WSM

WORKSHOP MANUAL

KUBOTA EXCAVATOR

U25S
U20-3α
U25-3α

Service Chapter

Kubota

Code No.97899-61500

Record of Revisions

Symbol	Date	Main Revised Points & Corrective Measures	Person-in-charge
△1			
△2			
△3			
△4			

CONTENTS

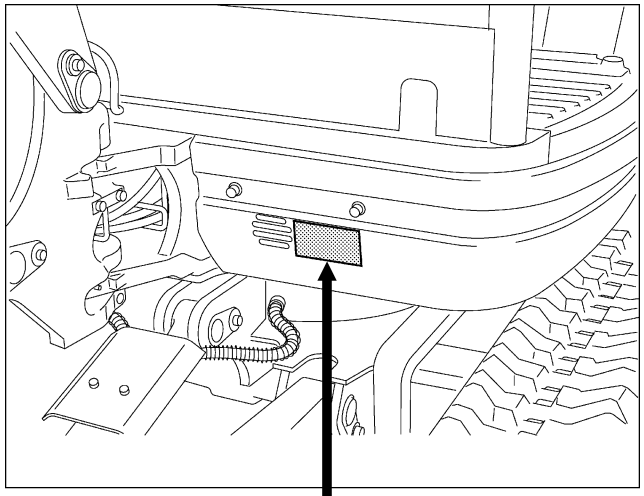
(Note)
U25S is for KTC, KCL and KTA, what we call, PP-version in this manual.
U20-3α and U25-3α are for KE, KUK and KBM, what we call, EU-version in this manual.

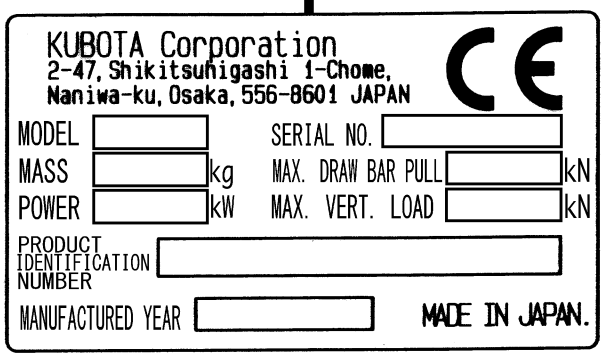
I General

A.Body and engine identification marks

If trouble should occur during use, or if servicing is necessary, contact the dealer who handles the machine. At that time please inform the machine model and engine type and serial numbers.

(1)Machine serial number





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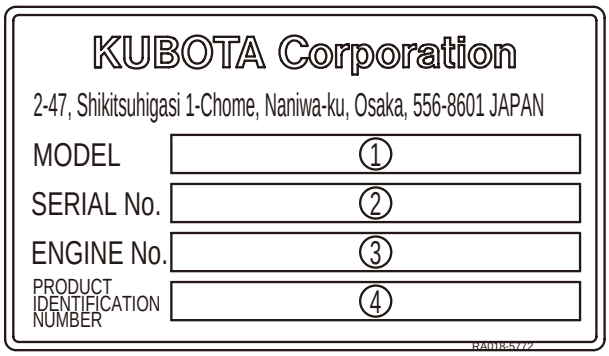
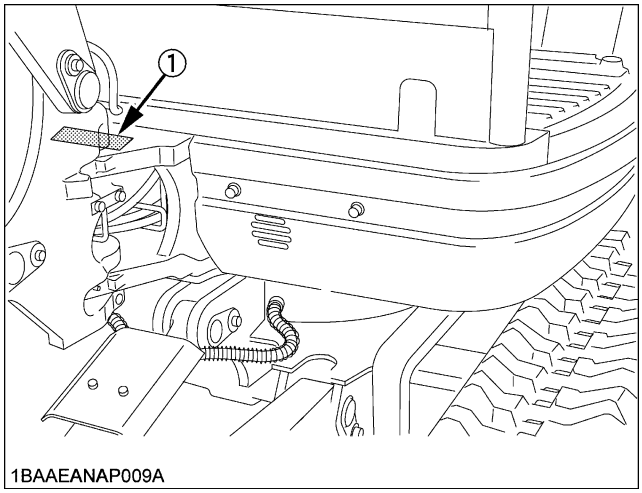
KTC, KCL, KTA-version



Name plate : Code No. RA018-57721

(2) Engine serial number
e.g. D1105-5L0025
"5" indicates year of 2005 and "L" indicates June. So, 5L indicates that the engine was manufactured in June 2005.

(3)Engine serial number



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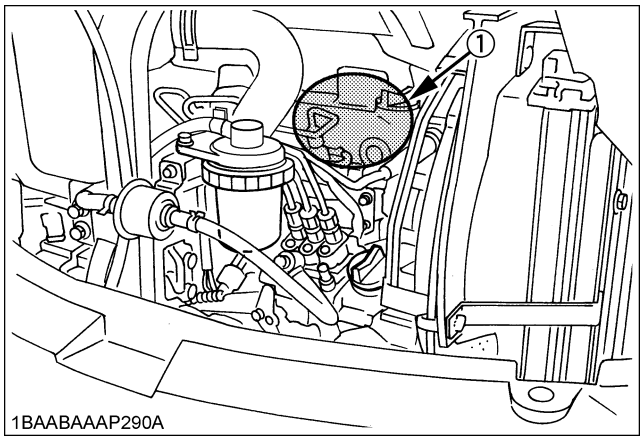

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(Engine production month code)

Month	Serial No.	
	0001~9999	10001~19999
Jan.	A	B
Feb.	C	D
Mar.	E	F
April	G	H
May	J	K
June	L	M
July	N	P
Aug.	Q	R
Sept.	S	T
Oct.	U	V
Nov.	W	X
Dec.	Y	Z

B. Safety precautions for servicing, disassembly and reassembly

⚠ Safety precautions for servicing

Most accidents during servicing arise from carelessness. Please remember that Safety involves both the welfare of the employees and improved work efficiency.

⚠ Safety precautions for Disassembly and reassembly

Machines must be disassembled and assembled efficiently and safely.
It is very important to thoroughly understand the construction and function of the machine, to make all appropriate preparations, and start operations according to the specified working procedures.

a. Safety measures before starting work

(1) Work clothes

1. Wear specified work cap and clothed. (Under no circumstances may workers wear undershirts only.)
   Cuffs must be kept buttoned, and any tears must be mended.)
2. Wear safety shoes.
3. Do not wear cotton gloves when working on the internal section of engine, reduction gears or hydrauric units for repair or others, or when using a hammer. Wear leather gloves, however, when hoisting wires.

(2) Inspecting equipment and tools

1. Prepare equipment (cranes, fork lifts, tool, etc.) required for servicing and inspect for any problems before starting work.
2. Hammer heads (metal parts) must be firmly secured to their handles.
3. Check hosting tools (wire ropes, hoisting chains, etc.) before use.

(3) Keep workshop in order

1. Secure appropriate space needed for disassembly to the job.
2. Secure a clean, safe place for arranging disassembled parts.
3. Store volatile substances (gasoline, light oil, thinner, oily articles, etc.) in appropriate containers at selected locations to prevent fire hazards.

b. Safety measures during work

(1) Protectors

1. Wear goggles when using chisels for chipping.
2. Use appropriate protectors during welding.
3. Wear a helmet when working with a crane or at elevated locations.

(2) Team work

1. When working with two or more people, divide the work and maintain close communication.
2. Crane work must be carried out using predetermined signals.

(3) Disassembly and assembly

1. Do not wear gloves when using hammers.
2. Use rods of the specified soft material for removing pins. Do not use a hammer as a pad.
3. Do not place fingers in holes when centering.
4. Heavy parts must be adequately supported before removing bolts.

(4) Cranes

1. In principle, use a crane for objects heavier than 44lb (20kg).
2. Crane operation and hoisting must be performed only by qualified personal.
3. Pay careful attention to the center of gravity when hoisting, and do not stand under the lifted objects.

(5) Others

1. To work under a jacked-up carrier, be sure to place wood pieces under it.
2. When charging batteries, make sure there are no open flames in the immediate vicinity.
3. All electric tools must be grounded.
4. Before welding the machine, remove the battery.
   - When removing the battery, be sure to disconnect negative (-) cord first.
   - When mounting the battery, be sure to connect the positive (+) cord first.

c. Preparation for disassembly

(1) Cleaning

Remove mud and dirt from the body before disassembly.

(2) Acceptance inspection

The machine must be checked before it is disassembled to record existing conditions, such as those listed below.

Model, serial number, and hourmeter reading

- Reason for repair and repair history
- Element stains
- Fuel and oil condition
- Parts damage *(Take photographs if necessary.)

(3) Equipment and tools

prepare equipment, tools, cranes and parts storage racks as required.

d. Precautions for disassembly and reassembly

(1) Disassembly

1. Follow the specified disassembly procedures.
2. Make alignment marks to insure correct reassembly.
3. Arrange disassembled parts in an orderly way, and attach identification tags or put marks if needed.

(2) Reassembly

1. Clean all parts before assembly. Repair any scratches or dents. Take special precautions against dirt and dust.
2. Parts with rust-preventive coatings must be assembles only after removing the coating.
3. Separated parts must be correctly reassembled using alignment marks.
4. As a rule, use a press to reassembled bearings, bushing and oil seals. Use pads when using a hammer.

C.IMPORTANT SAFETY PROCESS AND CRITICAL FUNCTIONAL PROCESS

The following instructions are related to essential adhesives, important safety process [S] and critical functional process [A] .Pay special attention in servicing these process. (Pay also close attention in reconnecting the electrical cables.)

a. Essential Adhesives

Type of screw adhesive

- Unless otherwise specified, use Three-Bond 1324 adhesive (medium-duty type). Keep the screw threads free of oil and water.

Type of instantaneous adhesive

- Use Three-Bond 1733 or Three-Bond 1741E adhesive. Keep the bond areas free of oil and water.

b. Important Safety Process [S] .

1. Reconnecting the fuel hose (clearance, hose routes, clamps, etc.)
2. Electrical cabling (engine, instrument panel, seat stand, etc.) (wiring routes, clamps and couplers)

c. Important Critical Functional Process [A] .

1. Setting up the travel wheel motor (tightening torque)
2. Reassembling the rotary joints (joint direction and shaft set-up)
3. Installing the swivel base bearing and the swivel motor (tightening torque)
4. Fitting the pump couplings (tightening torque)

D.IMPORTANT INSPECTION ITEMS AFTER REASSEMBLING

a Operate the Machine and check for Unusual Noise and Vibrations.

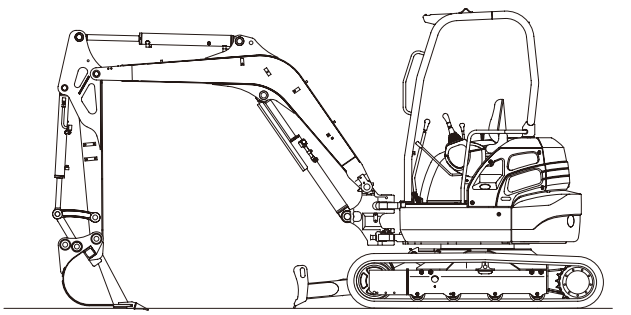
b Make Sure the Safety decals and Wireharness Clamps are in their Specified Positions.

c With the Machine Front in a Specified Posture, Check the Amount of Hydrauric Oil

Checking the oil level (For further details, refer to the Operator's Manual of each model.)

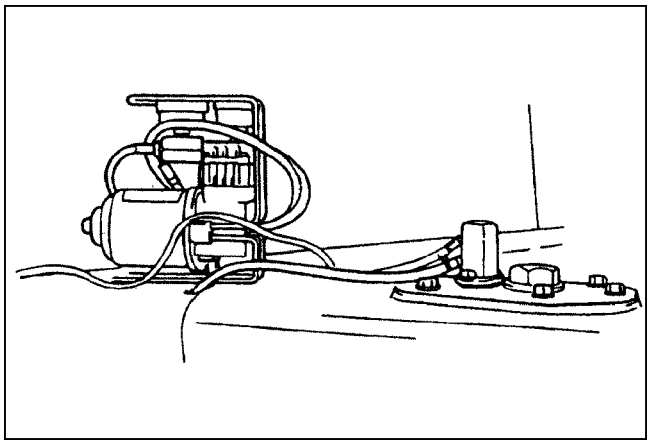
(1) Park the machine on a level ground.
(2) Make sure the hydrauric oil temperature is in the range of 10-30°C (50-86°F) and see if the oil level is within the specified zone of the oil level gauge.
(3) Keep the machine front as shown as following posture.

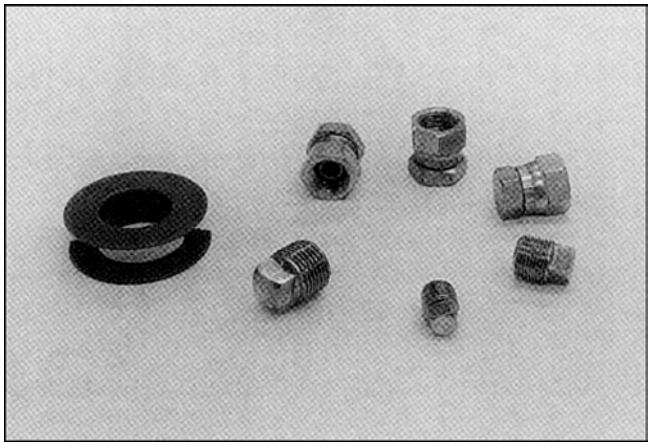
Posture: Extend the rods of the arm and bucket cylinders nearly half. Place the bucket on the ground, the offset swing at the center, and the dozer also on the ground.

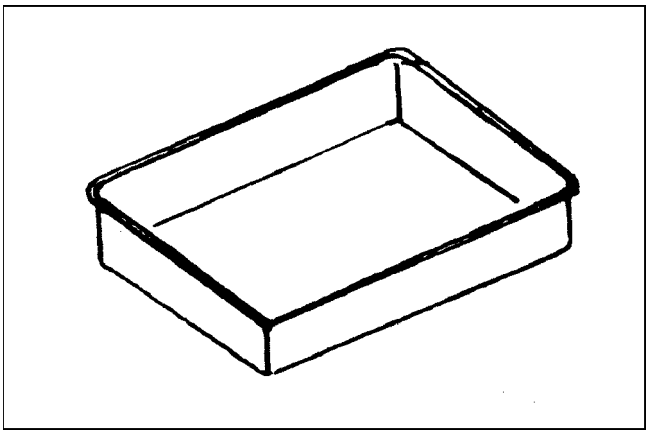


E.SERVICING FUNDAMENTALS

Locking adhesive







a. Items for Servicing

(1) Tighten bolts, nuts, adapters,and similar parts to their specified torques which are given in the list of tightening torques and adhesive as well as in this manual. Be sure to observe the specified torques for important tightened parts and components.

(2) Wipe out water, oil and grease off the screws on which LOCTITE adhesive is to be applied. Be sure to apply the adhesive to specified locations.

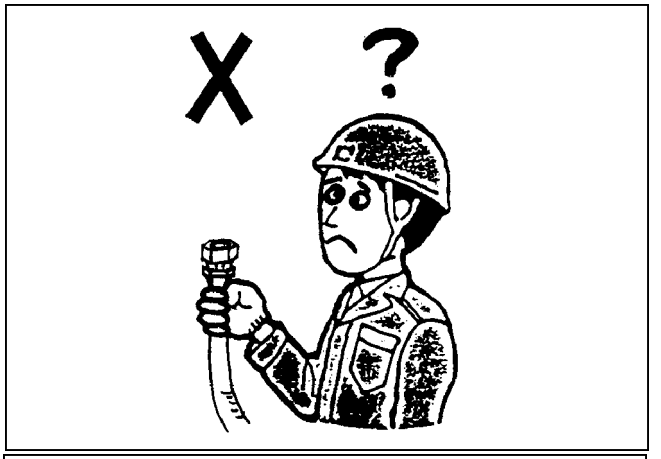
Types of screw adhesive
Equivalent to LOCTITE 271 (Heavy-duty) Equivalent to THREE-BOND 1305P (Heavy-duty) Equivalent to THREE-BOND TB1401B (Light-duty) Unless specified otherwise, use THREE-BOND 1324 (Medium-duty).

Type of instantaneous adhesive
Use THREE-BOND 1733 or 1741E

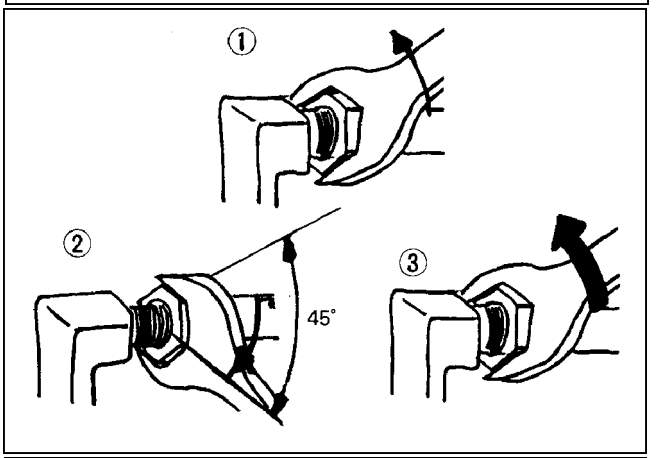
The word “LOCTITE“ in this manual denotes the red-color type.

(3) Precautions in disassembling the hydraulic equipment

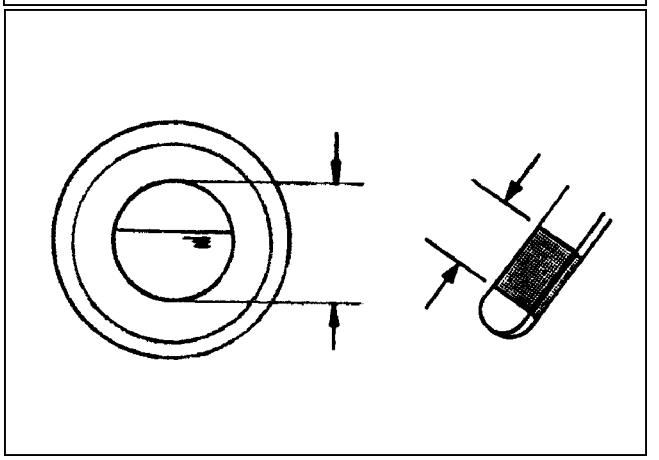
- Use a vacuum pump, plugs, oil pans, waste cloth and the like to prevent oil from running out or splashing.
  Wipe out leaking oil completely first and then add oil as required.
- Protect the openings with plugs, covers or the like to keep off foreign matters. Most of hydraulic system troubles are caused by the entry of foreign matters.
- Before reassembling, clean up the parts and components and apply hydraulic oil on them.
- The system consists of precision parts. Be careful not to scratch them and apply excessive force on them.



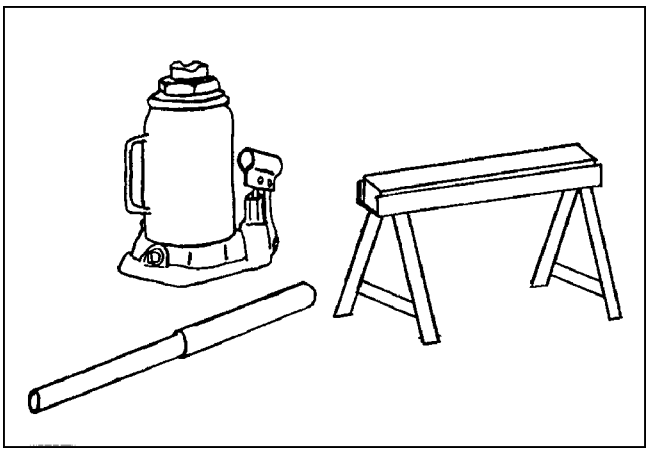
(4) Precautions in tightening hoses and pipes.
- Flexible hoses have a slight natural bend of their own. Utilize the natural bend. Be also careful not to twist them.
- Be careful not to confuse the routes of the hoses.
- Do not hold the hoses in tight contact with their adjacent parts and surfaces.



- Tightening steps
  1. First tighten the nut to its specified torque.
  2. Then loosen the nut by about 45° to fit the seat of the joint to the connection.

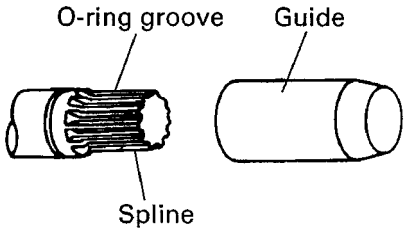


(5) The quantities of oil, fuel, water and others, except for the oil to be filled in the track rollers and idlers, are listed just as reference. Fill up the fluid up to the specified center level of a level gauge if it is provided.

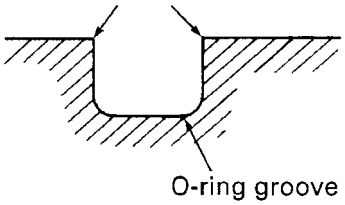


(6) Security support the machine with a jack and a supporting jig when it is jacked up for servicing.
(7) Be sure to use a crane in disassembling and reassembling heavy parts and components (frame, front attachment, crawler, etc.).

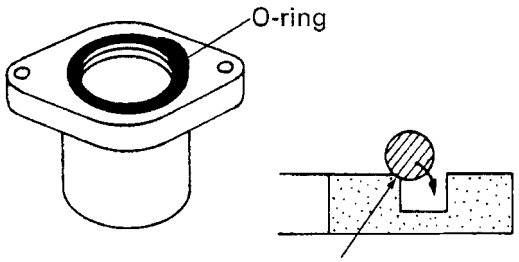
b. O-ring, Oil seal, Circlip and Roll Pin



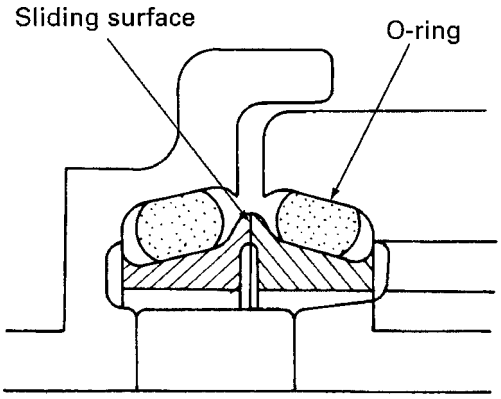
(1) General precautions
- Make sure the O-ring and the oil seal are free of anything unusual (uneven surface, scratches, chipping, etc.).
- Check the O-ring groove for burrs. Correct, if any, using an oil stone or the like.
- When putting a part past a sharp edge into position, protect such edge with a cover or get the part chamfered.



(2) O-ring
- Clean up the O-ring groove and deburr its edge as required.
- Before installing the ring, be sure to apply lubricant (grease) over it. (Do not do this to the floating seal.)
- Fit the O-ring into its groove without twist. With your fingertip, push the ring gently and evenly into the final position. Otherwise the ring would easily get twisted in contact with the inner edge of the groove.

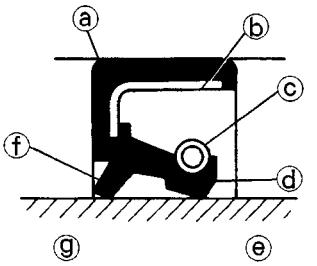


(3) Floating seal
- Be sure to wipe oil off the O-ring and the O-ring contact surface. (Note, however, that oil must be applied thinly over those of the wheel motor.)
- In fitting the O-ring into the floating seal, be careful not to twist the O-ring.
- Before installing the floating seal together with the O-ring, apply sealing oil thinly over the sliding surface. Be careful to keep the sliding surface and O-ring in alignment with the housing.
- Finally turn the floating seal 2 or 3 times by hand in order to form an oil film over the sliding surface as well as to get the sealing surface well it.

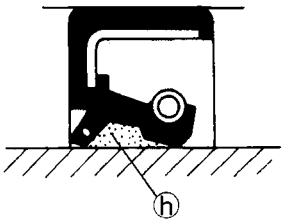


(4) Oil seal

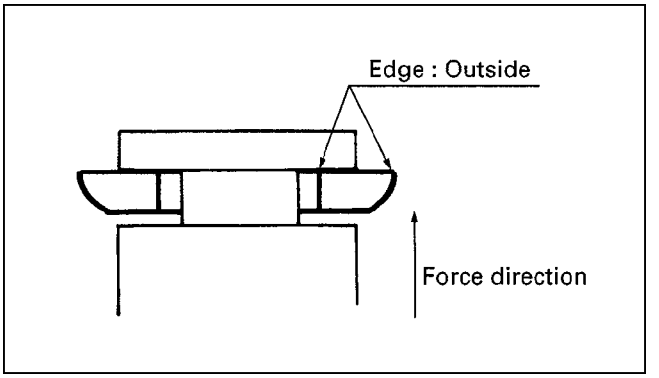
- Do not confuse the orientation of the oil seal lips. Direct the main lip toward the oil chamber; in other word, toward what is to be sealed.



a.	Packing	f.	Dustpans lip
b.	Metal ring	g.	Atmosphere (outside)
c.	Spring	h.	Grease
d.	Main lip		
e.	Oil chamber (inside)		

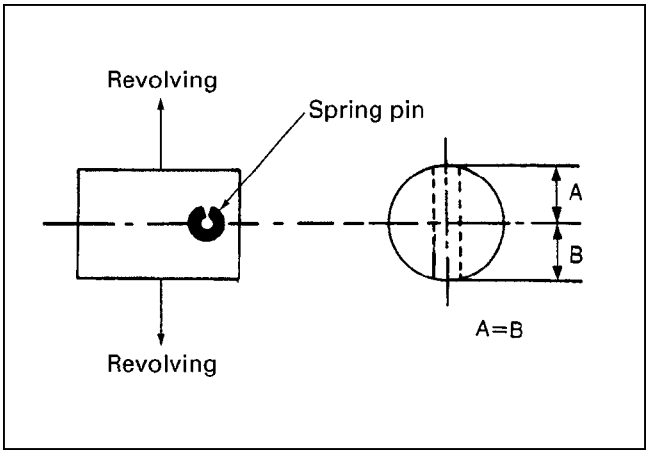


- If in dry state, the oil seal may wear out when running in the machine. To prevent this, be sure to apply lubricant (grease) over the lip sliding surface. If provided also with a dustproof lip, fill the space between this lip and the main lip with grease.
- As a rule, use a press to press-fit the oil seal. If not available, apply a suitable tool and tap it evenly without allowing any tilt. Press-fit the oil seal deep down to the bottom of the oil seal fitting boss.



(5) Mounting the circlip

- Place the circlip with its sharp edge facing outward (in the locking direction).
- Fit the circlip securely in the groove. For the hole circlip in particular, install and turn it slightly to make sure it fits well.



(6) Tapping the roll pin (spring pin)

- Place the roll pin (spring pin) with its opening perpendicular to the load.
- Place the roll pin (spring pin) with its opening in the turning direction.
- Evenly tap the roll pin (spring pin) into position.

c. Piping

(1) General precautions

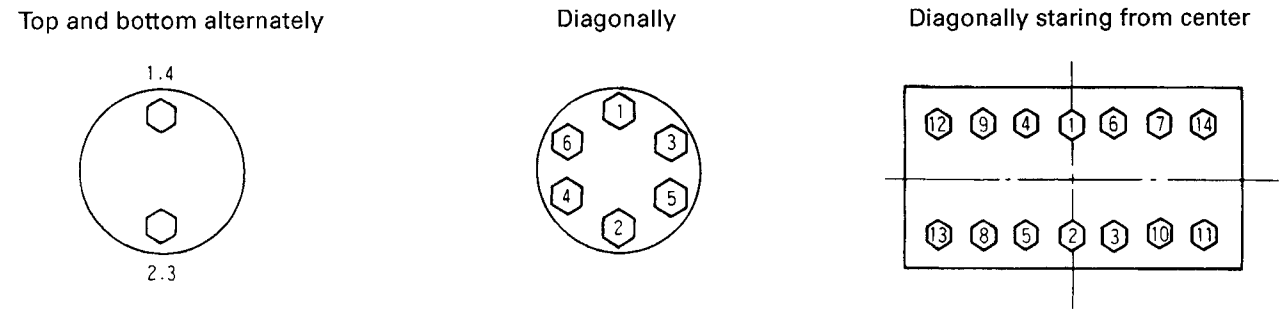
- Tightening the pipe socket to the specified torque. If too tight, the socket itself or a hydraulic component may get damaged. It too loose, an oil leak may result.
- In connecting a new hose or pipe, tighten its nut first to the specified torque and then turn it back (about 45°). Then tighten it again to the specified torque. (Do not this to the sealing tape-applied hose or pipe.)
- When disconnecting a vertical hose or pipe, separate its bottom connection first.
- In disconnecting and reconnecting the hose and pipe, be sure to use two wrenches. With one wrench, restrain the mating part to allow no twist.
- Check the mating connector's sleeve and the hose's taper for dust deposits and scratches.
- When the pipe socket has been tightened up, wipe the joint clean. Apply the maximum operating pressure 2 or 3 times to make sure there is no oil leak.

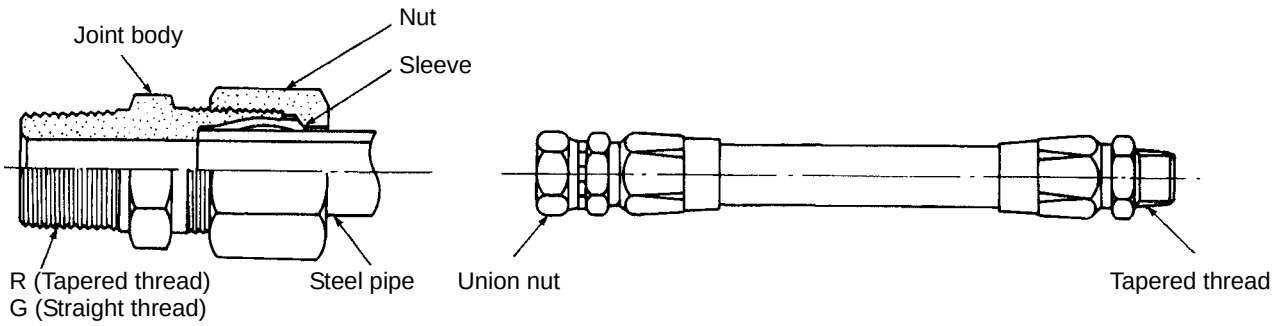
(2) Hydraulic hose

Check the hydraulic hose for too tight a connect or twist.
*Excessively tight contact
Let's suppose that a hose is in contact with another hose or other part. If the hose is pulled away by a force of 2 kg but still in contact, it means the contact is too tight.

(3) Precautions in tightening the bolts and nuts

- Use bolts of specified length.
- Do not over tighten the bolts: Its threads may get deformed or the fixed part may get damaged. Do not undertighten the bolt either: It may get loose.
- In other words, tighten the bolt to the specified torque.
- Tighten the bolts and nuts diagonally for even tightness.





(4) Hose screw

Thread size (piping screw)	Tightening torque N·m kgf·m ft·lbf		Wrench size (reference)
	Union nut section	Taper thread section	
1/8”	7.8 ~ 11.8 N·m 0.8 ~ 1.2 kgf·m 5.8 ~ 8.7 ft·lbf	14.71 ~ 19.61 N·m 1.5 ~ 20 kgf·m 10.85 ~ 14.47 ft·lbf	17 mm 0.67 in
1/4”	24.5 ~ 29.4 2.5 ~ 3.0 18.1 ~ 21.7	36.3 ~ 44.1 3.7 ~ 4.5 26.8 ~ 32.5	19 mm 0.75 in
3/8”	49.0 ~ 53.9 5.0 ~ 5.5 36.2 ~ 39.8	49.0 ~ 68.6 5.0 ~ 7.0 36.2 ~ 50.6	22 mm 0.87 in
1/2”	58.8 ~ 63.7 6.0 ~ 6.5 43.4 ~ 47.0	83.4 ~ 88.3 8.5 ~ 9.0 61.5 ~ 65.1	27 mm 1.06 in
3/4”	117.7 ~ 127.5 12.0 ~ 13.0 86.8 ~ 94.0	127.5 ~ 147.1 13.0 ~ 15.0 94.0 ~ 108.5	36 mm 1.42 in
1”	137.3 ~ 147.1 14.0 ~ 15.0 101.3 ~ 108.5	147.1 ~ 166.7 15.0 ~ 17.0 108.5 ~ 123.0	41 mm 1.61 in

Metric Size Hose

Thread size (piping screw)	Torque N·m kgf·m ft·lbf
M12 × 1.5	20 ~ 30 2.0 ~ 3.1 14.75 ~ 22.13
M14 × 1.5	20 ~ 30 2.0 ~ 3.1 14.75 ~ 22.13
M16 × 1.5	30 ~ 50 3.1 ~ 5.1 22.13 ~ 36.9
M18 × 1.5	30 ~ 50 3.1 ~ 5.1 22.13 ~ 36.9
M22 × 1.5	40 ~ 60 4.1 ~ 6.1 29.5 ~ 44.25

(5) Joint bodies

Thread size (piping screw)	Tightening torque N·m kgf·m ft·lbf		Spanner size (reference)	Remarks Steel pipe (OD)	
	R (tapered thread)	G (straight thread)			
1/8”	19.6 ~ 29.4 N·m 2.0 ~ 3.0 kgf·m 14.5 ~ 21.7 ft·lbf	-	17 mm 0.67 in	When in steel pipe is in use.	8 mm 0.31 in
1/4”	36.3 ~ 44.1 3.7 ~ 4.5 26.8 ~ 32.5	W/O-ring *Joint Torque* 58.8 ~ 78.5 6 ~ 8 43.4 ~ 57.9	19 mm 0.75 in		12 mm 0.47 in
3/8”	39.2 ~ 49.0 4.0 ~ 5.0 28.9 ~ 36.2	W/O-ring *Joint Torque* 78.5 ~ 98.1 8 ~ 10 57.9 ~ 72.3	23 mm 0.91 in		15 mm 0.59 in
1/2”	49.0 ~ 68.6 5.0 ~ 7.0 36.2 ~ 50.6	W/O-ring *Joint Torque* 117.7 ~ 137.3 12 ~ 14 86.8 ~ 101.3	26 mm 1.02 in		16 mm 0.63 in

(6) Tightening torque table for hose clamp (Screw type)

No.	Dia. (mm)	Code No.	Tightening torque N·m kgf·m ft·lbf
1	Ø12 ~ 16	09318-89016	2.5 ~ 3.4 25 ~ 35 1.84 ~ 2.51
2	Ø19 ~ 25	09318-89024	
3	Ø31 ~ 40	09318-89039	
4	Ø36 ~ 46	09318-89045	
5	Ø15 ~ 25	RC101-64580	4.9 ~ 5.9 50 ~ 60 3.61 ~ 4.35
6	Ø26 ~ 38	68311-72820	
7	Ø13 ~ 20	RB101-63630	3.4 ~ 4.4 35 ~ 45 2.58 ~ 3.31
8	Ø40 ~ 55	RC411-63180	4.9 ~ 5.9 50 ~ 60 3.61 ~ 4.35
9	Ø77 ~ 95	69284-63170	
10	Ø50 ~ 60	RC401-63190	
11	Ø32 ~ 44	RD411-63820	

(7) Nuts for piping

Steel pipe size (O.D. × I.D. × Thickness)	Tightening torque N·m kgf·m ft·lbf	Spanner size (reference)	Remarks
8 × 6 × 1 mm 0.31 × 0.24 × 0.04 in	29.4 ~ 39.2 3.0 ~ 4.0 21.7 ~ 28.9	17 mm 0.67 in	When sleeve nut is in use.
10 × 7 × 1.5 mm 0.39 × 0.28 × 0.06 in	39.2 ~ 44.1 4.0 ~ 4.5 28.9 ~ 32.5	19 mm 0.75 in	
12 × 9 × 1.5 mm 0.47 × 0.35 × 0.06 in	53.9 ~ 63.7 5.5 ~ 6.5 39.7 ~ 47.0	21 mm 0.83 in	
16 × 12 × 2 mm 0.63 × 0.47 × 0.08 in	88.3 ~ 98.1 9.0 ~ 10.0 65.1 ~ 72.3	29 mm 1.14 in	
18 × 14 × 2 mm 0.71 × 0.55 × 0.08 in	127.5 ~ 137.3 13.0 ~ 14.0 94.0 ~ 101.3	32 mm 1.26 in	
27.2 × 21.6 × 2.8 mm 1.07 × 0.85 × 0.11 in	235.4 ~ 254.97 24.0 ~ 16.0 173.6 ~ 188.1	41 mm 1.61 in	

(8) Tightening torque of bolts and nuts

Refer to the tightness torque table below.

Bolts, Nuts / Nomial Dia.	4T 	7T 	9T 
	SS41	S40C, S45C	SCr4
M6	7.8 ~ 9.3 N·m 0.80 ~ 0.95 kgf·m 5.8 ~ 6.9 ft·lbf	9.8 ~ 11.3 N·m 1.00 ~ 1.15 kgf·m 7.2 ~ 8.3 ft·lbf	12.3 ~ 14.2 N·m 1.25 ~ 1.45 kgf·m 9.0 ~ 10.5 ft·lbf
M8	17.7 ~ 20.6 N·m 1.80 ~ 2.10 kgf·m 13.0 ~ 15.2 ft·lbf	23.5 ~ 27.5 N·m 2.40 ~ 2.80 kgf·m 17.4 ~ 20.3 ft·lbf	29.4 ~ 34.3 N·m 3.00 ~ 3.50 kgf·m 21.7 ~ 25.3 ft·lbf
M10	39.2 ~ 45.1 N·m 4.00 ~ 4.60 kgf·m 28.9 ~ 33.3 ft·lbf	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 ft·lbf	60.8 ~ 70.6 N·m 6.20 ~ 7.20 kgf·m 44.8 ~ 52.1 ft·lbf
M12	62.8 ~ 72.6 N·m 6.40 ~ 7.40 kgf·m 46.3 ~ 53.5 ft·lbf	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 ft·lbf	103.0 ~ 117.7 N·m 10.50 ~ 12.00 kgf·m 75.9~ 86.8 ft·lbf
M14	107.9 ~ 125.5 N·m 11.00 ~ 12.80 kgf·m 79.6 ~ 92.6 ft·lbf	123.6 ~ 147.1 N·m 12.60 ~ 15.0 kgf·m 91.1 ~ 108.5 ft·lbf	166.7 ~ 196.1 N·m 17.00 ~ 20.00 kgf·m 123.0 ~ 144.7 ft·lbf
M16	166.7 ~ 191.2 N·m 17.00 ~ 19.50 kgf·m 123.0 ~ 141.0 ft·lbf	196.1 ~ 225.6 N·m 20.00 ~ 23.00 kgf·m 144.7 ~ 166.4 ft·lbf	259.9 ~ 304.0 N·m 26.50 ~ 31.00 kgf·m 191.7 ~ 224.2 ft·lbf
M18	245.2 ~ 284.4 N·m 25.00 ~ 29.0 kgf·m 180.8 ~ 209.7 ft·lbf	274.6 ~ 318.7 N·m 28.00 ~ 32.50 kgf·m 202.5 ~ 235.1 ft·lbf	343.2~ 402.1 N·m 35.00 ~ 41.00 kgf·m 253.2 ~ 296.5 ft·lbf
M20	333.4~ 392.2 N·m 34.00 ~ 40.00 kgf·m 245.9 ~ 389.3 ft·lbf	367.7 ~ 431.5 N·m 37.50 ~ 44.0 kgf·m 271.2 ~ 318.2 ft·lbf	519.8 ~ 568.8 N·m 53.00 ~ 58.00 kgf·m 383.3 ~ 419.5 ft·lbf

(9) Types and materials of bolts and nuts

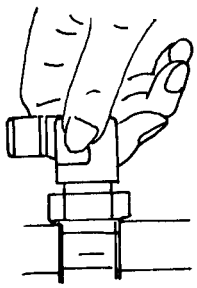
[ex. bolts]

Types	Material	Tensile strength	Hardness	Bolt head marking	
4T	SS41	Over 392 MPa 4000 kgf/cm^2 56892 lbf/in^2	H_RB 62 ~ 98		No mark or marked 4
7T	S40C S45C	Over 686 MPa 7000 kgf/cm^2 99561 lbf/in^2	H_RC 20 ~ 28		Marked 7
9T	SCr4	Over 882 MPa 9000 kgf/cm^2 128007 lbf/in^2	H_RC 28 ~ 34		Marked 9

(10)Washer-equipped elbow

Tightening torque

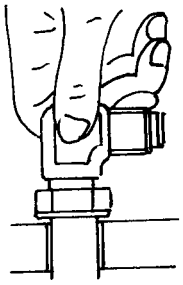
Size	N·m	kgf·m	ft·lbs
G1/4	25 ~ 30	2.5 ~ 3.0	18 ~ 22
G3/8	49 ~ 54	5.0 ~ 5.5	36 ~ 40
G1/2	59 ~ 64	6.0 ~ 6.5	43 ~ 47
G3/4 G1	118 ~ 127	12.0 ~ 13.0	87 ~ 94



Tightening procedure

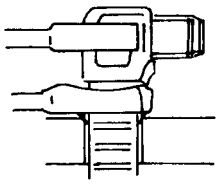
1. Connecting with the valve
   - Screw in the elbow by hand until the washer comes into contact.

Note: Clean up the mating seal beforehand.



2. Positioning
   - Turn the elbow back to its set position.

Note: Do not make any more than one turn back.



3. Fixing
   - Tighten up the lock nut with a wrench.
   - Lock nut tightening torque

F. Maintenance intervals

a. Maintenance intervals chart : EU-version

	General Maintenance	Elapsed Operating Hours																				
		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	Interval
Operator Services	Check engine oil level																					daily
	Check hydraulic oil level																					daily
	Check fuel level																					daily
	Check coolant level																					daily
	Grease front attachments																					daily
	Check V-belt																					daily
	Check washer liquid																					daily
	Check water separator																					daily
	Grease swivel gear	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	50 h
	Check, clean air filter 1.)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	50 h
	Grease swivel gear bearing				○				○				○				○				○	200 h
	Check battery electrolyte level										○										○	500 h
	Drain water in fuel tank										○										○	500 h

IMPORTANT:

● ◉ First operation

1.) Clean the air filter more frequently if used under dusty conditions. By heavy soiling, replace the filter.
2.) When using a hydraulic breaker, change hydraulic oil and return filter according to the table on "Hydraulic Oil Change".
3.) Earlier if necessary.
4.) At least annually .
(including Exchange of the Suction Filter in the Hydraulic Tank) under "EVERY 1000 SERVICE HOURS" in "REGULAR CHECKS AND MAINTENANCE WORK".

	Service	Elapsed Operating Hours																				
		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	Interval
Servicing by skilled personnel or KUBOTA dealer	Change engine oil and oil filter	◉				○					○					○					○	250 h
	Inspect coolant hoses and clamps					○					○					○					○	250 h
	Check/adjust V-belt tension					○					○					○					○	250 h
	Grease pilot valve linkage					○					○					○					○	250 h
	Change fuel filter cartridge 3.)																				○	500 h
	Drain of the water separator										○										○	500 h
	Change hydraulic return line filter element					◉					○										○	500 h
	Change drive unit oil 4.)		◉								○										○	500 h
	Change hydraulic oil and suction filter 2.)																				○	1000 h
	Renewing the pilot circuit filter																				○	1000 h
	Change air filter elements 1.)																				○	1000 h
	Change idler and track roller oil																					2000 h
	Check alternator and starter motor						Please contact your KUBOTA dealer.															2000 h
	Inspect electric cables and connections						Please contact your KUBOTA dealer.															annually
	Change coolant																					every 2 years
	Change hydraulic hoses						Please contact your KUBOTA dealer.															every 6 years
	Safety inspection																					annually

b.Maintenance intervals chart : PP-version

No.	Check points		Intervals	Hour meter indicator									Consequently	Ref. page		
				50	100	150	200	250	300	350	400	450				
1	Coolant		check	Daily check												
			change										every 2 years			
2	Fuel		check	Daily check												
3	Engine oil		check	Daily check												
			change	◉					○				every 250 hrs			
4	Hydraulic oil		check	Daily check												
			change										every 1000 hrs		*1	
5	Lubrication points		-	Daily check												
6	Radiator and oil cooler		check	Daily check												
7	Engine and electrical wiring		check	Daily check									every year			
8	Fuel tank, Water separator		drain	○	○	○	○	○	○	○	○	○	every 50 hrs			
9	Battery condition		check	○	○	○	○	○	○	○	○	○	every 50 hrs			
10	Greasing swing bearing teeth		-	○	○	○	○	○	○	○	○	○	every 50 hrs			
11	Fan belt tension		check	Daily check												
			adjust				○				○		every 200 hrs			
12	Radiator hoses and clamps		check				○				○		every 200 hrs			
			replace										every 2 years			
13	Air filter element	Outer element	clean				○				○		every 200 hrs		*2	@
			replace										every 1000 hrs		*2	
		Inner element	replace										every 1000 hrs		*2	
14	Greasing swing ball bearings		-				○				○		every 200 hrs			
15	Fuel filter cartridge		replace										every 500 hrs			@
16	Engine oil filter		replace	◉					○				every 250 hrs			
17	Drive unit oil		change		◉								every 500 hrs			
18	Hydraulic return filter element		replace					◉					every 500 hrs			
19	Hydraulic suction filter element		replace										every 1000 hrs			
20	Filter in the pilot hydraulic system		replace										every 1000 hrs			
21	Fuel injection nozzle injection pressure		check										every 1500 hrs		*4	@
22	Front idler and track roller oil		change										every 2000 hrs			
23	Alternator and starter motor		check										every 2000 hrs			
24	Injection pump		check										every 3000 hrs		*4	@
25	Radiator system		rinse										every 2 years			
26	Fuel line and Intake air line		check				○				○		every 200 hrs			@
			replace										every 2 years		*3	
27	Greasing pilot valve linkage		-					○					every 250 hrs			
28	Pilot circuit filter		clean										every 1000 hrs			

D 500 thru 1000 continued to the following table.

No.	Check points		Intervals	Hour meter indicator								Consequently	Ref. page		
				500	550	600	650	700	750	800	1000				
1	Coolant		check	Daily check											
			change									every 2 years			
2	Fuel		check	Daily check											
3	Engine oil		check	Daily check											
			change		○					○		every 250 hrs			
4	Hydraulic oil		check	Daily check											
			change								○	every 1000 hrs		*1	
5	Lubrication points		-	Daily check											
6	Radiator and oil cooler		check	Daily check											
7	Engine and electrical wiring		check	Daily check								every year			
8	Fuel tank, Water separator		drain	○	○	○	○	○	○	○	○	every 50 hrs			
9	Battery condition		check	○	○	○	○	○	○	○	○	every 50 hrs			
10	Greasing swing bearing teeth		-	○	○	○	○	○	○	○	○	every 50 hrs			
11	Fan belt tension		check	Daily check											
			adjust			○				○	○	every 200 hrs			
12	Radiator hoses and clamps		check			○				○	○	every 200 hrs			
			replace									every 2 years			
13	Air filter element	Outer element	clean			○				○	○	every 200 hrs		*2	
			replace								○	every 1000 hrs		*2	@
		Inner element	replace								○	every 1000 hrs		*2	
14	Greasing swing ball bearings		-			○				○	○	every 200 hrs			
15	Fuel filter cartridge		replace	○							○	every 500 hrs			@
16	Engine oil filter		replace		○					○		every 250 hrs			
17	Drive unit oil		change			○						every 500 hrs			
18	Hydraulic return filter element		replace						○			every 500 hrs			
19	Hydraulic suction filter element		replace								○	every 1000 hrs			
20	Filter in the pilot hydraulic system		replace								○	every 1000 hrs			
21	Fuel injection nozzle injection pressure		check									every 1500 hrs		*4	@
22	Front idler and track roller oil		change									every 2000 hrs			
23	Alternator and starter motor		check									every 2000 hrs			
24	Injection pump		check									every 3000 hrs		*4	@
25	Radiator system		rinse									every 2 years			
26	Fuel line and Intake air line		check			○				○	○	every 200 hrs			@
			replace									every 2 years		*3	
27	Greasing pilot valve linkage		-	○					○		○	every 250 hrs			
28	Pilot circuit filter		clean									every 1000 hrs			

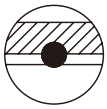
c. Water and oil quantity

	Unit	U20-3α	U25-3α	U25S	Remarks
Radiator Canopy / Cab	L gal	3.0 0.79	←	←	Kubota LLC-N-50F 50%
Reserve tank	L gal	0.6 0.16	←	←	
Engine oil with filter	L gal	4.4 1.16	←	←	SAE10W30(CF-4)
Hydraulic oil Full	L gal	37.0 9.98	←	←	ISO 46
Hydraulic oil Tank gauge center	L gal	22.5 5.94	←	←	ISO 46
Wheel motor	L gal	0.33 0.09	0.35 0.09	←	SAE90 (API GL-4)
Track roller	cc gal	50 0.01	80 0.02	←	SAE30(CD)
Upper roller	cc gal	60 0.02	←	←	SAE30(CD)
Front idler	cc gal	35 0.01	75 0.02	←	SAE30(CD)
Fuel tank	L gal	27.5 7.27	←	←	

Grease	Supply grease to such amount that it oozes out of periphery of the rotating end.	Ultra -pressure grease : EP2, Beacon Q2
Control leaver and links Du-bushing	Assemble after applying grease	

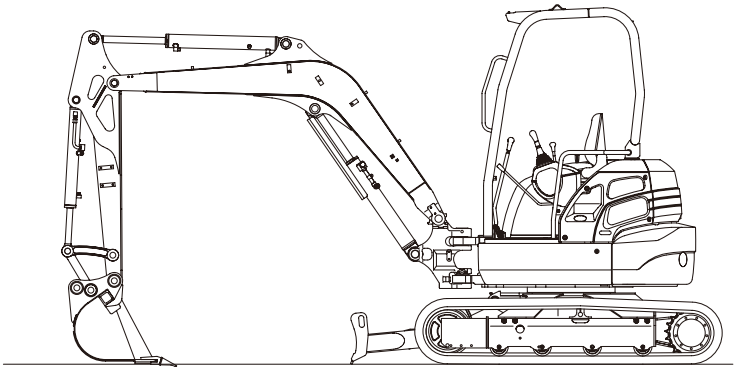
Inspection of hydraulic oil

When checking the hydraulic oil level, satisfy the following conditions and make sure the oil level is above the center the oil gauge.



The oil level is within the shaded area shown in the figure at left.

1) Oil temp. should be between 10 ~ 30 °C (50 ~ 86 °F)
2) Stance of front attachment :
   Swing : Straight forward
   Arm : Vertical to the ground
   Bucket : On the ground at its bottom
   Dozer blade : Down to the ground



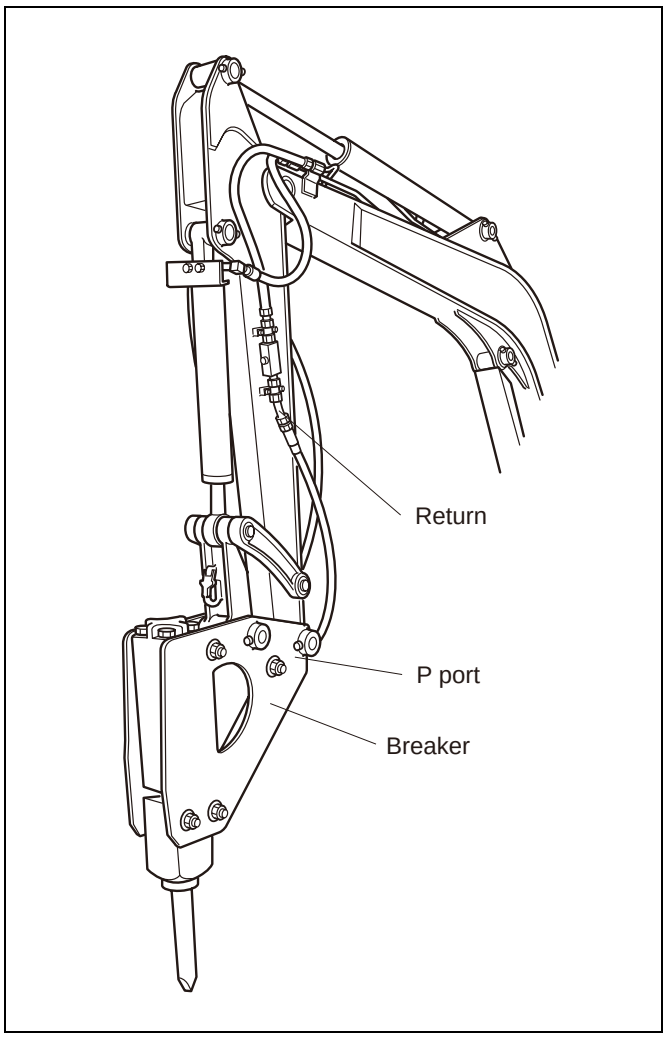
d. Recommended oil

IMPORTANT:

1. Before delivery the hydraulic oil used was an ISO 46 viscosity grade.
2. Use engine oil API service classification CD, CE or CF.
3. Use SAE 90 (API, CLA/GL5) as drive unit oil for all seasons.

	Application	Viscosity	Shell	Mobil	Exxon	MIL-Standard
Engine oil	In winter or by low temperatures	SAE 10W	Shell Rotella T10W Shell Rimula 10W	Mobil Delvac 1310	XD-3 10W XD-3 Extra 10W	MIL-L-2104C MIL-L-2104D
		SAE 20W	Shell Rotella T20W-2 Shell Rimula 20W-2	Mobil Delvac 1320	XD-3 20W-20 XD-3 Extra 20W-20	
	In summer or by high ambient temperatures	SAE 30	Shell Rotella T30 Shell Rimula 30	Mobil Delvac 1330	XD-3 30 XD-3 Extra 30	
		SAE 40	Shell Rotella T40 Shell Rimula 40	Mobil Delvac 1340	XD-3 40 XD-3 Extra 40	
		SAE 50	Shell Rotella 50	Mobil Delvac 1350		
	All-Season Engine oil	Multi-purpose	Shell Rotella T15W		XD-3 15W-40 XD-3 Extra 15W-40	
Gear oil	In winter or by low temperatures	SAE 75		Mobilube HD80W-90		MIL-L-2105C
			Shell Oil S8643			
		SAE 80		Mobilube HD80W-90		
			Shell Spirax HD80W			
	In summer or by high ambient temperatures	SAE 90		Mobilube 46		MIL-L-2105
			Shell Spirax HD90	Mobilube HD80W-90		MIL-L-2105C
		SAE 140		Mobilube HD85W-140		MIL-L-2105C
			Shell Spirax HD140	Mobilube HD80W-140		MIL-L-2105C
	All-weather gear oil	Multi-purpose	Shell Spirax HD80W Shell Spirax HD85W	Mobilube HD80W-90	GX80W-90	MIL-L-2105C
Hydraulic oil	In winter or by low temperatures	ISO 32	Shell Tellus T32	Mobil DTE-Oil 13	NUTO H32	
		ISO 46	Shell Tellus T46	Mobil DTE-Oil 15	NUTO H46	
	In summer or by high ambient temperatures	ISO 68	Shell Tellus T68	Mobil DTE-Oil 16	NUTO H68	
Grease			Shell Alvania EP2	Mobilux EP2	BEACON Q2	
Fuel			Light oil No. 2-D (ASTM D975)			
Fuel under -5 °C (+23 °F)			Light oil No. 1-D (ASTM D975)			

e Hydraulic Oil Check for machines with Hydraulic Breakers



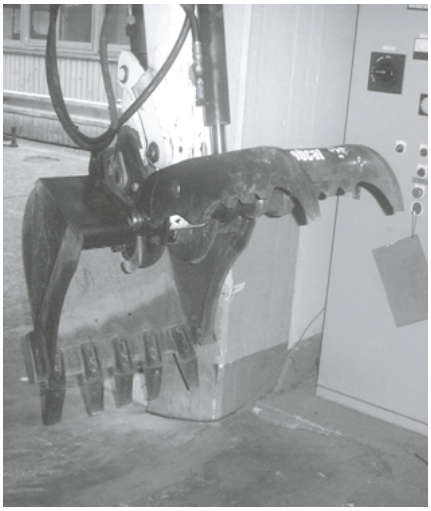
The Hydraulic oil change after 1000 operating hours in the operator's manual is based on the type of work done. Following inspection measure are valid when hydraulic breakers are used:

(1) Changing and filling up of hydraulic oil
   1. The hydraulic oil must be changed more often when breakers are used because the machine is subject to harder conditions than at normal excavating work.
   2. Use only the recommended oils mentioned in the operator's manual when changing or fill oil.
   3. When filling up oil, never mix oils of different makes.

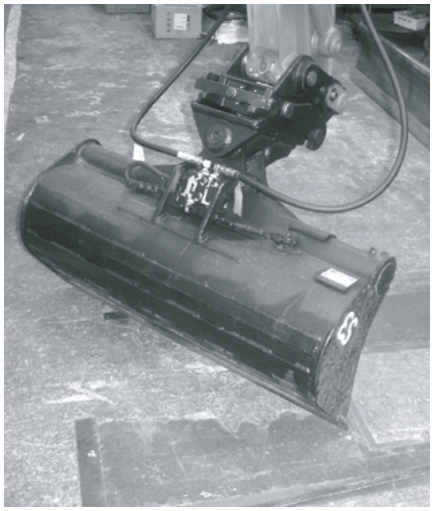
(2) Changing the return filter and oil
   1. The filter must be changed more often because of contamination resulting from the frequent assembly and disassembly of the hoses.
   2. Use the correct replacement filter.
   3. Oil change according to operating hours.

		Hydraulic oil	Return Filter	Suction Filter
Normal excavator work		every 1000 Hrs.	500 Hrs.	1000 Hrs.
Breaker work portion	20%	every 800 Hrs.	300 Hrs.	
	40%	every 400 Hrs.		
	60%	every 300 Hrs.	100 Hrs.	
	More than 80%	every 200 Hrs.		

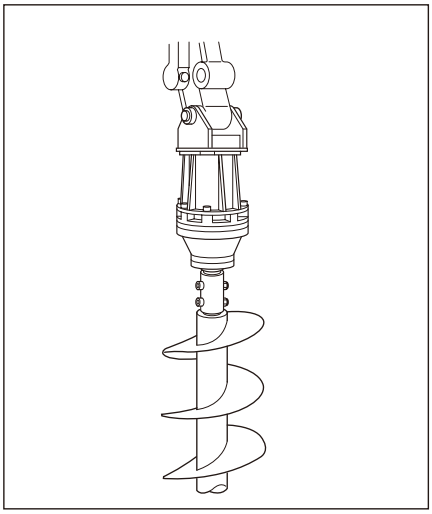
(Other attachments for service port)



Thumb



Tilt bucket



Auger

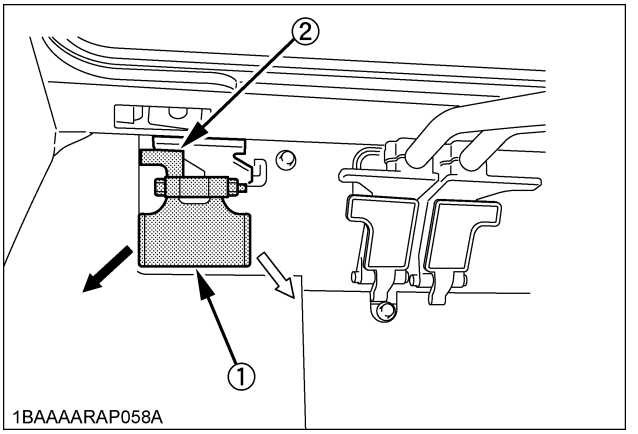
SERVICE PORT OPERATION

CAUTION

To avoid personal injury:

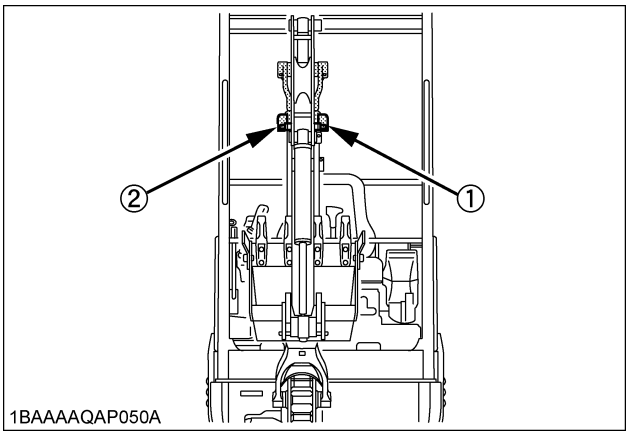
- **Tilt the service port pedal forward when the pedal is not used. Be sure to lock the pedal.**

This pedal is used to operate hydraulic attachments such as breakers or others.



(1) Service port pedal
(2) Pedal lock

- Push the front part of the pedal (⇩), send oil to the pipe (1).
- Push the back part of the pedal (⬇), send oil to the pipe (2).



IMPORTANT :

- When the service port is not used for a long period, dirt particles can settle in the lower part of the service port lines.
  When the plugs on the service port lines are removed to connect attachments, drain approx. 3.4oz(100 cc) of oil per side before making connections.
  Concerning the choice of a breaker, contact your dealer.

Max. Flow Volume LPM (GPM) (No load, theoretical)	**U20-3α**	35.8 (9.46)
	U25-3α, U25S	48.0 (12.68)
Max. Pressure MPa (kgf/cm^2) (psi)	**U20-3α**	21.6 (220) (3129)
	U25-3α, U25S	

f. Periodic replacement of important parts

To ensure safety in traveling and operating the machine, the user is strongly requested to carry out periodic inspection and servicing. For added safety, the following important parts, related to safety and fire hazards in particular, must be replaced at their specified intervals.
With the passage of time, these parts easily get degraded in material or worn out. They are difficult to check for anything unusual even at periodic inspection and servicing. Even if nothing unusual is found, it is essential to replace them with new ones after their specified service life, in order to maintain complete function.
If by any chance any of these parts gets in trouble even before its service life, it must be repaired or replaced as usual.
In replacing the hoses, check also the hose clamps for deformation, cracks and other troubles. Replace the hose clamps too with new ones, as required.
Check all the hydraulic hoses, including those to be replaced at regular intervals, for the following points. Tighten up or replace them, as required.
When replacing the hydraulic hoses, change their O-rings and sealing for new ones at the same time.

• Check the fuel and hydraulic hoses too at the following periodic inspections.

Inspection intervals	Inspection item
Daily inspection	Fuel and hydraulic hose connections as well as crimped parts for oil leak
Monthly inspection	Fuel and hydraulic hose connections as well as crimped parts for oil leak Fuel and hydraulic hoses for damages (cracks, wear-out and peel-off)
Specified self-imposed (yearly) inspection	Fuel and hydraulic hose connections as well as crimped parts for oil leak Fuel and hydraulic hoses for interference, deformation, degrading, twist and other damages (cracks, wear-out, peel-off)

• List of important parts

No.	Periodic-replaced parts	Q'ty	Replacement intervals
1	Fuel hose (Fuel tank ~ Fuel filter)	1	2 years or 4000 operating hours, whichever comes earlier
2	Fuel hose (Fuel filter ~ Fuel pump)	1	
3	Fuel hose (Fuel pump ~ Fuel nozzle)	1	
4	Fuel hose (Fuel nozzle ~ Fuel tank)	1	
5	Hydraulic hose (Main pump suction)	1	
6	Hydraulic hose (Main pump delivery)	4	
7	Hydraulic hose (Boom cylinder)	*2	
8	Hydraulic hose (Arm cylinder)	*2+2	
9	Hydraulic hose (Bucket cylinder)	*4	
10	Hydraulic hose (Swing cylinder)	2	
11	Hydraulic hose (Dozer cylinder)	4	
12	Hydraulic hose (Service port)	*2+2	
13	Hydraulic hose (Swivel motor)	2	

Note: The *-marked hydraulic hoses are Kubota's genuine ultra wear-resistant hoses. Be sure to use these parts.

II Machine Body

A. Specifications

a. Machine weight

	Truck	Arm	Unit	**U20-3α**	**U25-3α**	**U25S**
Canopy	Rubber	STD.	kgf	2030	2460	-
			(lbs)	(4475)	(5423)	-
		Long	kgf	-	-	2480
			(lbs)	-	-	(5467)
	Steel	STD.	kgf			-
			(lbs)			-
		Long	kgf	-	-	
			(lbs)	-	-	
Cabin	Rubber	STD.	kgf	2120	2540	-
			(lbs)	(4674)	(5600)	-
		Long	kgf	-	-	-
			(lbs)	-	-	-
	Steel	STD.	kgf			-
			(lbs)			-
		Long	kgf	-	-	-
			(lbs)	-	-	-

b. Machine specifications

		Unit		U20-3α		U25-3α		U25S	
Engine									
Type				"Vertical, water-cooled 4 cycle, 3 cylinders diesel"					
Model				Kubota D1105-E2BH-12		Kubota D1105-E2BH-13		Kubota D1105-E2BH-14	
gross engine output (SAE J1349)		kW/rpm		14.0/2200		15.5/2400		15.5/2400	
		PS/rpm		19.0/2200		21.1/2400		21.1/2400	
Displacement		cc	in3	1123.0	68.5	1123.0	68.5	1123.0	68.5
Dimensions									
Overall length		mm	in	3848	151.5	4107	161.7	4107	161.7
Overall width	STD track	mm	in	1400	55.1	1500	59.1	1500	59.1
	Variable track	mm	in	1300 / 1500	51.2 / 59.1	-	-	-	-
Overall crawler width	STD track	mm	in	1400	55.1	1500	59.1	1500	59.1
	Variable track	mm	in	1300 / 1500	51.2 / 59.1	-	-	-	-
Overall height	Canopy	mm	in	2375	93.5	2420	95.3	2420	95.3
	Cabin	mm	in	2355	92.7	2400	94.5	-	-
Min. ground clearance		mm	in	265	10.4	300	11.8	300	11.8
Max. digging depth	Canopy	mm	in	2298	90.5	2526	99.2	2807	110.5
	Cabin	mm	in	2298	90.5	2526	99.2	-	-
Max. digging height	Canopy	mm	in	3879	152.7	4327	170.4	C:4532	178.4
	Cabin	mm	in	3655	143.9	4125	162.4	P:4167	164.1
Max. digging radius	Canopy	mm	in	4136	162.8	4501	177.2	4666	183.7
	Cabin	mm	in	4136	162.8	4501	177.2	-	-
Max. dumping height	Canopy	mm	in	2552	100.5	2972	117.0	3208	126.3
	Cabin	mm	in	2320	91.3	2775	109.3	-	-
Swing angle (left/right)		deg.		73/55		←		←	
Travel speed	Low speed	km/h	mph	2.2	1.4	2.5	1.6	2.5	1.6
	High speed	km/h	mph	4.2	2.6	4.5	2.8	4.5	2.8
Swivel speed		rpm		9.1		9.5		9.5	
Max. traction force	Low speed	kN	lbf	17.2	3.9	22.5	5.1	22.5	5.1
		kgf		1754.0		2294.0		2294.0	
	High speed	kN	lbf	9.0	2.0	10.8	2.4	10.8	2.4
		kgf		918.0		1101.0		1101.0	
Performance									
Tumbler distance		mm	in	1474	58.0	1561	61.5	1561	61.5
Tread		mm	in	1150	45.3	1200	47.2	1200	47.2
Crawler width x No. of shoe x pitch (Rubber crawler)		mm		250x47x84		300x53x80		300x53x80	
		in		9.8x1.9x3.3		11.8x2.1x3.2		11.8x2.1x3.2	
Bucket									
Heaped capacity		m3	yd3	0.066	0.086	0.08	0.105	0.08	0.105
Width		mm	in	450	17.7	500	19.7	500	19.7
Blade									
Width x height	STD track	mm	in	1400x292	55.1x11.5	1500x292	59.1x11.4	1500x292	59.1x11.4
	Variable track	mm	in	1500x292	59.1x11.5	-	-	-	-
Lift above GL / below GL	STD track	mm	in	318 / 440	12.5 / 17.3	354/315	13.9/12.4	354/315	13.9/12.4
	Variable track	mm	in	318 / 440	12.5 / 17.3	-	-	-	-

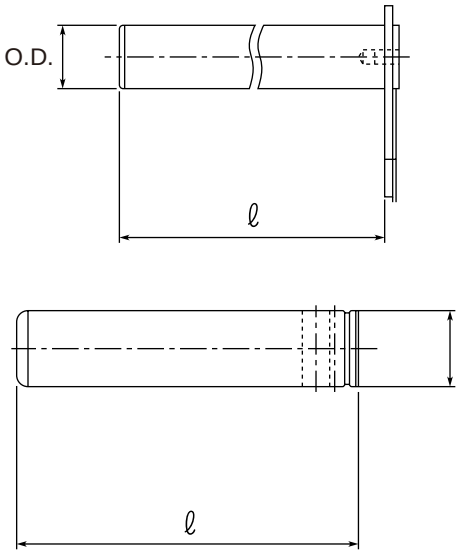
c. Lever stroke and operating force

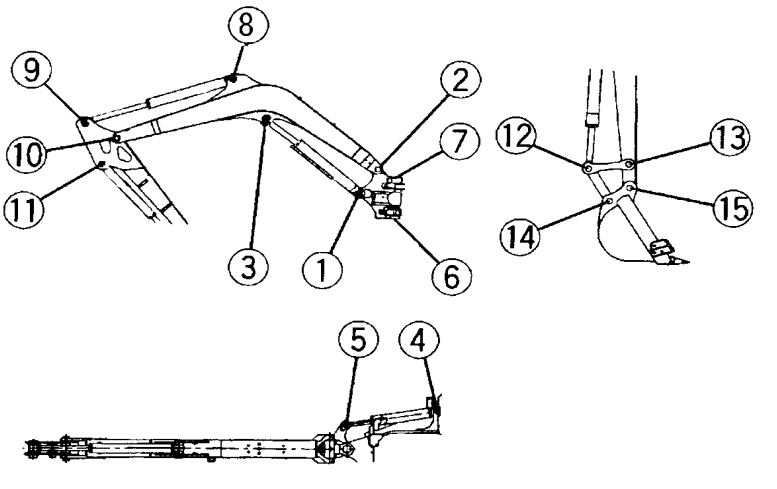
			Unit	U20-3α / U20-3α	U25S	Remarks
Boom (Up/Down)		Stroke	mm	72.0	←	Up/Down
			in.	2.8	←	
		Force	N	14.4	←	
			kgf	1.47	←	
			lbf	3.2	←	
Arm (Crowd/Dump)		Stroke	mm	72.0	←	Crowd/Dump
			in.	2.8	←	
		Force	N	14.4	←	
			kgf	1.47	←	
			lbf	3.2	←	
Bucket (Crowd/Dump)		Stroke	mm	72.0	←	Crowd/Dump
			in.	2.8	←	
		Force	N	14.4	←	
			kgf	1.47	←	
			lbf	3.2	←	
Swivel (Right/Left)		Stroke	mm	72.0	←	Right/Left
			in.	2.8	←	
		Force	N	14.4	←	
			kgf	1.47	←	
			lbf	3.2	←	
"Travel (Left/Right, F/R)"		Stroke	mm	70.0	←	F/R
			in.	2.8	←	
		Force	N	12.5	←	
			kgf	1.27	←	
			lbf	2.8	←	
Blade (Up/Down)		Stroke	mm	60.0	←	Up/Down
			in.	2.4	←	
		Force	N	19.6	←	
			kgf	2.0	←	
			lbf	4.4	←	
Acceleration	Up	Force	N	44.1	←	Up/Down
			kgf	4.5	←	
			lbf	9.9	←	
	Down	Force	N	39.2	←	Up/Down
			kgf	4.0	←	
			lbf	8.8	←	
Swing pedal (Up/Down)		Force	N	44.1	←	Up/Down
			kgf	4.5	←	
			lbf	9.9	←	
Safety lock lever (Left)	Up	Force	N	7.8	←	Up/Down
			kgf	0.8	←	
			lbf	1.8	←	
	Down	Force	N	7.8	←	
			kgf	0.8	←	
			lbf	1.8	←	

d. Dimensions of parts

[1] Front pins

No.		Unit	U20-3α	U25-3α	U25S	Position
1	Pin diameter x llength	mm	Φ40.0 x 164.0	←	←	Swing bracket -Boom cylinder
		in.	Φ1.57 x 6.46			
2	Pin diameter x llength	mm	Φ40.0 x 236.0	←	←	Swing bracket - Boom
		in.	Φ1.57 x 9.29			
3	Pin diameter x llength	mm	Φ40.0 x 177.0	←	←	Boom - Boom cylinder
		in.	Φ1.57 x 6.97			
4	Pin diameter x llength	mm	Φ30.0 x 118.0	←	←	Swivel frame -Swing cylinder
		in.	Φ1.18 x 4.65			
5	Pin diameter x l length	mm	Φ30.0 x 83.5	←	←	Swing bracket - Swing cylinder
		in.	Φ1.18 x 3.29			
6	Pin diameter x llength	mm	Φ60.0 x 104.0	←	←	Swing bracket - Swivel frame(Lower)
		in.	Φ2.36 x 4.09			
7	Pin diameter x llength	mm	Φ60.0 x 137.0	←	←	Swing bracket - Swivel frame(Upper)
		in.	Φ2.36 x 5.39			
8	Pin diameter x length	mm	Φ40.0 x 177.0	←	←	Boom - Arm cylinder
		in.	Φ1.57 x 6.97			
9	Pin diameter x llength	mm	Φ40.0 x 145.0	Φ40.0x163.0	←	Arm - Arm cylinder
		in.	Φ1.57 x 5.71	Φ1.57x6.42		
10	Pin diameter x length	mm	Φ40.0 x 199.0	←	←	Boom - Arm
		in.	Φ1.57 x 7.83			
11	Pin diameter x llength	mm	Φ40.0 x 145.0	Φ40.0x163.0	←	Arm - Bucket cylinder
		in.	Φ1.57 x 5.71	Φ1.57x6.42		
12	Pin diameter x llength	mm	Φ40.0 x 104.0	←	←	Bucket links 1, 2, 3 - Bucket cylinder"
		in.	Φ1.57 x 4.09			
13	Pin diameter x l length	mm	Φ30.0 x 170.0	←	←	Arm - Bucket links 2, 3
		in.	Φ1.18 x 6.69			
14	Pin diameter x llength	mm	Φ30.0 x 183.0	←	←	Bucket - Bucket link 1
		in.	Φ1.18 x 7.20			
15	Pin diameter x l length	mm	Φ30.0 x 183.0	←	←	Arm - Bucket
		in.	Φ1.18 x 7.20			





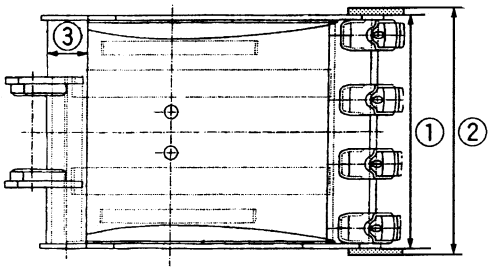
ℓ : length

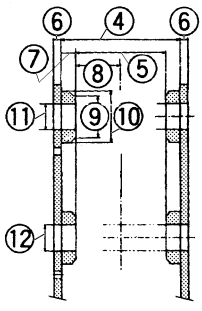
[2] Bucket

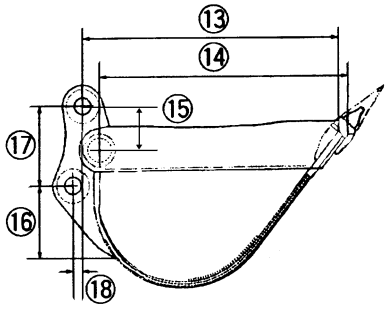
1) Bucket dimensions

No.	Unit	**U20-3α**	**U25-3α**	**U25S**
1	mm	400.0	450.0	
	in.	15.75	17.72	
2	mm	450.0	500.0	
	in.	17.72	19.69	
3	mm	76.3 x t9.5	←	
	in.	3.00 x t0.37		
4	mm	154.0	←	
	in.	6.06		
5	mm	110.0	←	
	in.	4.33		
6	mm	12.0	←	
	in.	0.47		
7	mm	22.0	←	
	in.	0.87		
8	mm	55.0	←	
	in.	2.17		
9	mm	49.0	←	
	in.	1.93		
10	mm	65.0	←	
	in.	2.56		
11	mm	30.0 $^{+0.10}_{+0.05}$	←	
	in.	1.18 $^{+0.004}_{+0.002}$		
12	mm	30.0 $^{+0.10}_{+0.05}$	←	
	in.	1.18 $^{+0.004}_{+0.002}$		
13	mm	563.5	←	
	in.	22.18		
14	mm	478.0	←	
	in.	18.82		
15	mm	78.5	←	
	in.	3.09		
16	mm	145.7	←	
	in.	5.74		
17	mm	139.0	←	
	in.	5.47		
18	mm	14.5	←	
	in.	0.57		

NOTE:U20-3α, U25-3α: KUBOTA JAPAN BUCKET
U25S: KTC ADAPTED BUCKET,



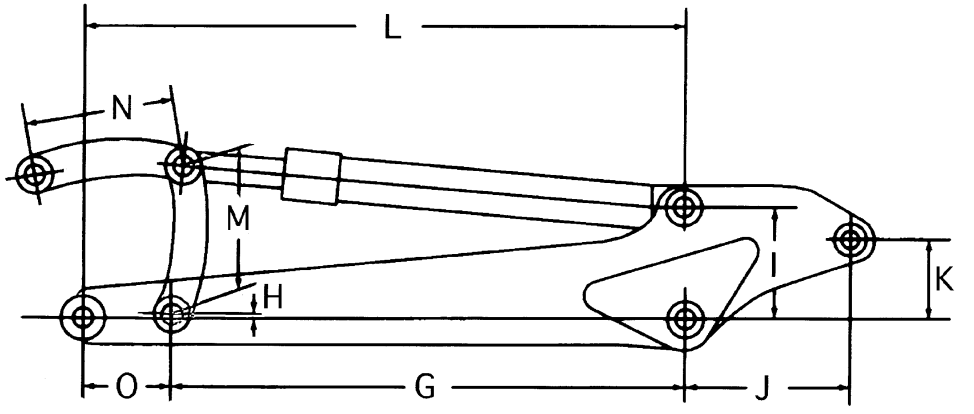


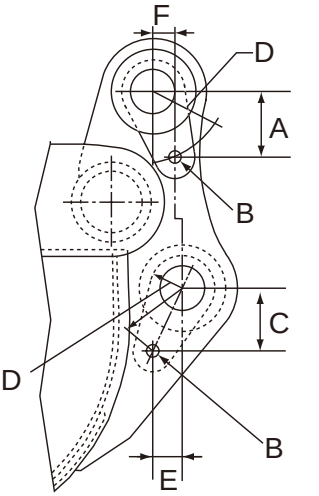


2) Bucket installation relevant dimensions

No.	Unit	**U20-3α**	**U25-3α**	**U25S**
A	mm	59.8	←	
	in.	2.35		
B	mm	M12 x 1.25	←	
C	mm	52	←	
	in.	2.5		
D	mm	60.0	←	
	in.	2.36		
E	mm	30.0	←	
	in.	1.18		
F	mm	5.0	←	
	in.	0.20		
G	mm	795.0	905.0	
	in.	31.30	35.63	
H	mm	10.0	←	
	in.	0.39		
I	mm	250.0	←	
	in.	9.84		
J	mm	225.5	←	
	in.	8.88		
K	mm	157.0	←	
	in.	6.18		
L	mm	1015.0	10.76	
	in.	39.36	42.38	
M	mm	250.0	←	
	in.	9.84		
N	mm	255.0	←	
	in.	10.04		
O	mm	145.0	←	
	in.	5.71		

NOTE:U20-3α, U25-3α: KUBOTA JAPAN BUCKET,STANDARD ARM
U25S: KTC ADAPTED BUCKET, LONG ARM





[3] Rubber crawler

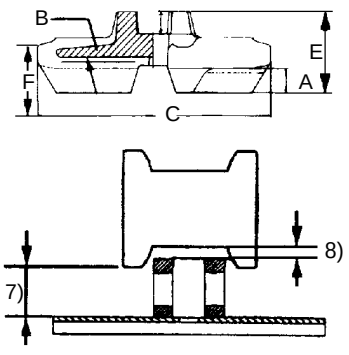
	Unit	**U20-3α**	**U25-3α, U25S**	Remarks
Crawler ass'y code No.		RB411-2231-0	RB511-2231-0	
Identification mark (Core metal rapping position)		∞	∞	
A : Lug height	mm	22	25	
	in.	0.87	0.89	
B : Link height	mm	21	←	
	in.	0.83		
C : Crawler width	mm	250	300	
	in.	9.84	11.81	
D : Crawler sag distance	mm	10 to 15	←	
	in.	0.39 to 0.59		
E : Crawler height	mm	72.0	80.5	
	in.	2.83	3.17	
Number of core metal		84	80	Material : FCD450T
Circumference	mm	3948	4240	
	in.	155.43	166.93	
Core metal pitch	mm	47	53	
	in.	1.85	2.09	
Rubber thickness	mm	51	59.5	
	in.	2.01	2.34	

[4] Iron crawler

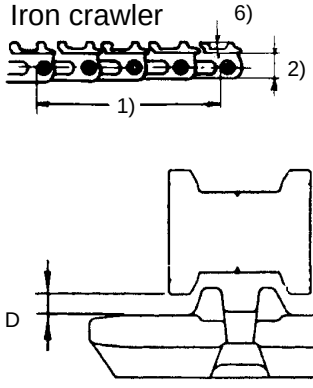
	Unit	**U20-3α**	**U25-3α, U25S**	Remarks
Crawler ass'y code No.		RB411-2210-0	RC308-2210-0	
Crawler width	mm	250.0	300.0	
	in.	9.84	11.81	
1) 4 links length (A)/(B)	mm	360.0	406.0	
	in.	14.17	15.98	
2) Height	mm	56.0	68.0	
	in.	2.20	2.68	
3) Bushing O. D. (A)/(B)	mm	Φ22.0 / Φ21.0	Φ28.0 / Φ27.0	
	in.	Φ0.87 / Φ0.83	Φ1.10 / Φ1.06	
4) Bushing I. D. (A)/(B)	mm	Φ14.0 / Φ15.0	Φ17.0 / Φ18.0	
	in.	Φ0.55 / Φ0.59	Φ0.67 / Φ0.71	
5) Master pin O. D. (A)/(B)	mm	Φ14.0 / Φ13.0	Φ17.0 / Φ16.0	
	in.	Φ0.55 / Φ0.51	Φ0.67 / Φ0.63	
6) Grouser height	mm	16.5	←	
	in.	0.65		
7) Crawler sag distance	mm	75 to 80	←	
	in.	2.95 to 3.15		
Number of links		43	41	

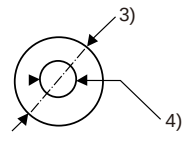
(A)New machine reference value (B)Allowable limit

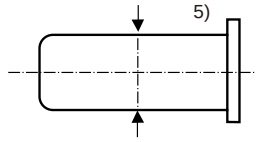
Rubber crawler



Iron crawler



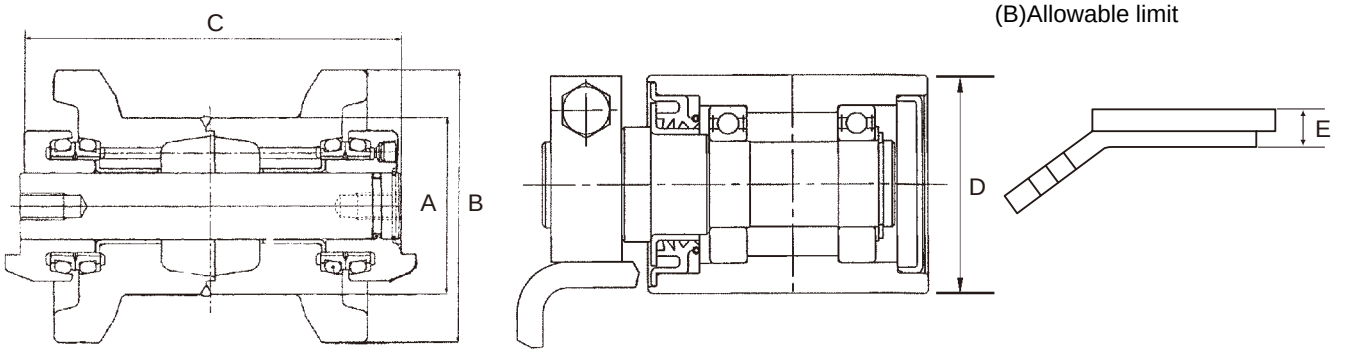




[5] Track roller, idler, and sprockett

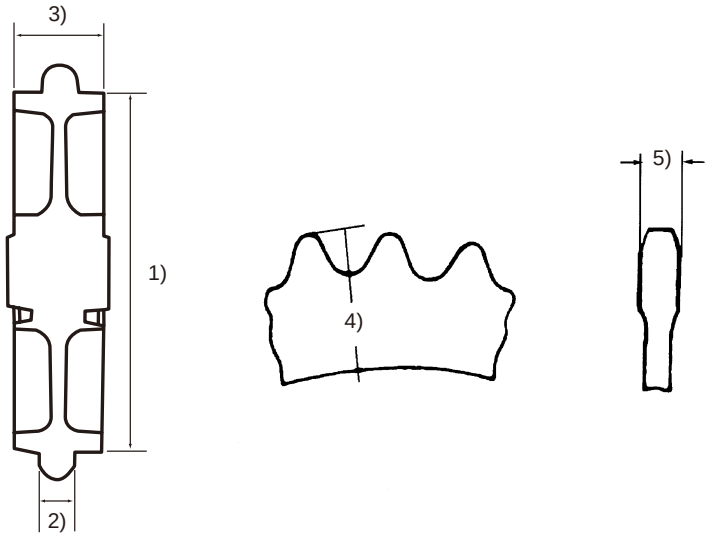
		Unit	**U20-3α**	**U25-3α, U25S**	Remarks
A : Guide width	(A)/(B)	mm	63 / 59	80 / 76	
		in.	2.48 / 2.32	3.15 / 2.99	
B : Outer diameter	(A)/(B)	mm	Φ107 / Φ103	Φ124 / Φ120	
		in.	Φ4.21 / Φ4.06	Φ4.88 / Φ4.72	
C : Roller width		mm	150	175	
		in.	5.91	6.89	
D : Upper roller diameter	(A)/(B)	mm	Φ76.3 / Φ72.5	←	
		in.	Φ3.00 / Φ2.85		
E : Sliding plate thickness	(A)/(B)	mm	22 / 11	←	
		in.	0.87 / 0.43		

(A)New machine reference value
(B)Allowable limit



		Unit	**U20-3α**	**U25-3α, U25S**	Remarks
1) Idler O.D.	(A)/(B)	mm	Φ238 / Φ230	Φ272 / Φ264	
		in.	Φ9.37 / Φ9.06	Φ10.71 / Φ10.39	
2) Guide width	(A)/(B)	mm	24 / 20	30 / 26	
		in.	0.94 / 0.79	1.18 / 1.02	
3) Idler width	(A)/(B)	mm	88 / 84	113 / 109	
		in.	3.46 / 3.31	4.45 / 4.29	
4) Sprocket wheel O.D.	(A)/(B)	mm	Φ316 / Φ308	Φ356 / Φ348	
		in.	Φ12.44 / Φ12.13	Φ14.02 / Φ13.70	
5) Sprocket wheel width	(A)/(B)	mm	23 / 19	30 / 26	
		in.	0.91 / 0.75	1.18 / 1.02	

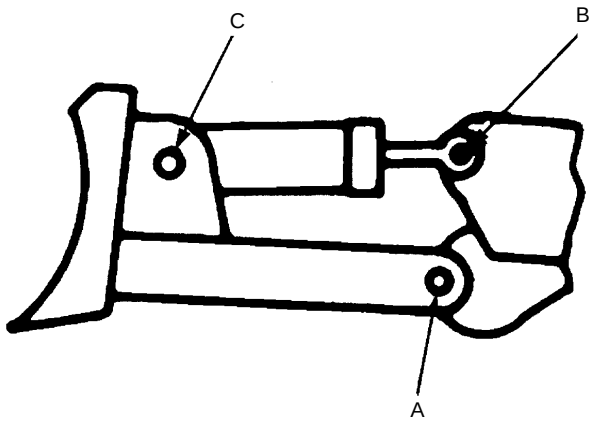
(A)New machine reference value
(B)Allowable limit

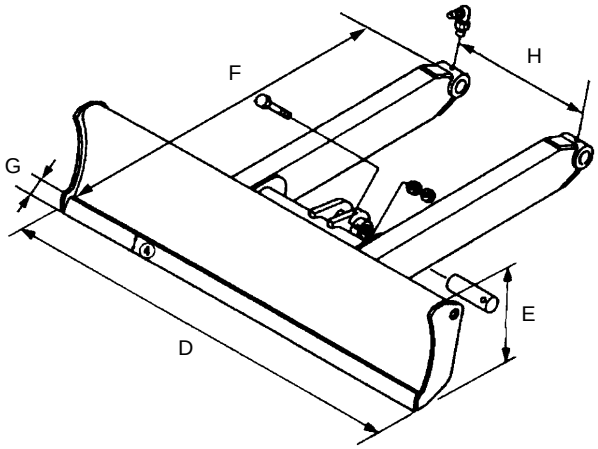


[6] Dozerr

	Unit	**U20-3α(STD)**	**U20-3α(VT)**	**U25-3α**	**U25S**	Remarks
Blade ass'y code No.		RB411-7440-0	RB411-7460-0	RB511-7440-0	RB511-7440-0	
A : Pin diameter x length	mm	Φ40 x 125	Φ40 x 125	Φ40 x 125	Φ40 x 125	
	in.	Φ1.57x 4.92	Φ1.57x 4.92	Φ1.57x 4.92	Φ1.57x 4.92	
B : Pin diameter x length	mm	Φ45x 95	Φ45x 95	Φ45x 95	Φ45x 95	
	in.	Φ1.77x 3.74	Φ1.77x 3.74	Φ1.77x 3.74	Φ1.77x 3.74	
C : Pin diameter x length	mm	Φ45x 95	Φ45x 95	Φ45x 95	Φ45x 95	
	in.	Φ1.77x 3.74	Φ1.77x 3.74	Φ1.77x 3.74	Φ1.77x 3.74	
D : Blade width	mm	1400	1300 / 1500	1500	1500	
	in.	55.12	51.18 / 59.06	59.06	59.06	
E : Blade height	mm	290	286	290	←	
	in.	11.42	11.26	11.42		
F : Blade length	mm	934	760	966	←	
	in.	36.75	29.92	38.01		
G : Blade tip plate height x thickness	mm	65 x 12	←	←	←	
	in.	2.56 x 0.47				
H : Length between blade arms	mm	420	←	←	←	
	in.	16.54				

STD : Standard Truck
VT : Variable width Truck





[7] Parts weight

		Unit	**U20-3α**	**U25-3α**	**U25S**	Remarks
Truck frame		kgf	232	265	265	
		(lbs)	(511.5)	(584.2)	(584.2)	
Swivel frame		kgf	200	200	200	
		(lbs)	(440.9)	(440.9)	(440.9)	
Swing bracket		kgf	48	48	48	
		(lbs)	(105.8)	(105.8)	(105.8)	
Boom		kgf	72	100	100	
		(lbs)	(158.7)	(220.5)	(220.5)	
Arm	STD.	kgf	37	46		
		(lbs)	(81.6)	(101.4)		
	Long	kgf	-	-	66	
		(lbs)	-	-	(145.5)	
Bucket	For STD. arm	kgf	50	56	-	Japan S.T.D.
		(lbs)	(110.2)	(123.5)	-	
	For Long arm	kgf	-	-		
		(lbs)	-	-	(0.0)	
Blade		kgf	92	95	95	
		(lbs)	(202.8)	(209.4)	(209.4)	
Weight (left)		kgf	-	-	-	
		(lbs)	-	-	-	
Weight (right)		kgf	-	-	-	
		(lbs)	-	-	-	
Weight (rear)		kgf	220	380	380	
		(lbs)	(485.0)	(837.8)	(837.8)	
Rubber crawler		kgf	86	125	125	
		(lbs)	(189.6)	(275.6)	(275.6)	
Steel crawler		kgf	88	168	168	
		(lbs)	(194.0)	(370.4)	(370.4)	
Arch frame		kgf	36	36	36	
		(lbs)	(79.4)	(79.4)	(79.4)	
Engine		kgf	89	89	89	Dry weight
		(lbs)	(196.2)	(196.2)	(196.2)	
Hydraulic tank		kgf	21	21	21	With filter
		(lbs)	(46.3)	(46.3)	(46.3)	
Fuel tank		kgf	4	4	4	
		(lbs)	(8.8)	(8.8)	(8.8)	
Swivel bearing		kgf	24	24	24	
		(lbs)	(52.9)	(52.9)	(52.9)	
Battery		kgf	16	16	16	
		(lbs)	(35.3)	(35.3)	(35.3)	
Truck roller		kgf	5	5	5	
		(lbs)	(11.0)	(11.0)	(11.0)	
Upper roller		kgf	3	3	3	
		(lbs)	(6.6)	(6.6)	(6.6)	
ROPS/FOPS canopy		kgf	-	-		
		(lbs)	-	-		
ROPS/FOPS cabin		kgf			-	
		(lbs)			-	
Hydraulic pump		kgf	17	17	17	
		(lbs)	(37.5)	(37.5)	(37.5)	
Traveling motor		kgf	25	24	24	
		(lbs)	(55.1)	(52.9)	(52.9)	
Swivel motor		kgf	23	23	23	
		(lbs)	(50.7)	(50.7)	(50.7)	
Sprocket		kgf	5	8	8	
		(lbs)	(11.0)	(17.6)	(17.6)	
Idler ass'y		kgf	22	26	26	
		(lbs)	(48.5)	(57.3)	(57.3)	
Control valve		kgf	31	29	29	Without adaptors
		(lbs)	(68.3)	(63.9)	(63.9)	
Boom cylinder		kgf	20	26	26	Canopy / Cabin
		(lbs)	(44.1)	(57.3)	(57.3)	
Arm cylinder		kgf	18	21	21	
		(lbs)	(39.7)	(46.3)	(46.3)	
Bucket cylinder		kgf	16	18	18	
		(lbs)	(35.3)	(39.7)	(39.7)	
Swing cylinder		kgf	16	16	16	
		(lbs)	(35.3)	(35.3)	(35.3)	
Blade cylinder		kgf	15	21	21	
		(lbs)	(33.1)	(46.3)	(46.3)	
Rotary joint		kgf	16	16	16	
		(lbs)	(35.3)	(35.3)	(35.3)	

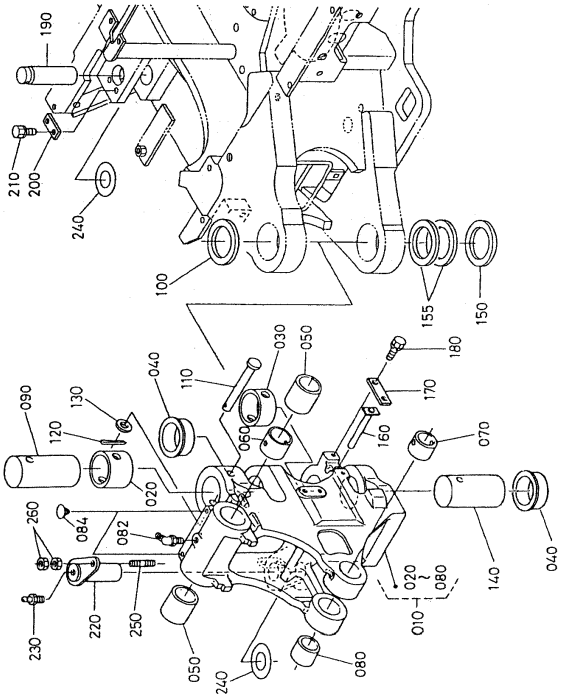
The weights listed above are based on calculations and slightly different from actual ones.

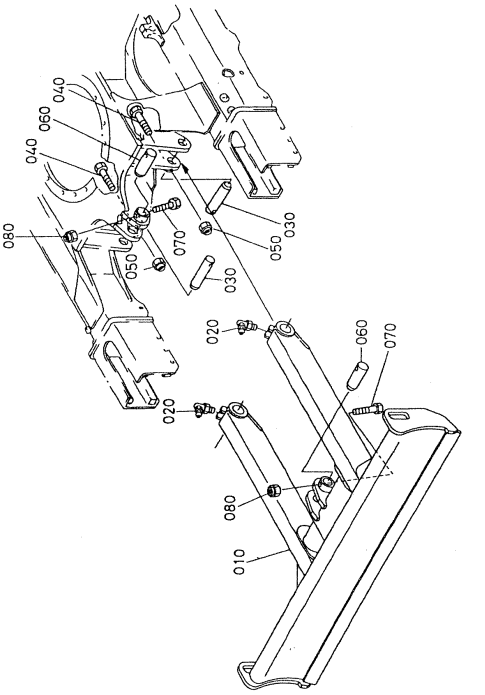
[8] Water and oil quantity

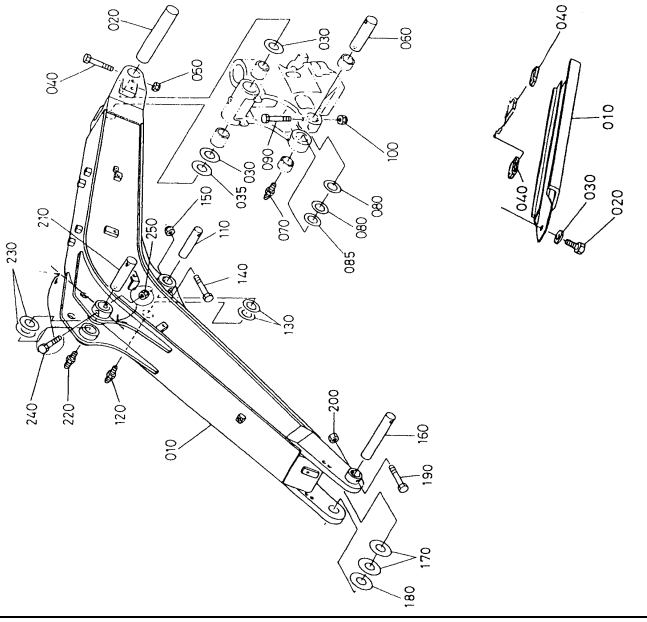
	Unit	**U20-3α**	**U25-3α, U25S**		Remarks
Radiator	L	3.0	←		
	(US gal)	(0.8)			
Reserve tank	L	0.6	←		
	(US gal)	(0.2)			
Engine crank case with filter	L	4.4	←		
	(US gal)	(1.16)			
Hydraulic oil Full	L	37.0	←		
	(US gal)	(9.8)			
Hydraulic oil Tank	L	22.5	←		
	(US gal)	(5.9)			
Wheel motor	L	0.33	0.35		
	(US gal)	(0.087)	(0.09)		
Track roller	L	50.0	80.0		
	(US gal)	(0.01)	(0.02)		
Upper roller	L	60.0	←		
	(US gal)	(0.02)			
Front idler	L	35.0	75.0		
	(US gal)	(0.01)	(0.02)		
Fuel tank	L	27.5	←		
	(US gal)	(7.3)			

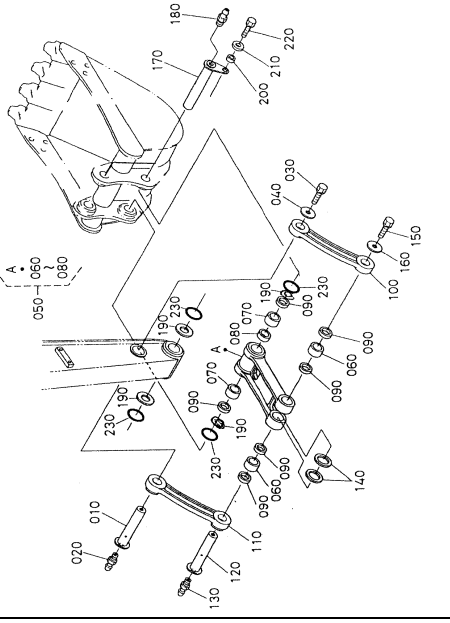
B. Front attachment

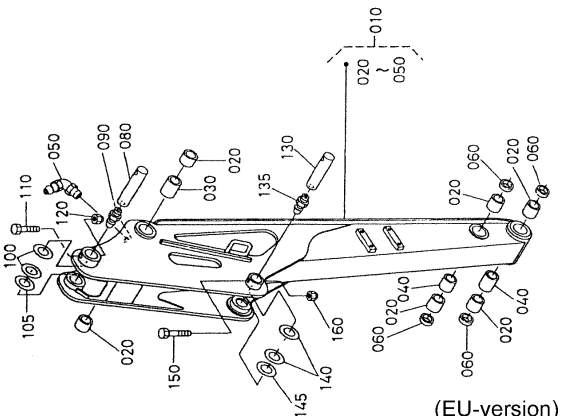
a. Parts designation











(EU-version)

(1) Swing bracket

No.	PART NAME	No.	PART NAME	No.	PART NAME
010	Assy bracket, swing	090	Pin	180	Bolt
020	Bush	100	Collar, Thrust	190	Pin
030	Bush	110	Pin, Joint	200	Plate, Key
040	Bush	120	Pin, Sprit	210	Bolt
050	Bush	130	washer, Plain	220	Pin
060	Collar	140	Pin	230	Nipple, Grease
070	Bush	150	Collar, Thrust	240	Shim
080	Bush	155	Shim	250	Stud
082	Nipple, Grease	160	Pin	260	Nut
084	Plug	170	Plate, Retainer		

(2) Boom

No.	PART NAME	No.	PART NAME	No.	PART NAME
010	Boom	085	Shim	170	Shim
020	Pin	090	Bolt	180	Shim
030	Shim	100	Nut, Lock	190	Bolt
035	Shim	110	Pin	200	Nut, Lock
040	Bolt	120	Nipple, Grease	210	Pin
050	Pin	130	Shim	220	Nipple, Grease
060	Pin	140	Bolt	230	Shim
070	Nipple, Grease	150	Nut, lock	240	Bolt
080	Shim	160	Pin	250	Nut, Lock

(3) Boom Cylinder Cover

No.	PART NAME	No.	PART NAME
010	Cover, Cylinder	030	Washer, Plain
020	Bolt	040	Cap, Cylinder cover

(4) Arm

No.	PART NAME	No.	PART NAME	No.	PART NAME
010	Assy, Arm	080	Pin	130	Pin
020	Bush	090	Nipple, Grease	135	Nipple, Grease
030	Collar	100	Shim	140	Shim
040	Collar	105	Shim	145	Shim
050	Nipple, Grease	110	Bolt	150	Bolt
060	Seal, Dust	120	Nut, Lock	160	Nut, Lock
070	Blank				

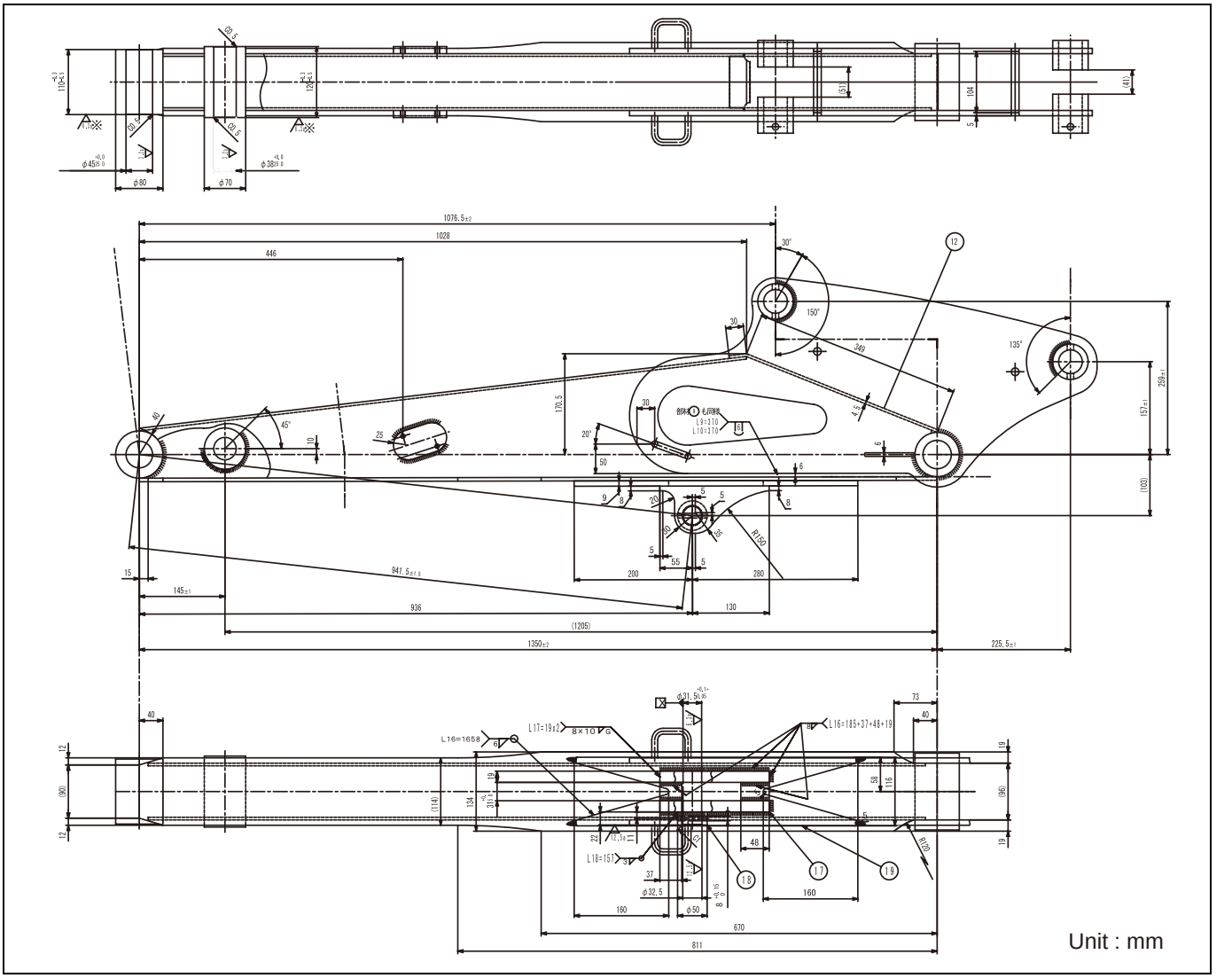
(5) Bracket Link

No.	PART NAME	No.	PART NAME	No.	PART NAME
010	Pin	090	Seal, Dust	170	Pin
020	Nipple, Grease	100	Link, Bucket	180	Nipple, Grease
030	Bolt	110	Link, Bucket	190	Shim
040	Washer	120	Pin	200	Spacer
050	Assy link, Bucket	130	Nipple, Grease	210	Washer, Plain
060	Bush	140	Shim	220	Bolt
070	Bush	150	Bolt	230	O-ring
080	Collar	160	Washer	240	Cap

(6) Blade

No.	PART NAME	No.	PART NAME	No.	PART NAME
010	Blade	040	Bolt	070	Bolt
020	Nipple, Grease	050	Nut, Lock	080	Nut, Lock
030	Pin	060	Pin		

Arm with thumb bracket : U25S, Arm 1350 (sp, thumb), RB548-6711



b. Exchange of bucket (Kubota Japan Bucket)

CAUTION

* When replacing the bucket, wear a hard helmet, goggles and other protective gears.
* When working in buddy system, fully understand signals from each other for added safety.

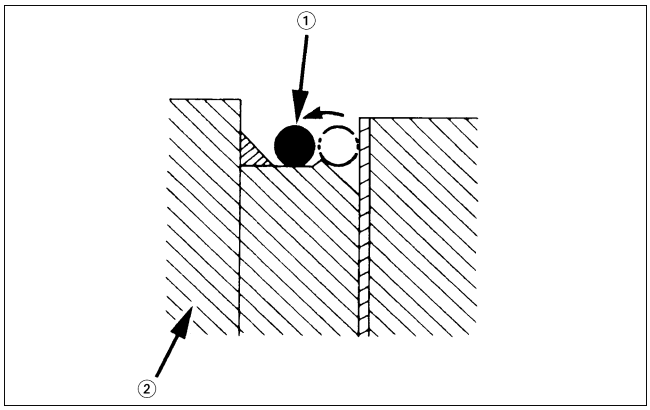
Take the following procedures to replace the bucket.

IMPORTANT

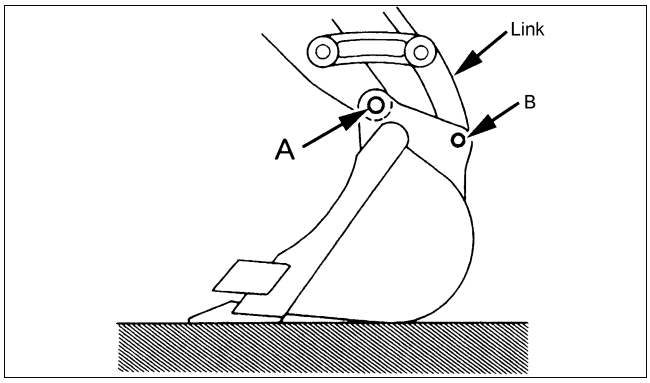
* Be careful to keep the drawn-out pins free of sand and mud.
* A dust seal is attached at each end of the bushing. In removing and fitting the pins, be careful not to damage the dust seals.

■ Removing the bucket

1. Place the bucket just on a flat, level ground.
2. Stop the engine and let out pressure from the hydraulic system.
3. Detach the O-ring from the groove and draw out the pins A and B.

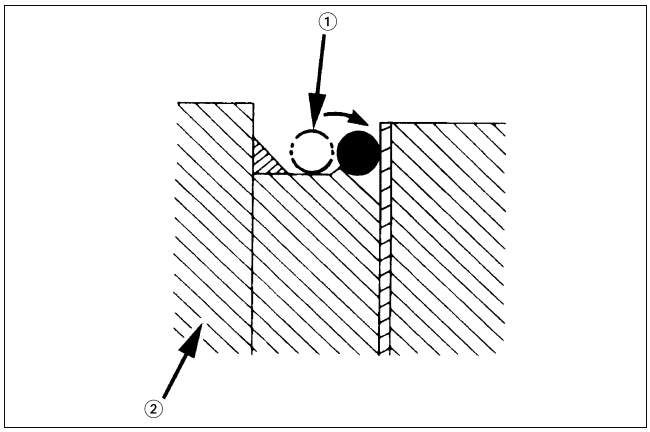


1 Move the O-ring 2 Bucket boss



■ Fitting the bucket

1. Place the O-ring on the boss of the bucket.
2. Align the arm with the hole A, put the shims at both ends of the arm, and couple them with the pins. Align the link with the hole B, put the shims at both ends of the link, and couple them with the pins.
3. Apply and tighten up the pin fixing bolts.
4. Fit the O-ring in the groove.



1 Move the O-ring 2 Bucket boss

5. Grease up the pins.

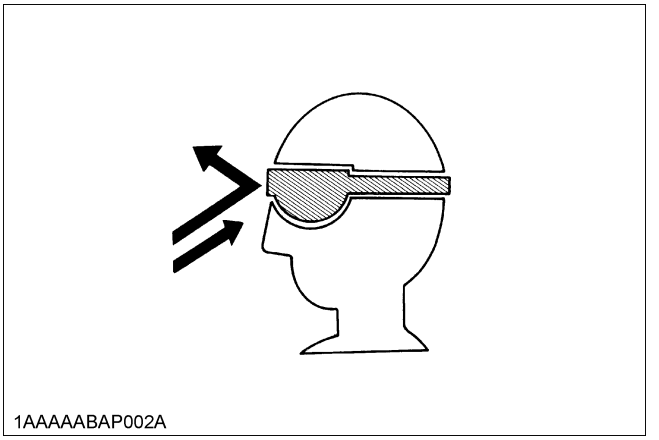
c. Exchange of bucket teeth and side cutters [JPN bucket version]

■ Bucket Tooth Replacement

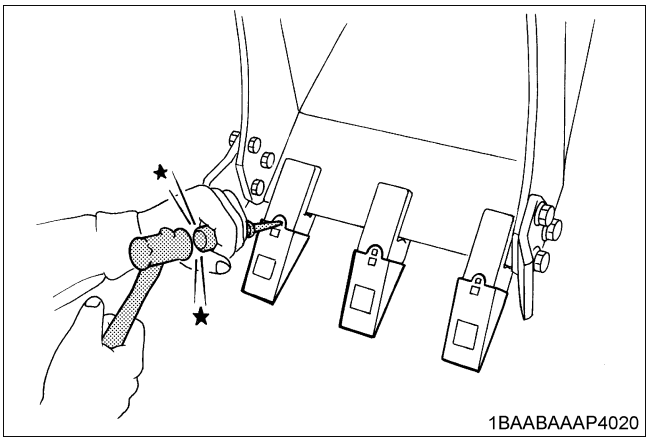
CAUTION

To avoid personal injury:

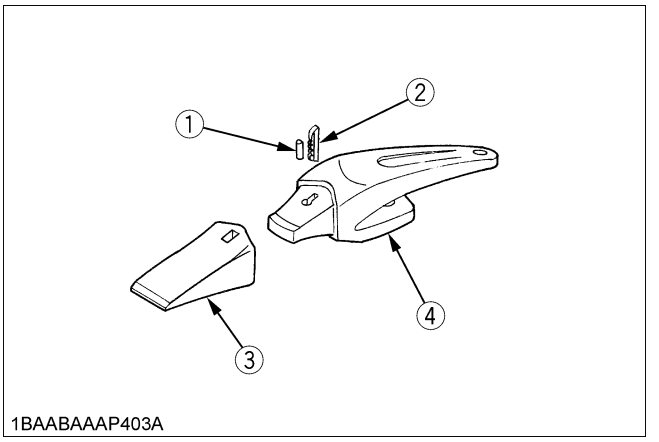
• Wear eye protection when changing the tooth points.



1. Position a screw driver or similar tool above the lock pin and knock out the pin and rubber plug with a hammer.
2. Remove the worn point from the adapter by hitting it with a hammer.
3. Clean the adapter.



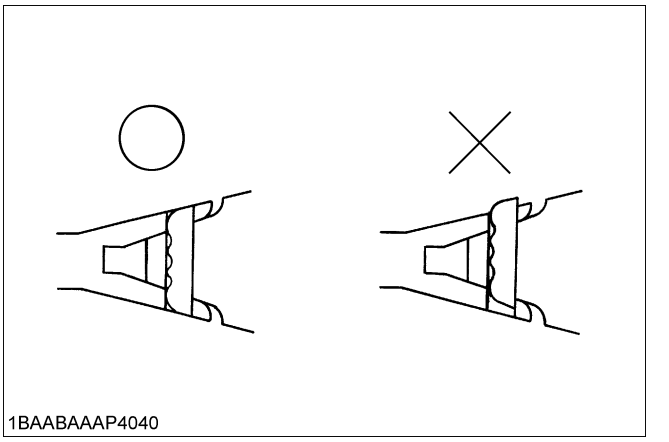
4. Mount a new point on the adapter.



(1) Rubber plug (3) Point

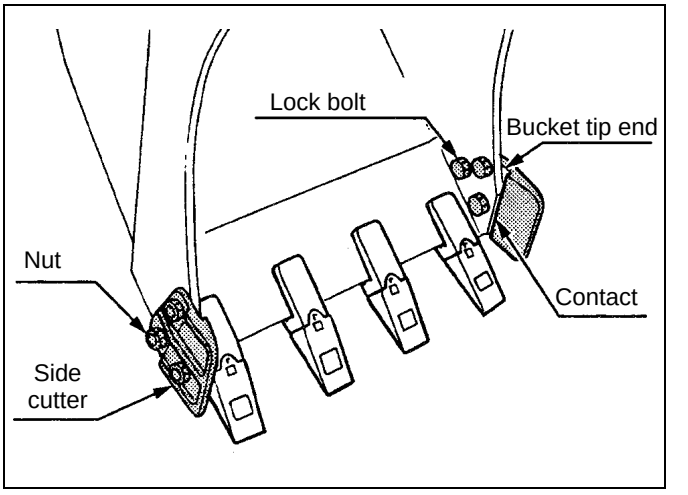
(2) Lock pin (4) Tooth adapter

5. Align the holes of the point and adapter and knock in the rubber plug together with the lock pin until the top surface of the pin is flush with the top surface of the adapter. (It is recommended to replace the rubber plug and lock pin when replacing the point.)



■ Replacing the side cutter

1. Using a box wrench and an adjustable wrench, remove the side cutter lock bolts.
2. Fit new side cutters. Temporarily tighten the bolts.
3. Make sure the side cutters are in close contact with the bucket tip ends. Then tighten up the bolts.

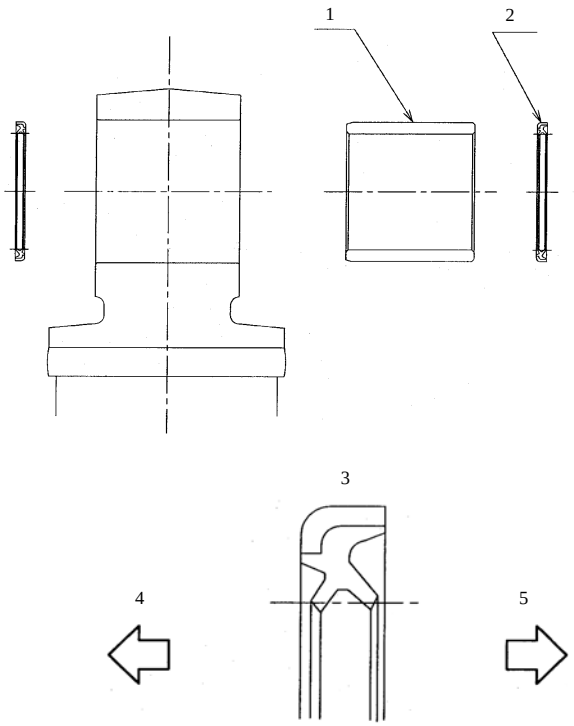


• Tighten the bolts to the torque of 260 to 304 Nm (26.5 to 31 kgf-m) 191.67 to 224.23ft·lbs.

• If the side cutters are out of contact, or in poor contact with the bucket tip ends, the bolts may get loose.

d. Installing of dust seal and thrust collar

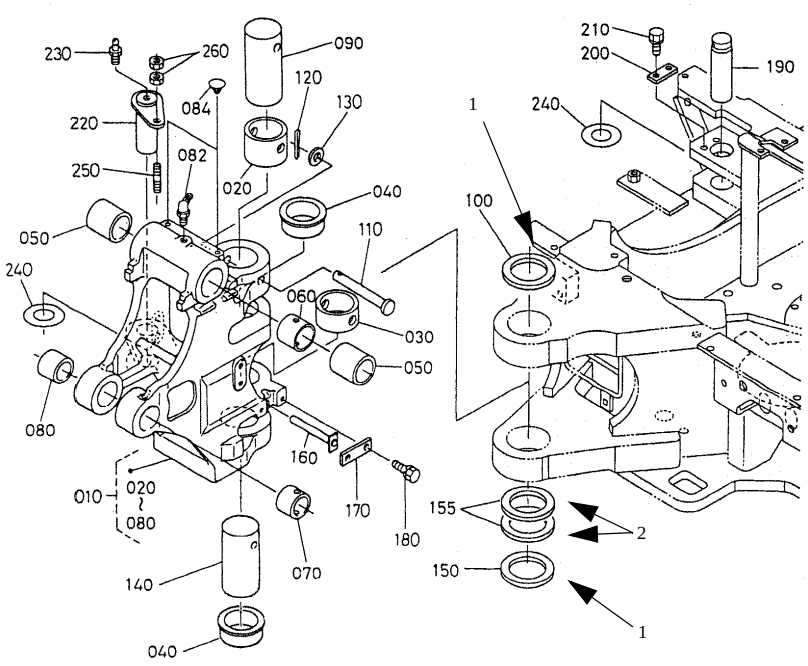
Installation of dust seal



Install the dust seals in the direction as shown at left. If in the wrong direction, the sealing effect is adversely affected, which may get the pins worn out earlier.

No.	
1	Bush
2	Dust seal
3	(Enlarged view of dust seal)
4	Toward the Bushing
5	Outside

Installation of thrust collar on the swing bracket

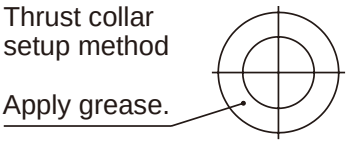


1. Install the thrust collar (t3.5), with its grooved face downward, on top of the swivel frame.
2. Select and install a 0.5 or 1.0mm (0.02 ~ 0.04inch) thick shim to have the clearance smaller than 0.5 mm (0.02inch).

No.	
1	Thrust collar (t3.5)
2	Shim

e. Installation of pin and bush

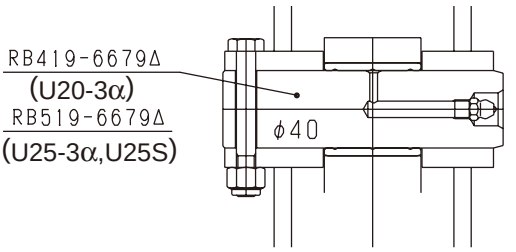
1.Apply grease to both sides.(See Figure A.)
(Molybdenum anti-seizing agent also applicable.)



[1] Pin bush

1) Front clearances

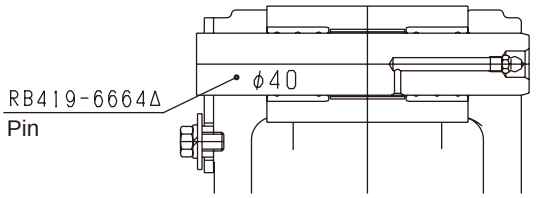
(1) If the clearance at each support pin in the thrust direction is larger than 0.6 mm (0.024in.), add a shim.
(2) Make sure the vertical clearance between the swivel frame and swing bracket is +0.3 mm to +1.3 mm (0.012~0.051in.) .
(3) For the swing cylinder bottom, check the clearance and add a shim as required.
(4) Apply grease to both sides of the thrust collars (8) and (9).
(Molybdenum anti-seizing agent also applicable.)



(1)

Arm assembly
Bucket cylinder

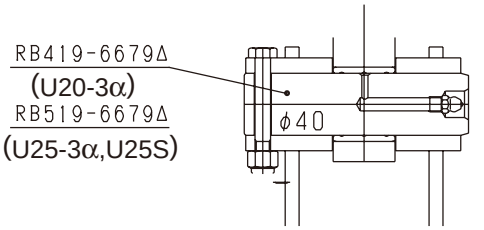
RC411-6694Δ	Shim(0.5, 65-41)	Use selectively.
RC411-6695Δ	Shim(1.0, 65-41)	



(2)

Boom assembly
Arm assembly

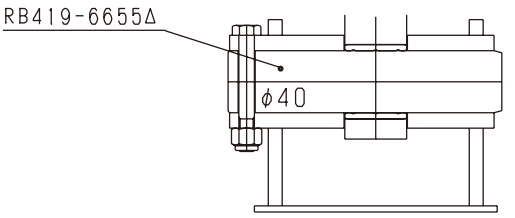
RC411-6694Δ	Shim(0.5, 65-41)	Use selectively.
RC411-6695Δ	Shim(1.0, 65-41)	



(3)

Arm assembly
Arm cylinder

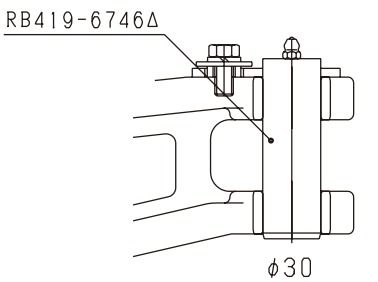
RC411-6694Δ	Pin(0.5, 65-41)	Use selectively.
RC411-6695Δ	Pin(1.0, 65-41)	



(4)

Boom assembly
Arm cylinder

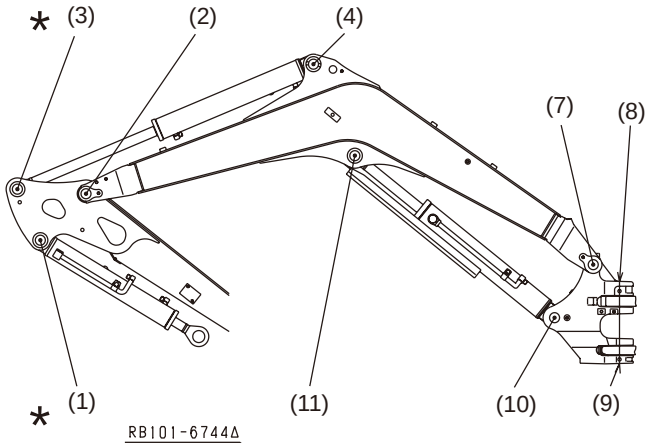
RC411-6694Δ	Pin(0.5, 65-41)	Use selectively.
RC411-6695Δ	Pin(1.0, 65-41)	



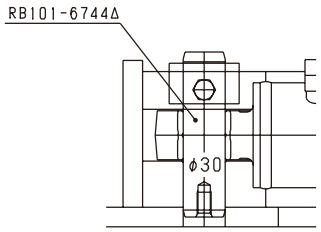
(5)

Swing bracket
Swing cylinder

68721-6697Δ	Shim(0.5, 60-31)	Use selectively.
68721-6633Δ	Shim(1.0, 60-31)	
68721-6634Δ	Shim(1.6, 60-31)	



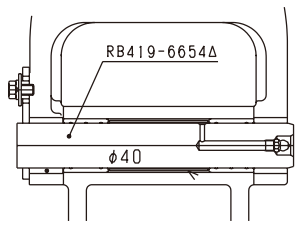
The *-marked parts are different between U20-3αEU and U25-3αEU.



(6)

Swivel frame
Swing cylinder

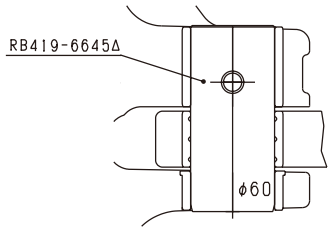
68721-6697 Δ	Pin(0.5, 60-31)	Use selectively.
68051-6633 Δ	Pin(1.0, 60-31)	
68051-6634 Δ	Pin(1.6, 60-31)	



(7)

Boom assembly
Swing bracket

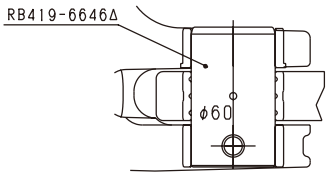
RC411-6694 Δ	Shim(0.5, 65-41)	Use selectively.
RC411-6695 Δ	Shim(1.0, 65-41)	



(8)

Swing bracket
Swivel frame(Upper)

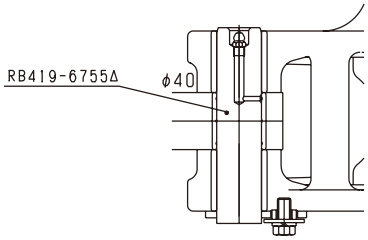
RB411-6687 Δ	Thrust collar (0.5, 65-41)	Use selectively.
68351-6645 Δ	Thrust collar (1.0, 65-41)	



(9)

Swing bracket
Swivel frame(Lower)

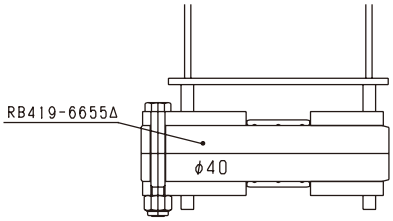
RC411-6874 Δ	Thrust collar (0.5, 65-41)	Use selectively.
68351-6645 Δ	Thrust collar (1.0, 65-41)	



(10)

Swing bracket
Boom cylinder

RC411-6694 Δ	Shim(0.5, 65-41)	Use selectively.
RC411-6695 Δ	Shim(1.0, 65-41)	

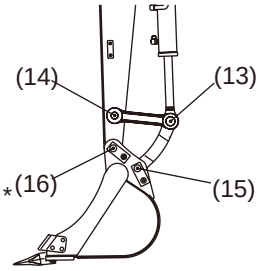


(11)

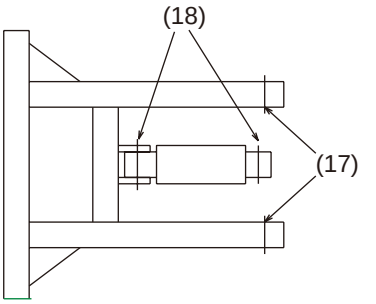
Boom assembly
Boom cylinder

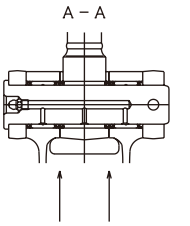
RC411-6694 Δ	Shim(0.5, 65-41)	Use selectively.
RC411-6695 Δ	Shim(1.0, 65-41)	

[2] Pin, bush-(2)



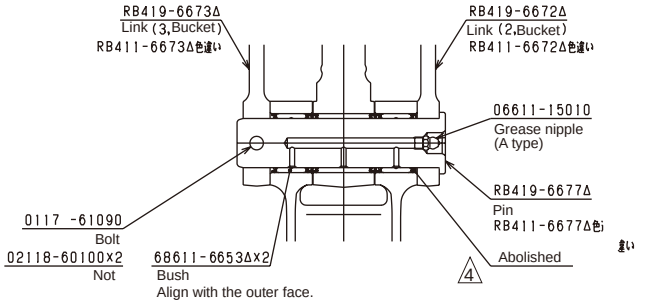
The *-marked parts are different between U20-3αEU and U25-3αEU.





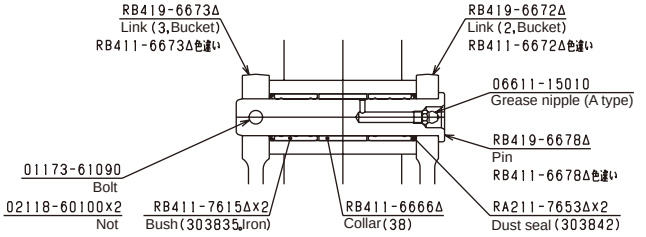
These 2 spots only
If the clearance is larger than 0.6 mm:

RC411-6694△ Shim (0.5, 65-41)	Use
RC411-6695△ Shim (1.0, 65-41)	selectively.



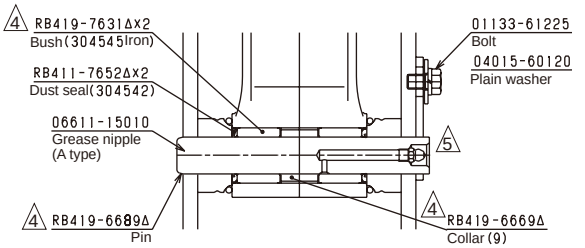
(13)

Bucket link (1)·(2)·(3)
– Bucket link single-support
Bucket CYL side



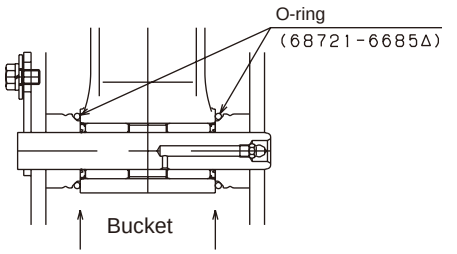
(14)

Bucket link (2)·(3)
– Arm assembly
Bucket link double-support (Arm side)



(15)

Bucket
– Bucket link
Bucket link single-support (Bucket side)



(15) Bucker link (1)

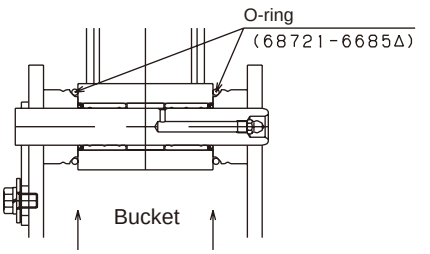
If the clearance is larger than 0.6 mm (0.024in) :

U20-3α EU

RP201-6646△ Shim (0.5)	SK5M	Use
RB411-6633△ Shim (1.0, 70-31)	SK5M	selectively.

U25-3α EU

RB511-6634△ Shim (0.5, 80-31)	SK5M	Use
RB511-6633△ Shim (1.0, 80-31)	SK5M	selectively.



(16) Arm

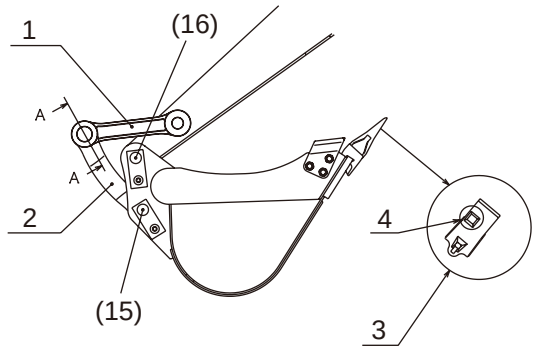
If the clearance is larger than 0.6 mm (0.024in) :

U20-3α EU

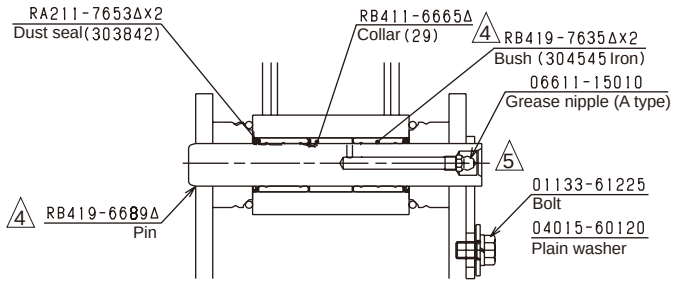
RP201-6646△ Shim (0.5)	SK5M	Use
RB411-6633△ Shim (1.0, 70-31)	SK5M	selectively.

U25-3α EU

RB511-6634△ Shim (0.5, 80-31)	SK5M	Use
RB511-6633△ Shim (1.0, 80-31)	SK5M	selectively.



No.	
1	Place the bucket links 2 and 3 with their machined faces inward.
2	Place the bucket link 1 with its character-relief side inward (toward the machine).
3	Attach in position with the gate (convex) toward outside of the bucket.
4	Gate

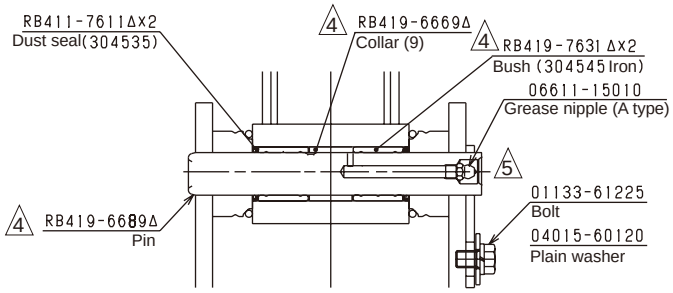


(16)-1

U20-3α only

Bucket
- Arm assembly

Bucket support

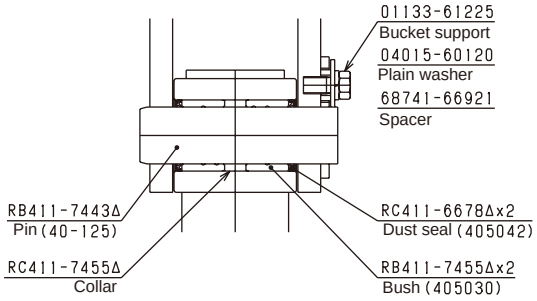


(16)-2

U25-3α only

Bucket
- Arm assembly

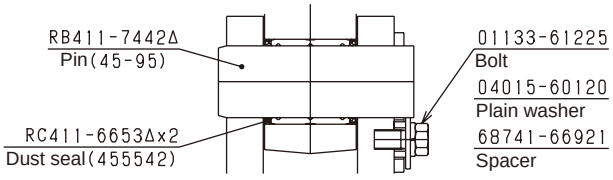
Bucket support



(17)

Track frame
- Blade

(2 locations)



(18)

Cylinder
- Blade
- double-support

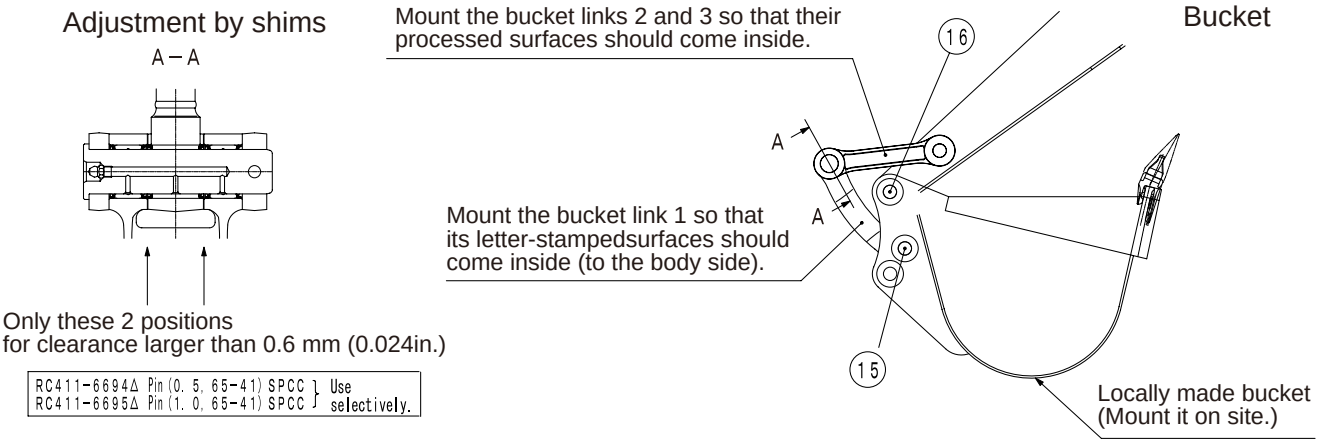
(2 locations)

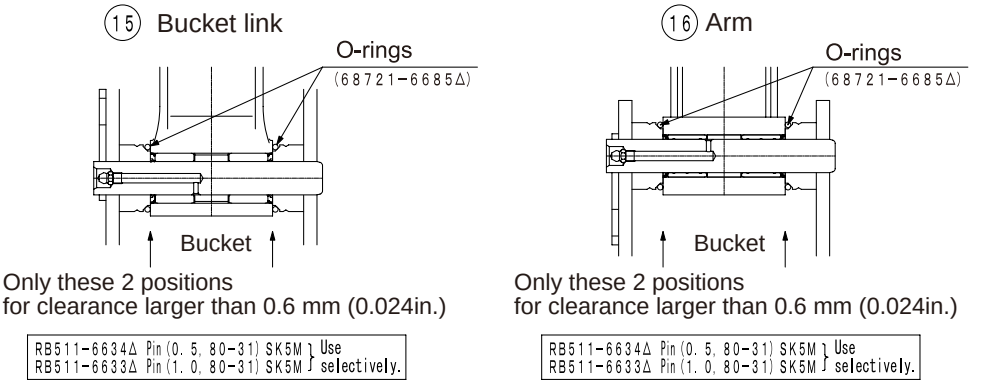
Note : As for PP-version, bucket is supposed to install locally.

[3] Front bucket mounting instruction (PP-version)

Clearances at front side
* Clearances in the thrusting direction of each supporting pin

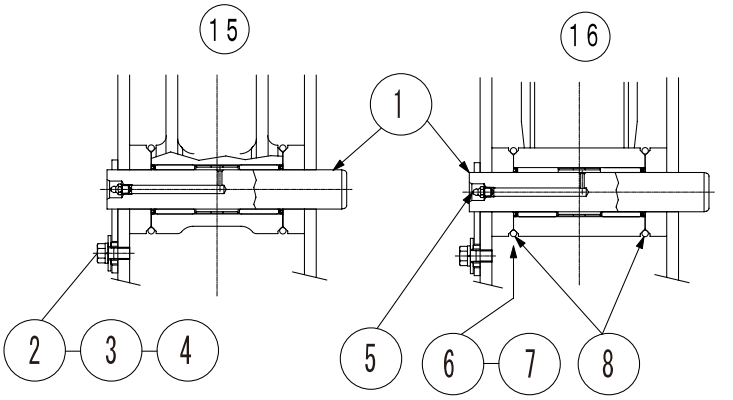
Less than 0.6 mm (0.024in.)
* If clearance is larger than 0.6 mm (0.024in.), adjust it by adding shims.
(Use the shims as shown in the figure.)





[List of parts in the same package for bucket-less type]

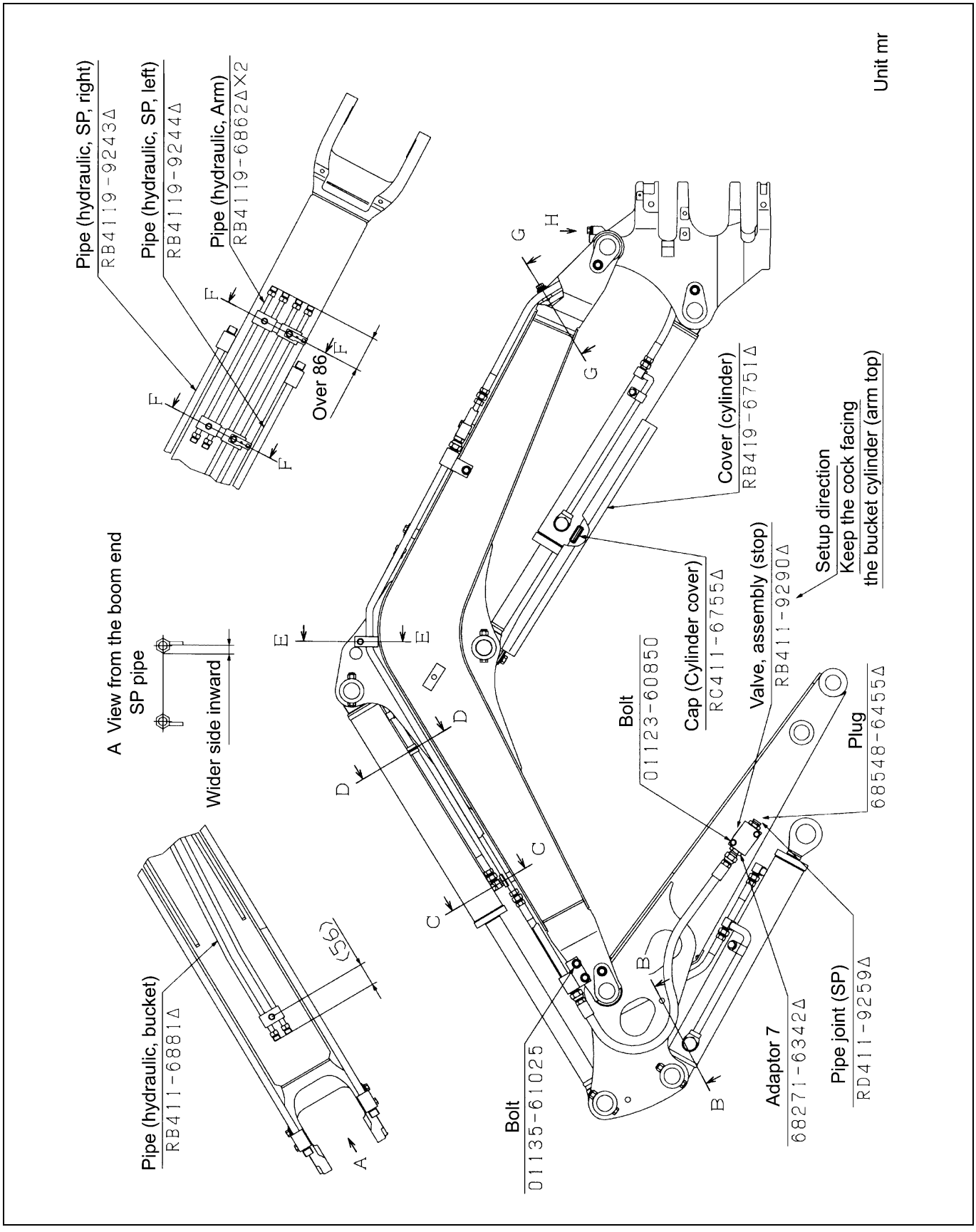
1	Pin	RB548-6689Δ	2
2	Spacer	68741-6692Δ	2
3	Plain washer	04015-60120	2
4	Bolt	01133-61225	2
5	Grease nipple	06611-15010	2
6	Shim (1.0, 80-31)	RB511-6633Δ	2
7	Shim (0.5, 80-31)	RB511-6634Δ	2
8	O-ring	68721-6685Δ	4



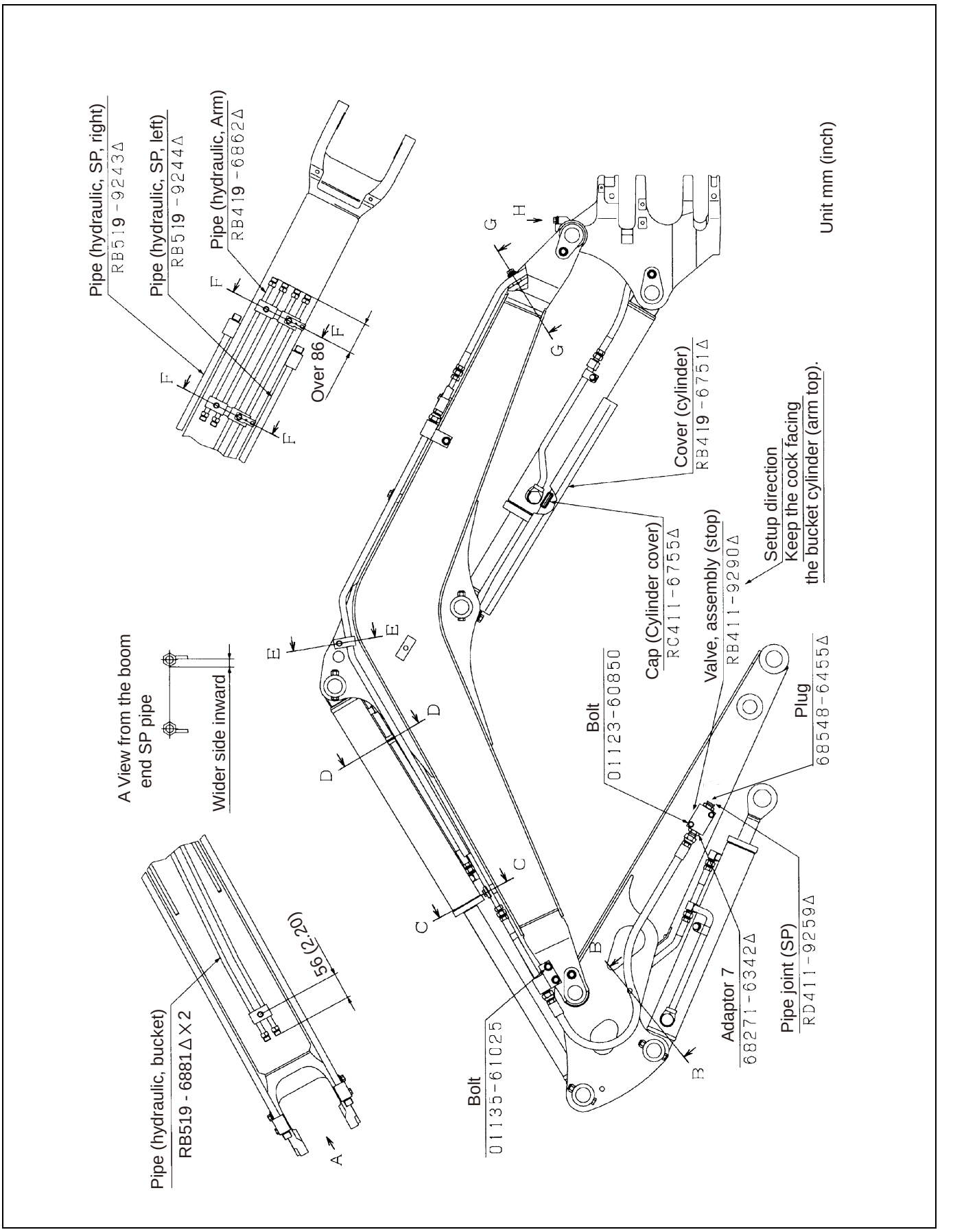
f. Front hose

[1] Front hose assembly (U20-3α)

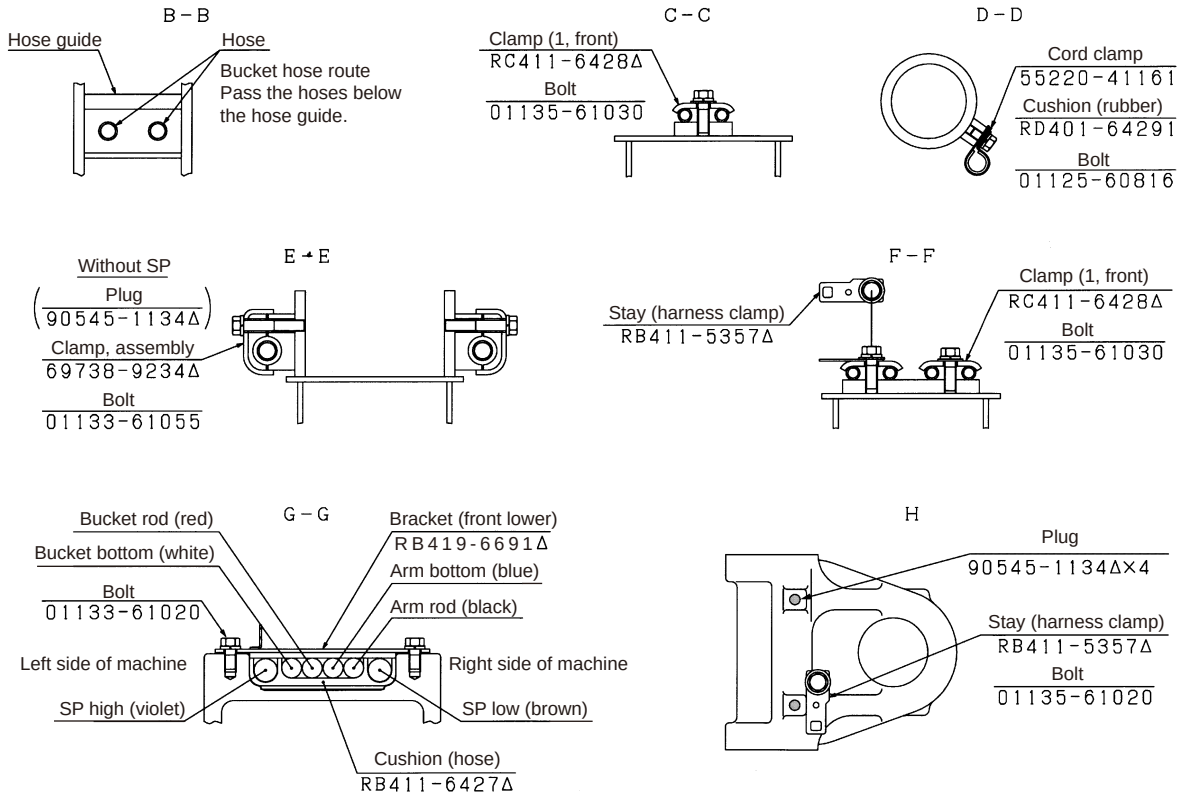
IMPORTANT: Replace the hydraulic hoses (boom, arm, bucket, swing, service port), after 2 years or 4000 operating hours, whichever comes earlier.



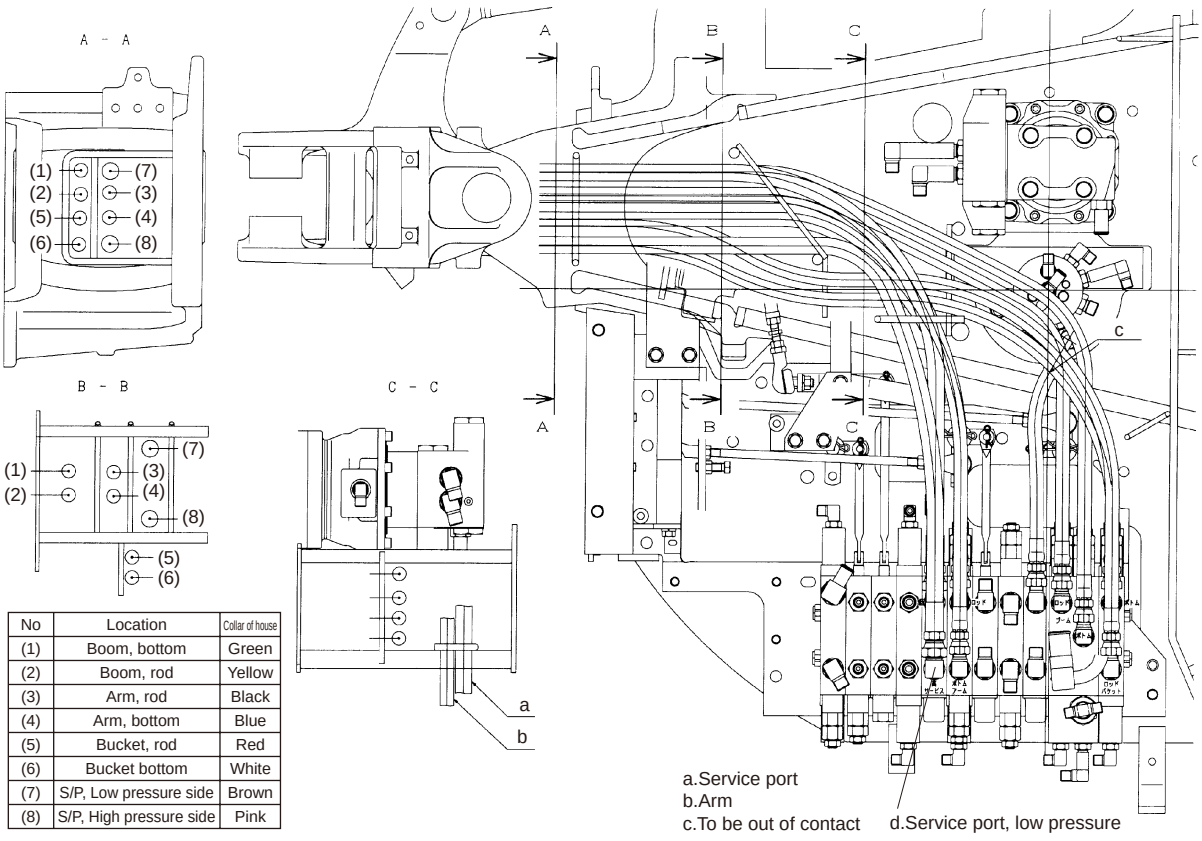
[2]Front hose assembly (U25-3α, U25S)



[3] Hose clamp



[4] Front hose control valve side

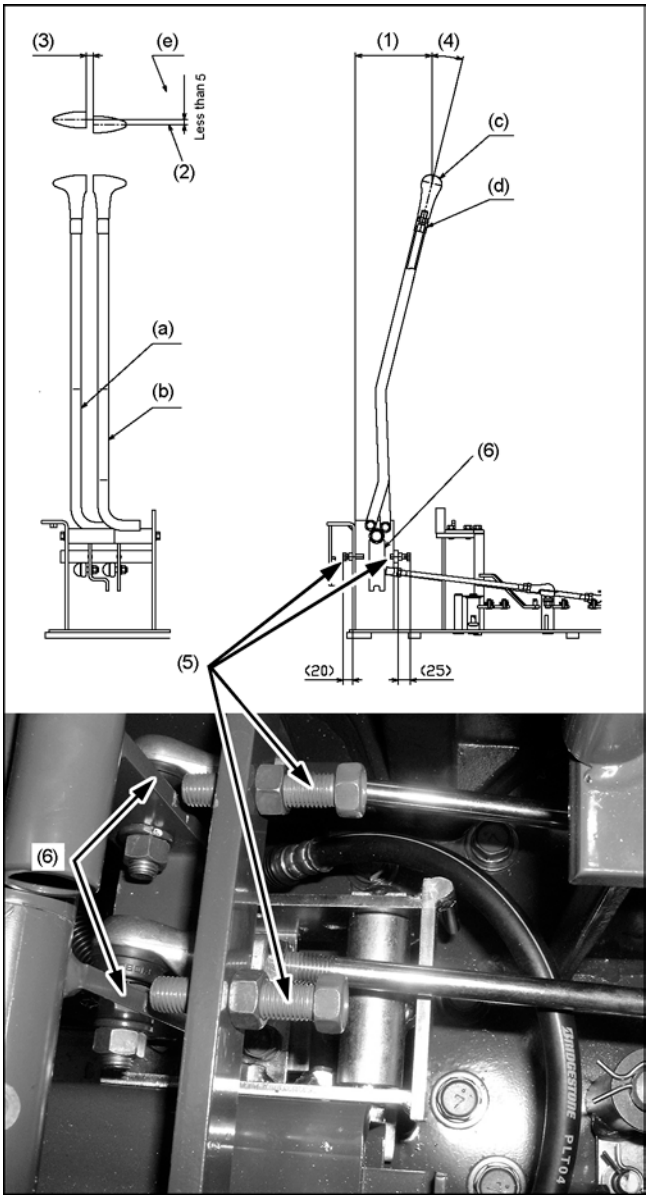


No	Location	Collar of house
(1)	Boom, bottom	Green
(2)	Boom, rod	Yellow
(3)	Arm, rod	Black
(4)	Arm, bottom	Blue
(5)	Bucket, rod	Red
(6)	Bucket bottom	White
(7)	S/P, Low pressure side	Brown
(8)	S/P, High pressure side	Pink

C.Upper structure

a. Lever and pedal

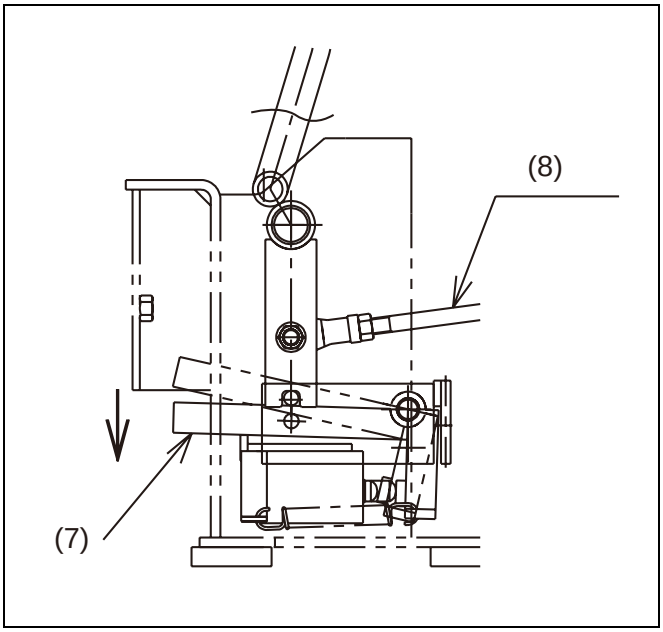
[1] Travel lever

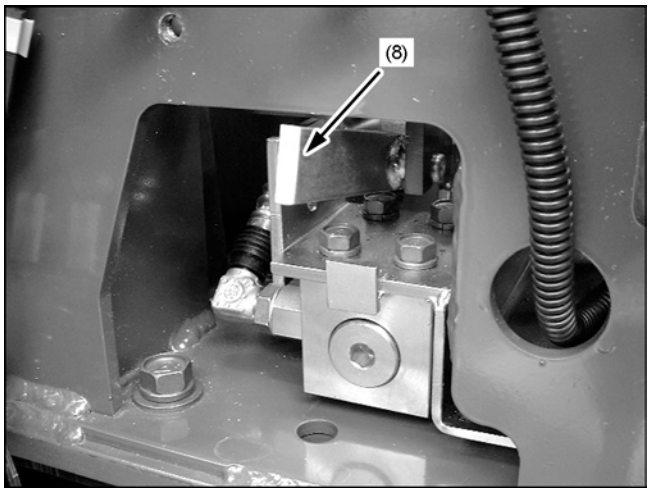


No.	
(a)	Lever (travel, right) RB419-6536Δ
(b)	Lever (travel, left) RB419-6531Δ
(c)	Grip (travel) RC101-65282
(d)	Cap RC101-65292
(e)	Misalignment between right sand left levers

1) Assembling procedure

1. Adjust the levers neutral positions, setup directions and angles, referring to the figure at left.
   (1) Dimension between bracket front and grip center
   159mm (reference)
   (2) Adjusting the travel levers neutral positions
   Keep the levers locked with a round bar (10 dia.) and adjust the misalignment between their tips within 5 mm.
   (3) Clearance between right and left levers
   11~17mm (0.43~0.67in.)
   (4) Setup angle of travel levers
   14 degrees
   (5) 01175-61045
   Locking the stopper bolt
   Bring the stay of the lever (travel, right/ left) in contact. Loosen the bolt by 90 degrees and lock it in this position. Make sure the valve spool works all over its stroke.
   (6) With the levers at the neutral positions, orient this part vertically.
   (7) Move down the lever (lock, travel) against the spring force to unlock the travel mode.
   (8) Adjust the rod to keep the travel levers misalignment within the specified range.
   (9) Return the lever (lock, travel) back into position to make sure the travel levers get locked.



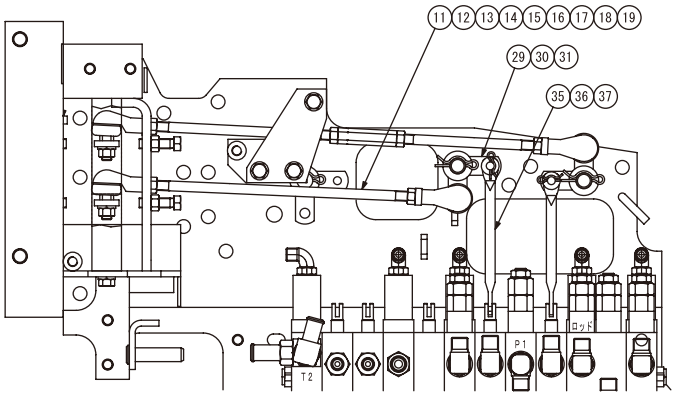


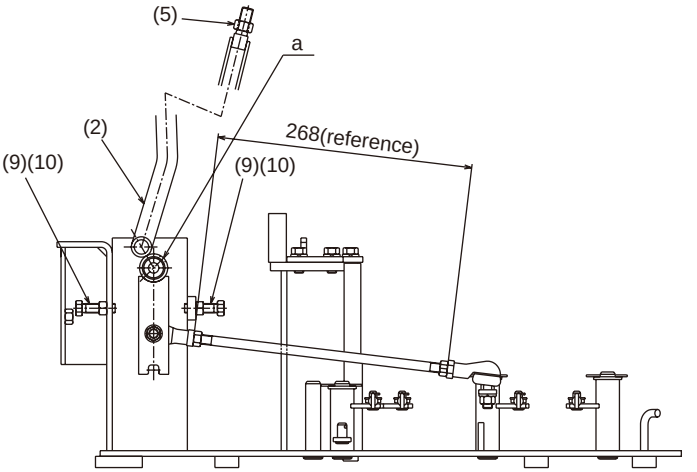
2) Check items after setup

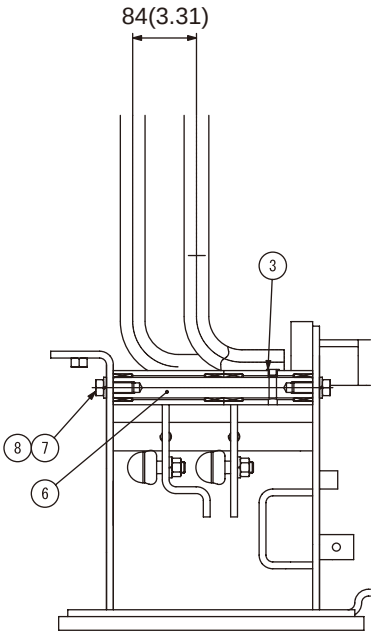
Make sure the valve spool works all over the stroke.
Make sure the valve spool moves smoothly.
Lock the stopper bolt and nut tight enough.

(7) Lock release lever
(8) Control rod

3) Travel lever assembly view







(3) Fitting the plastic cap (3)
Install the cap tight enough.
Otherwise the turning part may get rusty.

