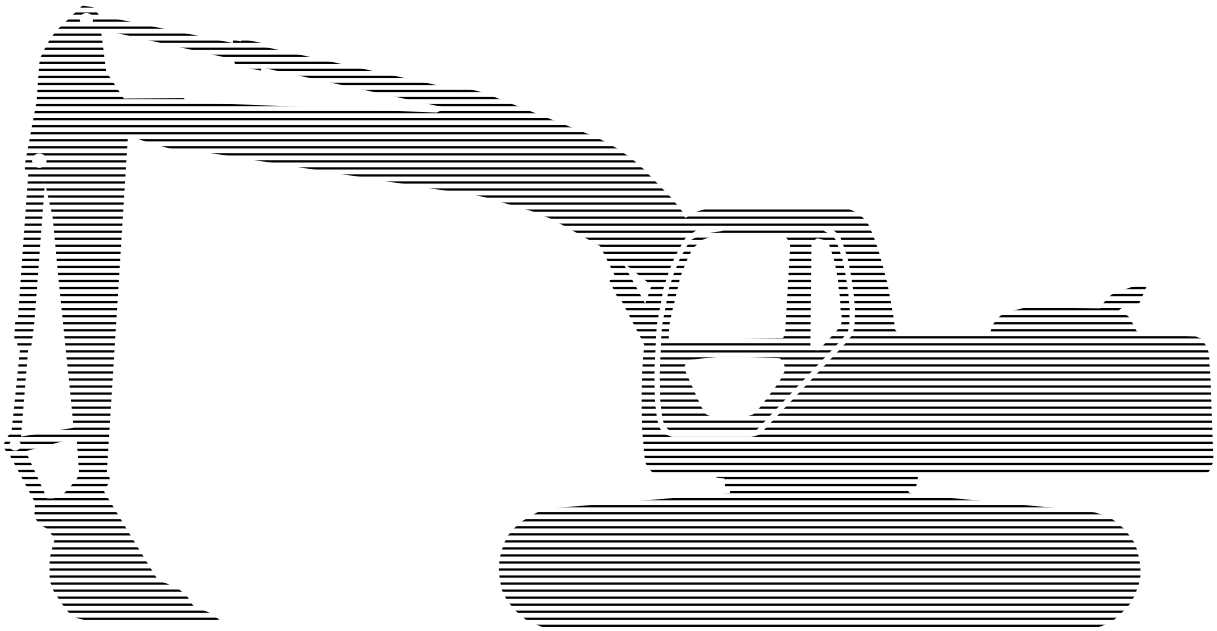
E485B

WORKSHOP MANUAL



All the information and data contained in this manual are based upon most recent information available at the time of its publication.

NEW HOLLAND KOBELCO has the right to implement, at any time, any modification without providing any communication.

NEW HOLLAND KOBELCO CONSTRUCTION MACHINERY S.p.A. - Product Support

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SAFETY PRECAUTIONS

GENERALITIES

Read the Operation and Maintenance Instruction Manual carefully before starting, operating, maintaining, fuelling or servicing the machine.

Carefully read the explanation to each and all safety signs in the special section of this Manual before starting, operating, maintaining, fuelling or servicing the machine.

Machine-mounted safety plates are colour coded yellow with black borders when they refer to points where special **ATTENTION** must be paid and failure to observe them may cause a serious **DANGER** to the integrity of machine operators. They are white with red borders and black lettering when they refer to a **FORBIDDEN** practice.

It is fundamental that all machine operators know very well the meaning of each safety plate as this considerably decreases operating hazards and accidents.

Do not allow unauthorised personnel to operate or service this machine.

Do not wear rings, wrist watches, jewellery, loose or hanging garments, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can get caught in moving parts. Wear certified safety clothes such as: hard hat, no-slip footwear, heavy gloves, ear protection, safety glasses, reflector vests, respirators every time the job requires it. Ask your employer about safety regulations in force and protective equipment.

Always keep the operator's compartment, step plates, grab-rails and handles clean and clear of foreign objects, oil, grease, mud or snow to minimise the danger of slipping or stumbling. Remove mud or grease from your shoes before operating the machine.

Do not jump on or off the machine. Always keep both hands and one foot, or both feet and one hand in contact with steps and/or grab rails.

Do not use controls or hoses as hand holds. Hoses and controls are movable parts and do not provide solid support. Besides, controls may be inadvertently moved and cause unexpected movement of the machine or its attachments.

Never operate the machine or its attachments from any position other than sitting in the driver's seat. Keep head, body, limbs, hands and feet inside the operator's compartment at all times to reduce exposure to external hazards.

Be careful of possible slippery conditions of the steps and hand rails as well as of the ground around the machine. Wear protective boots or shoes with the soles made of highly no-slip rubber

Do not leave the machine until it has come to a complete stop.

Always check height, width and weight limitations which may be encountered in the working site and ensure the machine does not exceed them.

Assess exact paths of gas ducts, water mains, telephone lines, sewers, overhead and underground electric lines and all other possible obstacles.

Such paths should be opportunely defined by competent Authorities. If necessary, require that the service is interrupted or said installations are moved prior to starting the work.

You must know the working capacity of the machine.

Define the rear upperstructure swing area and provide for opportune barriers to prevent access into it.

Never exceed machine lifting capacity.

Remain within the limits shown in the loading capacity chart which located on the machine.

STARTING

Never start or operate a failed machine. Walk all around the machine before mounting.

Before operating the machine, make sure that any possible dangerous condition has been properly removed. Before starting machine, check that steering and attachment controls are in the neutral position and the safety lever is in the LOCK position. Immediately report any malfunction of parts or systems to the maintenance managers for proper action.

Prior to starting the engine, check, adjust and lock the driver's seat for maximum riding comfort and control accessibility. Prior to operating the machine and/or its attachments, check that bystanders are outside the machine operating range. Sound the horn.

Obey all hand signals, safety indications and signs.

Due to the presence of flammable fluids, never check fuel level, refuel, charge the batteries in the presence of smoking materials, open flames or sparks.

Ensure that nobody is within the excavator operating area before starting the machine, swinging the upper structure or moving in any direction.

Adjust all rear-view mirrors for maximum visibility of the area behind the machine.

Ensure that engine speed is appropriate to the job to be carried out.

WEAR PROTECTIVE CLOTHING

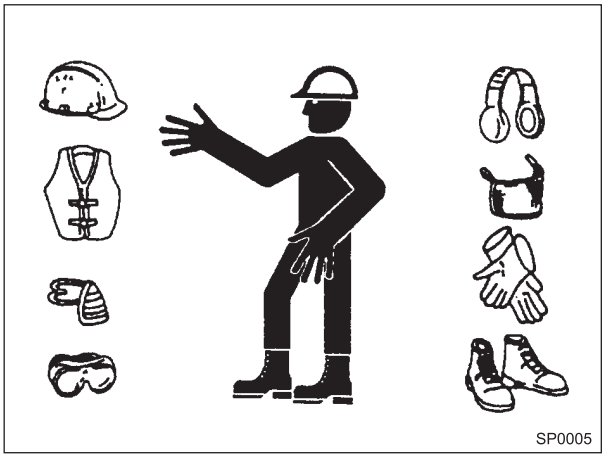
- Wear close-fitting clothing and safety equipment appropriate to the job.

  You need:

  - A hard hat;
  - Safety shoes;
  - Safety glasses or face shield;
  - Heavy gloves;
  - Ear protection;
  - Reflective clothing;
  - Waterproof clothing;
  - Respirator or filter mask;

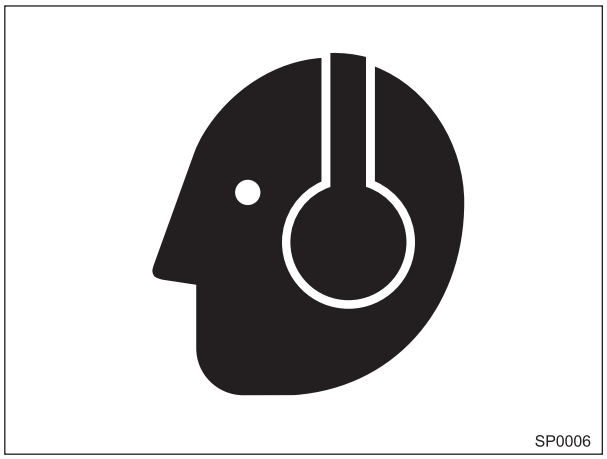
  Be sure to correctly wear equipment and clothing for the job.

  - Do not take any chances.
  - Avoid wearing loose clothing, jewellery, or other items that can catch on control levers or other parts of the machine.
- Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating the machine.


SP0005

PROTECT AGAINST NOISE

- Prolonged exposure to loud noise can cause impairment or loss of hearing.
  - Wear a suitable hearing protection such as earmuffs or earplugs to protect objectionable or uncomfortably loud noise.


SP0006

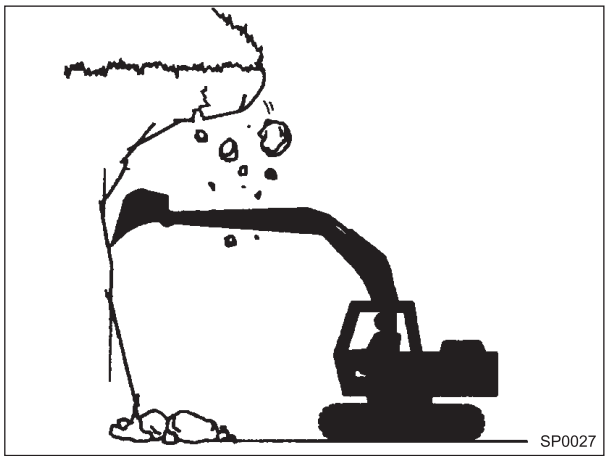
INSPECT THE MACHINE

- Inspect the machine carefully every day or work-shift by an attentive visual inspection of machine outside prior to starting it to prevent damages and personal injuries.


SP0007

NEVER UNDERCUT A HIGH BANK

- The edges could collapse or a land slide could occur causing serious injury or death.

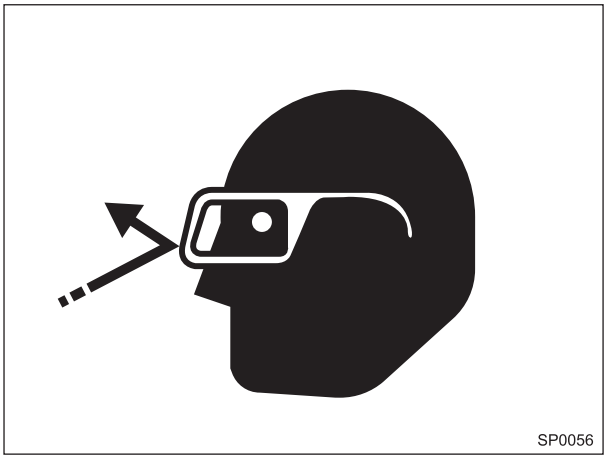


SAFETY LOADS MOVING

- The excavator is a machine designed specifically to perform digging/loading works, thus it must not be used to handle suspended loads. In the event, under exceptional conditions, it becomes necessary to handle materials, the following indications must be strictly implemented:
  - The machine must be equipped compulsorily with the appropriate variant provided upon request. Also, totally comply with the safety precautions for the operation of the excavator as a lifting equipment.
  - Secure the loads to be raised using cables or chains fastened with appropriate hooking mechanisms.
  - Never hook cables or chains to the bucket teeth.
  - Nobody should be allowed to remain under the raised load or within the excavator operating range for any reason whatever.
  - Never exceed specified loading capacity. Incorrect fastening of slings or chains may cause boom/arm failure or failure of the lifting means with consequent bodily injuries and even death.
  - Always ensure that slings and chains used for lifting are adequate to the load and in good condition.
  - All loading capacities are referred to the machine on a level surface and should be disregarded when working on a slope.
  - In any case, comply with the current national or local regulations on this matter.

PROTECT AGAINST FLYING DEBRIS

- If flying debris hit eyes or any other part of the body, serious injury may result.
  - Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.
  - Keep bystanderds away from the working area before striking any object.

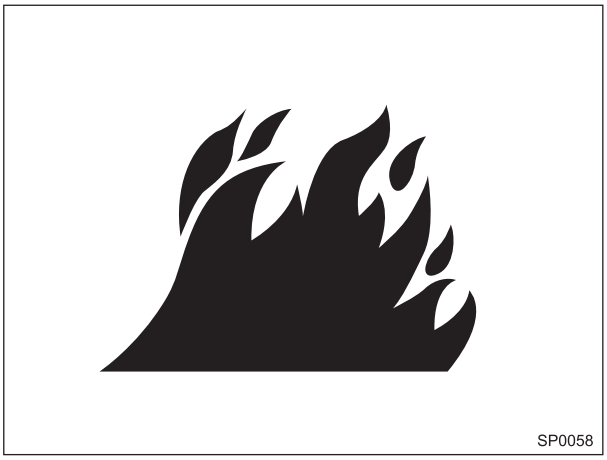

SP0056

HANDLE FLUIDS SAFELY - AVOID FIRES

- Handle fuel with care: it is highly flammable. If fuel ignites, an explosion and/or a fire may occur, possibly resulting in serious injuty or death.
  - Do not refuel the machine while smoking or when near open flame or sparks.
  - Always stop the engine before refuelling the machine.
  - Fill the tank outdoors.

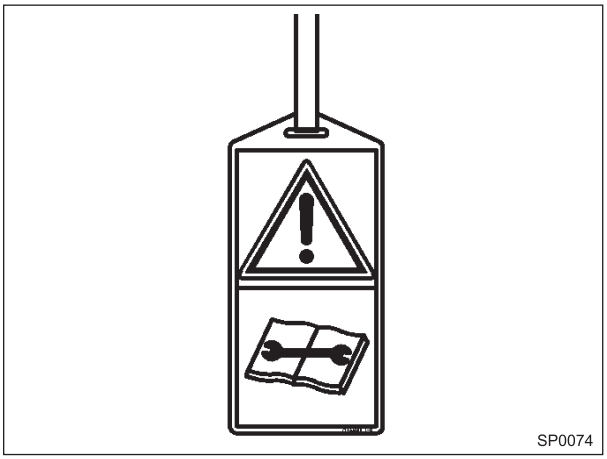

SP0057

- All fuels, most lubrificants, and some antifreeze fluids are flammable.
  - Store flammable fluids well away from fire hazards.
  - Do not burn or puncture pressurized containers.
  - Do not store oily rags; they can ignite and burn spontaneously.


SP0058

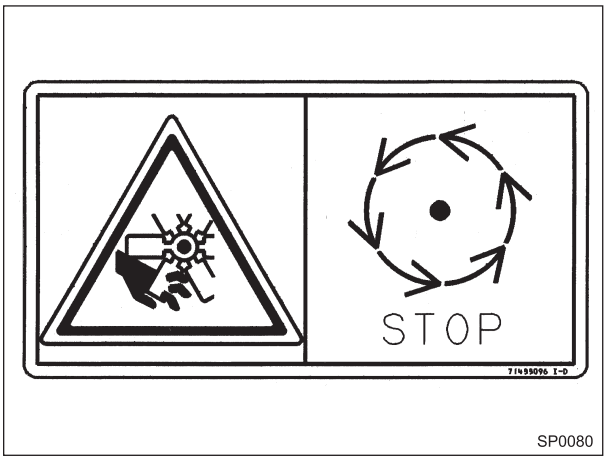
7 - Tag indicating maintenance in progress

Maintenance staff is obliged to apply the tag that indicates that the machine is not fully efficient and warns about maintenance staff being located in not visible positions. This tag should be applied to the left-hand control lever, safety lever or cab door.
Background: yellow
Border and icons: black



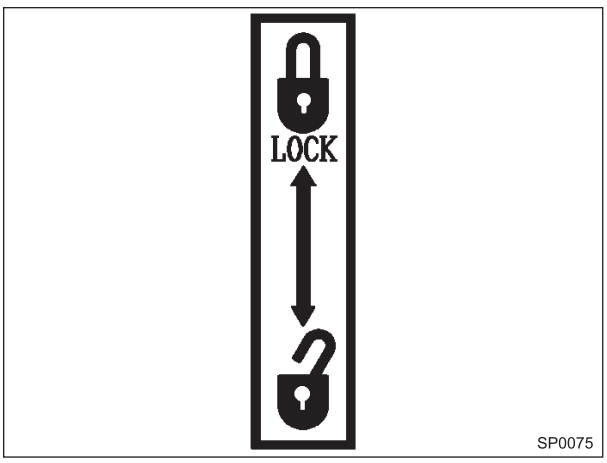
8 - Engine hood warning plate

It highlights the obligation to stop the engine before opening engine hood.
Danger of severe injuries following the presence of rotating parts such as fan, pulleys, and belts.
Background: yellow
Border and icons: black

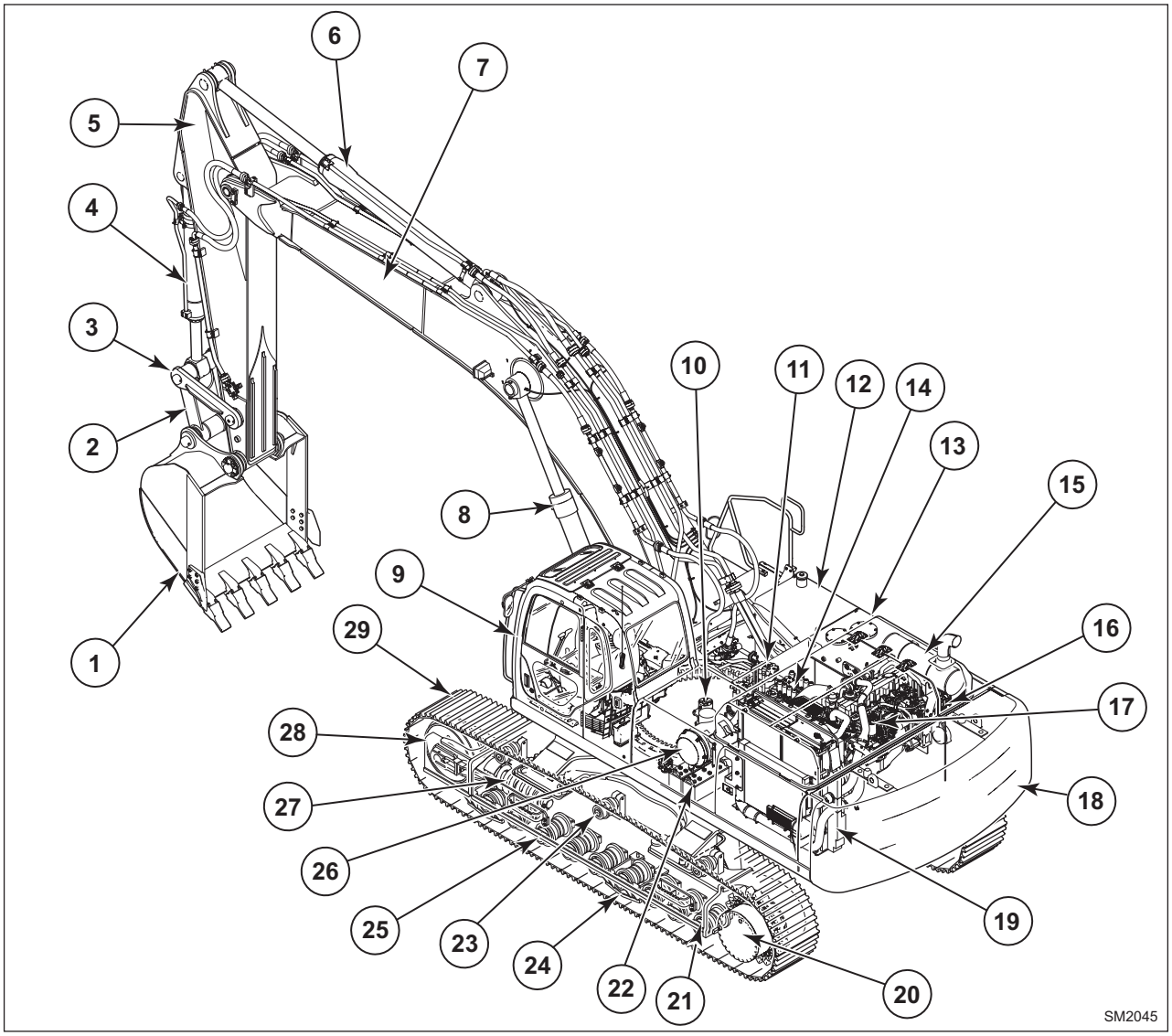


9 - Controls lock/unlock plate

It shows the position that the safety lever can assume when the engine is running.
When the operator is about to leave the cab with the engine running, even if for a short time, he must move the safety lever to the **LOCK** position. Controls are disabled and therefore no accidental machine or attachment movement is possible.
Background: white
Border and icons: black



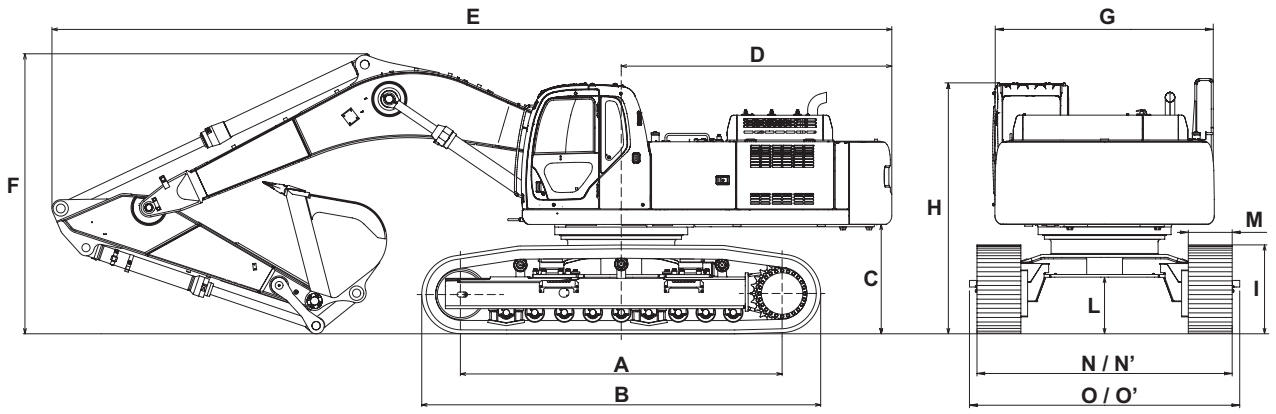
MAIN COMPONENTS



1 - Bucket
2 - Bucket link
3 - Idler link
4 - Bucket cylinder
5 - Arm
6 - Arm cylinder
7 - Boom
8 - Boom cylinder
9 - Cab
10 - Swivel joint
11 - Swing motor
12 - Fuel tank
13 - Hydraulic oil tank
14 - Control valve
15 - Engine muffler
16 - Hydraulic pump
17 - Engine
18 - Counterweight
19 - Engine radiator
20 - Travel motor
21 - Track link
22 - Batteries
23 - Upper roller
24 - Track guide
25 - Lower roller
26 - Air cleaner
27 - Crawler adjuster
28 - Front idler
29 - Shoe plate

TRANSPORTING DIMENSIONS

(Monoblock Version)



NH0518

VERSIONS	A	B	C	D	E	F	G	H	I	L
E485BLCH	4400	5460	1496	3700	(1) 12100	(1) 3570	3000	3430	1215	771
					(2) 12080	(2) 3560				
					(3) 12070	(3) 3550				
E485BLCH (without bucket)	4400	5460	1496	3700	(1) 12070	(1) 3500	3000	3430	1215	771
					(2) 12060	(2) 3520				
					(3) 12070	(3) 3550				

Arm:

(1) 2900 mm

(2) 3450 mm

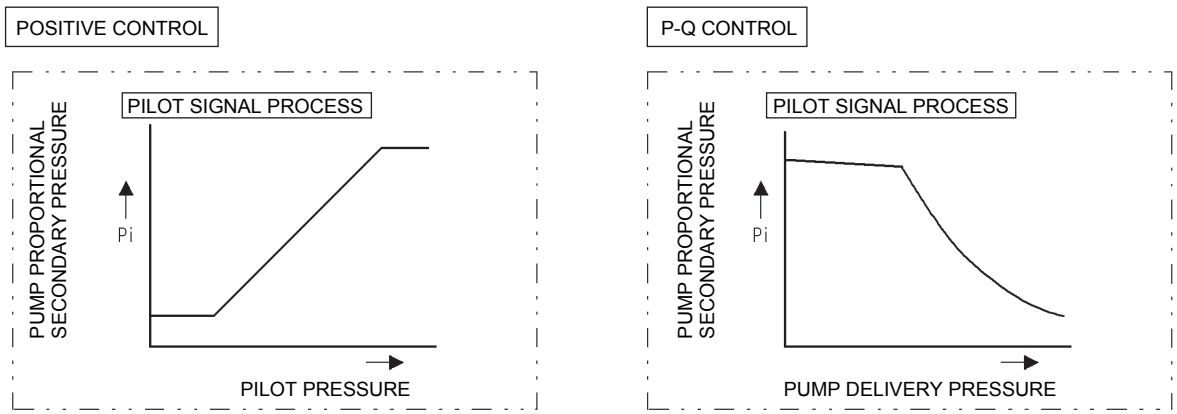
(3) 4040 mm

(dimensions in mm)

			E485BLCH			
M	**Track shoe width**	**(mm)**	600	700	800	900
N	**Gauge (reduced for transportation)**	**(mm)**	2990	3090	3190	3290
N'	**Gauge (in operational position)**	**(mm)**	3490	3590	3690	3790
O	**Frame width (reduced for transportation)**	**(mm)**	3196	3196	3196	3196
O'	**Frame width (in operational position)**	**(mm)**	3696	3696	3696	3696
Working weight (*)		**(kg)**	48830	49380	49930	50480
Spec. ground pres.		**(bar)**	0.91	0.79	0.70	0.62

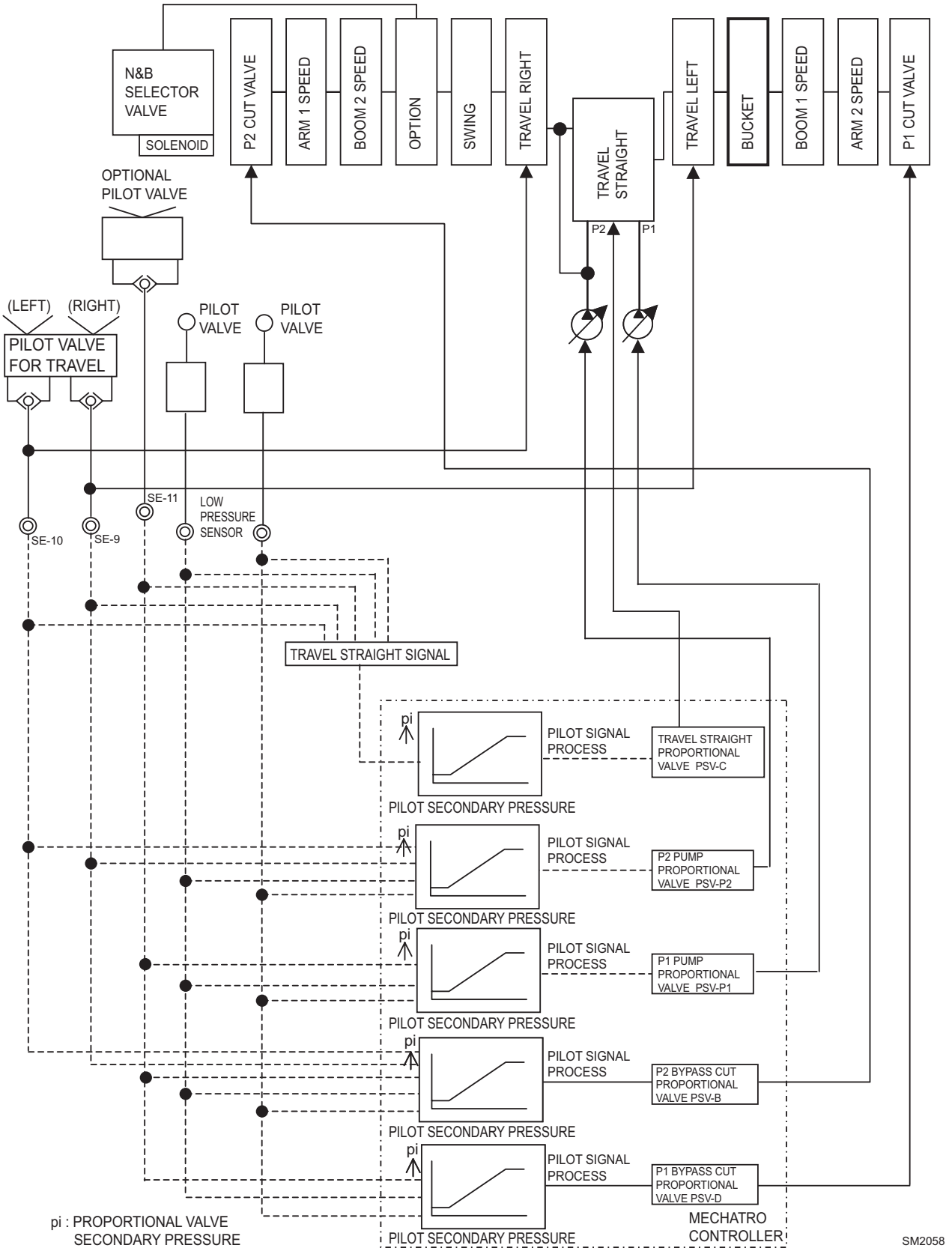
(*) With arm 3450 mm and bucket 2.2 m^3

1. Positive control
   1) On starting any one of operations, pilot secondary pressure switches each spool and is input to each 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 each unload pressure proportional valve.
   3) Each pump proportional valve outputs pilot secondary pressure according to the command output by mechatro controller and changes the tilting angle of each pump and controls the delivery rate.
   4) With this operation, the delivery rate according to lever manipulated movement is fed to the actuator, and consequently the working speed according to the lever manipulated movement will be obtained.
2. P-Q control
   1) The output voltage of high pressure sensor provided on each pump line is input to mechatro controller and the mechatro controller processes pilot signal and operates the command according to the input voltage (load pressure).
   2) The lower value between command values calculated by positive control and operated value found by P-Q control {operated value found in item 1)} is selected and is output to each pump proportional valve as command value.
   3) Each pump proportional valve outputs pilot secondary pressure according to the command output by mechatro controller and changes tilting angle of each pump and controls the delivery rate.
   4) With this operation, the delivery rate according to lever manipulated movement is fed to actuator and consequently working speed will be obtained according to lever movement.

