# SERVICE MANUAL

## E385B

ROPS Tier III

Crawler Excavator

Print No. 84392431A

NEW HOLLAND CONSTRUCTION

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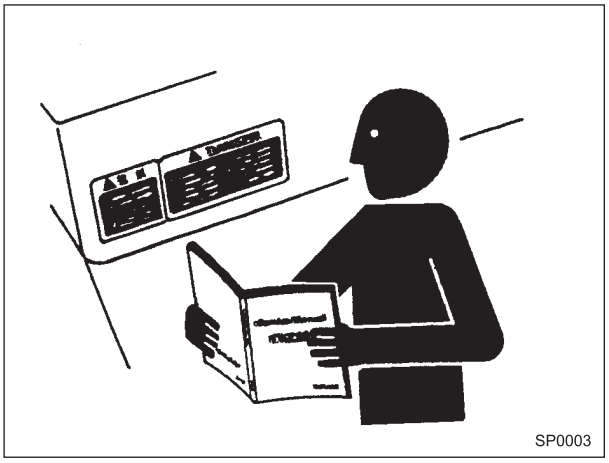
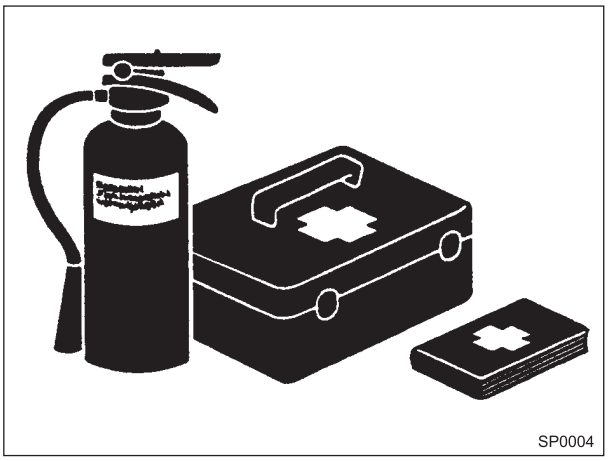
## FOLLOW SAFETY PRECAUTIONS

- Carefully read and observe all safety signs on the machine and read all safety precautions in this Manual.
- Safety signs should be installed, maintained, and replaced when necessary.
  - If a safety sign or this Manual are damaged or missing, obtain a replacement from your Dealer in the same way you order a spare part (be sure to detail machine model and serial number upon ordering).
- Learn how to operate the machine and its controls correctly and safely.
- Allow only trained, qualified, authorised personnel to operate the machine.
- Keep the machine in proper working conditions.
  - Unauthorised changes to the machine may impair function and/or safety and affect machine life.
- Safety messages in this Chapter "**SAFETY PRECAUTIONS**", are intended to illustrate basic safety procedures of the machine. However, it is impossible for these safety messages to cover every hazardous situation you may encounter. If you have any doubts, consult your direct supervisor prior to operating or servicing the machine.


SP0003

## PREPARE FOR EMERGENCIES

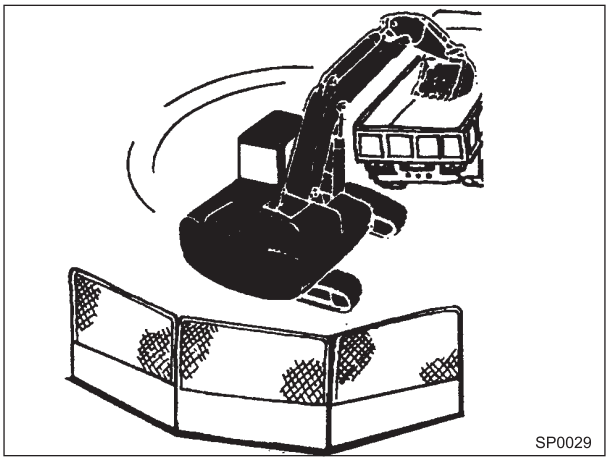
- Be prepared if a fire starts or an accident occurs.
  - Keep the first-aid kit and fire extinguisher on hand.
  - Thoroughly read and understand the label attached to the fire extinguisher to use it properly.
  - Establish emergency priority procedures to cope with fires and accidents.
  - Keep emergency numbers for doctors, ambulance service, hospitals and fire department posted near the telephone.


SP0004

## KEEP PERSONNEL CLEAR FROM WORKING AREA

- A person may be hit severely by the swinging front attachment or counterweight and/or may be crushed against an other object, resulting in serious injury or death.

  - Keep all persons clear from the area of operation and machine movement.
  - Before operating the machine, set up barriers to the sides and rear area of the bucket swing radius to prevent anyone from entering the work area.


SP0029

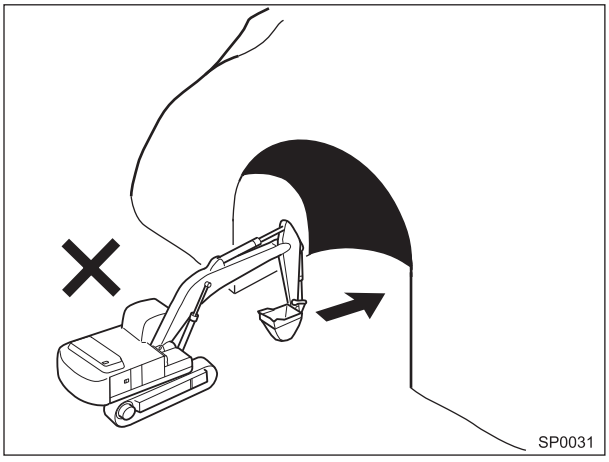
## NEVER MOVE THE BUCKET OVER ANY ONE

- Never lift, move, or swing bucket above anyone or a truck cab. Serious injury or machine damage may result due to bucket load spill or due to collision with the bucket.


SP0030

## DO NOT OPERATE IN TUNNELS

- DO NOT operate the machine in enclosed spaces or, in any case, without appropriate ventilation. Operations in tunnels or underground sites where potential explosive conditions exist are not allowed. There is a danger for explosions and potentially deadly injuries. Please comply with the ATEX regulation relative to devices to be used in a potentially explosive environment.


SP0031

## AVOID HIGH-PRESSURE FLUIDS

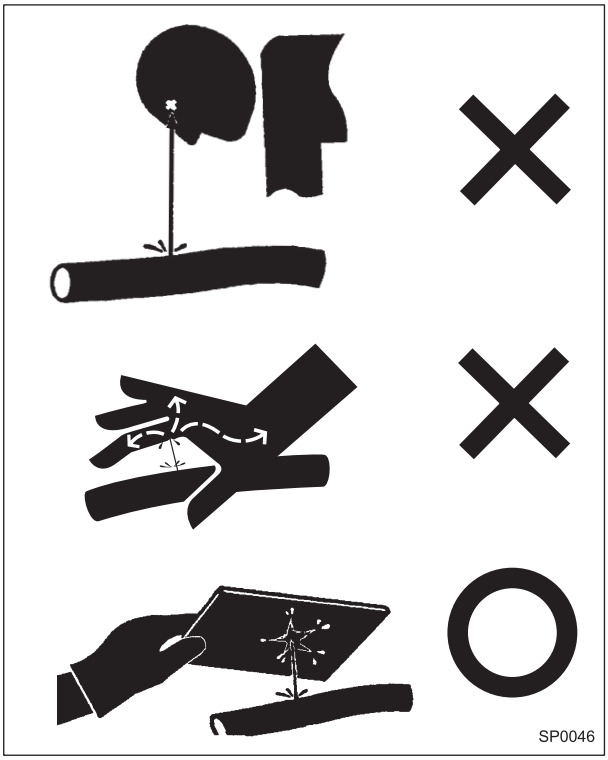
- Fluids such as diesel fuel or hydraulic oil under pressure can penetrate the skin or eyes causing serious injury, blindness or death.

  - Avoid this hazard by relieving pressure before disconnecting hydraulic or other lines.

  - Tighten all connections before applying pressure.

  - Search for leaks with a piece of cardboard; take care to protect hands and body from high-pressure fluids. Wear a face shield or goggles for eye protection.

  - In an accident occurs, see a doctor familiar with this type of injury immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.



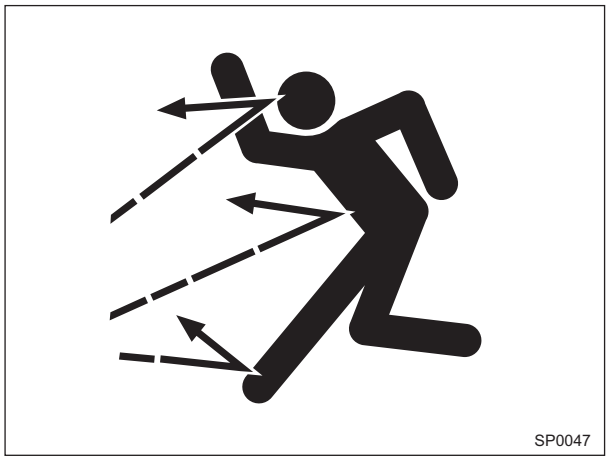

## PREVENT PARTS FROM FLYING OFF

- Grease in the track adjuster is under high pressure. Failure to follow the precautions below may result in serious injury, blindness, or death.

  - **NEVER** attempt to remove **GREASE FITTING** or **VALVE ASSEMBLY.**
  - As pieces may fly off, be sure to keep body and face away from valve.

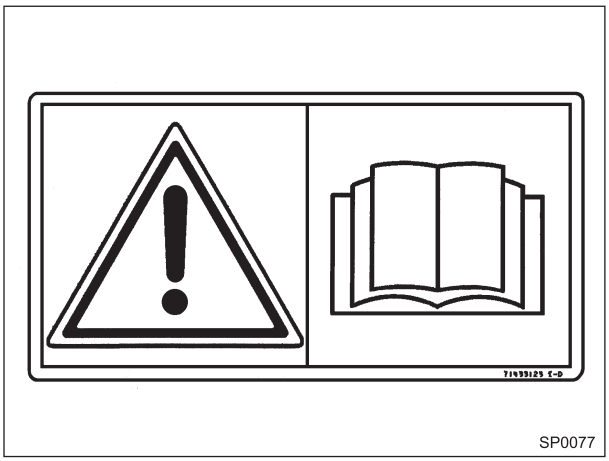
- Travel reduction gears are under pressure.

  - As pieces may fly off, be sure to keep body and face away from air release plug to avoid injury. Reduction gear oil is hot. Wait for gear oil to cool down, then gradually loosen the air release plug to release pressure.



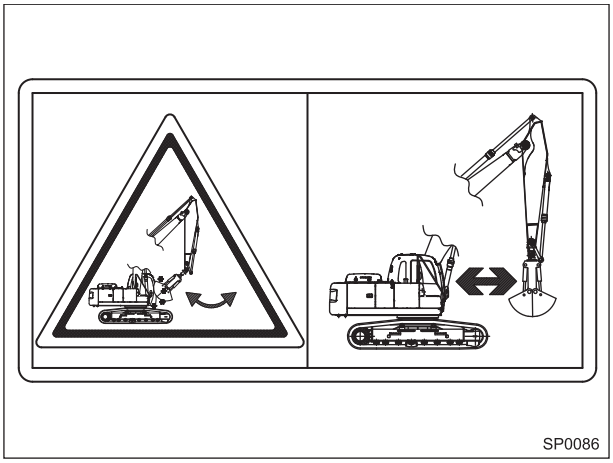
**4 - Read-your-manual plate**

It is positioned in the cab to recommend to carefully read the Operation and Maintenance Instruction Manual prior to starting, operating, servicing, refuelling or carrying out any other work on the machine.
Background: yellow
Border and icons: black


SP0077

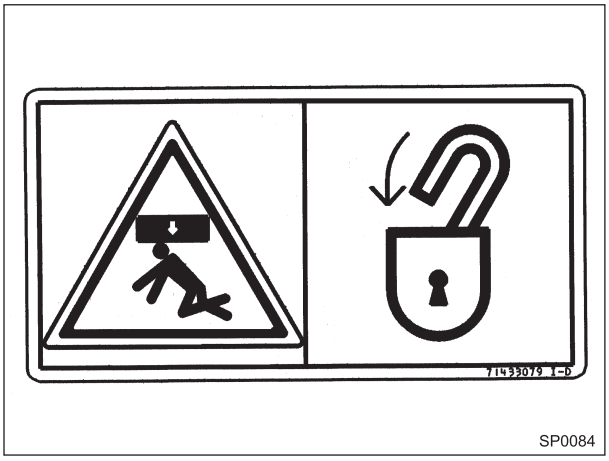
**5 - Special equipment movement warning plate**

It shows the danger represented by the special equipment hitting the cab.
Pay special attention as no stops are provided to prevent this problem.
Background: yellow
Border and icons: black


SP0086

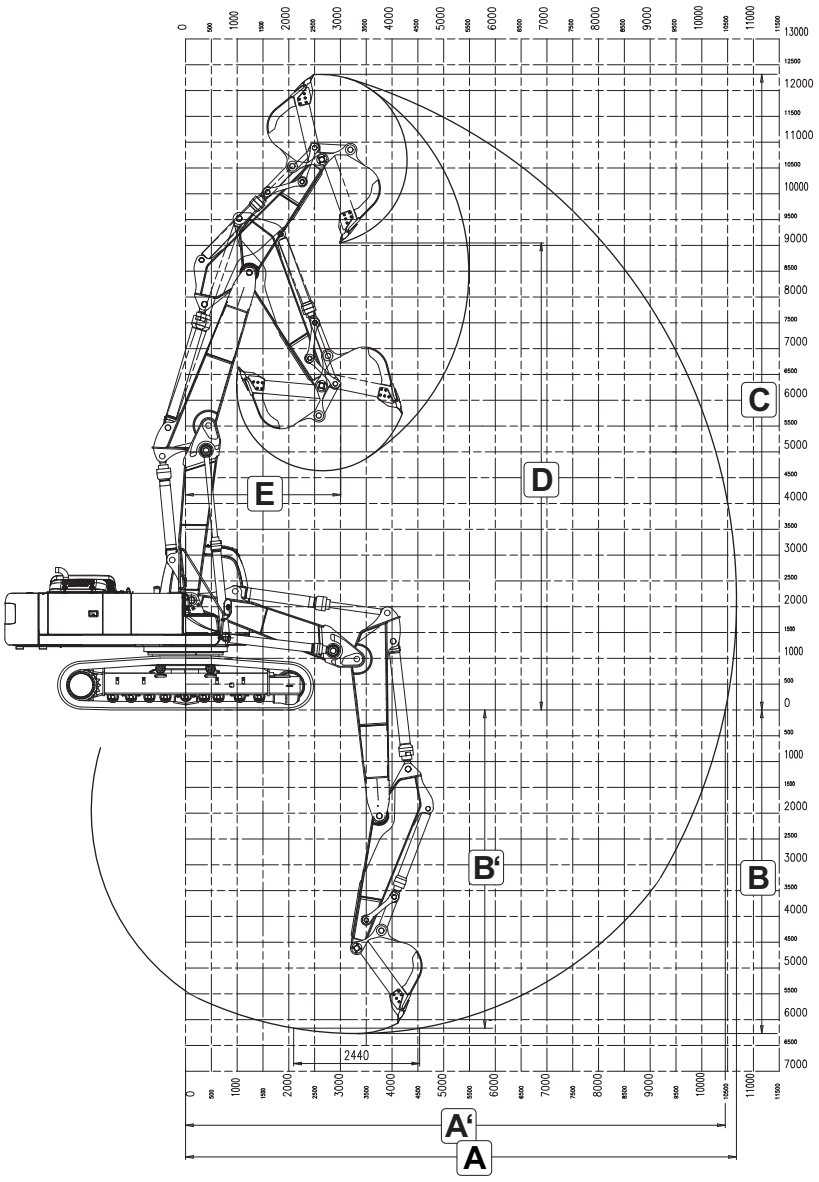
**6 - Open windscreen warning plate**

It indicates the risk of injuries deriving from the windscreen not being locked or being improperly locked in the open position.
Background: yellow
Border and icons: black


SP0084

## DIGGING DATA

**(Triple Articulation Version)**

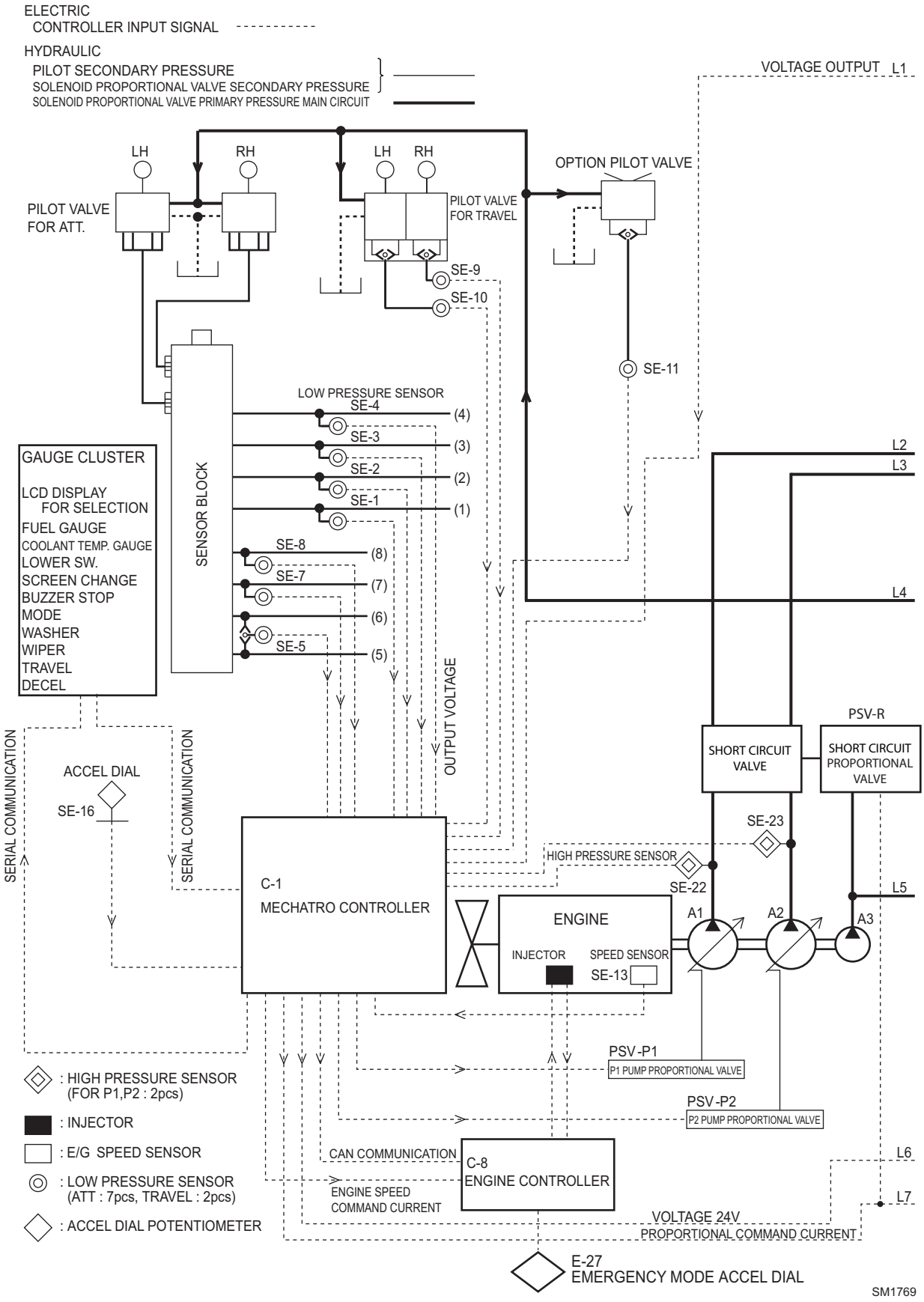



| Arm | 2330 | 2600 | 3300 | 4150 |
|---|---|---|---|---|
| **A** | 10376 | 10671 | 11304 | 12077 |
| **A'** | 10153 | 10455 | 11101 | 11887 |
| **B** | 5981 | 6269 | 6937 | 7751 |
| **B'** | 5873 | 6165 | 6842 | 7665 |
| **C** | 12022 | 12315 | 12821 | 13422 |
| **D** | 8738 | 9047 | 9554 | 10142 |
| **E** | 3050 | 3007 | 2784 | 2980 |

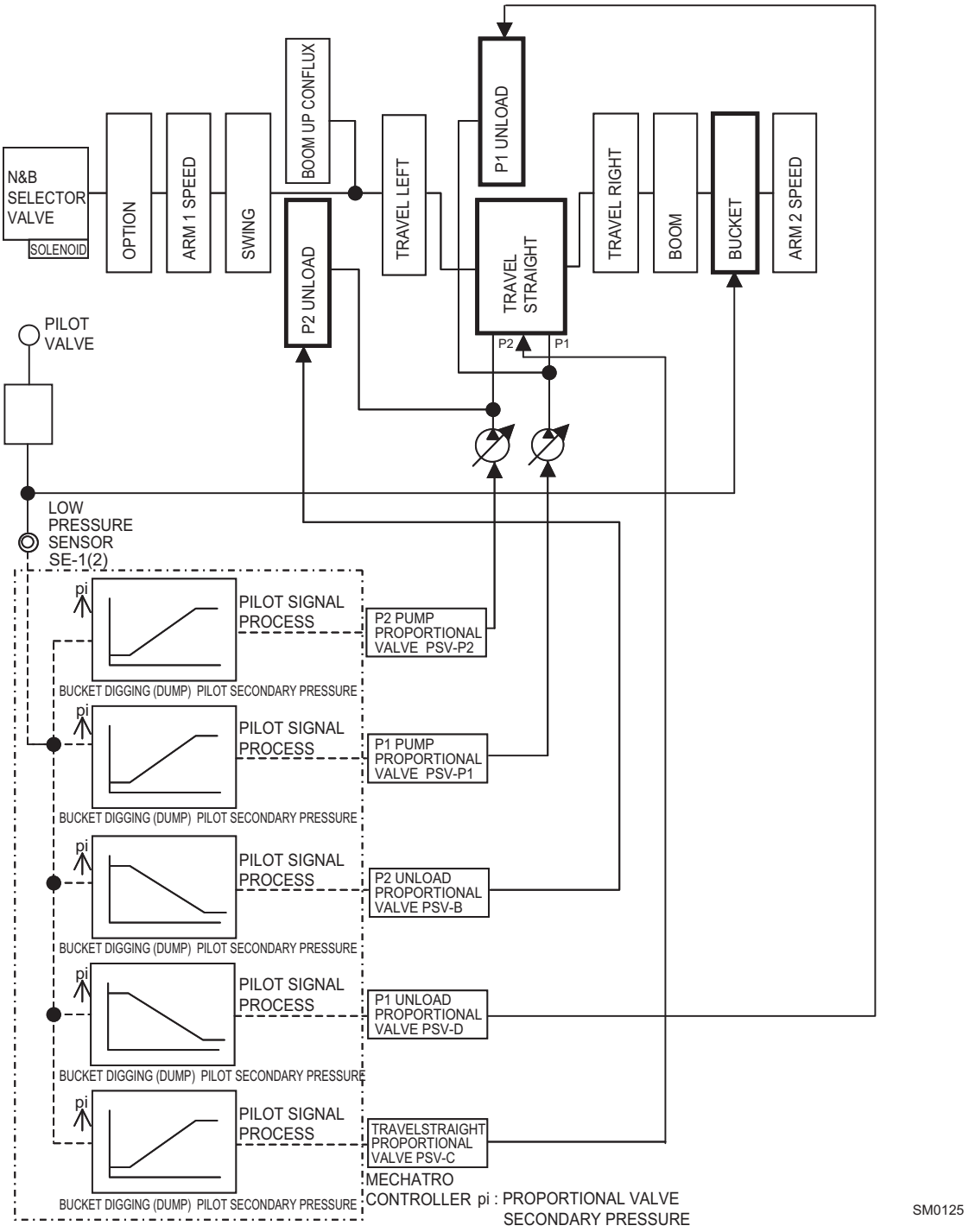
(Dimensions in mm)

## 2 SUMMARY OF MECHATRO CONTROL SYSTEM

### 2.1 MECHATRO CONTROL SYSTEM IN GENERAL

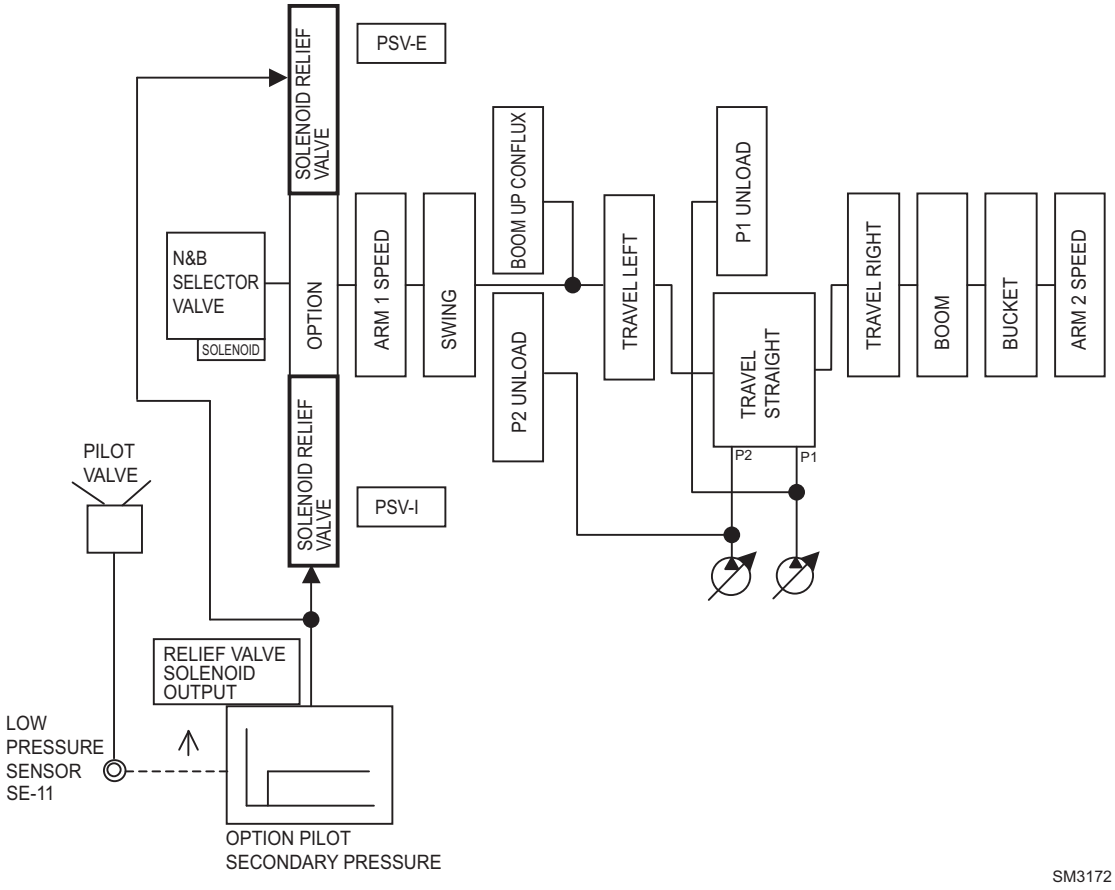


## 2.8 BUCKET DIGGING (DUMP) CONFLUX CONTROL




1. On starting bucket digging (dump) operation, bucket digging (dump) operating pilot pressure switches bucket spool and is input to low pressure sensor.
2. The output voltage of low pressure sensor is input to mechatro controller and the mechatro controller processes pilot signal and outputs command according to the input voltage to P1 and P2 pump proportional valves, P1 and P2 unload proportional valves and travel straight proportional valve.
3. Each proportional valve outputs pilot secondary pressure according to the command output by mechatro controller and changes P1 and P2 pump delivery rate and switches P1 and P2 unload valves and travel straight valve of the control valve.
4. The tandem passage is connected to P2 port because of the travel straight valve switched and P1 pump delivery oil confluxes P2 pump delivery oil because of P2 unload valve switched.

## 2.15 N&B SOLENOID RELIEF VALVE CONTROL




1. Solenoid relief valve
   Using solenoid relief valve, relief pressure is able to set in advance.
   1) Using gauge cluster, setting pressure of A and B mode is selectable individually.
   2) When optional operation is done, command value according to setting pressure which is selected with solenoid relief valve is output from mechatro controller.
   3) Each proportional valve outputs pilot proportional secondary pressure according to command value from mechatro controller, and the pressure switches relief pressure.

### 3.3 SERVICE DIAGNOSIS DISPLAY FUNCTION

The current service diagnosis is displayed on multi display based on the data received from mechatro controller. This section explains the operating procedure and examples of each screen. The values in display changes according to the conditions like engine speed, attachment position, etc.

1. Service diagnosis display screen operating procedure
   1)  Turn starter switch ON keeping buzzer stop switch pressed.
   2) After logo mark is displayed, the screen changes in service diagnosis mode.
      The service diagnosis screen "**Mode No.1**", "Screen No.1" is displayed first.

      The service diagnosis is classified into three modes, 1, 2, and 3, and the present mode is displayed in "Screen No.1".
      The screen number each mode can display differs. The screen number displayed by each mode is as follows.
      - **Mode No.1**: Screen No.1~No.30
      - **Mode No.2**: Screen No.1, Screen No.31~No.40
      - **Mode No.3**: Screen No.1, Screen No.41~No.50
   3) The screen changes each time each switch is pressed from now on.

       Washer switch: Screen gains by 1 in order. (No.2→No.3→No.4→...)

       Wiper switch: Screen loses by 1 in order. (No.24→No.23→No.22→...)

       Auto idling switch: Service diagnosis number advances from No.1 to No.3, and then returns to No.1. (No.1→No.2→No.3→No.1→...)

       Travel 1, 2 speed switch: Service diagnosis number advances from No.3 to No.1, and then returns to No.3. (No.3→No.2→No.1→No.3→...)

   4) Turn key switch OFF and the display of service diagnosis mode is closed.

### 3.4 TROUBLE HISTORY DIAGNOSIS

The items of error detected by mechatro controller self diagnosis function are stored in mechatro controller as one of history. And the errors are able to be indicated on the multi display.

- A part of warning contents is stored (the stored items are listed in warning table).
- The error code for self diagnosis is stored.

1. How to display
   1) Turn starter switch on.
   2) Press buzzer stop switch continuously 5 times and the trouble history screen is displayed.

(Example)

| No errors | NO ERROR |
|---|---|
| Error detected in the past | １０５３０Ｈｒ　Ｆ０２３<br>８５００Ｈｒ　Ｇ０３３<br>１５００Ｈｒ　Ｃ０１３ |

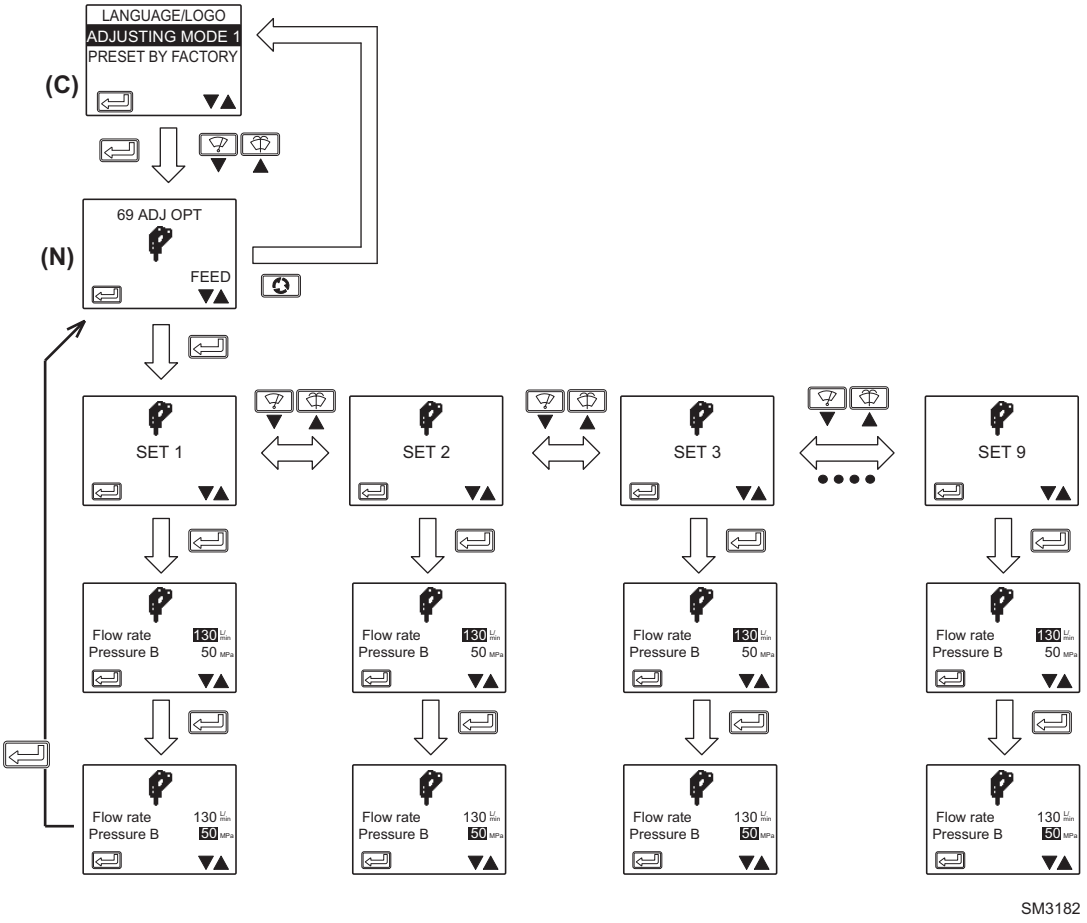
SM0154

   3) Transmit trouble history data (One or many) and hour meter to gauge cluster.
      - Hour meter and 4 failure data are displayed on screen.
      - In case of more than 4 failure data, 4 data is displayed at a time for 10 seconds by turns.
   4) Paging (Up and down)
      - Press washer switch (▲) A, and the item moves upward.
      - Press wiper switch (▼), and the item moves downward.
   5) Turn starter switch off, and the display is disappeared.

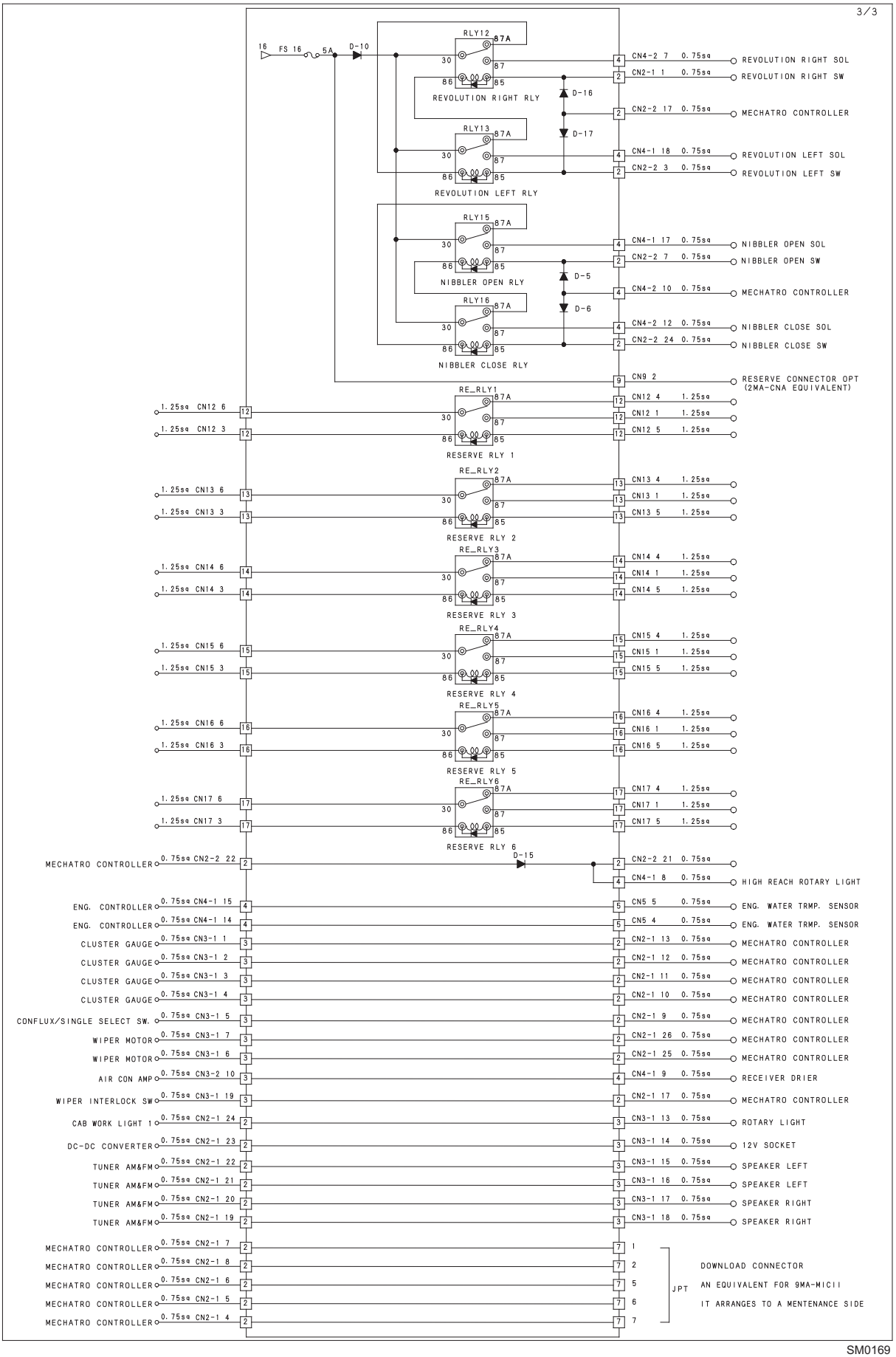
2. How to delete contents of trouble history
   1) Display trouble history screen.
   2) Press work mode change switch and buzzer stop switch simultaneously for 10 seconds or more.
   3) When "NO ERROR" is displayed, the deletion is completed.
   4) Turn starter switch off.