(4) Tightening torque of bolt (7)
60.8~70.6N•m (6.2~7.2kgf•m) 44.8~52.1ft•lbs

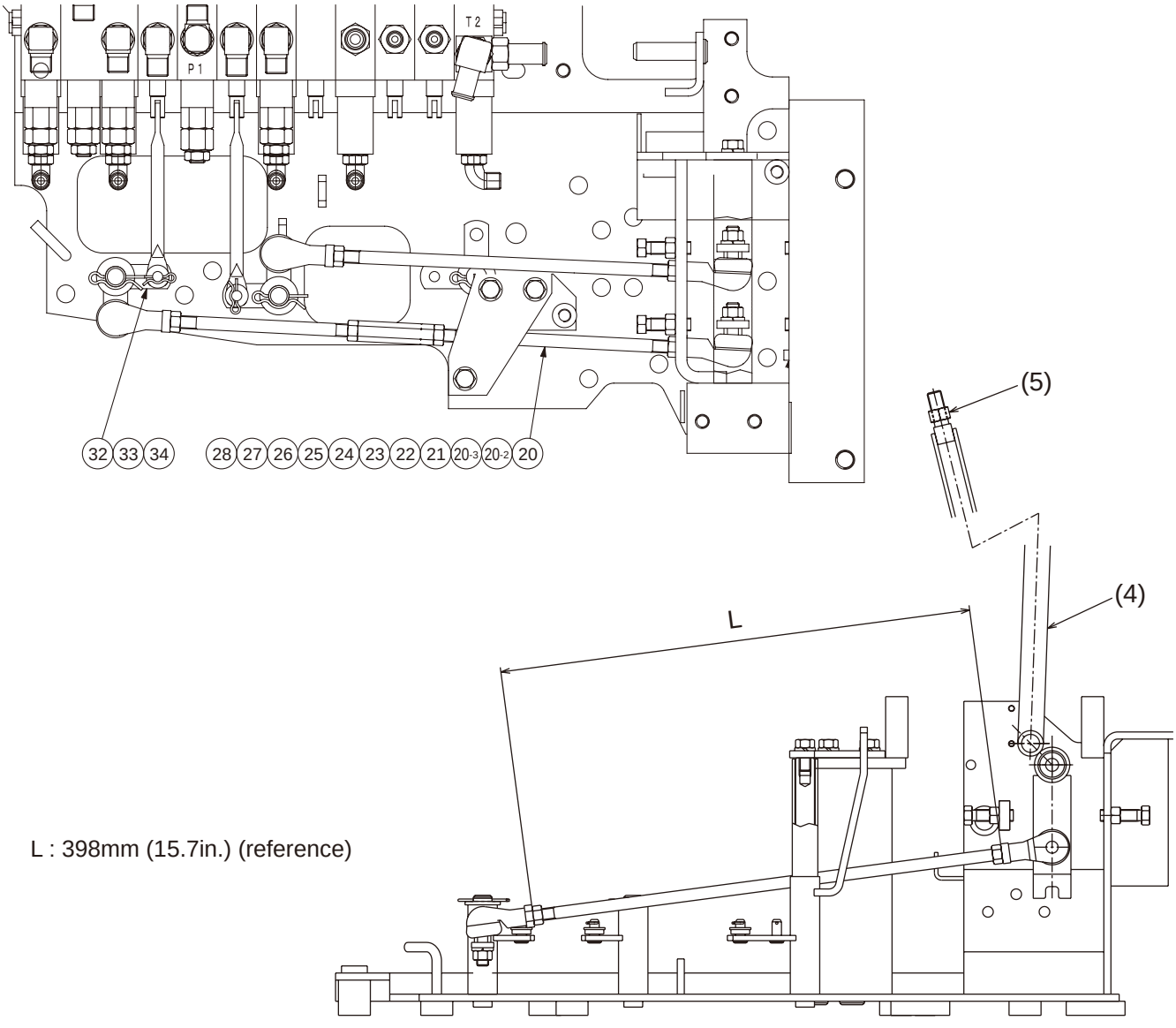
No.	Part name	Q'ty	Remarks
2	Lever, assembly (travel, left)	1	
	Lever (travel, left)	1	
	Needle bearing	2	
3	Plastic cap	1	
5	Nut	1	M12 × 1.25 4T
6	Pin (travel)	1	
7	Bolt	2	M10 × 1.25 9T
8	Plain washer	2	
9	Bolt	4	M10 × 1.25 7T
10	Nut	4	M10 × 1.25 4T
11	Rod (10-305)	1	
12	Link ball 1	1	
13	Spring washer	1	
14	Nut	1	M10 × 1.25 4T
15	Nut	1	M10 × 1.25 4T
16	Left-threaded lock nut	1	
17	Link ball 2	1	
18	Spring washer	1	
19	Nut	1	M10 × 1.25 4T
29	Link, assembly (travel, left)	1	
	Link (travel, left)	1	
	Bushing	12	
30	Plain washer	1	
31	Snap pin	1	
35	Rod (145)	1	
36	Plain washer	1	
37	Snap pin	1	

a : First orient the lock hole vertically, then insert the pin and others, and finally tighten up the bolts (7).

No.	Part name	Q'ty	Remarks
4	Lever, assembly (travel, right)	1	
	Lever (travel, right)	1	
	Needle bearing	2	
5	Nut	1	M12 × 1.25 4T
20	Rod (10-225)	1	
20-2	Turnbuckle	1	
20-3	Rod (180)	1	
21	Link ball 1	1	
22	Spring washer	1	
23	Nut	1	M10 × 1.25 4T
24	Nut	2	M10 × 1.25 4T
25	Left-threaded lock nut	2	
26	Link ball 2	1	
27	Spring washer	1	
28	Nut	1	M10 × 1.25 4T
32	Link, assembly (travel, right)	1	
	Link (travel, right)	1	
	Bushing	2	
33	Plain washer	1	
34	Snap pin	1	

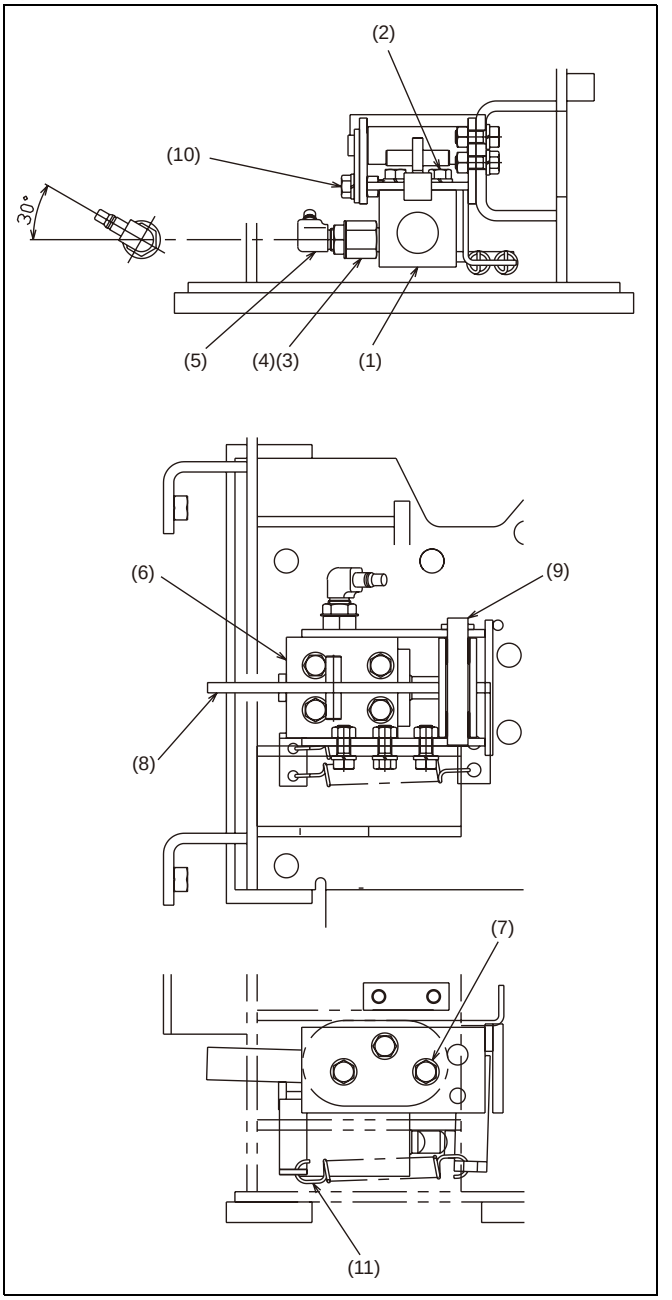
(5) Apply grease to the needle and DU bushing, and make sure the rotary shaft turns smoothly.

(6) Tightening torque of link ball lock nut
39.2~45.1N•m (4.0~4.6kgf•m) 28.9~33.3ft•lbs



L : 398mm (15.7in.) (reference)

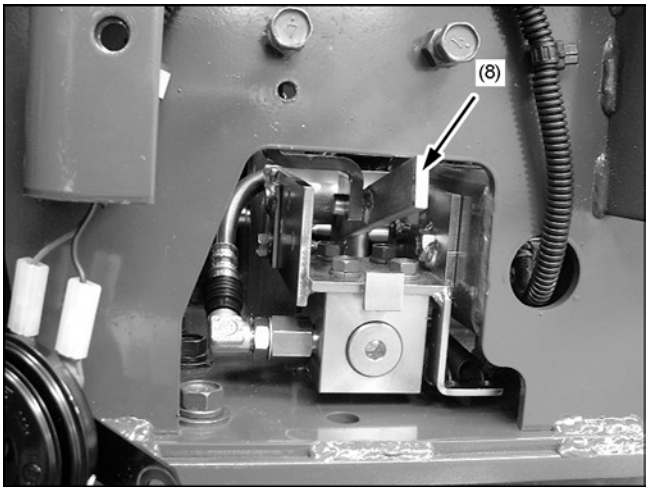
4) Travel lever lock

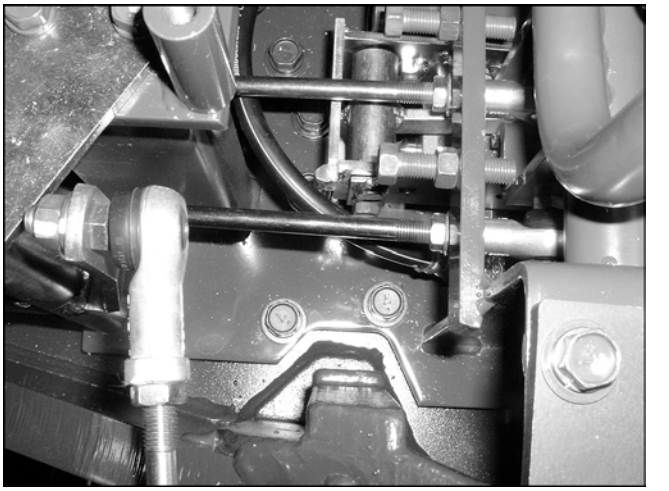


(1) Apply grease to the DU bushing bearing.

(2) Tightening torque of adaptor
G1/8:15.0~16.5N·m (1.5~1.7kgf·m) 10.8~12.3ft·lbs
G1/4:24.5~29.4N·m (2.5~3.0kgf·m) 18.1~21.7ft·lbs

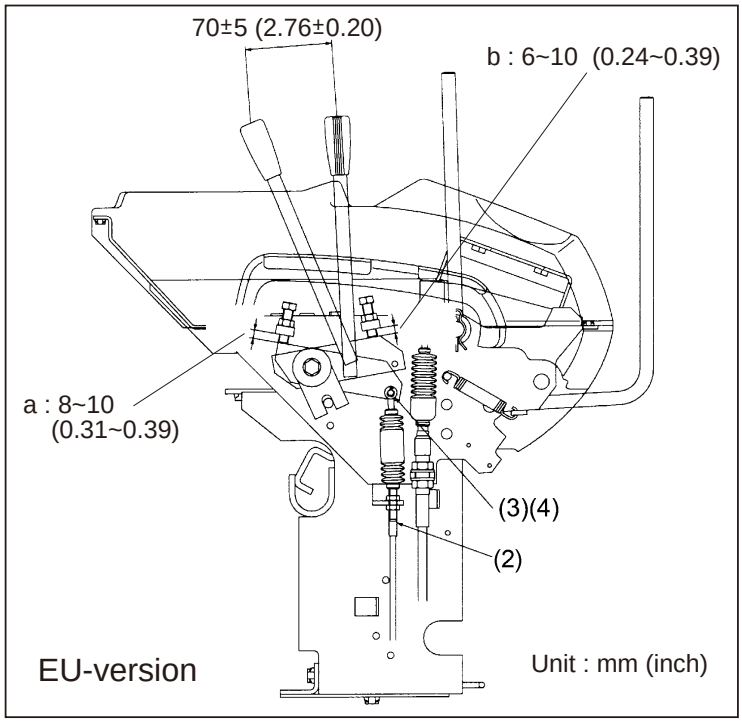
No.	Part name	Q'ty	Remarks
1	Assy Cylinder (TL)	1	
2	Bolt	4	
3	Pipe joint (S.G1/8-G1/4)	1	
4	O-ring	1	
5	Pipe joint (QL. G1/4-8.4)	1	
6	Bracket (lock, travel)	1	
7	Bolt	3	
8	Lever assembly (lock, travel) Lever (lock, travel) Bushing	1 1 2	
9	Shaft (lock, travel)	1	
10	Bolt	1	
11	Tension spring	2	



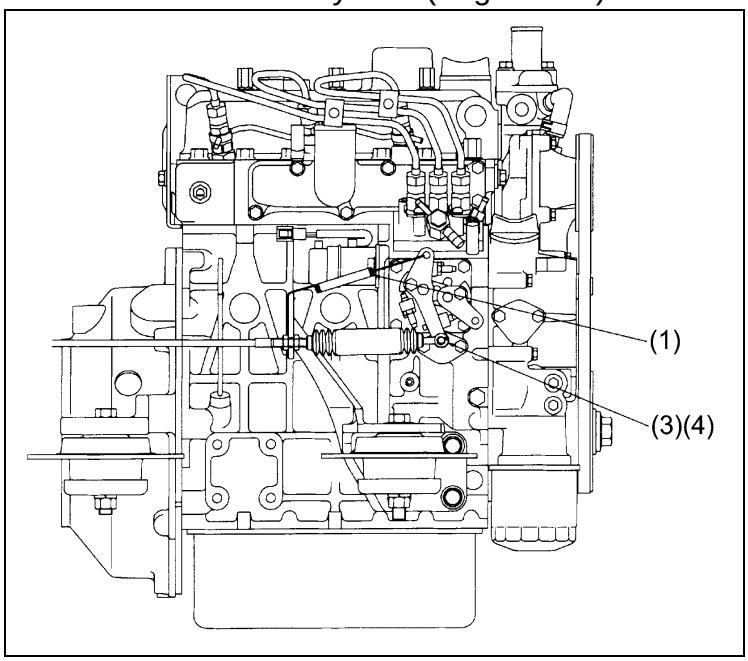


[2] Acceleration lever

Acceleration lever assembly view (lever side)



Acceleration lever assembly view (Engine side)

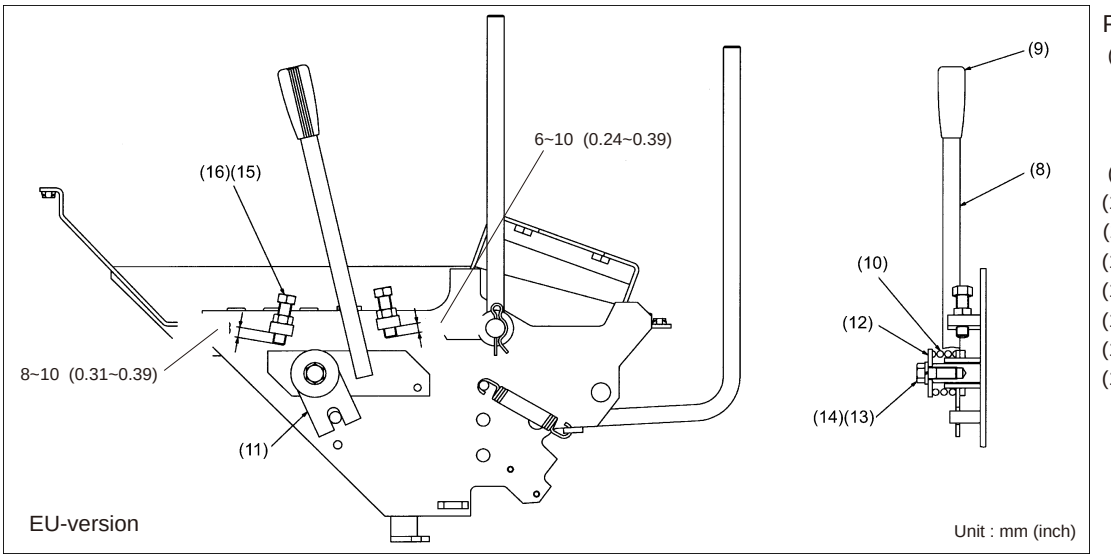


1) Assembling procedure

1. Idling control
   1350±50rpm
2. Set the engine rpm to maximum. Make sure the lever is exactly at the engine maximum rpm position.
3. Lever stroke (idling to maximum rpm)
   70±5mm (2.76±0.20inch) Lever should not contact to the cover
4. Pay attention not to allow the notch of the cover to come in contact with lever.
5. Adjustment b : Turn this back by 1/2 turns with the end of the adjusting bolt being in contact with the lever when the engine lever is at max. speed position.
6. Parts list

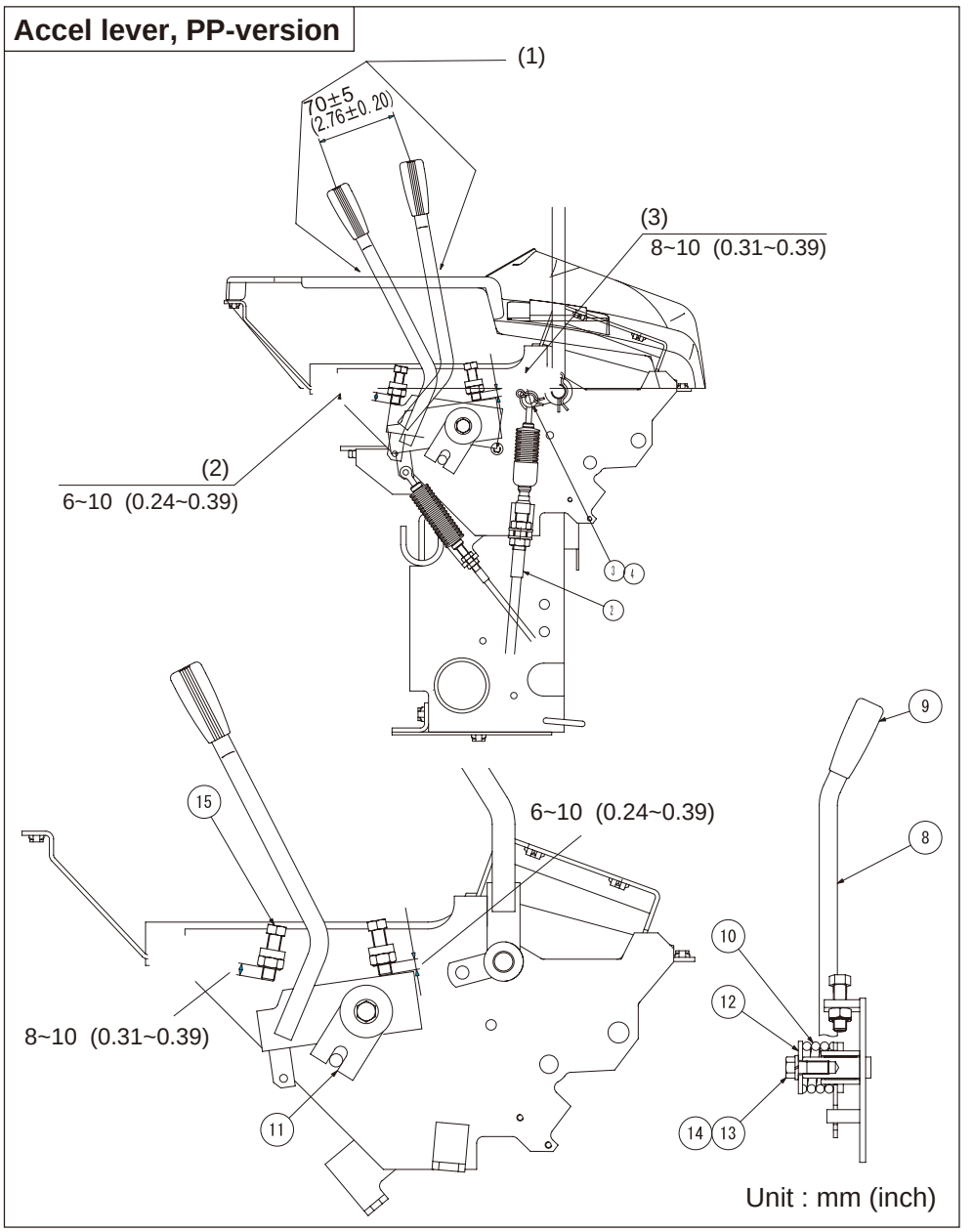
No.	Part name	Q'ty	Remarks
1	Spring (acceleration)	1	
2	Cable (acceleration)	1	
3	Plain washer	2	
4	Split pin	2	

7. Apply grease to the DU bushing and make sure the rotary shaft turns smoothly.
8. Tightening torque of bolt (14)
   48.1~55.9N·m (4.9~5.7kgf·m)
   35.4~41.2ft·lbs



Part list :

(8)	Lever, assembly (acceleration)	1
	Lever (acceleration)	1
	Bushing	1
(9)	Lever grip	1
(10)	Compression spring	1
(11)	Plate	1
(12)	Plate	1
(13)	Spring washer	1
(14)	Bolt M10x1.25 7T	1
(15)	Bolt M10x1.25 7T	2
(16)	Nut	2

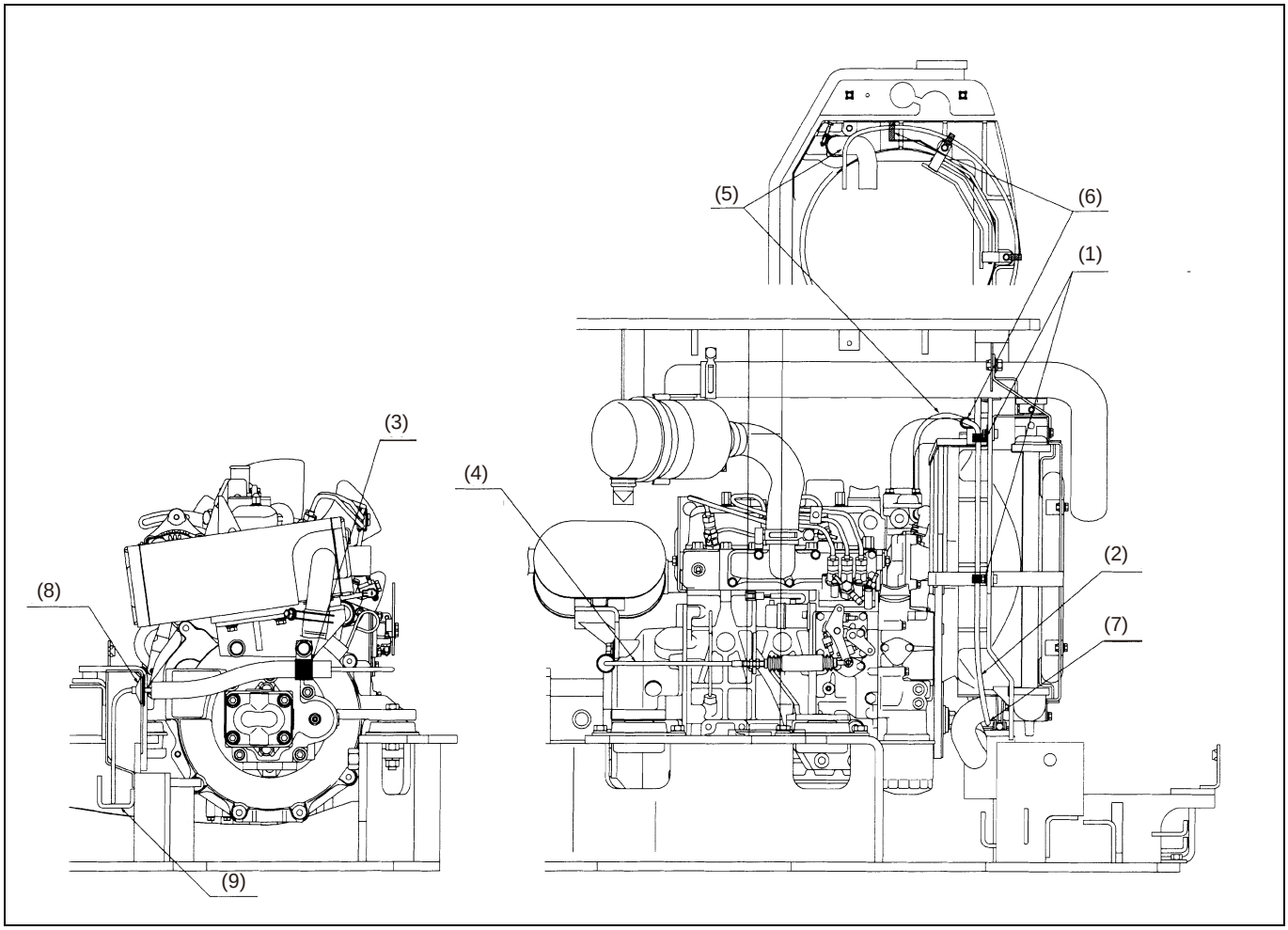


(1) Pay attention not to allow the notch of the cover to come in contact with lever.
(2) Turn this back by 1/2 turns with the end of the adjusting bolt being in contact with the lever when the engine lever is at idling position.
(3) Turn this back by 1/2 turns with the end of the adjusting bolt being in contact with the lever when the engine lever is at max. speed position.

① Spring (Accelerator)
② Cable (Accelerator)
③ Plain washer
④ Cotter pin

8.Lever, assfy (Accelerator)
Lever (Accelerator)
Bush
9.Lever grip
10.Compression spring
11.Plate
12Plate
13.Spring washer
14.Bolt
15.Bolt

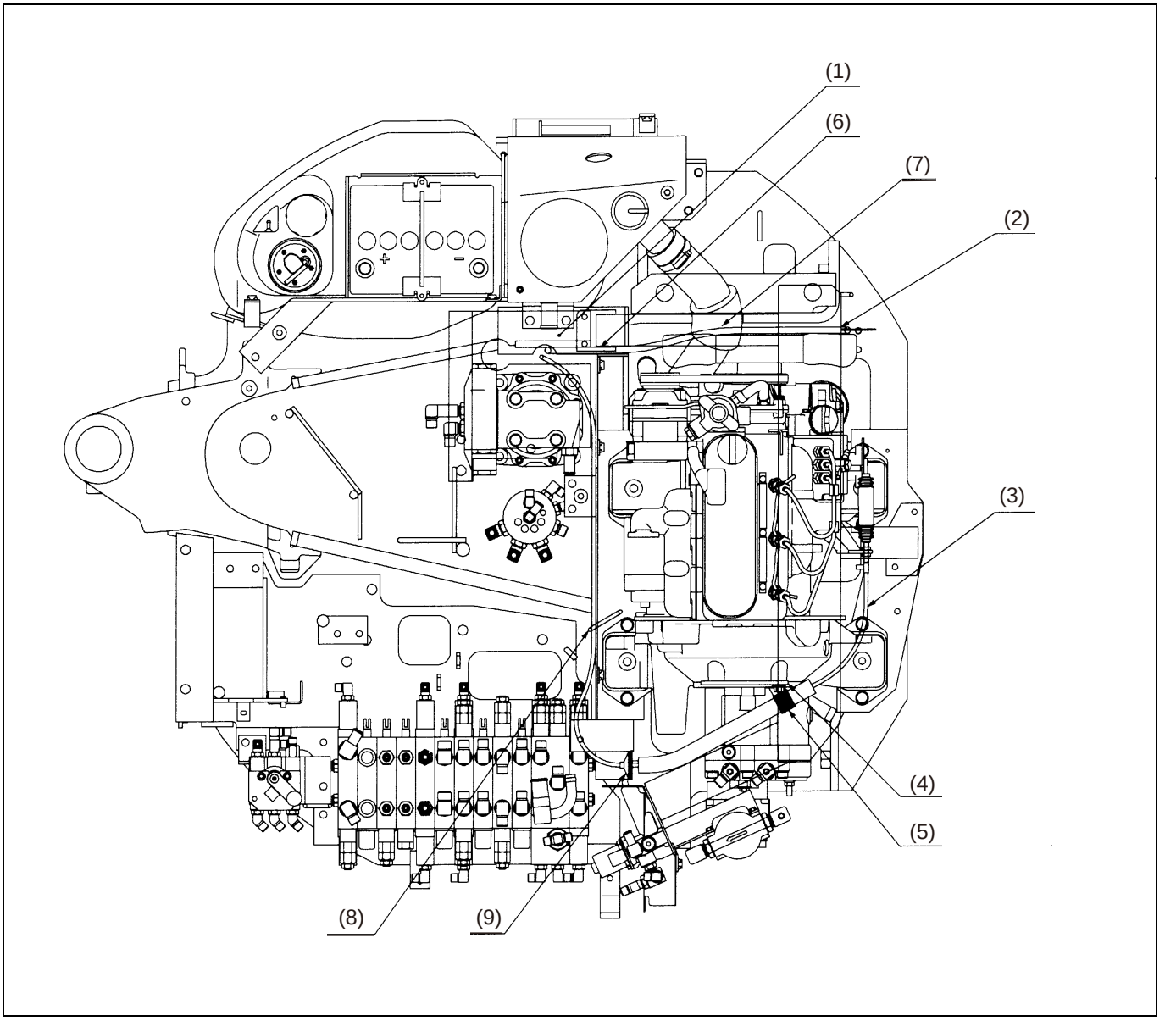
2) Acceleration cable and hour meter cable routes



No.
(1) 15272-67591
Cord clamp
(2) RB411-5329 D
Cable (meter)
(3) 36200-77611
Cord clamp assembly 2
(4) RB411-3515 D
Cable (acceleration)
(5) Pass on top of the water hose.
(6) Clamp to the cover (fan).
(7) Pass below the water hose.
(8) Grommet
(9) Swivel frame guide member

*Minimum bending radius of cables: To be over 150mm (5.91in.) radius
*Pass the cables along the shown routes without kink.

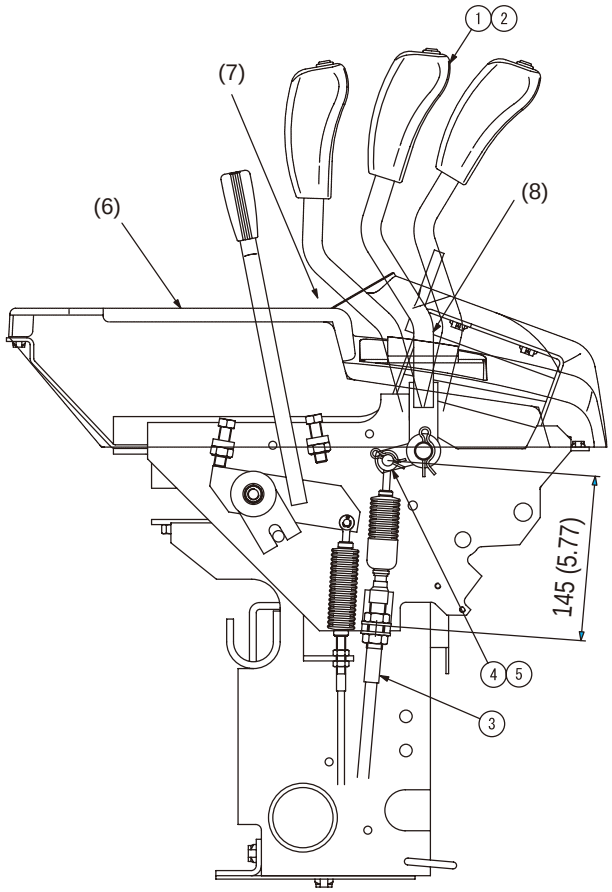
3) Acceleration cable and hour meter cable routes



No.
(1) Step (5)
(2) RB411-5329A
Cable (meter)
(3) RB411-3515 D
Cable (acceleration)
(4) Muffler bracket
(5) 36200-77611
Cord clamp assembly 2
(6) Pass between the swivel frame partition and frame (arch).
(7) Pass on top of the suction hose.
(8) Swivel frame guide member
(9) Grommet
Pass through the notch of the swivel frame.

[3] Blade lever

Blade lever assembly view

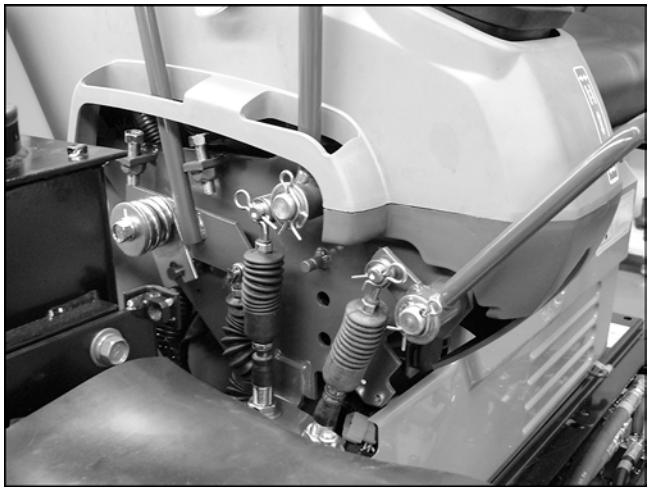


(6) Cover (right, top) RB411-4486Δ
(7) Pay attention not to allowthe lever to come in contact with the cover (right, upper) in full stroke operation.
(8) In vertical position

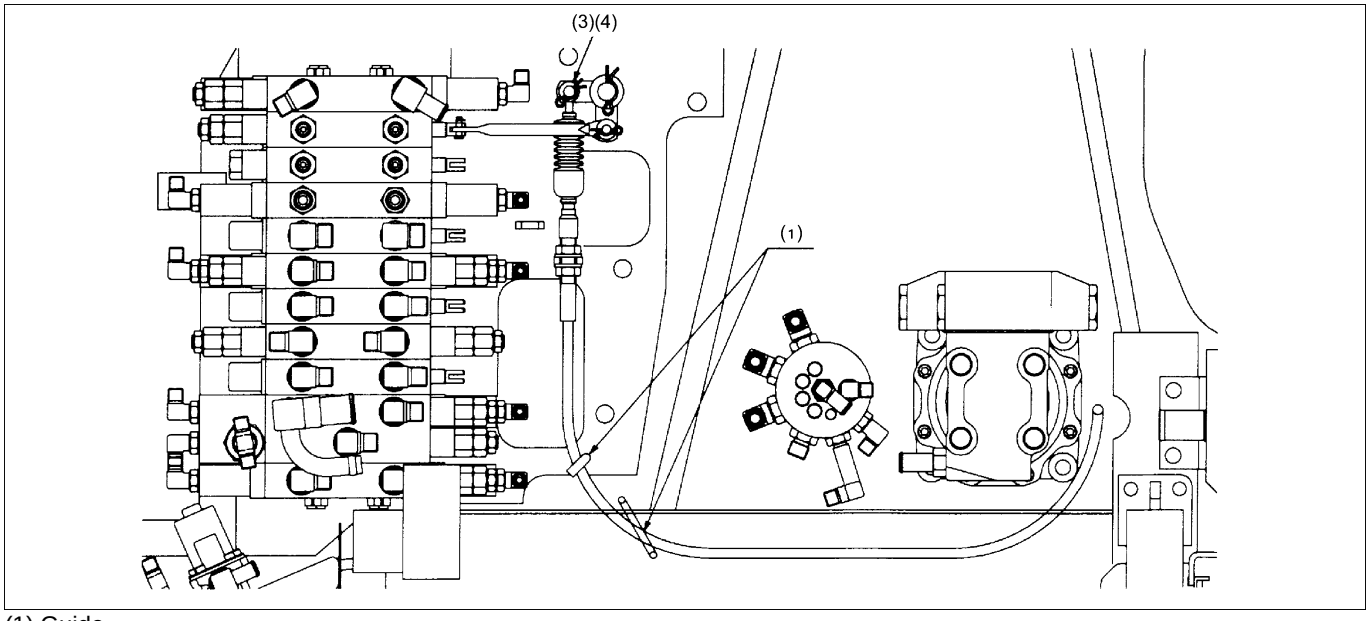
1) Assembling Procedure

1. Adjust the levers neutral positions, referring to the figure at left.
2. Do not bend the end of the cable outer casing.
   * Ensure a straight section of at least 20mm.
3. Allowable cable bending radius to be over 150mm (5.9in.) radius.
4. Check items after setup
   1. Make sure the valve spool works all over the stroke.
   2. Make sure the valve spool moves smoothly.
5. Parts list

No.	Part name	Q'ty	Remarks
1	Grip	1	
2	Screw	1	
3	Cable (dozer)	1	
4	Plain washer	2	
5	Snap pin	2	



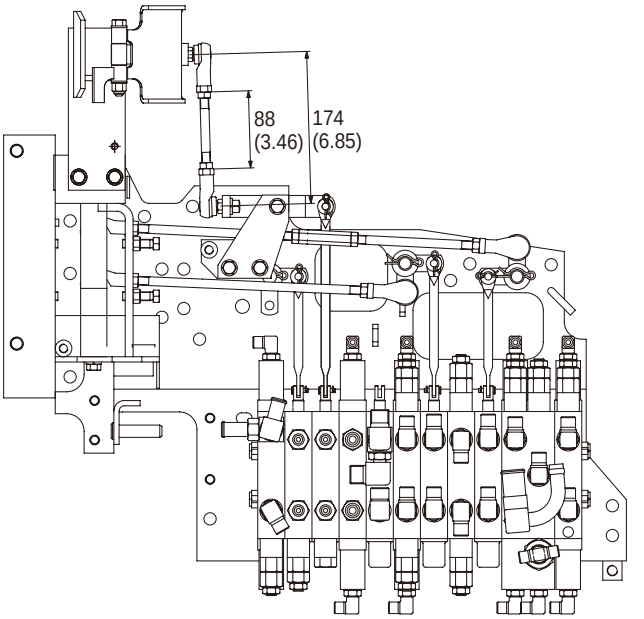
Dozer cable route



(1) Guide

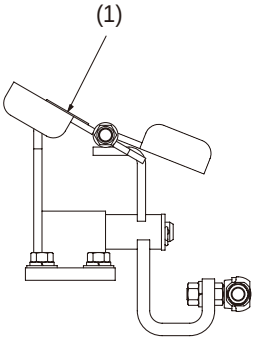
[4] Swing pedal

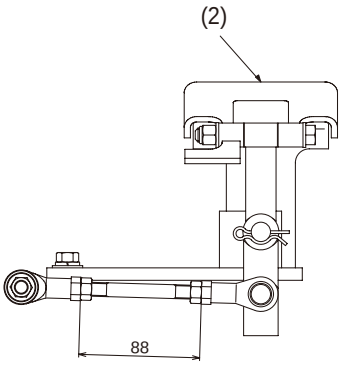
Swing pedal assembly view

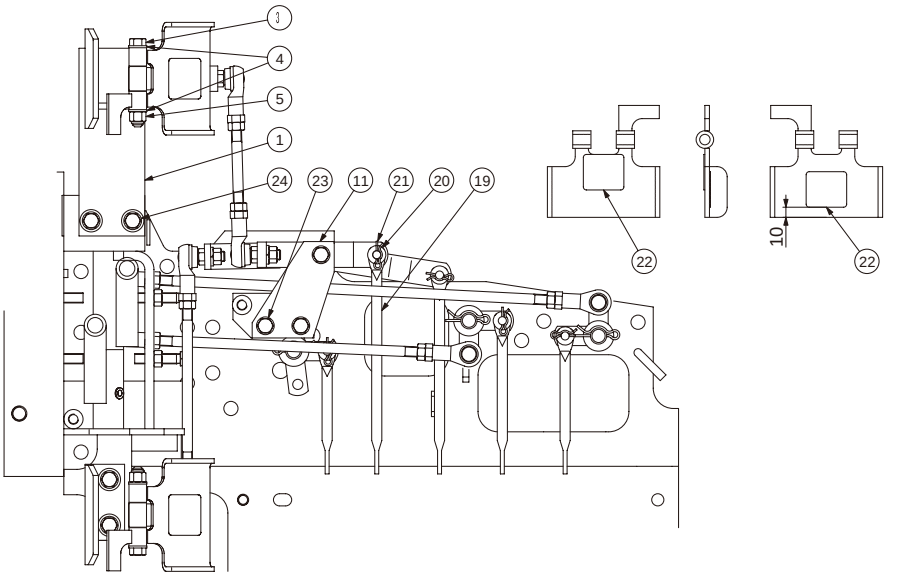


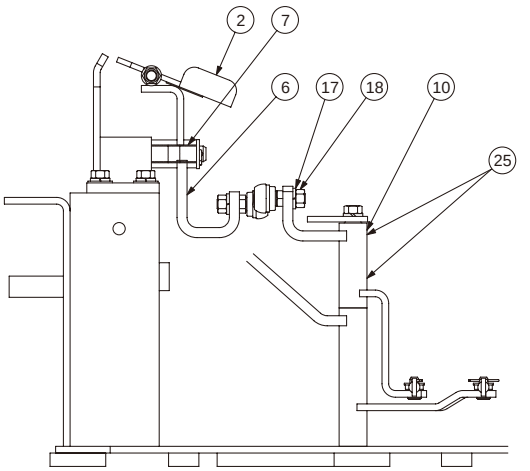
1. Apply grease to the DU bushing and makes sure the rotary shaft turns smoothly.
2. Tightening torque of link ball mock nut
   39.2~45.1N•m (4.0~4.6kgf•m) 28.9~33.3ft•lbs
3. Tightening torque of bolts 22 and 23
   48.1~55.9N•m (4.9~5.7kgf•m) 35.4~41.2ft•lbs

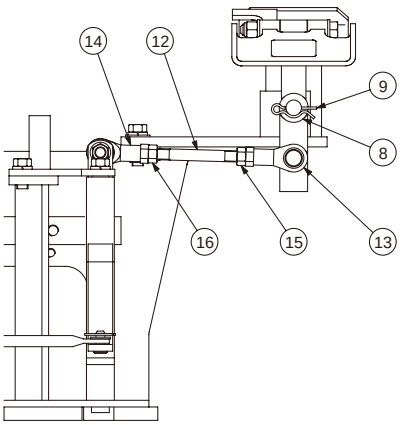
(1) Pedal must be moved smoothly back and forth at neutral position.
(2) Mount the pedal so that its top face stays horizontal at neutral position.





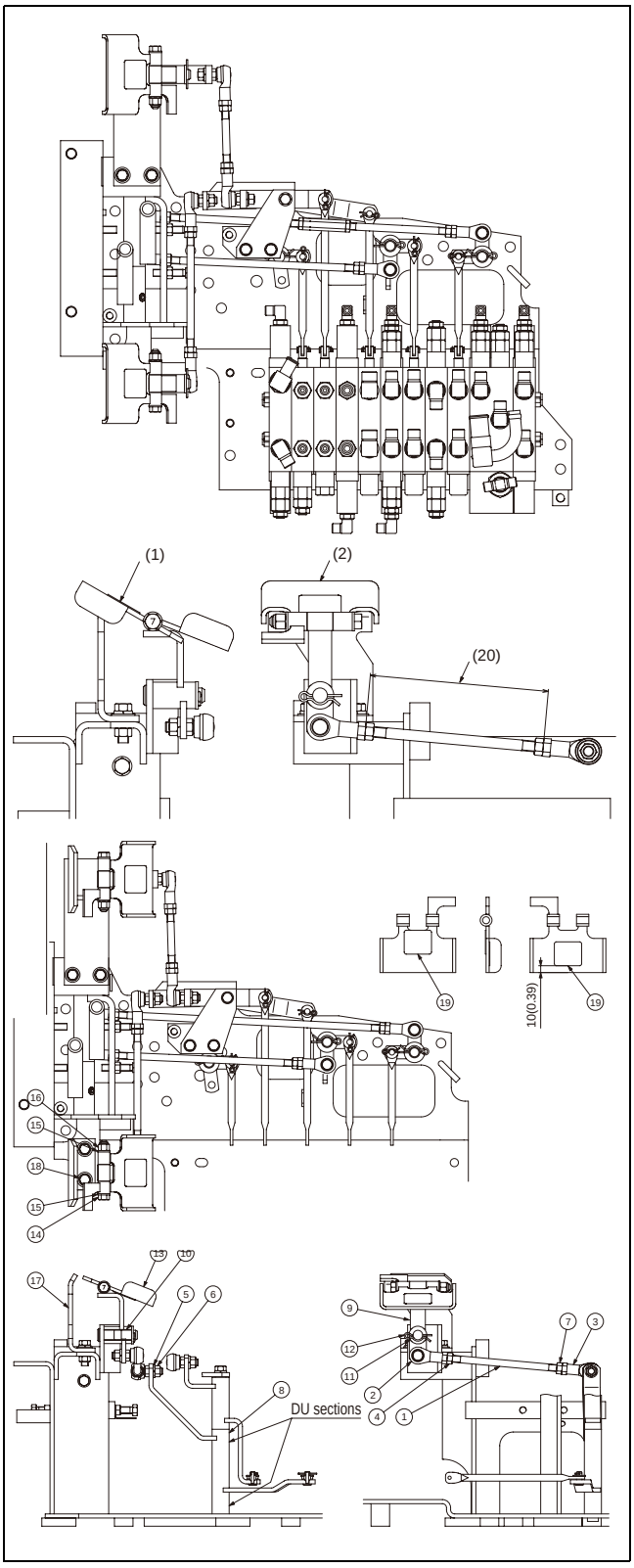






1.Bracket (Pedal)
2.Pedal
3.Bolt
4.Plain washer
5.Locknut
6.Link (2, swing)
7.Bush
8.Plain washer
9.Snap pin
10.Link, assy (1, swing)
Link (1, swing)
Bush
11.Plate (Link support)
12.Rod (10-120)
13.Link ball 1
14.Link ball 2
15.Nut
16.Left-hand threaded locknut
17.Spring washer
18.Nut
19.Rod (210)
20.Plain washer
21.Snap pin
22.Seat (Pedal)
23.Bolt
24.Bolt
25.DU-bush section

(Service port assembly view)



[5]Service port pedal

1.Make sure the pedal swings equally right and left (horizontal at the center).
Right and left →Swing
2.Fit the pedal with its top horizontal at the neutral position.
3.Move both the service port and swing port spools full stroke and release them. Now make sure the pedal goes back smoothly to its neutral position.
(1)Pedal must be moved smoothly back and forth at neutral position.
(2)Mount the pedal so that its top face stays horizontal at neutral position.

.

Link ball mounting nut tightening torque 39.2~45.1N·m (4.0~4.6kgf) 28.93~33.27ft·lbs
Bolt tightening torque ⑱ (M10 x1, 25) 48.1~55.9N·m (4.9~5.7kgf) 35.28~41.23ft·lbs

1.Rod (10-200) Operation, assfy (C)
2.Link ball 1
3.Link ball 2
4.Nut
5.Spring washer
6.Nut
7.Left-hand threaded locknut
8.Link, assfy (1, SP) Link (1, SP) Bush
9.Lever (2, SP)
10.Bush
11.Plain washer
12.Snap pin
13.Pedal
14.Bolt
15.Plain washer
16.Locknut
17.Stay (Pedal)
18.Bolt
19.Seat (Pedal)
20.171(6.73") (Reference value)

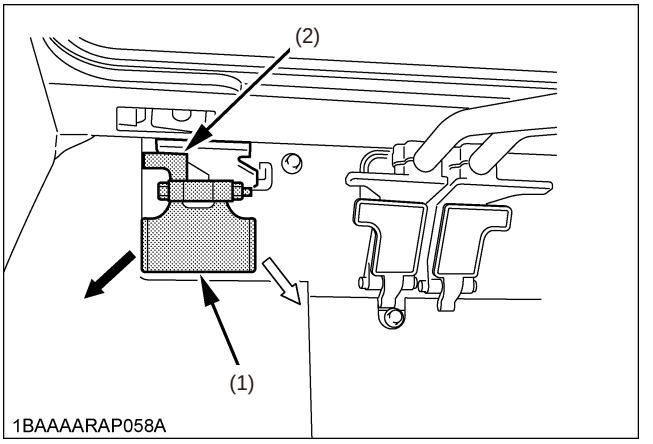
SERVICE PORT OPERATION

CAUTION

To avoid personal injury:

- Tilt the service port pedal forward when the pedal is not used. Be sure to lock the pedal.

This pedal is used to operate attachments such as breakers.

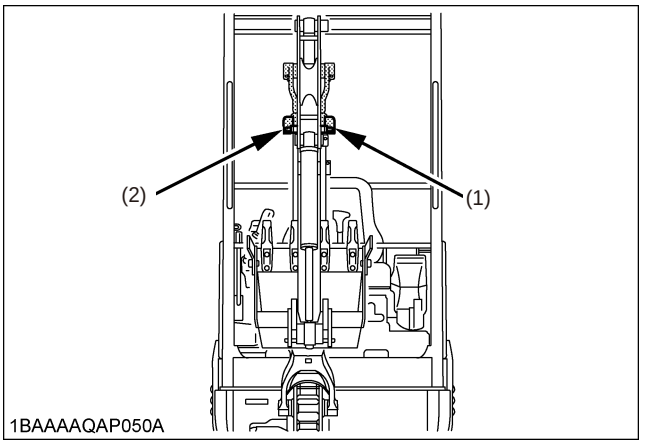


(1) Service port pedal (2) Pedal lock

1) Assembling procedure

1. Adjusting the pedal
   Make sure the pedal stays horizontal at the center and swings equally right and left.
   Right and left→Swing
2. Tightening torque of link ball lock nut
   39.2~45.1N·m (4.0~4.6kgf·m) 28.9~33.3ft·lbs
3. Link fitting dimensions
   Fit the link as shown at left.

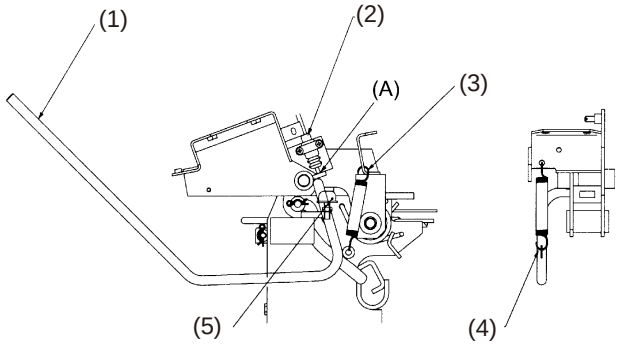
- Push the right side of the pedal (⇩) send oil to the pipe (1).
- Push the left side of the pedal (🡻) to send oil to the pipe (2).



Max. Flow Volume LPM (GPM) (No load, theoretical)	**U20-3α**	35.8 (9.46)
	U25-3α, U25S	48.0 (12.68)
Max. Pressure MPa (kgf/cm^2) (psi)	**U20-3α**	21.6 (220) (3129)
	U25-3α, U25S	

[6] Limit switch

Limit switch setup view



1) Assembling procedure

1. Tightening torque of limit switch
   3.9~4.9N·m (0.4~0.5kgf·m)
   Apply screw LOCTITE. (Three-BondTB1401B)

CAUTION

Allow no gap at the points (A) and (B) when the limit switch is activated.

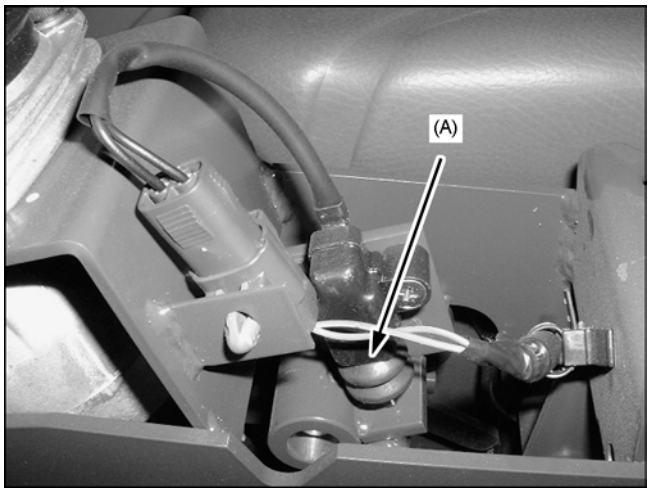
2. Apply instantaneous adhesive to the acceleration pedals rubber cover and attach it in place.

3. Hook the tension spring to the unload lever (left).
   Make sure the end of the spring hook at the unload lever faces outward of the machine.

4. Squeeze allowance of seat support rubber 1~2mm (0.04~0.08in.)

5. Apply grease to the DU bushing bearing.

(1) Lever (lock)
Spring pin
(2) Switch (limit)
Counttersunk head screw
Tightening torque 3.9~4.9N·m
(0.4~0.5kgf·m) 2.89~3.62ft·lbs
(3) Tension spring
(4) Keep the hook end outward of the machine.
(5) Seat support number
Squeeze allowance 1~2mm (0.04~0.08in.)

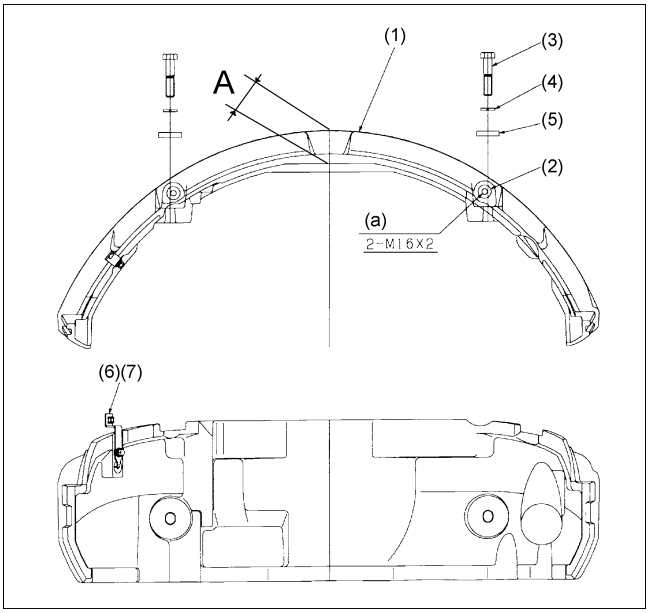


Limit switch, left

Normal open type switch.

b Counterweight

Counterweight assembly view



a : Hook bolt

1) Counterweight removal procedure

1. Park the machine on a level place and bring the front attachment and blade down on the floor.
2. Remove the bonnet and left bonnet cover.
3. Apply two hook bolts (M16x2) to the counterweight. Using two nylon slings with shackle, lift the counterweight halfway with a crane.
4. Remove the two mounting bolts off the counterweight and lift it away from the machine.

2) Assembling procedure

1. Tightening torque of counterweight mounting bolt : M20x2.5, Spanner=30
   367.7~431.5N·m (37.5~44.0kgf·m)
   271~318ft·lbs
   Apply screw loctite.(Loctite 271)
2. Parts list

No.	Part No.	Part name	Q'ty	Remarks
1	RB419-4831Δ Counter weight (Cabin)		1	U20-3α EU (Cabin type)
	RB411-4831Δ in different color			Blue No. 24
	RB519-4811Δ Counter weight		1	U25-3α EU (Cabin type)
	RB511-4811Δ in different color			Blue No. 24
2	90585-1199Δ	Plug	2	
3	RC411-4841Δ	Bolt	2	M20×2.5
4	04512-60200	Plain washer	2	
5	RP801-4812Δ	Washer	2	
6	RB411-4325Δ	Stay (1, bonnet)	1	
7	01135-61020	Bolt	1	M10×1.25 7T

Counterweight identification

Type		Part No.	Dimension of A mm(inch)
U20-3α EU	Fixed track+Canopy type	RB419-4811Δ (Different-color part)	70 (2.76)
	Variable track+Canopy type	RB419-4821Δ (Different-color part)	70 (2.76)
	Fixed track,Variable track+Canbin type	RB419-4831Δ (Different-color part)	115 (4.53)
U25-3α EU (Canopy,cabin type)		RB519-4811Δ (Different-color part)	115 (4.53)

Cabin type

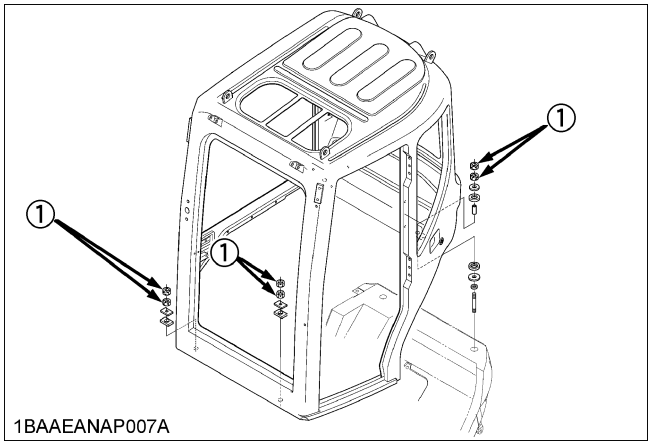
Type		Part No.	Casting
U20-3α EU	Cabin+Fixed track	RB419-4831Δ Different-color part	U-20C
	Cabin+Variable track		
U25-3α EU (cabin type)		RB519-4811Δ Different-color part	None

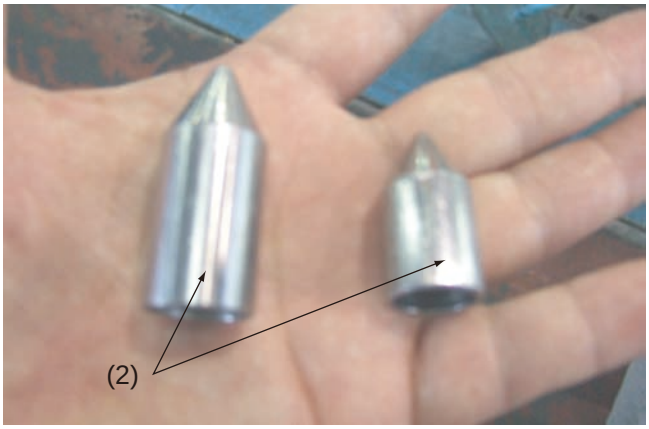
D.Cab / canopy installation

a. Installing the cabin or canopy

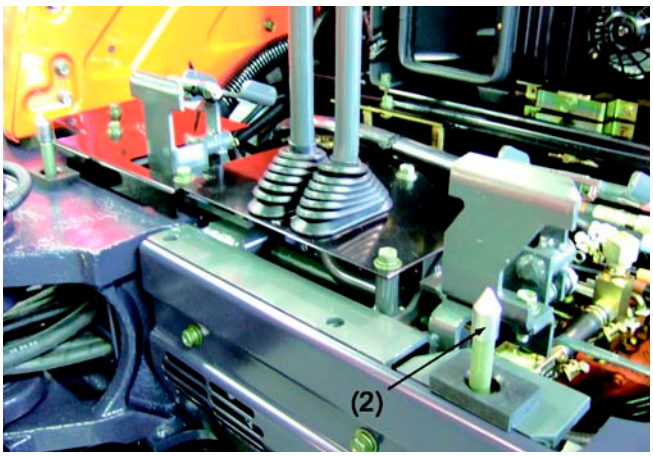
[1] Installing the cabin

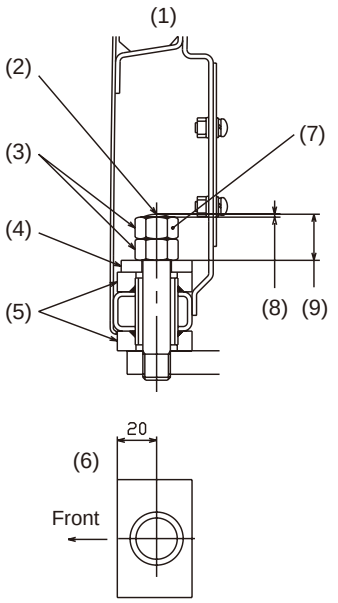
(1)Nut

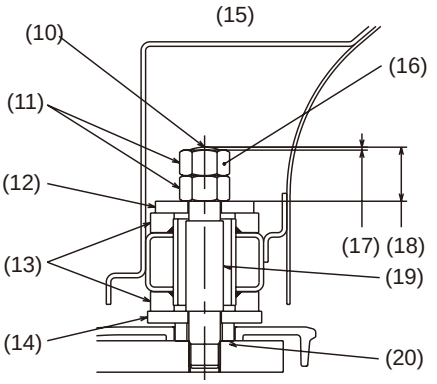




(2)Bolt thread protection jig when mounting a cab.

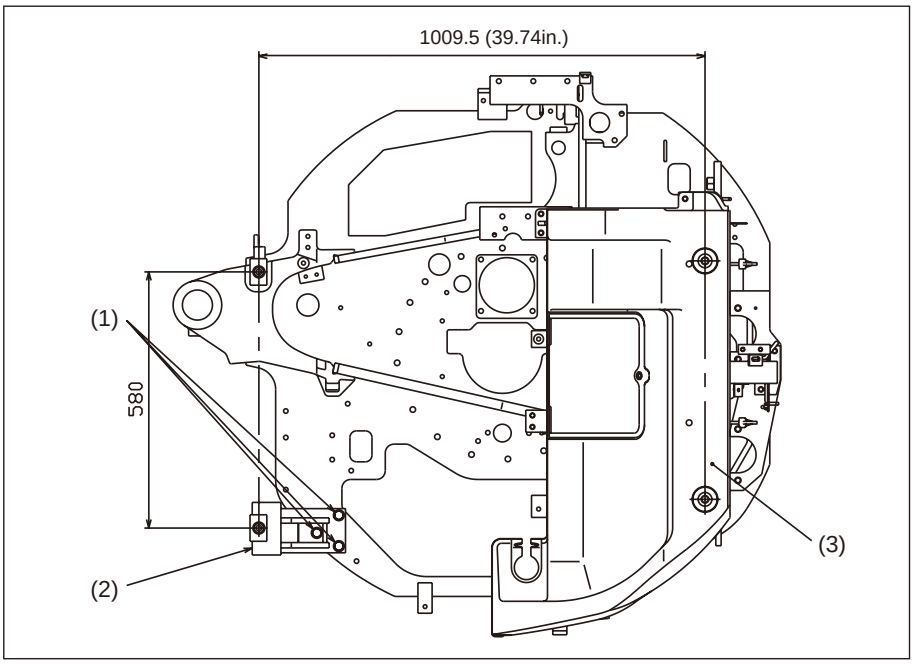






(1)Front,crosswise
(2)Stud(front,right) RC411-4850Δ
(3)Nut 02176-60140
(4)Washer(front) RC411-4853Δ
(5)Anti-vibration rubber(front) RC411-4852Δ
(6)Thicker side frontward
(7)Tightening torque 107.9~125.5N·m
(11.0~12.8kgf·m)79.56~92.58ft·lbs
(8)1.5 reference dimension
(9)23.5 reference dimension
(10)Stud(back) RC411-4854Δ
(11)Nut 02176-60160
(12)Washer(1,rear) RC411-4857Δ
(13)Anti-vibration rubber(rear) RC411-4856Δ
(14)Washer(2,rear) RC411-4858Δ
(15)Back,crosswise
(16)Tightening torque 166.7~191.2N·m
(17.0~19.5kgf·m) 122.96~141.04ft·lbs
(17)1.5 reference dimension
(18)27.5 reference dimension
(19)Tube(behind the stud) RC411-4855Δ
(20)Collar RP401-45261

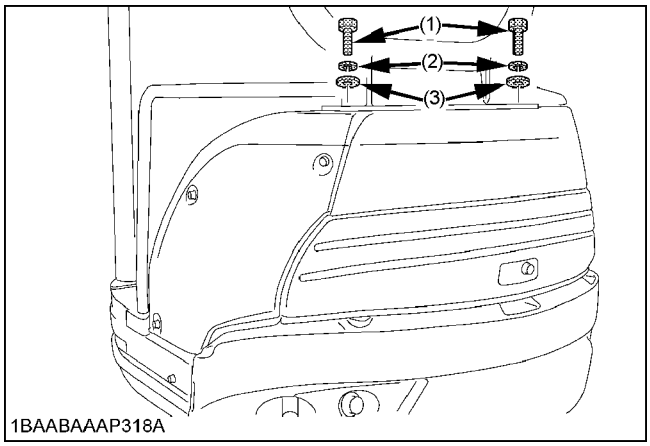
Tuck the front opening window in the ceiling to see if it can be tightly locked.



(1)Bolt 01135-61230
(2)Bracket(cabin) RB411-4592Δ
(3)Bonnet(1,left,cabin) RB419-4771Δ

[2] Canopy installation

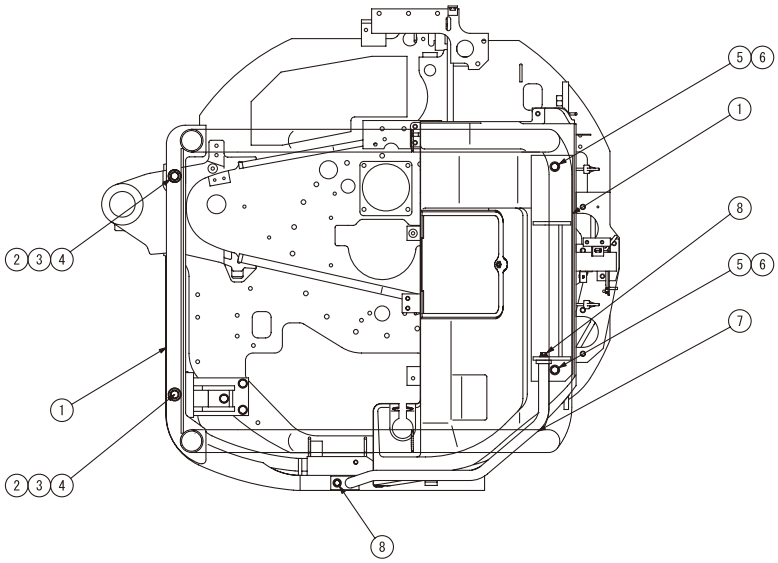
1) Tightening torque of canopy lock screw



(1)Bolt
(2)Spring washer
(3)Plain washer

Front of the machine

Back of the machine

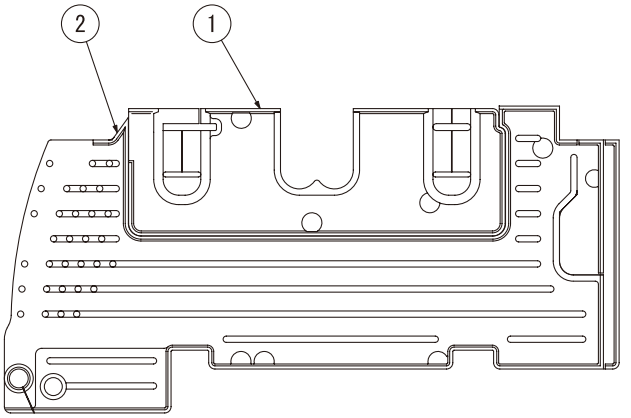


1	Canopy (ROPS)	1	
2	Bolt	2	M14×1.5 9T
3	Spring washer	2	
4	Plain washer (M14, T4, 5)	2	
5	Bolt	2	M16×1.5 9T
6	Plain washer	2	
7	Handrail (Left)	1	
8	Bolt	2	M10×1.25 7T
9	Plug (1)	2	Cup holder mounting position

Mounting of canopy (ROPS)	
(M14×1.5 9T)	123.6~147.1N·m (12.6~15.0kgf·m) 91.1~108.5ft·lbs
(M16×1.5 9T)	196~225.6N·m (20.0~23.0kgf·m) 144.7~166.4ft·lbs

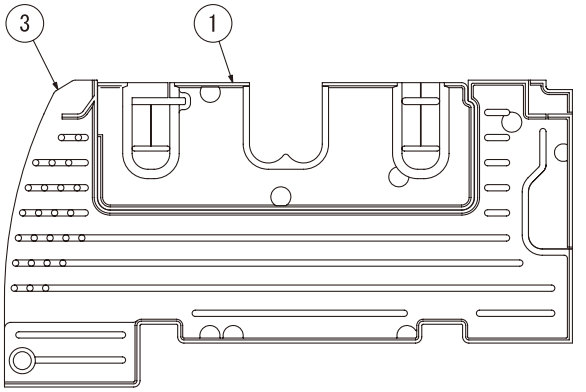
[3]Floor Mat

(4 post canopy)

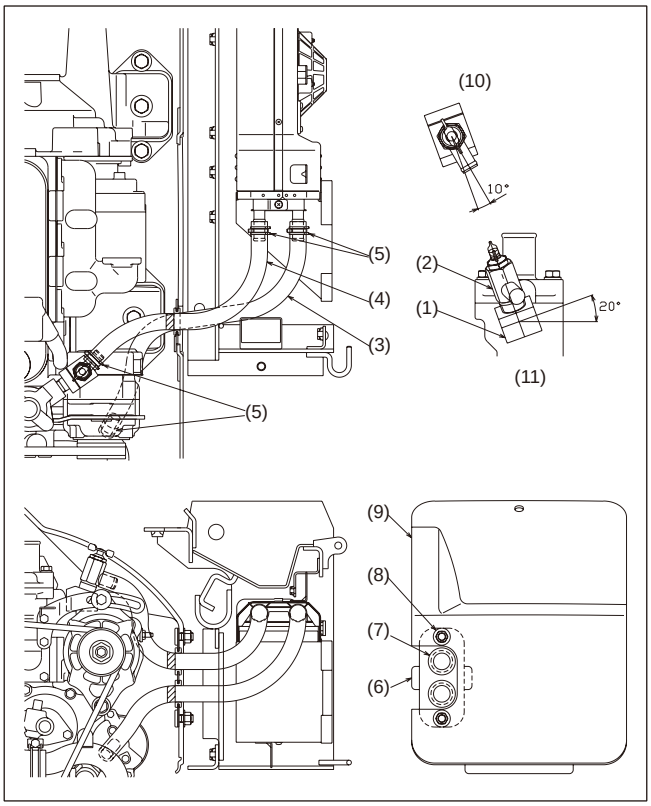


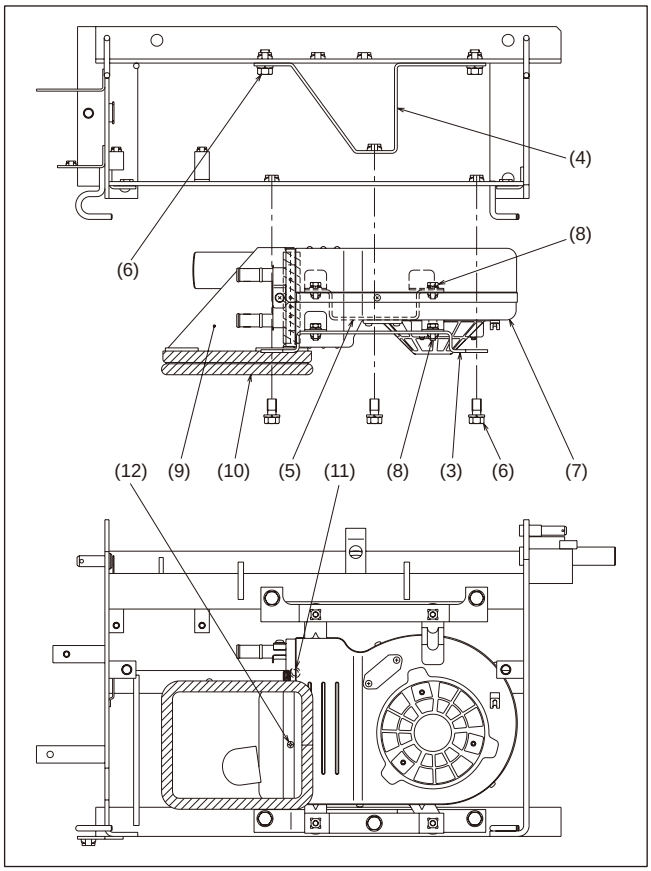
1	RC348-4872△	Mat (2, cabin)	1	4-post canopy, cabin
2	RB449-4443△	Mat (2, 4-post)	1	4-post canopy
3	RB449-4874△	Mat (2, cabin)	1	Cabin

(Cab)

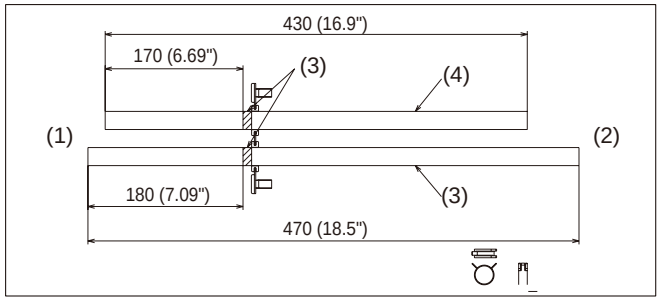


[4] Heater setup



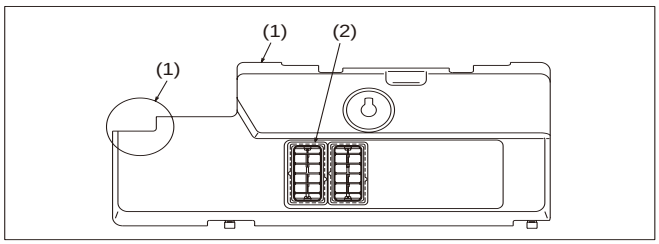


No.	Part name	Q'ty	Remarks
1	Pipe joint (R3/8-R1/2)	1	
2	Valve	1	
3	Hose (1, WP heater)	1	L=470 (18.5")
4	Hose (2, WP heater)	1	L=430 (16.9")
5	Hose clump (spring type)	4	
6	Blade	1	
7	Grommet	2	
8	Nut	2	
9	Cover (1, cabin)	1	Red No.1
10	Adaptor/valve setup angle	1	
11	Tightening torque of adaptor(R318) 9.0~9.8N·m over	1	



(1) Engine side (2) Heater side (3) Marking positions

1.Make sure the heat hose is not kinked.
2.Tightening torque of adaptor 9.0~ 9.8N.m over (0.9~1.0kgf.m) 65~7.2ft.lbs

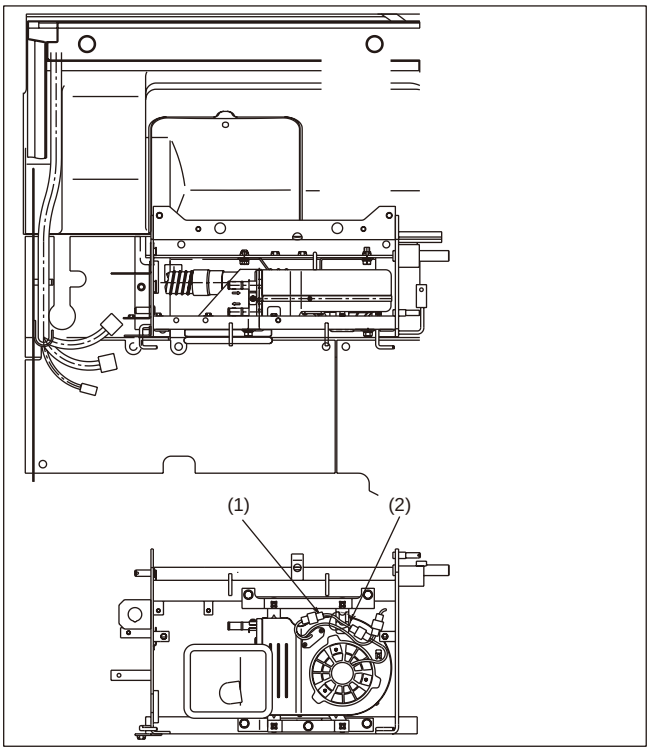


(1) Notch

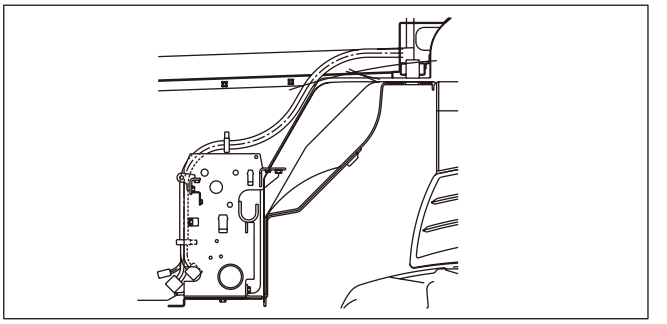
No.	Part name	Q'ty	Remarks
1	Cover (Support Seat, heater)	1	Cabin type
2	Grille, assembly (airconditioner)	2	
3	Bracket (1, heater)	1	
4	Bracket (2, heater)	1	
5	Bracket (3, heater)	1	
6	Bolt	5	M10×1.25 7T
7	Heater, unit	1	
8	Bolt	4	M6×1 7T
9	Cover (heater, defroster)	1	
10	Seal rubber (540)	1	L=540
11	Seal rubber (100)	1	L=100
12		3	Nominal size : 4

Reference
Cover (Seat support) identification

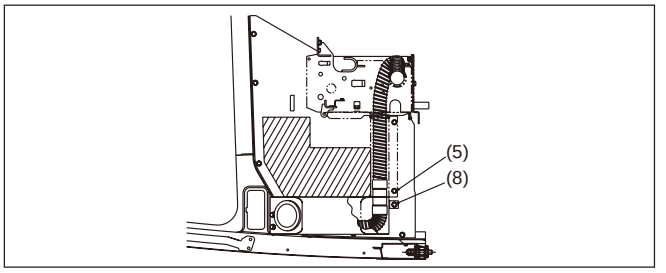
Type	Notch	Grille installation
Canopy type + fixed track	None	None
Canopy type + variable track	Exist	None
Cabin type + fixed track variable track	Exist	Exist



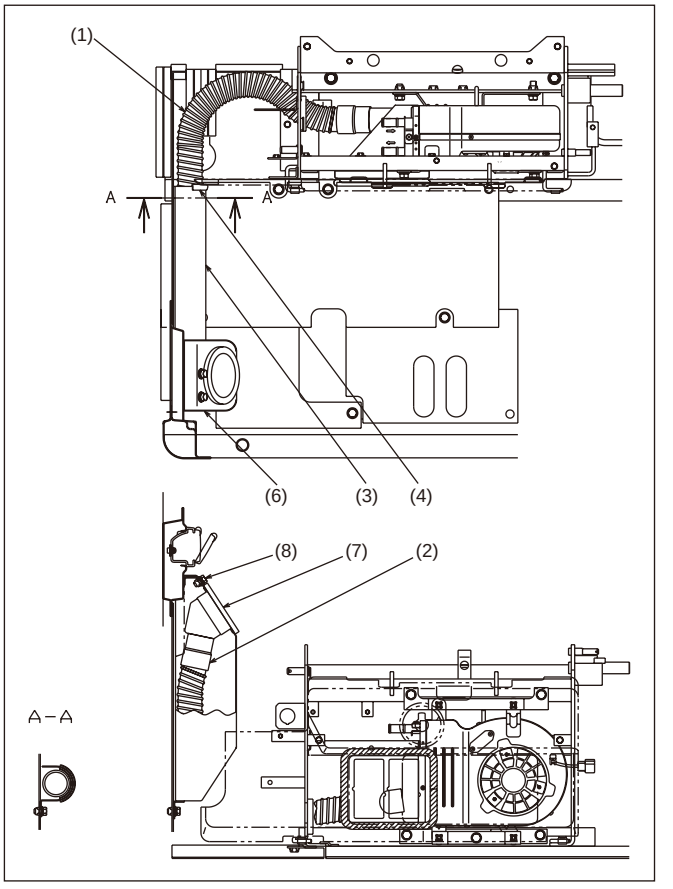
(1)Wire hamess(heater conversion2) RC611-4703Δ
(2)Cord band 55311-4126Δ Clamp the heater and hamess.



[5]Defroster setup



No.	Part name	Q'ty	Remarks
1	Hose (defroster, 700)	1	
2	Hose (defroster, 400)	1	
3	Cover (duct)	1	
4	Grommet + 3	1	
5	Bolt	2	
6	Duct (1, defroster)	1	
7	Grille (defroster)	1	
8	Bolt	3	

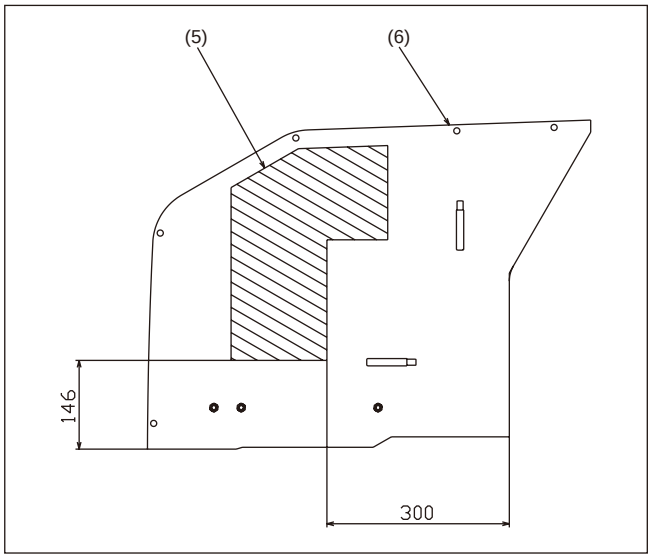


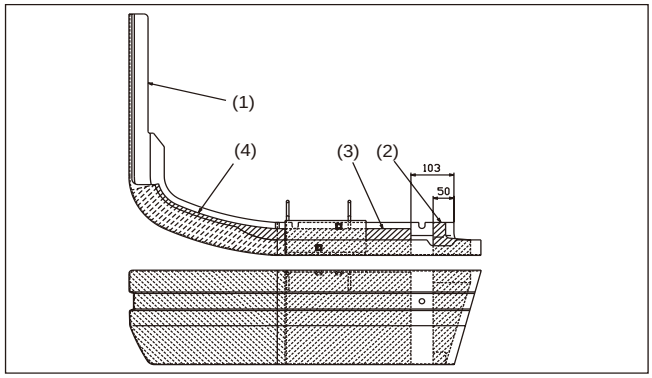
[6] Thermal insulation and sound absorber

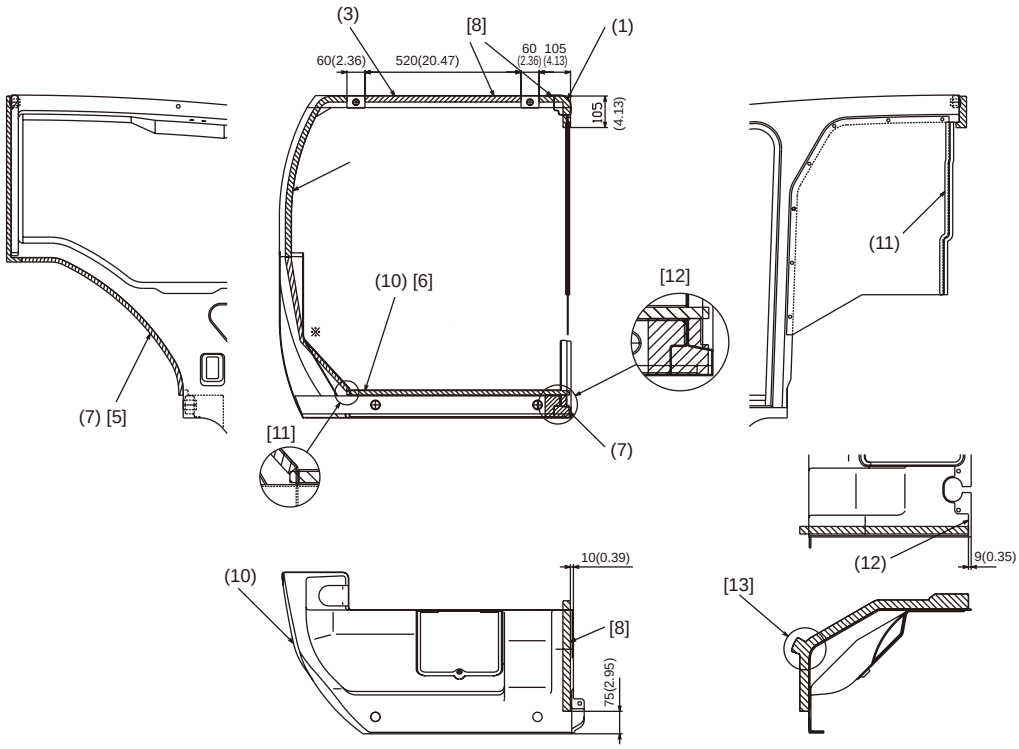
1. Before applying the thermal insulation and sound-absorbing sheet, check the surfaces for dust and fat. Finally press upon along the edges to ensure tight fitness overall.

No.	Part name	Q'ty	Remarks
1	Cover (left, cabin)	1	Blue No.24
2	sound absorber (cover, left)	1	
3	sound absorber (cover, left2)	1	
4	Sound absorber (cover, left3)	1	

No.	Part name	Q'ty
5	Cover (right)	1
6	Sound absorber (cover, right)	1







(1)Sealing rubber RB411-4860Δ
(2)
(3)Sealing rubber RB411-4862Δ
(4)Sealing rubber RB411-4863Δ
(5)Sealing rubber RB411-4864Δ
(6)Sealing rubber RB411-4865Δ
(7)Sealing rubber RB411-4866Δ
(8)Sealing rubber RB411-4867Δ
(9)
(10)Red No.1 Bonnet (1,left,cabin)
RB449-4771Δ
(11)Trimming (1,Cab) RB411-4691Δ
(12)Align with this line

2.

[7] Apply the material along the end of the sealing rubber [4]. Bring it in contact with the inner line at the *-marked point. Finally align it with the sealing rubber [6]. Make sure the soft side faces the sealing rubber [6].

[8] Set the front sealing rubber in reference to the front of the frame.

[9] Set to the inner line of the square pipe.

[10] Apply along the inside of the groove. Keep the projected side to the right.

[11] Be sure to join the sealing rubber (5) and (6) tight together.

[12] Get the sealing rubber (6), (7) and (8) in close contact with each other.

[13] Apply the two-layer section at the round center of the bonnet.

(1) Assembly item Sound absorber & trim <Swivel frame, cover (left)>

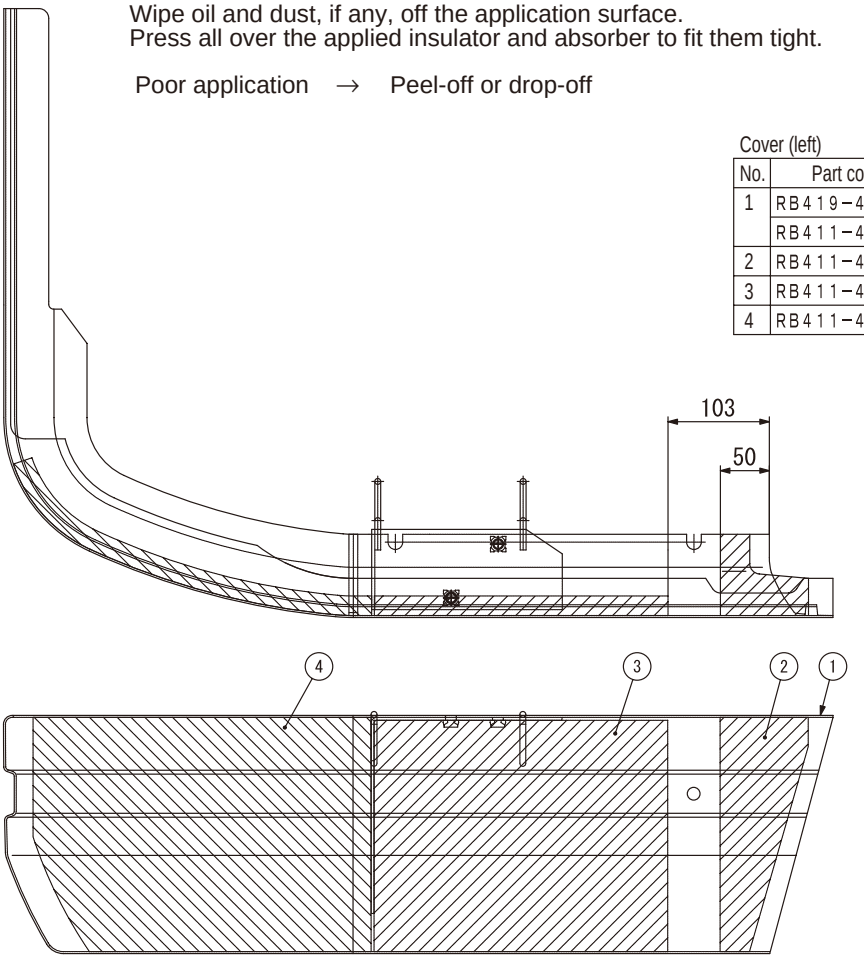
1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.
Press all over the applied insulator and absorber to fit them tight.

Poor application → Peel-off or drop-off

Cover (left)

No.	Part code	Part name	Q'ty	Remarks
1	RB419−4115Δ	Cover (left, cab)	1	Red No. 24
	RB411−4115Δ	Ditto in different color		
2	RB411−4117Δ	Sound absorber (left cover)	1	
3	RB411−4127Δ	Sound absorber (left cover 2)	1	
4	RB411−4128Δ	Sound absorber (left cover 3)	1	

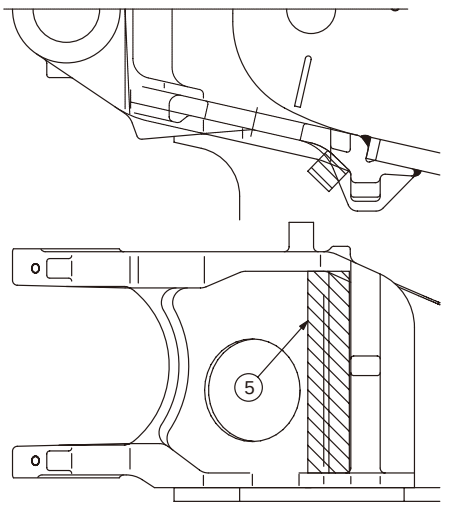


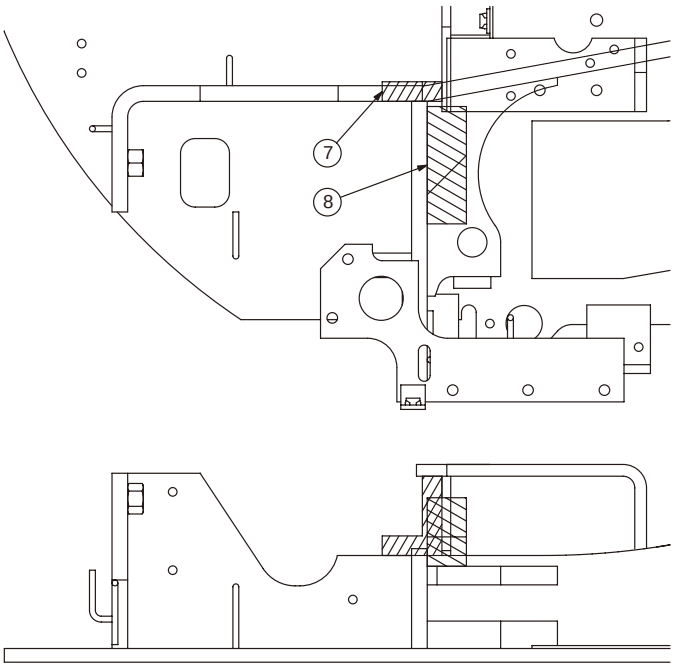
Swivel frame, swing support

5	RB441−4153Δ	Sound absorber (3, frame)	1

Swivel frame

6	RB411−4151Δ	Sound absorber (1, frame)	1
7	RB411−4152Δ	Sound absorber (2, frame)	2





(2) Sound absorber & trim <Arch>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface. Press all over the applied insulator and absorber to fit them tight.

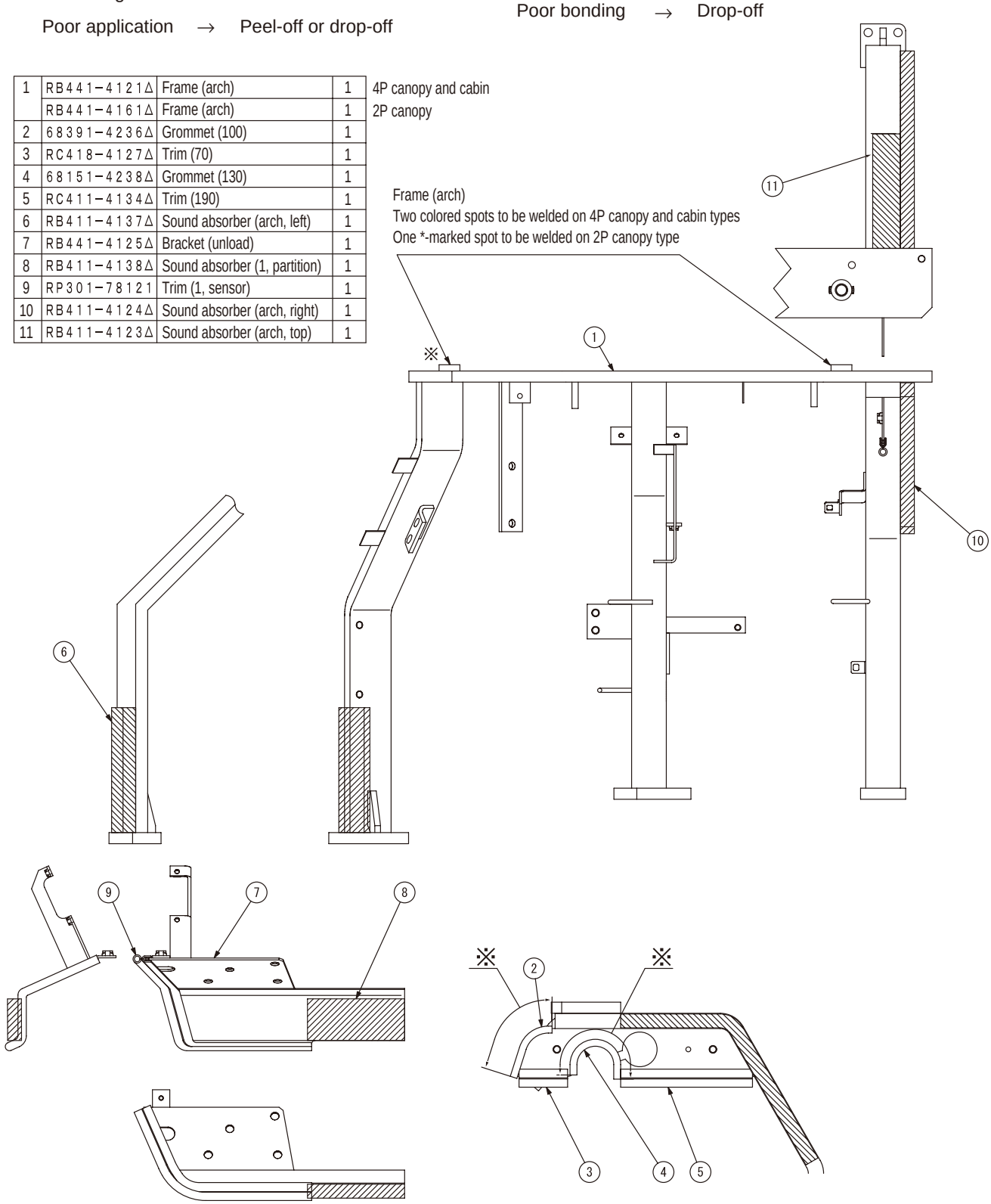
Poor application → Peel-off or drop-off

2 Adhesive-bonding the trim

* Apply instant adhesive on the two *-marked spots and bond the trim tightly.

Poor bonding → Drop-off

1	RB441−4121Δ	Frame (arch)	1	4P canopy and cabin
	RB441−4161Δ	Frame (arch)	1	2P canopy
2	68391−4236Δ	Grommet (100)	1	
3	RC418−4127Δ	Trim (70)	1	
4	68151−4238Δ	Grommet (130)	1	
5	RC411−4134Δ	Trim (190)	1	
6	RB411−4137Δ	Sound absorber (arch, left)	1	
7	RB441−4125Δ	Bracket (unload)	1	
8	RB411−4138Δ	Sound absorber (1, partition)	1	
9	RP301−78121	Trim (1, sensor)	1	
10	RB411−4124Δ	Sound absorber (arch, right)	1	
11	RB411−4123Δ	Sound absorber (arch, top)	1	



(3) Sound absorber & trim <Partition, step>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.

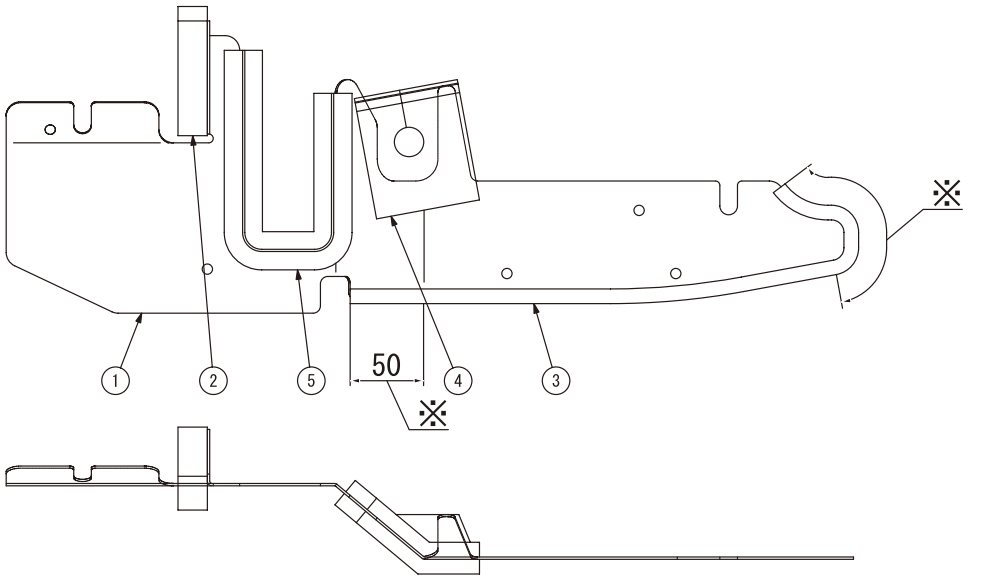
Press all over the applied insulator and absorber to fit them tight.

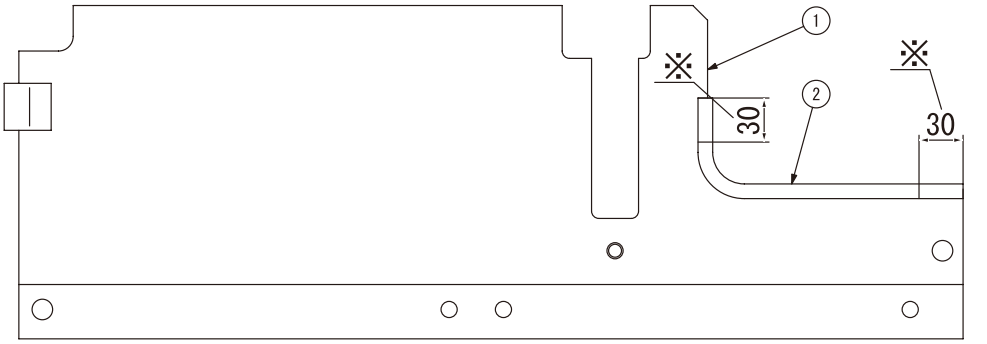
Poor application → Peel-off or drop-off

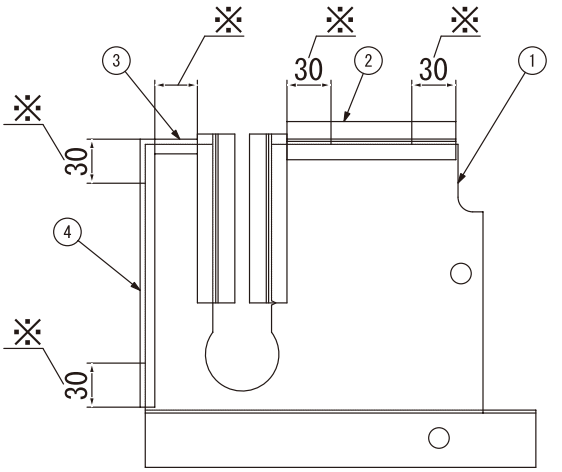
2 Adhesive-bonding the trim

* Apply instant adhesive on the nine *-marked spots and bond the trim tightly.

Poor bonding → Drop-off







Partition

1	RB411−4131Δ	Plate (partition)	1
2	RB411−4139Δ	Sound absorber (2, partition)	1
3	68651−4252Δ	Grommet (440)	1
4	RB411−4141Δ	Sound absorber (3, partition)	2
5	RD101−4126Δ	Trim	1

Step (4)

1	RB411−4414Δ	Step (4)	1
2	68311−4143Δ	Trim (2-220)	1

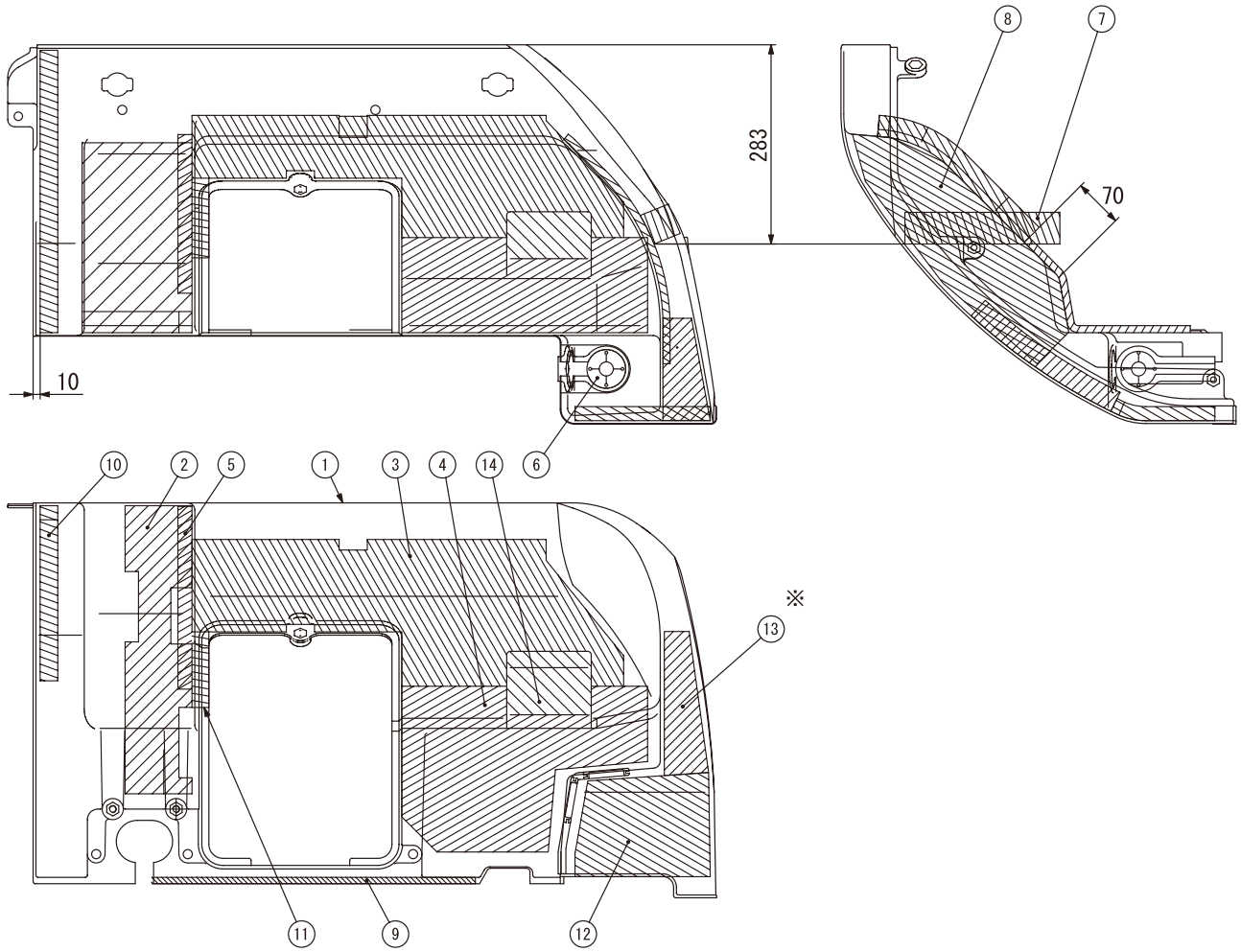
Step (5)

1	RB411−4415Δ	Step (5)	1
2	RP201−4334Δ	Sealing rubber 4	3
3	RC348−6313Δ	Trim (30)	1
4	RB411−4417Δ	Trim (180)	1

(4) Sound absorber & trim <Hood, left>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.
Press all over the applied insulator and absorber to fit them tight.
Poor application → Peel-off or drop-off



1	RB449−4771Δ	Hood (1, left, cab)	1	Red No. 1
	RB441−4771Δ	Ditto in different color		
2	RB411−4311Δ	Thermal insulator (1, hood, left)	1	
3	RB441−4312Δ	Thermal insulator (2, hood, left)	1	
4	RB411−4313Δ	Thermal insulator (3, hood, left)	1	
5	RB411−4314Δ	Thermal insulator (4, hood, left)	1	
6	RB411−4329Δ	Grommet (hose)	1	
7	RB411−4318Δ	Sound absorber (hood, left)	1	
8	RB411−4316Δ	Thermal insulator (5, hood, left)	1	
9	RB411−4319Δ	Sealing (hood, left)	1	
10	RB411−4324Δ	Thermal insulator (6, hood, left)	1	
11	RB411−4338Δ	Sound absorber (1, hood, left)	1	
12	RB411−4342Δ	Sound absorber (2, hood, left)	1	
13	RB411−4328Δ	Sound absorber (3, hood, left)	1	* Only for the cab type
14	RB441−4309Δ	Thermal insulator (7, hood, left)	1	

(5) Sound absorber & trim <Hood, right>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.

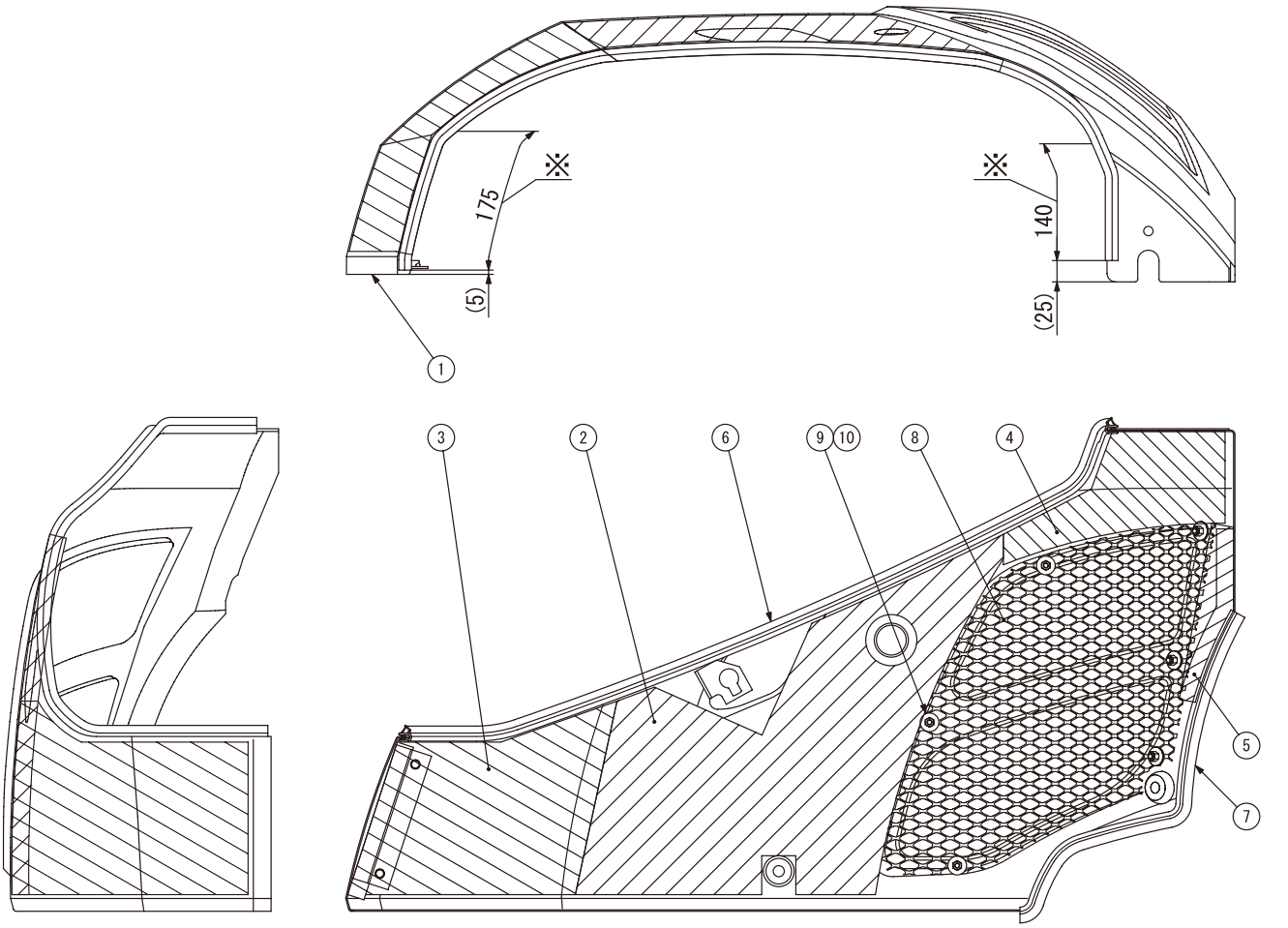
Press all over the applied insulator and absorber to fit them tight.

Poor application → Peel-off or drop-off

2 Adhesive-bonding the trim

* Apply instant adhesive on the two *-marked spots and bond the trim tightly.

Poor bonding → Drop-off



1	RB419−4331Δ	Hood (right)	1	Red No. 1
	RB411−4331Δ	Ditto in different color		
2	RB411−4347Δ	Sound absorber (1, hood, right)	1	
3	RB411−4348Δ	Sound absorber (2, hood, right)	1	
4	RB411−4345Δ	Sound absorber (3, hood, right)	1	
5	RB411−4352Δ	Sound absorber (4, hood, right)	1	
6	RB411−4374Δ	Trim (1, hood, right)	1	
7	RB411−4375Δ	Trim (2, hood, right)	1	
8	RB411−4334Δ	Cover (air intake)	1	
9	04015−50060	Plain washer	6	
10	02552−50060	Anti-rotation nut	6	

(6) Sound absorber & trim <Hood, rear>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.

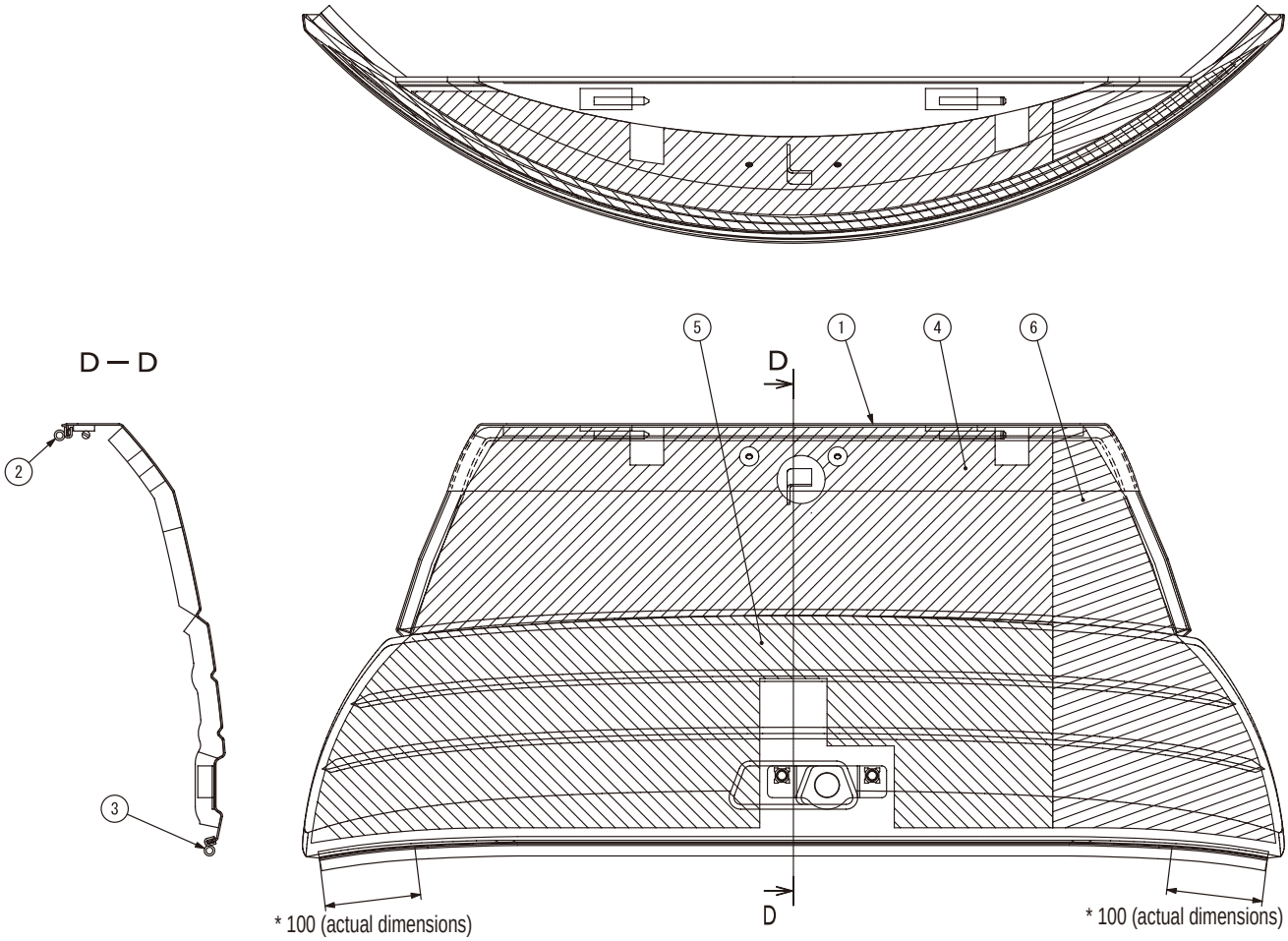
Press all over the applied insulator and absorber to fit them tight.

Poor application → Peel-off or drop-off

2 Adhesive-bonding the trim

* Apply instant adhesive on the two *-marked spots and bond the trim tightly.

Poor bonding → Drop-off



1	RB449−4341Δ	Hood (rear)	1	Red No. 1 + Red No. 7
	RB441−4341Δ	Ditto in different color		
2	RB411−4361Δ	Trim (1, hood, rear)	1	
3	RB411−4362Δ	Trim (2, hood, rear)	1	
4	RB441−4366Δ	Sound absorber (1, hood)	1	
5	RB411−4367Δ	Sound absorber (2, hood)	1	
6	RB411−4369Δ	Sound absorber (3, hood)	1	

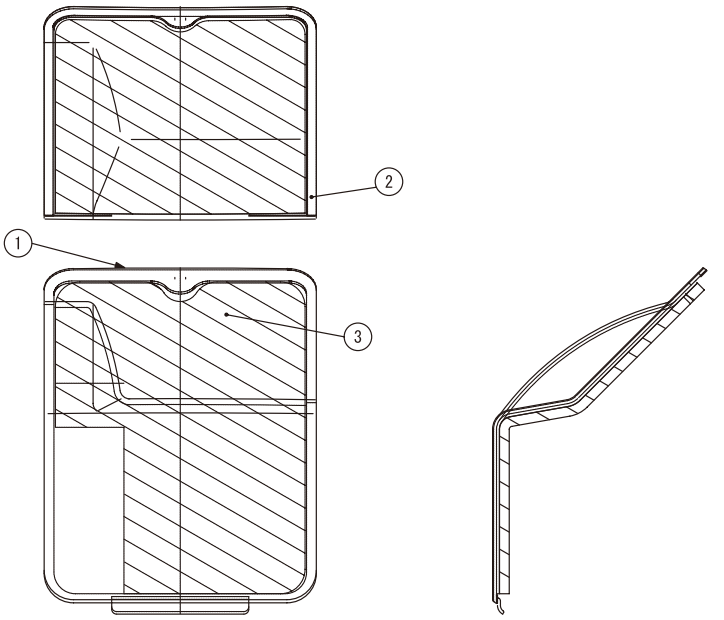
(7) Sound absorber & trim <Cover, center and left>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.

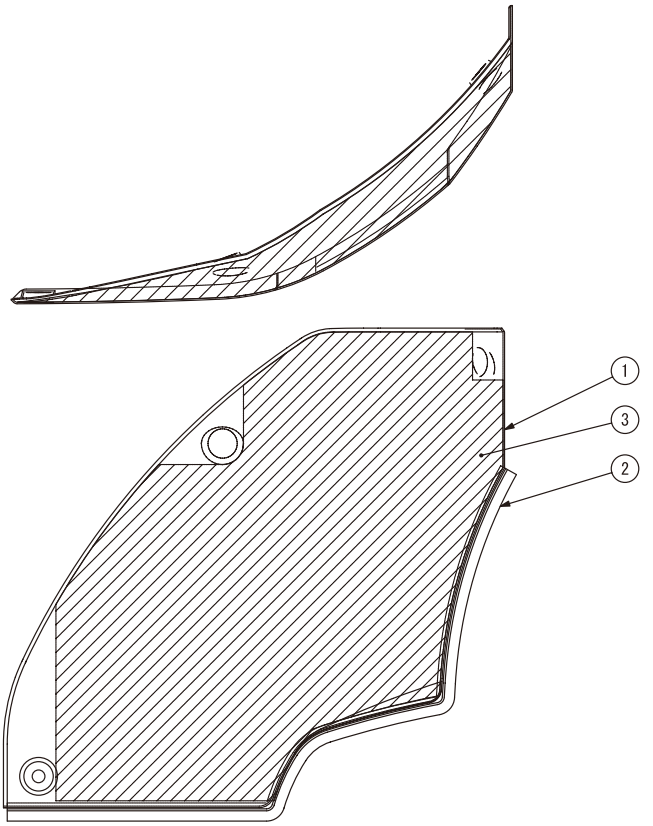
Press all over the applied insulator and absorber to fit them tight.

Poor application → Peel-off or drop-off



Cover

1	RB419−4327Δ	Cover (1)	1	Red No. 1
	RB411−4327Δ	Ditto in different color		
2	RB411−4391Δ	Tape (1, sealing)	1	
3	RB411−4315Δ	Thermal insulator (cover 1)	1	



Hood

1	RB419−4322Δ	Hood (2, left)	1	Red No. 1
	RB411−4322Δ	Ditto in different color		
2	RB411−4383Δ	Trim (770, hood, left)	1	
3	RB411−4317Δ	Sound absorber (hood 2, left)	1	

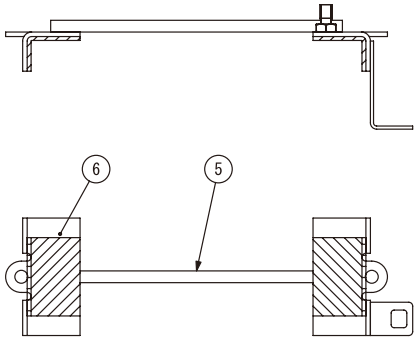
(8) Sound absorber & trim <Partition plate, fixture (battery)>

1 Applying the thermal insulator and sound absorber

Wipe oil and dust, if any, off the application surface.

Press all over the applied insulator and absorber to fit them tight.

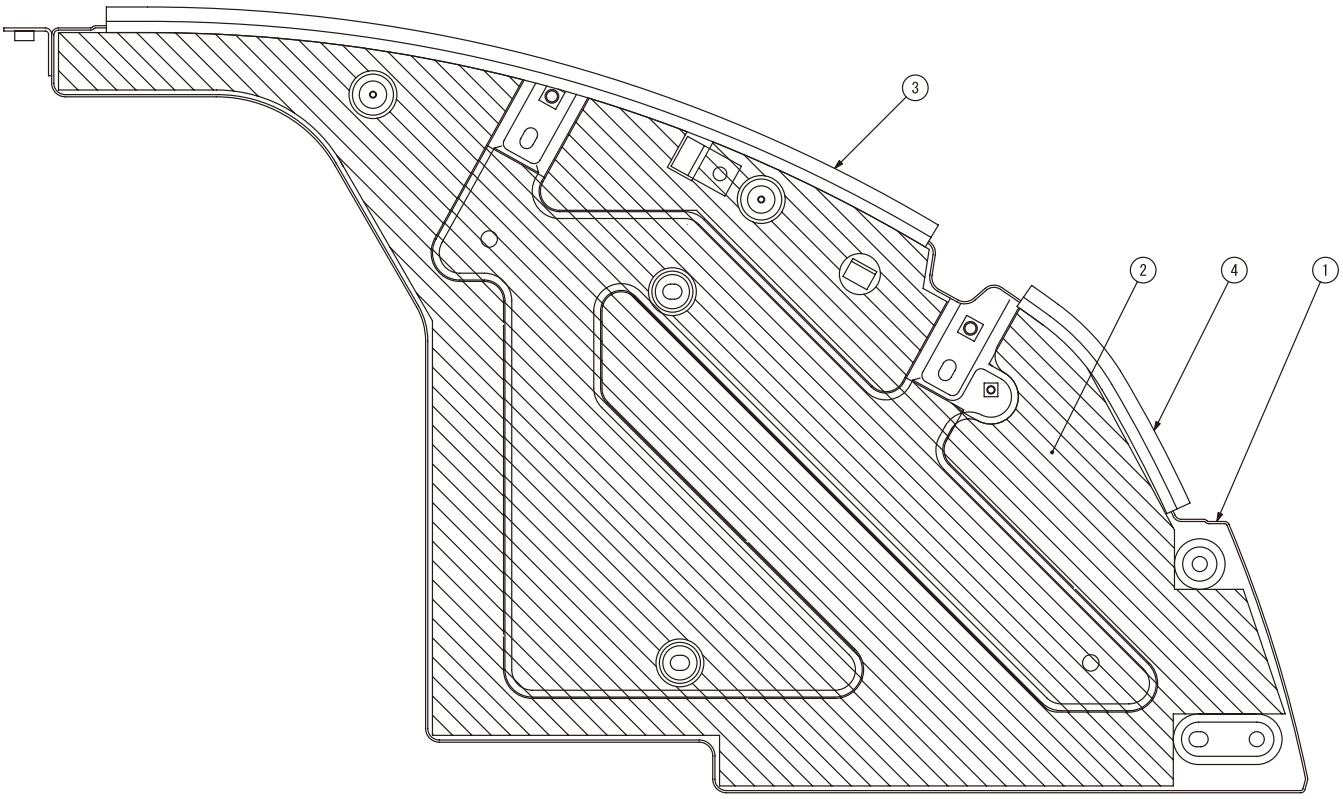
Poor application → Peel-off or drop-off



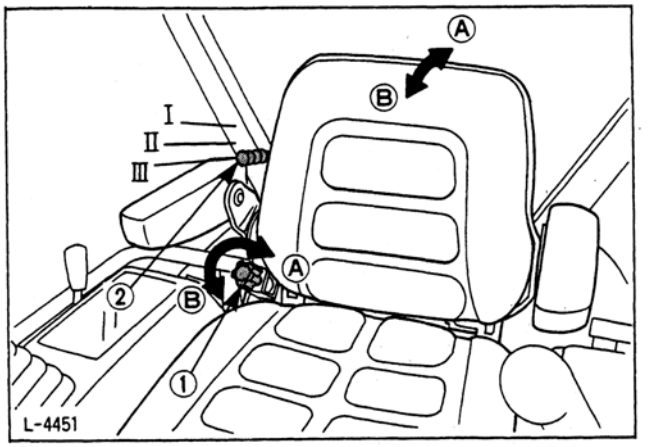
Fixture (battery)

5	RB411−5316Δ	Fixture (battery)	1
6	RB411−5327Δ	Cushion (battery fixture)	2

1	RB419−4336Δ	Plate (partition)	1	Red No. 1
	RB411−4336Δ	Ditto in different color		
2	RB411−4377Δ	Thermal insulator (plate, partition)	1	
3	RB411−4371Δ	Trim (1, plate, partition)	1	
4	RB411−4372Δ	Trim (2, plate, partition)	1	



[7] Seat and seat belt



(1) Knob for tilt
(2) Adjustment lever

(1) Seat adjustment

Semi-suspension type (Half-simplified)
1. F-R slide adjustment
2. Weight adjustment

FYI (For your information)

Comparison between full-suspension seat and semi-suspension sheet

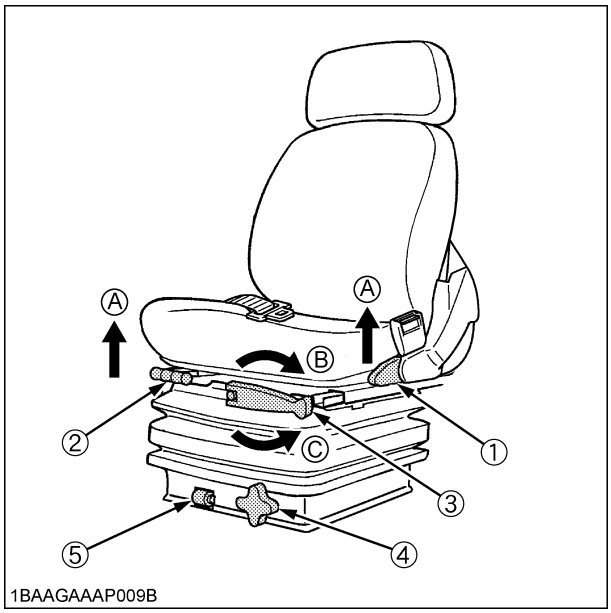
1) Comparison

Name	Full-suspension seat	Semi-suspension seat
Suspension adjustment system	Well cushioned by pantograph mechanism	Poorly cushioned by leaf spring
Weight-dependent (suspension weight) adjustment	Adjustable to the operator's weight	Somewhat adjustable
Height adjustment (stroke)	Dial-adjustable in 3 levels (60mm)	None
Seat to-and-fro sliding (stroke)	Slidable (160mm)	Slidable (135mm)
Armrest adjustment (angle)	Adjustable (40°)	None
Backrest adjustment (angle)	Adjustable (27.5°)	Adjustable (15°)
Models applied	CE-Version, 4-tone class	CE-Version, 3-tone class

* Keep in mind that the seats on some models are not provided with the armrests and others.

2) Structural outline

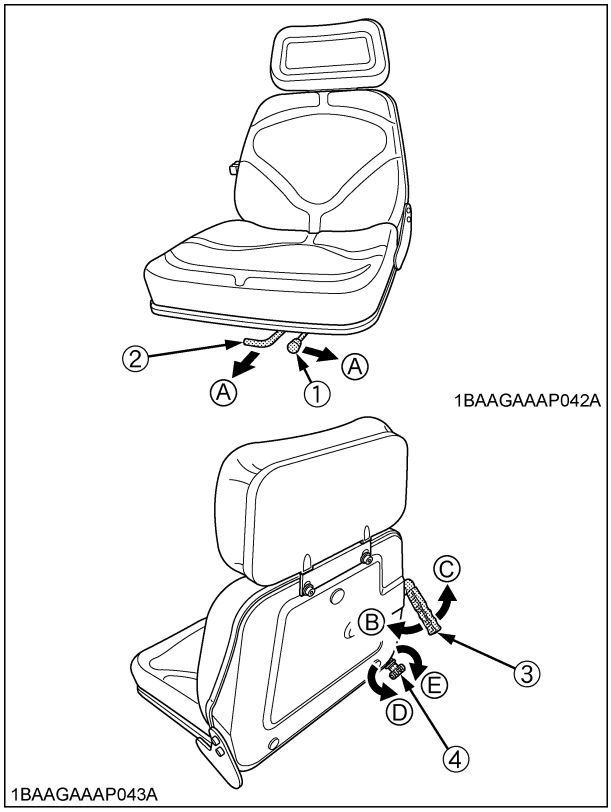
Full-suspension seat



1BAAGAAAP009B

(1) Backet tilt adjust lever
(2) Travel adjust lever
(3) Weight adjust lever
(4) Height adjust knob
(5) Weight and height indicator
(A) "UNLOCK"
(B) "To INCREASE TENSION"
(C) "To DECREASE TENSION"

Semi-suspension seat

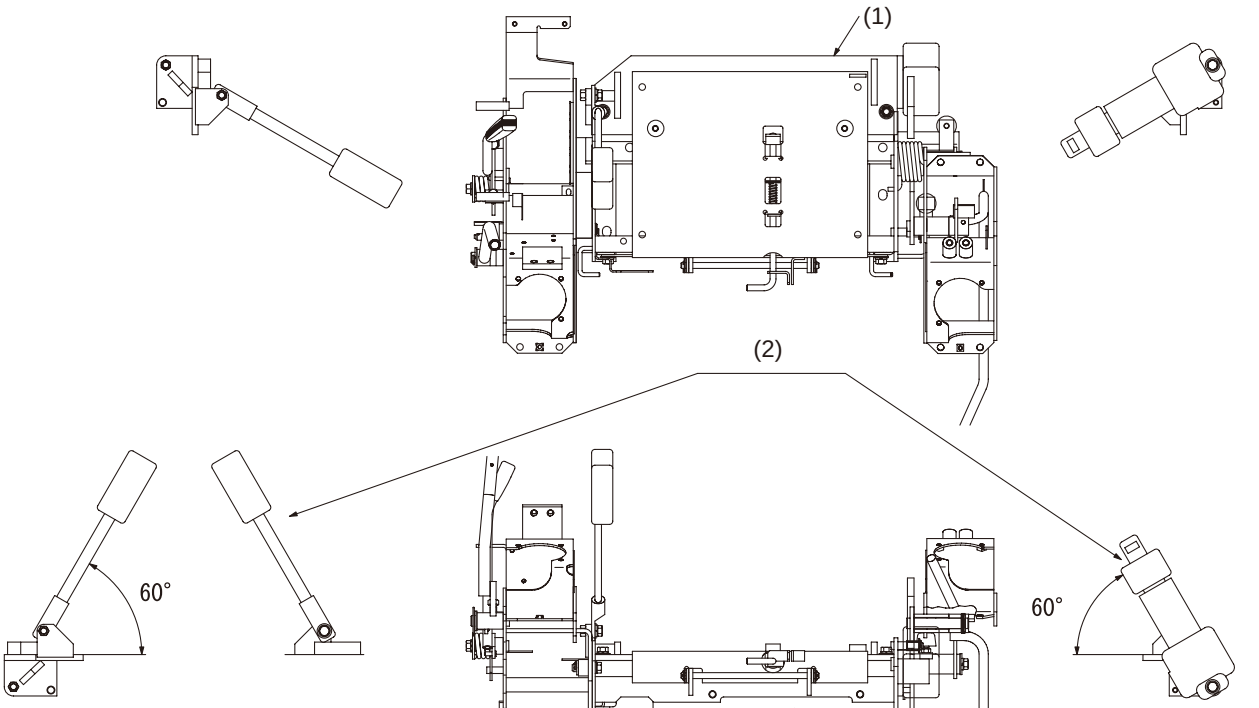


1BAAGAAAP043A

(1) Travel adjust lever
(2) Seat lock lever
(3) Weight adjust lever
(4) Backet tilt adjust lever
(A) "UNLOCK"
(B) "To INCREASE TENSION"
(C) "To DECREASE TENSION"
(D) "To INCREASE ANGLE"
(E) "To DECREASE ANGLE"

(2)Seat belt connection

CAUTION: EU-version
(1) Install the seat belt for both the cabin and canopy types.
(2) Do not install the right-hand unload lever on both the cabin and canopy types.

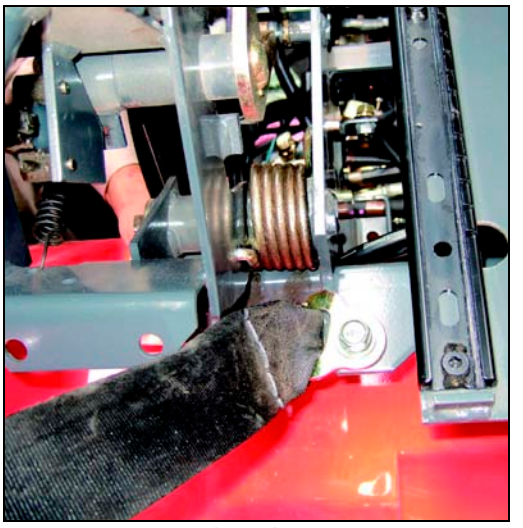


(1) Bracket (Seat belt) RB548-4561△
Bolt, 2pcs. 01135-61025

(2) Seat belt, ass'y K2561-5685△
Bolt, 2pcs. 01135-61020

a	Seat belt assembly K2561-5685△
b	Bolt 01135-61020
c	Orientation of seat belt fixture
d	Folded end downward

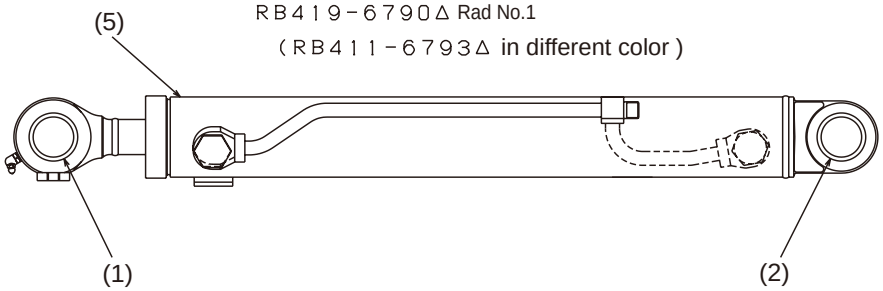
1. Tightening torque of seat belt assembly
48.1~55.9N•m (4.9~5.7kgf•m) 35.4~41.2ft•lbs


Left-hand setup


Right-hand setup

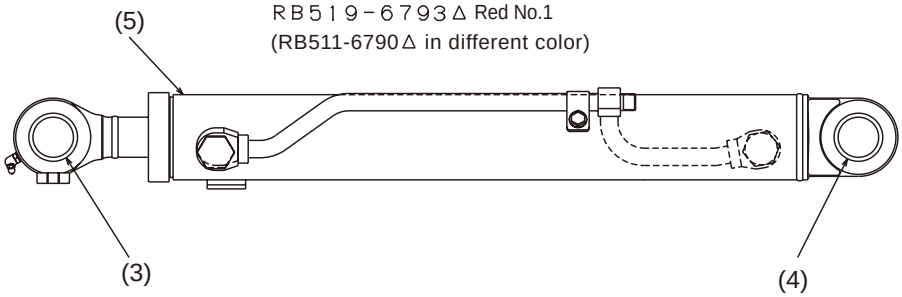
[8] Boom cylinder for cab type

U20-3α EU Cabin type
Hydraulic cylinder, assembly (boom)
RB419-6790Δ Rad No.1
(RB411-6793Δ in different color)



(1) RB419-7633Δ Bushing
(2) RB419-7642Δ Bushing
(3) RB419-7633Δ Bushing
(4) RB419-7642Δ Bushing
(5) "M2EC" marking

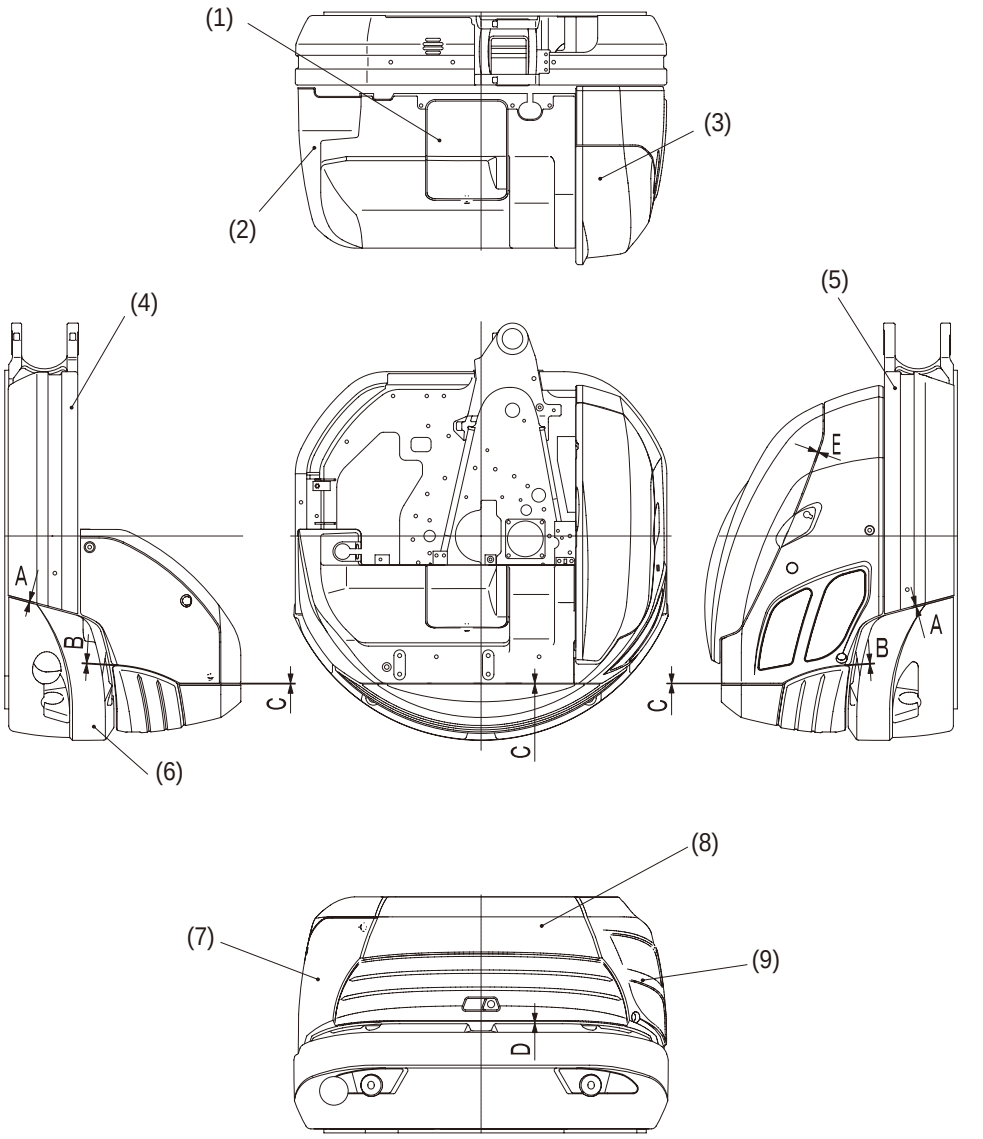
U25-3αEU Cabin type
Hydraulic cylinder, assembly (boom)
RB519-6793Δ Red No.1
(RB511-6790Δ in different color)



Cylinder identification

Identified by markings	
U20-3αEU	M2E
U25-3αEU	M4E
U20-3αEU Cabin	M2EC
U25-3αEU Cabin	M4EC

[9] Outlook of covers



(1) Cover
RB419-4772Δ Cabin version
RB419-4327Δ Canopy version

(2) Bonnet, ass'y (1, left)
RB449-4770Δ Cabin version
RB449-4870Δ Canopy version

(3) Cover (Tank)
RB419-4349Δ
RB411-4349ΔDifferent color

(4) Cover, ass'y (left, cabin)
RB419-4590Δ
RB411-4590ΔDifferent color

(5) Cover (right)
RB419-4161Δ
RB411-4161ΔDifferent color

(6) Weight
RB419-4811Δ (U20-3α EU)
RB411-4811ΔDifferent color
RB519-4811Δ (U25-3α EU)
RB511-4811ΔDifferent color

(7) Bonnet (2, left)
RB419-4322Δ
RB411-4322ΔDifferent color

(8) Bonnet (rear)
RB449-4341Δ
RB441-4341ΔDifferent color

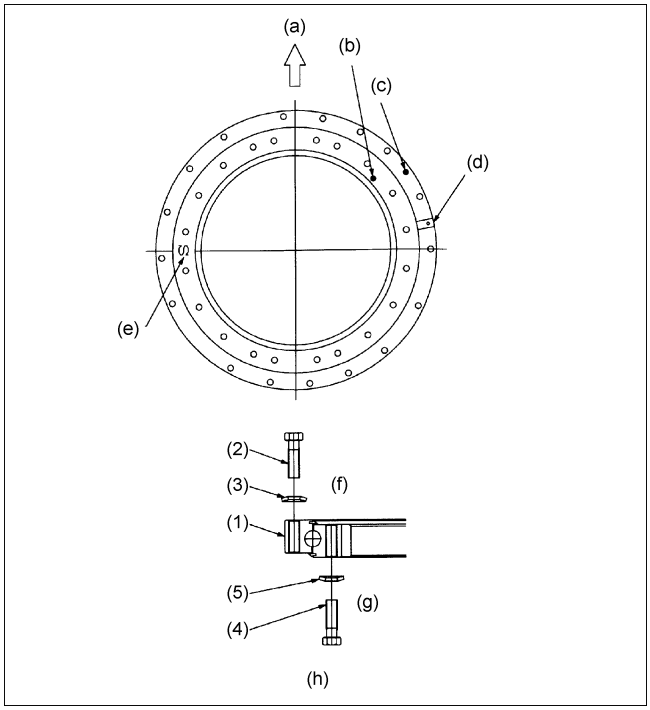
(9) Bonnet (right)
RB419-4331Δ
RB411-4331ΔDifferent color

1	Clearance btw. cover (left) and cover (right), and weight (Section A)	3 ~ 7 mm (0.12~0.28in.)
2	Clearance btw. both sides of the bonnet (rear) (Section B)	3 ~ 10 mm (0.12~0.39in.)
3	Clearance at the upper side of the bonnet (rear)(Section C)	1 ~ 5 mm (0.04~0.20in.)
4	Clearance btw. the bonnet (rear) and the weight (Section D)	There should be no clearance btw. the sealing rubber and the weight.
5	Clearance btw. the bonnet (right) and the cover (Tank) (Section E)	4 ~ 8 mm (0.16~0.32in.)
6	Differences in level at each corner	Less than 2 mm (Section C) Less than 3 mm (others) (0.12in.)
7	Difference in dimensions of clearances (Parallelism) (Section A, Section C)	a − b < 2 mm(0.08in.) b a
8	Cover (1) mounting bolt tightening torque (for bolt insertion in plastic part)	M10 18.1~28.9N·m (1.85~2.95kgf·m) 13.4~21.3ft·lbs

E. Under carriage

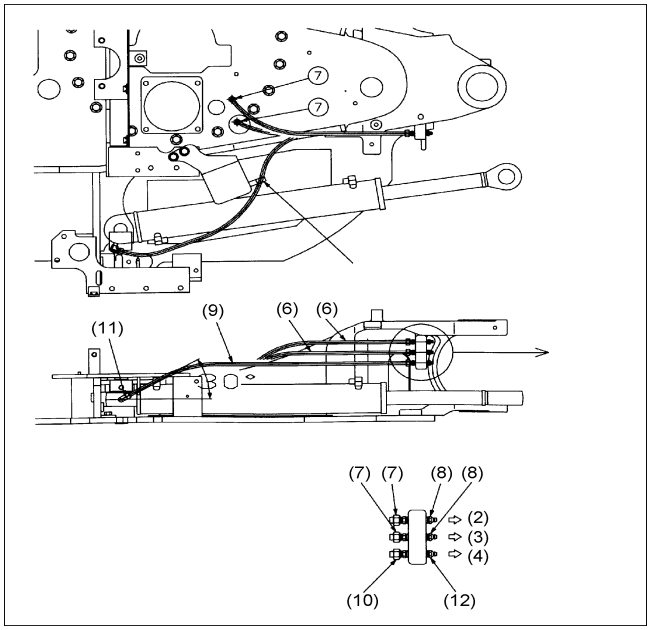
a Swivel bearing

Swivel bearing assembly view.



a	Front of the machine
b	Tooth greasing zone
c	Ball greasing port Match with the swivel frame holes
d	Ball inserting port Outer ring soft zone
e	“S” marking Inner ring soft zone
f	Swivel frame side
g	Track frame side
h	Pay attention to the plain spring direction

b Grease tube



1) Assembling procedure

1. Installing the bearing (swivel)
   Set the inner rings soft zone (marked “S”) at the left hand of the machine.
2. Tightening torque of bearing (swivel):
   103.0~117.7N·m(10.5~12.0kgf·m)
   75.9~86.8ft·lbs
   * Tighten the bolts temporarily first and then tighten them up in diagonal order.
   Swivel bearing assembly view.(Loctite 271)
3. Apply grease evenly over the bearing teeth.
4. Parts list.

U20-3α

No.	Part name	Q’ty	Remarks
1	Bearing (swivel)	1	
2	Bolt	17	M12×1.25 9T
3	Plain spring	17	
4	Bolt	20	M12×1.25 9T
5	Plain spring	20	

U25-3α, U25S

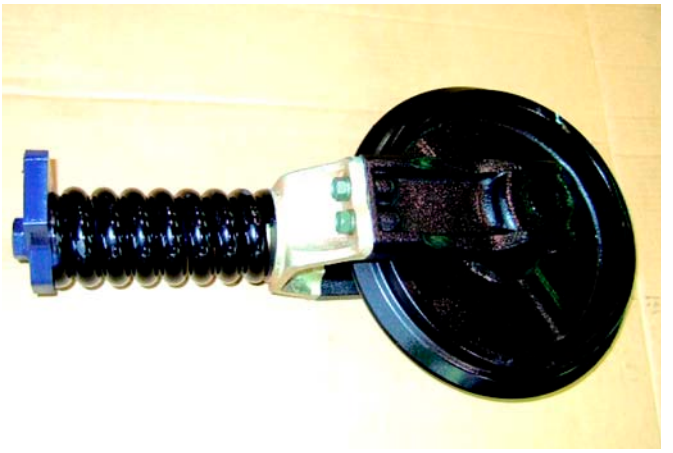
No.	Part name	Q’ty	Remarks
1	Bearing (swivel)	1	
2	Bolt	21	M12×1.25 9T
3	Plain spring	21	
4	Bolt	24	M12×1.25 9T
5	Plain spring	24	

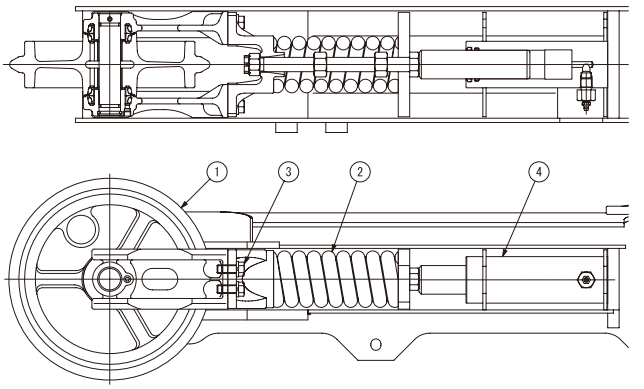
5. See the figure at left for the grease tube routing and the connector tightening angle.
6. Parts list.

No.	Part name	Q’ty	Remarks
6	Tube (grease)	2	
7	Connector	4	
8	Grease nipple	2	
9	Tube (grease)	1	
10	Connector	1	
11	Connector	1	
12	Grease nipple	1	

(1)Clamp
(2)Swivel bearing,teeth
(3)Swivel bearing,ball
(4)Swing cylinder

c Track tension device

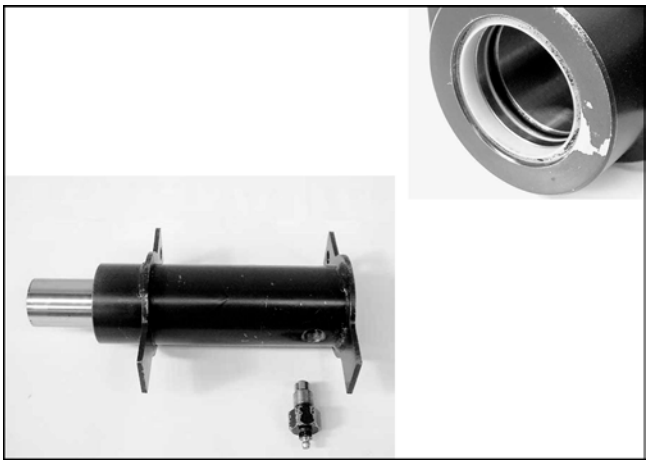


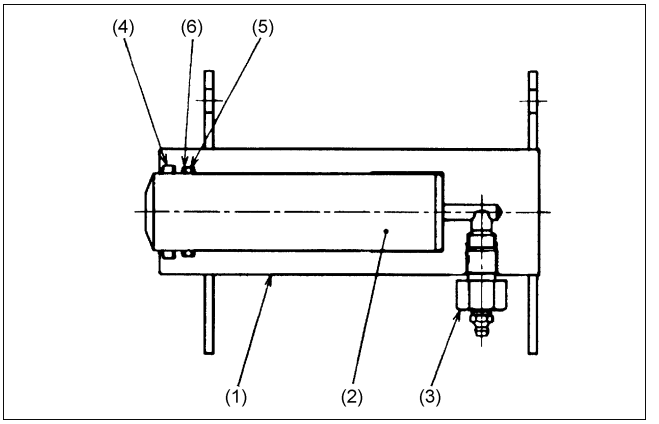


1) Assembling procedure

1. Make sure the unit slides smoothly in the track frame.
2. Tightening torque of idler assembly and tension spring plate:
   77.5~90.2N·m(7.9~9.2kgf·m)
   27.14~66.54ft·lbs
   Apply screw LOCTITE. (Loctite 547)
3. Idler lubricant amount Engine Oil Release controller SAE#30CD
   U20-3α:35cc (0.01 US gal)
   U25-3α·U25S:75cc (0.02 US gal)
4. Engine Oil Make the setting at split pin position nearest to 174.3±0.5 mm (6.86±0.02in.).
5. Parts list

No.	Part name	Q'ty	Remarks
1	Idler, assembly	2	U20-3α
	Idler, assembly	2	U25-3α, U25S
2	Spring, assembly	2	U20-3α
	Spring, assembly	2	U25-3α, U25S
3	Bolt	8	M12×1.25
4	Cylinder, assembly	2	

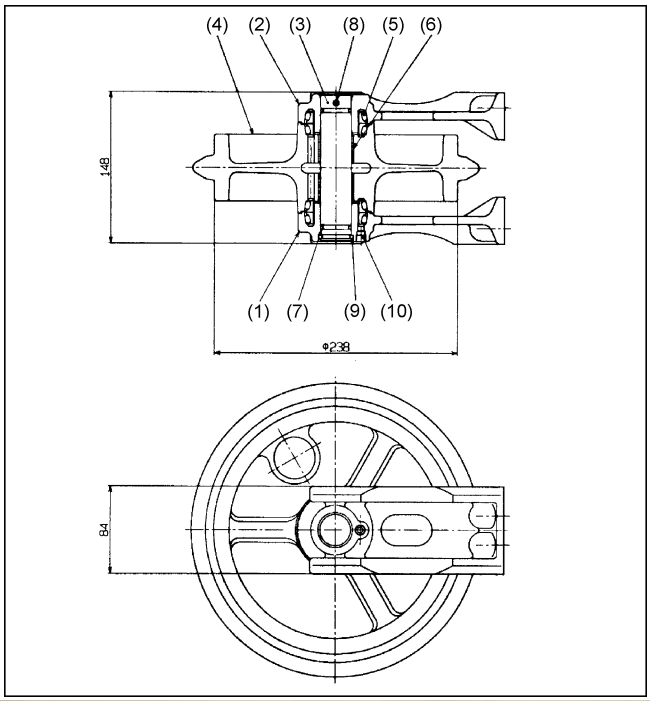




2) Tension cylinder

1. Tightening torque of nipple:
   98~107.8N·m(10~11kgf·m)
   72.33~79.56ft·lbs
2. If the cylinder has been detached, check the rod (rod seal, O-ring side) for grease leak.
3. If the nipple has been detached, check the tube and nipple seat for scratches and dust deposits.
4. In detaching the nipple, keep in mind that the nipple may pop out because of the inner pressure of the cylinder.

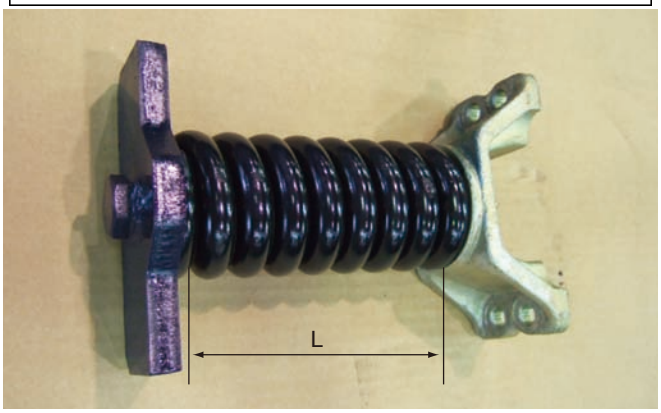
No.	Part name	Q'ty
1	Cylinder tube	1
2	Rod	1
3	Nipple, assembly	1
4	Rod seal	1
5	O-ring	1
6	Backup ring	1

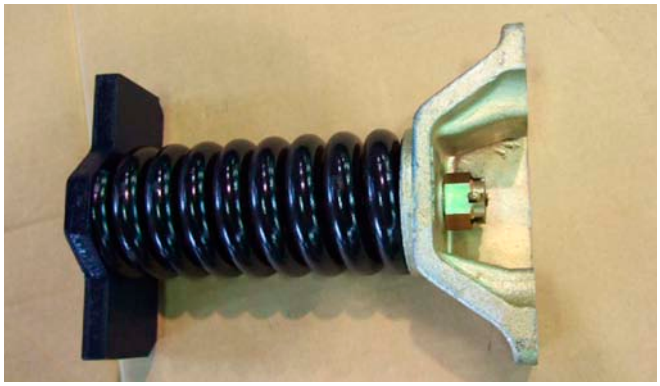


3) Idler

1. Idler
2. Check the floating seal and the shafts O-ring for twist.
3. Apply lubricant to the floating seals sliding surface and the shafts O-ring.
4. The lube oil to pour is Engine Oil Class SAE#30CD. Its specified amount is 35 cc for U20-3α and 75 cc for U25-3α, U25S
5. The U20-3α and U25-3α, U25S are the same in construction, but different in size.

No.	Part name	Q'ty	Remarks
10	Plug (R1/8)	1	
9	WIre	1	
8	Spring pin	1	ϕ6×L63
7	O-ring	2	G25
6	Bushing	2	
5	Seal (floating)	2	
4	Idler	1	
3	Shaft (Idler)	1	
2	Bracket (2, Idler)	1	
1	Bracket (1, Idler)	1	





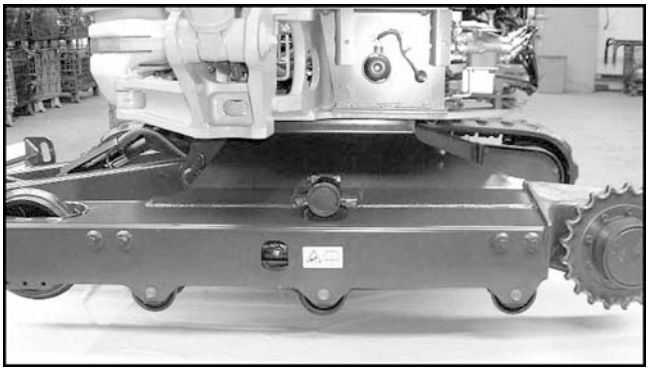
4) Tension spring

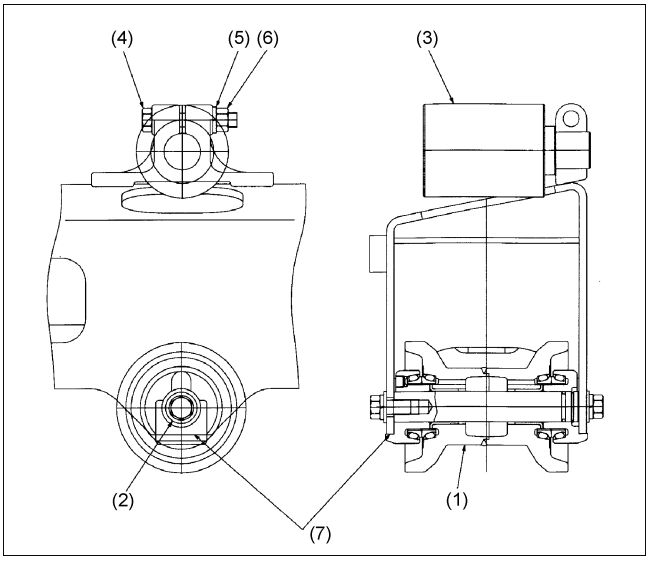
1. Preset length of spring
   L=174.3±0.5mm (6.86±0.02in.)

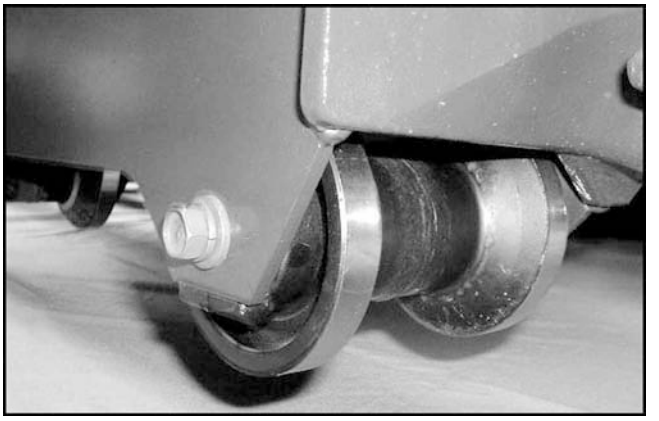
* Make the setting at the split pin position nearest to the above length.

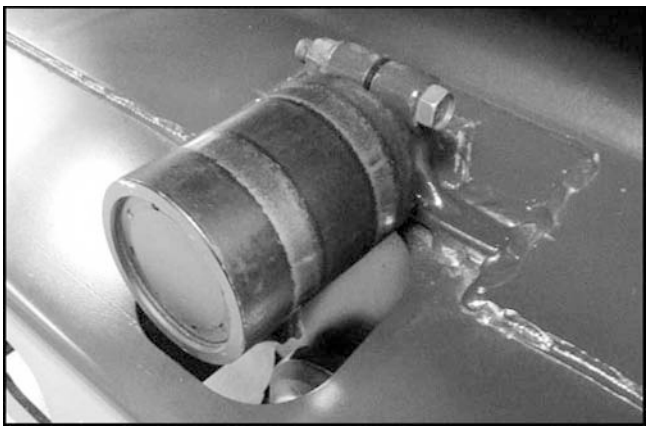
No.	Part name	Q'ty	Remarks
16	Split pin	1	ϕ4×L35
15	Slotted nut	1	
14	Spring	1	
13	Bolt (spring)	1	
12	Retainer	1	
11	Plate (idler)	1	

d Upper roller and track roller









1) Assembling procedure

1. Keep possible out-of-center between the sprocket, idler and track roller within±2mm (0.08in.) (with the idler loosely fitted).

CAUTION

When jacking up the machine, place wooden blocks or the like under the lower frame to prevent the machine from falling.

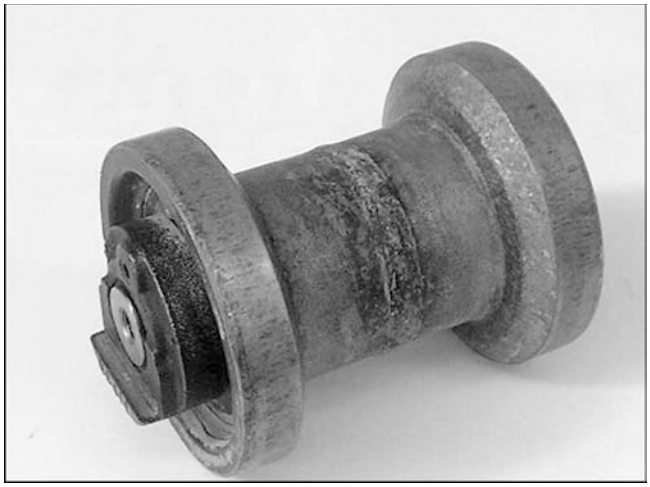
No.	Part name	Q'ty	Remarks
1	Track roller, assembly	6	U20-3α
	Track roller, assembly	6	U25-3α, U25S
2	Bolt	12	
3	Carrier roller, assembly	2	
4	Bolt	2	M10×1.25 7T
5	Nut	2	
6	Spring washer	2	
7	No gap allowed		

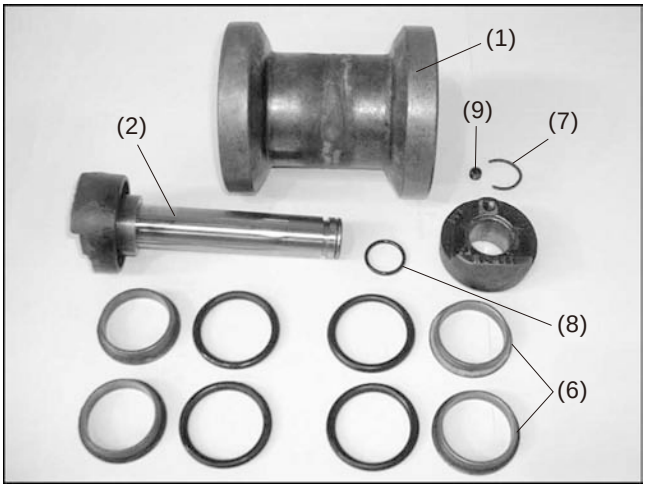
2) Track roller

1. When attaching the track roller, make sure there is no gap between the frame end and the track roller bracket.
2. Tightening torque of roller assembly mounting bolt:
   103~117.7N·m(10.5~12kgf·m)
   75.9~86.8ft·lbs
3. Apply screw LOCTITE (Three-Bond 1305P) to the internal threads. Before doing this, wipe out oil, paint and other coating off the surface.

3) Carrier roller

1. Tightening torque of carrier roller:
   103~117.7N·m(10.5~12kgf·m)
   75.9~86.8ft·lbs
2. Apply screw LOCTITE (Loctite 271) to the carrier roller.





4) Track roller disassembling procedure

1. Check the roller surface and shaft for wear, and measure the outside diameter, as required. If out of spec, replace them with new ones.
2. In reassembling, be careful to keep the roller inside and incoming parts free from dust, cuttings and other foreign matters.
3. The lube oil to pour is Engine Oil Class SAE#30CD.
   Its specified amount is :
   U20-3α=50cc (0.01US gal),
   U25-3α, U25S=80cc (0.02US gal).
4. The U20-3α and U25-3α, U25S are the same in construction, but different in size.

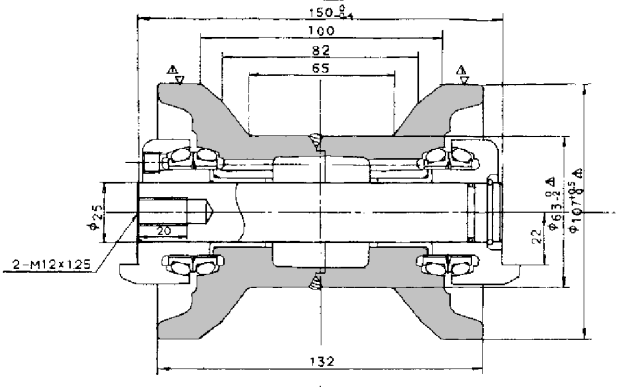
No.	Part name	Q'ty
1	Roller	1
	Roller A	1
	Roller B	1
2	Shaft	1
3	Collar A	1
4	Collar B	1
5	Backup ring	2
6	Floating seal	2
7	Ring,stopper	1
8	O-ring	1
9	Plug	1

1. Press-fit the bushing in position.
2. The bracket and shaft are press-fitted in place at one side. A press is needed in order to detach and attach them.
3 Apply the lube oil to the O-ring of the shaft.

CAUTION

In disconnecting the anti-fall wire, keep in mind that the wire may pop out.

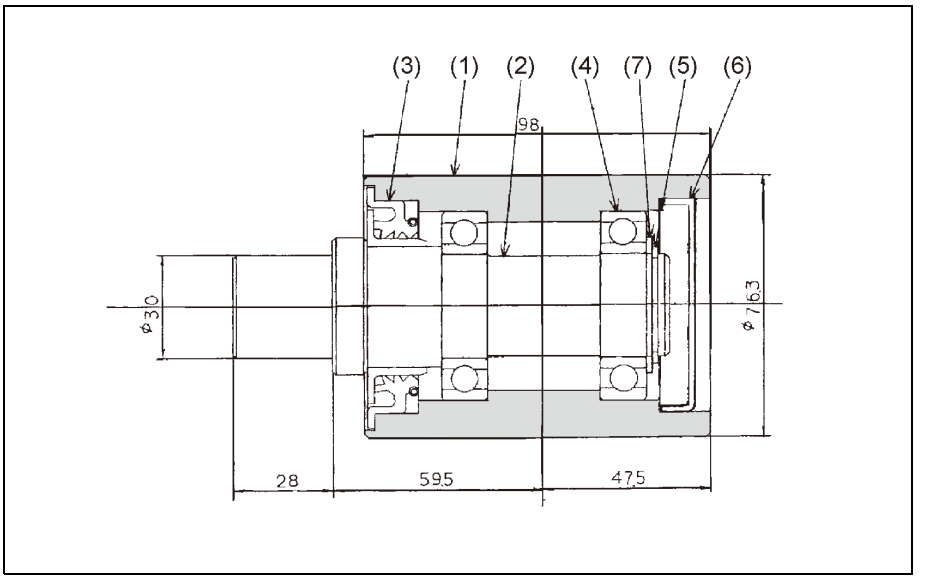
1. Check the O-ring of the floating seal for dust and oily deposits.
   Install the seal in place without twist and tilt.
2. Apply the lube oil thinly over the seal sliding surface.
3. Finally move the seal 2 or 3 turns to see if it turns smoothly. This also helps form an oil film over the seal sliding surface.

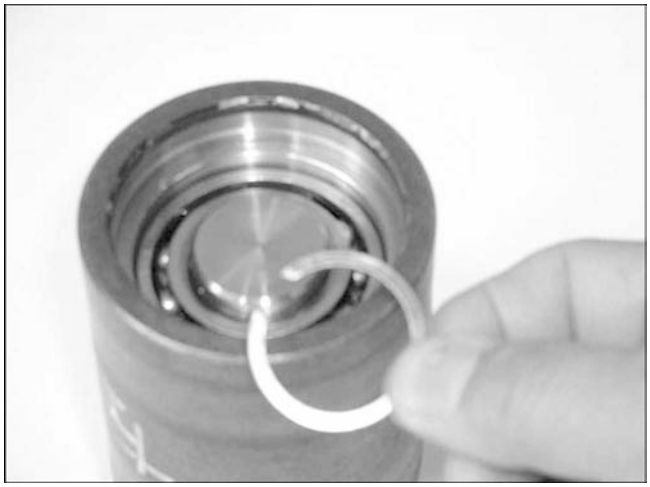


5) Carrier roller disassembling procedure

1. Check the roller surface and shaft for wear, and measure the outside diameter, as required. If out of spec, replace them with new ones.
2. Put a bladed screwdriver at the cap side to disassemble the roller. Replace the parts with new ones in this case.