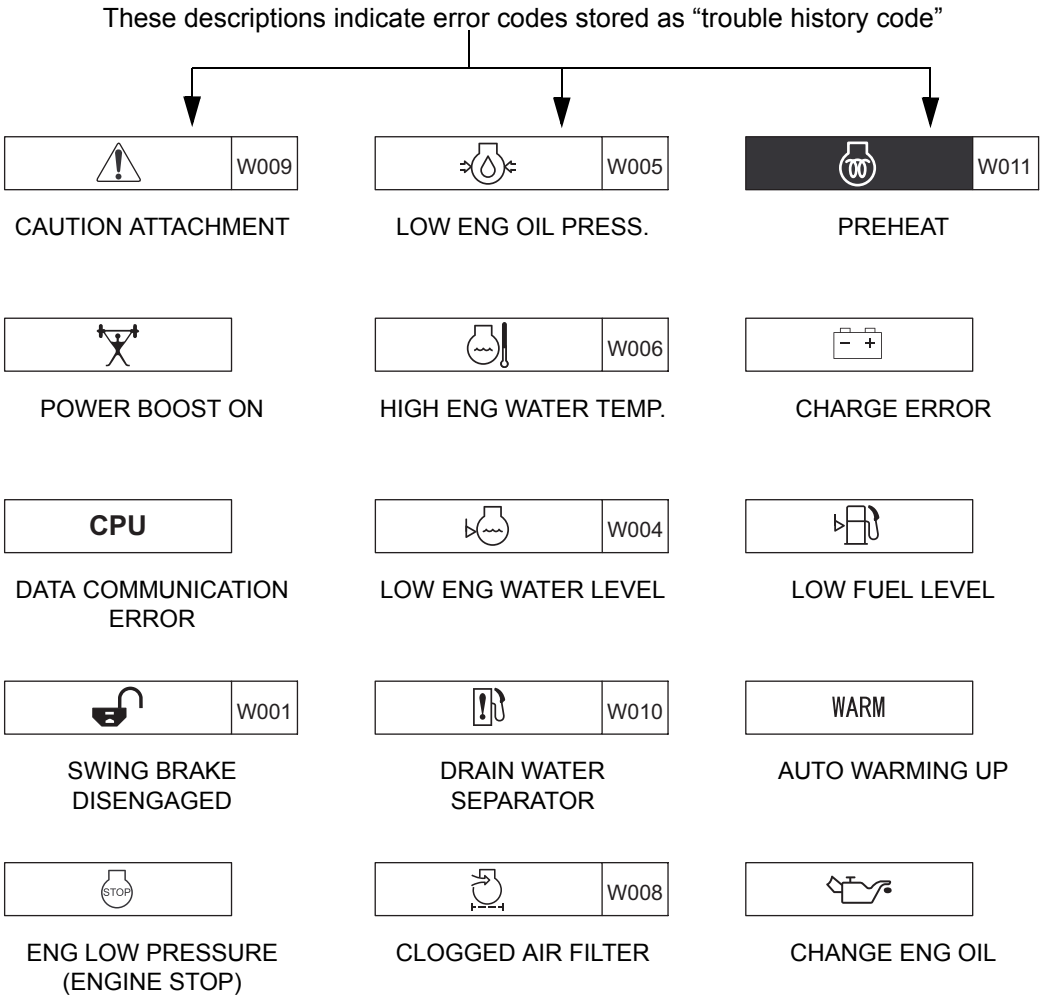


SM0120

2.10 TRAVEL STRAIGHT CONTROL



- Warning table



NOTE: *Error codes were stored as trouble history, and displayed on the monitor by the trouble history display function.*

Operation No.8 : Arm-out in full lever operation & relief H mode Hi idle		
No.32 ARM, SWING		
C-1	P1-PRES	30.5~33.5 M
C-2	P2-PRES	30.5~33.5 M
E-1	P1-PSV	470~585 mA
E-2	P2-PSV	470~585 mA
D-1	P1-UL(BPC)	300 mA
D-2	P2-UL(BPC)	300 mA
D-3	S-TRAVEL	350 mA
D-6	ARM-IN-2	750 mA
B-3	ARM OUT	3.0 M
B-4	ARM IN	0.0 M
B-1	BOOM RAISE	0.0 M
B-7	SWING	0.0 M
G-3	ENG SPEED	1800~2000
	POWER SHIFT	0 mA

* Measure the values after a lapse of 5 minutes or after release of low temperature mode

Operation No.9 : Arm-out in full lever operation & in operation H mode Hi idle		
No.32 ARM, SWING		
C-1	P1-PRES	14.0~21.0 M
C-2	P2-PRES	14.0~21.0 M
E-1	P1-PSV	580~750 mA
E-2	P2-PSV	580~750 mA
D-1	P1-UL(BPC)	300 mA
D-2	P2-UL(BPC)	300 mA
D-3	S-TRAVEL	350 mA
D-6	ARM-IN-2	750 mA
B-3	ARM OUT	3.0 M
B-4	ARM IN	0.0 M
B-1	BOOM RAISE	0.0 M
B-7	SWING	0.0 M
G-3	ENG SPEED	1800~2000
	POWER SHIFT	0 mA

* Measure the values after a lapse of 5 minutes or after release of low temperature mode

Operation No.10 : Swing in full lever operation & relief H mode Hi idle		
No.32 ARM, SWING		
C-1	P1-PRES	0.2~2.0 M
C-2	P2-PRES	24.0~33.5 M
E-1	P1-PSV	350 mA
E-2	P2-PSV	500~750 mA
D-1	P1-UL(BPC)	300 mA
D-2	P2-UL(BPC)	300 mA
D-3	S-TRAVEL	350 mA
D-6	ARM-IN-2	750 mA
B-3	ARM OUT	0.0 M
B-4	ARM IN	0.0 M
B-1	BOOM RAISE	0.0 M
B-7	SWING	3.0 M
G-3	ENG SPEED	1800~2000
	POWER SHIFT	0 mA

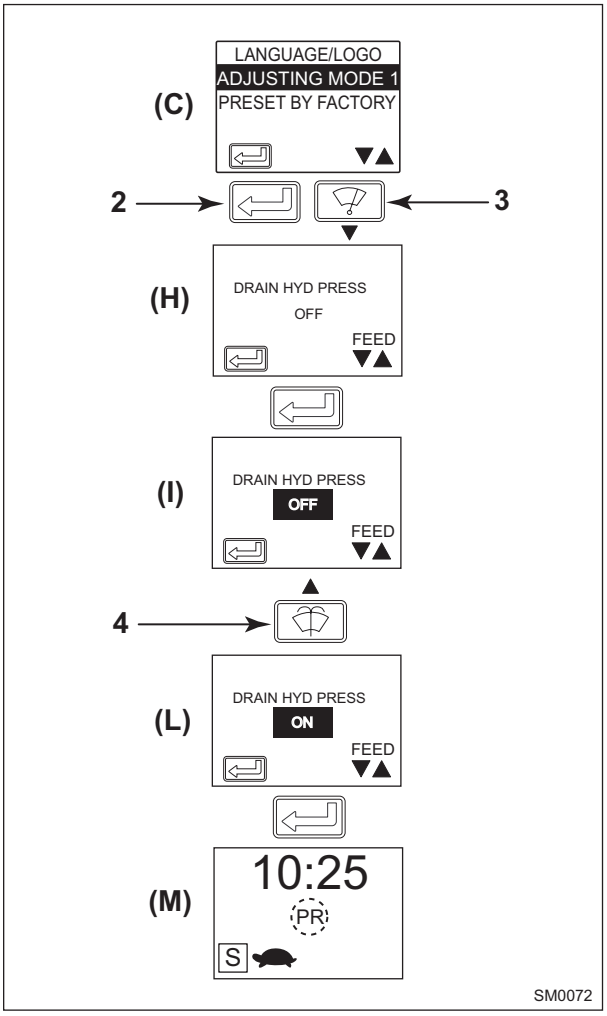
Operation No.11 : Swing in full lever operation & in operation H mode Hi idle		
No.32 ARM, SWING		
C-1	P1-PRES	0.2~2.0 M
C-2	P2-PRES	3.0~10.0 M
E-1	P1-PSV	350 mA
E-2	P2-PSV	750 mA
D-1	P1-UL(BPC)	300 mA
D-2	P2-UL(BPC)	300 mA
D-3	S-TRAVEL	350 mA
D-6	ARM-IN-2	750 mA
B-3	ARM OUT	0.0 M
B-4	ARM IN	0.0 M
B-1	BOOM RAISE	0.0 M
B-7	SWING	3.0 M
G-3	ENG SPEED	1800~2000
	POWER SHIFT	0 mA

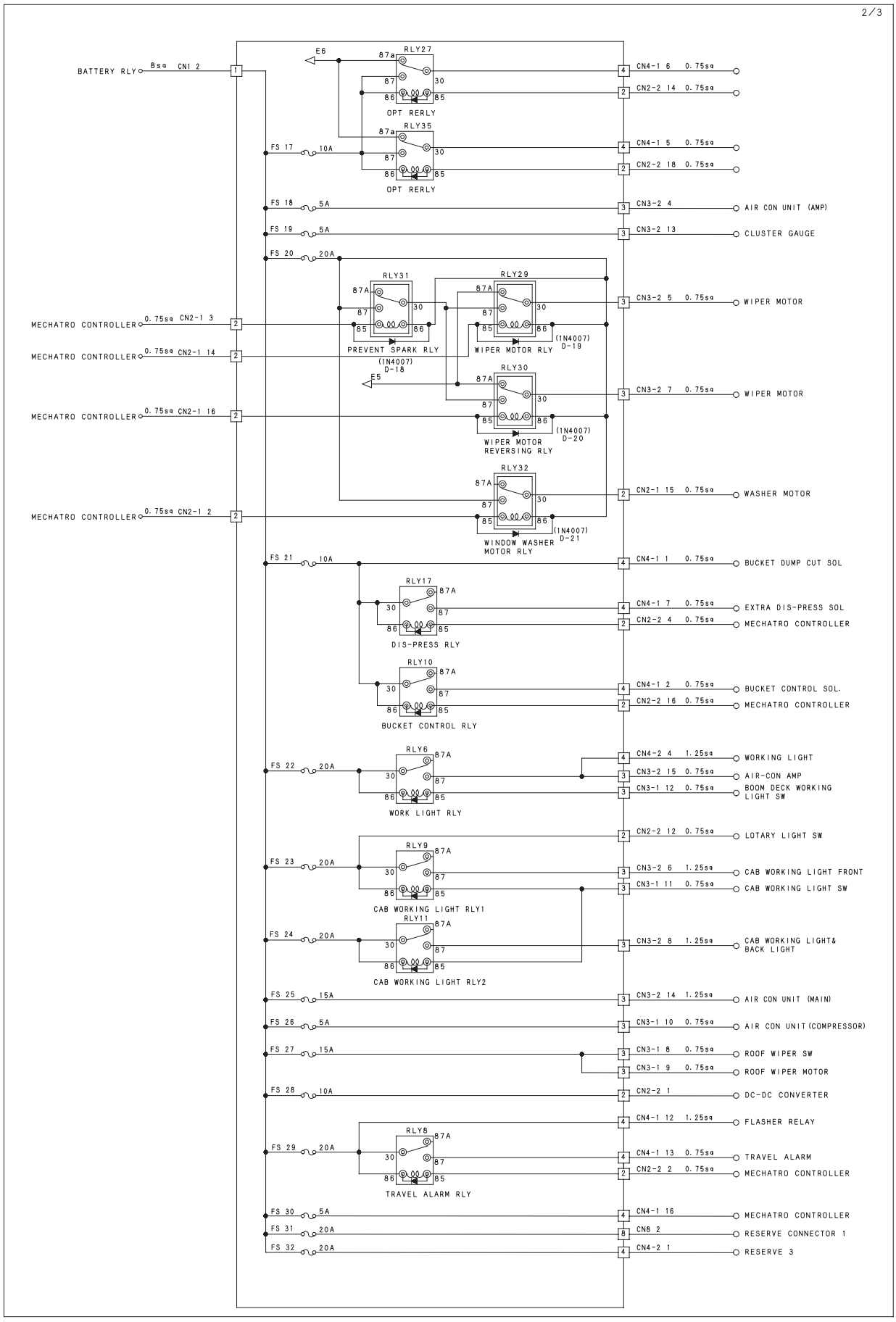
2.4 Drain Hyd. Press

To drain the hydraulic pressure from the system, proceed as follows:

1. In function **Adjusting Mode 1**, display (**C**), press SELECT button (**2**) to enter the functions and using WIPER button (**3**), select on the display function DRAIN HYD. PRESS, display (**H**).
2. Press SELECT button (**2**) to show the writing OFF, display (**I**).
3. Press WINDSHIELD WASHER button (**4**) to activate function ON, display (**L**).
4. Press SELECT button (**2**) and start the engine. The screen shows display (**M**). At this point, with the engine in operation, actuate the pilot valves performing all the movements so that the pressure is drained from all the actuators.
   The function is automatically deactivated by returning the STARTER SWITCH onto “OFF”.

NOTE: *if the monitor displays “FAIL DRAIN HYD PRES.” this means that the pressure draining operation has not been performed correctly. In this case, repeat the operation.*

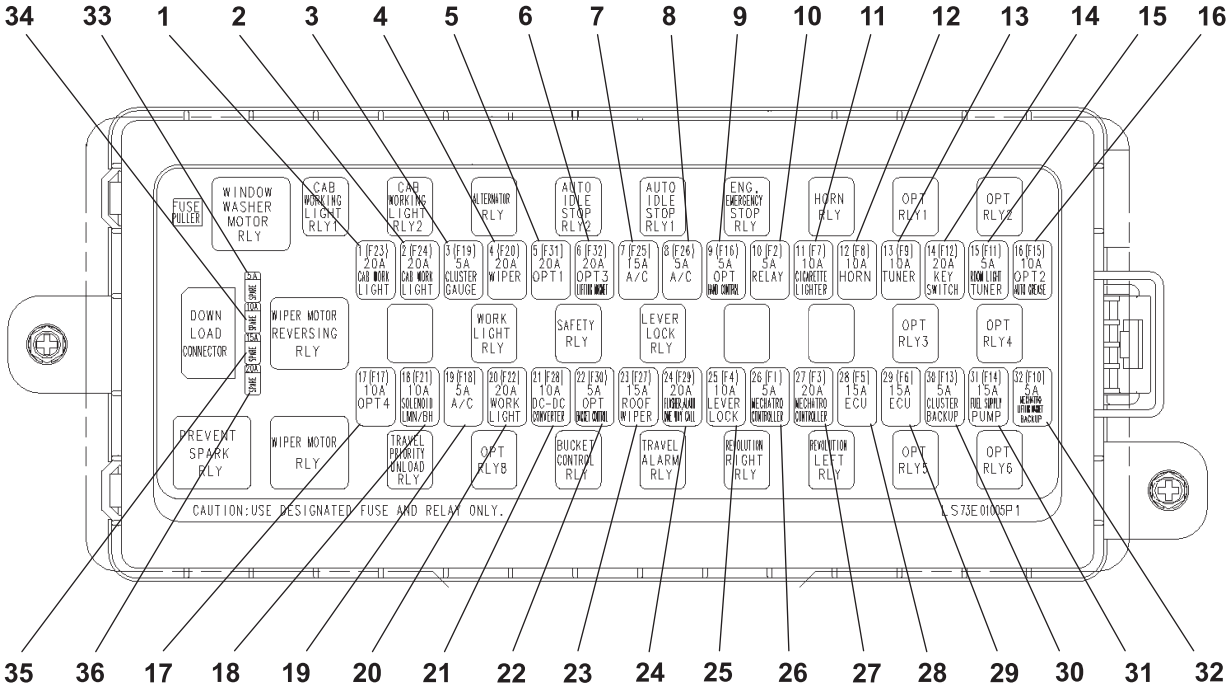



2/3
BATTERY RLY
8sq CN1 2
E6
RLY27
OPT RERLY
RLY35
OPT RERLY
FS 17 10A
FS 18 5A
FS 19 5A
FS 20 20A
RLY31
PREVENT SPARK RLY
(1N4007) D-18
RLY29
WIPER MOTOR RLY
(1N4007) D-19
E5
RLY30
WIPER MOTOR REVERSING RLY
(1N4007) D-20
RLY32
WINDOW WASHER MOTOR RLY
(1N4007) D-21
MECHATRO CONTROLLER 0.75sq CN2-1 3
MECHATRO CONTROLLER 0.75sq CN2-1 14
MECHATRO CONTROLLER 0.75sq CN2-1 16
MECHATRO CONTROLLER 0.75sq CN2-1 2
FS 21 10A
RLY17
DIS-PRESS RLY
RLY10
BUCKET CONTROL RLY
FS 22 20A
RLY6
WORK LIGHT RLY
FS 23 20A
RLY9
CAB WORKING LIGHT RLY1
FS 24 20A
RLY11
CAB WORKING LIGHT RLY2
FS 25 15A
FS 26 5A
FS 27 15A
FS 28 10A
FS 29 20A
RLY8
TRAVEL ALARM RLY
FS 30 5A
FS 31 20A
FS 32 20A
CN4-1 6 0.75sq
CN2-2 14 0.75sq
CN4-1 5 0.75sq
CN2-2 18 0.75sq
CN3-2 4 AIR CON UNIT (AMP)
CN3-2 13 CLUSTER GAUGE
CN3-2 5 0.75sq WIPER MOTOR
CN3-2 7 0.75sq WIPER MOTOR
CN2-1 15 0.75sq WASHER MOTOR
CN4-1 1 0.75sq BUCKET DUMP CUT SOL
CN4-1 7 0.75sq EXTRA DIS-PRESS SOL
CN2-2 4 0.75sq MECHATRO CONTROLLER
CN4-1 2 0.75sq BUCKET CONTROL SOL.
CN2-2 16 0.75sq MECHATRO CONTROLLER
CN4-2 4 1.25sq WORKING LIGHT
CN3-2 15 0.75sq AIR-CON AMP
CN3-1 12 0.75sq BOOM DECK WORKING LIGHT SW
CN2-2 12 0.75sq LOTARY LIGHT SW
CN3-2 6 1.25sq CAB WORKING LIGHT FRONT
CN3-1 11 0.75sq CAB WORKING LIGHT SW
CN3-2 8 1.25sq CAB WORKING LIGHT& BACK LIGHT
CN3-2 14 1.25sq AIR CON UNIT (MAIN)
CN3-1 10 0.75sq AIR CON UNIT(COMPRESSOR)
CN3-1 8 0.75sq ROOF WIPER SW
CN3-1 9 0.75sq ROOF WIPER MOTOR
CN2-2 1 DC-DC CONVERTER
CN4-1 12 1.25sq FLASHER RELAY
CN4-1 13 0.75sq TRAVEL ALARM
CN2-2 2 0.75sq MECHATRO CONTROLLER
CN4-1 16 MECHATRO CONTROLLER
CN8 2 RESERVE CONNECTOR 1
CN4-2 1 RESERVE 3

SM0168

Fuse & Relay box

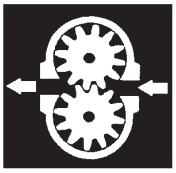
FUSES



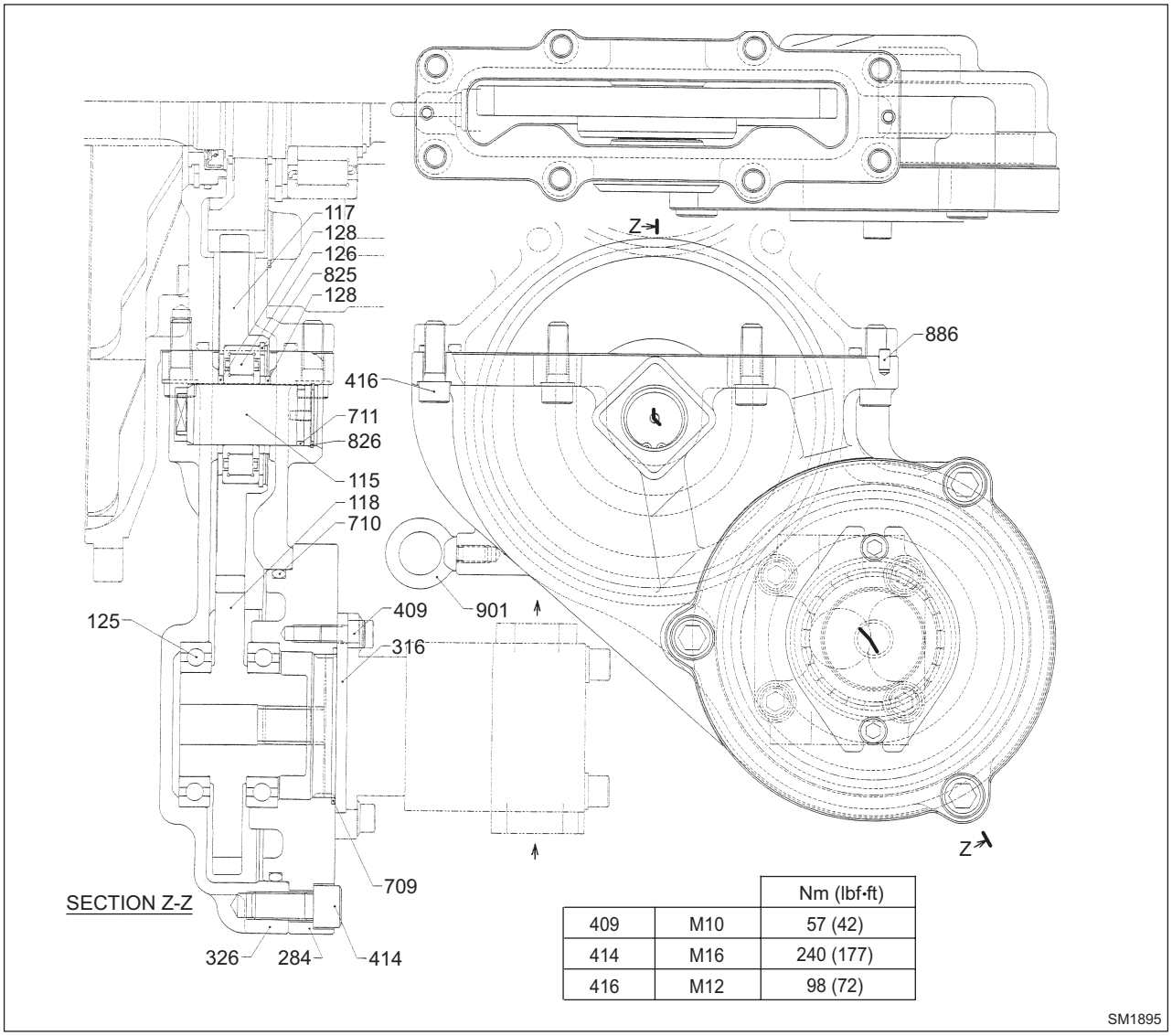
FUSES BOX		
FUSE No.	**PROTECTED CIRCUIT**	**Rating (A)**
FUSE 1	Cab Work Light	**20**
FUSE 2	Cab Work Light	**20**
FUSE 3	Monitor	**5**
FUSE 4	Wiper , Washer	**20**
FUSE 5	Option 1	**20**
FUSE 6	Option 3	**20**
FUSE 7	Air Conditioner	**15**
FUSE 8	Air Conditioner	**5**
FUSE 9	Opt. (Hand Control)	**5**
FUSE 10	Relay, Hour Meter	**5**
FUSE 11	Cigarette Lighter	**10**
FUSE 12	Horn, Horn Relay	**10**
FUSE 13	Radio	**10**
FUSE 14	Starter Key Switch	**20**
FUSE 15	Room Lamp, Tuner	**5**
FUSE 16	Opt.2 (Auto Grease)	**10**
FUSE 17	Option 4	**10**
FUSE 18	Solenoid Valve	**10**

FUSES BOX		
FUSE No.	**PROTECTED CIRCUIT**	**Rating (A)**
FUSE 19	Air Conditioner	**5**
FUSE 20	Work Light	**20**
FUSE 21	DC-DC Converter	**10**
FUSE 22	Opt. (Bucket Control)	**5**
FUSE 23	Roof Wiper	**15**
FUSE 24	Option	**20**
FUSE 25	Safety Look Lever	**10**
FUSE 26	Mechatro Controller	**5**
FUSE 27	Mechatro Controller	**20**
FUSE 28	Engine Controller (ECU)	**15**
FUSE 29	Engine Controller (ECU)	**15**
FUSE 30	Monitor (Back Up)	**5**
FUSE 31	Fuel Supply Pump	**15**
FUSE 32	Mechatro Contr. (Back Up)	**5**
FUSE 33	Spare	**5**
FUSE 34	Spare	**10**
FUSE 35	Spare	**15**
FUSE 36	Spare	**20**

SECTION AND GROUP CONTENTS



PTO GEAR CASE

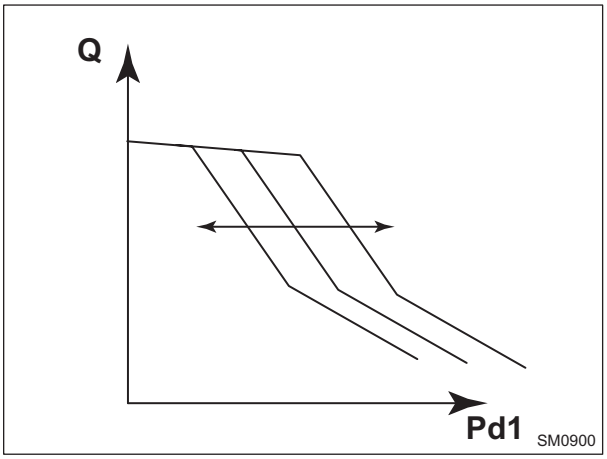


		Nm (lbf·ft)
409	M10	57 (42)
414	M16	240 (177)
416	M12	98 (72)

12 - Pin
115 - Idle shaft
117 - 2nd gear
118 - 3rd gear
125 - Ball bearing (Q.ty 2)
126 - Roller bearing
128 - Bearing spacer (Q.ty 3)
284 - Bearing case
316 - Cover
326 - Gear case
409 - Socket bolt: M10x16 (Q.ty 2)
414 - Socket bolt; M16x35 (Q.ty 3)
416 - Socket bolt: M12x35 (Q.ty 8)
709 - O-Ring
710 - O-Ring
711 - O-Ring
825 - Snap ring
826 - Snap ring
886 - Pin (Q.ty 2)
901 - Eye bolt: M10

Power shift control

The pump set power is controlled according to the movement of control by power shift pressure Pf. As power pressure Pf rises, the compensating rod (**623**) moves rightward through pin (**898**) and compensating piston (**621**). Consequently like the overloading prevention operation of power control, the pump tilt angle becomes smaller and the power setting value is reduced. Conversely, if the power shift pressure Pf is reduced, the power set value is raised.
The power shift pressure Pf of this pump is ordinary set to 0 MPa, but in emergency mode, the power shift pressure Pf is raised to 4.9 MPa.



Adjusting the regulator

The regulator may be adjusted in terms of maximum flow, minimum flow, horsepower (at emergency mode control) control characteristics, flow control characteristics using the adjust screw.

ADJUSTING THE MAXIMUM FLOW
(See HYDRAULIC PUMP-construction)

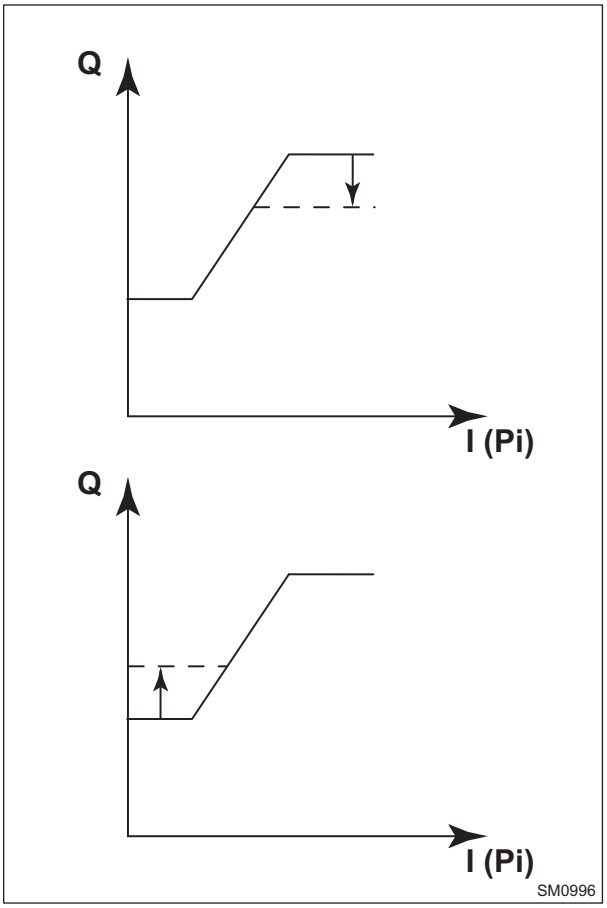
Adjust the maximum flow by loosening nut (**807**) and by tightening set screw (**954**) (or loosening it). Tightening set screw (**954**) decreases the delivery rate, as indicated.
Only the maximum flow varies, but other control characteristics remain unchanged.

Adjust screw No	954
No. of turns for tightening	1/4
Pilot pressure Pi (Input current I)	No change
Min. increase in delivery flow L/min	7.1

ADJUSTING THE MINIMUM FLOW
(See HYDRAULIC PUMP-construction)

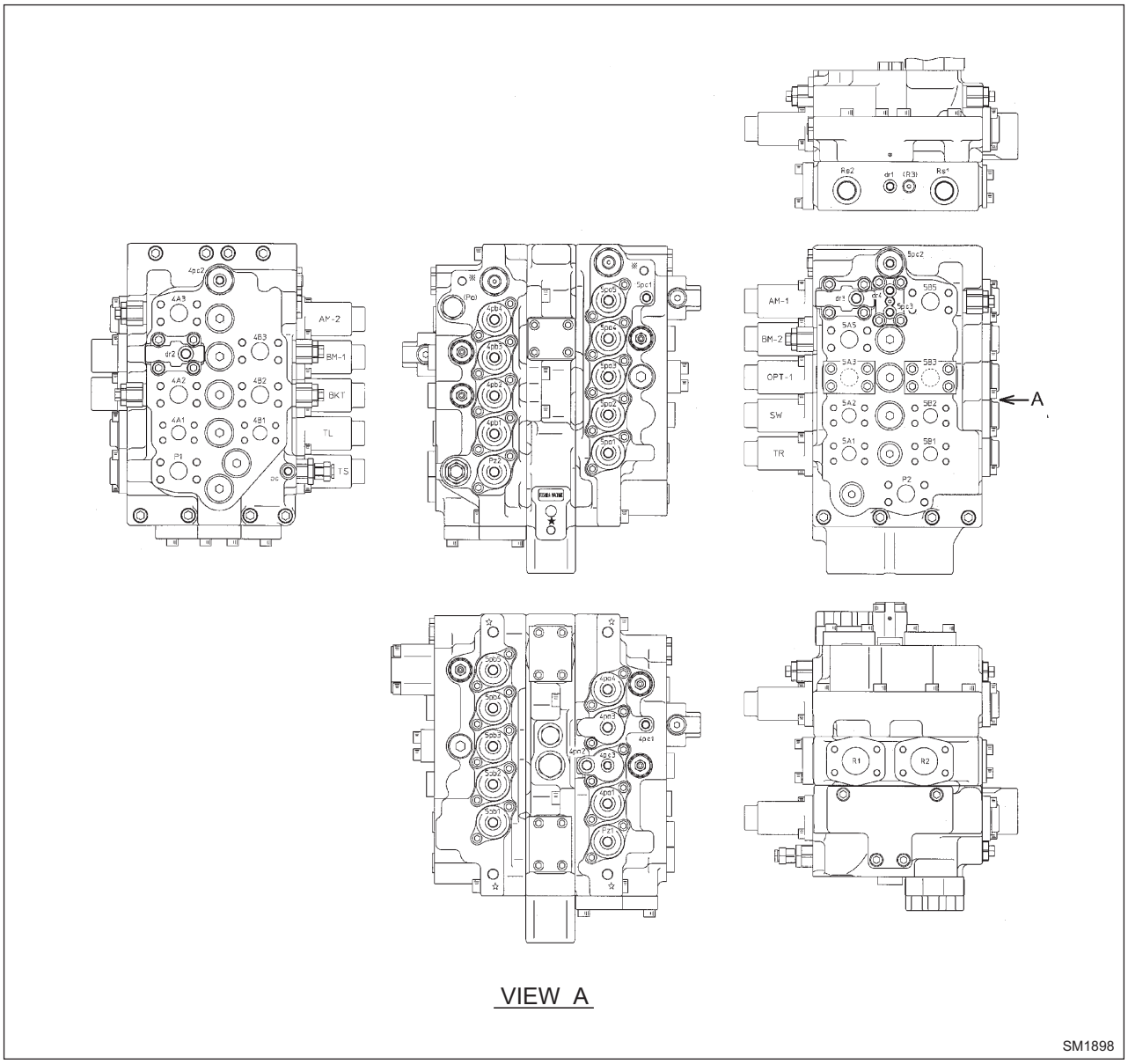
Adjust the minimum flow by loosening nut (**806**) and by tightening socket screw (**953**) (or loosening it). Tightening socket screw increases the delivery rate, as indicated.
Other control characteristics remain unchanged in the same way as maximum flow adjustment, care should be used of the fact that overtightening may increase a required power at the maximum delivery pressure (at relieving action).

Adjust screw No	953
No. of turns for tightening	1/4
Pilot pressure Pi (Input current I)	No change
Min. increase in delivery flow L/min	7.1



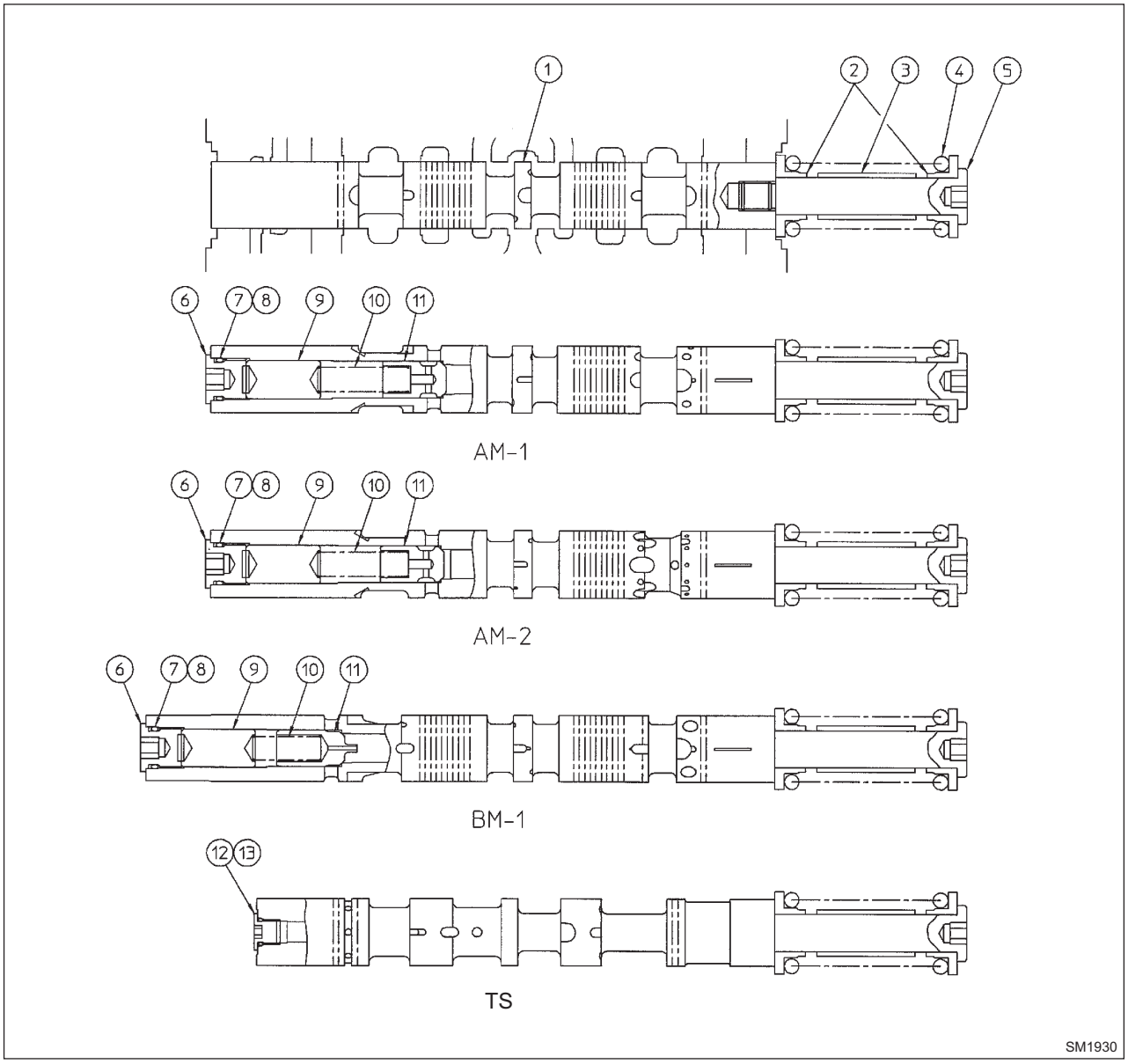
CONTROL VALVE

OUTSIDE VIEW



	Abbreviation table		
ARM-1	AM-1	AM-2	ARM-2
BOOM-2	BM-2	BM-1	BOOM-1
OPTION 1	OPT-1	BKT	BUCKET
SWING	SW	TL	TRAVEL LEFT
TRAVEL RIGHT	TR	TS	TRAVEL STRAIGHT

Main plunger

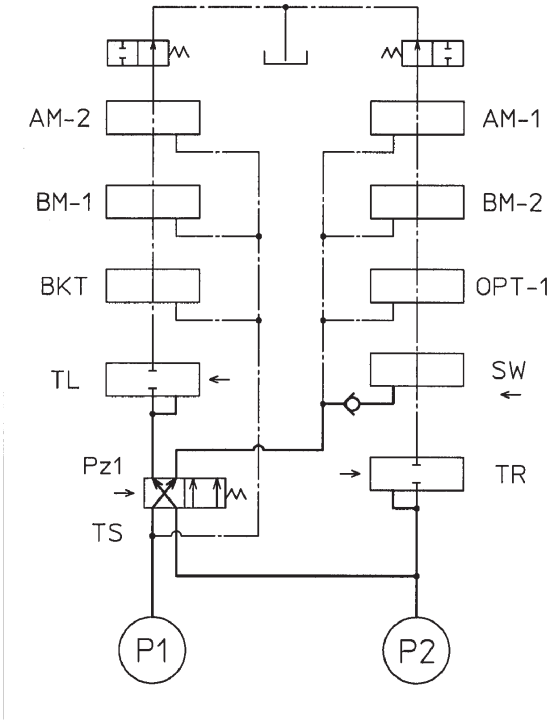


1 - Plunger
2 - Spring guide (Q.ty 2)
3 - Sleeve
4 - Spring
5 - Plunger cap
6 - Cap
7 - Back-up ring
8 - O-Ring
9 - Spacer
10 - Spring
11 - Check valve
12 - Cap
13 - O-Ring

TRAVEL STRAIGHT CIRCUIT

“**TR**" and "**TL**" plungers operated. The other section is switched simultaneously (e.g. "**SW**").
As the pilot port "**5pb2**" is pressurized "**SW**" plunger is switched. At the same time, the pilot port "**Pz1**" is pressurized and the straigh travel plunger is switched make the connection between the high pressure passage of "**TR**" and "**TL**".

