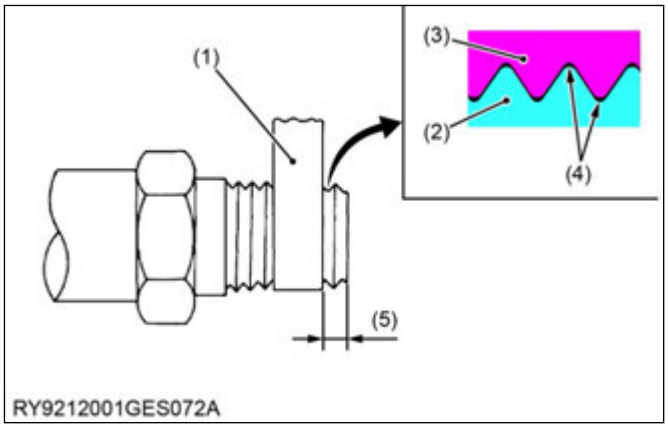

RY9212001GES071A

## 2. Wrapping thread seal tape

1. Wrap the thread seal tape 2 or 3 revolutions around taper threads.
2. Tighten the taper thread with the specified torque.

**■ NOTE**

- **Do not loosen taper thread after tightened to avoid oil leakage.**
- **Do not warp the thread seal on the first and second threads to avoid the thread seal contaminating in the hydraulic circuit.**



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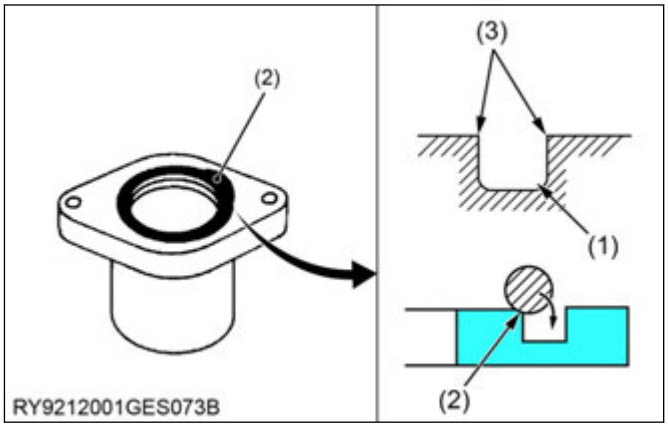
(1) Thread seal tape
(2) Male thread
(3) Female thread
(4) Clearance
(5) First and second threads

## 3. Replacing O-rings

1. Remove the burr and clean the O-ring groove.
2. Grease the O-ring. Do not apply any grease to the floating seal.
3. Put the O-ring in the groove.

**■ NOTE**

- **Do not kink the O-ring.**
- **Remove the burr to avoid the O-ring from damage by the burr.**



RY9212001GES073B

(1) O-ring groove
(2) O-ring
(3) Burr

## 4. Replacing oil seals

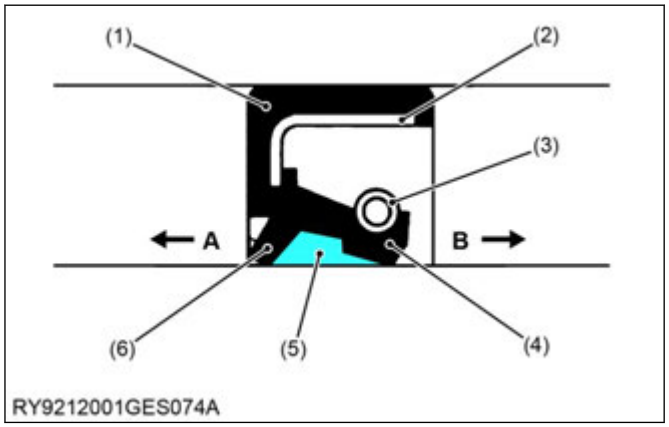
1. Do not face the lip of the oil seal in the wrong direction. Face the main lip toward the material to be sealed.

2. Use a press to install the oil seal until it seats firmly in the boss.

**■ NOTE**
- **In cases of installing without a press, hit the oil seal with hammer lightly, straightly and evenly to install.**

3. Grease the seal lip and dust lip.

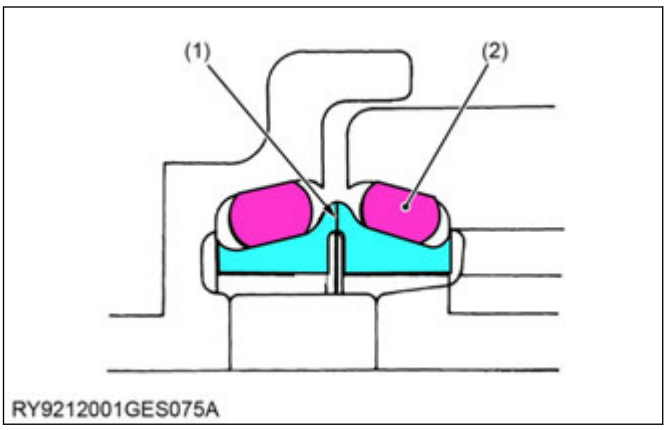
**■ NOTE**
- **If the seal has a dust lip, grease the gap between the lips.**
- **After oil seals are replaced, grease the moving parts around the lip to prevent the dry surfaces from wearing against each other when the engine is started.**




(1) Packing
(2) Metal ring
(3) Spring
(4) Seal lip
(5) Grease
(6) Dust lip
A: Air side
B: Oil side

# 5. Replacing floating seals

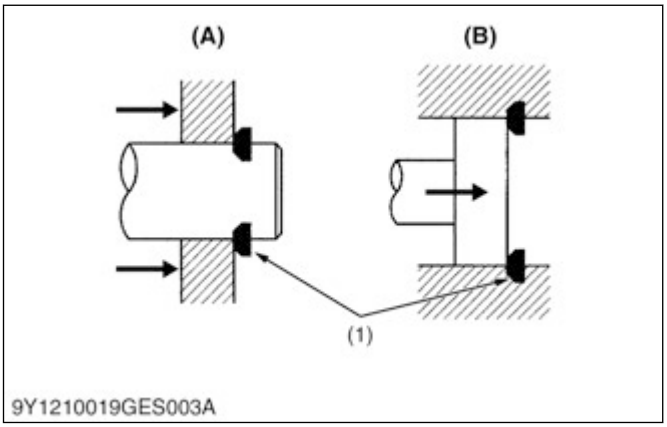
1. Apply oil to both sides of the O-ring and the contact surface properly.
2. Do not kink the O-ring when installing the floating seal.
3. Apply oil thinly to the sliding surfaces.
4. Install the floating seal in parallel to the sliding surfaces, O-ring, and housing.
5. After installing, rotate the floating seal 3 revolutions to make an oil film on the sliding surface.




(1) Sliding surface
(2) O-ring

# 6. Installing circlips

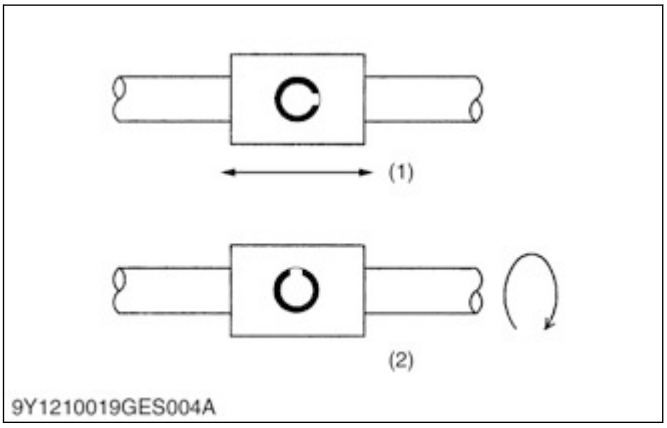
1. When installing the circlip, set the surface of the edge in the direction of the received force.




(1) Circlip
(A) External circlip
(B) Internal circlip

# 7. Installing spring pins

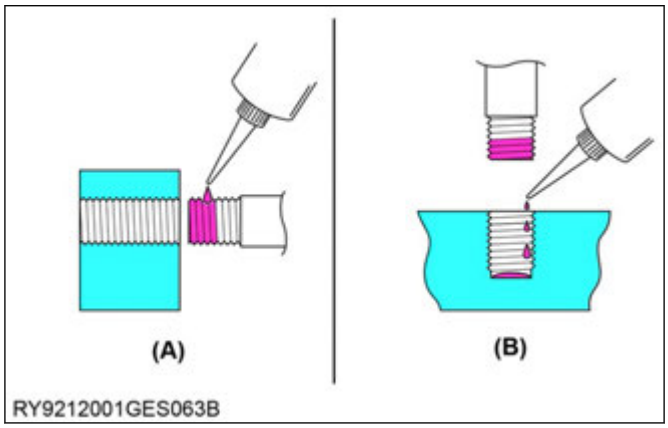
1. Install the slit of spring pin in the direction that receive the force.




(1) Parallel force
(2) When rotating

# 8. Applying thread lock

1. Clean and dry the location where thread lock will be applied with a solvent, so it is free of moisture, oil and dirt.
2. Apply thread lock all around the threads of the bolt except the top thread.
3. If the threads are large, accordingly apply the thread lock all around the bolt hole as well.

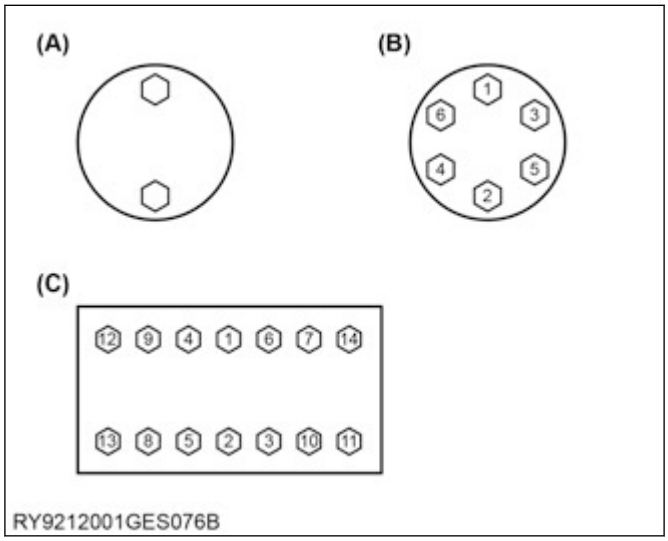



(A) Bolt hole (bolt, nuts) (B) Screw hole

# 9. Tightening bolts and nuts

1. Tighten bolts and nuts with their specified torque.

**■ NOTE**
- **Tighten bolts and nuts alternately top to bottom, left to right so the torque is distributed evenly.**
- **Tighten bolts and nuts divided into two or three times.**



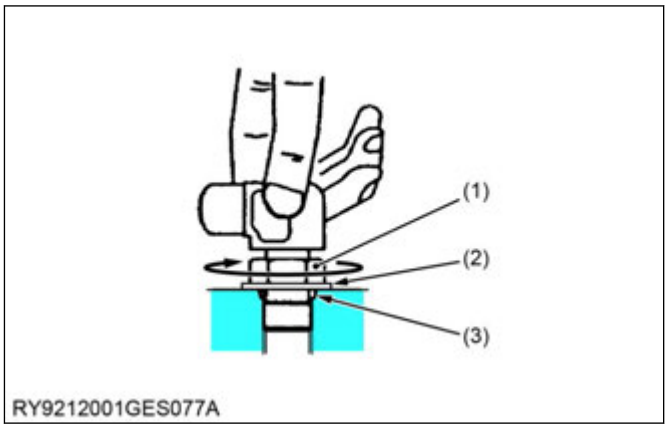

(A) Alternately
(B) Diagonally
(C) Center to outside

# 10. Connecting hydraulic hoses

1. Clean the inside of the hose fittings.
2. Tighten with the specified torque.
3. Apply pressure on the hydraulic hose to check for oil leakage.

# 11. Installing elbows with male seat

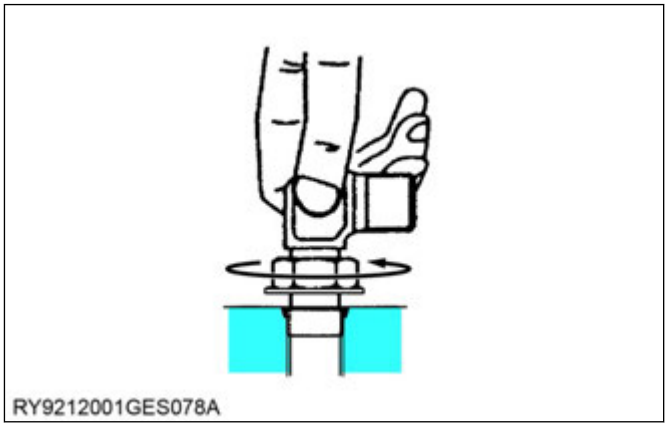
1. Clean the male seat surface and the seal.
2. Loosen the locknut until the top end.
3. Install the elbow by hand tightening until the male seat touches to the material surface.




(1) Locknut
(2) Seat
(3) Seal (O-ring)

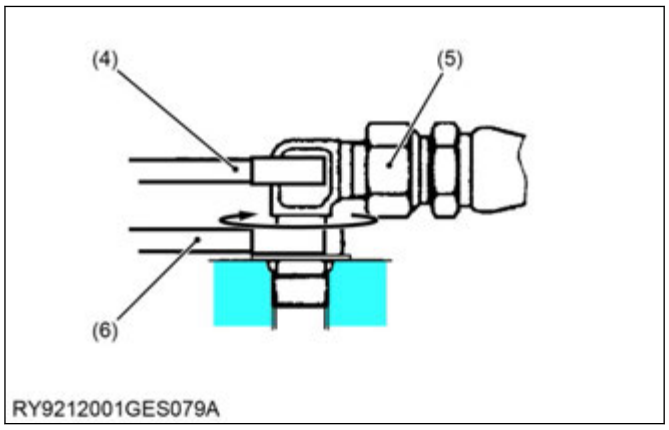
4. Adjust direction for the elbow.

**■ NOTE**
- **Do not loosen more than one revolution.**



5. Tighten the locknut with the specified torque.

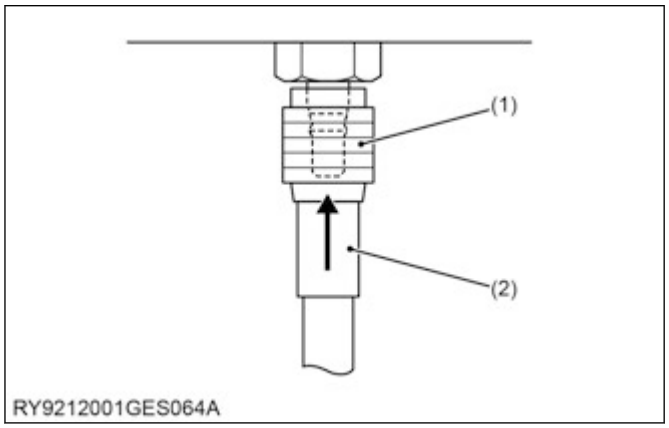
**■ NOTE**
- **Check for oil leakage.**




(4) Wrench (6) Torque wrench
(5) Hose

## 12. Connecting and disconnecting quick hose couplings

1. Push the metal fittings in the direction of the arrow mark.

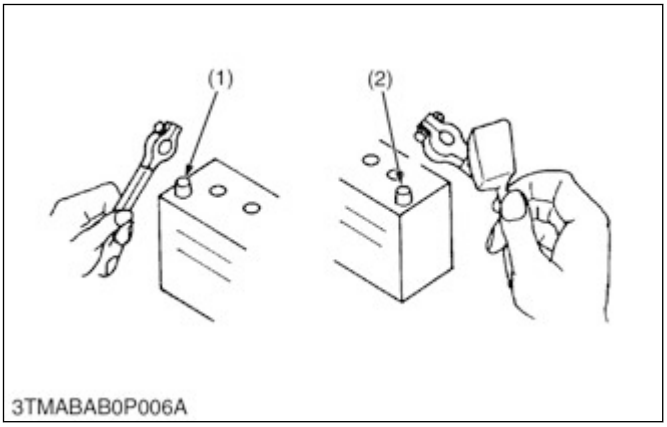



(1) Plastic part (2) Metal fitting

2. Pull the plastic part in the opposite direction of the arrow mark.
3. Disconnect the quick hose coupling.
4. Push the quick hose coupling in the direction of the arrow mark to connect.
5. Confirm that the hose is installed correctly.

## 13. Handling the battery

**⚠ CAUTION**
- **Disconnect negative (-) terminal first.**
- **Connect positive (+) terminal first.**

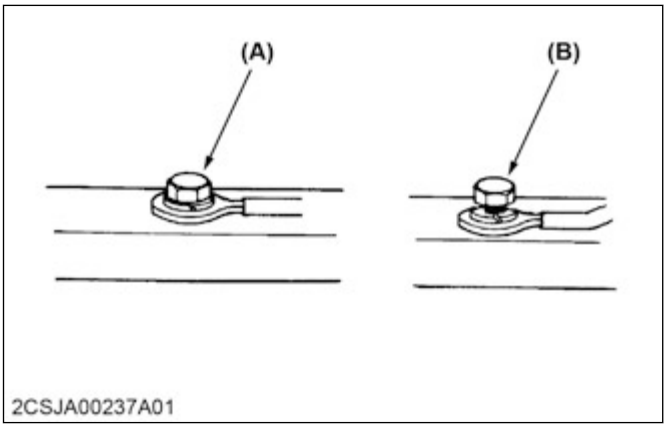



(1) Battery negative (-) terminal (2) Battery positive (+) terminal

## 14. Handling electrical wiring

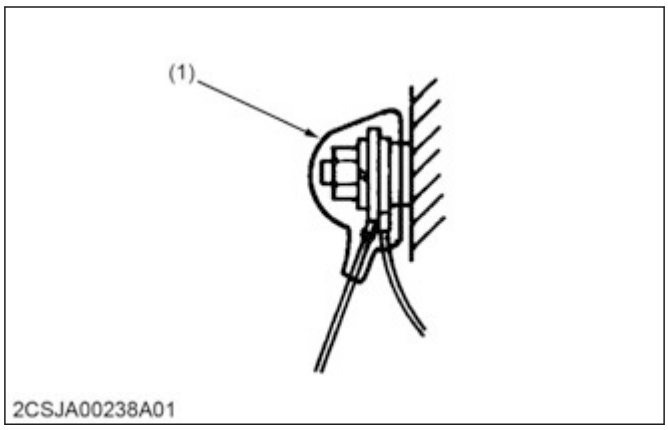
**⚠ CAUTION**
- **Do not contact an unprotected electrical wiring to other components.**
- **Do not clamp the electrical wiring to fuel hoses.**
- **Check for damage and poor connection of the electrical wiring.**
- **Do not alter the electrical device and wiring.**

- Tighten the electrical terminals securely.



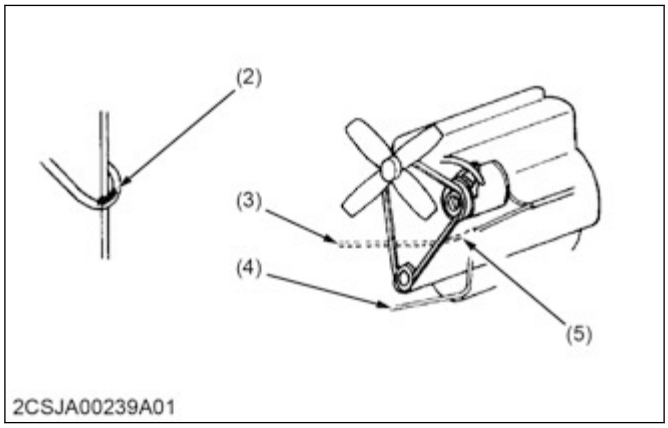

(A) Correct (B) Incorrect (the bolt is loose)

- Check the electrical terminal protection and clamping conditions before connecting the battery cable.



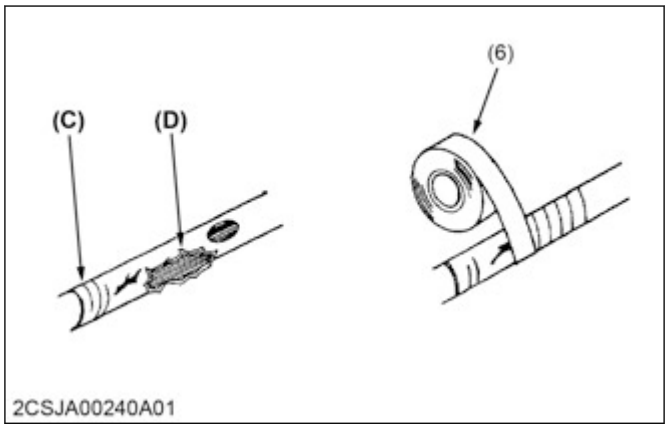

(1) Covered completely

- Keep the wiring away from hazards.



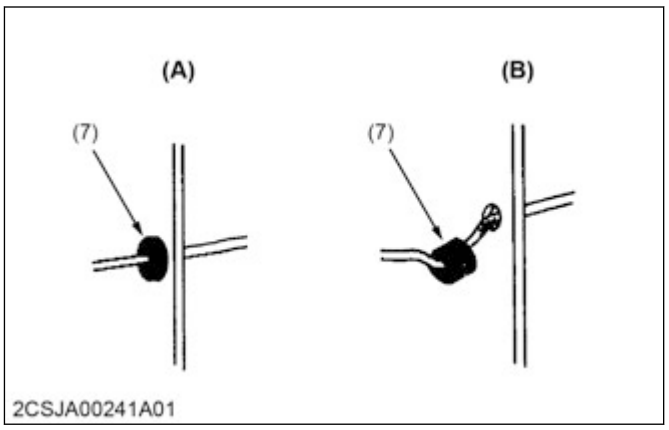

(2) Hazardous position
(3) Wiring position (poor)
(4) Wiring position (good)
(5) Hazardous position

- Repair or replace the damaged or old wiring immediately.



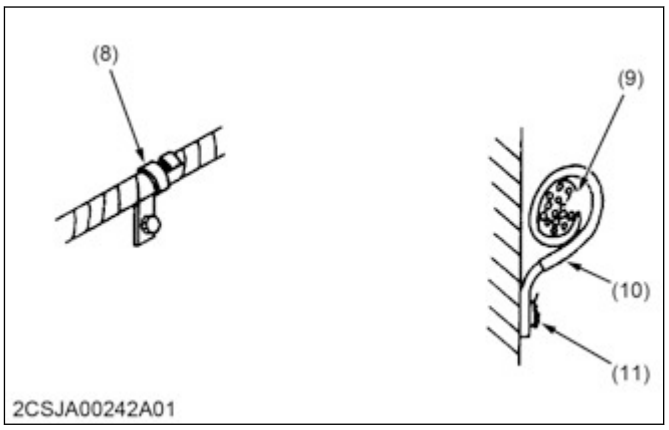

(6) Insulating tape
(C) Damaged
(D) Torn

- Install the grommet securely.



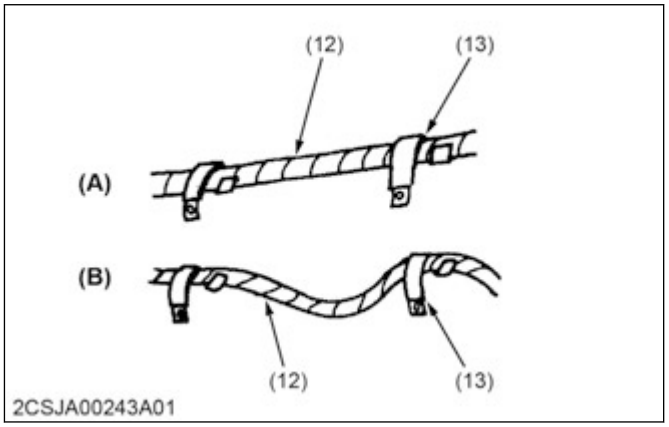

(7) Grommet
(A) Correct
(B) Incorrect (poor installation)

- Clamp the electrical wiring securely. Do not damage the electrical wiring by the clamp.



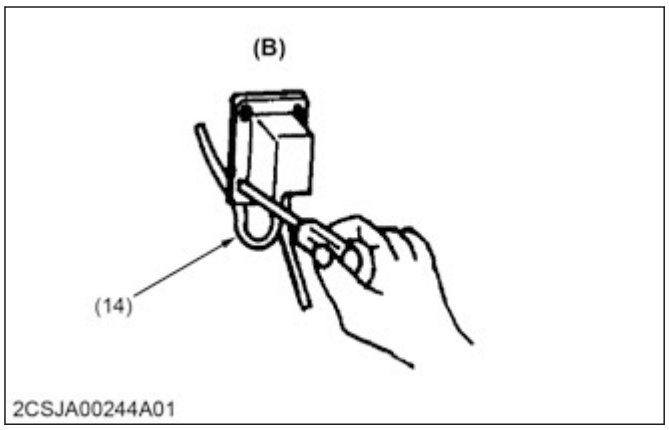

(8) Clamp (clamp spirally)
(9) Electrical wiring
(10) Clamp
(11) Welding point

- Clamp the electrical wiring correctly. Do not slack, twist, and pull.
- In cases of connecting the electrical wiring to moving or vibrating locations, make sure to clamp the electrical wiring loosely.




(12) Electrical wiring
(13) Clamp
(A) Correct
(B) Incorrect

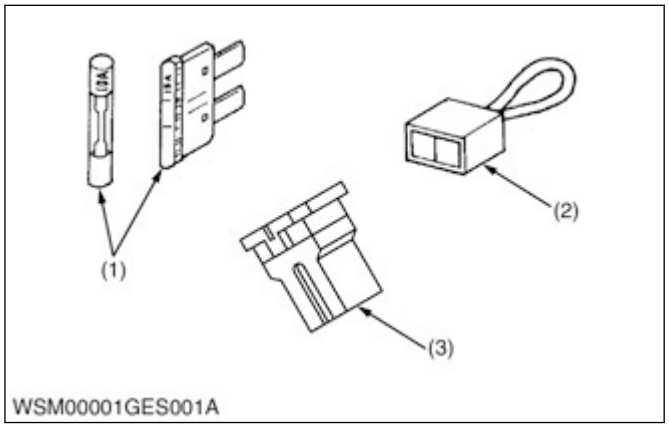
- Do not pinch the electrical wiring when installing parts.




(14) Electrical wiring (B) Incorrect

# 15. Handling fuses

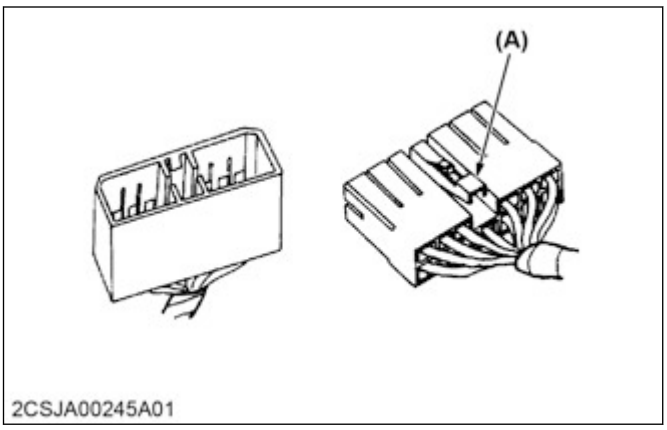
- Always use fuses of the specified capacity.
- Do not use steel or copper wiring instead of fuse.
- Do not install work light or radio without auxiliary power line.
- Do not install auxiliaries to the fuses. The fuses may blow.




(1) Fuse (3) Slow blow fuse
(2) Fusible link

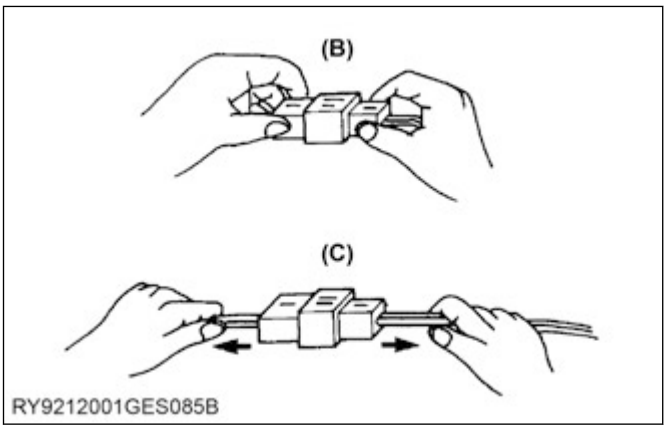
# 16. Handling connectors

- Press the lock securely when disconnecting the locking connectors.



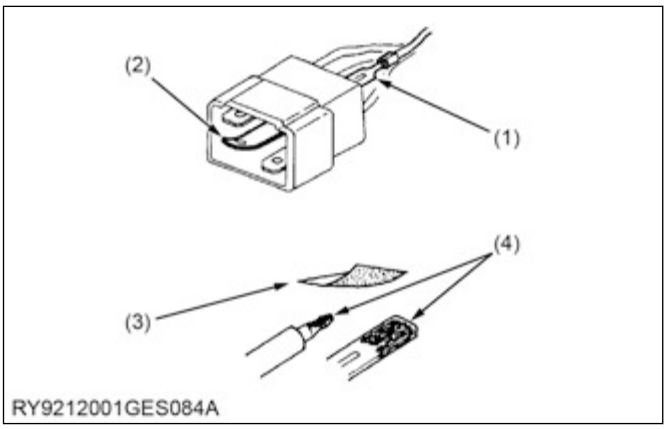

(A) Press

- Pull the connector body securely when disconnecting the connectors.
- Do not pull the wire harness to separate.



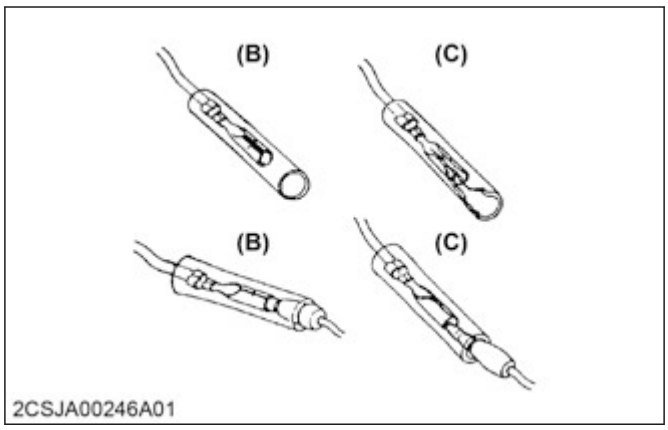

(B) Correct (C) Incorrect

- Make sure the terminal condition of the connectors that is not bent, rusty, etc..
- Remove rust with sandpaper.



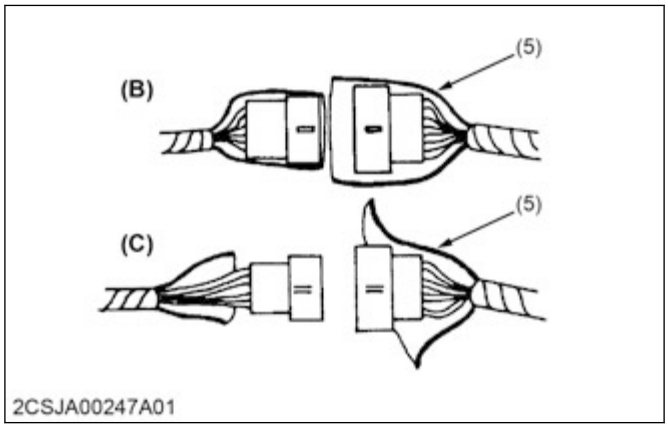

(1) Missing terminal (4) Rust
(2) Bent terminal
(3) Sandpaper

- Cover the female bullet terminals and male bullet terminals securely with the waterproof plastic covers.
- Make sure that the connection of bullet terminals are inserted till the deep end.




(B) Correct (C) Incorrect

- Cover the female connectors and male connectors securely with the waterproof plastic covers.




(5) Cover (C) Incorrect
(B) Correct

# 17. Washing the machine with a high pressure washer

Use a high pressure washer properly to avoid personal injuries and machine damages.

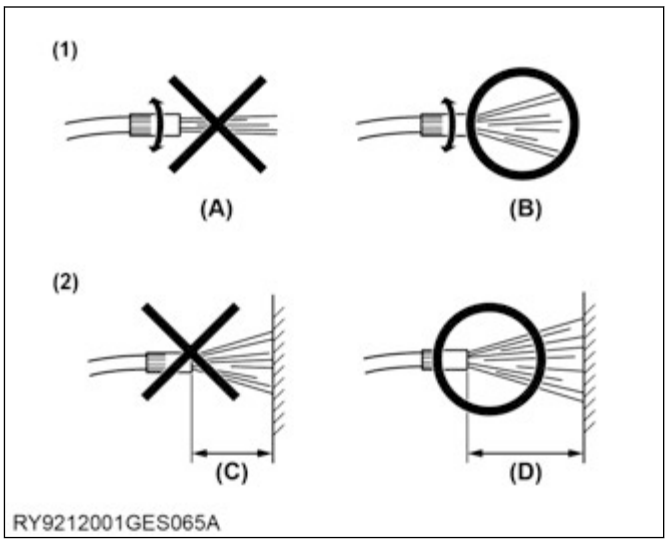
**⚠ CAUTION**

- **Damaged or cut electrical wiring may cause a fire.**
- **Damaged hydraulic hoses or oil seals may cause an injury due to gushing hydraulic oil.**

**■ IMPORTANT**

- **Water infiltration may cause machine problems.**

- Adjust the high pressure washer nozzle for a wide spray. Do not adjust for a blast.
- Spray the water at least 2 m away from the machine.



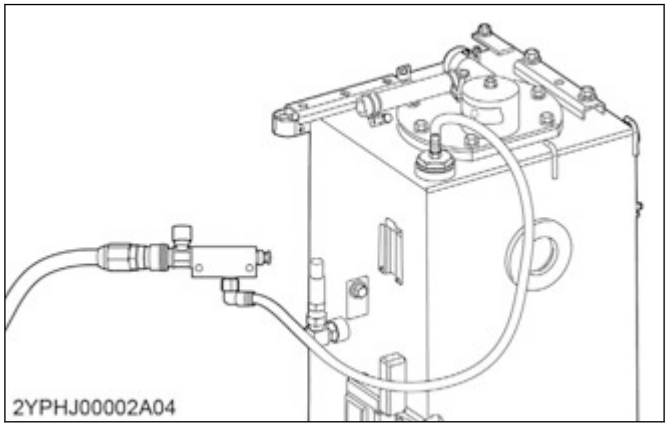

(1) Adjusting the washer power (C) Less than 2 m (80 in.)
(2) Washing distance (D) Over 2 m (80 in.)
(A) Blasting
(B) Wide spray

# PRELIMINARY WORKING INSTRUCTIONS

## 1. Vacuuming the hydraulic tank

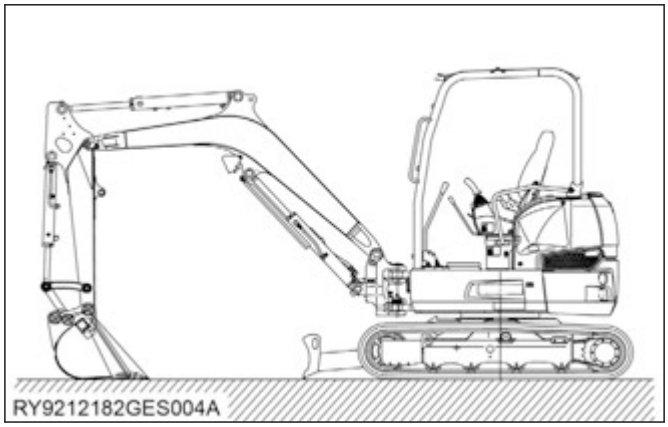
In case of removing the hydraulic devices and hydraulic hoses, vacuum the hydraulic tank to reduce the hydraulic oil leakage.

1. Replace the oil tank cap with a vacuum plug.
2. Plug the air breather hose or any other opening vent on the hydraulic tank.
3. Connect the vacuum pump and vacuum plug with a hose.
4. Connect an air hose to the vacuum pump and vacuum the hydraulic tank.

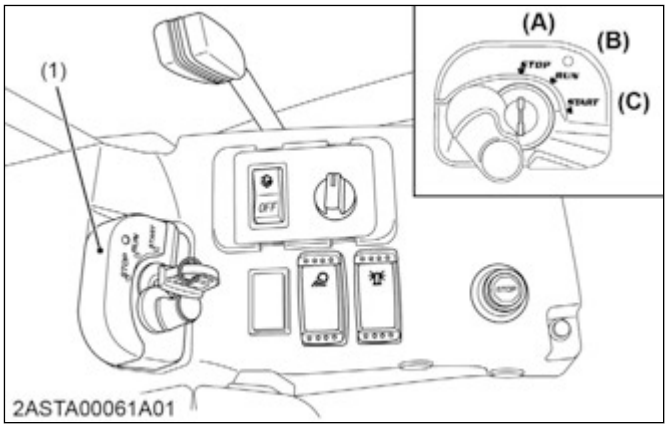



## 2. Releasing residual pressure of hydraulic circuit

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

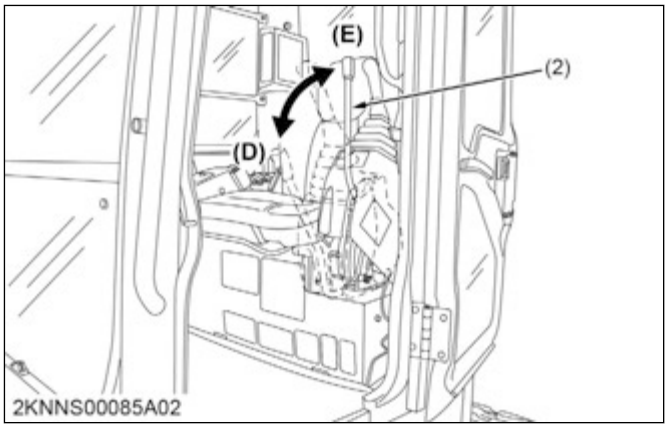



2. Turn the starter switch to **[RUN]** without starting the engine.




(1) Starter switch
(A) **[STOP]**
(B) **[RUN]**
(C) **[START]**

3. Lower the lever lock.

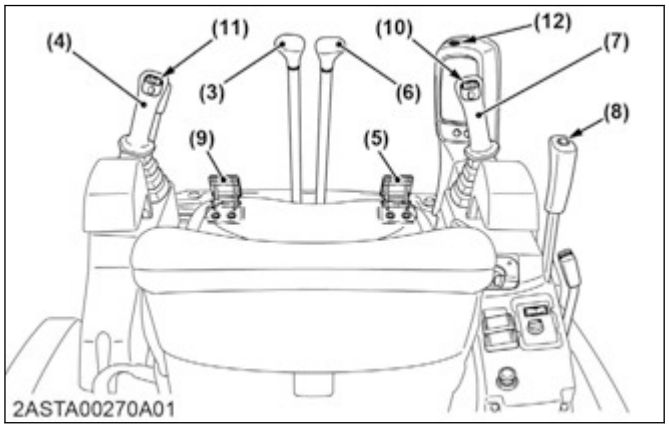



(2) Lever lock
(D) Release
(E) Lock

4. Operate pilot control lever (boom, arm, bucket, and swivel) several times in full-stroke.
5. Operate the travel control lever several times in full-stroke.
6. Operate the blade control lever several times in full-stroke.
7. Operate the swing pedal several times in full-stroke.

8. Operate AUX control pedal (knob switches) several times in full-stroke.

**■ NOTE**
- **In case of Hi-spec,**
  - **– activate AUX function by the switch on the meter panel and set the maximum flow rate.**
  - **– activate AUX function by the switch on the meter panel and rotate the AUX2 dial to the maximum flow rate.**




(3) LH travel lever
(4) LH pilot control lever
(5) Swing control pedal
(6) RH travel control lever
(7) RH pilot control lever
(8) Blade control lever
(9) AUX1 control pedal (basic)
(10) AUX1 knob switch (Hi-spec only)
(11) AUX2 knob switch (Hi-spec only)
(12) AUX2 dial (Hi-spec only)

9. Raise the lever lock and turn the starter switch to **[STOP]**.

# 3. Bleeding the air from the hydraulic cylinder

Bleed air from the hydraulic cylinder after removing and disassembling the hydraulic cylinder to prevent cavitation and seizure of the internal parts.

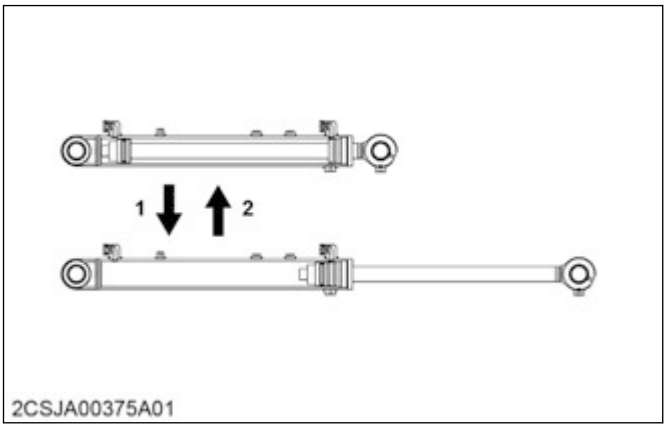
1. Set the engine speed to less than 1500 rpm.

**■ IMPORTANT**
- **If the engine speed is higher than 1500 rpm, the seals and bushings may be damaged.**

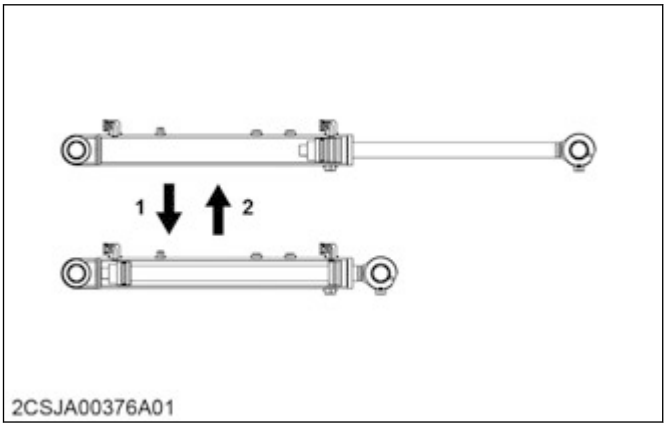
2. Compress and extend the hydraulic cylinder slowly to bleed air.

**■ IMPORTANT**
- **Do not relief the main relief valve of the hydraulic cylinder at the end of stroke.**

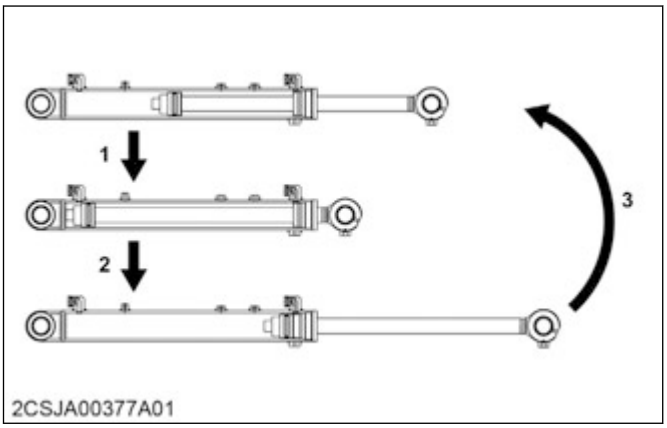
**Compressed stroke end**




**Extended stroke end**




**Middle stroke**




# 4. Removing the battery

**⚠ CAUTION**
- **Keep a fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.**
- **Disconnect the negative (-) terminal first when removing the battery cable.**

- **Connect the positive (+) terminal first when connecting the battery cable.**

**Removing**

1. Disconnect the battery cables from the battery.

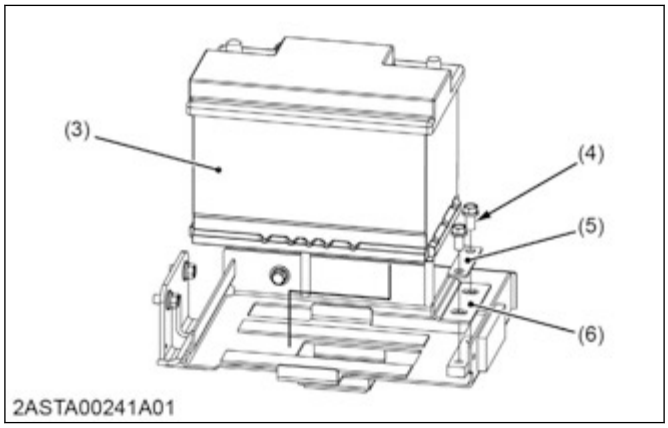



(1) Negative (-) terminal (2) Positive (+) terminal

**NOTE**

- **Wrap the insulating tape to the terminal after removing.**

2. Remove the two bolts.
3. Remove the plate and battery holder.




(3) Battery (6) Battery holder
(4) Bolt (M10 × 20) ×2
(5) Plate

4. Remove the battery.

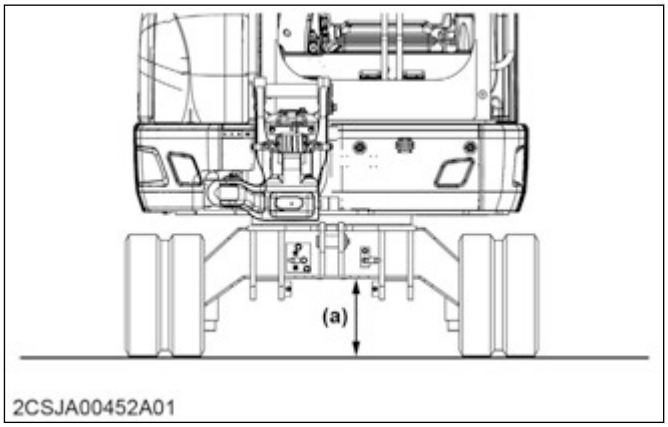
# 5. Jacking up the machine

**CAUTION**

- **Do not work underneath when the machine is jacked up.**
- **Put the machine on the jack stands securely when lifting the machine.**

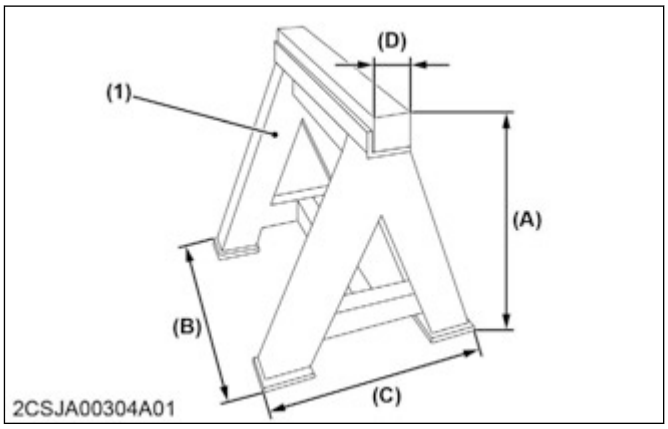
**Preparing**

1. Park the machine on firm and level ground.
2. Prepare the proper jack stands based on dimension (a).




(a) 296 mm (11.7 in.)

**Recommended jack stand**




(1) Jack stand

| Items | Dimensions |
|---|---|
| (A) | 520mm<br>20.5in. |
| (B) | 500mm<br>19.7in. |
| (C) | 440mm<br>17.3in. |
| (D) | 75mm<br>3.0in. |

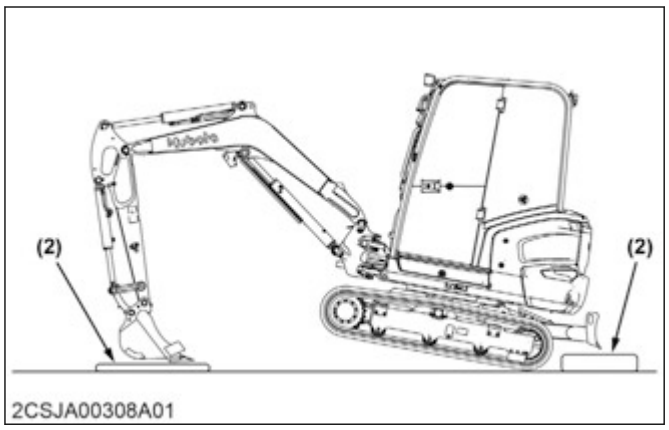
**Jacking up the machine**

1. Swivel the upper structure of the machine for 180 degrees so that the blade is behind the operator.

**NOTE**

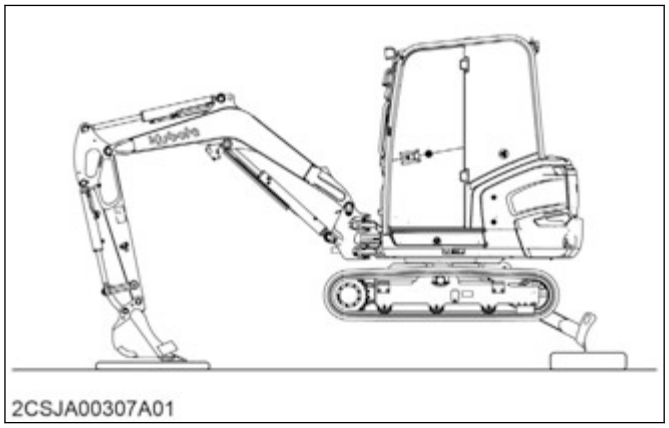
- **Put a cushioning materials under the bucket and blade.**

2. Operate the arm, boom, and blade to jack up the front of the machine.

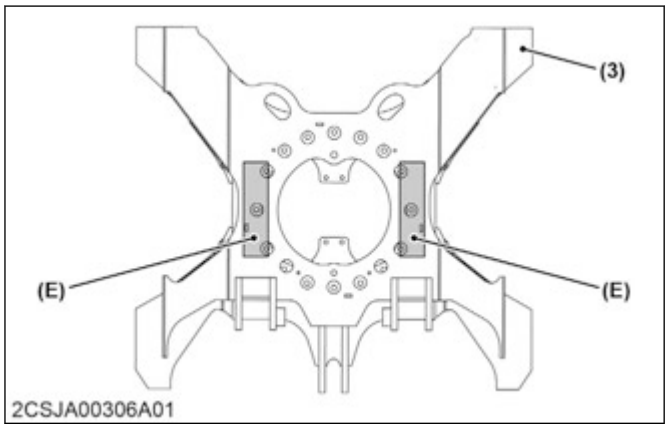



(2) Cushion

3. Operate the blade to jack up the rear of the machine.

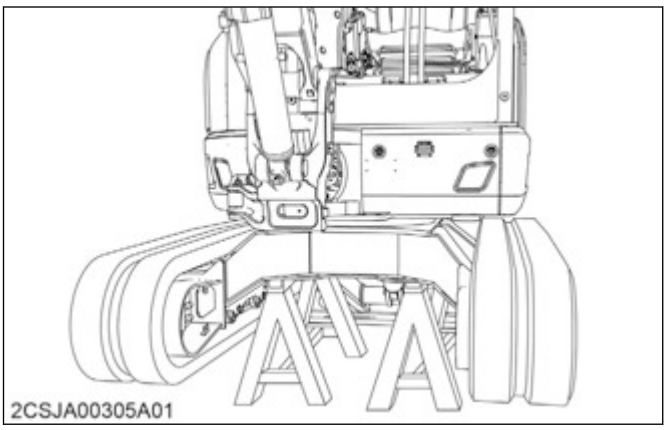



4. Put the two jack stands under the track frame.




(3) Track frame (E) Contact surface

5. Lower the machine and put the machine on the jack stands.




6. Place the bucket and blade on the ground.

# TIGHTENING TORQUES

## 1. Bolts and nuts tightening torque

**■ NOTE**

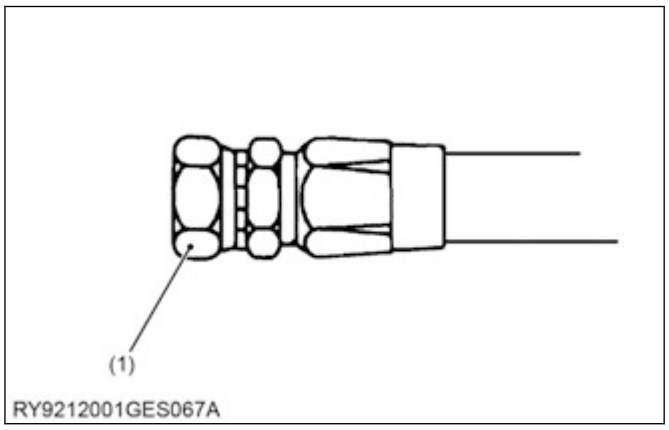
- **Screws, bolts and nuts which tightening torques are not specified in this workshop manual should be tightened according to the table below.**

| Mark on top of bolt | 4 4T (4.6) | | | | | | 7 7T (8.8) | | | | | | 9 9T (9.8-10.9) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Materi-al | Steel | | | Aluminum | | | Steel | | | Aluminum | | | Steel | | |
| Units | N·m | kgf·m | lbf·ft | N·m | kgf·m | lbf·ft | N·m | kgf·m | lbf·ft | N·m | kgf·m | lbf·ft | N·m | kgf·m | lbf·ft |
| M6 | 7.9 to 9.3 | 0.80 to 0.95 | 5.8 to 6.8 | 7.9 to 8.8 | 0.80 to 0.90 | 5.8 to 6.5 | 9.81 to 11.2 | 1.00 to 1.15 | 7.24 to 8.31 | 7.9 to 8.8 | 0.80 to 0.90 | 5.8 to 6.5 | 12.3 to 14.2 | 1.25 to 1.45 | 9.05 to 10.4 |
| M8 | 18 to 20 | 1.8 to 2.1 | 13 to 15 | 17 to 19 | 1.7 to 2.0 | 13 to 14 | 24 to 27 | 2.4 to 2.8 | 18 to 20 | 18 to 20 | 1.8 to 2.1 | 13 to 15 | 30 to 34 | 3.0 to 3.5 | 22 to 25 |
| M10 | 40 to 45 | 4.0 to 4.6 | 29 to 33 | 32 to 34 | 3.2 to 3.5 | 24 to 25 | 48 to 55 | 4.9 to 5.7 | 36 to 41 | 40 to 44 | 4.0 to 4.5 | 29 to 32 | 61 to 70 | 6.2 to 7.2 | 45 to 52 |
| M12 | 63 to 72 | 6.4 to 7.4 | 47 to 53 | - | - | - | 78 to 90 | 7.9 to 9.2 | 58 to 66 | 63 to 72 | 6.4 to 7.4 | 47 to 53 | 103 to 117 | 10.5 to 12.0 | 76.0 to 86.7 |
| M14 | 108 to 125 | 11.0 to 12.8 | 79.6 to 92.5 | - | - | - | 124 to 147 | 12.6 to 15.0 | 91.2 to 108 | - | - | - | 167 to 196 | 17.0 to 20.0 | 123 to 144 |
| M16 | 167 to 191 | 17.0 to 19.5 | 123 to 141 | - | - | - | 197 to 225 | 20.0 to 23.0 | 145 to 166 | - | - | - | 260 to 304 | 26.5 to 31.0 | 192 to 224 |
| M18 | 246 to 284 | 25.0 to 29.0 | 181 to 209 | - | - | - | 275 to 318 | 28.0 to 32.5 | 203 to 235 | - | - | - | 344 to 402 | 35.0 to 41.0 | 254 to 296 |
| M20 | 334 to 392 | 34.0 to 40.0 | 246 to 289 | - | - | - | 368 to 431 | 37.5 to 44.0 | 272 to 318 | - | - | - | 491 to 568 | 50.0 to 58.0 | 362 to 419 |

## 2. Stud bolts tightening torque

| Material | Steel | | | Aluminum | | |
|---|---|---|---|---|---|---|
| Units | N·m | kgf·m | lbf·ft | N·m | kgf·m | lbf·ft |
| M8 | 12 to 15 | 1.2 to 1.6 | 8.7 to 11 | 8.9 to 11 | 0.90 to 1.2 | 6.5 to 8.6 |
| M10 | 25 to 31 | 2.5 to 3.2 | 18 to 23 | 20 to 25 | 2.0 to 2.6 | 15 to 18 |
| M12 | 30 to 49 | 3.0 to 5.0 | 22 to 36 | 31 | 3.2 | 23 |
| M14 | 62 to 73 | 6.3 to 7.5 | 46 to 54 | – | – | – |
| M16 | 98.1 to 112 | 10.0 to 11.5 | 72.4 to 83.1 | – | – | – |
| M18 | 172 to 201 | 17.5 to 20.5 | 127 to 148 | – | – | – |

# 3. Hydraulic hose fittings tightening torque



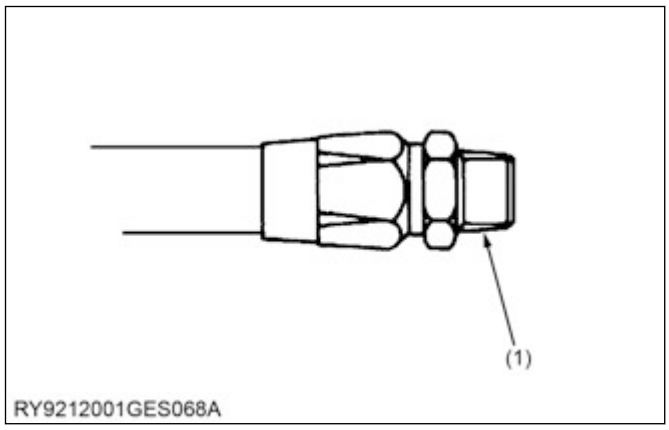

(1) Union nut

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| 1/8 | 7.8 to 11.8 | 0.8 to 1.2 | 5.8 to 8.7 |
| 1/4 | 24.5 to 29.2 | 2.5 to 3.0 | 18.1 to 21.5 |
| 3/8 | 37.2 to 42.1 | 3.8 to 4.3 | 27.5 to 31.0 |
| 1/2 | 58.8 to 63.7 | 6.0 to 6.5 | 43.4 to 46.9 |
| 3/4 | 117.6 to 127.4 | 12.0 to 13.0 | 86.7 to 94.0 |
| 1 | 181.3 to 191.1 | 18.5 to 19.5 | 133.8 to 140.9 |
| 1-1/4 | 220.5 to 230.3 | 22.5 to 23.5 | 162.8 to 170.0 |

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| 9/16-18 (ORS type) | 35.2 to 43.1 | 3.6 to 4.4 | 26.0 to 31.8 |
| 11/16-16 (ORS type) | 60.0 to 73.5 | 6.0 to 7.5 | 44.3 to 54.2 |
| 13/16-16 (ORS type) | 70.6 to 86.2 | 7.2 to 8.8 | 52.1 to 63.6 |
| 1-14 (ORS type) | 105.8 to 129.4 | 10.8 to 13.2 | 78.0 to 98.4 |

| Units | | N·m | kgf·m | lbf·ft |
|---|---|---|---|---|
| DN4-1/8 | M12 × 1.5 | 15 to 20 | 1.5 to 2.0 | 11.1 to 14.8 |
| DN6-1/4 | M14 × 1.5 | 15 to 20 | 1.5 to 2.0 | 11.1 to 14.8 |
| DN8-5/16 | M16 × 1.5 | 30 to 35 | 3.1 to 3.6 | 22.1 to 25.8 |
| DN10-3/8 | M18 × 1.5 | 40 to 45 | 4.1 to 4.6 | 29.5 to 33.2 |
| DN12/ DN13-1/2 | M22 × 1.5 | 50 to 55 | 5.1 to 5.6 | 36.9 to 40.6 |

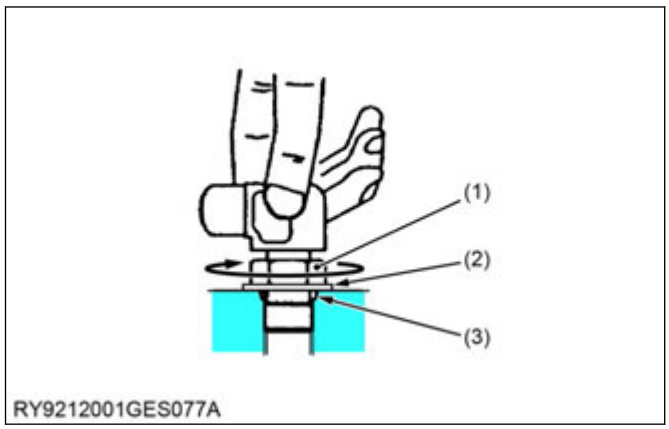
# 4. Hydraulic hoses tightening torque (taper thread)




(1) Taper thread

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| 1/8 | 19.6 to 29.4 | 2.0 to 3.0 | 14.5 to 21.6 |
| 1/4 | 36.6 to 44.1 | 3.7 to 4.5 | 27.0 to 32.5 |
| 3/8 | 68.6 to 73.5 | 7.0 to 7.5 | 50.6 to 54.2 |
| 1/2 | 83.4 to 88.3 | 8.5 to 9.0 | 61.6 to 65.1 |
| 3/4 | 166.6 to 181.3 | 17.0 to 18.5 | 122.9 to 133.7 |

# 5. Locknuts of adapters with O-ring tightening torque (straight thread)

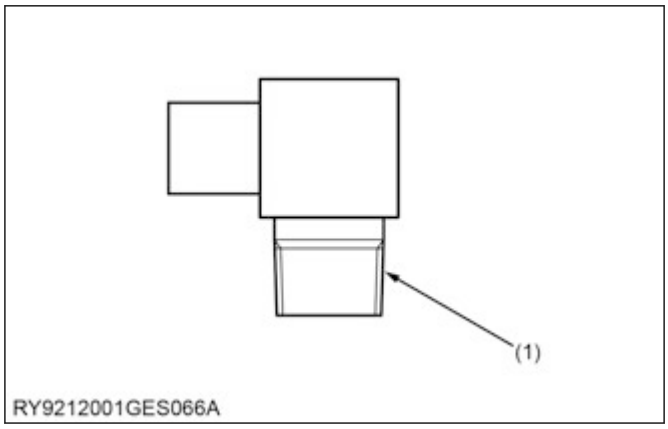



(1) Locknut
(2) Seat
(3) Seal (O-ring)

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| 1/8 | 15.0 to 16.5 | 1.5 to 1.7 | 11.1 to 12.1 |
| 1/4 | 24.5 to 29.4 | 2.5 to 3.0 | 18.1 to 21.5 |
| 3/8 | 49.0 to 53.9 | 5.0 to 5.5 | 36.2 to 39.7 |
| 1/2 | 58.8 to 63.7 | 6.0 to 6.5 | 43.4 to 46.9 |
| 3/4, 1 | 117.6 to 127.4 | 12.0 to 13.0 | 86.74 to 93.96 |
| 1-1/4 | 220.5 to 230.3 | 22.5 to 23.5 | 162.7 to 169.8 |

| Units | | N·m | kgf·m | lbf·ft |
|---|---|---|---|---|
| 1/8 | M10 × 1.0 | 15 to 20 | 1.5 to 2.0 | 11.1 to 14.8 |
| 1/8 | M12 × 1.5 | 25 to 35 | 2.6 to 3.6 | 18.4 to 25.8 |
| 1/4 | M14 × 1.5 | 34 to 45 | 3.5 to 4.6 | 25.1 to 33.2 |
| 1/4 | M16 × 1.5 | 40 to 55 | 4.1 to 5.6 | 29.5 to 40.6 |
| 3/8 | M18 × 1.5 | 45 to 65 | 4.6 to 6.6 | 33.2 to 47.9 |
| 1/2 | M22 × 1.5 | 70 to 80 | 7.1 to 8.2 | 51.6 to 59.0 |
| 1/2 | M24 × 1.5 | 80 to 90 | 8.2 to 9.2 | 59.0 to 66.4 |
| 3/4 | M26 × 1.5 | 100 to 120 | 10.2 to 12.2 | 73.8 to 88.5 |
| 1 | M30 × 2.0 | 120 to 140 | 12.2 to 14.3 | 88.5 to 103.3 |

# 6. Adapters tightening torque (taper thread)

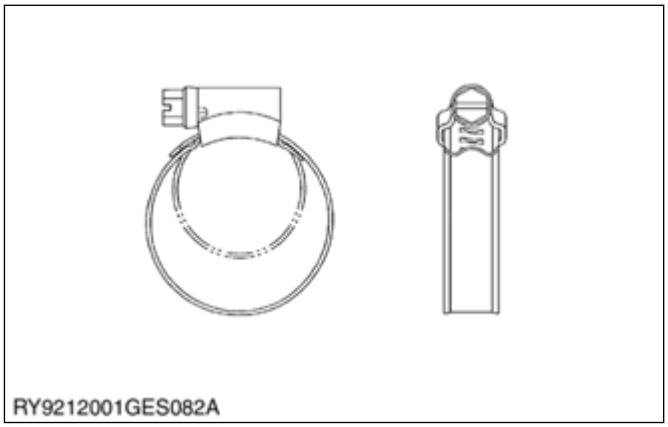



(1) Taper thread

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| 1/8 | 19.6 to 29.4 | 2.0 to 3.0 | 14.5 to 21.6 |
| 1/4 | 36.3 to 44.1 | 3.7 to 4.5 | 27.0 to 32.5 |
| 3/8 | 68.6 to 73.5 | 7.0 to 7.5 | 50.6 to 54.2 |
| 1/2 | 83.4 to 88.3 | 8.5 to 9.0 | 61.6 to 65.1 |
| 3/4 | 166.6 to 181.3 | 17.0 to 18.5 | 122.9 to 133.7 |

# 7. Hose clamps tightening torque

**Steel band type**




**Used for hydraulic hoses**

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| ϕ10-ϕ16 | 4.0 | 0.41 | 2.95 |
| ϕ13-ϕ20 | | | |
| ϕ16-ϕ25 | | | |
| ϕ22-ϕ32 | | | |
| ϕ25-ϕ40 | | | |
| ϕ40-ϕ60 | | | |
| ϕ32-ϕ50 | | | |
| ϕ50-ϕ70 | | | |

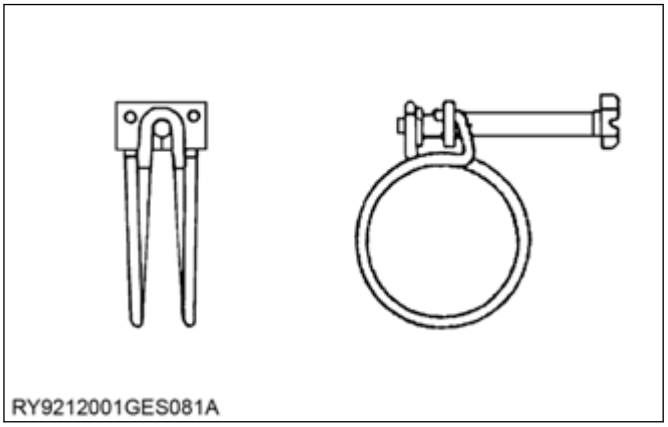
**Used for water hoses**

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| ϕ10-ϕ16 | 3.0 | 0.31 | 2.21 |
| ϕ13-ϕ20 | | | |
| ϕ16-ϕ25 | 4.5 | 0.46 | 3.32 |
| ϕ22-ϕ32 | | | |
| ϕ25-ϕ40 | | | |
| ϕ40-ϕ60 | | | |
| ϕ32-ϕ50 | | | |
| ϕ50-ϕ70 | | | |

### Used for air hoses

| Units | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| ϕ10-ϕ16 | 2.5 | 0.25 | 1.84 |
| ϕ13-ϕ20 | | | |
| ϕ16-ϕ25 | | | |
| ϕ22-ϕ32 | | | |
| ϕ25-ϕ40 | | | |
| ϕ40-ϕ60 | | | |
| ϕ32-ϕ50 | | | |
| ϕ50-ϕ70 | | | |

### Wire band type


RY9212001GES081A

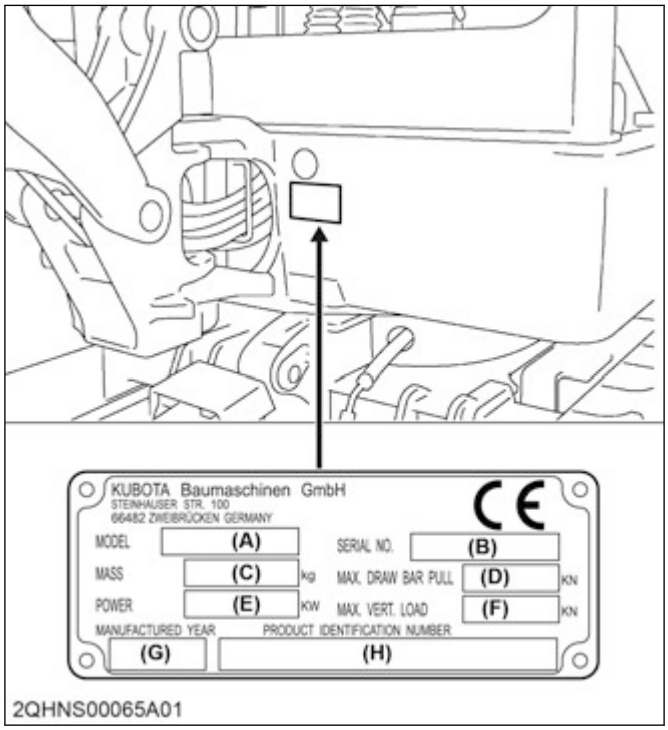
| Units | N·m | kgf·cm | lbf·ft |
|---|---|---|---|
| ϕ13-ϕ20 | 2.5 to 3.4 | 25 to 35 | 1.9 to 2.5 |
| ϕ15-ϕ25 | 4.9 to 5.9 | 50 to 60 | 3.7 to 4.3 |
| ϕ19-ϕ28 | | | |
| ϕ22-ϕ32 | | | |
| ϕ26-ϕ38 | | | |
| ϕ32-ϕ44 | | | |
| ϕ44-ϕ56 | | | |
| ϕ50-ϕ65 | | | |
| ϕ58-ϕ75 | | | |
| ϕ60-ϕ80 | | | |
| ϕ68-ϕ85 | | | |
| ϕ77-ϕ95 | | | |

# GENERAL MACHINE INFORMATION

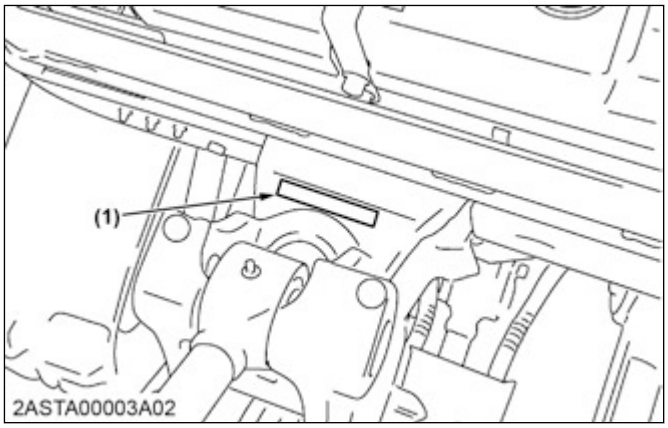
## 1. Machine model identification

**IMPORTANT**

- **Before contacting customer support, note the excavator model, serial number, engine type, engine serial number, and hour meter.**




| | |
|---|---|
| (A) | Model |
| (B) | Serial number |
| (C) | Operating weight |
| (D) | Maximum pulling capacity at the towing eyes |
| (E) | Engine performance |
| (F) | Maximum vertical load at the towing eyes |
| (G) | Year of manufacturing |
| (H) | Product identification number PIN |

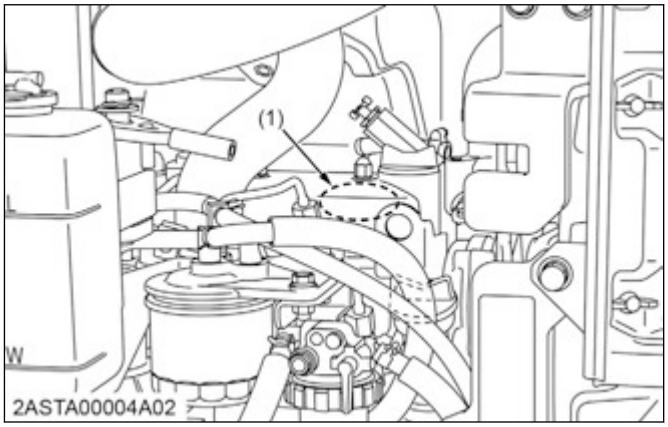



(1) Serial number

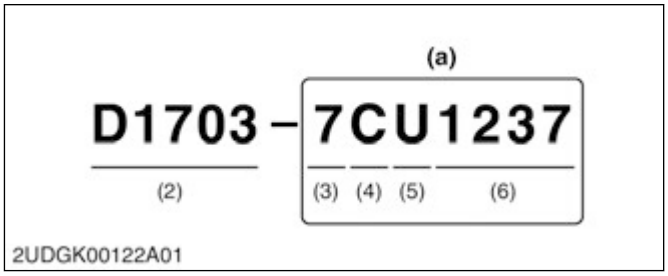
## 2. Engine model identification

**IMPORTANT**

- **Before contacting customer support, note the excavator model, serial number, engine type, engine serial number, and hour meter.**




(1) Engine model and serial number




(2) Engine model
(3) Engine series
(4) Production year
(5) Production month
(6) Lot number
(a) Engine serial number

**Engine serial number**

The engine serial number identifies the engine series, production year, production month, and lot number.

### Engine series

| Number or letter | Series |
|---|---|
| 1 | 05 (include: WG) |
| 2 | V3 |
| 3 | 08 |
| 4 | SM (include: WG) |
| 5 | Air-cooled gasoline |
| 6 | GZ, OC, AC, EA, E |
| 7 | 03 |
| 8 | 07 |
| A | EA, RK |
| B | 03 (KET production) |

### Production year

| Number or letter | Year | Number or letter | Year |
|---|---|---|---|
| 1 | 2001 | F | 2015 |
| 2 | 2002 | G | 2016 |
| 3 | 2003 | H | 2017 |
| 4 | 2004 | J | 2018 |
| 5 | 2005 | K | 2019 |
| 6 | 2006 | L | 2020 |
| 7 | 2007 | M | 2021 |
| 8 | 2008 | N | 2022 |
| 9 | 2009 | P | 2023 |
| A | 2010 | R | 2024 |
| B | 2011 | S | 2025 |
| C | 2012 | T | 2026 |
| D | 2013 | V | 2027 |
| E | 2014 | | |

### Production month and lot number

| Month | Lot number | |
|---|---|---|
| January | A0001 to A9999 | From B0001 |
| February | C0001 to C9999 | From D0001 |
| March | E0001 to E9999 | From F0001 |
| April | G0001 to G9999 | From H0001 |
| May | J0001 to J9999 | From K0001 |
| June | L0001 to L9999 | From M0001 |
| July | N0001 to N9999 | From P0001 |
| August | Q0001 to Q9999 | From R0001 |
| September | S0001 to S9999 | From T0001 |
| October | U0001 to U9999 | From V0001 |
| November | W0001 to W9999 | From X0001 |
| December | Y0001 to Y9999 | From Z0001 |

(Continued)

# 3. Specifications

| Model | | | KX027-4 | | | |
|---|---|---|---|---|---|---|
| Type | | | Canopy | | Cabin | |
| | | | Rubber track | Steel track | Rubber track | Steel track |
| Machine weight[*1] | | | 2520 kg | 2635 kg | 2590 kg | 2705 kg |
| Operating weight[*2] | | | 2595 kg | 2710 kg | 2665 kg | 2780 kg |
| Bucket | Capacity (CECE) | | 0.060 $m^3$ | | | |
| | Width with teeth (without teeth) | | 500 mm (450 mm) | | | |
| Engine | Type | | Water-cooled four-cylinder diesel engine | | | |
| | Model name | | V1505-E4-BH-2 | | | |
| | Displacement | | 1498 $cm^3$ | | | |
| | Engine performance (ISO 9249) | | 17.5 kW (23.8 HP) | | | |
| | Rated speed | | 2250 $min^{-1}$(rpm) | | | |
| | Maximum speed | | 2470 $min^{-1}$(rpm) | | | |
| Performance | Swivel speed<br>Swivel frame | | 9.8 $min^{-1}$(rpm) | | | |
| | Travel speed | High speed | 4.6 km/h | | | |
| | | Low speed | 2.7 km/h | | | |
| | Ground pressure (without operator) | | 24.0 kPa (0.24 $kgf/cm^2$) | 25.1 kPa (0.25 $kgf/cm^2$) | 24.7 kPa (0.25 $kgf/cm^2$) | 25.8 kPa (0.26 $kgf/cm^2$) |
| | Climbing performance | | 36% (20 degrees) | | | |
| | Max. lateral sway | | 27% (15 degrees) | | | |
| Blade | width × height | | 1400 × 300 mm | | | |
| Swing angle of the boom | Left | | 1.34 rad (77 degrees) | | | |
| | Right | | 0.99 rad (57 degrees) | | | |
| AUX1 port connector | Max. flow rate (theoretical) | | 47.3 L/min | | | |
| | Max. pressure | | 22.5 MPa (225 bar) | | | |
| AUX2 port connector[*3] | Max. flow rate (theoretical) | | 18.0 L/min | | | |
| | Max. pressure | | 17.2 MPa (172 bar) | | | |
| Fuel tank capacity | | | 48 L | | | |
| Pulling capacity at the towing eyes | | | 70500 N | | | |
| Vertical load at the towing eyes | | | 7200 N | | | |
| Noise level | | LpA | 76.5 dB (A) | | | |
| | | LwA (2000/14/EC) | 93 dB (A) | | | |
| Vibration[*4] | Hand arm system (ISO 5349-2: 2001) | Digging | less than 2.5 $m/s^2$ RMS | | | |
| | | Leveling | less than 2.5 $m/s^2$ RMS | | less than 2.2 $m/s^2$ RMS | |
| | | Driving | less than 2.5 $m/s^2$ RMS | | | |
| | | Idling | less than 2.5 $m/s^2$ RMS | | | |
| | Whole body (ISO 2631-1: 1997) | Digging | less than 0.5 $m/s^2$ RMS | | | |
| | | Leveling | less than 0.5 $m/s^2$ RMS | | | |
| | | Driving | less than 0.5 $m/s^2$ RMS | | | |

(Continued)

| Model | | | KX027-4 |
|---|---|---|---|
| Vibration*4 | Whole body (ISO 2631-1: 1997) | Idling | less than 0.5 $m/s^2$ RMS |

*1 With standard bucket 55 kg, operating readiness established.

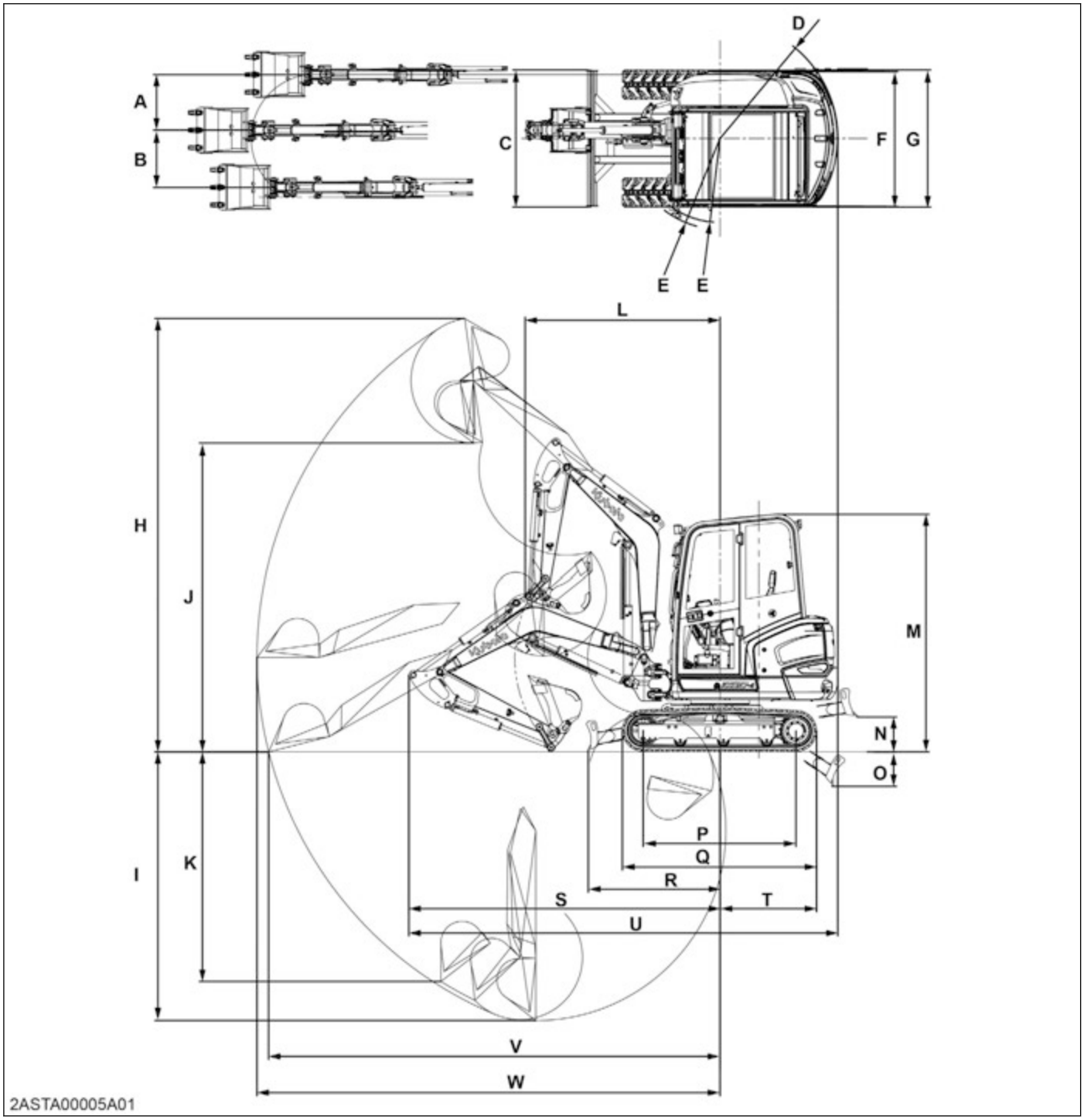
*2 Machine weight, including operator 75 kg.

*3 Only for KX027-4 HI-spec.

*4 These values are measured under specific conditions at maximum engine speed and can deviate, depending on the operating situation.

The main specifications are subject to change without prior notice.

# 4. Machine dimensions




**Canopy specification (1300 mm arm)**

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 570 mm 22.4 in. | 580 mm 22.8 in. | 1400 mm 55.1 in. | 1200 mm 47.2 in. | 930 mm 36.6 in. | 1380 mm 54.3 in. | 1400 mm 55.1 in. | 4410 mm 173.6 in. | 2740 mm 107.9 in. | 3140 mm 123.6 in. | 2340 mm 92.1 in. | 1990 mm 78.3 in. |
| M | N | O | P | Q | R | S | T | U | V | W | - |
| 2420 mm 95.3 in. | 360 mm 14.2 in. | 350 mm 13.8 in. | 1560 mm 61.4 in. | 1980 mm 78.0 in. | 1340 mm 52.8 in. | 3170 mm 124.8 in. | 1200 m m 38.6 in. | 4370 mm 172.0 in. | 4600 mm 181.1 in. | 4720 mm 185.8 in. | - |

### Cabin specification (1300 mm arm)

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 570 mm 22.4 in. | 580 mm 22.8 in. | 1400 mm 55.1 in. | 1200 mm 47.2 in. | 860 mm 33.9 in. | 1380 mm 54.3 in. | 1400 mm 55.1 in. | 4410 mm 173.6 in. | 2740 mm 107.9 in. | 3140 mm 123.6 in. | 2340 mm 92.1 in. | 1990 mm 78.3 in. |
| M | N | O | P | Q | R | S | T | U | V | W | - |
| 2420 mm 95.3 in. | 360 mm 14.2 in. | 350 mm 13.8 in. | 1560 mm 61.4 in. | 1980 mm 78.0 in. | 1340 mm 52.8 in. | 3170 mm 124.8 in. | 1200 mm 38.6 in. | 4370 mm 172.0 in. | 4600 mm 181.1 in. | 4720 mm 185.8 in. | - |

### Canopy specification (1050 mm arm)

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 570 mm 22.4 in. | 580 mm 22.8 in. | 1400 mm 55.1 in. | 1200 mm 47.2 in. | 930 mm 36.6 in. | 1380 mm 54.3 in. | 1400 mm 55.1 in. | 4420 mm 174.0 in. | 2490 mm 98.0 in. | 2970 mm 116.9 in. | 2100mm 82.7 in. | 1990 mm 78.3 in. |
| M | N | O | P | Q | R | S | T | U | V | W | - |
| 2420 mm 95.3 in. | 360 mm 14.2 in. | 350 mm 13.8 in. | 1560 mm 61.4 in. | 1980 mm 78.0 in. | 1340 mm 52.8 in. | 3140 mm 123.6 in. | 1200 mm 38.6 in. | 4340 mm 170.9 in. | 4360mm 171.7 in. | 4480 mm 176.4 in. | - |

### Cabin specification (1050 mm arm)

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 570 mm 22.4 in. | 580 mm 22.8 in. | 1400 mm 55.1 in. | 1200 mm 47.2 in. | 930 mm 36.6 in. | 1380 mm 54.3 in. | 1400 mm 55.1 in. | 4420 mm 174.0 in. | 2490 mm 98.0 in. | 2970 mm 116.9 in. | 2100mm 82.7 in. | 1990 mm 78.3 in. |
| M | N | O | P | Q | R | S | T | U | V | W | - |
| 2420 mm 95.3 in. | 360 mm 14.2 in. | 350 mm 13.8 in. | 1560 mm 61.4 in. | 1980 mm 78.0 in. | 1340 mm 52.8 in. | 3140 mm 123.6 in. | 1200 mm 38.6 in. | 4340 mm 170.9 in. | 4360mm 171.7 in. | 4480 mm 176.4 in. | - |

**■ NOTE**

- **Dimensions are based on the machine with rubber tracks.**
- **Dimensions are based on the machine with standard bucket.**
- **Specifications are subjected to change without prior notice.**

# 5. Maintenance

## 5.1 Maintenance intervals table

**Operator maintenance chart**

| Check item | | Tasks | Hours of operation indicator | | | | | | | | | | Maintenance intervals | Pages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | | |
| Walk-around inspection | | Check | | | | | | | | | | | Daily | 2-29 |
| Dust valve | | Cleaning | | | | | | | | | | | Daily | 2-29 |
| Engine oil level | | Check | | | | | | | | | | | Daily | 2-29 |
| Coolant level | | Check | | | | | | | | | | | Daily | 2-29 |
| Radiator and oil cooler | | Check | | | | | | | | | | | Daily | 2-30 |
| Fan belt | | Check | | | | | | | | | | | Daily | 2-30 |
| Exhaust system leakage | | Check | | | | | | | | | | | Daily | 2-31 |
| Hydraulic oil level | | Check | | | | | | | | | | | Daily | 2-31 |
| Water separator | | Check | | | | | | | | | | | Daily | 2-31 |
| Bucket and bucket linkage | | Grease | | | | | | | | | | | Daily | 2-31 |
| Front attachments | Swing bracket | Grease | | | | | | | | | | | Daily | 2-32 |
| | Other greasing points | Grease | | | | | | | | | | | Daily | 2-32 |
| Fuel level | | Check | | | | | | | | | | | Daily | 2-33 |
| Washer liquid level | | Check | | | | | | | | | | | Daily | 2-33 |
| Electrical equipment | | Check | | | | | | | | | | | Daily | 2-33 |
| Fuel tank | | Drain | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-33 |
| Battery | | Check | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-34 |
| Swivel gear | | Grease | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-36 |
| Track tension | | Check | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-36 |
| | | Adjust | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-37 |
| Water separator | | Cleaning | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-38 |
| Swivel bearing | | Grease | | | | ○ | | | | ○ | | | 200 h | 2-39 |
| Air filter *1 | | Check | | | | ○ | | | | ○ | | | 200 h | 2-39 |
| | | Cleaning | | | | ○ | | | | ○ | | | 200 h | |
| Air cleaner *1 | | Check | | | | ○ | | | | ○ | | | 200 h | 2-39 |
| | | Cleaning | | | | ○ | | | | ○ | | | 200 h | |
| Radiator hoses and hose clamps | | Check | | | | ○ | | | | ○ | | | 200 h | 2-40 |
| Fuel line and intake air line | | Check | | | | ○ | | | | ○ | | | 200 h | 2-40 |

*1 If there is a lot of dust, air filters must be cleaned or replaced more often.

| Check item | | Tasks | Hours of operation indicator | | | | | | | | | | Maintenance intervals | Pages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 550 | 600 | 650 | 700 | 750 | 800 | 850 | 900 | 950 | 1000 | | |
| Walk-around inspection | | Check | | | | | | | | | | | Daily | 2-29 |
| Dust valve | | Clean | | | | | | | | | | | Daily | 2-29 |
| Engine oil level | | Check | | | | | | | | | | | Daily | 2-29 |
| Coolant level | | Check | | | | | | | | | | | Daily | 2-29 |
| Radiator and oil cooler | | Check | | | | | | | | | | | Daily | 2-30 |
| Fan belt | | Check | | | | | | | | | | | Daily | 2-30 |
| Exhaust system leakage | | Check | | | | | | | | | | | Daily | 2-31 |
| Hydraulic oil level | | Check | | | | | | | | | | | Daily | 2-31 |
| Water separator | | Check | | | | | | | | | | | Daily | 2-31 |
| Bucket and bucket linkage | | Grease | | | | | | | | | | | Daily | 2-31 |
| Front attachments | Swing bracket | Grease | | | | | | | | | | | Daily | 2-32 |
| | Other greasing points | Grease | | | | | | | | | | | Daily | 2-32 |
| Fuel level | | Check | | | | | | | | | | | Daily | 2-33 |
| Washer liquid level | | Check | | | | | | | | | | | Daily | 2-33 |
| Electrical equipment | | Check | | | | | | | | | | | Daily | 2-33 |
| Fuel tank | | Drain | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-33 |
| Battery | | Check | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-34 |
| Swivel gear | | Grease | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-36 |
| Track tension | | Check | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-36 |
| | | Adjust | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-37 |
| Water separator | | Clean | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | 50 h | 2-38 |
| Swivel bearing | | Grease | | ○ | | | | ○ | | | | ○ | 200 h | 2-39 |
| Air filter *1 | | Check | | ○ | | | | ○ | | | | ○ | 200 h | 2-39 |
| | | Clean | | ○ | | | | ○ | | | | ○ | 200 h | |
| Air cleaner *1 | | Check | | ○ | | | | ○ | | | | ○ | 200 h | 2-39 |
| | | Clean | | ○ | | | | ○ | | | | ○ | 200 h | |
| Radiator hoses and hose clamps | | Check | | ○ | | | | ○ | | | | ○ | 200 h | 2-40 |
| Fuel line and intake air line | | Check | | ○ | | | | ○ | | | | ○ | 200 h | 2-40 |

*1 If there is a lot of dust, air filters must be cleaned or replaced more often.

## Skilled personnel maintenance chart

| Servicing | Tasks | Hours of operation indicator * | | | | | | | | | | Maintenance intervals | Pages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | | |
| Fan belt | Adjust | | | | | ○ | | | | | ○ | 250 h | 2-41 |
| Pilot control valve linkage | Grease | | | | | ○ | | | | | ○ | 250 h | 2-41 |
| Engine oil and engine oil filter | Replace | | | | | | | | | | ○ | 500 h | 2-42 |
| Travel motor gear oil *3 | Replace | ● | | | | | | | | | ○ | 500 h | 2-43 |
| Fuel filter | Replace | | | | | | | | | | ○ | 500 h | 2-43 |
| Return filter *2 | Replace | | | | | ● | | | | | ○ | 500 h | 2-44 |
| In-line filter | Replace | | | | | | | | | | | 1000 h | 2-44 |
| Hydraulic oil and suction filter *2 | Replace | | | | | | | | | | | 1000 h | 2-45 |
| Air filter *1 | Replace | | | | | | | | | | | 1000 h | 2-46 |
| Air cleaner elements*1 | Replace | | | | | | | | | | | 1000 h | 2-46 |
| Pilot filter | Replace | | | | | | | | | | | 1000 h | 2-47 |
| Injection nozzle | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 1500 h | 2-47 |
| Engine oil in front idler and track roller | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | 2000 h | 2-48 |
| Alternator and starter motor | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 2000 h | 2-49<br>2-50 |
| Fuel injection pump | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 3000 h | 2-51 |
| Safety inspection *4 | Check | | | | | | | | | | | Annually | 2-51 |
| Radiator hoses and hose clamps | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 2 years | 2-52 |
| Fuel lines and intake air hoses | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 2 years | 2-53 |
| Coolant | Replace | | | | | | | | | | | Every 2 years | 2-53 |
| Hydraulic hoses | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 6 years | 2-54 |

* The servicing identified with ● must be carried out once the specified hours of operation after initial commissioning have been reached.
*1 If there is lot of dust, the air filters and the fresh air filters must be cleaned or replaced more often.
*2 When using a breaker over 20% → every 800 h.
When using a breaker over 40% → every 400 h.
When using a breaker over 60% → every 300 h.
When using a breaker over 80% → every 200 h.
*3 Earlier if necessary.
*4 At least annually

| Servicing | Tasks | Hours of operation indicator * | | | | | | | | | | Maintenance intervals | Pages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 550 | 600 | 650 | 700 | 750 | 800 | 850 | 900 | 950 | 1000 | | |
| Fan belt | Adjust | | | | | ○ | | | | | ○ | 250 h | 2-41 |
| Pilot control valve linkage | Grease | | | | | ○ | | | | | ○ | 250 h | 2-41 |
| Engine oil and engine oil filter | Replace | | | | | | | | | | ○ | 500 h | 2-42 |
| Travel motor gear oil *3 | Replace | | | | | | | | | | ○ | 500 h | 2-43 |
| Fuel filter | Replace | | | | | | | | | | ○ | 500 h | 2-43 |
| Return filter*2 | Replace | | | | | | | | | | ○ | 500 h | 2-44 |
| In-line filter | Replace | | | | | | | | | | ○ | 1000 h | 2-44 |
| Hydraulic oil and suction filter *2 | Replace | | | | | | | | | | ○ | 1000 h | 2-45 |
| Air filter *1 | Replace | | | | | | | | | | ○ | 1000 h | 2-46 |
| Air cleaner elements*1 | Replace | | | | | | | | | | ○ | 1000 h | 2-46 |
| Pilot filter | Replace | | | | | | | | | | ○ | 1000 h | 2-47 |
| Injection nozzle | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 1500 h | 2-47 |
| Engine oil in front idler and track roller | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | 2000 h | 2-48 |
| Alternator and starter motor | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 2000 h | 2-49<br>2-50 |
| Fuel injection pump | Check | Servicing by KUBOTA dealer. | | | | | | | | | | 3000 h | 2-51 |
| Safety inspection *4 | Check | | | | | | | | | | | Annually | 2-51 |
| Radiator hoses and hose clamps | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 2 years | 2-52 |
| Fuel lines and intake air hoses | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 2 years | 2-53 |
| Coolant | Replace | | | | | | | | | | | Every 2 years | 2-53 |
| Hydraulic hoses | Replace | Servicing by KUBOTA dealer. | | | | | | | | | | Every 6 years | 2-54 |

* The servicing identified with ● must be carried out once the specified hours of operation after initial commissioning have been reached.
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*2 When using a breaker over 20% → every 800 h.
When using a breaker over 40% → every 400 h.
When using a breaker over 60% → every 300 h.
When using a breaker over 80% → every 200 h.
*3 Earlier if necessary.
*4 At least annually

# 5.2 Lubricants quantity

| Items | | Quantity | Remarks |
|---|---|---|---|
| Engine oil | Engine | 4.5 L<br>1.19 U.S.gals | Including engine oil filter |
| | Front idler | 75 cc<br>4.6 cu.in. | - |
| | Track roller | 80 cc<br>4.9 cu.in. | - |
| | Carrier roller | 60 cc<br>3.7 cu.in. | - |
| Coolant | Without reserve tank | 2.4 L<br>0.63 U.S.gals | Canopy specification |
| | | 2.6 L<br>0.69 U.S.gals | Cabin specification |
| | Reserve tank | 0.6 L<br>0.16 U.S.gals | At **[FULL]** mark |
| Hydraulic oil | All hydraulic system | 42 L<br>11.1 U.S.gals | - |
| | Hydraulic oil tank | 34 L<br>8.98 U.S.gals | At center of gauge |
| Fuel | Fuel tank | 48 L<br>12.7 U.S.gals | - |
| Gear oil | Travel motor | 0.35 L<br>0.09 U.S.gals | - |

# 5.3 Recommended lubricants

| Items | Recommendation | | | Filled at factory | | Note |
|---|---|---|---|---|---|---|
| | Ambient temperature conditions | Viscosity | Quality standard | Brand | Type | |
| Engine oil | In winter or at low temperature | SAE 10W<br>SAE 20W | API CF*<br>API CI-4<br>API CJ-4 | - | - | • When diesel fuel with a high sulfur content (between 0.50% and 1.00%) is used, the engine oil and engine oil filter must be replaced at shorter intervals.<br>• Never use diesel fuel with a sulfur content exceeding 1.00%. |
| | In summer or at high temperature | SAE 30<br>SAE 40<br>SAE 50 | | - | - | |
| | All weather | 15W-40 * | | Shell | Rimula R4L* | |
| Coolant | - | - | SAE J1034*<br>MB 325.0*<br>ASTM D3306*<br>D4985 | ROWE | Hightec Antifreeze AN G48*<br>(-37°C)* | • Always use distilled water to mix with anti-freeze.<br>• Always follow the recommendations of the coolant manufacturer for the mixing ratio.<br>Do not mix with other coolants. |
| Grease | - | NLGI-2* | DIN 51825<br>KP2K-30* | Mobil | Mobilux EP2* | |
| | - | NLGI-1 | - | WEICON | Antiseize Standard | • Only use during the first 50 working hours (on all greasing points around the swing block). |
| Hydraulic oil | In winter or at low temperature | ISO 32<br>ISO 46* | - | Shell | Tellus S2M46* | |
| | In summer or at high temperature | ISO 46<br>ISO 68 | - | - | - | |
| Gear oil | In winter or at low temperature | SAE 75<br>SAE 80 | MIL-L-2105C* | - | - | |
| | In summer or at high temperature | SAE 90<br>SAE 140 | | - | - | |
| | All weather | 80W-90* | | Shell | Spirax MA80W* | |
| Fuel | - | - | EN 590<br>ASTM D975 | - | - | • For preparing the excavator for use in winter, fill the fuel tank with winter diesel and allow the engine to run for a few minutes.<br>• Never use diesel fuel with a sulfur content exceeding 1.00%. |

* These lubricants are used by the manufacturer for the initial filling.

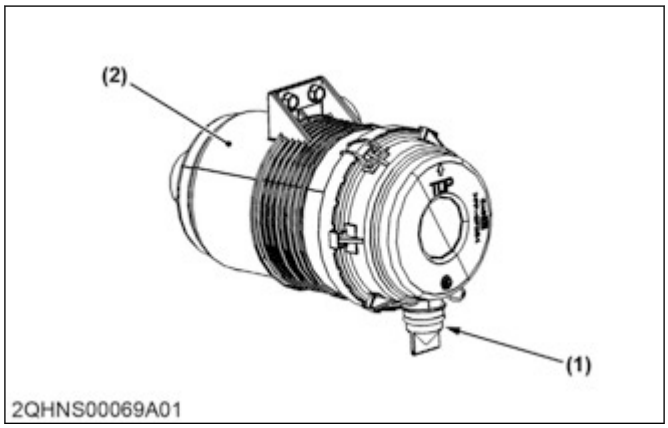
# 5.4 Daily check

## 5.4.1 Walk-around inspection

1. Check the excavator for visible damage, loose nuts and screws, and leaks.
2. Check and remove the accumulated dirt adjacent to hot components, such as engine, exhaust manifold, and muffler.
3. Check and remove the accumulated residues from leaves, straw, pine needles, twigs, bark and other flammable materials.
4. Check the safety instructions on the excavator. They must be complete and legible.
5. Ensure that the emergency hammer is present for the cabin specification.

## 5.4.2 Cleaning the dust valve

1. Press the dust valve several times or remove to clean inside.




(1) Dust valve (2) Air cleaner

## 5.4.3 Checking the engine oil level

**■ IMPORTANT**

- **If the oil level is too high or too low, the engine might be damaged during operation.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

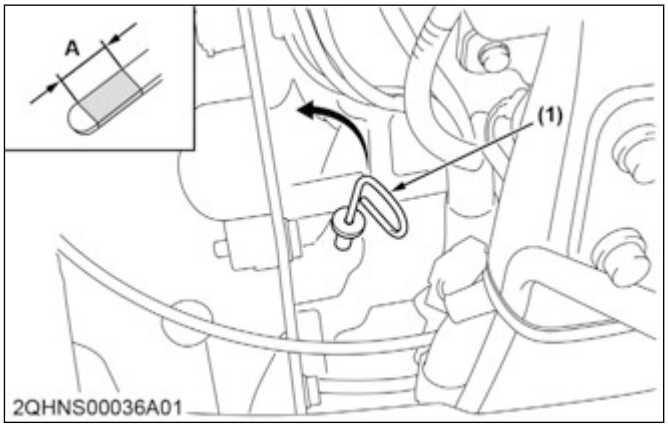
**Checking**

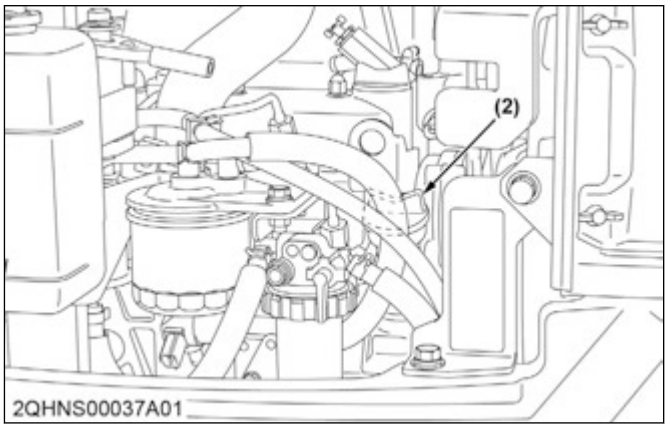
1. Pull the engine oil gauge out from the engine and wipe the engine oil off.

   **■ NOTE**

   - **Check the engine oil level 5 minutes after stopping the engine.**

2. Insert the engine oil gauge fully into the engine oil gauge port.
3. Pull the engine oil gauge out from the engine again and check the engine oil level.




(1) Engine oil gauge A: Correct oil level range
(2) Oil filler port

4. Replenish the engine oil if necessary.

**Recommended lubricants**

| | | |
|---|---|---|
| Engine oil | In winter or at low ambient temperature | API CF, API CI-4, API CJ-4 SAE 10W, SAE 20W |
| | In summer or at high ambient temperature | API CF, API CI-4, API CJ-4 SAE 30, SAE 40, SAE 50 |
| | All weather | API CF, API CI-4, API CJ-4 15W-40 |

## 5.4.4 Checking the coolant level

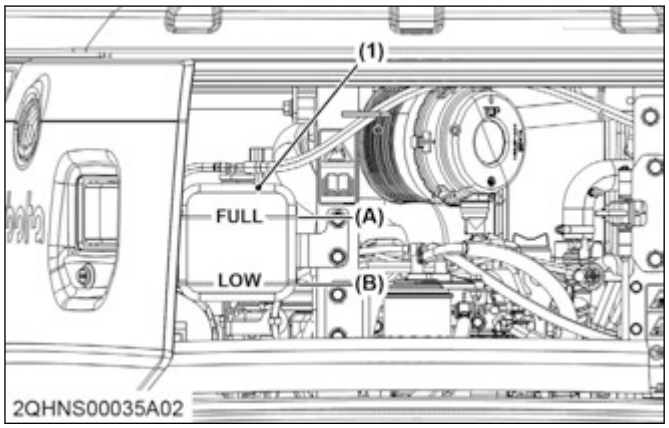
**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**

1. Check the coolant level is between the **[FULL]** and **[LOW]**.

**■ NOTE**
- **Check the coolant level in the reserve tank after the engine has cooled down.**




(1) Reserve tank (B) **[LOW]**
(A) **[FULL]**

2. Replenish the coolant into the reserve tank if necessary.

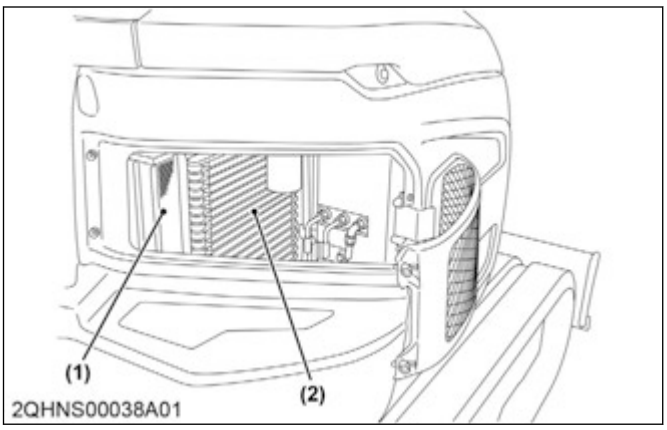
**■ IMPORTANT**
- **Do not replenish the coolant exceeding the [FULL].**
- **Do not mix the coolant with dirty or salt water.**
- **In case that the coolant level decreases soon after replenishing, there is a possibility of cooling system leakage. Repair the leakage before starting the engine.**

## 5.4.5 Checking the radiator and oil cooler

**⚠ CAUTION**
- **Wear the eye protector when cleaning the radiator and oil cooler with compressed air.**

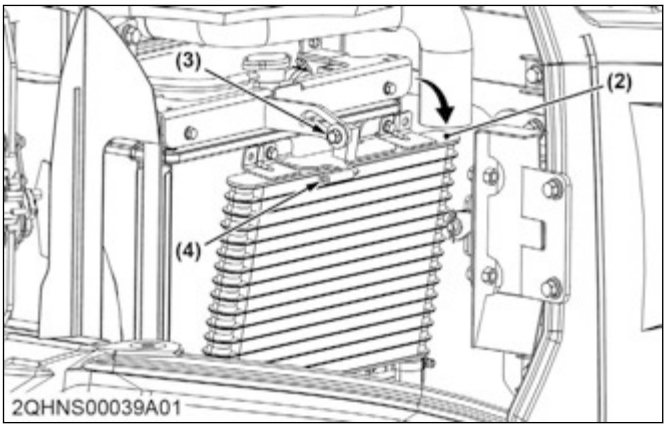
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**
1. Check if the fins of the radiator and oil cooler are clogged.




(1) Radiator (2) Oil cooler

2. Remove the bolt and pull the handle to tilt the oil cooler.




(2) Oil cooler (4) Handle
(3) Bolt (M8 × 20)

3. Remove the dirt by compressed air if necessary.

**■ IMPORTANT**
- **Pressure of compressed air must be under 205 kPa (2.1 kgf/cm$^2$, 30 psi).**

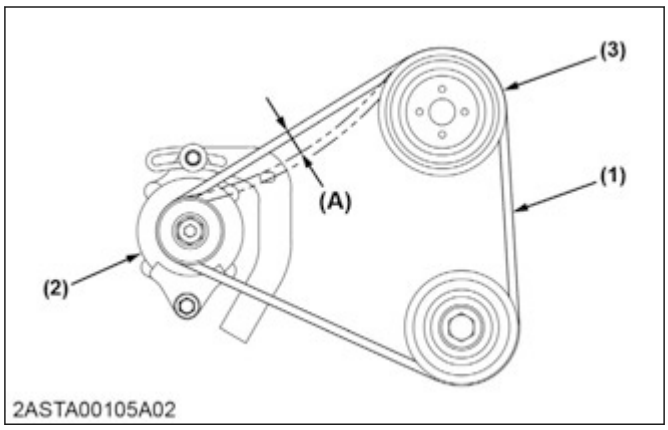
4. Check the radiator and oil cooler for damage.
5. Return the oil cooler to the original position and install the bolt.

## 5.4.6 Checking the fan belt

**⚠ CAUTION**
- **Stop the engine, remove the key, and hang a DO NOT OPERATE tag near the operator's seat when checking and adjusting the fan belt.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**
1. Check the crack and damage of the fan belt and replace if necessary.
2. Push position (A) to check the fan belt tension.




(1) Fan belt
(2) Alternator
(3) Pulley

3. Adjust the fan belt tension if necessary.

**Service specifications**

| | | |
|---|---|---|
| (A) Fan belt tension | 7 to 9 mm | Push with 60 to 70 N<br>Push with 6 to 7 kgf |

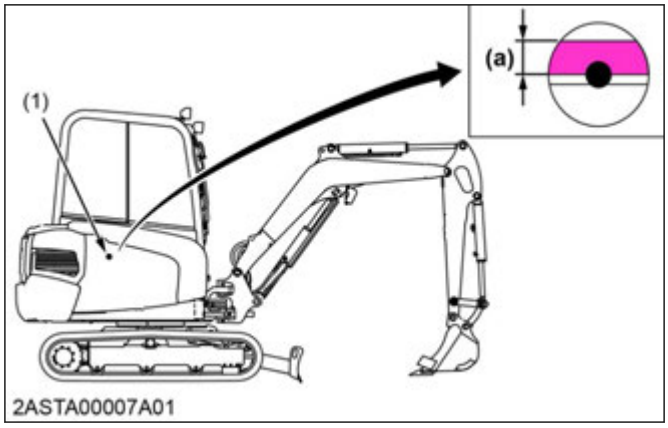
## 5.4.7 Checking the exhaust system leakage

**⚠ CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

1. Check the leakage, tightness, and cracks of exhaust system.
2. Repair the leakage or loosen parts before starting the engine.

## 5.4.8 Checking the hydraulic oil level

1. Park the machine on firm and level ground.
2. Operate the machine to hydraulic oil checking position.




(1) Hydraulic oil gauge
(a) Normal range

3. Check the hydraulic oil level at hydraulic oil temperature between 10 to 30 ℃.
4. Replenish the hydraulic oil if necessary.

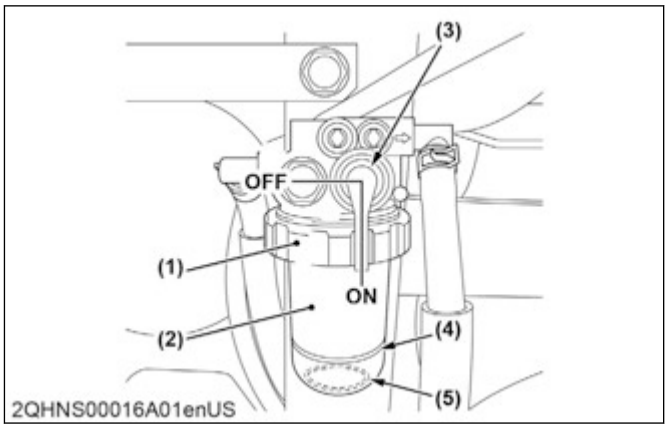
**■ IMPORTANT**
- **Clean around on the hydraulic oil tank before replenishing the hydraulic oil to avoid dust contamination.**
- **Do not use or mix different oil.**

**Recommended lubricants**

| | | |
|---|---|---|
| Hydraulic oil | In winter or at low ambient temperature | ISO 32, ISO 46 |
| | In summer or at high ambient temperature | ISO 46, ISO 68 |

## 5.4.9 Checking the water separator

1. Check the water level by the float position.




(1) Water separator
(2) Cup
(3) Water separator handle
(4) Mark
(5) Float

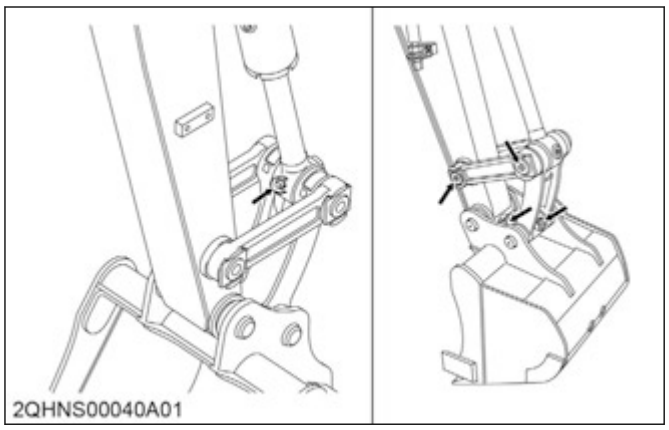
2. Clean the water separator if necessary.

## 5.4.10 Greasing the bucket and bucket linkage

**■ IMPORTANT**
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

1. Operate the bucket so that the greasing points are accessible.
2. Stop the engine.
3. Grease each grease fitting.

**■ NOTE**
- **Clean around the grease fittings before and after greasing.**



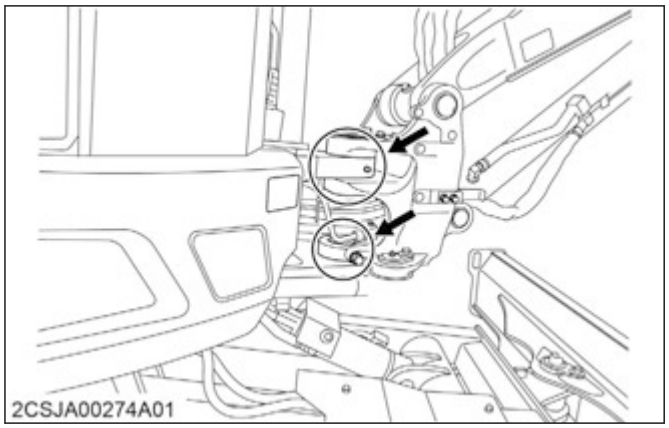

## 5.4.11 Greasing the swing bracket

**■ IMPORTANT**
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Greasing**
1. Grease the each grease fitting.

**■ NOTE**
- **Clean around the grease fittings before and after greasing.**



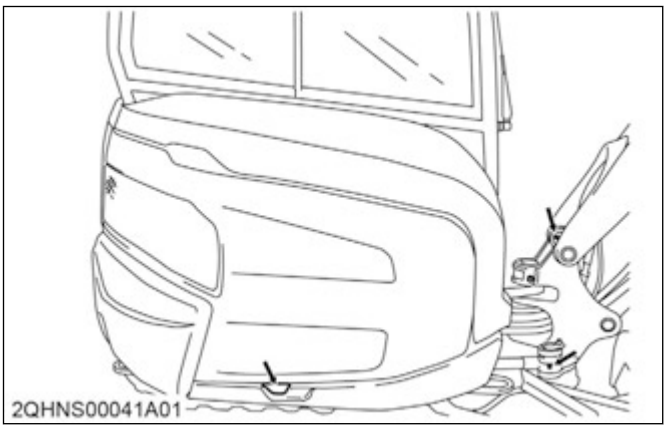

## 5.4.12 Greasing the other greasing points

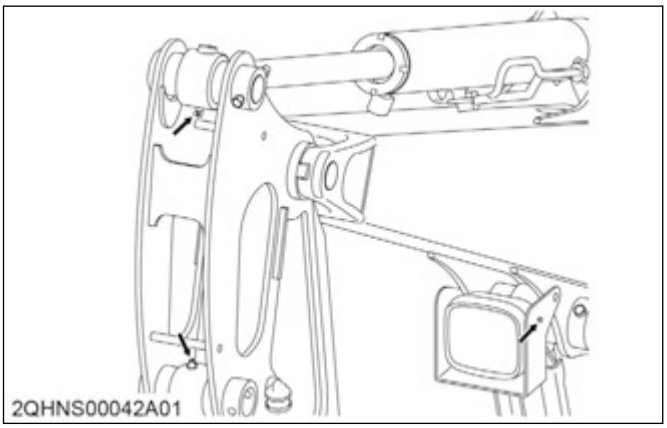
**■ IMPORTANT**
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

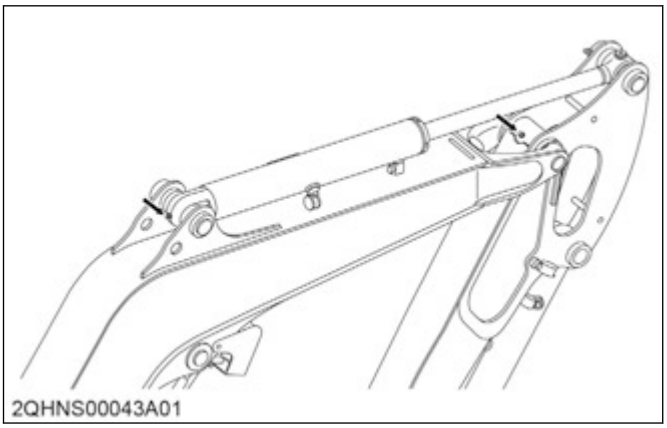
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

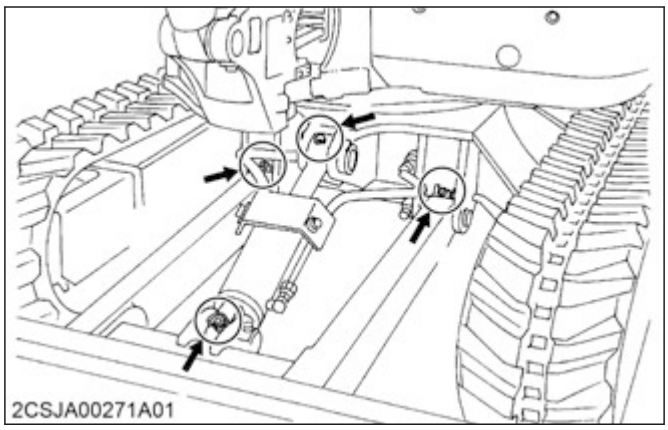
**Greasing**
1. Grease the each grease fitting.

**■ NOTE**
- **Clean around the grease fittings before and after greasing.**
- **Greasing the swivel gear and swivel bearing are not necessary for daily check.**





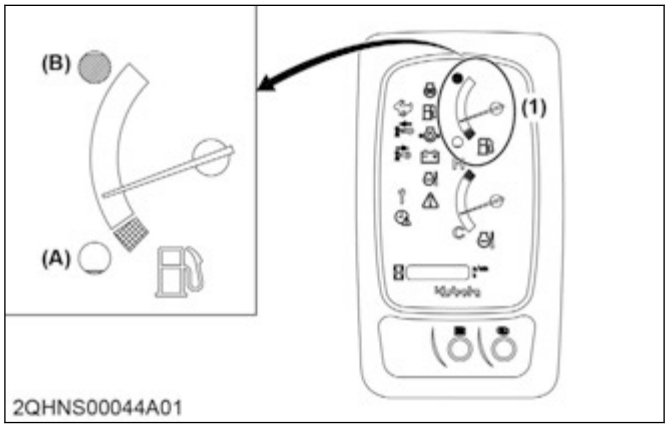

## 5.4.13 Checking the fuel level

**WARNING**
- **Keep fire and flammable items away from the working area.**

**IMPORTANT**
- **If the fuel is empty, do not start the engine to avoid mixing the air into the fuel system.**
- **Replenish the fuel into the fuel tank fully before parking overnight to prevent condensation accumulations in the fuel tank.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**
1. Turn the key switch to **[RUN]**.
2. Check the fuel level.




(1) Fuel gauge (B) Full
(A) Empty

3. Replenish the fuel if necessary.

**Recommended lubricant**

| | |
|---|---|
| Diesel fuel | EN 590<br>ASTM D975 |

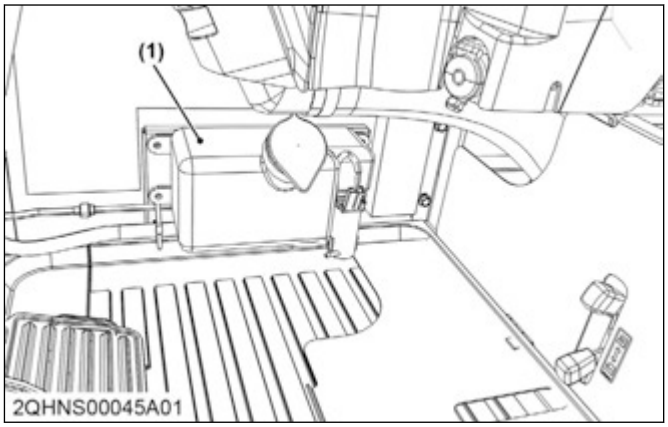
## 5.4.14 Checking the washer liquid level

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**
1. Check the washer liquid level.

**IMPORTANT**
- **Do not turn on the washer motor when the washer tank is empty to avoid damaging the washer motor.**

2. Replenish the washer tank if necessary.




(1) Washer tank

## 5.4.15 Checking the electrical equipment

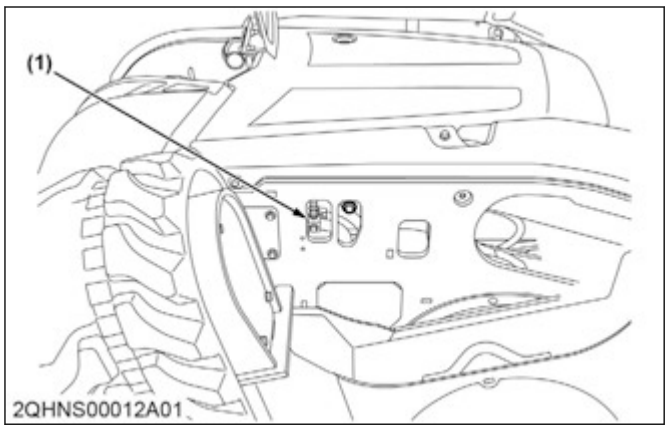
1. Check the function of the room light.
2. Check the function of the work light.
3. Check the function of the beacon.
4. Check the function of the blower motor.
5. Check the function of the washer system.
6. Check the tightness and condition of all accessible electrical wires and connectors.
7. Repair or replace damaged parts.
8. Check the rust and dirt of the fuses and clean if necessary.

# 5.5 Every 50 hours

## 5.5.1 Draining the fuel tank

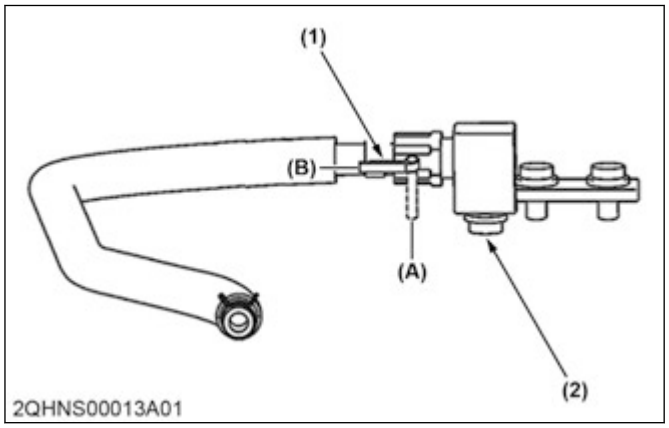
**WARNING**
- **Keep fire and flammable items away from the working area.**

1. Operate the swivel to put a tray under the drain plug on firm and level ground.




(1) Drain valve

2. Lower the bucket and blade to the ground and stop the engine.
3. Put a tray under the drain plug for receiving the water mixed fuel.
4. Close the drain valve.
5. Remove the drain plug.




(1) Drain valve
(2) Drain plug
(A) Close
(B) Open

6. Open the drain valve to drain the water mixed fuel.
7. Close the drain valve and install the drain plug with a new washer.

## 5.5.2 Checking the battery

**DANGER**

- **In case of the electrolyte level is below the "LOWER" mark, do not use or charge the battery to avoid battery explosion.**

**WARNING**

- **Do not remove the vent caps while the engine is running.**
- **Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water and get medical aid immediately.**
- **Do not use metal tools when cleaning battery terminals. It may cause short-circuit.**
- **Do not open a maintenance free battery.**

**CAUTION**

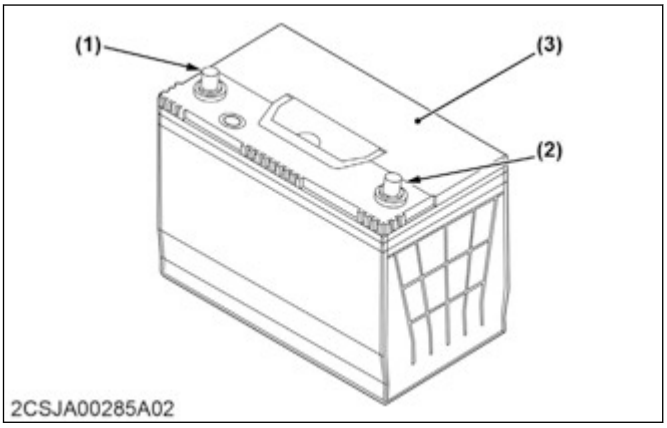
- **Keep a fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.**
- **Disconnect the negative (-) terminal first when removing the battery cable.**
- **Connect the positive (+) terminal first when connecting the battery cable.**

**IMPORTANT**

- **In case of using a maintenance free battery, checking the electrolyte level and density are not necessary. Check the battery condition with the indicator and replace the battery if necessary.**

**Checking the battery terminal**

1. Check the condition of the battery terminal.

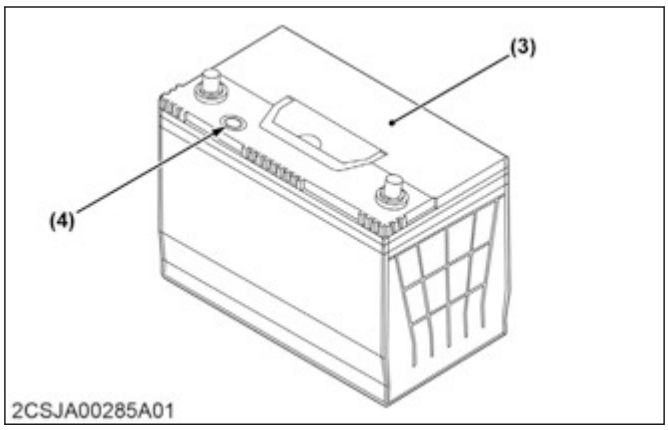



(1) Positive (+) terminal
(2) Negative (-) terminal
(3) Battery

2. Clean the battery terminal and grease with petroleum jelly if necessary.

**Checking the battery indicator**

1. Check the battery condition with the battery indicator.




(3) Battery (4) Indicator

**Battery condition (indicator color)**

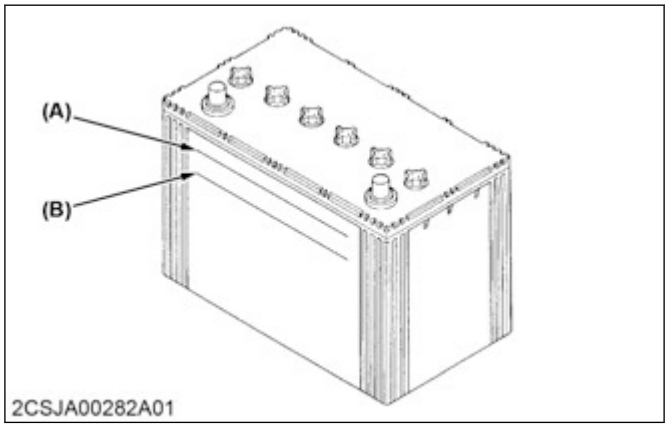
| Blue | Red | White |
|---|---|---|
| Normal | Need charging | Need replacing |

**■ NOTE**
- **Follow the battery manufacture's manual for details when checking the battery indicator.**

**Checking the electrolyte level**

1. Check the electrolyte level is between the upper and lower level line.
2. Replenish the distilled water if necessary.

**■ IMPORTANT**
- **Do not replenish the distilled water exceeding the upper level line.**

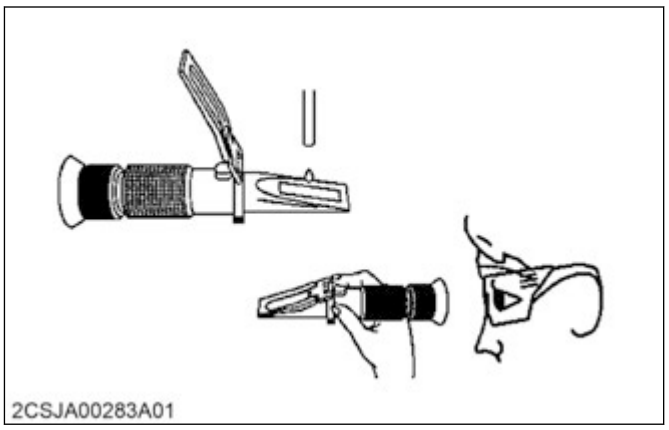


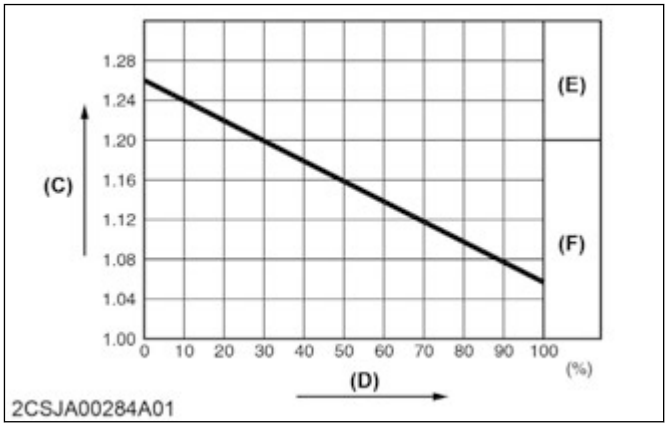

(A) Upper level line (B) Lower level line

**Checking the electrolyte density**

**⚠ CAUTION**
- **Wear the protective gloves, work clothing and eye protector to protect your skin and eyes from sulfuric acid in battery electrolyte.**

1. Remove the vent caps from the battery.
2. Measure the density of electrolyte with the refractometer and charge the battery if necessary..



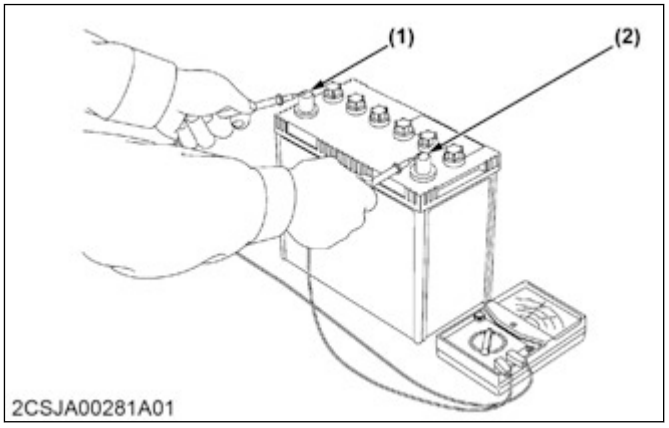




(C) Electrolyte density (F) Charging is necessary
(D) Discharge
(E) Normal

3. Install the vent caps.

**Checking the battery voltage**

1. Check the battery voltage with a voltage tester.




(1) Positive terminal (+) (2) Negative terminal (-)

| Battery voltage | Higher than 12 V |
|---|---|

2. Check the electrolyte density in case that the battery voltage is lower than the service specification.

**■ IMPORTANT**
- **Replace the maintenance free battery in case that the battery voltage is lower than 12 V.**

**Charging the battery**

**⚠ CAUTION**
- **Do not charge the maintenance free battery.**
- **Wear the protective gloves, work clothing and eye protector to protect your skin and eyes from sulfuric acid in battery electrolyte.**
- **In case of working indoors, make sure to ventilate the work area.**

1. Check the electrolyte level and replenish the distilled water if necessary.
2. Disconnect the battery cables from the battery.
3. Remove the vent caps.
4. Connect the battery to the charger.

**■ NOTE**
- **Follow the battery charger manufacture's manual for details when charging the battery.**

5. Charge the battery.

**■ IMPORTANT**
- **Charge the battery in normal speed.**
- **Charge the battery in fast speed only for emergencies because fast speed charge may shorten the battery life.**

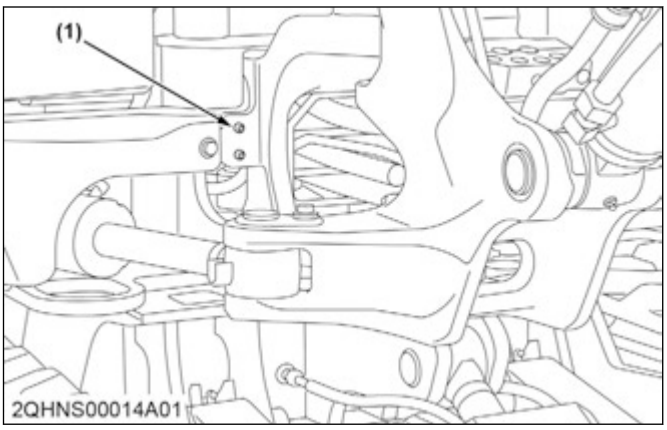
6. Check the electrolyte level after charging and replenish the distilled water if necessary.
7. Install the vent caps.
8. Connect the battery cables.

## 5.5.3 Greasing the swivel gear

**⚠ CAUTION**
- **Keep any persons or objects away from the swivel range.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Greasing**
1. Grease the swivel gear from the grease fitting.




(1) Grease fitting (for swivel gear)

**■ NOTE**
- **The grease amount should be approximately 50 g (20 to 30 pumps with the grease gun) at each position.**

2. Swivel the upper structure of the machine 90 degrees for 3 times to grease the gear.
3. Swivel the upper structure of the machine 360 degrees several times to distribute the grease evenly.

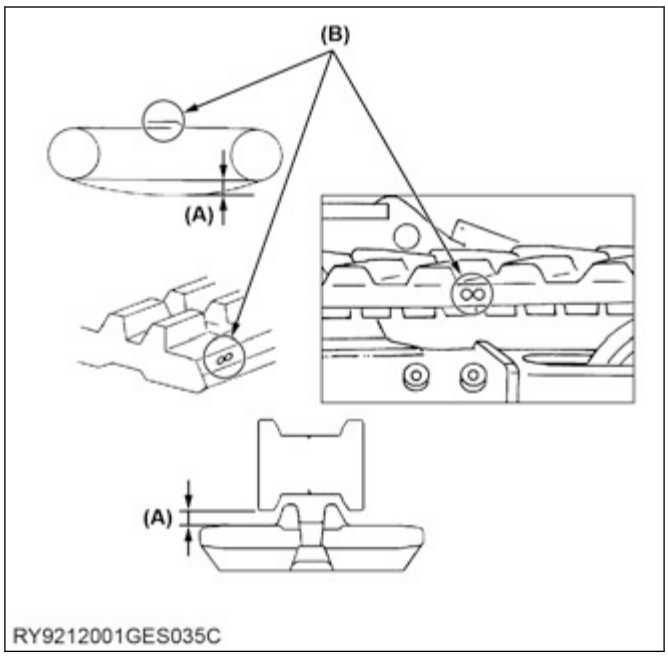
## 5.5.4 Checking the track tension

**⚠ CAUTION**
- **Put the machine on the jack stands securely when jacking up the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**

**■ IMPORTANT**
- **Wear amount is increased if the tracks are too tight or loose.**
- **The tracks may be derailed if the tracks are too loose.**

**Preparing**
1. Remove dirt such as stones caught between the tracks and sprockets, track rollers, and front idlers.
2. Jack up the machine on firm and level ground. Secure the machine on the jack stands.

**Checking the rubber track tension**
1. Rotate the track to set the match mark right over the carrier roller.
2. Check the track tension.



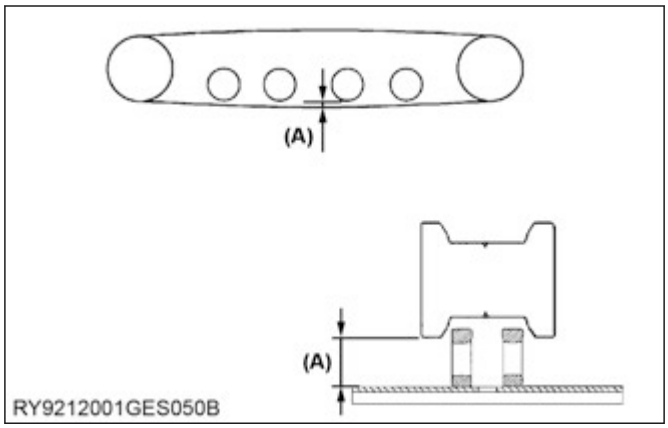

(A) Tension dimension (B) Match mark

**Service specification**

| | | |
|---|---|---|
| (A) | 10 to15 mm<br>0.39 to 0.59 in. | |

**Checking the steel track tension**

1. Check the track tension.




(A) Tension dimension

**Service specification**

| | |
|---|---|
| (A) | 80 to 85 mm<br>3.1 to 3.3 in. |

## 5.5.5 Adjusting the track tension

**⚠ CAUTION**

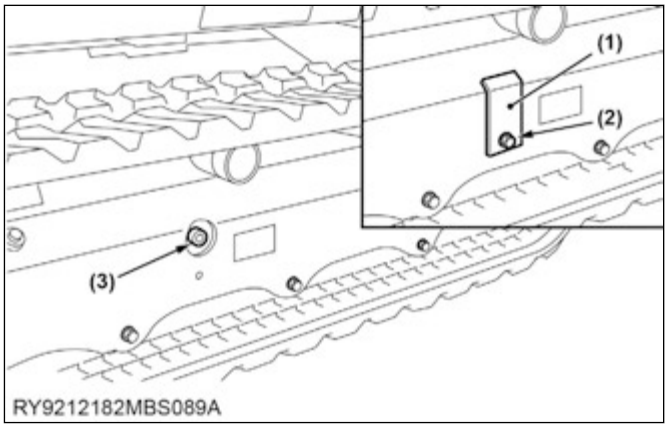
- **Put the machine on the jack stands securely when jacking up the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**Preparing**

1. Remove dirt such as stones caught between the tracks and sprockets, track rollers, and front idlers.
2. Jack up the machine on firm and level ground. Secure the machine on the jack stands.

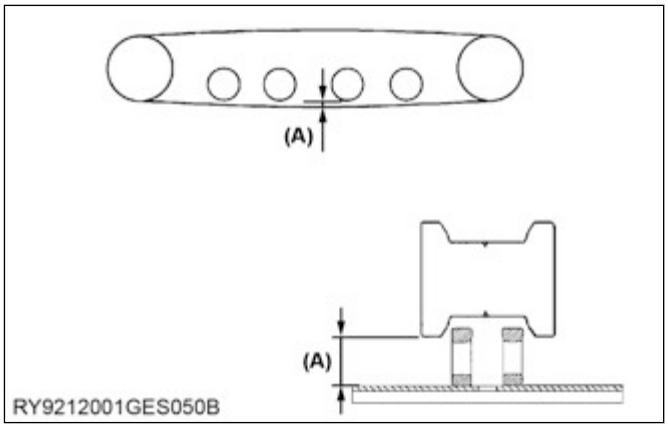
**Tightening the track tension**

1. Remove the bolt and cover.
2. Put grease into the grease fitting to extend the grease cylinder.




(1) Cover (3) Grease fitting
(2) Bolt

3. Adjust the distance between the track and track roller in range.



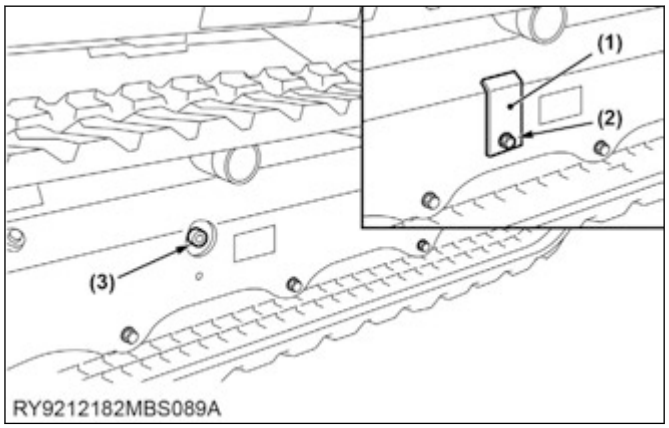

**Service specifications**

| | | |
|---|---|---|
| (A) | Rubber track | 10 to15 mm<br>0.39 to 0.59 in. |
| | Steel track | 80 to 85 mm<br>3.1 to 3.3 in. |

4. After adjustment, rotate the rubber track two revolutions and check the distance.

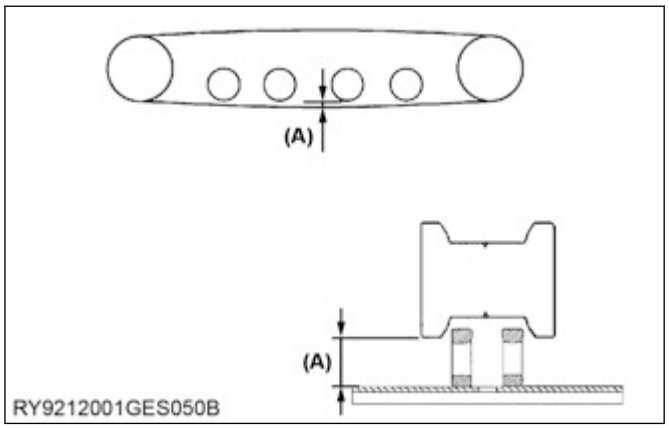
**Loosening the track tension**

1. Remove the cover.
2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.




(1) Cover
(2) Bolt
(3) Grease fitting

3. Adjust the distance between the track and track roller in range.




**Service specifications**

| | | |
|---|---|---|
| (A) | Rubber track | 10 to15 mm<br>0.39 to 0.59 in. |
| | Steel track | 80 to 85 mm<br>3.1 to 3.3 in. |

4. Tighten the grease fitting.

**Tightening torque**

| | | |
|---|---|---|
| (2) Grease fitting | 98 to 108 N·m<br>10 to 11 kgf·m<br>72 to 80 lbf·ft | - |

5. After adjustment, rotate the rubber track two revolutions and check the distance.

## 5.5.6 Cleaning the water separator

**WARNING**

- **Keep fire and flammable items away from the working area.**

**IMPORTANT**

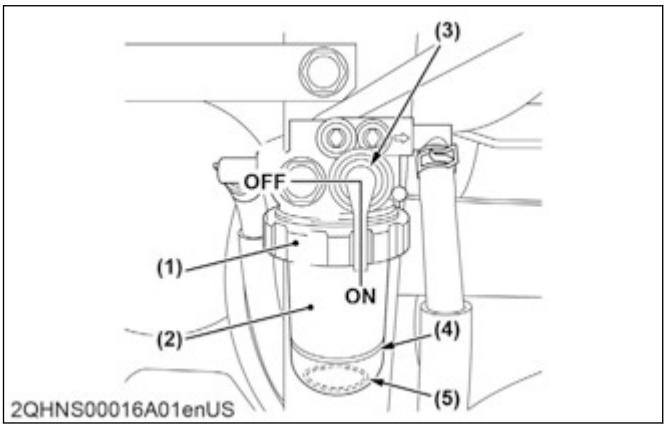
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

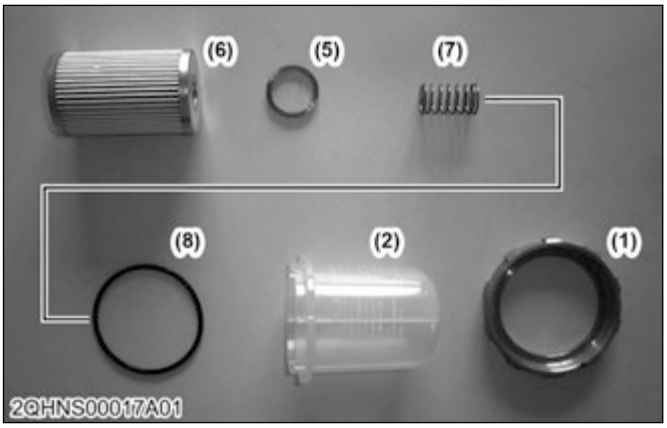
**Cleaning**

1. Turn the water separator lever to the **[OFF]**.




(1) Retainer ring
(2) Cup
(3) Water separator lever
(4) Line
(5) Float

2. Loosen the retainer ring to remove the cup.




(1) Retainer ring
(2) Cup
(5) Float
(6) Filter
(7) Spring
(8) O-ring

3. Remove the water mixed fuel from the cup.
4. Clean the cup with clean fuel.

5. Check damage and dirt of the filter and replace if necessary.
6. Apply fuel to the O-ring, assemble the water separator, and install the retainer ring by hand tightening.
7. Turn the water separator lever to the **[ON]**.
8. Turn the starter switch to **[RUN]** to bleed the air from the fuel line.

# 5.6 Every 200 hours

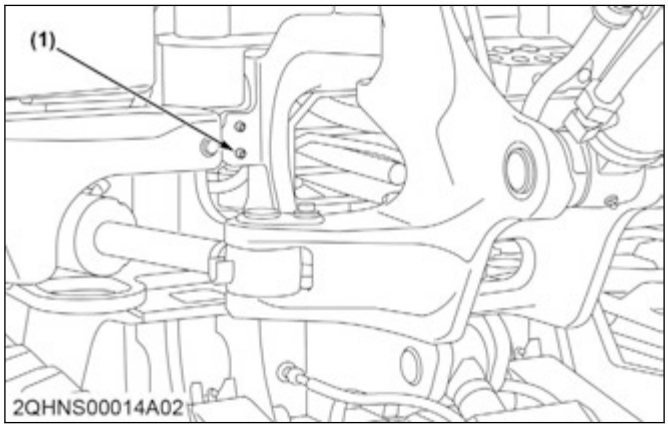
## 5.6.1 Greasing the swivel bearing

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Greasing**

1. Grease the swivel bearing from the grease fitting.




(1) Grease fitting (for swivel bearing)

**IMPORTANT**

- **The grease amount should be 10 g (approximately 5 pumps with the grease gun) for each position.**
- **Do not grease excessively to avoid damaging the seal of the swivel bearing.**

2. Swivel the upper structure of the machine 90 degrees for 3 times to grease the gear.
3. Swivel the upper structure of the machine 360 degrees several times to distribute the grease evenly.

## 5.6.2 Checking and cleaning the air filter

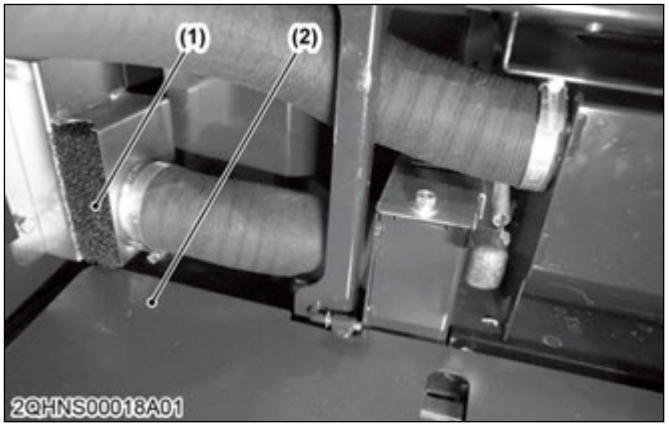
**CAUTION**

- **Wear eye protector when cleaning the air filter with compressed air.**

**IMPORTANT**

- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter more frequently.**

1. Unlock and open the cover.

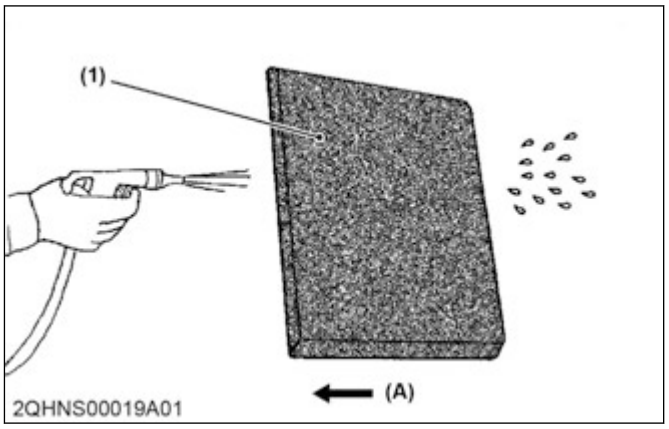



(1) Air filter (2) Cover

2. Remove the air filter.
3. Check damage and dirt of the air filter and replace if necessary.
4. Clean the air filter with compressed air from opposite direction of the intake air flow.

**IMPORTANT**

- **Pressure of the compressed air must be under 205 kPa (2.1 kg/cm$^2$, 30 psi).**




(1) Air filter (A) Intake air flow

5. Install the air filter.

## 5.6.3 Checking and cleaning the air cleaner elements

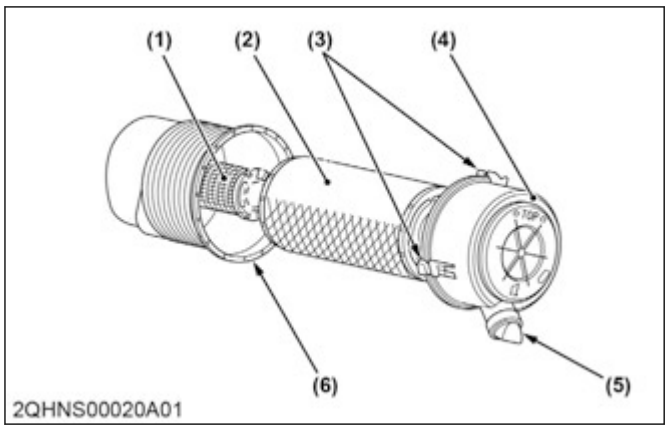
**CAUTION**

- **Wear eye protector when cleaning the outer element with compressed air.**

**IMPORTANT**
- **In case of using the machine in extremely dusty conditions, check and clean or replace the outer element more frequently.**
- **Do not start the engine without installing the filter elements.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking and cleaning**
1. Open the clips and remove the cover.




(1) Inner element
(2) Outer element
(3) Clip
(4) Cover
(5) Dust valve
(6) Air cleaner case

2. Remove the outer element from the air cleaner case.
3. Check the outer element for damage and dirt and replace it if necessary.
4. Clean the outer element with compressed air.




**IMPORTANT**
- **Pressure of the compressed air must be under 500 kPa (5.1 kg/cm$^2$, 73 psi).**
- **Blow the compressed air from inside the element to outside.**
- **Do not clean the outer element with fluids.**

5. Clean the air cleaner case and cover without removing the inner element.
6. Clean the dust valve.
7. Install the outer element and cover.

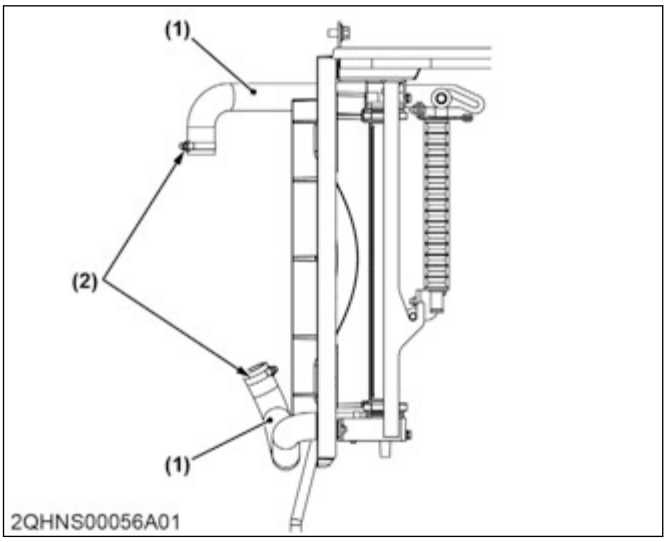
**IMPORTANT**
- **Install the cover so that the top mark faces upwards.**

## 5.6.4 Checking the radiator hoses and clamps

**CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**
1. Check the radiator hoses and replace if necessary.
2. Check the tightness of the hose clamps and tighten if necessary.




(1) Radiator hose
(2) Hose clamp

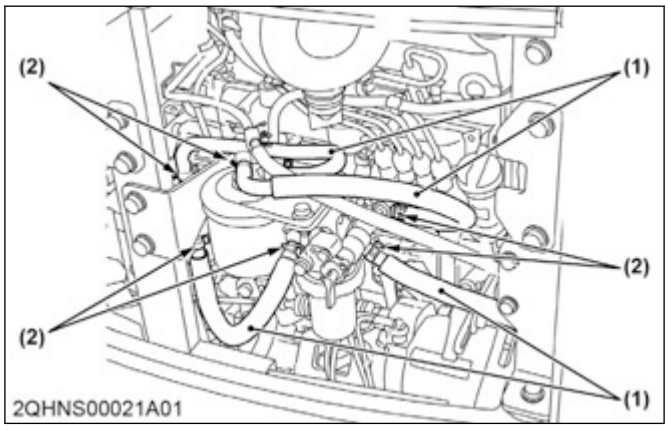
## 5.6.5 Checking the fuel line and intake air line

**CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

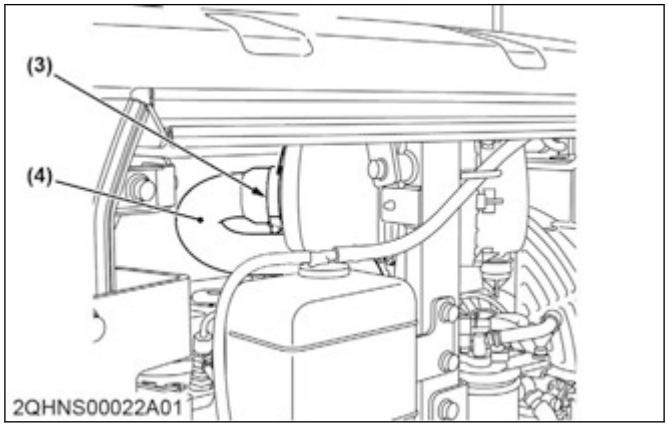
**Checking**

1. Check the fuel hoses and replace if necessary.
2. Check the tightness of the hose clamps and tighten if necessary.




(1) Fuel hose (2) Hose clamp

3. Check the intake air pipe and hose. Replace if necessary.
4. Check tightness of the intake air pipe and hose clamps. Tighten if necessary.




(3) Intake air pipe (4) Hose clamp

# 5.7 Every 250 hours

## 5.7.1 Adjusting the fan belt

**⚠ CAUTION**

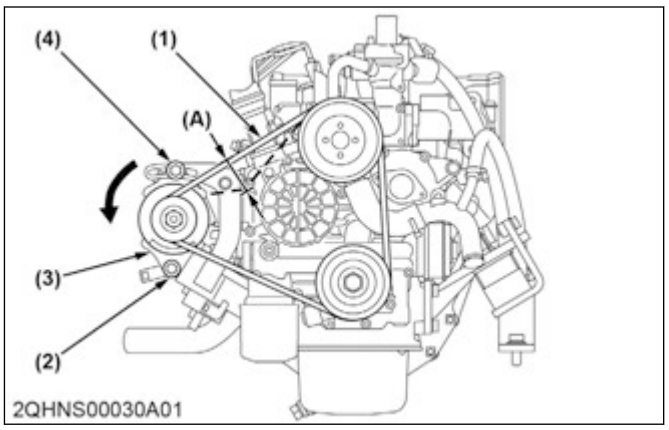
- **Stop the engine, remove the key, and hang a DO NOT OPERATE tag near the operator's seat when checking and adjusting the fan belt.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Adjusting**

1. Loosen the bolt and nut. Move the alternator to adjust the fan belt tension.




(1) Fan belt (4) Nut (M10)
(2) Bolt (M8 × 30)
(3) Alternator

**Service specification**

| | | |
|---|---|---|
| (A) Fan belt tension | 7 to 9 mm | Push with 60 to 70 N<br>Push with 6 to 7 kgf |

2. Tighten the bolt and nut.

**Tightening torque**

| | | |
|---|---|---|
| (2) Bolt | 17.7 to 20.6 N·m<br>1.8 to 2.1 kgf·m<br>13.1 to 15.2 lbf·ft | - |
| (4) Nut | 39.2 to 45.1 N·m<br>4.0 to 4.6 kgf·m<br>28.9 to 33.3 lbf·ft | - |

3. Start the engine and check if the fan belt is not slipping.

## 5.7.2 Greasing the pilot valve linkage

**⚠ CAUTION**

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.

**Greasing**

1. Pull up the boot on the pilot control valve.




(1) Universal joint (3) Boot
(2) Push rod

2. Grease the universal joint and push rod.




## 5.8 Every 500 hours

### 5.8.1 Replacing the engine oil and engine oil filter

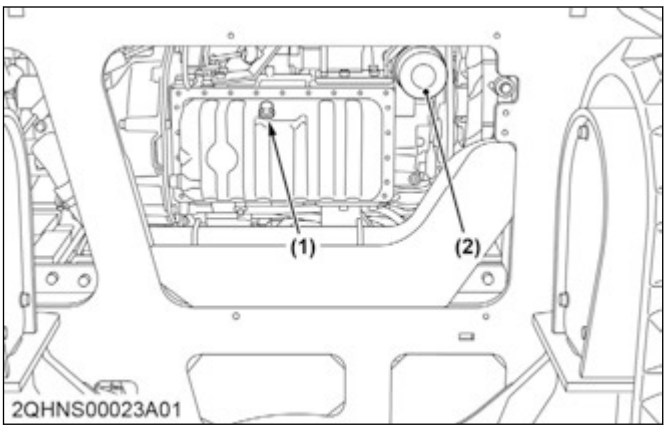
**⚠ CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, muffler, and oil are extremely hot.**
  - **Pressure in the engine oil line is high.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**

1. Put a tray under the drain plug for receiving the engine oil.




(1) Drain plug (2) Engine oil filter

2. Remove the drain plug and drain all of the engine oil.

**■ NOTE**
- **Remove the filler cap to drain the engine oil faster.**

3. Install the drain plug with the washer.
4. Put a tray under the engine oil filter for receiving the engine oil.
5. Remove the engine oil filter with a filter wrench.
6. Apply the engine oil to the O-ring and install the new engine oil filter by hand tightening.

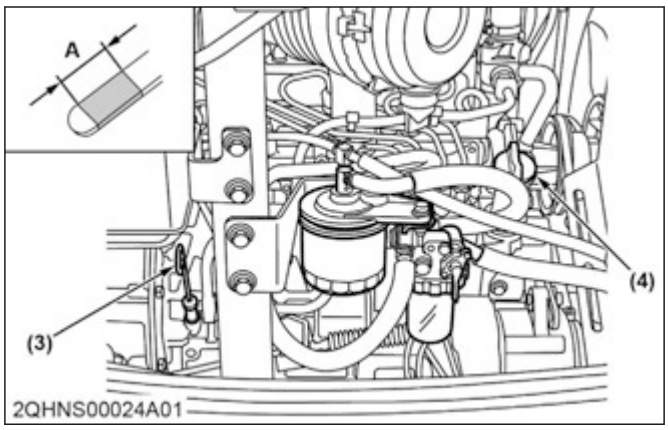
**■ IMPORTANT**
- **Do not tighten the engine oil filter strongly with the filter wrench.**

7. Fill the engine oil from the oil filler port up to the maximum level of the engine oil gauge.

**Recommended lubricants**

| | | |
|---|---|---|
| Engine oil | 4.5 L<br>1.19 U.S.gals | In winter or at low ambient temperature<br>API CF, API CI-4, API CJ-4<br>SAE 10W, SAE 20W |
| | | In summer or at high ambient temperature<br>API CF, API CI-4, API CJ-4<br>SAE 30, SAE 40, SAE 50 |
| | | All weather<br>API CF, API CI-4, API CJ-4<br>15W-40 |

8. Check the engine oil level with the engine oil gauge.




(3) Engine oil gauge A: Required oil level range
(4) Engine oil filler port

9. Start the engine in idling speed and leave it for 5 minutes.
10. Replenish the engine oil if necessary.

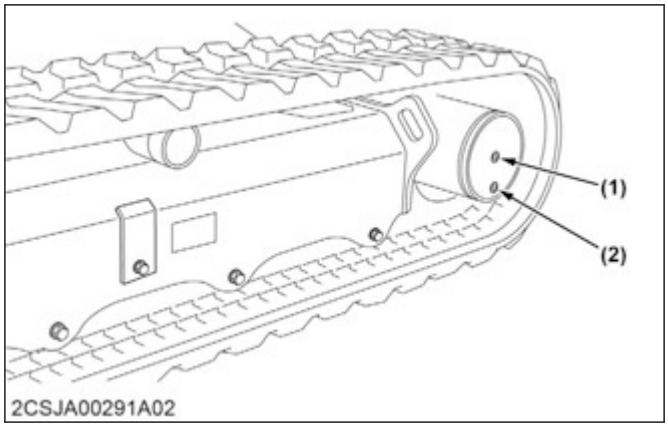
## 5.8.2 Replacing the travel motor gear oil

**IMPORTANT**
- **Initial replacement is 50 hours.**

1. Travel the machine for a while to warm up the gear oil.

**NOTE**
- **It is difficult to drain the gear oil in case that the gear oil is cold.**

2. Travel the machine so that the drain port is in the bottom position on firm and level ground.




(1) Oil filler and check port (2) Drain port

3. Lower bucket and blade to the ground and stop the engine.
4. Put a tray under the drain port for receiving the gear oil.
5. Remove the drain plug and drain all of the gear oil.
6. Install the drain plug with the new O-ring.
7. Remove the oil filler plug and replenish the gear oil.

**Recommended lubricants**

| | | |
|---|---|---|
| Gear oil | 0.35L<br>0.09 U.S.gals | In winter or at low ambient temperature<br>SAE 75, SAE 80 |
| | | In summer or at high ambient temperature<br>SAE 90, SAE 140 |
| | | All-weather<br>80W-90 |

8. Check the oil level from the oil filler and check port.
9. Install the oil filler plug with the new O-ring.

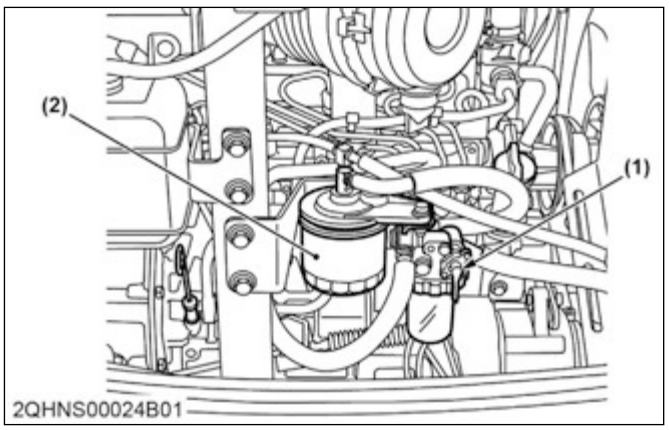
## 5.8.3 Replacing the fuel filter

**WARNING**
- **Keep fire and flammable items away from the working area.**

**CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**
1. Turn the water separator lever to **[OFF]**.
2. Remove the fuel filter with the filter wrench.




(1) Water separator lever (2) Fuel filter

3. Apply the fuel to the O-ring and install the new fuel filter by hand tightening.

**IMPORTANT**
- **Do not tighten the filter strongly with the filter wrench.**

4. Turn the water separator lever to the **[ON]**.
5. Turn the starter switch to **[RUN]** to bleed the air from the fuel line.

6. Check the leakage from the fuel filter and tighten the filter slightly with the filter wrench if it is leaking.

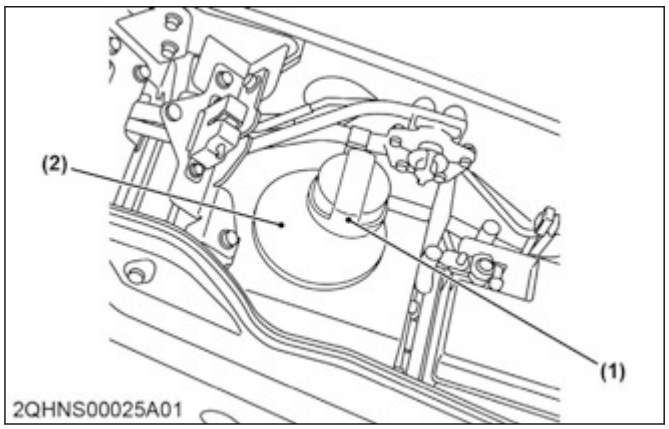
### 5.8.4 Replacing the return filter

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

**■ IMPORTANT**
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

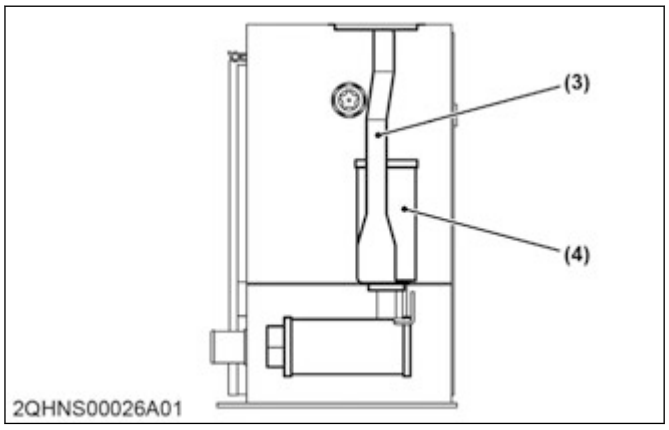
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**
1. Remove the breather filter and cover.




(1) Breather filter (2) Cover

2. Remove the return filter with the filter support from the hydraulic oil tank.




(3) Filter support (4) Return filter

3. Remove the filter support from the return filter.
4. Install the filter support to the new return filter.
5. Apply the hydraulic oil to the O-ring and install the return filter with the filter support to hydraulic oil tank.
6. Check the hydraulic oil level and replenish if necessary.

**Recommended lubricants**

| | | |
|---|---|---|
| Hydraulic oil | In winter or at low ambient temperature | ISO 32, ISO 46 |
| | In summer or at high ambient temperature | ISO 46, ISO 68 |

7. Apply the hydraulic oil to the O-ring and install the cover.

**Tightening torque**

| | |
|---|---|
| (2) Cover | 26.0 to 31.0 N·m<br>2.7 to 3.2 kgf·m<br>19.2 to 22.9 lbf·ft |

8. Apply the hydraulic oil to the O-ring and install the breather filter by hand tightening.

## 5.9 Every 1000 hours

### 5.9.1 Replacing the in-line filter

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

1. Remove the lower cover.




(1) Lower cover

2. Disconnect the hydraulic hose with the white tape.

**NOTE**
- **Put waste cloths under the pilot control valve.**

3. Replace the in-line filter.




(2) In-line filter

4. Connect the hydraulic hose with the white tape to the in-line filter.
5. Install the lower cover.

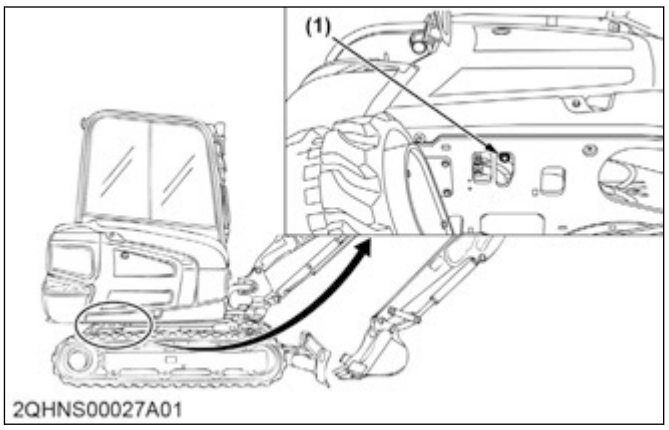
## 5.9.2 Replacing the hydraulic oil and suction filter

**CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

**IMPORTANT**
- **Do not reuse removed O-rings to assemble to avoid oil leakage.**

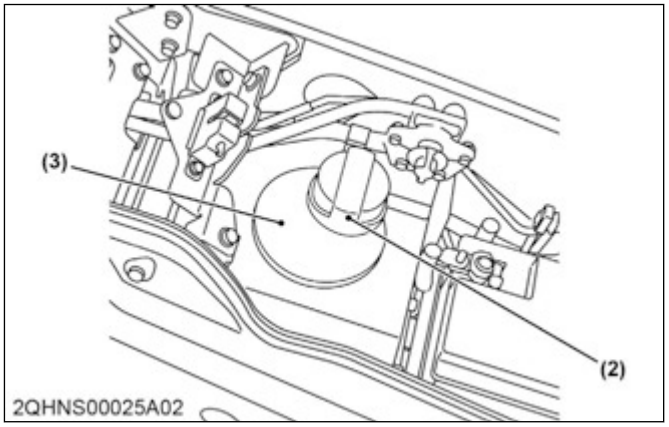
**NOTE**
- **Replace the return filter at the same time.**

1. Operate the swivel to put a tray under the drain plug on firm and level ground.



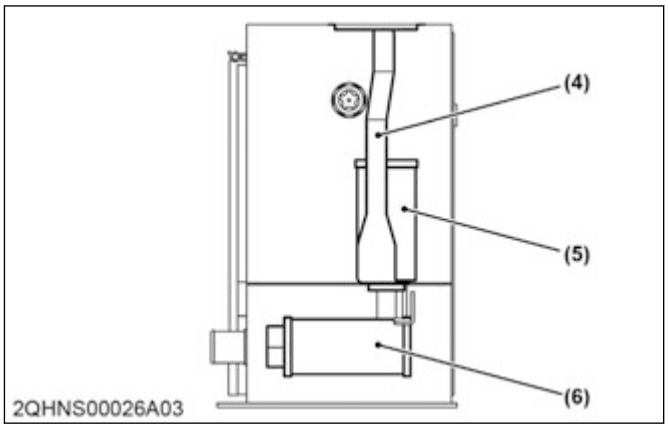

(1) Drain plug

2. Operate the machine to the hydraulic oil checking position.
3. Put a tray under the drain plug for receiving the hydraulic oil.
4. Remove the drain plug and drain all of the hydraulic oil.
5. Install the drain plug.
6. Remove the breather filter and cover.




(2) Breather filter (3) Cover

7. Remove the filter support with the return filter from the hydraulic tank.




(4) Filter support (6) Suction filter
(5) Return filter

8. Replace the suction filter.

**Tightening torque**

| | |
|---|---|
| (6) Suction filter | 58.8 to 68.6 N·m<br>6.0 to 7.0 kgf·m<br>43.4 to 50.6 lbf·ft |

9. Install the filter support with the new return filter.
10. Replenish the hydraulic oil.

**■ IMPORTANT**
- **Clean around the oil filler port on the hydraulic tank before replenishing the hydraulic oil.**
- **Do not use or mix different oil.**

**Recommended lubricants**

| | | |
|---|---|---|
| Hydraulic oil | 34 L<br>9.0 U.S.gals | In winter or at low ambient temperature<br>ISO 32, ISO 46 |
| | | In summer or at high ambient temperature<br>ISO 46, ISO 68 |

11. Apply the hydraulic oil to the O-ring and install the cover.

**Tightening torque**

| | |
|---|---|
| (3) Cover | 26.0 to 31.0 N·m<br>2.7 to 3.2 kgf·m<br>19.2 to 22.9 lbf·ft |

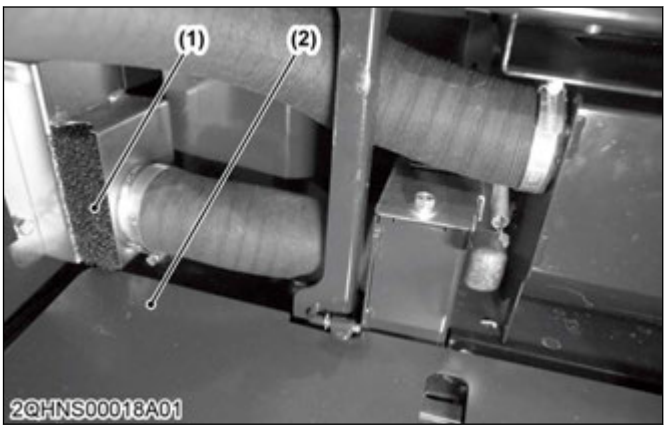
12. Apply the hydraulic oil to the O-ring and install the breather filter by hand tightening.
13. Start the engine and operate all of the hydraulic devices several times to bleed air in the hydraulic circuit.
14. Operate the machine to the hydraulic oil level check position.
15. Check the hydraulic oil level with the sight glass and replenish if necessary.

**■ NOTE**
- **Make sure that the oil level is in the center to third quarter of the sight glass.**

## 5.9.3 Replacing the air filter

**■ IMPORTANT**
- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter more frequently.**

1. Unlock and open the cover.




(1) Air filter (2) Cover

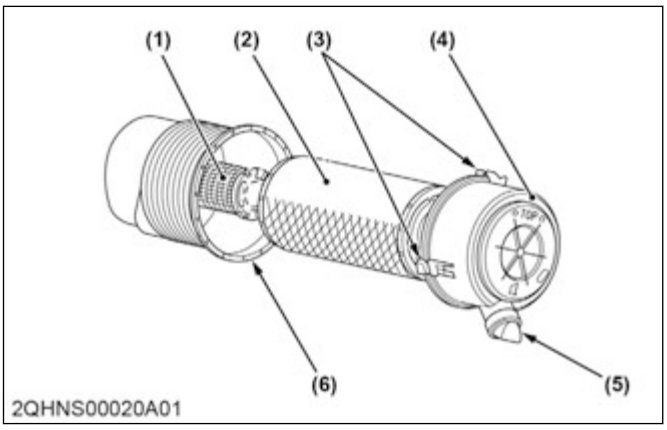
2. Remove the air filter from the support.
3. Install the new air filter.

## 5.9.4 Replacing the air cleaner elements

**■ IMPORTANT**
- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter element more frequently.**
- **Do not start the engine without installing the filter elements.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**
1. Open the clips and remove the cover.




(1) Inner element (5) Dust valve
(2) Outer element (6) Air cleaner case
(3) Clip
(4) Cover

2. Remove the outer element from the air cleaner case.
3. Clean the air cleaner case and cover without removing the inner element.
4. Clean the dust valve.
5. Replace the inner element.
6. Install the new outer element.

7. Install the cover.

**IMPORTANT**
- **Install the cover so that the top mark faces upwards.**

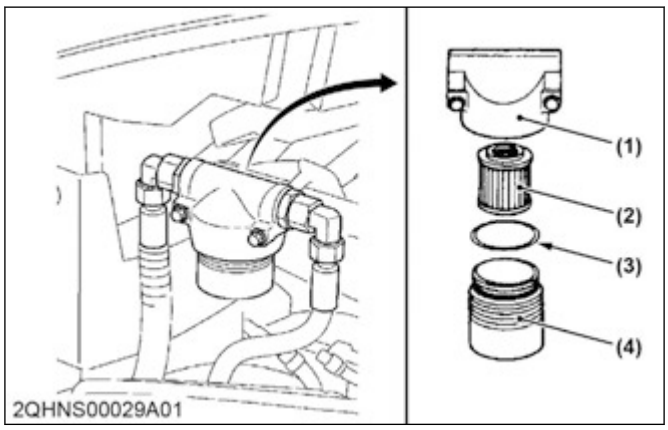
### 5.9.5 Replacing the pilot filter

**CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Release the residual pressure of the hydraulic circuit.**

**IMPORTANT**
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Replacing**
1. Remove the pilot filter case from the head cover.




(1) Head cover
(2) Element
(3) O-ring
(4) Case

**NOTE**
- **Put waste cloths under the pilot filter.**

2. Replace the element, apply the hydraulic oil to the O-ring, and install the case by hand tightening.
3. Start the engine in idling speed and leave it for a while.
4. Check the hydraulic oil level and replenish if necessary.

**Recommended lubricants**

| | | |
|---|---|---|
| Hydraulic oil | In winter or at low ambient temperature | ISO 32, ISO 46 |
| | In summer or at high ambient temperature | ISO 46, ISO 68 |

## 5.10 Every 1500 hours

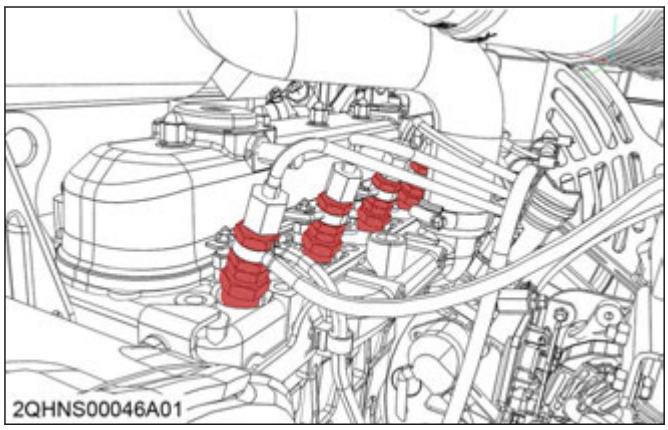
### 5.10.1 Checking the injection nozzles

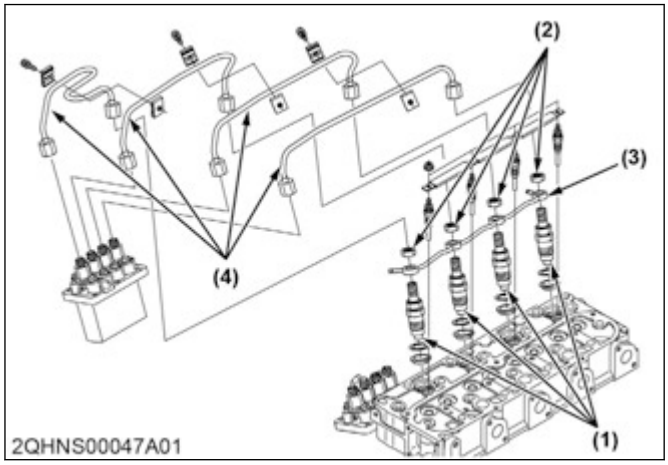
**WARNING**
- **Keep fire and flammable items away from the working area.**

**CAUTION**
- **Make sure that there are no person in the injecting direction.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

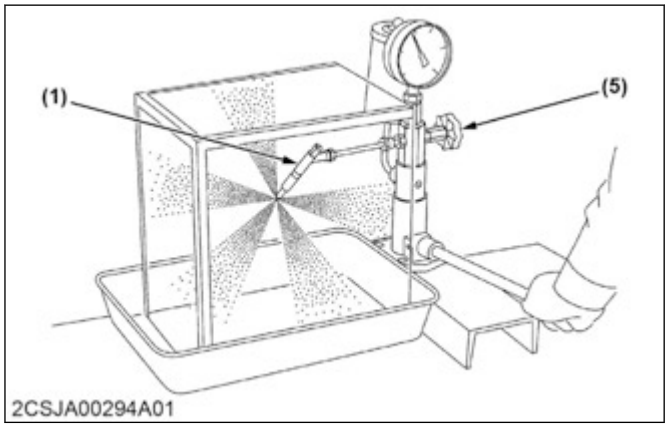
**Checking**
1. Remove the injection pipes, 4 nuts, and over flow pipe.
2. Remove the injection nozzles from the engine.




(1) Injection nozzle ×4
(2) Nut ×4
(3) Over flow pipe
(4) Injection pipe nut

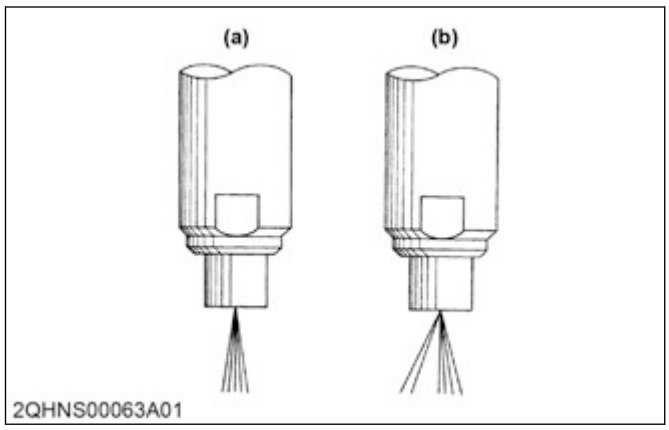
3. Set the injection nozzle to the nozzle tester.
4. Operate the lever of the nozzle tester slowly until injecting from the tip of the injection nozzle.
5. Measure the pressure when injecting.