No.	Part name	Q'ty
1	Carrier roller	1
2	Shaft	1
3	Oil seal	1
4	Ball bearing	2
5	Shaft circlip	1
6	Plug	1
7	Spacer	1





1. In reassembling, be careful to keep the roller inside and incoming parts free from dust, cuttings and other foreign matters.
2. The lube oil to pour is Engine Oil Class SAE#30CD. Its specified amount is U20-3α , U25-3α, U25S=60cc (0.02 US gal).

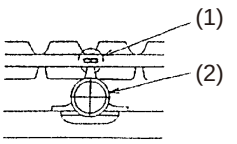
CAUTION

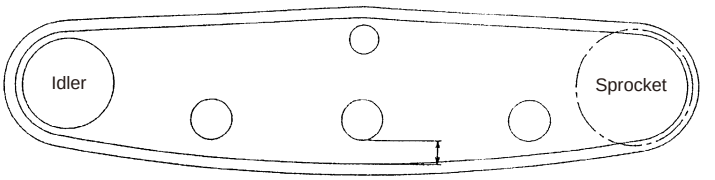
In disassembling and reassembling, keep in mind that the shaft circlip may pop out.

e. Crawler replacement and tension adjustment procedure

1) Required parts and installation

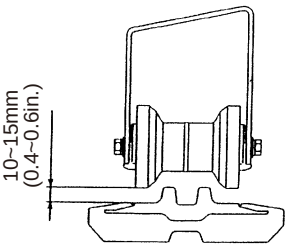
Rubber crawler





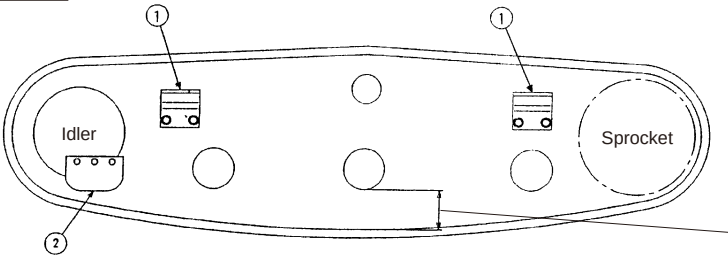
(1)Seam joint
(2)Upper roller
(3)Track shoe sag distance

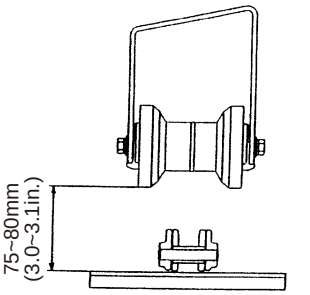
Move the rubber crawler until the joint marking (∞) comes at the top center (see left) and the upper roller comes between the links.



(3)

Iron crawler





(3)

Additional parts required for replacing the rubber crawler with the iron crawler

No.	Part No.	Part name.	Q'ty	Remarks
1	RB411-2181Δ	Plate (sliding)	4	U20-3α
	RB611-2181Δ	Plate (sliding)	4	U25-3α, U25S
2	RB411-2182Δ	Guide (crawler)	4	U20-3α
	RB511-2182Δ	Guide (crawler)	4	U25-3α, U25S

(To be removed when changing the iron crawler back to the rubber crawler)

(3)Track shoe sag distance

2) Adjustment of crawlers

◆ **To loosen the crawlers, follow the following procedure:**

CAUTION

To avoid personal injury:

- **Do not loosen the grease nipple completely or too quickly. Otherwise grease under high pressure in the tension cylinder could squirt out.**
- **Do not crawl under the excavator.**

1. Using a socket wrench, loosen the grease nipple a few turns.
2. When grease oozes out from the thread, rotate the crawler and loosen the crawler in the lifted position (see illustration).

After adjustment is completed:

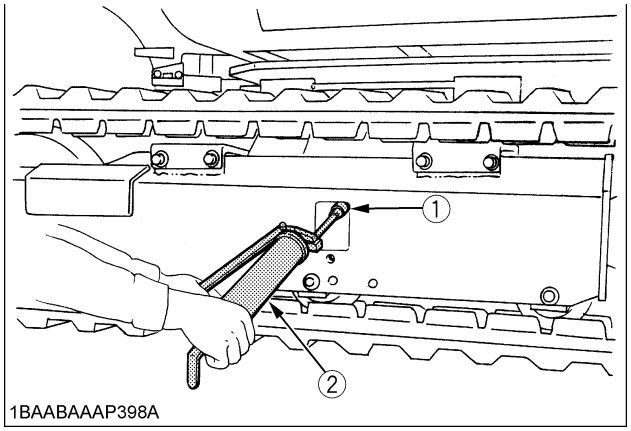
Using the socket wrench, tighten the grease nipple.
Tightening torque must be between 98 to 108 N-m (10 to 11 kgf-m).

IMPORTANT :

- If the crawlers are too tight, wear is increased.
- If the crawlers are too loose, the crawler shoes may collide with the sprocket and wear is increased.
  The crawler may dislocate or come off.
- Clean the crawler after every use.
- Should the crawler tension be heightened due to sticking mud, lift the crawler with the help of the boom, arm and bucket, idle the engine and remove mud from the crawler by rotating it.

◆ **Tension the crawlers as specified:**

1. Apply grease (2) to the grease nipple (1).



(1) Grease nipple
(2) Grease gun

2. **Rubber Crawlers**
   Tension the crawler in the lifted position, so that the distance "A" (clearance between the track roller and the inside surface of the crawler) see illustration, in this case, the crawler seam is positioned on the top centre between the idler and the sprocket.

   Steel Crawlers
   To check the crawler tension, the crawler must be lifted from the ground as shown. The crawler tension is correct if the clearance between the outer end of the track roller and the crawler interior surface corresponds to the dimension specified in the table below.

DANGER

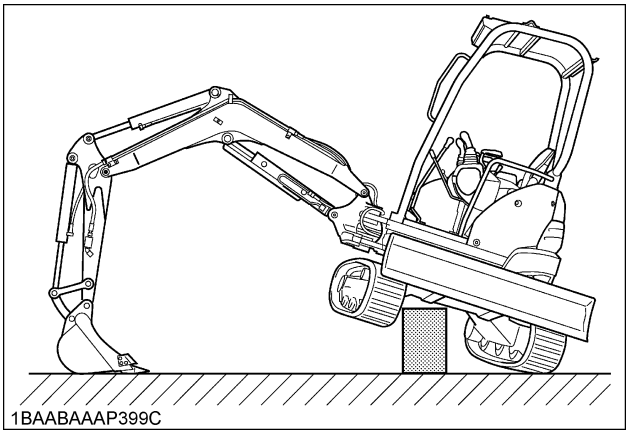
To avoid serious injury or death:

- **Do not work under the machine in this condition.**
- **For your safety do not rely on hydraulically supported devices, they may leak down suddenly drop or be accidentally lowered.**

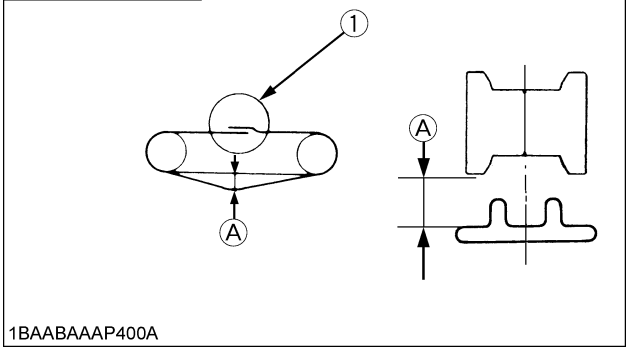
WARNING

To avoid personal injury or death:

- **When lifting the machine itself with an attachment, place a safety block or safety post to prevent the machine from turning over. Keep the lock lever for attachment control in the "LOCK" position.**

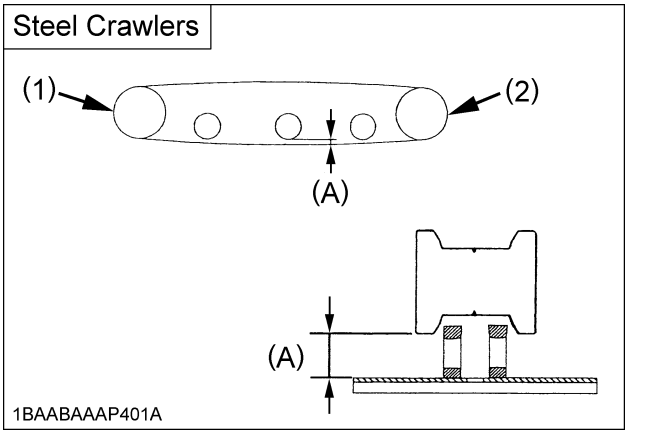


Rubber Crawlers



(1) Seam (Mark " ∞ ") (A) 10 to 15 mm (0.39~0.59)

Steel Crawlers



(1) Drive sprocket
(2) Idler

(A)	75 to 80mm (2.95~3.15in.)

IMPORTANT :

- Make sure that no obstacles, such as stones are caught in the crawler. Remove such obstacles before adjusting the crawler tension.
- Crawler seam
  The ends of the rubber crawler are joined with a seam. When adjusting the crawlers, the seam must be positioned on the top centre between the idler and the sprocket.

  If the seam is positioned incorrectly, the crawlers will be tensioned to loosely, and a further readjustment will be necessary.

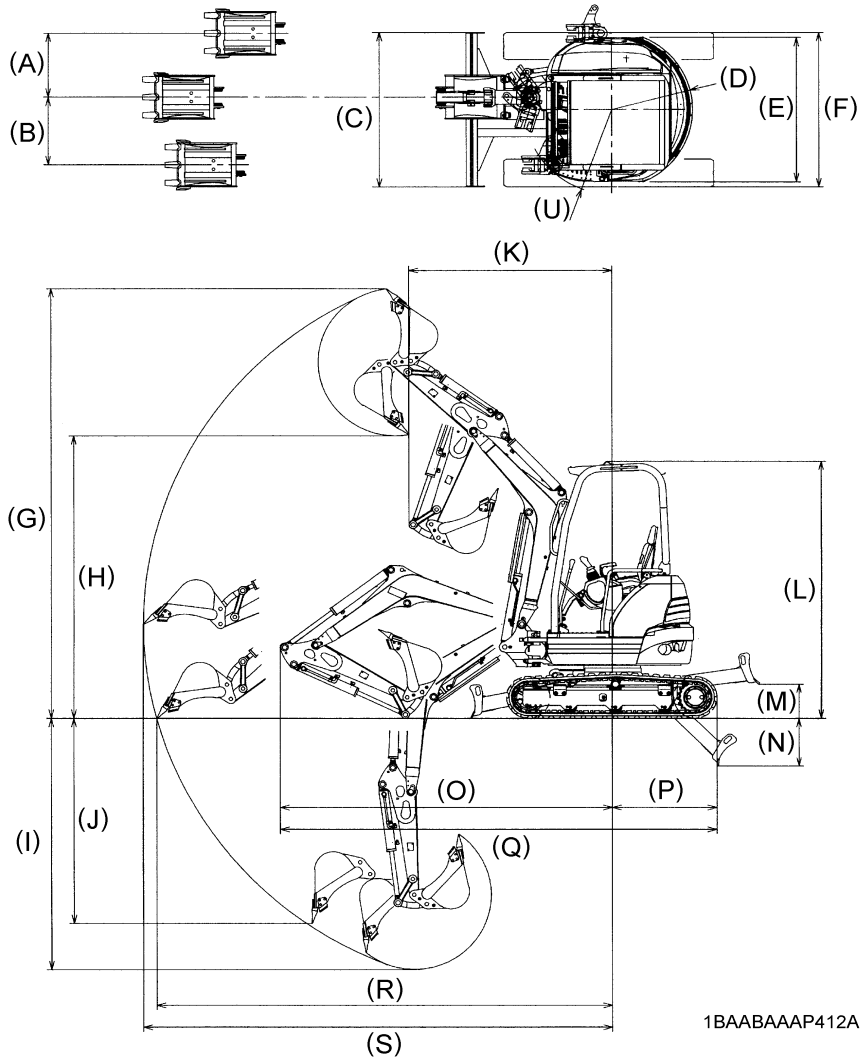
- Rotate the crawler after adjustment one to two times to check the tension.
- Additionally following points are to be observed when adjusting rubber crawlers.
  (1) If the crawler slackens more than 25mm, readjust them.
  (2) Check crawler tension 50 hours after initial use and readjust if necessary. Check and adjust thereafter every 50 service hours.

■ Special Information when Using Rubber Crawlers

1. When turning, preferably make a slow swing turn. Avoid spin turns to lessen lug wear and entry of dirt.
2. The relief valve may be activated if too much dirt and sand clog the crawlers. In this case move the machine for a short distance straight backwards to let the earth and sand fall off, then a turn can be made.
3. Avoid using rubber crawler on riverbeds, stony underground, ferro-concrete and on iron plates. The rubber can be damaged as well as wear of the crawler increased.

F. Variable track (U20-3α)

a. Dimensional view



mm

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
U20-3α CANOPY	590	620	1400 [1300/1500]	710 (760)	1300	1400 [1300/1500]	3880 (3630)	2550 (2360)	2320	1900
U25-3α CANOPY	590	620	1500	760	1300	1500	4330 (4130)	2970 (2800)	2550	2300

	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(S)	(U)
U20-3α CANOPY	1850 (1970)	2370 (2360)	320 [330]	440 [280]	2930	920	3850	4030	4140	800
U25-3α CANOPY	1830 (1940)	2420 (2400)	360	320	3120	990	4110	4400	4510	800

(Cabin type models) [Track width changes models]

mm (inch)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
U25S CANOPY	590 (23.2)	620 (24.4)	1500 (59.1)	760 (29.9)	1300 (51.2)	1500 (59.1)	4530 (178.3)	3200 (126.0)	2810 (110.6)	1960 (77.2)

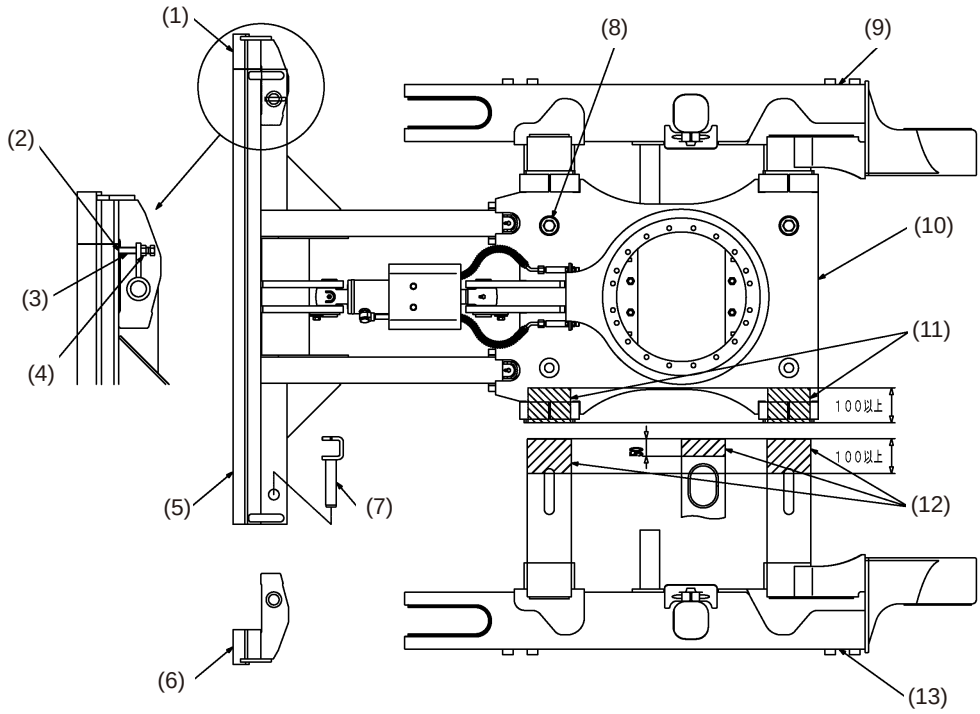
	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(S)	(U)
U25S CANOPY	1900 (74.8)	2420 (95.3)	360 (14.2)	320 (12.6)	3160 (124.4)	990 (39.0)	4150 (163.4)	4670 (183.9)	4780 (188.2)	800 (31.5)

b.Service data

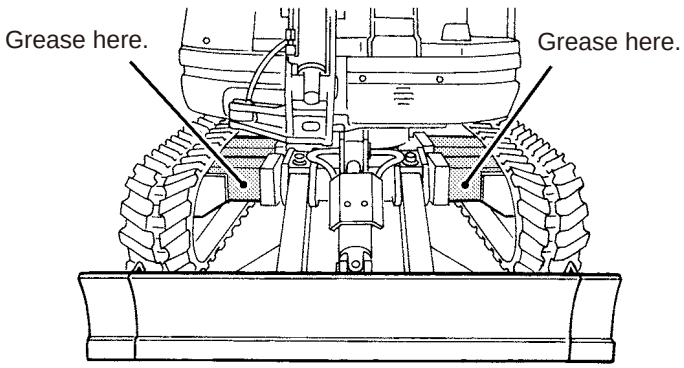
(Items different from standard specifications only) New-model delivery guideline

Item	Movement	Unit	Reference value	Allowable range	Remarks
Overall width (retracted)		mm (inch)	1300 (51.18)	1287~1313 (50.67~51.69))	
Overall width (extended)		mm	1500 (59.06)	1485~1515 (58.46~59.65)	
Machine weight	Canopy	kg	2030	1929~2132	Full fuel·Specified lubricant amount
Machine weight	Cabin	kg	2220	2109~2331	Full fuel·Specified lubricant amount
Crawler overall width	Overall width (retracted)	mm (inch)	1300 (51.08)	1274~1326 (50.16~52.20)	
Crawler overall width	Overall width (extended)	mm (inch)	1500 (59.06)	1470~1530 (57.87~60.24)	
Minimum road clearance		mm (inch)	164 (6.46)	159~169 (6.26~6.65)	Track frame center
Blade size	Stretchable width	mm (inch)	1300 (51.18)	1295~1305 (50.98~51.38)	
Blade size	Retractable width	mm (inch)	1500 (59.06)	1495~1505 (58.86~59.25)	
Blade size	Height	mm (inch)	293 (11.54)	283~303 (11.14~11.93)	
Blade upper limit		mm (inch)	333 (13.11)	283~383 (11.14~15.08)	
Blade lower limit		mm (inch)	277 (10.91)	227~327 (8.94~12.87)	
Blade approach angle		degree	33.8	30~37	
Dozer speed Top (ground~upper limit)		Sec	1.1	0.8~1.4	
Dozer speed Top (lower limit~upper limit)		Sec	2.2	1.9~2.5	
Dozer speed Top (upper limit~ground)		Sec	1.5	1.2~1.8	
Dozer speed Top (upper limit~lower limit)		Sec	2.8	2.5~3.1	
Swiveling angle on slope	L·R	degree	23.5	21.5	Front attachment horizontal, crowded, maximum rpm
Swivel block performance Engine idling	L·R	degree	21	30≧	Lever unlocked
Swivel start-up speed	L·R	Sec	1.95	1.7~2.3	
Track control lever operating force	Up	N (kgf) lbs	38 (3.88) 8.55	33~43 (3.37~4.39) 7.43~9.68	
Track control lever operating force	Down	N (kgf) lbs	39 (3.98) 8.77	34~44 (3.47~4.49) 7.65~9.90	
Track control lever stroke	Up·Down	mm (inch)	37 (1.46)	27~47 (1.06~1.85)	

c. Track frame



(1)Blade(right) RB411-7463Δ
(2)While pressing tightly enough,lock the nut.Then make sure the extension blade lock pin can be smoothly pulled and pushed.
(3)Bolt 01175-61260
(4)Nut 02174-60120
(5)Blade,assembly(center) RB411-7460Δ
(6)Blade(left) RB411-7462Δ
(7)Pin(30-135) RB411-7466Δ
(8)Bolt(stopper)4pcs. RB411-2125Δ spring washer 4pcs. 69201-66321 Discontinued as from in 7th unit in August production
Frame(track,center):discontinued as from Hirakata production lot
(9)Frame(Frack,right) RB411-2123Δ
(10)Frame(Frack,center) RB-411-2121Δ
(11)Apply grease all over the hatched inner surfaces.(Do the same for the right side.)
(12)Apply grease all over the hatched inner surfaces.(Do the same to the frame(track,right).)
(13)Frame(track,left) RB411-2122Δ

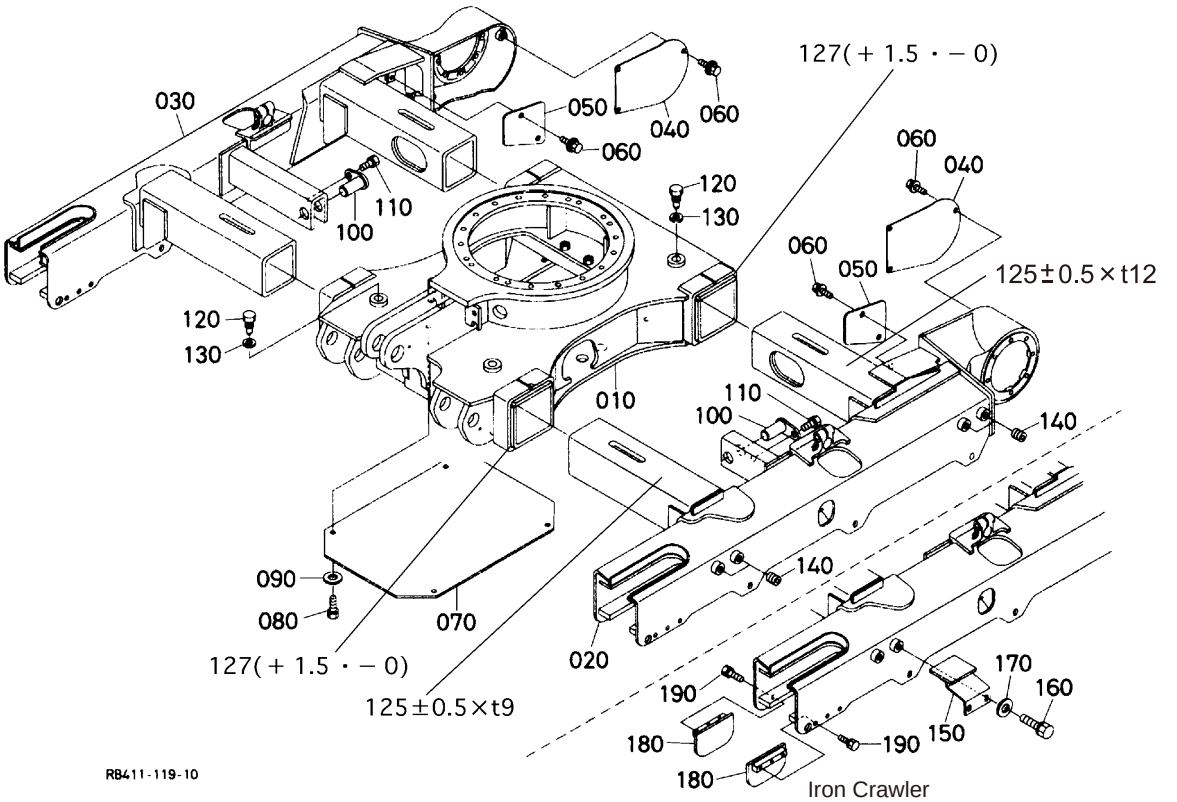


L-4929B

Preparatory steps

■ Greasing the slide track frame

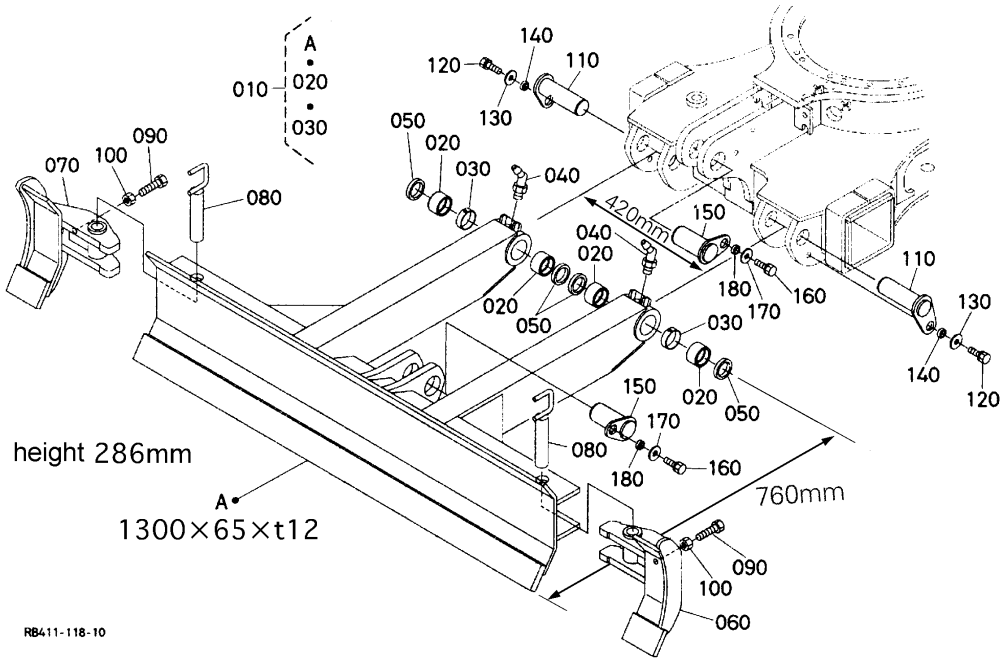
1. Press down the track stretch lever to get the track width to maximum (1500 mm).
2. Remove mud off the slide frame, and apply grease evenly all around the square pipe. (4 locations at front and back)
3. Do the track stretching several times between maximum (1500 mm) and minimum (1300 mm) in order to get the slide frame well greased.



Iron Crawler

Dwg. No.	Part name	Q'ty A	Interchangeability	Remarks
010	Frame(track, center)	1		Weight about 152 kg (335lbs)
020	Frame (track, left)	1		
020	Frame (track, left)	1 50186~	≠	Weight about 103 kg (227.1lbs)
030	Frame (track, right)	1 ~50185		
030	Frame (track, right)	1 50186~	≠	
040	Cover (moter)	2		
050	Cover (hose)	2		
060	Bolt	10		M10×20L×1.25p 7T 48.1~55.9N·m (4.9~5.7kgf·m) 35.44~41.23ft·lbs
070	Plain washer	1		
080	Bolt	4		M10×20L×1.25p 7T 48.1~55.9N·m (4.9~5.7kgf·m) 35.44~41.23ft·lbs
090	Plain washer	4		
100	Pin	2		ϕ30×62L
110	Bolt	2		M10×20L×1.25p 7T 48.1~55.9N·m (4.9~5.7kgf·m) 35.44~41.23ft·lbs
120	Bolt (stopper)	4		Tipϕ24 M32 fine-threaded 7T Tightning torgue:294.2~343.2N·m (30~35kgf·m) 216.99~253.16ft·lbs
130	Spring washer	4		
140	Plug	8		Rubber crawler
150	Plate (slide)	4		Iron crawler
160	Bolt	8		Iron crawler M10×20L×1.25p 7T 48.1~55.9N·m (4.9~5.7kgf·m) 35.44~41.23ft·lbs
170	Plain washer	8		Iron crawler
180	Guide (crawler)	4		Iron crawler
190	Bolt	12		Iron crawler M10×20L×1.25p 7T 48.1~55.9N·m (4.9~5.7kgf·m) (35.5~41.2ft·lbs)

d. Blade



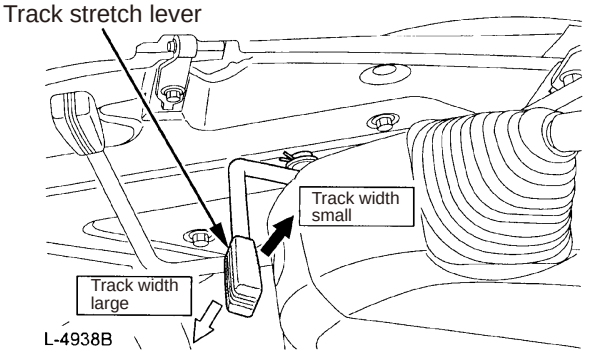
Dwg. No.	Part name	Q'ty	Interchangeability	Remarks
		A		
010	Blade, assembly (center)	1		Weight about 93 kg (205lbs)
020	Bushing (405030)	4		
030	Collar	2		
040	Grease nipple	2		
050	Dust seal (405042)	4		50 in out. dia. 40 in inn. dia high DR type dust seal (ϕ40)
060	Blade (left)	1		
070	Blade (right)	1		
080	Pin (30-135)	2		ϕ30×135L
090	Bolt	2		M12×60L×1.25p 7T 77.5~90.2N·m (7.9~9.2kgf·m) (57.2~66.5ft·lbs)
100	Nut	2		
110	Pin (40-125)	2		ϕ40×125L
120	Bolt	2		M12×25L×1.25p 7T 77.5~90.2N·m (7.9~9.2kgf·m) (57.2~66.5ft·lbs)
130	Plain washer	2		
140	Spacer	2		
150	Pin (45-95)	2		ϕ45×95L
160	Bolt	2		M12×25L×1.25p 7T 77.5~90.2N·m (7.9~9.2kgf·m) (57.2~66.5ft·lbs)
170	Plain washer	2		
180	Spacer	2		

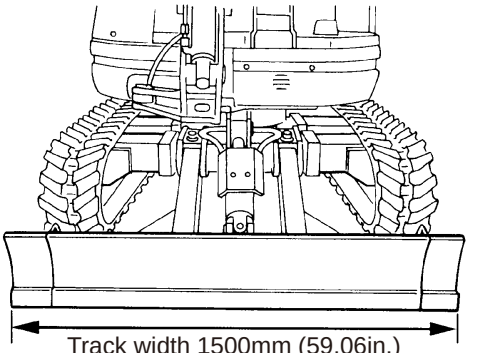
Track width operation

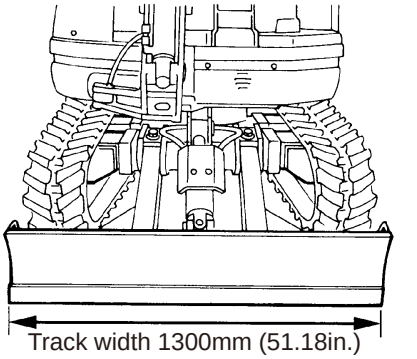
CAUTION:

* Adjust the track width to maximum (1500 mm) (59.06in.) or minimum (1300 mm) (51.18in.). If halfway, the variable track is not fixed, which causes the swivel frame to wobble.
* Use the small track width only when passing through a narrow flat place.
* For other traveling, digging, bulldozing and breaking jobs, be sure to keep the track width largest. Otherwise the machine may turn over.

Change the track width using the track stretch lever.
Large track width: Tilt the track stretch lever forward.
••••••The track width will be large.
(1300mm→1500mm) (51.18→59.06in.)
Small track width: Pull the track stretch lever toward yourself.
••••••The track width will be small.
(1500mm→1300mm) (51.18→59.06in.)



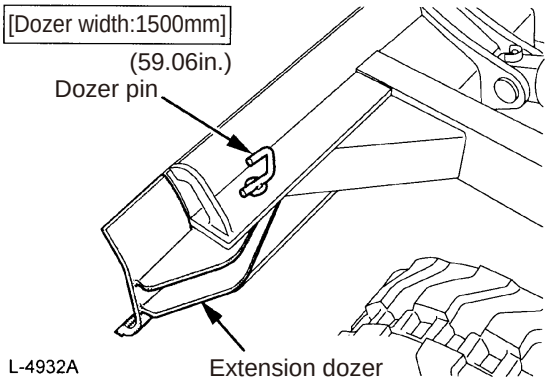


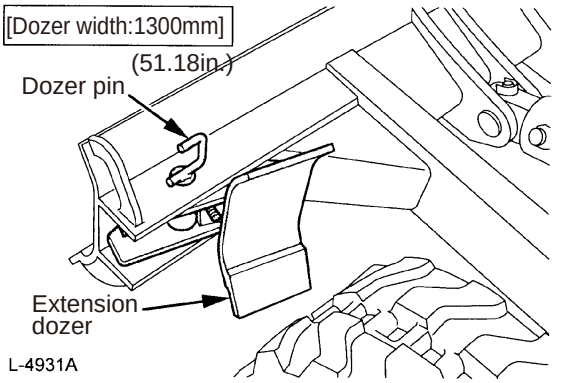


IMPORTANT

* If an obstacle is in the way of track stretching, get rid of the obstacle or move the machine to a flat ground. If the track still cannot be stretched, use the attachment and the dozer to keep the crawlers off the ground. Now stretch the track in this posture. Check also the stretcher for mud and the like, and remove it as required.

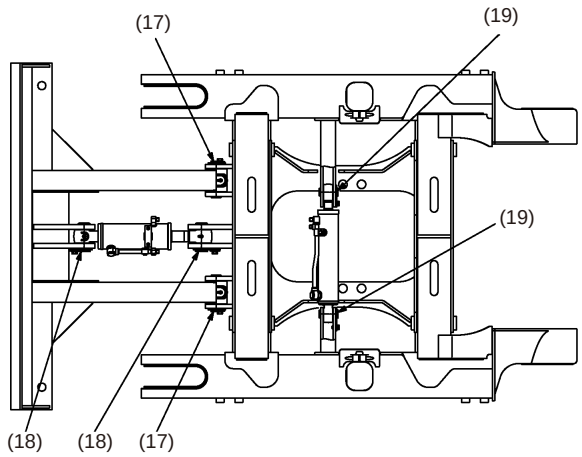
The dozer width can be changed by adding the extension dozer.
Large dozer width 1500mm(59.06in.)
Small dozer width 1300mm(51.18in.)



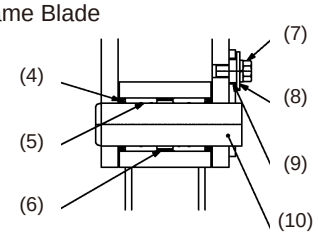


To change the track width from large to small:
1. Pull out the dozer pin.
2. Reverse the extension dozer and set its hole to the narrow-track hole. Put the dozer pin in this hole.

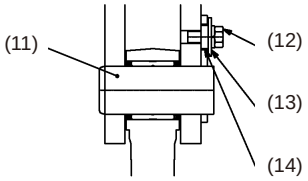
e. Track cylinder

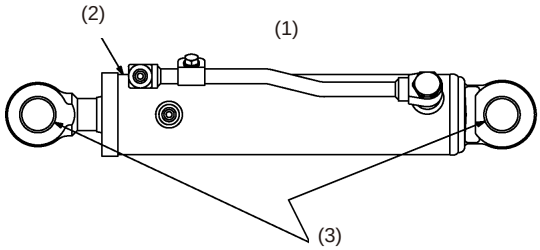


(17) Track frame Blade

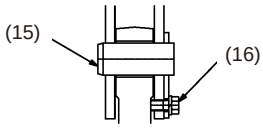


(18) Cylinder(blade)-Blade, track frame





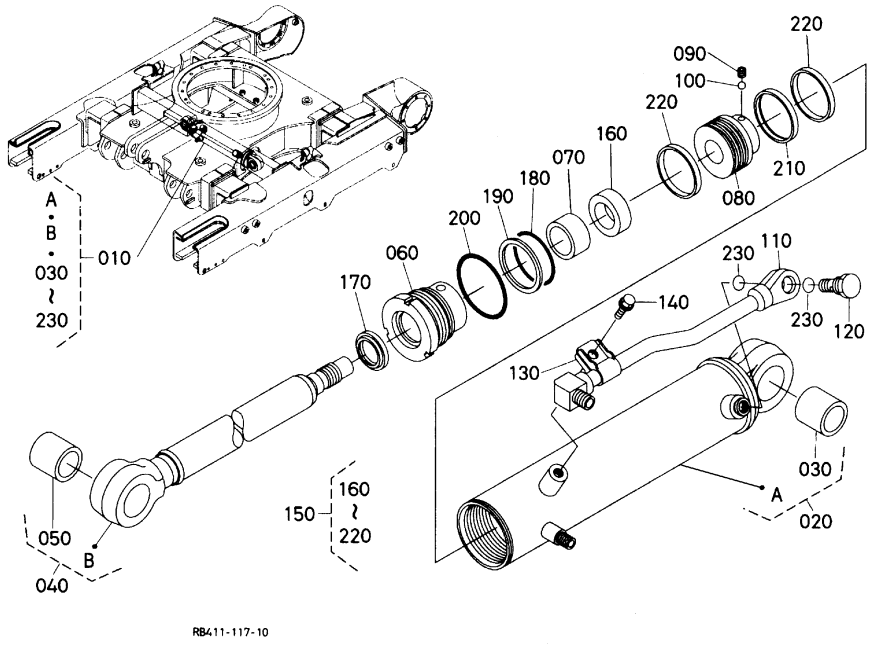
(19) Cylinder (track)Track frame



(1) Cylinder, assembly(Track) RB411-2128Δ
(2) "M2D"markings
(3) RB401-7118Δ (Bushing)
(4) Dust seal (405042) RC411-6678Δ x4
(5) Bushing (405030) RB411-7455Δ x4
(6) Collar RC411-7445Δ x2
(7) Bolt 01133-61225 x2
(8) Plan washer 68741-66921 x2
(9) Spacer 68741-66921 x2
(10) Pin(40-125) RC411-7443Δ x4
(11) Pin (40-95) RB411-7442Δ x2
(12) Bolt 01133-61225x2
(13) Plan washer 04015-60120 x2
(14) Spacer 68741-66921 x2
(15) Pin (30-62) RB411- 2129Δ x2
(16) Bolt 01133-61020 x2

Cylinder identification

Identified by markings	
U20-3α	M2
U20-3α variable track	M2D



RB411-117-10

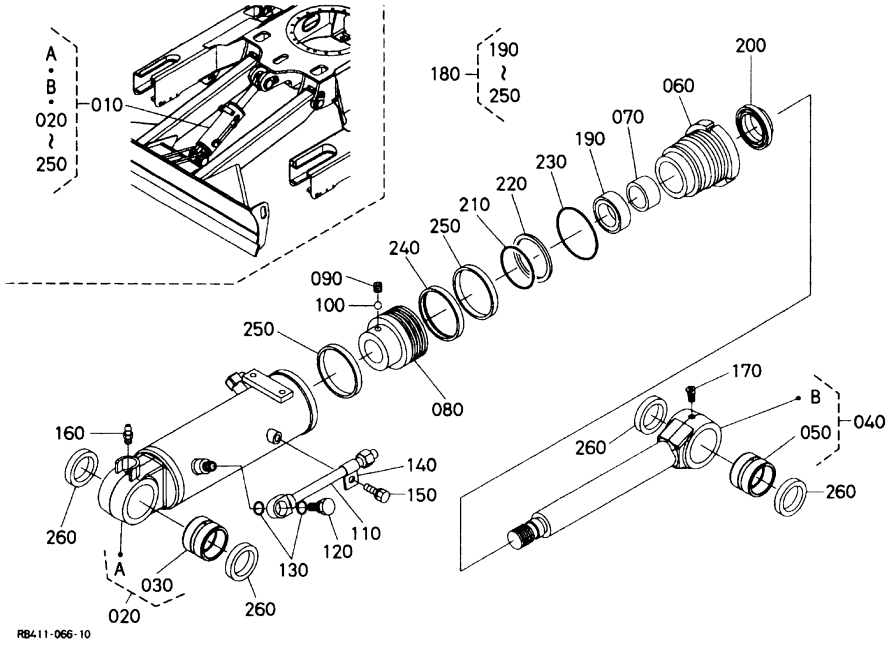
Main specifications

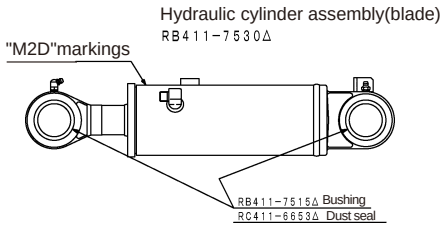
Rod outside diameter	ϕ30mm (ϕ1.18in.)
Tube inside diameter	ϕ60mm (ϕ2.36in.)
Tube outside diameter	ϕ75mm (ϕ2.95in.)
Stroke	215mm (8.46in.)
Maximum stretch	450mm (17.72in.) Between the centers of pins at both ends

Kayaba Industry-made/Weight about 11 kg

Dwg. No.	Part name	Q'ty A	Interchangeability	Remarks
010	Cylinder, assembly (track)	1		
020	Cylinder tube kit	1		
030	Bushing	1		
040	Piston rod kit	1		
050	Bushing	1		
060	Cylinder head	1		Tightening torque:304N·m (31.01kgf·m) 224.2ft·lbs 224.30ft·lbs(M67×2p)Three·Bond#1901to be applied
070	Bushing	1		
080	Piston	1		Tightening torque of piston:333N·m (33.97kgf·m) 245.71ft·lbs (M24×2p)Hexagonal across41mm (1.61in.)
090	Set-screw	1		Tightening torque:6.86N·m (0.70kgf·m) 5.06ft·lbs(M6×1p)Two spots to be then caulked with punch
100	Steel ball	1		
110	Pipe assembly	1		ϕ13.8×t2.4mm (ϕ0.54×t0.09in.)
120	Plug	1		Tightening torque of piston:39.3N·m (4.01kgf·m)29.00ft·lbs(M12×1.25p)
130	Pipe holder	1		
140	Bolt, assembly	1		
150	Cylinder repair kit	1		
160	U-ring	1		
170	Wiper ring	1		
180	O-ring	1		Class1B (hard) G (fixing) Nominal dia.
190	Ring (backup)	1		
200	O-ring	1		Class1A (Soft) G (fixing) Nominal dia.
210	Seal ring assembly	1		
220	Ring (slide)	2		
230	O-ring	2		

f. Blade cylinder





Main specifications

Rod outside diameter	ϕ30
Tube inside diameter	ϕ60
Tube outside diameter	ϕ75
Stroke	215
Maximum stretch	450 Between the centers of pins at both ends

Kayaba Industry-made/Weight about 16 kg

Dwg. No.	Part name	Q'ty A	Interchangeability	Remarks
010	Hydraulic cylinder, assembly (blade)	1		Variable track not included
010	Hydraulic cylinder, assembly (blade)	1		Variable track
020	Cylinder tube kit	1		Variable track not included
020	Cylinder tube kit	1		Variable track
030	Bushing (455540)	1		
040	Piston rod kit	1		Variable track not included
040	Piston rod kit	1		Variable track
050	Bushing (455540)	1		
060	Cylinder head	1		Tightening torque:304N·m (31.01kgf·m) 224.30ft·lbs(M67×2p)Three-Bond#1901to be applied
070	Bushing	1		
080	Piston	1		Tightening torque:333N·m (33.97kgf·m) 245.71ft·lbs(M24×2p)Hexagonal across 41mm (1.61in.)
090	Set-screw	1		Tightening torque:6.86N·m (0.70kgf·m) 5.06ft·lbs(M6×1p)Two spots to be then caulked with punch
100	Steel ball	1		
110	Pipe assembly	1		Variable track not included
110	Pipe assembly	1		Variable track ϕ13.8×t2.4mm (ϕ0.54×t0.09in.)
120	Plug	1		Tightening torque:39.3N·m(M12×1.25p) 29.0ft·lbs
130	O-ring	2		
140	Pipe holder	1		
150	Bolt, assembly	1		
160	Grease nipple	1		
170	Grease nipple	1		
180	Cylinder repair kit	1		
190	U-ring	1		
200	Ring (wiper)	1		
210	O-ring	1		
220	Ring (backup)	1		
230	O-ring	1		
240	Seal ring assembly	1		
250	Ring (slide)	2		
260	Dust seal	4		

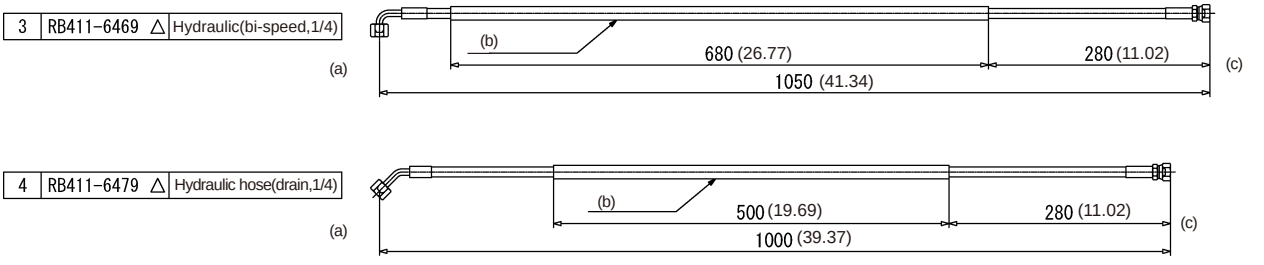
g. Hydraulic hose

1) List of high-pressure hoses (Upper route)

No.	Location	Part No.		Part name	Q'ty	Size mm (inch)	Color of tape	Hose configuration	Remarks
		Variable track	Fixed track reference						
1	Pump~C/VP3 (delivery)	RB411-6464Δ	RB411-6323Δ	Hydraulic hose (P3,3/8)	1	700 (27.56)		G3/8 PF2106 G3/8	(632)
2	C/V~R/J Track narrow(K)rod	RB411-6465Δ	—	Hydraulic hose (Track,1/4)	1	800 (31.50)		G1/4 PF1704 G1/4	(647)
3	C/V~R/J Track wide(J)bottom	RB411-6466Δ	—	Hydraulic hose (Track,1/4)	1	900 (35.43)	White	G1/4 PF1704 G1/4	

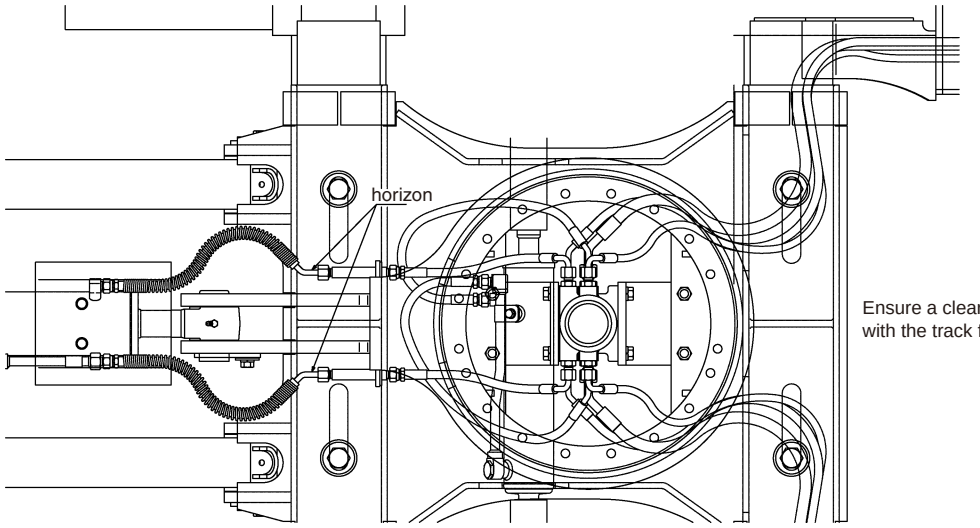
2) List of high-pressure hoses(Lower routes)

No.	Location	Part No.		Part name	Q'ty	Size mm (inch)	Color of tape	Hose configuration	Remarks
		Variable track	Fixed track reference						
1	R/J~Travel M Travel (top)	RB411-6467Δ	RB411-6323Δ	Hydraulic (travel, 3/8)	2	940 (37.01)	red	G3/8 SQ2106 G3/8	Ultra wear-resistant (637)
2	R/J~Travel M Travel (bottom)	RB411-6468Δ	RB411-6375Δ	Hydraulic (travel, 3/8)	2	940 (37.01)		G3/8 SQ2106 G3/8	Ultra wear-resistant
3	R/J~Travel M Bi-speed	RB411-6469Δ	RB411-6372Δ	Hydraulic (bi-speed, 1/4)	2	1050 (41.34)		G1/4 PF1704 G1/4	See below
4	R/J~Travel M drain (top)	RB411-6479Δ	RB411-6373Δ	Hydraulic (drain, 1/4)	2	1000 (31.37)	red	G1/4 PF1704 G1/4	See below
5	R/J~Joint, (Dozer)	RB411-6475Δ	RB411-6472Δ	Hydraulic (drain, 1/4)	2	290 (11.42)		G1/4 PF1704 G1/4	Brown
6	Joint~(Dozer)cyl	RB411-6476Δ	RB411-6473Δ	Hydraulic (drain, 1/4)	2	440 (17.32)		G1/4 PF1704 G1/4	SP winding
7	R/J(J·K)~Track cyl.	RB411-6477Δ	—	Hydraulic (track, 1/4)	2	560 (22.05)		G1/4 PF1704 G1/4	

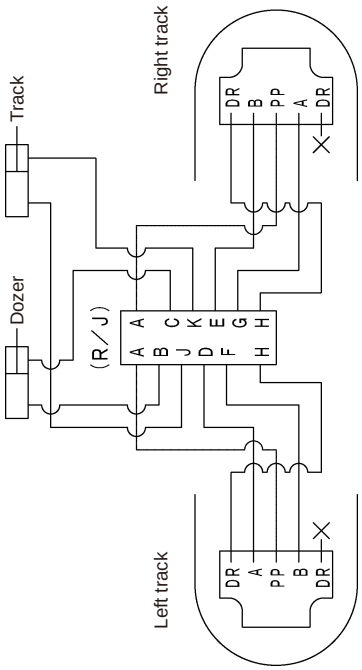


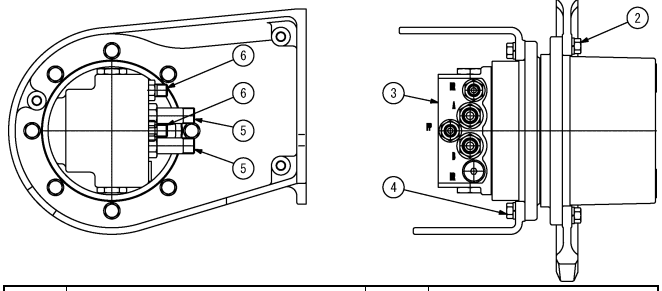
a	R/J side
b	Protective tube
c	Travel M bi-speed

3) Hydraulic hose routes



4) Travel wheel motor setup





No.	Part name	Q'ty	Remarks
1	Drive sprocket	2	
2	Bolt	18	M10×1.5 9T
3	Motor, assembly (wheel)	2	Fujikoshi-made
4	Bolt	16	M10×1.5 9T
5	Straight pipe joint	4	A·B
6	Adaptor	4	Above PP and DR
	O-ring	4	For 1/4 : PP and DR
	O-ring	4	For 3/8 : A,B

R/J Side	Travel motor, cylinder side
A Bi-speed pilot	Right/left travel bi-speed
B Dozer down	Cylinder, bottom side
C Dozer up	Cylinder, rod side
J Track wide	Cylinder, bottom side
K Track narrow	Cylinder, rod side

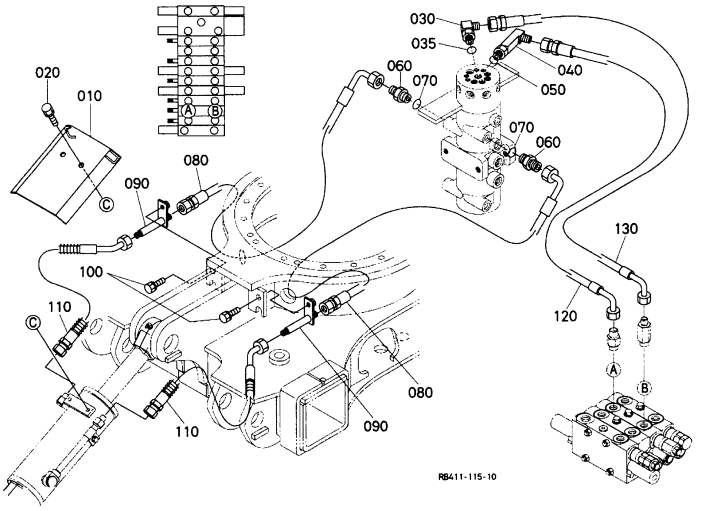
R/J Side	Travel motor, cylinder side
D Left forward	Left A (top)
E Right forward	Right B (top)
F Left backward	Left B (bottom)
G Right backward	Left A (bottom)
H Drain	Right / left drain port (top)

	Part name	Q'ty	mm(inch)	Tape color
R/J-Travel M, Travel (top)	Hydraulic hose (travel 3/8)	2	940(37.01)	Red
R/J-Travel M, Travel (Bottom)	Hydraulic hose (travel 3/8)	2	940(37.01)	
R/J-Travel M, Bi-speed	Hydraulic hose (bi-speed 1/4)	2	1050(41.34)	
R/J-Joint (Dozer)	Hydraulic hose (blade 1/4)	2	290(11.42)	Brown
Joint-Dozer cylinder	Hydraulic hose (blade 1/4)	2	440(17.32)	
R/J (J-K)-Track cylinder	Hydraulic hose (track 1/4)	2	560(2.05)	
R/J -Travel M, Drain (top)	Hydraulic hose (drain 1/4)	2	1000(39.37)	Red

Precautions in disassembling/reassembling

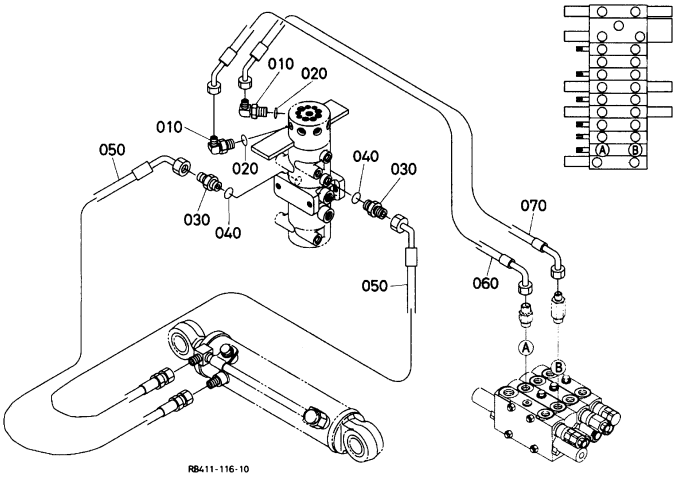
1. Install the motor to the track frame with the ports facing forward.
2. Tightening torque of travel motor (track frame, sprocket)
   60.8~70.6N·m(6.2~7.2kgf·m) 44.8~52.1ft·lbs
   Apply screw loctite.(Loctite 271)
3. Connect the motor drain hose to the top port and plug up its bottom end.
4. Keep the hoses inside the track frame with excessive twist or strong contact.

5) Blade piping



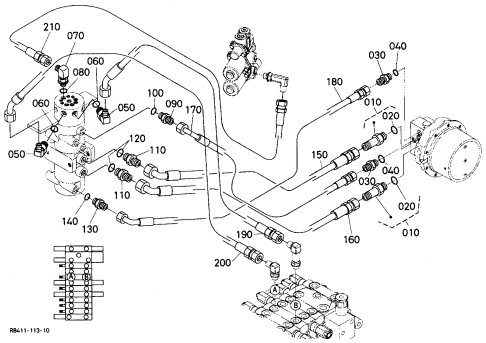
Dwg. No.	Part name	Q'ty	Interchange ability	Remarks
		A		
010	Cover (blade cylinder)	1		
020	Bolt	2		M10×16L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m) 35.44~41.23ftl·bs
030	Pipe joint(L, G 1/4 - G 1/4)	1		
035	O-ring	1		Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
040	Pipe joint(L, G 1/4 - G 1/4)	1		
050	O-ring	1		Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
060	Adaptor	2		
070	O-ring	2		Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
080	Hydraulic hose (blade, 1/4)	2		
090	Joint (blade hose)	2		
100	Bolt	2		M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m) 35.44~41.23ftl·bs
110	Hydraulic hose (blade, 1/4)	2		Length 440mm (17.32in.) G1/4×CR4·G1/4
120	Hydraulic hose (1/4)	1		Length 660mm (25.98in.) G1/4×CR9·G1/4
130	Hydraulic hose (1/4)	1		Length 800mm (31.50in.) G1/4×CR4·G1/4

6) Track cylinder piping



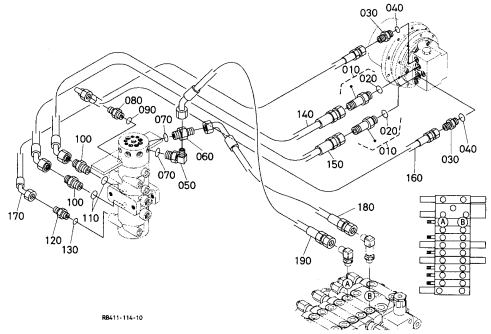
Dwg. No.	Part name	Q'ty	Interchange ability	Remarks
		A		
010	Pipe joint (L, G 1/4 - G 1/4)	2		
020	O-ring	2		Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
030	Adaptor	2		
040	O-ring	2		Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
050	Hydraulic hose (track, 1/4)	2		Length 560mm (22.05in.) G1/4×CR4·G1/4
060	Hydraulic hose (track, 1/4)	1		Length 800mm (31.50in.) CR4·G1/4×CR9·G1/4
070	Hydraulic hose (track, 1/4)	1		Length 900mm (31.50in.) CR4·G1/4×CR9·G1/4

7) Left-travel piping



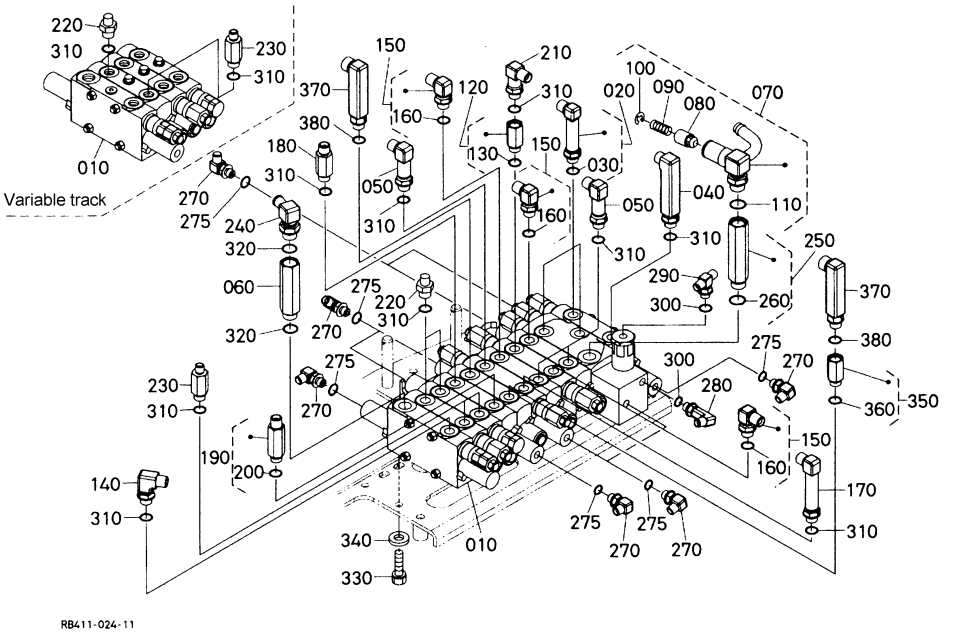
Dwg. No.	Part name	Q'ty	Remarks
		A	
010	Straight pipe joint (3-3-50)	2	
020	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.55in.)
030	Adaptor	2	
040	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
050	Pipe joint (L, G 3/8 - G 3/8)	2	
060	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.55in.)
070	Pipe joint (L, G 1/4 - G 1/4)	1	
080	O-ring	1	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
090	Adaptor	1	
100	O-ring	1	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
110	Straight pipe joint	2	
120	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.553in.)
130	Adaptor	1	
140	O-ring	1	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
150	Hydraulic hose (travel, 3/8)	1	Length 940mm (37.01n.) G3/8×CR4·G3/8
160	Hydraulic hose (travel, 3/8)	1	Length 940mm (37.01in.) G3/8×CR4·G3/8
170	Hydraulic hose (bi-speed, 1/4)	1	Length 1050mm (41.34in.) G1/4×CR9·G1/4
180	Hydraulic hose (drain, 1/4)	1	Length 1000mm (39.37n.) G1/4×CR4·G1/4
190	Hydraulic hose (3/8)	1	Length 440mm (17.32in.) G3/8×CR4·G3/8
200	Hydraulic hose (3/8)	1	Length 380mm (14.96in.) G3/8×CR4·G3/8
210	Hydraulic hose (1/4)	1	Length 970mm (38.19in.) G1/4×CR9·G1/4

8) Right-travel piping



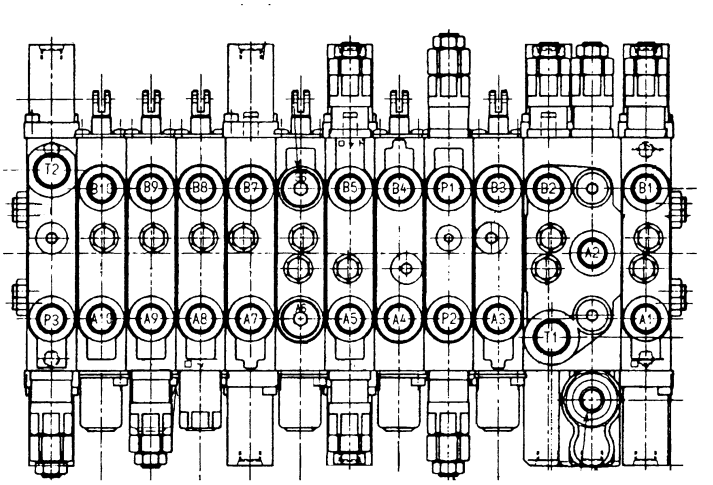
Dwg. No.	Part name	Q'ty	Remarks
		A	
010	Straight pipe joint (3-3-50)	2	
020	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.55in.)
030	Adaptor	2	
040	O-ring	2	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
050	Pipe joint (L, G 3/8 - G 3/8)	2	
060	O-ring	2	
070	Pipe joint (L, G 1/4 - G 1/4)	1	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.55in.)
080	O-ring	1	
090	Adaptor	1	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
100	O-ring	1	
110	Straight pipe joint	2	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
120	O-ring	2	
130	Adaptor	1	Class 1B (hard) P (fixing·movable) nominal dia14mm (0.55in.)
140	O-ring	1	Class 1B (hard) P (fixing·movable) nominal dia11mm (0.43in.)
150	Hydraulic hose (travel, 3/8)	1	Length 940mm (37.01n.) G3/8×CR4·G3/8
160	Hydraulic hose (travel, 3/8)	1	Length 940mm (37.01n.) G3/8×CR4·G3/8
170	Hydraulic hose (bi-speed, 1/4)	1	Length 1050mm (41.34in.) G1/4×CR9·G1/4
180	Hydraulic hose (drain, 1/4)	1	Length 1000mm (39.37n.) G1/4×CR4·G1/4
190	Hydraulic hose (3/8)	1	Length 440mm (17.32in.) G3/8×CR4·G3/8

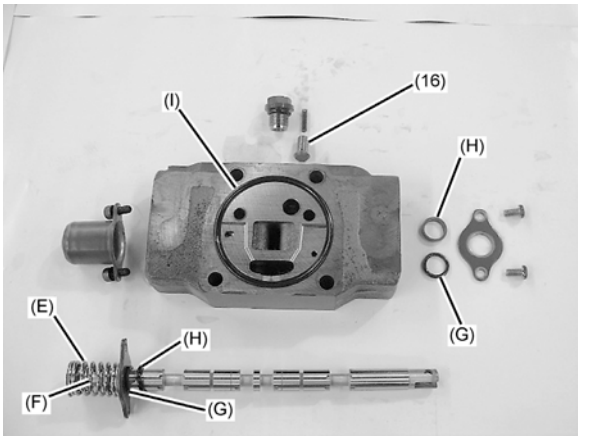
h. Control valve



Maker: Kayaba Industry
Model: KVSE-36-11
Weight: About 34 kg (75lbs)

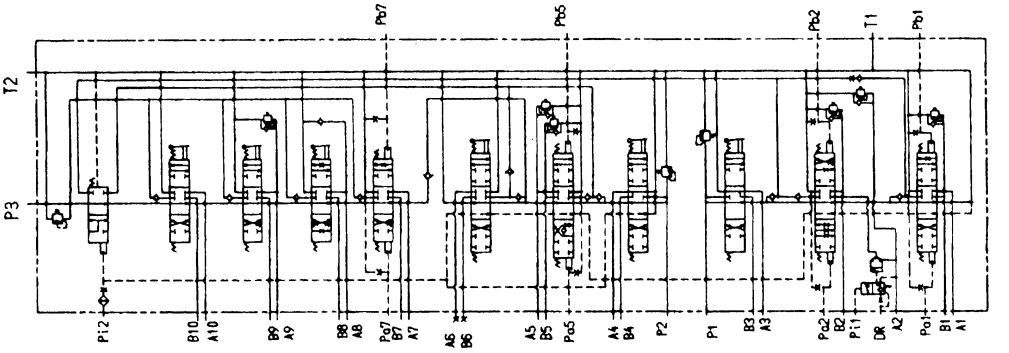
Dwg. No.	Part name	Q'ty	Remarks
		A	
010	Control valve, assembly (variable)	1	Variable track
135	Valve, assembly (width)	1	Variable track
310	O-ring	19	Variable track



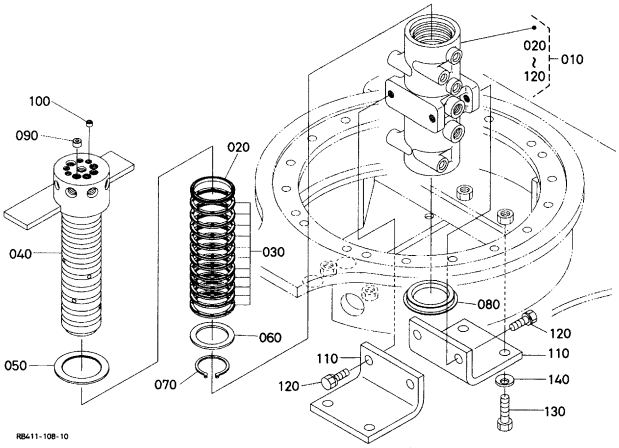


Component parts

(16) Poppet
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I) O-ring



i. Swivel joint



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No.	Part name	Q'ty	Remarks
1	Swivel joint, assembly	1	
2	Bolt	4	M14×1.5 9T
3	Plain spring	4	
4	Pipe joint (L, G 1/4 - G 1/4)	4	A·B·J·K
5	Pipe joint (L, G 1/4 - G 1/4)	1	C
6	Pipe joint (L, G 3/8 - G 3/8)	3	D·F·G
7	Straight pipe joint	1	E
8	Pipe joint (bushing G 3/4)	1	H
9	Elbow pipe joint (G 4-13)	1	H
	O-ring	7	For 1/4 A·B·C·H·J·K
	O-ring	4	For 3/8 D·E·F·G
10	Adaptor	8	A·B·C·H·J·K
11	Straight pipe joint	4	D·E·F·G
	O-ring	8	For 1/4 A·B·C·H·J·K
	O-ring	4	For 3/8 D·E·F·G

1) Precautions in disassembling/reassembling

(1) Tightening torque of hydraulic adaptor
G1/4:24.5~29.4N·m(2.5~3.0kgf·m)
18.1~21.7ft·lbs
G3/8:49.0~53.9N·m(5.0~5.5kgf·m)
36.2~39.8ft·lbs

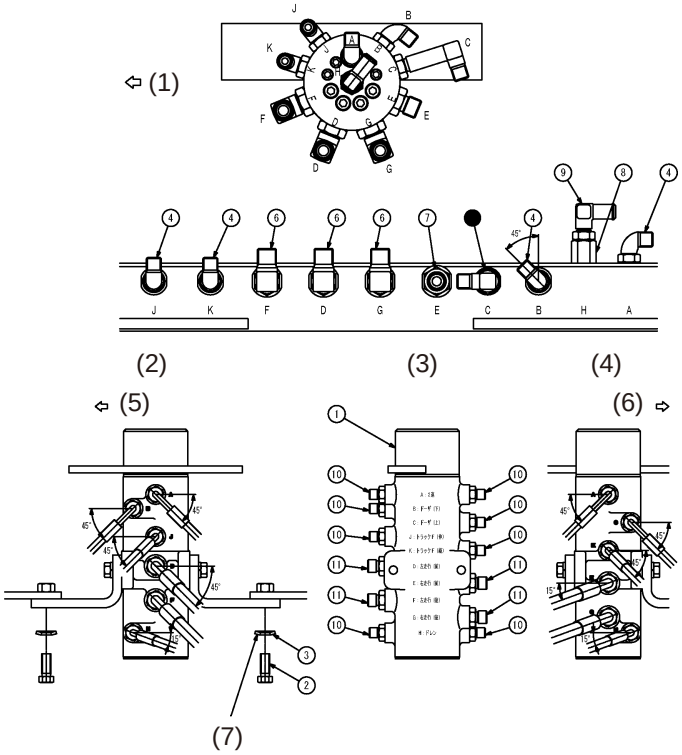
(2) Installing on the track frame
Tightening torque:
166.7~196.1N·m(17.0~20.0kgf·m)
123~145ft·lbs
Apply screw LOCKTIGHT. (Locktight 271)

(3) Before setting up, check the packings for scratches, deformation and other troubles. Apply grease over the seals inner and outer surfaces. Mount the seal with its lip outward.

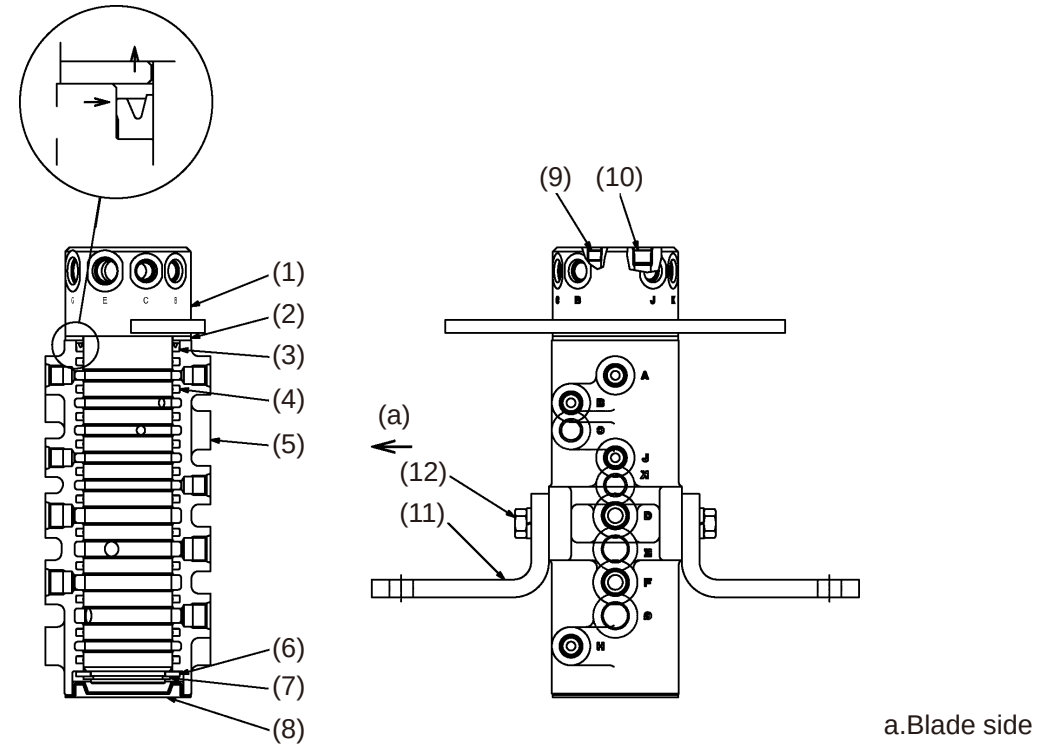
(4) Before joining the body and shaft together, apply grease over the seals inner and outer surfaces. Join them together gently.

(5) Installing the swivel joint assembly and stay
Tightening torque:77.5~90.2N·m(7.9~9.2kgf·m)
57.1~66.5ft·lbs
Apply screw LOCKTIGHT. (Locktight 271)

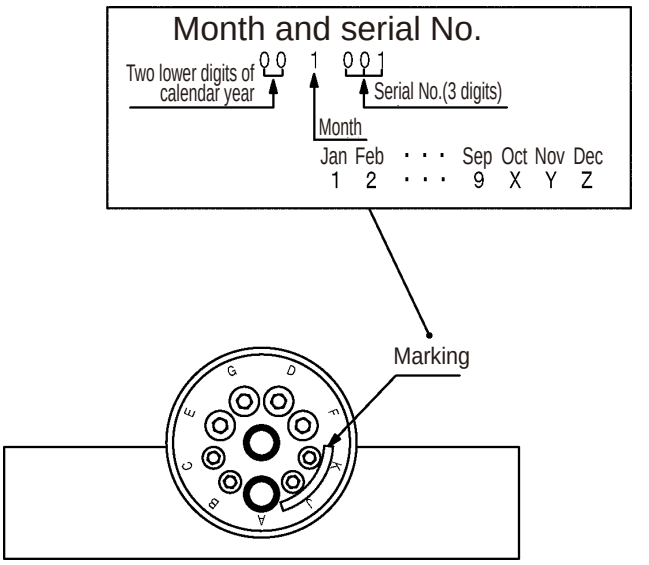
(6) Place the plugs (PT1/8, PT1/4) so that they do not stretch out of the shaft end.



(1)Front(Front side)
(2)Left
(3)Rear
(4)Right
(5)Front(Blade side)
(6)Front(Blade side)
(7)Attention to the direction of the belleville spring

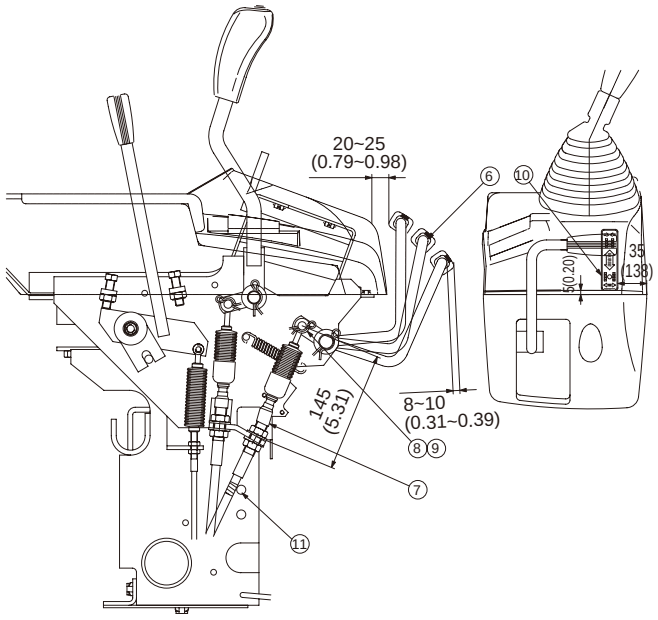


a.Blade side



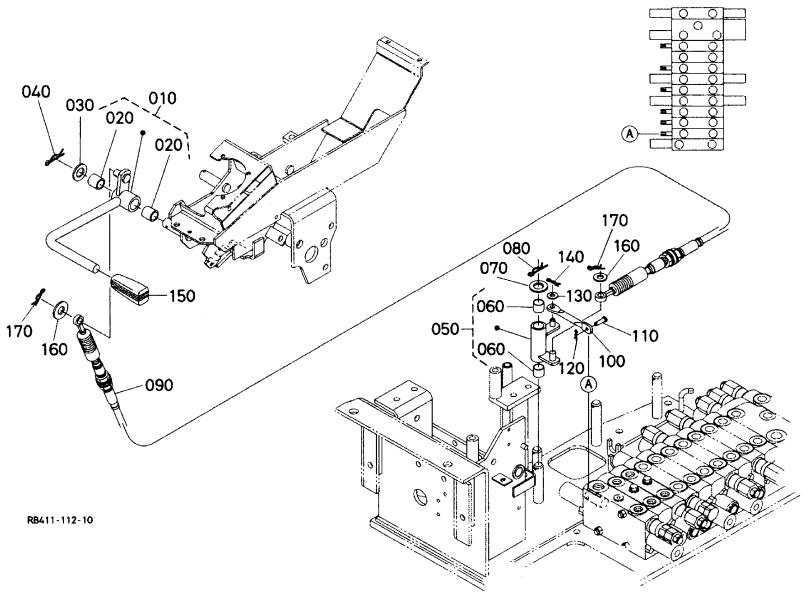
No.	Part name	Q'ty	Remarks
1	Shaft (swivel joint)	1	
2	Collar (swivel joint)	1	
3	Gasket	1	
4	Gasket (swivel joint)	11	
5	Body (swivel joint)	1	
6	Collar (swivel joint)	1	
7	Shaft circlip	1	
8	Plug	1	
9	Plug (PT 1/8)	4	
10	Plug (PT 1/4)	4	
11	Collar (swivel joint)	2	
12	Bolt	4	M12×1.25 7T

j. Track control lever



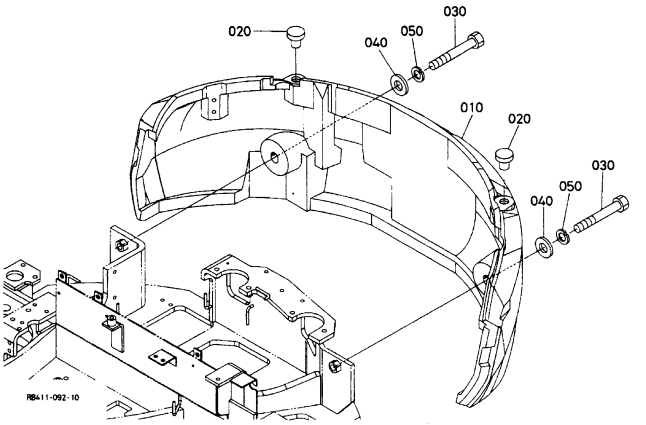
1) Precautions in disassembling/reassembling
   (1) Do not bend the tip of the cable outer casing. Ensure the end straight at least 20 mm (0.79in.) long.
   (2) Apply grease to the rotary bearing. Make sure it moves smoothly.
   (3) Route the cable with a bend of at least 150R.
   (4) Finally make sure the valve spool moves smoothly all over its stroke.

1	Rod (95)	1	
2	Pin	1	
3	Snap pin	1	
4	Plain washer	1	
5	Snap pin	1	
6	Lever grip 1	1	
7	Cable (flexible foot)	1	White identification mark
8	Plain washer	1	
9	Snap pin	1	
10	Label (Flexible lever EU)	1	
11	White identification mark	1	



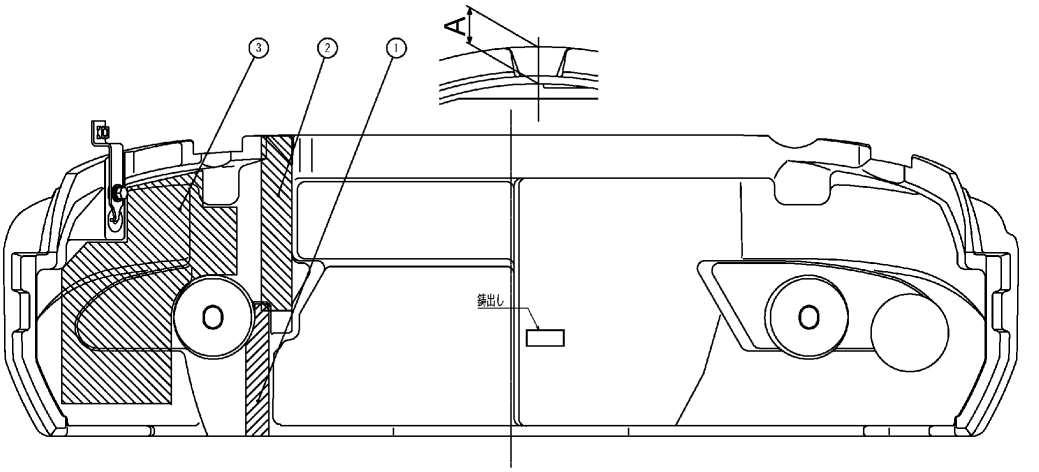
Dwg. No.	Part name	Q'ty A	Interchange ability	Remarks
010	Lever, assembly (track stretching)	1		
020	Bushing	2		
030	Flat washer	1		
040	Snap pin	1		
050	Link, assembly (dozer)	1		
060	Bushing	2		
070	Flat washer	1		
080	Snap pin	1		
090	Cable (track stretching)	1		White ID marking
100	Rod (95)	1		
110	Pin	1		
120	Snap pin	1		
130	Flat washer	1		
140	Snap pin	1		
150	Lever grip 1	1		
160	Flat washer	2		
170	Snap pin	2		

k. Counterweight



1) Precautions in disassembling / reassembling
   (1) Tightening torque of counterweight:
   367.7~431.5N·m (37.5~44.0kgf·m)
   271~318ft·lbs
   Apply screw LOCKTIGHT. (Locktight 271)
   (2) Before applying the thermal insulation and sound-absorbing sheet, check the contact surfaces for oil and dust. Clean the surfaces as required.
   (3) Apply and press all over the insulation and compound, leaving no looseness.

Dwg. No.	Part No.	Part name	Q'ty	Interchange ability	Remarks
			A		
010	RB419-4811-0	Counterweight	1		Canopy fixed track
010	RB419-4821-0	Counterweight (variable)	1		Canopy variable track
010	RB419-4831-0	Counterweight (cabin)	1		Cabin
020	90585-1199-0	Plug	2		
030	RC411-4841-0	Bolt	2		M20×2.5
040	RP801-4812-0	Washer	2		
050	04512-60200	Spring washer	2		



Counterweight identification

Model		Part No.	Dimension A mm (in.)
U20-3α	Fixed track + canopy type	RB419-4811 Δ	70 (2.76)
	Variable track + canopy type	RB419-4821 Δ	70 (2.76)
	Fixed track, variable track + cabin type	RB419-4831 Δ	115 (4.53)
U25α (Canopy, cabin type)		RB519-4811 Δ	115 (4.53)

No.	Part No.	Part name	Q'ty
1	RB411-4835 Δ	Sound absorber (1, counterweight)	1
2	RB411-4836 Δ	Sound absorber (2, counterweight)	1
3	RB411-4838 D	Sound absorber (3, counterweight)	1

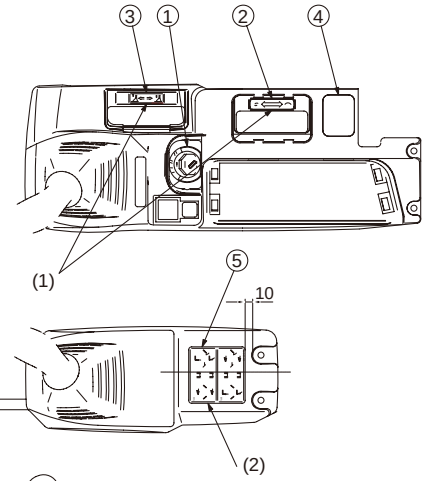
Variable type

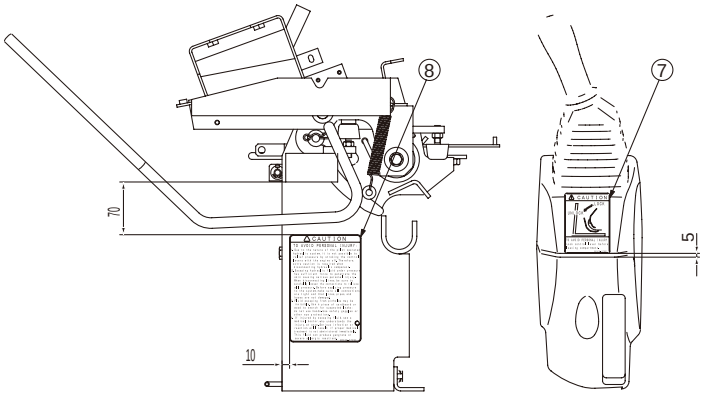
Model		Part No.	Casting
U20-3α	Variable track + canopy type	RB419-4821 Δ	U-20D
	Variable track + cabin type	RB419-4831 Δ	U-20C

G. Label

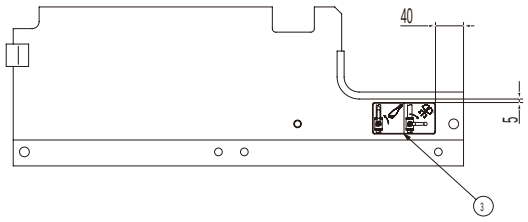
(1) Align with the center of groove.
(2) Apply at the center.
(3) 4P canopy type.
(4) Actual dimension.

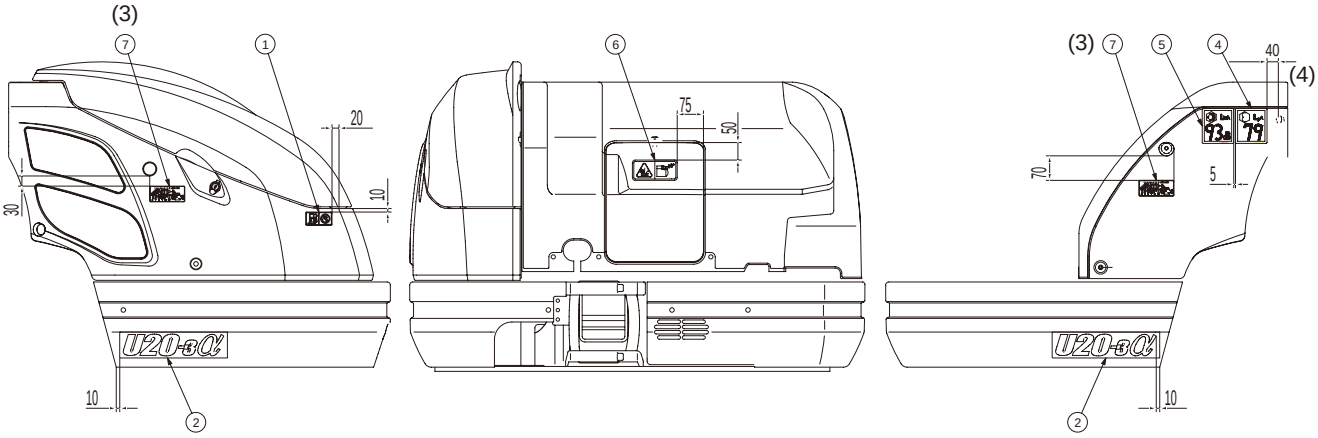
1	RB238-5775Δ	Label (main switch)	1
2	RC418-5761Δ	Label (accelerator)	1
3	RC101-5743Δ	Label (blade)	1
4	RB238-5744Δ	Label (panel)	1
5	RC418-5731Δ	Label (control pattern)	1
6	RC418-5753Δ	Label (lever lock)	1
7	RD118-5763Δ	Label (get-on/off caution)	1
8	RC348-5728Δ	Label (caution)	1





1	RB238-5736Δ	Label (refueling)	1	
2	RB449-5715Δ	Marking (model)	2	For U20-3α EU only
	RB549-5715Δ	Marking (model)	2	For U25-3α EU only
3	RB419-5787Δ	Label (third line, EU)	1	
4	RB408-5731Δ	Marking (LPA)	1	Ear level: 79 dB
5	RB419-5739Δ	Marking (LWA, 98)	1	Around the machine: 93 dB
6	69198-5739Δ	Label (operation caution)	1	
7	RA228-9338Δ	Label (anti-theft)	2	Canopy type



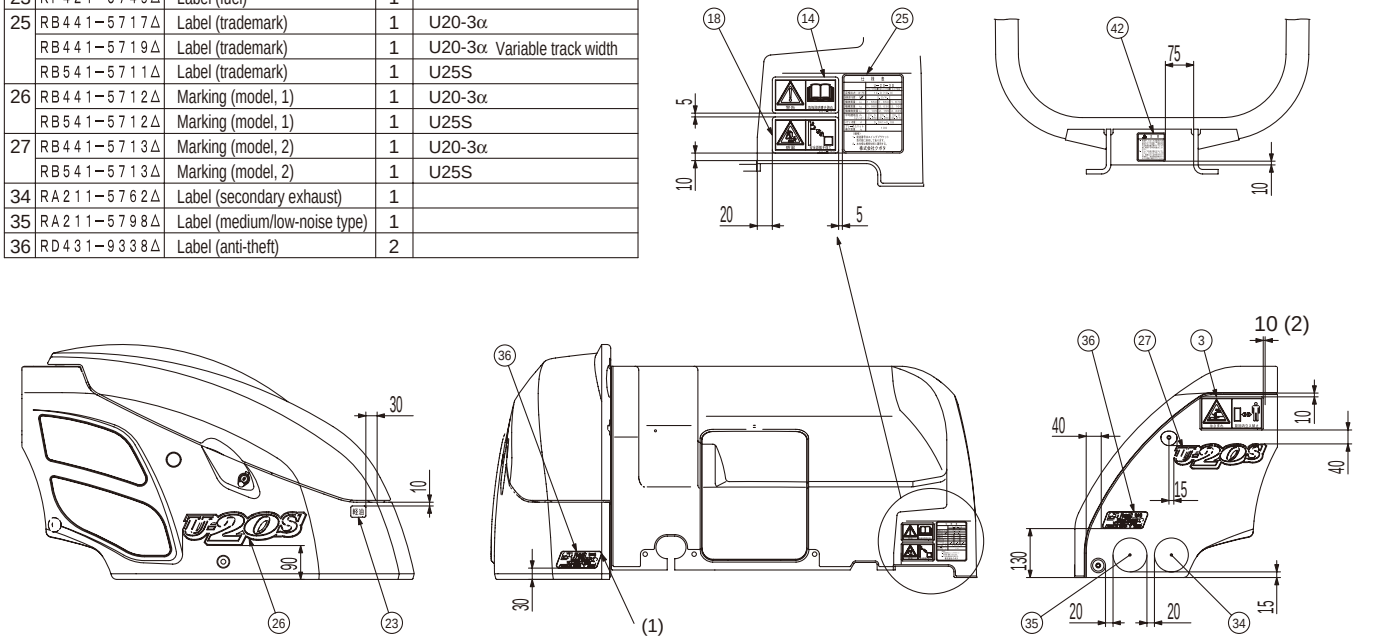


(1) Adjust to the corner.
(2) Actual dimension.

3	RA211-5782Δ	Label (keep-out caution)	1	
14	RA211-5781Δ	Label (warning)	1	
18	RA211-5788Δ	Label (electric shock)	1	
23	RP421-5749Δ	Label (fuel)	1	
25	RB441-5717Δ	Label (trademark)	1	U20-3α
	RB441-5719Δ	Label (trademark)	1	U20-3α Variable track width
	RB541-5711Δ	Label (trademark)	1	U25S
26	RB441-5712Δ	Marking (model, 1)	1	U20-3α
	RB541-5712Δ	Marking (model, 1)	1	U25S
27	RB441-5713Δ	Marking (model, 2)	1	U20-3α
	RB541-5713Δ	Marking (model, 2)	1	U25S
34	RA211-5762Δ	Label (secondary exhaust)	1	
35	RA211-5798Δ	Label (medium/low-noise type)	1	
36	RD431-9338Δ	Label (anti-theft)	2	

2P canopy type

42	RC431-5729Δ	Label (caution, canopy)	1	

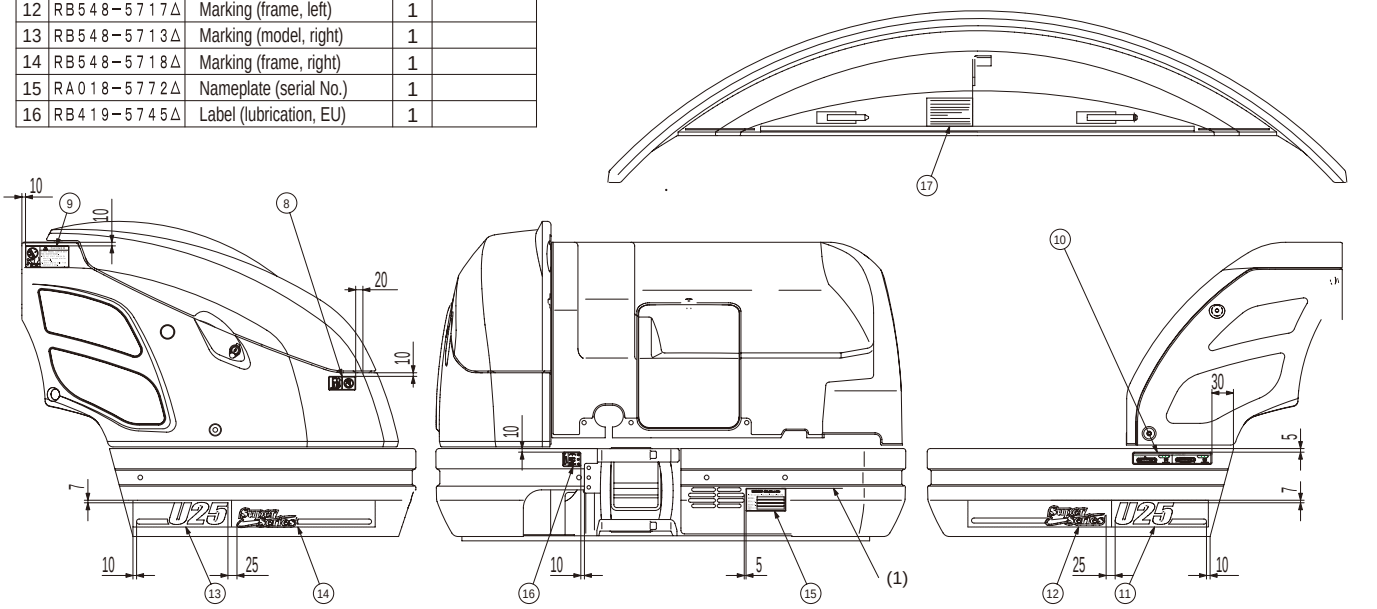


(1) Adjust to the corner.

8	RB238-5736Δ	Label (refueling)	1	
9	RC108-5718Δ	Label (engine start caution)	1	
10	RB548-5752Δ	Label (crawler adjustment)	1	
11	RB548-5712Δ	Marking (model, left)	1	
12	RB548-5717Δ	Marking (frame, left)	1	
13	RB548-5713Δ	Marking (model, right)	1	
14	RB548-5718Δ	Marking (frame, right)	1	
15	RA018-5772Δ	Nameplate (serial No.)	1	
16	RB419-5745Δ	Label (lubrication, EU)	1	

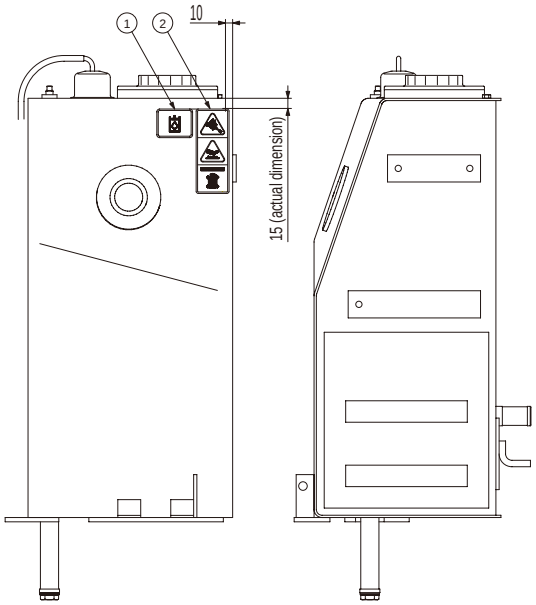
Hood (rear)

17	1G994-8891Δ	Label (exhaust, certificate)	1	

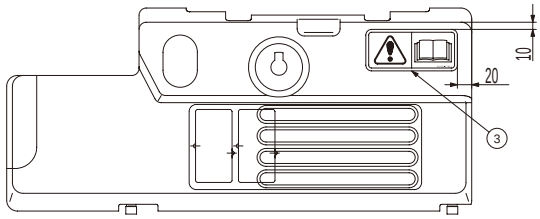


(1) Actual dimension.
(2) Align the marking's right end with this line.
(3) Apply at the groove-to-groove center.

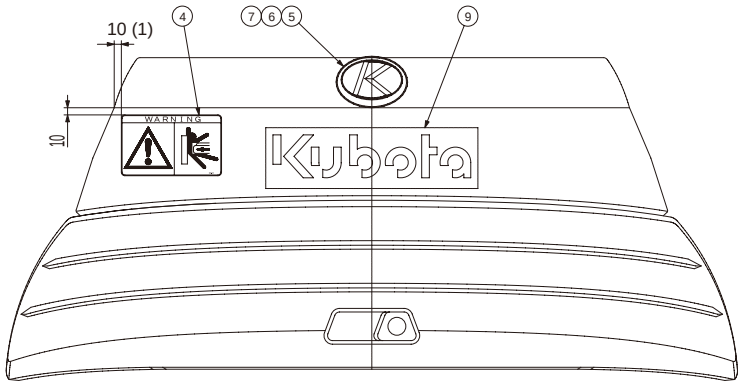
1	RC108-5747Δ	Label (hydraulic oil)	1	
2	69198-5724Δ	Label (scald caution)	1	



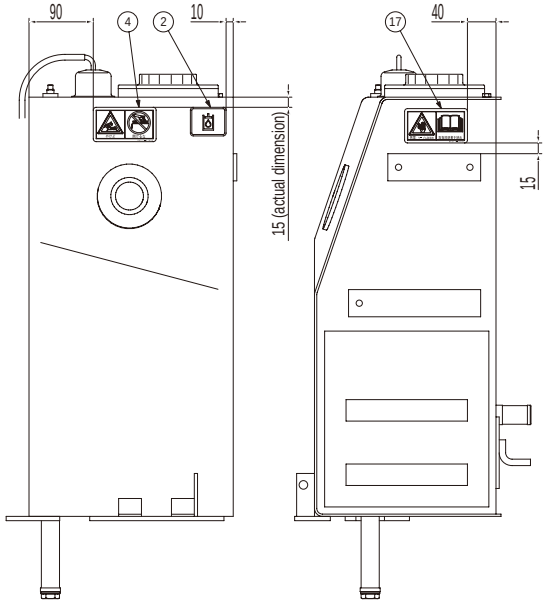
3	69198-5784Δ	Label (operator's manual)	1	



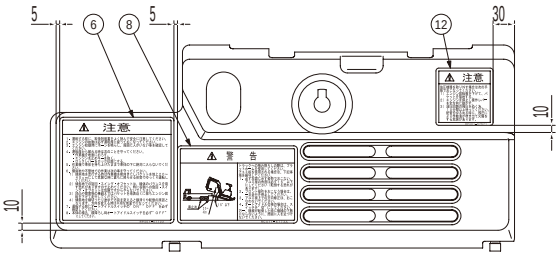
4	RC418-5725Δ	Label (keep-out caution)	1	
5	RC411-5722Δ	Marking (K, emblem)	1	
6	RA111-4369Δ	Nut (speed)	1	
7	55611-4421Δ	Washer (plate)	1	
9	68311-5726Δ	Marking (Kubota 2)	1	



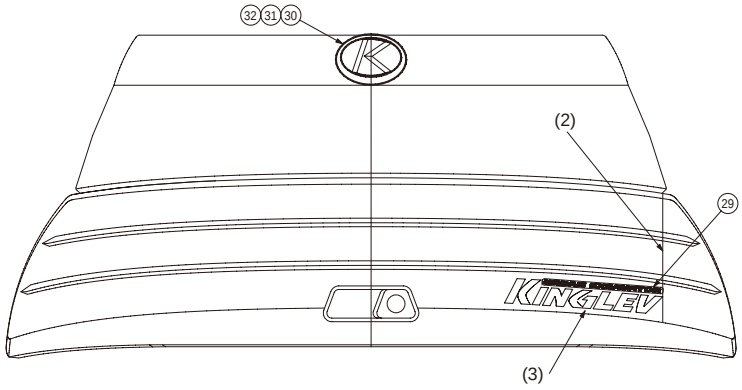
2	RC108-5747Δ	Label (hydraulic oil)	1	
4	RA211-5785Δ	Label (scald, 1)	1	
17	RA211-5786Δ	Label (electric shock, cable)	1	



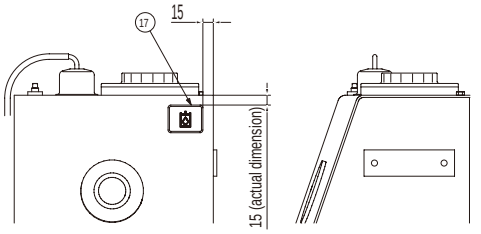
6	RP402-5772Δ	Label (A1, caution)	1	
8	RC411-5773Δ	Label (A1, loading)	1	
12	RP401-5757Δ	Label (hydraulic system)	1	



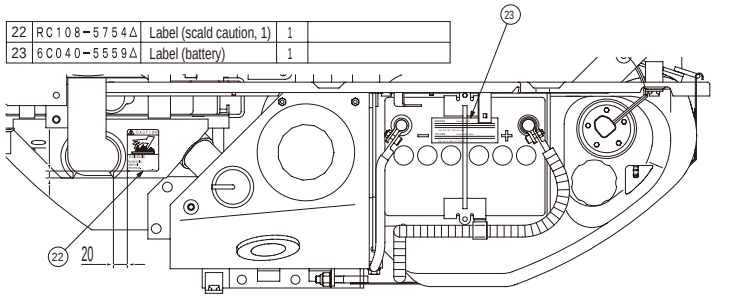
29	RC441-5716Δ	Marking (KINGLEV)	1	
30	RC411-5722Δ	Marking (K, emblem)	1	
31	RA111-4369Δ	Nut (speed)	1	
32	55611-4421Δ	Washer (plate)	1	



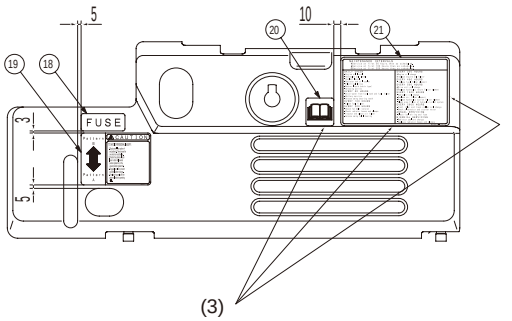
17	RC108-5747Δ	Label (hydraulic oil)	1	



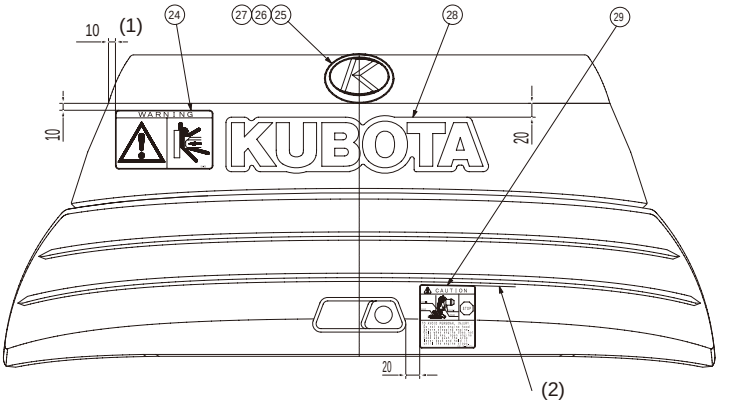
22	RC108-5754Δ	Label (scald caution, 1)	1	
23	6C040-5559Δ	Label (battery)	1	



18	RC418-5781Δ	Label (fuse)	1	
19	RB548-5732Δ	Label (caution, control pattern)	1	
20	RC418-5783Δ	Label (book)	1	
21	RB548-5746Δ	Label (inspection)	1	

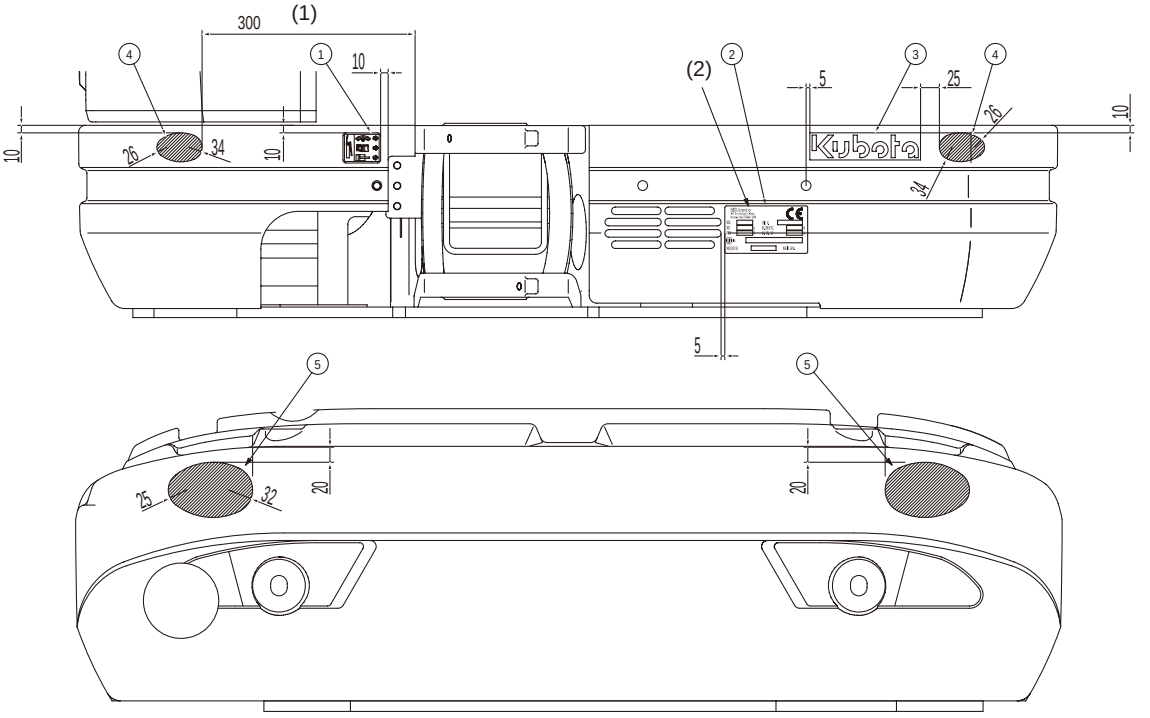


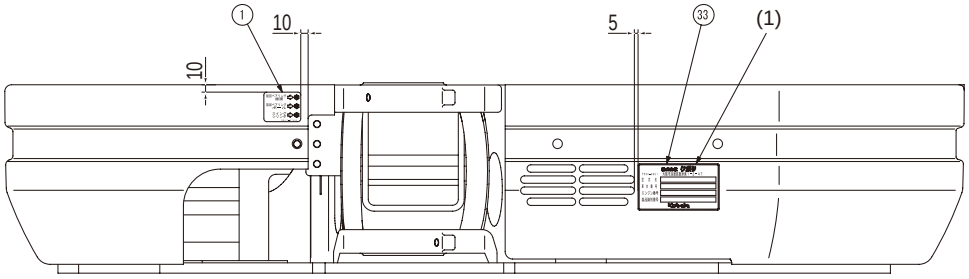
24	RC418-5725Δ	Label (keep-out caution)	1	
25	RC411-5722Δ	Marking (K, emblem)	1	
26	RA111-4369Δ	Nut (speed)	1	
27	55611-4421Δ	Washer (plate)	1	
28	TC220-8093Δ	Label (KUBOTA)	1	
29	RD118-5737Δ	Label (engine stop)	1	



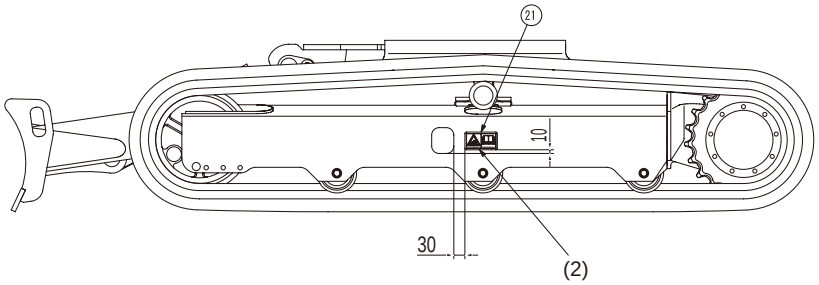
(1) Actual dimension.
(2) Adjust to the end of the curve.
(3) Ajust to the corner of the cover.

1	RB419-5745Δ	Label (lubrication, EU)	1	
2	RA018-5771Δ	Nameplate (serial No.)	1	
3	68709-5725Δ	Marking (Kubota 1)	1	
4	RB419-5767Δ	Label (reflector, white, EU)	2	
5	RB419-5766Δ	Label (reflector, red, EU)	2	

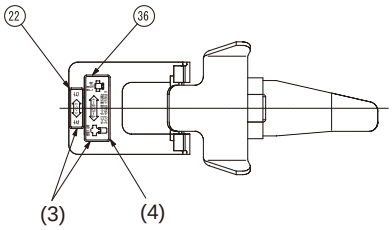




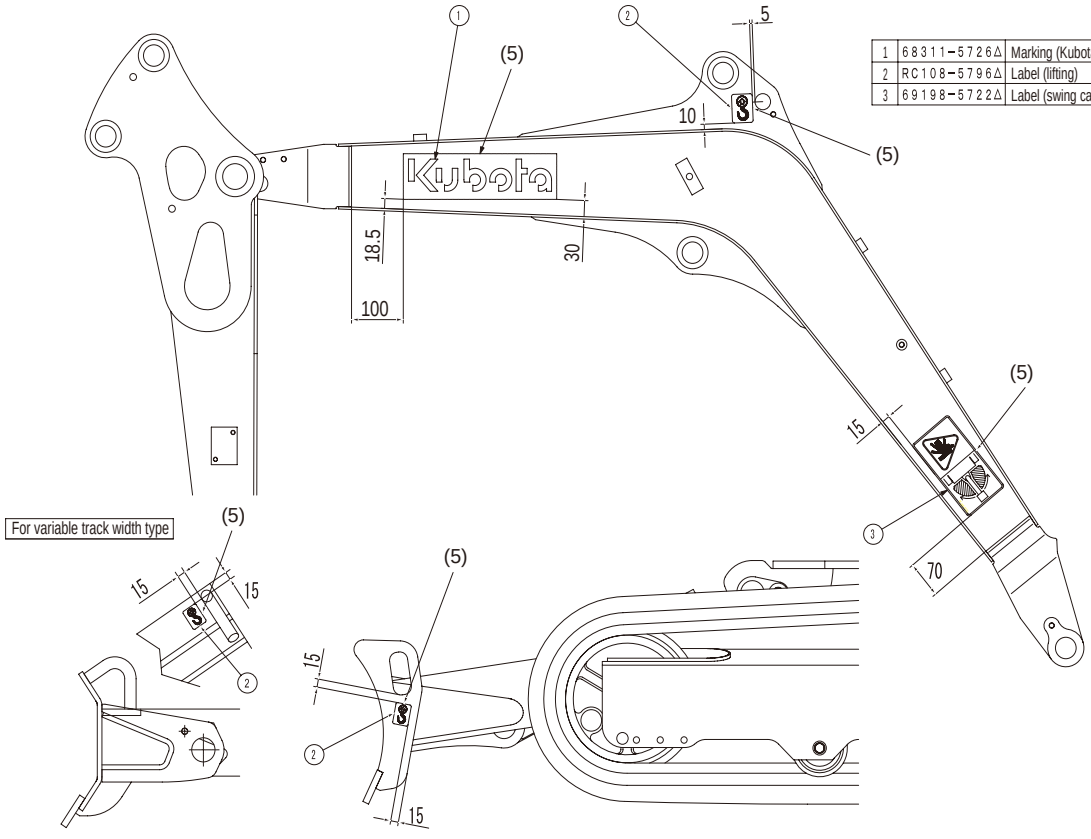
1	RB411−5745Δ	Label (lubrication)	1	
21	RC411−5795Δ	Label (plug)	1	
33	69171−5772Δ	Nameplate (serial No.)	1	



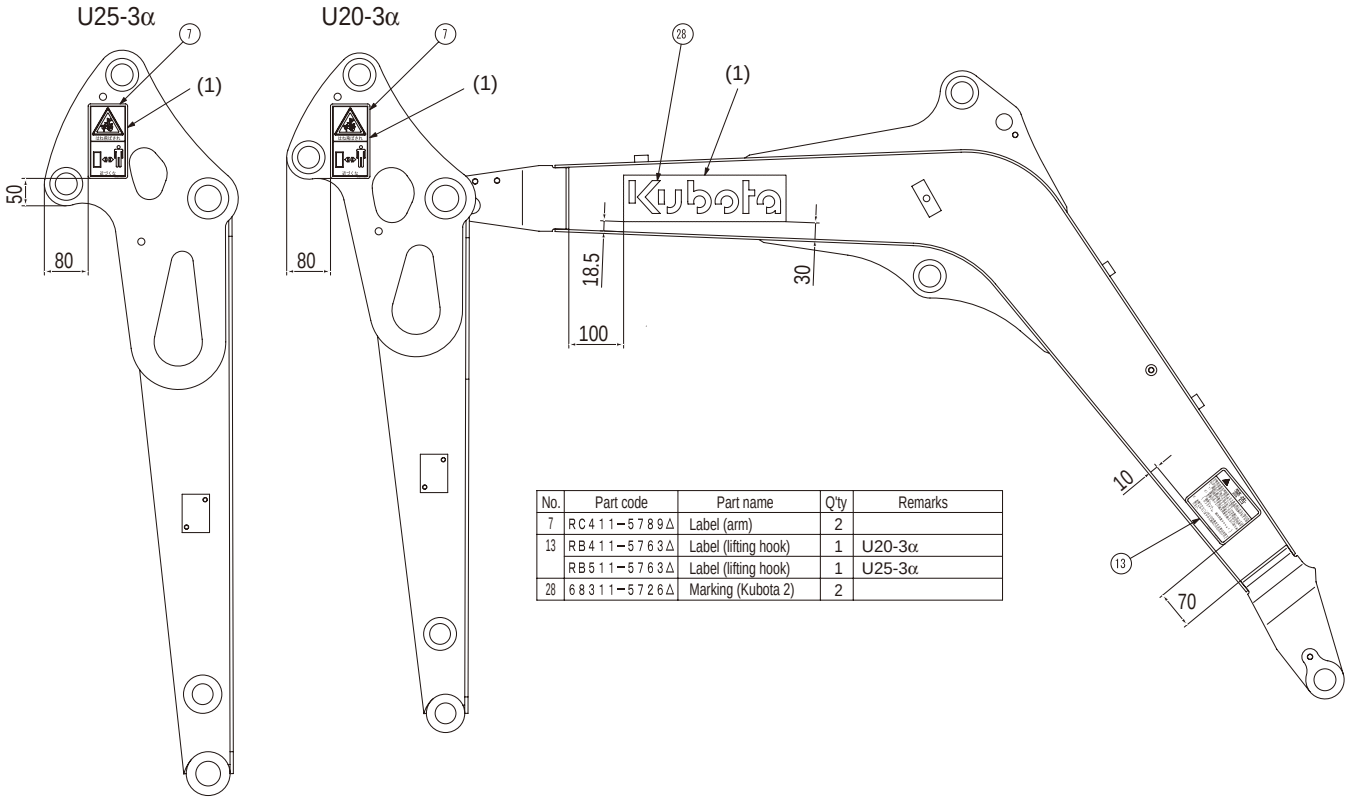
22	RC101−5757Δ	Label (swing)	1	
36	RB401−5717Δ	Label (SP pedal)	1	SP type



(1) Adjust to the end of the curve.
(2) Apply on the right side too.
(3) Align with the center line.
(4) Apply on the service port type machine only.
(5) Apply on the other side too.

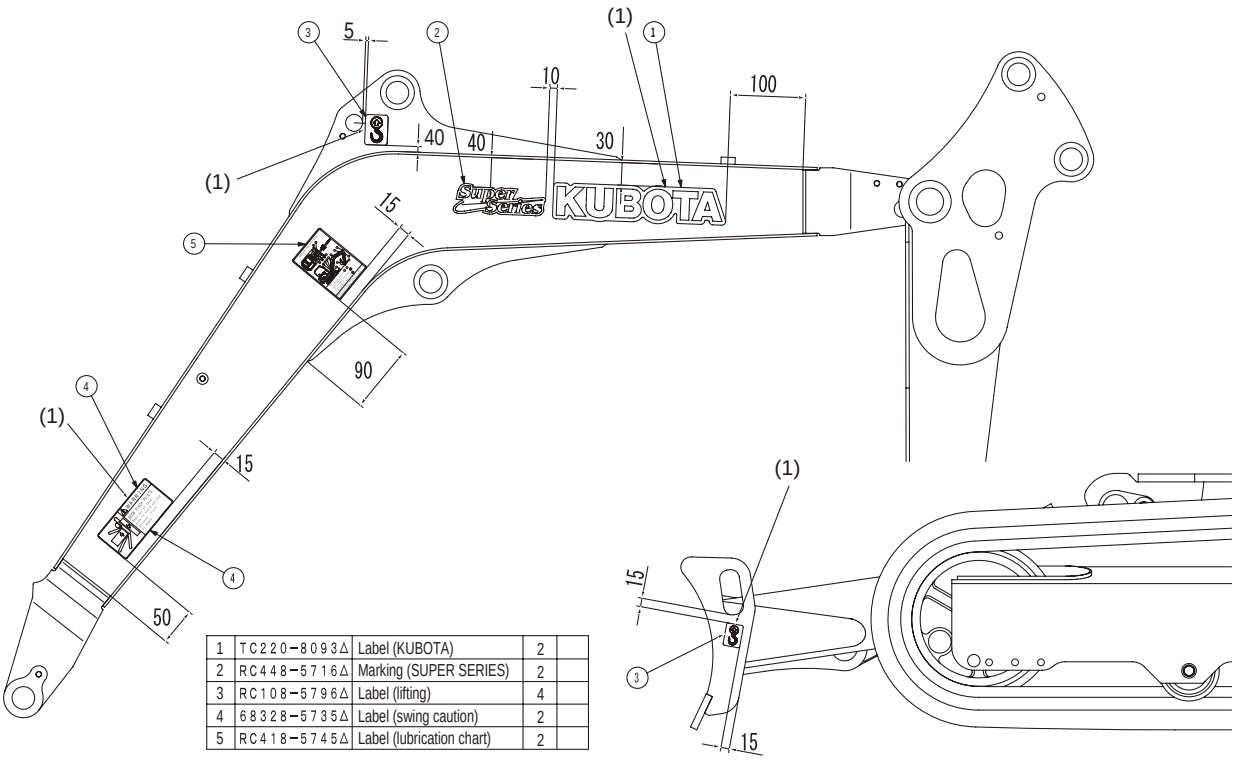


1	68311−5726Δ	Marking (Kubota 2)	2	
2	RC108−5796Δ	Label (lifting)	4	
3	69198−5722Δ	Label (swing caution)	2	



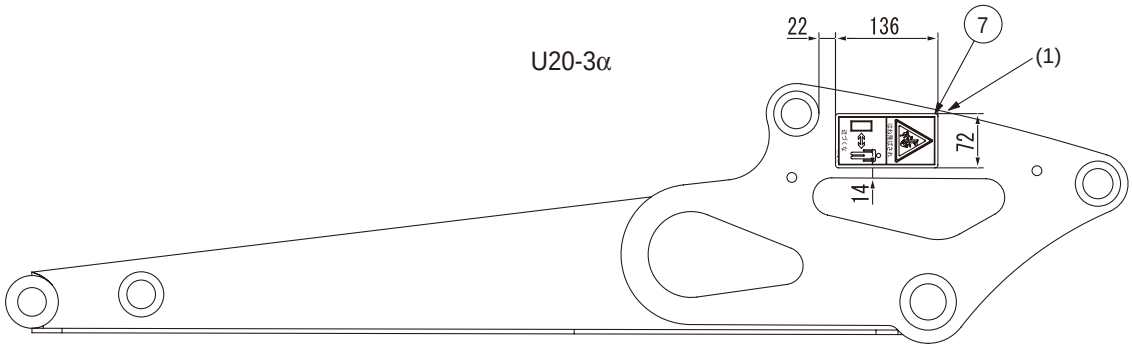
No.	Part code	Part name	Q'ty	Remarks
7	RC411-5789Δ	Label (arm)	2	
13	RB411-5763Δ	Label (lifting hook)	1	U20-3α
	RB511-5763Δ	Label (lifting hook)	1	U25-3α
28	68311-5726Δ	Marking (Kubota 2)	2	

(1) Apply on the other side too.



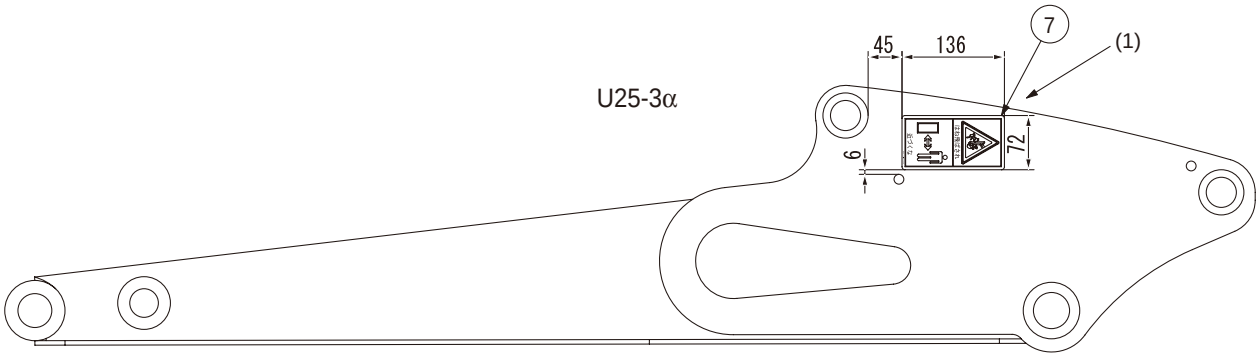
1	TC220-8093Δ	Label (KUBOTA)	2	
2	RC448-5716Δ	Marking (SUPER SERIES)	2	
3	RC108-5796Δ	Label (lifting)	4	
4	68328-5735Δ	Label (swing caution)	2	
5	RC418-5745Δ	Label (lubrication chart)	2	

U20-3α

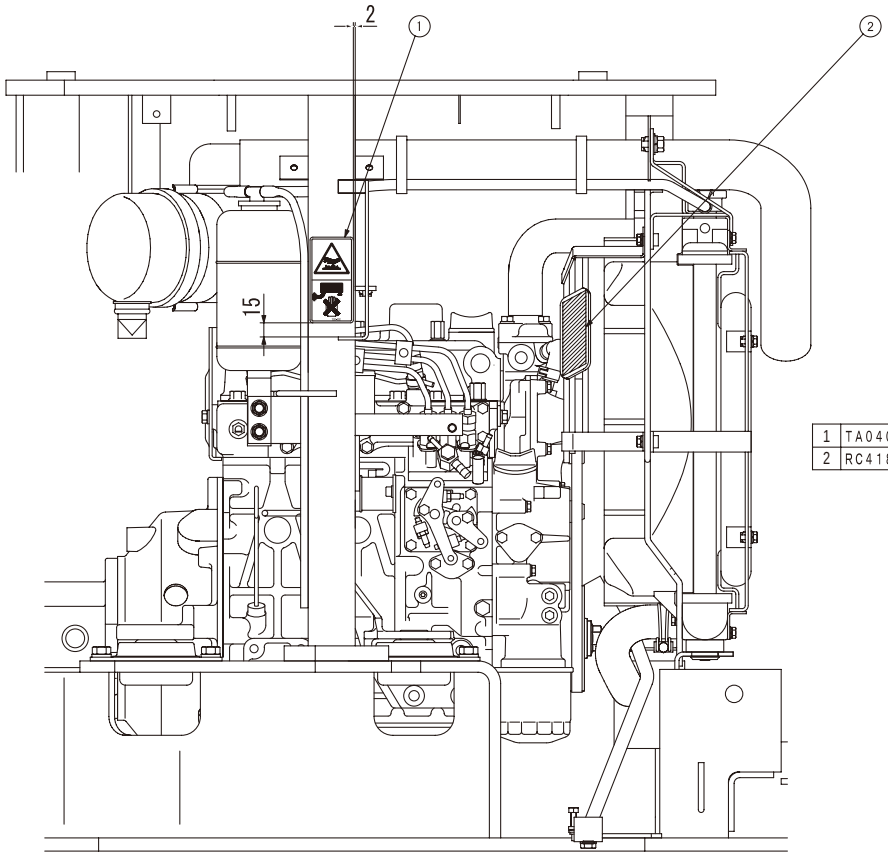


7	RC411-5789△	Label (arm)	2	

U25-3α



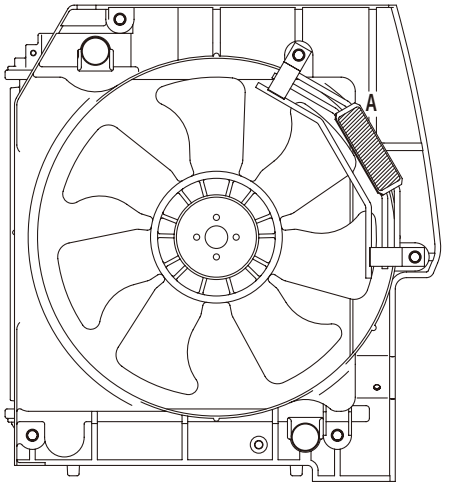
(1) Apply on the other side too.
(2) Positioning details of Part (2)

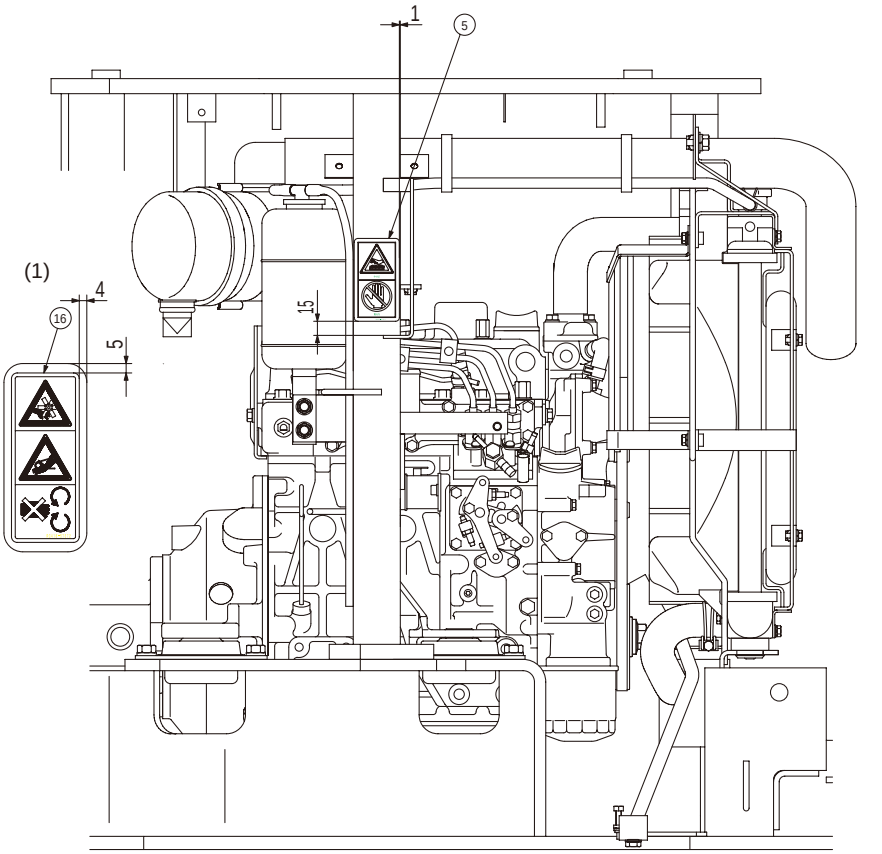


(2)

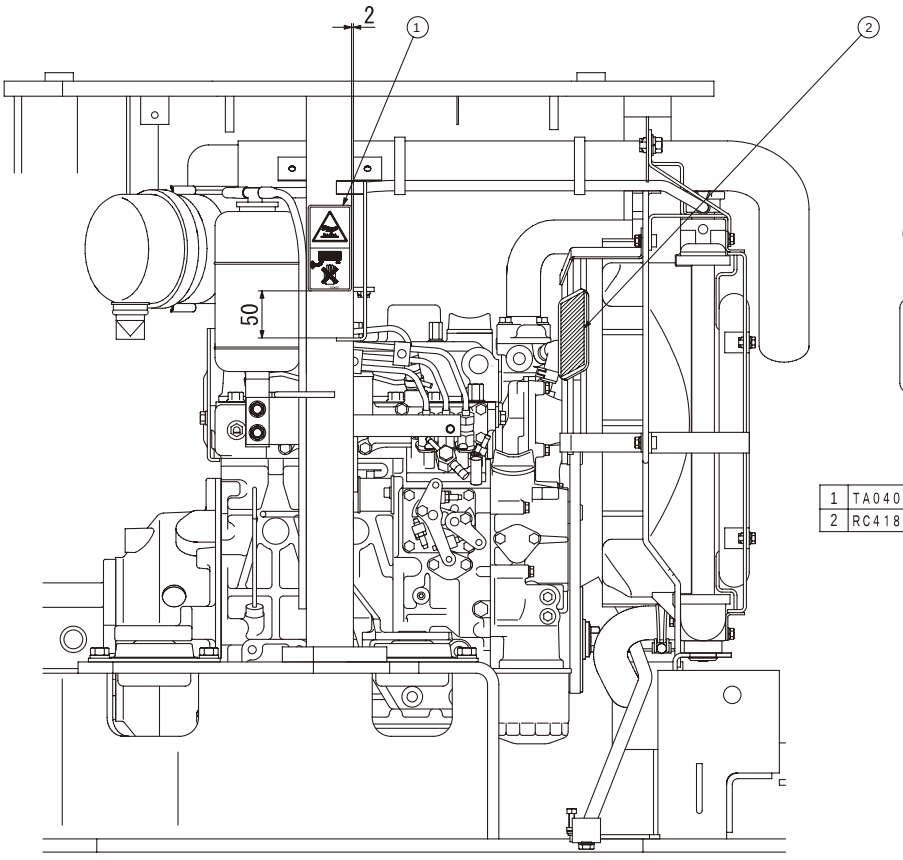
1	TA040-4958△	Label (muffler, warning)	1	
2	RC418-5737△	Label (fan, warning)	1	

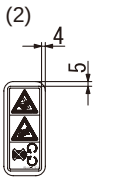
5	RB401−5791Δ	Label (scald, 2)	1	
16	RC418−5737Δ	Label (fan, warning)	1	





(1) Details of Part A
(2) Positioning details of Part (2)

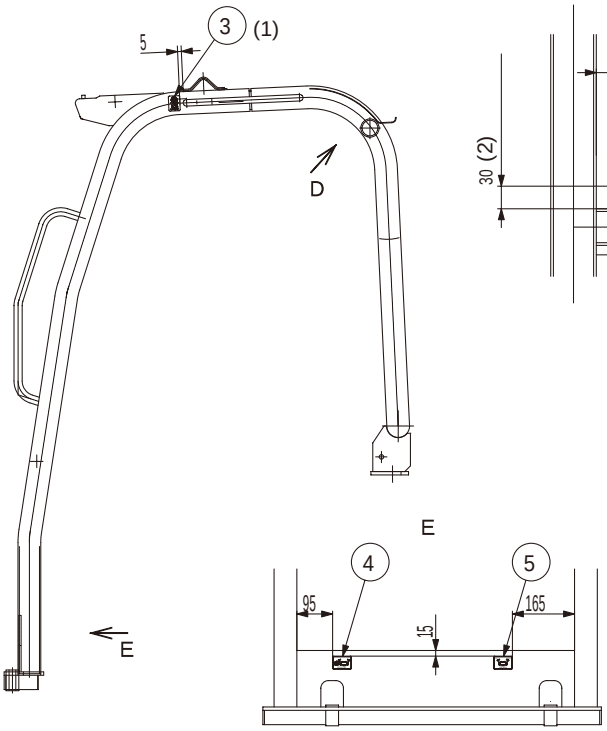


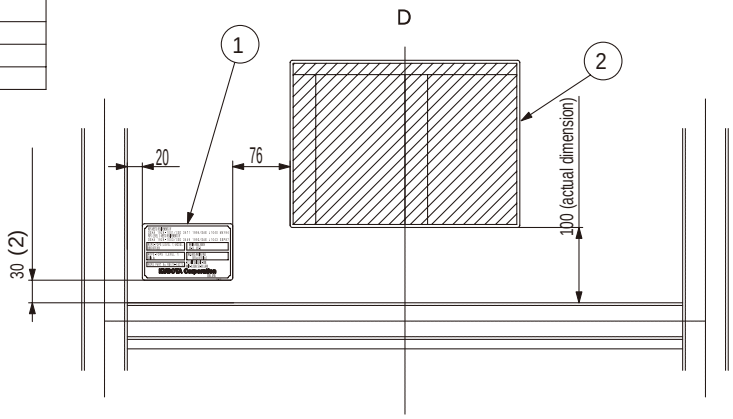


1	TA040−4958Δ	Label (muffler, warning)	1	
2	RC418−5737Δ	Label (fan, warning)	1	

(1) Apply on the other side too.
(2) Actual dimension.

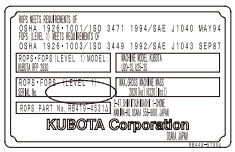
No.	Part code	Part name	Q'ty	Remarks
1	RB419-5799Δ	Nameplate (ROPS, canopy)	1	
2	RB419-5746Δ	Label (inspection)	1	
3	RB419-5796Δ	Label (no machine back floating, EU)	2	
4	RB238-5757Δ	Label (swing)	1	Canopy type
5	RB238-5758Δ	Label (SP)	1	Canopy type





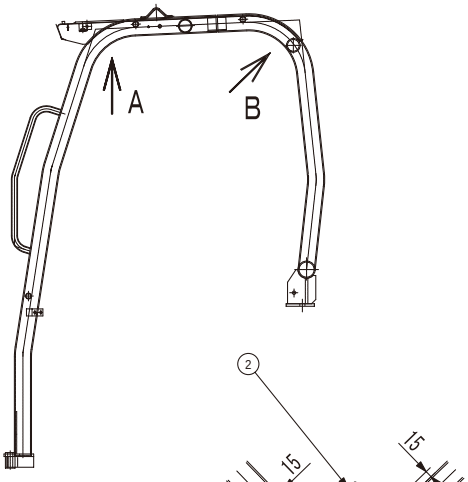
* Markings on nameplate

Part code: RB449-5799Δ



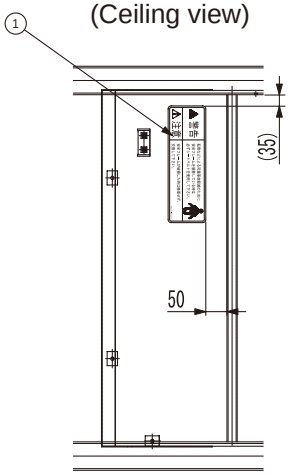
Markings

Item	Description
SERIAL No.	Canopy's serial number

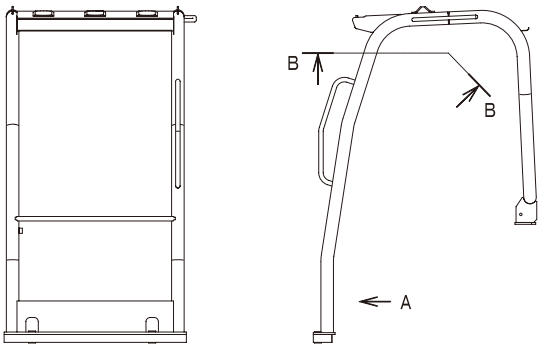


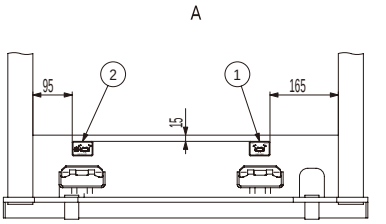
View B
(Top right behind)

View A
(Ceiling view)



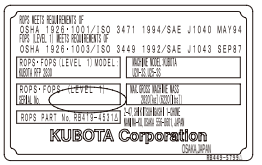
1	RC441-5729Δ	Label (ROPS, caution)	1	
2	RB441-5793Δ	Nameplate (ROPS, canopy)	1	





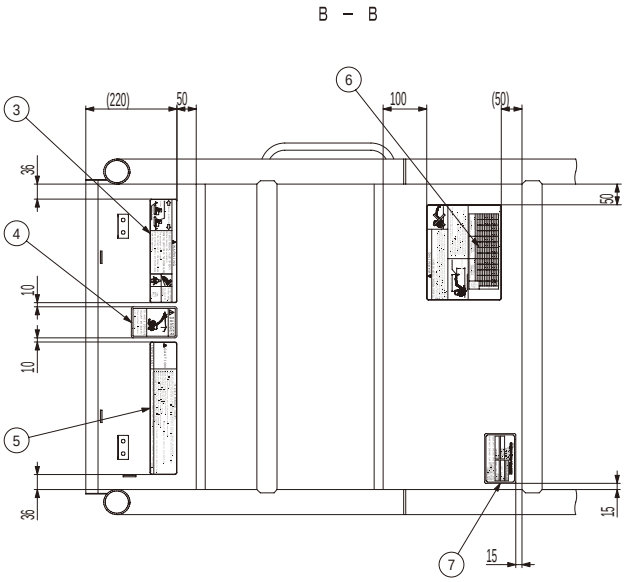
* Markings on nameplate

Part code: RB449-5799Δ



Markings

Item	Description
SERIAL No.	Canopy's serial number



1	RB238-5757Δ	Label (swing)	1	(571)
2	RB238-5758Δ	Label (SP)	1	
3	RC418-5727Δ	Label (warning)	1	
4	RC418-5733Δ	Label (electric shock caution)	1	
5	RC418-5728Δ	Label (caution)	1	
6	RB548-5747Δ	Label (lifting load, canopy)	1	
7	RB449-5799Δ	Nameplate (ROPS, canopy)	1	

III Engine

III-1 Engine specifications for construction machinery

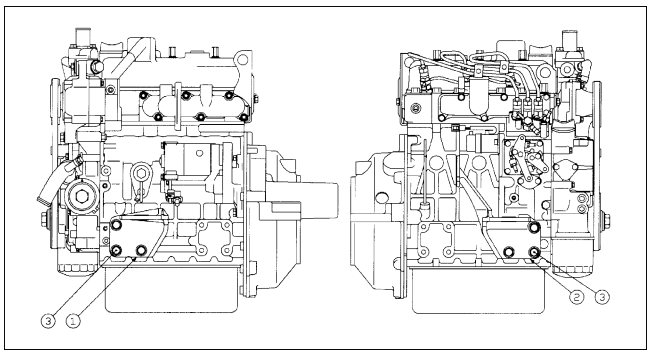
	Unit	**U20-3α**	**U25-3α**	**U25S**
Model		D1105-E2BH-12	D1105-E2BH-13	D1105-E2BH-14
Number of cylinder		3	3	3
Bore x Stroke	mm	78.0 x 78.4	78.0 x 78.4	78.0 x 78.4
	in	3.07 x 3.09	3.07 x 3.09	3.07 x 3.09
Displacement	cc	1123	1123	1123
	in3	68.53	68.53	68.53
Max. output/rpm	kW/rpm	14.0 / 2200	15.4 / 2400	15.4 / 2400
	PS/rpm	19 / 2200	21 / 2400	21 / 2400
	HP/rpm	18.7 / 2200	20.7 / 2400	20.7 / 2400
Compression ratio		24	24	24
Max. torque/rpm	N.m	69.6 / 1500-1700	69.6 / 1500-1700	69.6 / 1500-1700
	kgf.m	7.1 / 1500-1700	7.1 / 1500-1700	7.1 / 1500-1700
	ft.lbf	51.4 / 1500-1700	51.4 / 1500-1700	51.4 / 1500-1700
Dimensions: L x W x H	mm	506 x 396 x 581	506 x 396 x 581	506 x 396 x 581
	in	19.9 x 15.6 x 22.9	19.9 x 15.6 x 22.9	19.9 x 15.6 x 22.9
Dry weight	kg	89	89	89
	lbs	196.2	196.2	196.2
Valve clearance	mm	0.145 - 0.185	0.145 - 0.185	0.145 - 0.185
	in	0.0057 - 0.0073	0.0057 - 0.0073	0.0057 - 0.0073
Firing sequence		1-2-3	1-2-3	1-2-3
Combustion chamber		E-TVCS	E-TVCS	E-TVCS
Compression pressure (A)/(B)	MPa	3.24 - 3.63 / 2.26	3.24 - 3.63 / 2.26	3.24 - 3.63 / 2.26
	kgf/cm^2	33 - 37 / 23	33 - 37 / 23	33 - 37 / 23
	psi	469 - 526 / 327	469 - 526 / 327	469 - 526 / 327
Fan belt		Bando RPF2370	Bando RPF2370	Bando RPF2370
Fuel consumption ratio	g/kWh	265	265	267
	g/PSh	195	195	196
	lbs/HPh	0.436	0.436	0.439
Fuel consumption amount Load facter = 100% Fuel specific gravity = 0.86	l/h	4.5	4.8	4.8
	US gal/h	1.19	1.27	1.27
Max. engine speed without road	rpm	2600 ≧	2600 ≧	2600 ≧
Engine speed with 2 pumps relief	rpm	2200 ≧	2200 ≧	2200 ≧
Engine speed with idling	rpm	1200 - 1300	1200 - 1300	1200 - 1300
Engine oil pressure with rated engine rpm	kPa	196 - 441 / 98	196 - 441 / 98	196 - 441 / 98
	kgf/cm^2	2.0 - 4.5 / 1.0	2.0 - 4.5 / 1.0	2.0 - 4.5 / 1.0
	psi	28 - 64 / 14	28 - 64 / 14	28 - 64 / 14
Fuel injection pressure	MPa	13.7 - 14.7	13.7 - 14.7	13.7 - 14.7
	kgf/cm^2	140 - 150	140 - 150	140 - 150
	psi	1991 - 2133	1991 - 2133	1991 - 2133
Engine oil consumption ratio	g/kWh	0.95	0.95	0.95
	g/PSh	0.7	0.7	0.7
	lbs/HPh	0.0016	0.0016	0.0016

	Unit	**U20-3α**	**U25-3α**	**U25S**
Engine model		D1105-E2BH-12	D1105-E2BH-13	D1105-E2BH-14
Fuel injection pump type		Bosch PFR3MD type mini-pump	Bosch PFR3MD type mini-pump	Bosch PFR3MD type mini-pump
Nozzle type		DN4PDN mini-nozzle	DN4PDN mini-nozzle	DN4PDN mini-nozzle
Injection pressure	MPa	13.7 - 14.7	13.7 - 14.7	13.7 - 14.7
	kgf/cm^2	140 - 150	140 - 150	140 - 150
	psi	1991 - 2133	1991 - 2133	1991 - 2133
Alternator		12V 480W	12V 480W	12V 480W
Manufacturer P/N		1G070-6401-0	1G070-6401-0	1G070-6401-0
Regulator adjusting voltage	V	12V 14A	12V 14A	12V 14A
Battery type(JIS)		75D23R MF	75D24R MF	75D24R MF
Nominal Capacity of 5 hrs rating	Ah	52	52	52
Specific gravity of electrolite		1.26 ≧	1.26 ≧	1.26 ≧
Sterter motor		12V 1.4kW	12V 1.4kW	12V 1.4kW
Manufacturer P/N		19269-6301-0	19269-6301-0	19269-6301-0
Glow plug resistance	Ω	0.9	0.9	0.9

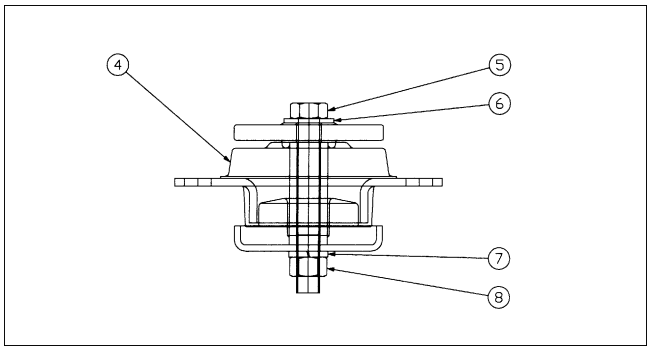
III-2 Engine mount on the construction machinery

A. Engine bracket

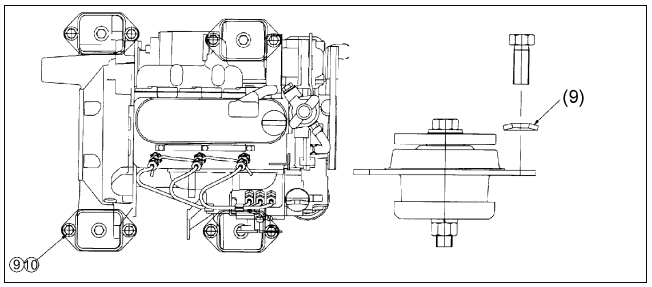
Engine bracket assembly view

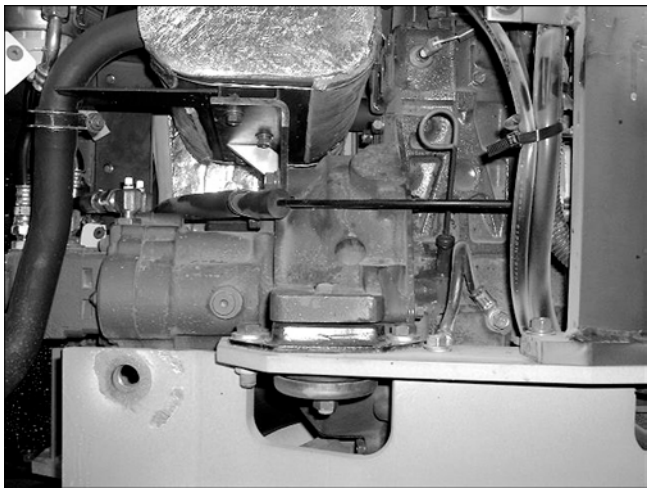


Anti-vibration rubber assembly view



Engine setup view





Engine front side

[1] Assembling procedure

1) Tightening torque of engine bracket:
   48.1~55.9N·m (4.9~5.7kgf·m)35.44~41.23ft·lbs
   * Apply screw loctite (Loctite 271).
2) Tightening torque of anti-vibration rubber:
   77.5~90.2N·m (7.9~9.2kgf·m)57.14~66.54ft·lbs
   * Apply screw loctite (Loctite 271).

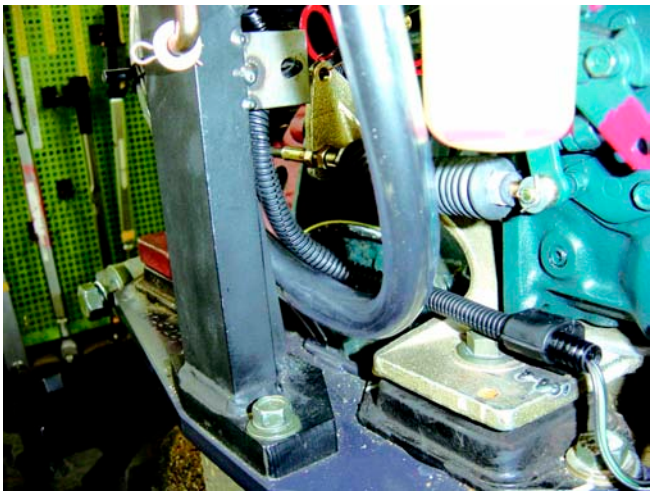
3) Parts list

No.	Part name	Q'ty	Remarks
1	Bracket (1, engine)	1	
2	Bracket (2, engine)	1	
3	Bolt	6	M10×1.25 7T
4	Anti-vibration rubber	4	
5	Bolt	4	M12×1.25 7T
6	Plain washer	4	
7	Spring washer	4	
8	Nut	4	4T
(9)	Attention to the direction of belleville spring		

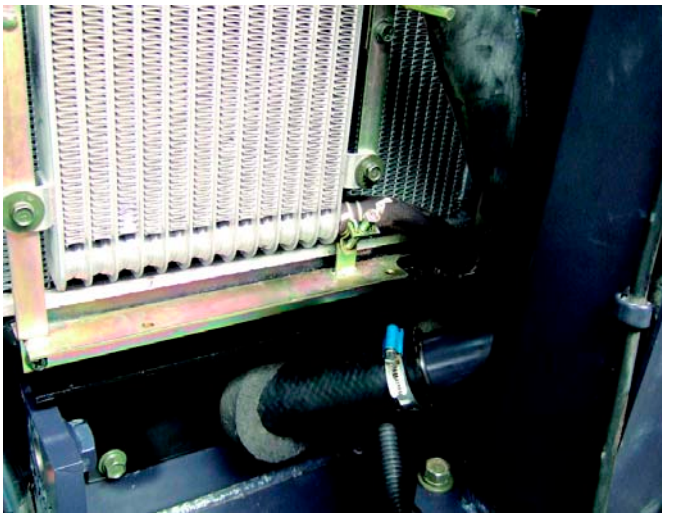
4) Tightening torque of engine mounting bolt:
   103.0~117.7N·m
   (10.5~12.0kgf·m) 75.95~86.80ft·lbs
   * Apply screw loctite (Loctite 271).
5) Parts list

No.	Part name	Q'ty	Remarks
1	Bolt	8	M12×1.25 9T
2	Plain spring	8	

Engine rear side



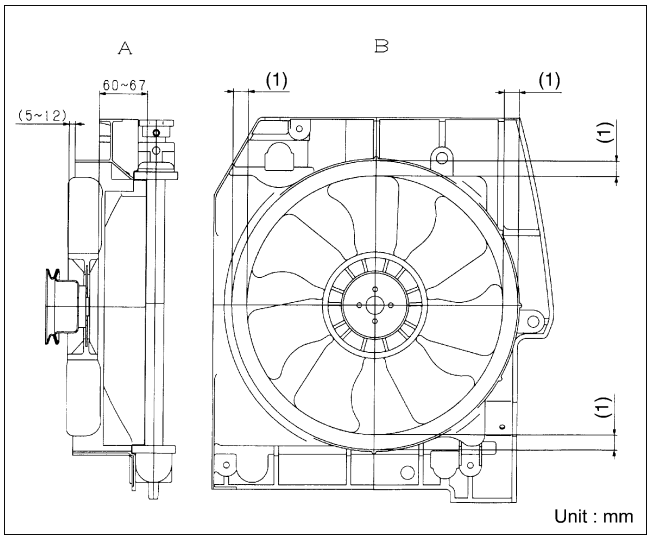
B. Radiator



[1] Detaching the radiator

1) Park the machine on a level floor. Bring down the front attachment and blade on the floor.
2) Remove the bonnet and the right side cover.
3) Remove the drain plug from the bottom of the radiator to let out all cooling water.
4) Using a vacuum pump, detach the oil cooler.
5) Disconnect the two radiator hoses from the radiator. Take out the radiator.

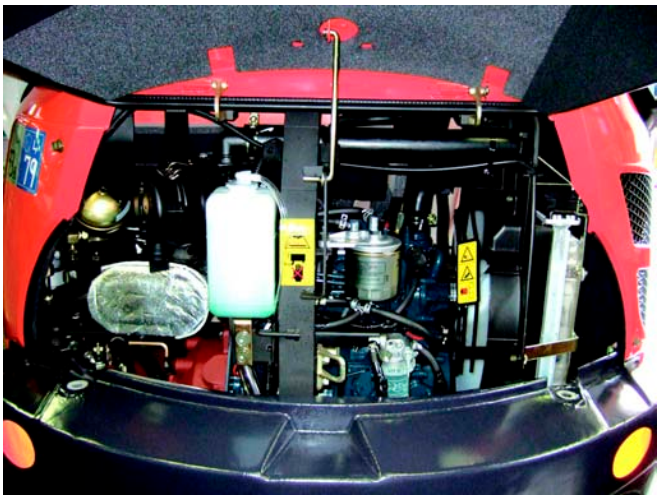
Radiator assembly view 1

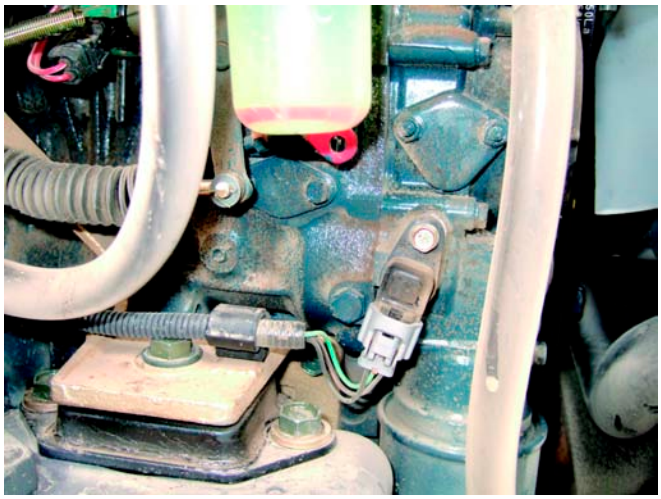


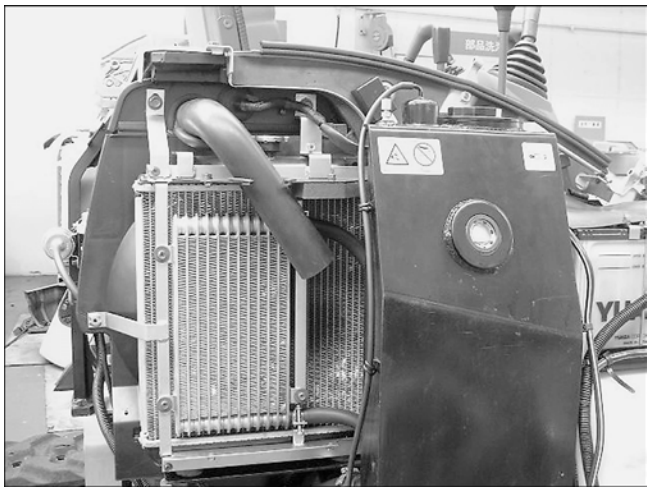
[2] Reassembling the radiator

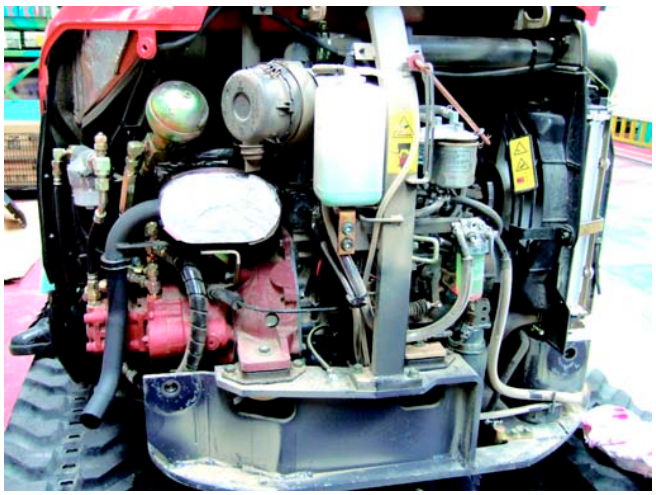
1) Clearance between radiator core (fin) and fan (part A): 60-67 mm (2.36~2.64in.)
   * Keep the fan stretching evenly out of the fan shroud.
2) Clearance between fan and fan shroud (part B): Over 10 mm (0.39in.)

(1)10mm or more

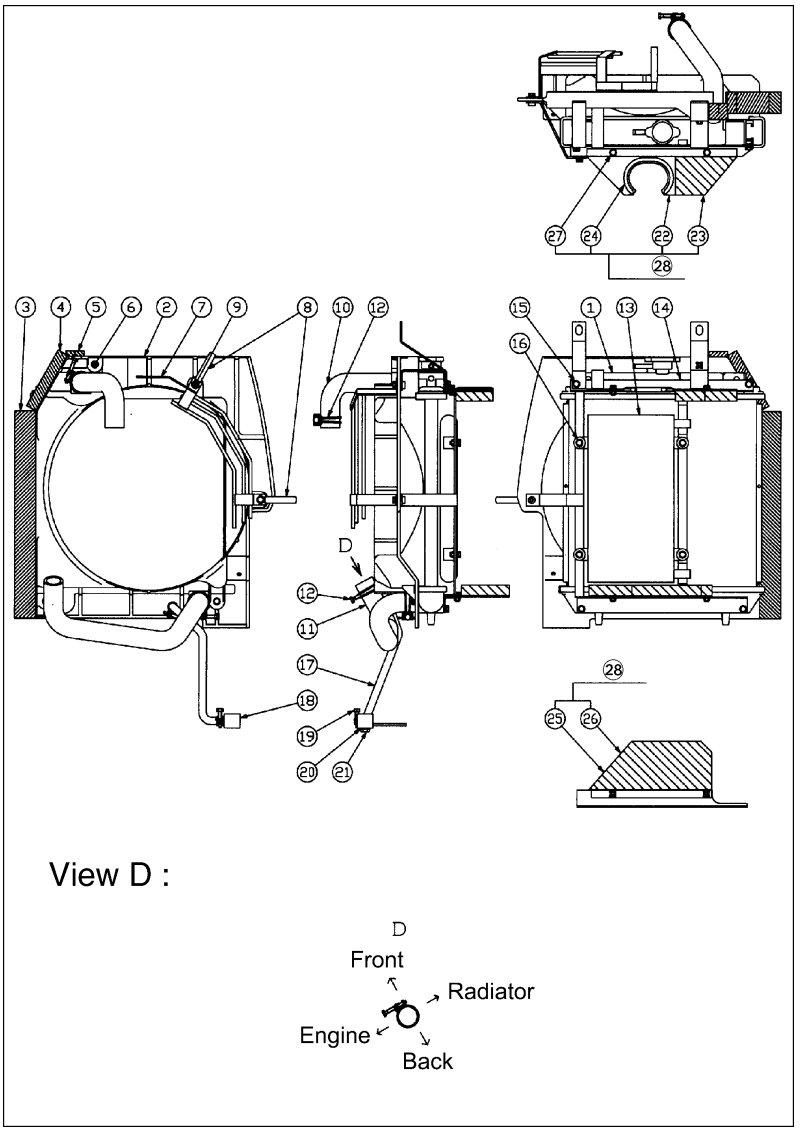








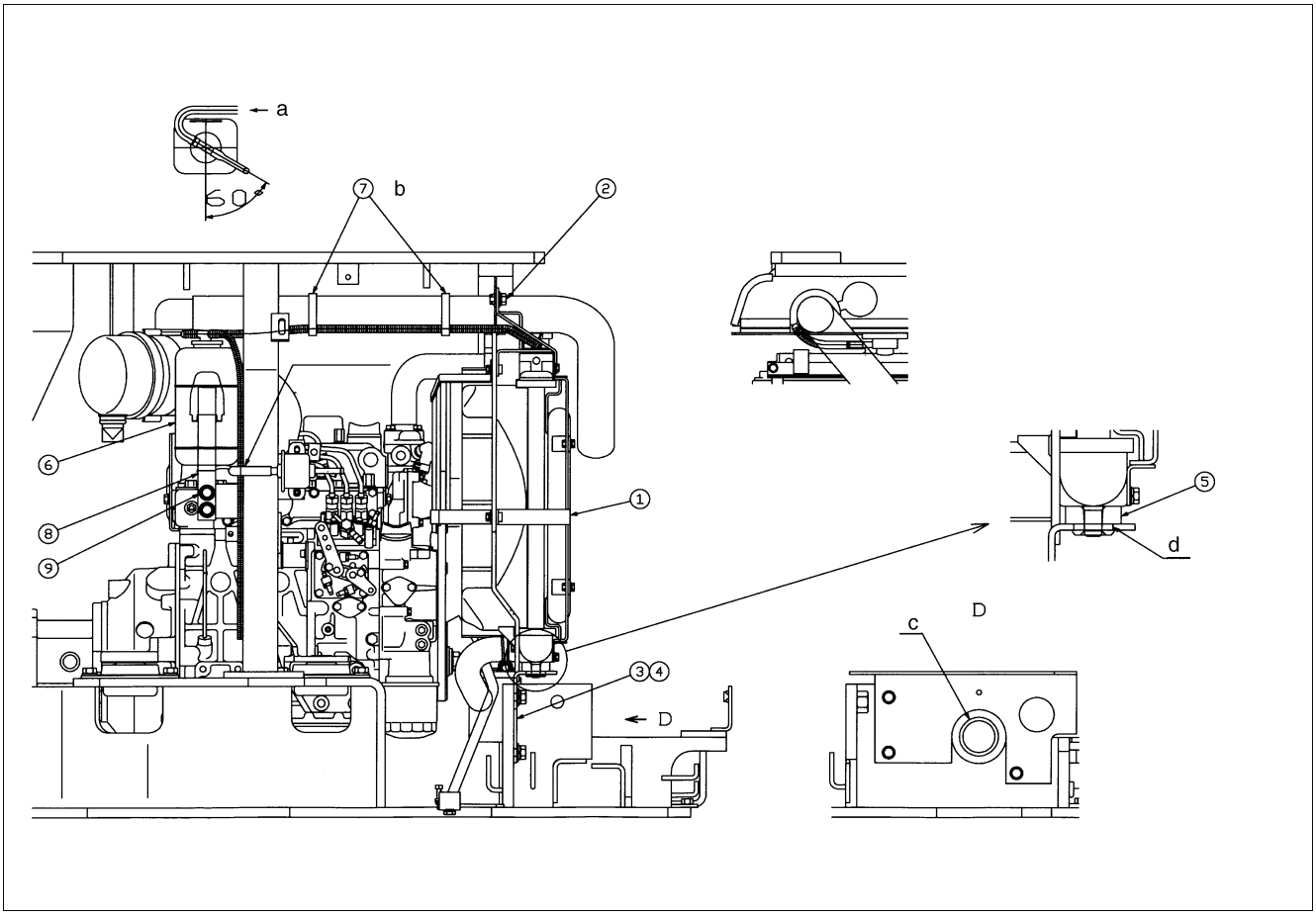
Radiator assembly view 2



3) Parts listt

No.	Part name	Q'ty	Remarks
1	Radiator, assembly	1	
2	Shroud (fan)	1	
3	Sound absorber (shroud, 1)	1	
4	Sound absorber (shroud, 2)	1	
5	Sound absorber (shroud, 3)	1	
6	Bolt	3	M6×1 7T
7	Cover (fan)	1	
8	Cord clamp	2	
9	Bolt	2	M6×1 7T
10	Hose (1, WP)	1	
11	Hose (2, WP)	1	
12	Hose clamp (threaded)	4	
13	Oil cooler	1	U20-3α
	Oil cooler	1	U25-3α, U25S
14	Bracket (oil cooler)	1	U20-3α
	Bracket (oil cooler)	1	U25-3α, U25S
15	Bolt	4	M6×1 7T
16	Bolt	4	M6×1 7T
17	Hose (drain)	1	
18	Hose (drain)	1	
19	Hose clamp (threaded 14)	2	
20	Rubber-fitted washer	1	
21	Plug	1	
22	Plate (partition, top)	1	
23	Sound absorber (partition, top)	1	
24	Grommet (200)	1	
25	Plate (partition, bottom)	1	
26	Sound absorber (partition, bottom)	1	
27	Bolt	4	M6×1 7T
28	U25-3α	4	M6×1 7T

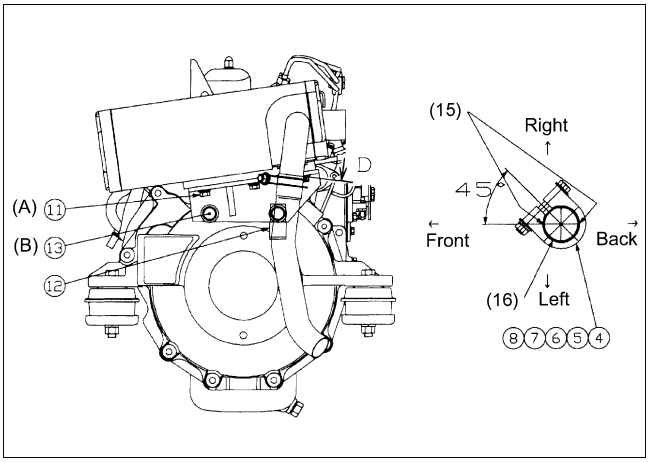
Radiator assembly view 3



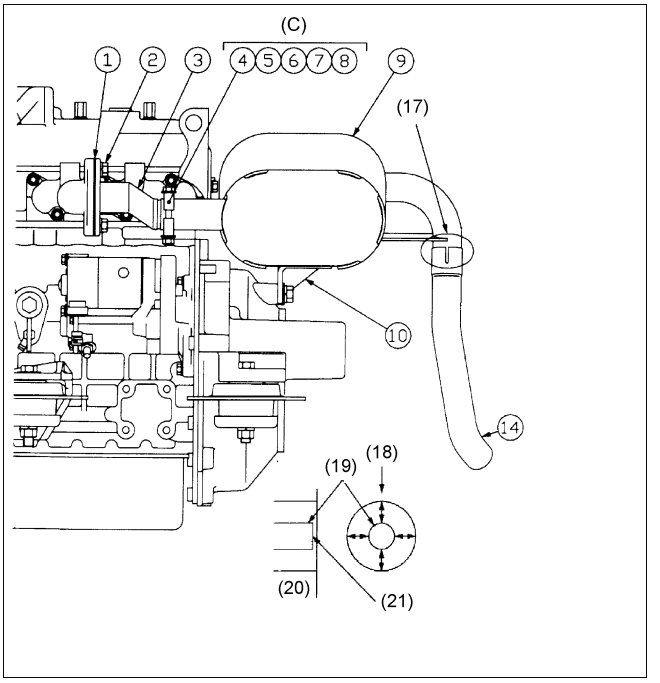
a) Radiator
b Clamp to the inlet hose
c Suction hose, to be passed along center
d Catch the rubber's hook tightly

C. Muffler

Muffler assembly view 1



Muffler assembly view 2



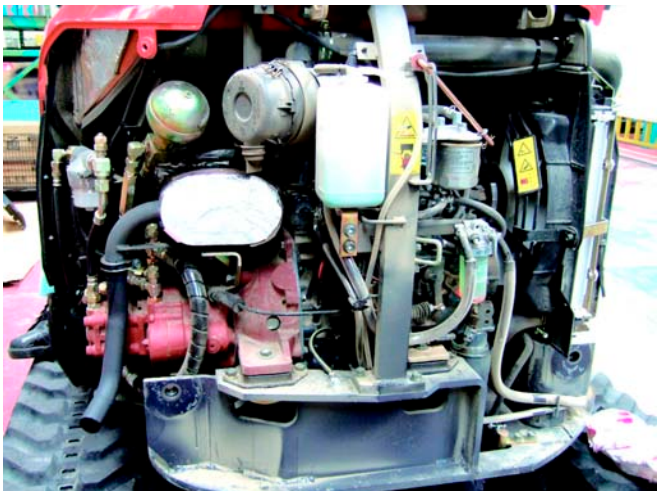
[1] Reassembling procedure

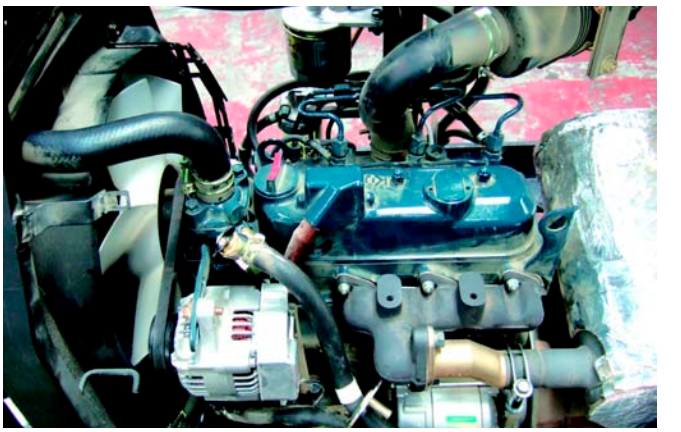
1) Reassembling steps
Temporarily tighten the bolts (A), (B) and (C).
→ Make sure there is no gap at the bolts.
First tighten up the bolt (A).
→ Tightening torque
23.5~27.5N·m (2.4~2.8kgf·m) 17.36~20.25ft·lbs
Second tighten up the bolt (B).
→ Tightening torque
77.5~90.2N·m (7.9~9.2kgf·m) 57.14~66.54ft·lbs
Third tighten up the bolt (C).
→ Tightening torque
3.9~5.9N·m (0.4~0.6kgf·m) 2.89~4.34ft·lbs

2) Keep a clearance of over 20 mm (0.79in.) between the tail pipe and counterweight.