Oil discharged from the pump "**P2**" flows into the control valve's inlet port "**P2**" and flows to the "**TR**" section, and "**TL**" section through the straight travel plunger.
On the other hand, oil discharged from the pump "**P1**" flows into the control valve's inlet port "**P1**" and flows to "**SW**" section. Other in the case of actuator "**SW**" it is the same.



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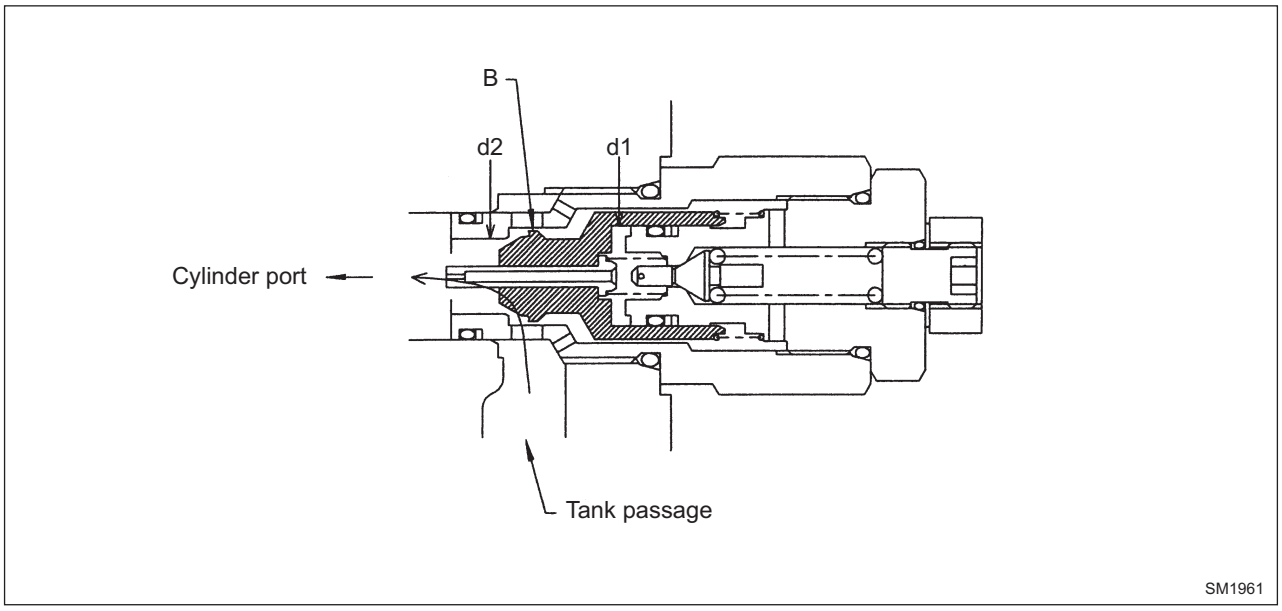
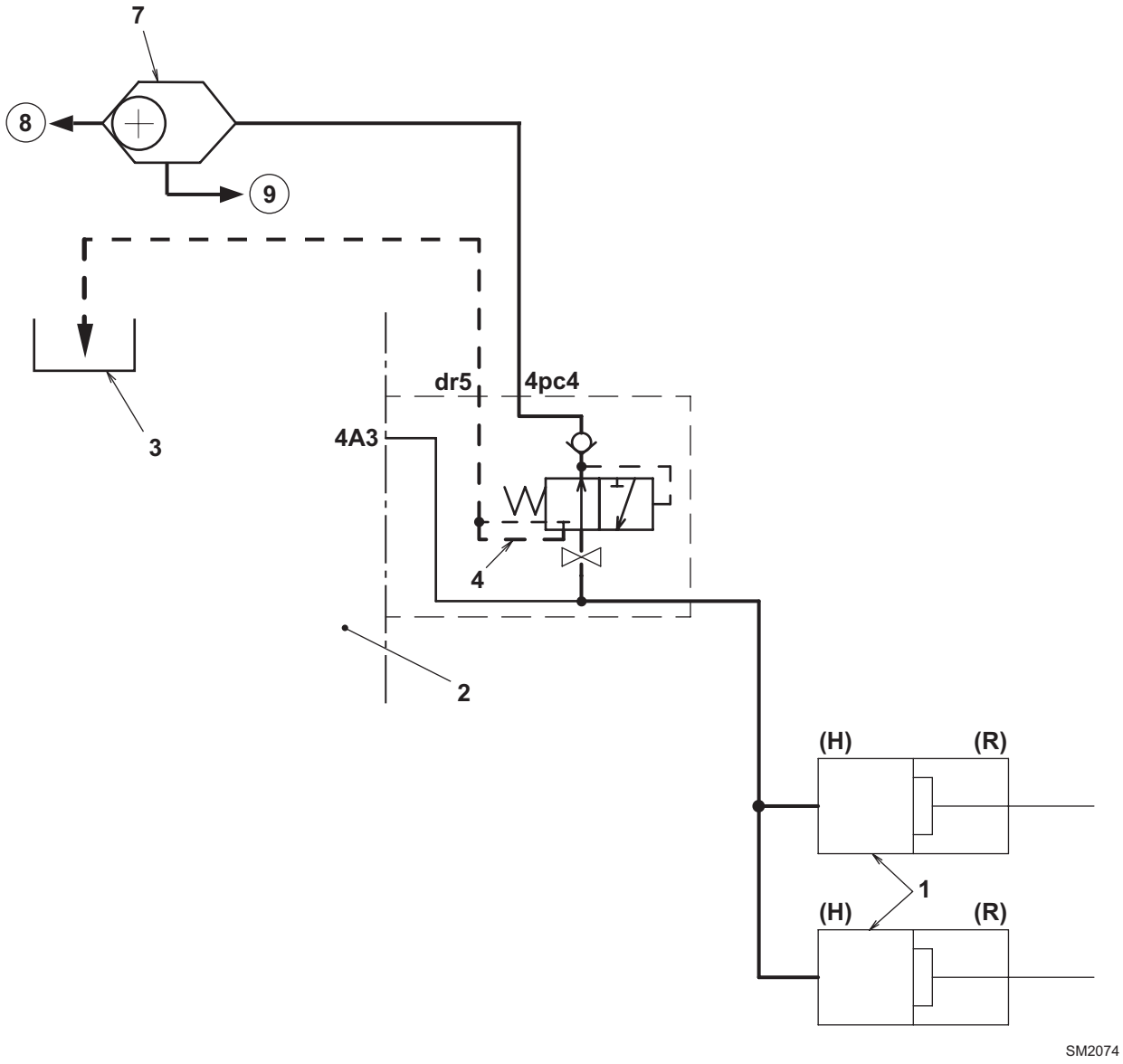


2. Make-up Function

2.1. As the cylinder port pressure is normally higher than the tank passage pressure and **d1** > **d2**, the main poppet "**B**" is securely seated.

2.2. When the cylinder part pressure comes to lower than the tank passage pressure(closer to negative pressure), the main poppet "**B**" opens receiving the tank passage pressure for the difference in area between "**d1**" and "**d2**". Oil florws from the tank passage flows to the cylinder port in order to prevent cavitation.

Emergency manual valve for lowering attachment operation

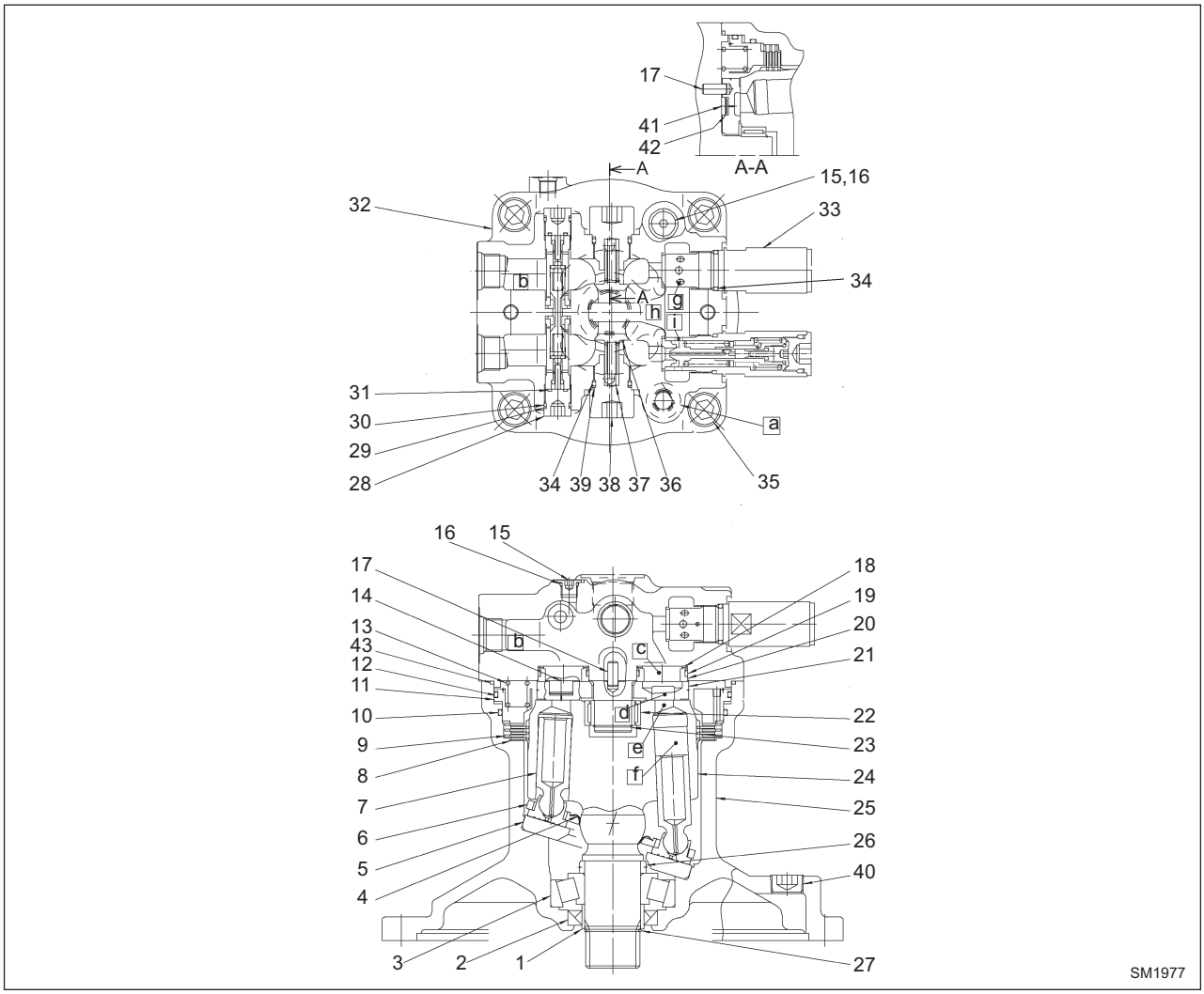


1- Boom cylinder head side
2- Control valve
3- Hydraulic oil tank
4- Drain passage
7- Shuttle valve
8- To lever lock solenoid valve
9- To control pilot valve

OPERATION

Swing motor

The pressure oil fed by the pump via the control valve, etc. enters the motor through port A (or port B) installed on cover (**32**), and is discharged from port B (or port A).
Also the oil leaking through the sliding section or clearance returns to the tank through drain port Dr installed on cover (**32**).
The pressure oil fed to port A goes through passage (**b**) inside of cover (**32**) and to the passage on bushing (**20**) section installed cover, then is fed to piston bore (**f**) on the cylinder through balance plate (**21**) passage (**b**) which contains crescent shaped port switching supply and discharge by 180 degree of core rotation of motor, and cylinder (**24**) passage (**e**).
The pressure oil exerts on piston assy (**7**), then the piston assy is pushed against cam plate (**5**) through a part of the shoe. Since the shoe sliding surface of cam plate (**5**) is inclined at a uniform angle, the pushing force of piston assy (**7**) on which pressure oil is exerted is converted into sliding power for the shoe on the swash plate.
In addition, the shoe bulb is similarly joined to universal joint. As a result, the shoe sliding power on the swash plate is converted into rotating power through piston assy (**7**) and cylinder assy (**24**) and transmitted to the motor output shaft section.
In this way, every piston assy (**7**) receives the pressure oil within the stroke from top dead point to bottom dead point on a grade, the oil pressure is converted to rotating power to rotate cylinder assy (**24**), resulting in discharging oil in the stroke from bottom dead end and top dead point.
The discharge line function in reverse of the supply line, and the oil is discharged from port B.
As described above, the hydraulic motor is operated, and the output torque of hydraulic motor is determined by oil pressure, and speed of revolution by supply flow rate.



1 - Motor housing
2 - O-Ring
3 - Drain plug
4 - O-Ring (Q.ty 4)
5 - Motor seal ring
6 - Bearing
7 - Motor shaft assy
8 - O-Ring (Q.ty 4)
9 - O-Ring
10 - Drain plug
11 - Piston spring (Q.ty 2)
12 - Piston (Q.ty 2)
13 - Ball
14 - Swash plate
15 - Piston (Q.ty 9)
16 - Retainer plate
17 - Spherical bush
18 - Spring (Q.ty 9)
19 - Cylinder block
20 - Valve plate
21 - Bush
22 - Bearing
23 - Steel disc (Q.ty 2)
24 - Steel disc
25 - Brake disc (Q.ty 4)
26 - Steel disc (Q.ty 3)
27 - Steel disc (Q.ty 2)
28 - Back-up ring
29 - O-Ring
30 - O-Ring
31 - Back-up ring
32 - Brake piston
33 - O-Ring
34 - Plug
35 - O-Ring
36 - Screw
37 - Screw
38 - Plug
39 - O-Ring
40 - Spring seat
41 - Spring (Q.ty 2)
42 - Spring seat
43 - Plug (Q.ty 2)
44 - O-Ring (Q.ty 2)
45 - Spring
46 - Check valve
47 - Orifice (Q.ty 2)
48 - O-Ring (Q.ty 2)
49 - Check valve (Q.ty 2)
50 - Spring (Q.ty 2)
51 - O-Ring (Q.ty 2)
52 - Plug (Q.ty 2)
53 - Relief valve assy
54 - Plug
55 - O-Ring (Q.ty 2)
56 - Spring seat
57 - Spring seat
58 - Spring
59 - Orifice (Q.ty 2)
60 - Plug (Q.ty 6)
61 - O-Ring (Q.ty 6)
62 - Plug
63 - Spool 2nd Speed
64 - Spool 2nd Speed
65 - Back-up ring
66 - O-Ring
67 - O-Ring
68 - Back-up ring
69 - Filter
70 - Circlip
71 - Spring seat
72 - O-Ring (Q.ty 2)
73 - Plug
74 - Base plate
75 - Screw (Q.ty 9)
76 - Poppet seat
77 - Back-up ring
78 - O-Ring
79 - O-Ring
80 - Poppet
81 - Relief valve assy
82 - Free piston
83 - Back-up ring (Q.ty 4)
84 - O-Ring
85 - Back-up ring
86 - Spring seat
87 - Spring
88 - Spring seat
89 - Back-up ring
90 - Back-up ring
91 - O-Ring
92 - Plug valve
93 - Nut
94 - Screw
95 - Check valve (Q.ty 2)
96 - Spring (Q.ty 2)
97 - O-Ring (Q.ty 2)
98 - Plug (Q.ty 2)
99 - -
100 - Screw
101 - O-Ring (Q.ty 2)
102 - Plug
103 - Screw (Q.ty 4)
104 - Plug
105 - O-Ring (Q.ty 2)
106 - Spring seat (Q.ty 2)
107 - Spring (Q.ty 2)
108 - Spring seat (Q.ty 2)
109 - Plug (Q.ty 2)
110 - O-Ring (Q.ty 2)
111 - Spring
112 - Check valve
113 - Plunger
114 - Orifice (Q.ty 2)
115 - O-Ring (Q.ty 2)
116 - Plug (Q.ty 6)
117 - O-Ring (Q.ty 6)
118 - Orifice
119 - Spring (Q.ty 10)
120 - Pin (Q.ty 2)

MOTOR DRAIN PRESSURE

Continuous running	Less than 2 bar
Max. intermittent	Less than 5 bar

Brake

The track drive is supplied with a safety negative disc brake fitted into the hydraulic motor (parking brake).
Parking brake release is automatically operated when high pressure oil is supplied to one of the two ports of the hydraulic motor. For this reason, there is no need of brake external pilot.
The brake technical data are shown on the track drive installation drwing.

BRAKE TECHNICAL DATA

Min. pressure for release parking brake	MPa	1.8
Static parking brake torque	Nm	1120

Hydraulic cylinder construction (for boom, arm and bucket cylinders)

By construction the hydraulic cylinder consists mainly of cylinder tube assy (**2**), piston rod assy (**1**) that takes out the motion of pistons reciprocating in the cylinder tube assy, and cylinder head (**4**) that serves as both a lid and a guide. Cylinder tube assy (**2**) is equipped with a pin mount that connects piston rod assy (**1**) with other parts.
In addition to these main components, seal ring (**9a**) and back-up ring (**9b**) are located between cylinder tube assy (**2**) and piston rod assy (**1**); seals rod (**3**) are located between piston rod assy (**1**) and cylinder head (**4**); and an O-Ring and a back-up ring (**5**) are placed between cylinder tube assy (**2**) and cylinder head (**4**).

OPERATION

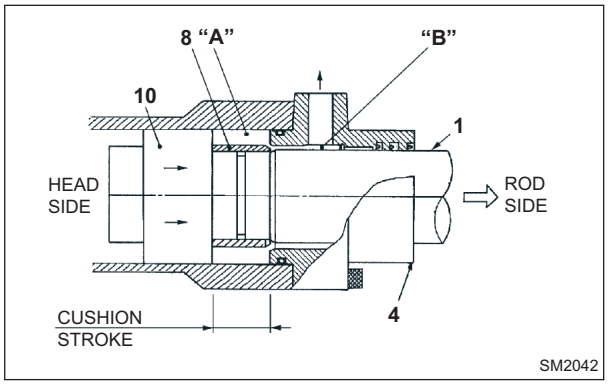
If pressurized oil is fed alternatively to the oil inlet and outlet provided in the cylinder, force acts on the piston which in turn causes the piston rod (**1**) to extend and retract.

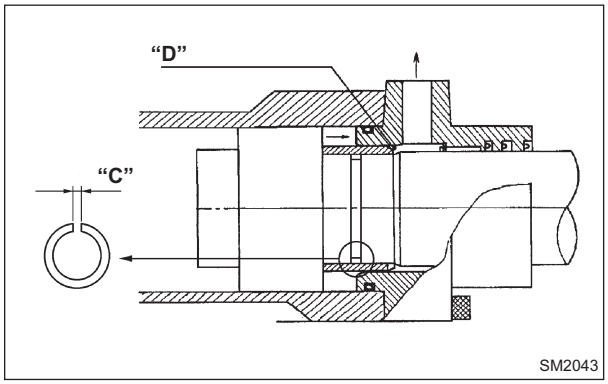
Operation of cylinder with cushion

CUSHION ON ROD SIDE

The cushion mechanism is provided to prevent the generation of shock when the moving speed of piston (**10**) is not reduced and strikes cylinder head (**4**).
An oil in chamber "A" returns to the tank by passing through paths "B" at a fixed flow rate in a intermediate stroke state of pressing bottom side.

Next, in a state of just before stroke end, cushion ring (**8**) plunges into path "B".
At this time, an oil in chamber "A" passes clearance "D" and mouth gap "C", an oil flow volume returning to tank suddenly drops and the piston part movement slows down.



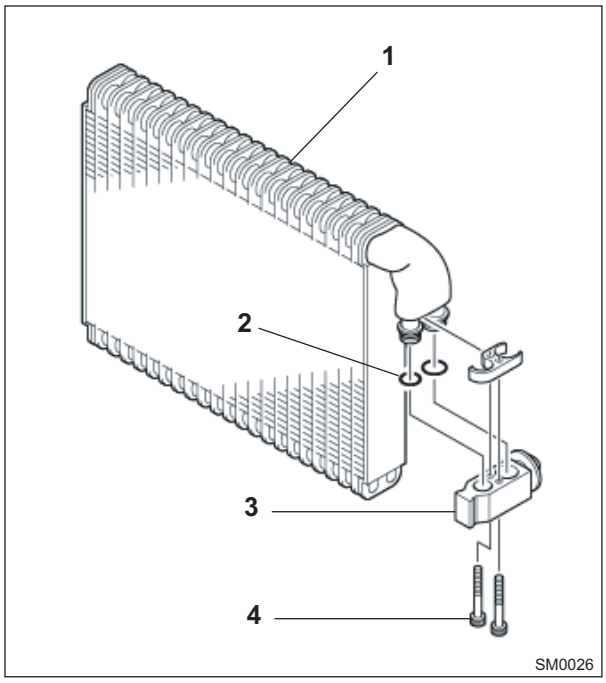


Consequently, the cooling circuit is so constructed that the evaporator can cool down an object (air in this case) sufficiently (i.e. so as to decrease the pressure in the evaporator) and that an adequate amount of refrigerant can be fed to the evaporator.
The feed rate of the refrigerant is controlled 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.

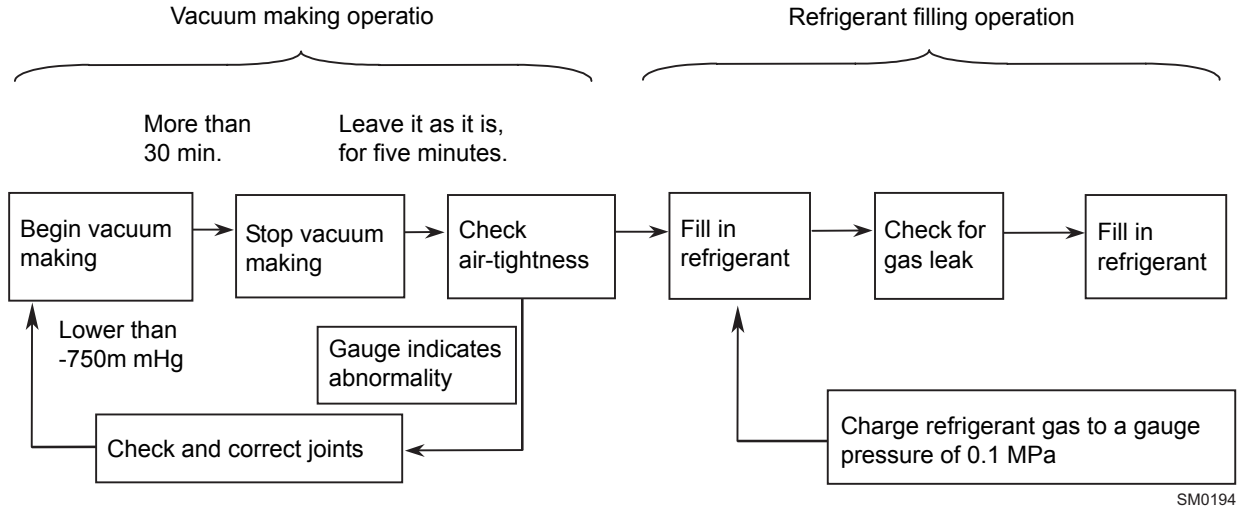
OPERATING PROCEDURE

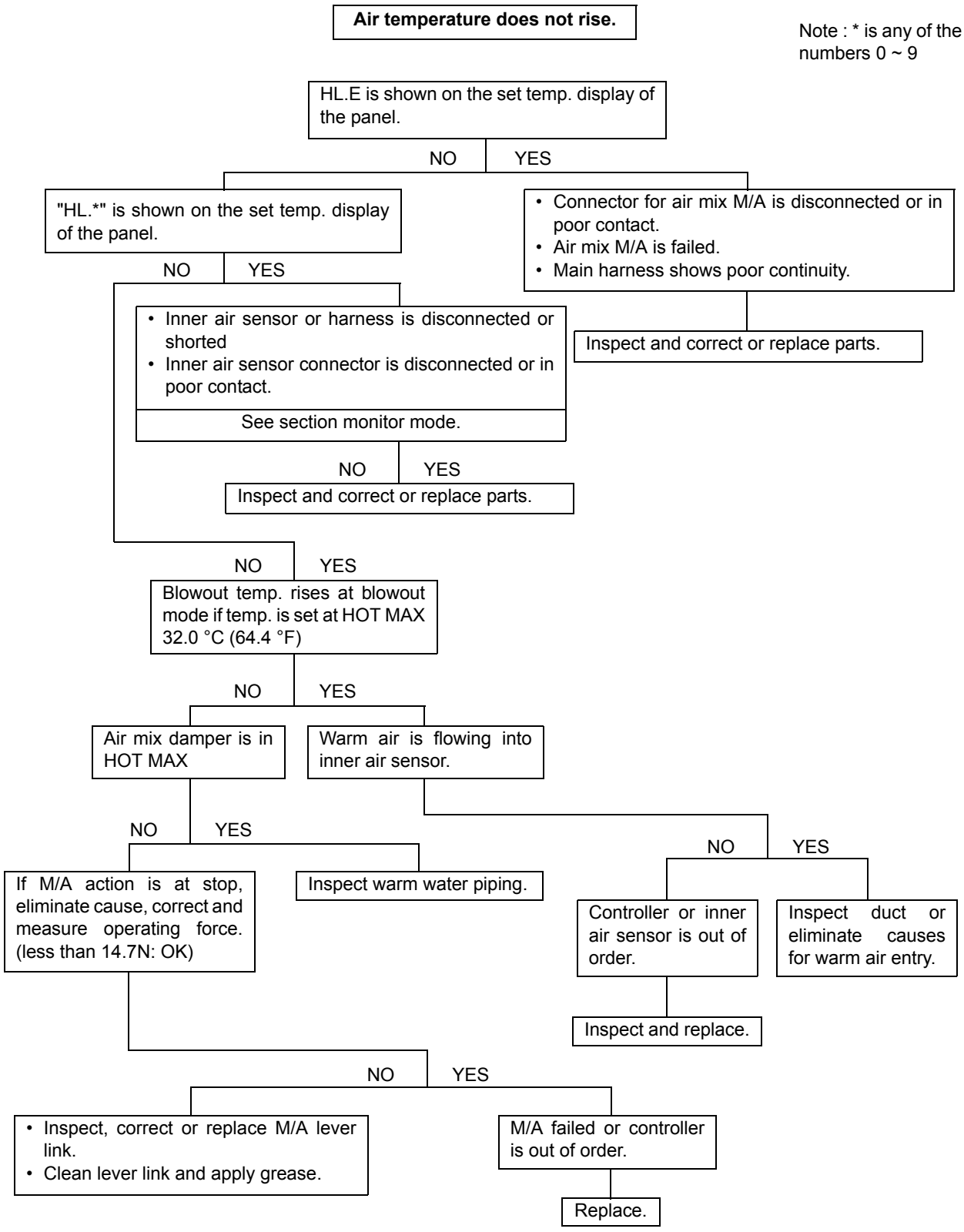
The change of refrigerant in the air conditioner requires a "vacuum generation procedure" and a "gas charging procedure".

- 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.

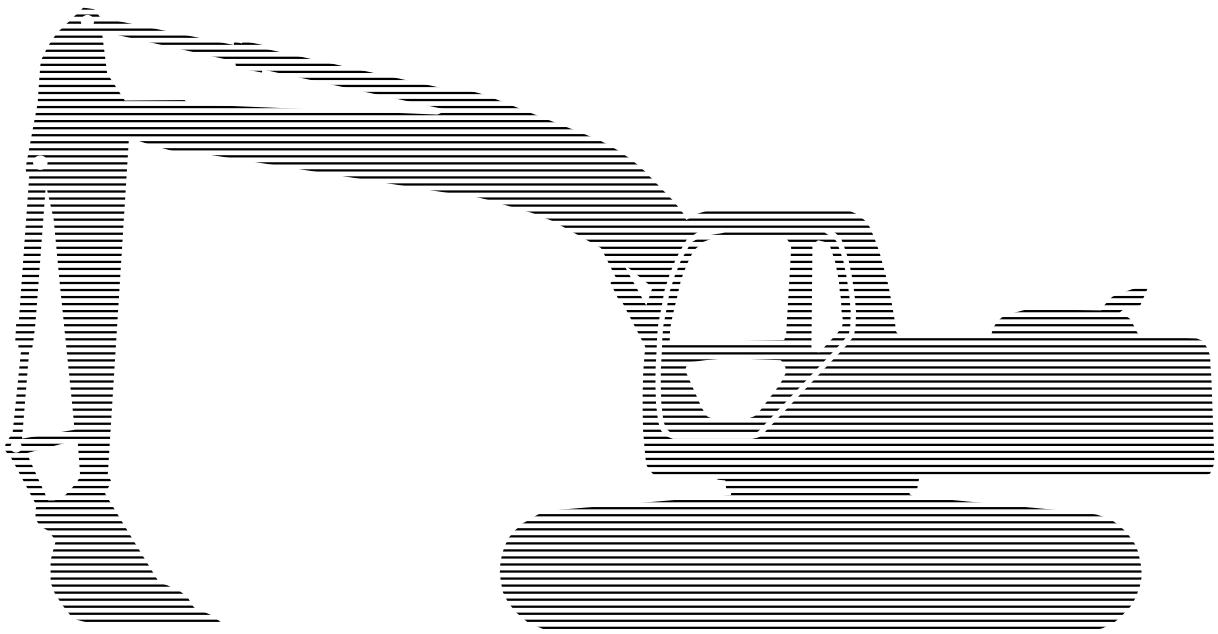
WARNING

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.




Air temperature does not rise.
Note : * is any of the numbers 0 ~ 9
HL.E is shown on the set temp. display of the panel.
NO
YES
"HL.*" is shown on the set temp. display of the panel.
• Connector for air mix M/A is disconnected or in poor contact.
• Air mix M/A is failed.
• Main harness shows poor continuity.
NO
YES
Inspect and correct or replace parts.
• Inner air sensor or harness is disconnected or shorted
• Inner air sensor connector is disconnected or in poor contact.
See section monitor mode.
NO
YES
Inspect and correct or replace parts.
NO
YES
Blowout temp. rises at blowout mode if temp. is set at HOT MAX 32.0 °C (64.4 °F)
NO
YES
Air mix damper is in HOT MAX
Warm air is flowing into inner air sensor.
NO
YES
If M/A action is at stop, eliminate cause, correct and measure operating force. (less than 14.7N: OK)
Inspect warm water piping.
NO
YES
Controller or inner air sensor is out of order.
Inspect duct or eliminate causes for warm air entry.
Inspect and replace.
NO
YES
• Inspect, correct or replace M/A lever link.
• Clean lever link and apply grease.
M/A failed or controller is out of order.
Replace.