**NOTE:** *all the stored items are erased. It is impossible to erase data partially.*

**Breaker**




1. In function **Adjusting Mode 1**, display (**C**), press SELECT button to enter the functions and use WIPER button to select function 69 – ADJ OPT, on display (**N**).
2. Press SELECT button to enter the selection menu of the set flow rate/pressure values for adjusting.
3. Press SELECT button to choose the number relative to the flow rate. Press WINDSHIELD WASHER button to increase the flow rate, or WIPER button to decrease it.
4. Press SELECT button to choose the number relative to the pressure (**B**). To select the pressure, start the engine and actuate the breaker/crusher pedal, keeping it pressed with the toe of the foot. Press WINDSHIELD WASHER button to increase the pressure, or WIPER button to decrease it. When desired pressure is indicated, press SELECT button to set. (When SELECT button is pressed, be careful that 0MPa is usually displayed at time if you do not depress the toe side of breaker/crusher pedal down.)
5. Set the desired flow rate and pressure values, press SELECT button to return to display (**N**).
   By pressing SCREEN CHANGE button you return to display (**C**).
   To exit the program, move the STARTER SWITCH onto "**OFF**".


3/3
RLY12
87A
30
87
86
85
REVOLUTION RIGHT RLY
16
FS 16
5A
D-10
D-16
D-17
RLY13
REVOLUTION LEFT RLY
RLY15
NIBBLER OPEN RLY
D-5
RLY16
D-6
NIBBLER CLOSE RLY
RE_RLY1
RESERVE RLY 1
RE_RLY2
RESERVE RLY 2
RE_RLY3
RESERVE RLY 3
RE_RLY4
RESERVE RLY 4
RE_RLY5
RESERVE RLY 5
RE_RLY6
RESERVE RLY 6
D-15
CN4-2 7 0.75sq
REVOLUTION RIGHT SOL
CN2-1 1 0.75sq
REVOLUTION RIGHT SW
CN2-2 17 0.75sq
MECHATRO CONTROLLER
CN4-1 18 0.75sq
REVOLUTION LEFT SOL
CN2-2 3 0.75sq
REVOLUTION LEFT SW
CN4-1 17 0.75sq
NIBBLER OPEN SOL
CN2-2 7 0.75sq
NIBBLER OPEN SW
CN4-2 10 0.75sq
MECHATRO CONTROLLER
CN4-2 12 0.75sq
NIBBLER CLOSE SOL
CN2-2 24 0.75sq
NIBBLER CLOSE SW
CN9 2
RESERVE CONNECTOR OPT
(2MA-CNA EQUIVALENT)
1.25sq CN12 6
1.25sq CN12 3
CN12 4 1.25sq
CN12 1 1.25sq
CN12 5 1.25sq
1.25sq CN13 6
1.25sq CN13 3
CN13 4 1.25sq
CN13 1 1.25sq
CN13 5 1.25sq
1.25sq CN14 6
1.25sq CN14 3
CN14 4 1.25sq
CN14 1 1.25sq
CN14 5 1.25sq
1.25sq CN15 6
1.25sq CN15 3
CN15 4 1.25sq
CN15 1 1.25sq
CN15 5 1.25sq
1.25sq CN16 6
1.25sq CN16 3
CN16 4 1.25sq
CN16 1 1.25sq
CN16 5 1.25sq
1.25sq CN17 6
1.25sq CN17 3
CN17 4 1.25sq
CN17 1 1.25sq
CN17 5 1.25sq
MECHATRO CONTROLLER 0.75sq CN2-2 22
CN2-2 21 0.75sq
CN4-1 8 0.75sq
HIGH REACH ROTARY LIGHT
ENG. CONTROLLER 0.75sq CN4-1 15
CN5 5 0.75sq
ENG. WATER TRMP. SENSOR
ENG. CONTROLLER 0.75sq CN4-1 14
CN5 4 0.75sq
ENG. WATER TRMP. SENSOR
CLUSTER GAUGE 0.75sq CN3-1 1
CN2-1 13 0.75sq
MECHATRO CONTROLLER
CLUSTER GAUGE 0.75sq CN3-1 2
CN2-1 12 0.75sq
MECHATRO CONTROLLER
CLUSTER GAUGE 0.75sq CN3-1 3
CN2-1 11 0.75sq
MECHATRO CONTROLLER
CLUSTER GAUGE 0.75sq CN3-1 4
CN2-1 10 0.75sq
MECHATRO CONTROLLER
CONFLUX/SINGLE SELECT SW. 0.75sq CN3-1 5
CN2-1 9 0.75sq
MECHATRO CONTROLLER
WIPER MOTOR 0.75sq CN3-1 7
CN2-1 26 0.75sq
MECHATRO CONTROLLER
WIPER MOTOR 0.75sq CN3-1 6
CN2-1 25 0.75sq
MECHATRO CONTROLLER
AIR CON AMP 0.75sq CN3-2 10
CN4-1 9 0.75sq
RECEIVER DRIER
WIPER INTERLOCK SW 0.75sq CN3-1 19
CN2-1 17 0.75sq
MECHATRO CONTROLLER
CAB WORK LIGHT 1 0.75sq CN2-1 24
CN3-1 13 0.75sq
ROTARY LIGHT
DC-DC CONVERTER 0.75sq CN2-1 23
CN3-1 14 0.75sq
12V SOCKET
TUNER AM&FM 0.75sq CN2-1 22
CN3-1 15 0.75sq
SPEAKER LEFT
TUNER AM&FM 0.75sq CN2-1 21
CN3-1 16 0.75sq
SPEAKER LEFT
TUNER AM&FM 0.75sq CN2-1 20
CN3-1 17 0.75sq
SPEAKER RIGHT
TUNER AM&FM 0.75sq CN2-1 19
CN3-1 18 0.75sq
SPEAKER RIGHT
MECHATRO CONTROLLER 0.75sq CN2-1 7
MECHATRO CONTROLLER 0.75sq CN2-1 8
MECHATRO CONTROLLER 0.75sq CN2-1 6
MECHATRO CONTROLLER 0.75sq CN2-1 5
MECHATRO CONTROLLER 0.75sq CN2-1 4
JPT
DOWNLOAD CONNECTOR
AN EQUIVALENT FOR 9MA-MICII
IT ARRANGES TO A MENTENANCE SIDE

SM0169

## 5. POSITIONING CIRCUIT (TRIPLE ARTICULATION VERSION)

HYDRAULIC POSITIONING CIRCUIT READING KEY

| Item | Component name |
|---|---|
| 56 | P1 OPT valve |
| 57 | Holding valve for positioner cylinder |
| 58 | Positioner cylinder |
| 59 | Positioning pilot valve |

OPERATION

When the operation for positioning is performed, the pilot proportional secondary pressure is delivered through port **A** of the positioning pilot valve (**59**) and flows to **PAo1** port of the P1 OPT valve (**56**) then, the spool of P1 OPT valve (**56**) is switched. The pressure oil by P1 pump is supplied to (**R**) side of positioner cylinder (**58**) through **Ao1** port of P1 OPT valve (**56**). On the other hand, the return oil from (H) side of positioner cylinder returns to the tank circuit thorough **Bo1** port of P1 OPT valve (**56**).
The holding valve (**57**) prevents the positioning falling in case of rod side cylinder piping breaks.

This section describes boom lower operation.

10.3 Boom down pilot circuit

10.4 Prevention of natural fall by lock valve and actuation at lowering

10.5 Constant recirculation function of boom down main circuit

### 10.3 BOOM DOWN PILOT CIRCUIT

(1) Operation:

1) If the boom down operation is performed, the secondary pilot proportional pressure comes out of port 2 of the right pilot valve (9) and acts upon the low pressure sensor (SE-4).
   At the same time, the pressure acts upon the PBb port of C/V (2).
2) The voltage output of the low pressure sensor (SE-4) enters the mechatro controller and processed in it.
3) Then, the proportionl secondary pressure fed into C/V (2) PBb port and branches off in two lines and switches boom spool and releases boom lock valve.

### 10.4 PREVENTION OF NATURAL FALL BY LOCK VALVE AND ACTUATION AT LOWERING

(1) Purpose:
Prevention of natural fall when the lever is neutral

(2) Principle:
The oil is prevented from returning to the boom spool by the poppet seat of the boom lock valve.

(3) Operation:
In the boom down action, the selector valve is changed over by the secondary proportional pressure of PBb port. Then the poppet spring chamber of the lock valve CRb gets through the drain line (Dr) and makes the lock valve poppet open.
When the boom lever is at neutral, the drain line on the lock valve CRb poppet spring chamber is closed which causes the poppet closed.
The result is that the oil returning from the boom cylinder head (H) to the boom spool is held and makes the leak from the boom spool zero.
Thus the boom cylinder is prevented from making a natural fall.

### 10.5 CONSTANT RECIRCULATION FUNCTION OF BOOM DOWN MAIN CIRCUIT

(1) Purpose:
Prevention of cavitation during boom lowering motion.

(2) Principle:
The oil returning from the boom cylinder head (H) is recirculated to the rod (R).

(3) Operation:
When the oil is supplied to the boom cylinder rod (R) side during boom down operation, the boom moves faster than it should do in some cases by the self weight of the attachment.
On that occasion, the circuit pressure on the rod (R) side is on the negative side.
The oil supplied to the boom cylinder rod (R) flows into the A1 port of the P1 pump and the P1 port of C/V. The oil then passes through the boom spool and goes out of the Bb port.
On that occasion, the oil returning from the head (H) goes through the recirculation path in the boom spool, pushes the check valve in the spool open, is recirculated to the Bb port and is supplied to the rod (R). When the (R) pressure is larger than the head (H) pressure, the check valve in spool closes.
Thereupon, the recirculation is stopped.

## 13. COMBINED CIRCUIT

The combined operation during travel independence operation is described in this section.

13.1 Boom up / travel, pilot circuit

13.2 Boom up / travel, main circit

### 13.1 BOOM UP / TRAVEL, PILOT CIRCUIT

(1) Operation:
<Operation: different point of circuit from single operation>

1) The mechatro controller outputs command current to travel priority solenoid proportional valve (PSV-C) and to short-circuit solenoid proportional valve (PSV-R) after signal processing.
And the solenoid proportional valve outputs secondary pressure and acts on PTb port and short-circuit valve.
2) Then the pressure of PTb port moves spool of travel priority valve to the end. The secondary pressure of solenoid valve in short-circuit valve switches spool of short-circuit valve 1 step.

### 13.2 BOOM UP / TRAVEL, MAIN CIRCUIT

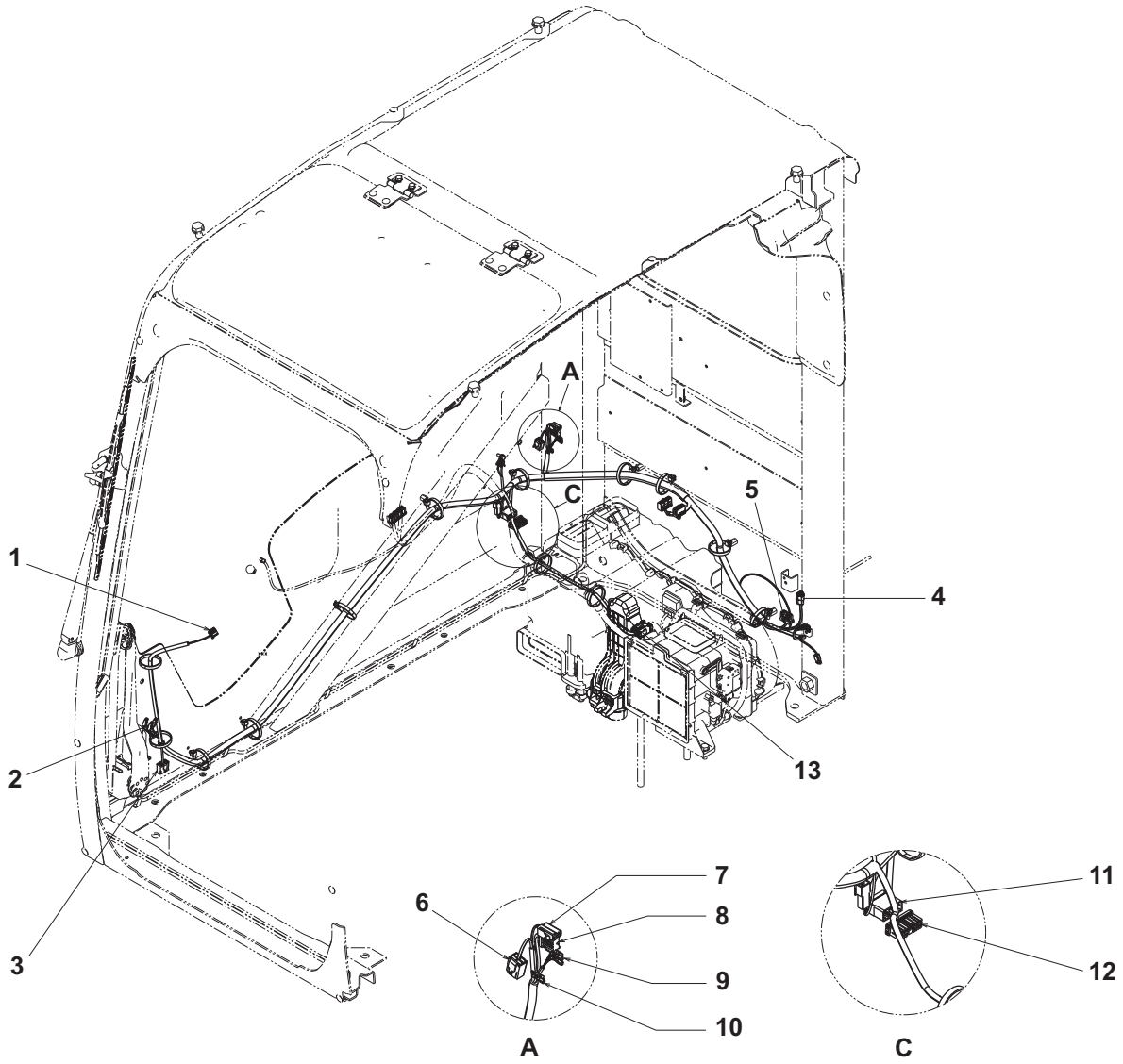
(1) Purpose:
Even if the attachment is operated, during travel operation, the travel speed does not change.

(2) Principle:
The travel action and the attachment action are actuated by quite different pump.

(3) Operation:

1) P1 pump delivery oil flows through P1 port of C/V(2) and branches off in P1 parallel circuit and spool of short-circuit valve.
P2 pump delivery oil flows through P2 port of C/V(2) and branches off in P2 tandem circuit and spool of short-circuit valve.
2) The delivery oil flowed into P1 parallel circuit of P1 pump opens check valve CT1 and LCb and flows in boom spool, which exerts on boom up operation.
The delivery oil flowed into travel priority spool of P1 pump opens check valve CT2 because the travel priority spool is shifted, and flows in boom conflux spool and exerts on boom up operation with the internal oil conflux.
(In travel independent operation, P1 pump delivery oil exerts on swing and attachment operations.)
3) The delivery oil flowed into P2 tandem circuit of P2 pump flows in left travel spool to travel leftward.
The delivery oil flowed into travel priority spool of P2 pump flows in right travel spool because the travel straight spool is shifted and exerts on the right travel operation.
(In travel independent operation, P2 pump delivery oil exerts on travel operations.)
4) Some part of rate flows to the travel priority spool notch restriction. But travel speed is not affect by simultaneous attachment operation like a boom etc. because the flow is not led to notch while travel independent operation is actuated.

**Cluster gauge wiring harness**



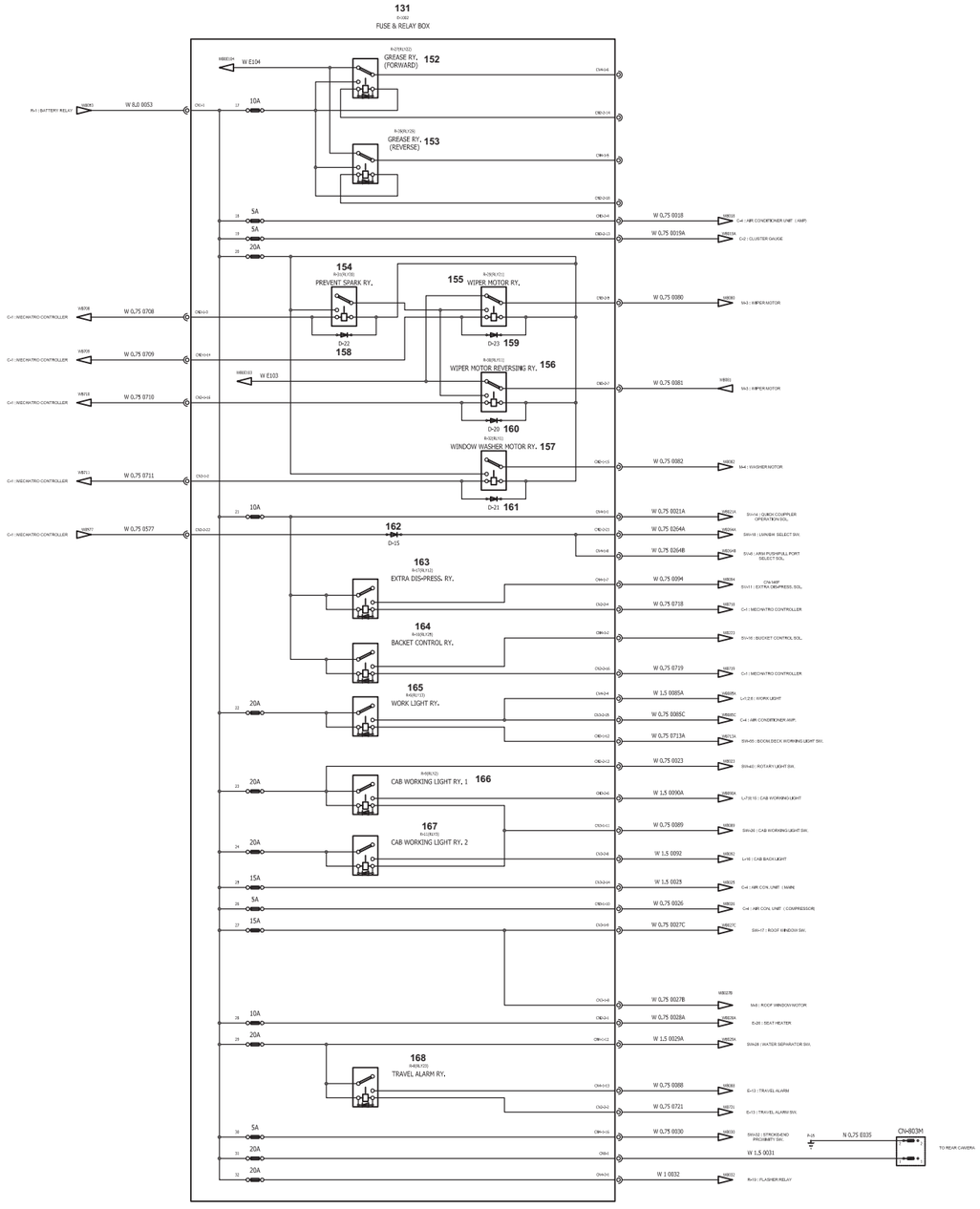

**1 - Cluster gauge (C-2)**
**2 - Hour meter (E-3)**
**3 - Wiper motor (M-3)**
**4 - Connector for DC-DC Converter (E-22)**
**5 - Connector for flasher relay (R-19)**
**6 - Connector for roof wiper (opt.) (CN-37F)**
**7 - Connector for wiper interlock switch (CN-60F)**
**8 - Connector for speaker (CN-611F)**
**9 - Connector for cab working light**
**10 - Connector for rotary light (CN-54F)**
**11 - Connector for platform harness (CN-574F)**
**12 - Connector for platform harness (CN-573F)**
**13 - Connector for air conditioner unit (CN-500F)**

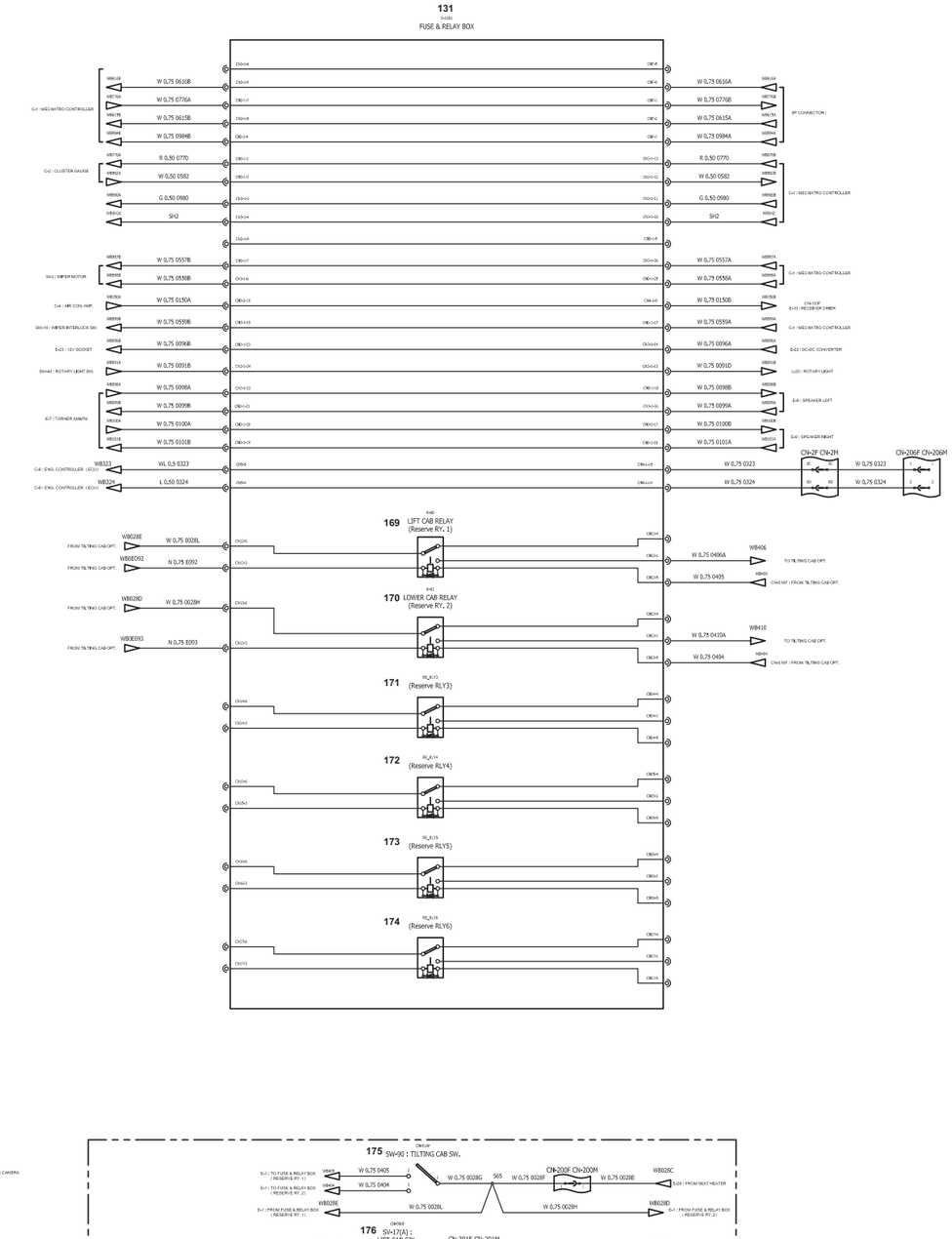
## ELECTRICAL SYSTEM DIAGRAM

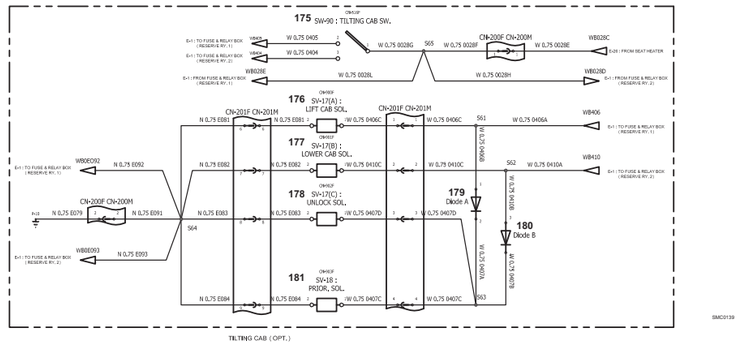
### ELECTRICAL SYSTEM DIAGRAM READING KEY (No. 1)

| Item | Description | Code |
|---|---|---|
| 1 | Key starter switch | SW - 1 |
| 2 | Starter motor | M - 1 |
| 3 | Starter relay | R - 2 |
| 4 | Battery relay | R - 1 |
| 5 | Fuse link box | E - 25 |
| 6 | Engine preheating relay | R - 3 |
| 7 | Engine preheating glow plug | --- |
| 8 | Diode | D - 4 |
| 9 | Emergency Mode potentiometer | E - 27 |
| 10 | Engine control unit (ECU) | C - 6 |
| 11 | Alternator | E - 2 |
| 12 | Hour meter | E - 3 |
| 13 | Batteries | --- |
| 14 | Diagnosis connector | --- |
| 15 | Engine oil pressure switch | SW - 7 |
| 16 | Sediment filter switch | SW - 28 |
| 17 | Coolant level switch | SW - 27 |
| 18 | Coolant level control | C - 5 |
| 19 | Electric wiring of engine | --- |
| 20 | Diode | D - 25 |
| 21 | Left horn switch | SW - 10 |
| 22 | “low” Horn | E - 6 |
| 23 | “high” Horn | E - 5 |
| 24 | Mechatro Controller | C - 1 |

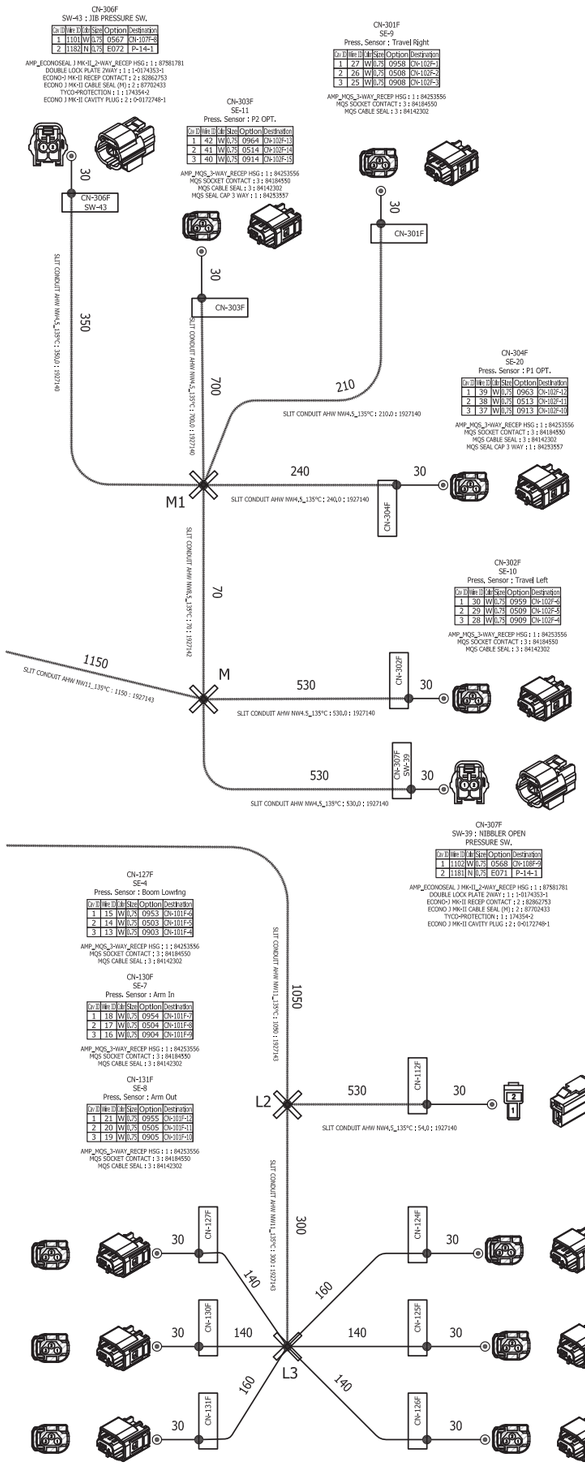
## ELECTRICAL SYSTEM DIAGRAM (No. 6)



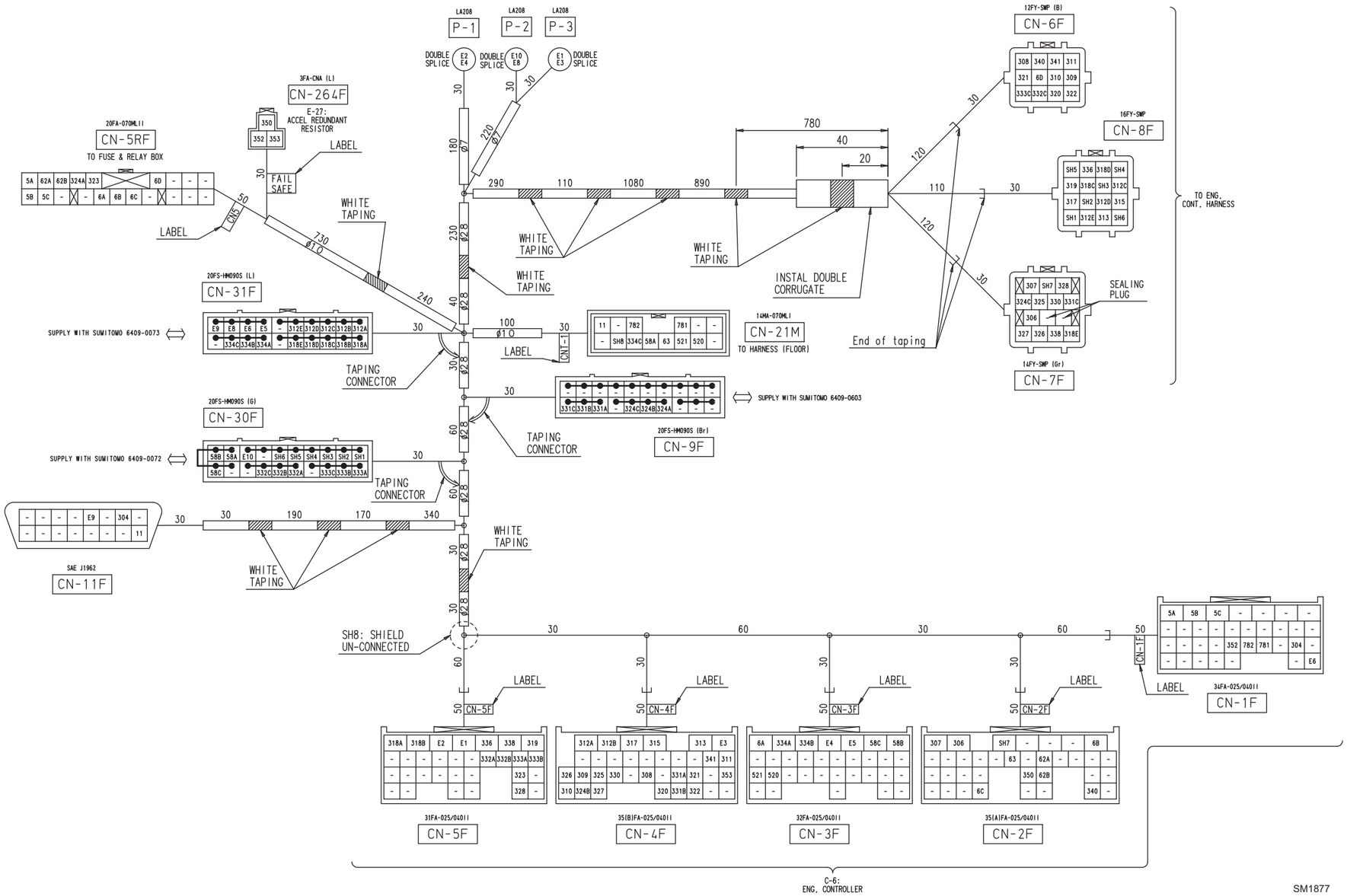



## PLATFORM WIRING HARNESS ASSEMBLY (No. 4)



## ECU WIRING HARNESS ASSEMBLY



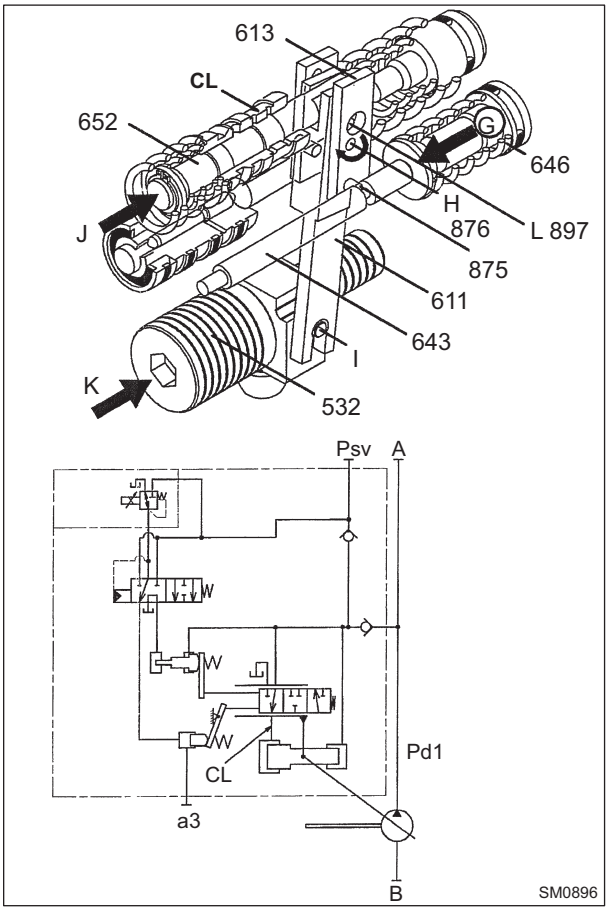
**Specifications**

| Item | | | Main pump | Gear pump for pilot |
|---|---|---|---|---|
| Pump | | | K5V140DTP1KLR-YTOK-HV | ZX10LGRZ2-07G |
| Type | | | Variable displacement plunger pump: regulator attached type | Fixed displacement type gear pump |
| Max. displacement capacity | | $cm^3$ | 140 x 2 | 10 |
| Revolution | Rated | rpm (Clockwise seen from shaft end) | 2100 | ← |
| Pressure | Rated | MPa (psi) | 34.3 (4980) | 5.0 (725) |
| | ATT boost | | 37.8 (5480) | |
| Max. flow | | L/min (gal/min) | 294 (78) x 2 at 7.8 MPa (1130 psi) | 21 (5.5) |
| Max. input Power (at 2100 rpm) | | kW (PS) | 195 (265) | 3.4 (4.6) |
| Max. input torque (at 1600 rpm) | | Nm (lbf·ft) | 886 (653) | 14.7 (10.8) |
| Regulator | | Model | KR3S-YTOK-HV | |
| | | Control function | Electric flow control, positive flow control, total power control at emergency mode and power shift control | |
| | | Others | With solenoid proportional reducing valve (KDRDE5K-31/30C50) | |
| Mass | | kg (lbs) | 143 (315) | |

**NOTE:** *the max. input power and the max. input torque of the main pump include those of the gear pump.*

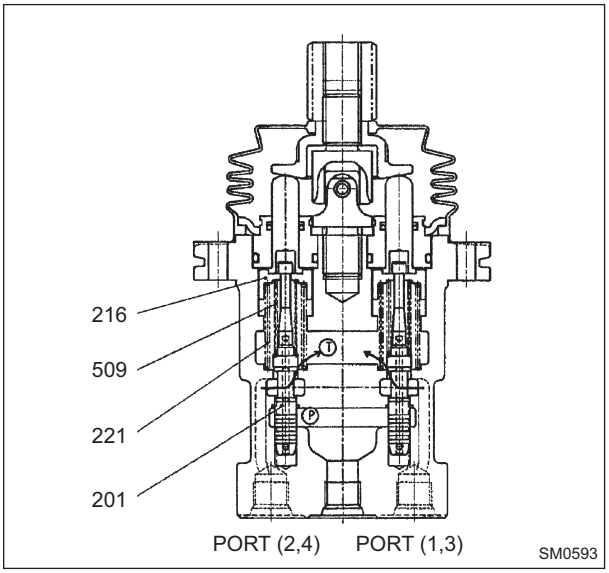
*Flow rate decrease*

As the command current value I is reduced, the secondary pressure P2 of electromagnetic proportional pressure-reducing valve is reduced, and by pressing pilot piston (**643**) in (**G**) direction it stops at the position the pilot spring force (**646**) balances the secondary pressure P2. The movement of pilot piston is transferred to lever 2 (**613**) through pin (**875**), and rotates at (H) fulcrum in arrow direction. Furthermore the lever 2 movement is transferred to feedback lever (**611**) through pin (**897**) and rotates at (**I**) fulcrum in the same arrow direction as (**H**). Consequently the spool (**652**) connected to the feedback lever moves towards (**J**). When the spool moves towards (**J**), the delivery pressure Pd1 is led in servo piston large bore diameter chamber through spool and port CL. The servo piston small bore diameter chamber constantly receives delivery the pressure Pd1, consequently the servo piston moves towards (**K**) according to the difference of area resulting in the reduction of tilt angle, and finally the flow rate is reduced. Since the feed back lever is connected to servo piston and spool, the feed back lever rotates at (**L**) fulcrum with the movement of servo piston towards (**K**), consequently the spool is returned to the original position.
With this movement, the opening of spool sleeve gradually closes, and the servo piston stops at the position the opening closes completely.