3) Parts list

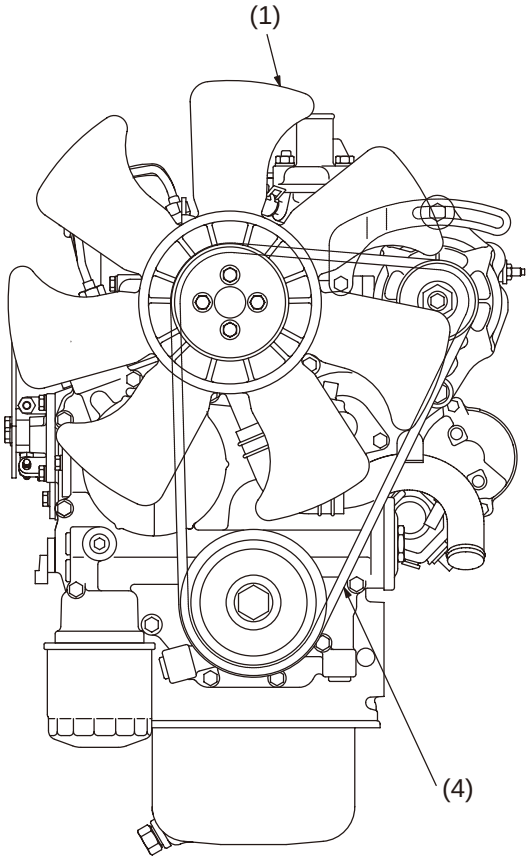
No.	Part name	Q'ty	Remarks
1	Packing (non-asbestos)	1	(424)
2	Bolt	2	M10×1.25 7T
3	Flange (muffler)	1	
4	Exhaust pipe band	2	
5	Bolt	2	M10×1.25 7T
6	Plain washer	4	
7	Spring washer	2	
8	Nut	2	
9	Muffler, assembly	1	
10	Bracket (muffler)	1	
11	Bolt	3	
12	Cord clamp assembly 2	1	
13	Bolt	2	M10×1.25 7T
14	Pipe (muffler)	1	U-20-3
	Pipe (muffler)	1	U-20-3
15	Slit (front and back)	1	
16	Pipe (muffler)		
17	Fit together with the slit and stay end in alignment.		
18	Clearance to be over 20 mm		
19	Tail pipe		
20	Counterweight		
21	Keep the tail pipe inward the counterweight end.		

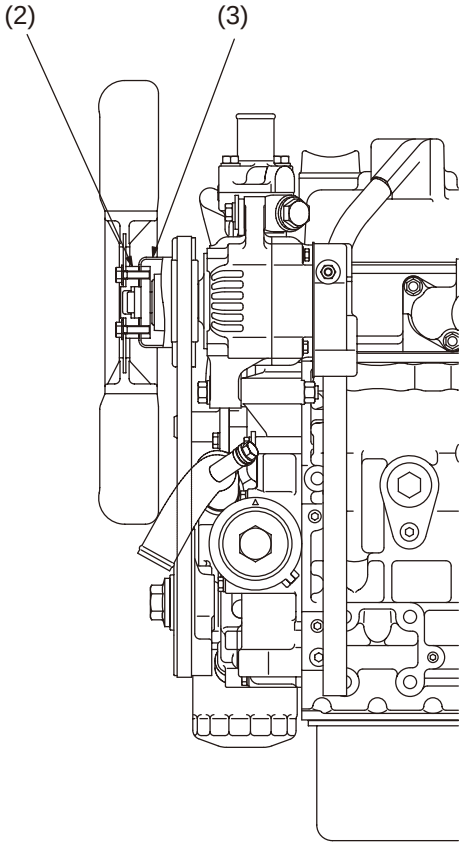


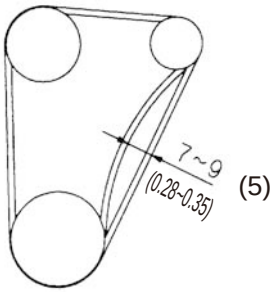


D. Fan belt

Engine assembly view







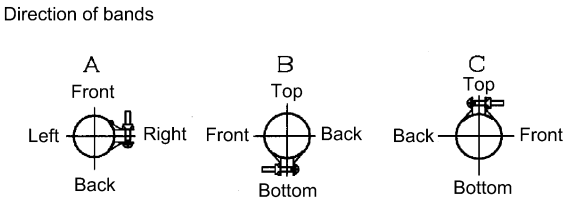
(1)Fan 17510-7411Δ
(2)Fan collar 15876-7415Δ
(3)U20-3α,U25α Fan pulley 16241-7425Δ
Pulley dia.:96mm
U25-3α Pulley(Fan 103) 1G071-7425Δ
Pulley dia.:103mm
(4)U20-3α,U25α 37V-belt 16241-9701Δ
Effective peripherallength:940mm,
tolerance:±6mm
U25-3? 37.5V-belt 16282-9701Δ Effective peripheral length:952.5mm,tolerance:±6mm
(5)Applying a force of 58.8-68.6N(0.67kgf) 13.23~15.43lbs,make sure the deflection is 7~9mm(0.28~0.35lbs)

[1] Reassembling procedure

1) Tightening torque of fan flange bolt:
7.8~8.8N·m (0.8~0.9kgf·m) 5.79~6.51ft·lbs
Fit the fan in position, referring to the figure at left.
2) Tightening torque of sensor (temperature):
62.7~72.5N·m (6.4~7.4kgf·m) 46.3~53.5ft·lbs
3) Tightening torque of alternator assembly mounting bolt:
39.2~44.1N·m (4.0~4.5kgf·m) 28.9~32.5ft·lbs
4) Adjusting the V belt tension
Pressing the belt with a force of 58.8-68.6 N (6~7 kgf) 13.2~15.4lbs, readjust the deflection to 7~9 mm (0.28~0.35in.).

E. Air cleaner

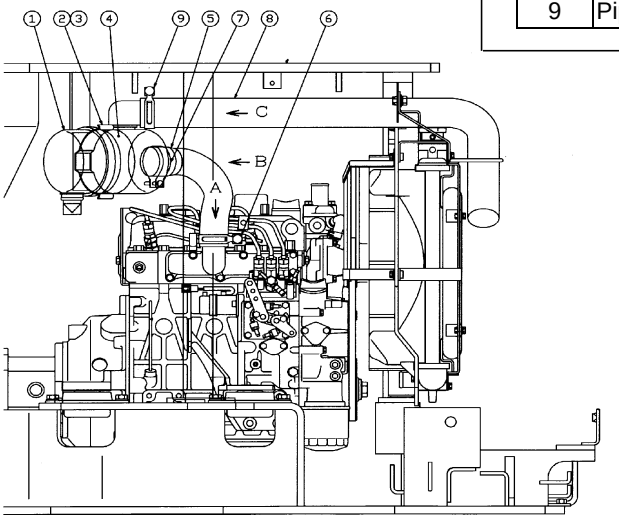
Air cleaner assembly view

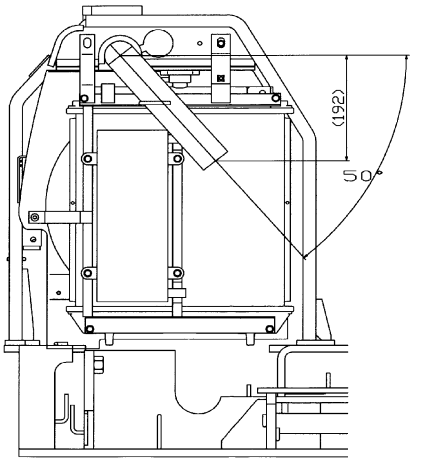


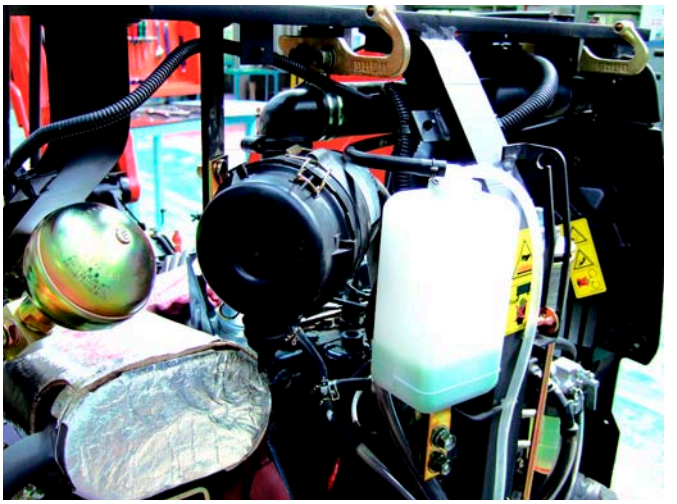
[1] Reassembling procedure

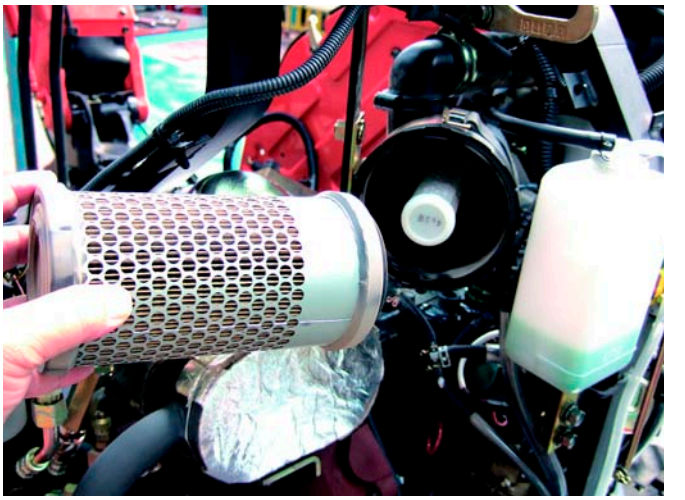
1) Connect the hose (1, inlet) as shown at left.
   * An out-of-spec angle may cause unusual operating noise.
2) Parts list

No.	Part name	Q'ty	Remarks
1	Air cleaner, assembly	1	(422)
2	Base (air cleaner)	1	
3	Nut	2	M10×1.25 4T
4	Air cleaner band	1	
5	Hose (1, inlet)	1	
6	Pipe band	1	
7	Pipe band	1	
8	Hose (2, inlet)	1	
9	Pipe band	1	



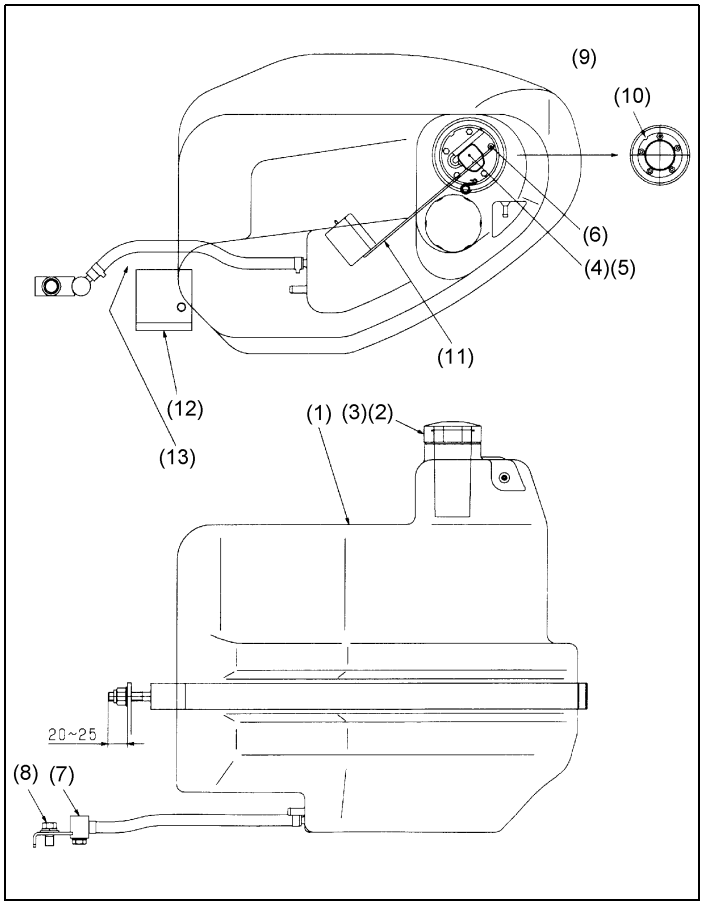






F. Fuel tank and hose

Fuel tank assembly view



Parts list

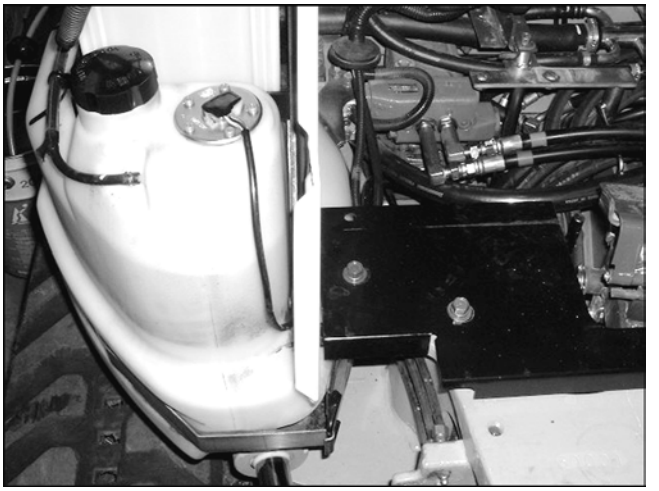
No.	Part name	Q'ty	Remarks
1	Fuel tank	1	
2	Cap assembly (Fuel)	1	
3	Fuel filter assembly	1	
4	Sensor (Fuel)	1	
5	Gasket	1	
6	Head screw with washer	5	M5 × 0.8
7	Base (drain) assembly	1	
8	Bolt	1	M10 x 1.25 7T

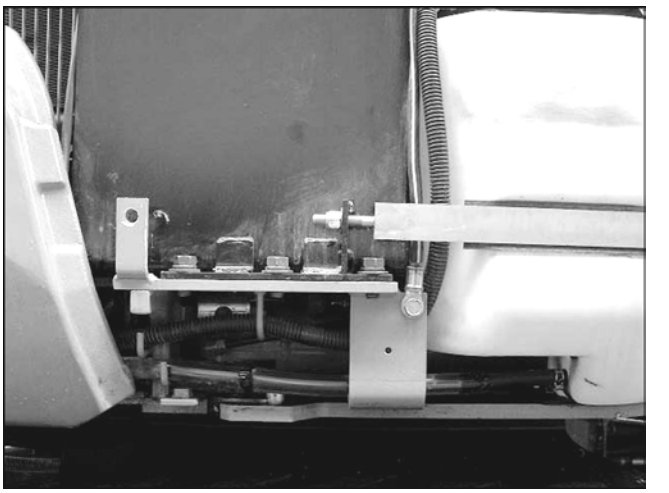
(9)Orientation of the gasket
(10)Notch
(11)When installing the sensor,position the float in this direction
(12)Swivel frame member
(13)Keep an open space here without contact.

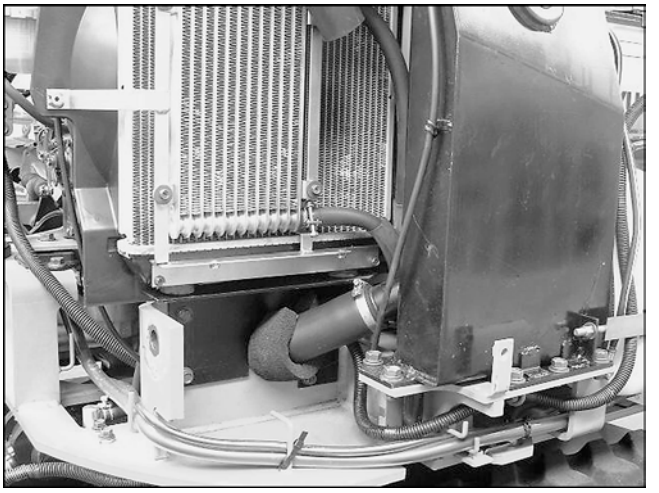
1) Assembling procedure

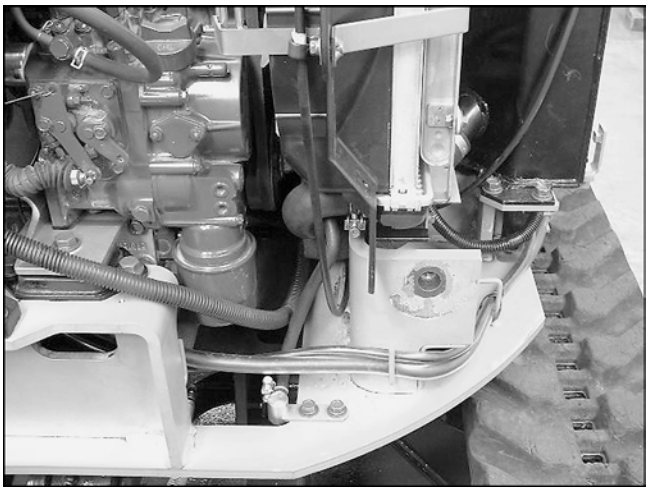
1. Installing the sensor (fuel)
   Tightening torque of washer-fitted machine screw (6) : 3~4N·m (0.3~0.4kgf·m)
   2.2~2.9ft·lbs
2. Tightness of fuel band
   Stretch allowance of fuel band out of the hydraulic oil tank:
   20~25mm (0.79~0.98in.) (reference)

CAUTION
With the band in place, make sure the fuel tank is tight in position.







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2)Fuel hose route

1	S	**Routing checkpoints**	**No contact with sharp edges, hot and moving parts.** **No clamping together of fuel hose and electrical cables.** **No excessive tension and no local slack.** **No flattened hose.** *** Attention when clamping the hoses**
2		**Installing the protective tube Taping one end of the tube**	**Strictly follow the dimensions indicated.**

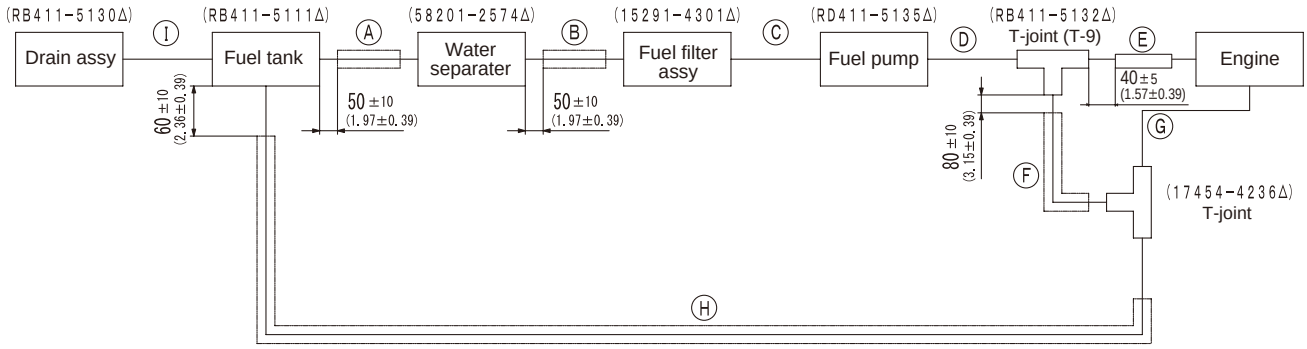
Fuel tube	fuel tube length	Protection tube length
Ⓐ	1300mm (51.2") (09664-81300)	1150mm (45.3") (RC411-5147Δ)
Ⓑ	800mm (31.5") (09664-80800)	550mm (21.7") (RB441-5121Δ)
Ⓒ	340mm (13.4") (09664-80340)	——
Ⓓ	60mm (2.36") (09664-80060)	——
Ⓔ	260mm (10.2") (09664-80260)	70mm (2.76") (RB441-5124Δ)
Ⓕ	250mm (9.84") (09664-80250)	120mm (4.72") (RB441-5123Δ)
Ⓖ	110mm (4.35") (09664-40110)	——
Ⓗ	2120mm (83.5") (RB441-5112Δ)	2000mm (78.7") (RB441-5122Δ)
Ⓘ	260mm (10.2") (09664-80260)	——

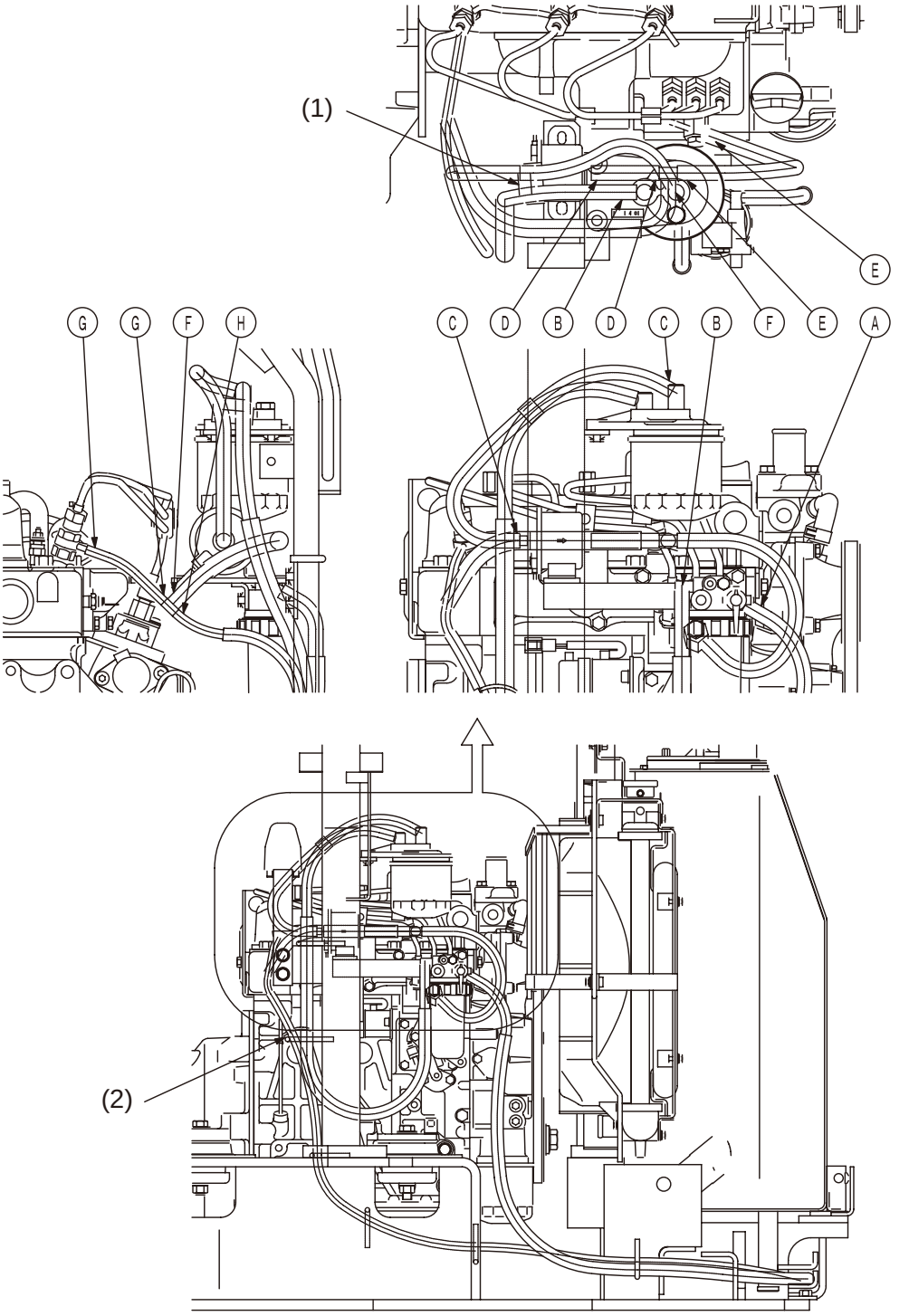
Hose clamp

ⒶⒷⒸ ⒹⒺⒻ → 14911-4275Δ Pipe clip

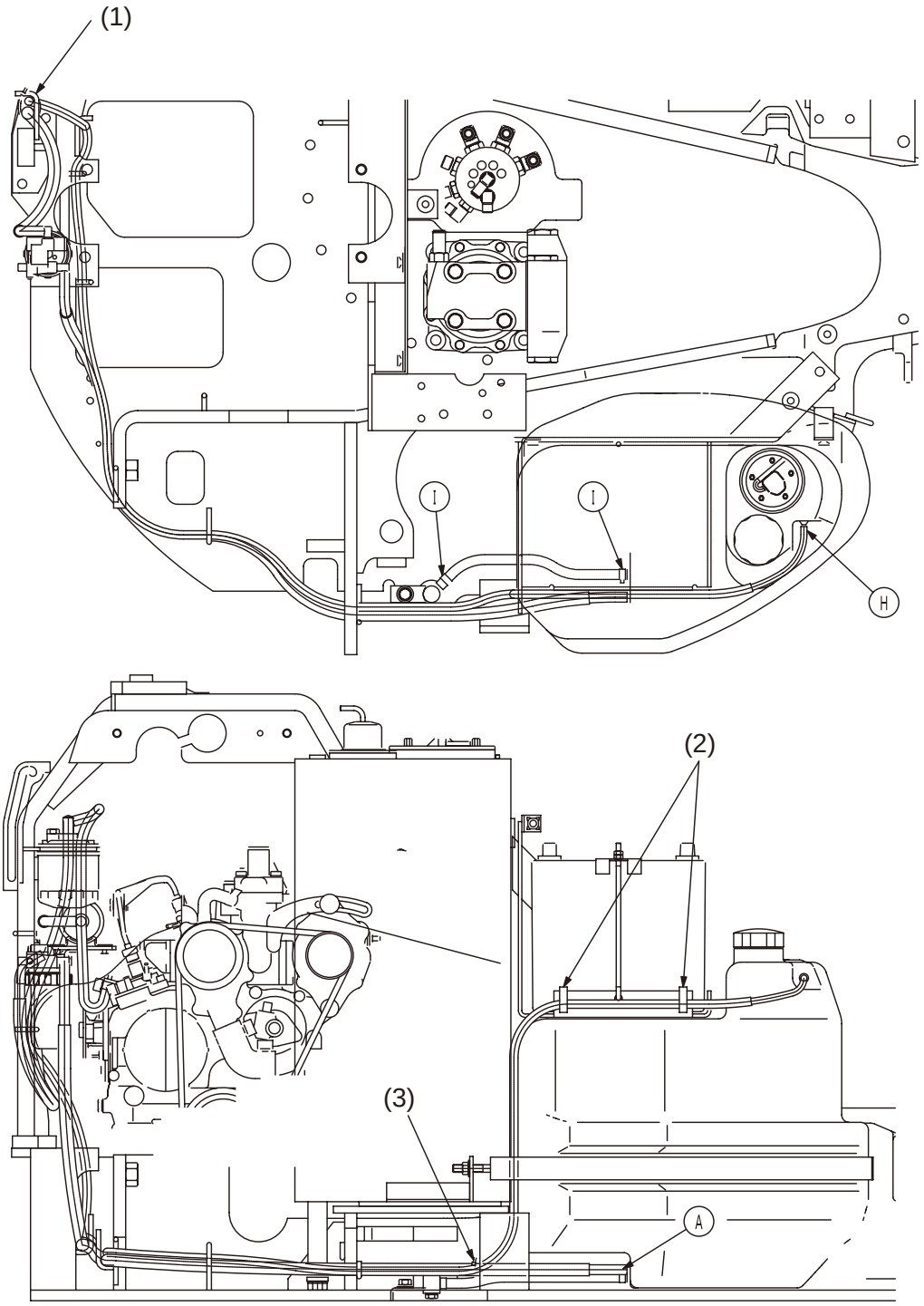
ⒼⒽ → 14971-4275Δ Pipe clip

Ⓘ → 14911-4275Δ Pipe clip





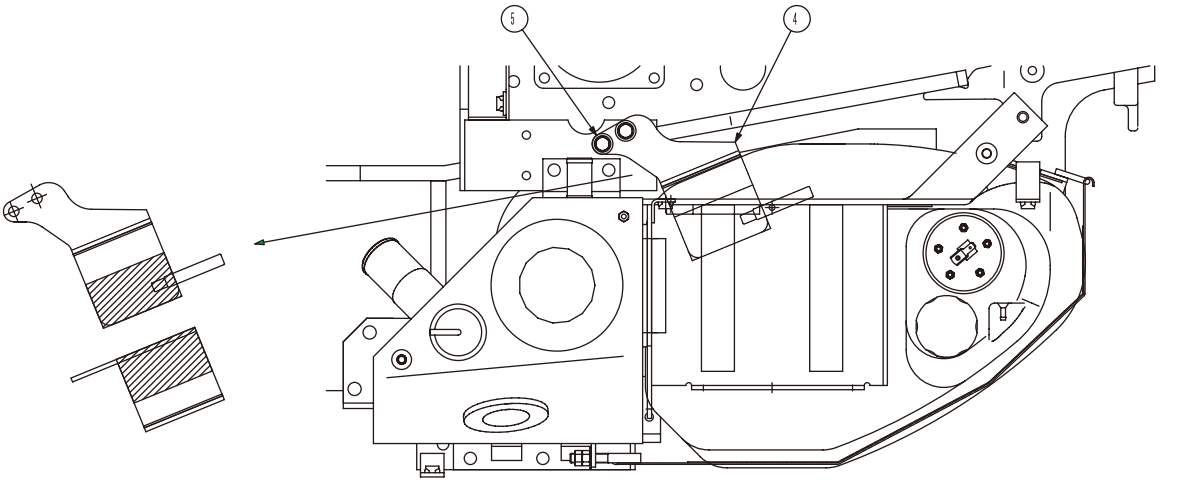
(1)Clamp 3F740-6320Δ
(2)Cord band 55311-4126Δ

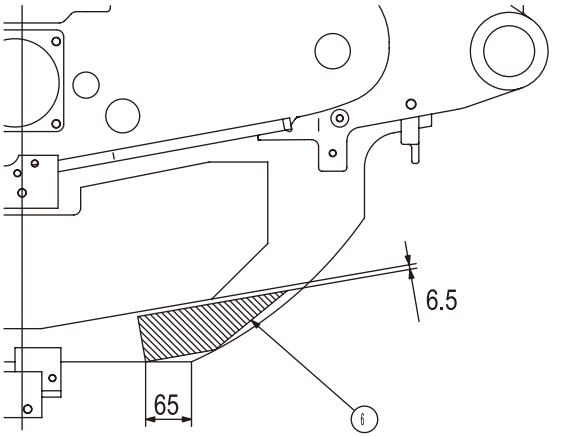


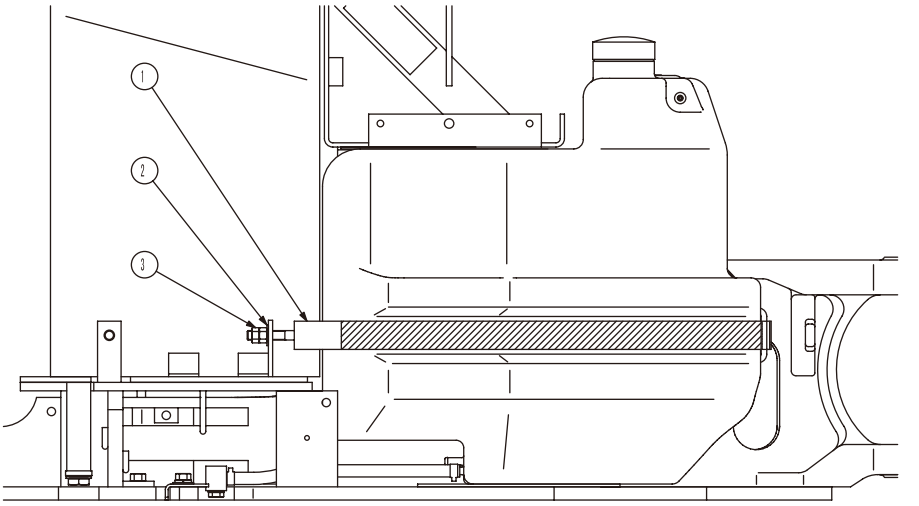
(1)Cord band 55311-4126Δ
(2)Clamp RP421-5413Δ
(3)Cord band 55311-4126Δ

1	Application of cushion	Apply cushion to the position shown in the figure. * Remove dust before application.

(Unit : mm)





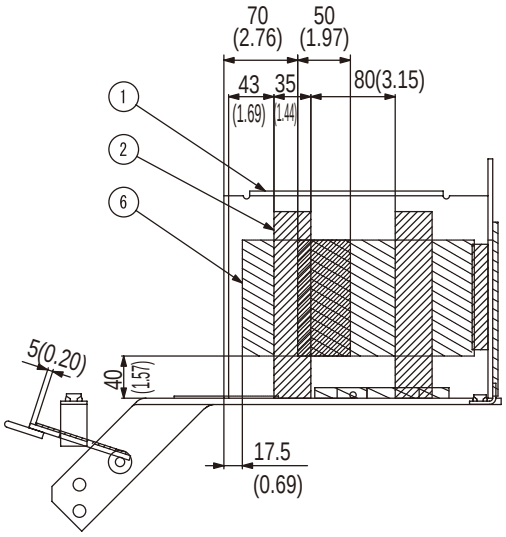


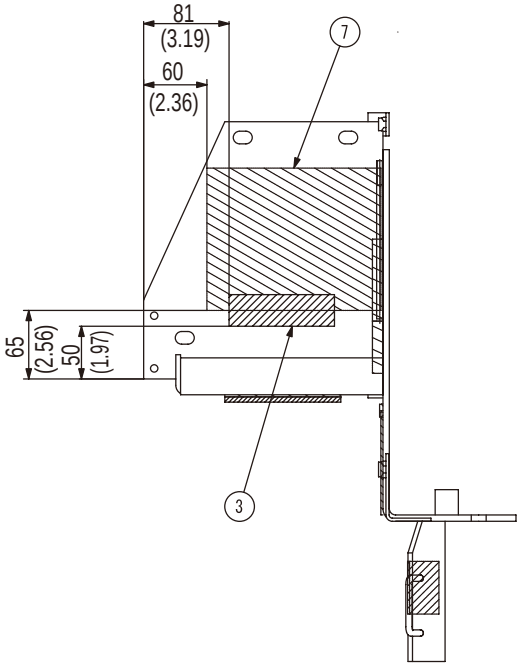
1	Band, ass'y (Fuel tank)	1	
2	Plain washer	1	
3	Nut	2	
4	Stay, ass'y (Fuel tank)	1	
5	Bolt	2	M10×1.25 7T
6	Cushion (Fuel tank 5)	1	

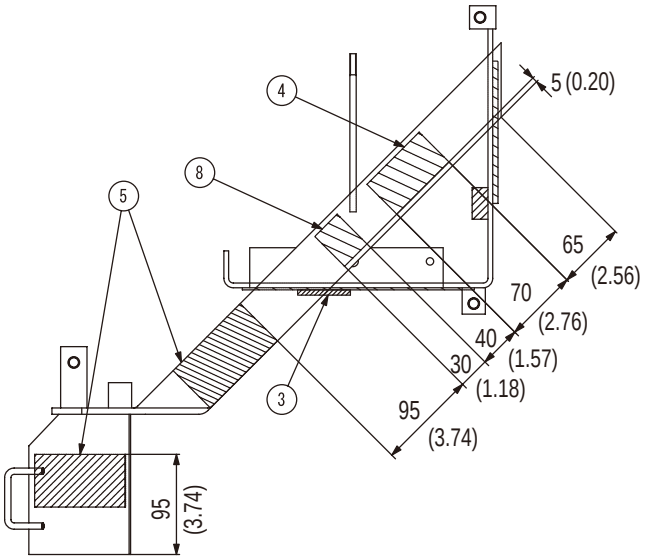
1	Application of cushion	Apply cushion to the position shown in the figure. * Remove dust before application.

(Unit : mm)

1	Bracket (Battery)	1	
2	Cushion (1, battery)	2	
3	Cushion (2, battery)'	1	
4	Cushion (4, battery)	1	
5	Cushion (Fuel tank, 2)	2	
6	Cushion (Fuel tank, 4)	1	
7	Insulator (Battery)	1	
8	Cushion (5, battery)	1	
9	Cushion (6, battery)	1	

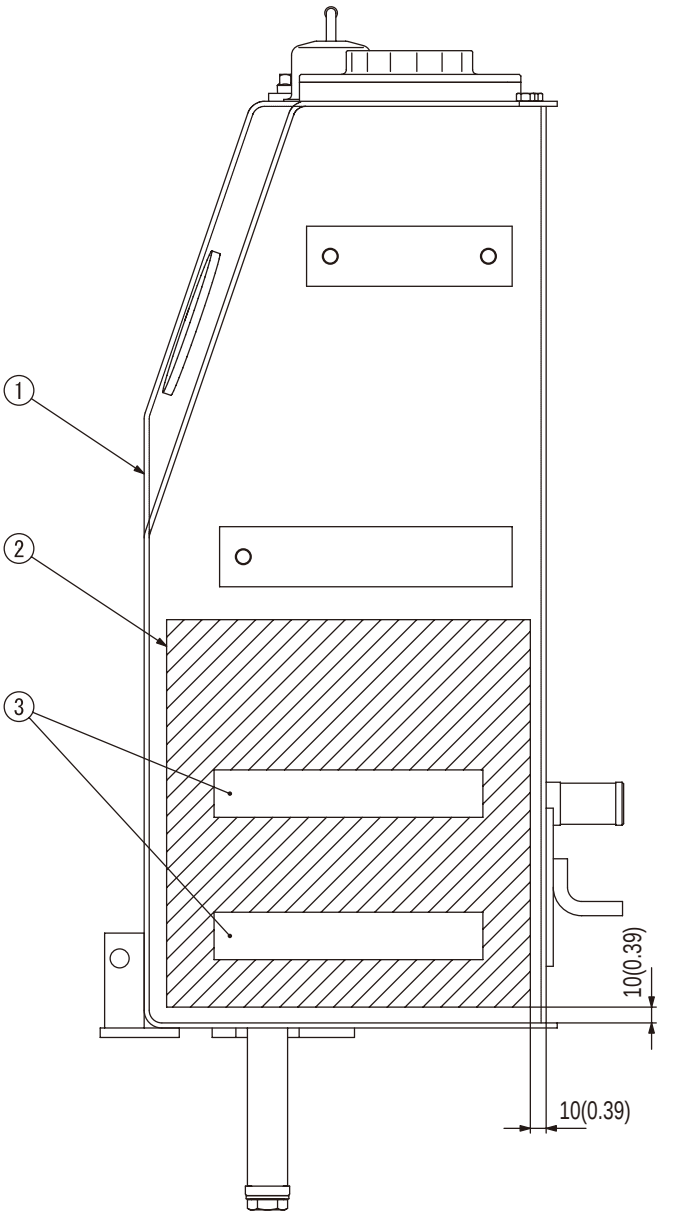






1	Application of cushion	Apply cushion to the position shown in the figure. * Remove dust before application.

1	Hydraulic oil tank	1	
2	Insulator (Hydraulic oil tank)	1	
3	Cushion (Hydraulic oil tank)	2	



(Unit : mm)

III-3. 05-M Series Engine WSM-General

TO THE READER OF Construction machinery

The following engine WSM has been compiled after minor changing of original -05 series engine WSM by eliminating some pages which doesn't apply to construction machinery model of U-3 series.
Still some pages contain common specifications on -05 series engine. Therefore, some data may differ from the engine mounted on construction machinery. In that case, please come to a. Engine specifications for construction machinery.

Nov. 2005

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA Diesel Engine 03-M Series. It is divided into two parts, "Mechanism" and "Servicing" for each section.

■ **Mechanism**
Information on the Features and New Mechanisms are described. This information should be understood before proceeding with troubleshooting, disassembling and servicing.

■ **Servicing**
The heading "General" includes general precautions, check and maintenance and special tools. There are troubleshooting, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.
All information illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. The right is reserved to make changes in all information at any time without notice.
Due to covering many models of this manual, illustration being used, have not been specified as one model.

July 2003

⚠ SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals on the engine itself to warn of the possibility of personal injury. Read these instructions carefully.

It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

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

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

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

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

■ **NOTE** : **Gives helpful information.**

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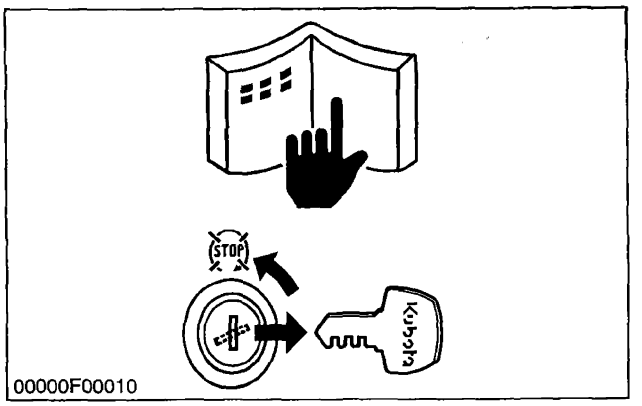


00000F00010

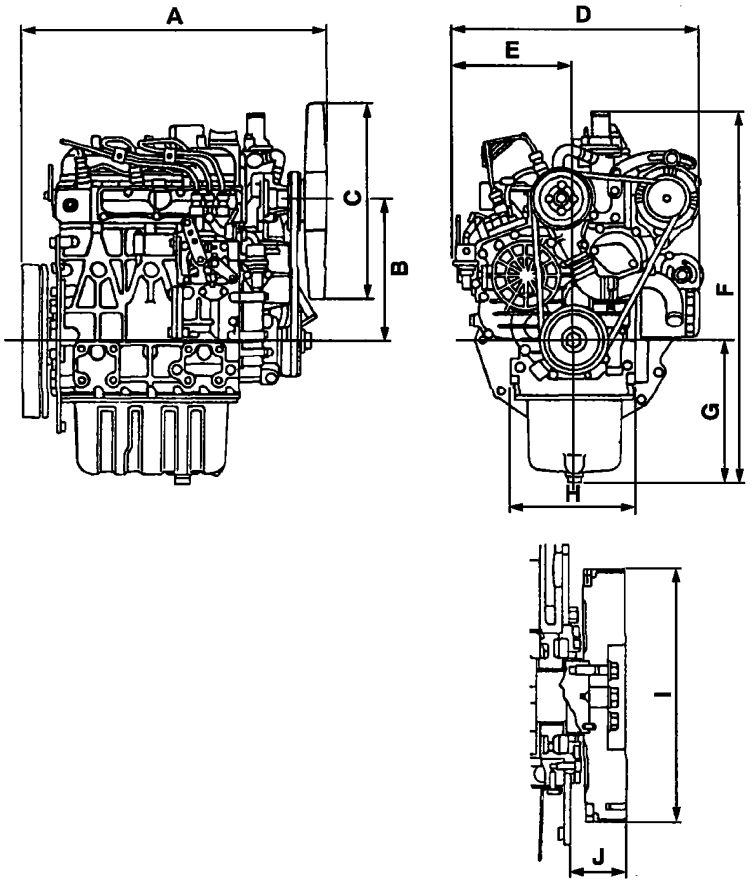
BEFORE SERVICING AND REPAIRING

(1) Read all instructions and safety instructions in this manual and on your engine safety decals.
(2) Clean the work area and engine.
(3) Place the engine on a firm and level ground.
(4) allow the engine to cool before proceeding.
(5) Stop the engine, and remove the key.
(6) Disconnect the battery negative cable.

00000Z00021

b. Dimensions

Unit : mm (in.)



01640F10040

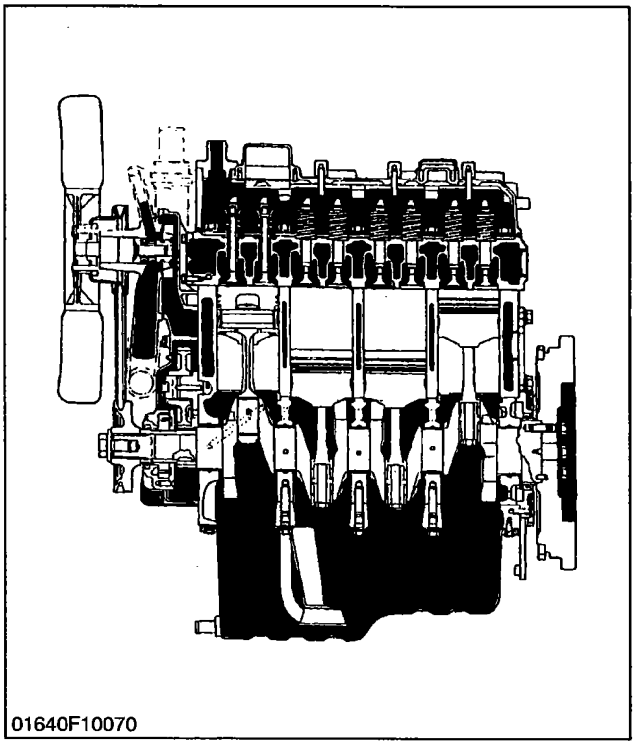
~ = to = à = bis

	D905-B (E)	D1005-B (E)	D1105-B (E)	D1105-T-B (E)
A	497.8 (19.60)	497.8 (19.60)	497.8 (19.60)	497.8 (19.60)
B	230 (9.06)	230 (9.06)	230 (9.06)	230 (9.06)
C	Ø320 (Ø12.60)	Ø330 (Ø12.99)	Ø330 (Ø12.99)	Ø330 (Ø12.99)
D	396 (15.59)	396 (15.59)	396 (15.59)	396 (15.59)
E	194 (7.64)	194 (7.64)	194 (7.64)	194 (7.64)
F	608.7 (23.96)	608.7 (23.96)	608.7 (23.96)	608.7 (23.96)
G	233.5 (9.19)	233.5 (9.19)	233.5 (9.19)	233.5 (9.19)
H	200 (7.87)	200 (7.87)	200 (7.87)	200 (7.87)
I	Ø251.12 ~ 250.81 (Ø9.887 ~ 9.874)	Ø251.12 ~ 250.81 (Ø9.887 ~ 9.874)	Ø 251.12 ~ 250.81 (Ø9.887 ~ 9.874)	Ø 251.12 ~ 250.81 (Ø9.887 ~ 9.874)
J	56 (2.20)	56 (2.20)	56 (2.20)	56 (2.20)

01640Z00130

III-4. Engine WSM (Mechanism section)

A.Feature



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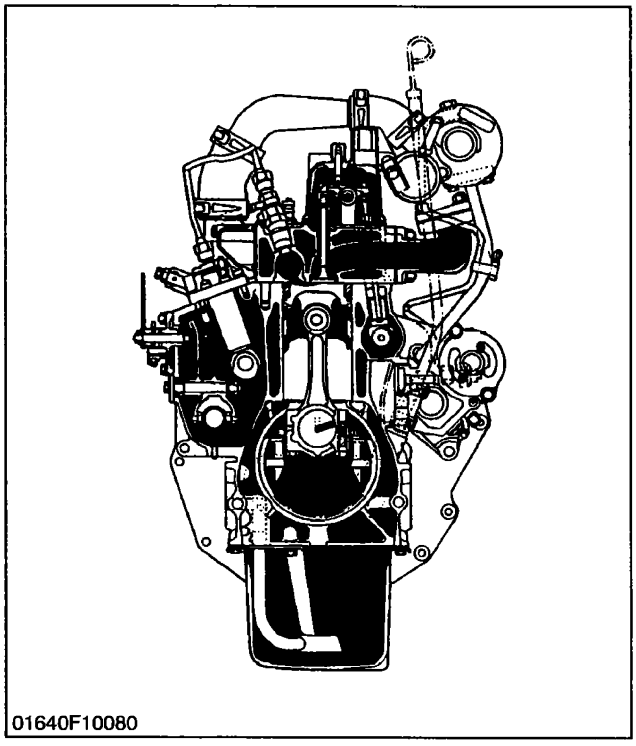


01640F10080

The 05 SERIES ENGINE are vertical, water-cooled, 4 cycle diesel engines.

They are incorporated KUBOTA's foremost technologies. With KUBOTA's E-TVCS (Three Vortex Combustion System), well-known Bosch MD type injection pump and the well-balanced designs, they give greater power, low fuel consumption, little vibration and quiet operation.

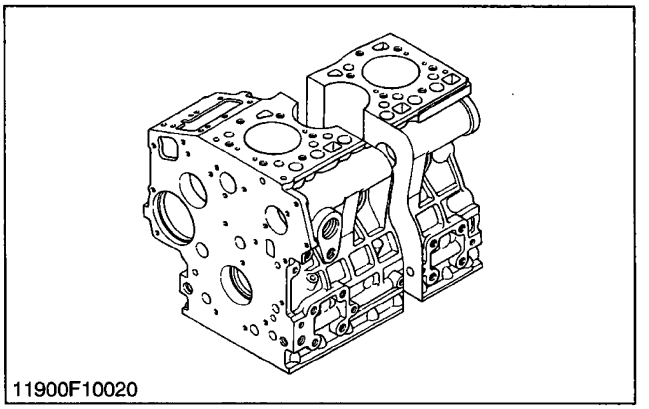
■ NOTE

- **Since January 1994, E-TVCS has been used for the combustion chamber of our products instead of traditional N-TVCS.**
  E-TVCS was developed with an eye toward clean exhaust gas which is more environmentally freindly.
  The combustion chamber models mentioned hereinafter refers to E-TVCS.
  Model of combustion chamber :
  N-TVCS
  (Engine Serial Number ; 489290 or lower)
  E-TVCS
  (Engine Serial Number ; 489291 or higher)

11900M10011

B. Engine body

[1] Cylinder block


11900F10020

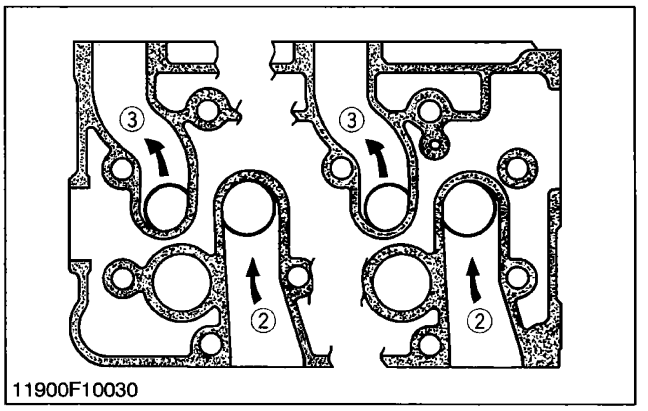
The engine has a high durability tunnel-type cylinder block in which the crank bearing component is a constructed body.

Furthermore, liner less type, allow effective cooling, less distortion, and greater wear-resistance.

The noise level is reduced to a minimum because each cylinder has its own chamber.

11900M10020

[2] Cylinder head



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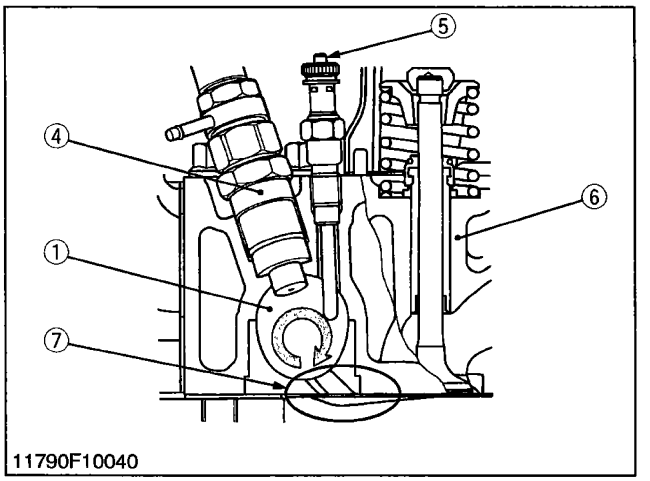


11790F10040

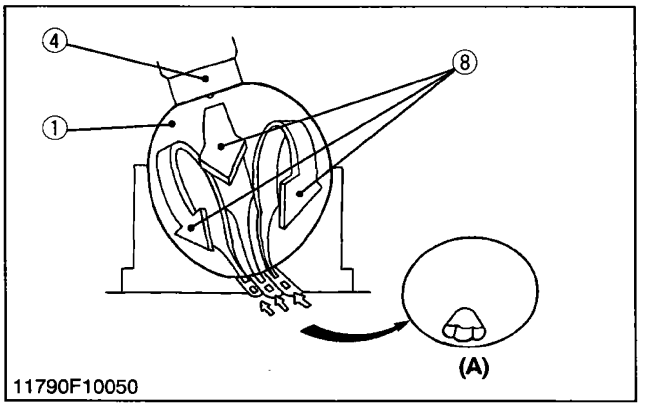
(1) Combustion Chamber
(2) Intake Port
(3) Exhaust Port
(4) Nozzle Assembly
(5) Glow Plug
(6) Cylinder Head
(7) Depression
(8) Compressed Air

(A) Connect to Combustion Chamber

The cross-flow type intake / exhaust ports in this engine have their openings at both sides of the cylinder head. Because overlaps of intake / exhaust ports are smaller than in ports of other types which have openings on one side, the suction air can be protected from being heated and expanded by heated exhaust air. The cool, high density suction air has high volume efficiency and raises the power of the engine. Furthermore, distortion of the cylinder head by heated exhaust gas is reduced because intake ports are arranged alternately.

The combustion chamber is of KUBOTA's exclusive E-TVCS combustion chamber type. Suction air is whirled to be mixed effectively with fuel, prompting combustion and reducing fuel consumption.

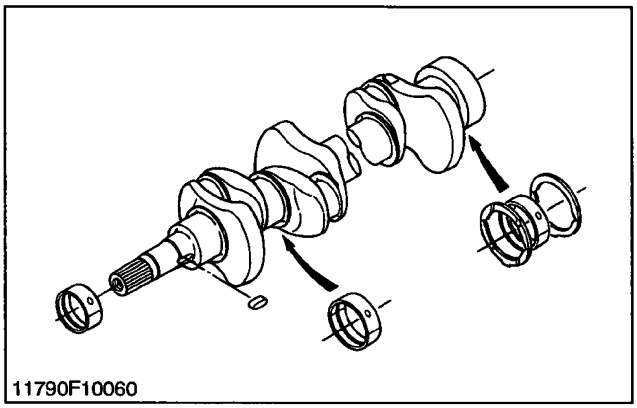
In the combustion chamber are installed throttle type injection nozzle and rapid heating sheathed type glow plug. This glow plug assures easier than ever engine starts even at −15 °C (5 °F).



11790F10050

11900M10031

[3] Crankshaft


11790F10060

The crankshaft with the connecting rod converts the reciprocating motion of the piston into the rotating motion.

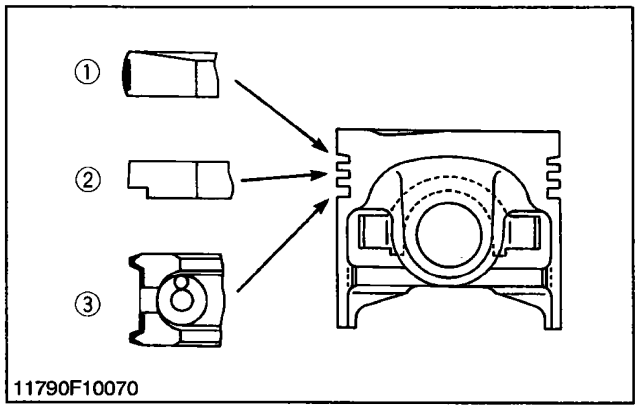
The crankshaft is made of tough special alloy steel, and the journals, pins and oil seal sliding portions are induction hardened to increase the hardness for higher wear resistance.

The front journal is supported by a solid type bearing, the intermediate journal by a split type, and the rear journal by a split type with thrust bearings.

The crankshaft is provided with an oil gallery, through which engine oil is fed to the crankpin portion, and lubricates it.

11790M10040

[4] Piston and piston rings



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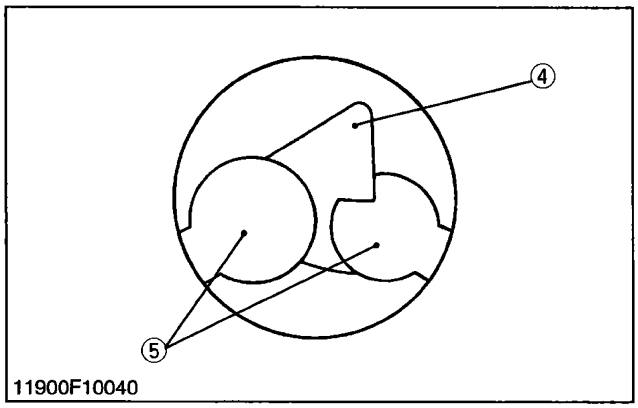


11900F10040

The piston has a slightly oval shape when cold (in consideration of thermal expansion) and a concave head.

Three rings are installed in grooves in the piston.

The top ring (1) is a keystone type, which can stand against heavy loads, and the barrel face on the ring fits well to the cylinder wall.

The second ring (2) is an undercut type, which effectively prevents the oil from being carried up.

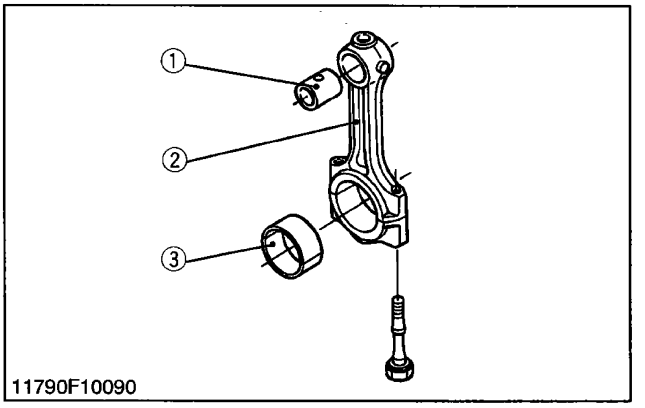
The oil ring (3) has chamfered contact faces and an expander ring, which increase the pressure of the oil ring against the cylinder wall.

Several grooves are cut on the top land to help heat dissipate and to prevent scuffing.

(1) Top Ring
(2) Second Ring
(3) Oil Ring
(4) Depression
(5) Valve Recess

11900M10041

[5] Connecting rod



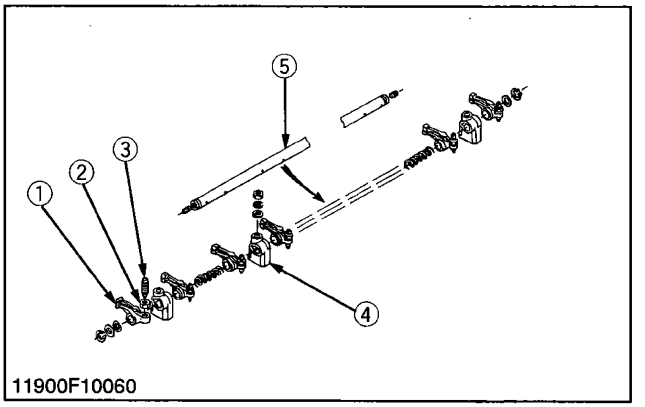
The connecting rod (2) is used to connect the piston with the crankshaft.

The big end of the connecting rod has a crankpin bearing (3) (split type) and the small end has a small end bushing (1) (solid type).

(1) Small End Bushing
(2) Connecting Rod
(3) Crankpin Bearing

11790M10060

[6] Rocker arm



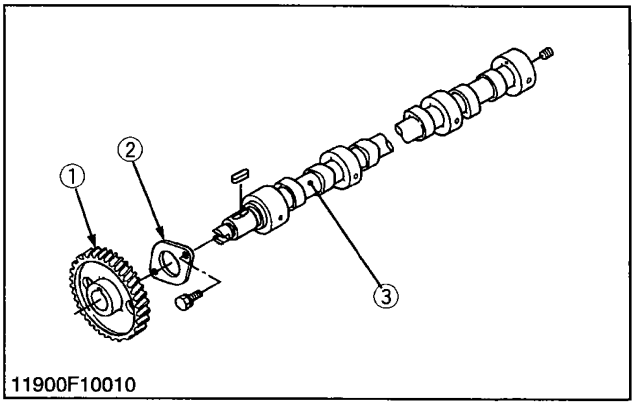
The rocker arm assembly includes the rocker arms (1), rocker arm brackets (4) and rocker arm shaft (5), and converts the reciprocating movement of the push rods to an open / close movement of the intake and exhaust valves.

Lubricating oil pressurized through the bracket to the rocker arm shaft, which serves as a fulcrum so that the rocker arm and the entire system are lubricated sufficiently.

(1) Rocker Arm
(2) Lock Nut
(3) Adjusting Screw
(4) Rocker Arm Bracket
(5) Rocker Arm Shaft

11900M10070

[7] Camshaft



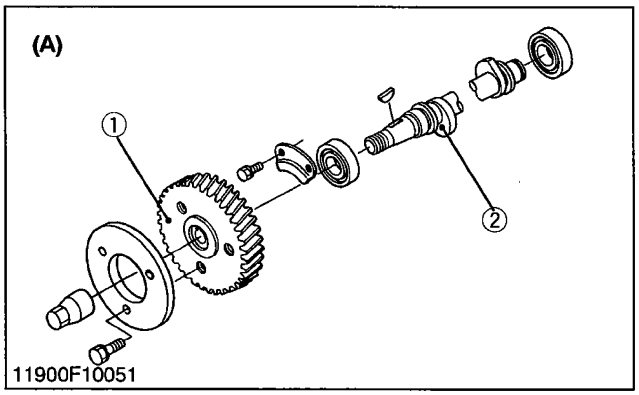
The camshaft (3) is made of special cast iron, and the journal and cam sections are chilled to resist wear.

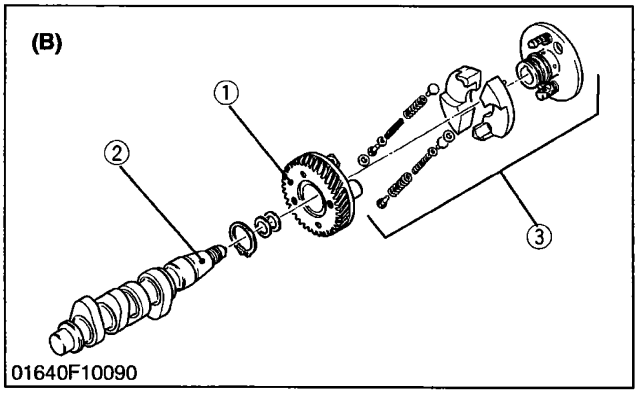
The journal sections are force-lubricated.

(1) Cam Gear
(2) Camshaft Stopper
(3) Camshaft

11900M10050

[8] Fuel camshaft





The fuel camshaft (2) controls the reciprocating movement of the injection pump.

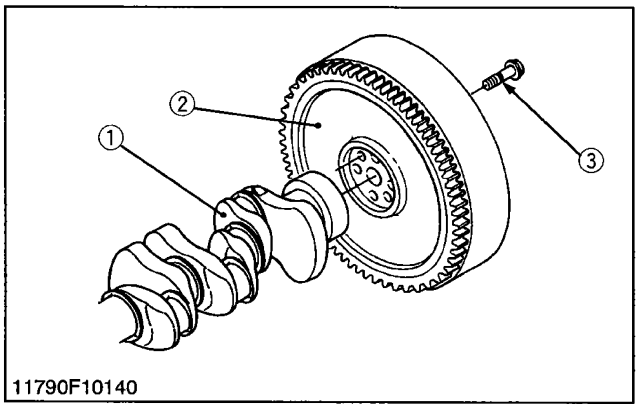
The fuel camshaft is made of carbon steel and the cam sections are quenched and tempered to provide greater wear resistance.

(1) Injection Pump Gear
(2) Fuel Camshaft
(3) Automatic Advance Timer (not included in the basic model)

(A) Without Timer
(B) With Timer

11900M10061

[9] Flywheel



The flywheel stores the rotating force in the combustion stroke as inertial energy, reduces crankshaft rotating speed fluctuation and maintains the smooth rotating conditions.

The flywheel periphery is inscribed with the marks showing fuel injection timing angle lines and top dead center mark **TC**.

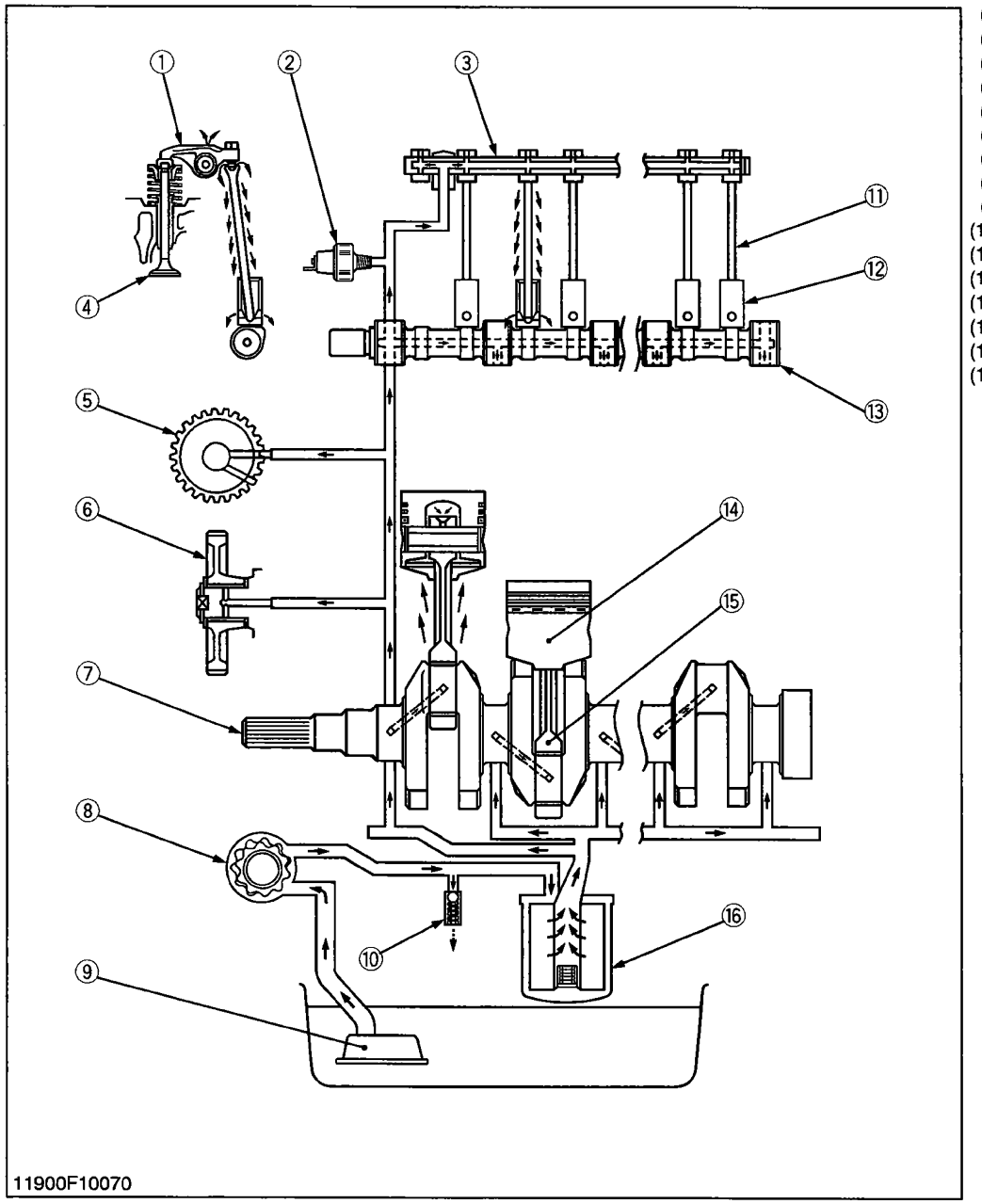
The flywheel has gear teeth around its outer rim, which mesh with the drive pinion of the starter.

(1) Crankshaft
(2) Flywheel
(3) Flywheel Screw

11900M10081

C.Lubricating system

[1] General



(1) Rocker Arm
(2) Oil Pressure Switch
(3) Rocker Arm Shaft
(4) Valve
(5) Governor Shaft
(6) Idle Gear
(7) Crankshaft
(8) Oil Pump
(9) Oil Strainer
(10) Relief Valve
(11) Push Rod
(12) Tappet
(13) Camshaft
(14) Piston
(15) Connecting Rod
(16) Oil Filter Cartridge

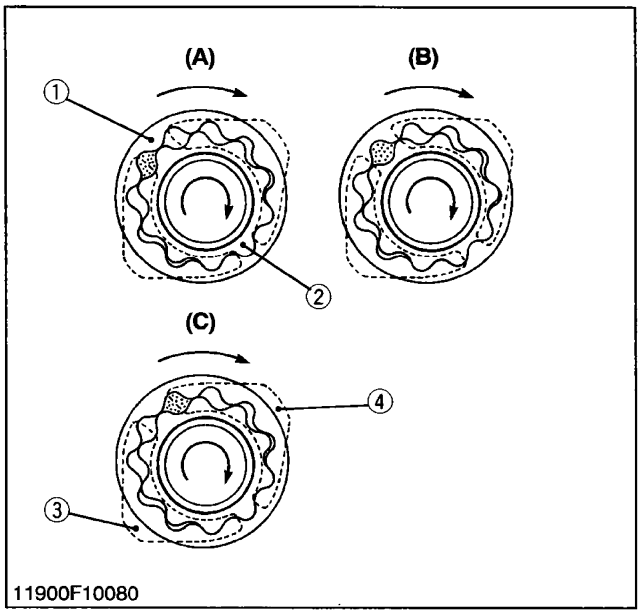
This engine's lubricating system consists of oil strainer (9), oil pump (8), relief valve (10), oil filter cartridge (16) and oil pressure switch (2).

The oil pump sucks lubricating oil from the oil pan through the oil strainer and the oil flows down to the filter cartridge, where it is further filtered. Then the oil is forced to crankshaft (7), connecting rods (15), idle gear (6), governor shaft (5), camshaft (13) and rocker arm shaft (3) to lubricate each part.

Some part of oil, splashed by the crankshaft or leaking and dropping from gaps of each part, lubricates these parts : pistons (14), cylinders, small ends of connecting rods, tappets (12), push rods (11), inlet and exhaust valves (4) and timing gears.

11900M10090

[2] Oil pump



The oil pump in this engine is a trochoid pump.

Inside the pump body, the 10 lobe inner rotor (2) is eccentrically engaged with the 11 lobe outer rotor (1). The inner rotor is driven by the crankshaft, which in turn rotate the outer rotor.

When the inner rotor rotates, the outer rotor also rotates in the same direction. The two rotors have differences in lobe number and center, which generates space between lobes as shown in the figure.

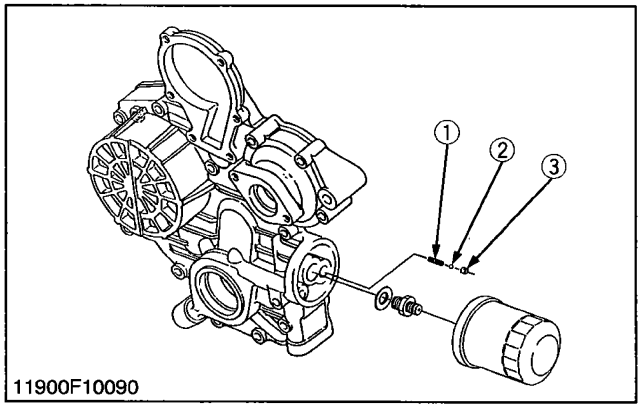
At position **(A)**, there is little space between lobes in the inlet port. As the rotor rotates towards position, the space between the lobes becomes larger, creating a negative pressure which sucks in oil.

Outside the inlet port, as shown in position **(B)**, the space between the lobes becomes gradually smaller, and oil pressure increases. At position **(C)**, oil is discharged from the outlet port.

(1) Outer Rotor
(2) Inner Rotor
(3) Inlet Port
(4) Outlet Port

11900M10101

[3] Relief valve



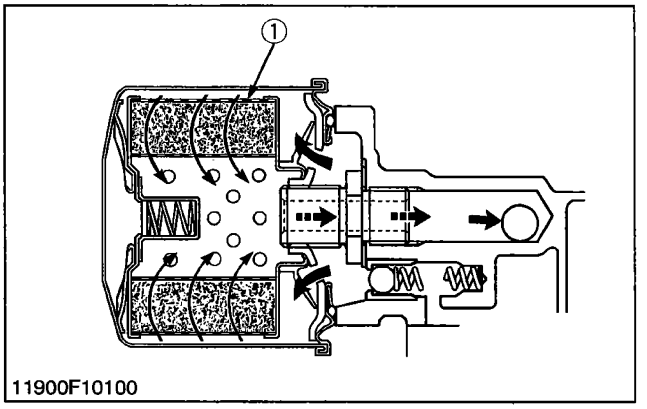
The relief valve prevents the damage of the lubricating system due to high oil pressure. This relief valve is a ball type direct acting relief valve, and is best suited for low pressures.

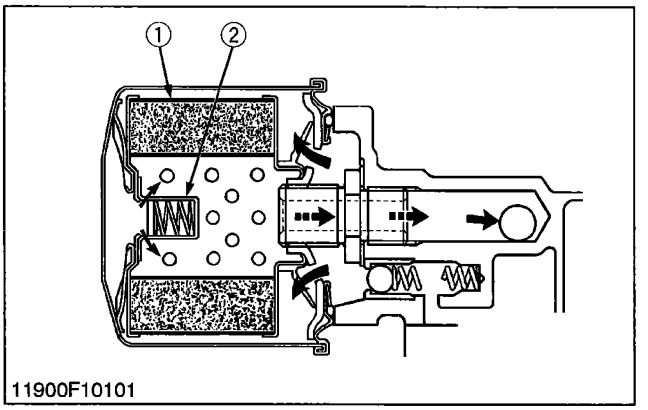
When oil pressure exceeds the upper limit, the ball (2) is pushed back by the pressure oil and the oil escapes.

(1) Spring
(2) Steel Ball
(3) Valve Seat

11900M10111

[4] Oil filter cartridge





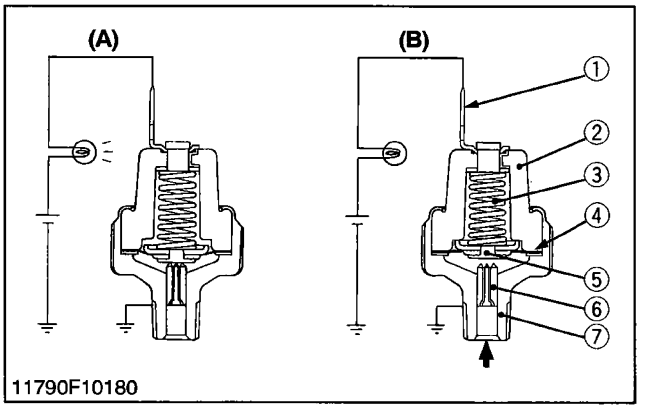
Impurities in engine oil can cause to wear and seize components as well as impairing the physical and chemical properties of the oil itself. Impurities contained in force-fed engine oil are absorbed on the filter paper for removal as they pass through the filter element (1).

When the filter element is clogged and the oil pressure in inlet line builds up by 98 kPa (1.0 kgf/cm^2, 14 psi) more than the outlet line, the bypass valve (2) opens and the oil flows from inlet to outlet bypassing the filter element.

(1) Filter Element
(2) Bypass Valve

11900M10120

[5] Oil pressure switch



The oil pressure switch is mounted on the cylinder block, to warn the operator that the lubricating oil pressure is poor.

If the oil pressure falls below 49 kPa (0.5 kgf/cm^2, 7 psi), the oil warning lamp will light up, warning the operator. In this case, stop the engine immediately and check the cause of pressure drop.

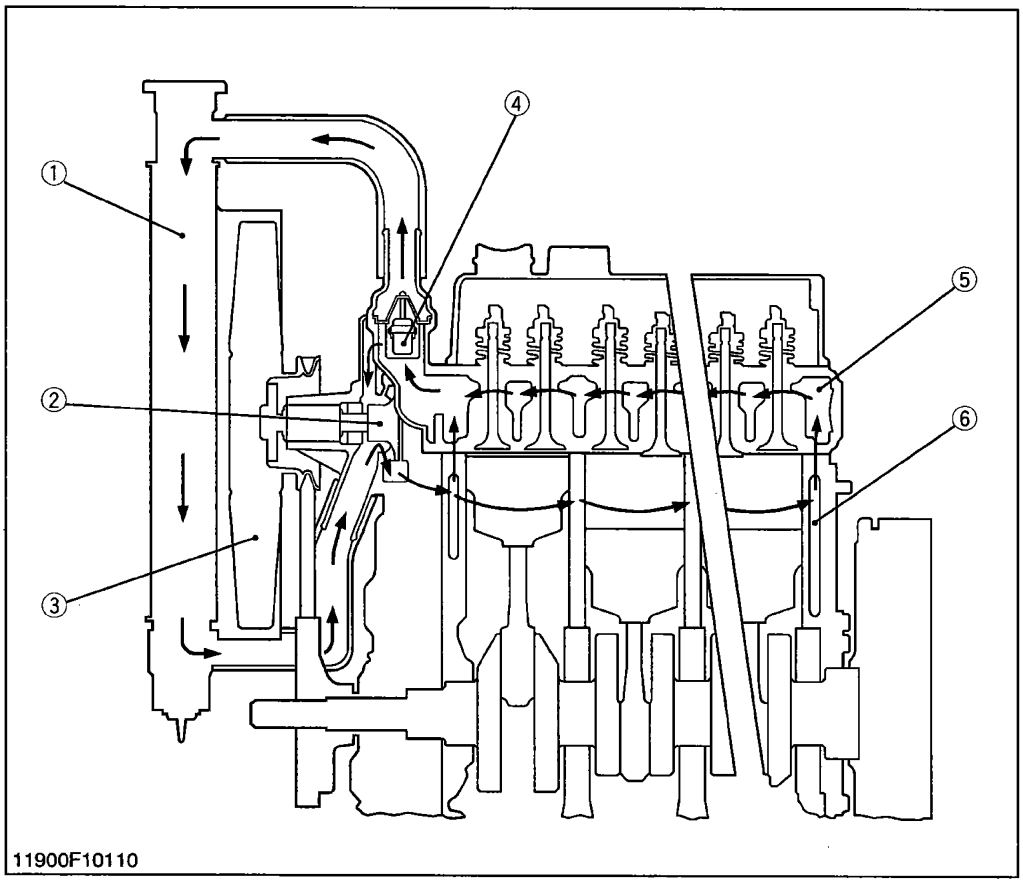
(1) Terminal
(2) Insulator
(3) Spring
(4) Rubber Gasket
(5) Contact Rivet
(6) Contact
(7) Oil Switch Body

(A) At Oil Pressures of 49 kPa (0.5 kgf/cm^2, 7 psi) or Less
(B) At Proper Oil Pressure

11790M10152

D.Cooling system

[1] General



(1) Radiator
(2) Water Pump
(3) Suction Fan
(4) Thermostat
(5) Cylinder Head
(6) Cylinder Block

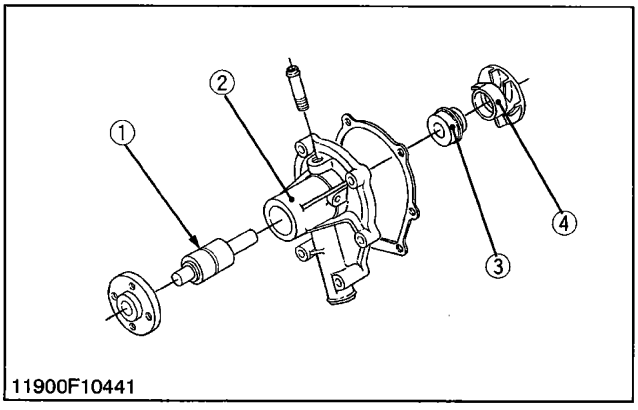
The cooling system consists of a radiator (1) (not included in the basic engine), centrifugal water pump (2), suction fan (3) and thermostat (4).

The water is cooled through the radiator core, and the fan set behind the radiator pulls cooling air through the core to improve cooling.

The water pump sucks the cooled water, forces it into the cylinder block and draws out the hot water. Then the cooling is repeated. Furthermore, to control temperature of water, a thremostat is provided in the system. When the thermostat opens, the water moves directly to radiator, but when it closes, the water moves toward the water pump through the bypass between thremostat and water pump. The opening temperature of thermostat is approx. 71 °C (160 °F).

11900M10131

[2] Water pump

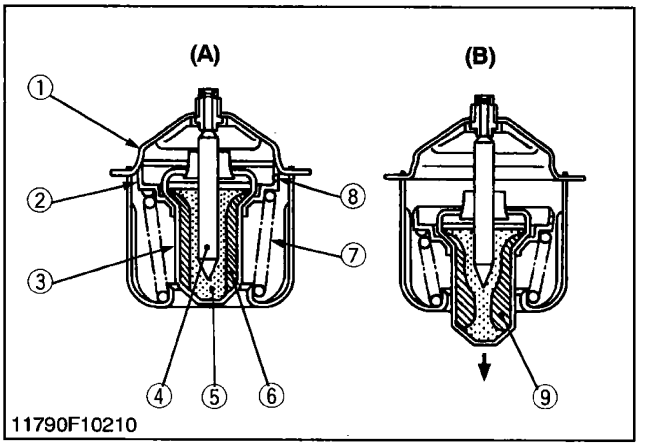


The water pump is driven by the crankshaft via a V belt. Water cooled in the radiator is sucked into the water pump from its lower portion and is sent from the center of the water pump impeller (4) radially outward into the water jacket in the crankcase.

(1) Bearing Unit
(2) Water Pump Body
(3) Mechanical Seal
(4) Water Pump Impeller

11900M10141

[3] Thermostat



The thermostat maintains the cooling water at correct temperature. KUBOTA's engine uses a wax pellet type thermostat. Wax is enclosed in the pellet. The wax is solid at low temperatures, but turns liquid at high temperatures, expands and opens the valve.

(A) At low temperature (lower than 71 °C, 160 °F)

As the thermostat is closed, cooling water circulates in the engine through the water return pipe without running to the radiator.

Air in the water jacket escapes to the radiator side through leak hole (8) of the thermostat.

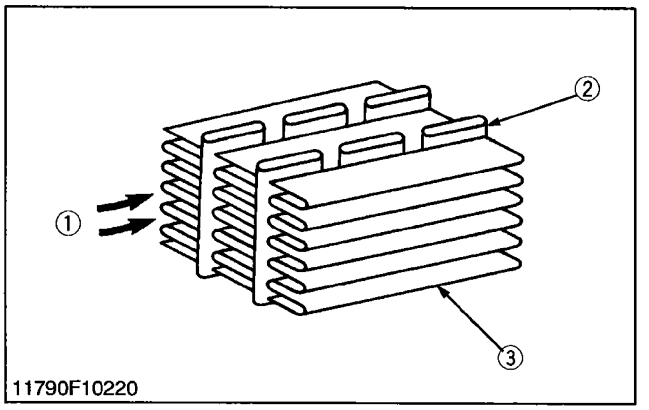
(B) At high temperature (higher than 71 °C, 160 °F)

When the temperature of cooling water exceeds 71 °C (160 °F), wax in the pellet turns liquid and expands. Because the spindle (4) is fixed, the pellet (3) is lowered, the valve (2) is separated from the seat (1), and then cooling water is sent to the radiator.

(1) Seat
(2) Valve
(3) Pellet
(4) Spindle
(5) Synthetic Rubber
(6) Wax (Solid)
(7) Spring
(8) Leak Hole
(9) Wax (Liquid)

11790M10182

[4] Radiator (not included in the basic engine)

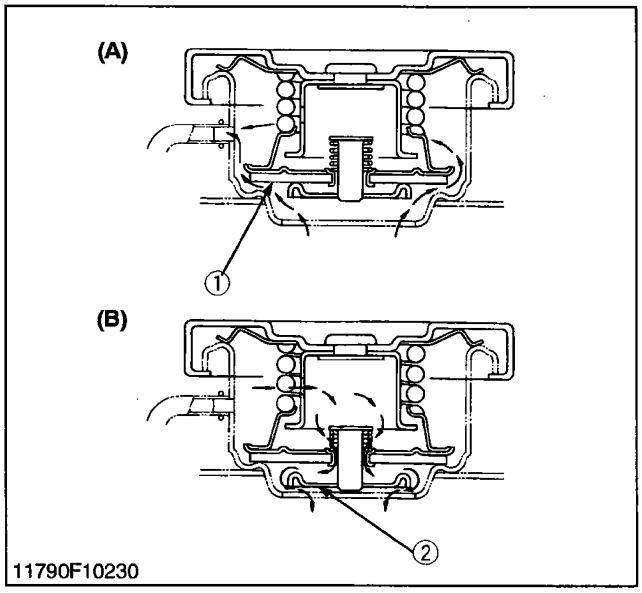


The radiator core consists of water carrying tubes (2) and fins (3) at a right angle to the tubes (2). Heat of hot water in the tubes is radiated from the tube walls and fins. KUBOTA's engine uses corrugated fin type core which has a light weight and high heat transfer rate. Clogging is minimized by the louverless corrugated fins.

(1) Cooling Air
(2) Tube
(3) Fin

11790M10191

[5] Radiator cap



The radiator cap is for sustaining the internal pressure of the cooling system at the specified level 88 kPa (0.9 kgf/cm^2, 13 psi) when the engine is in operation. The cap consists of a pressure valve (1) a vacuum valve (2), valve springs, gasket, etc.

Cooling water is pressurized by thermal expansion of steam, and as its boiling temperature rises, generation of air bubbles will be suppressed. (Air bubbles in cooling water lowers the cooling effect.)

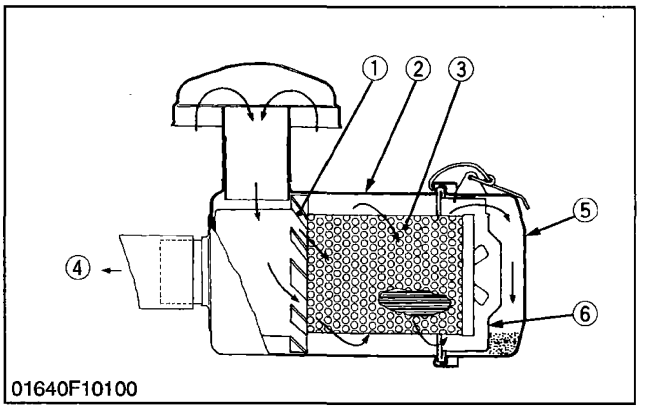
(1) Pressure Valve
(2) Vacuum Valve

(A) When radiator internal pressure is high
(B) When radiator internal pressure is negative

11790M10201

E. Intake / exhaust system

[1] Air cleaner (not included in the basic engine)

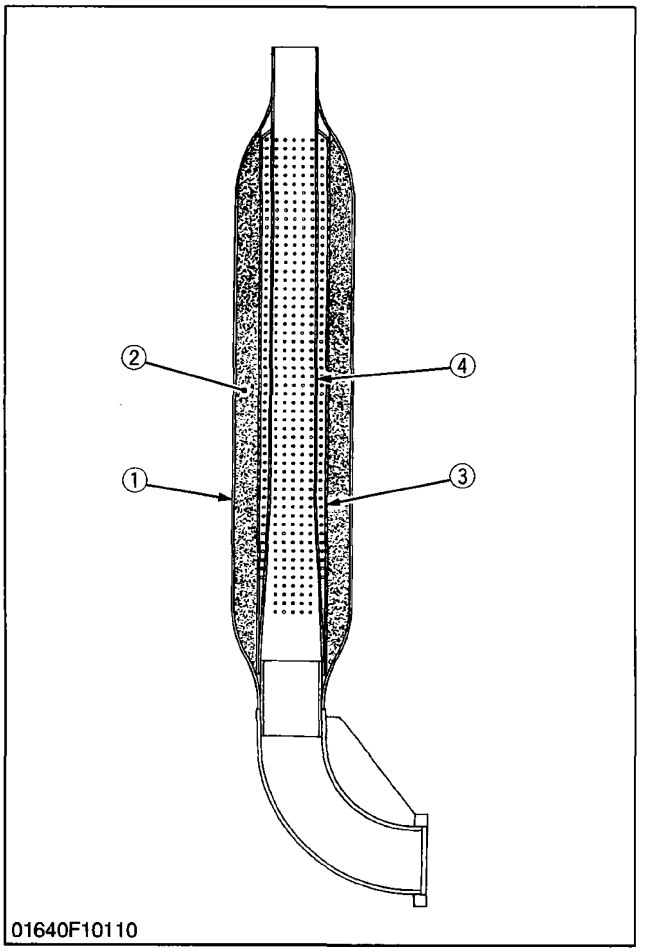


The air cleaner is a dry-cyclone type for easy maintenance. Sucked air is caused to flow in a whirling way with fin (1). As a result, heavier dust particles circulate around the circumference and enter the holes in the baffle cover (6) and accumulate in the dust cup (5). Minute dust, while circulating in the air flow, is absorbed by the element (3) and thus prevented from entering the engine.

(1) Fin
(2) Air Cleaner Body
(3) Air Filter Element
(4) To Cylinder
(5) Dust Cup
(6) Baffle Cover

01640M10010

[2] Muffler (not included in the basic engine)



High temperature and high pressure exhaust gas is intermittently discharged by fuel combustion generating pressure waves inside the exhaust pipe which will result in noise.

The muffler is used to reduce this noise.

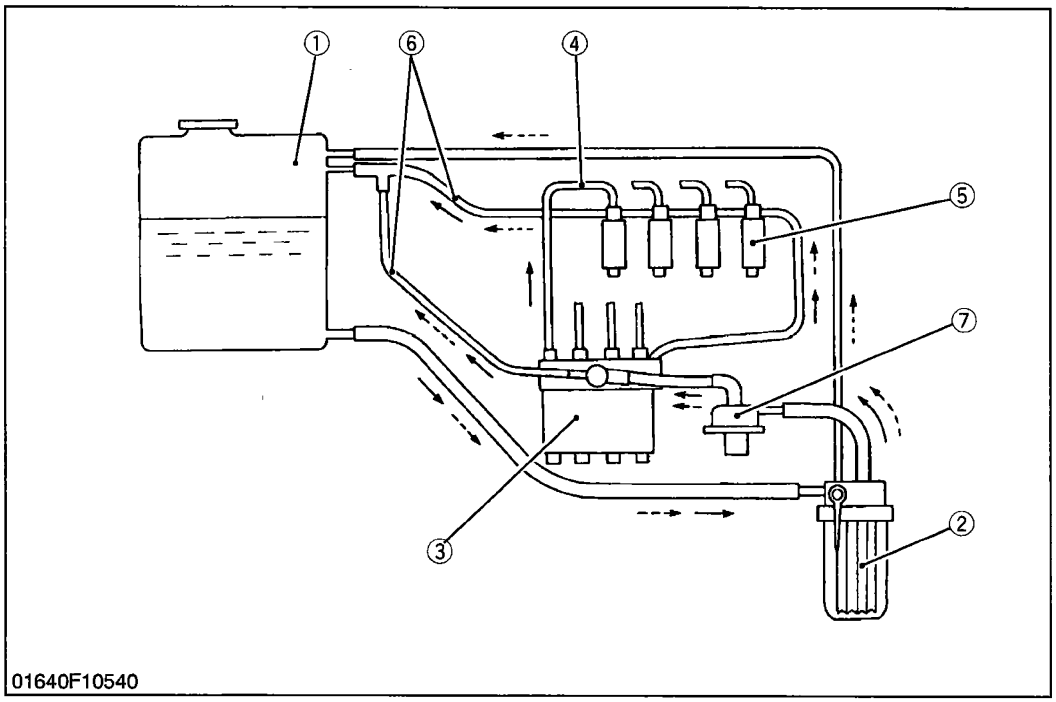
This muffler consists of a perforated inner tube (4) and outer tube (3), glass wool (2), main body (1), etc. The glass wool placed between the outere tube and main body, absorbs the exhaust noise of higher frequency.

(1) Main Body
(2) Glass Wool
(3) Outer Tube
(4) Inner Tube

01640M10020

F. Fuel system

[1] General



(1) Fuel Tank
(2) Fuel Filter
(3) Injection Pump
(4) Injection Pipe
(5) Injection Nozzle
(6) Fuel Overflow Pipe
(7) Fuel Feed Pump

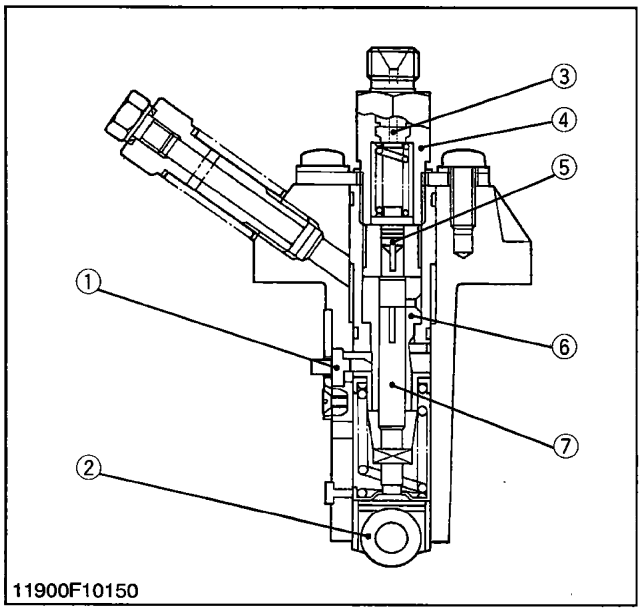
Fuel from the fuel tank (1) passes through the fuel filter (2), and then enters the injection pump (3) after impurities such as dirt, water, etc. are removed.

The fuel pressurized by the injection pump to the opening pressure (13.73 to 14.71 MPa, 140 to 150 kgf/cm^2, 1991 to 2133 psi), of the injection nozzle (5) is injected into the combustion chamber.

Part of the fuel fed to the injection nozzle (5) lubricates the moving parts of the plunger inside the nozzle, then returns to the fuel tank through the fuel overflow pipe (6) from the upper part of the nozzle holder.

11900M10151

[2] Injection pump



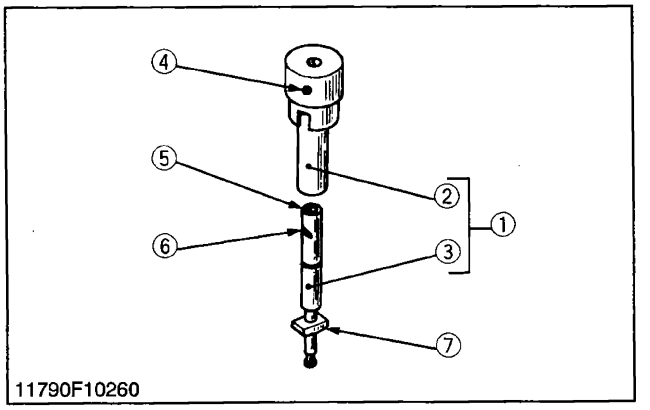
A Bosch MD type mini pump is used for the injection pump. It is small, lightweight and easy to handle.

The plunger (7) with a left-hand lead reciprocates via the tappet roller (2) by means of the fuel camshaft, causing the fuel to be delivered into the injection nozzle.

(1) Control Rack
(2) Tappet Roller
(3) Dumping Valve
(4) Delivery Valve Holder
(5) Delivery Valve
(6) Cylinder
(7) Plunger

11900M10170

(1) Pump Element



11790F10260

The pump element (1) is consist of the plunger (3) and cylinder (2).

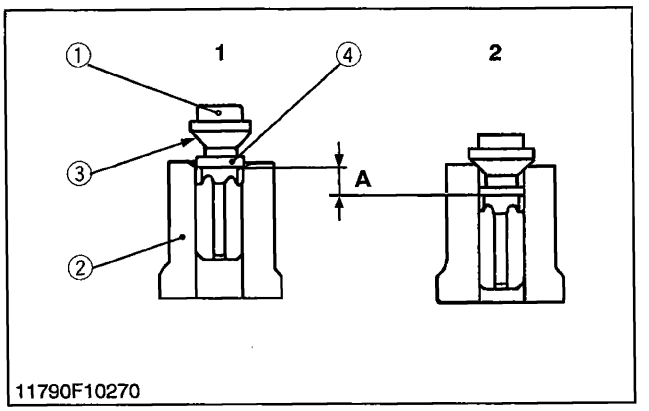
The sliding surfaces are super-precision machined to maintain injection pressure at engine low speeds. Since the driving face (7) fits in the control sleeve, the plunger (3) is rotated by the movement of the control rack to increase or decrease of fuel delivery.

As described above, the plunger (3) is machined to have the slot (5) and the control groove (6).

(1) Pump Element
(2) Cylinder
(3) Plunger
(4) Feed Hole
(5) Slot
(6) Control Groove
(7) Driving Face

11790M10231

(2) Delivery Valve



11790F10270

The delivery valve consists of the delivery valve (1) and delivery valve seat (2).

The delivery valve performs the following functions.

1. Reverse flow preventing function

If the fuel flow reverse from the injection nozzle side when the plunger lowers, the time lag between the next delivery start and the nozzle injection start increases. To avoid this, the delivery chamber to injection pipe interruption by delivery valve (1) prevents this reverse flow, thus keeping fuel always filled in the nozzle and pipe.

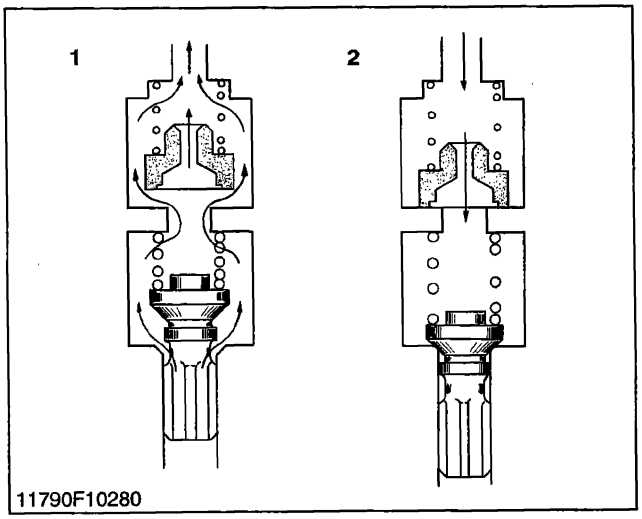
2. Suck-back function

After completing the fuel delivery, the delivery valve lowers, and the relief plunger (4) end contacts the delivery valve seat (2). The valve further lowers until its seat surface (3) seats firmly the delivery valve seat. During this time, the amount of fuel corresponding to **(A)** is sucked back from inside the injection pipe, the pressure inside the pipe is reduced, thus leading to an improved injection shut off and preventing after leakage dribbling.

(1) Delivery Valve
(2) Delivery Valve Seat
(3) Seat Surface
(4) Relief Plunger

11790M10241

(3) Dumping Valve



1. At fuel injection

Since dumping valve is pushed up to press the spring, fuel is pressure-fed to injection nozzle the same as without dumping valve.

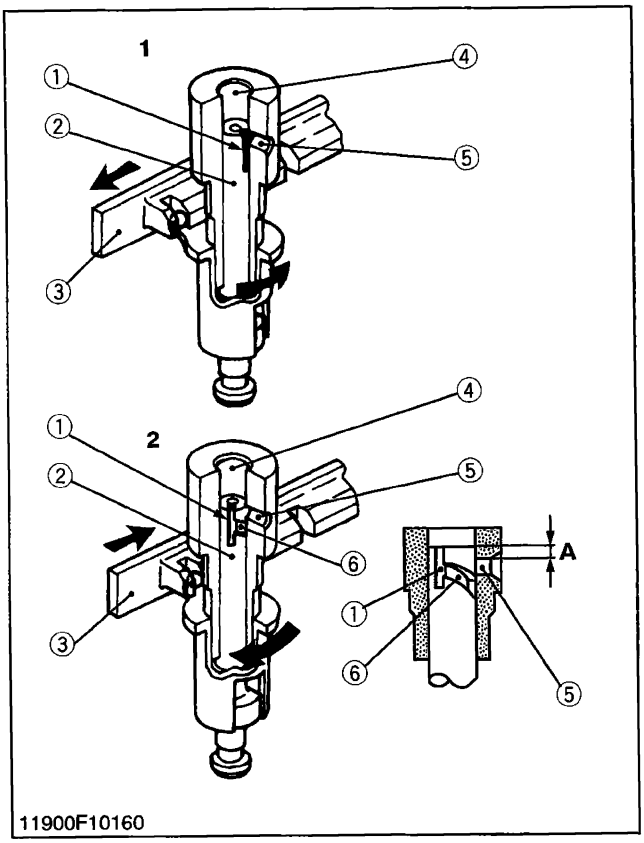
2. At suck-back

At suck-back by delivery valve after fuel injection fuel returns through dumping valve orifice. Generally second injection is apt to occur by reflex pressure due to reaction of sudden pressure drop when changing into suck-back by delivery valve from high injection pressure.

As a result of preventing this second injection perfectly by dumping valve and dissolving nozzle clogging, durability of injection nozzle is improved.

11790M10251

(4) Injection Control



1. No fuel delivery

At the engine stop position of the control rack (3), the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). And the delivery chamber (4) is led to the feed hole during the entire stroke of the plunger.

The pressure in the delivery chamber does not build up and no fuel can be forced to the injection nozzle.

2. Fuel delivery

The plunger (2) is rotated (see figure) by the control rack (3).

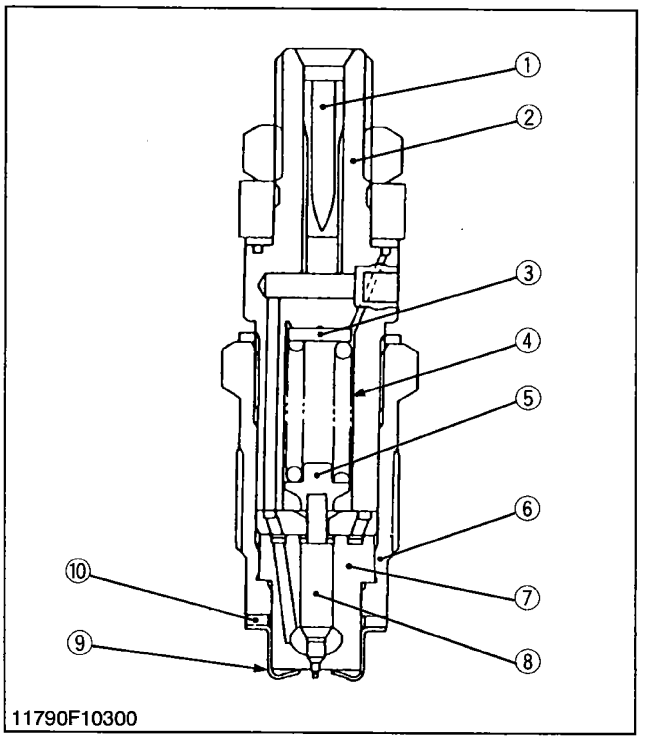
When the plunger is pushed up, the feed hole (5) is closed. The pressure in the delivery chamber (4) builds up and forcefeeds the fuel to the injection nozzle until the control groove (6) meets the feed hole (5).

The amount of the fuel corresponds to the distance **"A"**.

(1) Slot
(2) Plunger
(3) Control Rack
(4) Delivery Chamber
(5) Feed Hole
(6) Control Groove

11900M10181

[3] Injection nozzle



11790F10300

This nozzle is throttle-type. The needle valve (8) is pushed against the nozzle body (7) by the nozzle spring via the push rod (5). Fuel pressurized by the injection pump pushes the needle valve up and then is injected into the sub-combustion chamber.

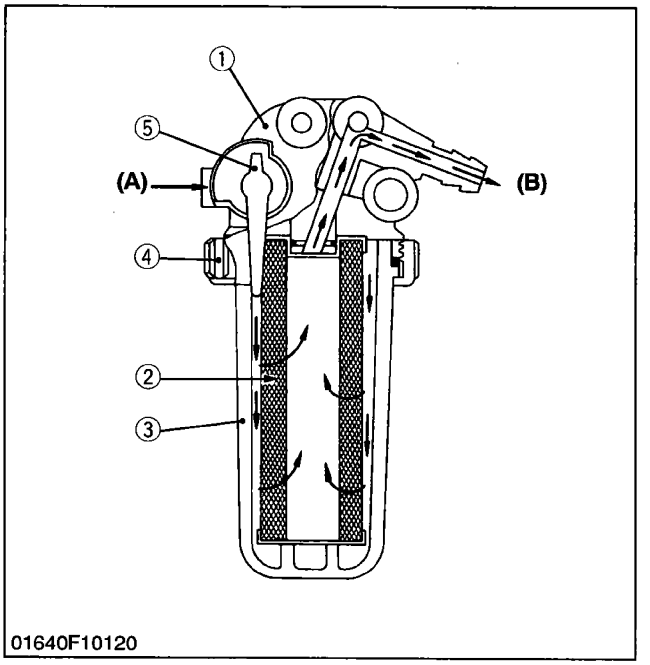
Excessive flow passes from nozzle holder center through the eye joint and the fuel overflow pipe to the fuel tank.

The injection pressure is 13.73 to 14.71 MPa (140 to 150 kgf/cm^2, 1991 to 2133 psi), and is adjusted with adjusting washers (3).

(1) Bar Filter
(2) Nozzle Holder Body
(3) Adjusting Washer
(4) Nozzle Spring
(5) Push Rod
(6) Retaining Nut
(7) Nozzle Body
(8) Needle Valve
(9) Heat Seal
(10) Gasket

11790M10272

[4] Fuel filter (not included in the basic model)



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Each moving part of the injection pump and nozzle is extremely precision machined, and clearances of their sliding parts are extremely small. Fuel itself serves as lubricating oil. For this reason, it is extremely important to completely remove water and dirt contained in fuel.

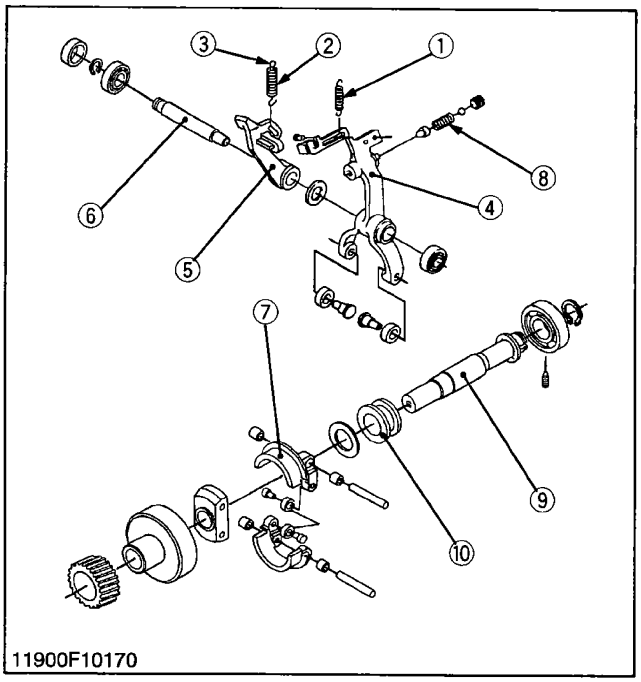
This fuel filter, which uses very fine filter paper, serves to separate and filter dirt in fuel and water accumulated in the tank.

Air vent plug is fitted to the cock body. Before starting or after disassembling and reassembling, loosen this plug and bleed the air in the fuel system.

(1) Cock Body
(2) Filter Element
(3) Filter Cup
(4) Retaining Ring
(5) Fuel Cock
(A) Inlet
(B) Outlet

01640M10030

[5] Governor



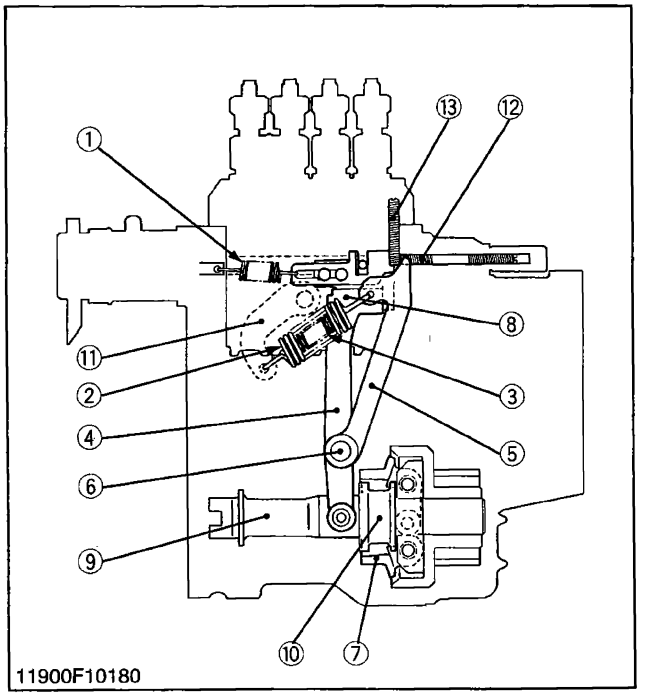
This mechanism maintains engine speed at a constant level even under fluctuating loads, provides stable idling and regulates maximum engine speed by controlling the fuel injection rate.

This engine uses a mechanical governor that controls the fuel injection rate at all speed ranges (from idling to maximum speed) by utilizing the balance between the flyweight's centrifugal force and spring tension.

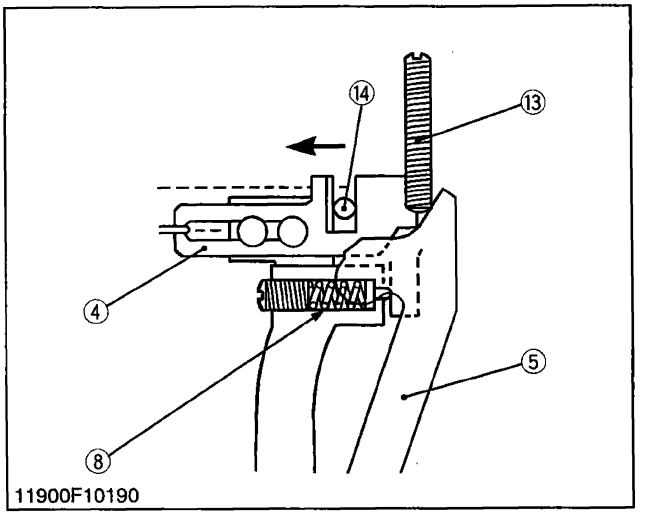
A governor shaft for monitoring engine speed is independent of the injection pump shaft and rotates at twice the speed of conventional types, providing better response to load fluctuation and delivering greater engine output.

(1) Start Spring
(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(5) Fork Lever 2
(6) Fork Lever Shaft
(7) Flyweight
(8) Torque Spring
(9) Governor Shaft
(10) Governor Sleeve

11900M10190



11900F10180



11900F10190

■ At Start

As no centrifugal force is applied to flyweight (7), low tension of start spring (1) permits control rack to move to the starting position, supplying the amount of fuel required to start the engine.

■ At Idling

Setting speed control lever (11) to the idling position during engine rotation permits the low tension of governor spring 2 (3), start spring (1) and idle limit spring (12) to balance the centrifugal force of flyweight (7) without activating high tension governor spring 1 (2). In this way, the fuel injection rate can be controlled to ensure stable idling.

■ At High Speed Running with Overload

Governor spring 1 (2) and 2 (3) control the fuel injection rate. To maintain the required engine speed, fuel is supplied according to the speed control lever setting and load by balancing the tension of governor springs 1 and 2 with the centrifugal force of flyweight (7).

In addition, idle limit spring (12) provides stable engine rotation.

■ During Overload

At load increases, the engine speed decreases, reducing the flyweight's centrifugal force. Governor springs 1 (2) and 2 (3), therefore, pull fork levers 1 (4) and 2 (5), increasing the fuel injection rate and maintaining engine speed.

If engine speed decreases due to a further increase in load, fork lever 2 (5) will come in contact with the fuel limit bolt, stopping a further increase in the fuel injection rate.

Torque spring (8) incorporated in fork lever 1 (4) moves the lever in the direction of fuel injection rate increase, thereby boosting torque and providing greater engine output.

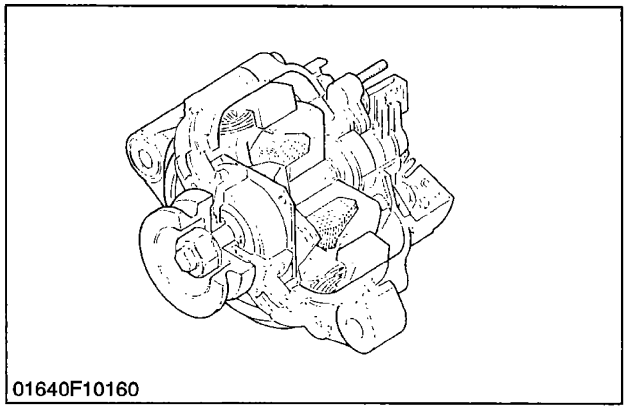
(1) Start Spring
(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(5) Fork Lever 2
(6) Fork Lever Shaft
(7) Flyweight
(8) Torque Spring
(9) Governor Shaft
(10) Governor Sleeve
(11) Speed Control Lever
(12) Idle Limit Spring
(13) Fuel Limit Adjust Bolt
(14) Control Rack Pin

11900M10200

G. Electrical system

[1] Charging system

(1) Alternator

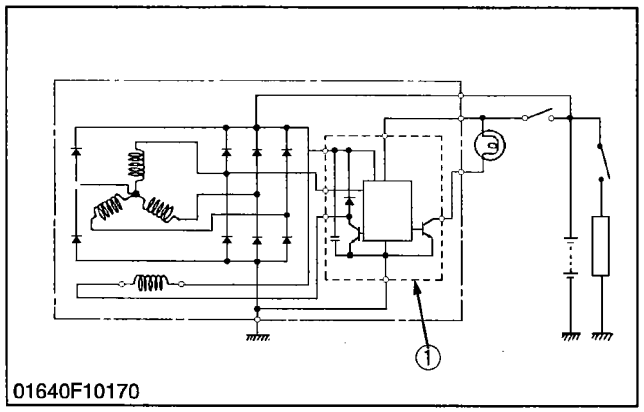

01640F10160

A compact alternator with an IC regulator is used, having the following characteristics:

- Approximately 26 % lighter and 17 % smaller than a standard alternator.
- Cooling performance and safety have been improved by combining the cooling fan with the rotor and incorporating the fan / rotor unit inside the alternator.
- IC regulator is fitted inside the alternator.
- The rectifier, IC regulator and similar components are easy to remove, making it easier to service the alternator.

01640M90010

(2) IC Regulator



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An IC regulator uses solid state transistors, chips or othere semiconductor elements instead of the relays in a conventional regulator. Stable characteristics are achieved by cutting off the field current.

IC regulators have the following characteristics:

- The control voltage does not change over time, so the need for readjustment is eliminated. Since there are no moving parts, IC regulators are extremely durable and resistant to vibration.
- The overheat compensation characteristics ensure that the control voltage is reduces as the temperature rises, so the battery is charged at just the right level.

The internal circuitry of the IC regulator is shown in the diagram. It consists of a hybrid IC incorporating a monolighic IC. (The internal circuitry of the monolithic IC is extremely complex, so it is shown as simply "**M.IC circuit**".

Tr1 acts as the contacts controlling the field current, and **Tr2** acts as the charge lamp relay controlling the flashing of the charge lamp.

The M.IC circuit controls **Tr1** and **Tr2**, and monitors the alternator output voltage, and detacts any drop in **L** terminal voltage or breaks in the rotor coil.

(1) IC Regulator

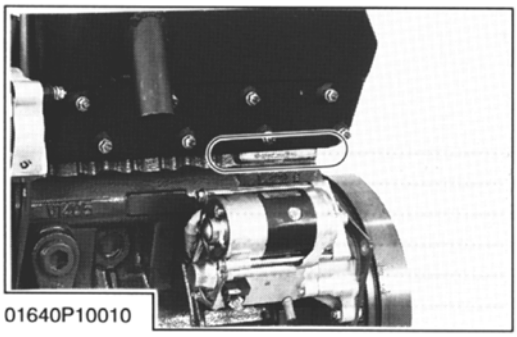
01640M90020

III-5. Engine WSM (Service section)

B.General

[1] Engine identification

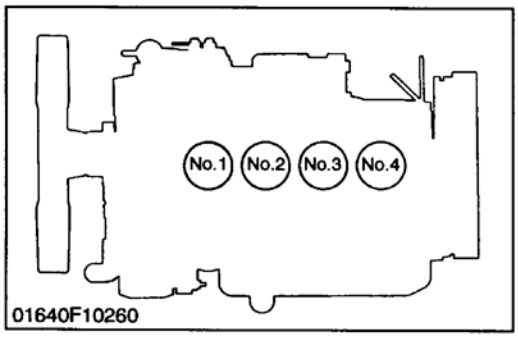
(1) Model Name and Engine Serial Number


01640P10010

When contacting the manufacturer, always specify your engine model name and serial number.

01640S10010

(2) Cylinder Number



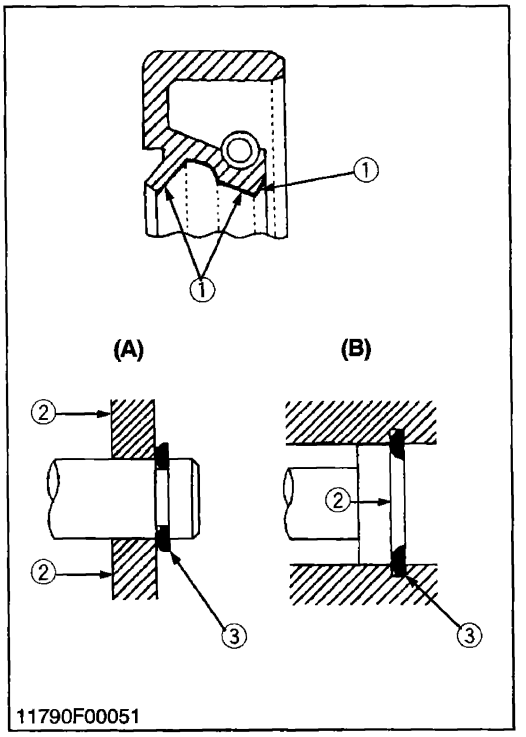
01640F10260

The cylinder numbers of 05 SERIES diesel engine are designated as shown in the figure.

The sequence of cylinder numbers is given as No. 1, No. 2, No. 3 and No. 4 starting from the gear case side.

01640S10020

[2] General precaution



- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be replaced in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently used should be make according to the drawings provided.
- Before disassembling or servicing live wires, make sure to always disconnect the grounding cable from the battery first.
- Remove oil and dirt from parts before measuring.
- Use only KUBOTA genuine parts for parts replacement to maintain engine performance and to ensure safety.
- Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling.
- When reassembling external or internal snap rings, position them so that the sharp edge faces against the direction from which force is applied.
- Be sure to perform run-in the serviced or reassembled engine. Do not attempt to give heavy load at once, or serious damage may result to the engine.

CAUTION

- **Certain components used in this engine (cylinder head-gasket, exhaust gasket, etc.) contain asbestos. Handle with care according to safety regulation.**

(1) Grease
(2) Force
(3) Place the Sharp Edge against the Direction of Force

(A) External Snap Ring
(B) Internal Snap Ring

01640S10030

[3] Tightening torques

Screws, bolts and nuts must be tightened to the specified torque using a torque wrench, several screws, bolts and nuts such as those used on the cylinder head must be tightened in proper sequence and at the proper torque.

01640S10760

(1) Tightening torques for special use screws, bolts and nuts

■ NOTE

- **In removing and applying the bolts and nuts marked with "*", a pneumatic wrench or similar pneumatic tool, if employed, must be used with enough care not to get them seized.**
- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size × Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.**

Item	Size × Pitch	N·m	kgf·m	ft-lbs
* Cylinder head cover cap nuts	M7 × 1.0	6.9 to 8.8	0.7 to 0.9	5.1 to 6.5
* Cylinder head screws	M10 × 1.25	63.7 to 68.6	6.5 to 7.0	47.0 to 50.6
* Main bearing case screws 1	M8 × 1.25	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
* Main bearing case screws 2	M9 × 1.25	49.0 to 53.9	5.0 to 5.5	36.2 to 39.8
* Flywheel screws	M10 × 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Connecting rod screws	M8 × 1.0	41.2 to 46.1	4.2 to 4.7	30.4 to 34.0
* Rocker arm bracket nuts	M7 × 1.0	21.6 to 26.5	2.2 to 2.7	15.9 to 19.5
* Idle gear shaft screws	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Crankshaft (Serial No: ~ 604086)	M14 × 1.5	142.2 to 152.0	14.5 to 15.5	104.9 to 112.1
end bolt (Serial No: 604087 ~)	M14 × 1.5	235.4 to 245.2	24.0 to 25.0	173.6 to 180.8
* Bearing case cover screws	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
Glow plugs (Serial No: ~ 489290)	M10 × 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
(Serial No: 489291 ~)	M8 × 1.0	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
Nozzle holder assembly	M20 × 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Oil switch taper screw	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Injection pipe retaining nuts	M12 × 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Overflow pipe assembly retaining nuts	M12 × 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Starter's terminal **B** mounting nut	M8	8.8 to11.8	0.9 to 1.2	6.5 to 8.7

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(2) Tightening torques for general use screws, bolts and nuts

When the tightening torques are not specified, tighten the screws, bolts and nuts according to the table below.

Nominal Diameter \ Grade / Unit	Standard Screw and Bolt ④			Special Screw and Bolt ⑦		
	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M6	7.9 to 9.3	0.80 to 0.95	5.8 to 6.9	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
M8	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
M10	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
M12	62.8 to 72.6	6.4 to 7.4	46.3 to 53.5	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5

Screw and bolt material grades are shown by numbers punched on the screw and bolt heads. Prior to tightening, be sure to check out the numbers as shown below.

Punched number	Screw and bolt material grade
None or 4	Standard screw and bolt SS41, S20C
7	Special screw and bolt S43C, S48C (Refined)

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[4] Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	• No fuel	Replenish fuel	–
	• Air in the fuel system	Vent air	III-S-27
	• Water in the fuel system	Change fuel and repair or replace fuel system	–
	• Fuel pipe clogged	Clean	–
	• Fuel filter clogged	Clean or change	III-S-29
	• Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	III-S-28
	• Fuel with low cetane number	Use specified fuel	–
	• Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	–
	• Incorrect injection timing	Adjust	III-S-78, 79
	• Fuel camshaft worn	Replace	III-S-47
	• Injection nozzle clogged	Clean	III-S-80, 81
	• Injection pump malfunctioning	Repair or replace	III-S-46, 79 III-S-80
	• Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	–
	• Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	III-S-39, 42 III-S-43
	• Improper valve timing	Correct or replace timing gear	III-S-50
	• Piston ring and cylinder worn	Replace	III-S-63, 64 III-S-71
	• Excessive valve clearance	Adjust	III-S-31
(Starter Does Not Run)	• Battery discharged	Charge	–
	• Starter malfunctioning	Repair or replace	–
	• Key switch malfunctioning	Repair or replace	–
	• Wiring disconnected	Connect	–
Engine Revolution Is Not Smooth	• Fuel filter clogged or dirty	Clean or change	III-S-29
	• Air cleaner clogged	Clean or change	III-S-30
	• Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	–
	• Injection pump malfunctioning	Repair or replace	III-S-46, 79 III-S-80
	• Incorrect nozzle opening pressure	Adjust	III-S-80, 81
	• Injection nozzle stuck or clogged	Repair or replace	III-S-80, 81
	• Governor malfunctioning	Repair	III-S-48
Either White or Blue Exhaust Gas Is Observed	• Excessive engine oil	Reduce to specified level	III-S-26, 28
	• Piston ring and liner worn or stuck	Repair or replace	III-S-63, 64 III-S-71
	• Incorrect injection timing	Adjust	III-S-78, 79
	• Deficient compression	Adjust top clearance	III-S-39

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Symptom	Probable Cause	Solution	Reference Page
Either Black or Dark Gray Exhaust Gas Is Observed	• Overload	Lessen load	–
	• Low grade fuel used	Use specified fuel	–
	• Fuel filter clogged	Clean or change	III-S-29
	• Air cleaner clogged	Clean or change	III-S-30
	• Deficient nozzle injection	Repair or replace nozzle	III-S-80, 81
Deficient Output	• Incorrect injection timing	Adjust	III-S-78, 79
	• Engine's moving parts seem to be seizing	Repair or replace	–
	• Uneven fuel injection	Repair or replace injection pump	III-S-46, 78 III-S-79
	• Deficient nozzle injection	Repair or replace nozzle	III-S-80, 81
	• Compression leak	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	III-S-39, 42 III-S-43
Excessive Lubricant Oil Consumption	• Piston ring's gap facing the same direction	Shift ring gap direction	III-S-52
	• Oil ring worn or stuck	Replace	III-S-52, 63 III-S-63
	• Piston ring groove worn	Replace piston	III-S-52, 63
	• Valve stem and valve guide worn	Replace	III-S-57, 58
	• Carnkshaft bearing, and crank pin bearing worn	Replace	III-S-66, 67
	• Oil leaking due to defective seals or packing	Replace	–
Fuel Mixed into Lubricant Oil	• Injection pump's plunger worn	Replace pump element or injection pump	III-S-46, 79 III-S-80
	• Deficient nozzle injection	Repair or replace nozzle	III-S-42, 82
	• Injection pump broken	Replace	III-S-46
Water Mixed into Lubricant Oil	• Head gasket defective	Replace	III-S-43
	• Cylinder block or cylinder head flawed	Replace	III-S-57
Low Oil Pressure	• Engine oil insufficient	Replenish	III-S-26, 28
	• Oil strainer clogged	Clean	III-S-50
	• Relief valve stuck with dirt	Clean	–
	• Relief valve spring weaken or broken	Replace	–
	• Excessive oil clearance of crankshaft bearing	Replace	III-S-67, 68 III-S-69
	• Excessive oil clearance of crankpin bearing	Replace	III-S-66
	• Excessive oil clearance of rocker arm bearing	Replace	III-S-59
	• Oil passage clogged	Clean	–
	• Different type of oil	Use specified type of oil	–
	• Oil pump defective	Repair or replace	III-S-73, 74
High Oil Pressure	• Different type of oil	Use specified type of oil	–
	• Relief valve defective	Replace	–

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Symptom	Probable Cause	Solution	Reference Page
Engine Overheated	• Engine oil insufficient	Replenish	III-S-26, 28
	• Fan belt broken or elongated	Replace or adjust	III-S-29
	• Cooling water insufficient	Replenish	–
	• Radiator net and radiator fin clogged with dust	Clean	–
	• Inside of radiator corroded	Clean or replace	–
	• Cooling water flow route corroded	Clean or replace	–
	• Radiator cap defective	Replace	III-S-76
	• Overload running	Loosen load	–
	• Head gasket defective	Replace	III-S-43
	• Incorrect injection timing	Adjust	III-S-78, 79
	• Unsuitable fuel used	Use specified fuel	–
Battery Quickly Discharge	• Battery electrolyte insufficient	Replenish distilled water and charge	–
	• Fan belt slips	Adjust belt tension or change	III-S-29
	• Wiring disconnected	Correct	–
	• Rectifier defective	Replace	III-S-92
	• Alternator defective	Replace	III-S-90, 91 III-S-92
	• Battery defective	Change	–

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[5] Servicing specifications

(1) Engine Body

Cylinder Head

Item	Factory Specification	Allowable Limit
Cylinder Head Surface Flatness	–	0.05 mm 0.0019 in.
Top Clearance	0.55 to 0.75 mm 0.0217 to 0.0295 in.	–
Compression Pressure	2.84 to 3.23 MPa 29.0 to 33.0 kgf/cm^2 412 to 469 psi	2.25 MPa 23 kgf/cm^2 327 psi
Variance Among Cylinders	–	10 % or less

Valves

Valve Clearance (Cold)		0.145 to 0.185 mm 0.0057 to 0.0072 in.	–
Valve Seal Width	IN.	2.12 mm 0.0835 in	–
	EX.	2.12 mm 0.0835 in.	–
Valve Seat Angle	IN.	1.047 rad. 60°	–
	EX.	0.785 rad. 45°	–
Valve Face Angle	IN.	1.047 rad. 60°	–
	EX.	0.785 rad. 45°	–
Valve Recessing		– 0.05 to 0.25 mm 0.0020 to 0.0060 in.	0.4 mm 0.016 in.
Clearance between Valve Stem and Valve Guide		0.035 to 0.065 mm 0.0014 to 0.0025 in.	0.1 mm 0.0039 in.
		6.960 to 6.975 mm 0.2741 to 0.2764 in.	–
		7.010 to 7.025 mm 0.2760 to 0.2765 in.	–

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Valve Timing

Item		Factory Specification	Allowable Limit
Intake Valve Open	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.24 rad. (14°) before T.D.C.	–
	D1105-T-B (E) V1505-T-B (E)	0.38 rad. (22°) before T.D.C.	–
Close	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.52 rad. (30°) after B.D.C.	–
	D1105-T-B (E) V1505-T-B (E)	0.82 rad. (47°) after B.D.C.	–
Exhaust Valve Open	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.96 rad. (55°) before B.D.C.	–
	D1105-T-B (E) V1505-T-B (E)	0.91 rad. (52°) before B.D.C.	–
Close	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.24 rad. (14°) after T.D.C.	–
	D1105-T-B (E) V1505-T-B (E)	0.30 rad. (17°) after T.D.C.	–

Valve Spring

Free Length	37.0 to 37.5 mm 1.457 to 1.476 in.	36.5 mm 1.437 in.
Setting Load / Setting Length	11.97 kgf / 31.0 mm 117.4 N / 31.0 mm 26.4 lbs / 1.22 in.	10.2 kgf / 31.0 mm 100.0 N / 31.0 mm 22.5 lbs / 1.22 in.
Tilt	–	1.0 mm 0.039 in.

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Rocker Arm

Item	Factory Specification	Allowable Limit
Clearance between Rocker Arm Shaft and Rocker Arm	0.016 to 0.045 mm 0.0006 to 0.0018 in.	0.10 mm 0.0039 in.
Rocker Arm Shaft O.D.	11.973 to 11.984 mm 0.4714 to 0.4718 in.	–
Rocker Arm I.D.	12.000 to 12.018 mm 0.4724 to 0.4731 in.	–

Tappet

Clearance between Tappet and Guide	0.020 to 0.062 mm 0.0008 to 0.0024 in.	0.07 mm 0.0028 in.
Tappet O.D.	19.959 to 19.980 mm 0.7858 to 0.7866 in.	–
Tappet Guide I.D.	20.000 to 20.021 mm 0.7874 to 0.7882 in.	–

Camshaft

Camshaft Side Clearance		0.07 to 0.22 mm 0.0028 to 0.0087 in.	0.3 mm 0.0118 in.
Camshaft Alignment		–	0.01 mm 0.0004 in.
Cam Height	IN.	28.80 mm 1.1339 in.	28.75 mm 1.1319 in.
	EX.	29.00 mm 1.1417 in.	28.95mm 1.1398 in.
Oil Clearance of Camshaft		0.050 to 0.091 mm 0.0020 to 0.0036 in.	0.12 mm 0.0047 in.
Camshaft Journal O.D.		35.934 to 35.050 mm 1.4147 to 1.3799 mm	–
Camshaft Bearing I.D.		36.000 to 36.025 mm 1.4173 to 1.4183 in.	–

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Timing Gear

Item	Factory Specification	Allowable Limit
Timing Gear Backlash		
Crank Gear-Idle Gear 1	0.032 to 0.115 mm 0.0013 to 0.0045 in.	0.15 mm 0.0059 in.
Idle Gear 1-Cam Gear	0.036 to 0.114 mm 0.0014 to 0.0045 in.	0.15 mm 0.0059 in.
Idle Gear 1-Injection Pump Gear	0.034 to 0.116 mm 0.0013 to 0.0046 in.	0.15 mm 0.0059 in.
Idle Gear 1-Idle Gear 2	0.0033 to 0.117 mm 0.0013 to 0.0046 in.	0.15 mm 0.0059 in.
Idle Gear 2-Governor Gear	0.030 to 0.117 mm 0.0012 to 0.0046 in.	0.15 mm 0.0059 in.
Clearance between Idle Gear Shaft and Idle Gear Bushing		
Idle Gear 1	0.020 to 0.054 mm 0.0008 to 0.0021 in.	0.10 mm 0.0039 in.
Idle Gear Bushing I.D.	26.000 to 26.021 mm 1.0236 to 1.0244 in.	–
Idle Gear Shaft 1 O.D.	25.967 to 25.980 mm 1.0223 to 1.0228 in.	–
Idle Gear 2	0.020 to 0.054 mm 0.0008 to 0.0021 in.	0.10 mm 0.0039 in.
Idle Gear Bushing I.D.	26.000 to 26.021 mm 1.0236 to 1.0244 in.	–
Idle Gear Shaft 2 O.D.	25.967 to 25.980 mm 1.0223 to 1.0228 in.	–
Idle Gear Side Clearance		
Idle Gear 1	0.20 to 0.51 mm 0.0079 to 0.0200 in.	0.8 mm 0.0315 in.
Idle Gear 2	0.20 to 0.51 mm 0.0079 to 0.0200 in.	0.8 mm 0.315 in.

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Piston · Piston Ring

Item		Factory Specification	Allowable Limit
Piston Pin Bore		22.000 to 22.013 mm 0.8661 to 0.8687 in.	22.03 mm 0.8673 in.
Clearance between Compression Ring 2 and Ring Groove		0.085 to 0.112 mm 0.0033 to 0.0044 in.	0.20 mm 0.0079 in.
Clerance between Oil Ring and Ring Groove		0.020 to 0.055 mm 0.0008 to 0.0021 in.	0.15 mm 0.0059 in.
Ring Gap Compression Ring 1	D905-B (E) V1205-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1005-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.30 to 0.45 mm 0.0118 to 0.0170 in.	1.25 mm 0.0492 in.
	D1105-T-B (E) V1205-T-B (E) V1505-T-B (E)	0.20 to 0.35 mm 0.0079 to 0.0138 in.	1.20 mm 0.047 in.
Compression Ring 2	D905-B (E) V1205-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1005-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.30 to 0.45 mm 0.0118 to 0.0170 in.	1.25 mm 0.0492 in.
	V1205-T-B (E)	0.20 to 0.35 mm 0.0079 to 0.0138 in.	1.20 mm 0.047 in.
	D1105-T-B (E) V1505-T-B (E)	0.40 to 0.55 mm 0.0157 to 0.0217 in.	1.20 mm 0.047 in.
Oil Ring	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1105-T-B (E) V1505-T-B (E)	0.30 to 0.55 mm 0.0118 to 0.0217 in.	1.25 mm 0.0492 in.

Connecting Rod

Connecting Rod Alignment	-	0.05 mm 0.0020 in.
Clearance between Piston Pin and Small end Bushing	0.014 to 0.038 mm 0.0006 to 0.0015 in.	0.15 mm 0.0059 in.
Piston Pin O.D.	22.002 to 22.011 mm 0.8662 to 0.8666 in.	–
Small End Bushing I.D.	22.025 to 22.040 mm 0.8671 to 0.8677 in.	–

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Crankshaft

Item	Factory Specification	Allowable Limit
Crankshaft Alignment	–	0.02 mm 0.0008 in.
Oil Clearance between Crankshaft and Crankshaft Bearing 1	0.034 to 0.114 mm 0.0013 to 0.0045 in.	0.20 mm 0.0079 in.
Crankshaft O.D.	47.934 to 47.950 mm 1.8872 to 1.8878 in.	–
Crankshaft Bearing 1 I.D.	47.984 to 48.084 mm 1.8891 to 1.8917 in.	–
Oil Clearance between Crankshaft and Crankshaft Bearing 2	0.034 to 0.095 mm 0.0013 to 0.0037 in.	0.20 mm 0.0079 in.
Crankshaft O.D.	47.934 to 47.950 mm 1.8872 to 1.8878 in.	–
Crankshaft Bearing 2 I.D.	47.984 to 48.029 mm 1.8891 to 1.8909 in.	–
Oil Clearance between Crankshaft and Crankshaft Bearing 3	0.034 to 0.098 mm 0.0013 to 0.0039 in.	0.20 mm 0.0079 in.
Crankshaft O.D.	51.921 to 51.940 mm 2.0441 to 2.0449 in.	–
Crank bearing 3 I.D.	51.974 to 52.019 mm 2.0462 to 2.0480 in.	–
Oil Clearance between Crank Pin and Crank Pin Bearing	0.029 to 0.091 mm 0.0011 to 0.0036 in.	0.20 mm 0.0079 in.
Crank Pin O.D.	39.959 to 39.975 mm 1.5732 to 1.5738 in.	–
Crank Pin Bearing I.D.	40.004 to 40.050 mm 1.5750 to 1.5768 in.	–
Crankshaft Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.

Cylinder Liner

Cylinder Liner I.D.	D905-B (E) V1205-B (E) V1205-T-B (E)	72.000 to 72.019 mm 2.8346 to 2.8354 in.	+ 0.15 mm 0.0059 in.
	D1005-B (E) V1305-B (E)	76.000 to 76.019 mm 2.9921 to 2.9929 in.	+ 0.15 mm 0.0059 in.
	D1105-B (E) D1105-T-B (E) V1505-B (E) V1505-T-B (E)	78.000 to 78.019 mm 3.0709 to 3.0716 in.	+ 0.15 mm 0.0059 in.
Oversized Cylinder Liner I.D.		+ 0.5 mm + 0.0197 in.	+ 0.15 mm 0.0059 in.

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(2) Lubricating System

Oil Pump

Item	Factory Specification	Allowable Limit
Engine Oil Pressure At Idle Speed	49 kPa 0.5 kgf/cm^2 7 psi	–
At Rated Speed	196.0 to 441.0 kPa 2.0 to 4.5 kgkf/cm^2 28.0 to 64.0 psi	147.1 kPa 1.5 kgf/cm^2 21.3 psi
Clearance between Inner Rotor and Outer Rotor	0.06 to 0.18 mm 0.0024 to 0.0071 in.	–
Clearance between Outer Rotor and Pump Body	0.100 to 0.180 mm 0.0039 to 0.0071 in.	–
End Clearance between Inner Rotor and Cover	0.025 to 0.75 mm 0.0098 to 0.0295 in.	–

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(3) Cooling System

Thermostat

Thermostat's Valve Opening Temperature	69.5 to 72.5 °C 157.1 to 162.5 °F	–
Temperature at Which Thermostat Completely Opens	85 °C 185 °F	–

Radiator

Radiator Water Tightness	Water tightness at specified pressure 137 kPa (1.4 kgf/cm^2, 20 psi)	–
Radiator Cap Air Leakage	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm^2 13 → 9 psi	–
Fan Belt Tension	10 to 12 mm / 98 N 10 to 12 mm / 10 kgf 0.394 to 0.472 in. / 22.1 lbs.)	–

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(4) Fuel System

Injection Pump

Item		Factory specification	Allowable Limit
Injection Timing Without Timer	3000 rpm	0.31 to 0.35 rad. (18 to 20°) Before T.D.C.	–
	3600 rpm	0.37 to 0.40 rad. (21 to 23°) Before T.D.C.	–
With Timer	3000 rpm	0.14 to 0.17 rad. (8 to 10°) Before T.D.C.	–
	V1505-B (E)	0.21 to 0.24 rad. (12 to 14°) Before T.D.C.	–
	3600 rpm	0.16 to 0.19 rad. (9 to 11°) Before T.D.C.	–
Fuel Titghtness of Pump Element		–	14.7 MPa 150 kgf/cm^2 2133 psi
Fuel Tightness of Delivery Valve		More 10 seconds 14.7 → 13.7 MPa 150 → 140 kgf/cm^2 2133 → 1990 psi	5 seconds 14.7 → 13.7 MPa 150 →140 kgf/cm^2 2133 → 1990 psi

Injection Nozzle

Fuel Injection Pressure	13.73 to 14.71 MPa 140 to 150 kgf/cm^2 1991 to 2133 psi	–
Fuel Titghtness of Nozzle Valve Seat	When the pressure is 12.75 MPa (130 kgf/cm^2, 1849 psi), the valve seat must be fuel tightness	–

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(5) Electrical System

Starter

Item	Factory Specification	Allowable Limit
Commutator O.D.	30.0 mm 1.1811 in.	29.0 mm 1.1417 in.
Mica Undercut	0.5 to 0.8 mm 0.0197 to 0.0315 in.	0.2 mm 0.079 in.
Brush Length	13.0 mm 0.5118 in.	8.5 mm 0.3346 in.

Alternator

No-load Voltage	13.5 V at 5000 rpm	–
Stator Resistance	Less than 1 Ω	–
Rotor Resistance	2.9 Ω	–
Slip Ring O.D.	14.4 mm 0.5669 in.	14 mm 0.5512 in.
Brush Length	10.0 mm 0.3937 in.	1.5 mm 0.0591 in.

Glow Plug

Glow Plug Resistance A	Approx. 1.0 to 1.2 Ω	–
B	Approx. 0.9 Ω	–

A : S / N 489290 & below
B : S / N 489291 & above

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[6] Maintenance check list

To maintain long-lasting and safe engine performance, make it a rule to carry out regular inspections by following the table below.

Item		Service Interval											
		Every 50 hrs	Every 75 hrs	Every 100 hrs	Every 150 hrs	Every 200 hrs	Every 300 hrs	Every 400 hrs	Every 500 hrs	Every 800 hrs	Every 1500 hrs	Every one year	Every two years
Checking fuel pipes and clamps		☆											
* Changing engine oil	(1), (3) Oil pan depth (101 mm)		(1) ☆		(3) ☆								
	(2), (4) Oil pan depth (125 mm)			(2) ☆		(4) ☆							
Cleaning air filter element				☆									
Cleaning fuel filter element				☆									
Checking fan belt tension and damage				☆									
Checking water pipes and clamps						☆							
* Changing oil filter cartridge	(5), (7) Oil pan depth (101 mm)				(5) ☆		(7) ☆						
	(6), (8) Oil pan depth (125 mm)					(6) ☆		(8) ☆					
Changing fuel filter cartridge								☆					
Cleaning radiator interior									☆				
Changing radiator coolant (L.L.C)													☆
** Checking injection nozzle											☆		
Changing air filter element												☆	
Cheking valve clearance										☆			
Changing water pipes and clamps													☆
Changing fuel pipes and clamps													☆

(1), (2) For generators (3000 / 3600 rpm)
(3), (4) For generators (1800 / 1500 rpm) and general construction / industrial machinery and farm equipment
(5), (6) For generators (3000 / 3600 rpm) and general construction / industrial machinery and farm equipment
(7), (8) For generators (1800 / 1500 rpm)

* Change engine oil and oil cartridge after the first 50 hours of operation.
** Maintenance inetrvals as per EPA instructions.

CAUTION

- **When changing or inspecting, be sure to level and stop the engine.**

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[7] Check and maintenance

(1) Daily Check Points

Checking Engine Oil Level

1. Level the engine.
2. To check the oil level, draw out the dipstick, wipe it clean, reinsert it, and draw it out again.
   Check to see that the oil level lies between the two notches.
3. If the level is too low, add new oil to the specified level.

■ IMPORTANT

- **When using an oil of different maker or viscosity from the previous one, drain old oil. Never mix two different types of oil.**

01640S10050

Checking and Replenish Cooling Water

1. Remove the radiator cap and check to see that the cooling water level is just bellow the port.
2. If low, add clean water and antifreeze.

⚠ CAUTION

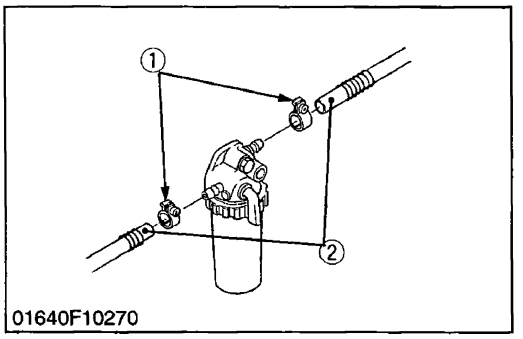
- **Do not remove the radiator cap until cooling water temperature is below its boiling point. Then loosen the cap slightly to relieve any excess pressure before removing the cap completely.**

■ IMPORTANT

- **Be sure to close the radiator cap securely. If the cap is loose or improperly closed, water may leak out and the engine could overheat.**
- **Do not use an antifreeze and scale inhibitor at the same time.**

01640S10060

(2) Check Point of Every 50 hours



01640F10270

Checking Fuel Pipe

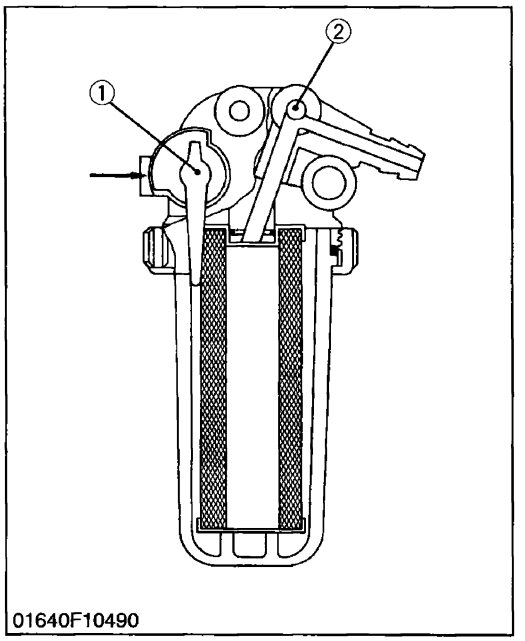
1. If the clamp (1) is loose, apply oil to the threads and securely retighten it.
2. The fuel pipe (2) is made of rubber and ages regardless of the period of service.
   Change the fuel pipe together with the clamp every two years.
3. However, if the fuel pipe and clamp are found to be damaged or deteriorate earlier than two years, then change or remedy.
4. After the fuel pipe and the clamp have been changed, bleed the fuel system.

⚠ CAUTION

- **Stop the engine when attempting the check and change prescribed above.**

(1) Clamp (2) Fuel Pipe

01640S10070



01640F10490

(When bleeding fuel system)

1. Fill the fuel tank with fuel, and open the fuel cock (1).
2. Loosen the air vent plug (2) of the fuel filter a few turns.
3. Screw back the plug when bubbles do not come up any more.
4. Open the air vent cock on top of the fuel injection pump.
5. Retighten the plug when bubbles do not come up any more.

■ NOTE

- **Always keep the air vent plug on the fuel injection pump closed except when air is vented, or it may cause the engine to stop.**

(1) Fuel Cock (2) Air Vent Plug

01640S10080

(3) Check Point of Every 100 hours

Changing Engine Oil

1. After warming up, stop the engine.
2. To change the used oil, remove the drain plug at the bottom of the engine and drain off the oil completely.
3. Reinstall the drain plug.
4. Fill the new oil up to the upper notch on the dipstick. (See page S-47.)

■ IMPORTANT

- **Engine oil should be MIL-L-46152 / MIL-L-2104C or have properties of API classification CD / CE grades.**
- **Change the type of engine according to the ambient temperature.**
  Above 25 °C (77 °F)..... SAE 30 or 10W-30
  0 °C to 25 °C (32 °F to 77 °F)..... SAE 20 or 10W-30
  Below 0 °C (32 °F)..... SAE 10W or 10W-30

Oil pan depth / Models	Capacity	
	125 mm (4.92 in.)	101 mm (3.97 in.)
D905-B (E) D1005-B (E) D1105-B(E) D1105-T-B (E)	5.1 L 5.39 U.S.qts. 4.49 Imp.qts	4.0 L 4.23 U.S.qts. 3.52 Imp.qts
V1205-B (E) V1305-B (E) V1505-B (E)	6.0 L 6.34 U.S.qts. 5.28 Imp.qts.	4.7 L 4.97 U.S.qts. 4.14 Imp.qts.
V1205-T-B (E) V1505-T-B (E)	6.7 L 7.08 U.S.qts. 5.90 Imp.qts.	—

01640S10090

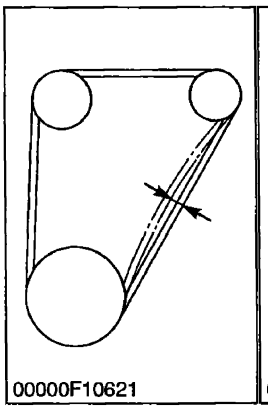
Changing Engine Oil Filter Cartridge

1. Remove the oil filter cartridge with a filter wrench.
2. Apply engine oil to the rubber gasket on the new cartridge.
3. Screw the new cartridge in by hand. (See page S-44.)

■ NOTE

- **Over-tightening may cause deformation of rubber gasket.**
- **After cartridge has been replaced, engine oil normally decreases a little.**
  Check the oil level and add new oil to the specified level.

01640S10100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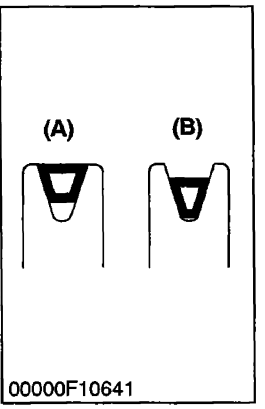


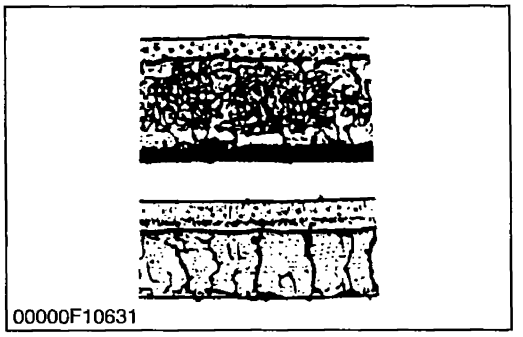
00000F10641

Checking Fan Belt Tension

1. Press the fan belt between fan pulley and pulley at force of 98 N (10 kgf, 22 lbs).
   Check if the fan belt deflection is 10 to 12 mm (0.394 to 0.472 in.).
2. If the deflection is not within the factory specifications, adjust with the tension pulley adjusting bolts.

(A) Good **(B) Bad**

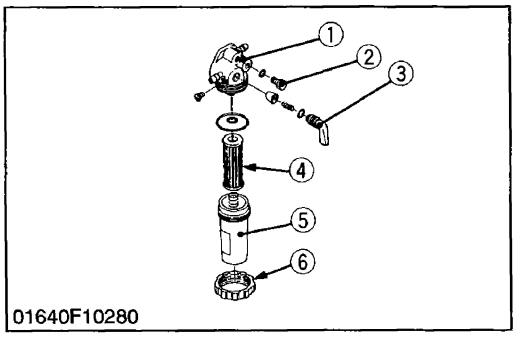
01640S10110


00000F10631

Checking Fan Belt Damage

1. Check the fan belt for damage.
2. Check if the fan belt is worn and sunk in the pulley groove.
3. Replace the fan belt if the belt is damaged or nearly worn out and deeply sunk in the pulley groove.

00000S10461



01640F10280

Cleaning Fuel Filter

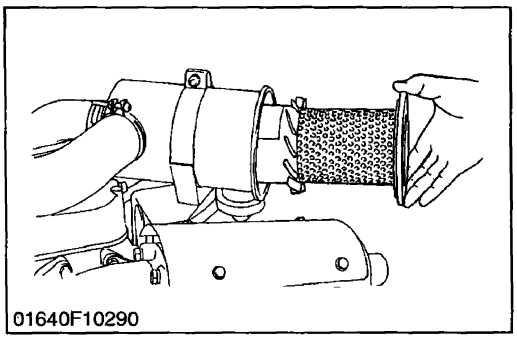
1. Close the fuel filter cock (3).
2. Unscrew the retaining ring (6) and remove the cup (5), and rinse the inside with kerosene.
3. Take out the element (4) and dip it in the kerosene to rinse.
4. After cleaning, reassemble the fuel filter, keeping out dust and dirt.
5. Bleed the fuel system.

■ IMPORTANT

- **If dust and dirt enter the fuel, the fuel injection pump and injection nozzle will wear quickly. To prevent this, be sure to clean the fuel filter cup periodically.**

(1) Cock Body
(2) Air Vent Plug
(3) Filter Cock
(4) Filter Element
(5) Filter Cup
(6) Retaining Ring

01640S10120


01640F10290

Cleaning Air Cleaner

1. The air cleaner uses a dry element. Never apply oil to it.
2. Remove and clean out the dust cup before it becomes half full with dust.
3. When the air filter element is dusty, clean it.

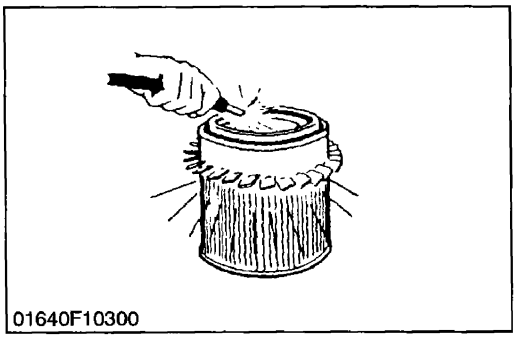
■ **NOTE**

- **Change the element once a year or every 6th cleaning.**

■ **IMPORTANT**

- **Install the air cleaner dust cup with "TOP" indicated on the rear of the cup in the upside.**
  If the dust cup is mounted incorrectly, dust or dirt does not collect in the cup, and direct attachment of the dust to the element will cause its life time to shorten to a great extent.

01640S10130

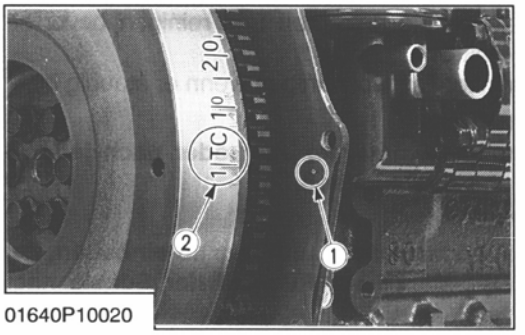

01640F10300

Cleaning Air Filter Element

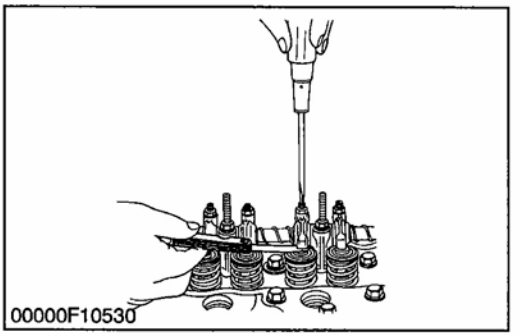
- **When dry dust adheres**
  Use clean dry compressed air on the inside of the element.
  Air pressure at the nozzle must not exceed 690 kPa (7 kgf/cm^2, 100 psi).
  Maintain reasonable distance between the nozzle and the filter.

01640S10140

(4) Check Point of Every 800 hours



01640P10020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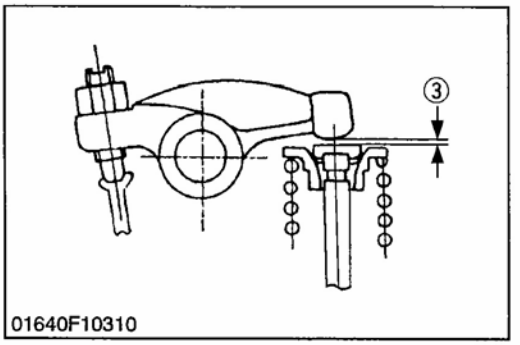


01640F10310

Checking Valve Clearance

■ IMPORTANT

- **Valve clearance must be checked and adjusted when engine is cold.**

1. Remove the head cover.
2. Align the **"1TC"** mark on the flywheel and projection (1) on the housing so that the No. 1 piston comes to the compression or overlap top dead center.
3. Check the following valve clearance marked with "☆" using a feeler gauge.
4. If the clearance, adjust with the adjusting screw.

Valve clearance	Factory spec.	0.145 to 0.185 mm 0.0057 to 0.0072 in.

■ NOTE

- **The "TC" marking on the flywheel is just for No. 1 cylinder. there is no "TC" marking for the other cylinders.**
- **No. 1 piston comes to the T.D.C. position when the "TC" marking is aligned with the projection in the window on flywheel-housing. Turn the flywheel 0.26 rad. (15°) clockwise and counter-clockwise to see if the piston is at the compression top dead center or the overlap position. Now referring to the table below, readjust the valve clearance. (The piston is at the top dead center when both the IN. and EX. valves do not move; it is at the overlap position when both the valves move.**
- **Finally turn the flywheel 6.28 rad. (360°) and aligne the "TC" marking and the projection perfectly. Adjust the other valve clearance as required.**
- **After turning the flywheel counterclockwise twice or three times, recheeck the valve clearance.**
- **After adjusting the valve clearance, firmly tighten the lock nut of the adjusting screw.**

Number of cylinders Valve arrangement Adjustable cylinder Location of piston		3 cylinder		4 cylinder	
		IN.	EX	IN.	EX
When No. 1 piston is compression top dead center	1st	☆	☆	☆	☆
	2nd		☆	☆	
	3rd	☆			☆
	4th				
When No. 1 piston is overlap position	1st				
	2nd	☆			☆
	3rd		☆	☆	
	4th			☆	☆

(1) Projection
(2) **TC** Mark Line
(3) Valve Clearance

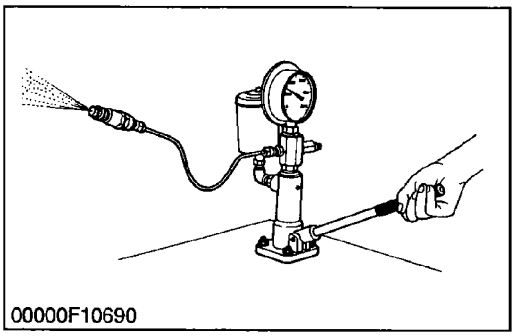
01640S10150

(5) Check Point of 1500 hours (Serial No: ~ 489290)

⚠ CAUTION

- **Check the nozzle injection pressure and condition after confirming that there is nobody standing in the direction the fume goes. If the fume from the nozzle directly contacts the human body, cells may be destroyed and blood poisoning may be caused.**

01640S10160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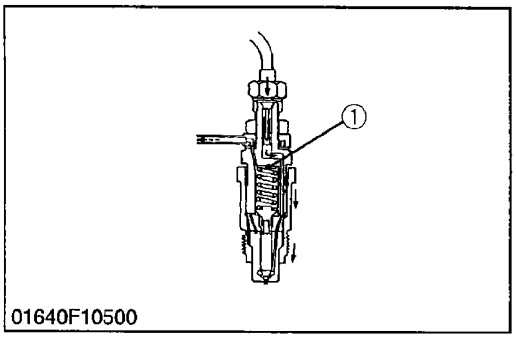


01640F10500

Checking Nozzle Injection Pressure

1. Set the injection nozzle to the nozzle tester (Code No: 07909-31361).
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, disassemble the injection nozzle, and change adjusting washer (1) until the proper injection pressure is obtained. (See page S-159.)
4. If the spraying condition is defective, replace the nozzle piece.

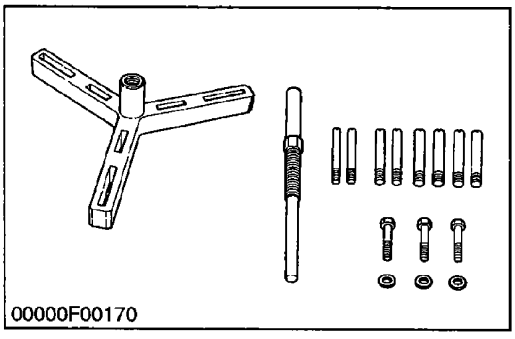
(Reference)

- Pressure variation with 0.025 mm (0.001 in.) difference of adjusting washer thickness.
  Approx. 59 kPa (6 kgf/cm^2, 85 psi)

(1) Adjusting Washer

01640S10170

[8] SPECIAL TOOLS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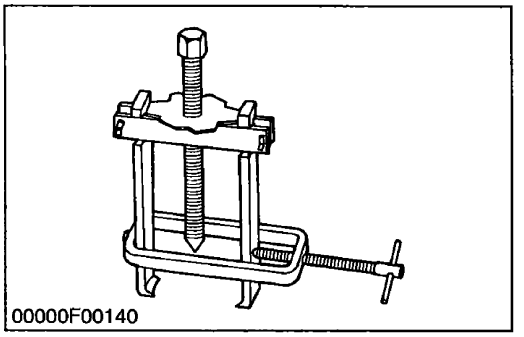
Flywheel Puller

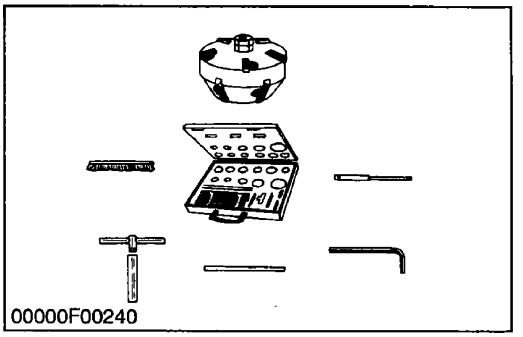
Code No: 07916-32011
Application: Use to remove the flywheel.

01640S10180



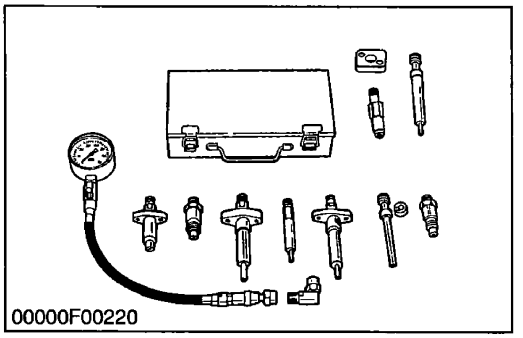
Special-use Puller Set
Code No: 07916-09032
Application: Use for pulling out bearings, gears and other parts.

01640S10190



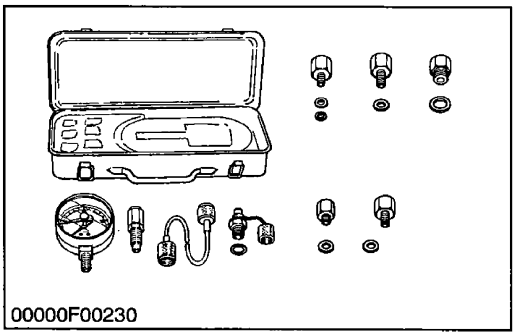
Valve Seat Cutter Set
Code No: 07909-33102
Application: Use for correcting valve seats.

01640S10200



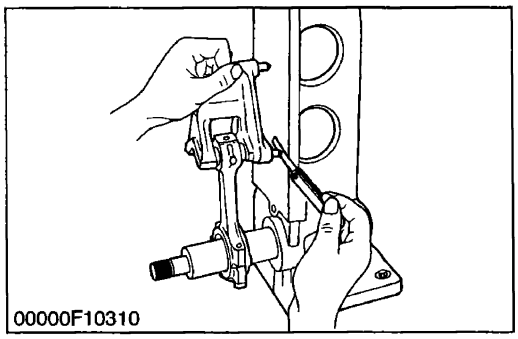
Diesel Engine Compression Tester
Code No: 07909-30207
Application: Use for measureing diesel engine compression pressure.