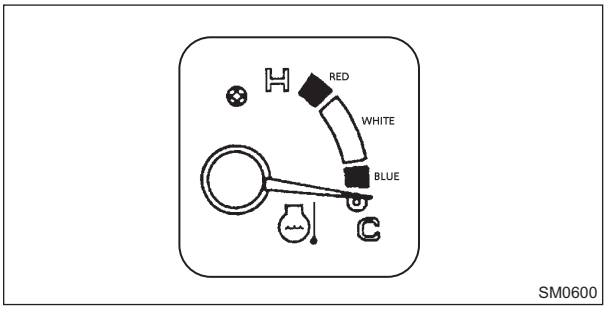
OPERATIONAL PERFORMANCE TEST



MEASUREMENT OF ENGINE SPEED

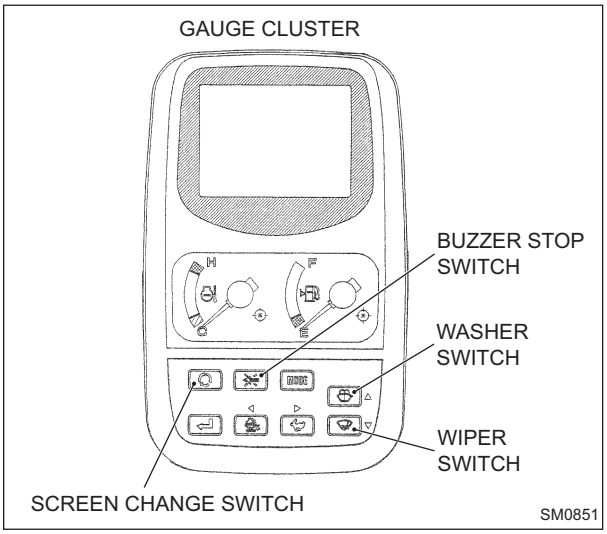
Warming up of engine

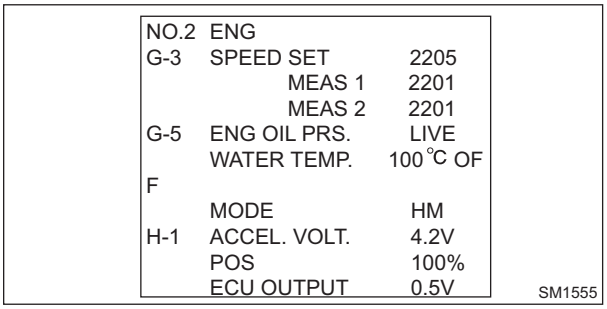
Start engine to raise the coolant temperature of engine to 60 to 90°C (140 to 194°F) at surface of radiator upper tank.
The E/G coolant temperature gauge is used to measure.
The range in white color shows the temperature of approx. 65 to 105°C (149 to 221°F), so confirm that the pointer indicates the temperature within the white range.



Engine speed measured value through service diagnosis

1. Turn "ON" the starter switch with the buzzer stop switch pressed.
2. A program No. and an actual engine revolution are displayed as the No.2 Item.
3. The screen advances like No.2, No.3....each time the "Wiper switch" on the gauge cluster is pushed.
4. The screen returns like No.45, No.44....each time the "Washer switch" is pushed.
5. The display does not disappear unless the starter switch is turned to"OFF".





MEASURING SWING PERFORMANCES

Swing speed

PURPOSE

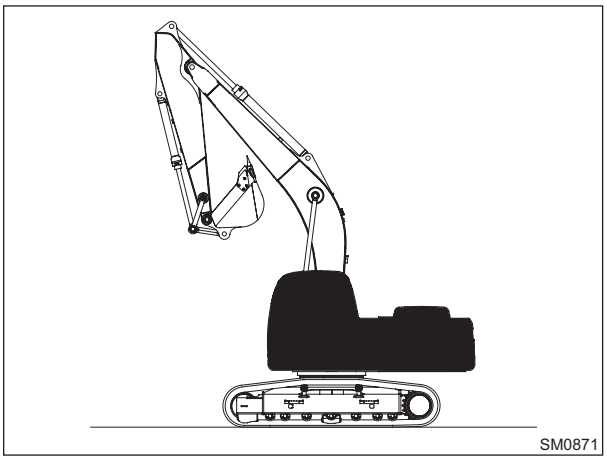
Measure the swing time and confirm the performances between the hydraulic pump and the swing motor of the swing drive system.

CONDITIONS

Hydraulic oil temperature: 45~55°C (113~131°F)
Firm, level ground
Engine revolution: Hi idle

PREPARATION

Put the bucket empty and extend the boom, arm and bucket cylinder fully.
And the machine becomes a position of minimum reach.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MEASUREMENT

Swing the machine by bringing the swing level to its full stroke. After a preliminary run of one turn, measure the time required to make three complete turns.

Swing speed Unit : s/3 rev

Measuring position	Standard value	Reference value for remedy	Service limit
Swing speed at min. reach	23~25	29.5~32.0	36.1~

ADJUSTMENT OF MECHATRO CONTROLLER OUTPUT (A-B ADJUSTMENT)

Purpose of the adjustment

There are 2 kinds of adjustment of mechatro controller as shown below; every adjustment is an essential function to ensure performance of machine.

1. Adjustment of engine (“A” adjustment)
   This adjustment is performed to set the relation between the acceleration command voltage output from mechatro controller to engine controller and the engine speed.
2. Adjustment of pump ("B" adjustment)
   This adjustment is performed to correct the output variation by coordinating the output hydraulic pressure with engine rated output.

In cases where the adjustment of mechatro controller is required

When the following parts are replaced or repaired, carry out the adjustment without fail:

1. Mechatro controller
2. Engine or engine controller
3. Hydraulic pump or hydraulic pump proportional valve
4. Bypass cut proportional valve, spool of bypass cut valve.

Preparation

1. Raise the oil temperature to about 50°C (122°F) to warm up the engine.
2. Turn the air-con OFF.
3. Turn the starter key switch OFF to stop the engine.
   When the mechatro controller was replaced, the following error code is displayed because the adjustment data is not entered.
   A215, A225, A015, A025

As the error codes other than those shown above may suggest failures of machine, repair the machine into the ordinary operating condition according to Error Code List.

TROUBLESHOOTING

CONTENTS

Table 8

Error code	**B012**		
Trouble	Boom up pressure sensor outputs error.		
Judging condition	After starter switch ON and engine does not start yet. And the input voltage from the sensor after starter switch ON is in the range of 1.4 V or more to less than 4.7 V.		
Symptom	The boom up operability becomes poor.		
Control in the event of failure	Normal control.		
Returned in normal condition	Not returned automatically under normal condition. Switch the power OFF once and turns on it again.		
Service diagnosis checking screen	Screen No.	5	B-1 BOOM RAISE
	Screen No.		
	Screen No.		
Checking object			Checking contents and remedy
1	• Boom up pressure sensor SE-3		When B012 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between boom up pressure sensor and controller CN-126F CN-101F		When B012 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 9

Error code	**B013**		
Trouble	Boom up pressure sensor's wiring disconnects.		
Judging condition	The input voltage from boom up pressure sensor is less than 0.1 V.		
Symptom	The boom up speed slows down.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode) 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.	5	B-1 BOOM RAISE
	Screen No.		
	Screen No.		
Checking object			Checking contents and remedy
1	• Boom up pressure sensor SE-3		When B013 is cancelled and other error occurs after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between boom up pressure sensor and controller CN-126F CN-101F		When B013 is displayed after the connector is exchanged with other sensor. 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 26

Error code		**B072**		
Trouble		Swing pressure sensor outputs error.		
Judging condition		After starter switch ON and engine does not start yet. And the input voltage from the swing pressure sensor after starter switch ON is in the range of 1.4 V or more to less than 4.7 V.		
Symptom		The swing operability becomes poor.		
Control in the event of failure		Normal control.		
Returned in normal condition		Not returned automatically under normal condition. Switch the power OFF once and turns on it again.		
Service diagnosis checking screen		Screen No.	6	B-7 SWING
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Swing pressure sensor SE-5			When B072 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between swing pressure sensor and controller CN-169F CN-103F			When B072 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 27

Error code		**B073**		
Trouble		Swing pressure sensor's wiring is disconnected.		
Judging condition		The input voltage from swing pressure sensor is 0.1 V or less.		
Symptom		The swing operability becomes poor.		
Control in the event of failure		Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode) Set output of P2 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.	6	B-7 SWING
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Swing pressure sensor SE-5			When B073 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between swing pressure sensor and controller CN-169F CN-103F			When B073 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 41

Error code	**B173**		
Trouble	P2 side option pressure sensor's wiring is disconnected.		
Judging condition	The input voltage from P2 side option pressure sensor is 0.1 V or less.		
Symptom	The selection of conflux does not work.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode) Set output of P2 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.	6	B-17 P2 OPT.
	Screen No.		
	Screen No.		

	Checking object	Checking contents and remedy
1	• P2 side option pressure sensor SE-11	When B173 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between P2 side option pressure sensor and controller CN-303F CN-102F	When B173 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 42

Error code	**B174**		
Trouble	P2 side option pressure sensor's wiring is disconnected.		
Judging condition	The input voltage from P2 side option pressure sensor is 4.7 V or more.		
Symptom	The selection of conflux does not work.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to 0 mA. (Hydraulic pump emergency mode) Set output of P2 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.	6	B-17 P2 OPT.
	Screen No.		
	Screen No.		

	Checking object	Checking contents and remedy
1	• P2 side option pressure sensor SE-11	When B174 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between P2 side option pressure sensor and controller CN-303F CN-102F	When B174 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 59

Error code	**D062**		
Trouble	Arm-in spool 2 proportional valve and output transistor ON are failure.		
Judging condition	The feed-back value from proportional valve is 1000 mA or more		
Symptom	Operability of combined operation with arm-in becomes poor.		
Control in the event of failure	Set Arm-in spool 2 proportional valve output to 0 mA.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	8	D-4 ARM IN-2-SPEED
	Screen No.		
	Screen No.		

Checking object		Checking contents and remedy
1	• Arm-in spool 2 proportional valve PSV-A	When D062 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between Arm-in spool 2 proportional valve and controller CN-121F CN-105F	When D062 is displayed after turning the starter switch on after the connector is exchanged with other sensor. 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 75

Error code		**G042**		
Trouble		Mechatro controller direct input speed sensor and received data from engine controller are overrun.		
Judging condition		Engine rpm input is 3000 rpm or more. (Only trouble history).		
Symptom		Operate without problem.		
Control in the event of failure		Normal control		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	2	G-3 MEAS 1 (for mechatro controller)
		Screen No.	2	G-3 MEAS 2 (receive from engine controller)
		Screen No.		
Checking object				Checking contents and remedy
1	• Engine speed sensor SE-13			Measure the resistance between terminals of speed sensor. Normal value: 1.6~2.0k Ω .
2	• Wiring between engine speed sensor and controller CN-136F CN-106F			Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. Especially check wiring for false disconnection and noise included.
3	• Wiring between ECU engine speed sensor and controller pressure sensor and controller			Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. Especially check wiring for false disconnection and noise included.
4	• Mechatro controller			Check that the error is corrected after replacement of controller. (Controller is broken by only applying power to grounding of signal).
5	• Engine controller			Check that the error is corrected after replacement of controller.

Table 76

Error code		**G043**		
Trouble		Mechatro controller direct input speed sensor and received data from engine controller are disconnected.		
Judging condition		Voltage of alternator is 24V or more, and speed sensor and receipt data from engine controller indicate excess low engine rpm.		
Symptom		Engine speed down may cause extension by abrupt loading.		
Control in the event of failure		Enter 0 rpm for engine speed. Enter 0 for ESS power shift command		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	2	G-3 MEAS 1 (for mechatro controller)
		Screen No.	2	G-3 MEAS 2 (receive from engine controller)
		Screen No.		
Checking object				Checking contents and remedy
1	• Engine speed sensor SE-13			Measure the resistance between terminals of speed sensor. Normal value: 1.6~2.0k Ω .
2	• Wiring between engine speed sensor and controller CN-136F CN-106F			Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.
3	• Wiring between ECU engine speed sensor and controller pressure sensor and controller			Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.
4	• Mechatro controller			Check that the error is corrected after replacement of controller. (Controller is broken by only applying power to grounding of signal).
5	• Engine controller			Check that the error is corrected after replacement of controller.

Table 91

Error code	**R034**		
Trouble	Wiper motor reverse rotation relay error.		
Judging condition	The mechatro controller output line to wiper motor reverse rotation relay is short-circuited with the power source.		
Symptom	Wiper does not move after forward rotation.		
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.	25	CCW MOTOR RLY
	Screen No.		
	Screen No.		

Checking object		Checking contents and remedy
1	• Wiper motor reverse rotation relay R-30	When error is cancelled after removing wiper motor reverse rotation relay, check relay unit for failure, replace it with new one if failed. When resistance between relays (1) and (2) is 0 Ω , it is in abnormal condition. 
2	• Wiring between wiper motor forward rotation relay and controller CN-109F, CN2-1 • Fuse& relay box E-1	When R034 is left displayed with the relay removed Check that no power 24 V is produced on relay (-) line according to the wiring checking procedure and replace it if necessary. When no failure found after checking on wiring and R034 is left displayed Replace fuse/relay box.
3	• Mechatro controller	Check that the error is corrected after replacement of controller.

TROUBLESHOOTING BY TROUBLE

1. HYDRAULIC SYSTEM

Preface:
The troubleshooting for the failures shown below is explained here.
Identify the failure and trouble and carry forward the troubleshooting in order of the failure item number.

1. All controls do not function/slow
2. Engine down/stalled
3. Move at lever neutral position
4. Poor fine operability
5. Slow boom up, insufficient power
6. Slow boom down, insufficient power for lifting up body
7. Slow arm in, insufficient power
8. Slow independent arm out (in the air)
9. Bucket digging is slow
10. Bucket dump is slow
11. Swing operation not functioned/slow
12. Noise occurred at swing operation
13. Swing drifts on a slope while swing control lever is in neutral position
14. Swing drifts at stopping
15. Travel speed is slow/poor
16. Travel deviation
17. Travel $1^{st}/2^{nd}$ speed cannot be switched
18. Machine does not stay on slope in travelling
19. Machine does not travel straight in simultaneous operation of travelling and attachment.
20. Breaker works slowly and power is poor (In case of conflux, check P1 side bypass valve and pump)
21. Selector valve for option malfunction: not switched to breaker circuit
22. Selector valve for option malfunction: not switched to nibbler circuit

No.	Sections	Contents/normal value		Corrective action, others
4	Unload solenoid proportional valve (Travel straight proportional valve)	Carry out service diagnosis	• No.21 D-06 • At arm out : OFF • At pressure release: ON	Check controller for possible failure.
5	Secondary pressure of unload solenoid proportional valve (Travel straight proportional valve)	Measure the secondary pressure of unload proportional valve directly (A port)	• Arm out: 0 Mpa • At pressure release: 4 MPa or more	Replace solenoid proportional valve
6	Actual measuring current value of P1/ P2 pump proportional valve	Carry out service diagnosis	• No.9 E-1 P1 pump E-2 P2 pump • See Service Diagnosis Data List Operation No.9 Arm out full lever & in operation	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
7	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a6, a7)	Check that P1/P2 pump proportional valve pressures are within the range of 1.9 to 3.1 MPa in arm out full lever and high idling operation (Secondary pressure is affected by oil temperature and attachment weight)	Replace proportional valve
8	Actual measuring current value of travel straight proportional valve	Carry out service diagnosis	• No. 8 Travel straight • See Service Diagnosis Data List Operation No. 9 arm out full lever & in operation.	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
9	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 pressure is 1.1 MPa to 1.6 MPa in arm out full lever and high idling operation.	Replace proportional valve
10	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
11	Main relief valve <Trouble> Relief pressure is low.	Check set pressure	• See Service Diagnosis Data List Operation No.3 boom up full lever and relief	Reset or replace
12	Over load relief valve <Trouble> P1, P2 pressure is low.	Visual check (Rod side)	Pressure is 28 MPa or more in arm out and relief. Free from dust entered in over load relief valve. Seat is free from abnormality	When only relief pressure of arm out is low, replace valve
13	Arm 1 spool <Trouble> P2 pressure is high.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)

No.	Sections	Contents/normal value		Corrective action, others
4	Secondary pressure of travel straight proportional valve	Measure directly the proportional valve secondary pressure	0.8 MPa or less in high idling operation regardless of neutral/operation	Replace proportional valve
5	Unload solenoid proportional valve (Travel straight proportional valve)	Carry out service diagnosis	• No.21 D-06 • At travel: OFF • At pressure release: ON	Check controller for possible failure.
6	Secondary pressure of unload solenoid proportional valve (Travel straight proportional valve)	Measure the secondary pressure of unload solenoid proportional valve directly (A port)	• At forward (reverse): 0 Mpa • At pressure release: 4 MPa or more	Replace solenoid proportional valve.
7	Actual measuring current value of P1/ P2 pump proportional valve	Carry out service diagnosis	• No.9 E-1 P1 pump E-2 P2 pump • See Service Diagnosis Data List Operation No.18 Travel right full lever & idling Operation No.19 Travel left full lever & idling	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
8	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a6, a7)	Check that P1/P2 unload secondary pressures are within the range of followings in travel right (left), forward (reverse) full lever and high idling operation Travel right (P1 pump): 2.7 MPa or more Travel left (P2 pump): 2.7 MPa or more	Replace proportional valve
9	Exchange P1 for P2	Exchange delivery pipe of P1 for P2	Check the direction of deviation	If the direction is changed, inspect a pump. If the direction is not changed, inspect a valve and travel unit.
10	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage Check sealing ability of shuttle valve and entry of dust in orifice	Replace
11	Travel straight spool <Trouble> P1 pressure is high.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage	Replace (Check on the casing side for damage)
12	Travel spool <Trouble> Pump pressure is high.	Visual check of targeted spool	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage	Replace (Check on the casing side for damage)
13	Travel motor relief valve	Check set pressure	Check P1 and P2 pump pressures are 32 MPa or more in right and left travel levers full lever (relief operation at locked crawler belt) and high idling	If P1 is low, right travel motorÅfs relief valve is failed. If P2 is low, left travel motorÅfs relief valve is failed. Replace as necessary

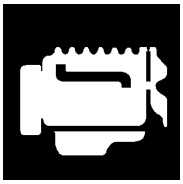
1. Engine does not stop.

No.	Sections	Contents/normal value		Corrective action, others
1	Starter key switch	Check signal of starter key switch ON by carrying out service diagnosis.	No.4 K-3 Key switch OFF at starter key switch OFF position ON at starter key switch ON position	Check continuity between terminals of starter switch using tester
2	Engine forcible stop relay	When ON is displayed with the starter switch OFF, then pull out R-25 engine forcible stop relay and carry out the service diagnosis.	No.4 K-3 Key switch OFF at starter key switch OFF position ON at starter key switch ON position	Check on engine forcible stop relay
3	Wiring	Voltage between line No.62 among starter switch, engine forcible stop relay, enginestop solenoid and the body grounding	0 V when starter switch is OFF	Check harness Check diode D-9 between starter switch and auto idling stop relay 1

2. "CPU DATA COMMUNICATION ERROR" is displayed on multi display.

No.	Sections	Contents/normal value		Corrective action, others
1	Fuse	No.1 fuse (5 A)	Not blown fuse	Check harness Replace fuse
2	Mechatro controller	Accel control	Engine speed varies according to accel potentiometer operation. (Use remote control because the auto accel function is working.)	Check mechatro controller and replace as necessary
3	Wiring	Transmission circuit line No.770 from mechatro controller to gauge cluster	See “WIRING CHECKING PROCEDURE"	Repair wiring
4	Gauge cluster	Gauge cluster		Replace gauge cluster

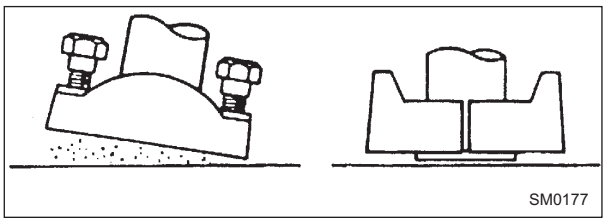
SECTION AND GROUP CONTENTS

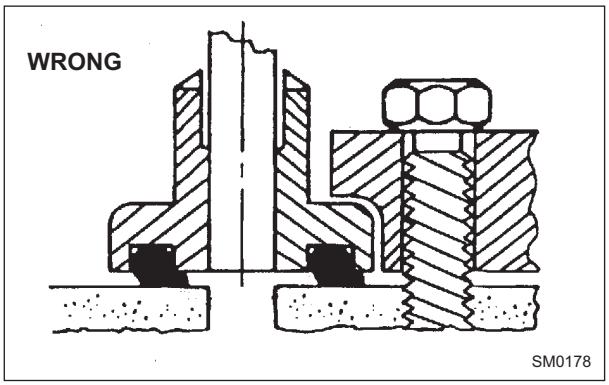


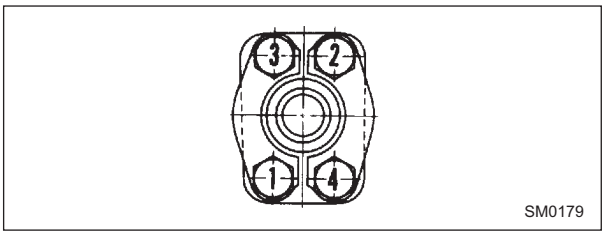
Service Recommendations for Split Flange

IMPORTANT

1. *Be sure to clean and inspect sealing surfaces. Scratches / roughness cause leaks and seal wear. Unevenness causes seal extrusion. If defects cannot be polished out, replace the component.*
2. *Be sure to use only specified O-rings. Inspect O-rings for any damage. Take care not to file O-ring surfaces. When installing an O-ring into a groove, use grease to hold it in place.*
3. *Loosely assemble split flange halves. Make sure that the split is centrally located and perpendicular to the port. Hand-tighten the bolts to hold the parts in place. Take care not to pinch the O-ring.*
4. *Tighten bolts alternately and diagonally, as shown, to ensure even tightening.*
5. *Do not use air wrenches. Using an air wrench often causes tightening of one bolt fully before tighten the others, resulting in damage to O-rings or uneven tightening of bolts.*







Nut and Bolt Lockings

- **Lock Plate**

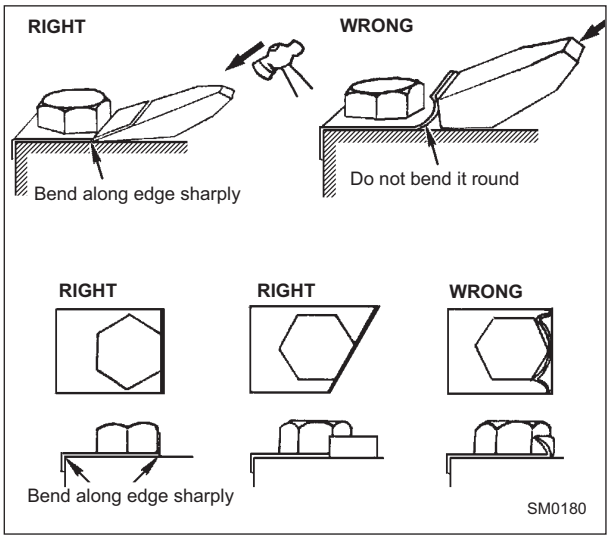
IMPORTANT: *do not reuse lock plates. Do not try to bend the same point twice.*

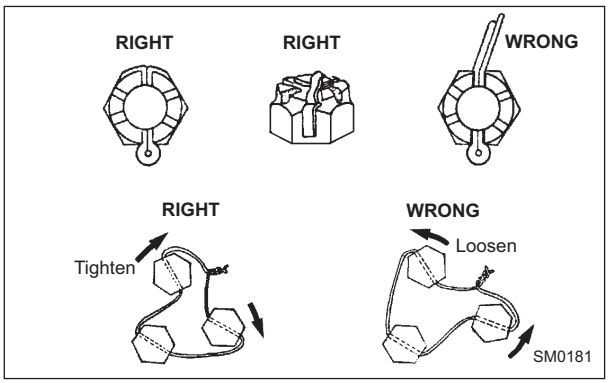
- **Cotter Pin**

IMPORTANT: *do not reuse cotter pins. Match the holes in the bolt and nut while tightening, not while loosening.*

- **Lock Wire**

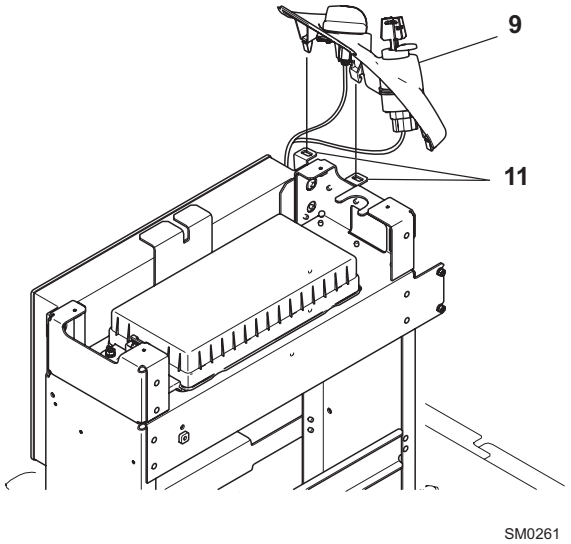
IMPORTANT: *apply wire to bolts in the bolt-tightening direction, not in the bolt-loosening direction.*



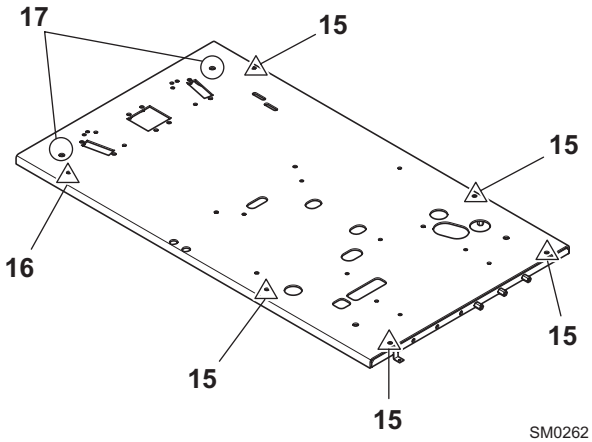


7. Remove cab attaching bolt.
   1) 5 capscrews (**15**) M12x65 and 1 capscrew (**16**) M12x30
   2) 2 nuts (**17**) M16
8. Slinging cab.
   1) Remove two plastic plugs at the front of the ceiling of the cab. Then place a wire sling with eye bolts (**18**) and a hook around the cab, as shown in Fig. SM0263.
   2) Then lift up slowly avoiding interference with surroundings.
      Eye bolts M10 (q.ty 2).
      Wire with hook:
      Length 1.5 m (4ft 11in), Dia. 8 mm (0.315in) – (3 pcs).

NOTE: *weight of cab: Approx. 265 kg (584 lbs)*



SM0261

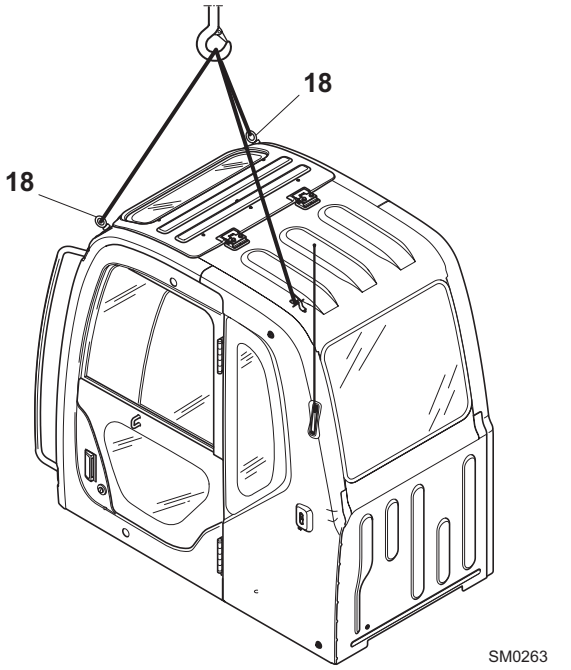


SM0262

installation of the cab

Install it in reverse order of removing according to the Tightening Torque Table.

Tightening position	Allen wrench HEX	Tightening torque Nm (lbf·ft)
Nut M16 - (17)	24	191 (140)
Capscrew - (2), (9)	19	79.4 (60)
Sems bolt M6 - (5), (6)	Torxdriver T30	8.5 (6.3)
Sems bolt M6 - (12), (13)	Plus driver	5.0 (3.7)



SM0263

19. Loosen capscrews M12x40 (**A21**), M12x110 (**A42**) and remove half clamp (**A36**).
    : 19 mm

20. Disconnect two hoses from the delivery side.
    : 19 mm

NOTE: *attach tags to hoses to identify. Put a plug in the hoses and the pump.*

21. Remove side branch hoses (**A1**) and (**A2**).
    : 41 mm

22. Remove four capscrews M16x35 (**A25**).
    : 14 mm

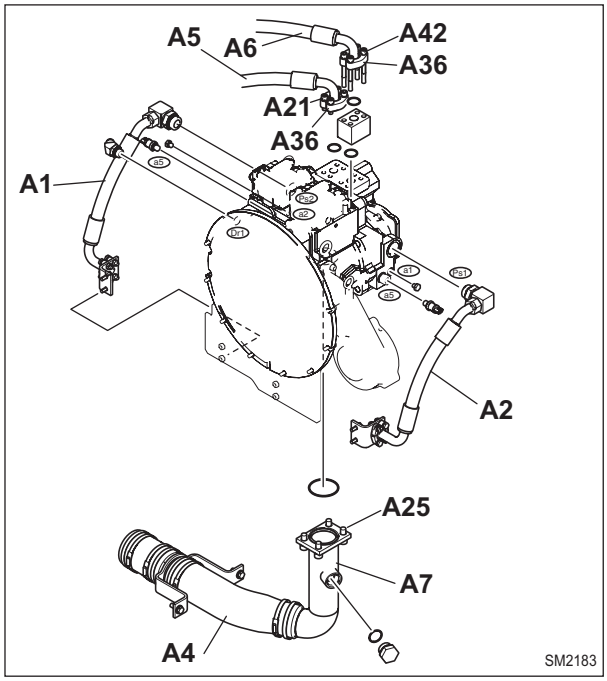
23. Remove elbow (**A7**) of suction hose (**A4**) from pump,

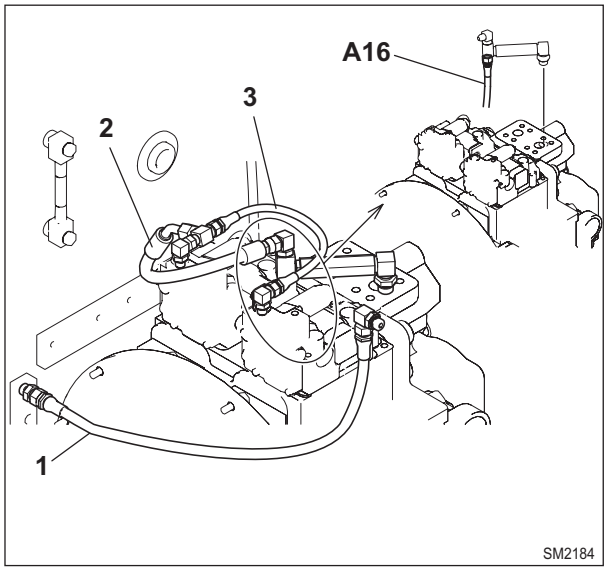
24. Remove drain hose between tank and pump (**1**).
    : 22 mm

25. If necessary, remove hose (**3**) between ports Psv1 and Psv2.
    : 19 mm

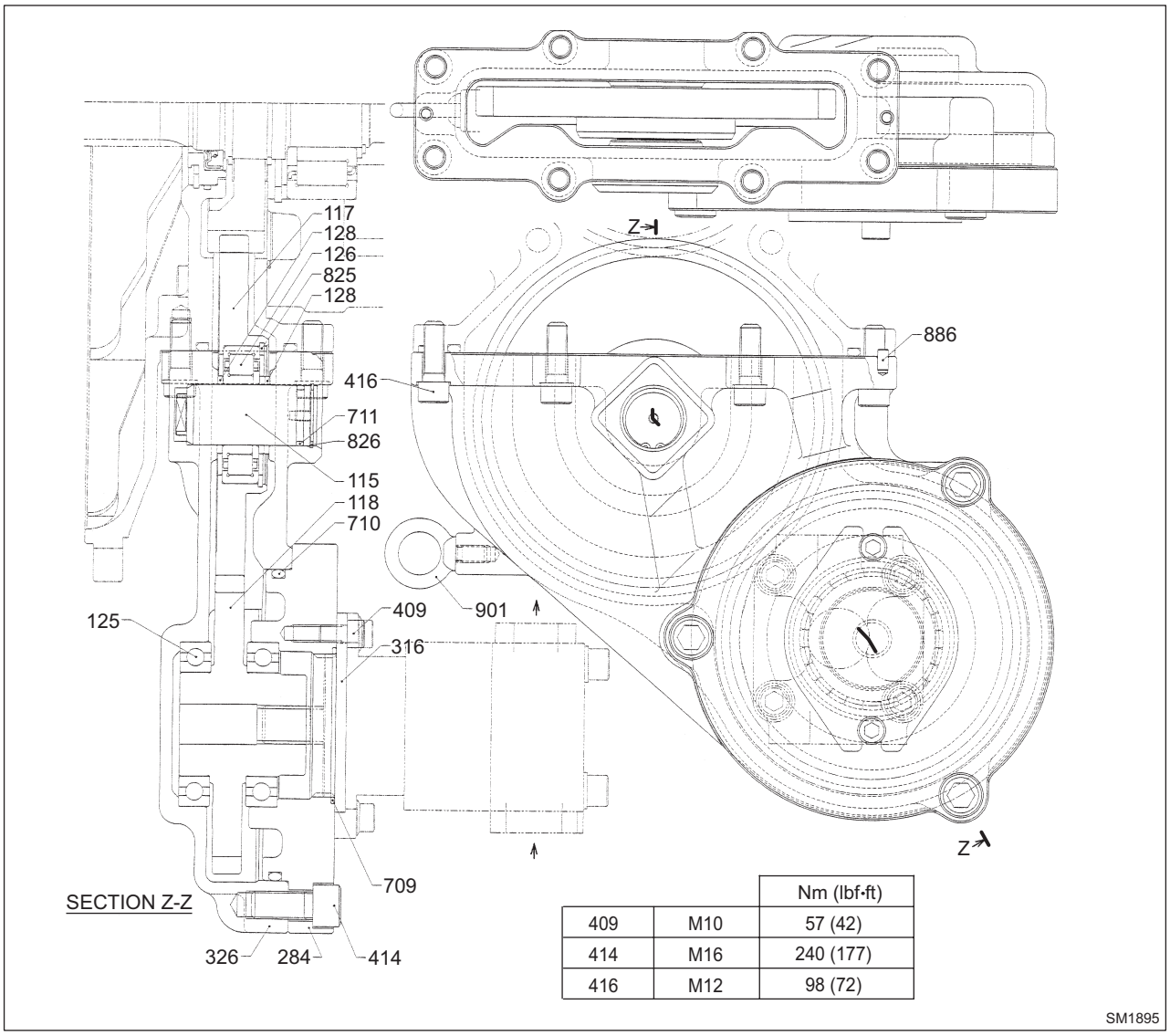
26. If necessary, remove hose (**2**) between filter and port Psv2.
    : 19 mm

27. Remove hose (**A16**) between ports P1 and A3.
    : 22 mm





POWER TAKE OFF (PTO)

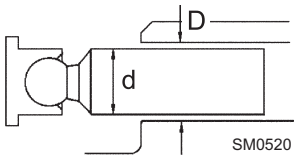
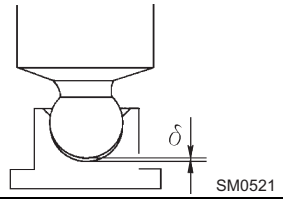
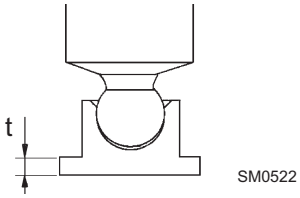
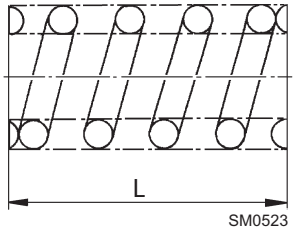
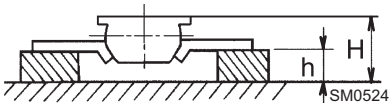


		Nm (lbf·ft)
409	M10	57 (42)
414	M16	240 (177)
416	M12	98 (72)

12 - Pin
115 - Idle shaft
117 - 2nd gear
118 - 3rd gear
125 - Ball bearing (Q.ty 2)
126 - Roller bearing
128 - Bearing spacer (Q.ty 3)
284 - Bearing case
316 - Cover
326 - Gear case
409 - Socket bolt; M10x16 (Q.ty 2)
414 - Socket bolt; M16x35 (Q.ty 3)
416 - Socket bolt; M12x35 (Q.ty 8)
709 - O-Ring
710 - O-Ring
711 - O-Ring
825 - Snap ring
826 - Snap ring
886 - Pin (Q.ty 2)
901 - Eye bolt; M10

MAINTENANCE STANDARD:

Unit: mm (poll.)