(1) Injection nozzle
(5) Nozzle tester

| | |
|---|---|
| Fuel injection pressure | 13.7 MPa<br>139.7 kgf/cm$^2$<br>1987 psi |

6. Check the condition of injection.




(a) Normal
(b) Need to replace

7. Replace the injection nozzle if necessary.

**Tightening torque**

| | | |
|---|---|---|
| (1) Injection nozzle | 49 to 68 N·m<br>5.0 to 7.0 kgf·m<br>37 to 50 lbf·ft | - |
| (4) Injection pipe nut | 25 to 34 N·m<br>2.5 to 3.5 kgf·m<br>18 to 25 lbf·ft | - |

# 5.11 Every 2000 hours

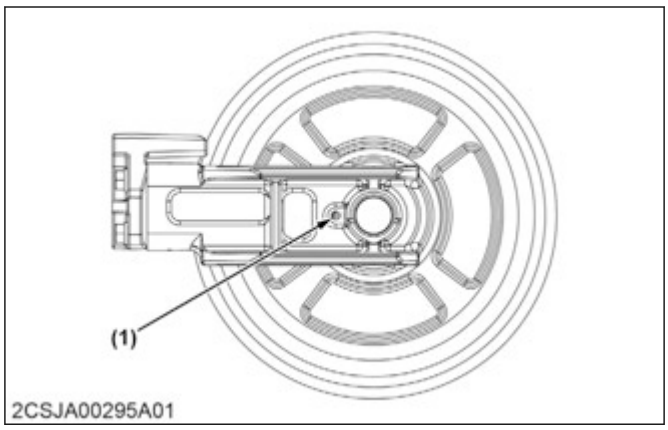
## 5.11.1 Replacing the engine oil in the front idler and track roller

**⚠ CAUTION**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**■ IMPORTANT**
- **Be sure to install the tracks in the correct direction.**

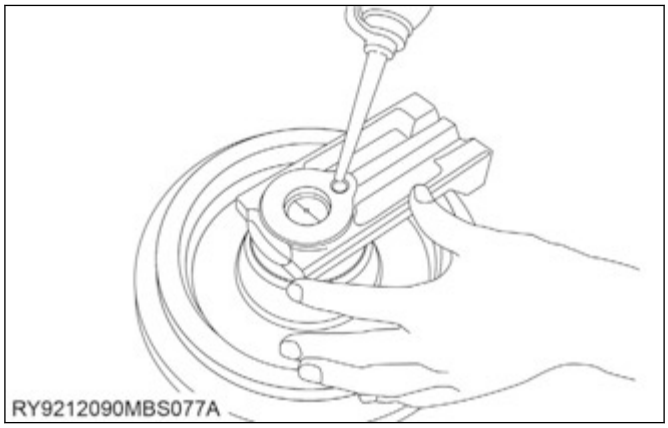
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Remove the two tracks.
3. Remove the two front idlers.
4. Remove all of the track rollers.

**Changing the engine oil in the front idler**
1. Remove the plug.




(1) Plug

2. Drain the engine oil from the front idler.
3. Fill up the new engine oil to specified volume.




**Recommended lubricant**

| | | |
|---|---|---|
| Front idler | Approximately 75 cc Approximately 4.57 cu.in. | CF, CF-4, CI-4, CJ-4 SAE #30CD |

4. Tighten the plug and install the two front idler assemblies to the machine.

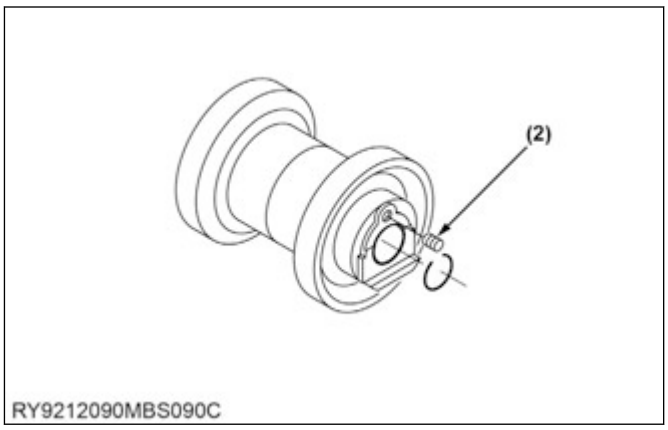
**Tightening torque**

| | | |
|---|---|---|
| (1) Plug (R1/8) | 10 N·m 1.0 kgf·m 7.4 lbf·ft | Thread lock (Loctite 262) |

5. Install the tracks and adjust the track tension.

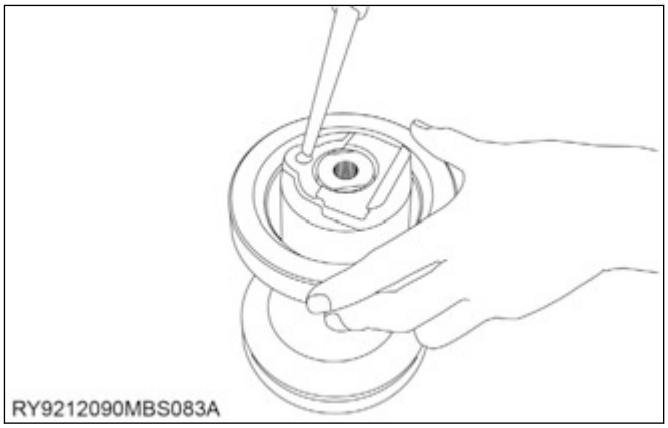
**Changing the engine oil in the track roller**

1. Remove the plug.




(2) Plug

2. Drain the engine oil from the track roller.
3. Fill up the new engine oil to specified volume.




**Recommended lubricant**

| | | |
|---|---|---|
| Track roller | Approximately 80 cc Approximately 4.9 cu.in. | CF, CF-4, CI-4, CJ-4 SAE #30CD |

4. Tighten the plug and install the track rollers to the machine.

**Tightening torque**

| | | |
|---|---|---|
| (2) Plug | 10 N·m 1.0 kgf·m 7.4 lbf·ft | Thread lock (Loctite 503) |

5. Install the tracks and adjust the track tension.

## 5.11.2 Checking the alternator

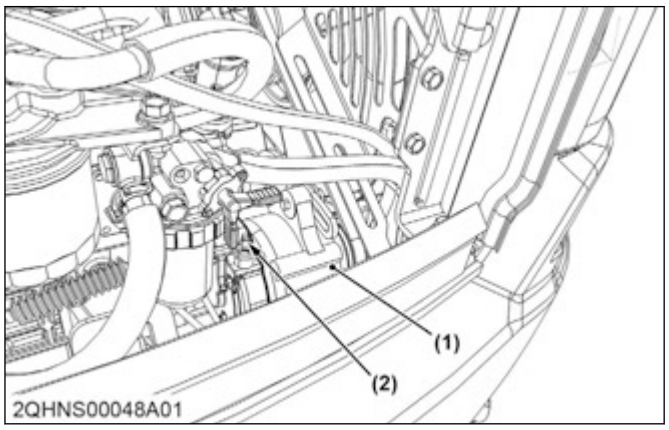
**WARNING**
- **Keep hands, body, tools and waste cloth away from the rotating fan and belt.**
- **Do not clamp the electrical wiring to fuel hoses.**

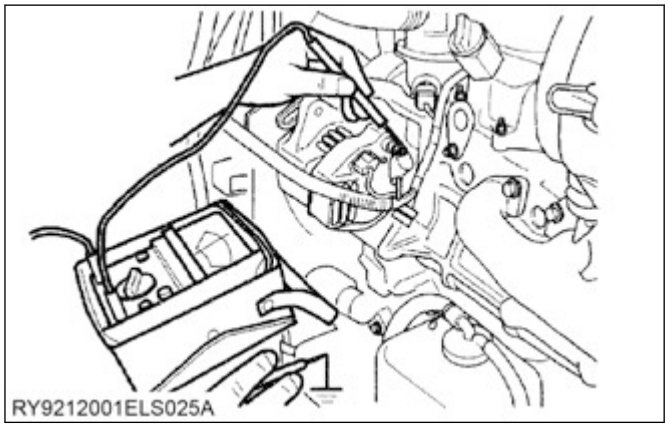
**CAUTION**
- **Do not alter the electrical device and wiring.**

1. Check the connections of the battery terminals.
2. Check the connections of the alternator terminal and connector.
3. Check the conduction of the slow blow fuse.
4. Check the tension of the fan belt.
5. Start the engine.
6. Check the abnormal noise heard from the alternator.

**■ NOTE**
- **If abnormal noise is heard from the alternator, there are possibilities of bearing deterioration, loosened or damaged fan belt, and wear of the pulley.**

7. Measure the voltage of the alternator between the terminal B and body ground.




(1) Alternator (2) Terminal B

| | | |
|---|---|---|
| Normal | Engine stop | Engine running |
| | 12 V | Approximately 14 V |

**■ NOTE**
- **If the voltage of alternator is not normal, check each component part following the engine WSM.**

## 5.11.3 Checking the starter motor

**⚠ WARNING**
- **Do not clamp the electrical wiring to fuel hoses.**

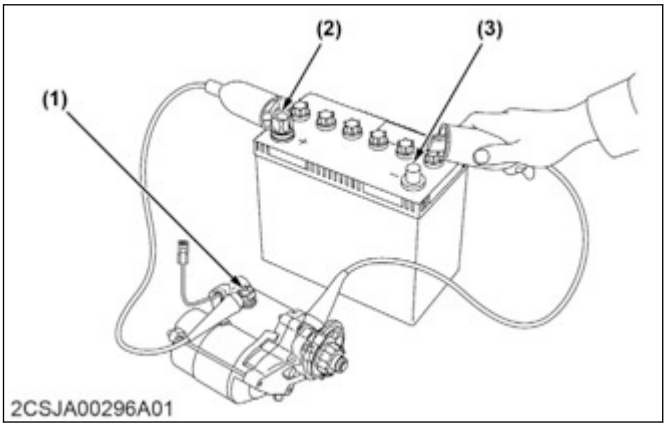
**⚠ CAUTION**
- **Do not alter the electrical device and wiring.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Remove the battery.
3. Disconnect all of the wire harnesses from the starter motor.
4. Remove the starter motor from the engine.

**Checking the motor**
1. Connect terminal C to the battery positive (+) terminal and connect the starter motor body to the battery negative (-) terminal.

**■ IMPORTANT**
- **Fix the starter motor when testing.**

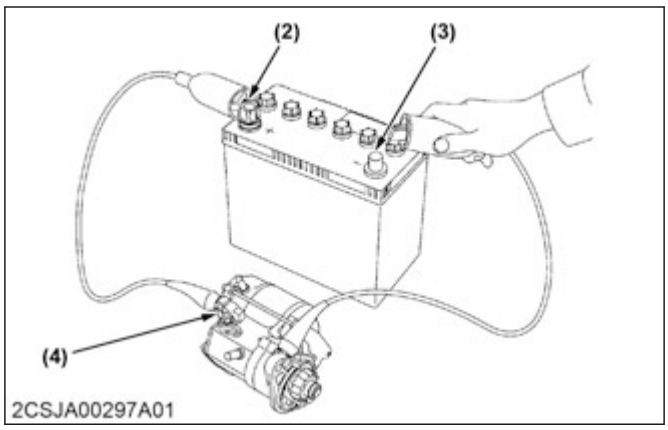
**■ NOTE**
- **If the starter motor does not operate, starter motor is damaged. Repair or replace the starter motor following the engine WSM.**




(1) Terminal C (3) Negative (-) terminal
(2) Positive (+) terminal

**Checking the magnetic switch**
1. Connect terminal S to the battery positive (+) terminal and connect the starter motor body to the battery negative (-) terminal.

**■ NOTE**
- **If the pinion gear does not come out, the magnetic switch is damaged. Repair or replace the starter motor following the engine WSM.**



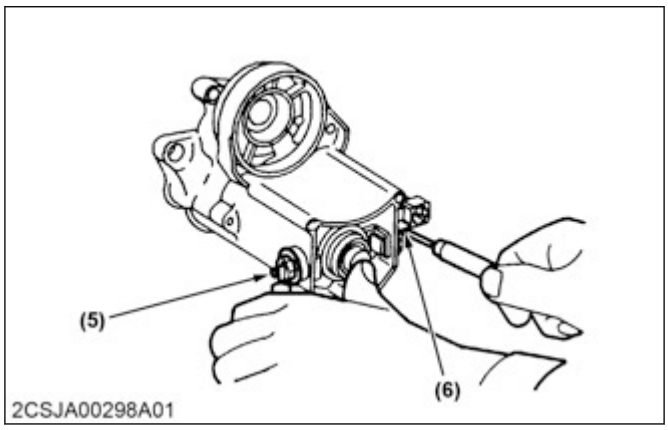

(2) Positive (+) terminal
(3) Negative (-) terminal
(4) Terminal S

**Checking the conduction of the magnetic clutch**

1. Push in the plunger and check the conduction between the terminal C and terminal B with a circuit tester.

**■ NOTE**

- **If there is no conduction, the magnetic clutch is damaged. Replace the starter motor following the engine WSM.**




(5) Terminal C
(6) Terminal B

# 5.12 Every 3000 hours

## 5.12.1 Checking the fuel injection pump

**⚠ WARNING**

- **Keep fire and flammable items away from the working area.**

**⚠ CAUTION**

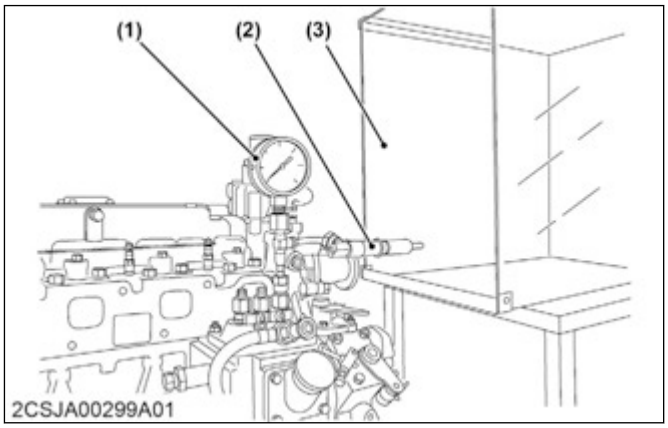
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Checking**

1. Remove the engine stop solenoid.
2. Remove the injection pipes and injection nozzles.
3. Install the pressure tester to the fuel injection pump.




(1) Fuel injection pump pressure tester
(2) Injection nozzle
(3) Protection cover

4. Install the injection nozzle to fuel injection pump pressure tester joint.
5. Set the speed control lever to the maximum speed position.
6. Crank the engine with the stater and measure the pressure.

| | |
|---|---|
| Fuel injection pressure | 13.7 MPa<br>139.7 kgf/cm$^2$<br>1987 psi |

7. If the pressure is lower than 13.7 MPa, replace the fuel injection pump following the engine WSM.

**■ IMPORTANT**

- **Do not disassemble the fuel injection pump assembly.**

# 5.13 Every 1 year

## 5.13.1 Safety inspection

- All safety inspections are based on the national worker's protection regulations, safety regulations and technical specifications applicable to the country in which the machine is operated.
  The owner should arrange for the safety inspections to be performed at specified intervals according to national rules and regulations.
- Based on their technical training and experience, the qualified personnel should have sufficient knowledge in the domain of the machine described here and be familiar with the applicable national work safety regulations, accident prevention regulations and the generally accepted technical

rules so that they can assess the sound operating condition of the machine.
- The qualified person must keep his appraisal and evaluation neutral and must not be influenced by personal, economic or operational interests. The inspection is a visual and functional check of all components for condition and completeness and of the effectiveness of the safety devices.
  The performance of the inspection must be documented in the form of an inspection report containing at least the following information:
  – Date and scope of the inspection indicating all pending checks.
  – Result of the inspection with a report of the determined faults.
  – Assessment with respect to commencing or continuing operation.
  – Information on necessary follow-up inspections.
  – Name, address, and signature of the inspector.
- The owner/employer (company) is responsible for the observance of the inspection intervals. The acknowledgement and the elimination of the determined faults must be confirmed by the owner/employer in writing, along with the date, in the inspection report.
- The inspection report must be kept on file at least until the next inspection.

## 5.14 Every 2 years

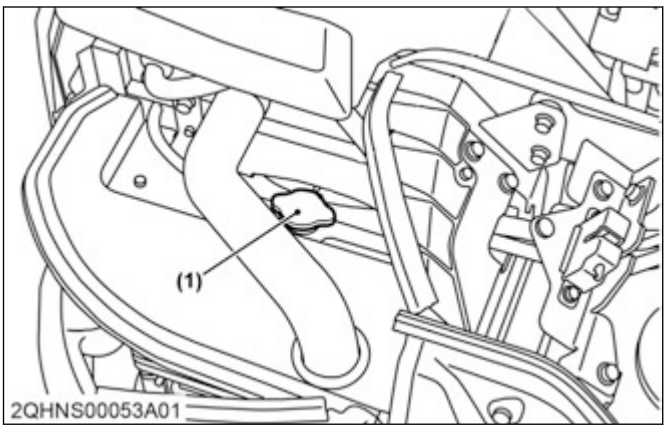
### 5.14.1 Replacing the radiator hoses and hose clamps

**WARNING**
- **Do not open the radiator cap soon after the engine has stopped. There is a possibility of serious burn injury due to the coolant blow out from the radiator.**

**CAUTION**
- **Do not work soon after the engine has stopped.**
  **– Engine, fuel, and oil are extremely hot.**

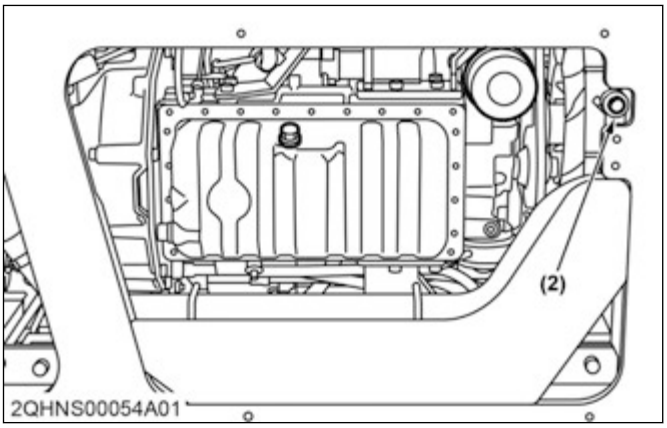
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**
1. Remove the radiator cap.



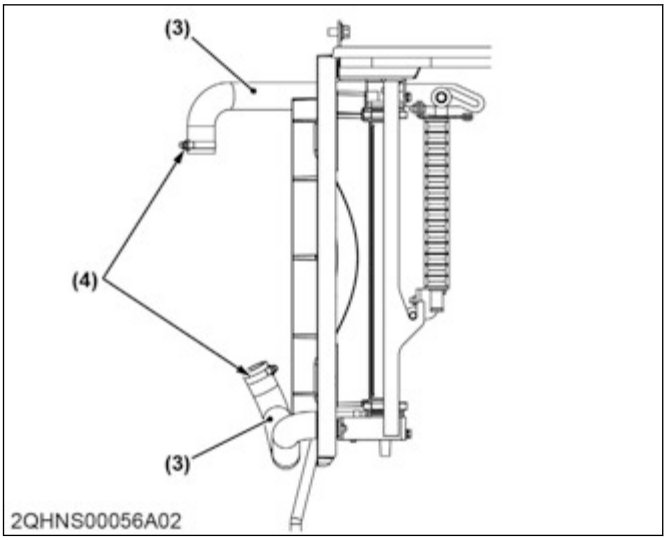

(1) Radiator cap

2. Put a tray for receiving the coolant.
3. Remove the drain plug and drain all of the coolant.




(2) Drain plug

4. Install the drain plug.
5. Replace the radiator hoses and hose clamps.




(3) Radiator hose (4) Hose clamp

6. Replenish the new coolant.

**Coolant quantity**

| | | | |
|---|---|---|---|
| Coolant | Canopy | 2.4 L<br>0.63 U.S.gals | 50% anti-freeze |
| | Cabin | 2.6 L<br>0.69 U.S.gals | |
| | Reserve tank | 0.6 L<br>0.16 U.S.gals | |

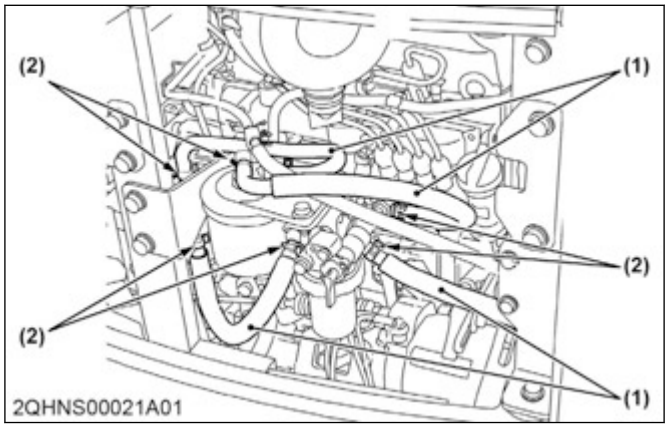
7. Start the engine in idle speed and leave it for 5 minutes.
8. Replenish the coolant if necessary.
9. Check leakage of the coolant.

## 5.14.2 Replacing the fuel line and intake air line

**WARNING**
- **Keep fire and flammable items away from the working area.**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, muffler, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

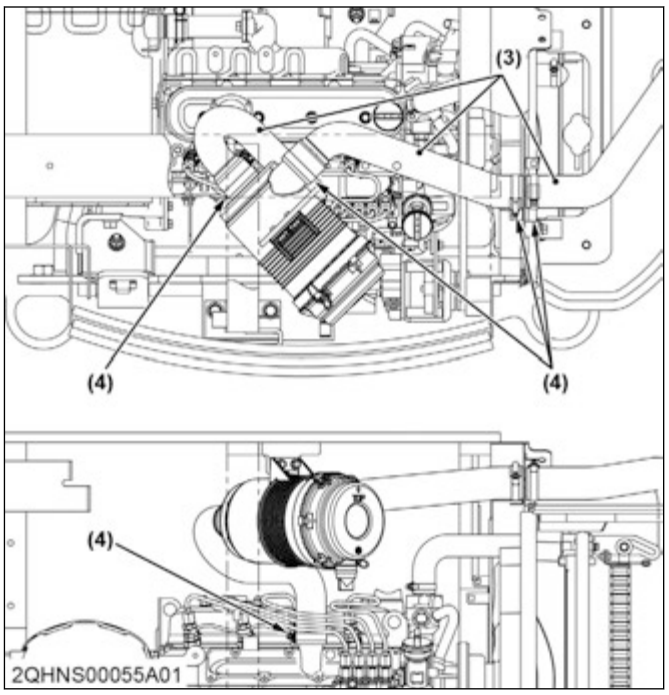
**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

**Replacing**
1. Replace all of the fuel hoses and clamps.




(1) Fuel hose (2) Hose clamp

2. Replace all of the intake air hoses and clamps.




(3) Intake air hose (4) Hose clamp

## 5.14.3 Replacing the coolant

**WARNING**
- **Do not open the radiator cap soon after the engine has stopped. There is a possibility of serious burn injury due to the coolant blow out from the radiator.**

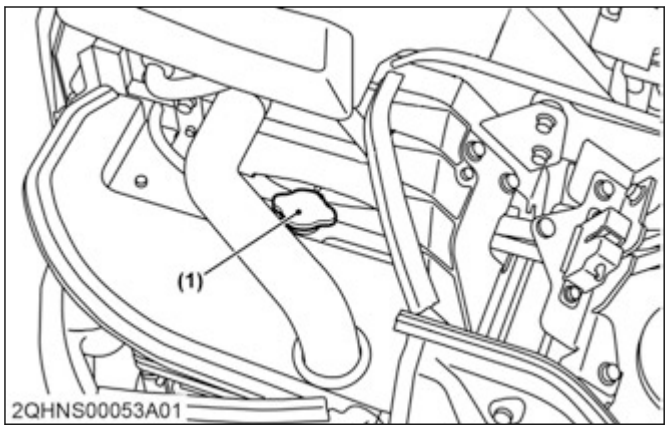
**CAUTION**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

**NOTE**
- **Replace the radiator hoses and hose clamps at the same time.**

**Preparing**
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

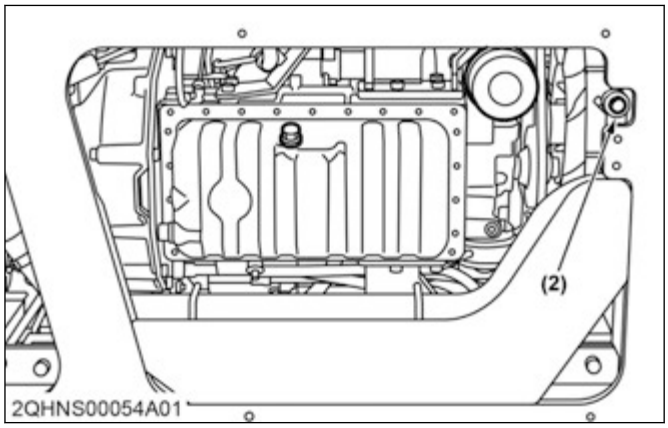
**Replacing**
1. Check the fins of radiator and oil cooler. If the fins are clogged with dirt, remove the dirt using compressed air.

   **IMPORTANT**
   - **Pressure of compressed air must be under 205 kPa (2.1 kgf/cm$^2$, 30 psi).**
2. Remove the radiator cap.



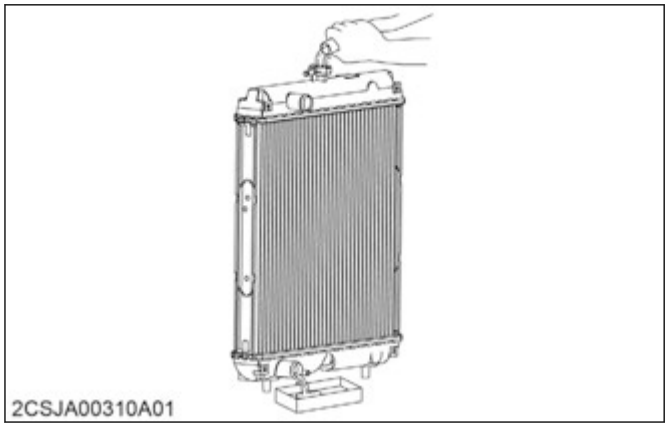

(1) Radiator cap

3. Put a tray for receiving the coolant.
4. Remove the drain plug and drain all of the coolant.




(2) Drain plug

5. Clean inside of the radiator with water.




**■ IMPORTANT**
- **Do not apply excessive pressure to the radiator to avoid the radiator from bursting. The coolant pressure inside the radiator must be below 0.9 kgf/cm$^2$.**

6. Close the drain valve and fill up the radiator with water for flushing.
7. Install the radiator cap
8. Start the engine in idle speed for flushing with water in the coolant circuit.

**■ NOTE**
- **Warm up the water until the thermostat is opened.**
- **In case of heater specification, activate the heater.**

9. Drain the water and refill new water again for flushing repeatedly.
10. Repeat several times until the drained water is clean.
11. Close the drain plug and fill up the radiator with new coolant.

**■ IMPORTANT**
- **Do not fill the coolant into the reserve tank exceeding [FULL] level.**
- **Do not mix the coolant with dirty or salt water.**
- **Do not operate the machine without coolant.**

**Coolant quantity**

| | | | |
|---|---|---|---|
| Coolant | Canopy | 2.4 L<br>0.63 U.S.gals | 50% anti-freeze |
| | Cabin | 2.6 L<br>0.69 U.S.gals | |
| | Reserve tank | 0.6 L<br>0.16 U.S.gals | |

12. Start the engine in idle speed and leave it for 5 minutes.

**■ NOTE**
- **In case of heater specification, activate the heater.**

13. Check the coolant level and replenish the coolant if necessary.

# 5.15 Every 6 years

## 5.15.1 Replacing the hydraulic hoses

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.

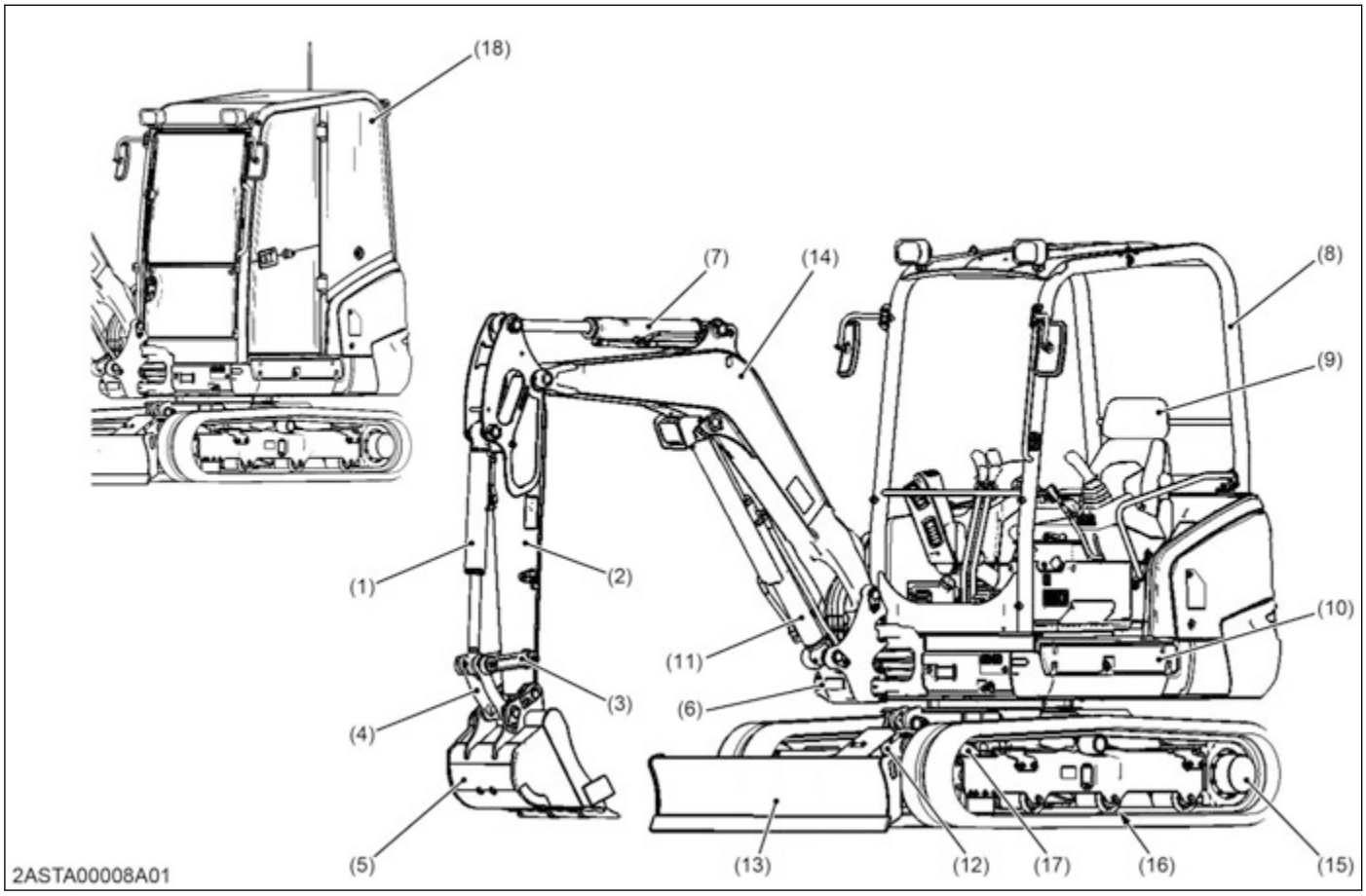
**Replacing**

1. Drain the hydraulic oil.
2. Replace all of the hydraulic hoses.

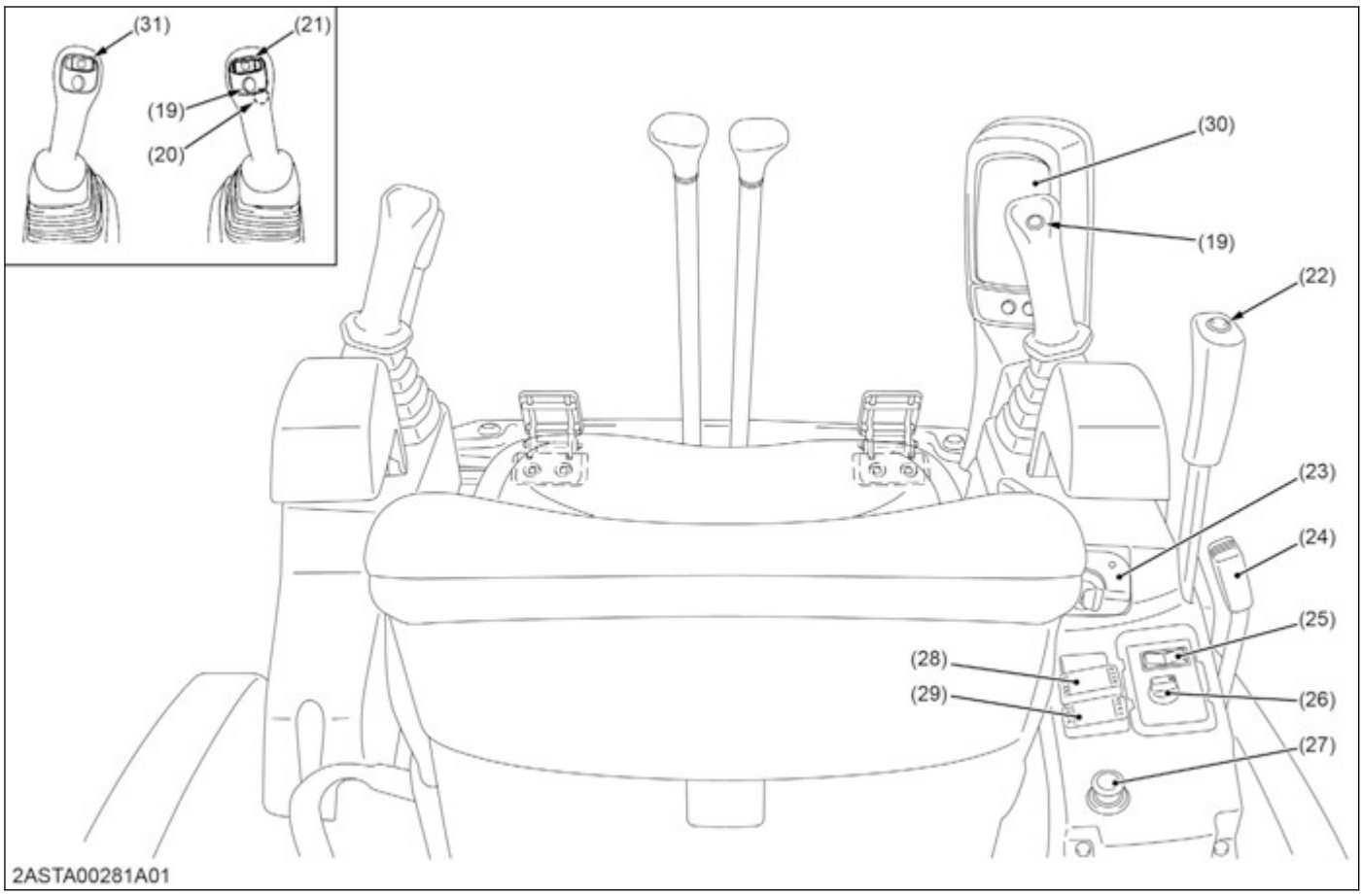
# 3. MACHINE BODY

# MECHANISM

## 1. Machine devices layout



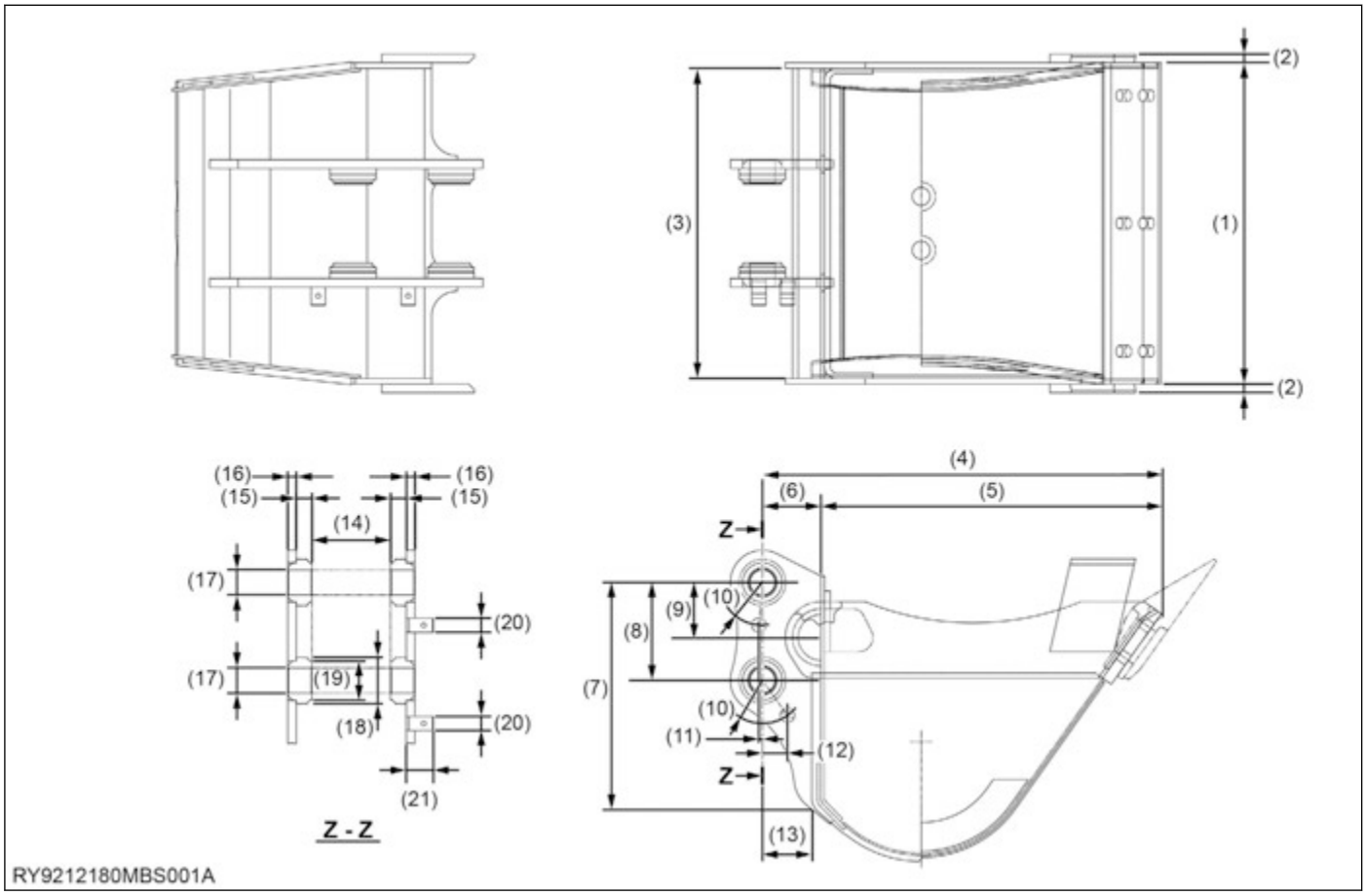

(1) Bucket cylinder
(2) Arm
(3) Bucket link 2 and 3
(4) Bucket link 1
(5) Bucket
(6) Swing bracket
(7) Arm cylinder
(8) Canopy
(9) Seat
(10) Swing frame
(11) Boom cylinder
(12) Blade cylinder
(13) Blade
(14) Boom
(15) Travel motor
(16) Track roller
(17) Front idler
(18) Cabin




(19) Horn switch
(20) One way hold switch (Hi-spec only)
(21) AUX1 knob switch (Hi-spec only)
(22) Travel speed switch
(23) Starter switch
(24) Accelerator lever
(25) Wiper / Washer switch (Cabin only)
(26) Heater switch (Cabin only)
(27) Engine stop switch
(28) Working light switch
(29) Beacon switch
(30) Meter panel
(31) AUX2 knob switch (Hi-spec only)

# 2. Bucket

## 2.1 Bucket dimensions




**■ NOTE**

- **The bucket is attached to define all specifications and service specifications.**

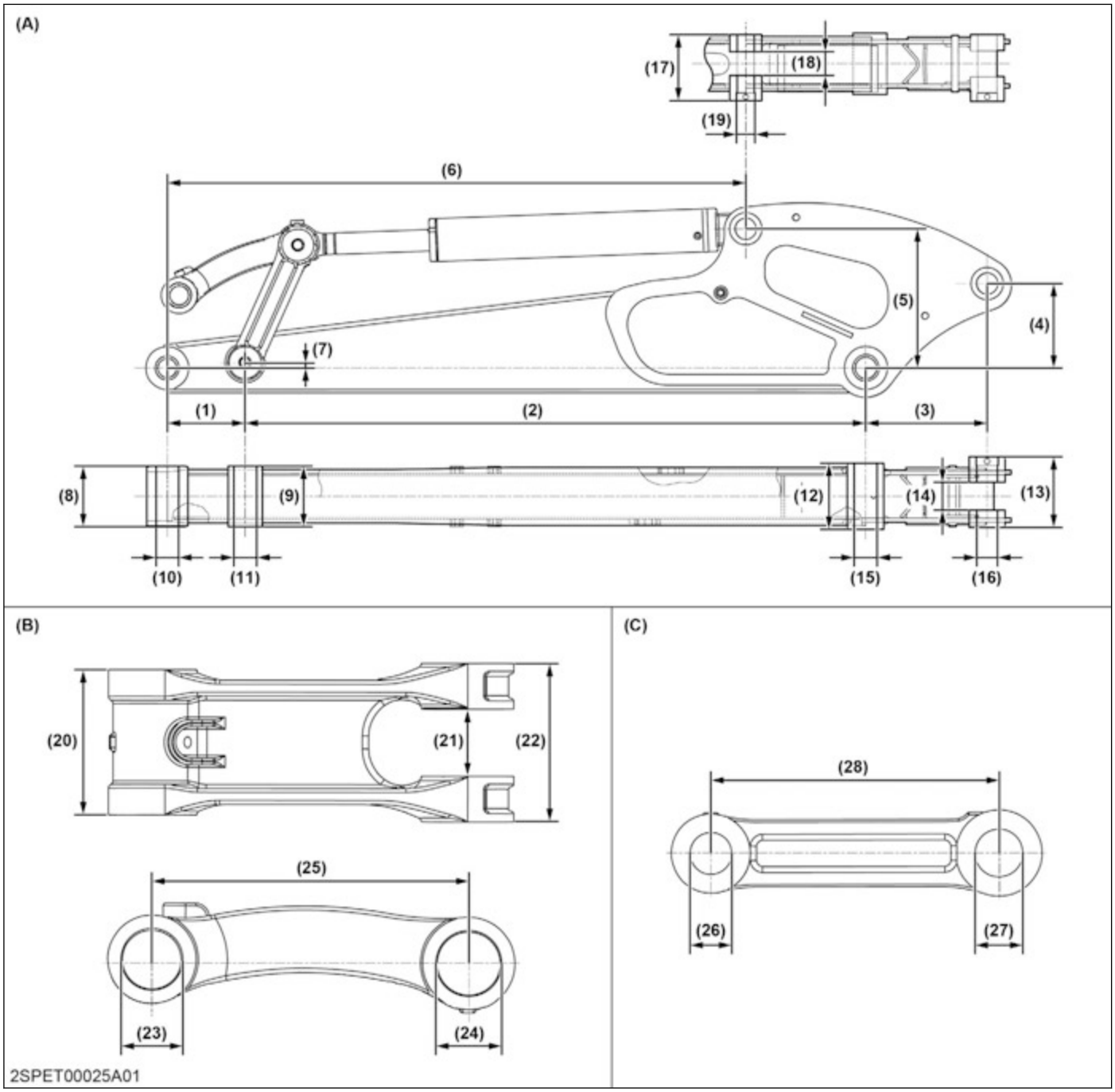
| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (1) | 450 mm<br>17.7 in. | (12) | 35 mm<br>1.4 in. |
| (2) | 12 mm<br>0.47 in. | (13) | 69 mm<br>2.7 in. |
| (3) | 434 mm<br>17.1 in. | (14) | 110 mm<br>4.3 in. |
| (4) | 555 mm<br>21.8 in. | (15) | 22 mm<br>0.87 in. |
| (5) | 473 mm<br>18.6 in. | (16) | 12 mm<br>0.47 in. |
| (6) | 82 mm<br>3.2 in. | (17) | ϕ35 mm<br>ϕ1.4 in. |
| (7) | 313 mm<br>12.3 in. | (18) | ϕ65 mm<br>ϕ2.6 in. |
| (8) | 137 mm<br>5.4 in. | (19) | ϕ55 mm<br>ϕ2.2 in. |

(Continued)

| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (9) | 57 mm<br>2.2 in. | (20) | ϕ20 mm<br>ϕ0.79 in. |
| (10) | 60 mm<br>2.4 in. | (21) | 34 mm<br>1.3 in. |
| (11) | 5.0 mm<br>0.2 in. | - | - |

# 3. Arm

## 3.1 Arm dimensions




(A) Arm (B) Bucket link 1 (C) Bucket link 2, 3

**NOTE**

- **(10), (11), (15), (23), and (24) show inner dimensions with installed bushings.**

### Standard arm (1300 mm)

| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (1) | 144 to 146 mm<br>5.67 to 5.75 in. | (15) | ϕ40 mm<br>ϕ1.57 in. |
| (2) | 1155 mm<br>45.5 in. | (16) | ϕ40 mm<br>ϕ1.57 in. |
| (3) | 224.5 to 226.5 mm<br>8.84 to 8.92 in. | (17) | 154 mm<br>6.06 in. |
| (4) | 156 to 158 mm<br>6.14 to 6.22 in. | (18) | 51 mm<br>2.00 in. |
| (5) | 258 to 260 mm<br>10.16 to 10.24 in. | (19) | ϕ40 mm<br>ϕ1.57 in. |
| (6) | 1074.5 to 1078.5 mm<br>42.30 to 42.46 in. | (20) | 110 mm<br>4.33 in. |
| (7) | 8.5 to 11.5 mm<br>0.33 to 0.45 in. | (21) | 51 mm<br>2.01 in. |
| (8) | 110 mm<br>4.33 in. | (22) | 120 mm<br>4.72 in. |
| (9) | 120 mm<br>4.72 in. | (23) | ϕ35 mm<br>ϕ1.38 in. |
| (10) | ϕ35 mm<br>ϕ1.38 in. | (24) | ϕ40 mm<br>ϕ1.57 in. |
| (11) | ϕ35 mm<br>ϕ1.38 in. | (25) | 240 mm<br>9.45 in. |
| (12) | 140 mm<br>5.51 in. | (26) | ϕ35 mm<br>ϕ1.38 in. |
| (13) | 154 mm<br>6.06 in. | (27) | ϕ40 mm<br>ϕ1.57 in. |
| (14) | 51 mm<br>2.00 in. | (28) | 240 mm<br>9.45 in. |

### Short arm (1050 mm)

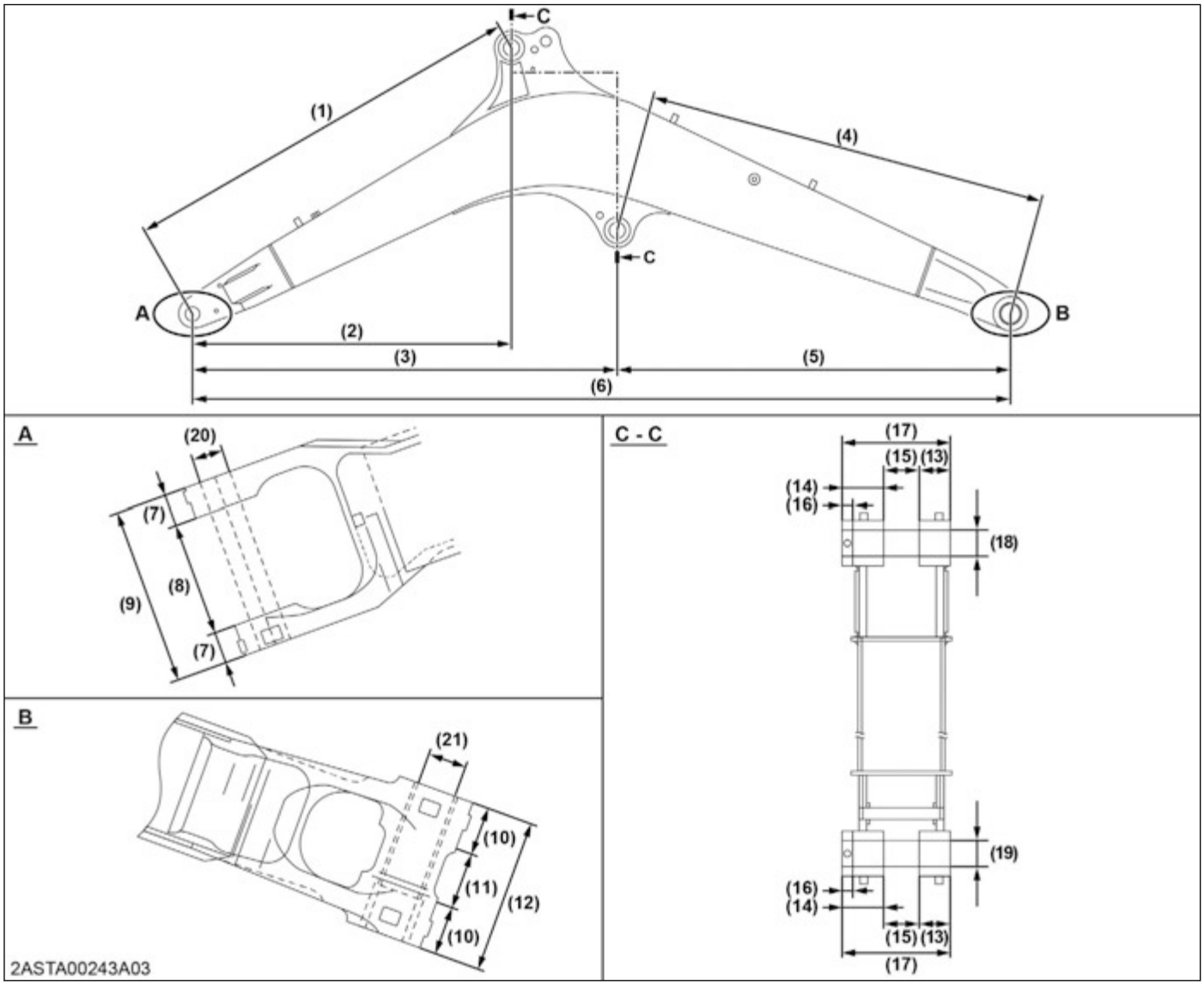
| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (1) | 144 to 146 mm<br>5.67 to 5.75 in. | (15) | ϕ40 mm<br>ϕ1.57 in. |
| (2) | 905 mm<br>35.6 in. | (16) | ϕ40 mm<br>ϕ1.57 in. |
| (3) | 224.5 to 226.5 mm<br>8.84 to 8.92 in. | (17) | 154 mm<br>6.06 in. |
| (4) | 156 to 158 mm<br>6.14 to 6.22 in. | (18) | 51 mm<br>2.00 in. |
| (5) | 258 to 260 mm<br>10.16 to 10.24 in. | (19) | ϕ40 mm<br>ϕ1.57 in. |
| (6) | 1074.5 to 1078.5 mm<br>42.30 to 42.46 in. | (20) | 110 mm<br>4.33 in. |
| (7) | 8.5 to 11.5 mm<br>0.33 to 0.45 in. | (21) | 51 mm<br>2.01 in. |
| (8) | 114 mm<br>4.49 in. | (22) | 120 mm<br>4.72 in. |

(Continued)

| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (9) | 90 mm<br>3.54 in. | (23) | ϕ35 mm<br>ϕ1.38 in. |
| (10) | ϕ35 mm<br>ϕ1.38 in. | (24) | ϕ40 mm<br>ϕ1.57 in. |
| (11) | ϕ35 mm<br>ϕ1.38 in. | (25) | 240 mm<br>9.45 in. |
| (12) | 140 mm<br>5.51 in. | (26) | ϕ35 mm<br>ϕ1.38 in. |
| (13) | 154 mm<br>6.06 in. | (27) | ϕ40 mm<br>ϕ1.57 in. |
| (14) | 51 mm<br>2.00 in. | (28) | 240 mm<br>9.45 in. |

# 4. Boom

## 4.1 Boom dimensions




A: Arm side edge B: Frame side edge

**NOTE**

- **(21) Show inner dimensions with installed bushing.**

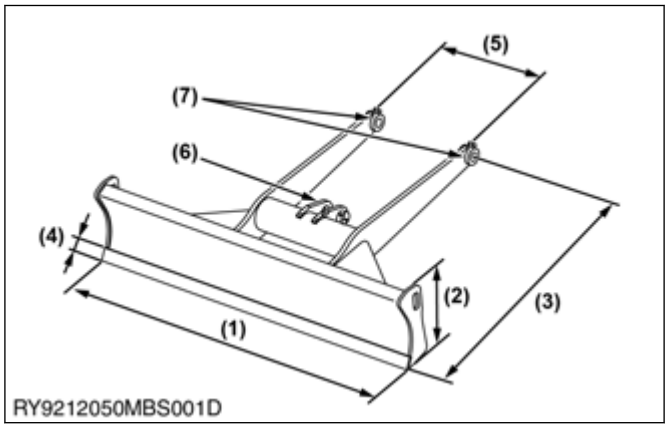
| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (1) | 1048 to 1050 mm<br>41.26 to 41.34 in. | (12) | 195 mm<br>7.68 in. |
| (2) | 824 to 830 mm<br>32.44 to 32.68 in. | (13) | 54 mm<br>2.13 in. |
| (3) | 961 to 967 mm<br>37.83 to 38.07 in. | (14) | 71 mm<br>2.80 in. |

(Continued)

| Items | Dimensions | Items | Dimensions |
|---|---|---|---|
| (4) | 1155 to 1157 mm<br>45.47 to 45.55 in. | (15) | 51 mm<br>2.13 in. |
| (5) | 1118 to 1124 mm<br>44.02 to 44.25 in. | (16) | 11 mm<br>0.43 in. |
| (6) | 2082 to 2088 mm<br>81.97 to 88.20 in. | (17) | 176 mm<br>6.93 in. |
| (7) | 41 mm<br>1.61 in. | (18) | ϕ40 mm<br>ϕ1.57 in. |
| (8) | 140.6 to 141.1 mm<br>5.54 to 5.56 in. | (19) | ϕ40 mm<br>ϕ1.57 in. |
| (9) | 222.6 to 223.1 mm<br>8.76 to 8.78 in. | (20) | ϕ40 mm<br>ϕ1.57 in. |
| (10) | 50 mm<br>1.97 in. | (21) | ϕ40 mm<br>ϕ1.57 in. |
| (11) | 95 mm<br>3.74 in. | - | - |

# 5. Blade

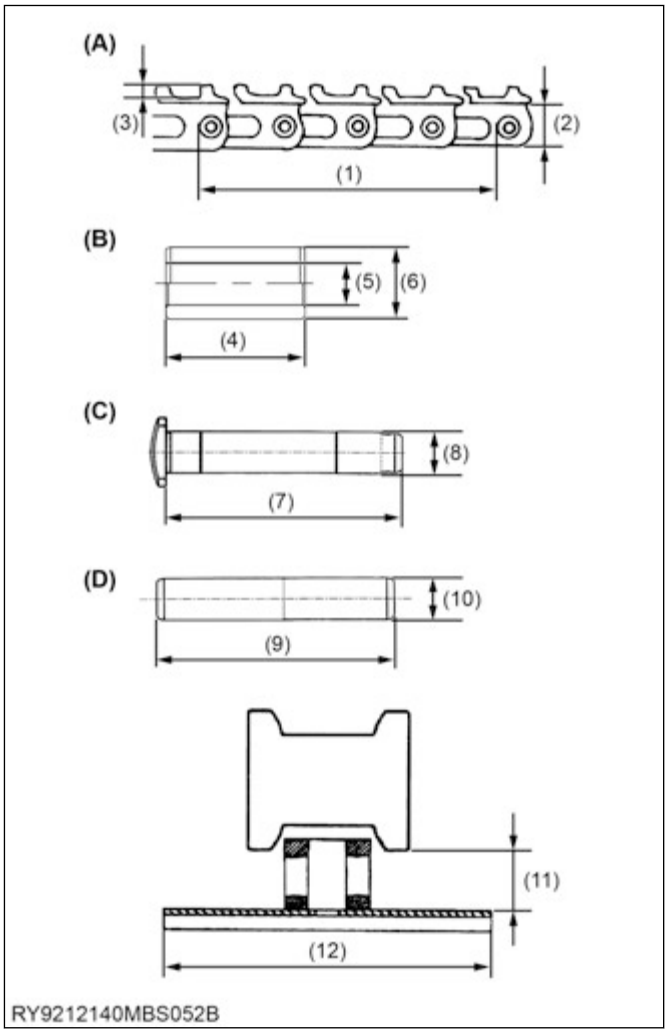
## 5.1 Blade dimensions




| Items | Dimensions |
|---|---|
| (1) | 1400 mm<br>55.12 in. |
| (2) | 282 mm<br>13.56 in. |
| (3) | 1025 mm<br>40.35 in. |
| (4) | 65 mm<br>2.56 in. |
| (5) | 430 mm<br>16.93 in. |
| (6) | ϕ45.01 to 45.03 mm<br>ϕ1.77 to 1.78 in. |
| (7) | ϕ40.01 to 40.03 mm<br>ϕ1.58 to 1.59 in. |

# 6. Steel track

## 6.1 Steel track dimensions

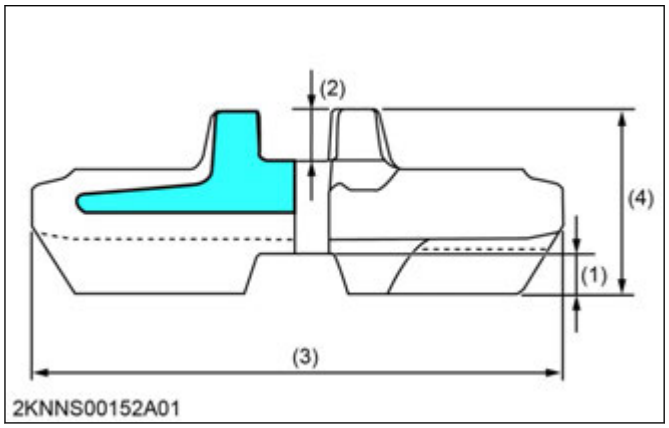


(A) Steel track
(B) Bushing
(C) Master pin
(D) Pin

| Items | Dimensions |
|---|---|
| (1) Link length | 406.4 mm<br>16 in. |
| (2) Height | 90.5 mm<br>3.56 in. |
| (3) Grouser height | 16.5 mm<br>0.65 in. |
| (4) Bushing length | 55 mm<br>2.2 in. |
| (5) Bushing inner diameter | ϕ17 mm<br>ϕ0.67 in. |
| (6) Bushing outer diameter | ϕ28 mm<br>ϕ1.1 in. |
| (7) Master pin length | 96.5 mm<br>3.8 in. |
| (8) Master pin outer diameter | ϕ16.8 mm<br>ϕ0.66 in. |
| (9) Pin length | 97 mm<br>3.8 in. |
| (10) Pin outer diameter | ϕ17 mm<br>ϕ0.67 in. |
| (11) Track tension dimension | 75 to 80 mm<br>3.0 to 3.1 in. |
| (12) Width | 300 mm<br>11.8 in. |
| Number of links | 40 |

# 7. Rubber track

## 7.1 Rubber track dimensions



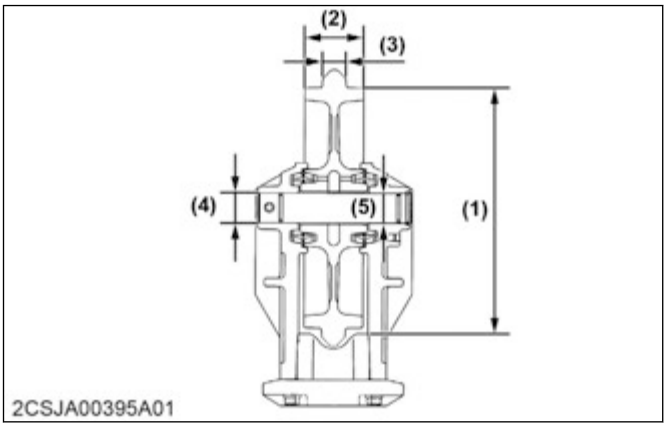

| Items | Dimensions |
|---|---|
| (1) Lug height | 19.5 mm<br>0.77 in. |
| (2) Link height | 24.0 mm<br>0.94 in. |

(Continued)

| Items | Dimensions |
|---|---|
| (3) Width | 300 mm<br>11.81 in. |
| (4) Height | 75.5 mm<br>2.97 in. |

# 8. Front idler

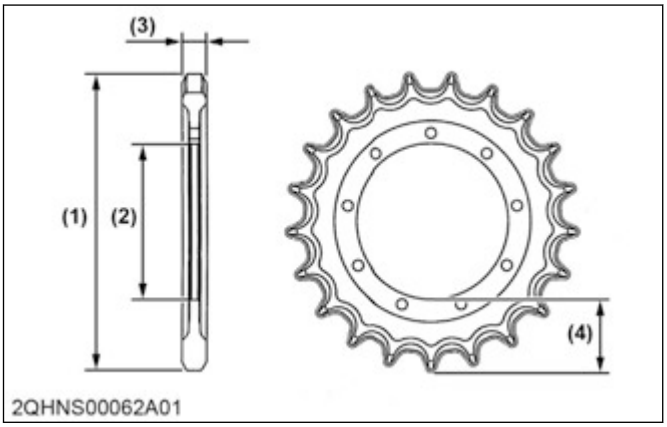
## 8.1 Front idler dimensions




| Items | Dimensions |
|---|---|
| (1) Idler outer diameter | ϕ292 mm<br>ϕ11.5 in. |
| (2) Guide width | 30 mm<br>1.18 in. |
| (3) Idler width | 72 mm<br>2.83 in. |
| (4) Shaft outer diameter | ϕ30 mm<br>ϕ1.18 in. |
| (5) Bushing inner diameter | ϕ30 mm<br>ϕ1.18 in. |

# 9. Sprocket

## 9.1 Sprocket dimensions

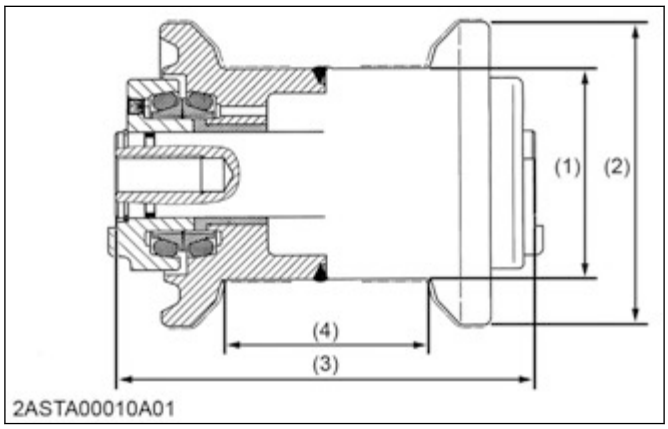


| Items | Dimensions |
|---|---|
| (1) Sprocket outer diameter | ϕ356 mm<br>ϕ14.02 in. |
| (2) Sprocket inner diameter | ϕ156mm<br>6.14 in. |
| (3) Sprocket width | 29 to 30 mm<br>1.14 to 1.18 in. |
| (4) Gear height | 100 mm<br>3.94 in. |

| Items | Dimensions |
|---|---|
| (1) Outer diameter | ϕ76.3 mm<br>ϕ3.0 in. |
| (2) Outer diameter | ϕ30 mm<br>ϕ1.2 in. |

# 10. Track roller

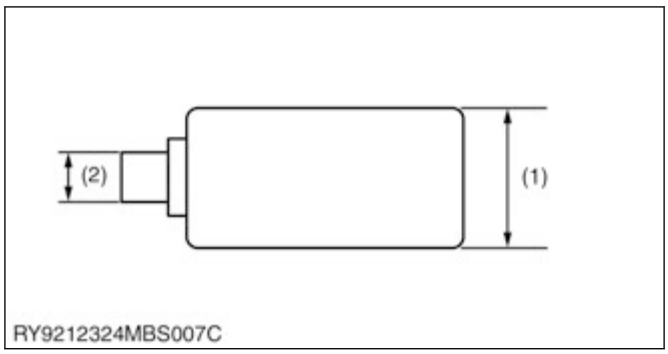
## 10.1 Track roller dimensions




| Items | Dimensions |
|---|---|
| (1) Guide diameter | ϕ80.0 mm<br>ϕ3.1 in. |
| (2) Outer diameter | ϕ124.0 mm<br>ϕ4.88 in. |
| (3) Roller width | 175.0 mm<br>6.89 in. |
| (4) Guide width | 81.0 mm<br>3.2 in. |

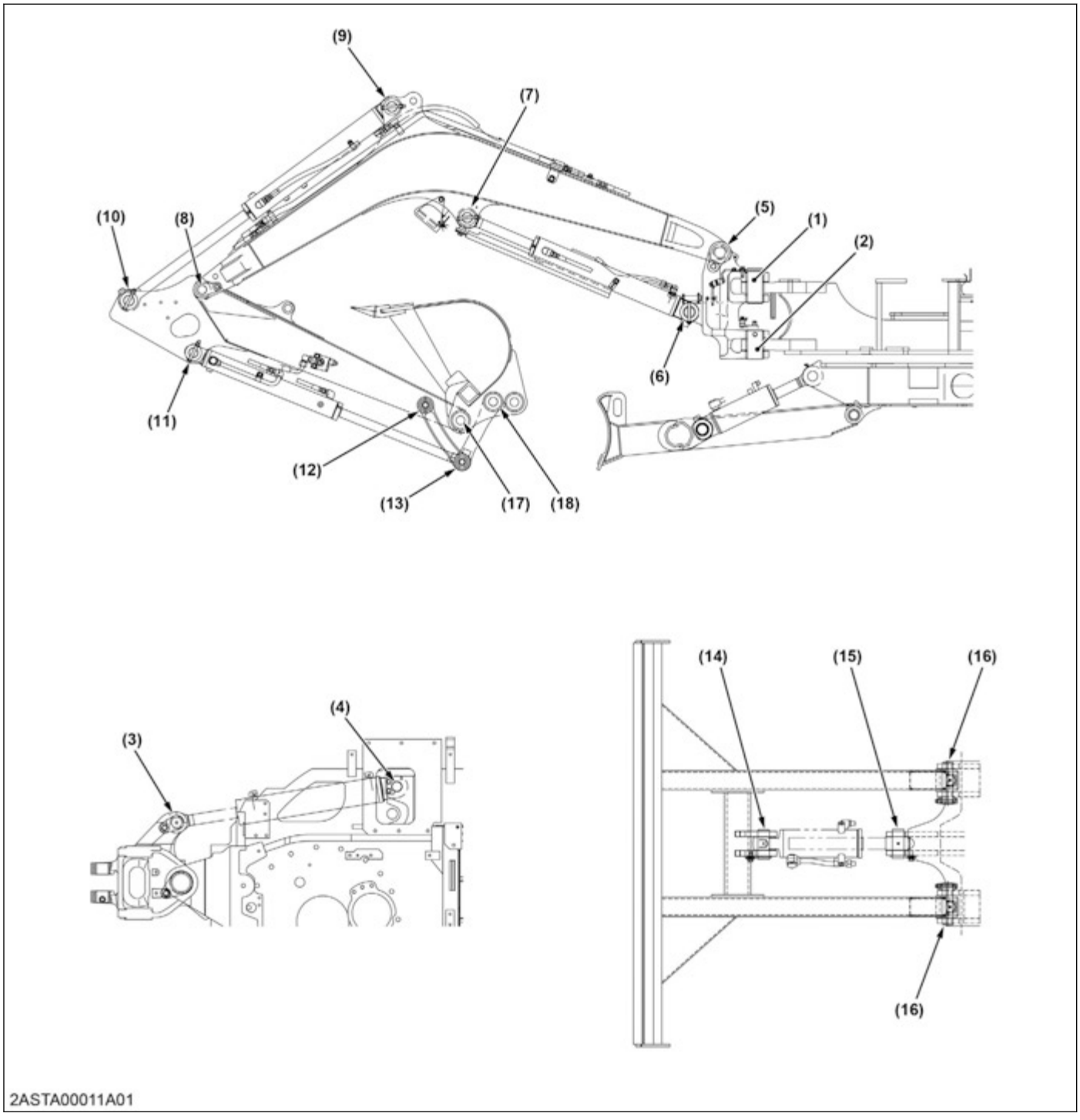
# 11. Carrier roller

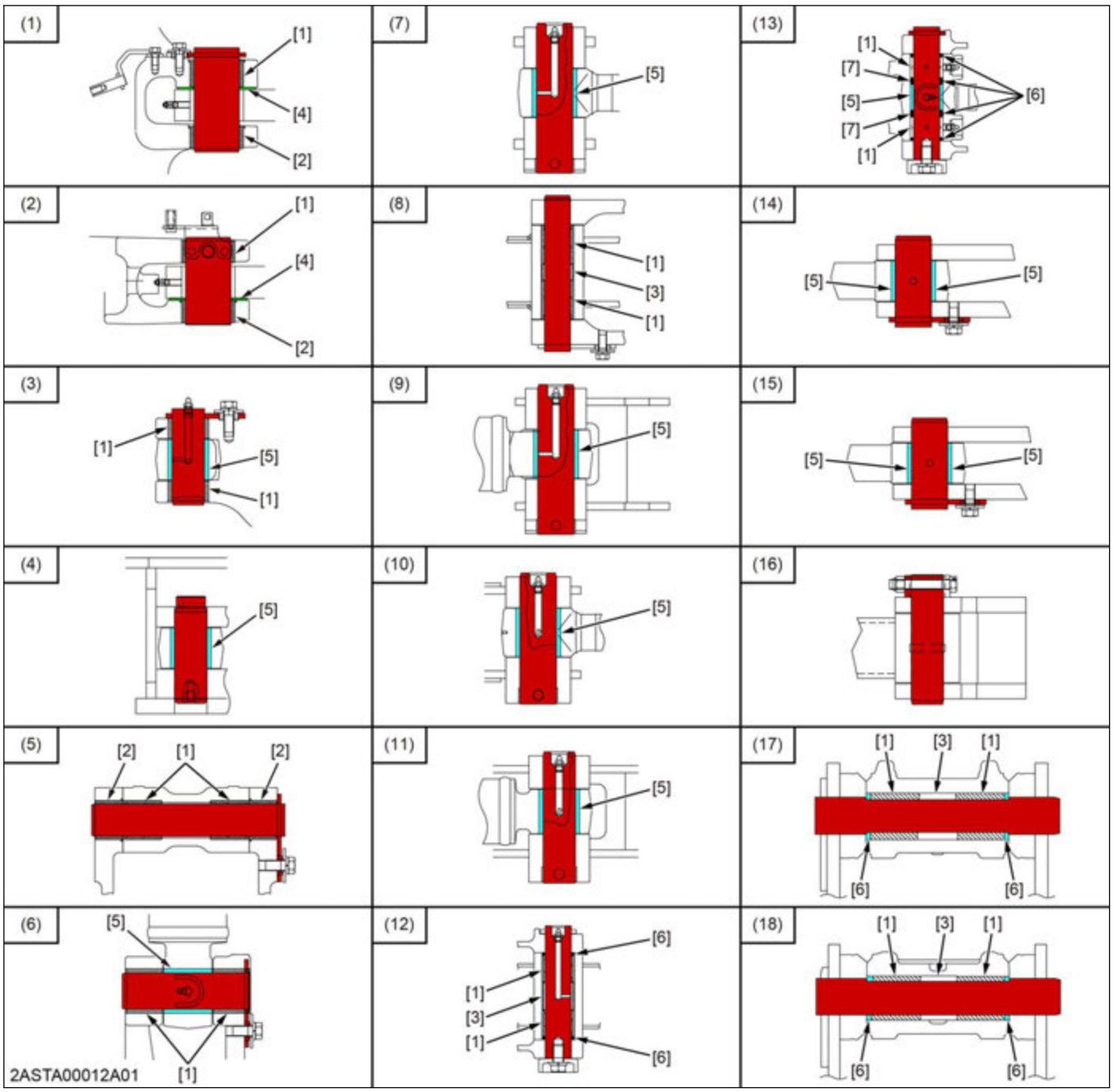
## 11.1 Carrier roller dimensions



# 12. Pins, bushings, and shims

## 12.1 Pin, bushing, and shim dimensions






(1) Swing bracket upper side - Frame
(2) Swing bracket lower side - Frame
(3) Swing bracket - Swing cylinder (rod side)
(4) Swing cylinder (bottom side) - Frame
(5) Swing bracket - Boom
(6) Swing bracket - Boom cylinder (bottom side)
(7) Boom - Boom cylinder (rod side)
(8) Boom - Arm
(9) Boom - Arm cylinder (bottom side)
(10) Arm - Arm cylinder (rod side)
(11) Arm - Bucket cylinder (bottom side)
(12) Bucket link (2, 3) - Arm
(13) Bucket link (1) - Bucket cylinder (rod side)
(14) Blade - Blade cylinder (bottom side)
(15) Frame - Blade cylinder (rod side)
(16) Blade - Frame
(17) Arm - Bucket
(18) Bucket link (1) - Bucket

## IMPORTANT

- **Dimensions of pins and bushings correspond to new and unused parts.**
- **Bushing dimensions are in not assembled condition. After assembling, bushing generally slightly shrinks.**

## Dimensions table (mm unit)

| No. | Pin | | [1] Bushing<br>[2] Bushing<br>[3] Collar | | [4] Thrust collar | Shim | [5] Cylinder bushing | [6] Dust seal<br>[7] Dust seal |
|---|---|---|---|---|---|---|---|---|
| | Diameter × length | Diameter tolerance | ID × OD × length | Bushing ID tolerance | ID × OD × thickness | ID × OD × thickness | ID × OD × length | ID × OD × thickness |
| (1) | ϕ60 × 154 | -0.02<br>-0.05 | [1] 60 × 72 × 58<br>[2] 60 × 72 × 27 | +0.12<br>+0.09 | [4] 61 × 100 × 3.0 | - | - | - |
| (2) | ϕ60 × 128 | -0.02<br>-0.05 | [1] 60 × 72 × 27<br>[2] 60 × 72 × 30 | +0.12<br>+0.09 | [4] 61 × 100 × (2.0 or 2.5 or 3.0) | - | - | - |
| (3) | ϕ 35 × 100 | -0.05<br>-0.08 | [1] 35 × 45 × 24 | +0.07<br>+0.04 | - | 36 × 70 × (1.5 or 0.5 or 1.0) | [5] 35 × 45 × 40 | - |
| (4) | ϕ35 × 116 | -0.03<br>-0.06 | - | - | - | 36 × 70 × (1.5 or 0.5 or 1.0) | [5] 35 × 45 × 35 | - |
| (5) | ϕ40 × 284 | -0.05<br>-0.08 | [1] 40 × 50 × 50<br>[2] 40 × 48 × 37 | +0.13<br>+0.10 | - | 41 × 75 × (0.5 or 1.0) | - | - |
| (6) | ϕ40 × 180 | -0.05<br>-0.08 | [1] 40 × 50 × 50 | +0.07<br>+0.04 | - | 41 × 75 × (0.5 or 1.0) | [5] 40 × 50 × 60 | - |
| (7) | ϕ40 × 182 | -0.05<br>-0.08 | - | - | - | 41 × 75 × (0.5 or 1.0) | [5] 40 × 50 × 50 | - |
| (8) | ϕ40 × 227 | -0.05<br>-0.08 | [1] 40 × 50 × 60<br>[3] 45.3 × 48.5 × 39 | +0.13<br>+0.10 | - | 41 × 80 × (0.2 or 0.6) | - | - |
| (9) | ϕ40 × 182 | -0.05<br>-0.08 | - | - | - | 41 × 65 × (0.5 or 1.0) | [5] 40 × 50 × 45 | - |
| (10) | ϕ40 × 160 | -0.05<br>-0.08 | - | - | - | 41 × 65 × (0.5 or 1.0) | [5] 40 × 50 × 45 | - |
| (11) | ϕ40 × 160 | -0.05<br>-0.08 | - | - | - | 41 × 65 × (0.5 or 1.0) | [5] 40 × 50 × 45 | - |
| (12) | ϕ35 × 182 | -0.05<br>-0.08 | [1] 35 × 45 × 45<br>[3] (39.2 or 39.5) × (42.4 or 42.7) × 19 | +0.13<br>+0.10 | - | - | - | [6] 35 × 42 × 4.2 |
| (13) | ϕ40 × 182 | -0.05<br>-0.08 | [1] 40 × 48 × 24 | +0.13<br>+0.10 | - | 41 × 65 × (0.5 or 1.0) | [5] 40 × 50 × 40 | [6] 40 × 48 × 4.2<br>[7] 40 × 50 × 4.2 |
| (14) | ϕ45 × 113 | -0.05<br>-0.08 | - | - | - | 46 × 70 × (0.5 or 1.0) | [5] 45 × 55 × 50 | - |
| (15) | ϕ45 × 113 | -0.05<br>-0.08 | - | - | - | 46 × 70 × (0.5 or 1.0) | [5] 45 × 55 × 50 | - |
| (16) | ϕ40 × 151 | -0.05<br>-0.08 | - | - | - | - | - | - |

(Continued)

| No. | Pin | | [1] Bushing<br>[2] Bushing<br>[3] Collar | | [4] Thrust collar | Shim | [5] Cylinder bushing | [6] Dust seal<br>[7] Dust seal |
|---|---|---|---|---|---|---|---|---|
| | Diameter × length | Diameter tolerance | ID × OD × length | Bushing ID tolerance | ID × OD × thickness | ID × OD × thickness | ID × OD × length | ID × OD × thickness |
| (17) | ϕ35 × 189 | -0.05<br>-0.08 | [1] 35 × 45 × 45<br>[3] (39.2 or 39.5) × (42.4 or 42.7) × 9 | +0.13<br>+0.10 | - | - | - | [6] 35 × 45 × 4.2 |
| (18) | ϕ35 × 189 | -0.05<br>-0.08 | [1] 35 × 45 × 45<br>[3] (39.2 or 39.5) × (42.4 or 42.7) × 9 | +0.13<br>+0.10 | - | - | - | [6] 35 × 45 × 4.2 |

**Dimensions table (inch unit)**

| No. | Pin | | [1] Bushing<br>[2] Bushing<br>[3] Collar | | [4] Thrust collar | Shim | [5] Cylinder bushing | [6] Dust seal<br>[7] Dust seal |
|---|---|---|---|---|---|---|---|---|
| | Diameter × length | Diameter tolerance | ID × OD × length | Bushing ID tolerance | ID × OD × thickness | ID × OD × thickness | ID × OD × length | ID × OD × thickness |
| (1) | ϕ2.36 × 6.06 | -0.00079<br>-0.00197 | [1] 2.36 × 2.83 × 2.28<br>[2] 2.36 × 2.83 × 1.06 | +0.00472<br>+0.00354 | [4] 2.40 × 3.94 × 0.118 | - | - | - |
| (2) | ϕ2.36 × 5.04 | -0.00079<br>-0.00197 | [1] 2.36 × 2.83 × 1.06<br>[2] 2.36 × 2.83 × 1.18 | +0.00472<br>+0.00354 | [4] 2.40 × 3.94 × (0.079 or 0.098 or 0.118) | - | - | - |
| (3) | ϕ1.38 × 3.94 | -0.00197<br>-0.00315 | [1] 1.38 × 1.77 × 0.945 | +0.00276<br>+0.00157 | - | 1.42 × 2.80 × (0.059 or 0.020 or 0.039) | [5] 1.38 × 1.77 × 1.57 | - |
| (4) | ϕ1.38 × 4.57 | -0.00118<br>-0.00236 | - | - | - | 1.42 × 2.80 × (0.059 or 0.020 or 0.039) | [5] 1.38 × 1.77 × 1.38 | - |
| (5) | ϕ1.57 × 11.2 | -0.00197<br>-0.00315 | [1] 1.57 × 1.97 × 1.97<br>[2] 1.57 × 1.89 × 1.46 | +0.00512<br>+0.00394 | - | 1.61 × 2.95 × (0.020 or 0.039) | - | - |
| (6) | ϕ1.57 × 7.09 | -0.00197<br>-0.00315 | [1] 1.57 × 1.97 × 1.97 | +0.00276<br>+0.00157 | - | 1.61 × 2.95 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 2.36 | - |
| (7) | ϕ1.57 × 8.94 | -0.00197<br>-0.00315 | - | - | - | 1.61 × 2.95 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 1.97 | - |
| (8) | ϕ1.57 × 7.17 | -0.00197<br>-0.00315 | [1] 1.57 × 1.97 × 2.36<br>[3] 1.78 × 1.91 × 1.54 | +0.00512<br>+0.00394 | - | 1.61 × 3.15 × (0.008 or 0.024) | - | - |
| (9) | ϕ1.57 × 7.17 | -0.00197<br>-0.00315 | - | - | - | 1.61 × 2.56 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 1.77 | - |

(Continued)

| No. | Pin | | [1] Bushing<br>[2] Bushing<br>[3] Collar | | [4] Thrust collar | Shim | [5] Cylinder bushing | [6] Dust seal<br>[7] Dust seal |
|---|---|---|---|---|---|---|---|---|
| | Diameter × length | Diameter tolerance | ID × OD × length | Bushing ID tolerance | ID × OD × thickness | ID × OD × thickness | ID × OD × length | ID × OD × thickness |
| (10) | ϕ1.57 × 6.30 | -0.00197<br>-0.00315 | - | - | - | 1.61 × 2.56 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 1.77 | - |
| (11) | ϕ1.57 × 6.30 | -0.00197<br>-0.00315 | - | - | - | 1.61 × 2.56 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 1.77 | - |
| (12) | ϕ1.38 × 7.17 | 0<br>0 | [1] 1.38 × 1.77 × 1.77<br>[3] (1.67 or 1.68) × (1.54 or 1.56) × 0.75 | +0.00512<br>+0.00394 | - | - | - | [6] 1.38 × 1.65 × 0.17 |
| (13) | ϕ1.57 × 7.17 | -0.00197<br>-0.00315 | [1] 1.57 × 1.89 × 0.94 | +0.00512<br>+0.00394 | - | 1.61 × 2.56 × (0.020 or 0.039) | [5] 1.57 × 1.97 × 1.57 | [6] 1.57 × 1.89 × 0.17<br>[7] 1.57 × 1.97 × 0.17 |
| (14) | ϕ1.77 × 4.45 | -0.00197<br>-0.00315 | - | - | - | 1.81 × 2.76 × (0.020 or 0.039) | [5] 1.77 × 2.17 × 1.97 | - |
| (15) | ϕ1.77 × 4.45 | -0.00197<br>-0.00315 | - | - | - | 1.81 × 2.76 × (0.020 or 0.039) | [5] 1.77 × 2.17 × 1.97 | - |
| (16) | ϕ1.57 × 5.94 | -0.00197<br>-0.00315 | - | - | - | - | - | - |
| (17) | ϕ1.38 × 7.44 | -0.00197<br>-0.00315 | [1] 1.38 × 1.77 × 1.77<br>[3] (1.67 or 1.68) × (1.54 or 1.56) × 0.35 | +0.00512<br>+0.00394 | - | - | - | [6] 1.38 × 1.77 × 0.17 |
| (18) | ϕ1.38 × 7.44 | -0.00197<br>-0.00315 | [1] 1.38 × 1.77 × 1.77<br>[3] (1.67 or 1.68) × (1.54 or 1.56) × 0.35 | +0.00512<br>+0.00394 | - | - | - | [6] 1.38 × 1.77 × 0.17 |

# SERVICING

## 1. Service specifications

### 1.1 Service specifications for machine body

- Standard measurement condition,
  - Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)
  - Engine speed: maximum speed

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Wear | Pin | | | - | - | - | 1 mm wear on pin outer diameter. |
| | Bushing | | | - | - | - | 1 mm wear on bushing inner diameter. |
| Play | Swivel bearing (vertical play) | | | mm<br>in. | 0.82<br>0.032 | - | 1.64<br>0.066 |
| | Front attachment | | | mm<br>in. | less than 73<br>less than 2.8 | - | 146<br>5.7 |
| Clearance | Swing bracket (vertical clearance) | | | mm<br>in. | 0.5<br>0.02 | - | - |
| | Front attachment (each pin) | | | mm<br>in. | 0.5<br>0.02 | - | - |
| | Front attachment (pins of bucket link 2, 3) | | | mm<br>in. | 1.0<br>0.04 | - | - |
| Force | Control lever | Pilot control lever (Basic) | Forwards | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | | LH and RH | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | Pilot control lever (Hi-spec) | Forwards | N<br>kgf | 11.8<br>1.2 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 11.3<br>1.2 | ±4.9<br>±0.50 | - |
| | | | LH and RH | N<br>kgf | 9.3<br>0.95 | ±4.9<br>±0.50 | - |
| | | Travel control lever | Forwards | N<br>kgf | 21.6<br>2.2 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 21.6<br>2.2 | ±4.9<br>±0.50 | - |
| | | Blade control lever | Forwards | N<br>kgf | 24.0<br>2.5 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 24.0<br>2.5 | ±4.9<br>±0.50 | - |

(Continued)

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Force | Control lever | Lever lock | Raising | N<br>kgf | 27<br>2.8 | ±9.8<br>±1.0 | - |
| | | | Lowering | N<br>kgf | 68<br>6.9 | ±9.8<br>±1.0 | - |
| | | Accelerator lever | Forwards | N<br>kgf | 39.2<br>4.0 | ±14.7<br>±1.5 | - |
| | | | Backwards | N<br>kgf | 34.3<br>3.5 | ±14.7<br>±1.5 | - |
| | | Swing control pedal | LH | N<br>kgf | 44.1<br>4.5 | ±6.7<br>±0.68 | - |
| | | | RH | N<br>kgf | 44.1<br>4.5 | ±6.7<br>±0.68 | - |
| | | AUX control pedal | LH | N<br>kgf | 48.0<br>4.9 | ±6.7<br>±0.68 | - |
| | | | RH | N<br>kgf | 48.0<br>4.9 | ±6.7<br>±0.68 | - |
| Dimension | Track | Steel track | Width | mm<br>in. | 300.0<br>11.8 | - | - |
| | | | Link length | mm<br>in. | 406.4<br>16 | - | 416.4<br>16.4 |
| | | | Height | mm<br>in. | 90.5<br>3.56 | - | 85.5<br>3.37 |
| | | | Grouser height | mm<br>in. | 16.5<br>0.65 | - | 8.0<br>0.3 |
| | | | Bushing length | mm<br>in. | 55.0<br>2.2 | - | - |
| | | | Bushing inner diameter | mm<br>in. | ϕ17.0<br>ϕ0.67 | - | ϕ19.0<br>ϕ0.75 |
| | | | Bushing outer diameter | mm<br>in. | ϕ28.0<br>ϕ1.1 | - | ϕ26.5<br>ϕ1.04 |
| | | | Master pin length | mm<br>in. | 96.5<br>3.8 | - | - |
| | | | Master pin outer diameter | mm<br>in. | ϕ16.8<br>ϕ0.66 | - | ϕ15.5<br>ϕ0.61 |
| | | | Pin length | mm<br>in. | 97<br>3.8 | - | - |
| | | | Pin outer diameter | mm<br>in. | ϕ17<br>ϕ0.67 | - | ϕ15.5<br>ϕ0.61 |
| | | | Number of links | - | 40 | - | - |
| | | | Tension dimension | mm<br>in. | 75.0<br>3.0 | 0 to 5.0<br>0 to 0.1 | - |
| | | Rubber track | Lug height | mm<br>in. | 19.5<br>0.77 | - | - |
| | | | Link height | mm<br>in. | 24.0<br>0.94 | - | - |
| | | | Width | mm<br>in. | 300<br>11.81 | - | - |

(Continued)

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Dimension | Track | Rubber track | Height | mm<br>in. | 75.5<br>2.97 | - | - |
| | | | Tension dimension | mm<br>in. | 10.0<br>0.4 | 0 to 5 0<br>0 to 0.2 | - |
| | Carrier roller | Outer diameter | | mm<br>in. | ϕ76.3<br>ϕ3.0 | - | ϕ73.3<br>ϕ2.9 |
| | Front idler | Outer diameter | | mm<br>in. | ϕ272.0<br>ϕ10.7 | 0 to 2.0<br>0 to 0.08 | ϕ268<br>ϕ10.6 |
| | | Guide width | | mm<br>in. | 30.0<br>1.2 | - | 26<br>1.0 |
| | | Idler width | | mm<br>in. | 72.0<br>2.8 | - | - |
| | Sprocket | Outer diameter | | mm<br>in. | ϕ356<br>ϕ14.02 | - | - |
| | | Inner diameter | | mm<br>in. | ϕ156<br>ϕ6.14 | - | - |
| | | Sprocket width | | mm<br>in. | 30<br>1.18 | -1.0 to 0 | 26<br>1.02 |
| | | Gear height | | mm<br>in. | 100<br>3.94 | - | 97<br>3.82 |
| | Tension spring | Steel track | Spring dimension | mm<br>in. | 174.3<br>6.86 | ±0.5<br>±0.020 | - |
| | | Rubber track | Spring dimension | mm<br>in. | 174.3<br>6.86 | ±0.5<br>±0.020 | - |
| | Track roller | Guide diameter | | mm<br>in. | 80.0<br>3.1 | - | 65<br>2.8 |
| | | Guide width | | mm<br>in. | 81.0<br>3.2 | - | 91<br>3.6 |
| | | Outer diameter | | mm<br>in. | ϕ124.0<br>ϕ4.88 | - | ϕ114<br>ϕ4.5 |
| | | Roller width | | mm<br>in. | 175.0<br>6.89 | - | - |

# 2. Testing

## 2.1 Measuring the front attachment horizontal play

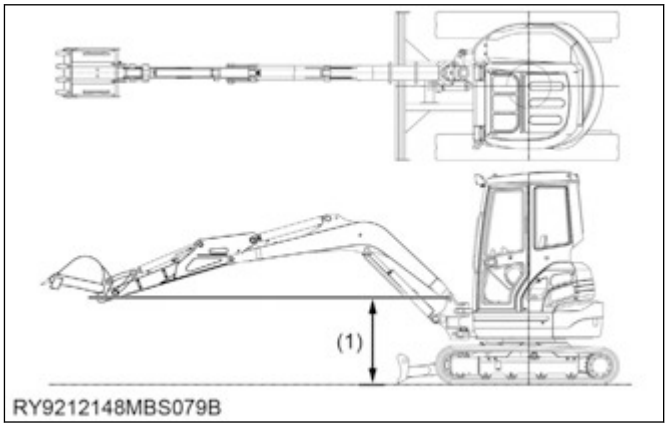
Measure the play of the front attachment to check the wear condition of the pins and bushings.

**■ IMPORTANT**

- **The measured value is the sum of all clearances in each pin and bushing connection.**
- **Start to adjust with shims from the pin connection that has the largest play.**
- **Consider the swivel gear backlash when measuring the front attachment play.**

**Preparing**

1. Dump the arm and bucket to the stroke end.
2. Set the boom support pin and bucket pin in a straight line.




(1) Boom support pin height

3. Stop the engine.

**Measuring**

1. Press the bucket to the right side by 50 N (5 kgf, 11 lbs) to set the zero point.

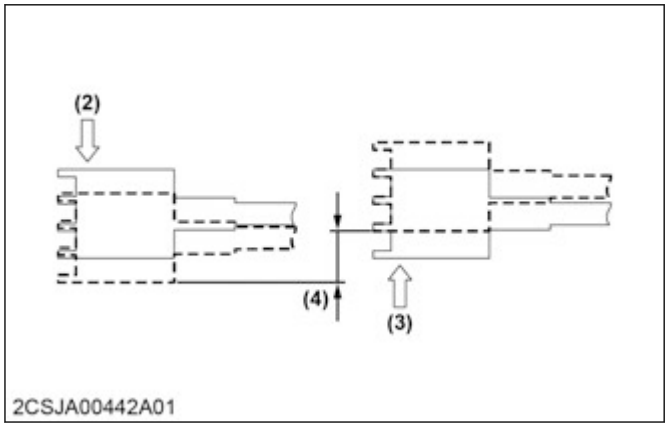
**NOTE**

- **Set a pole or put a mark on ground to recognize the zero point.**

2. Press the bucket to the left side by 300 N (30 kgf, 67 lbs) and measure the value of play.

**NOTE**

- **Measure distance from the zero point to stroke end with a scale or measuring tape.**




(2) 50 N (5 kgf, 11 lbs)
(3) 300 N (30 kgf, 67.4 lbs)
(4) Play

3. Measure 3 times to calculate the average.
4. Measure in the opposite direction as well.

**Service specification**

| | |
|---|---|
| Play | less than 73 mm<br>less than 2.8 in. |

**Service limit**

| | |
|---|---|
| Play | 146 mm<br>5.7 in. |

**Adjusting**

1. Install the designated shim to each pin for reducing each clearance.

**IMPORTANT**

- **Install the designated shims to both sides equally to reduce the clearance.**

**Service specifications**

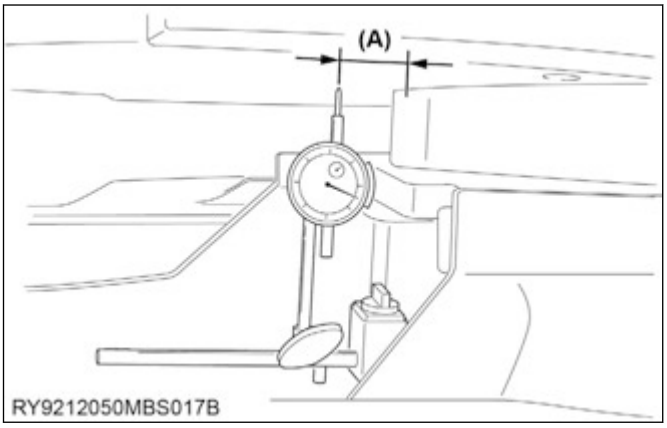
| | | |
|---|---|---|
| Clearance | Each pin | 0.5 mm<br>0.02 in. |
| | Pin of bucket link 2, 3 | 1.0 mm<br>0.04 in. |

## 2.2 Measuring the swivel bearing vertical play

Measure the play of the swivel bearing to check the wear condition of the ball, inner ring and outer ring.

**Preparing**

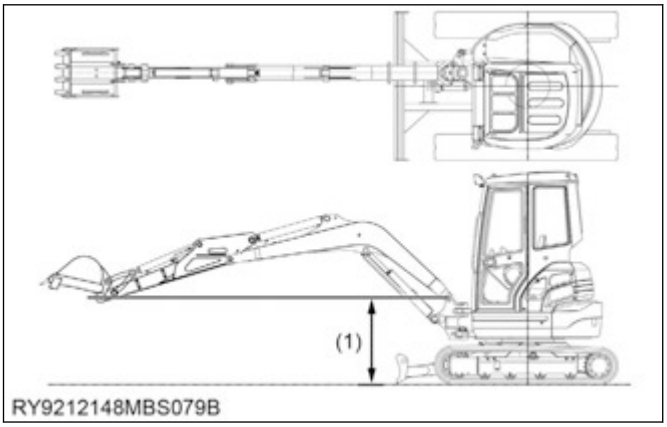
1. Fix the dial gauge by magnet to the track frame and contact the tip of the dial gauge.




(A) 50 mm (1.97 in.)

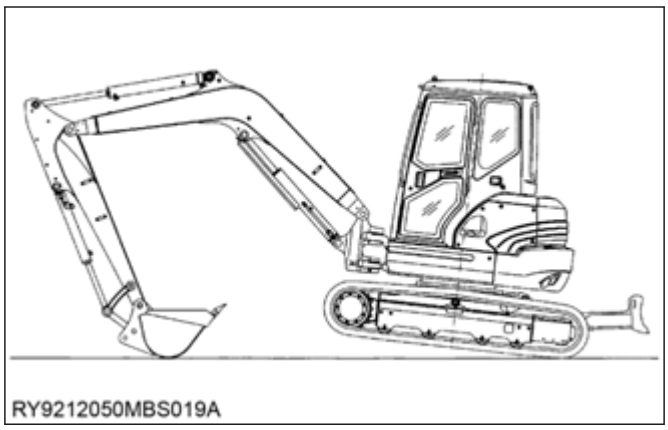
**Measuring**

1. Dump the arm and bucket to the stroke end.
2. Set the boom support pin and bucket pin in a straight line.




(1) Boom support pin height

3. Set the dial gauge to zero.
4. Jack up the machine with the front attachments and measure with the dial gauge.




5. Measure 3 times to calculate the average.

**Service specification**

| | |
|---|---|
| Play | 0.82 mm<br>0.032 in. |

**Service limit**

| | |
|---|---|
| Play | 1.64 mm<br>0.066 in. |

## 2.3 Measuring swing bracket vertical clearance

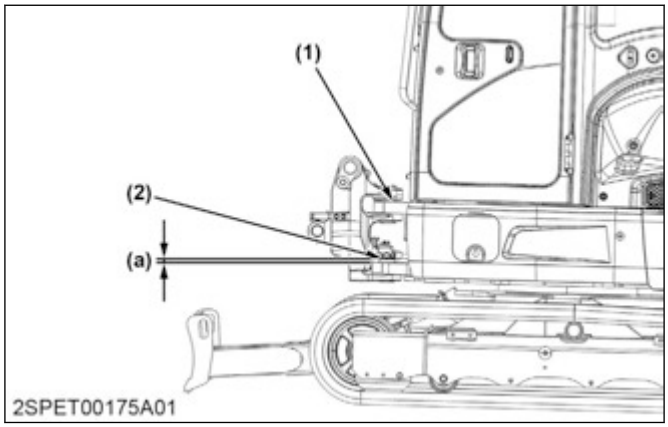
Measure the clearance of the swing bracket vertical clearance to check the wear condition of the thrust collar, swing bracket, and track frame.

**Preparing**

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the front attachment.

**Measuring**

1. Measure the lower side clearance between the swing bracket and track frame with a feeler gauge.




(1) Upper thrust collar (2) Lower thrust collar

**Service specification**

| | |
|---|---|
| (a) Clearance | 0.5 mm<br>0.002 in. |

**Adjusting**

1. Replace the upper thrust collar.

**NOTE**
- **Install the 3.0 mm thickness thrust collar.**
- **Grease the thrust collar.**

2. Replace the lower thrust collar.

**NOTE**
- **Adjust the clearance with the 3.0, 2.5, or 2.0 mm thickness thrust collars.**

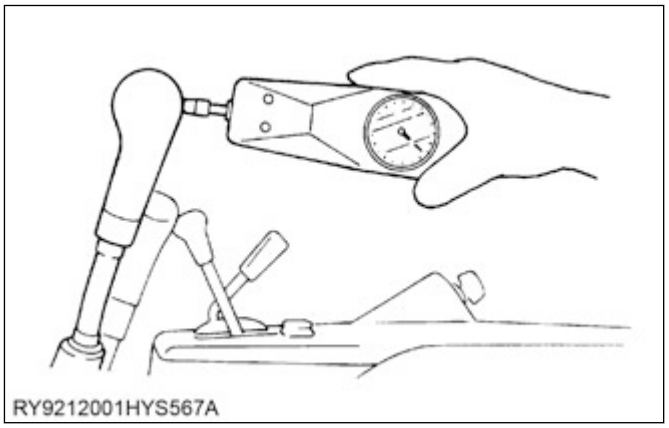
## 2.4 Measuring the operating force for levers and pedals

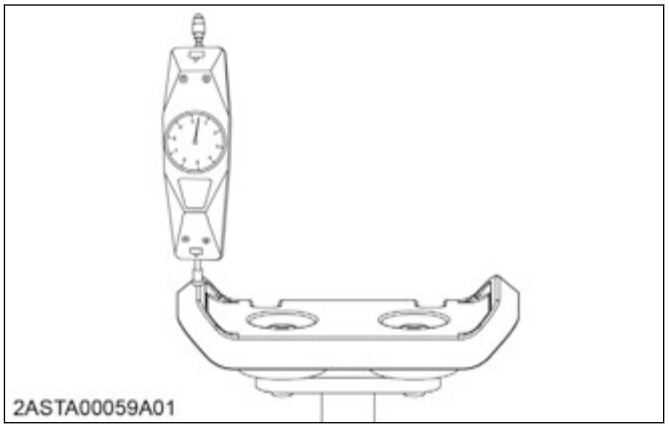
Measure the operating force for levers and pedals to check the wear or fixation condition of its internal parts.

**CAUTION**
- **Make sure the lever lock is raised before the measurement.**

**Measuring**

1. Start the engine and accelerate the engine speed to approximately 2250 rpm.
2. Set an operating force measuring device to the lever or pedal.
   - Levers: At 20 mm below from the grip edge
   - Pedals: At the pedal edge



3. Operate the lever or pedal and measure the force right before the lever or pedal reaches the end.
4. Measure 3 times to calculate the average.

**Service specifications**

| | | | |
|---|---|---|---|
| Operating force | Pilot control lever (Basic) | Forwards | 4.7 to 14.5 N 0.48 to 1.48 kgf |
| | | Backwards | 4.7 to 14.5 N 0.48 to 1.48 kgf |
| | | LH and RH | 4.7 to 14.5 N 0.48 to 1.48 kgf |
| | Pilot control lever (Hi-spec) | Forwards | 6.9 to 16.7 N 0.7 to 1.7 kgf |
| | | Backwards | 6.4 to 16.2 N 0.7 to 1.7 kgf |
| | | LH and RH | 4.4 to 14.2 N 0.45 to 1.45 kgf |
| | Travel control lever | Forwards | 16.7 to 26.5 N 1.7 to 2.7 kgf |
| | | Backwards | 16.7 to 26.5 N 1.7 to 2.7 kgf |
| | Blade control lever | Forwards | 19.1 to 28.9 N 2.0 to 3.0 kgf |
| | | Backwards | 19.1 to 28.9 N 2.0 to 3.0 kgf |
| | Lever lock | Raising | 17.2 to 36.8 N 1.8 to 3.8 kgf |
| | | Lowering | 58.2 to 77.8 N 5.9 to 7.9 kgf |
| | Accelerator lever | Raising | 24.5 to 53.9 N 2.5 to 5.5 kgf |
| | | Lowering | 19.6 to 49 N 2.0 to 5.0 kgf |
| | Swing control pedal | LH | 37.4 to 50.8 N 3.82 to 5.18 kgf |
| | | RH | 37.4 to 50.8 N 3.82 to 5.18 kgf |
| | AUX control pedal | LH | 41.3 to 54.7 N 4.21 to 5.58 kgf |
| | | RH | 41.3 to 54.7 N 4.21 to 5.58 kgf |

# 3. Repairing

## 3.1 Bucket

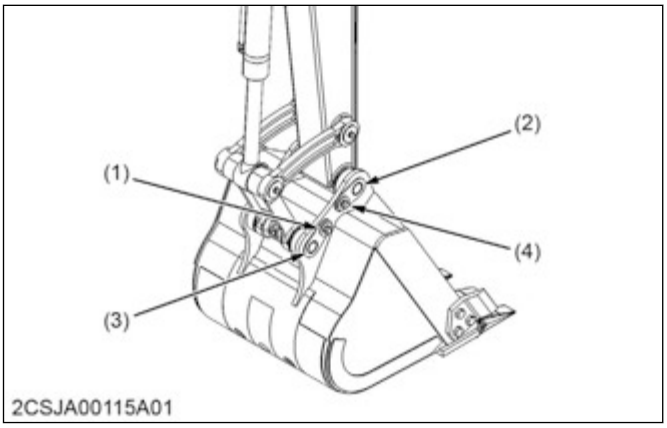
### 3.1.1 Removing the bucket

**CAUTION**

- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

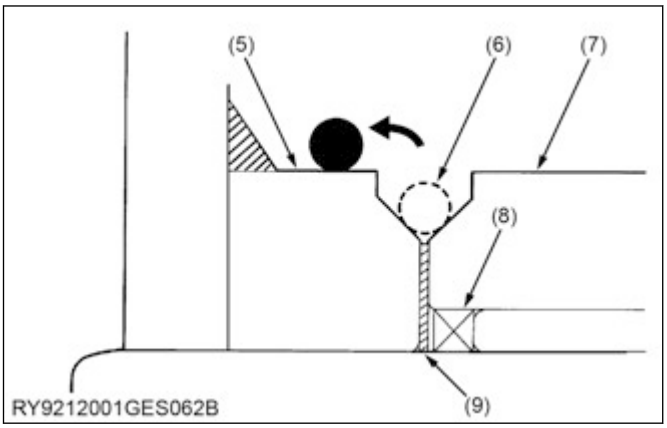
**Removing**

1. Place the bucket on level ground.
2. Stop the engine and release residual pressure.
3. Remove two bolts.




(1) Pin
(2) Pin
(3) Bolt (M16 × 30) ×1
(4) Bolt (M16 × 30) ×1

4. Remove the O-ring from a groove.




(5) Bucket
(6) O-ring
(7) Arm
(8) Dust seal
(9) Shim

5. Hit the two pins with a hammer and a round bar to remove.
6. Start the engine to lift the boom carefully. The bucket will be removed.

**Mass**

| | |
|---|---|
| Bucket | Approximately 46 kg Approximately 101 lbs |

# 3.2 Arm

## 3.2.1 Removing the arm

**CAUTION**

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

**IMPORTANT**

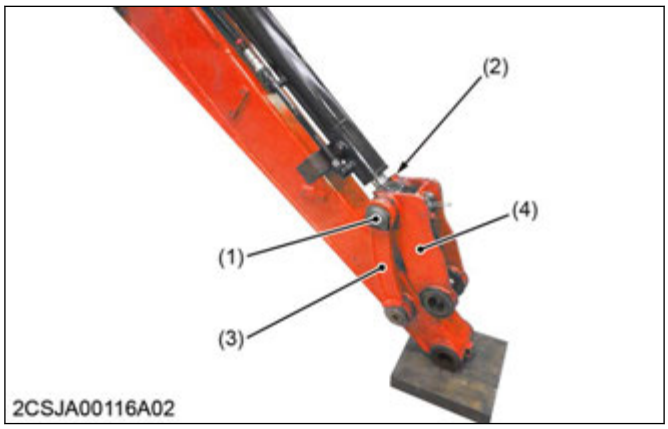
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the bucket.

**Removing**

1. Dump the bucket to the stroke end and lower the arm to the ground.
2. Remove the pin fixing bolt of bucket cylinder rod side.
3. Hit the pin with a hammer and a round bar to remove the link 1, 2, and 3.




(1) Pin
(2) Link 2
(3) Link 3
(4) Link 1

4. Attach a nylon sling to bucket cylinder and hoist for support.




(5) Bucket cylinder
(6) Pin
(7) Nylon sling

5. Disconnect the hydraulic hoses from the bucket cylinder.
6. Remove both the bucket cylinder bottom pin and the bucket cylinder.

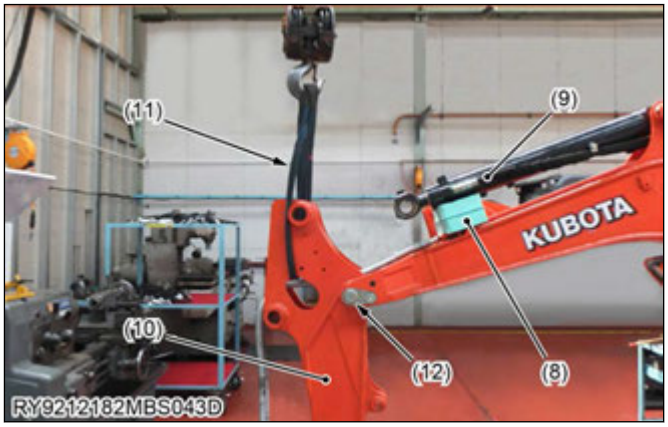
**Mass**

| | |
|---|---|
| (5) Bucket cylinder | Approximately 19.3 kg<br>Approximately 42.5 lbs |

**NOTE**

- **This value does not include the mass of the hydraulic oil.**

7. Put a supporting block under the arm cylinder for support.
8. Attach a nylon sling to the arm and hoist for support.
9. Remove all of the hydraulic hoses.
10. Remove the pin on the rod side of the arm cylinder.
11. Remove the pin and the arm.




(8) Supporting block
(9) Arm cylinder
(10) Arm
(11) Nylon sling
(12) Pin

**Mass**

| | | |
|---|---|---|
| (10) Arm | Standard arm specification | Approximately 52 kg Approximately 115 lbs |
| | Short arm specification | Approximately 46 kg Approximately 101 lbs |

# 3.3 Boom

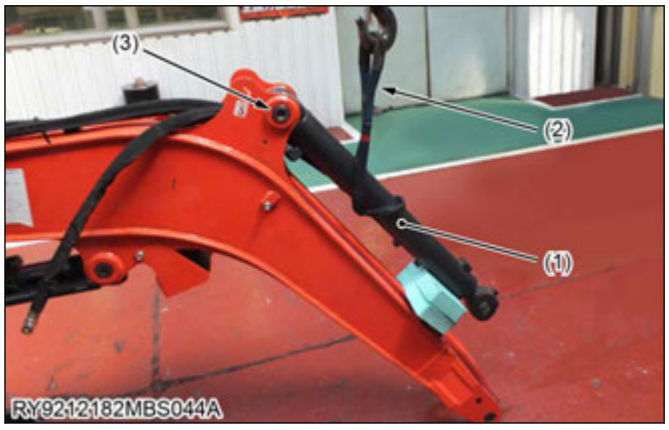
## 3.3.1 Removing the boom

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

**■ IMPORTANT**
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the arm.

**Removing**
1. Lower the boom end to the ground.
2. Attach a nylon sling to the arm cylinder and hoist for support.
3. Disconnect all of the hydraulic hoses from the arm cylinder.
4. Remove the pin on the bottom side of the arm cylinder.



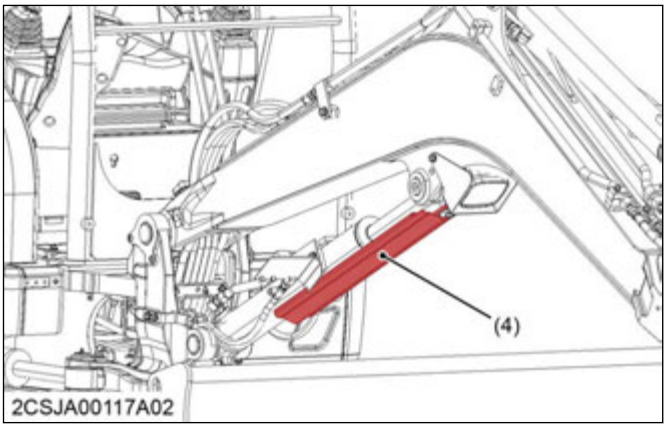

(1) Arm cylinder
(2) Nylon sling
(3) Pin

**Mass**

| | |
|---|---|
| (1) Arm cylinder | Approximately 22.0 kg Approximately 48.5 lbs |

**■ NOTE**
- **This value does not include the mass of hydraulic oil.**

5. Remove the cylinder cover from the boom cylinder.




(4) Cylinder cover

6. Attach a nylon sling to the boom cylinder and hoist for support.
7. Disconnect all of the hydraulic hoses.
8. Remove both the boom cylinder pins and the boom cylinder.



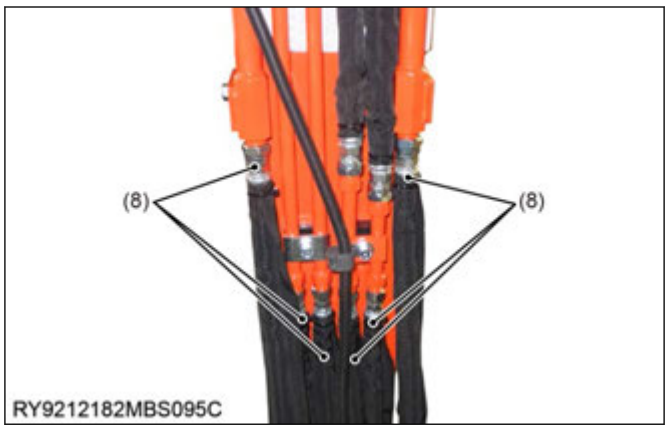

(5) Nylon sling
(6) Boom cylinder
(7) Pin

**Mass**

| | |
|---|---|
| (6) Boom cylinder | Approximately 25.7 kg Approximately 56.7 lbs |

**■ NOTE**
- **This value does not include the mass of the hydraulic oil.**

9. Disconnect all of the wire harnesses for work light and hydraulic hoses.




(8) Hydraulic hose

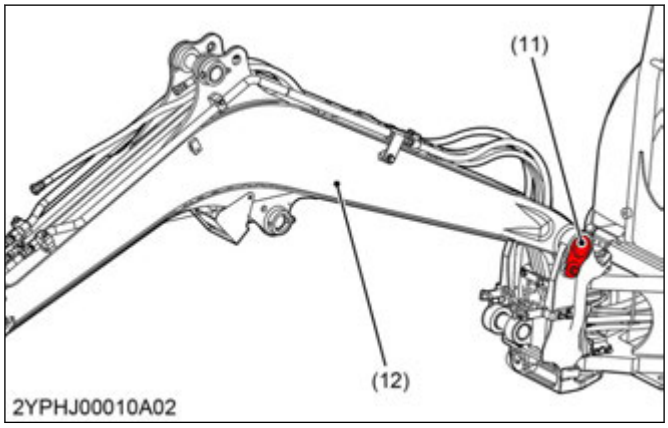
10. Attach a nylon sling to the boom and hoist for support.

**NOTE**
- **Install a shackle to the boom.**




(9) Nylon sling (10) Shackle

11. Remove the boom support pin and the boom.




(11) Boom support pin (12) Boom

**Mass**

| | |
|---|---|
| (12) Boom | Approximately 101 kg<br>Approximately 223 lbs |

## 3.4 Blade

### 3.4.1 Removing the blade

**CAUTION**
- **Lower the front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

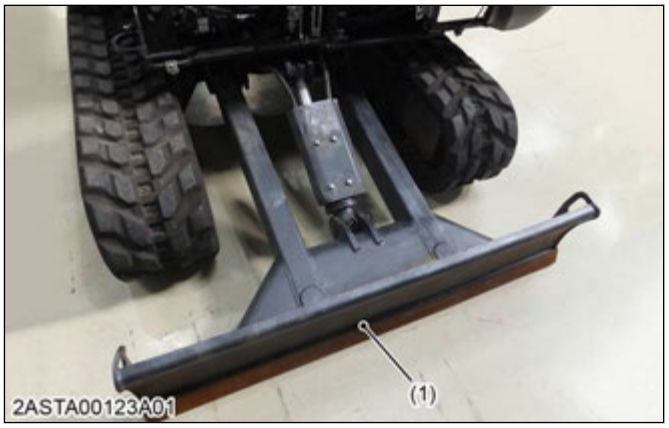
**IMPORTANT**
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

1. Install the vacuum pump to the hydraulic tank, and vacuum the hydraulic tank.

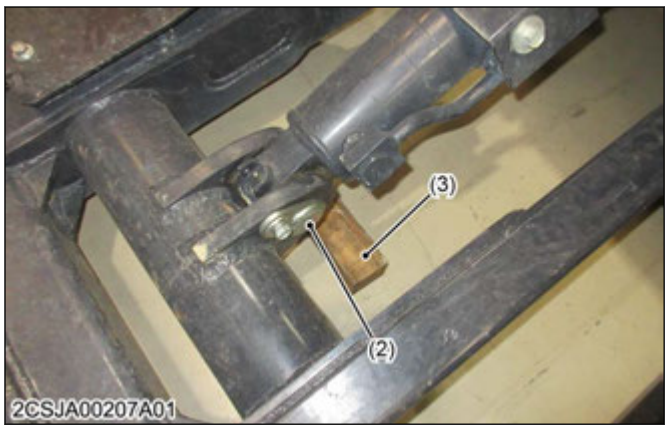
**Removing**

1. Swivel the upper structure 90 degrees against the blade.
2. Lower the bucket and blade to the ground and stop the engine.




(1) Blade

3. Put a supporting block under the blade cylinder and remove the cylinder bottom pin.

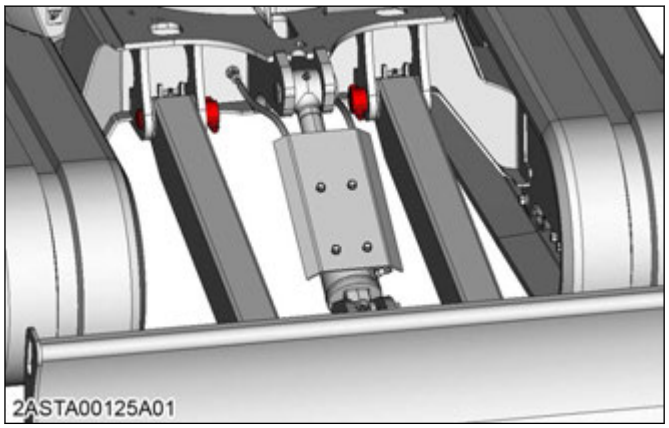



(2) Cylinder bottom pin (3) Supporting block

4. Remove all of the hydraulic hoses from the blade cylinder.
5. Attach 3 nylon slings on the blade (right end, left end and center pin hole), and hoist for support.




6. Remove the 2 pins from the blade and blade assembly.




**Mass**

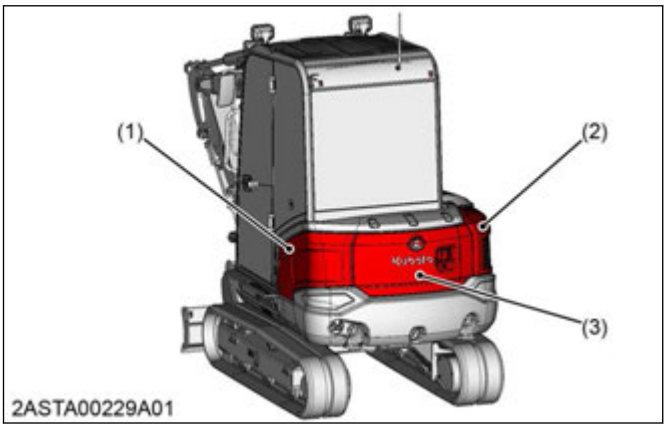
| | |
|---|---|
| (1) Blade | Approximately 88.0 kg<br>Approximately 194 lbs |

# 3.5 Counterweight

## 3.5.1 Removing and installing the counterweight

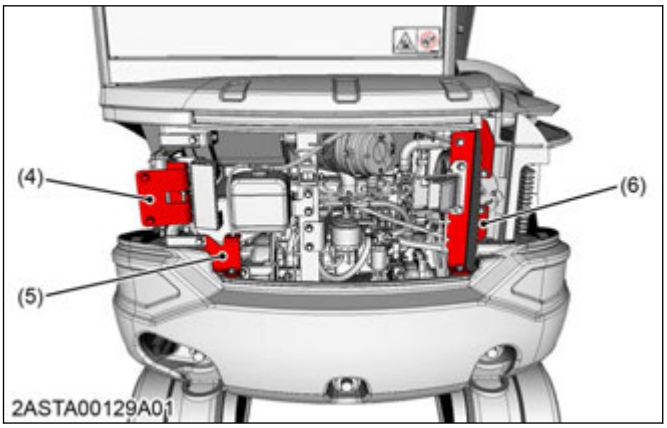
**Removing**

1. Remove the LH, RH, and rear bonnet.



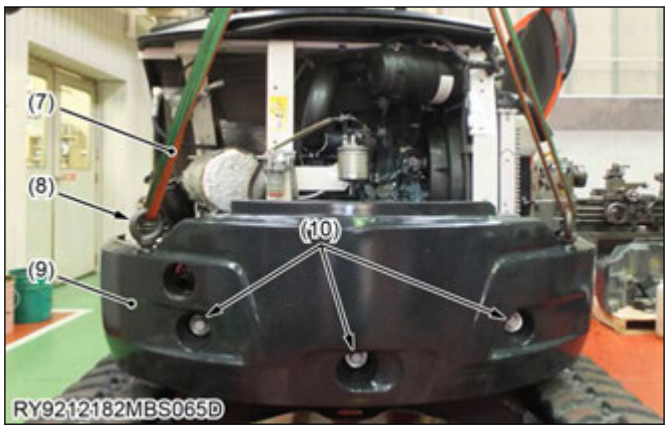

(1) LH bonnet (3) Rear bonnet
(2) RH bonnet

2. Remove the rear bonnet hinge, stay, and partition plate.




(4) Rear bonnet hinge (6) Partition plate
(5) Stay

3. Install 2 eye bolts to the counterweight.
4. Attach nylon sling to the eye bolts and hoist for support.
5. Remove the 3 bolts.




(7) Nylon sling
(8) Eye bolt
(9) Counterweight
(10) Bolt (M20 × 90) ×3

6. Remove the counterweight carefully.




(9) Counterweight

**Mass**

| | |
|---|---|
| (9) Counterweight | Approximately 164 kg<br>Approximately 362 lbs |

**Installing**

**Tightening torque**

| | | |
|---|---|---|
| (10) Bolt | 367.7 to 431.5 N·m<br>37.5 to 44.0 kgf·m<br>271.2 to 318.2 lbf·ft | Thread lock<br>(Loctite 301) |

# 3.6 Canopy

## 3.6.1 Removing and installing the canopy

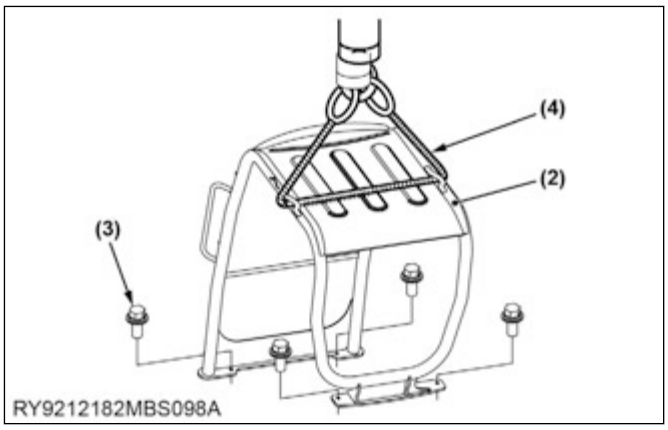
**Removing**

1. Lower the bucket and blade to the ground. Stop the engine.
2. Remove the 2 bolts and handrail.




(1) Handrail

3. Attach a nylon sling to the canopy and hoist for support.
4. Remove the 4 bolts.




(2) Canopy
(3) Bolt (M14 × 60) ×4
(4) Nylon sling

5. Remove the canopy.




(2) Canopy

**Mass**

| | |
|---|---|
| (2) Canopy | Approximately 79.5 kg<br>Approximately 175.3 lbs |

**Installing**

**Tightening torque**

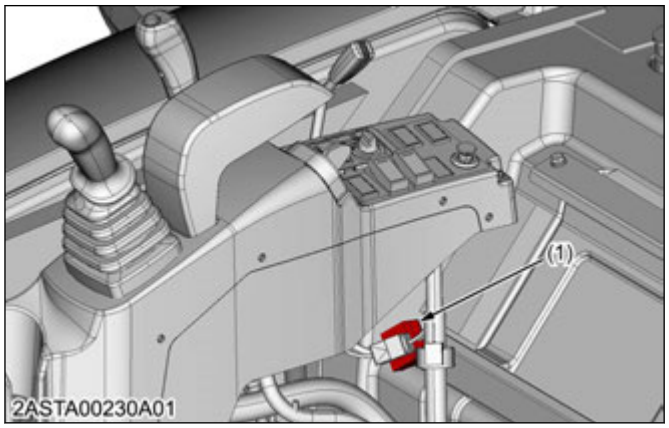
| | | |
|---|---|---|
| (3) Bolt | 123.6 to 147.1 N·m<br>12.6 to 15.0 kgf·m<br>91.2 to 108.5 lbf·ft | Thread lock<br>(Loctite 301-70) |

# 3.7 Cabin

## 3.7.1 Removing and installing the cabin

**Removing**

1. Lower the blade and bucket to the ground. Stop the engine.
2. Slide the seat forwards and remove the cabin harness.




(1) Cabin harness

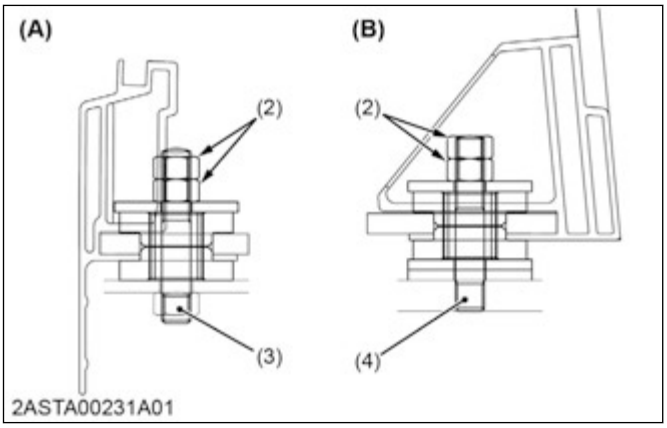
3. Remove the 8 nuts in the front and rear.





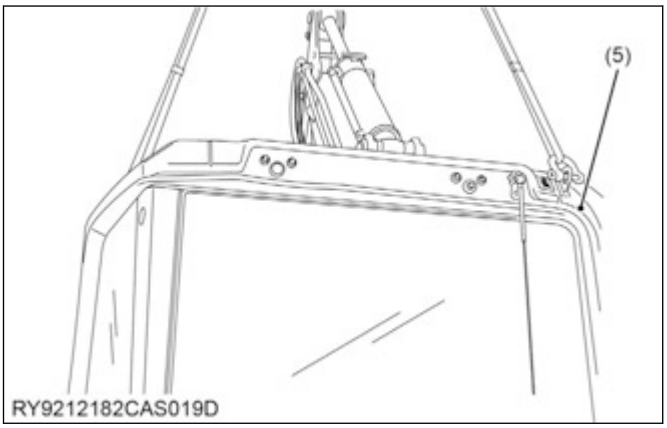


(2) Nut (M14) ×8




(2) Nut (M14) ×8
(3) Stud bolt (front)
(4) Stud bolt (rear)
(A) Front
(B) Rear

4. Attach the nylon sling to the cabin and hoist to remove.




(5) Cabin

**Mass**

| | |
|---|---|
| (5) Cabin | Approximately 140 kg<br>Approximately 309 lbs |

**Installing**

**Tightening torque**

| | | |
|---|---|---|
| (2) Nut | 107.9 to 125.5 N·m<br>11.0 to 12.8 kgf·m<br>79.6 to 92.6 lbf·ft | - |
| (3), (4) Stud bolt | 62 to 73 N·m<br>6.3 to 7.4 kgf·m<br>45.7 to 53.8 lbf·ft | Thread lock<br>(Loctite 301-70) |

## 3.8 Lever lock

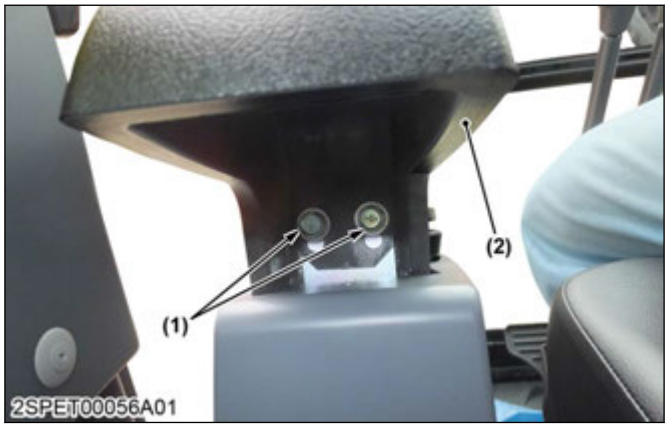
### 3.8.1 Removing and installing the lever lock

**CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Lower the front attachments to the ground, and stop the engine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Removing**

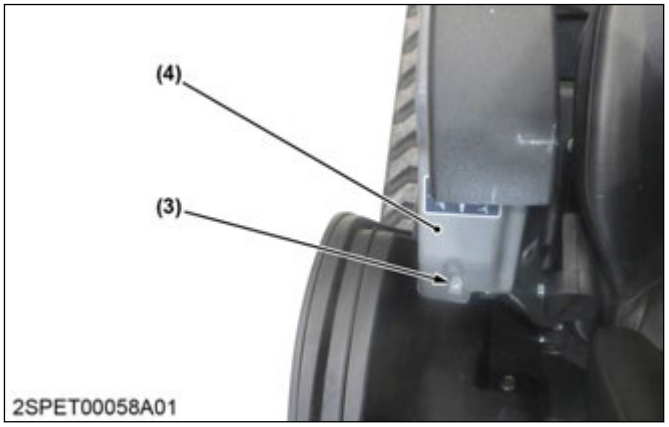
1. Remove the two bolts and arm rest.




(1) Bolt (M8 × 20) ×2 (2) Arm rest

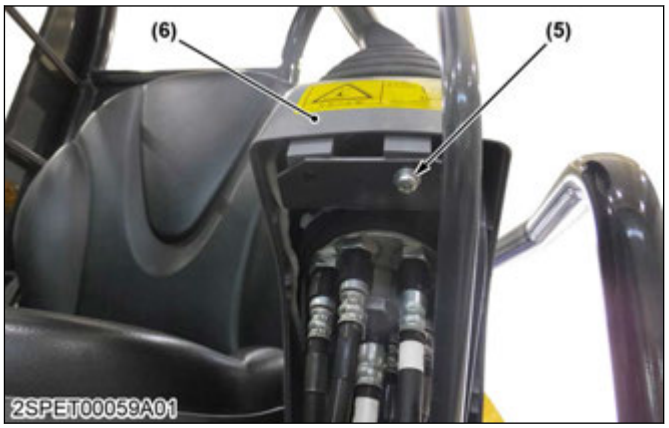
2. Remove the two screws and lower cover.




(3) Screw ×2 (4) Lower cover

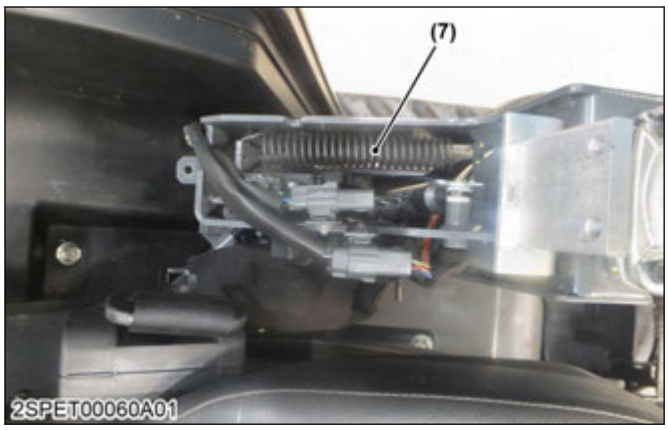
3. Remove the screw and upper cover.




(5) Screw (6) Upper cover

4. Remove the spring.

**CAUTION**
- **Be careful that the spring may pop out rapidly when removing.**



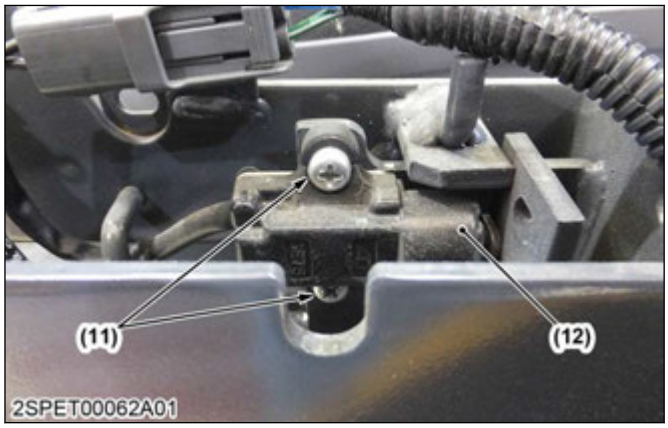

(7) Spring

5. Remove the two split pins, two washers, and damper.



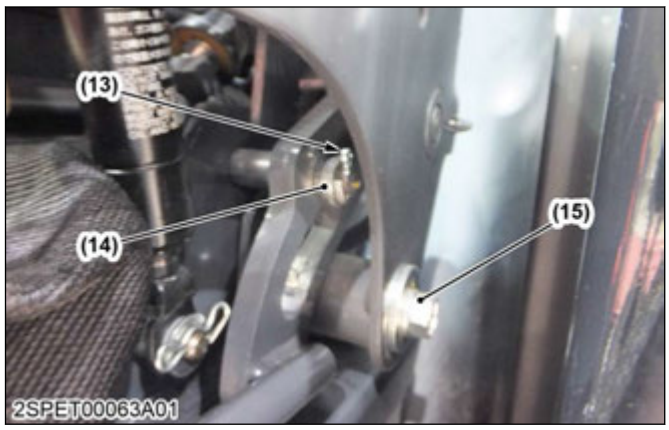

(8) Split pin ×2
(9) Washer ×2
(10) Damper

6. Remove the two screws and lever lock switch.




(11) Screw ×2
(12) Lever lock switch

7. Remove the LH bonnet and all of the hydraulic hoses from the LH pilot control valve.
8. Remove the split pin and washer.




(13) Split pin
(14) Washer
(15) Bolt (M10 × 20)

9. Remove the bolt and lever lock.

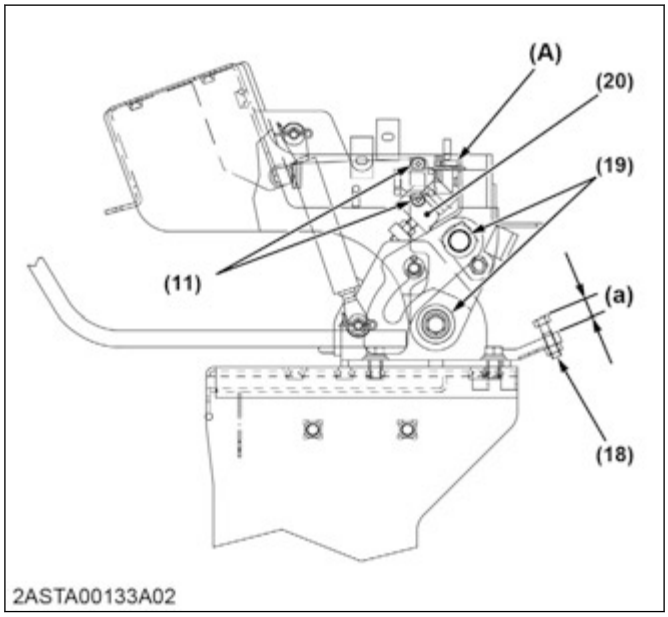
**■ NOTE**
- **Slide the lever lock leftwards to remove.**

10. Remove the bolt, pin, and unload lever.




(16) Bolt (M10 × 20)
(17) Pin

**Installing**




(11) Screw ×2
(18) Stopper bolt
(19) Bushing ×2
(20) Cushion

**■ IMPORTANT**

- **Install the rod side of the damper to the lower base.**
- **Grease the bushings.**

**■ NOTE**

- **Remove the stopper bolt when installing the damper.**
- **Adjust the cushion position to contact the unload lever bracket onto the lever lock stopper bracket (A) when lowering the lever lock.**

**Tightening torque**

| | | |
|---|---|---|
| (11) Screw | 3.9 to 4.9 N·m<br>0.4 to 0.5 kgf·m<br>2.9 to 3.6 lbs·ft | Thread lock<br>(Loctite 307 - 70) |

**Adjusting dimension**

| | |
|---|---|
| (a) | 15 mm<br>0.59 in. |

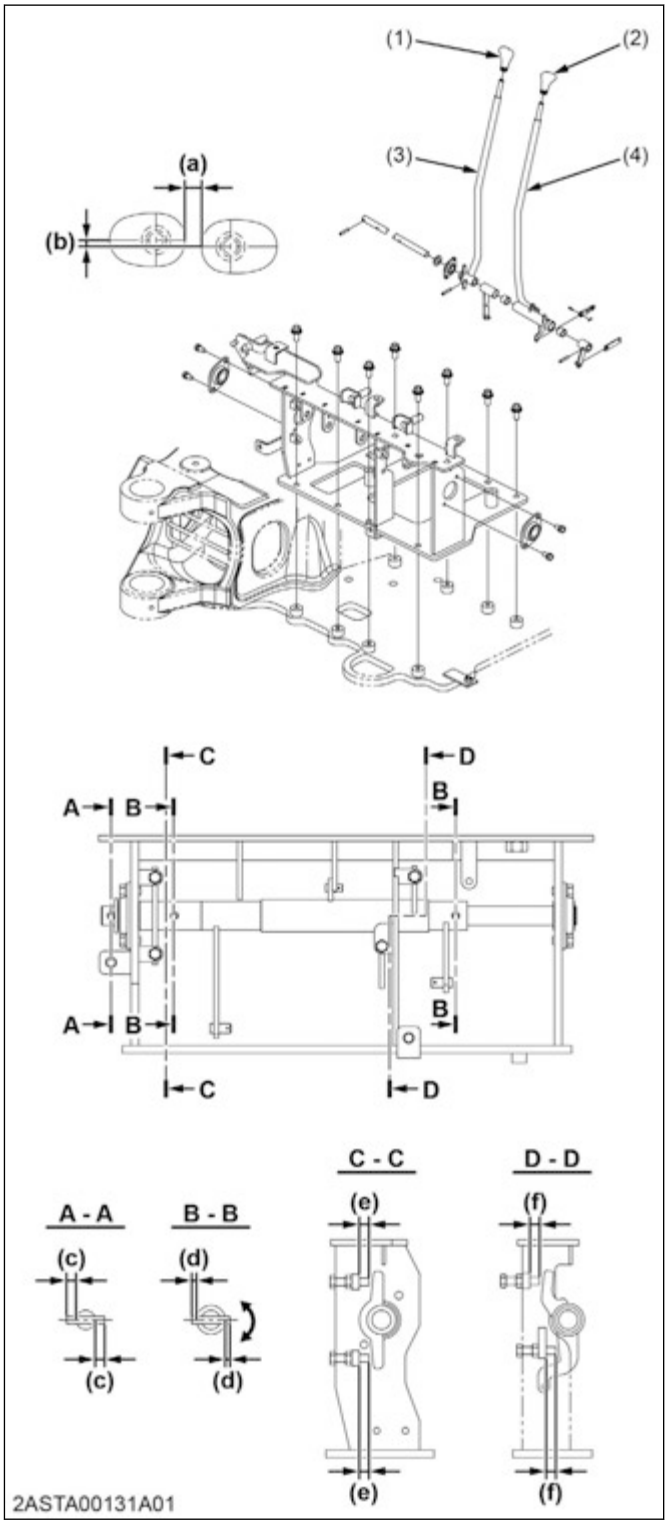
# 3.9 Travel control lever

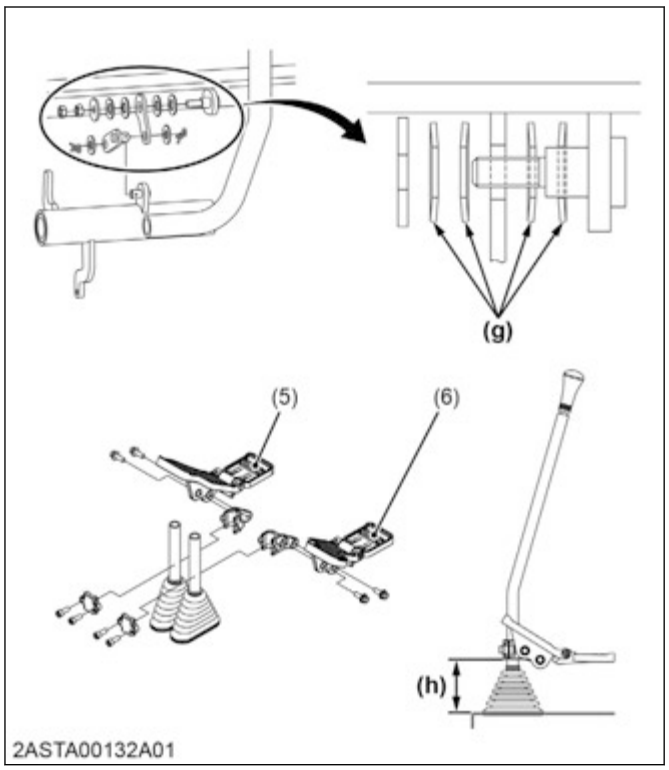
## 3.9.1 Installing the travel control lever

**⚠ CAUTION**

- **Lower the front attachments to the ground and stop the engine.**

**Installing**






(1) Grip (travel RH)
(2) Grip (travel LH)
(3) Lever (travel RH)
(4) Lever (travel LH)
(5) Pedal (travel RH)
(6) Pedal (travel LH)

**■ NOTE**

- **Install the spring plates (g) in correct direction.**

### Adjusting dimensions

| | |
|---|---|
| (a) | 5 to 15 mm<br>0.2 to 0.6 in. |
| (b) | less than 5.0 mm<br>less than 0.20 in. |
| (c) | 10 mm<br>0.40 in. |
| (d) | 5.0 mm<br>0.20 in. |
| (e) | 10 mm<br>0.40 in. |
| (f) | 10 mm<br>0.40 in. |
| (h) | 105 mm<br>4.1 in. |

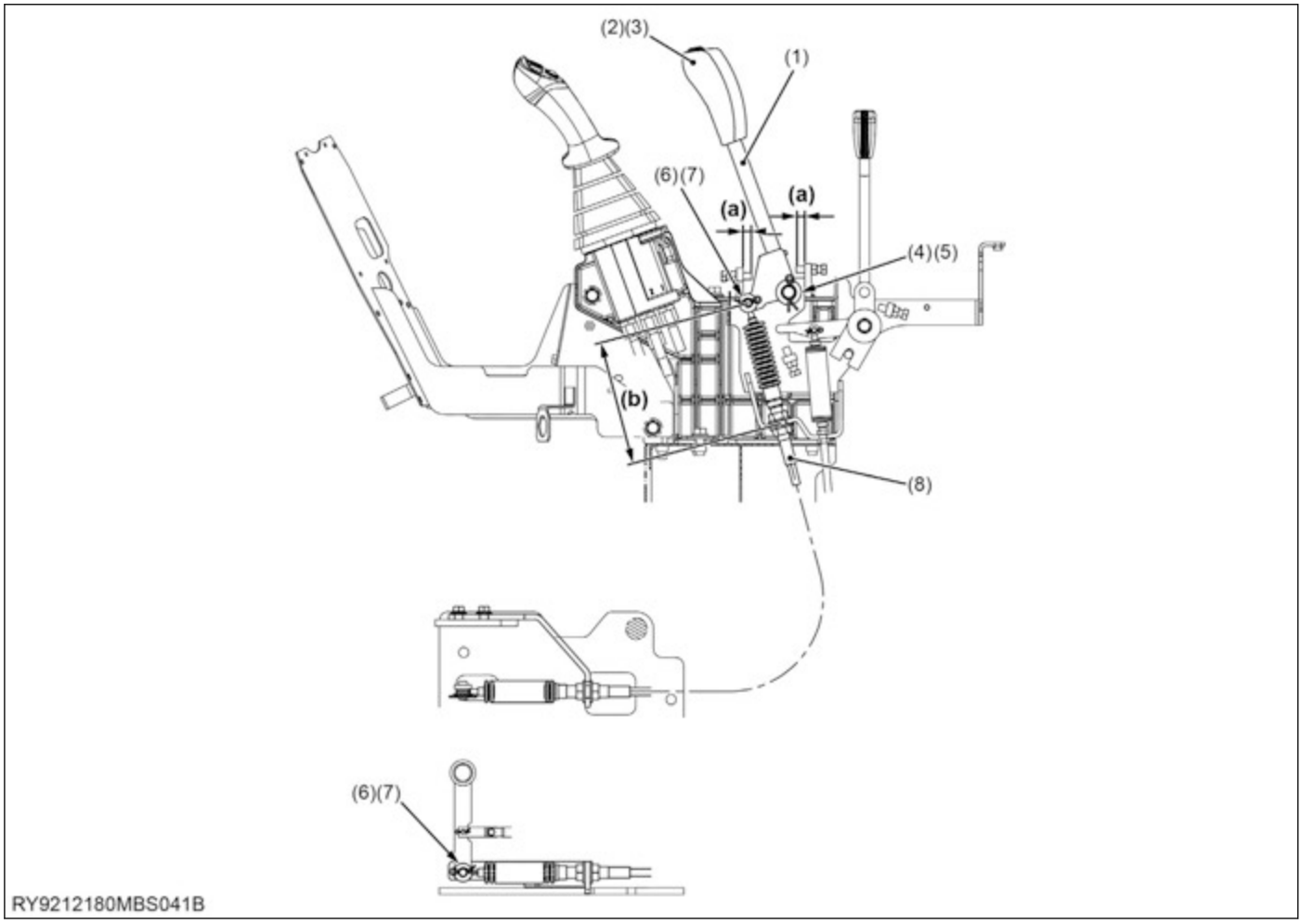
# 3.10 Blade control lever

## 3.10.1 Installing the blade control lever

**CAUTION**
- **Lower the front attachments to the ground and stop the engine.**

**NOTE**
- **Install the blade cable through the hose guide with the pilot hose.**

**Installing**




(1) Blade lever
(2) Grip
(3) Screw
(4) Washer
(5) Snap pin
(6) Washer
(7) Snap pin
(8) Blade cable

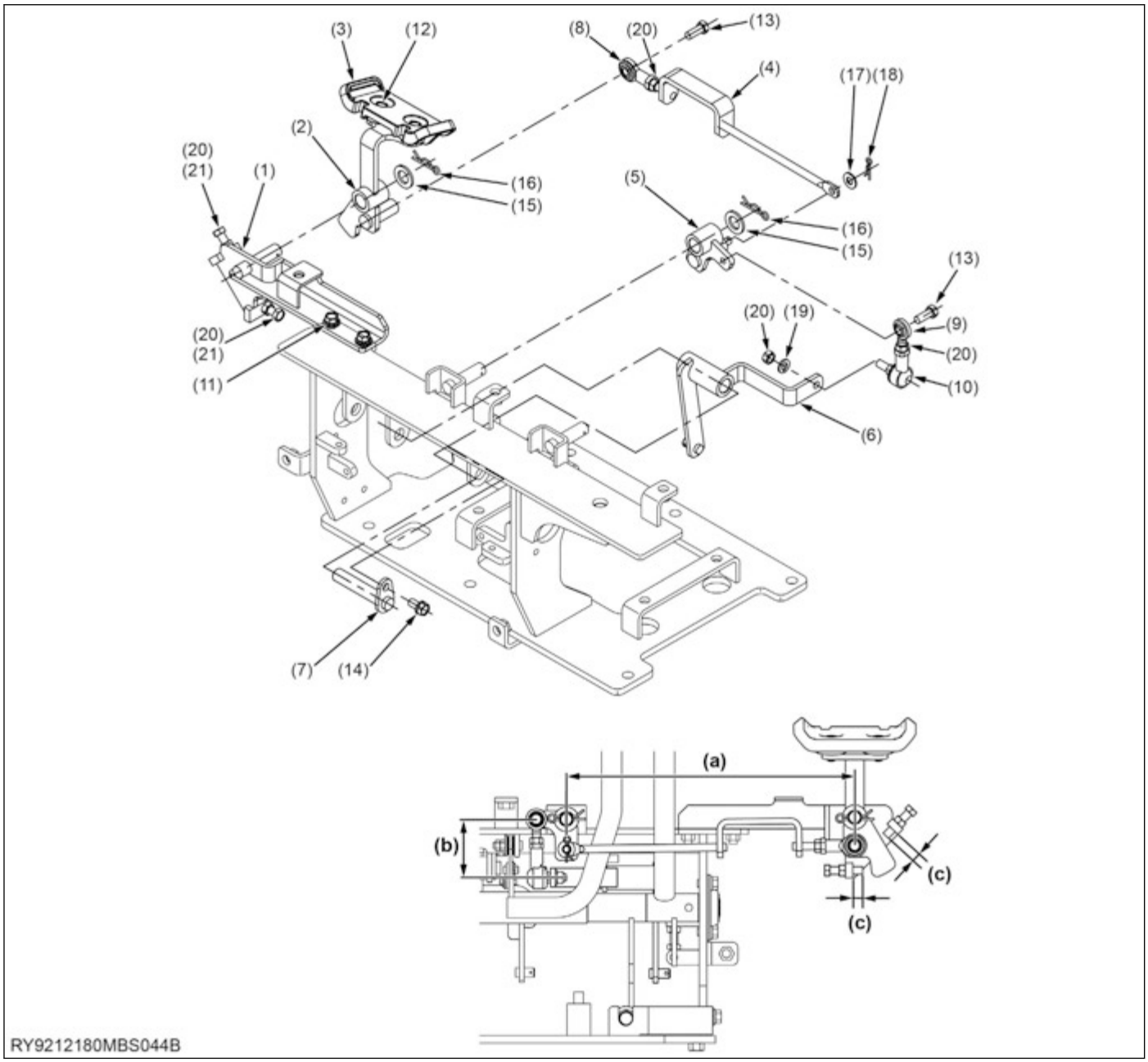
**Adjusting dimension**

| | | | |
|---|---|---|---|
| (a) | 10 mm<br>0.40 in. | (b) | 148 mm<br>5.8 in. |

# 3.11 Swing control pedal

## 3.11.1 Installing the swing control pedal

**Installing**




(1) Bracket
(2) Pedal lever
(3) Swing control pedal
(4) Rod
(5) Link 1
(6) Link 2
(7) Shaft
(8) Rod end (RH)
(9) Rod end screw (RH)
(10) Rod end (LH)
(11) Bolt (M8 × 20)
(12) Bolt (M8 × 20)
(13) Bolt (M8 × 20)
(14) Bolt (M8 × 16)
(15) Washer
(16) Snap pin
(17) Washer
(18) Snap pin
(19) Spring washer
(20) Nut
(21) Bolt

**■ IMPORTANT**

- **Make sure that the control valve spool moves smoothly in full stroke.**

**■ NOTE**

- **Install the swing control pedal so that the notched side faces toward the front of machine.**

### Tightening torque

| | | |
|---|---|---|
| (20) Nut | 17.7 to 20.6 N·m<br>1.8 to 2.1 kgf·m<br>13.1 to 15.2 lbf·ft | - |

### Adjusting dimension

| | | | |
|---|---|---|---|
| (a) | 306 mm<br>12.0 in. | (b) | 62 mm<br>2.4 in. |
| (c) | 10 mm<br>0.39 in. | - | - |

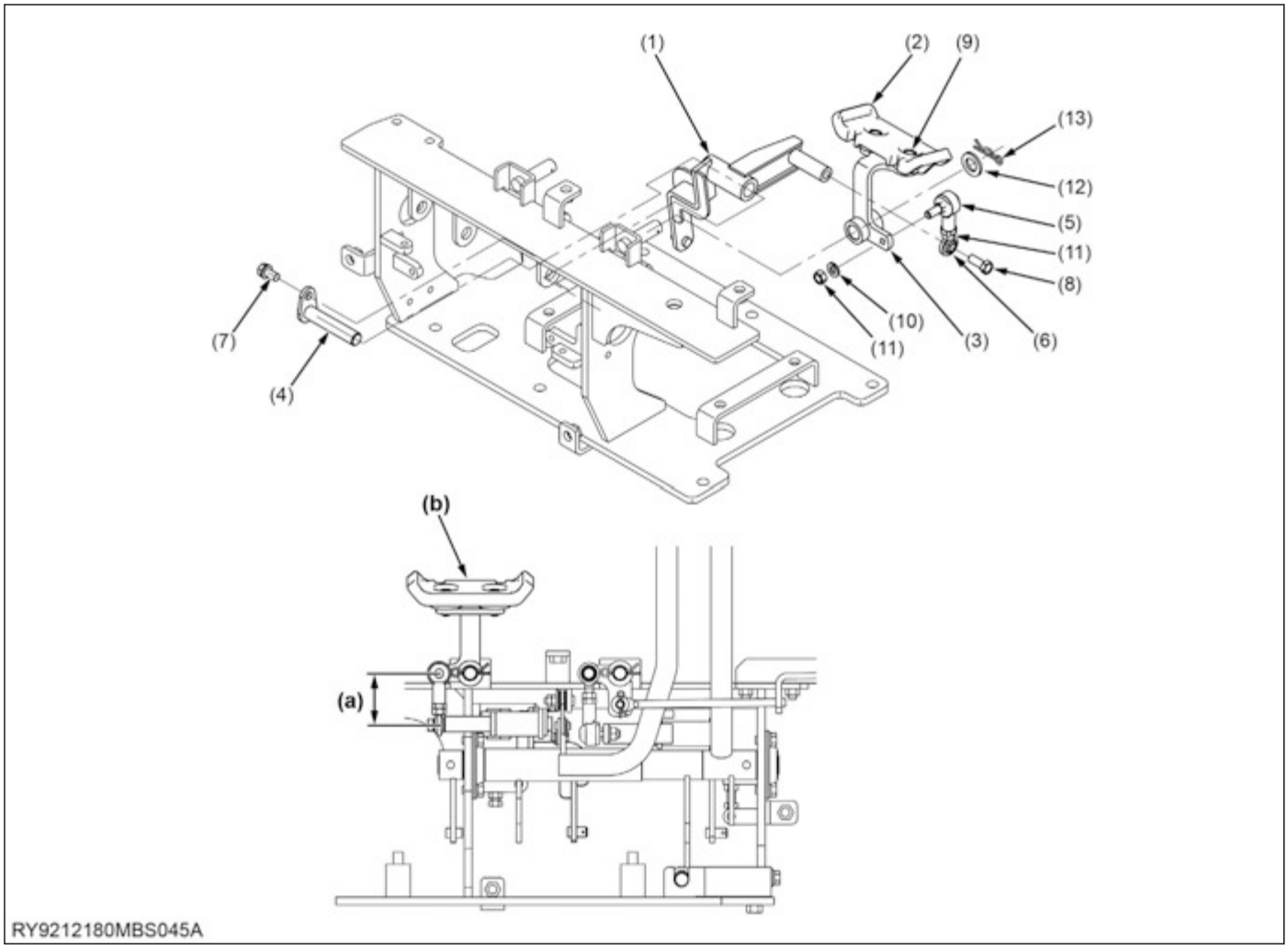
# 3.12 AUX control pedal

## 3.12.1 Installing the AUX control pedal

**Installing**

**■ NOTE**

- **The AUX control pedal is only installed for basic model.**




(1) Link assembly
(2) AUX control pedal
(3) Lever
(4) Shaft
(5) Rod
(6) Rod end
(7) Bolt (M8 × 1.25)
(8) Bolt (M8 × 1.25)
(9) Bolt (M8 × 1.25)
(10) Spring washer
(11) Nut
(12) Washer
(13) Snap pin

**■ IMPORTANT**

- **Make sure that the control valve spool moves smoothly in full stroke.**

**Tightening torque**

| | | |
|---|---|---|
| (11) Nut | 17.7 to 20.6 N·m<br>1.8 to 2.1 kgf·m<br>13.1 to 15.2 lbf·ft | - |

**Adjusting dimension**

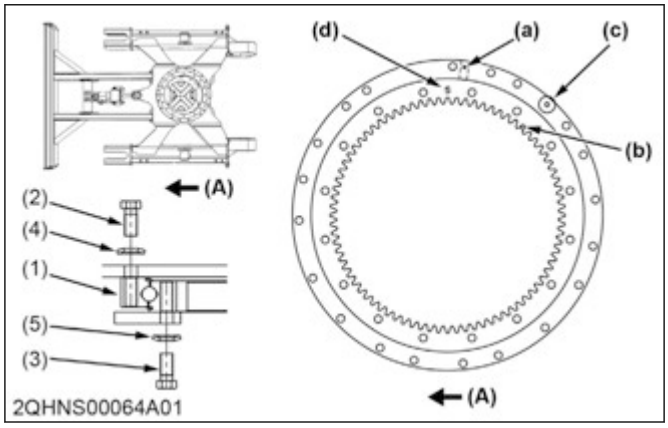
| | | | |
|---|---|---|---|
| (a) | 62 mm<br>2.4 in. | (b) | 180° |

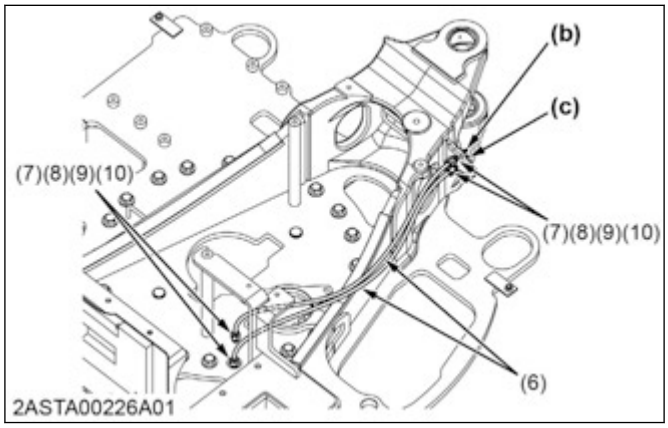
# 3.13 Swivel bearing

## 3.13.1 Installing the swivel bearing

**Installing**

1. Set the **[S]** mark on the right side of the machine and mount the swivel bearing by finger tightening.




(1) Swing bearing
(2) Bolt (M16 × 35) ×20
(3) Bolt (M16 × 35) ×16
(4) Spring washer
(5) Spring washer
(6) Grease tube
(7) Adapter
(8) Nut
(9) Sleeve
(10) Sleeve
(a) Ball insertion opening (outer ring soft zone)
(b) Filler hole for bearing teeth
(c) Filler hole for ball bearing
(d) **[S]** mark (inner ring soft zone)
(A) Front of machine

2. Tighten the 36 bolts.

**■ IMPORTANT**

- **Tighten the bolts in order alternately.**

3. Grease the bearing teeth.

**Tightening torque**

| | | |
|---|---|---|
| (2) (3) Bolt | 259.9 to 304.0 N·m<br>26.5 to 31.0 kgf·m<br>191.7 to 224.0 lbf·ft | Thread lock<br>(Loctite 301-70) |

# 3.14 Steel track

## 3.14.1 Removing and installing the steel track

**⚠ CAUTION**

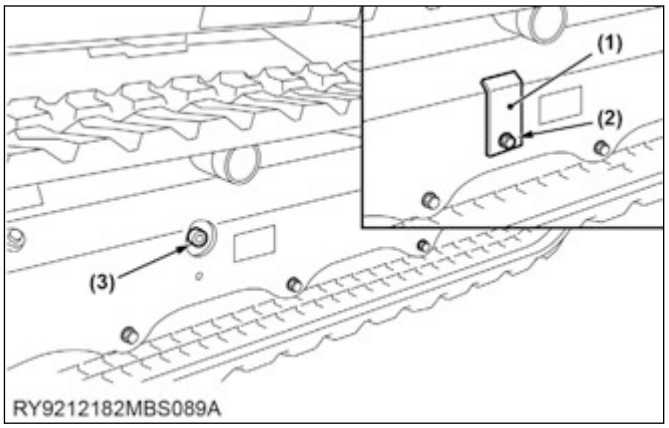
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**■ IMPORTANT**

- **Be sure to install the steel track in the correct direction.**
- **In case of exchanging the steel track to rubber track, it is possible to exchange and not needed to adjust the dimension of the tension spring.**

**Removing**

1. Remove the bolt and cover.




(1) Cover
(2) Bolt (M10 × 20)
(3) Grease fitting

2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.
3. Jack up the machine and remove the grease from the grease cylinder completely.

**■ NOTE**

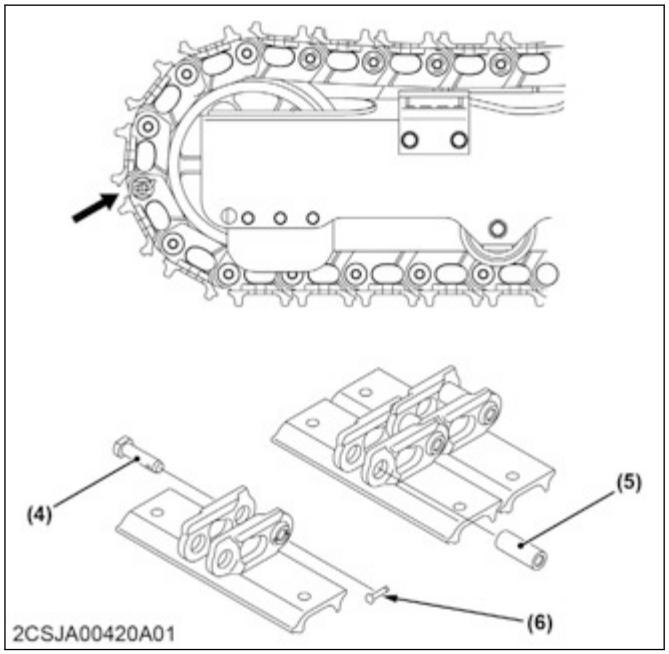
- **The grease comes out by own weight of the track.**

4. Tighten the grease fitting.

**Tightening torque**

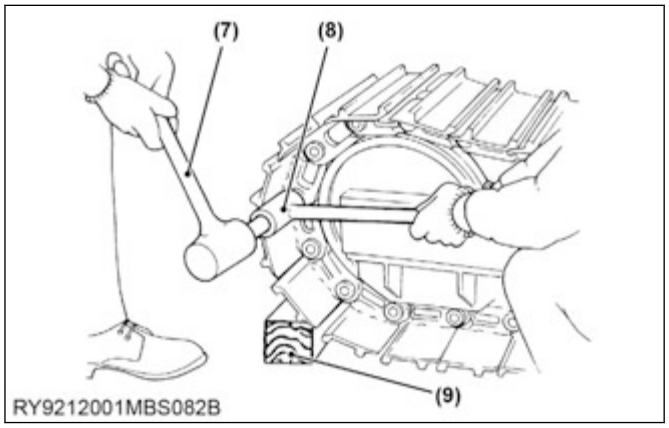
| | | |
|---|---|---|
| (3) Grease fitting | 98.0 to 107.8 N·m<br>10.0 to 11.0 kgf·m<br>72.3 to 79.5 lbf·ft | - |

5. Slowly rotate the travel motor until the master pin is in front of the front idler.
6. Remove the locking pin from the master pin.



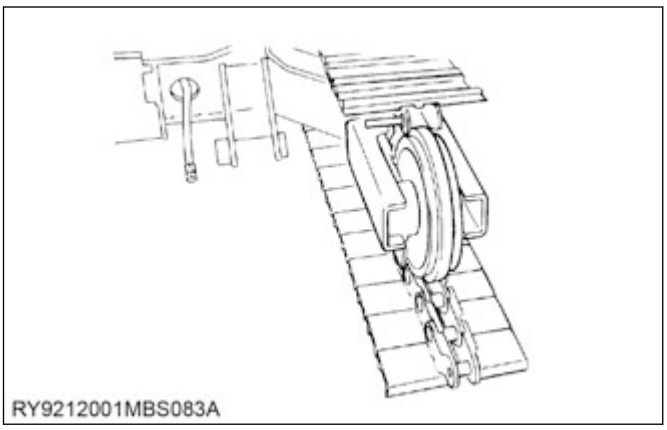

(4) Master pin
(5) Master link
(6) Locking pin

7. Remove the master pin with a hammer and jig.




(7) Hammer
(8) Jig
(9) Support block

8. Slowly rotate the travel motor backwards to remove the steel track.

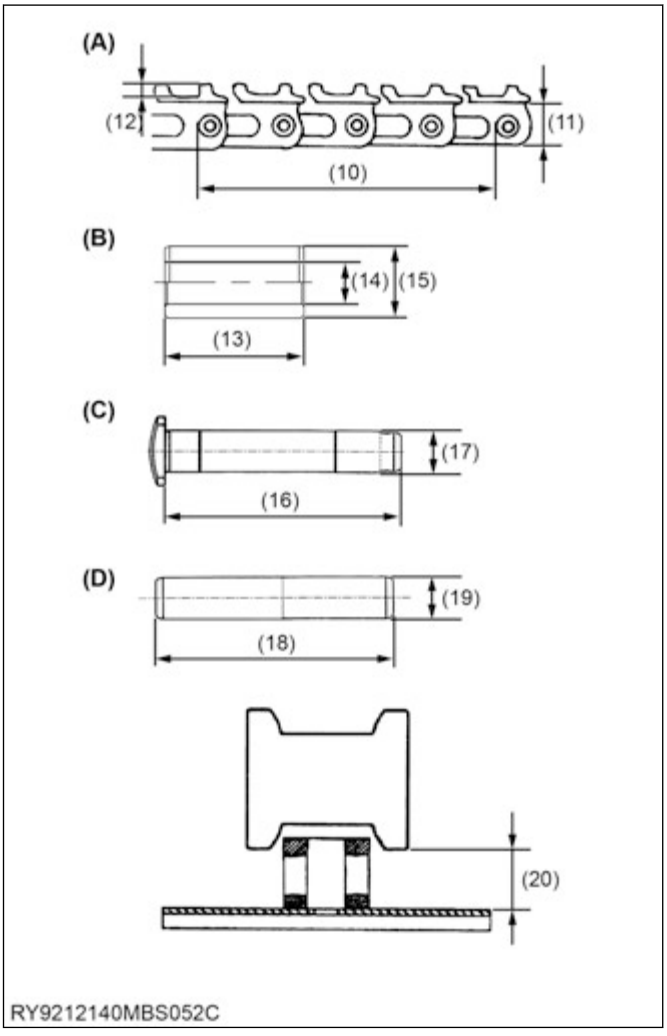



**Mass**

| | |
|---|---|
| Steel track | Approximately 174 kg<br>Approximately 384 lbs |

**Measuring**

1. Check the steel track dimensions.




(A) Steel track
(B) Bushing
(C) Master pin
(D) Pin

### Service specifications

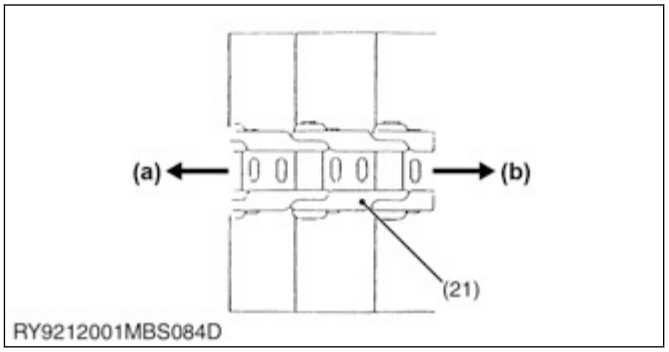
| | |
|---|---|
| (10) Link length | 406.4 mm<br>16.0 in. |
| (11) Height | 90.5 mm<br>3.6 in. |
| (12) Grouser height | 16.5 mm<br>0.65 in. |
| (13) Bushing length | 55.0 mm<br>2.2 in. |
| (14) Bushing inner diameter | ϕ17.0 mm<br>ϕ0.67 in. |
| (15) Bushing outer diameter | ϕ28.0 mm<br>ϕ1.1 in. |
| (16) Master pin length | 96.5 mm<br>3.8 in. |
| (17) Master pin outer diameter | ϕ16.8 mm<br>ϕ0.66 in. |
| (18) Pin length | 97 mm<br>3.8 in. |
| (19) Pin outer diameter | ϕ17 mm<br>ϕ0.67 in. |
| (20) Track tension dimension | 75 mm<br>3.0 in. |

### Service limits

| | |
|---|---|
| (10) Link length | 416.4 mm<br>16.4 in. |
| (11) Height | 85.5 mm<br>3.37 in. |
| (12) Grouser height | 8.0 mm<br>0.3 in. |
| (13) Bushing length | - |
| (14) Bushing inner diameter | ϕ19.0 mm<br>ϕ0.75 in. |
| (15) Bushing outer diameter | ϕ26.5 mm<br>ϕ1.04 in. |
| (16) Master pin length | - |
| (17) Master pin outer diameter | ϕ15.5 mm<br>ϕ0.61 in. |
| (18) Pin length | - |
| (19) Pin outer diameter | ϕ15.5 mm<br>ϕ0.61 in. |

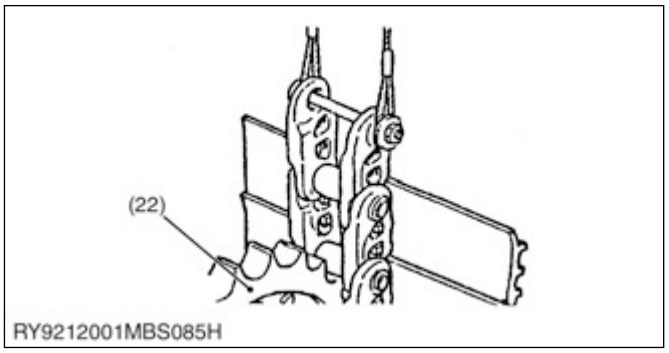
**Installing**

1. Jack up the machine and put the steel track under the track roller as it protrudes a little from the sprocket.



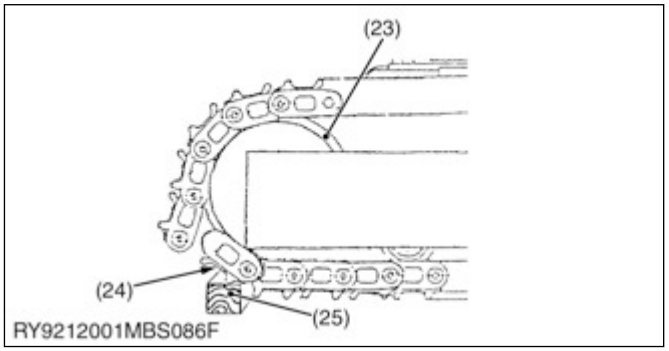

(21) Master link
(a) Sprocket side
(b) Front idler side

2. Hoist the steel track by the crane and install the steel track on the sprocket.



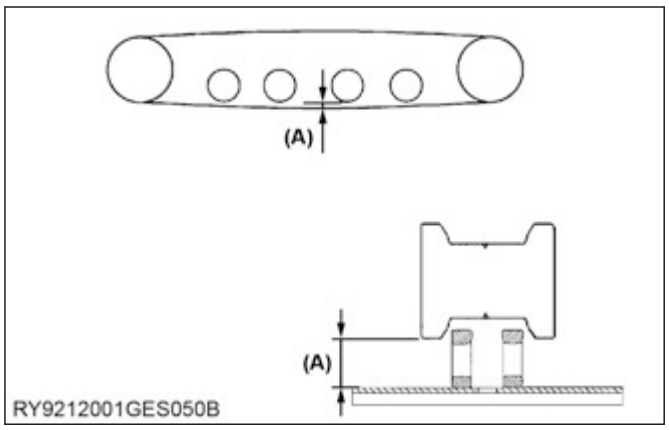

(22) Sprocket

3. Slowly rotate the travel motor forwards to mesh with the steel track.
4. Mesh with the steel track in a full circle and stop rotating the travel motor.
5. Set a support block under the track.




(23) Idler
(24) Track
(25) Support block

6. Adjust the hole position and install the master pin and locking pin.
7. Bend the tip of the locking pin.
8. Put grease into the grease fitting to extend the grease cylinder.
9. Adjust the distance between the steel track and track roller in range.
10. After adjustment, rotate the steel track two revolutions and check the distance.




(A) Tension dimension

**Service specification**

| | |
|---|---|
| (A) | 75 to 80 mm<br>3.0 to 3.1 in. |

# 3.15 Rubber track

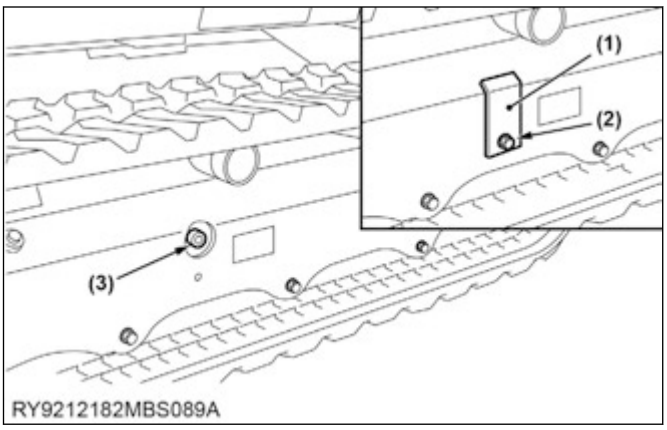
## 3.15.1 Removing and installing the rubber track

**⚠ CAUTION**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **– Do not stand in front of the grease fitting.**
  - **– Loosen the grease fitting slowly.**

**■ IMPORTANT**
- **Be sure to install the rubber track in the correct direction.**
- **It is not possible to exchange the rubber track to the steel track due to the track frame structure.**

**Removing**

1. Remove the bolt and cover.




(1) Cover
(2) Bolt (M10 × 20)
(3) Grease fitting

2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.
3. Jack up the machine and remove the grease from the grease cylinder completely.

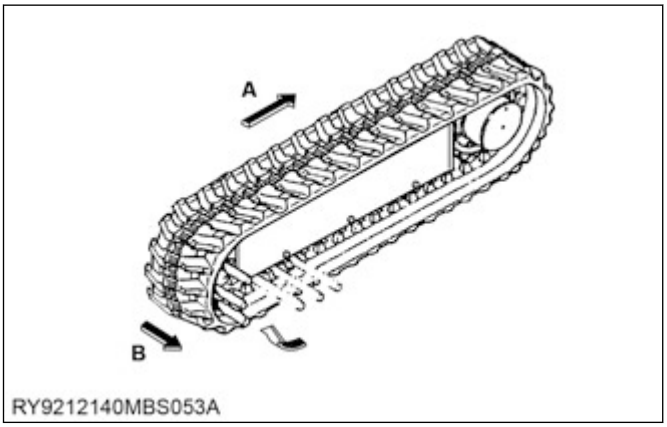
**■ NOTE**
- **The grease comes out by own weight of the track.**

4. Tighten the grease fitting.

**Tightening torque**

| | | |
|---|---|---|
| (3) Grease fitting | 98.0 to 108.0 N·m<br>10.0 to 11.0 kgf·m<br>72.3 to 79.7 lbf·ft | - |

5. Insert the three or four steel pipes between the rubber track links.
6. Slowly rotate the travel motor until rubber track derails from idler.
7. Remove the rubber track.



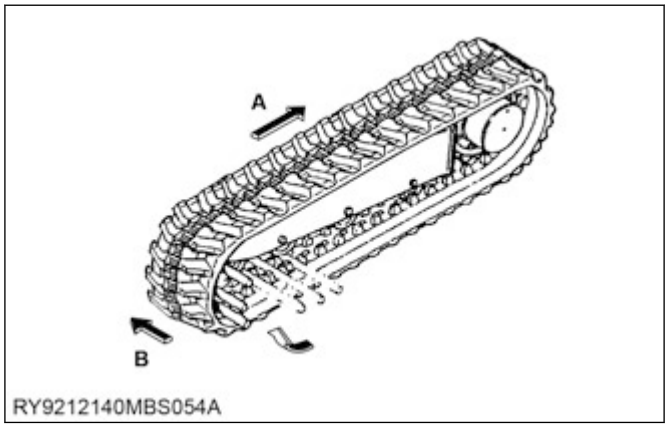

**Mass**

| | |
|---|---|
| Rubber track | Approximately 119 kg<br>Approximately 262 lbs |

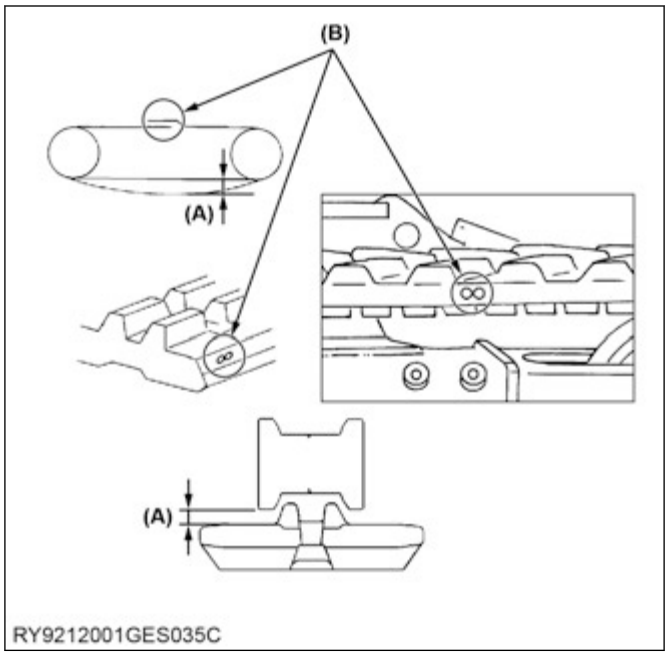
**Installing**

1. Jack up the machine and set the rubber track on the sprocket.

2. Insert three or four steel pipes in rubber track lower side.
3. Slowly rotate the travel motor forwards until the pipes comes between the idler and rubber track.
4. Stop rotating the travel motor.
5. Slide the rubber track to B direction to mesh the rubber track.




6. Remove the pipes.
7. Set the match mark right over the carrier roller.
8. Put grease into the grease fitting to extend the grease cylinder.
9. Adjust the distance between the rubber track and track roller in range.
10. After adjustment, rotate the rubber track two revolutions to check the distance.




(A) Tension dimension (B) Match mark

### Service specification

| | | |
|---|---|---|
| (A) | 10 to15 mm<br>0.39 to 0.59 in. | |

# 3.16 Front idler

## 3.16.1 Removing the front idler

**⚠ CAUTION**

- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**Preparing**

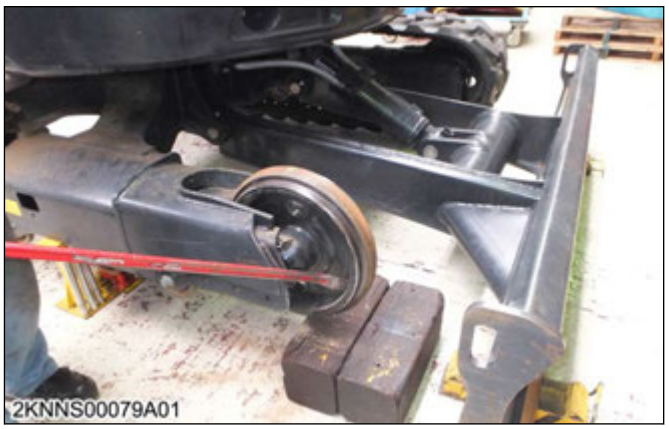
1. Remove the track.