01640S10210



Oil Pressure Tester
Code No: 07916-32031
Application: Use for measureing lubricating oil pressure.

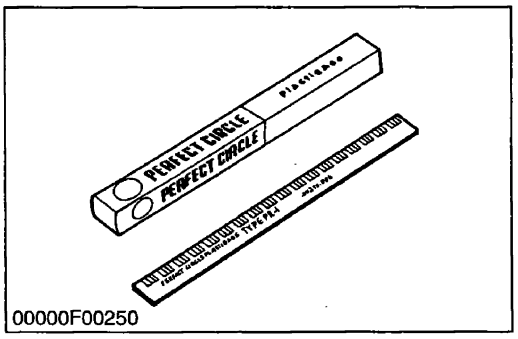
01640S10220


00000F10310

Connecting Rod Alignment Tool

Code No: 07909-31661
Application: Use for checking the connecting rod alignment.
Applicable range: Connecting rod big end I.D. 30 to 75 mm (1.18 to 2.95 in.dia.). Connecting rod length 65 to 330 mm (2.56 to 12.99 in.).

01640S10230

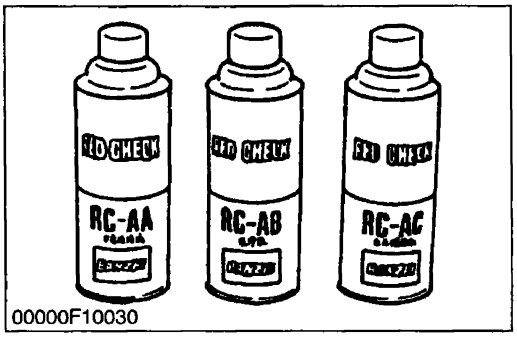


00000F00250

Press Gauge

Code No: 07909-30241
Application: Use for checking the oil crearance between crankshaft and bearing, etc.
Measureing range: Green ---- 0.025 to 0.076 mm (0.001 to 0.003 in.)
Red ------- 0.051 to 0.152 mm (0.002 to 0.006 in.)
Blue-------- 0.102 to 0.229 mm (0.004 to 0.009 in.)

01640S10240



00000F10030

Red Check (Crack Check Liquid)

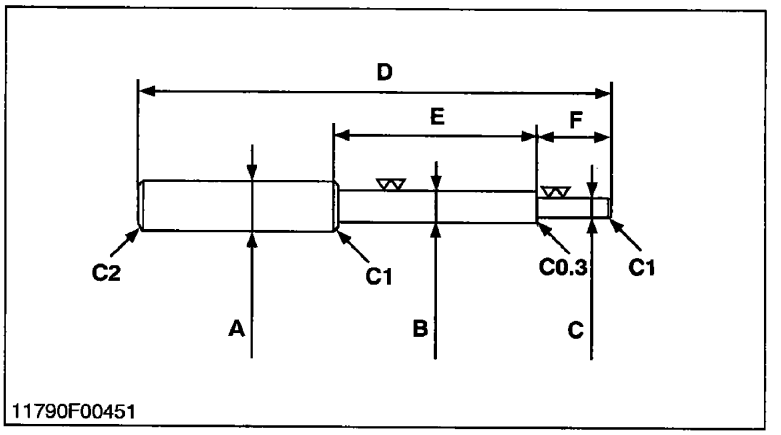
Code No: 07909-31371
Application: Use for checking cracks on cylinder head, cylinder block, etc.

01640S10250

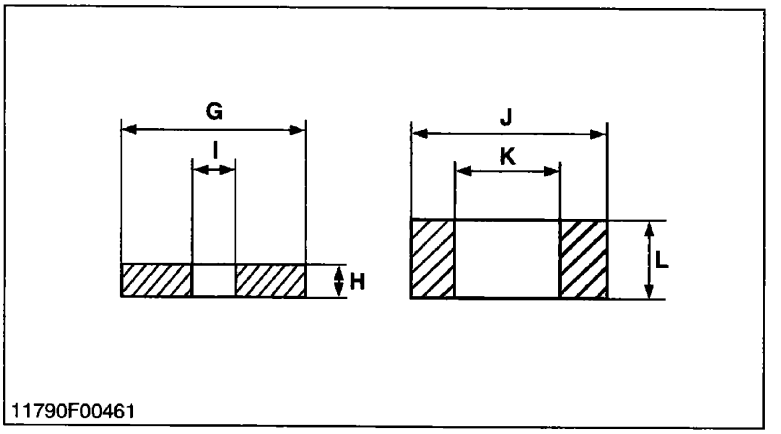
■ **NOTE**

- **The following special tools are not provided, so make them referring to the figure.**

01640S10910



11790F00451



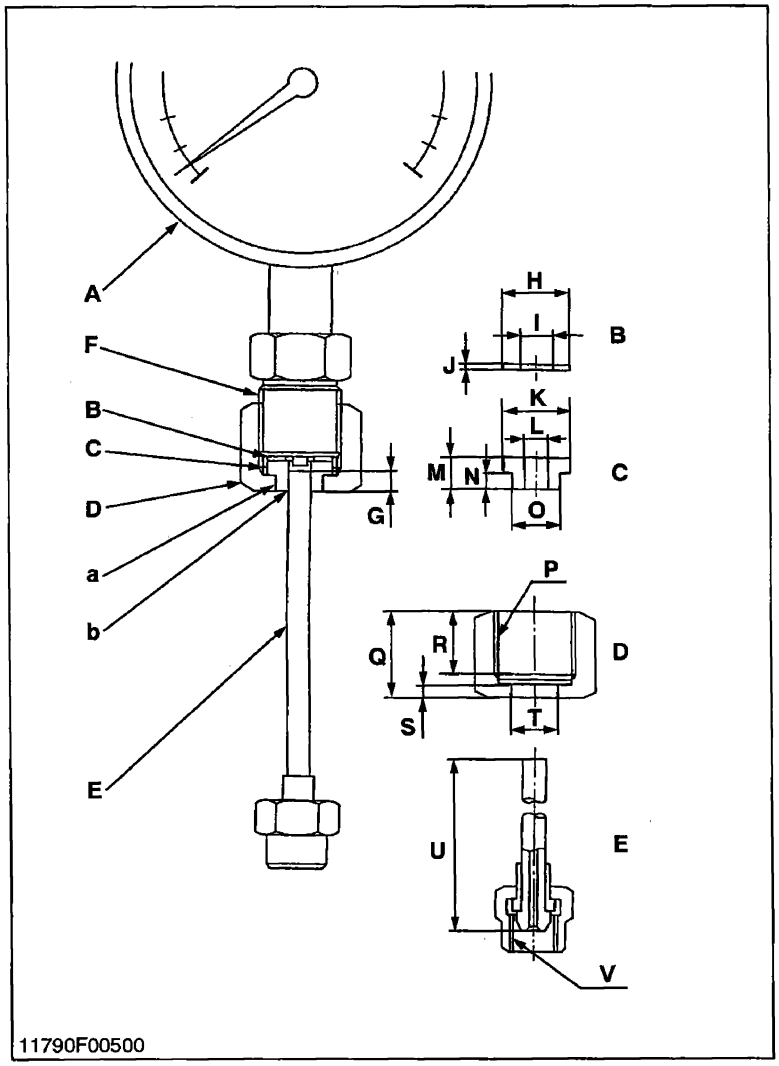
11790F00461

Valve Guide Replacing Tool

Application: Use to press out and press fit the valve guide.

A	20 mm dia. (0.79 in. dia.)
B	11.7 to 11.9 mm dia. 0.460 to 0.468 in. dia.
C	6.5 to 6.6 mm dia. 0.256 to 0.259 in. dia.
D	225 mm (8.86 in.)
E	70 mm (2.76 in.)
F	45 mm (1.77 in.)
G	25 mm (0.98 in.)
H	5 mm (0.197 in.)
I	6.7 to 7.0 mm dia. (0.263 to 0.275 in. dia.)
J	20 mm dia. (0.787 in. dia.)
K	12.5 to 12.8 mm dia. (0.492 to 0.504 in. dia.)
L	8.9 to 9.1 mm (0.350 to 0.358 in.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)
C0.3	Chamfer 0.3 mm (0.012 in.)

11790G00622



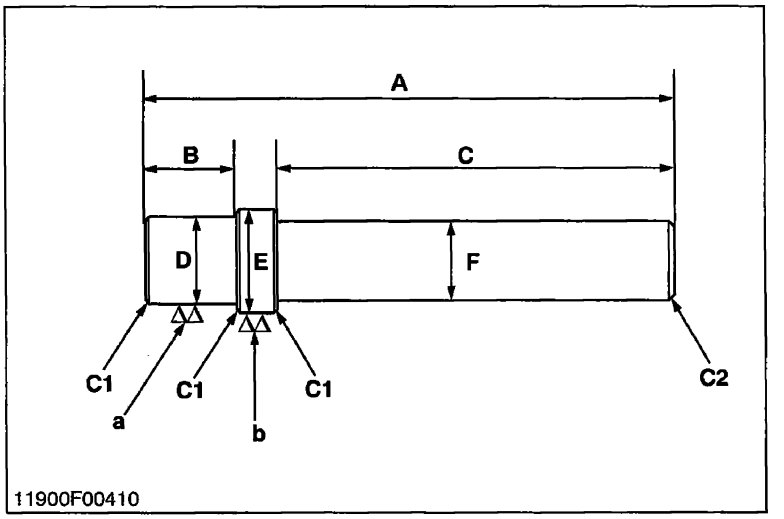
11790F00500

Injection Pump Pressure Tester

Application: Use to check fuel tightness of injection pumps.

A	Pressure gauge full scale : More than 29.4 MPa (300 kgf/cm^2, 4267 psi)
B	Copper gasket
C	Flange (Material : Steel)
D	Hex. nut 27 mm (1,06 in.) across the plat
E	Injection pipe
F	PF 1/2
G	5 mm (0.20 in.)
H	17 mm dia. (0.67 in. dia.)
I	8 mm dia. (0.31 in. dia.)
J	1.0 mm (0.039 in.)
K	17 mm dia. (0.67 in. dia.)
L	6.10 to 6.20 mm dia. 0.2402 to 0.2441 in. dia.
M	8 mm (0.31 in.)
N	4 mm (0.16 in.)
O	11.97 to 11.99 mm dia. 0.4713 to 0.4721 in. dia.
P	PF 1/2
Q	23 mm (0.91 in.)
R	17 mm (0.67 in.)
S	4 mm (0.16 in.)
T	12.00 to 12.02 mm dia. 0.4724 to 0.4732 in. dia.
U	100 mm (3.94 in.)
V	M12 × P1.5
a	Adhesive application
b	Fillet welding on the enter circumference

11790G00811



Bushing Replacing Tool

Application: Use to press out and to press fit the bushing.

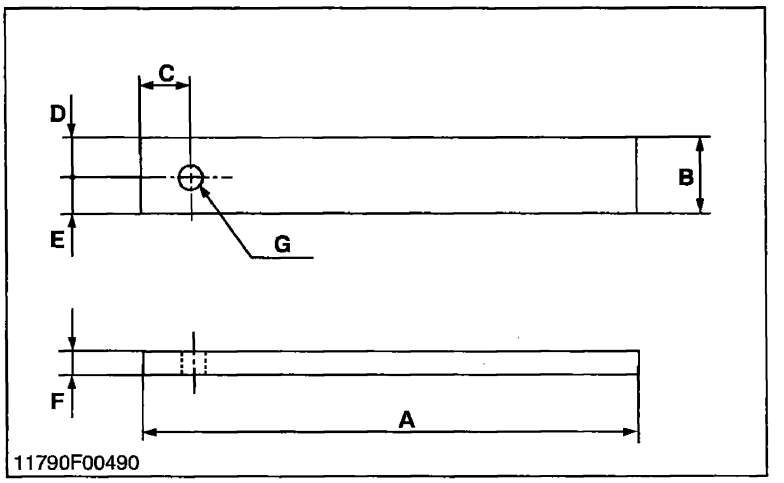
1. For small end bushing

A	157 mm (6.1811 in.)
B	24 mm (0.9449 in.)
C	120 mm (4.7244 in.)
D	21.8 to 21.9 mm (0.8583 to 0.8622 in.)
E	24.8 to 24.9 mm (0.9764 to 0.9803 in.) DIA.
F	20 mm (0.7874 in.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

2. For idle gear bushing

A	196 mm (7.7165 in.)
B	26 mm (1.0236 in.)
C	150 mm (5.9055 in.)
D	25.8 to 25.9 mm (1.0157 to 1.0197 in.)
E	28.8 to 28.9 mm (1.0157 to 1.0197 in.) DIA.
F	20 mm (0.7874 in.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

11900G00441

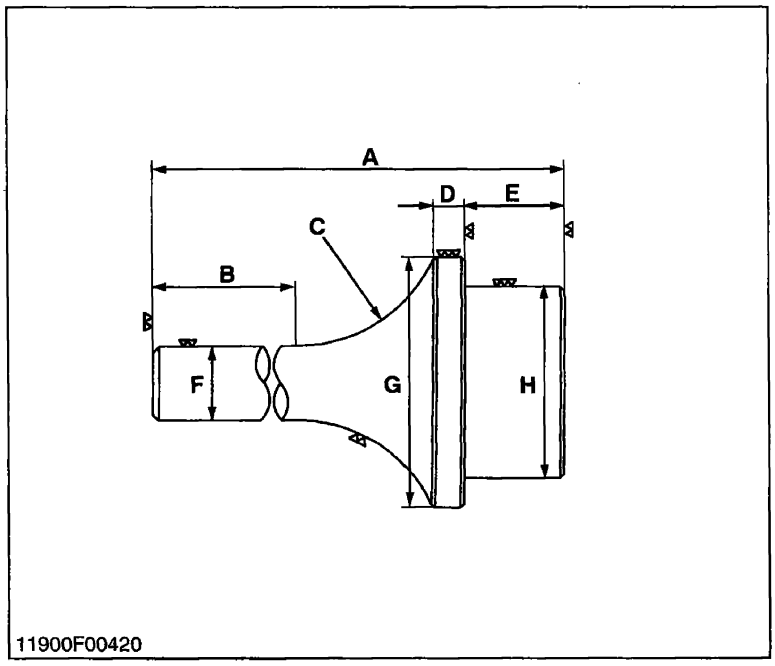


Flywheel Stopper

Application: Use to loosen and tighten the flywheel screw.

A	200 mm (7.87 in.)
B	30 mm (1.18 in.)
C	20 mm (0.79 in.)
D	15 mm (0.59 in.)
E	15 mm (0.59 in.)
F	8 mm (0.31 in.)
G	10 mm DIA. (0.39 in. DIA.)

11790G00801



11900F00420

Crankshaft Bearing 1 Replacing Tool

Application: Use to press out and to press fit the crankshaft bearing 1.

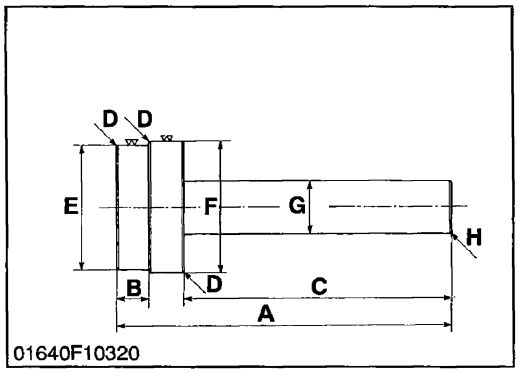
[Press Out]

A	135 mm (5.31 in.)
B	72 mm (2.83 in.)
C	40° (1.57 rad.)
D	10 mm (0.39 in.)
E	20 mm (0.79 in.)
F	20 mm (0.79 in.)
G	56.80 to 56.90 mm dia. 2.2362 to 2.2402 in. dia.
H	51.80 to 51.90 mm dia. 2.0393 to 2.0433 in. dia.

[Press Fit]

A	130 mm (5.12 in.)
B	72 mm (2.83 in.)
C	40° (1.57 rad.)
D	9 mm (0.35 in.)
E	24 mm (0.95 in.)
F	20 mm dia. (0.79 in. dia.)
G	68 mm dia. (2.68 in. dia.)
H	47.38 to 47.48 mm dia. 1.865 to 1.869 in. dia.

11900G00451



01640F10320

Governor Gear Holder Bushing Replacing Tool

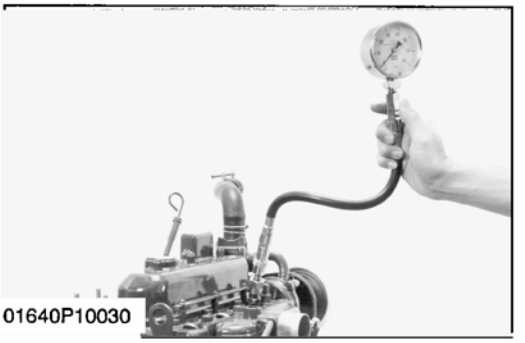
Application: Use to press out and to press fit the governor gear holder bushing.

A	188 mm (7.4 in.)
B	18 mm (0.7 in.)
C	150 mm (5.9 in.)
D	C1 : Chamfer 1.0 mm (0.039 in.)
E	73.9 to 74.0 mm dia. (29.09 to 29.13 in. dia.)
F	69.8 to 69.9 mm dia. (2.748 to 2.751 in. dia.)
G	30 mm dia. (1.181 in. dia.)
H	C2 : Chamfer 2.0 mm (0.079 in.)

01640S10260

C.Engine body

CHECKING AND ADJUSTING



Compression Pressure

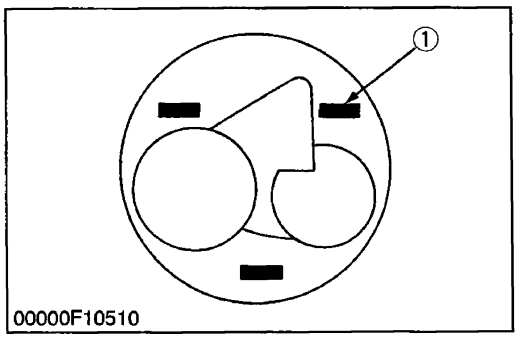
1. After warming up the engine, stop it and remove the air cleaner, the muffler and all nozzle holders.
2. Install a compression tester (Code No: 07909-30204) for diesel engines to nozzle holder hole.
3. After making sure that the speed control lever is set at the stop position (Non-injection), run the engine at 200 to 300 rpm with the starter.
4. Read the maximum pressure. Measure the pressure more than twice.
5. If the measurement is below the allowable limit, check the cylinder, piston ring, top clearance, valve and cylinder head.
6. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the nozzle hole and measure the compression pressure again.
7. If the compression pressure is still less than the allowable limit, check the top clearance, valve and cylinder head.
8. If the compression pressure increases after applying oil, check the cylinder wall and piston rings.

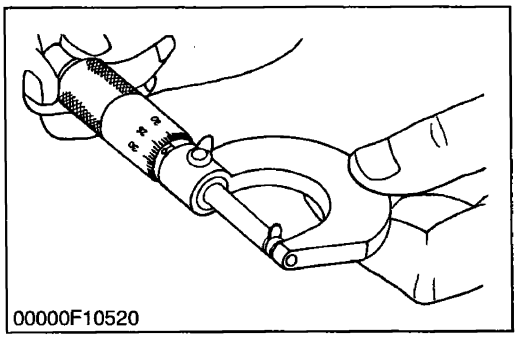
■ NOTE

- **Check the compression pressure with the specified valve clearance.**
- **Always use a fully charged battery for performing this test.**
- **Variances in cylinder compression values should be under 10 %.**

Compression pressure	Factory spec.	2.84 to 3.24 MPa 29 to 33 kgf/cm^2 412 to 469 psi
	Allowable limit	2.26 MPa 23 kgf/cm^2 327 psi

11900S10011





Top Clearance

1. Remove the cylinder head (remove the cylinder head gasket completely).
2. Bring the piston to its top dead center fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the intake and exhaust valves and the combustion chamber ports.
3. Bring the piston to its middle position, install the cylinder head, and tighten the cylinder head bolts to specification. (Head gasket must be changed to new one.)
4. Turn the crank shaft until the piston exceeds its top dead center.
5. Remove the cylinder head, and measure squeezed fuse wires for thickness.
6. If the measurement is not within the specified value, check the oil clearance of the crankpin journal and the piston pin.

Top clearance	Factory spec.	0.55 to 0.75 mm 0.0217 to 0.0295 in.

Tightening torque	Cylinder head mounting bolts	63.7 to 68.6 N·m 6.5 to 7.0 kgf·m 47.0 to 50.6 ft-lbs

(1) Fuse

01640S10270

DISASSEMBLING AND ASSEMBLING

■ **NOTE**

- **The cylinder heads with serial numbers 489291 and on are partially modified in configuration because of the introduction of the nozzle heat seal.**
  For replacing the cylinder head, see the parts list and choose the right one in reference to its serial number.

01640S10280

[1] Draining water and oil

Draining Cooling Water and Engine Oil

CAUTION

- **Never remove radiator cap until cooling water temperature is below its boiling point. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

1. Prepare a bucket. Open the drain cock to drain cooling water.
2. Prepare an oil pan. Remove the drain plug to drain engine oil in the pan.

01640S10290

[2] External components

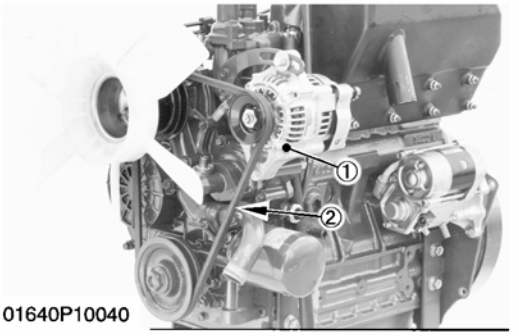
Air Cleaner and Muffler

1. Remove the air cleaner.
2. Remove muffler retaining nuts to remove the muffler.

(When reassembling)

- Install the muffler gasket so that its steel side face the muffler.

01640S10300



01640P10040

Alternator and Fan Belt

1. Remove the alternator (1).
2. Remove the fan belt (2).

(When reassembling)

- Check to see that there are no cracks on the belt surface.

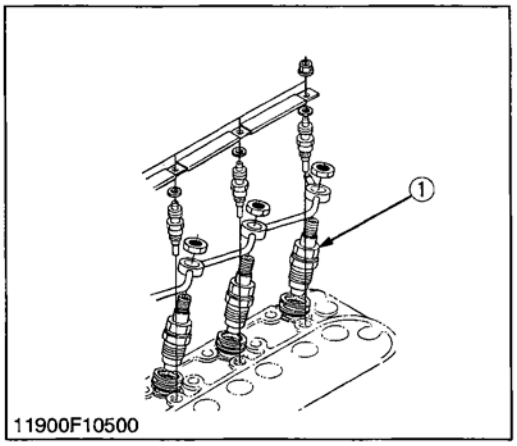
■ IMPORTANT

- **After reassembling the fan belt, be sure to adjust the fan belt tension.**

(1) Alternator (2) Fan Belt

01640S10310

[3] Cylinder head and valves

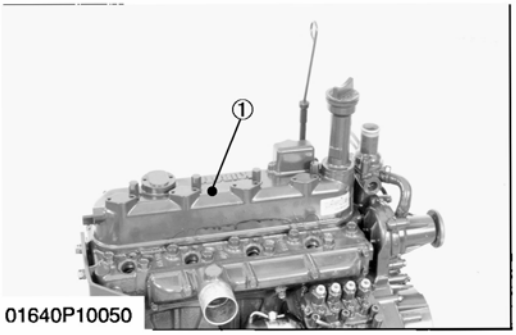


Nozzle Holder Assembly

1. Loosen the screws on the pipe clamps.
2. Remove the injection pipes.
3. Remove the fuel overflow pipes.
4. Loosen the lock nuts, and remove the nozzle holder assemblies.
5. Remove the copper gaskets on the seats.
6. Remove the nozzle heat seal. (See page S-83.)

(1) Nozzle Holder Assembly

01640S10320



Cylinder Head Cover

1. Remove the head cover cap nuts.
2. Remove the cylinder head cover (1).

(When reassembling)

- Check to see if the cylinder head cover gasket is not defective.

(1) Head Cover

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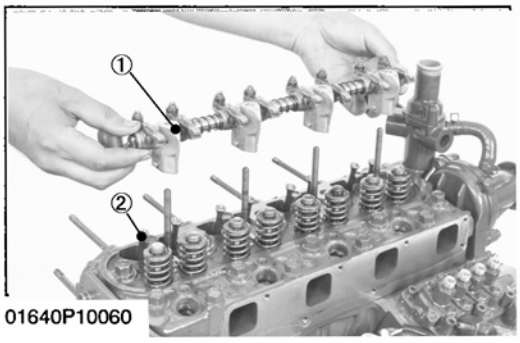

Rocker Arm and Push Rod

1. Remove the rocker arm bracket mounting nuts.
2. Detach the rocker arm as a unit.
3. Remove the push rods.

■ IMPORTANT

- **After reassembling the rocker arm, be sure to adjust the valve clearance.**

(When reassembling)

- When putting the push rods onto the tappets, check to see if their ends are properly engaged with the grooves.

(1) Rocker Arm Assembly (2) Push Rod

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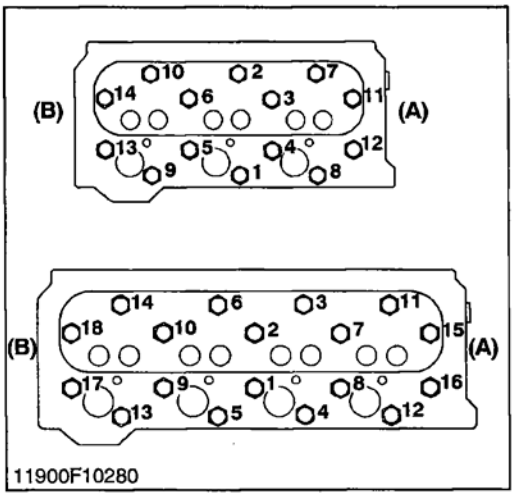

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Cylinder Head

1. Loosen the pipe band, and remove the water return pipe.
2. Remove the cylinder head screws in the order of (14, 18) to (1), and remove the cylinder head.
3. Remove the cylinder head gasket and O-ring.

(When reassembling)

- Replace the head gasket with a new one.
- Install the cylinder head, using care not to damage the O-ring.
- Tighten the cylinder head screwsgradually in the order of (1) to (14, 18) after applying engine oil.
- Retighten the cylinder head screws after running the engine for 30 minutes.

(A) Gear Case Side **(B) Flywheel Side**

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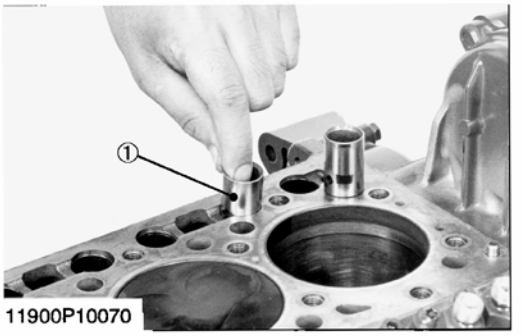


11900P10070

Tappets

1. Remove the tappets (1) from the crankcase.

(When reassembling)

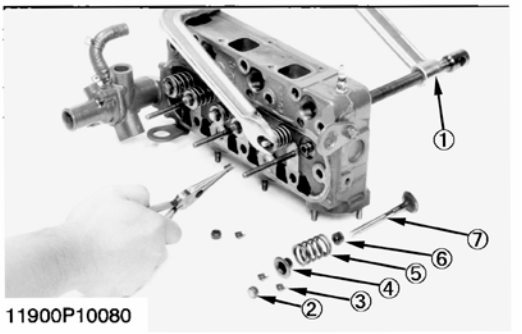
- Before installing the tappets, apply engine oil thinly around them.

■ IMPORTANT

- **Mark the cylinder number to the tappets to prevent interchanging.**

(1) Tappet

11900S10081



11900P10080

Valves

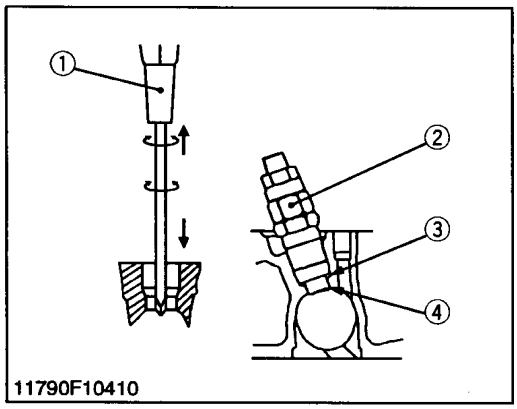
1. Remove the valve cap (2).
2. Remove the valve spring collet (3) with a valve lifter.
3. Remove the valve spring retainer (4), valve spring (5) and valve (7).

(When reassembling)

- Wash the valve stem and valve guide hole, and apply engine oil sufficiently
- After installing the valve spring collets, lightly tap the stem to assure proper fit with a plastic hammer.

(1) Valve Lifter
(2) Valve Cap
(3) Valve Spring Collet
(4) Valve Spring Retainer
(5) Valve Spring
(6) Valve Stem Seal
(7) Valve

11900S10091



Nozzle Heat Seal Service Removal Procedure
(Engine Serial Number : 489291 and beyond

■ IMPORTANT

- **Use a plus (phillips head) screw driver that has a Dia. which is bigger than the heat seal hole (Approx. 6 mm) 1/4 in.**

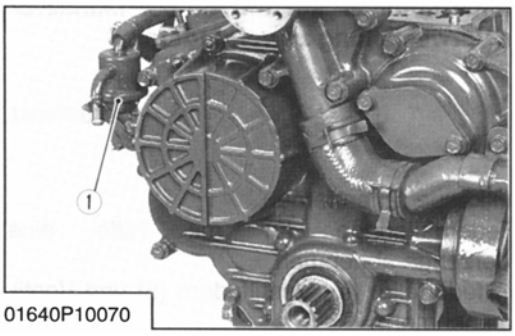
1. Drive screw driver lightly into the heat seal hole.
2. Turn screw driver three or four times each way.
3. While turning the screw driver, slowly pull the heat seal out together with the injection nozzle gasket.

   If the heat seal drops, repeat the above procedure. Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.

(1) Plus Screw Driver
(2) Injection Nozzle
(3) Injection Nozzle Packin
(4) Heat Seal

11790S10131

[4] Gear case



Fuel Feed Pump and Hour Meter Gear Case

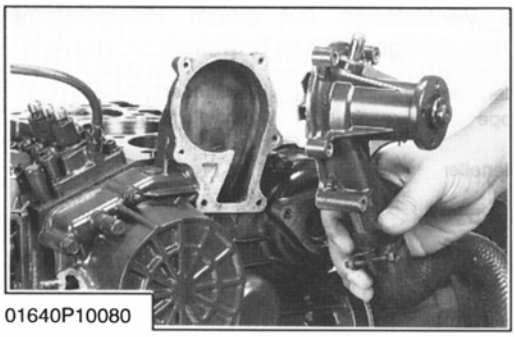
1. Loosen the pipe clamp and remove the fuel pipe from the injection pump side.
2. Remove the fuel feed pump mounting nuts.
3. Remove the fuel feed pump (1).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of fuel feed pump gasket and hour meter gear case.

(1) Fuel Feed Pump

01640S10340



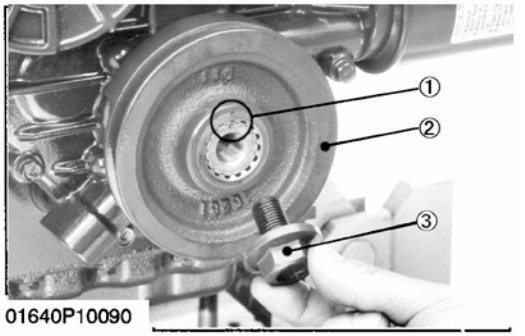
Water Pump

1. Remove the water pump flange.

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of water pump flange gasket.

01640S10350



01640P10090

Fan Drive Pulley

1. Set the stopper to the flywheel.
2. Remove the crankshaft screw (1).
3. Draw out the fan drive pulley (2) with a puller.

(When reassembling)

- Install the pulley (D905, D1005, D1105) to the crankshaft, aligning the marks (3) on them.

Tightening torque	Crankshaft screw (Serial No : ~ 604086)	142.2 to 152.0 N·m 14.5 to 15.5 kgf·m 104.9 to 112.1 ft-lbs
	Crankshaft screw (Serial No : 604087 ~)	235.4 to 245.2 N·m 24.0 to 25.0 kgf·m 173.6 to 180.8 ft-lbs

(1) Crankshaft Screw
(2) Fan Drive Pulley
(3) Aligning Marks

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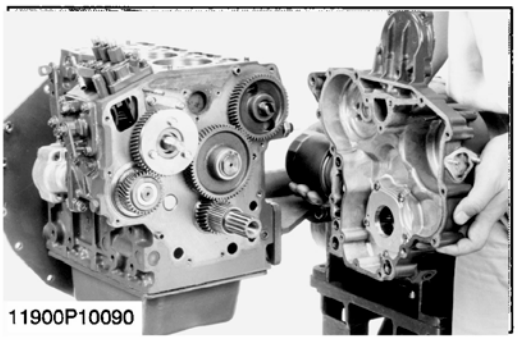
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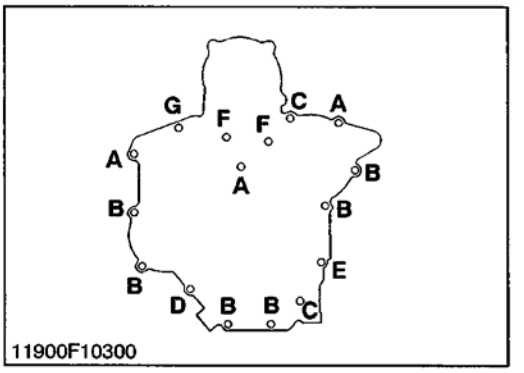

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Gear Case

1. Remove the gear case.

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the gear case gasket.
- Grease thinly to the oil seal, and install it, ensuring the lip does not come off.

Length of the gear case mounting bolts (refer to the figure)

A : 45 mm 1.17in.
B : 50 mm 1.97in.
C : 55 mm 2.17in.
D : 59 mm 2.32in.
E : 68 mm 2.68in.
F : 80 mm 3.15in.
G : Nut

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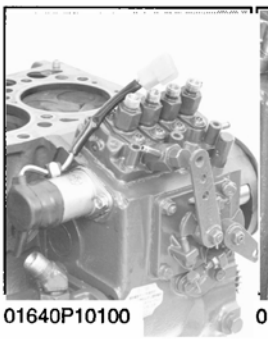
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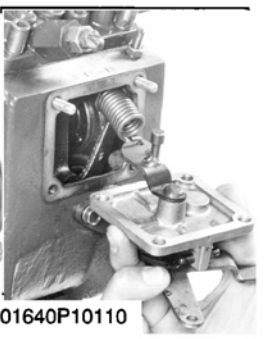
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Engine Stop Solenoid and Speed Control Plate

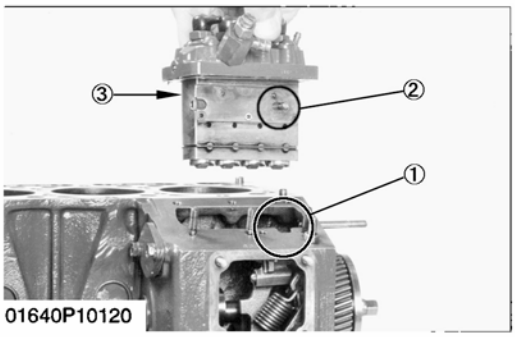
1. Remove the engine stop solenoid (1).
2. Remove the speed control plate with the governor springs 1 (2).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket and control plate gasket.
- Be careful not to drop the governor springs 1 into the crankcase.

(1) Engine Stop Solenoid
(2) Governor Spring 1

11900S10121



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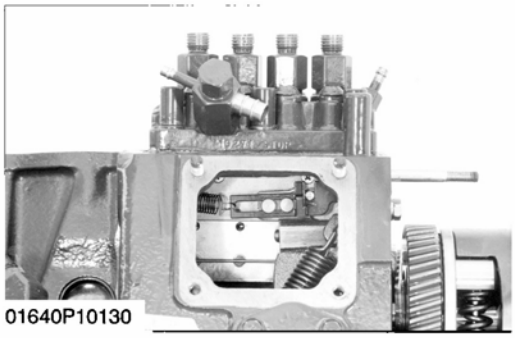

01640P10130

Injection Pump

1. Align the control rack pin (3) with the notch (1) on the crankcase, and remove the injection pump (2).
2. Remove the injection pump shims.
3. In principle, the injection pump should not be disassembled.

(When reassembling)

- When installing the injection pump, insert the control rack pin (3) firmly into the groove of the fork lever and thrust lever.

■ NOTE

(Engine serial number : ~ 489290)

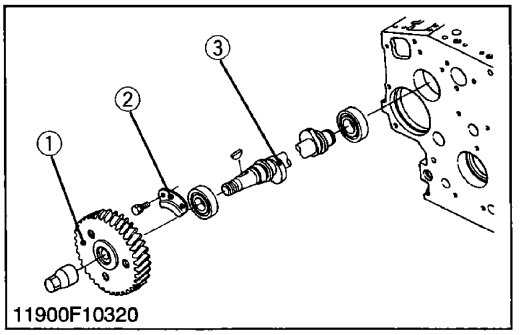
- **Insert the same number of shims as used before between crank case and pump.**
- **Addition or reduction of shim (0.15 mm, 0.0059 in.) delays or advances the injection timing by approx. 0.026 rad. (1.5°).**
- **Apply liquid-type gasket (Three Bons 1215 or its equivalent) to both sides of the injection pump shim before reassembling.**

(Engine serial number : 489291 ~)

- **The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.**
- **Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad. (0.5°).**
- **In disassembling and replacing, be sure to use the same number of new gasket shims with the same thickness.**

(1) Notch
(2) Injection Pump
(3) Control Rack Pin

11900S10131



Fuel Camshaft

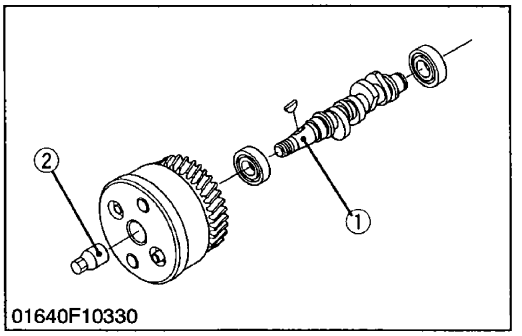
1. Remove the fuel camshaft stopper (2).
2. Draw out the fuel camshaft (3) and injection pump gear (1).

(When reassembling)

- Apply engine oil thinly to the fuel camshaft before installation.

(1) Injection Pump Gear
(2) Fuel Camshaft Stopper
(3) Fuel Camshaft

11900S10140



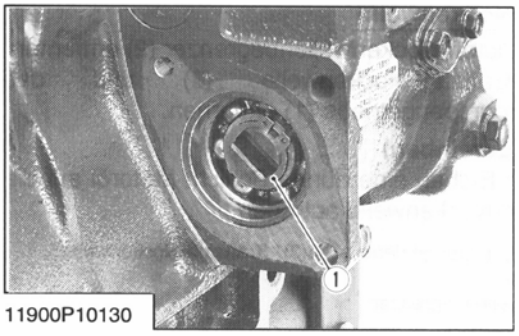
Timer

■ IMPORTANT

- **If there are not problems with the timer, there is no need to separate it from the fuel camshaft.**
- **Hammers and similar tools should not be used if the timer is to be separated from the shaft.**

(1) Fuel Camshaft
(2) Timer Mounting Nut

01640S10380



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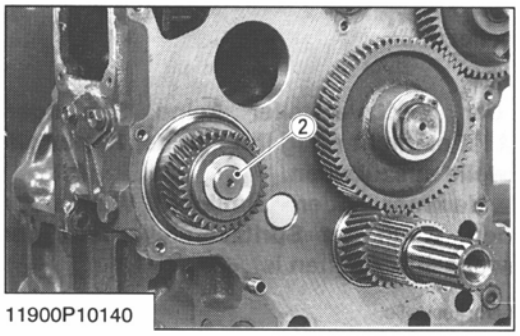

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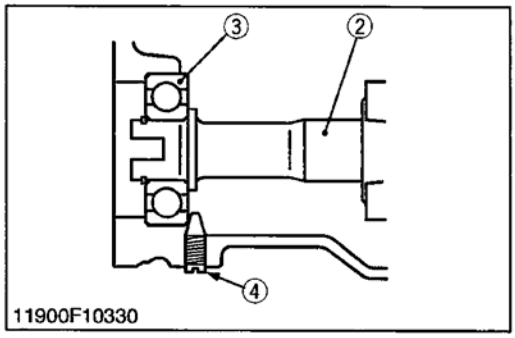

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Governor Shaft

1. Remove the external snap ring (1) from the governor shaft.
2. Remove the governor shaft (2).

(When reassembling)

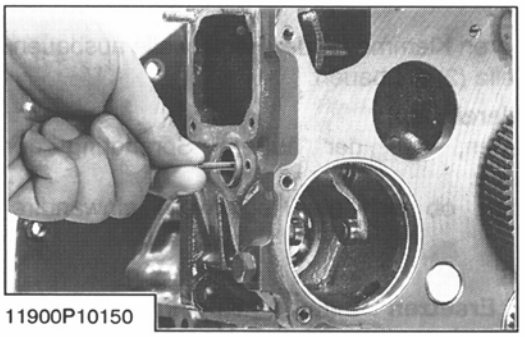
- Make sure assembling the external snap ring of the governor shaft.
- Check the governor shaft for smooth rotation.

■ IMPORTANT

- **When replacing the ball bearing of governor shaft, securely fit the ball bearing (3) to the crankcase, apply an adhesive (Three Bond 1324B or equivalent) to the set screw (4), and fasten the screw until its tapered part contacts the circumferential end of the ball bearing.**

(1) External Snap Ring
(2) Governor Shaft
(3) Ball Bearing
(4) Set Screw

11900S10151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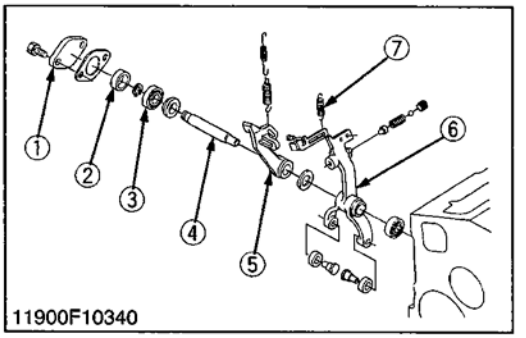

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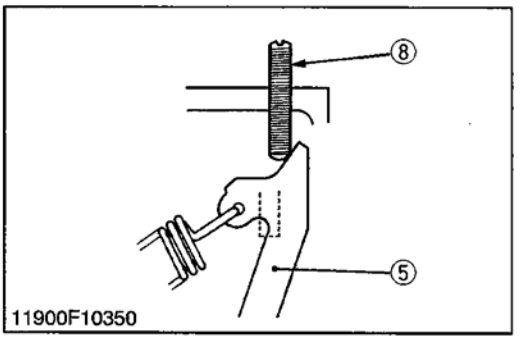


11900F10350

Fork Lever

1. Remove the start spring (7).
2. Remove the fork lever shaft cover (1).
3. Remove the fork lever shaft (4).
4. Remove the spacer (2), bearing (3) and fork lever 1, 2.

(When reassembling)

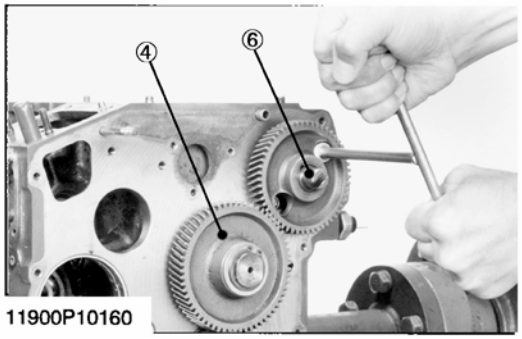
- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the fork lever shaft cover.
- to assembling the fork lever shaft cover to position the mark **"UP"** on it upwards.
- Make sure assembling the start spring.

■ IMPORTANT

- **To assembling the fork lever 2 to the right side of fuel limit bolts as shown in the figure.**

(1) Fork Lever Shaft Cover
(2) Spacer
(3) Bearing
(4) Fork Lever Shaft
(5) Fork Lever 2
(6) Fork Lever 1
(7) Start Spring
(8) Fuel Limit Bolt

11900S10161



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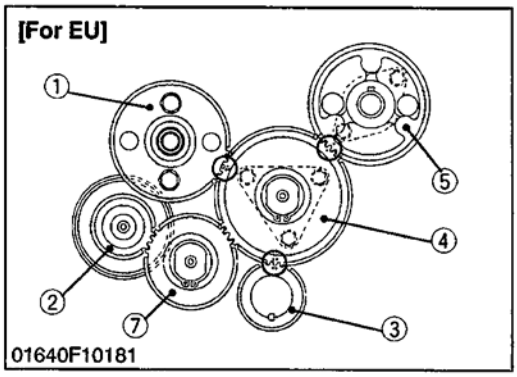

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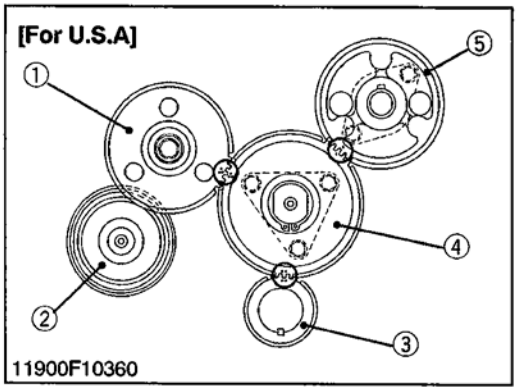

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Cam Gear and Idle Gear 1, 2

1. Remove the external snap ring.
2. Remove the idle gear 2 (7).
3. Remove the idle gear 1 (4).
4. Remove the camshaft stopper mounting bolt.
5. Remove the camshaft (6).

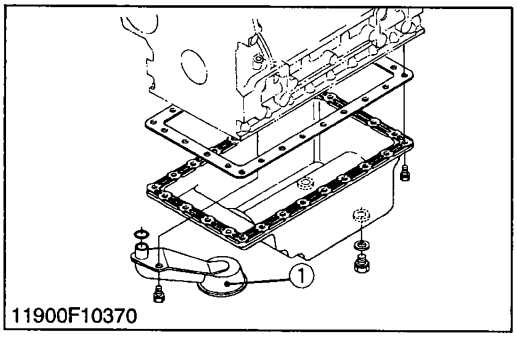
■ IMPORTANT

- **When installing the idle gear, be sure to align the alignment marks on gears.**
- **Make sure assembling the external snap ring and stopper.**

(1) Injection Pump Gear
(2) Governor Gear
(3) Crank Gear
(4) Idle Gear 1
(5) Cam Gear
(6) Camshaft
(7) Idle Gear 2

11900S10171

[5] Piston and connecting rod



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Oil Pan and Oil Strainer

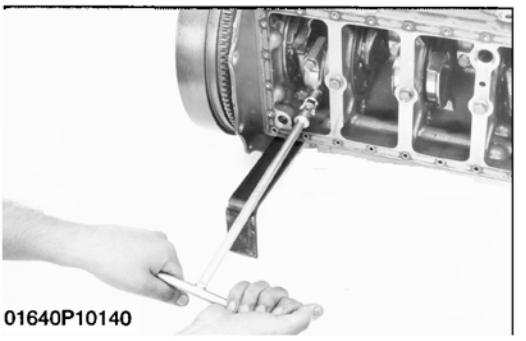
1. Remove the oil pan mounting screws.
2. Remove the oil pan by lightly tapping the rim of the pan with a wooden hammer.
3. Remove the oil strainer (1).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the oil pan gasket.
- To avoid uneven tightening, tighten mounting screws in diagonal order from the center.
- After cleaning the oil strainer, install it.
- Install the oil strainer (1), using care not to damage the O-ring.

(1) Oil Strainer

11900S10181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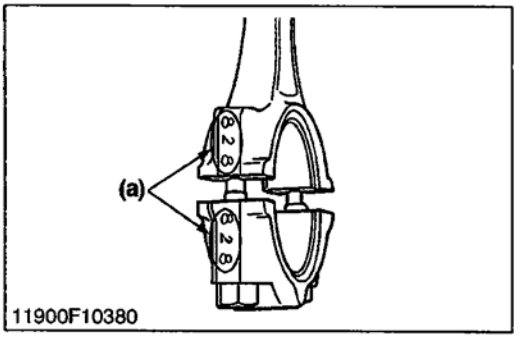

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Connecting Rod Cap

1. Remove the connecting rod screws from connecting rod cap.
2. Remove the connecting rod caps.

(When reassembling)

- Align the marks **(a)** with each other. (Face the marks toward the injection pump.)
- Apply engine oil to the connecting rod screws and lightly screw it in by hand, then tighten it to the specified torque.
  If the connecting rod screw won't be screwed in smoothly, clean the threads.
  If the connecting rod screw is still hard to screw in, replace it.

Tightening torque	Connecting rod screw	41.2 to 46.1 N·m 4.2 to 4.7 kgf·m 30.3 to 33.9 ft-lbs

(a) Mark

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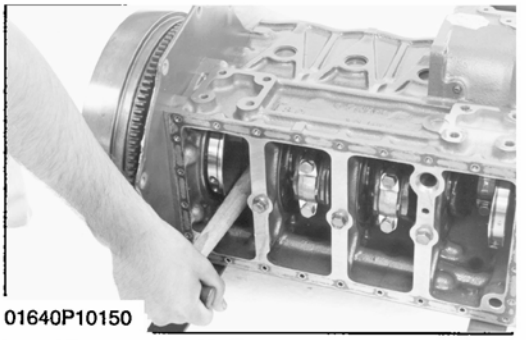
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Piston

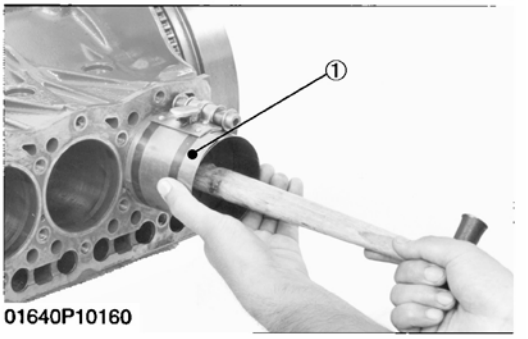
1. Turn the flywheel and bring the No. 1 piston to the top dead center.
2. Pull out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.

(When reassembling)

- Before inserting the piston into the cylinder, apply enough engine oil to the cylinder.
- When inserting the piston into the cylinder, face the mark on the connecting rod to the injection pump.

■ IMPORTANT

- **Do not change the combination of cylinder and piston. Make sure of the position of each piston by marking. For example, mark "1" on the No.1 piston.**
- **When inserting the piston into the cylinder, place the gap of the compression ring 1 on the opposite side of the combustion chamber and stagger the gaps of the compression ring 2 and oil ring making a right angle from the gap of the compression ring 1.**
- **Carefully insert the pistons using a piston ring compressor (1). Otherwise, their chrome-plated section may be scratched, causing trouble inside the liner.**



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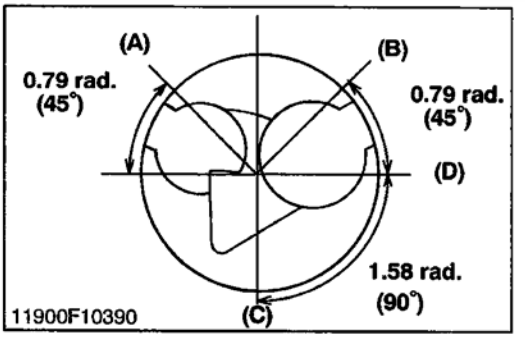
(1) Piston Ring Compressor



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(A) Top Ring Gap
(B) Second Ring Gap
(C) Oil Ring Gap
(D) Piston Pin Hole

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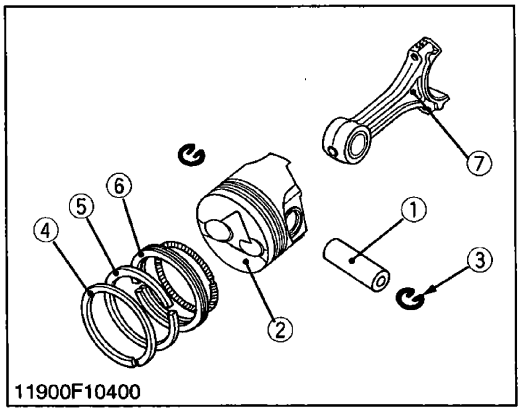
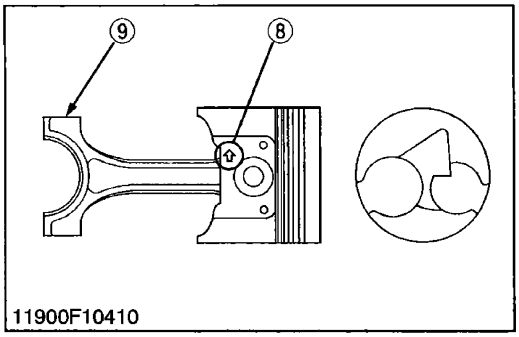
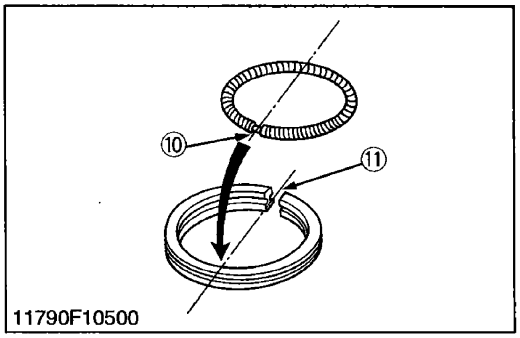
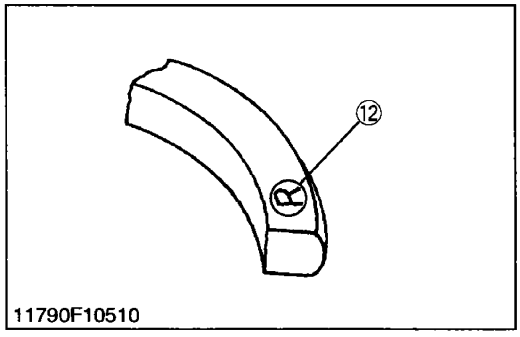








Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Put the casting mark (↑) (8) on the piston as shown in figure.
3. Remove the piston pin (1), and separate the connecting rod (7) from the piston (2).

(When reassembling)

- When installing the ring, assemble the rings so that the manufacturer's mark (12) near the gap faces the top of the piston.
- When installing the oil ring onto the piston, place the expander joint (10) on the opposite side of the oil ring gap (11).
- Apply engine oil to the piston pin.
- When installing the piston pin, immerse the piston in 80 °C (176 °F) oil for 10 to 15 minutes and insert the piston pin to the piston.
- When installing the connecting rod to the piston, align the mark (9) on the connecting rod to the casting mark (8).

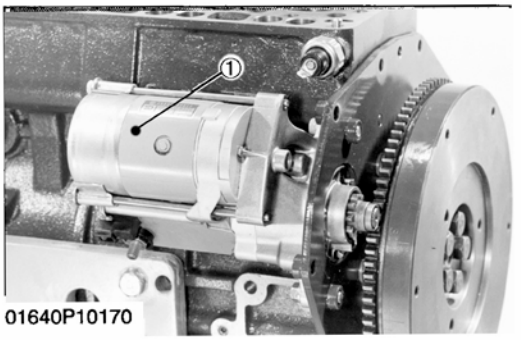
■ IMPORTANT

- **Mark the same number on the connecting rod and the piston so as not to change the combination.**

(1) Piston Pin
(2) Piston
(3) Piston Pin Snap Ring
(4) Compression Ring 1
(5) Compression Ring 2
(6) Oil Ring
(7) Connecting Rod
(8) Casting Mark
(9) Mark
(10) Expander Joint
(11) Oil Ring Gap
(12) Manufacturer's Mark

11900S10211

[6] Flywheel and crankshaft



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Starter

1. Remove the starter (1).

(1) Starter

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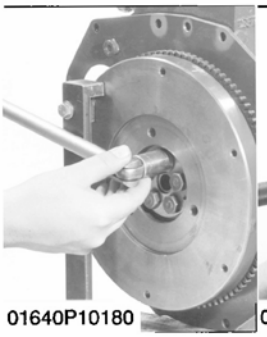
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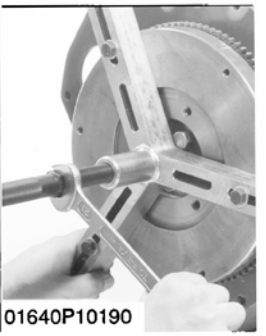
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Flywheel

1. Lock the flywheel not to turn using the flywheel stopper.
2. Remove the flywheel screws, except for two which must be loosened and left as they are.
3. Set a flywheel puller (Code No: 07916-32011), and remove the flywheel.

(When reassembling)

- Apply engine oil to the flywheel screws.

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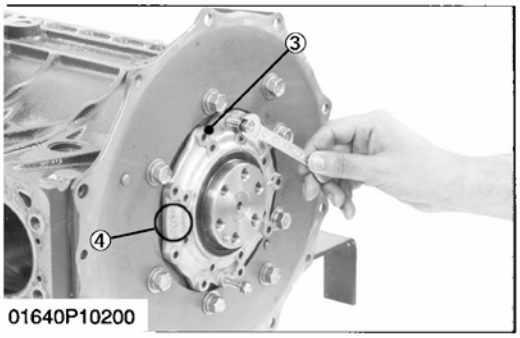

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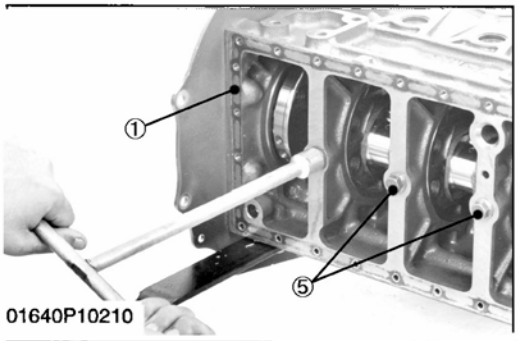

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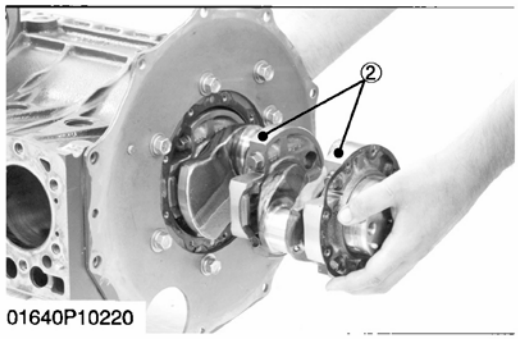

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Bearing Case Cover and Crankshaft

■ **NOTE**

- **Before disassembling, check the side clearance of crankshaft. Also check it during reassembly.**

1. Remove the bearing case cover mounting screws.
2. Screw two removed screws into the screw hole of bearing case cover to remove it.
3. Remove the bearing case screw 2 (5).
4. Pull out the crankshaft.

(When reassembling)

■ **IMPORTANT**

- **Install the crankshaft sub assembly, aligning the screw hole of main bearing case 2 (2) with the screw hole of cylinder block (1).**
- **Apply engine oil to the seat and thread of bearing case screw 2 (5) and tightening it.**
- **Install the bearing case cover (3) to position the casting mark "UP" (4) on it upward.**
- **Tighten the bearing case cover mounting screws with even force on the diagonal line.**

(1) Cylinder Block
(2) Main Bearing Case 2
(3) Bearing Case Cover
(4) Top Mark "UP"
(5) Bearing Case Screw 2

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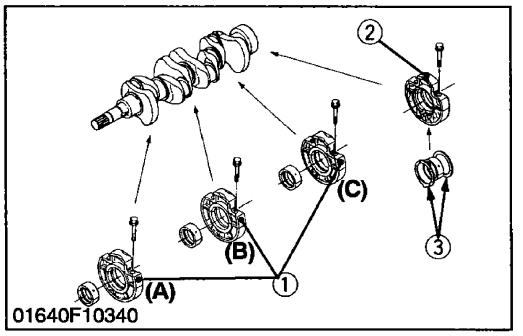

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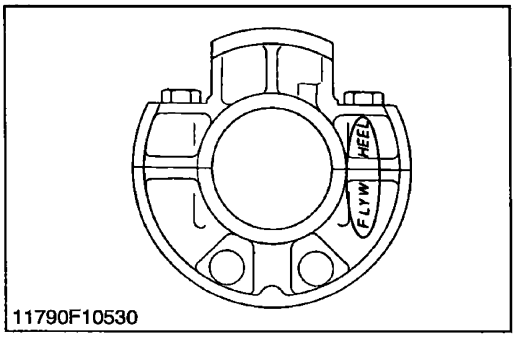

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Main Bearing Case Assembly

1. Remove the two main bearing case screws 1, and remove the main bearing case assembly (2), being careful with the thrust bearing (3) and crankshaft bearing 2.
2. Remove the main bearing case assembies 1, 2 and 3 as above.

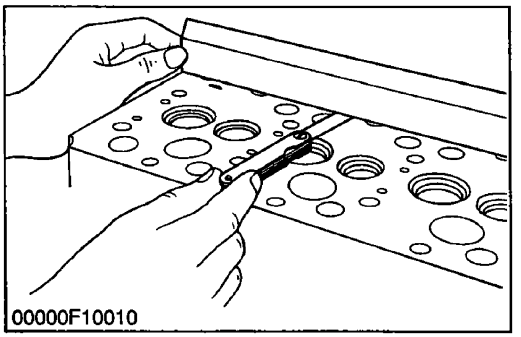
(When reassembling)

- Clean the oil passage in the main bearing case.
- Apply clean engine oil on the crankshaft bearing 2 and thrust bearings.
- Since diameters of main bearing case vary, install them in order of makings (**A, B, C**) from the gear case side.
- When installing the main bearing case assemblies 1, 2 and 3, face the mark **"FLYWHEEL"** to the flywheel.
- Be sure to install the thrust bearing with its oil groove facing outward.

(1) Main Bearing Case Assembly 1, 2 and 3
(2) Main Bearing Case Assembly
(3) Thrust Bearing

11900S10251

SERVICING
[1] Cylinder head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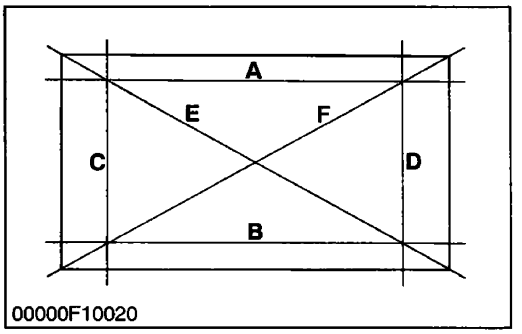

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Cylinder Head Surface Flatness

1. Thoroughly clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure.
   Measure the clearance with a feeler gauge.
3. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ IMPORTANT

- **Do not place the straight edge on the combustion chamber.**
- **Be sure to check the valve recessing after correcting.**

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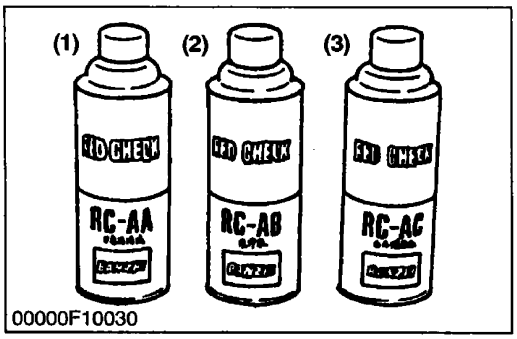

Cylinder Head Flaw

1. Prepare an air spray red check (Code No. 07909-31371).
2. Clean the surface of the cylinder head with detergent (2).
3. Spray the cylinder head surface with the red permeative liquid (1). Leave it five to ten minutes after spraying.
4. Wash away the red permeative liquid on the cylinder head surface with the detergent (2).
5. Spray the cylinder head surface with white developer (3).
6. If flawed, it can be identified as red marks.

(1) Red Permeative Liquid
(2) Detergent
(3) White Developer

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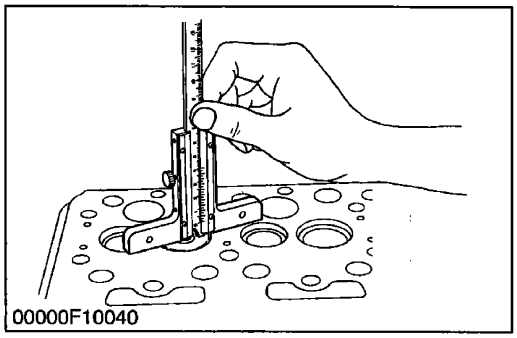

Valve Recessing

1. Clean the cylinder head, the valve face and seat.
2. Insert the valve into the valve guide.
3. Measure the valve recessing with a depth gauge.
4. If the measurement exceeds the allowable limit, replace the valve.
   If it still exceeds the allowable limit after replacing the valve, correct the valve seat face of the cylinder head with a valve seat cutter (Code No. 07909-33102) or valve seat grinder.
   Then, correct the cylinder head surface with a surface grinder, or replace the cylinder head.

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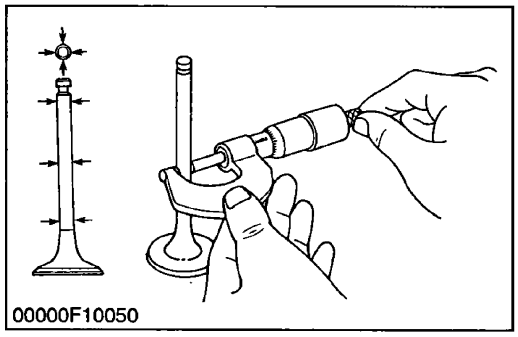

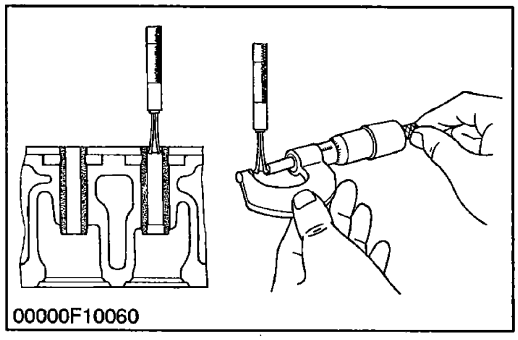

Clearance between Valve Stem and Valve Guide

1. Remove carbon from the valve guide section.
2. Measure the valve stem O.D. with an outside micrometer.
3. Measure the valve guide I.D. of the cylinder head at the most wear part as shown in the figure below with a small hole gauge. And calculate the clearance.
4. If the clearance exceeds the allowable limit, replace the valves. If it still exceeds the allowable limit, replace the valve guide.

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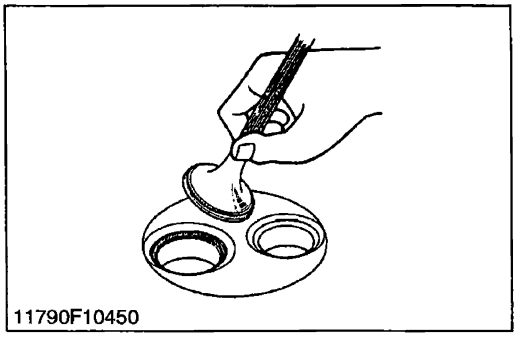
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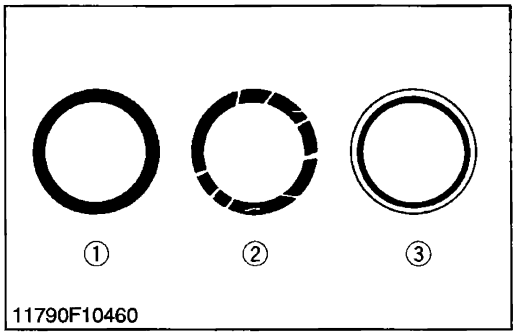

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Valve Seating

1. Coat the valve face lightly with prussian blue and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70 %, correct the valve seating as follows.
3. If the valve contact does not comply with the reference value, replace the valve or correct the contact of valve seating.

(1) Correct
(2) Incorrect
(3) Incorrect

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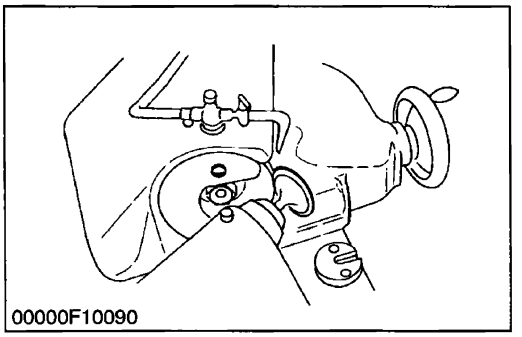
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Correcting Valve and Valve Seat

■ NOTE

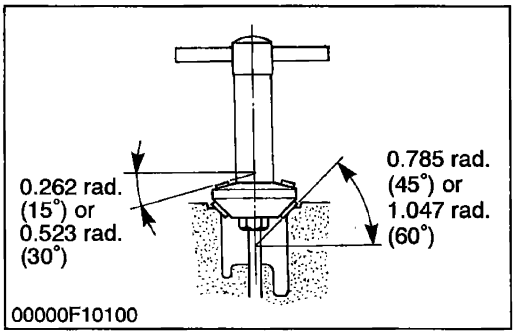
- **Before correcting the valve and seat, check the valve stem and the I.D. of the valve guide section, and repair them if necessary.**
- **After correcting the valve seat, be sure to check the valve recessing.**

1) Correcting Valve

1. Correct the valve with a valve refacer.

2) Correcting Valve Seat

1. Slightly correct the seat surface with a 1.047 rad. (60°) (intake valve) or 0.785 rad. (45°) (exhaust valve) seat cutter (Code No. 07909-33102).
2. Resurface the seat surface with a 0.523 rad. (30°) valve seat cutter to intake valve seat and with a 0.262 rad. (15°) valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width (2.12 mm, 0.0835 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.



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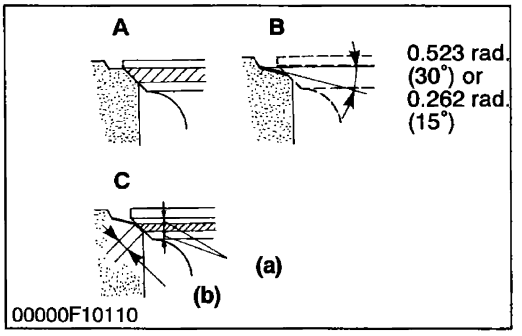

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(a) Identical Dimensions
(b) Valve Seat Width
(A) Check Contact
(B) Correct Seat Width
(C) Check Contact

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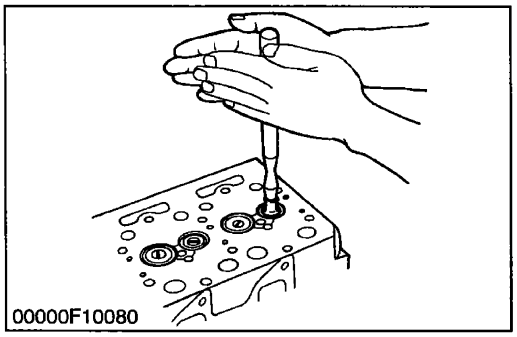

Valve Lapping

1. Apply compound evenly to the valve lapping surface.
2. Insert the valve into the valve guide. Lap the valve onto its seat with a valve flapper or screwdriver.
3. After lapping the valve, wash the compound away and apply oil, then repeat valve lapping with oil.
4. Apply prussian blue to the contact surface to check the seated rate. If it is less than 70 %, repeat valve lapping again.

■ IMPORTANT

- **When valve lapping is performed, be sure to check the valve recessing and adjust the valve clearance after assembling the valve.**

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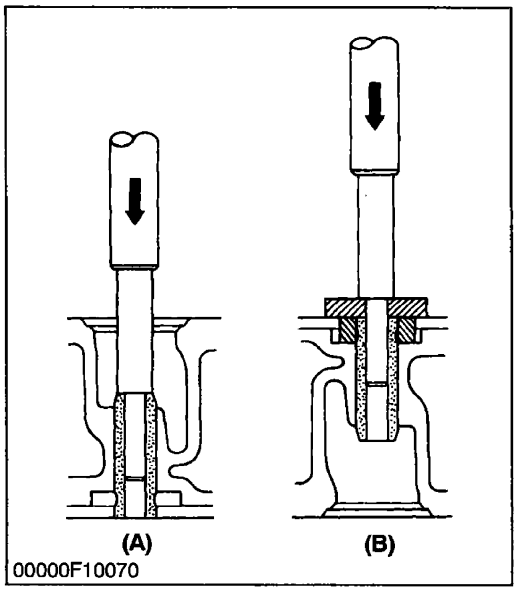

Replacing Valve Guide

(When removing)

1. Using a valve guide replacing tool (see page S-65), press out the used valve guide.

(When installing)

1. Clean a new valve guide, and apply engine oil to it.
2. Using a valve guide replacing tool, press in a new valve guide until it is flush with the cylinder head as shown in the figure.
3. Ream precisely the I.D. of the valve guide to the specified dimension.

■ IMPORTANT

- **Do not hit the valve guide with a hammer, etc. during replacement.**

(A) When Removing **(B) When Installing**

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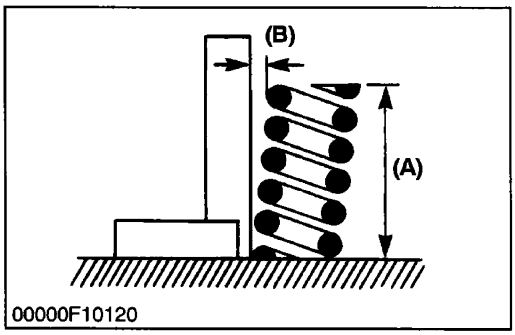

Free Length and Tilt of Valve Spring

1. Measure the free length **(A)** with vernier calipers. If the measurement is less than the allowable limit, replace it.
2. Put the spring on a surface plate, place a square on the side of the spring, and check to see if the entire side is in contact with the square. Rotate the spring and measure the maximum **(B)**. If the measurement exceeds the allowable limit, replace.
3. Check the entire surface of the spring for scratches. Replac it, if any.

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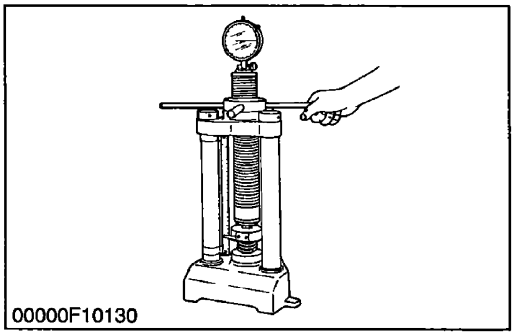
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Valve Spring Setting Load

1. Place the valve spring on a tester and compress it to the same length it is actually compressed in the engine.
2. Read the compression load on the gauge.
3. If the measurement is less than the allowable limit, replace it.

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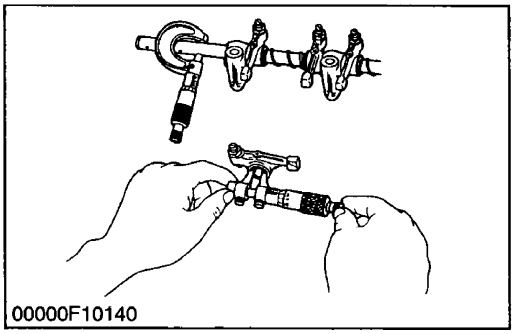
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Oil Clearance between Rocker Arm Shaft and Beraing

1. Measure the rocker arm bearing I.D. with an inside micrometer.
2. Measure the rocker arm shaft O.D. with an outside micrometer, and then calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the rocker arm and measure the oil clearance again. If it still exceeds the allowable limit, replace also the rocker arm shaft.

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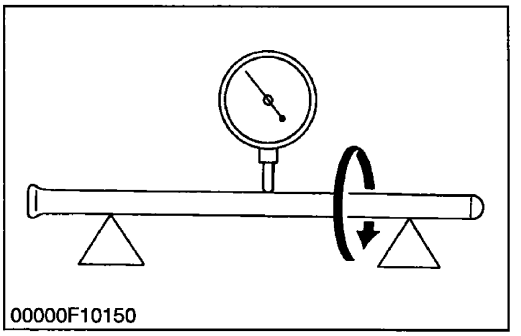
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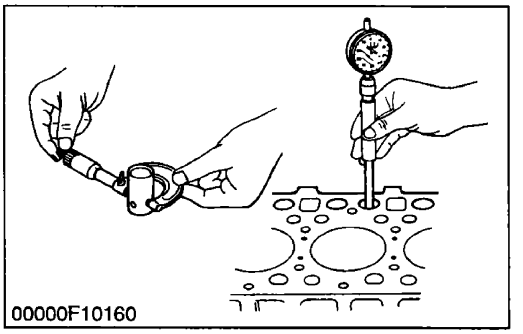
Push Rod Alignment

1. Check the both end of the push rod for cracks, damage and unusual wear.
2. Measure the bending of the push rod with a dial indicator.
3. If the measurement exceeds the allowable limit, replace the push rod.

00000S10111

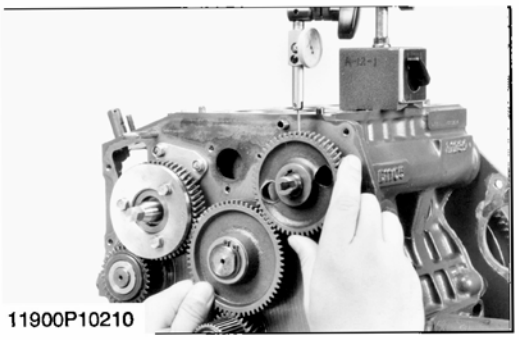

00000F10160

Oil Clearance between Tappet and Tappet Guide Bore

1. Measure the tappet O.D. with an outside micrometer
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

00000S10122

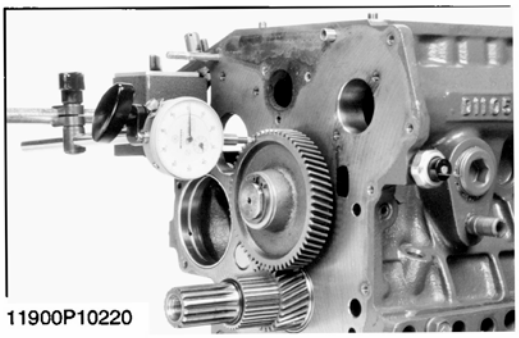
[2] Timing gear and camshaft


11900P10210

Timing Gear Backlash

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the gear to measure the backlash, holding its mating gear.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shafts and the gear.
4. If the oil clearance is proper, replace the gear.

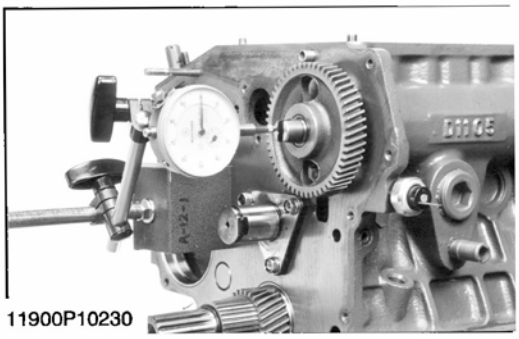
00000S10132


11900P10220

Idle Gear Side Clearance

1. Set a dial indicator with its tip on the idle gear.
2. Measure the side clearance by moving the idle gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the idle gear collar.

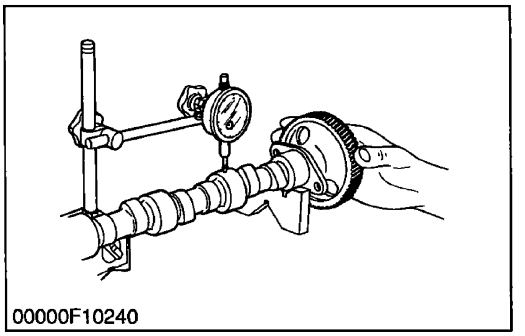
00000S10142


11900P10230

Camshaft Side Clearance

1. Set a dial indicator with its tip on the camshaft.
2. Measure the side clearance by moving the cam gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the camshaft stopper.

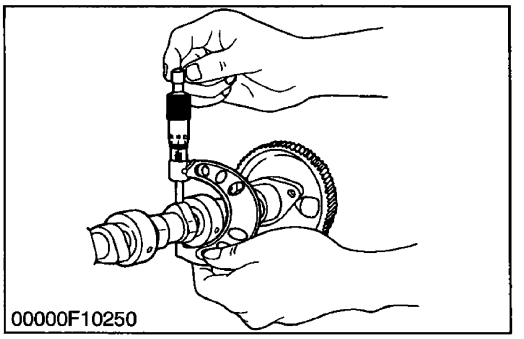
00000S10182


00000F10240

Camshaft Alignment

1. Support the camshaft with V blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. rotate the camshaft on the V blocks and get the misalignment (half of the measurement).
3. if the misalignment exceeds the allowable limit, replace the camshaft.

00000S10191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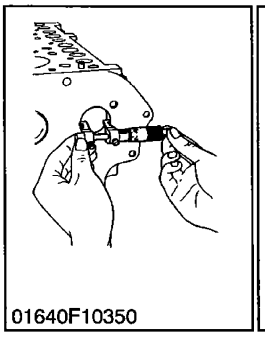
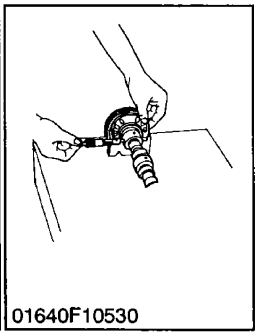
Cam Height

1. Measure the height of the cam at its highest point with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the camshaft.

00000S10202


01640F10350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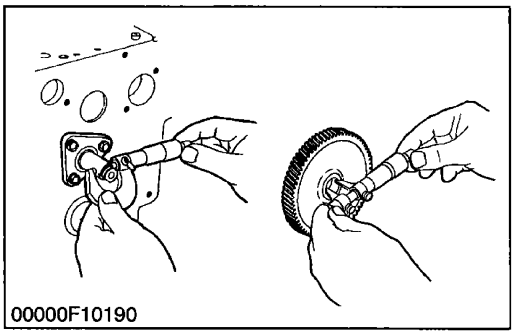
Oil Clearance of Camshaft Journal

1. Measure the camshaft journal O.D. with an outside micrometer
2. Measure the cylinder block bore I.D. for camshaft with an inside micrometer.
   Calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the camshaft.

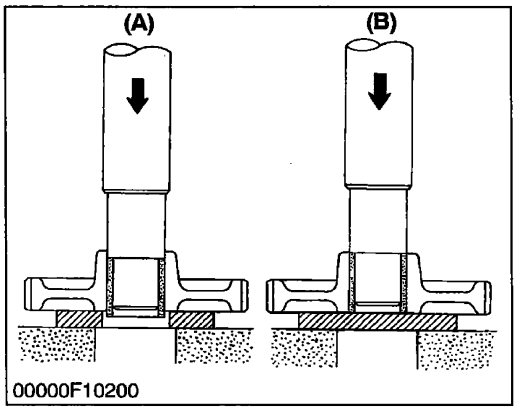
00000S10172


00000F10190

Oil Clearance between Idle Gear Shaft and Idle Gear Bushing

1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing.

00000S10152



Replacing Idle Gear Bushing

(A) (When removing)

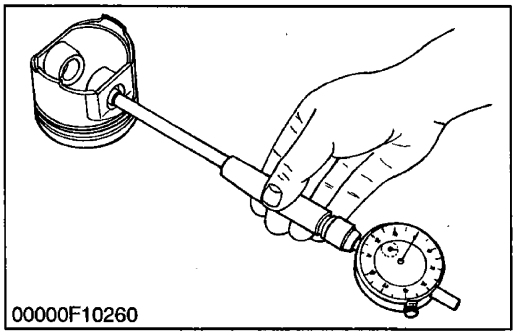
1. Using an idle gear bushing replacing tool (see page S-69), press out the used bushing.

(B) (When installing)

1. Clean a new idle gear bushing and idle gear bore, and apply engine oil to them.
2. Using an idle gear bushing replacing tool, press in a new bushing (service parts) to the specified dimension. (See figure.)

00000S10161

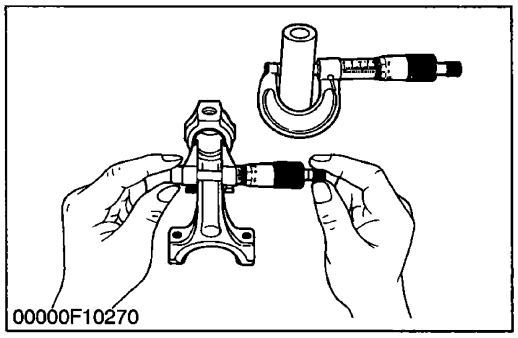
[3] Piston and connecting rod



Piston Pin Bore I.D.

1. Measure the piston pin bore I.D. in both the horizontal and vertical directions with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the piston.

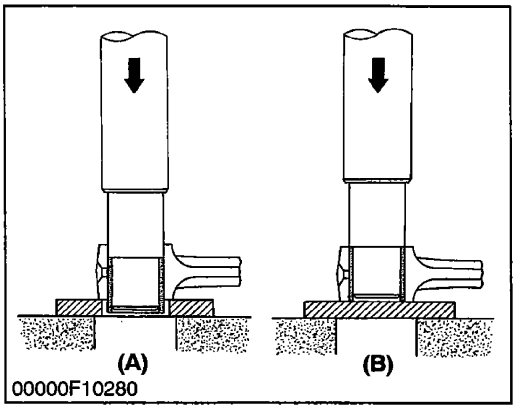
00000S10212

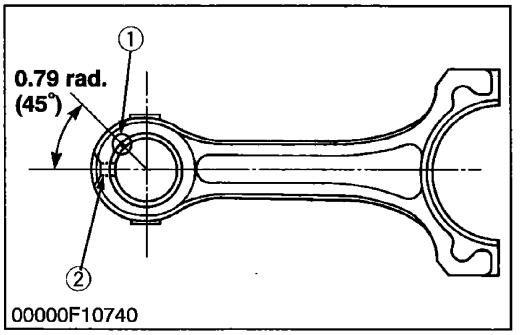


Oil Clearance between Piston Pin and Small End Bushing

1. Measure the O.D. of the piston pin where it contacts the bushing with an outside micrometer.
2. Measure the I.D. of the piston pin bushing at the connecting rod small end with a cylilnder gauge.
   Calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the allowable limit, replace the piston pin.

00000S10222





Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool.

(When installing)

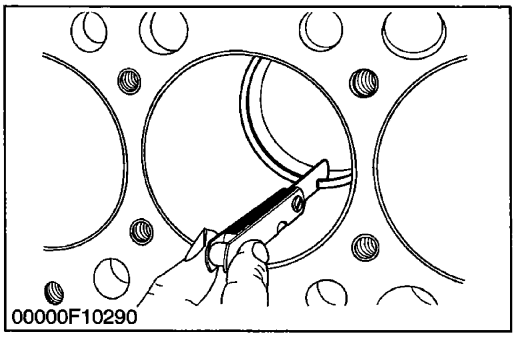
1. Clean a new small end bushing and bore, and apply engine oil to them.
2. Insert a new bushing onto the tool and press-fit it with a press so that the seam (1) of bushing positions as shown in the figure, until it is flash with the connecting rod.
3. Drill a hole to the bushing with aligning the oil hole (2) of connecting rod using 4.0 mm dia. (0.157 in. dia.) drill.

■ **NOTE**

- **Be sure to chamfer the oil hole circumference with an oil stone.**

(1) Seam
(2) Oil Hole
(A) When Removing
(B) When Installing

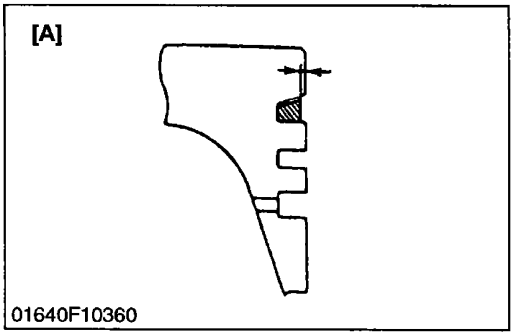
00000S10231

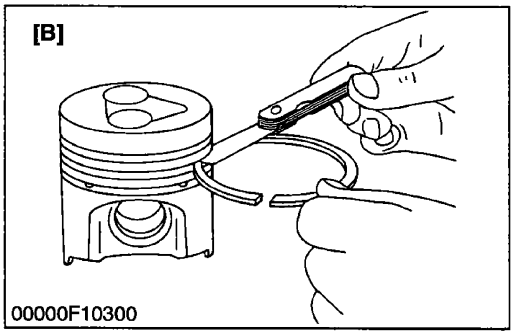


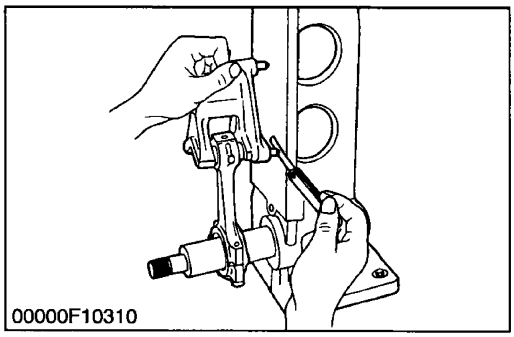
Piston Ring Gap

1. Insert the piston ring into the lower part of the liner (the least worn out part) with the piston.
2. Measure the ring gap with a feeler gauge.
3. If the gap exceeds the allowable limit, replace the piston ring.

00000S10242







Clearance between Piston Ring and Groove

1. Remove carbon from the ring grooves.
2. Measure the clearance between the ring and the groove with a feeler gauge or depth gauge.
3. If the clearance exceeds allowable limit, replace the ring since compression leak and oil shortage result.
4. If the clearance still exceeds the allowable limit after replacing the ring, replace the piston.

Factory spec : **A**	More than 0.2 mm 0.079 in.

(A) Top Ring (Key Stone Type) **(B) 2nd, Oil Ring**

00000S10252

Connecting Rod Alignment

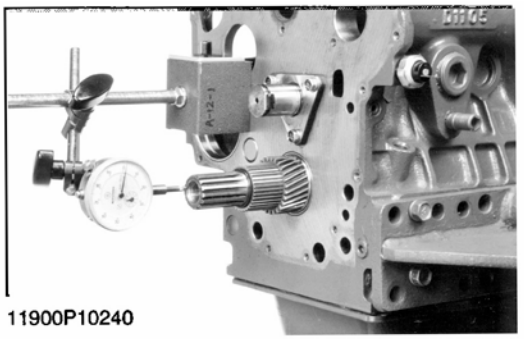
■ NOTE

- **Since the I.D. of the connecting rod small end bushing is the basis of this check, check the bushing for wear beforehand.**

1. Remove the crankpin bearing, and install the connecting rod cap.
2. Install the piston pin in the connecting rod.
3. Install the connecting rod on the connecting rod alignment tool (Code No. 07909-31661).
4. Put a gauge over the piston pin, and move it against the face plate.
5. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
6. If the measurement exceeds the allowable limit, replace the connecting rod.

00000S10261

[4] Crankshaft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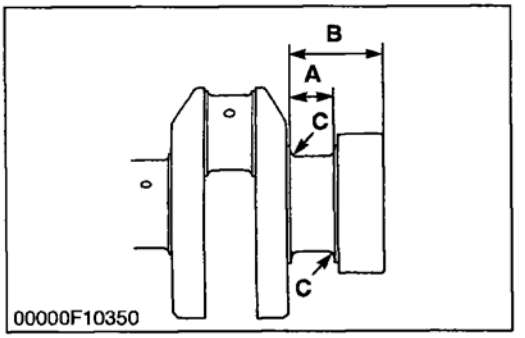


00000F10350

Crankshaft Side Clearance

1. Set a dial indicator with its tip on the end of the crankshaft.
2. Measure the side clearance by moving the crankshaft to the front and rear.
3. If the measurement exceeds the allowable limit, replace the thrust bearings.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an oversize one referring to the table and figure.

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

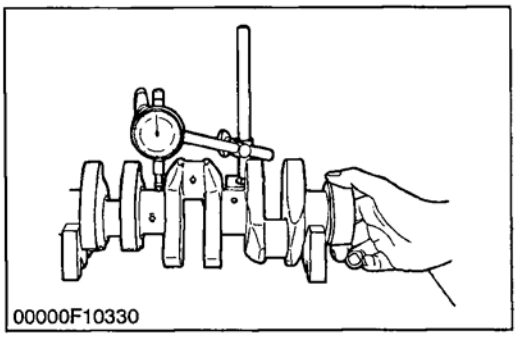
- Oversize thrust bearing

Oversize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Thrust bearing 1 02	15521-23951	020 OS
	Thrust bearing 2 02	19202-23971	020 OS
0.4 mm 0.016 in.	Thrust bearing 1 04	15521-23961	040 OS
	Thrust bearing 2 04	19202-23981	040 OS

- Oversize dimensions of crankshaft journal

Dimension \ Over-size	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	28.20 to 28.25 mm 1.1102 to 1.1122 in.	28.40 to 28.45 mm 1.1181 to 1.1201 in.
B	51.5 to 51.7 mm 2.028 to 2.035 in.	51.6 to 51.8 mm 2.031 to 2.039 in.
C	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius
The crankshaft journal must be fine-finished to higher than (0.8-S) ▽▽▽▽.		

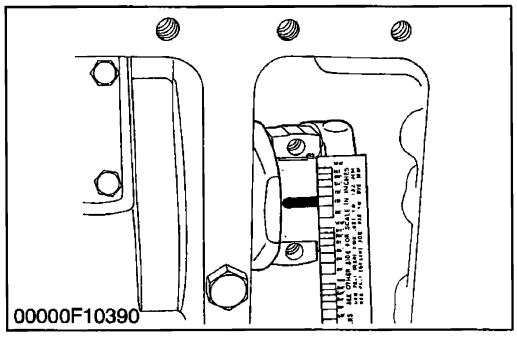
00000S10291


00000F10330

Crankshaft Alignment

1. Support the crankshaft with V blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. Rotate the crankshaft on the V blocks and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the crankshaft.

00000S10281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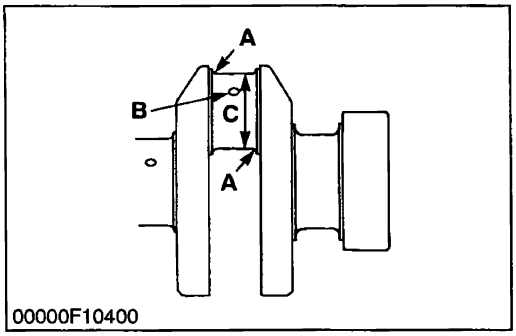


00000F10400

Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage (Code No. 07909-30241) on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
5. If the oil clearance exceeds the allowable limit, replace the crankpin bearing.
6. If the same size bearing is useless because of the crankpin wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

- **Never insert the plastigage into the crankpin oil hole.**
- **Be sure not to move the crankshaft while the connecting rod screws are tightened.**

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.029 to 0.091 mm 0.00114 to 0.00358 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankpin O.D.	Factory spec.	39.959 to 39.975 mm 1.57319 to 1.57382 in.
Crankpin bearing I.D.	Factory spec.	40.004 to 40.050 mm 1.57496 to 1.57677 in.

(Reference)

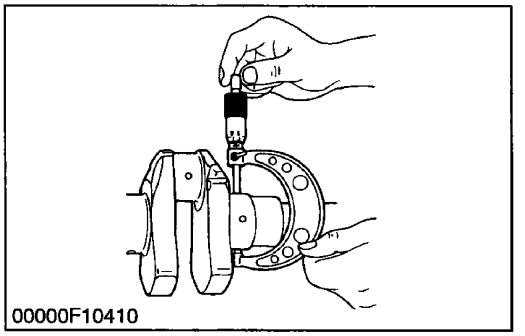
- Undersize crankpin bearing

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankpin bearing 02	16241-22971	020 US
0.4 mm 0.016 in.	Crankpin bearing 04	16241-22981	040 US

- Undersize dimensions of crankpinl

Undersize / Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.8 to 3.2 mm radius 0.1102 to 0.1260 in.radius	2.8 to 3.2 mm radius 0.1102 to 0.1260 in.radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	39.759 to 39.775 mm 1.56531 to 1.56594 in.	39.559 to 39.575 mm 1.55744 to 1.55807 in.
The crankpin must be fine-finished to higher than (0.8-S) ▽▽▽▽.		

00000S10321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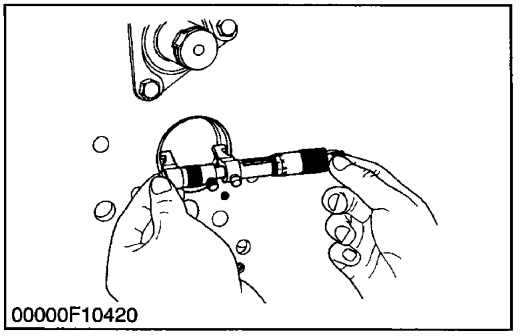
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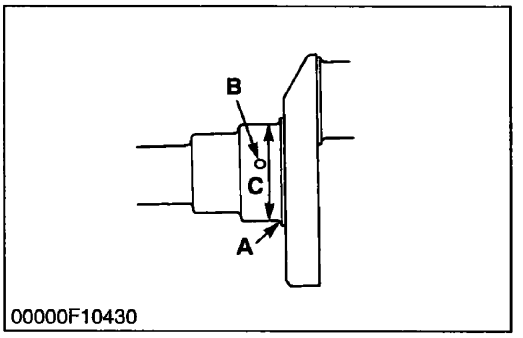

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

1. Measure the O.D. of the crankshaft front journal with an outside micrometer.
2. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 1.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.034 to 0.114 mm 0.00134 to 0.00449 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D.	Factory spec.	47.934 to 47.950 mm 1.88716 to 1.88779 in.
Crankshaft bearing 1 I.D.	Factory spec.	47.984 to 48.048 mm 1.88913 to 1.89165 in.

(Reference)

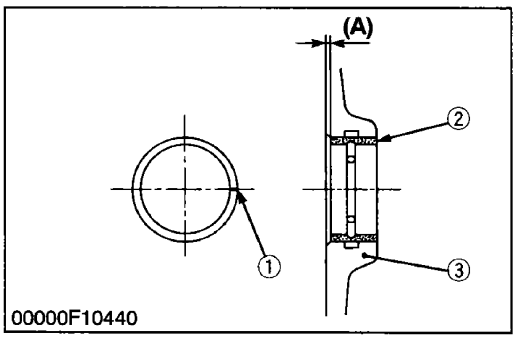
- Undersize crankshaft bearing 1

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 1 02	16241-23911	020 US
0.4 mm 0.016 in.	Crankshaft bearing 1 04	16241-23921	040 US

- Undersize dimensions of crankshaft journal

Undersize / Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.0906 to 0.1063 in.radius	2.3 to 2.7 mm radius 0.0906 to 0.1063 in.radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	47.734 to 47.750 mm 1.87929 to 1.87992 in.	47.534 to 47.550 mm 1.87142 to 1.87204 in.
The crankshaft journal must be fine-finished to higher than (0.8-S) ▽▽▽▽.		

00000S10331



Replacing Crankshaft Bearing 1

(When removing)

1. Press out the used crankshaft bearing 1 using a crankshaft bearing 1 replacing tool.

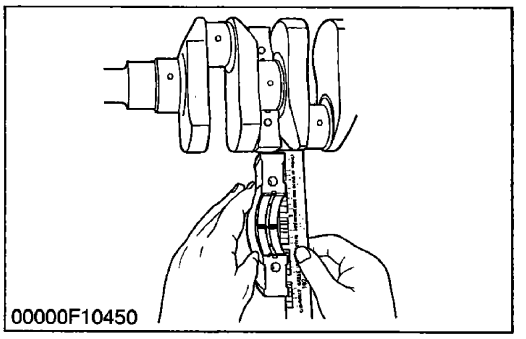
(When installing)

1. Clean a new crankshaft bearing 1 and crankshaft journal bore, and apply engine oil to them.
2. Using a crankshaft bearing 1 replacing tool, press in a new bearing 1 (2) so that its seam (1) directs toward the exhaust manifold side. (See figure)

Dimension **(A)**	Factory spec.	0 to 0.3 mm 0 to 0.0118 in.

(1) Seam
(2) Crankshaft Bearing 1
(3) Cylinder Block

00000S10341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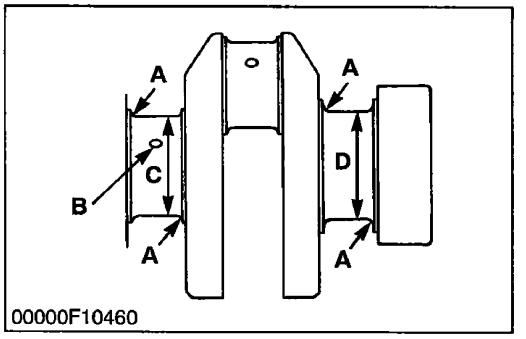

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 (Crankshaft Bearing 3)

1. Put a strip of plastigage (Code No. 07909-30241) on the center of the journal.
2. Install the bearing case and tighten the bearing case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale, and get the oil clearance.
4. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 2 (crankshaft bearing 3).
5. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

- **Be sure not to move the crankshaft while the bearing case screws are tightened.**

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.034 to 0.095 mm 0.00134 to 0.00374 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Intermediate)	Factory spec.	47.934 to 47.950 mm 1.88716 to 1.88779 in.
Crankshaft bearing 2 I.D.	Factory spec.	47.984 to 48.029 mm 1.88913 to 1.89091 in.

Oil clearance between crankshaft journal and crankshaft bearing 3	Factory spec.	0.034 to 0.098 mm 0.00134 to 0.00386 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Flywheel side)	Factory spec.	51.921 to 51.940 mm 2.04413 to 2.04488 in.
Crankshaft bearing 3 I.D.	Factory spec.	51.974 to 52.019 mm 2.04622 to 2.04799 in.

00000S10351

Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 and 3 (Continue)

(Reference)

- Undersize crankshaft bearing 2 and 3

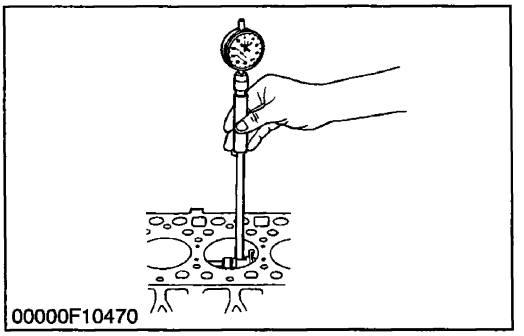
Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 2 02	16241-23931	020 US
	Crankshaft bearing 3 02	16241-23861	020 US
0.4 mm 0.016 in.	Crankshaft bearing 2 04	16241-23941	040 US
	Crankshaft bearing 3 04	16241-23871	040 US

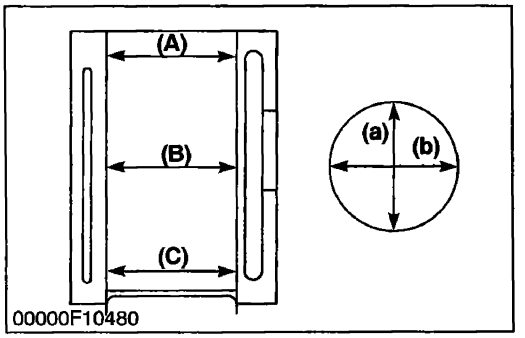
- Undersize dimensions of crankshaft journal

Undersize / Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.0906 to 0.1063 in. radius	2.3 to 2.7 mm radius 0.0906 to 0.1063 in.radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	47.734 to 47.750 mm 1.87929 to 1.87992 in.	47.534 to 47.550 mm 1.87141 to 1.87204 in.
D	51.721 to 51.740 mm 2.03626 to 2.03700 in.	51.521 to 51.540 mm 2.02838 to 2.02913 in.
• The crankpin journal must be fine-finished to higher than ▽▽▽ (0.8 S).		

00000S10352

[5] Cylinder





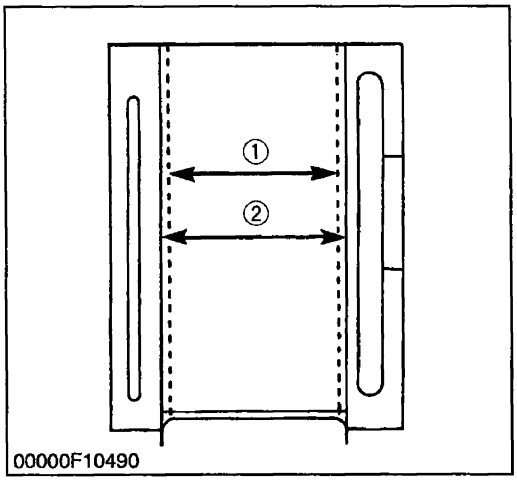
Cylinder Wear

1. Measure the I.D. of the cylinder at the six positions (see figure) with a cylinder gauge to find the maximum and minimum I.D.'s.
2. Get the difference (Maximum wear) between the maximum and the minimum I.D.'s
3. If the wear exceeds the allowable limit, bore and hone to the oversize dimension. (Refer to **"Correcting Cylinder"**.)
4. Visually check the cylinder wall for scratches. If deep scratches are found, the cylinder should be bored. (Refer to **"Correcting Cylinder"**.)

Cylinder I.D.	Factory spec.	D905-B (E) V1205-B (E) V1205-T-B (E)	72.000 to 72.019 mm 2.8346 to 2.8353 in.
		D1005-B (E) V1305-B (E)	76.000 to 76.019mm 2.9921 to 2.9929 in.
		D1105-B (E) D1105-T-B (E) V1505-B (E) V1505-T-B (E)	78.000 to 78.019 mm 3.0709 to 3.0716 in.
Maximum wear	Allowable limit		0.15 mm 0.0059 in.

(A) Top
(B) Middle
(C) Bottom (Skirt)
(a) Right-angled to Piston Pin
(b) Piston Pin Direction

01642S10362



Correcting Cylinder

1. When the cylinder is worn beyond the allowable limit, bore and hone it to the specified dimension.

Cylinder I.D.	Factory spec.	D905-B (E) V1205-B (E) V1205-T-B (E)	72.500 to 72.519 mm 2.8346 to 2.8551 in.
		D1005-B (E) V1305-B (E)	76.500 to 76.519mm 3.0118 to 3.0126 in.
		D1105-B (E) D1105-T-B (E) V1505-B (E) V1505-T-B (E)	78.500 to 78.519 mm 3.0906 to 3.0913 in.
Maximum wear	Allowable limit		0.15 mm 0.0059 in.
Finishing	Hone to 1.2 to 2.0 μR max. (0.00047 to 0.00079 in.R max.)		

2. Replace the piston and piston rings with oversize (0.5 mm) ones.

Part Name	Model	Code Number	Marking
Piston	D905-B (E), V1205-B (E)	16224-2191-0	05 OS
	V1205-T-B (E)	16295-2191-0	
	D1005-B (E), V1305-B (E)	16050-2191-0	
	D1105-B (E), V1505-B (E)	16060-2191-0	
	D1105-T-B (E) V1505-T-B (E)	16292-2191-0	
Piston ring assembly	D905-B (E), V1205-B (E)	15901-2109-0	05 OS
	V1205-T-B (E)	16269-2109-0	
	D1005-B (E), V1305-B (E)	16271-2109-0	
	D1105-B (E), V1505-B (E)	16261-2109-0	
	D1105-T-B (E) V1505-T-B (E)	16292-2109-0	

■ NOTE

- **When the oversize cylinder is worn beyond the allowable limit, replace the cylinder block with a new one.**

(1) Cylinder I.D. (Before Correction) (2) Oversize Cylinder I.D.

01642S10372

D.Lubricating system

CHECKING


01640P10230

Engine Oil Pressure

1. Remove the oil switch and set a pressure tester (Code No. 07916-32031).
2. Start the engine. After warming up, measure the oil pressure of both idling and rated speeds.
3. If the oil pressure is less than the allowable limit, check the following.

- Engine oil insufficient
- Oil pump defective
- Oil strainer clogged
- Oil filter cartridge
- Oil gallery clogged
- Excessive oil clearance of bearing
- Foreign matter in the relief valve

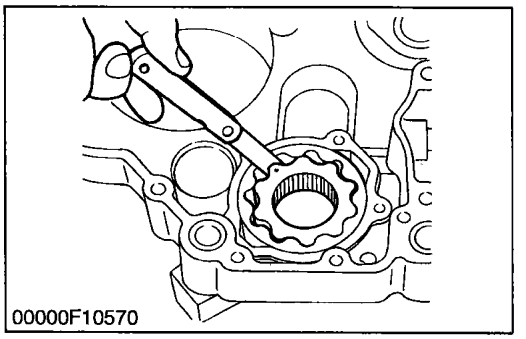
(When reassembling)

- After checking the engine oil pressure, tighten the engine oil pressure switch to the specified torque.

11900S10261

SERVICING

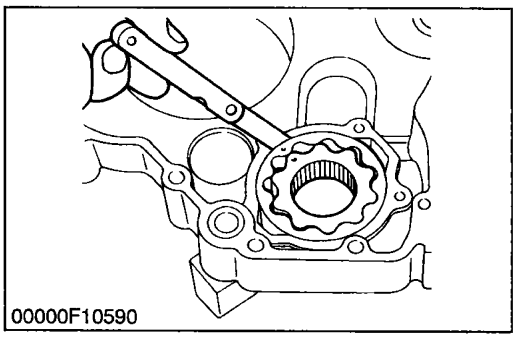
[1] Oil pump


00000F10570

Rotor Lobe Clearance

1. Measure the clearance between lobes of the inner rotor and the outer rotor with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

00000S10422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Clearance between Outer Rotor and Pump Body

1. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

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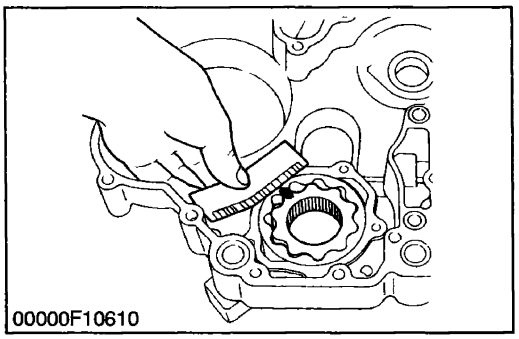


Clearance between Rotor and Cover

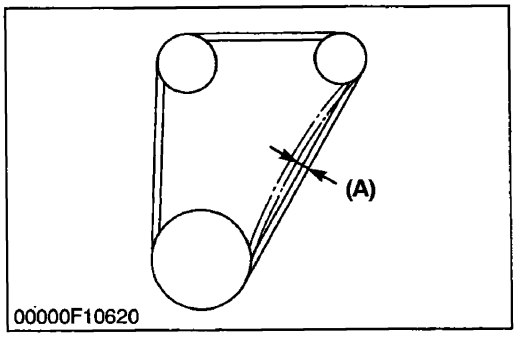
1. Put a strip of plastigage (Code No. 07909-30241) onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully, and measure the amount of the flattening with the scale and get the clearance.
4. If the clearance exceeds the factory specifications, replace oil pump rotor assembly.

00000S10442

E.Cooling system

CHECKING

[1] Fan belt



Fan Belt Tension

1. Press the fan belt between fan pulley and pulley at force of 10 kgf (98 N, 22 lbs).
   Check if the fan belt deflection is 10 to 12 mm (0.394 to 0.472 in.)
2. If the deflection is not within the factory specifications, adjust with the tension pulley adjusting nut.

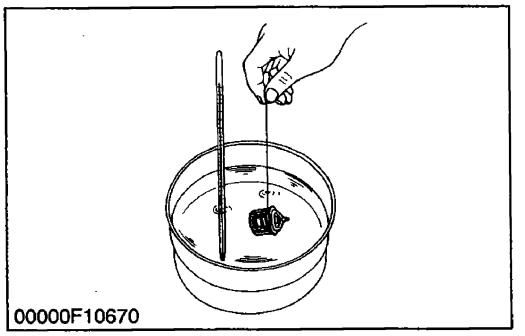
00000S10451

[2] Radiator

CAUTION

- **When removing the radiator cap, wait at least ten minutes after the engine has stopped and cooled down. Otherwise, hot water may gush out, scalding nearby people.**

01640S10430



Thermostat Valve Opening Temperature

1. Push down the thermostat valve and insert a string between the valve and the valve seat.
2. Place the thermostat and a thermometer in a container with water and gradually heat the water.
3. Hold the string to suspend the thermostat in the water. When the water temperature rises, the thermostat valve will open, allowing it to fall down from the string.
   Read the temperature at this moment on the thermometer.
4. Continue heating the water and read the temperature when the valve has risen by about 6 mm (0.236 in.).
5. If the measurement is not acceptable, replace the thermostat.

Thermostat's valve opening temperature	Factory spec.	69.5 to 72.5 °C 157.1 to 162.5 °F
Temperature at which thermostat completely opens	Factory spec.	85 °C 185 °F

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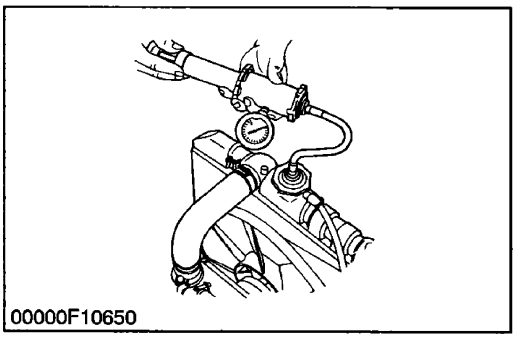
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Radiator Water Leakage

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (Code No. 07909-31551).
   Increase water pressure to the specified pressure of 1.4 kgf/cm^2 (137 kPa, 20 psi).
3. Check the radiator for water leaks.
4. When water leakage is excessive, replace the radistor. If water leakage is caused by a small pinhole, correct the radiator with radistor cement.

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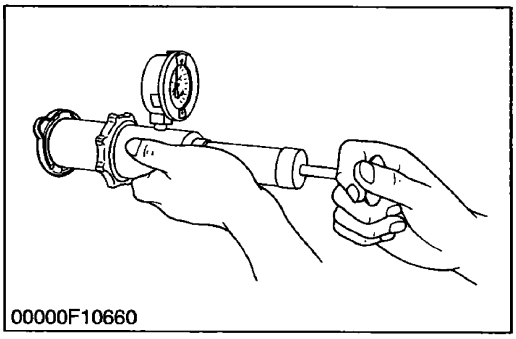
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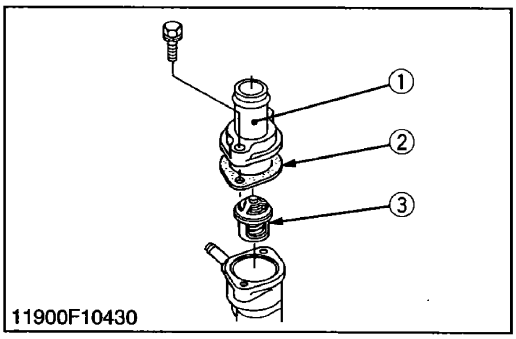
Radiator Cap Air Leakage

1. Set a radiator tester (Code No. 07909-31551) on the radiator cap.
2. Apply the specified pressure of 0.9 kgf/cm^2 (98.1 kPa, 12.8 psi).
3. ,Check if the pressure drop to less than 0.6 kgf/cm^2 (59 kPa, 9 psi) in 10 seconds.
4. If the pressure is less than the factory specification, replace it.

00000S10481

DISASSEMBLING AND ASSEMBLING



11900F10430

Thermostat Assembly

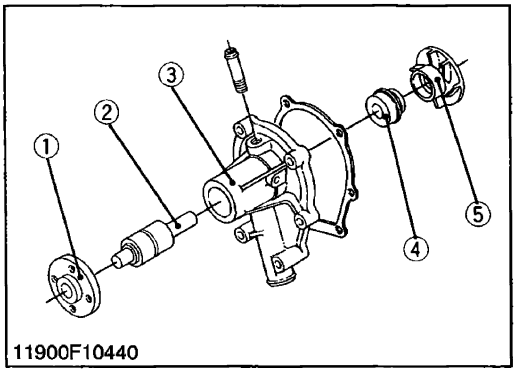
1. Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
2. Remove the thermostat assembly (3).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the gasket (2).

(1) Thermostat Cover
(2) Thermostat Cover Gasket
(3) Thermostat Assembly

11900S10270



11900F10440

Water Pump Assembly

1. Loosen the alternator mounting bolts, and remove the fan belt.
2. Remove the fan and fan pulley.
3. Remove the water pump assembly from the gear case cover.
4. Remove the water pump flange (1).
5. Press out the water pump shaft (2) with the impeller (5) on it.
6. Remove the impeller from the water pump shaft.
7. Remove the mechanical seal (4).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of gasket.
- Replace the mechanical seal with new one.

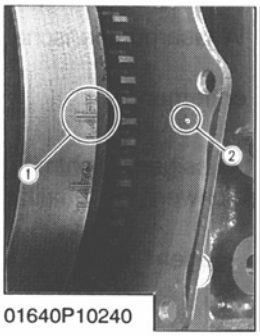
(1) Water Pump Flange
(2) Water Pump Shaft
(3) Water Pump Body
(4) Mechanical Seal
(5) Impeller

11900S10280

F. Fuel system

CHECKING AND ADJUSTING

[1] Injection pump



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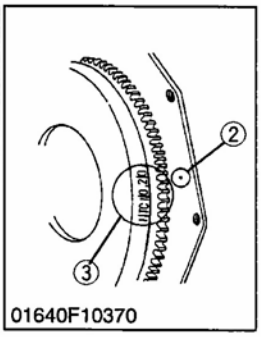

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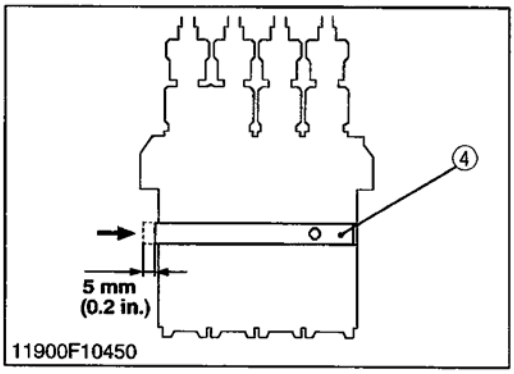

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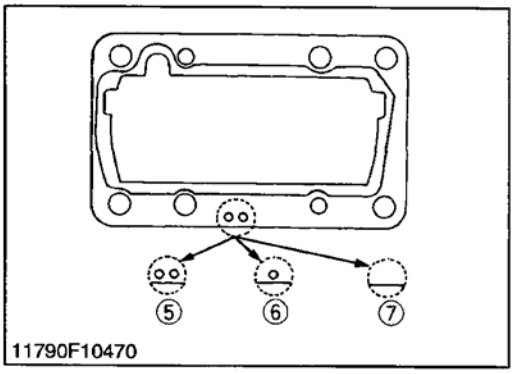


11790F10470

Injection Timing

■ IMPORTANT

- **When inspecting the fuel injection timing, the timing control actuates during starting and the correct fuel injection timing cannot be measured.**

1. Remove the injection pipes.
2. Remove the engine stop solenoid, push in the control rack of the injection pump by 5 mm (0.2 in.) and hold it at that position.
3. Turn the flywheel counterclockwise until fuel flows from the delivery valve holder.
4. Continue to turn the flywheel slowly, and stop it as soon as the fuel level at the tip of the delivery valve holder begins to increase.
5. Check to see if the mark **"FI"** (1) or timing angle lines on the flywheel is aligned with the punch mark (2).
6. If the timing is out of adjustment, readjust the timing with shims.

(1) Mark "FI"
(2) Punch Mark
(3) Timing Mark
(4) Control Rack
(5) Two-holes : 0.20 mm (0.0079 in.)
(6) One-hole : 0.25 mm (0.0098 in.)
(7) Without hole : 0.30 mm (0.0118 in.)

11900S10291

Injection Timing (Continue)

■ NOTE

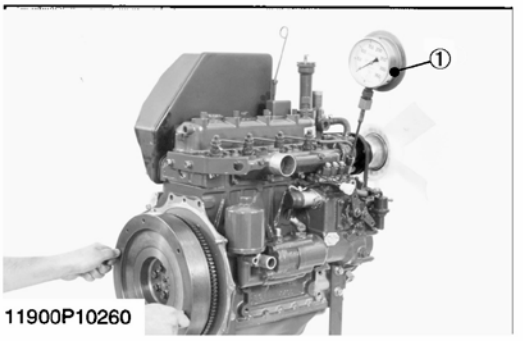
(Engine serial number : ~ 489290)

- **Shims are available in thickness of 0.15 mm (0.0059 in.), 0.30 mm (0.0118 in.). Combine these shims for adjustments.**
- **Addition or reduction of shim (0.15 mm, 0.0059 in.) delays or advances the injection timing by approx. 0.026 rad. (1.5°).**
- **After adjusting the injection timing, apply liquid-type gasket (Three Bond 1215 or its equivalent) to both sides of the injection pump shim before reassembling.**

(Engine serial number : 489291 ~)

- **The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.**
- **Shims are available in thickness of 0.20 mm (0.0079 in.), 0.25 mm (0.0098 in.) and 0.30 mm (0.0118 in.). Combine these shims for adjustments.**
- **Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad. (0.5°).**
- **In disassembling and replacing, be sure to use the same number of new gasket shims with the same thickness.**

11900S10292



11900P10260

Fuel Tightness of Pump Element

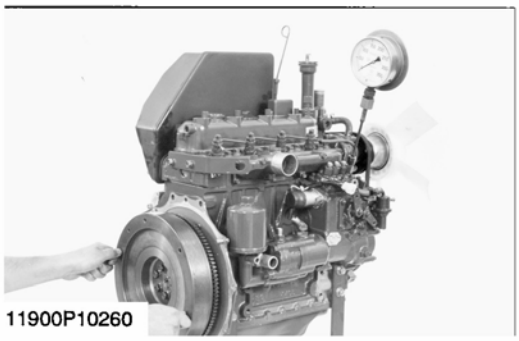
1. Remove the injection pipes and glow plugs.
2. Install the injection pump pressure tester (1) to the injection pump.
3. Set the speed control lever to the maximum speed position.
4. Turn the flywheel ten times or more to increase the pressure.
5. If the pressure can not reach the allowable limit, replace the pump element or injection pump assembly.

■ NOTE

- **Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket.**

(1) Injection Pump Pressure Tester

11900S10301


11900P10260

Fuel Tightness of Delivery Valve

1. Remove the injection pipes and glow plugs.
2. Set a pressure tester to the fuel injection pump.
3. Turn the flywheel and raise the pressure to approx. 14.7 MPa (150 kgf/cm^2, 2133 psi).
4. Now turn the flywheel back about half a turn (to keep the plunger free). Maintain the flywheel at this position and clock the time taken for the pressure to drop from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm^2, from 2133 to 1990 psi).
5. Measure the time needed to decrease the pressure from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm^2, from 2133 to 1990 psi).
6. If the measurement is less than allowable limit, replace the delivery valve.

■ **NOTE**

- **Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket.**

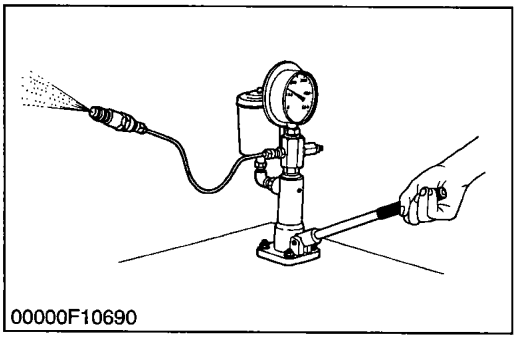
11900S10311

[2] Injection nozzle

CAUTION

- **Check the injection pressure and condition after confirming that there is nobody standing in the direction the fume goes.**
  If the fume from the nozzle directly contacts the human body, cells may be destroyed and blood poisoning may be caused.

11790S10690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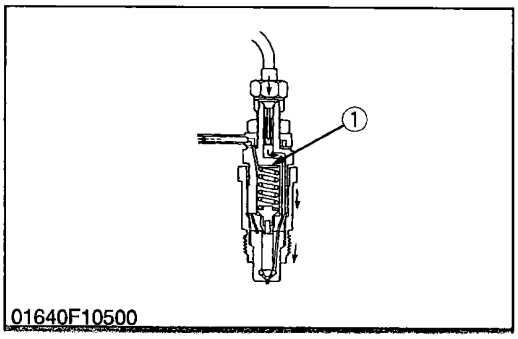

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Nozzle Injection Pressure

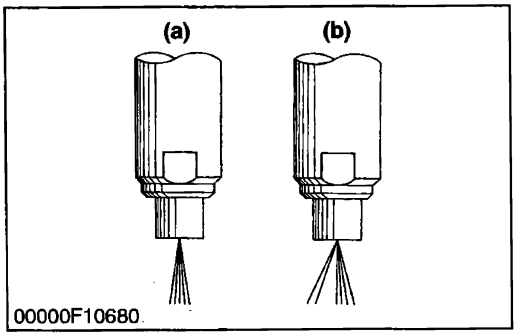
1. Set the injection nozzle to the nozzle tester.
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, disassemble the injecetion nozzle, and change adjusting washer (1) until the proper injection pressure is obtained.

(Reference)

- Pressure variation with 0.025 mm (0.001 in.) difference of adjusting washer thickness.
  Approx. 59 kPa (6 kgf/cm^2, 85 psi)

(1) Adjusting Washer

00000S10512

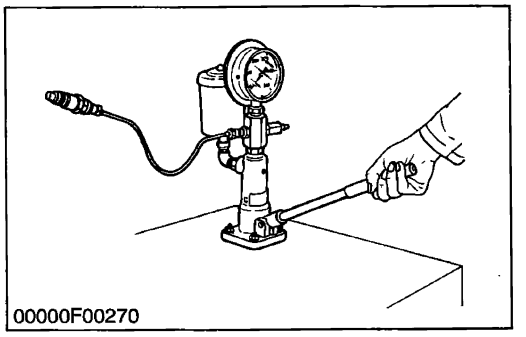


Nozzle Spraying Condition

1. Set the injection nozzle to a nozzle tester (Code No. 07909-31361), and check the nozzle spraying condition.
2. If the spraying condition is defective, replace the nozzle piece.

(a) Good **(b) Bad**

00000S10500



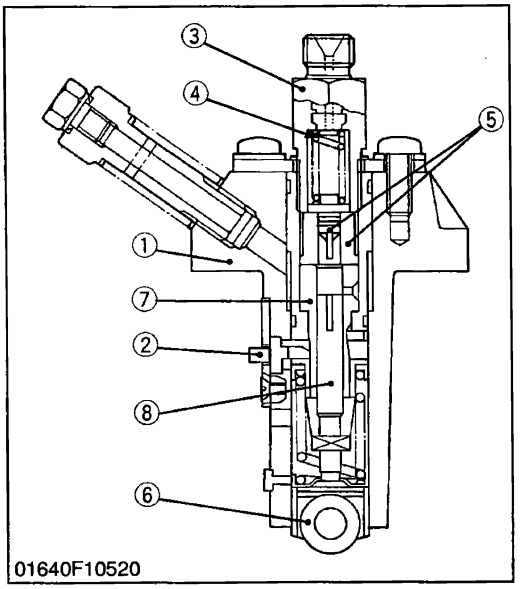
Valve Seat Tightness

1. Set the injection nozzle to a nozzle tester (Code No. 07909-31361).
2. Raise the fuel pressure, and keep at 12.75 MPa (130 kgf/cm^2, 1849 psi) for 10 seconds.
3. If any fuel leak is found, replace the nozzle piece.

00000S10521

DISASSEMBLING AND ASSEMBLING

[1] Injection pump



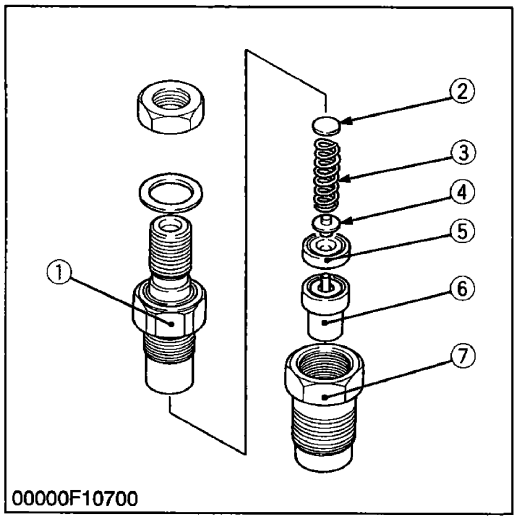
■ IMPORTANT

- **If replacing the pump element, the amount of fuel injection should be adjusted on a specified bench.**

(1) Pump Body
(2) Control Rack
(3) Delivery Valve Holder
(4) Delivery Valve Spring
(5) Delivery Valve
(6) Tappet Roller
(7) Cylinder
(8) Plunger

01640S10440

[2] Injection nozzle



Nozzle Holder

1. Secure the nozzle retaining nut (7) with a vise.
2. Remove the nozzle holder (1), and take out parts inside.

(When reassembling)

- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), noting its direction.
- After assembling the nozzle, be sure to adjust the fuel injection pressure.

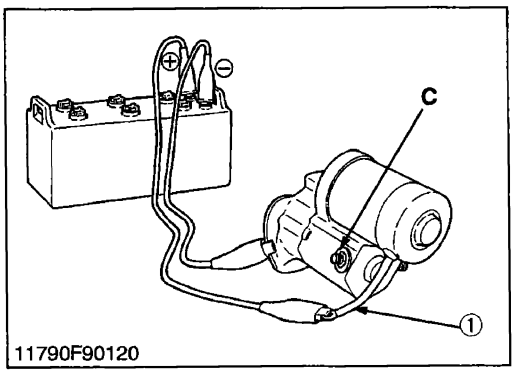
(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut

00000S10531

G. Electrical system

CHECKING

[1] Starter



Motor Test

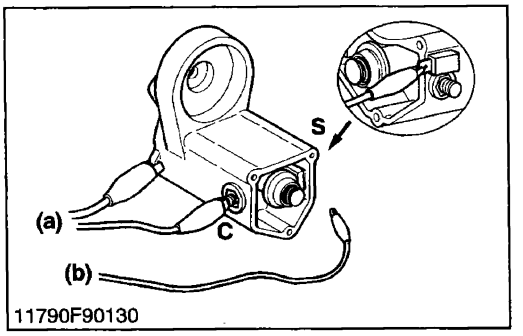
CAUTION

- **Secure the starter in a vise to prevent it from jumping up and down while testing the motor.**

1. Disconnect the ground cable clamp from the battery negative terminal post.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter motor from the engine.
4. Disconnect the connecting lead (1) from the starter **C** terminal.
5. Connect a jumper lead from the connecting lead (1) to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

(1) Connecting Lead

11790S90180



Magnet Switch Test (Pull-in, Holding Coils)

1. Remove the motor from the starter housing.
2. Preparate a 6 V battery for the test.
3. Connect jumper leads from the battery negative terminal to the housing and the starter **C** terminal.
4. The plunger should be attached and the pinion gear should pop out when a jumper lead is connected from the battery positive terminal to the **S** terminal. It's a correct.
5. Disconnect the jumper lead to the starter **C** terminal. Then the pinion gear should remain popped out. It's a correct.

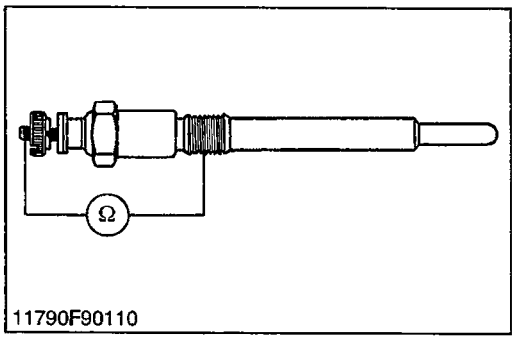
IMPORTANT

- **Testing time must be 3 to 5 sec.**

(a) To Negative Terminal **(b) To Positive Terminal**

11790S90190

[2] Glow plug



Glow Plug

1. Disconnect the leads from the flow plugs.
2. Measure the resistance with a circuit tester across the glow plug terminal and the housing.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the reference value is not indicated, the glow plug is faulty, replace the glow plug.

[S / No. 489290 and below]

Glow plug resistance	Factory spec.	Approx. 1.0 to 1.2 ohms

[S / No. 489291 and above]

Glow plug resistance	Factory spec.	Approx. 0.9 ohms

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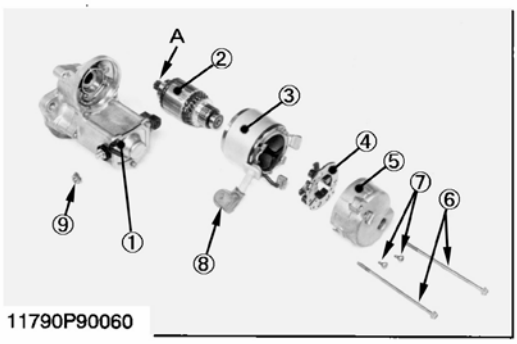
DISASSEMBLING AND ASSEMBLING

[1] Starter



Disassembling Motor

1. Disconnected the connecting lead (8) from the magnet switch (1).
2. Remove the through screws (6), and then separate the end frame (5), yoke (3) and armature (2).
3. Remove the two screws (7), and then take out the brush holder (4) from the end frame (5).

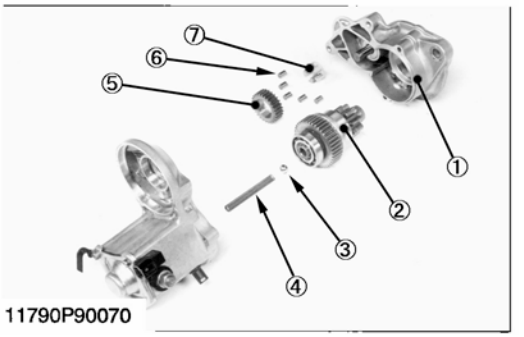
(When reassembling)

- Apply grease to the spline teeth **(A)** of the armature (2).

(1) Magnet Switch
(2) Armature
(3) Yoke
(4) Brush Holder
(5) End Frame
(6) Screws
(7) Screws
(8) Connecting Lead
(9) Nut

(A) Spline Teeth

11790S90200



11790P90070

Disassembling Magnet Switch

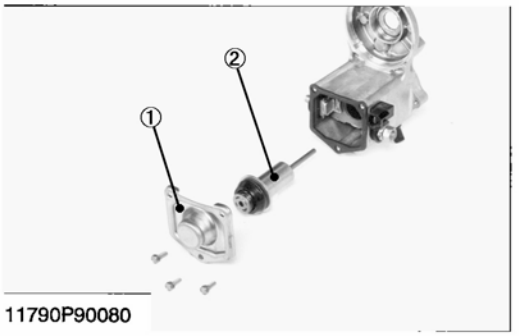
1. Remove the drive end frame (1) mounting screws.
2. Take out the over running clutch (2), ball (3), spring (4), gear (5), rollers (6) and retainer (7).

(When reassembling)

- Apply grease to the gear teeth of the gear (5) and over running clutch (2), and ball (3).

(1) Drive End Frame
(2) Over Running Clutch
(3) Ball
(4) Spring
(5) Gear
(6) Roller
(7) Retainer

11790S90210



11790P90080

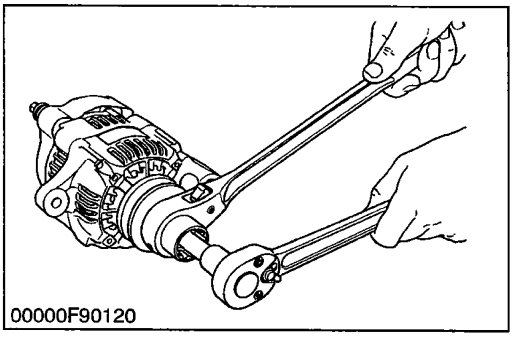
Plunger

1. Remove the end cover (1).
2. Take out the plunger (2).

(1) End Cover
(2) Plunger

11790S90220

[2] Alternator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Pulley

1. Secure the hexagonal end of the pulley shaft with a double-ended ratchet wrench as shown in the figure, loosen the pulley nut with a socket wrench and remove it.

(When reassembling)

Tightening torque	Pulley nut	58.3 to 78.9 N·m 5.95 to 8.05 kgf·m 43.0 to 58.2 ft-lbs

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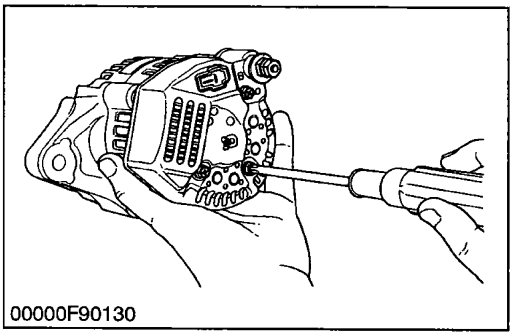
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Rear End Cover

1. Unscrew the three rear end cover screws and the **B** terminal nut, and remove the rear end cover.

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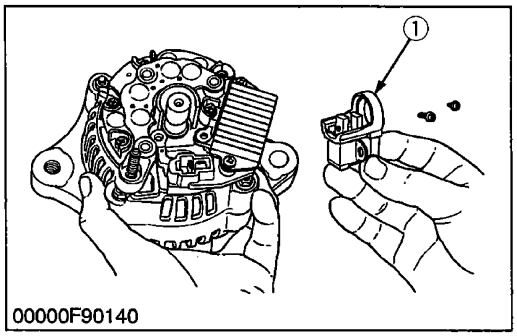

Brush Holder

1. Unscrew the two screws holding the brush holder, and remove the brush holder (1).

(1) Brush Holder

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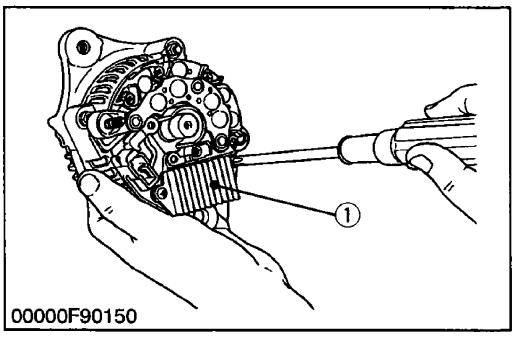

IC Regulator

1. Unscrew the three screws holding the IC regulator, and remove the IC regulator (1).

(1) IC Regulator

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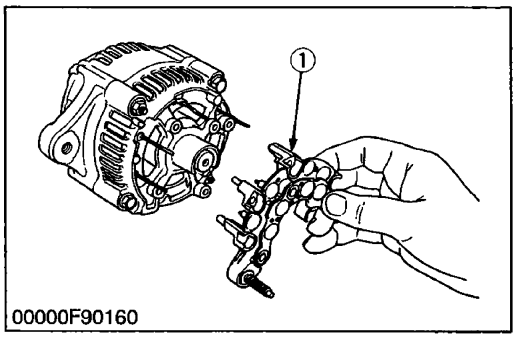

Rectifier

1. Remove the four screws holding the rectifier and the stator lead wires.
2. Remove the rectifier (1).

(1) Rectifier

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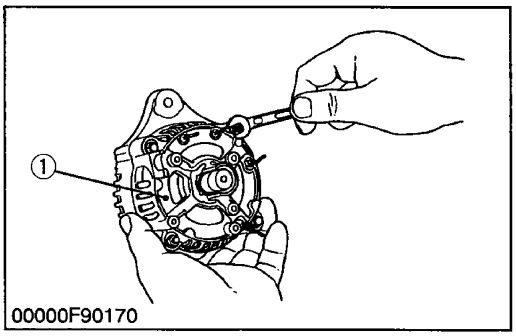

Rear End Frame

1. Unscrew the two nuts and two screws holding the drive end frame and the rear end frame.
2. Remove the rear end frame (1).

(1) Rear End Frame

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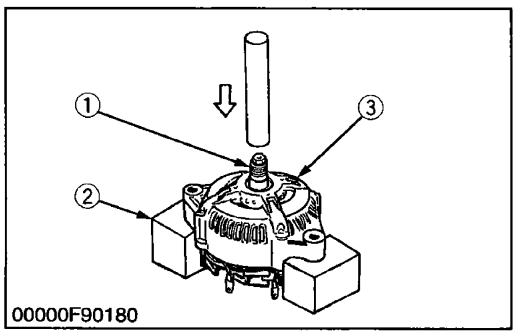

Rotor

1. Press out the rotor (1) from drive end frame (3).

■ IMPORTANT

- **Take special care not to drop the rotor and damage the slip ring or fan, etc.**

(1) Rotor
(2) Block
(3) Drive End Frame

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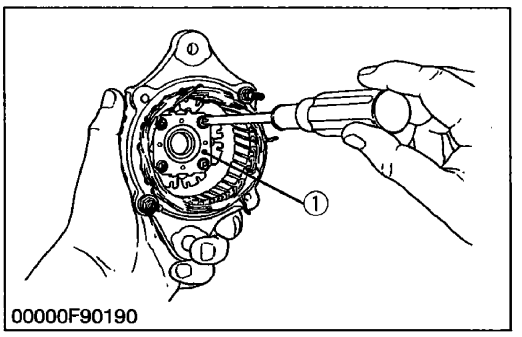

Retainer Plate

1. Unscrew the four screws holding the retainer plate, and remove the retainer plate (1).

(1) Retainer Plate

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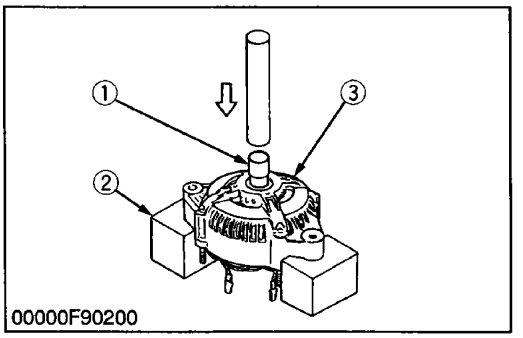

Bearing on Drive End Side

1. Press out the bearing from drive end frame (3) with a press and jig (1).

(1) Jig
(2) Block
(3) Drive End Frame

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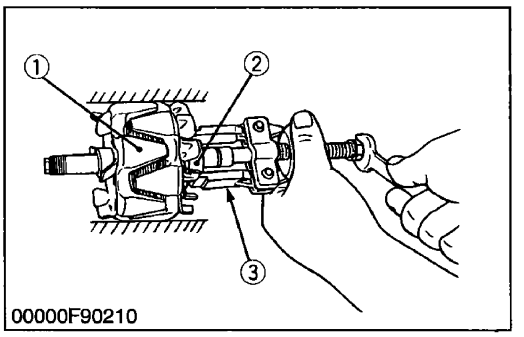


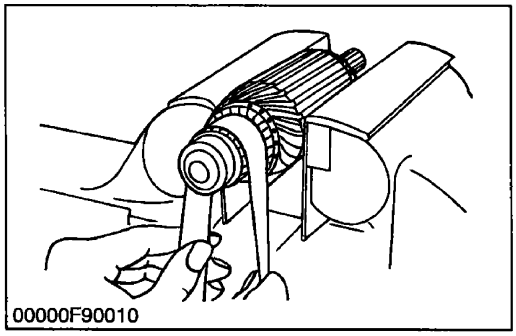
Bearing at Slip Ring Side

1. Lightly secure the rotor (1) with a vise to prevent damage, and remove the bearing (2) with a puller (3).

(1) Rotor
(2) Bearing
(3) Puller

00000S90170

SERVICING
[1] Starter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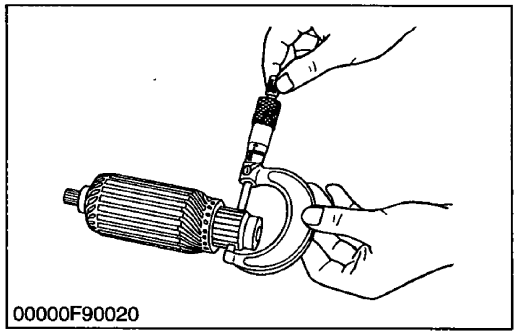
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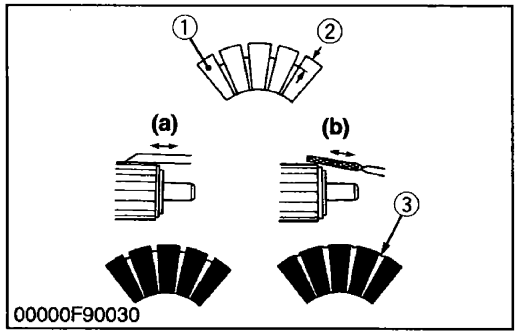

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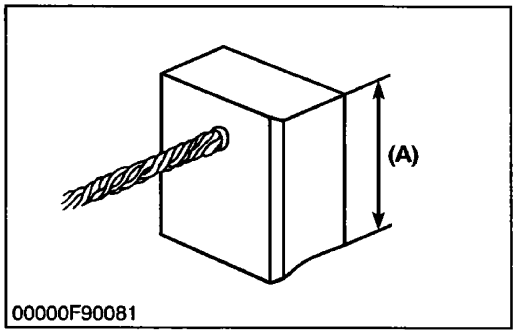
Commutator and Mica

1. Check the contact face of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

(1) Segment
(2) Depth of Mica
(3) Mica
(a) Good
(b) Bad

00000S90011



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Brush Wear

1. If the contact face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length **(A)** with vernier calipers.
3. If the length is less than the allowable limit, replace the yoke assembly and brush holder.

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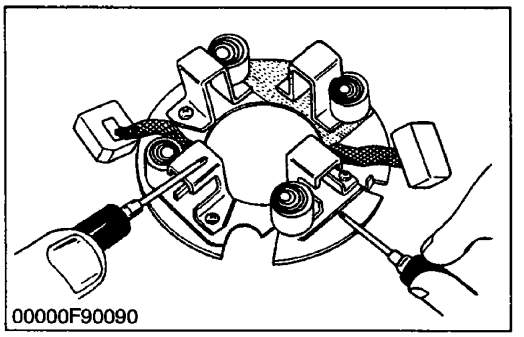

Brush Holder

1. Check the continuity across the brush holder and the holder support with an ohmmeter.
2. If it conducts, replace the brush holder.

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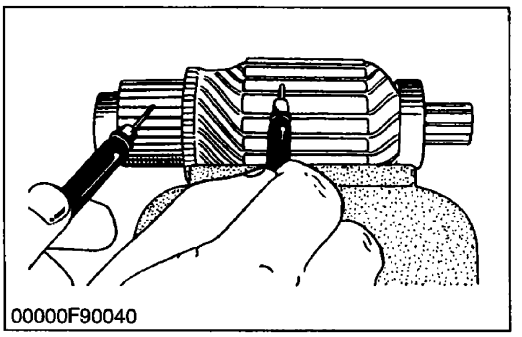
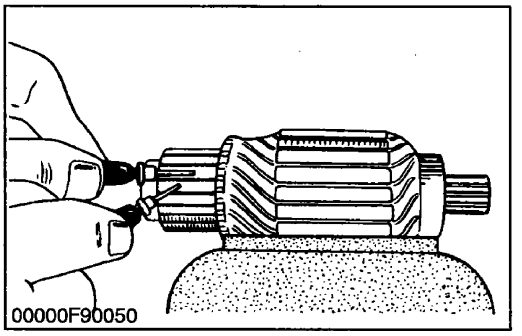


Armature Coil

1. Check the continuity across the commutator and armature coil core with an ohmmeter.
2. If it conducts, replace the armature.
3. Check the continuity across the segments of the commutator with an ohmmeter.
4. If it does not conduct, replace the armature.



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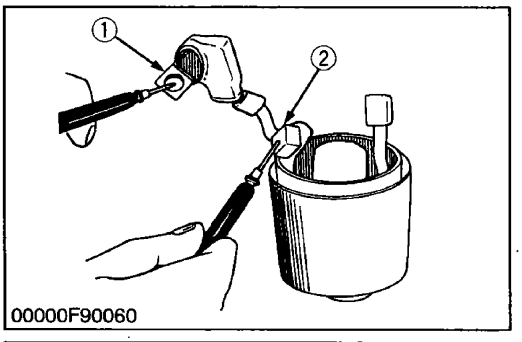
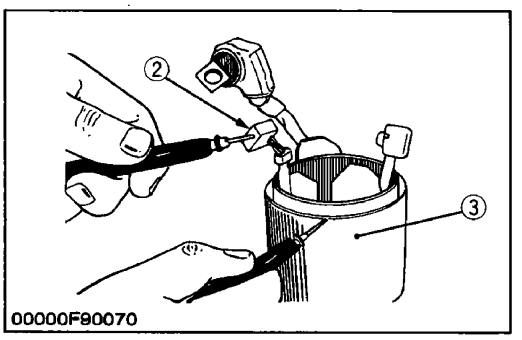


Field Coil

1. Check the continuity across the lead (1) and brush (2) with an ohmmeter.
2. If it does not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with an ohmmeter.
4. If it conducts, replace the yoke assembly.

(1) Lead
(2) Brush
(3) Yoke



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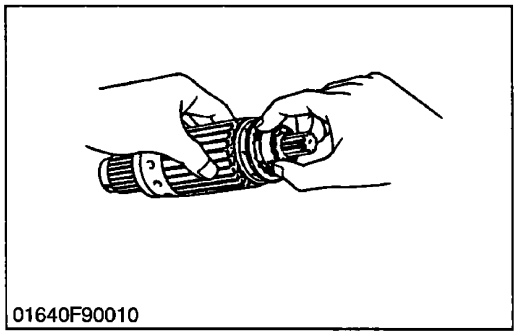
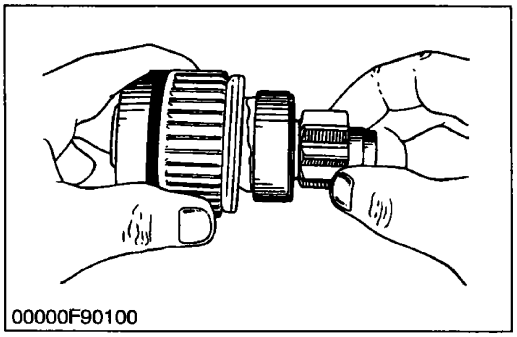

01640F90010

Armature Bearing

1. Check the bearing for smooth rotation.
2. If it does not smooth rotation, replace it.

01640S90010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Overrunning Clutch

1. Inspect the pinion for wear or damage.
2. If there is any defect, replace the overrunning clutch assembly.
3. Check that the pinion turns freely and smoothly in the overrunning direction and does not slip in the cranking direction.
4. If the pinion slips or does not turn in the both directions, replace the overrunning clutch assembly.

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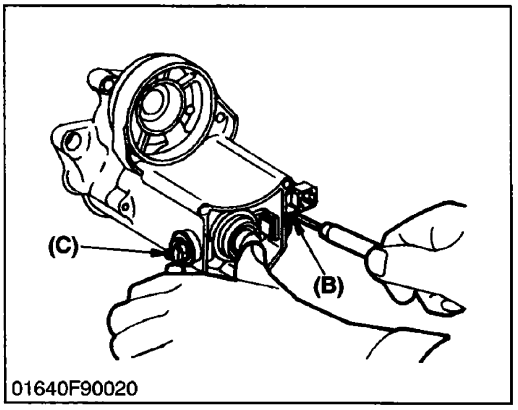

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Magnet Switch

1. Check the continuity across the **"C"** terminal and the **"B"** terminal with an ohmmeter pushing the plunger.
2. If it does not conduct, check the contacts.

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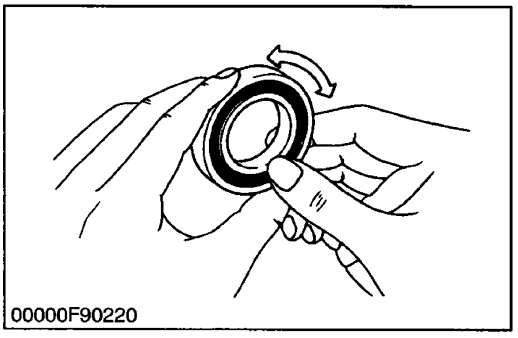
[2] Alternator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Bearing

1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.

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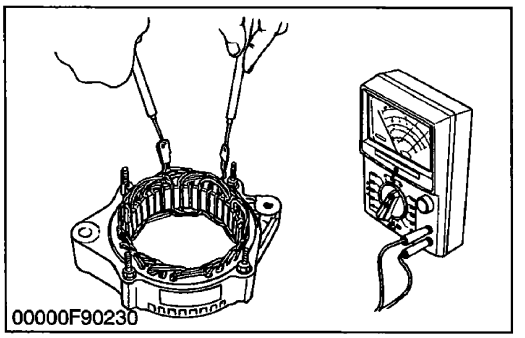

Stator

1. Measure the resistance across each lead of the stator coil with an ohmmeter.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

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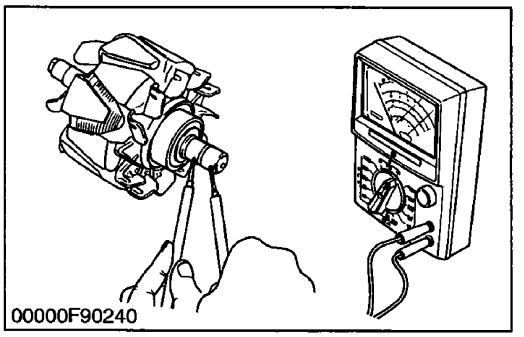

Rotor

1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If continuous, replace it.

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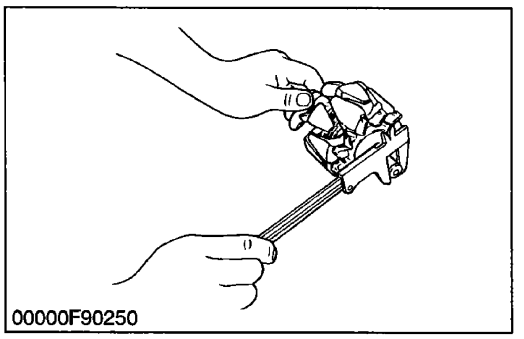

Slip Ring

1. Check the slip ring for score.
2. If scored, correct with an sand paper or on a lathe.

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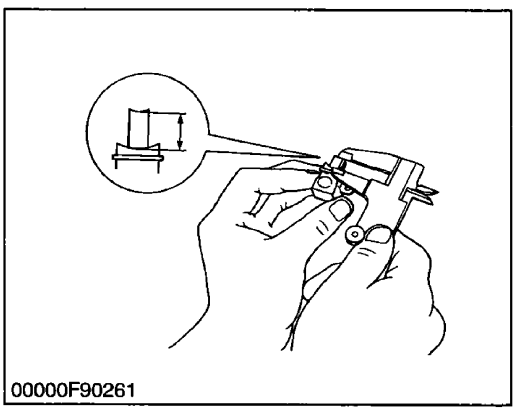

Brush Wear

1. Check the length of the brush, if the length is shorter than the allowable limit, replace it.
2. Make sure that the brush moves smoothly.
3. If the brush is defective, replace it.

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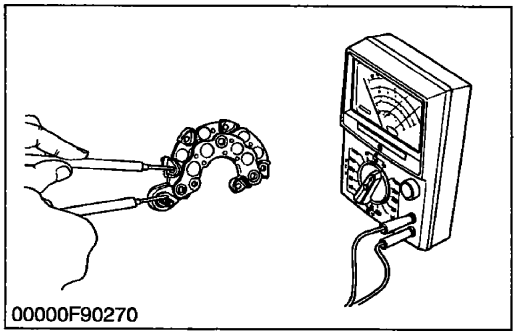
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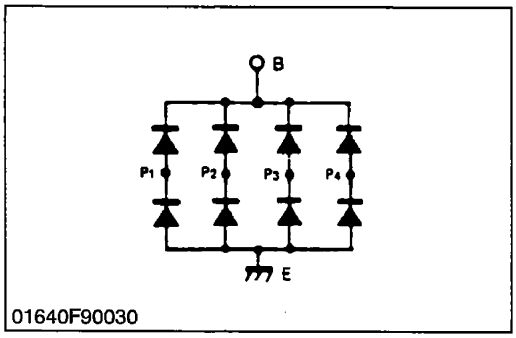

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Rectifier

1. Check the continuity across each diode of rectifier with an ohmmeter.
2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

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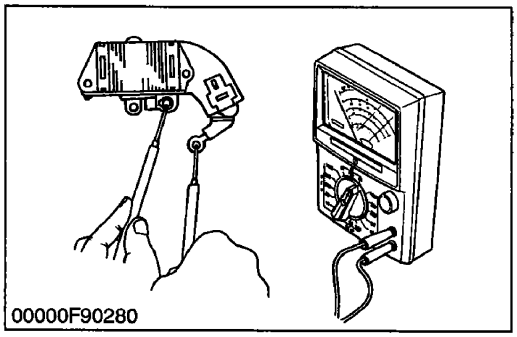
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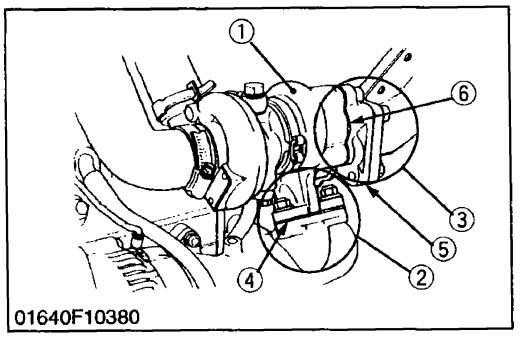
IC Regulator

1. Check the continuity across the **"B"** terminal and the **"F"** terminal of IC regulator with an ohmmeter.
2. The IC regulator is normal if the conducts in one direction and does not conduct in the reverse direction.

01640S90060

H.Turbo charger system

CHECKING



Turbine Side

1. Check the exhaust port (3) and inlet port (2) side of the turbine housing (1) to see if there is no exhaust gas leak.
2. If any gas leak is found, retighten the bolts and nuts or replace the gasket (4) / (5) / (6) with new one.

(1) Turbine Housing
(2) Inlet Port
(3) Exhaust Port
(4) Gasket
(5) Gasket
(6) Gasket

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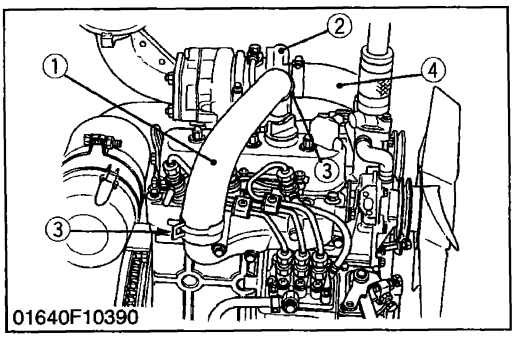

Compressor Side

1. Check the inlet pipe 1 (1) of the compressor cover (2) to see if there is no air leak.
2. Check for loose connections or cracks in the suction side of the intake pipe (4).
3. If any air leak is found, change the clamp (3) and or inlet pipes.

(1) Inlet Pipe 1
(2) Compressor Cover
(3) Clamp
(4) Intake Pipe

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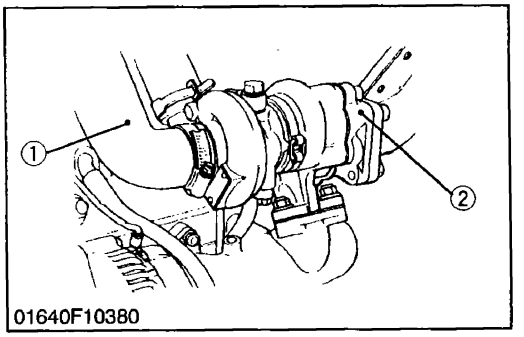
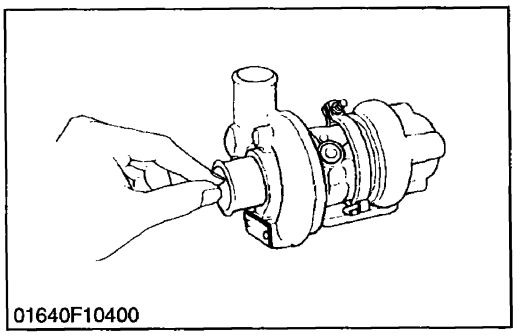


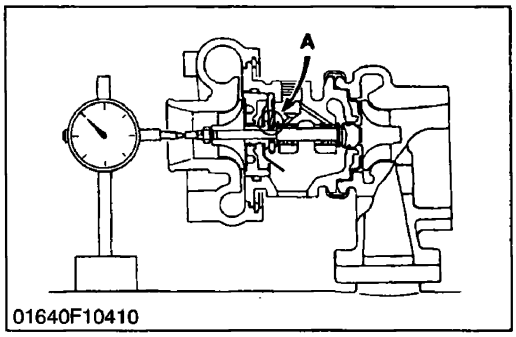


Wheel Shaft

1. Remove the intake pipe (1) and flange (2).
2. Turn the compressor wheel gently with a finger and check for contact.
3. If the wheel does not turn smoothly and / or found the damage, and abnormal sound, check the axial and radial clearance.
4. If the compressor / turbine wheel and housing is found to be damaged, replace the turbocharger assembly with new one.

(1) Intake Pipe
(2) Flange

01640S10830



Axial Clearance

1. Set the dial gauge.
2. Move the shaft in the axial direction, and measure the end play.
3. If the end play **(A)** exceeds 0.12 mm (0.0047 in.), replace the turbocharger assembly with new one.

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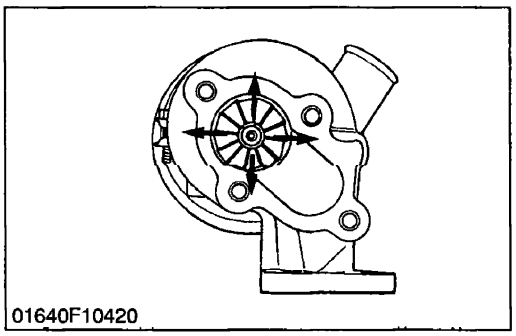

Radial Clearance

1. Move the compressor / turbine wheel (up and down / right and left).
2. If the wheel contact to the housing, replace the turbocharger assembly with new one.

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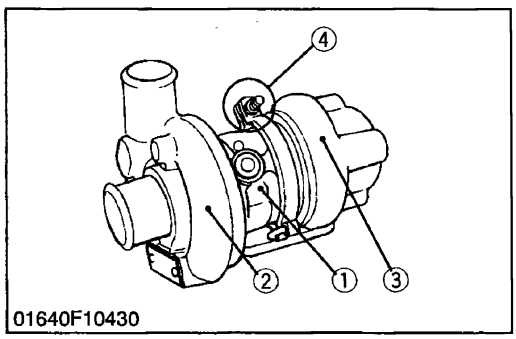
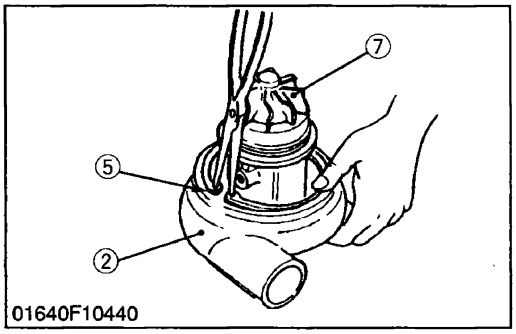


Turbine / Compressor Wheel

■ **NOTE**

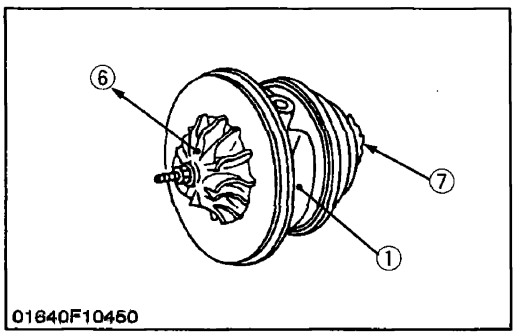
- **When carbon or oil adheres to the wheel remove the carbon or oil adheres with a brass brush or other soft tools.**
- **Do not scratch or damage the wheel with a brass brush or any other soft tools.**
- **Do not disassembling the compressor wheel and turbine shaft.**
- **After cleaning the compressor / turbine wheel, be sure to check the axial and radial clearance.**

1. Parting marks must be marked on the bearing housing (1) and compressor (2) / turbine housing (3).
2. Remove the coupling (4) and turbine housing.
3. Remove the snap ring (5) and compressor housing (2).
4. Clean the compressor wheel (6) and turbine wheel (7) with a brass brush or other soft tools.



Tightening torque	Housing clamp bolt	1.47 to 2.45 N·m 0.15 to 0.25 kgf·m 1.09 to 1.91 ft-lbs

(1) Bearing Housing
(2) Compressor Housing
(3) Turbine Housing
(4) Coupling
(5) Snap Ring
(6) Compressor / Wheel
(7) Turbine Wheel



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DISASSEMBLING AND ASSEMBLING

⚠ CAUTION

- **While the engine is running and or just after it stops, the turbocharger is hot, be careful not to touch the turbocharger.**

■ NOTE

- **When detaching and attaching the turbocharger assembly, be very careful not to allow dust, dirt and other foreign matters in the oil pipes.**
- **When the turbocharger assembly has been replaced, pour fresh engine oil through the oil filter port of the turbocharger.**
- **Before starting the engine, make sure that the air cleaner is in position.**

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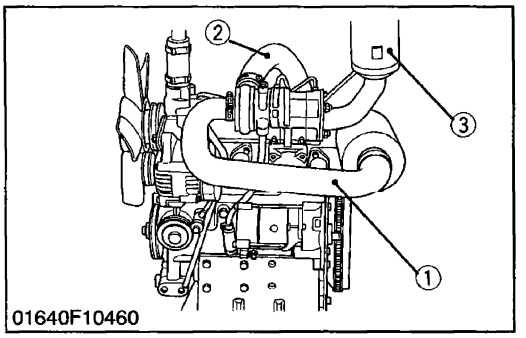

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Air Cleaner and Muffler

1. Remove the intake pipe (1).
2. Remove the inlet pipe 1 (2).
3. Remove the muffler (3).

(When reassembling)

- Replace the gaskets with new one.