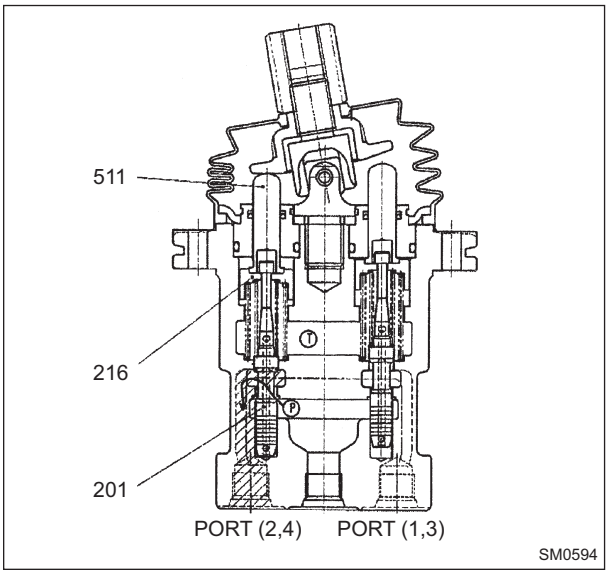


## OPERATION

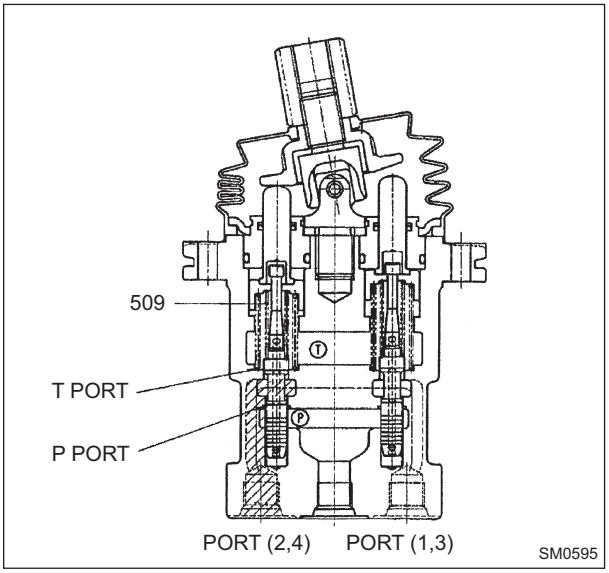
1. Lever in neutral (See Fig.SM0593)
   The action of spring (**509**) (for secondary pressure setting) that determines the output pressure of the pilot valve does not act upon spool (**201**).
   Therefore, spool (**201**) (for return) is pushed up by spring (**221**) [spring seat (**216**)]. The output ports (**2**, **4**) connect with the T port. The result is that the output pressure is equal to the tank pressure.



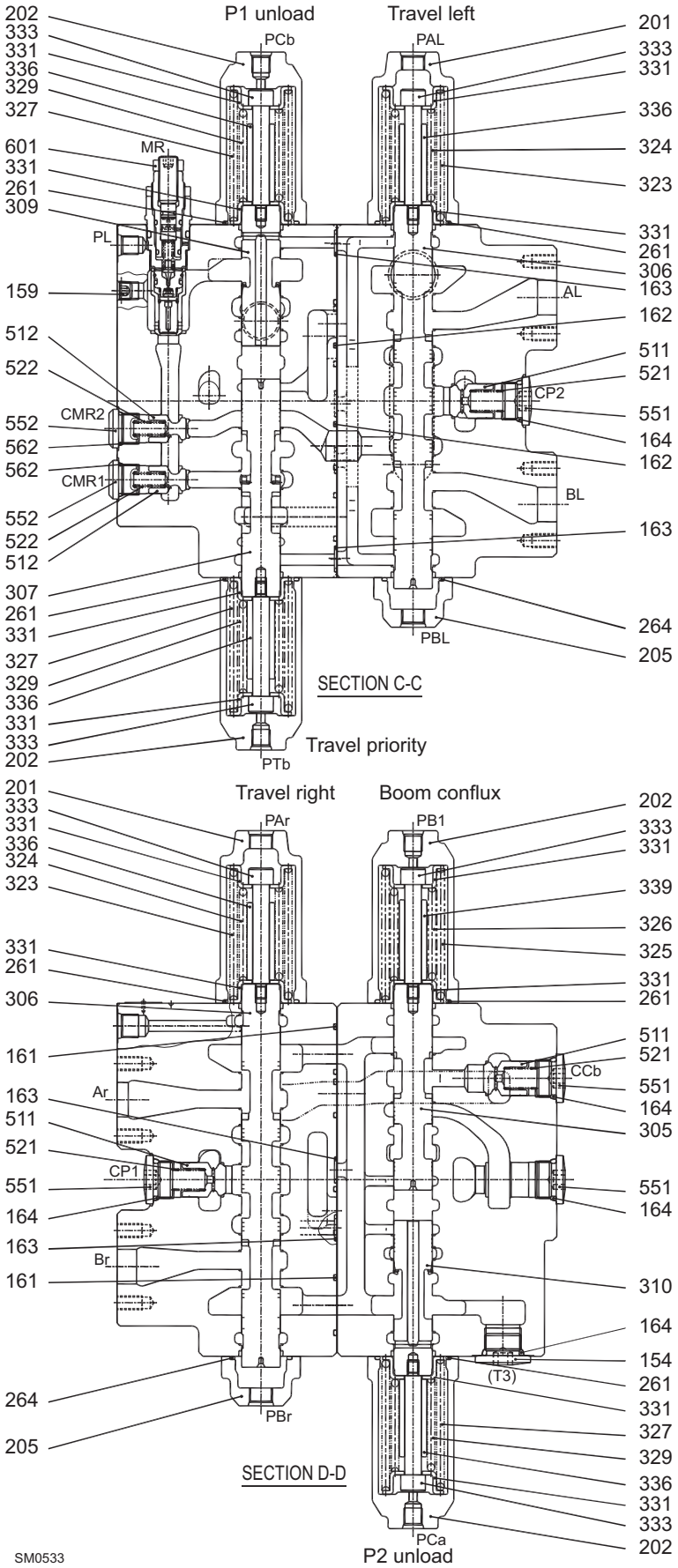

2. When the pilot lever is tilted (See Fig.SM0594)
   When the lever is tilted and the push rod (**511**) strokes, the spool (**201**) [spring seat (**216**)] moves downward to make the port P to connect with the port **2**, **4**, with the result that the oil of the pilot pump flows to the port **2** ,**4** to produce a pressure.



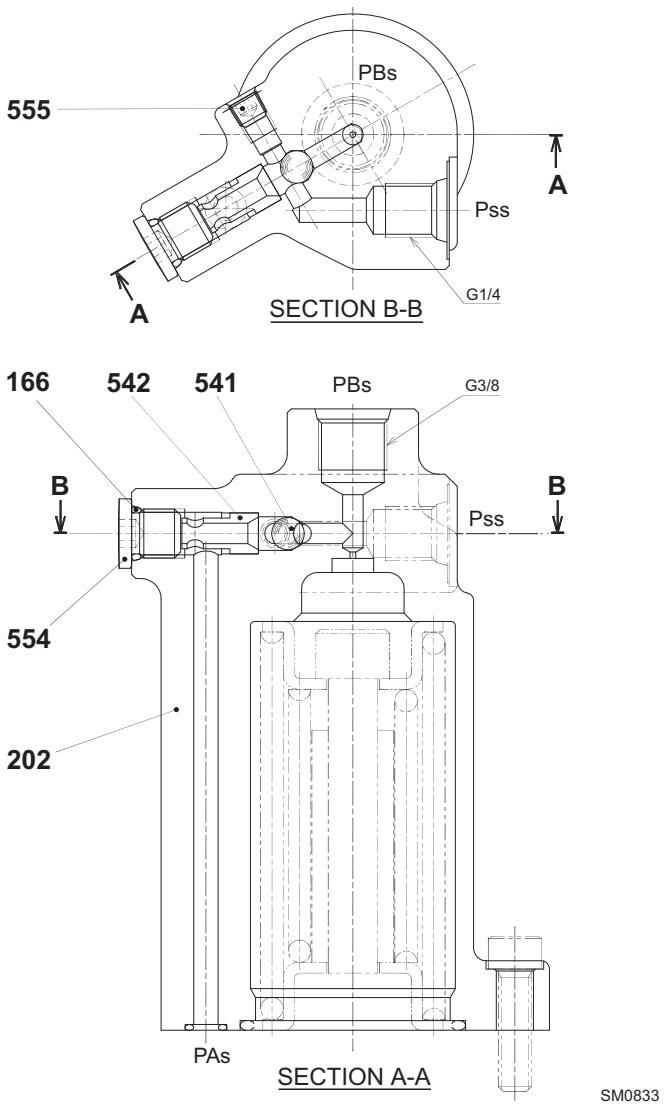

3. Lever held (See Fig.SM0595)
   When the pressure at ports (**2**, **4**) rises to a level equivalent to the action of spring (**509**) that is set by tilting the lever, the hydraulic pressure balances the spring action.
   When the pressure of ports (**2**, **4**) rises above a set value, ports (**2**, **4**) and the P port close while ports (**2**, **4**) and the T port open.
   When the pressure at ports (**2**, **4**) falls below a set value, ports (**2**, **4**) and the P port open while ports (**2**, **4**) and the T port close. Thus the secondary pressure is kept constant.



**Control valve (3/6)**



**Swing shuttle valve cover (204)**




**Swing shuttle valve cover**

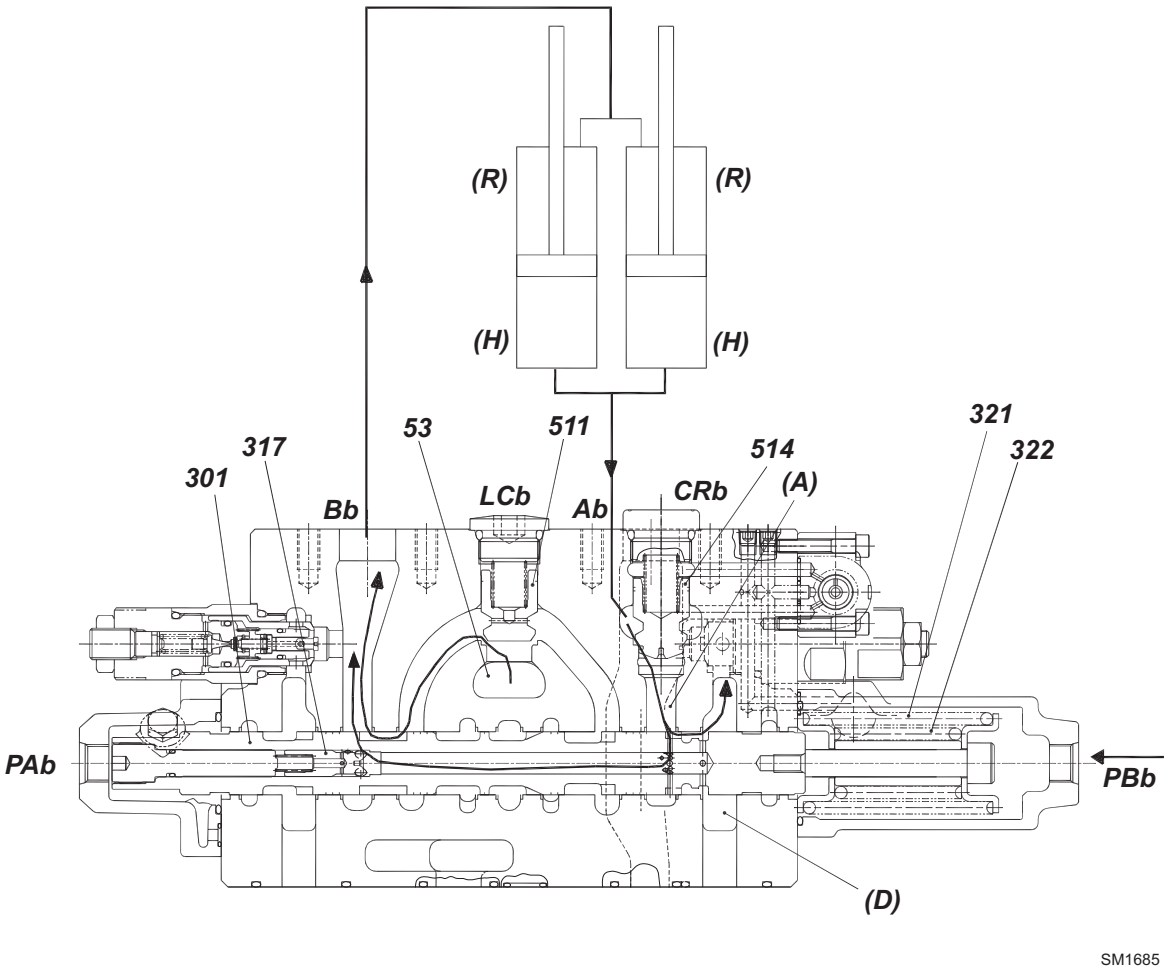
| Tightening torque N•m (lbf•ft) | No. | Parts | Q'ty | Tightening torque N•m (lbf•ft) | No. | Parts | Q'ty |
|---|---|---|---|---|---|---|---|
| | 166 | O-ring | 1 | | 542 | Seat | 1 |
| | 202 | Cover | 1 | 25~29 (18~21) | 554 | Plug | 1 |
| | 541 | Steel ball | 1 | 7.9~9.8 (5.9~7.2) | 555 | Plug | 1 |

c) In boom down operation

On starting boom down operation, the pilot pressure enters port PBb and boom spool (**301**) moves leftward against the force of springs (**321**) (**322**) and the secondary pressure of solenoid proportional valve [X1] acts on PCb and switches unloading spool (**309**). And simultaneously the spool of lock valve selector (**211**) is switched, and the poppet (**514**) is released because the spring chamber of lock valve poppet CRb (**514**) is connected to the drain circuit.

The hydraulic oil delivered by hydraulic pump P1 flows into parallel passage (**53**), and pushes and opens load check valve LCb (**511**), and flows through between the perimeter of boom spool (**301**) and casing through U-shaped passage, and is supplied to boom cylinder rod side (**R**) through port (**Bb**).

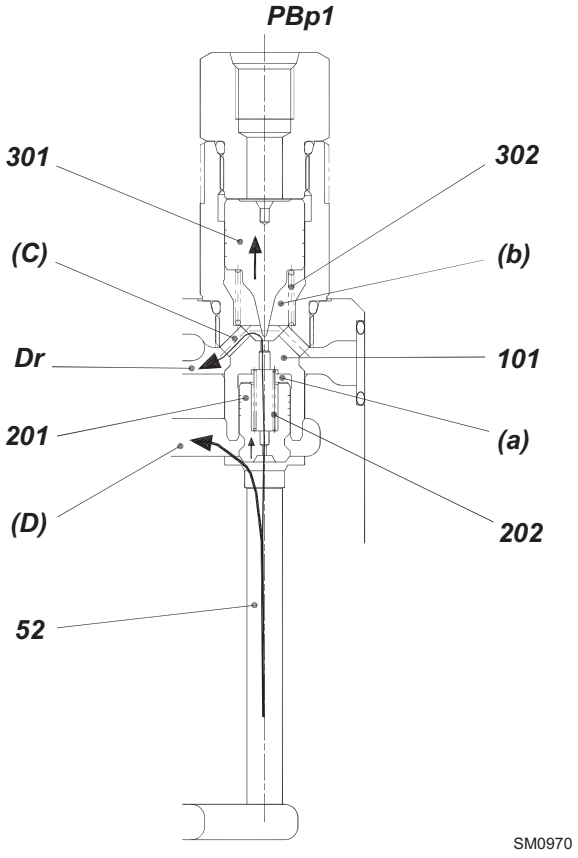
In the meantime, the return oil from boom cylinder head side (**H**) enters the control valve through port (**Ab**). Because the retention of lock valve poppet CRb (**514**) which is located on this side of boom spool (**301**) is released, the lock valve poppet (**514**) pushes and opens. And then the return oil enters BH chamber and passes through between the perimeter of boom spool (**301**) and casing, and flows through low pressure circuit (**D**) and boost check valve (**517**), and the returns to the hydraulic tank through tank port T1. And a part of the return oil flows into the inside of boom spool (**301**) through circular notch of boom spool (**301**). Since the return oil contains sufficient pressure with the self weight of boom, arm, etc. the return oil passes through inside passage of boom spool (**301**) and pushes and opens poppet (**317**) leftward as shown in the figure and flows through the circular notch, and then supplied to boom cylinder rod (**R**) side again through port Bb. (Boom recirculation function)




**(A): BH Chamber**

**In boom down operation**

b) At the time when failure occurred
When the electric system is failed and consequently the secondary pressure of solenoid proportional valves [X1] and [X2] is not produced, plunger (**301**) is moved upward by the force of spring (**302**). Since the taper section at the top end of plunger (**301**) is lifted up from the seat section of plug (**101**), spring chamber (**a**) of poppet (**201**) and spring chamber (**b**) of plug (**101**) are connected each other.
The hydraulic oil from center by-pass passage (**52**) passes through the orifice of poppet (**201**) and enters spring chamber (**a**) of poppet (**201**). Because spring chamber (**a**) of poppet (**201**) and spring chamber (**b**) of plug (**101**) are connected each other, the hydraulic oil in spring chamber (**a**) of poppet (**201**) passes through from seat section of plug (**101**) to spring chamber (**b**) and flows into passage (**Dr**) through passage (**c**). Consequently the pressure in spring chamber (**a**) of poppet (**201**) lowers, poppet (**201**) receives the pressure of center by-pass passage (**52**) and is lifted up against the force of spring (**202**), and the hydraulic oil from center by-pass passage (**52**) flows into low pressure passage (**D**) through poppet (**201**) of by-pass cut valve (**606**). Therefore when the electric system is failed, P1 unloading spool (**309**) is shifted to the neutral position and the passage to low pressure passage (**D**) is cut off, but because center by-pass passage (**52**) is connected to low pressure passage (**D**) through by-pass cut valve (**606**), the abnormal rise of the pump pressure is prevented.




**By-pass cut valve (In condition of failure)**

| No. | Parts | Q.ty | Tightening torque Nm (lbf•ft) | No. | Parts | Q.ty | Tightening torque Nm (lbf•ft) |
|---|---|---|---|---|---|---|---|
| 051 | Relief valve; M33-P1,5 | 2 | 177 (130) | 400 | Anti-reaction valve; M22-P1.5 | 2 | 69 (51) |
| 051-1 | O-ring; 1B G30 | 2 | | 400-1 | O-ring; 1B P20 | 2 | |
| 052 | Anti-reaction valve sub | 1 | | 400-2 | Backup ring | 2 | |
| 100 | Casing for anti-reaction valve | 1 | | 401 | Socket bolt; M20×45 | 4 | 431 (318) |
| 101 | Drive shaft | 1 | | 443 | Roller bearing | 1 | |
| 111 | Cylinder | 1 | | 444 | Roller bearing | 1 | |
| 114 | Spring plate | 1 | | 451 | Pin | 2 | |
| 121 | Piston | 9 | | 469 | ROMH plug; M36-P1.5 | 2 | 539 (398) |
| 122 | Shoe | 9 | | 472 | O-ring; W1516,WG44 | 1 | |
| 123 | Set plate | 1 | | 488 | O-ring; 1B P34 | 2 | |
| 124 | Shoe plate | 1 | | 491 | Oil seal | 1 | |
| 131 | Valve plate | 1 | | 702 | Brake piston | 1 | |
| 151 | Plug; PF1/4 | 2 | 36 (27) | 706 | O-ring; W1516,WG42 | 1 | |
| 161 | O-ring; 1B P11 | 2 | | 707 | O-ring; W1516,WG45 | 1 | |
| 162 | O-ring; 1B P12 | 2 | | 712 | Brake spring | 14 | |
| 163 | O-ring; 1B P6 | 2 | | 742 | Friction plate | 3 | |
| 171 | Socket bolt; M8×55 | 4 | 29 (21) | 743 | Separator plate | 4 | |
| 301 | Casing | 1 | | 984 | Plug; PF1/2 | 1 | 2.7 (2.0) |
| 303 | Valve casing | 1 | | 985 | Plug; PF1 | 1 | 5.6 (4.1) |
| 351 | Plunger | 2 | | 986 | Plug; PF1/4 | 1 | 0.9 (0.66) |
| 355 | Spring | 2 | | 994 | Plug; PT3/4 | 1 | 98 (72) |
| 390 | Name plate | 1 | | | | | |
| 391 | Rivet | 2 | | | | | |

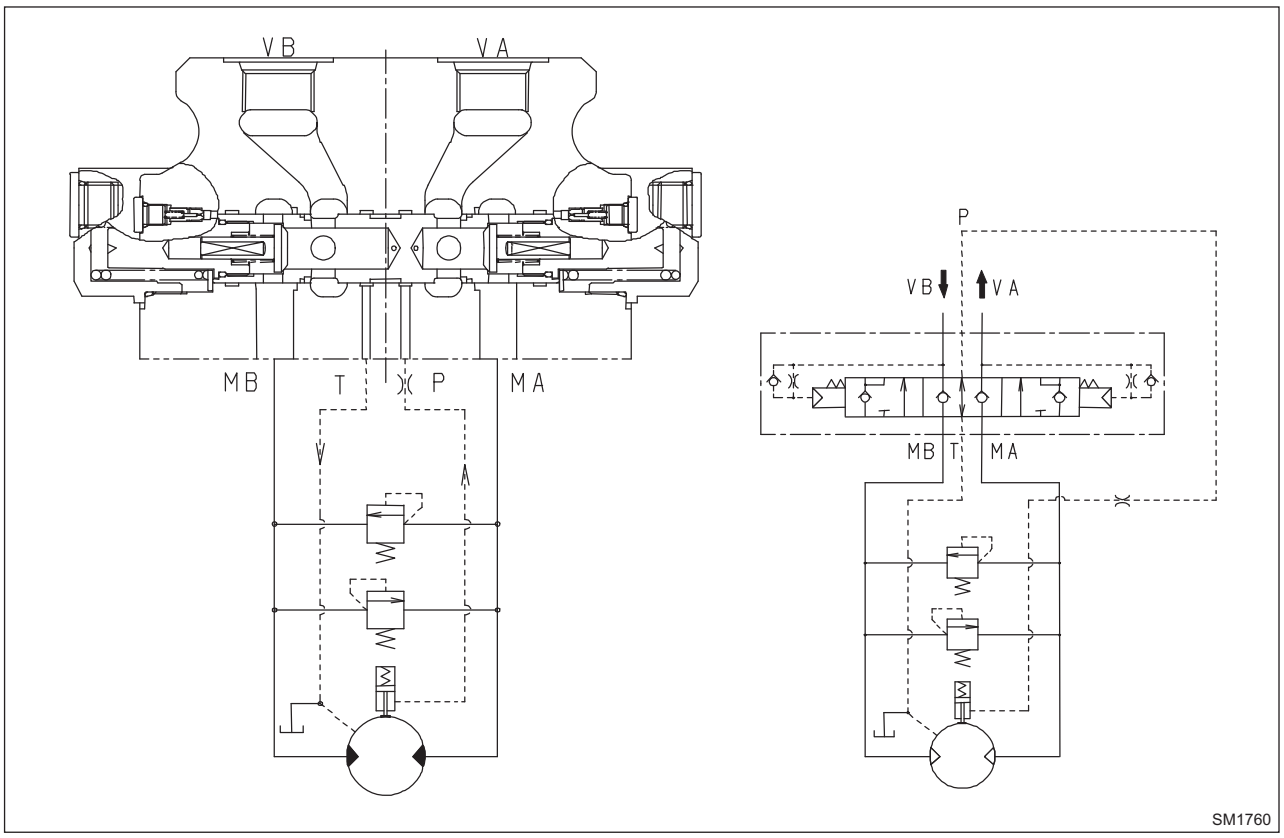
## OUTLINE

### Characteristics

| Item | | E385B |
|---|---|---|
| Reduction gear unit | | Epicycloidal, two-stage planetary type |
| Model | | - |
| Reduction gear ratio | | 40.467 |
| Travel motor | | Two speed, axial piston swash plate type |
| Model | | M4V290/170F-RG6,5F |
| Displacement | max | 290.7 $cm^3$/rev |
| | min | 170.1 $cm^3$/rev |
| Rated flow | | 370 L/min (98 gal/min) |
| Theoretical output torque | low speed | 64260 Nm (47392 lbf·ft) |
| | high speed | 37600 Nm (27730 lbf·ft) |
| Parking brake torque | | 902 Nm (665 lbf·ft) |
| Release pressure or parking brake | | 1.54 MPa (223 psi) |
| Relief valve set pressure | cracking | 35.8~37.8 MPa (5191~5481 psi) |
| | working | 34,3 MPa (4974 psi) |
| Mass (with oil) | | 399 Kg (880 lbs) |

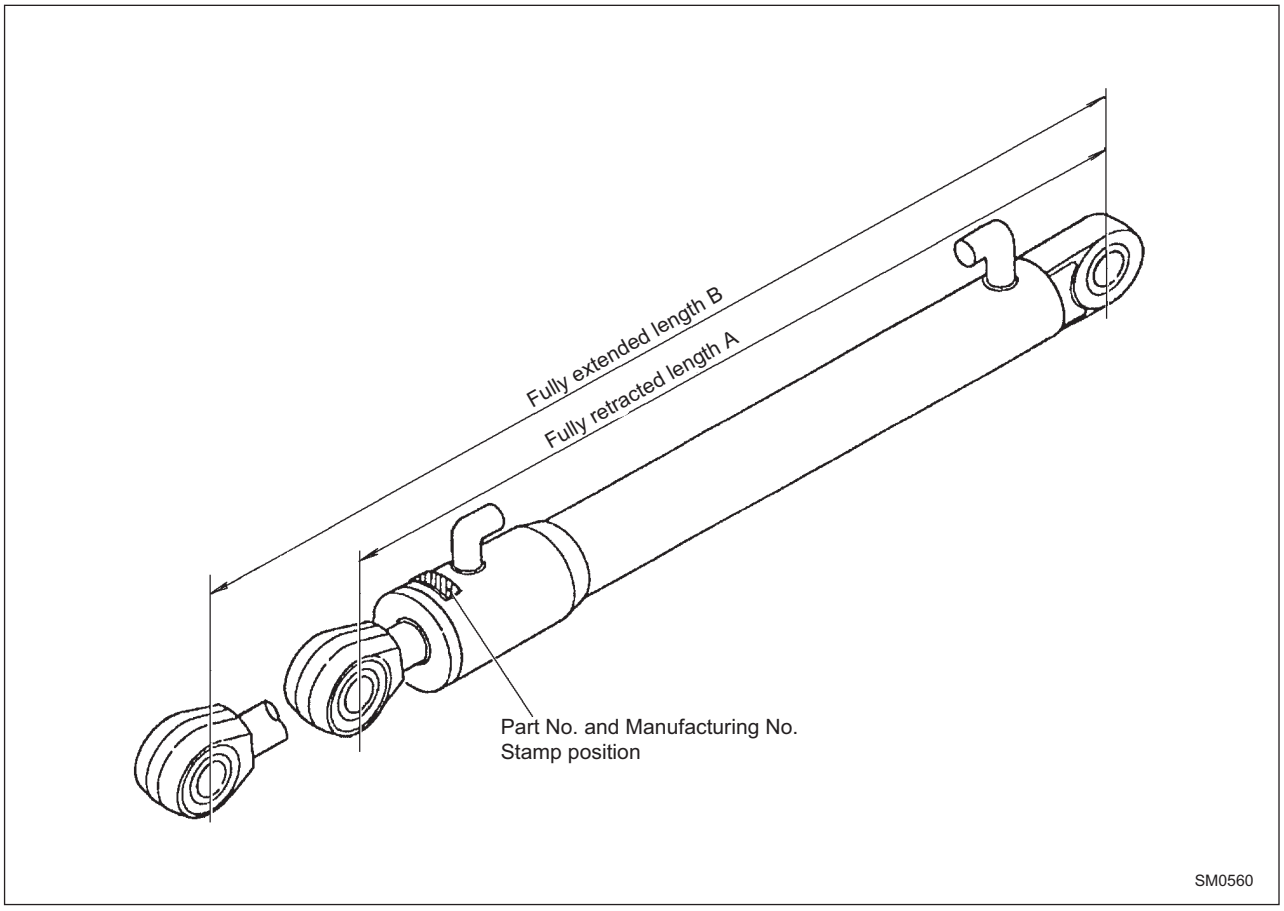
**Function of brake valve**

1. Hold condition
   When the selector valve is at neutral, the **VA** and **VB** ports are connected with the tank. Spool (**26**) is held in its center position by the action of springs located at its both ends. Since the **VA→MA** passage and the **VB→MB** passage are closed, the **MA** and **MB** ports that are connected with both sides of the hydraulic motor are closed.
   Furthermore, since the parking brake passage is connected with the tank, the feed pressure for the brake cylinder of the negative brake mechanism is equal to the tank pressure. This makes the brake in operating condition and prevents the hydraulic motor from turning mechanically.
   If an external force acts upon the hydraulic motor, the motor is kept normally from turning by the negative brake. Suppose the negative brake is released, pressure is built up at the **MA** or **MB** port. Since the hydraulic motor turns a little as the high pressure of the closed circuit escapes due to internal leaks of the hydraulic motor, cavitation is about to be built up on the low pressure side of the closed circuit. The check valve built in the spool operates to prevent cavitation it allows the **VA→MA** or **VB→MB** passage to be formed and makes up an amount of oil equal to the leakage to the closed circuit from the tank.