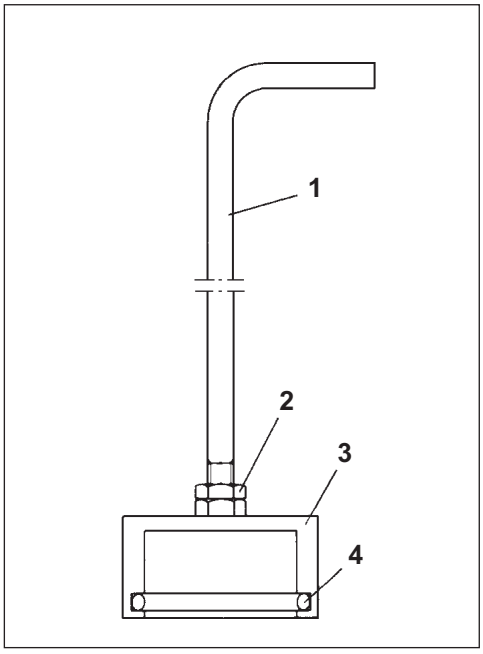
Part name and inspection item	Standard dimension (mm)	Recommended value for replacement (mm)	Remedy
Clearance between piston and cylinder bore (D-d) 	0.0375 (0.00147)	0.078 (0.00307)	Replace piston or cylinder.
Gap between piston and caulked part of shoe (δ) 	0 ~ 0.1 (0 ~ 0.00393)	0.35 0.0138)	Replace piston shoe assy.
Thickness of shoe (t) 	5.4 (0.213)	5.0 (0.197)	Replace piston shoe assy.
Free height of cylinder spring (L) 	40.9 (1.610)	40.1 (1.579)	Replace cylinder spring.
Combined height of retainer plate and spherical bushing (H-h) 	23.8 (0.937)	22.8 (0.898)	Replace a set of spherical bushing or retainer plate.
Cylinder over pin diameter (spline in cylinder) Spline in spherical bushing	35.17 (1.385)	35.57 (1.400)	Replace cylinder, spherical bushing

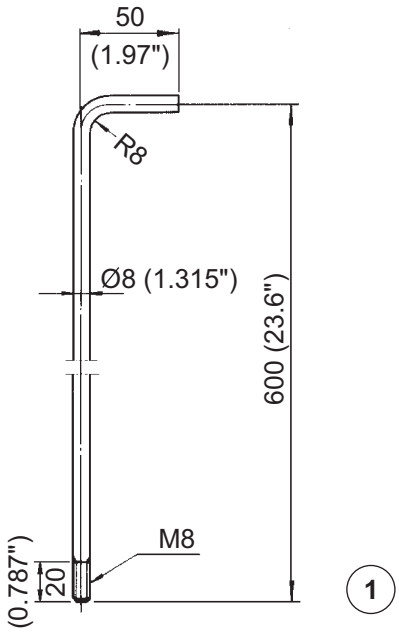
Repair standards for cylinder, valve plate and swash plate (shoe plate face)

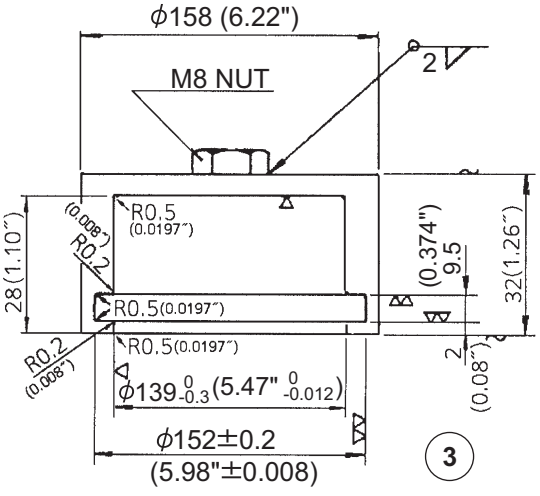
Valve plate (sliding section). Swash plate (shoe plate face). Cylinder (sliding section). Roughness of each surface.	Surface roughness requiring correction.	3-Z
	Standard surface roughness (correction value).	Less than 0.4 Z (lapping)

TOOL TABLE

REF.	CODE	DESCRIPTION
Q	xxxxxxxxx	Suction stopper assy
	1	Rod
	2	Nut M8
	3	Cover
	4	O-ring

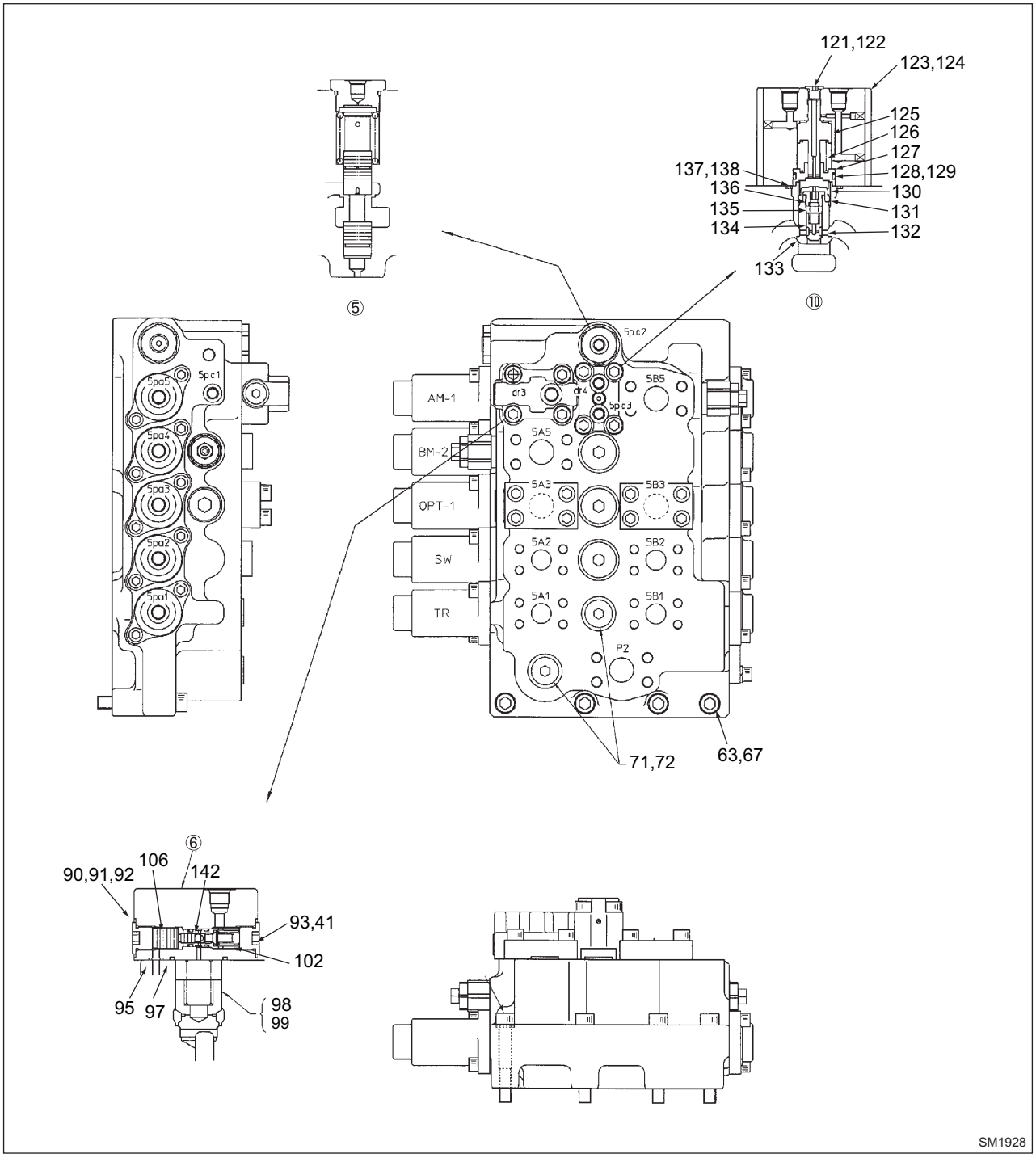






SM2195

Control valve (5/6)

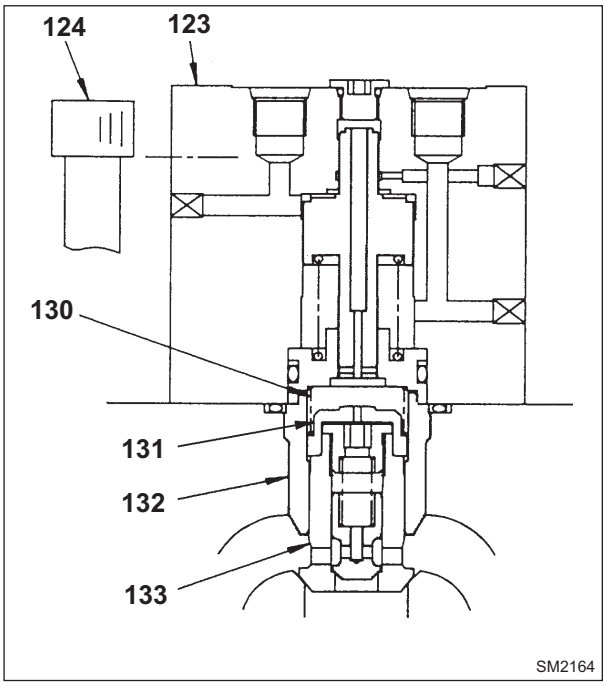


5) Center by pass valve (BKT Conflux)
6) Load holding valve pilot
10) Priority valve

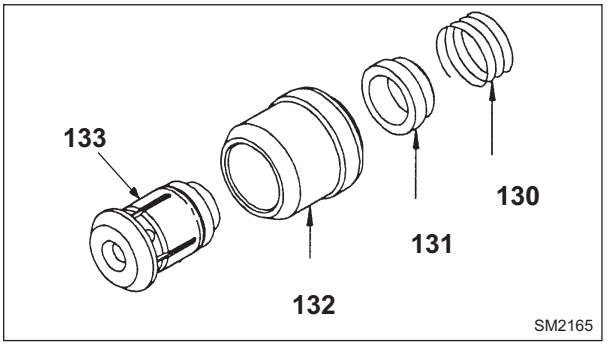
Disassembling the priority valve

1. Remove socket bolt (124) and take out cover (**123**).
   : 12 mm
   : 176.5 Nm (130 lbf·ft)

NOTE: *before reassembling the cover, make certain that an O-Ring is placed on the mouth of the housing.*

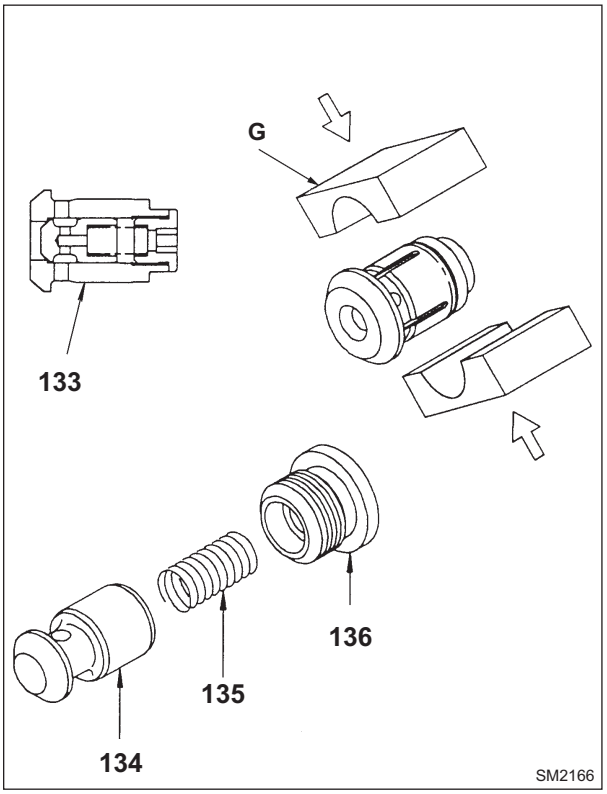


2. Take out spring (**130**), spring guide (**131**), sleeve (**132**) and poppet sub-assembly (**133**).



3. Hold poppet sub-assembly (**133**) in the holder (**G**), hold it further in a vise, remove cap (**136**) and separate spring (**135**) and check (**134**).
   : 6 mm
   : 34.5 Nm (25 lbf·ft)

NOTE: *degrease the poppet and the holder (**G**) thoroughly.*



Installation

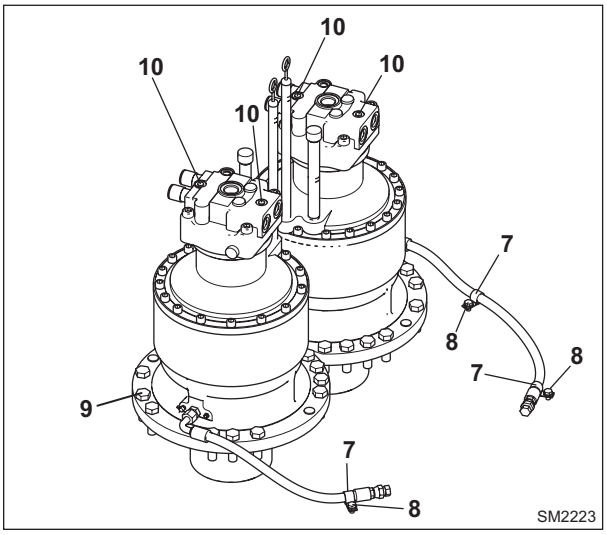
1. Clean mating surfaces of swing motor unit and upper frame.
2. Apply Loctite #515 on entire mounting surface of swing motor unit.
3. Place the swing unit on the upper frame.

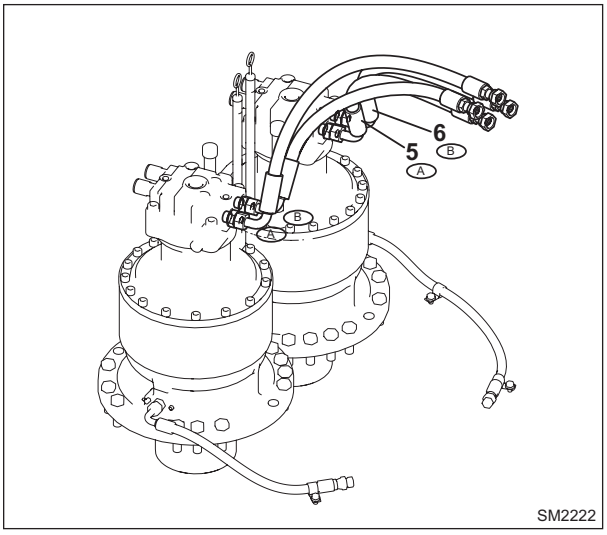
IMPORTANT: *use care so no dirt falls into the swing grease bath.*

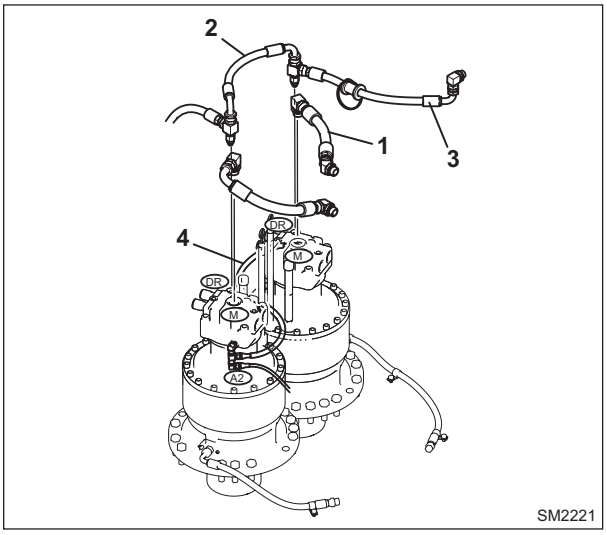
NOTE: *swing unit weight: 286 kg (630 lbs)*

4. Remove the lifting eye bolts and inserts on the holes, the plastic caps (**10**) M12, previsiously removed.
5. Fix the swing unit to the frame by tightening the screws (**9**) (Q.ty 14).
   : 30 mm
   : 415 ± 40 Nm (306 ± 29.5 lbf·ft)
6. Fix the clip (**7**) to the frame by tightening the screws (**8**).
   : 17 mm
   : 46.1 ± 4.9 Nm (34 ± 3.6 lbf·ft)
7. Before piping for draining, fill casing with hydraulic oil from drain port of motor.
8. Install the hoses (**5** and **6**) on the elbows of port A and B.
   : 36 mm
   : 177 ± 18 Nm (131 ± 13 lbf·ft)
9. Install the hose (**4**) on the elbow of port P.
   : 19 mm
   : 29 ± 4.9 Nm (21 ± 3.6 lbf·ft)
10. Install the hoses (**2** and **3**) on the tee in the drain port Dr.
    : 36 mm
    : 118 ± 9.8 Nm (87 ± 7.2 lbf·ft)
11. Install the hose (**1**) on the make up port Mu.
    : 41 mm
    : 137 ± 15 Nm (101 ± 11 lbf·ft)
12. Before starting operation, check the gear oil level of swing reduction unit.
    Amount of oil: 7L (1.9gal)

IMPORTANT: *when starting operation, operate motor in low idling and at low speed for several minutes, and check it for possible oil leak and noise.*

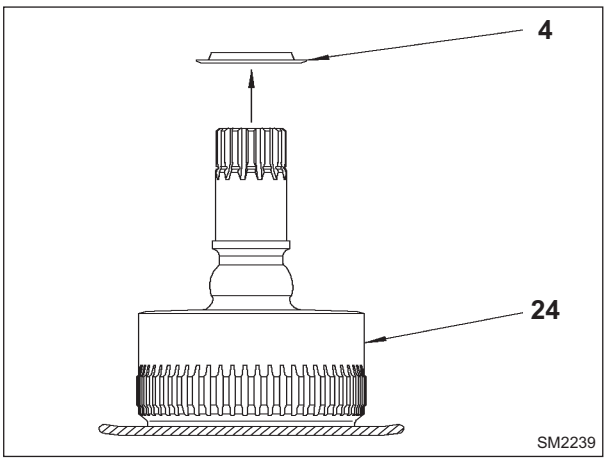






d. Remove retaining spring (**4**) from cylinder (**24**).

This completes disassembly.



1 - Pinion shaft
2 - # 1 Sun gear
3 - # 1 Planetary pinion (Q.ty 4)
4 - # 1 Spider assy
5 - # 2 Sun gear
6 - # 2 Planetary pinion (Q.ty 4)
7 - Ring gear
8 - # 2 Spider
9 - Shaft (Q.ty 4)
10 - Needle bearing (Q.ty 4)
11 - Needle bearing (Q.ty 4)
12 - Bearing
13 - Bearing
14 - Oil seal
15 - Housing
16 - Oil seal
17 - Sleeve
18 - Thrust washer (Q.ty 8)
19 - Thrust washer (Q.ty 8)
20 - Retaining ring (Q.ty 4)
21 - Retaining ring
22 - Spring pin (Q.ty 4)
23 - Capscrew M14 x 150 (Q.ty 16), 181 Nm (134 lbf·ft)
24 - Cap (Q.ty 2)

Swing reduction gear

INSPECTION AT DISASSEMBLY

1. Spacer and thrust washer
   a. Inspect that the parts are not seized or worn abnormally or unevenly.
   b. Inspect and measure the parts to see that the wear does not exceed the allowable values.

2. Gears
   a. Inspect that the gear teeth do not show pitching and seizure.
   b. Inspect by dye penetrant examination that the bottom of the teeth does not show cracks.

3. Bearing
   Turn the bearing and check that it does not generate abnormal sound, catching and other faults.
   Do not reuse spherical bearing.

4. O-Rings and oil seals
   Do not reuse O-Rings and oil seals; always replace them with new ones at reassembly.

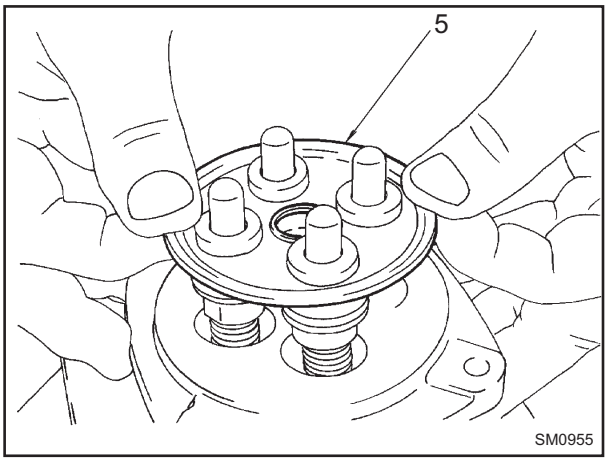
INSPECTION AFTER ASSEMBLY

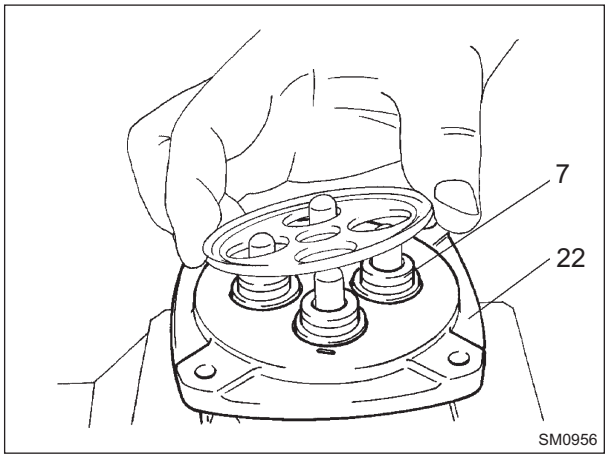
1. Function
   Check to see that #1 sun gear (**2**) is not faulty when turned by hand.

2. Checking for oil leakage and oil quality
   Check for oil leakage.
   Check the oil level by level gauge and confirm that the oil is not dirty. If the oil is short, replenish 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**).*

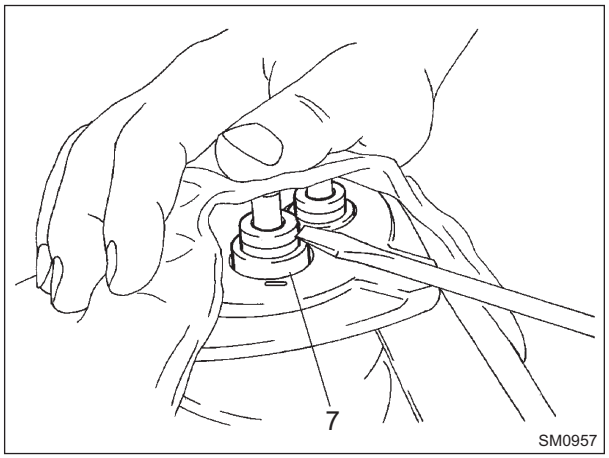




7. Pull plug (**7**) out with a driver.

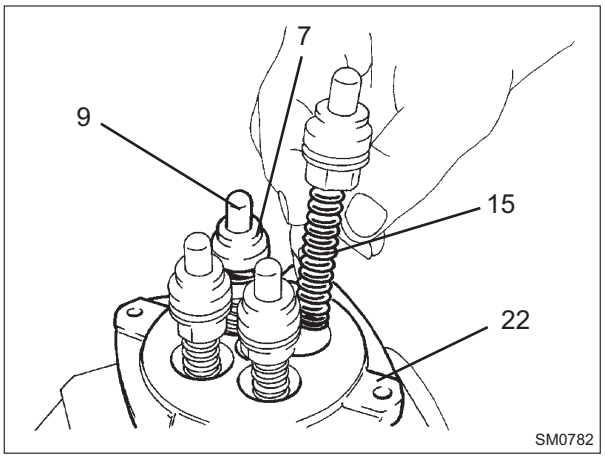
WARNING

*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.

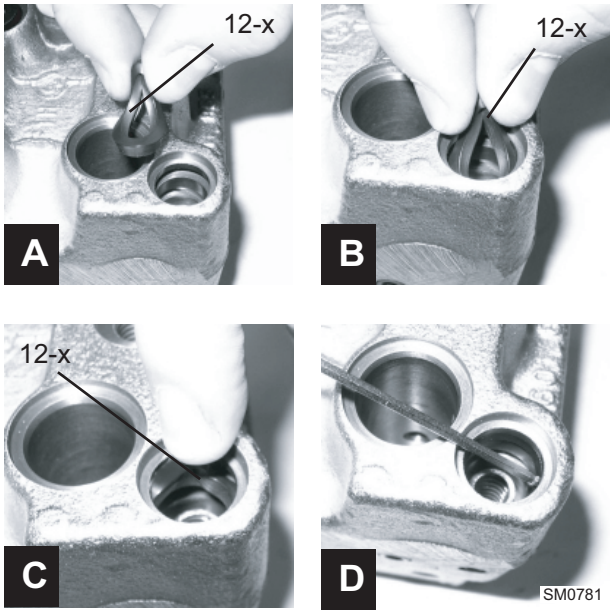
IMPORTANT: *during the reassembly, make sure the seal (**12-x**) is correctly positionned, and pay attention not to damage nor twist it.*

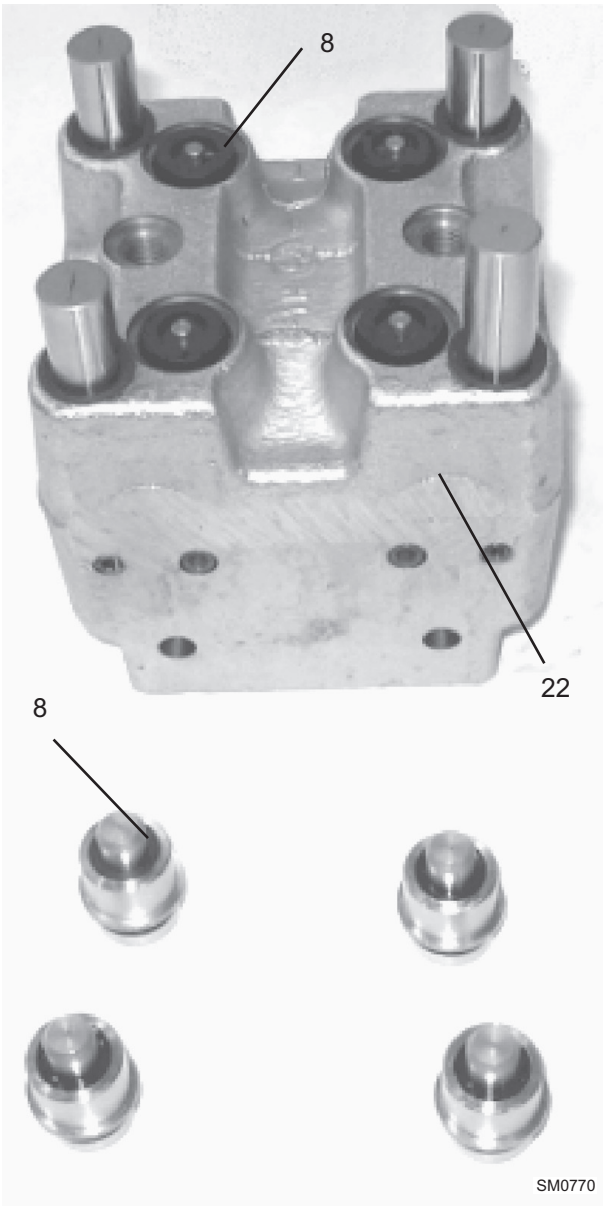
5) Repeat the operation for the other 3 assemblies.
6) Extract the damping springs (**13**) from the body (**22**) (using flat nose pliers).
7) Inspect the damping springs (**13**). If defects are detected, replace the 4 springs.
8) Reassemble parts in reverse order.

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

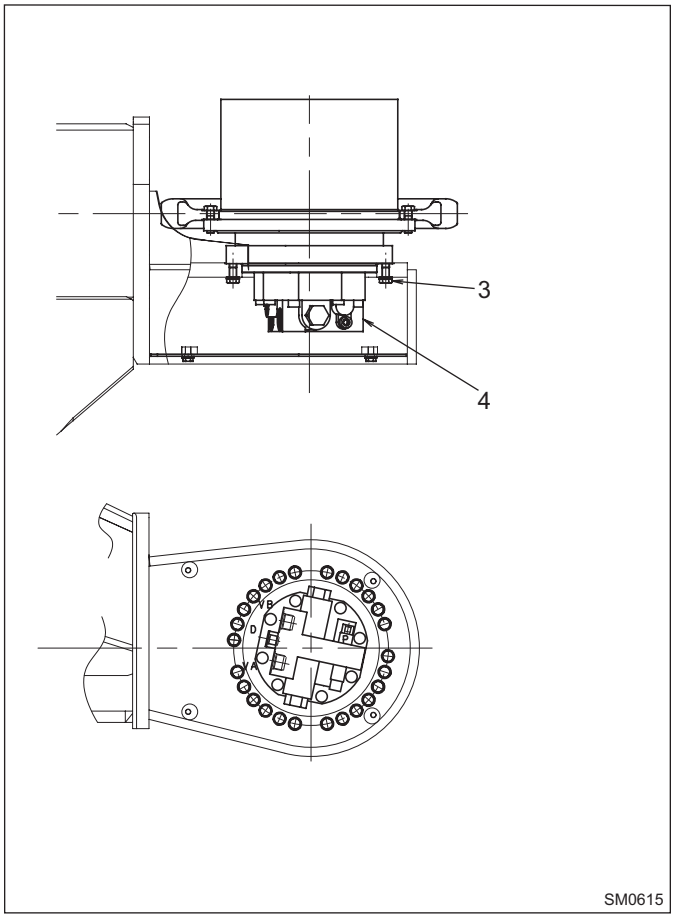
Possible leakages of fluids under pressure could penetrate the skin, causing serious injuries. Prevent these dangers, discharging the pressure before disconnecting hydraulic pipes or other pipes. Hydraulic oil, at the end of a work shift, can be very hot and can cause, when spilling, potentially serious 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 T2-1-47.
3. Cut-off the engine. Press the valve located on the hydraulic oil cap to release any residual pressure present in the tank itself. Remove hydraulic oil tank cap. Connect a vacuum pump to maintain negative pressure in the hydraulic oil tank.