(1) Intake Pipe
(2) Inlet Pipe 1
(3) Muffler

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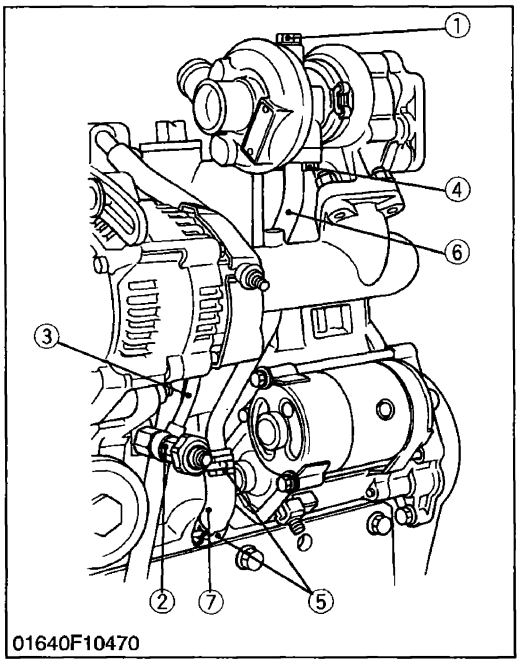

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Oil Pipe

1. Remove the joint bolt (2), (3) and take off the pipe 1 (4).
2. Remove the bolts (5) and release the clamp (6).
3. Disconnect the oil pipe 2 (7) and pipe 4 (8).

(When reassembling)

- Pour fresh engine oil through the oil filter port of the turbocharger.
- Replace the gaskets with new one.
- Be careful not to allow dust, dirt and other foreign matters in the oil pipes.

■ NOTE

- **Tape or plug all openings to prevent foreign matters from damaging the oil cavities in the turbocharger.**

(1) Joint Bolt
(2) Joint Bolt
(3) Oil Pipe 1
(4) Bolt
(5) Clamp
(6) Oil Pipe 2
(7) Oil Pipe 4

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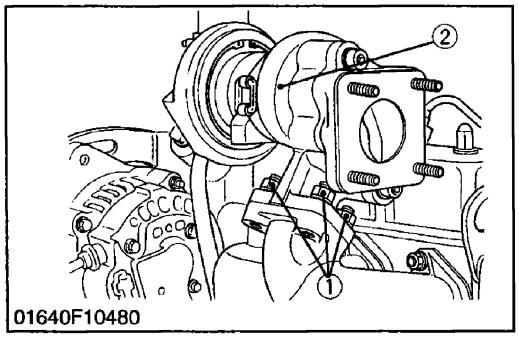

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Turbocharger

1. Remove the bolt (1).
2. Take off the turbocharger assemble (2).

(When reassembling)

- Replace the gasket with new one.

(1) Bolt
(2) Turbocharger Assemble

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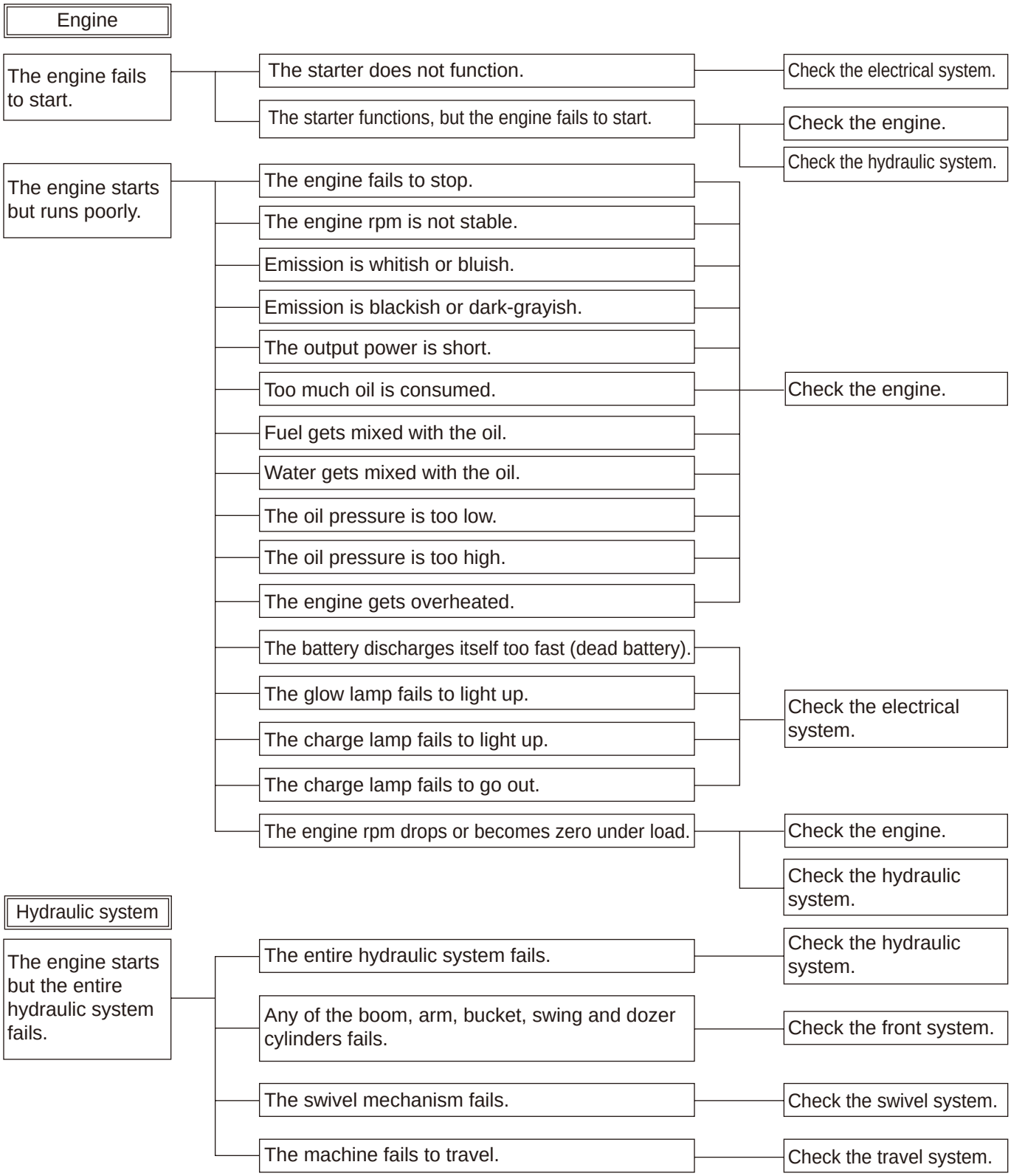
IV.Hydraulic system (Service section)

A. Troubleshooting

a. Common Circuit



The hydraulic equipment respond too slow or too weak.	The engine's maximum rpm is unusual.	Check the engine.
	The entire hydraulic system responds too slow or too weak.	Check the front system.
	Any of the boom, arm, bucket, swing and dozer cylinders responds too slow or too weak.	Check the front system.
	The swivel motion is too slow or too weak.	Check the swivel system.
	The travel movement is too slow or too weak.	Check the travel system.
	The travel speed fails to shift.	Check the travel system.
	The machine zigzags.	Check the travel system.
The hydraulic attachment drops too much by gravity, or the swivel or travel system fails.	Any of the boom, arm, bucket, swing and dozer cylinders drops too much by gravity.	Check the front system.
	The swivel mechanism fails to stop or overruns.	Check the swivel system.
	The travel mechanism fails to stop or runs away on slope.	Check the travel system.
The hydraulic tank temperature rises too high.	The engine section is in trouble: Cooling water, oil or combustion line.	Check the engine.
	The engine cover is poorly lined with thermal insulation.	See if the thermal insulation and covers are all in position.
	The operator runs the machine in the wrong way.	Train the operator.
	The attachment is not as specified for the job.	Check the specifications of the attachment.
	The grade and quantity of hydraulic oil are not as recommended.	Use the recommended hydraulic oil.
	The hydraulic system is in trouble.	Check the hydraulic system.
Unusual operating noise is heard.	Cover mounting bolts are nuts are loose.	See if the covers are tight in position.
	A pipe or hose is in contact with its nearby part.	See if the pipes and hoses are tight in position.
	Unusual noise is heard from a pin or bushing.	Check the pins and bushings for wear or seizure.
	Unusual noise is heard from the hydraulic system.	Check the hydraulic system.
	Unusual noise is heard from the engine.	Check the engine.
	Unusual noise is heard from the track or the like.	See if the crawlers, idlers, track rollers and the like are in place.

b. Hydraulic system and front attachment

Problem	Cause	Correction
The entire hydraulic system fails or responds too slow or too weak.	(1) Hydraulic oil too short in the tank or oil degraded.	Add or change the hydraulic oil.
	(2) Suction line (suction filter) clogged.	Check the suction line and replace the suction filter as required.
	(3) Pump coupling defective.	Repair or replace the pump coupling.
	(4) Pump drive shaft broken.	Replace the shaft.
	(5) Pump internal parts seized or damaged.	Repair or replace the pump.
The boom, arm, bucket and swivel mechanism fail or respond too slow or too weak.	(1) Hydraulic pilot filter or hydraulic pilot line filter clogged.	Clean or replace the pilot filter.
	(2) Selector valve defective.	Overhaul or replace the selector valve.
	(3) Pilot pump internal parts seized or damaged.	Replace the pilot pump.
The boom, bucket and right-travel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P1) not at specified pressure.	Check the main relief valve (P1) and readjust as required.
	(2) P1 or P2 line pump internal parts seized or damaged if the arm, service port and left-travel mechanism fail too.	Overhaul or replace the pump.
The arm, service port and left-travel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P2) not at specified pressure.	Check the main relief valve (P2) and readjust as required.
	(2) P1 or P2 line pump internal parts seized or damaged if the boom, bucket and right-travel mechanism fail too.	Overhaul or replace the pump.
The swing, dozer and swivel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P3) not at specified pressure.	Check the main relief valve (P3) and readjust as required.
	(2) P3 line pump internal parts seized or damaged.	Overhaul or replace the pump.
The boom alone fails or responds too slow or too weak.	(1) Boom overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or boom section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Boom cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The arm alone fails or responds too slow or too weak.	(1) Arm overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or arm section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Arm cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The bucket alone fails or responds too slow or too weak.	(1) Bucket overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or bucket section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Bucket cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.

Problem	Cause	Correction
The swing mechanism alone fails or responds too slow or too weak.	(1) Swing pedal and link maladjusted.	Check the pedal and link and readjust as required.
	(2) Control valve swing section spool malfunctioning.	Check the spool and repair as required.
	(3) Anti-void valve defective.	Check the anti-void valve and replace as required.
	(4) Swing cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The dozer alone fails or responds too slow or too weak.	(1) Dozer overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Dozer lever and cable maladjusted.	Check the lever and cable and readjust as required.
	(3) Control valve dozer section spool malfunctioning.	Check the spool and repair as required.
	(4) Dozer cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The boom cylinder allows too much gravity fall.	(1) Overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve's anti-drift valve malfunctioning.	Check the anti-drift valve and repair as required.
	(3) Control valve spool scratched or spring broken.	Check the spool and repair as required.
	(4) Boom cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The bucket cylinder and arm cylinder allow too much gravity fall.	(1) Overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve spool scratched or spring broken.	Check the spool and repair as required.
	(3) Bucket cylinder or arm cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The swing cylinder still works at neutral position.	(1) Swing pedal linkage maladjusted.	Check the linkage and readjust as required.
	(2) Anti-void valve defective.	Check the anti-void valve and repair as required.
	(3) Control valve spool stick or spring broken.	Check the spool and repair as required.
	(4) Swing cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The dozer cylinder allows too much gravity fall.	(1) Overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve spool scratched or spring broken.	Check the spool and repair as required.
	(3) Dozer cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The hydraulic oil tank temperature is too high.	(1) Hot air backflow due to damaged partition around oil cooler.	Check the oil cooler and its surrounding.
	(2) Oil cooler clogged.	Clean the oil cooler.
	(3) Return filter clogged.	Check the return filter and replace as required.
	(4) Low-pressure line clogged with foreign matters.	Check the low-pressure line.

c. Pump

Problem	Cause	Correction
1. The engine gets overloaded.	1) Engine rpm higher than specified. 2) Pressure higher than specified. 3) Pump internal parts seized or damaged.	1) Readjust as specified. 2) Readjust as specified. 3) repair or replace the pump.
2. The pump flowrate drops extremely with too low discharge pressure.	1) Engine rpm too low. 2) Pump coupling defective. 3) Pump internal parts seized or damaged.	1) Readjust the rpm. 2) Repair or replace the pump coupling. 3) Repair or replace the pump.
3. Unusual noise or unusual vibrations occur (cavitation phenomenon).	1) Air or water mixed in hydraulic oil. 2) Suction strainer clogged. 3) Suction pipe clogged or throttled. 4) Attached pump in trouble (if provided). 5) Piston shoe poorly crimped. 6) Pump loosely mounted. 7) Coupling defective.	1) Retighten the circuit connections, the suction pipe in particular. Replace if water is mixed in. 2) Clean or replace the suction strainer. 3) Correct the suction pipe. 4) Repair or replace the attached pump. 5) Replace the piston assembly. 6) Mount correctly. 7) Replace the coupling.
4. There is oil leak.	1) O-ring or sheet packing defective. 2) Oil leak from oil seal edge.	1) Replace the O-ring or sheet packing (install as specified). 2) Replace or repair the oil seal or shaft.

d. Motor

Problem	Cause	Correction
Motor failure to run	No pressure rise or no oil flow.	Check the entire hydraulic circuit including the valves and pumps.
	Oil viscosity inappropriate.	Ensure the specified viscosity ranges.
	Dust, degraded hydraulic oil, cavitation, internal parts seized due to excessive radial load, unusual contact, bearing damaged.	Run the motor alone and get it under a pressure of 30 kgf/cm^2 (2.9 MPa) or so. If it fails to run, then some internal parts might be seized or damaged. Disassemble the motor and replace damaged parts.
Rpm not as designed	Incoming flowrate too low.	Check the pump discharge rate, the motor rpm, and the valves for oil leak.
	Low viscosity and internal leak for oil temperature or other reason.	Ensure the specified viscosity ranges.
	Internal parts worn out.	Replace worn-out parts.
Wrong turning direction	Wrong pipe connections.	Reverse the pipe connections.
	Poor valve timing due to wrong disassembling/reassembling procedures.	Disassemble and reassemble again for good valve timing.
Oil leak	Oil seal scratched or worn.	Replace the oil seal. Repair or replace if the shaft seal contact surface is scratched or worn.
	Loose bolt or plug, resulting in oil leak (at joints) from O-ring.	Tighten the bolt and plug to their specified torques. See also if the O-ring is damaged. Replace the O-ring as required.
	O-ring scratched or damaged.	Replace the O-ring.
	Dust or dent on the O-ring contact face.	Check for hit marks, burr, etc. Correct the surface with #600 or so sandpaper. Replace the O-ring. Clean up and reassemble.
	Cracked port, damaged screw. Inappropriate joint.	Replace the housing. Use an appropriate joint and tighten it to the specified torque.
Unusual noise	Shaft poorly fitted.	Center the shaft exactly.
	Air left in the circuit or motor.	Let out the air completely. Fill the motor with oil and keep it running under no load until there is no air bubbles in the tank.
	Pump's cavitation.	Unclog the suction filter.
	Air mixed in the suction pipe line.	Apply oil or grease to each connection and carefully listen to the noise there. If the noise is less, retighten the joint there.
Unusual temperature rise	Cooler in trouble.	Repair the cooler.
	Motor seized.	Repair or replacement

As listed above, there are various problems and their possible causes. The majority of troubles are, however, caused by the entry of dust. Be very attentive not to allow any dust into the system.

e. Swivel performance

First make sure the swivel mechanism alone is in trouble.

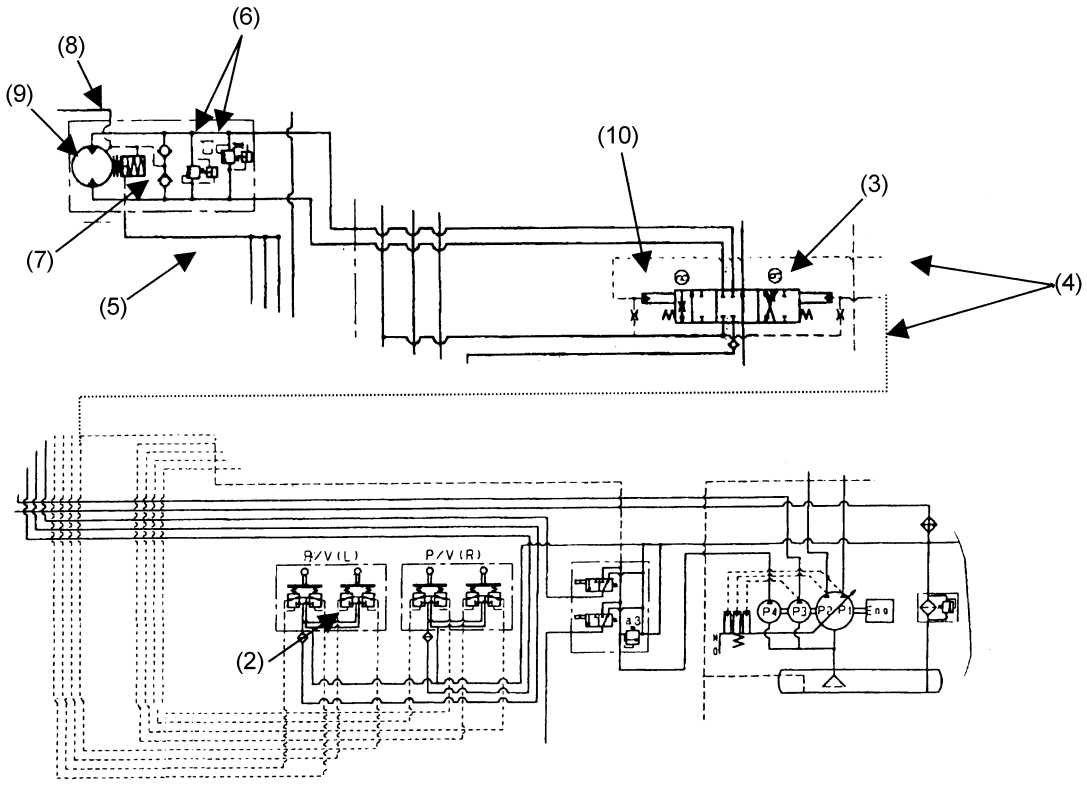
Problem		Cause		Correction
1	No swiveling in both directions	(2)	Pilot valve spool malfunctioning	Check the performance. Overhaul and clean.
		(3)	Control valve spool stick malfunctioning	Check the performance. Overhaul and clean.
		(4)	Pilot secondary pressure unspecified	Measure the pressure.
		(5)	Brake poorly unlocked	Measure the pressure.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(7)	Anti-void valve malfunctioning, valve seat defective	Overhaul and clean.
		(8)	Motor drain too much	Measure the drain amount.
		(9)	Motor internal parts damaged	Overhaul, clean and replace.
		(10)	Control valve internal parts damaged	Overhaul, clean and replace.
2	No swiveling in one direction	(2)	Pilot valve spool malfunctioning	Check the performance. Overhaul and clean.
		(3)	Control valve spool stick malfunctioning	Check the performance. Overhaul and clean.
		(4)	Pilot secondary pressure unspecified	Measure the pressure.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(7)	Anti-void valve malfunctioning, valve seat defective	Overhaul and clean.
		(8)	Motor drain too much	Measure the drain amount.
		(9)	Motor internal parts damaged	Overhaul, clean and replace.
		(10)	Control valve internal parts damaged	Overhaul, clean and replace.
3	No enough power. Too slow motion	(2)	Pilot valve spool malfunctioning	Check the performance. Overhaul and clean.
		(3)	Control valve spool stick malfunctioning	Check the performance. Overhaul and clean.
		(4)	Pilot secondary pressure unspecified	Measure the pressure.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(7)	Anti-void valve malfunctioning, valve seat defective	Overhaul and clean.
		(8)	Motor drain too much	Measure the drain amount.
		(9)	Motor internal parts damaged	Overhaul, clean and replace.
		(10)	Control valve internal parts damaged	Overhaul, clean and replace.
4	No stop even at neutral position. Overrunning	(2)	Pilot valve spool malfunctioning	Check the performance. Overhaul and clean.
		(3)	Control valve spool stick malfunctioning	Check the performance. Overhaul and clean.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(7)	Anti-void valve malfunctioning, valve seat defective	Overhaul and clean.
		(8)	Motor drain too much	Measure the drain amount.
5	Too high shock at start and stop. No inching operation	(2)	Pilot valve spool malfunctioning	Check the performance. Overhaul and clean.
		(3)	Control valve spool stick malfunctioning	Check the performance. Overhaul and clean.
		(7)	Anti-void valve malfunctioning, valve seat defective	Overhaul and clean.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(8)	Motor drain too much	Measure the drain amount.

Problem		Cause		Correction
6	Wobbling if pressed by hand	(3)	Control valve spool malfunctioning	Check the performance. Overhaul and clean.
		(7)	Anti-void valve malfunctioning, valve seat defective	Check the performance. Overhaul and clean.
		(6)	Brake valve pressure unspecified	Measure the pressure. Overhaul, clean and readjust.
		(8)	Motor drain too much	Measure the drain amount.

1) Swivel mechanism check points

1. First make sure the swivel mechanism alone is in trouble.
2. Then see if what is in trouble is in both directions or in either direction.
3. Also see if the trouble occurs all the time or from time to time and how often it happens.

The numbers given in the figure below correspond to those in the troubles at a glance.

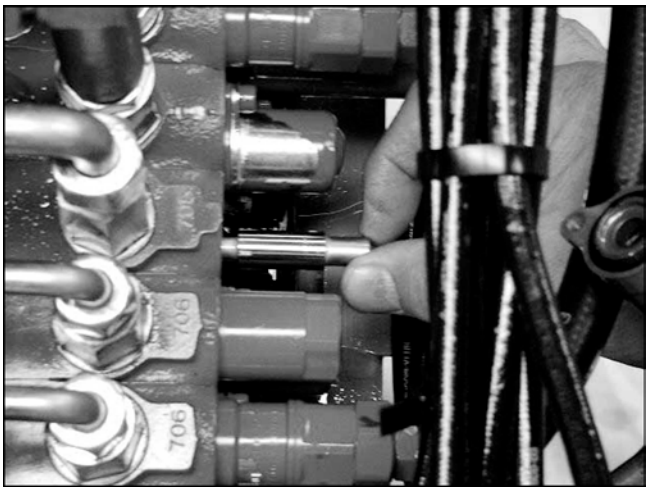


4. If the trouble is found in either direction, reverse the right and left hoses and see if the trouble occurs in the other direction.
5. If the hoses have been reversed and the trouble found in the other direction, it means that the trouble spot is upstream. If still in the same direction, the trouble spot is downstream.
6. Hose reversing points (~)
   (2) Pilot valve ~ (4) Control valve ~ (9) Swivel motor
7. Right and left parts switching
   (2) Pilot valve (6) Brake valve

2) Checking the pilot valve spool performance

1. Operate the swivel lever and see if the pilot valve spool functions well.
2. If the spool malfunctions, check for foreign matters, scratches, deformation, etc.
3. If the swivel mechanism is in trouble in either direction, reverse the two one-touch coupler hoses below the valve. See if the trouble happens in the other direction this time.

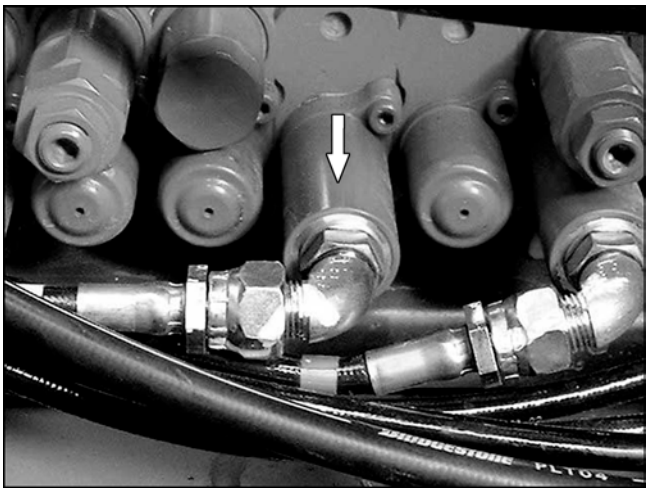
3) Checking the control valve spool stick performance



1. See if the swivel section spool moves well.
2. If the spool fails to move smoothly, check for foreign matters, scratches, deformation, etc.

For servicing, refer to page IV-S- .

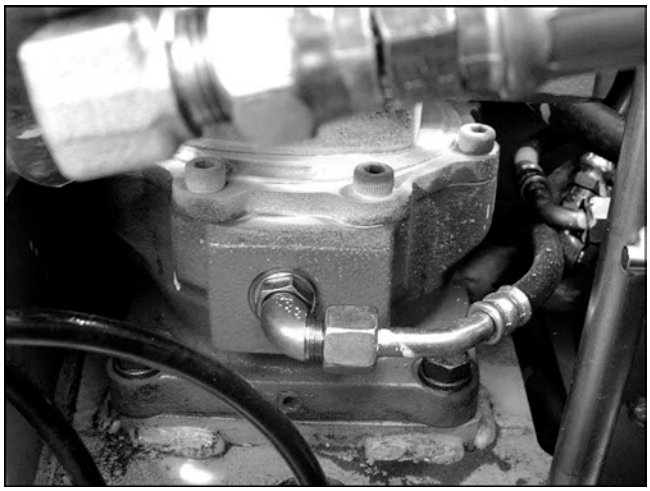
4) Measuring the pilot secondary pressure



1. Measure the secondary pressure between the pilot valve and the control valve.
2. Make sure the pressure is as specified.

For measuring, refer to page IV-S- .

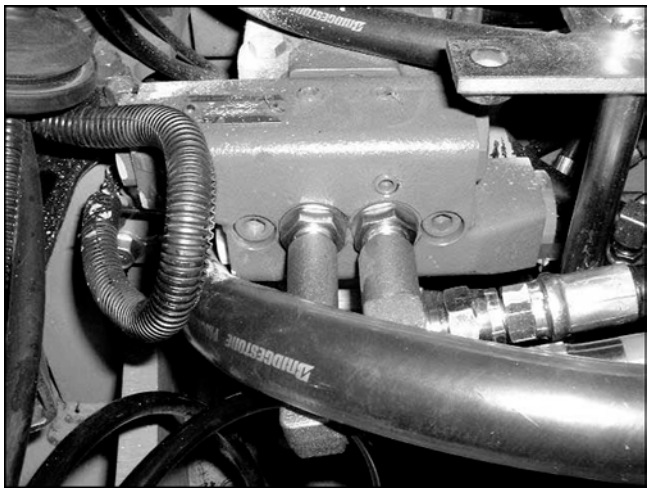
5) Checking the brake release



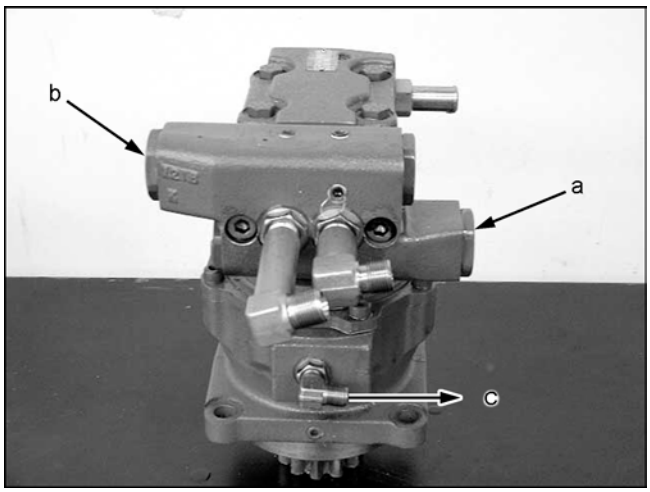
1. Measure the pressure between the solenoid valve and the swivel motor brake.
2. Make sure the pressure is as specified.
3. Start the engine and unlock the control lever. Extend the front attachment in maximum reach in the air, and move the bucket by hand (using your reaction force). Make sure the swivel mechanism starts and the brake gets applied when it gets locked.

   For measuring and servicing, refer to the relevant pages, respectively.

6) Checking the brake valve pressure



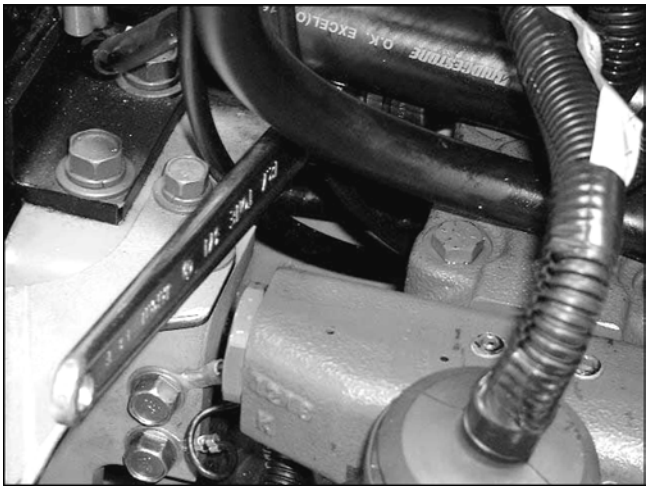
1. Measure the brake valve pressure. (Before the measurement, bring the bucket end in contact with something fixed.)
2. Make sure the pressure is as specified.



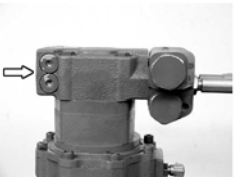
3. Readjust the relief valve, or disassemble and clean it up.
   a: For clockwise swivel
   b: For counterclockwise swivel
   c: For brake release

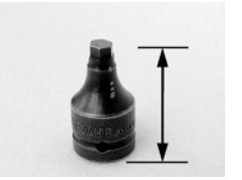
   For measuring and servicing, refer to the relevant pages, respectively.

7) Checking the anti-void valve and valve seat

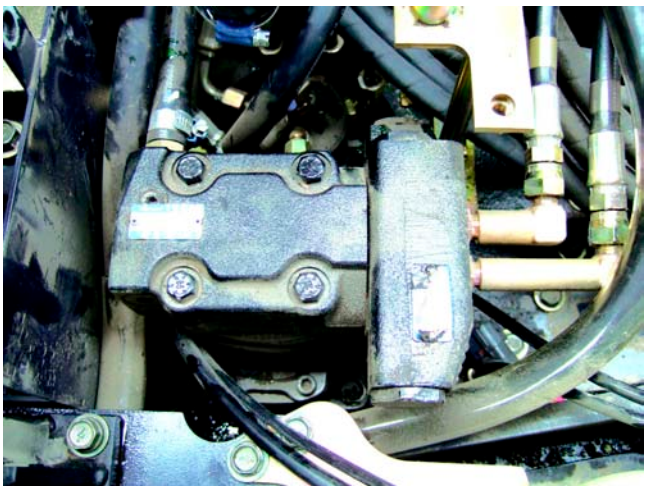


1. Check the anti-void valve for heavy movement, scratches, foreign matters, etc.
   Prepare an 8M hex hollow wrench that is 45 mm or so tall.





8) Checking the motor drain amount



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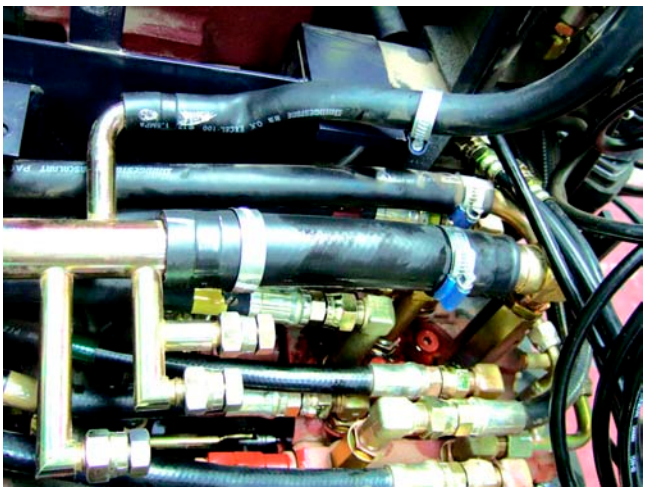
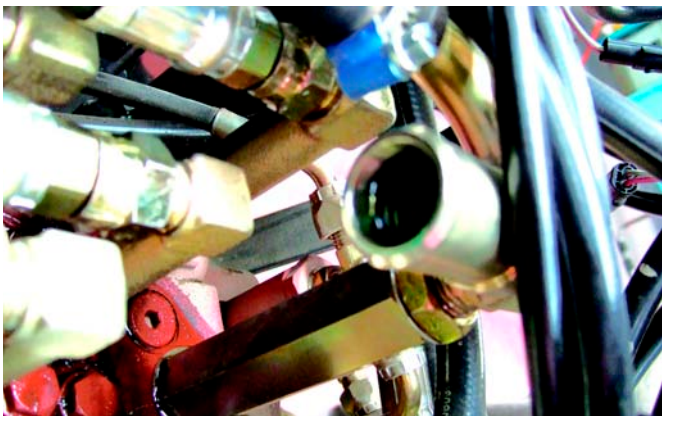


1. Remove the steps.
2. The drain hose is between the swivel motor and drain pipe. Disconnect this hose from the drain pipe alone. Plug one end of a 30 cm or so long spare hose and connect the other end to the drain pipe.
3. Do and lock the swiveling (with the bucket end in contact with something fixed), and measure their respective drain amounts.

t



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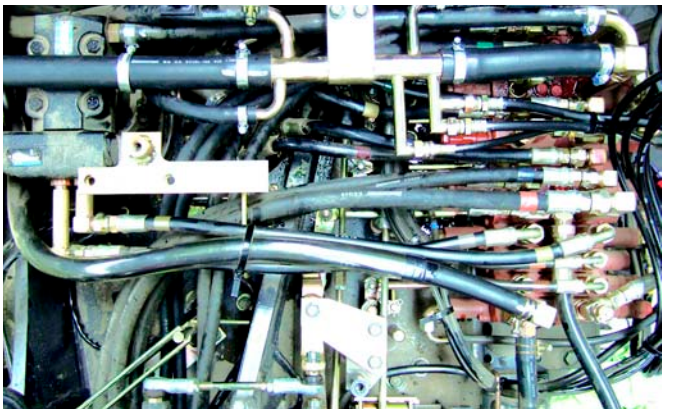
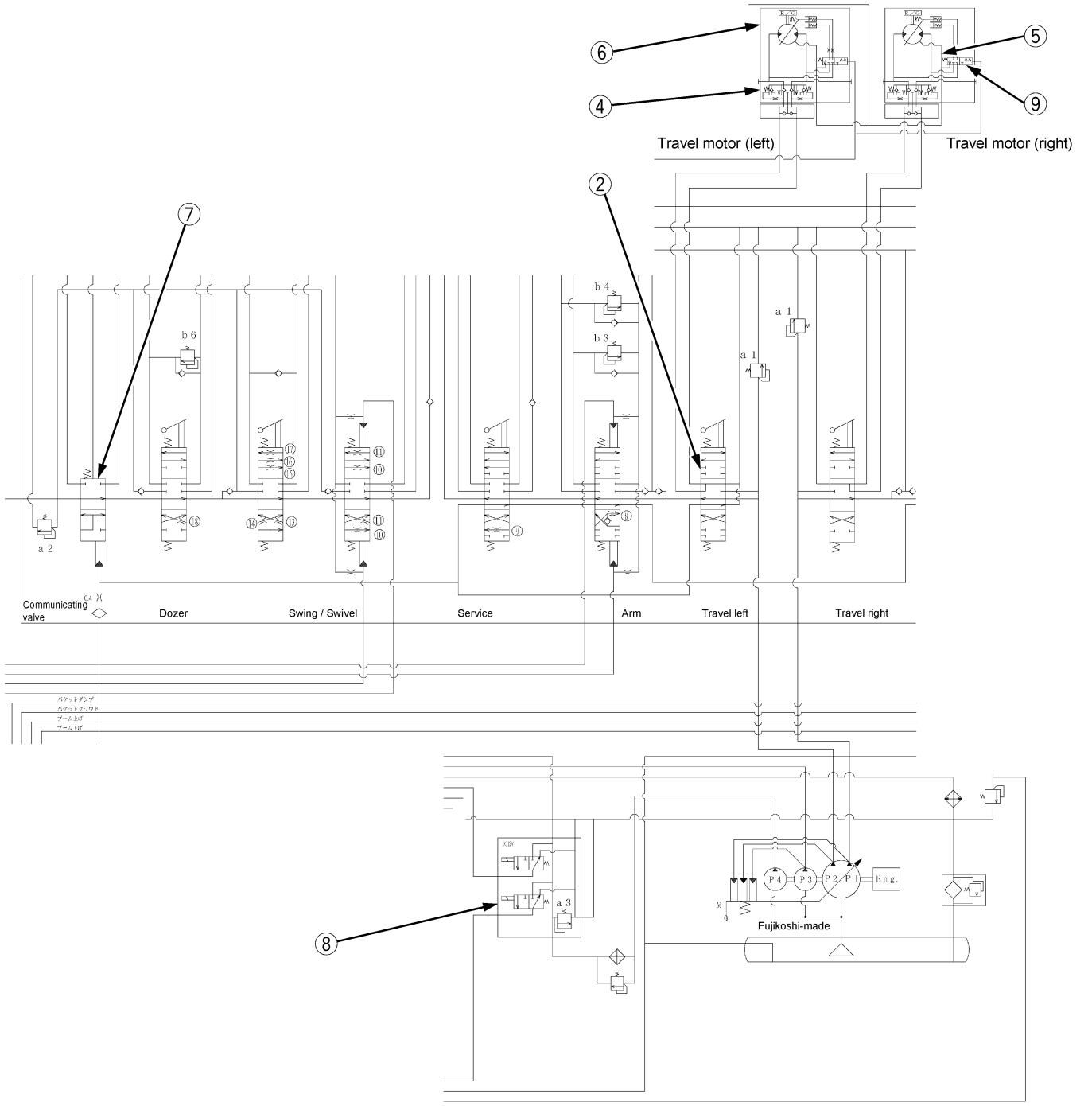


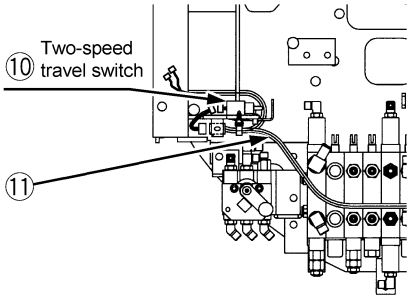
f. Traveling performance

In advance, make sure the trouble is in the travel mechanism alone.

Problem		Cause	Correction
Failure to run.	(1)	Travel lever linkage stuck or missing.	Readjust the linkage or replace as required.
	(2)	Control valve spool stuck.	Overhaul and clean the control valve. Replace as required.
	(3)	Internal leak in rotary joint.	Overhaul the rotary joint. Replace the seal.
	(4)	Counterbalance valve spool stuck.	Overhaul and clean the counterbalance valve. Replace as required.
	(5)	Too much motor drain.	Measure the drain amount. Overhaul the motor. Replace as required.
	(6)	Motor internal parts damaged.	Overhaul the motor. Replace as required.
Too slow travel speed. Too low travel force.	(1)	Travel lever linkage malfunctioning.	Readjust the linkage.
	(2)	Control valve spool stuck.	Overhaul and clean the control valve. Replace as required.
	(3)	Internal leak in rotary joint.	Overhaul the rotary joint. Replace the seal.
	(4)	Counterbalance valve spool stuck.	Overhaul and clean the counterbalance valve. Replace as required.
	(5)	Too much motor drain.	Measure the drain amount. Overhaul the motor. Replace as required.
	(6)	Motor internal parts damaged.	Overhaul the motor. Replace as required.
	(7)	Communicating valve spool stuck.	Clean the communicating valve. Replace as required. Clean the filter.
Zigzagging. (while traveling)	(1)	Right and left travel lever linkages out of alignment.	Readjust the linkage.
	(2)	Right and left control valve spools out of alignment.	Overhaul and clean the control valve. Replace as required.
	(3)	Internal leak in rotary joint on one side.	Overhaul the rotary joint. Replace the seal.
	(4)	Counterbalance valve spool stuck.	Overhaul and clean the counterbalance valve. Replace as required.
	(5)	Too much difference between right and left motor drain amounts.	Measure the drain amount. Overhaul the motor. Replace as required.
	(6)	Internal parts damaged on motor on one side.	Overhaul the motor. Replace as required.
	If there is a difference in the flowrate and pressure between the right-travel and left-travel pumps, check the delivery hoses on both sides. If one of them is in trouble, the machine travels zigzag. In this case, other operations are also affected.		
Failure to stop.	(1)	Travel lever linkage poor in return or stuck.	Readjust the linkage.
	(2)	Control valve spool poor in return or stuck.	Overhaul and clean the control valve. Replace as required.
	(4)	Counterbalance valve spool poor in return or stuck.	Overhaul and clean the counterbalance valve. Replace as required.
Failure to shift the gears.	(8)	Selector valve's two-travel-speed switching in trouble.	Overhaul and clean the selector valve. Replace as required.
	(9)	Travel motor's high/low-speed switch spool malfunctioning.	Overhaul and clean the high/low-speed selector valve control. Replace as required.
	(10)	Limit switch malfunctioning.	Check the limit switch. Replace as required.
	(11)	Solenoid and limit switch harness broken.	Check the harness. Replace as required.

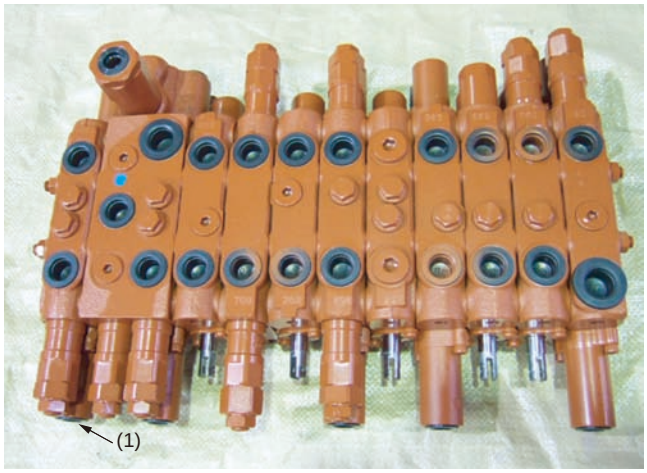
1) Travel mechanism check points





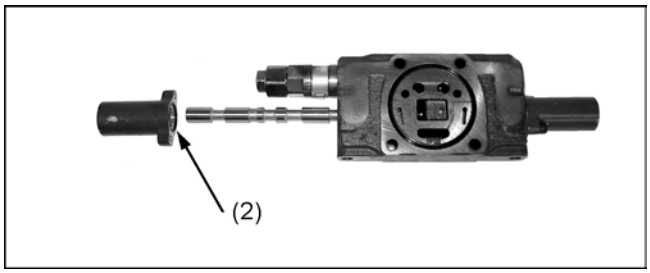
Left front of the machine

2) Checking the communicating valve



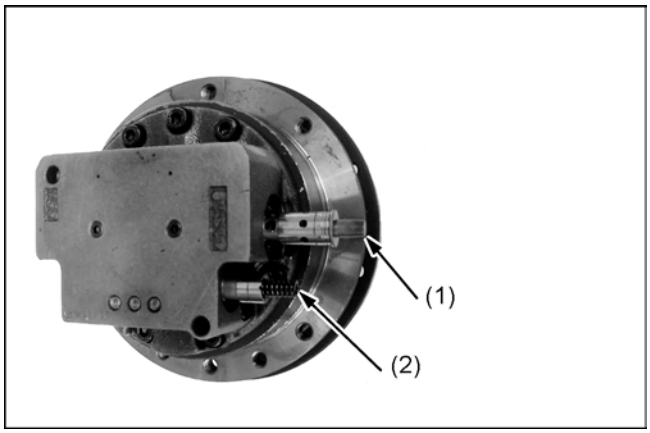
1. For disassembling and reassembling the control valve, refer to service section.
2. Remove the cap and spool. Check and clean them up.
3. Clean up the filter in the cap too.

(1)Communicating valve
(2)Filter



3) Checking the counterbalance valve and high/low-speed selector valve (travel motor)

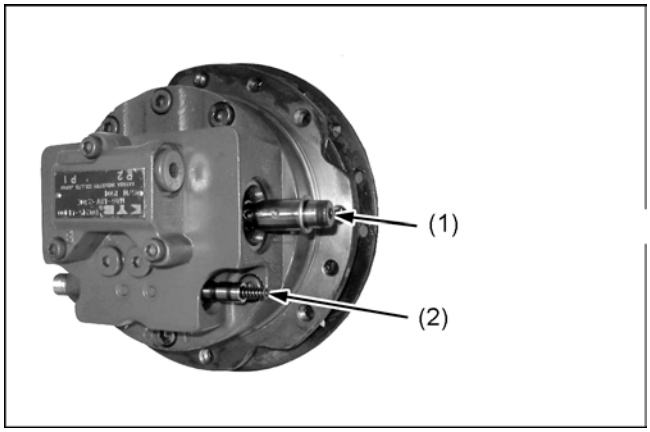
U20-3α (Fujikoshi-made)



Checking the counterbalance valve and high/low-speed selector valve

1. For disassembling and reassembling the valves, refer to service section.
2. Remove the plug and spool. Check and clean them up.

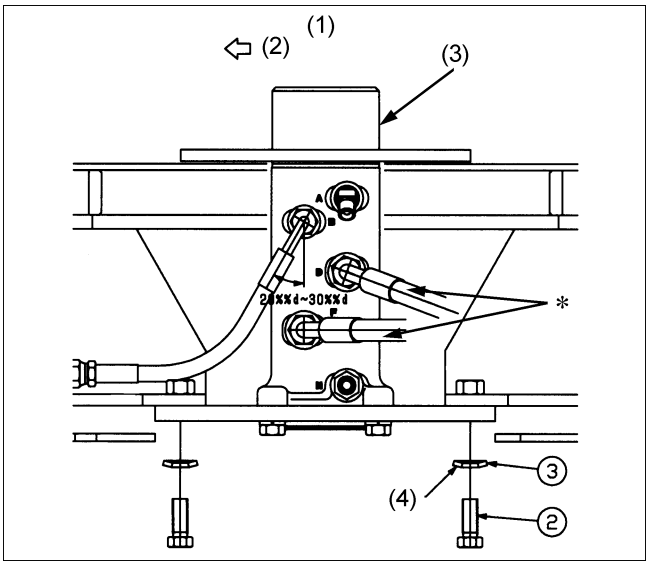
U25-3α, U25S (Kayaba-made)



(1)Counterbalance valve
(2)High/low-speed selector valve

4) Checking the rotary joint for internal leak

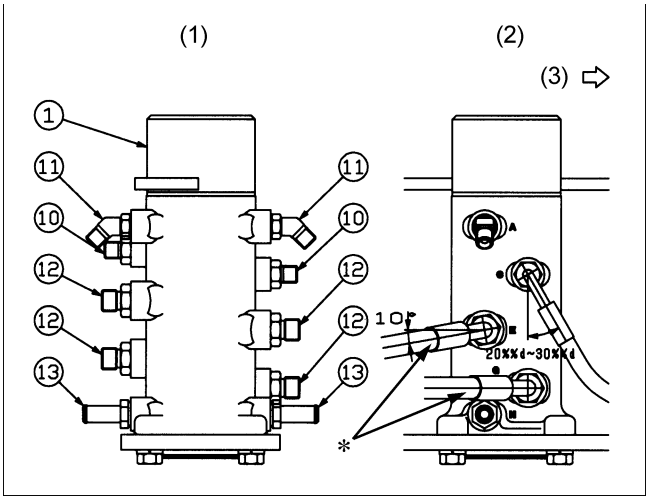
Checking the left travel



1. Make sure there is nothing unusual between the pump and rotary joint.
2. Disconnect the *-marked hoses as shown at left. Put plugs to the openings.
3. Raise the pump pressure and make sure the main relief pressure reaches the specified level.

(1)Left
(2)Front (blade)
(3)Rotary joint
(4)Attention to the direction of the Belleville spring

Checking the right travel



1. Make sure there is nothing unusual between the pump and rotary joint.
2. Disconnect the *-marked hoses as shown at left. Put plugs to the openings.
3. Raise the pump pressure and make sure the main relief pressure reaches the specified level.

A : Two-speed
B : Dozer (lower, bottom)
C : Dozer (upper, rod)
D : Travel left (front)
E : Travel right (front)
F : Travel left (back)
G : Travel right (back)
H : Drain

(1)Back
(2)Right
(3)Front (blade)

B. Specifications

a. Pump

[1] Specifications

Prefomance curve

U20-3α

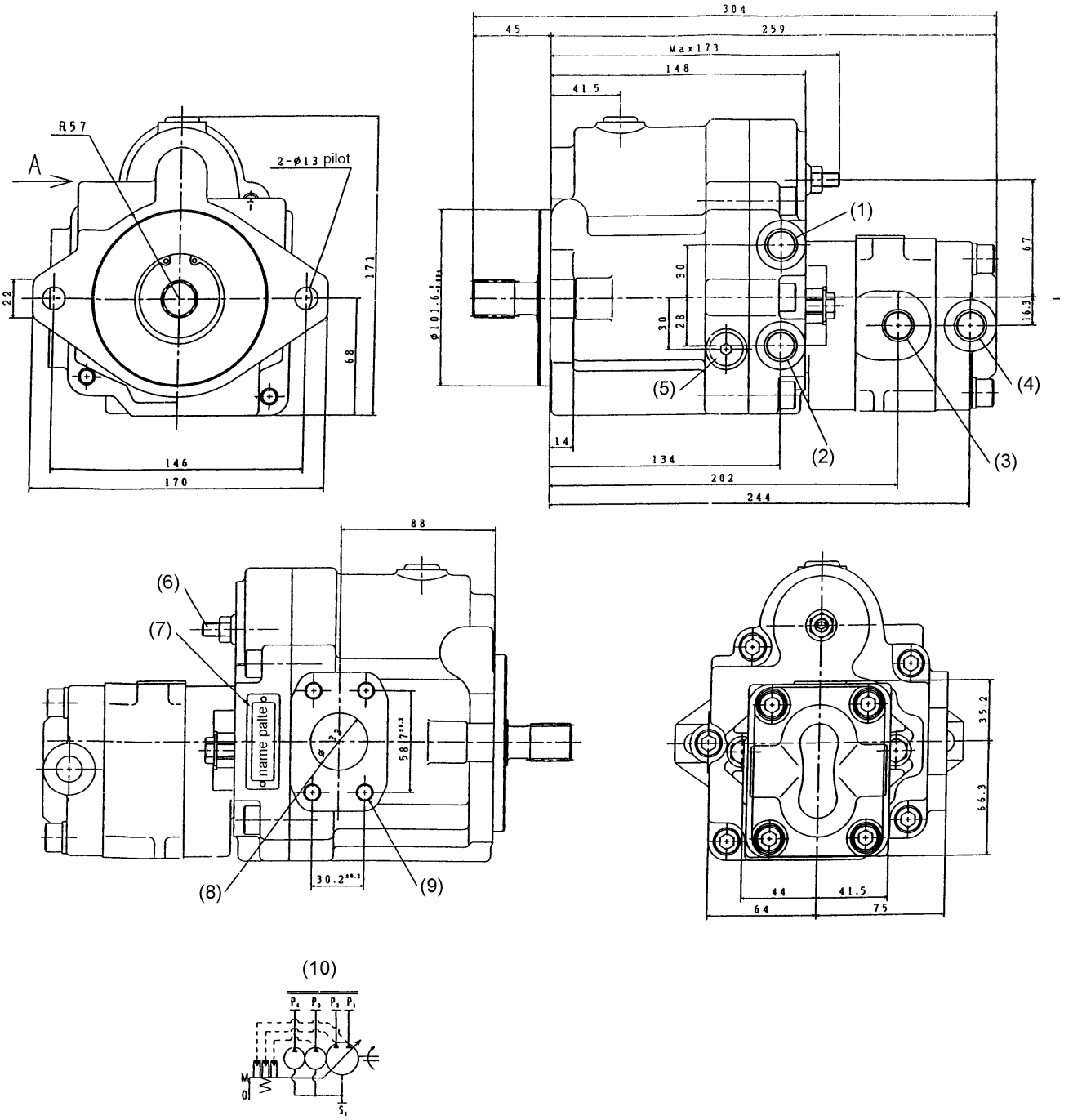
Type : PDV-0B-24P-6G3-4649A (NACHI-Fujikoshi Corp.)

		P1, P2	P3	PP
Operating Pressure	MPa	21.6	20.6	3.9
	kgf/cm^2	220	210	40
	psi	3129	2987	569
Displacement	cc/rev	10.5	5.8	2.7
	cu.in./rev	0.641	0.354	0.165
Discharge capacity	L/min	23.0	12.8	5.9
	USGPM	6.08	3.38	1.56
P3 shift pressure	MPa	0.49 to 20.6		
	kgf/cm^2	5 to 210		
	psi	71.1 to 2987		
Operating RPM	rpm	2200		
Rotating direction		Clockwise, viewed from input shaft side		
Weight	kg	17.0		
	lbs	37.5		

U20-3α, U25S

Type : PDV-0B-24P-8G3-4837A (NACHI-Fujikoshi Corp.)

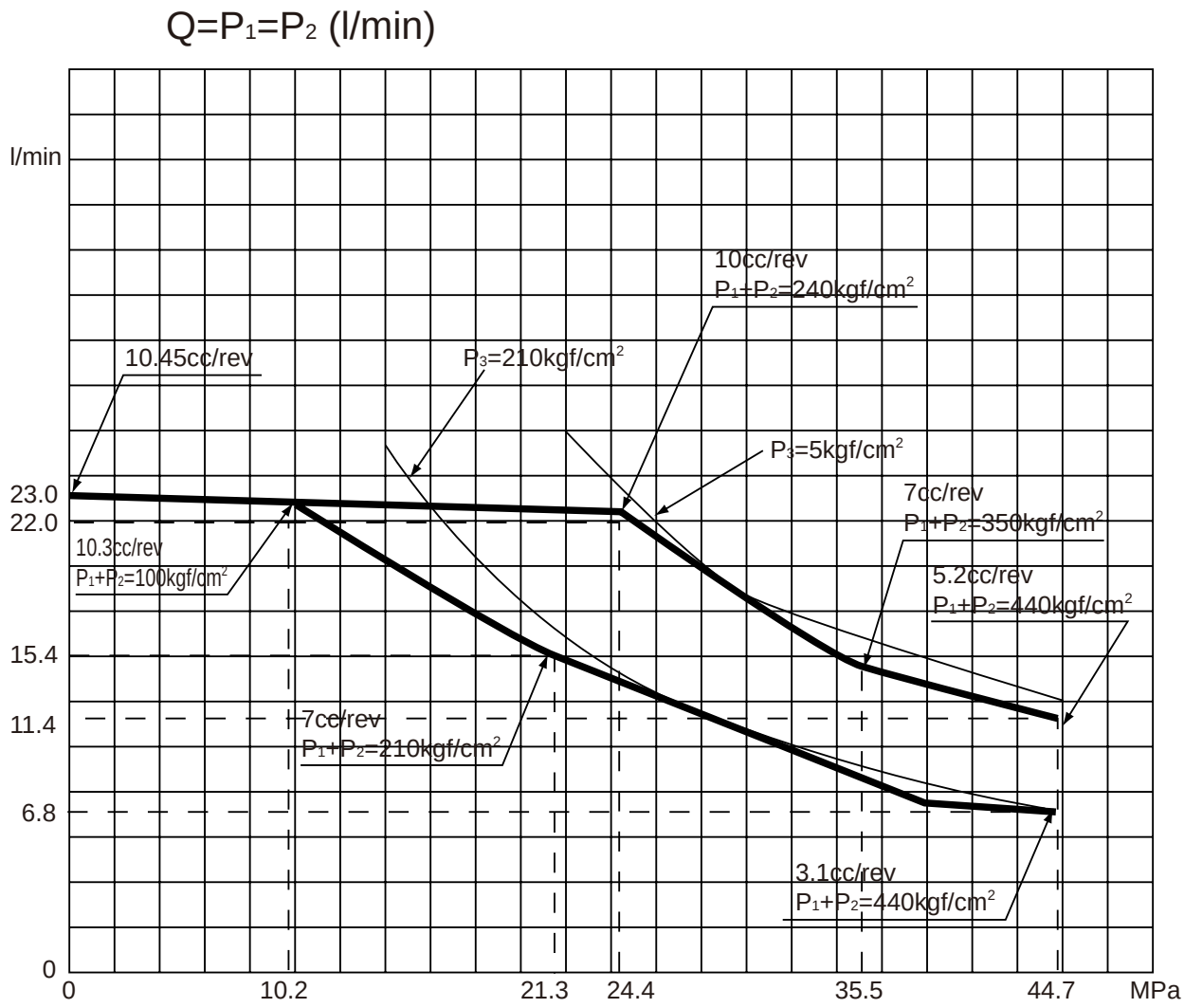
		P1, P2	P3	PP
Operating Pressure	MPa	21.6	17.2	3.9
	kgf/cm^2	220	175	40
	psi	3129	2489	569
Displacement	cc/rev	12.0	8.0	2.7
	cu.in./rev	0.732	0.488	0.165
Discharge capacity	L/min	28.8	19.2	6.5
	USGPM	7.61	5.07	1.72
P3 shift pressure	MPa	0.49 to 17.2		
	kgf/cm^2	5 to 175		
	psi	71.1 to 2489		
Operating RPM	rpm	2400		
Rotating direction		Clockwise, viewed from input shaft side		
Weight	kg	17.0		
	lbs	37.5		



(1)discharge opening P1 G3/8
(2)discharge opening P2 G3/8
(3)discharge opening P3 G3/8
(4)discharge opening P4 G3/8
(5)2-oil hole G1/4
(6)No adjustment
(7)name plate blue
(8)Section port S1 SAE J518b 1/4
(9)4-M10 depth15 pitch1.5
(10)Hydraulic mark

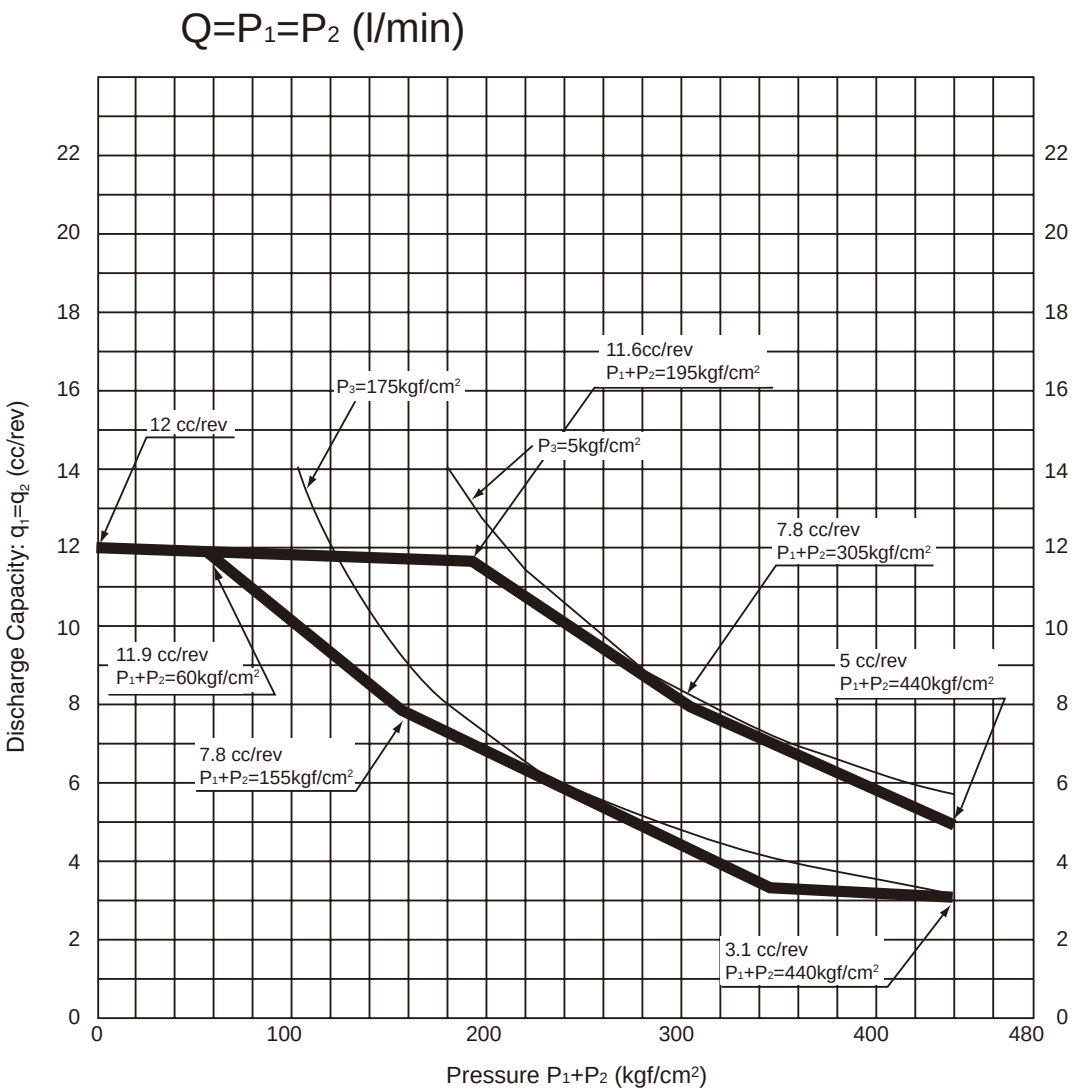
[2] Piston pump P-Q performance curve (Theoretical)

U20-3α



Measuring conditions	
Oil used	ISO VG46 or equivalent
Oil temperature	50±5℃
Turning speed	2,200 rpm
Turning direction	Clockwise
8_3	5.8 cc/rev
8_4	2.7 cc/rev
P_4	4.1 MPa

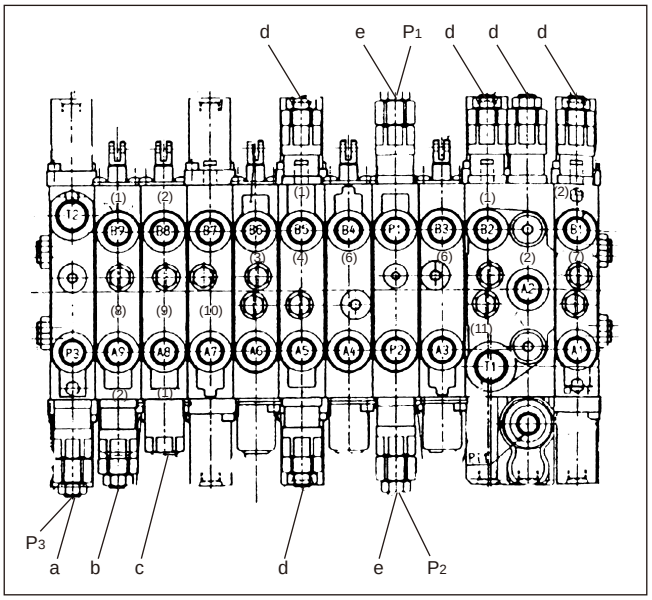
U25-3α, U25S



Measuring conditions	
Oil used	ISO VG46 or equivalent
Oil temperature	50±5℃
Turning speed	2,400 rpm
Turning direction	Clockwise
8_3	8 cc/rev
8_4	2.7 cc/rev
P_4	4.1 MPa

b. Relief valve

[1] Location



(1) Rod
(2) Bottom
(3) Spare
(4) Arm
(5) Travel left
(6) Travel right
(7) Bucket
(8) Dozer
(9) Swing
(10) Swivel
(11) Boom

No	Location
a	P3 main relief valve
b	Dozer overload relief valve
c	Swing anti-void valve
d	Overload relief valve
e	P1-P2 main relief valve

(U20-3α, rigid track type)

(U20-3α, retractable track type)

(U25S, U25-3α)

[2]Main relief valve (bench data)

No.	Valve location	Operating work	Unit	U20-3α			U25-3α			U25S			Remarks
				Value	Allowance		Value	Allowance		Value	Allowance		
1	P_1 : Main relief valve	Bucket crowd	MPa	21.6	0.49	0.00	21.6	0.49	0.00	21.6	0.49	0.00	U20-3α : at 23.0L/min (6.08USGPM) U25-3α, U25S : at 28.8L/min (7.61USGPM)
			kgf/cm^2	220	5.0	0.0	220	5.0	0.0	220	5.0	0.0	
			bar	215.7	4.9	0.0	215.7	4.9	0.0	215.7	4.9	0.0	
			psi	3128	71	0	3128	71	0	3128	71	0	
2	P_2 : Main relief valve	Arm crowd or dump	MPa	21.6	0.49	0.00	21.6	0.49	0.00	21.6	0.49	0.00	U20-3α : at 23.0L/min (6.08USGPM) U25-3α, U25S : at 28.8L/min (7.61USGPM)
			kgf/cm^2	220	5.0	0.0	220	5.0	0.0	220	5.0	0.0	
			bar	215.7	4.9	0.0	215.7	4.9	0.0	215.7	4.9	0.0	
			psi	3128	71	0	3128	71	0	3128	71	0	
3	P_3 : Main relief valve	Swing Left or Right	MPa	20.6	0.49	0.00	17.2	0.49	0.00	17.2	0.49	0.00	U20-3α : at 12.8L/min (3.38USGPM) U25-3α, U25S : at 19.2L/min (5.07USGPM)
			kgf/cm^2	210	5.0	0.0	175	5.0	0.0	175	5.0	0.0	
			bar	205.9	4.9	0.0	171.6	4.9	0.0	171.6	4.9	0.0	
			psi	2986	71	0	2489	71	0	2489	71	0	

[3]Main relief valve (at the measurement port on the machine)

No.	Type of valve	Actuator	Unit	U20-3α			U25-3α			U25S			Remarks
				Value	Allowance		Value	Allowance		Value	Allowance		
1	P_1 : Main relief valve	Bucket crowd	MPa	22.1	0.98	-0.49	22.1	0.98	-0.49	22.1	0.98	-0.49	
			kgf/cm^2	225	10.0	-5.0	225	10.0	-5.0	225	10.0	-5.0	
			bar	220.6	9.8	-4.9	220.6	9.8	-4.9	220.6	9.8	-4.9	
			psi	3200	142	-71	3200	142	-71	3200	142	-71	
2	P_2 : Main relief valve	Arm crowd or dump	MPa	22.1	0.98	-0.49	22.1	0.98	-0.49	22.1	0.98	-0.49	
			kgf/cm^2	225	10.0	-5.0	225	10.0	-5.0	225	10.0	-5.0	
			bar	220.6	9.8	-4.9	220.6	9.8	-4.9	220.6	9.8	-4.9	
			psi	3200	142	-71	3200	142	-71	3200	142	-71	
3	P_3 : Main relief valve	Swing Left or Right	MPa	21.4	0.49	-0.49	17.7	0.49	-0.49	17.7	0.49	-0.49	
			kgf/cm^2	218	5.0	-5.0	180	5.0	-5.0	180	5.0	-5.0	
			bar	213.8	4.9	-4.9	176.5	4.9	-4.9	176.5	4.9	-4.9	
			psi	3100	71	-71	2560	71	-71	2560	71	-71	

[4]Pilot system pressure

No.	Valve location	Operating work	Unit	U20-3α	U25-3α	U25S	Remarks
1	Primary pilot pressure	At bench	MPa	3.9 +0.2 -0.3	3.9 +0.2 -0.3	3.9 +0.2 -0.3	
			kgf/cm^2	40 +2 -3	40 +2 -3	40 +2 -3	
			psi	569 +28 -43	569 +28 -43	569 +28 -43	
2	Primary pilot pressure at machine	All pilot lines at machine port	MPa	4.1 ± 0.5	4.2 ± 0.5	4.2 ± 0.5	
			kgf/cm^2	42 ± 5	43 ± 5	43 ± 5	
			psi	597 ± 71	612 ± 71	612 ± 71	
3	Secondary pilot pressure	At bench	MPa	2.6 +0.2 0.0	2.6 +0.2 0.0	2.6 +0.2 0.0	
			kgf/cm^2	27 +2 0	27 +2 0	27 +2 0	
			psi	384 +28 0	384 +28 0	384 +28 0	
4	Secondary pilot pressure at machine	All pilot lines at C/V port	MPa	2.8 ± 0.3	2.8 ± 0.3	2.8 ± 0.3	
			kgf/cm^2	29 ± 3	29 ± 3	29 ± 3	
			psi	412 ± 43	412 ± 43	412 ± 43	

[5]Overload relief valve (bench data)

No.	Type of valve	Actuator	Unit	U20-3α			U25-3α			U25S			Remarks
				Value	Allowance		Value	Allowance		Value	Allowance		
1	Control valve	Boom up Boom down	MPa	24.0	0.98	-0.49	24.0	0.98	-0.49	24.0	0.98	-0.49	U20-3α : at 29.0L/min (7.66USGPM) U25-3α, U25S : at 29.0L/min (7.66USGPM)
			kgf/cm^2	245	10.0	-5.0	245	10.0	-5.0	245	10.0	-5.0	
			bar	240.3	9.8	-4.9	240.3	9.8	-4.9	240.3	9.8	-4.9	
			psi	3484	142	-71	3484	142	-71	3484	142	-71	
2	Control valve	Bucket crowd	MPa	24.0	0.98	-0.49	24.0	0.98	-0.49	24.0	0.98	-0.49	U20-3α : at 29.0L/min (7.66USGPM) U25-3α, U25S : at 29.0L/min (7.66USGPM)
			kgf/cm^2	245	10.0	-5.0	245	10.0	-5.0	245	10.0	-5.0	
			bar	240.3	9.8	-4.9	240.3	9.8	-4.9	240.3	9.8	-4.9	
			psi	3484	142	-71	3484	142	-71	3484	142	-71	
3	Control valve	Arm dump Arm crowd	MPa	24.0	0.98	-0.49	24.0	0.98	-0.49	24.0	0.98	-0.49	U20-3α : at 29.0L/min (7.66USGPM) U25-3α, U25S : at 29.0L/min (7.66USGPM)
			kgf/cm^2	245	10.0	-5.0	245	10.0	-5.0	245	10.0	-5.0	
			bar	240.3	9.8	-4.9	240.3	9.8	-4.9	240.3	9.8	-4.9	
			psi	3484	142	-71	3484	142	-71	3484	142	-71	
4	Control valve	Blade down	MPa	24.0	0.98	-0.49	24.0	0.98	-0.49	24.0	0.98	-0.49	U20-3α : at 18.0L/min (4.76USGPM) U25-3α, U25S : at 18.0L/min (4.76USGPM)
			kgf/cm^2	245	10.0	-5.0	245	10.0	-5.0	245	10.0	-5.0	
			bar	240.3	9.8	-4.9	240.3	9.8	-4.9	240.3	9.8	-4.9	
			psi	3484	142	-71	3484	142	-71	3484	142	-71	
5	Swivel motor	Swivel, R&L	MPa	19.6	0.98	-0.49	16.2	0.98	-0.49	16.2	0.98	-0.49	U20-3α : at 12.8L/min (3.38USGPM) U25-3α, U25S : at 19.2L/min (5.07USGPM)
			kgf/cm^2	200	10.0	-5.0	165	10.0	-5.0	165	10.0	-5.0	
			bar	196.1	9.8	-4.9	161.8	9.8	-4.9	161.8	9.8	-4.9	
			psi	2844	142	-71	2346	142	-71	2346	142	-71	

[6]Overload relief valve (at the measurement port on the machine)

No.	Type of valve	Actuator	Unit	U20-3α			U25-3α			U25S			Remarks
				Value	Allowance		Value	Allowance		Value	Allowance		
1	Control valve	Boom up, down Arm dump, crowd Bucket dump, crowd Blade down	MPa	24.0	1.47	-1.47	24.0	1.47	-1.47	24.0	1.47	-1.47	at 1500 rpm.
			kgf/cm^2	245	15.0	-15.0	245	15.0	-15.0	245	15.0	-15.0	
			bar	240.3	14.7	-14.7	240.3	14.7	-14.7	240.3	14.7	-14.7	
			psi	3484	213	-213	3484	213	-213	3484	213	-213	
2	Swivel motor	Swivel R&L	MPa	19.6	1.47	-1.47	17.7	1.47	-1.47	17.7	1.47	-1.47	at 1500 rpm.
			kgf/cm^2	200	15.0	-15.0	180	15.0	-15.0	180	15.0	-15.0	
			bar	196.1	14.7	-14.7	176.5	14.7	-14.7	176.5	14.7	-14.7	
			psi	2844	213	-213	2560	213	-213	2560	213	-213	
3	Swivel motor	Swivel R&L	MPa	20.6	1.47	-1.47	19.1	1.47	-1.47	19.1	1.47	-1.47	at Max rpm.
			kgf/cm^2	210	15.0	-15.0	195	15.0	-15.0	195	15.0	-15.0	
			bar	205.9	14.7	-14.7	191.2	14.7	-14.7	191.2	14.7	-14.7	
			psi	2963	213	-213	2773	213	-213	2773	213	-213	

c.Swivel performance

Machine model		Unit	**U20-3α**	**U25-3α**	**U25S**	Remarks
Manufacturer			Eaton Fluid Power			
Kubota part No.			RB411-6139-0	RB511-6139-0	RB511-6139-0	
Model			25PB20A1124-C (Orbit Motor)	25PB25A1125-C (Orbit Motor)	25PB25A1125-C (Orbit Motor)	
Displacement		cc/rev	195.0	244.0	244.0	
		in3/rev	11.90	14.89	14.89	
Gear reduction ratio			-	-	-	
Total displacement		cc/rev	195.0	244.0	244.0	
		in3/rev	11.90	14.89	14.89	
Pump oil delivery		L/min	30.0	30.0	30.0	
		USGPM	7.93	7.93	7.93	
Motor ass'y speed		rpm	63.4	75.4	75.4	
Swivel bearing / pinion teeth			80 /11	80 / 11	80 / 11	
Swivel speed		rpm	9.5	9.4	9.4	
Motor brake valve setting pressure		MPa	19.6	16.2	16.2	U20-3α : at 10 L/min "U25-3α, U25S : at 20 L/min"
		kgf/cm2	200.00	165.00	165.00	
Motor brake valve cracking pressure		MPa	20.2	20.2	20.2	at 1 L/min
		kgf/cm2	160.00	160.00	160.00	
Parking brake friction torque		N·m	440.00	440.0	440.0	
		kgf·m	44.88	44.9	44.9	
Brake release pressure	Max.	MPa	4.9	4.9	4.9	
		kgf/cm2	50.0	50.0	50.0	
		psi	711	711	711	
	Min.	MPa	2.0	2.0	2.0	
		kgf/cm2	20.2	20.2	20.2	
		psi	287	287	287	
3 times rotation swivel speed		sec	20.2	19.1	19.1	
Swivel block performance at engine stop		deg.	5 ≧	5 ≧	5 ≧	
Swivel block performance at engine running		deg.	30 ≧	30 ≧	30 ≧	
Capable swivel rotation angle		deg.	23.7	21.5	21.5	

d.Traveling performance

		Unit	**U20-3α**	**U25-3α, U25S**	Remarks
Manufacturer			NACHI-Fujikoshi Corp.	KAYABA Industry	
Model			PHV-190-39-1	MAG-18V-230E	
Kubota part No.			RB411-6129-0	RB511-6129-0	
Capacity	1st	cc/rev	16.1	18.0	
		cu.in./rev	0.98	1.10	
	2nd	cc/rev	8.4	10.0	
		cu.in./rev	0.51	0.61	
Reduction ratio			1/39	1/42.958	
Total displacement	1st	cc/rev	627.9	774.0	
		cu.in./rev	38.32	47.23	
	2nd	cc/rev	327.6	430.0	
		cu.in./rev	19.99	26.24	
Rated oil flow		L/min	23	27.6	
		USGPM	6.08	7.29	
Theoretical torque	1st	N.m	2157.5	2643.9	"U20-3α: at 21.6MPa (220kgf/cm^2, 3129 psi) U25-3α, U25S: at 20.9MPa (213kgf/cm^2, 3030 psi)"
		kgf.m	220	269.6	
		ft.lbf	1591.3	1950.0	
	2nd	N.m	1125.6	1468.8	
		kgf.m	114.8	149.8	
		ft.lbf	830.2	1083.3	
Theoretical speed	1F	rpm	36.6	35.6	"U20-3α : at 23.0 L/min (6.08 USGPM) U25-3α, U25S : at 27.6 L/min (7.29 USGPM)"
	2F		70.2	64.2	
Relief valve pressure		MPa	21.6	21.6	
		kgf/cm2	220	220	
		psi	3129	3129	
Counter balance valve operating pressure		MPa	0.1	0.1	
		kgf/cm2	0.9	0.9	
		psi	13	13	
Climbing ability		deg.	30	30	
Max. traction force	1F	kN	15.5	20.3	Slip 70% theoretical torque Oil temp.:50±5(122±9°F)
		kgf	1580	2070	
		lbf	3483.9	4564.4	
	2F	kN	8.1	9.7	Relief 60% theoretical torque
		kgf	826	990	
		lbf	1821.3	2183.0	
Traveling block performance		mm/10min	300 ≧	300 ≧	10 min engine stop Testing slope angle: 20 deg.
		in./10min	11.81 ≧	11.81 ≧	
Traveling speed (Rubber/Steel)	1st	km/h	2.2 / 2.1	2.5 / 2.4	
		mph	1.37 / 1.30	1.55 / 1.49	
	2nd	km/h	4.2 / 4.0	4.5 / 4.4	
		mph	2.61 / 2.49	2.80 / 2.73	
10m(32.8ft) traveling time (Rubber crawler)	1F	sec./10m (32.8ft)	16.0	14.0	
	2F		8.6	8.0	
Straight travel performance	1F/2F	mm/10m	600 ≧	600 ≧	
		in./32.8ft	23.62 ≧	23.62 ≧	
Drain amount at lock	1F/2F	L/min	1.00 ≧	1.00 ≧	
		cu.in./min	61.03 ≧	61.03 ≧	
Drain amount while rotating	1F	L/min	0.05 ≧	0.05 ≧	
		cu.in./min	3.05 ≧	3.05 ≧	
	2F	L/min	0.20 ≧	0.20 ≧	
		cu.in./min	12.21 ≧	12.21 ≧	

	Unit	**U20-3α**	**U25-3α, U25S**	Remarks
Hi-speed change pressure 1st to 2nd	MPa	1.5	0.59	
	kgf/cm2	15	6	
	psi	213	85	
Hydraulic motor oil		ISO VG46		
Gearbox oil type		ISO VG150 E.P. / SAE 80W90 API GL5 / MIL-L2105		
Gearbox oil : quantity	L	0.6±10%	0.6±10%	
	US Gal	0.16±10%	0.16±10%	
Oil temperature	°C	-20 -90	-20 -90	
	°F	-4 -194	-4 -194	
Total mass	kg	25	28	
	lbs	55.1	61.7	
Sprocket P.C.D.	mm	344.7	344.7	
	in	13.57	13.57	

e. Cylinder

[1] Specifications and dimensions listt

		Unit	**U20-3α**	**U25-3α**	**U25S(KTC)**	**U25S(KCL)**	Remarks
Boom	Tube I.D.xRod O.D.	mm	Φ65xΦ35	Φ75xΦ40	Φ75xΦ40	Φ75xΦ40	
		in.	Φ2.56xΦ1.38	Φ2.95xΦ1.57	Φ2.95xΦ1.57	Φ2.95xΦ1.57	
	Stroke	mm	474 / 452	473 /455	473 /455	473 /455	Canopy/Cabin
		in.	18.66 / 17.80	18.62 / 17.91	18.62 / 17.91	18.62 / 17.91	
	Min. retraction length	mm	778/ 778	795 / 778	795 / 778	795 / 778	Canopy/Cabin
		in.	30.63 / 30.63	31.30 / 30.63	31.30 / 30.63	31.30 / 30.63	
	Manufacturer		KAYABA Industry	KAYABA Industry	KAYABA Industry	KAYABA Industry	
	Parts No.		RB419-6773-0	RB519-6753-0	RB519-6753-0	RB519-6753-0	Canopy
			RB419-6793-0	RB519-6793-0	RB519-6793-0	RB519-6793-0	Cabin
	Seal kit No.		RB411-71471	RB511-71471	RB511-71471	RB511-71471	
	Piston tightening torque	N.m	579	747	747	747	
		kgf.m	59.0	76.2	76.2	76.2	
		ft.lbf	426.7	551.2	551.2	551.2	
	Piston screw size	mm	M27	M30	M30	M30	
	Width for tightening by spanner	mm	41	50	50	50	
Arm	Tube I.D.xRod O.D.	mm	Φ65xΦ40	Φ70xΦ40	Φ70xΦ40	Φ70xΦ40	
		in.	Φ2.56xΦ1.57	Φ2.76xΦ1.57	Φ2.76xΦ1.57	Φ2.76xΦ1.57	
	Stroke	mm	447	484	484	484	
		in.	17.60	19.06	19.06	19.06	
	Min. retraction length	mm	733	800	800	800	
		in.	28.86	31.50	31.50	31.50	
	Manufacturer		KAYABA Industry	KAYABA Industry	KAYABA Industry	KAYABA Industry	
	Parts No.		RB419-6763-0	RB519-6763-0	RB519-6763-0	RB519-6763-0	
	Seal kit No.		RB411-7155-0	RB511-7155-0	RB511-7155-0	RB511-7155-0	
	Piston tightening torque	N.m	644	747	747	747	
		kgf.m	65.7	76.2	76.2	76.2	
		ft.lbf	475.2	551.2	551.2	551.2	
	Piston screw size	mm	M30	M30	M30	M30	
	Width for tightening by spanner	mm	50	50	50	50	
Bucket	Tube I.D. x Rod O.D.	mm	Φ60xΦ35	Φ65xΦ35	Φ65xΦ35	Φ65xΦ35	
		in.	Φ2.36xΦ1.38	Φ2.56xΦ1.38	Φ2.56xΦ1.38	Φ2.56xΦ1.38	
	Stroke	mm	407	407	392	407	
		in.	16.02	16.02	15.43	16.02	
	Min. retraction length	mm	679	741	756	741	
		in.	26.73	29.17	29.76	29.17	
	Manufacturer		KAYABA Industry	KAYABA Industry	KAYABA Industry	KAYABA Industry	
	Parts No.		RB419-6783-0	RB519-6783-0	RB548-9990-0	RB519-6783-0	
	Seal kit No.		RB411-7179-0	RB511-7179-0	RB511-7179-0	RB511-7179-0	
	Piston tightening torque	N.m	735	462	462	462	
		kgf.m	75.0	47.1	47.1	47.1	
		ft.lbf	542.5	340.7	340.7	340.7	
	Piston screw size	mm	M27	M27	M27	M27	
	Width for tightening by spanner	mm	41	41	41	41	

		Unit	**U20-3α**	**U25-3α**	**U25S(KTC)**	**U25S(KCL)**	Remarks
Swing	Tube I.D.xRod O.D.	mm	Φ60xΦ35	Φ60xΦ35	Φ60xΦ35	Φ60xΦ35	
		in.	Φ2.36xΦ1.38	Φ2.36xΦ1.38	Φ2.36xΦ1.38	Φ2.36xΦ1.38	
	Stroke	mm	420	420	420	420	
		in.	16.54	16.54	16.54	16.54	
	Min. retraction length	mm	686	688	688	688	
		in.	27.01	27.07	27.07	27.07	
	Manufacturer		KAYABA Industry	KAYABA Industry	KAYABA Industry	KAYABA Industry	
	Parts No.		RB419-6743-0	RB419-6743-0	RB419-6743-0	RB419-6743-0	
	Seal kit No.		RB411-7187-0	RB411-7187-0	RB411-7187-0	RB411-7187-0	
	Piston tightening torque	N.m	471	471	471	471	
		kgf.m	48.0	48.0	48.0	48.0	
		ft.lbf	347.2	347.2	347.2	347.2	
	Piston screw size	mm	M27	M27	M27	M27	
	Width for tightening by spanner	mm	41	41	41	41	
Blade	Tube I.D.xRod O.D.	mm	Φ80xΦ40	Φ90xΦ45	Φ90xΦ45	Φ90xΦ45	
		in.	Φ3.15xΦ1.57	Φ3.54xΦ1.77	Φ3.54xΦ1.77	Φ3.54xΦ1.77	
	Stroke	mm	138	126	126	126	U20-3α: Standard/Variable track
		in.	5.43	4.96	4.96	4.96	
	Min. retraction length	mm	499	505	505	505	U20-3α: Standard/Variable track
		in.	19.65	19.88	19.88	19.88	
	Manufacturer		Wipro Fluid Power	Wipro Fluid Power	Wipro Fluid Power	Wipro Fluid Power	U20-3α: Standard track
			KAYABA Industry				U20-3α: Variable track
	Parts No.		RB411-7540-0	RB511-7540-0	RB511-7540-0	RB511-7540-0	U20-3α: Standard track
			RB411-7530-0				U20-3α: Variable track
	Seal kit No.		RB411-7565-0	RB511-7565-0	RB511-7565-0	RB511-7565-0	U20-3α: Standard track
			RB411-7167-0				U20-3α: Variable track
	Piston tightening torque	N.m	530 / 795	530	530	530	U20-3α: Standard/Variable track
		kgf.m	54.0 / 81.1	54.0	54.0	54.0	
		ft.lbf	390.6 / 586.6	390.6	390.6	390.6	
	Piston screw size	mm	M30 / M33	M36	M36	M36	U20-3α: Standard/Variable track
	Width for tightening by spanner	mm	50 / 50	55	55	55	
Track	Tube I.D.xRod O.D.	mm	Φ60xΦ30				U20-3α: Variable track only
		in.	Φ2.36xΦ1.18				
	Stroke	mm	215	-	-	-	
		in.	8.46	-	-	-	
	Min. retraction length	mm	450	-	-	-	
		in.	17.72	-	-	-	
	Manufacturer		KAYABA Industry	-	-	-	
	Parts No.		RB411-2128-0	-	-	-	
	Seal kit No.		RB411-7327-0	-	-	-	
	Piston tightening torque	N.m	333	-	-	-	
		kgf.m	34.0	-	-	-	
		ft.lbf	245.9	-	-	-	
	Piston screw size	mm	M24	-	-	-	
	Width for tightening by spanner	mm	41	-	-	-	

[2] Speed

Unit				U20-3α		U25-3α, U25S		Remarks
				(A)	(B)	(A)	(B)	
Boom cylinder	Up	Canopy	sec.	2.9±0.3	3.8	2.5±0.3	3.4	GL to Max. height (exclude cushion time)
		4 post canopy	sec.	2.8±0.3	3.7	-	-	
		Cabin	sec.	2.4±0.3	3.2	2.4±0.3	3.2	
Boom cylinder	Down	Canopy	sec.	2.9±0.3	3.8	2.8±0.3	3.7	Max. height to GL
		4 post canopy	sec.	2.9±0.3	3.8	-	-	
		Cabin	sec.	2.5±0.3	3.4	2.6±0.3	3.5	
Boom cylinder	cushion		sec.	0.4~1.3	1.6	-	-	50°C (122 °F)
Arm cylinder	Crowd		sec.	2.8±0.3	3.7	2.7±0.3	3.6	Cylinder full stroke
Arm cylinder	Dump		sec.	2.7±0.3	3.6	2.7±0.3	3.6	
Bucket cylinder	Crowd		sec.	3.2±0.3	4.2	3.0±0.3	4.0	Cylinder full stroke
Bucket cylinder	Dump		sec.	2.1±0.3	2.9	2.1±0.3	2.9	
Swing cylinder	Left	Canopy	sec.	5.5±0.5	7.2	4.6±0.5	6.1	Cylinder full stroke
		Cabin	sec.	5.5±0.5	7.2	4.6±0.5	6.1	
Swing cylinder	Right	Canopy	sec.	5.3±0.5	7.0	5.2±0.5	6.8	
		Cabin	sec.	5.3±0.5	7.0	5.2±0.5	6.8	
Blade cylinder	Up		sec.	2.6±0.3	3.5	2.2±0.3	3.0	Cylinder full stroke
Blade cylinder	Down		sec.	3.3±0.3	4.4	2.6±0.3	3.5	

(A) New machine reference value
(B) Allowable limit

[3] Natural fall

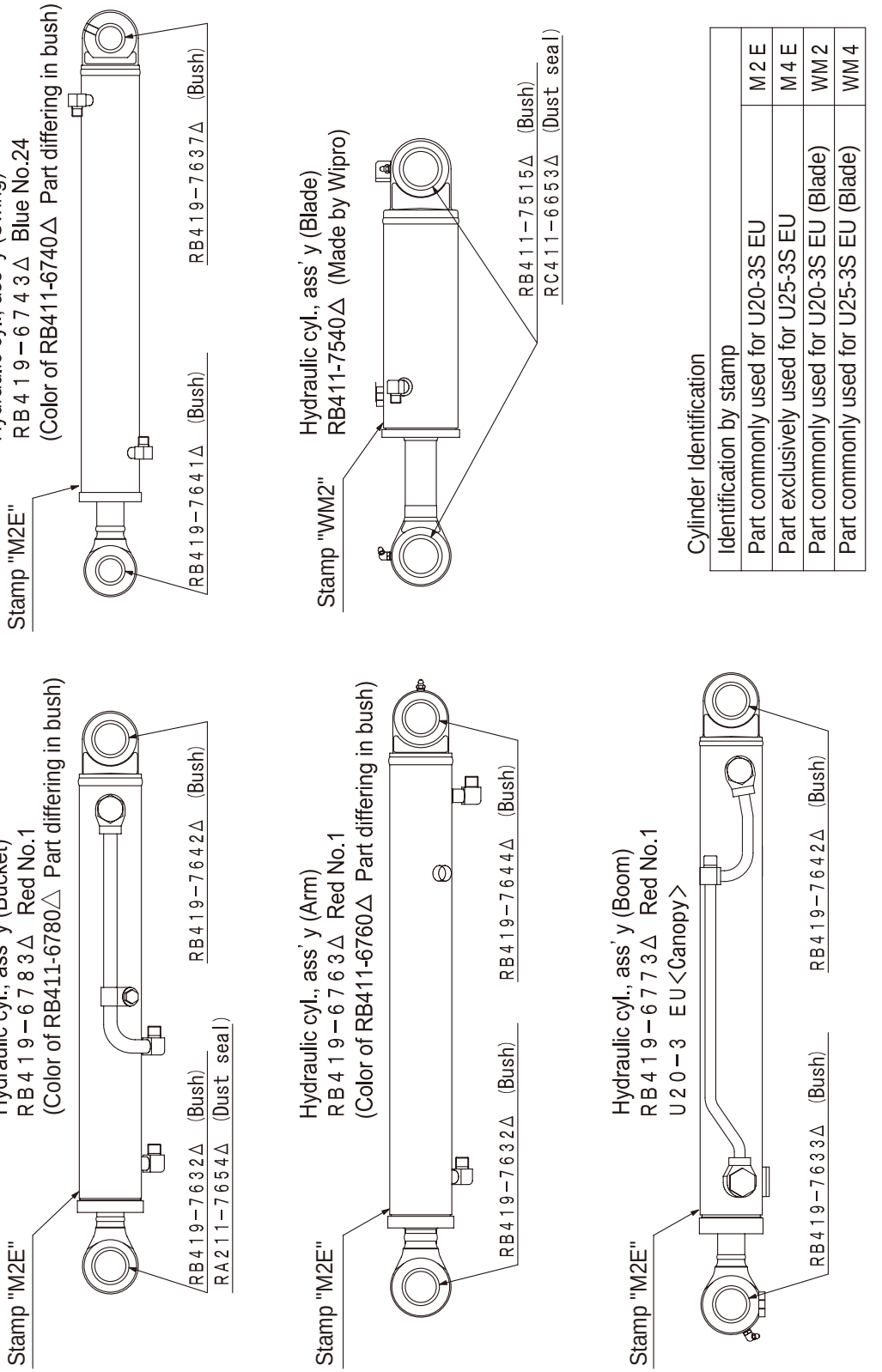
Unit		U20-3α		U25-3α, U25S		Remarks
		(A)	(B)	(A)	(B)	
Load weight	kg	117 (258)		117 (258)		Include bucket weight
Boom cylinder	mm (inch.)	20 (0.79)	100 (3.94)	20	100	Boom raise, Arm extend, Bucket crowd, Bucket load : heaped capacity 10 min Engine stop
Arm cylinder	mm (inch.)	11 (0.43)	55 (2.17)	11 (0.43)	55 (2.17)	
Bucket cylinder	mm (inch.)	10 (0.39)	50 (1.97)	10 (0.39)	50 (1.97)	
Blade cylinder	mm (inch.)	20 (0.79)	100 (3.94)	20 (0.79)	100 83.94)	Arm vertical

Oil temp. : 50 ± 5 °C (122 ± 9 °F), 10 minutes

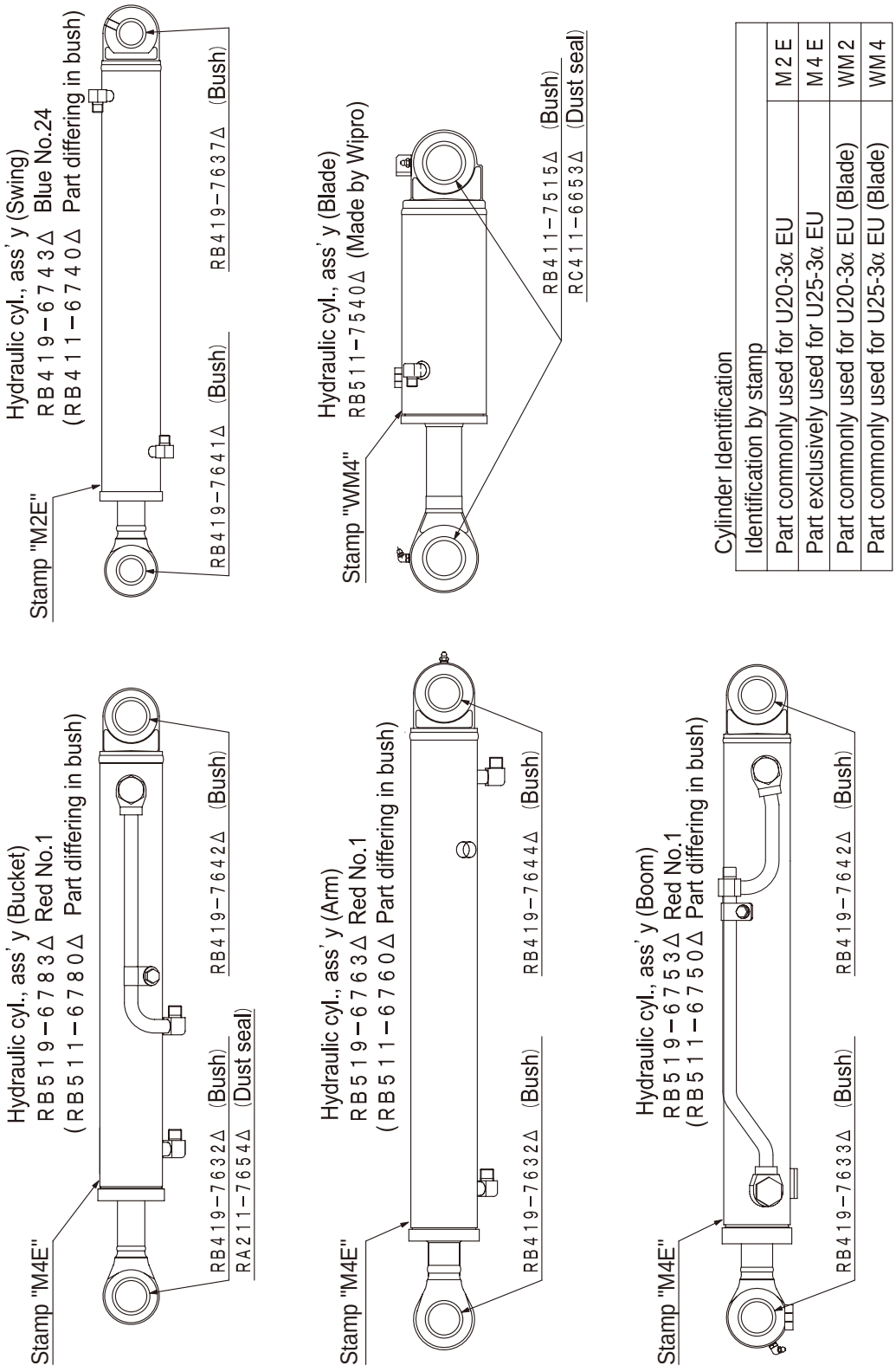
(A) New machine reference value
(B) Allowable limit

[4] Cylinder list

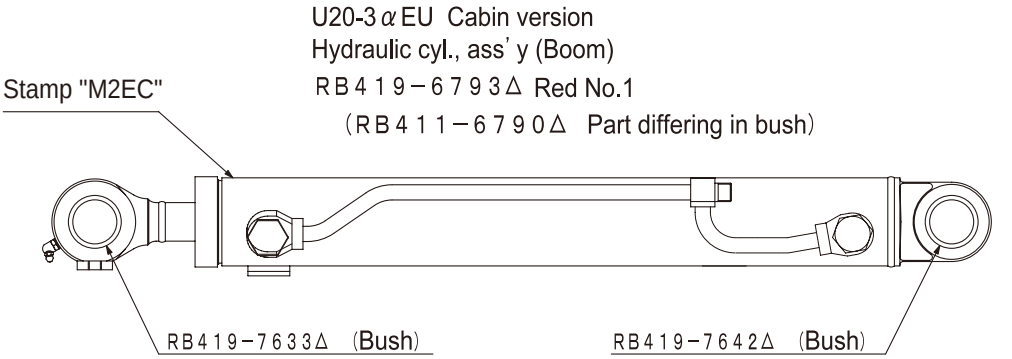
(1) U20-3α

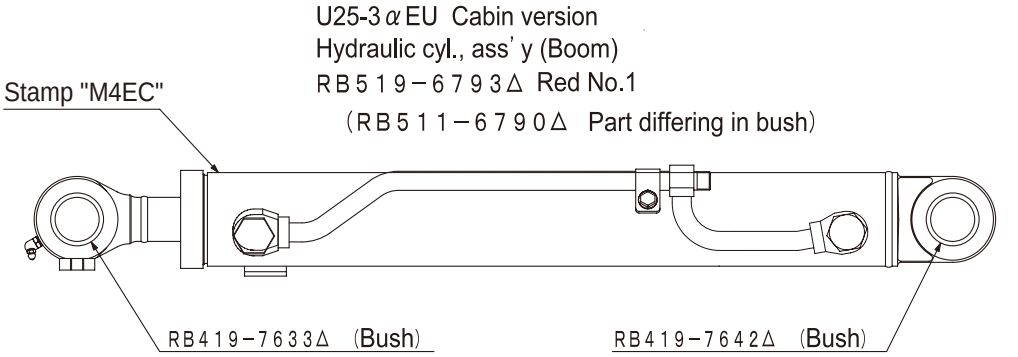


(2) U25-3α


Hydraulic cyl., ass'y (Swing)
RB419-6743Δ Blue No.24
(RB411-6740Δ Part differing in bush)
Stamp "M2E"
RB419-7641Δ (Bush)
RB419-7637Δ (Bush)
Hydraulic cyl., ass'y (Blade)
RB511-7540Δ (Made by Wipro)
Stamp "WM4"
RB411-7515Δ (Bush)
RC411-6653Δ (Dust seal)
Cylinder Identification
Identification by stamp
Part commonly used for U20-3α EU M2E
Part exclusively used for U25-3α EU M4E
Part commonly used for U20-3α EU (Blade) WM2
Part commonly used for U25-3α EU (Blade) WM4
Hydraulic cyl., ass'y (Bucket)
RB519-6783Δ Red No.1
(RB511-6780Δ Part differing in bush)
Stamp "M4E"
RB419-7632Δ (Bush)
RA211-7654Δ (Dust seal)
RB419-7642Δ (Bush)
Hydraulic cyl., ass'y (Arm)
RB519-6763Δ Red No.1
(RB511-6760Δ Part differing in bush)
Stamp "M4E"
RB419-7632Δ (Bush)
RB419-7644Δ (Bush)
Hydraulic cyl., ass'y (Boom)
RB519-6753Δ Red No.1
(RB511-6750Δ Part differing in bush)
Stamp "M4E"
RB419-7633Δ (Bush)
RB419-7642Δ (Bush)

(3) U20-3α, U25-3α, Cab-version

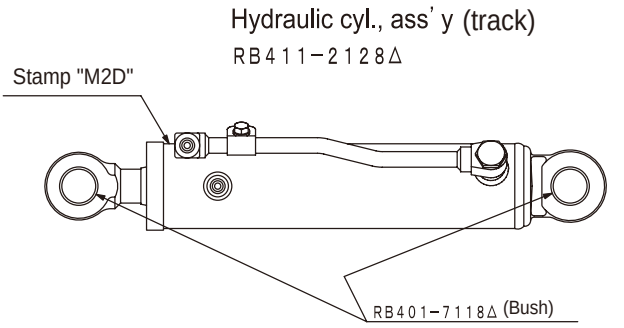


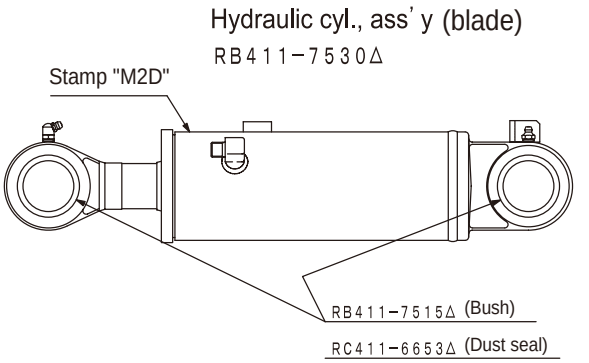


Cylinder Identification

Identification by stamp	
U20-3α EU	M2E
U25-3α EU	M4E
U20-3α EU Cabin	M2EC
U25-3α EU Cabin	M4EC

(4) U20-3α retractable type

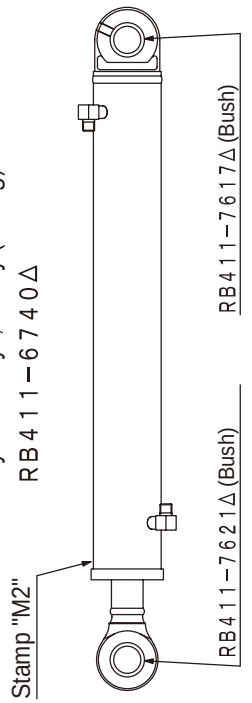


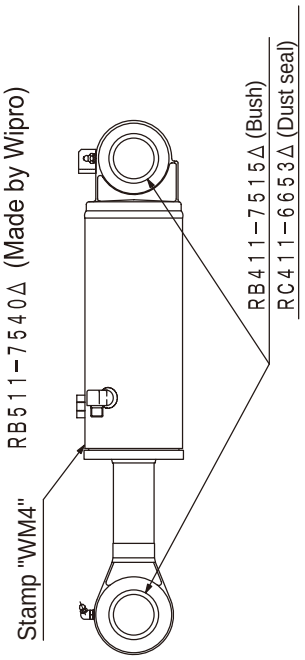


Cylinder Identification

Identification by stamp	
U20-3α-V	M2D

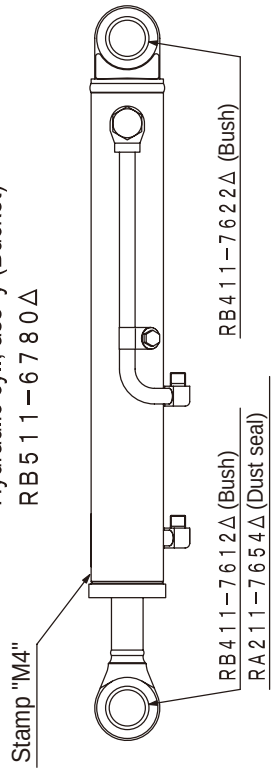
(2) U25S

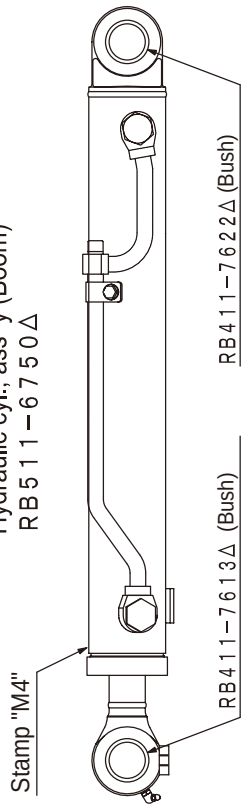




Cylinder Identification

Identification by stamp	
U20-3α	M2
U25-3α	M4
U20-3α (blade)	WM2
U25-3α (blade)	WM4



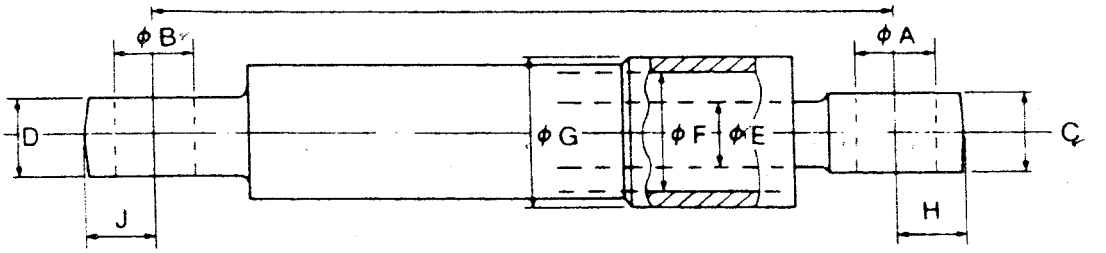


[3] Cylinder dimensional specifications

(1)U20-3α

	Unit	A	B	C	D	E	F	G	H	J	Port screw size	Remarks
Boom	mm	48.0	48.0	45.0	50.0	35.0	65.0	80.0	39.0	36.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.77	1.97	1.38	2.56	3.15	1.54	1.42		
Arm	mm	48.0	48.0	40.0	40.0	40.0	65.0	80.0	39.0	36.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.56	3.15	1.54	1.42		
Bucket	mm	48.0	48.0	50.0	50.0	35.0	60.0	75.0	36.0	36.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.97	1.97	1.38	2.36	2.95	1.42	1.42		
Swing	mm	38.0	38.0	35.0	35.0	35.0	60.0	75.0	34.0	36.0	G 1/4"	KAYABA Industry
	in.	1.50	1.50	1.38	1.38	1.38	2.36	2.95	1.34	1.42		
Blade	mm	45.0	45.0	50.0	50.0	40.0	80.0	100.0	39.0	39.0	G 1/4"	Wipro Fluid Power (for Standard track)
	in.	1.77	1.77	1.97	1.97	1.57	3.15	3.94	1.54	1.54		
	mm	45.0	45.0	50.0	50.0	40.0	80.0	97.0	39.0	39.0	G 1/4"	KAYABA Industry (for Variable track)
	in.	1.77	1.77	1.97	1.97	1.57	3.15	3.82	1.54	1.54		
Track	mm	30.0	30.0	35.0	35.0	30.0	60.0	78.0	30.0	32.0	G 1/4"	KAYABA Industry (Variable track only)
	in.	1.18	1.18	1.38	1.38	1.18	2.36	3.07	1.18	1.26		

Max. retraction length (stroke)



(2)U25-3α

	Unit	A	B	C	D	E	F	G	H	J	Port screw size	Remarks
Boom	mm	48.0	48.0	45.0	50.0	40.0	70.0	85.0	39.0	39.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.77	1.97	1.57	2.76	3.35	1.54	1.54		
Arm	mm	48.0	48.0	40.0	40.0	40.0	70.0	85.0	48.0	48.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.76	3.35	1.89	1.89		
Bucket	mm	48.0	48.0	50.0	50.0	35.0	65.0	80.0	36.0	36.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.97	1.97	1.38	2.56	3.15	1.42	1.42		
Swing	mm	38.0	38.0	35.0	35.0	35.0	60.0	75.0	34.0	36.0	G 1/4"	KAYABA Industry
	in.	1.50	1.50	1.38	1.38	1.38	2.36	2.95	1.34	1.42		
Blade	mm	45.0	45.0	50.0	50.0	45.0	90.0	105.0	44.0	42.0	G 1/4"	Wipro Fluid Power
	in.	1.77	1.77	1.97	1.97	1.77	3.54	4.13	1.73	1.65		

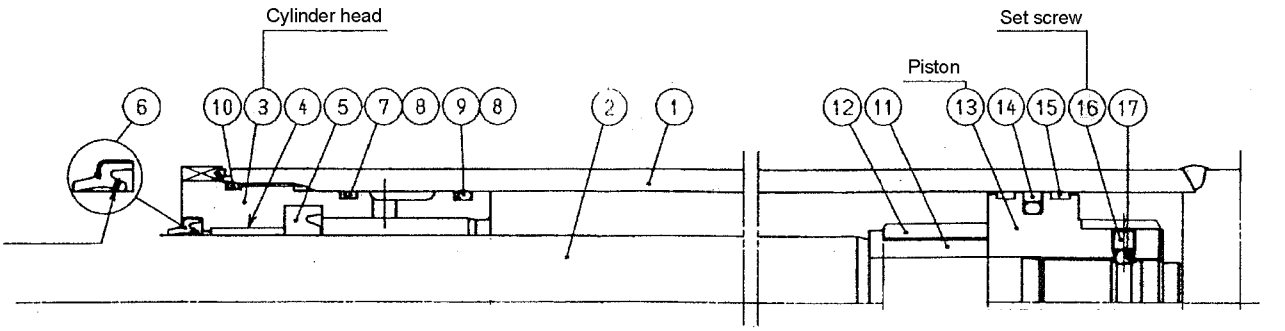
U25S(KTC)

	Unit	A	B	C	D	E	F	G	H	J	Port screw size	Remarks
Boom	mm	48.0	48.0	45.0	50.0	40.0	70.0	85.0	39.0	39.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.77	1.97	1.57	2.76	3.35	1.54	1.54		
Arm	mm	48.0	48.0	40.0	40.0	40.0	70.0	85.0	48.0	48.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.76	3.35	1.89	1.89		
Bucket	mm	40.0	40.0	50.0	50.0	35.0	65.0	82.0	40.0	36.0	G 3/8"	KAYABA Industry
	in.	1.57	1.57	1.97	1.97	1.38	2.56	3.23	1.57	1.42		
Swing	mm	38.0	38.0	35.0	35.0	35.0	60.0	75.0	34.0	36.0	G 1/4"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.76	3.35	1.89	1.89		
Blade	mm	45.0	45.0	50.0	50.0	45.0	90.0	105.0	44.0	42.0	G 1/4"	Wipro Fluid Power
	in.	1.77	1.77	1.97	1.97	1.77	3.54	4.13	1.73	1.65		

U25S(KCL)

	Unit	A	B	C	D	E	F	G	H	J	Port screw size	Remarks
Boom	mm	48.0	48.0	45.0	50.0	40.0	70.0	85.0	39.0	39.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.77	1.97	1.57	2.76	3.35	1.54	1.54		
Arm	mm	48.0	48.0	40.0	40.0	40.0	70.0	85.0	48.0	48.0	G 3/8"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.76	3.35	1.89	1.89		
Bucket	mm	40.0	40.0	50.0	50.0	35.0	65.0	82.0	40.0	36.0	G 3/8"	KAYABA Industry
	in.	1.57	1.57	1.97	1.97	1.38	2.56	3.23	1.57	1.42		
Swing	mm	38.0	38.0	35.0	35.0	35.0	60.0	75.0	34.0	36.0	G 1/4"	KAYABA Industry
	in.	1.89	1.89	1.57	1.57	1.57	2.76	3.35	1.89	1.89		
Blade	mm	45.0	45.0	50.0	50.0	45.0	90.0	105.0	44.0	42.0	G 1/4"	Wipro Fluid Power)
	in.	1.77	1.77	1.97	1.97	1.77	3.54	4.13	1.73	1.65		

3) Tightening torque



(1) boom cylinder

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	343	382	382	382	M72x2	M77x2	M77x2	M77x2	Three bond # 1901
	kgf·m	35.0	39.0	39.0	39.0					
	ft·lbs	253.2	282.1	282.1	282.1					
Piston	N·m	579	747	747	747	M27x2	M30x2	M30x2	M30x2	
	kgf·m	59.0	76.2	76.2	76.2					
	ft·lbs	426.7	551.2	551.2	551.2					
Set screw	N·m	6.9	16.2	16.2	16.2	M6x1	M8x1.25	M8x1.25	M8x1.25	
	kg·m	0.7	1.7	1.7	1.7					
	ft·lbs	5.1	11.9	11.9	11.9					

(2) Arm cylinder

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	343	382	382	382	M72x2	M77x2	M77x2	M77Åx2	Three bond # 1901
	kgf·m	35.0	39.0	39.0	39.0					
	ft·lbs	253.2	282.1	282.1	282.1					
Piston	N·m	644	747	747	747	M30x2	M30x2	M30x2	M30x2	
	kgf·m	65.7	76.2	76.2	76.2					
	ft·lbs	475.2	551.2	551.2	551.2					
Set screw	N·m	16.2	16.2	16.2	16.2	M8x1.25	M8x1.25	M8x1.25	M8x1.25	
	kgf·m	1.7	1.7	1.7	1.7					
	ft·lbs	11.9	11.9	11.9	11.9					

(3) Bucket cylinder

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	304	343	343	343	M67x2	M72x2	M72x2	M72Åx2	Three bond # 1901
	kgf·m	31.0	35.0	35.0	35.0					
	ft·lbs	224.2	253.2	253.2	253.2					
Piston	N·m	735	462	462	462	M27x2	M30x2	M30x2	M30x2	
	kgf·m	75.0	47.1	47.1	47.1					
	ft·lbs	542.5	340.7	340.7	340.7					
Set screw	N·m	6.9	6.9	6.9	6.9	M6x1	M6x1	M6x1	M6x1	
	kgf·m	0.7	0.7	0.7	0.7					
	ft·lbs	5.1	5.1	5.1	5.1					

(4) Swing cylinder

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	304	304	304	304	M67x2	M67x2	M67x2	M67x2	Three bond # 1901
	kgf·m	31.0	31.0	31.0	31.0					
	ft·lbs	224.2	224.2	224.2	224.2					
Piston	N·m	471	471	471	471	M27x2	M27x2	M27x2	M27x2	
	kgf·m	48.0	48.0	48.0	48.0					
	ft·lbs	347.2	347.2	347.2	347.2					
Set screw	N·m	6.9	6.9	6.9	6.9	M6x1	M6x1	M6x1	M6x1	
	kgf·m	0.7	0.7	0.7	0.7					
	ft·lbs	5.1	5.1	5.1	5.1					

(5) Blade cylinde

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	450	451	530	530	M87x2	M87x2	M97x2	M97x2	Three bond # 1901
	kgf·m	46	46.0	54.0	54.0					
	ft·lbs	332.0	332.7	390.6	390.6					
Piston	N·m	530	795	530	530	M30x2	M33x2	M36x3	M36x3	
	kgf·m	54.0	81.1	54.0	54.0					
	ft·lbs	390.6	586.6	390.6	390.6					
Set screw	N·m	14.7	16.2	14.7	14.7	M6x1	M8x1.25	M6x1	M6x1	
	kgf·m	1.5	1.7	1.5	1.5					
	ft·lbs	10.8	11.9	10.8	10.8					

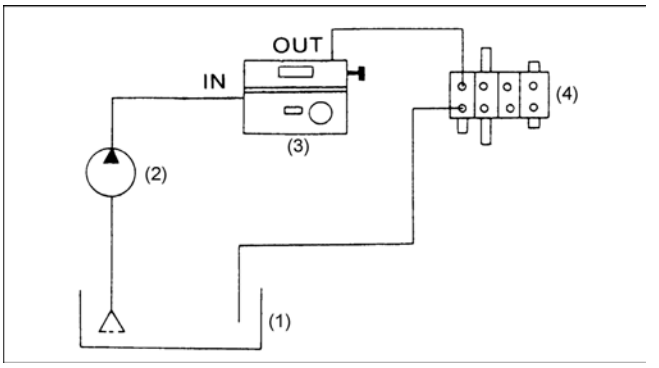
VT : Variable Track

(6)Track cylinder (U20-3α Variable track only)

	Unit	Tightening torque				Thread size				Adhesive
		U20-3a	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	**U20-3a**	**U25-3a**	**U25S(KTC)**	**U25S(KCL)**	
Cylinder head	N·m	304.0	-	-	-	M67x2	-	-	-	Three bond # 1901
	kgf·m	31.0	-	-	-					
	ft·lbs	224.2	-	-	-					
Piston	N·m	333.4	-	-	-	M24x2	-	-	-	
	kgf·m	34.0	-	-	-					
	ft·lbs	245.9	-	-	-					
Set screw	N·m	6.9	-	-	-	M6x	-	-	-	
	kgf·m	0.7	-	-	-					
	ft·lbs	5.1	-	-	-					

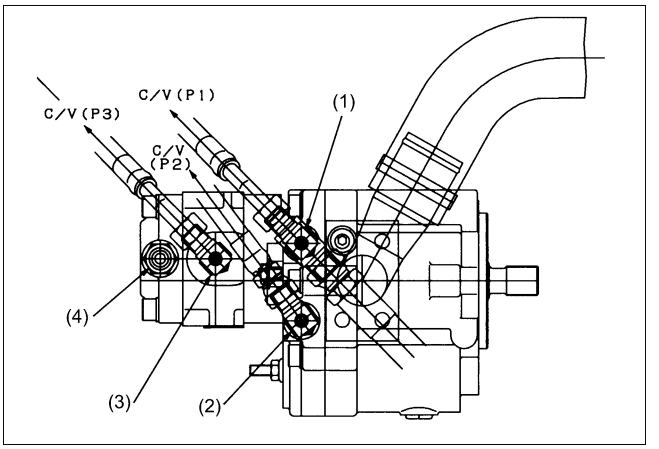
C.Testing

a. Pump flow



(1) Hydraulic oil tank (2) Pump
(3) Tester (4) Control valve

Pump discharge side



(1) To control valve (P1) (2) To control valve (P2)
(3) To control valve (P3) (4) To pilot filter

1) Measuring procedure

1. Connect the tester to the pump outlet. Be careful not to confuse the tester's pipe connections.
2. Open the tester's loading valve. Start the engine.
3. Set the engine to the maximum rpm.
4. Gradually close the loading valve. Apply the rated load pressure (test pressure) to the pump.
5. Measure the discharge flowrate and pump rpm (engine rpm).
6. Calculate the volumetric efficiency and judge the performance.

2) Checking the pump performance

To inspect the pump performance, apply the specified pressure to the pump discharge side. Measure the discharge rate at the specified rpm to check the volumetric efficiency.

$$\text{Volumetric efficiency} = \frac{\text{Discharge rate at rated load}}{\text{Theoretical discharge rate (calculated value)}} \times 100(\%)$$

Notes

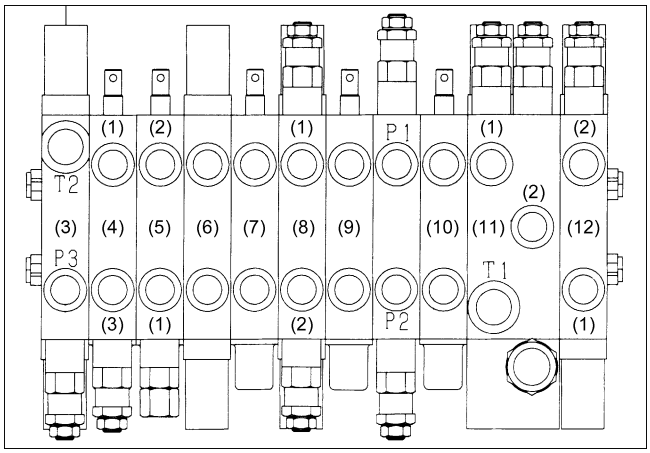
1. The pump's volumetric efficiency is proportional to the pump rpm and inversely proportional to the load pressure. During the test, keep the engine at its maximum rpm.
2. The volumetric efficiency is the ratio of the discharge rate per pump turn (cc/rev) to the theoretical discharge rate (calculated value). The main relief set pressure is used as the rated load.
3. The discharge rate under rated load must be converted to that per pump turn. This is because the pump usually runs at lower rpm.

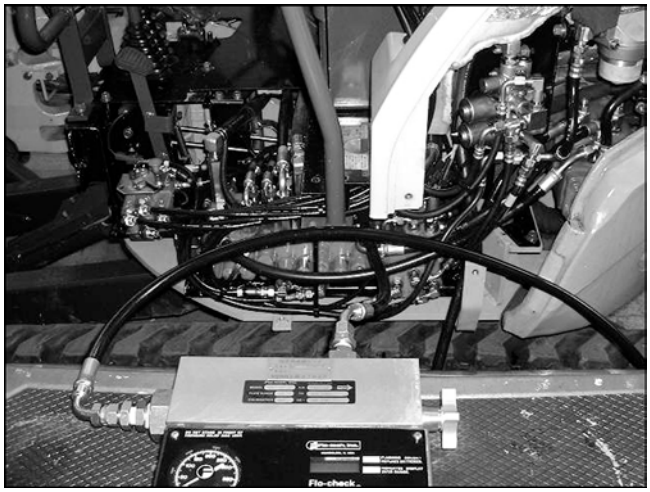
Discharge rate under rated load

$$\text{(cc/rev)} = \frac{\text{Discharge rate at rated load (L/min)} \times 1000}{\text{Pump rpm at rated load (rpm)}}$$

4. The volumetric efficiency must be satisfied to accept the pump for its performance.
5. The hydraulic oil temperature must be 50±5°C (122±9°C).

Control valve section layout

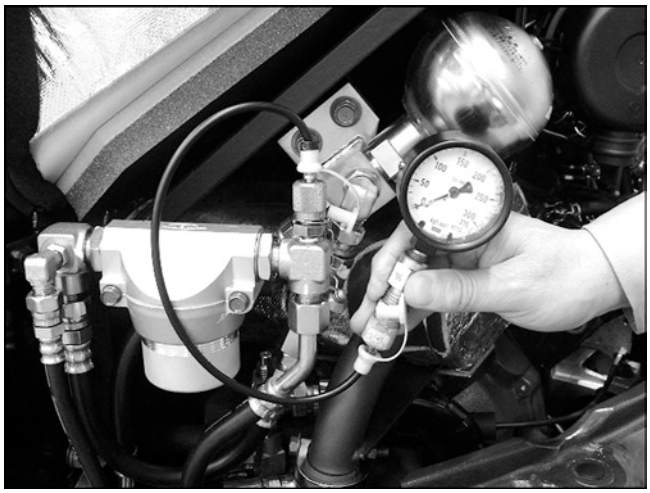




(1) Rod
(2) Bottom
(3) Communicating valve
(4) Dozer
(5) Swing
(6) Swivel
(7) Spare
(8) Arm
(9) Travel left
(10) Travel right
(11) Boom
(12) Bucket

b. Pressure measurement

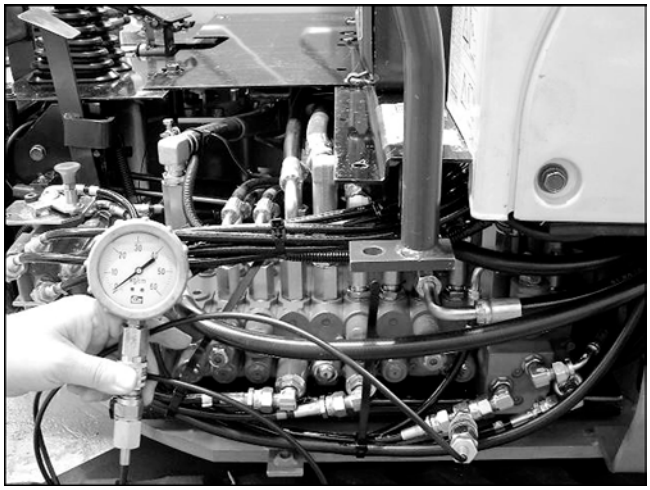
[1] Pilot pressure



1) Pilot primary pressure

1. Remove the left cover of the bonnet.
2. Disconnect the plug (1/8) from the elbow pipe joint of the pilot filter. Set the pressure gauge.
3. Start the engine. Take the reading at the maximum speed. Take 3 measurements and take the average.

* Keep the oil temperature at 50±5°C (122±9°F).

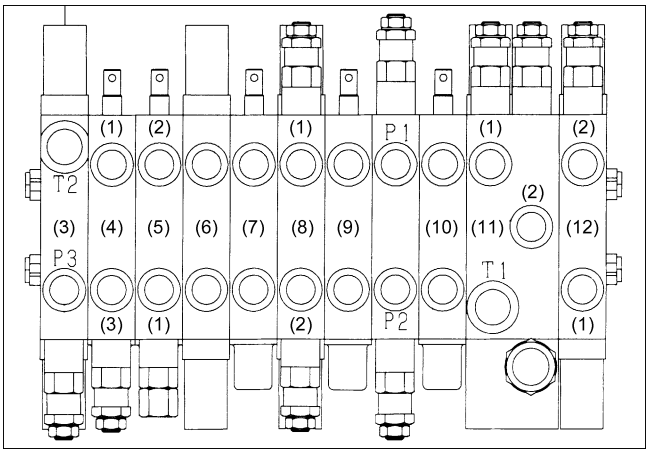


2) Pilot secondary pressure(in moving up the boom)

1. Remove the steps and swivel cover.
2. There is the hose between the pilot valve and control valve. Disconnect this hose from the control valve alone.
3. Attach the T joint and set the pressure gauge.
4. Start the engine. At the maximum rpm, move up the boom and take the reading.
5. Take 3 measurements and take the average.

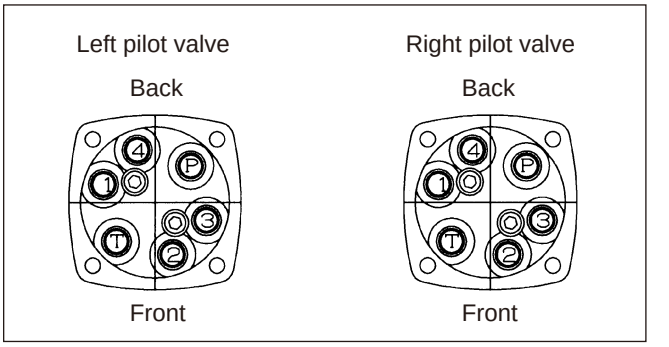
* Keep the oil temperature at 50±5°C (122±9°F).

Control valve section layout



(1) Rod
(2) Bottom
(3) Communicating valve
(4) Dozer
(5) Swing
(6) Swivel
(7) Spare
(8) Arm
(9) Travel left
(10) Travel right
(11) Boom
(12) Bucket

Pilot valve hose routes



Left pilot valve

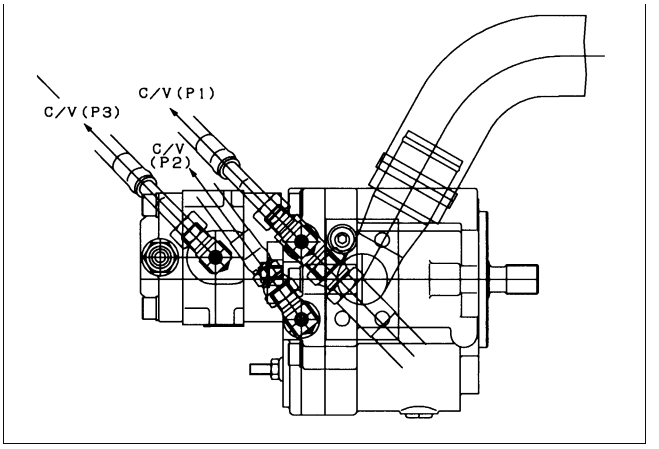
	Location	Hose tape color
1	Swivel left	Red
2	Arm dump	Blue
3	Swivel right	Yellow
4	Arm tuck-in	Green
P	Port P	No color
T	Port T	No color

Right pilot valve

	Location	Hose tape color
1	Bucket tuck-in	Pink
2	Boom down	Sky-blue
3	Bucket dump	Brown
4	Boom up	Gray
P	Port P	No color
T	Port T	No color

[2] Main relief valve pressure

Pump discharge side



1) Measuring procedure

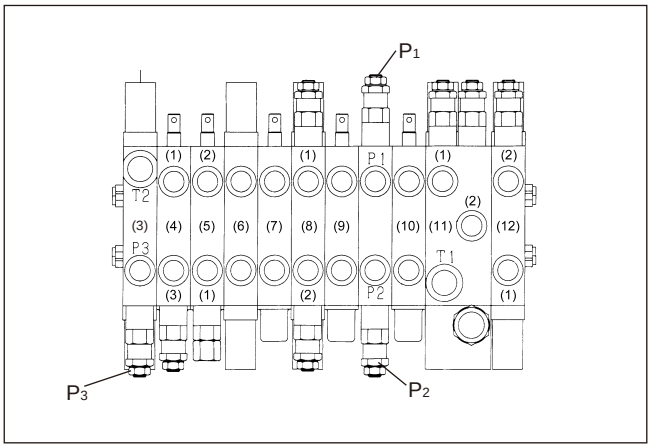
1. Remove the adaptor plug (1/8) of main pump discharge side and connect thereto a pressure gauge.
   - P1 Bucket, boom and travel right
   - P2 Arm, service port and travel left
   - P3 Swivel, swing and dozer
2. Start the engine. Check the circuit to be measured for oil leak.
3. With the engine running at maximum rpm, operate the lever to relieve the cylinder.
4. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

* Measure the pressure at oil temperature of 50±5°C (122±9°F).

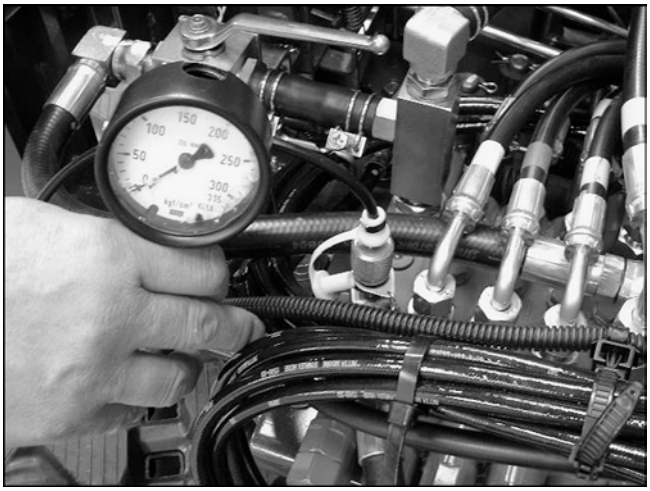
Note : Quick coupler is for EU-version.

(Pressure port : EU-version)

Control valve section layout



(1) Rod
(2) Bottom
(3) Communicating valve
(4) Dozer
(5) Swing
(6) Swivel
(7) Spare
(8) Arm
(9) Travel left
(10) Travel right
(11) Boom
(12) Bucket



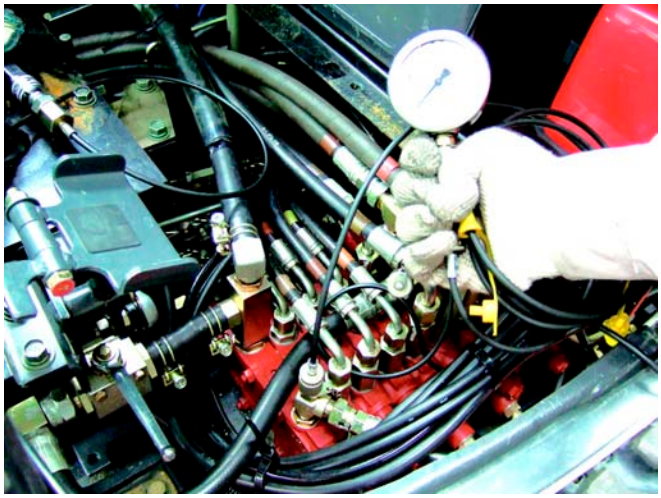
(Pressure port : EU-version)

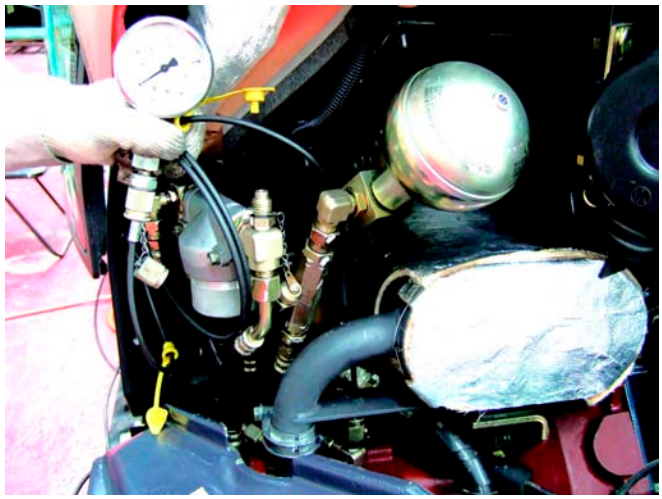
2) Adjusting procedure

1. Loosen the lock nut of the relief valve.
2. Turn the adjusting screw with a hex wrench to set the pressure and tighten the lock nut after setting.

* Clockwise turning increases the pressure and counterclockwise turning decreases it.

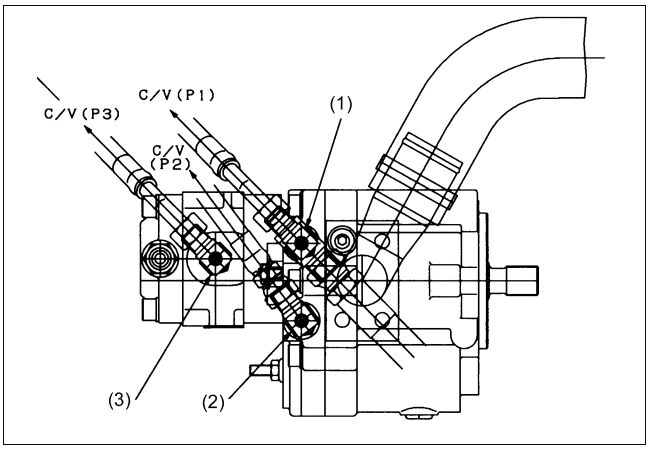
3. With the engine running at maximum rpm, operate the lever and check the set pressure.



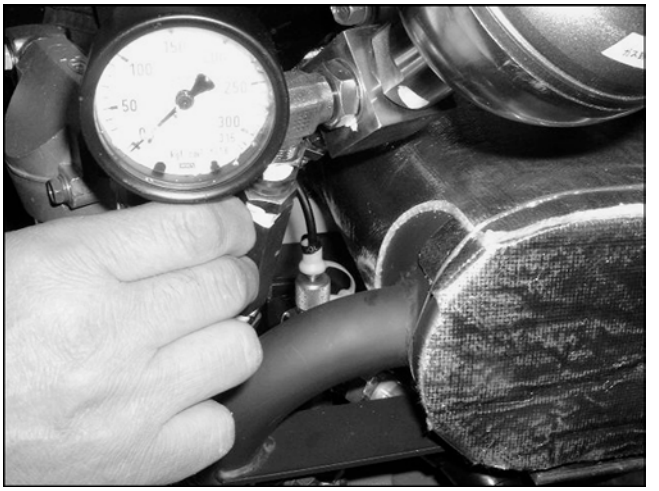


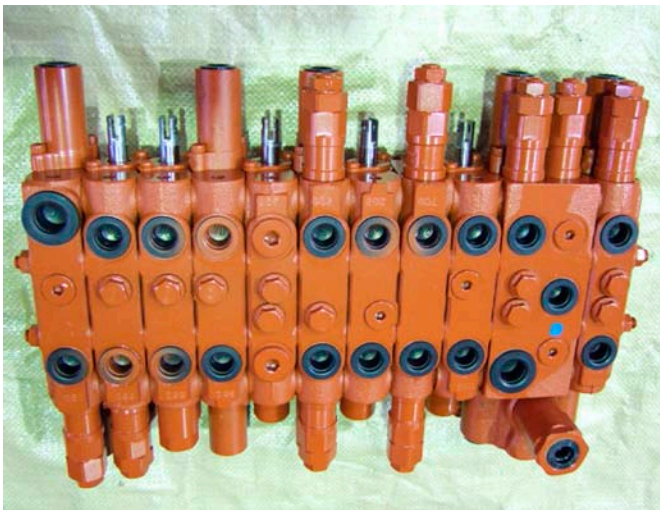
[3] Overload relief pressure

Pump discharge side



(1)C/V(P1) (2)C/V(P2) (3)C/V(P3)



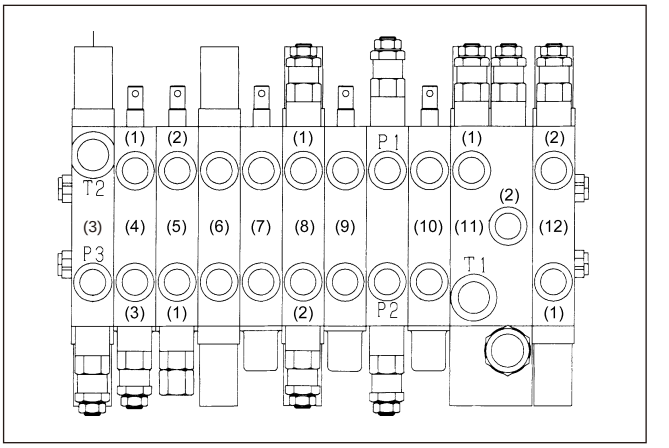


1) Measuring procedure (Arm operation)

1. Remove the adaptor plug (2) (1/8) of main pump discharge side and connect thereto a pressured gauge.
2. Raise the set pressure of the main relief valve (P2) approx. 0.98 MPa (10 kgf/cm^2 142psi) higher than that of the overload relief valve.
3. With the engine running at maximum rpm, operate the arm cylinder, relieve the cylinder and measure the set pressure.
4. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.
5. After the measurement, return the pressure of the main relief valve to the original set value.

* Measure the pressure at oil temperature of 50±5°C (122±9°F).

Control valve section layout

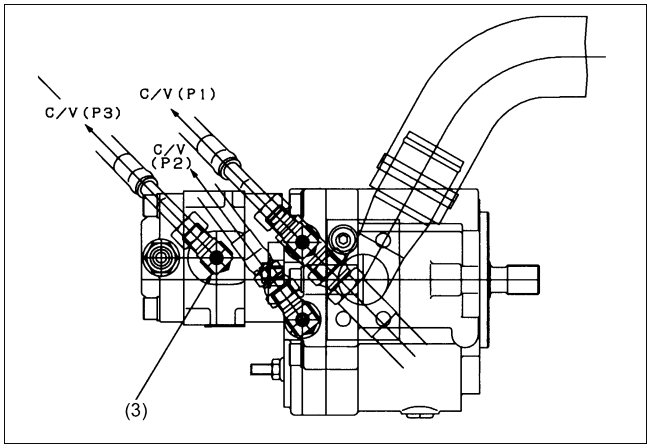


(1) Rod
(2) Bottom
(3) Communicating valve
(4) Dozer
(5) Swing
(6) Swivel
(7) Spare
(8) Arm
(9) Travel left
(10) Travel right
(11) Boom
(12) Bucket

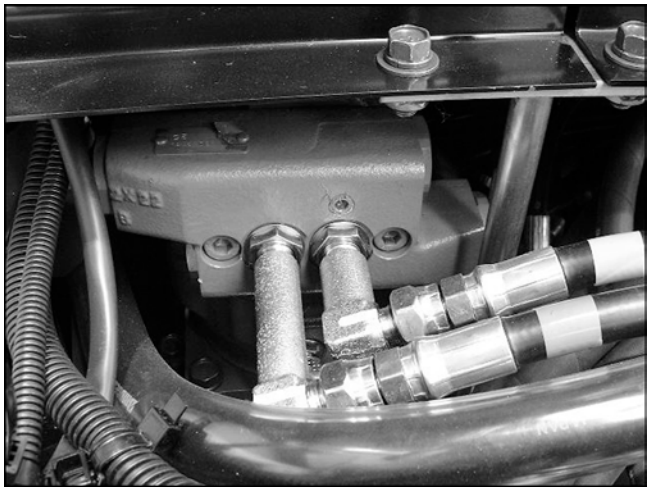
2) Adjusting procedure

1. Loosen the lock nut of the overload relief valve, turn the adjusting screw with a hex wrench to set the pressure and tighten the lock nut after setting.
2. With the engine running at maximum rpm, operate the lever and check the set pressure.
3. After the measurement, return the pressure of the main relief valve to the original set pressure.

[4] Swivel brake pressure



(3) P_3 discharge



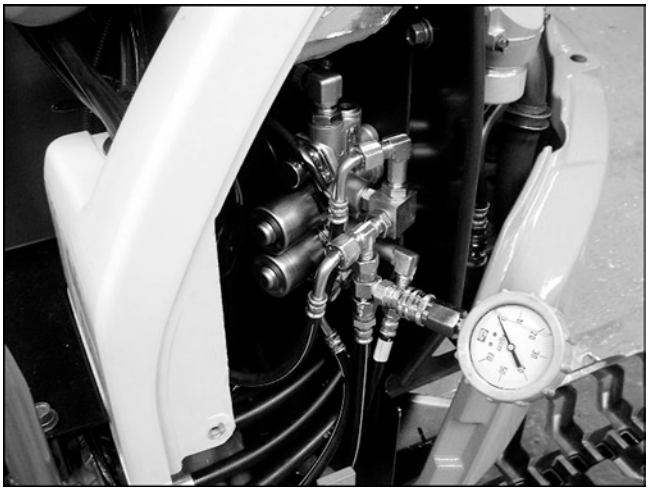
(4) Left swivel relief valve
(5) Right swivel relief valve

1) Measuring procedure

1. Remove the adaptor plug (P_3 discharge) of main pump discharge side and connect thereto a pressured gauge.
2. Support the bucket with a strongly-built stand.
3. Operate the swivel lever slowly and measure the brake valve relief pressure while operating the engine at maximum rpm.
4. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

* Measure the pressure at oil temperature of 50±5°C (122±9°F).

[5] Swivel brake release valve

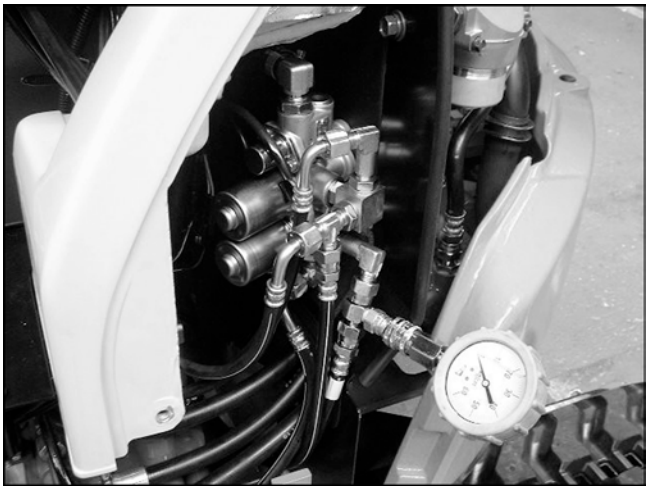


1) Measuring procedure

1. Stop the engine, disconnect the swivel brake release hose of the selector valve using a vacuum pump and set the pressure gauge.
2. With the engine running at maximum rpm, unlock the lever (to bring it to operating position) and measure the pressure.
3. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

* Measure the pressure at oil temperature of 50±5°C (122±9°F).

[6] Travel two-speed selector pressure



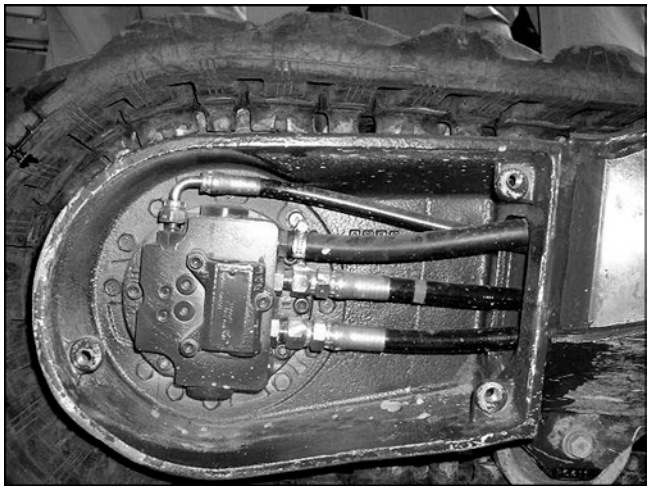
1) Measuring procedure

1. Stop the engine, disconnect the travel two-speed selector hose of the selector valve using the vacuum pump and set the pressure gauge.
2. With the engine running at maximum rpm, step on the two-speed pedal and measure the pressure.
3. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

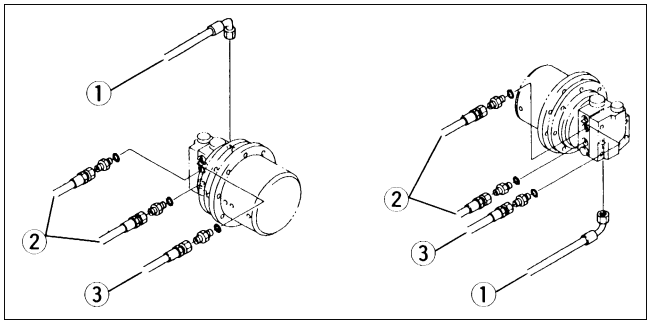
* Measure the pressure at oil temperature of 50±5°C (122±9°F).

c. Drain measurement

[1] Travel motor



(Travel left) (Travel right)



1) Measuring procedure

1. Disconnect the drain hose of the travel motor and plug the drain hose to prevent oil from flowing out of the tank.
2. Connect another hose (a vinyl hose for low pressure will do) to the travel motor drain port. (Photo: Left travel motor U25-3α)
3. Lift up the crawler and bring it into measurable posture.
4. With the engine running at maximum rpm, rotate the crawler for 1 minute and measure the amount of hydraulic oil collected in a container
5. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

Caution:
Be very careful not to put your hands and feet under the crawler.

(1) Two-speed selector hose
(2) Travel forward/backward hose
(3) Motor drain hose

[2] Swivel motor

2) Measuring procedure

1. Disconnect the drain hose using the vacuum pump as shown in the photo.
2. Plug the tank-side hose which has been disconnected.
3. Dismount the vacuum pump.

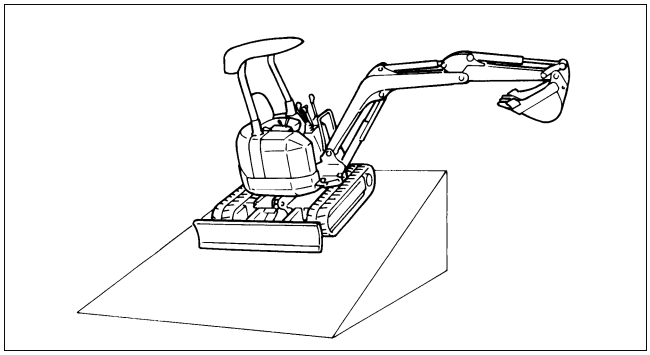
4. Bring the front attachment into travel posture and hold up the bucket 1m (3.28ft) above the ground.
5. With the engine running at maximum rpm, do the swiveling for 1 minute and measure the amount of oil collected in a container.
6. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

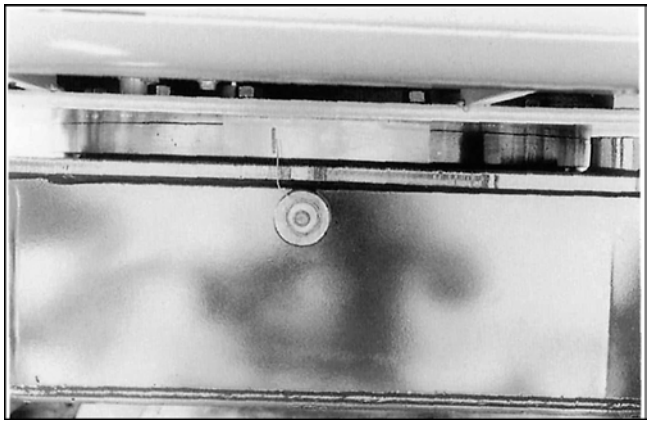
Caution:

Pay full attention to the surrounding during swiveling.

d. Measurement of block performance

[1] Swivel





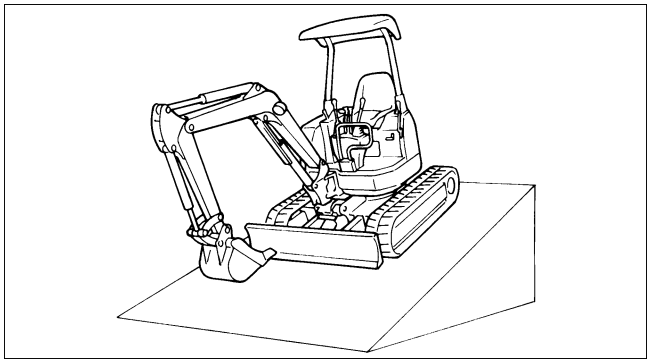
1) Measuring procedure

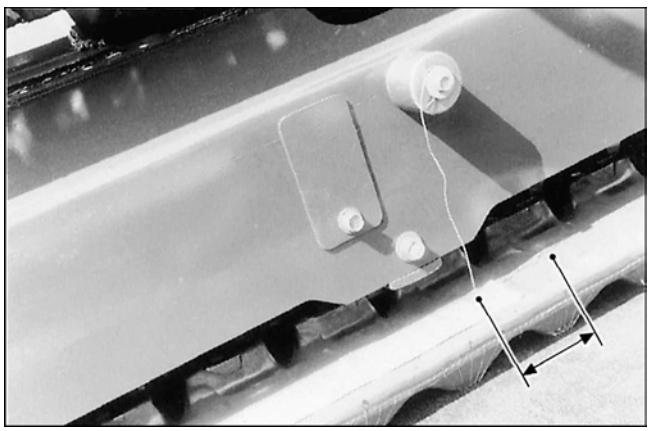
1. Park the machine on a 20-degree slope.
2. Bring the front attachments into such a posture that the arm is ready for dumping and the bucket is crowded, and hold the boom in line with the boom root pin and bucket pin.
3. Mark the swivel race outer ring and the lower frame and measure the displacement generated for 1 minute.
4. Start the engine, unlock the lever while idling and start the measurement.
5. A bucket load should be JIS heaped x specific gravity 1.8. Bucket load = 147kgf (324lbs)
6. Conduct the measurement at hydraulic temperature of 50±5°C (122±9°F).
   Allowable range

On race periphery:	U20-3α	131≧
	U25-3α	140≧
	U25S	140≧

U20-3α, U25-3α, U25S	Angle (deg)	On race periphery
Engine stop	0, 5 >	21.8mm (0.86in.)
		23.2mm (0.91in.)
Engine idle running, lever lock release	0, 30 >	131.0mm (5.16in.)
		140.0mm (5.51in.)
Swivel bearing dia.		131.0mm (5.16in.)
		U20-3α: 499mm(19.6in.) U25-3α, U25S: 535mm(21.1in.)

[2] Travel





1) Measuring procedure

1. Park the machine on a 20-degree slope and bring the front attachments into traveling posture.
2. Mark the lower travel frame and the crawler and measure the displacement generated for 10 minutes.
3. Conduct the measurement at hydraulic temperature of 50±5°C (122±9°F).
   Allowable range

Crawler inside:	300 mm(11.8in.)≧

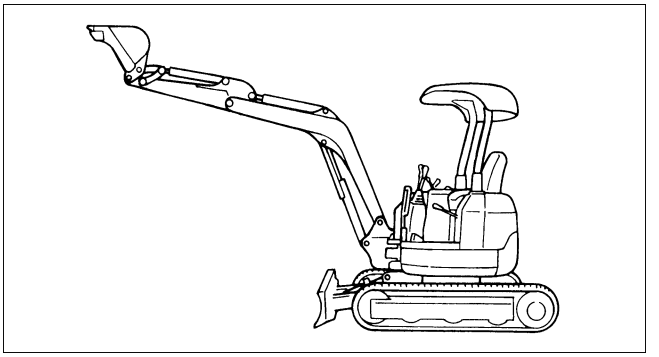
e. Operating speed

[Points]
(1) Measure the time required for full stroke with the standard front attachments without load.
(2) Repeat the measurement several times, obtain the average and adopt it as measured value.
(3) When two kinds of measured value such as for forward/backward and for right swivel/left swivel can be obtained, do not work out the average.
(4) Pay full attention to the surrounding.

[Conditions]
(1) The engine should be run at maximum rpm.
(2) The hydraulic oil temperature should be 50±5°C (122±9°F).
(3) Measurement should be done on a flat ground.
(4) Take the measurement after each operation has been done several times without load.

[1] Checking procedure of each speed

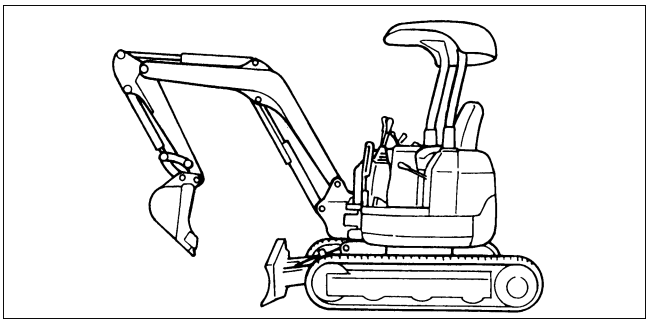
1) Boom cylinder



Each specification ; Refer to page IV-S-26

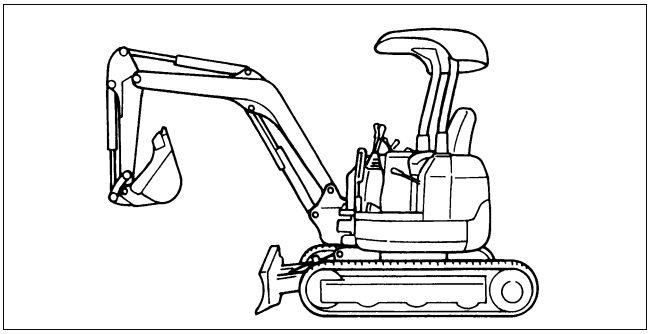
1. Fully retract the arm cylinder and bucket cylinder.
2. Operate the engine at maximum rpm.
3. Measure the time required for the movement from the ground to the cylinder end.
   Note: Cushion operating time is not included.

2) Arm cylinder



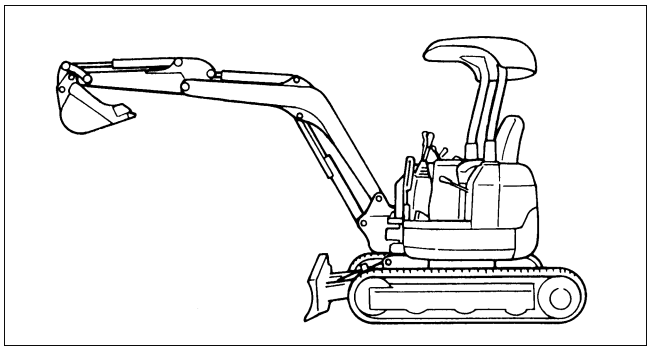
1. Bring the boom and arm into the postures as shown in the figure.
2. Operate the engine at maximum rpm.
3. Measure the time required for full stroke of the arm cylinder.

3) Bucket cylinder



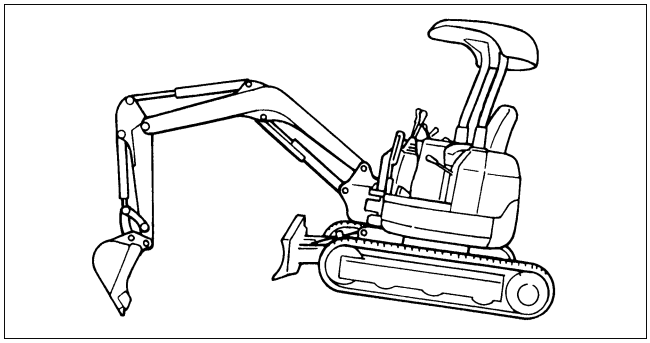
1. Bring the boom and arm into the postures as shown in the figure.
2. Operate the engine at maximum rpm.
3. Measure the time required for full stroke of the bucket cylinder.

4) Swing cylinder



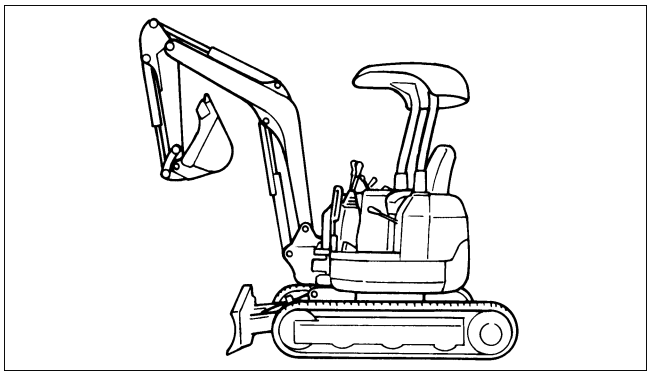
1. Bring the boom, arm and bucket into the postures as shown in the figure. (Keep the bucket bottom approx.1 m above the ground.)
2. Operate the engine at maximum rpm.
3. Measure the time required for full stroke of the swing cylinder (Right to left and let to right).
   Note: Cushion operating time is not included.

5) Dozer cylinder



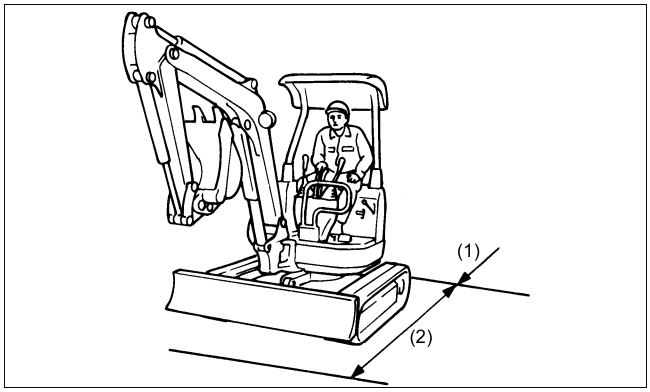
1. Bring the bucket down to the ground in such a posture that the dozer can be operated at full stroke as shown in the figure.
2. Operate the engine at maximum rpm.
3. Measure the time required for full stroke of the dozer cylinder.

6) Swivel



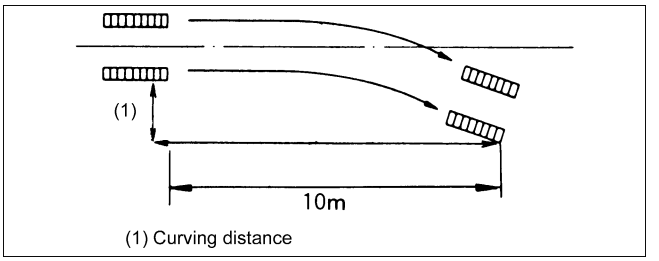
1. Bring the front attachments into the posture as shown in the figure.
2. Operate the engine at maximum rpm.
3. Measure the time required for three turns.

7) Travel



1. Bring the machine into traveling posture and run up the machine until each speed reaches the maximum.
2. Measure the time required for travel in 10 m distance.
   (1) Run-up
   (2) Distance for measurement (10 m) (32.8ft)
   * Rubber crawler type

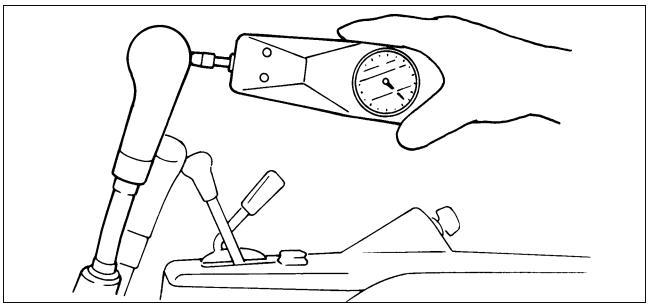
f. Straight travel performance



1. Bring the machine into traveling posture. With the engine running at maximum rpm, move the lever for full stroke to run the machine in 10 m distance.
2. Measure the error from the track as viewed above from the straight line.

600mm (23.6in) ≧

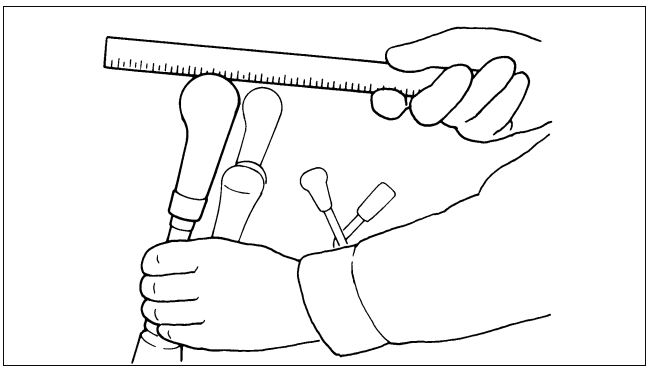
g. Control and traveling lever operating force



1. Conduct measurement with regard to the right and left levers.
2. Start the engine, move the levers for full stroke and measure the maximum operating force in relief state.
3. Repeat the measurement 3 times, obtain the average and adopt it as measured value.

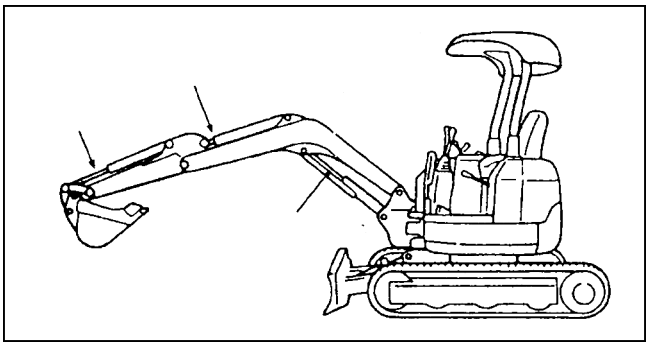
* Conduct measurement at oil temperature of 50±5°C (122±9°F).

h. Control and traveling lever stroke



1. Stop the engine.
2. Move each of the travel, boom, arm, bucket and dozer control levers from neutral to full stroke end and measure their strokes at the top center of each lever grip.
3. If any of the levers is out of position, measure the stroke from its loose end.
4. Conduct the measurement along a straight line.
5. Repeat the measurement 3 times, obtain the average and adopt it as measured value

i. Cylinder natural fall amount

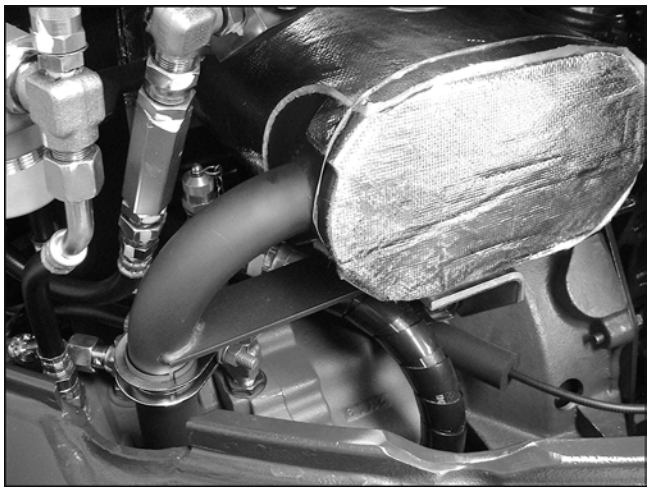


1. Locate the machine on the flat ground, and put the load the bucket.
   Load on the bucket should be as follows.
   U20-3α, U25-3α, U20-3:147kgf (324lbs)
   (exclude bucket weight)
2. Arm cylinder must be fully retracted. Bucket cylinder must be fully extended.
3. Locate the bottom of bracket about 1 m above from the ground. Stop the engine.
4. Mark on the rod of each cylinder.
5. Measure the fall distance after 10 min.

D.Disassembling and Assembling

a. Pump

[1] Pump coupling



1) Disassembling the pump

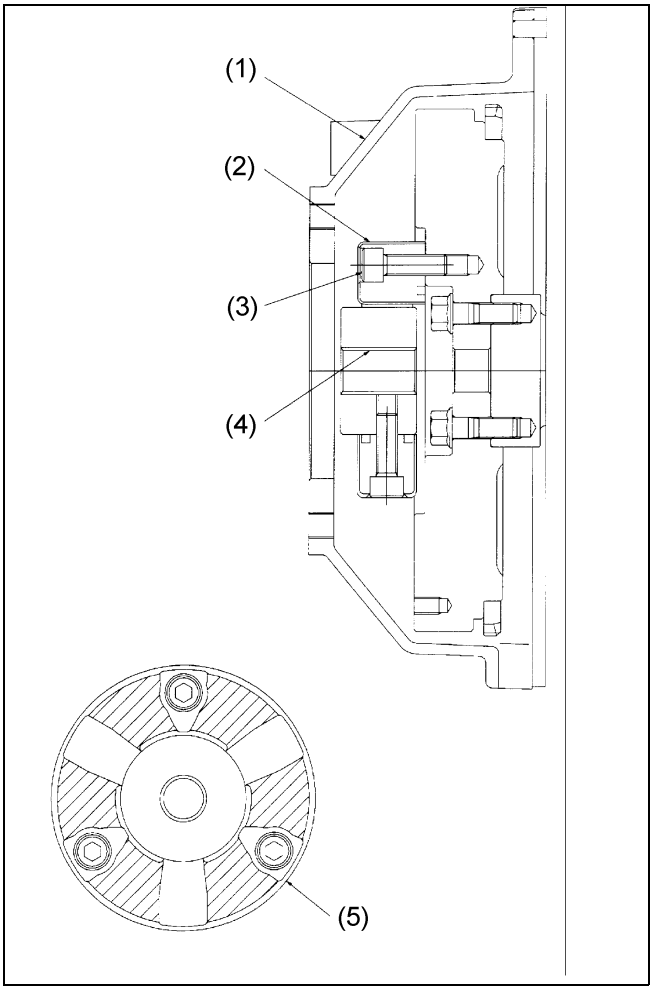
1. Bring the attachments down to the ground and stop the engine.