## OUTLINE

### General view

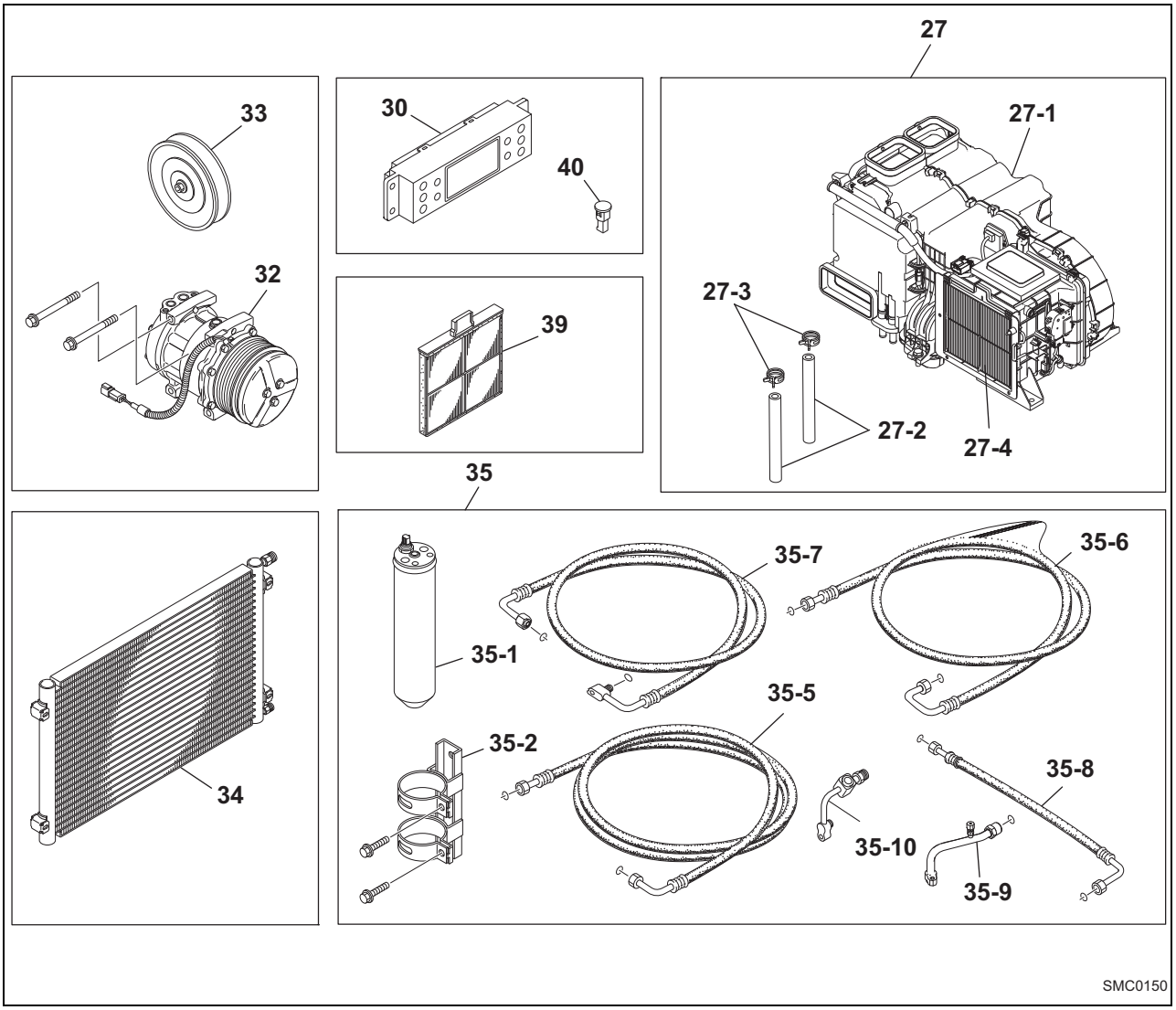



### Specifications

| Use | Cylinder bore Rod Dia. (mm) | Stroke (mm) | Center distance of pins Full extend B / Full retract A (mm) | Cushion | Dry weight kg (lbs) |
|---|---|---|---|---|---|
| Boom | Ø 140 / Ø 100 | 1550 | 3651 / 2101 | With cushion on rod side | 295 (650) |
| Arm | Ø 170 / Ø 120 | 1788 | 4281 / 2493 | With cushion on both sides | 504 (1111) |
| Bucket | Ø 145 / Ø 95 | 1250 | 3085 / 1835 | With cushion on rod side | 257 (566) |
| Bucket (BEH version) | Ø 150 / Ø 100 | 1250 | 3085 / 1835 | With cushion on rod side | 270 (595) |
| Positioning | Ø 170 / Ø 110 | 1334 | 3355 / 2021 | Without cushion | 392 (864) |

## COMPONENT AND CONSTRUCTION

### COMPONENT




**Air conditioner group**

| No. | Parts | Q.ty |
|---|---|---|
| 27 | Air conditioner assy | 1 |
| 27-1 | Air conditioner unit | 1 |
| 27-2 | Hose | 2 |
| 27-3 | Clamp | 2 |
| 27-4 | Filter | 1 |
| 30 | Panel assy | 1 |
| 32 | Compressor | 1 |

| No. | Parts | Q.ty |
|---|---|---|
| 33 | Pulley | 1 |
| 34 | Condenser | 1 |
| 35 | Air dryer assy | 1 |
| 35-1 | Receiver dryer | 1 |
| 35-2 | Bracket | 1 |
| 35-5 | S hose: Ø 24 | 1 |
| 35-6 | D hose | 1 |

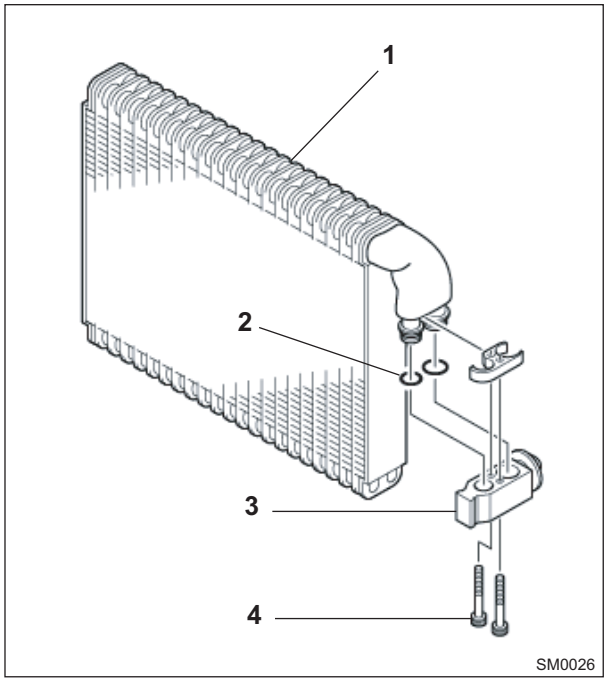
| No. | Parts | Q.ty |
|---|---|---|
| 35-7 | L hose | 1 |
| 35-8 | L hose: Ø 15 | 1 |
| 35-9 | S tube: Ø 16 | 1 |
| 35-10 | L tube: Ø 8.5 | 1 |
| 39 | Filter | 1 |
| 40 | Solar radiation sensor | 1 |

Consequently, the cooling circuit is so constructed that the evaporator can cool down an object (air in this case) sufficiently (i.e. so as to decrease the pressure in the evaporator) and that an adequate amount of refrigerant can be fed to the evaporator.
The feed rate of the refrigerant is controlled by the expansion valve, but the pressure in the evaporator is held low by the throttling action of the expansion valve and the suction action of the compressor. The compressor acts as a pump that allows the refrigerant to circulate. The compressive action of the compressor and the heat exchange (heat radiation) action of the condenser transform the refrigerant in a dry vapor state back to a liquid state.

**Component parts**

*EVAPORATOR*

The evaporator is an important heat exchanger that absorbs the heat of the compartment air (object) by the utilization of the latent vaporization heat of the low-temperature, low-pressure liquid-state refrigerant. Therefore, it is necessary that satisfactory heat transfer between the object and the refrigerant take place in the evaporator.
To that end, the evaporator is equipped with fins on the air side in order to increase the heat transfer area of the air side and thereby perform excellent thermal transfer between the refrigerant and the air.
The humidity in the air condenses as the air cools down and adheres to the outside of the evaporator as water drops. The cooling effect deteriorates if the water drops freeze. Therefore, how to discharge water is an important point.
The amount of refrigerant supplied to the evaporator is controlled by the expansion valve which is described in the following. In order to attain proper control, it is necessary to reduce the pressure drop of the refrigerant of the evaporator. Accordingly, reducing the pressure drop is one element that makes the evaporator attain its full performances.




**1 - Evaporator**
**2 - O-ring**
**3 - Expansion valve**
**4 - Socket bolt M5 x 40**

*EXPANSION VALVE*

In order for the evaporator to fulfill its performances, a proper amount of low-pressure low-temperature liquid refrigerant must be fed to the evaporator.
If the feed rate is too low, the refrigerant completes vaporization early in the evaporator which results in deterioration of the cooling effect. If the feed rate is too high, unvaporized liquid refrigerant returns to the compressor (liquid back). This not only deteriorates the cooling effect, but also damages the compressor valves.

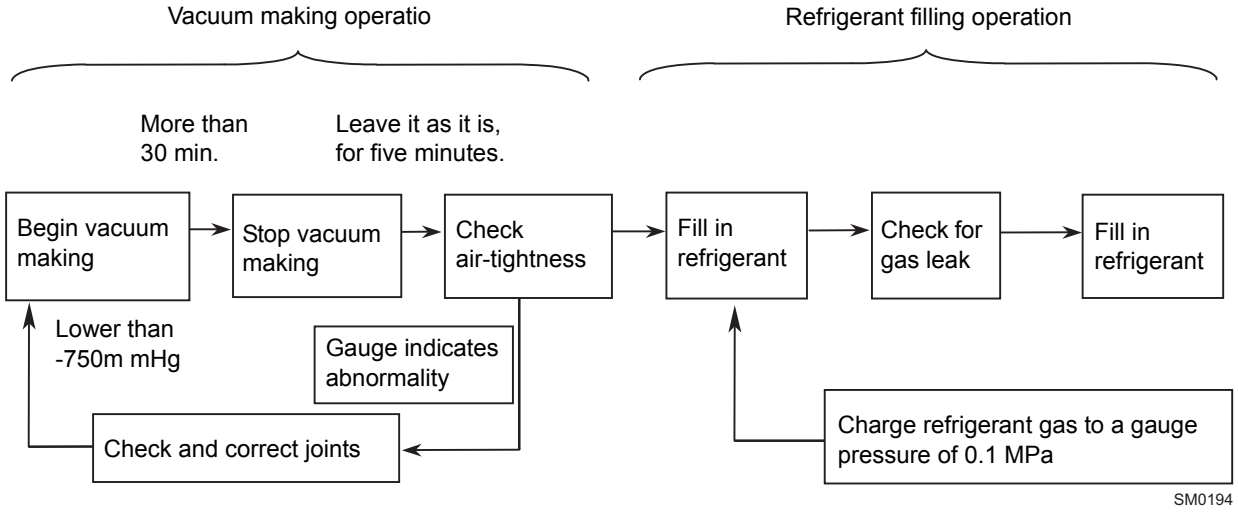
## OPERATING PROCEDURE

The change of refrigerant in the air conditioner requires a "vacuum generation procedure" and a "gas charging procedure".

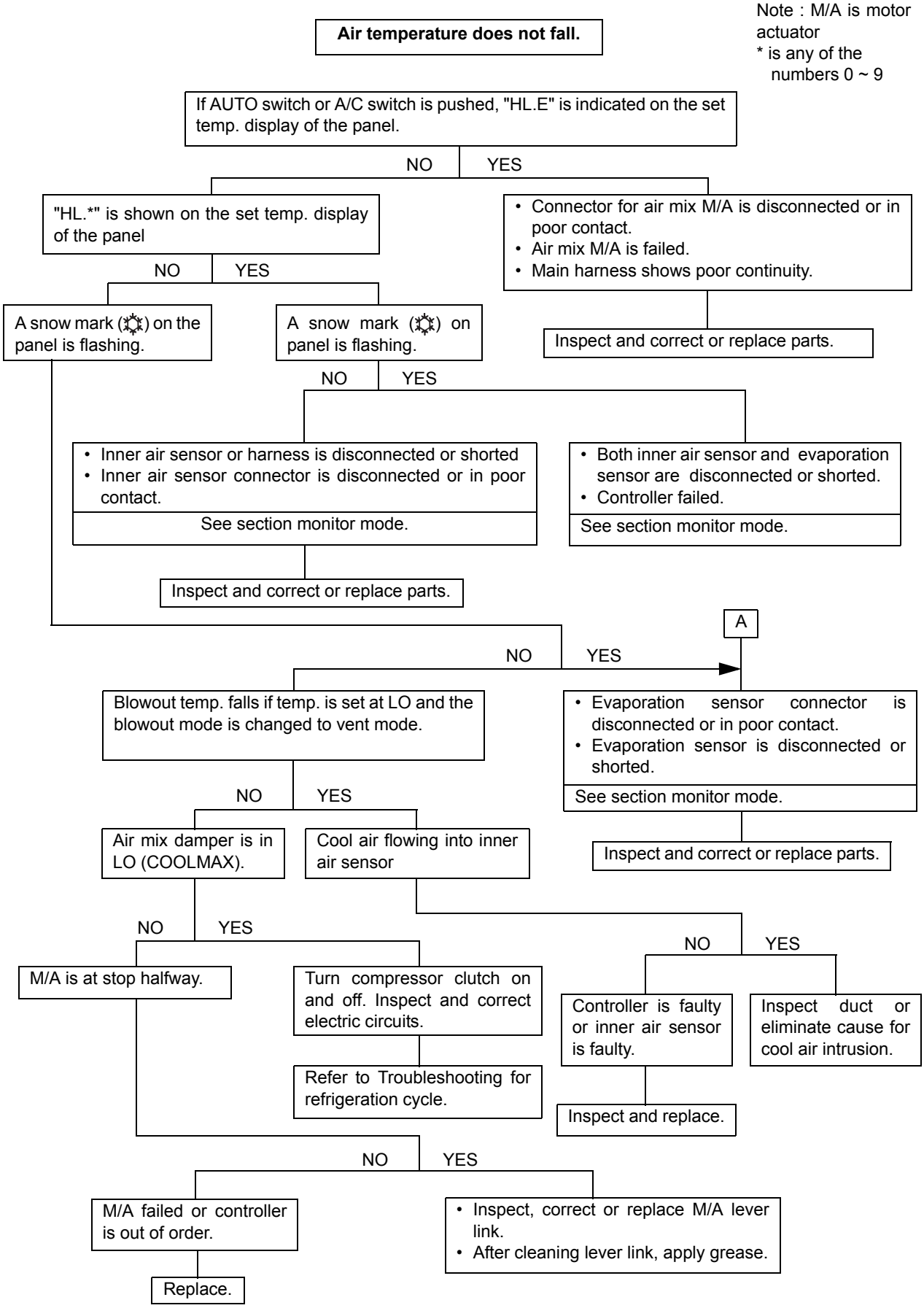
- The "vacuum generation procedure" consists in removing moisture from the air conditioner circuit. In the event even a small quantity of moisture remains in the system, it would freeze in the small orifices of the expansion valve when in operation. This causes a clogging of the circuit or the formation of rust, with a series of operational troubles. prior to filling the circuit with refrigerant, apply the vacuum and cause the boiling and vaporisation of the moisture. In this manner, moisture is eliminated from the system.
- The "gas charging procedure" consists in the filing the circuit with refrigerant, after applying a vacuum. the filling of the gas is not only depending upon the cooling performance of the air conditioner, but it influences also the useful working life of the circuit components. An excessive overloading increases considerably the pressure of the system and damages the cooling performance. On the contrary, a too low charging, results in an insufficient circulation of lubricant oil in the compressor, causing the wear of the moving parts of the compressor.

**CAUTION**

The gas filling operation involves the handling of highly compressed gases; it is dangerous to handle the gas without complying strictly with the relevant procedures. The procedures and the protections described in this manual for the filling of refrigerant gas must be strictly adhered to.



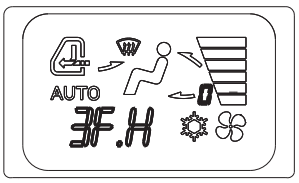
## TROUBLESHOOTING



### 3. Contents of monitor mode display

Refer to the list of segment display exclusively used for monitor and the list of segments in three digits.

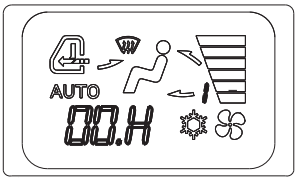
1. Example 1




SMC0055

When the segment exclusively used for monitor indicates 0 (displays the inner air sensor condition), since the segment indicates 3F, the sensor is in normal operating condition according to the list of 3 segments.
--> The inner air sensor is in normal operating condition.

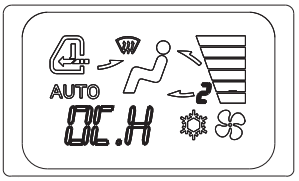
2. Example 2




SMC0056

When the segment exclusively used for monitor indicates 1 (displays the evaporator sensor condition), since the segment indicates 00, the sensor is in disconnection condition according to the list of 3 segments.
--> The evaporator sensor is in disconnection condition.

3. Example 3




SMC0057

When the segment exclusively used for monitor indicates 2 (displays the solar radiation sensor condition), since the segment indicates FF,the sensor is in short-circuiting condition according to the list of 3 segments.
-->The solar radiation sensor is in short-circuiting condition.

### 4. List of 3 segments

| TERZO SEGMENTO \ SECONDO SEGMENTO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | SENSORE INGRESSO ARIA SCOLLEGATO<br>SENSORE EVAPORATORE SCOLLEGATO<br>SENSORE IRRAGGIAMENTO SOLARE CORTOCIRCUITATO | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | |
| A | | | | | | | | | | | | | | | | |
| B | | | | | | | | | | | | | | | | |
| C | | | | | | | | | | | | | | | | |
| D | | | | | | | | | | | | | | | | |
| E | | | | | | | | | | | | | | | | |
| F | | | | | | | | | | | | | | | | |


OGNI SENSORE FUNZIONA CORRETTAMENTE


SENSORE INGRESSO ARIA CORTOCIRCUITATO
SENSORE EVAPORATORE CORTOCIRCUITATO

SMC0058

## PERFORMANCE INSPECTION STANDARD TABLE

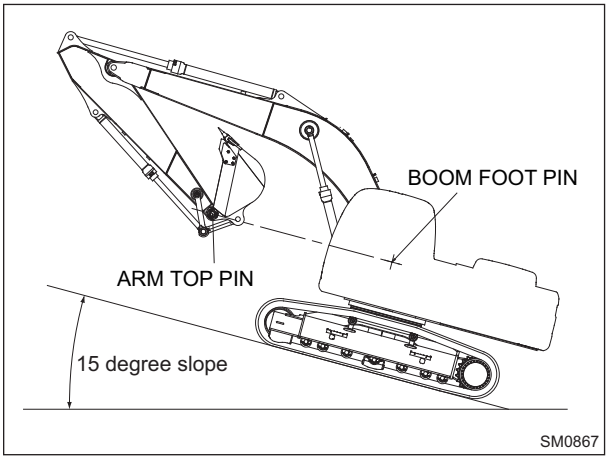
**NOTE:** ***unless otherwise specified, measure it on "H" mode.***

| Inspection Item | | | | | Measuring Position | | | Standard Value | Unit | Adjusting Point | Measuring Condition |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Position | Size | Port | | | | |
| Std. Measuring condition | Cleanliness of hydraulic oil | | | | Hydraulic oil in tank | | | NAS 9 or less | Class | - | Sampling |
| | Hydraulic oil temperature | | | | Tank surface | | | 50 ± 5 | °C | - | Atmospheric temp 50 °C ~ -10 °C |
| | Water temperature | | | | Radiator surface | | | 75 ± 15 | | - | |
| | Engine speed | H mode Lo idle | | | Measure the engine speed at multi display on the gauge cluster, or measure with diesel speed meter | | | 1000 ± 25 | $min^{-1}$ | Adjustment not required | Low throttle |
| | | H mode Hi idle | | | | | | 2100 $^{+30}_{-70}$ | | | Full throttle (Hi Idle) |
| | | Auto-Idle | | | | | | 1050 ± 25 | | | Perform all measurement with the air-conditioner “OFF” |
| | | S mode Hi idle | | | | | | 1900 $^{+30}_{-70}$ | | | |
| | | - | | | | | | - | | | |
| | | - | | | | | | - | | | |
| Pilot primary pressure circuit | | | | | G pump | PF 1/4 | a5 | 5,0 $+^{0.5}_{-0}$ | MPa | PR1 | HI idle |
| High pressure circuit | Main relief valve pressure | ATT Travel | | P1 | Main pump | | a1 | 34.3 $^{+1.5}_{+0}$ | | MR1 | Boom up |
| | | | | P2 | | | a2 | | | | |
| | | Power boost | | P1 | | | a1 | 37.8 $^{+1,0}_{-0.5}$ | | MR1 | Boom up |
| | | | | P2 | | | a2 | | | | |
| | Over load relief valve pressure | Boom | | H | | | a1 | 39.7 $^{+0}_{-5.4}$ | | OR3 | Boom up |
| | | | | R | | | | 37.8 $^{+0}_{-3.5}$ | | OR4 | Boom down |
| | | Bucket | | H | | | a1 | 39.7 $^{+0}_{-5.4}$ | | OR1 | Bucket digging |
| | | | | R | | | | 37.8 $^{+0}_{-3.5}$ | | OR2 | Bucket dump |
| | | Arm | | H | | | a2 | 37.8 $^{+0}_{-3.5}$ | | OR7 | Arm in |
| | | | | R | | | | 39.7 $^{+0}_{-5.4}$ | | OR8 | Arm out |
| | | Swing | | LH | | | a2 | 29.0 $^{+5.3}_{+0}$ | | OR5 | Swing LH |
| | | | | RH | | | | | | OR6 | Swing RH |
| | | Travel | RH | Forward | | | a1 | 35.8 $^{+0}_{-1.5}$ | | | Simultaneous Operation of travel RH and LH |
| | | | | Reverse | | | | | | | |
| | | | LH | Forward | | | a2 | 35.8 $^{+0}_{-1.5}$ | | | |
| | | | | Reverse | | | | | | | |

**Performances of parking brake**

*PURPOSE*

Confirm that the parking brake holds a stopped condition of the machine in a no-load travel position and on a 15 degree slope.

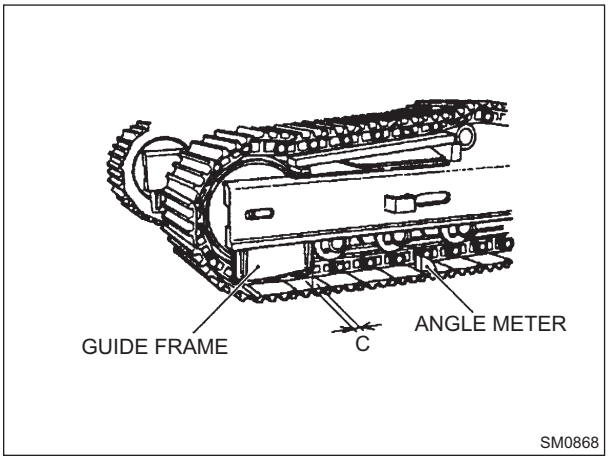



*CONDITION*

A slope with (Approx. 15 deg) gradient and a stopped condition in a no-load travel position.

*PREPARATION*

Place an angle meter on the shoe plate and confirm that it makes an angle more than 15 degree.
Hang a perpendicular in parallel with the guide frame rib on the track frame and put a mark (matching mark) on the shoe plate.



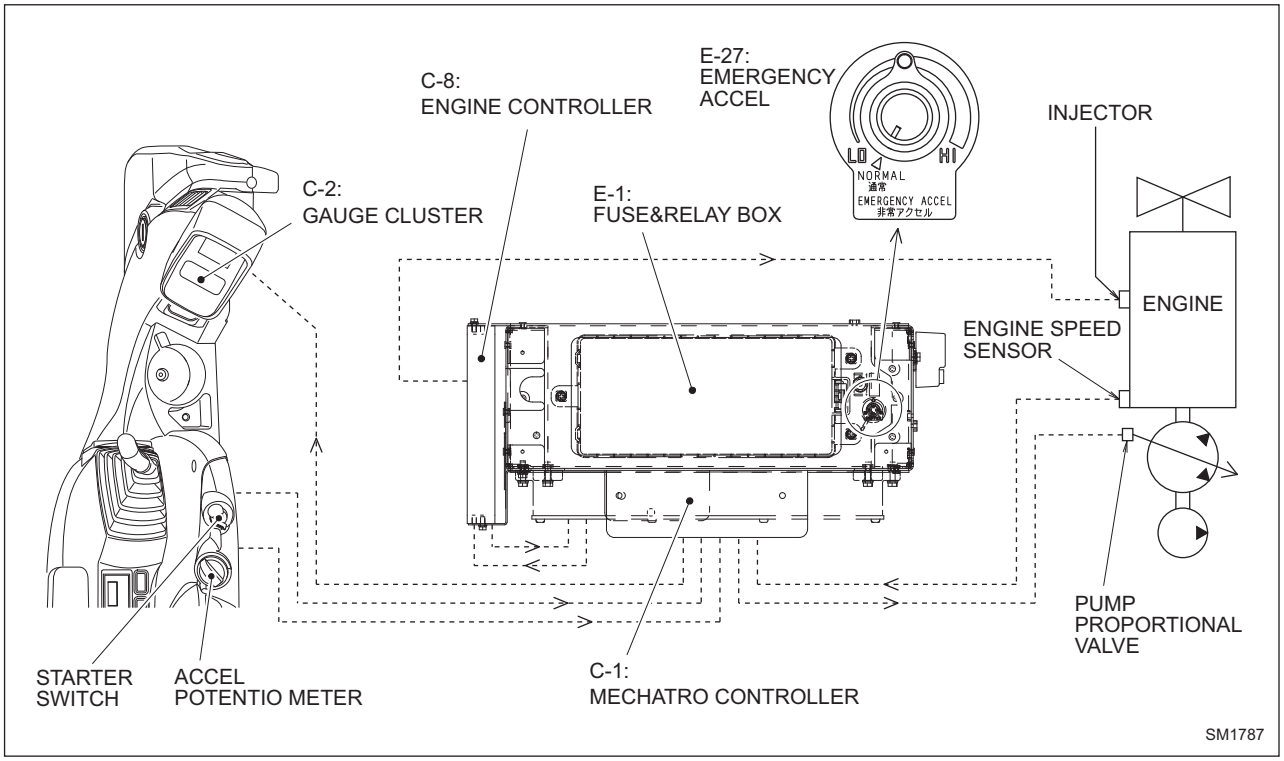

*MEASUREMENT*

Five minutes after the engine stops, measure the movement distance of the matching mark.

Parking brake Units: mm (in)/5 min

| Measuring position | Standard value | Reference value for remedy | Service limit |
|---|---|---|---|
| C | 0 | 1 (0.04) | 2 (0.08) |

## ENGINE CONTROL INPUT/OUTPUT



# TROUBLESHOOTING

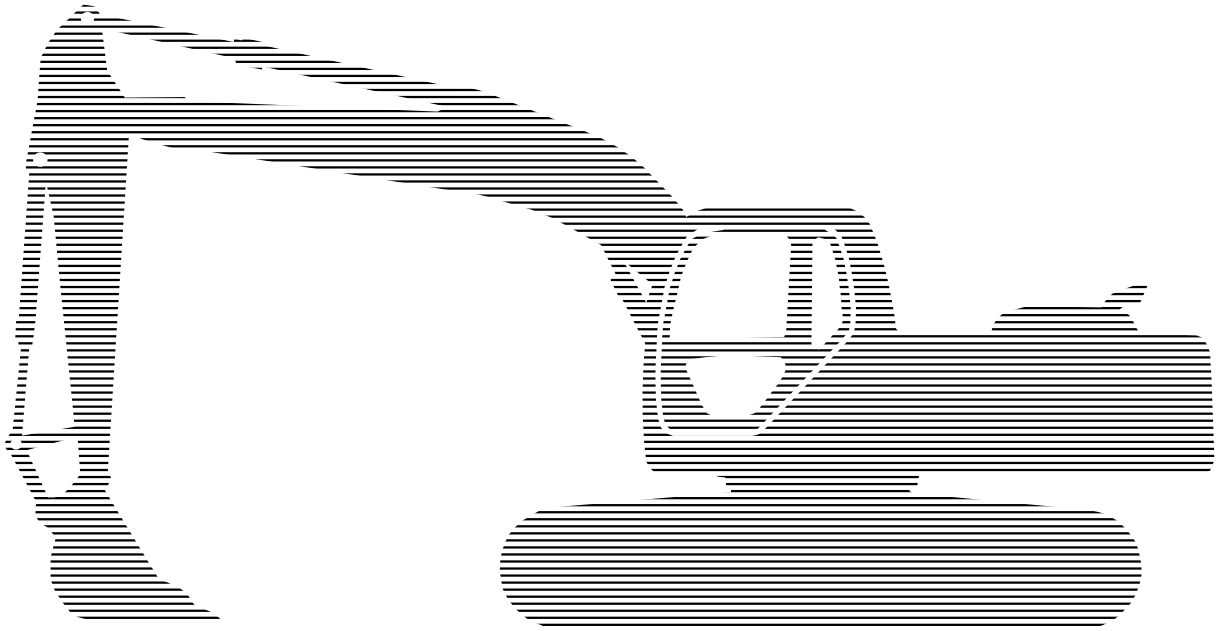


**Table 1**

| **Error code** | | **A015** | | |
|---|---|---|---|---|
| Trouble | | Not yet adjusted engine or failed adjustment of engine (A adjustment) | | |
| Judging condition | | Engine adjustment is missed. Or it is impossible to set the adjusting value within the adjustment range. | | |
| Symptom | | Deviated from the required value, but no problem in normal operations. | | |
| Control in the event of failure | | Rotate with the default engine | | |
| Returned in normal condition | | The engine adjustment is completed normally. | | |
| Service diagnosis checking screen | | Screen No. | 2 | G-3 SPEED SET |
| | | Screen No. | | |
| | | Screen No. | | |
| Checking object | | | | Checking contents and remedy |
| 1 | • Checking | | | Carry out engine adjustment (A adjustment). When "ERROR ENG" was displayed during adjustment, refer to the section "Adjustment procedure - Measures to be taken with the adjustment failed" |
| 2 | • Mechatro controller | | | Check that the error is corrected after replacement of controller. |
| 3 | | | | |

**Table 2**

| **Error code** | | **A025** | | |
|---|---|---|---|---|
| Trouble | | Not yet adjusted engine or failed adjustment of pump proportional valve (B adjustment) | | |
| Judging condition | | Pump proportional valve adjustment is missed. Or it is impossible to set the adjusting value within the adjusting range. | | |
| Symptom | | Deviated from the rated output, but no problem in normal operation. | | |
| Control in the event of failure | | Workable with the default proportional valve output. | | |
| Returned in normal condition | | The pump proportional valve adjustment is completed normally. | | |
| Service diagnosis checking screen | | Screen No. | 9 | E-1 P1 PUMP |
| | | Screen No. | 9 | E-2 P2 PUMP |
| | | Screen No. | | |
| Checking object | | | | Checking contents and remedy |
| 1 | • Checking | | | Carry out pump adjustment (B adjustment).<br>When"ERROR PUMP" was displayed during adjustment, refer to the section "Adjustment procedure - Measures to be taken with the adjustment failed" |
| 2 | • Mechatro controller | | | Check that the error is corrected after replacement of controller. |
| 3 | | | | |

**Table 20**

| **Error code** | **B044** | | |
|---|---|---|---|
| Trouble | Arm-in pressure sensor's power source is shortcut. | | |
| Judging condition | The input voltage from arm-in pressure sensor is 4.7 V or more. | | |
| Symptom | Cavitation occurs at independent work of arm-in. Arm horizontal arm pulling can be barely done but if attachment is pulled in the air, arm falls first. Bucket can drag under the condition that the bucket bottom put on the ground. | | |
| Control in the event of failure | Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode)<br>Set output of P1, P2 unload proportional valves to 0 mA. (Valve emergency mode)<br>Set output of arm 2 arm-in proportional valve to 200 mA. | | |
| Returned in normal condition | It returns automatically in normal condition. | | |
| Service diagnosis checking screen | Screen No. | 5 | B-4 ARM IN |
| | Screen No. | | |
| | Screen No. | | |

| | Checking object | Checking contents and remedy |
|---|---|---|
| 1 | • Arm-in pressure sensor<br>SE-7 | When B044 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor.<br>Check sensor unit for possible failure. If failure found, replace it. |
| 2 | • Wiring between arm-in pressure sensor and controller<br>CN-130F<br>CN-101F | When B044 is displayed after turning the starter switch on after the connector is exchanged with other sensor.<br>Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 36**

| **Error code** | **B113** | | |
|---|---|---|---|
| Trouble | Option selector position detect pressure sensor's wiring is disconnected. | | |
| Judging condition | The input voltage from option selector position detect pressure sensor is 0.1 V or less. | | |
| Symptom | When B mode is selected, option selector valve error is indicated. | | |
| Control in the event of failure | Normal control. | | |
| Returned in normal condition | It returns automatically in normal condition. | | |
| Service diagnosis checking screen | Screen No. | 16 | B-11 |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • Option selector position detect pressure sensor<br>SE-29 | When B113 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor.<br>Check sensor unit for possible failure. If failure found, replace it. |
| 2 | • Wiring between option selector position detect pressure sensor and controller<br>CN-162F<br>CN-104F | When B113 is displayed after turning the starter switch on after the connector is exchanged with other sensor.<br>Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 54**

| **Error code** | **D012** | | |
|---|---|---|---|
| Trouble | P1 unload proportional valve and output transistor ON are failure. | | |
| Judging condition | The feed-back value from proportional valve is 1000 mA or more. | | |
| Symptom | Option conflux can not be done. | | |
| Control in the event of failure | Set output of P1 unload proportional valve to 0 mA. (Valve emergency mode). | | |
| Returned in normal condition | It returns automatically in normal condition. | | |
| Service diagnosis checking screen | Screen No. | 8 | D-1 P1 UN-LOAD (BP-CUT) |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • P1 unload proportional valve PSV-D | When D012 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor.<br>Check sensor unit for possible failure. If failure found, replace it. |
| 2 | • Wiring between P1 unload proportional valve and controller CN-120F CN-105F | When D012 is displayed after turning the starter switch on after the connector is exchanged with other sensor.<br>Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 55**

| **Error code** | **D013** | | |
|---|---|---|---|
| Trouble | P1 unload proportional valve's wiring is disconnected. | | |
| Judging condition | The feed-back value from proportional valve is 100 mA or less.<br>(If output is 100 mA or less, judging is not done.) | | |
| Symptom | Option conflux can not be done. | | |
| Control in the event of failure | Set output of P1 unload proportional valve to 0mA. (Valve emergency mode). | | |
| Returned in normal condition | It returns automatically in normal condition. | | |
| Service diagnosis checking screen | Screen No. | 8 | D-1 P1 UN-LOAD (BP-CUT) |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • P1 unload proportional valve PSV-D | When D013 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor.<br>Check sensor unit for possible failure. If failure found, replace it. |
| 2 | • Wiring between P1 unload proportional valve and controller CN-120F CN-105F | When D013 is displayed after turning the starter switch on after the connector is exchanged with other sensor.<br>Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 69**

| **Error code** | **F013** | | |
|---|---|---|---|
| Trouble | ATT boost solenoid valve and output transistor ON are failure, and disconnection. | | |
| Judging condition | The feed-back signal is 24 V level while exciting command is not output. | | |
| Symptom | ATT boost is not available or is leaving available. | | |
| Control in the event of failure | Normal control. | | |
| Returned in normal condition | The feed-back signal is grounding level while exciting command is not output. | | |
| Service diagnosis checking screen | Screen No. | 3 | F-1 POWER BOOST |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • ATT boost solenoid valve<br>SV-2 | When F013 is cancelled and other error occurs by exchanging the connector for other solenoid valve.<br>Check solenoid valve unit for possible failure. If failure found, replace it. |
| 2 | • Wiring between ATT boost solenoid valve and controller<br>CN-117F<br>CN-105F | When F013 is displayed after the connector is exchanged with other solenoid valve.<br>Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 84**

| **Error code** | **H033** | | |
|---|---|---|---|
| Trouble | Arm angle potentiometer's wiring is disconnected. | | |
| Judging condition | The input voltage from arm angle potentiometer is 0.1 V or less. | | |
| Symptom | Indications of rating load and working radius of High-reach crane become abnormal. | | |
| Control in the event of failure | Normal control. | | |
| Returned in normal condition | It returns automatically in normal condition. | | |
| Service diagnosis checking screen | Screen No. | 12 | H-3 ARM |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • Arm angle potentiometer SE-18 | Measure the resistance between terminals of arm angle potentiometer. 4.0~6.0k Ω . Turn the potentiometer and measure resistance between signal and GND. Normal value: 0 to all resistance (4.0~6.0)k Ω |
| 2 | • Wiring between arm angle potentiometer and controller CN-703F CN-103F | Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

**Table 96**

| **Error code** | **R134** | | |
|---|---|---|---|
| Trouble | Swing flasher relay error. | | |
| Judging condition | The mechatro controller output line to swing flasher relay is short-circuited with the power source. | | |
| Symptom | Right swing flasher does not light. | | |
| Control in the event of failure | Relay output is stopped. | | |
| Returned in normal condition | When the power is OFF. | | |
| Service diagnosis checking screen | Screen No. | 22 | D13 |
| | Screen No. | | |
| | Screen No. | | |

| Checking object | | Checking contents and remedy |
|---|---|---|
| 1 | • Swing flasher relay R-19 | When error is cancelled after removing connector (CN-74F) of swing flasher relay, check relay unit for failure, replace it with new one if failed.<br>When resistance between relays (HB) and (HC) is 0 Ω, it is in abnormal condition.<br>  |
| 2 | • Wiring between swing flasher relay and controller CN-74F, CN-109F | When R134 is left displayed with the relay removed<br>Check that no power 24 V is produced on relay (-) line (as shown right upper figure C) according to the wiring checking procedure and replace it if necessary. |
| 3 | • Mechatro controller | Check that the error is corrected after replacement of controller. |

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| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 13 | Secondary pressure of pump proportional valve | Measure the pump proportional valve secondary pressure directly in idling operation. (Ports a3, a4) | Check that pump proportional valve secondary pressure is 2.7 MPa or more in right (left) travel full lever and high idling operation<br>Right travel: P1 pump proportional valve<br>Left travel: P2 pump proportional valve | Replace proportional valve |
| 14 | Main relief pressure | Carry out service diagnosis | • See Service Diagnosis Data List<br>Operation No.3 Boom up full lever & relief | Measure the relief pressure actually |
| 15 | | Check set pressure | Check that P1 and P2 pump pressures are 32 MPa in boom up full lever, high idling and H mode operation. | Reset or replace |
| 16 | Pump regulator | Visual check | When removing, free from abnormal resistance against sliding.<br>Free from abnormal damage, etc on outside surface<br>Spring free from breakage, damage, etc. | Replace |
| 17 | Pump | Visual check | When removing, inside parts (cylinder block, piston, valve plate, shaft, etc.) are free from abnormal resistance against sliding, abnormal damage, etc. | Replace |

2. Engine down/stalled

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 1 | Actual measuring current value of P1/P2 pump proportional valve | Carry out service diagnosis | • No.9 E-1 P1 pump<br>E-2 P2 pump<br>• See Service Diagnosis Data List<br>Operation No. 1 Operation is nil | In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure. |
| 2 | Secondary pressure of P1, P2 pump proportional valve | Measure the pump proportional valve secondary pressure directly (Ports a3, a4) | Check that P1/P2 pump proportional valve pressures are within the range of 0.5 to 1.0 MPa in control lever neutral and high idling operation. | Replace proportional valve |
| 3 | Pressure sensor of P1, P2 pump | Check pressure | • See Service Diagnosis Data List<br>Operation No. 1 Operation is nil<br>Operation No.3 Boom up full lever & relief | Check pressure sensor and replace it if necessary |
| 4 | Pump regulator | Visual check | When removing, free from abnormal resistance against sliding<br>Free from abnormal damage, etc on outside surface<br>Spring free from breakage, damage, etc. | Replace |
| 5 | Pump | Visual check | When removing, inside parts (cylinder block, piston, valve plate, shaft, etc.) are free from abnormal resistance against sliding, abnormal damage, etc. | Replace |

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 8 | Attachment boost solenoid command | Carry out service diagnosis | No.3 POWER BOOST<br>Bucket digging COMP OFF, MEAS OFF | Check harness<br>Replace solenoid valve |
| 9 | Attachment boost solenoid secondary pressure | Measure switching valve secondary pressure | Check that pressure is 0 MPa in bucket digging full lever and high idling operation | Replace solenoid valve |
| 10 | Actual measuring current value of travel straight proportional valve | Carry out service diagnosis | • See Service Diagnosis Data List Operation No.12 Bucket digging full lever & relief | In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure. |
| 11 | Secondary pressure of travel straight proportional valve | Measure directly the proportional valve secondary pressure at the ports A6 (travel straight) of 8 sections solenoid block | Check that travel straight secondary pressure is 2.7 MPa or more in bucket digging full lever and high idling operation | Replace proportional valve |
| 12 | P2 by-pass cut valve <Trouble><br>Only P2 pressure is low. | Visual check | No problem for sliding ability of main poppet and no contamination on orifice<br>No problem for sliding ability of internal piston (Check it through PBp2 port.) | Clean or replace |
| 13 | Check stroke limiter <Trouble><br>Both P1, P2 pressures are high. | Visual check | When piston is removed from cover, it is free from abnormal resistance against sliding<br>Free from abnormal damage, etc on outside surface | Replace<br>(Check on the casing side for damage.) |
| 14 | Remote control valve | Check targeted remote control valve | Check that spool is free from abnormal damage and spring is free from breakage | Replace |
| 15 | Main relief valve | Check set pressure | • See Service Diagnosis Data List Operation No.3 Boom up full lever and relief | Reset or replace |
| 16 | Travel straight spool <Trouble><br>P2 pressure is high. | Visual check | When removing, free from abnormal resistance against sliding<br>Free from abnormal damage, etc on outside surface<br>Spring is free from breakage. | Replace<br>(Check on the casing side for damage) |
| 17 | Bucket spool <Trouble><br>Both P1, P2 pressures are high. | Visual check | When removing, free from abnormal resistance against sliding<br>Free from abnormal damage, etc on outside surface<br>Spring is free from breakage. | Replace<br>(Check on the casing side for damage) |
| 18 | Over load relief valve | Check targeted spool visually | Free from dust entered in over load relief valve.<br>Seat is free from abnormality. | Replace |

10. Slow bucket dumping

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 1 | Bucket dump pressure sensor | Carry out service diagnosis | • See Service Diagnosis Data List Operation No.14 Bucket dump full lever and relief | Check and replace pressure sensor<br>Check remote control valve |

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 4 | 1/2 speed switching orifice in travel motor | Visual check | Free from entry of dust | Remove dust or replace |
| 5 | Tilting piston in travel motor | Visual check | Free from abnormal wear on piston and seal | Replace<br>(Check on the casing side for damage) |

18. Machine does not stay on slope in travelling

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 1 | Pilot pressure sensor | Carry out service diagnosis | • Engine stop & starter key switch is ON<br>Targeted pilot low pressure sensor is in range of 0 to 0.1 MPa | Check pressure sensor and replace as necessary<br>Check remote control valve |
| 2 | Remote control valve | Check targeted remote control valve | Check that spool is free from abnormal damage and spring is free from breakage | Replace |
| 3 | Parking brake in travel motor | Visual check | When removing, free from abnormal resistance against sliding<br>Spring free from breakage, damage, etc. | Replace |
| 4 | Orifice of passage for parking brake in travel motor | Visual check | Free from entry of dust | Remove dust or replace |

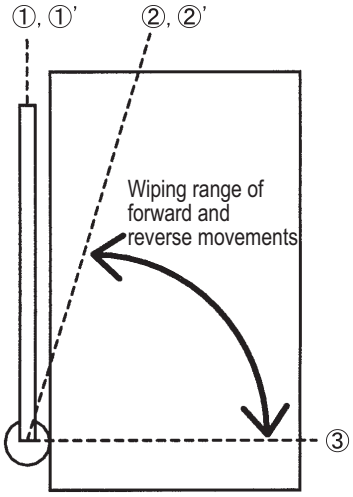
19. Machine does not travel straight in simultaneous operation of travelling and attachment.