**Removing**

1. Jack up the machine and set the supporting block under the track frame.




2. Set the supporting block under the front idler and remove the front idler from the track frame.

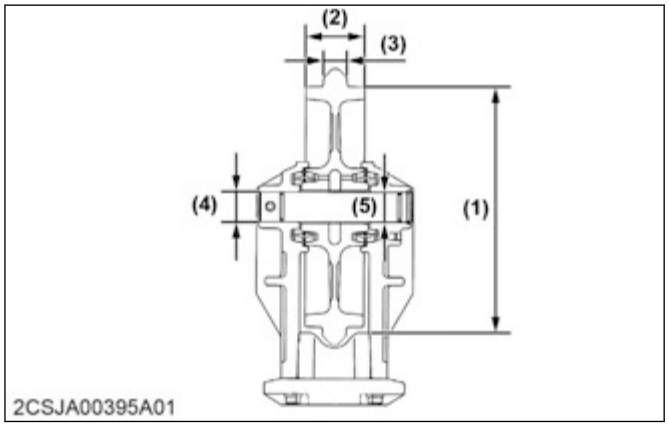



### Mass

| | |
|---|---|
| Front idler | Approximately 14.3 kg<br>Approximately 31.5 lbs |

**Measuring**

1. Check the front idler dimensions.



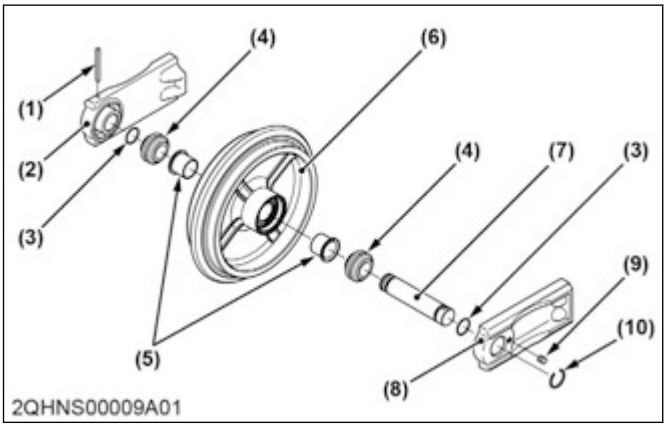

**Service specifications**

| | |
|---|---|
| (1) Idler outer diameter | ϕ272 mm<br>ϕ11.5 in. |
| (2) Guide width | 30 mm<br>1.18 in. |
| (3) Idler width | 72 mm<br>2.83 in. |
| (4) Shaft outer diameter | ϕ30 mm<br>ϕ1.18 in. |
| (5) Bushing inner diameter | ϕ30 mm<br>ϕ1.18 in. |

**Service limits**

| | |
|---|---|
| (1) Idler outer diameter | ϕ268 mm<br>ϕ10.6 in. |
| (2) Guide width | 26 mm<br>1.0 in. |
| (3) Idler width | - |
| (4) Shaft outer diameter | ϕ29 mm<br>ϕ1.14 in. |
| (5) Bushing inner diameter | ϕ31 mm<br>ϕ1.22 in. |

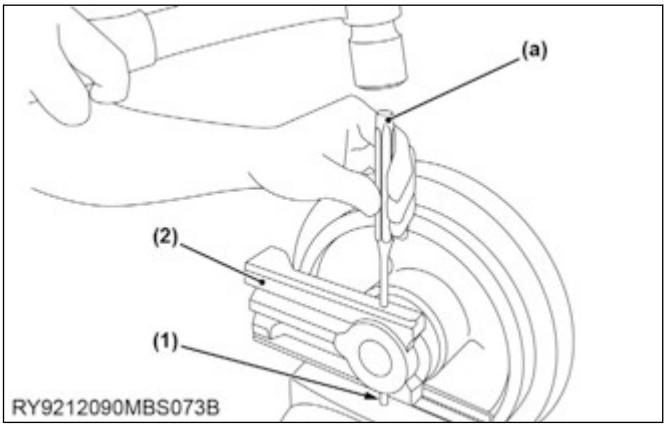
## 3.16.2 Front idler components




(1) Pin
(2) RH bracket
(3) O-ring
(4) Floating seal
(5) Bushing
(6) Idler
(7) Shaft
(8) LH bracket
(9) Plug (R1/8)
(10) External circlip

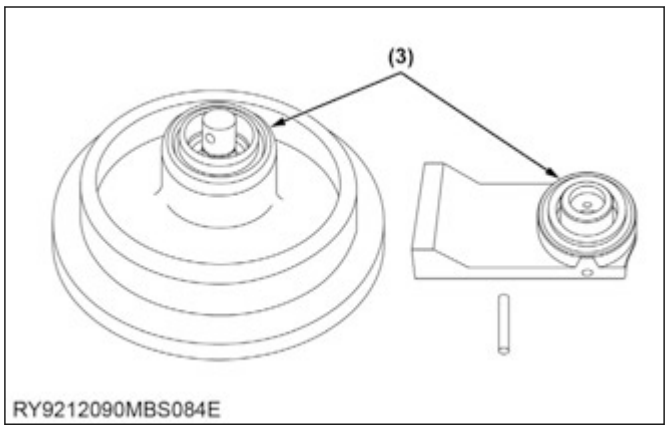
## 3.16.3 Disassembling the front idler

1. Remove the plug from RH bracket and drain the oil.
2. Remove the spring pin with a pin punch and remove the LH bracket.



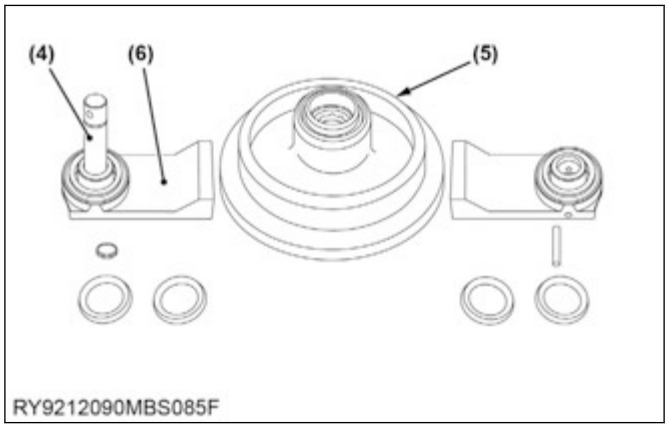

(1) Spring pin
(2) LH bracket
(a) Pin punch

3. Remove the floating seal.




(3) Floating seal

4. Remove the shaft and RH bracket from the idler.




(4) Shaft
(5) Idler
(6) RH bracket

## 3.16.4 Assembling the front idler

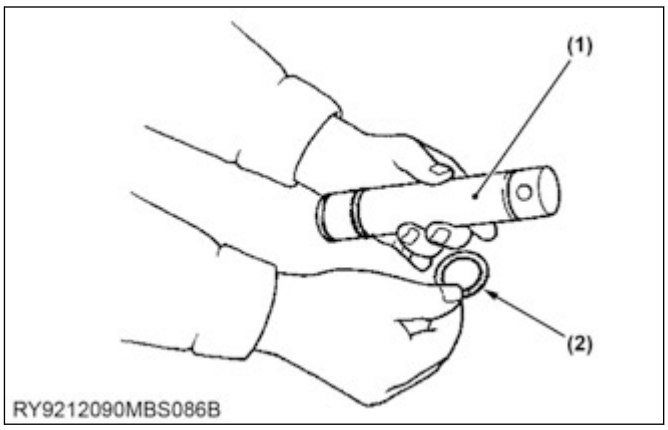
**■ IMPORTANT**

- **Clean the O-ring and installing portion.**
- **Lubricate the sliding surfaces of the floating seal.**
- **Do not twist the floating seal and O-ring.**
- **After assembling, rotate the front idler three revolutions to make an oil film on the sliding surface.**

1. Install the O-ring to the shaft.

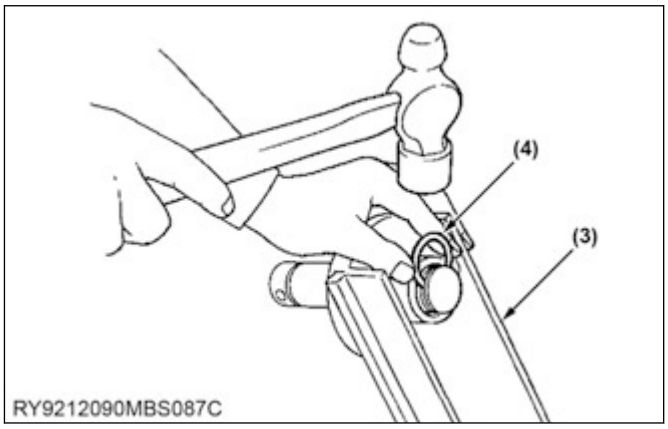
**■ NOTE**

- **Lubricate the O-ring.**



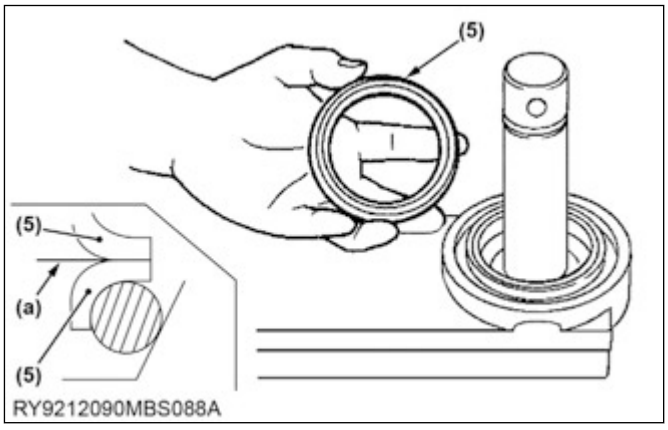

(1) Shaft
(2) O-ring

2. Install the shaft to the RH bracket.



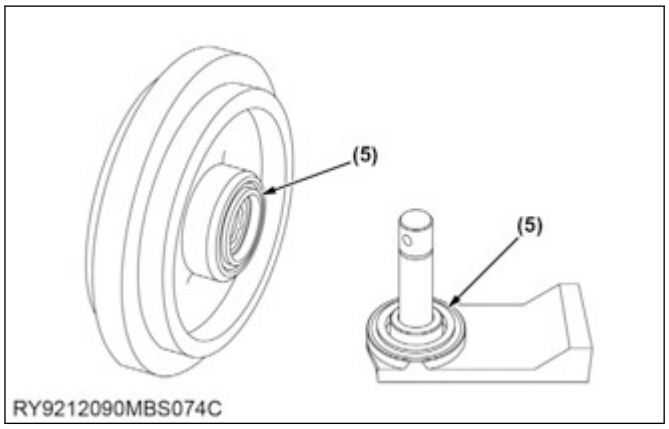

(3) RH bracket
(4) External circlip

3. Install one floating seal to the RH bracket.



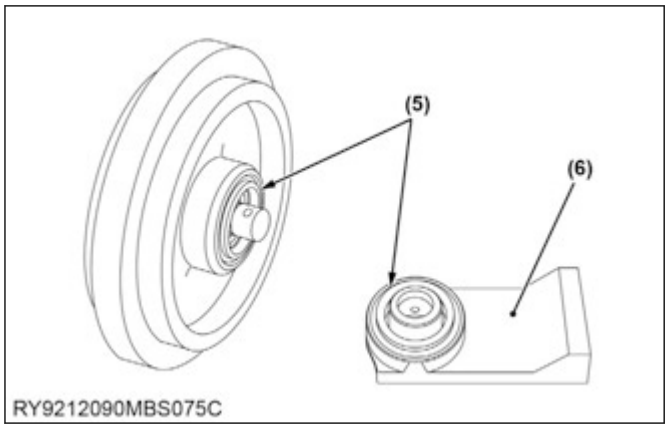

(5) Floating seal
(a) Sliding surfaces

4. Install a floating seal to the idler.



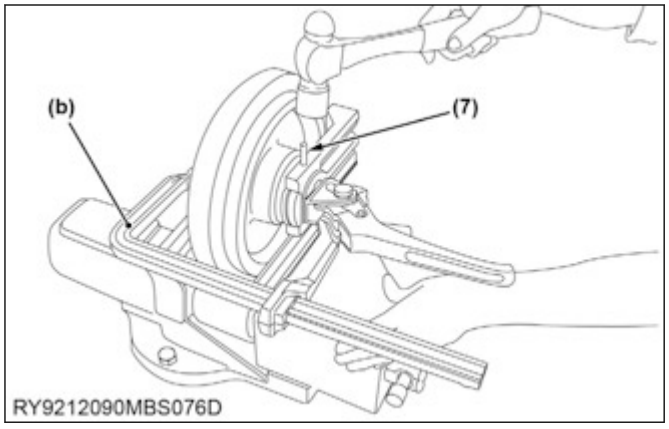

(5) Floating seal

5. Set a floating seal on the idler and LH bracket.



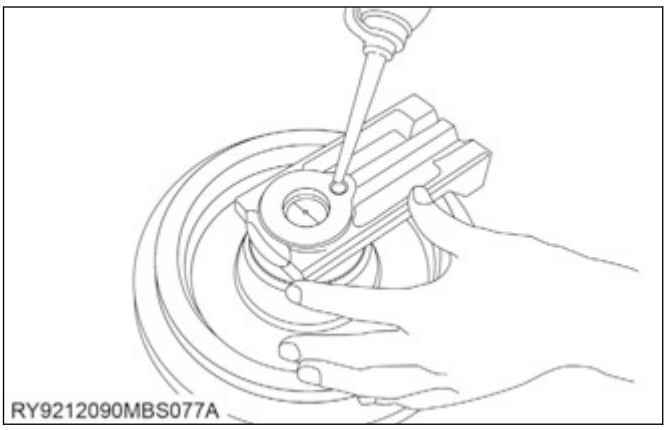

(5) Floating seal (6) LH bracket

6. Align the shaft hole and LH bracket hole and fix with a clamp.
7. Insert the spring pin.




(7) Spring pin (b) Clamp

8. Fill with engine oil from the plug hole.




**Recommended lubricant**

| | | |
|---|---|---|
| Front idler | Approximately 75 cc Approximately 4.57 cu.in. | CF, CF-4, CI-4, CJ-4 SAE #30CD |

**Tightening torque**

| | | |
|---|---|---|
| Plug (R1/8) | 10 N·m 1.0 kgf·m 7.4 lbf·ft | Thread lock (Loctite 262) |

## 3.17 Tension spring

### 3.17.1 Removing and installing the tension spring

**⚠ CAUTION**

- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**Preparing**

1. Remove the track.
2. Remove the front idler assembly.

**Removing**

1. Remove the tension spring from the track frame.

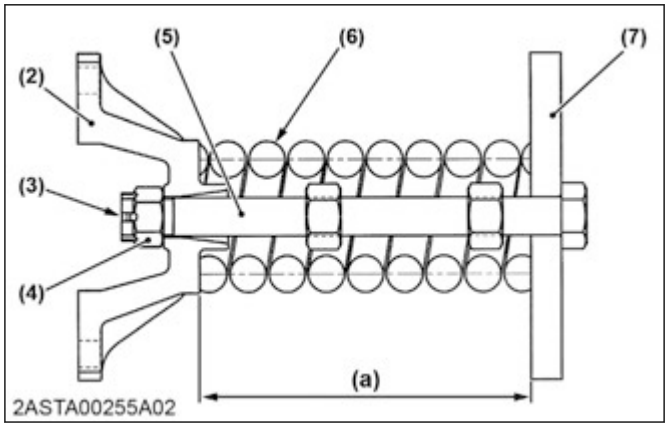



(1) Tension spring

**Mass**

| | |
|---|---|
| (1) Tension spring | Approximately 3.7 kg<br>Approximately 8.2 lbs |

**Installing**




(2) Spring seat
(3) Split pin
(4) Slotted nut
(5) Bolt
(6) Spring
(7) Spring seat

**Service specifications**

| | | |
|---|---|---|
| (a) Spring dimension | Steel track | 173.8 to 174.8 mm<br>6.84 to 6.88 in. |
| | Rubber track | |

# 3.18 Grease cylinder

## 3.18.1 Removing the grease cylinder

**CAUTION**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**Preparing**
1. Remove the track.
2. Remove the front idler assembly.
3. Remove the tension spring.

**Removing**
1. Remove the grease cylinder from the track frame.




(1) Grease cylinder

**Mass**

| | |
|---|---|
| (1) Grease cylinder | Approximately 4.0 kg<br>Approximately 8.8 lbs |

# 3.19 Track roller

## 3.19.1 Removing and installing the track roller

**CAUTION**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

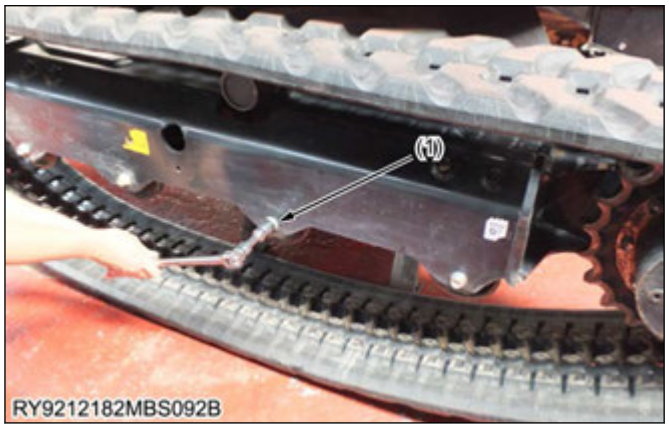
**Preparing**
1. Jack up the machine. Secure the machine on the jack stands.

**Removing**
1. Press a socket wrench onto the base of the grease fitting and loosen it slowly. Wipe away the grease.
2. Install the grease fitting after fully loosening the track.

### Tightening torque

| | | |
|---|---|---|
| Grease fitting | 98.0 to 107.8 N·m<br>10 to 11 kgf·m<br>72.0 to 79.5 lbf·ft | - |

3. Remove the bolt and track roller.

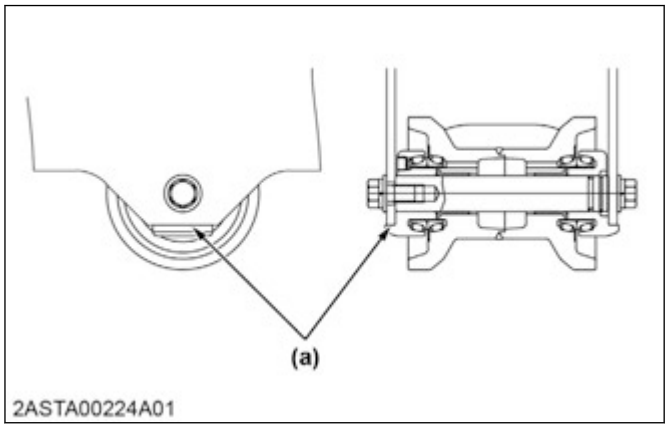



(1) Bolt (M16 × 40)

### Mass

| | |
|---|---|
| Track roller | Approximately 7.3 kg<br>Approximately 16.1 lbs |

### Installing




### Tightening torque

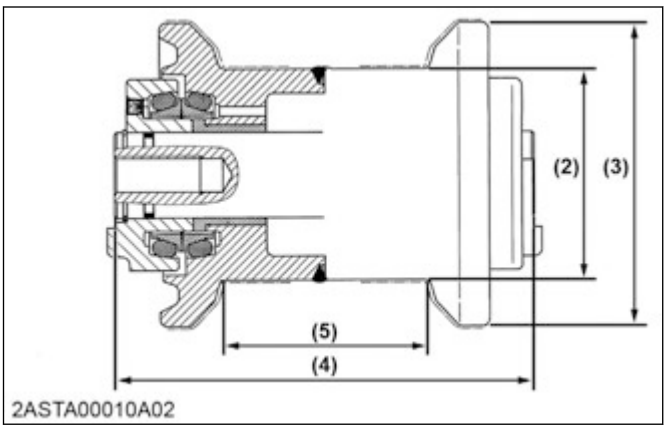
| | | |
|---|---|---|
| (1) Bolt | 103.0 to 117.7 N·m<br>10.5 to 12.0 kgf·m<br>76.0 to 86.8 lbf·ft | Thread lock (female thread side)<br>(Loctite 301-70) |

### Adjusting dimension

| | |
|---|---|
| (a) Clearance | less than 2 mm<br>less than 0.079 in. |

### Measuring

1. Check the track roller dimensions.



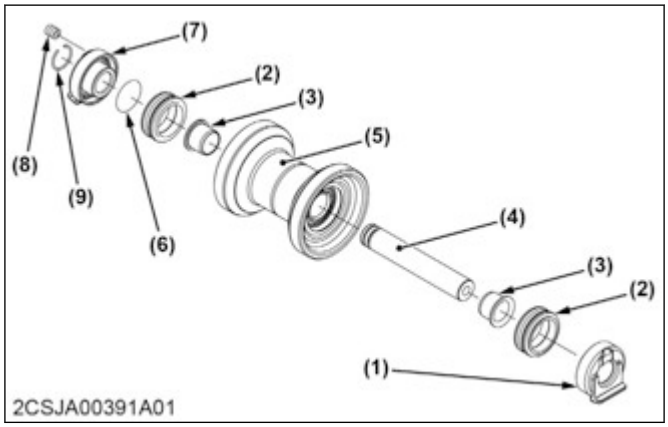

### Service specifications

| | |
|---|---|
| (2) Guide diameter | ϕ80 mm<br>ϕ3.1 in. |
| (3) Outer diameter | ϕ124 mm<br>ϕ4.9 in. |
| (4) Roller width | 175 mm<br>6.9 in. |
| (5) Guide width | 81 mm<br>3.2 in. |

### Service limits

| | |
|---|---|
| (2) Guide diameter | ϕ65 mm<br>ϕ2.8 in. |
| (3) Outer diameter | ϕ114 mm<br>ϕ4.5 in. |
| (4) Roller width | - |
| (5) Guide width | 91 mm<br>3.6 in. |

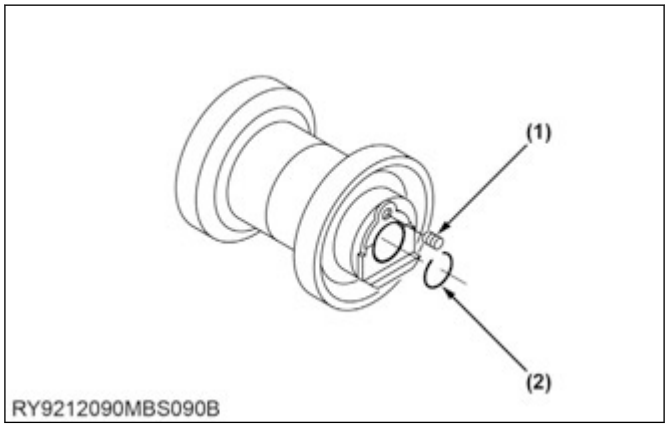
## 3.19.2 Track roller components




(1) Bracket 1
(2) Floating seal
(3) Bushing
(4) Shaft
(5) Track roller
(6) O-ring
(7) Bracket 2
(8) Plug (R1/8)
(9) External circlip

## 3.19.3 Disassembling the track roller

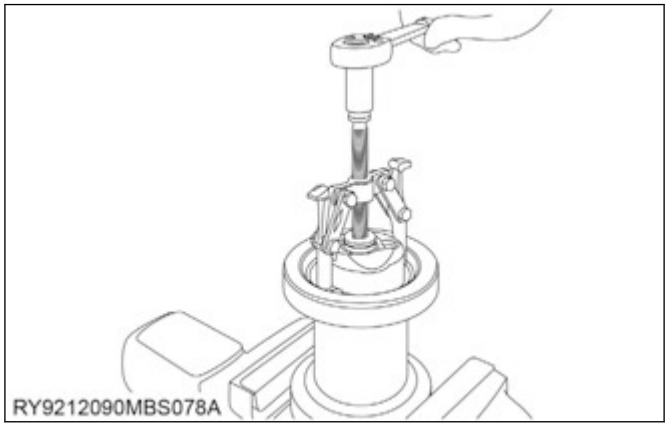
1. Remove the plug to drain the oil.




(1) Plug (R1/8)
(2) External circlip

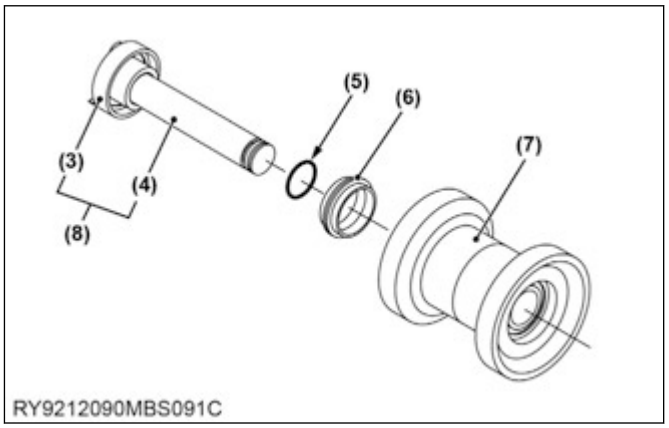
2. Remove the external circlip.
3. Remove the bracket and floating seal.

**■ NOTE**
- **Use a puller to remove the bracket.**




4. Remove the shaft assembly and floating seal.
5. Remove the shaft from the bracket 2.

**■ NOTE**
- **Use a press to remove the bracket 2.**

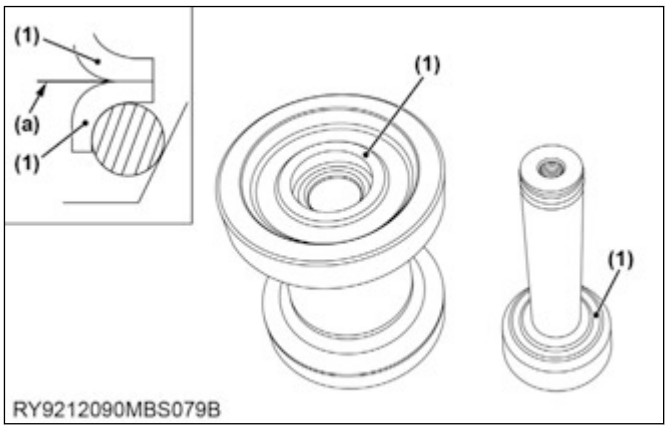



(3) Bracket 2
(4) Shaft
(5) O-ring
(6) Floating seal
(7) Track roller
(8) Shaft assembly

## 3.19.4 Assembling the track roller

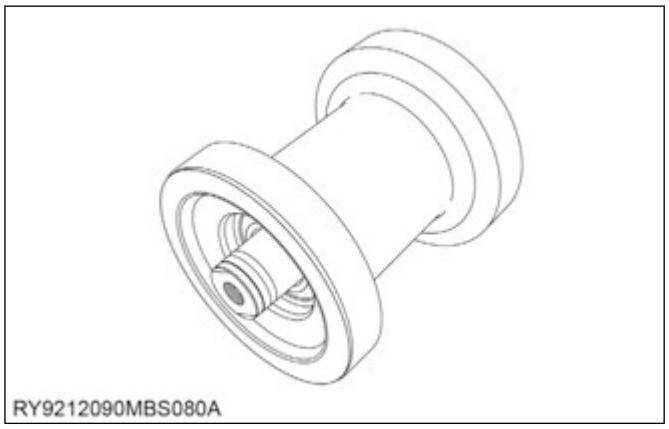
**■ IMPORTANT**
- **Clean the O-rings to assemble.**
- **Install floating seals and O-rings correctly. Do not kink or incline to install.**
- **Apply oil slightly to the sliding surface of the floating seals.**

1. Install the floating seal.

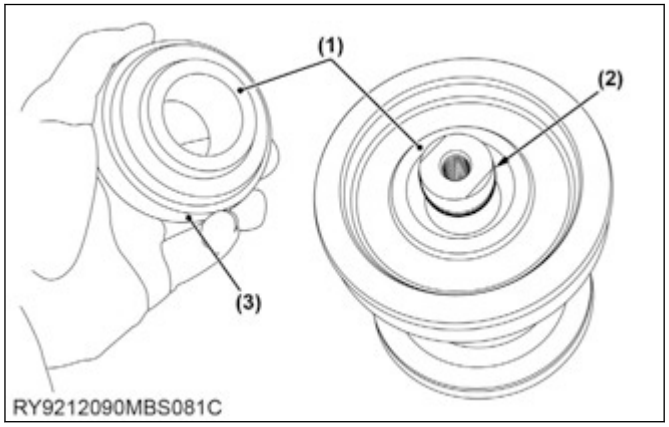



(1) Floating seal
(a) Sliding surface

2. Install the shaft assembly.


RY9212090MBS080A

3. Install the O-ring to the shaft assembly.
4. Install the floating seal and bracket 1.

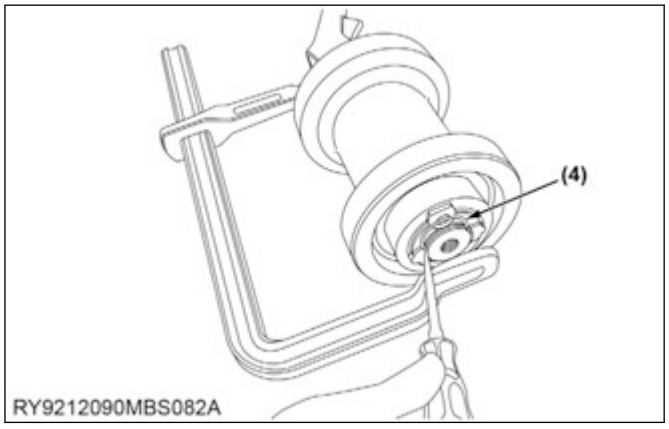


RY9212090MBS081C

(1) Floating seal
(2) O-ring
(3) Bracket 1

5. Install the external circlip.

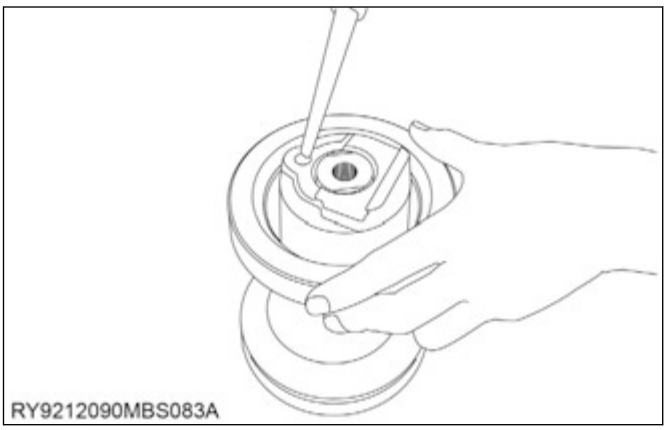
**NOTE**
- **Clamp the bracket 1 to install the external circlip.**



RY9212090MBS082A

(4) External circlip

6. Apply engine oil and install the plug.


RY9212090MBS083A

**Recommended lubricant**

| | | |
|---|---|---|
| Track roller | Approximately 80 cc Approximately 4.9 cu.in. | CF, CF-4, CI-4, CJ-4 SAE #30CD |

**Tightening torque**

| | | |
|---|---|---|
| Plug | 10 N·m 1.0 kgf·m 7.4 lbf·ft | Thread lock (Loctite 503) |

## 3.20 Carrier roller

### 3.20.1 Removing and installing the carrier roller

**CAUTION**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**Preparing**

1. Jack up the machine. Secure the machine on the jack stands.

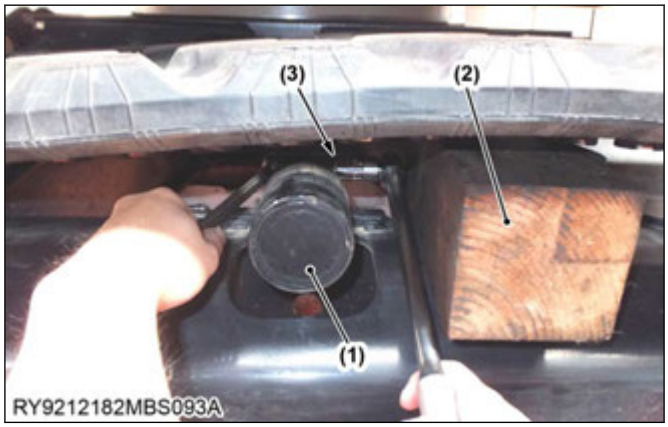
**Removing**

1. Press a socket wrench onto the base of the grease fitting and loosen it slowly. Wipe away the grease.
2. Install the grease fitting after fully loosening the track.

**Tightening torque**

| | | |
|---|---|---|
| Grease fitting | 98.0 to 107.8 N·m 10 to 11 kgf·m 72.0 to 79.5 lbf·ft | - |

3. Set a supporting block between the track and track frame.
4. Remove the nut and carrier roller.



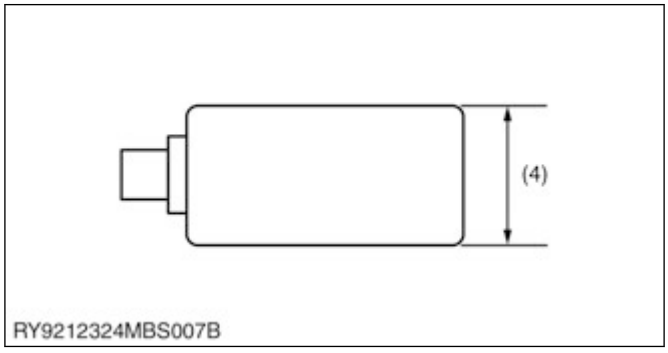

(1) Carrier roller
(2) Supporting block
(3) Nut

### Mass

| | |
|---|---|
| (1) Carrier roller | Approximately 2.4 kg<br>Approximately 5.3 lbs |

## Measuring

1. Check the outer diameter.




### Service specification

| | |
|---|---|
| (4) Outer diameter | ϕ76.3 mm<br>ϕ3.0 in. |

### Service limit

| | |
|---|---|
| (4) Outer diameter | ϕ73.3 mm<br>ϕ2.9 in. |

## Installing

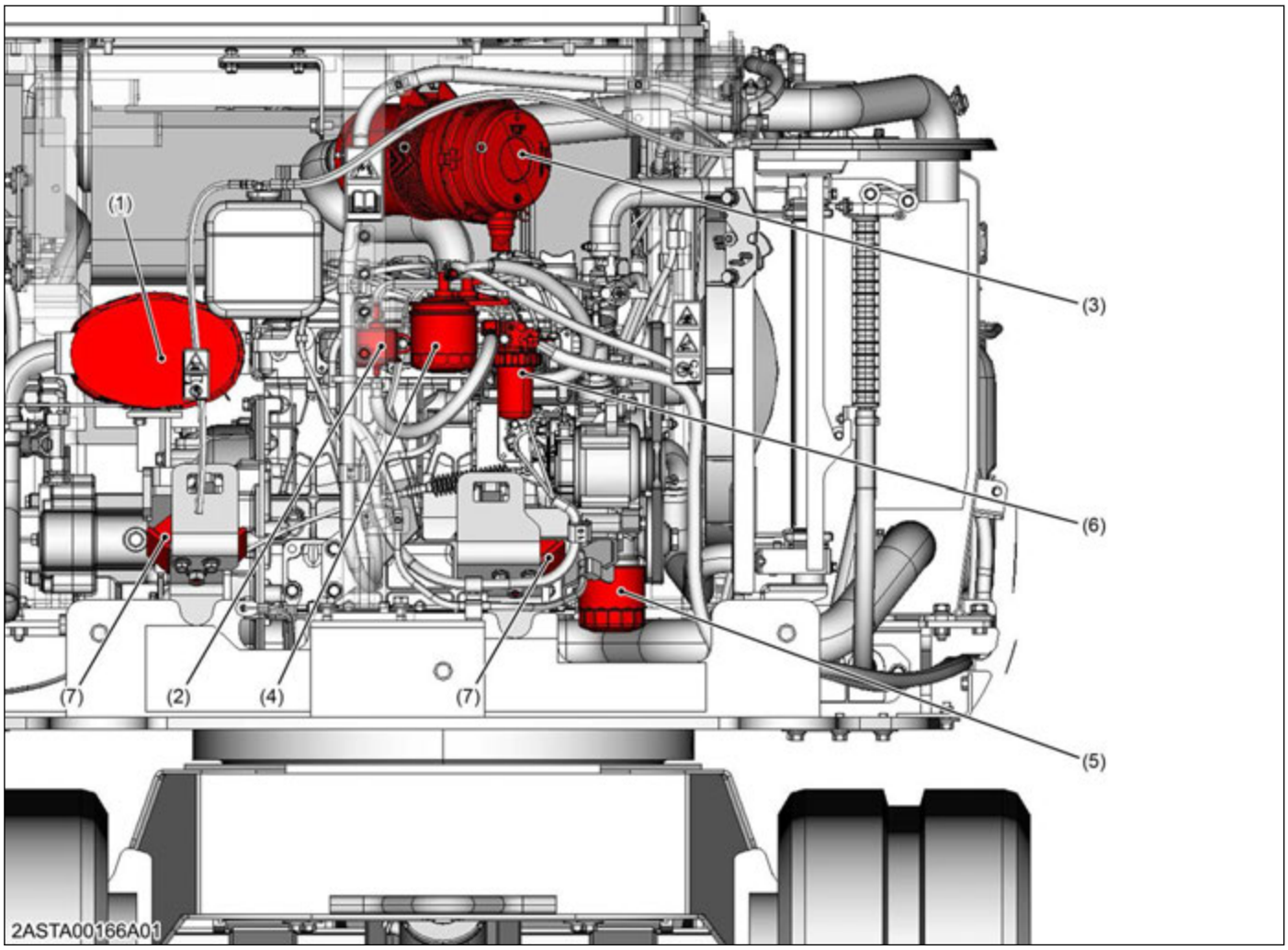
### Tightening torque

| | | |
|---|---|---|
| (3) Nut | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 301-70) |

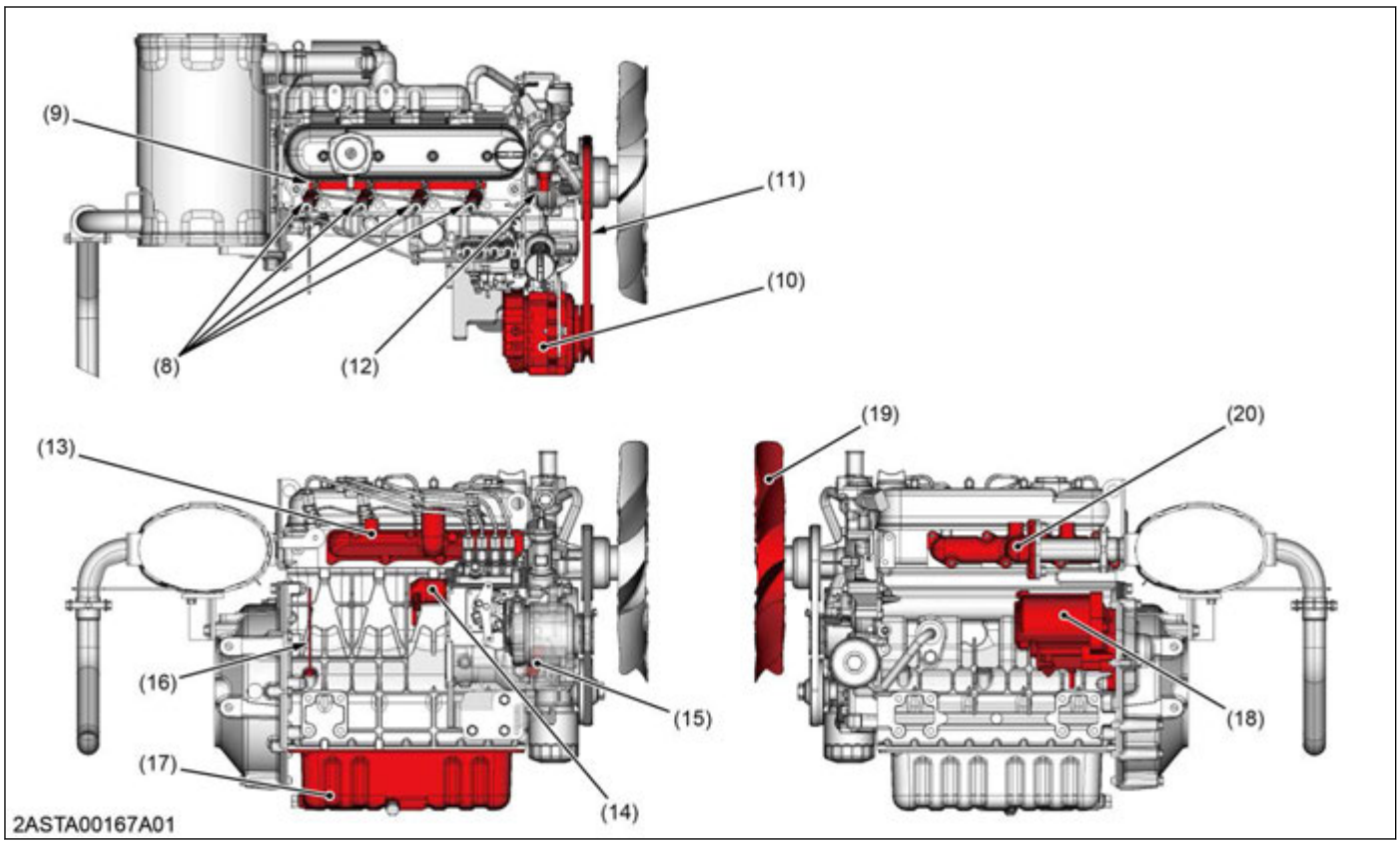
# 4. ENGINE

# MECHANISM

## 1. Engine device layout




(1) Muffler
(2) Fuel pump
(3) Air cleaner
(4) Fuel filter
(5) Engine oil filter
(6) Water separator
(7) Vibration-proof rubber




(8) Injection nozzle
(9) Glow plug
(10) Alternator
(11) Fan belt
(12) Water temperature sensor
(13) Intake manifold
(14) Engine stop solenoid
(15) Engine speed sensor
(16) Engine oil gauge
(17) Oil pan
(18) Starter motor
(19) Fan
(20) Exhaust manifold

# 2. Engine specifications

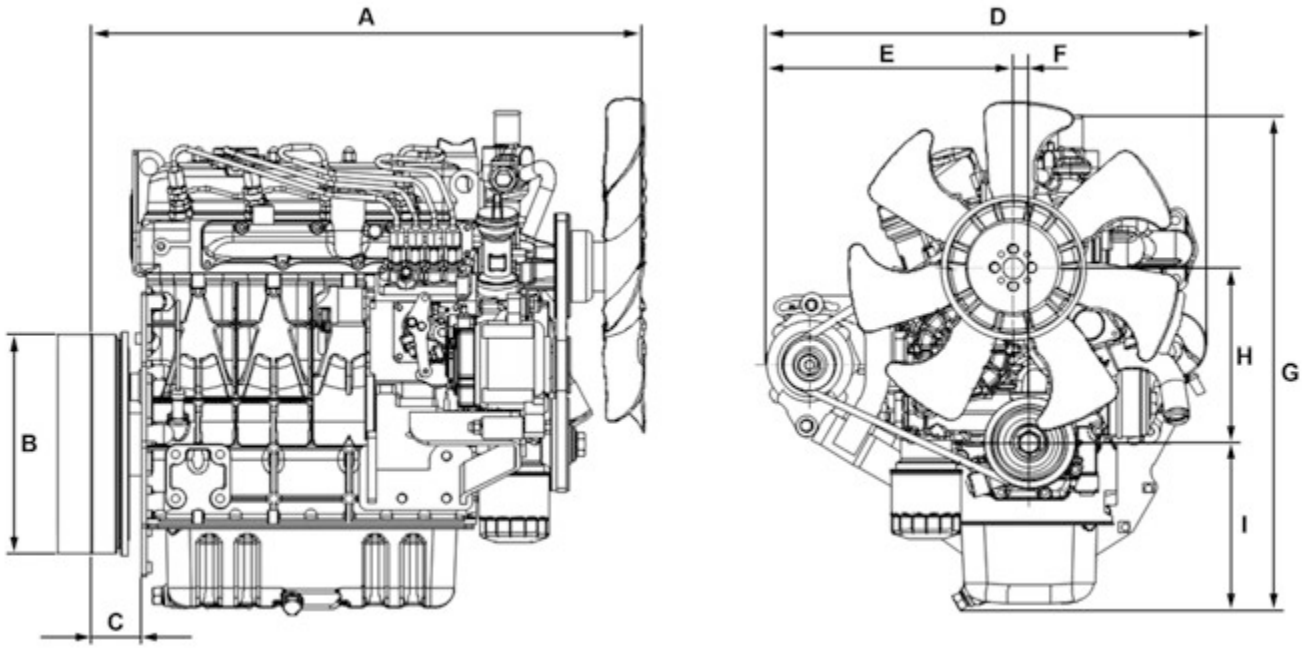
| Items | | Specifications |
|---|---|---|
| Model | | V1505-E4-BH-2 |
| Number of cylinders | | 4 |
| Cylinder bore × stroke | | 78 × 78.4 mm<br>3.07 × 3.09 in. |
| Displacement | | 1498 $cm^3$<br>91.4 cu.in. |
| Idling speed | Cabin | 1250 to 1350 $min^{-1}$(rpm) |
| | Canopy | 1050 to 1150 $min^{-1}$(rpm) |
| Rated speed | | 2250 $min^{-1}$(rpm) |
| Maximum speed | | 2470 $min^{-1}$(rpm) |
| Compression ratio | | 24.0 : 1 |
| Rated output / Speed | Net (SAE) | 17.5 kW / 2250 $min^{-1}$(rpm)<br>23.5 HP / 2250 $min^{-1}$(rpm) |
| | Net (ISO) | 17.9 kW / 2250 $min^{-1}$(rpm)<br>24.0 HP / 2250 $min^{-1}$(rpm) |
| | Gross (SAE) | 18.2 kW / 2250 $min^{-1}$(rpm)<br>24.4 HP/ 2250 $min^{-1}$(rpm) |
| Max torque / Speed | Net (SAE) | 86.2 N·m / 1700 $min^{-1}$(rpm)<br>8.8 kgf·m / 1700 $min^{-1}$(rpm)<br>63.6 lbf·ft / 1700 $min^{-1}$(rpm) |
| | Net (ISO) | 87.2 N·m / 1700 $min^{-1}$(rpm)<br>8.9 kgf·m / 1700 $min^{-1}$(rpm)<br>64.3 lbf·ft / 1700 $min^{-1}$(rpm) |
| | Gross (SAE) | 88.5 N·m / 1700 $min^{-1}$(rpm)<br>9.0 kgf·m / 1700 $min^{-1}$(rpm)<br>65.3 lbf·ft / 1700 $min^{-1}$(rpm) |
| Machine dimensions (L × W × H) | | 565.5 × 392.6 × 612.1 mm<br>22.3 × 15.5 × 24.1 in. |
| Dry weight | | 116 kg<br>256 lbs. |
| Valve clearance | | 0.145 to 0.185 mm<br>0.0057 to 0.0073 in. |
| Fuel injection order | | 1-3-4-2 |
| Combustion chamber | | Swirl combustion chamber |
| Compression pressure | | 3.73 to 4.11 MPa<br>38.0 to 41.9 $kgf/cm^2$<br>541 to 596 psi |
| Fuel consumption (at rated speed) | Net (SAE) | 263.8 g/kW·h<br>196.7 g/HP·h<br>0.434 lb/HP·h |
| | Net (ISO) | 202.5 g/kW·h<br>151.0 g/HP·h<br>0.333 lb/HP·h |
| | Gross (SAE) | 253.7 g/kW·h<br>189.2 g/HP·h<br>0.417 lb/HP·h |

(Continued)

## 4. ENGINE

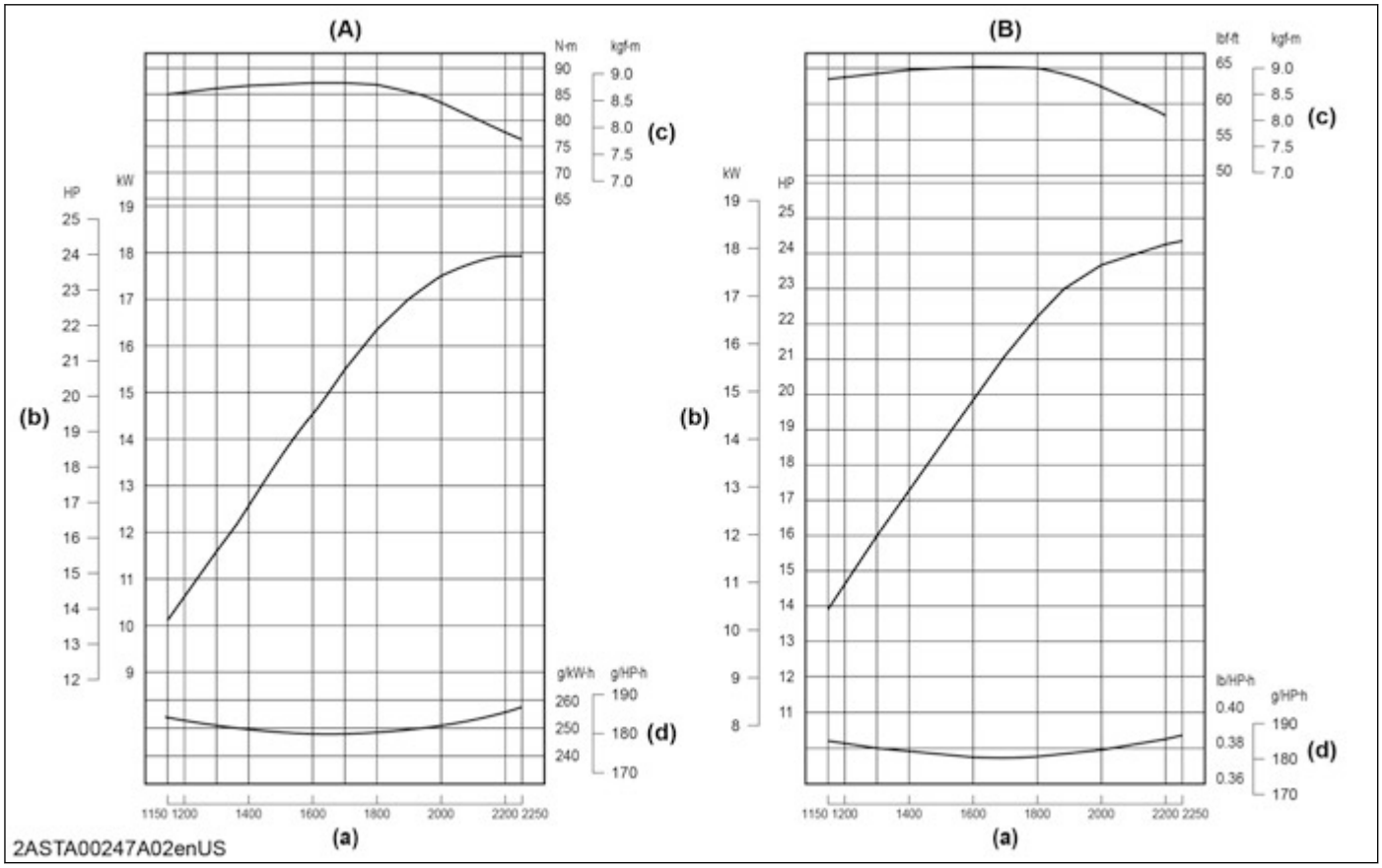
| Items | | Specifications |
|---|---|---|
| Fuel injection pressure | | 13.7 MPa<br>139.7 kgf/cm$^2$<br>1987 psi |
| Engine oil pressure (at rated speed) | | 196 to 441 kPa<br>2.0 to 4.5 kgf/cm$^2$<br>28.4 to 64.0 psi |
| Engine oil consumption (at rated speed) | | 0.50 g/kW·h<br>0.68 g/PS·h<br>0.00082 lb/HP·h |
| Alternator | | 12 V, 480 W |
| Charging current | | 40 A |
| Regulator adjusted voltage | | 14.2 to 14.8 V |
| Battery | JIS | 80D26R |
| Battery fluid ratio | | 1.27 to 1.29% |
| Starter motor | | 12 V, 1.4 kW |
| Glow plug | | 1.0 Ω |

# 3. Engine dimensions




| No. | Dimensions | No. | Dimensions |
|---|---|---|---|
| A | 619 mm<br>24.4 in. | F | 18 mm<br>0.7 in. |
| B | ϕ247 mm<br>ϕ9.72 in. | G | 567.2 mm<br>22.3 in. |
| C | 56 mm<br>2.2 in. | H | 200 mm<br>7.9 in. |
| D | 503.8 mm<br>19.8 in. | I | 192.7 mm<br>7.6 in. |
| E | 238.4 mm<br>9.39 in. | - | - |

# 4. Engine performance curves




(A) Net (ISO 3046, 2534)
(B) Gross (SAE J1349)

(a) Engine speed
(b) Output

(c) Torque
(d) Fuel consumption rate

# SERVICING

# 1. Troubleshooting

## 1.1 Engine troubleshooting

### The engine does not start

| Causes | Inspections | Actions |
|---|---|---|
| The lever lock is in the LOCK position. | Check the position of the lever lock. | Raise the lever lock. |
| The fuel is too viscous. | Check the fuel filter, fuel tank and water separator. | Remove the water from the water separator.<br>Replace the fuel filter.<br>Replace the fuel. |
| Air or water is mixed in the fuel system. | Check the fuel filter, fuel tank and water separator. | Remove the water from the fuel tank or water separator.<br>Purge the fuel line. |
| The engine oil and fuel become to too high viscous due to low temperature. | - | Use specified fuel or engine oil. |
| The battery voltage is too low.<br>The starter motor speed is low. | Check the battery voltage. | Recharge or replace the battery. |

### Insufficient engine power

| Causes | Inspections | Actions |
|---|---|---|
| The fuel level is low. | Check the fuel level by the fuel gauge. | Refuel. |
| The air cleaner is clogged. | Check if the air cleaner is clogged. | Clean the outer element.<br>Replace the inner and outer element of the air cleaner. |
| Piston ring is damaged.<br>Valve is damaged. | Check the engine compression pressure. | Follow the engine WSM to repair. |

### The exhaust gas color is abnormal

| Causes | Inspections | Actions |
|---|---|---|
| The fuel quality is low. | - | Change to proper quality fuel. |
| Too much engine oil is filled. | Check the engine oil level with the engine oil gauge. | Drain the engine oil to adjust the oil level. |

### Overheating (the water temperature is in the red zone)

| Causes | Inspections | Actions |
|---|---|---|
| The coolant level is low. | Check the coolant level in the reserve tank. | Fill the reserve tank with the coolant. |
| The radiator fins are clogged. | Check if the radiator fins are clogged.<br>Check the coolant pipe. | Clean the radiator. |
| The radiator cap is damaged. | Check the radiator cap. | Replace the radiator cap. |
| The thermostat is damaged. | Check the thermostat. | Replace the thermostat. |

(Continued)

| Causes | Inspections | Actions |
|---|---|---|
| The engine oil level is low. | Check the engine oil level with the engine oil gauge. | Fill with the engine oil. |
| The fan belt is damaged. | Check the fan belt.<br>Check the tension of the fan belt. | Replace the fan belt.<br>Adjust the fan belt tension. |
| The water pump seal is damaged. | Check the water pump seal. | Replace the water pump seal. |
| Rust is mixed in the coolant. | Check the condition of the coolant. | Replace the coolant. |
| The cylinder head gasket is damaged. | Check the damage and oil leakage around the cylinder head. | Replace the cylinder head gasket. |
| The fuel injection timing is incorrect. | Check if the injection timing is correct. | Adjust the injection timing. |
| Low quality fuel. | - | Change to the recommended quality fuel. |

# 2. Service specifications

## 2.1 Service specifications for engine

| Items | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Pressure | Compression pressure | | MPa<br>kgf/cm$^2$<br>psi | 3.92<br>40.0<br>569 | ±0.19<br>±2.0<br>±28 | 2.26<br>23.0<br>327 |
| | Engine oil | Idling | kPa<br>kgf/cm$^2$<br>psi | - | - | 49<br>0.5<br>7.1 |
| | | Rated speed | kPa<br>kgf/cm$^2$<br>psi | 319<br>3.25<br>46.25 | ±122<br>±1.25<br>±17.75 | 147<br>1.5<br>21.3 |
| Dimension | Fan belt | | mm<br>in. | 8.0<br>0.32 | ±1.0<br>±0.04 | - |

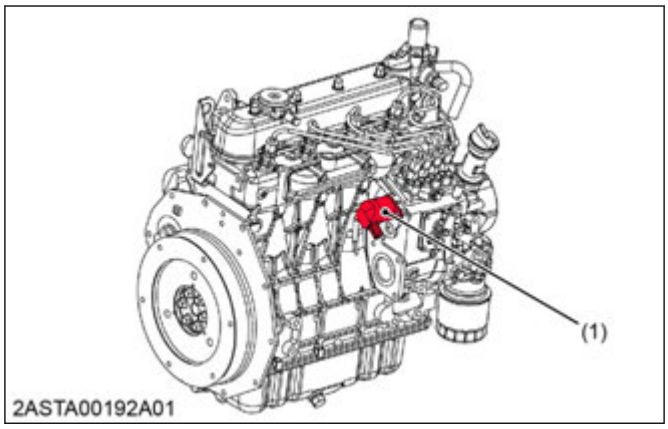
# 3. Testing

## 3.1 Measuring engine compression pressure

**⚠ CAUTION**
- **Keep hands and body away from the rotating fan and belt.**

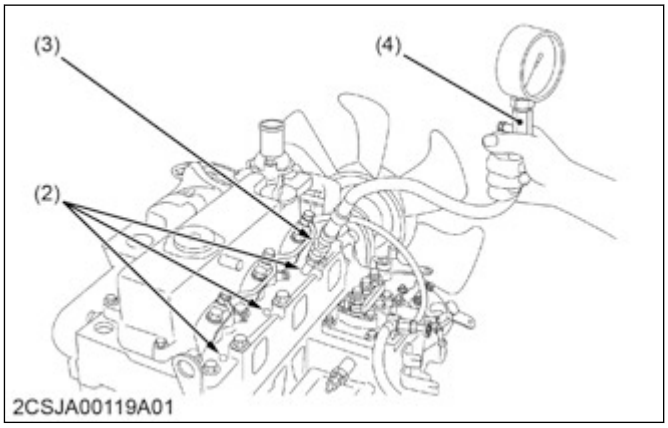
**■ IMPORTANT**
- **Measure each cylinder individually to measure the correct value.**

**Preparing**
1. Warm up the engine.
2. Stop the engine.
3. Disconnect the connector of the engine stop solenoid to stop the supply of fuel.




(1) Engine stop solenoid

4. Remove all of the glow plugs and install a compression tester with adapter to the glow plug hole.




(2) Glow plug hole
(3) Adapter
(4) Compression tester

**Measuring**
1. Crank the engine with the starter motor.
2. Measure the compression pressure with the compression tester.

**Service specification**

| | |
|---|---|
| Compression pressure | 3.73 to 4.11 MPa<br>38.0 to 42.0 kgf/cm$^2$<br>541 to 597 psi |

**Service limit**

| | |
|---|---|
| Compression pressure | 2.26 MPa<br>23.0 kgf/cm$^2$<br>327 psi |

## 3.2 Measuring engine oil pressure

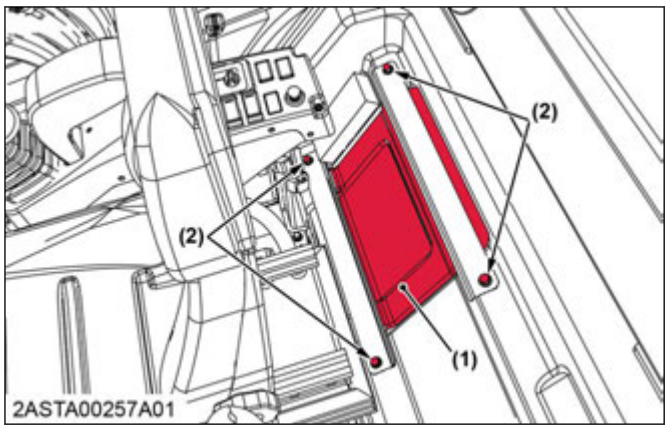
**⚠ CAUTION**
- **Do not work soon after the engine has stopped.**

– **Engine, fuel, and oil are extremely hot.**
– **Pressure in the engine oil line is high.**

- **Keep hands and body away from the rotating fan and belt.**
- **Make sure the lever lock is raised before the measuring.**

**Preparing**

1. Move the operator seat forwards.
2. Remove the four bolts and the cover.



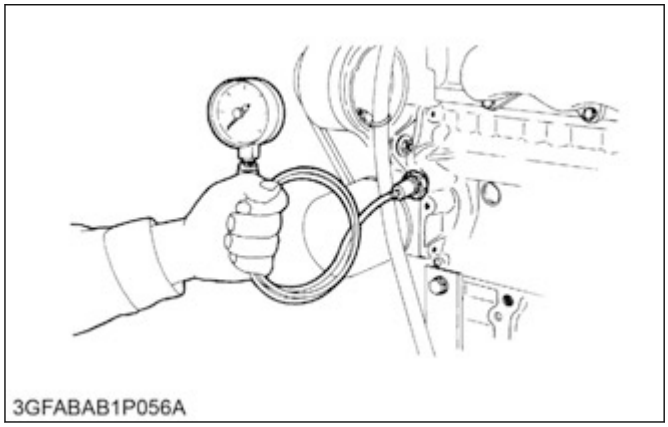

(1) Cover (2) Bolt (M8 × 16) ×4

3. Remove the engine oil pressure switch.




(3) Engine oil pressure switch

4. Install a pressure tester.




**IMPORTANT**

- **Wrap the thread seal tape to the pressure tester adapter to avoid oil leakage.**

5. Warm up the engine.

**Measuring**

1. Start the engine.
2. Measure the engine oil pressure at the idling speed.
3. Measure the oil pressure at the rated speed.
4. After measuring the engine oil pressure, install the engine oil pressure switch with the specified torque.

**IMPORTANT**

- **Wrap the thread seal tape to the engine oil pressure switch to avoid oil leakage.**

**Tightening torque**

| | | |
|---|---|---|
| Engine oil pressure switch | 15 to 19 N·m<br>1.5 to 2.0 kgf/cm$^2$<br>11 to 14 lbf·ft | - |

**Service specifications**

| | | |
|---|---|---|
| Engine oil pressure | At rated speed | 197 to 441 kPa<br>2.0 to 4.5 kgf/cm$^2$<br>28.5 to 64.0 psi |

**Service limits**

| | | |
|---|---|---|
| Engine oil pressure | At idling speed | 49 kPa<br>0.5 kgf/cm$^2$<br>7.1 psi |
| | At rated speed | 147 kPa<br>1.5 kgf/cm$^2$<br>21.3 psi |

# 4. Repairing

## 4.1 Fuel hose and tank

### 4.1.1 Removing and installing fuel tank

**CAUTION**

- **Lower the front attachments to the ground and stop the engine.**
- **Keep fire and flammable items away from the working area.**

**Removing**

1. Remove the RH cover and RH bonnet.



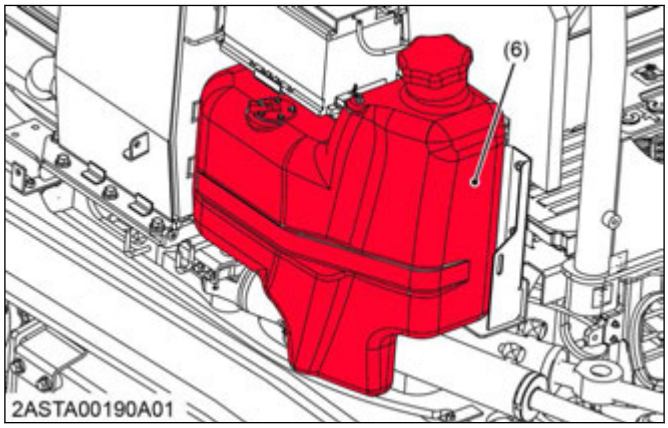

(1) RH cover (2) RH bonnet

2. Remove the band.
3. Disconnect the fuel hoses and connector.




(3) Band (5) Connector
(4) Fuel hose

4. Remove the fuel tank.



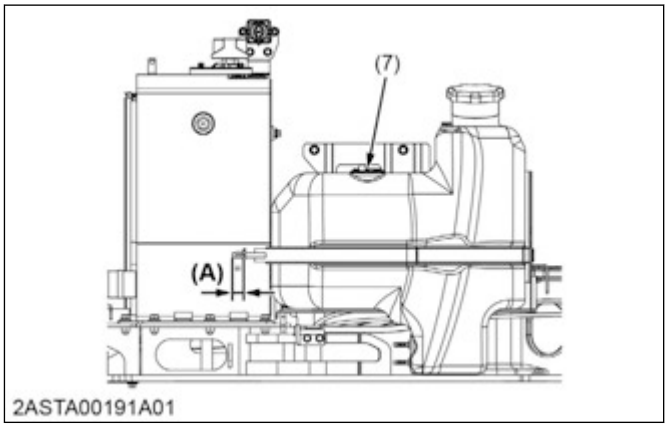

(6) Fuel tank

### Mass

| | |
|---|---|
| (6) Fuel tank | Approximately 4 kg<br>Approximately 8.8 lbs |

**NOTE**
- **This value is fuel tank empty weight.**

## Installing




(7) Fuel sensor bolt

### Tightening torque

| | | |
|---|---|---|
| (7) Fuel sensor bolt | 3 to 4 N·m<br>0.3 to 0.4 kgf·m<br>2 to 3 lbf·ft | - |

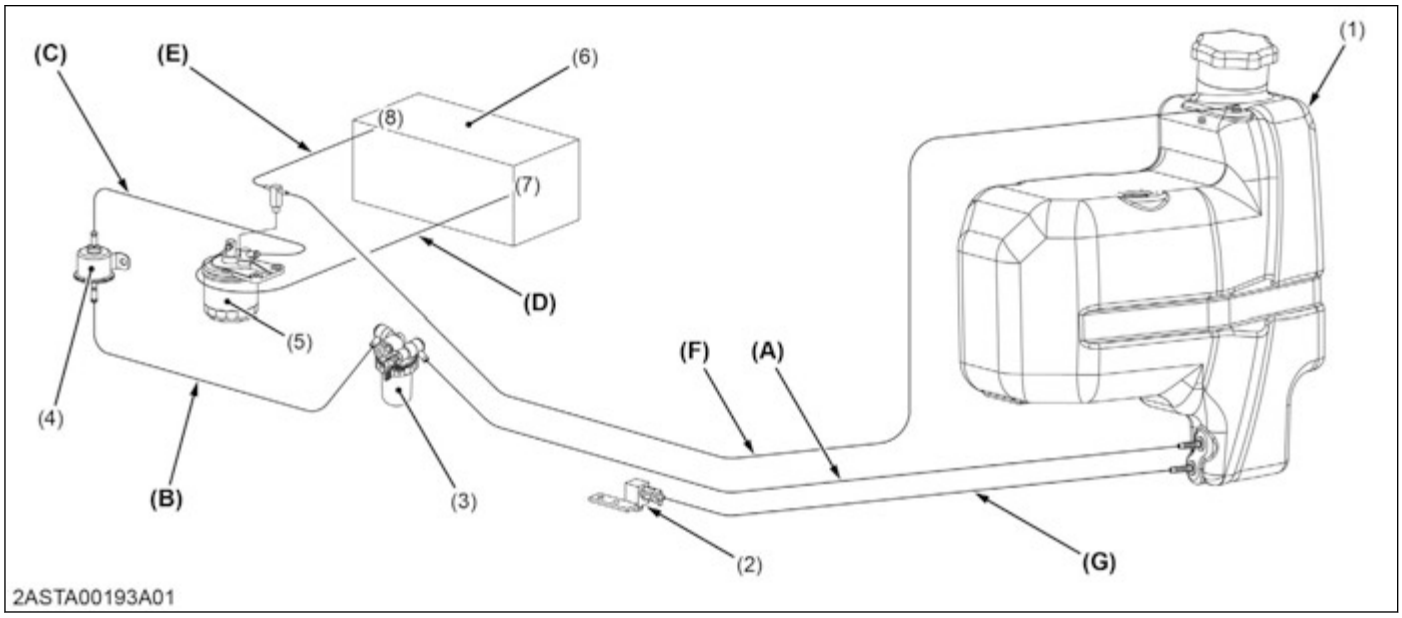
### Adjusting dimension

| | |
|---|---|
| (A) | 24 to 30 mm<br>0.94 to 1.18 in. |

## 4.1.2 Fuel hose routing

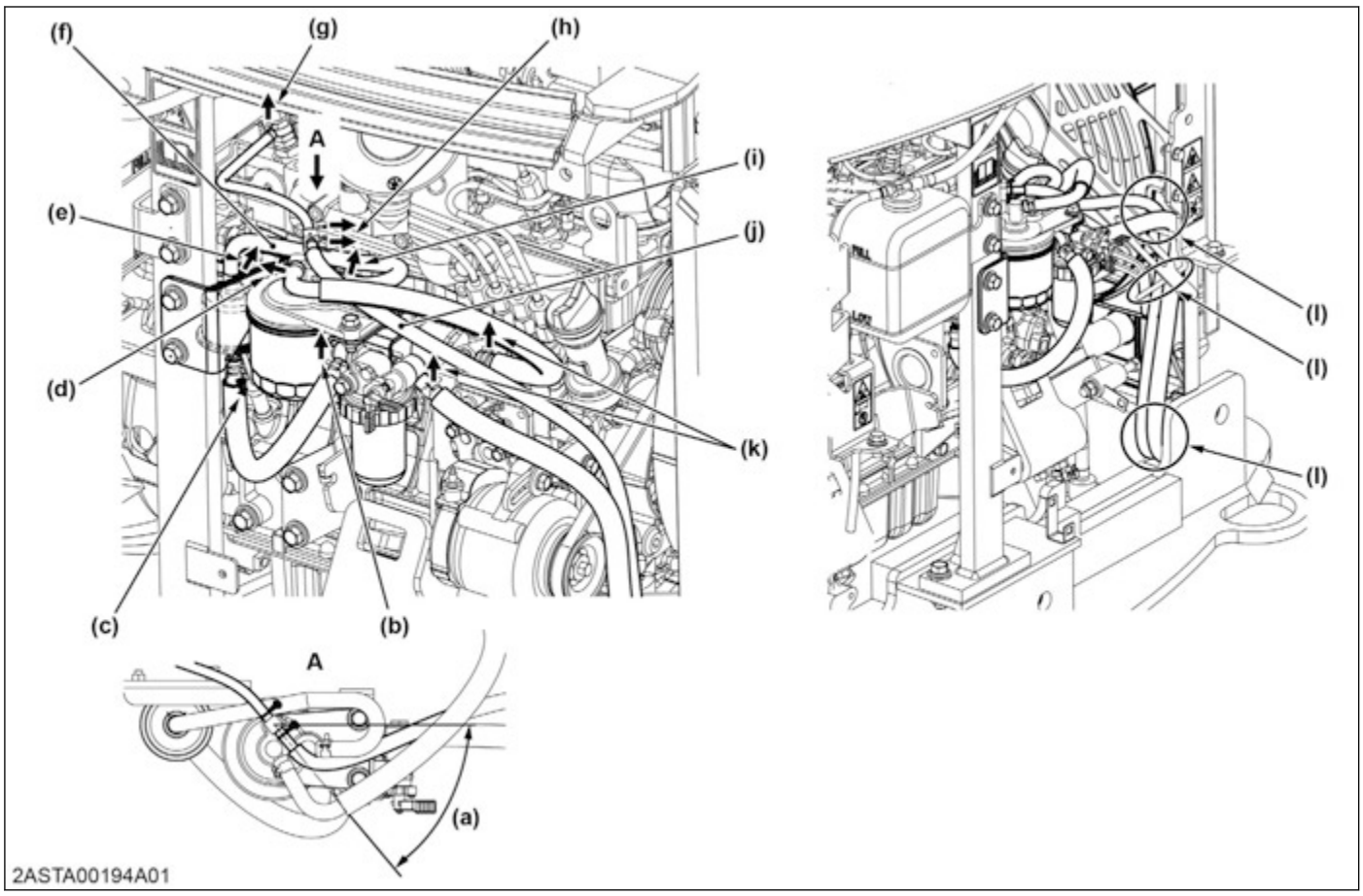
**⚠ CAUTION**

- **Do not contact the fuel hoses to sharp edges, high temperature parts, and rotating parts.**
- **Do not stretch the fuel hoses excessively.**
- **Do not clamp with electrical wiring.**

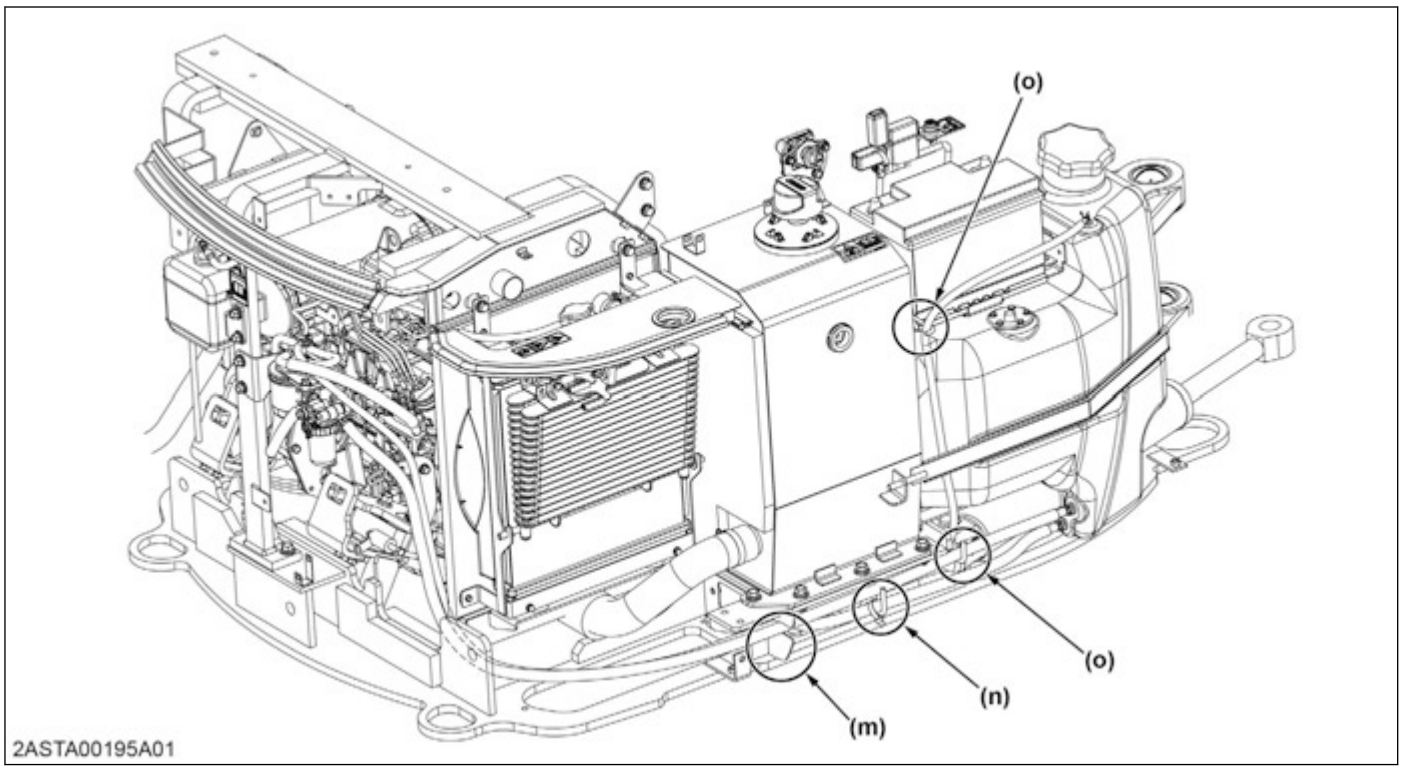



(1) Fuel tank
(2) Drain
(3) Water separator
(4) Fuel pump
(5) Fuel filter
(6) Engine
(7) Injection pump
(8) Return

| No. | Hose | | Protection tube | |
|---|---|---|---|---|
| | Length | Inner diameter | Length | Inner diameter |
| (A) | 1780 mm<br>68.9 in. | ϕ9 mm<br>ϕ0.35 in. | 1630 mm<br>64.2 in. | ϕ15 mm<br>ϕ0.59 in. |
| (B) | 300 mm<br>11.8 in. | ϕ9 mm<br>ϕ0.35 in. | 230 mm<br>9.1 in. | ϕ15 mm<br>ϕ0.59 in. |
| (C) | 306 mm<br>12.0 in. | ϕ8 mm<br>ϕ0.31 in. | - | - |
| (D) | 360 mm<br>14.2 in. | ϕ8 mm<br>ϕ0.31 in. | 230 mm<br>9.1 in. | ϕ15 mm<br>ϕ0.59 in. |
| (E) | 320 mm<br>12.6 in. | ϕ5 mm<br>ϕ0.20 in. | - | - |
| (F) | 2500 mm<br>98.4 in. | ϕ5 mm<br>ϕ0.20 in. | 2400 mm<br>94.5 in. | ϕ10 mm<br>ϕ0.39 in. |
| (G) | 600 mm<br>23.6 in. | ϕ8 mm<br>ϕ0.31 in. | 490 mm<br>19.3 in. | ϕ15 mm<br>ϕ0.59 in. |




- (a) 50°
- (b) Align the clamp face up.
- (c) Align the clamp face right 45°.
- (d) Align the clamp face out.
- (e) Align the clamp face engine side.
- (f) Hose (fuel pump to fuel filter) should not contact with adapter and bracket.
- (g) Align the clamp face up.
- (h) Align the clamp face out.
- (i) Align the clamp face out.
- (j) Hose (fuel filter to tank) should not contact with hose (fuel filter to fuel pump).
- (k) Face the clamp to angle up.
- (l) Pass through the guide.




- (m) Pass through the notch.
- (n) Clamp with guide.
- (o) Pass through the guide.

# 4.2 Engine

## 4.2.1 Removing and installing engine

**CAUTION**

- **Do not work soon after stopped the engine.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**
- **Do not install the fuel hose as below.**
  - **Contact to sharp edges, high temperature parts, and rotating parts.**
  - **Stretch excessively, deform, or clamp with electrical wiring.**
- **Keep fire and flammable items away from the working area.**

**IMPORTANT**

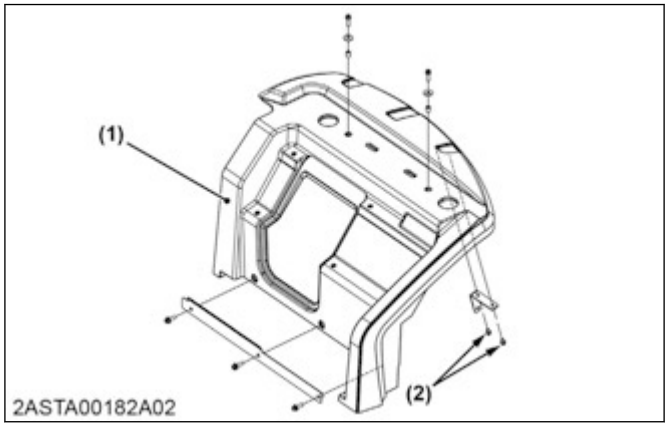
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**
- **Install plugs or covers to the removed fuel hoses, radiator hoses, and air conditioning hoses to avoid dust contamination.**

**Preparing**

1. Disconnect the battery cable from negative (-) terminal.
2. Install the vacuum pump to the hydraulic oil tank and vacuum the hydraulic oil tank.
3. Drain the coolant.
4. Remove the rear and RH bonnets, LH cover, and LH swivel cover.
5. Remove the rear bonnet hinge, stay, and partition plate.
6. Remove the cabin or canopy.
7. Remove the counterweight.
8. Remove the muffler.
9. Disconnect all of the hydraulic hoses from the hydraulic pump.
10. Remove the hydraulic pump.

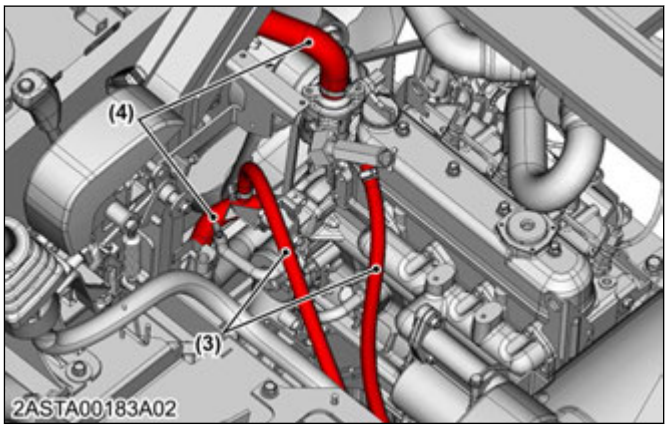
**Removing**

1. Remove the 7 bolts and the center bonnet.



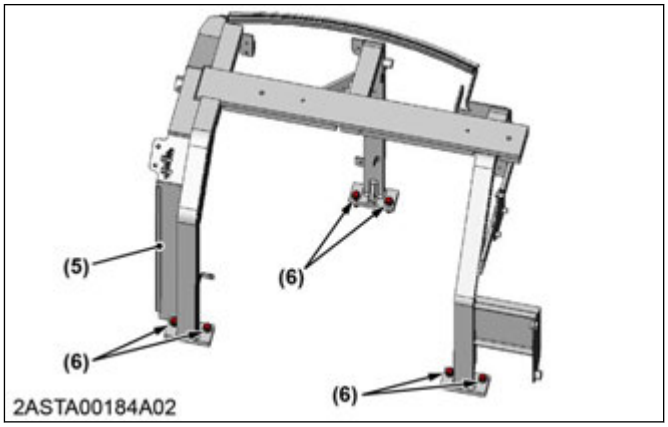

(1) Center bonnet (2) Bolt (M8 × 16) ×7

2. Disconnect the heater and radiator hose.




(3) Heater hose (4) Radiator hose

3. Disconnect all of the connectors for engine speed sensor, water temperature sensor, engine stop solenoid, oil pressure switch, glow plug, alternator, and starter motor.
4. Disconnect the ground cable.
5. Disconnect all of the fuel hose.
6. Remove the accelerator cable.
7. Remove the 6 bolts and the arch frame.

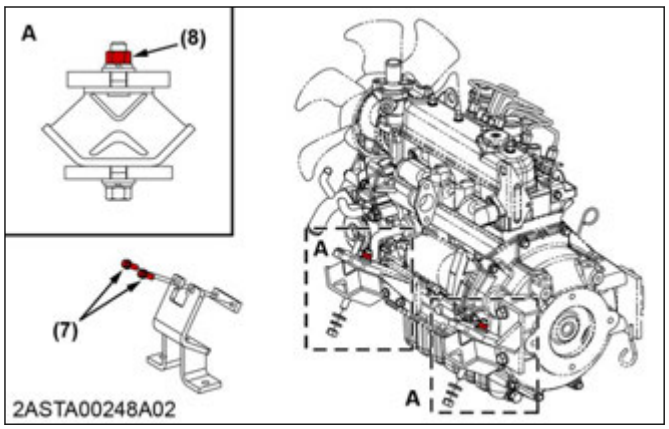


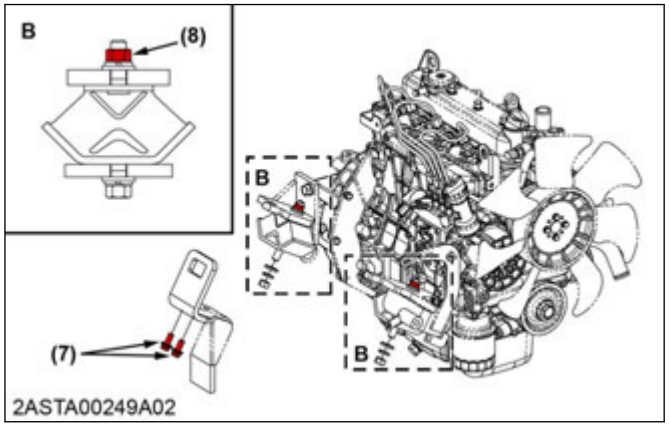

(5) Arch frame (6) Bolt (M12 × 45) ×6

**Mass**

| | |
|---|---|
| (5) Arch frame | Approximately 47 kg<br>Approximately 104 lbs |

8. Remove the 8 bolts and 4 nuts.




(7) Bolt (M10 × 25) ×8 (8) Nut (M12) ×4

9. Attach a nylon sling with 2 shackles and hoist the engine to remove.




(9) Nylon sling

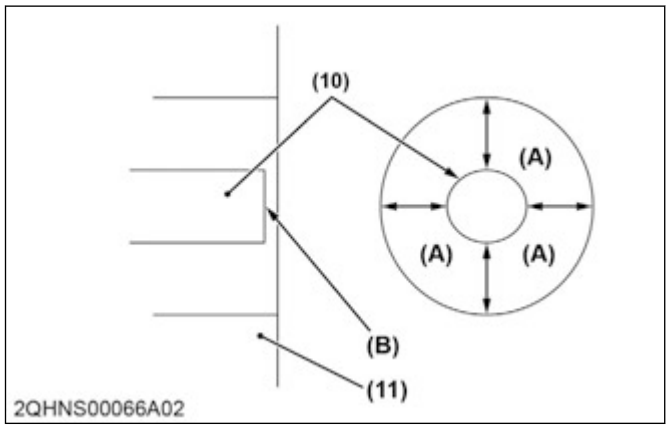
## Mass

| | |
|---|---|
| Engine | Approximately 93 kg<br>Approximately 205 lbs |

**■ NOTE**

- **This value is the engine dry weight.**

## Installing




(10) Tail pipe (11) Counter weight

**■ IMPORTANT**

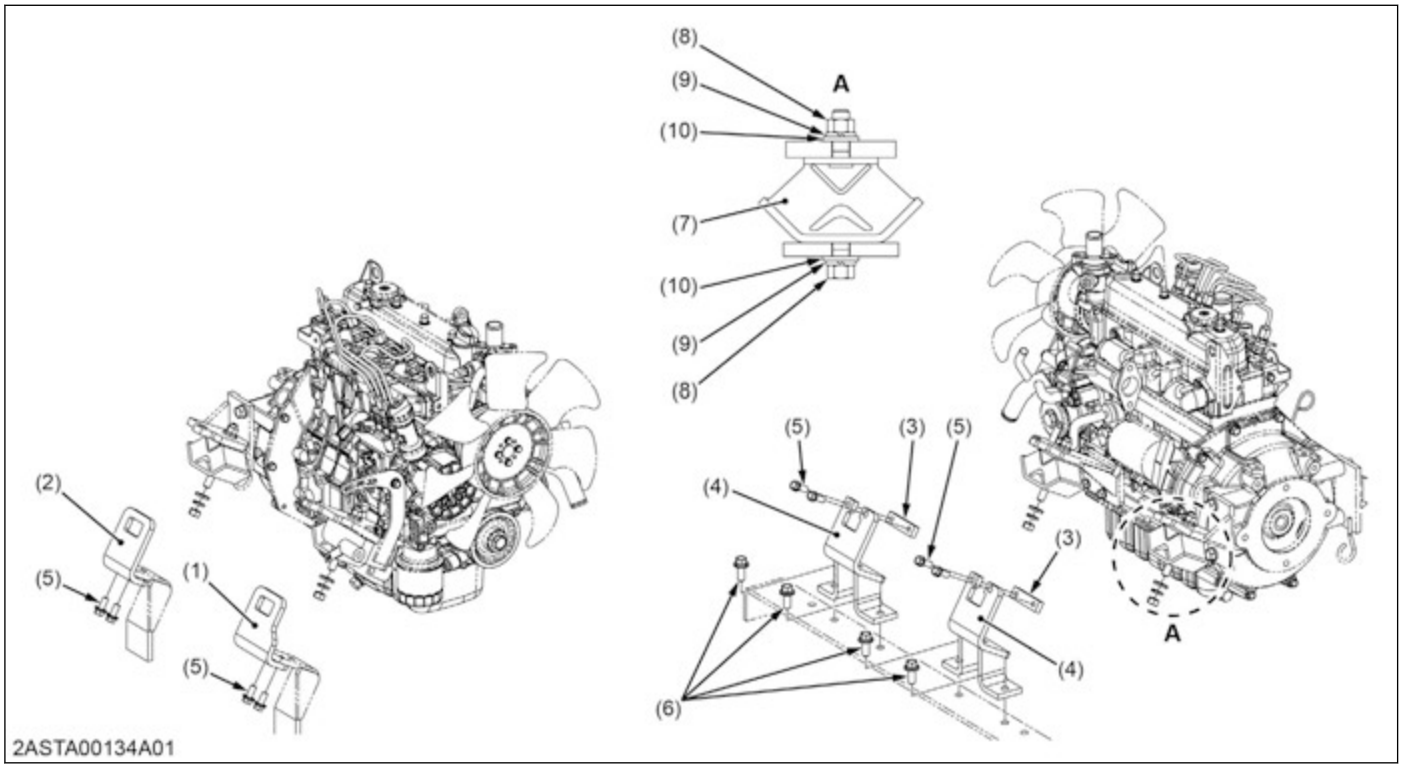
- **Leave a clearance (A) of approximately 20 mm (0.79 in.) between the tail pipe of the muffler and the counterweight.**
- **(B) Do not protrude the pipe from the counterweight.**

### Tightening torque

| | | |
|---|---|---|
| (2) Bolt | 17.7 to 20.6 N·m<br>1.80 to 2.10 kgf·m<br>13.1 to 15.2 lbf·ft | - |
| (6) Bolt | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 301-70) |
| (8) Nut | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 301-70) |

## 4.2.2 Installing engine mount

### Installing



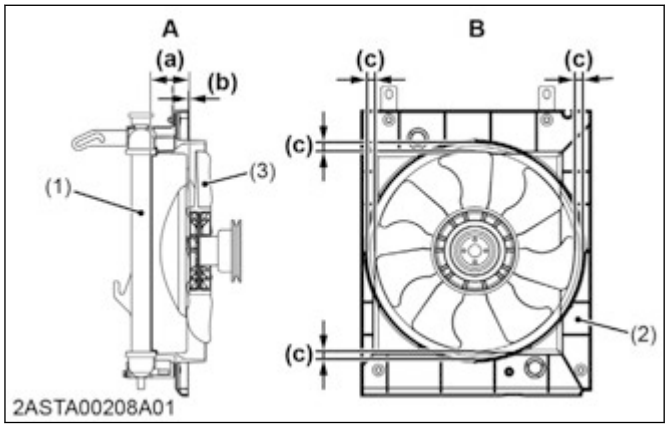

(1) Support 1
(2) Support 2
(3) Plate
(4) Support 3
(5) Bolt (M10 × 25) ×8
(6) Bolt (M12 × 35) ×4
(7) Cushion ×4
(8) Nut ×8
(9) Spring washer ×8
(10) Washer ×8

### Tightening torque

| | | |
|---|---|---|
| (4) Nut | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 310-70) |
| (6) Bolt | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 310-70) |

## 4.2.3 Installing radiator

### Installing




(1) Radiator
(2) Fan shroud
(3) Fan

### Adjusting dimensions

| | |
|---|---|
| (a) | 70 to 78 mm<br>2.76 to 3.07 in. |
| (b) | 6 to 13 mm<br>0.24 to 0.51 in. |
| (c) | more than 10 mm<br>more than 0.39 in. |

## 4.2.4 Removing and installing muffler

**CAUTION**

- **Do not work soon after stopped the engine.**
  - **Engine, fuel, and oil are extremely hot.**

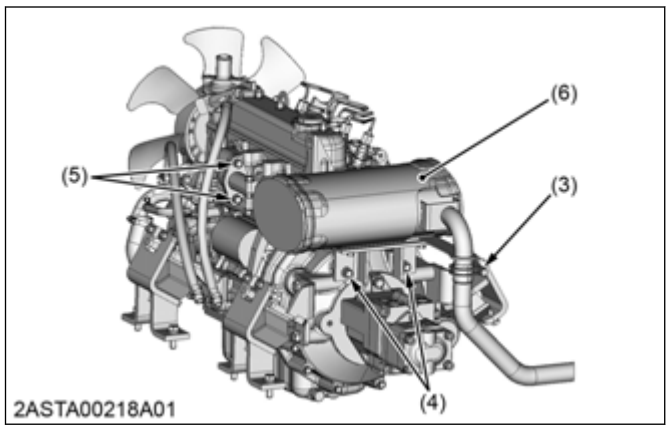
### Removing

1. Remove the LH bonnet.




(1) Rear bonnet
(2) LH bonnet

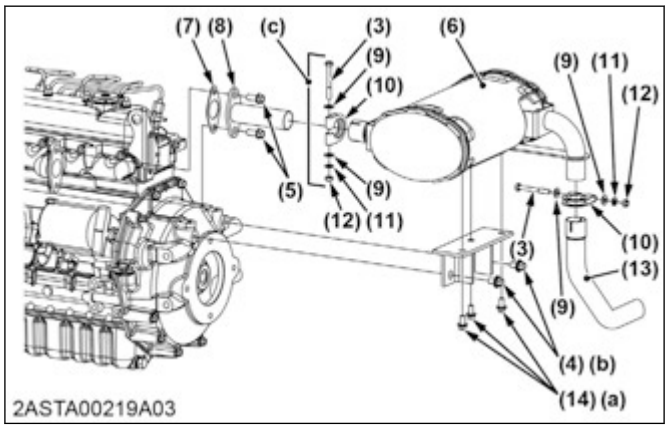
2. Remove the 5 bolts and muffler assembly.




(3) Bolt (M8 × 65)
(4) Bolt (M10 × 20) ×2
(5) Bolt (M10 × 25) ×2
(6) Muffler

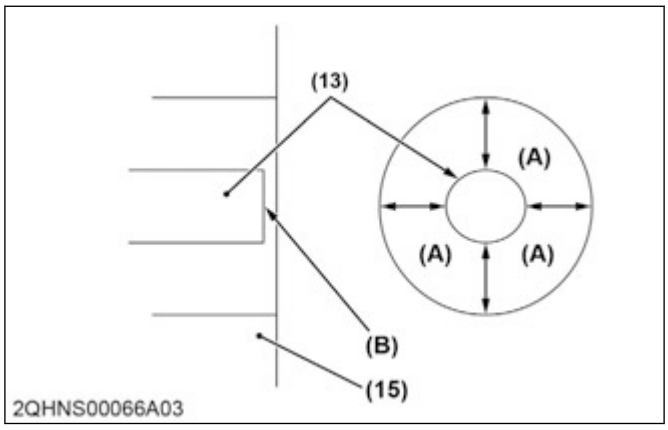
**Installing**

1. Install the muffler flange.
2. Install the pipe to muffler.
3. Tighten bolts (a), (b), and (c) in order.




(3) Bolt (M8 × 65)
(4) Bolt (M10 × 20) ×2
(5) Bolt (M10 × 25) ×2
(6) Muffler
(7) Gasket
(8) Flange
(9) Washer
(10) Pipe band
(11) Spring washer
(12) Nut
(13) Pipe
(14) Bolt (M8 × 20)

4. Leave the clearance between the pipe and counterweight.




(13) Pipe
(15) Counterweight

- (B) Do not protrude the tail pipe from weight.

**Adjusting dimension**

| | |
|---|---|
| (A) | 20 mm<br>0.79 in. |

**Tightening torque**

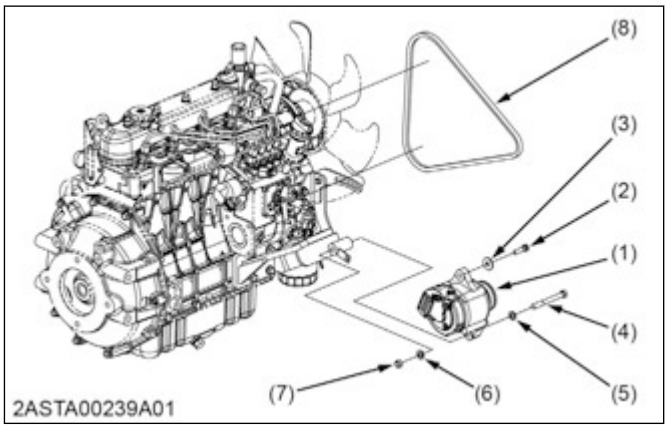
| | | |
|---|---|---|
| (3) Bolt | 17.7to 20.6 N·m<br>1.8 to 2.1 kgf·m<br>13.1 to 15.2 lbf·ft | - |
| (4) Bolt | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | - |
| (5) Bolt | 48.1 to 55.9 N·m<br>4.9 to 5.7 kgf·m<br>10.8 to 12.6 lbf·ft | - |
| (14) Bolt | 23.5 to 27.5 N·m<br>2.4 to 2.8 kgf·m<br>17.3 to 20.3 lbf·ft | - |

## 4.2.5 Installing the alternator

**Installing**

**■ IMPORTANT**

- **Make sure to adjust the fan belt tension after installing the alternator.**

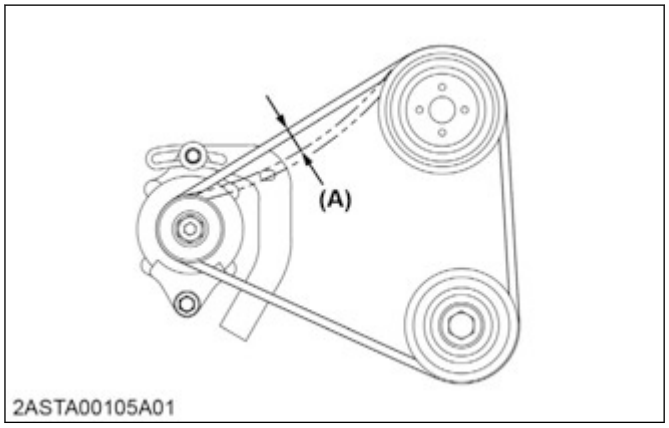



(1) Alternator
(2) Bolt (M8 × 30)
(3) Washer
(4) Bolt (M10 × 85)
(5) Washer
(6) Spring washer
(7) Nut (M10)
(8) Fan belt

**Tightening torque**

| | | |
|---|---|---|
| (2) Bolt | 17.7 to 20.6 N·m<br>1.8 to 2.1 kgf·m<br>13.1 to 15.2 lbf·ft | - |
| (7) Nut | 39.2 to 45.1 N·m<br>4.0 to 4.6 kgf·m<br>28.9 to 33.3 lbf·ft | - |

**Adjusting**



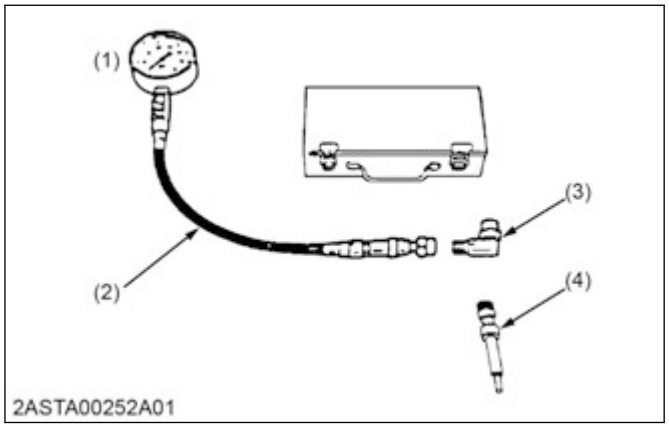

**Service specification**

| | | |
|---|---|---|
| (A) | 7 to 9 mm<br>0.28 to 0.35 in. | Push with 60 to 70 N<br>Push with 6.12 to 7.14 kgf<br>Push with 13.49 to 15.74 lbf |

# 4.3 Special jigs and tools

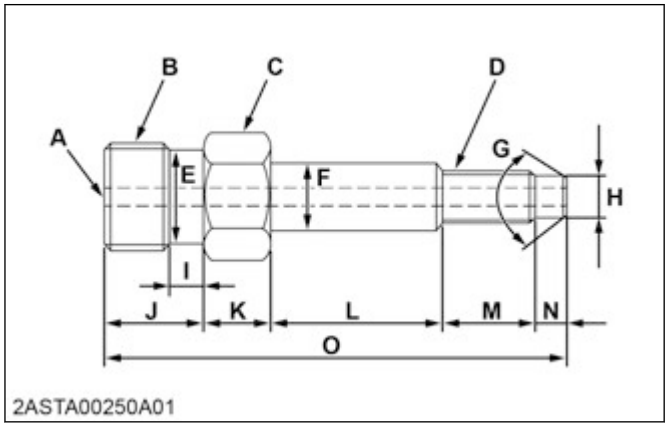
## 4.3.1 Engine compression pressure measuring kit

**Diesel engine compression tester**




(1) Pressure gauge
(2) Hose assembly
(3) L joint
(4) Adapter

**Adapter**

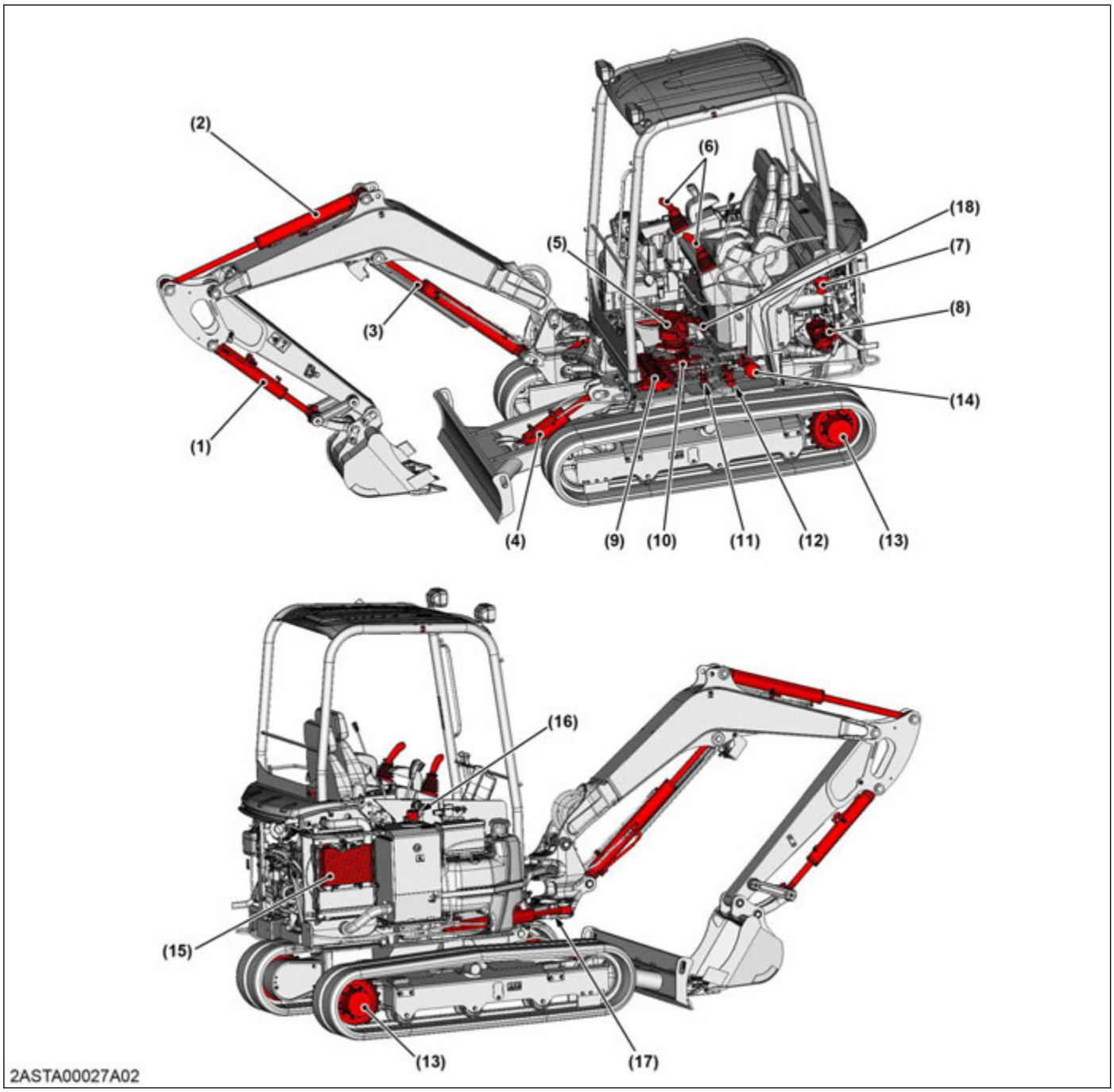



| | |
|---|---|
| A | ϕ3 mm drill<br>ϕ0.12 in. drill |
| B | 5/8-18UNF |
| C | M17 |
| D | M8×1.0 |
| E | ϕ13 mm<br>ϕ0.51 in. |
| F | ϕ10 mm<br>ϕ0.39 in. |
| G | 119° |
| H | ϕ6.6 mm<br>ϕ0.26 in. |
| I | 5 mm<br>0.20 in. |
| J | 15 mm<br>0.59 in. |
| K | 10 mm<br>0.39 in. |
| L | 26 mm<br>1.02 in. |
| M | 15 mm<br>0.59 in. |
| N | 7 mm<br>0.28 in. |
| O | 73 mm<br>2.87 in. |

# 5. HYDRAULIC SYSTEM

# MECHANISM

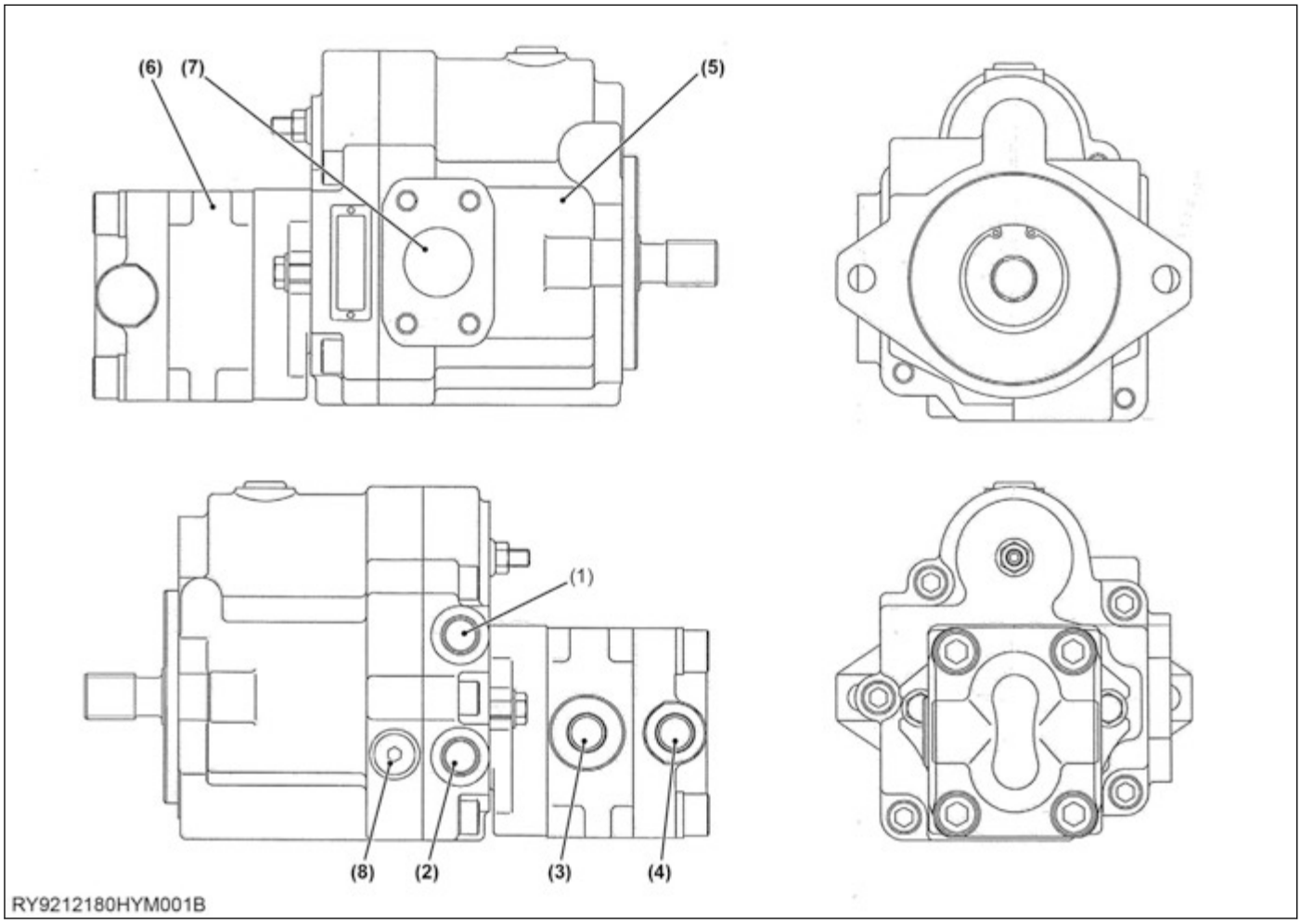
## 1. Hydraulic device layout




(1) Bucket cylinder
(2) Arm cylinder
(3) Boom cylinder
(4) Blade cylinder
(5) Swivel motor
(6) Pilot control valve
(7) Pilot filter
(8) Hydraulic pump
(9) Control valve
(10) Swivel joint
(11) Third line valve
(12) AUX1 proportional valve (Hi-spec only)
(13) Travel motor
(14) Unload valve
(15) Oil cooler
(16) Breather filter
(17) Swing cylinder
(18) AUX2 proportional valve (Hi-spec only)

# 2. Hydraulic pump

## 2.1 Hydraulic pump specifications




(5) Piston pump (6) Gear pump (7) Suction port (8) Lubrication port

| Items | | Specifications |
|---|---|---|
| Manufacturer | | Nachi-Fujikoshi |
| Model | | PDV-1B-26P-8G3-5755Z |
| Rated rotational speed | | 2250 rpm |
| Maximum displacement | Piston pump (P1+P2) | 13+13 cc/rev<br>0.79+0.79 cu.in./rev |
| | Gear pump (P3) | 8 cc/rev<br>0.49 cu.in./rev |
| | Gear pump (P4) | 2.7 cc/rev<br>0.16 cu.in./rev |
| Maximum flow rate | Piston pump (P1+P2) | 31.9+31.9 L/min<br>8.4+8.4 U.S. gal/min |
| | Gear pump (P3) | 19.6 L/min<br>5.2 U.S. gal/min |

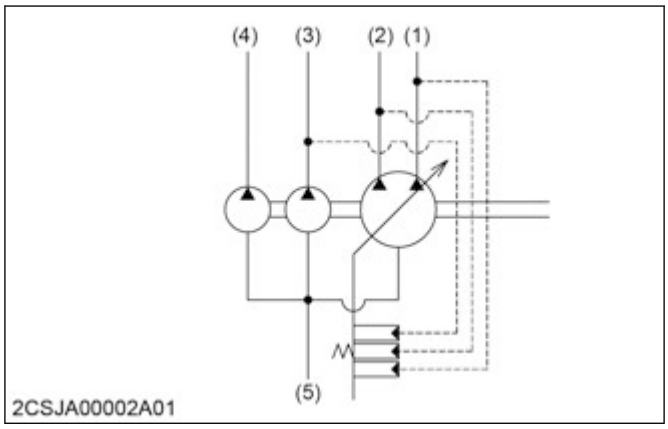
(Continued)

| Items | | Specifications |
|---|---|---|
| Maximum flow rate | Gear pump (P4) | 6.6 L/min<br>1.7 U.S. gal/min |
| Maximum pressure | Piston pump (P1+P2) | 22.5+22.5 MPa<br>229+229 kgf/cm$^2$<br>3263+3263 psi |
| | Gear pump (P3) | 17.2 MPa<br>175 kgf/cm$^2$<br>2495 psi |
| | Gear pump (P4) | 3.9 MPa<br>40 kgf/cm$^2$<br>566 psi |

### Port location table

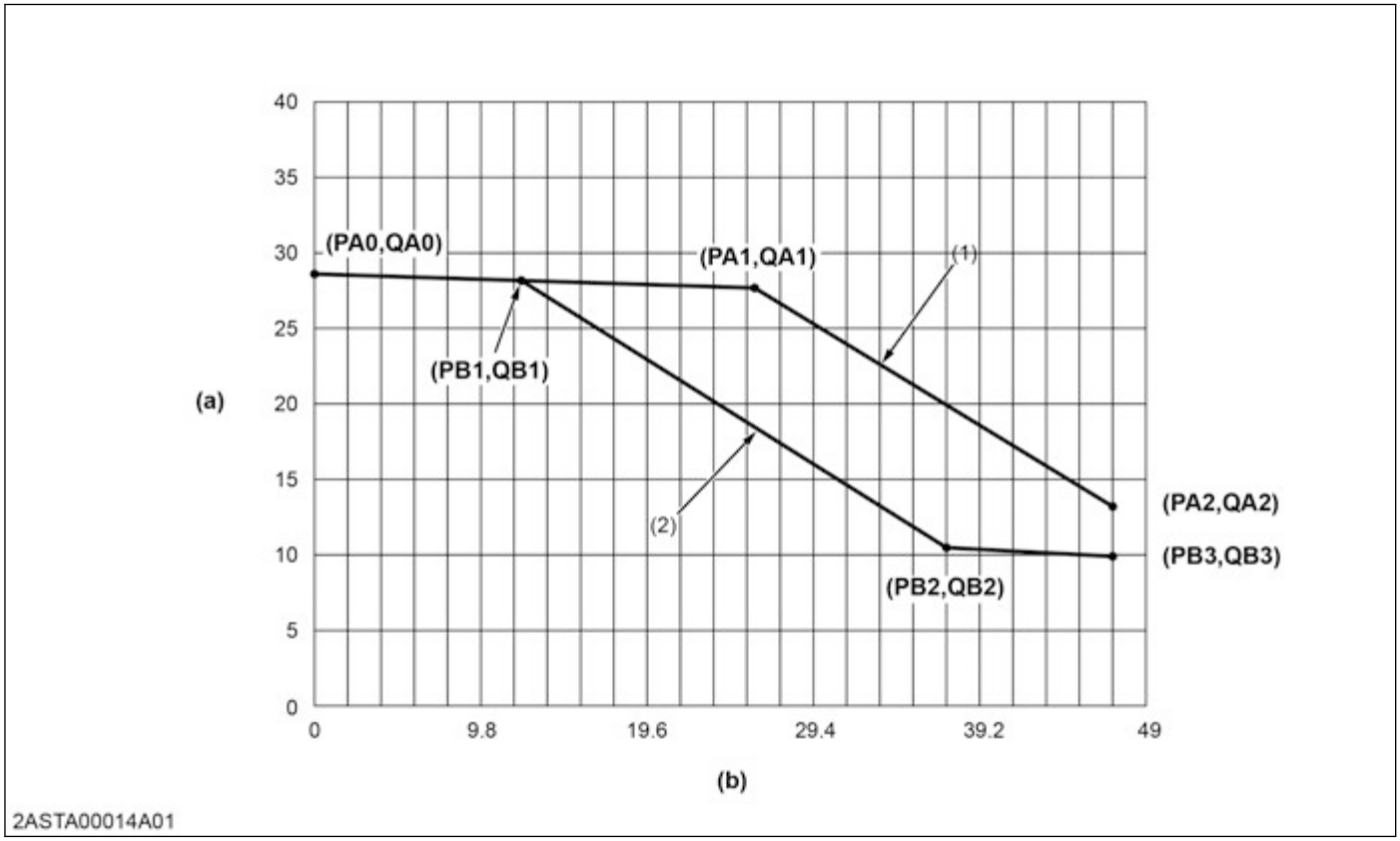
| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (1) | P1 | Control valve (P1) | (3) | P3 | Control valve (P3) |
| (2) | P2 | Control valve (P2) | (4) | P4 | Pilot filter |

## 2.2 Hydraulic pump hydraulic circuit




(1) Piston pump discharging port (P1)
(2) Piston pump discharging port (P2)
(3) Gear pump discharging port (P3)
(4) Gear pump discharging port (P4)
(5) Suction port (S1)

## 2.3 Piston pump P-Q performance




(1) P3 no load
(2) P3 load (relief)

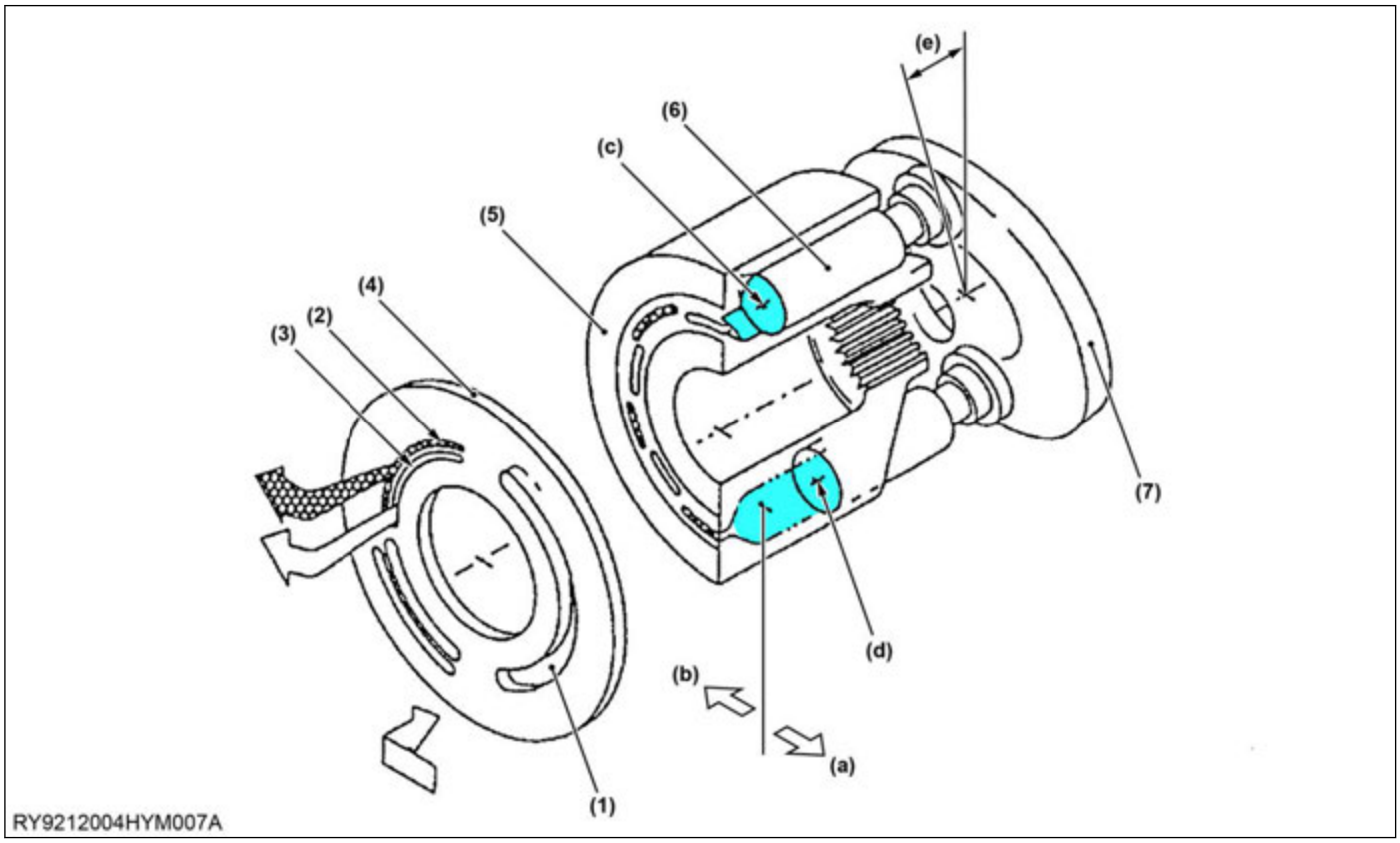
(a) Discharging flow rate: q1 = q2 (L/min)

(b) Discharging pressure: P1+P2 (MPa)

| Pump speed: 2200 rpm | | | |
|---|---|---|---|
| P3 no load (0.49 MPa) | | P3 load (relief) (20.6 MPa) | |
| Discharging pressure (MPa) | Discharging flow rate (L/min) | Discharging pressure (MPa) | Discharging flow rate (L/min) |
| PA0 = 0.0 | QA0 = 28.6 | PB0 = 12 | QB0 = 28.2 |
| PA1 = 25.8 | QA1 = 27.7 | PB1 = 37.2 | QB1 = 10.6 |
| PA2 = 47.0 | QA2 = 13.2 | PB2 = 47.0 | QB2 = 9.9 |

# 2.4 Hydraulic pump function and structure

## 2.4.1 Piston pump working principles

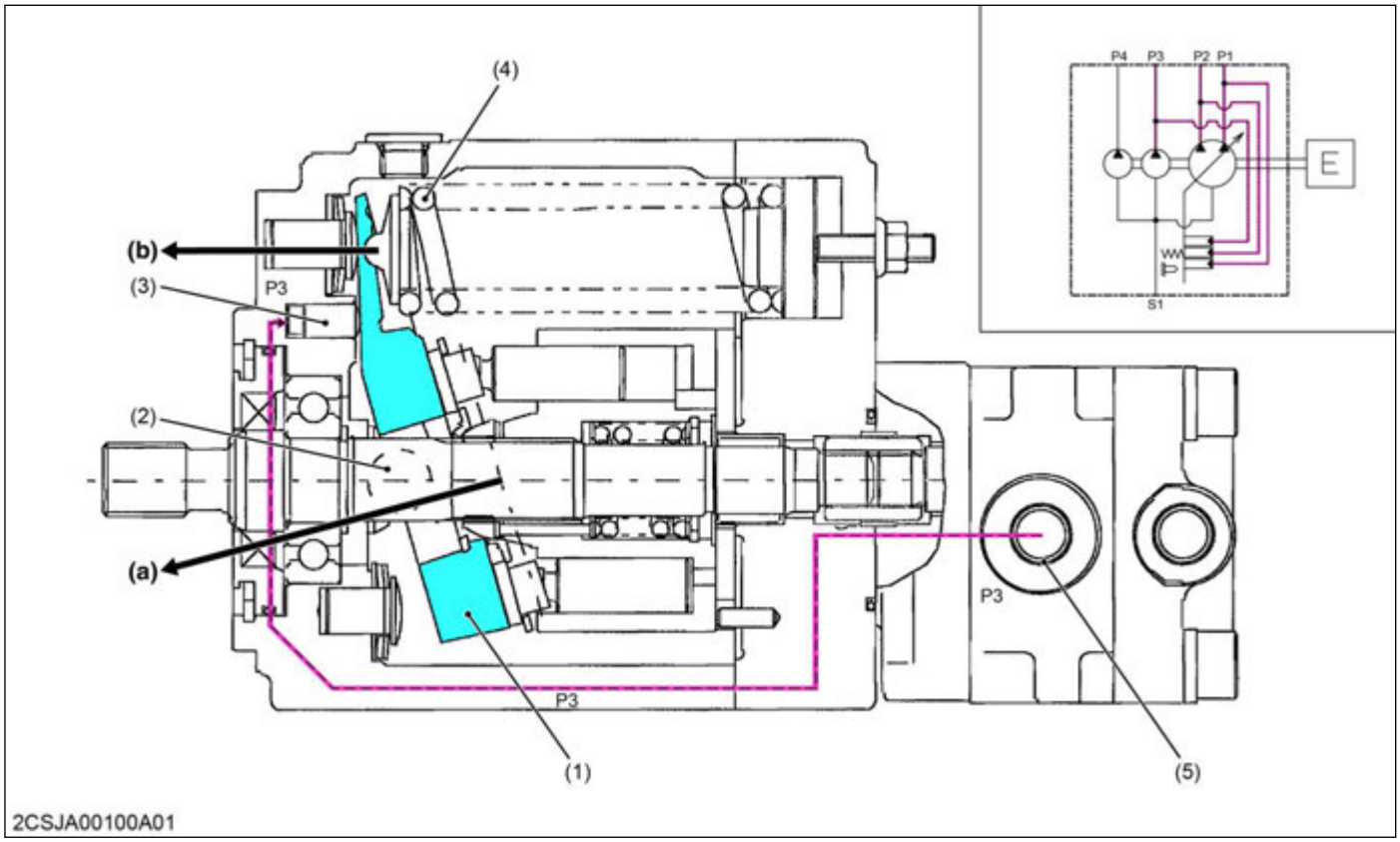



(1) Suction port
(2) Discharging port (P1)
(3) Discharging port (P2)
(4) Valve plate
(5) Cylinder block
(6) Piston
(7) Swash plate
(a) Suction side
(b) Discharging side
(c) Top dead center
(d) Bottom dead center
(e) Tilt angle

- The engine is connected to the cylinder block by the shaft.
- The cylinder block is composed of a number of pistons.
- The pistons are reciprocated inside the cylinder block according to the rotation of the cylinder block and the angle of the swash plate.
- The piston pump suctions and discharges the hydraulic oil with their reciprocating motion.
  - Suction process
    - The pistons are pulled out from the cylinder block.
    - Hydraulic oil is suctioned into the cylinder block through the valve plate.
  - Discharging process
    - The pistons are pushed into the cylinder block.
    - Hydraulic oil is discharged from the cylinder block through the valve plate.
- Suction and discharging flow rate depends on angle of the swash plate.

## 2.4.2 Horsepower control

The piston pump reduces the discharging flow rate to control horsepower consumption.



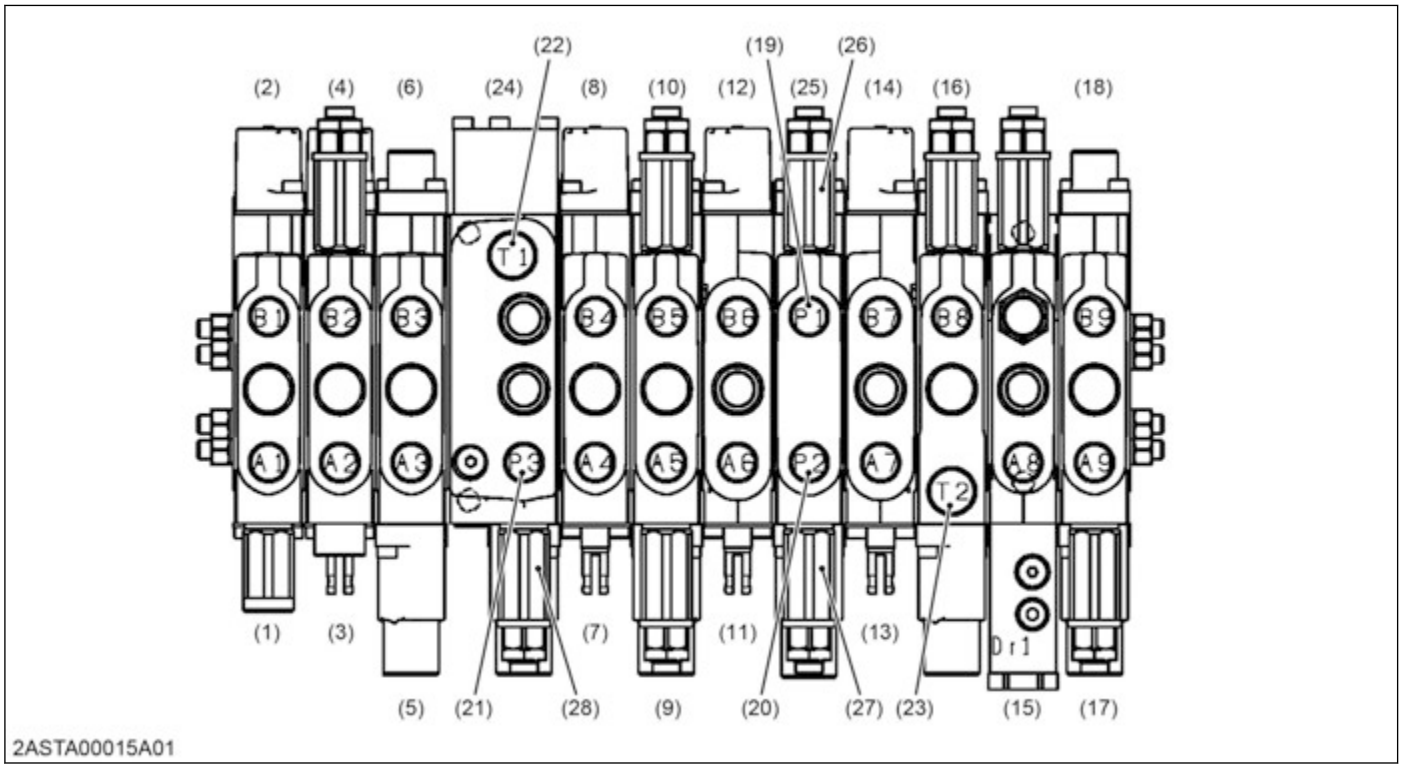

(1) Swash plate
(2) Ball
(3) Control pin
(4) Spring
(5) P3
(a) Load F1
(b) Spring force F2

- The spring presses the swash plate in direction (b) to tilt the swash plate in maximum angle. The discharging flow rate is maximized.
- In case of high load on P1 and P2,
  - P1 and P2 pressurized oil push back the pistons from discharging port.
  - The pistons press the swash plate in direction (a) to decrease the swash plate angle.
  - The discharging flow rate decreases to lower horse power consumption.
- In case of high load on P3,
  - P3 pressurized oil pushes the control pin to decrease angle of the swash plate.
  - Then, the discharging flow rate is reduced to lower the consumed horsepower.

# 3. Control valve

## 3.1 Control valve specifications

**Basic**



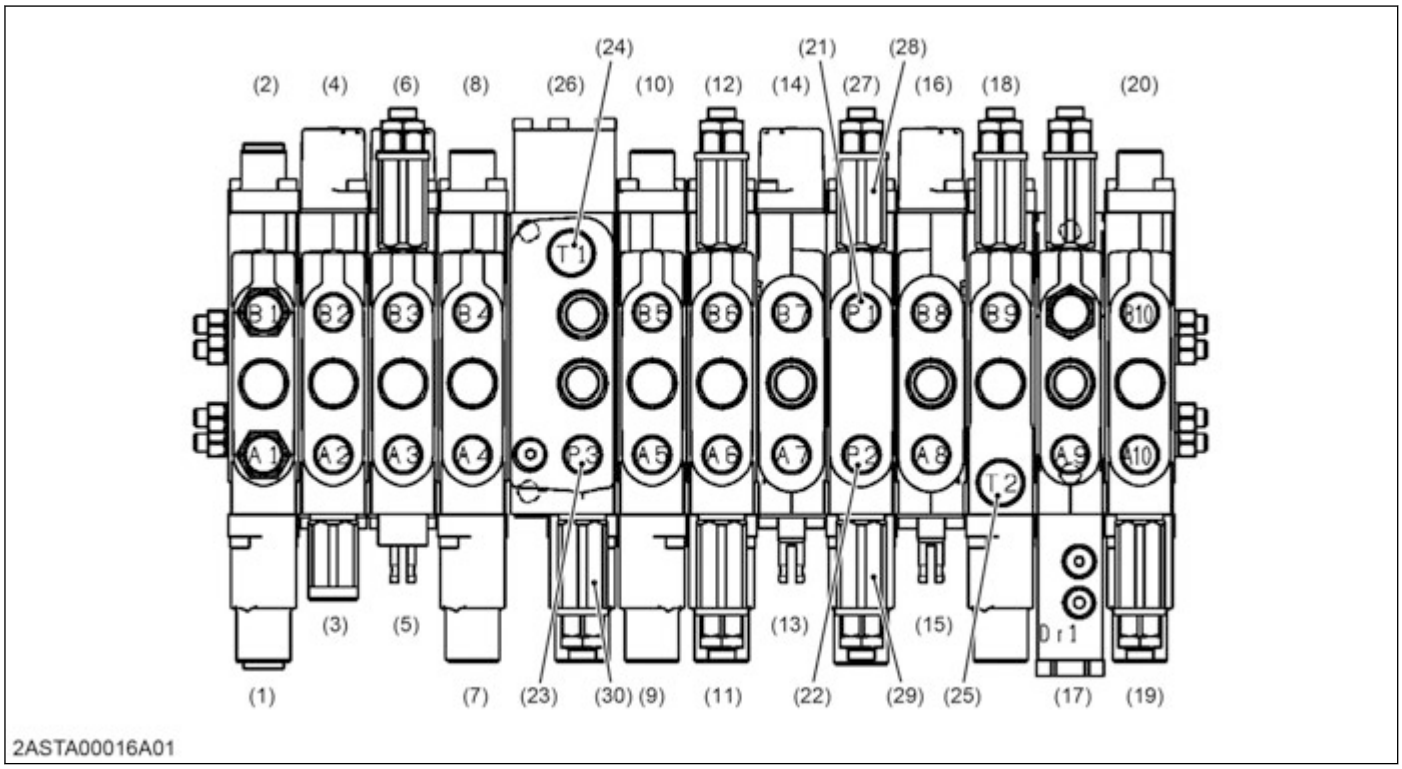

(26) P1 main relief valve (27) P2 main relief valve (28) P3 main relief valve

| Items | | Specifications | Remarks |
|---|---|---|---|
| Manufacturer | | Hydro control | - |
| Model | | EV310177 | - |
| Main relief valve setting pressure | (26) P1<br>(27) P2 | 22.5 MPa<br>229 kgf/cm$^2$<br>3263 psi | At 29 L/min<br>At 7.7 U.S. gal/min |
| | (28) P3 | 17.2 MPa<br>175 kgf/cm$^2$<br>2495 psi | At 18 L/min<br>At 4.8 U.S. gal/min |
| Overload relief valve setting pressure | (15) Boom bottom (b1B) | 26.5 MPa<br>270 kgf/cm$^2$<br>3844 psi | At 5.0 L/min<br>At 1.3 U.S. gal/min |
| | (16) Boom rod (b1R) | | |
| | (9) Arm rod (b2R) | | |
| | (10) Arm bottom (b2B) | | |
| | (17) Bucket bottom (b3B) | | |
| | (3) Blade bottom (b4B) | | |

## Port location table

| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (1) | Mechanical link | Swing RH | (14) | - | Travel RH forwards |
| (2) | - | Swing LH | (15) | Pa8 | Pilot control valve RH (1)<br>Boom lift |
| (3) | Mechanical link | Blade lift | (16) | Pb8 | Pilot control valve RH (3)<br>Boom lower |
| (4) | - | Blade lower | (17) | Pa9 | Pilot control valve RH (2)<br>Bucket crowd |
| (5) | Pa3 | Pilot control valve LH (4)<br>Swivel RH | (18) | Pb9 | Pilot control valve RH (4)<br>Bucket dump |
| (6) | Pb3 | Pilot control valve LH (2)<br>Swivel LH | (19) | P1 | Hydraulic pump (P1) |
| (7) | Mechanical link | AUX RH | (20) | P2 | Hydraulic pump (P2) |
| (8) | - | AUX LH | (21) | P3 | Hydraulic pump (P3) |
| (9) | Pa5 | Pilot control valve LH (3)<br>Arm dump | (22) | T1 | Tank |
| (10) | Pb5 | Pilot control valve LH (1)<br>Arm crowd | (23) | T2 | Tank |
| (11) | Mechanical link | Travel LH backwards | (24) | PP1<br>PP3 | Swivel motor (PP)<br>Unload valve (C)<br>Pilot pressure |
| (12) | - | Travel LH forwards | (25) | PP2 | Unload valve (B)<br>Pilot pressure |
| (13) | Mechanical link | Travel RH backwards | - | - | - |

**Hi-spec**




(28) P1 main relief valve (29) P2 main relief valve (30) P3 main relief valve

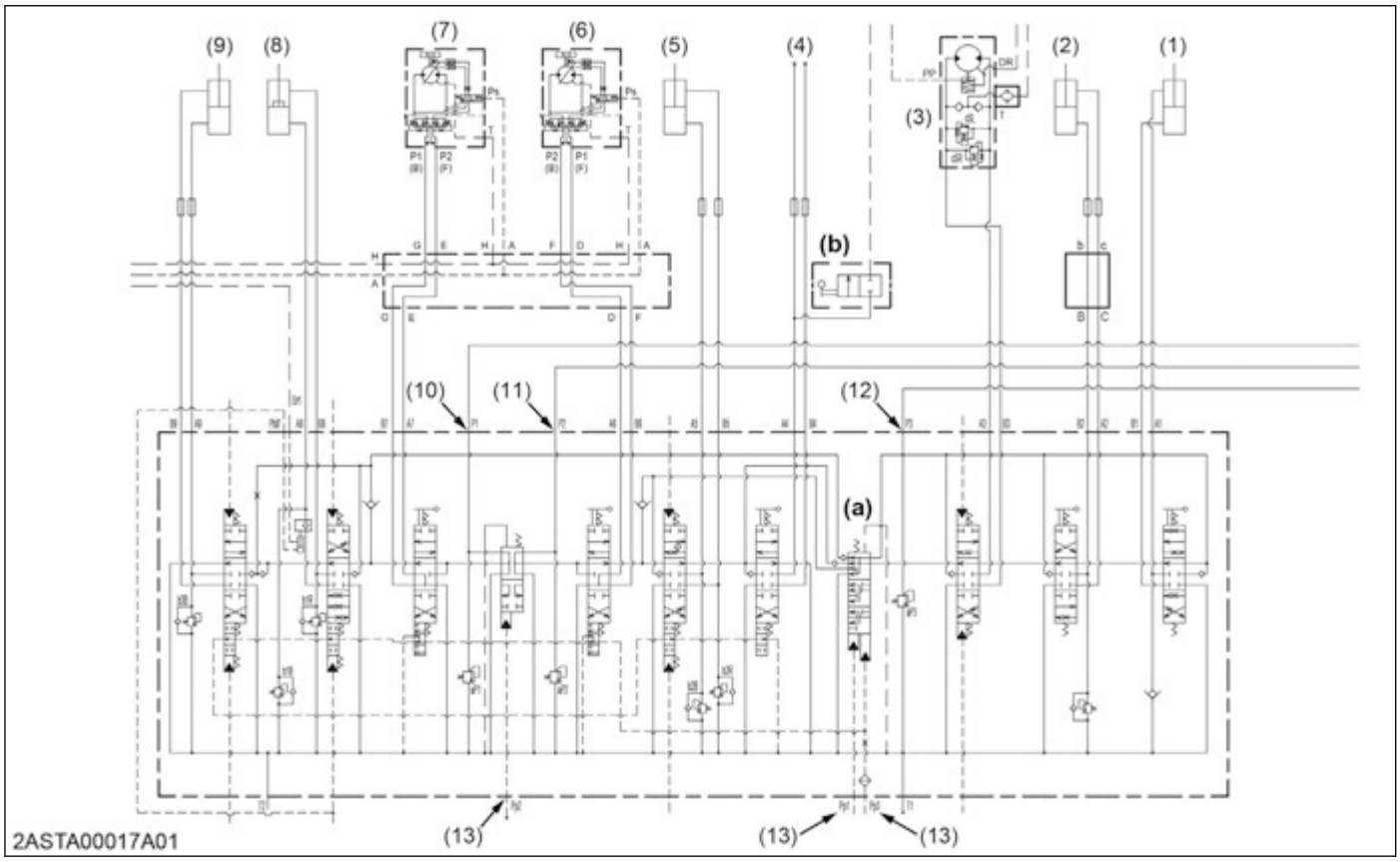
| Items | | Specifications | Remarks |
|---|---|---|---|
| Manufacturer | | Hydro control | - |
| Model | | EV310176 | - |
| Main relief valve setting pressure | (28) P1<br>(29) P2 | 22.5 MPa<br>229 kgf/cm$^2$<br>3263 psi | At 29 L/min<br>At 7.7 U.S. gal/min |
| | (30) P3 | 17.2 MPa<br>175 kgf/cm$^2$<br>2495 psi | At 18 L/min<br>At 4.8 U.S. gal/min |
| Overload relief valve setting pressure | (17) Boom bottom (b1B) | 26.5 MPa<br>270 kgf/cm$^2$<br>3844 psi | At 5.0 L/min<br>At 1.3 U.S. gal/min |
| | (18) Boom rod (b1R) | | |
| | (11) Arm bottom (b2B) | | |
| | (12) Arm rod (b2R) | | |
| | (19) Bucket bottom (b3B) | | |
| | (6) Blade bottom (b4B) | | |

## Port location table

| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (1) | Pa1 | AUX2 RH | (15) | Mechanical link | Travel RH forwards |
| (2) | Pb1 | AUX2 LH | (16) | - | Travel RH backwards |
| (3) | Mechanical link | Swing RH | (17) | Pa9 | Pilot control valve RH (4)<br>Boom lift |
| (4) | - | Swing LH | (18) | Pb9 | Pilot control valve RH (2)<br>Boom lower |
| (5) | Mechanical link | Blade lift | (19) | Pa10 | Pilot control valve RH (1)<br>Bucket crowd |
| (6) | - | Blade lower | (20) | Pb10 | Pilot control valve RH (3)<br>Bucket dump |
| (7) | Pa4 | Pilot control valve LH (3)<br>Swivel RH | (21) | P1 | Hydraulic pump (P1) |
| (8) | Pb4 | Pilot control valve LH (1)<br>Swivel LH | (22) | P2 | Hydraulic pump (P2) |
| (9) | Pa5 | Proportional valve (A2)<br>AUX RH | (23) | P3 | Hydraulic pump (P3) |
| (10) | Pb5 | Proportional valve (A1)<br>AUX LH | (24) | T1 | Tank |
| (11) | Pa6 | Pilot control valve LH (4)<br>Arm crowd | (25) | T2 | Tank |
| (12) | Pb6 | Pilot control valve LH (2)<br>Arm dump | (26) | PP1<br>PP3 | Swivel motor (PP)<br>Unload valve (C)<br>Pilot pressure |
| (13) | Mechanical link | Travel LH backwards | (27) | PP2 | Unload valve (B)<br>Pilot pressure |
| (14) | - | Travel LH forwards | - | - | - |

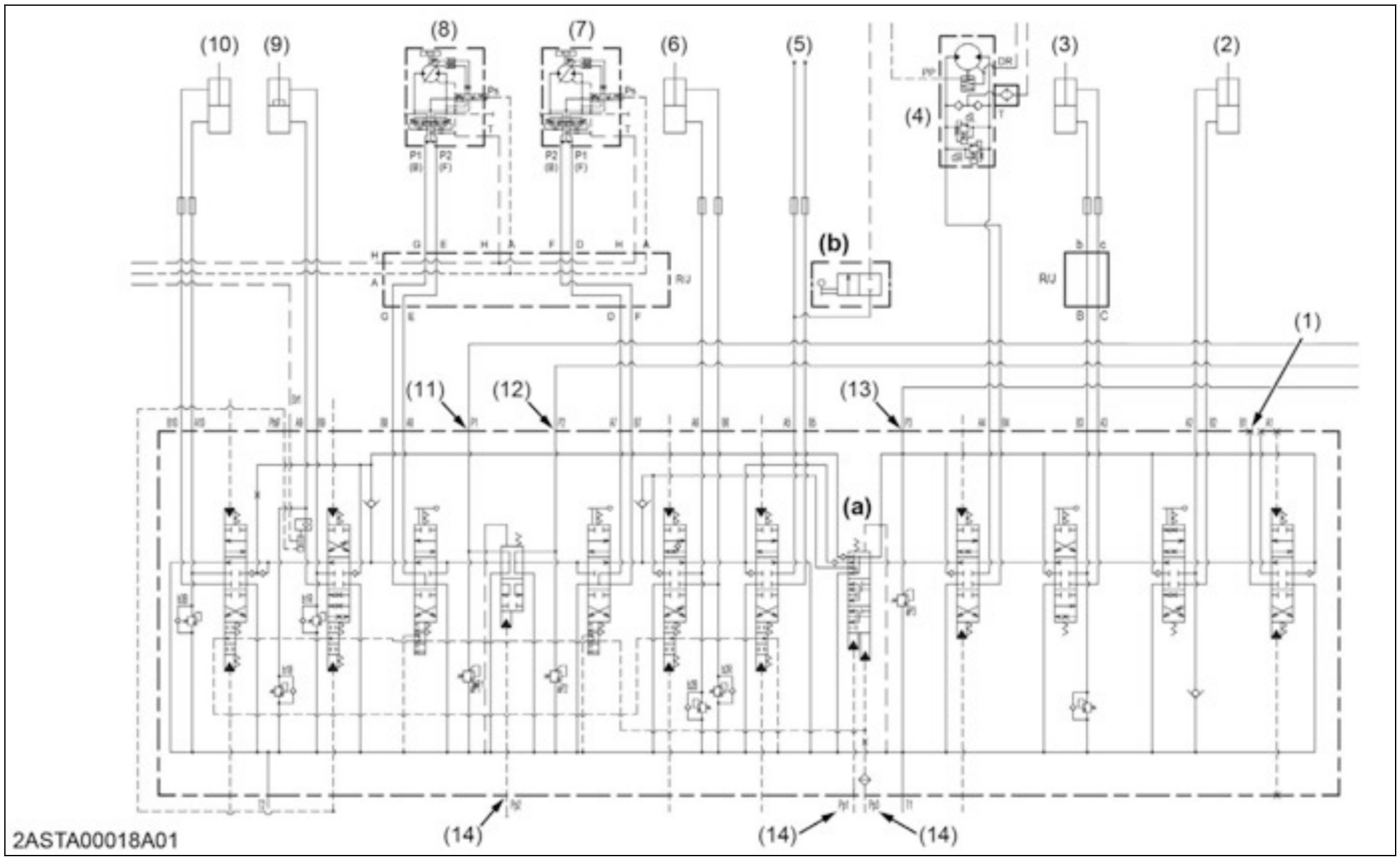
# 3.2 Control valve hydraulic circuit

**Basic**



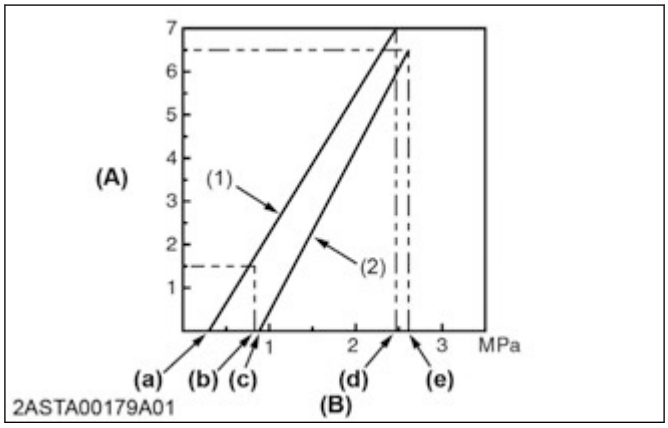

(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) Port P4
(a) Communication valve
(b) Third line valve

**Hi-spec**




(1) AUX2 port
(2) Swing cylinder
(3) Blade cylinder
(4) Swivel motor
(5) AUX1 port
(6) Arm cylinder
(7) Travel motor LH
(8) Travel motor RH
(9) Boom cylinder
(10) Bucket cylinder
(11) Port P1
(12) Port P2
(13) Port P3
(14) Port P4
(a) Communication valve
(b) Third line valve

## 3.3 Control valve spool shift performance




(1) Other
(2) Communication valve
(A) Spool stroke (mm)
(B) Pilot pressure (MPa)

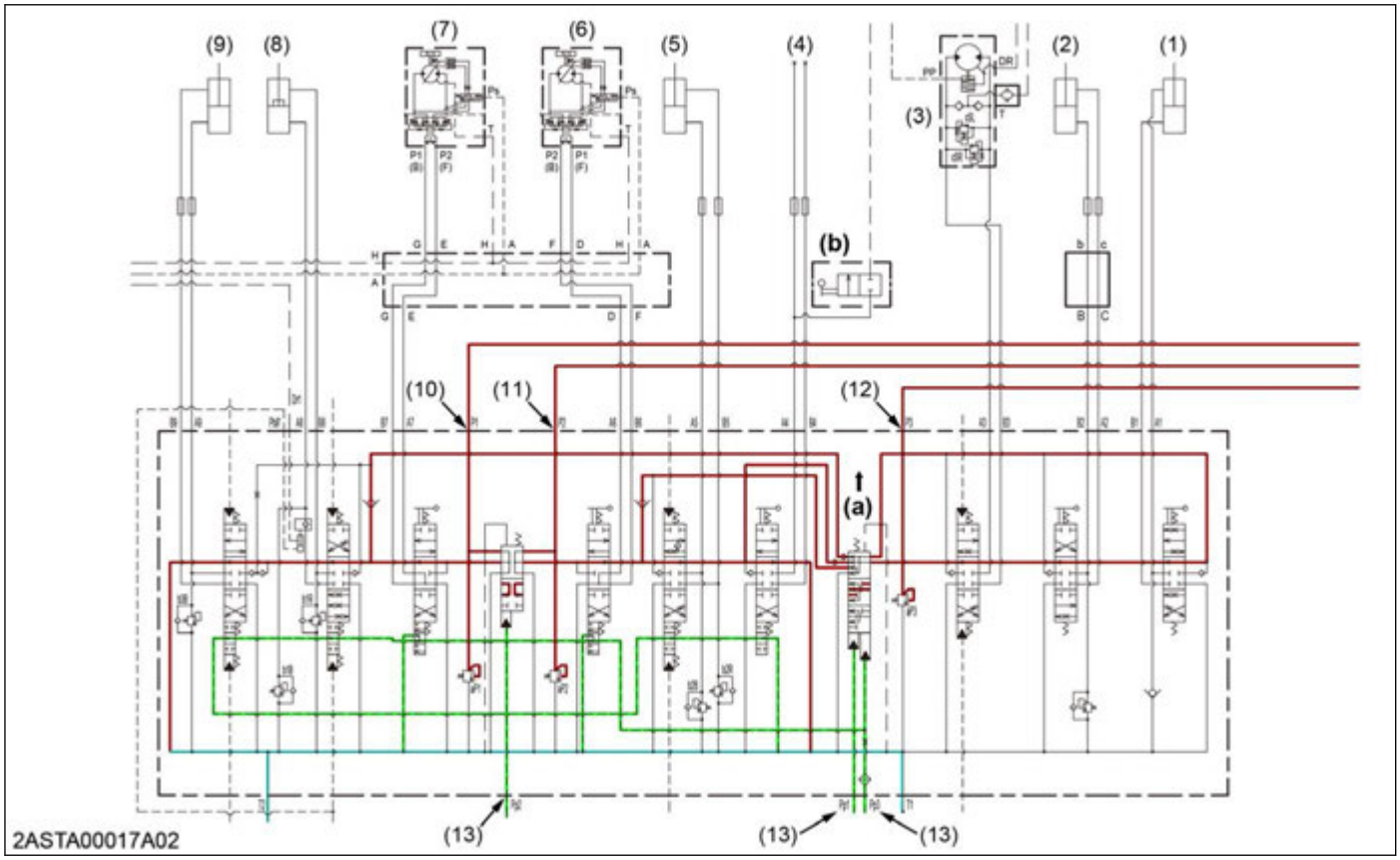
| Items | Pressures |
|---|---|
| (a) | 0.33 MPa<br>3.37 kgf/cm$^2$<br>47.86 psi |
| (b) | 0.79 MPa<br>8.06 kgf/cm$^2$<br>114.58 psi |
| (c) | 0.82 MPa<br>8.36 kgf/cm$^2$<br>118.93 psi |
| (d) | 2.47 MPa<br>25.19 kgf/cm$^2$<br>358.24 psi |
| (e) | 2.55 MPa<br>26.00 kgf/cm$^2$<br>369.85 psi |

# 3.4 Control valve function and structure

## 3.4.1 Straight traveling circuit

In case of the simultaneous operation of travel and front attachments, P1 and P2 pressurized oil flows independently to each travel motor to ensure the straight travel.

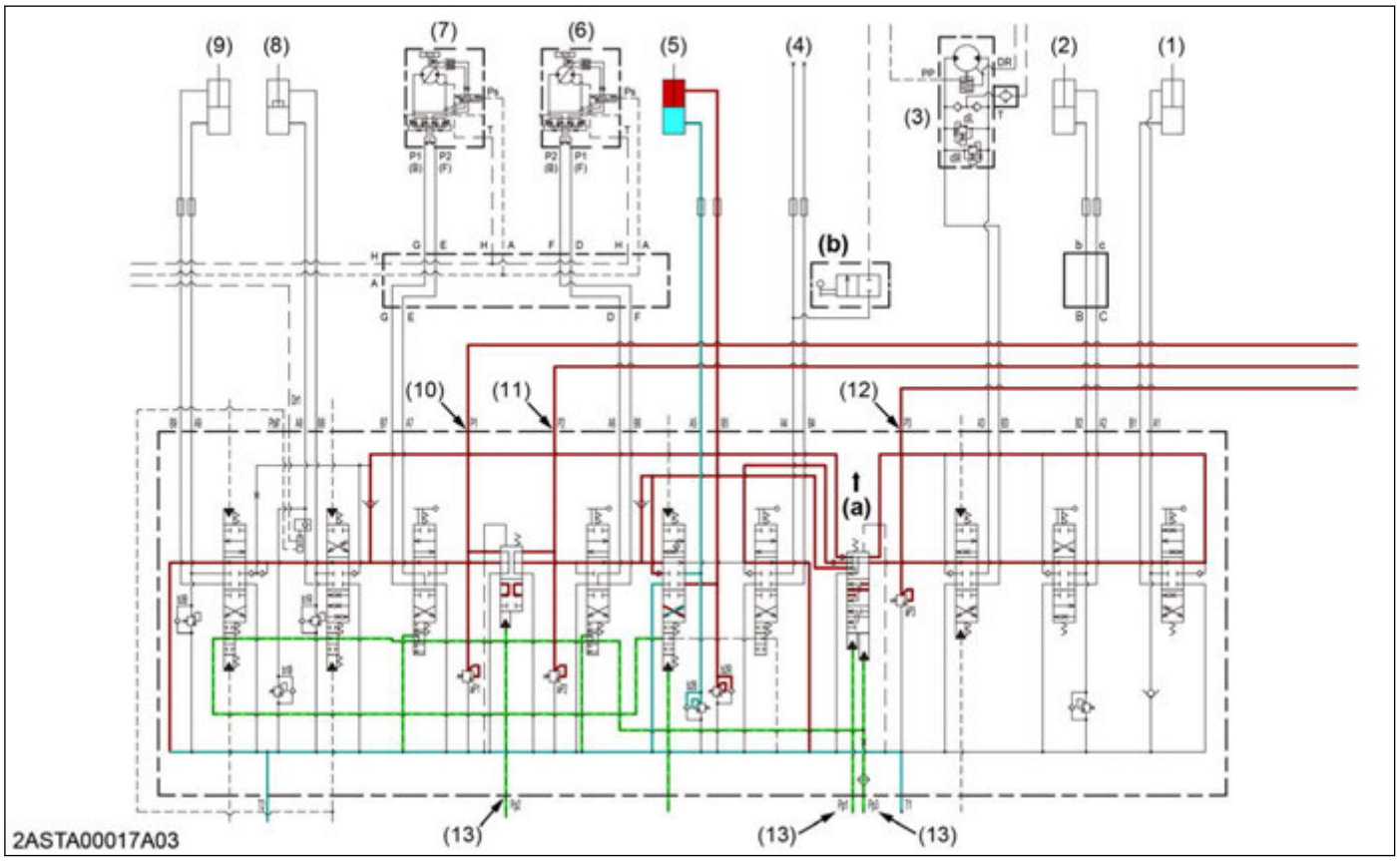
**Not operating any sections**




(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp1 pressurized oil shifts the communication valve to the middle position when the lever lock is lowered.
- All pressurized oil returns to the tank.

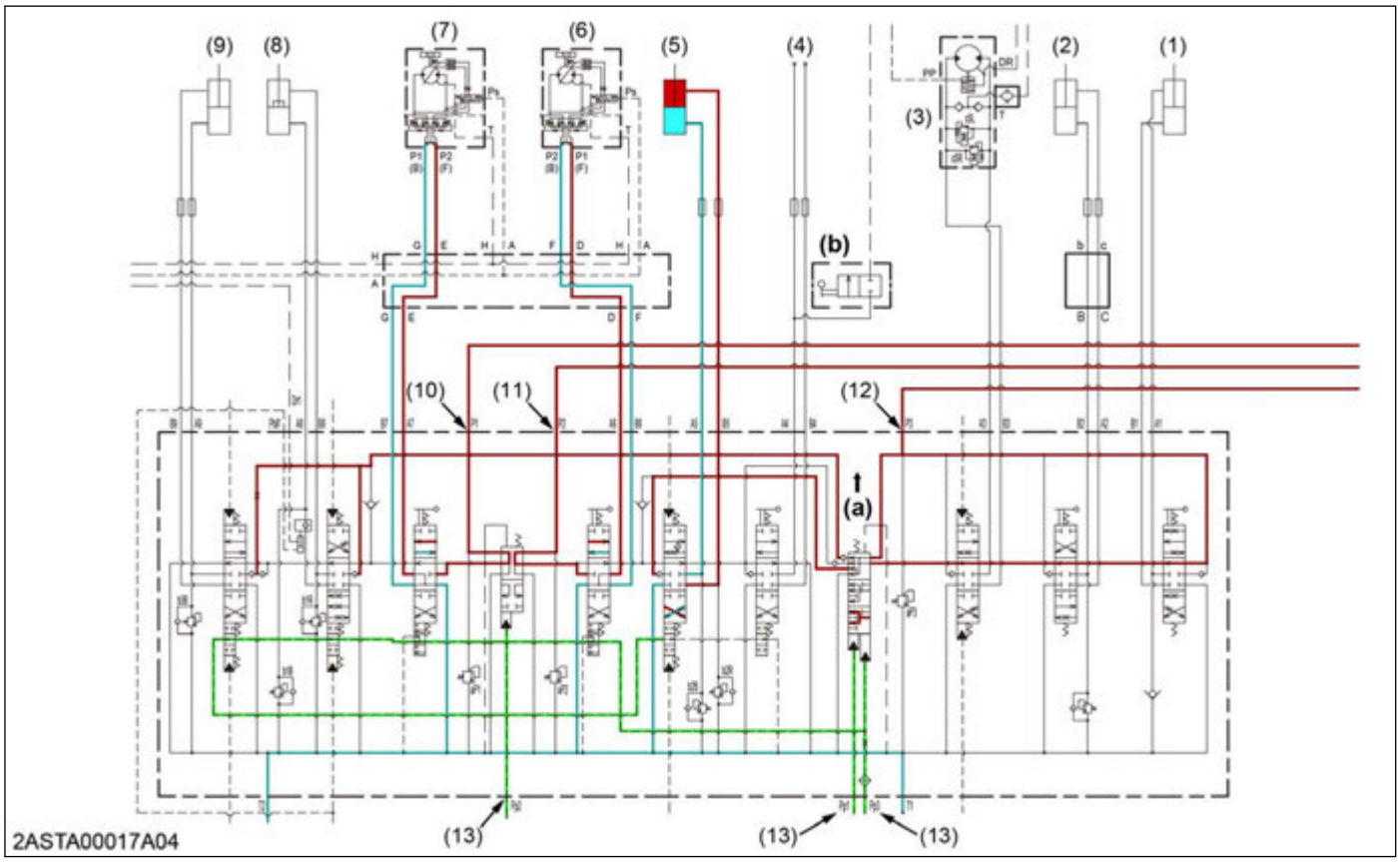
## Operating the arm (travel in neutral)




(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp3 pressurized oil in the signal circuit returns to tank through the spools of the travel sections.
- The communication valve spool stays in the middle position.
- P2 pressurized oil flows to the arm cylinder.

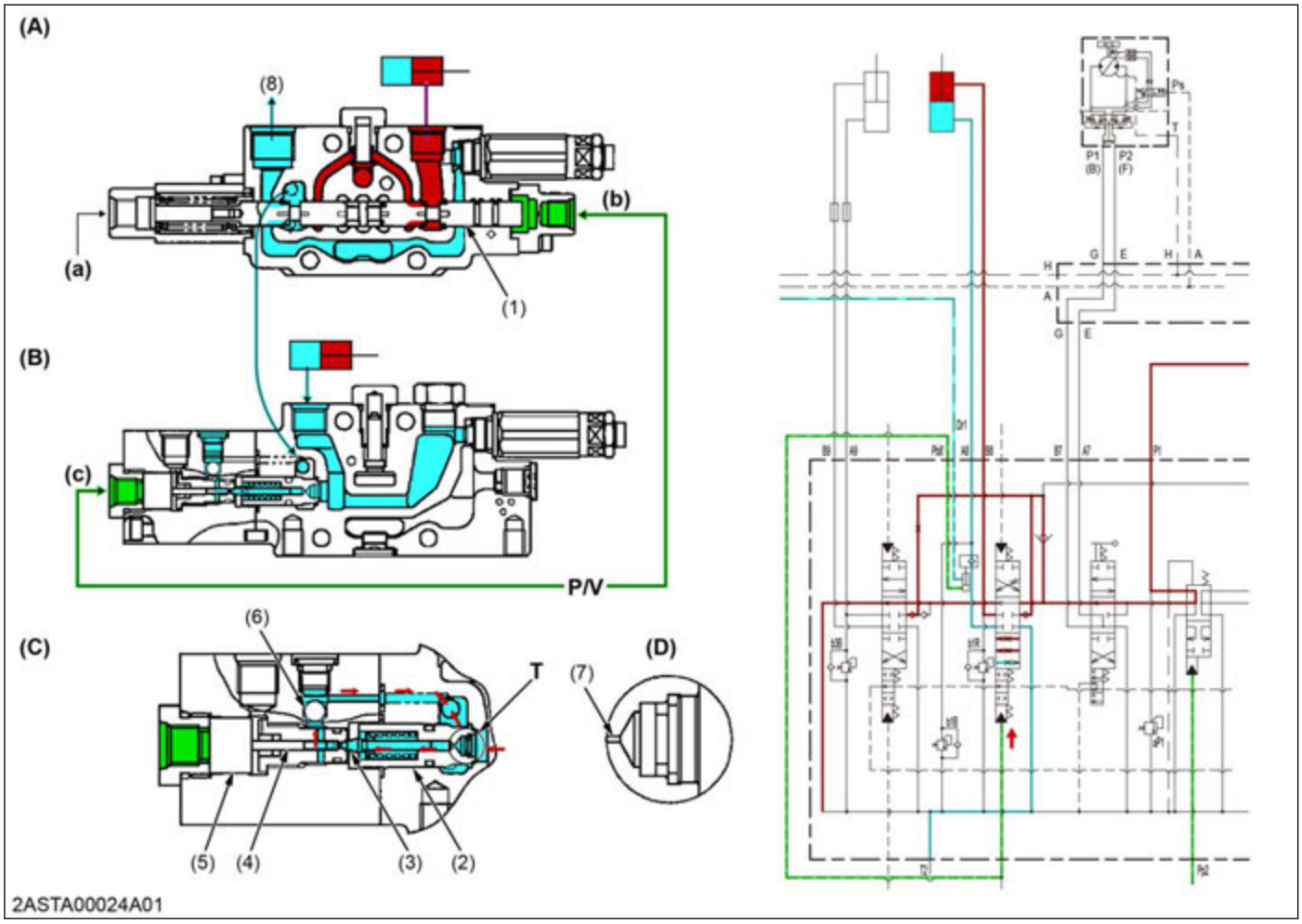
## Operating the arm and travel




(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp3 pressurized oil is cut off at spool in the arm section.
- Tank passage of the signal circuit is closed at the travels spools.
- The signal circuit pressure increases to shift the communication valve.
- P3 pressurized oil flows to the arm cylinder.
- P1 and P2 pressurized oil flows independently to each travel motor ensure the straight travel.

## 3.4.2 Boom lock valve

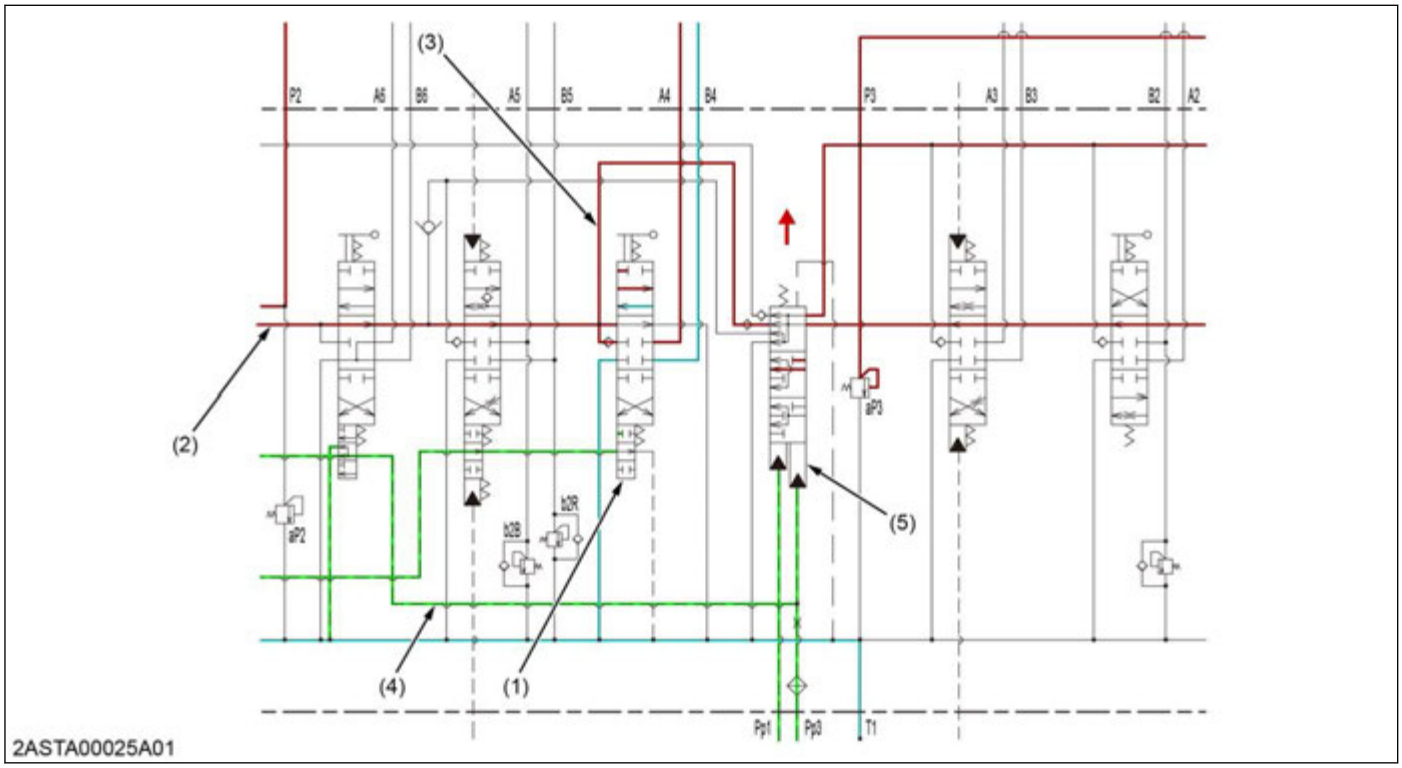



(1) Spool
(2) Boom lock valve
(3) Needle valve
(4) Piston A
(5) Piston B
(6) Check valve
(7) Orifice
(8) To oil cooler
(A) Boom switching section
(B) Boom lock valve section
(C) Boom lock valve (detailed view)
(D) T section (detailed view)
(a) Boom lift pilot pressure (port Pb8)
(b) Boom lower pilot pressure (port Pa8)
(c) Boom lock valve pressure (port Pb8')

- In case of not operating the boom,
  - The check valve shuts off the hydraulic oil from the boom cylinder bottom circuit to prevent internal leakage.
- In case of lowering the boom
  - Pilot pressurized oil flows into port Pb8 to shift the spool.
  - P1 pressurized oil flows to the boom cylinder rod side.
  - Pilot pressurized oil flows into port Pb8' to open the boom lock valve.
  - The hydraulic oil from the boom cylinder bottom returns to the tank through the opened check valve.

## 3.4.3 AUX1 converge circuit

Converge P2 and P3 flow for AUX1.

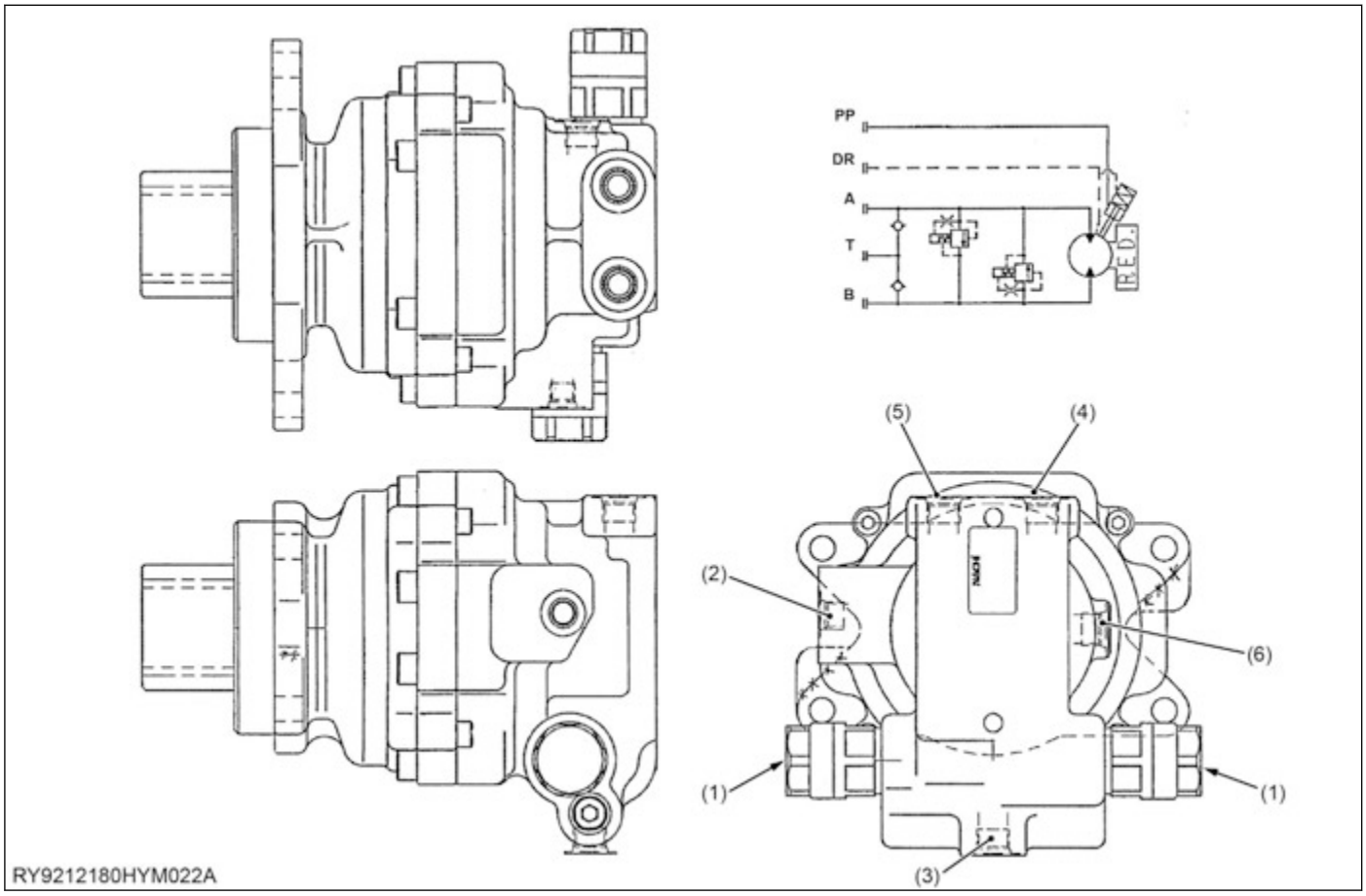



(1) AUX1 section
(2) P2 pressurized oil
(3) P3 pressurized oil
(4) Signal circuit
(5) Communication valve

- Pp1 pressurized oil shifts the communication valve spool to the middle position.
- Pp3 pressurized oil returns to the tank through the travel sections and the communication valve spool stays in the middle position.
- P3 pressurized oil converges with P2 pressurized oil in the AUX1 section to increase the AUX1 flow rate.
- In case of operating travel,
  - Pp3 pressurized oil shifts the communication valve spool.
  - P3 pressurized oil does not converge with P2 pressurized oil and flows to AUX1 port.

# 4. Swivel motor

## 4.1 Swivel motor specifications




(1) Relief valve

| Items | Specifications |
|---|---|
| Manufacturer | Nachi-Fujikoshi |
| Model | PCR-1B-05A-P-8290A |
| Motor displacement | 22.1 cc/rev<br>1.35 cu.in./rev |
| Reduction gear ratio | 10 |
| Maximum flow rate | 18.4 L/min<br>4.9 U.S. gal/min |
| Theoretical rotational speed | 81 rpm |
| Theoretical output torque | 530 N·m<br>54 kgf·m<br>391 lbf·ft |
| Relief valve setting pressure | 17.7 MPa<br>180 kgf/cm$^2$<br>2567 psi |
| Mechanical brake torque | higher than 68.4 N·m<br>higher than 7.0 kgf·m<br>higher than 50.5 lbf·ft |
| Parking brake release pressure | less than 4.9 MPa<br>less than 50 kgf/cm$^2$<br>less than 711 psi |

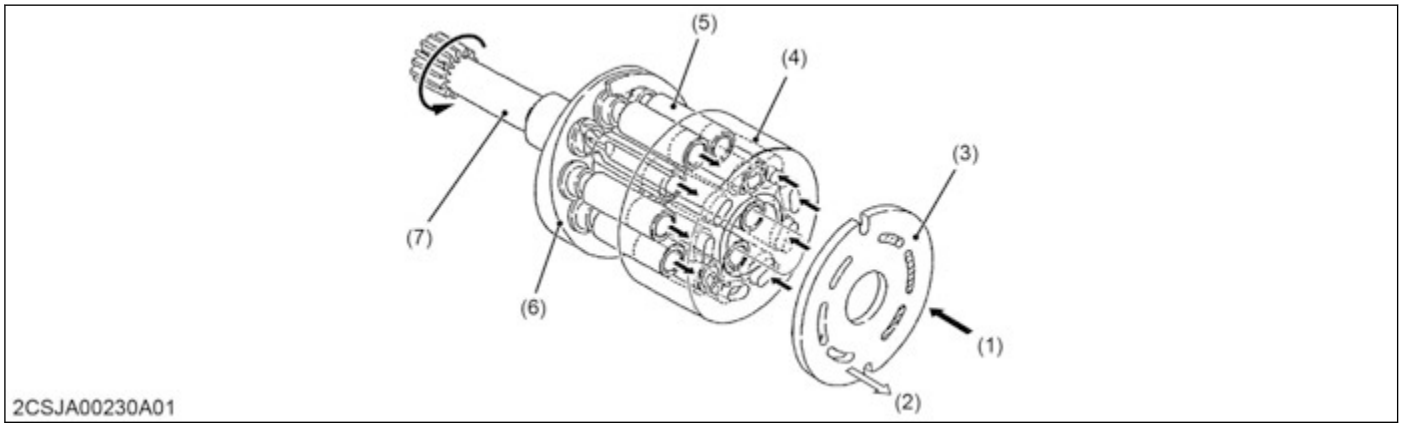
### Port location table

| No. | Port | Using location | No. | Port | Using location |
|---|---|---|---|---|---|
| (2) | PP | Unload valve (B)<br>Parking brake | (5) | A | Control valve (Pb4)<br>Swivel LH |
| (3) | M | Control valve (T1)<br>Make-up | (6) | Drain port | Tank |
| (4) | B | Control valve (Pa4)<br>Swivel RH | - | - | - |

# 4.2 Swivel motor function and structure

## 4.2.1 Swivel motor working principles

Convert fluid energy (pressurized oil flow) into shaft rotation.
**Rotating in LH direction (oil flow from port A)**

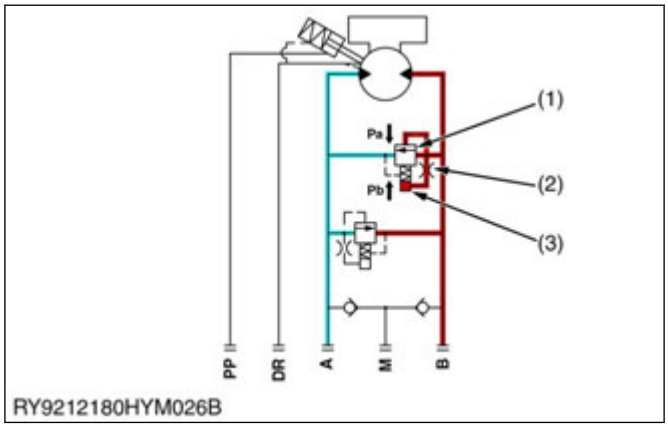



(1) Port A
(2) Port B
(3) Valve plate
(4) Cylinder block
(5) Piston
(6) Swash plate
(7) Shaft

- Input process
  - The pressurized oil flows into the cylinder block from the port A through the valve plate.
  - The pressurized oil pushes the piston.
  - The piston pushes the swash plate.
  - The piston slides down on the swash plate to generate the rotational force with the cylinder block.
  - Stops to supply pressurized oil to the piston at the lowest point.
- Output process
  - The piston slides up on the swash plate by rotational force from port A side.
  - The piston pushes out the hydraulic oil inside the cylinder block from port B.

## 4.2.2 Shockless function

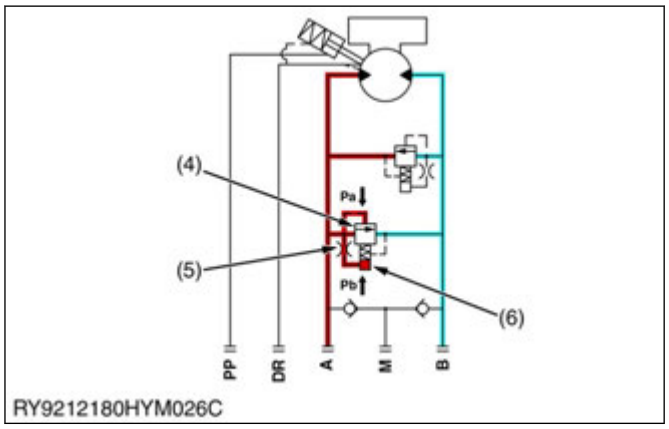
Reduces shock for starting and stopping the swivel motor.
**Stopping → Starting**




(1) Relief valve
(2) Orifice
(3) Chamber B

- Port B pressurized oil flows into the chamber B through the orifice in the relief valve.
- The orifice reduces the flow rate of port B pressurized oil to make gradual response of Pb.
- Pa is higher than Pb for a moment due to the gradual response of Pb.
- The relief valve opens to let the port B pressurized oil flow into the port A.
- Reduces the flowing oil to the swivel motor and decreases the starting shock.
- Chamber B will be filled with port B pressurized oil.
- Pb with spring force becomes higher than Pa and the relief valve is closed.

**Rotating → Stopping**

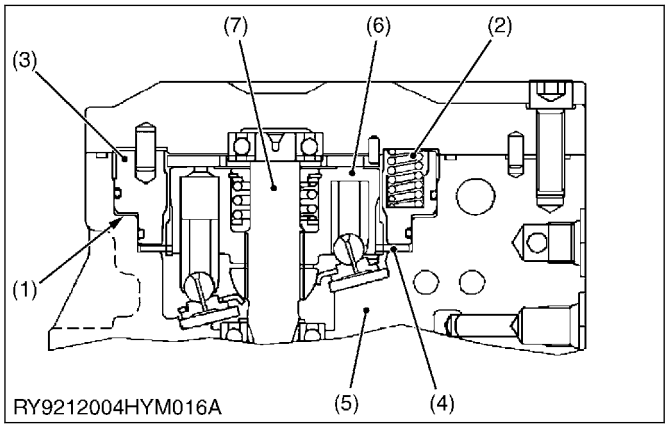



(4) Relief valve
(5) Orifice
(6) Chamber A

- Port A pressure increases by inertial force.
- Port A pressurized oil flows into the chamber A through the orifice in the relief valve.
- The orifice reduces the flow rate of port A pressurized oil to make gradual response of Pb.
- Pa is higher than Pb for a moment due to gradual response of Pb.
- The relief valve opens and oil flows from port A into port B.
- The shock during stopping is decreased while the relief valve is open.
- Chamber A will be filled with compressed oil from port A.
- Pb with spring force becomes higher than Pa and the relief valve is closed.

## 4.2.3 Swivel motor parking brake

Stops the swivel motor rotation as a negative brake.



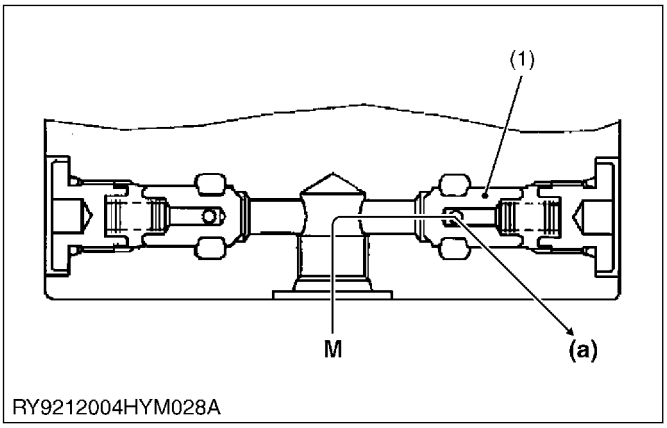

(1) Brake piston chamber
(2) Spring
(3) Brake piston
(4) Friction plate
(5) Case
(6) Cylinder block
(7) Shaft

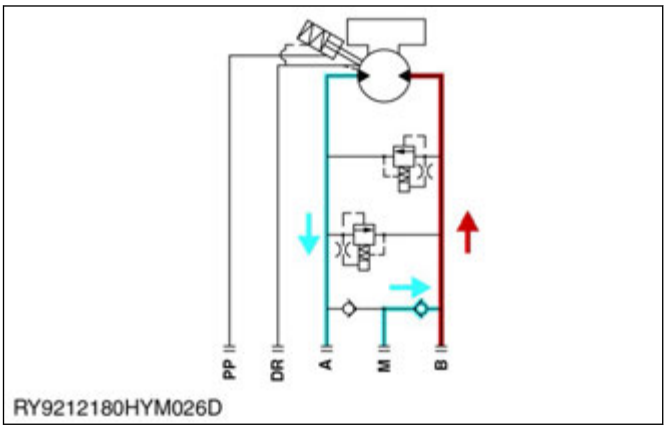
- Activating the parking brake (raising the lever lock)
  - The spring presses the brake piston.
  - The friction plate is wedged between the case and brake piston and is engaged with the shaft.
  - The swivel motor cannot rotate.
- Deactivating the parking brake (lowering the lever lock)
  - P4 pressurized oil flows into the brake piston chamber.
  - P4 pressurized oil pushes the brake piston to compress the spring.
  - The friction plate disengages the shaft and the swivel motor is able to rotate.

## 4.2.4 Make-up circuit

Prevents cavitation in case of decelerating the swivel motor.