2. Open the bonnet, remove the bonnet left cover and dismount the muffler.

3. Mount a vacuum pump and disconnect the hydraulic hose and suction hose from the pump.

4. Remove the two pump mounting bolts.
   Tightening torque of bolt:
   77.5 ~ 90.2N·m (7.9~9.2kgf·m) 57.1~66.5ft·lbs

5. Pull the pump assembly toward the counterweight, separate it from the pump coupling and dismount it.



(1)Housing(pump) RB411-4261Δ
(2)Coupling RB411-4263Δ
(3)Coupling mounting bolt
(4)Apply grease to the spline
(5)Cut off the outer tape after mounting

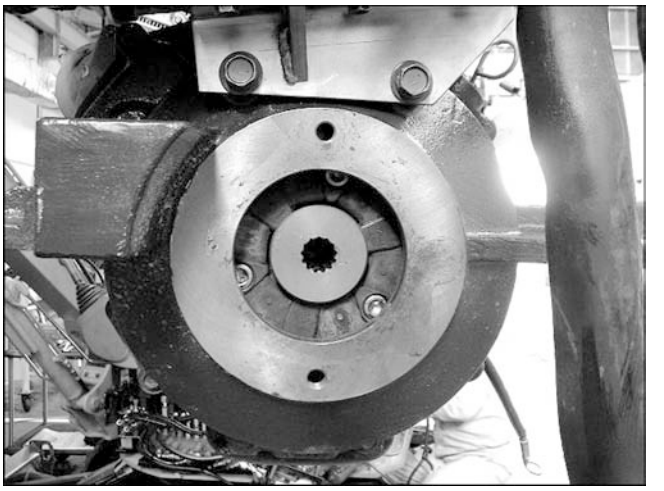
2) Reassembling procedure

1. Apply an appropriate amount of grease to the spline before mounting the pump.

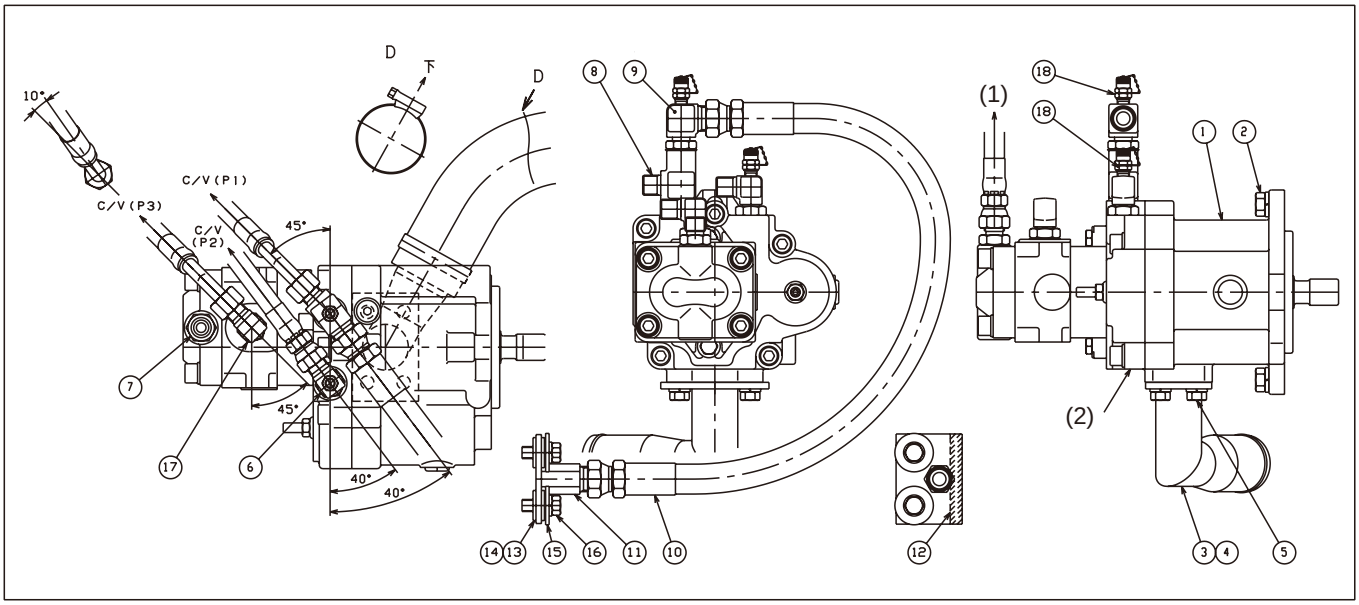
CAUTION:
Do not allow grease onto the rubber parts. Rubber may be deteriorated.

2. Tightening torque of coupling mounting bolt: 48.1-55.9N·m(4.9 ~ 5.7kgf·m) 35.4~41.2ft·lbs

CAUTION:
Do not apply screw LOCTITE. Rubber may be deteriorated.



[2] Mounting and dismounting the pump



(1)Filter (2)Identification of pumps

Color of nameplate	
U20-3α EU	Blue
U25-3α EU	Yellow
U25S	

[Note]
Both the U20-3α EU, U25-3α and U25S have side branches.

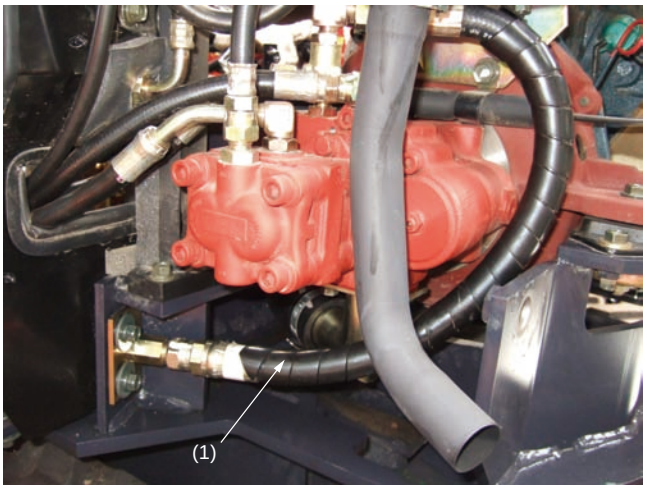
2) Reassembling procedure

1. Hydraulic adaptor mounting direction and angle.
   Mount it as shown at left.

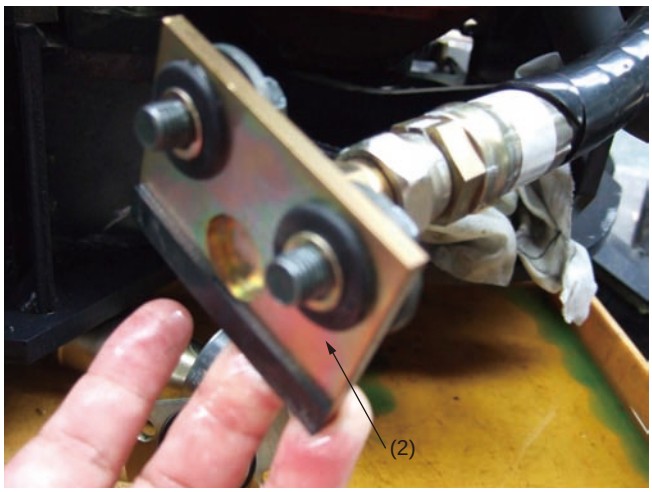
⚠ CAUTION:
There should be no close contact with other parts in the hose line.

2. Tightening torque of hydraulic adaptor:
   G3/8 49.0~53.9N·m(5.0~5.5kgf·m) 36.2~39.8ft·lbs

(1) Side branch hose

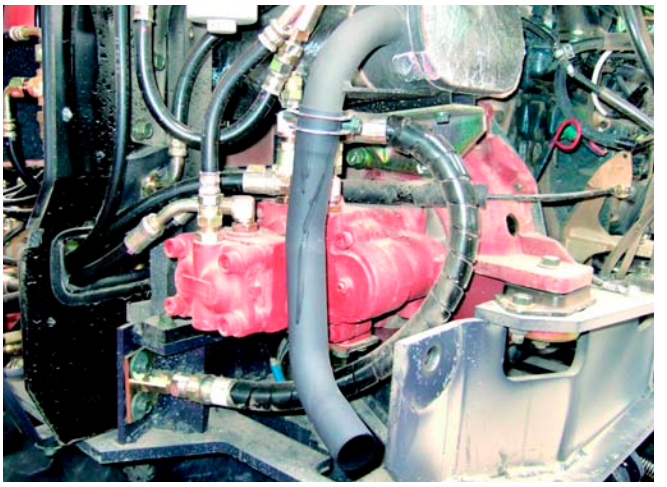


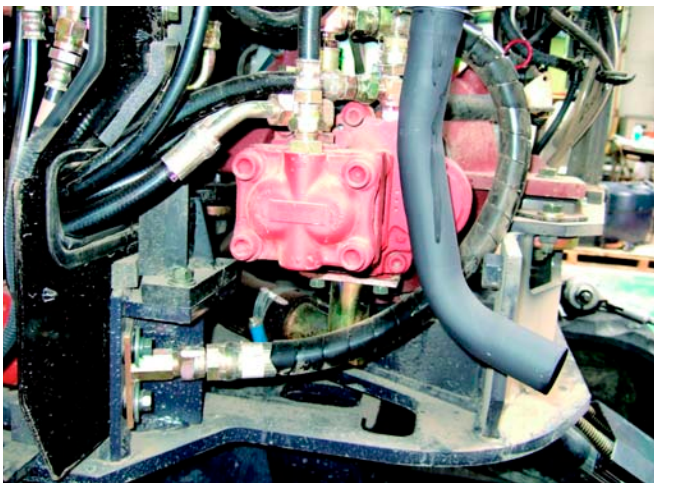
(2) Hose bracket

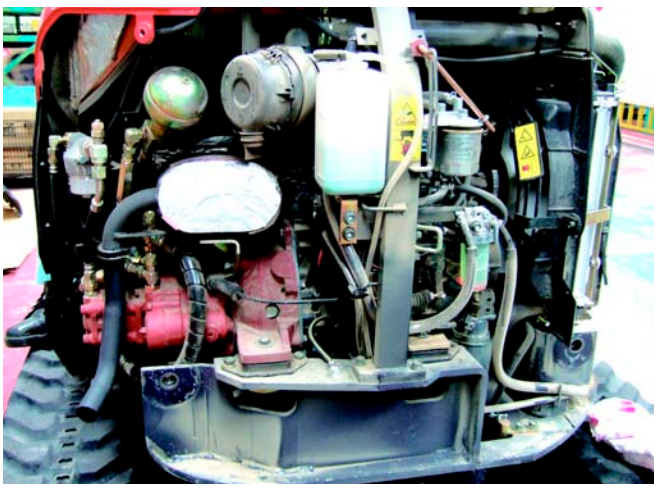


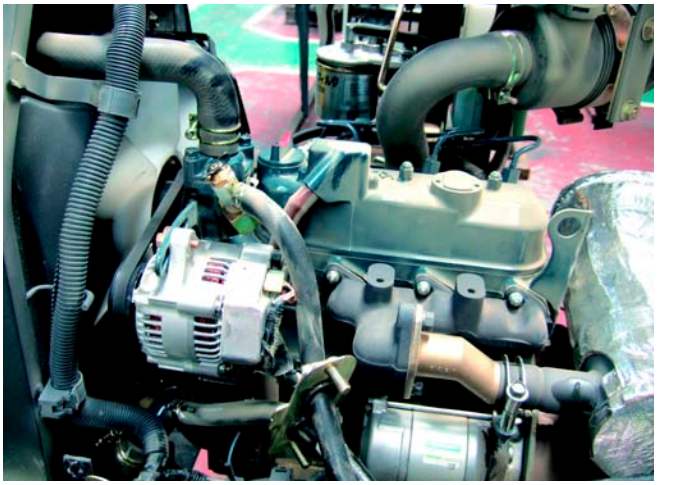
No.	Part name	Q'ty	Remarks
1	Pump assembly	1	U20-3α EU(blue)
	Pump assembly	1	U25-3α EU(yellow)
2	Bolt	2	M12×1.25 7T
3	Flange (suction)	1	
4	O-ring	1	
5	Bolt	4	M10×1.5 7T
6	Elbow pipe joint (F3x2-T1)	1	P2, P3
7	Straight pipe joint	1	P4
8	T pipe joint (3-3-3)	1	P1
	Elbow pipe joint (F3x2-T1)	1	P1
9	Elbow pipe joint (3-4-25)	1	P1
10	Hydraulic hose (5/8)	1	
11	Plug (G1/2, hose)	1	
12	Cushion (plug)	1	
13	Cushion	2	
14	Collar	2	
15	Plain washer	2	
16	Bolt	2	
	Plug	3	R1/8, P1·P2·P3
	O-ring		for 3/8

Pump mounting bolt tightening torque : 77.5~90.2N·m (7.9~9.2kgf·m) 57.1~66.5ft·lbs









[3]Component parts of pump

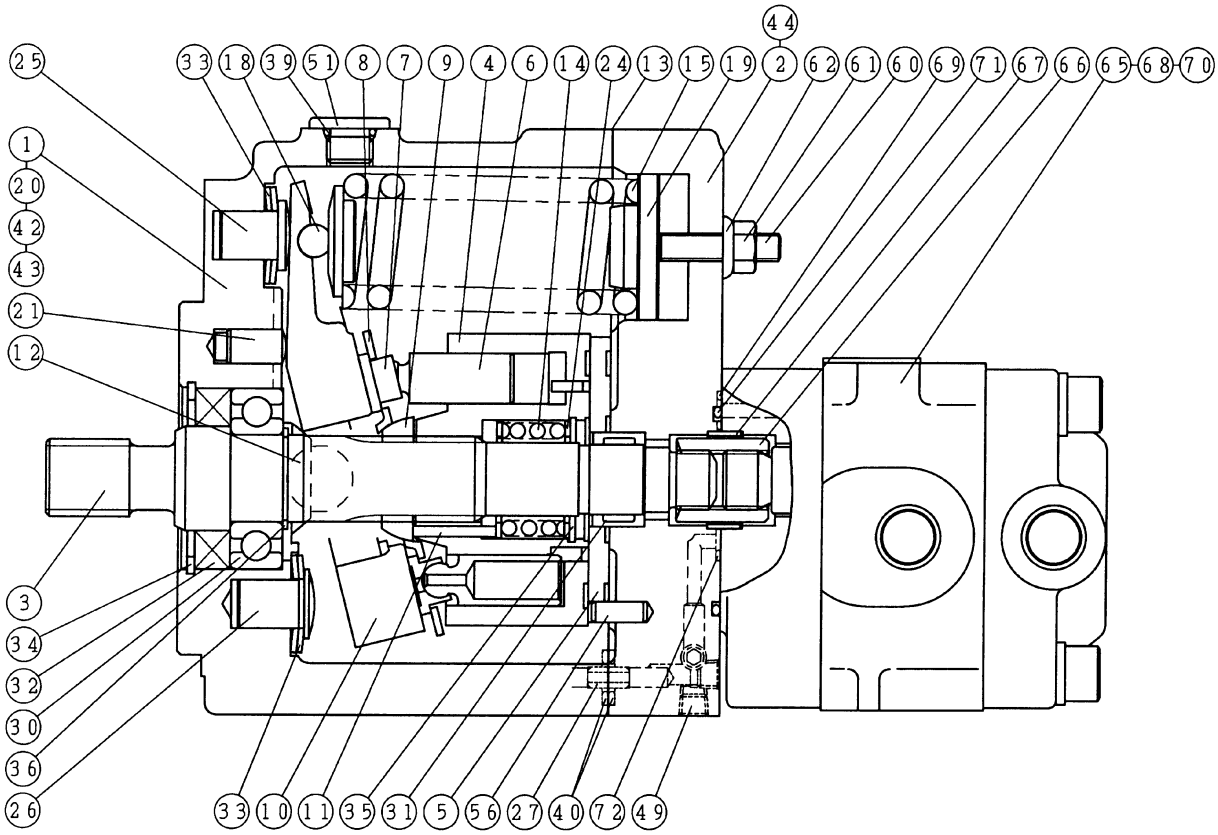


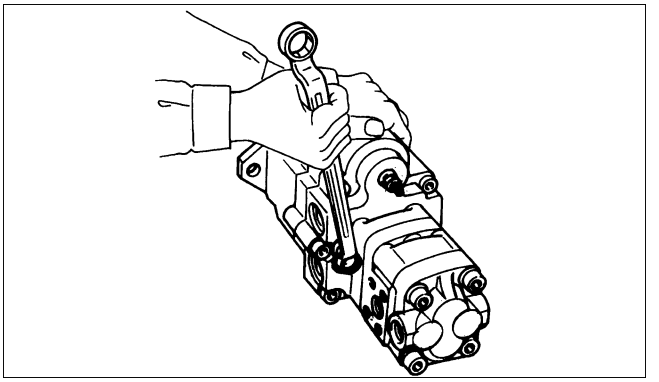
Fig. 2 Construction of Hydraulic Pump

No.	Part name	Q'ty	No.	Part name	Q'ty	No.	Part name	Q'ty	No.	Part name	Q'ty
1	Body S	1	21	Rod G	1	41	None		61	Hex nut	1
2	Body H	1	22	None		42	Plug	1	62	Sealing washer	1
3	Shaft	1	23	None		43	O-ring	1	63	None	
4	Cylinder barrel	1	24	Retainer	2	44	Hex socket bolt	5	64	None	
5	Valve plate	1	25	Stopper pin A	1	45	None		65	Gear pump	1
6	Piston	10	26	Stopper pin B	1	46	None		66	Coupling	1
7	Shoe	10	27	Pin with hole	1	47	None		67	Collar	1
8	Shoe holder	1	28	None		48	None		68	Hex bolt	2
9	Barrel holder	1	29	None		49	Hex socket plug	5	69	O-ring	1
10	Swash plate	1	30	Ball bearing	1	50	None		70	Washer	2
11	Needle	3	31	Needle bearing	1	51	Plug	1	71	O-ring	1
12	Rocking pin	2	32	Oil seal	1	52	None		72	O-ring	1
13	Packing	1	33	Plate spring	4	53	None				
14	Spring C	1	34	Snap ring	1	54	None				
15	Spring T1	1	35	Snap ring	1	55	None				
16	None		36	Snap ring	1	56	Spring pin	1			
17	None		37	None		57	None				
18	Spring holder	1	38	None		58	None				
19	Spring guide	1	39	O-ring	1	59	None				
20	Pin	1	40	O-ring	2	60	Hex socket lock screw	1			

[4]Disassembling and reassembling the pump.

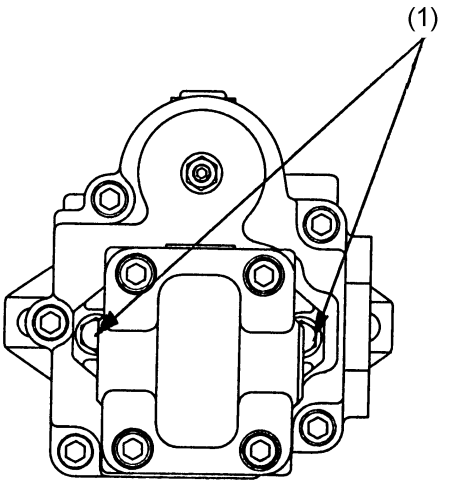
General precautions

After draining the oil out of the pump, first clean up the pump. Lay clean paper, cloth or rubber sheet on the workbench and place the pump on them. Disassembly and reassemble the pump with care using necessary tools. Take proper measures against scratches, foreign matters and other troubles.

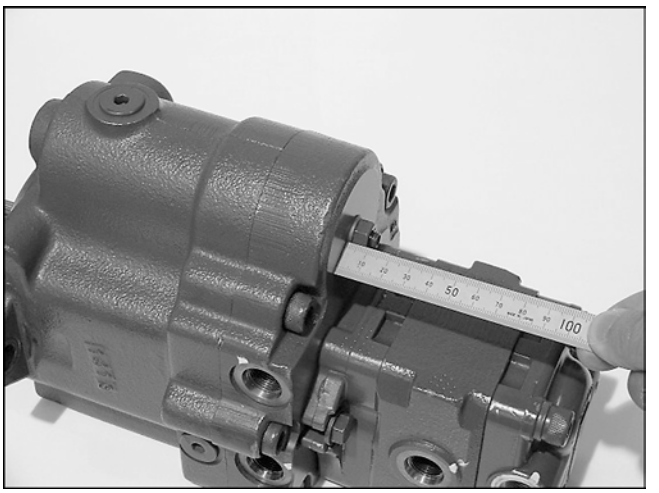


1) Disassembling

1. Dismounting the gear pump
   Remove the two M8x25 hex bolts (68).



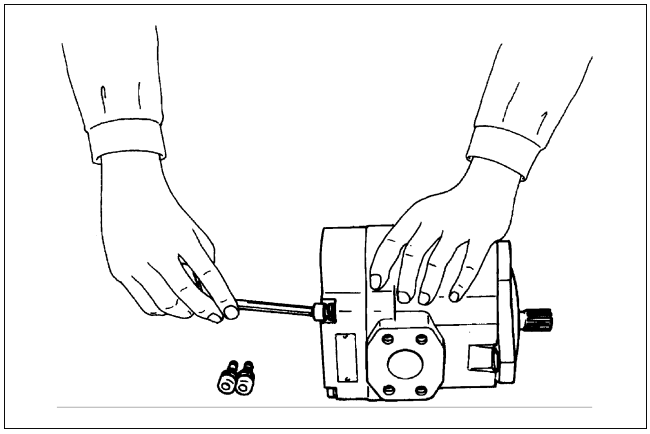
(1)Hex bolt (68) M8x20



2. Removal of hex socket lock screw
   Loosen the hex nut (61) completely and remove the hex socket lock screw (60).
   Tools: Wrench 13 mm, hex wrench 4 mm

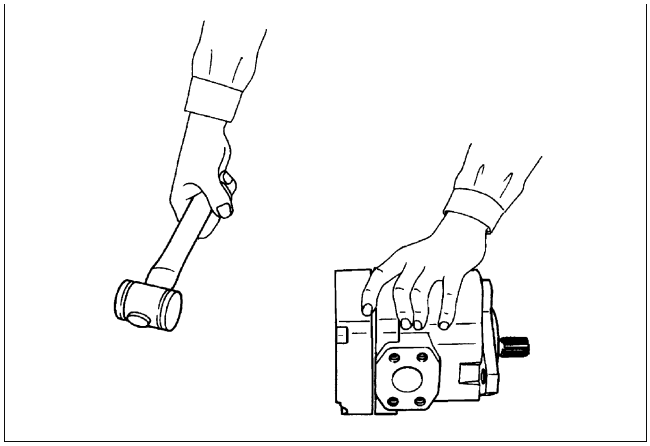
Service Tip :

Preferably record the stretch-out distance of this hex socket lock screw, and it will facilitate pressure adjustment after reassembly.

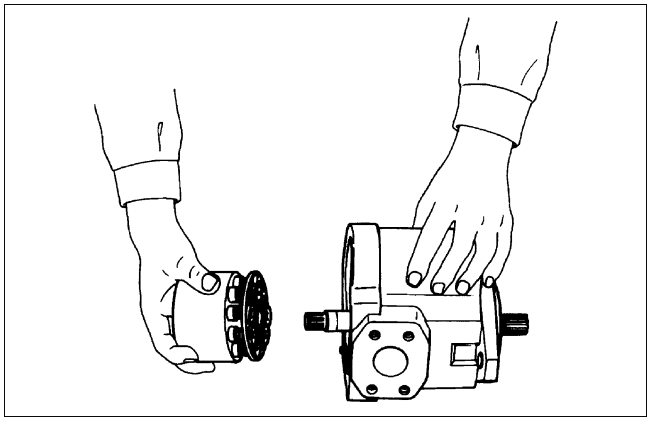


3. Separating the body S from the body H

Remove the upper two of the five M10x35 hex socket bolts (44).
Tool: Hex wrench 8 mm
Temporarily tighten the two M10x65 bolts about 10 mm deep to this position and slowly tighten the remaining three bolts.
Next, loosen the former two temporary bolts and separate the body S kit.

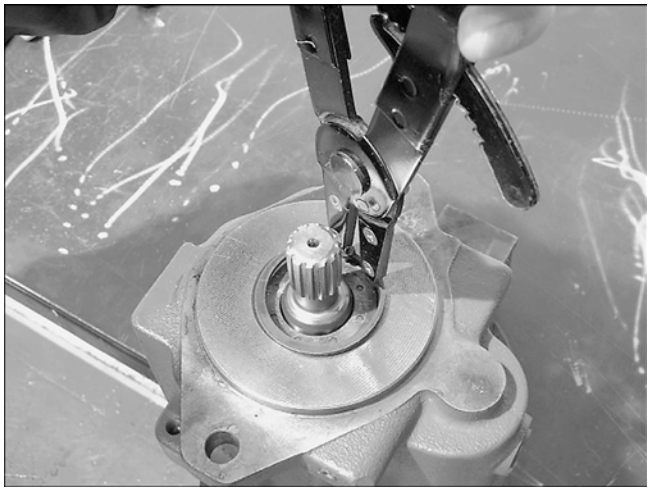


The body can be separated easily by tapping on the spring inserting part of the body H with a plastic or copper hammer.



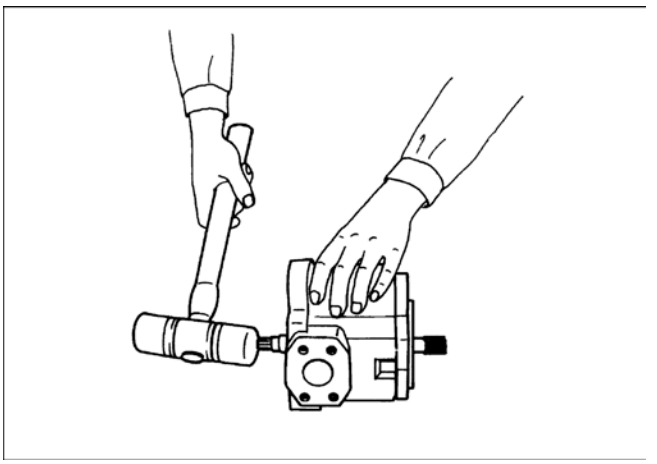
4. Disassembling the body S kit

Take the following parts out of the body S kit in this order: spring T (15), spring holder (18), cylinder barrel (4), swash plate (10), rocking pin (12), stopper pin A (25), two plain springs (33), stopper pin B (26), two plate springs (33) and rod (21).



5. Dismounting the oil seal

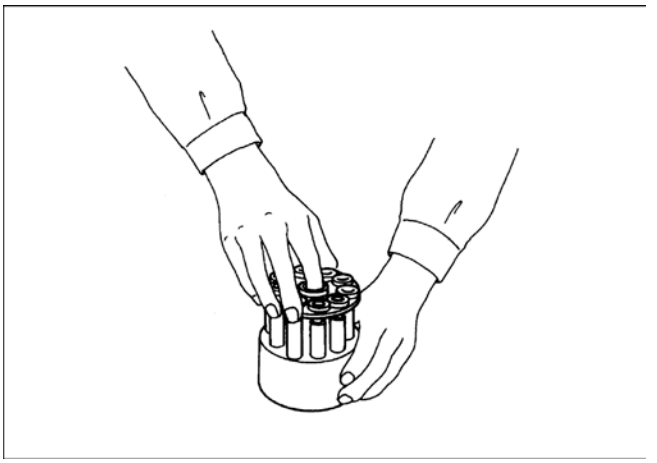
Remove the snap ring (34) provided at the drive shaft (3) from the body S.



Using a plastic hammer, tap on the opposite end of the shaft, and the oil seal (32) and the shaft (with bearing (30)) can be removed.

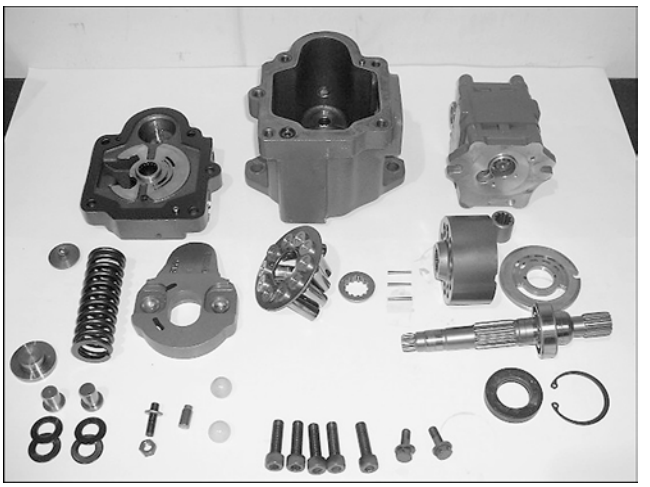
6. Disassembling the body H kit

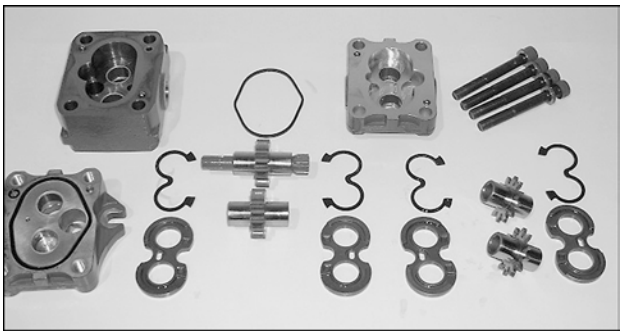
When the hex socket lock screw (60) is screwed in the hex socket lock screw hole of the body H (2), the spring guide (19) can be taken out.



7. Disassembling the cylinder barrel kit

Remove the shoe holder (8), to which the piston shoe assemblies (6) and (7) are mounted, out of the cylinder barrel kit, and dismount the barrel holder (9) and needle valve (11) in this order.
Then, remove the snap ring (35), retainer (24), spring C (14) and retainer (24), in this order, out of the cylinder barrel (4).



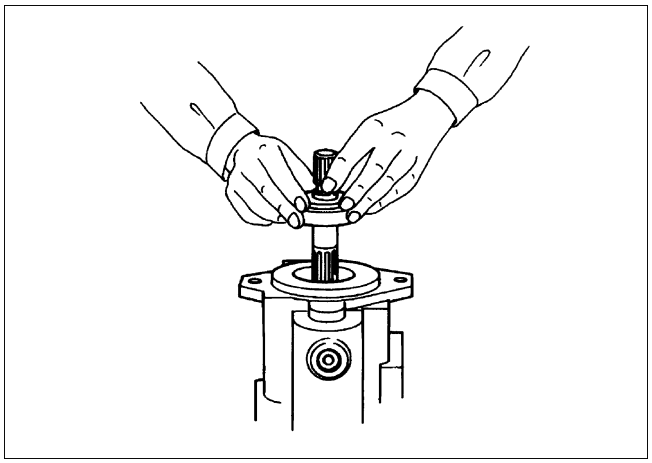


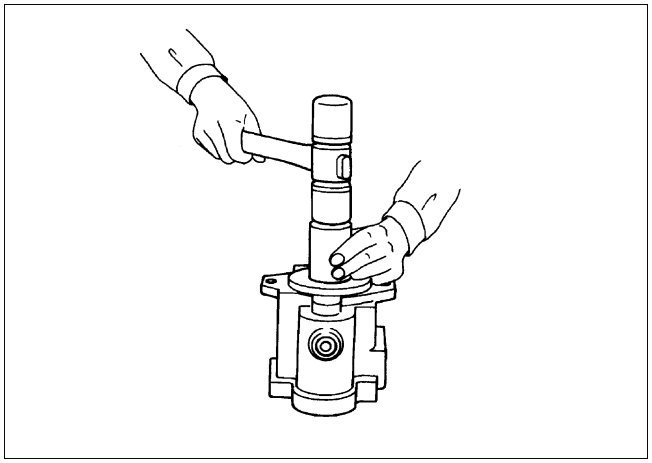
2) Reassembling

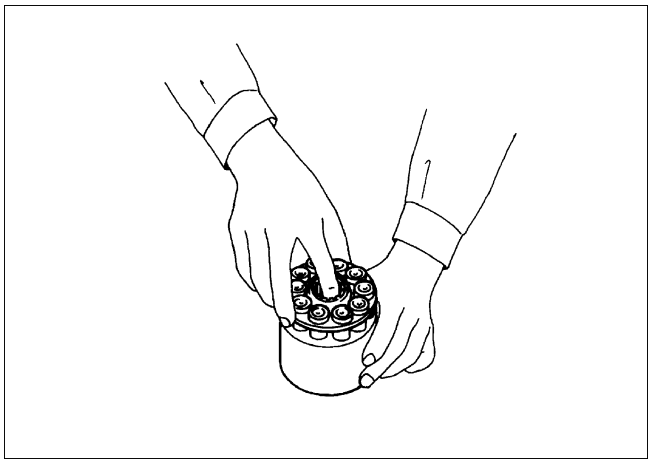
Reassembling precautions

The parts are reassembled in the reverse order of being disassembled. Wash the parts with clean washing oil and handle them with due care not to allow dust deposits and foreign matters as well as not to damage the sliding faces of parts during assembly work.

* To protect the outer surface of the O-ring to be fitted to the spigot joint, apply a small amount of grease.

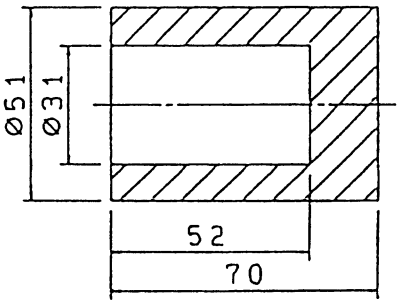






1. Assembling the oil seal

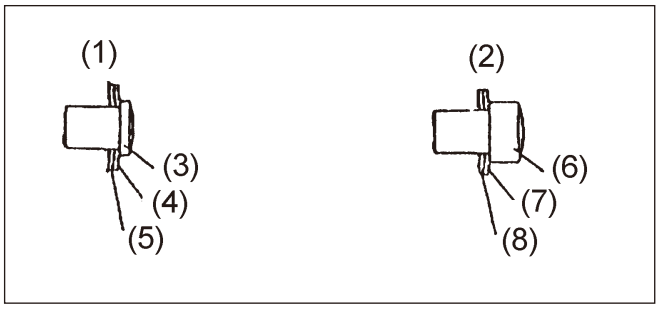
Assemble the shaft (3) kit, oil seal (32) and snap ring (34) in this order into the body S (1).
Apply a small amount of grease to the lip and outer surface of the oil seal, and mount the oil seal using a specific tool and tapping with a hammer.
(At this time, replace the oil seal with new one.)
Temporary mounting of the body S (1) on the body H (2) facilitates the work.



Oil seal insertion tool

2. Assembling the cylinder barrel kit

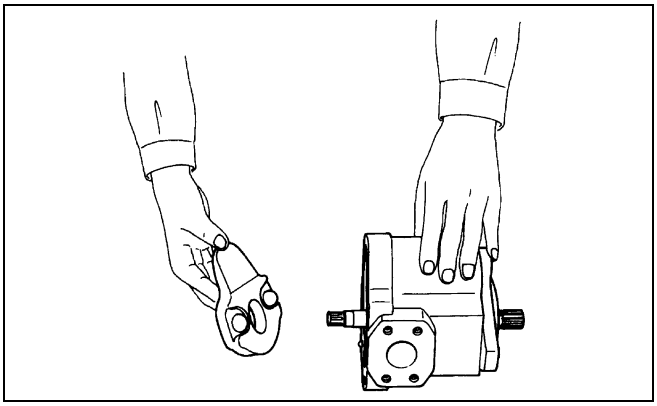
Assemble the retainer (24), spring C (14), retainer (24) and snap ring (33), in this order, into the shaft hole of the cylinder barrel (4), and carefully assemble the needle (11), barrel holder (9) and shoe holder (8) in which ten pistons and shoe assemblies are fitted.



(1)Stopper pin A kit
(2)Stopper pin A(16)
(3)Plate spring(33)
(4)Plate spring(33)
(5)Stopper pin B kit
(6)Stopper pin B(17)
(7)Plate spring(33)
(8)Plate spring(33)

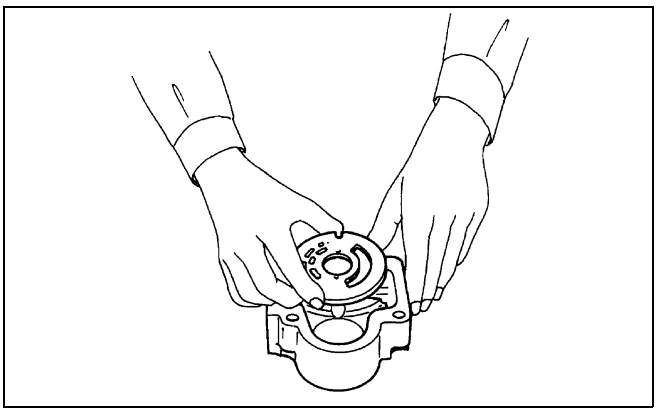
3. Assembling the stopper pin A and B kits

Assemble the two plate springs (33) to the stopper pin A (25) to form the stopper pin A kit. Similarly, assemble the two plate springs (33) to the stopper pin B (26) to form the stopper pin B kit.
At this time, use care not to confuse the plate spring mounting direction. Mount it in the manner as shown in Fig.5.



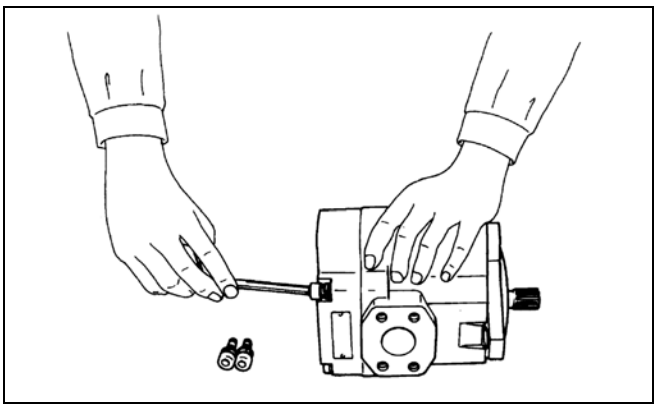
4. Assembling the body S kit (Photo 11)

Assemble the stopper pin A kit, stopper pin B kit and rod (21) to the body S, and then insert the rocking pin (12) into the hole of the swash plate (10) and mount them into the hole of the body S (1).
Next, mount one spring T (15) to the spring holder (18) and set the spherical portions of the spring holder (18) into the holes of the swash plate (10).



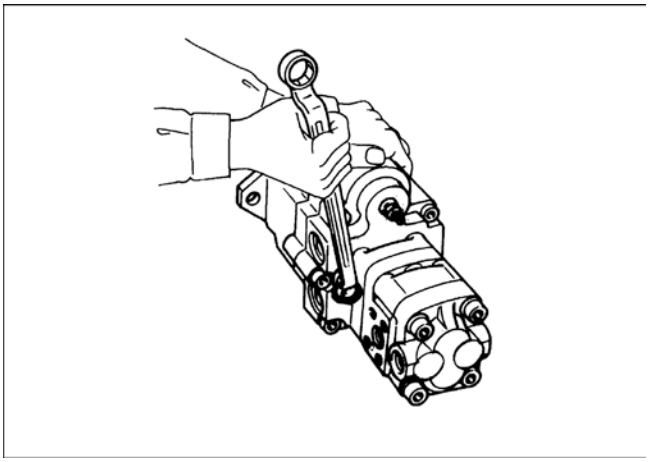
5. Assembling the body H kit (Photo 12)

Mount the spring holder (18) to the body H (2). Then, position the valve plate (5) by the spring pin (56) of the body H (2) and gently mount it in place.
The cylinder barrel (4) slides over the surface of the valve plate having fine grooves. Use care not to confuse the mounting direction.



6. Assembling the body S kit and body H kit (Photo 13)

Mount the packing (13) to the mating face of the body S (1) with use of the positioning pin (27).
At this time, replace the packing with new one. Place the two M10x6.5 hex socket bolts for temporary mounting to the upper side and tighten them slowly.
When the clearance between the mating faces becomes 5 to 10 mm, replace with the five M10x35 hex socket bolts (44) and fix them firmly.
Tool: Hex wrench 8 mm
Tightening torque: 5.2 ~ 6.6 kgf·m (37.6~47.7ft·lbs)



7. Mounting the hex socket lock screw
   Secure the hex socket lock screw (60) and the hex nut (61) to achieve the same length as before disassembly.
   (Wrench “13”, hex wrench “4”)

8. Mounting the gear pump
   Assemble the collar (67), coupling (66) and O-rings (71) and (72) to the gear pump joint of the piston pump kit, and mount the gear pump with the two M8x20 hex bolts (68) and the polished washer (70).
   (Closed wrench “13”)
   Tightening torque: 1.0 ~ 1.4 kgf·m
   (7.23~10.1ft·lbs)

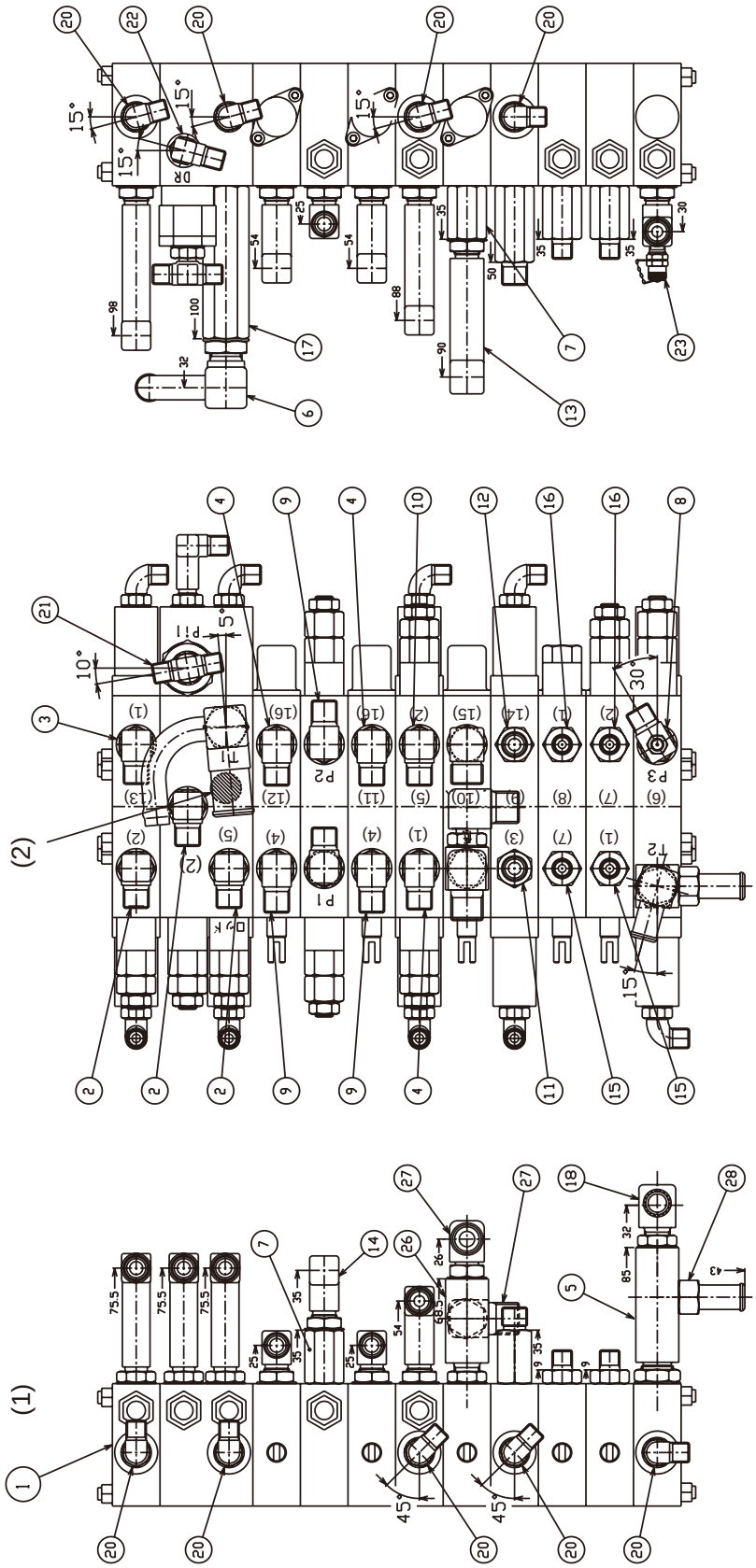
9. Checking after assembly
   The above completes the reassembly work. Turn the shaft and check to see if it turns smoothly.

[5]Troubleshooting of pump

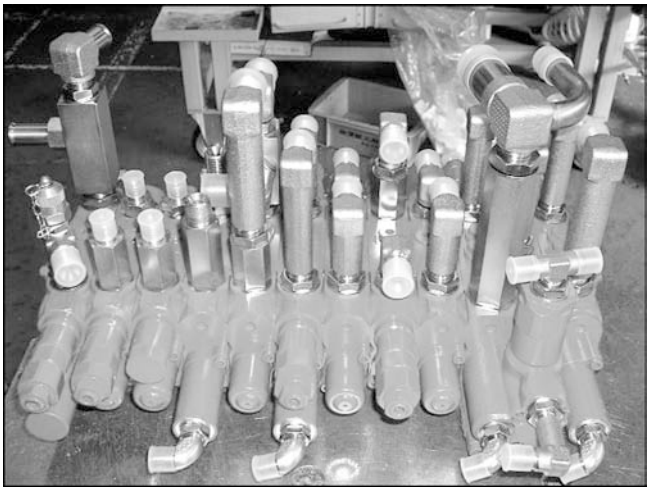
Trouble	Cause	Remedy
1. Engine is overloaded.	(1) Engine rpm higher than specified. (2) Pressure higher than specified. (3) Pump internal parts seized or broken.	(1) Readjust as specified. (2) Readjust as specified. (3) Repair or replace the pump.
2. Pump oil amount drops extremely. Discharge pressure does not rise.	(1) Engine rpm drop. (2) Pump mounting coupling defective. (3) Pump internal parts seized or broken.	(1) Readjust the rpm. (2) Repair or replace the pump coupling. (3) Repair or replace the pump.
3. Unusual noise or vibrations (Cavitation)	(1) Air or water mixed in hydraulic oil. (2) Suction strainer clogged. (3) Suction pipe clogged or choked. (4) Attached pump in trouble (if it is attached.) (5) Caulking of piston shoe broken. (6) Pump mount loose. (7) Coupling defective.	(1) Repair the circuit. Retighten the suction pipe in particular. Replace if mixed with water. (2) Wash or replace the suction strainer. (3) Repair the suction pipe. (4) Repair or replace the attached pump. (5) Replace the piston assembly. (6) Mount the pump firmly. (7) Replace the coupling.
4. Oil leak	(1) O-ring or seat packing defective. (2) Cap ring in poor contact. (3) Oil leak from oil seal edge.	(1) Replace the O-ring or seat packing. (Fit it correctly.) (2) Retighten to the specified torque. (3) Replace or repair the oil seal and shaft.

b. Control valve

[1]Mounting and dismounting the valve



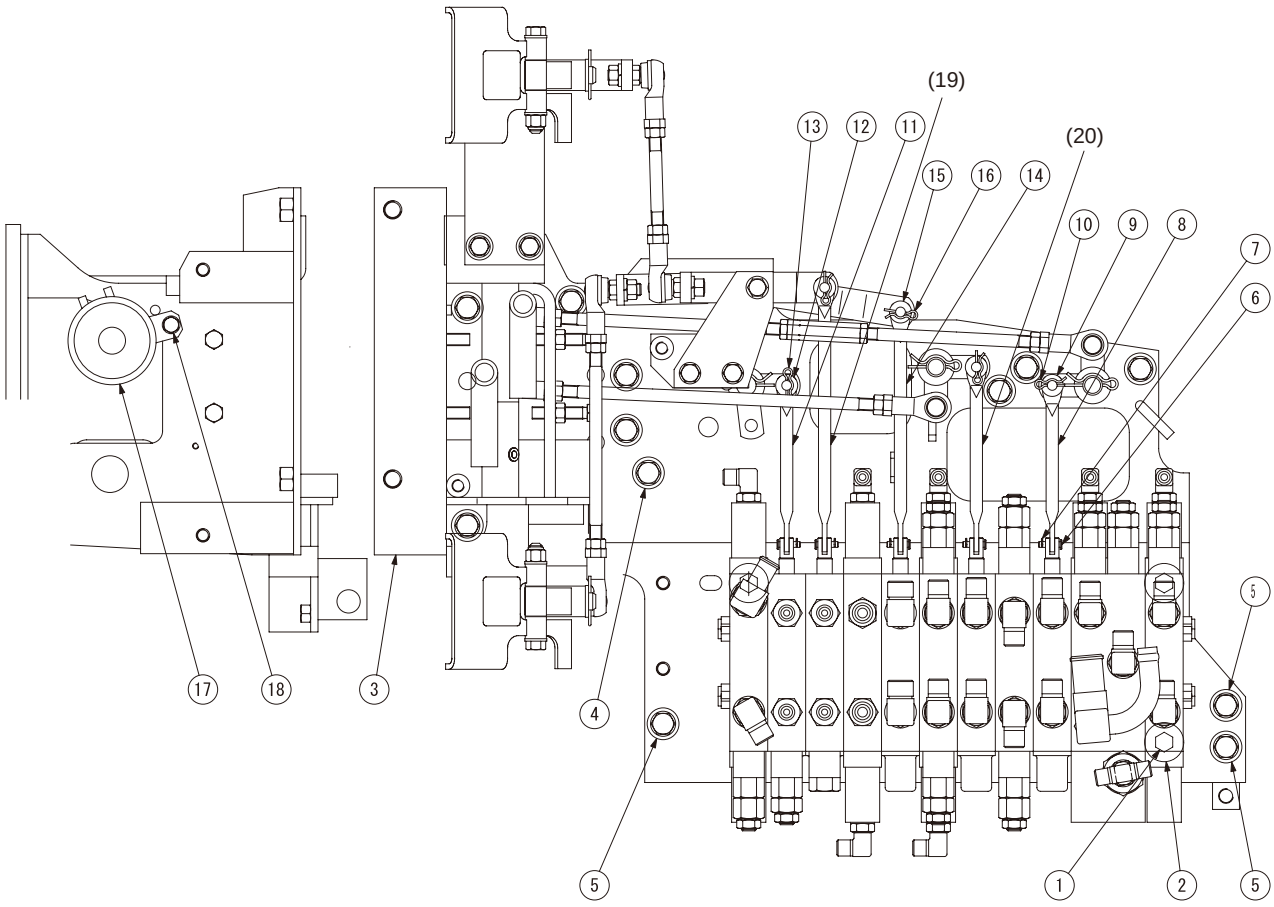
(1) Mount each rod and control valve as shown in the figure.
(2) Tightening torque of control valve mounting bolt (1) : M10x1.5
48.1 ~ 55.9 N-m (4.9 ~ 5.7 kgf·m)
35.4 ~ 41.2 ft·lbs
(3) Tightening torque of bracket (control valve) mounting bolt (4) : M12x1.25
77.5 ~ 90.2 N-m (7.9 ~ 9.2 kgf·m)
57.1 ~ 66.5ft·lbs

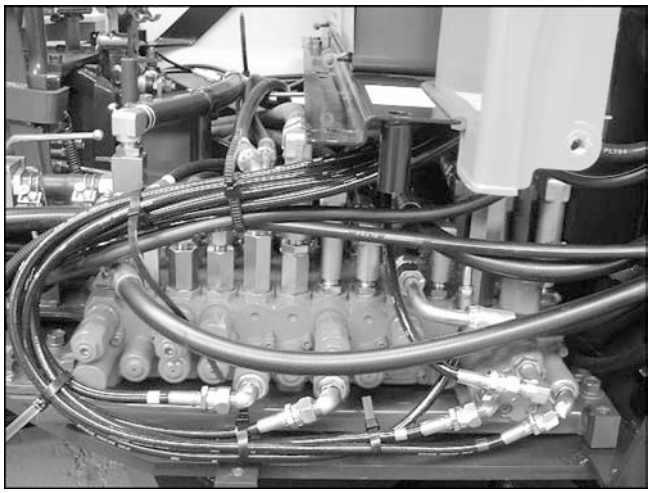


No.	Part name	Q'ty	Remarks
1	Valve, assembly (Control)	1	U20-3 EU (Blue)
	Valve, assembly (Control)	1	U25-3 EU (None)
2	Elbow pipe joint (3-3-75)	3	
3	Pipe joint (L. G3/8-G3/8)	1	
4	Flange-faced elbow	3	
5	Pipe joint (T. G1/2-G3/8)	1	T2
6	Valve, assembly (Check)	1	T1
7	Straight pipe joint (3-3-35)	1	P1
8	Pipe joint (L. G3-G3-R1)	1	P3
9	Pipe joint (L. G3/8-G3/8)	3	Travel right back, P2, travel left back
10	Pipe joint (L. F3/8-H3/8)	1	

No.	Part name	Q'ty	Remarks
11	Pipe joint (S. G3/8-G3/8)	1	Swivel left
12	Straight pipe joint (3-3-65)	1	Swivel right
13	Pipe joint (L. G1/2-G3/8)	1	
14	Pipe joint (L. G3-G3)	1	P1
15	Straight pipe joint	2	
16	Pipe joint (S. F3/8-F1/4)	2	
17	Straight pipe joint (4-4-100)	1	T1
18	Pipe joint (L. G3/8-16)	1	T2
19			
20	Pipe joint (L. G1/4-G1/4)/Pilot	9	
21	T-pipe joint (F2)	1	P11

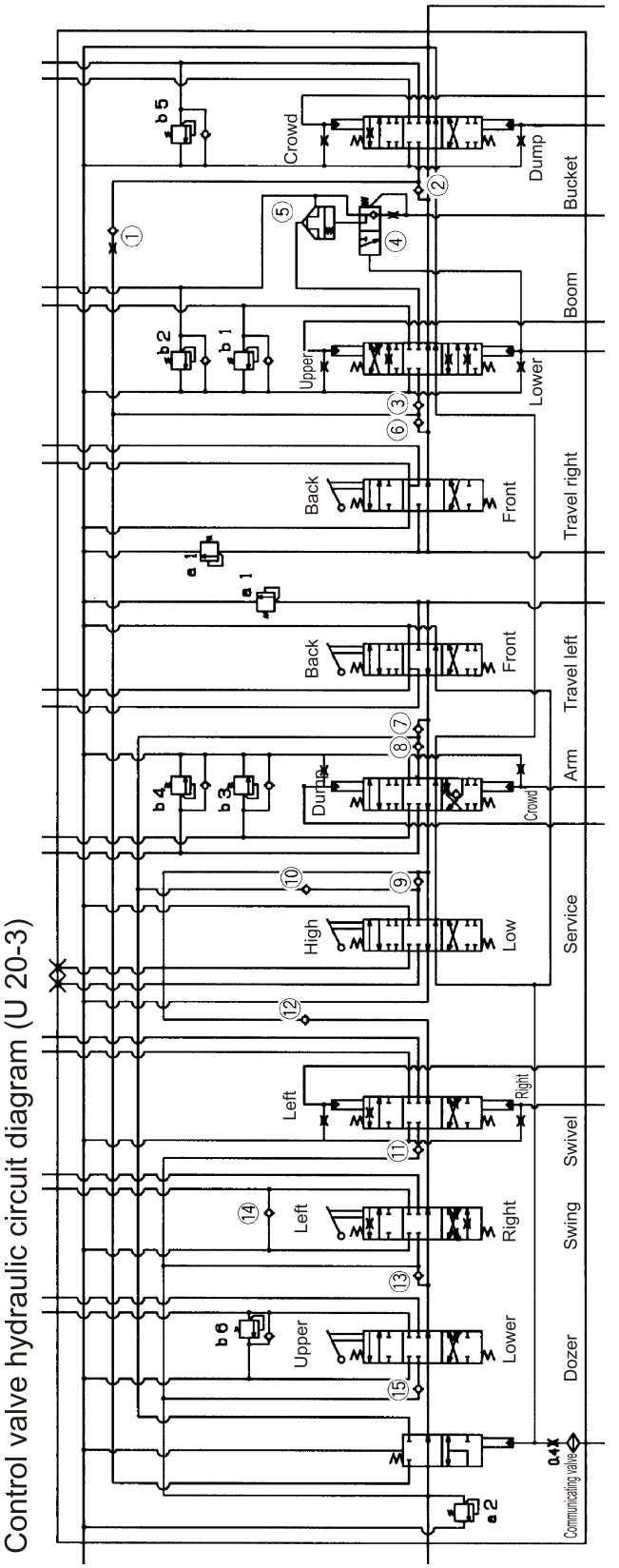
No.	Part name	Q'ty	Remarks
22	Flange-faced elbow	1	DR
23	Adapter	1	
24			
25			
26	Pipe joint (T. G3/8)	1	
27	Pipe joint (L. G1/2-G3/8)	2	
28	Pipe joint (S. G3/8-16)	1	T2





1	Bolt	3	M10×1.5 7T
2	Plain washer	3	
3	Bracket (Control valve)	1	
4	Bolt	10	M12×1.25 7T
5	Bolt	3	M12×1.25 7T
6	Headed pin (4, 75)	5	
7	Snap pin	5	
8	Rod (130)	1	Travel, right
9	Plain washer	1	
10	Snap pin	1	
11	Rod (130)	1	Blade
12	Plain washer	1	
13	Snap pin	1	
14	Rod (190)	1	Service port
15	Plain washer	1	
16	Snap pin	1	
17	Horn, ass'y	1	
18	Bolt	1	M8×1.25 7T
19	Rod (210) RB411-6534Δ		
20	Rod (145) RB411-6533Δ		

[2] Disassembling and reassembling the valve

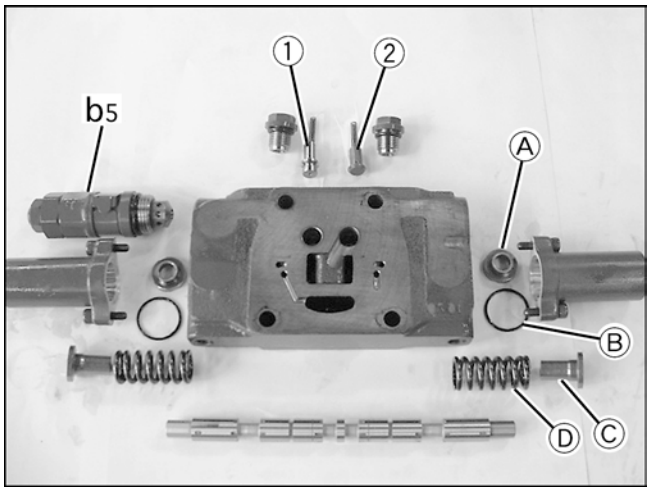


●Specification

Model	KVSE-36-10
Maker	Kayaba Industry Co., Ltd.
Weight	Approx. 31kg (63.1lbs)
Tightening torque of tie rod	26.5 ~ 29.4 N·m (2.7~3.kgf·m) 19.5~21.7ft·lbs

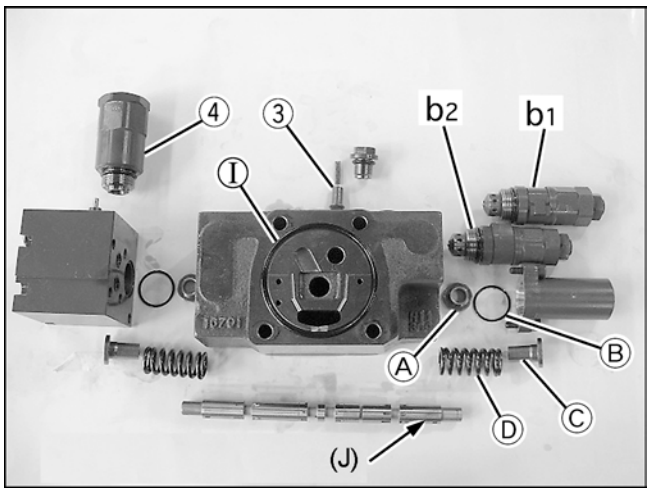
[3] Component parts of sections

1) Bucket section

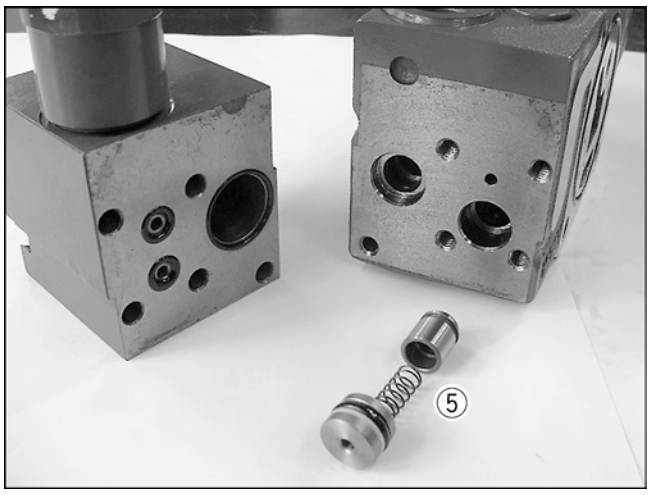


Component parts
(1) Poppet
(2) Poppet
b_5 Overload relief valve
(A) Spring seat
(B) O-ring
(C) Spring seat
(D) Spring

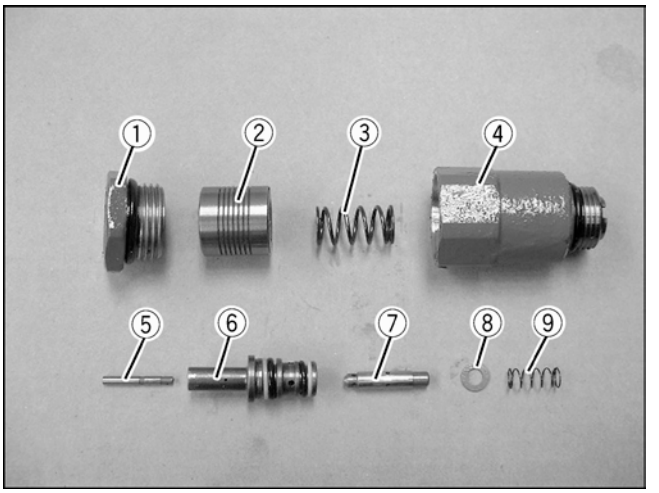
2) Boom section



Component parts
(3) Poppet
(4) Anti-drift valve
b_1 Overload relief valve
b_2 Overload relief valve
(A) Spring seat
(B) O-ring
(C) Spring seat
(D) Spring
(I) O-ring
(J) Identification groove for reassembling the spool

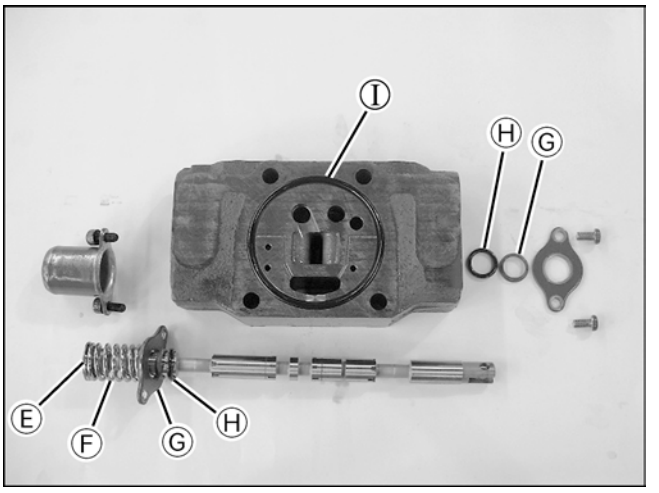


(5) Poppet
Spring
Spacer
O-ring
Backup ring

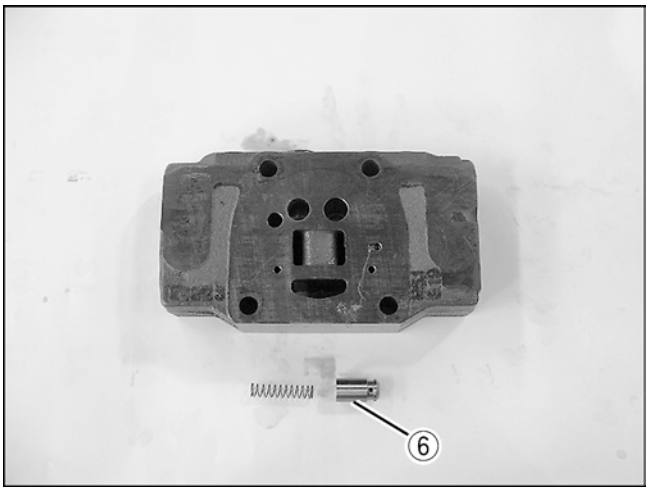


Component parts of anti-drift valve
(1) Plug assembly
(2) Piston
(3) Spring
(4) Plug
(5) Spool
(6) Sleeve
(7) Poppet
(8) Spring seat
(9) Spring
Tightening torque of plug assembly (1): 69 ~78 N·m (7.0~8.0kgf·m) 50.6~57.9ft·lbs
Reassembling precautions
The spool (5) is directional. Do not confuse its inserting direction.

3) Travel right section

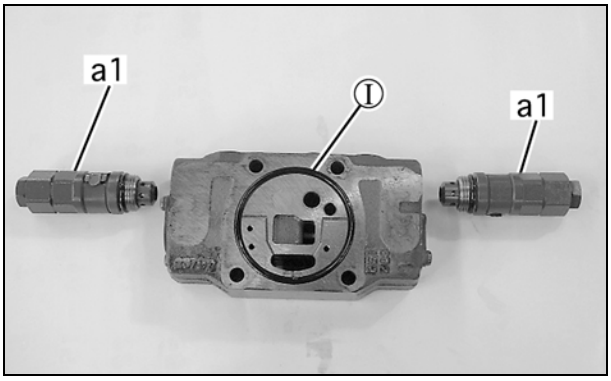


Component parts
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I) O-ring

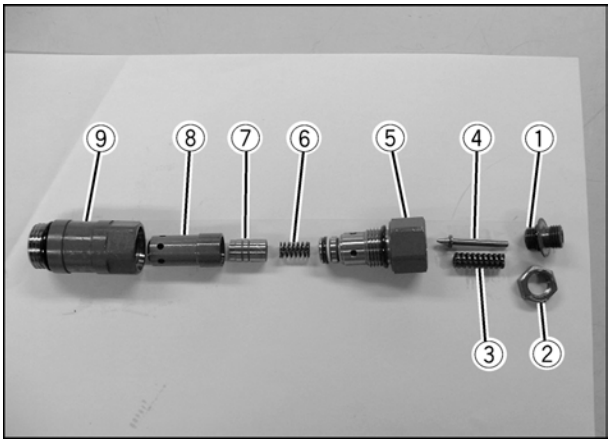


(6) Poppet, spring

4) Inlet section

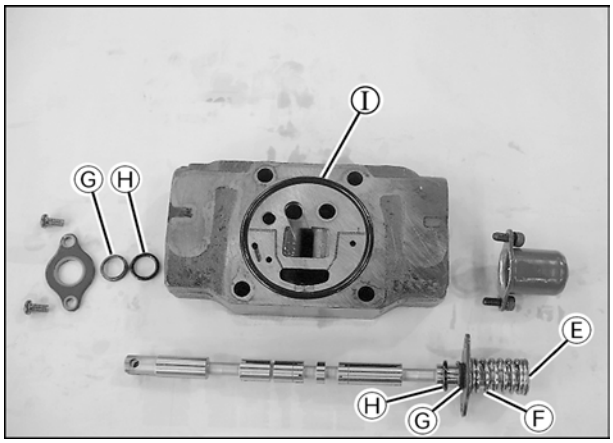


Component parts
a1 Main relief valve
(1) O-ring

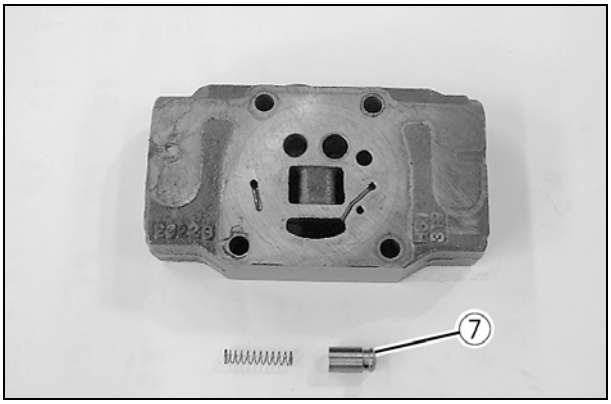


Component part of main relief valve
(1) Adjuster, washer
(2) Nut
(3) Spring
(4) Pilot poppet
(5) Plug
(6) Spring
(7) Piston
(8) Sleeve
(9) Cap

5) Travel left section

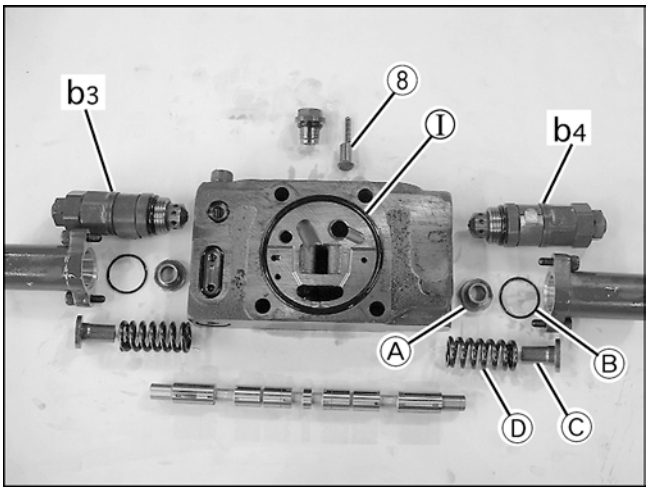


Component parts
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I) O-ring



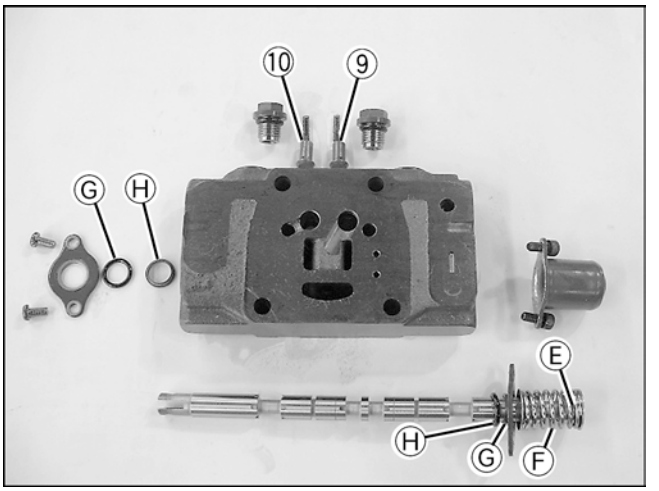
(7) Poppet, spring

6) Arm section



Component parts
(8) Poppet
b_3 Overload relief valve
b_4 Overload relief valve
(A) Spring seat
(B) O-ring
(C) Spring seat
(D) Spring
(E) O-ring

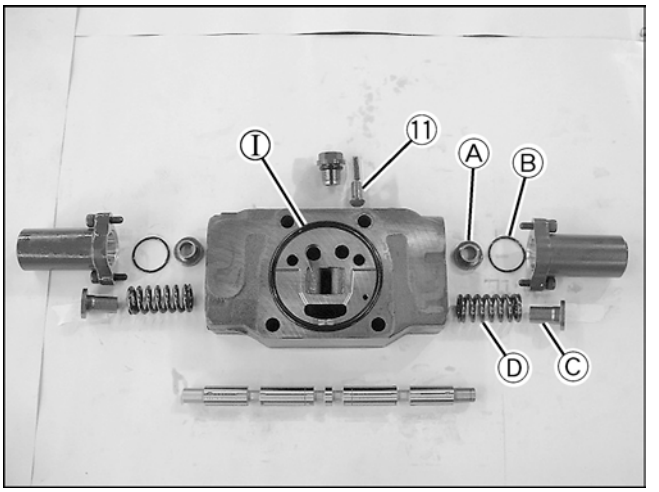
7) Service port section



Component parts
(9) Poppet
(10) Poppet

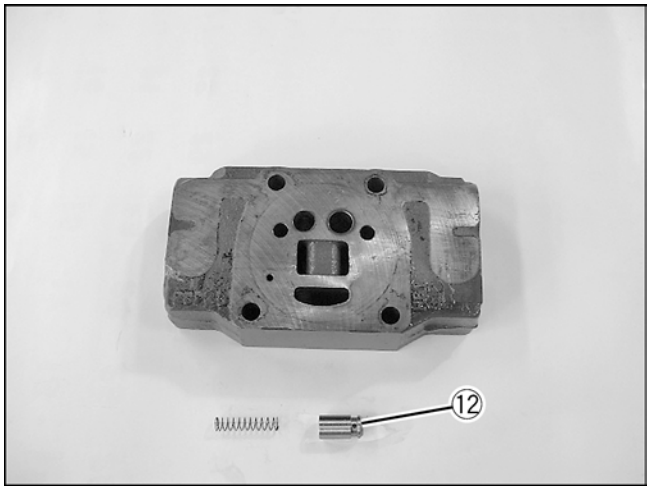
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring

8) Swivel section



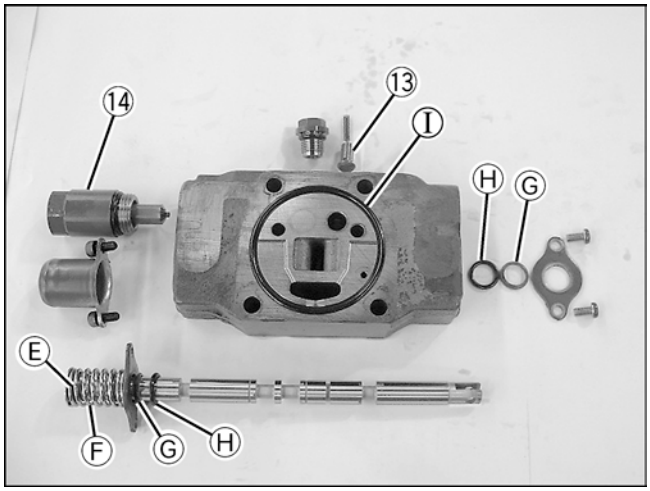
Component parts
(11) Poppet

(A) Spring seat
(B) O-ring
(C) Spring seat
(D) Spring
(I) O-ring



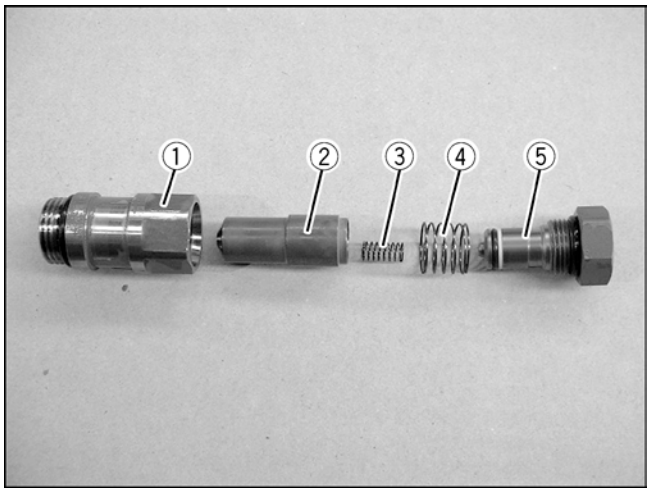
(12)Poppet, spring

9) Swing section



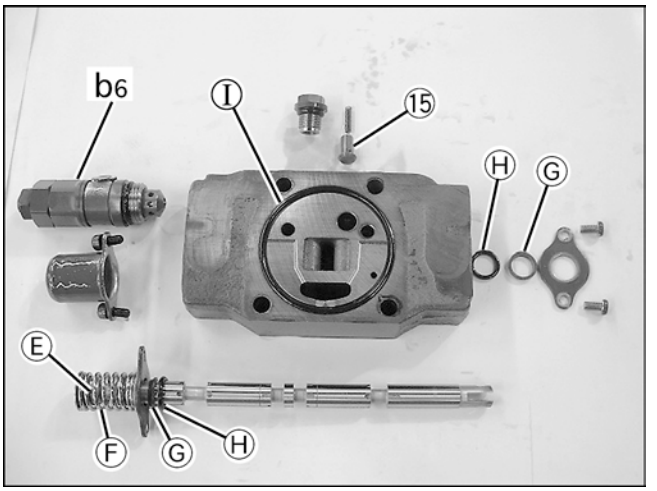
Component parts
(13)Poppet
(14)Anti-void valve

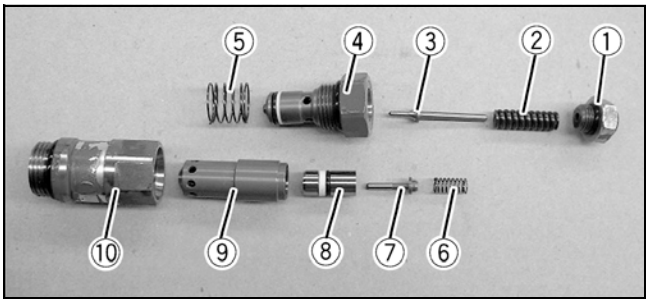
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I) O-ring



Component parts of anti-void valve
(1) Cap
(2) Sleeve
(3) Spring
(4) Spring
(5) Plug
Tightening torque of anti-void valve: 69 ~ 78 N·m (7.0~8.0kgf·m) 50.6~57.9ft·lbs

10) Dozer section





Component parts

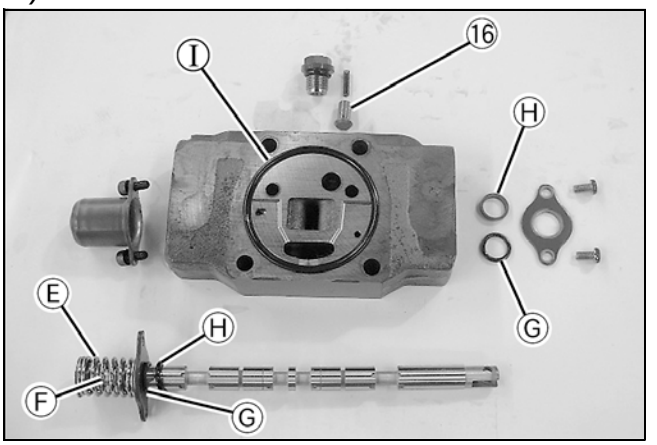
(15)Poppet
b_6 Overload relief valve
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I) O-ring

Component parts of overload relief valve

(1) Adjuster, nut, washer
(2) Spring
(3) Pilot poppet
(4) Plug
(5) Spring
(6) Spring
(7) Piston
(8) Poppet
(9) Sleeve
(10)Cap

Tightening torque of overload relief valve: 69~78 N·m (7.0~8.0kgf·m) 50.6~57.9ft·lbs
Check the seats of the poppets (3) and (8) carefully for dust deposits or metal chippings. If there is dent or scratch on the seat face, repair or replace.

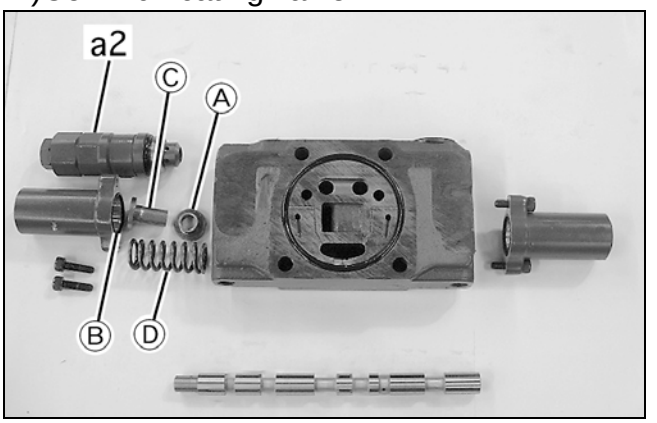
11) Track section



Component parts

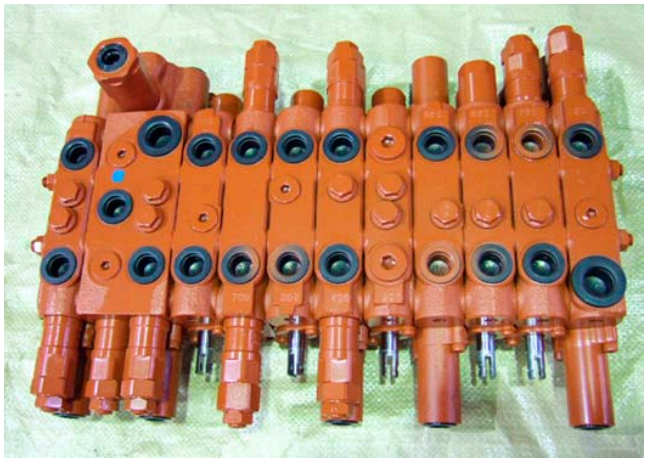
(16) Poppet
(E) Cap screw
(F) Spring
(G) Wiper
(H) O-ring
(I)O-ring

12)Communicating valve

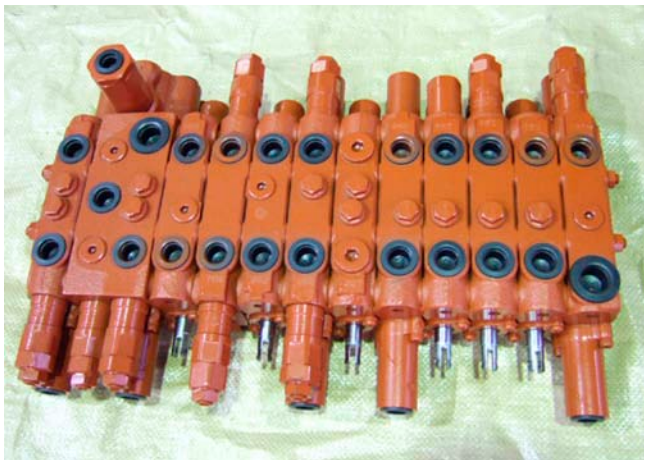


Component parts

a2 Main relief valve
(A) Spring seat
(B) O-ring
(C) Spring seat
(D)Spring



(U20-3α, solid track type)

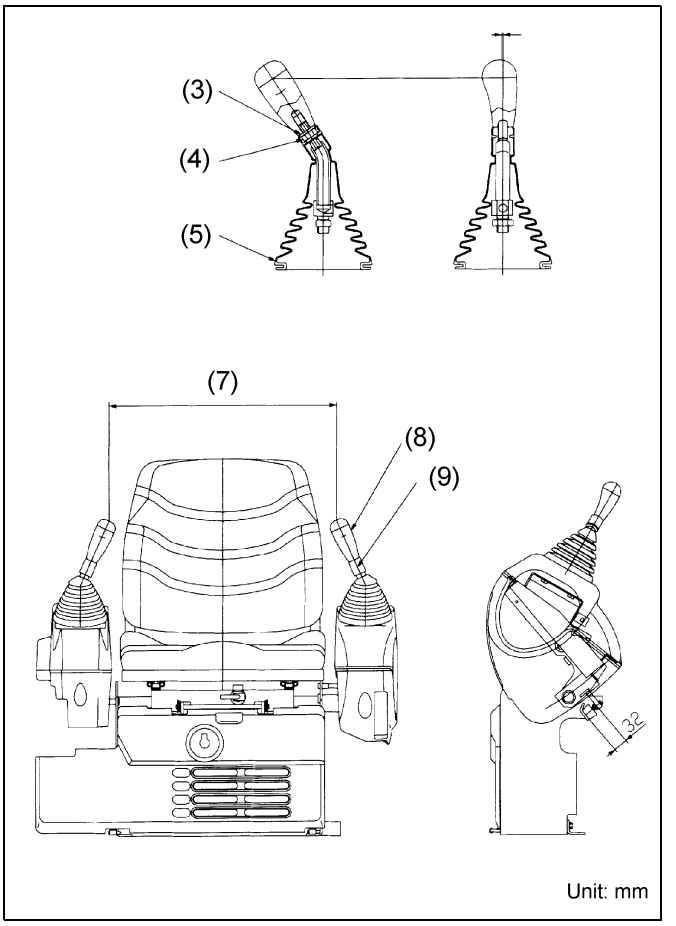


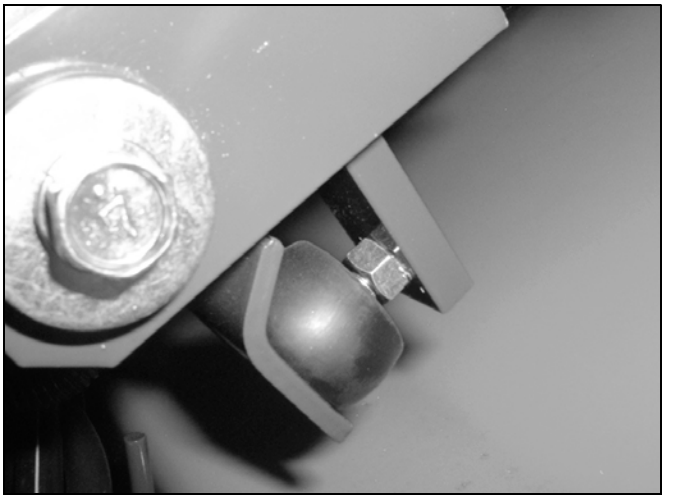
(U20-3α, variable track type)

(U25-3α, U25S)

C. Pilot valve

[1] Mounting and dismounting the pilot valve

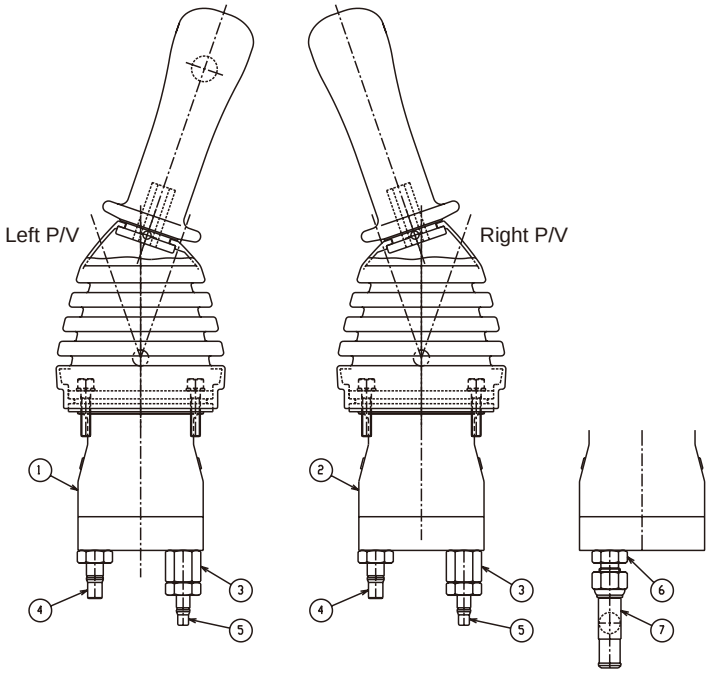


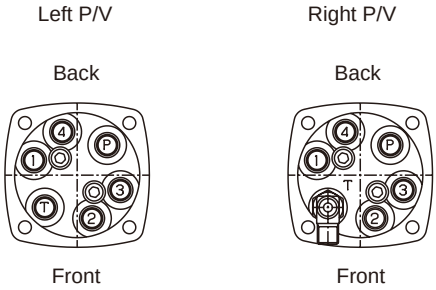


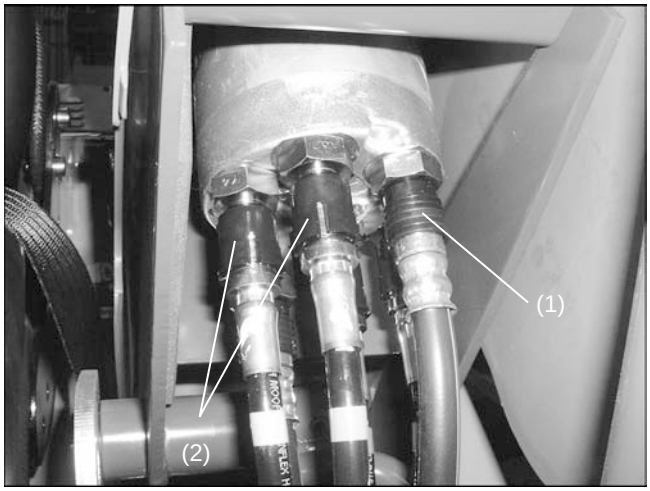
1) Reassembling procedure

1. Tightening torque of grip lock nut: 25.0~27.0 N-m (2.5~2.8 kgf·m) 50.6~57.9ft·lbs
   The stepped (machined) part should be toward the lever.
   Bring the stepped part of the nut to the opposite side of the grip, and fit the projection of the rubber bellows securely to the stepped part.
2. Play of lever
   Less than 2 mm (0.08in.)
3. Control lever mounting dimension
   Refer to the left figure. 517 mm (20.4in.) (reference value)

(1) Tightening torque of hydraulic adaptor: G1/4: 24.5 ~ 29.4 N·m (2.5 ~ 3.0 kgf·m) 18.1~21.7ft·lbs
(2) Check the fitting part of the quick adaptor coupler for any flaw.
(3) Play:Less than 2mm
(4) 04011-50120 Plain washer
(5) RC301-6524Δ Nut
(6) RD411-6527Δ Bellows
(7) (517)Reference value
(8) Grip forward
(9) Grip inward







(1) BS-make (2) Nitta-make

Left P/V

	Position for Use	Color of Hose Tape
1	Swivel left	Red
2	Arm dump	Blue
3	Swivel right	Yellow
4	Arm tuck-in	Green
P	P port	None
T	T port	None

Right P/V

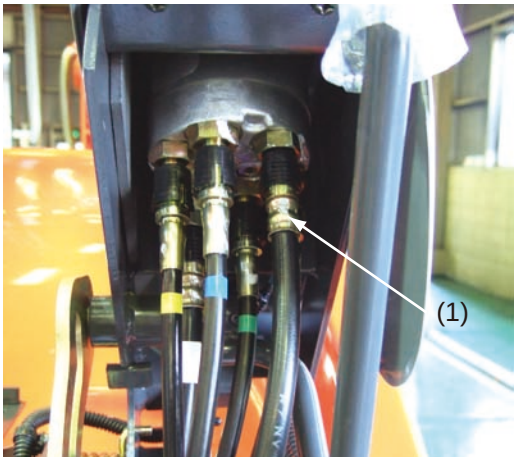
	Position for Use	Color of Hose Tape
1	Bucket crowd	Pink
2	Boom down	Sky-blue
3	Bucket dump	Brown
4	Boom up	Gray
P	P port	None
T	T port	None

No.	Part No.	Part name	Q'ty	Maker	Remarks
1	**RC417-61711**	**Valve, assembly (Pilot L)**	**1**	Kawasaki Heavy Ind-made.	(652)
2	**RC417-61721**	**Valve, assembly (Pilot R)**	**1**	Kawasaki Heavy Ind-made	(652)
3	68499-83741	Filter	2		R&L P/V ports
4	RB411-6386	Pipe joint (S. G1/4)	8	Nitta-made / R&L	P/V 1,2,3,4 ports
5	RD411-61761	Pipe joint (S. G1/4 ~ 8. 4)	3	B. S-made / R&L	P/V P-port, L P/V T-port
6	68728-76151	Adaptor	1		R P/V T-port
7	RP201-61872	Pipe joint	1		R P/V T-port
	04811-00110	O-ring	14		For 1/4

(Adaptor tightening torqu) G1/4 : 24.5~29.4N·m (2.5~3.0kgf·m) 18.1~21.7ft·lbs,

1) How to disconnect the quick coupler

Bridgestone-make quick coupler



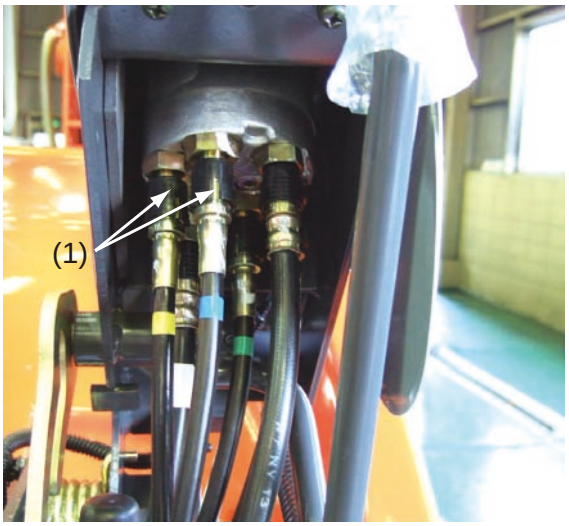
(1) BS-make quick coupler.

1. Push the hose upward.

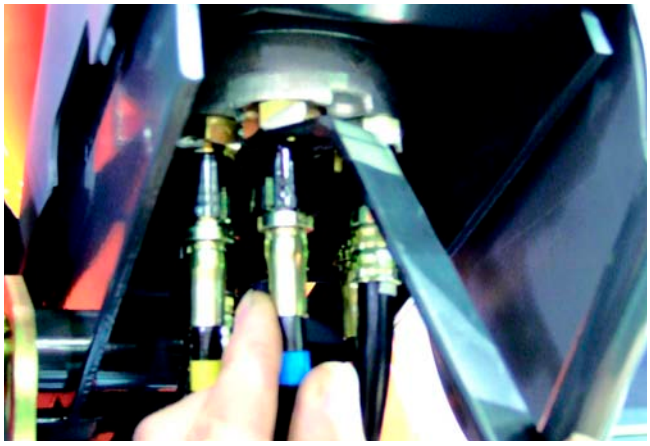
2. While pushing the hose upward, grip down the plastic socket and pull down the hose assy.

3. View after disconnection.

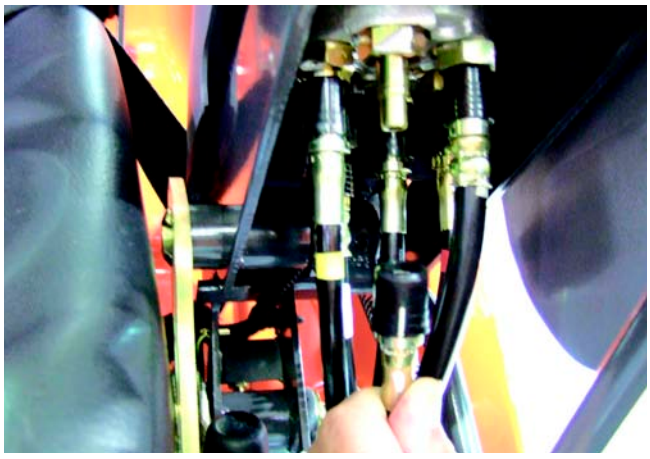
Nitta-make quick coupler



(1)Nitta-make quick coupler.



1. Pull down the hose assy with the special tool.



2.View after disconnection.

3.Special tool.

[2] Disassembling and reassembling the pilot valve

1) Tools and tightening torque

Tool	Size	Part No.	Part name	Screw size	Tightening torque (N·m)
Hex wrench	6mm 0.24in.	125	Hex socket bolt	M8	20.6 ± 1.5 2.10 ± 1.5 15.19 ± 1.08
Money wrench	22mm 0.87in.	312	Adjusting nut	M14	68.6 ± 4.9 7.00 ± 0.503.621.5
	32 mm 1.26in.	302	Disc	M14	
Special tool (Drawing on page 17)	24mm 0.94in.	301	Joint	M14	47.1 ± 2.9 4.80 ± 0.30 34.72 ± 2.17

Others

- Vapor phase inhibitor
- Kerosene
- Heat-resistant grease
- Sandpaper (#1000, #2000)
- Oilstone
- Vise

2) Maintenance standard

Checkpoints	Criteria	Remarks
Leak amount	Replace the pilot valve assembly with new one if the oil leak exceeds 1000 cc/min with the steering wheel at neutral or 2000 cc/min while in operation.	Conditions: Primary pressure: 2.95 MPa Oil viscosity: 23 mm^2/s
Spool	If the sliding face is worn over 10 μ more than the non-sliding one, replace the pilot valve assembly with new one.	This amount of wear corresponds to the above leak amount. The same conditions as above are expected.
Push rod	If the tip is worn 1 mm or more, replace the push rod with new one.	
Loose control elements	If the disc (302) or joint (301) is worn out and loose 2 mm or more, replace it with new one.	If the shakiness is caused by a loose fixture, tighten it up.
Stable operation	If unusual noise, hunting, primary pressure drop, etc, occurs and it cannot be corrected according to "Chapter 8 Troubleshooting", replace the pilot valve assembly with new one.	

Note 1: It is advisable to replace the O-rings and other sealing elements at every disassembly. They may be reused when they are found not damaged.

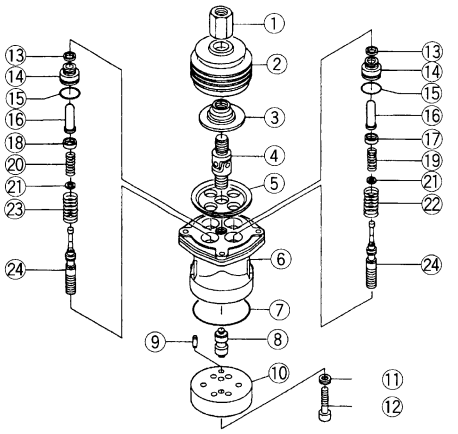
Note 2: When the hex socket bolt (125) has been loosened, be sure to replace the sealing washer (121).

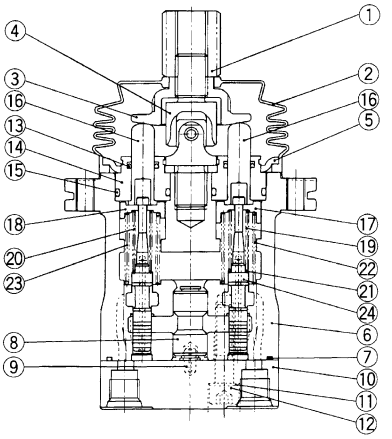
3) Disassembling

1. Preparations
   (1) Prepare a workbench that is spacious enough for the parts handled and strong and stable enough to keep the parts in place.
   (2) Also have the tools and jigs, discussed in Item 7-1, at hand.
2. General precautions
   (1) The parts are precision-machined. Handle them with enough care not to hit them against each other or drop them.
   (2) Even if any part is hard to remove, do not strike it out or pry out forcibly. Such handling may cause burrs or damages, which may invite oil leak or poor performance later. Try to do the job with patience.
   (3) Do not leave the taken-out or exposed parts unprotected. Moisture or dust may get stuck on them, causing rust. If unavoidably the job is interrupted halfway, be careful to protect such parts against rust and dust.
3. Disassembling procedure

	Procedure	Precautions
1	Clean up the pilot valve with kerosene.	* Apply blind plugs to all the open ports.
2	Fix the pilot valve on a vise using copper (or lead) sheets.	
3	Remove the bellows (501). [Photo 7-1]	* Be careful not to break the bellows (501).
4	Apply a wrench across the adjusting nut (312) and disc (302). Loosen and remove the adjusting nut and disc. [Photos 7-2, 7-3 and 7-4]	
5	With the specified jig, turn the joint (301) counterclockwise to get it loose. [Photos 7-5 and 7-6]	* Photo 7-5 shows the jig in its specified position. **CAUTION:** * When the return spring (221) is strong in force, take care in loosening and drawing out the joint (301). The plate (151), plug (211) and push rod (212) may pop out together when taking out the joint.
6	Remove the plate (151). (When the return spring (221) is strong in force) [Photo 7-7] (When the return spring (221) is weak in force) [Photo 7-8]	
7	When the return spring (221) is weak in force, the sliding resistance of the O-ring holds the plug (211) inside the casing (101). Using a bladed screwdriver, draw out the plug. [Photo 7-9]	* Using its outer groove, draw out the plug (211) with care not to get it damaged by an unbalanced load. **CAUTION:** * Keep in mind that when the plug (211) may pop out by the force of the return spring (221).
8	Pull the push rod (212), plug (211), reducing valve assembly, and return spring (221) out of the casing (101). [Photo 7-10]	* Keep record of the positional relation with the casing hole.
9	Fix the pilot valve, with its port plate (111) upward, in the vise.	
10	Using the specified hex wrench, loosen and remove the hex socket bolt (125). [Photo 7-11]	
11	Detach the port plate (111) and O-ring (122) from the casing (101). [Photos 7-12 and 7-13] Draw the bushing (131) out of the casing (101).	
12	To disassemble the reducing valve, do the following. Press in the spring seat (216) to get the secondary-pressure spring (241) warped. Then slide this spring seat sideways and pass it through the larger hole and out of the spool (201). [Photo 7-14] Next separate the following parts: spool (201), spring seat (216), secondary-pressure spring (241) and washer 2 (217). [Photo 7-15]	* Be careful not to scratch the surface of the spool (201). * Do not allow the spring seat (216) 6 mm or lower than specified. * Handle this group of parts as an assembly.

	Procedure	Precautions
13	Remove the folding-purpose spring (246) and spring seat (218) from the push rod (212). [Photo 7-16]	
14	Draw the push rod (212) out of the plug (211). [Photo 7-17]	
15	Remove the O-ring (214) and seal (213) from the plug (211). Use a small bladed screwdriver or the like to take out the seal (213). [Photos 7-18 and 7-19]	
16	Clean up the parts. 1) Put the parts one by one in a rough-washing container with kerosene. (Rough washing) 2) Put the parts one by one in a finish-washing container with kerosene. Slowly turn them and wipe them clean thoroughly inside and out. (Finish washing) Using clean waste cloth, wipe kerosene away from the parts.	* Do not wipe dirty parts in kerosene from the beginning because otherwise they might get scratched. Keep them dipped until dirt, fat and grease become loose enough off the parts. * Be attentive to keep the kerosene clean enough. Otherwise the parts may get scratched, leading to poor performance when reassembled. * Do not dry up the parts with compressed air. Dust and moisture in the air may damage the parts or get them rusty later.
17	Keep the parts against rust. Apply rust-preventive to the specified parts.	* Do not leave the parts without rust-preventive. Rust may build up, causing malfunction later.



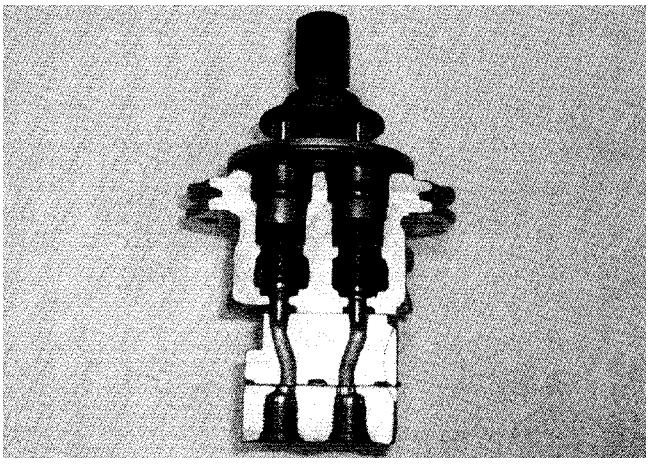


No.	Part name	No.	Part name
1	Nut (Adjusting)	13	Seal
2	Bellows	14	Plug
3	Nut (Disk)	15	O-ring
4	Joint	16	Bush rod
5	Plate	17	Seat (Spring)
6	Valve body	18	Seat (Spring)
7	O-ring	19	Spring
8	Bush	20	Spring
9	Spring pin	21	Washer 2
10	Plate (Port)	22	Spring
11	Sealing washer	23	Spring
12	Hex socket bolt	24	Spool

2. Reassembling procedure

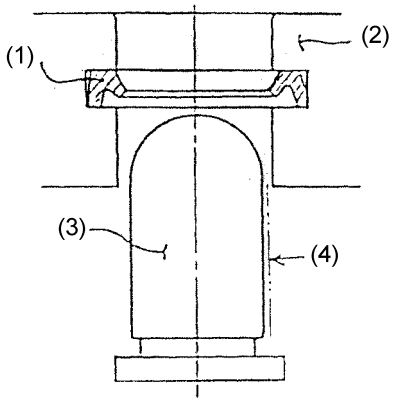
(1) Apply grease to the following parts.
- Rotating part of joint (4)
- Top of push rod (16)

(2)Cut model of pilot valve



4) Assembling

1. Preparations
   (1) As in the case of disassembling, prepare the specified workbench, tools and materials.
2. General precautions
   (1) Take the same general precautions as in disassembling.
   (2) Before reassembling, remove metal chippings and foreign matters from all the parts. Make sure the parts are free of burrs, hit marks and other problems. If a burr or hit mark is found, get rid of it with an oilstone.
   (3) In principle, replace the O-rings and backup rings with new ones.
   (4) When fitting the O-rings and backup rings, handle them with care not to damage it. (Apply a small amount of grease for smooth fitting.)
   (5) When fitting the parts in place, preferably use grease to avoid accidental drop.
   (6) Tighten the bolts and the like to the their specified torques listed in "7-1 Tightening Torque Chart". Measure the tightening torques with a torque wrench.
   (7) Finally apply blind plugs to all the open ports to avoid entry of dust.
3. Reassembling procedure

	Procedure	Precautions
1	Fit the bushing (131) and O-ring (122) to the casing (101). [Photo 7-20]	
2	Install the port plate (111), with the hex socket bolt (125) and seal washer (121) in between, on the casing (101). [Photos 7-21 and 7-22]	* Carefully position the spring pin (126) in the casing hole. * Replace the seal washer (121) with new one.
3	Tighten the hex socket bolt (125) to the specified torque. [Photo 7-23]	* Alternately tighten the two bolts.
4	Install the washer 2 (217), secondary-pressure spring (241) and spring seat (216) in this order on the spool (201). [Photo 7-24] Then press in the spring seat (216) to get the secondary-pressure spring (241) warped. Now slide this spring seat sideways and pass it through the larger hole and onto the spool (201). [Photo 7-25]	* Do not allow the spring seat (216) 6 mm or lower than specified.
5	Fit the return spring (221) in the casing (101). Also fit the reducing valve assembly to the casing (101). [Photo 7-26]	* Place these parts back in their original positions.
6	Fit the O-ring (214) to the plug (221). [Photo 7-27]	
7	Fit the seal (213) to the plug (211). [Photo 7-28]	* Place the seal (213) with its lip positioned as shown below.
8	Fit the push rod (212) into the plug (211). [Photo 7-29] Fit the folding-purpose spring (246) and spring seat (218) into the push rod (212). [Photo 7-30] (1)Seal (2)Plug (3)Push rod (4)Apply hydraulic oil.	* Apply hydraulic oil over the surface of the push rod. 

	Procedure	Precautions
9	Fit the plug assembly to the casing (101). When the return spring (221) is weak in force, this assembly is kept in place by the sliding resistance of the O-ring. [Photo 7-31] When the return spring (221) is strong in force, fit all the four plugs at once using the plate (151). Apply and temporarily tighten the joint (301). [Photo 7-32]	* Be careful not to pry the spool (201) too hard. Otherwise the casing hole (101) may get damaged. **CAUTION:** * Keep in mind that the plug assembly and plate (151) may pop out.
10	Place the plate (151) in position.	
11	Using the specified jig, tighten the joint (301) to the casing (101) by the specified torque. [Photos 7-33 and 7-34]	* Photo 7-33 shows the jig in its specified position.
12	Fit the disc (302) to the joint (301). [Photo 7-35]	* Screw in the disc until it comes into even contact with the four push rods (212). **WARNING:** * Carefully adjust the final position of the disc (302). If it is screwed in too much, the secondary pressure with the lever at neutral may be wrongly applied, causing the machine to malfunction.
13	Apply the adjusting nut (312) and fix it by applying the specified wrench across the disc (302). Tighten the adjusting nut to the specified torque. [Photo 7-36]	* In tightening the nut, keep the disc (302) in position.
14	Apply grease to the turning portion of the joint (301) and the top of the push rod (212). [Photo 7-37]	
15	Fit the bellows back into position. [Photo 7-38]	* Be careful not to break the bellows (501).
16	Pour vapor phase inhibitor from the ports and apply the blind plugs.	

Photo 7-1

Photo 7-2

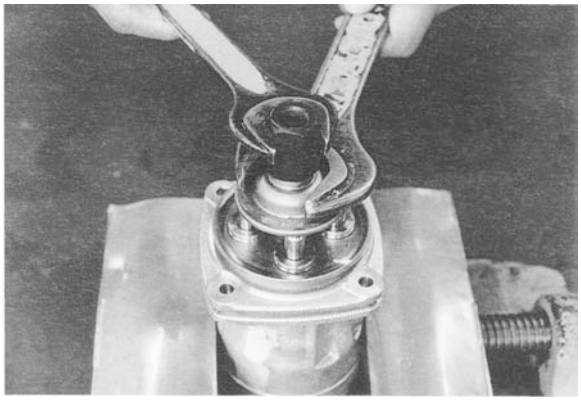


Photo 7-3

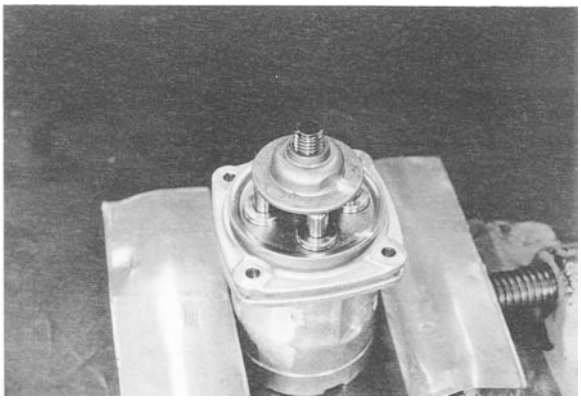


Photo 7-4

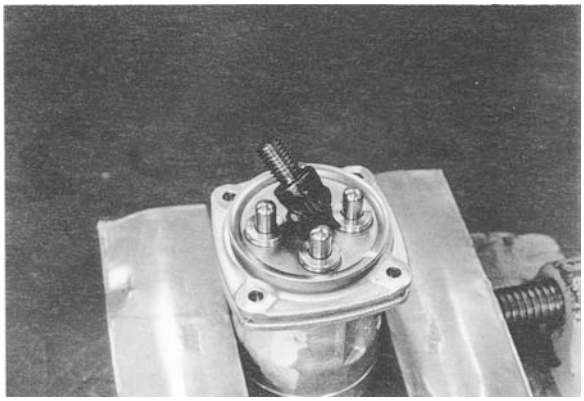


Photo 7-5

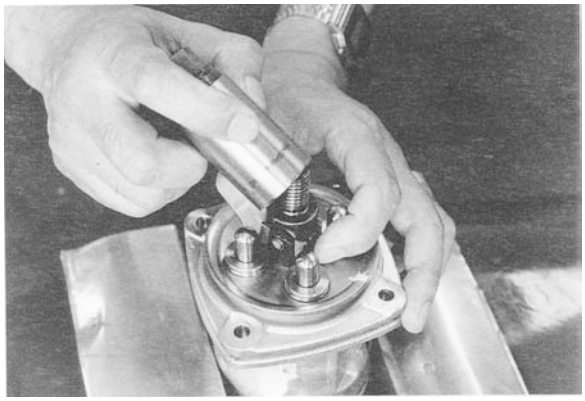
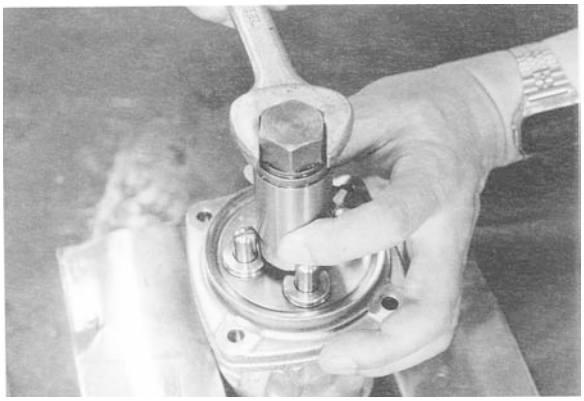


Photo 7-6



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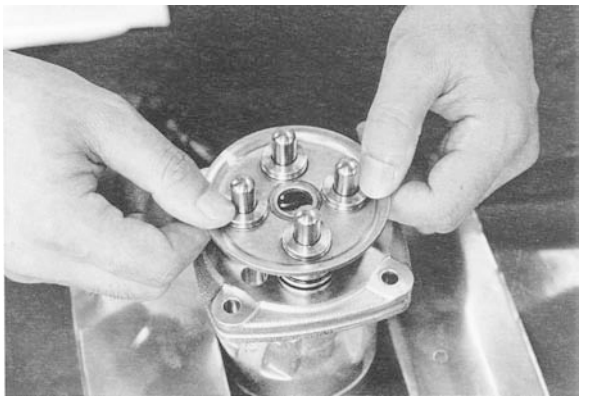

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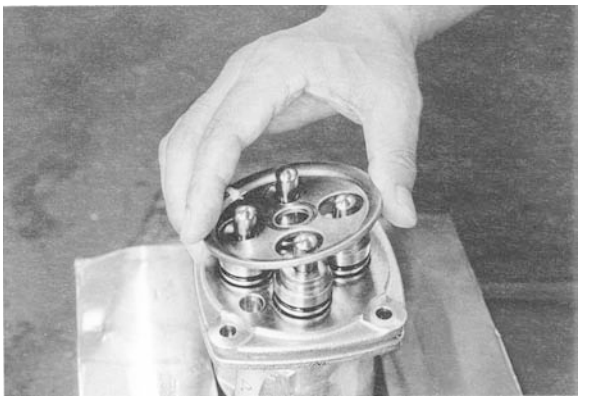
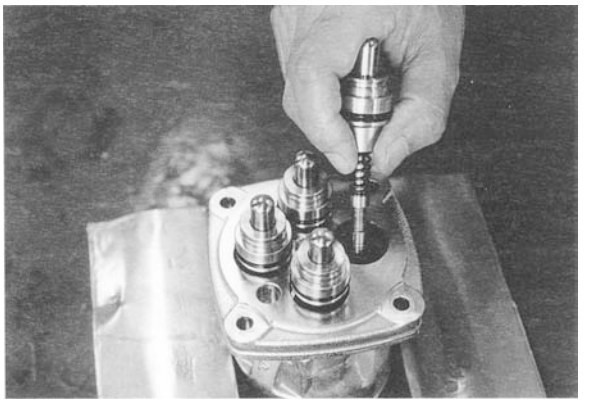


Photo 7-9

Photo 7-10



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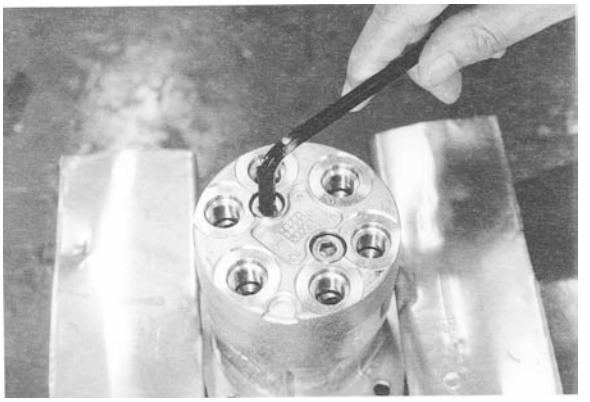

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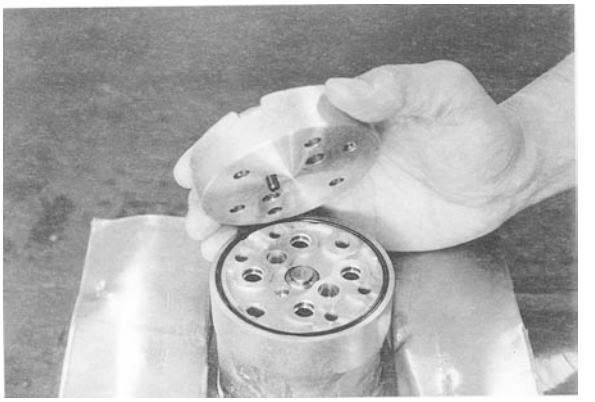


Photo 7-13

Photo 7-14

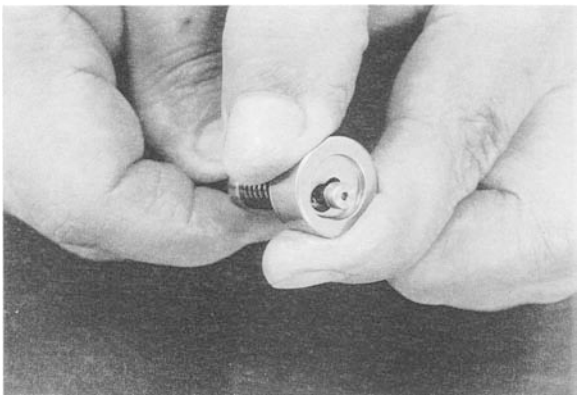


Photo 7-15

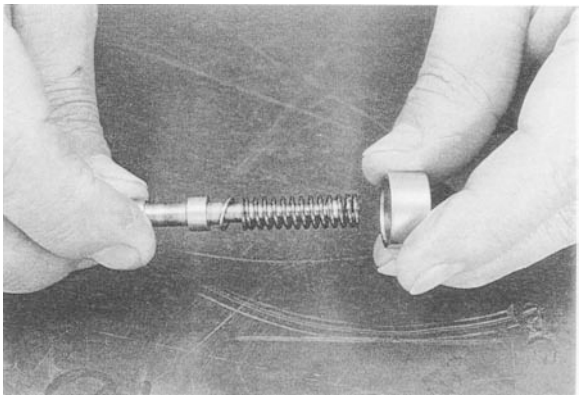


Photo 7-16

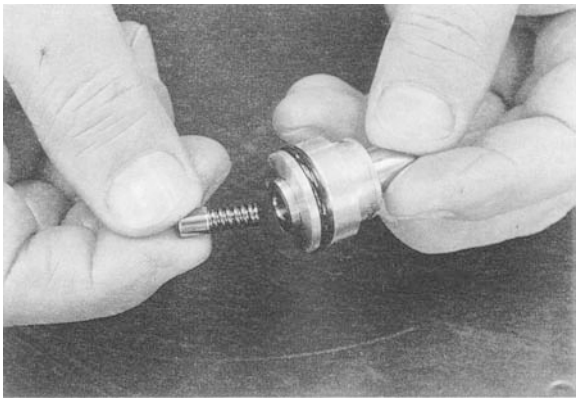


Photo 7-17

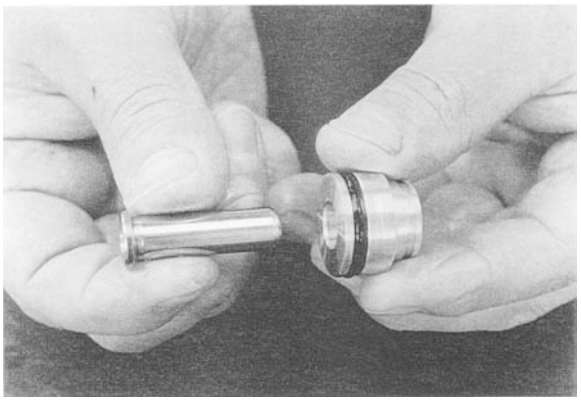
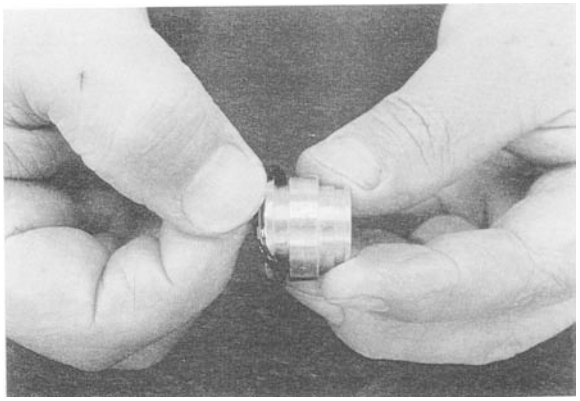


Photo 7-18



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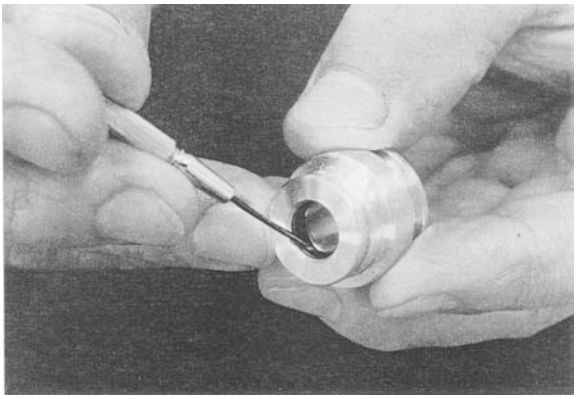

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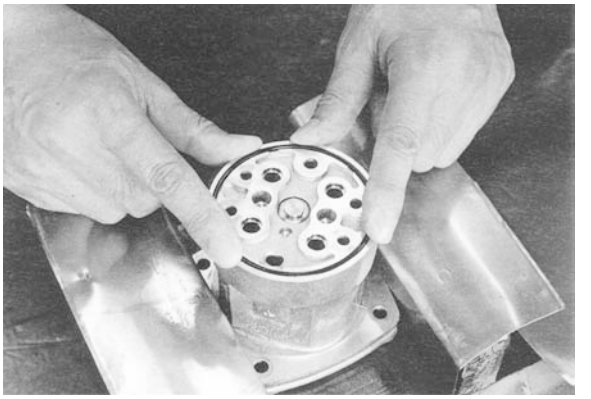
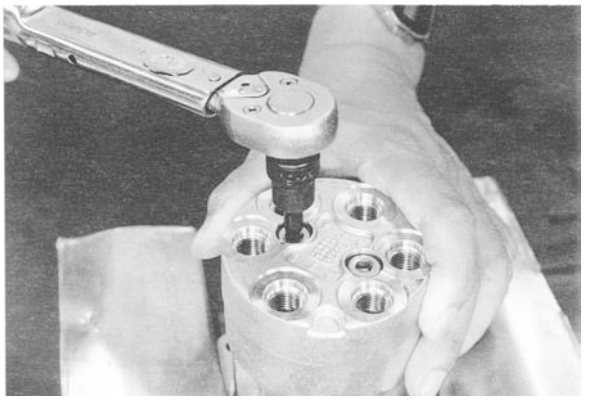


Photo 7-21

Photo 7-22

Photo 7-23



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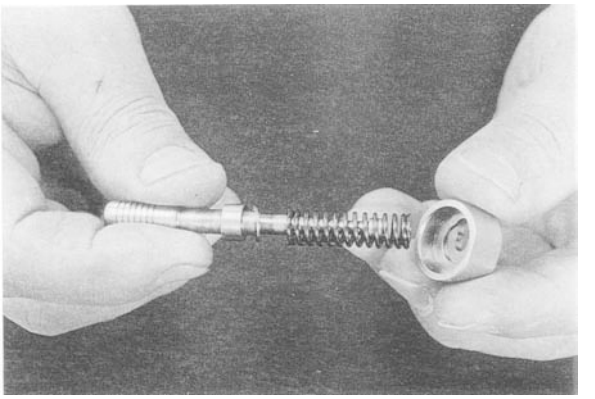

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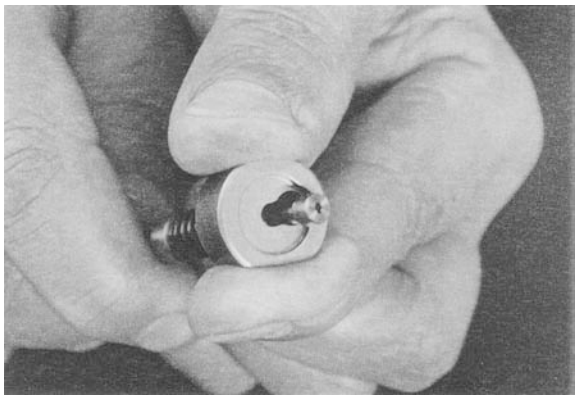

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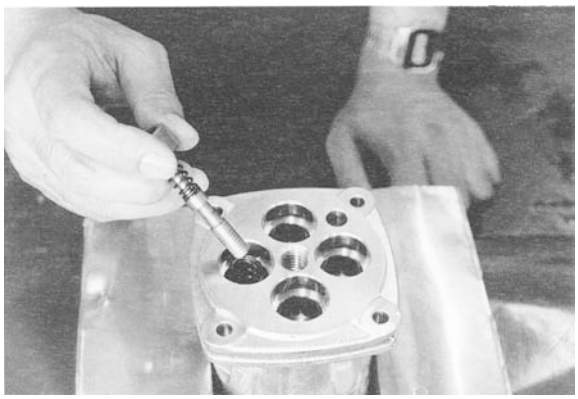
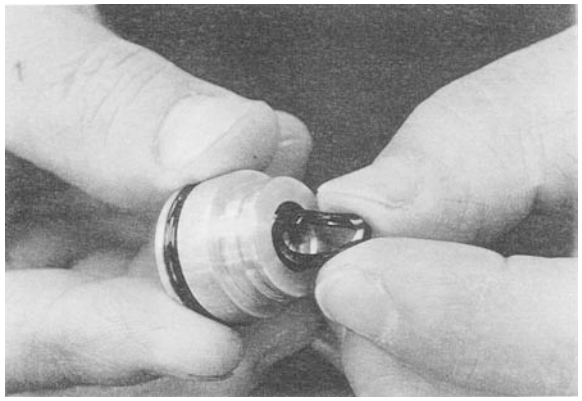


Photo 7-27

Photo 7-28



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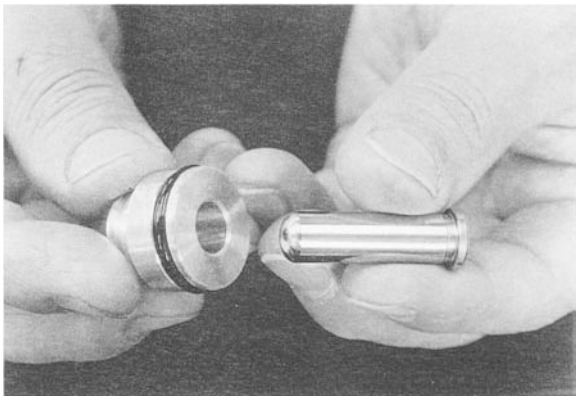

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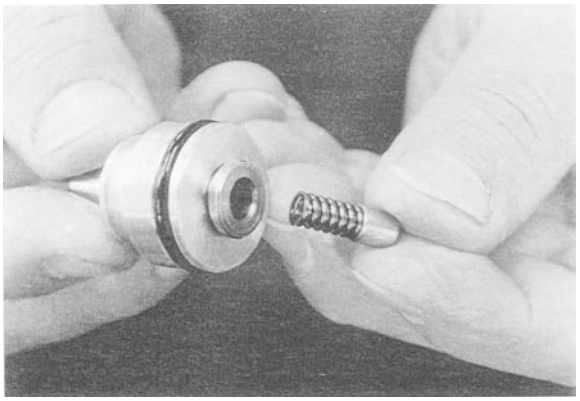

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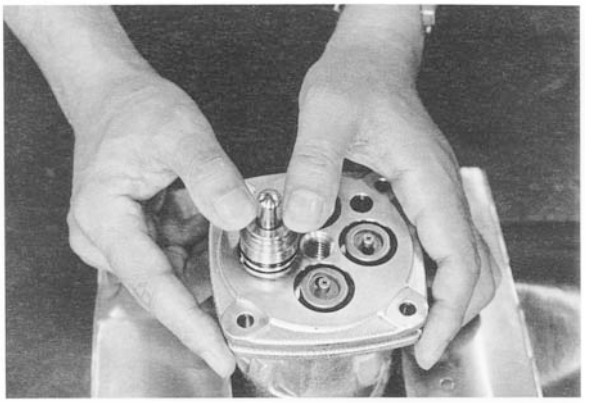


Photo 7-32

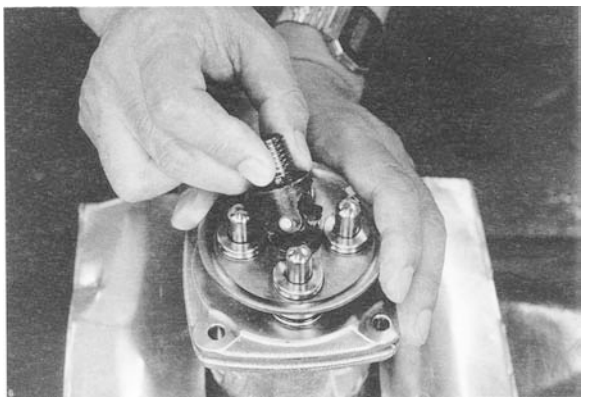


Photo 7-33

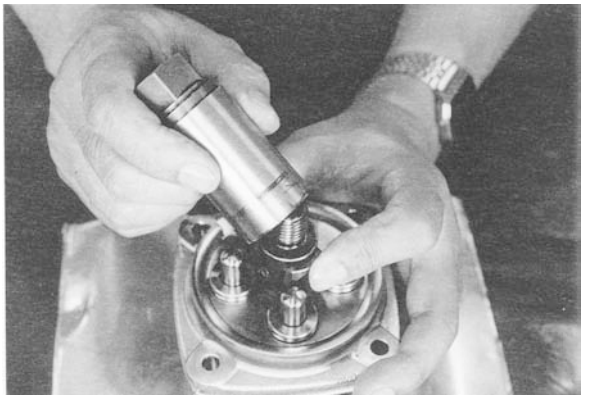


Photo 7-34

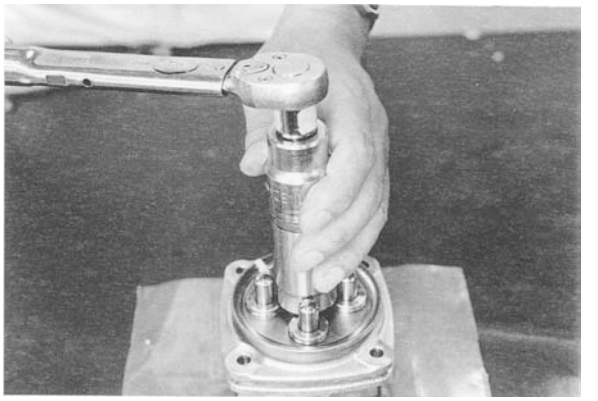
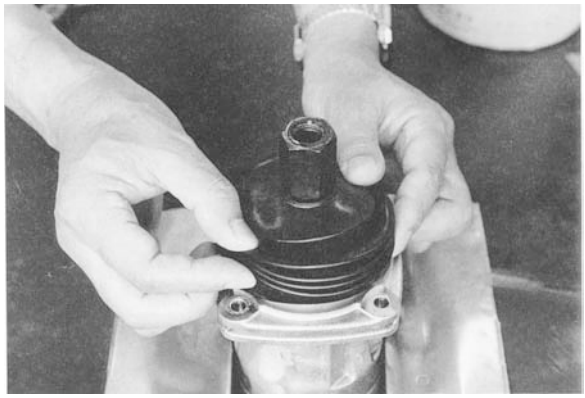


Photo 7-35

Photo 7-36

Photo 7-37

Photo 7-38



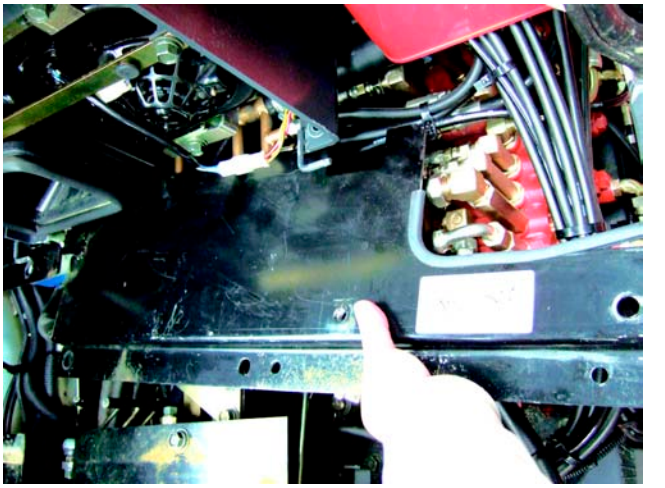
[3] Trouble shooting

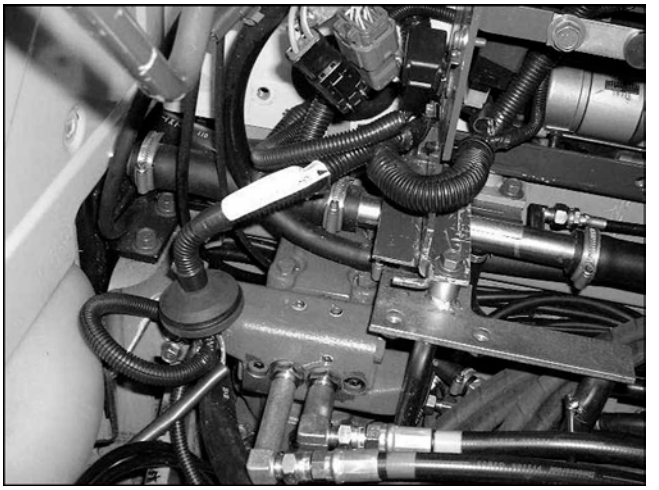
It is not easy to pinpoint trouble spots. The table below lists some typical problems, their possible causes and corrections. Before starting repair jobs, refer to the table below.
A machine trouble is not necessarily caused by just one part, but by come different parts combined. It should be noted that the corrections listed below might not be enough and additional measures might be needed.
This chart does not cover all possible causes and corrections. Whenever necessary, it is therefore essential for the repair supervisor to look further into the problem and cause in question.

Problem	Causes	Corrections
Secondary pressure failure to rise	(1) Primary pressure too low. (2) Secondary-pressure spring (241) broken or worn out. (3) Too large a gap between the spool (201) and casing (101). (4) Steering wheel too loose.	(1) Ensure the specified primary pressure. (2) Replace the spring with new one. (3) Replace the remotely operated valve with new one. (4) Disassemble and reassemble the related section. Or replace the steering wheel as required.
Secondary pressure unstable	(1) Sliding parts stuck. (2) Tank line pressure fluctuating too much. (3) Air sucked in the piping.	(1) Correct the stuck spot. (2) Return the oil direct to the oil tank. (3) Operate the machine to let out the air.
Secondary pressure too high	(1) Tank line pressure too high. (2) Sliding parts stuck.	(1) Correct the stuck spot. (2) Return the oil direct to the oil tank.

d. Swivel motor

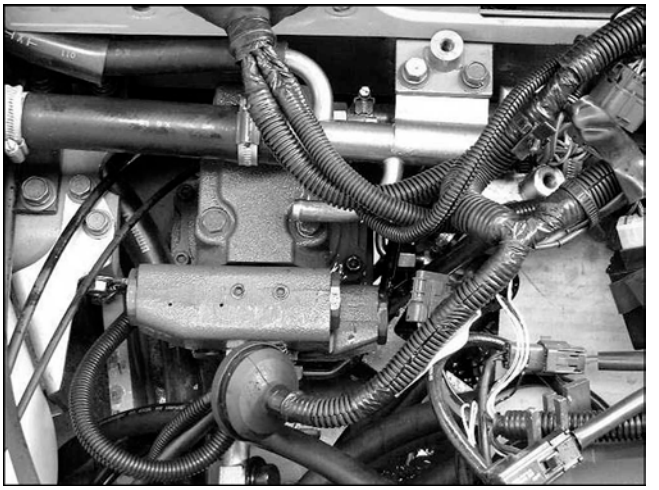
[1] Mounting and dismounting the swivel motor



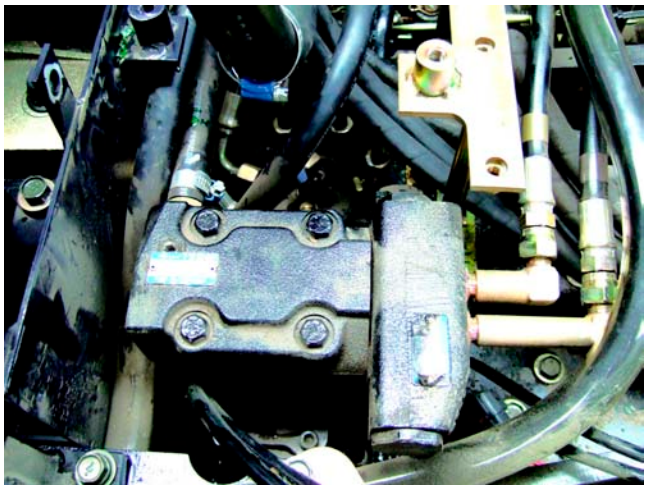


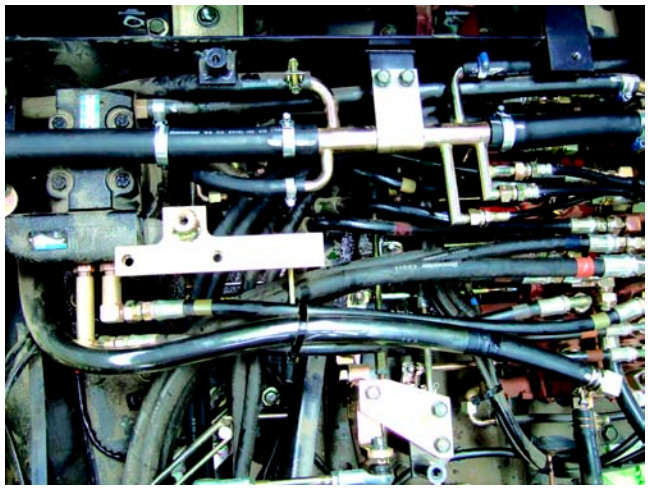
1) Dismounting the swivel motor

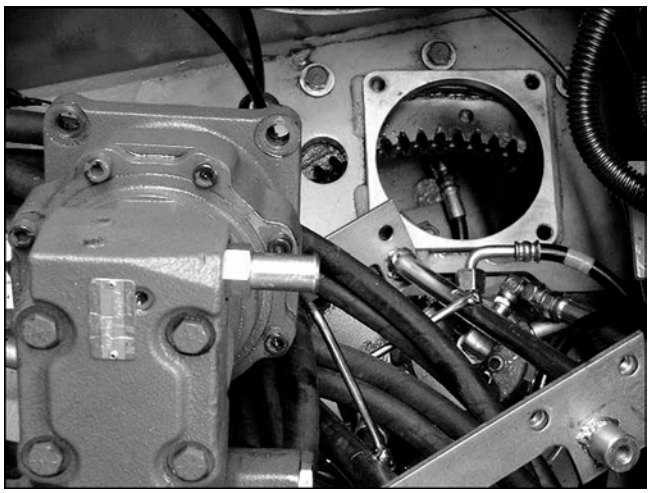
1. Let out the hydraulic oil.
2. Remove the steps.
3. Remove the related wire harnesses for dismounting the seat stand.
4. Dismount the left pilot valve from the operation panel.
5. Dismount the left operation panel together with the seat stand.
6. Be careful not to bend the pilot hose.



7. Disconnect the panel related wire harnesses and cables.
8. Remove the bolts which fix the right operation panel and seat stand. Tilt the seat stand forward, paying attention not to bend the pilot hose. Confirm the safety.
9. Dismount the seat stand.
10. Disconnect the return hose and return pipe running between the swivel and the control valve.
11. Remove the hose guide fixing bolts. (Make the guide free beforehand.)
12. Disconnect the brake release hose.

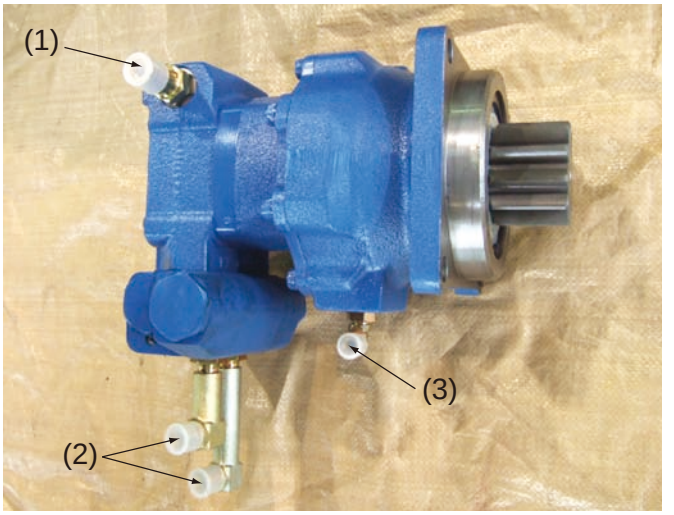






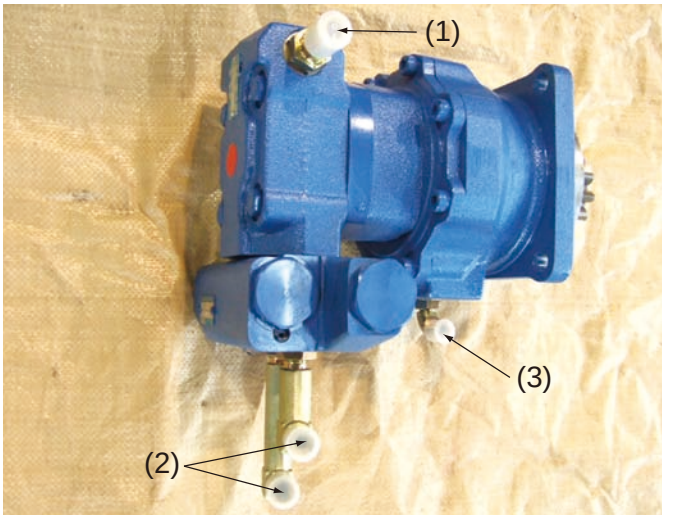
13. Remove the 4 motor mounting bolts.
    Tightening torque: 103.0 ~117.7 N·m (10.5 ~ 12.0 kgf·m) 75.95 ~ 86.80 ft·lbs
    Apply screw loctite. (Loctite 271)
14. Dismount the motor.

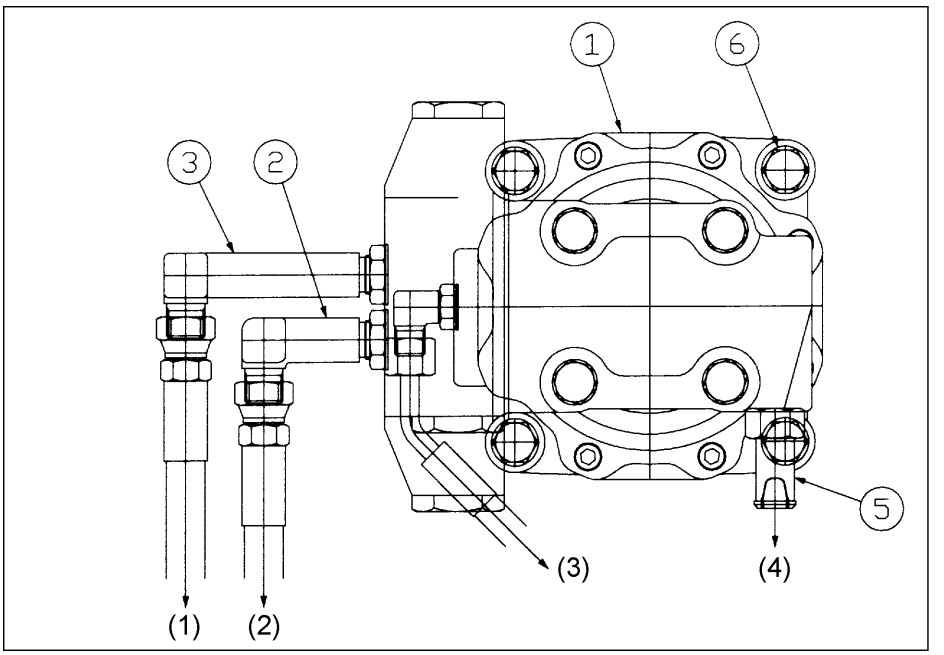
[2] Swivel motor mounting/dismounting component parts



2) Reassembling procedure

(1) Drain hose (to return pipe)
(2) To right and left control valves
(3) For negative brake releasing (to selector valve)
(4) Brake valve
(5) Anti-void valve



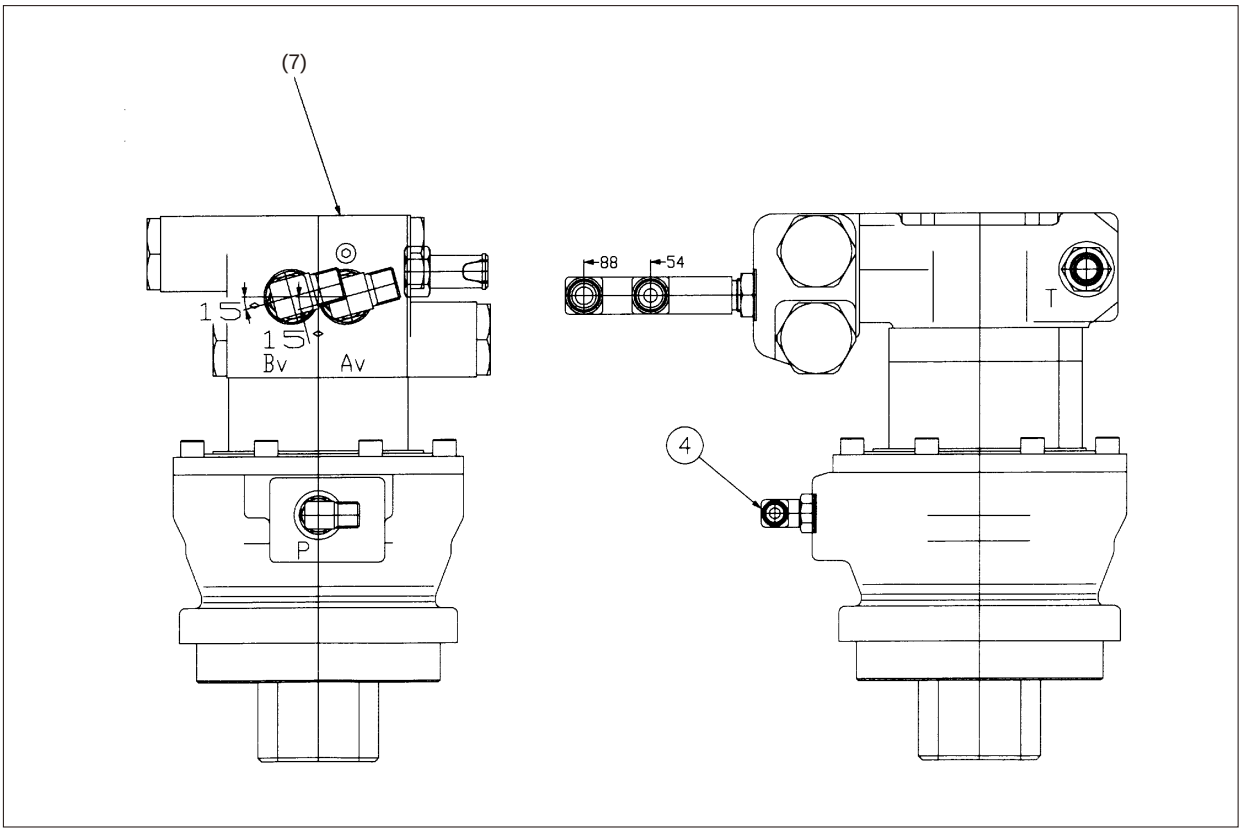


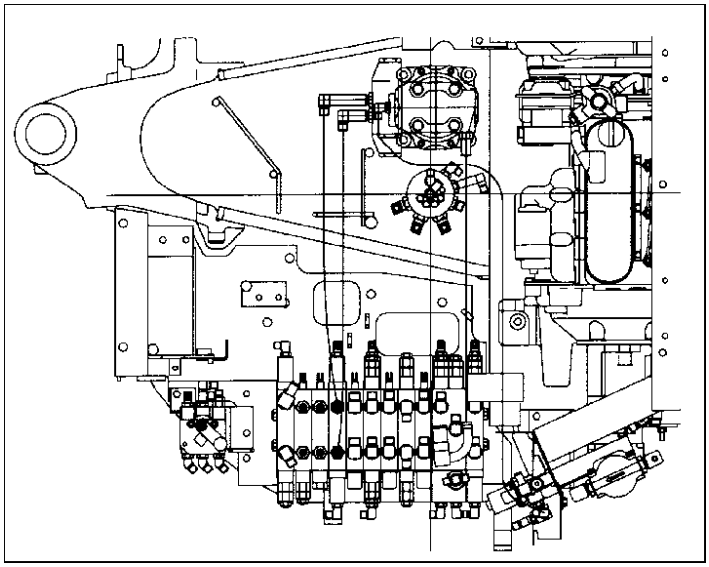
(1) Control valve (Swivel left)

(2) Control valve (Swivel right)

(3) Selector valve

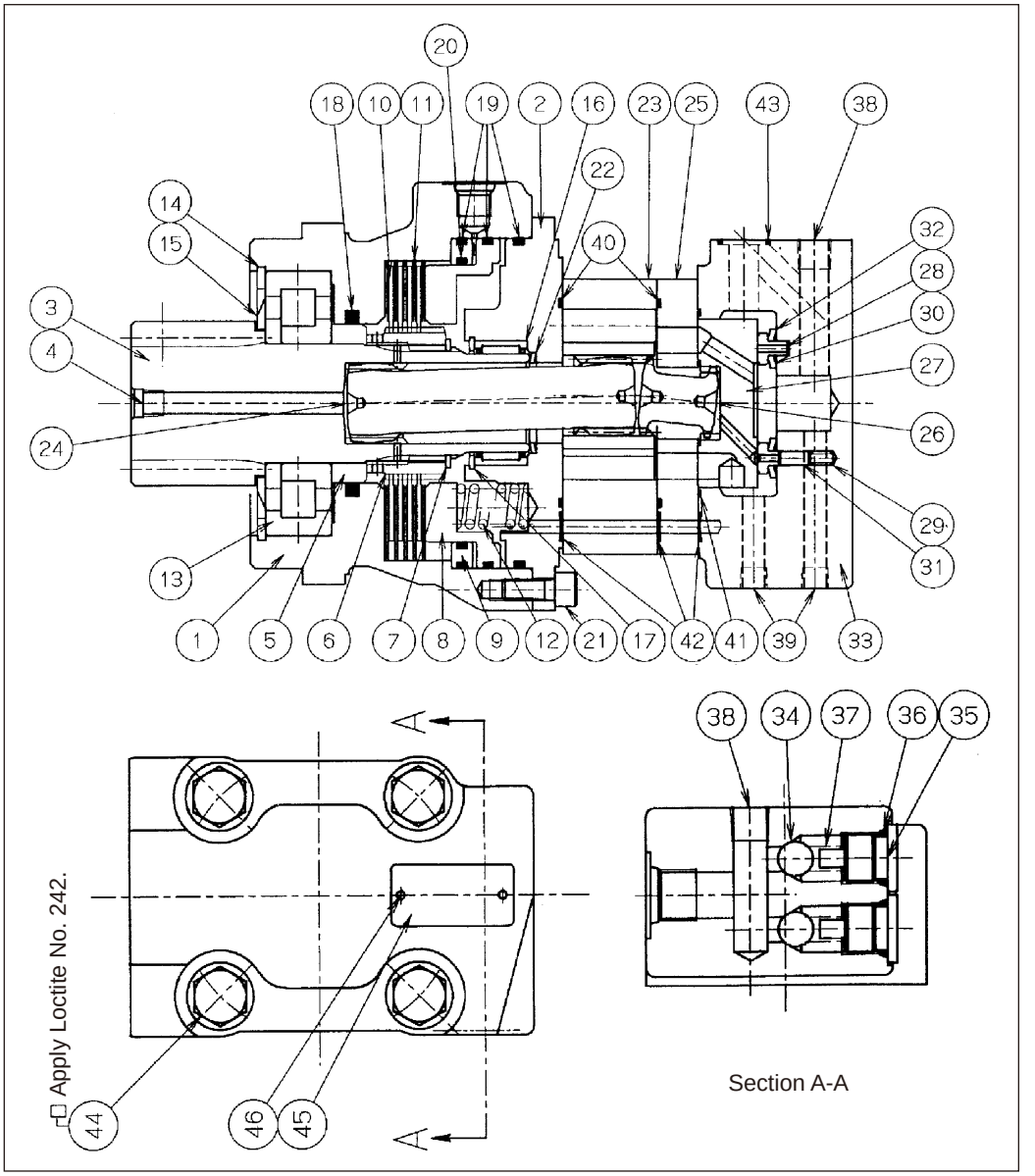
(4) Control valve (Check valve)





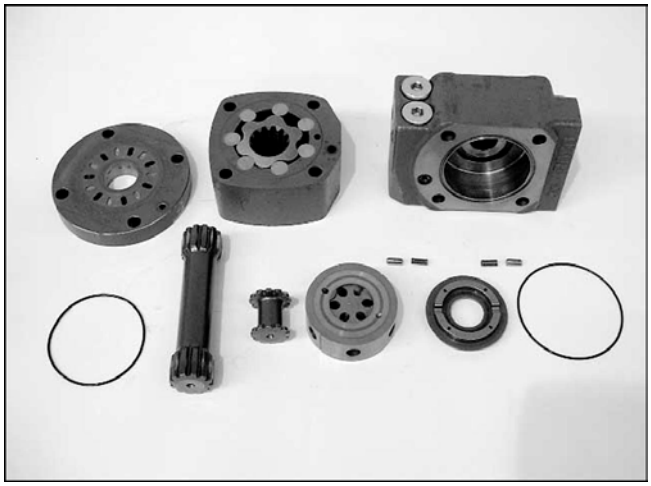
No.	Part No.	Part name	Q'ty	Remarks
(1)	RB411-6128△	Motor, assembly (Swivel)	1	U20-3α (Black)
	RB511-6128△	Motor, assembly (Swivel)	1	U25-3α (Blue)
(2)	68881-34933	Flange-based elbow	2	Av
(3)	68191-61831	Pipe joint (L. F3/8-F3/8)	1	Bv
(4)	RC601-63721	Pipe joint (L. G1/4-G1/4))	1	P
(5)	RC101-63801	Pipe joint (Filter), assembly	1	T
	04810-00110	O-ring	1	For 1/4P
	04810-00140	O-ring	3	For 3/8 Av · Bv · T
(6)	01138-61240	Bolt	4	M12 x 1.25 9T
(7)	Body paint color U20-3a : Black U25-3a, U25S : Blue			

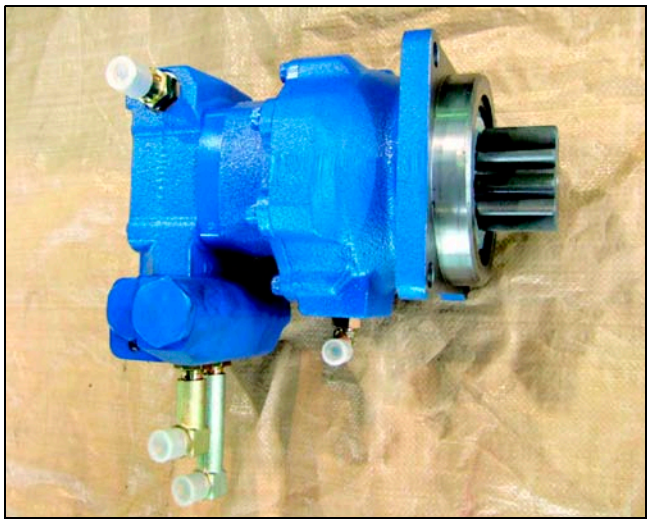
Tightening torque of hydraulic adaptor:
G1/4 24.5~29.4N·m(2.5~3.0kgf·m)18.08~21.70kgf·m
G3/8 49.0~53.9N·m(5.0~5.5kgf·m)36.17~39.78kgf·m

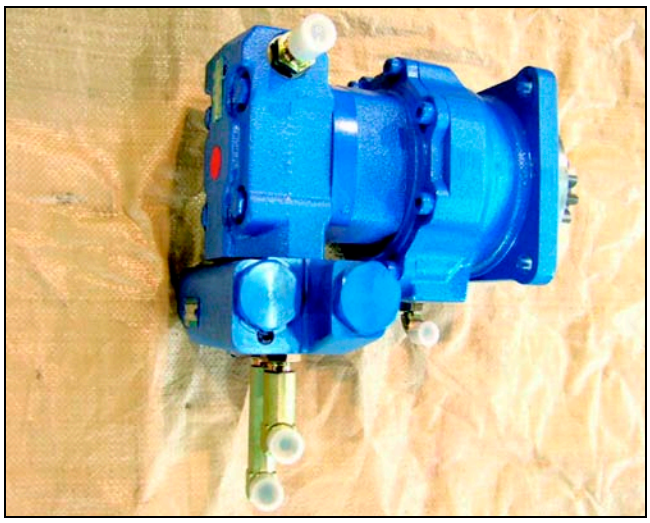


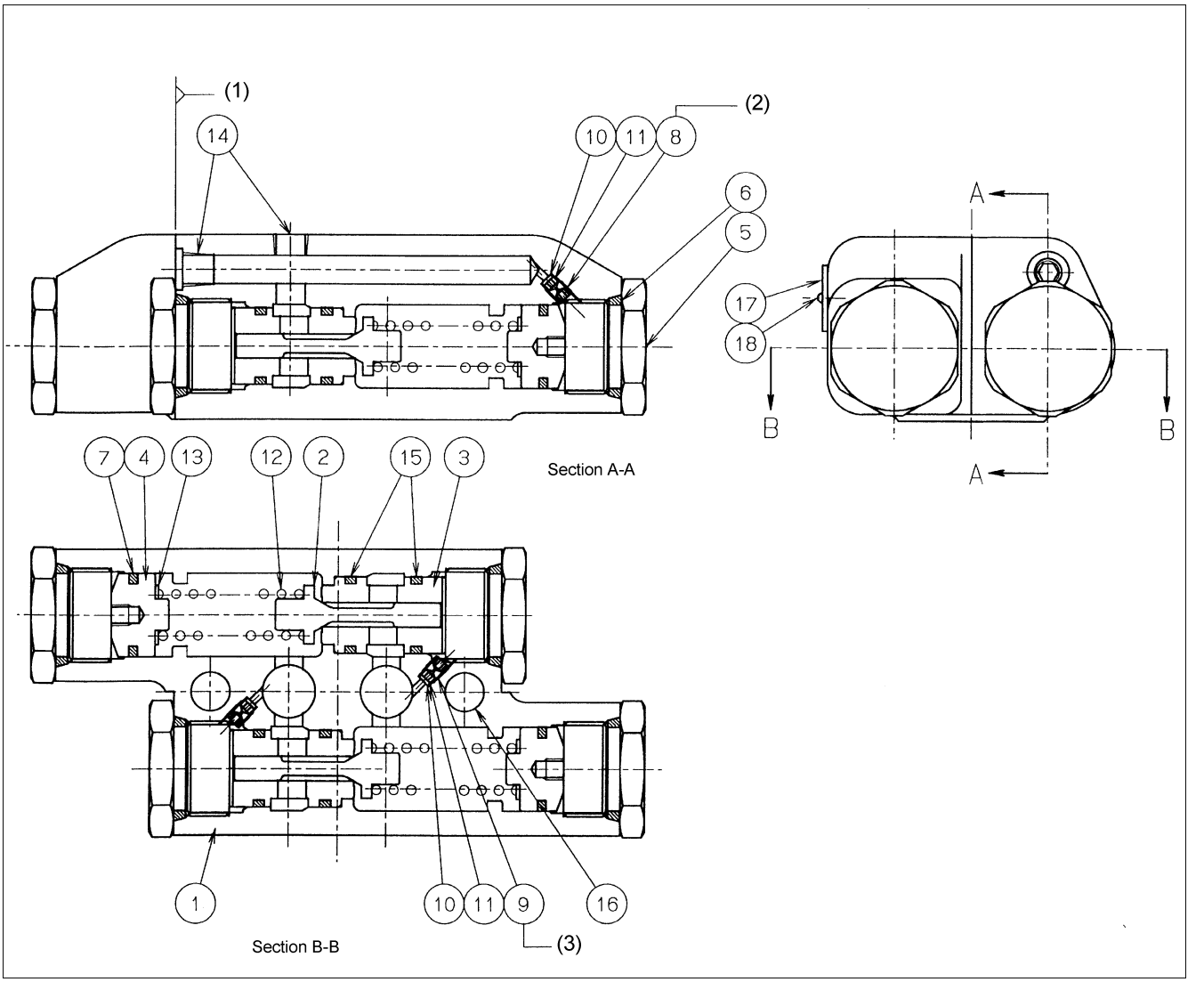
No.	Part name	Part No.	Q'ty	Remarks
47	Pinion gear assembly	AD1165C	1	Including 1 ~ 22
1	Bearing housing		(1)	
2	Flange mounting		(1)	
3	Pinion gear		(1)	
4	Plug		(1)	Rc1/8
5	Collar		(1)	
6	Ring gear		(1)	
7	Snap ring for shaft		(1)	ϕ42
8	Piston		(1)	
9	Ring		(1)	
10	Friction plate		(4)	
11	Mating plate		(5)	
12	Spring		(8)	
13	Front bearing		(1)	NUP309
14	Snap ring for hole		(1)	ϕ100
15	Bearing cover		(1)	
16	Rear bearing		(1)	RLM3720
17	Snap ring		(1)	IRTW-047
18	X-ring	AD1046A	(1)	ϕ60
19	O-ring	AA0014B-120	(3)	TBG120
20	O-ring	AA0014B-105	(1)	TBG105
21	Hex socket bolt		(8)	M8×20
22	Shaft face seal	9050	(1)	
23	Geroller	AD1160C-503	1	

No.	Part name	Part No.	Q'ty	Remarks
24	Drive	AD1158C-005	1	
25	Valve plate	AD1135B	1	
26	Valve drive	AD1161B	1	
27	Valve	8435S-6	1	
28	Balancing ring	8915-1	1	
29	Spring	7383	2	
30	Inner face seal	9135-1	1	
31	Pin	14351	2	
32	Outer face seal	9135-2	1	
48	Valve housing assembly	AD1048A	1	Including 33 ~ 39
33	Valve housing		(1)	
34	Steel ball		(2)	7/16"
35	Plug		(2)	
36	O-ring	A40001-14	(2)	4BP14
37	Spring		(2)	
38	Plug		(2)	Rc1/4
39	Plug		(2)	Rc1/8
40	O-ring	9022S-6	2	AS568-041
41	O-ring	9022S-2	1	AS568-038
42	O-ring	9022S-12	3	AS568-011
43	O-ring	A40001-18	2	1BP18
44	Hex bolt	14313	4	3/8"UNF
45	Name plate		1	
46	Rivet		2	

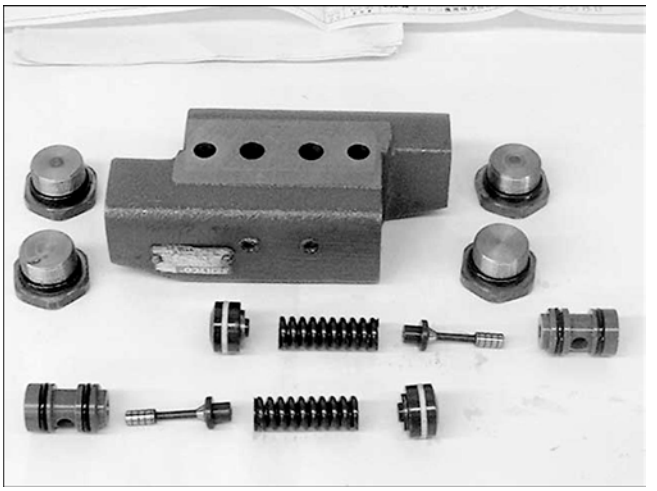








(1)Plugs to be below this face
(2)Apply Loctite No.242.
(3)Apply Loctite No.242.