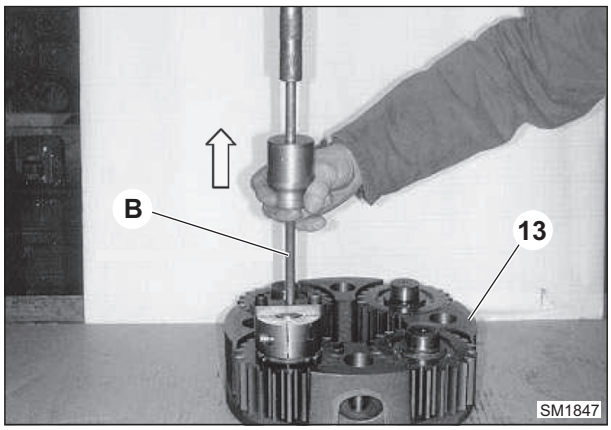
IMPORTANT: *be sure to run the vacuum pump continuously while working.*

INSTALL ASSY			LS53D00009F1
No.	**NAME**	**Q'TY**	**REMARKS**
3	CAPSCREW	24	M22x68
4	TRAVEL MOTOR ASSY	2	LS53D00010F1

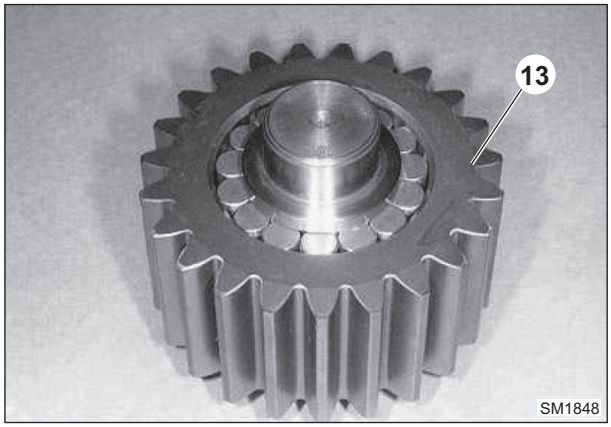


21. By using a puller remove the inner ring of the bearing and the spacer remaining on the flanged hub (**20**).

22. Using the tool **380002066** (**B**), remove the four planet assemblies of the 3rd reduction (**13**).

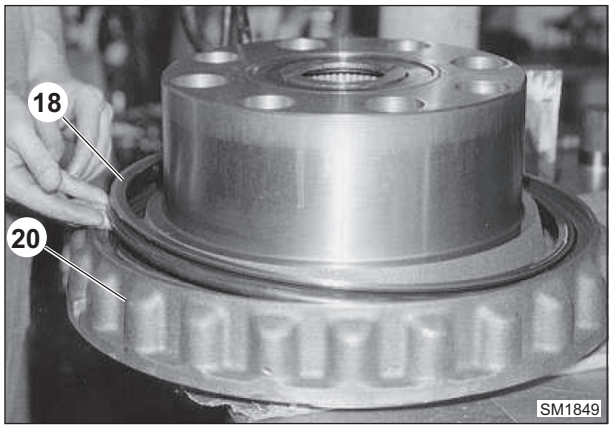


23. View of the loose planet assembly of the 3rd reduction (**13**).

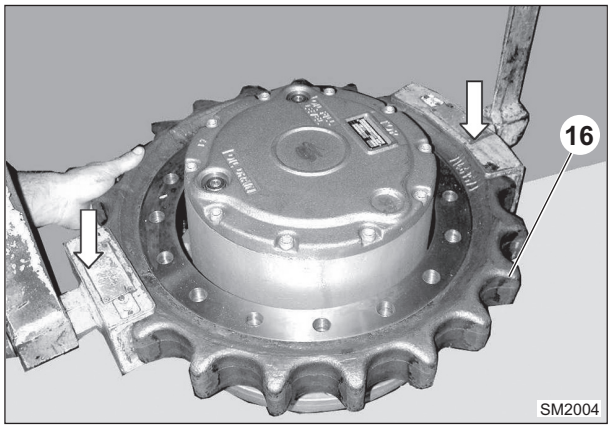


IMPORTANT: *in case of oil leakages, it might be necessary to check and if needed replace the lifetime seal (**18**), which means both the steel rings and the O-Ring seals.*

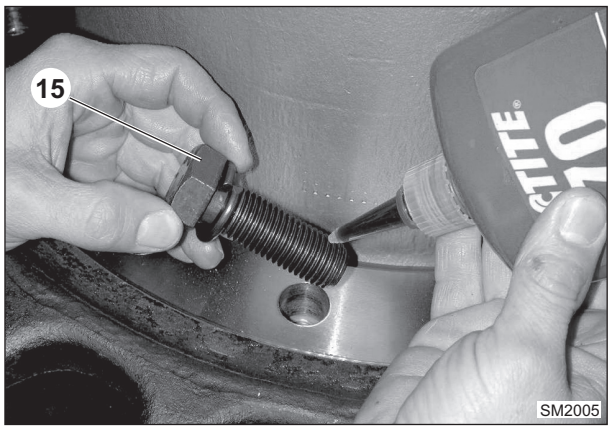
24. Remove both the half-seals (**18**) from the flanged hub (**20**) and from the gearbox housing (**17**).



28. Place the sprocket (**16**) on the gearbox.

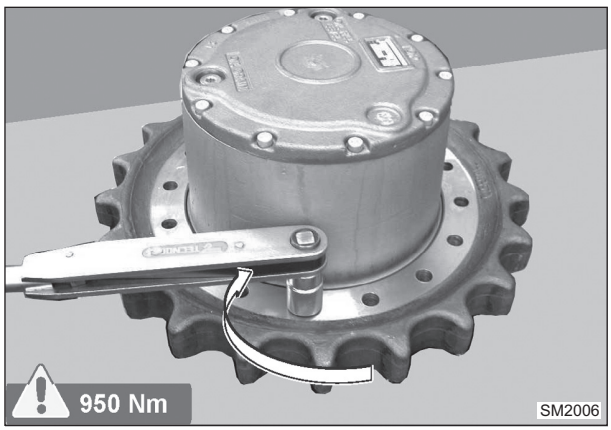


29. Apply LOCTITE type 270 on the thread of the nos. 24 hexagonal head screws M24x65 (**15**).

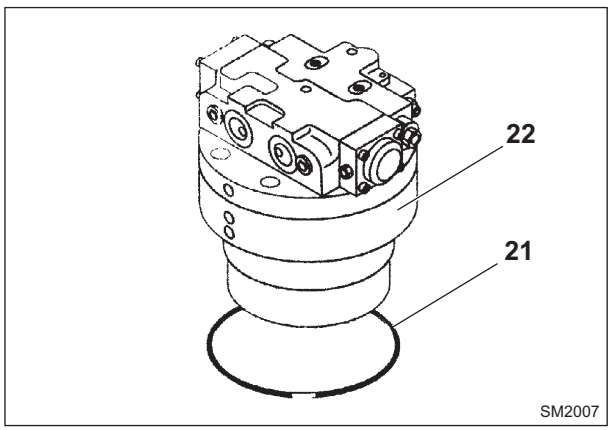


30. Tighten the nos. 24 hexagonal head screws M24x65 (**15**).

: 950 Nm (701 lbf·ft)



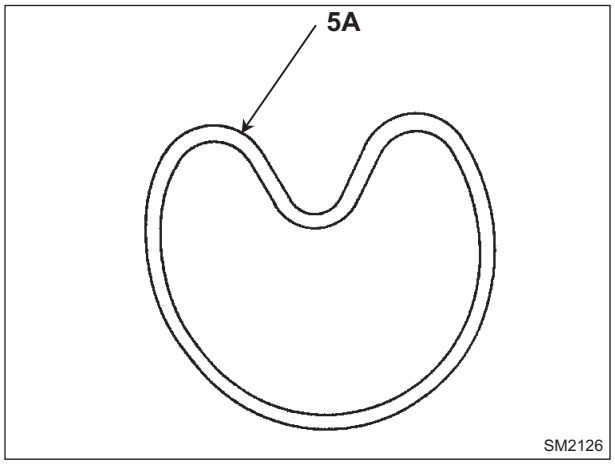
31. Assemble the O-Ring seal (**21**) into its seat in the hydraulic motor (**22**).



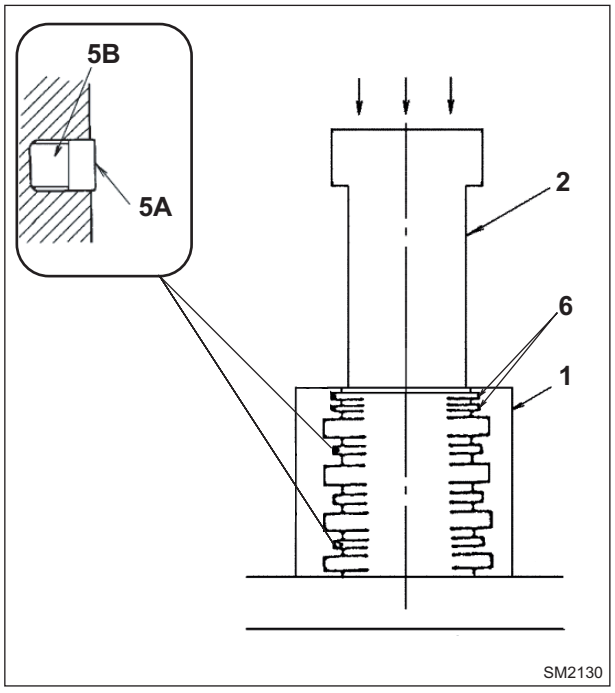
Assembly

Prior to assembly, clean each parts (excluding the O- Ring and slipper ring), and arrange in the sequence of assembly.

1. Make sure that oil and grease remains have been completely removed.
2. Apply grease on the groove where are seated the O- Ring (**5B**).
3. Apply hydraulic oil to O-ring (**6**) thinly and insert it into O-ring groove. Check the twist of O-ring.
4. Slipper ring (**5A**) is assembled, after first inserting the backup ring (**5B**), by slightly-distorting the shape as shown in figure. Also after inserting all of the seals, be certain that these are installed in the seal groove by use of the spatula.
5. Lightly coat the outer circumference of stem (**2**) and the inner surface of body (**1**) with grease or vaseline and slowly insert stem (**2**) into body (**1**).



NOTE: *If stem (**2**) is pressed in too fast, the seal may be damaged. Do it slowly. The clearance between body (**1**) and stem (**2**) is about 0.1 mm (0.0039 in). Push stem straight along the shaft center.*



*A: Push with both hands

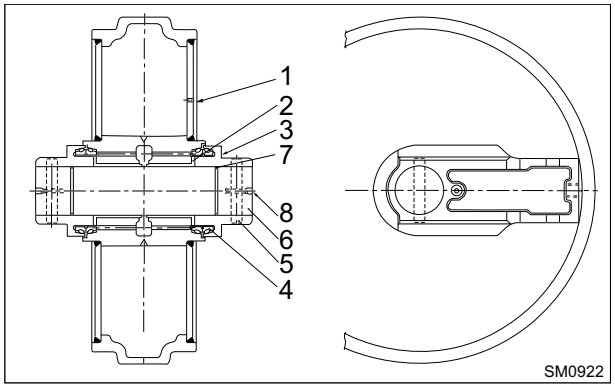
DISASSEMBLY AND ASSEMBLY
FRONT IDLER ASSY

Disassembly

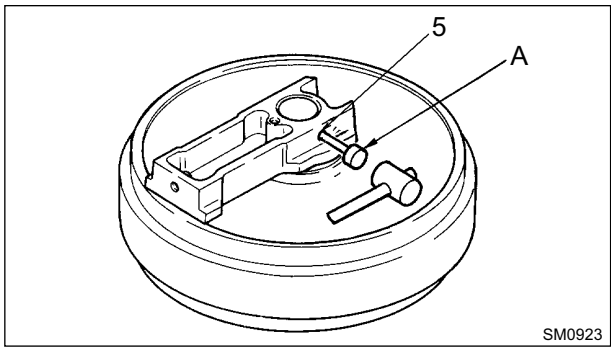
NOTE: *mass of front idler assembly with bracket: 327 kg (721 lbs)*

1. Remove plug (**8**) on the side of collar (**3**) to drain oil.

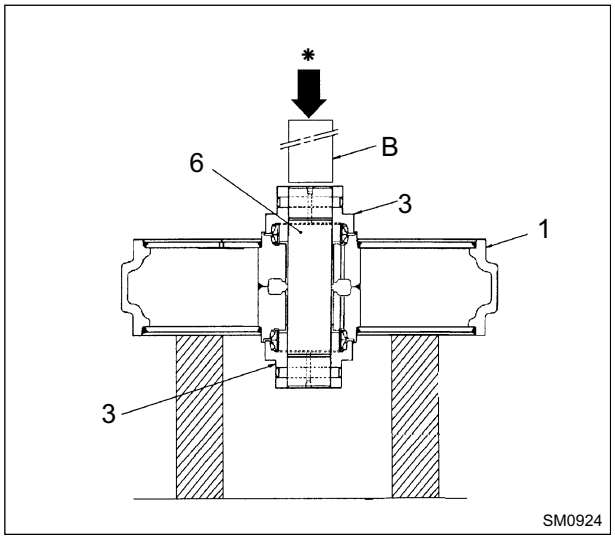
   : 5 mm



2. To remove pin (**5**) apply pin push bar (**A**) (**380001051**) to the top of pin, and push out striking bar lightly by hammer.

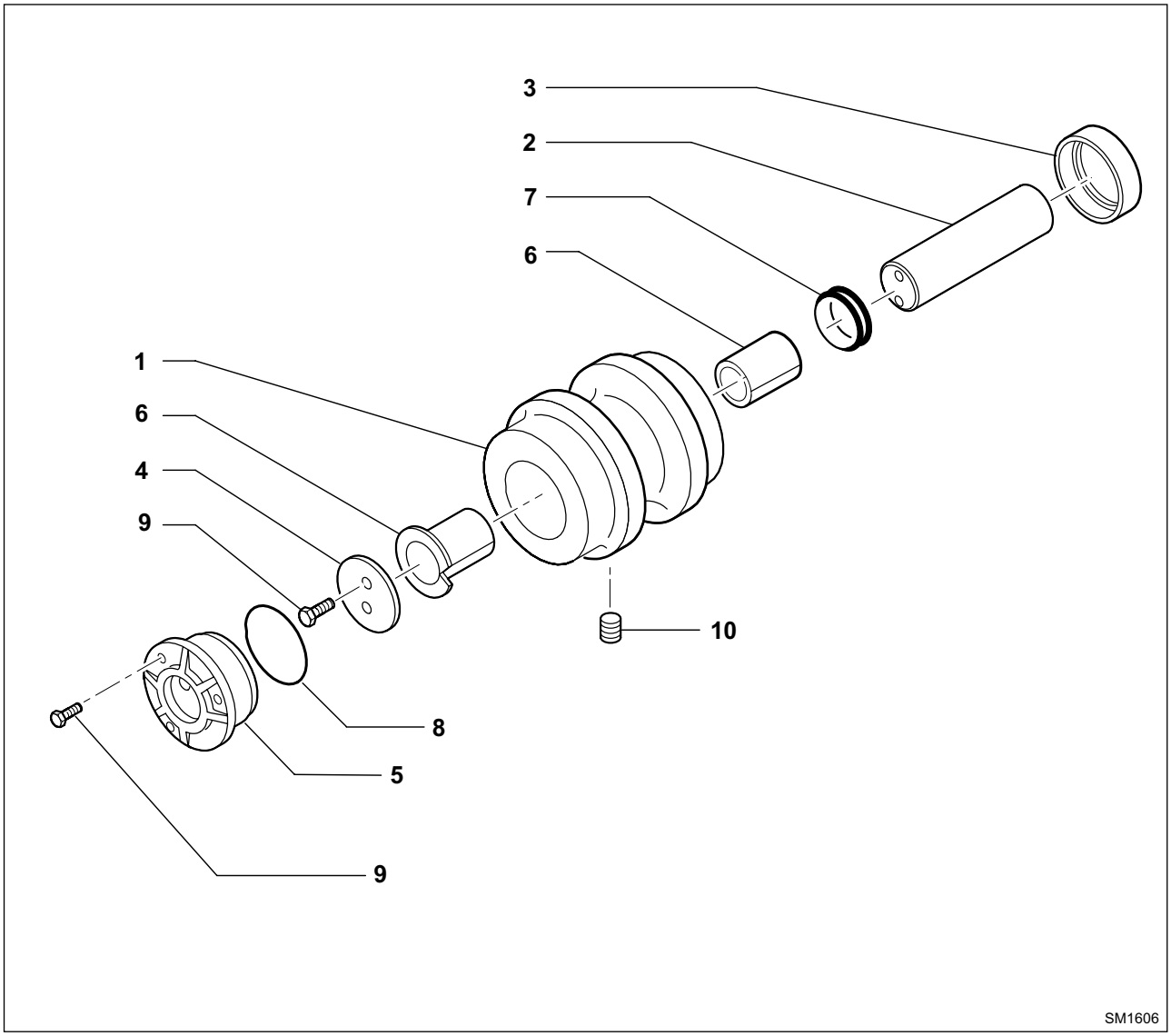


3. Put idler on repair stand. Apply push-out jig on shaft (**B**) (**380001052**), push out shaft (**6**) with collar (**3**), then remove collar (**3**).



* : Push with press

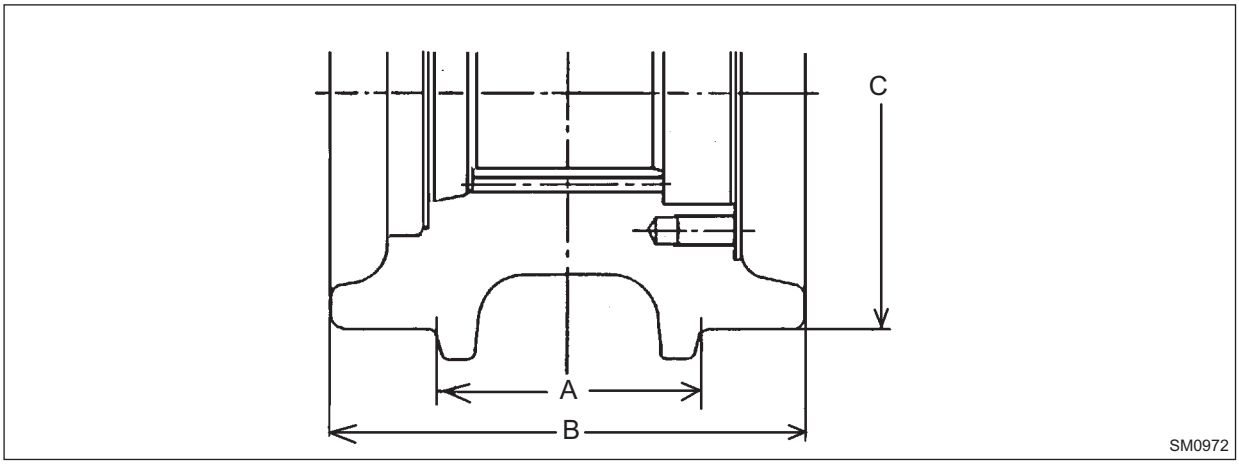
UPPER ROLLER DISASSEMBLY



1 - **Upper roller**
2 - **Shaft**
3 - **Collar**
4 - **Thrust washer**
5 - **Cover**
6 - **Bushing**
7 - **Floating seal**
8 - **O-Ring**
9 - **Screw M12 x 30** (Q.ty 5)
10 - **Plug**

MAINTENANCE STANDARD

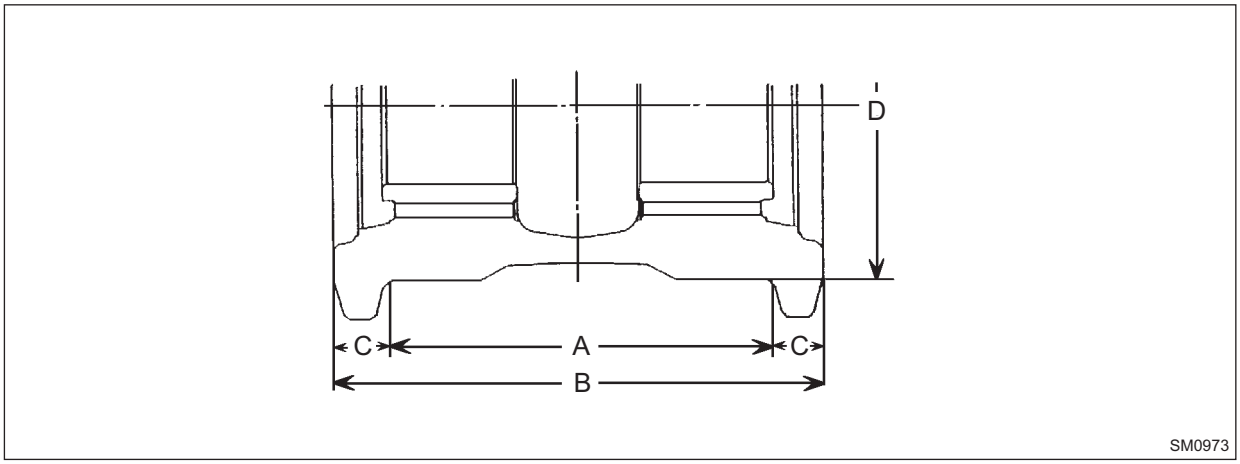
Upper Roller



Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	95 (3.740)	85 (3.346)	Build up weld and finishing or replace.
B	210 (8.268)	-	
C	Ø 160 (Ø 6.299)	Ø 150 (Ø 5.906)	

Lower Roller



Unit: mm (in)

	Standard	Allowable Limit	Remedy
A	218 (8.583)	-	Build up weld and finishing or replace.
B	280 (11.024)	-	
C	31 (1.220)	-	
D	Ø 220 (Ø 8.661)	Ø 210 (Ø 8.268)	

IMPORTANT: *consulting **NEW HOLLAND KOBELCO** for any inquiries concerning welding procedure.*

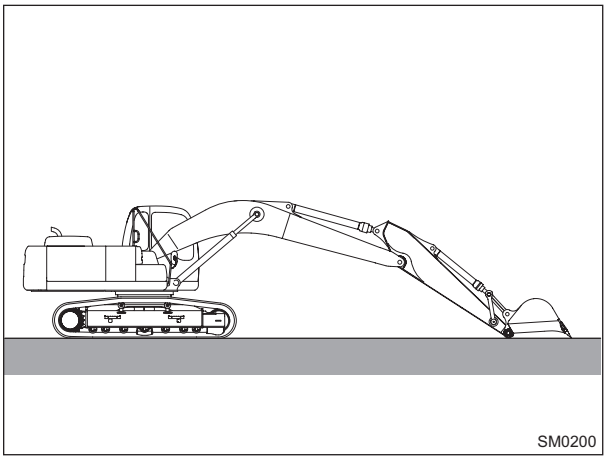
FRONT ATTACHMENT REMOVAL AND INSTALLATION

WARNING

Possible leakages of fluids under pressure can penetrate the skin, resulting in serious injuries. Prevent this dangers by releasing residual pressure prior to disconnecting hydraulic pipes or any other pipes. Press the valve located on the hydraulic oil tank to bleed the residual pressure trapped inside the tank.
Hydraulic oil, at the end of the work shift, can be very hot and cause, when spilling, possible serious burns. Before starting any intervention, make sure that oil and components have cooled off.
Always ensure that hooks and chains used for lifting are in good condition and adequate to the expected load.
Metal fragments may fly off when a hammer is used to remove pins. Be sure to wear necessary protection.

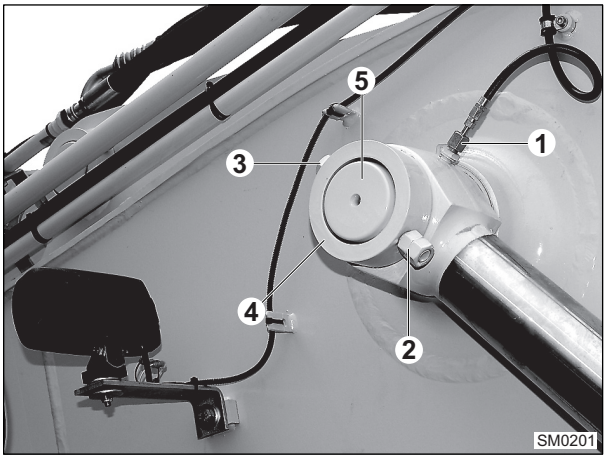
Removal

1. Park the machine on firm, level ground. Position the front attachment as illustrated and lower the bucket to the ground.


SM0200

2. Disconnect lubrication hoses (**1**) from boom cylinder rod end.
   : 17 mm

3. Loosen lock nuts (**2**), remove bolt (**3**) and stopper (**4**) from boom cylinder rod end.
   Carry out the same procedure for the other boom cylinder.
   : 30 mm

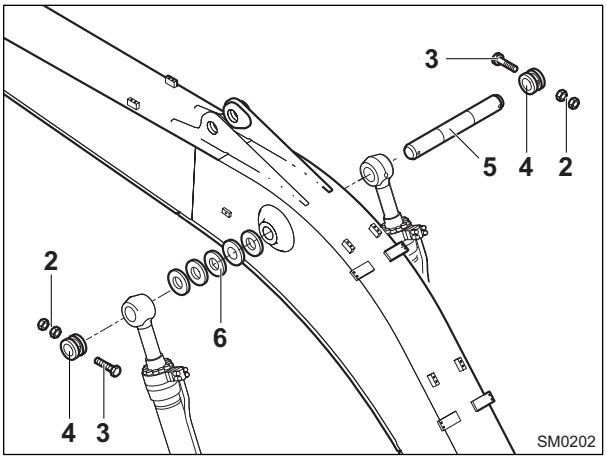


SM0201

4. Attach each boom cylinder to a crane.

NOTE: *boom cylinder mass: 415 kg (915 lbs)*

Remove cylinder rod end pin (**5**) and shims (**6**) using a hammer and bar.



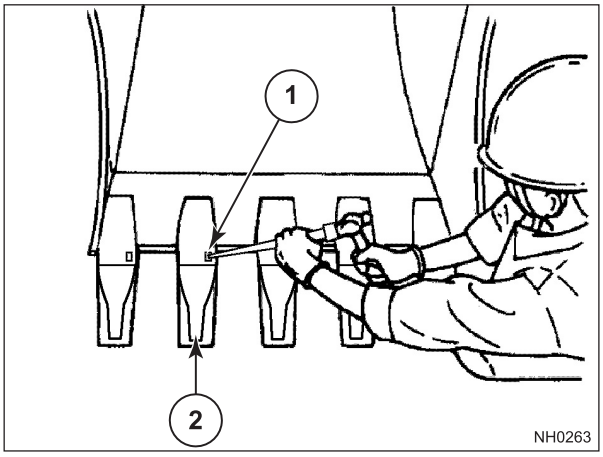
SM0202

Bucket teeth replacement

WARNING

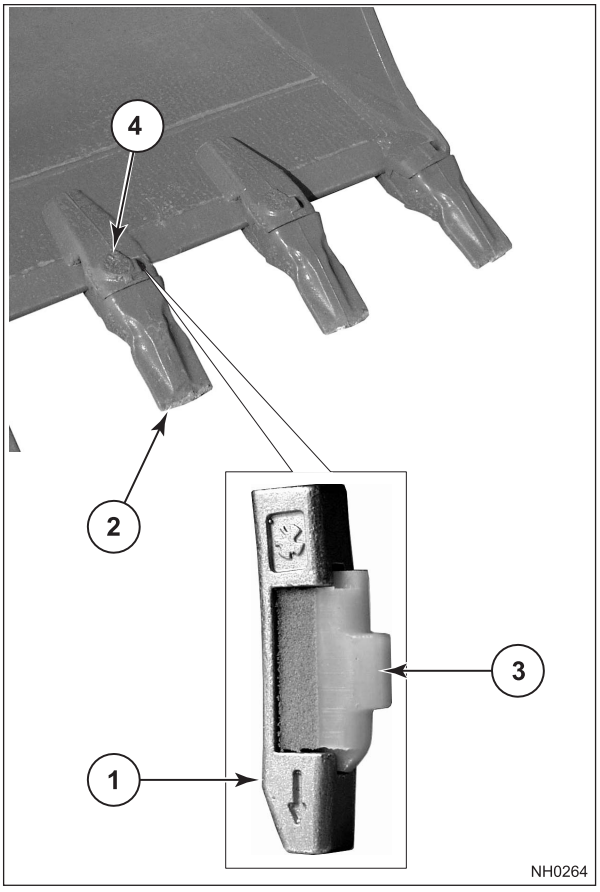
Keep people not involved in the maintenance work outside the working area.

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



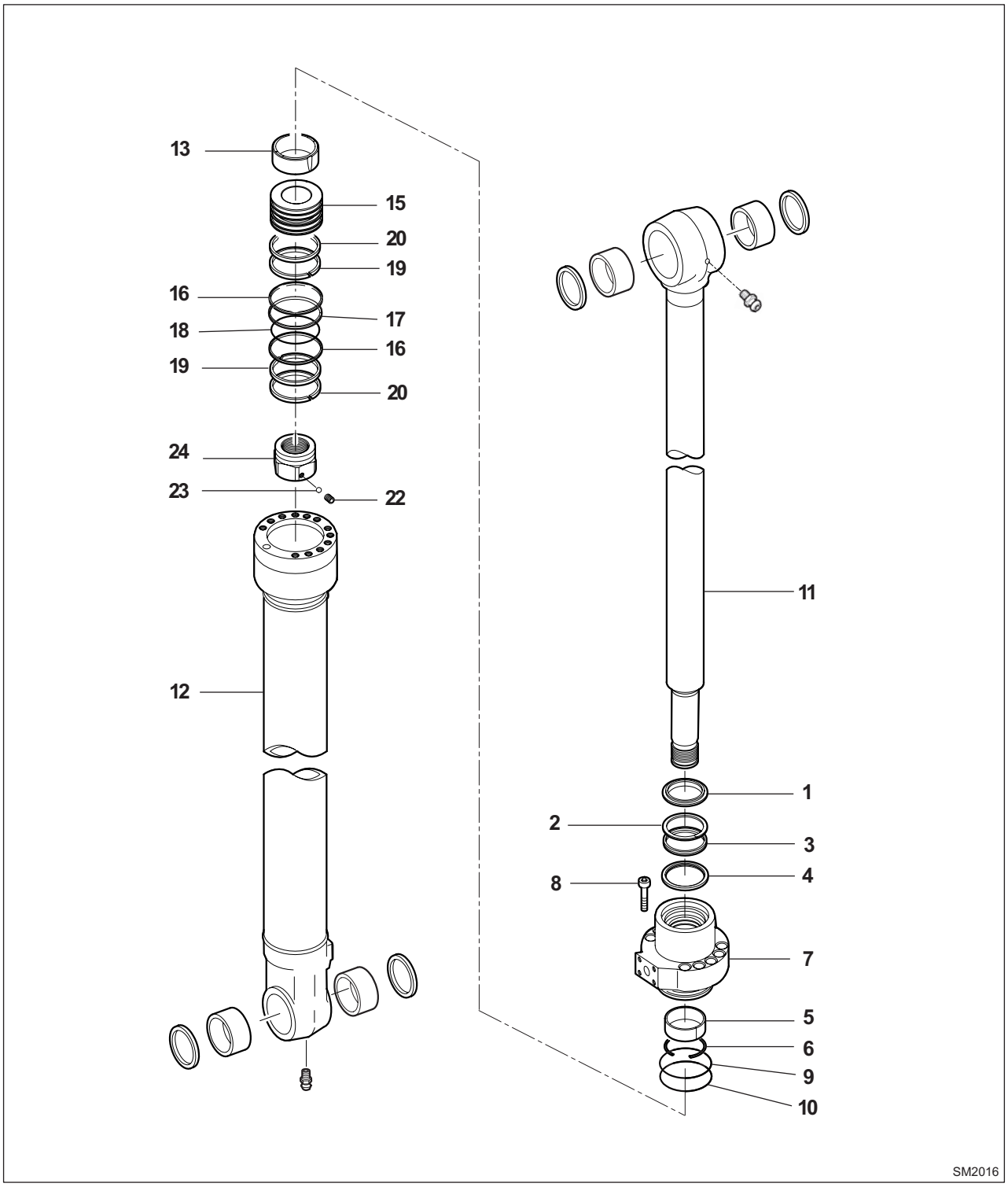
- Ensure the machine is parked on a level surface.
- Rest the bucket to the ground.
- Switch off the Auto-Idle, fully turn the engine speed manual control anticlockwise, stop the engine, remove the ignition key and move the safety lever in the locked position (**LOCK**).
- Use a hammer and punch to push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

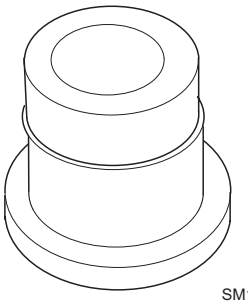
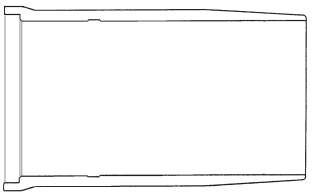


- Install a new rubber insert (**3**) inside lock pin (**1**).
- Clean the surface of bucket tooth (**4**) and insert a new tip.
- Insert lock pin (**1**) into its seat using a punch and hammer, until it is fully mounted.