**Decelerating the swivel motor**



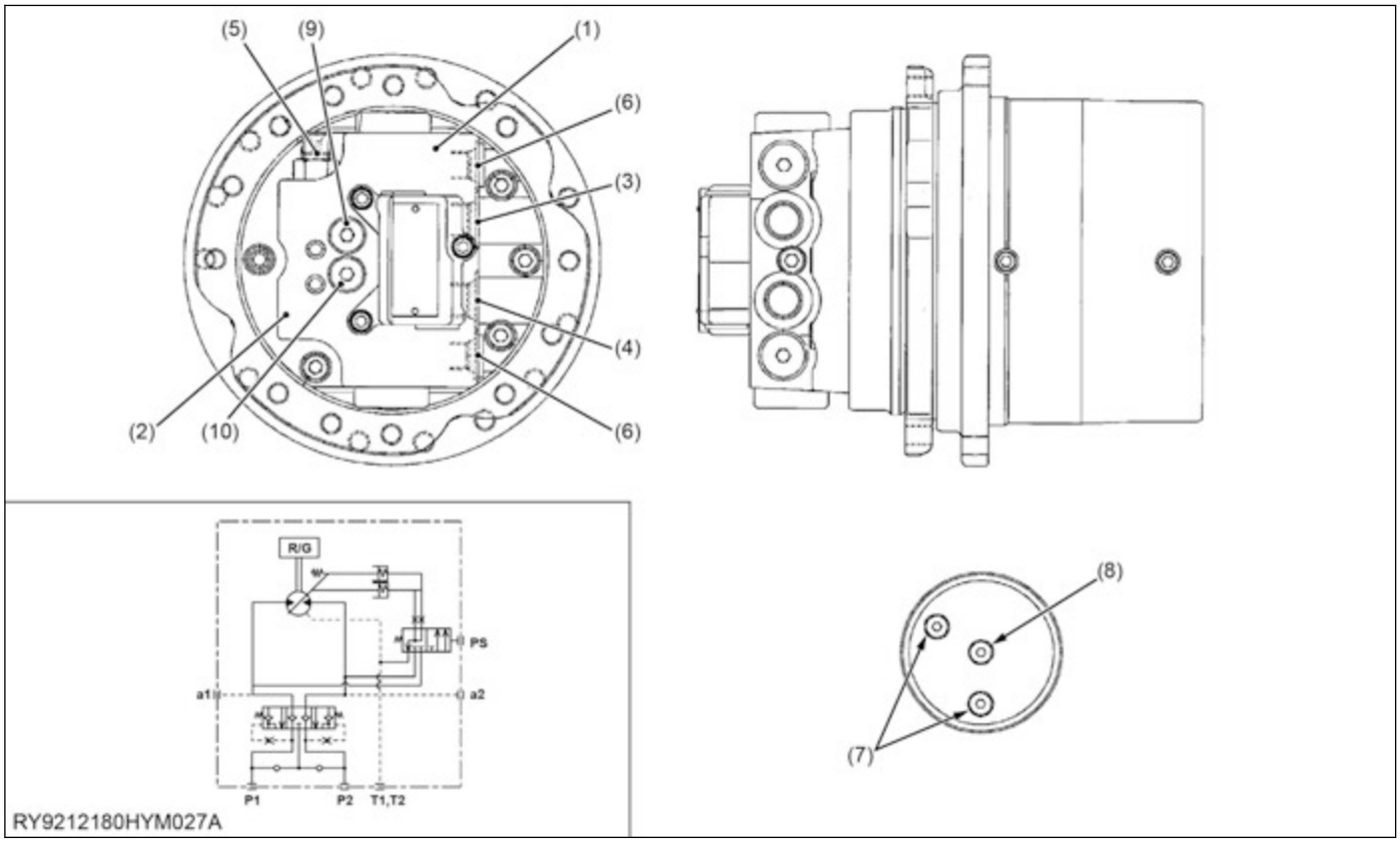

(1) Poppet
(a) To port M

- The primary pressure (port B) decreases due to the inertial force.
- Port M oil flows into the primary line (port B) through the check valve to prevent cavitation.

# 5. Travel motor

## 5.1 Travel motor specifications

**Basic**



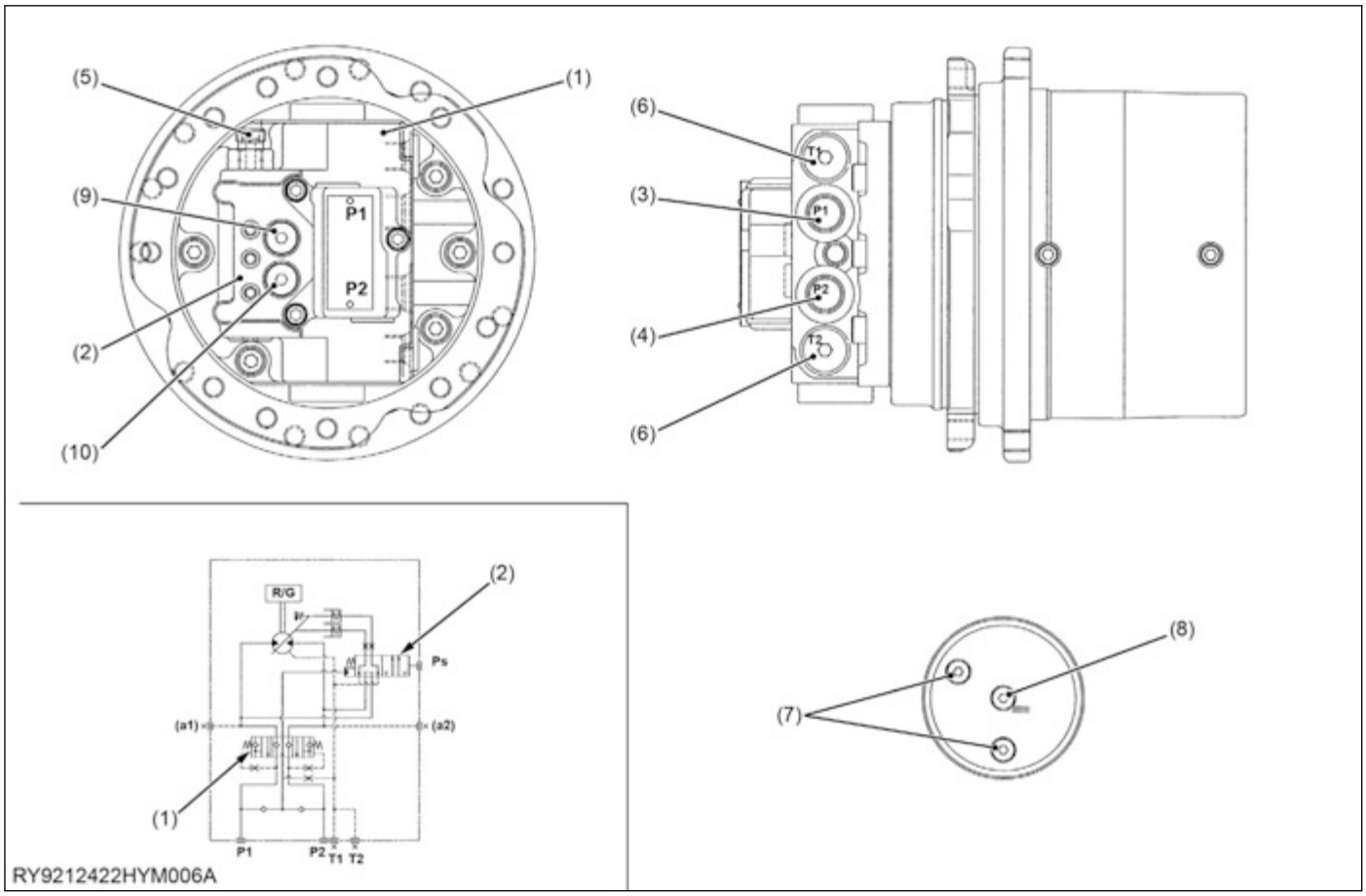

(1) Counterbalance valve
(2) Travel speed shift spool
(7) Oil filler port
(8) Oil inspection port
(9) Port a1
(10) Port a2

| Items | | Specifications |
|---|---|---|
| Manufacturer | | KYB |
| Model | | MAG-18V-230E-1 |
| Motor displacement | Low speed | 18.0 cc/rev<br>1.10 cu.in./rev |
| | Hi speed | 10.0 cc/rev<br>0.61 cu.in./rev |
| Reduction gear ratio | | 1: 42.958 |
| Maximum pressure | | 22.5 MPa<br>229 kgf/cm$^2$<br>3263 psi |
| Maximum flow rate | | 29.3 L/min<br>7.7 U.S. gal/min |
| Theoretical rotational speed | Low speed | 37.9 rpm at 29.3 L/min |
| | High speed | 68.2 rpm at 29.3 L/min |
| Theoretical output torque | Low speed | 2769 N·m<br>282 kgf·m<br>2042 lbf·ft |
| | High speed | 1538 N·m<br>157 kgf·m<br>1134 lbf·ft |

### Port location table

| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (3) | P1 | Swivel joint (F)<br>Backwards (RH) | (5) | PS | Swivel joint (A)<br>Travel speed shift |
| | | Swivel joint (G)<br>Backwards (LH) | | | |
| (4) | P2 | Swivel joint (D)<br>Forwards (RH) | (6) | T1, T2 | Swivel joint (H)<br>Drain |
| | | Swivel joint (E)<br>Forwards (LH) | | | |

**Hi-spec**




(1) Counterbalance valve
(2) Travel speed shift spool
(7) Oil filler port
(8) Oil inspection port
(9) Port a1
(10) Port a2

| Items | | Specifications |
|---|---|---|
| Manufacturer | | KYB |
| Model | | MAG-18V-230F-5 |
| Motor displacement | Low speed | 18.0 cc/rev<br>1.10 cu.in./rev |
| | High speed | 10.0 cc/rev<br>0.61 cu.in./rev |
| Reduction gear ratio | | 1: 42.958 |

(Continued)

| Items | | Specifications |
|---|---|---|
| Maximum pressure | | 22.5 MPa<br>229 kgf/cm$^2$<br>3263 psi |
| Maximum flow rate | | 29.3 L/min<br>7.7 U.S. gal/min |
| Theoretical rotational speed | Low speed | 37.9 rpm at 29.3 L/min |
| | High speed | 68.2 rpm at 29.3 L/min |
| Theoretical output torque | Low speed | 2769 N·m<br>282 kgf·m<br>2042 lbf·ft |
| | High speed | 1538 N·m<br>157 kgf·m<br>1134 lbf·ft |
| Automatic deceleration shifting pressure | | 16.0 to 18.4 MPa<br>163 to 188 kgf/cm$^2$<br>2320 to 2669 psi |

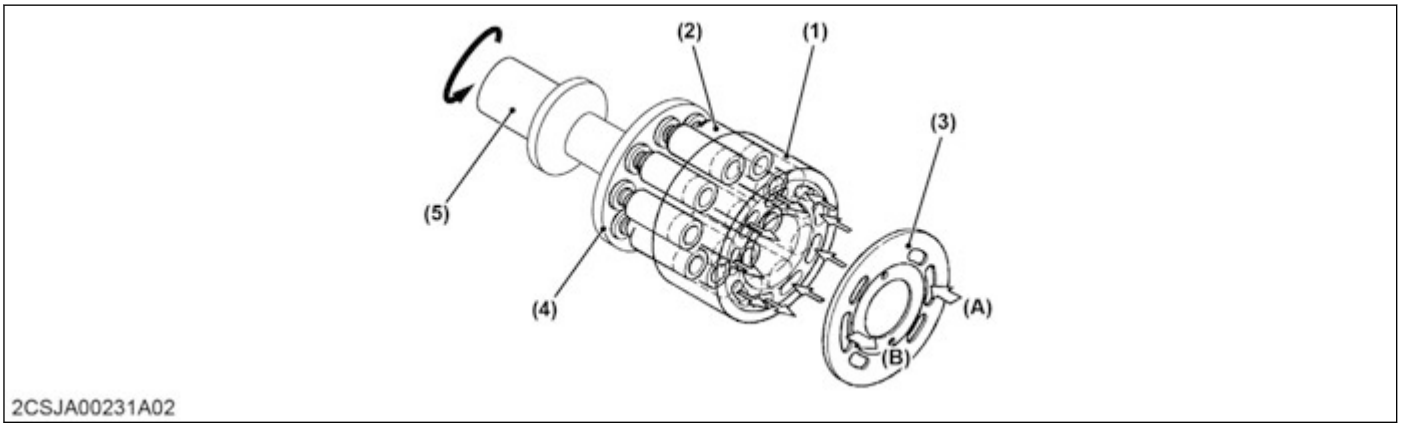
## Port location table

| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (3) | P1 | Swivel joint (F)<br>Backwards (RH) | (5) | PS | Swivel joint (A)<br>Travel speed shift |
| | | Swivel joint (G)<br>Backwards (LH) | | | |
| (4) | P2 | Swivel joint (D)<br>Forwards (RH) | (6) | T1, T2 | Swivel joint (H)<br>Drain |
| | | Swivel joint (E)<br>Forwards (LH) | | | |

# 5.2 Travel motor function and structure

## 5.2.1 Travel motor working principles

Converts fluid energy (pressurized oil flow) into shaft rotation.
**Rotating in LH direction (oil flow from port B)**

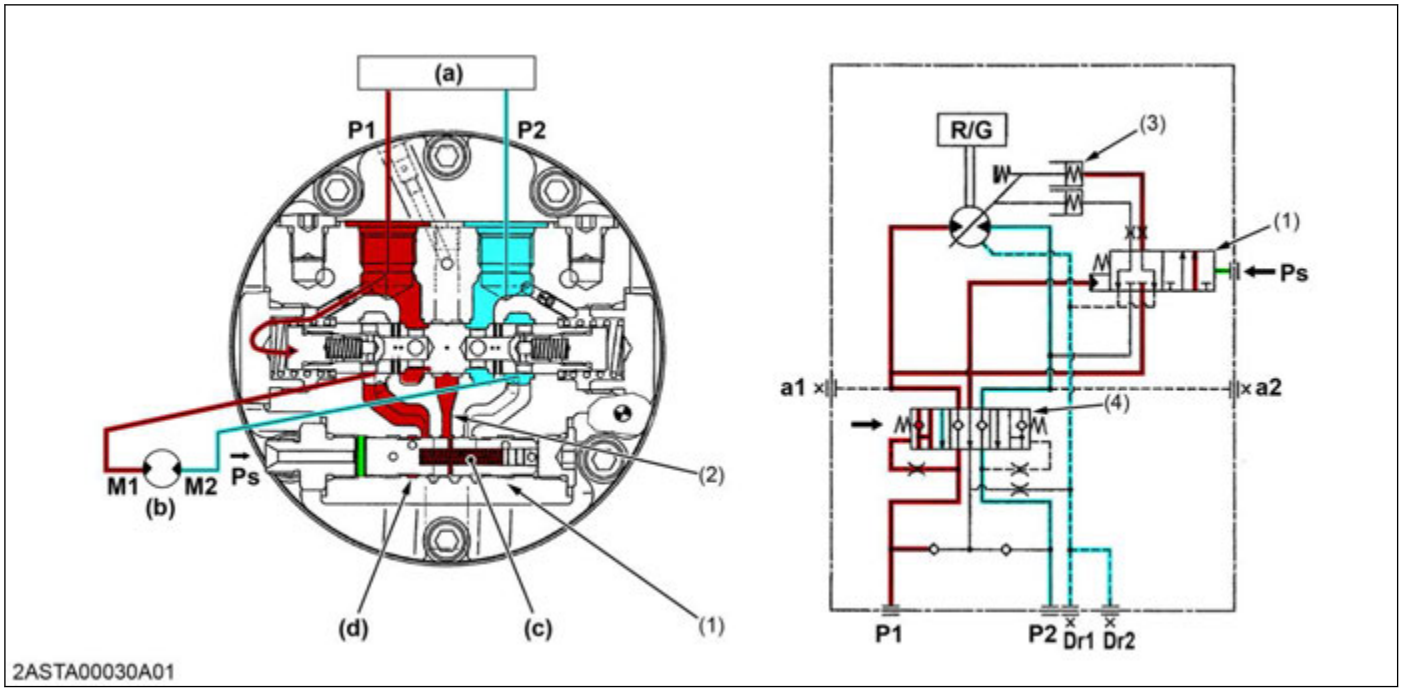



(1) Cylinder block
(2) Piston
(3) Valve plate
(4) Swash plate
(5) Shaft
(A) Port B
(B) Port C

- Input process
  - The pressurized oil flows into the cylinder block from the port B through the valve plate.
  - The pressurized oil pushes the piston.
  - The piston pushes the swash plate.
  - The piston slides down on the swash plate to generate rotational force with the cylinder block.
  - Stops to supply pressurized oil to the piston at the lowest point.
- Output process
  - The piston slides up on the swash plate by rotational force from port B side.
  - The piston pushes out the hydraulic oil inside the cylinder block from port C.

## 5.2.2 Automatic deceleration

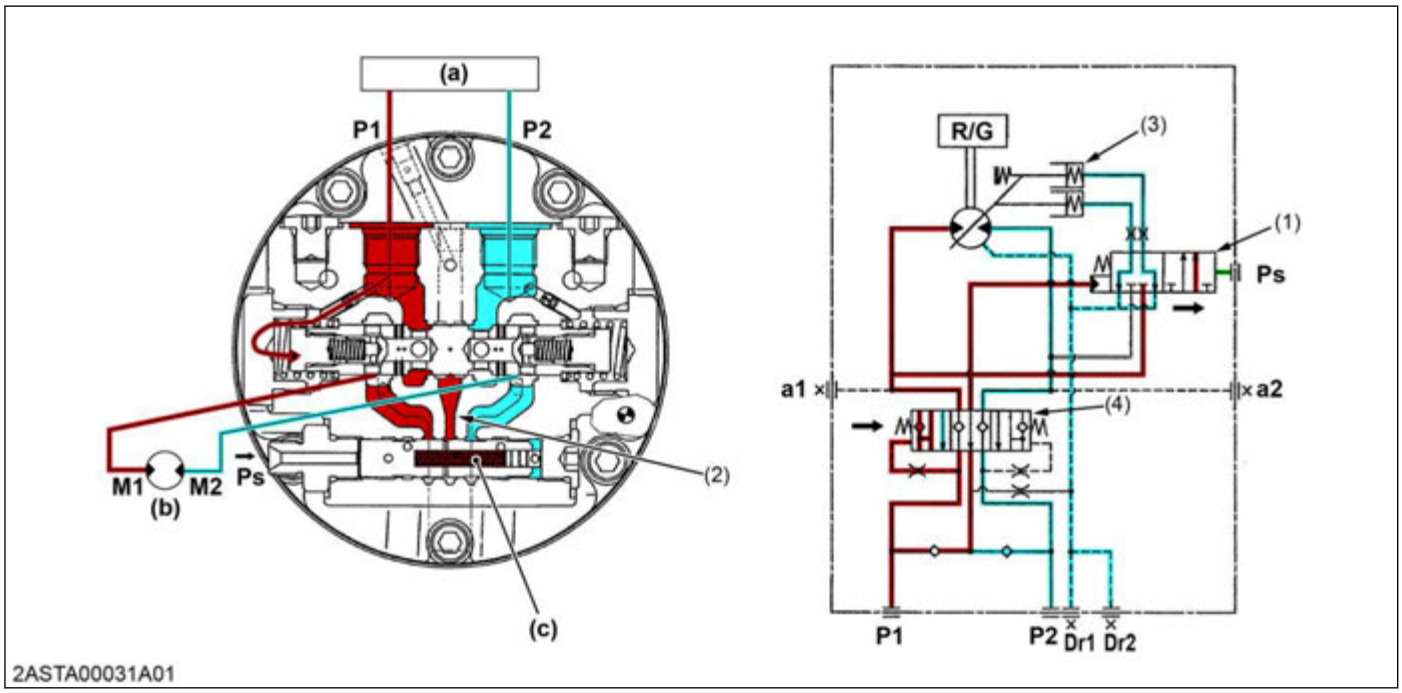
Decelerate the travel speed from high to low automatically under high loading.
**Traveling in high speed (low load)**




(1) Travel speed shift spool
(2) Motor loading pressure chamber
(3) Travel speed shift piston
(4) Counterbalance valve
(a) Control valve
(b) Motor
(c) Motor loading pressure
(d) To speed switching piston

- P4 pressurized oil pushes the travel speed shift spool to high speed side through the port PS.
- P1 pressurized oil pushes the travel speed shift piston to low speed side through the counterbalance valve.
- Port PS pressure is higher than P1 pressure with spring force and travel speed shift spool switches to high speed side.
- The travel speed shift piston presses the swash plate to increase the swash plate angle and the machine travels at high speed.

## Traveling under high load



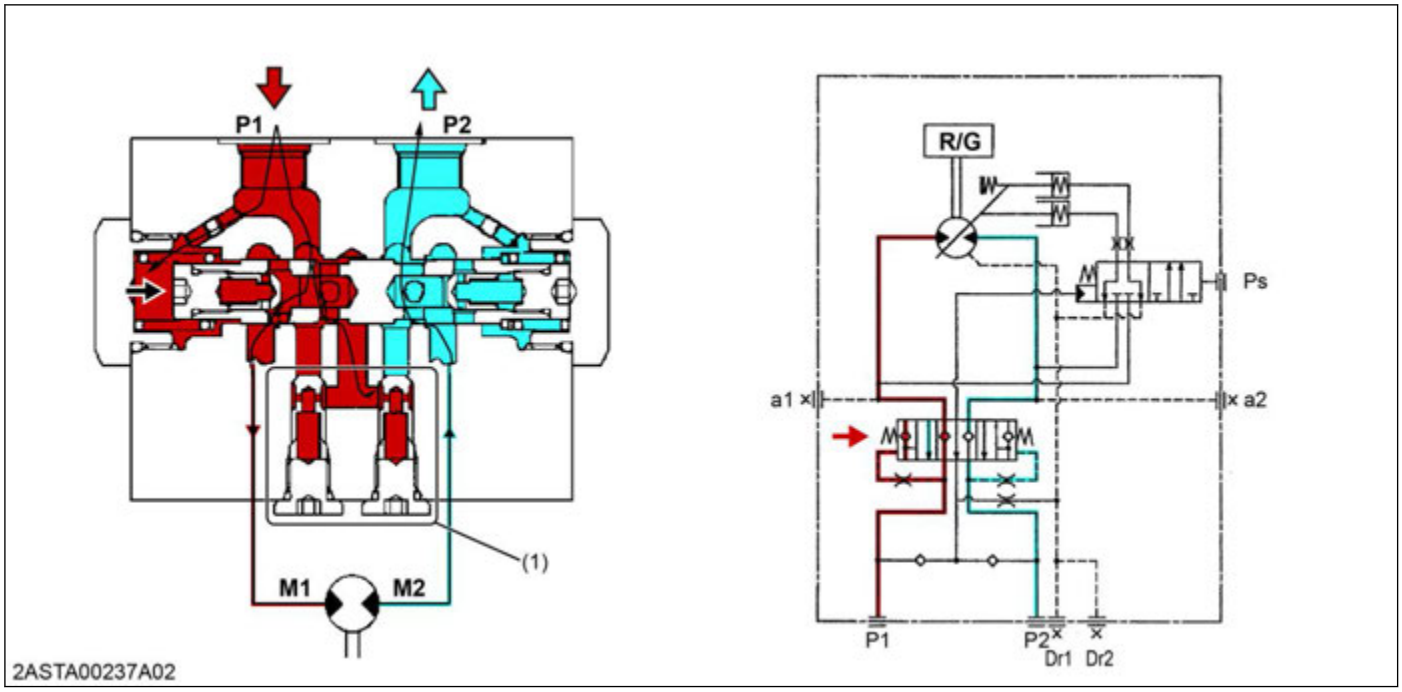

(1) Travel speed shift spool
(2) Motor loading pressure chamber
(3) Travel speed shift piston
(4) Counterbalance valve
(a) Control valve
(b) Motor
(c) Motor loading pressure

- In case of high loading while traveling (such as climbing a slope), the primary pressure (P1) will increase by external force.
- The primary pressure (P1) with spring force is higher than port PS pressure and travel speed shift spool switches to low speed side.
- Oil in the travel speed shift piston returns to the tank through drain port.
- The swash plate angle decreases and travel speed changes to low speed automatically.

## 5.2.3 Anti-cavitation function

Prevents cavitation in the case of decelerating the travel motor.

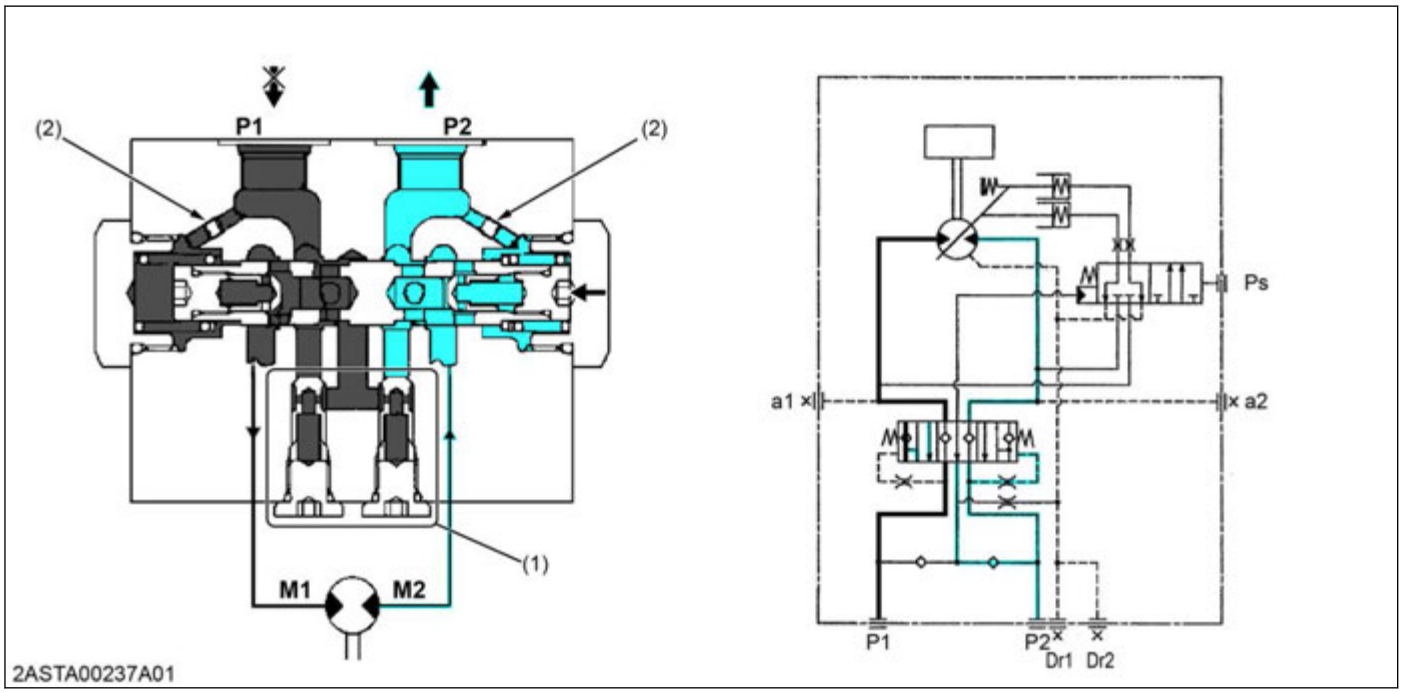
**Rotating the travel motor**




(1) Check valve

- P1 pressurized oil flows into the counterbalance valve through the check valve and closes the check valve for the return oil from the travel motor.
- The pressurized oil flows into the travel motor (M1) through the counterbalance valve to rotate the travel motor.
- P1 pressurized oil pushes the counterbalance valve to RH side through the orifice.
- The return oil flows to the tank from the travel motor (M2) through the counter balance valve.

## Decelerating the travel motor



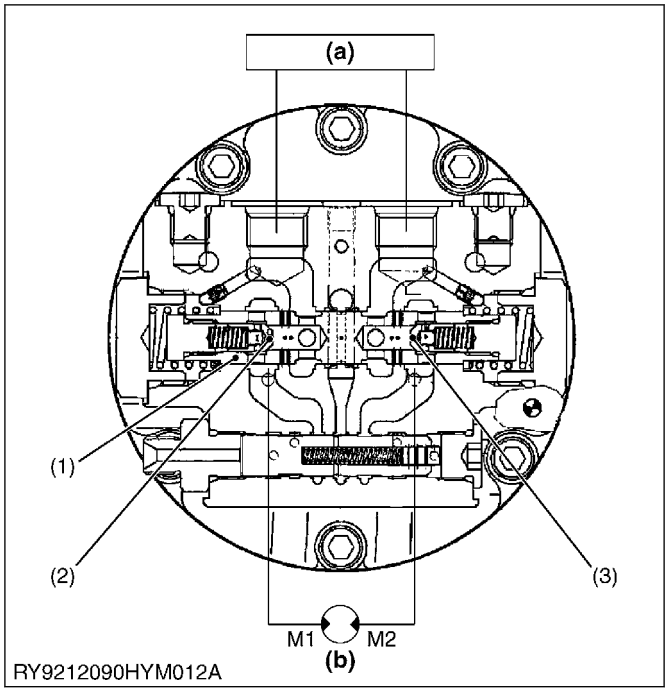

(1) Check valve (2) Orifice

- The travel motor suctions the oil from the primary oil line (M1) due to the inertial force, while decelerating.
- The return oil flows into the primary oil line (M1) through the check valve due to the negative pressure in the primary oil line (M1) and prevent cavitation in the primary oil line (M1).
- Due to the working of the orifices, the counterbalance valve shifts to the neutral position gradually.

## 5.2.4 Counterbalance valve

Three functions which are preventing internal oil leakage between M1 and M2 when stopping the travel motor, keeping travel motor rotation constantly under any load, and reducing shock from stopping.

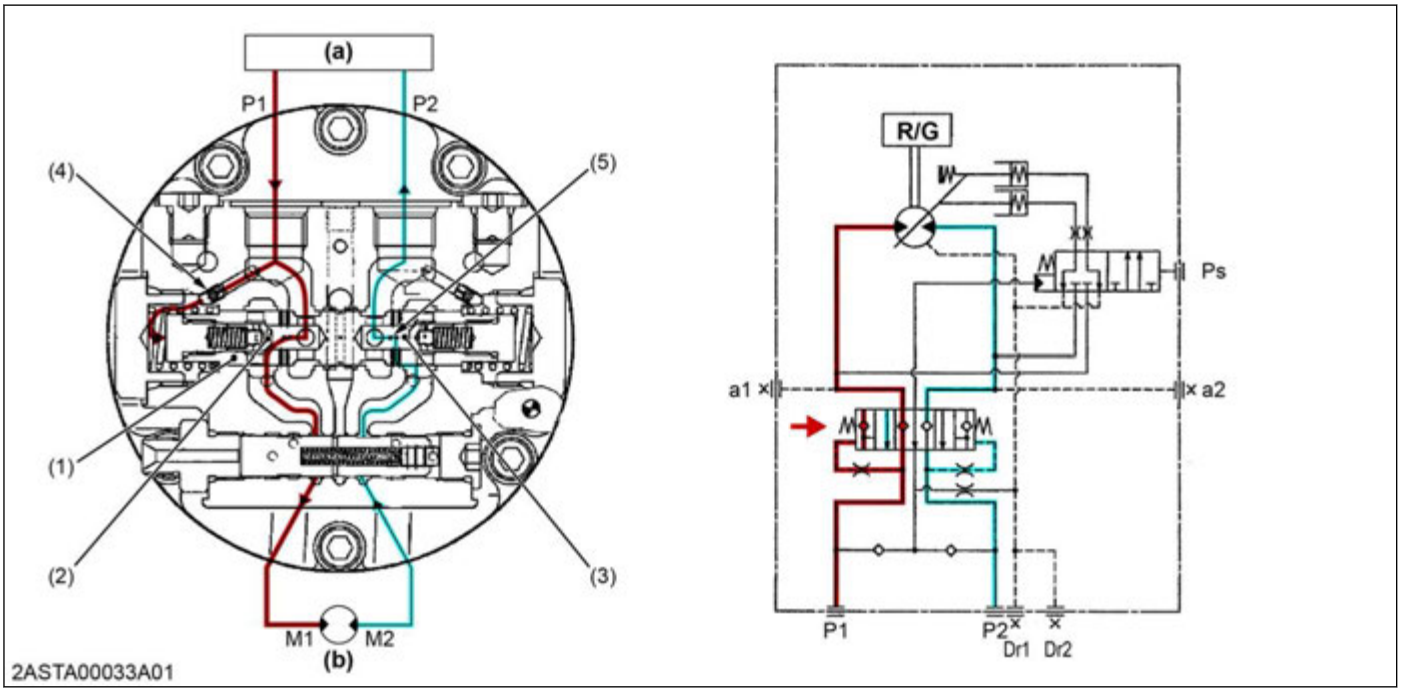
**Stopping**




(1) Plunger
(2) Check valve LH
(3) Check valve RH
(a) Control valve
(b) Motor

- When stopping the travel motor, the plunger, the check valve LH, and the check valve RH cuts off internal leakage between the port M1 and the port M2 of the travel motor to stop the motor rotation securely.

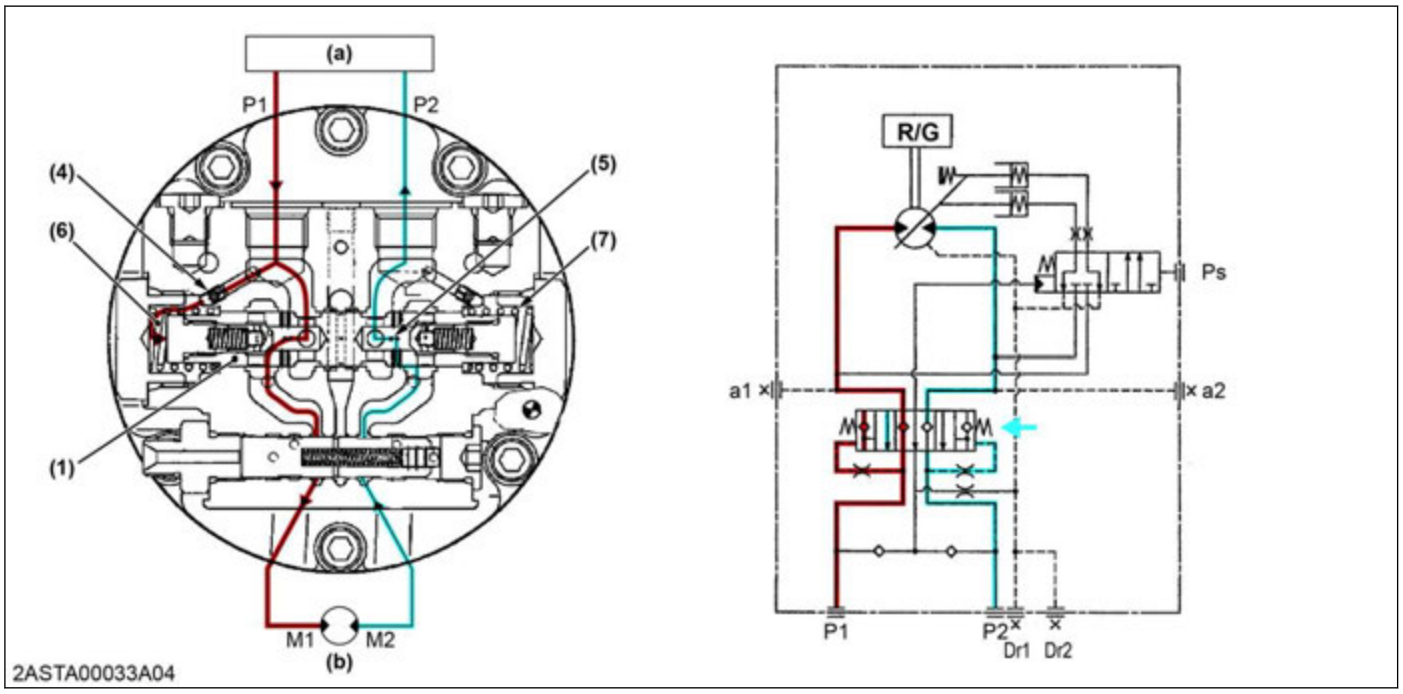
**Stopping → Rotating**




(1) Plunger
(2) Check valve LH
(3) Check valve RH
(4) Orifice LH
(5) Plunger notch
(a) Control valve
(b) Motor

- P1 pressurized oil flows to port M1 through the check valve LH.
- The orifice LH reduces the oil flow and delays the plunger to shift to RH direction.
- Secondary pressurized oil (M2) is cut off by check valve LH.
- The primary pressure (M1) increases and the plunger is pushed through the orifice LH to RH direction.
- The secondary pressurized oil (M2) flows to port P2 through the notch inside the plunger.
- The back pressure raises due to the restricted flow between port M2 and the plunger.
- The primary pressure (M1) increases more and presses the plunger to RH direction to the stroke end.
- The oil passage in the line M2 is completely opened and the oil returns to the tank freely.
- Back pressure in line M2 decreases.

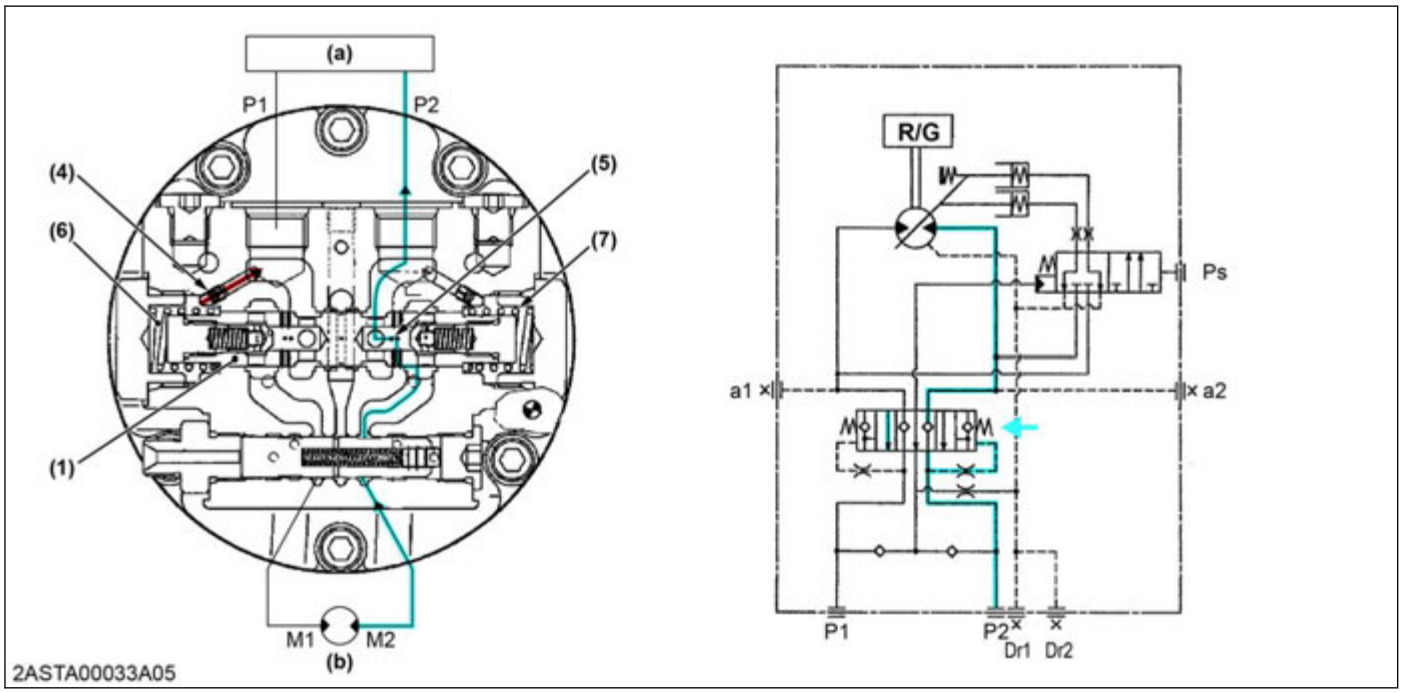
## Counterbalance function




(1) Plunger
(4) Orifice LH
(5) Plunger notch
(6) Pressure chamber LH
(7) Spring RH
(a) Control valve
(b) Motor

- Traveling speed will be increasing by gravity force on the down slope.
- The travel motor speed is increased due to the gravity force and the primary pressure (M1) decreases.
- The plunger is returned back slightly due to the decreased primary pressure (M1).
- The outer passage of the orifice closes, then all return oil from port M2 flows through the notch inside the plunger to restrict oil flow.
- Reduction of the oil returning to the tank line prevents increasing travel speed by external force.

**Rotating → Stopping**

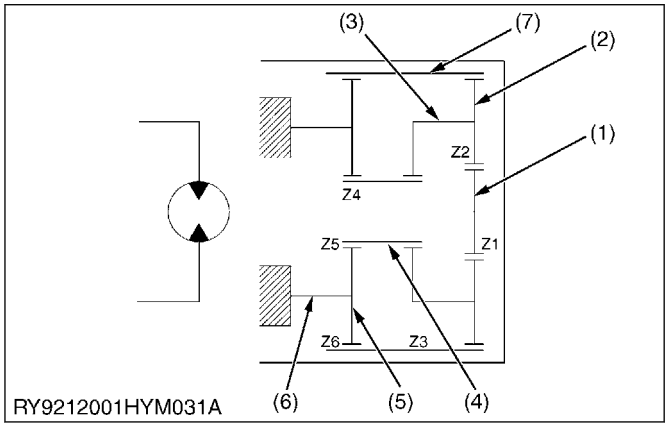



(1) Plunger
(4) Orifice LH
(5) Plunger notch
(6) Pressure chamber LH
(7) Spring RH
(a) Control valve
(b) Motor

- Primary pressure (M1) decreases and secondary pressure (M2) increases by inertial force.
- No pressurized oil flows from port P1 and the plunger starts returning to LH direction.
- Secondary pressurized oil (M2) flows to port P2 through the notch inside the plunger and prevents the line M1 pressure to drop down suddenly.
- The plunger presses out the oil in pressure chamber LH through the orifice LH.
- The plunger returns to neutral position gradually.
- The travel stopping shock is decreased by gradual response of counterbalance valve.

## 5.2.5 Travel motor decelerator

Decelerate the input rotation speed to increase the output torque.




(1) Drive gear
(2) First planetary gear
(3) First planetary carrier
(4) Second sun gear
(5) Second planetary gear
(6) Second planetary carrier
(7) Ring gear (housing)

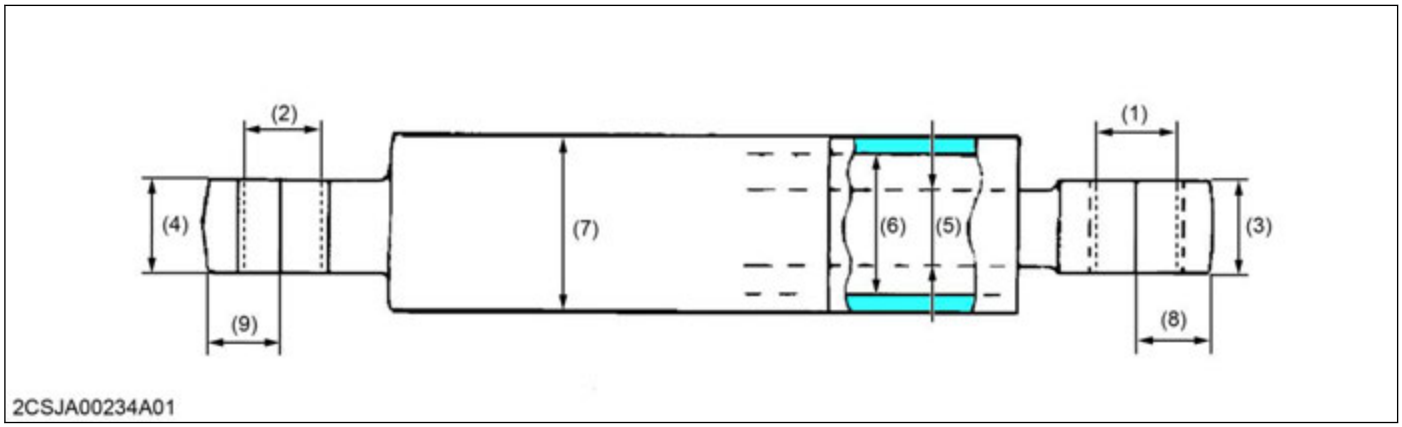
- The drive gear meshes with the first planetary gear.
- The second sun gear meshes with the second planetary gear.
- The second planetary gear is fixed with the frame.
- The first planetary gear and second planetary gear are meshed with the ring gear.
- Driving force from the motor is transmitted by the drive gear and decreases the rotating speed by each gear.
- The decelerated drive force is transmitted to the ring gear via the second planetary gear of the second planetary carrier which is fixed to the final stage of the decelerator.
- Input rotation is opposite the output rotation.

# 6. Hydraulic cylinder

## 6.1 Hydraulic cylinder specifications

**■ NOTE**

- **All hole dimensions show inner dimensions with installed bushings.**

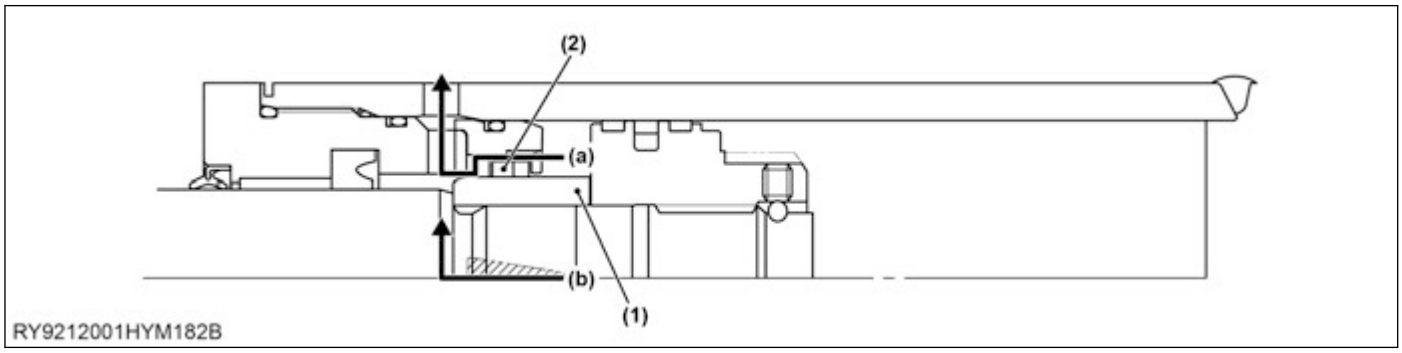



| Items | Dimensions | | | | |
|---|---|---|---|---|---|
| | Boom | Arm | Bucket | Swing | Blade |
| (1) | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ35 mm<br>ϕ1.38 in. | ϕ45 mm<br>ϕ1.77 in. |
| (2) | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ35 mm<br>ϕ1.38 in. | ϕ45 mm<br>ϕ1.77 in. |
| (3) | ϕ50 mm<br>ϕ1.97 in. | ϕ50 mm<br>ϕ1.97 in. | 50 mm<br>1.97 in. | ϕ45 mm<br>ϕ1.77 in. | ϕ55 mm<br>ϕ2.17 in. |
| (4) | 60 mm<br>2.36 in. | 50 mm<br>1.97 in. | 50 mm<br>1.97 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ55 mm<br>ϕ2.17 in. |
| (5) | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ40 mm<br>ϕ1.57 in. | ϕ35 mm<br>ϕ1.38 in. | ϕ45 mm<br>ϕ1.77 in. |
| (6) | ϕ70 mm<br>ϕ2.76 in. | ϕ70 mm<br>ϕ2.76 in. | ϕ65 mm<br>ϕ2.56 in. | ϕ70 mm<br>ϕ2.76 in. | ϕ90 mm<br>ϕ3.54 in. |
| (7) | ϕ85 mm<br>ϕ3.35 in. | ϕ85 mm<br>ϕ3.35 in. | ϕ80 mm<br>ϕ3.15 in. | ϕ85 mm<br>ϕ3.35 in. | ϕ105 mm<br>ϕ4.13 in. |
| (8) | 40 mm<br>1.57 in. | 40 mm<br>1.57 in. | 40 mm<br>1.57 in. | 37.5 mm<br>1.48 in. | 42.5 mm<br>1.67 in. |
| (9) | 40 mm<br>1.57 in. | 40 mm<br>1.57 in. | 40 mm<br>1.57 in. | 37.5 mm<br>1.48 in. | 42.5 mm<br>1.67 in. |
| Minimum length | 860 mm<br>33.86 in. | 800 mm<br>31.50 in. | 761 mm<br>29.96 in. | 686 mm<br>27.01 in. | 505 mm<br>19.88 in. |
| Stroke | 542 mm<br>21.34 in. | 482 mm<br>18.98 in. | 382 mm<br>15.04 in. | 432.5 mm<br>17.03 in. | 126 mm<br>4.96 in. |
| Manufacturer | Burnside Euro Ltd. | Burnside Euro Ltd. | Burnside Euro Ltd. | Burnside Euro Ltd. | Burnside Euro Ltd. |

# 6.2 Hydraulic cylinder function and structure

## 6.2.1 Hydraulic cylinder cushioning

Decelerate the cylinder speed at end of stroke to reduce operating shock.

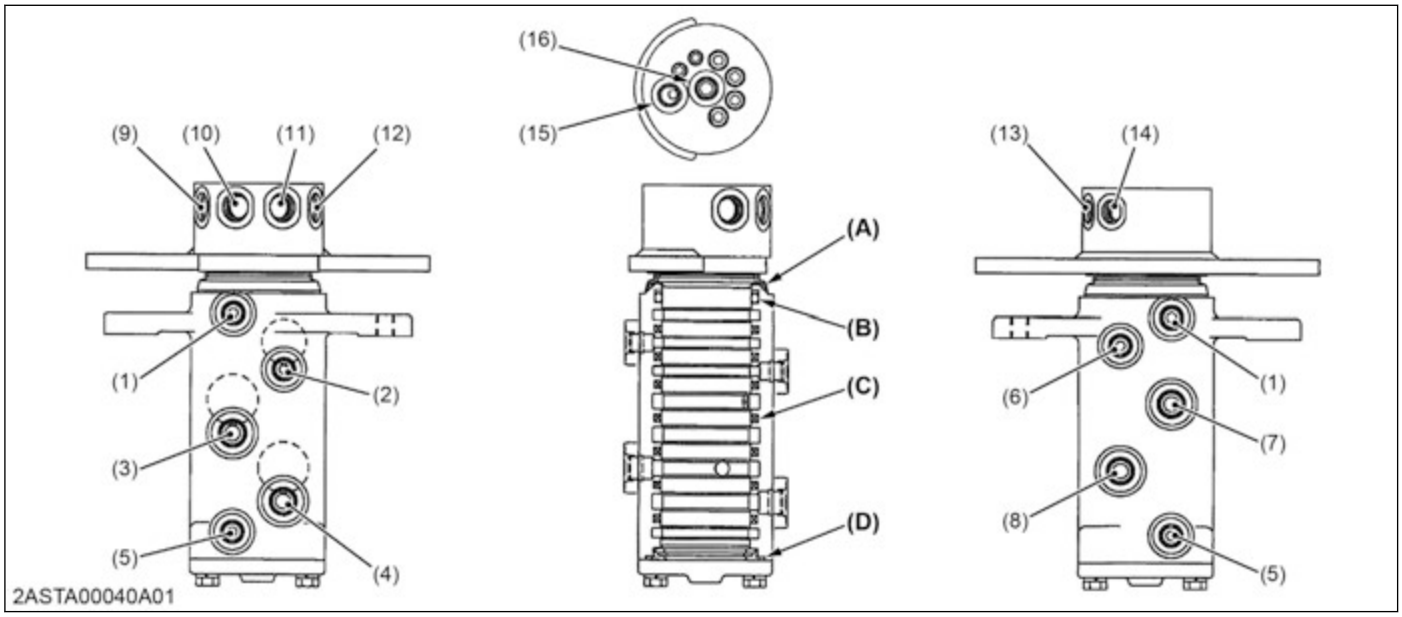



(1) Cushion bearing (2) Cushion seal (a) Oil flow through slit (b) Pressed oil flow by piston

- The cushion bearing enters into cushion seal at end of stroke.
- The hydraulic oil flows through the slit to decelerate the cylinder speed.

# 7. Swivel joint

## 7.1 Swivel joint specifications




(A) Oil seal (B) U seal (C) O-ring (D) Thrust ring

| Items | Specifications |
|---|---|
| Manufacturer | Nachi Fujikoshi |
| Rotational speed | 15 rpm |
| Rotational torque (no loading) | 50 N·m<br>5.1 kgf·m<br>36.9 lbf·ft |
| Hydraulic oil temperature range | -20 to 100 ℃<br>-4 to 212 ℉ |
| Pressure capacity | 35.0 MPa<br>357 kgf/cm$^2$<br>5076 psi |

## Port location table

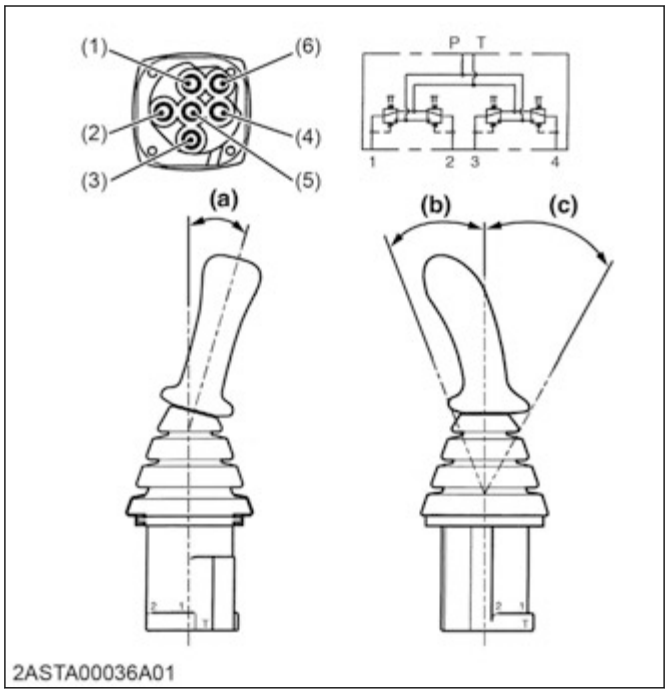
| Lower side | | | Upper side | | | |
|---|---|---|---|---|---|---|
| No. | Port (swivel joint) | Location | No. | Port (swivel joint) | Location | |
| | | | | | Basic | Hi-spec |
| (1) | A | Travel motor (PS)<br>Travel speed shift | (9) | f | Control valve (B6) | Control valve (B7) |
| (2) | C | Blade cylinder (rod) | (10) | d | Control valve (A6) | Control valve (A7) |
| (3) | E | Travel motor (P2)<br>RH, forwards | (11) | g | Control valve (B7) | Control valve (B8) |
| (4) | G | Travel motor (P1)<br>RH, backwards | (12) | e | Control valve (A7) | Control valve (A8) |
| (5) | H | Travel motor (T) | (13) | c | Control valve (A2) | Control valve (A3) |
| (6) | B | Blade cylinder (bottom) | (14) | b | Control valve (B2) | Control valve (B3) |
| (7) | D | Travel motor (P1)<br>LH, forwards | (15) | a | Unload valve (A) | Unload valve (A) |
| (8) | F | Travel motor (P2)<br>LH, backwards | (16) | h | Tank | Tank |

# 8. Pilot control valve

## 8.1 Pilot control valve specifications

### Basic

#### LH pilot control valve



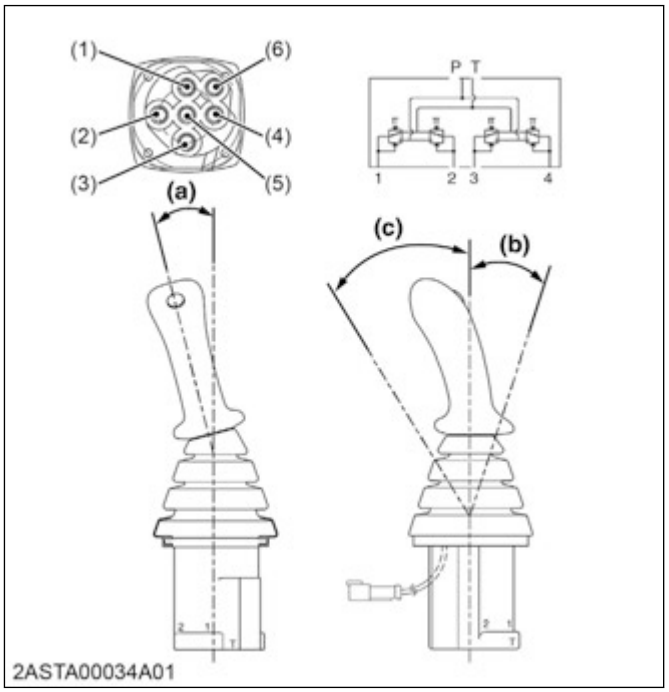

(a) Tilting angle of the lever: 15°
(b) Single operation angle: 20°
(c) Simultaneous operation angle: 28°

| Items | Specifications |
|---|---|
| Manufacturer | Rexroth |
| Model | 4TH5E187-11 / TT43M04S057 |

#### Port location table

| No. | Port | Location |
|---|---|---|
| (1) | 1 | Control valve (Pa5)<br>Arm crowd |
| (2) | 2 | Control valve (Pa3)<br>Swivel LH |
| (3) | 3 | Control valve (Pb5)<br>Arm dump |
| (4) | 4 | Control valve (Pb3)<br>Swivel RH |
| (5) | P | Control valve (PP2)<br>Pilot pressure |
| (6) | T | Tank |

#### RH pilot control valve




(a) Tilting angle of the lever: 19°
(b) Single operation angle: 20°
(c) Simultaneous operation angle: 28°

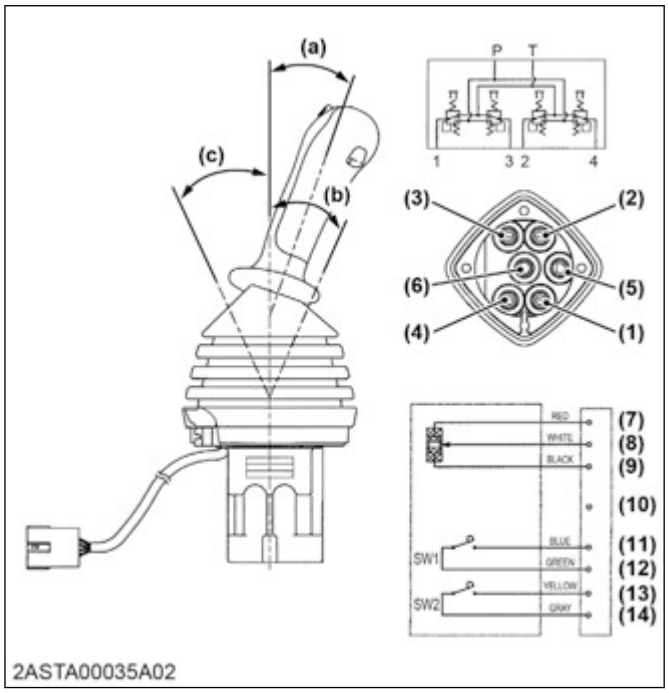
| Items | Specifications |
|---|---|
| Manufacturer | Rexroth |
| Model | 4TH5E187-11 /<br>ST235M04S158 |

#### Port location table

| No. | Port | Location |
|---|---|---|
| (1) | 1 | Control valve (Pa8)<br>Boom lift |
| (2) | 2 | Control valve (Pa9)<br>Bucket crowd |
| (3) | 3 | Control valve (Pb8)<br>Boom lower |
| (4) | 4 | Control valve (Pb9)<br>Bucket dump |
| (5) | P | Control valve (PP1)<br>Pilot pressure |
| (6) | T | Tank |

## Hi-spec

### LH pilot control valve



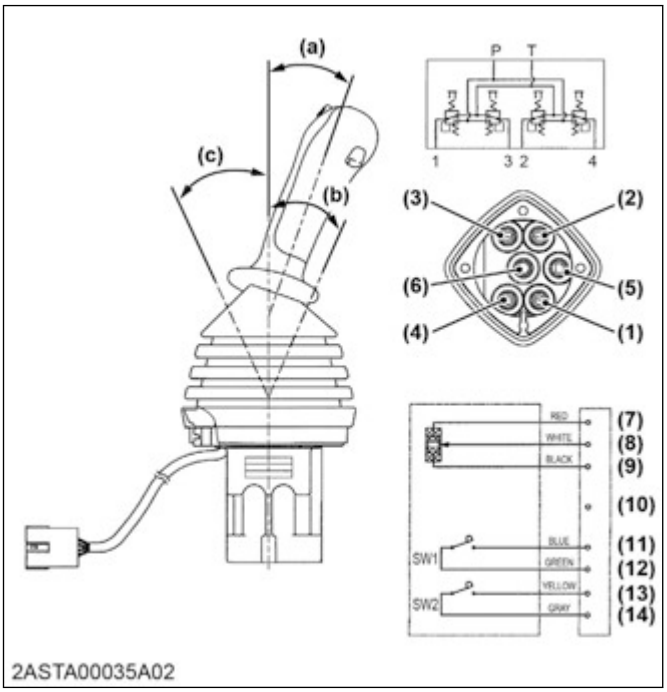

(7) 5 V power input
(8) Proportional output
(9) Ground
(10) - (blank)
(11) Switch 1
(12) Switch 1
(13) Switch 2
(14) Switch 2
(a) Tilting angle of the lever: 19°
(b) Single operation angle: 19°
(c) Simultaneous operation: 21.5°

| Items | Specifications |
|---|---|
| Manufacturer | KPM (Kawasaki Precision Machinery) |
| Model | PV48M2157C |

### Port location table

| No. | Port | Location |
|---|---|---|
| (1) | 1 | Control valve (Pb4) Swivel LH |
| (2) | 2 | Control valve (Pb6) Arm dump |
| (3) | 3 | Control valve (Pa4) Swivel RH |
| (4) | 4 | Control valve (Pa6) Arm crowd |
| (5) | P | Control valve (PP2) Pilot pressure |
| (6) | T | Tank |

### RH pilot control valve




(7) 5 V power input
(8) Proportional output
(9) Ground
(10) - (blank)
(11) Switch 1
(12) Switch 1
(13) Switch 2
(14) Switch 2
(a) Tilting angle of the lever: 19°
(b) Single operation angle: 19°
(c) Simultaneous operation: 21.5°

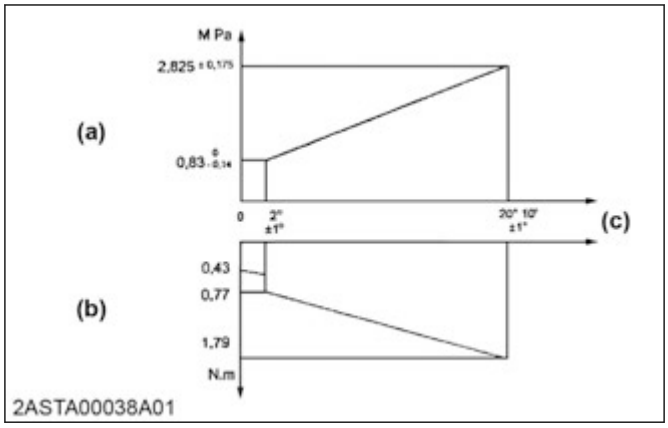
| Items | Specifications |
|---|---|
| Manufacturer | KPM (Kawasaki Precision Machinery) |
| Model | PV48M2158C |
| Input voltage | 5 V |

### Port location table

| No. | Port | Location |
|---|---|---|
| (1) | 1 | Control valve (Pa10) Bucket crowd |
| (2) | 2 | Control valve (Pb9) Boom lower |
| (3) | 3 | Control valve (Pb10) Bucket dump |
| (4) | 4 | Control valve (Pa9) Boom lift |
| (5) | P | Control valve (PP1) Pilot pressure |
| (6) | T | Tank |

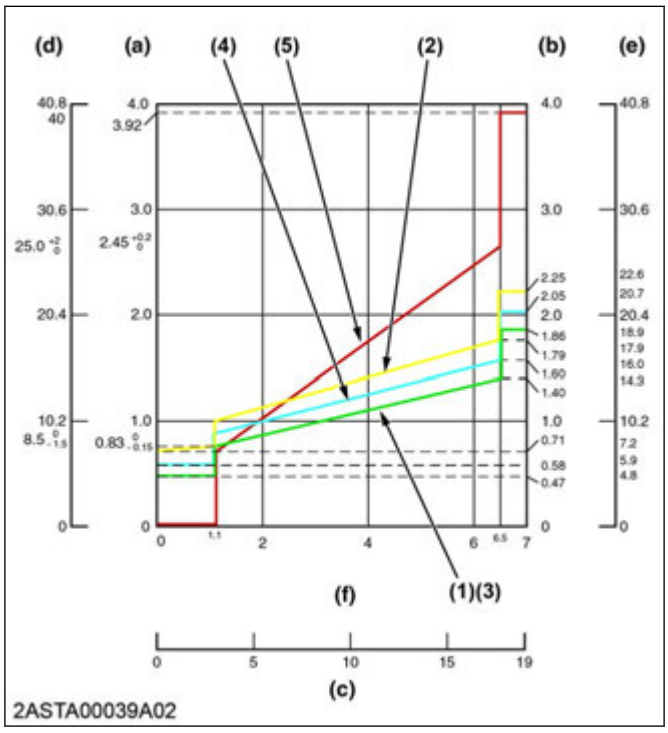
## 8.2 Pilot control valve performance diagram

**Basic**




(a) Secondary pressure (MPa)
(b) Operating torque (N·m)
(c) Operating angle (deg)

**Hi-spec**

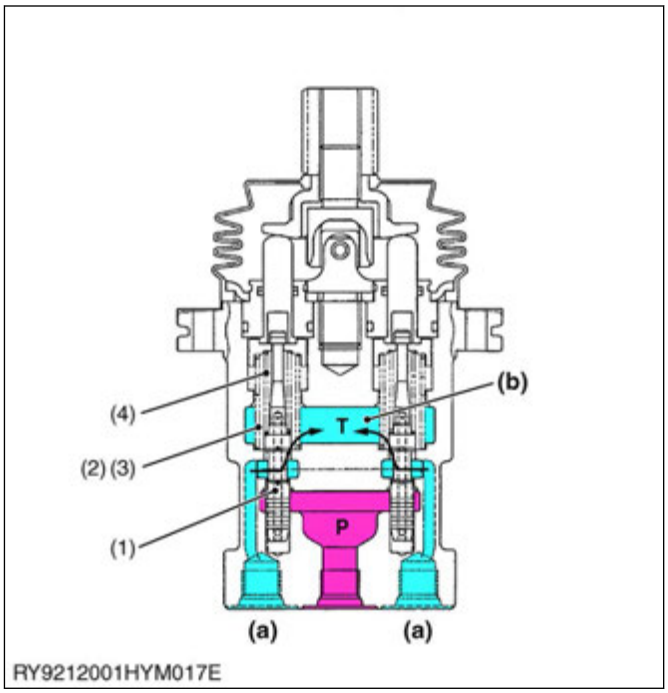



(1) Single operation torque (Port 1)
(2) Single operation torque (Port 2)
(3) Single operation torque (Port 3)
(4) Single operation torque (Port 4)
(5) Secondary pressure
(a) Secondary pressure (MPa)
(b) Operating torque (N·m)
(c) Operating angle (deg)
(d) Secondary pressure (kgf/cm$^2$)
(e) Operating torque (kgf·cm)
(f) Push rod stroke (mm)

## 8.3 Pilot control valve function and structure

Reduces pressure of P4 pressurized oil to control the direction and stroke of spool in the control valve.

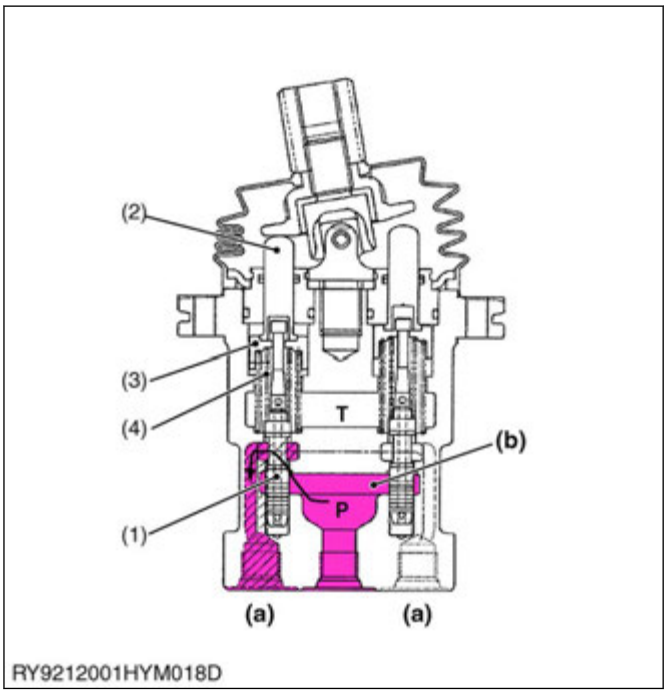
**Not operating**




(1) Spool
(2) Return spring
(3) Return spring
(4) Primary setting spring
(a) Output port
(b) Port T

- P4 pressurized oil is cut off by the spool.
- Output port is connected to the tank.

## Operating

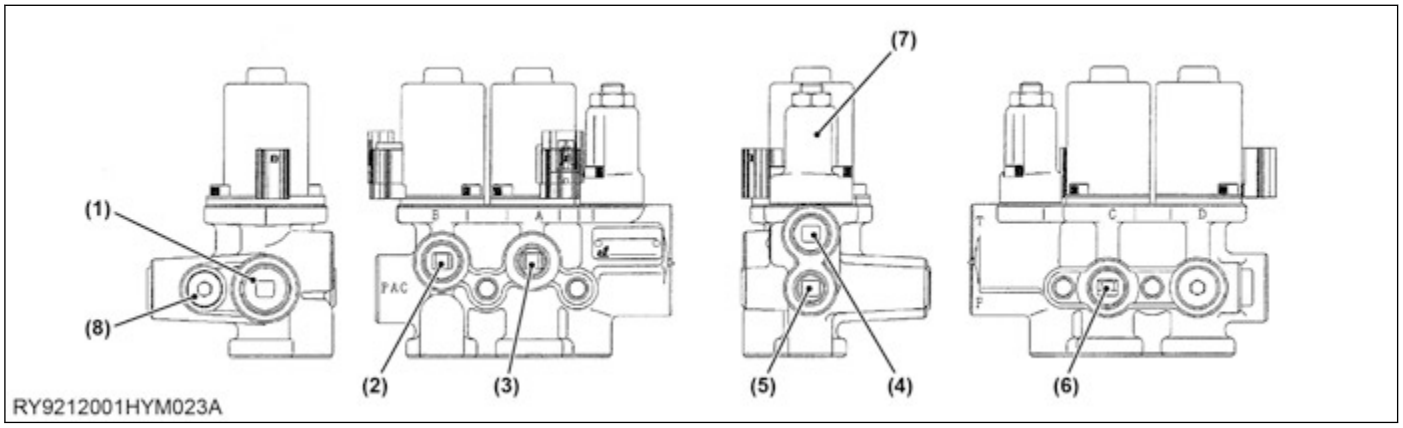



(1) Spool
(2) Push rod
(3) Spring seat
(4) Primary setting spring
(a) Output port
(b) Port P

- The push rod pushes the spring seat.
- The spring seat pushes the spool through the spring.
- The spool reduces the P4 pressure to the outlet port due to spool stroke.
- Reduced P4 pressurized oil flows to the control valve through the output port.

# 9. Unload valve

## 9.1 Unload valve specifications




(7) Pilot primary pressure relief valve
(8) Check valve

| Items | Specifications | Remarks |
|---|---|---|
| Manufacturer | Nishina Industrial | - |
| Rated Voltage | 12 V | - |
| Pilot primary pressure relief valve setting pressure | 4.3 to 4.6 MPa<br>43.8 to 46.9 kgf/cm$^2$<br>624 to 667 psi | At temp. 50 ℃, 6 L/min<br>At temp 144 ℉, 1.6 U.S.gals/min |
| Internal leakage volume port P → port T | less than 0.13 L/min<br>less than 0.034 U.S.gals/min | At 2.5 MPa<br>At 25.5 kgf/cm$^2$<br>At 363 psi |
| Internal leakage volume port PAC → other ports | 0.1 ml/min<br>0.026 U.S.gals/min | At 4.3 MPa<br>At 43.8 kgf/cm$^2$<br>At 624 psi |

### Port location table

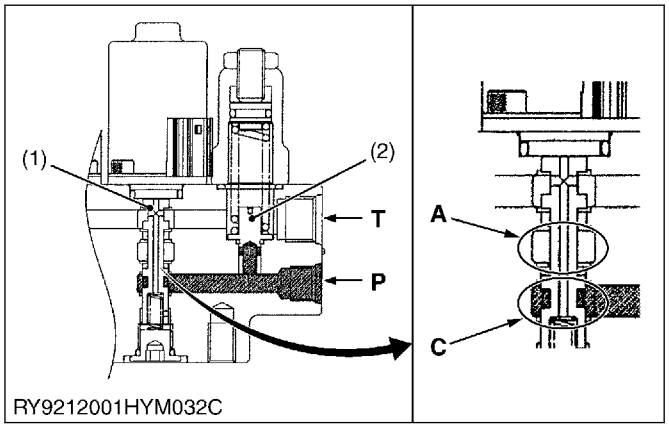
| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (1) | PAC | Accumulator | (4) | T | Tank |
| (2) | A | Travel motor (PS)<br>Travel speed shift | (5) | P | -<br>(plugged) |
| (3) | B | Control valve (Pp2) | (6) | C | Pilot filter |
| | | Pilot control valve (P) | | | Control valve (Pp3) |
| | | Swivel motor (PP)<br>Parking brake | (-) | D | -<br>(plugged) |

# 9.2 Unload valve function and structure

## 9.2.1 Unload valve working principles

Composed of two solenoid valves. One solenoid valve activates the pilot control valves, cuts tank return passage in the control valve to enable pressurized oil of P1, P2, and P3, and deactivates the swivel motor negative brake. The other shifts the travel speed.

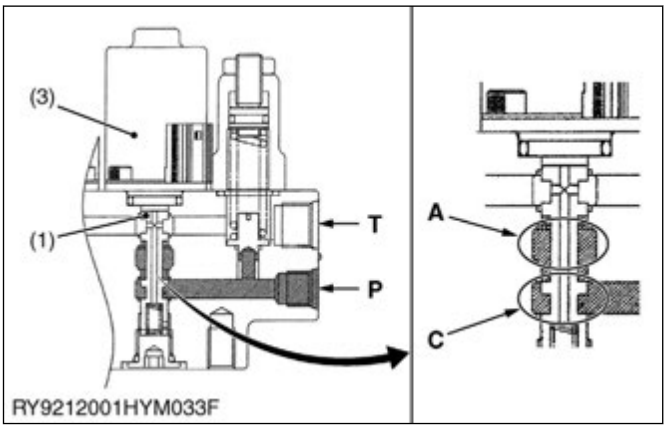
**Activating pilot control valves, deactivating swivel motor parking brake**




(1) Spool
(2) Plunger
A Port A
C Port C
P Port P
T Port T

- In case of the solenoid valve (pilot control valves, swivel motor parking brake) OFF,
  - P4 pressurized oil is cut off by the spool.
  - No oil flows to the pilot control valves and swivel motor parking brake.
  - Pilot control valves are deactivated and the swivel motor parking brake is activated.
- In case of the solenoid valve (pilot control valves, swivel motor parking brake) ON,
  - P4 pressurized oil flows to the pilot control valves through the opened spool and able to operate the machine.
  - P4 pressurized oil flows to the swivel motor through the opened spool to deactivate the parking brake.

**Shifting travel speed**

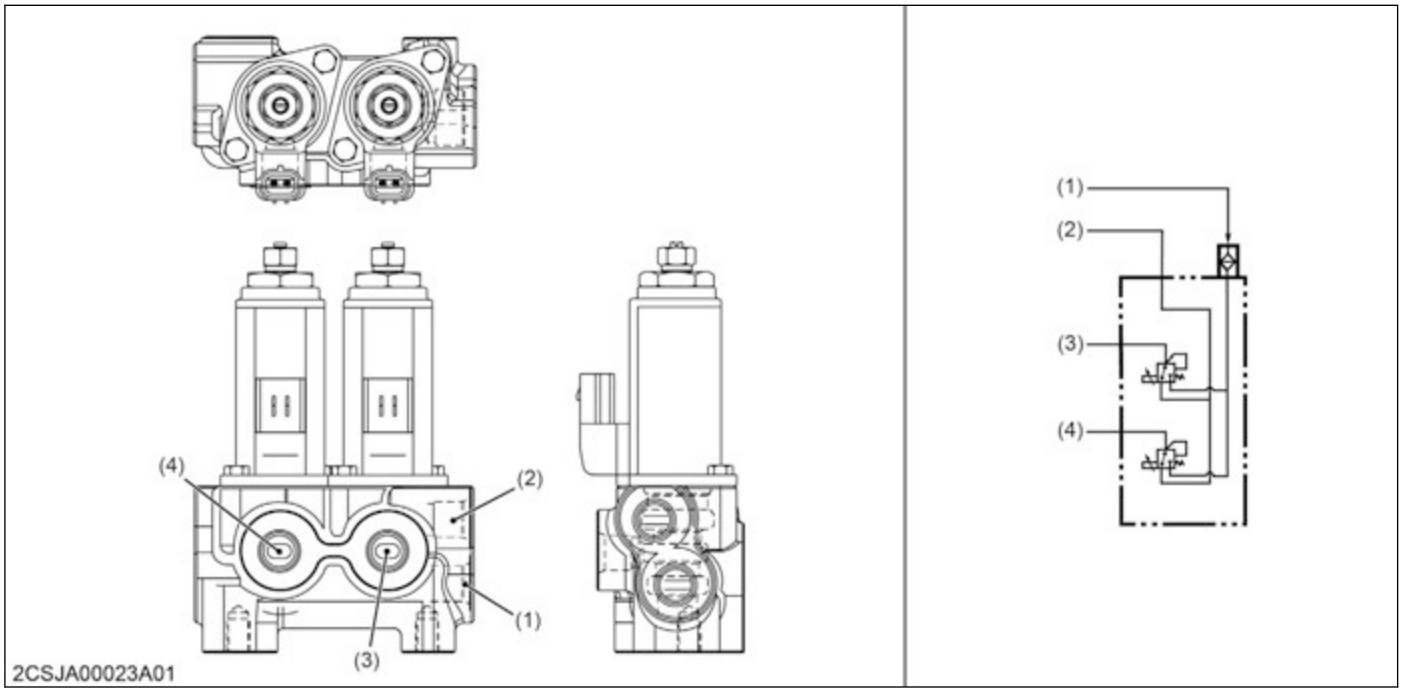



(1) Spool
(3) Solenoid
A Port A
C Port C
P Port P
T Port T

- In case of the solenoid valve (travel speed shift) OFF,
  - P4 pressurized oil is cut off by the spool.
  - No oil flows to the travel speed shift spool and travel is low speed.
- In case of the solenoid valve (travel speed shift) ON,
  - P4 pressurized oil flows to the travel speed shift spool through the opened spool and shifts travel to high speed.

# 10. Proportional valve

## 10.1 AUX1 proportional valve specifications

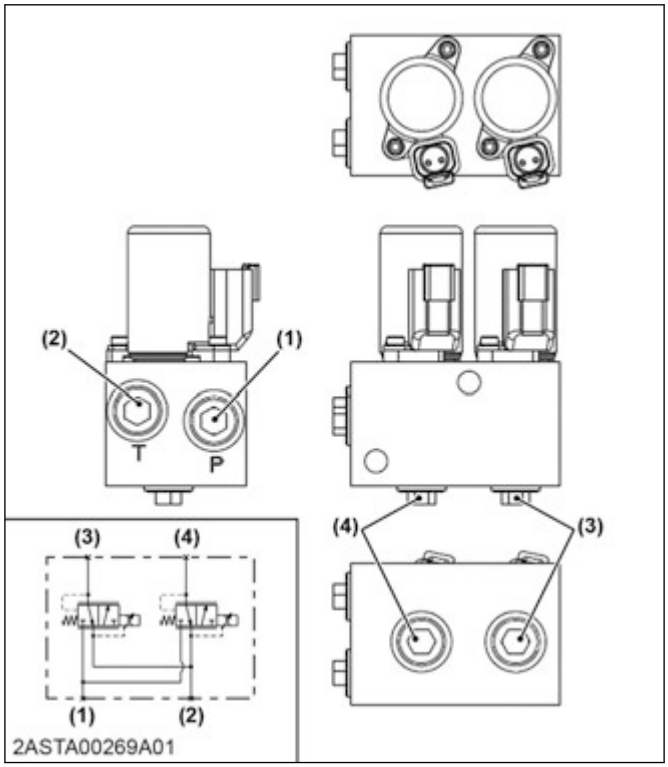



| Items | Specifications | Remarks |
|---|---|---|
| Manufacturer | KPM (Kawasaki Precision Machinery) | - |
| Rated pressure | 7 MPa<br>71.4 kgf/cm$^2$<br>1015 psi | Port P pressure |
| Allowable back pressure | 1.0 MPa<br>10.2 kgf/cm$^2$<br>145 psi | Port T pressure |
| Maximum flow rate | 10 L/min<br>2.6 U.S. gal/min | Per one valve |
| Drain flow rate | less than 0.4 L/min<br>less than 0.1 U.S. gal/min | At port P pressure 4.9 MPa<br>At port P pressure<br>49.9 kgf/cm$^2$<br>At port P pressure 710 psi |
| Temperature range | -20 to 90 ℃<br>-4 to 194 ℉ | - |
| Maximum contamination limits | NAS grade 10 and below | - |
| Rated current | 1600 mA | - |
| Coil resistance | 2.7 to 3.7 Ω | At 20 ℃<br>At 68 ℉ |
| Voltage | 12 V | - |
| Secondary pressure setting range | 0 to 2.7 MPa<br>0 to 27.5 kgf/cm$^2$<br>0 to 392 psi | - |

### Port location table

| No. | Port | Location | No. | Port | Location |
|---|---|---|---|---|---|
| (1) | P | Swivel motor (PP)<br>Pilot pressure | (3) | A1 | Control valve (Pb5)<br>AUX1 LH |
| (2) | T | Tank | (4) | A2 | Control valve (Pa5)<br>AUX1 RH |

## 10.2 AUX2 proportional valve specifications

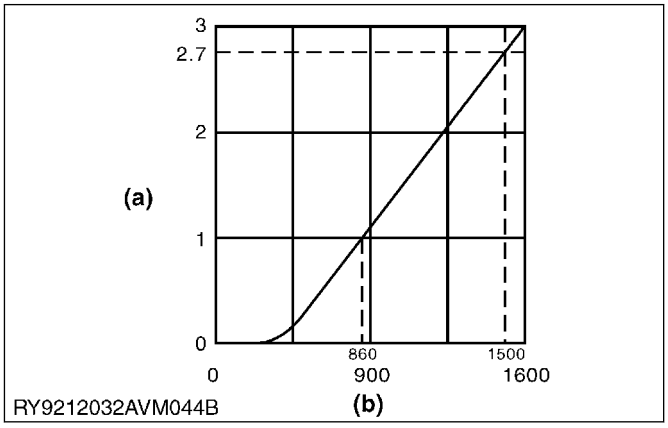



| Items | Specifications | Remarks |
|---|---|---|
| Manufacturer | HYDRAFORCE | - |
| Rated pressure | 3.0 MPa<br>30.6 kgf/cm$^2$<br>435 psi | Port P pressure |
| Rated flow rate | 2 L/min<br>0.5 U.S. gal/min | Per one valve |
| Drain flow rate | less than 0.125 L/min<br>less than 0.03 U.S. gal/min | At port P pressure 2.5 MPa<br>At port P pressure 25.8 kgf/cm$^2$<br>At port P pressure 365 psi |
| Temperature range | -40 to 100 ℃<br>-40 to 212 ℉ | - |
| Rated power | 8.6 W | Per one valve |
| Rated voltage | 12 V | - |

**Port location table**

| No. | Port | Location |
|---|---|---|
| (1) | P | Unload valve (P)<br>Pilot pressure |
| (2) | T | Unload valve (T) |
| (3) | Pa1 | Control valve (Pa1)<br>AUX2 RH |
| (4) | Pb1 | Control valve (Pb1)<br>AUX2 LH |

## 10.3 AUX1 proportional valve performance diagram



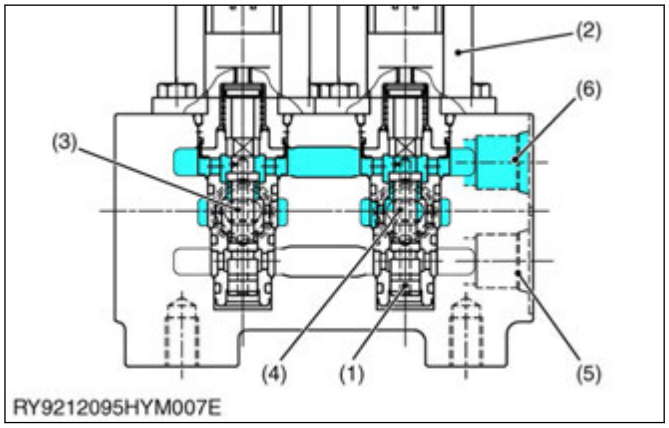

(a) Secondary pressure (MPa) (b) Input current (mA)

# 10.4 Proportional valve function and structure

## 10.4.1 Proportional valve working principles

Variably adjust P4 oil pressure according to input current to flow the adjusted pilot pressurized oil into the pilot port of the control valve.

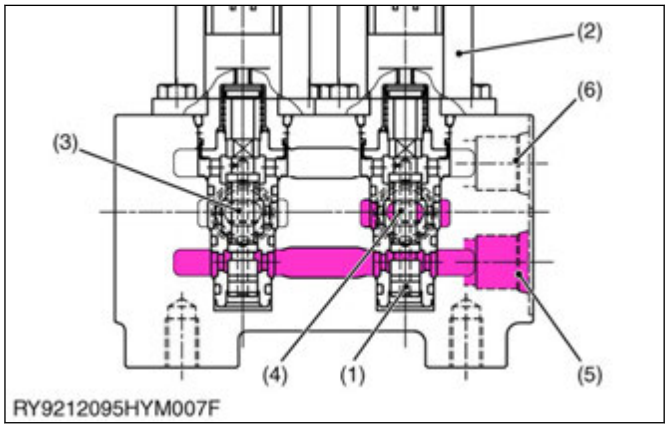
**Solenoid OFF**




(1) Spool
(2) Solenoid
(3) Port A
(4) Port B
(5) Port P
(6) Port T

- P4 pressurized oil is cut off by the spool.
- No hydraulic oil flows to AUX1 section of the control valve.

**Solenoid ON**

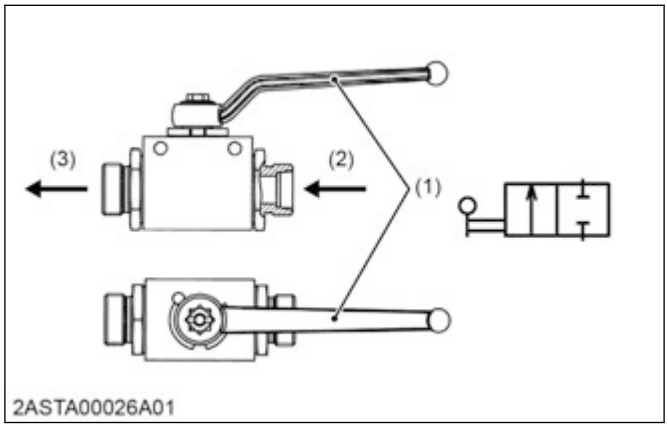



(1) Spool
(2) Solenoid
(3) Port A
(4) Port B
(5) Port P
(6) Port T

- The spool is pushed down to connect port P to port B.
- P4 pressurized oil flows to AUX1 section of the control valve through the opened spool.
- The spool opening area is able to control variably according to AUX operation.

# 11. Third line valve

## 11.1 Third line valve specifications




(1) Switching lever

| Items | Specifications | Remarks |
|---|---|---|
| Manufacturer | HYDAC | - |
| Maximum pressure | 50 MPa<br>510.0 kgf/cm$^2$<br>7252 psi | - |
| Hydraulic oil temperature range | -10 to 80 ℃<br>-14 to 176 ℉ | - |

| No. | Port | Location |
|---|---|---|
| (2) | - | Control valve (A4) |
| (3) | - | Hydraulic oil tank<br>Oil cooler |

# SERVICING

## 1. Troubleshooting

### 1.1 Hydraulic troubleshooting for front attachment

**All of the front attachments does not operate or operate slowly**

| Causes | Inspections | Actions |
|---|---|---|
| The engine is malfunctioning. | Measure the engine speed. | Adjust each part of the engine. |
| The hydraulic oil level is low.<br>The hydraulic oil quality is low. | Check for the hydraulic oil level and oil quality. | Replenish or replace the hydraulic oil. |
| The suction line or suction filter is clogged. | Check if the suction line or suction filter is clogged. | Clean the suction line.<br>Replace the suction filter. |
| The pilot filter is clogged. | Check if the pilot filter is clogged. | Replace the pilot filter. |
| The pilot primary pressure relief valve setting pressure is too low. | Measure the pilot primary pressure. | Adjust or replace the pilot primary pressure relief valve. |
| The pilot primary pressure relief valve spring is weaken or damaged. | Measure the pilot primary pressure. | Adjust or replace the pilot primary pressure relief valve. |
| The pilot primary pressure relief valve is clogged by contamination. | Measure the pilot primary pressure. | Clean or replace the pilot primary pressure relief valve. |
| The pilot pump is damaged. | Check for damage of the pilot pump. | Replace the pilot pump. |
| The main relief valve setting pressure is too low. | Measure the main relief valve pressure. | Adjust or replace the main relief valve. |
| The main relief valve spring is weaken or damaged. | Measure the main relief valve pressure. | Adjust or replace the main relief valve. |
| The main relief valve is clogged by contamination. | Measure the main relief valve pressure. | Clean or replace the main relief valve. |
| The hydraulic pump coupling is damaged. | Check for damage of the hydraulic pump coupling. | Replace the hydraulic pump coupling. |
| The drive shaft of the hydraulic pump is damaged. | Check for damage of the hydraulic pump drive shaft. | Replace the hydraulic pump drive shaft. |
| The internal parts of the hydraulic pump are damaged or worn. | Measure the hydraulic pump P-Q performance.<br>Check for damage of the internal parts of the hydraulic pump. | Repair or replace the internal parts of the hydraulic pump. |

**The pilot control valve RH or LH does not operate or operates slowly**

| Causes | Inspections | Actions |
|---|---|---|
| The pilot line filter is clogged. | Check if the pilot line filter is clogged. | Clean the pilot line filter. |
| The pilot control valve spring is weaken or damaged. | Measure the pilot secondary pressure. | Replace the pilot control valve. |
| The pilot control valve is clogged by contamination. | Measure the pilot secondary pressure. | Clean or replace the pilot control valve. |

**Power of the entire hydraulic system is weak**

| Causes | Inspections | Actions |
|---|---|---|
| The pilot primary pressure relief valve setting pressure is too low. | Measure the pilot primary pressure. | Replace the pilot primary pressure relief valve. |
| The pilot primary pressure relief valve spring is weaken or damaged. | Measure the pilot primary pressure. | Adjust or replace the pilot primary pressure relief valve. |
| The pilot primary pressure relief valve is clogged by contamination. | Measure the pilot primary pressure. | Clean or replace the pilot primary pressure relief valve. |
| The main relief valve setting pressure is too low. | Measure the main relief valve pressure. | Adjust or replace the main relief valve. |
| The main relief valve spring is weaken or damaged. | Measure the main relief valve pressure. | Adjust or replace the main relief valve. |
| The main relief valve is clogged by contamination. | Measure the main relief valve pressure. | Clean or replace the main relief valve. |

**One of the cylinders does not operate or operates slowly**

| Causes | Inspections | Actions |
|---|---|---|
| The pilot control valve spring is weaken or damaged. | Measure the pilot secondary pressure. | Replace the pilot primary pressure relief valve. |
| The pilot control valve is clogged by contamination. | Measure the pilot secondary pressure. | Clean or replace the pilot control valve. |
| The overload relief valve setting pressure is too low. | Measure the overload relief valve pressure. | Adjust the overload relief valve. |
| The overload relief valve spring is weaken or damaged. | Measure the overload relief valve pressure. | Replace the control valve travel section. |
| The overload relief valve is clogged by contamination. | Measure the overload relief valve pressure. | Clean or replace the control valve travel section. |
| The spool of the control valve is damaged or stuck. | Check for damage or sticking of the control valve. | Disassemble and clean or replace the control valve section. |

**Large amount of the cylinder leakage**

| Cause | Inspections | Actions |
|---|---|---|
| The overload relief valve setting pressure is too low. | Measure the overload relief valve pressure. | Adjust the overload relief valve. |
| The overload relief valve spring is weaken or damaged. | Measure the overload relief valve pressure. | Replace the control valve travel section. |
| The overload relief valve is clogged by contamination. | Measure the overload relief valve pressure. | Clean or replace the control valve travel section. |
| The spool of the control valve is damaged or stuck. | Check for damage or sticking of the control valve. | Disassemble and clean or replace the control valve section. |
| The internal leakage of the cylinder is too much. | Measure the cylinder internal leakage.<br>Check for damage of the seal. | Repair or replace the cylinder. |

## 1.2 Hydraulic troubleshooting for swivel

**The swivel does not operate or operates slowly**

| Causes | Inspections | Actions |
|---|---|---|
| The pilot control valve spring is weaken or damaged. | Measure the pilot secondary pressure. | Replace the pilot primary pressure relief valve. |
| The pilot control valve is clogged by contamination. | Measure the pilot secondary pressure. | Clean or replace the pilot primary pressure relief valve. |
| The spool of the control valve swivel section is damaged or stuck. | Check for damage or sticking of the control valve swivel section. | Disassemble and clean or replace the control valve swivel section. |
| The overload relief valve setting pressure is too low. | Measure the overload relief valve pressure. | Adjust the overload relief valve. |
| The overload relief valve spring is weaken or damaged. | Measure the overload relief valve pressure. | Replace the overload relief valve. |
| The overload relief valve is clogged by contamination. | Measure the overload relief valve pressure. | Clean or replace the overload relief valve. |
| The internal leakage or drain of the swivel motor is too much. | Measure the swivel motor internal leakage. Measure the swivel motor drain. | Repair or replace the swivel motor. |
| The friction plate for swivel motor parking brake does not disengage correctly. | Check for wear or sticking of the friction plate. | Repair or replace the friction plate. |

**The swivel is overrunning**

| Causes | Inspections | Actions |
|---|---|---|
| The pilot control valve spring is weaken or damaged. | Measure the pilot secondary pressure. | Replace the pilot primary pressure relief valve. |

(Continued)

| Causes | Inspections | Actions |
|---|---|---|
| The pilot control valve is clogged by contamination. | Measure the pilot secondary pressure. | Clean or replace the pilot primary pressure relief valve. |
| The spool of the control valve swivel section is damaged or stuck. | Check for damage or sticking of the control valve swivel section. | Repair or replace the control valve swivel section. |
| The overload relief valve setting pressure is too low. | Measure the overload relief valve pressure. | Adjust the overload relief valve. |
| The overload relief valve spring is weaken or damaged. | Measure the overload relief valve pressure. | Replace the overload relief valve. |
| The overload relief valve is clogged by contamination. | Measure the overload relief valve pressure. | Clean or replace the overload relief valve. |
| The make-up poppet of the swivel motor is damaged or stuck. | Check for damage or sticking of the make-up poppet. | Clean or replace the make-up poppet. |
| The internal leakage or drain of the swivel motor is too much. | Measure the swivel motor internal leakage.<br>Measure the swivel motor drain. | Repair or replace the swivel motor. |

## 1.3 Hydraulic troubleshooting for traveling

**Does not travel, travel slowly, or not running straight**

| Cause | Inspections | Actions |
|---|---|---|
| The track tension is too loosen or tighten.<br>Dirt is clogged to the base carrier. | Check the track tension.<br>Check for dirt clogging. | Adjust the track tension.<br>Clean the base carrier. |
| The travel control lever or mechanical link is malfunctioning. | Check the travel control lever and mechanical link. | Adjust or replace the travel control lever and mechanical link. |
| The spool of the control valve travel section is damaged or stuck. | Check for damage or sticking of the control valve travel section. | Disassemble and clean, or replace the control valve travel section. |
| The spool of the counterbalance valve is damaged or stuck. | Check for damage or sticking of the counterbalance valve. | Disassemble and clean, or replace the counterbalance valve. |
| The internal leakage or drain of the travel motor is too much. | Measure the travel motor internal leakage.<br>Measure the travel motor drain. | Disassemble or replace the travel motor. |
| The internal leakage of the swivel joint. | Disconnect the travel outlet hose of the swivel joint and install a plug, and then measure the relief pressure. | Replace the seal of the swivel joint. |

# 2. Service specifications

## 2.1 Service specifications for hydraulic system

**■ NOTE**

- **Standard measurement condition,**
  - **– Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)**
  - **– Engine speed: Maximum speed**
  - **– Hydraulic cylinder speed not including cushioning.**

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Pressure | Main relief valve | P1 (aP1) | MPa<br>kgf/cm$^2$<br>psi | 23.0<br>234.5<br>3336 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |
| | | P2 (aP2) | MPa<br>kgf/cm$^2$<br>psi | 23.0<br>234.5<br>3336 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |
| | | P3 (aP3) | MPa<br>kgf/cm$^2$<br>psi | 17.9<br>182.5<br>2596 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |
| | Pilot primary pressure relief valve | Pilot primary (aPP) | MPa<br>kgf/cm$^2$<br>psi | 4.5<br>45.9<br>652.3 | -0.3 to 0.2<br>-3 to 2<br>-44 to 29 | - |
| | Overload relief valve | Boom bottom (b1B) | MPa<br>kgf/cm$^2$<br>psi | 26.7<br>272.3<br>3873 | ±1.0<br>±10.0<br>±144 | - |
| | | Boom rod (b1R) | MPa<br>kgf/cm$^2$<br>psi | 26.3<br>268.2<br>3815 | ±1.0<br>±10.0<br>±144 | - |
| | | Arm bottom (b2B) | MPa<br>kgf/cm$^2$<br>psi | 26.5<br>270.2<br>3844 | ±1.0<br>±10.0<br>±144 | - |
| | | Arm rod (b2R) | MPa<br>kgf/cm$^2$<br>psi | 26.4<br>269.2<br>3829 | ±1.0<br>±10.0<br>±144 | - |
| | | Bucket bottom (b3B) | MPa<br>kgf/cm$^2$<br>psi | 26.6<br>271.2<br>3858 | ±1.0<br>±10.0<br>±144 | - |
| | | Blade bottom (b4B) | MPa<br>kgf/cm$^2$<br>psi | 26.4<br>269.2<br>3829 | ±1.0<br>±10.0<br>±144 | - |
| | | Swivel RH (cSR) | MPa<br>kgf/cm$^2$<br>psi | 18.0<br>183.5<br>2611 | ±1.0<br>±10.0<br>±144 | - |
| | | Swivel LH (cSL) | MPa<br>kgf/cm$^2$<br>psi | 18.0<br>183.5<br>2611 | ±1.0<br>±10.0<br>±144 | - |
| Flow rate | Piston pump (P1 + P2)<br>(Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 61.1<br>16.1 | - | 48.9<br>12.9 |

(Continued)

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Flow rate | AUX1 (Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 48.7<br>12.9 | - | - |
| | AUX2 (Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 19.4<br>5.12 | - | - |
| Internal leakage | Hydraulic cylinder | Boom (10 min, engine stop) | mm<br>in. | less than 20<br>less than 0.79 | - | 100<br>3.94 |
| | | Arm (10 min, engine stop) | mm<br>in. | less than 11<br>less than 0.43 | - | 55<br>2.17 |
| | | Bucket (10 min, engine stop) | mm<br>in. | less than 10<br>less than 0.39 | - | 50<br>1.96 |
| | | Blade (10 min, engine stop) | mm<br>in. | less than 25<br>less than 0.98 | - | 75<br>2.95 |
| | Swivel motor | Stopped the engine Activating negative brake | mm<br>in.<br>degree | 0<br>0<br>0 | - | 26<br>1.02<br>5 |
| | | Running the engine in idle speed Releasing negative brake | mm<br>in.<br>degree | 10.0<br>0.39<br>1.9 | - | 157<br>6.18<br>30 |
| | Travel motor | (20 degrees slope) | mm<br>in. | less than 300<br>less than 11.8 | - | - |
| Drain | Swivel motor | RH and LH (Rotating) | L/min<br>U.S.gals/min | 0<br>0 | - | 1.0<br>0.26 |
| | | RH and LH (Relief) | L/min<br>U.S.gals/min | 0.87<br>0.23 | - | 6.0<br>1.6 |
| | Travel motor | Low speed (Rotating) | L/min<br>U.S.gals/min | 0.03<br>0.008 | - | 0.4<br>0.11 |
| | | High speed (Rotating) | L/min<br>U.S.gals/min | 0.14<br>0.037 | - | - |
| | | Low speed (Relief) | L/min<br>U.S.gals/min | 0.59<br>0.16 | - | - |
| | | High speed (Relief) | L/min<br>U.S.gals/min | 0.63<br>0.17 | - | - |
| Speed | Boom cylinder | Lifting (ground to highest) | s | 2.7 | ±0.3 | - |
| | | Lowering (highest to ground) | s | 2.6 | ±0.3 | - |
| | Arm cylinder | Crowding | s | 2.4 | ±0.3 | - |
| | | Dumping | s | 2.6 | ±0.3 | - |
| | Bucket cylinder | Crowding | s | 2.6 | ±0.3 | - |
| | | Dumping | s | 1.7 | ±0.3 | - |

(Continued)

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Speed | Blade cylinder | Lifting (lowest to highest) | s | 2.1 | ±0.3 | - |
| | | Lowering (highest to lowest) | s | 2.8 | ±0.3 | - |
| | Swing cylinder | Swing RH | s | 5.6 | ±0.3 | - |
| | | Swing LH | s | 6.4 | ±0.3 | - |
| | Swivel motor | RH | rpm<br>s/3rotation | 9.8<br>18.4 | ±0.9<br>±1.7 | - |
| | | LH | rpm<br>s/3rotation | 9.8<br>18.4 | ±0.9<br>±1.7 | - |
| | Travel motor | High speed with rubber track | km/h<br>mph<br>s/10 m | 4.6<br>2.86<br>7.83 | ±0.5<br>±0.31<br>-0.87 to +1.10 | - |
| | | Low speed with rubber track | km/h<br>mph<br>s/10 m | 2.5<br>1.68<br>13.33 | ±0.3<br>±0.19<br>-1.16 to +1.43 | - |
| | | High speed with steel track | km/h<br>mph<br>s/10 m | 4.4<br>2.73<br>8.18 | ±0.4<br>±0.25<br>-0.65 to +0.78 | - |
| | | Low speed with steel track | km/h<br>mph<br>s/10 m | 2.4<br>1.49<br>15.00 | ±0.2<br>±0.12<br>-0.92 to +1.07 | - |
| Travel straightness (10 m, 32.8 ft) | | | mm<br>in. | - | - | 600<br>23.6 |

# 3. Testing

## 3.1 Measuring hydraulic devices

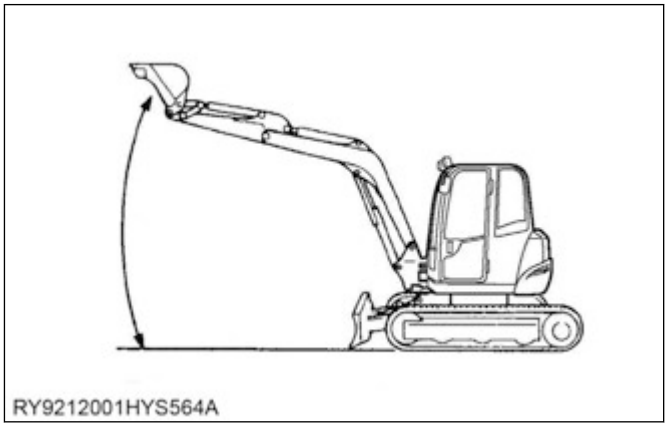
### 3.1.1 Measuring boom cylinder speed

**⚠ CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Dump arm to the stroke end, dump bucket to the stroke end, lower boom to the stroke end, and accelerate engine to the maximum speed.
3. Lift the boom to the stroke end in full-stroke operation to measure the boom cylinder speed.

**■ NOTE**
- **Do not include cushion range.**

4. Measure 3 times to calculate average.
5. Measure the boom lowering speed as well.


RY9212001HYS564A

**Service specifications**

| | | |
|---|---|---|
| Boom cylinder speed | Lifting (Ground to Highest) | 2.4 to 3.0 s |
| | Lowering (Highest to Ground) | 2.3 to 2.9 s |

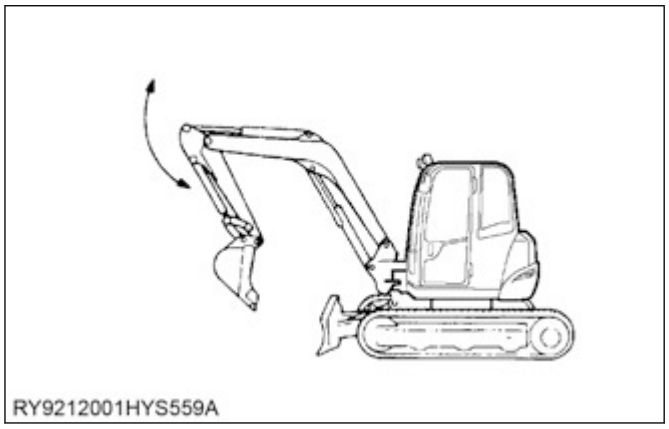
### 3.1.2 Measuring arm cylinder speed

**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Dump arm to the stroke end and accelerate engine to the maximum speed.
3. Crowd arm to the stroke end in full-stroke operation to measure the arm cylinder speed.

**NOTE**
- **Do not hit bucket to ground or blade.**

4. Measure 3 times to calculate average.
5. Measure the arm dumping speed as well.




**Service specifications**

| | | |
|---|---|---|
| Arm cylinder speed | Crowding | 2.1 to 2.7 s |
| | Dumping | 2.3 to 2.9 s |

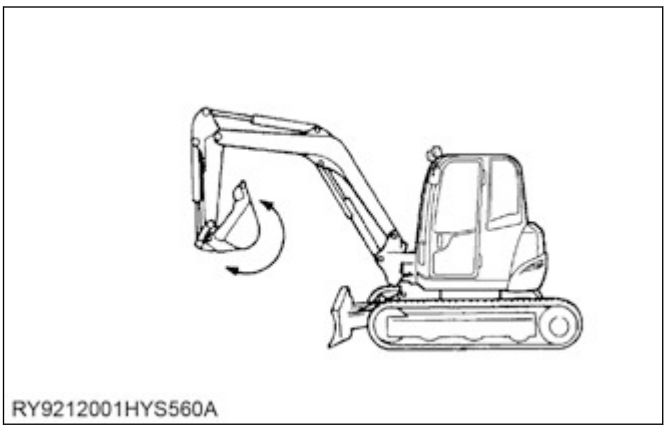
### 3.1.3 Measuring bucket cylinder speed

**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Dump bucket to the stroke end and accelerate engine to the maximum speed.
3. Crowd bucket to the stroke end in full-stroke operation to measure the bucket cylinder speed.

**NOTE**
- **Do not hit bucket to ground or blade.**

4. Measure 3 times to calculate average.
5. Measure the bucket dumping speed as well.




**Service specifications**

| | | |
|---|---|---|
| Bucket cylinder speed | Crowding | 2.3 to 2.9 s |
| | Dumping | 1.4 to 2.0 s |

### 3.1.4 Measuring blade cylinder speed

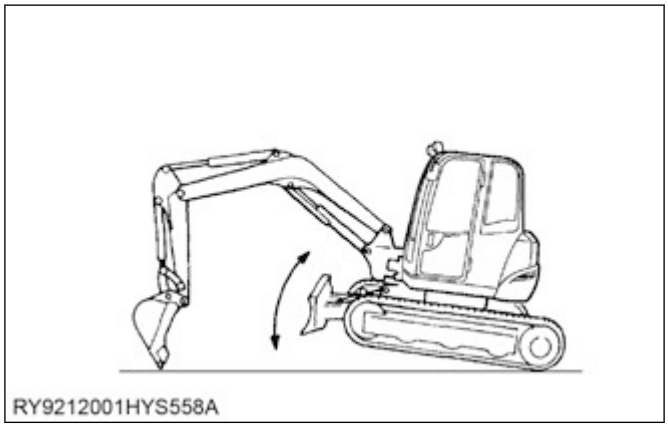
**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Jack up the machine by front attachments, lower blade to the stroke end, and accelerate engine to the maximum speed.

**NOTE**
- **Do not hit ground at blade lower end.**

3. Lift the blade to the stroke end in full-stroke operation to measure the blade cylinder speed.
4. Measure 3 times to calculate the average.

5. Measure the blade lowering speed as well.


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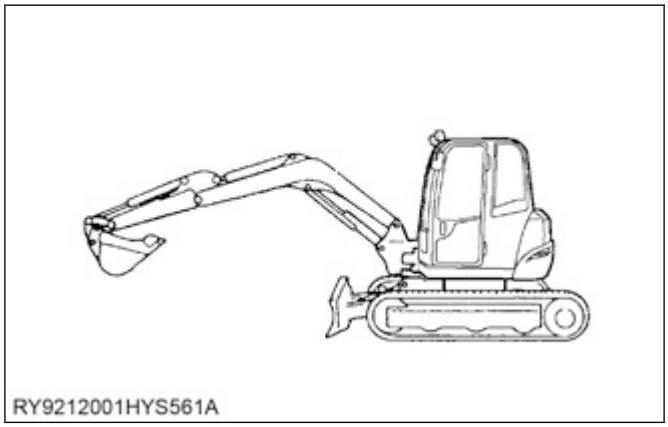
**Service specifications**

| | | |
|---|---|---|
| Blade cylinder speed | Lifting (Lowest to Highest) | 1.8 to 2.4 s |
| | Lowering (Lowest to Highest) | 2.5 to 3.1 s |

## 3.1.5 Measuring swing cylinder speed

**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Dump arm to the stroke end, crowd bucket to the stroke end, set bucket bottom surface to one meter from ground, and accelerate engine to the maximum speed.
3. Swing boom from the left end to the right end in full-stroke operation to measure the swing cylinder speed.
4. Measure 3 times to calculate average.
5. Measure the reverse direction speed as well.


RY9212001HYS561A

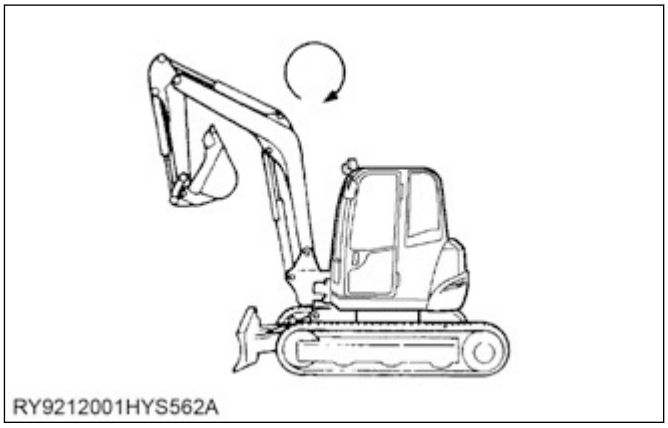
**Service specifications**

| | | |
|---|---|---|
| Swing cylinder speed | Swing RH | 5.3 to 5.9 s |
| | Swing LH | 6.1 to 6.7 s |

## 3.1.6 Measuring swivel speed

**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Lift boom to the stroke end, crowd arm to the stroke end, crowd bucket to the stroke end, and accelerate engine to the maximum speed.
3. Swivel to left in full-stroke operation until the swivel speed reaches a uniform speed and measure the swivel speed for three rotations.
4. Measure 3 times to calculate average.
5. Measure the right swivel speed as well.


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**Service specifications**

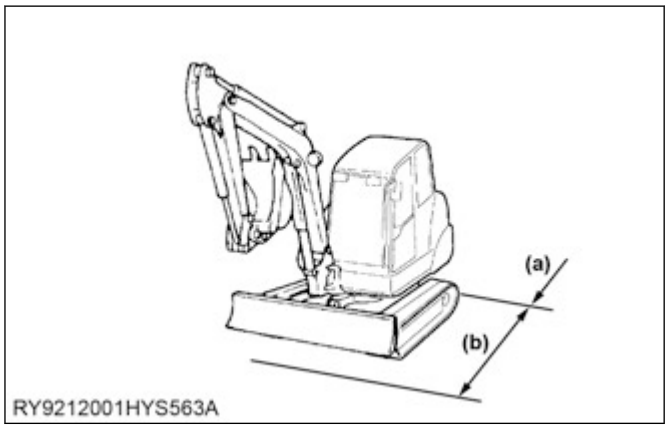
| | | |
|---|---|---|
| Swivel speed | RH | 16.7 to 20.1 s / 3 rotations (8.9 to 10.7 rpm) |
| | LH | |

## 3.1.7 Measuring travel speed

**CAUTION**
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set machine to traveling position and accelerate engine to the maximum speed.
3. Running start 5 meters (16.4 ft) and measure time for 10 meters (32.8 ft) forwards travel operation in full-stroke.

4. Measure 3 times to calculate average.




(a) Running start distance (5 m) (b) Measuring distance (10 m)

**Service specifications**

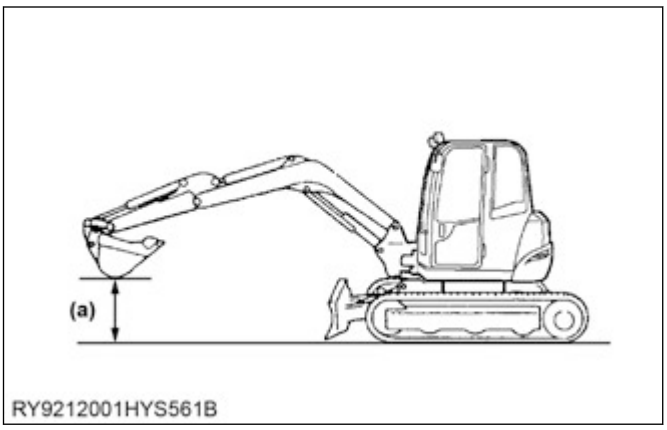
| | | | |
|---|---|---|---|
| Travel speed | Rubber track | High speed | 6.96 to 8.93 s/ 10 m<br>4.1 to 5.1 km/h<br>2.55 to 3.17 mph |
| | | Low speed | 12.17 to 14.76 s/10 m<br>2.2 to 2.8 km/h<br>1.49 to 1.87 mph |
| | Steel track | High speed | 7.53 to 8.96 s/ 10 m<br>4.0 to 4.8 km/h<br>2.48 to 2.98 mph |
| | | Low speed | 14.08 to 16.07 s/10 m<br>2.2 to 2.6 km/h<br>1.37 to 1.61 mph |

## 3.1.8 Measuring cylinder internal leakage

**⚠ CAUTION**
- **Keep out any persons or objects from the machine.**

**Measuring the boom, arm and bucket cylinder**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Put a weight (soil) on the bucket with approximately 97.2 kg (214.3 lbs).
3. Park the machine on firm and level ground.
4. Dump arm to the stroke end, crowd bucket to the stroke end, set bucket bottom surface to 1 meter from the ground, and stop the engine.

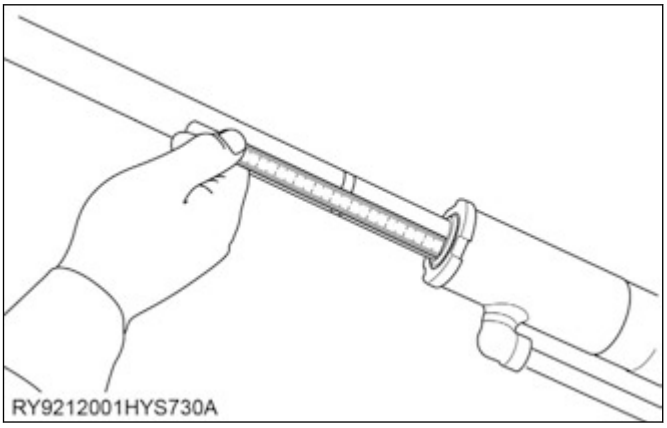



(a) 1 m

5. Put a mark on the boom, arm, and bucket cylinder rods.
6. Measure internal leakage for each cylinders after waiting 10 minutes.

**■ NOTE**
- **Measure compressed distance of the rod for the boom cylinder.**
- **Measure extended distance of the rod for the arm cylinder.**

7. Measure three times to calculate the average.




**Service specifications**

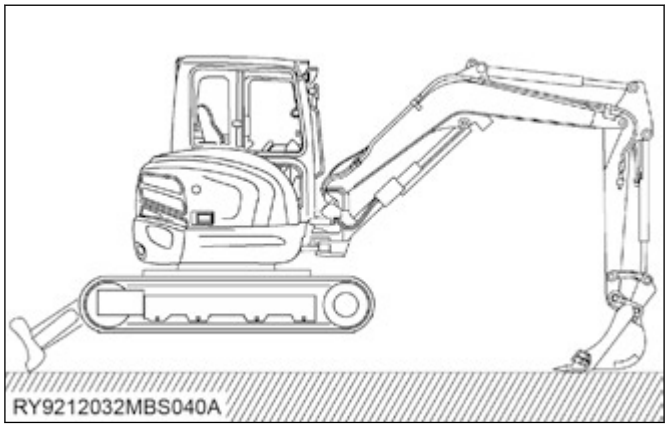
| | | |
|---|---|---|
| Internal leakage | Boom cylinder | less than 20 mm<br>less than 0.79 in. |
| | Arm cylinder | less than 11 mm<br>less than 0.43 in. |
| | Bucket cylinder | less than10 mm<br>less than 0.39 in. |

**Service limits**

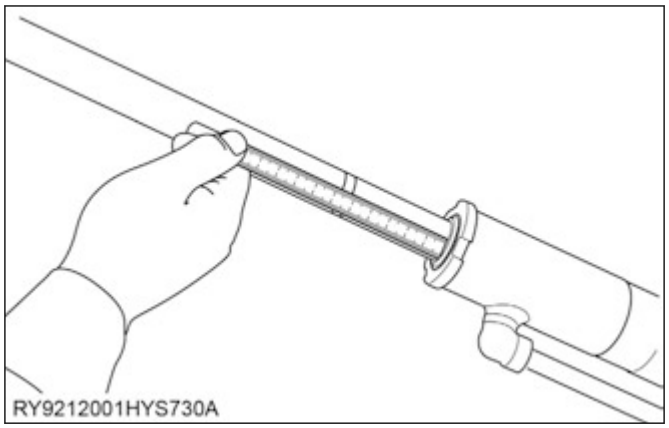
| | | |
|---|---|---|
| Internal leakage | Boom cylinder internal leakage | 100 mm<br>3.94 in. |
| | Arm cylinder internal leakage | 55 mm<br>2.17 in. |
| | Bucket cylinder internal leakage | 50 mm<br>1.97 in. |

**Measuring the blade cylinder**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Operate the front attachment and blade to jack up the machine.
3. Extend the blade fully and crowd the arm to vertical position.




4. Stop the engine and put a mark on the blade cylinder rod.
5. Measure internal leakage for each cylinder after waiting 10 minutes.
6. Measure three times to calculate the average.




**Service specification**

| | | |
|---|---|---|
| Internal leakage | Blade cylinder | less than 25 mm<br>less than 0.98 in. |

**Service limit**

| | | |
|---|---|---|
| Internal leakage | Blade cylinder | 50 mm<br>1.97 in. |

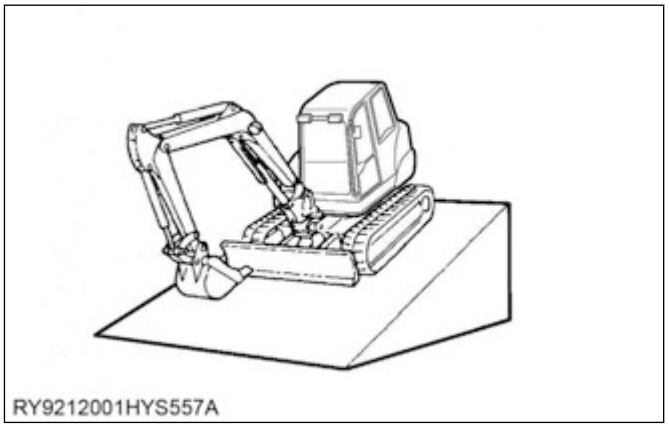
## 3.1.9 Measuring travel motor internal leakage

**⚠ CAUTION**

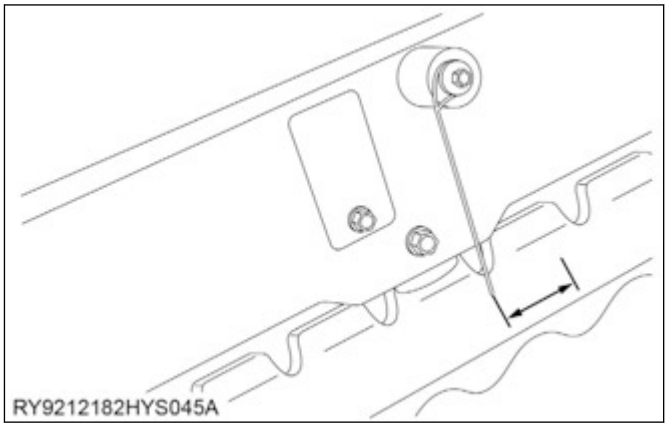
- **Keep out any persons or objects from the machine.**

**Measuring**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Park the machine on firm and 20 degrees slope.
3. Set the machine to traveling position and stop the engine.




4. Put a mark on track frame and track.
5. Measure the internal leakage for between track frame and track after 10 minutes.
6. Measure three times to calculate the average.




**Service specification**

| | | |
|---|---|---|
| Internal leakage | Travel motor<br>(20 degrees slope) | less than 300 mm<br>less than 11.8 in. |

## 3.1.10 Measuring swivel motor internal leakage

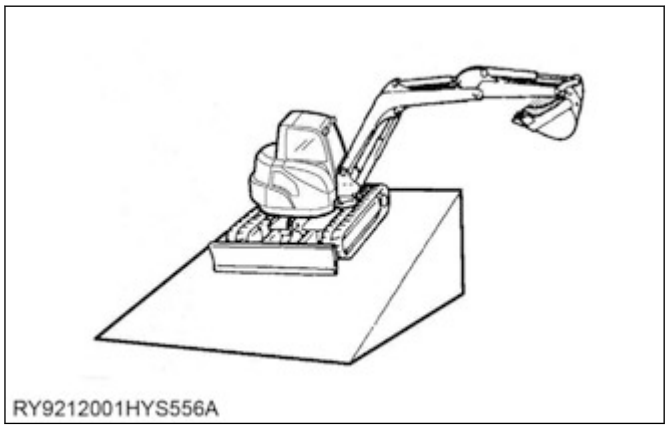
**⚠ CAUTION**

- **Keep out any persons or objects from the machine.**

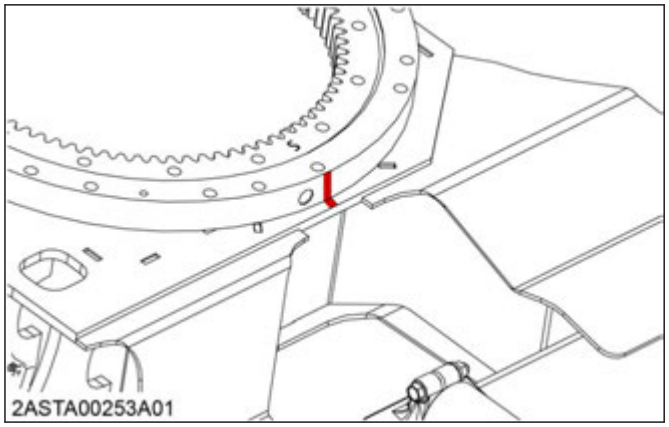
**Measuring**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Put a weight (soil) on the bucket with approximately 216 kg (476 lbs).

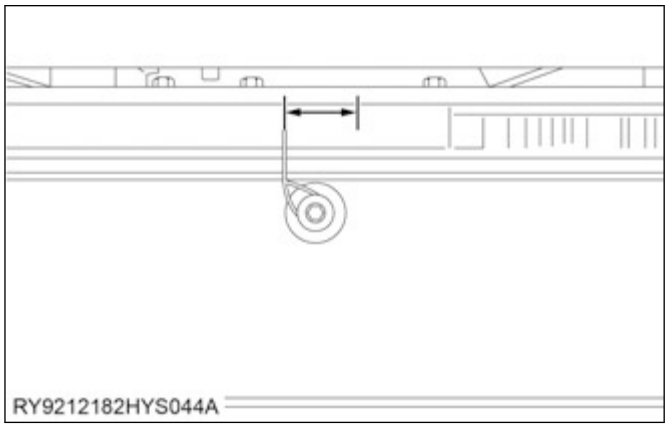
3. Park the machine on firm and 20 degrees slope. Swivel the machine 90 degrees against the slope.
4. Dump the arm to the stroke end, crowd the bucket to the stroke end, set the boom support pin and the bucket pin in straight line.




5. Put a mark on the swivel bearing and track frame.




6. Lower the lever lock and measure internal leakage for between the swivel bearing and the track frame after waiting one minute.
   - Activating the negative brake (Stopping the engine).
   - Releasing the negative brake (Running the engine in idle speed).
7. Measure 3 times to calculate the average.
8. Measure opposite direction (180 degrees) as well.




**Service specifications**

| | | |
|---|---|---|
| Internal leakage | Swivel motor (Stopping the engine, activating negative brake) | 0 mm<br>0 in.<br>0 degrees |
| | Swivel motor (Running the engine in idle speed, releasing negative brake) | less than 157 mm<br>less than 6.18 in.<br>less than 30 degrees |

**Service limits**

| | | |
|---|---|---|
| Internal leakage | Swivel motor (Stopping the engine, activating negative brake) | 26 mm<br>1.02 in.<br>5 degrees |
| | Swivel motor (Running the engine in idle speed, releasing negative brake) | 157 mm<br>6.18 in.<br>30 degrees |

## 3.1.11 Testing travel straightness

**⚠ CAUTION**
- **Keep out any persons or objects from the machine.**

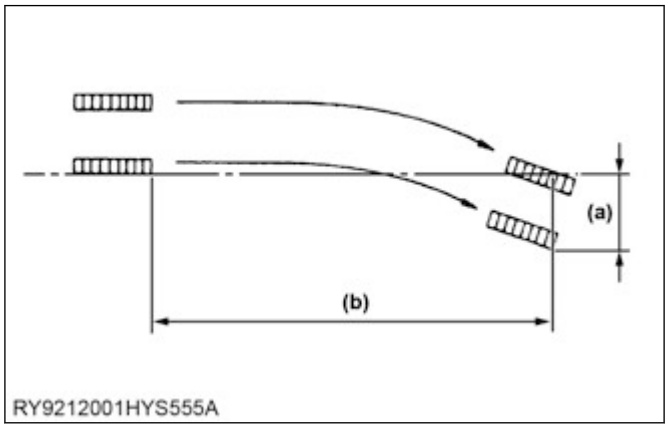
**Measuring**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Adjust tension for left and right track equally.
3. Set the machine to the traveling position.
4. Mark the starting position.
5. Accelerate the engine to the maximum speed.
6. Operate the travel control lever in the full stroke to travel forwards for 10 meters (32.8 ft).

**■ NOTE**

- **Make sure to start the machine straightly.**

7. Measure the distance (a).
8. Measure three times to calculate the average.
9. Measure the distance for backwards travel as well.




(a) Distance (b) 10 m (32.8 ft)

**Service limit**

| | |
|---|---|
| Travel straightness (10 m, 32.8 ft) | 600 mm 23.6 in. |

# 3.2 Measuring hydraulic pump

## 3.2.1 Measuring piston pump P-Q performance

There is a possibility of the hydraulic pump trouble in case of slow speed of hydraulic devices and power lack of the hydraulic force. Measure the hydraulic pump P-Q performance to be normal or not.

**⚠ CAUTION**

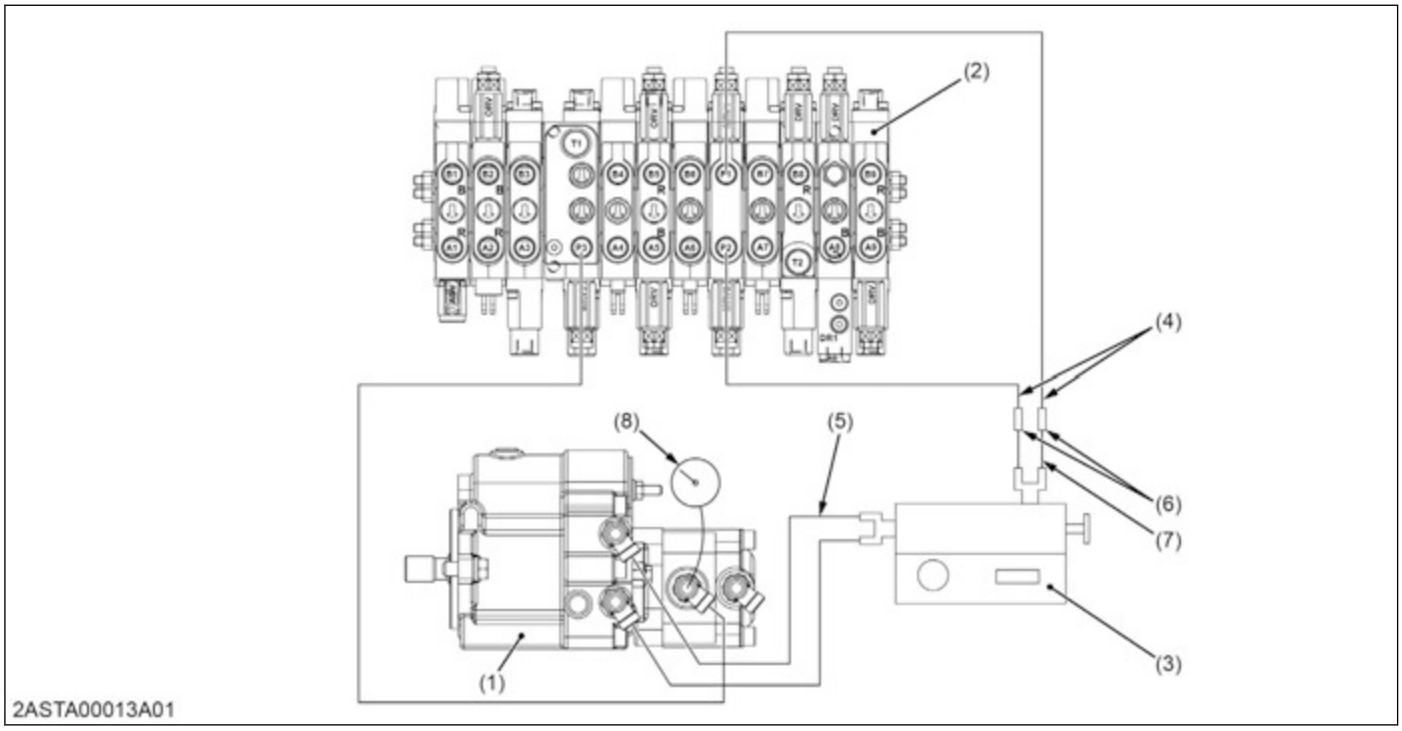
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

**■ IMPORTANT**

- **Open the loading valve (restrictor valve) of the flow meter completely before starting the engine, to avoid damaging the flow meter and pressure gauge.**
- **Install the plugs to removed hydraulic hoses and adapters, to avoid oil leakage and dust contamination.**

**Preparing**

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Connect test hose (B) to hydraulic pump and flow meter **[IN]** port.
5. Connect test hose (A) to flow meter **[OUT]** port and delivery hose.
6. If the pressure gauge is not attached on the flow meter, install the pressure gauge to port P on the hydraulic pump.
7. Install the pressure gauge to port P3.
8. Remove the vacuum pump and make sure to check for oil leakage.




(1) Hydraulic pump
(2) Control valve
(3) Flow meter
(4) Delivery hose
(5) Test hose (B)
(6) Adapter
(7) Test hose (A)
(8) Pressure gauge

**Measuring**

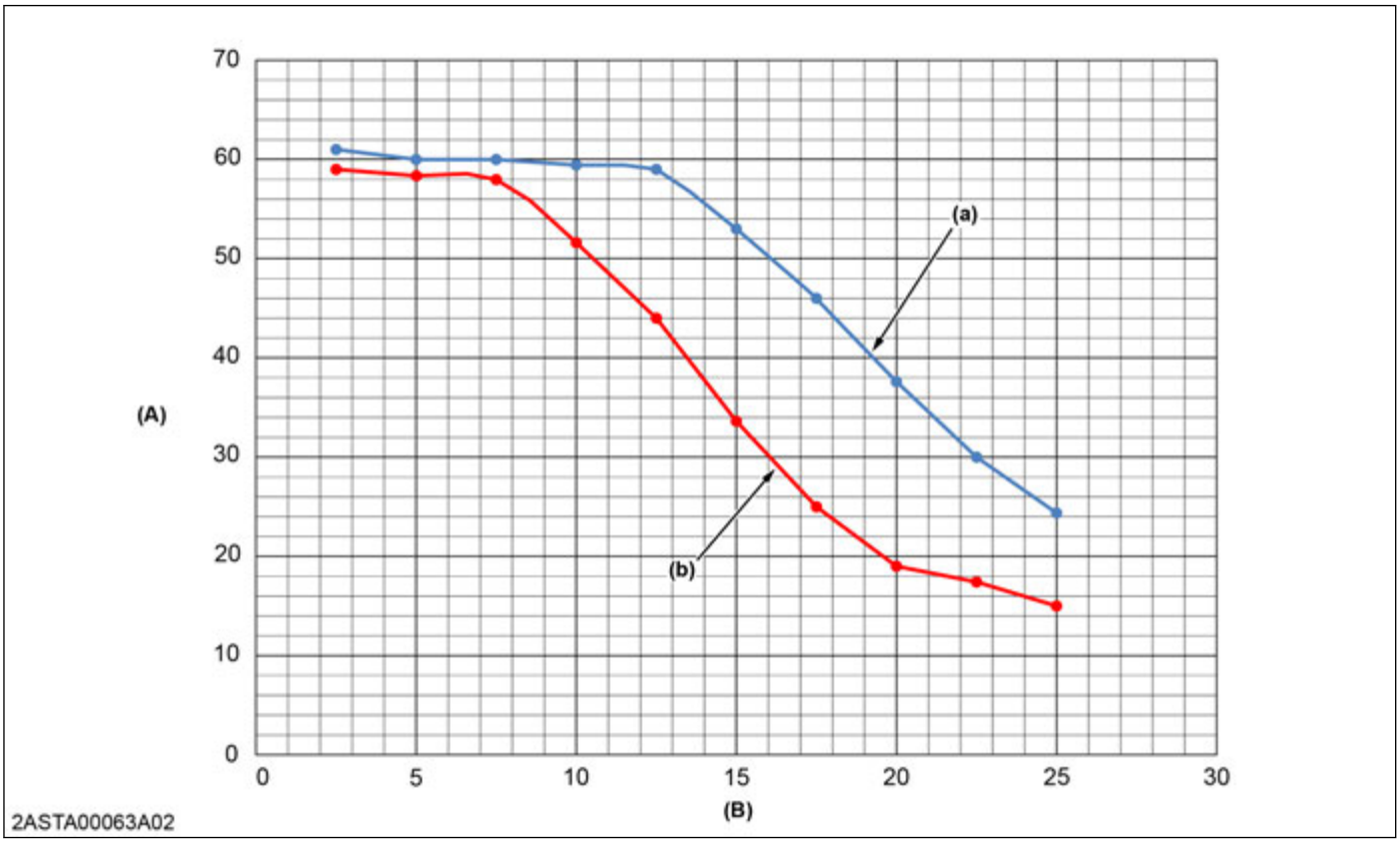
1. Open the loading valve (restrictor valve) of the flow meter completely and start up engine.
2. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
3. Set the engine speed to the maximum.

**■ NOTE**

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

4. Measure the flow rate without P3 load.
   a. Close the loading valve (restrictor valve) gradually until setting pressure of main relief valve and measure flow rate and engine speed in each load pressure by following service specifications.
   b. Measure flow rate 3 times and calculate the average flow rate.
5. Measure the flow rate with P3 load (relief).
   a. Keep lifting the blade to end stroke to relief the P3.
   b. Close the loading valve (restrictor valve) until main relief valve value gradually and measure flow rate and engine speed in each load pressure.
   c. Measure flow rate 3 times and calculate the average flow-rate.
6. Convert all of the flow rate values to rated engine speed.

## Service specification




(a) P1 + P2 (P3 no load) (b) P1 + P2 (P3 load (relief)) (A) Flow rate (L/min) (B) Pressure (MPa)

| Pressure | | Flow rate (converted to 2250 rpm) | | | |
|---|---|---|---|---|---|
| | | P3 no load | | P3 load (relief) | |
| MPa | psi | L/min | U.S.gals/min | L/min | U.S.gals/min |
| 2.5 | 363 | 61.1 | 16.1 | 59.2 | 15.6 |
| 5.0 | 725 | 60.2 | 15.9 | 58.4 | 15.4 |
| 7.5 | 1088 | 60.1 | 15.9 | 58.0 | 15.3 |
| 10.0 | 1450 | 59.4 | 15.7 | 51.6 | 13.6 |
| 12.5 | 1813 | 58.8 | 15.5 | 43.7 | 11.5 |
| 15.0 | 2175 | 53.0 | 14.0 | 33.7 | 8.9 |
| 17.5 | 2538 | 46.2 | 12.2 | 25.0 | 6.6 |
| 20.0 | 2900 | 37.6 | 9.9 | 19.1 | 5.0 |
| 22.5 | 3263 | 30.2 | 8.0 | 17.3 | 4.6 |
| 25.0 | 3625 | 24.5 | 6.5 | 14.6 | 3.9 |

**IMPORTANT**

- **Service limit**
  - **The service limit is 80% of the service specification.**

## 3.2.2 Measuring AUX flow rate

**⚠ CAUTION**

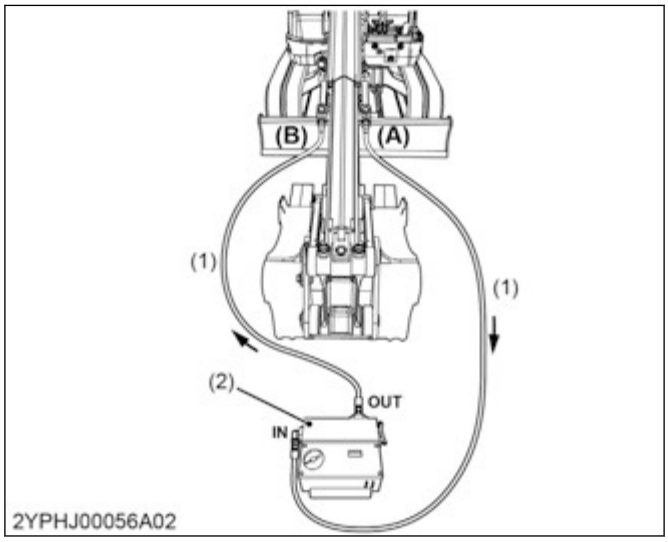
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

**■ IMPORTANT**

- **Open the loading valve (restrictor valve) fully before starting the engine, to avoid damaging the flow meter and pressure gauge.**
- **Install the plugs to removed hydraulic hoses and adapters, to avoid oil leakage and dust contamination.**

**Preparing**

1. Park the machine on firm and level ground and stop the engine.
2. Release the residual pressure of the hydraulic circuit.
3. Connect test hose AUX LH discharging port to flow meter **[IN]** port.
4. Connect test hose AUX RH discharging port to flow meter **[OUT]** port.




(1) Test hose
(2) Flow meter
(A) AUX LH discharging port
(B) AUX RH discharging port

**Measuring**

1. Open the loading valve (restrictor valve) of flow meter fully and start the engine.
2. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
3. Set the engine speed to the maximum.

**■ NOTE**

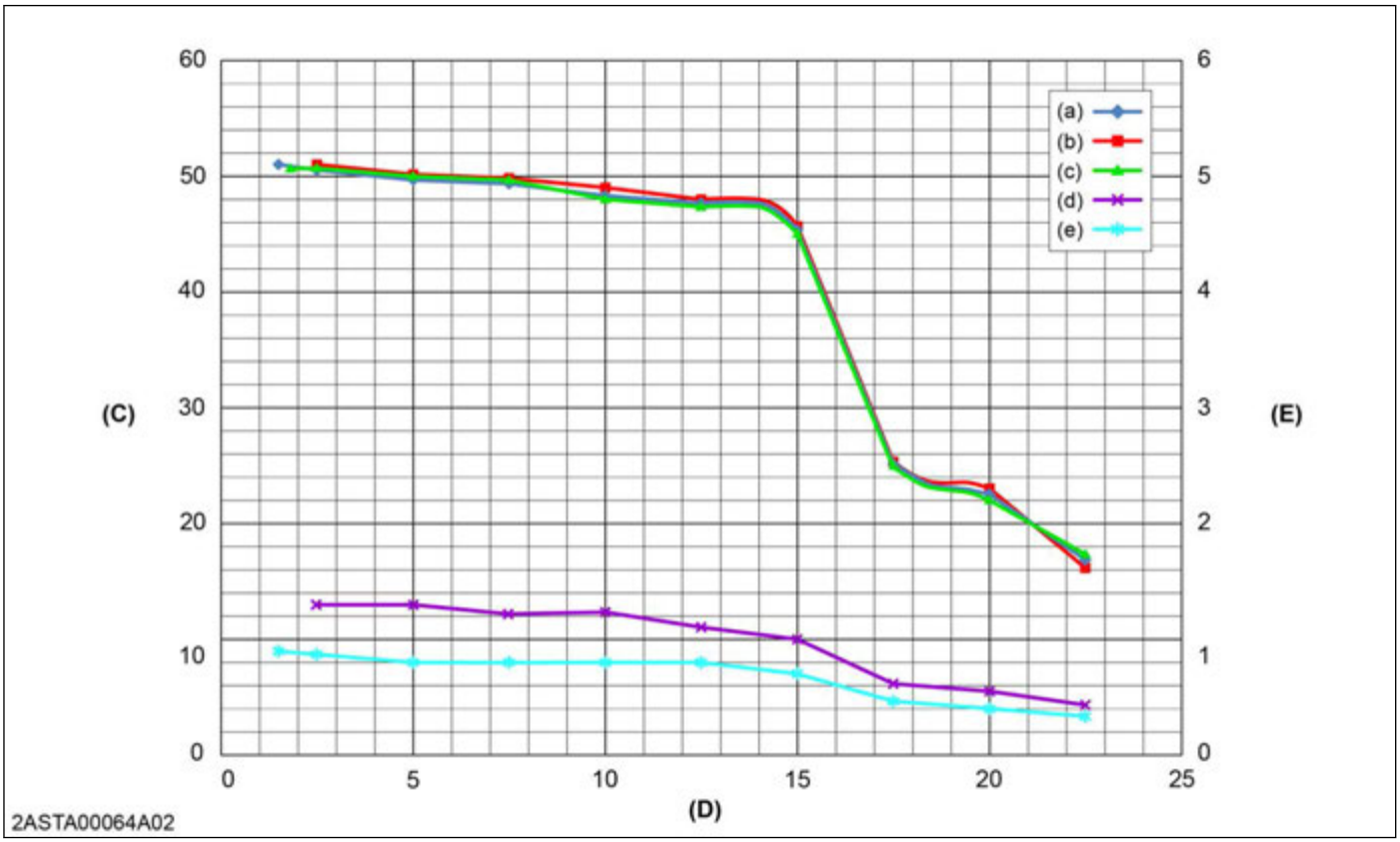
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

4. Close the loading valve (restrictor valve) gradually until setting pressure of main relief valve and measure flow rate and engine speed in each loading pressure.
5. Measure flow rate 3 times and calculate the average flow rate.
6. Convert all of the flow rate values to rated engine speed.

**■ NOTE**

- **If there is a need to measure opposite side (RH discharging), exchange both hoses between LH and RH.**

## Service specification




(C) Flow rate (L/min)
(D) Pressure (MPa)
(E) Back pressure (MPa)
(a) AUX1 LH (third line open)
(b) AUX1 LH (third line close)
(c) AUX1 RH (third line close)
(d) Back pressure (third line close)
(e) Back pressure (third line open)

### AUX1 LH (Third line open)

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 50.6 | 13.4 | 0.84 | 122 |
| 5.0 | 725 | 50.0 | 13.2 | 0.81 | 117 |
| 7.5 | 1088 | 49.0 | 12.9 | 0.79 | 115 |
| 10.0 | 1450 | 48.4 | 12.8 | 0.79 | 115 |
| 12.5 | 1813 | 47.4 | 12.5 | 0.76 | 110 |
| 15.0 | 2176 | 45.4 | 12.0 | 0.69 | 100 |
| 17.5 | 2538 | 25.6 | 6.8 | 0.43 | 62 |
| 20.0 | - | 22.5 | 5.9 | 0.41 | 59 |
| 22.5 | - | 17.0 | 4.5 | 0.35 | 51 |

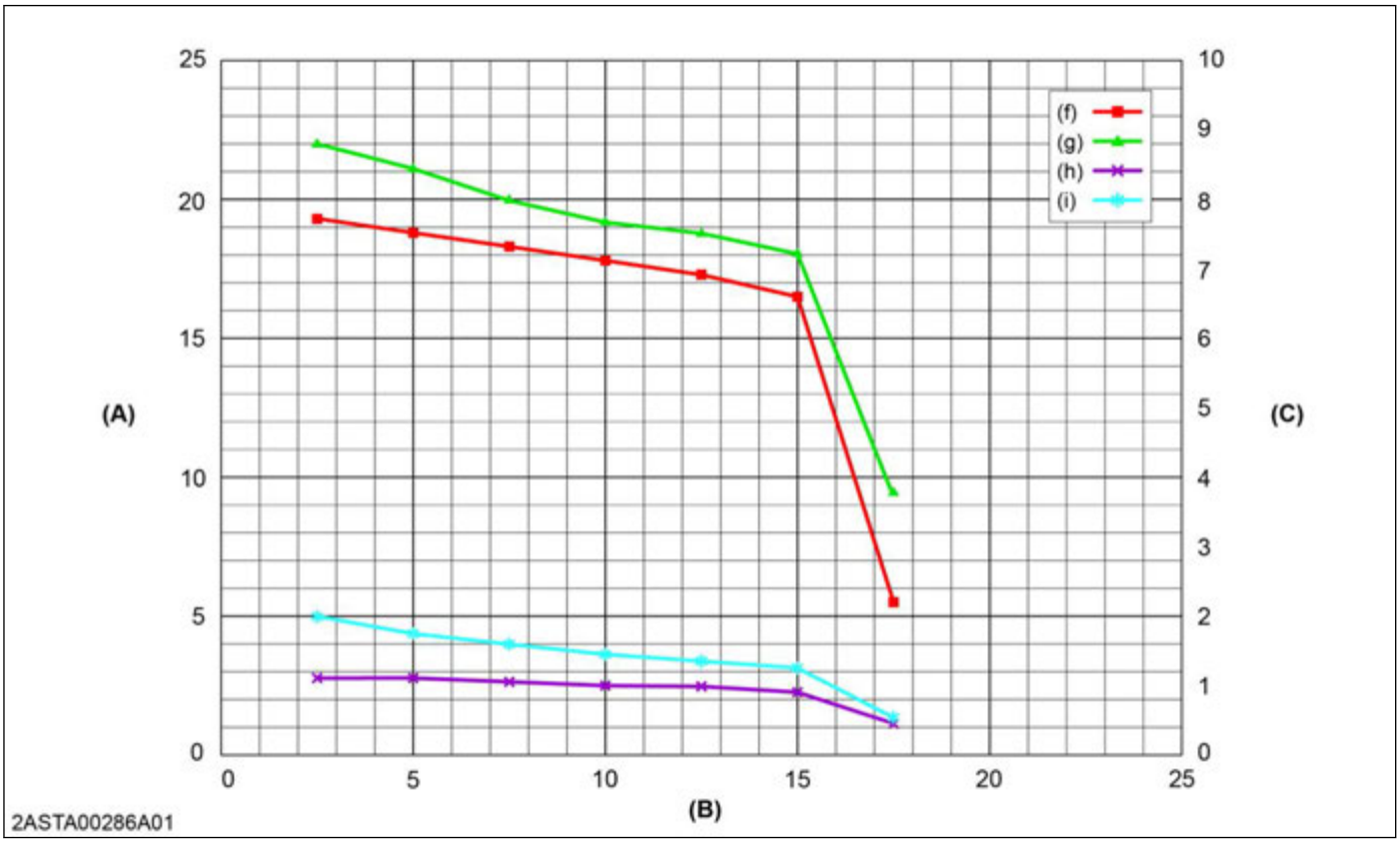
### AUX1 LH (third line close)

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 51.0 | 13.5 | 1.28 | 186 |
| 5.0 | 725 | 50.0 | 13.2 | 1.26 | 183 |
| 7.5 | 1088 | 49.7 | 13.1 | 1.22 | 177 |
| 10.0 | 1450 | 48.8 | 12.9 | 1.22 | 177 |
| 12.5 | 1813 | 47.8 | 12.6 | 1.10 | 160 |
| 15.0 | 2176 | 45.6 | 12.0 | 1.00 | 145 |
| 17.5 | 2538 | 25.6 | 6.8 | 0.58 | 84 |
| 20.0 | - | 23.0 | 6.1 | 0.53 | 77 |
| 22.5 | - | 16.3 | 4.3 | 0.41 | 59 |

### AUX1 RH (third line close)

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 50.6 | 13.4 | 1.12 | 162 |
| 5.0 | 725 | 50.0 | 13.2 | 1.07 | 155 |
| 7.5 | 1088 | 49.3 | 13.0 | 1.06 | 154 |
| 10.0 | 1450 | 48.2 | 12.7 | 1.02 | 148 |
| 12.5 | 1813 | 47.7 | 12.6 | 0.97 | 141 |
| 15.0 | 2176 | 45.1 | 11.9 | 0.87 | 126 |
| 17.5 | 2538 | 25.3 | 6.9 | 0.48 | 70 |
| 20.0 | - | 22.2 | 5.9 | 0.45 | 65 |
| 22.5 | - | 17.5 | 4.6 | 0.39 | 57 |

## Service specification




(C) Flow rate (L/min)
(D) Pressure (MPa)
(E) Back pressure (MPa)
(f) AUX2 LH
(g) AUX2 RH
(h) Back pressure (AUX2 LH)
(i) Back pressure (AUX2 RH)

### AUX2 LH

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 508 | 19.2 | 5.07 | 1.13 | 164 |
| 5.0 | 725 | 18.8 | 4.97 | 1.09 | 158 |
| 7.5 | 1088 | 18.3 | 4.83 | 1.04 | 151 |
| 10.0 | 1450 | 17.8 | 4.70 | 1.01 | 146 |
| 12.5 | 1813 | 17.3 | 4.53 | 0.97 | 140 |
| 15.0 | 2176 | 16.5 | 4.36 | 0.91 | 130 |
| 17.5 | 2538 | 5.5 | 1.5 | 0.46 | 67 |

### AUX2 RH

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 508 | 22.0 | 5.81 | 1.98 | 287 |
| 5.0 | 725 | 21.1 | 5.57 | 1.76 | 255 |
| 7.5 | 1088 | 19.9 | 5.26 | 1.60 | 232 |
| 10.0 | 1450 | 19.2 | 5.07 | 1.43 | 207 |
| 12.5 | 1813 | 18.8 | 4.97 | 1.35 | 196 |
| 15.0 | 2176 | 18.1 | 4.78 | 1.26 | 183 |
| 17.5 | 2538 | 10.4 | 2.75 | 0.55 | 80 |

# 3.3 Measuring control valve

## 3.3.1 Measuring main relief valve pressure

There is a possibility of the main relief valves trouble in case of power lack of the hydraulic force. Measure the relief pressure of main relief valves to be normal or not.

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

**■ IMPORTANT**
- **Install the plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Install pressure gauges to each detection ports.




(1) Port P1
(2) Port P2
(3) Port P3

5. Remove the vacuum pump and check oil leakage in each piping hose in idling.

**Measuring**
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

**■ NOTE**
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate the front attachment pilot control lever gradually until main relief valve relieves.

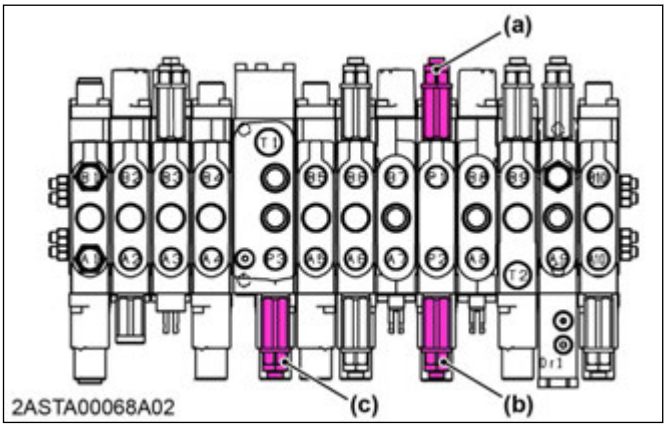
**■ NOTE**
- **P1 main relief valve: boom, bucket**
- **P2 main relief valve: arm, AUX1**
- **P3 main relief valve: blade, swivel, swing, AUX2 (hi-spec only)**

4. Measure the relief pressure 3 times to calculate average.

**Service specifications**

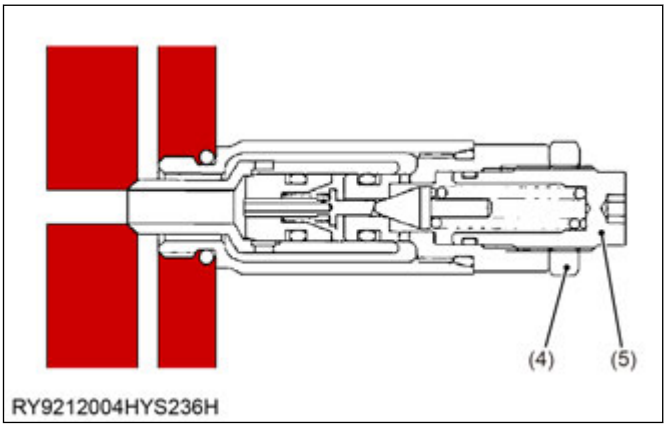
| | |
|---|---|
| P1 main relief valve pressure | 22.5 to 24.0 MPa<br>229.4 to 244.7 kgf/cm$^2$<br>3263 to 3481 psi |
| P2 main relief valve pressure | 22.5 to 24.0 MPa<br>229.4 to 244.7 kgf/cm$^2$<br>3263 to 3481 psi |
| P3 main relief valve pressure | 17.4 to 18.9 MPa<br>177.4 to 192.7 kgf/cm$^2$<br>2524 to 2741 psi |

**Adjusting**



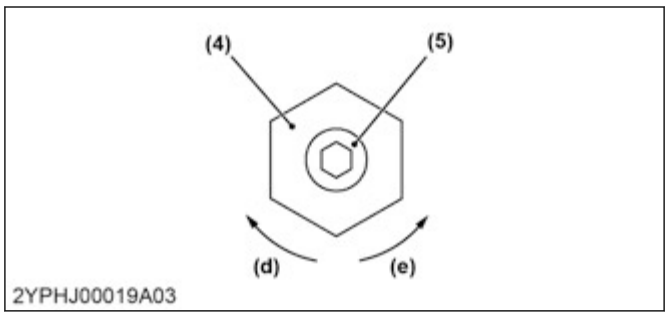

(a) P1 main relief valve
(b) P2 main relief valve
(c) P3 main relief valve

1. Loosen the locknut of relief valve.




(4) Locknut
(5) Adjusting screw

2. Set the position of adjusting screw to adjust relief pressure and tighten the locknut.




(4) Locknut
(5) Adjusting screw
(d) Increase relief pressure
(e) Decrease relief pressure

**Tightening torque**

| | | |
|---|---|---|
| (4) Locknut | 19.6 N·m<br>2.0 kgf·m<br>14.5 lbf·ft | - |

3. Operate pilot control lever in engine maximum speed and check the main relief pressure.

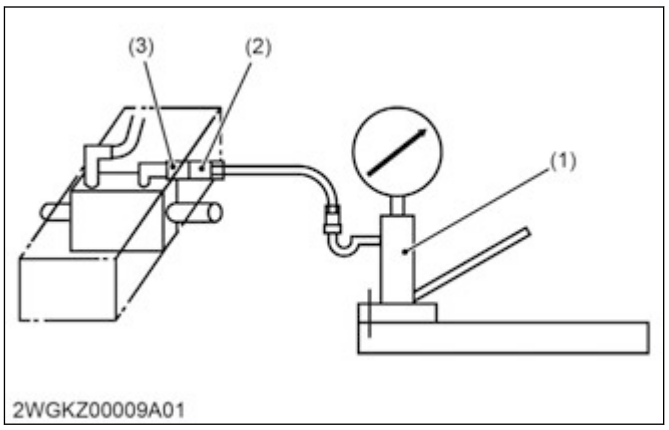
## 3.3.2 Measuring overload relief valve

There is a possibility of the overload relief valves trouble in case of power lack of the hydraulic force. Measure the relief pressure of the overload relief valve to check the condition of the overload relief valve.

**⚠ CAUTION**
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Disconnect high pressure hose which is connected to the overload relief valve.
5. Install the pressure measurement kit.




(1) Pressure measurement kit
(2) Pipe fittings
(3) Pipe fittings

6. Remove the vacuum pump.

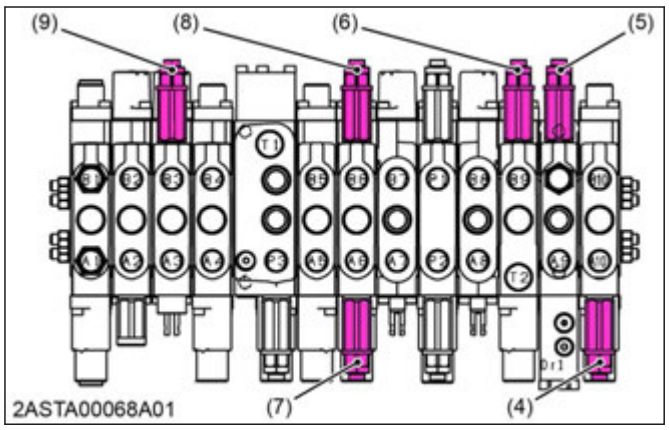
**Measuring**
1. Apply pressure to relief the overload relief valve with the pressure measurement kit and measure the pressure when the overload relief valve relieves.
2. Measure 3 times to calculate the average.

**Service specifications**

| | | |
|---|---|---|
| Boom | Bottom (b1B) | 25.7 to 17.7 MPa<br>262.3 to 282.3 kgf/cm$^2$<br>3729 to 4017 psi |
| | Rod (b1R) | 25.3 to 27.3 MPa<br>258.2 to 278.2 kgf/cm$^2$<br>3770 to 4058 psi |
| Arm | Bottom (b2B) | 25.5 to 27.5 MPa<br>260.2 to 280.2 kgf/cm$^2$<br>3700 to 3988 psi |
| | Rod (b2R) | 25.4 to 27.4 MPa<br>259.2 to 279.2 kgf/cm$^2$<br>3685 to 3973 psi |
| Bucket | Bottom (b3B) | 25.6 to 27.6 MPa<br>261.2 to 281.2 kgf/cm$^2$<br>3714 to 4002 psi |
| Blade | Bottom (b4B) | 25.4 to 27.4 MPa<br>259.2 to 279.2 kgf/cm$^2$<br>3685 to 3973 psi |

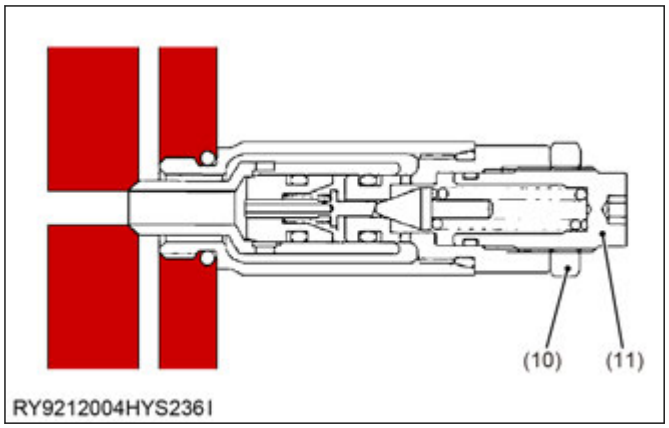
**Adjusting**

**■ IMPORTANT**
- **Adjust overload relief pressure only if the overload relief pressure is too low.**
- **Do not set the overload relief pressure exceeded to the setting pressure, to avoid damages on the machine components.**



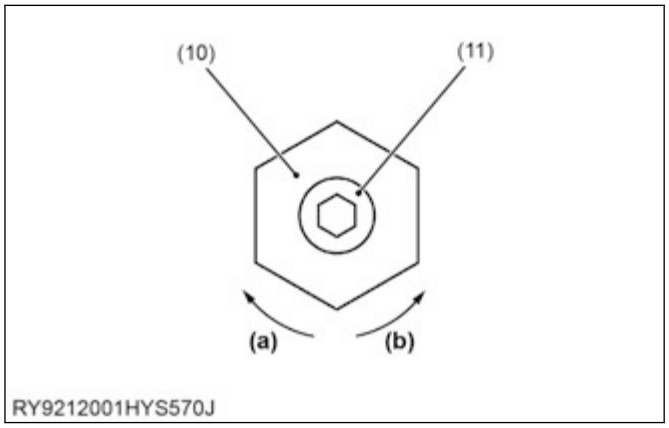

(4) Bucket (Bottom)
(5) Boom (Bottom)
(6) Boom (Rod)
(7) Arm (Bottom)
(8) Arm (Rod)
(9) Blade (Bottom)

1. Loosen the locknut of relief valve.




(10) Locknut
(11) Adjusting screw

2. Set the position of adjusting screw to adjust relief pressure and tighten the locknut.




(10) Locknut
(11) Adjusting screw
(a) Increase relief pressure
(b) Decrease relief pressure

**Tightening torque**

| | | |
|---|---|---|
| (10) Locknut | 19.6 N·m<br>2.0 kgf·m<br>14.5 lbf·ft | - |

3. Check the overload relief pressure with the pressure measurement kit.

## 3.4 Measuring swivel motor

### 3.4.1 Measuring swivel motor overload relief valve pressure

Check if the relief pressure is normally. Replace as needed.

**⚠ CAUTION**

- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**

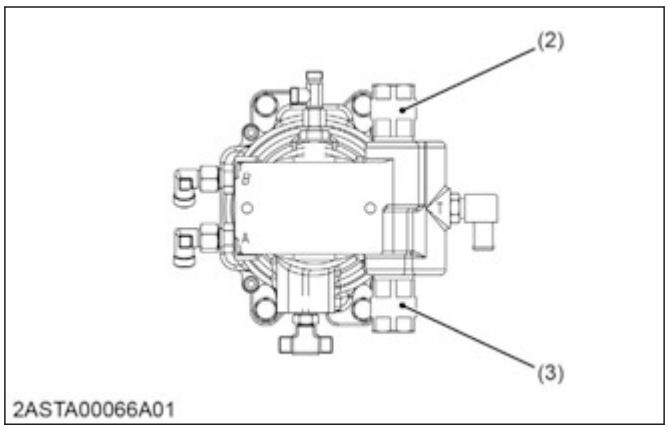
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the pressure gauge to P3 detection port.




(1) Main relief valve pressure detection port of pump 3




(2) Swivel LH relief valve (3) Swivel RH relief valve

4. Make sure to check oil leakage.

**Measuring**

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

**■ NOTE**

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Block the swivel motor to rotate by hitting the bucket against a solid object.
4. Slowly operate the swivel against the solid object and measure the pressure when overload relief valve relieves.
5. Measure the pressure 3 times and calculate the average pressure.

**Service specifications**

| | | |
|---|---|---|
| Swivel motor overload relief pressure | RH | 17.0 to 19.0 MPa<br>173.5 to 193.5 kgf/cm$^2$<br>2467 to 2755 psi |
| | LH | |

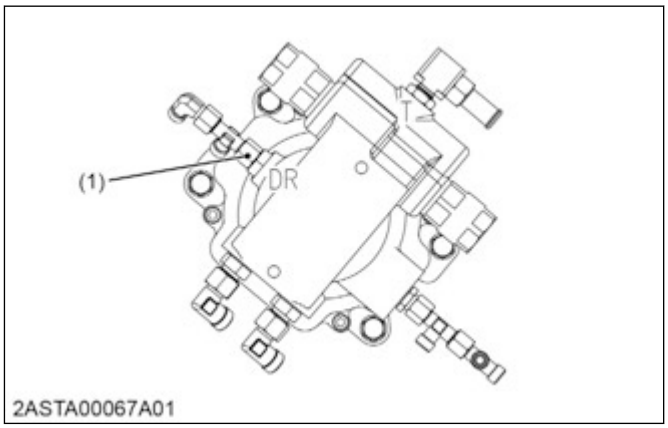
## 3.4.2 Measuring swivel motor drain

**⚠ CAUTION**

- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**Preparing**

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Remove the drain hose.
5. Install the test hose to swivel motor drain port.




(1) Drain port

6. Remove the vacuum pump.

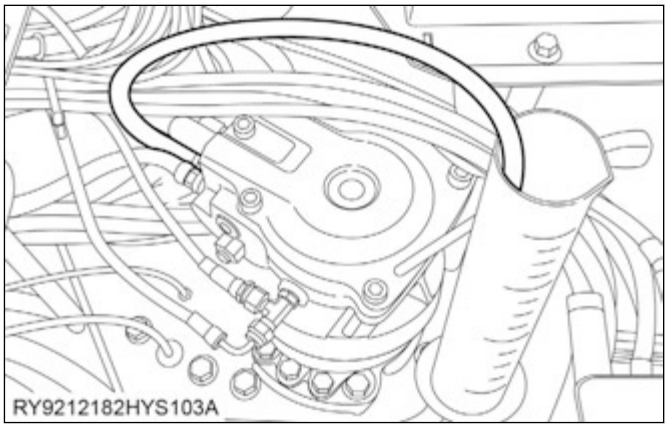
**Measuring**

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

**■ NOTE**

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate swivel in full stroke and collect the drain oil in the measuring cup.




4. Measure the drain amount for one minute.
5. Measure 3 times to calculate the average.
6. Measure the opposite direction as well.

**Service specifications**

| | |
|---|---|
| RH and LH (rotating) | 0 L/min<br>0 U.S.gals/min |
| RH and LH (relief) | 0.87 L/min<br>0.23 U.S.gals/min |

# 3.5 Measuring travel motor

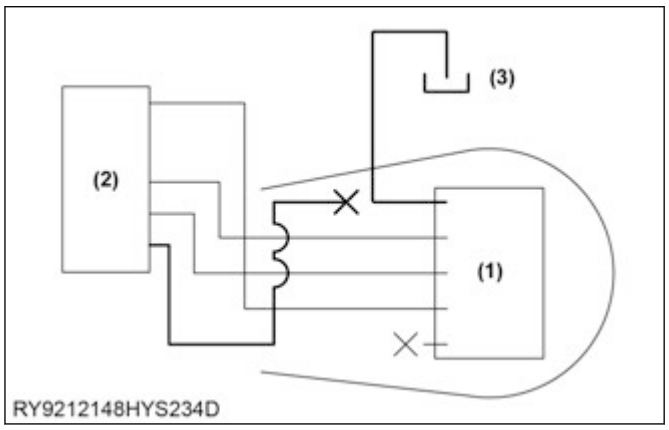
## 3.5.1 Measuring travel motor drain

**CAUTION**

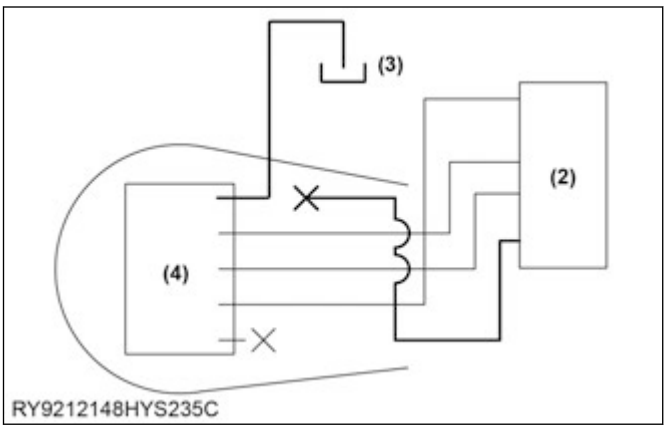
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Keep your body away from rotating track.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **When jacking up the machine, set a jack stands under the machine.**

**Preparing**

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Remove travel motor drain hose and install a plug.
5. Install the test hose to travel motor drain port.




(1) Travel motor RH
(2) Swivel joint
(3) Measuring cup




(2) Swivel joint
(3) Measuring cup
(4) Travel motor LH

6. Remove the vacuum pump.
7. Jack up the machine and set a jack stands under the track frame.




**Measuring**

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

**NOTE**

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate travel in full stroke and collect the drain oil in the measuring cup.



4. Measure the drain amount for 1 minute.
5. Measure 3 times to calculate the average.
6. Measure the opposite side as well.

**Service specifications**

| | |
|---|---|
| Low speed (rotating) | 0.03 L/min<br>0.008 U.S.gals/min |
| High speed (rotating) | 0.14 L/min<br>0.037 U.S.gals/min |
| Low speed (relief) | 0.59 L/min<br>0.16 U.S.gals/min |
| High speed (relief) | 0.63 L/min<br>0.17 U.S.gals/min |

**Service limit**

| | |
|---|---|
| Low speed (rotating) | 0.4 L/min<br>0.11 U.S.gals/min |

# 3.6 Measuring pilot control valve

## 3.6.1 Measuring pilot primary pressure

**⚠ CAUTION**
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Connect the pressure gauge to P4 detection port.




(1) Port P4

**Measuring**
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

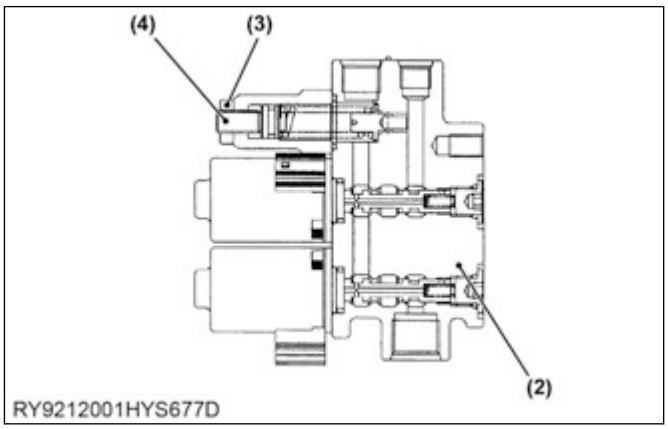
**■ NOTE**
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Measure pilot primary pressure when unloaded.
4. Measure 3 times to calculate average.

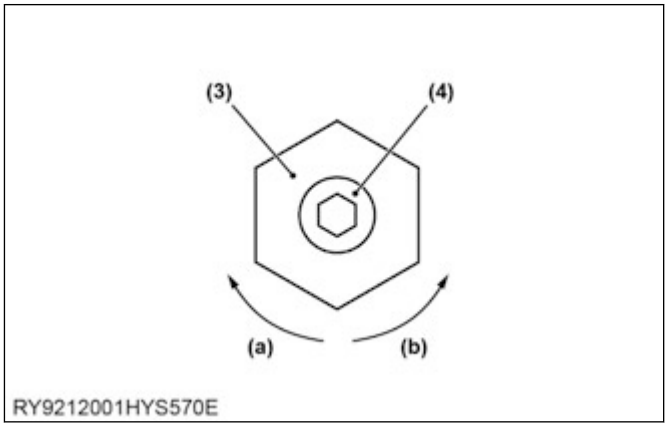
**Service specification**

| | |
|---|---|
| Pilot primary pressure | 4.2 to 4.7 MPa<br>42.9 to 47.9 kgf/cm$^2$<br>608.3 to 681.3 psi |

**Adjusting**
1. Loosen the locknut of relief valve.
2. Set position of adjusting screw to adjust relief pressure and tighten the locknut.




(2) Unload valve
(3) Locknut
(4) Adjusting screw




(3) Locknut
(4) Adjusting screw
(a) Increase relief pressure
(b) Decrease relief pressure

**Tightening torque**

| | | |
|---|---|---|
| (3) Locknut | 15.7 N·m<br>1.6 kgf·m<br>11.6 lbf·ft | - |

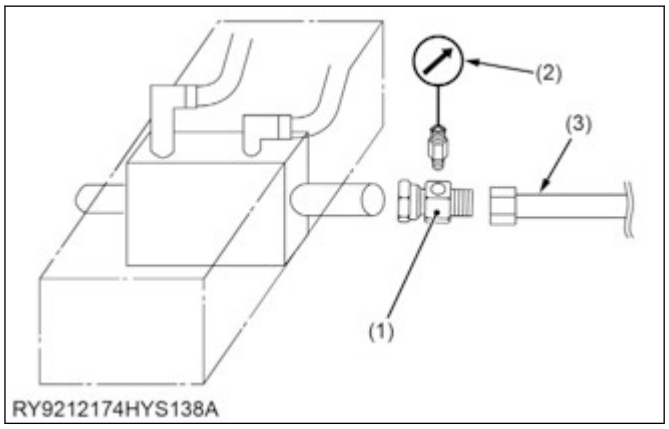
3. Operate control lever at engine maximum and check pilot primary pressure.

### 3.6.2 Measuring pilot secondary pressure

**⚠ CAUTION**
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparation**
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Connect T-joint to pilot port of control valve and install pressure gauge.




(1) T-joint (3) Test hose
(2) Pressure gauge

5. Remove the vacuum pump and make sure to check oil leakage in each piping hose in idling.

**Measuring**
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

**■ NOTE**
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate lever in full stroke and measure pressure.
4. Measure 3 times to calculate average.

# 4. Repairing

## 4.1 Hydraulic pump

### 4.1.1 Removing and installing the hydraulic pump

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**
1. Remove the rear bonnet.
2. Remove the LH bonnet.