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 1 | Actual measuring current value of travel straight proportional valve | Carry out service diagnosis | No. 8 D-3 S-TRAVEL is should be COMP 557 mA and MEAS 580±30 mA in both travel full lever and in boom-up full lever at high idling. | • Check voltage of low pressure sensor other than travel sensor<br>• In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure. |
| 2 | Secondary pressure of travel straight proportional valve | Measure directly the proportional valve secondary pressure | Check secondary pressure is within range of 1.8 to 2.2 MPa in both travel full lever and in boom-up full lever at high idling. | Replace proportional valve |
| 3 | Travel straight spool | Visual check | When removing, free from abnormal resistance against sliding<br>Free from abnormal damage, etc on outside surface<br>Spring is free from breakage. | Replace<br>(Check on the casing side for damage) |

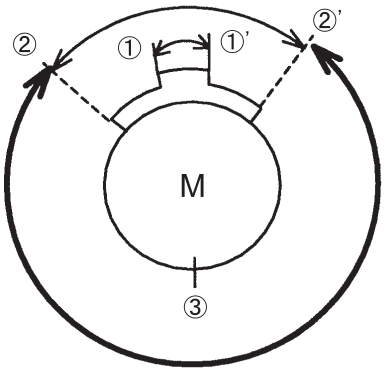
20. Breaker works slowly and power is poor (In case of conflux, check p1 unload/pump and travel straight)

| No. | Sections | Contents/normal value | | Corrective action, others |
|---|---|---|---|---|
| 1 | Pressure sensor for optional attachment | Carry out service diagnosis | • See Service Diagnosis Data List<br>Operation No.16 P2 side OPT full lever and relief | Check and replace pressure sensor<br>Check remote control valve |

5. Wiper does not function.




① Rise up (storing) position
② Upper reversing position
③ Lower reversing position




Wiper motor
①～①' Rise up limit switch's ON range
②～②' Reverse limit switch's ON range

SM0111

| No. | Sections | Contents/normal value | Corrective action, others |
|---|---|---|---|
| 1 | Fuse | Check fuse No.20 | Replace fuse |
| 2 | SW-19:<br>Wiper interlock switch | Service diagnosis No.19 D125<br>Wiper switch display (D125) is OFF with front window closed. | Check wiper interlock switch and repair it if necessary<br>Check according to "WIRING CHECKING PROCEDURE" and repair it if necessary |
| 3 | Rise up limit switch built-in wiper motor<br>Reverse limit switch | Service diagnosis No.25 Wiper system<br><br>Switch action in operation | Check according to "WIRING CHECKING PROCEDURE" |
| 4 | R-31:<br>Arc prevention relay<br>R-29:<br>Forward rotation relay<br>R-30:<br>Reverse rotation relay | Service diagnosis No.25 Wiper system | |

| Normal condition | ①～①' | ①～②,①'～②' | ②～③～②' |
|---|---|---|---|
| Rise up limit switch | ON | OFF | OFF |
| Reverse limit switch | ON | ON | OFF |

| When started by forward rotation: | STOP | START① | ①～② | ②～③ | ③～②' | ②' (STOP) | ②'(REVERSE) | ②' ～③ | ③～② | ② (STOP) | ②(FORWARD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arc prevention relay | OFF | ON | ON | ON | ON | OFF | ON | ON | ON | OFF | ON |
| Forward rotation relay | OFF | ON | ON | ON | ON | OFF | OFF | OFF | OFF | OFF | ON |
| Reverse rotation relay | OFF | OFF | OFF | OFF | OFF | OFF | ON | ON | ON | OFF | OFF |

Check that the relay is worked as shown in the table.
* When the limit switch does not change in OFF after 4 seconds from the wiper startup, turn OFF all relay's outputs.

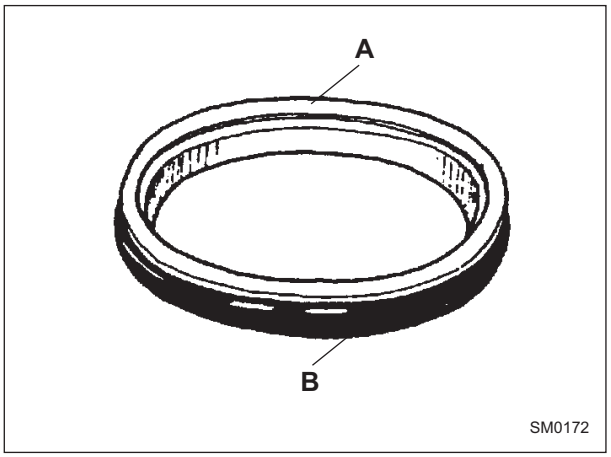
Check that the relay is excited.
Check relay & fuse box and replace it if necessary.

**Table 2 - Failure diagnosis Mode-1/Diagnosis and Remedy**

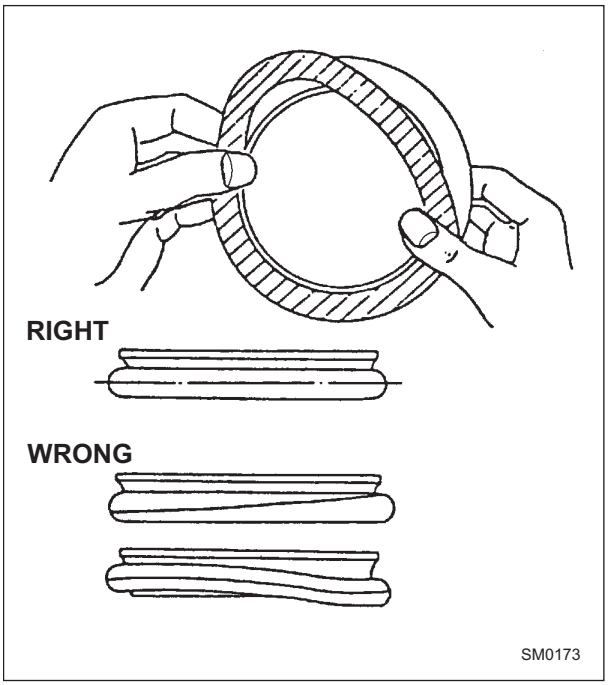
| Diagnosis (Display) | Possible cause | Remedy |
|---|---|---|
| P2 UN-LOAD PSV NG | Secondary pressure is excessive high against the command | Check P2 unload proportional valve and replace it if necessary |
| | Secondary pressure is excessive low against the command | |
| P2 UN-LOAD SPOOL NG | Stuck at full-stroke side | Check P2 unload spool and replace it if necessary |
| | Stuck at neutral side | |
| P1 B-P CUT NG | Stuck at closing side | Check P1 by-pass cut valve and replace it if necessary |
| | Stuck at neutral side | |
| P2 B-P CUT NG | Stuck at closing side | Check P2 by-pass cut valve and replace it if necessary |
| | Stuck at neutral side | |
| P1 PUMP PSV NG | Secondary pressure is excessive high against the command | Check P1 pump proportional valve and replace it if necessary |
| | Secondary pressure is excessive low against the command | |
| P1 PUMP NG | Delivery rate is excessive large against the command | Check P1 pump regulator and replace it if necessary.<br>Check P1 pump and replace it if necessary. |
| | Delivery rate is excessive small against the command | |
| P2 PUMP PSV NG | Secondary pressure is excessive high against the command | Check P2 pump proportional valve and replace it if necessary |
| | Secondary pressure is excessive low against the command | |
| P2 PUMP NG | Delivery rate is excessive large against the command | Check P2 pump regulator and replace it if necessary.<br>Check P2 pump and replace it if necessary. |
| | Delivery rate is excessive small against the command | |
| S-TRAVEL PSV NG | Secondary pressure is excessive high against the command | Check travel straight proportional valve and replace it if necessary |
| | Secondary pressure is excessive low against the command | |
| S-TRAVEL SPOOL NG | Stuck at full-stroke side | Check travel straight spool and replace it if necessary |
| | Stuck at neutral side | |
| PUMP 1 PRESS. SENSOR NG | Pressure is recognized lower than it is | Check P1 high pressure sensor and replace it if necessary |
| PUMP 2 PRESS. SENSOR NG | Pressure is recognized lower than it is | Check P2 high pressure sensor and replace it if necessary |
| MAIN RELIEF NG | Set pressure decreases | Check main relief valve and replace it if necessary |
| | Set pressure increases | |
| ENGINE NG | Output is lowered | Check engine and replace it if necessary |
| E/G R SENSOR NG | Characteristics is misaligned | Check engine speed sensor and replace it if necessary |

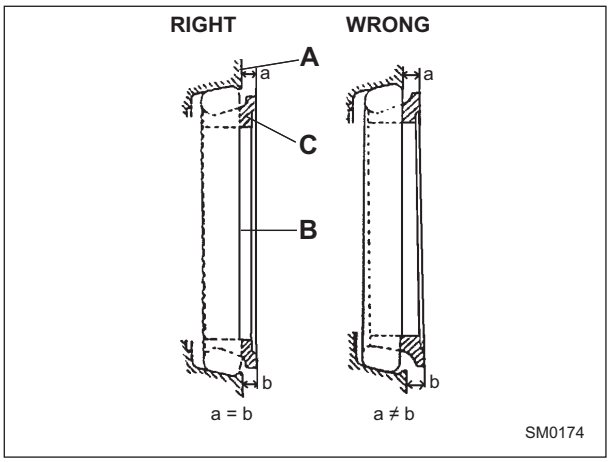
**Floating Seal Precautions**

1. In general, replace the floating seal with a new one. If the floating is to be reused, follow these procedures:
   1) Keep seal rings together as a matched set with seal ring faces together. Insert a piece of cardboard to protect surfaces.
   2) Check the seal ring face (**A**) for scuffing, scoring, corrosion, deformation or uneven wear.
   3) Check O-Ring (**B**) for tears, breaks, deformation or hardening.

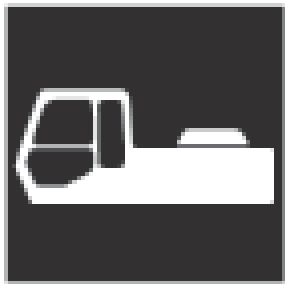



2. If incorrectly assembled, oil leakage or damage will occur. Be sure to do the following, to prevent trouble.
   1) Clean the floating seal and seal mounting bores with cleaning solvent.
      Use a wire brush to remove mud, rust or dirt. After cleaning, thoroughly dry parts with compressed air.
   2) Clean the floating seal and seal mounting bores, as dust on them tends to enter the floating seal when installing it.
   3) Check that the O-Ring is not twisted, and that it is installed correctly on the seal ring.
   4) After installing the floating seal, check that seal ring surface (**C**) is parallel with mating face (**A**) by measuring the distances (**a**) and (**b**), as illustrated.
      If these distances differ, correct the O-Ring (**B**) seating.



# UPPERSTRUCTURE



## CONTENTS

## REMOVAL AND INSTALLATION OF MAIN FRAME

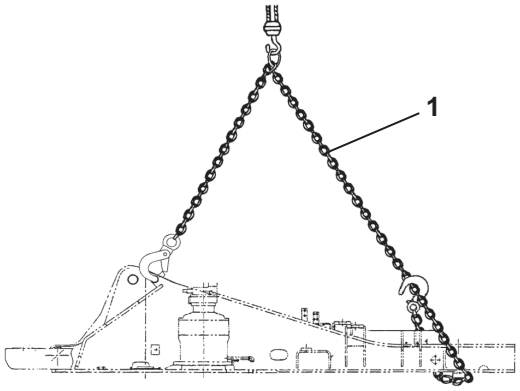
### Removal of main frame

**NOTE:** *approximate mass of main frame: 9500 kg (20950 lbs).*

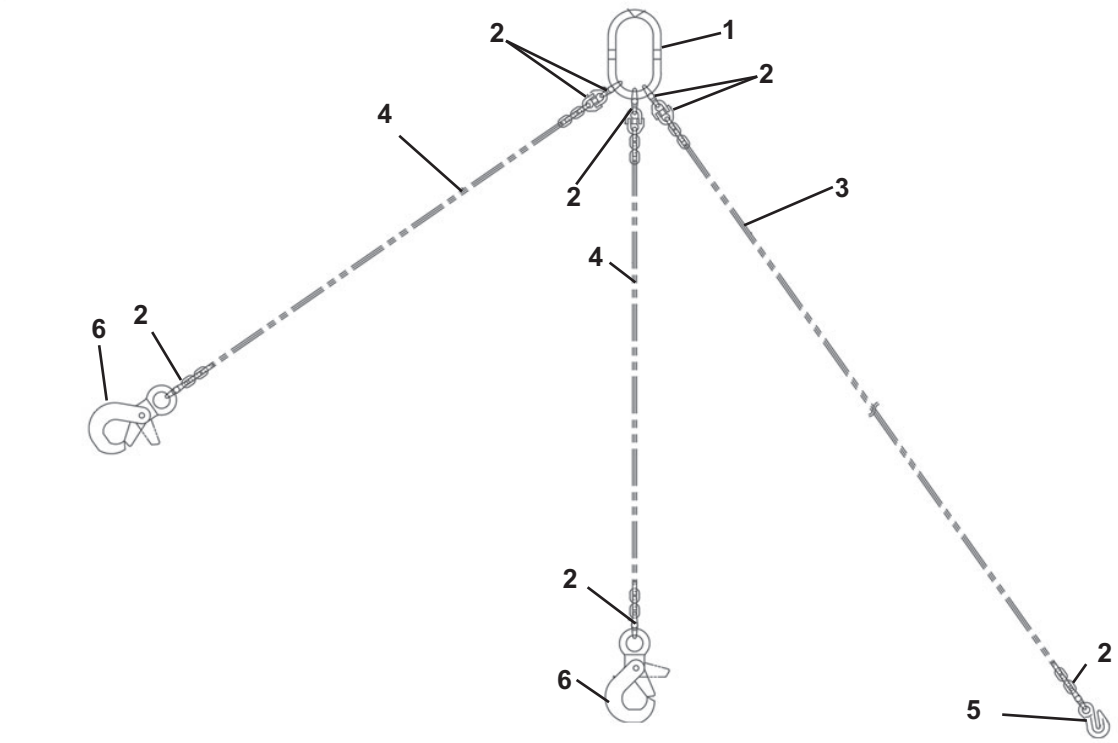
1. Attach a chain block (**1**), (of the type illustrated in the figure SM1402), to the boom foot side and the rear of the upper frame.

2. Adjust chains lengths to level the frame.

**IMPORTANT:** *make sure rear chains do not touch engine.*



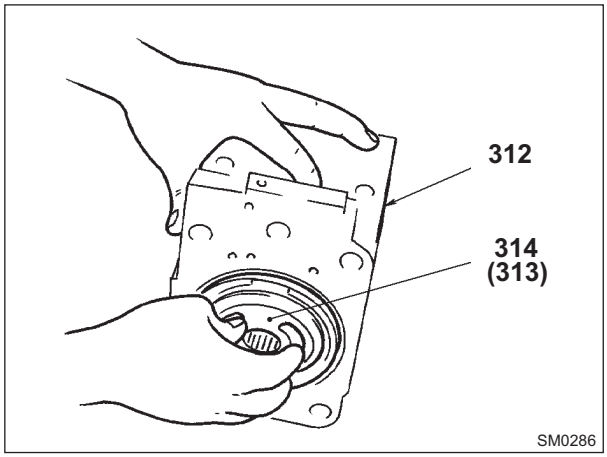

SM1401




SM1402

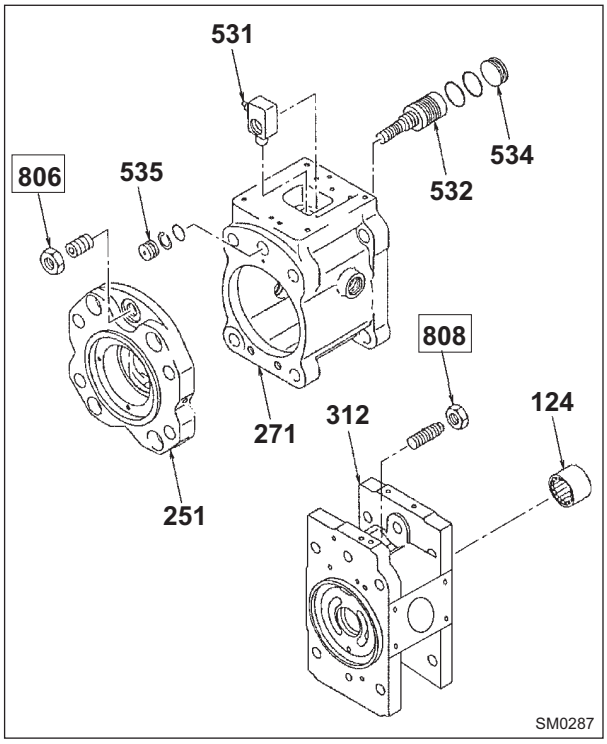
| N. | Item | Quantity | Type |
|---|---|---|---|
| 1 | Master link L | 1 | KITO HL050 |
| 2 | High coupling HC | 9 | KITO HC020 |
| 3 | Chain | 1 | Ø 8x 4,4 m (14 ‘ 5”) |
| 4 | Chain | 2 | Ø 8x 1,5 m (4 ‘ 11”) |
| 5 | Grab hook H | 1 | KITO HH020 |
| 6 | Hook | | KITO HJ050 |

11. Remove valve plate (**313** and **314**) from valve block (**312**).



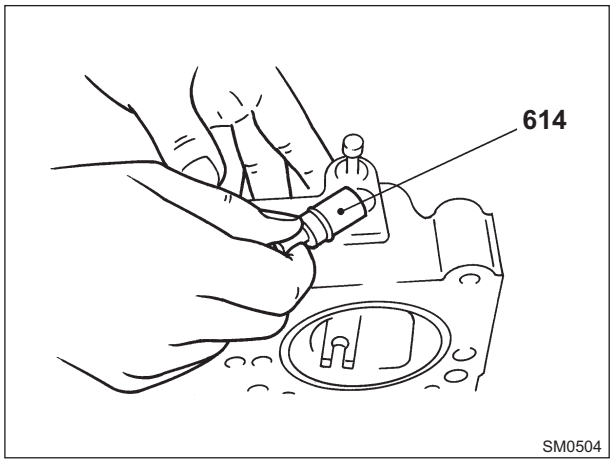

**NOTE:** *the valve plate may come off during the separation of pump casing from valve block.*

12. If necessary, remove stoppers (**534** and **535**), servo piston (**532**) and tilting pin (**531**) from pump casing (**271**), and remove needle bearing (**124**) from valve block (**312**).



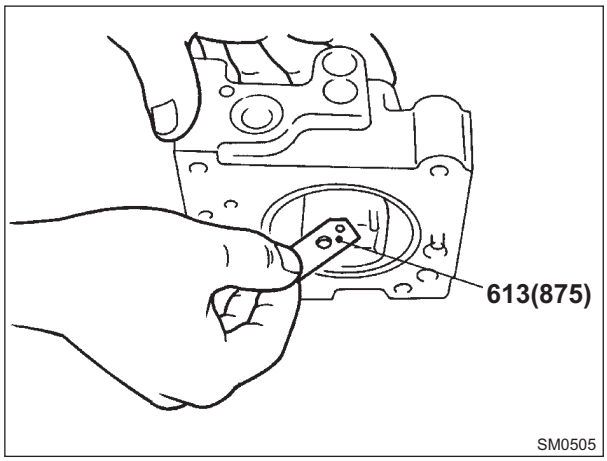

**NOTE:** *When removing the tilting pin, use care so as not to score the head of the tilting pin, using a jig. It is hard to separate the tilting pin from the servo piston in some cases as Loctite is coated on the mating part between them. Use care so as not to score the servo piston by applying unreasonable force.*
*Do not draw out needle bearings except when their service life has ended.*
*Do not loosen hex nuts (**806** and **808**) of valve block (**312**) and swash plate support (**251**). A set flow rate changes.*

**NOTE:** *fulcrum plug (**614**) and adjust plug (**615**) come off easily if a M6 bolt is used.*



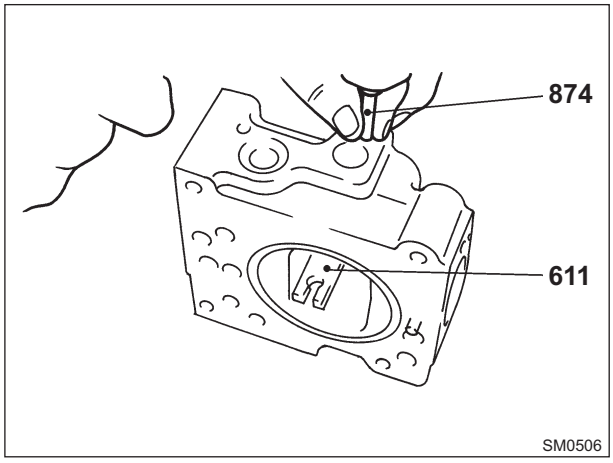

10. Remove lever 2 (**613**) with tweezer.

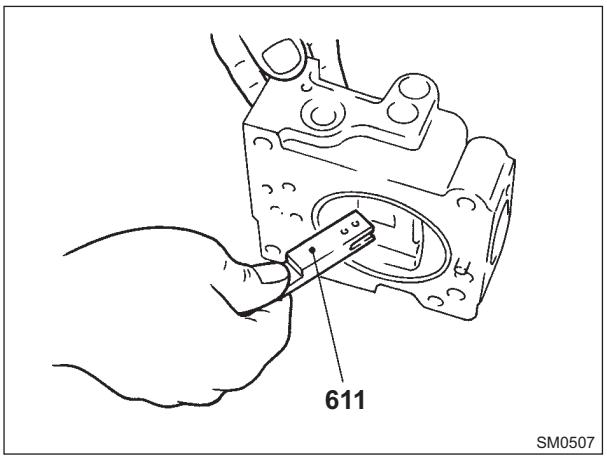
**NOTE:** *do not draw out pin (**875**).*




11. Draw out pin (**874**) and remove feedback lever (**611**).

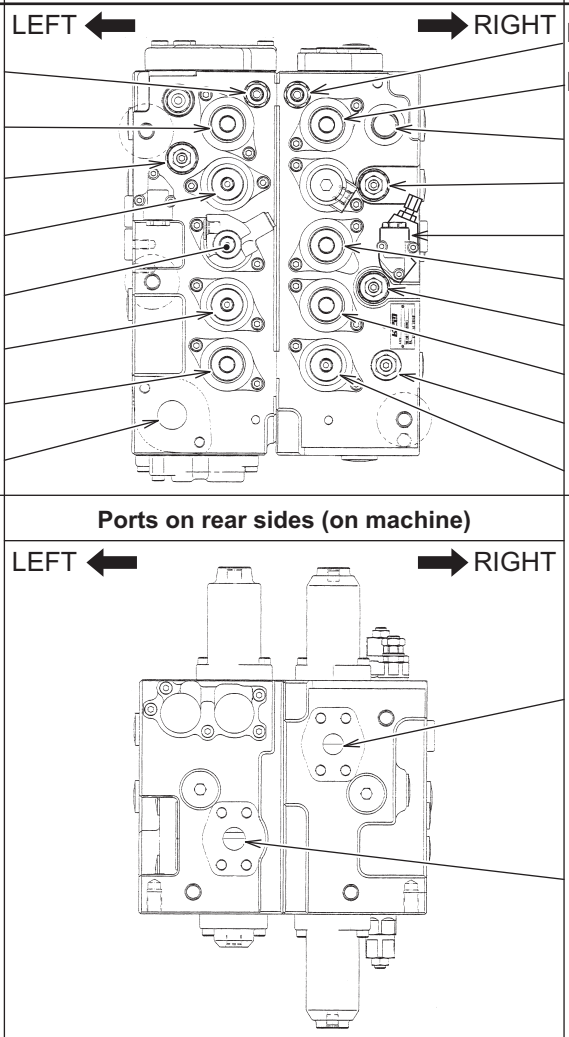
**NOTE:** *push out pin (**874**) from above with a slender steel rod (Ø 4 x 100) so as not to interfere with lever (**612**).*



## CONTROL VALVE PORTS (1/2)

| Functions | Ports | Ports on upper sides | Ports | Functions |
|---|---|---|---|---|
| | | LEFT ⬅ ➡ RIGHT | PBp1 | P1 bypass cut |
| P2 bypass cut | PBp2 | | PBa2 | Arm 2 in |
| Option | PAo | | Mu | Make-up line |
| Arm (R) relief valve | – | | – | Bucket (R)relief valve |
| Arm 1 out | PBa1 | | XAb | Boom lowering valve |
| Swing (LH) | PBs | | PBb | Boom down |
| Boom conflux | PB1 | | – | Boom (H) relief valve |
| Travel left forward | PAL | | PAr | Travel right forward |
| Tank return | T2 | | – | Main relief valve |
| | | | PCb | P1 unload |
| | | **Ports on rear sides (on machine)** | | |
| | | LEFT ⬅ ➡ RIGHT | P 1 | P1 pump |
| | | | P 2 | P2 pump |
| | | **Ports on right sides (on machine)** | | |
| | | UPPER SIDE ⬅ ➡ LOWER SIDE | | |
| Bucket dump | BC | | | |
| Bucket dump | PBc | | | |
| Bucket (H) stroke limit | PCc | | AC | Bucket digging |
| Boom up | Ab | | Bb | Boom down |
| Drain | Dr | | BR | Travel right reverse |
| Travel right forward | AR | | | |
| ATT power boost | PL | | | |



SM0529

## DISASSEMBLY

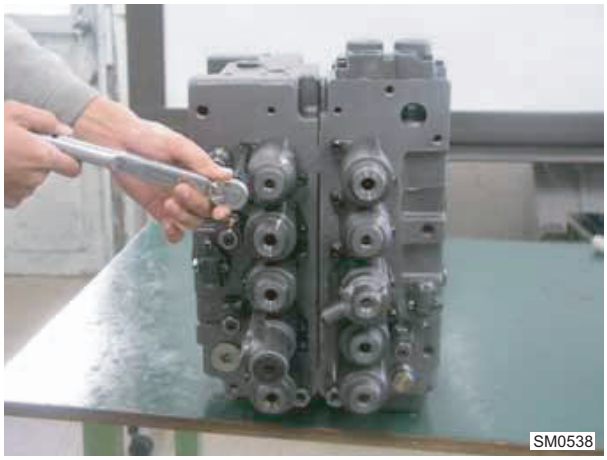
Place the control valve on a work bench so as to locate back pressure check valve upwards.


**IMPORTANT:** *disassemble the valve in a clean place, and be careful not to damage flange surfaces or plate mounting surfaces.*

### 1. Disassembling P1 unload spool

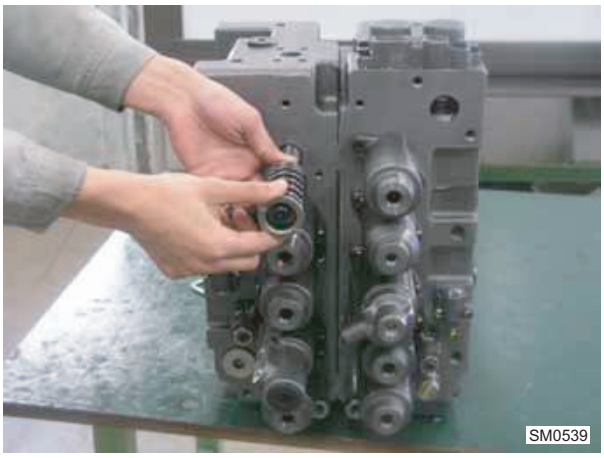
1.1 Loosen the socket bolts (**273**) and remove the spring cover (**202**) and the O-ring (**261**) for P1 unload spool.

1.2 Draw out, from casing B (**102**), as a assy of P1 unload spool (**309**), spring seat (**331**), springs (**327**), (**329**), stopper (**336**) and bolt (**333**).



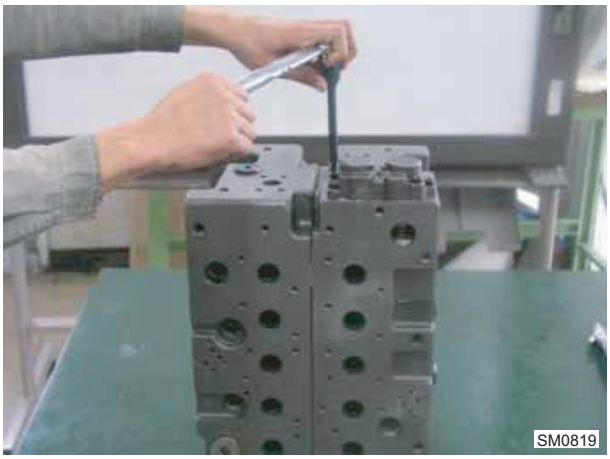

**IMPORTANT:** *when drawing out the spool assy, use care so as not to score casing B (**102**).*

1.3 Fix the P1 unload spool assy with vise via a protective plate (aluminum plate, etc.) and remove bolt (**333**). Then separate spring seat (**331**), springs (**327**), (**329**) and stopper (**336**) from P1 unload spool (**309**).




### 16. Removing back pressure check valve

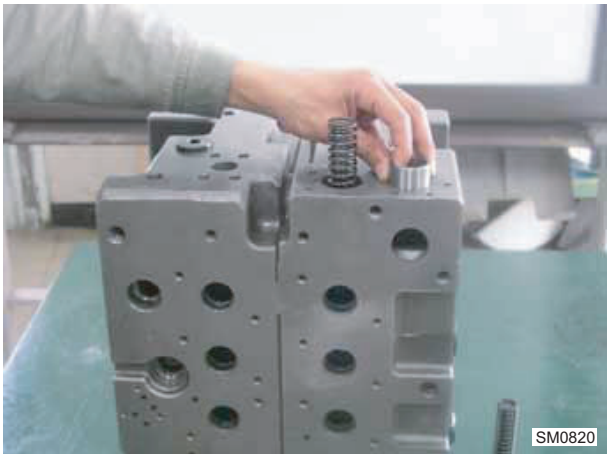
16.1 Loosen socket bolt (**278**) and remove back pressure check valve (**207**) and the O-rings (**264**), (**266**) from the casing.


SM0819

16.2 Remove springs (**527**), (**528**), boost check valve poppet sub (**517**) and by-pass check valve poppet (**518**) from the casing. The further disassembly of boost check valve poppet sub (**517**) is not allowed.

Replace control valve so that the spool cover face directs downward.