CYLINDERS ASSEMBLY AND DISASSEMBLY
Bucket cylinder



1 - **Wiper Ring**
2 - **Backup Ring**
3 - **Seal**
4 - **Seal**
5 - **Bushing**
6 - **Snap Ring**
7 - **Cylinder Head**
8 - **Socket Bolt** (q.ty 12)
9 - **Backup Ring**
10 - **O-Ring**
11 - **Cylinder Rod**
12 - **Cylinder Tube**
13 - **Cushion Bearing**
15 - **Piston**
16 - **Backup Ring** (q.ty 2)
17 - **Seal Ring**
18 - **O-Ring**
19 - **Slide Ring** (q.ty 2)
20 - **Slide Ring** (q.ty 2)
21 - **Shim**
22 - **Set Screw**
23 - **Steel Ball**
24 - **Nut**

Tool for the installation and removal of the rod guide bushing: XXXXXXXXX for boom cylinders (Ø 115 mm) (4.53 in) XXXXXXXXX for bucket cylinder (Ø 120 mm) (4.72 in) XXXXXXXXX for arm cylinder (Ø 130 mm) (5.12 in)	 SM1371
Head installation tool: XXXXXXXXX for boom cylinders XXXXXXXXX for bucket cylinder	 SM1372

Precautions for work

JP30002010101001

1. General precautions

To ensure safety in work and to prevent accidents, observe the following items :

(1) Appearance
   a. Wear safety goggles.
   b. Do not wear watch, necktie, ring, bracelet, necklace, etc. to prevent accident before work.
   c. Bind long hair at the back.
   d. Be sure to wear a cap and safety shoes.

(2) Safety work
   a. Do not touch radiator, muffler, exhaust pipe, tail pipe, etc. after stop of the engine to prevent burn.
   b. Do not put your clothes or tools near the rotating part (in particular, cooling fan or V–belt) during operation of the engine.
   c. Remove the starter key when the engine is not started.
   d. Start the engine at a well ventilated place so that carbon monoxide may not be filled.
   e. Since gas from the fuel or the battery is flammable, do not spark a fire or smoke a cigarette near the area.
   f. Since the battery fluid is poisonous and corrosive, be careful for handling.
   g. Do not short-circuit the cable of the battery or starter. Otherwise, the cable may be burned or burn may occur.
   h. If a tool or rag is left in the engine compartment, it may be bounced with a rotating part of the engine, resulting in injury.
   i. To tow a failure machine, refer to “Towing” in the "Operation manual" of the machine.

2. Precautions for service work

Pay attention to the following points before service work

(1) Preparation before disassembly
   a. Prepare general tools, special tools and gauges before work.
   b. To disassemble a complicated area, put a stamp or match mark on the location not functionally affected to ease assembly. To repair the electric system, disconnect the cable from the minus terminal of the battery before work.
   c. Perform inspection according to the procedure in the text before disassembly.

(2) Inspection during disassembly
   Every time parts are removed, check the area where the parts are assembled and check for deformation, damage, wear or scratch.

(3) Arrangement of disassembled parts
   Place removed parts neatly in order. Separate parts to be replaced from parts to be reused.

(4) Washing of disassembled parts
   Clean and wash parts to be reused well.

(5) Inspection and measurement
   Inspect and measure parts to be reused as required.

(6) Assembly
   a. Keep the specified standard values (tightening torque, adjusting values, etc.) and assemble correct parts in the correct order.
   b. Be sure to use genuine parts for parts to be replaced.
   c. Use new packing, gasket, O–ring and cotter pin.
   d. Use seal gaskets for some areas where gaskets are used. Apply specified oil or grease to sliding areas where application of oil is required, and apply specified grease to the oil seal lip before assembly.

(7) Check of adjustment
   Make adjustments to the service standard values using a gauge or tester.

Assembly of joints and gaskets for piping

JP30002010102007

1. Tightening torque of joints

Unit : N·m{kgf·cm}

Sealing method / Tightening screw size	Gasket sealing method (Aluminum + Rubber or Copper)	Metal sealing method (Flare pipe type, nipple connector type)	
		Type A	Type B
M8	13{130}		
M10	20{200}		11{110}
M12	25{250}	20{200}	
M14	25{250}	31{320}	
M16	29{300}	39{400}	
M18	39{400}	59{600}	
M20	*39{400}	64{650}	20{200}
M24	69{700}		
M28	*127{1300}		

2. Joint assembly procedure and subsequent inspection

(1) Before assembly, make sure that there is no dirt or burr on the seating surface (mating part, pipe joint, gasket, etc.).

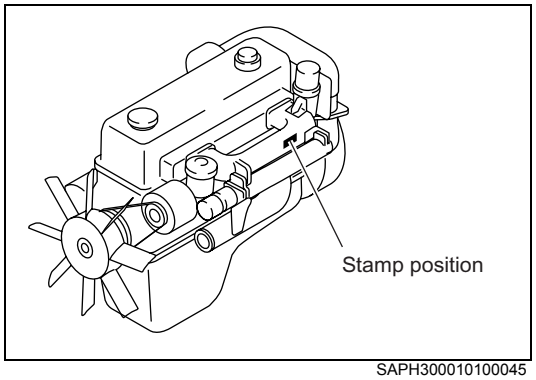
(2) Since pipes have some degrees of freedom for assembly, the seating surface tends to incline. Tighten pipes finally after temporary tightening to prevent leak.

(3) After tightening, apply the specified pressure to each pipe joint to ensure that there is no leak.

(4) Observe the values above for each tightening torque.
*When assembled soft washer # 4840FR-N (aluminum and rubber carbon pressure bonding) is loosened or removed, be sure to replace it with a new part. This is not necessary for normal retightening.

Chassis number and engine number

JP30002010401001



SAPH300010100045

1. Engine type and engine number

(1) Engine type and engine number are stamped at the left cylinder block.
For order of parts, information of this number will facilitate procedures smoothly.
Ex. P11C TB10001

Inspection item			Standard value	Repair limit	Operation limit	Action
Valve system	Valve stem outer diameter	IN	8{0.315}	—	7.88{0.3102}	Replace valve.
		EX	8{0.315}	—	7.88{0.3102}	
	Valve guide inner diameter	IN	8{0.315}	—	Refer to the main text.	Replace valve guide.
		EX	8{0.315}	—		
	Oil clearance between valve system and valve guide	IN	0.040 - 0.077 {0.0016 - 0.0030}	—	0.12{0.0047}	Replace valve or valve guide
		EX	0.057 - 0.094 {0.0023 - 0.0037}	—	0.14{0.0055}	
	Valve sink	IN	-0.05 - 0.35 {-0.0020 - 0.0137}	—	0.7{0.0275}	Replace valve or valve seat.
		EX	0.55 - 0.95 {0.0217 - 0.0374}	—	1.3{0.0511}	
	Valve seat angle	IN	30°	30° - 30°35’	—	Correction
		EX	45°	45° - 45°30’	—	
	Valve spring inner (IN)	Set length	54.1{2.130}	—	—	
	Valve spring inner (EX)	Set length	54.7{2.1535}	—	—	
	Valve spring inner (IN)	Set load	166.7N {17.0kgf, 37.5lbf}	—	153.0N {15.6kgf,34.4 lbf}	Replacement
	Valve spring inner (EX)	Set load	160.8N {16.4kgf, 36.2lbf}	—	147.1N {15.0kgf, 33.0lbf}	
	Valve spring inner	Free length	72.0{2.8346}	—	70.0{2.7559}	
	Valve spring outer (IN)	Set length	58.1{2.2874}	—	—	
	Valve spring outer (EX)	Set length	58.7{2.3110}	—	—	

3 PARTS TO BE PREPARED

Engine Body

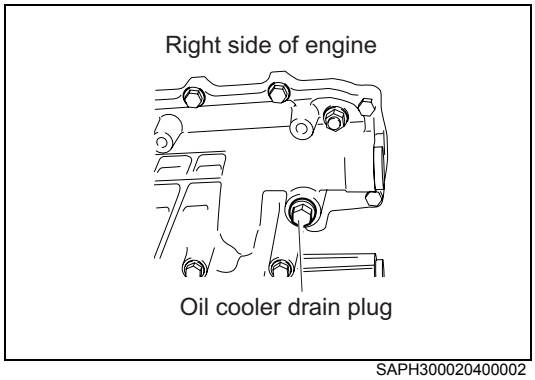
Removal

JP30002040702002

1. Preliminary work before removal of engine

(1) Place the machine on a level ground.

(2) Remove the battery cable from the battery minus terminal.



SAPH300020400002

2. Drain of coolant and engine oil

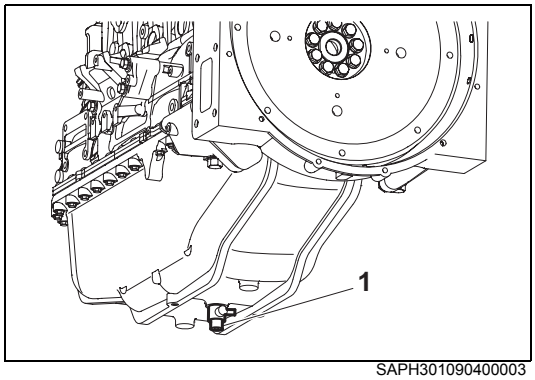
(1) Drain coolant from the radiator drain cock (1) and the oil cooler drain plug.

NOTICE

- **Removal of the filler cap facilitates quick drain.**
- **Connection of an appropriate hose to the oil cooler drain pipe facilitates drain of coolant without spread.**

⚠ CAUTION

- **To prevent burn, drain coolant after the temperature is sufficiently low.**
- **To dispose coolant, observe the specified method (waste disposal) or the method with attention to environment.**

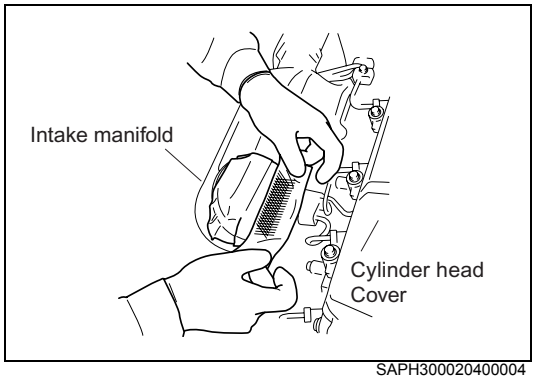


SAPH301090400003

(2) Drain engine oil from the oil pan drain plug as required.

⚠ CAUTION

- **To prevent burn, drain coolant after the temperature is sufficiently low.**
- **Dispose coolant according to the specified method (waste treatment) or with a method considering the environment.**



SAPH300020400004

3. Removal of intake hose, intercooler hose and exhaust pipe

(1) Loosen the clamp and remove the intake hose.

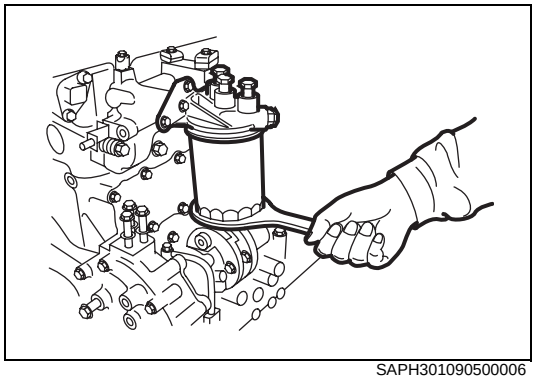
(2) Remove nuts and remove the exhaust pipe.

⚠ CAUTION

- **Close the opening of the intake manifold with a packing tape to prevent entry of dirt inside the engine.**

Replacement of the fuel filter

JP30109050704001



SAPH301090500006

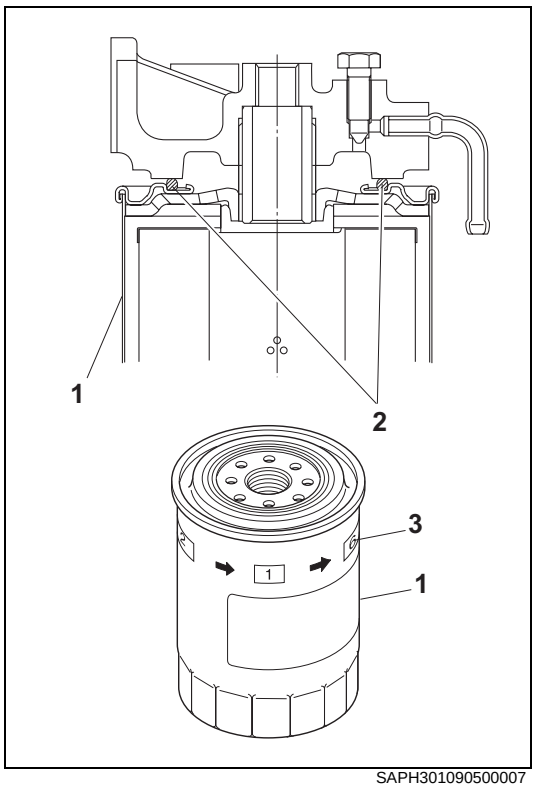
1. Fuel filter removal

(1) Use the special tool and remove the fuel filter.

Special tool : 09553-1010 Fuel filter wrench

⚠ CAUTION

- **Prepare a tray because the filter contains diesel fuel**
- **Do not use a commercial chain-type filter wrench or similar to remove the filter. This can cause scratches or deformation for the outer circumference, which can lead to fuel leakage and fire.**
- **For disposal of fuel, observe the local disposal procedure.**



SAPH301090500007

2. Fuel filter installation

(1) Remove dirt and foreign matter from the installation surface.

(2) Apply a thin coating of diesel oil to the gasket (2) of the new fuel filter.

(3) Turn the fuel filter clockwise by hand until the gasket (2) comes into contact with the body seal face.

⚠ CAUTION

- **Confirm that the gasket (2) is in positive contact with the seal surface.**

(4) Use the special tool and tighten for approximately another 2/3 turns.

⚠ CAUTION

- **At the time of installation, take care that the gasket (2) is not damaged by twisting.**
- **Replace the gasket (2) by the new one in the element kit (1).**
- **Do not reuse an element (1).**
- **After work, wipe off spilled fuel. After start of the engine, make sure that there is no fuel leak.**
- **Do not use a commercial chain-type filter wrench or similar to install the filter. This can cause scratches or deformation for the outer circumference, which can lead to fuel leakage and fire.**

NOTICE

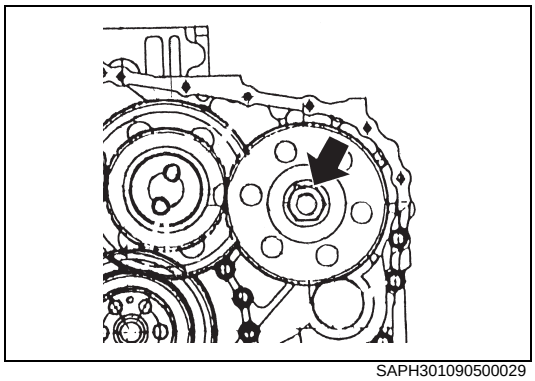
- **The scale markings (3) are in the order of 1→2→3→4→5→6→1→2..., and one gradation corresponds to 60°.**
- **The above 2/3 turns corresponds to 4 gradations (240°), and element (1) and body should be marked before turning.**

Overhaul of supply pump drive bearing case

JP30109050702001

1. Removal of timing gear case cover

"Reference: Engine mechanical, timing gear cover and flywheel housing, timing gear case cover replacement"

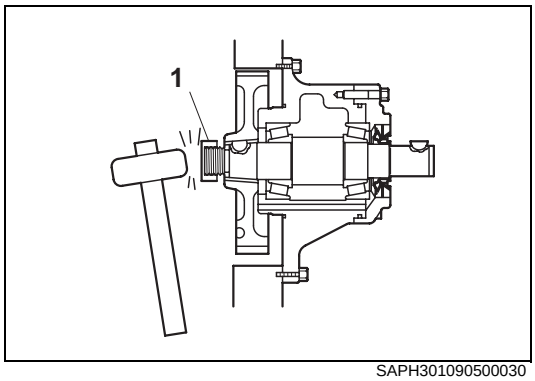


SAPH301090500029

2. Removal of supply pump drive gear

(1) Remove the drive gear mounting nut.

(2) Remove the oil pipe connected to the supply pump drive bearing case.

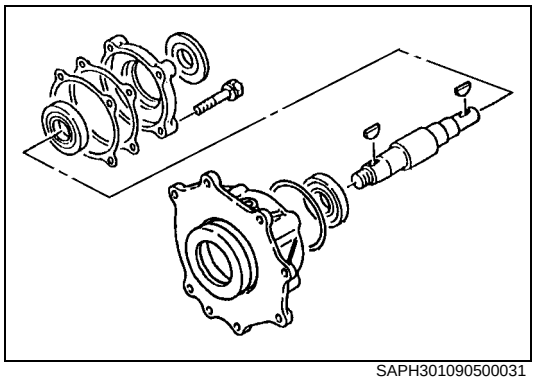


SAPH301090500030

(3) Pull out the gear using a special tool or install a box nut (1) on the shaft, hit the shaft with a copper hammer, loosen and remove the gear with impact.

Special tool : 09420-1111 Timing gear puller

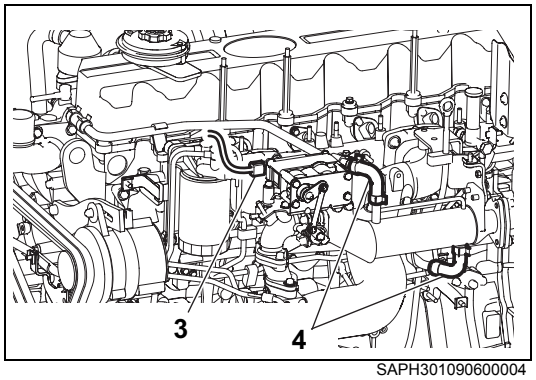
(4) Remove the supply pump drive bearing case.



SAPH301090500031

3. Disassembly of supply pump drive bearing case

(1) Remove the bolt and disassemble the supply pump drive bearing case.



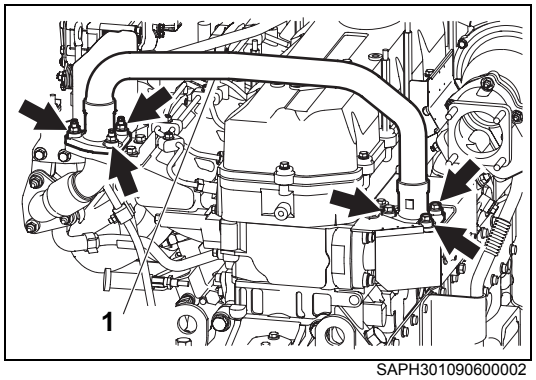
SAPH301090600004

(5) Connect the coolant hose (4) to be connected to the EGR cooler.

(6) Connect the wiring (3) to be connected to EGR valve and EGR cooler.

(7) Return the shifted engine harness to its original position.

(8) Fill up coolant.



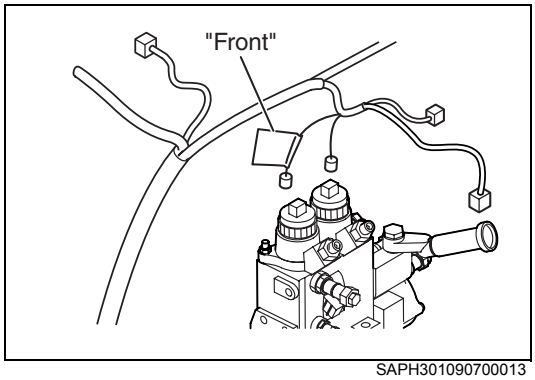
SAPH301090600002

6. EGR pipe installation

(1) Replace the gaskets by new ones and install EGR pipe (1).
Tightening torque:72N·m{734kgf·cm,53 lbf·ft}(Nut)

Installation of components

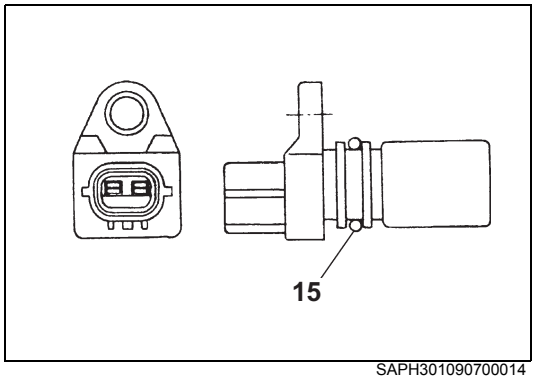
JP30109070702001



SAPH301090700013

1. Pressure control valve (PCV) wire

⚠ CAUTION
- **Wire the main harness with the "Front" label to the pressure control valve.**



SAPH301090700014

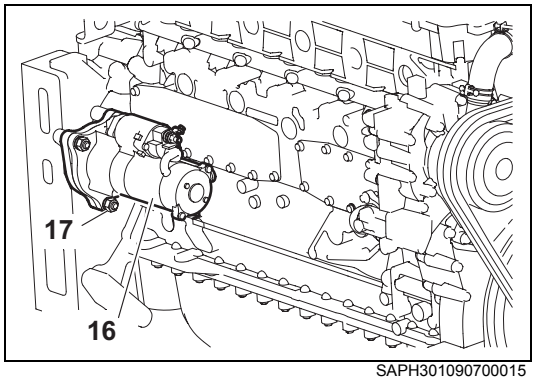
2. Installation of engine speed sensor (main)

(1) Make sure that the sensor has an O-ring (15). Install the sensor on the upper surface of the flywheel.

NOTICE
- **Since this sensor is a flange type, gap does not have to be adjusted.**

Installation of starter

JP30109070702002



SAPH301090700015

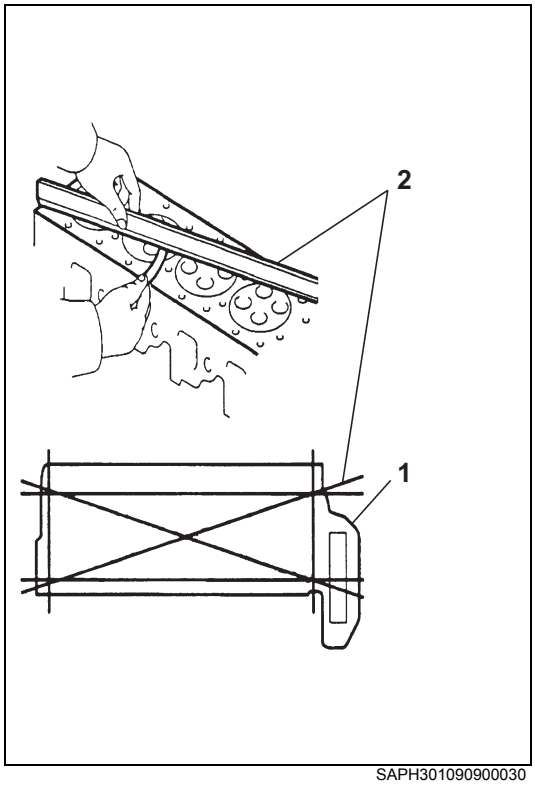
1. Installation of starter

(1) Install the starter (16) with bolts and nuts (17).

Tightening torque : 127 N·m {1,300 kgf·cm, 94 lbf·ft}

Tightening torque

11185	69N·m{700kgf·cm,51 lbf·ft}	9191-08401	25N·m{250kgf·cm,18 lbf·ft}
11185A	118N·m{1,200kgf·cm,87 lbf·ft}+90°+90°	9349A	30N·m{300kgf·cm,22 lbf·ft}
11185B	118N·m{1,200kgf·cm,87 lbf·ft}+90°+90°	9412-10301	54N·m{550kgf·cm,40 lbf·ft}
9068-10250	68.5N·m{700kgf·cm,51 lbf·ft}	9412-10551	54N·m{550kgf·cm,40 lbf·ft}
9068-10350	68.5N·m{700kgf·cm,51 lbf·ft}	9412-10851	54N·m{550kgf·cm,40 lbf·ft}
9068-10600	68.5N·m{700kgf·cm,51 lbf·ft}	SZ109	25N·m{250kgf·cm,18 lbf·ft}



SAPH301090900030

(2) Measure distortion of cylinder head lower surface (1) using a ruler (2). If the measurement value is beyond the repair limit, grind and correct it.

Standard value (mm{in.})	Repair limit (mm{in.})
0.05{0.0019}	0.15{0.0059}

Replacement of timing gear case cover

JP30109090704004

1. **Removal of crankshaft front oil seal**
   Reference: "Engine mechanical, Timing gear cover and flywheel housing, Replacement of crankshaft front oil seal"

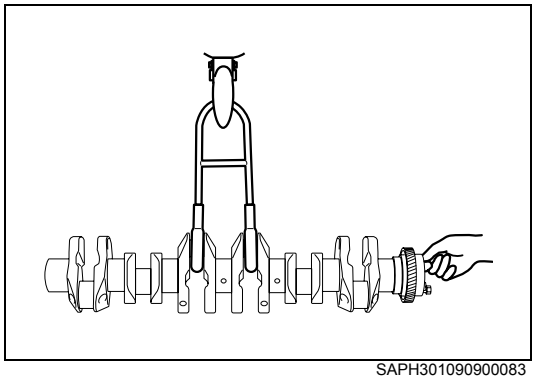
2. **Removal of timing gear case cover**
   (1) Remove bolts and remove the timing gear cover.

3. **Installation of timing gear cover**
   (1) Replace the gasket and O–ring with new ones and install the timing gear cover.
   Tightening torque : 44 N·m {450 kgf·cm, 32 lbf·ft}
   (2) Cut the gasket projecting to the engine lower surface so that it becomes a flat surface.

4. **Installation of crankshaft front oil seal**
   Reference: "Engine mechanical, Timing gear cover and flywheel housing, Replacement of crankshaft front oil"

Replacement of crankshaft

JP30109090704006

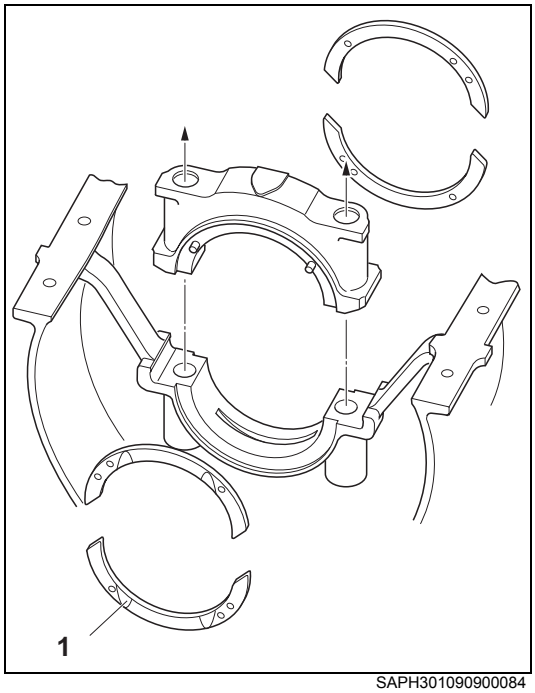


SAPH301090900083

1. Removal of crankshaft

(1) Remove the main bearing cap and the crankshaft bearing. Remove the crankshaft using a hoist.

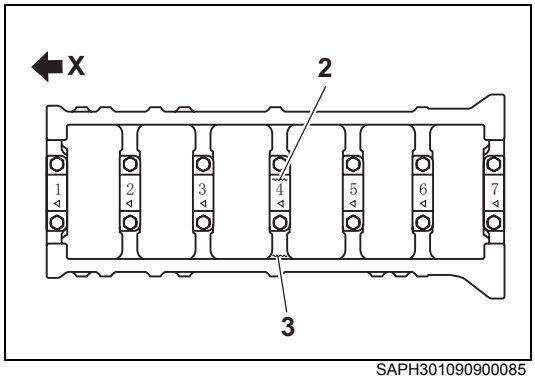
⚠ **CAUTION**
- **Since the part is heavy, be careful for handling.**
- **Store removed main bearing caps and crankshaft bearings for each cylinder number.**



SAPH301090900084

2. Installation of crankshaft

(1) Place the bearing with oil hole on the cylinder block and apply engine oil.
(2) Place the crankshaft.
(3) Align the bearing with no hole with the bearing cap and apply engine oil.
(4) Insert the thrust bearing applied with engine oil between the crankshaft and the cylinder block so that the dented surface (1) faces outside.
(5) Apply engine oil to the thrust bearing at the cap side in the same way and install the cap with the dented surface (1) facing outside.



SAPH301090900085

(6) Install it so that the triangular mark on the main bearing cap faces the front of the engine (X).

⚠ **CAUTION**
- **Check the stamp number (2) of each main bearing cap with the stamp number (3) of the cylinder block.**

(7) Apply engine oil to the bolt seating and the bolt thread of the main bearing cap bolt and tighten the bolts three times from the center to outside.

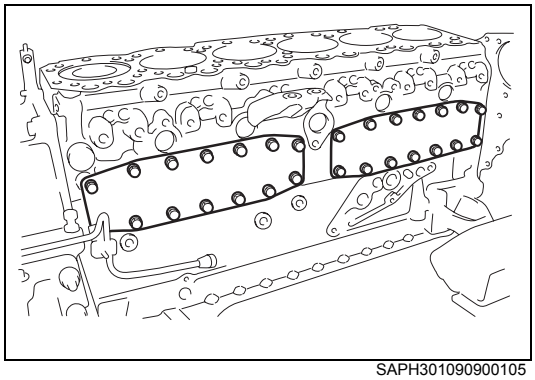
⚠ **CAUTION**
- **Loosen the No. 4 cap bolt, tap the front/rear ends of the crankshaft with a plastic hammer for initial fit and tighten it while sometimes turning the crankshaft.**

Tightening order : 4—3—5—2—6—1—7
Tightening torque : 274 N·m {2,800 kgf·cm, 200 lbf·ft}

(8) Make sure that the crankshaft turns smoothly.

Removal of camshaft

JP30109090702004

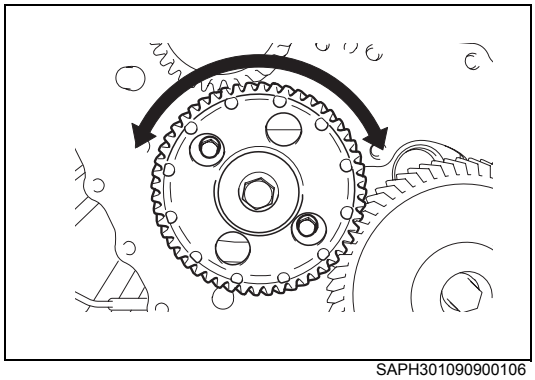


SAPH301090900105

1. Removal of push rod cover

(1) Remove the push rod cover on the side of the engine.

(2) Hold the roller tappet so that it does not fall using a special tool.
Special tool : 09451-1040 Stopper



SAPH301090900106

2. Removal of camshaft

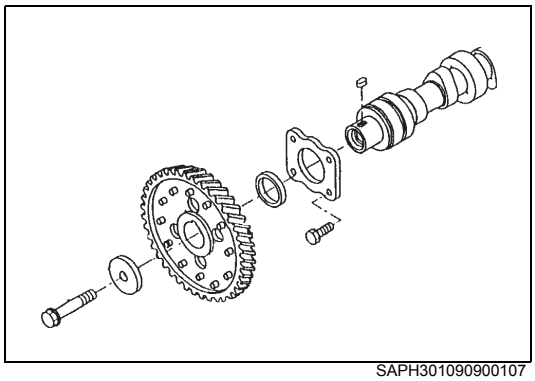
(1) Turn the camshaft gear, align the camshaft gear hole with the thrust plate mounting bolt position, remove the bolt and remove the shaft.

⚠ CAUTION
- **Pull out the cam bearing so that it is not damaged.**

NOTICE
- **Refer to the following for installation of the camshaft.**
  Reference: "Engine mechanical, Camshaft and idle gear, Installation of camshaft"

Disassembly of camshaft

JP30109090702005



SAPH301090900107

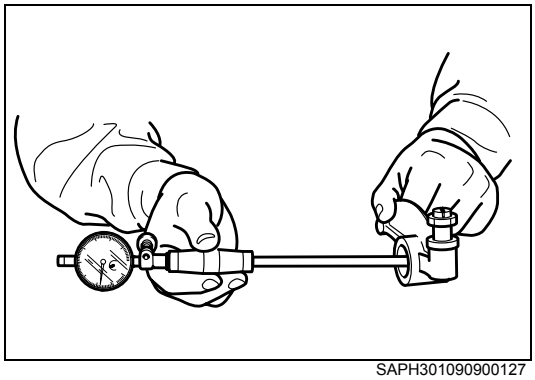
1. Removal of camshaft

(1) Fix the camshaft through an aluminum plate, etc. with a vice and remove the camshaft gear bolt.