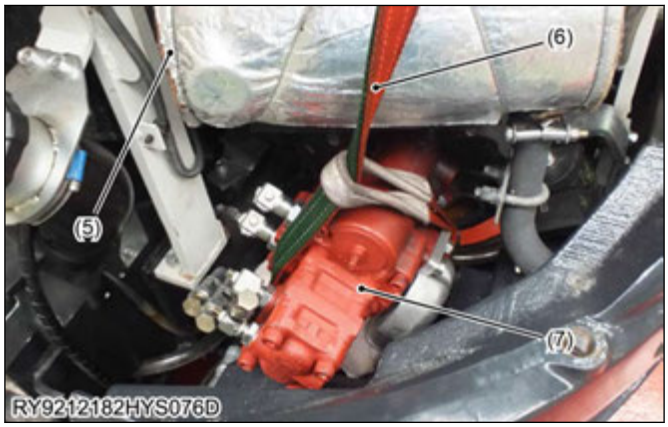

(1) Rear bonnet (2) LH bonnet

3. Disconnect the hydraulic hoses.
4. Loosen clamp to disconnect suction hose.
5. Remove suction flange.



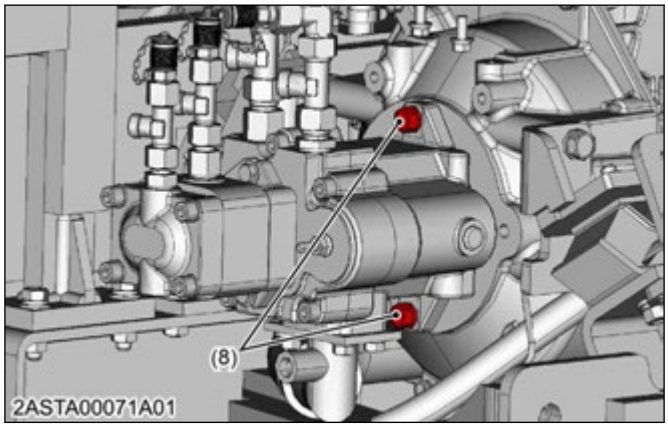

(3) Suction hose
(4) Suction flange

6. Remove muffler.
7. Attach nylon sling and hoist the hydraulic pump for support.




(5) Muffler
(6) Nylon sling
(7) Hydraulic pump

8. Remove 2 bolts.




(8) Bolt (M12 × 30) ×2

9. Pull-out the hydraulic pump from the coupling.




### Mass

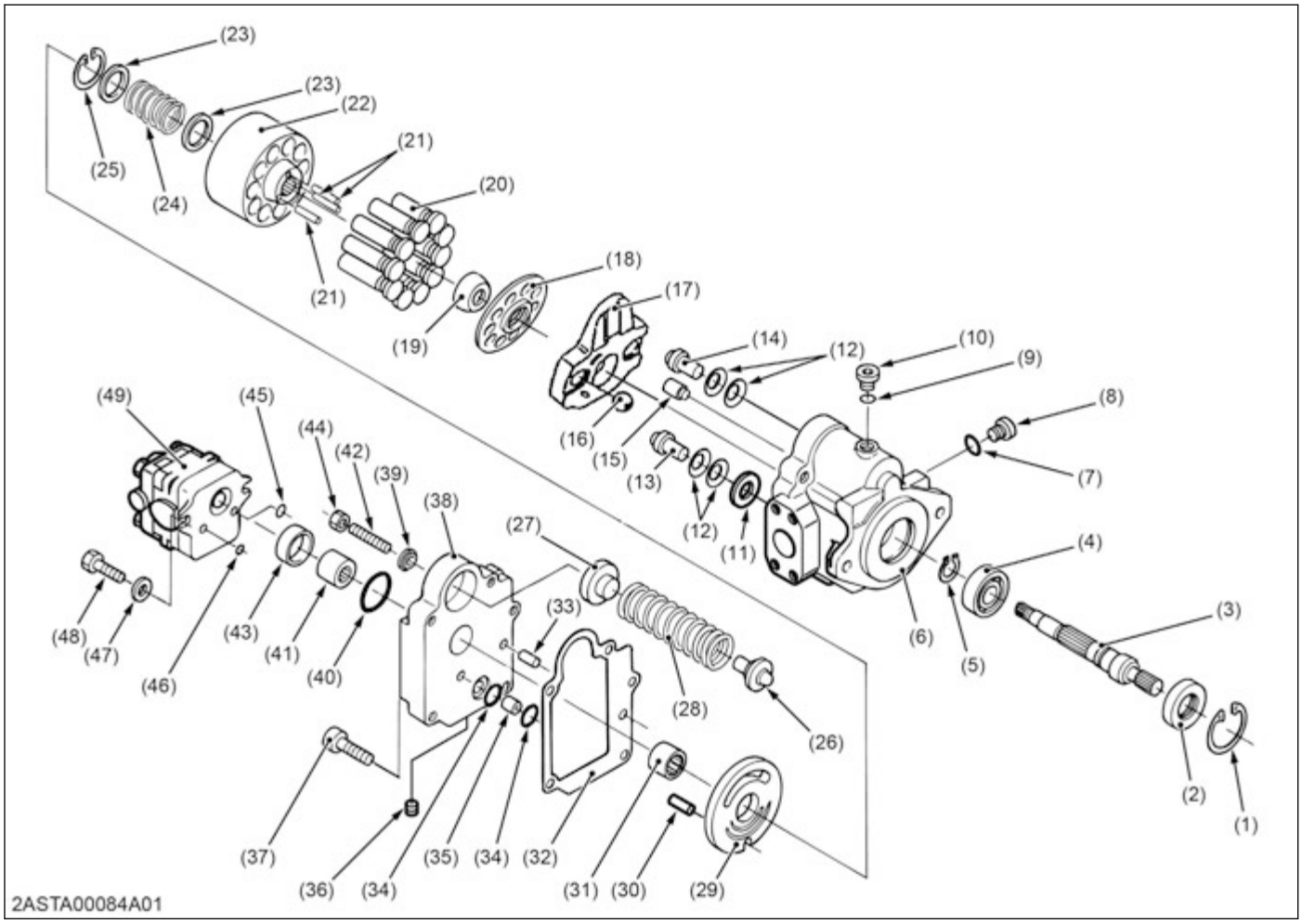
| | |
|---|---|
| (7) Hydraulic pump | Approximately 18 kg<br>Approximately 40 lbs |

## Installing

### Tightening torque

| | | |
|---|---|---|
| (8) Bolt | 77.5 to 90.2 N·m<br>7.9 to 9.2 kgf·m<br>57.2 to 66.5 lbf·ft | - |

## 4.1.2 Hydraulic pump components



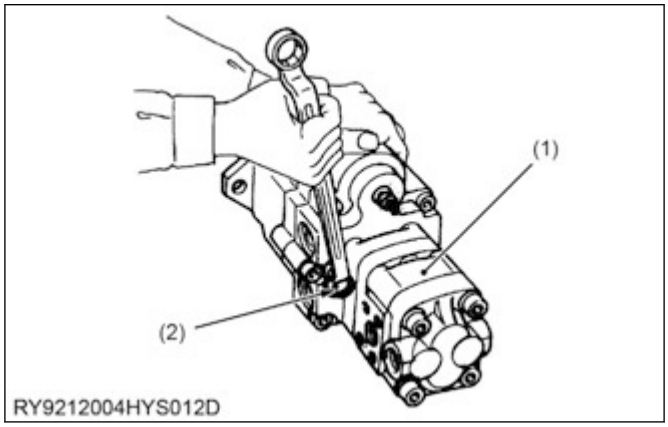

(1) Internal circlip
(2) Oil seal
(3) Shaft
(4) Ball bearing
(5) External circlip
(6) Body S
(7) O-ring
(8) Plug
(9) O-ring
(10) Plug
(11) Metal washer
(12) Spring plate ×4
(13) Stopper pin B
(14) Stopper pin A
(15) Control pin
(16) Ball ×2
(17) Swash plate
(18) Shoe holder
(19) Barrel holder
(20) Piston, ASSY ×10
(21) Pin ×3
(22) Cylinder block
(23) Retainer ×2
(24) Spring
(25) Internal circlip
(26) Spring holder
(27) Spring guide
(28) Compression spring
(29) Valve plate
(30) Spring pin
(31) Needle bearing
(32) Gasket
(33) Pin
(34) O-ring ×2
(35) Hole pin
(36) Plug
(37) Cap bolt ×5
(38) Body H
(39) Washer
(40) O-ring
(41) Coupling
(42) Adjusting screw
(43) Collar
(44) Lock nut
(45) O-ring
(46) O-ring
(47) Washer ×2
(48) Bolt ×2
(49) Gear pump

## 4.1.3 Disassembling the piston pump

**IMPORTANT**

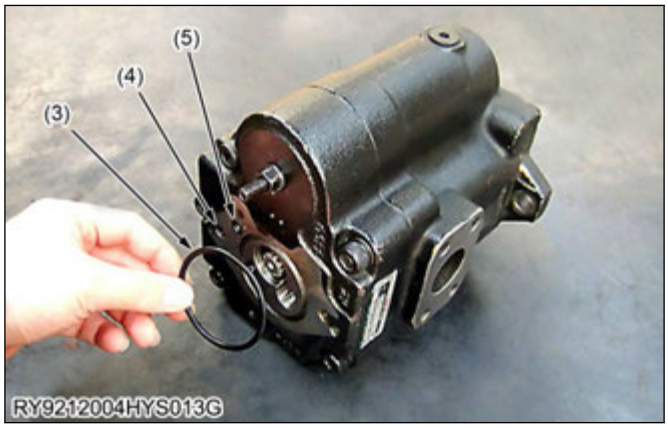
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

1. Remove the 2 bolts and remove the gear pump.




(1) Gear pump
(2) Bolt (M8 × 25)

2. Remove the O-rings.

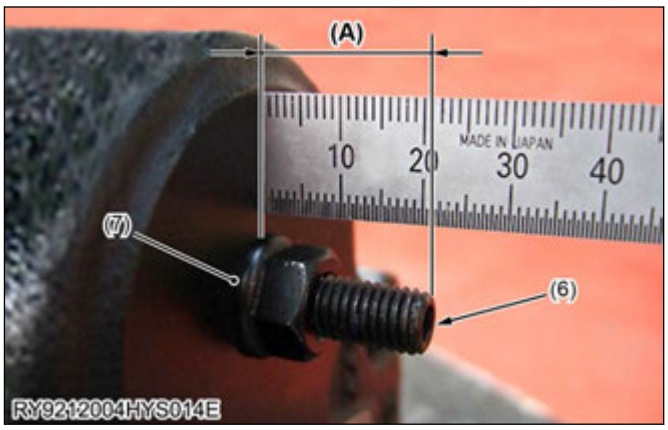



(3) O-ring
(4) O-ring
(5) O-ring

3. Measure length of the adjusting screw.

**IMPORTANT**

- **Note the set-length of adjusting screw before loosening.**
- **Horse power control performance depends on set-length of adjusting screw.**




(6) Adjusting screw
(7) Locknut
(A) Set-length

4. Remove the nut and adjusting screw.

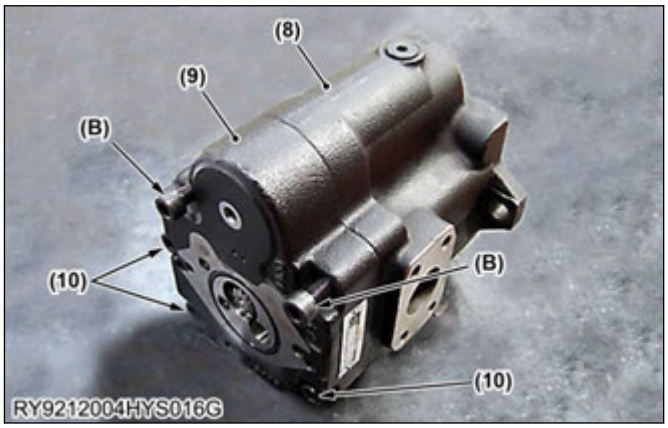



(6) Adjusting screw

5. Remove the 2 cap bolts from upper side.
6. Install the 2 slightly longer cap bolts (for stopper) loosely.

**NOTE**

- **Insert the cap bolts for only 10 mm (0.39 in.).**



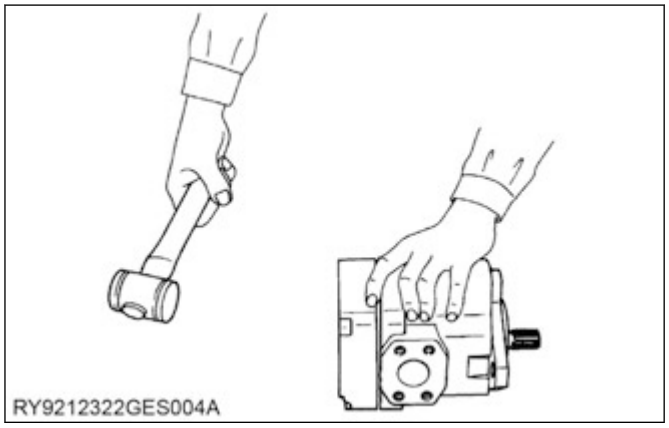

(8) Body S
(9) Body H
(10) Cap bolt (M10 × 45) ×5
(B) Cap bolt (M10 × 65) ×2

7. Remove 3 cap bolts from lower side.

8. Separate body H and body S.

**■ NOTE**

- **If it is difficult to remove the body H, hit with the plastic hammer slightly to give a shock.**

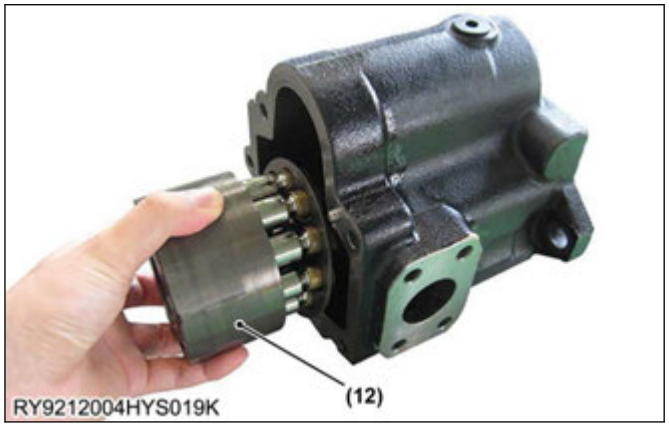



9. Remove 2 cap bolts (for stopper) from upper side.
10. Remove the valve plate, gasket, compression spring, and O-ring.



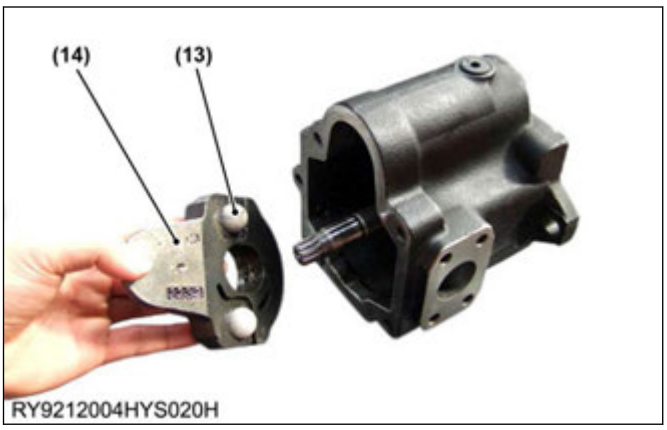

(11) Compression spring

11. Remove the cylinder block.



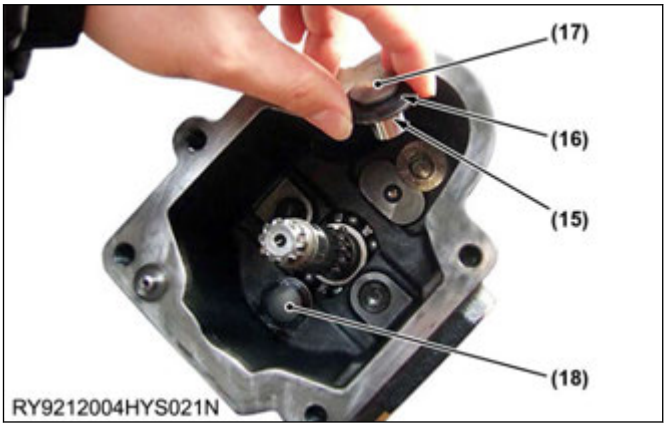

(12) Cylinder block

12. Remove the spring holder, swash plate, and ball.



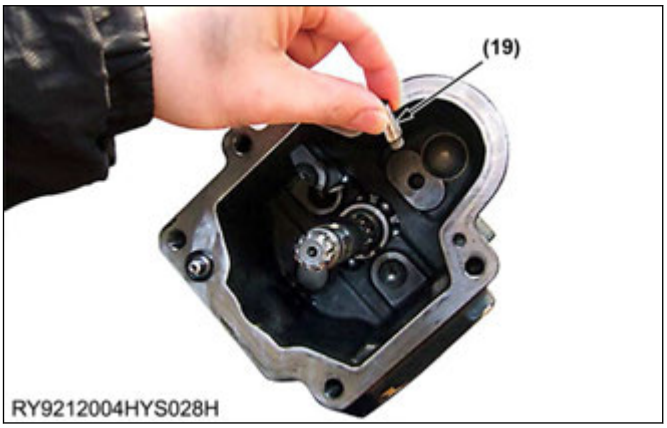

(13) Ball
(14) Swash plate

13. Remove the stopper pin A, stopper pin B, diaphragm springs, metal, and washer.



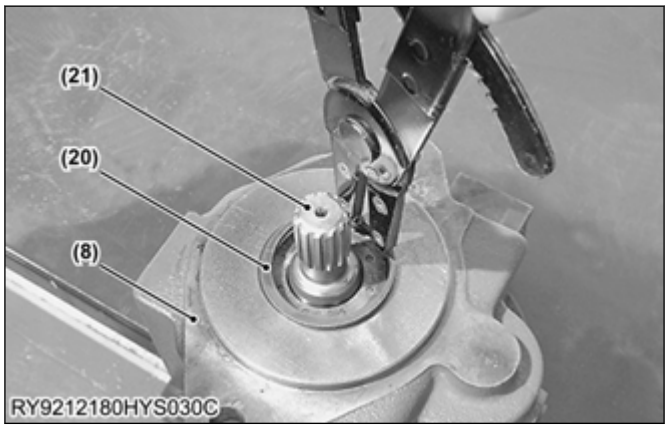

(15) Metal washer
(16) Diaphragm spring ×2
(17) Stopper pin A
(18) Stopper pin B

14. Remove the control pin.




(19) Control pin

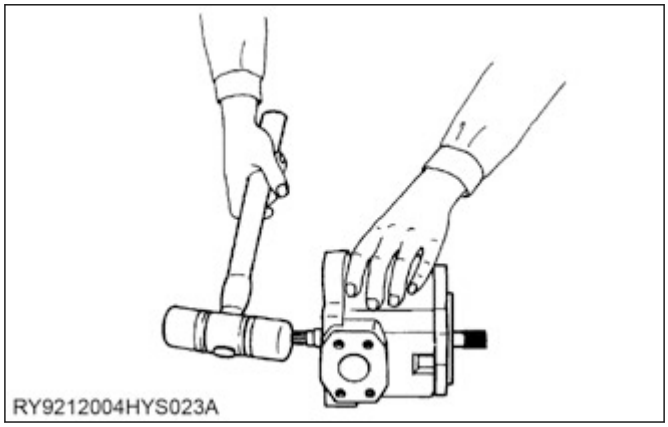
15. Remove circlip from body S.



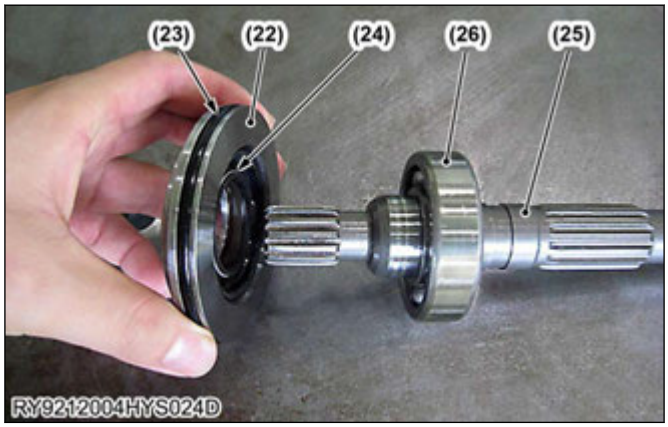

(8) Body S
(20) Circlip
(21) Shaft

16. Hit the shaft with hammer to remove the shaft, seal holder (with oil seal and O-ring), and ball bearing.

**NOTE**
- **Use the plastic hammer only.**




17. Remove the seal holder from the shaft.
18. Remove the O-ring and oil seal from the shaft.



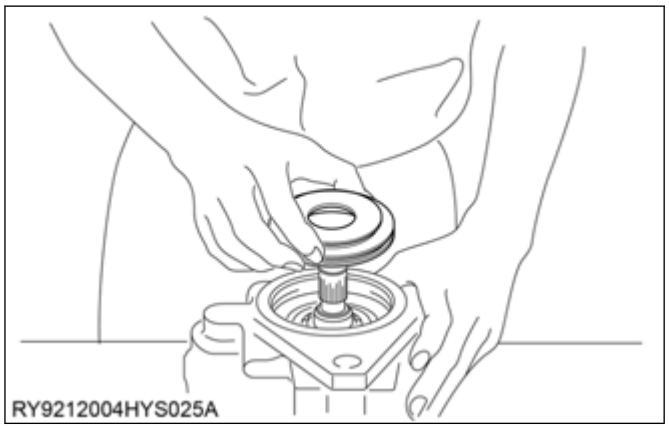

(22) Seal holder
(23) O-ring
(24) Oil seal
(25) Shaft
(26) Ball bearing

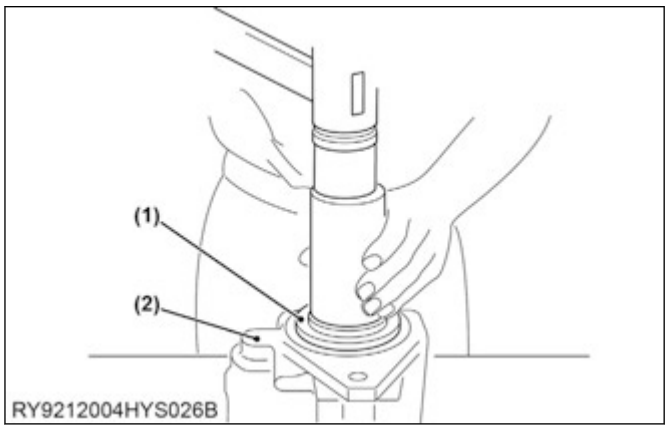
## 4.1.4 Assembling the piston pump

**IMPORTANT**
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **To avoid seizure and rust, apply lubricants or greases to every seal and part surface when assembling.**
- **After assembling, clean the out side of hydraulic component.**
- **To prevent seizure and cavitation after assembling, fill the hydraulic oil from the lubrication port fully.**

1. Install the shaft (with ball bearing), oil seal, and internal circlip in order to the body S.

**■ NOTE**
- **Grease the oil seal and O-ring.**
- **Use the seal holder installation jig and plastic hammer to install the seal holder.**

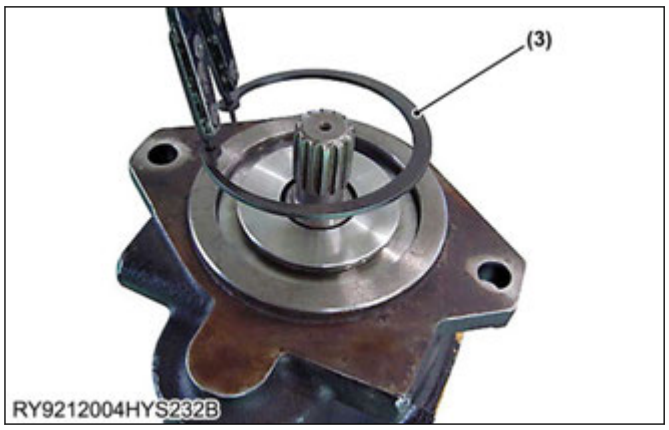



(1) Seal holder (2) Body S

2. Install the internal circlip.

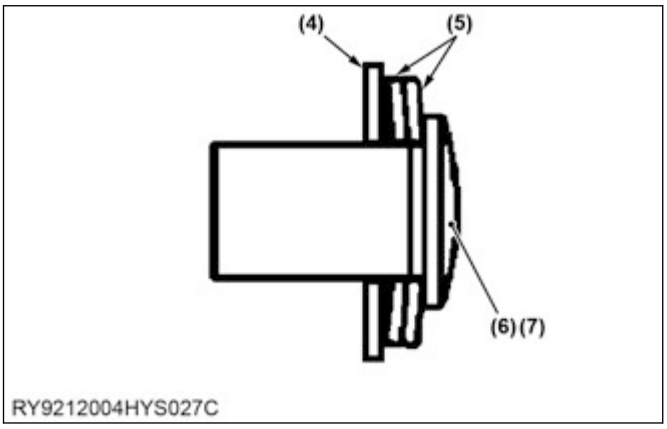
**■ NOTE**
- **Set the curved surface to the seal holder side.**




(3) Internal circlip

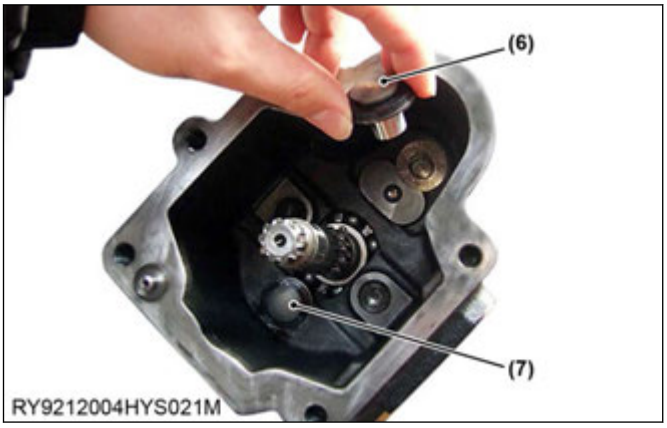
3. Install the two diaphragm springs and metal washer to stopper pin A and stopper pin B.

**■ NOTE**
- **Make sure to install the diaphragm spring and metal washer in correct direction.**



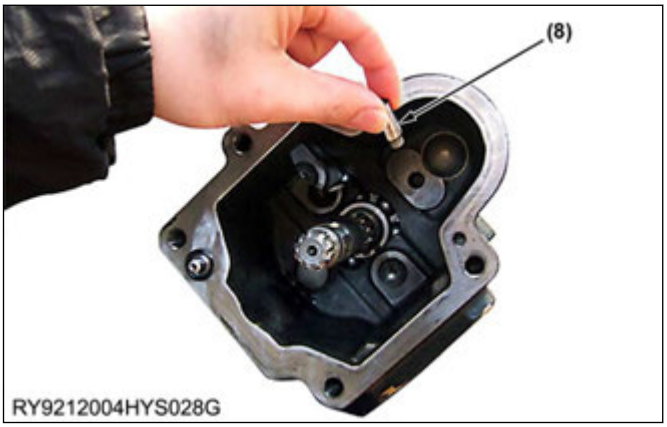

(4) Metal washer (7) Stopper pin B
(5) Diaphragm spring
(6) Stopper pin A

4. Install the stopper pin A and stopper pin B to body S.




(6) Stopper pin A (7) Stopper pin B

5. Install the control pin to the body S.

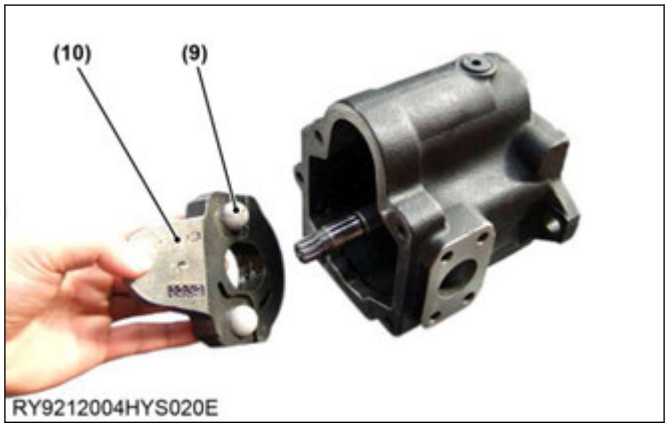



(8) Control pin

6. Install the ball to the swash plate.

**NOTE**
- **Grease the ball to avoid ball from coming off.**

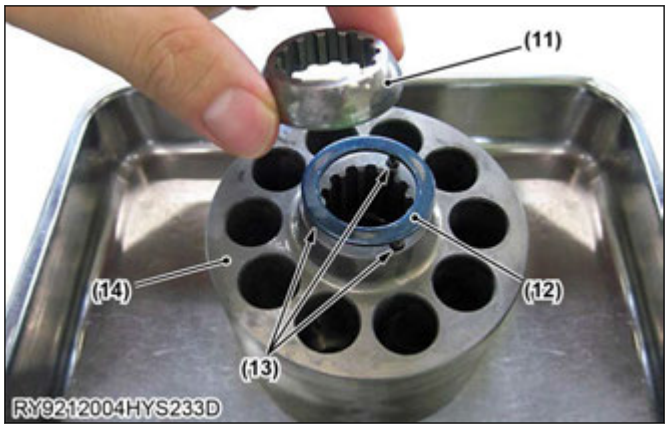
7. Install the swash plate.




(9) Ball
(10) Swash-plate

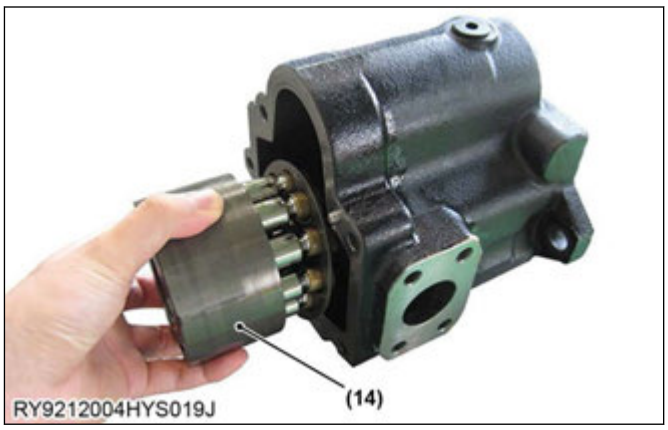
8. Install the needle, three pins, washer, and shoe holder to the cylinder block.

**NOTE**
- **Apply hydraulic oil to the each part to avoid seizure and rust.**




(11) Shoe holder
(12) Washer
(13) Pin
(14) Cylinder block

9. Install the cylinder block.




(14) Cylinder block

10. Install the spring holder to the compression spring.

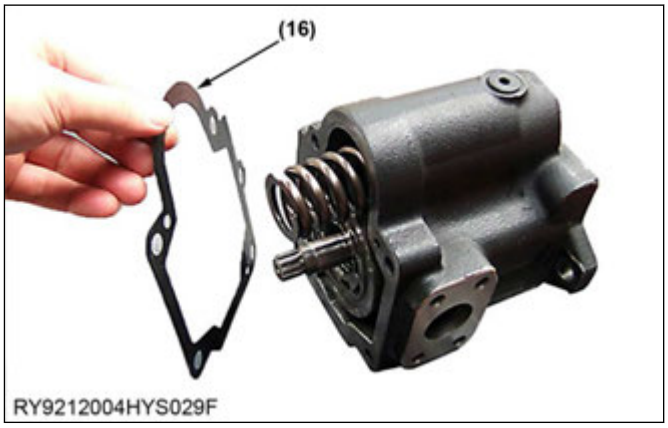
**NOTE**
- **Grease the spring holder.**

11. Install the compression spring to the swash plate.




(15) Compression spring

12. Install the gasket to the mating surface.

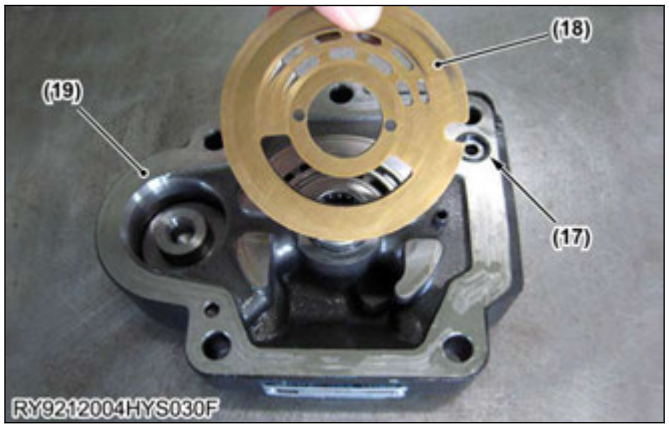



(16) Gasket

13. Install the valve plate.

**NOTE**
- **Make sure to install the valve plate in correct direction.**
- **Apply hydraulic oil to the valve plate.**

- **Set the valve plate gently to avoid damaging.**



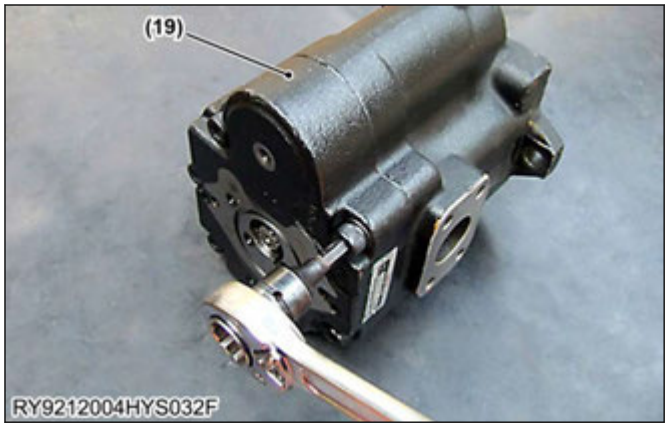

(17) O-ring
(18) Valve plate
(19) Body H

14. Install the two slightly longer cap bolts to upper side.




(A) Cap bolt

15. Install the three cap bolts to lower side.
16. Remove the two longer cap bolts from upper side to replace to the regular two cap bolts.
17. Tighten five cap bolts with the specified torque.




(19) Body H

**Tightening torque**

| | | |
|---|---|---|
| Cap bolt | 51.0 to 64.7 N·m<br>5.2 to 6.6 kgf·m<br>37.6 to 47.7 lbf·ft | - |

18. Tighten the adjusting screw with the specified torque.

**■ IMPORTANT**

- **Set-length should be exactly same as before disassembling.**



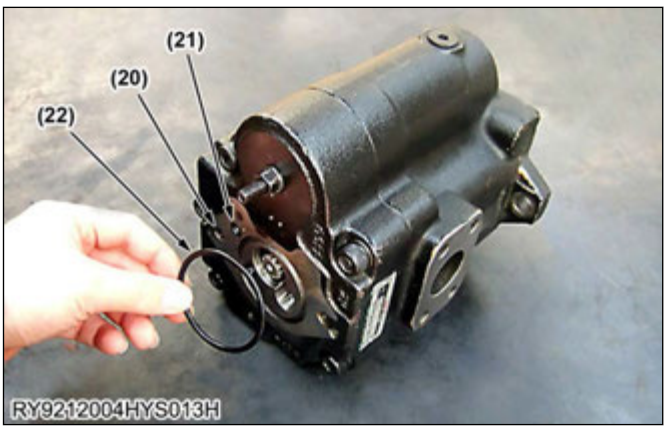

**Tightening torque**

| | | |
|---|---|---|
| Lock nut | 14.7 to 19.6 N·m<br>1.5 to 2.0 kgf·m<br>10.8 to 14.5 lbf·ft | - |

19. Install the O-rings.

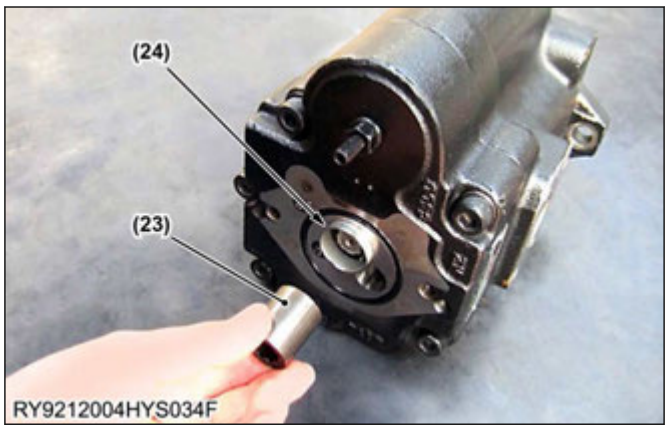
**■ NOTE**

- **Grease the O-rings.**




(20) O-ring
(21) O-ring
(22) O-ring

20. Install the collar and the coupling.

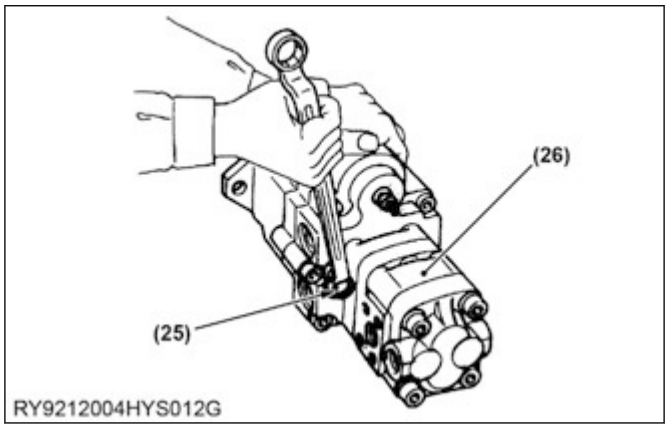



(23) Coupling (24) Collar

21. Install the gear pump.

**■ NOTE**

- **After reassembling, make sure that the hydraulic pump is rotating smoothly.**

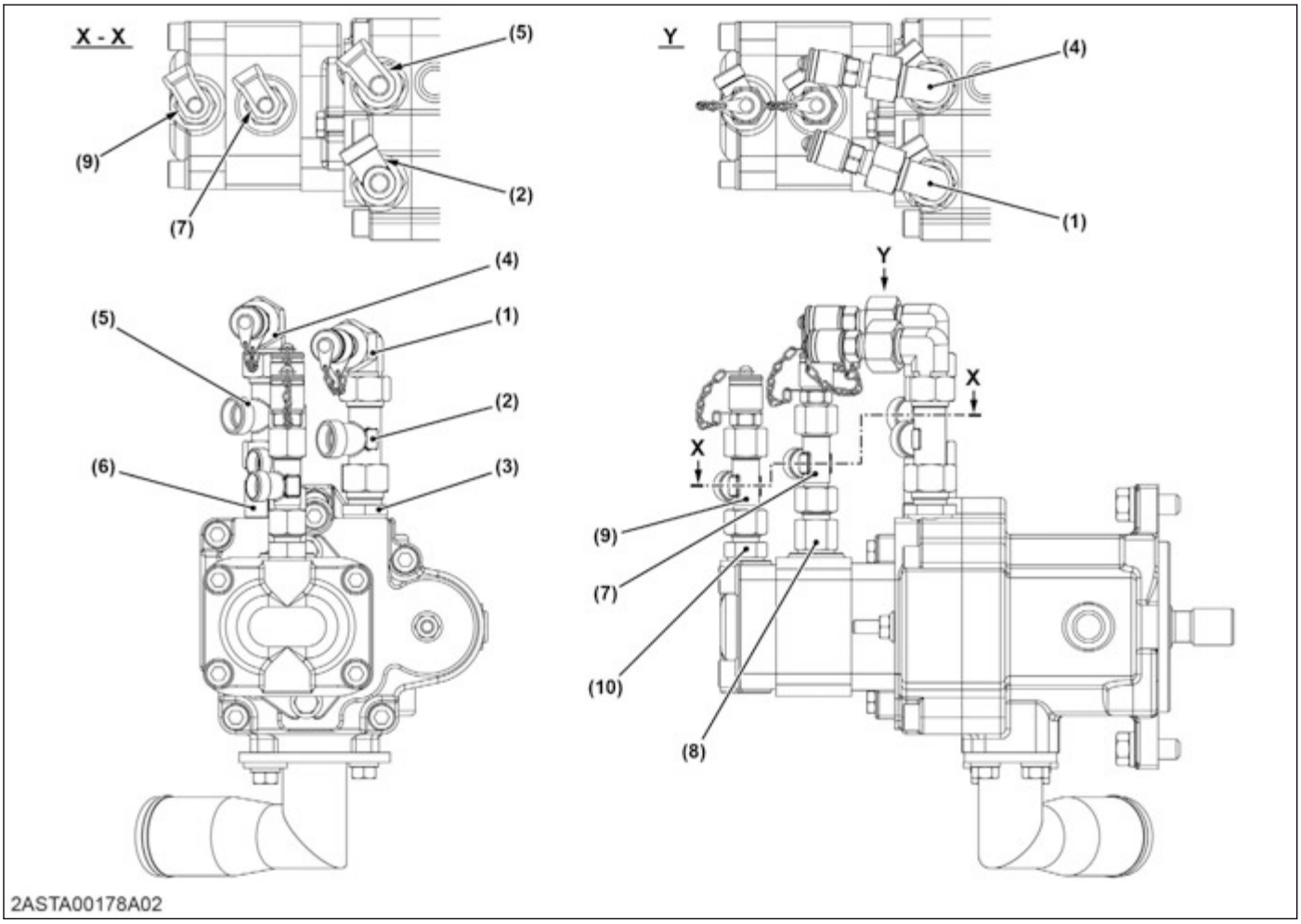



(25) Bolt (M8 × 25) ×2 (26) Gear pump

**Tightening torque**

| | | |
|---|---|---|
| (25) Bolt | 19.6 to 23.5 N·m<br>2.0 to 2.4 kgf·m<br>14.5 to 17.4 lbf·ft | - |

## 4.1.5 Installing adapter layout for the hydraulic pump

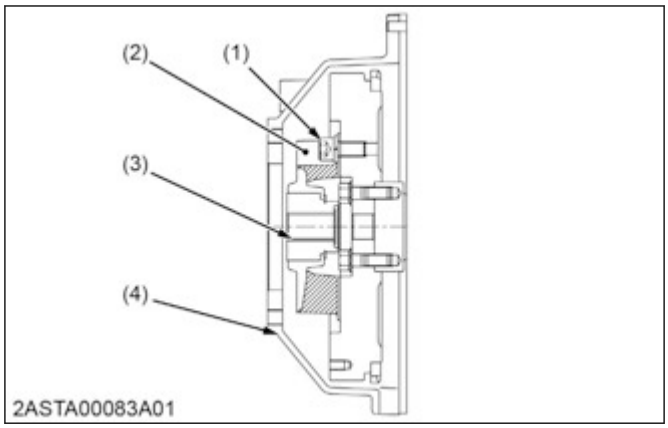



| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (1) | M22-M22 | 18° | (6) | G1/2-M22 | - |
| (2) | M22-M22-M22 | 58° | (7) | M18-M18-M18 | 58° |
| (3) | G1/2-M22 | - | (8) | G3/8-M18 | - |
| (4) | M22-M22 | 10° | (9) | M18-M18-M18 | 60° |
| (5) | M22-M22-M22 | 50° | (10) | G3/8-M18 | - |

## 4.1.6 Installing hydraulic pump coupling

1. Grease the spline.
2. Grease coupling seating surface a little and tighten the bolts.

**■ IMPORTANT**
- **Grease the spline of the pump coupling.**
- **Do not grease the pump coupling body.**
- **Do not apply thread lock.**

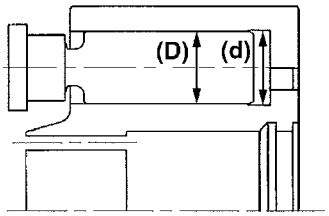
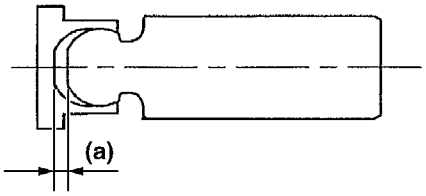
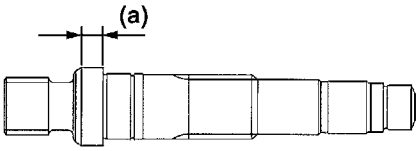



(1) Bolt
(2) Coupling
(3) Spline
(4) Housing

**Tightening torque**

| | | |
|---|---|---|
| (1) Bolt | 103.0 to 117.7 N·m<br>10.5 to 12.0 kgf·m<br>76.0 to 86.8 lbf·ft | - |

### 4.1.7 Hydraulic pump maintenance standard

| Parts | Maintenance | Service limits |
|---|---|---|
| Piston<br>Cylinder block<br>Valve plate | Check the clearance between the piston and cylinder block.<br>  <br><br>RY9212004HYS035A<br>■ **NOTE**<br>• **Clearance is the difference between (d) and (D).** | 0.05 mm<br>0.002 in. |
| | Check the play (a) between the piston and shoe.<br>  <br><br>RY9212004HYS036A | 0.2 mm<br>0.008 in. |
| Shaft | Check the wear amount of oil seal installing location (a).<br>  <br><br>RY9212004HYS037A | 0.25 mm<br>0.01 in. |

## 4.2 Control valve

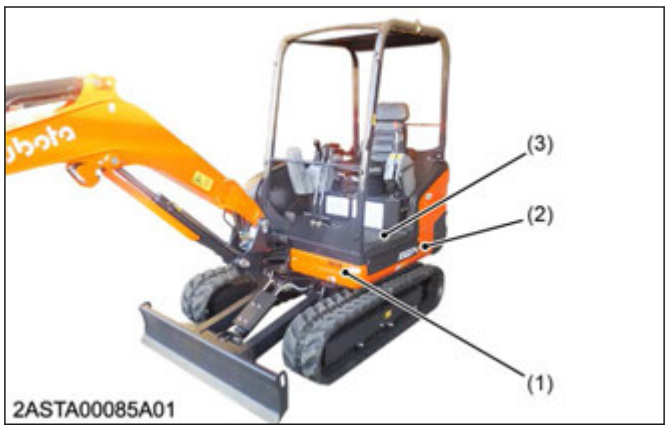
### 4.2.1 Removing and installing the control valve

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ **IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

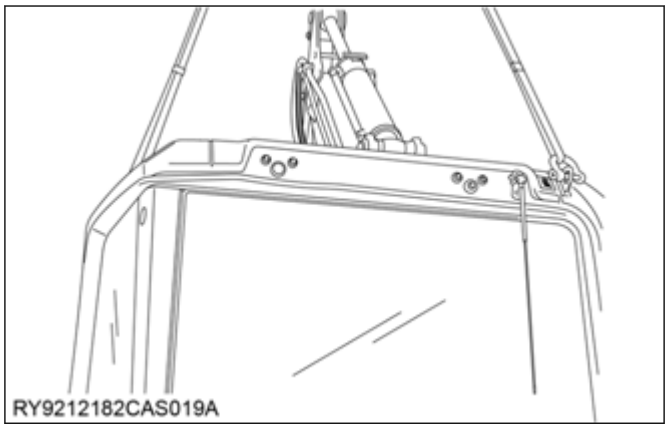
**Preparing**
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**
1. Remove the front swivel cover.
2. Remove the LH swivel cover.
3. Remove the step cover and step plate.




(1) Front swivel cover
(2) LH swivel cover
(3) Step cover and step plate

4. Remove the cabin or canopy.



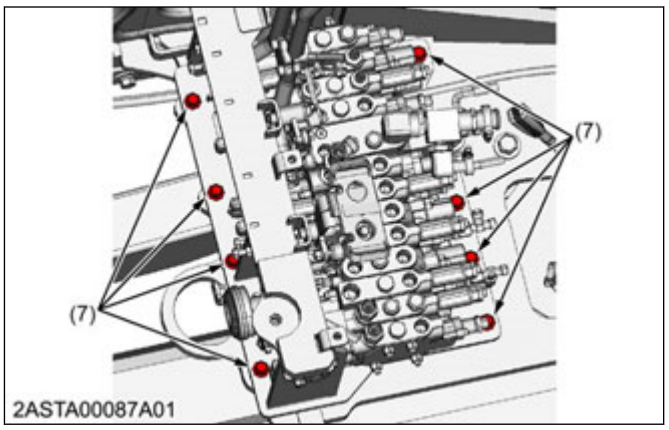

5. Disconnect all of the hydraulic hoses, mechanical links, and wire harnesses.




(4) Hydraulic hose
(5) Wire harness
(6) Mechanical link

**IMPORTANT**
- **Put a mark on disconnected hydraulic hoses to reconnect each hose correctly.**

6. Remove the 8 bolts.



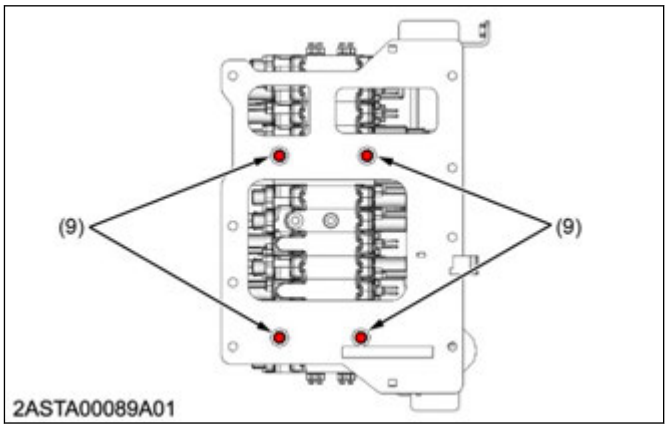

(7) Bolt (M10 × 25) ×8

7. Attach a nylon sling and hoist the control valve.




(8) Nylon sling

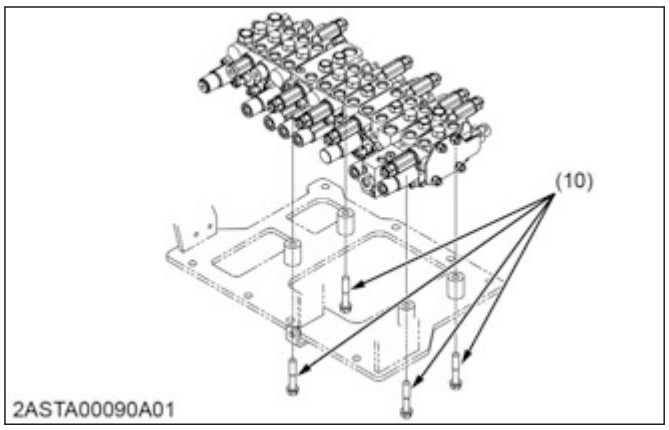
8. Remove the 4 bolts.




(9) Bolt (M10 × 55) ×4

## Installing

1. Tighten the 4 bolts with the specified torque.

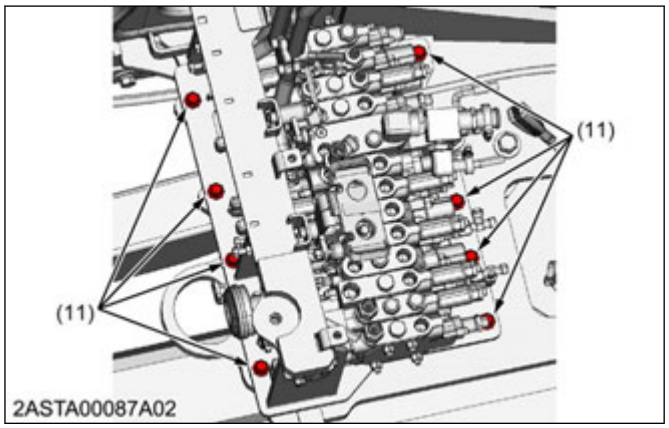



(10) Bolt (M10 × 55) ×4

### Tightening torque

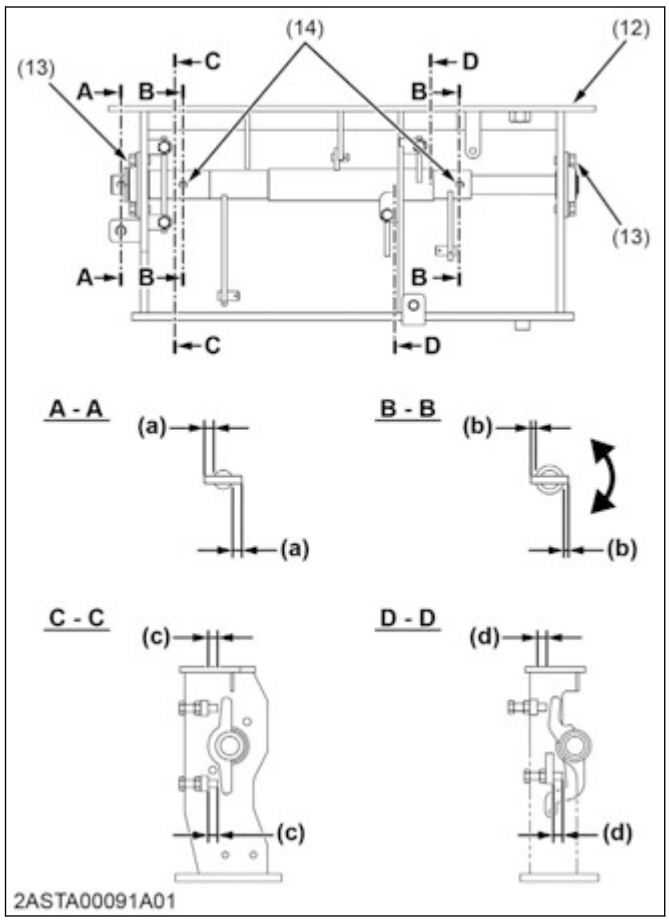
| | | |
|---|---|---|
| (10) Bolt | 48.1 to 55.9 N·m<br>4.9 to 5.7 kgf·m<br>35.5 to 41.2 lbs·ft | Thread lock<br>(Loctite 301-70) |

2. Tighten the 8 bolts.




(11) Bolt (M10 × 25) ×8

3. Adjust the control valve bracket.

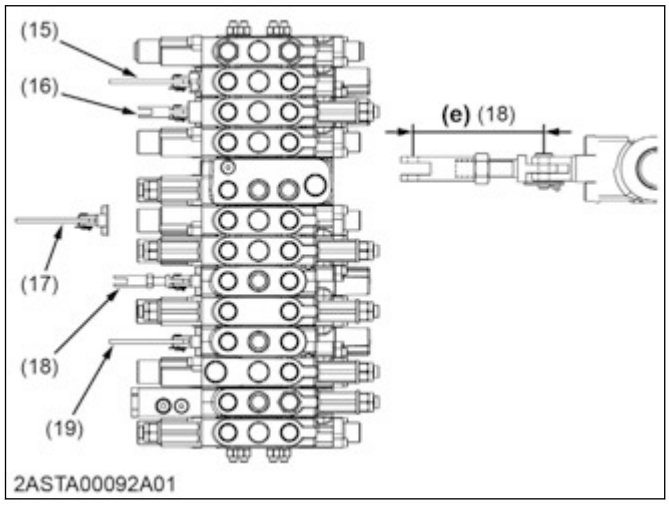



(12) Bracket
(13) Flange bearing
(14) Slit

### Adjusting dimensions

| | | | |
|---|---|---|---|
| (a) | 10 mm<br>0.39 in. | (c) | 10 mm<br>0.39 in. |
| (b) | 5 mm<br>0.20 in. | (d) | 10 mm<br>0.39 in. |

4. Connect the links.




(15) Swing link
(16) Blade link
(17) AUX1 link (Basic only)
(18) Travel LH link
(19) Travel RH link

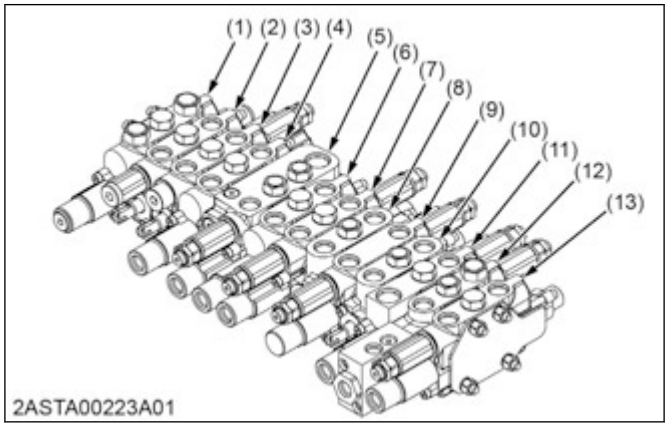
**Adjusting dimension**

| | |
|---|---|
| (e) | 119 mm<br>4.7 in. |

5. Connect the hydraulic hoses and wire harness.
6. Install the cabin or canopy.
7. Install the LH and front swivel cover.
8. Install the step cover and step plate.

## 4.2.2 Control valve components

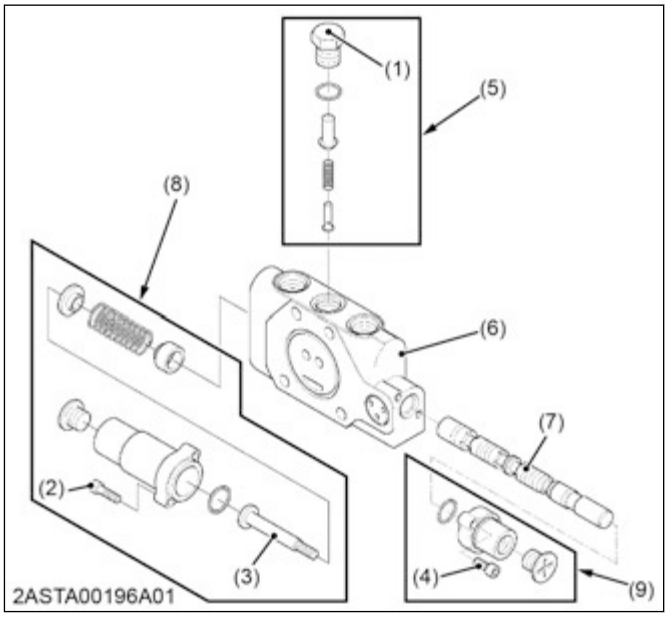
### 4.2.2.1 Control valve section components




(1) AUX 2 (Hi-spec only)
(2) Swing
(3) Blade
(4) Swivel
(5) Confluence valve
(6) AUX 1
(7) Arm
(8) Travel LH
(9) Inlet
(10) Travel RH
(11) Boom
(12) Boom lock section
(13) Bucket

**NOTE**
- **This control valve is for Hi-spec.**

### 4.2.2.2 Control valve AUX2 section (Hi-spec only)

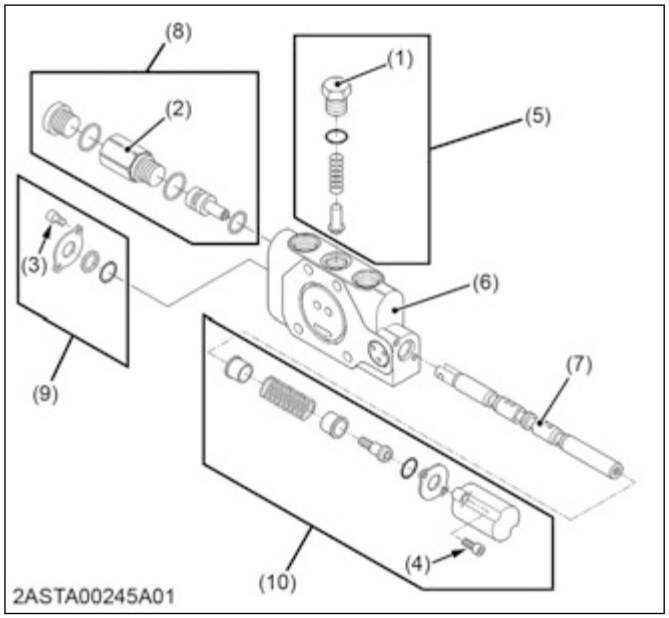



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cap assembly
(9) Cap assembly

**Tightening torque**

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.3 Control valve swing section

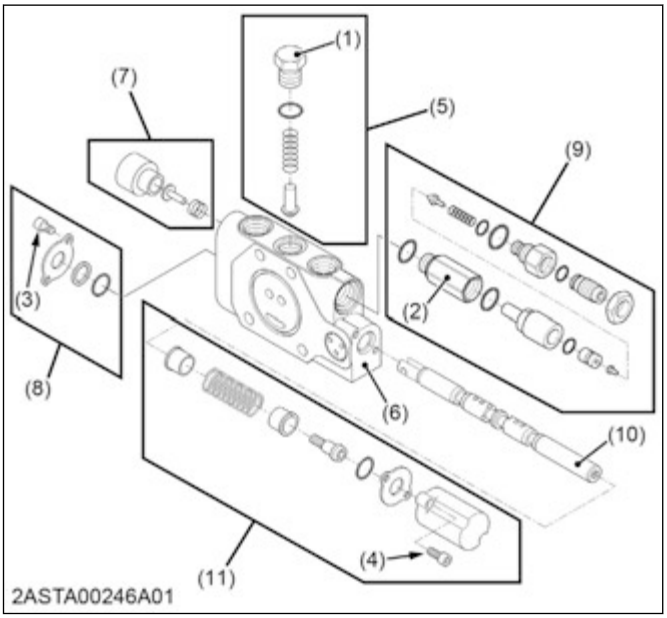



(1) Plug
(2) Anti-cavitation valve
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Anti-cavitation valve assembly
(9) Cover assembly
(10) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Anti-cavitation valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | Thread lock |
| (4) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | - |

## 4.2.2.4 Control valve blade section

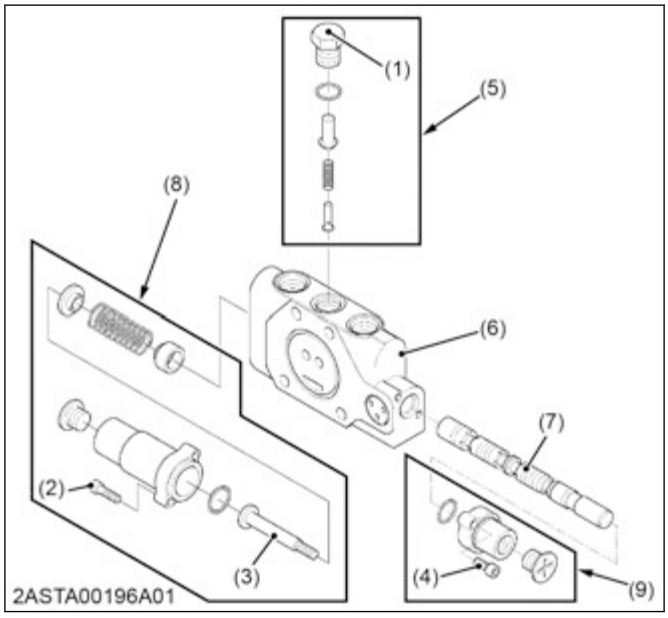



(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Cap assembly
(8) Cover assembly
(9) Overload relief valve assembly
(10) Spool
(11) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Adapter | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.5 Control valve swivel section

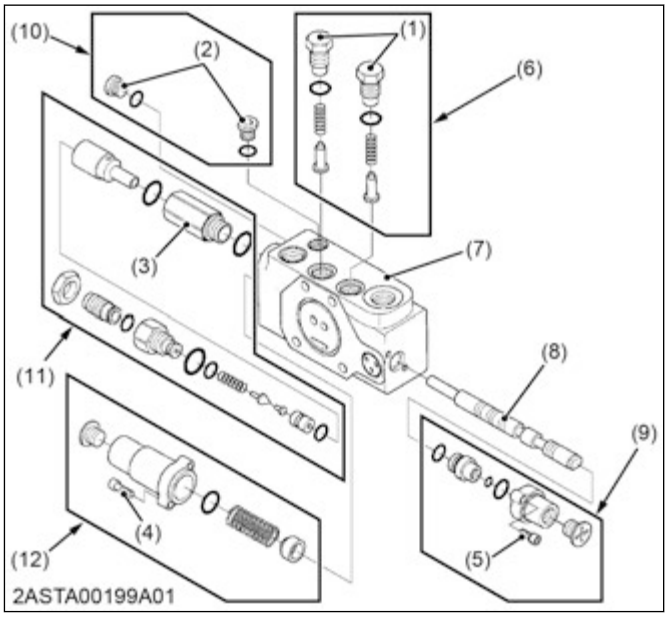



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.6 Control valve confluence valve section



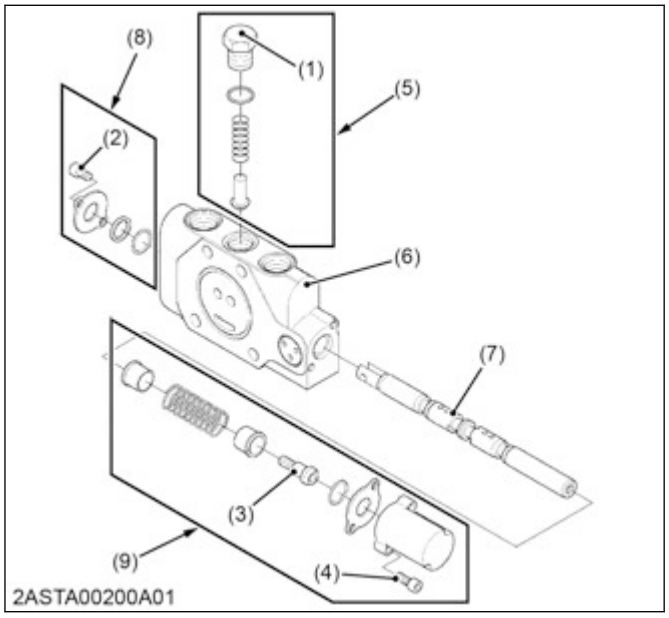

(1) Plug ×2
(2) Plug ×2
(3) Relief valve
(4) Bolt
(5) Bolt
(6) Plug assembly 1
(7) Valve body
(8) Spool
(9) Cap assembly
(10) Plug assembly
(11) Relief valve assembly
(12) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Plug | 17.61 to 18.59 N·m<br>1.80 to 1.90 kgf·m<br>12.94 to 13.66 lbf·ft | - |
| (3) Relief valve | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | - |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (5) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.7 Control valve AUX1 section

### Basic

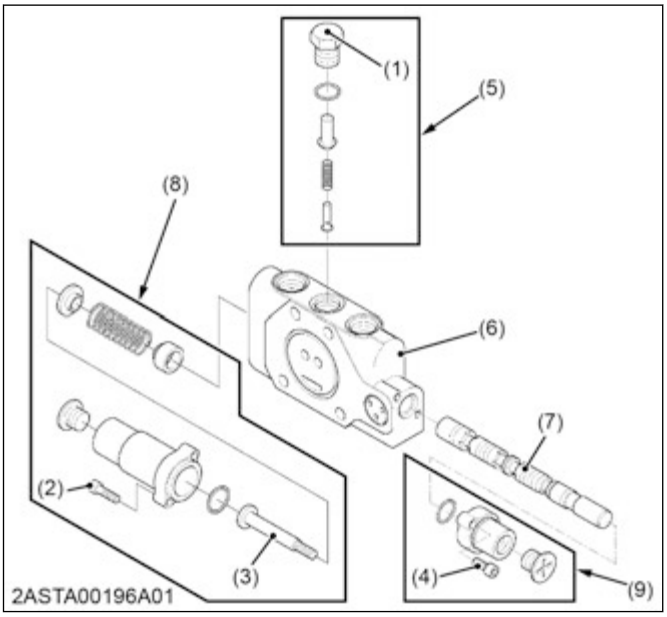



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

#### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

### Hi-spec

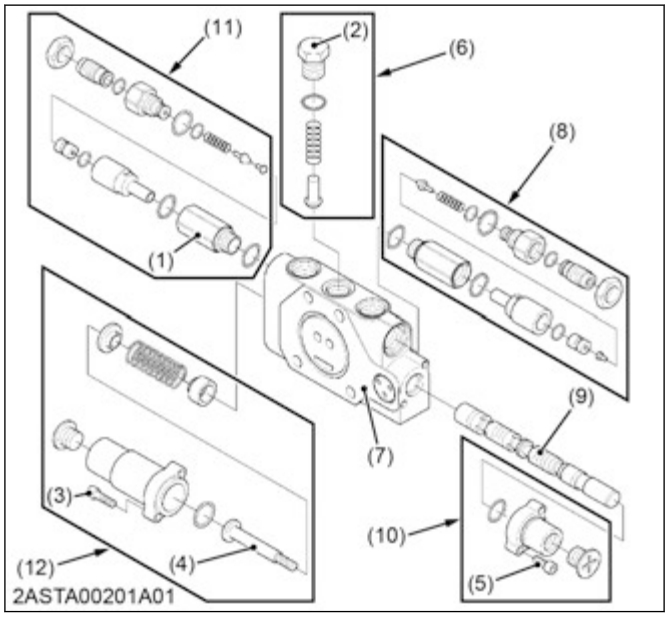



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cap assembly
(9) Cap assembly

#### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.8 Control valve arm section

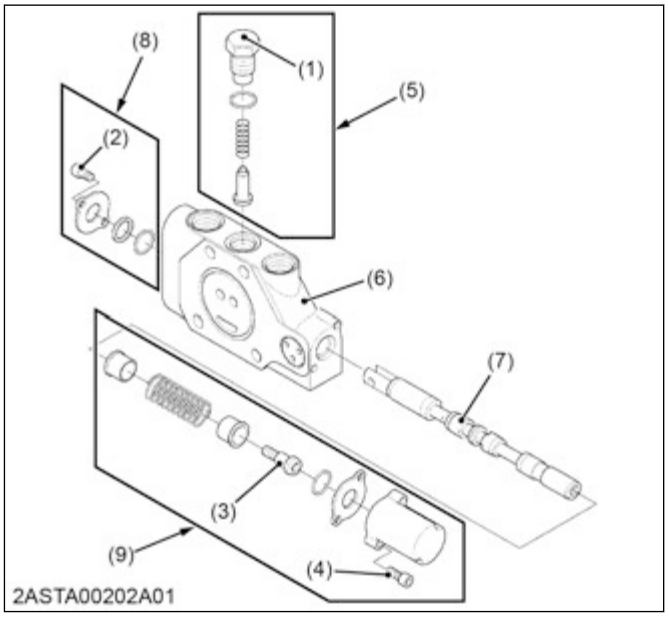



(1) Relief valve
(2) Plug
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Overload relief valve assembly
(9) Spool
(10) Cap assembly
(11) Overload relief valve assembly
(12) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (4) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (5) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.9 Control valve travel LH section

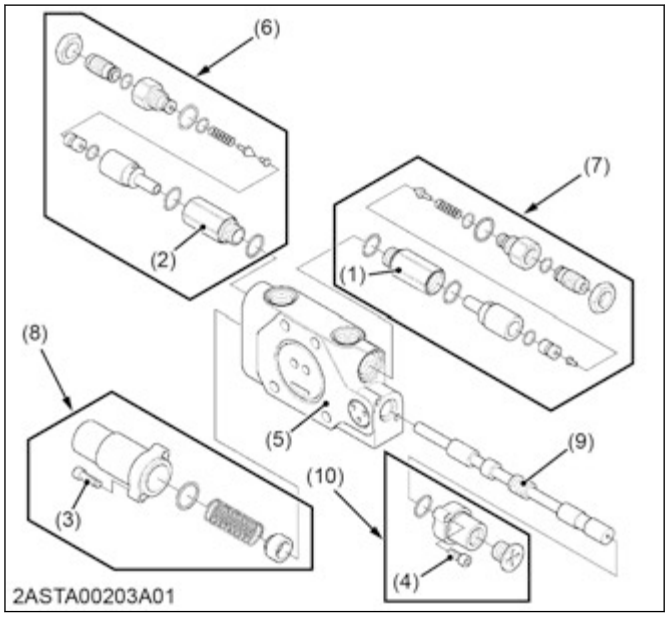



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.10 Control valve inlet section

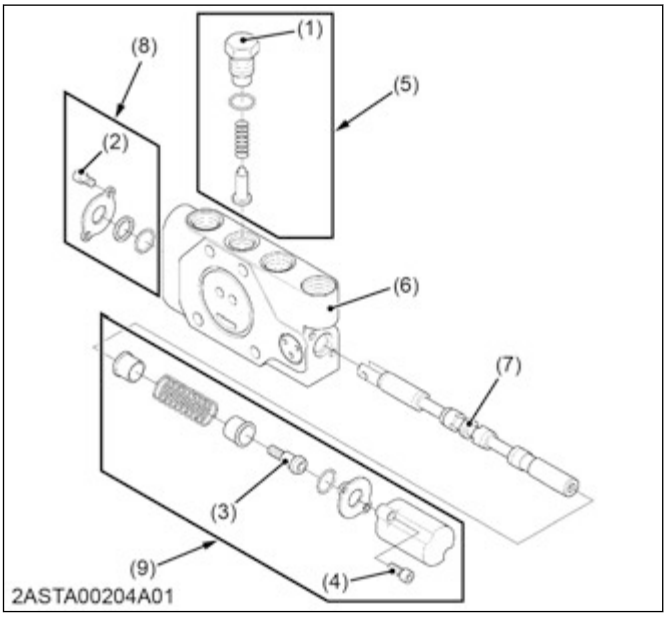



(1) Relief valve
(2) Relief valve
(3) Bolt
(4) Bolt
(5) Valve body
(6) Relief valve assembly
(7) Relief valve assembly
(8) Cap assembly
(9) Spool
(10) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.11 Control valve travel RH section

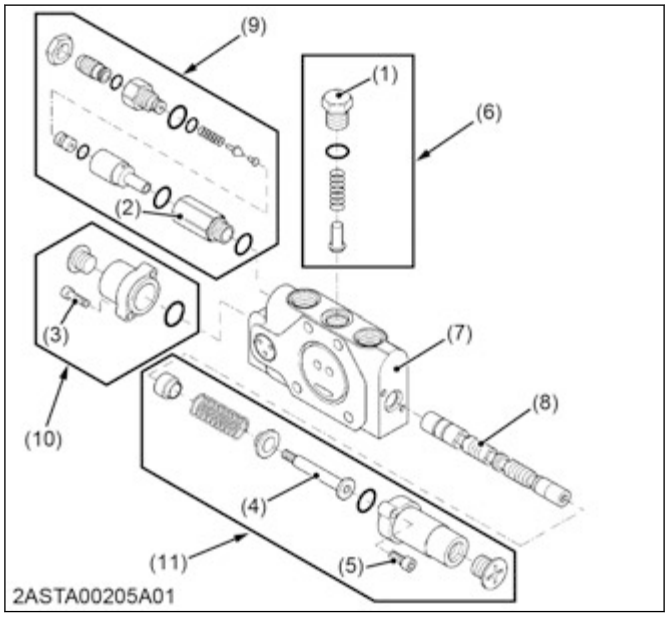



(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (3) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (4) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.12 Control valve boom section

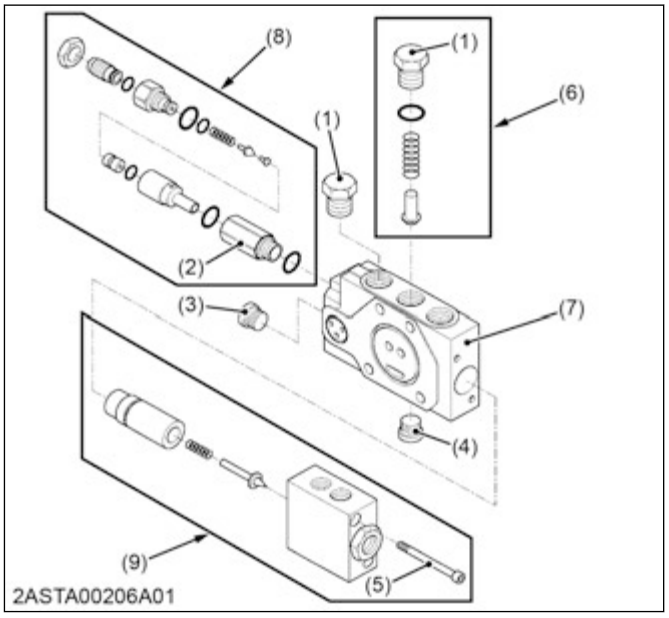



(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Spool
(9) Relief valve assembly
(10) Cap assembly
(11) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (4) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (5) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.13 Control valve boom lock section

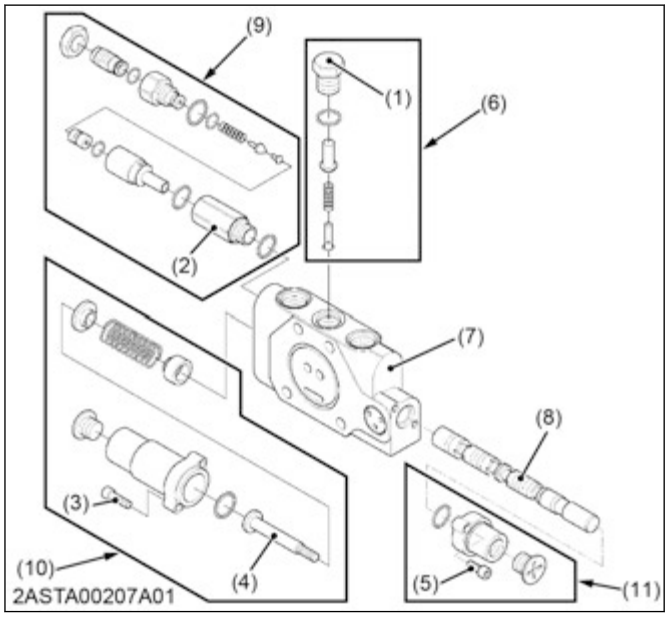



(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Relief valve assembly
(9) Boom lock valve case assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 24.55 to 29.45 N·m<br>2.50 to 3.00 kgf·m<br>18.19 to 21.81 lbf·ft | - |
| (4) Bolt | 17.61 to 18.59 N·m<br>1.80 to 1.90 kgf·m<br>12.94 to 13.66 lbf·ft | - |
| (5) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.2.14 Control valve bucket section




(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Spool
(9) Relief valve assembly
(10) Cap assembly
(11) Cap assembly

### Tightening torque

| | | |
|---|---|---|
| (1) Plug | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (2) Relief valve | 37.24 to 41.16 N·m<br>3.8 to 4.2 kgf·m<br>27.45 to 30.35 lbf·ft | - |
| (3) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |
| (4) Bolt | 3.92 to 4.90 N·m<br>0.40 to 0.50 kgf·m<br>2.89 to 3.61 lbf·ft | Thread lock |
| (5) Bolt | 5.88 to 6.86 N·m<br>0.60 to 0.70 kgf·m<br>4.34 to 5.06 lbf·ft | - |

## 4.2.3 Disassembling and assembling control valve

**■ IMPORTANT**

- **Do not reuse removed O-rings, oil seals, seal rings, and dust seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

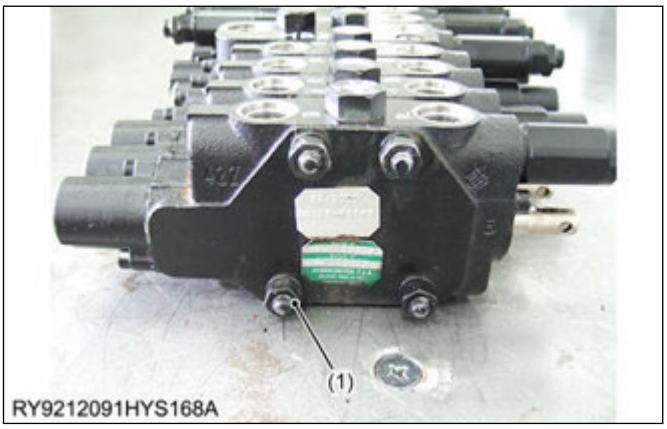
**Disassembling**

1. Remove the 4 nuts.

**■ NOTE**

- **Fix the nuts on the other side with a ring wrench.**

2. Remove the rods to disassemble each section.




(1) Nut

**Assembling**

**■ IMPORTANT**

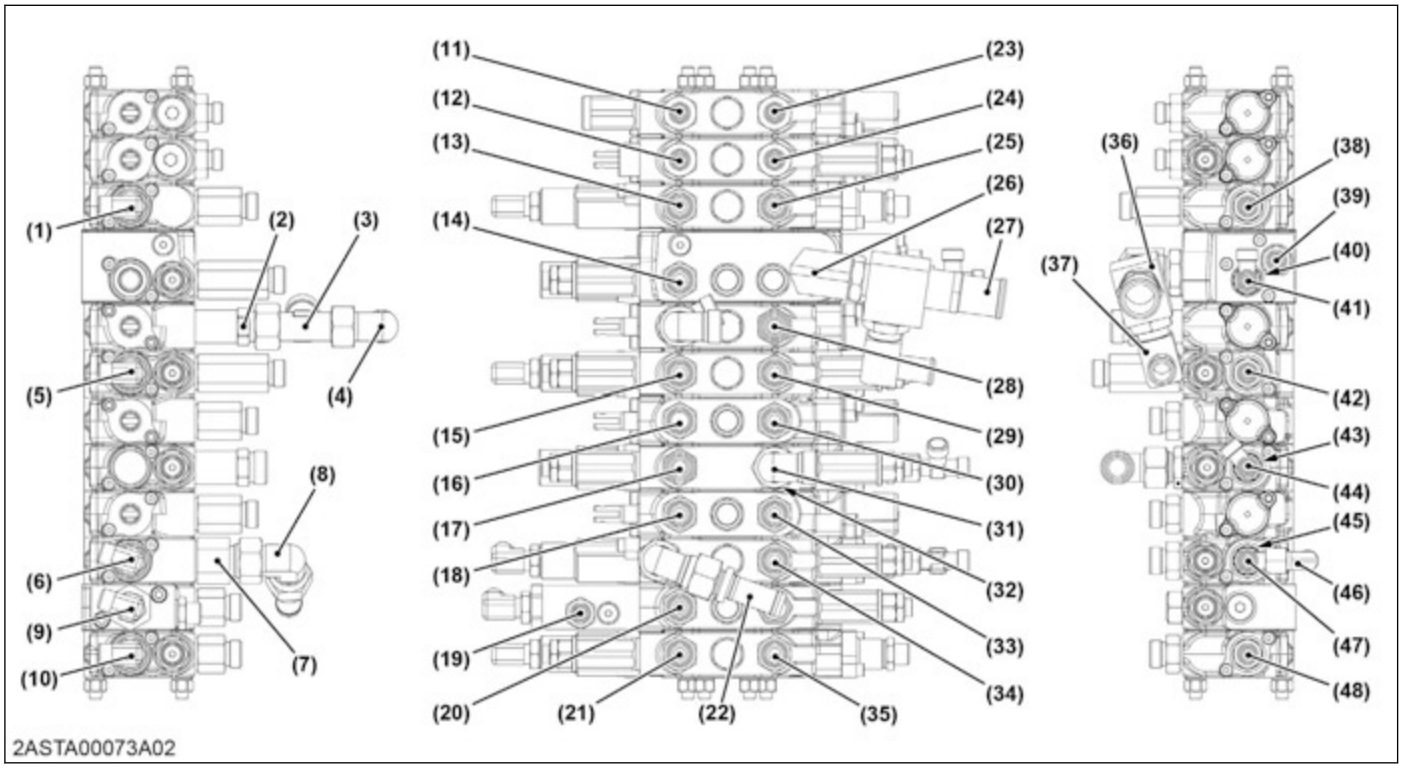
- **To avoid distortion by assembling, alternately tighten the nuts in diagonal direction, separate the tightening into 2 or 3 times and tighten each nut evenly.**

### Tightening torque

| | | |
|---|---|---|
| (1) Nut | 16.6 to 17.6 N·m<br>1.7 to 1.8 kgf·m<br>12.3 to 13.0 lbf·ft | - |

## 4.2.4 Installing adapter layout for control valve

**Basic**

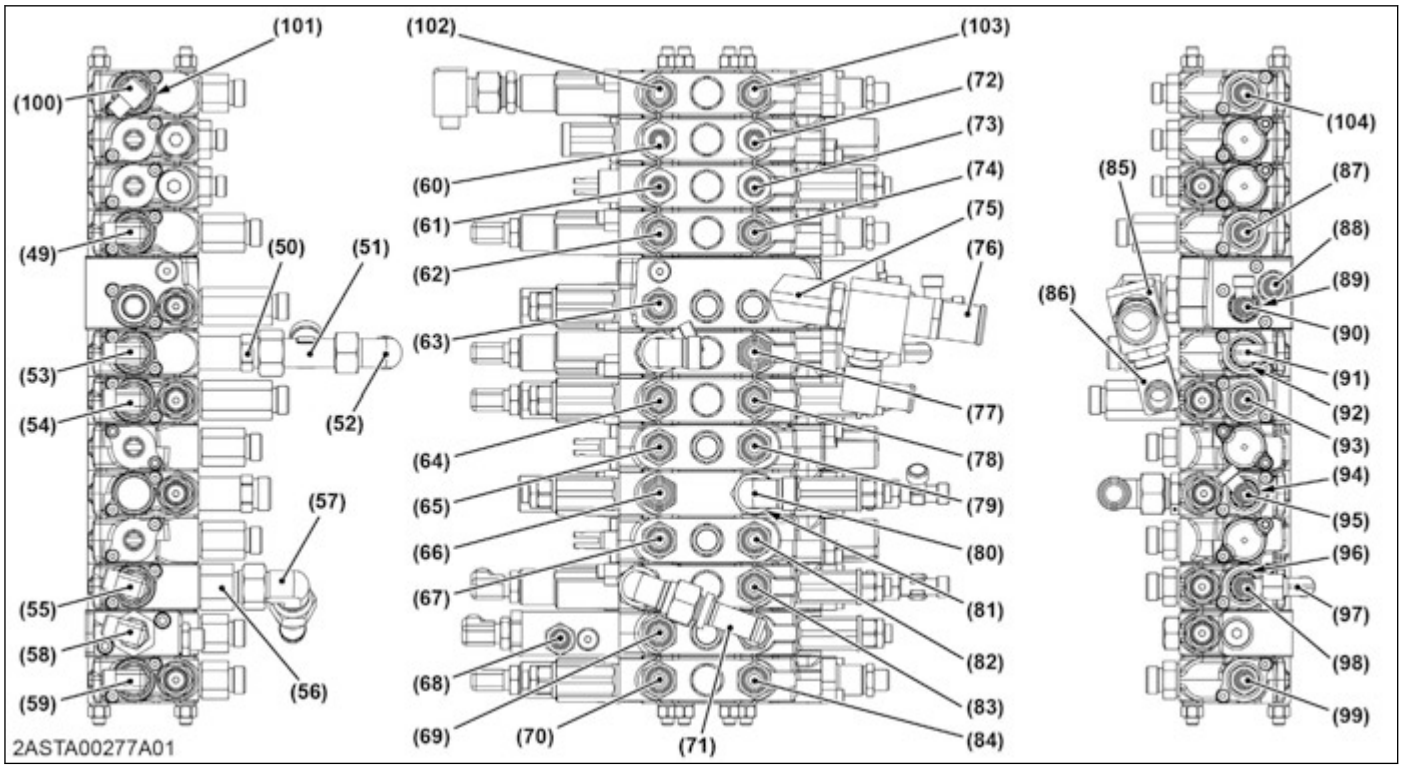



| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (1) | G1/4-M14 | - | (25) | G3/8-M18 | - |
| (2) | G3/8-M22 | - | (26) | G1/2-G1/2 | 8° |
| (3) | M22-M22-M22 | 25° | (27) | G1/2-ϕ25 (check valve) | - |
| (4) | M22-M22 | - | (28) | G3/8-M22 | - |
| (5) | G1/4-M14 | - | (29) | G3/8-M18 | - |
| (6) | G1/4-M14 | 17° | (30) | G3/8-M18 | - |
| (7) | G1/2-M22 | - | (31) | M22-M22 | - |
| (8) | M22-M22 | 20° | (32) | G3/8-M22 | - |
| (9) | G1/4-M14 | 17° | (33) | G3/8-M18 | - |
| (10) | G1/4-M14 | - | (34) | G3/8-M18 | - |
| (11) | G3/8-M14 | - | (35) | G3/8-M18 | - |
| (12) | G3/8-M14 | - | (36) | G1/2-G1/2-G1/2 | 15° |
| (13) | G3/8-M18 | - | (37) | G1/2-ϕ15.9 | - |
| (14) | G3/8-M18 | - | (38) | G1/4-M14 | - |
| (15) | G3/8-M18 | - | (39) | G1/4-M14 | - |
| (16) | G3/8-M18 | - | (40) | G1/4-M14 | - |
| (17) | G3/8-M22 | - | (41) | M14-M14-M14 | - |
| (18) | G3/8-M18 | - | (42) | G1/4-M14 | - |
| (19) | G1/4-M14 | - | (43) | G1/4-M14 | - |
| (20) | G3/8-M18 | - | (44) | M14-M14-M14 | 50° |

(Continued)

| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (21) | G3/8-M18 | - | (45) | G1/4-M14 | - |
| (22) | M22-ϕ16.2 | - | (46) | M14-M14 | - |
| (23) | G3/8-M14 | - | (47) | M14-M14-M14 | - |
| (24) | G3/8-M14 | - | (48) | G1/4-M14 | - |

**Hi-spec**




| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (49) | G1/4-M14 | - | (77) | G3/8-M22 | - |
| (50) | G3/8-M22 | - | (78) | G3/8-M18 | - |
| (51) | M22-M22-M22 | 25° | (79) | G3/8-M18 | - |
| (52) | M22-M22 | - | (80) | M22-M22 | - |
| (53) | G1/4-M14 | - | (81) | G3/8-M22 | - |
| (54) | G1/4-M14 | - | (82) | G3/8-M18 | - |
| (55) | G1/4-M14 | 17° | (83) | G3/8-M18 | - |
| (56) | G1/2-M22 | - | (84) | G3/8-M18 | - |
| (57) | M22-M22 | 20° | (85) | G1/2-G1/2-G1/2 | 15° |
| (58) | G1/4-M14 | 17° | (86) | G1/2-ϕ15.9 | - |
| (59) | G1/4-M14 | - | (87) | G1/4-M14 | - |
| (60) | G3/8-M14 | - | (88) | G1/4-M14 | - |
| (61) | G3/8-M14 | - | (89) | G1/4-M14 | - |
| (62) | G3/8-M18 | - | (90) | M14-M14-M14 | - |
| (63) | G3/8-M18 | - | (91) | G1/4-M14 | - |

(Continued)

| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (64) | G3/8-M18 | - | (92) | M14-M14 | - |
| (65) | G3/8-M18 | - | (93) | G1/4-M14 | - |
| (66) | G3/8-M22 | - | (94) | G1/4-M14 | - |
| (67) | G3/8-M18 | - | (95) | M14-M14-M14 | 50° |
| (68) | G1/4-M14 | - | (96) | G1/4-M14 | - |
| (69) | G3/8-M18 | - | (97) | M14-M14 | - |
| (70) | G3/8-M18 | - | (98) | M14-M14-M14 | - |
| (71) | M22-ϕ16.2 | - | (99) | G1/4-M14 | - |
| (72) | G3/8-M14 | - | (100) | M14-M14 | 40° |
| (73) | G3/8-M14 | - | (101) | G1/4-M14 | - |
| (74) | G3/8-M18 | - | (102) | G3/8-M18 | - |
| (75) | G1/2-G1/2 | 8° | (103) | G3/8-M18 | - |
| (76) | G1/2-ϕ25 (check valve) | - | (104) | G1/4-M14 | - |

# 4.3 Swivel motor

## 4.3.1 Removing and installing the swivel motor

**CAUTION**

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**IMPORTANT**

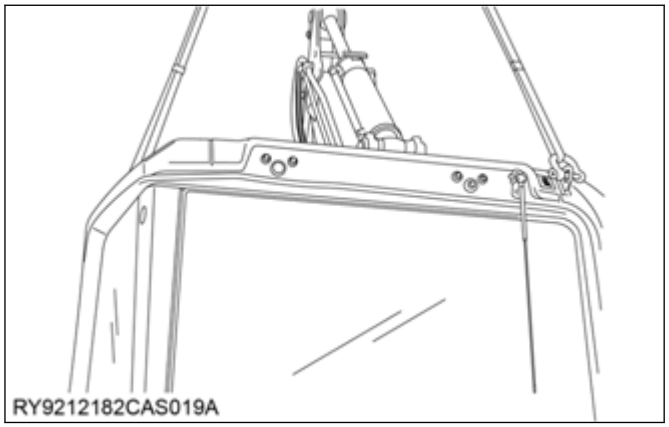
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

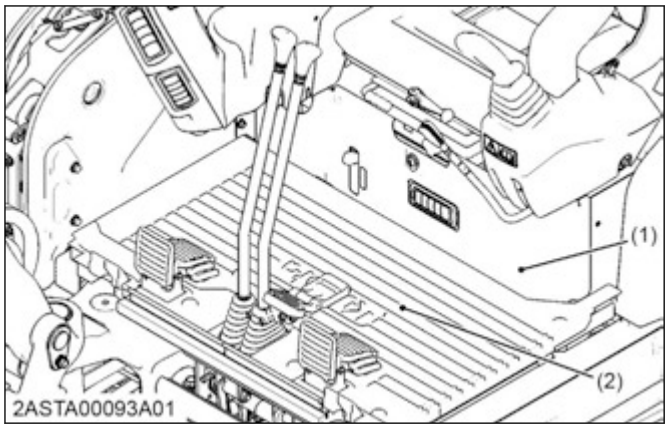
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**

1. Remove the canopy or cabin.

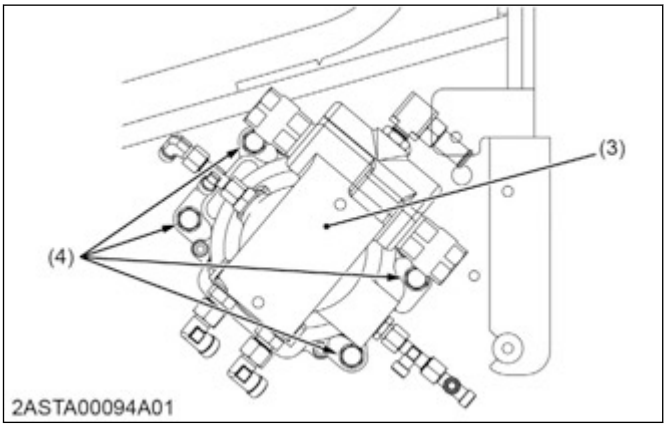



2. Remove the step and cover.



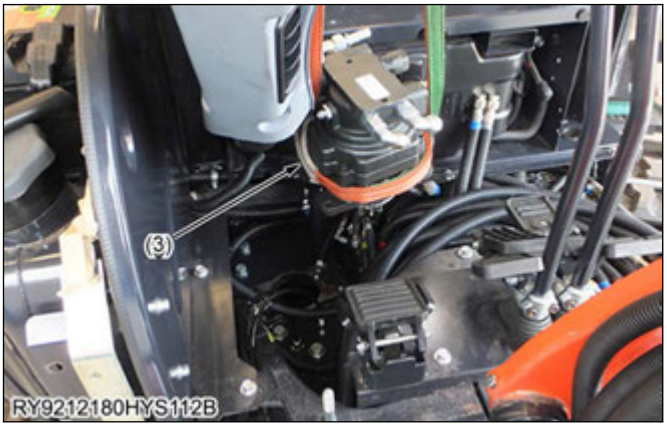

(1) Cover (2) Step

3. Disconnect the hydraulic hoses from swivel motor.
4. Remove 4 bolts.




(3) Swivel motor (4) Bolt (M12 × 40) ×4

5. Attach a nylon sling and hoist the swivel motor to remove.




(3) Swivel motor

**Mass**

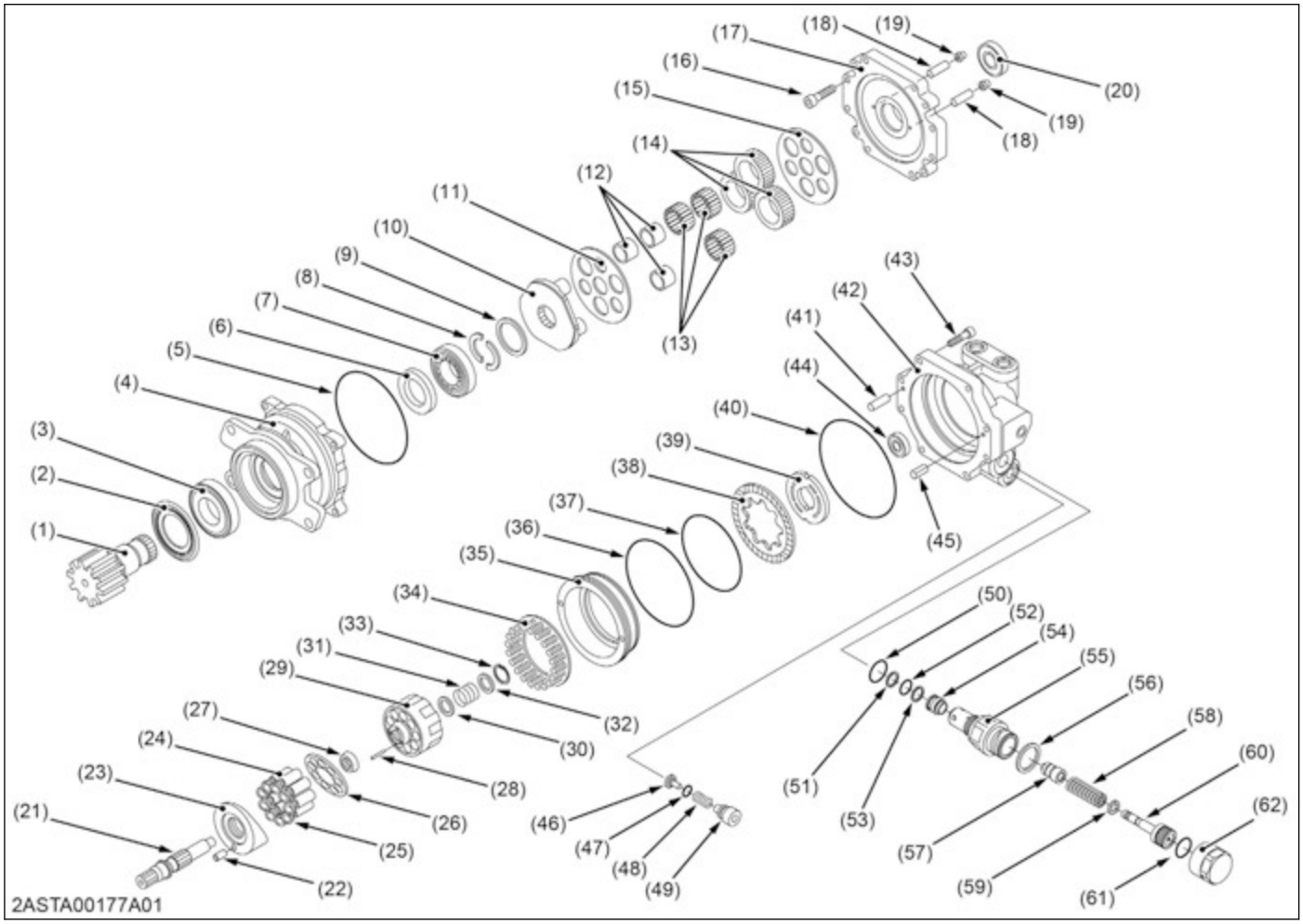
| | |
|---|---|
| (3) Swivel motor | Approximately 23 kg<br>Approximately 51 lbs |

**Installing**

**Tightening torque**

| | | |
|---|---|---|
| (4) Bolt | 103.0 to 117.7 N·m<br>10.5 to 12.0 kgf·m<br>76.0 to 86.8 lbf·ft | Thread lock<br>(Loctite 301-70) |

## 4.3.2 Swivel motor components




(1) Pinion shaft
(2) Ring seal
(3) Bearing
(4) Gear case
(5) O-ring
(6) Oil seal
(7) Bearing
(8) Preload collar ×2
(9) Ring
(10) Holder
(11) Thrust plate
(12) Collar ×3
(13) Needle ×54
(14) Planetary gear ×3
(15) Thrust plate
(16) Cap bolt ×4
(17) Plate
(18) Pin ×2
(19) Filter ×2
(20) Bearing
(21) Shaft
(22) Pin
(23) Swash plate
(24) Piston ×9
(25) Shoe ×9
(26) Retainer plate
(27) Retainer holder
(28) Pin ×3
(29) Cylinder block
(30) Spring washer
(31) Spring
(32) Spring washer
(33) Internal circlip
(34) Spring
(35) Brake piston
(36) O-ring
(37) O-ring
(38) Friction plate
(39) Valve plate
(40) O-ring
(41) Pin
(42) Housing
(43) Cap bolt ×4
(44) Bearing
(45) Spring pin
(46) Check valve ×2
(47) O-ring ×2
(48) Spring ×2
(49) Plug ×2
(50) O-ring ×2
(51) Buckup ring ×2
(52) O-ring ×2
(53) Buckup ring ×2
(54) Seat ×2
(55) Retainer ×2
(56) O-ring ×2
(57) Poppet ×2
(58) Spring ×2
(59) Spacer ×2
(60) Piston ×2
(61) O-ring ×2
(62) Cap ×2

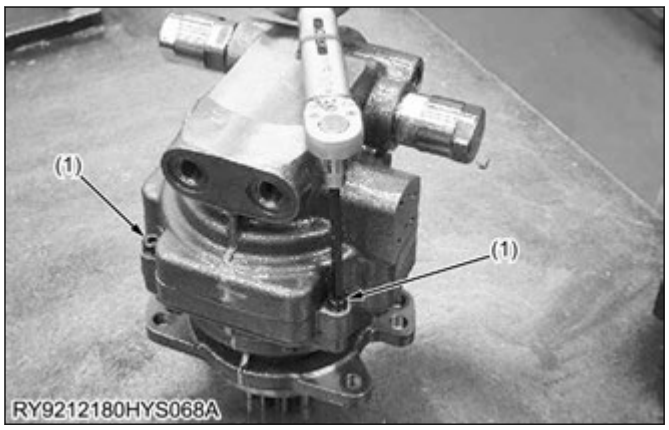
## 4.3.3 Disassembling the swivel motor

**■ IMPORTANT**

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

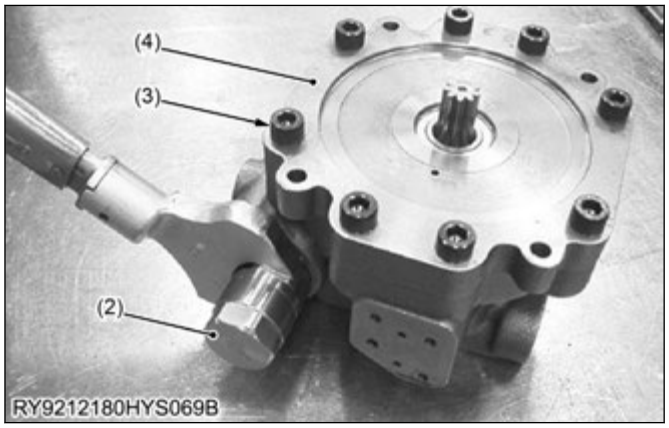
**Disassembling swivel motor**

1. Remove the 4 cap bolts and the swivel motor assembly from the gear case.



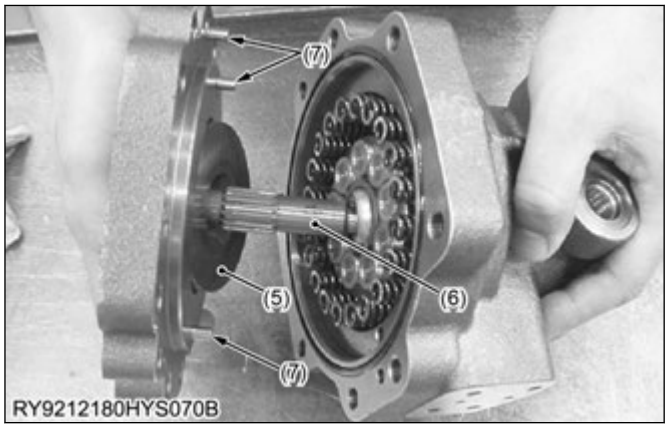

(1) Bolt ×4

2. Remove the relief valve assembly, 8 cap bolts and plate S.




(2) Relief valve assembly
(3) Bolt ×8
(4) Plate S

3. Remove the swash plate and shaft assembly.



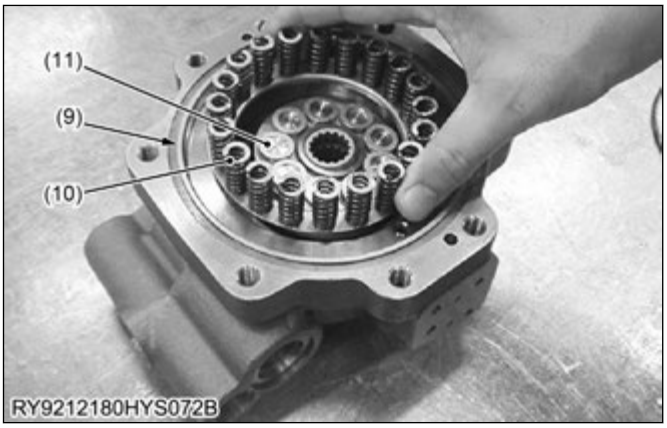

(5) Swash plate
(6) Shaft assembly
(7) Pin

4. Remove 2 filters and 3 pins.



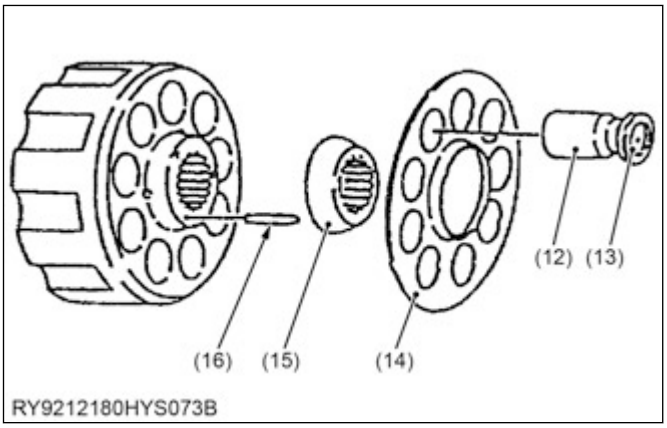

(8) Filter ×2

5. Remove the O-ring, spring assembly, and cylinder block assembly in order.



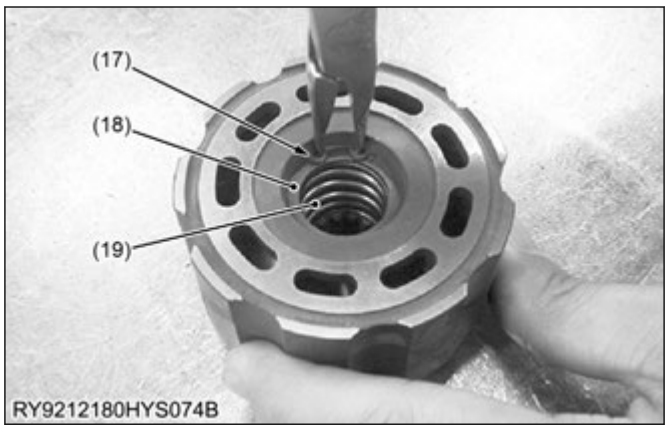

(9) O-ring
(10) Spring assembly
(11) Cylinder block assembly

6. Disassemble the cylinder block assembly.




(12) Piston
(13) Shoe
(14) Shoe holder
(15) Cylinder block holder
(16) Pin

7. Remove the circlip, retainer, and spring.




(17) Circlip
(18) Retainer
(19) Spring

8. Remove the brake piston and O-ring.

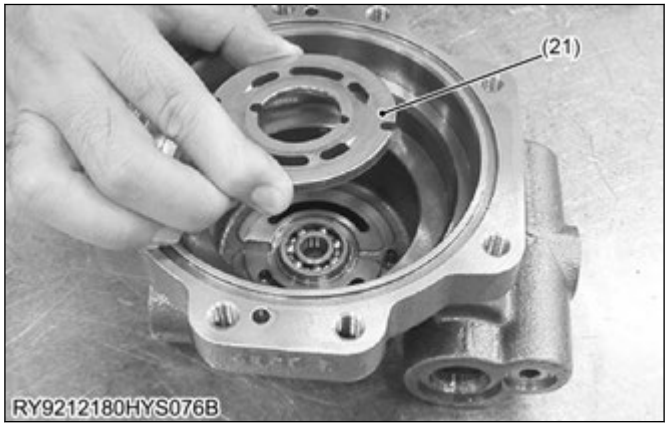
**CAUTION**
- **Hold brake piston with hand to avoid brake piston from popping out.**

**NOTE**
- **Blow air through the port PP to remove brake piston.**



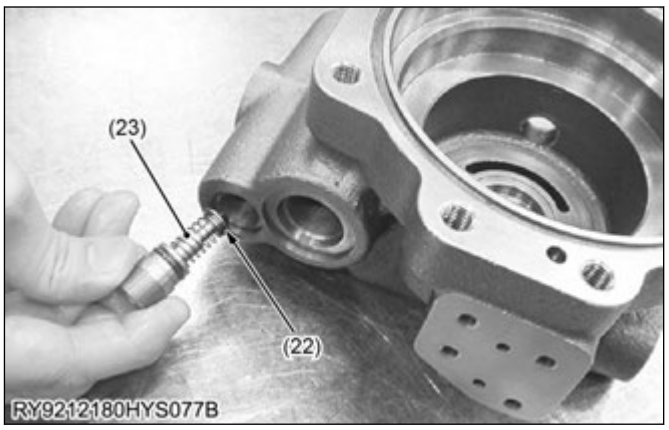

(20) Brake piston

9. Remove the disk plate and valve plate in order.




(21) Valve plate

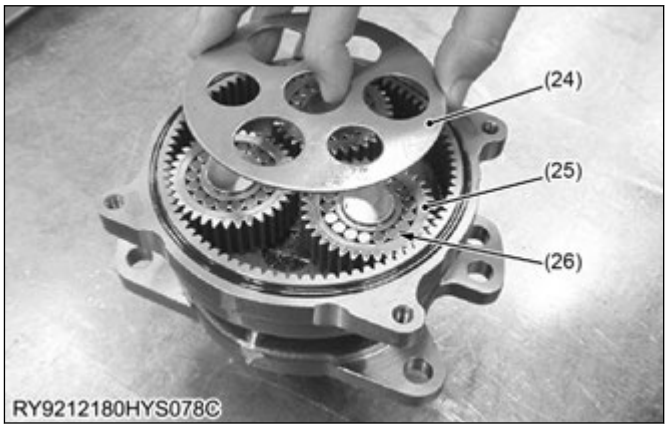
10. Remove the check valve and spring.




(22) Check valve
(23) Spring

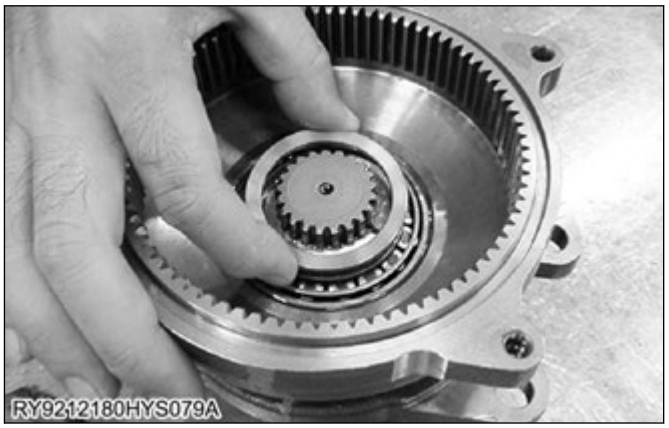
**Disassembling gear case**

1. Remove the thrust plate planetary gear, and needle bearing.




(24) Thrust plate
(25) Planetary gear
(26) Needle bearing

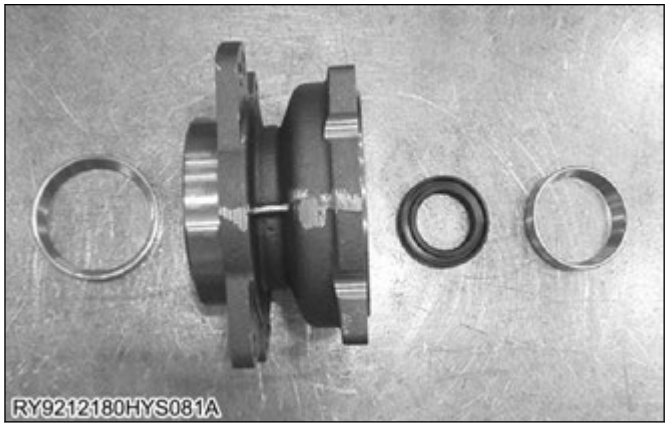
2. Remove the ring and collar.



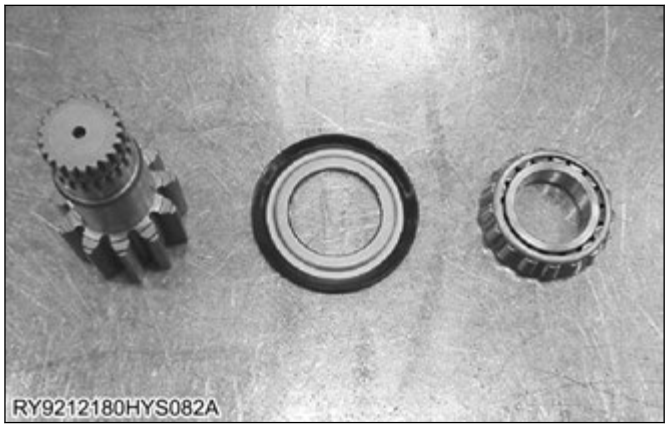

3. Remove the pinion shaft.




4. Remove the outer bearing and oil seal.




5. Remove the inner bearing and ring seal.



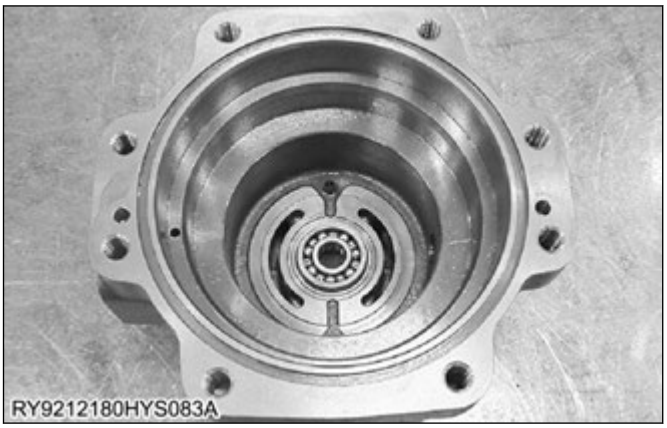

## 4.3.4 Assembling the swivel motor

**■ IMPORTANT**

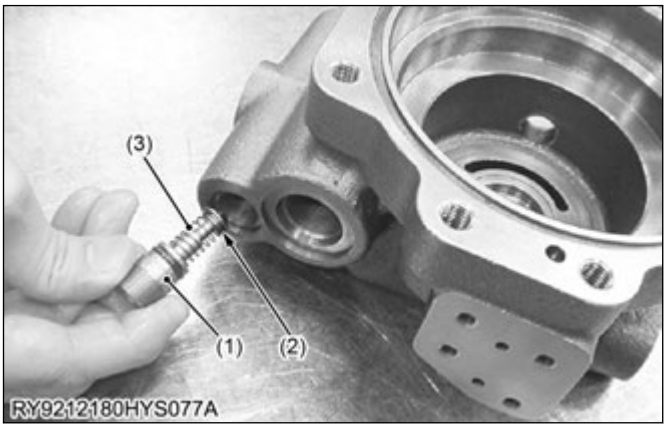
- **Do not reuse removed O-rings, oil seals, and seal rings for assembling to avoid oil leakage.**
- **Do not reuse removed bearings.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Assembling swivel motor**

1. Install the bearing on the housing.




2. Install the check valve, spring and plug.




(1) Plug
(2) Check valve
(3) Spring

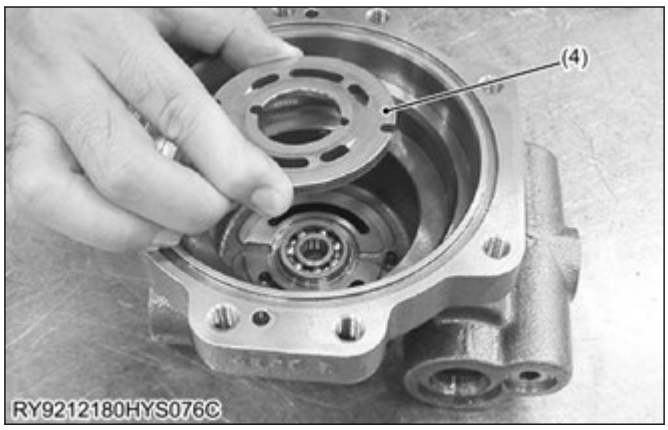
**Tightening torque**

| | | |
|---|---|---|
| (1) Plug | 58.8 N·m<br>6.0 kgf·m<br>43.4 lbf·ft | - |

3. Install the valve plate.

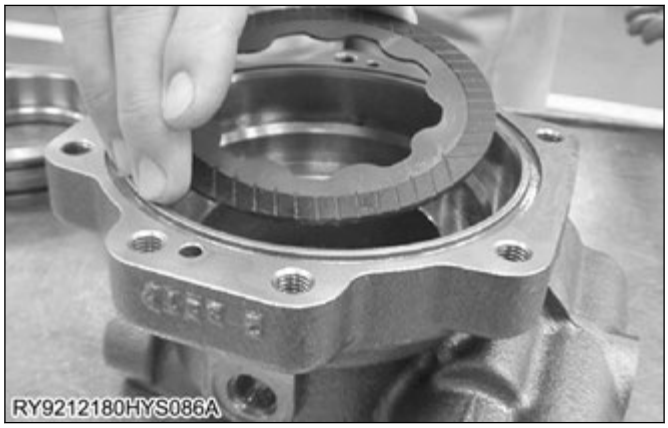
**■ IMPORTANT**

- **Iron surface of the valve plate is facing to the inlet and outlet ports of the housing.**
- **Brass surface of the valve plate is facing to the cylinder block.**

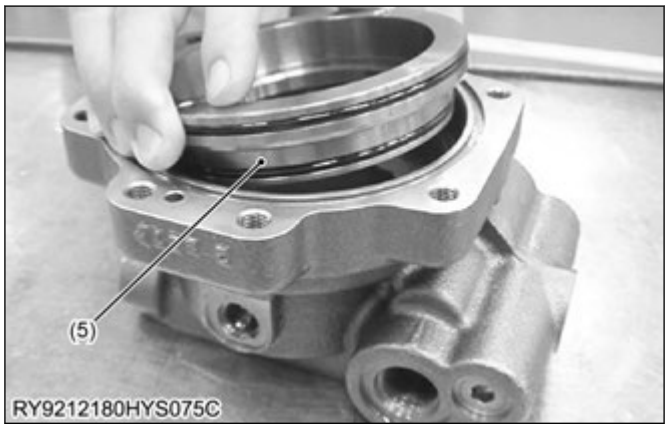



(4) Valve plate

4. Install the disc plate.

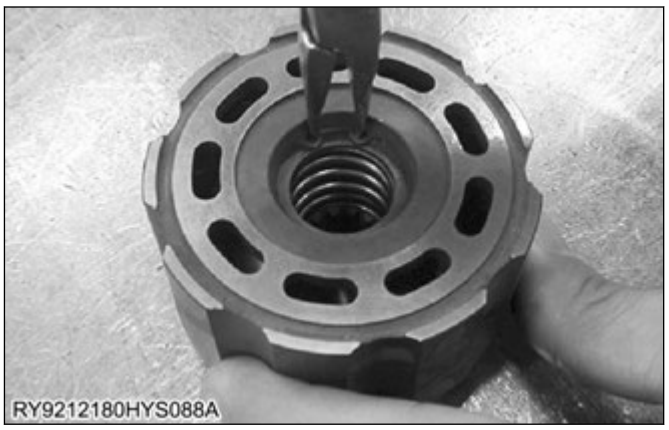



5. Install the brake piston assembly.

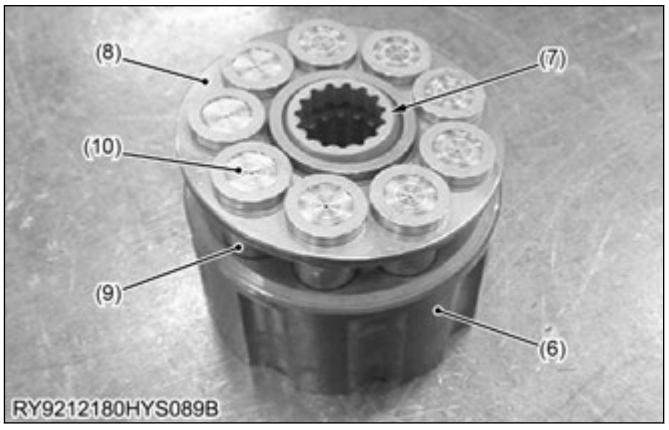



(5) Brake piston assembly

6. Install the retainer and spring C on the cylinder block and fix them with the circlip.

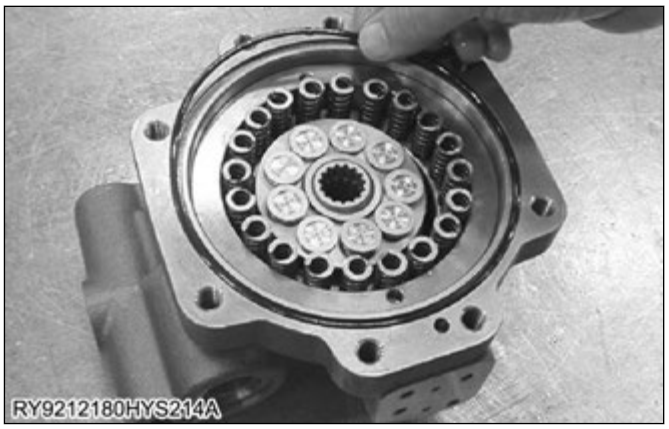



7. Install three pins, cylinder block holder, and shoe holder on the cylinder block.

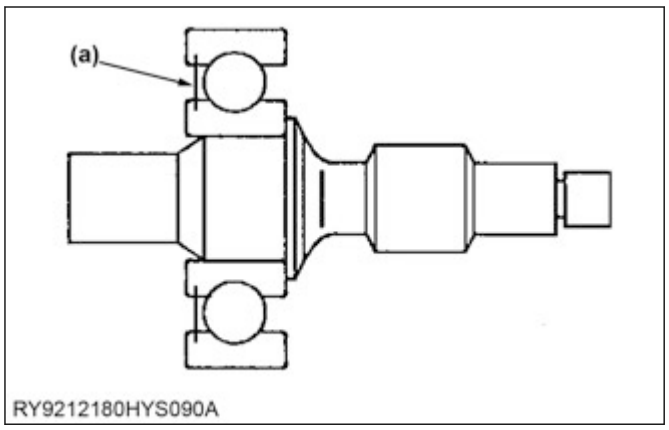



(6) Cylinder block
(7) Cylinder block holder
(8) Shoe holder
(9) Piston
(10) Shoe

8. Install the cylinder block assembly, spring assembly, and O-ring.



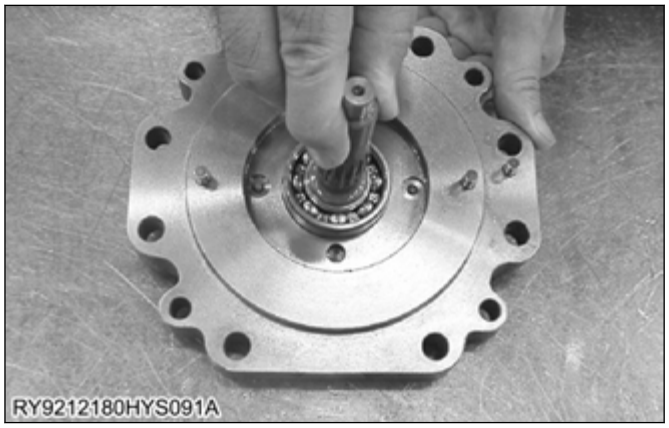

9. Install the bearing into the shaft.

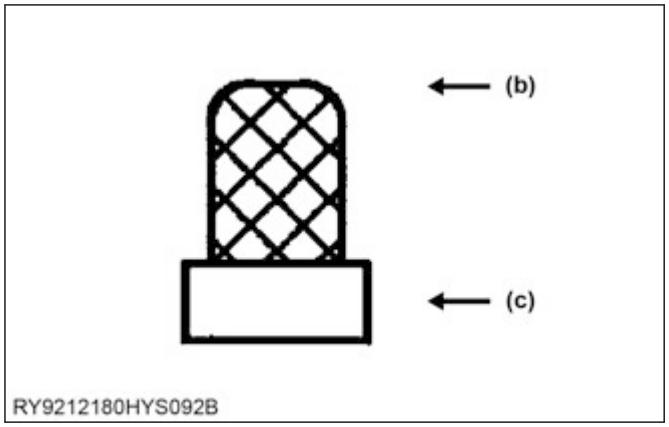



(a) Shield side

10. Install 2 filters and shaft assembly on the plate S.

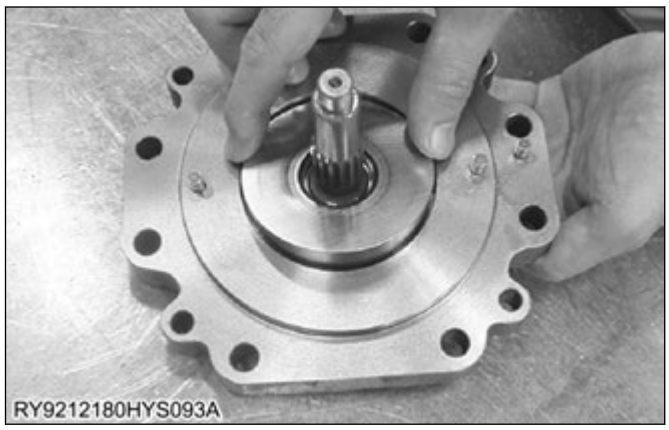
**IMPORTANT**
- **Install the filter in correct direction.**



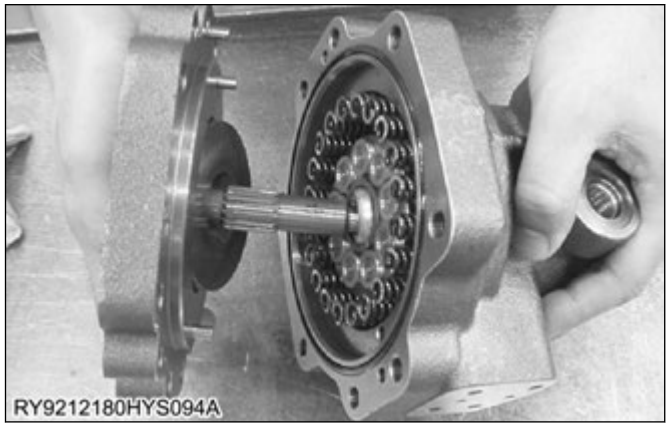




(b) Inserting hole side (c) Inserting hole back side

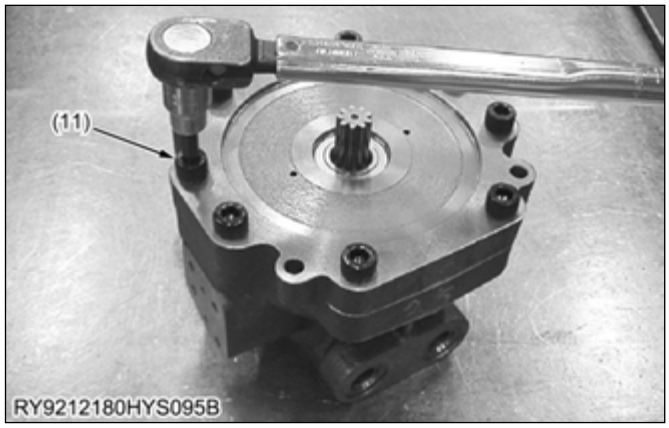
11. Install the swash plate.




12. Assemble the housing and plate S.




13. Install the 8 cap bolts.

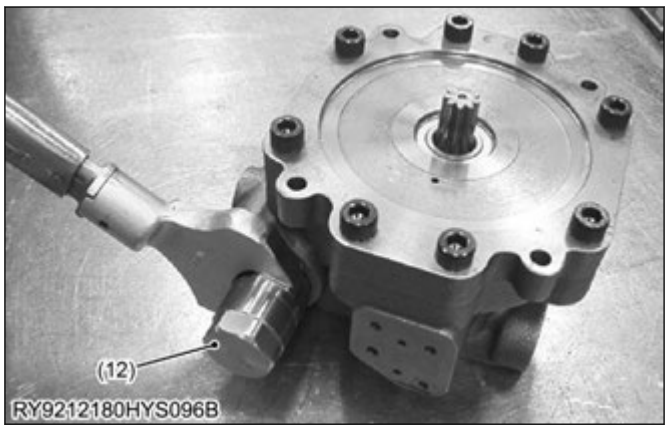



(11) Bolt (M10 × 35) ×8

**Tightening torque**

| | | |
|---|---|---|
| (11) Bolt | 59 N·m<br>6.0 kgf·m<br>44 lbf·ft | - |

14. Install the relief valve.




(12) Relief valve

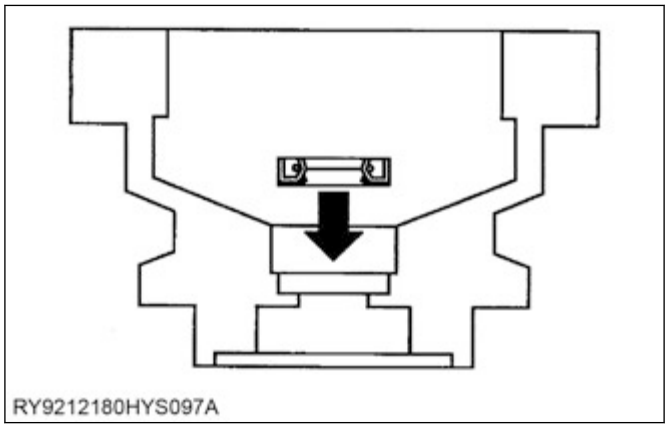
**Tightening torque**

| | | |
|---|---|---|
| (12) Relief valve | 147 N·m<br>15 kgf·m<br>108 lbf·ft | - |

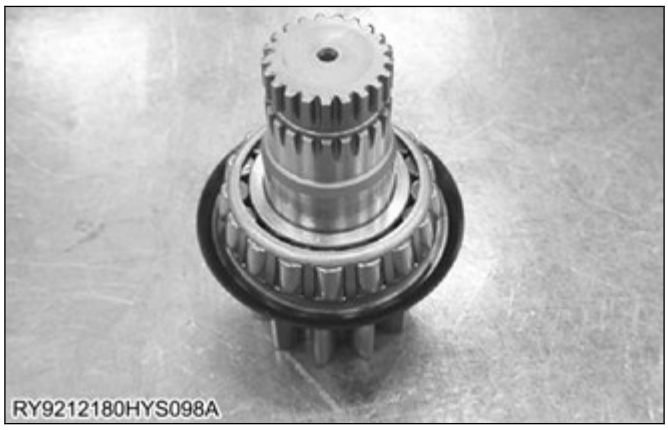
**Assembling the gear case**

1. Install the oil seal.

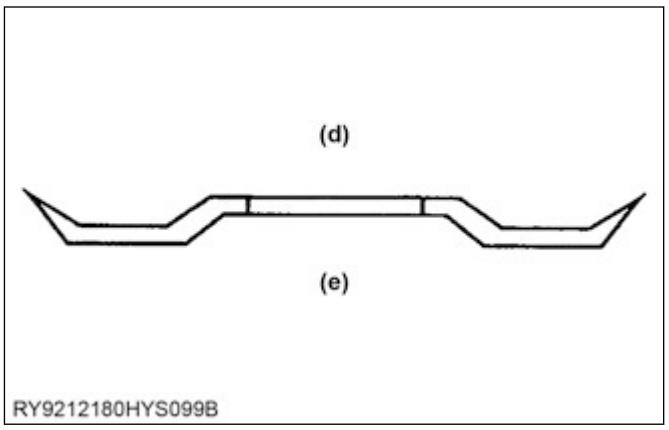
**IMPORTANT**
- **Install the oil seal in correct direction.**




2. Install the ring seal on the pinion shaft.




**IMPORTANT**
- **Install the ring seal in correct direction.**




(d) Bearing side (e) Pinion hole

3. Install the outer bearing into the housing.



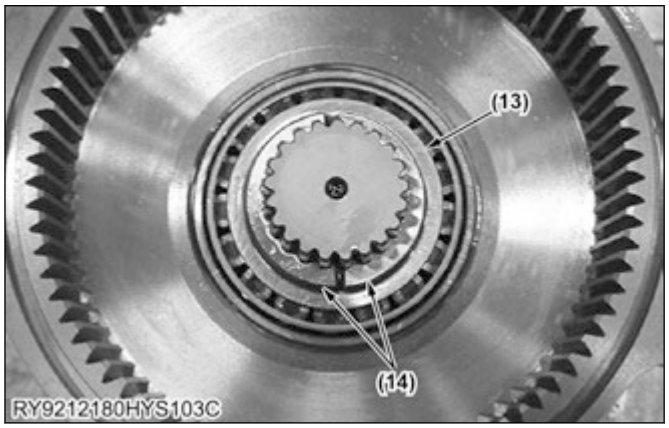

4. Install the outer bearing into the housing.




5. Put grease into the bearing section of the housing. Insert the pinion shaft into the housing.

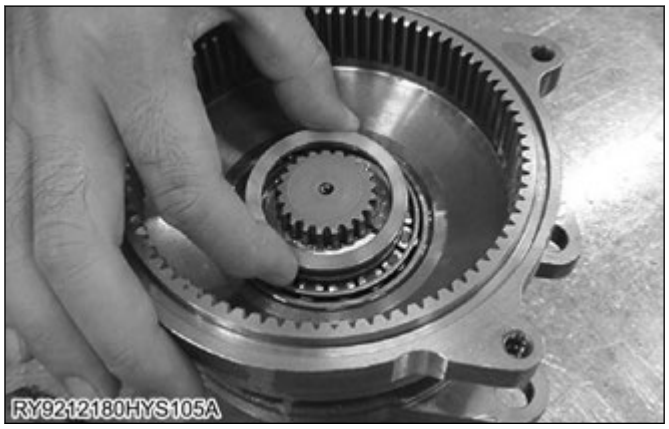



6. Turn the housing over and install the inner bearing. Install the collar.

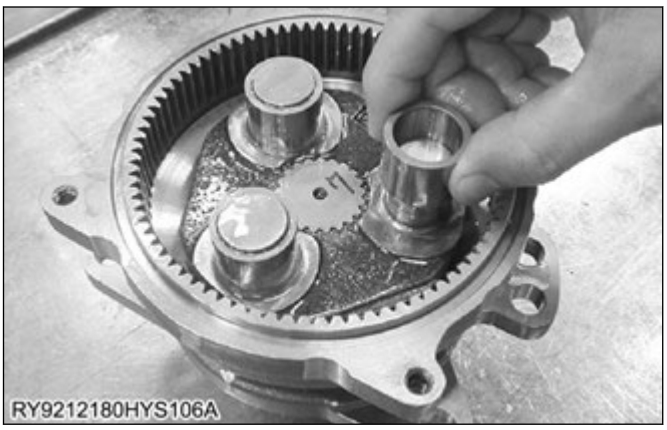



(13) Inner bearing (14) Collar

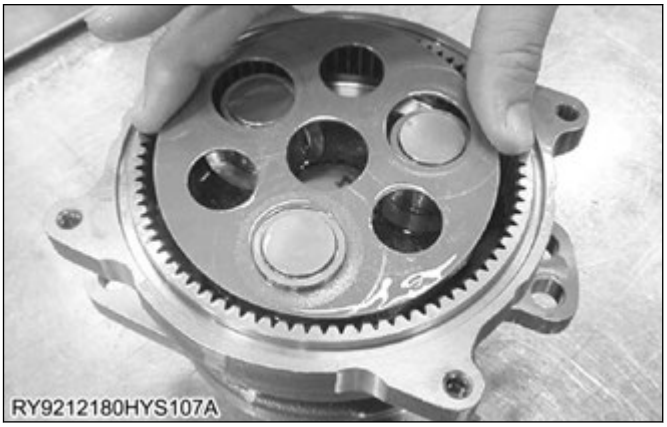
7. Install the ring.



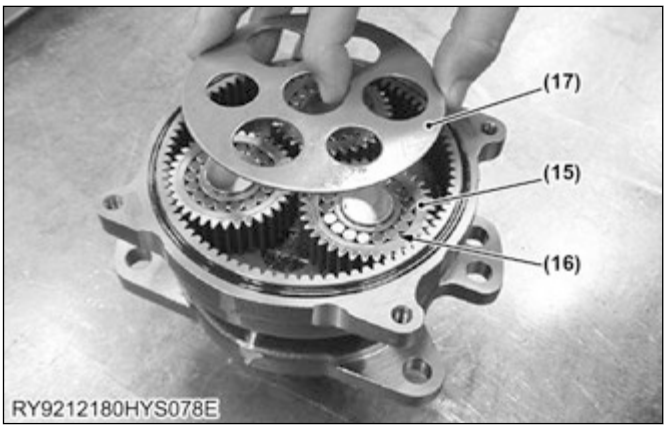

8. Install the carrier 1 and the 3 rings on the shaft.




9. Install the thrust plate.




10. Install the planetary gear and the 3 needles on the shaft. Install the thrust plate.

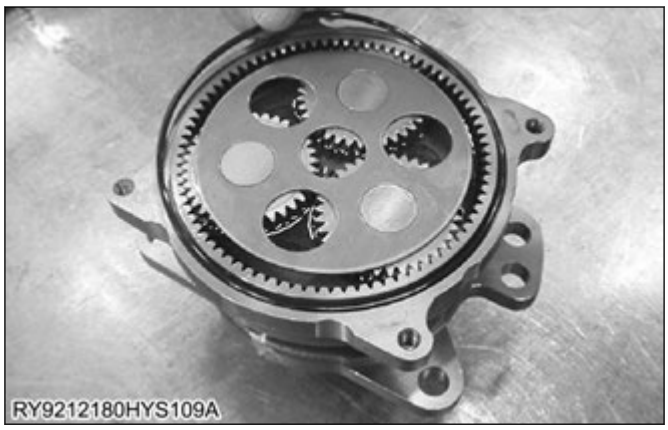



(15) Planetary gear (17) Thrust plate
(16) Needle

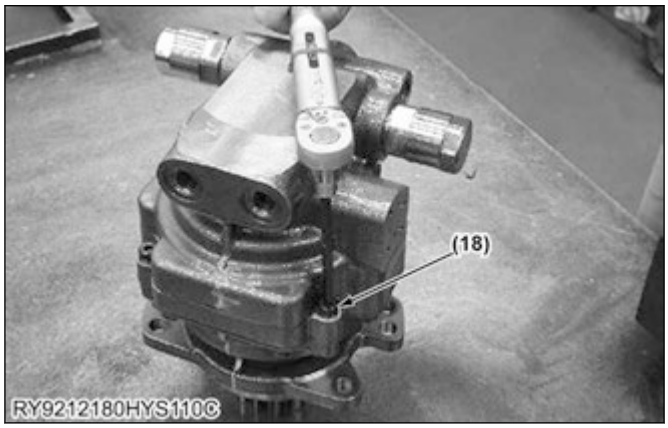
11. Replenish the hydraulic oil into the housing up to 3 to 4 mm below from the top of the thrust plate. Install the O-ring.

**■ IMPORTANT**

- **Remove hydraulic oil from the contact surface of the thrust plate in case that the oil adheres.**




12. Install the swivel motor on the gear case with the 4 cap bolts.

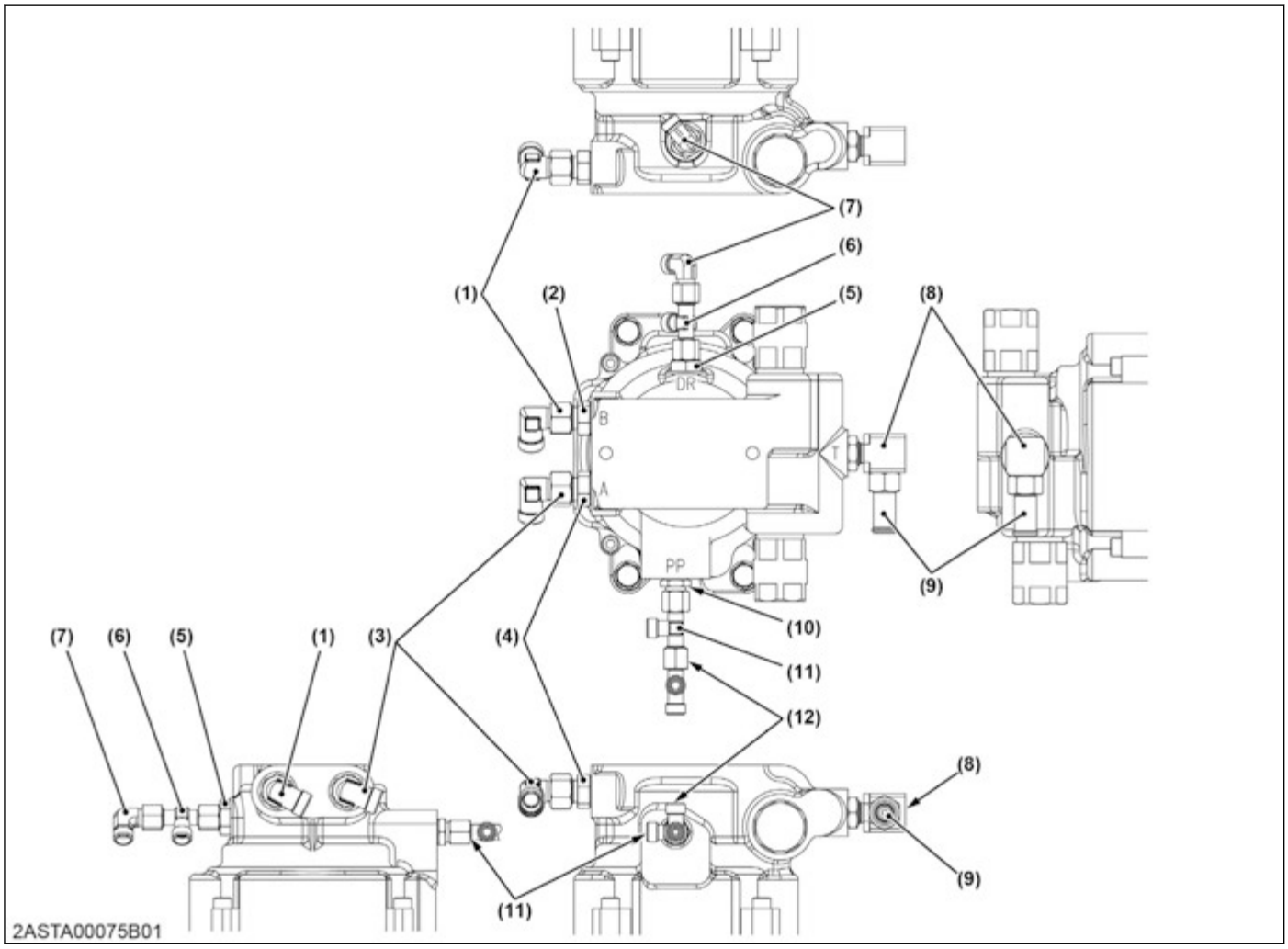



(18) Bolt (M8 × 35) ×4

### Tightening torque

| | | |
|---|---|---|
| (18) Bolt | 29 N·m<br>3.0 kgf·m<br>22 lbf·ft | Thread lock<br>(Three Bond 1305<br>or equivalent) |

## 4.3.5 Installing adapter layout for the swivel motor




| Adapter No. | Adapter size | Angle | Remarks |
|---|---|---|---|
| (1) | M18-M18 | 27° | - |
| (2) | G3/8-M18 | - | - |
| (3) | M18-M18 | 20° | - |
| (4) | G3/8-M18 | - | - |
| (5) | G3/8-M14 | - | - |
| (6) | M14-M14-M14 | 50° | - |
| (7) | M14-M14 | 50° | - |
| (8) | G3/8-G3/8 | - | - |
| (9) | G3/8-ϕ16 | - | - |
| (10) | G1/4-M14 | - | - |
| (11) | M14-M14-M14 | - | - |
| (12) | M14-M14-M14 | 45° | Hi-spec only |

# 4.4 Travel motor

## 4.4.1 Removing and installing the travel motor

**CAUTION**

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

**IMPORTANT**

- **Install plugs to removed hydraulic hoses and adapters, to avoid oil leakage and dust contamination.**

**Preparing**

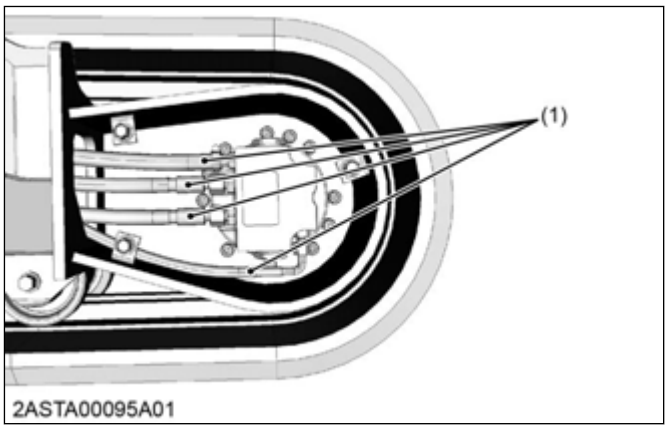
1. Remove the track.




2. Jack up the machine, and then support with the support block or stand.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

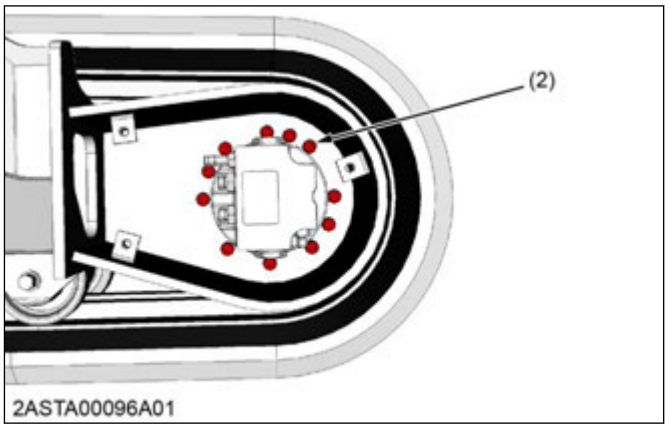
**Removing**

1. Remove 3 bolts.
2. Remove the cover.
3. Remove 4 hydraulic hoses.




(1) Hydraulic hose

4. Attach a nylon sling and hoist the travel motor for support.
5. Remove 11 bolts.




(2) Bolt (M10 × 28) ×11

6. Hoist the travel motor to remove. Place to level ground.




(3) Nylon sling
(4) Sprocket
(5) Bolt (M10 × 30) ×10
(6) Travel motor

7. Remove 10 bolts.
8. Remove the sprocket.

### Mass

| | | |
|---|---|---|
| (6) Travel motor | Basic specification | Approximately 28 kg Approximately 61.7 lbs |
| | Hi-spec | Approximately 22 kg Approximately 48.5 lbs |

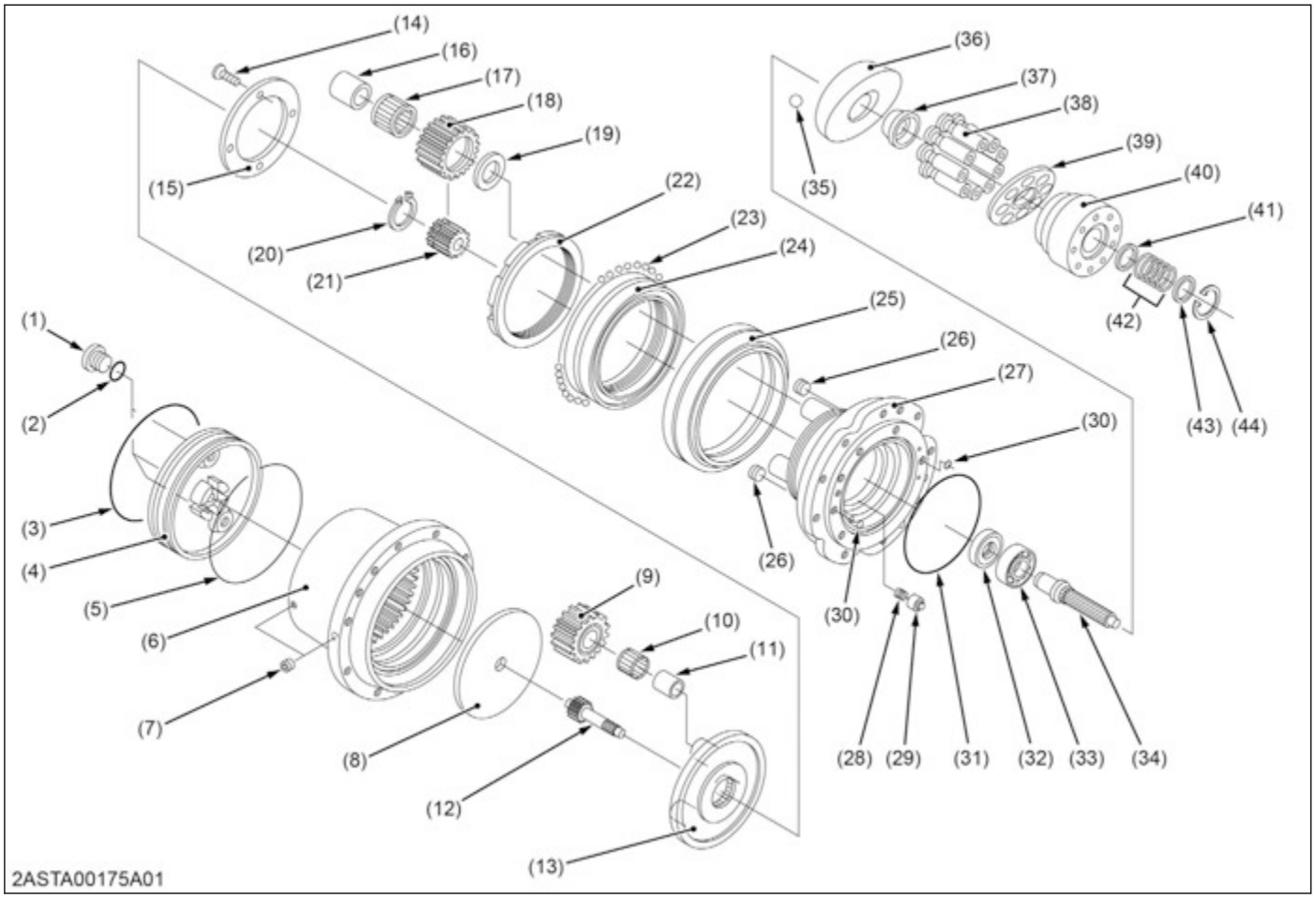
## Installing

### Tightening torque

| | | |
|---|---|---|
| (2) (5) Bolt | 60.8 to 70.6 N·m 6.2 to 7.2 kgf·m 44.8 to 52.1 lbf·ft | Thread lock (Loctite 301-70) |

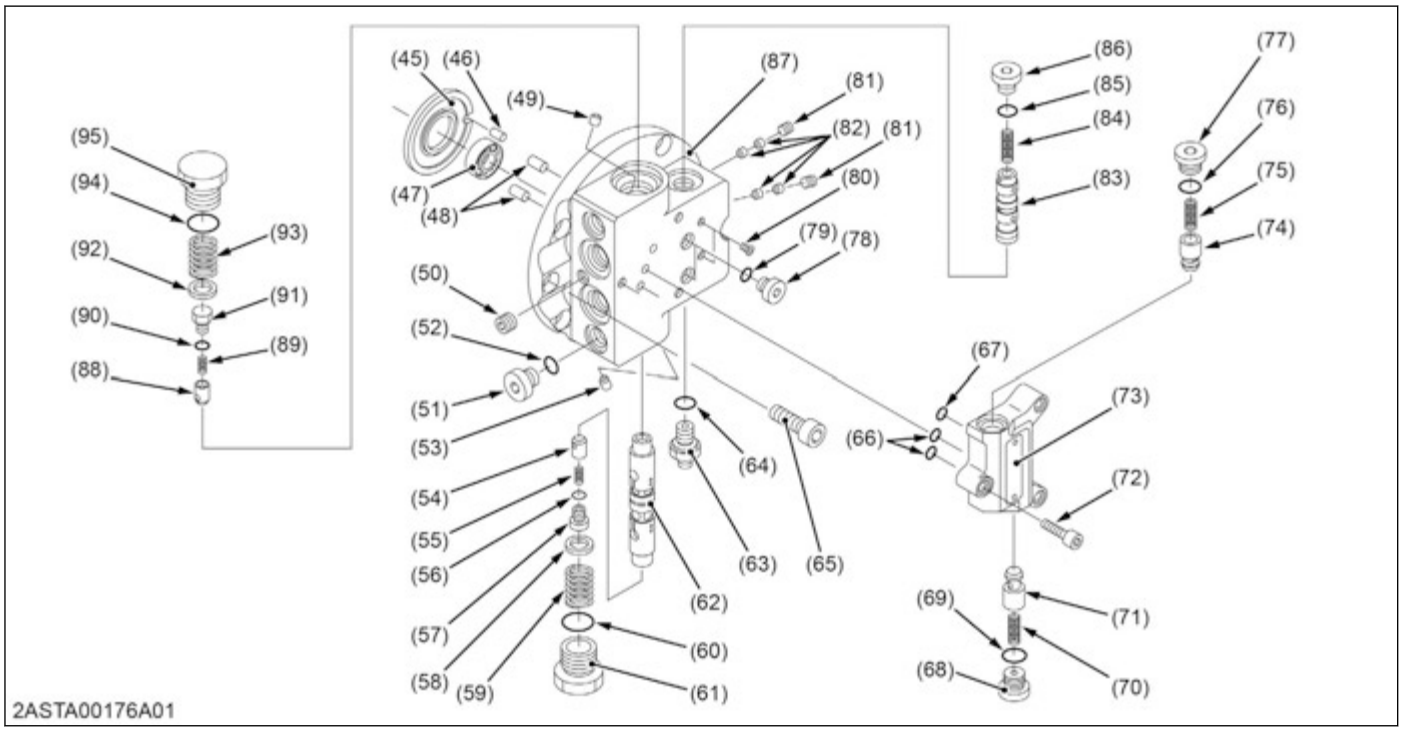
## 4.4.2 Travel motor components

**Gear case**




(1) Plug (G3/8) ×3
(2) O-ring ×3
(3) O-ring
(4) Cover
(5) Wire
(6) Gear case
(7) Plug (R1/8)
(8) Thrust plate t = 1.8
Thrust plate t = 2.3
Thrust plate t = 2.8
(9) Planetary gear A ×3
(10) Needle bearing ×3
(11) Collar ×3
(12) Drive gear
(13) Holder
(14) Screw ×4
(15) Plate
(16) Collar ×4
(17) Needle bearing ×4
(18) Planetary gear B ×4
(19) Thrust washer ×4
(20) External circlip
(21) Sun gear
(22) Ring nut
(23) Ball ×109
(24) Angular bearing
(25) Floating seal ×2
(26) Plug ×2
(27) Flange holder
(28) Spring ×2
(29) Piston ×2
(30) O-ring
(31) O-ring
(32) Oil seal
(33) Ball bearing
(34) Shaft
(35) Steel ball ×2
(36) Swash plate
(37) Retainer holder
(38) Piston
(39) Retainer plate
(40) Cylinder block
(41) Spring washer
(42) Spring
(43) Spring washer
(44) Internal circlip

## Motor




(45) Valve plate
(46) Parallel pin
(47) Ball bearing
(48) Parallel pin ×2
(49) Orifice
(50) Plug (Hi-spec only)
(51) Plug ×2
(52) O-ring ×2
(53) Orifice
(54) Poppet
(55) Compression spring
(56) O-ring
(57) Plug
(58) Spring washer
(59) Spring
(60) O-ring
(61) Plug
(62) Counterbalance plunger
(63) Adapter
(64) O-ring
(65) Cap bolt ×6
(66) O-ring ×2
(67) O-ring ×2
(68) Plug
(69) O-ring
(70) Anti-cavitation spring
(71) Poppet
(72) Cap bolt ×3
(73) Anti-cavitation body
(74) Poppet
(75) Anti-cavitation spring
(76) O-ring
(77) Plug
(78) Plug
(79) O-ring ×2
(80) Plug ×2 (Hi-spec only)
(81) Plug ×2
(82) Orifice ×4
(83) Speed switching spool
(84) Speed switching spring
(85) O-ring
(86) Plug
(87) Counter - balance body
(88) Poppet
(89) Compression spring
(90) O-ring
(91) Plug
(92) Spring washer
(93) Spring
(94) O-ring
(95) Plug

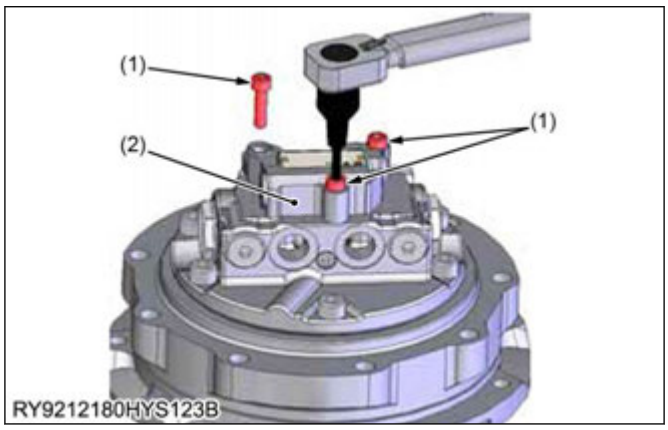
## 4.4.3 Disassembling the travel motor

**IMPORTANT**

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

**Disassembling the motor**

1. Remove the cap bolts.
2. Remove the valve assembly.

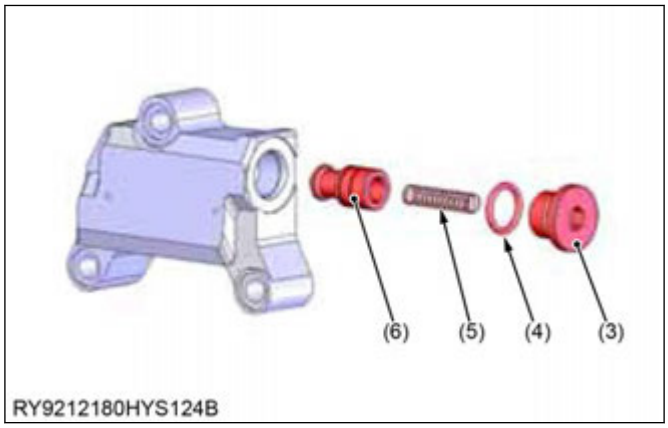



(1) Cap bolt (M6 × 25) ×3
(2) Valve assembly

3. Remove the plug, spring and check valve.

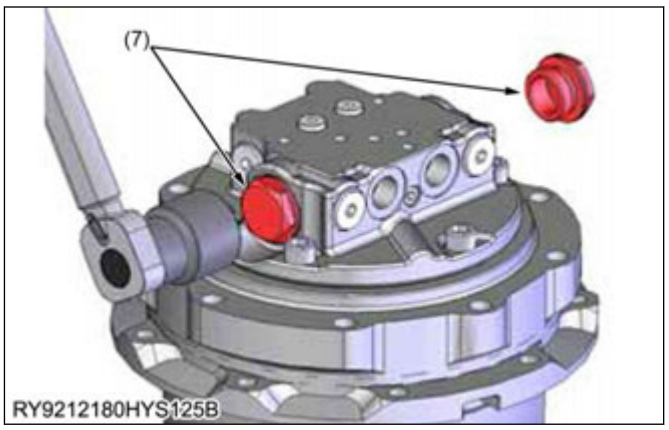
**IMPORTANT**

- **If there is no abnormality in the valve assembly, do not disassemble the valve assembly.**



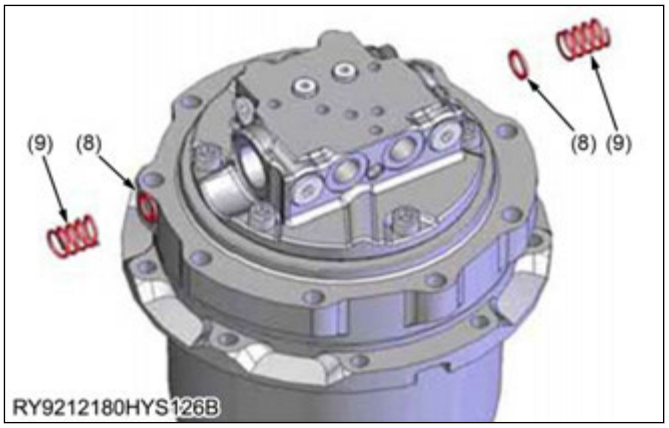

(3) Plug
(4) O-ring
(5) Spring
(6) Check valve

4. Remove the cap.




(7) Cap

5. Remove the spring and spring seat.

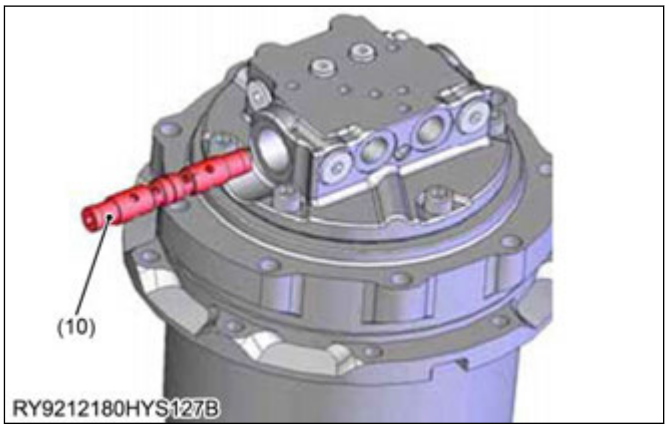



(8) Spring seat
(9) Spring

6. Remove the counterbalance valve spool.

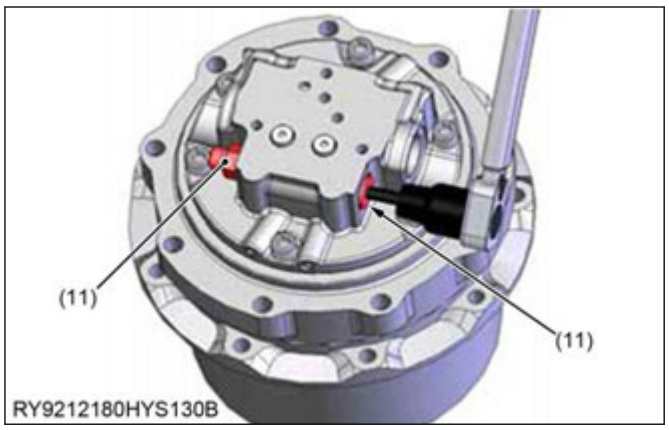
**IMPORTANT**

- **Do not scratch the spool.**



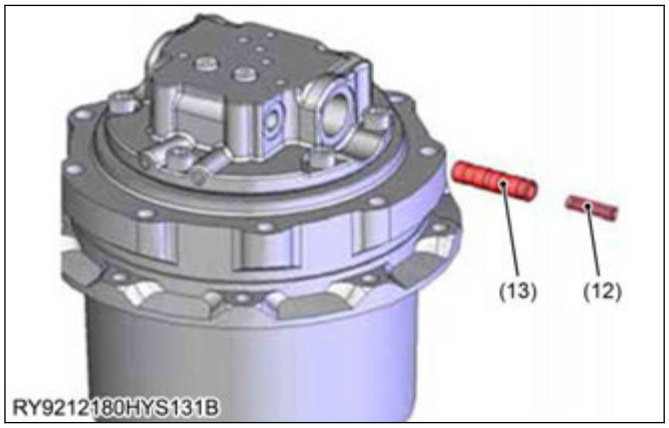

(10) Counterbalance spool

7. Remove the plug.



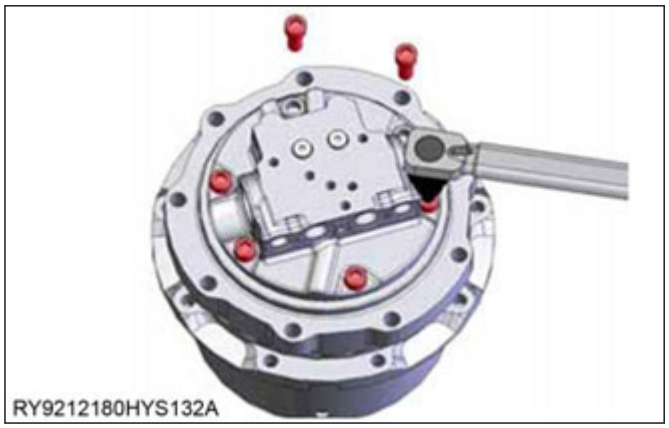

(11) Plug

8. Remove the spring and spool.




(12) Spring (13) Spool

9. Remove the cap bolts.

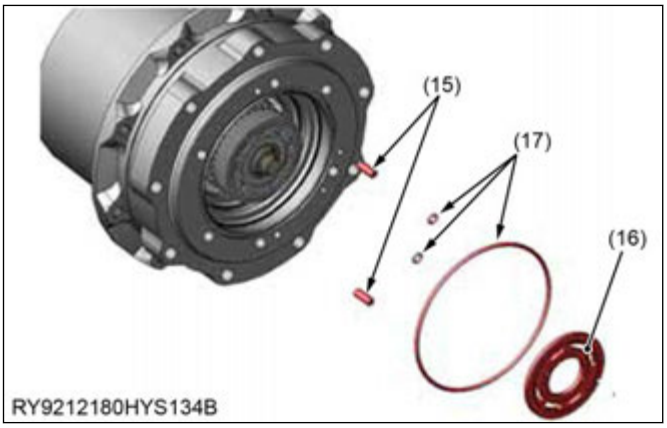



10. Remove the valve body with plastic hammer.



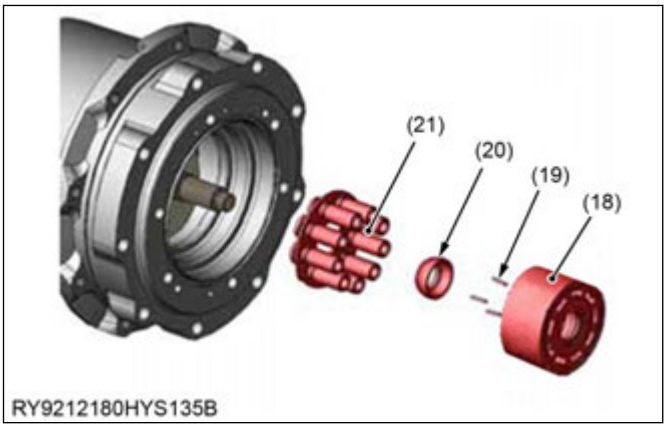

(14) Valve body

11. Remove the pin, valve plate, and O-ring.




(15) Pin (17) O-ring
(16) Valve plate

12. Remove the cylinder block, pin, retainer holder, and retainer plate piston.

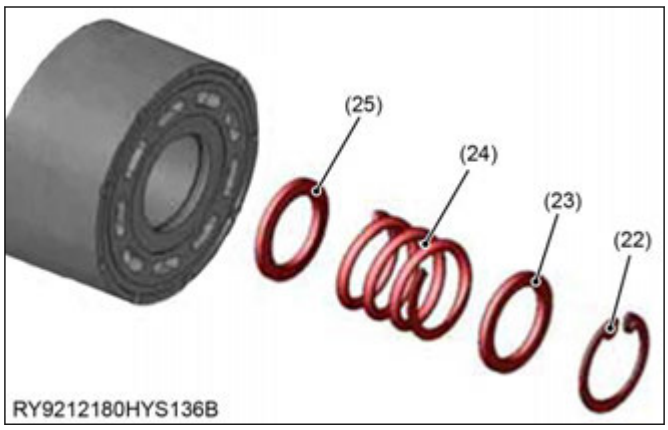



(18) Cylinder block (21) Retainer plate piston
(19) Pin
(20) Retainer holder

13. Remove the circlip, washer, spring and spring seat.

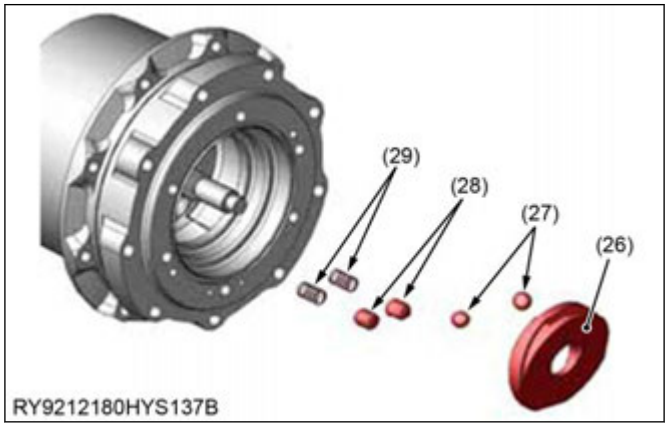
**CAUTION**

- **Make sure that the inner ring may pop out rapidly when removing the circlip.**




(22) Circlip
(23) Washer
(24) Spring
(25) Spring seat

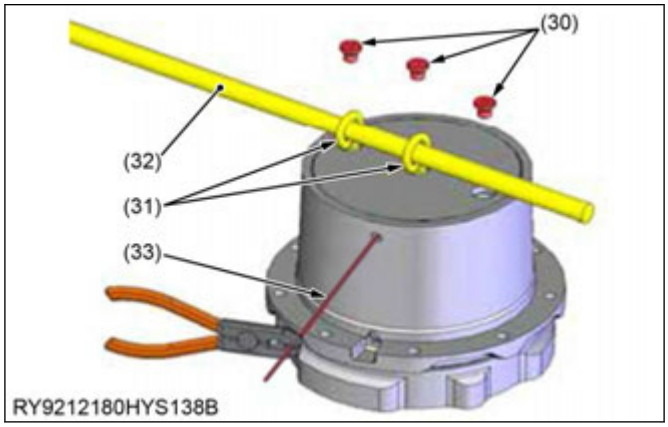
14. Remove swash plate, steel ball, piston and spring.




(26) Swash plate
(27) Steel ball
(28) Piston
(29) Spring

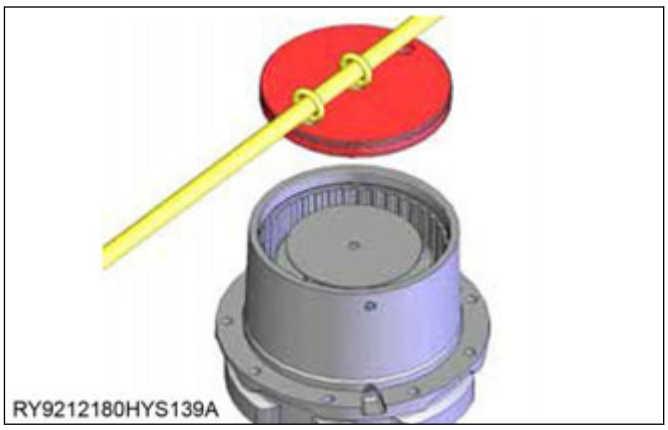
**Disassembling the gear case**

1. Remove the plug.
2. Install the 2 eye bolts to insert the rod.
3. Turn the rod until the wire tip becomes visible inside the plug hole and pull out the wire with nipper.

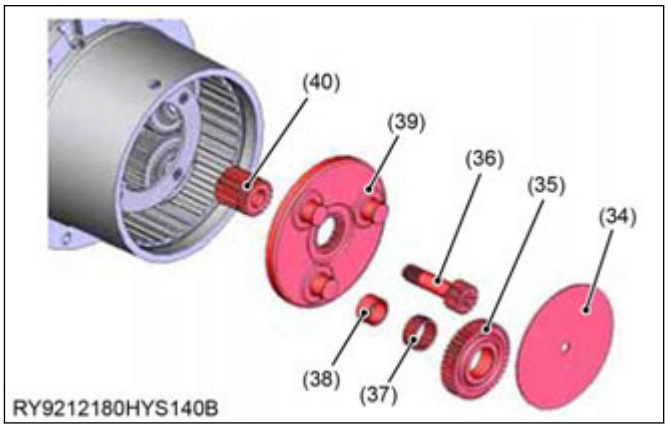



(30) Plug
(31) Eye bolt (M10)
(32) Rod
(33) Wire

4. Remove the cover.




5. Remove the sun gear, holder gear, needle bearing, inner race, drive gear and thrust plate.

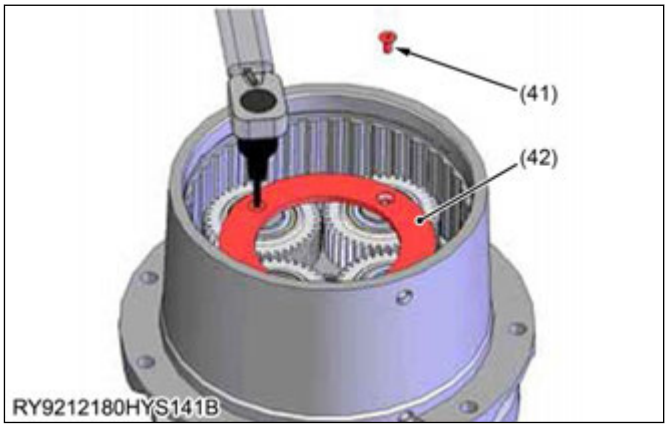



(34) Thrust plate
(35) Gear
(36) Drive gear
(37) Needle bearing
(38) Inner race
(39) Holder
(40) Sun gear

6. Remove the screw and thrust plate.

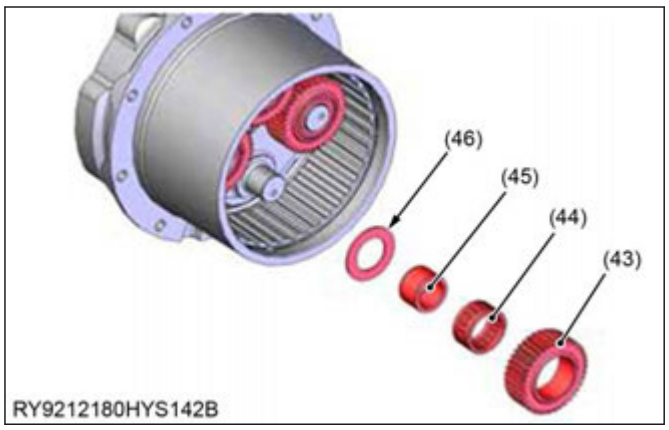
**NOTE**

- **The screw is coated with thread lock, warm it with a heat gun in advance before loose.**



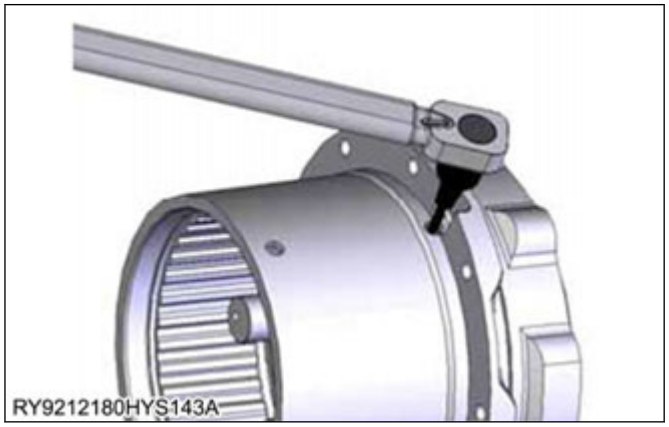

(41) Screw
(42) Thrust plate

7. Remove the gear, needle bearing, inner race and the thrust washer.

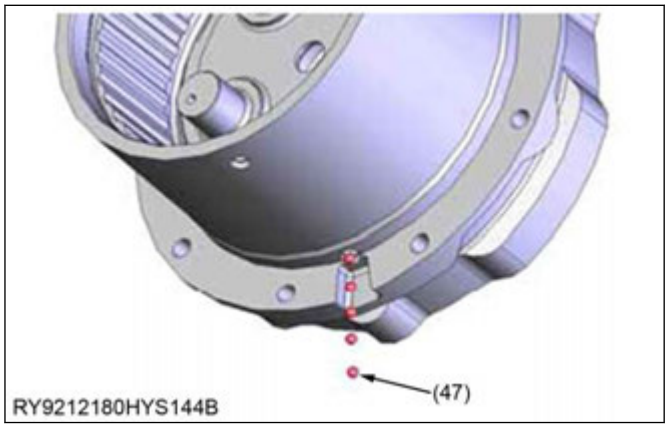



(43) Gear
(44) Needle bearing
(45) Inner race
(46) Thrust washer

8. Remove the plug.



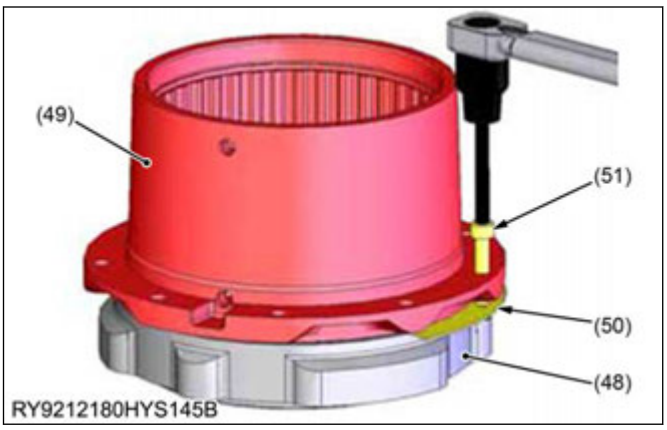

9. Pull the steel balls out from the plug hole.




(47) Steel ball (109 pcs)

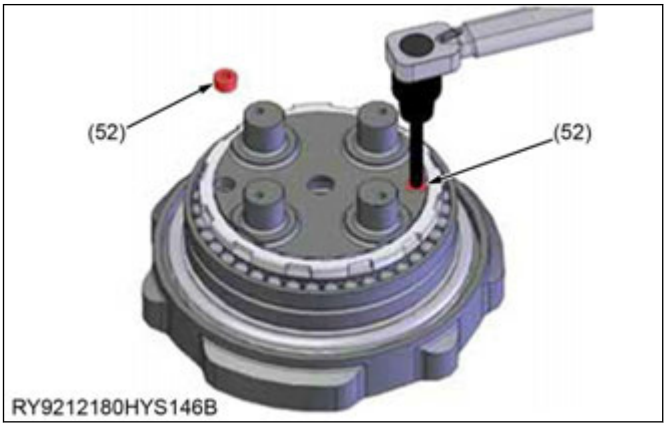
10. Remove the housing.

**NOTE**
- **Insert the plate between the flange holder and the housing.**
- **Tighten 3 cap bolts equally to remove the housing.**



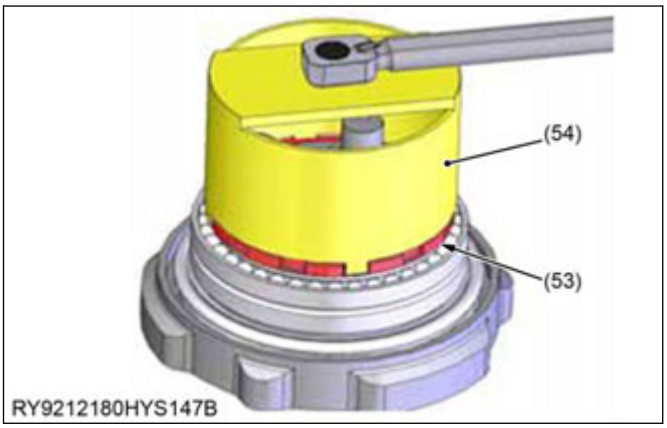

(48) Flange holder
(49) Housing
(50) Plate
(51) Bolt (M12 × 1.75)

11. Remove the plug.




(52) Plug

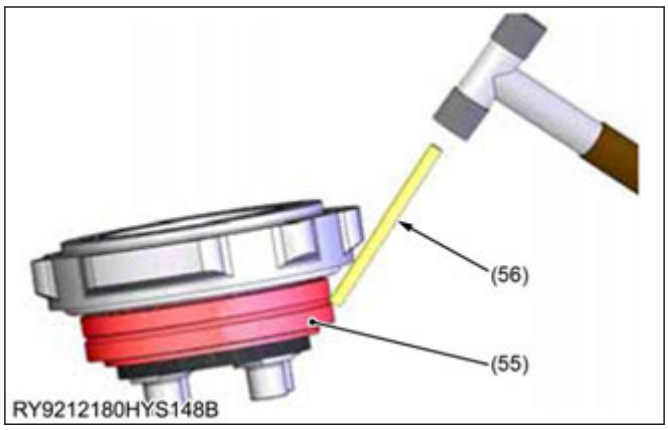
12. Remove the ring nut with jig.




(53) Ring nut
(54) Jig (S-1)

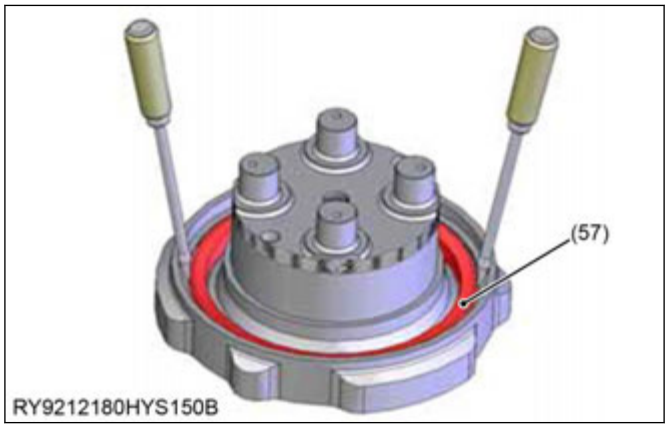
13. Remove the angular bearing.