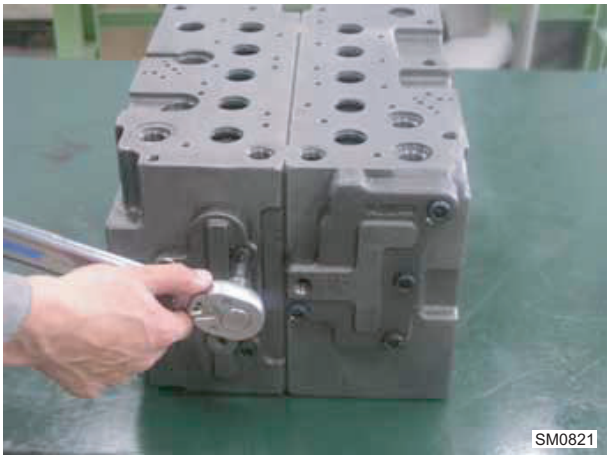
**IMPORTANT:** *when replacing, take care so as not to score the spool cover.*


SM0820

### 17. Removing plate

17.1 Loosen socket bolts (**274**), (**275**) and remove plates (**212**), (**213**).

17.2 After removing plates, remove all O-rings (**162**), (**163**) remained on the casing side.


SM0821

## REMOVAL AND INSTALLATION OF SWING DEVICE

**WARNING**

*Hydraulic oil, at the end of a work shift, can be very hot and can cause, when spilling, potentially serious burns. Prior to beginning any intervention, make sure that the oil and components are cooled-off.*
*The hydraulic oil tank cap can be ejected, if the pressure is not released from the tank. Press the valve located on the hydraulic oil tank to release any residual pressure present in the tank itself.*
*Check that the lifting devices (hooks, chains, etc.) are in perfect conditions without any sign of excessive wear and appropriate to hold the weight of load.*

### Preparation

1. Park the machine on a firm, level surface.

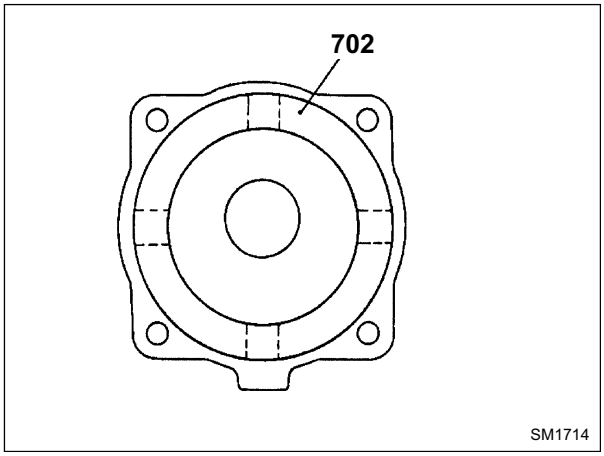
2. To drain the hydraulic pressure from the Hydraulic System, refer to procedure “Releasing the hydraulic pressure” at page T2-1-50.

3. Cut-off the engine. Press the valve located on the hydraulic oil cap to release any residual pressure present in the tank itself.

11. Fit O-Rings (**706** and **707**) to casing (**301**).

12. Assemble brake piston (**702**) into casing (**301**).

13. Assemble brake spring (**712**) into brake piston (**702**). Make sure that the spring is placed positively in the spot faced part of the brake piston.




**NOTE:** *this operation is necessary only where roller bearing (**444**) is removed.*

14. Insert the outer race of roller bearing (**444**) into valve casing (**303**), while lightly tapping the steel rod placed on the outer race, using a hammer.

15. Assemble valve plate (**131**) into valve casing (**303**) and fit O-Ring (**472**) in it.

16. Install valve casing (**303**) to casing (**301**) and fasten them with socket bolts (**401**).


: 17 mm
: 430 Nm (317 lbf·ft)

17. Fit plunger (**351**) and spring (**355**) to valve casing (**303**). Then tighten the plug (**469**) fitted with O-Ring (**488**) against valve casing (**303**).


: 17 mm
: 539 Nm (398 lbf·ft)

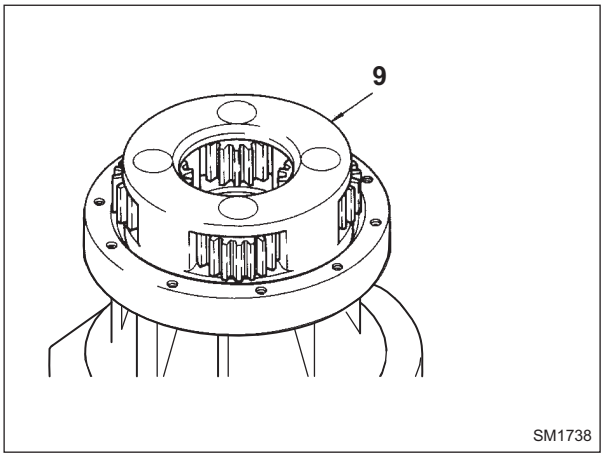
18. Fit relief valve (**51**) to valve casing (**303**).


: 41 mm
: 177 Nm (130.5 lbf·ft)

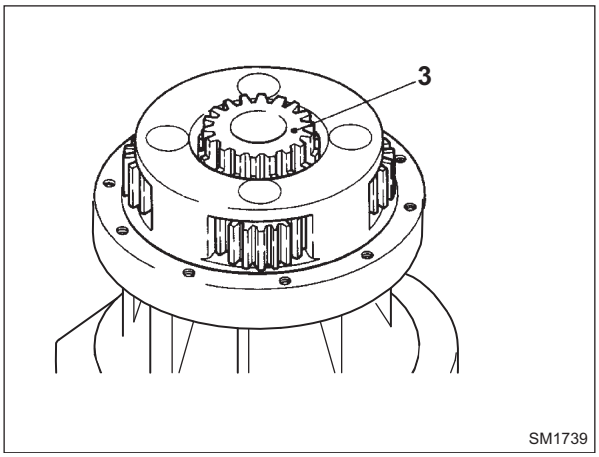
19. Fit the swing shockless valve (**52**) to valve casing (**303**).


: 6 mm
: 29 Nm (21.4 lbf·ft)

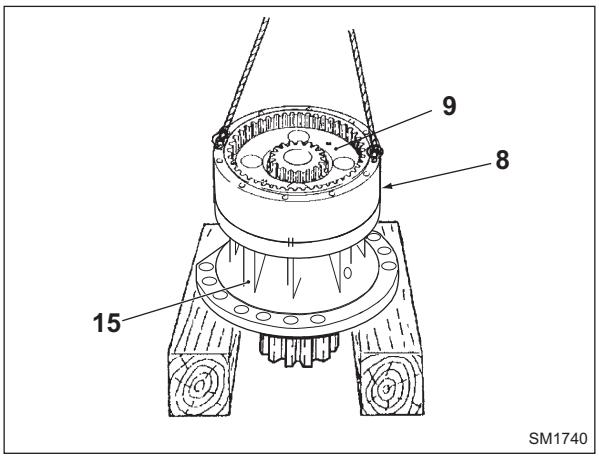
20. Insert spider assembly second reduction (**9**) in spline axis of shaft (**2**).




21. Install sun gear second reduction (**3**) with the spline facing upward.




22. Apply a thin film of sealant Loctite #515 to the matching surface of housing (**15**) and ring gear (**8**) and assemble them. Align the gear teeth accordino to the matching marks.



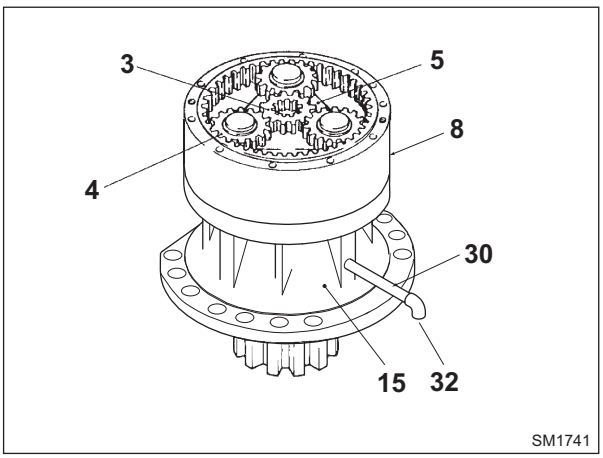

23. Mesh spider assembly first reduction (**5**) with ring gear (**8**) and set them in place.

24. Mesh sun gear first reduction (**3**) with pinion first reduction (**4**) and set them in place.

25. Fit drain tube (**30**) and plug (**32**).

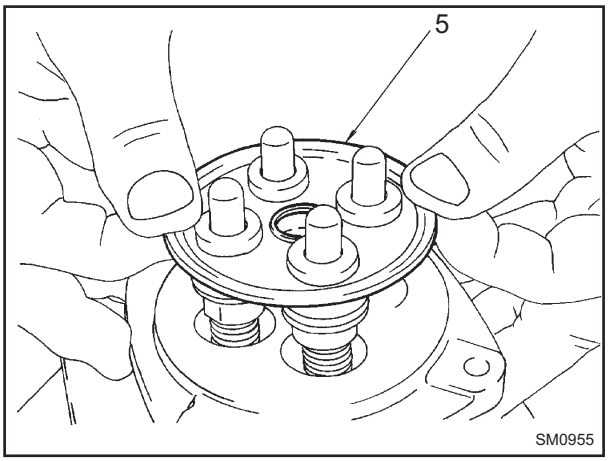
    : 10 mm

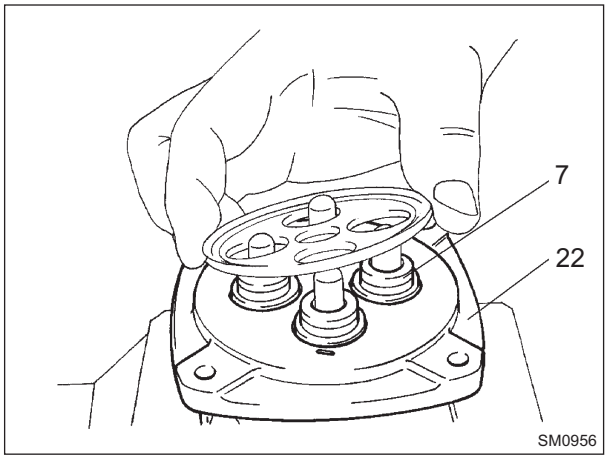
26. Fill with 7.4 L (2.0 gal) of gear oil SAE90 (API Service Grade GL-4).



6. Remove plate (**5**).

**NOTE:** *When the force of return spring (**15**) è is high, press plate to let it come up slowly.*
*When the force of return spring (**15**) is low, plug (**7**) is left in casing (**22**) due to sliding resistance of O-Ring (**8**).*

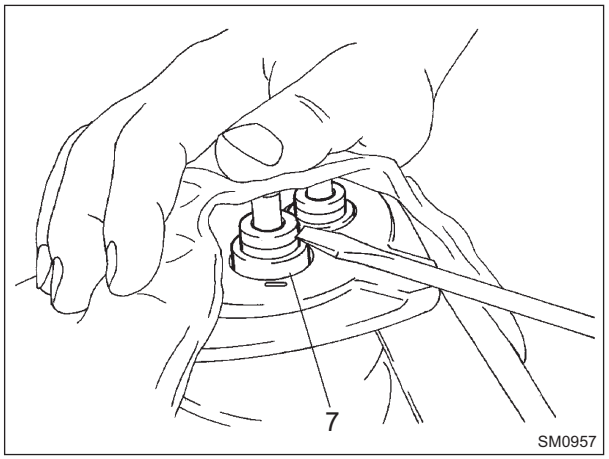



7. Pull plug (**7**) out with a driver.

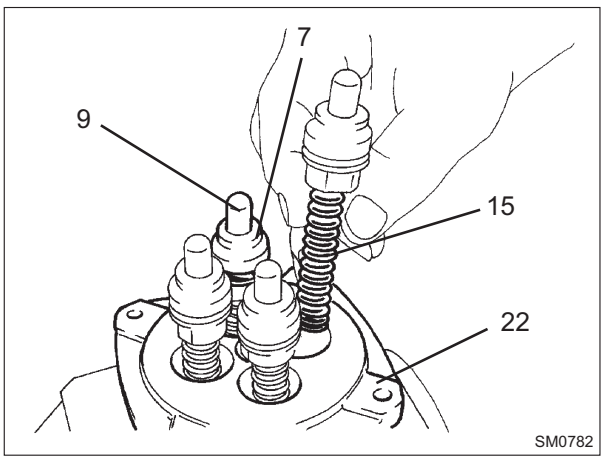
**WARNING**

*To prevent personal injury, plug (**7**) must be removed slowly and evenly until the return spring (**15**) force is completely released*




8. Remove push rod (**9**), plug (**7**), pressure reducing valve assy (spool) and the return springs (**15**) from casing (**22**).

**NOTE:** *record combination of port holes on casing and the pulled out parts. The stroke differs according to direction.*



- A: Squeeze the seal (**12-x**) between your fingers to obtain a 8-shape.
- B, C: Insert the seal (**12-x**) ithin the groove with your fingers (lip in bottom position).
- D: Push the seal (**12-x**) against the side using the round head of a small socket wrench.

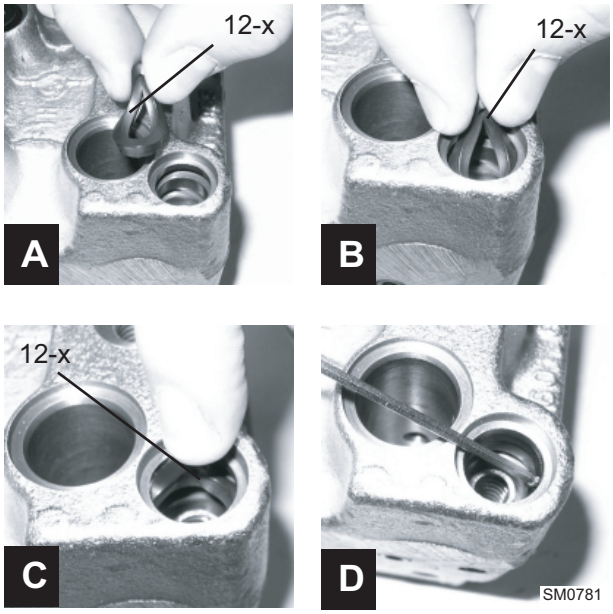
**IMPORTANT:** *during the reassembly, make sure the seal (**12-x**) is correctly positionned, and pay attention not to damage nor twist it.*

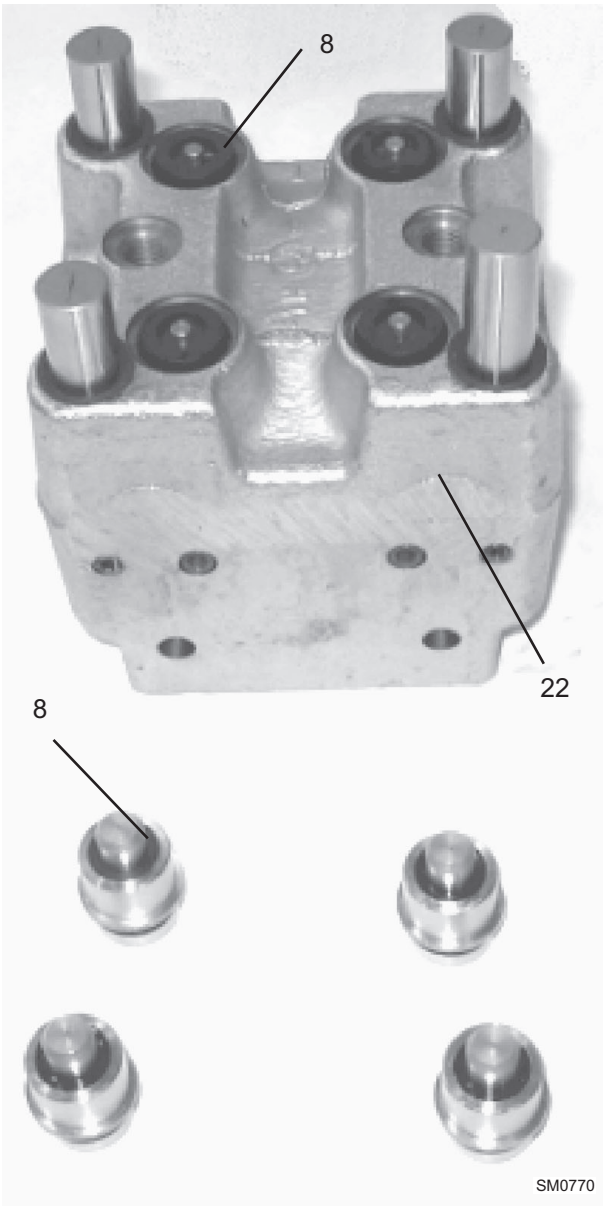
5) Repeat the operation for the other 3 assemblies.
6) Extract the damping springs (**13**) from the body (**22**) (using flat nose pliers).
7) Inspect the damping springs (**13**). If defects are detected, replace the 4 springs.
8) Reassemble parts in reverse order.

6. Guide/plunger and regulation unit replacement.
   1) Remove
      - The pilot control unit from the machine.
      - Both rubber boots
      - Both switch plates
      - The retaining plate
   2) Guide/plunger replacement:
      - Insert the end of a thin screwdriver between the guide and the body (**22**), carefully lift the guide to remove it from the body.

**NOTE:** *hold the guides with the other hand during the extraction operation to limit the effect of the return spring.*

3) Remove the guide / plunger assembly.
4) Repeat the operation for the other 3 sub-assemblies.
5) Visually check that the guides / plungers are in good condition. If defects are present, replace the 4 sub-assemblies.



## REMOVAL AND INSTALLATION OF TRAVEL DEVICE

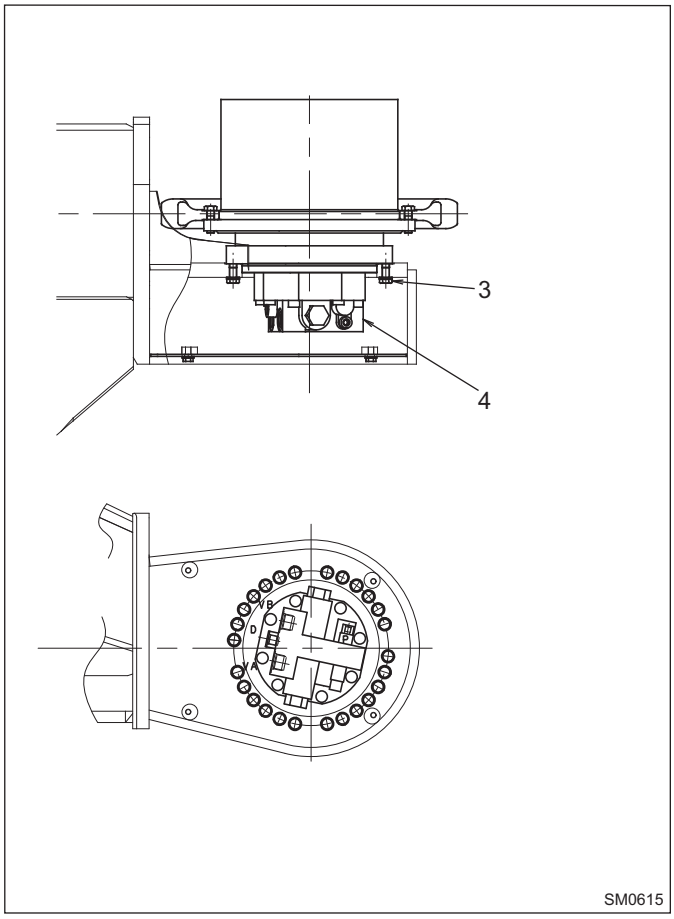
**WARNING**

*Possible leakages of fluids under pressure could penetrate the skin, causing serious injuries. Prevent these dangers, discharging the pressure before disconnecting hydraulic pipes or other pipes. Hydraulic oil, at the end of a work shift, can be very hot and can cause, when spilling, potentially serious burns. Prior to beginning any intervention, make sure that the oil and components are cooled-off. The hydraulic oil tank cap can be ejected, if the pressure is not released from the tank. Press the valve located on the hydraulic oil tank to release any residual pressure present in the tank itself. Check that the lifting devices (hooks, chains, etc.) are in perfect conditions without any sign of excessive wear and appropriate to hold the weight of load.*

### Preparation

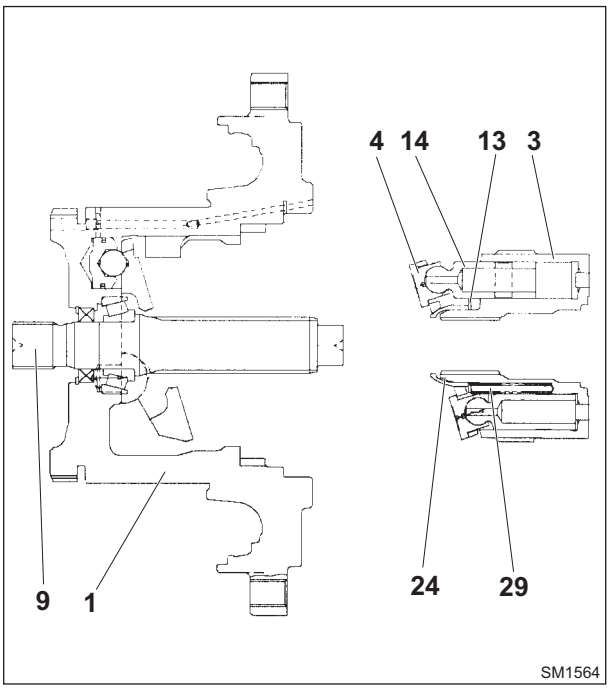
1. Park the machine on a firm, level surface.
2. To drain the hydraulic pressure from the Hydraulic System, refer to procedure "Releasing the hydraulic pressure" at page T2-1-50.
3. Cut-off the engine. Press the valve located on the hydraulic oil cap to release any residual pressure present in the tank itself.

| INSTALL ASSY | | | LC53D00010F1 |
|---|---|---|---|
| **No.** | **NAME** | **Q'TY** | **REMARKS** |
| 3 | CAPSCREW | 36 | M24x65 |
| 4 | TRAVEL MOTOR ASSY | 2 | LC53D00011F1 |



8. Assemble piston assy (**14**), shoe retainer (**4**), ball joint (**24**), spring retainer (**13**) and cylinder spring (**29**) into cylinder block (**3**), as shown in the figure.
   Then put the whole assembly into shaft (**9**).

**IMPORTANT:** *do not fail to bring back each piston assy (14) into the hole in which the assy was set.*

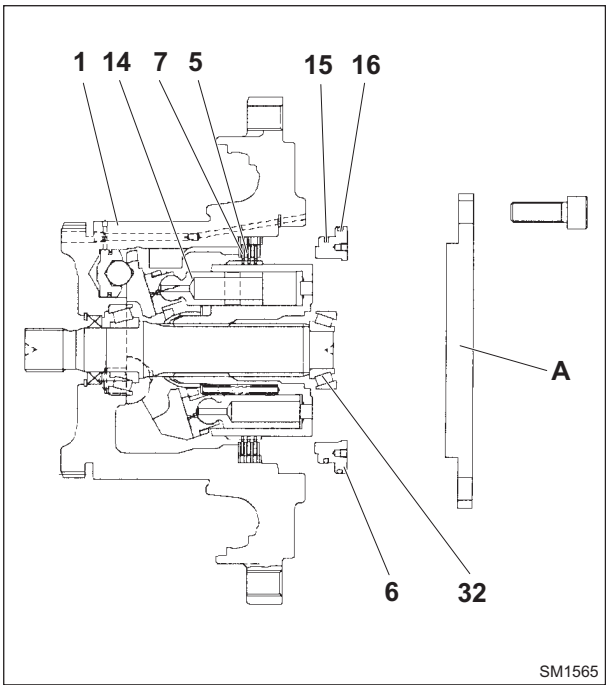



9. Install the inner race of bearing (**32**) to the end of shaft (**9**) by lightly tapping it with a mallet.

10. Assemble separator plate (**7**) and friction plate (**5**) by turns till all of them are put together. The first and the last are separator plates (**7**).

11. Fit brake piston (**6**) with D rings (**15**, **16**) to casing (**1**), using a fixing jig (**380001828**) (**A**).

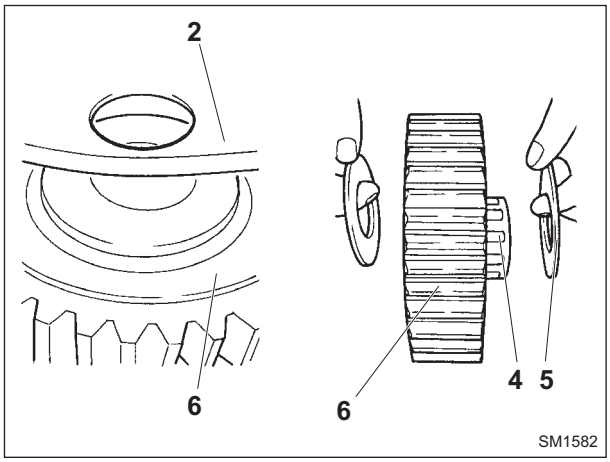
**IMPORTANT:** *the brake piston is equipped with two D rings (**15**, **16**), large and small.*
*The larger D ring (**16**) enters the hole first and the small D ring (**15**) enter the hole later.*
*You cannot check visually that the smaller D ring (**15**) is entering.*
*In some cases, the small D ring is scraped off by the hole of casing (**1**).*

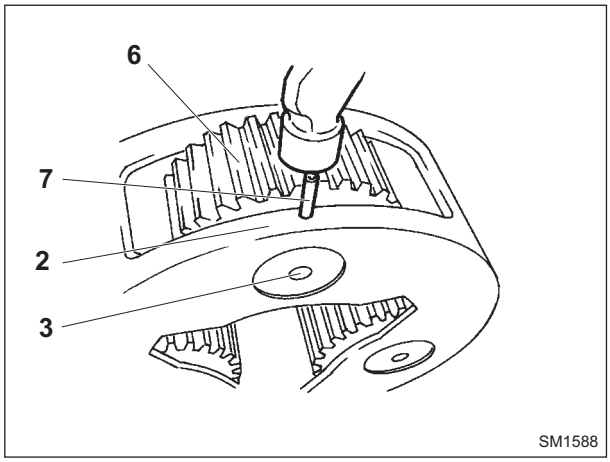


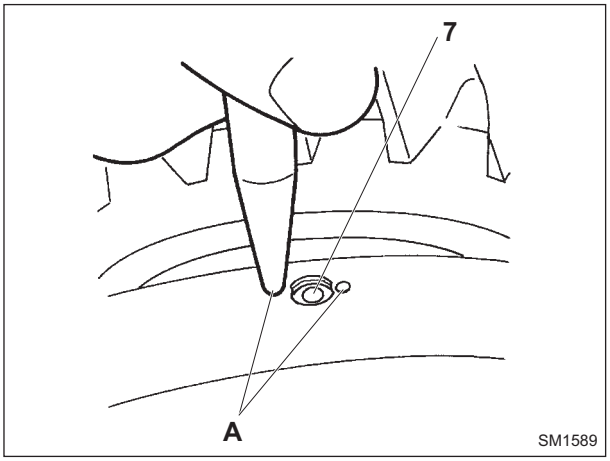
3. Installing carrier 1 assy
   a. Install planetary gear 1 (**6**), needle bearing (**4**), and thrust washer 1 (**5**) into carrier 1 (**2**).
   b. Insert carrier pin 1 (**3**) into carrier 1 (**2**), matching the carrier pin in the direction of the spring pin hole.
   c. Drive spring pin (**7**) into carrier 1 (**2**) and carrier pin 1 (**3**).

**NOTE:** *drive in the spring pin 1 ± 2 mm (0.04 ± 0.08 in) below the surface into which it is placed.*

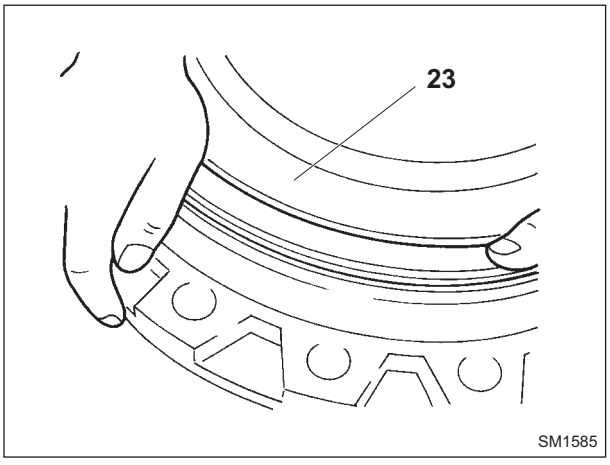
   d. Caulk two places 180° diametrically located.




4. Installing floating seal
   a. Install floating seal (**23**) on the motor side.



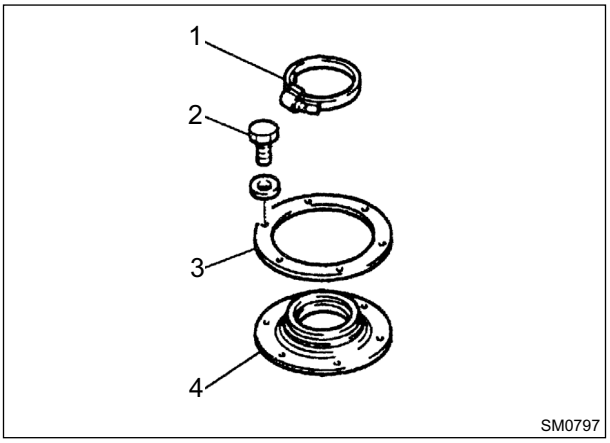
11. Remove eight screws (**2**) M10x25.

    : 17 mm
    : 14.7 ± 1.5 Nm (10.8 ± 1.2 lbf·ft)

12. Remove clip (**1**).

    : 6.8 ± 0.7 Nm (5.0 ± 0.5 lbf·ft)

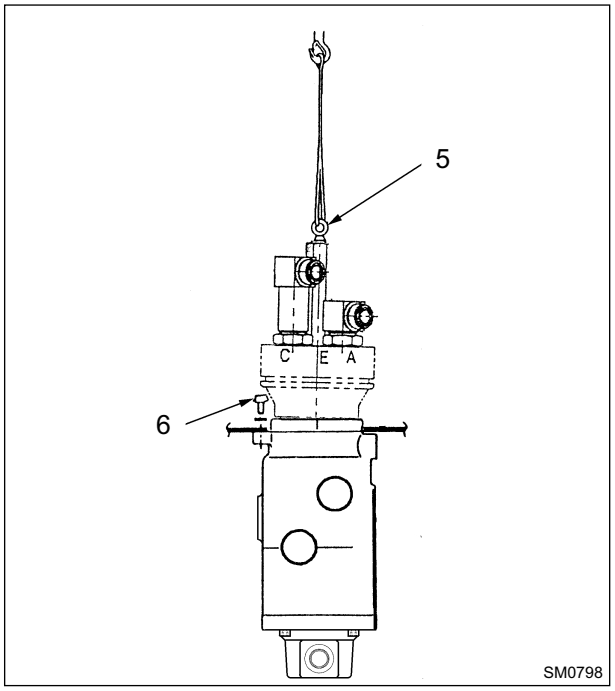
13. Remove seal (**4**).




14. Attach eye bolt (**5**), lift it up temporarily, and remove three screws (**6**) M12x40.

    : 19 mm
    : 107.8 ± 10.8 Nm (79.5 ± 7.9 lbf·ft)

**NOTE:** *swivel joint mass: 24.5 kg (54 lbs).*



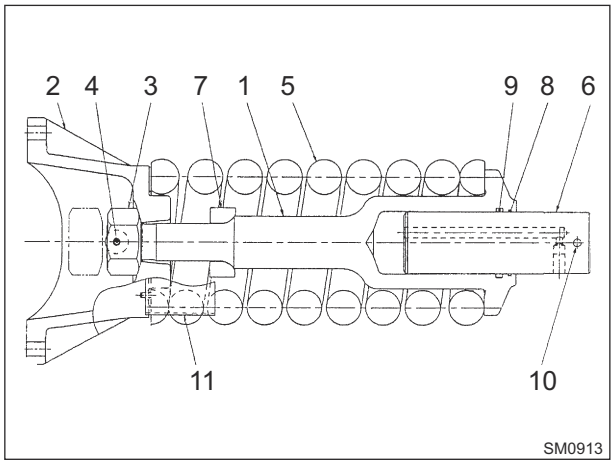

**Installation**

**NOTE:** *refer to "Removal" section above for wrench sizes and tightening torque.*

1. Proceed with the re-installation of the centre joint following the operation in reversed order with respect to the removal.

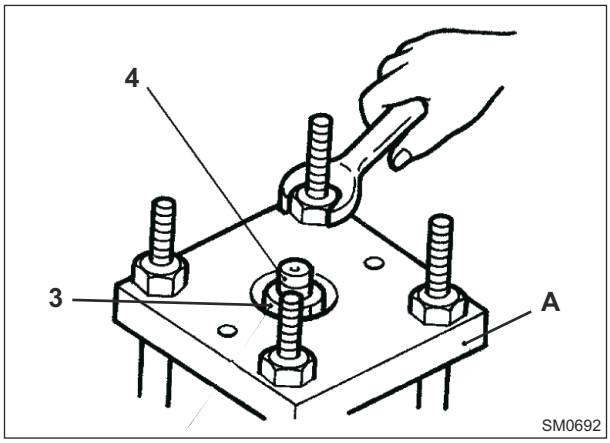
**NOTE:** *swivel joint mass: 24.5 kg (54 lbs).*

4. Draw out piston (**6**) from grease cylinder (**1**) of the idler adjuster assy.
5. Removing oil seal (**9**), O-Ring (**8**) from grease cylinder (**1**).
6. Set the idler adjuster assy on the stand of the jig, with its bracket side facing up.



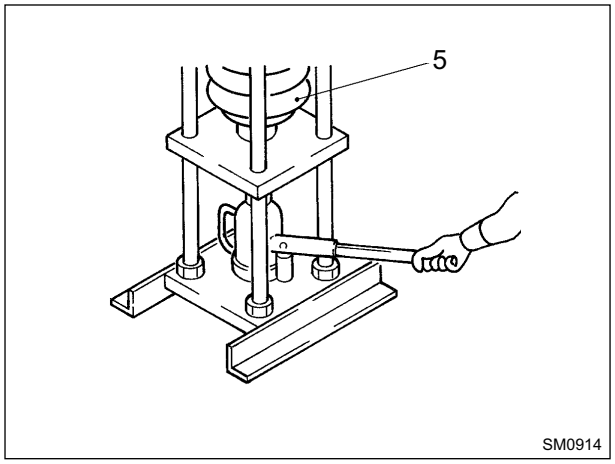

7. Fit retainer plate (**A**) to bracket (**2**), tighten holding-down nuts alternately, and secure idler adjuster assy.

: 46 mm




8. Remove spring pin (**4**), press spring (**5**) lifting it with jack so that nut (**3**) can be turned freely, and remove nut.