⚠ CAUTION
- **Prevent faulty conditions on the gear such as deformation, impact, scratch, etc.**

(2) Pull out the main bearing from the crankshaft using a special tool.
Special tool : 09420-1111 Timing gear puller

NOTICE
- **Refer to the following for inspection and disassembly of the camshaft.**
  Reference: "Engine mechanical, Camshaft and idle gear, Inspection of camshaft"
  Reference: "Engine mechanical, Camshaft and idle gear, Assembly of camshaft"

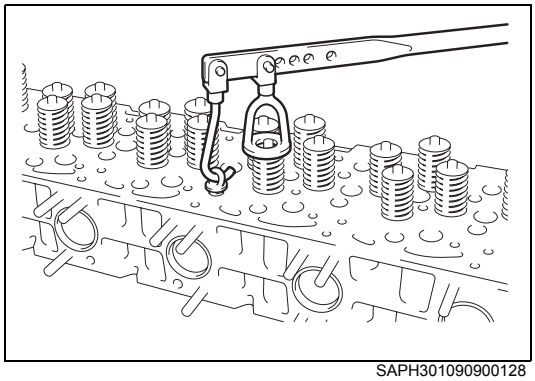

SAPH301090900127

(2) Measure the rocker arm bushing inner diameter using a cylinder gauge.

Standard value (mm{in.})	Operation limit (mm{in.})
28{1.102}	28.08{1.1055}

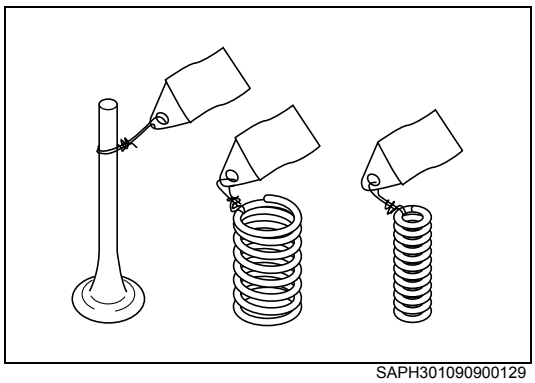
(3) Calculate the difference between the outer diameter of the rocker shaft and the inner diameter of the rocker arm bushing. If it is beyond the standard value, replace the rocker shaft or the rocker arm bushing.

Standard value (mm{in.})	0.044 - 0.120 {0.0018 - 0.0393}


SAPH301090900128

3. Removal of valve spring

(1) Compress the valve spring from the cylinder head using a special tool and remove the valve spring retainer.
Special tool : 09470-1120 Valve spring press


SAPH301090900129

(2) Remove the intake and exhaust valves.

⚠ **CAUTION**
- **Attach a tag with the applicable cylinder number to the valve so that combinations of the valve and the cylinder head may not be mixed.**

10 EXHAUST

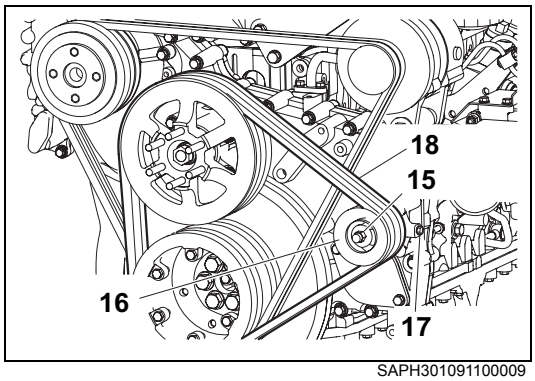
Replacement of fan drive, tension pulley

jp30109110704001

1. Removal of fan drive, tension pulley

(1) Remove the cooling fan.

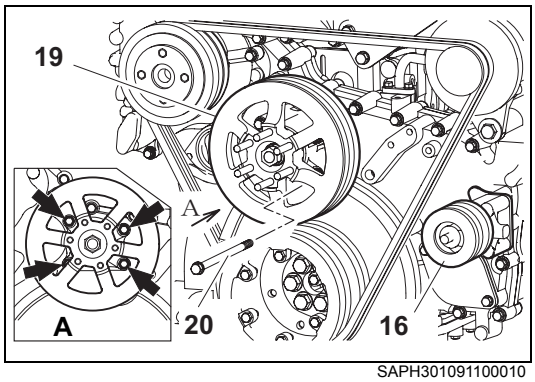
(2) The pulley fixing nut (15) of the tension pulley (16), loosen the adjusting bolt (17) and remove the V belt (18).



SAPH301091100009

(3) Loosen the four fan drive mounting bolts (20) and remove the fan drive (19) from the timing gear case cover.

(4) Remove the tension pulley (16).

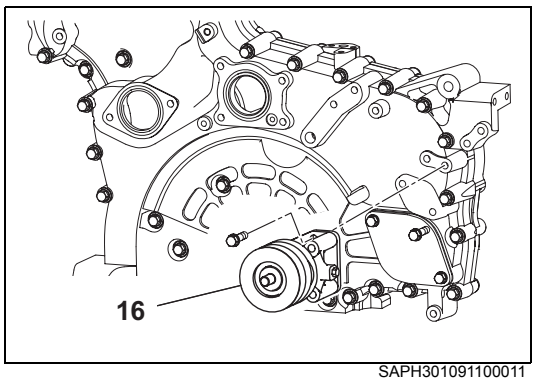


SAPH301091100010

2. Installation of fan drive, tension pulley

(1) Install the tension pulley (16) assembly on the timing gear case cover with the tension pulley bracket.
Install the pulley fixing nut temporarily.

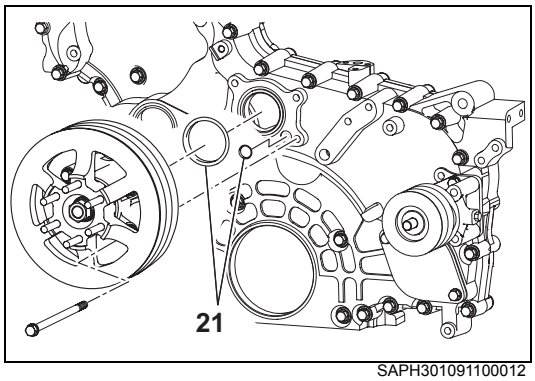
Tightening torque : 55 N·m {560 kgf·cm, 40 lbf·ft}



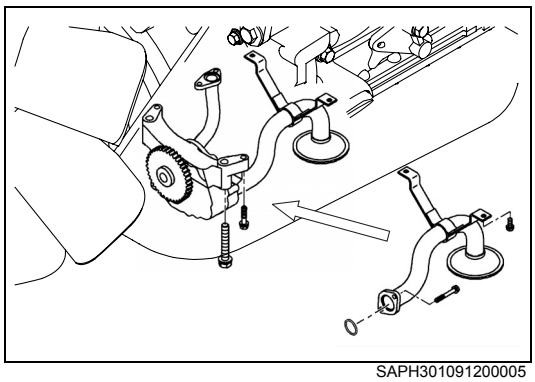
SAPH301091100011

(2) Install two new O–rings (21) on the O–ring groove at the timing case cover side and install the fan drive assembly on the timing gear case cover.

Tightening torque : 47 N·m {480 kgf·cm, 35 lbf·ft}



SAPH301091100012



SAPH301091200005

(2) Replace the O-ring with a new one and install the oil strainer.

Tightening torque : 23 N·m {230 kgf·cm, 17 lbf·ft}

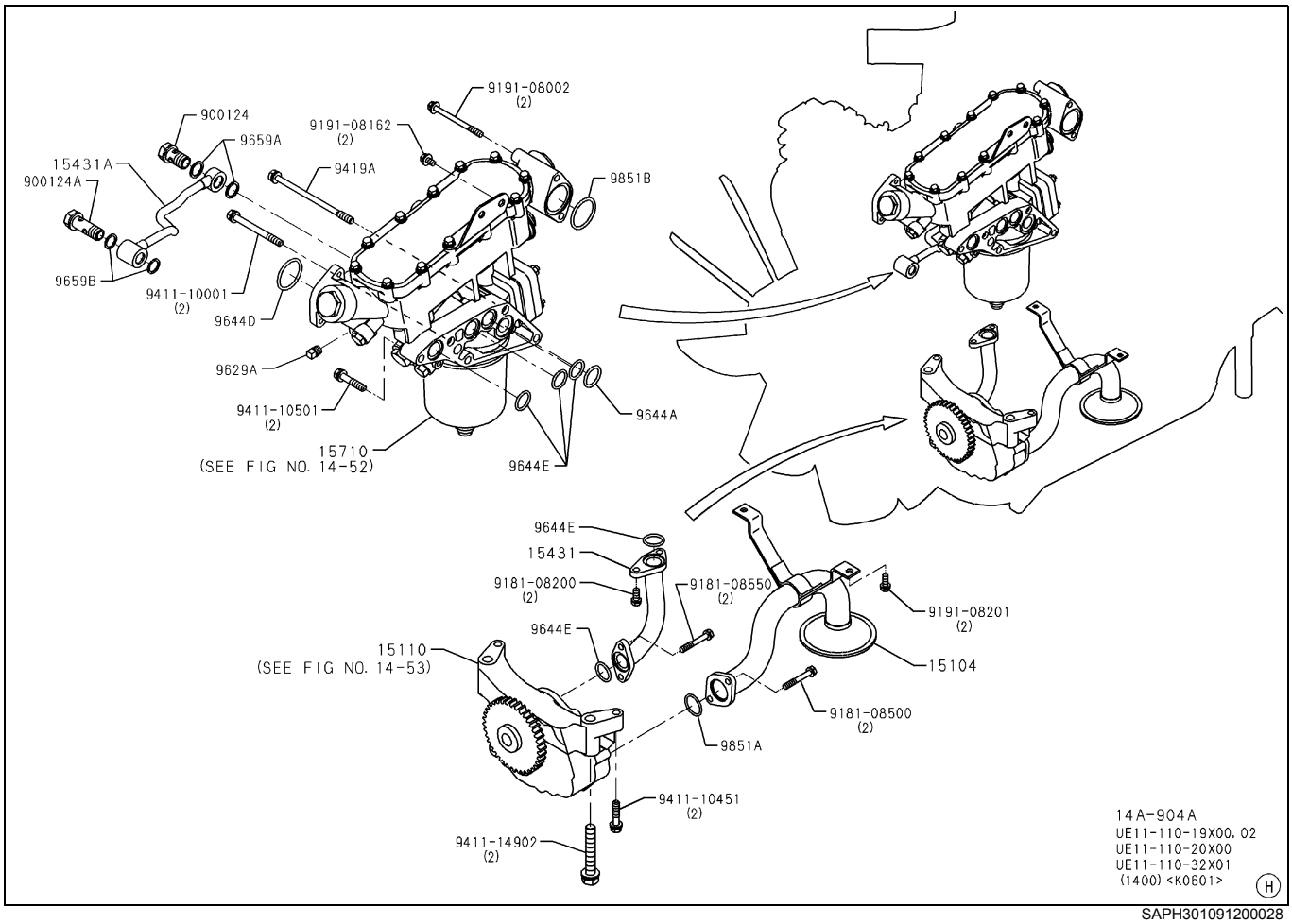
⚠ **CAUTION** • **In installation, be careful that the O-ring may not be caught.**

3. Installation of oil pan
"Reference: Lubrication, Oil pan, Replacement"

Oil cooler

Part layout

JP30109120402005



SAPH301091200028

15431A	Coolant pipe	9644E	O-ring*
15710	Oil cooler assembly	9659A	Gasket*
9644A	O-ring*	9659B	Gasket*
9644D	O-ring*		

*Parts not to be reused.

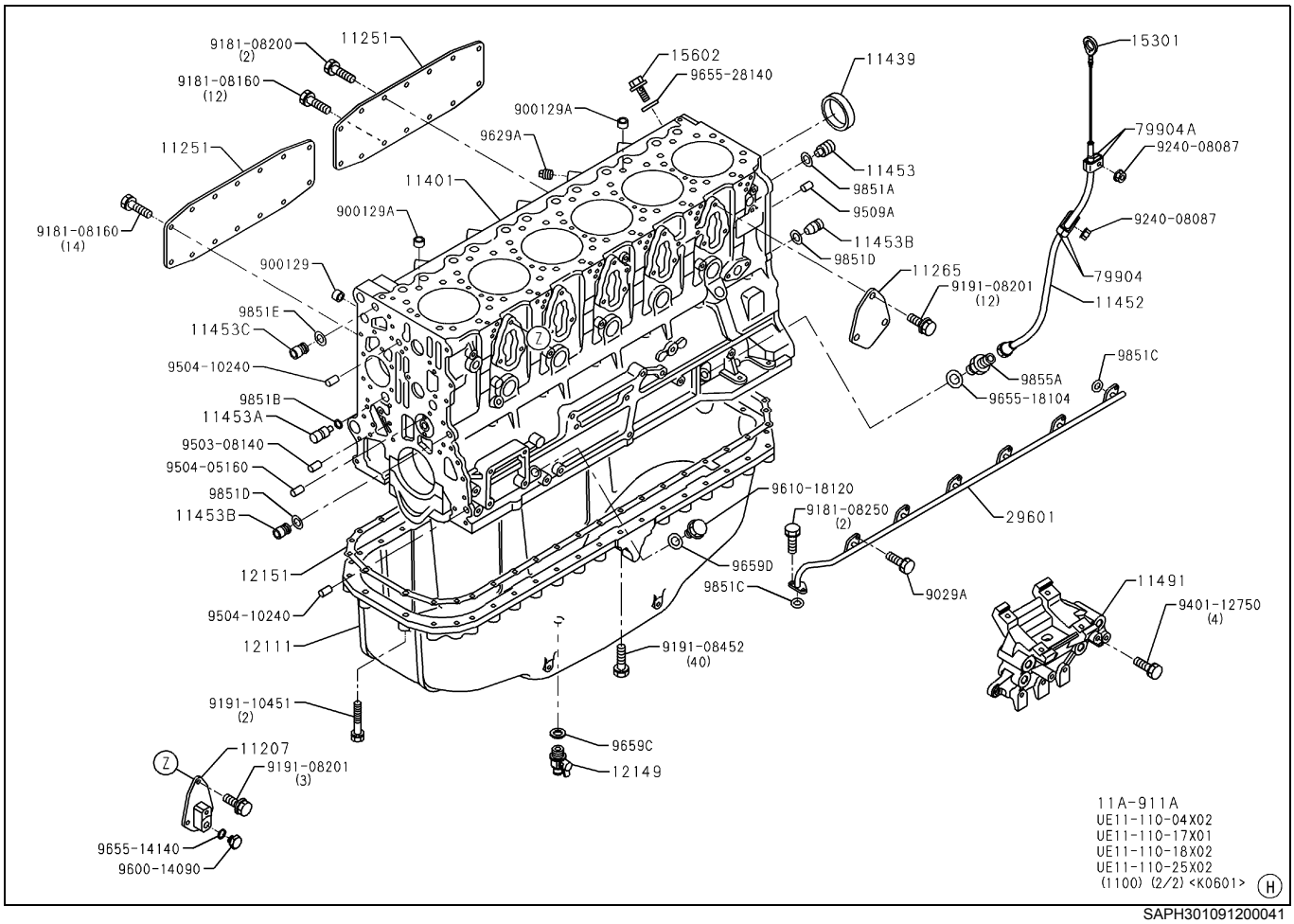
Tightening torque

900124	39N·m{400kgf·cm,29 lbf·ft}	9411-10001	47N·m{480kgf·cm,35 lbf·ft}
900124A	39N·m{400kgf·cm,29 lbf·ft}	9411-10501	55N·m{560kgf·cm,40 lbf·ft}
9191-08002	25N·m{250kgf·cm,18 lbf·ft}	9419A	47N·m{480kgf·cm,35 lbf·ft}

Oil pan

Part layout

JP30109120402004



SAPH301091200041

12111	Oil pan	12151	Gasket*
12149	Drain cock	9659C	Gasket*

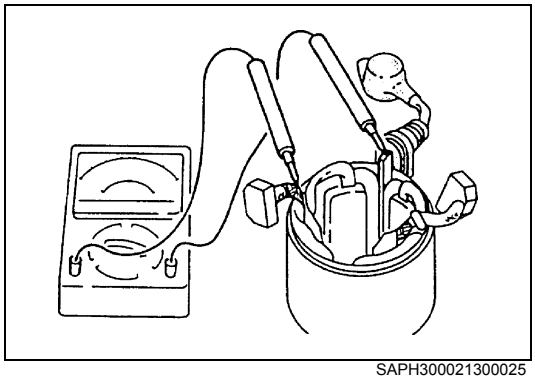
*Parts not to be reused.

Tightening torque

12149	69N·m{703kgf·cm,51 lbf·ft}	9191-10451	51N·m{520kgf·cm,38 lbf·ft}
9191-08452	31N·m{320kgf·cm, 23 lbf·ft}		

Inspection of components

JP30002130703001

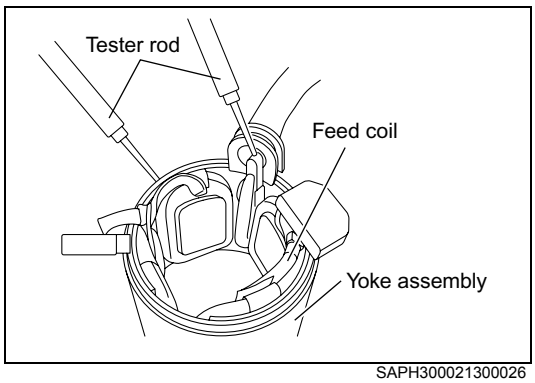


SAPH300021300025

1. Inspection of yoke assembly

(1) Make sure that the coil lead wire has electric continuity using a circuit tester.

(2) Make sure that there is no discoloration at the coil.

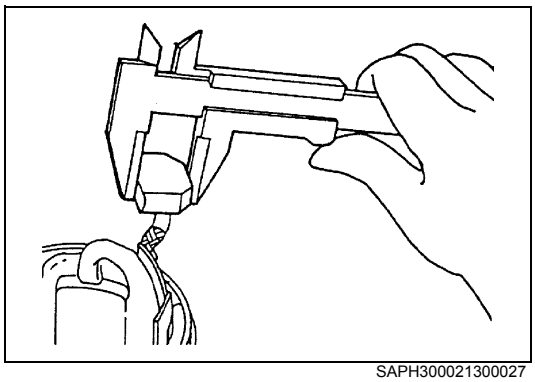


SAPH300021300026

(3) Measure the resistance between the coil lead wire and the yoke with a circuit tester and check insulation.
When the value is below the service limit, replace it.

Service limit	1kΩ or less

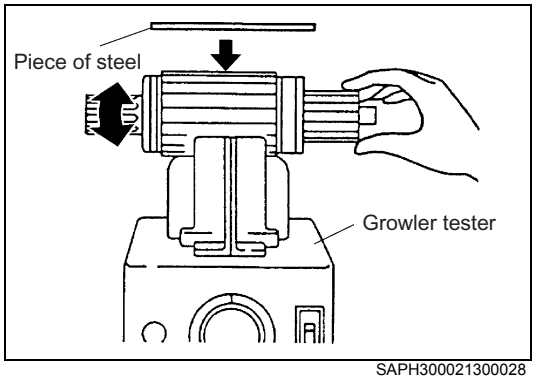
⚠ **CAUTION** • **After cleaning and drying, take measurements.**



SAPH300021300027

(4) Measure the brush length using vernier calipers.

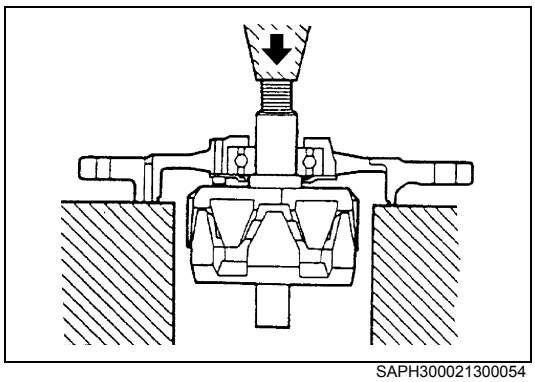
Standard value (mm{in.})	Service limit (mm{in.})
18{0.7087}	13{0.5118} or less



SAPH300021300028

2. Inspection of armature assembly

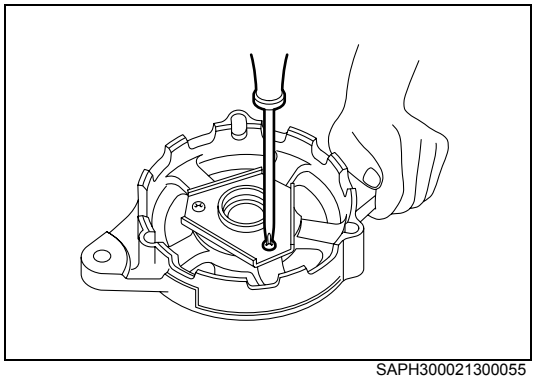
(1) Turn the armature assembly using a commercially available growler tester and put a piece of steel on the armature assembly. Make sure that the steel piece is not vibrating on the core circumference.



SAPH300021300054

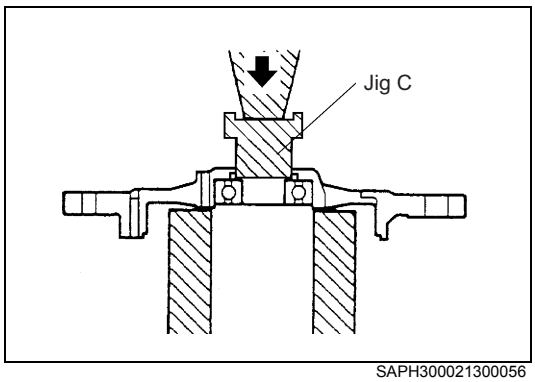
(2) Remove the rotor assembly using a press.

⚠ **CAUTION**
- **Do not damage the end of the thread.**
- **Support the rotor assembly to prevent fall of the rotor assembly.**



SAPH300021300055

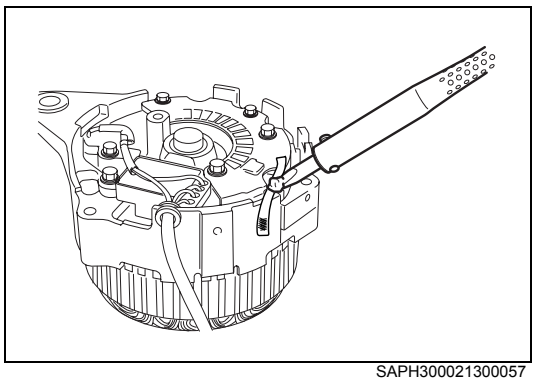
(3) Remove three bolts with a screwdriver and remove the bearing cover.



SAPH300021300056

(4) Remove the ball bearing from the front bracket using a press or jig C.

⚠ **CAUTION**
- **Place jig C at the inner race of the front bearing.**
- **Removed bearing must not be reused.**



SAPH300021300057

3. Disassembly of rear

(1) Remove solder of the lead wire connecting the stator coil and the diode using a soldering bit and suction line or a solder suction device

⚠ **CAUTION**
- **At solder of the stator coil and the diode, the end of the diode is clamped. Do not damage the diode by prying. Deformed diode must not be reused.**
- **Perform soldering in a short time (within 5 seconds).**

14 TURBOCHARGER

Status	Cause	Action
Piston seizure (lubrication unit)	Insufficient engine oil	Replenish engine oil
	Deterioration of engine oil	Replace engine oil
	Incorrect engine oil	Replace with correct engine oil.
	Low oil pressure	Inspection of lubrication unit
	Faulty oil pump	Replace oil pump
Piston seizure	Abnormal combustion	Refer to overheat section.
Piston seizure	Cooling unit	Refer to overheat section.
Insufficient engine power (air cleaner)	Clogging of air cleaner element	Clean or replace air cleaner element
Insufficient engine power	Overheat	Refer to overheat section.
Insufficient engine power (fuel unit)	Faulty injection of injector	Replace injector
	Faulty injector due to deposit of carbon	Replace injector
	Entry of air into fuel system	Air bleeding of fuel system
	Faulty fuel filter	Replace element
	Faulty fuel	Replace with correct fuel
Insufficient engine power	Abnormal compression pressure	Refer to overheat section.
Insufficient engine power	Piston, cylinder liner and piston ring	Refer to overheat section.
Faulty engine start (electric unit)	Faulty battery	Check battery
	Faulty wiring of starter	Replace starter wiring
	Loose battery cable	Tighten battery terminal connection or replace cable
	Faulty operation of starter	Replace starter assembly
	Faulty start assist unit	Replace start assist unit
Faulty engine start (air cleaner)	Clogging of air cleaner element	Clean or replace air cleaner element
Faulty engine start (fuel unit)	Insufficient fuel	Replenish fuel and bleed air from fuel system
	Clogging of fuel system	Clean fuel system.
	Air intake from connection of fuel system	Tighten connections
	Clogging of fuel filter	Replace fuel filter
	Loose connection of injection pipe	Tighten connecting nut of injection pump
Faulty engine start (injector)	Injector seizure	Replace injector
Faulty engine start (lubrication unit)	Excessive viscosity of engine oil	Replace with engine oil with correct viscosity
Faulty engine start (others)	Piston seizure	Replace piston, piston ring and cylinder liner
	Bearing seizure	Replace bearing and crankshaft
	Low compression pressure	Overhaul engine
	Damage to ring gear	Replace ring gear and replace starter pinion gear.

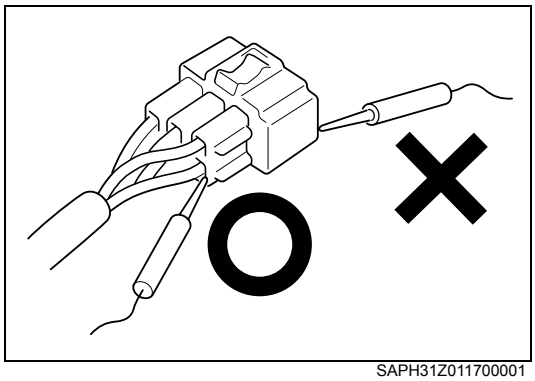
Engine ECU

Precautions

JP31Z01170102001

⚠ CAUTION

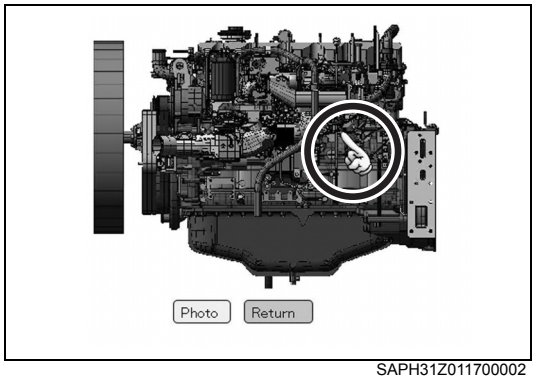
- **Make sure that each connector is connected before inspection.**
- **Do not place a tester rod on the connecting surface of the connector. Otherwise, terminals are damaged or short-circuited.**
- **Delete the past failure memory after recording. Perform failure diagnosis again to check current failure.**
- **After failure analysis, delete the past failure memory. If the past failure memory is not deleted, the failure indicator lamp remains ON.**
- **All connector drawings are viewed from the connecting surface. Place the tester rod from the back.**



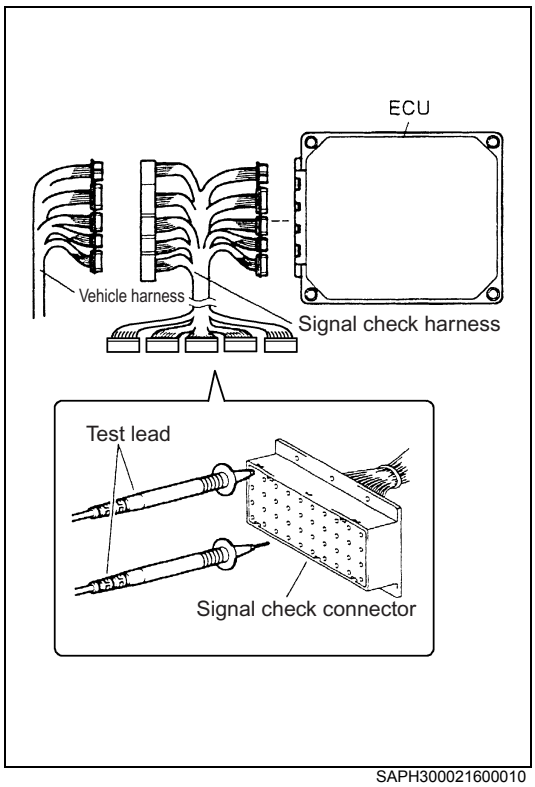
SAPH31Z011700001

NOTICE

- **The mounting position of each sensor is described in HinoDX with illustrations.**



SAPH31Z011700002



SAPH300021600010

2. Connection of signal check harness

(1) Set the starter key to "LOCK" and disconnect the connector from the engine ECU.

(2) Connect the signal check harness to the the engine ECU and the vehicle harness.

Signal check harness: 09049-1080

Engine speed main and sub sensor circuit malfunction (DTC code P0335)

JP31Z01170601006

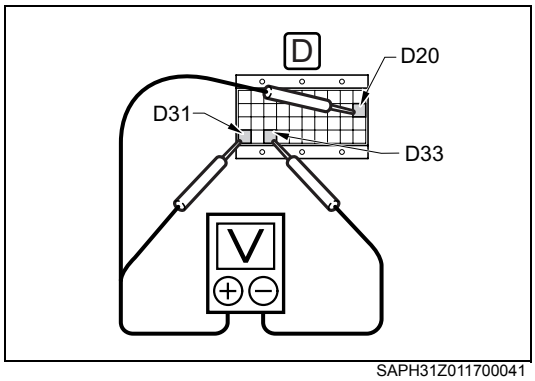
1	Inspection item

1. Take actions of (DTC code P0335) and (DTC code P0340).
"Reference : Engine speed main sensor circuit malfunction (DTC code P0335), Engine ECU, Engine diagnosis code"
"Reference : Engine speed sub sensor circuit malfunction (DTC code P0340), Engine ECU, Engine diagnosis code"

Excessive common rail pressure, supply pump excess forced feed (DTC code P0088)

JP31Z01170601016

1	Measurement of voltage between terminals



SAPH31Z011700041

1. Set the starter key to "OFF" and connect the signal check harness.
2. Start and warm-up the engine until the coolant gauge moves (failure code P0088 or 76 is displayed).
3. Set the engine speed to idling. PFIN = Approx. 25 MPa (approx. 1.5 V)
4. Measure the voltage between terminal D20/D31 and terminal D33 of the signal check harness.

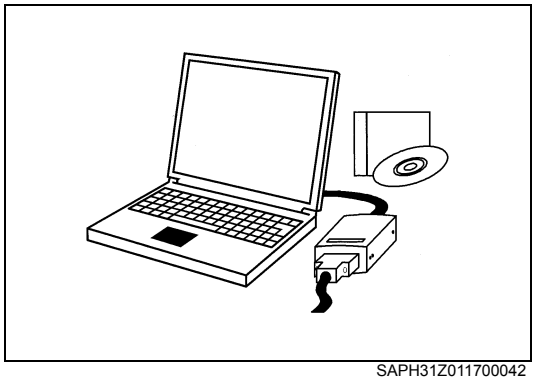
Standard value:1.56 V or less

NG → Common rail pressure sensor failure or engine ECU failure

OK

2	Check of failure code

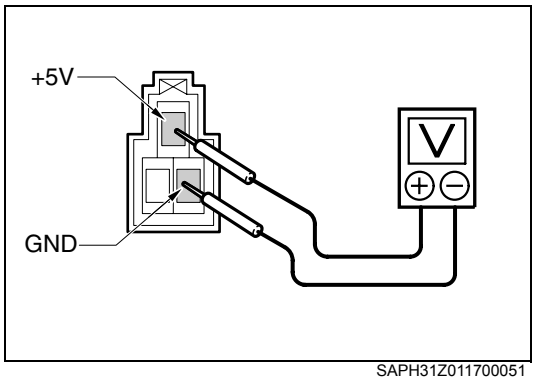
1. Make sure that other failure code is not output.
   If other failure code is output, repair the failure code and make sure again that failure code P0088 or 76 is output. In particular, if a failure code of the main and sub-engine speed sensor systems is output, make necessary repairs to prevent output of the code.
2. Check the fuel injection timing of the supply pump. If the timing is not set 0° for the top dead center, set it correctly.
3. When there is no error after the check above, delete the past failure and operate the engine.
   If the same code is output again, possible failures are the supply pump, common rail pressure sensor system and engine ECU. Perform more detailed diagnosis with HinoDX.


SAPH31Z011700042

Emergency accelerator sensor malfunction (DTC code P1133)

JP31Z01170601023

1	Power supply voltage measuring



SAPH31Z011700051

1. With the ECU connector connected, disconnect the sensor connector and measure the voltage between the power terminal (+5 V) and the GND terminal.

⚠ **CAUTION** • **The connector in the figure is seen from the fitting surface.**

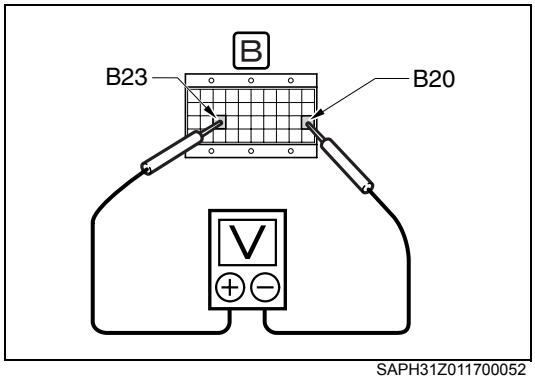
Standard value : 5.0 ± 0.5 V

NG → [2] Go to measurement of voltage between terminals.

OK

[3] Go to measurement of voltage between terminals.

2	Measurement of voltage between terminals



SAPH31Z011700052

1. Measure the voltage between terminals B20 and B23 of the signal check harness.

Standard value : 5.0 ± 0.5 V

NG → Engine ECU, engine ECU connector failure

OK

Harness failure