**NOTE**
- **Hit the steel ball groove with a rod and hammer.**



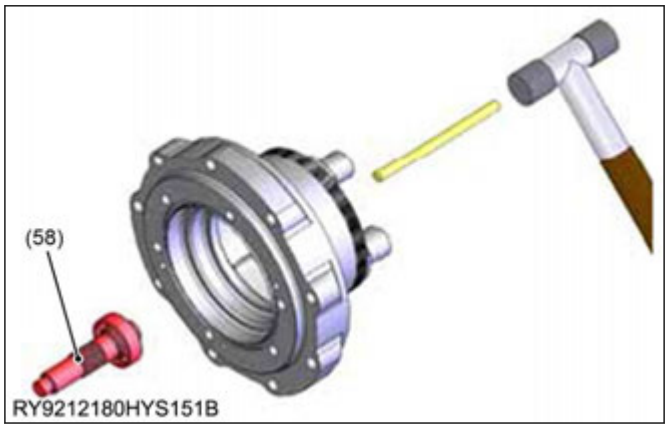

(55) Angular bearing (56) Rod

14. Remove the floating seal.




(57) Floating seal

15. Remove the shaft.

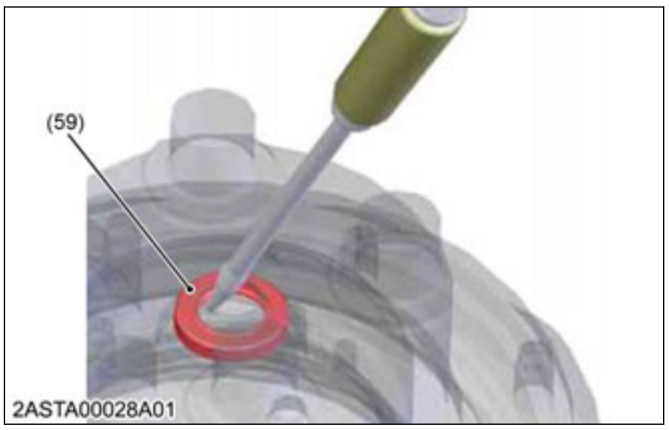



(58) Shaft

16. Remove the oil seal.

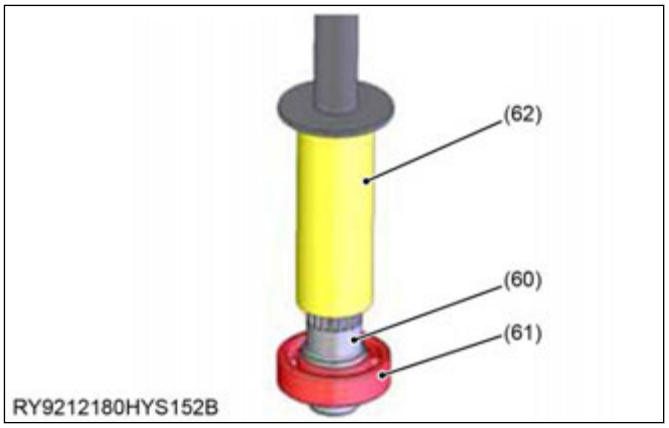
**■ IMPORTANT**

- **Do not reuse the removed oil seal when you install it.**




(59) Oil seal

17. Remove the ball bearing from the shaft.




(60) Shaft (62) Jig (S-2)
(61) Ball bearing

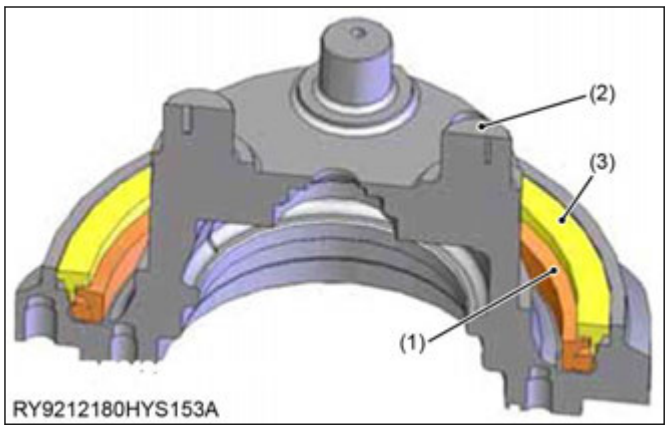
## 4.4.4 Assembling the travel motor

**■ IMPORTANT**

- **Do not reuse removed O-rings and floating seals for assembling to avoid oil leakage.**
- **Do not reuse removed bearings.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

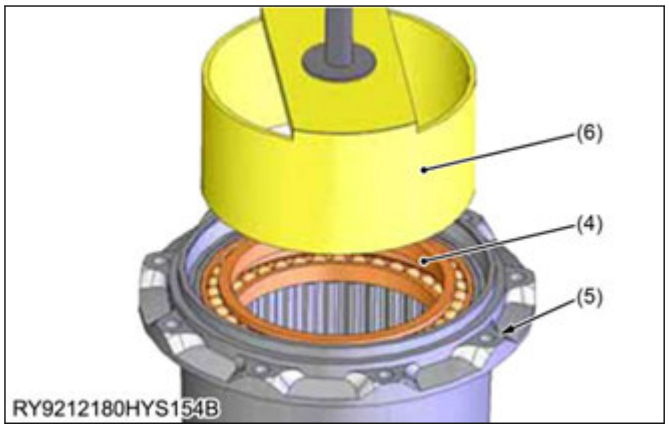
**Assembling the gear case**

1. Install the floating seal on the flange holder with jig after greasing the floating seal.



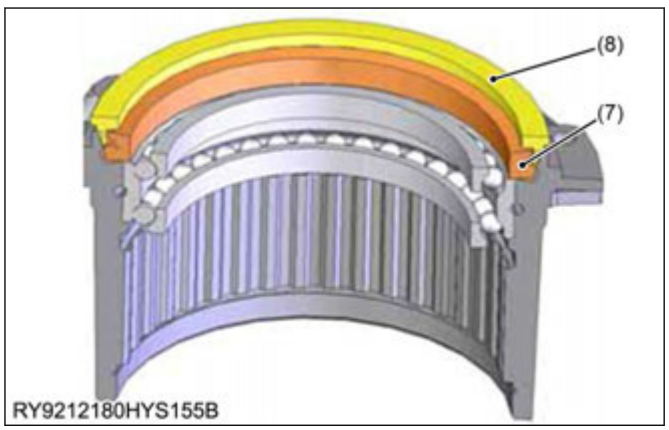

(1) Floating seal
(2) Flange holder
(3) Jig (S-3)

2. Press fit the bearing into the housing.




(4) Bearing
(5) Housing
(6) Jig (S-4)

3. Install the other floating seal on the housing.

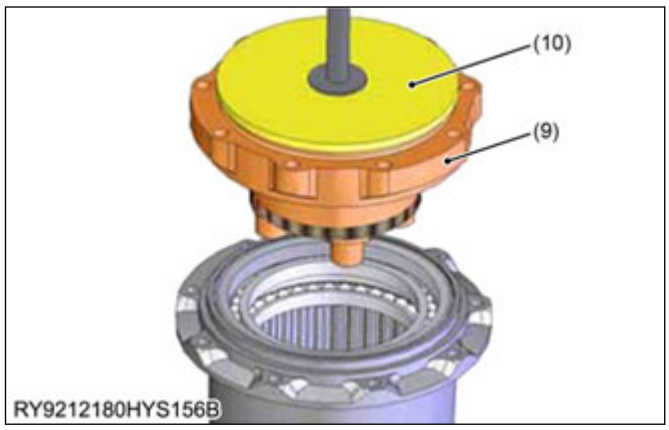



(7) Floating seal
(8) Jig (S-3)

4. Install the flange holder on the housing.

**IMPORTANT**

- **Before install the flange holder, clean the sealing face of the floating seal and apply the gear oil on the sealing face.**

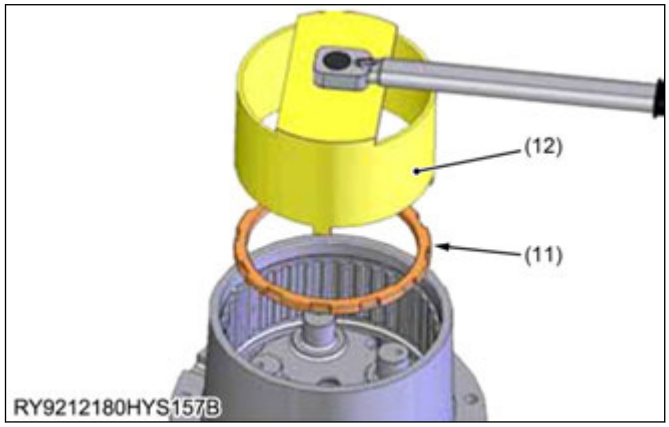



(9) Flange holder
(10) Jig (S-5)

5. Install the angular bearing with ring nut.

**IMPORTANT**

- **Do not reuse the removed angular bearing.**

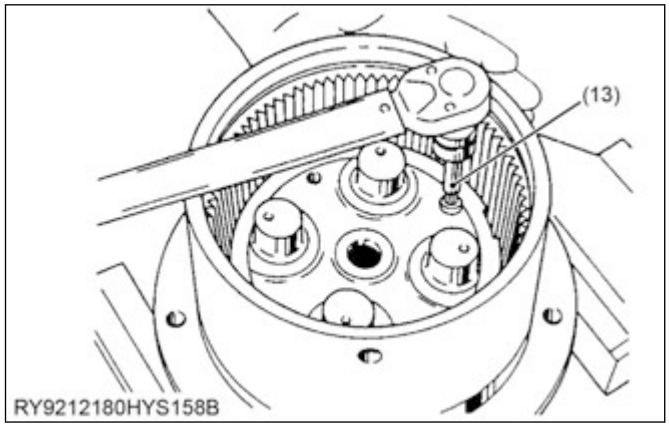



(11) Ring nut
(12) Jig (S-1)

**Tightening torque**

| | | |
|---|---|---|
| (11) Ring nut | 186.2 to 205.8 N·m<br>19 to 21 kgf·m<br>137.4 to 151.7 lbf·ft | - |

6. Install the plug.

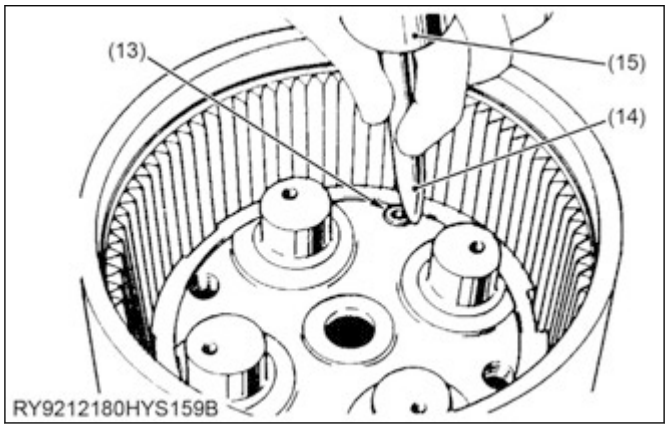



(13) Plug

**Tightening torque**

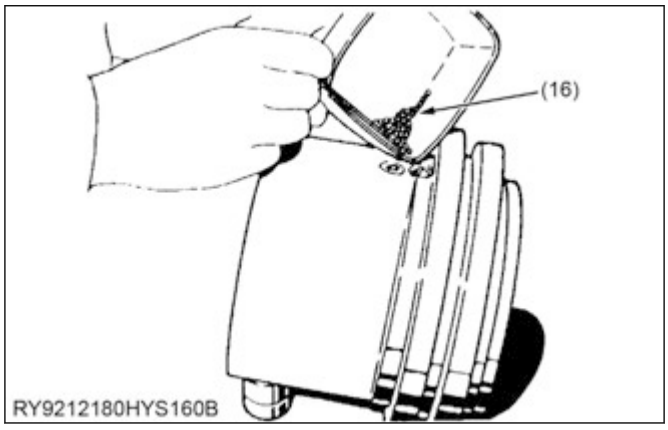
| | | |
|---|---|---|
| (13) Plug | 9.8 to 19.6 N·m<br>1.0 to 2.0 kgf·m<br>7.2 to 14.5 lbf·ft | - |

7. Swage 2 places beside the plug with a punch to prevent loosening of the plug.




(13) Plug
(14) Punch
(15) Hammer

8. Put the steel ball in plug hole.

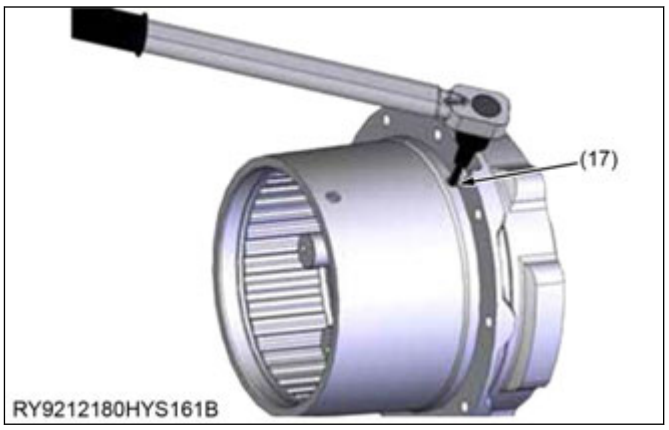



(16) Steel ball (109 pcs)

9. Wrap the thread seal tape around the plug and install the plug.

**IMPORTANT**

- **Tighten the plug until the plug head is fully inserted.**

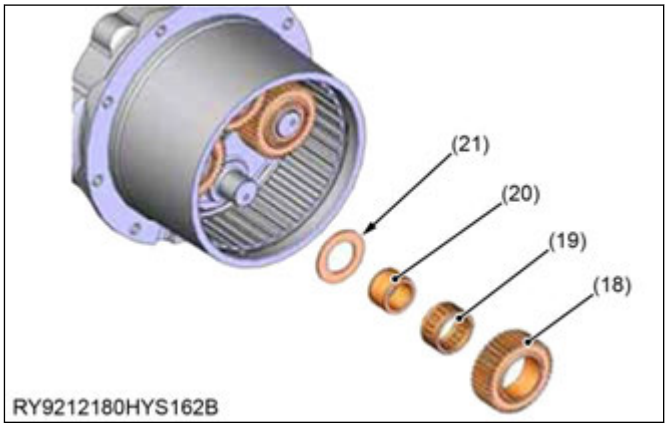



(17) Plug

**Tightening torque**

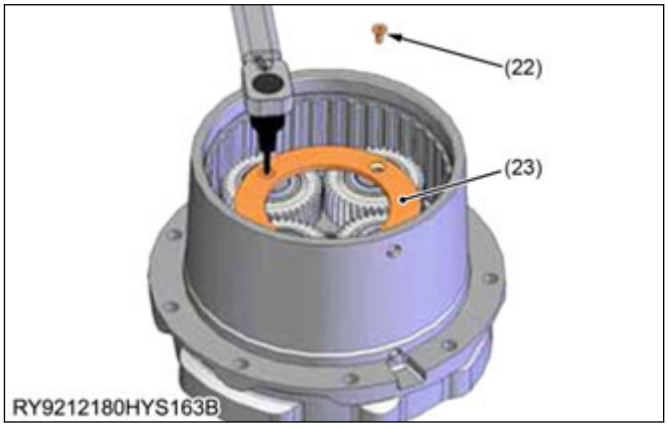
| | | |
|---|---|---|
| (17) Plug | 6.8 to 8.8 N·m<br>0.7 to 0.9 kgf·m<br>5.0 to 6.5 lbf·ft | - |

10. Install the gear, needle bearing, inner race and thrust washer.




(18) Gear
(19) Needle bearing
(20) Inner race
(21) Thrust washer

11. Install the thrust plate with screw.

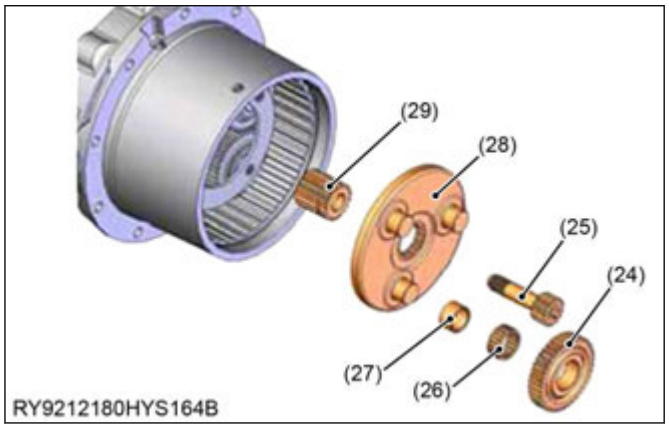



(22) Bolt
(23) Thrust plate

### Tightening torque

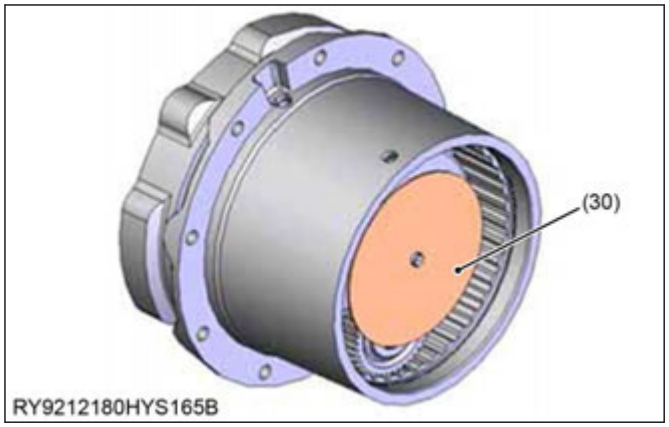
| | | |
|---|---|---|
| (22) Bolt | 12.1 to 13.3 N·m<br>1.24 to 1.35 kgf·m<br>8.93 to 9.80 lbf·ft | Thread lock<br>(Loctite 262) |

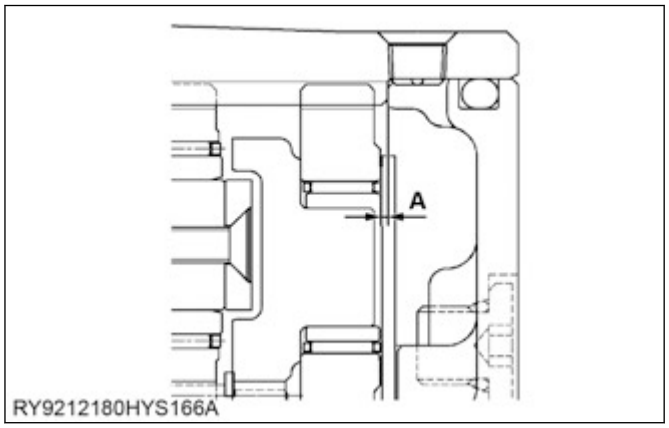
12. Install the sun gear (is installed circlip), inner race, needle bearing , holder, drive gear and gear.




(24) Planetary gear A
(25) Drive gear
(26) Needle bearing
(27) Inner race
(28) Holder
(29) Sun gear

13. Install the thrust plate.



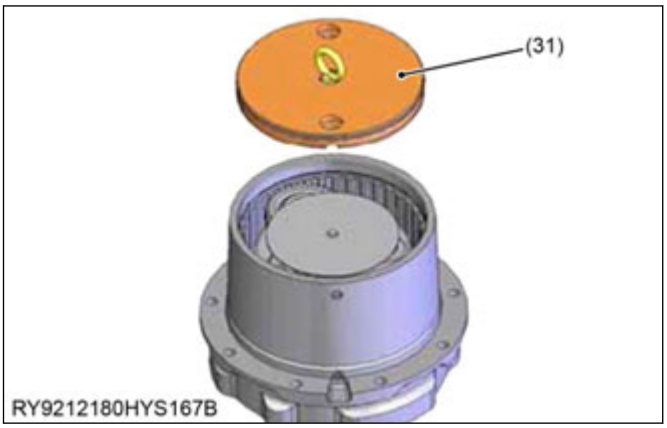

(30) Thrust plate

### Adjusting dimensions

| | | | |
|---|---|---|---|
| A | 0.3 to 0.7 mm<br>0.01 to<br>0.03 in. | 0.8 to 1.3 mm<br>0.03 to<br>0.05 in. | 1.4 to 1.8 mm<br>0.06 to<br>0.07 in. |
| Thrust plate thickness | 1.8 mm<br>0.07 in. | 2.3 mm<br>0.09 in. | 2.8 mm<br>0.11 in. |

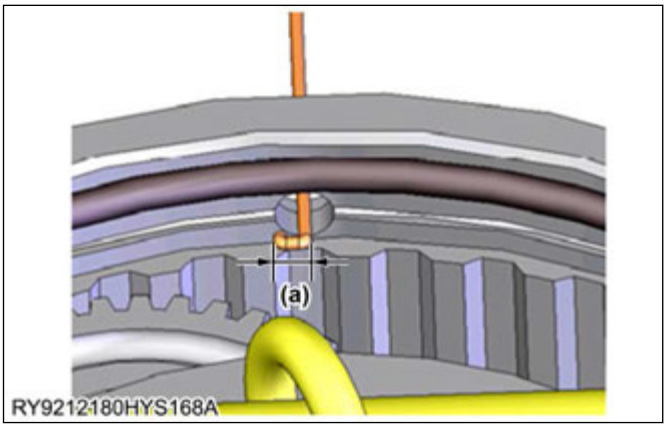
14. Install the cover so that plug thread hole and notch of cover are aligned.

**■ IMPORTANT**
- **Grease the O-ring before install the cover.**




(31) Cover

15. Bend the wire tip, insert the bent section, and hook it on the notch of cover.

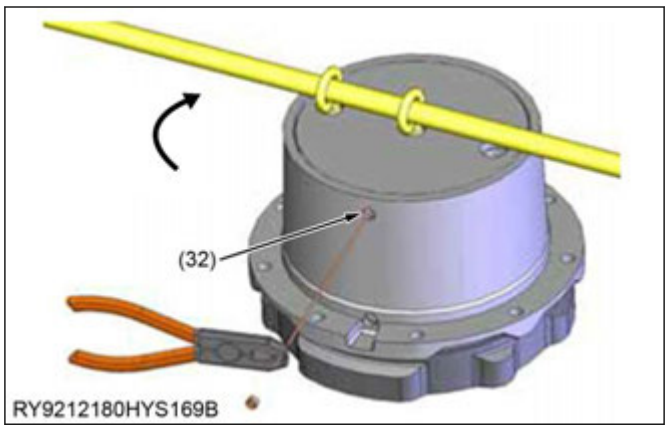



### Adjusting dimension

| | |
|---|---|
| (a) | 6.0 mm<br>0.23 in. |

16. Turn the cover until the wire makes one turn. And cut the wire with nipper.

**■ IMPORTANT**
- **Wrap the thread seal tape around the plug.**




(32) Plug

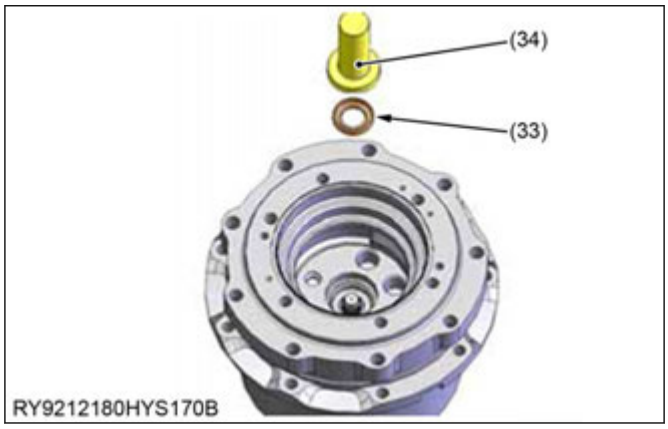
**Tightening torque**

| | | |
|---|---|---|
| (32) Plug | 6.8 to 8.8 N·m<br>0.7 to 0.9 kgf·m<br>5.0 to 6.5 lbf·ft | - |

**Assembling the motor**

1. Press fit the oil seal into the flange holder.

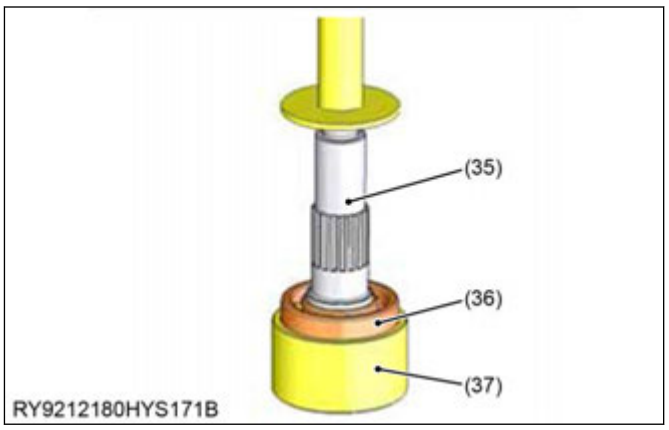
**IMPORTANT**
- **Do not reuse the oil seal.**




(33) Oil seal (34) Jig (S-6)

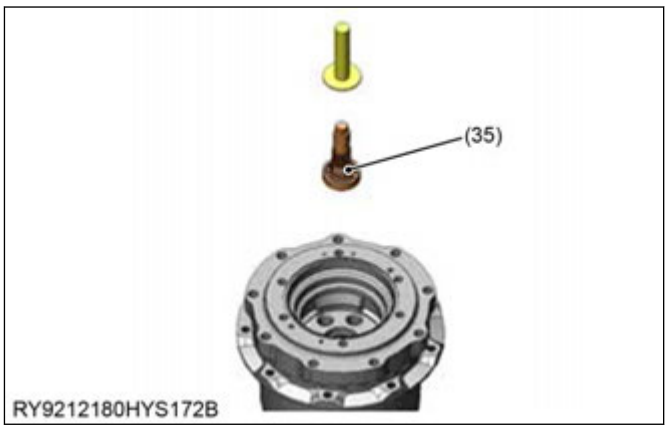
2. Press fit the ball bearing into the shaft.

**NOTE**
- **Install the new ball bearing.**



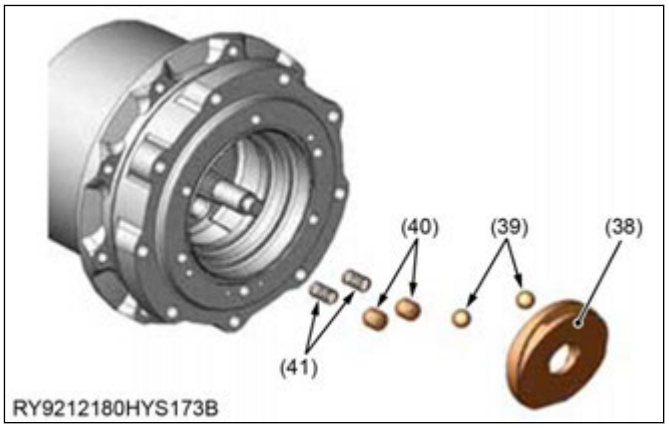

(35) Shaft (37) Jig (S-7)
(36) Ball bearing

3. Grease the slide section and side of the oil seal. And press fit the shaft into the flange holder.



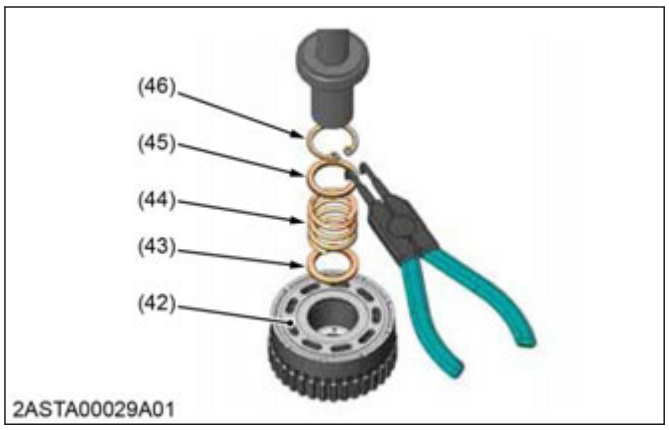

(35) Shaft

4. Install the steel balls, spring, piston and swash plate on the flange holder.



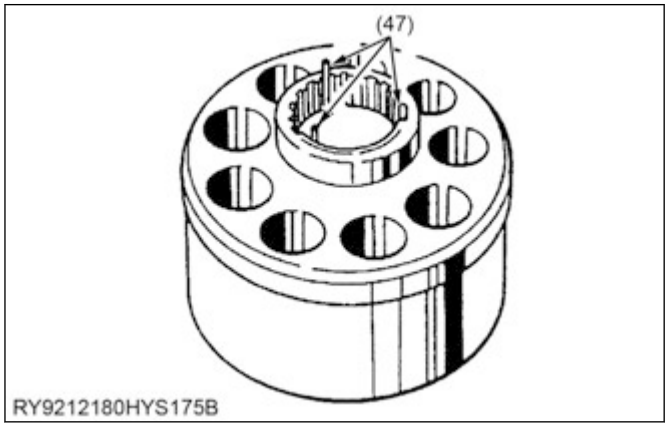

(38) Swash plate (41) Spring
(39) Steel ball
(40) Piston

5. Install the collar, spring, washer and circlip on the cylinder block.



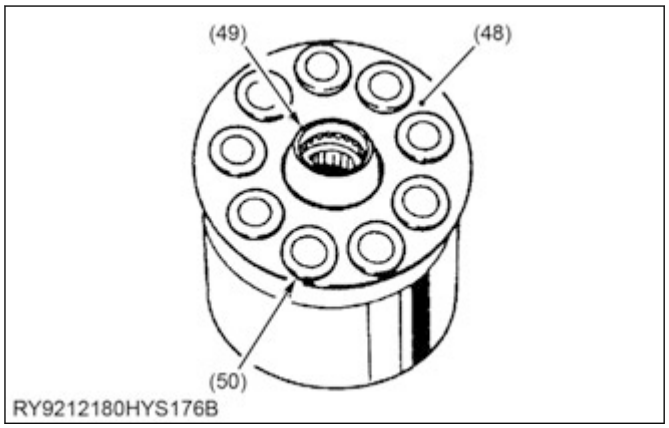

(42) Cylinder block
(43) Collar
(44) Spring
(45) Washer
(46) Circlip

6. Grease the pins and install to cylinder block.



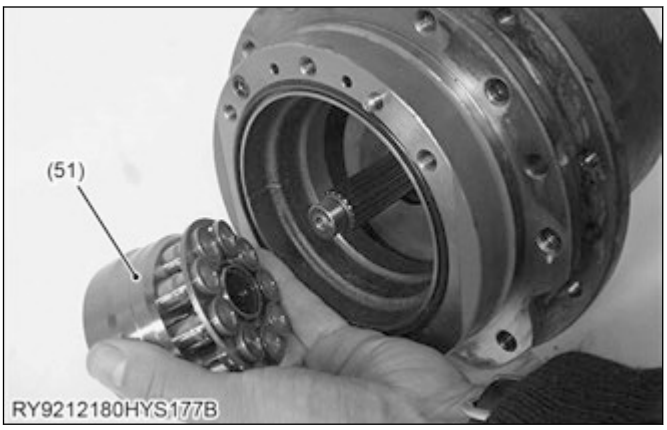

(47) Pin

7. Install the retainer holder, retainer plate and pistons.




(48) Retainer holder
(49) Retainer plate
(50) Piston

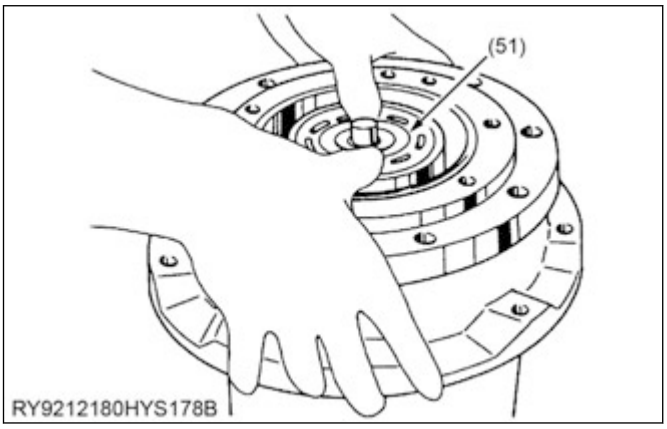
8. Install the cylinder block assembly.




(51) Cylinder block assembly

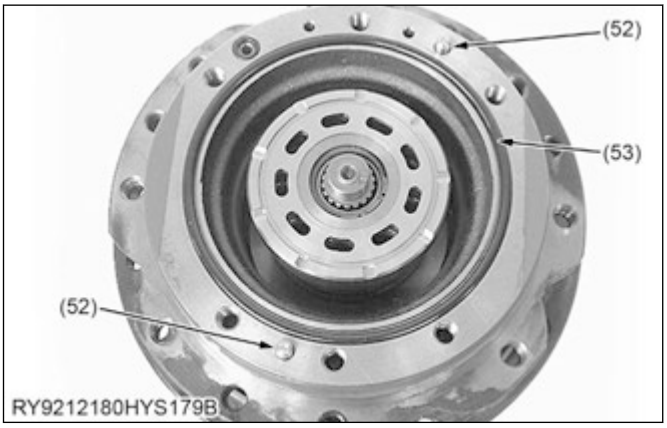
9. Press the cylinder block by hand to check that the spring is functioning.

**■ IMPORTANT**
- **Apply the hydraulic oil to the sliding part of cylinder block.**




(51) Cylinder block assembly

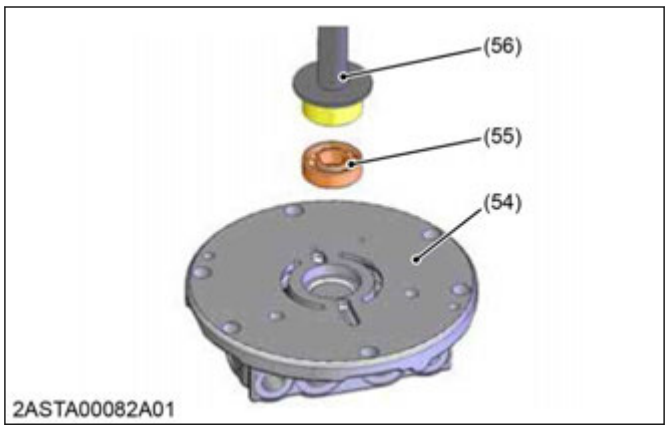
10. Install the pins and O-ring on the flange holder.




(52) Pin
(53) O-ring

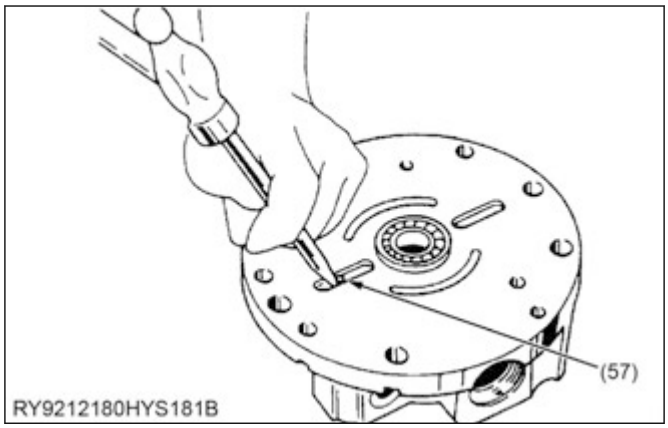
11. Press fit the ball bearing into the valve body.

**■ NOTE**
- **Install the new ball bearing.**



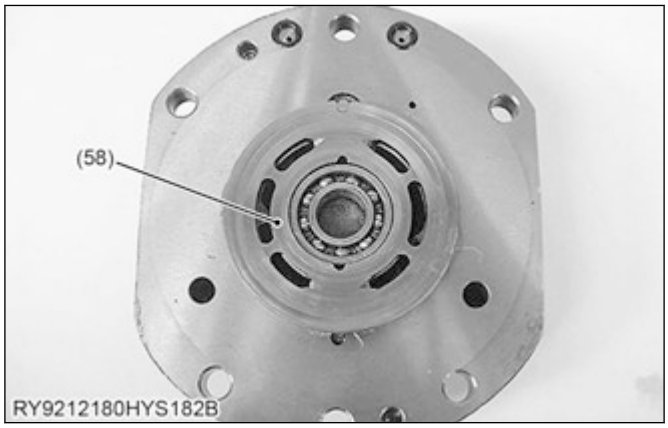

(54) Valve body
(55) Ball bearing
(56) Jig (S-8)

12. Install the pin and swage 1 place around the pin.



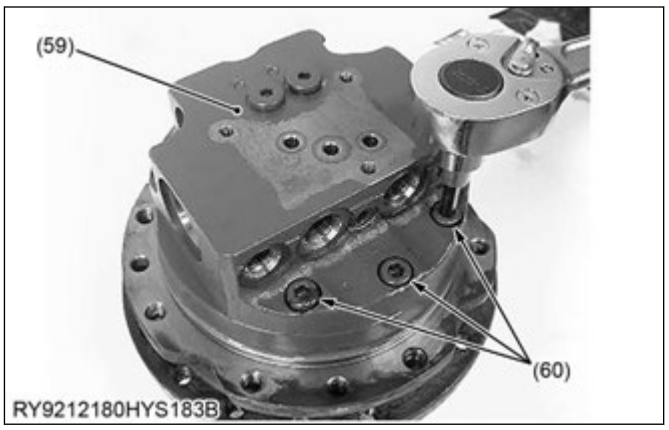

(57) Pin

13. Grease the backside of the valve plate and install it on the valve body.




(58) Valve plate

14. Install the valve body with cap bolts.

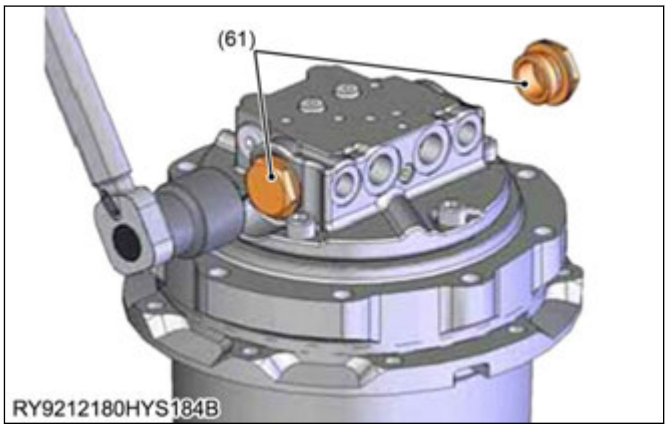



(59) Valve body
(60) Cap bolt ×6

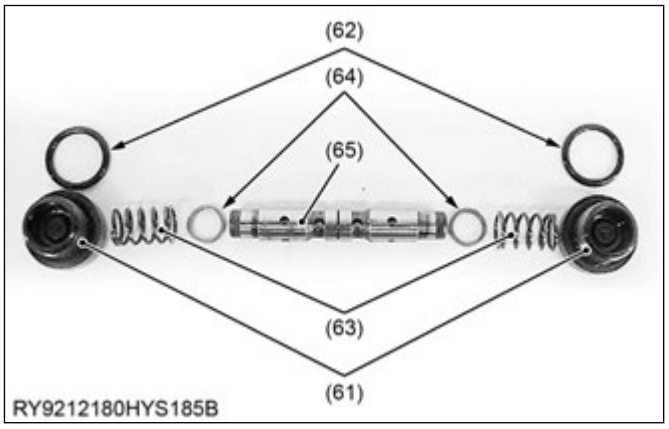
**Tightening torque**

| | | |
|---|---|---|
| (60) Cap bolt | 58.8 to 68.6 N·m<br>6.0 to 7.0 kgf·m<br>43.4 to 50.5 lbf·ft | - |

15. Install the shaft and swash plate in order.




(61) Cap

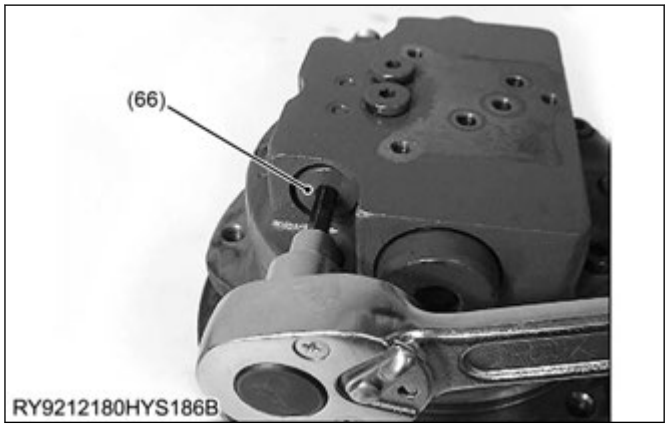



(61) Cap
(62) O-ring
(63) Spring
(64) Spring seat
(65) Counterbalance spool

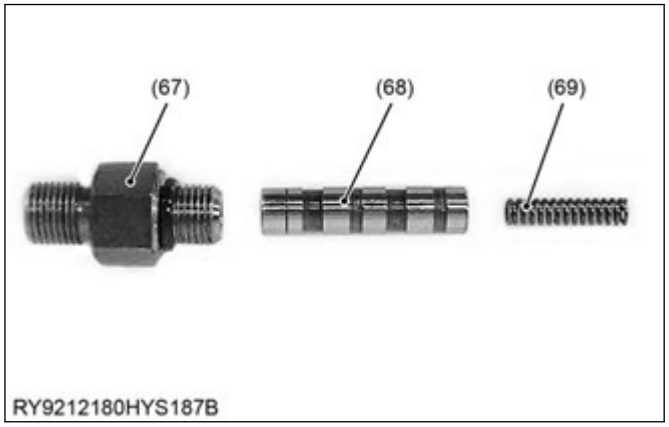
**Tightening torque**

| | | |
|---|---|---|
| (61) Cap | 235 to 245 N·m<br>24.0 to 25.0 kgf·m<br>173 to 181 lbf·ft | - |

16. Install the spring, spool and plug.




(66) Plug

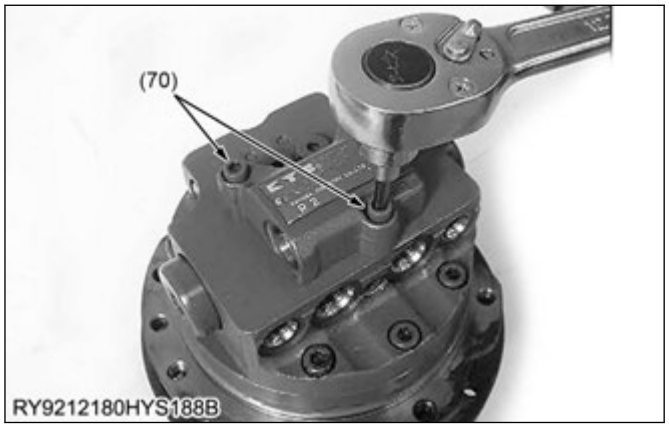



(67) Plug
(68) Spool
(69) Spring

**Tightening torque**

| | | |
|---|---|---|
| (66) Plug | 49.0 to 58.8 N·m<br>5.0 to 6.0 kgf·m<br>36 to 43 lbf·ft | - |

17. Install the O-ring on the valve body and tighten the cap bolts.

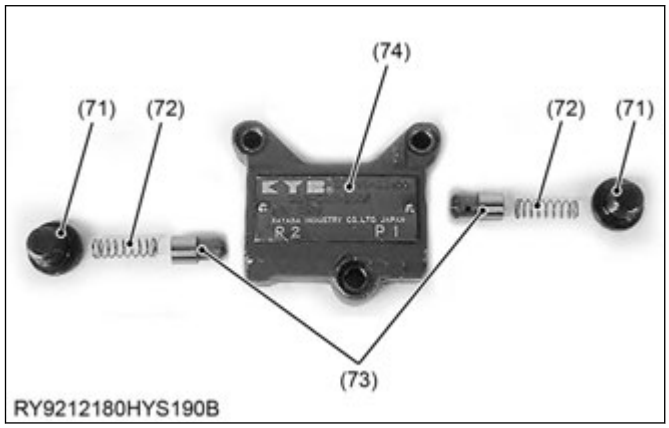



(70) Cap bolt ×3

**Tightening torque**

| | | |
|---|---|---|
| (70) Cap bolt | 35.0 to 38.8 N·m<br>3.6 to 4.0 kgf·m<br>26.0 to 28.6 lbf·ft | - |

18. Install the spool, spring and spring sheet on the valve body and tighten the plug.

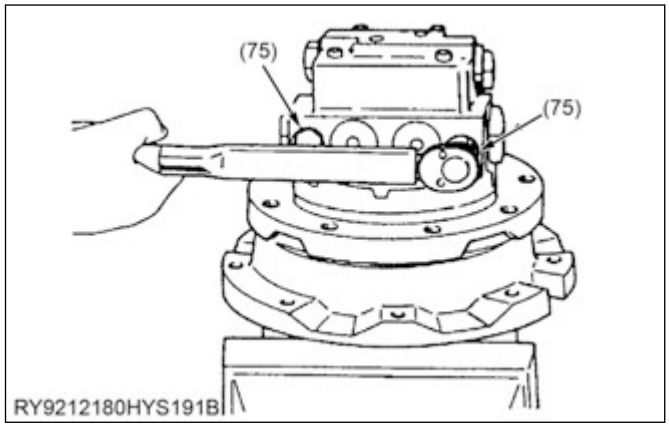



(71) Plug
(72) Spring
(73) Check valve
(74) Valve body

**Tightening torque**

| | | |
|---|---|---|
| (71) Plug | 49.0 to 58.8 N·m<br>5.0 to 6.0 kgf·m<br>36 to 43 lbf·ft | - |

19. Install the Plug.

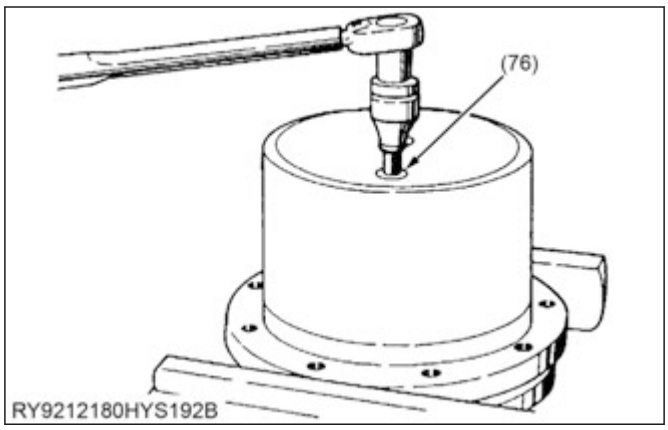



(75) Plug

**Tightening torque**

| | | |
|---|---|---|
| (75) Plug | 21.6 to 23.6 N·m<br>2.2 to 2.4 kgf·m<br>16.0 to 17.4 lbf·ft | - |

20. Fill in 0.6 L of gear oil from the plug hole. And tighten the plug.




(76) Plug

### Tightening torque

| | | |
|---|---|---|
| (76) Plug | 21.6 to 23.6 N·m<br>2.2 to 2.4 kgf·m<br>16.0 to 17.4 lbf·ft | - |

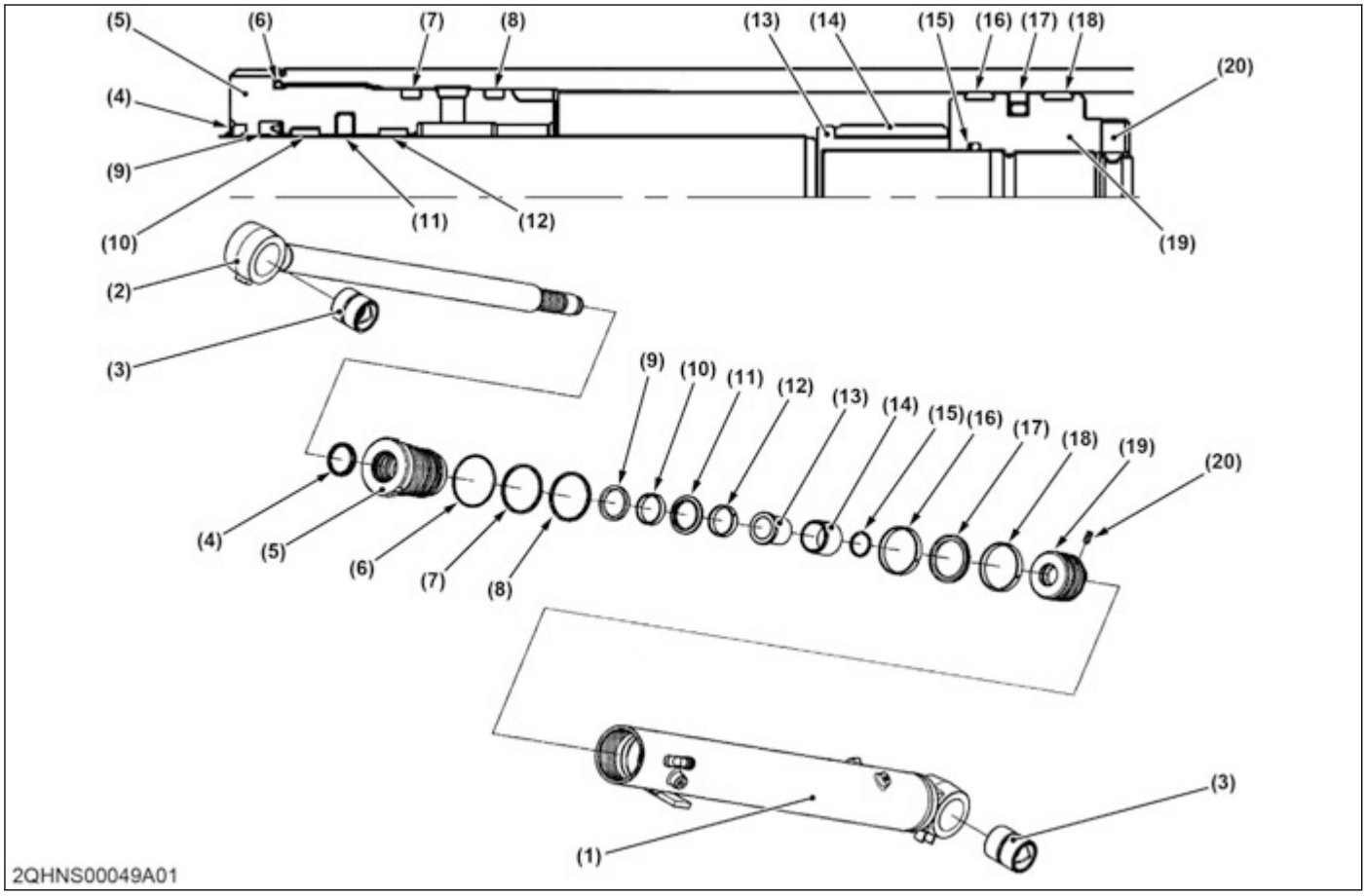
### Recommended lubricants

| | | |
|---|---|---|
| Gear oil | 0.5 L<br>0.09 U.S.gals | In winter or at low temperatures<br>SAE 75, SAE 80 |
| | | In summer or at high ambient temperatures<br>SAE 90, SAE 140 |
| | | All-weather<br>80W-90 |

# 4.5 Hydraulic cylinder

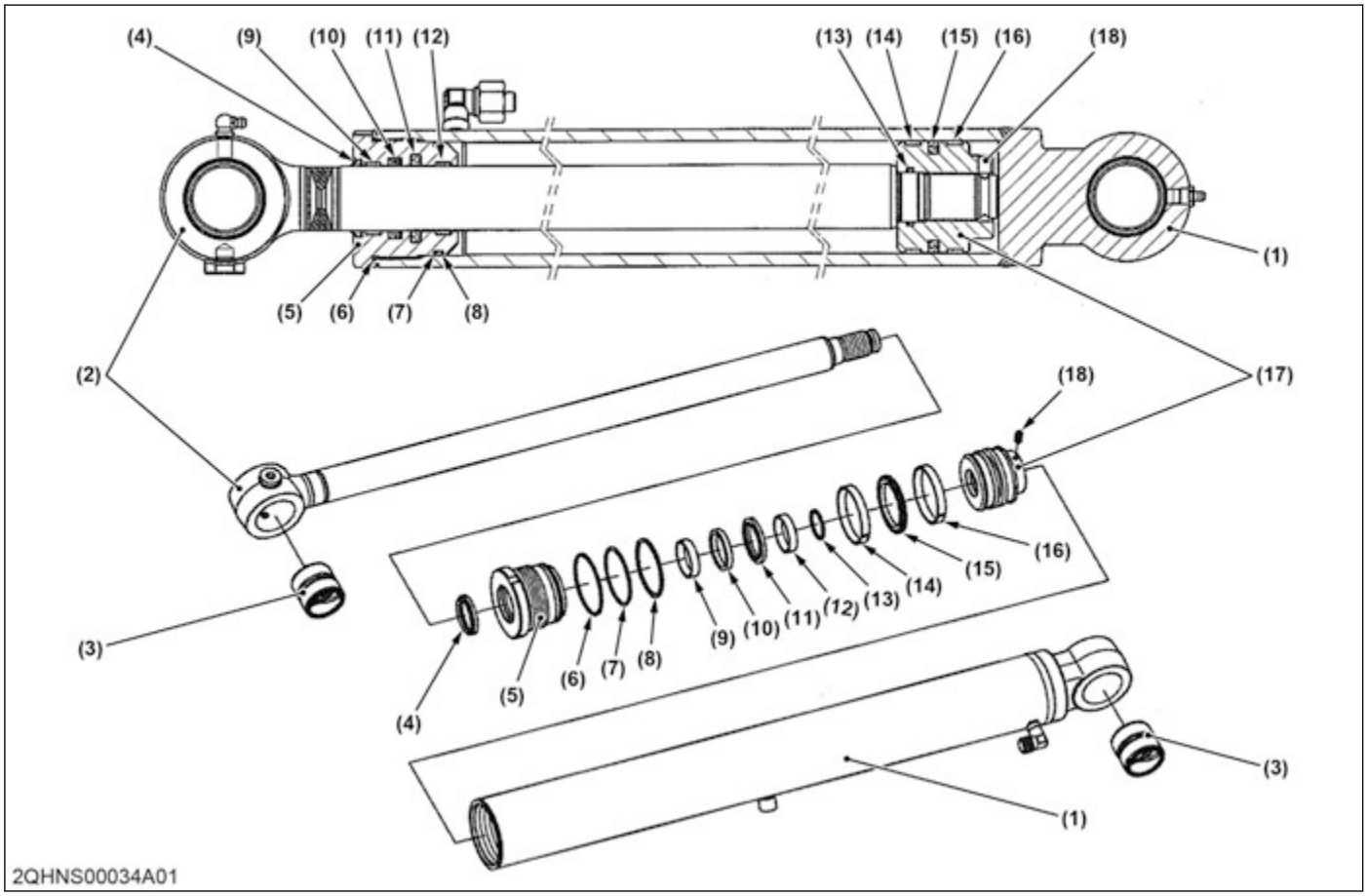
## 4.5.1 Cylinder components

### 4.5.1.1 Boom cylinder components




(1) Cylinder tube
(2) Piston rod
(3) Bushing
(4) Dust seal
(5) Cylinder head
(6) O-ring
(7) Seal ring
(8) Seal ring
(9) Oil seal
(10) Slide ring
(11) Seal ring
(12) Slide ring
(13) Inner cushion bearing
(14) Cushion bearing
(15) O-ring
(16) Slide ring
(17) Seal ring
(18) Slide ring
(19) Piston
(20) Set screw

## 4.5.1.2 Arm, bucket, swing and blade cylinder components




(1) Cylinder tube
(2) Piston rod
(3) Bushing
(4) Dust seal
(5) Cylinder head
(6) O-ring
(7) Back-up ring
(8) O-ring
(9) Slide ring
(10) Oil seal
(11) Seal ring
(12) Slide ring
(13) O-ring
(14) Slide ring
(15) Seal ring
(16) Slide ring
(17) Piston
(18) Set screw

## 4.5.2 Disassembling hydraulic cylinder

**■ IMPORTANT**

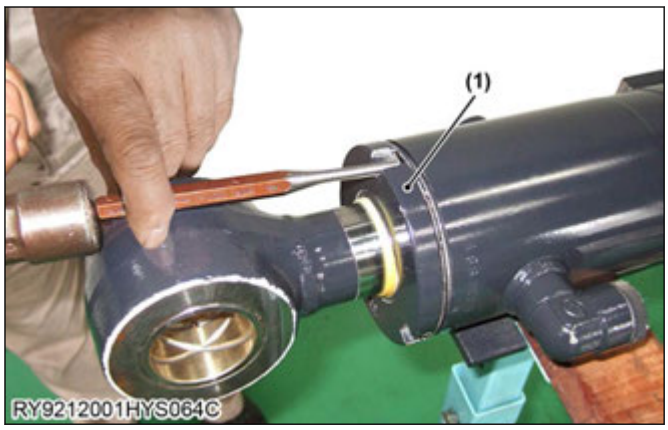
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

**Disassembling the piston rod**

1. Drain the hydraulic oil.
2. Fasten the bottom side of cylinder in a vice. Support the cylinder with stand.

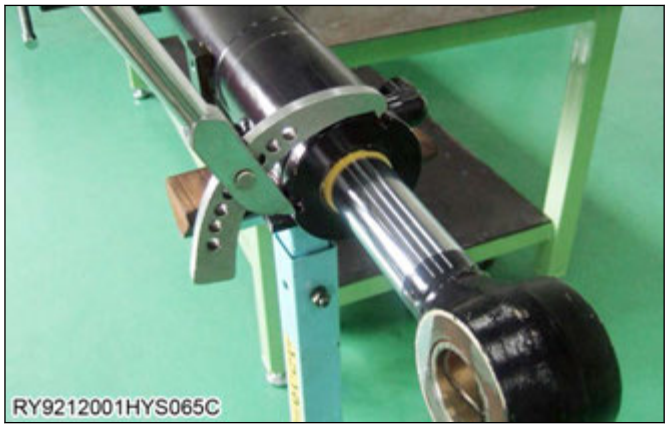



3. Hit the cylinder head with hammer and pin punch to open the rotation stopper.




(1) Cylinder head

4. Loosen the cylinder head with hook wrench or key wrench to remove.




5. Remove the piston rod and cylinder head.

**NOTE**
- **Remove plugs before pulling out the piston rod and cylinder head.**
- **Put oil pan on the cylinder head side.**




(1) Cylinder head (2) Piston rod

6. Fasten the piston rod assembly in a vice. Support the piston rod assembly with stand.

**IMPORTANT**
- **Do not damage the rod. Put a cushion under the rod for support.**




7. Remove the set screw.

**NOTE**
- **Set screw is swaged in 2 locations. Remove the swage by hand drill to loosen the set screw.**
- **Screw a tap (M8 × 1.25) after removed the set screw.**




(3) Set screw

8. Loosen the piston with wrench.



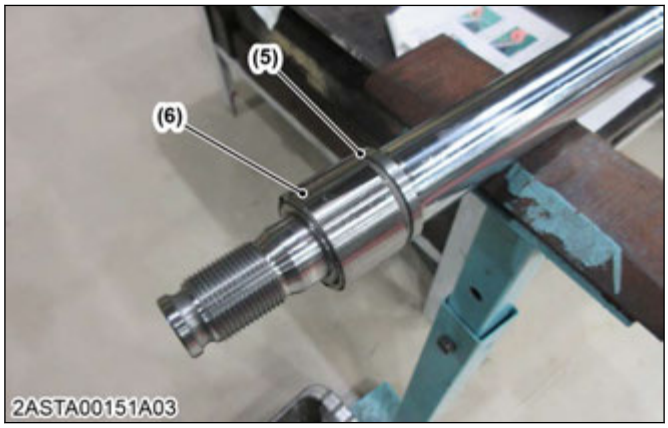

(4) Piston

9. Remove the piston.



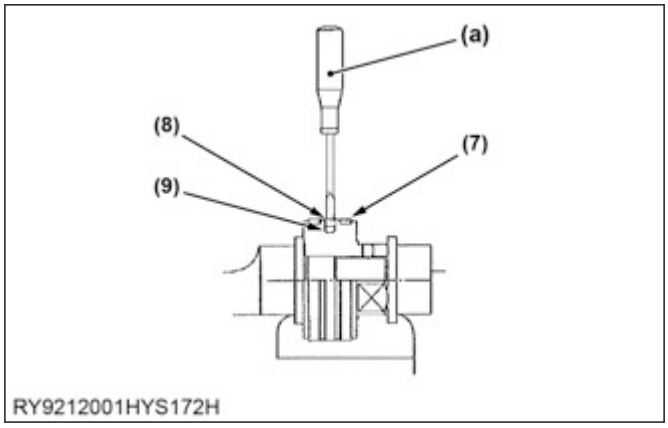

(4) Piston

10. Remove the cushion bushing and inner cushion bushing.




(5) Inner cushion bushing (6) Cushion bushing

11. Remove the slide ring by hand.



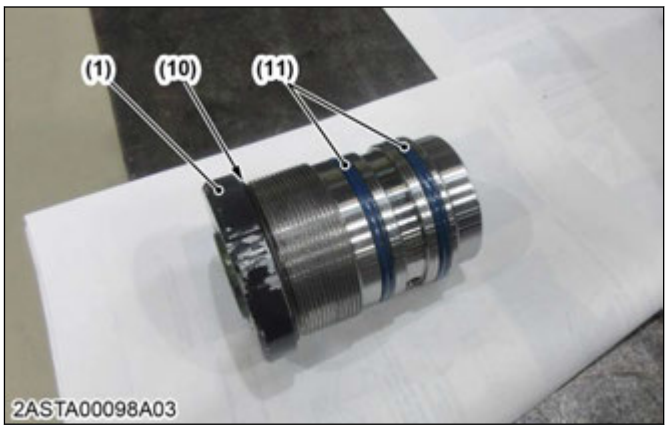

(7) Slide ring (a) Flat tip screwdriver
(8) Seal ring
(9) O-ring

12. Remove the seal ring and O-ring.

**■ NOTE**
- **Use a flat tip screwdriver to remove.**

**Disassembling the cylinder head**

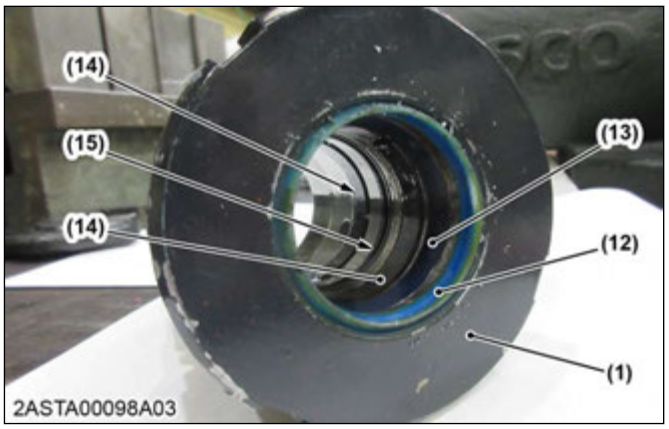
1. Remove the O-ring and seal rings.




(1) Cylinder head (11) Seal ring
(10) O-ring

2. Remove the dust seal, oil seal, slide rings and seal ring.

**■ NOTE**
- **Use a flat tip screwdriver to remove.**




(1) Cylinder head (14) Slide ring
(12) Dust seal (15) Seal ring
(13) Oil seal

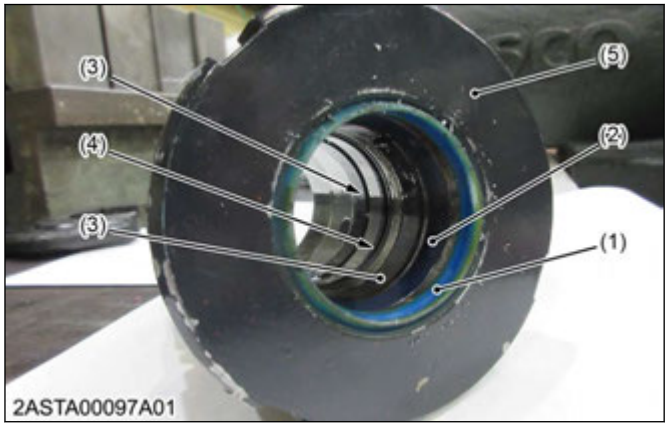
## 4.5.3 Assembling hydraulic cylinder

**■ IMPORTANT**
- **Do not reuse removed O-rings, oil seals, seal rings, and dust seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Assembling the cylinder head**

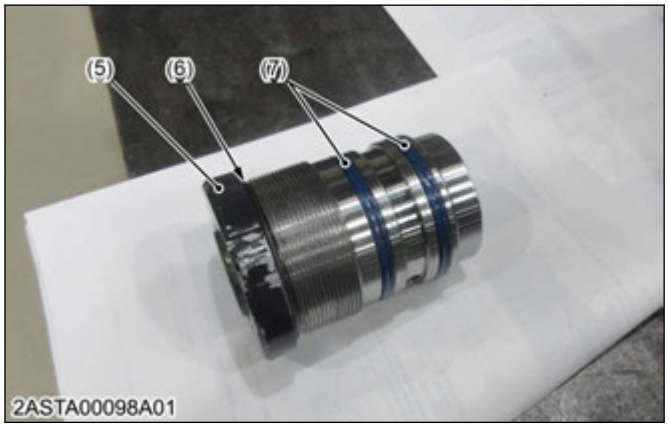
1. Install the dust seal, oil seal, slide ring and seal ring.

**■ NOTE**
- **Apply hydraulic oil to inside of the cylinder head before installing.**
- **Make sure not to damage the seal. Check for damages after the seal is installed.**




(1) Dust seal
(2) Oil seal
(3) Slide ring
(4) Seal ring
(5) Cylinder head

2. Install the O-ring and seal rings.




(5) Cylinder head
(6) O-ring
(7) Seal ring

**Assembling the piston rod**

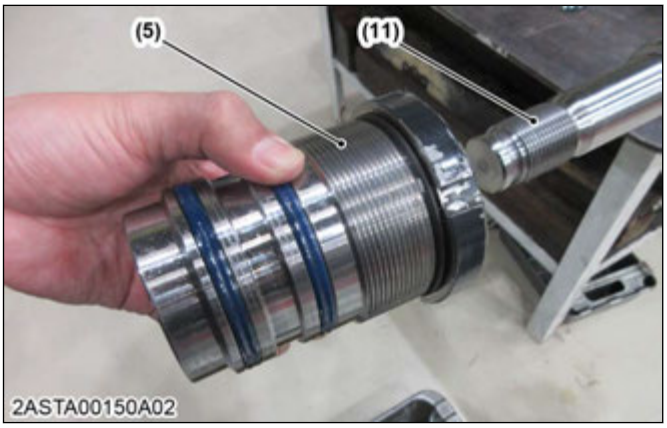
1. Screw a tap (M8 × 1.25) to thread hole of the set screw.
2. Install the seal ring and slide rings.




(8) Slide ring
(9) Seal ring
(10) Piston

3. Fasten the bottom side of cylinder in a vice.
4. Install the cylinder head into the piston rod carefully.

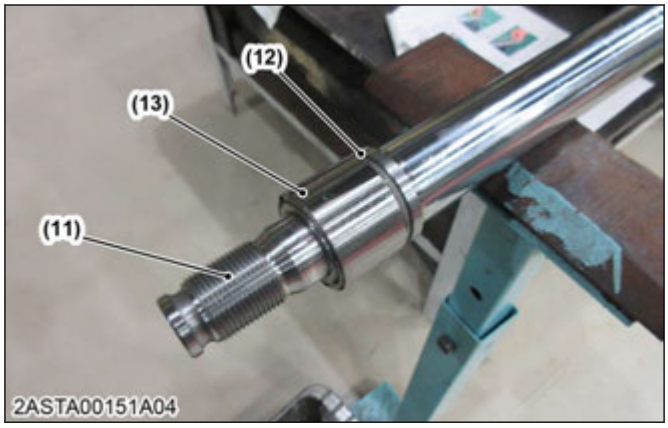
**■ NOTE**
- **Apply hydraulic oil to cylinder head (seal ring and O-ring).**
- **Do not damage the wiper ring and U-ring.**




(5) Cylinder head
(11) Piston rod

5. Install the inner cushion bearing and cushion bearing to the piston rod.

**■ NOTE**
- **Only for boom cylinder.**
- **Apply hydraulic oil to the holder and cushion bearing.**
- **Make sure that the cushion bearing faces to correct direction.**




(11) Piston rod
(12) Inner cushion bearing
(13) Cushion bearing

6. Tighten the piston onto the rod with the specified torque.

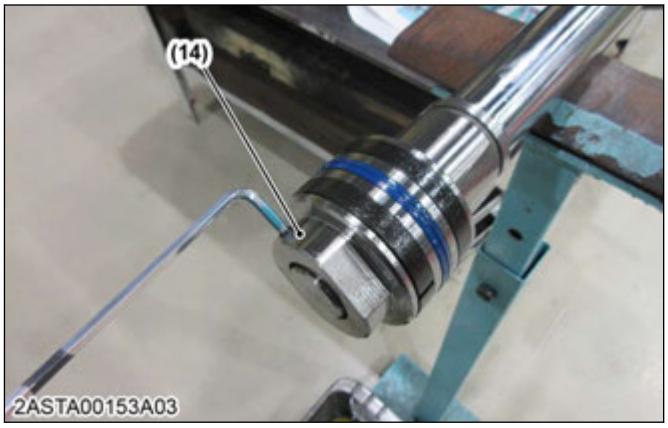



(10) Piston

**Tightening torque**

| | | | |
|---|---|---|---|
| Boom | (10) Piston | 300 N·m<br>30.6 kgf·m<br>221 lbf·ft | - |
| Arm | | 380 N·m<br>38.8 kgf·m<br>280 lbf·ft | - |
| Bucket | | 350 N·m<br>35.7 kgf·m<br>258 lbf·ft | - |
| Swing | | 300 N·m<br>30.6 kgf·m<br>221 lbf·ft | - |
| Blade | | 800 N·m<br>81.6 kgf·m<br>590 lbf·ft | - |

7. Tighten the set screw with the specified torque.




(14) Set screw

**Tightening torque**

| | | | |
|---|---|---|---|
| Boom | (14) Set screw | 13 N·m<br>1.33 kgf·m<br>9.59 lbf·ft | - |
| Arm | | | - |
| Bucket | | | - |
| Swing | | | - |
| Blade | | 32 N·m<br>3.26 kgf·m<br>23.6 lbf·ft | - |

8. Swage the set screw by hitting 2 punches to the circumference of the set screw.




9. Fasten the bottom side of cylinder in a vice.
10. Install the piston rod to the cylinder tube.

**NOTE**
- **Apply hydraulic oil to the piston rod.**




(11) Piston rod (15) Cylinder tube

11. Tighten the cylinder head by hook wrench or key wrench.




(5) Cylinder head

**Tightening torque**

| | | | |
|---|---|---|---|
| Boom | (5) Cylinder head | 400 N·m<br>40.8 kgf·m<br>295 lbf·ft | - |
| Arm | | | - |
| Bucket | | | - |
| Swing | | | - |
| Blade | | 600 N·m<br>61.2 kgf·m<br>443 lbf·ft | - |

12. Set the rotation stopper.

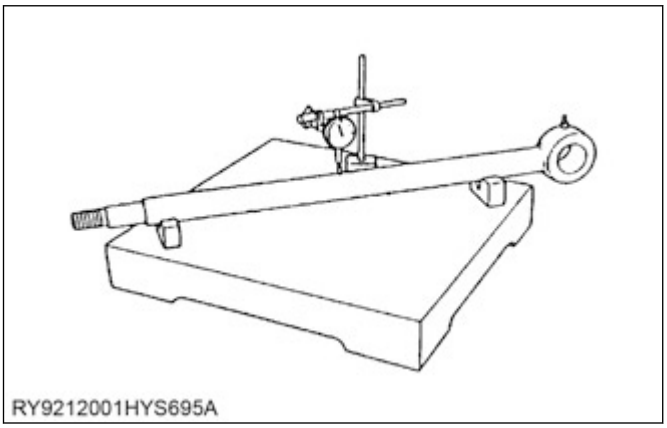



## 4.5.4 Measuring hydraulic cylinder

### 4.5.4.1 Measuring hydraulic cylinder bending

1. Put the cylinder rod on the V blocks.
2. Set a dial gauge on center of the rod.
3. Rotate the cylinder rod slowly to measure.

**■ NOTE**
- **The half of measured value is bending of the rod. Replace if exceeded the service limit.**




**Service specification**

| | |
|---|---|
| Bending | less than 0.05 mm<br>less than 0.002 in. |

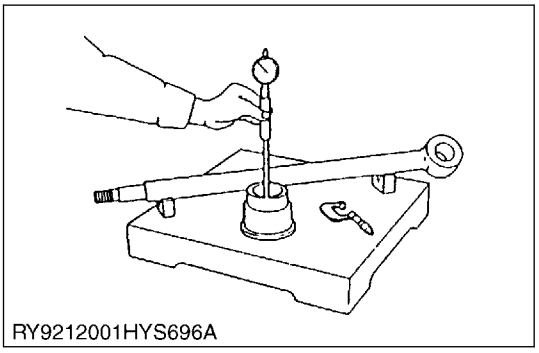
**Service limit**

| | |
|---|---|
| Bending | 0.5 mm<br>0.02 in. |

### 4.5.4.2 Measuring hydraulic cylinder rod and head clearance

1. Measure the external diameter of cylinder rod and internal diameter of cylinder head (inside of bushings) to calculate the clearance.

**■ NOTE**
- **Replace if exceeded the service limit.**



**Service specifications**

| | | |
|---|---|---|
| Clearance | Boom cylinder | less than 0.25 mm<br>less than 0.01 in. |
| | Arm cylinder | |
| | Blade cylinder | |
| | Swing cylinder | less than 0.3 mm<br>less than 0.012 in. |
| | Bucket cylinder | |

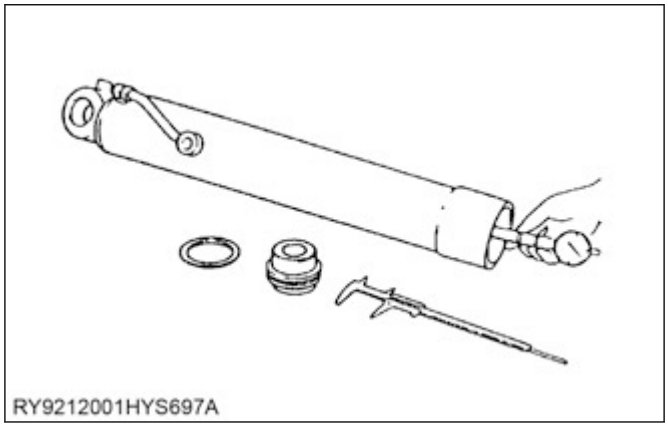
**Service limits**

| | | |
|---|---|---|
| Clearance | Boom cylinder | 0.4 mm<br>0.016 in. |
| | Arm cylinder | |
| | Blade cylinder | |
| | Swing cylinder | 0.5 mm<br>0.02 in. |
| | Bucket cylinder | |

### 4.5.4.3 Measuring hydraulic cylinder tube and piston wear ring clearance

1. Measure the internal diameter of cylinder tube and external diameter of cylinder wear ring to calculate the clearance.

**■ NOTE**
- **Replace if exceeded the service limit.**




**Service specifications**

| | | |
|---|---|---|
| Clearance | Boom cylinder | 0.05 to 0.35 mm<br>0.002 to 0.014 in. |
| | Arm cylinder | |
| | Blade cylinder | |
| | Swing cylinder | |
| | Bucket cylinder | |

**Service limits**

| | | |
|---|---|---|
| Clearance | Boom cylinder | 0.7 mm<br>0.028 in. |
| | Arm cylinder | |
| | Blade cylinder | |
| | Swing cylinder | |
| | Bucket cylinder | |

## 4.6 Pilot control valve

### 4.6.1 Removing and installing the pilot control valve

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

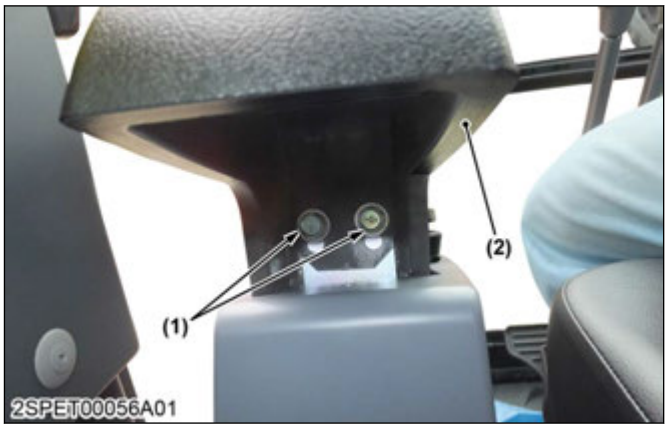
**■ IMPORTANT**
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**

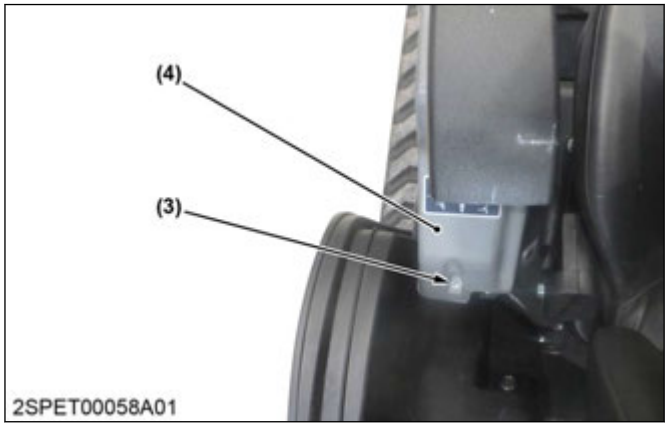
1. Remove the 2 bolts and arm rest.




(1) Bolt (M8 × 16) ×2 (2) Arm rest

2. Remove the 2 screws and lower cover.



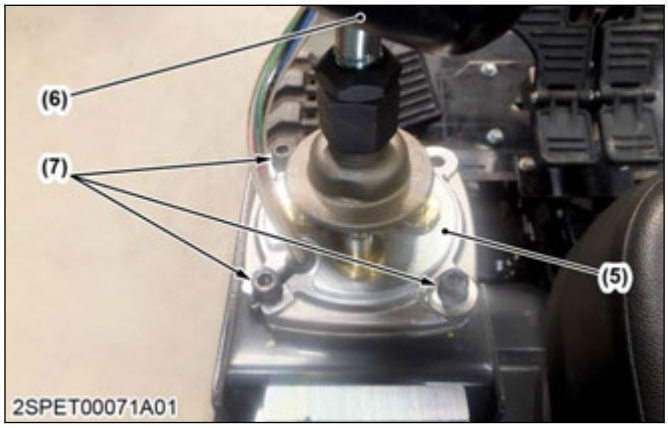




(3) Screw ×2 (4) Lower cover

3. Disconnect all of the hydraulic hoses and connector from the LH pilot control valve.

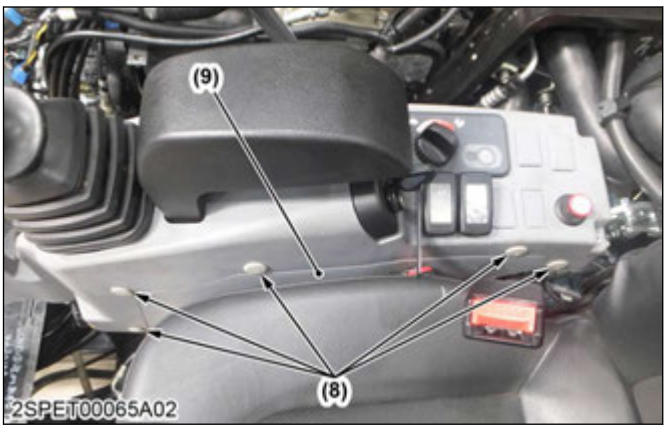
**■ NOTE**
- **Put marks on the disconnected hydraulic hoses to reconnect each hose correctly.**

4. Remove the boot from the LH pilot control valve.




(5) LH pilot control valve (7) Cap bolt ×3
(6) Boot

5. Remove the 3 cap bolts and LH pilot control valve.
6. Remove the 5 clips and panel.




(8) Clip ×5 (9) Panel

7. Remove the 2 bolts and arm rest.




(10) Bolt (M8 × 16) ×2 (11) Arm rest

8. Remove the 2 screws and bolt.




(12) Screw ×2 (14) Cover
(13) Bolt (M6 × 16)

9. Disconnect all of the connectors from the cover and remove the cover.
10. Disconnect all of the hydraulic hoses and connectors from the RH pilot control valve.

**■ NOTE**
- **Put marks on the disconnected hydraulic hoses to reconnect each hose correctly.**

11. Remove the boot from the RH pilot control valve.



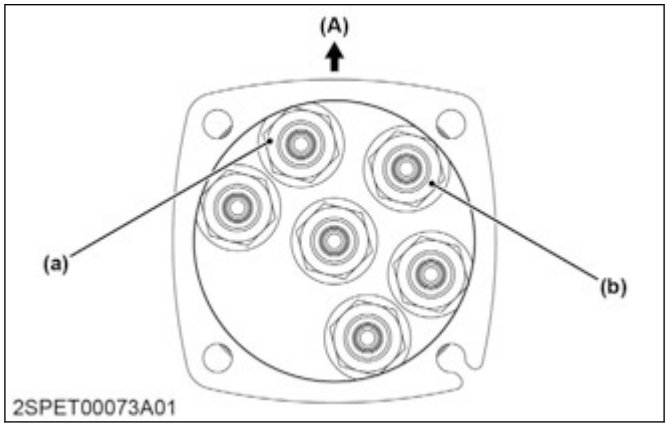

(15) RH pilot control valve
(16) Boot
(17) Cap bolt ×3

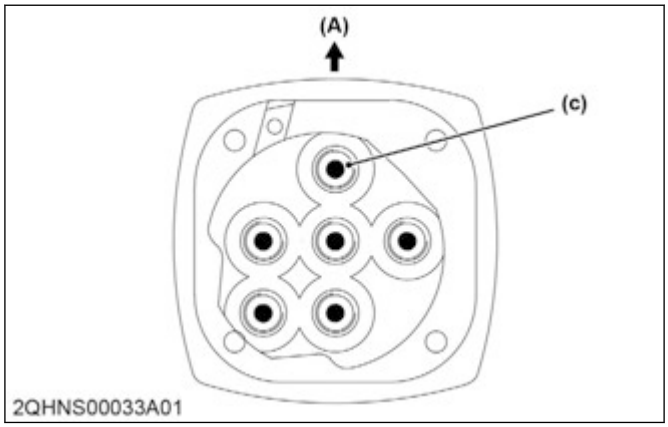
12. Remove the 3 cap bolts and pilot control valve.

**Installing**

**■ NOTE**

- **Make sure to connect the hydraulic hoses correctly.**

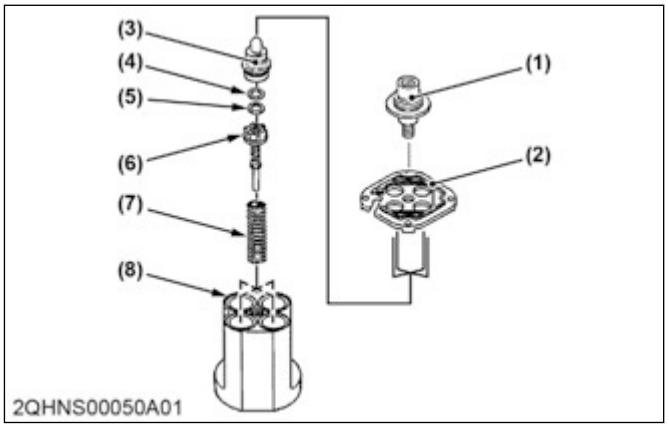



(a) Port 2
(b) Port T
(c) Port 3
(A) Forward

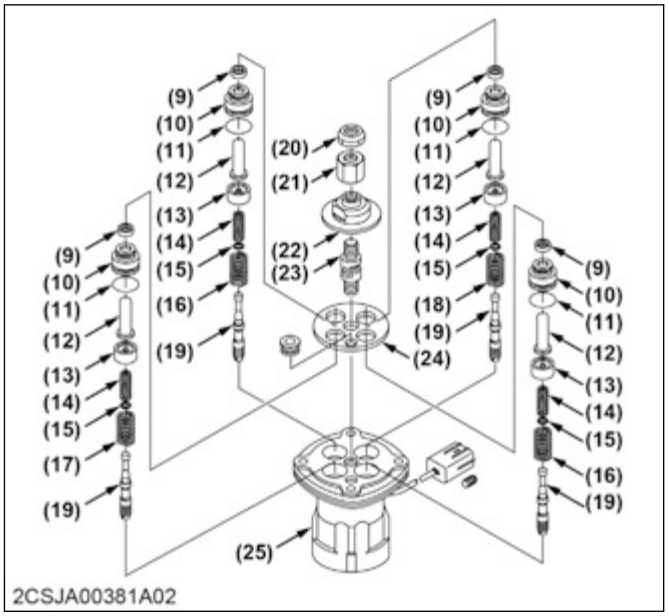
## 4.6.2 Pilot control valve components

**Basic**




(1) Universal joint
(2) Plate
(3) Plug assembly ×4
(4) Seal ×4
(5) O-ring ×4
(6) Pressure reducing valve ×4
(7) Spring ×4
(8) Casing

**Hi-spec**




(9) Seal ×4
(10) Plug ×4
(11) O-ring ×4
(12) Push rod ×4
(13) Spring seat ×4
(14) Spring ×4
(15) Seat ×4
(16) Spring (port 1 and 3) ×2
(17) Spring (port 2)
(18) Spring (port 4)
(19) Spool ×4
(20) Lock nut
(21) Adjusting nut
(22) Disc nut
(23) Universal joint
(24) Plate
(25) Casing

## 4.6.3 Disassembling the pilot control valve (basic)

**■ IMPORTANT**

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**

- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

**Disassembling the pressure reducing valves**

1. Fasten the pilot control valve (operating) in a vice.
2. Remove the universal joint.

**NOTE**
- **Loosen the universal joint slowly to avoid the pressure reducing valves from popping out.**



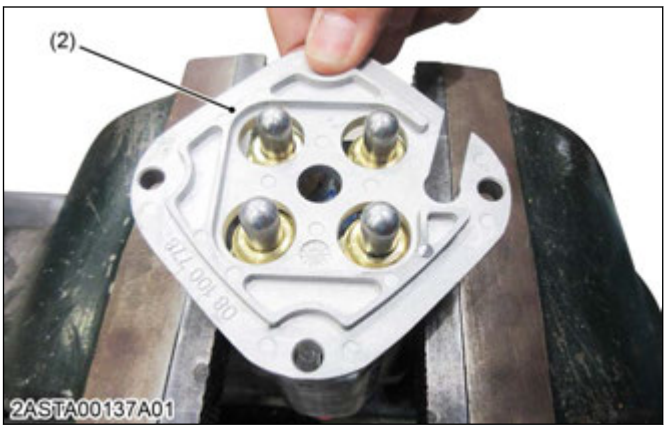

(1) Universal joint

3. Put a mark on the casing and pressure reducing valves.

**NOTE**
- **Make sure to install pressure reducing valves in the same locations.**




4. Remove the plate.




(2) Plate

5. Remove the plugs.

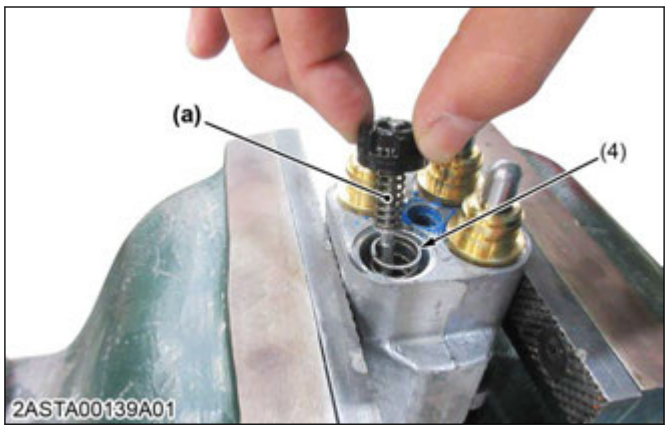
**NOTE**
- **Use a slotted screwdriver to remove.**
- **Hold the plug with hand to avoid from popping out.**
- **Make sure not to damage the plugs.**




(3) Plug

6. Remove the pressure reducing valves assembly and spring.

**NOTE**
- **Put marks on each removed springs for reassembling.**





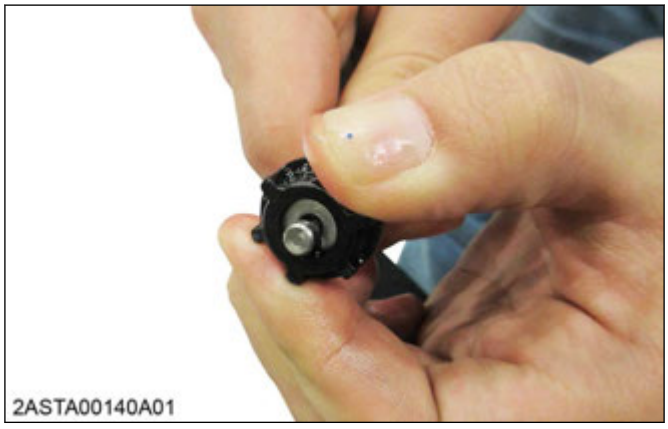


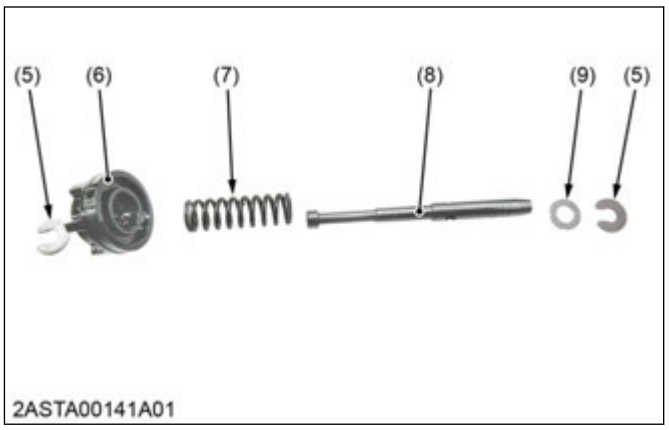
(4) Spring
(a) Pressure reducing valve

**Disassembling the pressure reducing valves**

1. Remove the spring seat.

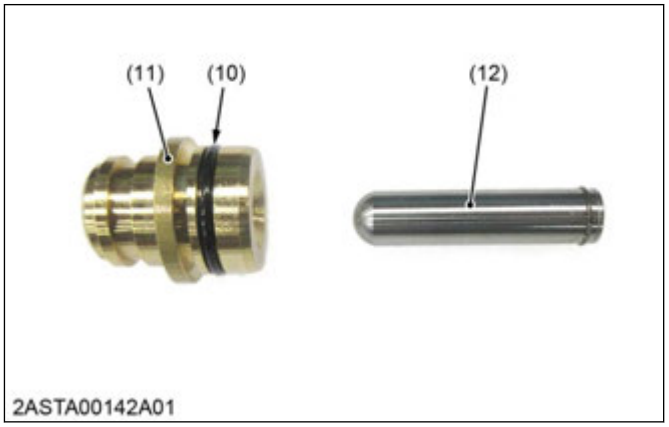
**NOTE**
- **Press the spring seat to compress the spring and slide to remove.**
- **Do not damage the spool.**
- **Do not compress the spring more than six millimeters.**




(5) Seat
(6) Spring seat
(7) Spring
(8) Spool
(9) Washer

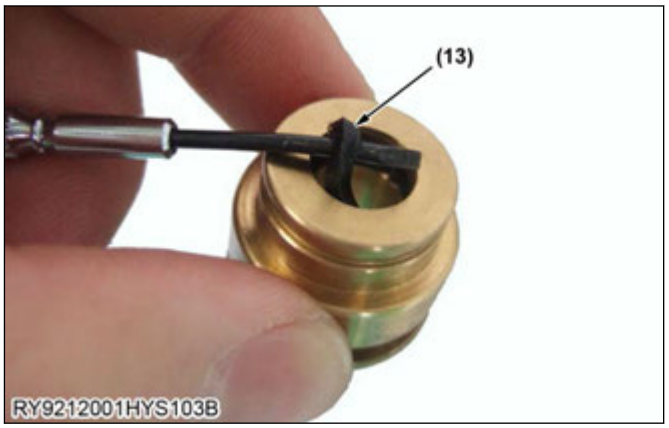
2. Remove the push rod from the plug.



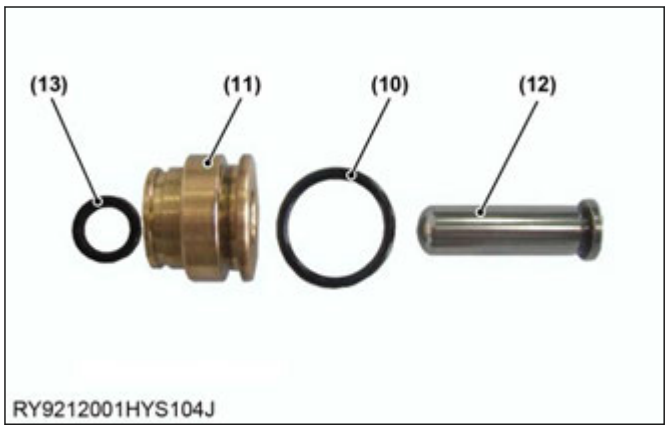

(10) O-ring
(11) Plug
(12) Push rod

3. Remove the O-ring and seal from the plug.

**NOTE**
- **Do not damage the plug.**




(13) Seal




(10) O-ring
(11) Plug
(12) Push rod
(13) Seal

## 4.6.4 Assembling the pilot control valve (basic)

**■ IMPORTANT**

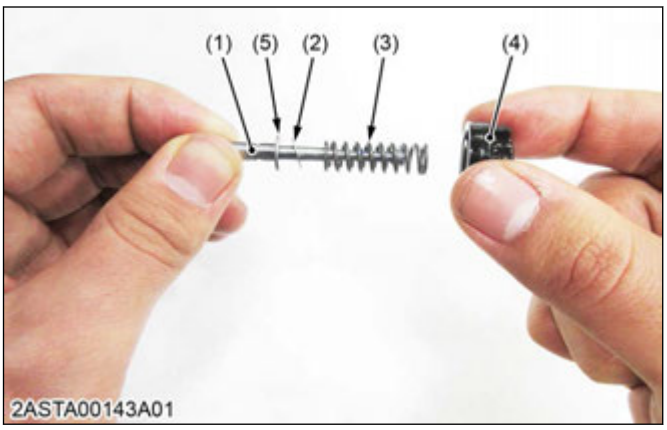
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Assembling the pressure reducing valves**

1. Assemble the seat, spring, and spring seat to the spool, in order.

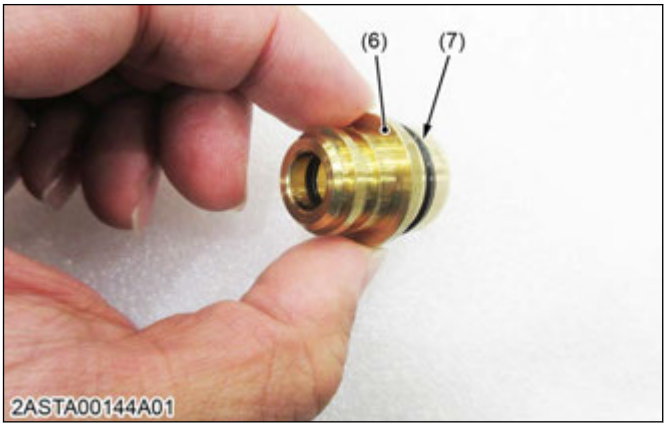
**■ IMPORTANT**

- **Do not compress the spring more than six millimeters.**




(1) Spool
(2) Washer
(3) Spring
(4) Spring seat
(5) Seat

2. Install the O-ring to the plug.

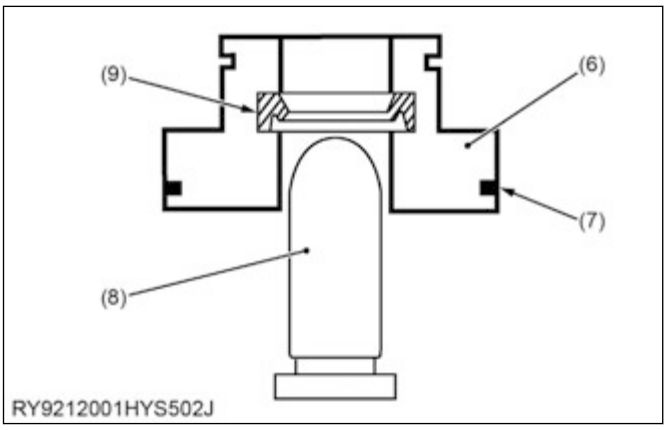



(6) Plug
(7) O-ring

3. Install the seal to the plug.

**■ NOTE**

- **Apply hydraulic oil to the seal.**
- **Install the seal in correct direction.**

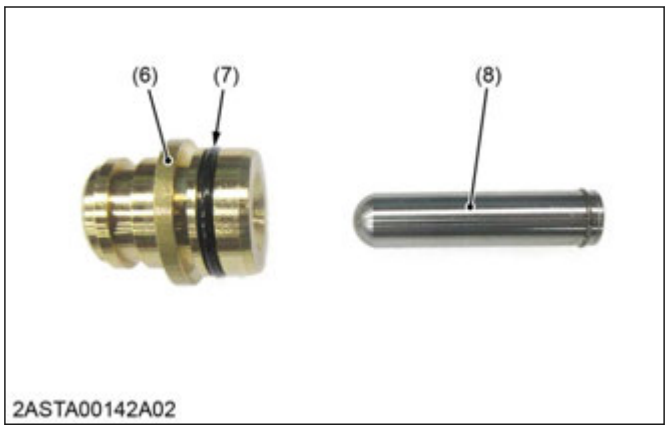



(6) Plug
(7) O-ring
(8) Push rod
(9) Seal

4. Install the push rod to the plug.

**■ NOTE**

- **Apply hydraulic oil to the plug.**

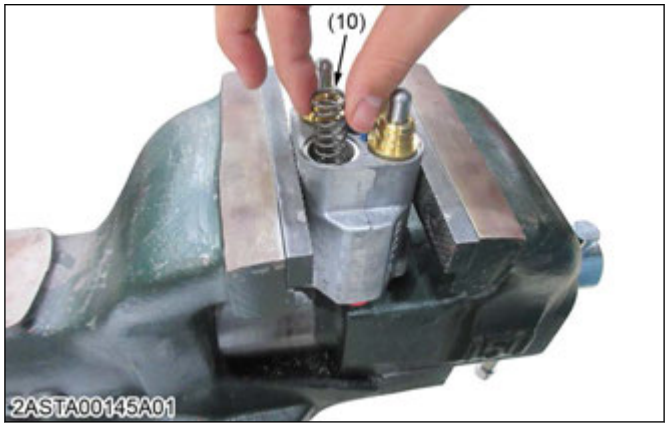



(6) Plug
(7) O-ring
(8) Push rod

**Installing the pressure reducing valves**

1. Install the springs, pressure reducing valves, and plugs to the casing, in order.

**NOTE**
- **Install each parts to same location.**



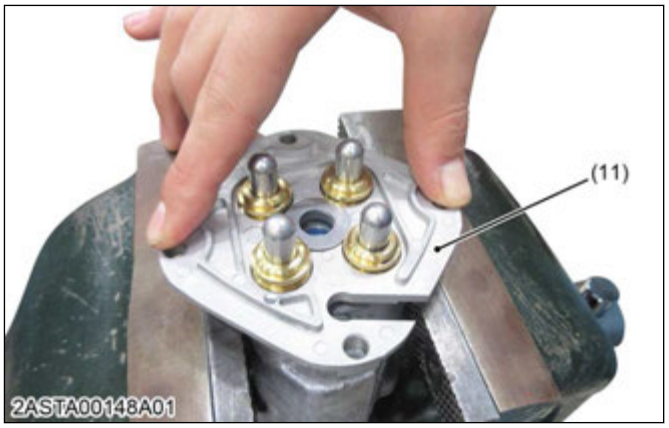






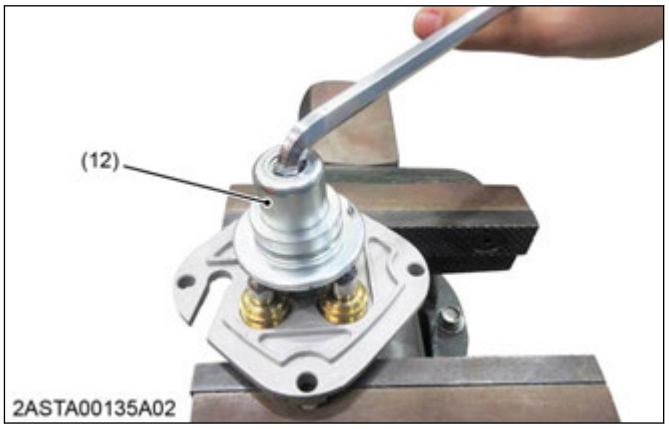

(10) Spring

2. Install the plate.




(11) Plate

3. Install the universal joint.




(12) Universal joint

**Tightening torque**

| | | |
|---|---|---|
| (12) Universal joint | 45 to 55 N·m<br>4.6 to 5.6 kgf·m<br>33.2 to 40.6 lbf·ft | Thread lock<br>(Loctite 262) |

4. Grease the universal joint and push rod.



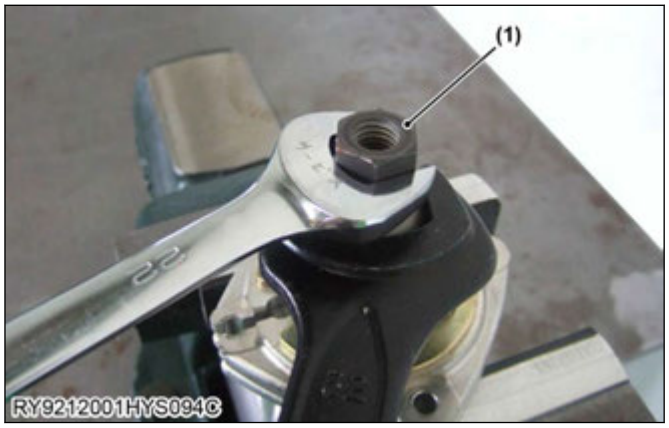

## 4.6.5 Disassembling the pilot control valve (Hi-spec)

**■ IMPORTANT**

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

**Disassembling the pressure reducing valves**

1. Fasten the pilot control valve (operating) in a vice.
2. Remove the adjusting nut and disc nut.




(1) Adjusting nut

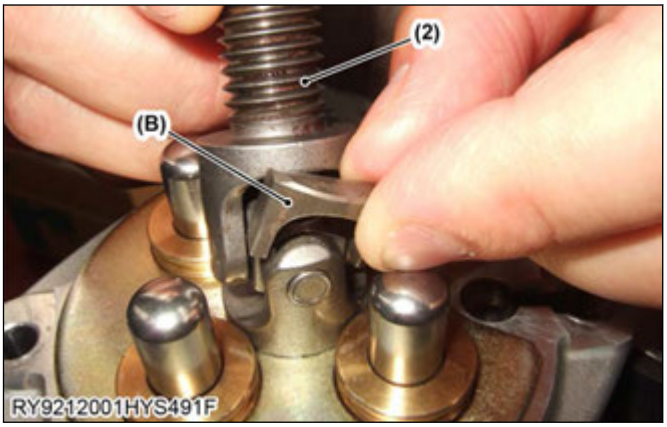
3. Put a mark on the casing and pressure reducing valves.

**■ NOTE**

- **Make sure to install pressure reducing valves in same locations.**




4. Install the jig B to the universal joint.

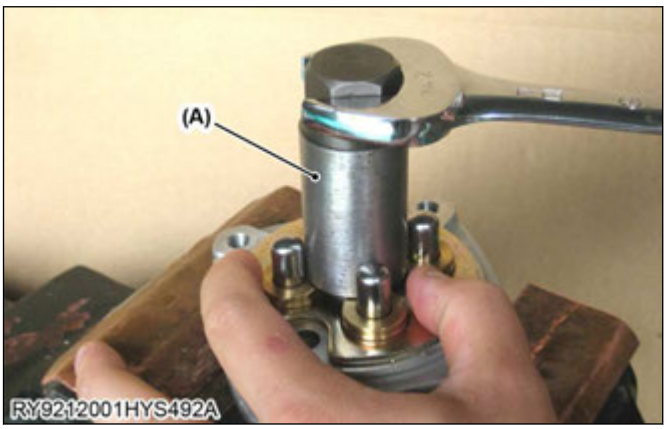



(2) Universal joint (B) Jig B ×2

5. Remove the universal joint. Use the jig A to loosen.

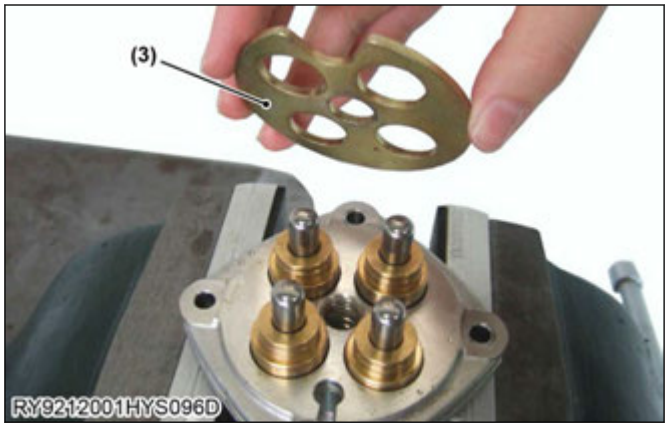
**■ NOTE**

- **Loosen the universal joint slowly to avoid the pressure reducing valves from popping out.**




(A) Jig A

6. Remove the plate.




(3) Plate

7. Remove the plug.

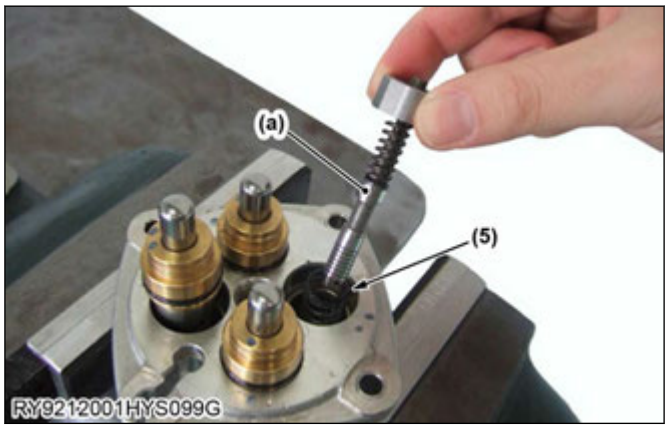
**NOTE**
- **Use a slotted screwdriver to remove.**
- **Hold the plug with hand to avoid from popping out.**
- **Make sure not to damage the plug.**

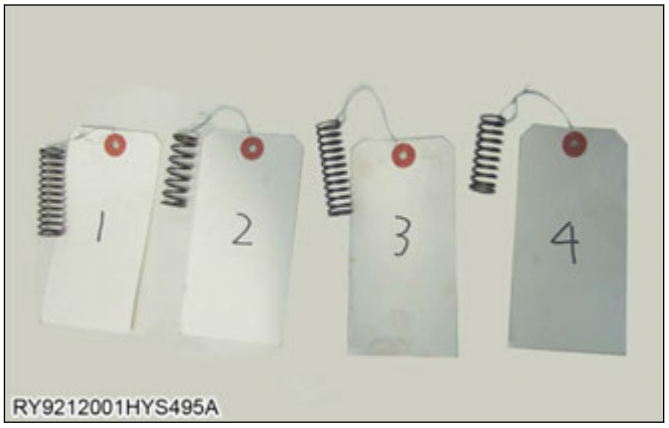



(4) Plug

8. Remove the pressure reducing valves assembly and springs.

**NOTE**
- **Put a mark on each removed spring and install them to same locations.**



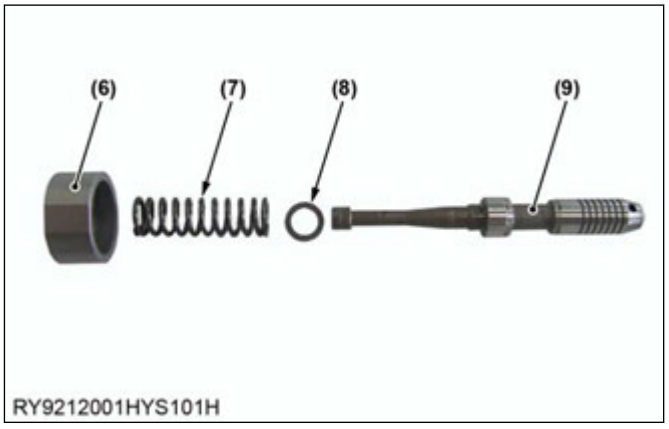

(5) Spring
(a) Pressure reducing valve

**Disassembling the pressure reducing valves**

1. Remove the spring seat.

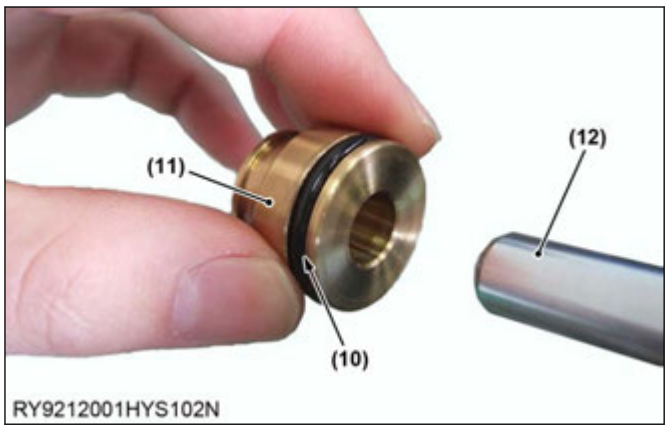
**NOTE**
- **Press the spring seat to compress the spring and slide to remove.**
- **Do not damage the spool.**
- **Do not compress the spring more than six millimeters.**




(6) Spring seat
(7) Spring
(8) Seat 2
(9) Spool

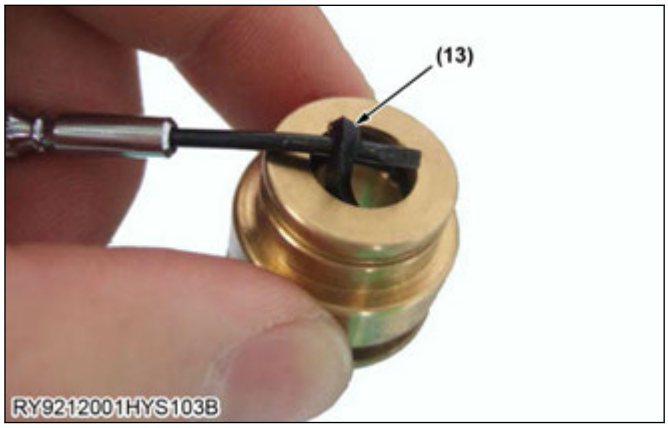
2. Remove the push rod from the plug.



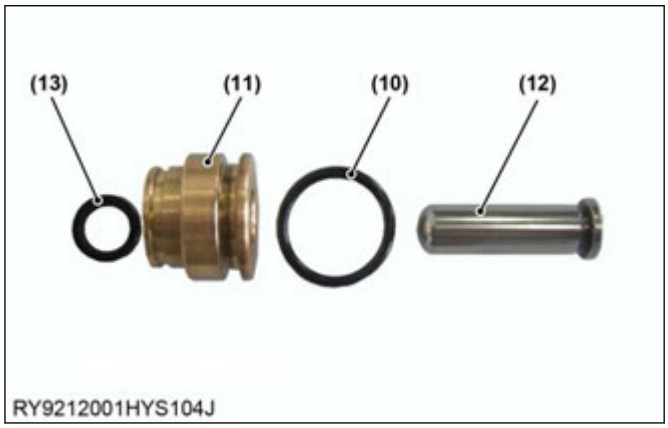

(10) O-ring
(11) Plug
(12) Push rod

3. Remove the O-ring and seal from the plug.

**■ NOTE**
- **Do not damage the plug.**




(13) Seal




(10) O-ring
(11) Plug
(12) Push rod
(13) Seal

## 4.6.6 Assembling the pilot control valve (Hi-spec)

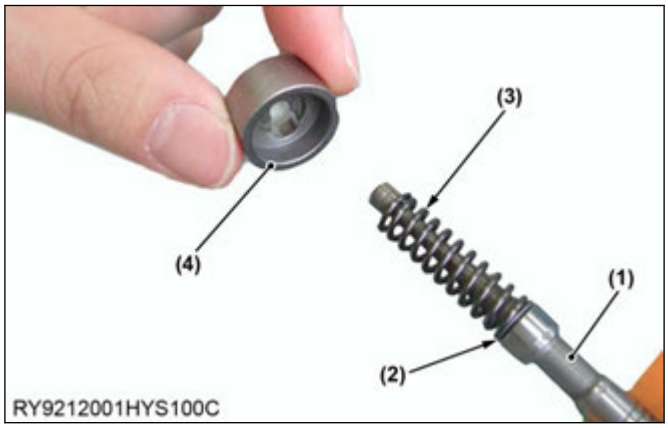
**■ IMPORTANT**
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Assembling the pressure reducing valves**

1. Assemble the seat, spring, and spring seat to the spool, in order.

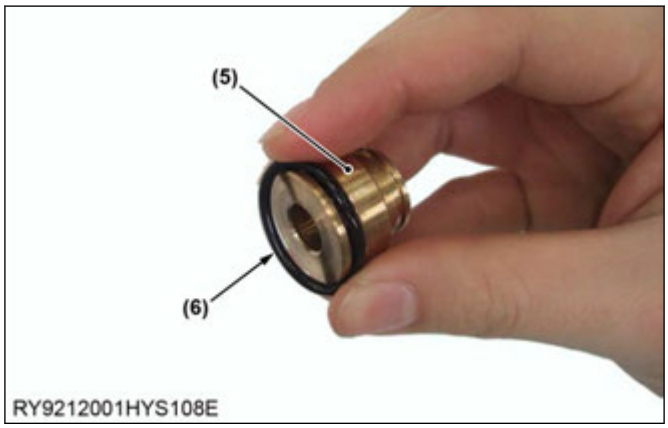
**IMPORTANT**

- **Do not compress the spring more than six millimeters.**




(1) Spool
(2) Seat 2
(3) Spring
(4) Spring seat

2. Install the O-ring to the plug.

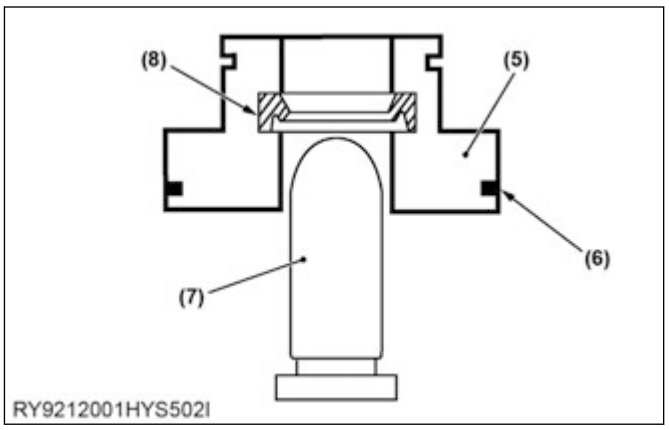



(5) Plug
(6) O-ring

3. Install the seal to the plug.

**NOTE**

- **Apply hydraulic oil to the seal.**
- **Install the seal in correct direction.**

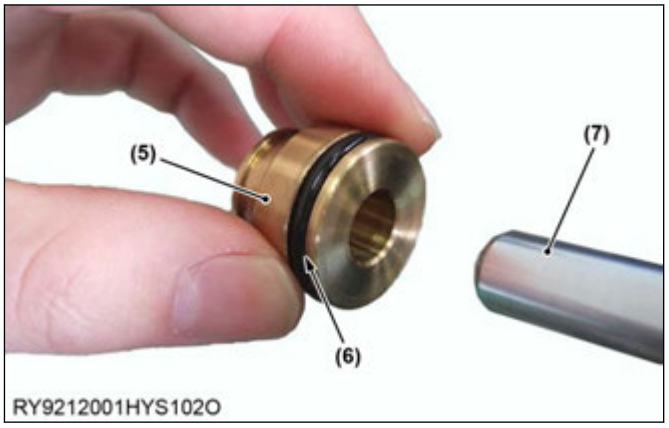



(5) Plug
(6) O-ring
(7) Push rod
(8) Seal

4. Install the push rod to the plug.

**NOTE**

- **Apply hydraulic oil to the plug.**



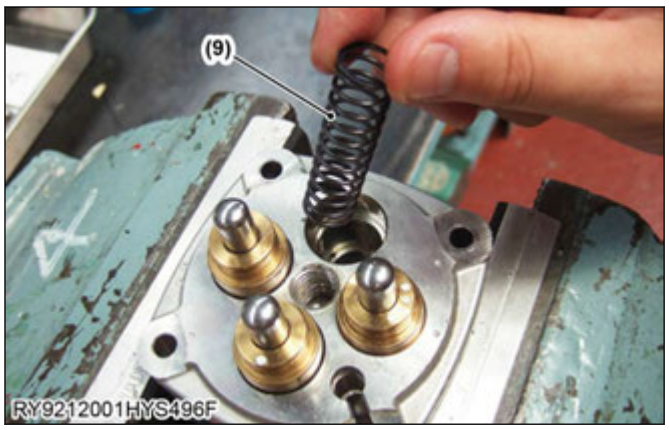

(5) Plug
(6) O-ring
(7) Push rod

**Installing the pressure reducing valves**

1. Install the springs, pressure reducing valves, and plugs to the casing, in order.

**NOTE**

- **Install each parts to same location.**



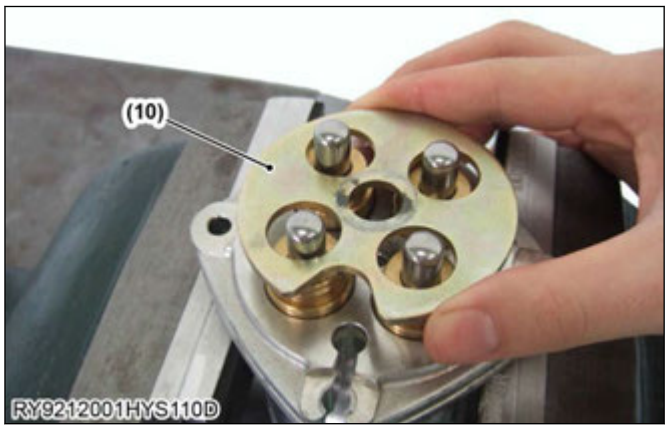







(9) Spring

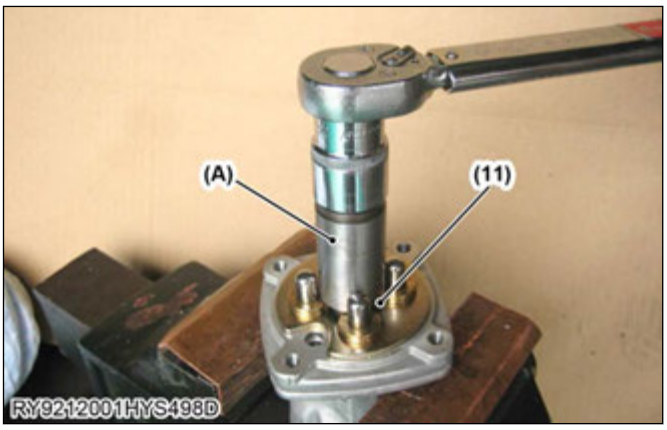
2. Install the plate.




(10) Plate

3. Install the universal joint.

**NOTE**
- **Use the jig A to install.**



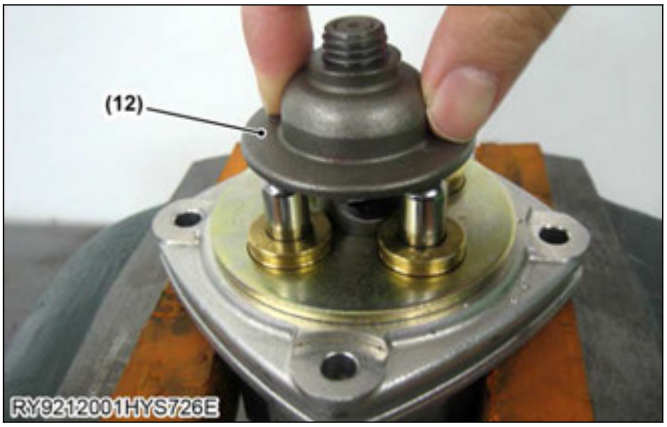

(11) Universal joint (A) Jig A

**Tightening torque**

| | | |
|---|---|---|
| (11) Universal joint | 44 to 50 N·m<br>4.5 to 5.1 kgf·m<br>32.5 to 36.9 lbf·ft | - |

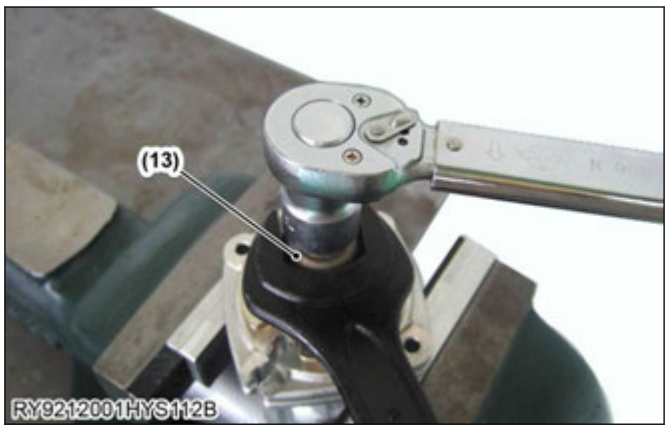
4. Install the disc nut.

**NOTE**
- **Tighten the disc nut until the tip of the four push rods of the pressure reducing valves touches evenly.**
- **Do not screw in the disc nut excessively to avoid the machine from malfunctioning.**




(12) Disc nut

5. Tighten the adjusting nut.




(13) Adjusting nut

### Tightening torque

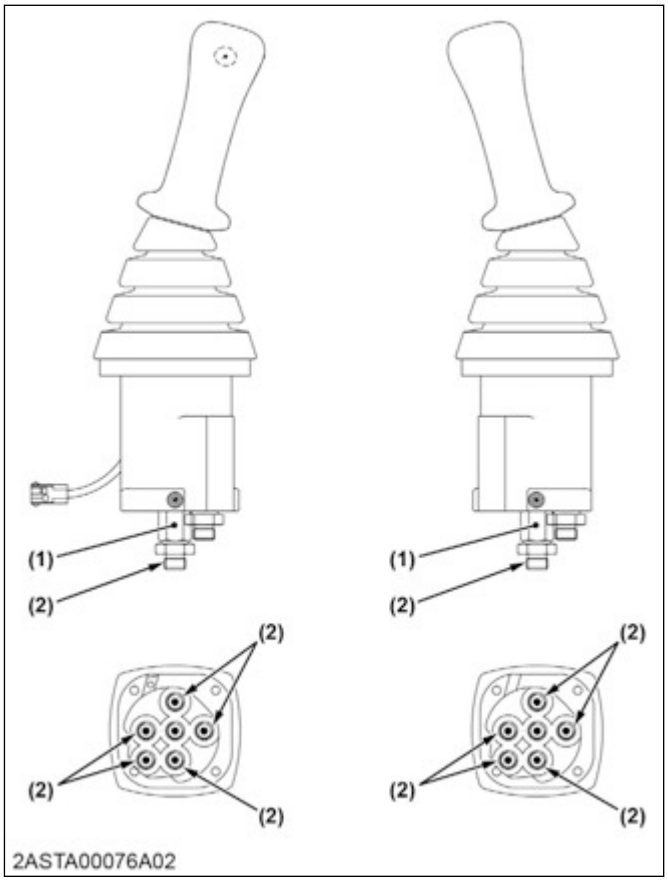
| | | |
|---|---|---|
| (13) Adjusting nut | 63.7 to 73.5 N·m<br>6.5 to 7.5 kgf·m<br>47.0 to 54.2 lbf·ft | - |

6. Grease the universal joint and push rods.



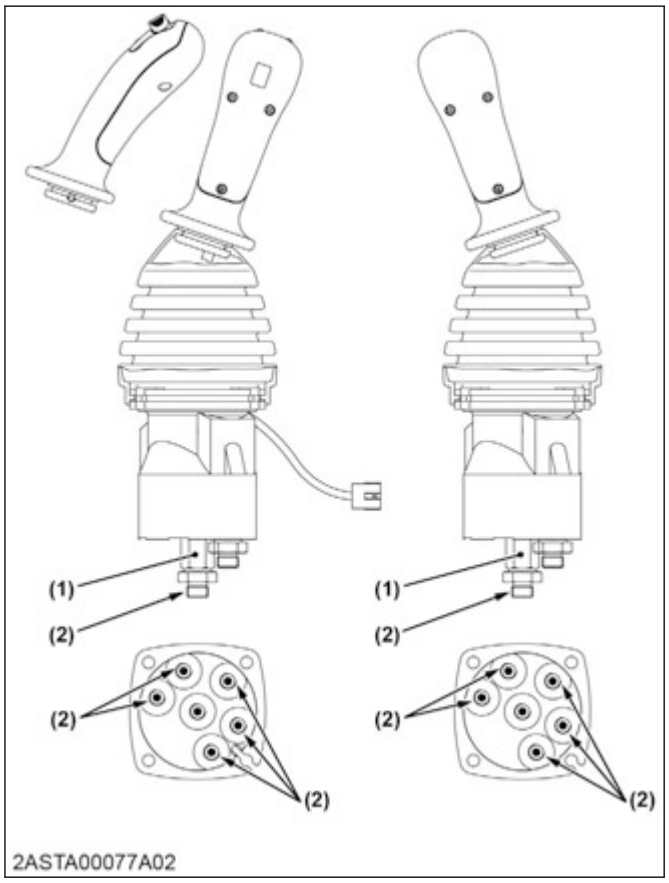

## 4.6.7 Installing adapter layout for the pilot control valve

**Basic**




| Adapter No. | Adapter size | Adapter angle |
|---|---|---|
| (1) | G1/4-G1/4 (filter) | - |
| (2) | G1/4-M14 | - |

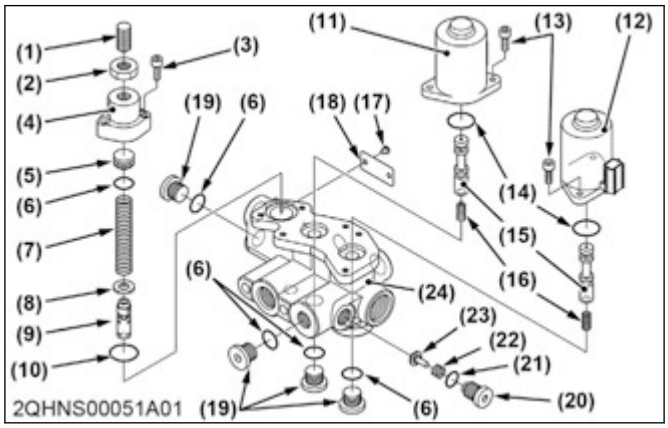
**Hi-spec**




| Adapter No. | Adapter size | Adapter angle |
|---|---|---|
| (1) | G1/4-G1/4 (filter) | - |
| (2) | G1/4-M14 | - |

# 4.7 Unload valve

## 4.7.1 Unload valve components




(1) Adjusting screw
(2) Locknut
(3) Cap bolt ×2
(4) Cover
(5) Plug
(6) O-ring ×5
(7) Spring
(8) Spring seat
(9) Plunger
(10) O-ring
(11) Solenoid
(12) Solenoid
(13) Cap bolt ×4
(14) O-ring ×2
(15) Spool ×2
(16) Spring ×2
(17) Screw
(18) Plate
(19) Plug ×4
(20) Plug
(21) O-ring
(22) Spring
(23) Plunger
(24) Valve body

## 4.7.2 Disassembling and assembling the unload valve

**■ IMPORTANT**

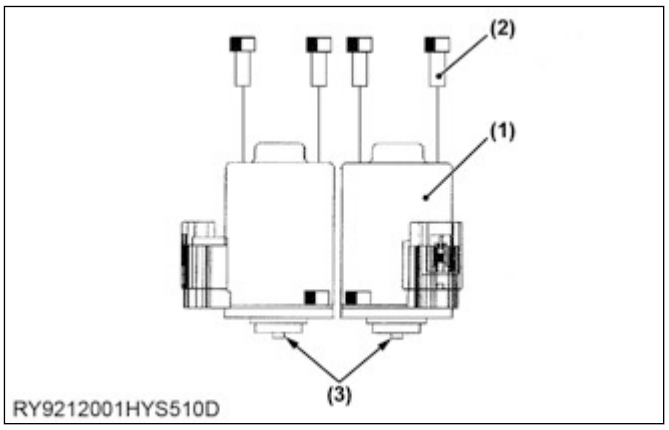
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Disassembling**

1. Remove four cap bolts and the solenoid.

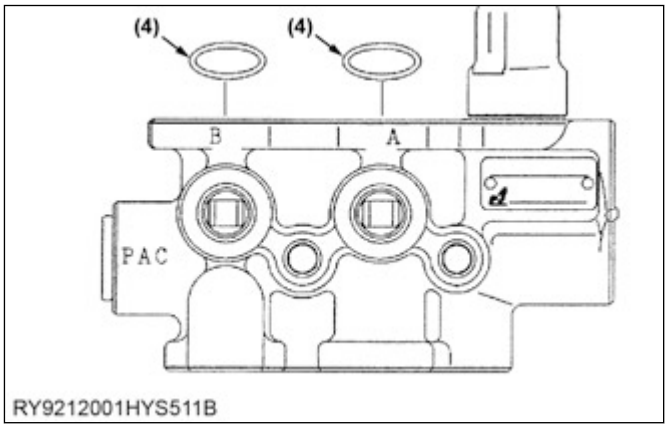
**■ NOTE**

- **Make sure not to drop the push rod.**



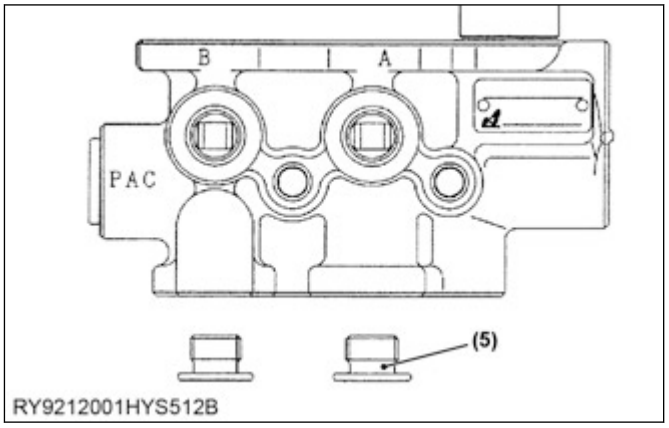

(1) Solenoid
(2) Cap bolt
(3) Push rod

2. Remove two O-rings.



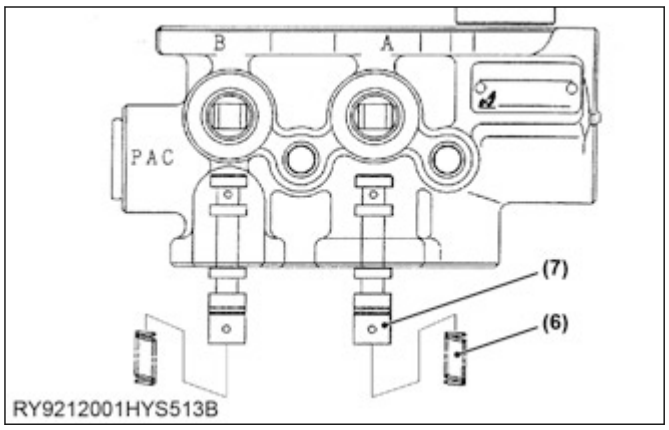

(4) O-ring

3. Remove two flanged plugs.



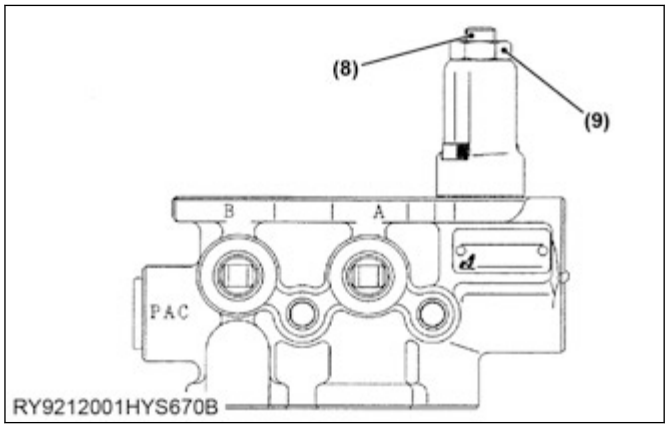

(5) Flanged plug

4. Remove the spring and spool.



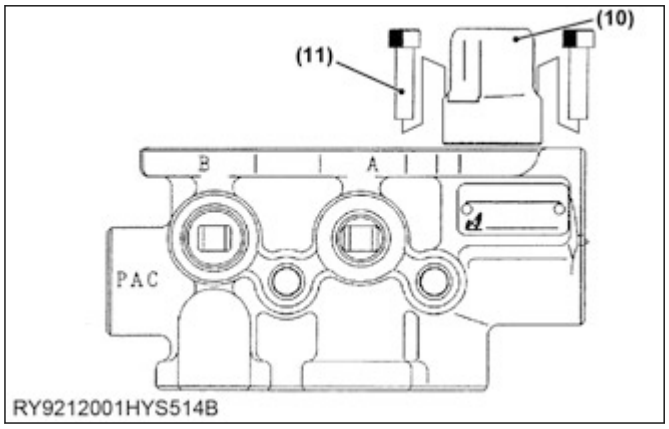

(6) Spring (7) Spool

5. Remove the nut and adjusting screw.



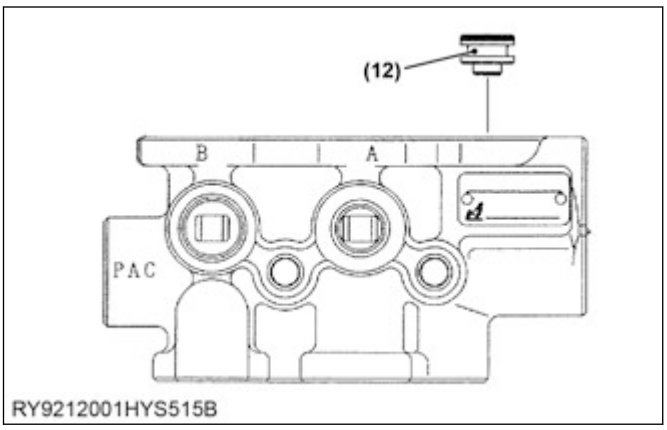

(8) Adjusting screw (9) Nut

6. Remove cap bolts and the cover.



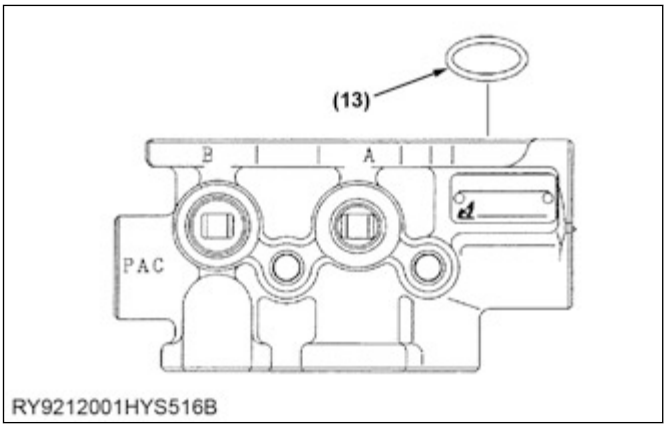

(10) Cover (11) Cap bolt

7. Remove the plug.



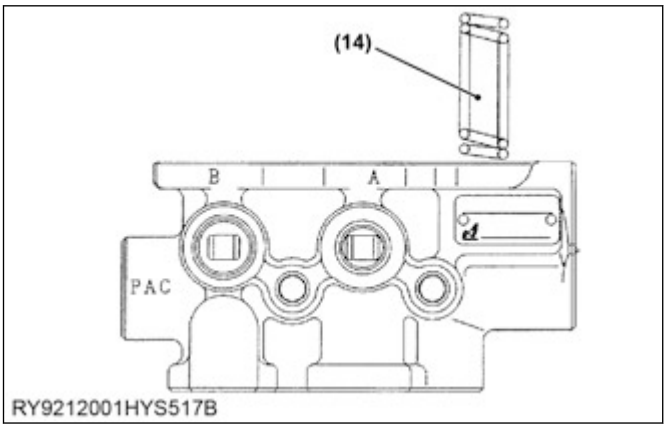

(12) Plug

8. Remove the O-ring.



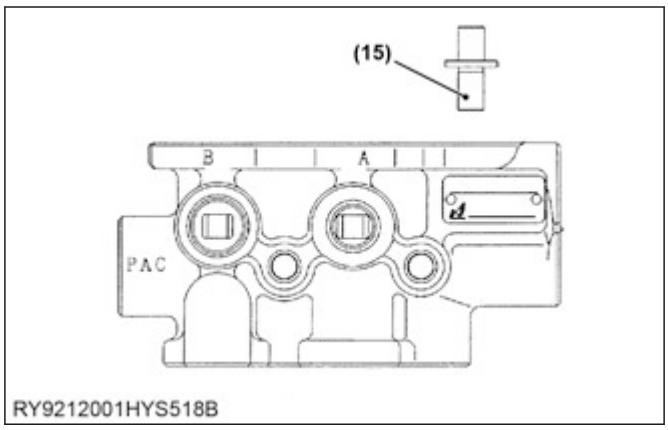

(13) O-ring

9. Remove the spring.




(14) Spring

10. Remove the plunger.




(15) Plunger

**Assembling**

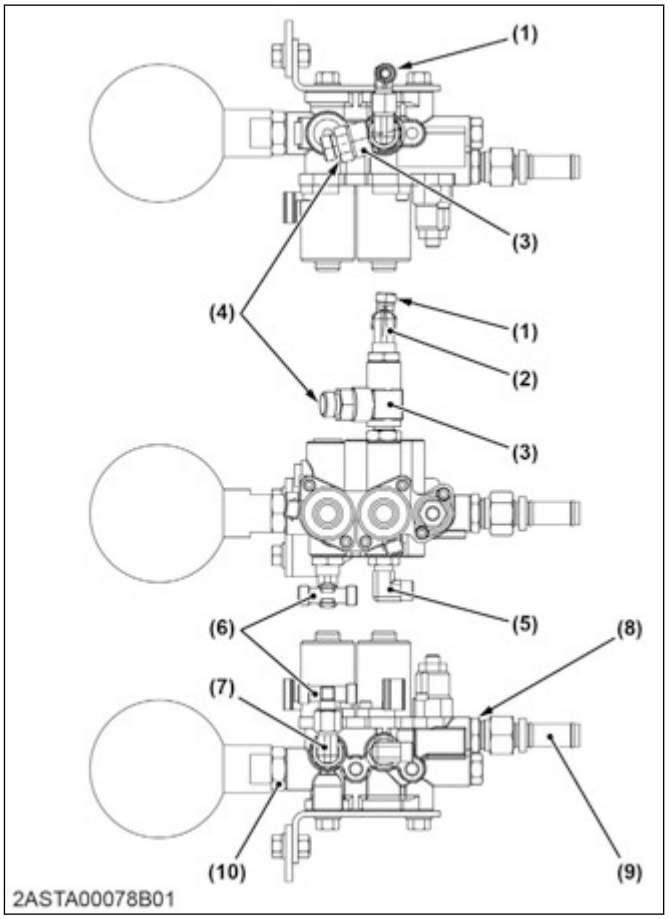
**■ IMPORTANT**

- **When installing the solenoid to the body, set the O-ring to the solenoid before installing.**
- **Grease the O-rings.**
- **Apply hydraulic oil to spools and plungers.**

**Tightening torque**

| | | |
|---|---|---|
| (5) Flanged plug | 26.5 N·m<br>2.7 kgf·m<br>19.6 lbf·ft | - |
| (2) (11) Cap bolt | 3.92 N·m<br>0.4 kgf·m<br>2.9 lbf·ft | |
| (9) Nut | 15.7 N·m<br>1.6 kgf·m<br>11.6 lbf·ft | |

## 4.7.3 Installing adapter layout for the unload valve




| Adapter No. | Size | Angle |
|---|---|---|
| (1) | M14-M14 | 6° |
| (2) | G3/8-M14 | - |
| (3) | G3/8-G3/8-G3/8 | 15° |
| (4) | G3/8-M18 | - |
| (5) | G1/4-M14 | - |
| (6) | M14-M14-M14 | - |
| (7) | G3/8-M14 | - |
| (8) | G3/8-M22 | - |
| (9) | M22-ϕ16.2 | - |
| (10) | G3/8-G1/2 | - |

# 4.8 Swivel joint

## 4.8.1 Removing and installing the swivel joint

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Remove the canopy or cabin.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
3. Remove the swivel motor.

**Removing**
1. Disconnect all of the hydraulic hoses on swivel frame side.




(1) Swivel joint

2. Remove the bottom cover of the track frame.
3. Disconnect all of the hydraulic hoses on the bottom side.

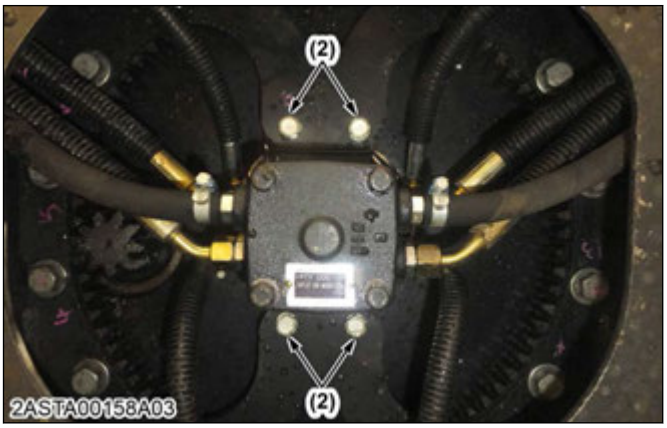



4. Attach a nylon sling and hoist the swivel joint for support.




5. Remove four mounting bolts.

**■ IMPORTANT**
- **Loosen the bolts slowly to avoid the swivel joint from falling.**




(2) Bolt (M12 × 35) ×4

6. Remove the swivel joint carefully.




(1) Swivel joint

### Mass

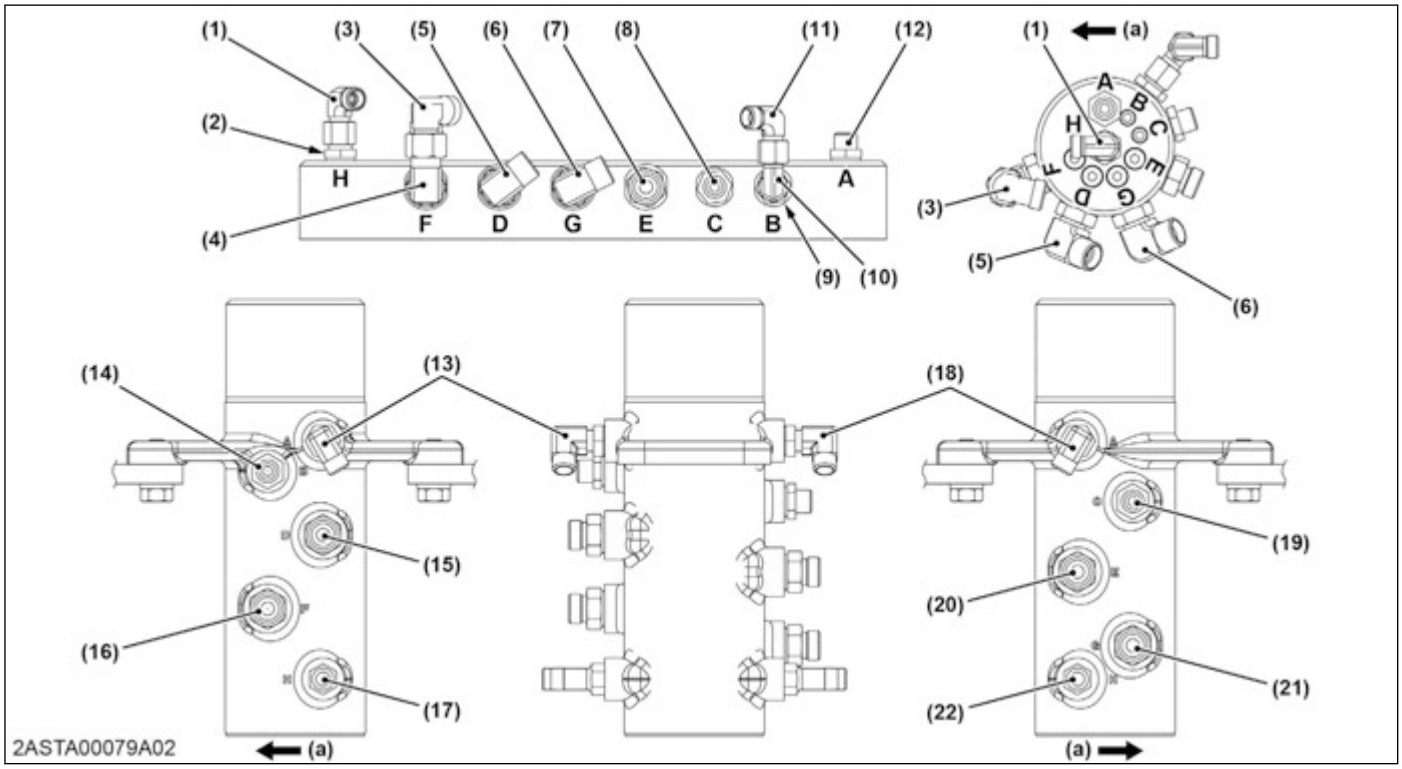
| | |
|---|---|
| (1) Swivel joint | Approximately 11.5 kg<br>Approximately 25.4 lbs |

## Installing

### Tightening torque

| | | |
|---|---|---|
| (2) Bolt | 77.5 to 90.2 N·m<br>7.9 to 39.2 kgf·m<br>57.2 to 66.5 lbf·ft | Thread lock<br>(Loctite 302-71) |

## 4.8.2 Installing adapter layout for the swivel joint




(a) Forward

| Adapter No. | Adapter size | Angle | Adapter No. | Adapter size | Angle |
|---|---|---|---|---|---|
| (1) | M14-M14 | - | (12) | G1/4-M14 | - |
| (2) | G1/4-M14 | - | (13) | G1/4-M14 | 60° |
| (3) | M18-M18 | 13° | (14) | G1/4-M14 | - |
| (4) | G3/8-M18 | - | (15) | G3/8-M18 | - |
| (5) | G3/8-M18 | 37° | (16) | G3/8-M18 | - |
| (6) | G3/8-M18 | 27° | (17) | G/1/4-ϕ13 | - |
| (7) | G3/8-M18 | - | (18) | G1/4-M14 | 60° |
| (8) | G1/4-M14 | - | (19) | G1/4-M14 | - |
| (9) | G1/4-M14 | - | (20) | G3/8-M18 | - |
| (10) | M14-M14 | - | (21) | G3/8-M18 | - |
| (11) | M14-M14 | - | (22) | G/1/4-ϕ13 | - |

# 4.9 Proportional valve

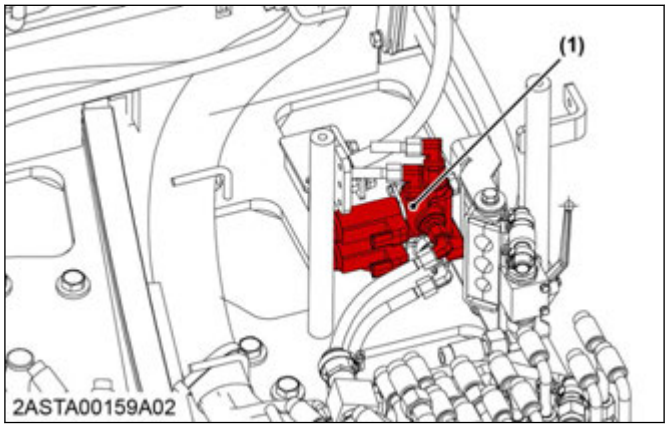
## 4.9.1 Removing and installing the AUX1 proportional valve

**CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

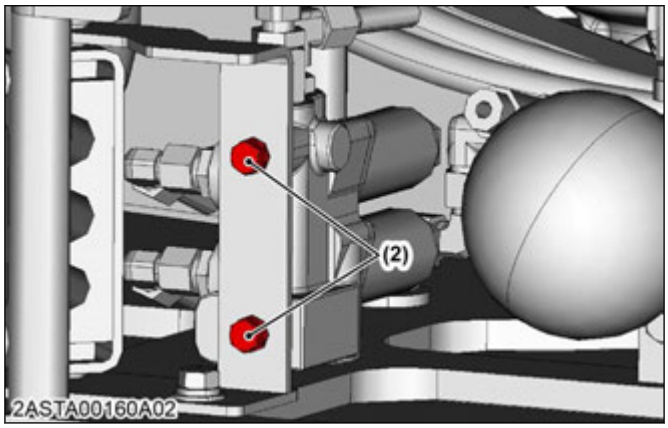
**Preparing**
1. Remove the front swivel cover, LH swivel cover and floor plate.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**
1. Disconnect all of the hydraulic hoses and connectors from the AUX1 proportional valve.




(1) AUX1 proportional valve

2. Remove the 2 bolts and AUX1 proportional valve.




(2) Bolt (M8 × 16) ×2

**Installing**

**Tightening torque**

| | | |
|---|---|---|
| (2) Bolt | 23.5 to 27.5 N·m<br>2.4 to 2.8 kgf·m<br>17.3 to 20.1 lbf·ft | - |

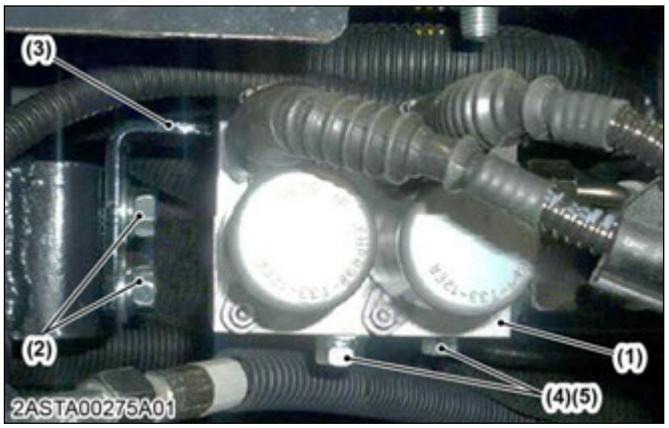
## 4.9.2 Removing and installing the AUX2 proportional valve

**CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

**Preparing**
1. Remove the floor plate.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**
1. Disconnect all of the hydraulic hoses and connectors from the AUX2 proportional valve.




(1) AUX2 proportional valve
(2) Bolt (M10 × 20) ×2
(3) Bracket
(4) Bolt (M8 × 65) ×2
(5) Washer ×2

2. Remove the 4 bolts and AUX2 proportional valve and bracket.

**Installing**

**Tightening torque**

| | | |
|---|---|---|
| (2) Bolt | 48.1 to 55.9 N·m<br>4.9 to 5.7 kgf·m<br>35.3 to 41.1 lbf·ft | - |
| | 23.5 to 27.5 N·m<br>2.4 to 2.8 kgf·m<br>17.3 to 20.1 lbf·ft | - |

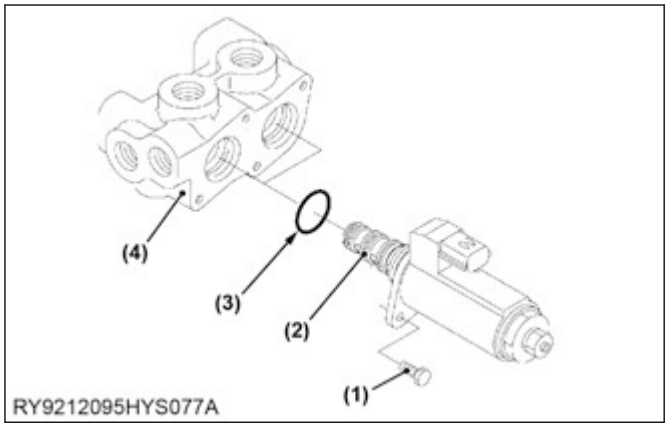
## 4.9.3 Disassembling and assembling the AUX1 proportional valve

**■ IMPORTANT**

- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Disassembling**

1. Remove the cap bolt, proportional solenoid, and O-ring.




(1) Cap bolt
(2) Proportional solenoid
(3) O-ring
(4) Case

**Assembling**

**Tightening torque**

| | | |
|---|---|---|
| (1) Cap bolt | 6 to 8 N·m<br>0.6 to 0.8 kgf·m<br>4.5 to 5.9 lbf·ft | - |

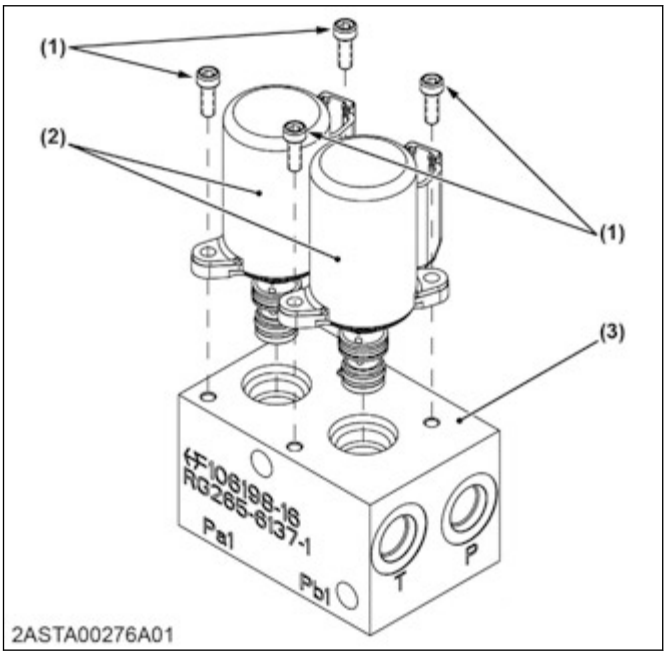
## 4.9.4 Disassembling and assembling the AUX2 proportional valve

**■ IMPORTANT**

- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

**Disassembling**

1. Remove the cap bolts, proportional solenoid, and O-ring.



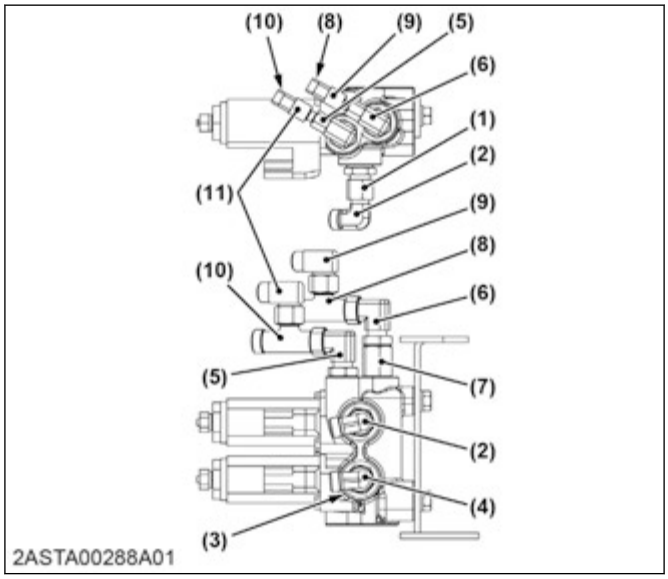

(1) Cap bolt ×4
(2) Proportional solenoid ×2
(3) Valve body

**Assembling**

**Tightening torque**

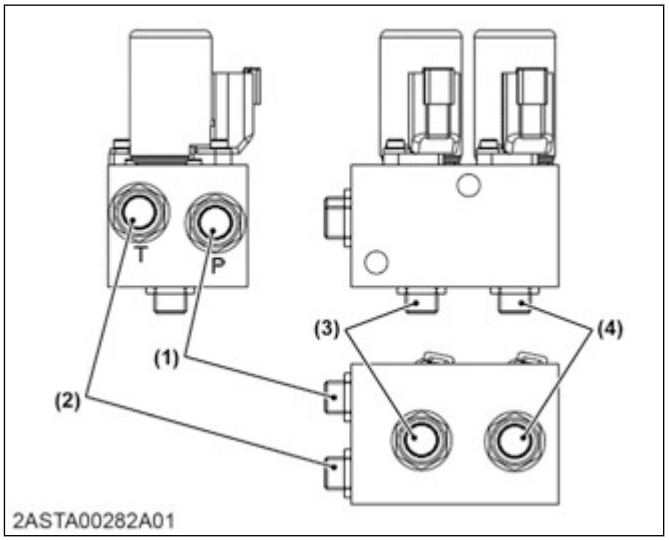
| | | |
|---|---|---|
| (1) Cap bolt | 2 N·m<br>0.2 kgf·m<br>1.5 lbf·ft | - |

## 4.9.5 Installing adapter layout for the AUX1 proportional valve




| Adapter No. | Adapter size | Angle |
|---|---|---|
| (1) | G1/4-M14 | - |
| (2) | M14-M14 | 12° |
| (3) | G1/4-M14 | - |
| (4) | M14-M14 | 5° |
| (5) | G1/4-M14 | 30° |
| (6) | G1/4-M14 | 30° |
| (7) | G1/4-G1/4 | - |
| (8) | M14-M14-M14 | - |
| (9) | M14-M14 | - |
| (10) | M14-M14-M14 | - |
| (11) | M14-M14 | - |

## 4.9.6 Installing adapter layout for the AUX2 proportional valve




| Adapter No. | Adapter size | Angle |
|---|---|---|
| (1) | G1/4-M14 | - |
| (2) | G1/4-M14 | - |
| (3) | G1/4-M14 | - |
| (4) | G1/4-M14 | 5° |

# 4.10 Third line valve

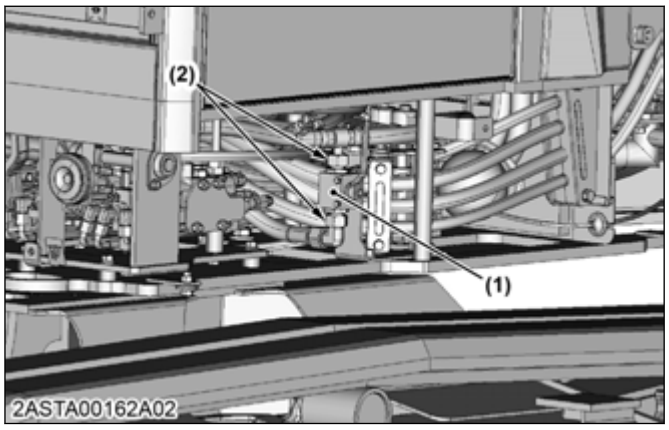
## 4.10.1 Removing and installing the third line valve

**⚠ CAUTION**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

**■ IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

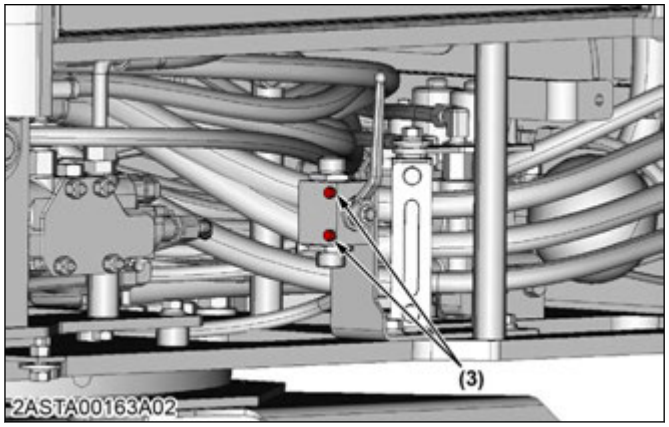
**Preparing**
1. Remove the front swivel cover and LH swivel cover.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

**Removing**
1. Disconnect all of the hydraulic hoses.




(1) Third line valve (2) Adapter (M22)

2. Remove 2 bolts.



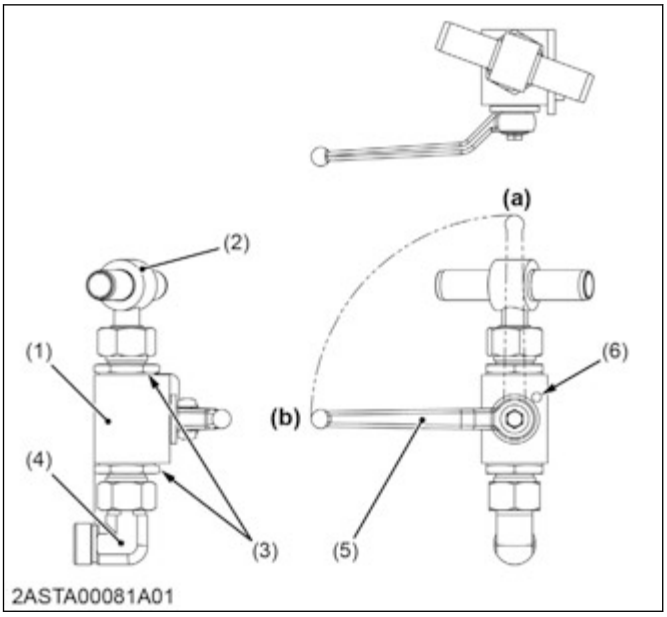

(3) Bolt (M5 × 45) ×2

**Installing**

**Tightening torque**

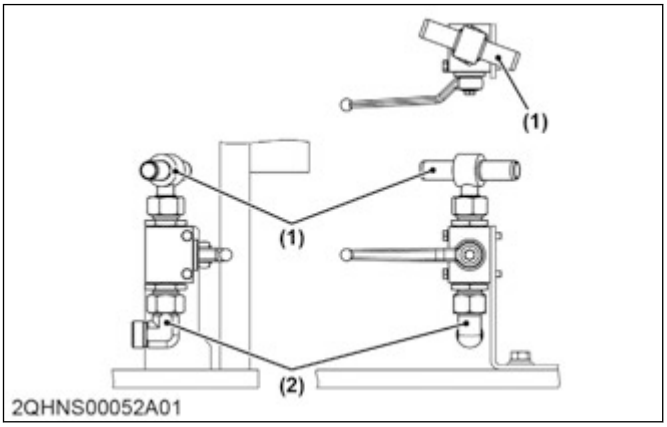
| | | |
|---|---|---|
| (2) Adapter | 50 to 55 N·m<br>5.1 to 5.6 kgf·m<br>36.9 to 40.6 lbf·ft | - |
| (3) Bolt | 3 to 4 N·m<br>0.3 to 0.4 kgf·m<br>2.21 to 2.95 lbf·ft | - |

## 4.10.2 Third line valve components




(1) Body
(2) Adapter
(3) Adapter ×2
(4) Adapter
(5) Lever
(6) Spring pin
(a) Close (AUX RH side is linked to C/V AUX RH)
(b) Open (AUX RH side is linked to C/V AUX RH and oil cooler)

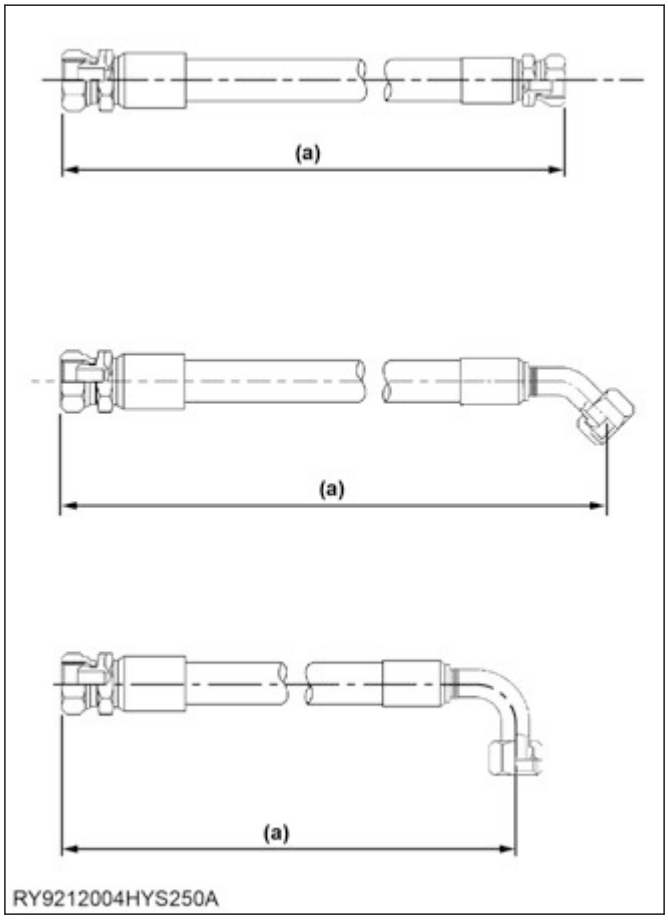
## 4.10.3 Installing adapter layout for the third line valve



| Adapter No. | Adapter size | Angle |
|---|---|---|
| (1) | M22-ϕ16-ϕ16 | 20° |
| (2) | M22-M22 | - |

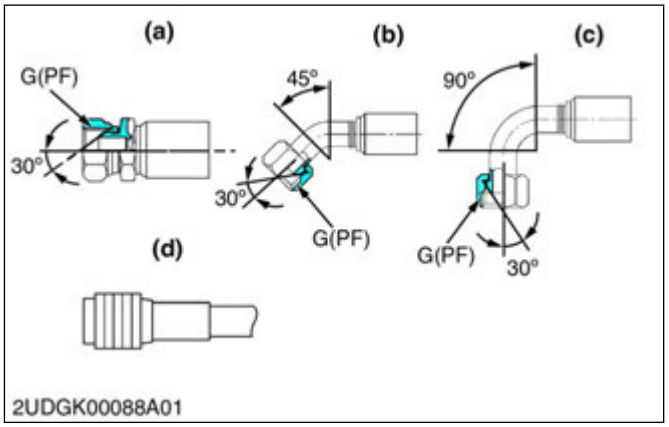
# 4.11 Hydraulic hose

## 4.11.1 Length description of hydraulic hoses



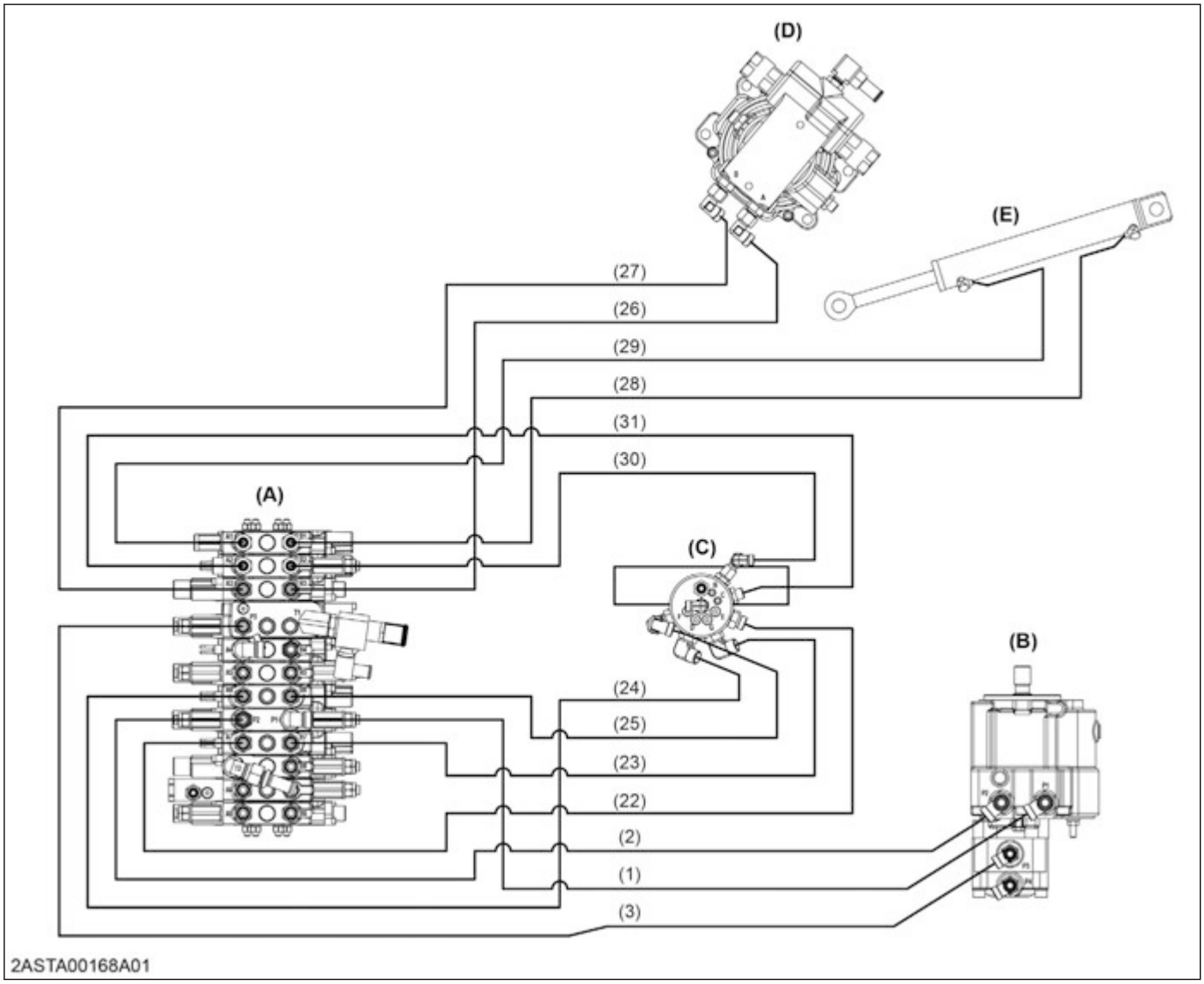

(a) Length

## 4.11.2 Metal fittings of hydraulic hoses




(a) Straight type parallel pipe thread (Male 30° seat)
(b) 45° type parallel pipe thread (Male 30° seat)
(c) 90° type parallel pipe thread (Male 30° seat)
(d) Quick hose coupling type

## 4.11.3 Delivery hoses routing (Basic)



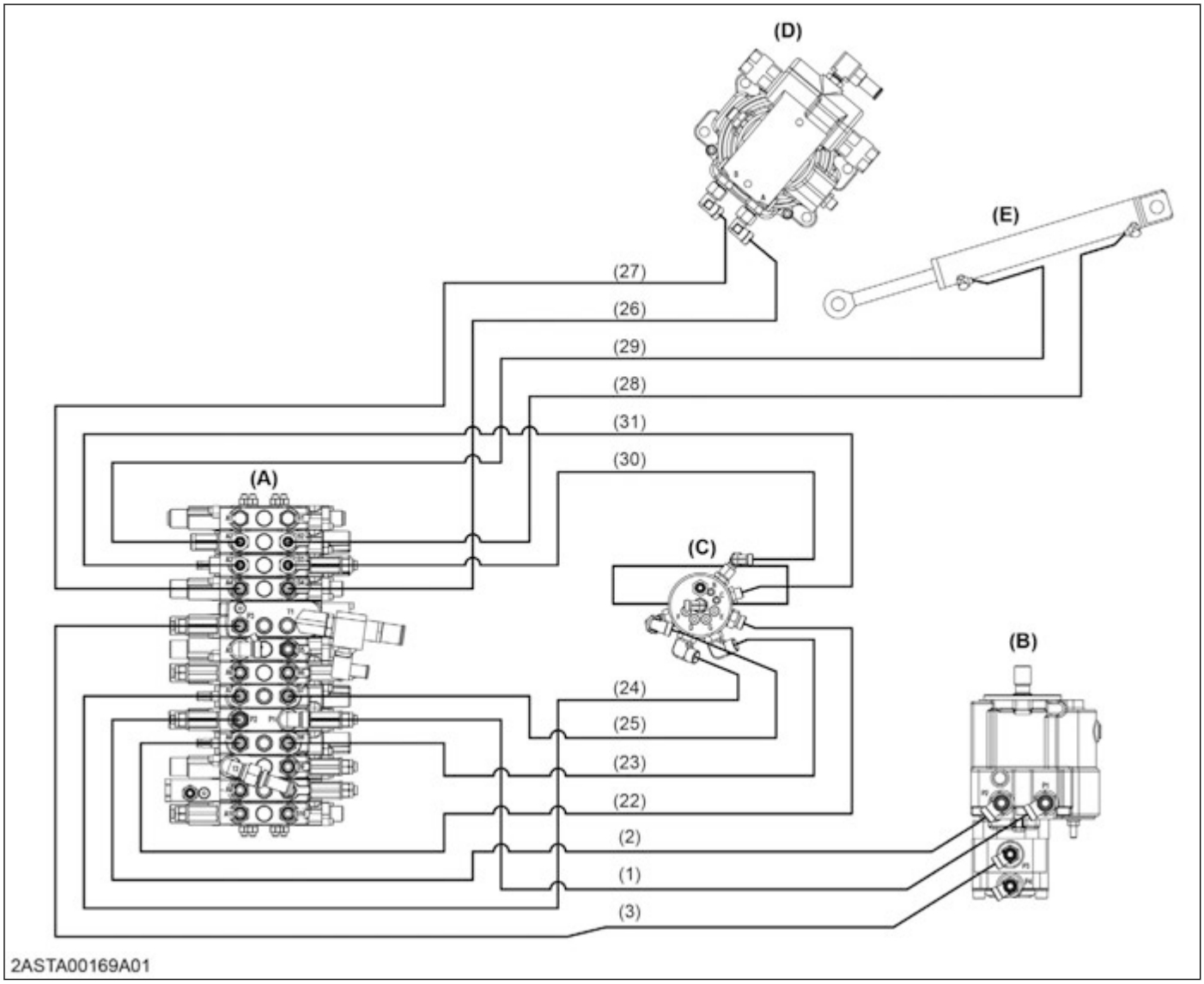

(A) Control valve
(B) Hydraulic Pump
(C) Swivel joint
(D) Swivel motor
(E) Swing cylinder

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (1) | Hydraulic pump (P1) - C/V (P1) | 1185 mm 46.65 in. | White - White | M22 Straight | M22 Straight | Corrugated tube |
| (2) | Hydraulic pump (P2) - C/V (P2) | 1190 mm 46.85 in. | Red - Red | M22 Straight | M22 90° | Corrugated tube |
| (3) | Hydraulic pump (P3) - C/V (P3) | 1380 mm 54.33 in. | Blue - Blue | M18 Straight | M18 90° | Corrugated tube |
| (22) | C/V - S/J (travel RH forwards) | 1030 mm 40.55 in. | Green - Green | M18 90° | M18 Straight | Corrugated tube |
| (23) | C/V - S/J (travel RH backwards) | 960 mm 37.80 in. | Yellow - Yellow | M18 90° | M18 Straight | Corrugated tube |
| (24) | C/V - S/J (travel LH forwards) | 900 mm 35.43 in. | Blue - Blue | M18 90° | M18 Straight | Corrugated tube |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (25) | C/V - S/J (travel LH backwards) | 905 mm 35.63 in. | Red - Red | M18 90° | M18 Straight | Corrugated tube |
| (26) | C/V - S/J (swivel LH) | 700 mm 27.56 in. | Gray - Gray | M18 90° | M18 Straight | Corrugated tube |
| (27) | C/V - S/J (swivel RH) | 760 mm 29.92 in. | Blue - Blue | M18 90° | M18 Straight | Corrugated tube |
| (28) | C/V - Swing cylinder (swing LH) | 1690 mm 66.54 in. | Green - Green | M14 90° | M14 Straight | Corrugated tube |
| (29) | C/V - Swing cylinder (swing RH) | 1815 mm 71.46 in. | Yellow - Yellow | M14 90° | M14 Straight | Corrugated tube |
| (30) | C/V - S/J (blade lift) | 1065 mm 41.93 in. | Brown - Brown | M14 90° | M14 Straight | Corrugated tube |
| (31) | C/V - S/J (blade lower) | 1100 mm 43.31 in. | Red - Red | M14 90° | M14 Straight | Corrugated tube |

## 4.11.4 Delivery hoses routing (Hi-spec)



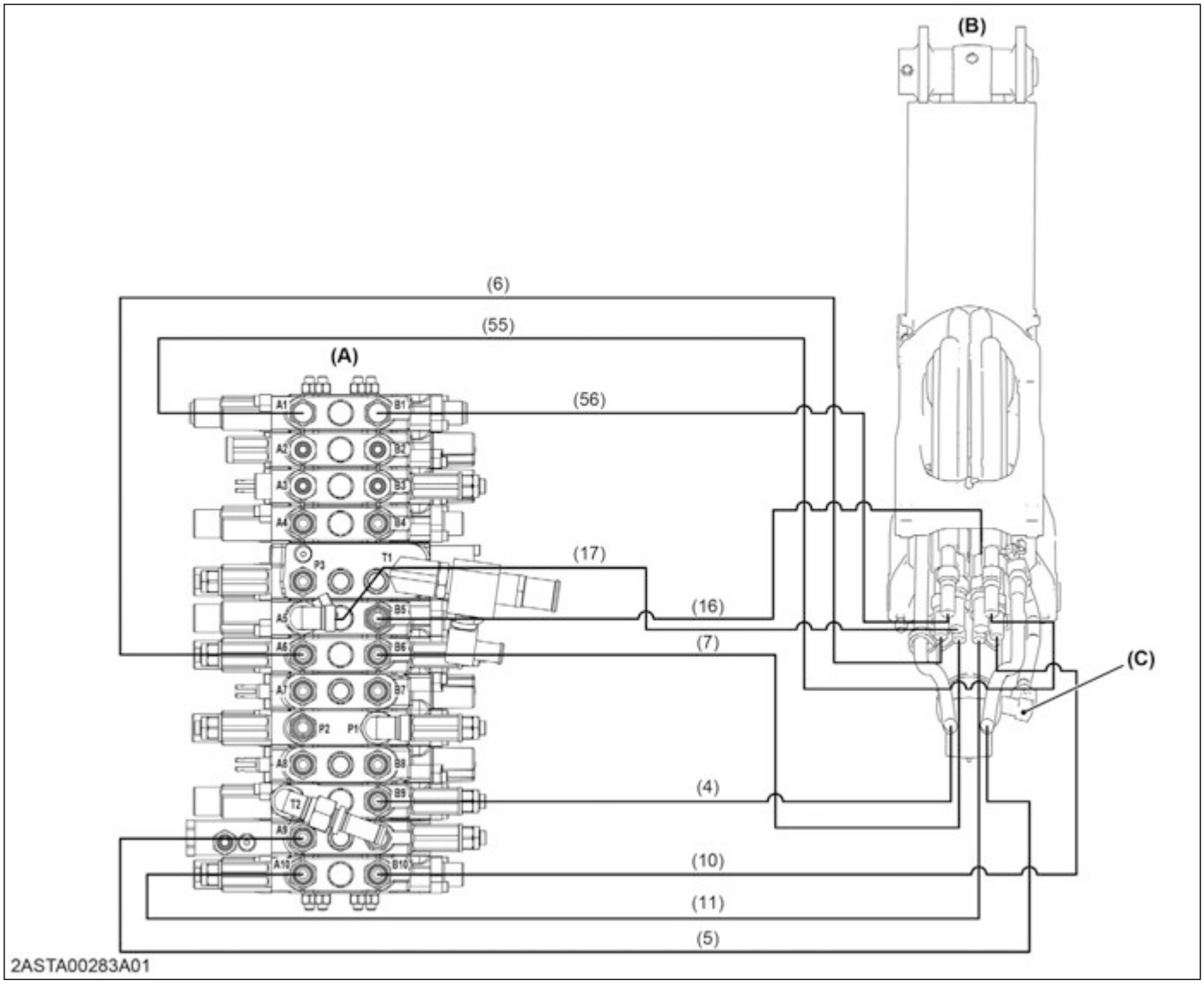

(A) Control valve
(B) Hydraulic Pump
(C) Swivel joint
(D) Swivel motor
(E) Swing cylinder

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (1) | Hydraulic pump (P1) - C/V (P1) | 1185 mm 46.65 in. | White - White | M22 Straight | M22 Straight | Corrugated tube |
| (2) | Hydraulic pump (P2) - C/V (P2) | 1190 mm 46.85 in. | Red - Red | M22 Straight | M22 90° | Corrugated tube |
| (3) | Hydraulic pump (P3) - C/V (P3) | 1380 mm 54.33 in. | Blue - Blue | M18 Straight | M18 90° | Corrugated tube |
| (22) | C/V - S/J (travel RH forwards) | 1030 mm 40.55 in. | Green - Green | M18 90° | M18 Straight | Corrugated tube |
| (23) | C/V - S/J (travel RH backwards) | 960 mm 37.80 in. | Yellow - Yellow | M18 90° | M18 Straight | Corrugated tube |
| (24) | C/V - S/J (travel LH forwards) | 900 mm 35.43 in. | Blue - Blue | M18 90° | M18 Straight | Corrugated tube |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (25) | C/V - S/J (travel LH backwards) | 905 mm 35.63 in. | Red - Red | M18 90° | M18 Straight | Corrugated tube |
| (26) | C/V - S/J (swivel LH) | 700 mm 27.56 in. | Gray - Gray | M18 90° | M18 Straight | Corrugated tube |
| (27) | C/V - S/J (swivel RH) | 760 mm 29.92 in. | Blue - Blue | M18 90° | M18 Straight | Corrugated tube |
| (28) | C/V - Swing cylinder (swing LH) | 1690 mm 66.54 in. | Green - Green | M14 90° | M14 Straight | Corrugated tube |
| (29) | C/V - Swing cylinder (swing RH) | 1815 mm 71.46 in. | Yellow - Yellow | M14 90° | M14 Straight | Corrugated tube |
| (30) | C/V - S/J (blade lift) | 1065 mm 41.93 in. | Brown - Brown | M14 90° | M14 Straight | Corrugated tube |
| (31) | C/V - S/J (blade lower) | 1100 mm 43.31 in. | Red - Red | M14 90° | M14 Straight | Corrugated tube |

## 4.11.5 Front hoses routing



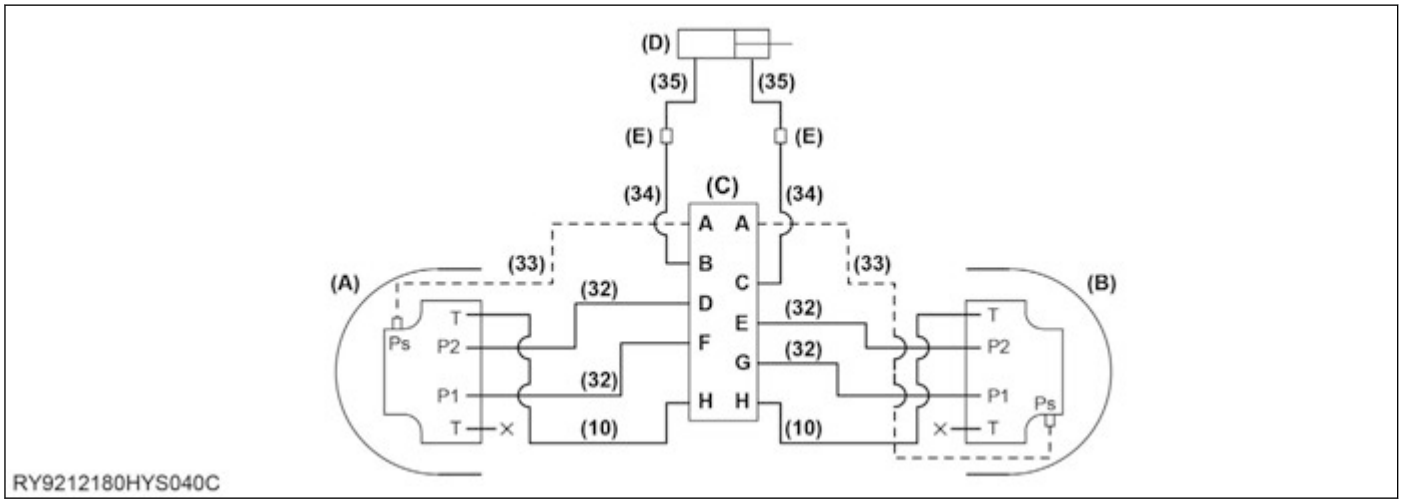

(A) Control valve (B) Boom (C) Boom cylinder

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (4) | C/V - Boom cylinder (boom lift) | 2065 mm 81.30 in. | Green - Green | M18 90° | M18 Straight | Corrugated tube |
| (5) | C/V - Boom cylinder (boom lower) | 2230 mm 87.80 in. | Yellow - Yellow | M18 90° | M18 Straight | Corrugated tube |
| (6) | C/V - Arm cylinder (arm crowd) | 1410 mm 55.51 in. | Gray - Gray | M18 90° | M18 Straight | Corrugated tube |
| (7) | C/V - Arm cylinder (arm dump) | 1380 mm 54.33 in. | Blue - Blue | M18 90° | M18 Straight | Corrugated tube |
| (10) | C/V - Bucket cylinder (bucket dump) | 1695 mm 66.73 in. | Orange - Orange | M18 90° | M18 Straight | Corrugated tube |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal Fittings (RH) | |
| (11) | C/V - Bucket cylinder (bucket crowd) | 1710 mm 67.32 in. | White - White | M18 90° | M18 Straight | Corrugated tube |
| (16) | C/V - Pipe (AUX1 LH) | 1260 mm 49.61 in. | Brown - Brown | M22 90° | M22 Straight | Corrugated tube |
| (17) | C/V - Pipe (AUX1 RH) | 1410 mm 55.51 in. | White - White | M22 Straight | M22 Straight | Corrugated tube |
| (55) | C/V - Hose (AUX2 RH) | 1240 mm 48.81 in. | White - White | M18 90° | M18 Straight | Corrugated tube |
| (56) | C/V - Hose (AUX2 LH) | 1060 mm 41.73 in. | Brown - Brown | M18 90° | M18 Straight | Corrugated tube |