: 46 mm
: 95 mm

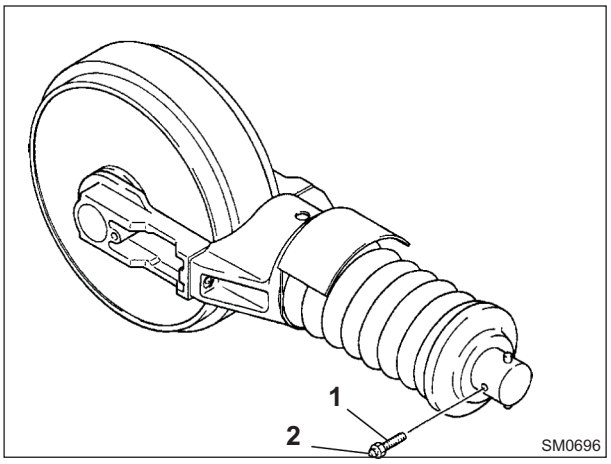


7. Supply grease to valve (**1**) to adjust tracks tension.

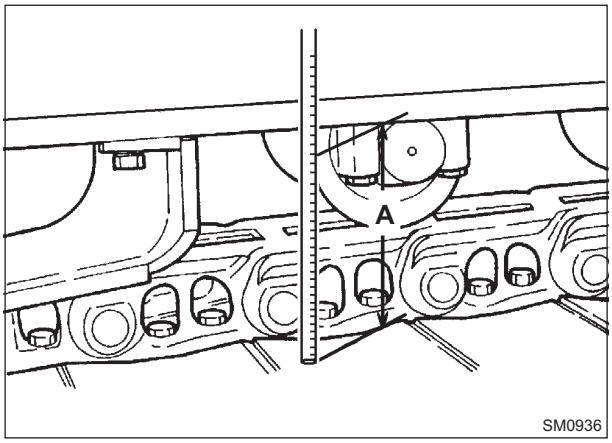
   Track sag specifications (A): 350 to 380 mm

   : 19 mm

   : 58.8 ± 9.6 Nm (43.4 ± 7 lbf·ft)




**NOTE:** *check track sag after thoroughly removing soil stuck on the track area by washing.*

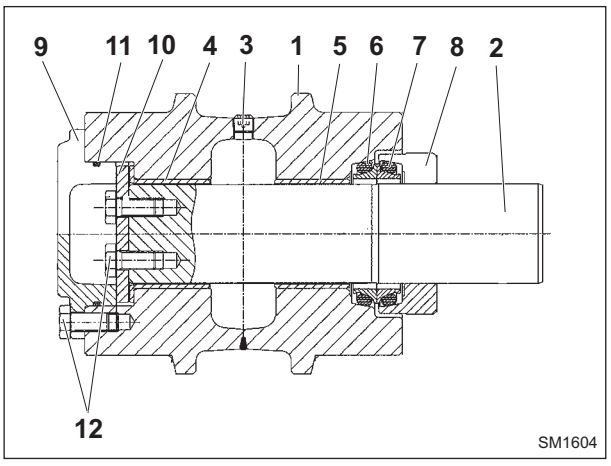



8. Add engine oil via plug (**3**) hole on cover (**9**). Tighten plug (**3**).

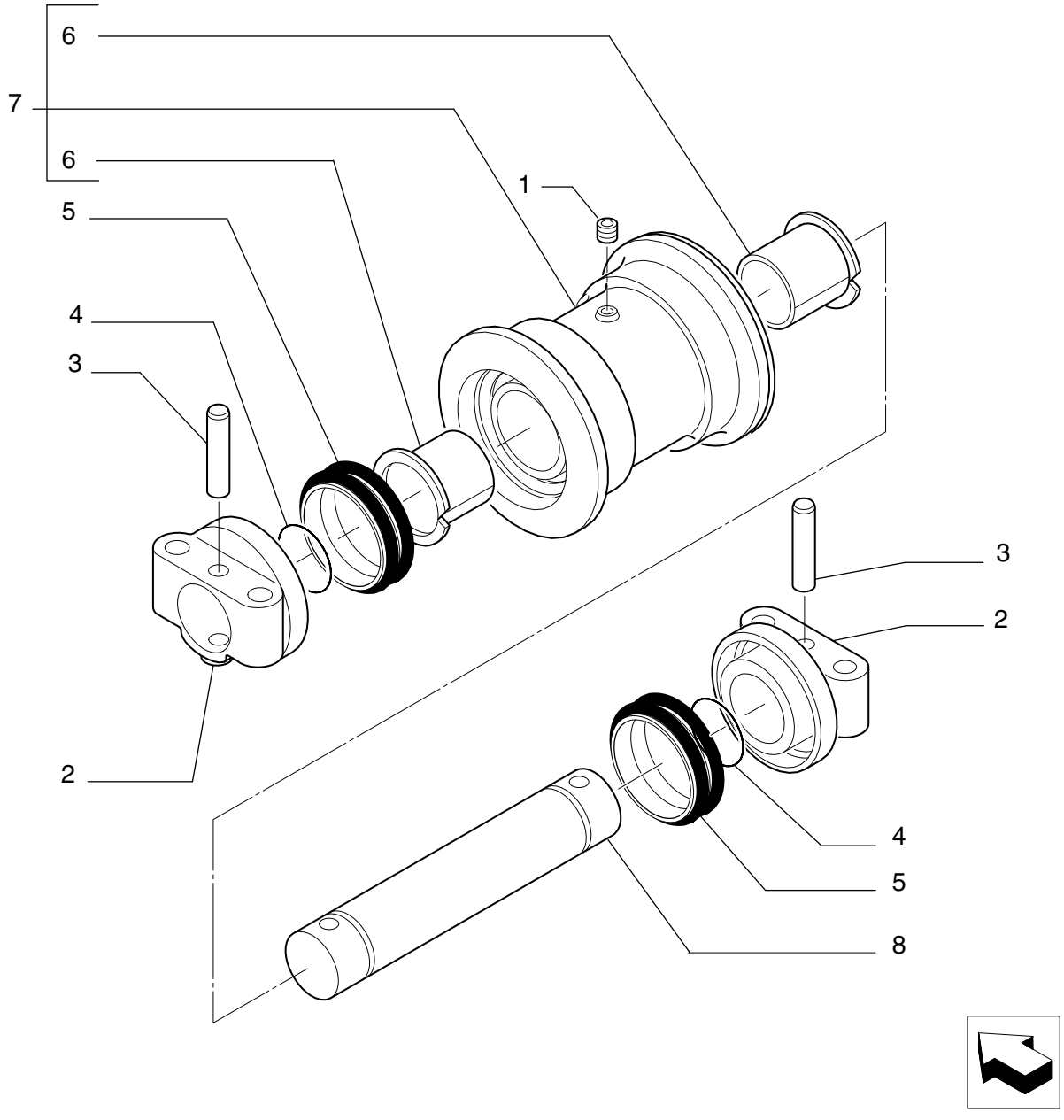
   Engine oil quantity: 366.9 $cm^3$ (22.39 cu·in)

   : 6 mm

   : 14.7 ± 4.9 Nm (10.8 ± 3.6 lbf·ft)



## LOWER ROLLER DISASSEMBLY



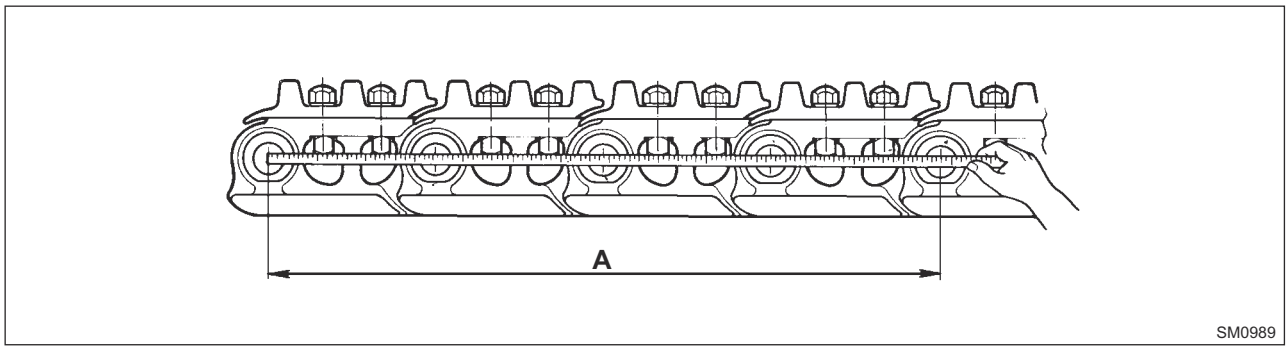

SMC0155

**1 - Plug**
**2 - Collar** (Q.ty 2)
**3 - Elastic pin** (Q.ty 2)
**4 - O-Ring** (Q.ty 2)
**5 - Floating Seal** (Q.ty 2)
**6 - Bushing** (Q.ty 2)
**7 - Roller**
**8 - Axle**

## MAINTENANCE STANDARD

### Link Pin and Track Bushing

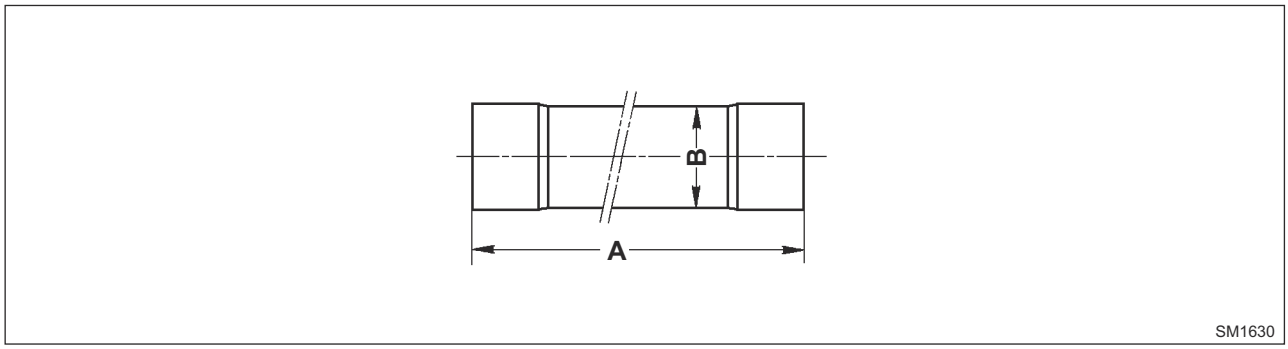
- Measure the length of four links, as illustrated, with the tension on the track.
- Do not measure the master-pin included part of the track.




Unit: mm (in)

| | Standard | Allowable Limit | Remedy |
|---|---|---|---|
| A | 864 | 882 | Replace |

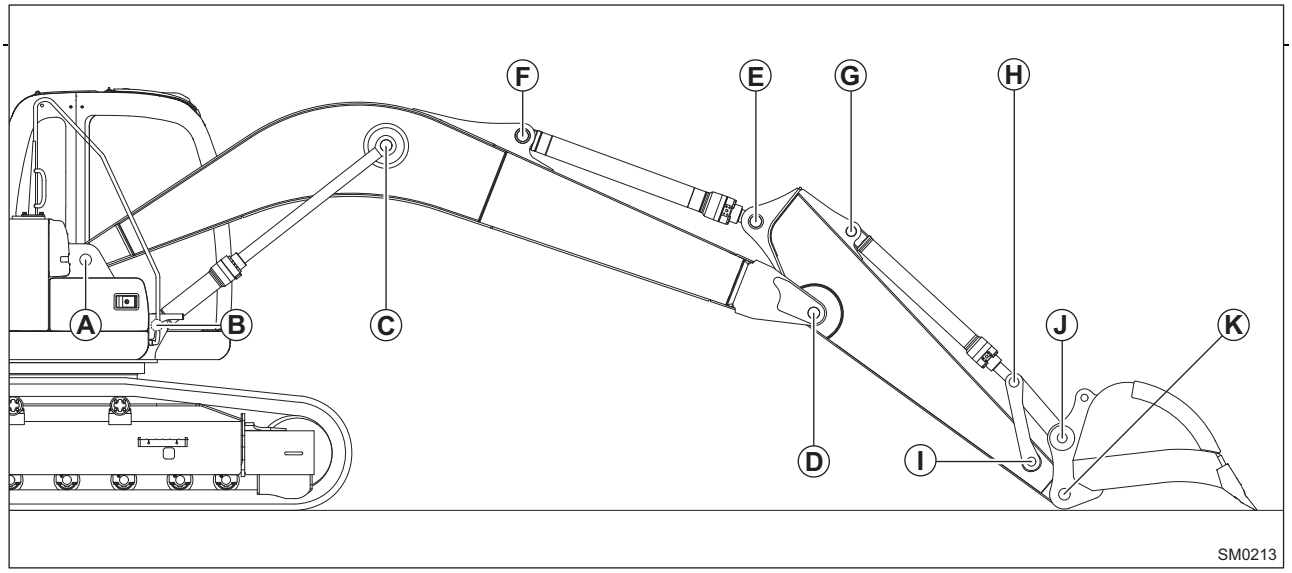
### Master Pin




Unit: mm (in)

| | Standard | Allowable Limit | Remedy |
|---|---|---|---|
| A | 242 | - | Replace |
| B | 44.6 | 41.7 | Replace |

## Maintenance: monoblock version




Unit: mm (in)

| | Parts name | Standard | Allowable limit | Remedy |
|---|---|---|---|---|
| A | Pin | 110 (4.33) | 109 (4.29) | Replace |
| | Bushing | 110 (4.33) | 111.5 (4.39) | |
| B | Pin | 100 (3.94) | 99 (3.90) | |
| | Boss (Main Frame) | 100 (3.94) | 101.5 (3.99) | |
| | Bushing (Boom Cylinder) | 100 (3.94) | 101.5 (3.99) | |
| C | Pin | 110 (4.33) | 109 (4.29) | |
| | Bushing (Boom Cylinder) | 110 (4.33) | 111.5 (4.39) | |
| | Foro (Boom) | 110 (4.33) | 111.5 (4.39) | |
| D | Pin | 110 (4.33) | 109 (4.29) | |
| | Bushing | 110 (4.33) | 111.5 (4.39) | |
| E | Pin | 110 (4.33) | 99 (3.90) | |
| | Boss (Arm) | 110 (4.33) | 111.5 (4.39) | |
| | Bushing (Arm Cylinder) | 110 (4.33) | 111.5 (4.39) | |
| F | Pin | 110 (4.33) | 109 (4.29) | |
| | Boss (Boom) | 112 (4.41) | 113.5 (4.46) | |
| | Bushing (Arm Cylinder) | 110 (4.33) | 111.5 (4.39) | |
| G | Pin | 90 (3.54) | 89 (3.50) | |
| | Boss (Arm) | 90 (3.54) | 91.5 (3.60) | |
| | Bushing (Bucket Cylinder) | 90 (3.54) | 91.5 (3.60) | |
| H | Pin | 90 (3.54) | 89 (3.50) | |
| | Bushing | 90 (3.54) | 91.5 (3.60) | |
| | Bushing (Bucket Cylinder) | 90 (3.54) | 91.5 (3.60) | |
| I | Pin | 80 (3.15) | 79 (3.11) | |
| | Bushing | 80 (3.15) | 81.5 (3.21) | |
| J | Pin | 100 (3.94) | 99 (3.90) | |
| | Bushing | 100 (3.94) | 101.5 (3.99) | |
| K | Pin | 100 (3.94) | 99 (3.90) | |
| | Bushing | 100 (3.94) | 101.5 (3.99) | |

**IMPORTANT:** *be sure to install front attachment bushings using a press.*

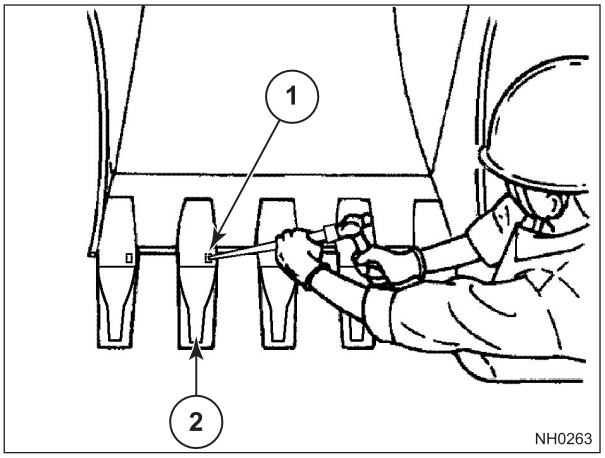
**Bucket teeth replacement**

**WARNING**

*Keep people not involved in the maintenance work outside the working area.*

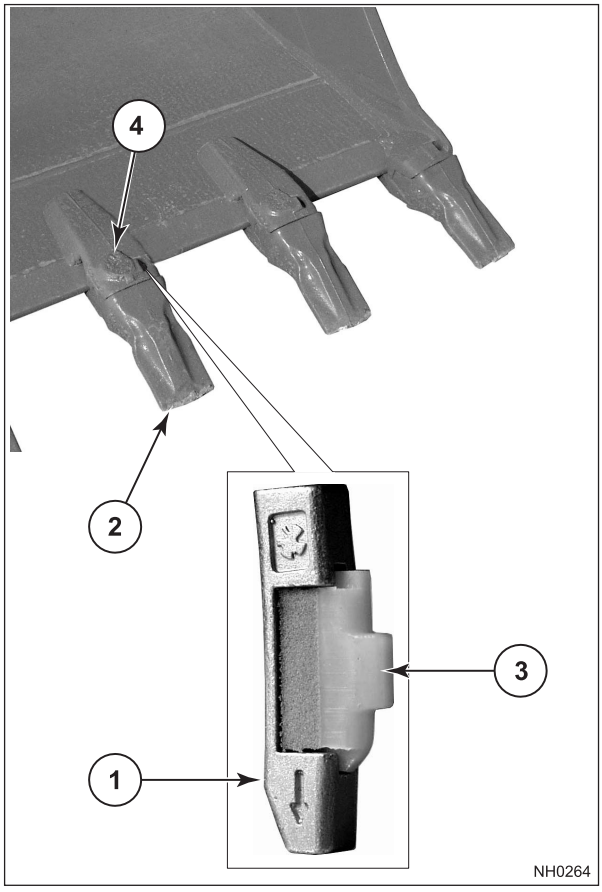
*Wear adequate personal clothes and glasses with side shields as a protection against flying debris.*

- Ensure the machine is parked on a level surface.
- Rest the bucket to the ground.
- Switch off the Auto-Idle, fully turn the engine speed manual control anticlockwise, stop the engine, remove the ignition key and move the safety lever in the locked position (**LOCK**).
- Use a hammer and punch to push lock pin (**1**) out of its seat and remove the tip of bucket tooth (**2**).




**NOTE:** *to push lock pin (**1**) out of its seat, strike it with a punch on its upper side.*

- Install a new rubber insert (**3**) inside lock pin (**1**).
- Clean the surface of bucket tooth (**4**) and insert a new tip.
- Insert lock pin (**1**) into its seat using a punch and hammer, until it is fully mounted.



**Positioner cylinder removal**

1. Insert a wooden block (**3**) between positioner cylinder (**1**) and boom (**2**).

2. Disconnect lubrication hose rod side.
   : 17 mm

3. Press the valve located on the hydraulic oil tank to bleed the residual pressure inside the tank itself.
   Complete the bleeding of the residual pressure from the hydraulic system, making reference to "Procedure for the bleeding of the pressure from the hydraulic system" at page T2-1-50.

4. Loosen lock nuts (**4**), remove bolt (**5**) and pull-out pin (**6**) with the help of a mallet and a bar so that the end of the cylinder is free, then remove adjusting shims (**7**).
   : 30 mm

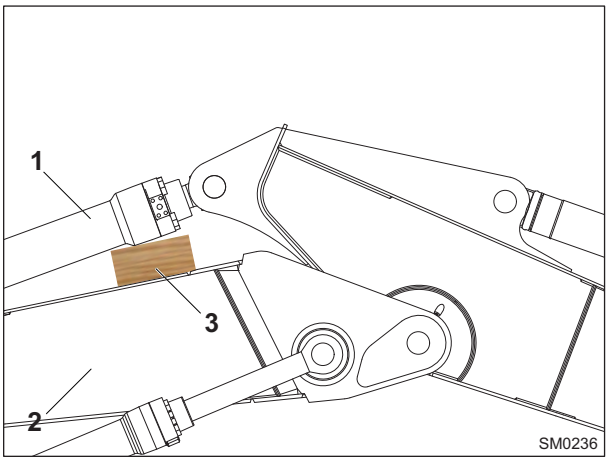
5. Disconnected hoses (**8**) and (**9**) from arm cylinder.
   Put plugs on cylinder pipes and hoses.
   : 10 mm
   : 36 mm

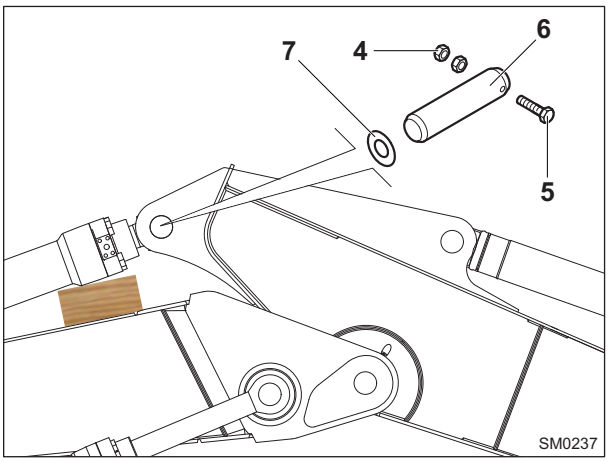
6. Disconnect lubrication hose (**10**).
   : 17 mm

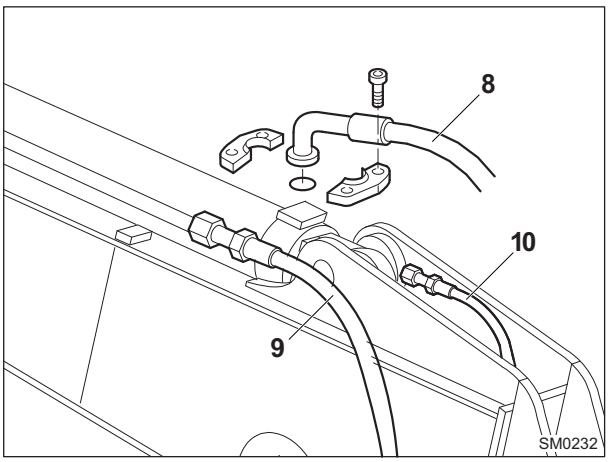
**NOTE:** *positioner cylinder mass: 392 kg (864 lbs)*

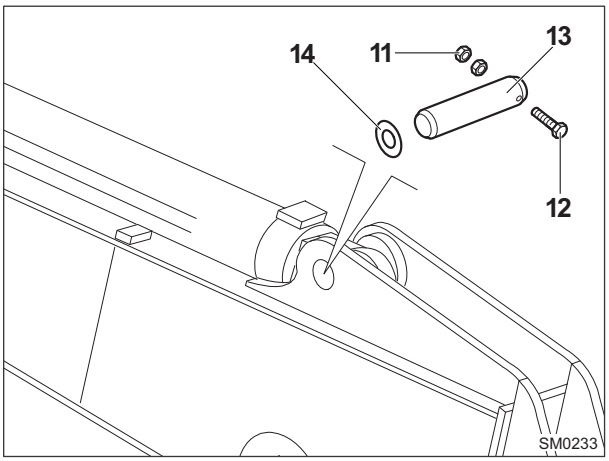
7. Using a hoist, slightly lift positioner cylinder (**1**). Loosen locking nuts (**11**) remove screw (**12**) and pull-out pin (**13**) with the help of a mallet and a bar so that the end of the cylinder is free, then remove adjusting shims (**14**).
   : 30 mm

8. Remove positioner cylinder (**1**).



**Positioner cylinder assembly**

1. Install bushing (**5**) to cylinder head (**7**) using a press.
   Special tools for bushing installation (**5**):
   Positioner cylinder: Ø 110 mm (XXXXXXXX)

**IMPORTANT:** *be sure that the rings are installed correctly.*

2. Install seal (**3**), back-up ring (**2**), elastic ring (**6**) and seal (**4**) on the cylinder front sleeve (**7**).

3. Install wiper ring (**1**) to cylinder head (**7**) using a plastic hammer (**7**).

4. Install O-Rings (**10**) and backup ring (**9**) to cylinder head (**7**).

5. Install O-Ring (**18**), backup ring (**16**) (Q.ty 2), seal ring (**17**), slide ring (**19**) (Q.ty 2), (**20**) (Q.ty 2) to piston (**15**).
   Special tools for seals assembly: (XXXXXXXX)

6. Install cylinder head (**7**) to cylinder rod (**11**).
   Special tools: (XXXXXXXX)

7. Install piston (**15**) to cylinder rod (**11**).

8. Install shim (**21**) to cylinder rod (**11**). Tighten nut (**24**) using special tool (XXXXXXXX).
   Be sure to align the machine mark on the rod with that on the nut.
   Nut Turning Special Tools (**24**):
   - 130 mm (XXXXXXXX)

   : 14300 Nm (10546 lbf·ft)

9. Align the holes on cylinder rod (**11**) and nut (**24**).
   Insert steel ball (**23**) into the hole, and tighten set screw (**22**) into the hole.
   Mushroom the head of set screw (**22**) at two places using a punch and hammer.

   : 12 mm

   : 96.6 ± 18.2 Nm (71.2 ± 13.4 lbf·ft)

**IMPORTANT:** *be sure to align cylinder rod (**11**) with the center of cylinder tube (**12**) when inserting, in order to avoid damaging the rings.*

10. Secure cylinder tube (**12**) horizontally using a work bench.
    Insert cylinder rod (**11**) into cylinder tube (**12**).

11. Install cylinder head (**7**) to cylinder tube (**12**).
    Tighten socket bolts (**8**).

    : 17 mm

    : 711 Nm (524 lbf·ft)

# How to read this manual

JP30002010102002

**1. Scope of repair work**

(1) Repair work is classified into three large categories of "Diagnosis", "Mounting/removal, replacement, assembly·disassembly and inspection·adjustment" and "Final inspection".

(2) This manual describes "Diagnosis" in the first process and "Mounting/removal, replacement, assembly·disassembly and inspection·adjustment" in the second process. Explanation of "Final inspection" in the third process is omitted here.

(3) Although the following work is not described in this manual, it should be performed in actual work.

a. Jacking and lifting
b. Cleaning and washing of removed parts as required
c. Visual inspection

**2. Standard value**

(1) Standard value, limit, action and tightening torque described in the text are summarized in tables.

**3. Items to be prepared**

(1) Items to be prepared before work are SST, tools, gauges and lubricant, etc. These are listed in the list section of items to be prepared. Items such as general tools, jack, rigid rack, etc. that are usually equipped in general service shop are omitted.

**4. How to read sections and titles**

(1) Sections are classified according to J2008, SAE standard.

(2) For areas that show system names like "Engine control system", "Inspection", "Adjustment", "Replacement", "Overhaul", etc. of components are described.

(3) For areas that show part names like "Injection pump", "Mounting/removal and disassembly" is described.

(4) Illustrations of the parts catalog are shown for part layout. (Part codes in the parts catalog are described in the illustration. Major names and tightening torque are listed in the table.)

⚠ **CAUTION** **The part layouts in this manual are inserted based on illustrations and part numbers of the parts catalog CD-ROM issued in october, 2005. (Some areas do not show exploded view. They will be additionally issued when the parts catalog CD is revised.) Be sure to use the parts catalog for confirmation of illustrations and part numbers and for ordering parts.**

# Tightening of flare nuts and hoses

JP30002010102005

## 1. Tightening torque of pipe flare nut

Unit : N·m{kgf·cm}

| Pipe outer diameter / Material | ϕ4.76 | ϕ6.35 | ϕ8 | ϕ10 | ϕ12 | ϕ15 |
|---|---|---|---|---|---|---|
| Steel pipe | 15±5{150±50} | 25±5{250±50} | 36±5{370±50} | 52±7{530±70} | 67±7{680±70} | 88±8{900±80} |

## 2. Tightening torque of hoses

Unit : N·m{kgf·cm}

| | Hose outer diameter ϕ10.5 fitting | Hose outer diameter ϕ13, ϕ20, ϕ22, fitting at packing | Hose outer diameter PF3/8 fitting |
|---|---|---|---|
| Air hose | 21.5±1.5{215±15} | 41.5±2.5{425±25} | — |
| | Only meter gauge 10{100} | | |
| Brake hose | Packing 51.5±7.5{525±75} | — | — |

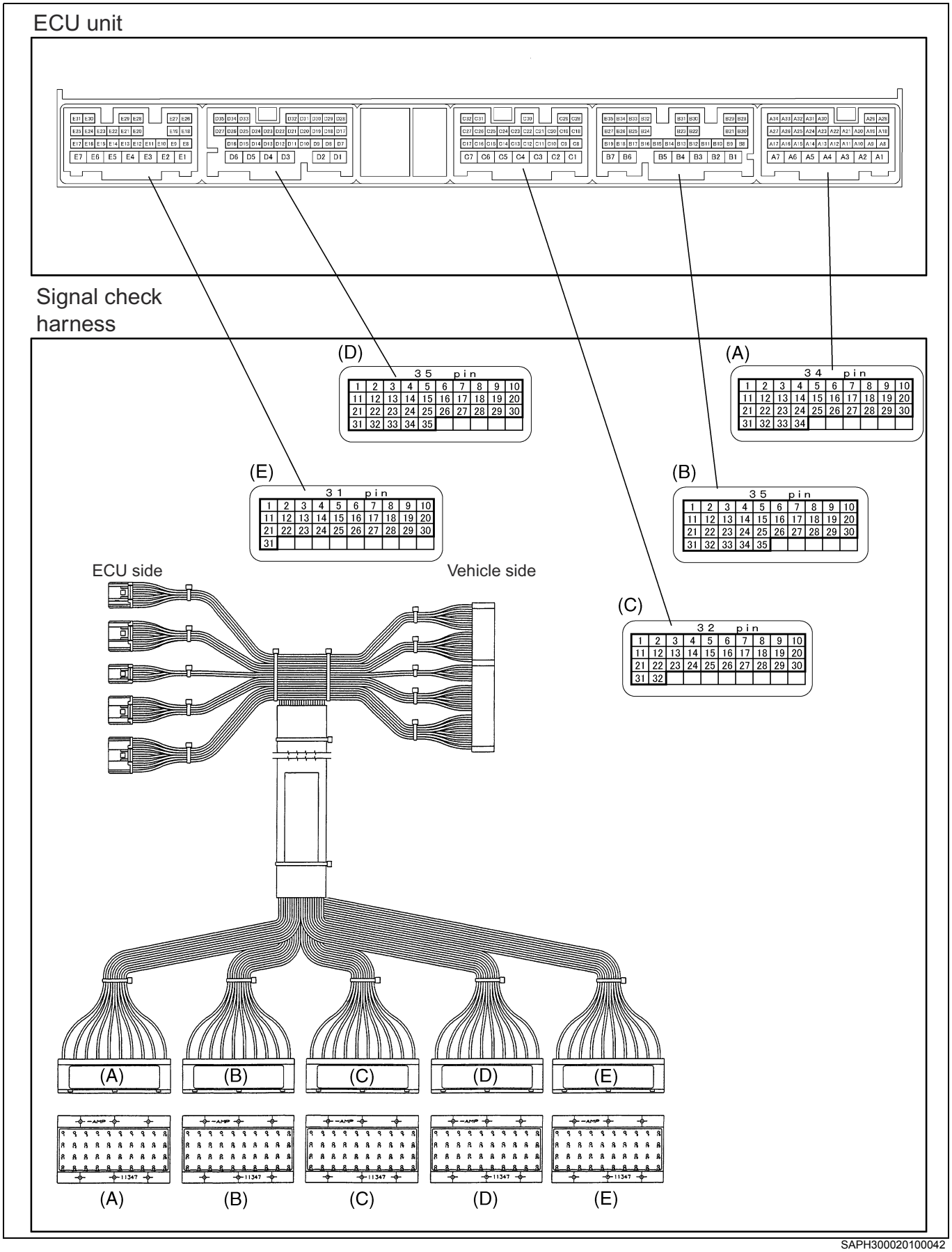
## 3. Lock nut tightening torque of brass joint

Unit : N·m{kgf·cm}

| Screw nominal size | M12 | M16 | M20 | M27 |
|---|---|---|---|---|
| Tightening torque | 15±2{150±20} | 66±6{670±60} | 97±9{990±90} | 209±19{2130±190} |

(2) Terminal No.

For the signal check harness connector, the ECU terminal number in the text is treated as follows :




SAPH300020100042

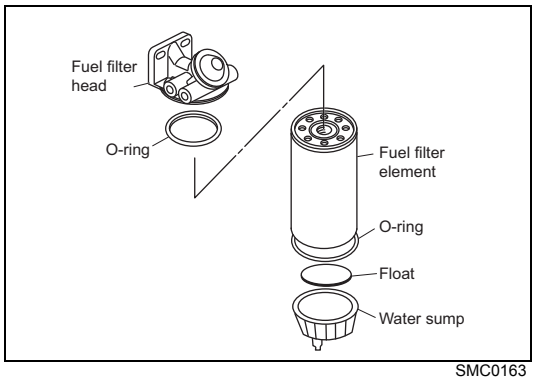
| Inspection item | | | Standard value | Repair limit | Service limit | Action |
|---|---|---|---|---|---|---|
| Camshaft | Camshaft journal outer diameter | | 40{1.5748} | — | –0.15 {–0.0059} | Replace camshaft |
| | Camshaft bearing inner diameter | | 40{1.5748} | — | +0.15 {+0.059} | Bearing Replacement |
| | Camshaft bearing oil Clearance | | 0.020 - 0.063 {0.0008 - 0.0025} | — | — | Replace camshaft or bearing |
| | Cam height | IN | 50.046{1.9703} | — | –0.08 {–0.0031} | Replace camshaft |
| | | EX | 52.739{2.0763} | — | | |
| | Cam lift | IN | 8.046{0.3168} | — | –0.08 {–0.0031} | Replace camshaft |
| | | EX | 10.739{0.4228} | — | | |
| Camshaft | Camshaft journal width (Rear journal) | | 33{1.2992} | — | — | |
| | Camshaft end play | | 0.100 - 0.178{0.0039 - 0.0070} | — | — | Replace camshaft |
| | Camshaft runout | | 0.04 {0.0016} | — | 0.1{0.039} | Replace camshaft |
| Rocker shaft outer diameter | | | 22{0.8661} | — | –0.08 {–0.0031} | Replace rocker shaft |
| Rocker arm bushing inner diameter | | | 22{0.8661} | — | +0.08 {+0.0031} | Replace rocker arm bushing |
| Rocker arm oil clearance | | | 0.030 - 0.101 {0.00012 - 0.0040} | 0.15 {0.0059} | — | |
| Valve stem outer diameter | | IN | 7{0.2756} | — | — | Replace valve |
| | | EX | 7{0.2756} | — | — | |
| Valve guide inner diameter | | IN | 7{0.2756} | — | — | Replace valve guide |
| | | EX | 7{0.2756} | — | — | |
| Oil clearance between valve guide and valve stem | | IN | 0.023 - 0.058 {0.0009 - 0.0020} | — | — | Replace valve or valve guide |
| | | EX | 0.050 - 0.083 {0.0020 - 0.0033} | — | — | |
| Valve sink | | IN | 0.55 - 0.85 {0.0217 - 0.0335} | — | 1.1{0.0433} | Replace valve and valve seat |
| | | EX | 1.15 - 1.45 {0.0453 - 0.0571} | — | 1.7{0.0669} | |
| Valve seat angle | | IN | 30° | Allowable anlge 30° - 30°35' | | Correction |
| | | EX | 45° | Allowable anlge 45° - 30°30' | | |
| Valve face angle | | IN | 30° | Allowable angle 29°30 - 45° | | |
| | | EX | 45° | Allowable angle 44°30 - 45° | | |

# 3 PARTS TO BE PREPARED

# 4 ENGINE ASSEMBLY/DISASSEMBLY

# Replacement of fuel filter element (on machine main unit)

JP30002050704002



SMC0163

**1. Removal of water cup**

(1) Refer to "Drain of the fuel filter" and discharge water from the fuel filter.

(2) Remove the water cup of the fuel filter.

**2. Removal of fuel filter element**

(1) Remove the fuel filter element.

**⚠ CAUTION** • **Since the filter contains diesel oil, prepare a tray.**

**3. Installation of fuel filter element**

(1) After the O-ring of the fuel filter touches the fuel filter head, turn the fuel filter element by 7/8 and install the fuel filter element on the fuel filter head.

(2) After the O-ring of the water cup touches the fuel filter element, turn the water cup by 3/4 and install the water cup of the fuel filter on the lower part of the fuel filter element.

(3) Mount the water cup of the fuel filter under the fuel filter element.

(4) Tighten the fuel filter drain valve.

**⚠ CAUTION** • **Element is not reused.**

(5) Start the priming pump and bleed air from the system.

**⚠ CAUTION** • **Make sure that the fuel filter air bleeding bolt is loose.**

(6) Tighten the fuel filter air bleeding bolt.
**Tightening torque :**
**1.8 - 2.2 N m {18.3 - 22.4, 1.3 - 1.6}**

**⚠ CAUTION** • **After work, wipe off spilled fuel. After start of the engine, make sure that there is no fuel leak.**

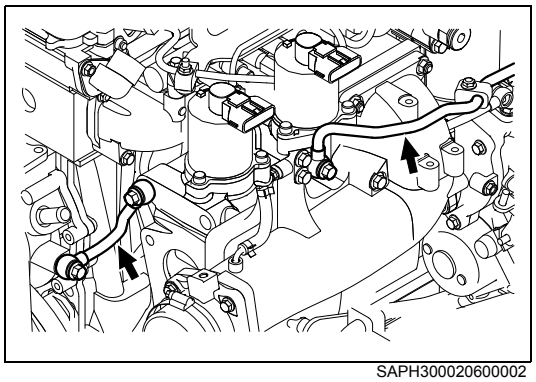
# Overhaul of EGR valve and EGR cooler

JP30002060704001

## 1. Removal of EGR valve

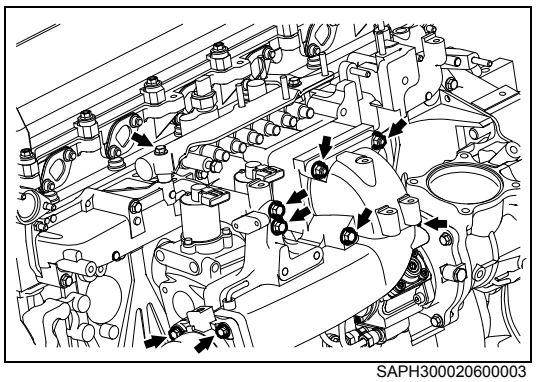
⚠ **CAUTION** • **Since burn may occur, replace the part after cooling. (Leave it standing for 30 minutes or more after the starter key is turned OFF.)**

(1) Remove the connector from the EGR solenoid valve.
(2) Remove the EGR pipe.
(3) Remove the coolant pipe (inlet pipe and outlet pipe) connected to the EGR valve.