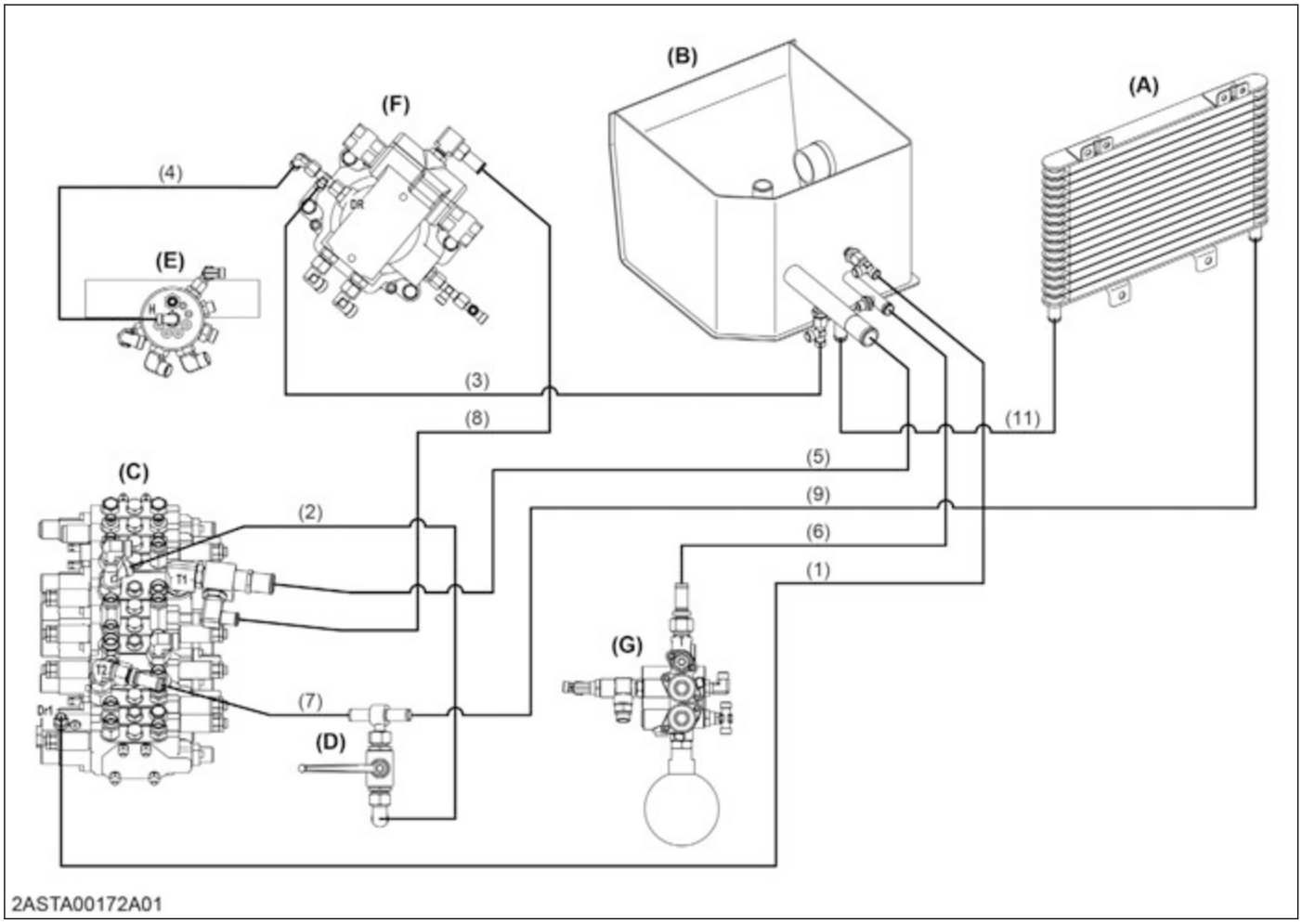
## 4.11.6 Travel and blade hoses routing




(A) Travel motor RH
(B) Travel motor LH
(C) Swivel joint
(D) Blade cylinder
(E) Blade joint

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (10) | S/J (H) - Travel motor (drain port) | 880 mm 34.65 in. | - | - | - | - |
| (32) | S/J (D, E) - Travel motor (forwards and backwards port) | 910 mm 35.83 in. | - | M18 45° | M18 Straight | Corrugated tube |
| (33) | S/J (A) - Travel motor (high speed port) | 1030 mm 40.55 in. | - | M14 90° | M14 Straight | Corrugated tube |
| (34) | Swivel joint (B, C) - Blade joint | 300 mm 11.81 in. | - | M14 90° | M14 Straight | Corrugated tube |
| (35) | Blade joint - Blade cylinder | 560 mm 22.05 in. | - | M14 Straight | M14 Straight | Spring guard |

## 4.11.7 Drain hoses routing



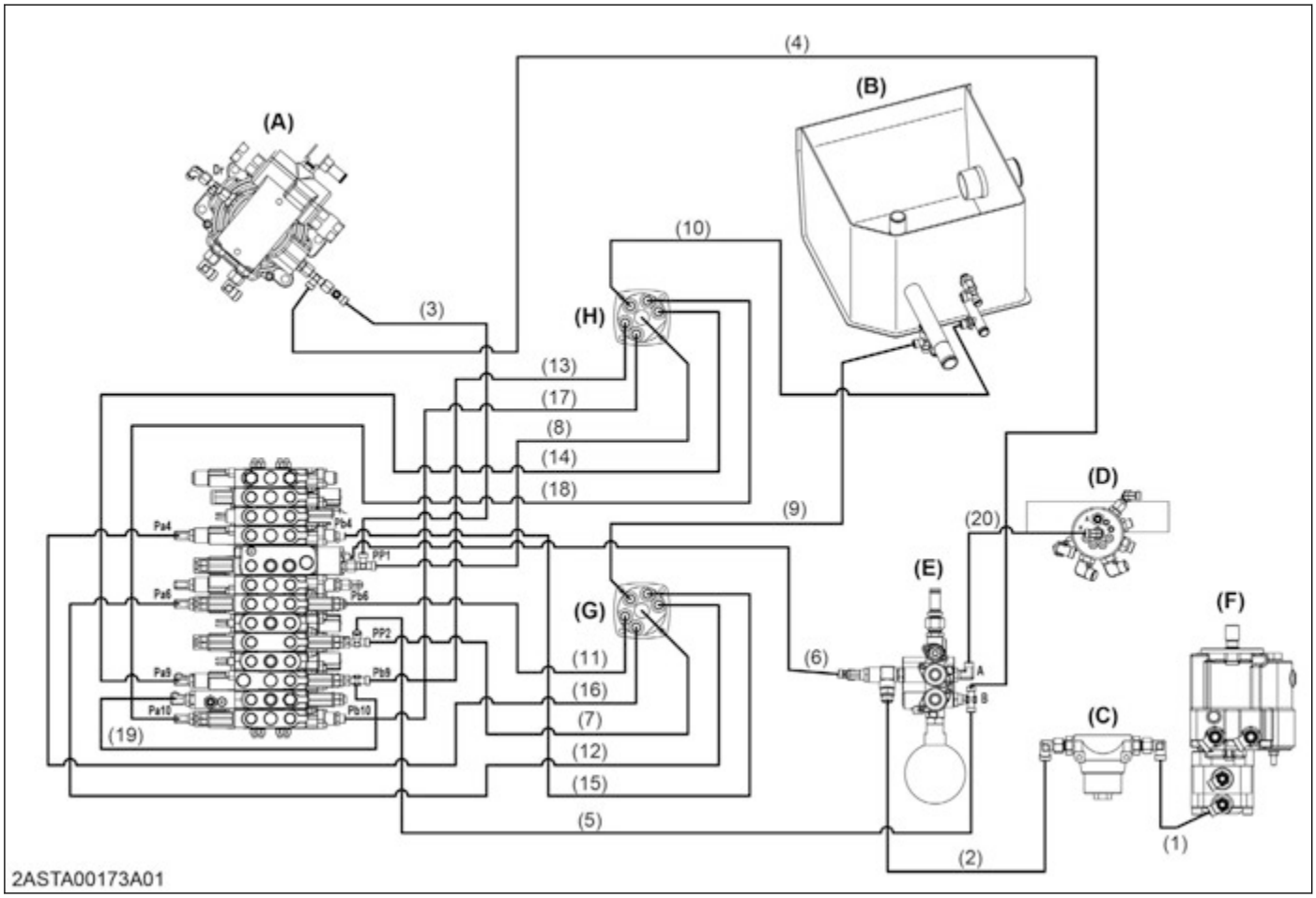

(A) Oil cooler
(B) Oil tank
(C) Control valve
(D) Third line valve
(E) Swivel joint
(F) Swivel motor
(G) Unload valve

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (1) | C/V (Dr1) - Hydraulic oil tank | 1430 mm 56.30 in. | - | M14 Straight | M14 Straight | Corrugated tube |
| (2) | Third line valve - C/V (AUX RH) | 530 mm 20.87 in. | - | M22 Straight | M22 Straight | Corrugated tube |
| (3) | Swivel motor (drain port) - Hydraulic oil tank | 675 mm 17.13 in. | Gray - Gray | M14 Straight | M14 Straight | Corrugated tube |
| (4) | S/J (H) - Swivel motor (drain port) | 435 mm 32.28 in. | Yellow - Green | M14 45° | M14 Straight | Corrugated tube |
| (5) | C/V (T1) - Hydraulic oil tank | 820 mm 32.28 in. | - | - | - | - |
| (6) | Unload valve (T) - Hydraulic oil tank | 550 mm 21.65 in. | - | - | - | Corrugated tube |
| (7) | C/V (T2) - Third line valve | 275 mm 10.83 in. | - | - | - | Corrugated tube |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (8) | Swivel motor (make up) - C/V (T1) | 1070 mm 42.13 in. | - | - | - | Corrugated tube |
| (9) | Third line valve - Oil cooler | 2090 mm 82.28 in. | - | - | - | Corrugated tube |
| (11) | Oil cooler - Return pipe | - | - | - | - | Corrugated tube |

## 4.11.8 Pilot hoses routing (Basic)



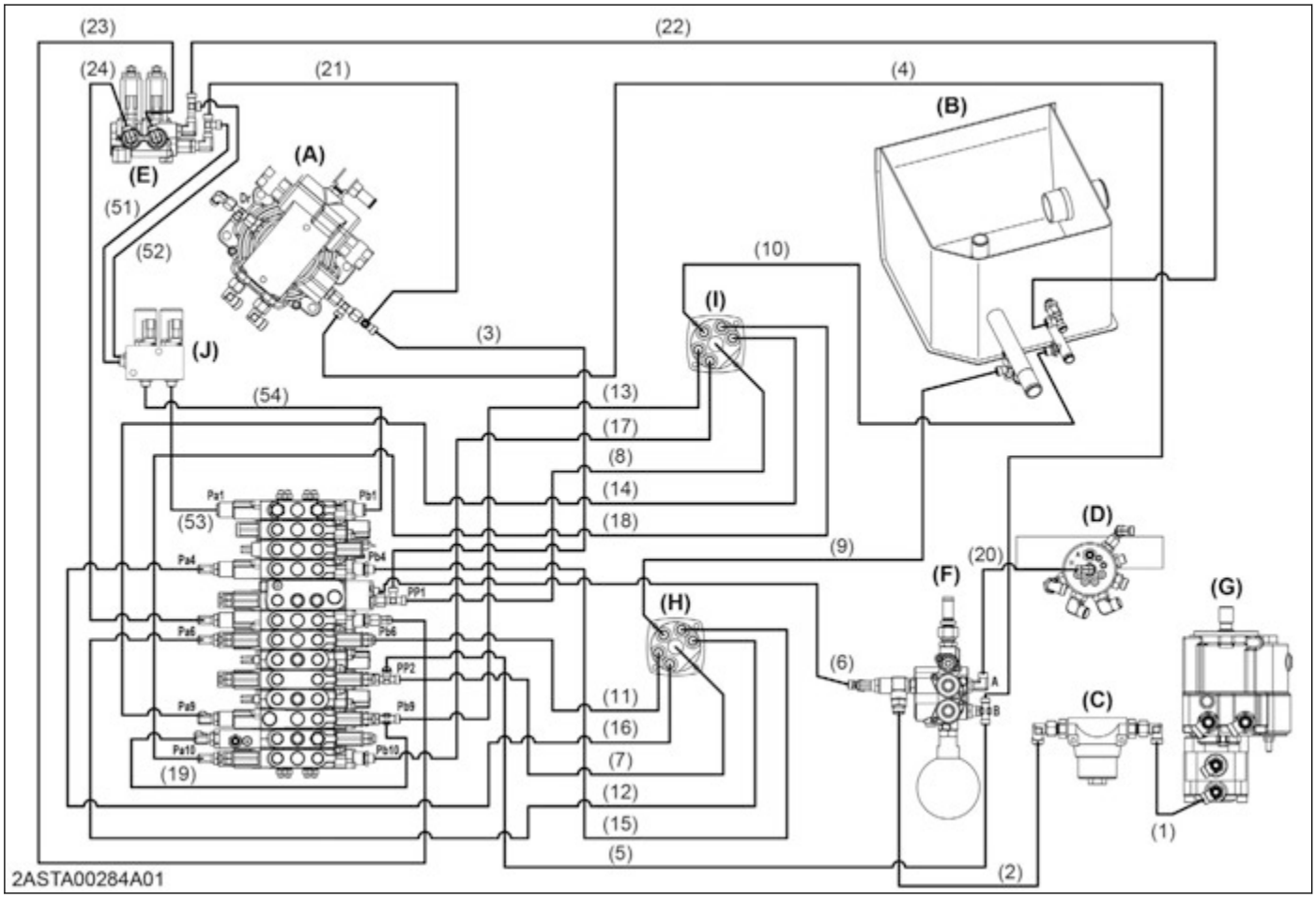

(A) Swivel motor
(B) Oil tank
(C) Pilot filter
(D) Swivel joint
(E) Unload valve
(F) Hydraulic pump
(G) Pilot control valve (LH)
(H) Pilot control valve (RH)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (1) | Hydraulic pump (P4) - Pilot filter | 370 mm 14.57 in. | - | M18 90° | M18 Straight | Corrugated tube |
| (2) | Pilot filter - Unload valve (C) | 940 mm 37.01 in. | Yellow - Yellow | M18 Straight | M18 Straight | Corrugated tube |
| (3) | C/V (Pp1) - Swivel motor (PP) | 880 mm 34.65 in. | White - White | M14 90° | M14 Straight | Corrugated tube |
| (4) | Unload valve (B) - Swivel motor (PP) | 580 mm 22.83 in. | Blue - Blue | M14 Straight | M14 90° | Corrugated tube |
| (5) | Unload valve (B) - C/V (Pp2) | 1170 mm 46.06 in. | - | M14 Straight | M14 45° | Corrugated tube |
| (6) | Unload valve (C) - C/V (Pp3) | 390 mm 15.35 in. | - | M14 Straight | M14 45° | Corrugated tube |
| (7) | C/V (Pp2) - LH pilot control valve (P) | 1585 mm 62.40 in. | White - White | M14 90° | M14 Straight | - |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (8) | C/V (Pp1) - RH pilot control valve (P) | 1945 mm 76.57 in. | White - White | M14 45° | M14 Straight | - |
| (9) | LH Pilot control valve (T) - Hydraulic oil tank | 1635 mm 64.37 in. | - | M14 Straight | M14 90° | - |
| (10) | RH pilot control valve (T) - Hydraulic oil tank | 1990 mm 78.35 in. | - | M14 Straight | M14 90° | - |
| (11) | Pilot control valve - C/V (arm dump) | 1590 mm 62.60 in. | Blue - Blue | M14 Straight | M14 45° | - |
| (12) | Pilot control valve - C/V (arm crowd) | 1830 mm 72.05 in. | Green - Green | M14 Straight | M14 90° | - |
| (13) | Pilot control valve - C/V (boom lower) | 2060 mm 81.10 in. | White - Blue | M14 Straight | M14 90° | - |
| (14) | Pilot control valve - C/V (boom lift) | 2240 mm 88.19 in. | Gray - Gray | M14 Straight | M14 90° | - |
| (15) | Pilot control valve - C/V (swivel LH) | 1570 mm 61.81 in. | Red - Red | M14 Straight | M14 45° | - |
| (16) | Pilot control valve - C/V (swivel RH) | 1795 mm 70.67 in. | Yellow - Yellow | M14 Straight | M14 90° | - |
| (17) | Pilot control valve - C/V (bucket dump) | 2110 mm 83.07 in. | Brown - Brown | M14 Straight | M14 45° | - |
| (18) | Pilot control valve - C/V (bucket crowd) | 2335 mm 91.93 in. | Pink - Pink | M14 Straight | M14 90° | - |
| (19) | C/V (boom lower) - C/V (lock release) | 300 mm 11.81 in. | - | M14 Straight | M14 90° | - |
| (20) | Unload valve (A) - S/J (A) | 670 mm 26.38 in. | - | M14 Straight | M14 90° | Corrugated tube |

## 4.11.9 Pilot hoses routing (Hi-spec)




(A) Swivel motor
(B) Oil tank
(C) Pilot filter
(D) Swivel joint
(E) AUX1 proportional valve
(F) Unload valve
(G) Hydraulic pump
(H) Pilot control valve (LH)
(I) Pilot control valve (RH)
(J) AUX2 proportional valve

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (1) | Hydraulic pump (P4) - Pilot filter | 370 mm 14.57 in. | - | M18 90° | M18 Straight | Corrugated tube |
| (2) | Pilot filter - Unload valve (C) | 940 mm 37.01 in. | Yellow - Yellow | M18 Straight | M18 Straight | Corrugated tube |
| (3) | C/V (Pp1) - Swivel motor (PP) | 880 mm 34.65 in. | White - White | M14 90° | M14 Straight | Corrugated tube |
| (4) | Unload valve (B) - Swivel motor (PP) | 580 mm 22.83 in. | Blue - Blue | M14 Straight | M14 90° | Corrugated tube |
| (5) | Unload valve (B) - C/V (Pp2) | 1170 mm 46.06 in. | - | M14 Straight | M14 45° | Corrugated tube |
| (6) | Unload valve (C) - C/V (Pp3) | 390 mm 15.35 in. | - | M14 Straight | M14 45° | Corrugated tube |
| (7) | C/V (Pp2) - LH pilot control valve (P) | 1585 mm 62.40 in. | White - White | M14 90° | M14 Straight | - |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (8) | C/V (Pp1) - RH pilot control valve (P) | 1945 mm 76.57 in. | White - White | M14 45° | M14 Straight | - |
| (9) | LH pilot control valve (T) - Hydraulic oil tank | 1635 mm 64.37 in. | - | M14 Straight | M14 90° | Corrugated tube |
| (10) | RH pilot control valve (T) - Hydraulic oil tank | 1990 mm 78.35 in. | - | M14 Straight | M14 90° | Corrugated tube |
| (11) | Pilot control valve - C/V (arm dump) | 1590 mm 62.60 in. | Blue - Blue | M14 Straight | M14 45° | - |
| (12) | Pilot control valve - C/V (arm crowd) | 1830 mm 72.05 in. | Green - Green | M14 Straight | M14 90° | - |
| (13) | Pilot control valve - C/V (boom lower) | 2060 mm 81.10 in. | White - Blue | M14 Straight | M14 90° | - |
| (14) | Pilot control valve - C/V (boom lift) | 2240 mm 88.19 in. | Gray - Gray | M14 Straight | M14 90° | - |
| (15) | Pilot control valve - C/V (swivel LH) | 1570 mm 61.81 in. | Red - Red | M14 Straight | M14 45° | - |
| (16) | Pilot control valve - C/V (swivel RH) | 1795 mm 70.67 in. | Yellow - Yellow | M14 Straight | M14 90° | - |
| (17) | Pilot control valve - C/V (bucket dump) | 2110 mm 83.07 in. | Brown - Brown | M14 Straight | M14 45° | - |
| (18) | Pilot control valve - C/V (bucket crowd) | 2335 mm 91.93 in. | Pink - Pink | M14 Straight | M14 90° | - |
| (19) | C/V (boom lower) - C/V (lock release) | 300 mm 11.81 in. | - | M14 Straight | M14 90° | - |
| (20) | Unload valve (A) - S/J (A) | 670 mm 26.38 in. | - | M14 Straight | M14 90° | Corrugated tube |
| (21) | AUX1 proportional valve (P) - Swivel motor (PP) | 660 mm 25.98 in. | White - White | M14 Straight | M14 90° | Corrugated tube |
| (22) | AUX1 proportional valve (P) - Hydraulic oil tank | 850 mm 33.46 in. | - | M14 Straight | M14 90° | Corrugated tube |
| (23) | AUX1 proportional valve (AUX1 LH) - C/V | 365 mm 14.37 in. | Pink - Pink | M14 Straight | M14 90° | Corrugated tube |
| (24) | AUX1 proportional valve (AUX1 RH) - C/V | 640 mm 25.20 in. | Yellow - Green | M14 Straight | M14 90° | Corrugated tube |
| (51) | AUX2 proportional valve (P) - AUX1 proportional valve (P) | 460 mm 18.11 in. | White - White | M14 45° | M14 Straight | Corrugated tube |
| (52) | AUX2 proportional valve (T) - AUX1 proportional valve (T) | 460 mm 16.14 in. | - | M14 45° | M14 Straight | Corrugated tube |

(Continued)

| No. | Point of use | Hose | | | | Guard |
|---|---|---|---|---|---|---|
| | | Length | Tape color | Metal fittings (LH) | Metal fittings (RH) | |
| (53) | AUX2 proportional valve (Pa1) - C/V | 1100 mm 43.31 in. | - | M14 90° | M14 Straight | - |
| (54) | AUX2 proportional valve (Pb1) - C/V | 600 mm 23.62 in. | - | M14 90° | M14 Straight | - |

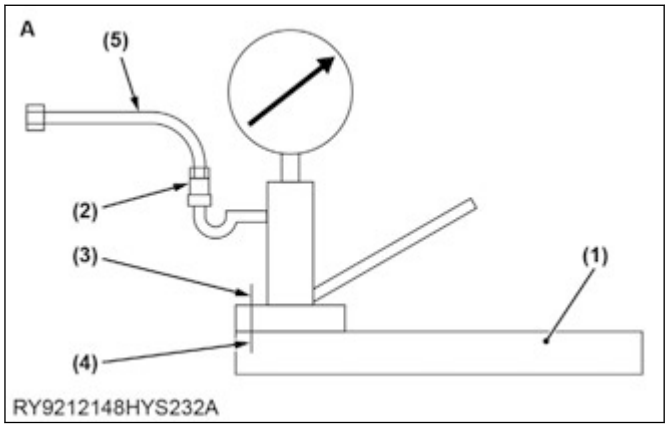
# 4.12 Special jigs and tools

## 4.12.1 Overload relief valve measuring kit

**CAUTION**

- **When measuring overload relief pressure, use a test hose which has enough pressure endurance.**

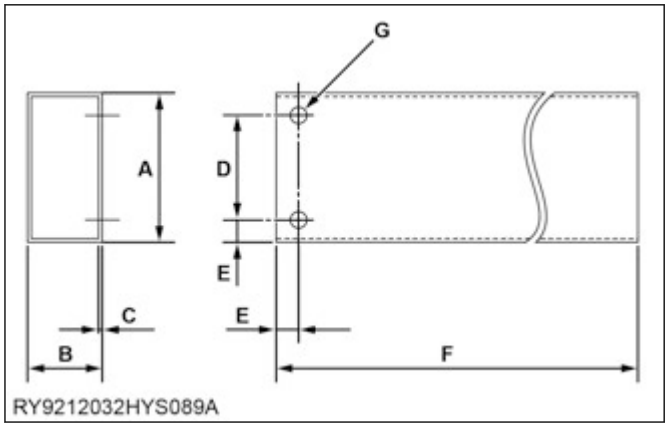
**Tester**




A Nozzle tester

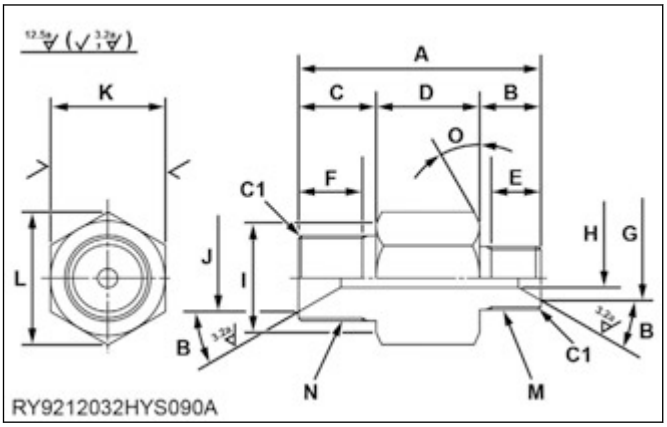
| No. | Parts name | Quantity |
|---|---|---|
| (1) | Support | 1 |
| (2) | Pipe fittings (M12 · G2) | 1 |
| (3) | Bolt (M10 × 35) | 2 |
| (4) | Nut (M12) | 2 |
| (5) | Test hose | 1 |

**Support**




| No. | Size |
|---|---|
| A | 100 mm 3.94 in. |
| B | 50 mm 1.97 in. |
| C | 2.3 mm 0.09 in. |
| D | 70 mm 2.76 in. |
| E | 15 mm 0.59 in. |
| F | 600 mm 23.62 in. |
| G | 11 mm 0.43 in. |

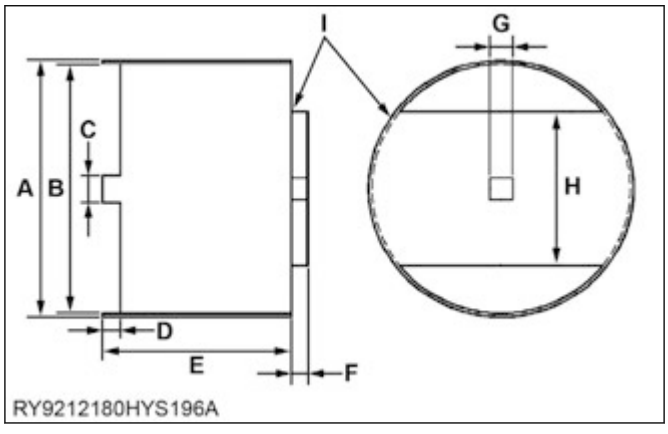
**Pipe fittings (M12-G1/4)**



| No. | Size |
|---|---|
| A | 47 mm<br>1.85 in. |
| B | 12 mm<br>0.47 in. |
| C | 15 mm<br>0.59 in. |
| D | 20 mm<br>0.79 in. |
| E | 10 mm<br>0.39 in. |
| F | 12 mm<br>0.47 in. |
| G | ϕ8 mm<br>ϕ0.31 in. |
| H | ϕ3 mm<br>ϕ0.12 in. |
| I | ϕ8 mm<br>ϕ0.71 in. |
| J | ϕ9±0.2 mm<br>ϕ0.37±0.01 in. |
| K | 19 mm<br>0.75 in. |
| L | 21.9 mm<br>0.86 in. |
| M | M12 x 1.5 |
| N | G1/4 |
| O | 0.52 rad<br>30° |

## 4.12.2 Travel motor special jigs and tools

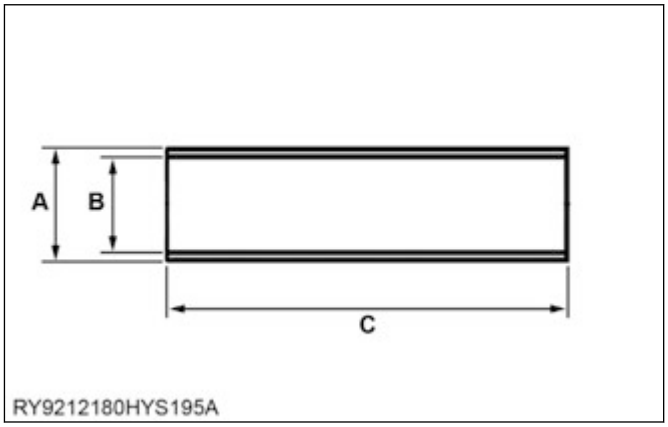
**(S-1)Ring nut fastening tool**




| No. | Size |
|---|---|
| A | ϕ150 mm<br>ϕ5.85 in. |
| B | ϕ146 mm<br>ϕ5.69 in. |
| C | 4-16 mm<br>0.63in. |
| D | 10 mm<br>0.39 in. |
| E | 107 mm<br>4.17 in. |
| F | 9.0 mm<br>0.35 in. |
| G | □12.8 to 13.0 mm<br>□0.50 to 0.51 in. |
| H | 90 mm<br>3.51 in. |
| I | 90 mm<br>3.51 in. |

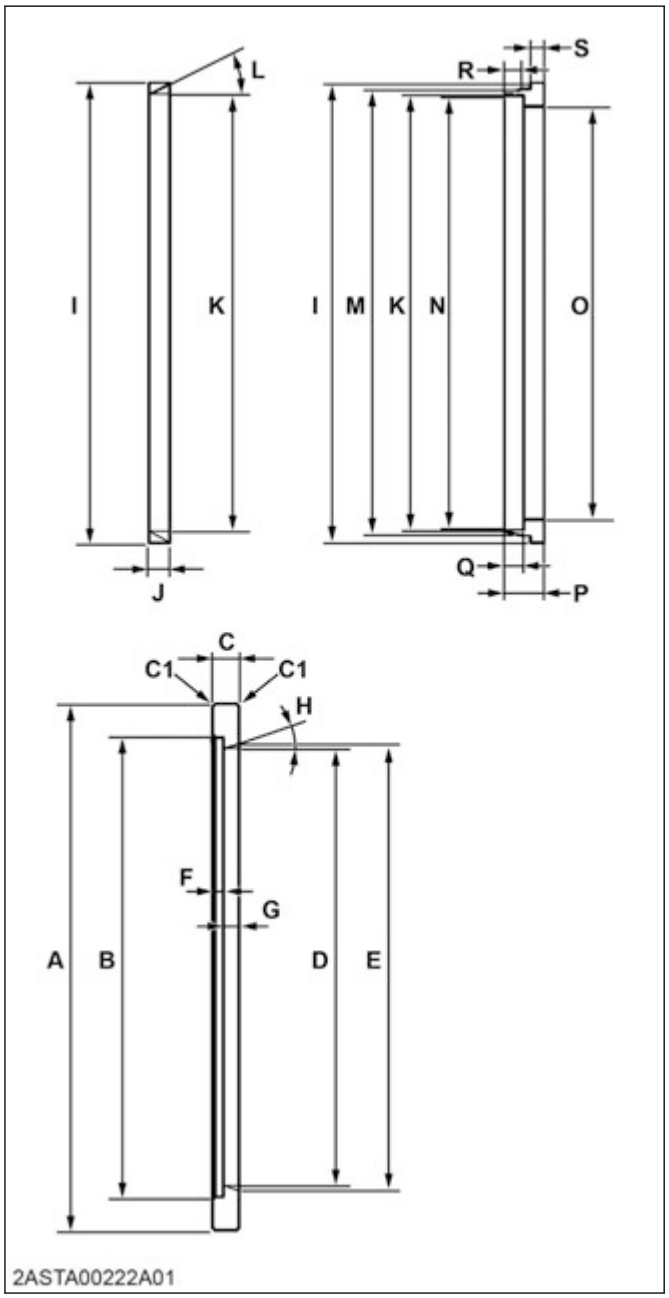
- Weld on (I).

**(S-2) Ball bearing removing tool**



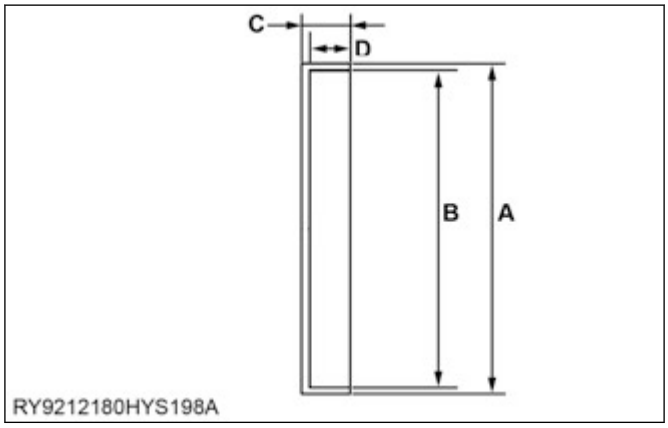

| No. | Size |
|---|---|
| A | ϕ29 mm<br>ϕ1.13 in. |
| B | ϕ25 mm<br>ϕ0.98 in. |
| C | 100 mm<br>3.9 in. |

## (S-3) Floating seal assembling tool



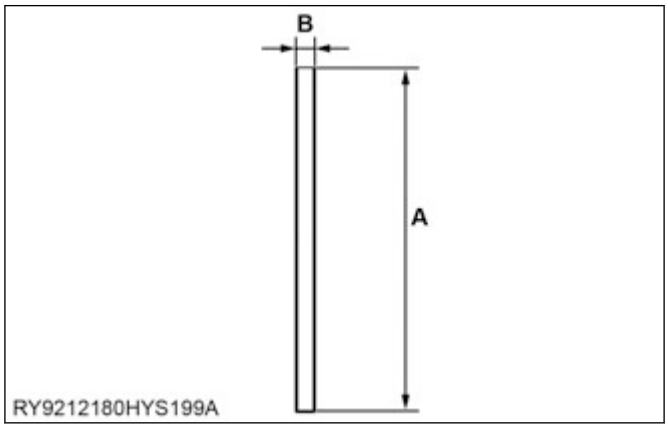

| No. | Size |
|---|---|
| A | ϕ205 mm<br>ϕ8.0 in. |
| B | 179.2 to 179.3 mm<br>6.989 to 6.993 in. |
| C | 10 mm<br>0.39 in. |
| D | 170.2 mm<br>6.64 in. |
| E | 173.4 mm<br>6.76 in. |
| F | 4.0 mm<br>0.16 in. |
| G | 6.0 mm<br>0.23 in. |
| H | 15° |
| I | ϕ179.3 to 179.5 mm<br>ϕ6.99 to 7.00 in. |
| J | 8.0 mm<br>0.31 in. |
| K | ϕ170.1 to 170.3 mm<br>ϕ7.99 to 8.00 in. |
| L | 14 to 15° in. |
| M | ϕ174 mm<br>ϕ6.79 in. |
| N | ϕ169 mm<br>ϕ6.59 in. |
| O | ϕ161 mm<br>ϕ6.28 in. |
| P | 15 mm<br>0.59 in. |
| Q | 7.5 mm<br>0.29 in. |
| R | 7.0 mm<br>0.27 in. |
| S | 5.0 mm<br>0.20 in. |
| C1 | Chamber 1.0 mm |

## (S-4) Angular bearing press-fit tool



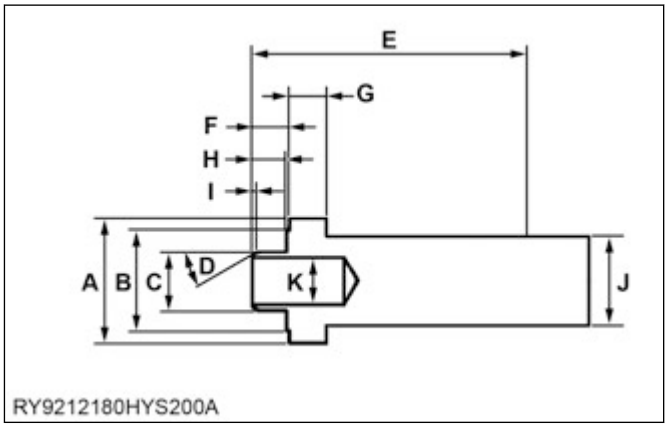

| No. | Size |
|---|---|
| A | ϕ165 mm<br>ϕ6.44 in. |
| B | ϕ158 mm<br>6.16 in. |
| C | 24 mm<br>0.94 in. |
| D | 20 mm<br>0.78 in. |

## (S-5) Flange holder press-fit tool



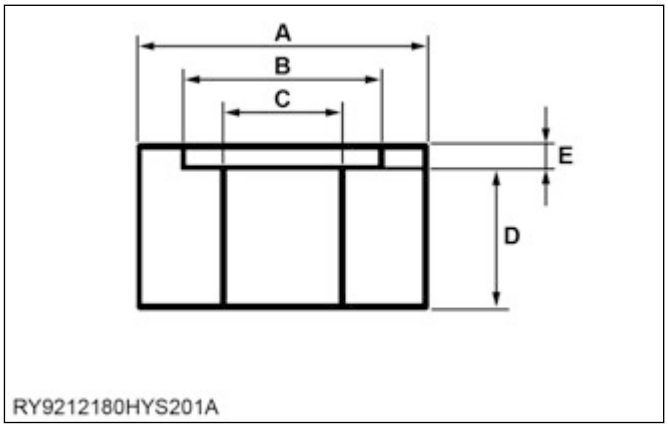

| No. | Size |
|---|---|
| A | ϕ180 mm<br>ϕ7.02 in. |
| B | 9.0 mm<br>0.35 in. |

## (S-6) Oil seal press-fit tool



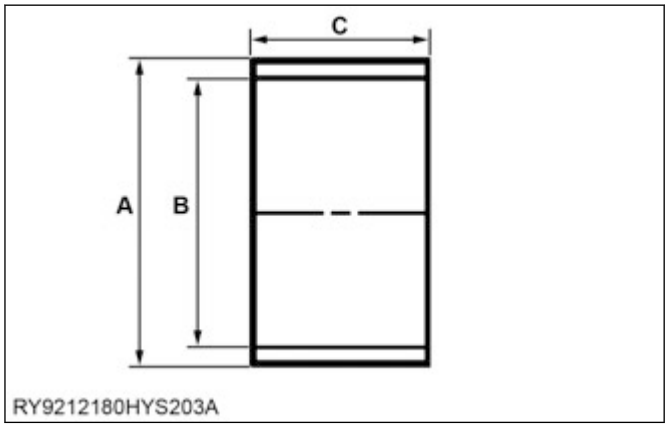

| No. | Size |
|---|---|
| A | ϕ42 mm<br>ϕ1.64 in. |
| B | ϕ34 mm<br>ϕ1.33 in. |
| C | ϕ19.6 to 19.8 mm<br>ϕ0.76 to 0.77 in. |
| D | 30° |
| E | 110 mm<br>4.29 in. |
| F | 12 mm<br>0.47 in. |
| G | 12 mm<br>0.47 in. |
| H | 11 mm<br>0.47 in. |
| I | 2.0 mm<br>0.078 in. |
| J | ϕ30 mm<br>ϕ1.17 in. |
| K | ϕ16 mm<br>0.62 in. |

## (S-7) Ball bearing press-fit tool



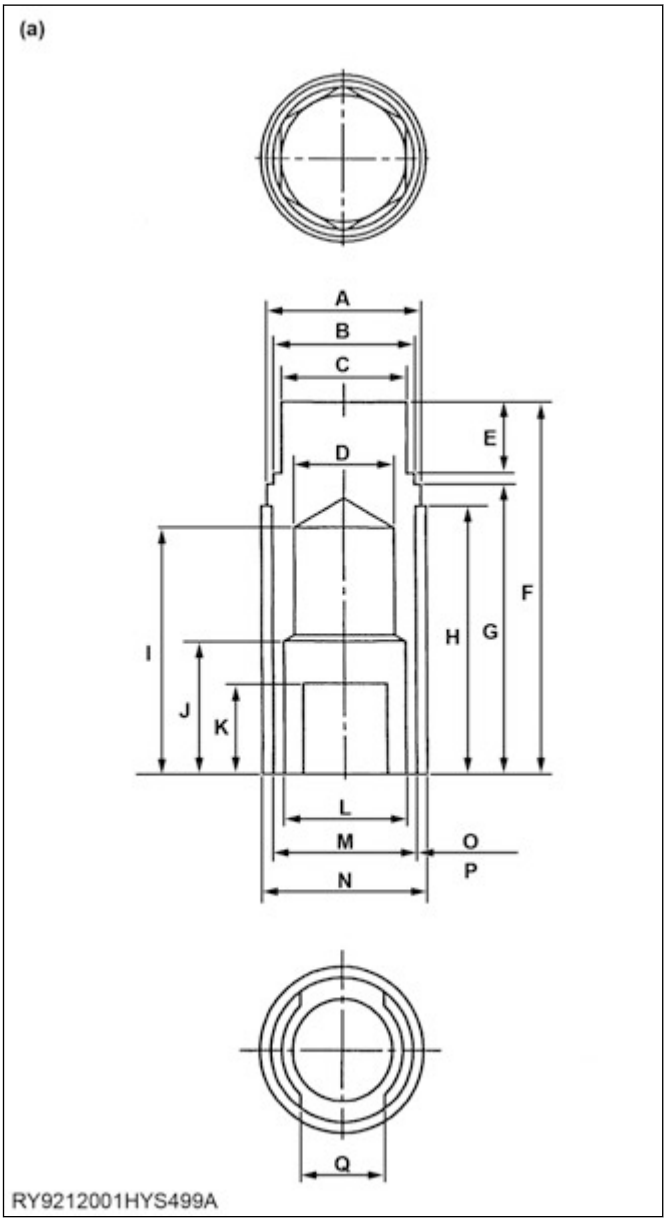
| No. | Size |
|---|---|
| A | ϕ60 mm<br>ϕ2.34 in. |
| B | ϕ42.005 to 42.100 mm<br>ϕ1.640 to 1.642 in. |
| C | ϕ25 mm<br>ϕ0.975 in. |
| D | 35 mm<br>1.365 in. |
| E | 5.0 mm<br>0.195 in. |

**(S-8) Ball bearing press-fit tool**




| No. | Size |
|---|---|
| A | ϕ36 mm<br>ϕ1.40 in. |
| B | ϕ32 mm<br>ϕ1.25 in. |
| C | 20 mm<br>0.78 in. |

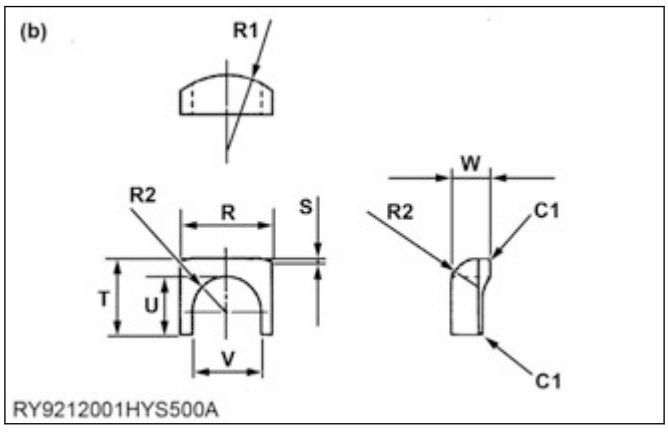
## 4.12.3 Universal joint tightening jig




(a) Universal joint tightening jig detail view

| No. | Size |
|---|---|
| A | ϕ29 mm<br>ϕ1.14 in. |
| B | ϕ26.5 mm<br>ϕ1.04 in. |
| C | 23.5 mm<br>0.93 in. |
| D | ϕ19 mm<br>ϕ0.75 in. |
| E | less than 13 mm<br>less than 0.51 in. |
| F | less than 69 mm<br>less than 2.72 in. |
| G | 54 mm<br>2.13 in. |
| H | 50 mm<br>1.97 in. |
| I | 46 mm<br>1.81 in. |
| J | 25 mm<br>0.98 in. |
| K | 17 mm<br>0.67 in. |
| L | ϕ23 mm<br>ϕ0.91 in. |
| M | ϕ27 mm<br>ϕ1.06 in. |
| N | ϕ31 mm<br>ϕ1.22 in. |
| O | H6 mm |
| P | N6 mm |
| Q | ϕ16 mm<br>ϕ0.63 in. |

| No. | Size |
|---|---|
| R | 15.5 mm<br>0.61 in. |
| S | 0.5 × 15 mm<br>0.02 × 0.59 in. |
| T | 12.5 mm<br>0.49 in. |
| U | 9.5 mm<br>0.37 in. |
| V | less than 11.6 mm<br>less than 0.46 in. |
| W | less than 6.5 mm<br>less than 0.26 in. |
| C1 | 0.5 mm chamfer<br>0.02 in. chamfer |
| R1 | R13 mm<br>R0.51 in. |
| R2 | R5.8 mm<br>R0.23 in. |




(b) Bushing detail view

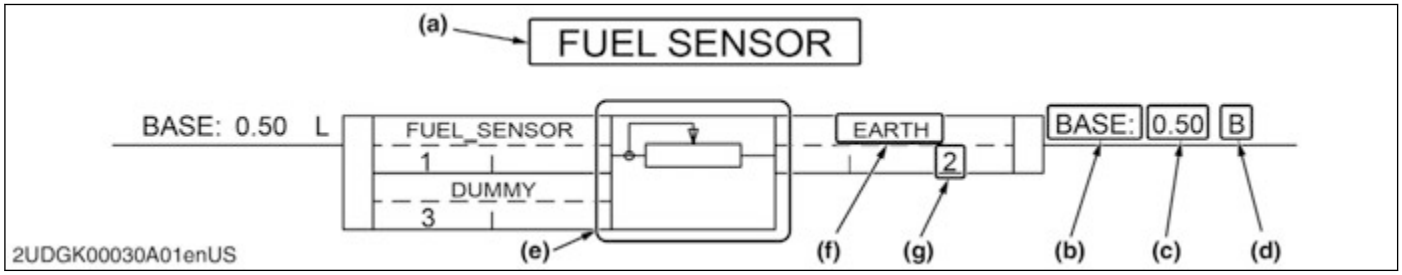
# 6. ELECTRICAL SYSTEM

# MECHANISM

## 1. Electrical circuit

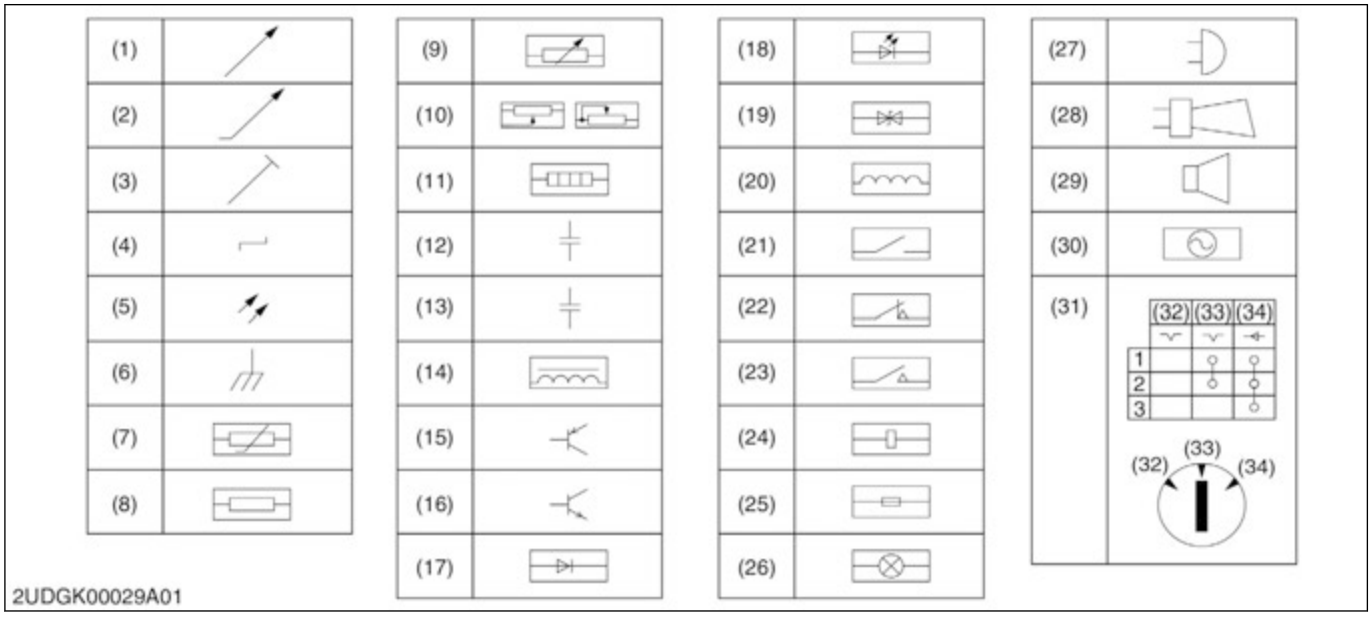
### 1.1 Electrical circuit general description

#### 1.1.1 Electrical circuit diagram description




(a) Part name
(b) Specification code
(c) Electrical wiring size
(d) Wiring color coding
(e) Unit symbol
(f) Pin name
(g) Pin number
(h) Connector name

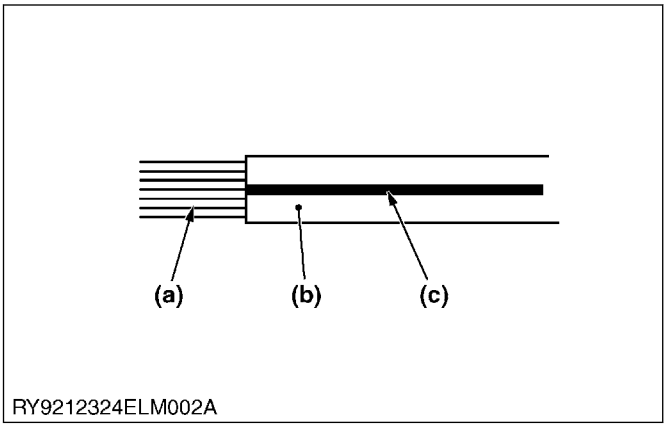
#### 1.1.2 Electrical circuit diagram unit symbol




(1) Variable
(2) Nonlinear variable
(3) Fixed setting
(4) Step variable
(5) Non-ionizing radiation (NIR)
(6) Body GND
(7) Thermistor
(8) Resistor
(9) Variable resistor
(10) Potentiometer with sliding contact
(11) Heating element
(12) Capacitor
(13) Electrolytic capacitor
(14) Magnetic core inductance
(15) PNP transistor
(16) NPN transistor
(17) Semiconductor diode
(18) Light-emitting diode (LED)
(19) Two-way breakdown diode
(20) Coil
(21) NO (normally open)
(22) Auto-resetting NC (normally closed)
(23) Auto-resetting NO (normally open)
(24) Relay coil
(25) Fuse
(26) Lamp
(27) Buzzer
(28) Horn
(29) Speaker
(30) AC voltage source
(31) Starter switch
(32) STOP
(33) RUN
(34) START

## 1.1.3 Electrical wiring color coding

| Wiring color | Color code | Wiring color | Color code |
|---|---|---|---|
| Black | B | Blue/Green | L/G |
| Green | G | Blue/Orange | L/O |
| Blue | L | Blue/Red | L/R |
| Pink | P | Blue/White | L/W |
| Red | R | Blue/Yellow | L/Y |
| White | W | Yellowish green/Blue | LG/L |
| Yellow | Y | Yellowish green/Red | LG/R |
| Brown | BR | Yellowish green/White | LG/W |
| Gray | GR | Yellowish green/Yellow | LG/Y |
| Yellowish green | LG | Orange/White | O/W |
| Orange | O | Pink/White | P/W |
| Light blue | SB | Pink/Blue | P/L |
| Black/Green | B/G | Red/Black | R/B |
| Black/Blue | B/L | Red/Green | R/G |
| Black/Pink | B/P | Red/Blue | R/L |
| Black/Violet | B/V | Red/White | R/W |
| Black/Red | B/R | Red/Yellow | R/Y |
| Black/White | B/W | Violet/White | V/W |
| Black/Yellow | B/Y | White/Black | W/B |
| Brown/Black | BR/B | White/Green | W/G |
| Brown/Yellow | BR/Y | White/Blue | W/L |
| Brown/Red | BR/R | White/Red | W/R |
| Green/Black | G/B | White/Yellow | W/Y |
| Green/Blue | G/L | Yellow/Black | Y/B |
| Green/Red | G/R | Yellow/Green | Y/G |
| Green/White | G/W | Yellow/Blue | Y/L |
| Green/Yellow | G/Y | Yellow/Red | Y/R |
| Blue/Black | L/B | | |



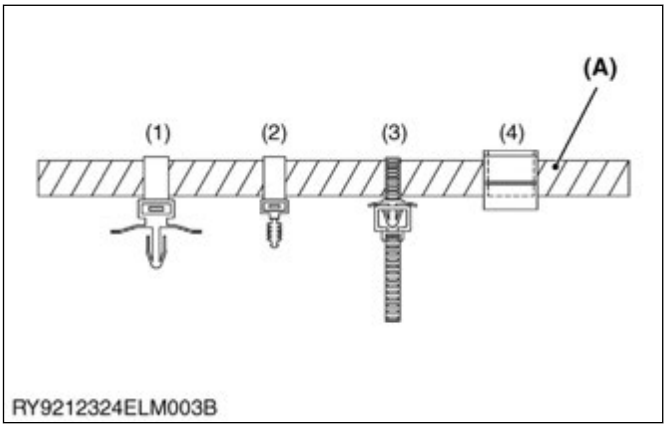
RY9212324ELM002A

(a) Electric wiring size ($mm^2$)
(b) Base color
(c) Stripe color

- 1.25–Y/R

1.25 $mm^2$ (electric wiring size)
Y: Yellow (base color)
R: Red (stripe color)

## 1.1.4 Electrical wiring clamp

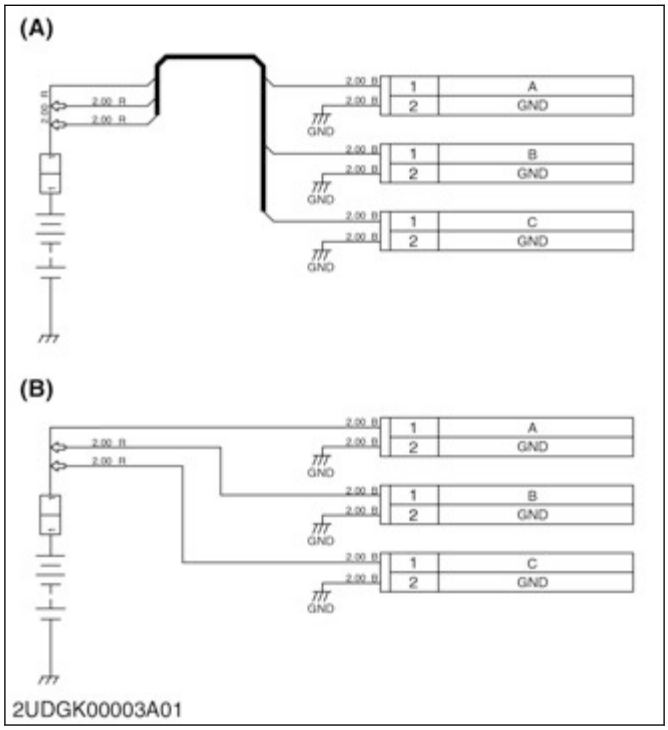


RY9212324ELM003B

(1) Anchor type (insert to the anchor)
(2) Screw type (insert to the screw end)
(3) Plug-in type (insert until it locks)
(4) Plug-in type (insert until it locks)
(A) Wire harness

## 1.1.5 Bus description

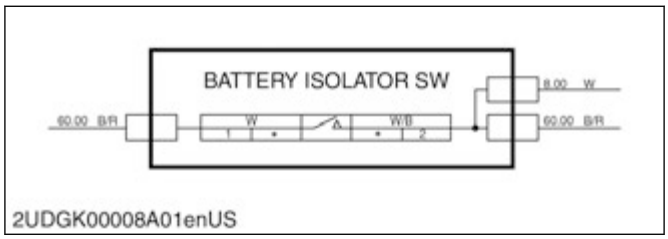
Bus simplifies complex circuits with many branches.

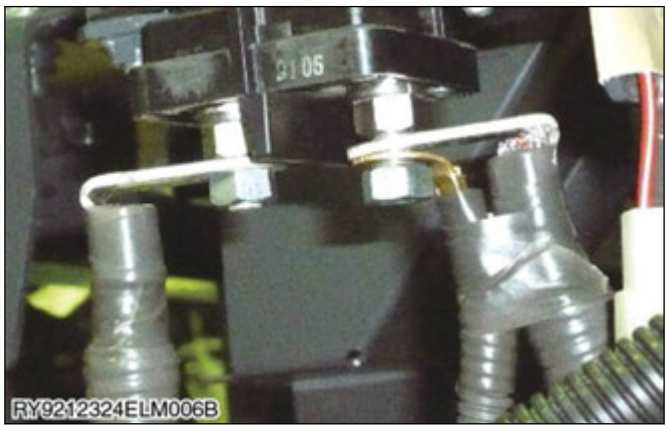



(A) Diagram with bus (B) Diagram without bus

## 1.1.6 Composite terminal description

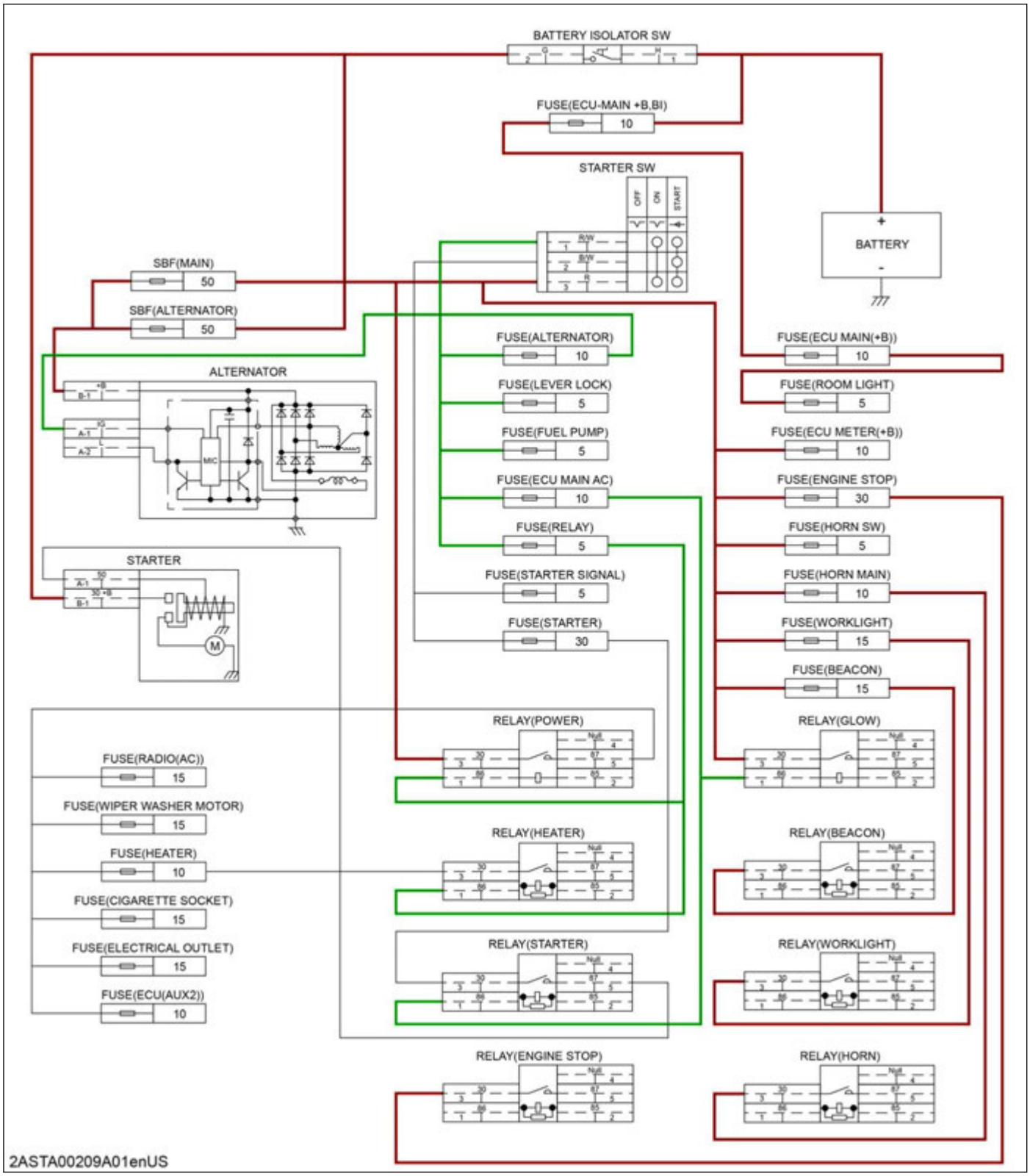
Connect two or more terminals together to a device.



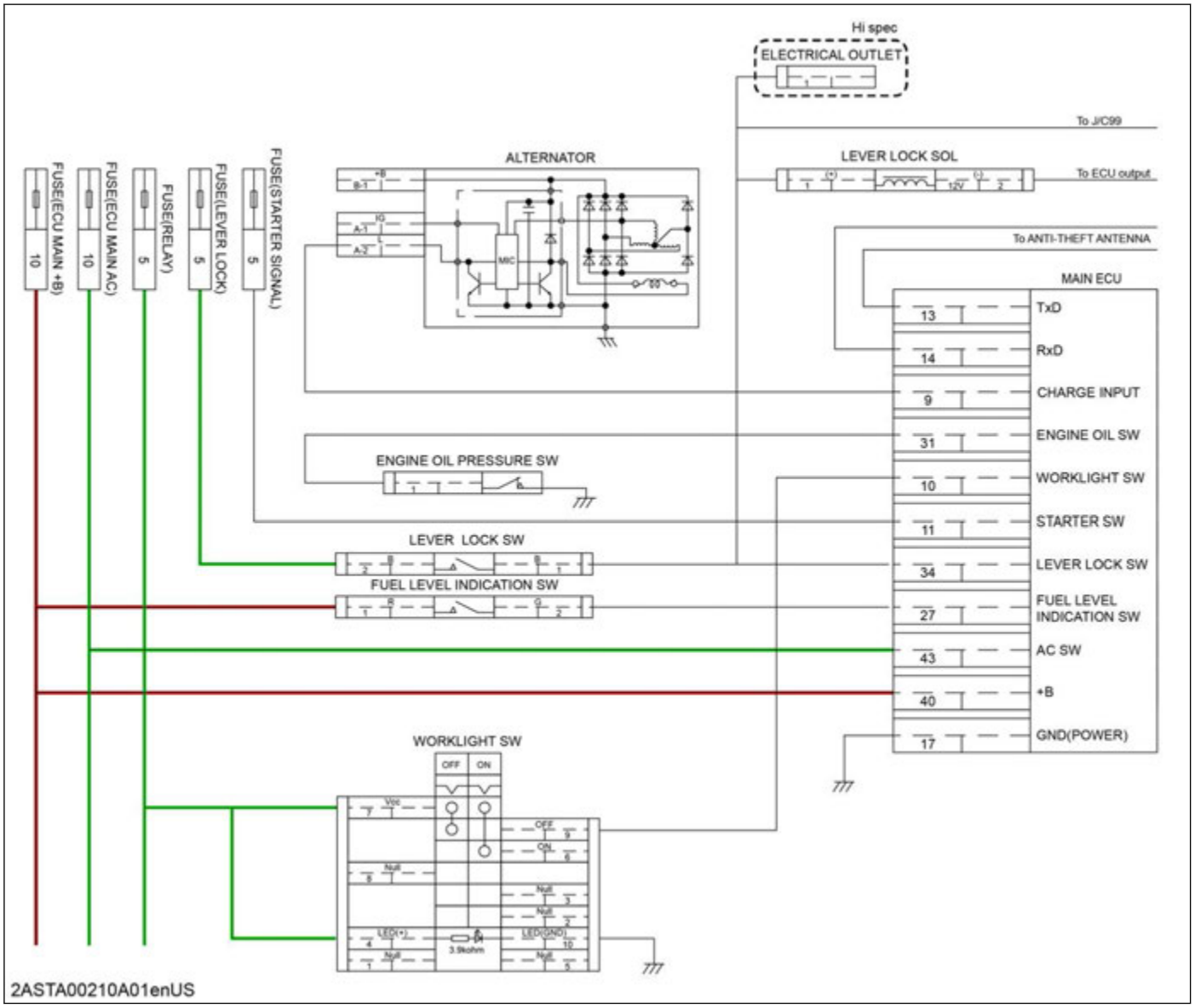
# 1.2 Functional electrical circuit

## 1.2.1 Power supply electrical circuit diagram

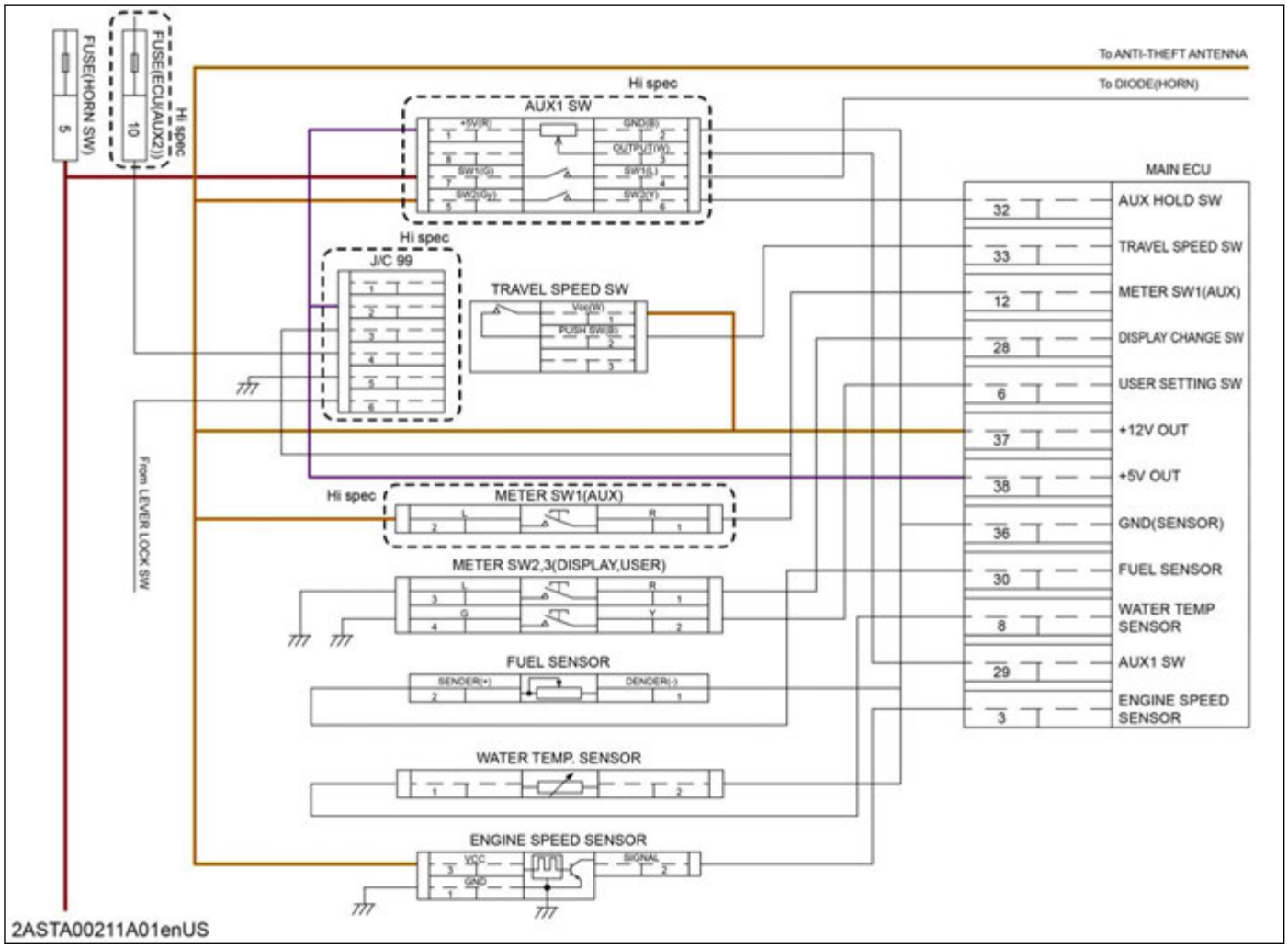



- In case of stopping the engine, the battery applies approximately 12.0 V.
- In case of running the engine, the alternator applies approximately 14.5 V.
- Generating of the alternator charges the battery and supplies power to all electrical devices.
- There are 2 general powers which are +B (SBF main) and ACC (starter switch **[RUN]**).

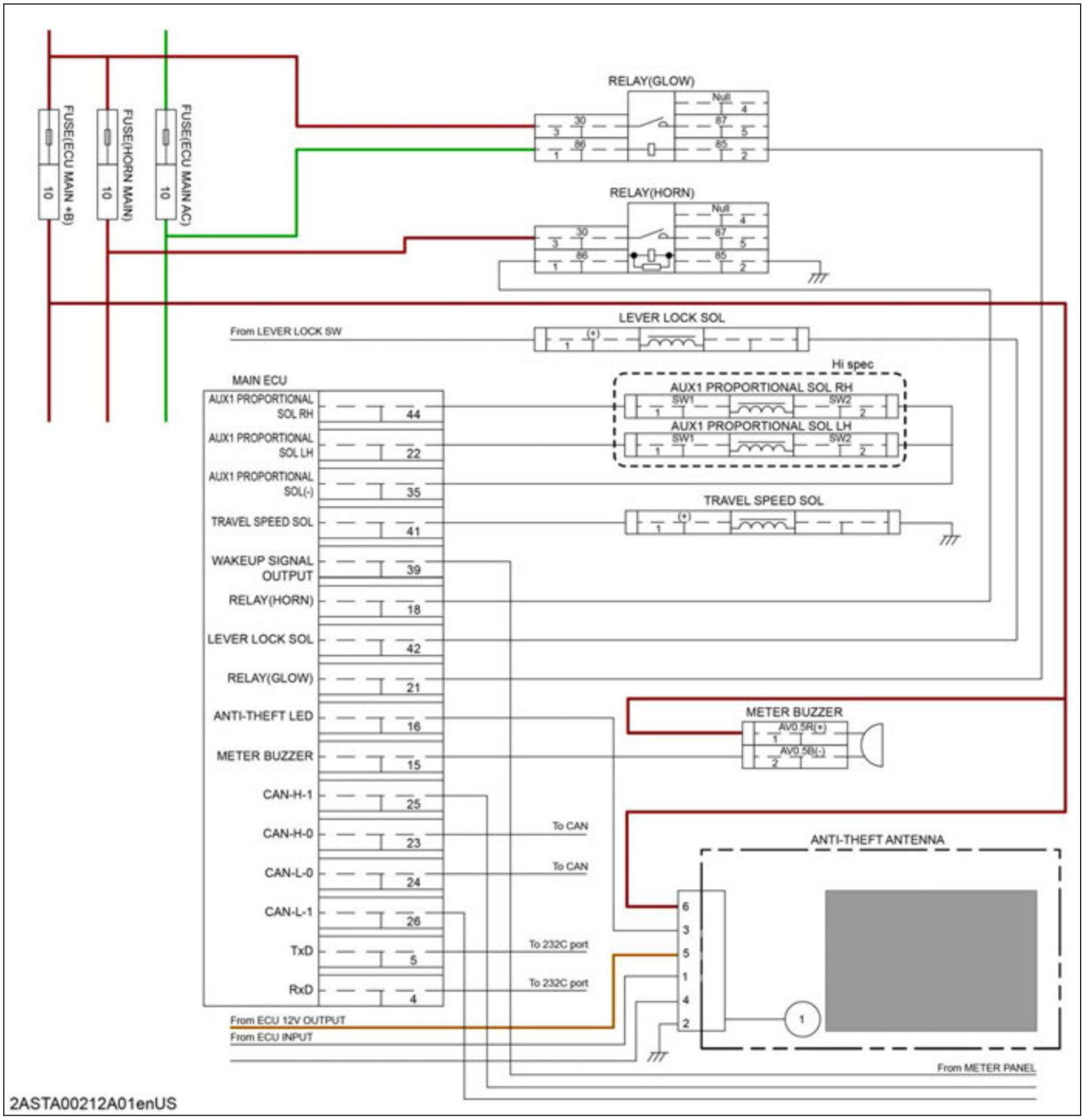
## 1.2.2 Main ECU input -1 electrical circuit diagram



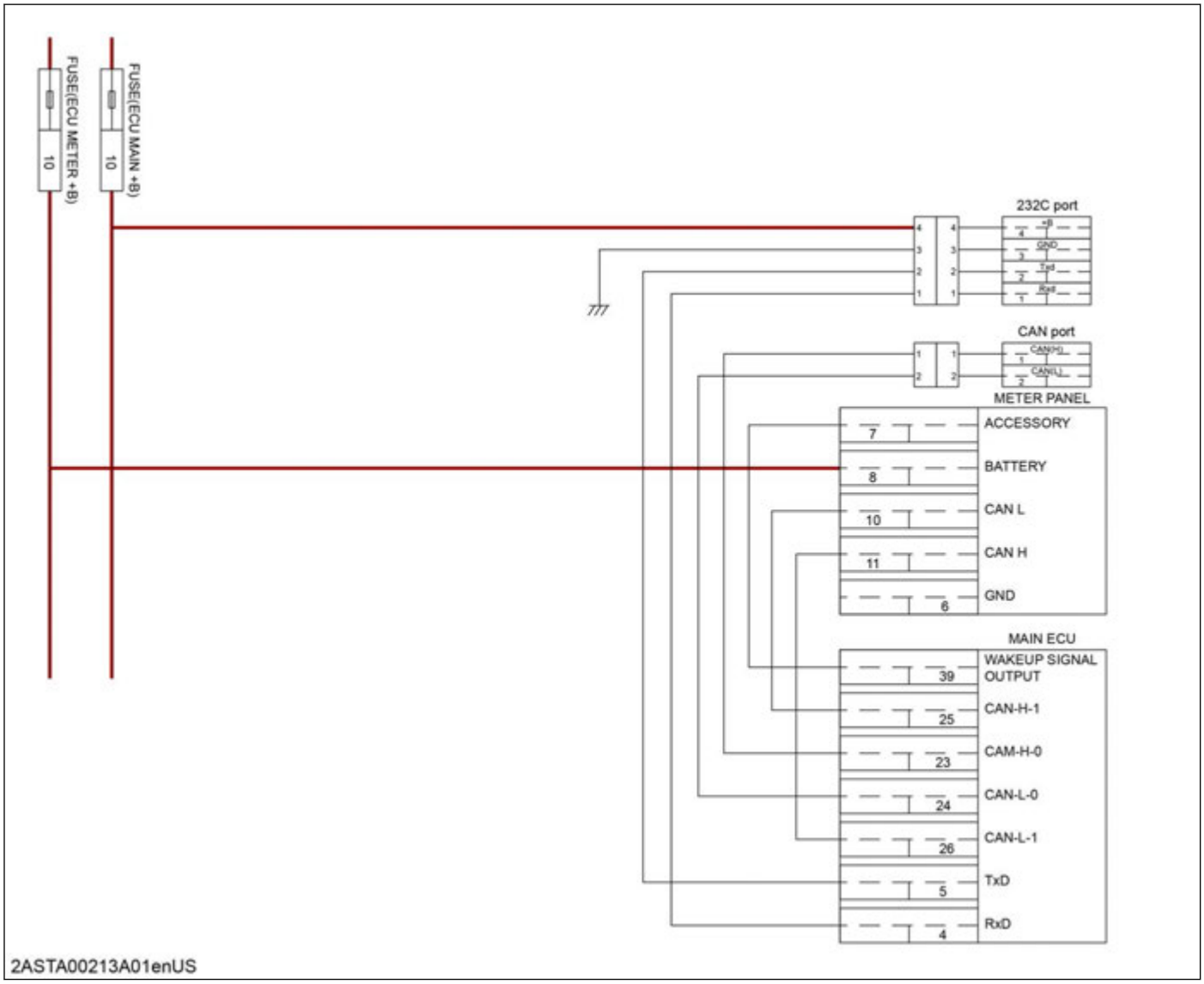
## 1.2.3 Main ECU input -2 electrical circuit diagram



## 1.2.4 Main ECU output electrical circuit diagram

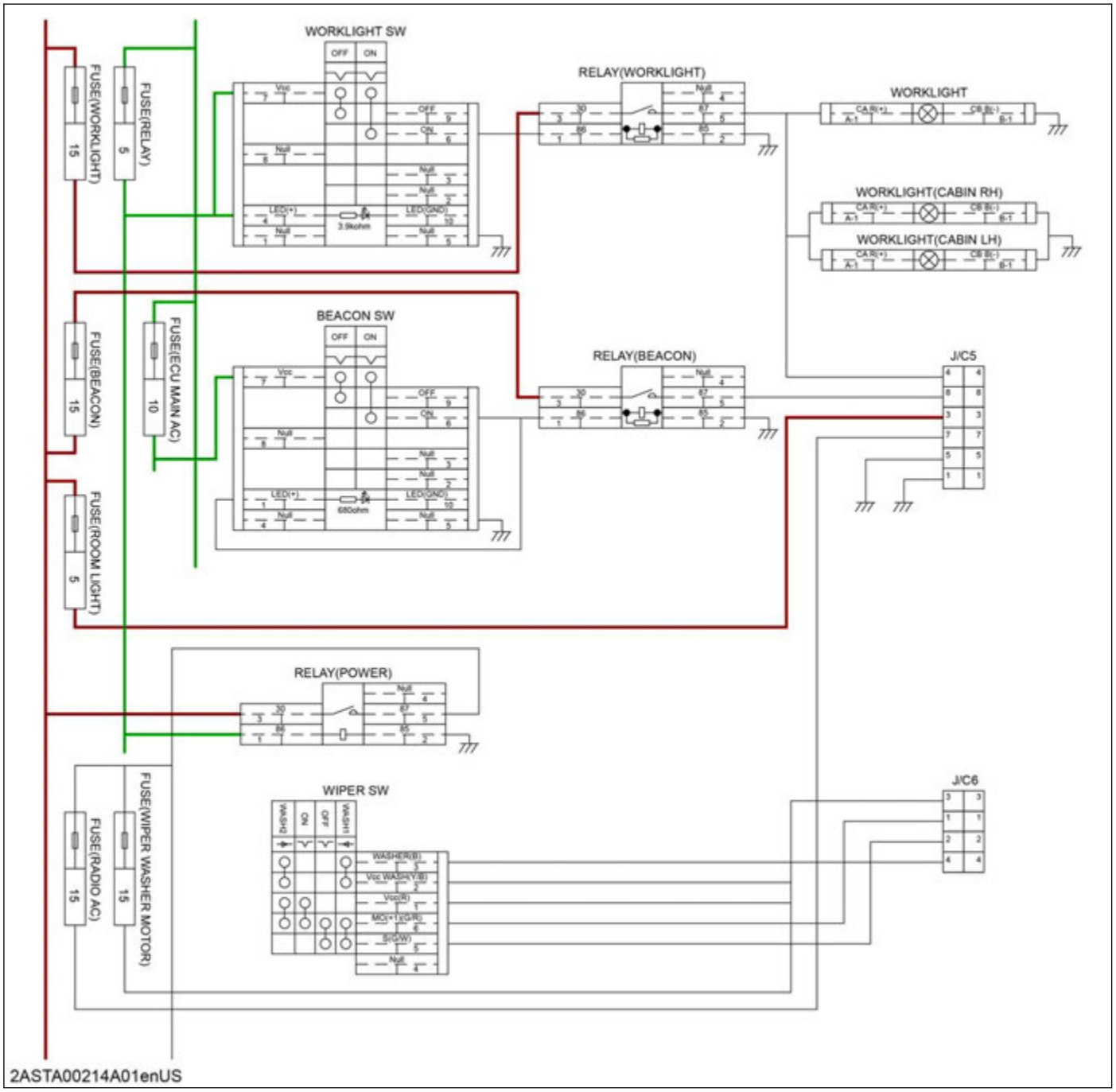


## 1.2.5 Communication electrical circuit diagram

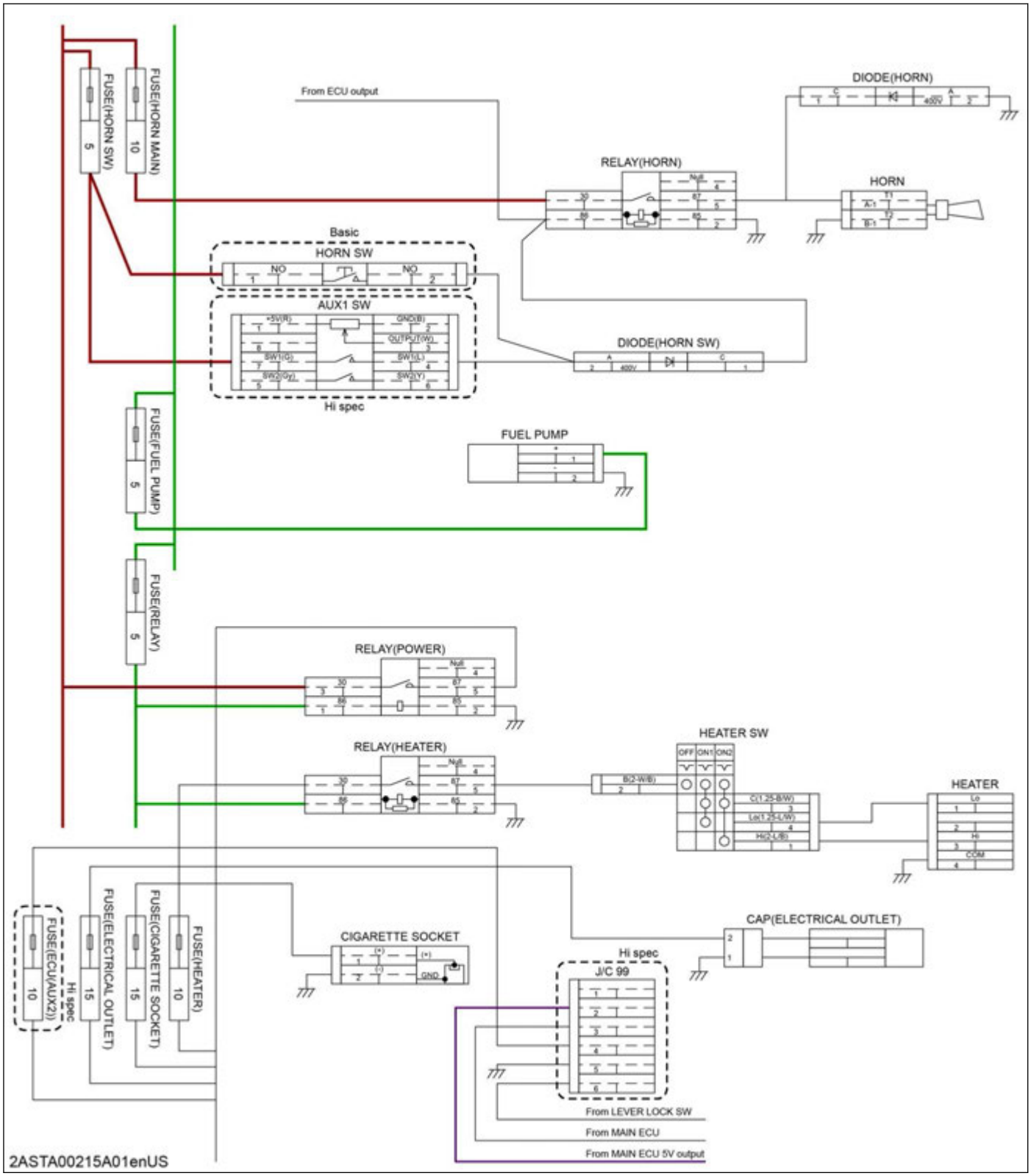



- CAN is communication network between each ECU (includes meter) to exchange information to each other.
- CAN port is used for connecting on board diagnostic software.
- RS232C port is used for writing software into ECU.

## 1.2.6 Accessory -1 electrical circuit diagram

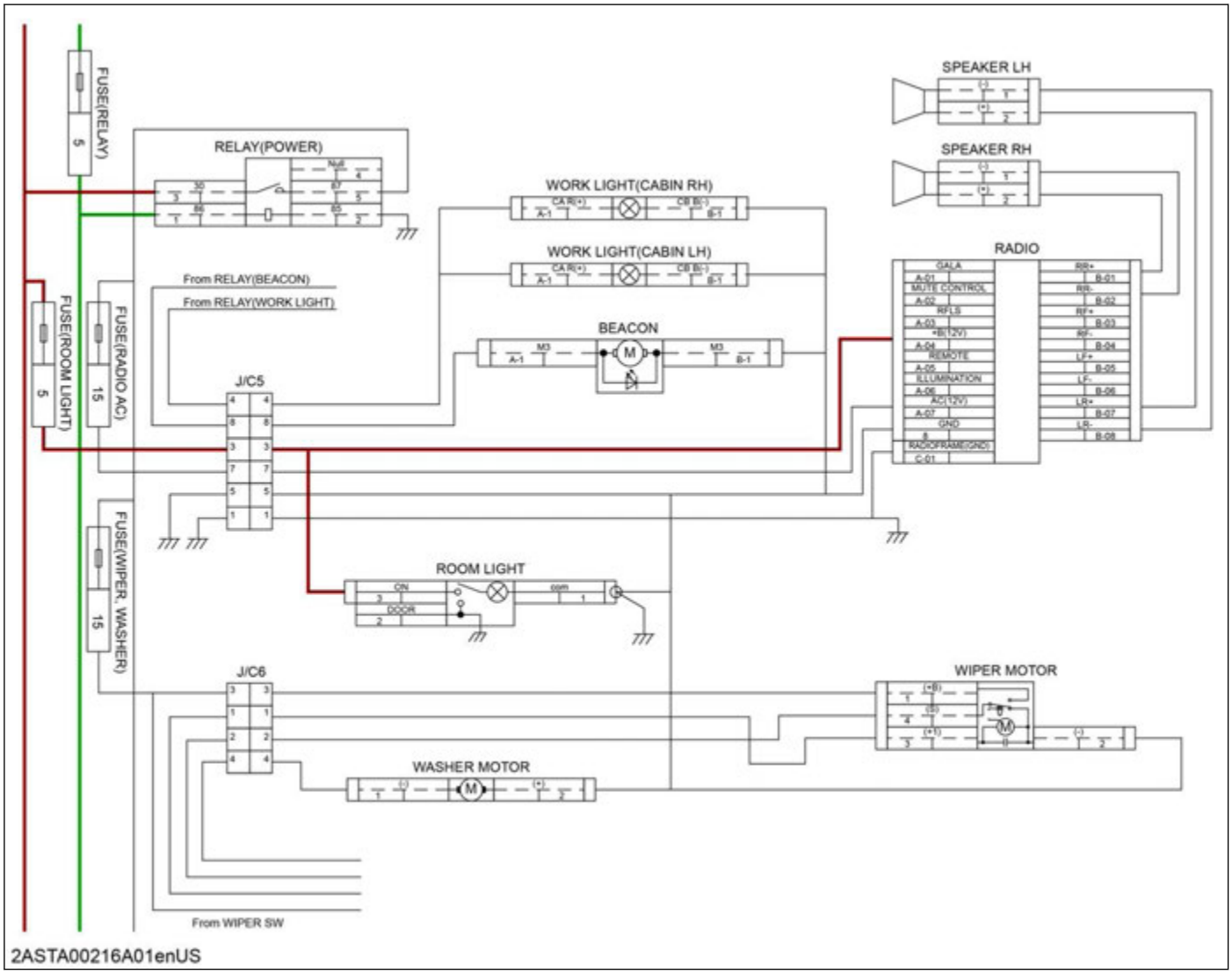


## 1.2.7 Accessory -2 electrical circuit diagram

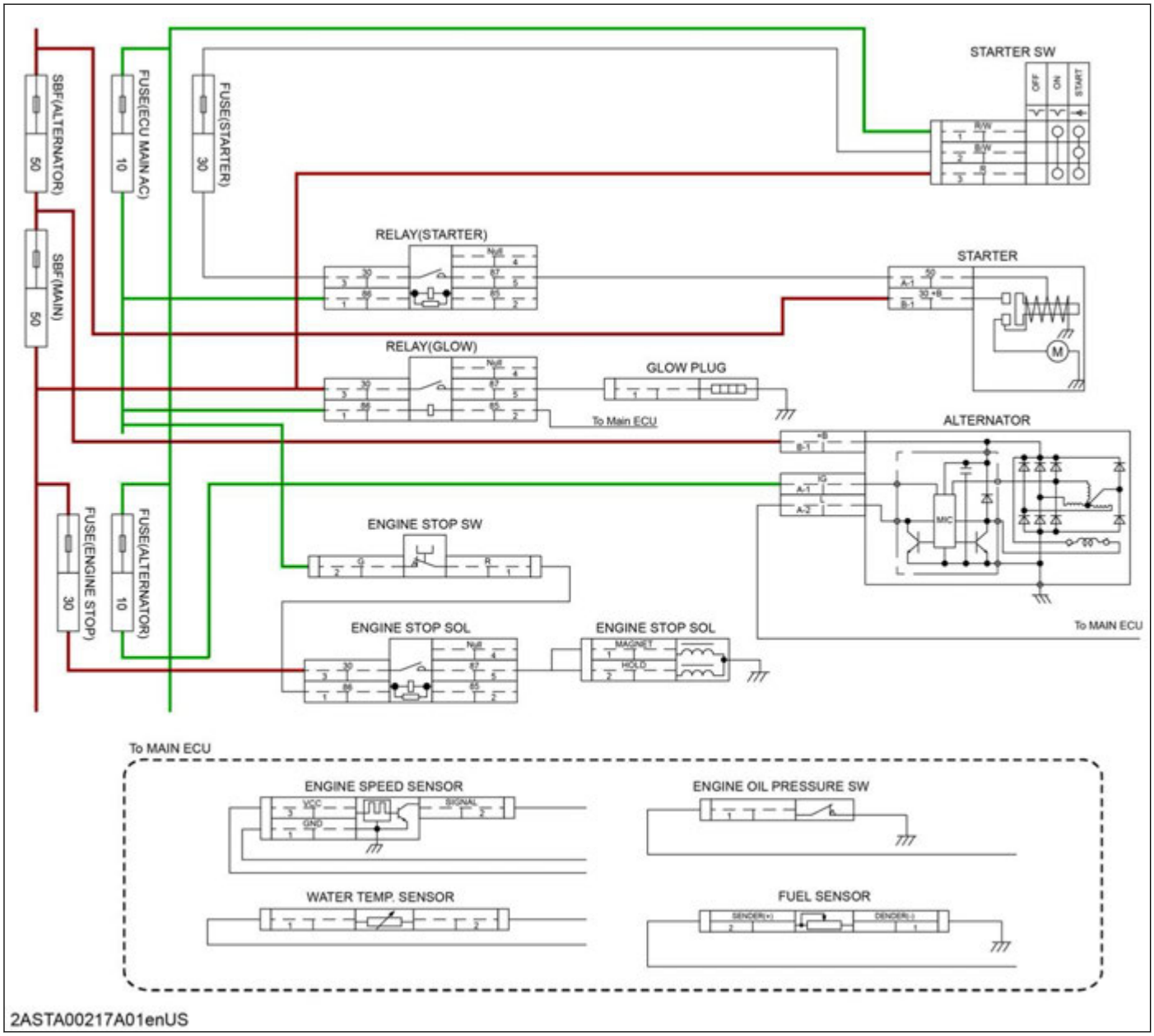



- The electrical outlet connector is connected Hi-spec harness as electrical power to control AUX2.

## 1.2.8 Cabin electrical circuit diagram



## 1.2.9 Engine electrical circuit diagram



# 2. Connector

## 2.1 Connector handling precaution

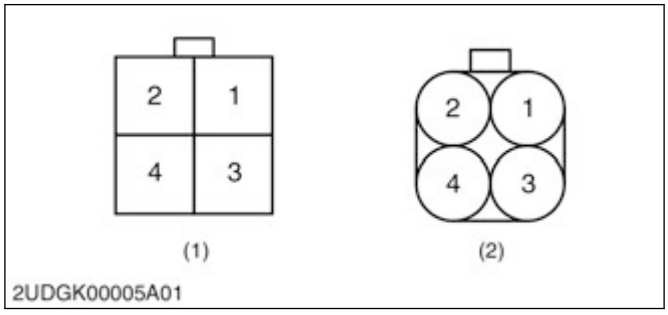
**■ IMPORTANT**

- **When disconnecting a connector, grasp the connector to pull it out. Do not pull by the wiring.**
- **When disconnecting a locking type connector, release the lock and pull it out.**
- **When removing the waterproof plastic cover of the connector, do not allow water to enter the connector.**
- **Correct any connector terminal deformations. Ensure that there is no protruding, loose, or rusty wiring.**
- **Ensure that the locking type connector is locked when inserted.**

## 2.2 Connector diagram description

**Fewer than 10 pins**

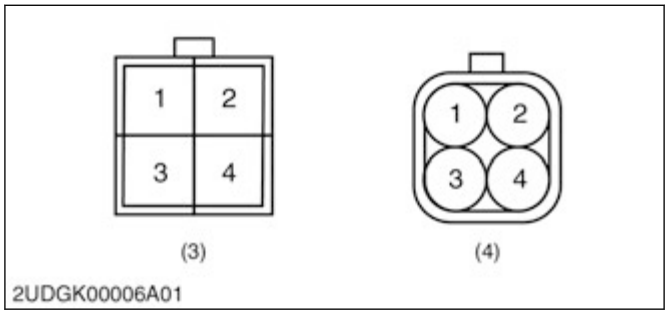
**Female**




(1) Non-waterproof (2) Waterproof

Number 1 is arranged from top right.

**Male**

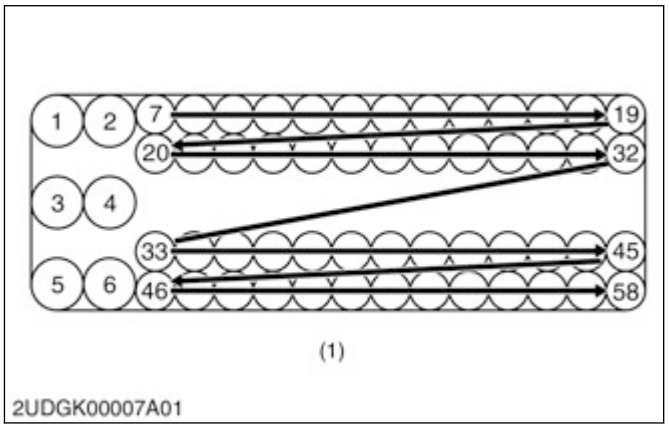



(3) Non-waterproof (4) Waterproofed

Number 1 is arranged from top left.

**More than 11 pins**

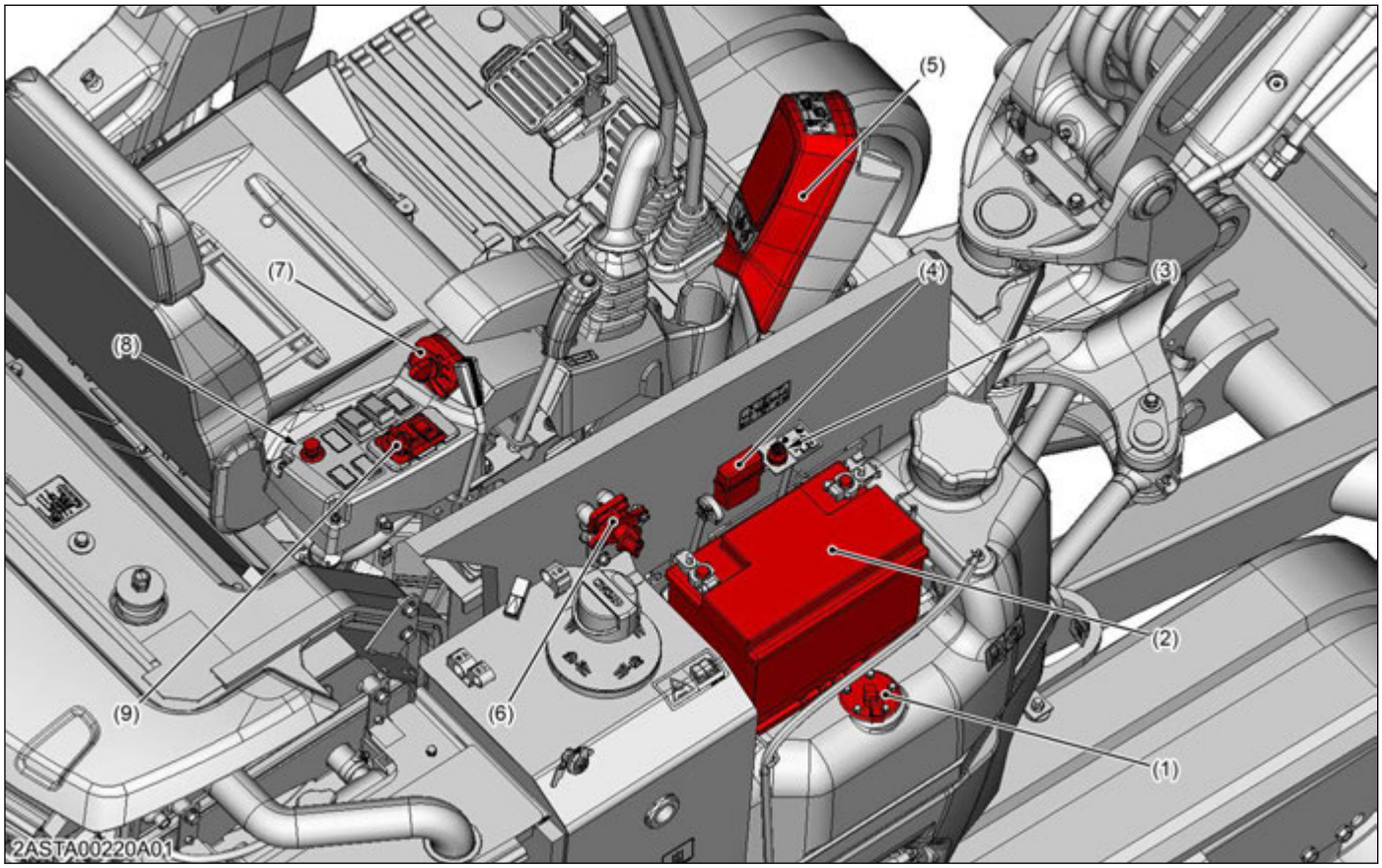
**Female**



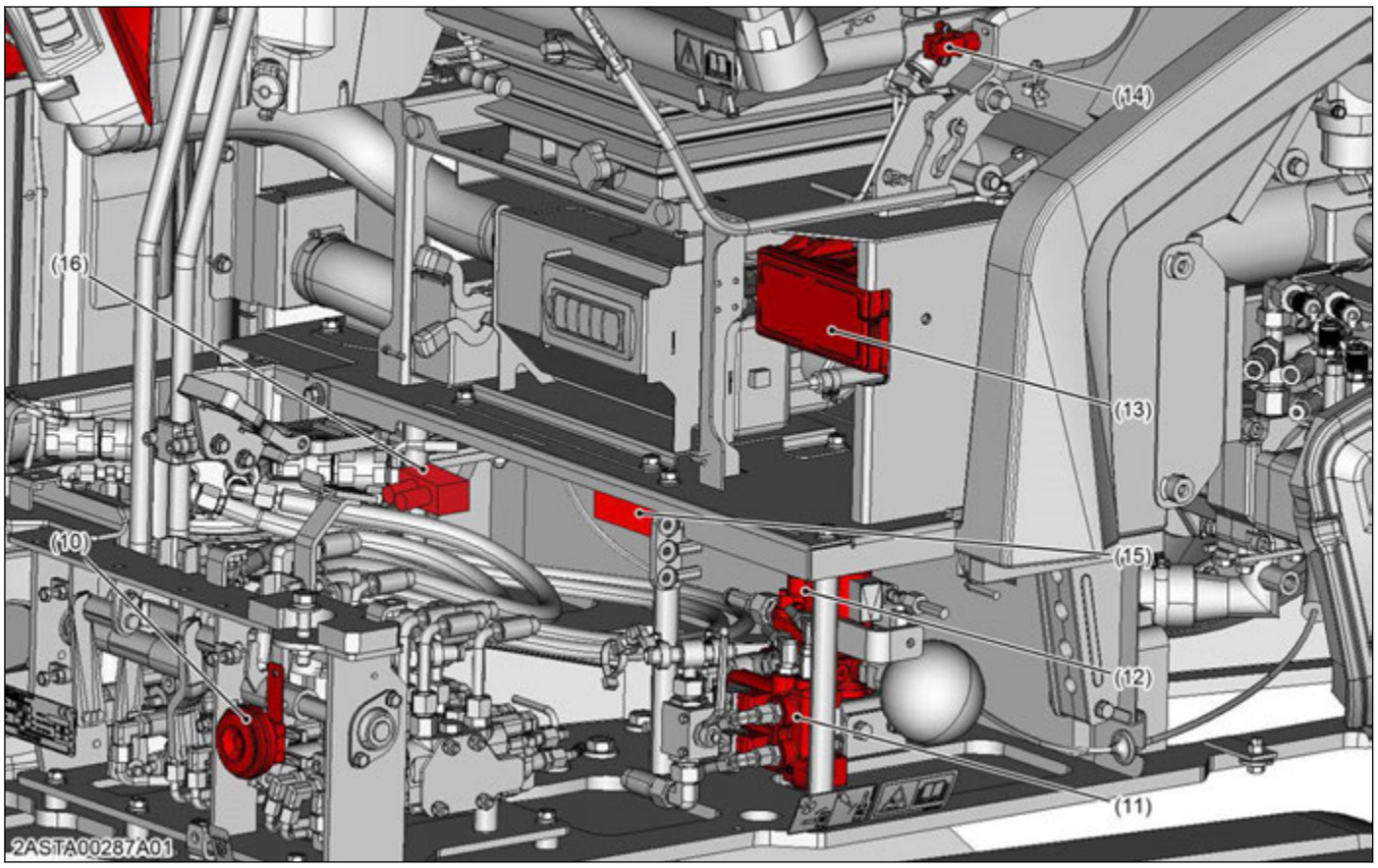

(1) Main ECU connector (female)

# 3. Electrical device

## 3.1 Electrical device layout

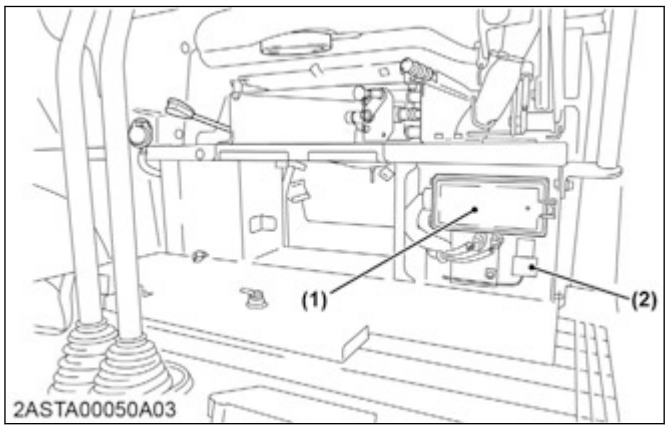



(1) Fuel sensor
(2) Battery
(3) Fuel level indicator switch
(4) Slow blow fuse
(5) Meter panel
(6) Battery isolator
(7) Starter switch
(8) Accelerator dial
(9) Engine stop switch




(10) Horn switch
(11) AUX1 proportional valve
(12) Unload valve
(13) Fuse box
(14) Limit switch
(15) ECU (AUX2)
(16) AUX2 proportional valve

## 3.2 Fuse and relay layout




(1) Fuse and relay box (2) AUX2 relay

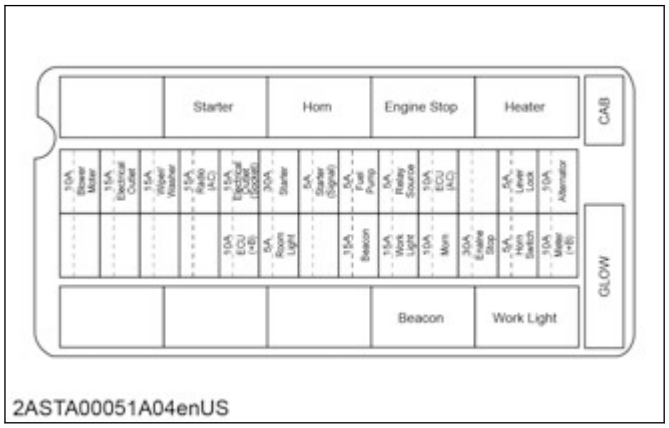
**NOTE**

- **AUX2 relay is installed only for AUX2 specification.**

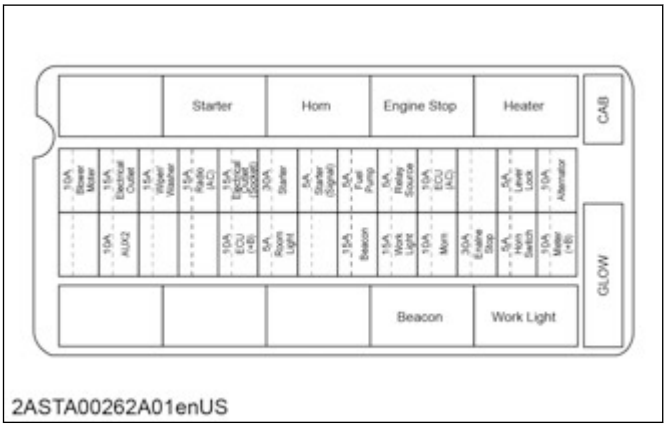



(3) Spare fuse

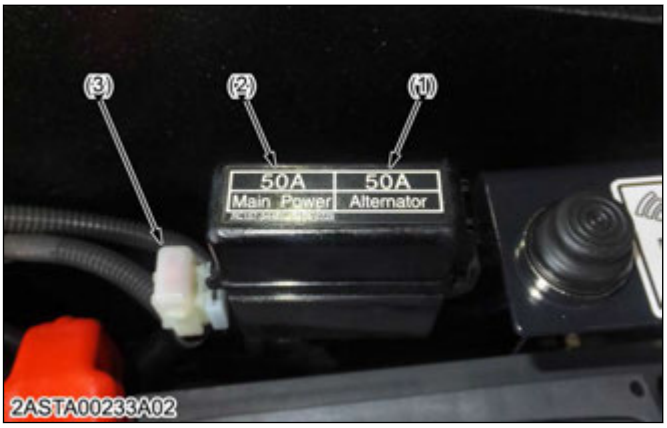
**Fuse label (basic)**




**Fuse label (Hi-spec)**

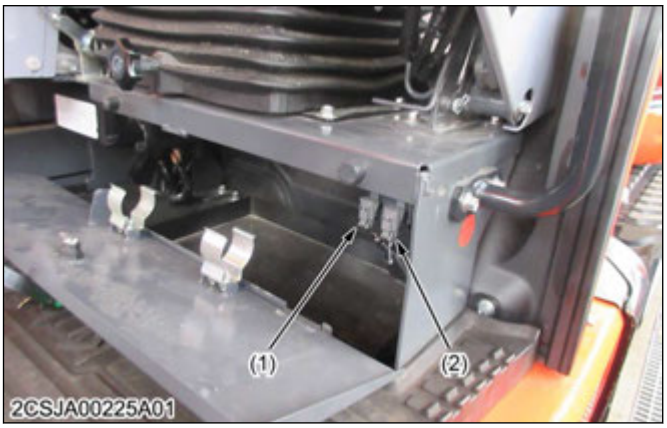



## 3.3 Slow blow fuse layout




(1) Alternator (50 A) (3) ECU-MAIN (+B) (10 A)
(2) Main power (50 A)

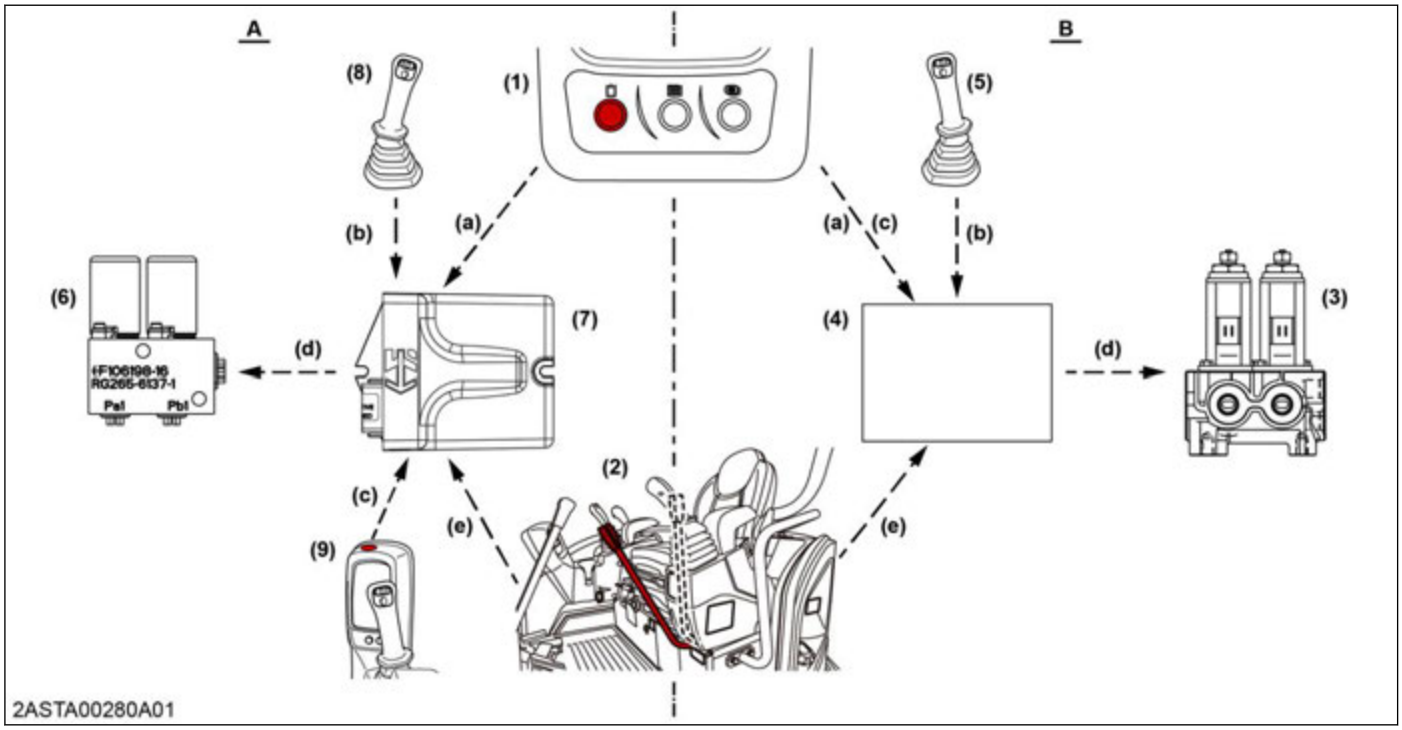
## 3.4 Communication port layout




(1) CAN connector (2) 232C connector

# 4. General description for AUX control on Hi-spec

There are two specifications for this model which are Basic and Hi-spec. Hi-spec machine is able to variably control the flow rate of AUX1 and AUX2.



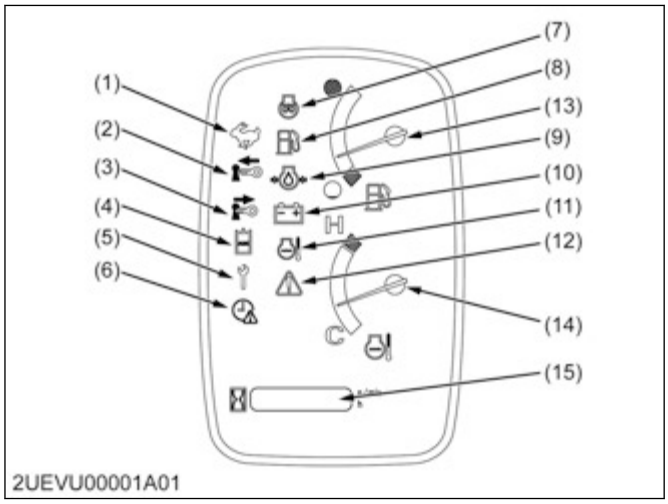

(1) Meter panel
(2) Lever lock switch
(3) AUX1 proportional valve
(4) Main ECU
(5) RH pilot control lever
(6) AUX2 proportional valve
(7) ECU (AUX2)
(8) LH pilot control lever
(9) AUX2 dial
A: AUX2 proportional control
B: AUX1 proportional control
(a) Activation (AUX activate SW operation)
(b) Knob switch operation
(c) Flow rate setting
(d) Flow rate control
(e) Activation (lowering the lever lock)

- AUX1 and AUX2 are activated by lowering the lever lock and pressing AUX activate switch.
- AUX1 and AUX2 are controlled by each ECU separately.
  - AUX1
    - The flow rate can be adjusted with the knob switch on the RH pilot control lever and meter panel setting.
    - The main ECU receives signals from RH pilot control lever, AUX activate switch, and lever lock switch.
    - The main ECU outputs current to the AUX1 proportional solenoid valve to control AUX1 flow rate.
  - AUX2
    - The flow rate can be adjusted with the knob switch on the LH pilot control lever and AUX2 dial.
    - The ECU (AUX2) receives signals from LH pilot control lever, AUX2 dial, and AUX activate switch.
    - The ECU (AUX2) outputs current to the AUX2 proportional solenoid to control AUX2 flow rate.

# 5. Meter panel

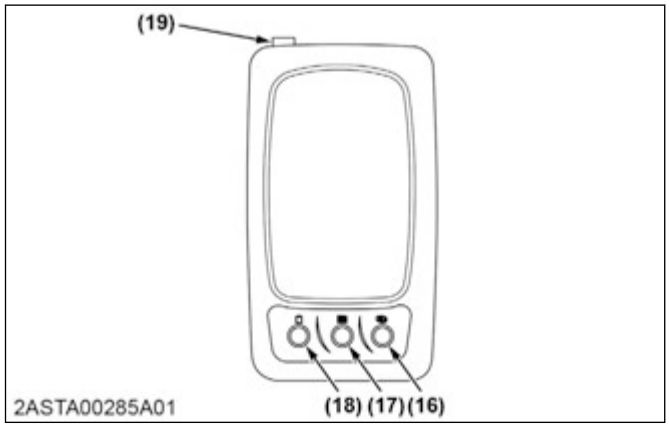
## 5.1 Meter panel function

### Panel




| No. | Name | Function |
|---|---|---|
| (1) | Travel speed shift lamp | Light - high speed |
| (2) | Key insertion lamp | Blink - requesting to insert key (registered key) |
| (3) | Key pull out lamp | Blink - requesting to pull out key (registered key), forgetting to pull out key |
| (4) | AUX lamp | Blink - AUX setting, AUX error |
| (5) | Periodic check lamp | Blink - requesting periodic check<br>Blink or light - periodic check mode |
| (6) | Clock setting lamp | Blink - set clock, clock offset |
| (7) | Glow lamp | Light - warming up the engine |
| (8) | Low fuel warning lamp | Blink - low fuel |
| (9) | Engine oil pressure lamp | Light - engine oil pressure switch is ON, low engine oil |
| (10) | Charging lamp | Light - low battery voltage |
| (11) | Coolant high temperature warning lamp | Blink - high coolant temperature |
| (12) | Warning lamp | Blink - warning (error) occurred |
| (13) | Fuel meter | – |
| (14) | Coolant temperature meter | – |
| (15) | LCD | – |

### Switch




(16) Display switch (SW3)
(17) User switch (SW2)
(18) AUX switch (SW1)
(19) AUX2 dial

| Switch name | Operation | Symbol | Function |
|---|---|---|---|
| SW3 | Press | ----► | Select a mode<br>Increase a number |
| | Press and hold | ——► | Set a mode |
| SW2 | Press | ----► | Decrease a number |
| | Press and hold | ——► | Return to a mode |
| SW1 | Press | - | AUX activation |
| AUX2 dial | Rotate clockwise | - | Increase AUX2 flow rate |
| | Rotate counter-clockwise | - | Decrease AUX2 flow rate |

**NOTE**

- **SW1 is installed in the meter panel only for Hi-spec.**
- **AUX2 dial is installed in the meter panel only for AUX2 specification.**

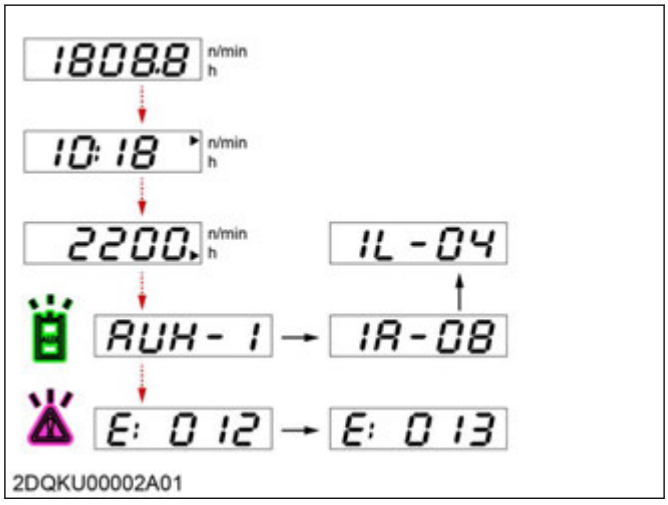
## 5.2 Display mode

| Mode | Function | Operation |
|---|---|---|
| Normal mode | Clock | Turn starter switch to **[RUN]** (press SW3 to change display). |
| | Tachometer (engine speed) | |
| | Hour meter | |
| | AUX flow rate (Hi spec only) | Display when AUX activated. |
| | Error code | Display when an error has occurred. |
| User setting mode | Periodic check information | Press SW2 in the normal mode. |
| | AUX flow rate setting (Hi spec only) | |
| | Clock setting | |
| Service dealer mode | Tester mode | Turn starter switch to **[RUN]** while pressing SW3. |
| | Read error history | |
| | Clear error history | |
| | Dealer setting | |
| | Read all error history | |

## 5.3 Operating normal mode

Displays five items which are hour meter, clock, tachometer (engine speed), AUX and error codes.

1. Turn the starter switch to **[RUN]**.
2. Press SW3 to change function.
   - Hour meter → Clock → Tachometer → AUX → Error code




**NOTE**

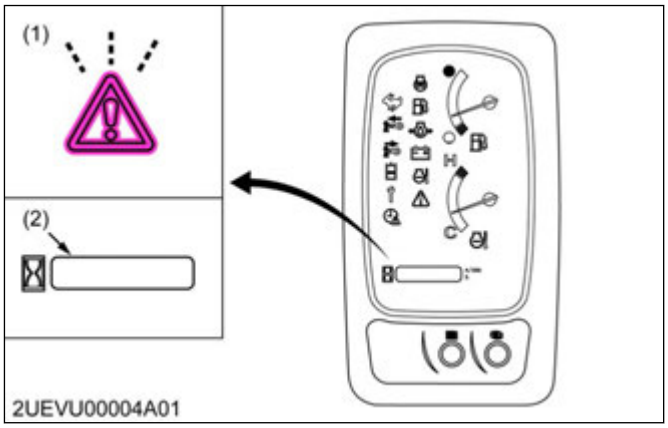
- **Normally, the error code is not displayed.**
- **Display AUX only for Hi-spec.**

**In case of AUX activation**

- Change display automatically in every one second.
  AUX number → Flow rate RH → Flow rate LH

**In case of error**

- The warning lamp blinks and the error code is displayed on the LCD.

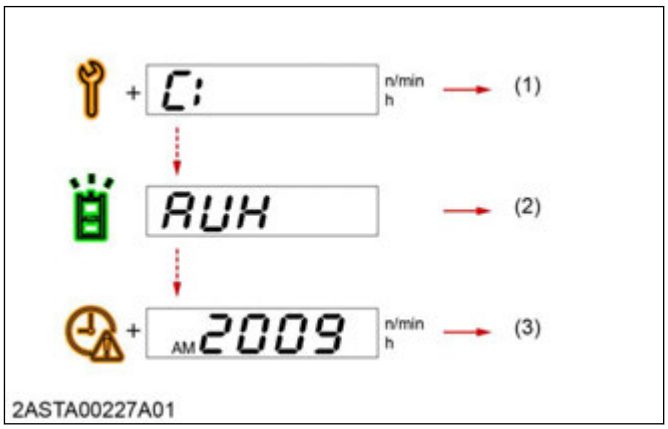



(1) Warning lamp (2) LCD

## 5.4 Operating user setting mode

Displays three functions which are periodic check mode, AUX flow rate setting, and clock setting.

1. Press SW2 in the normal mode.
2. Press SW3 to change function.
   - Periodic check mode → AUX flow rate setting → Clock setting




(1) Periodic check mode (3) AUX flow rate setting
(2) Clock setting

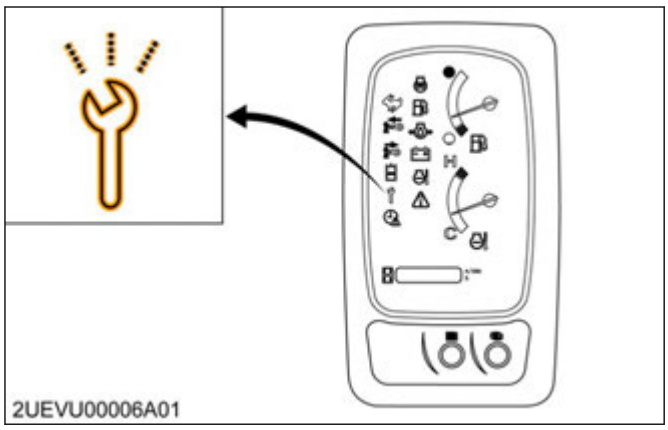
**NOTE**

- **Does not display AUX flow rate setting if the machine is basic spec.**

### 5.4.1 Operating periodic check mode

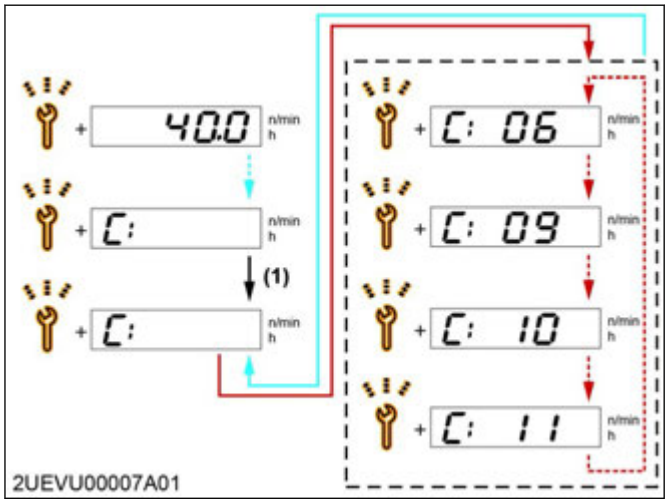
**In case of periodic check alert**

- Inform about periodic check by setting operation time (hour meter).
- The periodic check lamp blinks and a beep sounds before 10 hours of the periodic check.




## Checking the periodic check code

1. Press SW2 when the periodic check lamp blinks.
2. Push the work light switch to set from ON to OFF.
3. Press and hold SW3 to display the periodic check code.




(1) Push the work light switch:
OFF to ON to OFF




(2) Work light switch

**NOTE**

- **If there are 2 or more check items, press SW3 to display the other periodic check codes.**

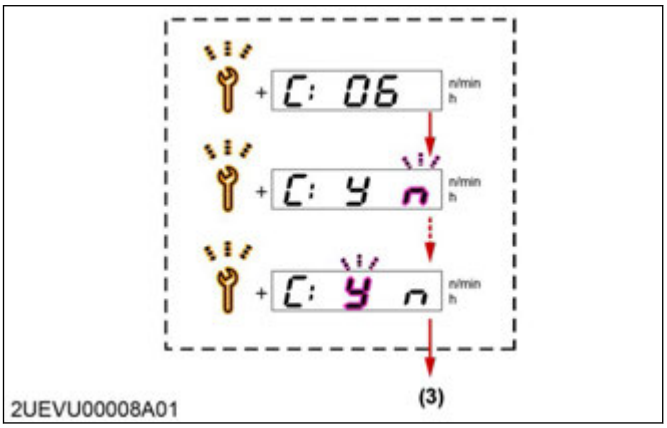
## Periodic check code list

| No. | Items |
|---|---|
| C:_01 | Engine oil |
| C:_02 | Hydraulic oil |
| C:_03 | Air cleaner element |
| C:_04 | Fuel filter cartridge |
| C:_05 | Engine oil filter |
| C:_06 | Drive motor gear oil |
| C:_07 | Hydraulic oil return filter |
| C:_08 | Hydraulic oil suction filter |
| C:_09 | Pilot filter |
| C:_10 | Track roller oil, front idler oil |
| C:_11 | Breather filter |

## Clearing the periodic check alert manually

- After checking the machine, clear the periodic check alert.

1. Display the periodic check code.
2. Press and hold SW3.
3. Press SW3 to make "Y" blink instead of "N".
4. Press and hold SW3.




(3) User setting mode

**NOTE**

- **If there are 2 or more periodic check alerts, clear them one by one.**
- **In case of "SET-4"/"no-06" is "Y", the periodic check alert will be cleared automatically by turning the starter switch repeatedly to [RUN] and [STOP] 10 times (clearing periodic check alert: Auto).**

## Alternative settings for periodic check

**NOTE**

- **There are 3 settings for periodic check in the service dealer mode.**

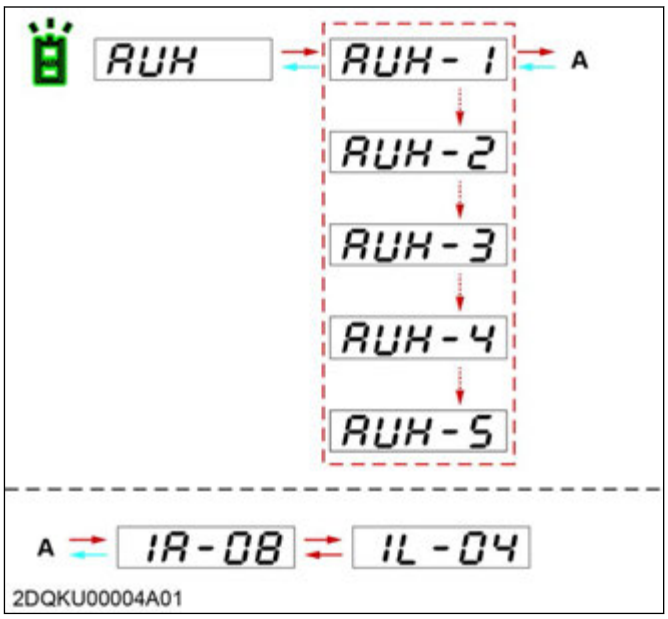
- Clearing the periodic check alert
  - Select automatic or manual.

  - "Y": (manual) Clear the periodic check alert manually.
  - "N": (automatic) Turn the starter switch repeatedly to **[RUN]** and **[STOP]** 10 times.
- Informing periodic check alert
  - Select informing or not informing of the periodic check alert.
    - "Y": Inform of the periodic check by blinking the lamp and beeping buzzer.
    - "N": Does not inform periodic check as alert.
- Time offset for periodic check
  - This setting is about the time offset between the hour meter and periodic check hour.
  - Input the old hour meter times after replacing the ECU.

## 5.4.2 Operating AUX flow rate setting mode

Set AUX flow rate for RH side and LH side of each "AUX-1" to "AUX-5".

1. Press SW2 to enter user setting mode.
2. Press SW2 or SW3 to select "AUX" (AUX flow rate setting mode).
3. Press and hold SW3 to display "AUX-1".
   a. Press and hold SW3 to display "1R-oo".
      i. Press SW2 or SW3 to set AUX1 RH flow rate from "00" to "14".
      ii. Press and hold SW3 to display "1L-oo".
      iii. Press SW2 or SW3 to set AUX1 LH flow rate from "00" to "14".
      iv. Press and hold SW2 to return to "AUX-1".
   b. Press SW3 to display "AUX-2".
      i. Set flow rate from "AUX-2" to "AUX-5" with same steps as "AUX-1" (procedure 3-a and 4 to 7).
      ii. When finish all of the settings, press and hold SW3 on "AUX-o" to return "AUX".

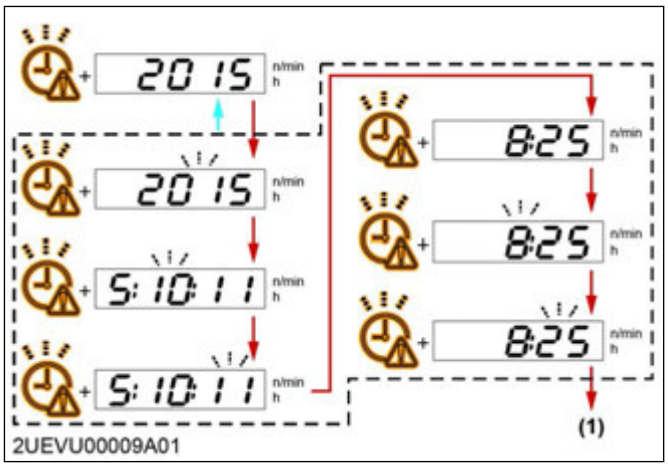



## 5.4.3 Operating clock setting mode

Set the calendar and clock.

1. Press SW3 in the user setting mode to display the clock settings.
2. Press and hold SW3 to make the number (year) blink.
3. Press SW2 and SW3 to select numbers and press and hold SW3 to set.
4. Set in the following order - year, month, date, 12 h or 24 h, hour, and minute.

   2015/10/11 AM 8:25




(1) Normal mode

**Other settings for clock**

**NOTE**

- **One clock setting is done in the service dealer mode.**

- Clock setting lamp
  - Clock setting lamp display or non-display setting.

- “Y”: (display) Inform of time offset by blinking clock setting lamp.
- “N”: (non-display) Inform of time offset without blinking the clock setting lamp.

## 5.5 Service dealer mode table

The service dealer mode is used for maintenance such as checking the machine condition, setting parameters, adjusting the devices and etc. Turn the starter switch to **[RUN]** while pressing SW3 to enter the service dealer mode.

**■ IMPORTANT**

- **It is necessary to set all of the items after replacing the main ECU.**

**■ NOTE**

- **"SET-4"/"no-01" to "no-04" are only used for Hi spec.**
- **Turn the starter switch to [STOP] to exit the service dealer mode.**

| Mode | Item | Detail | |
|---|---|---|---|
| SEt-1 | Tester mode | Displays the machine information, status of sensors and solenoids. | |
| SEt-2 | Reading error history | Displays the previous error code and hour meter from memory. | |
| SEt-3 | Clearing error history | Clears error history of "SET-2". | |
| SEt-4 | Dealer setting | no-01<br>AUX knob switch setting<br>(Hi spec only) | Sets the left and right ends and neutral for the AUX knob switch.<br>• Required setting after replacing the AUX knob switch. |
| | | no-02<br>AUX start-up point settings (with attachment)<br>(Hi spec only) | Sets the start-up point of the AUX with attachment.<br>• Required setting after replacing an attachment or cylinder.<br>• Required setting after repairing a hydraulic device. |
| | | no-03<br>AUX start-up point settings (without attachment)<br>(Hi spec only) | Sets the start-up point of the AUX without attachment.<br>• Required setting after replacing an attachment or cylinder.<br>• Required setting after repairing a hydraulic device. |
| | | no-04<br>AUX fine setting<br>(Hi spec only) | Fine setting for the start-up point of the actuator (cylinder) attached to AUX. |
| | | no-05<br>Model setting | Individual setting for the machine. |
| | | no-06<br>Clearing periodic check alert | Selects clearing method for periodic check alert. |
| | | no-07<br>Informing periodic check alert | Selects blinking or not blinking periodic check lamp when periodic check term. |
| | | no-08<br>Time offset for periodic check | Time offset between hour meter and periodic check hour. |

(Continued)

| Mode | Item | Detail | |
|---|---|---|---|
| SEt-4 | Dealer setting | no-09<br>Clock setting alert | Displays or not displays clock setting lamp when the clock is offset. |
| | | no-10<br>Travel buzzer function | Enables or disables the travel buzzer. |
| | | no-11<br>Travel speed shift switch<br>Select hand or foot | Selects hand or foot for the travel speed shift switch. |
| SEt-5 | Reading all error history | Displays the previous error code and hour meter from memory.<br>• Unable to clear in "SET-3" (clear error history). | |

# SERVICING

## 1. Troubleshooting

### 1.1 Electrical troubleshooting

**The starter motor does not work**

| Causes | Inspections | Actions |
|---|---|---|
| The anti-theft system is activated. | Turn the starter switch to **[RUN]** and check if the key pull-out lamp is blinking. | Use the registered key. |
| The ground terminals are disconnected or connected loosely. | Check for the connection of the relating ground terminals to the machine. | Tighten the loosened ground terminal. |
| The battery has discharged or is damaged. | Check for the battery voltage. | Recharge or replace the battery. |
| The fuse or slow blow fuse has blown. | Check if the fuses and slow blow fuses for the lever lock, starter, starter signal, and ECU main AC has blown. | Specify the cause of the fuse blowing and replace the fuse. |
| The starter relay is malfunctioning. | Check for the conduction of the starter relay. | Replace the starter relay. |
| The wire harnesses are damaged. | Check for the conduction of the relating wire harnesses of the starter motor, starter switch, lever lock switch. | Repair or replace the wire harness. |
| The starter switch is damaged. | Check for the conduction between the starter switch terminals. | Replace the starter switch. |
| The lever lock switch is damaged or adjusted improperly. | Check for the conduction between the lever lock switch terminals. | Adjust or replace the lever lock switch. |
| The starter motor is malfunctioning. | Measure the voltage of the starter motor. Check for the starter motor. | Replace the starter motor. |

**The engine does not start**

| Causes | Inspections | Actions |
|---|---|---|
| Engine stop solenoid relay is malfunctioning. | Check for the conduction of the engine stop solenoid relay. | Replace the engine stop solenoid relay. |
| Engine stop solenoid switch is damaged. | Check for the conduction between the engine stop solenoid switch terminals. | Replace the engine stop solenoid switch. |
| Wire harnesses are damaged. | Check for the conduction of the relating wire harnesses of the starter, starter switch, and lever lock switch. | Repair or replace the wire harness. |
| Engine stop solenoid is malfunctioning. | Check for the conduction of the engine stop solenoid connector. | Replace the engine stop solenoid. |
| Engine stop switch is pulled to stop the engine. | Check the engine stop switch position. | Turn off the engine stop switch. |

**The engine does not start occasionally**

| Cause | Inspection | Action |
|---|---|---|
| The anti-theft antenna does not recognize the key. | Check if there is interference from the metal attachments on the key ring. | Remove the metal attachments from the key ring. |

## The engine starts with the not registered key

| Cause | Inspection | Action |
|---|---|---|
| The anti-theft settings are OFF. | Check the anti-theft settings. | Turn ON the anti-theft settings.<br>Register the keys. |

## AUX2 does not work

| Causes | Inspections | Actions |
|---|---|---|
| The AUX function is not activated. | Check the activation of the AUX function on the meter panel. | Activate the AUX function. |
| The AUX2 flow rate is set to minimum. | Check the position of the AUX2 dial. | Adjust the AUX2 flow rate with the AUX2 dial. |
| The AUX2 knob switch connector is disconnected. | Check the connection of the AUX2 knob switch connector. | Reconnect the AUX2 knob switch connector. |
| The AUX2 knob switch malfunctions. | Check the conduction of the AUX2 knob switch. | Replace the grip of the pilot lever. |
| The wire harnesses are damaged. | Check for the conduction of the relating wire harnesses. | Repair or replace the wire harness. |
| The AUX2 dial malfunctions. | Check for the conduction of the AUX2 dial. | Replace the potentiometer of the AUX2 dial. |
| The AUX2 proportional valve malfunctions. | Check for the conduction of the AUX2 proportional valve. | Replace the AUX2 proportional valve. |

## 1.2 Error warning table

**NOTE**

- **Warning lamp lights in red (excluding "E:005").**

| Display | Lamp | Error | Cause(s) |
|---|---|---|---|
| E: 001 | - | CAN communication error | • There is no communication between the main ECU and the meter. |
| E: 005 |  | High coolant temperature | • Coolant temperature is higher than 117 ℃ and lower than 122 ℃. |
| E: 014 |  | Engine oil pressure error | • Oil switch is ON while the engine is running. |
| E: 015 |  | Engine overheating | • Coolant temperature is higher than 122 ℃. |
| E: 016 |  | Battery charging error | • Charge switch is ON while the engine is running. |
| E: 017 | - | Fuel sensor error | • Breaking in fuel sensor. |
| E: 018 | - | Coolant temperature sensor error | • Breaking or short circuit of the coolant temperature sensor. |
| E: 020 | - | Lever lock system error | • Short circuit of the lever lock solenoid. |
| E: 021 | - | Travel speed shift system error | • Short circuit of the travel speed shift solenoid. |
| E: 022 | - | AUX nob switch system error | • Breaking or short circuit of the AUX nob switch. |
| E: 023 | - | AUX RH solenoid error | • Breaking or short circuit of the AUX RH solenoid. |
| E: 024 | - | AUX LH solenoid error | • Breaking or short circuit of the AUX LH solenoid. |
| E: 025 | - | Battery overcharging | • Battery overcharging. |
| E: 026 | - | Anti-theft antenna error | • Antenna error. |
| E: 027 | - | 5 V error | • Short circuit in the 5 V line. |
| E: 028 | - | 12 V error | • Short circuit in the 12 V line. |

## 1.3 Lamp warning list

**NOTE**

- **Anti-theft lamp is only for anti-theft specification**

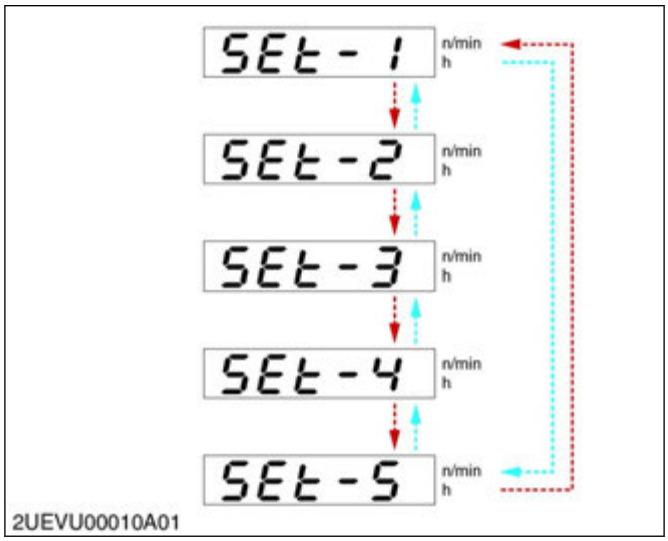
| Display | Lamp | Error | Probable cause(s) |
|---|---|---|---|
| - |  | Low fuel | • Fuel level is low. |
| - |  | Periodic check | • 10 hours before periodic check.<br>• Past the periodic check term. |
| - |  | Anti-theft | • Started the engine with a non-registered key.<br>• Started the engine with the red key.<br>• Forgot to remove the key. |
| - |  | Clock error | • Time on the clock is off. |
| - |  | Lever lock | • Start the engine while holding down the lever lock. |

# 2. Service dealer mode

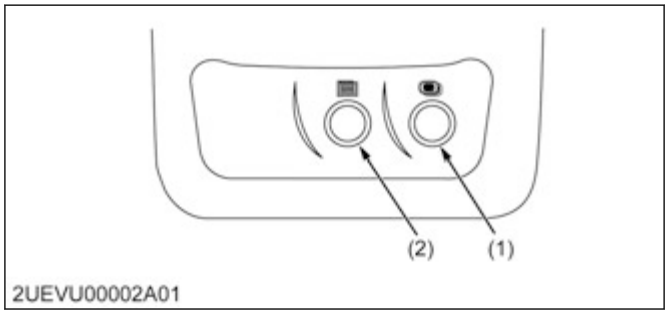
## 2.1 Entering service dealer mode

**Entering service dealer mode**

1. Turn the starter switch to **[RUN]** while pressing SW3.
2. Display "SET-1".
3. Press SW3 to select the functions (modes).
4. Press and hold SW3 to enter the needed function (mode).
5. Press and hold SW2 to return selected functions (mode).
6. Turn the starter switch to **[STOP]** to exit the service dealer mode.




**Switch**




(1) Display switch (SW3) (2) User switch (SW2)

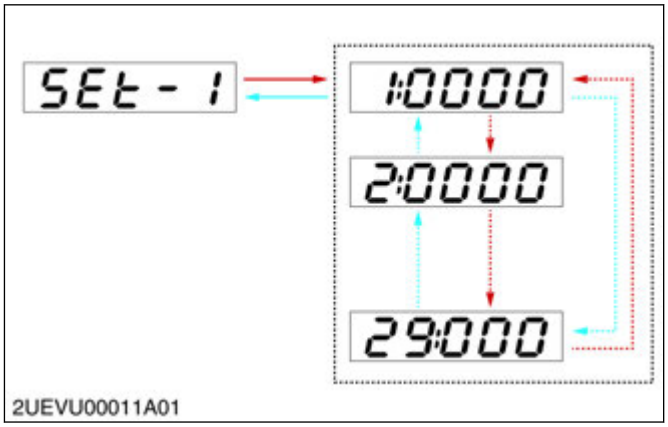
| Switch name | Operation | Symbol | Function |
|---|---|---|---|
| SW3 | Press | ----► | Select a mode<br>Increase a number |
| | Press and hold | ——► | Sets a mode |
| SW2 | Press | ----► | Decrease a number |
| | Press and hold | ——► | Return to a mode |

## 2.2 Operating SET-1 (Tester mode)

Displays the machine information, status of sensors, and solenoids.

**Operating SET-1 (Tester mode)**

1. Set "SET-1" in the service dealer mode.
2. Press SW2 or SW3 to select a number of the tester (from "1" to "29").
3. Press and hold SW2 to return to "SET-1".




**Tester mode item list**

| Number | Item | Display |
|---|---|---|
| 1 | Engine speed | "oooo" rpm |
| 2 | Battery voltage | "oo.o "V |
| 3 | Oil SW | "ON" or "OFF" |
| 4 | Battery charge SW | "ON" or "OFF" |
| 5 | Starter SW | "ON" or "OFF" |
| 6 | Work light SW | "ON" or "OFF" |
| 7 | Coolant temperature sensor (voltage) | "o.oo" V |
| 8 | Coolant temperature sensor (temperature) | "oo"°C |
| 9 | Fuel sensor (voltage) | "o.oo" V |
| 10 | Fuel sensor (resistance) | "ooo" Ω |
| 11 | Fuel feed SW | "ON" or "OFF" |
| 12 | Travel speed shift switch | "ON" or "OFF" |
| 13 | Travel speed shift solenoid | "ON" or "OFF" |
| 14 | Lever lock SW | "ON" or "OFF" |
| 15 | Lever lock SOL | "ON" or "OFF" |
| 16 | AUX 1 knob SW (voltage) and travel pressure sensor (voltage) | "o.oo" V |
| 17 | AUX 1 knob SW (setting voltage left) | "o.oo" V |

(Continued)

| Number | Item | Display |
|---|---|---|
| 18 | AUX 1 knob SW (setting voltage neutral) | "o.oo" V |
| 19 | AUX 1 knob SW (setting voltage right) | "o.oo" V |
| 20 | AUX 1 SOL (current) | "o.oo" A |
| 21 | AUX hold SW | "ON" or "OFF" |
| 22 | AUX switch | "ON" or "OFF" |
| 23 | AUX1 RH setting | "oo" × 10 mA |
| 24 | AUX1 LH setting | "oo" × 10 mA |
| 25 | Key type | "0" (Unknown)<br>"1" (Red)<br>"2" (Black)<br>"3" (Yellow)<br>"4" (Green)<br>"5" (Red Yellow)<br>"6" (Red Green) |
| 26 | Anti-theft key analysis (registered key) | "ON" (Match)<br>"OFF" (Mismatch) |
| 27 | Anti-theft mode | "ON" (Deactivation)<br>"OFF" (Activation) |
| 28 | Key | "ON" (Existence)<br>"OFF" (Non-existence) |
| 29 | Anti-theft antenna | "ON" (Error)<br>"OFF" (Normal) |

## 2.3 Operating SET-2 (Reading error history)

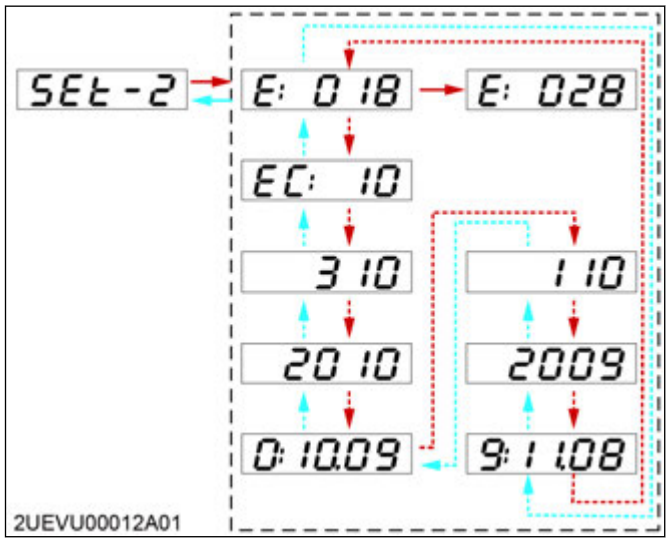
Display the previous error code and hour meter from the memory.

**NOTE**

- **Display seven items for each error code.**
  - **Number of times**
  - **Recent hour meter**
  - **Recent year**
  - **Recent month and date**
  - **First hour meter**
  - **First year**
  - **First month and date**
- **Set "SET-3" to clear error history.**
- **The first error memory is stored starting from the last "SET-3" error history clear.**

1. Set "SET-2" in the service dealer mode.
2. Display the previous error code from the memory.
3. Press SW2 or SW3 to change the item.
4. Press and hold SW3 to display other error codes.
5. Press and hold SW2 to return to "SET-2".

"E018": Issued 10 times
Recent data: 310 h, 2010/10/9
First data: 110 h, 2009/11/8



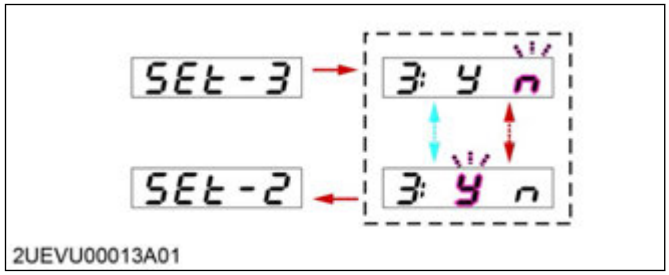

## 2.4 Operating SET-3 (Clearing error history)

Clear error history from memory.

1. Set the "SET-2" in the service dealer mode.
2. Press SW2 or SW3 to make "Y" or "N" blink.
3. Press and hold SW3 to set.

**NOTE**

- **"SET-3" (Reading error history) is cleared.**
- **"SET-5" (Reading all error history) cannot be cleared.**




| | |
|---|---|
| "Y" | Clear |

## 2.5 Operating SET-4 (Dealer setting)

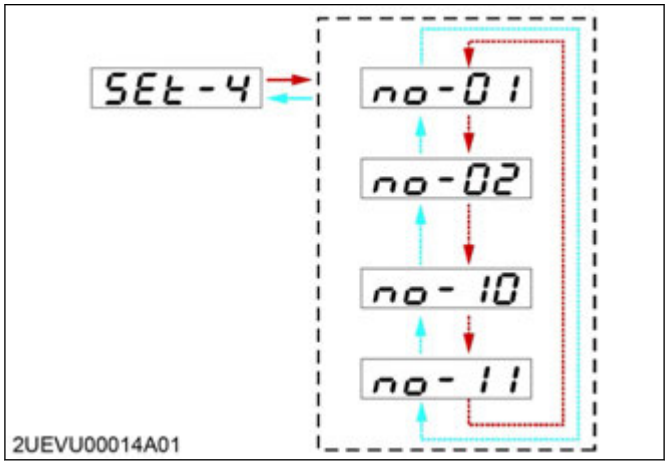
Individual settings for each machine (11 items).

1. Set "SET-4" in the service dealer mode.
2. Press SW3 to change function from "no-01" to "no-11".
3. Press and hold SW3 to set function.

4. Press and hold SW2 to return to "SET-2".

**■ NOTE**

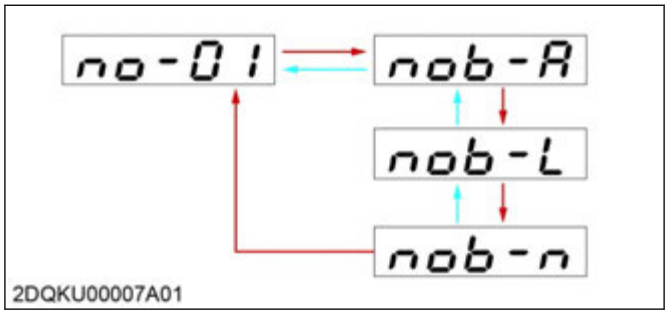
- **"no-01", "no-02", "no-03", and "no-04" are settings for proportional AUX specification.**



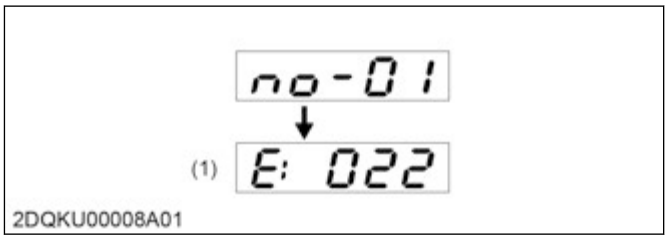

## 2.5.1 Operating SET-4 (Dealer setting) No-01 (AUX knob switch setting)

Set RH end, LH end, and neutral of the AUX knob switch.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-01".
3. Press and hold SW3 to set.
4. When display "nob-R", slide to hold AUX knob switch to RH end and press and hold SW3.
5. When display "nob-L", slide to hold AUX knob switch to LH end and press and hold SW3.
6. When display "nob-n", take hands off from AUX knob switch to stay in neutral and press and hold SW3.
7. Beep buzzer to return to "no-01".




**In case of problem with knob switch**




(1) E:022 AUX knob switch error

## 2.5.2 Operating SET-4 (Dealer setting) No-02 (AUX start-up point setting (w/ attachment))

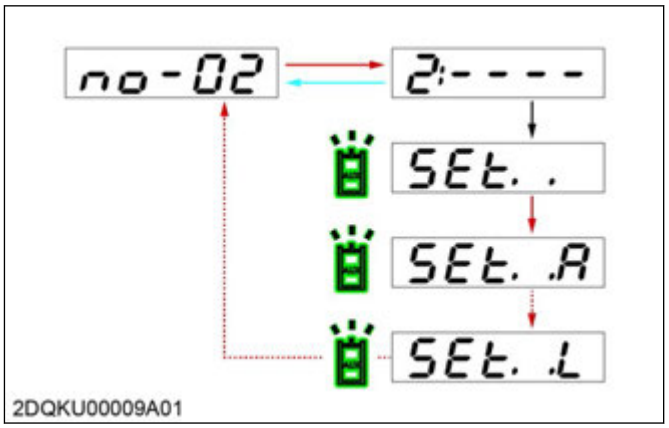
Adjust start-up point for AUX with mounting attachment.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-02".
3. Press and hold SW3 to set.
4. When display "2: ----", start the engine and lower the lever lock.
5. When display "SET.." with lighting AUX lamp, raise engine speed to maximum and move front attachment to correct position.

**■ IMPORTANT**

- **The attachment will start to move automatically in the setting. Make sure to be free of any obstructions around the machine.**

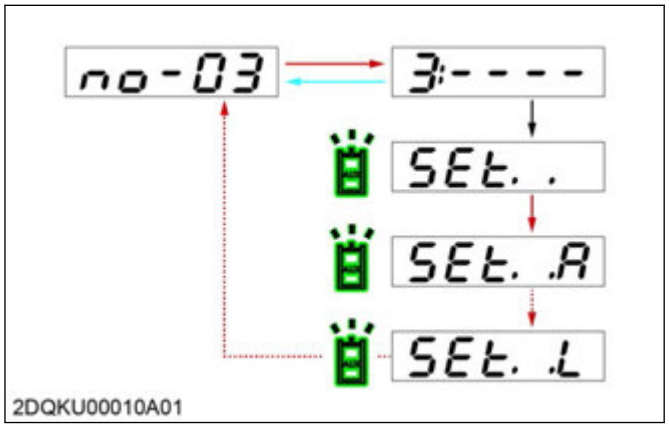
6. When ready for setting, press and hold SW3.
7. Display "SET..R" with lighting AUX lamp.
   When starting to move attachment to RH side automatically, press SW3.
8. Display "SET..L" with lighting AUX lamp.
   When starting to move attachment to LH side automatically, press SW3.
9. Beep buzzer to return to "no-02".



### 2.5.3 Operating SET-4 (Dealer setting) No-03 (AUX start-up point setting (w/o attachment))

Adjust start-up point for AUX without mounting attachment. Install pressure gauges on AUX discharging ports.

1. Install 2 pressure gauges on AUX discharging RH and LH ports.
2. Set the "SET-4" in the service dealer mode.
3. Press SW2 or SW3 to select "no-03".
4. Press and hold SW3 to set.
5. When display "3: ----", start the engine and lower the lever lock.
6. When display "SET.." with lighting AUX lamp, raise engine speed to maximum.
7. When ready for setting, press and hold SW3.
8. Display "SET..R" with lighting AUX lamp.
   When rising pressure on RH side pressure gauge automatically, press SW3.
9. Display "SET..L" with lighting AUX lamp.
   When rising pressure on LH side pressure gauge automatically, press SW3.
10. Beep buzzer to return to "no-03".




### 2.5.4 Operating SET-4 (Dealer setting) No-04 (AUX start-up point fine adjustment)

Adjust start-up point when is out of alignment between knob switch feeling and moving attachment.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-04".
3. Press and hold SW3 to set.
4. When display "4: ----", start the engine and lower the lever lock.
5. When display "R: 20" with lighting AUX lamp, adjust to input number from -40 to 40.

**NOTE**

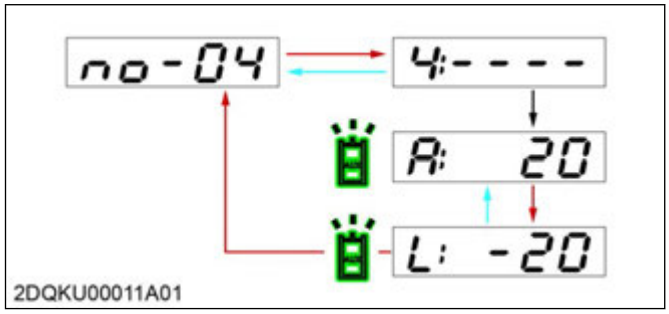
- **Increase number: press SW3**
  **Decrease number: press SW2**

6. Press and hold SW2.
7. When display "L: 20" with lighting AUX lamp, adjust to input number from -40 to 40.

**NOTE**

- **Increase number: press SW3**
  **Decrease number: press SW2**

8. Press and hold SW2.
9. Beep buzzer to return to "no-04".



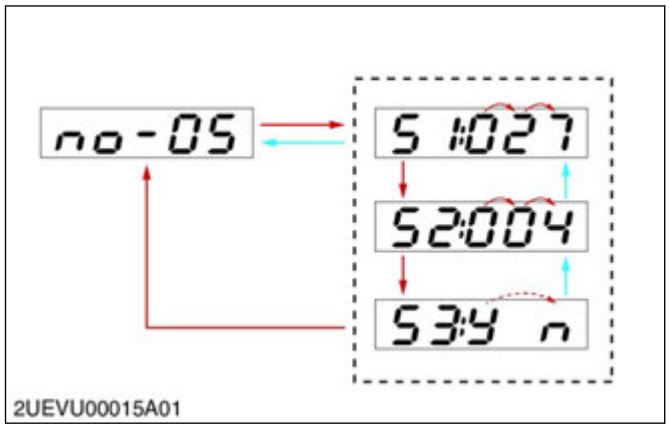

### 2.5.5 Operating SET-4 (Dealer setting) No-05 (Model setting)

Settings for each model (three items).

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-05".
3. Press and hold SW3 to set.
4. Set the following three items -model, region, AUX function.
5. Press and hold SW2 to return to "no-05".

**NOTE**

- **Press and hold SW2 or SW3: next or previous digit**
  **Press SW2 or SW3: above or below number**



**51. Model**

| | | | |
|---|---|---|---|
| 001 | U17, U-17, U17-3, U17-3α, U-17-5S 017CR | 024 | KX015-4 |
| 002 | U-20-3S, U20-5S, U20-3α 020CR | 025 | KX016-4 |
| 003 | U25, U-25S | 026 | KX018-4 |
| 012 | KX027-4 | 027 | KX019-4 |
| 013 | KX030-4 | 028 | U27-4 |

**52. Region**

| | |
|---|---|
| 001 | Japan |
| 002 | North America |
| 003 | Australia |
| 004 | EU |
| 007 | Others |

**53. Proportional AUX**

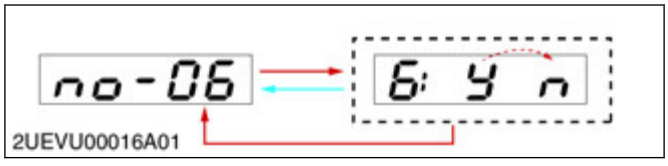
| | |
|---|---|
| "Y" | Proportional AUX (Kubota software control) |
| "N" | Other |

**Default setting**

| | |
|---|---|
| 51 | 12 |
| 52 | 004 |
| 53 | Y: Hi-spec<br>N: Basic |

## 2.5.6 Operating SET-4 (Dealer setting) No-06 (Clearing periodic check alert)

Select clearing method for periodic check alert.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-06".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-06".



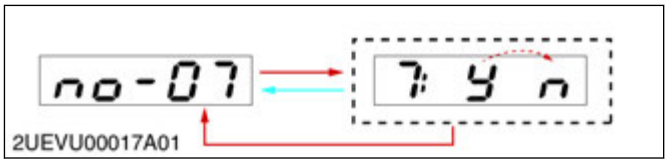

| | | |
|---|---|---|
| "Y" | Manual | Clear periodic check alert manually. |
| "N" | Auto | Turn the starter switch repeatedly to **[RUN]** and **[STOP]** 10 times to clear periodic check alert. |

**Default setting**

| | |
|---|---|
| EU | "Y" |
| JP, NA, AU, Other | "N" |

## 2.5.7 Operating SET-4 (Dealer setting) No-07 (Informing periodic check alert)

Inform (lamp blinking) or pass (lamp not blinking) the periodic check term.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-07".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-07".




| | | |
|---|---|---|
| "Y" | Inform | Inform the periodic check alert 10 hours in advance. |
| "N" | Pass | Dose not inform the periodic check. |

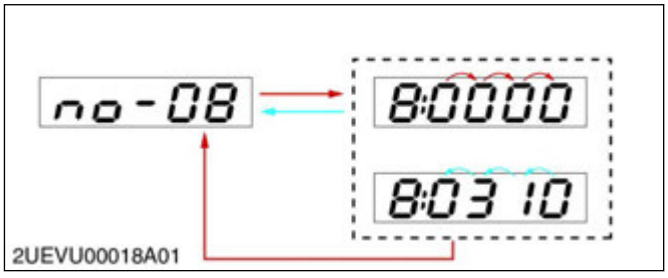
**Default setting**

| | |
|---|---|
| EU, JP, NA, AU, Other | "Y" |

## 2.5.8 Operating SET-4 (Dealer setting) No-08 (Time offset for periodic check)

The time offset between the hour meter and periodic check hour. Required setting after replacing the ECU.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-08".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to set the offset hours.

**■ NOTE**
- **Press and hold SW2 or SW3: next or previous digit.**
  **Press SW2 or SW3: above or below numbers.**

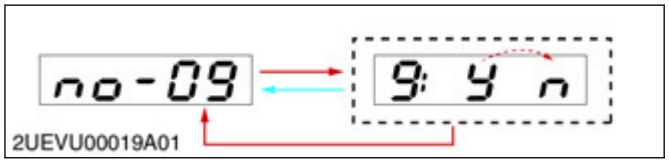



5. Press and hold SW3 to set and return to "no-08".

## 2.5.9 Operating SET-4 (Dealer setting) No-09 (Clock setting alert)

Setting if the clock setting lamps blinks or not when the time on the clock is off.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-09".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-09".




| | |
|---|---|
| "Y" | Inform the clock setting alert when the time on the clock is off. |
| "N" | Does not inform the clock setting alert. |

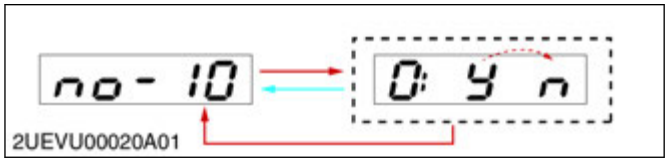
**Default setting**

| | |
|---|---|
| EU, JP, NA, AU, Other | "Y" |

## 2.5.10 Operating SET-4 (Dealer setting) No-10 (Travel buzzer function)

Activation or deactivation of the travel buzzer.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-10".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW2 to return to "no-10".




| | |
|---|---|
| "Y" | Activation |
| "N" | Deactivation |

**Default setting**

| | |
|---|---|
| AU | "Y" |
| JP, NA, EU, Other | "N" |

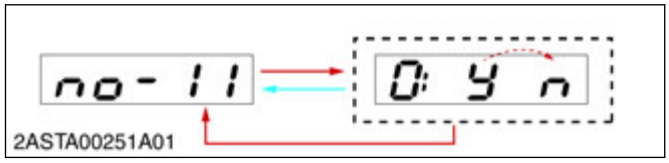
**■ NOTE**

- **This setting is only for controlled travel buzzer in the original ECU.**

## 2.5.11 Operating SET-4 (Dealer setting) No-11 (Travel speed shift switch)

Select hand switch or foot switch for the travel speed shift.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-11".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW2 to return to "no-11".




| | |
|---|---|
| "Y" | Foot |
| "N" | Hand |

**Default setting**

| | |
|---|---|
| EU, NA, JP, AU, Other | "N" |

## 2.5.12 Default settings for SET-4 (Dealer setting)

| | KX027-4 EU | |
|---|---|---|
| | **Basic** | **Hi-spec** |
| "no-05" Model setting | "1: 012" "2: 004" "3: N" | "1: 012" "2: 004" "3: Y" |
| "no-06" Clearing periodic check alert | "Y" | |
| "no-07" Informing periodic check alert | "Y" | |
| "no-09" Clock setting alert | "Y" | |
| "no-10" Travel buzzer function | "N" | |
| "no-11" Travel speed shift switch | "N" | |

# 2.6 Operating SET-5 (Reading all error history)

Display all error details from the memory.

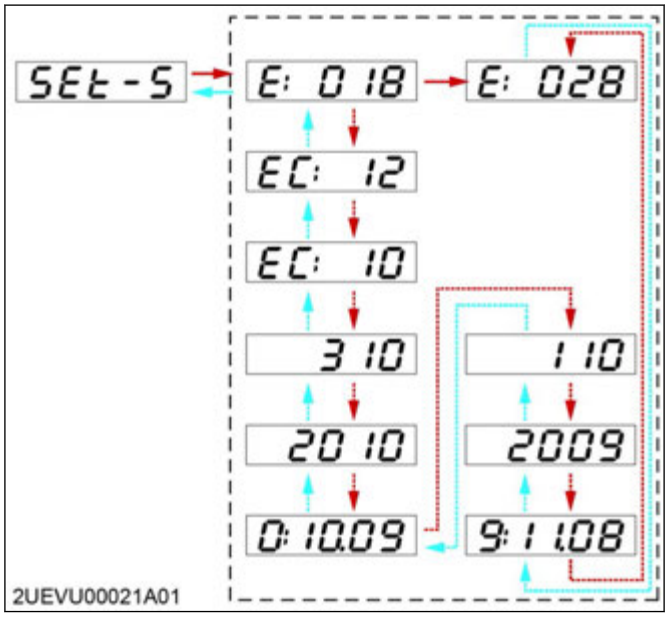
**■ NOTE**

- **Display eight items for each error code.**
  - **Number of times**
  - **Number of times after clearing error history**

  - **Recent hour meter**
  - **Recent year**
  - **Recent month and date**
  - **First hour meter**
  - **First year**
  - **First month and date**
- **This history is not erased even if the "SET-3" (clearing error history) is done.**

1. Set "SET-5" in the service dealer mode.
2. Displays the previous error code from memory.
3. Press SW2 or SW3 to change the item.
4. Press and hold SW3 to display other error codes.
5. Press and hold SW2 to return to "SET-5".

"E:018": Issued 12 times and 10 times after clearing history
Recent data 310 h, 2010/10/9
First data: 110 h, 2009/11/8



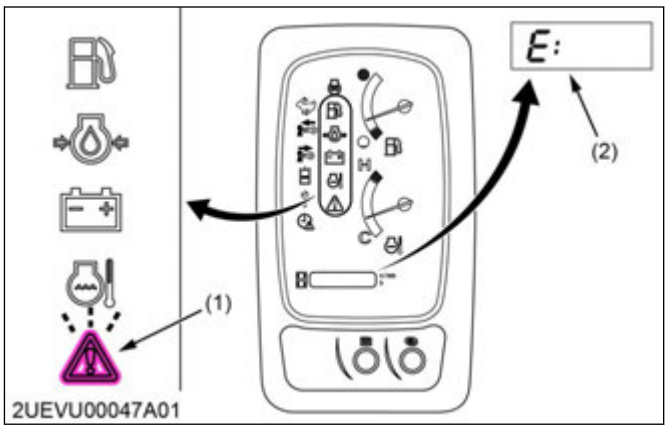

# 3. Handling error warning

## 3.1 Handling E:001 CAN communication error

There is no communication between the main ECU and the meter panel.

**Checking on the meter panel**

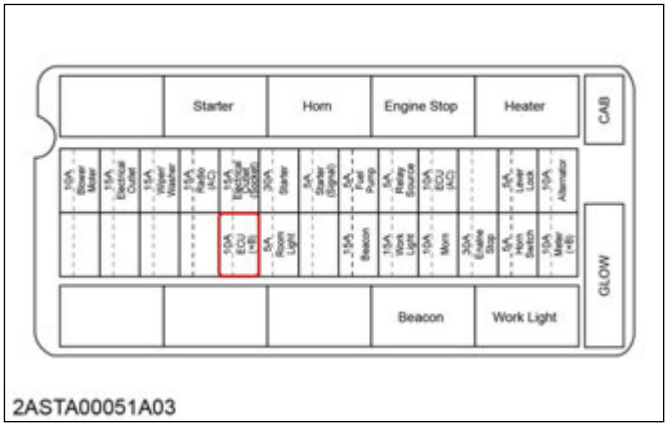
1. Check the meter panel.




(1) Warning lamp
(2) "E:001" CAN communication error

**Checking devices**

1. Check the fuse (ECU-MAIN (+B) 10 A).

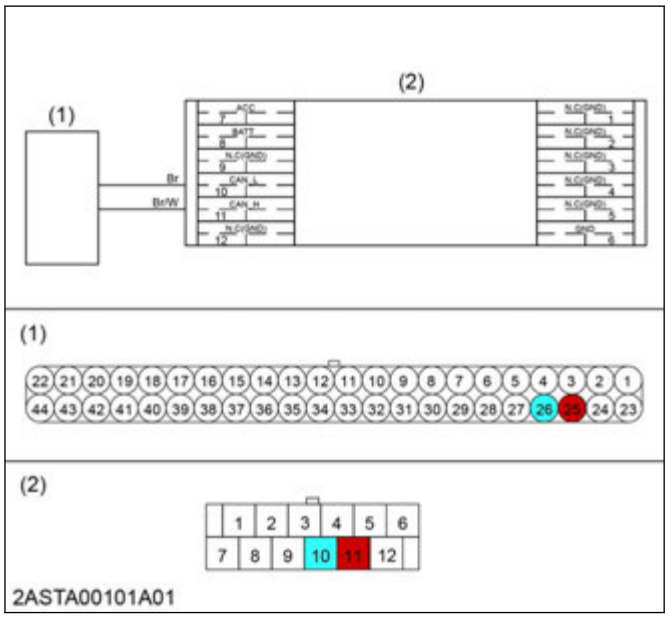



2. Check the main ECU and meter panel.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check by turning the starter switch to **[RUN]**.
   - Check the cover of the wiring for damage and that they are not touching the body.




(1) Meter panel connector

**Checking the wire harness**




(1) Main ECU connector (2) Meter panel connector

1. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the main ECU connector and meter panel connector.

| | CAN-HIGH | CAN-LOW |
|---|---|---|
| (1) Main ECU connector | 25 | 26 |
| (2) Meter panel connector | 11 | 10 |

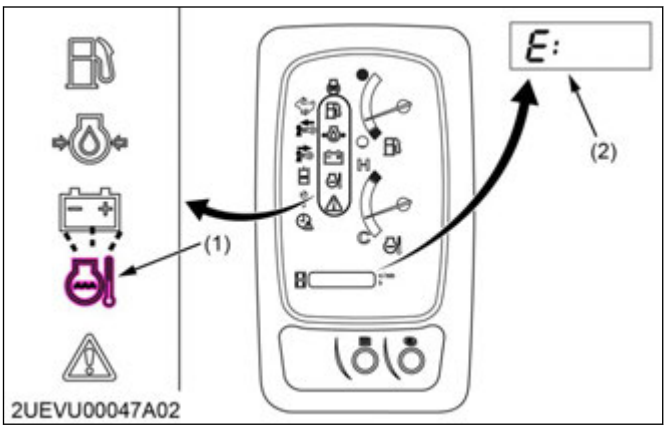
| Normal | Conduction |
|---|---|

## 3.2 Handling E:005 High coolant temperature

Coolant temperature is higher than 117 ℃ and lower than 122 ℃.

**Checking on the meter panel**

1. Check the meter panel.




(1) Coolant temperature lamp (2) "E:005" High coolant temperature

2. Check the engine coolant temperature in tester mode.

| | | |
|---|---|---|
| "SET-1" Tester | "8: oo ℃" Coolant temperature ℃ | lower than 117 ℃ |

**NOTE**

- **If the engine coolant temperature rises over 122 ℃, the ECU displays "E:015".**

**Checking devices**

1. Check the engine coolant level.




2. Check the radiator fin and radiator cap condition.



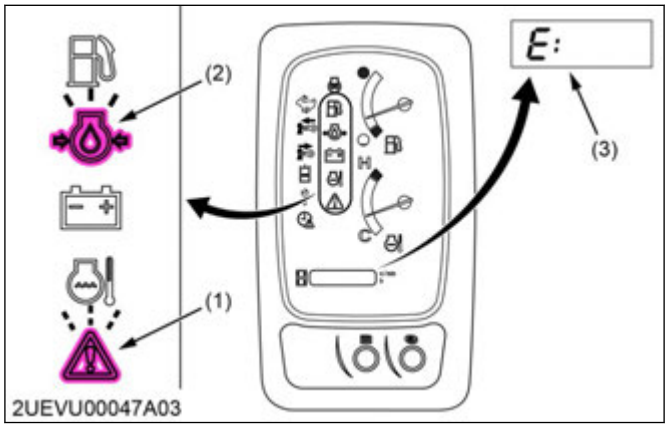

(1) Radiator

## 3.3 Handling E:014 Engine oil pressure error

Engine oil pressure switch is ON while the engine is running.

**Checking on the meter panel**

1. Check the meter panel.



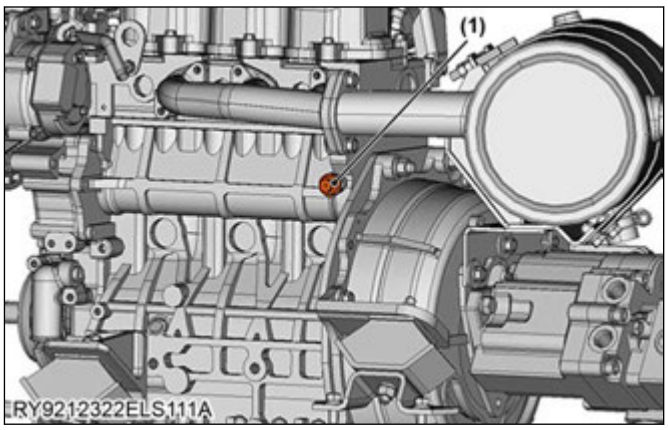

(1) Warning lamp
(2) Oil lamp
(3) "E:014" Engine oil pressure error

2. Check the oil switch in tester mode.

| "SET-1" Tester | "3: ON/OFF" Oil switch | Engine stopped | Engine running |
|---|---|---|---|
| | | "ON" | "OFF" |

**Checking devices**

1. Check the oil switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.



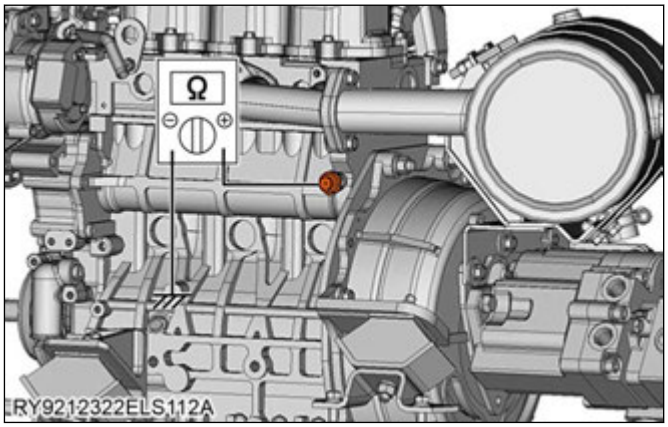

(1) Oil switch

2. Check the engine.
   - Check the engine oil level.
   - Measure the engine oil pressure.

**NOTE**
- **The oil pressure switch will turn on if the pressure is lower than 49 kPa.**

| | Idling | Rated speed |
|---|---|---|
| Normal | 68 kPa<br>0.69 kgf/cm$^2$<br>9.9 psi | 197 to 441 kPa<br>2.0 to 4.5 kgf/cm$^2$<br>28.5 to 64.0 psi |

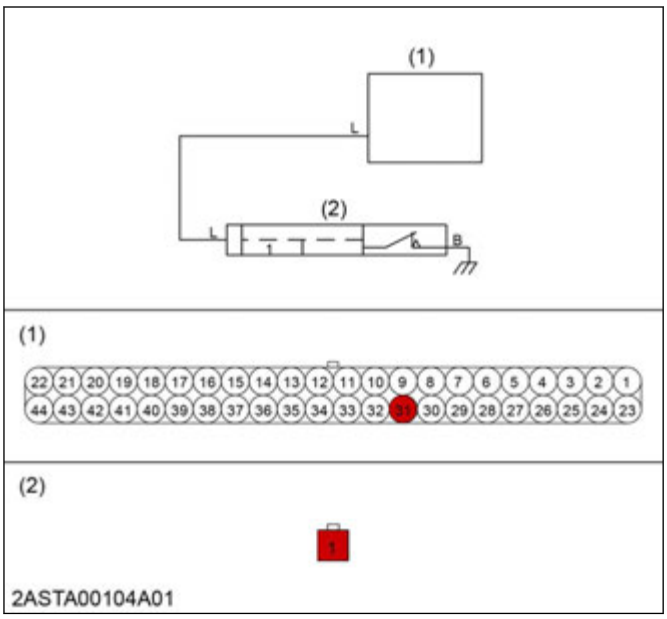
3. Measure the resistance of the oil pressure switch.
   - Disconnect the oil switch connector.
   - Measure between the oil pressure switch terminal and body GND.




| | Engine stopped | Engine running |
|---|---|---|
| Normal | Conduction | Non-conduction |

**Checking the wire harness**

1. Measure the voltage of the wire harness.
   - Disconnect the engine oil pressure switch connector and turn the starter switch to **[RUN]**.




(1) Main ECU connector (2) Engine oil pressure switch connector

| | (+) | (-) |
|---|---|---|
| (2) Engine oil pressure switch connector | 1 | Body ground |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 12 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the engine oil pressure switch connector and the main ECU connector.

| | **Engine oil pressure switch connector** |
|---|---|
| (1) Main ECU connector | 31 |
| (2) Engine oil pressure switch connector | 1 |

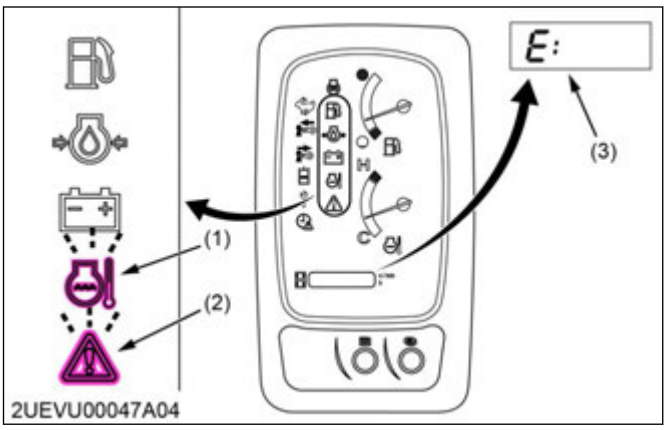
| Normal | Conduction |
|---|---|

## 3.4 Handling E:015 Engine overheating

Coolant temperature is higher than 122 ℃.

**Checking on the meter panel**

1. Check the meter panel.




(1) Coolant temperature lamp (3) "E:015" Engine overheating
(2) Warning lamp

2. Check the engine coolant temperature in tester mode.

| "SET-1" Tester | "8: ∞ ℃" Coolant temperature ℃ | lower than 117 ℃ |
|---|---|---|

**■ NOTE**

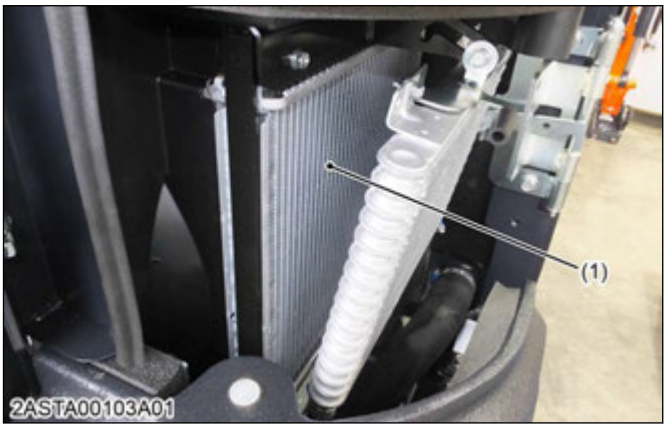
- **If the engine coolant temperature is between 117 to 122 ℃, the ECU displays "E:005".**

**Checking devices**

1. Check the engine coolant level.




2. Check the radiator grill, fin, and cap condition.



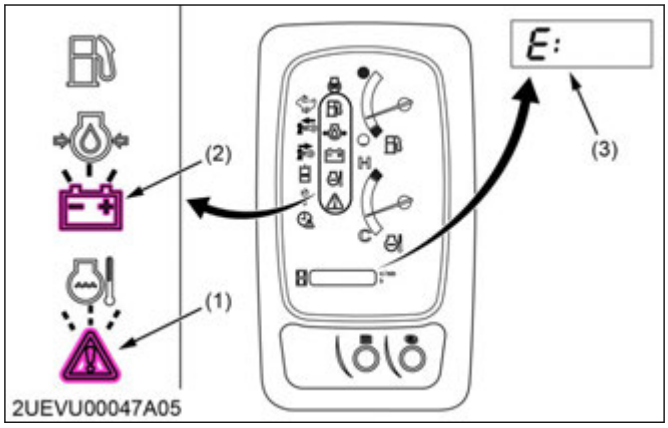

(1) Radiator

## 3.5 Handling E:016 Battery charging error

The charge switch is ON (no output from L terminal of the alternator) while the engine is running (over 700 rpm).

**Checking on the meter panel**

1. Check the meter panel.



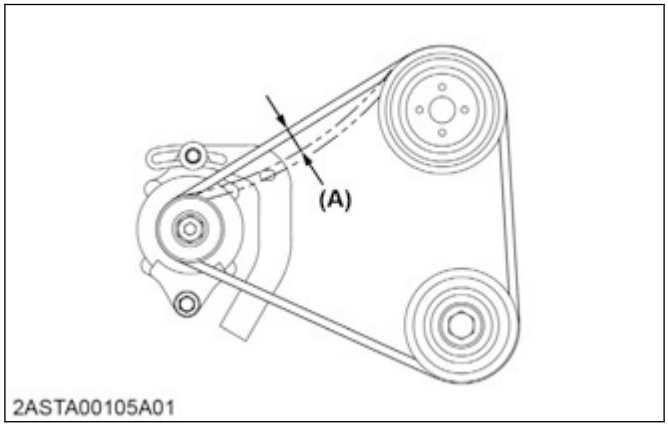

(1) Warning lamp
(2) Charging lamp
(3) "E:016" Battery charging error

2. Check the charging switch in tester mode.

| | | | |
|---|---|---|---|
| "SET-1" Tester | "4: ON/OFF" Charging switch | Engine stopped | Engine running |
| | | "ON" | "OFF" |

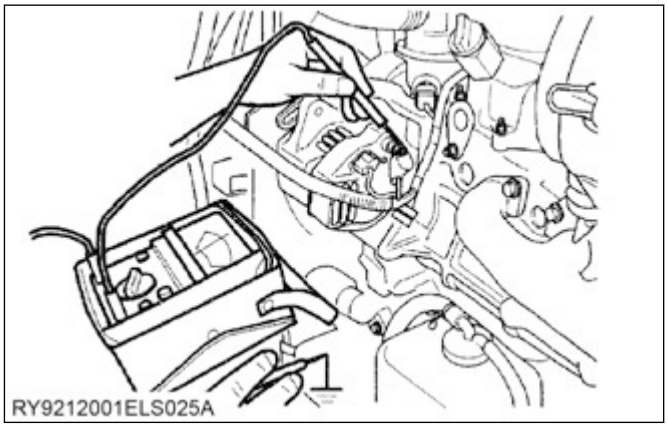
**Checking devices**

1. Check the alternator.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and to check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
2. Check the engine.
   - Check if the fan belt is broken, loose or if it is slipping.



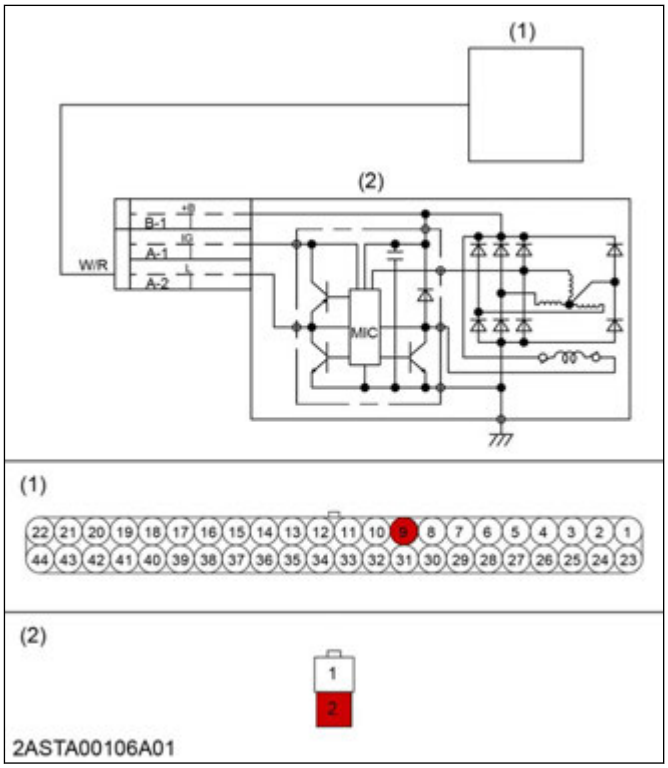

| | | |
|---|---|---|
| Normal | Fan belt deflection (A) | 7 to 9 mm |

3. Measure the voltage of the alternator.
   - Measure the voltage between terminal B of the alternator and body GND.




| | | |
|---|---|---|
| Normal | Engine stopped | Engine running |
| | 12 V | Approximately 14 V |

**Checking the wire harness**




(1) Main ECU connector
(2) Alternator connector

1. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the main ECU connector and the alternator connector.

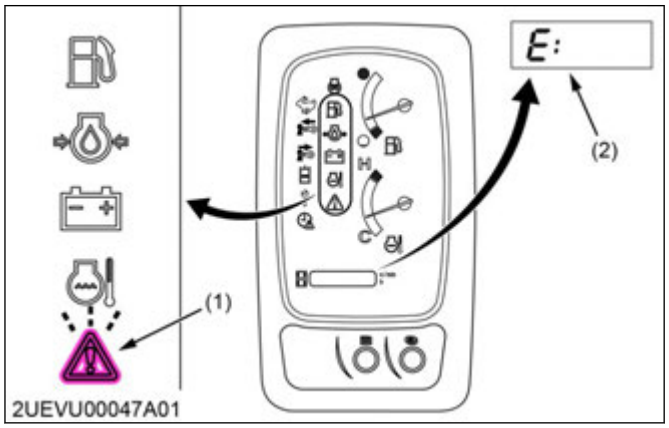
| | **12 V** |
|---|---|
| (1) Main ECU connector | 9 |
| (2) Alternator connector | 2 |

## 3.6 Handling E:017 Fuel sensor error

Fuel sensor resistance is over 135 Ω (broken wiring).

**Checking on the meter panel**

1. Check the meter panel.




(1) Warning lamp (2) "E:017" Fuel sensor error

2. Check the fuel sensor in tester mode.

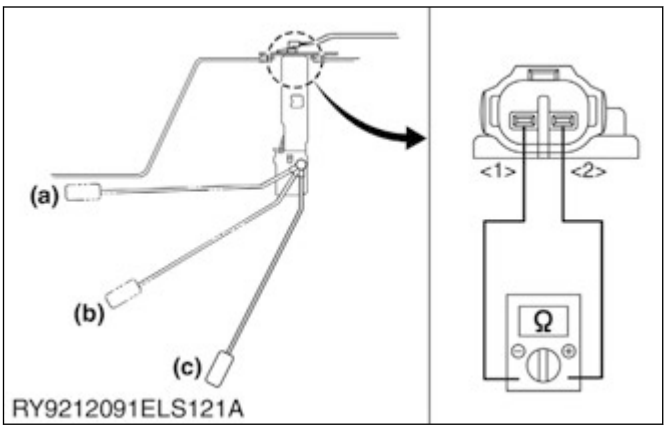
| | | |
|---|---|---|
| "SET-1" Tester | "10: ooo Ω" Sensor resistance value | 3±1 to 110±2.5 Ω |

**Checking devices**

1. Check the fuel sensor.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

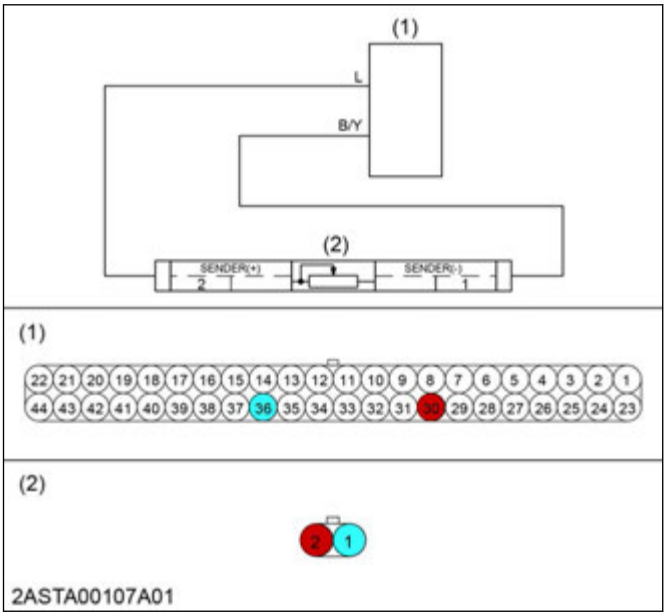



2. Measure the resistance of the fuel sensor.
   - Disconnect the fuel sensor connector.




| Float position | (a) | (b) | (c) |
|---|---|---|---|
| Resistance | 2 to 4 Ω | 32.5 Ω | 109 to 111 Ω |

**Checking the wire harness**




(1) Main ECU connector (2) Fuel sensor connector

1. Measure the voltage of the wire harness.
   - Disconnect the fuel sensor connector.

| | (+) | (-) |
|---|---|---|
| (2) Fuel sensor connector | 2 | 1 |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 12 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the fuel sensor connector and main ECU connector.

| | 12 V | Ground |
|---|---|---|
| (1) Main ECU connector | 30 | 36 |
| (2) Fuel sensor connector | 2 | 1 |

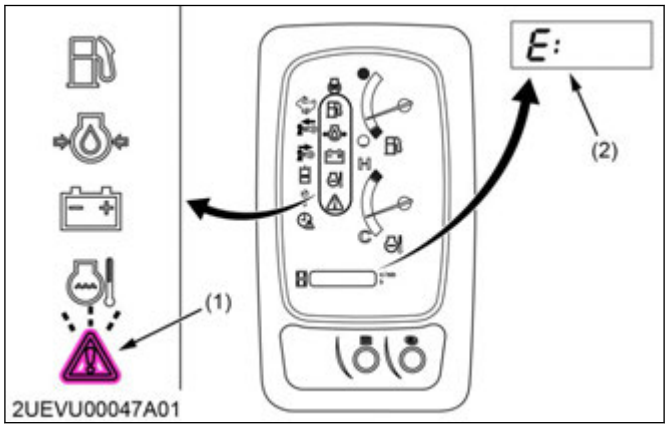
| Normal | Conduction |
|---|---|

## 3.7 Handling E:018 Water temperature sensor error

Water temperature is lower than -50 ℃ or higher than 150 ℃ (broken wiring or short-circuit).

**Checking on the meter panel**

1. Check the meter panel.



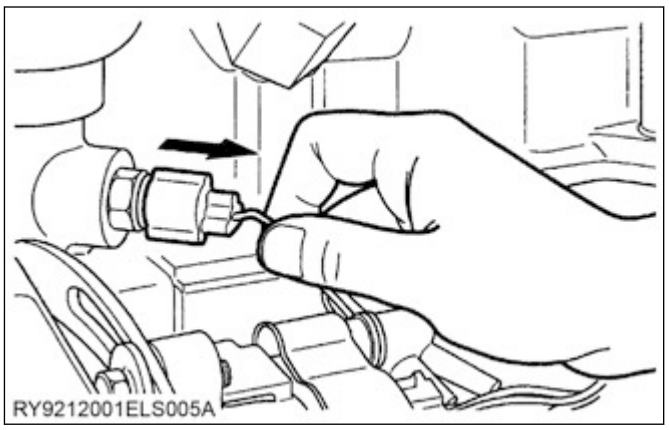

(1) Warning lamp
(2) "E:018" Water temperature sensor error

2. Check the engine water temperature sensor in tester mode.

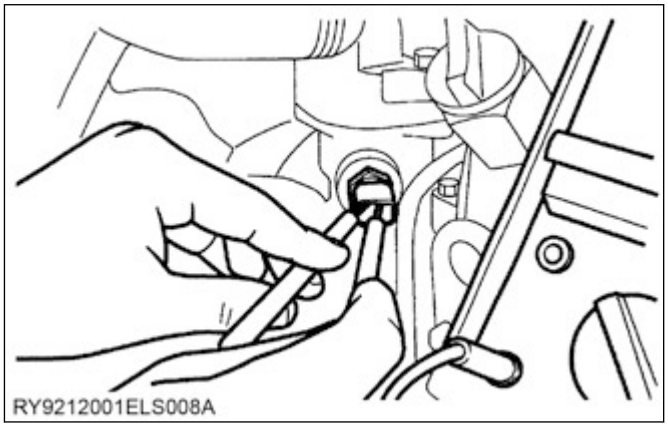
| | | |
|---|---|---|
| "SET-1" Tester | "8: oo ℃" Water temperature ℃ | -49 to 149 ℃ |

**Checking devices**

1. Check the water temperature sensor.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

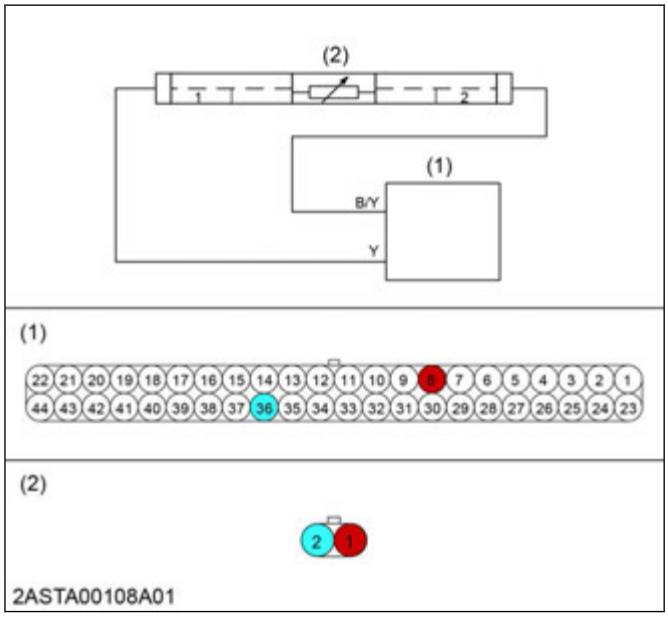



2. Measure the resistance of the water temperature sensor.
   - Disconnect the water temperature sensor connector.




| Water temperature | -20 ℃ | 50 ℃ | 110 ℃ |
|---|---|---|---|
| Resistance | 15.04 kΩ | 0.81 kΩ | 0.14 kΩ |

**Checking the wire harness**




(1) Main ECU connector (2) Water temperature sensor connector

1. Measure the voltage of the wire harness.
   - Disconnect the water temperature sensor connector and turn the starter switch to **[RUN]**.

| | (+) | (-) |
|---|---|---|
| (2) Water temperature sensor connector | 1 | 2 |

| Normal | Starter switch **[STOP]** | Starter switch **[RUN]** |
|---|---|---|
| | 0 V | 5 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the water temperature sensor connector and main ECU connector.

| | 5 V | GND |
|---|---|---|
| (1) Main ECU connector | 8 | 36 |
| (2) Water temperature sensor connector | 1 | 2 |

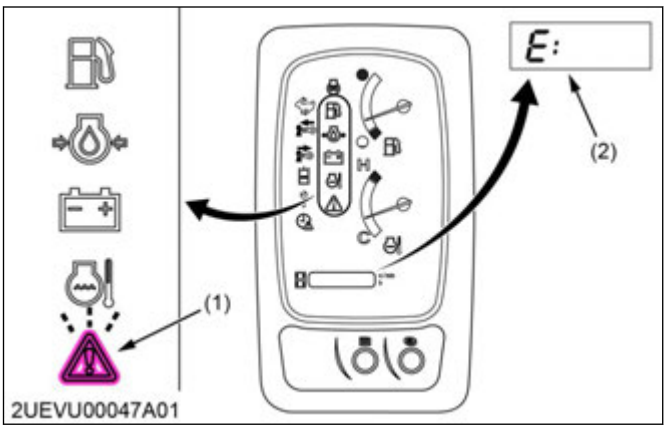
| Normal | Conduction |
|---|---|

## 3.8 Handling E:020 Lever lock solenoid error

Short circuit in the lever lock solenoid line.

**Checking on the meter panel**

1. Check the meter panel.




(1) Warning lamp (2) "E:020" lever lock solenoid error

2. Check the lever lock switch and the lever lock solenoid in tester mode.

| | | Lever lock down | Lever lock up |
|---|---|---|---|
| "SET-1" Tester | "14: ON/OFF" Lever lock switch | "OFF" | "ON" |
| | "15: ON/OFF" Lever lock solenoid | "OFF" | "ON" |

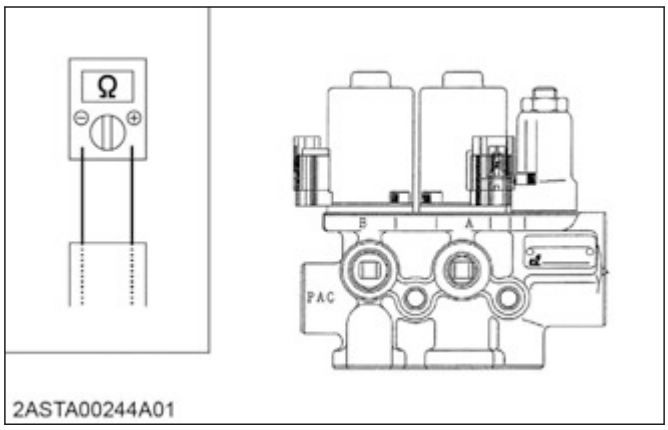
**Checking devices**

1. Check the lever lock switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.



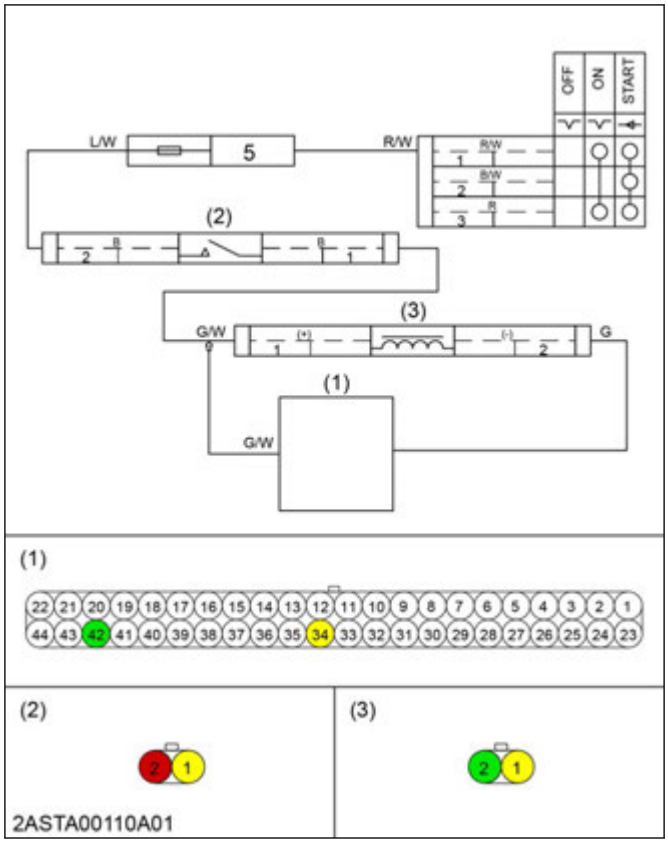

(1) Lever lock switch connector

2. Measure the resistance of the lever lock solenoid.
   - Disconnect the lever lock solenoid connector.




| | |
|---|---|
| Normal | 8 to 12 Ω |

**Checking the wire harness**




(1) Main ECU connector
(2) Lever lock switch connector
(3) Lever lock solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the lever lock solenoid connector and operate the lever lock switch.

| | (+) | (-) |
|---|---|---|
| (3) Lever lock solenoid connector | 1 | 2 |

| | | |
|---|---|---|
| Normal | Lever lock switch **[OFF]** (Up) | Lever lock switch **[ON]** (Down) |
| | 0 V | 12 to 14 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the lever lock switch connector, lever lock solenoid connector and main ECU connector.

| | **Lever lock switch connector input signal** | **Lever lock solenoid connector input signal** |
|---|---|---|
| (1) Main ECU connector | 34 | 42 |
| (2) Lever lock switch connector | 1 | - |
| (3) Lever lock solenoid connector | 1 | 2 |

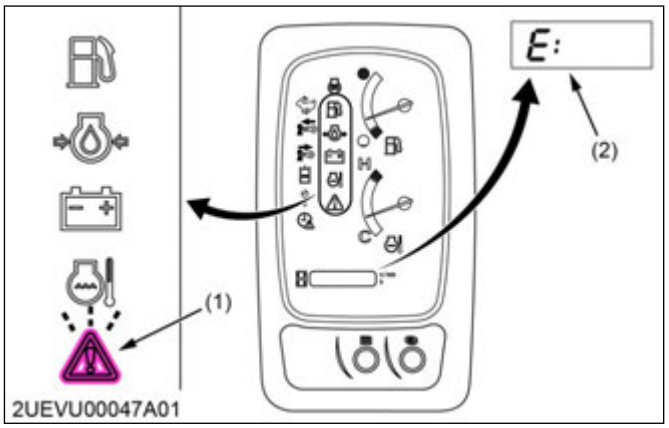
| | |
|---|---|
| Normal | Conduction |

## 3.9 Handling E:021 Travel speed shift system error

Short circuit in the travel speed solenoid line.

**Checking on the meter panel**

1. Check the meter panel.



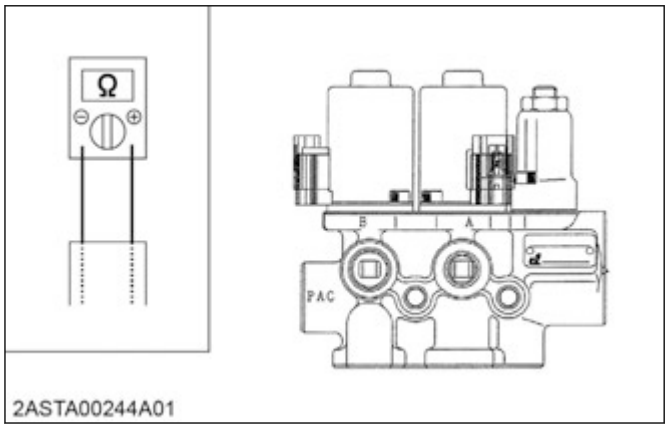

(1) Warning lamp
(2) "E:021" Travel speed shift system error

2. Check the travel speed shift solenoid in tester mode.

| | | | |
|---|---|---|---|
| "SET-1" Tester | | Travel speed shift switch ON | Travel speed shift switch OFF |
| | "12": Travel speed shift switch | "ON" | "OFF" |
| | "13": Travel speed shift solenoid | "ON" | "OFF" |

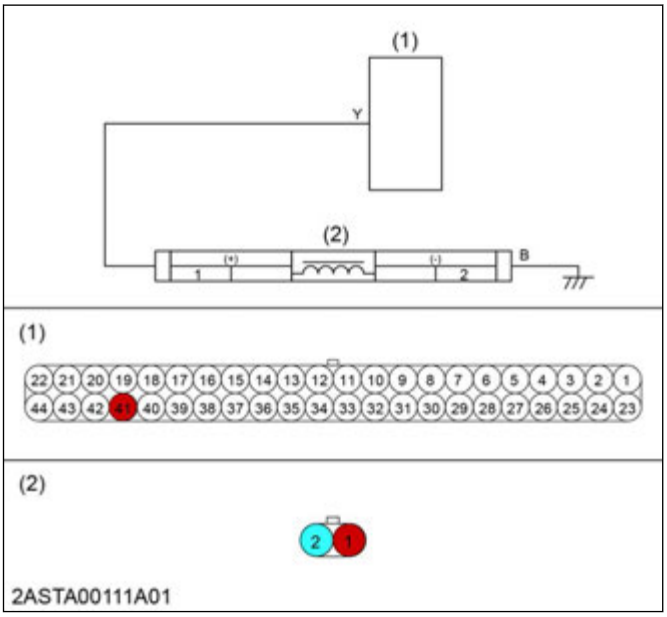
## Checking devices

1. Check the travel speed shift solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
2. Measure the resistance of the travel speed shift solenoid.
   - Disconnect the travel speed shift solenoid connector.




| | |
|---|---|
| Normal | 8 to 12 Ω |

## Checking the wire harness




(1) Main ECU connector (2) Travel speed shift solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the travel speed shift solenoid connector and main ECU connector.

| | (+) | (-) |
|---|---|---|
| (2) Travel speed shift solenoid connector | 1 | 2 |

| | | |
|---|---|---|
| Normal | Travel speed shift switch connector at **[OFF]** | Travel speed shift switch connector at **[ON]** |
| | 0 V | 12 to 14 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the travel speed shift solenoid connector and main ECU connector.

| | 12 V | GND |
|---|---|---|
| (1) Main ECU connector | 41 | - |
| (2) Travel speed shift solenoid connector | 1 | 2 |
| Body ground | - | ○ |

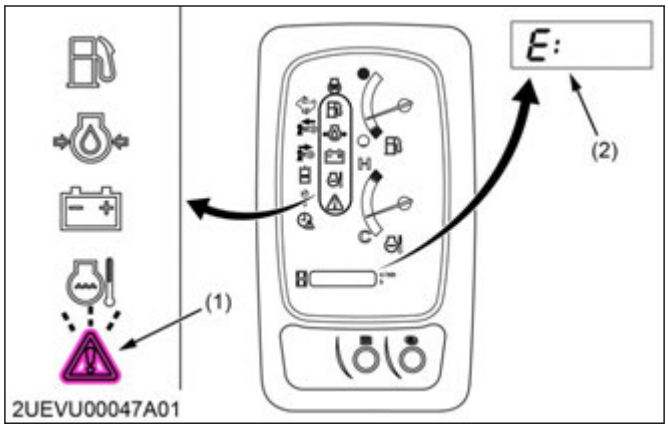
| | |
|---|---|
| Normal | Conduction |

## 3.10 Handling E:022 AUX1 knob switch error

Short circuit in the AUX1 knob switch line.

**Checking on the meter panel**

1. Check the meter panel.



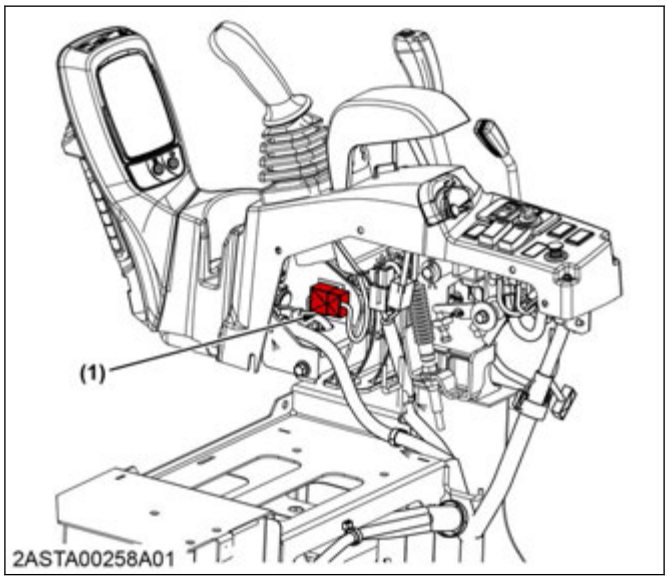

(1) Warning lamp
(2) "E:022" AUX1 knob switch breaking or short

2. Check the AUX1 knob switch in tester mode.

| | | |
|---|---|---|
| "SET-1" Tester | "16: oo.o V" AUX1 knob switch | 0.26 to 4.74 V |

**Checking devices**

1. Check the pilot control lever RH connector.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.



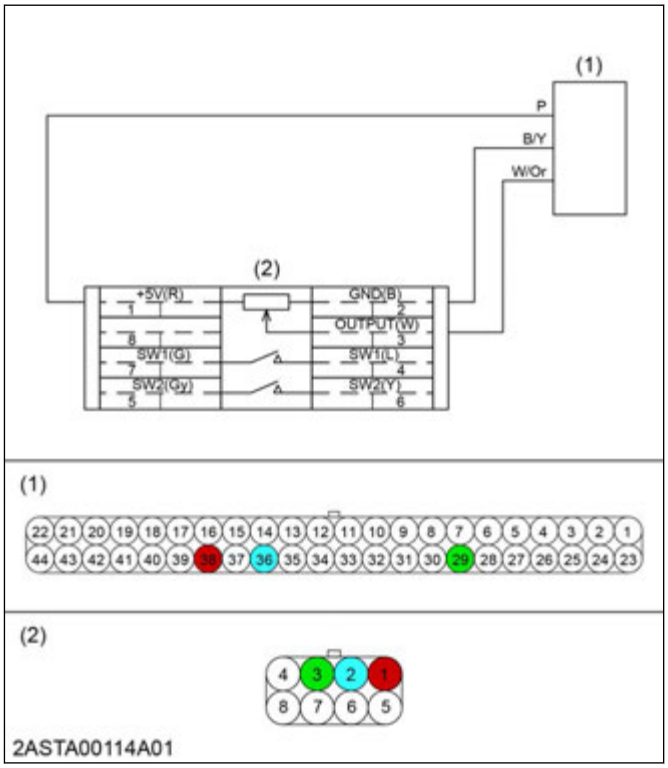

(1) Pilot control lever RH connector

2. Measure the resistance of AUX1 knob switch.

| | Resistance |
|---|---|
| Between 1 and 2 | 10 kΩ to 100 kΩ |
| Between 1 and 3 | |
| Between 2 and 3 | |

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

**Checking the wire harness**




(1) Main ECU connector
(2) Pilot control lever RH connector

1. Measure the voltage of the wire harness.
   - Disconnect the Pilot control lever RH connector.

| | (+) | (-) |
|---|---|---|
| (2) Pilot control lever RH connector | 1 | 2 |

| | | |
|---|---|---|
| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
| | 0 V | 5 V |

2. Check conduction for the wire harness.
   - Turn the key switch to **[STOP]** and disconnect the pilot control lever RH connector and main ECU connector.

| | 5 V | Signal | GND |
|---|---|---|---|
| (1) Main ECU connector | 38 | 29 | 36 |
| (2) Pilot control lever RH connector | 1 | 3 | 2 |

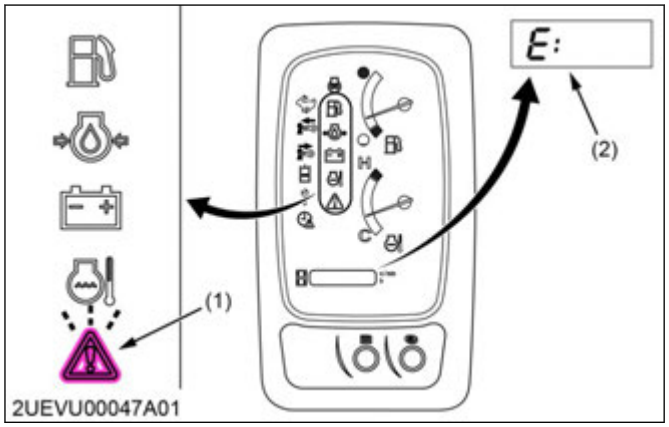
| Normal | Conduction |
|---|---|

## 3.11 Handling E:023 AUX1 RH solenoid error

Breaking or short in the AUX1 RH solenoid line.

**Checking on the meter panel**

1. Check the meter panel.



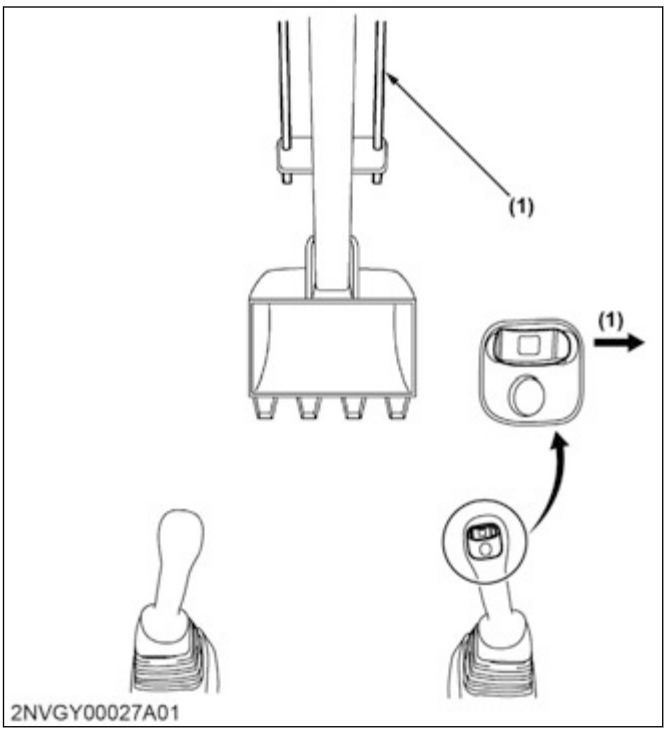

(1) Warning lamp
(2) "E:023" AUX1 RH solenoid breaking or short

2. Check the AUX1 RH solenoid in tester mode.

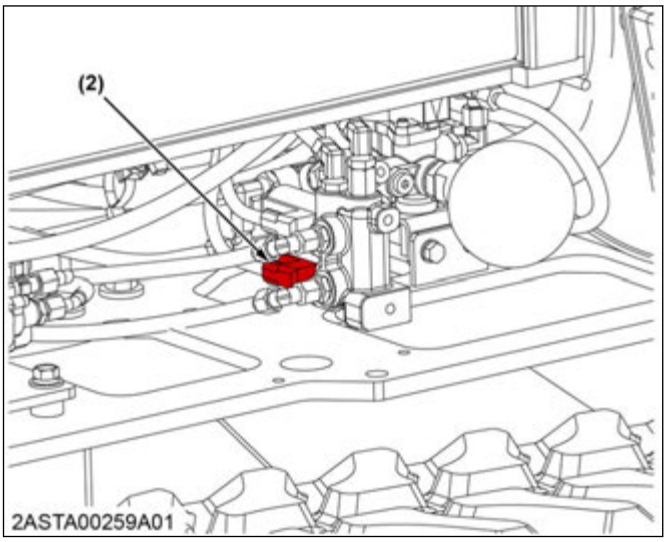
| | | |
|---|---|---|
| "SET-1" Tester | "20: 0.0 A" AUX1 RH SOL (current) | Pressing the AUX1 knob switch RH 0 to 1.7 A |

**Checking devices**

1. Check the AUX1 RH solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

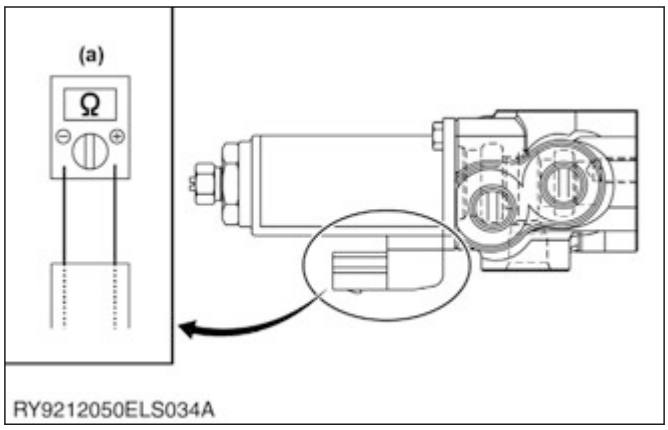



(1) AUX1 knob RH




(2) AUX1 RH solenoid

2. Measure the resistance of the AUX1 RH solenoid.
   - Disconnect the AUX1 RH solenoid connector.

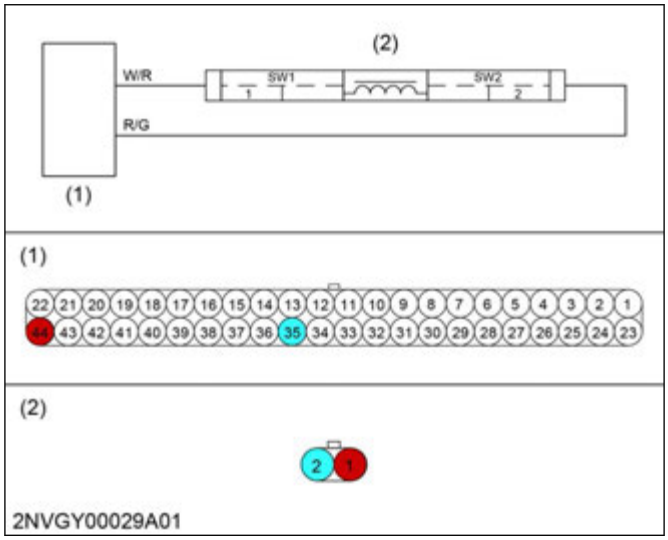



(a) Tester

| | |
|---|---|
| Normal | 2.7 to 3.7 Ω |

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

**Checking the wire harness**




(1) Main ECU connector (2) AUX1 RH solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the AUX1 RH solenoid connector.

| | (+) | (-) |
|---|---|---|
| (2) AUX1 RH solenoid connector | 1 | 2 |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 12 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the AUX1 RH solenoid connector and the main ECU connector.

| | 12 V | GND |
|---|---|---|
| (1) Main ECU connector | 44 | 35 |
| (2) AUX1 RH solenoid connector | 1 | 2 |

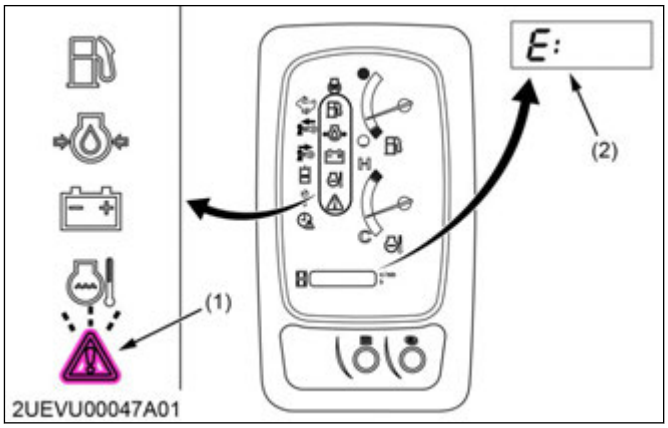
| Normal | Conduction |
|---|---|

## 3.12 Handling E:024 AUX1 LH solenoid error

Breaking or short in the AUX1 LH solenoid line.

**Checking on the meter panel**

1. Check the meter panel.



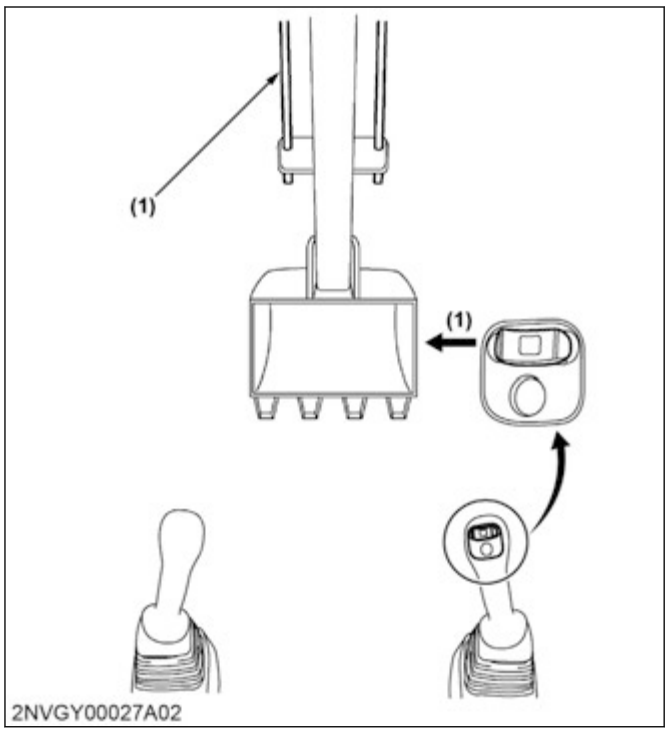

(1) Warning lamp (2) "E:024" AUX1 LH solenoid breaking or short

2. Check the AUX1 LH solenoid in tester mode.

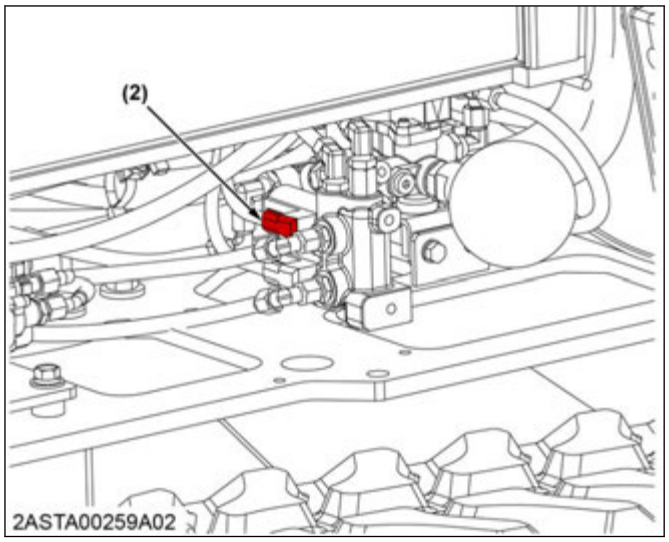
| | | |
|---|---|---|
| "SET-1" Tester | "20: o.o A" AUX1 1 SOL (current) | Pressing the AUX1 nob switch LH 0 to 1.7 A |

**Checking devices**

1. Check the AUX1 LH solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

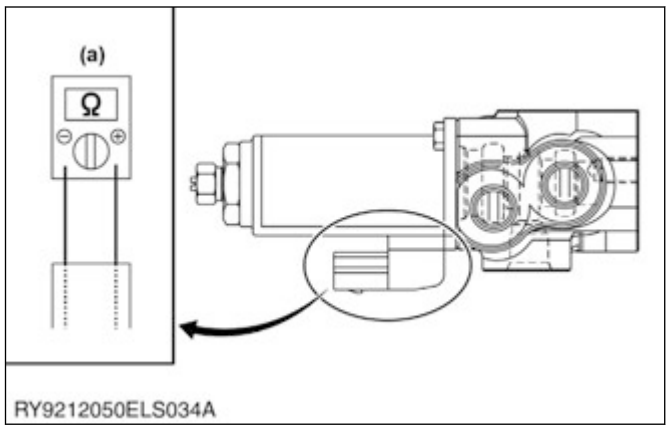



(1) AUX1 LH




(2) AUX1 LH solenoid

2. Measure the resistance of the AUX1 LH solenoid.
   - Disconnect the AUX1 LH solenoid connector.

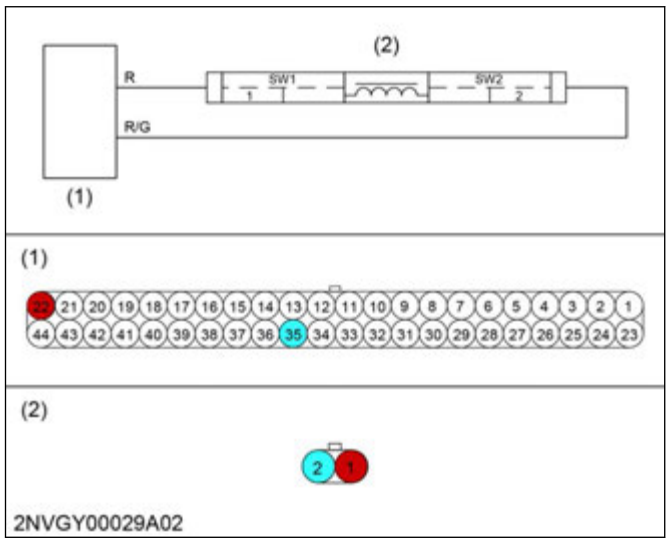



(a) Tester

| | |
|---|---|
| Normal | 2.7 to 3.7 Ω |

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

**Checking the wire harness**




(1) Main ECU connector (2) AUX1 LH solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the AUX1 LH solenoid connector.

| | (+) | (-) |
|---|---|---|
| (2) AUX1 LH solenoid connector | 1 | 2 |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 12 V |

2. Check conduction for the wire harness.

- Turn the starter switch to **[STOP]** and disconnect the AUX1 LH solenoid connector and the main ECU connector.

| | 12 V | GND |
|---|---|---|
| (1) Main ECU connector | 22 | 35 |
| (2) AUX1 LH solenoid connector | 1 | 2 |

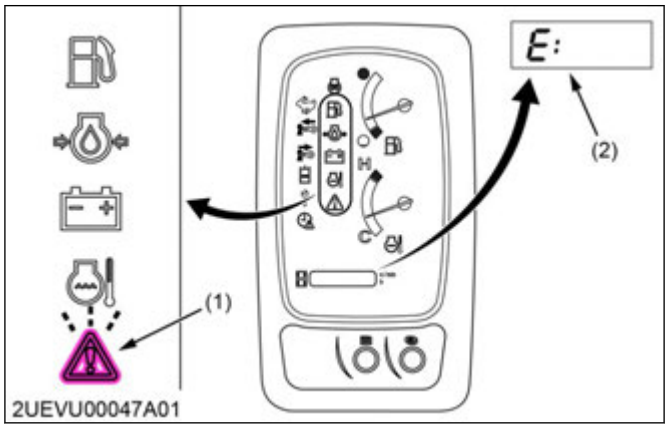
| Normal | Conduction |
|---|---|

## 3.13 Handling E:025 Battery overcharging

Power supply voltage is over 18 V.

**Checking on the meter panel**

1. Check the meter panel.



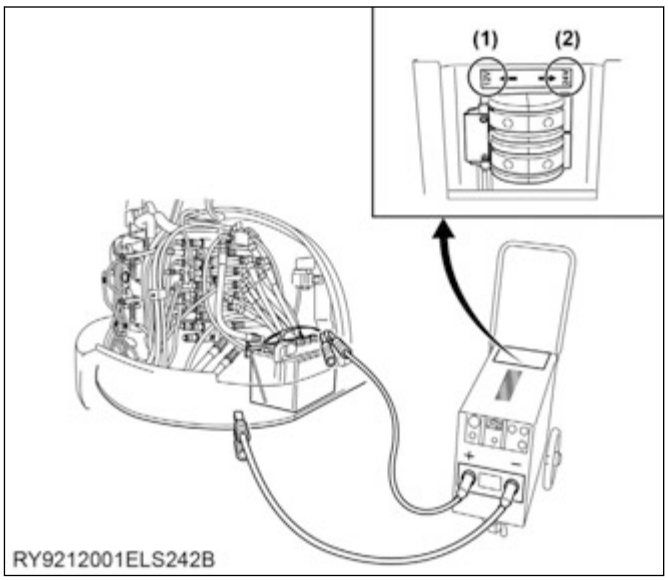

(1) Warning lamp (2) "E:025" battery overcharging

2. Check the battery voltage in tester mode.

| | | Engine stop | Engine running |
|---|---|---|---|
| "SET-1" Tester | "2: oo.o V" Battery voltage | 12.0 V | Approximately 14.0 V |

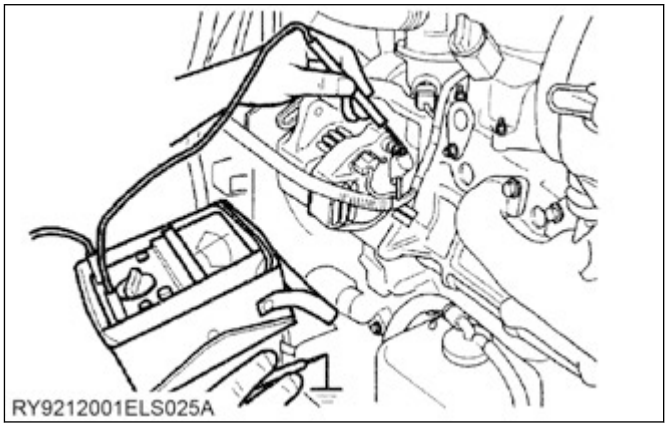
**Checking devices**

1. Check the battery.
   - Make sure to use the 12 V jump starter. Do not use 24 V jump starter.
   - Make sure to use the 12 V battery. Do not use 24 V battery.




(1) 12 V (2) 24 V

2. Measure the voltage of the alternator.
   - Measure the voltage between terminal B of the alternator and body GND.



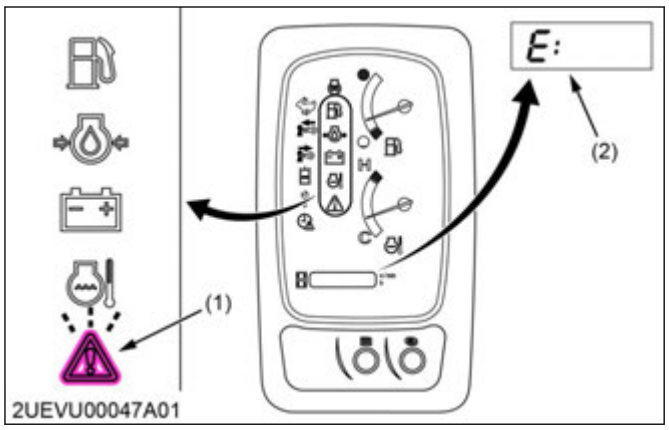

| Normal | Engine stopped | Engine running |
|---|---|---|
| | 12 V | Approximately 14 V |

## 3.14 Handling E:026 Anti-theft antenna error

No signal from the anti-theft antenna.

**Checking on the meter panel**

1. Check the meter panel.



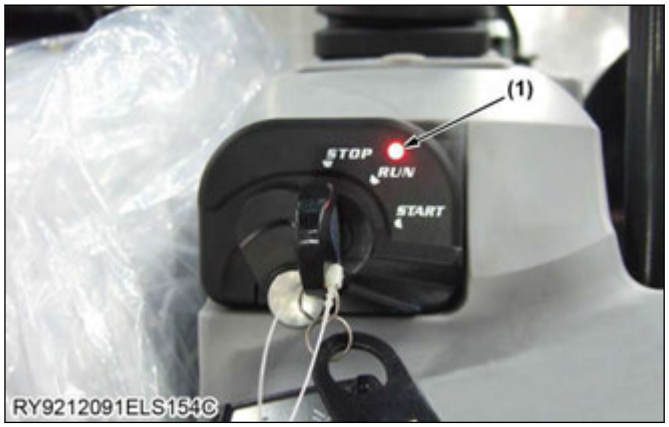

(1) Warning lamp (2) "E:026" Anti-theft antenna error

2. Check the anti-theft antenna in tester mode.

| | | |
|---|---|---|
| "SET-1" Tester | "29: ON/OFF" Anti-theft antenna | "OFF" |

**Checking devices**

1. Check the anti-theft antenna.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
   - Check whether the anti-theft lamp is blinking or not.







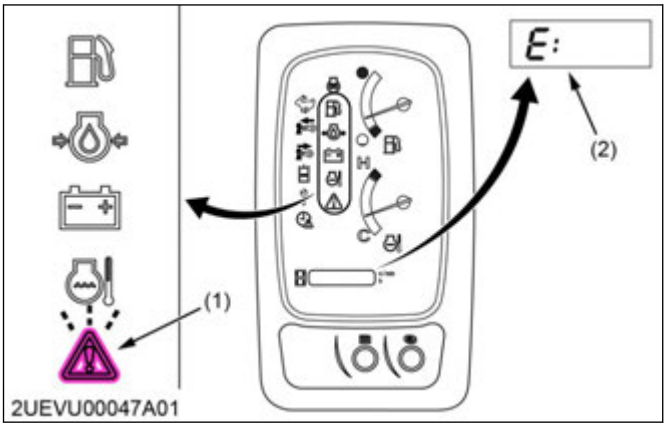
(1) Anti-theft lamp (2) Anti-theft antenna connector

## 3.15 Handling E:027 5 V short

Short circuit in the 5 V line.

**Checking on the meter panel**

1. Check the meter panel.



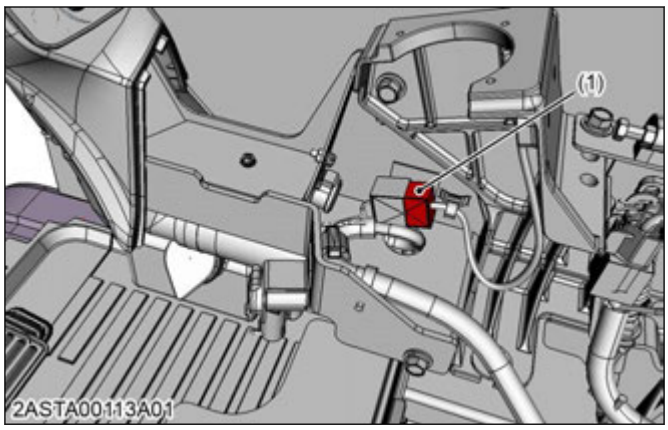

(1) Warning lamp (2) "E: 027" 5 V short

2. Check the AUX knob switch in tester mode.

| | | |
|---|---|---|
| "SET-1" Tester | "15: oo.o V" AUX knob switch | 0.26 to 4.74 V |

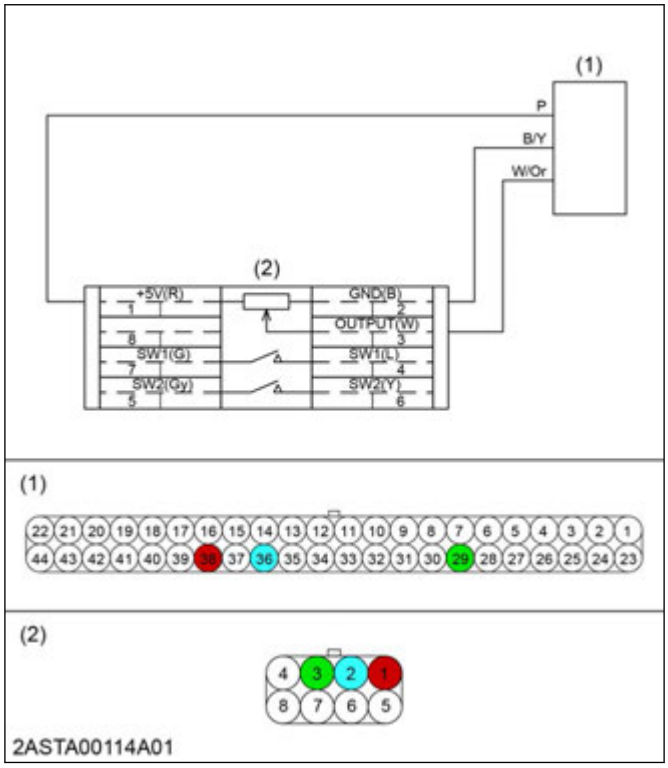
**Checking devices**

1. Check the AUX knob switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.




(1) AUX knob switch

**Checking the wire harness**




(1) Main ECU connector (2) AUX knob switch connector

1. Measure the voltage of the wire harness.
   - Disconnect the engine speed sensor connector and anti-theft antenna connector.

| | (+) | (-) |
|---|---|---|
| (2) AUX knob switch connector | 1 | 2 |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 5 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the AUX knob switch connector and the main ECU connector.

| | 5 V | Signal | GND |
|---|---|---|---|
| (1) Main ECU connector | 38 | 29 | 36 |
| (2) AUX knob switch connector | 1 | 3 | 2 |

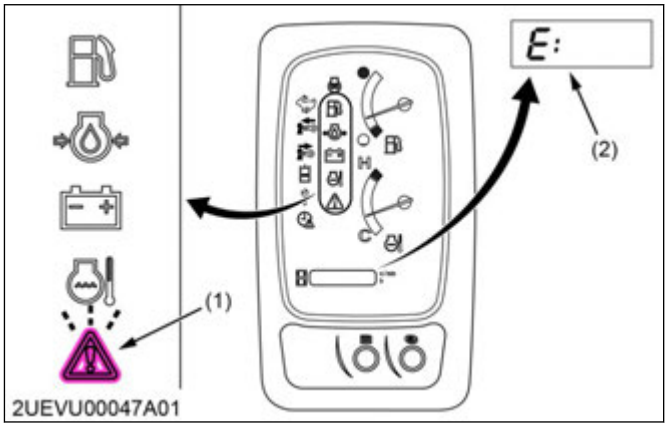
| Normal | Conduction |
|---|---|

## 3.16 Handling E:028 12 V error

Short circuit in the 12 V line.

**Checking on the meter panel**

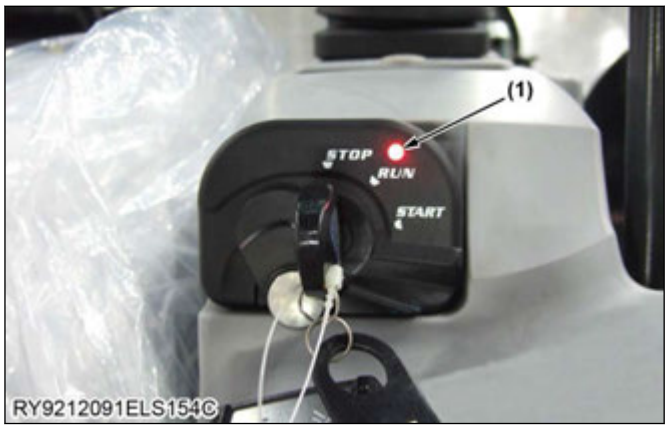
1. Check the meter panel.



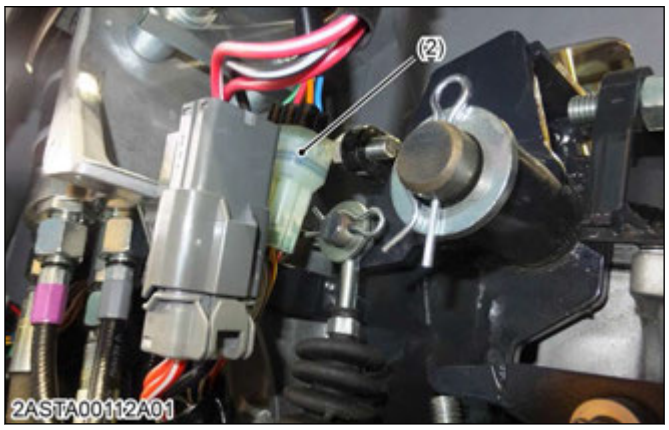

(1) Warning lamp (2) "E:028" 12 V error

**Checking devices**

1. Check the anti-theft antenna, engine speed sensor, travel speed shift switch, AUX switch and meter panel.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
   - Check whether the anti-theft lamp is blinking or not.




(1) Anti-theft lamp



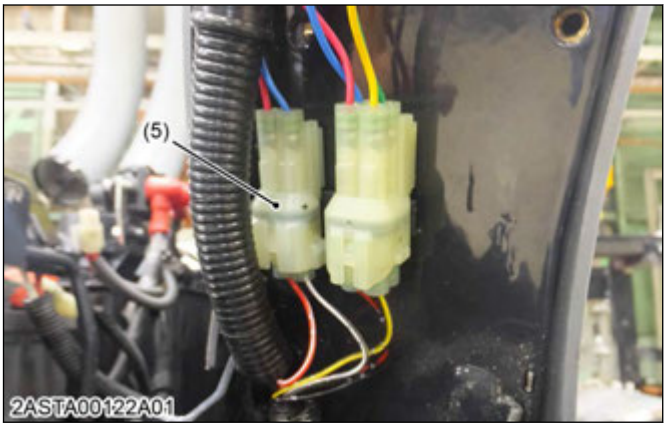

(2) Anti-theft antenna connector




(3) Engine speed sensor connector




(4) Travel speed shift switch connector

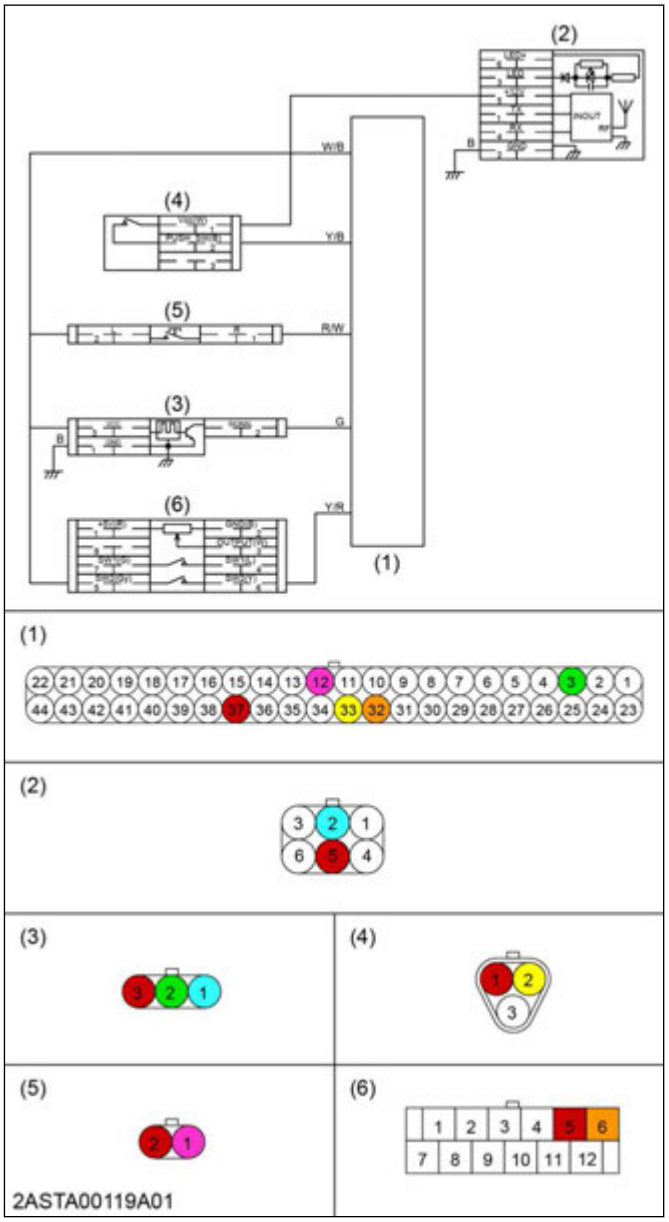



(5) AUX switch connector




(6) Meter panel connector

## Checking the wire harness




(1) Main ECU connector
(2) Anti-theft antenna connector
(3) Engine speed sensor connector
(4) Travel speed shift switch connector
(5) AUX switch connector
(6) Meter panel connector

1. Measure the voltage of the wire harness.
   - Disconnect the engine speed sensor connector and anti-theft antenna connector.

| | (+) | (-) |
|---|---|---|
| (2) Anti-theft antenna connector | 5 | 2 |
| (3) Engine speed sensor connector | 3 | 1 |
| (4) Travel speed shift switch connector | 1 | 2 |
| (5) AUX switch connector | 2 | 1 |
| (6) Meter panel connector | 5 | 6 |

| Normal | Starter switch at **[STOP]** | Starter switch at **[RUN]** |
|---|---|---|
| | 0 V | 12 V |

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the anti-theft antenna, engine speed sensor, travel speed shift switch, AUX switch, meter panel, and the main ECU connector.

| | 12 V | GND | Signal |
|---|---|---|---|
| (1) Main ECU connector | 37 | - | 3 |
| (2) Anti-theft antenna connector | 5 | 2 | - |
| (3) Engine speed sensor connector | 3 | 1 | 2 |
| (4) Travel speed shift switch connector | 1 | - | - |
| (5) AUX switch connector | 2 | - | - |
| (6) Meter panel connector | 5 | - | - |
| Body ground | - | ○ | - |

| | GND (Travel speed shift switch) | GND (AUX switch) | GND (Meter panel) |
|---|---|---|---|
| (1) Main ECU connector | 33 | 12 | 32 |
| (2) Anti-theft antenna connector | - | - | - |
| (3) Engine speed sensor connector | - | - | - |
| (4) Travel speed shift switch connector | 2 | - | - |
| (5) AUX switch connector | - | 1 | - |
| (6) Meter panel connector | - | - | 6 |
| Body ground | - | - | - |

| Normal | Conduction |
|---|---|

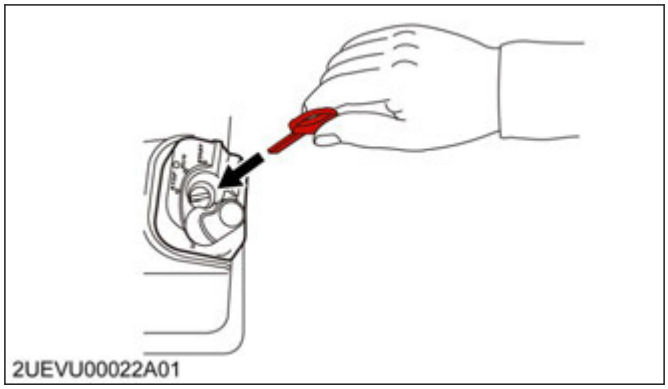
# ANTI-THEFT SYSTEM

## 1. Registering the black key

**■ IMPORTANT**

- **Delete the previous registration of the black keys when registering other new black keys.**
- **If the red key is lost, it is not able to register black keys.**
- **Do not put the metal ring or fob with the red or black keys. It may cause that the key cannot be registered or that the machine cannot be turned on.**
- **Do not bundle the red or black keys together. It may cause that the key cannot be registered or that the machine cannot be turned on.**
- **All black keys, which should be used on the machine, must be registered (old and new black keys).**

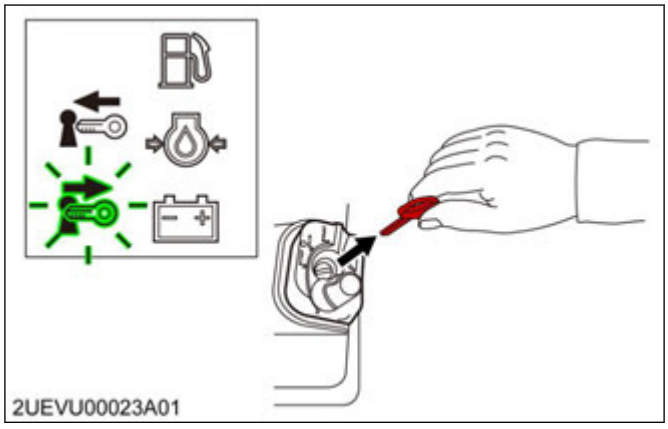
1. Insert the red key into the starter switch and press SW3.



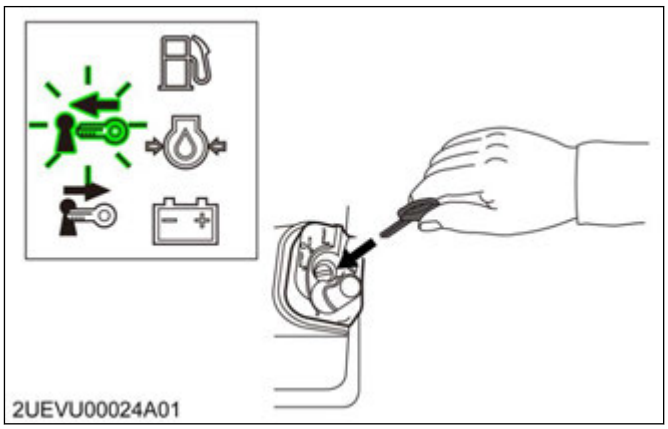

**■ NOTE**

- **Do not turn the starter switch.**

2. Remove the red key when the key pull out lamp turns on.



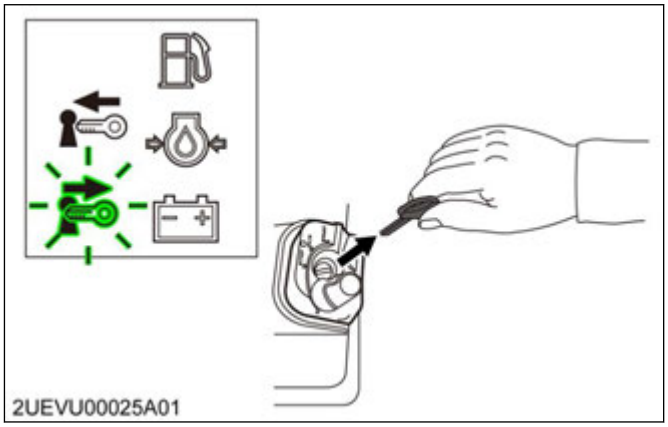

3. Insert the black key when the key insertion lamp turns on.




**■ NOTE**

- **Do not turn the starter switch.**

4. Remove the black key when the key pull out lamp turns on.



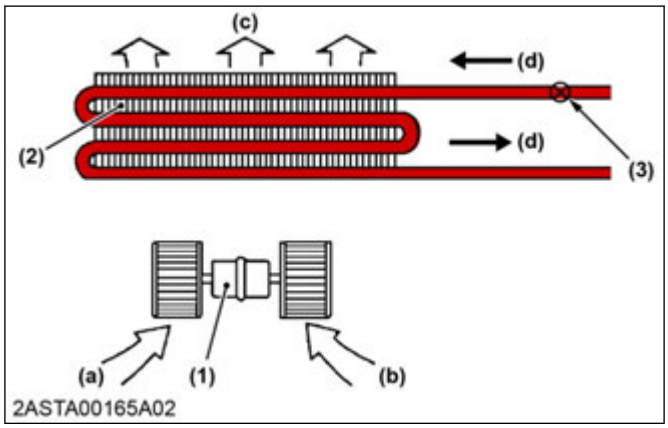

5. Turn the starter switch to **[RUN]** with the black key after completing all of the key registrations.

# 7. AIR CONDITIONING AND HEATER SYSTEM

# MECHANISM

## 1. Heater system general description

The temperature is controlled by a heating cycle using the heat of engine coolant.

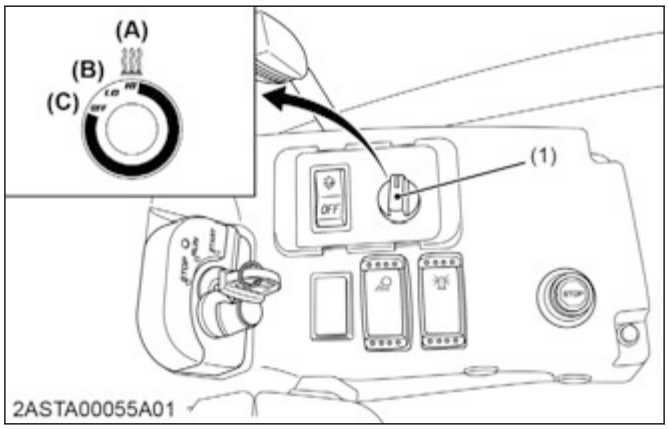


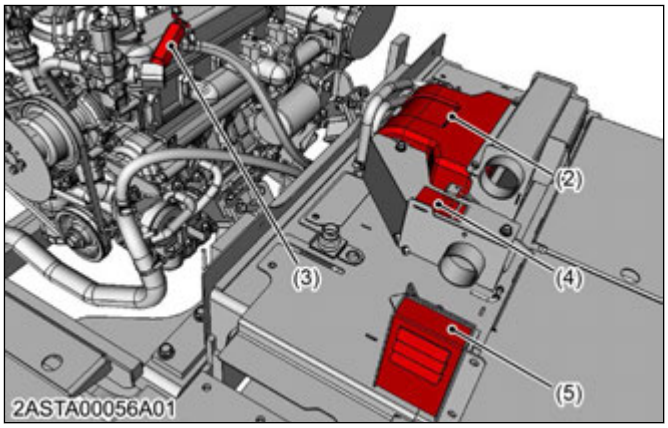

(1) Blower
(2) Heater core
(3) Heater valve
(a) Cabin air
(b) Ambient inlet air
(c) Hot air
(d) Coolant

**Heating cycle**

- The heated coolant flows into the heater core through the heater valve and heats up the cabin and ambient inlet air by the heat convection.
- The heater valve controls the flow rate of the heated coolant. The heated air temperature increases in case that the flow rate increases.
- The coolant returns to the engine.

## 2. Heater device layout

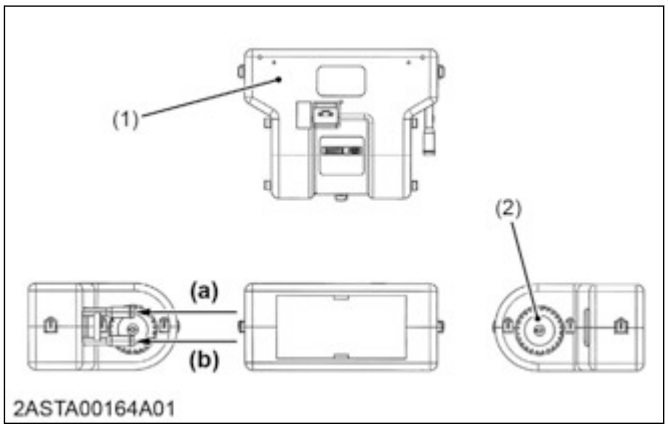



(1) Fan switch
(2) Heater unit
(3) Heater valve
(4) Cabin air inlet
(5) Ambient air inlet
(A) **[HI]**
(B) **[LO]**
(C) **[OFF]**

## 3. Heater unit

### 3.1 Heater unit specifications



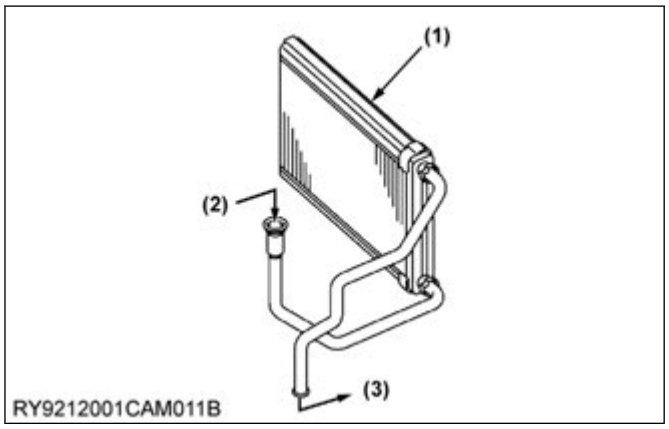

(1) Heater unit
(2) Blower motor
(a) Coolant IN
(b) Coolant OUT

| Items | Specifications | Remark |
|---|---|---|
| Heating capacity | 4.1 kW | Air flow 239 $m^3$/h |
| Mass | 1.7 kg | - |
| Current | 5.6 A | - |

# 3.2 Heater unit function and structure

## 3.2.1 Heater core

Heats up the air which flows through the heater core by the heat convection.

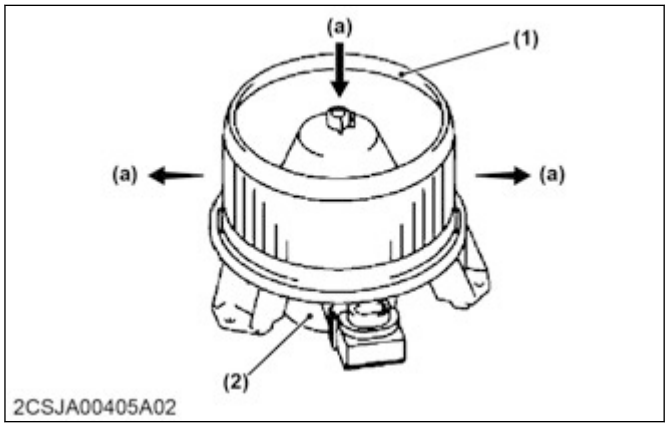



(1) Heater core
(2) Coolant inlet
(3) Coolant outlet

- The heated coolant flows into the heater core.
- The heater core heats up the air which flows through the heater core by the heat convection.

## 3.2.2 Blower

Blows the air to the evaporator and heater core.

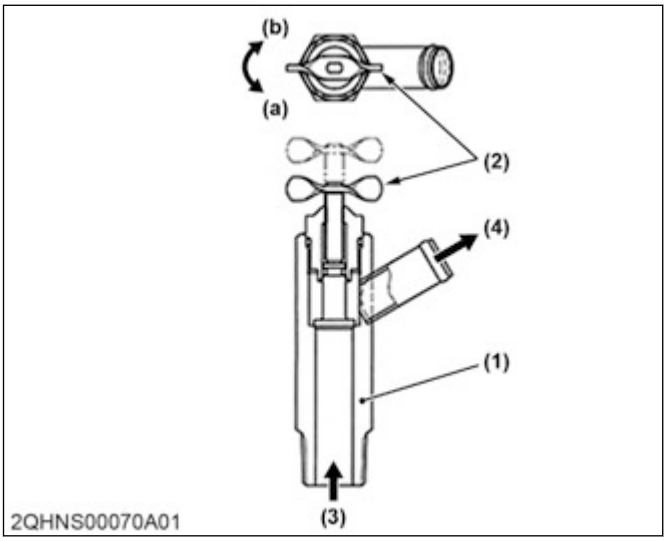



(1) Fan
(2) Blower motor
(a) Air flow

- The blower motor rotates the fan.
- The fan blows the air from inside to outside.
- The air flows to the evaporator and heater core.

## 3.2.3 Heater valve

Adjusts the coolant flow rate.




(1) Heater valve
(2) Lever
(3) Coolant inlet
(4) Coolant outlet
(a) Open
(b) Closed

- The heater valve opens and the coolant flows into the heater core.

# SERVICING

## 1. Troubleshooting

### 1.1 Heater system troubleshooting

**Not heating effectively**

| Cause | Inspections | Actions |
|---|---|---|
| The heater hose is bent or damaged.<br>The heater hose is pinched. | Check the bend and damage of the heater hoses. | Replace the heater hose. |
| The connectors are disconnected or connected loosely. | Check the connection of the relating connectors. | Reconnect the connector.<br>Replace the electrical wiring. |
| The fuse or slow blow fuse has blown. | Check the conduction of the related fuses and slow blow fuses. | Specify the cause of the fuse blowing and replace the fuse. |
| The heater valve is damaged. | Check the damage of the heater valve. | Replace the heater valve. |

**Insufficient air flow**

| Causes | Inspections | Actions |
|---|---|---|
| The air filters are clogged. | Check the condition of the air filters. | Clean or replace the air filter. |
| The air vent is clogged. | Check the condition of the air vents. | Clean the air vent. |
| The connector is connected insecurely. | Check the connection of the related connectors. | Reconnect the connector. |
| The fan switch is damaged. | Check the conduction of the fan switch. | Replace the fan switch. |
| The fan is deformed. | Check the deformation of the fan. | Replace the blower. |
| The blower motor malfunctions. | Check the motion of the blower motor. | Replace the blower. |
| Blower resister is damaged. | Check the resistance of the blower resister. | Replace the blower resistor. |
| The air duct has detached. | Check the connections of the air ducts. | Reinstall the air duct. |
| The wire harness is damaged. | Check the conduction of the related wire harnesses. | Repair or replace the wire harness. |
| Air duct is clogged. | Check the condition of the air ducts. | Clean the air duct.<br>Replace the air duct. |

**No air flow**

| Causes | Inspections | Actions |
|---|---|---|
| The fuse or slow blow fuse has blown. | Check the conduction of the related fuses and slow blow fuses. | Specify the cause of the fuse blowing and replace the fuse. |
| The relay malfunctions. | Check the conduction of the related relays. | Replace the relay. |
| The air duct has detached. | Check the connections of the air ducts. | Reinstall the air duct. |
| The connector is disconnected. | Check the connection of the related connectors. | Reconnect the connector. |
| The wire harness is damaged. | Check the conduction of the related wire harnesses. | Repair or replace the wire harness. |
| The fan switch is damaged. | Check the conduction of the fan switch. | Replace the fan switch. |
| The fan is deformed. | Check the deformation of the fan. | Replace the blower. |
| The blower motor malfunctions. | Check the motion of the blower motor. | Replace the blower. |
| Blower resister is damaged. | Check the resistance of the blower resister. | Replace the blower resister. |
| Air duct is clogged. | Check the condition of the air ducts. | Clean the air duct.<br>Replace the air duct. |
| The air vent is clogged. | Check the condition of the air vents. | Clean the air vent.<br>Replace the air vent. |

**Noise**

| Causes | Inspections | Actions |
|---|---|---|
| The blower motor malfunctions. | Check the noise of the blower motor. | Replace the blower. |
| The fan is deformed. | Check the noise the fan.<br>Check the deformation of the fan. | Replace the blower. |
| The air duct has detached. | Check the connections of the air ducts. | Reinstall the air duct. |
| Air duct is clogged. | Check the condition of the air ducts. | Clean the air duct.<br>Replace the air duct. |
| The air vent is clogged. | Check the condition of the air vents. | Clean the air vent.<br>Replace the air vent. |

# 2. Testing

## 2.1 Checking the fan switch

Check the conduction of the fan switch in each operation to check the condition of the fan switch.

**Preparing**

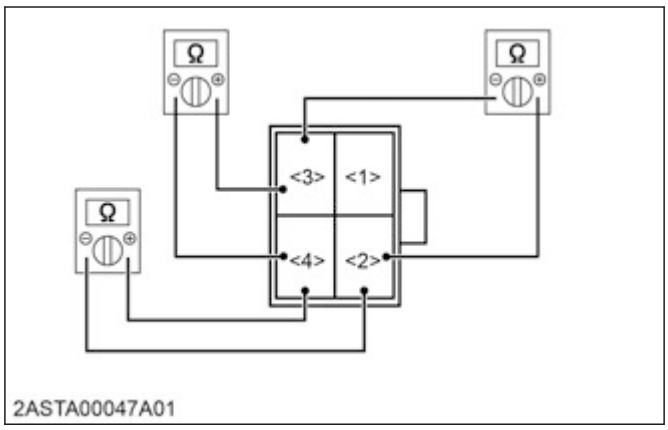
1. Stop the engine.
2. Disconnect the battery cable from negative (-) terminal.
3. Disconnect all of the connector from the fan switch.

**Checking**

1. Check the conduction of the fan switch **[LO]** operation.

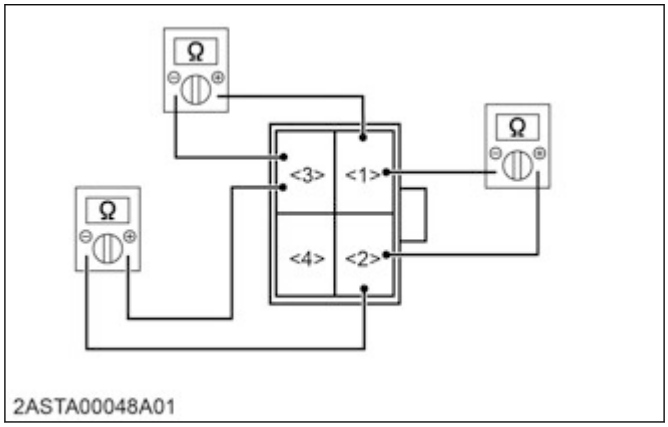



(1) Fan switch connector




- The terminal 2 and 3 conducts
- The terminal 2 and 4 conducts
- The terminal 3 and 4 conducts

2. Check the conduction of the fan switch **[HI]** operation.




- The terminal 1 and 2 conducts
- The terminal 1 and 3 conducts
- The terminal 2 and 3 conducts

## 2.2 Checking the blower motor

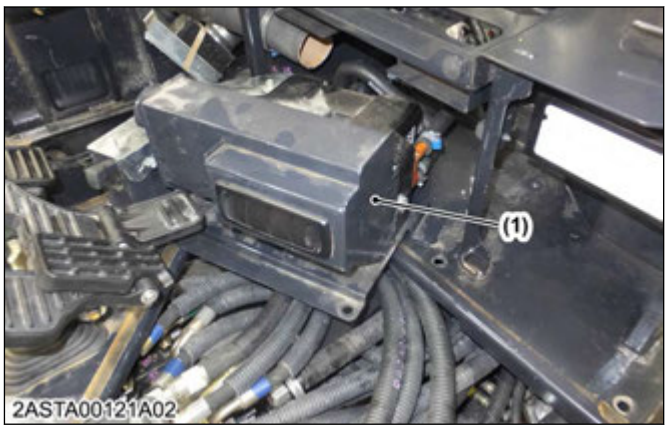
**CAUTION**
- **Stop the engine before working.**
- **Do not work soon after the engine has stopped.**
  - **Coolant is extremely hot.**

**Preparing**

1. Remove the heater unit.

**Checking**

1. Remove the blower motor from the heater unit.

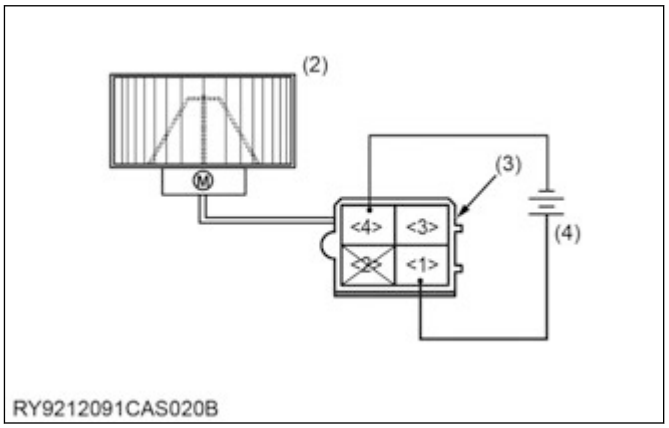



(1) Heater unit

2. Rotate the blower motor by hand and check that the blower motor rotates smoothly.

**NOTE**
- **The blower motor is damaged in case that the blower motor does not rotate smoothly.**

3. Connect a jumper cable from the battery positive (+) terminal to the blower motor connector terminal 1.




(2) Blower motor
(3) Blower motor connector
(4) Battery

4. Connect a jumper cable from the battery negative (-) terminal to the blower motor connector terminal 4 for a second.

**NOTE**
- **The blower motor is damaged in case that the blower motor does not rotate.**

# 3. Repairing

## 3.1 Heater unit

### 3.1.1 Removing and installing the heater unit

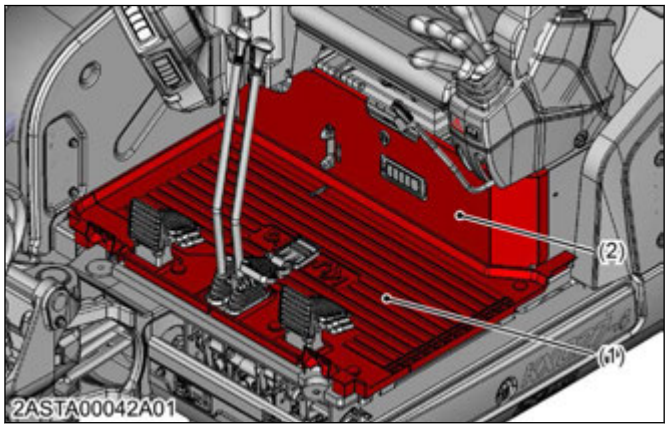
**IMPORTANT**
- **Work at the clean work space with clean tools.**
- **Install plugs to disconnected hoses.**

**Preparing**

1. Drain the coolant.

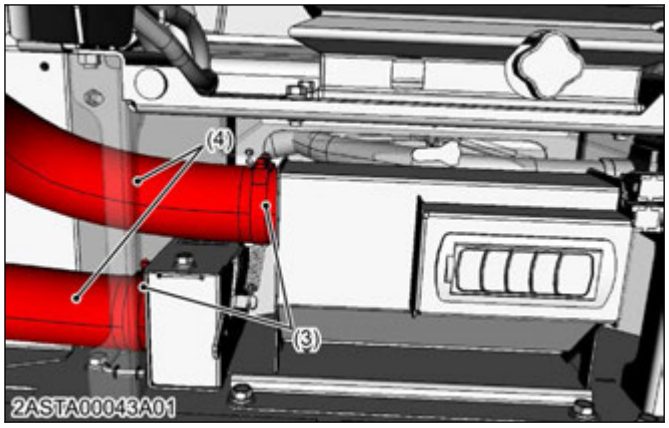
**Removing**

1. Remove the floor panel and cover.



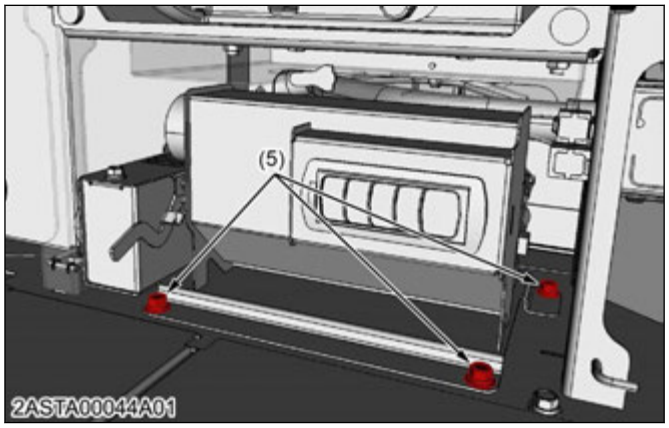

(1) Floor panel (2) Cover

2. Loosen the clamps and disconnect the air ducts.




(3) Clamp (4) Air duct

3. Remove the three bolts.




(5) Bolt (M10 × 20) ×3

4. Disconnect the heater hoses and connector.




(6) Heater hose

**■ NOTE**

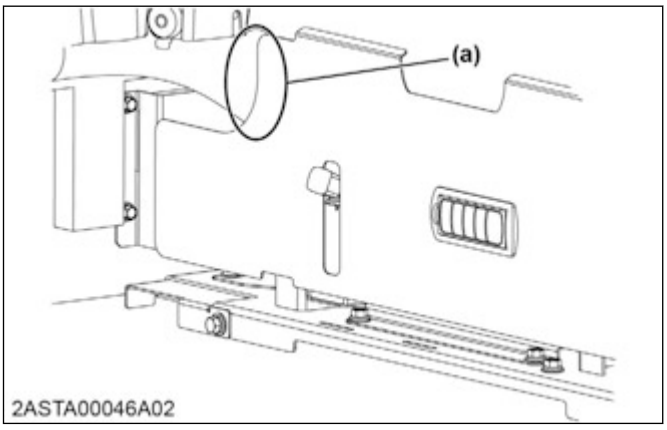
- **Take care of residual coolant in the heater hoses and heating core.**

5. Remove the heater unit.

**Installing**

**■ IMPORTANT**

- **Make sure that the hoses are not kinked.**
- **Replenish the coolant into the engine after installing.**



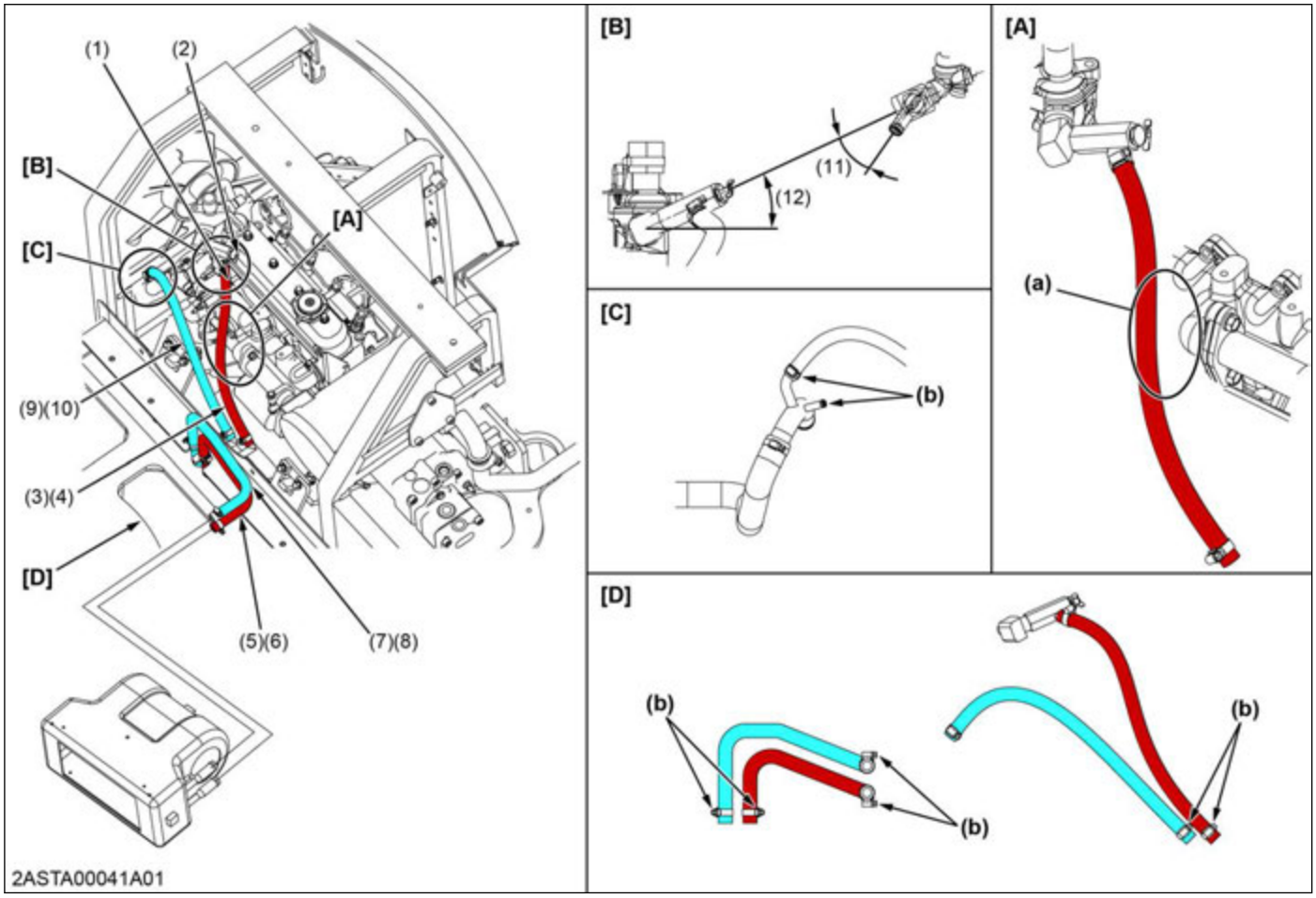

- (a) Do not contact on cover.

# 3.2 Heater hose

## 3.2.1 Heater hose routing

**IMPORTANT**

- **Do not kink the heater hoses.**
- **Insert the heater hoses securely.**




(1) Pipe
(2) Heater valve
(3) Heater hose
(4) Clamp
(5) Heater hose
(6) Clamp
(7) Heater hose
(8) Clamp
(9) Heater hose
(10) Clamp
(11) 30°
(12) 25°

- (a) Keep a clearance of 25 to 35 mm (0.98 to 1.38 in.) between the heater hoses and the exhaust manifold.
- (b) Install the clamp not to contact each other.

| No. | Point of use | Inner diameter |
|---|---|---|
| (3) | Heater valve - Joint | ϕ13 mm<br>ϕ0.51 in. |
| (5) | Joint - Heater core | ϕ13 mm<br>ϕ0.51 in. |
| (7) | Heater core - Joint | ϕ13 mm<br>ϕ0.51 in. |
| (9) | Joint - Engine | ϕ13 mm<br>ϕ0.51 in. |

# 8. APPENDICES

# APPENDICES

## 1. Servicing information

### 1.1 Service specifications for machine body

- Standard measurement condition,
  - Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)
  - Engine speed: maximum speed

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Wear | Pin | | | - | - | - | 1 mm wear on pin outer diameter. |
| | Bushing | | | - | - | - | 1 mm wear on bushing inner diameter. |
| Play | Swivel bearing (vertical play) | | | mm<br>in. | 0.82<br>0.032 | - | 1.64<br>0.066 |
| | Front attachment | | | mm<br>in. | less than 73<br>less than 2.8 | - | 146<br>5.7 |
| Clearance | Swing bracket (vertical clearance) | | | mm<br>in. | 0.5<br>0.02 | - | - |
| | Front attachment (each pin) | | | mm<br>in. | 0.5<br>0.02 | - | - |
| | Front attachment (pins of bucket link 2, 3) | | | mm<br>in. | 1.0<br>0.04 | - | - |
| Force | Control lever | Pilot control lever (Basic) | Forwards | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | | LH and RH | N<br>kgf | 9.6<br>0.98 | ±4.9<br>±0.50 | - |
| | | Pilot control lever (Hi-spec) | Forwards | N<br>kgf | 11.8<br>1.2 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 11.3<br>1.2 | ±4.9<br>±0.50 | - |
| | | | LH and RH | N<br>kgf | 9.3<br>0.95 | ±4.9<br>±0.50 | - |
| | | Travel control lever | Forwards | N<br>kgf | 21.6<br>2.2 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 21.6<br>2.2 | ±4.9<br>±0.50 | - |
| | | Blade control lever | Forwards | N<br>kgf | 24.0<br>2.5 | ±4.9<br>±0.50 | - |
| | | | Backwards | N<br>kgf | 24.0<br>2.5 | ±4.9<br>±0.50 | - |

(Continued)

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Force | Control lever | Lever lock | Raising | N<br>kgf | 27<br>2.8 | ±9.8<br>±1.0 | - |
| | | | Lowering | N<br>kgf | 68<br>6.9 | ±9.8<br>±1.0 | - |
| | | Accelerator lever | Forwards | N<br>kgf | 39.2<br>4.0 | ±14.7<br>±1.5 | - |
| | | | Backwards | N<br>kgf | 34.3<br>3.5 | ±14.7<br>±1.5 | - |
| | | Swing control pedal | LH | N<br>kgf | 44.1<br>4.5 | ±6.7<br>±0.68 | - |
| | | | RH | N<br>kgf | 44.1<br>4.5 | ±6.7<br>±0.68 | - |
| | | AUX control pedal | LH | N<br>kgf | 48.0<br>4.9 | ±6.7<br>±0.68 | - |
| | | | RH | N<br>kgf | 48.0<br>4.9 | ±6.7<br>±0.68 | - |
| Dimension | Track | Steel track | Width | mm<br>in. | 300.0<br>11.8 | - | - |
| | | | Link length | mm<br>in. | 406.4<br>16 | - | 416.4<br>16.4 |
| | | | Height | mm<br>in. | 90.5<br>3.56 | - | 85.5<br>3.37 |
| | | | Grouser height | mm<br>in. | 16.5<br>0.65 | - | 8.0<br>0.3 |
| | | | Bushing length | mm<br>in. | 55.0<br>2.2 | - | - |
| | | | Bushing inner diameter | mm<br>in. | ϕ17.0<br>ϕ0.67 | - | ϕ19.0<br>ϕ0.75 |
| | | | Bushing outer diameter | mm<br>in. | ϕ28.0<br>ϕ1.1 | - | ϕ26.5<br>ϕ1.04 |
| | | | Master pin length | mm<br>in. | 96.5<br>3.8 | - | - |
| | | | Master pin outer diameter | mm<br>in. | ϕ16.8<br>ϕ0.66 | - | ϕ15.5<br>ϕ0.61 |
| | | | Pin length | mm<br>in. | 97<br>3.8 | - | - |
| | | | Pin outer diameter | mm<br>in. | ϕ17<br>ϕ0.67 | - | ϕ15.5<br>ϕ0.61 |
| | | | Number of links | - | 40 | - | - |
| | | | Tension dimension | mm<br>in. | 75.0<br>3.0 | 0 to 5.0<br>0 to 0.1 | - |
| | | Rubber track | Lug height | mm<br>in. | 19.5<br>0.77 | - | - |
| | | | Link height | mm<br>in. | 24.0<br>0.94 | - | - |
| | | | Width | mm<br>in. | 300<br>11.81 | - | - |

(Continued)

| Items | | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|---|
| | | | | | Value | Tolerance | Value |
| Dimension | Track | Rubber track | Height | mm<br>in. | 75.5<br>2.97 | - | - |
| | | | Tension dimension | mm<br>in. | 10.0<br>0.4 | 0 to 5 0<br>0 to 0.2 | - |
| | Carrier roller | Outer diameter | | mm<br>in. | ϕ76.3<br>ϕ3.0 | - | ϕ73.3<br>ϕ2.9 |
| | Front idler | Outer diameter | | mm<br>in. | ϕ272.0<br>ϕ10.7 | 0 to 2.0<br>0 to 0.08 | ϕ268<br>ϕ10.6 |
| | | Guide width | | mm<br>in. | 30.0<br>1.2 | - | 26<br>1.0 |
| | | Idler width | | mm<br>in. | 72.0<br>2.8 | - | - |
| | Sprocket | Outer diameter | | mm<br>in. | ϕ356<br>ϕ14.02 | - | - |
| | | Inner diameter | | mm<br>in. | ϕ156<br>ϕ6.14 | - | - |
| | | Sprocket width | | mm<br>in. | 30<br>1.18 | -1.0 to 0 | 26<br>1.02 |
| | | Gear height | | mm<br>in. | 100<br>3.94 | - | 97<br>3.82 |
| | Tension spring | Steel track | Spring dimension | mm<br>in. | 174.3<br>6.86 | ±0.5<br>±0.020 | - |
| | | Rubber track | Spring dimension | mm<br>in. | 174.3<br>6.86 | ±0.5<br>±0.020 | - |
| | Track roller | Guide diameter | | mm<br>in. | 80.0<br>3.1 | - | 65<br>2.8 |
| | | Guide width | | mm<br>in. | 81.0<br>3.2 | - | 91<br>3.6 |
| | | Outer diameter | | mm<br>in. | ϕ124.0<br>ϕ4.88 | - | ϕ114<br>ϕ4.5 |
| | | Roller width | | mm<br>in. | 175.0<br>6.89 | - | - |

## 1.2 Service specifications for hydraulic system

**■ NOTE**

- **Standard measurement condition,**
  - **– Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)**
  - **– Engine speed: Maximum speed**
  - **– Hydraulic cylinder speed not including cushioning.**

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Pressure | Main relief valve | P1<br>(aP1) | MPa<br>kgf/cm$^2$<br>psi | 23.0<br>234.5<br>3336 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |

(Continued)

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Pressure | Main relief valve | P2 (aP2) | MPa<br>kgf/cm$^2$<br>psi | 23.0<br>234.5<br>3336 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |
| | | P3 (aP3) | MPa<br>kgf/cm$^2$<br>psi | 17.9<br>182.5<br>2596 | -0.5 to 1.0<br>-5 to 10<br>-73 to 144 | - |
| | Pilot primary pressure relief valve | Pilot primary (aPP) | MPa<br>kgf/cm$^2$<br>psi | 4.5<br>45.9<br>652.3 | -0.3 to 0.2<br>-3 to 2<br>-44 to 29 | - |
| | Overload relief valve | Boom bottom (b1B) | MPa<br>kgf/cm$^2$<br>psi | 26.7<br>272.3<br>3873 | ±1.0<br>±10.0<br>±144 | - |
| | | Boom rod (b1R) | MPa<br>kgf/cm$^2$<br>psi | 26.3<br>268.2<br>3815 | ±1.0<br>±10.0<br>±144 | - |
| | | Arm bottom (b2B) | MPa<br>kgf/cm$^2$<br>psi | 26.5<br>270.2<br>3844 | ±1.0<br>±10.0<br>±144 | - |
| | | Arm rod (b2R) | MPa<br>kgf/cm$^2$<br>psi | 26.4<br>269.2<br>3829 | ±1.0<br>±10.0<br>±144 | - |
| | | Bucket bottom (b3B) | MPa<br>kgf/cm$^2$<br>psi | 26.6<br>271.2<br>3858 | ±1.0<br>±10.0<br>±144 | - |
| | | Blade bottom (b4B) | MPa<br>kgf/cm$^2$<br>psi | 26.4<br>269.2<br>3829 | ±1.0<br>±10.0<br>±144 | - |
| | | Swivel RH (cSR) | MPa<br>kgf/cm$^2$<br>psi | 18.0<br>183.5<br>2611 | ±1.0<br>±10.0<br>±144 | - |
| | | Swivel LH (cSL) | MPa<br>kgf/cm$^2$<br>psi | 18.0<br>183.5<br>2611 | ±1.0<br>±10.0<br>±144 | - |
| Flow rate | Piston pump (P1 + P2) (Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 61.1<br>16.1 | - | 48.9<br>12.9 |
| | AUX1 (Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 48.7<br>12.9 | - | - |
| | AUX2 (Engine speed: 2250 rpm, no load, maximum flow rate) | | L/min<br>U.S.gals/min | 19.4<br>5.12 | - | - |
| Internal leakage | Hydraulic cylinder | Boom (10 min, engine stop) | mm<br>in. | less than 20<br>less than 0.79 | - | 100<br>3.94 |
| | | Arm (10 min, engine stop) | mm<br>in. | less than 11<br>less than 0.43 | - | 55<br>2.17 |
| | | Bucket (10 min, engine stop) | mm<br>in. | less than 10<br>less than 0.39 | - | 50<br>1.96 |

(Continued)

| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Internal leakage | Hydraulic cylinder | Blade (10 min, engine stop) | mm<br>in. | less than 25<br>less than 0.98 | - | 75<br>2.95 |
| | Swivel motor | Stopped the engine Activating negative brake | mm<br>in.<br>degree | 0<br>0<br>0 | - | 26<br>1.02<br>5 |
| | | Running the engine in idle speed Releasing negative brake | mm<br>in.<br>degree | 10.0<br>0.39<br>1.9 | - | 157<br>6.18<br>30 |
| | Travel motor | (20 degrees slope) | mm<br>in. | less than 300<br>less than 11.8 | - | - |
| Drain | Swivel motor | RH and LH (Rotating) | L/min<br>U.S.gals/min | 0<br>0 | - | 1.0<br>0.26 |
| | | RH and LH (Relief) | L/min<br>U.S.gals/min | 0.87<br>0.23 | - | 6.0<br>1.6 |
| | Travel motor | Low speed (Rotating) | L/min<br>U.S.gals/min | 0.03<br>0.008 | - | 0.4<br>0.11 |
| | | High speed (Rotating) | L/min<br>U.S.gals/min | 0.14<br>0.037 | - | - |
| | | Low speed (Relief) | L/min<br>U.S.gals/min | 0.59<br>0.16 | - | - |
| | | High speed (Relief) | L/min<br>U.S.gals/min | 0.63<br>0.17 | - | - |
| Speed | Boom cylinder | Lifting (ground to highest) | s | 2.7 | ±0.3 | - |
| | | Lowering (highest to ground) | s | 2.6 | ±0.3 | - |
| | Arm cylinder | Crowding | s | 2.4 | ±0.3 | - |
| | | Dumping | s | 2.6 | ±0.3 | - |
| | Bucket cylinder | Crowding | s | 2.6 | ±0.3 | - |
| | | Dumping | s | 1.7 | ±0.3 | - |
| | Blade cylinder | Lifting (lowest to highest) | s | 2.1 | ±0.3 | - |
| | | Lowering (highest to lowest) | s | 2.8 | ±0.3 | - |
| | Swing cylinder | Swing RH | s | 5.6 | ±0.3 | - |
| | | Swing LH | s | 6.4 | ±0.3 | - |
| | Swivel motor | RH | rpm<br>s/3rotation | 9.8<br>18.4 | ±0.9<br>±1.7 | - |
| | | LH | rpm<br>s/3rotation | 9.8<br>18.4 | ±0.9<br>±1.7 | - |

(Continued)

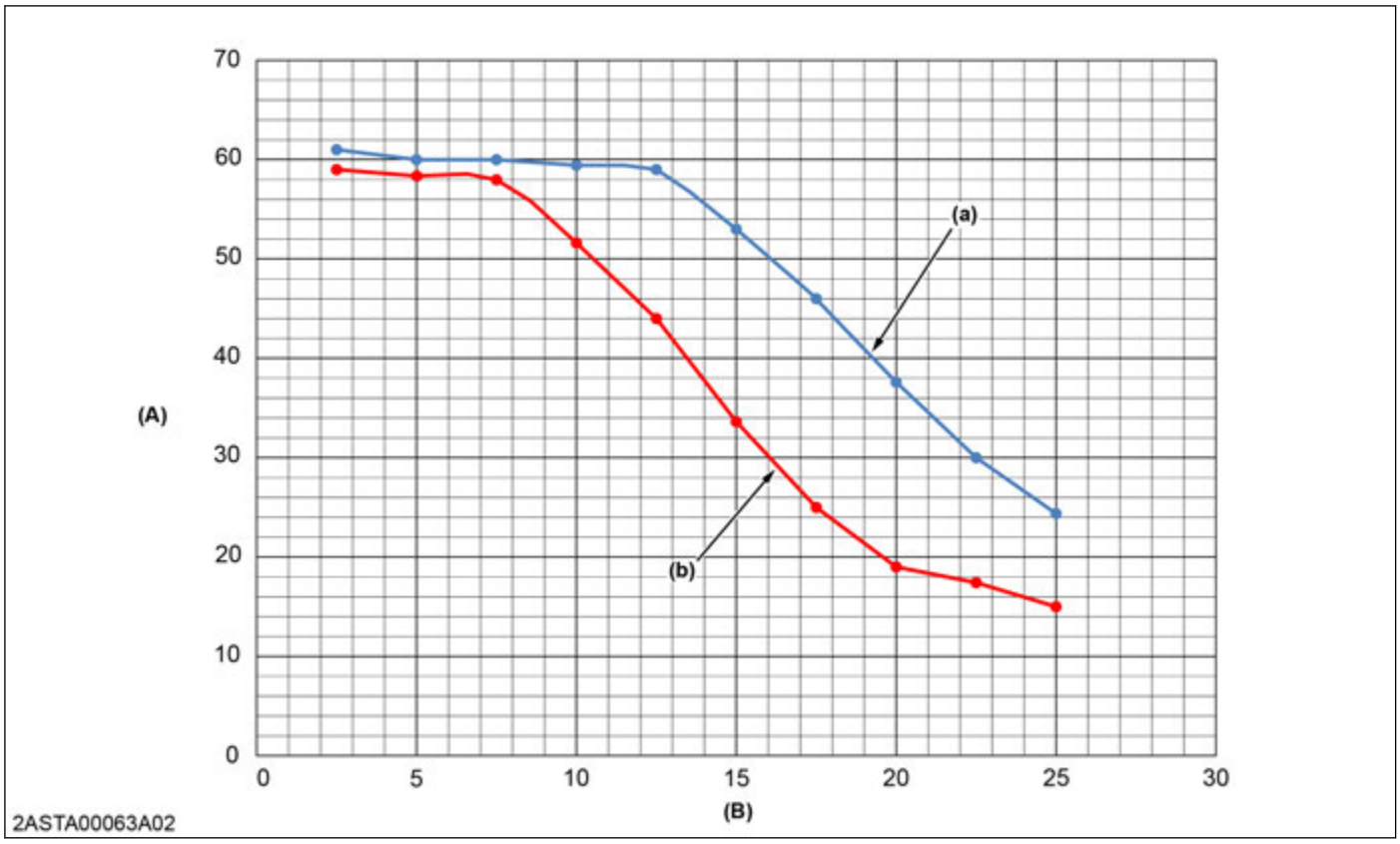
| Items | | | Unit | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Speed | Travel motor | High speed with rubber track | km/h<br>mph<br>s/10 m | 4.6<br>2.86<br>7.83 | ±0.5<br>±0.31<br>-0.87 to +1.10 | - |
| | | Low speed with rubber track | km/h<br>mph<br>s/10 m | 2.5<br>1.68<br>13.33 | ±0.3<br>±0.19<br>-1.16 to +1.43 | - |
| | | High speed with steel track | km/h<br>mph<br>s/10 m | 4.4<br>2.73<br>8.18 | ±0.4<br>±0.25<br>-0.65 to +0.78 | - |
| | | Low speed with steel track | km/h<br>mph<br>s/10 m | 2.4<br>1.49<br>15.00 | ±0.2<br>±0.12<br>-0.92 to +1.07 | - |
| Travel straightness (10 m, 32.8 ft) | | | mm<br>in. | - | - | 600<br>23.6 |

## 1.2.1 Piston pump P-Q performance

### Conditions

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

### Service specification




(a) P1 + P2 (P3 no load) (b) P1 + P2 (P3 load (relief)) (A) Flow rate (L/min) (B) Pressure (MPa)

| Pressure | | Flow rate (converted to 2250 rpm) | | | |
|---|---|---|---|---|---|
| | | P3 no load | | P3 load (relief) | |
| MPa | psi | L/min | U.S.gals/min | L/min | U.S.gals/min |
| 2.5 | 363 | 61.1 | 16.1 | 59.2 | 15.6 |
| 5.0 | 725 | 60.2 | 15.9 | 58.4 | 15.4 |
| 7.5 | 1088 | 60.1 | 15.9 | 58.0 | 15.3 |
| 10.0 | 1450 | 59.4 | 15.7 | 51.6 | 13.6 |
| 12.5 | 1813 | 58.8 | 15.5 | 43.7 | 11.5 |
| 15.0 | 2175 | 53.0 | 14.0 | 33.7 | 8.9 |
| 17.5 | 2538 | 46.2 | 12.2 | 25.0 | 6.6 |
| 20.0 | 2900 | 37.6 | 9.9 | 19.1 | 5.0 |
| 22.5 | 3263 | 30.2 | 8.0 | 17.3 | 4.6 |
| 25.0 | 3625 | 24.5 | 6.5 | 14.6 | 3.9 |

### Service limit

- The service limit is 80% of the service specification.

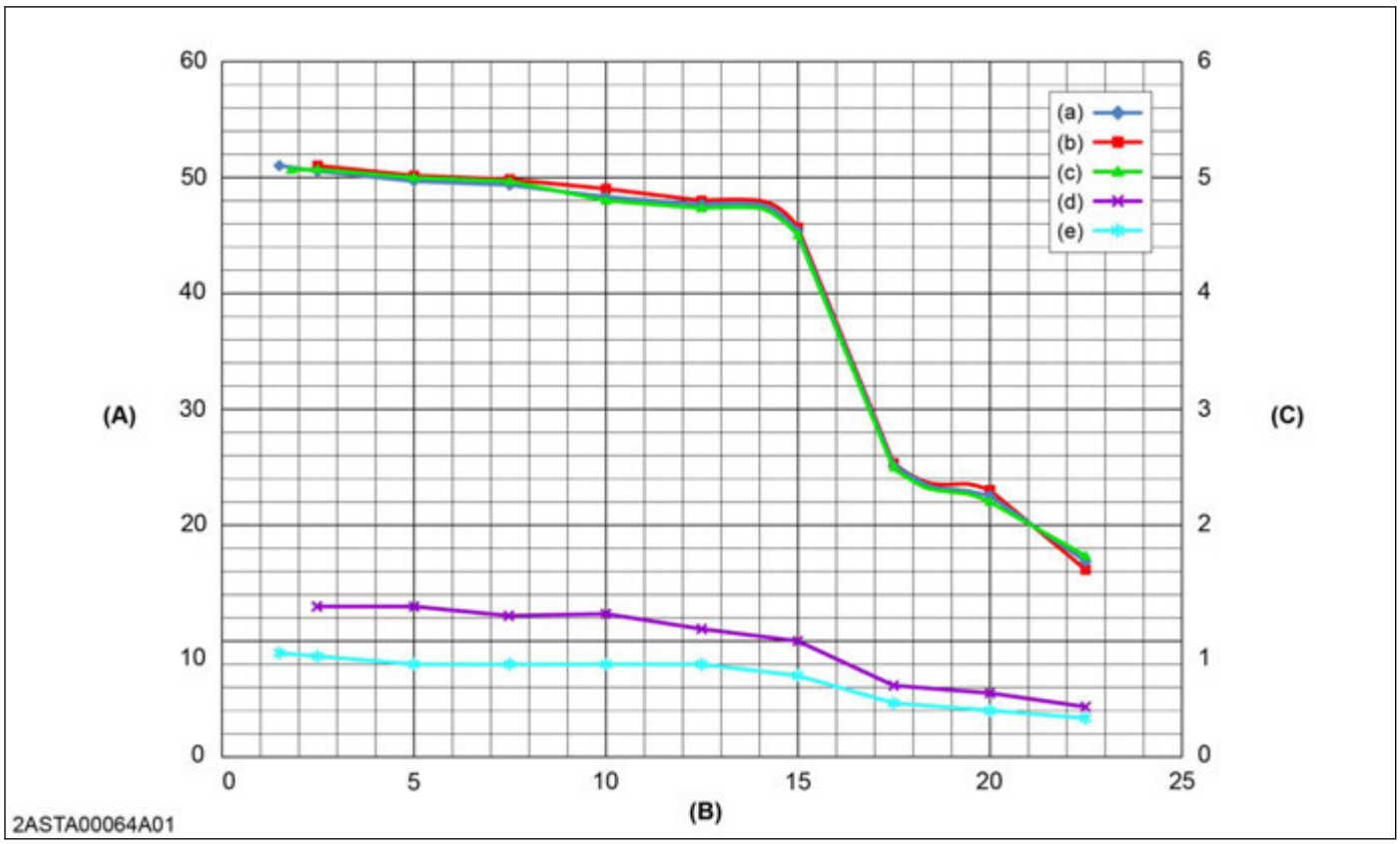
## 1.2.2 AUX P-Q performance

### AUX1 P-Q performance

**Conditions**

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

**Service specification**




(A) Flow rate (L/min)
(B) Pressure (MPa)
(C) Back pressure (MPa)
(a) AUX1 LH (third line open)
(b) AUX1 LH (third line close)
(c) AUX1 RH (third line close)
(d) Back pressure (third line close)
(e) Back pressure (third line open)

### AUX1 LH (third line open)

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 50.6 | 13.4 | 0.84 | 122 |
| 5.0 | 725 | 50.0 | 13.2 | 0.81 | 117 |
| 7.5 | 1088 | 49.0 | 12.9 | 0.79 | 115 |
| 10.0 | 1450 | 48.4 | 12.8 | 0.79 | 115 |
| 12.5 | 1813 | 47.4 | 12.5 | 0.76 | 110 |
| 15.0 | 2176 | 45.4 | 12.0 | 0.69 | 100 |
| 17.5 | 2538 | 25.6 | 6.8 | 0.43 | 62 |
| 20.0 | - | 22.5 | 5.9 | 0.41 | 59 |
| 22.5 | - | 17.0 | 4.5 | 0.35 | 51 |

### AUX1 LH (third line close)

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 51.0 | 13.5 | 1.28 | 186 |
| 5.0 | 725 | 50.0 | 13.2 | 1.26 | 183 |
| 7.5 | 1088 | 49.7 | 13.1 | 1.22 | 177 |
| 10.0 | 1450 | 48.8 | 12.9 | 1.22 | 177 |
| 12.5 | 1813 | 47.8 | 12.6 | 1.10 | 160 |
| 15.0 | 2176 | 45.6 | 12.0 | 1.00 | 145 |
| 17.5 | 2538 | 25.6 | 6.8 | 0.58 | 84 |
| 20.0 | - | 23.0 | 6.1 | 0.53 | 77 |
| 22.5 | - | 16.3 | 4.3 | 0.41 | 59 |

### AUX1 RH (third line close)

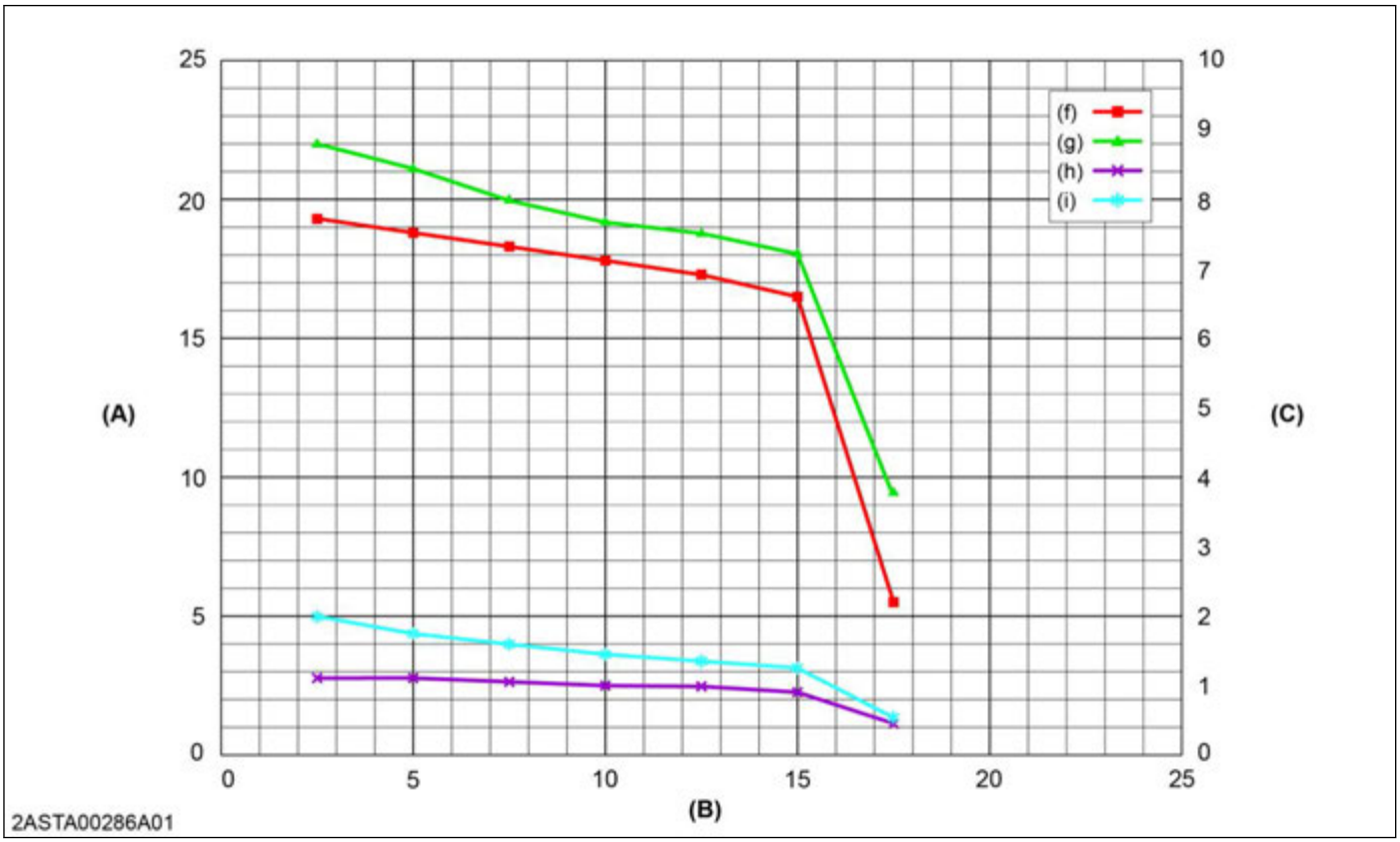
| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 363 | 50.6 | 13.4 | 1.12 | 162 |
| 5.0 | 725 | 50.0 | 13.2 | 1.07 | 155 |
| 7.5 | 1088 | 49.3 | 13.0 | 1.06 | 154 |
| 10.0 | 1450 | 48.2 | 12.7 | 1.02 | 148 |
| 12.5 | 1813 | 47.7 | 12.6 | 0.97 | 141 |
| 15.0 | 2176 | 45.1 | 11.9 | 0.87 | 126 |
| 17.5 | 2538 | 25.3 | 6.9 | 0.48 | 70 |
| 20.0 | - | 22.2 | 5.9 | 0.45 | 65 |
| 22.5 | - | 17.5 | 4.6 | 0.39 | 57 |

### AUX2 P-Q performance

**Conditions**

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

## Service specification




(A) Flow rate (L/min)
(B) Pressure (MPa)
(C) Back pressure (MPa)
(f) AUX2 LH
(g) AUX2 RH
(h) Back pressure (AUX2 LH)
(i) Back pressure (AUX2 RH)

### AUX2 LH

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 508 | 19.2 | 5.07 | 1.13 | 164 |
| 5.0 | 725 | 18.8 | 4.97 | 1.09 | 158 |
| 7.5 | 1088 | 18.3 | 4.83 | 1.04 | 151 |
| 10.0 | 1450 | 17.8 | 4.70 | 1.01 | 146 |
| 12.5 | 1813 | 17.3 | 4.53 | 0.97 | 140 |
| 15.0 | 2176 | 16.5 | 4.36 | 0.91 | 130 |
| 17.5 | 2538 | 5.5 | 1.5 | 0.46 | 67 |

### AUX2 RH

| Pressure | | Discharging flow rate (converted to 2250 rpm) | | Back pressure | |
|---|---|---|---|---|---|
| MPa | psi | L/min | U.S.gals/min | MPa | psi |
| 2.5 | 508 | 22.0 | 5.81 | 1.98 | 287 |
| 5.0 | 725 | 21.1 | 5.57 | 1.76 | 255 |
| 7.5 | 1088 | 19.9 | 5.26 | 1.60 | 232 |
| 10.0 | 1450 | 19.2 | 5.07 | 1.43 | 207 |
| 12.5 | 1813 | 18.8 | 4.97 | 1.35 | 196 |
| 15.0 | 2176 | 18.1 | 4.78 | 1.26 | 183 |
| 17.5 | 2538 | 10.4 | 2.75 | 0.55 | 80 |

# 1.3 Service specifications for engine

| Items | | | Units | Service specifications | | Service limits |
|---|---|---|---|---|---|---|
| | | | | Value | Tolerance | Value |
| Pressure | Compression pressure | | MPa<br>kgf/cm$^2$<br>psi | 3.92<br>40.0<br>569 | ±0.19<br>±2.0<br>±28 | 2.26<br>23.0<br>327 |
| | Engine oil | Idling | kPa<br>kgf/cm$^2$<br>psi | - | - | 49<br>0.5<br>7.1 |
| | | Rated speed | kPa<br>kgf/cm$^2$<br>psi | 319<br>3.25<br>46.25 | ±122<br>±1.25<br>±17.75 | 147<br>1.5<br>21.3 |
| Dimension | Fan belt | | mm<br>in. | 8.0<br>0.32 | ±1.0<br>±0.04 | - |

# 1.4 Service dealer mode

## 1.4.1 Default settings

| Display | Mode | KX027-4 | |
|---|---|---|---|
| | | Basic | Hi-spec |
| no-05 | Model setting | 1: 012<br>2: 004<br>3: N | 1: 012<br>2: 004<br>3: Y |
| no-06 | Clearing periodic check alert | Y (Manual) | |
| no-07 | Informing periodic check alert | N (Inform) | |
| no-09 | Clock setting alert | Y (Inform) | |
| no-10 | Travel buzzer function | N (Deactivation) | |
| no-11 | Travel speed shift switch | N (Hand) | |

## 1.4.2 Tester mode

| No. | Items | Display | Reference |
|---|---|---|---|
| 1 | Engine speed | “oooo” rpm | - |
| 2 | Battery voltage | “oo.o” V | 12 V |
| 3 | Oil SW | “ON” “OFF” | “ON”: lower than 49 kPa<br>“OFF”: higher than 49 kPa |

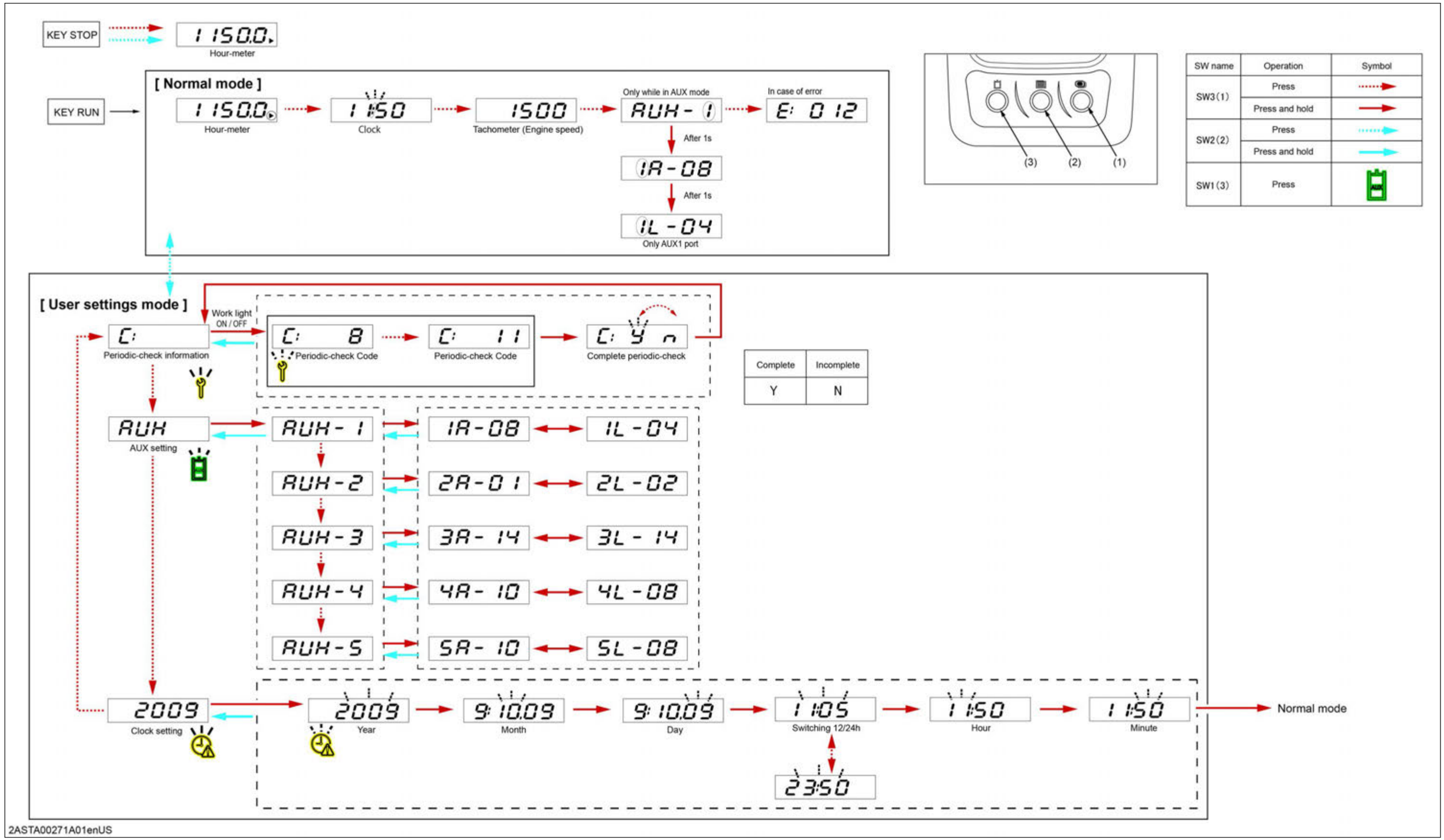
(Continued)

| No. | Items | Display | Reference |
|---|---|---|---|
| 4 | Battery charge SW | "ON" "OFF" | "ON": Engine start<br>"OFF": Engine stop |
| 5 | Starter SW | "ON" "OFF" | "ON": key "START"<br>"OFF": key "STOP" or "RUN" |
| 6 | Work light SW | "ON" "OFF" | "ON": work light SW is ON<br>"OFF": work light SW is OFF |
| 7 | Coolant temperature sensor (voltage) | "o.oo" V | Starter SW "Stop": 0 V<br>Starter SW "RUN": 5 V |
| 8 | Coolant temperature sensor (temperature) | "oo" ℃ | -49 to 149 ℃ |
| 9 | Fuel sensor (voltage) | "o.oo" V | Starter SW "Stop": 0 V<br>Starter SW "RUN": 12 V |
| 10 | Fuel sensor (resistance) | "ooo" Ω | 3±1 to 110±2.5 Ω |
| 11 | Fuel feed SW | "ON" "OFF" | "ON": feed SW is ON<br>"OFF": feed SW is OFF |
| 12 | Travel speed shift switch | "ON" "OFF" | "ON": travel speed shift SW is ON<br>"OFF": travel speed shift SW is OFF |
| 13 | Travel speed shift solenoid | "ON" "OFF" | "ON": travel speed shift SW is ON<br>"OFF": travel speed shift SW is OFF |
| 14 | Lever lock SW | "ON" "OFF" | "ON": lowering lever lock<br>"OFF": raising lever lock |
| 15 | Lever lock SOL | "ON" "OFF" | "ON": lowering lever lock<br>"OFF": raising lever lock |
| 16 | AUX 1 knob SW (voltage) and travel pressure sensor (voltage) | "o.oo" V | 0.26 to 4.74 V |
| 17 | AUX 1 knob SW (setting voltage left) | "o.oo" V | 0.26 to 4.74 V |
| 18 | AUX 1 knob SW (setting voltage neutral) | "o.oo" V | 0.26 to 4.74 V |
| 19 | AUX 1 knob SW (setting voltage right) | "o.oo" V | 0.26 to 4.74 V |
| 20 | AUX 1 SOL (current) | "o.oo" A | 0 to 1.7 A |
| 21 | AUX hold SW | "ON" "OFF" | "ON": AUX hold SW is ON<br>"OFF": AUX hold SW is OFF |
| 22 | AUX switch | "ON" "OFF" | "ON": AUX SW is ON<br>"OFF": AUX SW is OFF |
| 23 | AUX1 RH setting | "oo" × 10 mA | - |
| 24 | AUX1 LH setting | "oo" × 10 mA | - |
| 25 | Key type | "o" | "0" (Unknown)<br>"1" (Red)<br>"2" (Black)<br>"3" (Yellow)<br>"4" (Green)<br>"5" (Red Yellow)<br>"6" (Red Green) |
| 26 | Anti-theft key analysis (registered key) | "ON" "OFF" | "ON": match<br>"OFF": mismatch |
| 27 | Anti-theft mode | "ON" "OFF" | "ON": deactivation<br>"OFF": activation |

(Continued)

| No. | Items | Display | Reference |
|---|---|---|---|
| 28 | Key | “ON” “OFF” | “ON”: existence<br>“OFF”: non-existence |
| 29 | Anti-theft antenna | “ON” “OFF” | “ON”: error<br>“OFF”: normal |

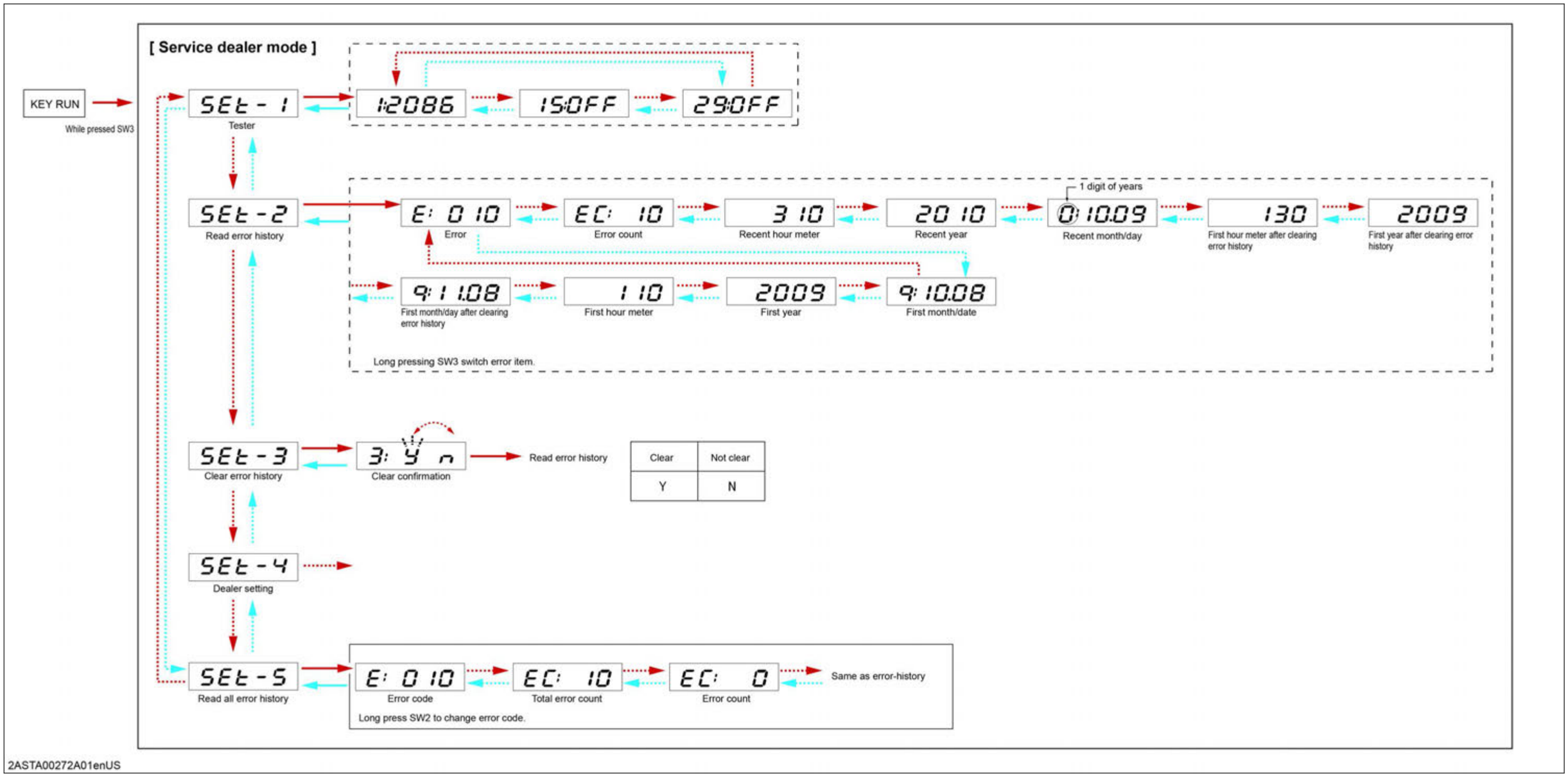
# 2. Meter flow chart



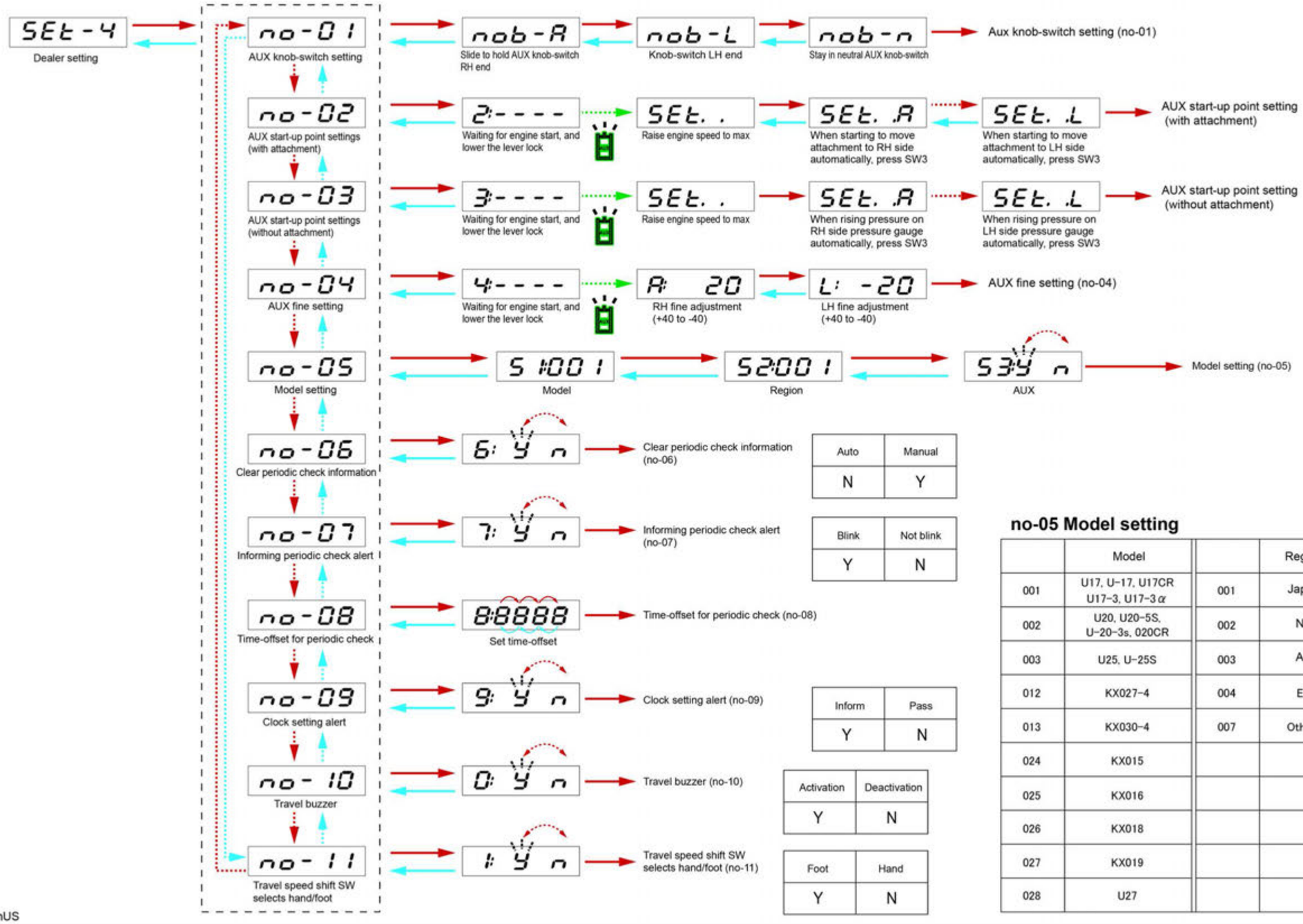

| SW name | Operation | Symbol |
|---|---|---|
| SW3(1) | Press | |
| | Press and hold | |
| SW2(2) | Press | |
| | Press and hold | |
| SW1(3) | Press | |

| Complete | Incomplete |
|---|---|
| Y | N |

## 8. APPENDICES




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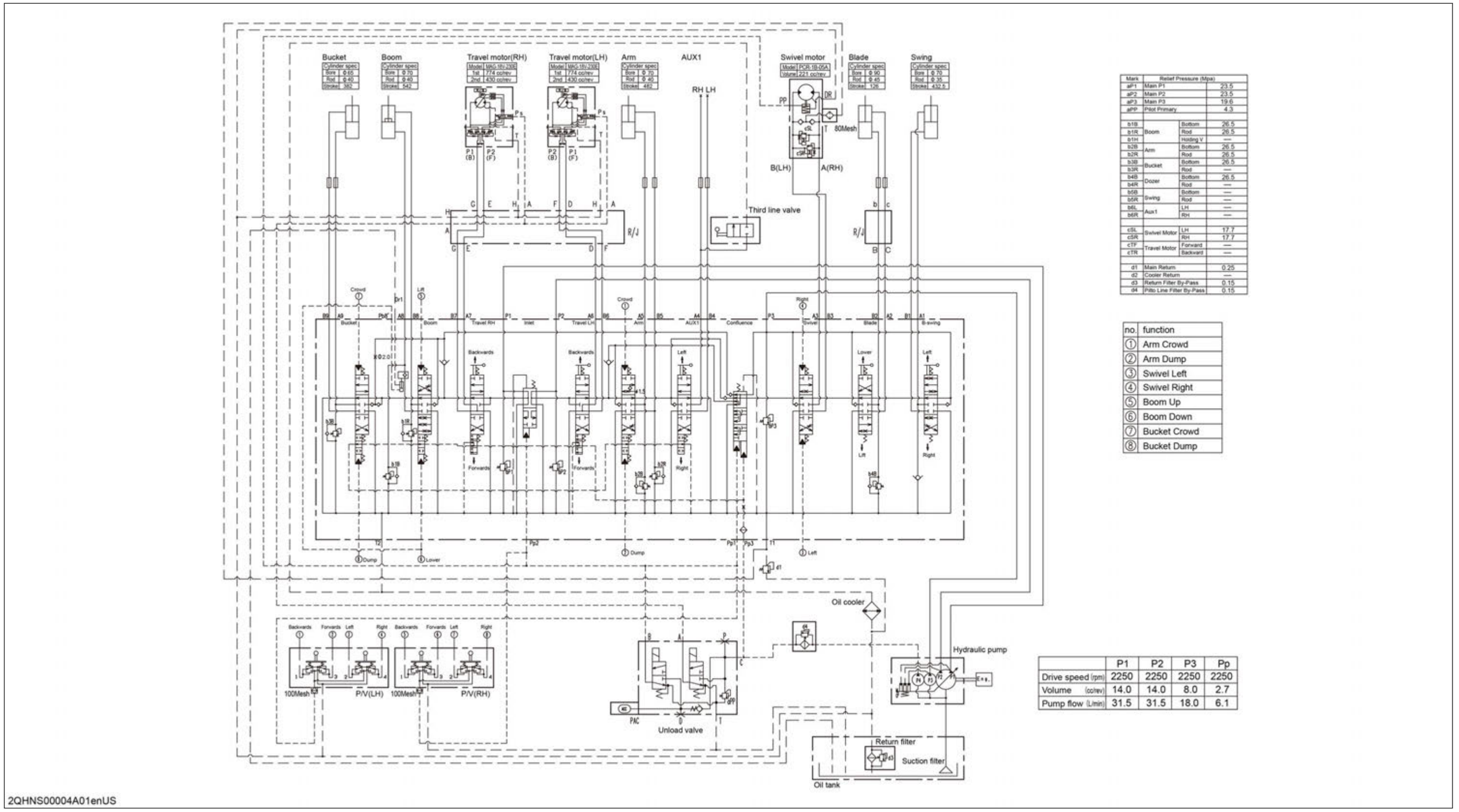

**no-05 Model setting**

| | Model | | Region | | AUX |
|---|---|---|---|---|---|
| 001 | U17, U-17, U17CR U17-3, U17-3 α | 001 | Japan | Y | Proportional AUX (Kubota software control) |
| 002 | U20, U20-5S, U-20-3s, 020CR | 002 | NA | N | Other |
| 003 | U25, U-25S | 003 | AU | | |
| 012 | KX027-4 | 004 | EU | | |
| 013 | KX030-4 | 007 | Others | | |
| 024 | KX015 | | | | |
| 025 | KX016 | | | | |
| 026 | KX018 | | | | |
| 027 | KX019 | | | | |
| 028 | U27 | | | | |

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# 3. Hydraulic circuit diagram

## 3.1 Hydraulic circuit diagram for basic specification

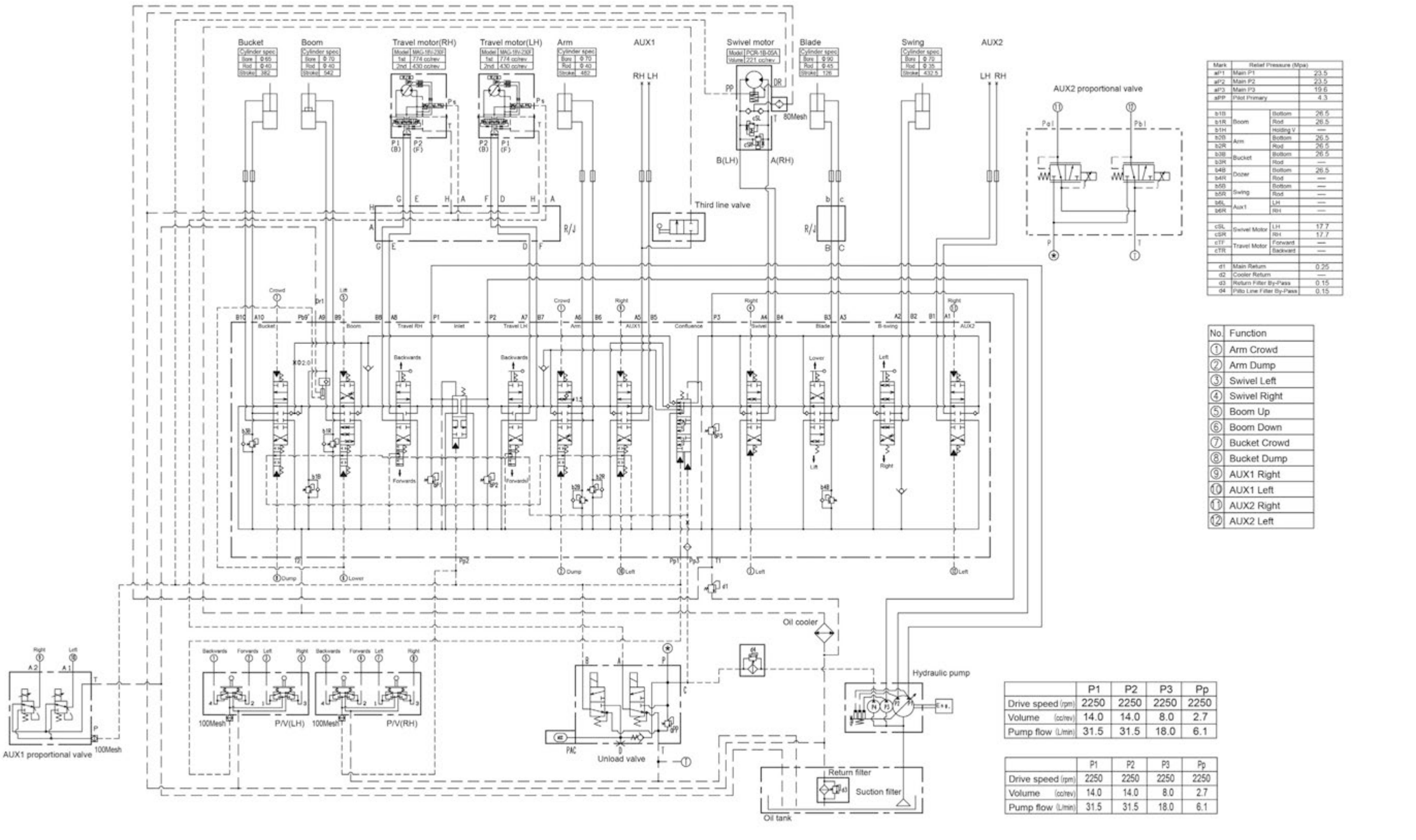



| Mark | Relief Pressure (Mpa) | | |
|---|---|---|---|
| aP1 | Main P1 | | 23.5 |
| aP2 | Main P2 | | 23.5 |
| aP3 | Main P3 | | 19.6 |
| aPP | Pilot Primary | | 4.3 |
| | | | |
| b1B | Boom | Bottom | 26.5 |
| b1R | | Rod | 26.5 |
| b1H | | Holding V. | — |
| b2B | Arm | Bottom | 26.5 |
| b2R | | Rod | 26.5 |
| b3B | Bucket | Bottom | 26.5 |
| b3R | | Rod | — |
| b4B | Dozer | Bottom | 26.5 |
| b4R | | Rod | — |
| b5B | Swing | Bottom | — |
| b5R | | Rod | — |
| b6L | Aux1 | LH | — |
| b6R | | RH | — |
| | | | |
| cSL | Swivel Motor | LH | 17.7 |
| cSR | | RH | 17.7 |
| cTF | Travel Motor | Forward | — |
| cTR | | Backward | — |
| | | | |
| d1 | Main Return | | 0.25 |
| d2 | Cooler Return | | — |
| d3 | Return Filter By-Pass | | 0.15 |
| d4 | Pilto Line Filter By-Pass | | 0.15 |

| no. | function |
|---|---|
| ① | Arm Crowd |
| ② | Arm Dump |
| ③ | Swivel Left |
| ④ | Swivel Right |
| ⑤ | Boom Up |
| ⑥ | Boom Down |
| ⑦ | Bucket Crowd |
| ⑧ | Bucket Dump |

| | P1 | P2 | P3 | Pp |
|---|---|---|---|---|
| Drive speed (rpm) | 2250 | 2250 | 2250 | 2250 |
| Volume (cc/rev) | 14.0 | 14.0 | 8.0 | 2.7 |
| Pump flow (L/min) | 31.5 | 31.5 | 18.0 | 6.1 |

## 3.2 Hydraulic circuit diagram for Hi spec




| Mark | Relief Pressure (Mpa) | | |
|---|---|---|---|
| aP1 | Main P1 | | 23.5 |
| aP2 | Main P2 | | 23.5 |
| aP3 | Main P3 | | 19.6 |
| aPP | Pilot Primary | | 4.3 |
| | | | |
| b1B | Boom | Bottom | 26.5 |
| b1R | | Rod | 26.5 |
| b1H | | Holding V | — |
| b2B | Arm | Bottom | 26.5 |
| b2R | | Rod | 26.5 |
| b3B | Bucket | Bottom | 26.5 |
| b3R | | Rod | — |
| b4B | Dozer | Bottom | 26.5 |
| b4R | | Rod | — |
| b5B | Swing | Bottom | — |
| b5R | | Rod | — |
| b6L | Aux1 | LH | — |
| b6R | | RH | — |
| | | | |
| cSL | Swivel Motor | LH | 17.7 |
| cSR | | RH | 17.7 |
| cTF | Travel Motor | Forward | — |
| cTR | | Backward | — |
| | | | |
| d1 | Main Return | | 0.25 |
| d2 | Cooler Return | | — |
| d3 | Return Filter By-Pass | | 0.15 |
| d4 | Pilto Line Filter By-Pass | | 0.15 |

| No. | Function |
|---|---|
| ① | Arm Crowd |
| ② | Arm Dump |
| ③ | Swivel Left |
| ④ | Swivel Right |
| ⑤ | Boom Up |
| ⑥ | Boom Down |
| ⑦ | Bucket Crowd |
| ⑧ | Bucket Dump |
| ⑨ | AUX1 Right |
| ⑩ | AUX1 Left |
| ⑪ | AUX2 Right |
| ⑫ | AUX2 Left |

| | P1 | P2 | P3 | Pp |
|---|---|---|---|---|
| Drive speed (rpm) | 2250 | 2250 | 2250 | 2250 |
| Volume (cc/rev) | 14.0 | 14.0 | 8.0 | 2.7 |
| Pump flow (L/min) | 31.5 | 31.5 | 18.0 | 6.1 |

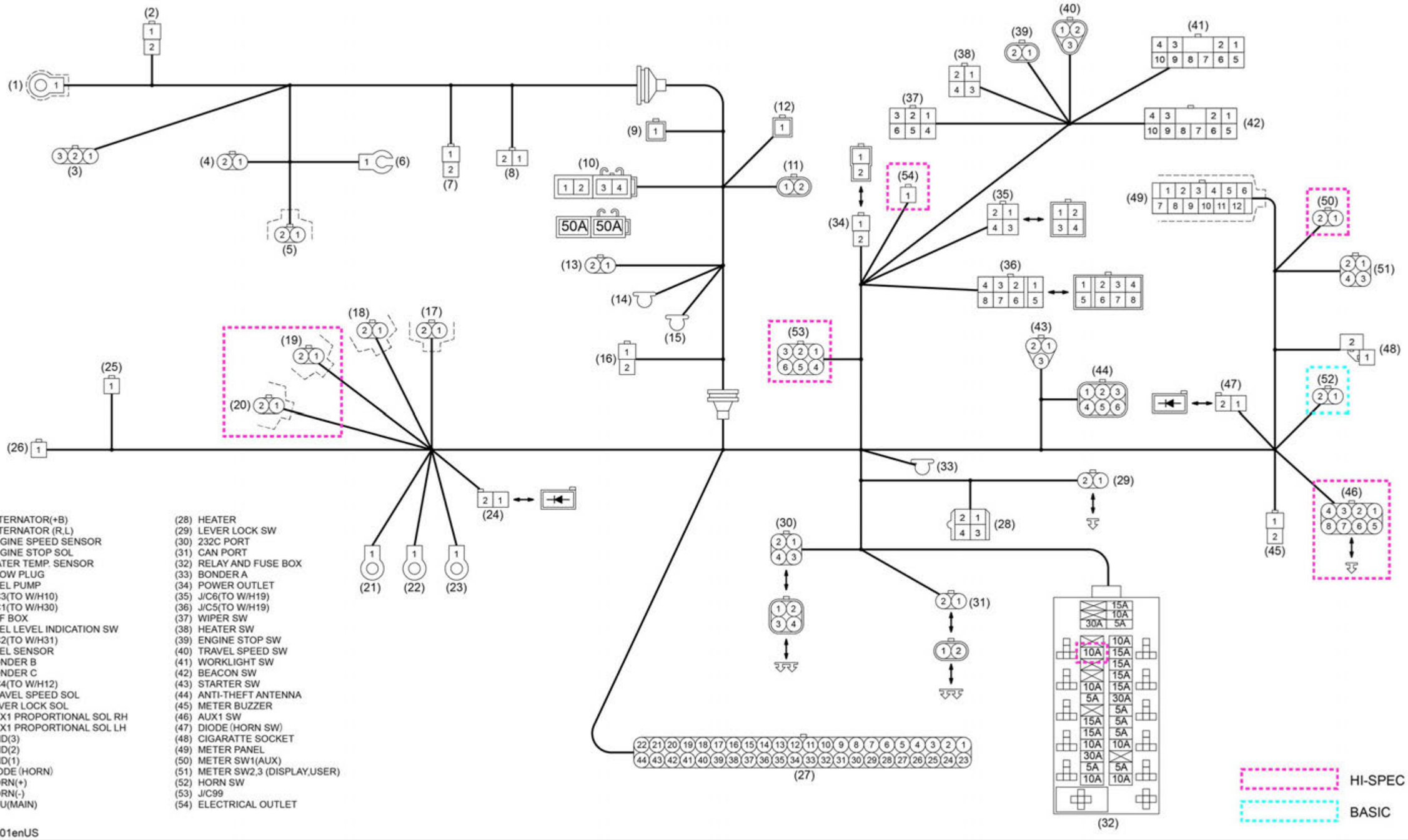
| | P1 | P2 | P3 | Pp |
|---|---|---|---|---|
| Drive speed (rpm) | 2250 | 2250 | 2250 | 2250 |
| Volume (cc/rev) | 14.0 | 14.0 | 8.0 | 2.7 |
| Pump flow (L/min) | 31.5 | 31.5 | 18.0 | 6.1 |

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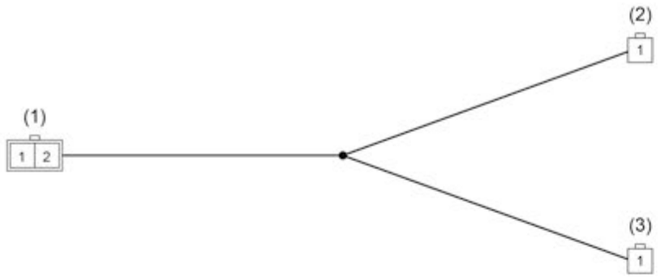
# 4. Wire harness

## 4.1 Wire harness

### W/H00 (MAIN)

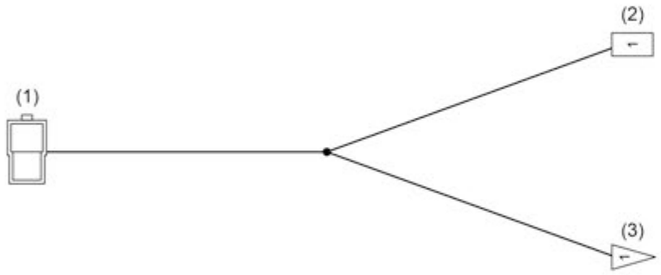


## W/H10 (ENGINE)



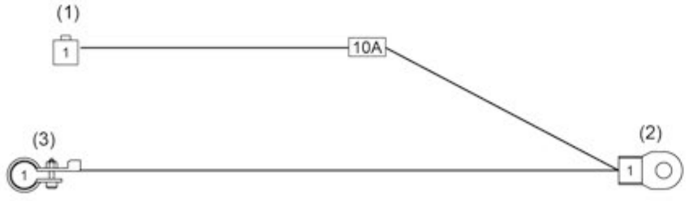

(1) J/C3(TO W/H00)
(2) ENGINE OIL PRESSURE SW
(3) STARTER

## W/H12 (FRONT)




(1) J/C4(TO W/H10)
(2) WORKLIGHT(+)
(3) WORKLIGHT(-)

## W/H30 CORD, BATTERY(1,+)




(1) J/C1 (TO W/H00)
(2) BATTERY_1+
(3) BATTERY_ISOLATER

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## W/H31 CORD, BATTERY(2, +)




(1) BATTERY ISOLATER(2+)
(2) STARTER(+B)
(3) J/C2(TO W/H00)

## W/H33 CORD, BATTERY(-)



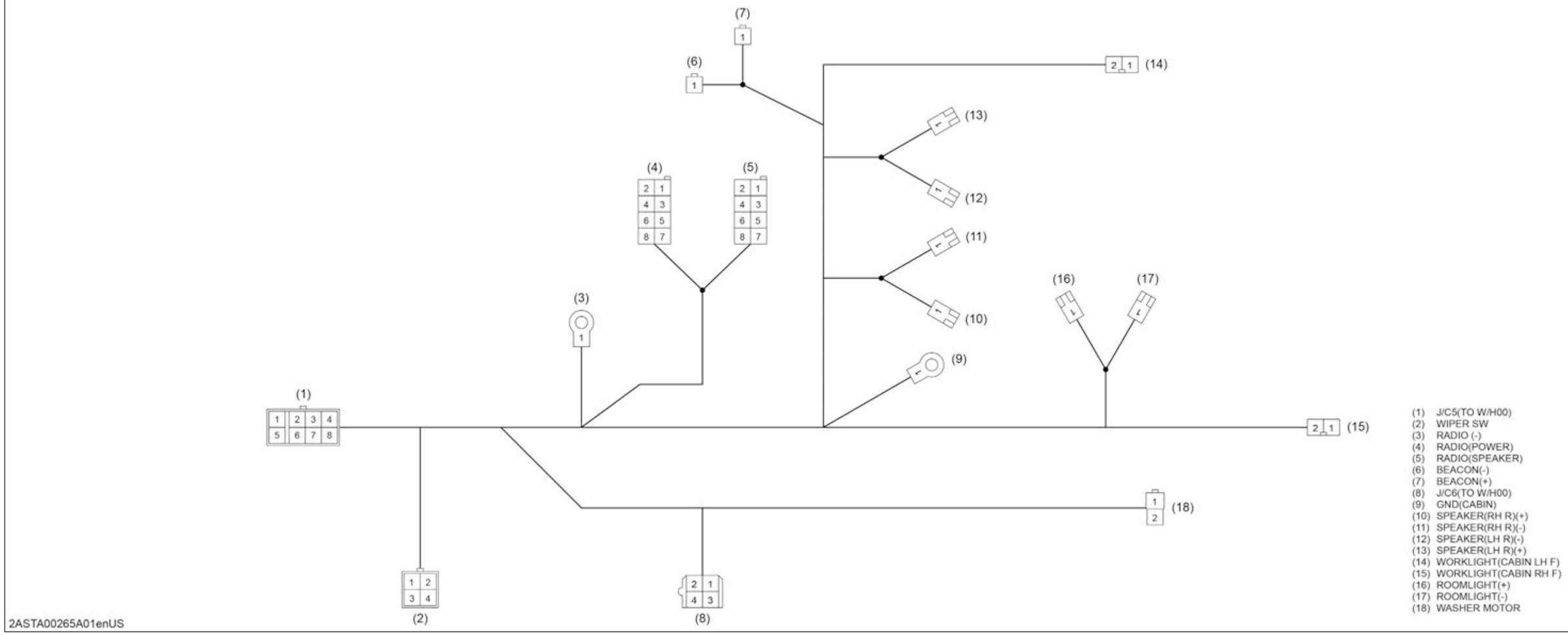

(1) BATTERY(-)
(2) GND(SWIVEL FRAME)

## W/H34 CORD, BODYEARTH



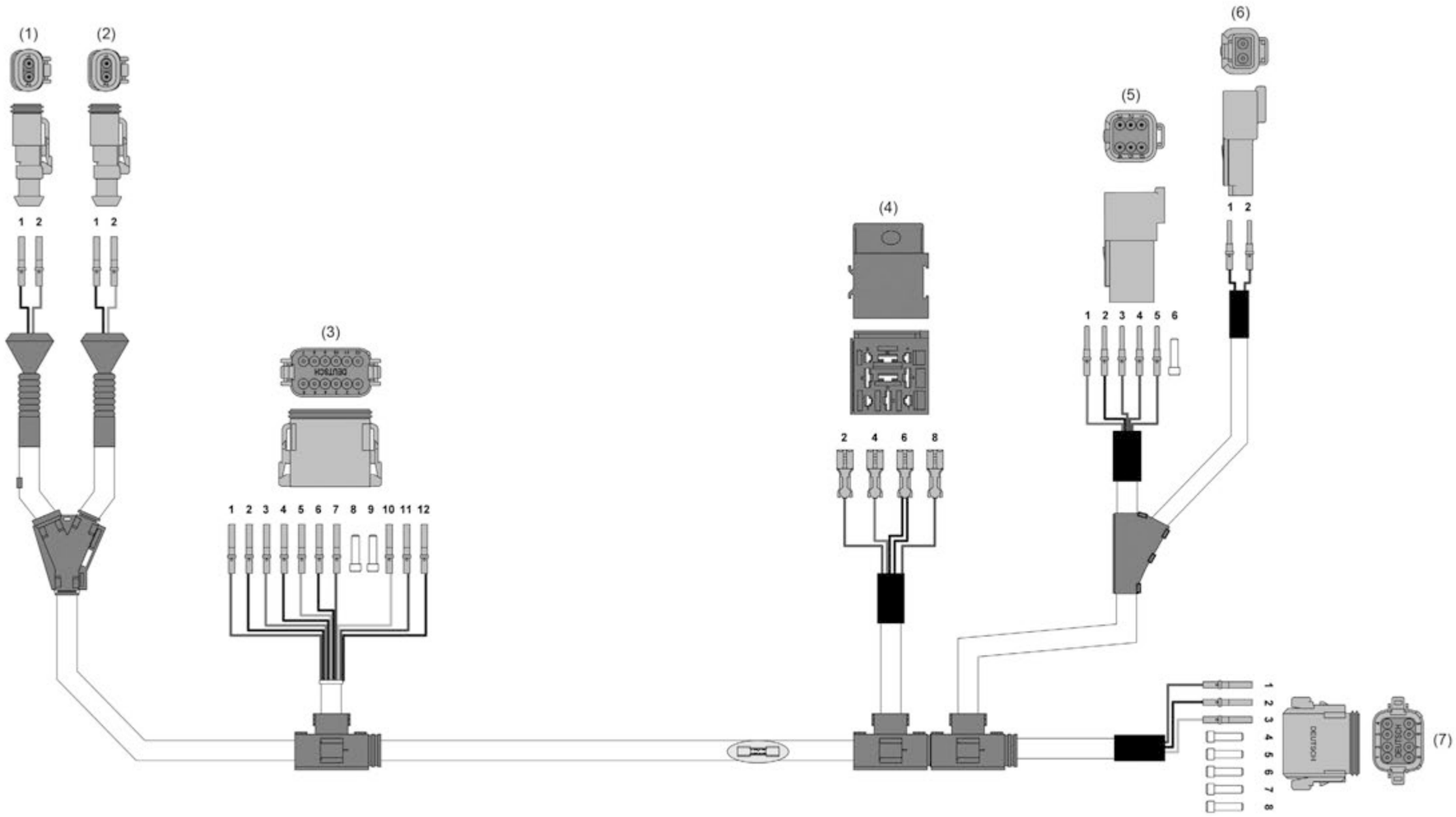

(1) ENGINE(GND)
(2) GND(SWIVEL FRAME)

# W/H19 (CABIN)




(1) J/C5(TO W/H00)
(2) WIPER SW
(3) RADIO (-)
(4) RADIO(POWER)
(5) RADIO(SPEAKER)
(6) BEACON(-)
(7) BEACON(+)
(8) J/C6(TO W/H00)
(9) GND(CABIN)
(10) SPEAKER(RH R)(+)
(11) SPEAKER(RH R)(-)
(12) SPEAKER(LH R)(-)
(13) SPEAKER(LH R)(+)
(14) WORKLIGHT(CABIN LH F)
(15) WORKLIGHT(CABIN RH F)
(16) ROOMLIGHT(+)
(17) ROOMLIGHT(-)
(18) WASHER MOTOR

## W/H (AUX2)




(1) AUX2 PROPOTIONAL SOL RH
(2) AUX2 PROPOTIONAL SOL LH
(3) ECU(AUX2)
(4) RELAY(AUX2)
(5) J/C99
(6) AUX2 DIAL
(7) J/C98

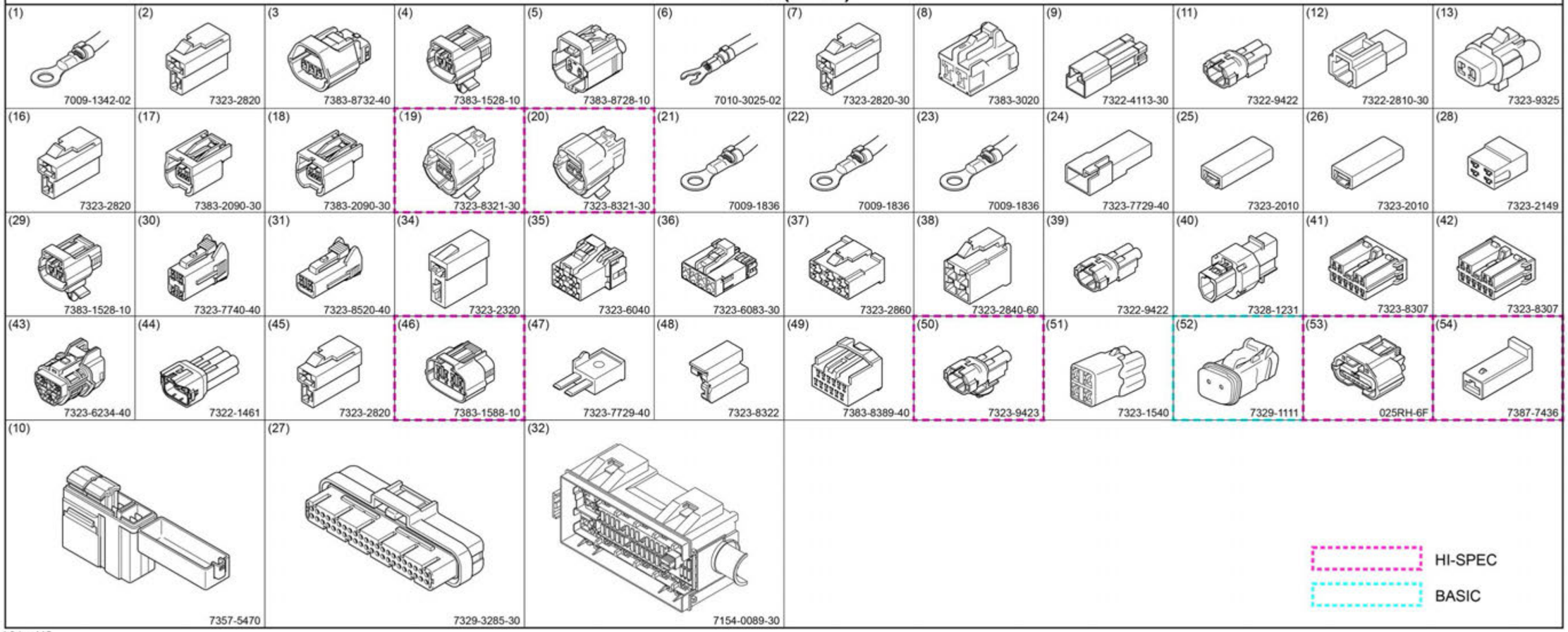
## W/H (AUX2 KNOB SWITCH)



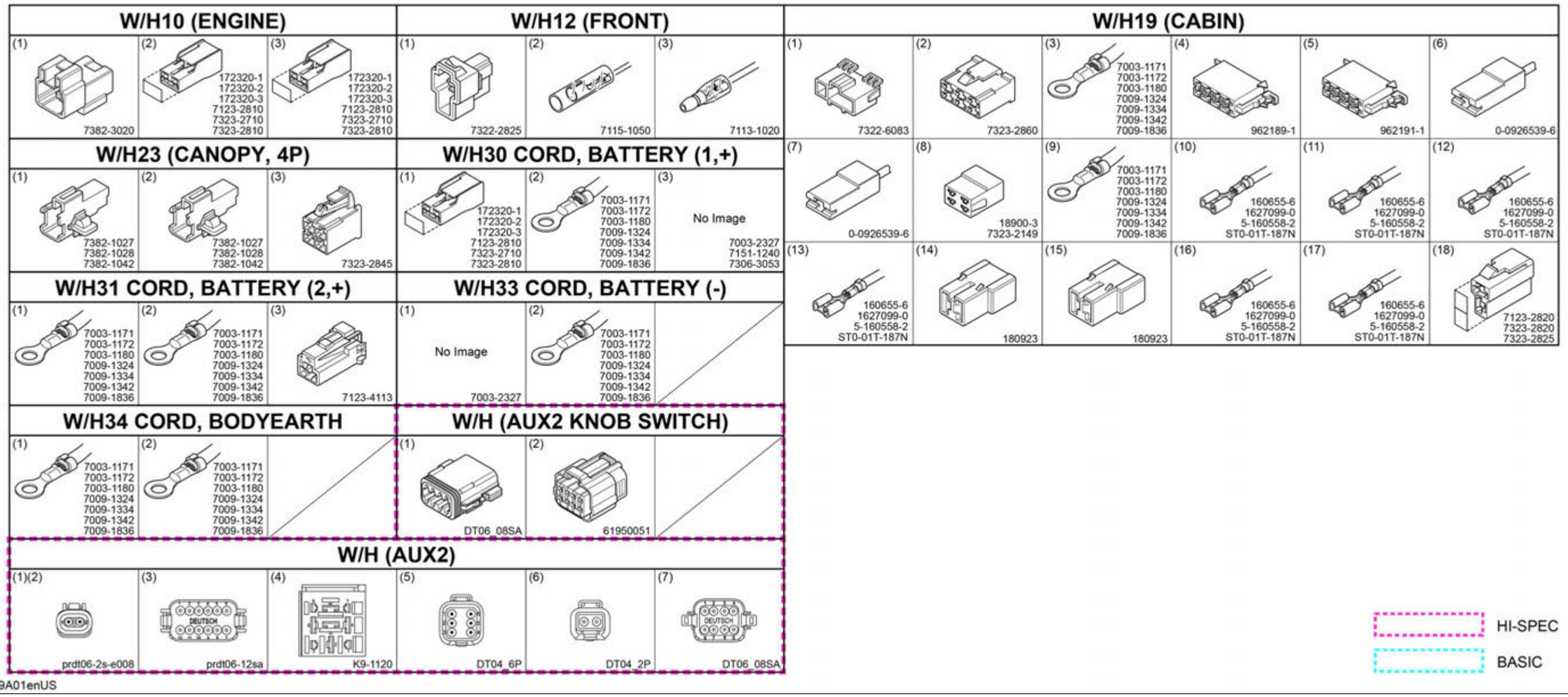

(7) J/C98
(8) AUX2 KNOB SWICH

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## W/H00 (MAIN)

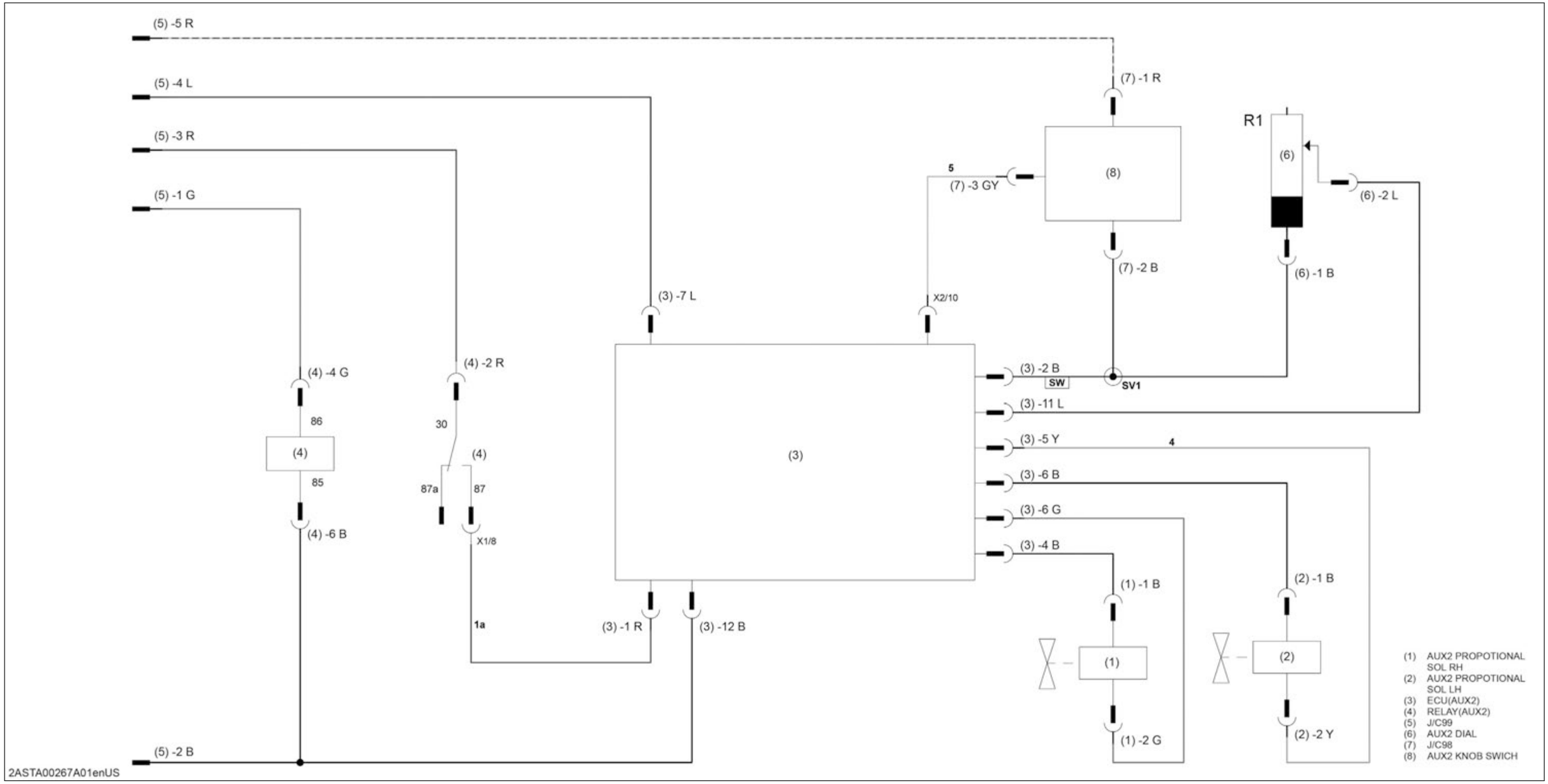



2ASTA00278A01enUS


W/H10 (ENGINE)
(1) 7382-3020
(2) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
(3) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
W/H12 (FRONT)
(1) 7322-2825
(2) 7115-1050
(3) 7113-1020
W/H19 (CABIN)
(1) 7322-6083
(2) 7323-2860
(3) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(4) 962189-1
(5) 962191-1
(6) 0-0926539-6
W/H23 (CANOPY, 4P)
(1) 7382-1027 7382-1028 7382-1042
(2) 7382-1027 7382-1028 7382-1042
(3) 7323-2845
W/H30 CORD, BATTERY (1,+)
(1) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(3) No Image 7003-2327 7151-1240 7306-3053
(7) 0-0926539-6
(8) 18900-3 7323-2149
(9) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(10) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(11) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(12) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
W/H31 CORD, BATTERY (2,+)
(1) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(3) 7123-4113
W/H33 CORD, BATTERY (-)
(1) No Image 7003-2327
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(13) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(14) 180923
(15) 180923
(16) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(17) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(18) 7123-2820 7323-2820 7323-2825
W/H34 CORD, BODYEARTH
(1) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
W/H (AUX2 KNOB SWITCH)
(1) DT06_08SA
(2) 61950051
W/H (AUX2)
(1)(2) prdt06-2s-e008
(3) prdt06-12sa
(4) K9-1120
(5) DT04_6P
(6) DT04_2P
(7) DT06_08SA
HI-SPEC
BASIC
2ASTA00279A01enUS

# 5. Electrical circuit diagram

## 5.1 Electrical circuit diagram for Hi-spec



| | |
|---|---|
| W/H00 | W/H(MAIN) |
| W/H10 | W/H(ENGINE) |
| W/H12 | W/H(FRONT) |
| W/H19 | W/H(CABIN) |
| W/H30 | BATTERY(1,+) |
| W/H31 | BATTERY(2,+) |
| W/H33 | CORD,BATTERY(-) |
| W/H34 | CORD,BODY EARTH |

| Composition Specification Code | Notes |
|---|---|
| BASE | All use |
| AT | Anti-Theft |
| BI | Battery isolator |
| ES | Engine stop SW |
| BCN | Beacon |
| HT | Heater |
| AUX1 | AUX1 SW |
| HS | Horn SW (Right grip) |
| CAB | Cabin specification |
| CNP | Canopy specification |
| N_AB | Not Angle blade |
| FUV | Fuel sensor-V |
| NIS | NISHINA SOLENOID |
| NCRSV | No.CRSV |
| CANV | CAN(V15) |
| V15 | V1505-E4 Engine |
| AUX2 | AUX2 |

GND3:SHIELD(SENSOR)

# ELECTRICAL CIRCUIT DIAGRAM (KX027-4)

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**KUBOTA Corporation**

Printed in Japan 2017. 12, H, EI, EI, engusa Code No.RY911-25021
2017. 02, H, EI, EI, engusa