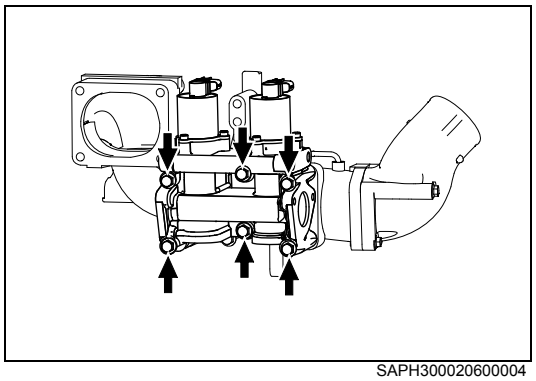
SAPH300020600002

(4) Remove 6 bolts and 2 nuts and remove the intake air pipe together with the EGR valve.

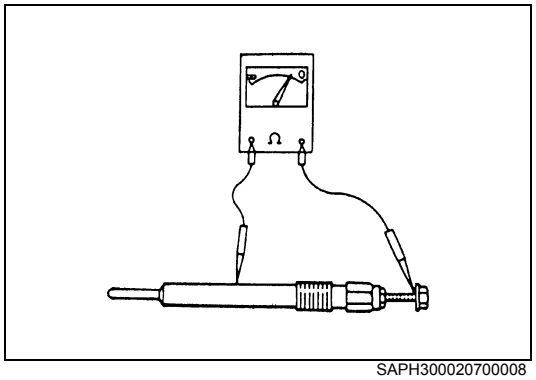


SAPH300020600003

(5) Fix the intake air pipe with a vice and remove 6 bolts to remove the EGR valve.



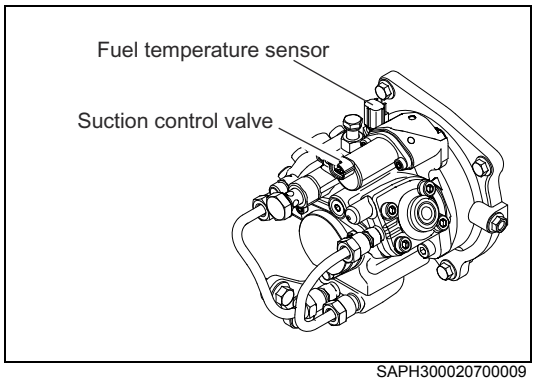
SAPH300020600004


SAPH300020700008

### 3. Inspection of glow plug

(1) Measure continuity between the body and the terminal using a circuit tester. If it is faulty, replace the glow plug.

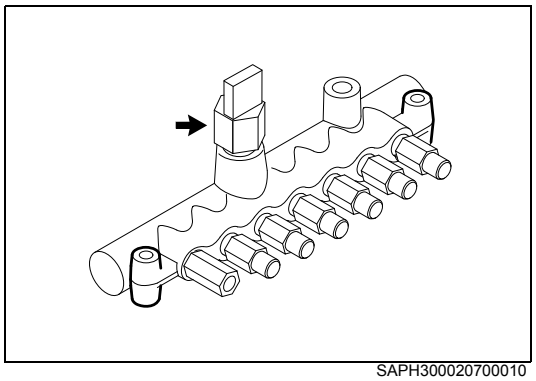
| Standard value | |
|---|---|
| Resistance value : Ω (Normal temperature 20°C{68°F}) | 2.59 - 3.29 |



SAPH300020700009

### 4. Inspection of suction control valve SCV and fuel temperature sensor

(1) For inspection and replacement of the suction control valve (SCV) and the fuel temperature sensor, refer to the chapter of "J08E Fuel".

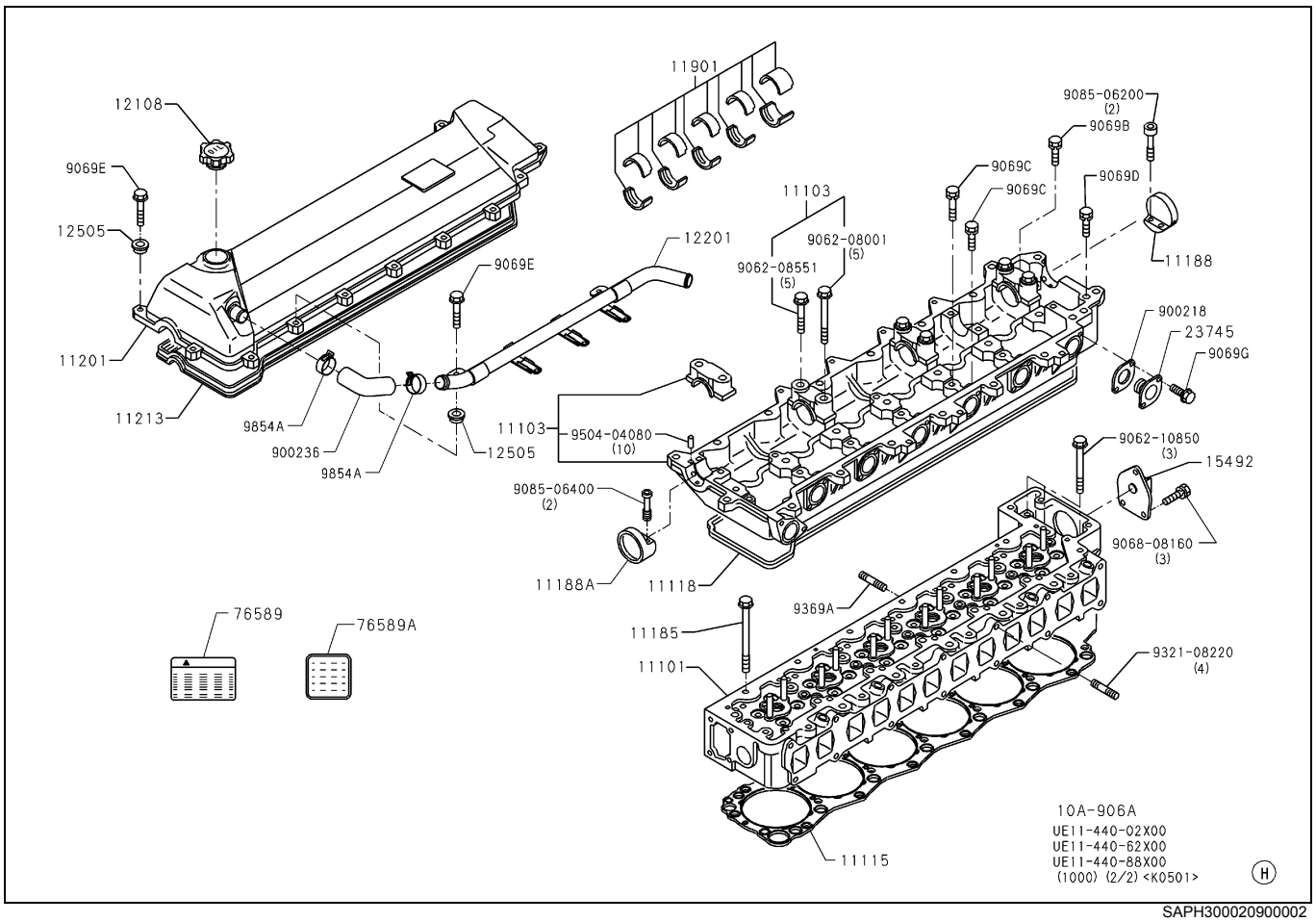

SAPH300020700010

### 5. Inspection of common rail pressure sensor

(1) For inspection and replacement of the common rail pressure sensor, refer to the chapter of "J08EFuel".

### 6. Inspection of injector

(1) For inspection and replacement of the injector, refer to the chapter of "J08EFuel".




SAPH300020900002

| | | | |
|---|---|---|---|
| 11101 | Cylinder head assembly | 11188A | Cylinder plug |
| 11103 | Camshaft housing | 11201 | Cylinder head cover |
| 11115 | Cylinder head gasket | 11213 | Head cover gasket |
| 11118 | Camshaft housing gasket | 12108 | Oil filler cap |
| 11188 | Cylinder plug | 23745 | Pipe oil seal |

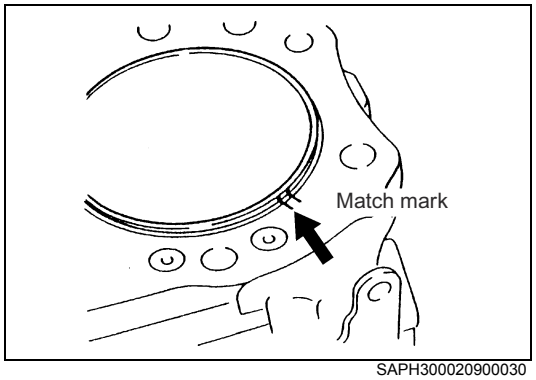
*Parts not to be reused.

**Tightening torque**

| | | | |
|---|---|---|---|
| 11185 | 59N·m{600kgf·cm, 44lbf·ft}+90°+90° | 9069E | 28.5N·m{290kgf·cm, 21lbf·ft} |
| 9062-10850 | 59N·m{600kgf·cm, 44lbf·ft} | 9062-08001 | 31N·m{320kgf·cm, 23lbf·ft} |
| 9069B | 23N·m{230kgf·cm, 17lbf·ft} | 9062-08551 | 31N·m{320kgf·cm, 23lbf·ft} |
| 9069C | 23N·m{230kgf·cm, 17lbf·ft} | 9085-06200 | 6N·m{60kgf·cm, 4lbf·ft} |
| 9069D | 23N·m{230kgf·cm, 17lbf·ft} | 9085-06400 | 6N·m{60kgf·cm, 4lbf·ft} |

# Overhaul

JP30002090702002

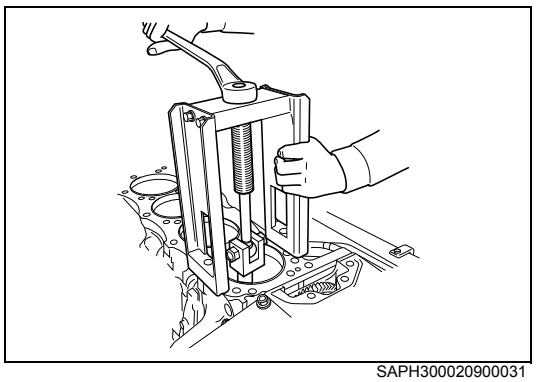


SAPH300020900030

**1. Replacement of cylinder liner**

(1) Put match marks on the flange surfaces of the cylinder block and the cylinder liner using a oil based marker.

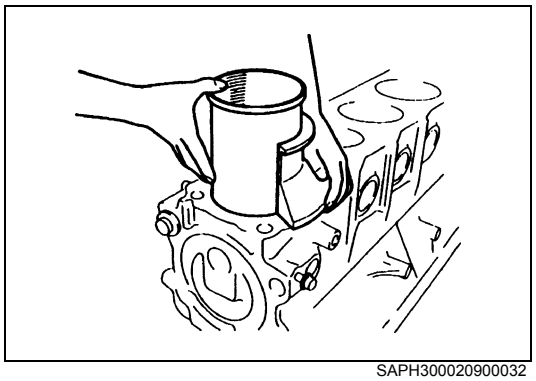
⚠ **CAUTION**
- **Store removed cylinder liners for each cylinder number.**
- **Never provide match marks with a punch.**


SAPH300020900031

(2) Pull out the cylinder liner toward the cylinder block upper part using a tool.

**Cylinder liner puller**

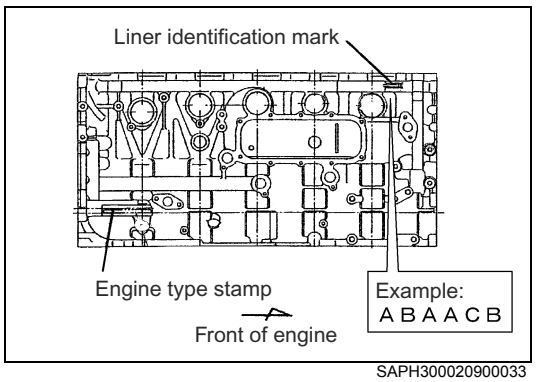
⚠ **CAUTION**
- **Be careful for handling of the cylinder liner. Do not reuse the cylinder liner which has been dropped.**
- **Do not touch the cooling jet during work.**


SAPH300020900032

(3) Apply engine oil to the inner bore of the cylinder block.

(4) Align the match mark of the cylinder liner with that of the cylinder block. Install the cylinder liner using a tool.

**Guide**



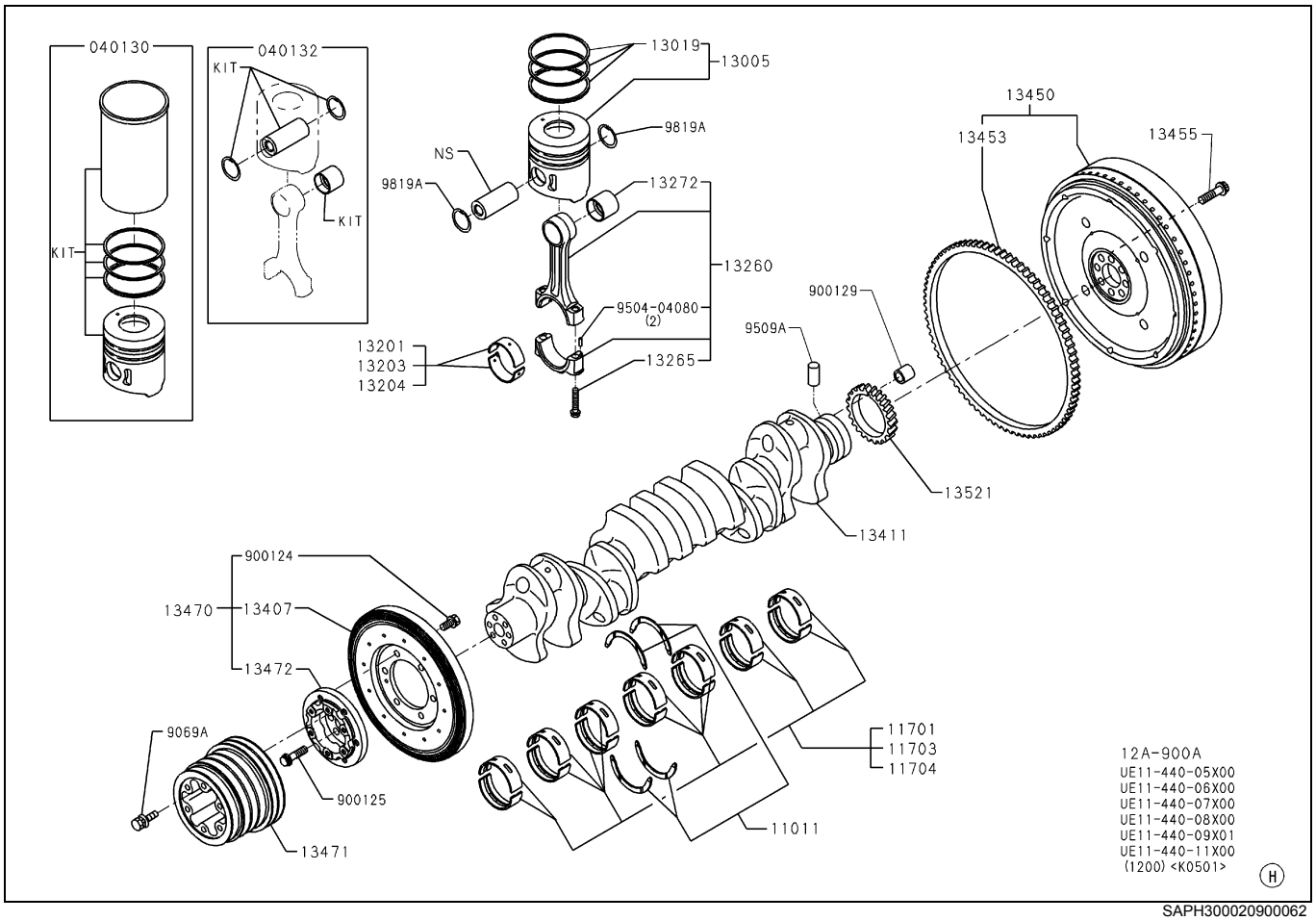
SAPH300020900033

⚠ **CAUTION**
- **When a new cylinder liner is installed, install the cylinder liner with the same identification mark (A, B, C) stamped on the cylinder block.**
- **The example in the figure shows that the #1 cylinder is a liner of B.**

# Main Moving Parts

## Part layout

JP30002090402004



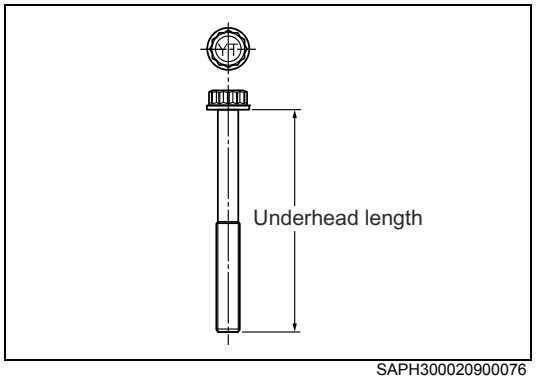

SAPH300020900062

| | | | |
|---|---|---|---|
| 11011 | Thrust bearing | 13407 | Crankshaft damper |
| 11701 | Main bearing | 13411 | Crankshaft |
| 11703 | Main bearing US 0.25 | 13450 | Flywheel assembly |
| 11704 | Main bearing US 0.50 | 13453 | Ring gear |
| 13005 | Piston and piston ring set | 13471 | Crankshaft pulley |
| 13201 | Bearing | 13521 | Crankshaft gear |
| 13260 | Connecting rod assembly | 9819A* | Retainer ring |

*Parts not to be reused.

### Tightening torque

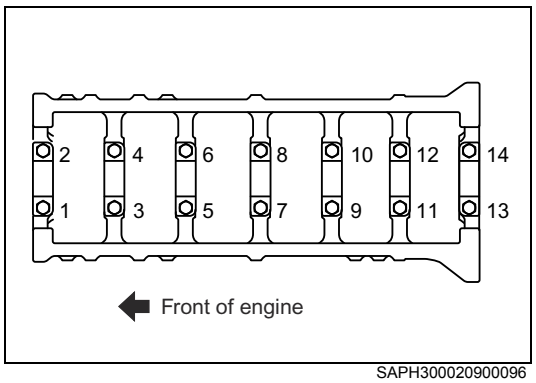
| | | | |
|---|---|---|---|
| 13265 | 69N·m{700kgf·cm, 51lbf·ft}+90°+45° | 900125 | 118N·m {1, 200 kgf·cm, 87lbf·ft} |
| 13455 | 186N·m {1, 900 kgf·cm, 137lbf·ft} | | |



SAPH300020900076

(5) Measure the underhead length of the bearing cap bolt using a vernier calipers. If it is out of the service limit, replace it with a new one.

| Service limit (mm{in.}) | 108{4.252} |
|---|---|



SAPH300020900096

(6) Apply engine oil to the bolt seat and the bolt thread of the bearing cap bolt.

(7) Tighten the bearing cap bolt according to the sequence in the figure.
**Tightening torque : 69 N·m {700 kgf·cm, 51 lbf·ft}**

(8) Loosen the bearing cap fixing the thrust bearing and hit the crankshaft gently at the front/rear end using a plastic hammer.

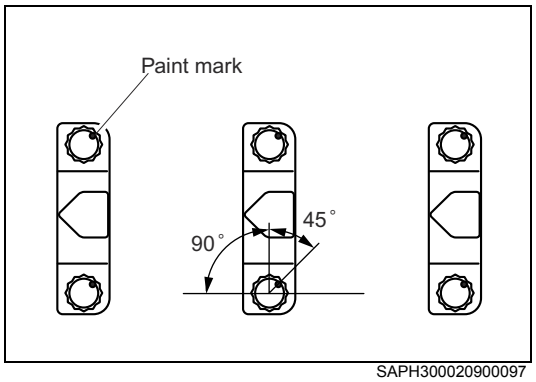
(9) Loosen all bearing cap bolts.

(10) Tighten the bearing cap bolt as in (7).
**Tightening torque : 69 N·m {700 kgf·cm, 51 lbf·ft}**

(11) Mark bearing cap bolt heads in the same direction with paint.

(12) Tighten 90 deg (1/4 turn) with the same order as in (7).

(13) Retighten 45 deg (1/8 turn) as in (7).



SAPH300020900097

(14) Make sure that all paint marks are in the same direction.

⚠ **CAUTION**
- **If it is excessively retightened, do not loosen it.**

(15) After tightening, hit the front/rear ends of the crankshaft gently with a plastic hammer for initial fit.

⚠ **CAUTION**
- **Make sure that the crankshaft turns smoothly.**
- **Measure the end play of the crankshaft and make sure that it is within the standard value.**

| Standard value (mm{in.}) | Repair limit (mm{in.}) | Service limit (mm{in.}) |
|---|---|---|
| 0.050 - 0.270 {0.0020 - 0.0106}} | 0.50{0.0197} | 1.270{0.0500} |

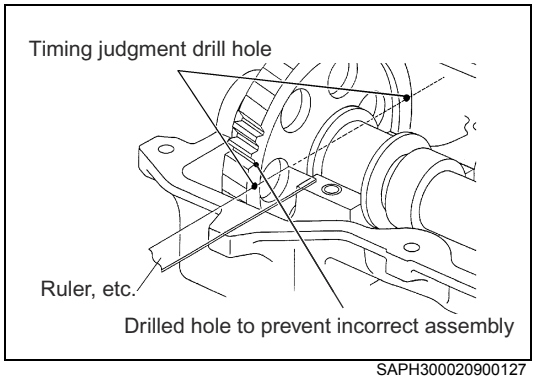
## Installation of camshaft

JP30002090702010

**1. Align the No. 1 cylinder to the compression top dead center.**

**2. Installation of camshaft**

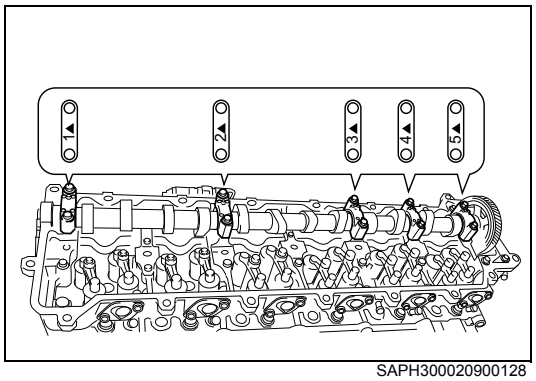
(1) Place the camshaft so that two holes at 180 degrees from the three drilled holes of the camshaft gear may be horizontal to the upper surface of the camshaft housing.




SAPH300020900127

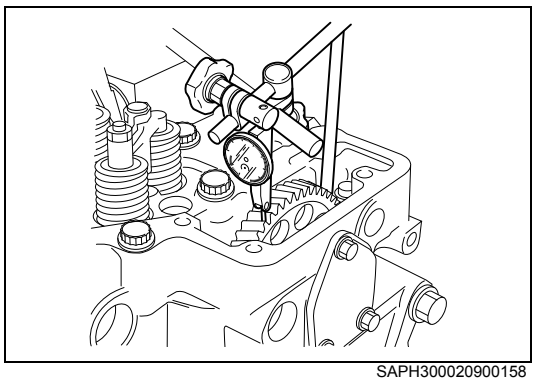
⚠ **CAUTION** • **Place a transparent plastic ruler or an edged ruler on the upper surface of the camshaft housing and the side of the camshaft gear. Make sure that the position of the foolproof drilled hole is below the ruler.**

(2) Adjust the direction and the position for installation of the camshaft bearing cap.
**Tightening torque : 31 N·m {320 kgf·cm, 23 lbf·ft}**




SAPH300020900128

⚠ **CAUTION** • **In the camshaft bearing cap, the triangle mark faces forward. The order of stamps is 1, 2, 3, 4 and 5 from the front.**



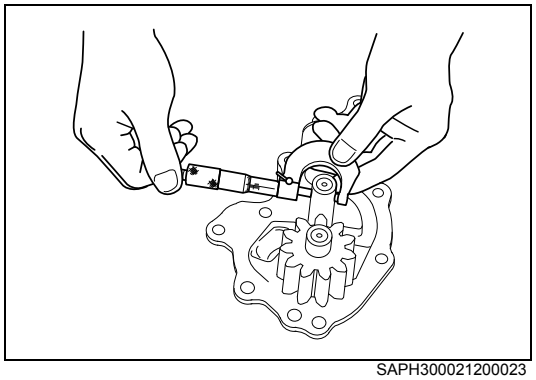
SAPH300020900158

(2) Measure backlash between the cam idle gear and the sub-idle gear using a dial gauge. If it is beyond the service limit, replace each gear.

| Standard value (mm{in.}) | Service limit (mm{in.}) |
|---|---|
| 0.050 - 0.218 {0.0020 - 0.0086} | 0.30{0.0118} |

# 10 EXHAUST

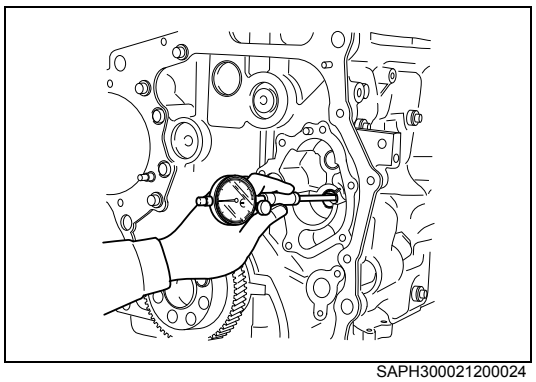
# 12 LUBRICATION


SAPH300021200023

**6. Inspection of clearance betweeen outer diameter of driven gear shaft and inner diameter of driven gear bushing**

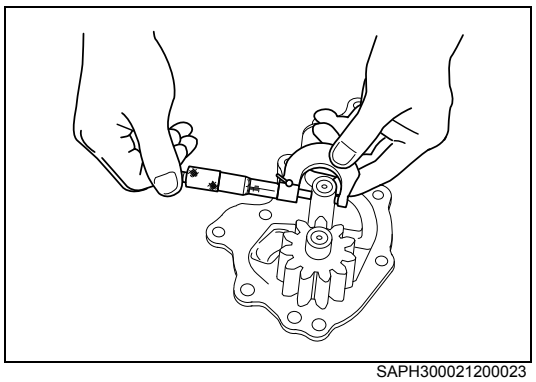
(1) Measure the outer diameter of the driven gear shaft using a micrometer and measure the inner diameter of the driven gear bushing using a cylinder gauge.

| Measuring area | Standard value (mm{in.}) |
|---|---|
| Outer diameter of driven gear shaft | 18{0.7087} |
| Cylinder block hole diameter | 18{0.7087} |


SAPH300021200024

(2) Calculate the difference between the outer diameter of the driven gear and the cylinder block hole diameter. If it is beyond the service limit, replace the oil pump assembly.

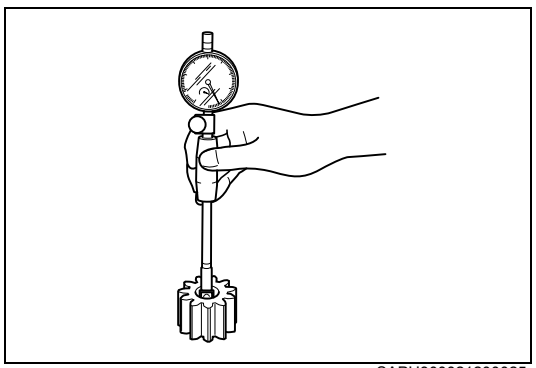
| Standard value (mm{in.}) | 0.030 - 0.075 {0.0012 - 0.0030} |
|---|---|


SAPH300021200023

**7. Inspection of clearance betweeen outer diameter of driven gear shaft and inner diameter of driven gear bushing**

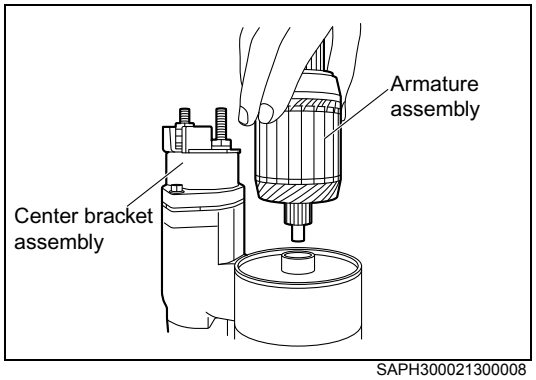
(1) Measure the outer diameter of the driven gear shaft using a micrometer and measure the inner diameter of the driven gear bushing using a cylinder gauge.

| Measuring area | Standard value (mm{in.}) |
|---|---|
| Outer diameter of driven gear shaft | 18{0.7087} |
| Inner diameter of driven gear bushing | 18{0.7087} |


SAPH300021200025

(2) Calculate the difference between the outer diameter of the driven gear shaft and the inner diameter of the driven gear bushing. If it is beyond the service limit, replace the oil pump assembly or the driven gear bushing.

| Standard value (mm{in.}) | Service limit (mm{in.}) |
|---|---|
| 0.040 - 0.083 {0.0016 - 0.0033} | 0.15{0.00059} |

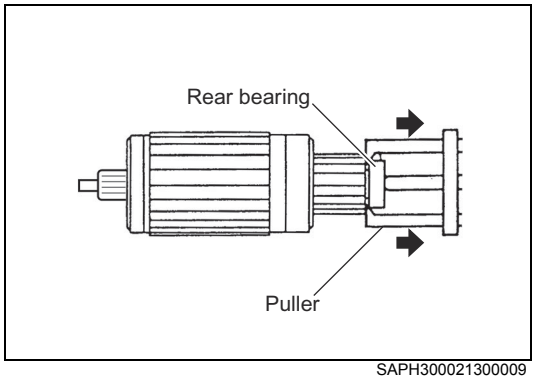


SAPH300021300008

**6. Removal of armature assembly**

(1) Remove the armature assembly by lifting.

⚠ **CAUTION** • **When the armature assembly is removed, the washer at the end of the gear may be dropped and lost. Be careful for handling.**

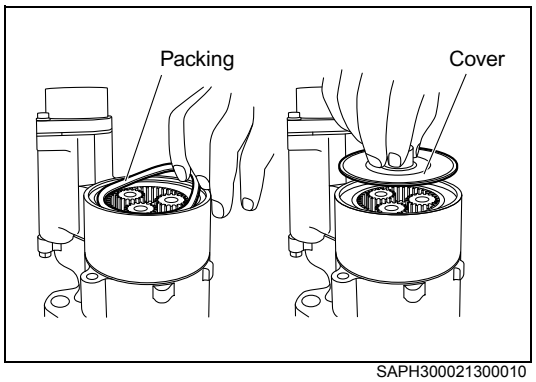


SAPH300021300009

**7. Removal of rear bearing**

(1) Pull out the bearing of the armature assembly using a puller or press.

⚠ **CAUTION** • **Removed bearing must not be reused. Replace it with a new one.**



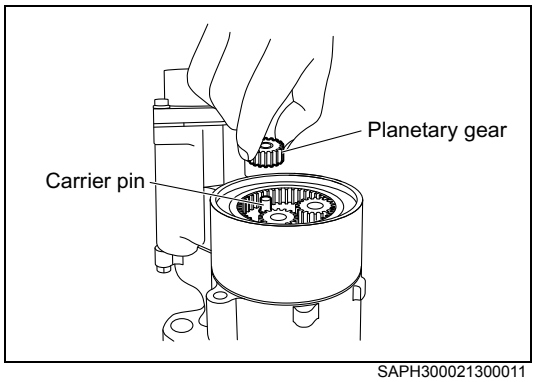
SAPH300021300010

**8. Removal of cover**

(1) Remove the cover from the center bracket assembly.

(2) Remove the packing.

⚠ **CAUTION** • **Damaged packing must not be resued. Replace it with a new part.**

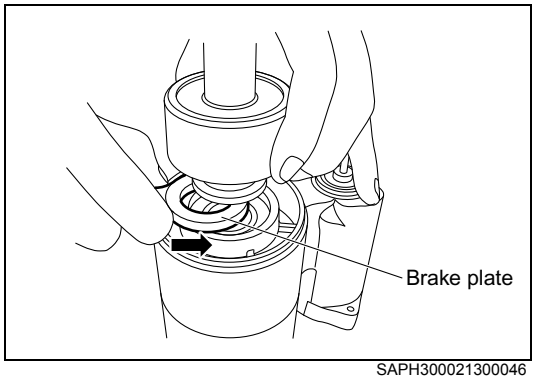


SAPH300021300011

**9. Removal of planetary gear**

(1) Remove the planetary gear from the carrier pin.

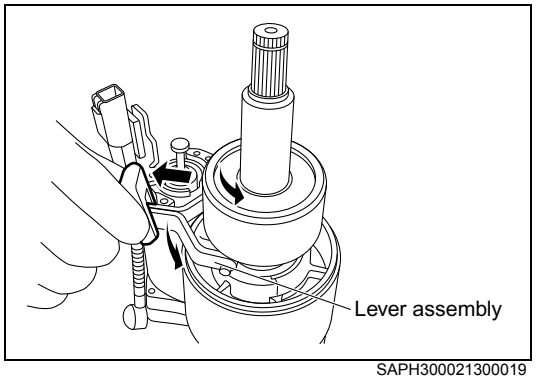
⚠ **CAUTION** • **Make sure that the gear is not damaged or chipped.**



SAPH300021300046

**4. Installation of brake plate**

(1) Lubricate parts (refer to the lubrication point drawing and the lubrication list) and install the brake plate.



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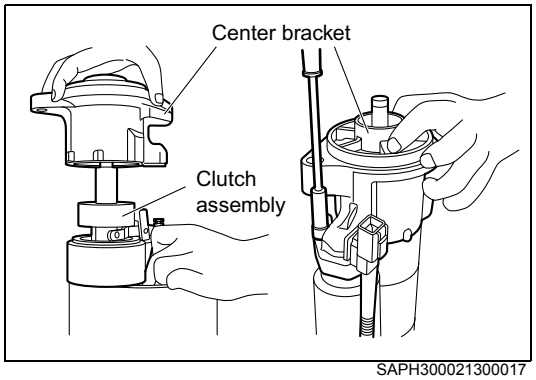
**5. Installation of lever**

(1) Lubricate parts (refer to the lubrication point drawing and the lubrication list). Turn and install the lever assembly using the clutch as the axis.



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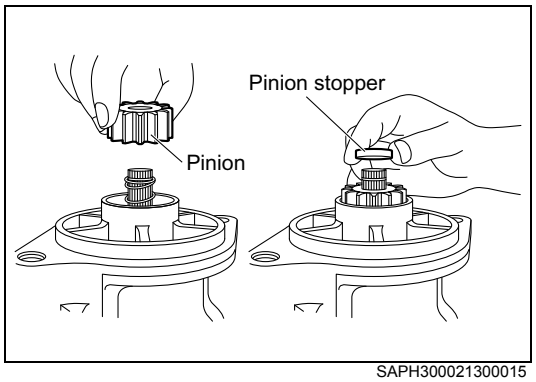
**6. Installation of pinion case**

(1) Install two set bolts at the switch using a box screwdriver or offset wrench.

**Tightening torque :**
**14 - 16 N·m {140 - 160 kgf·cm, 10 - 12 lbf·ft}**



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**7. Installation of pinion**

(1) Lubricate parts (refer to the lubrication point drawing and the lubrication list) and install the pinion and the pinion stopper.

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