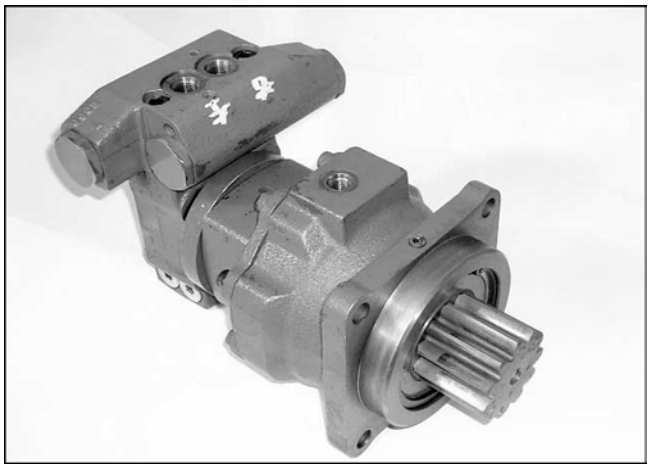


No.	Part name	Q'ty	Part No.	Remarks
1	Valve body	1		
2	Plunger	2		
3	Seat	2		
4	Piston	2		
5	M27 plug	4		M27
6	O-ring	4	A40001-24	1BP24
7	Seal set	2	AH0597A	
8	Orifice plug	2		ϕ0.40
9	Orifice plug	2		ϕ0.35
10	Filter	4		100-mesh
11	Collar	4		
12	Spring	2		
13	Shim	2		
14	Plug	4	A42041	Rc1/8
15	O-ring	4	A40001-18	1BP18
16	Hex socket bolt	2	DW0024A-055	M10×L55
17	Nameplate	1		
18	Rivet	2		
0	Seal kit		AH0615A	

[3] Disassembling and reassembling the swivel motor

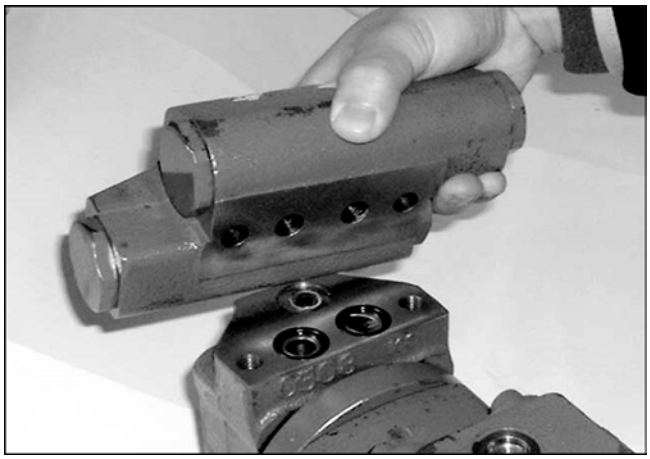
1) Disassembling/reassembling tools

Torque wrench: 9.8~98 N·m (1.00~10.00kgf·m) 7.23~72.33ft·lbs
Socket wrench: 14 mm (0.55in.)
Hex hollow wrench: 5.8 mm (0.23in.)
Bladed screwdriver
Plastic hammer
Snap ring removal tweezers (for hole and shaft)
Special screwdriver



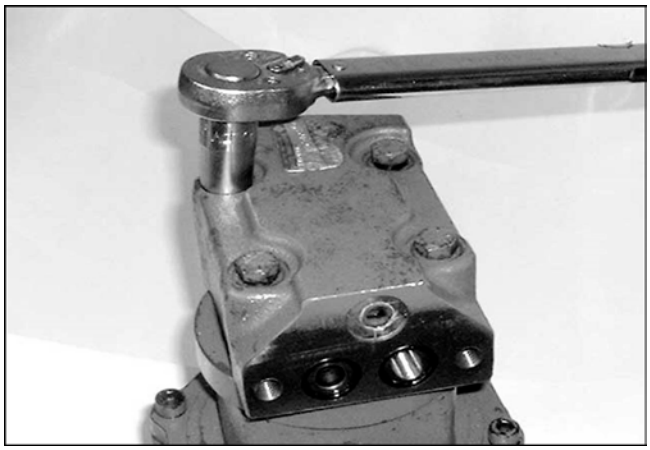
Wash the parts with clean oil and remove dust and dirt off them. Also use due care not to give damage or dent to them.
Replace the seals with new ones. Apply grease to the new seals beforehand.
When disassembling the parts, clean around the workshop and prepare plastic cases for keeping the removed parts.
Before disassembly, clean around the ports of the motor and remove paint from the connections using a wire brush.

2) Disassembling procedure

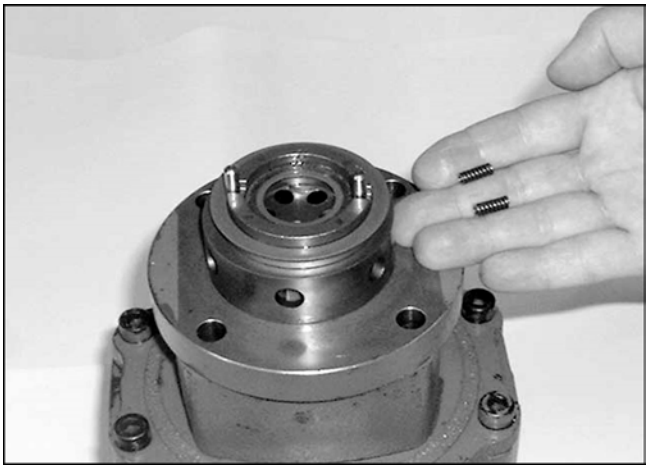


Disassembling procedure

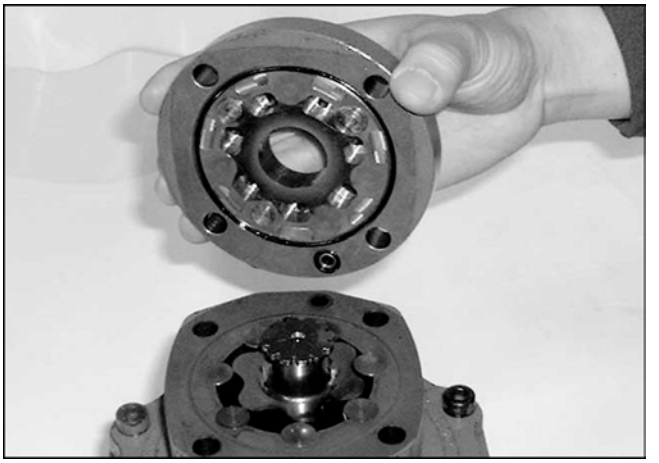
1. Dismount the shock-less valve from the motor body.
   Do not disassemble the shock-less valve unless necessary.



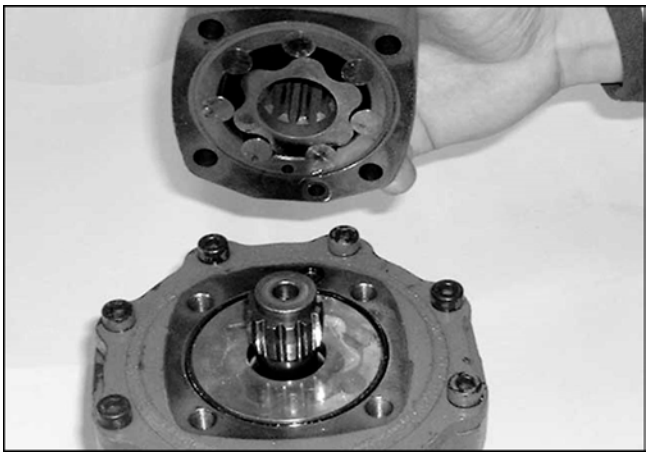
2. Fix the flange in a vise with the pinion gear facing downward.
   Remove the hex bolt.



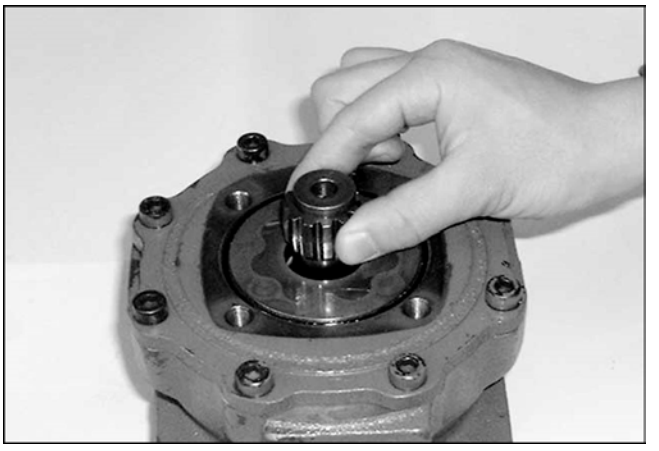
3. Dismount the valve housing. At this time, use care not to lose the spring.
   Do not disassemble the valve housing unless necessary.



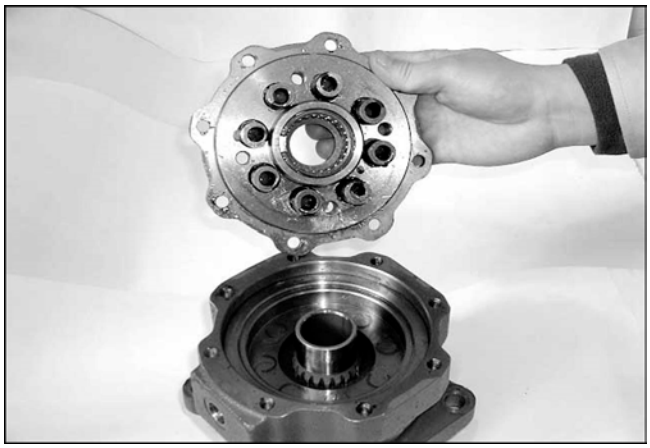
4. Remove the balancing ring, valve and valve seat.



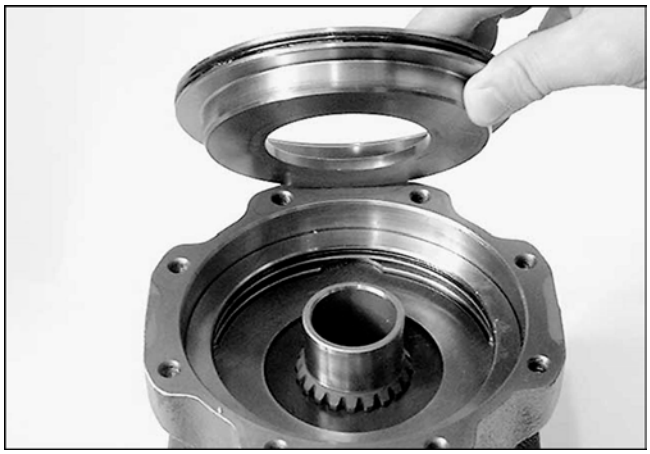
5. Remove the valve drive and geroller.



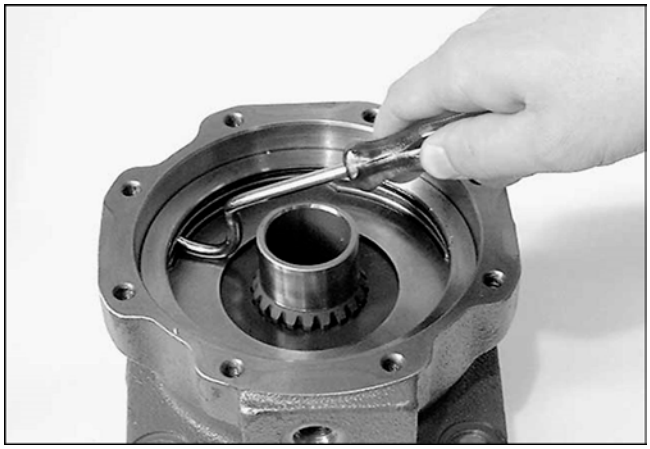
6. Dismount the drive.
   Do not disassemble the pinion gear unless necessary.



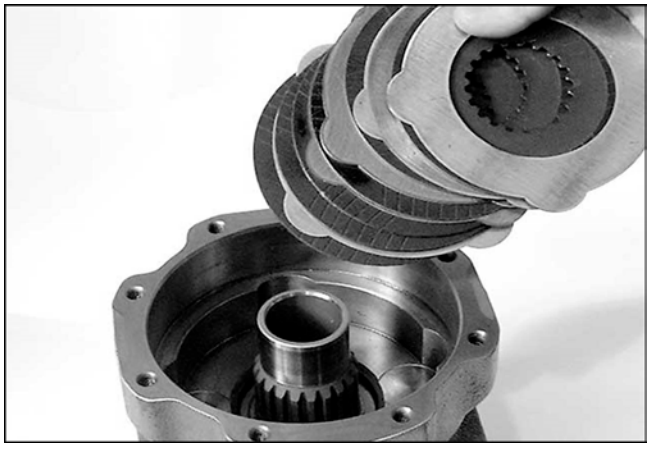
7. When the pinion gear must be disassembled, take the following.
   (1) Dismount the bearing housing.
   (2) Remove the 8 springs.



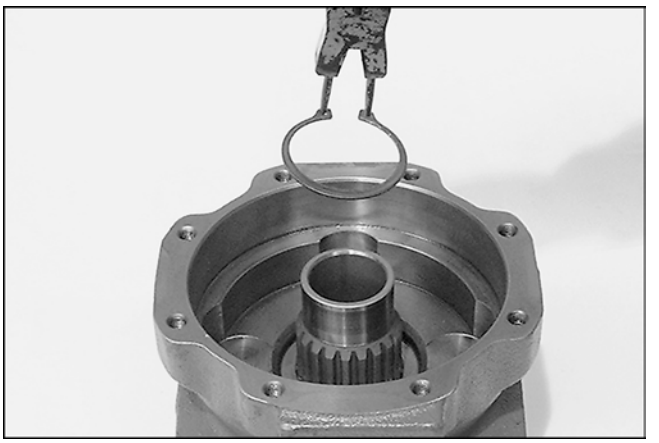
8. Remove the piston.
   The piston will be easily removed by blowing air through the brake release port. Keep in mind, however, that the piston may pop out.



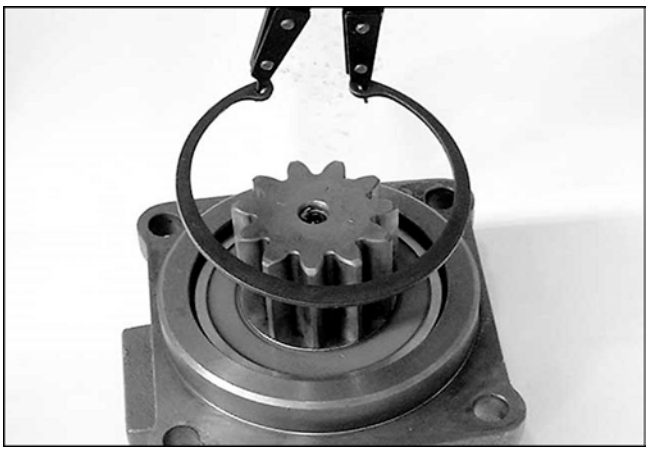
9. Remove the ring.
   Remove it with a screwdriver as shown at left. Be careful not to scratch the ring.



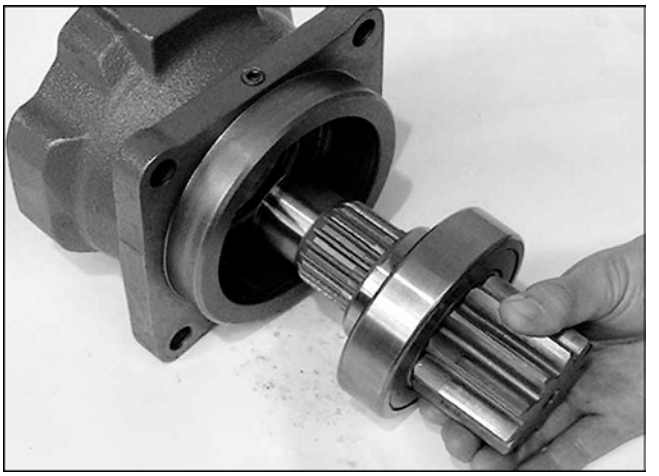
10. Remove the friction plates and mating plates.
    Remove them, paying attention to their orders and numbers.



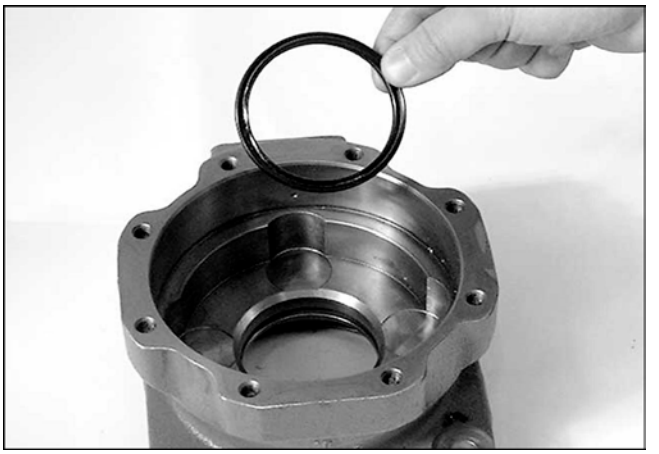
11. Remove the snap ring for shaft.
    Bear in mind that the snap ring may pop out.



12. Remove the snap ring for hole.
    Bear in mind that the snap ring may pop out.

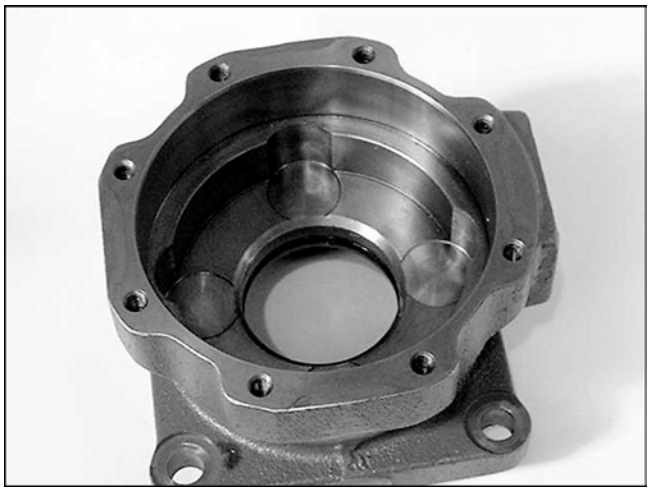


13. Strike out the pinion gear together with the bearing.



14. Remove the X-ring (60 mm dia.).

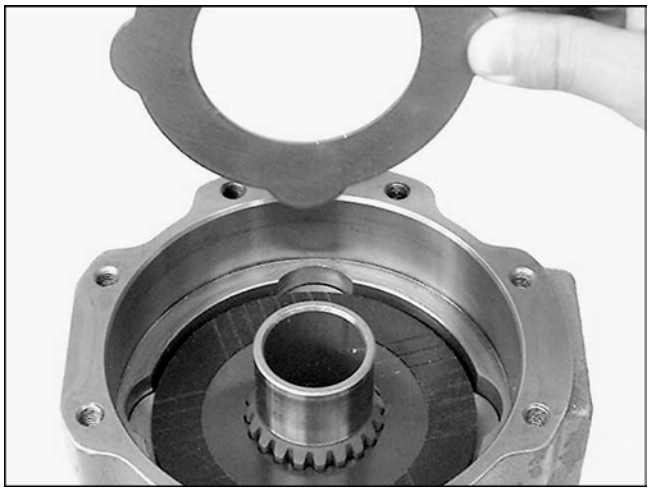
3) Reassembling procedure



Reassemble the parts after washing and checking them for any damage.

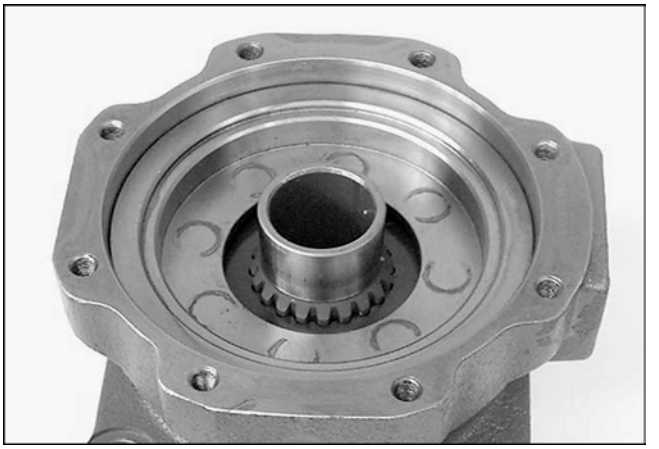
15. Apply hydraulic oil to the X-ring before mounting.

16. Mount the pinion gear and the snap rings for hole and shaft.

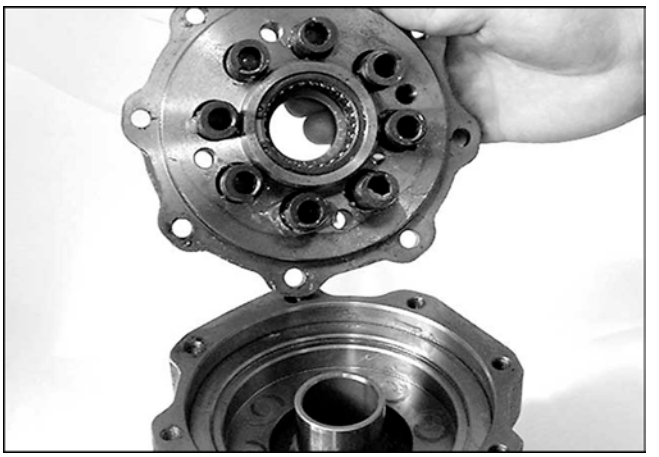


17. Check the friction plates and mating plates for scratches and dust deposits, and assemble them with care not to confuse their orders.

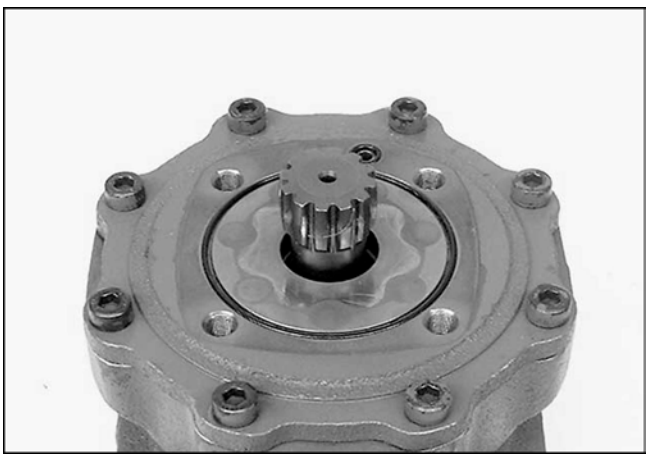
18. Check the inner and outer O-rings of the ring for scratches and distortion, and apply hydraulic oil to them before assembling.



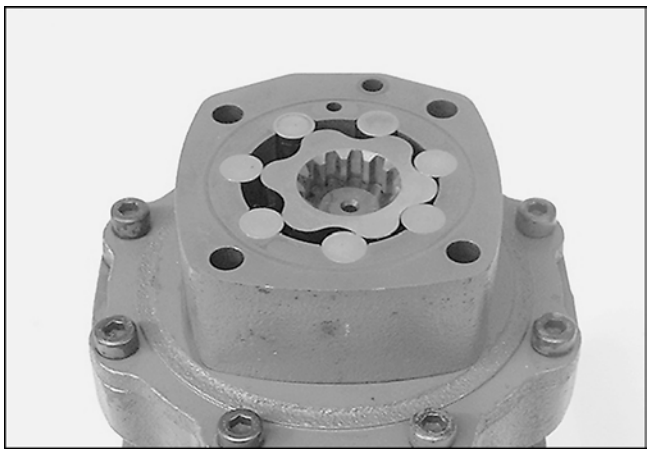
19. Check the outer O-ring of the piston for scratches and distortion, and apply hydraulic oil to it before assembling.



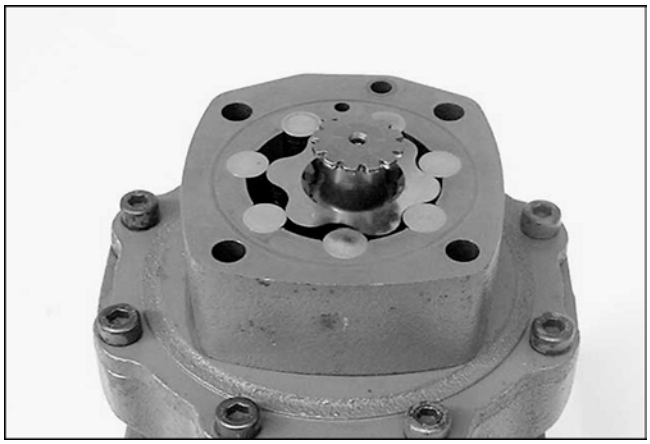
20. Apply grease to the bearing housing before assembling, paying attention not to let the spring drop.
    Tightening torque: 34.3 N·m (35 kgf·m) 25.3ft·lbs
    Apply LOCTITE No. 242.



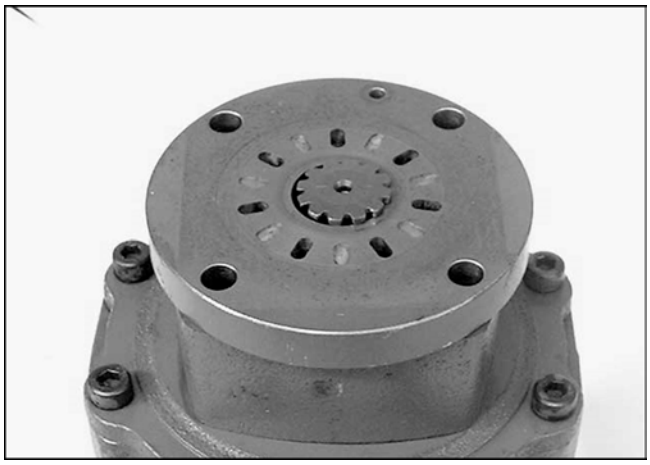
21. Fit the 2 different O-rings into the O-ring grooves of the flange mounting.
    Insert the drive.



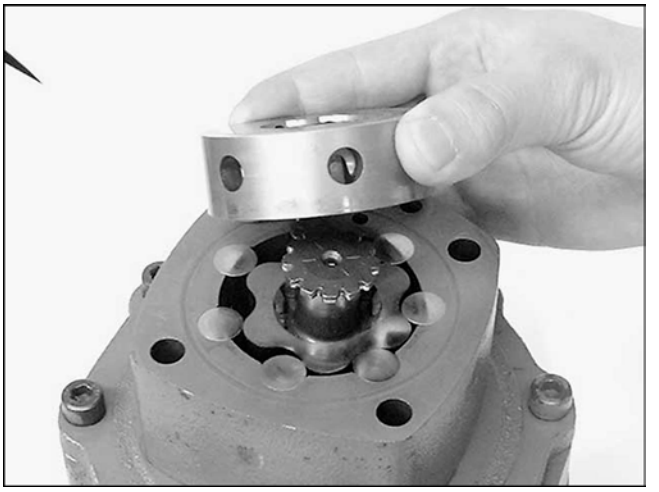
22. Mount the geroller.
    Align it with the drain hole.

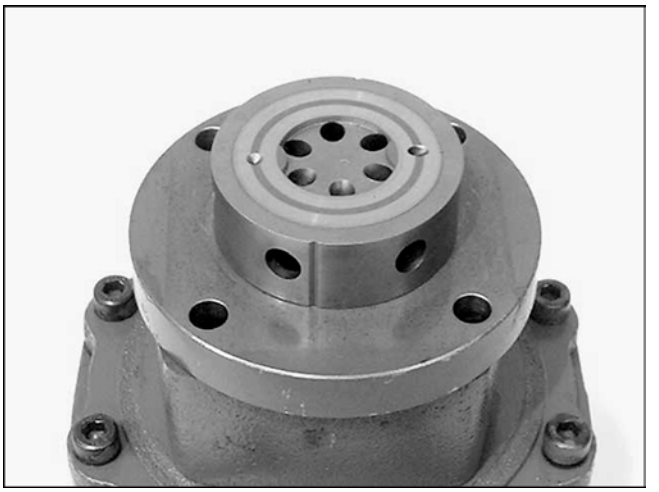


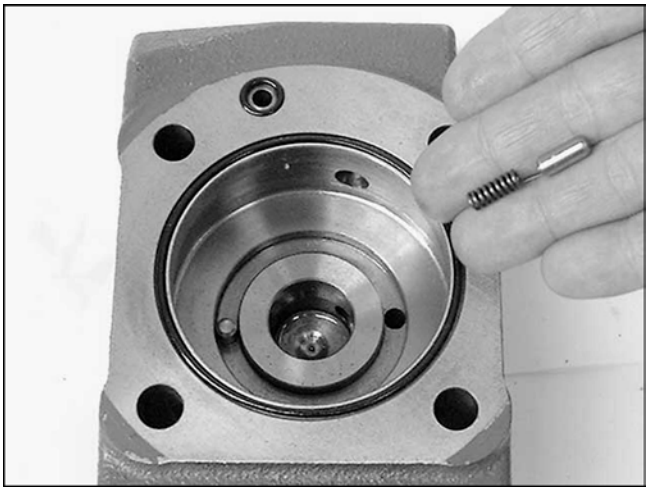
23. Insert the valve drive.



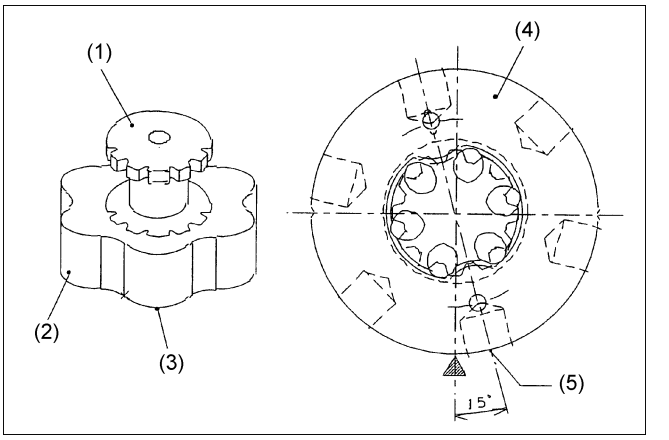
24. Fit the 2 different O-rings into the O-ring grooves of the valve plate.
    Mount the valve plate onto the geroller.
    Align it with the drain hole.







25. Mount the valve.

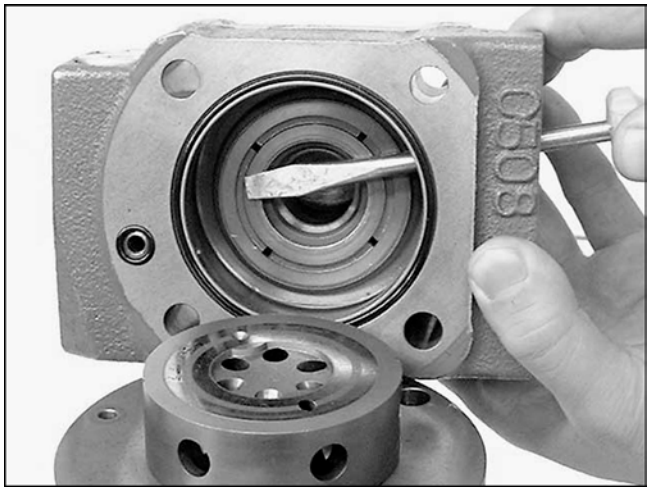


(1)Valve drive
(2)Geroller
(3)Outer crest
(4)Valve
(5)Side hole

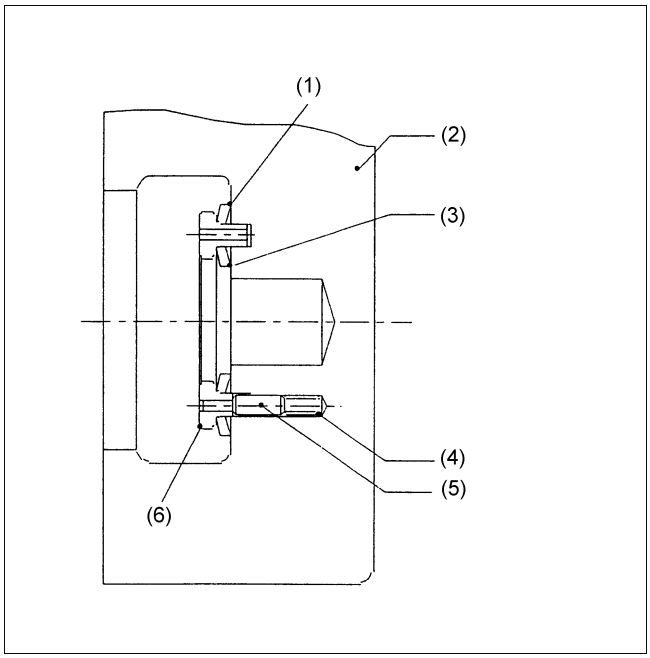
26. Mounting the valve is important for determining the motor rotating direction.
Mount it with care according to the left figure.

⚠ Wrong timing will rotate the motor in the wrong direction, which causes danger.

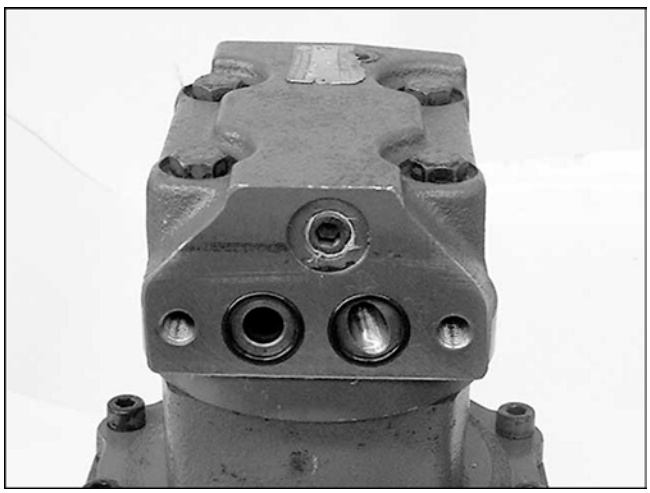
27. Fit the spring and pin to the valve housing.
Fit the outer face seal and inner face seal to the balancing ring.
Mount the balancing ring, with its notch in the pin, into the valve housing.



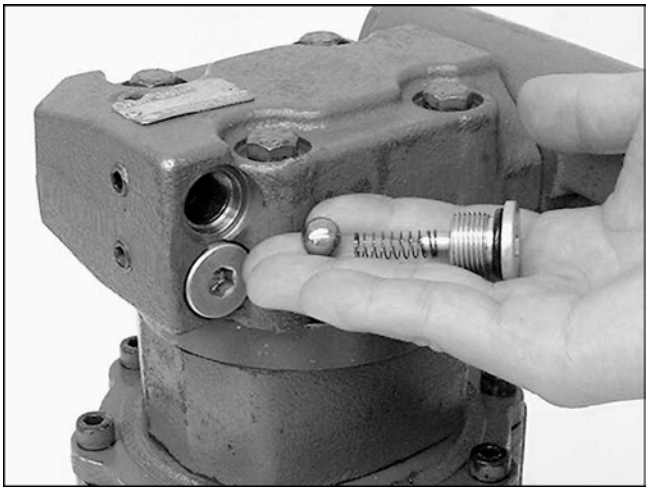
28. Fit the 2 different O-rings into the O-ring grooves of the valve housing.
    Insert a screwdriver or the like from the B port of valve housing, and mount the valve housing to the valve while holding the balancing ring in place.
    Align it with the drain hole.



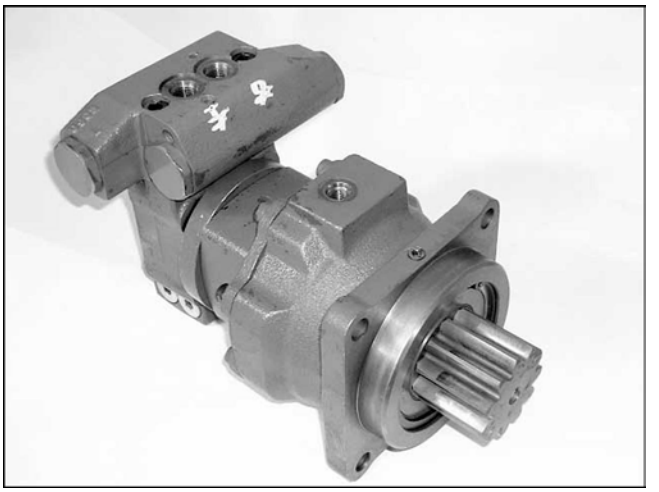
(1)Outer face seal
(2)Valve housing
(3)Inner face seal
(4)Spring
(5)Pin
(6)Balancing plate



29. Tighten the hex bolt.
    Tightening torque: 59 N·m (6 kgf·m) 43.4ft·lbs
    Apply LOCTITE No. 242.

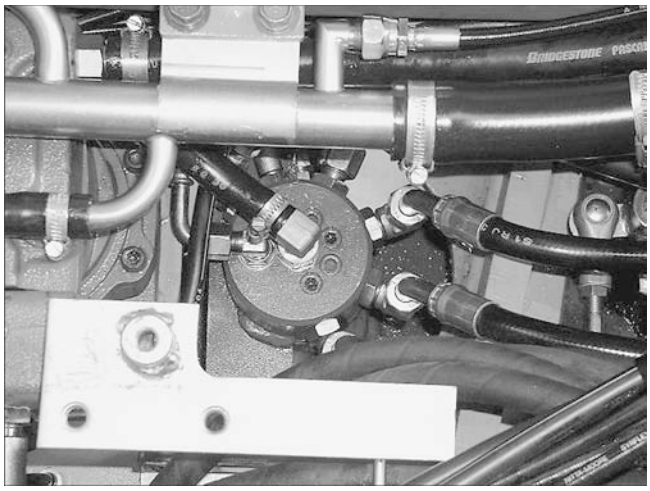


30. Fit the steel ball, spring and check plug to the valve housing.
    Tightening torque: 59 N·m (6 kgf·m) 43.4ft·lbs



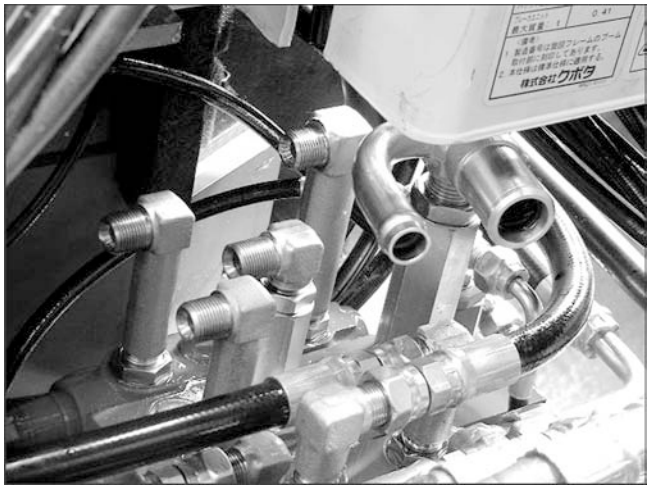
Now the swivel motor has been reassembled.
Before mounting it to the machine, check the motor rotating direction.
Rotating direction (as viewed from the pinion shaft side)
Av port pressurization: Clockwise
Bv port pressurization: Counterclockwise

e. Rotary joint (Swivel joint)

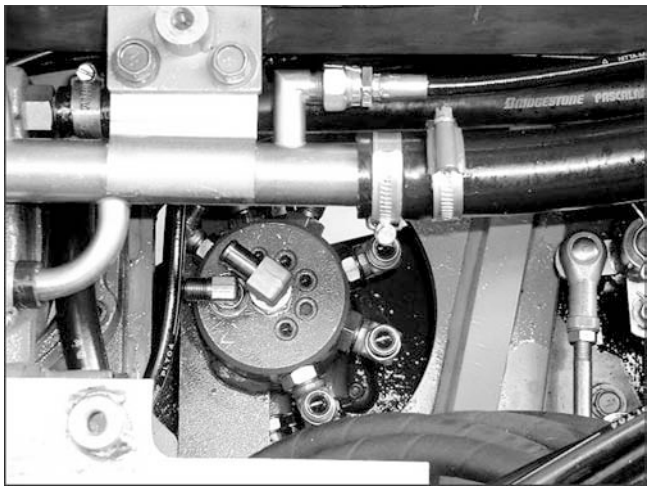


1) Mounting and dismounting procedure

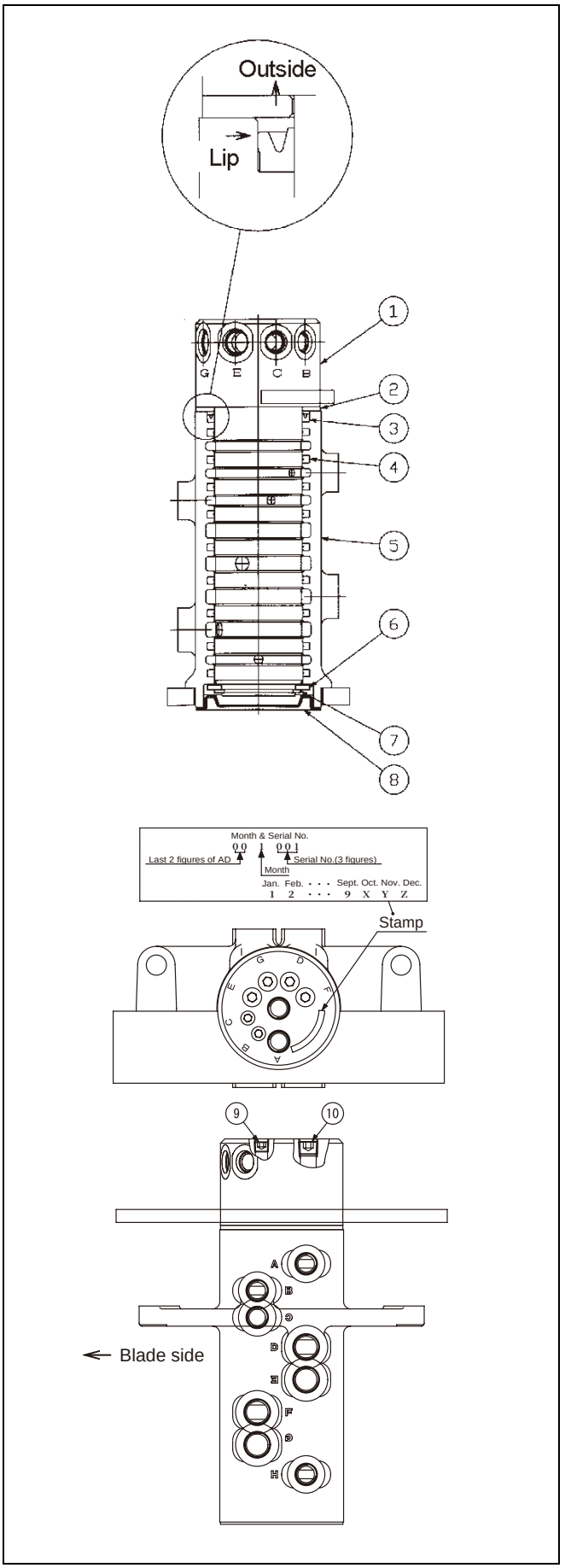
1. Let out the hydraulic oil.
2. Dismount the steps.
3. Disconnect the return, bucket and boom hoses from the control valve.
4. Disconnect the travel, dozer, 2-speed select and drain hoses.
   * Disconnect them from the upper side (shaft side).



5. When disconnecting the travel motor hose from the control valve, loosen the return joint 90 degrees. It helps disconnect the hose easily.



6. Disconnect the 10 hoses, including the travel, dozer, 2-speed select and drain hoses, from the bottom.

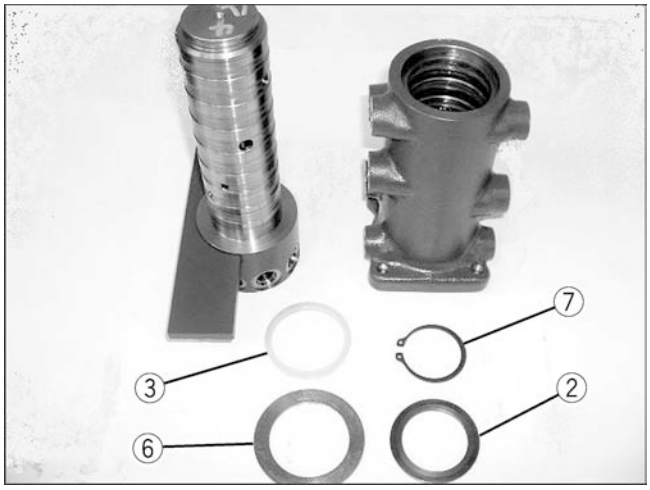


7. Remove the 4 lock bolts.
   (Place a jack below the machine or apply ropes or the like to the machine to avoid a fall.)
   Tightening torque of swivel joint assembly and track frame:
   77.5~90.2 N·m (7.9~9.2 kgf·m) 57.1~66.5ft·lbs

2) Reassembling procedure

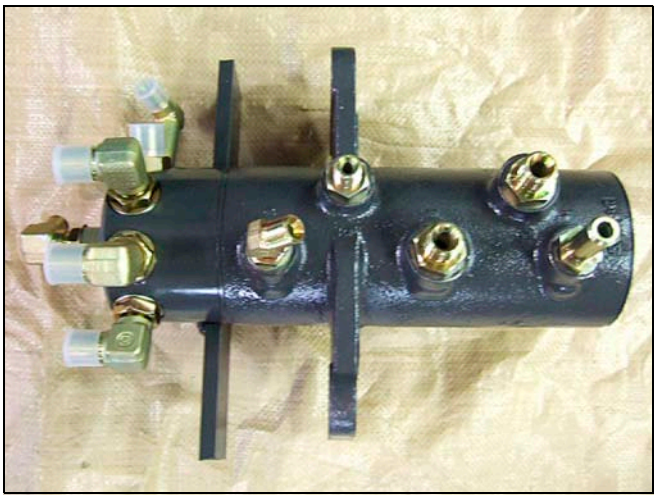
1. Check the outer casing, inner casing and seals for scratches and dust deposits before reassembling.
2. Fit the packing with its seal lip facing outward. (Apply grease to the outer and inner faces of the lip.)
3. When connecting the shaft to the body, apply grease to the outer and inner faces.
4. When mounting the plugs (PT1/8, PT1/4), tighten them so that they do not stretch out of the shaft end.

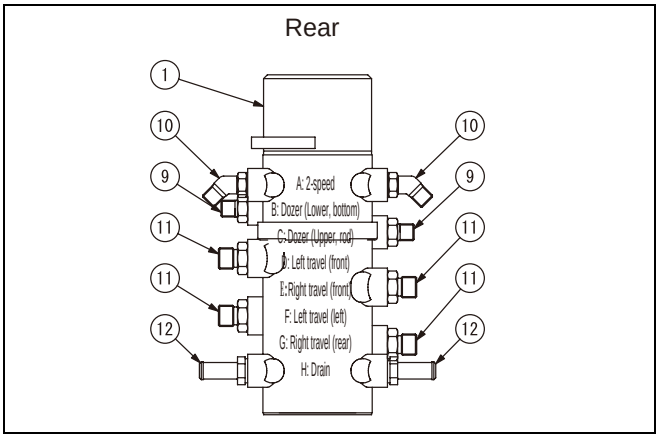
No.	Part name	Q'ty	Remarks
1	Body (Swivel joint)	1	
2	Collar (Swivel joint)	1	
	Packing	1	
3	Packing (Swivel joint)	9	
4	Shaft(Swivel joint)	1	
5.6	Collar	1	
7	Snap ring for shaft	1	
8	Plug	1	
9	Plug (PT1/4)	2	
10	Plug (PT1/8)	4	

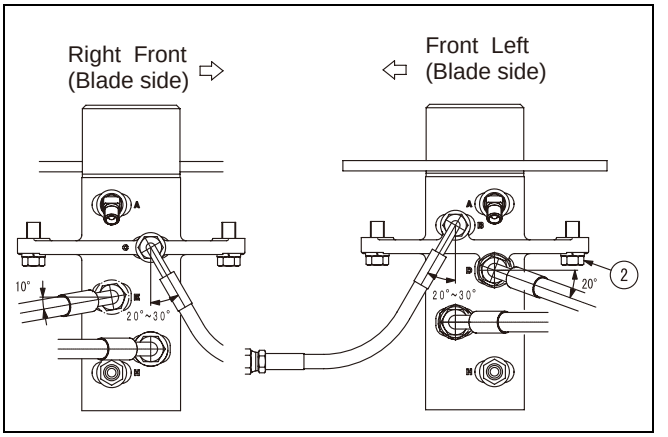


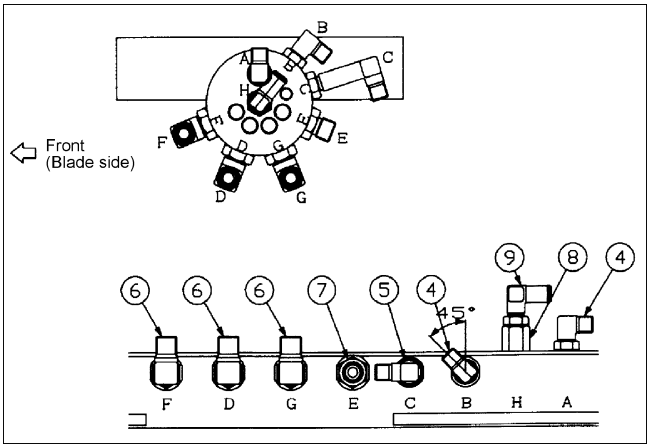
Insert the seal ring using a specific tool.

Seal inserting tool Tool No.: KS000-00130





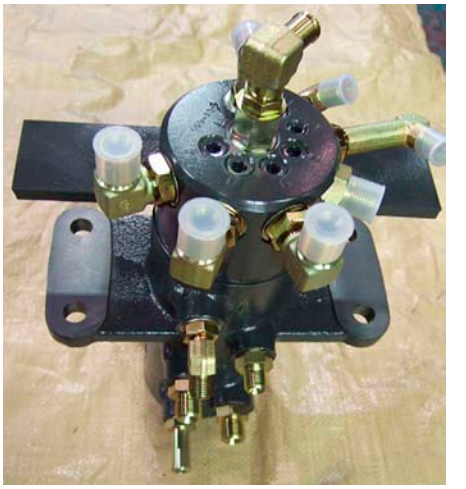


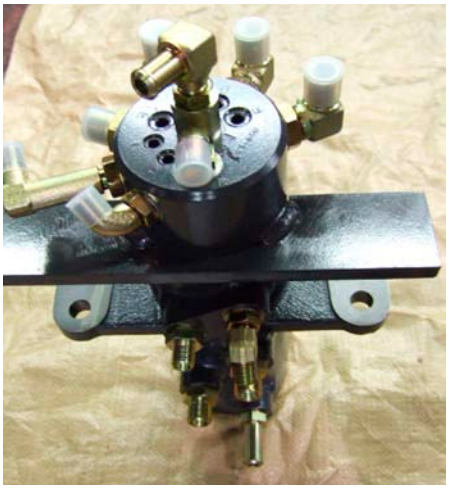


3) Mounting the adaptor

1. Mount the adaptor as shown in the figure and photo.
2. Tightening torque of hydraulic adaptor:
   G1/4 24.5 ~ 28.4 N·m (2.5~3.0 kgf·m)
   18.1~21.7ft·lbs
   G3/8 49.0 ~ 53.9 N·m (5.0~5.5kgf·m)
   36.2~39.8ft·lbs
3. Parts list.

	No.	Part name	Q'ty	Remarks
Shaft side	1	Swivel joint, assembly	1	
	2	Bolt	4	M12x1.27, 7T
	3	Pipe joint (L. G1/4~G1/4)	2	A·B
	4	Pipe joint (L. G1/4~G1/4)	1	C
	5	Pipe joint (L. G3/8~G3/8)	3	D·F·G
	6	Straight pipe joint	1	E
	7	Pipe joint (Bushing G1/4)	1	H
	8	Elbow pipe joint (G4 ~13)	1	H
		O-ring	5	For 1/4 A·B·C·H
		O-ring	4	For 3/8 A·B·C·H
Body side	9	Straight pipe joint	2	B·C
	10	Pipe joint (L. G1/4~G1/4)	2	A
	11	Straight pipe joint	4	D·E·F·G
	12	Straight pipe joint (F2~13)	2	H
		O-ring	6	For 1/4 A·B·C·H
		O-ring	4	For 3/8 A·B·C·H



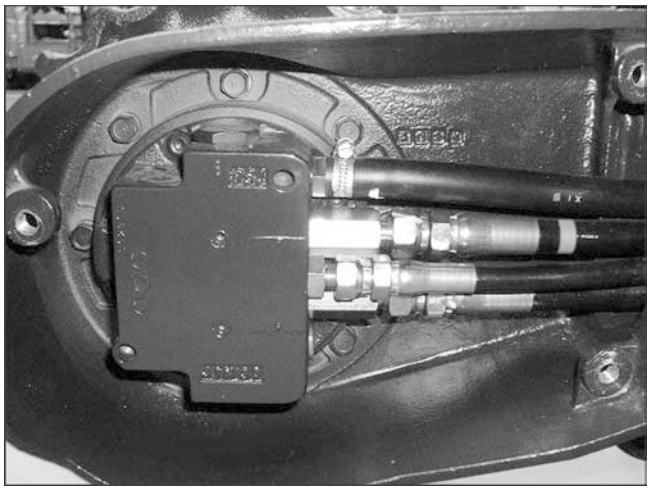


* For the hydraulic hose routing, refer to pages.

f. Traveling motor

[1] Mounting and dismounting the wheel motor

(Kayaba make)



(Fujikoshi make)

1) Mounting and dismounting the wheel motor

1. Loosen the tension cylinder and remove the crawler

⚠ CAUTION:
If you work together with a person to remove the crawler, pay attention to the positions of your and the person's feet and hands.

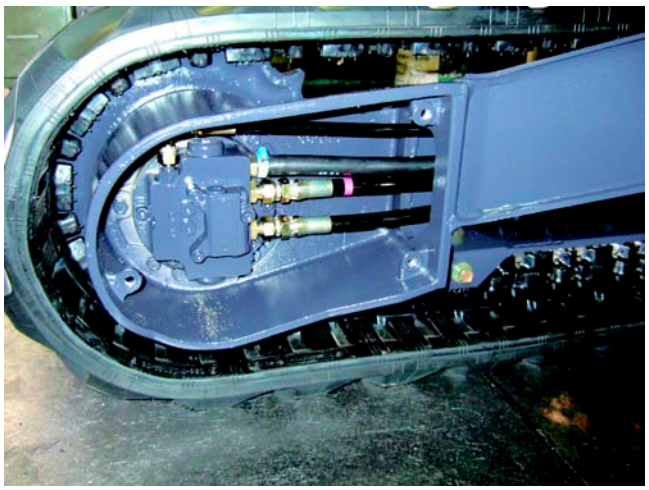
2. Remove the motor cover and then remove the high-pressure hose and drain hose, using a vacuum pump.
3. Remove the wheel motor mounting bolt and remove the wheel motor from the track frame.

- Tightening torque of motor (track frame, sprocket):
  166.7~196.1 N·m (17.0~20.0 kgf·m)
  123~145ft·lbs
  Apply screw LOCTITE. (LOCTITE No. 271)

2) Reassembling procedure

1. When installing the wheel motor on the track frame, face the port side to the front.
2. Face the motor drain hose upward and the plug downward.
3. The hoses connected between the motor and swivel joint should not be twisted or crossed unduly in the track frame.

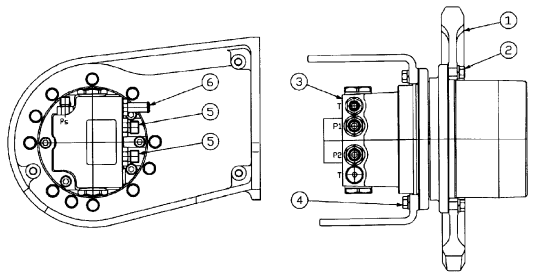
(Fujikoshi make)



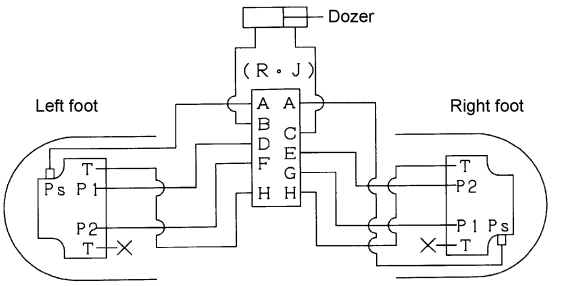
(Kayaba make)

[2] List of adapter hoses

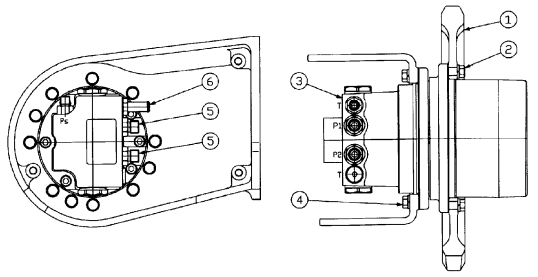
U25-3α U25S



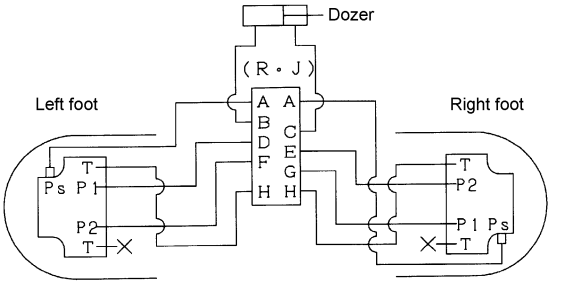
U25-3α U25S



U 20-3α



U 20-3α



Parts list

No.	Part name	Q'ty	Remarks
1	Drive sprocket	2	(111)
2	Bolt	20	M1051.5 9T
3	Motor assembly (wheel)	2	Kayaba-made (614)
4	Bolt	24	M1051.5 9T
5	Straight pipe joint	4	P1•P2
6	Straight pipe joint (F2-13)	2	T upper side
	O-ring	2	For 1/4 T
	O-ring	4	For 3/8 P1•P2

Parts list

Location	Part name	Q'ty	Dimension mm (inch.)	Tape color
R/J to travel M travel (upper side)	Hydraulic hose (travel, 3/8)	2	920 (36.22)	Red
R/J to travel M travel (lower side)	Hydraulic hose (travel, 3/8)	2	920 (36.22)	
R/J to travel M two-speed	Hydraulic hose (two-speed, 1/4)	2	1030 (40.55)	
R/J to connection (dozer)	Hydraulic hose (blade, 1/4)	2	255 (10.04)	
Joint to dozer cylinder	Hydraulic hose (blade, 1/4)	2	590 (23.23)	

Hose routing

S/J side	Travel motor and cylinder side
A Two-speed pilot	Right/Left travel two-speed
B Dozer down	Cylinder bottom side
C Dozer up	Cylinder rod side
D Left forward	Left P1 (upper side)
E Right forward	Right P2 (upper side)
F Left backward	Left P2 (lower side)
G Right backward	Right P1 (lower side)
H Drain	Right/Left drain port (upper side)

Parts list

No.	Part name	Q'ty	Remarks
1	Drive sprocket	2	(111)
2	Bolt	18	M1051.5 9T
3	Motor assembly (wheel)	2	Fujikoshi-made (614)
4	Bolt	16	M1051.5 9T
5	Straight pipe joint (3-3-35)	4	A•B
6	Straight pipe joint	2	PP
7	Straight pipe joint (F2-13)	2	DP upper side
	O-ring	4	For 1/4 PP•DR
	O-ring	4	For 3/8 A•B

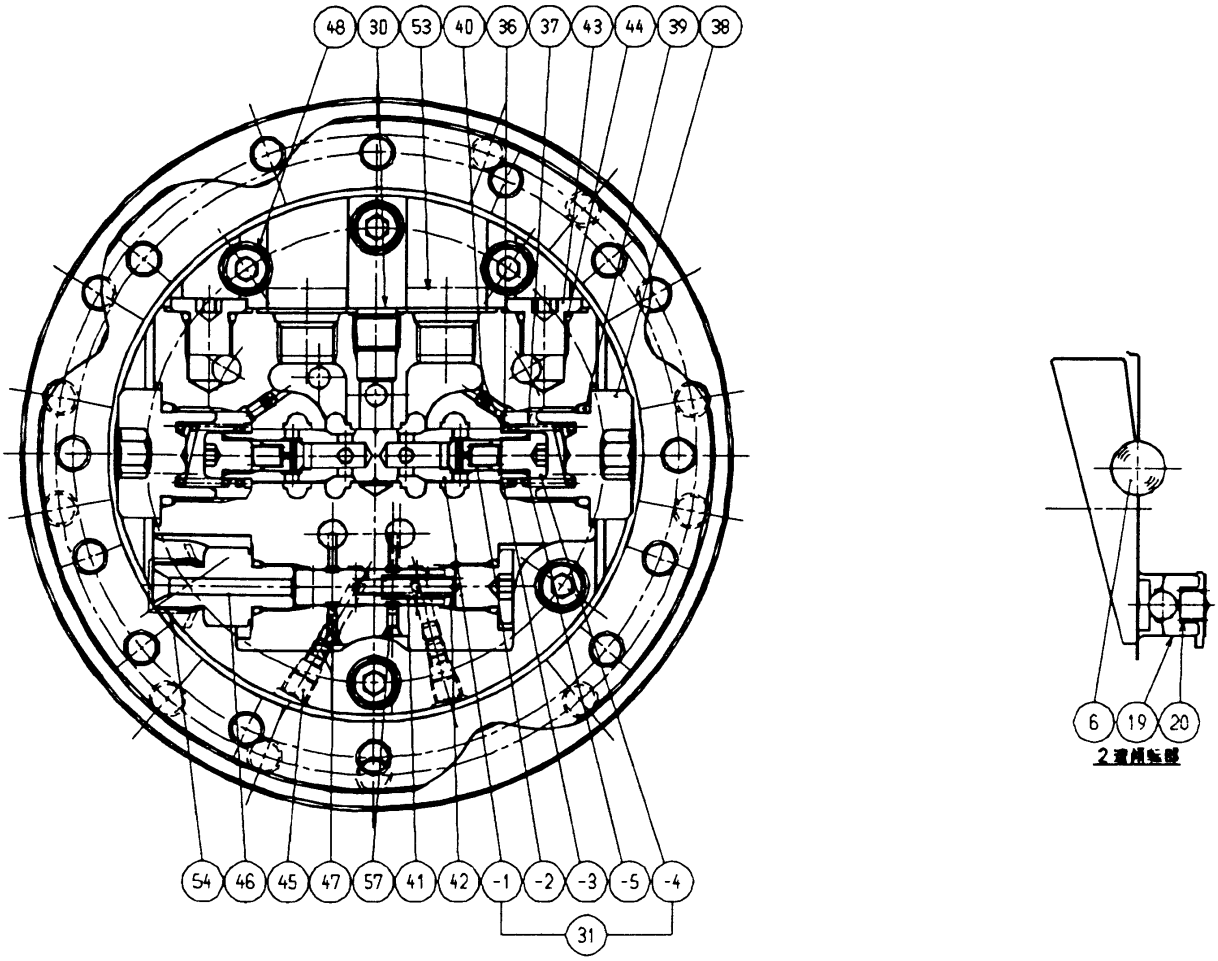
Parts list

Location	Part name	Q'ty	Dimension mm (inch.)	Tape color
R/J to travel M travel (upper side)	Hydraulic hose (travel, 3/8)	2	840 (33.07)	Red
R/J to travel M travel (lower side)	Hydraulic hose (travel, 3/8)	2	840 (33.07)	
R/J to travel M two-speed	Hydraulic hose (two-speed, 1/4)	2	890 (35.04)	
R/J to connection (dozer)	Hydraulic hose (blade, 1/4)	2	240 (9.45)	
Joint to dozer cylinder	Hydraulic hose (blade, 1/4)	2	490 (19.29)	

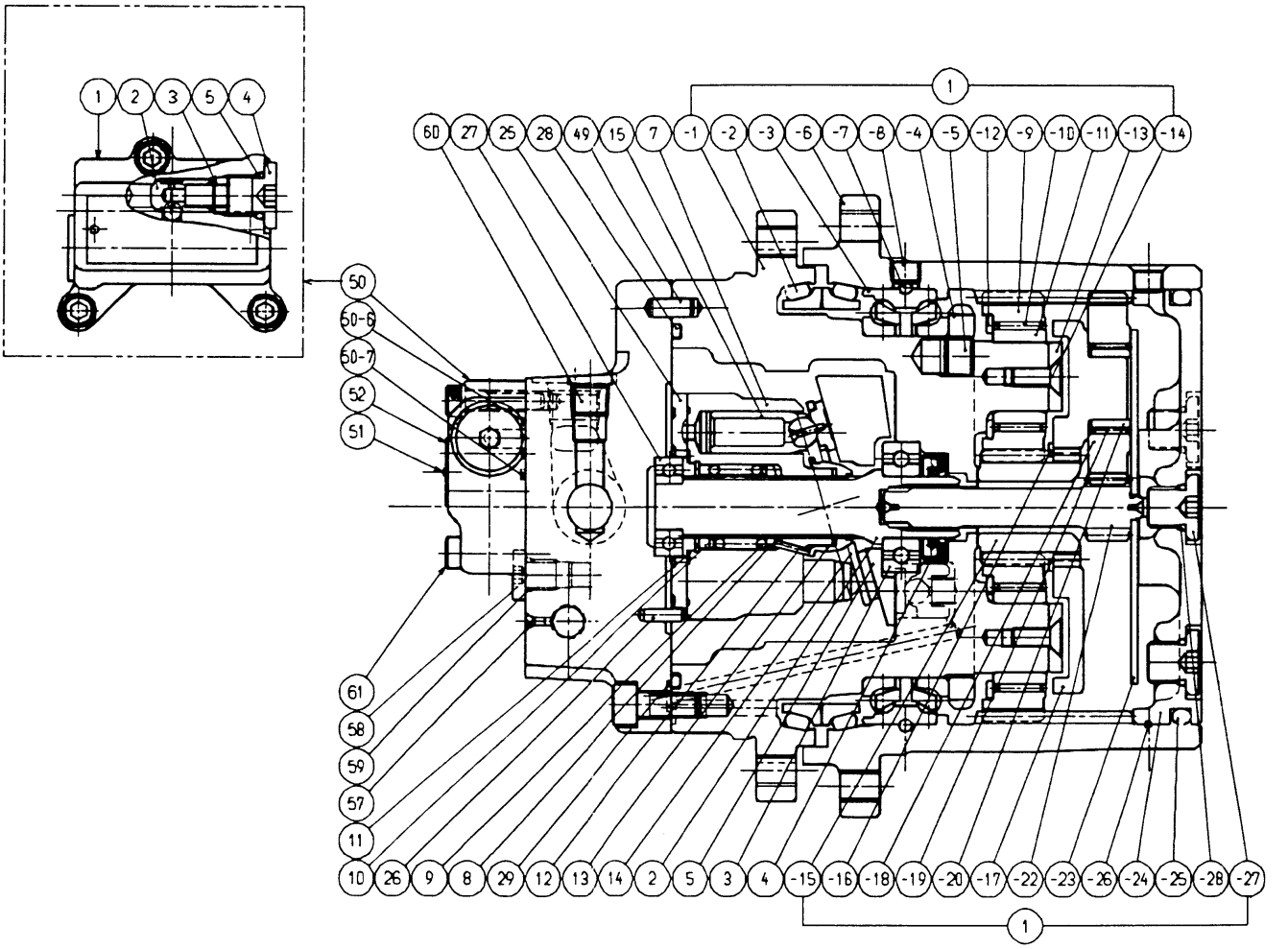
Hose routing

S/J side	Travel motor and cylinder side
A Two-speed pilot	Right/Left travel two-speed
B Dozer down	Cylinder bottom side
C Dozer up	Cylinder rod side
D Left forward	Left A (upper side)
E Right forward	Right B (upper side)
F Left backward	Left B (lower side)
G Right backward	Right A (lower side)
H Drain	Right/Left drain port (upper side)

[3] Component parts of wheel motor (Kayaba-make)



(31-4) Tightening torque 27.0±2.5N·m Hex5 (2.75±0.26kgf·m) 19.9±1.84ft·lbs
(38) Tightening torque 157±8N·m Hex12 (16.0±0.82kgf·m) 115.8±5.90ft·lbs
(40) Tightening torque 1.47±0.49N·m Hex2 (0.15±0.05kgf·m) 1.08±0.36ft·lbs
(45) Tightening torque 9.8±1.0N·m Hex 3.98 (1.00±0.10kgf·m) 7.23±0.73ft·lbs
(46) Tightening torque 36.8±2.5N·m Hex19 (3.75±0.26kgf·m) 27.1±1.84ft·lbs
(48) Tightening torque 37.0±1.9N·m Hex6 (3.77±0.19kgf·m) 27.3±1.40ft·lbs
(53) Tightening torque 1.0~1.14N·m Hex6 (0.102~0.116kgf·m) 0.738~0.841ft·lbs



(1-5) Tightening torque 14.7±4.9N·m Hex6 (1.5±0.5kgf·m) 10.8±3.6ft·lbs
(1-8) Tightening torque 7.8±1.0N·m Hex5 (0.80±0.10kgf·m) 5.75±0.74ft·lbs
(1-14) Tightening torque 6.1±2.0N·m Hex4 (0.62±0.20kgf·m) 4.50±1.48ft·lbs
(1-27) Tightening torque 34.3±4.9N·m Hex8 (3.50±0.50kgf·m) 25.3±3.6ft·lbs
(50-4) Tightening torque 36.8±2.5N·m Hex6 (3.75±0.26kgf·m) 27.1±1.84ft·lbs
(58) Tightening torque 15.3±3.0N·m Hex5 (1.56±0.31kgf·m) 11.3±2.21ft·lbs
(60) Tightening torque 12.3±2.5N·m Hex6 (1.25±0.26kgf·m) 9.07±1.84ft·lbs
(61) Tightening torque 15.2±0.8N·m Hex5 (1.55±0.08kgf·m) 11.2±0.59ft·lbs

Parts list

Part No.	Name	Q'ty
1	Reducer	1
1-1	Flange holder	1
1-2	Floating seal	2
1-3	Angular bearing	1
1-4	Ring nut	1
1-5	Plug	2
1-6	Housing	1
1-7	Steel ball	109
1-8	Hex socket plug	2
1-9	Planetary gear B	4
1-10	Needle bearing	4
1-11	Inner race	4
1-12	Thrust washer	4
1-13	Thrust plate	1
1-14	Screw	4
1-15	Sun gear	1
1-16	Snap ring	1
1-17	Holder	1
1-18	Planetary gear A	3
1-19	Cage & Roller	3
1-20	Inner race	3
1-22	Drive gear	1
1-23	Thrust plate	1
1-23	Thrust plate	1
1-23	Thrust plate	1
1-24	Cover	1
1-25	O-ring	1
1-26	Wire	1
1-27	Plug	2
1-28	O-ring	2
2	Shaft	1
3	Ball bearing	1
4	Oil seal	1
5	Swash plate	1
6	Steel ball	2
7	Cylinder block	1
8	Spring seat	1
9	Spring	1
10	Washer	1
11	Snap ring	1
12	Pin	3
13	Retainer holder	1
14	Retainer plate	1
15	Piston assembly	9
19	Piston assembly	2

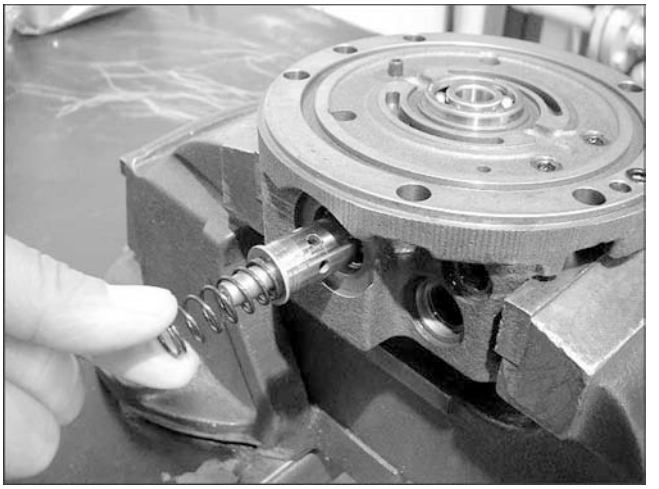
Part No.	Name	Q'ty
20	Spring	2
25	Valve plate	1
26	Pin	1
27	Ball bearing	1
28	O-ring	1
29	O-ring	3
30	Base plate	1
31	Spool assembly	1
31-1	Spool	1
31-2	Check valve	2
31-3	Spring	2
31-4	Plug	2
31-5	O-ring	2
36	Spring seat	2
37	Spring	2
38	Cap	2
39	O-ring	2
40	Orifice	2
41	Spool	1
42	Spring	1
43	Plug	3
44	O-ring	4
45	Plug	2
46	Plug	1
47	Orifice	4
48	Socket head bolt	6
49	Pin	2
50	Valve assembly	1
50-1	Valve body	1
50-2	Check valve	2
50-3	Spring	2
50-4	Plug	2
50-5	O-ring	2
50-6	O-ring	2
50-7	O-ring	1
51	Nameplate	1
52	Drive screw	2
53	Shipping plug	2
54	Shipping plug	1
57	Plug	2
58	Plug	2
59	O-ring	2
60	Plug	1
61	Socket head bolt	3

[4] Disassembling and reassembling the wheel motor

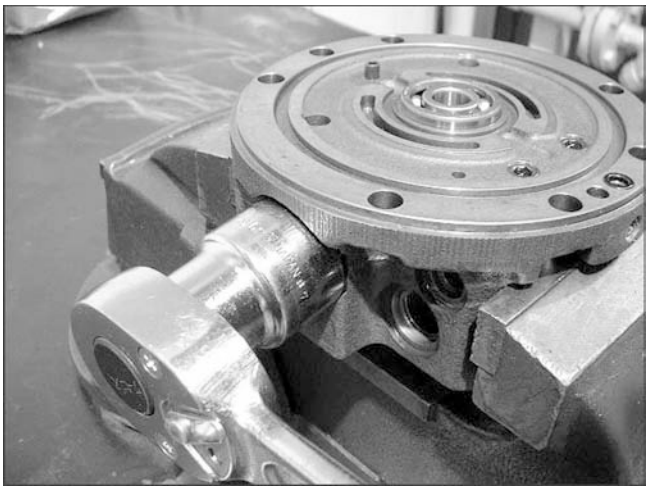
1) General cautions in disassembling/reassembling

In disassembling and reassembling, observe the following precautions.

1. Perform work in a clean place and take care not to allow dirt, dust, paint flakes, water, etc. to adhere to the motor. Have a clean container handy so that the removed parts can be put in it.
2. Before disassembling, clean dirt off the outer surface of the motor, and remove paint from the joints of each section using a wire brush or the like.
3. Put a marking on each part before disassembling so that it can be put back in place at the time of reassembling.
4. Carefully handle the removed parts so that they are not damaged.
5. Well wash the removed parts with washing oil, etc.
6. Check the removed parts for abnormal wear or seizure. Remove burrs etc., if any.
7. The seals and snap rings should be replaced with new ones.
8. Note that the parts to be press-fitted (bearing, pin, etc.) cannot be disassembled in principle.



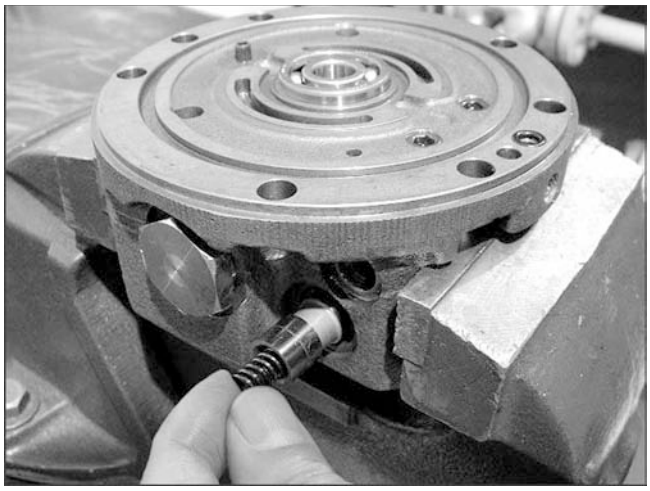
1. Insert the spool assembly ring (both sides) and spring (both sides) into the body 1.



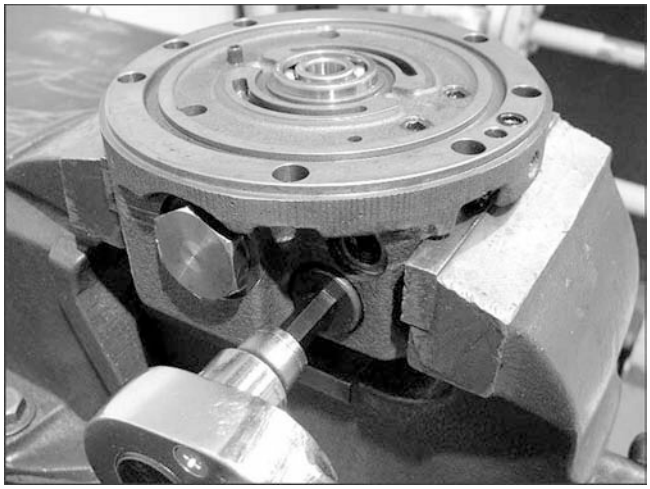
2. Tighten the plug (both sides) to which the O-ring is fitted.

   Tightening torque of plug: 167~196 N·m
   (17~20 kgf·m)
   123~145 ft·lbs

   Width across flat of hexagon: 27 mm



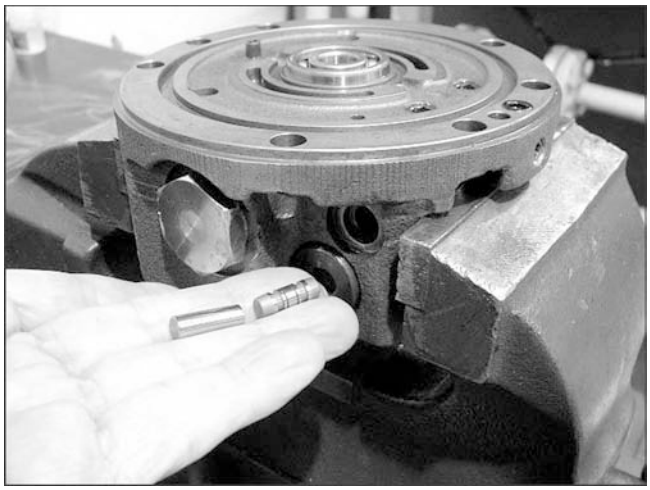
3. Insert the two-speed spool and spring into the body 1.



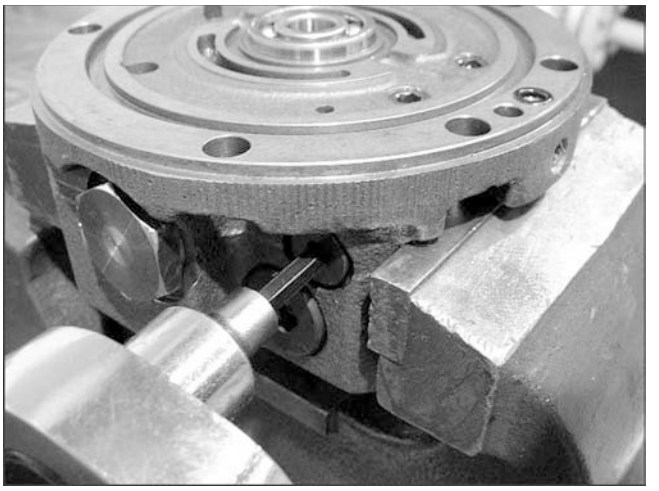
4. Tighten the plug (both sides) to which the O-ring is fitted.

   Tightening torque of plug: 46~51 N·m
   (4.7~5.3 kgf·m)
   34~38 ft·lbs

   Take care that the spool and spring are positioned and oriented properly.



5. Insert the shuttle spool and needle (both sides) in to the body 1.

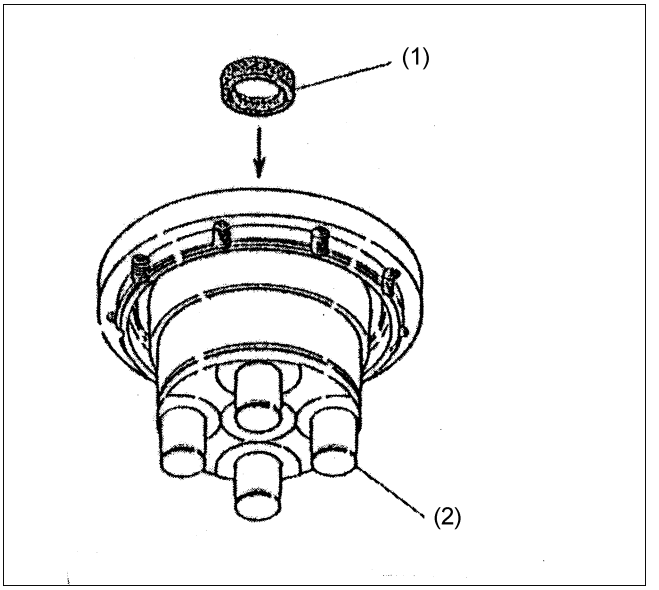


6. Tighten the plug (both sides) to which the O-ring is fitted.

   Tightening torque of plug: 12~22 N·m
   (1.2~2.3 kgf·m)
   8.7~16.6 ft·lbs

   Width across flat of hexagon: 5 mm

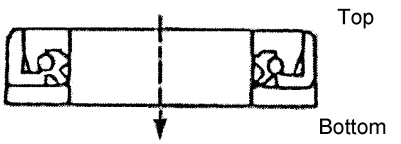
7. Press-fit the bearing and spring pin into the body 1. Then fit the O-rings (2 places).



8. Press-fit the oil seal into the body 2.

⚠ CAUTION:

1. Apply grease to between the lips of the oil seal
2. Press-fit the oil seal in the direction shown in the figure below.



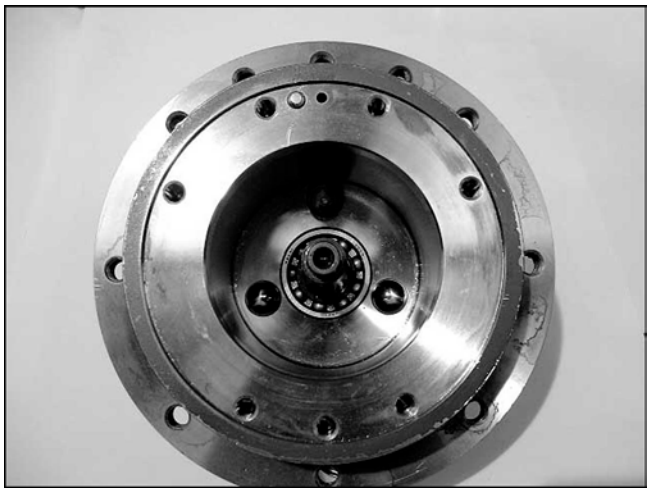
Oil seal press-fitting direction

(1)Oil seal
(2)Body2

9. Fit the parallel pin to the body 2.

10. Press-fit the bearing onto the shaft.

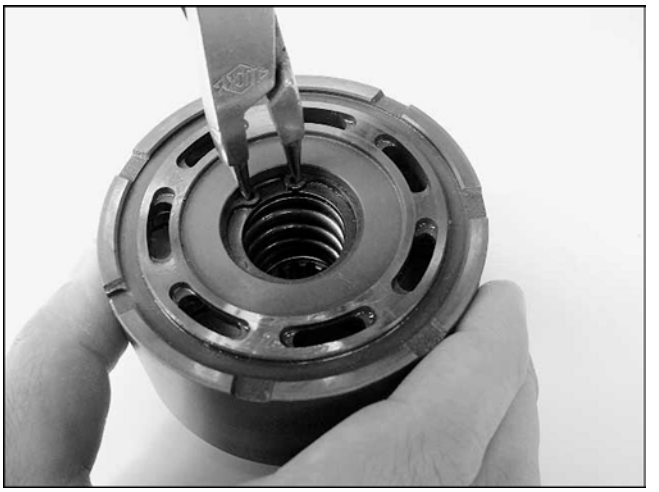
CAUTION:
The bearing cannot be disassembled because it is press-fitted.



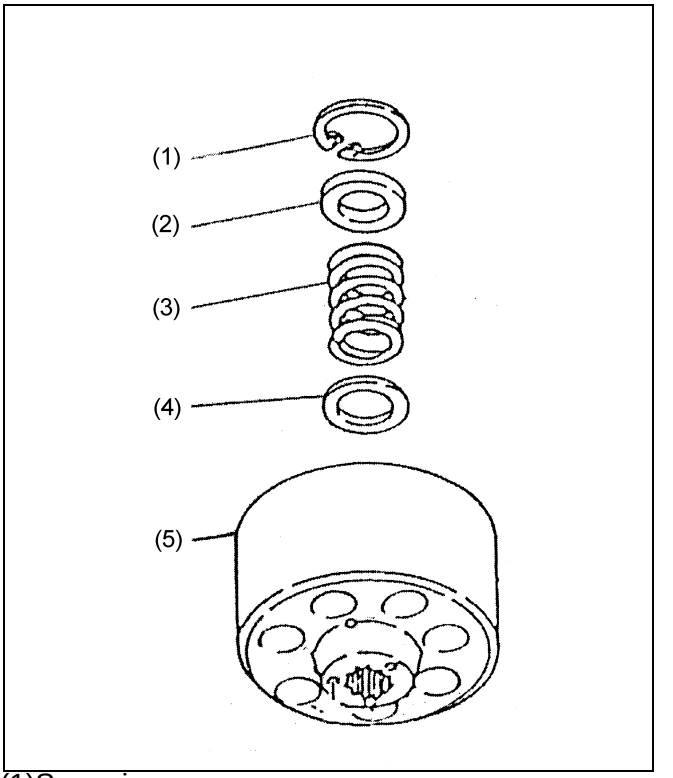
11. Fit the control piston, steel ball and shaft to the body 2.

CAUTION:
Take care not to allow the shaft to damage the oil seal.

12. Fit the swash plate.



13. Fit the retainer, spring and retainer to the cylinder barrel in this order and fix them with the snap ring.



(1)Snap ring
(2)Retainer
(3)Spring
(4)Retainer
(5)Cylinder barrel

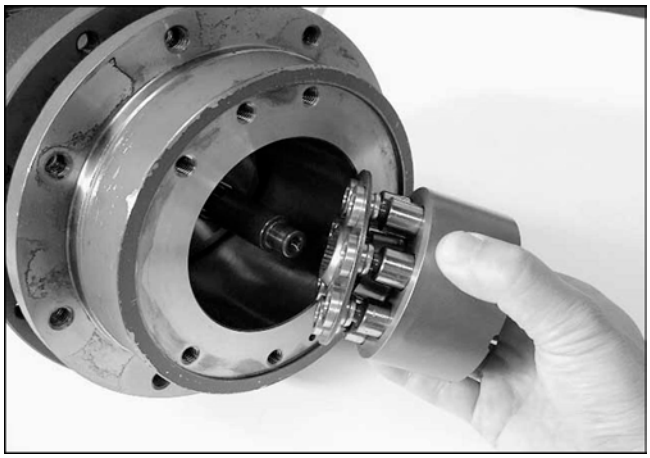
14. Insert the pins (3 pairs) into the cylinder barrel.

CAUTION:
Take care not to lose the pin at the time of disassembling/assembling.

15. Fit the retainer holder to the cylinder barrel.

16. Using the shoe holder assembly and barrel holder, assemble the cylinder barrel assembly.

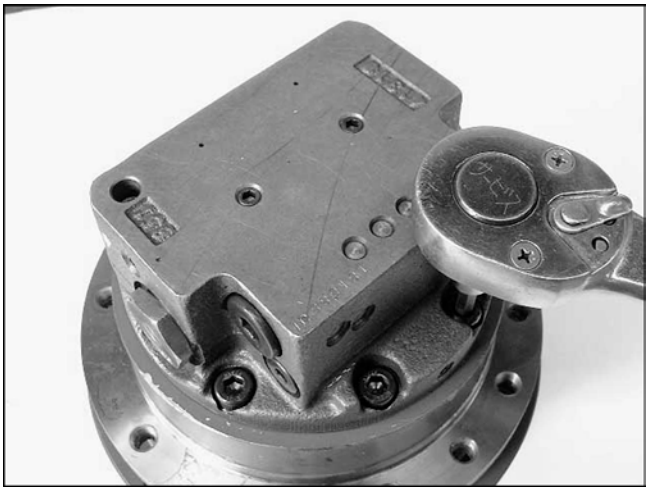
CAUTION:
Apply hydraulic oil to the seven holes in the cylinder barrel.



17. Fit the cylinder barrel assembly to the body 2 so that the shoe touches the swash plate.

18. Fit the valve plate to the body 1.
    1) Apply hydraulic oil to the sliding surface (copper surface) of the valve plate.
    2) Applying grease to the back surface (iron surface) of the valve plate will prevent it from coming off easily.

19. Combine the body 1 and body 2.



20. Tighten with the hex socket bolt.

    Tightening torque of M8 bolt:
    28.4~30.4 N·m (2.8~3.1 kgf·m) 20.3~22.4 ft·lbs

    Width across flat of hexagon: 5 mm

    When fixing the motor with a vise, protect the body with aluminum plates, etc.

2) Reassembling the reducer

1. Fit the bearing to the main body.

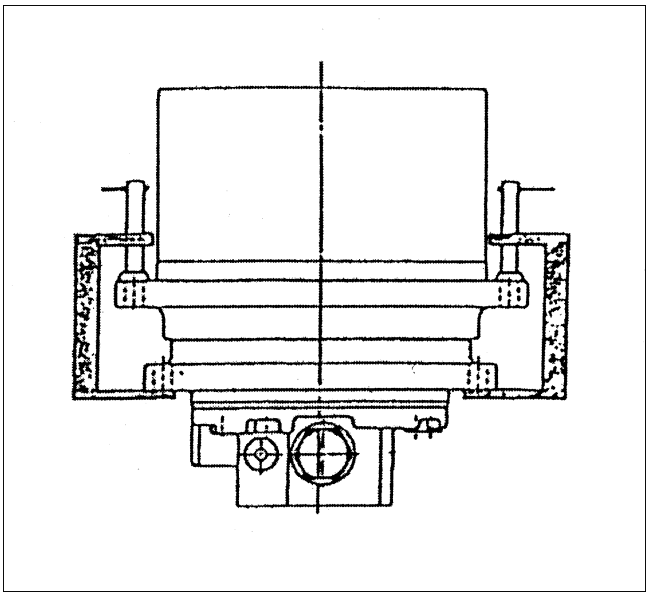
2. Fit the snap ring for hole.

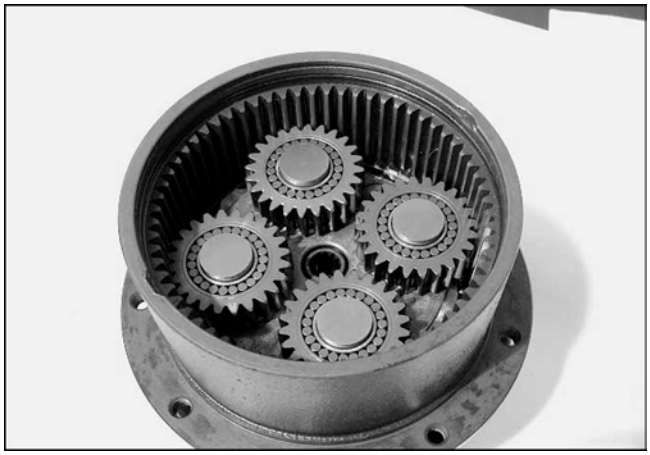
3. Fit the bearing.

4. Fit the floating seat combined with the O-ring.
   * If it is difficult to fit it, apply grease to the O-ring.

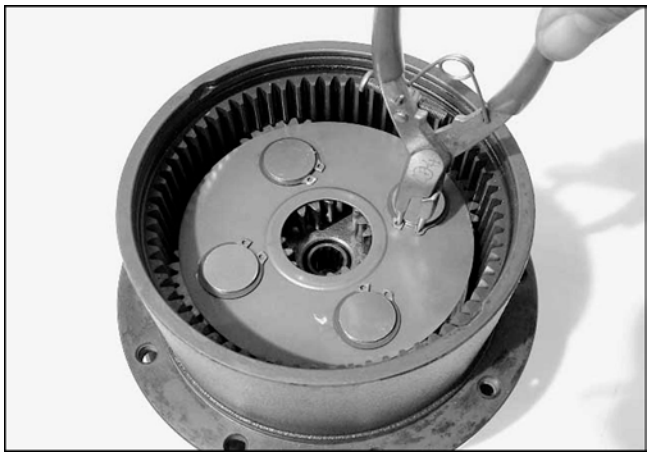
5. Fit the floating seat combined with the O-ring to the hydraulic motor.
   * If it is difficult to fit it, apply grease to the O-ring.

6. Combine the main body and the hydraulic motor and fix them with the snap ring.
   1) Degrease the seat surface of the floating seat.
   2) If it is difficult to fit the main body, evenly hit the periphery of the main body with a resin hammer to fit it.
   3) Fit the snap ring while clamping the reducer main body flange and hydraulic motor flange with a squill vise, hydraulic press, etc.
   4) Adjust the bearing preload with the thickness of the snap ring.



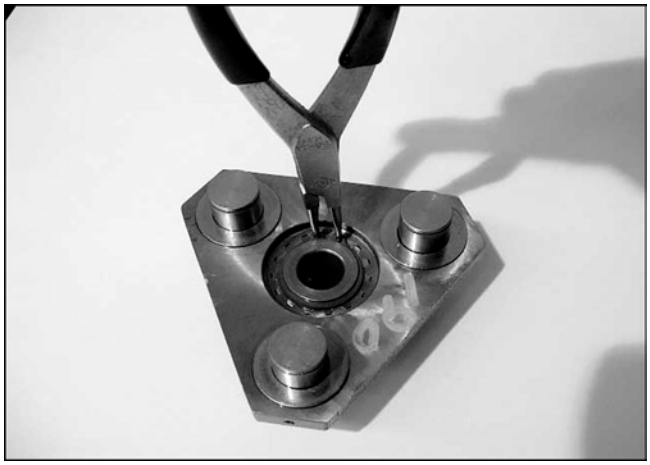


7. Fit the ring, thrust washer, gear b1 and needle to the body 2 in this order.

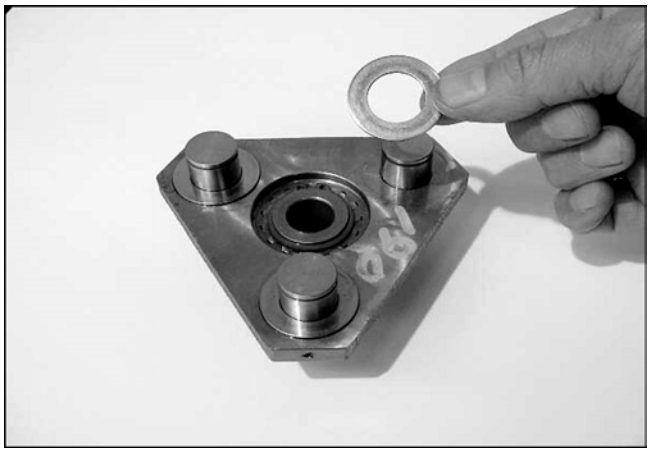


8. Fit the thrust plate 1 and fix it with the snap ring.

⚠ CAUTION:
Fit the plate with the convex surface of the inside diameter side faced upward.



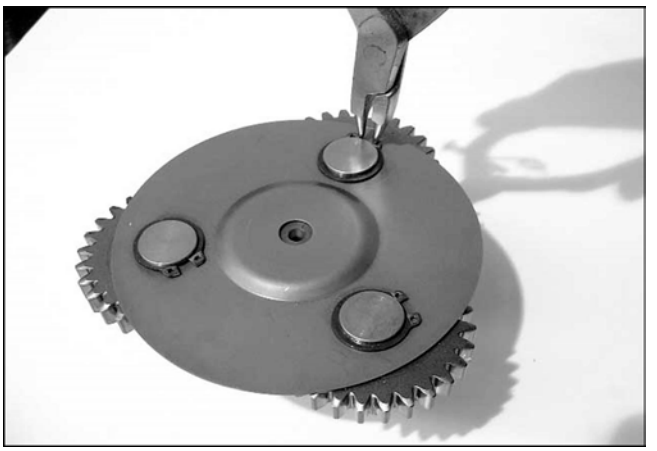
9. Fit the gear S1 to the carrier II and fix it with the snap ring.



10. Fit the thrust washer to the carrier II.

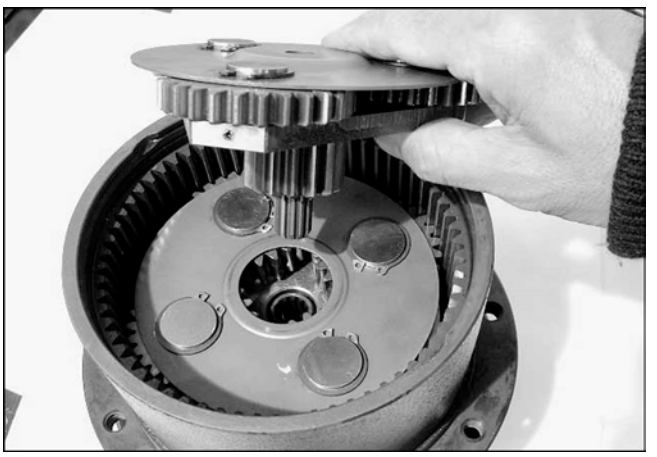
11. Fit the gear b2 and needle to the carrier II in this order.

12. Fit the gear S2.

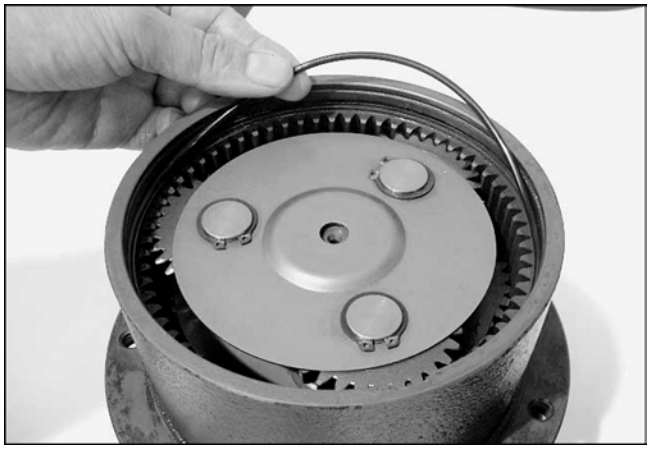


13. Fit the thrust plate II and fix it with the snap ring to assemble the carrier II assembly.

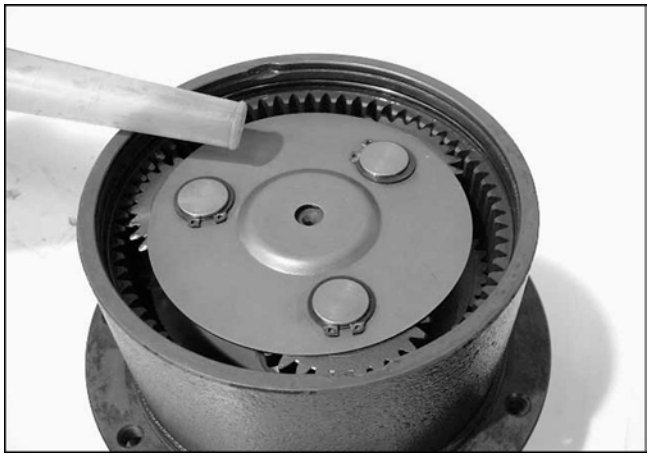
⚠ CAUTION:
Fit the plate with the convex surface faced upward.



14. Fit the carrier II assembly to the main body.

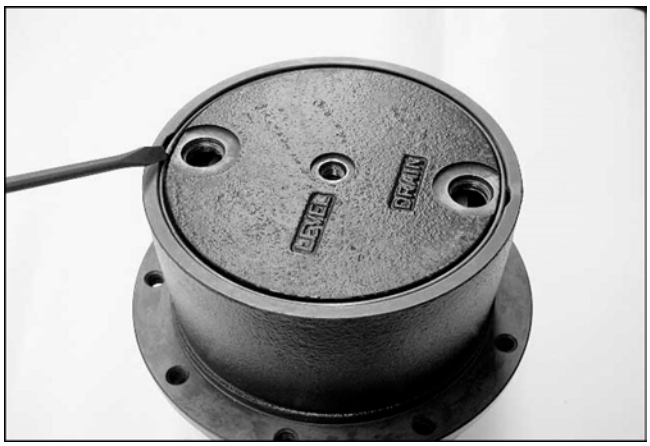


15. Fit the O-ring to the main body.



16. Inject 0.33L of lubricating oil.

17. Fit the cover to the main body.
    1) Apply grease to the O-ring and fit the cover horizontally while taking care not to damage it.
    2) Align the upper and lower tapped holes (G3/8) with the notches in the main body



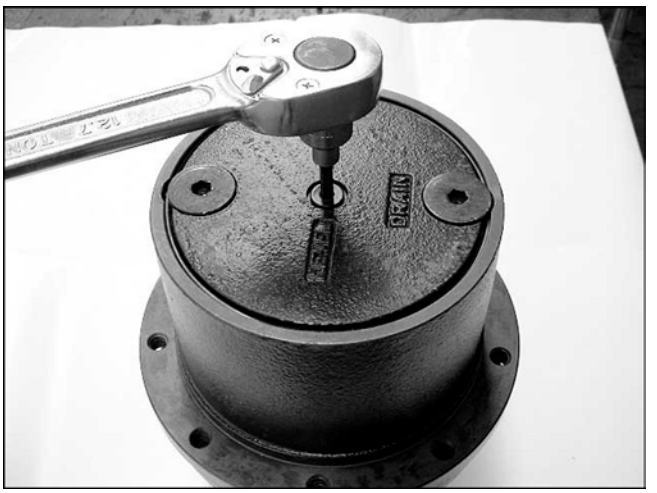
18. Fit the O-snap-ring and fix the cover.
    1) Put a flatblade screwdriver on the end face of the O-snap-ring and strike it in the circumferential direction.

19. Fit the flanged plug (G3/8) to which the O-ring is fitted.

CAUTION:
1. As shown in the figure below, use the flange of the plug to prevent the cover from turning.

   Tightening torque: 46 ~ 51 N·m (4.7 ~ 5.2 kgf·m) 34~38 ft·lbs

   Width across flat of hexagon: 8 mm

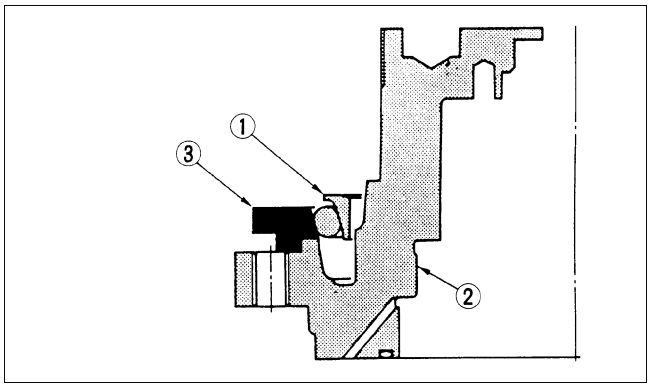


20. Fit the flanged plug (G1/8) to which the O-ring is fitted.

CAUTION:
1. Tightening torque: 12 ~ 22 N·m (1.2 ~ 2.3 kgf·m) 8.7~16.6 ft·lbs

   Width across flat of hexagon: 5 mm

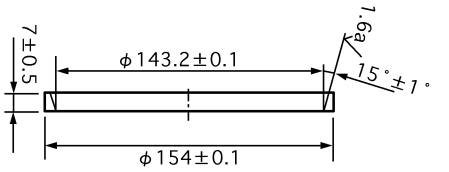
3) Reassembling the wheel motor

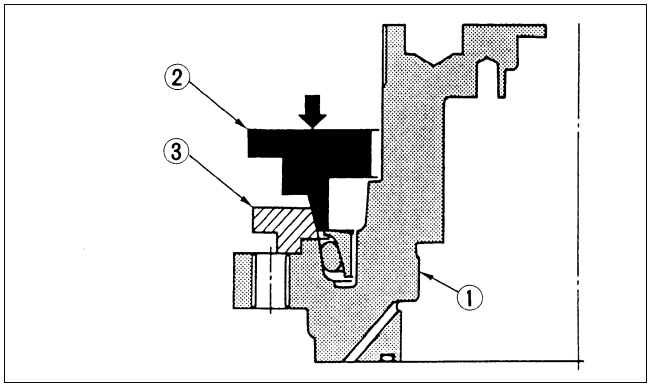


1. Fit the floating seal
   1) Temporarily set the floating seal using the guide jig (see the figure below).

(1) Floating seal
(2) Flange holder
(3) Guide jig

Unit : mm



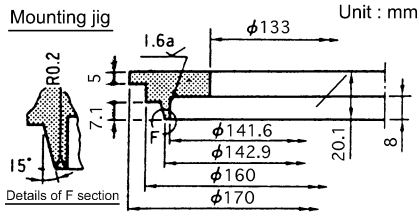


   2) Fit the floating seal using the mounting jig (see the figure below).

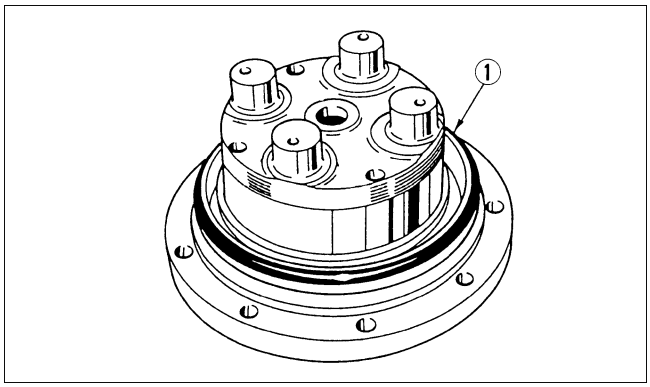
(1) Flange holder
(2) Mounting jig
(3) Guide jig

Mounting jig

Unit : mm

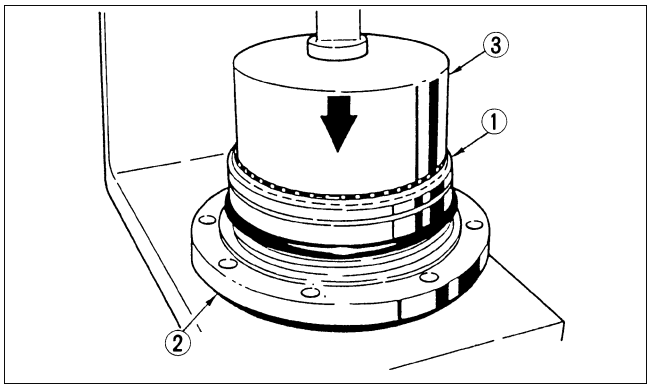


Material: Equivalent of STKM13A



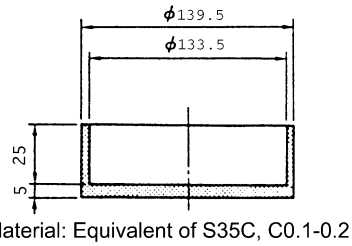
2. Place the other floating seal concentrically.

(1) Floating seal



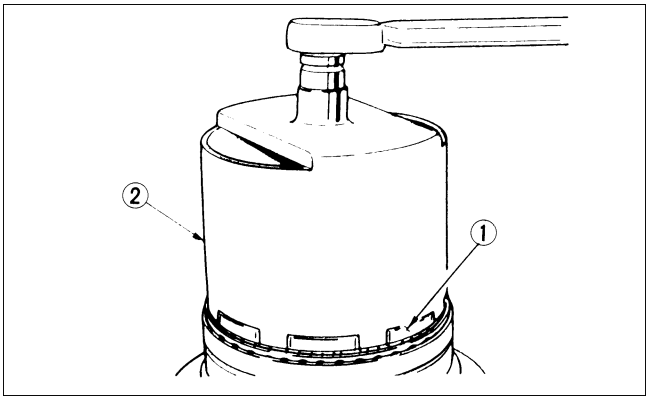
3. Press-fit the angular bearing into the flange holder using the mounting jig (see the figure below).

Unit : mm



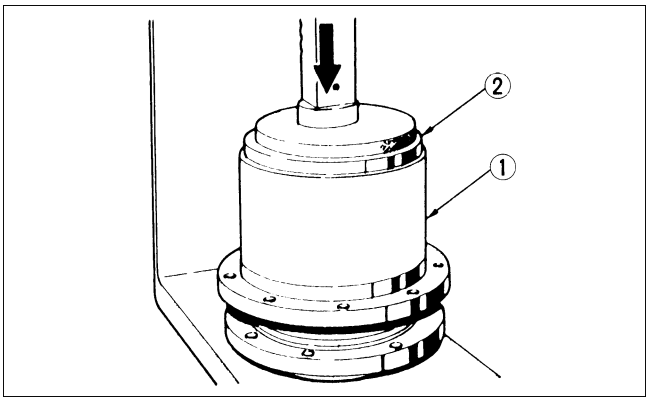
Material: Equivalent of S35C, C0.1-0.2

(1) Angular bearing
(2) Flange holder
(3) Mounting jig



4. Using the tightening jig, tighten the ring nut so as to leave no clearance between the ring nut and angular bearing.
   • For the tightening jig, refer to V17.

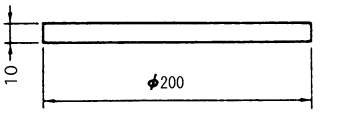
(1) Ring nut
(2) Tightening jig



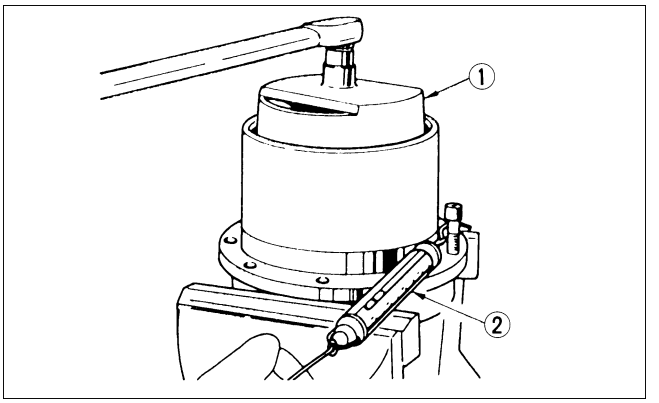
5. Using the press-fitting jig (see the figure below), press-fit the housing onto the angular bearing.

(1) Housing
(2) Press-fitting jig

Unit : mm

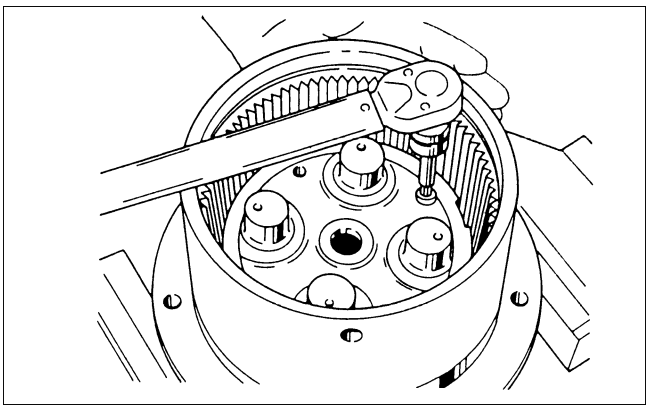


Material: Equivalent of S35C, C0.1

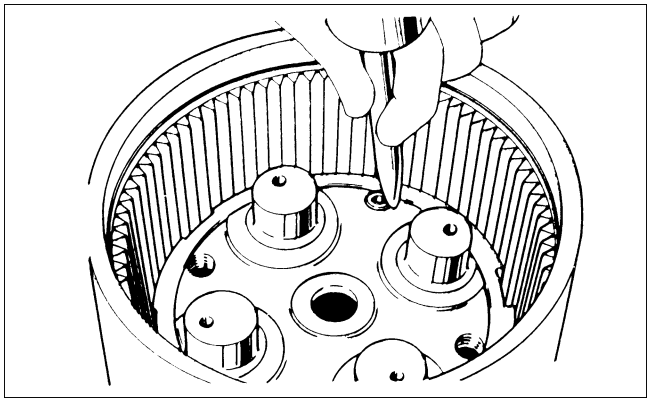


6. Tighten the ring nut using the tightening jig.
   - When the ring nut is tightened so as to leave no clearance between the ring nut and angular bearing, measure the load after turning the housing several turns. The load (starting load) measured at this time is assumed to be F kgf.
   - Tighten the ring nut so that the starting load becomes F + (1.7-2.5) kgf. (3.7~5.5 ft·lbs)

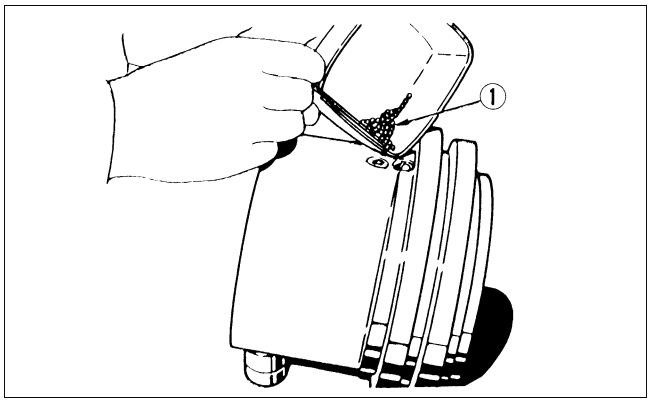
(1) Tightening jig
(2) Spring scale



7. Tighten the plug.
   - No seal tape is needed.

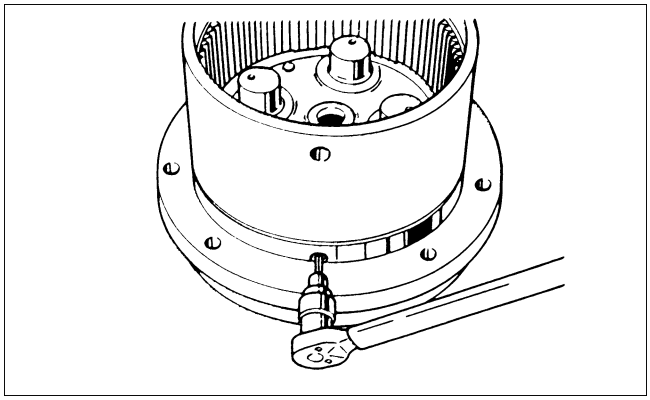


8. Using a punch, crimp the plug at two points in order to prevent it from getting loose.

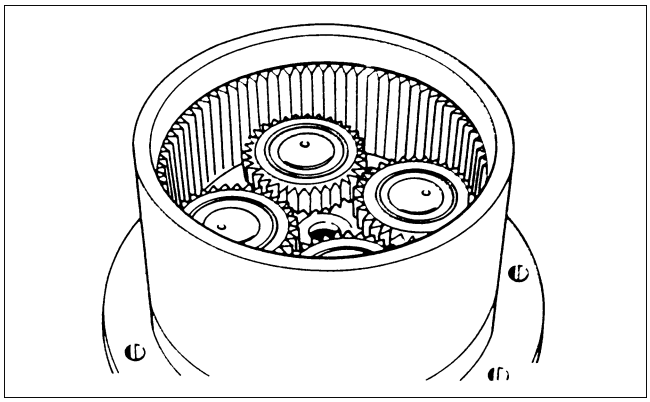


9. Put the steel balls in the unit.

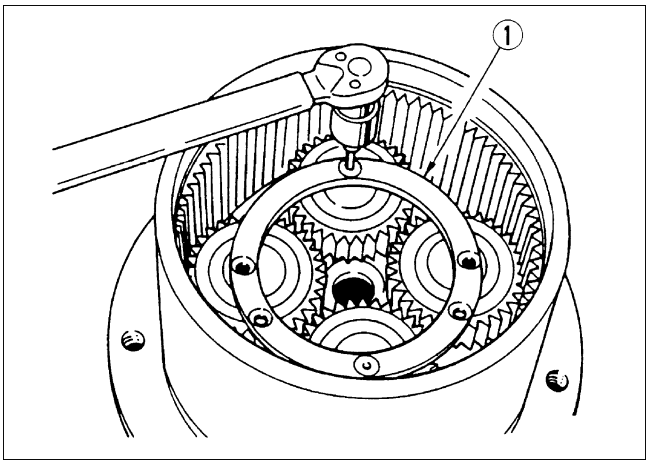
(1) Steel ball
- Number of steel balls



10. Wind seal tape around the plug and tighten it.
- Tightening torque of plug: 0.7~0.9 kgf·m (5.06~6.51 ft·lbs)

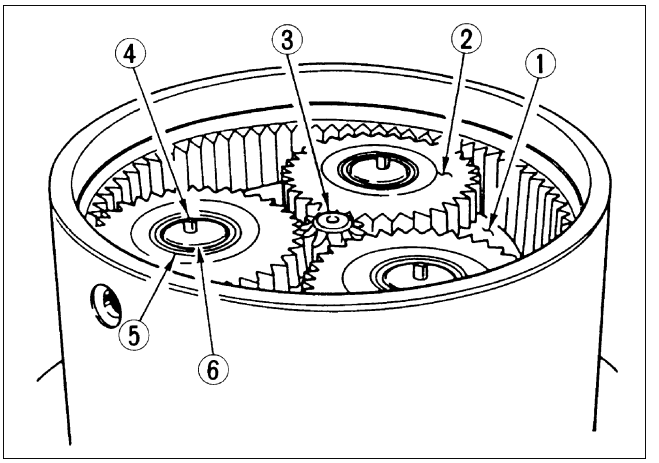


11. Fit the thrust washer, planetary gear B, bearing (roller) and collar.



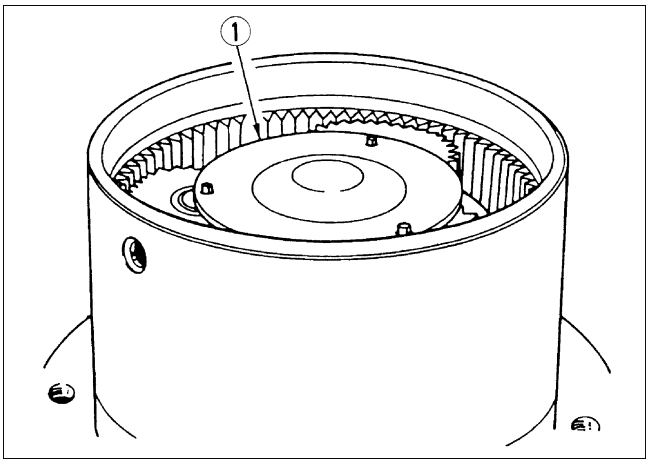
12. Attach the thrust plate, and apply loctite No. 262 to the flush screw and tighten it.
    - When applying loctite, well degrease the part and use a hardening accelerator.
    - Tightening torque of screw:
      0.41~ 0.83 kgf·m
      (2.97~6.00 ft·lbs)

(1) Thrust plate



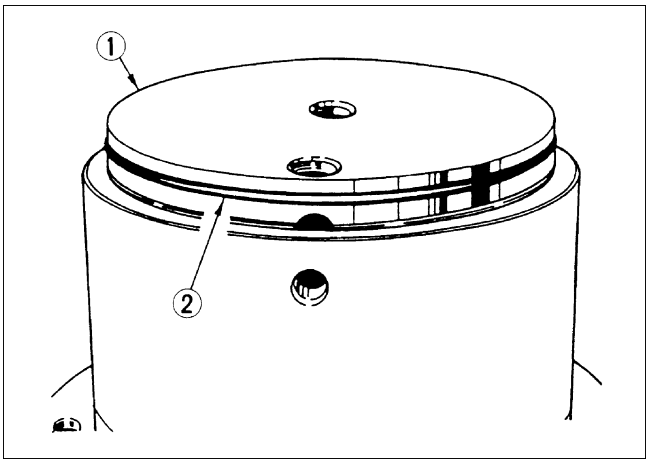
13. Attach the snap ring to the sun gear and fit the sun gear.
14. Attach the spring pin, bearing (inner), bearing (roller) and planetary gear A to the holder and fit the holder.
15. Fit the drive gear.

(1) Holder
(2) Planetary gear A
(3) Drive gear
(4) Spring pin
(5) Bearing (roller)
(6) Bearing (inner)



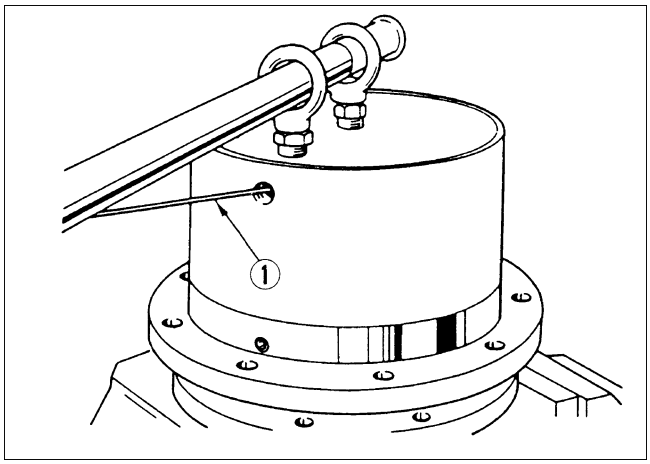
16. Fit the thrust plate.

(1) Thrust plate



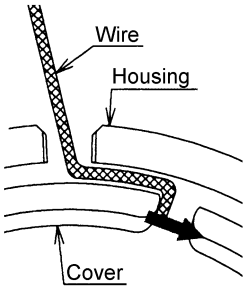
17. Apply grease to the O-ring and fit it to the cover. Fit the cover to the housing so that the U groove is aligned with the screw hole position of the plug in the housing.

(1) Cover
(2) O-ring

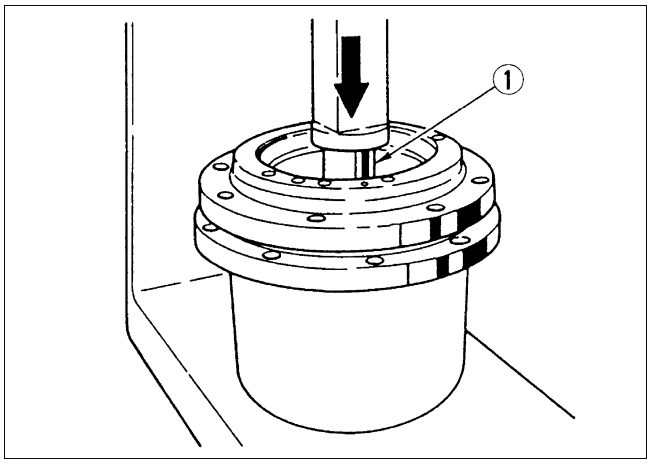


18. Bend the wire at a point about 8 mm apart from the end, insert it into the screw hole in the housing, and turn the cover to draw the wire into the housing.

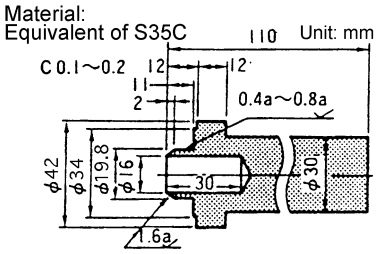
(1) Wire



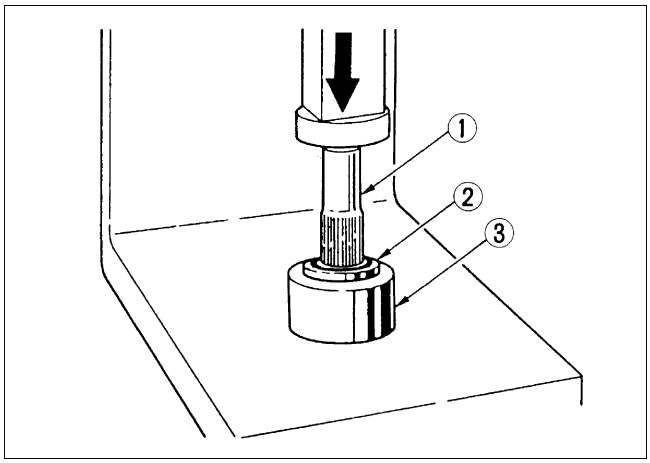
19. Wind seal tape around the plug and tighten it.
    - Tightening torque of plug:
      7.8 ±1.0 N·m
      (0.8 ±0.1 kgf·m)
      5.8 ±0.7 ft·lbs



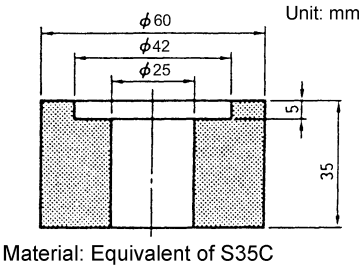
20. Press-fit the oil seal into the flange holder using the mounting jig (see the figure below).



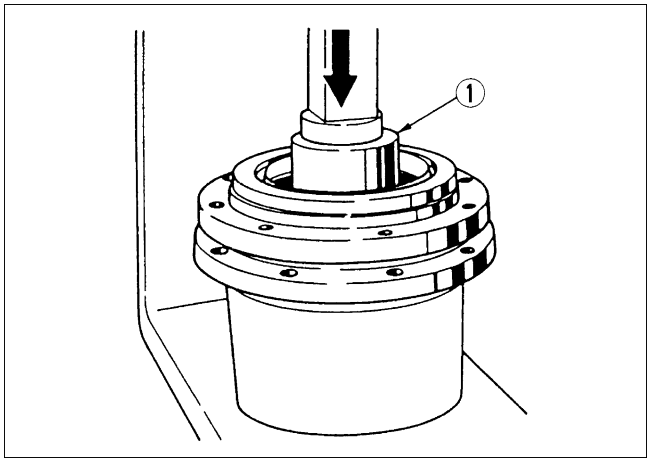
(1) Mounting jig



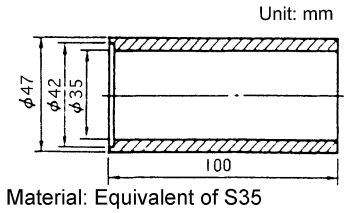
21. Press-fit the ball bearing onto the shaft using the press-fitting jig (see the figure below).



(1) Shaft (2) Bearing (3) Press-fitting jig



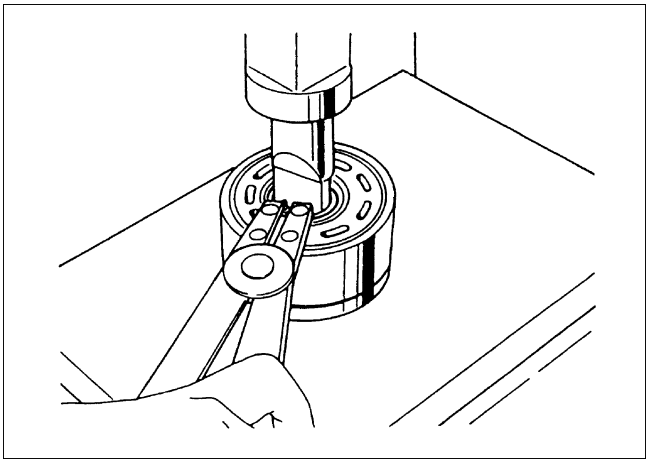
22. Press-fit the shaft subassembly into the flange holder using the mounting jig (see the figure below).



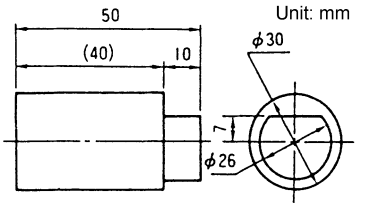
(1) Mounting jig

23. Fit the steel ball, spring, piston subassembly and swash plate to the flange holder.
    - Apply hydraulic oil to the sliding surface of the swash plate.

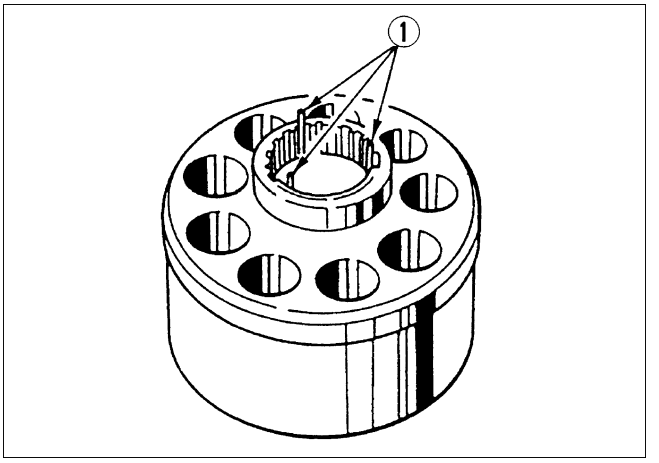
(1) Swash plate



24. Attach the collar, spring and washer to the cylinder block and fit the snap ring using the mounting jig (see the figure below).

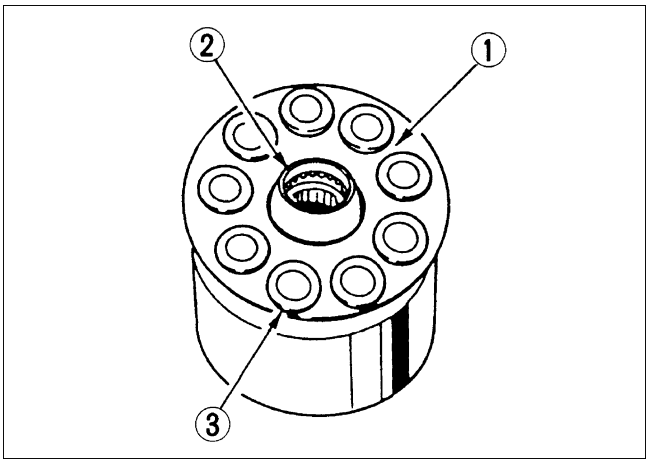


Material: Equivalent of S35C, C0.1-0.2



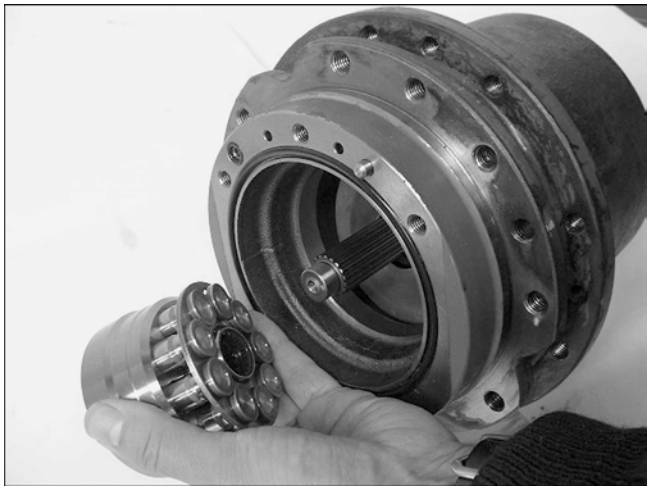
25. Apply grease to the pins and fit them into the three holes in the cylinder block.

(1) Pin

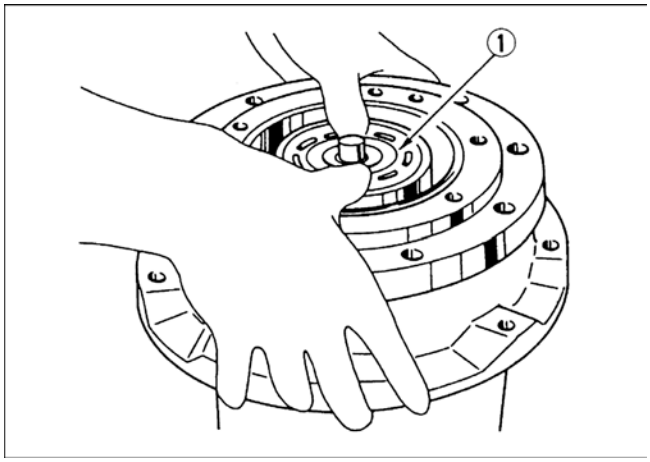


26. Fit the retainer holder, retainer plate and piston subassembly.
    - Apply hydraulic oil to the nine holes in the cylinder block.

(1) Retainer plate
(2) Retainer holder
(3) Piston assembly



27. Set the motor on its side and fit the cylinder block subassembly using the spline in the shaft as a guide.

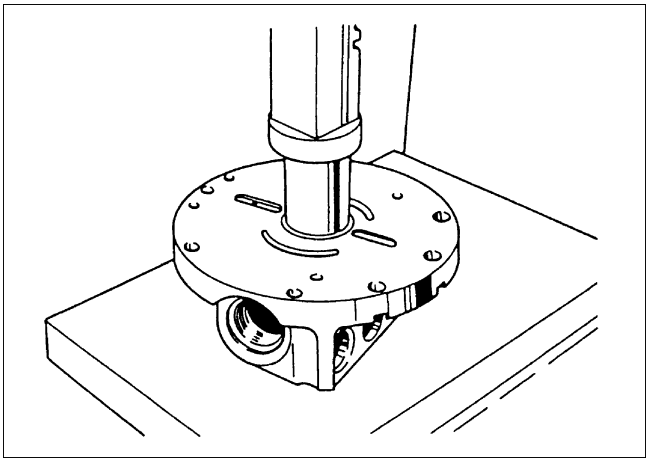


28. While pushing the cylinder block by hand, check that the spring works.
    - Apply hydraulic oil to the sliding part of the cylinder block.

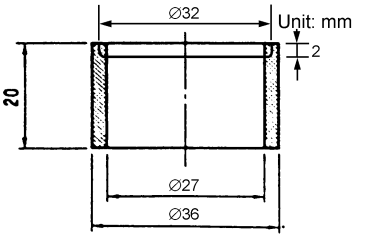
(1) Cylinder block

29. Fit the O-ring and pin to the flange holder.
    - Apply grease to the O-ring.

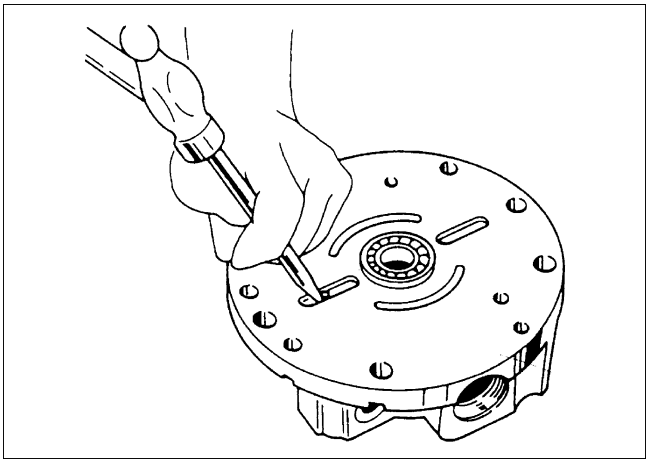
(1) O-ring
(2) Pin



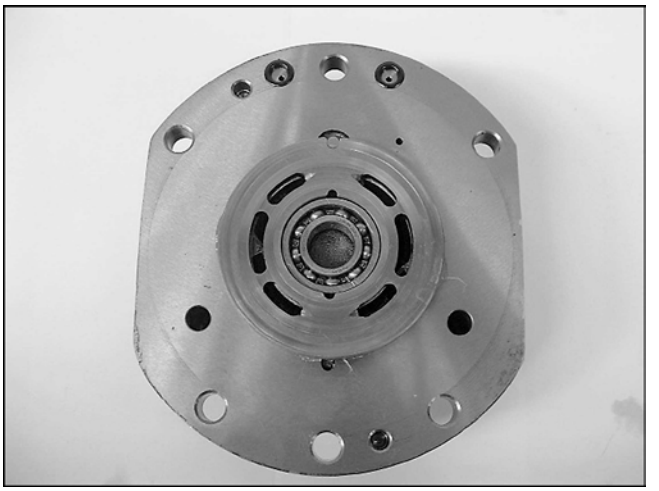
30. Press-fit the ball bearing into the base plate using the press-fitting jig (see the figure below).



Material: Equivalent of S35C, C0.1-0.2

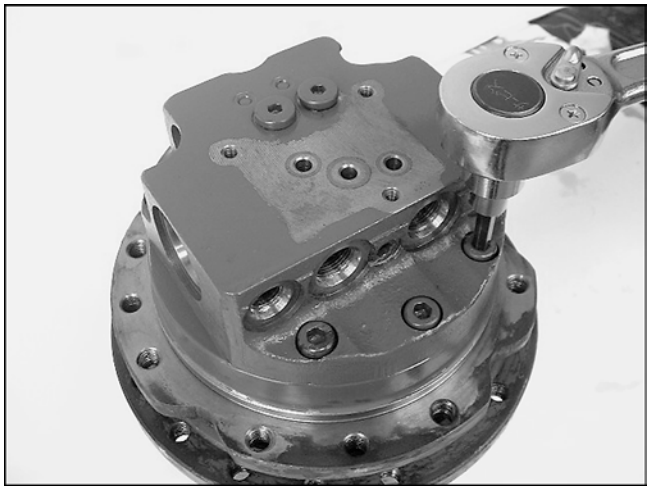


31. Fit the pin and crimp it at two at two points.

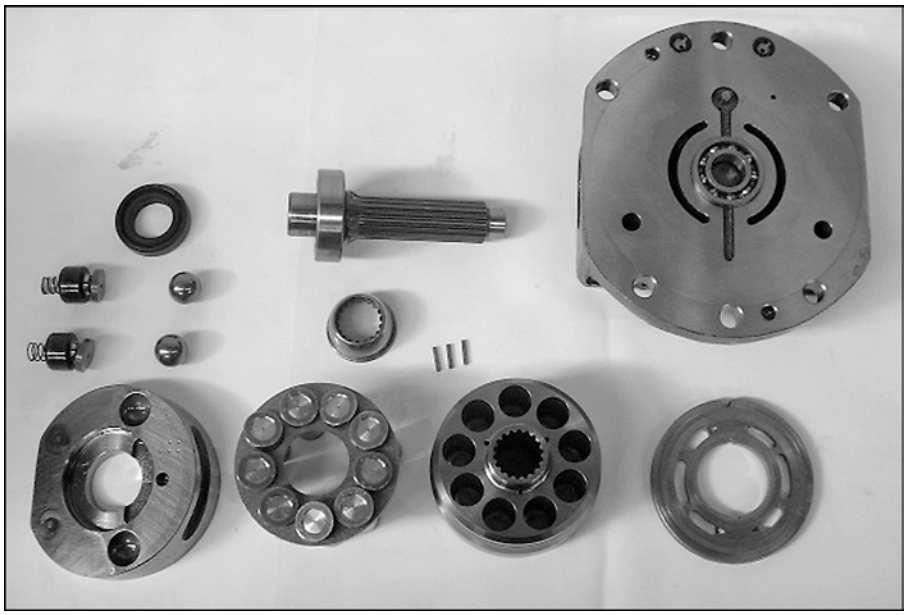


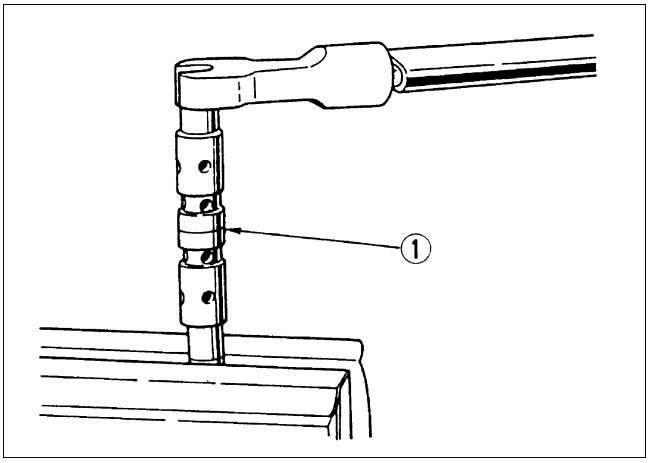
32. Apply grease to the back surface of the valve plate and fit it to the base plate.

(1) Valve plate
(2) Base plate



33. Fit the base plate and tighten the socket head bolt.
    - Tightening torque of socket head bolt: 37.0±1.9 N·m (3.78 ±0.19 kgf·m) 27.3 ±1.4 ft·lbs

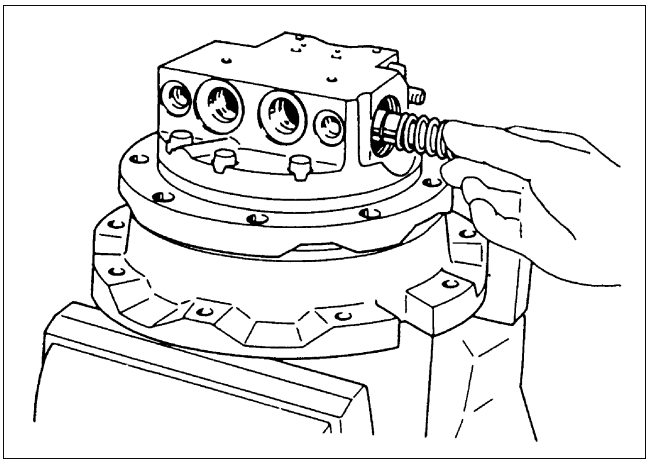




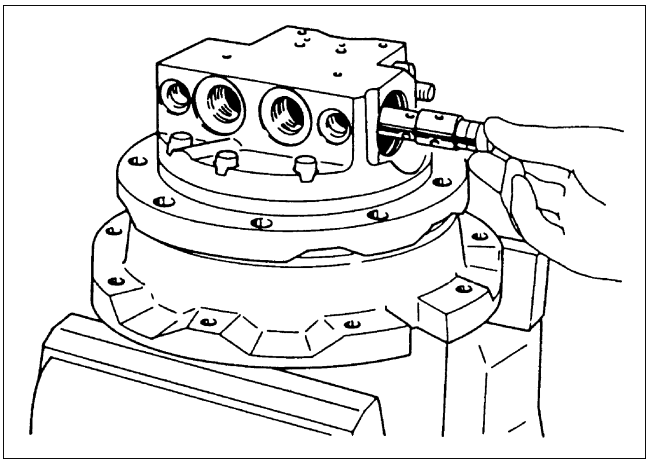
34. Fit the check valve and spring to the plunger.

35. Attach the O-ring to the plug and fit the plug to the plunger.
    - Tightening torque of plug: 27.0±2.45 N·m (2.76 ±0.25 kgf·m) 20.0 ±1.8 ft·lbs

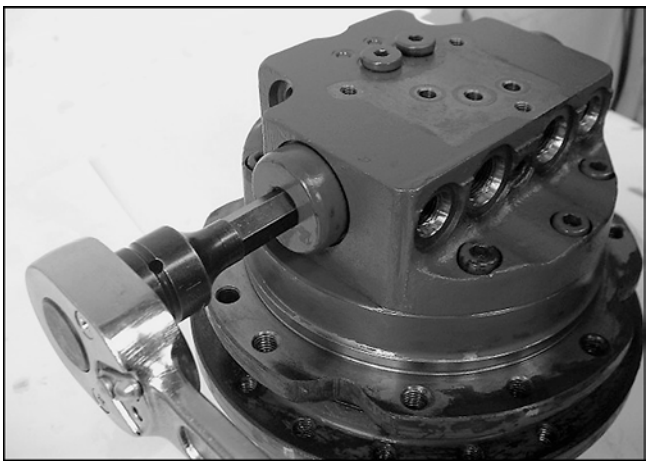
(1) Plunger assembly



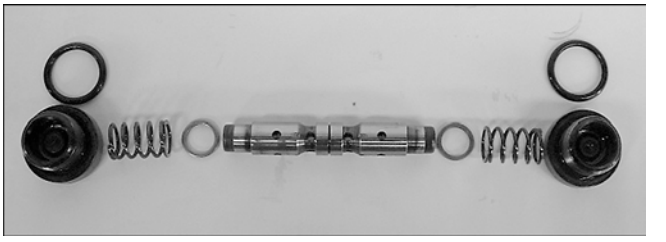
36. Fit the plunger assembly to the base plate.
    - Fit the plunger assembly while turning it so that it will not bind.
    - Apply hydraulic oil to the plunger subassembly

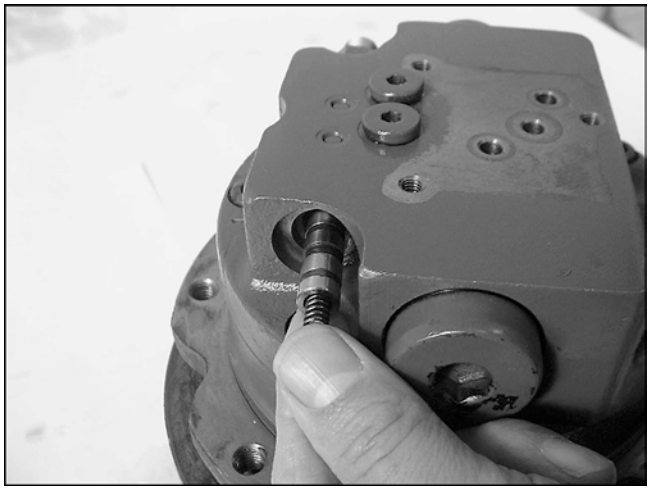


37. Fit the spring sheet and spring.

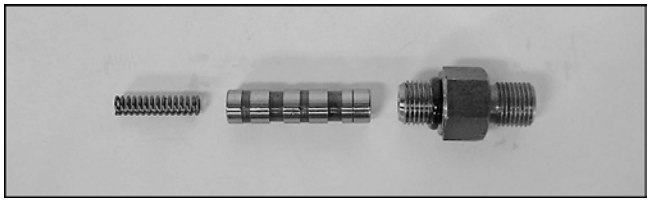


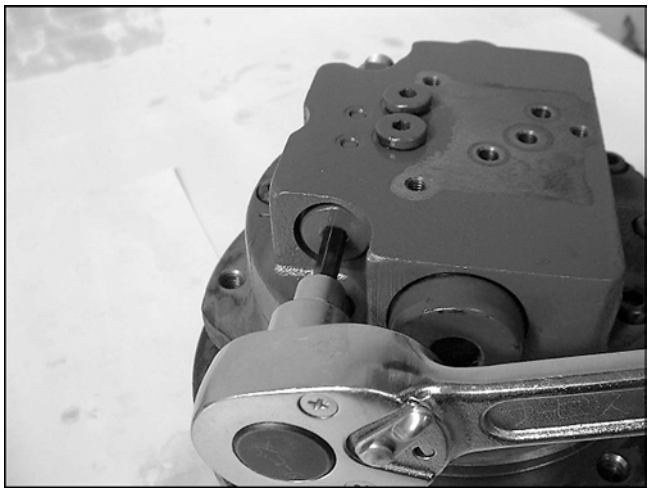
38. Attach the O-ring to the cap and fit the cap to the base plate by tightening it.
    - Apply grease to the O-ring.
    - Tightening torque: 157±8 N·m (16.0 ±0.8 kgf·m) 116 ±5.8 ft·lbs



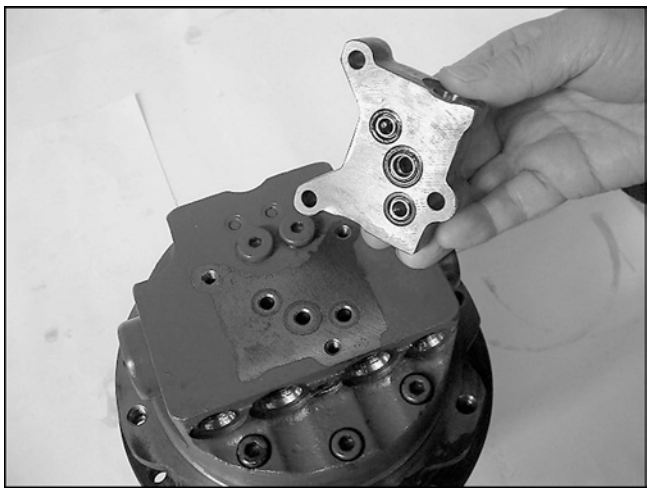


39. Attach the spring to the spool and fit the spool to the base plate.
    - Apply hydraulic oil to the spool and insert it while turning it.

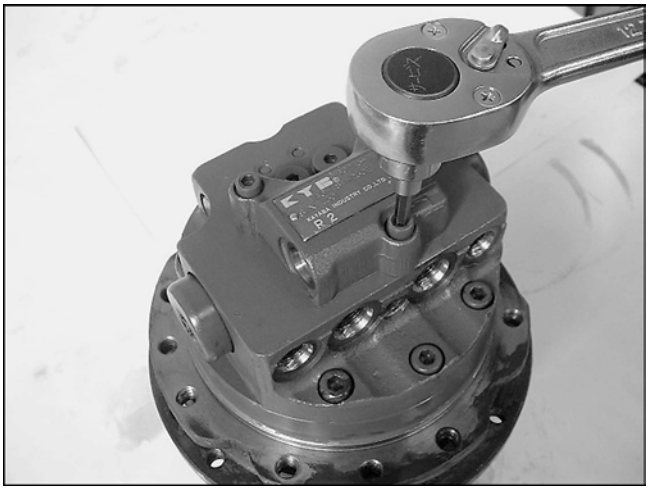




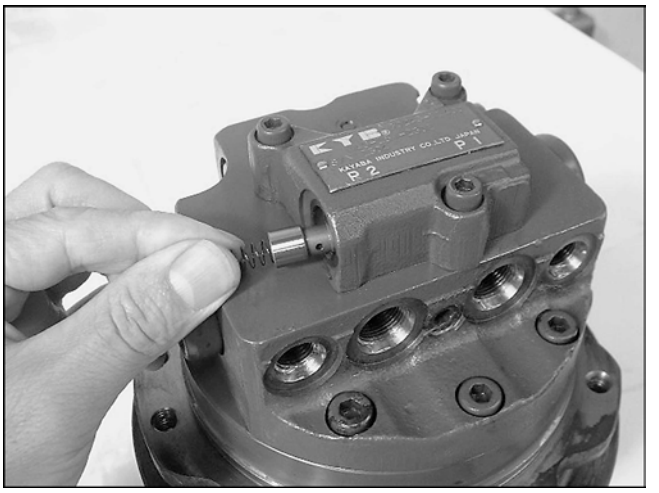
40. Attach the O-ring to the plug and fit the plug to the base plate.
    - Tightening torque of plug: 36.8±2.5 N·m



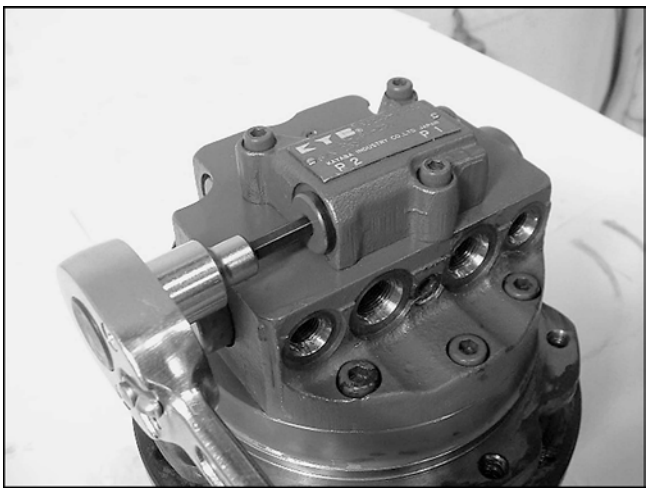
41. Fit the O-ring to the valve body.
    Apply a small amount of grease to the O-ring.



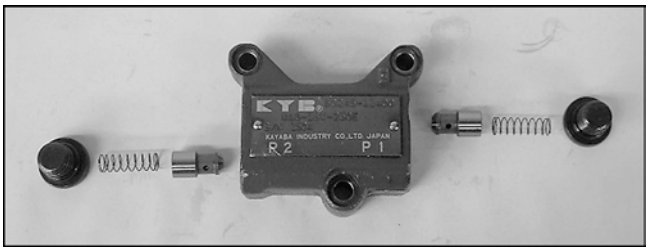
42. Fit the valve assembly to the base plate.
    - Tightening torque: 15.2±0.8 N·m

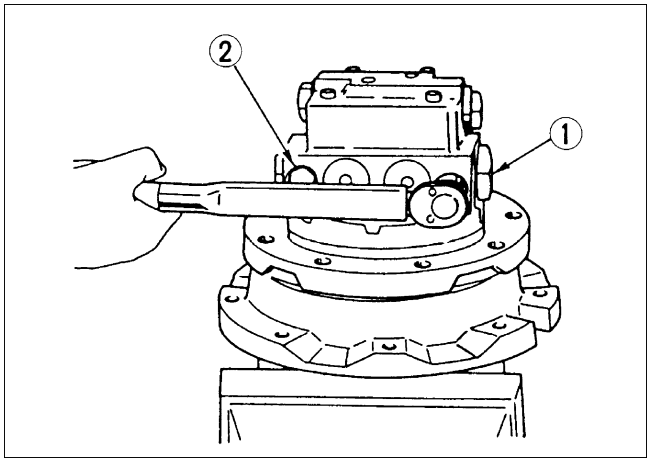


43. Fit the check valve and spring to the valve body.



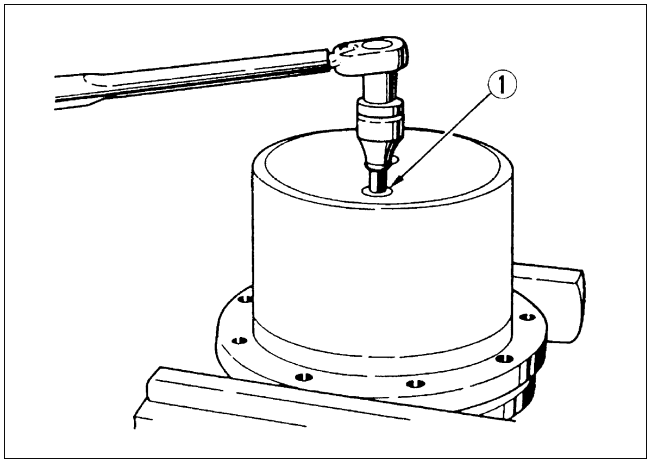
44. Tighten the plug.
    - Tightening torque of plug: 36.8±2.5 N·m





45. Attach the O-ring to the plug and fit the plug to the base plate.
    - Tightening torque of plug: 22.6±1.0 N·m (2.3±0.1kgf·m) 16.7±0.7ft·lbs

(1) Cap
(2) Plug

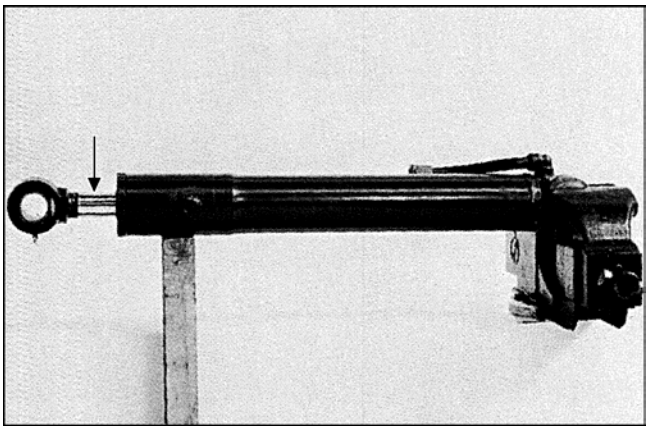


46. Inject the specified amount of gear oil (see below) through the plug screw hole and tighten the plug.
    - Wind seal tape around the plug.
    - Tightening torque of plug: 22.6±1.0 N·m (2.3±0.1kgf·m) 16.7±0.7ft·lbs

(1) Plug

Oil type	Amount
Gear oil SAE90 API GL-4	U20-3α : 0.33L (0.09USGal) U25-3α, U25S : 0.35L (0.09USGal)

g.Cylinder



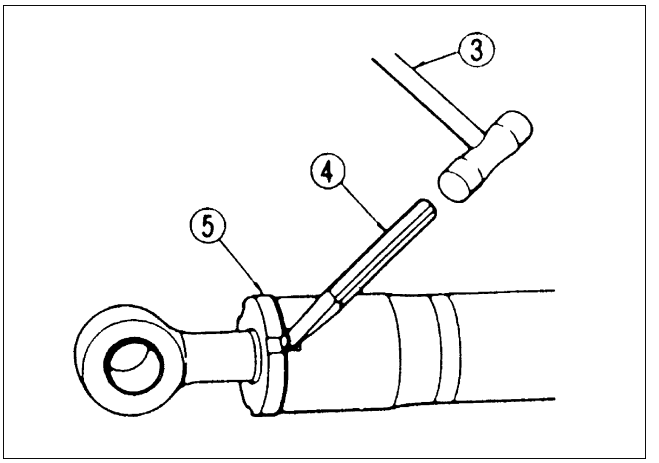
[1] Disassembling and reassembling the boom cylinder

1) Drain oil from the cylinder.

2) Fix the cylinder with a vise.

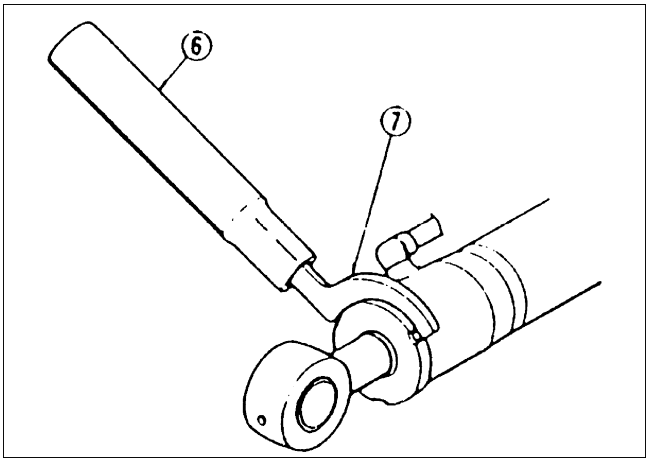
Service Tip :

* Support the cylinder tube with a wooden board.



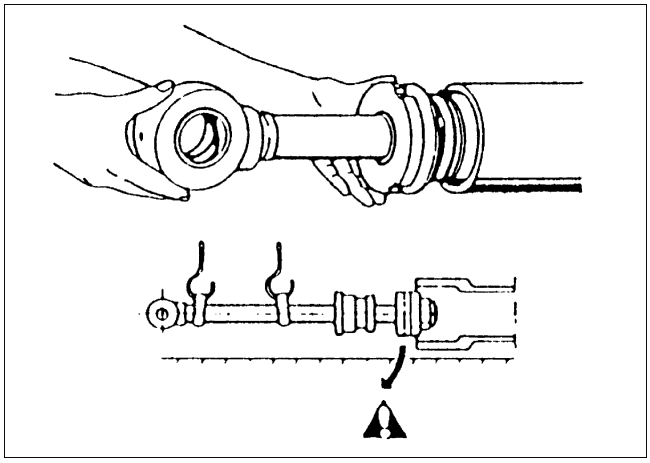
3) Straighten the lock washer.

(3) Hammer
(4) Chisel
(5) Straighten



4) Remove the cylinder head while loosening the screw on the cylinder head.

(6) Pipe
(7) Hook wrench



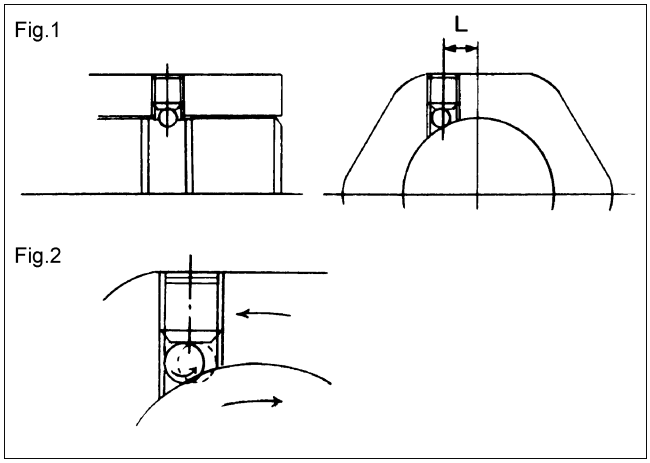
5) Pull out the piston rod together with the cylinder head.

Service Tip :

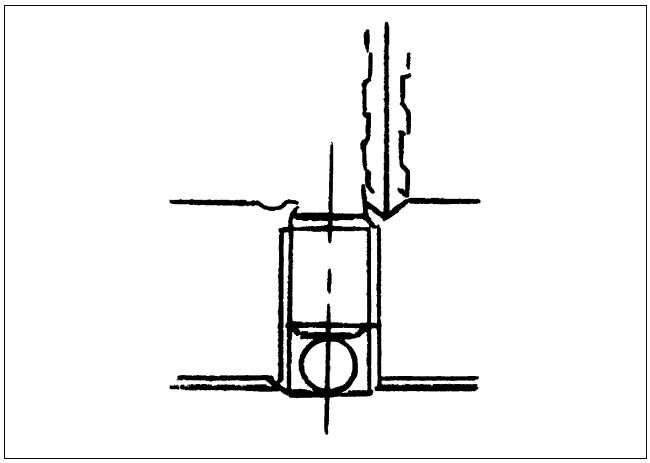
* Open the port of the pipe.

Caution:

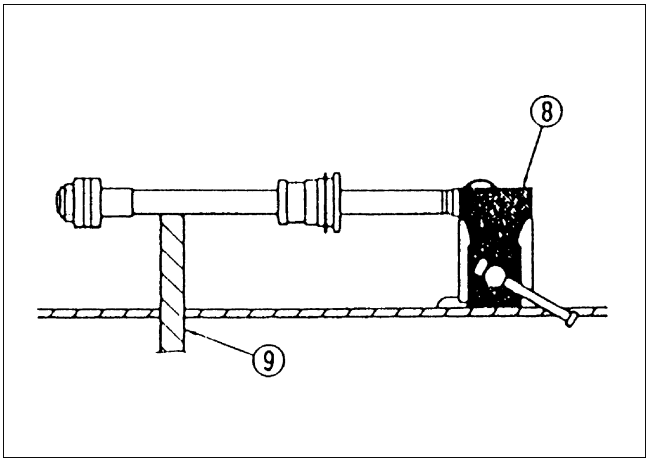
* When pulling out the piston, take care not to drop the piston end. If the piston end drops, it could injure your hand or damage the piston itself.



6) Remove the setscrew.
   - Because the setscrew is tightened and punch-crimped at two points, scrape away the punched portions with a hand drill, loosen the setscrew and remove the steel ball.



* How to use the steel ball to prevent the nut from turning
- By tightening the setscrew, fix the steel ball at a position decentered from the nut rod center line by L. (Fig.1)
- When the screw is loosened and the nut (rod) turns, the ball turns and moves to dig into the narrower side of the taper face. (Fig.2)
- The resistance of the steel ball generated at this time prevents the nut from turning

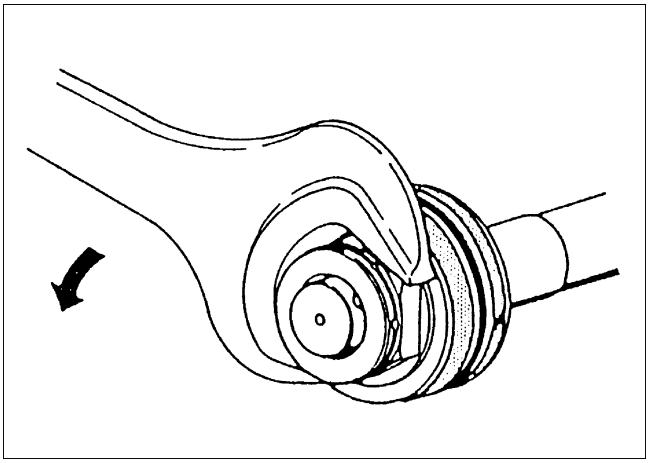


7) Fix the piston rod with a vise.

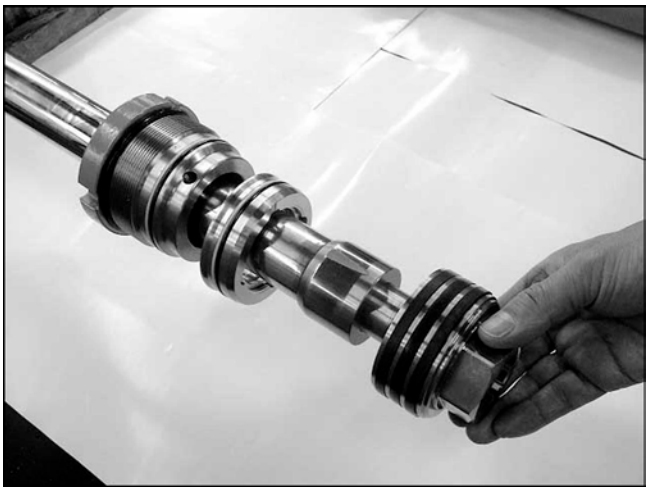
IMPORTANT

* Support the rod with a wooden board.

(8) Vise
(9) Wooden board



8) Set a spanner on the hex nut portion of the piston and loosen the piston.

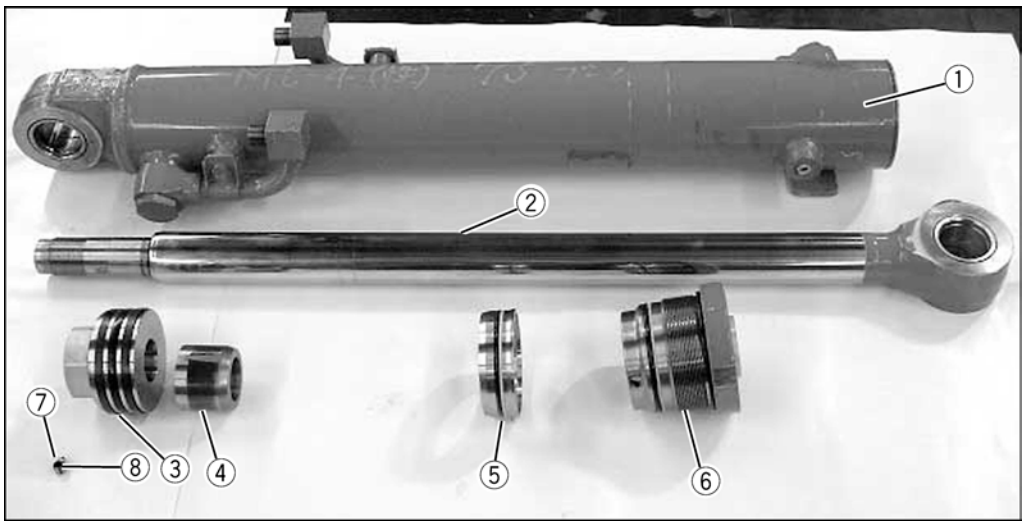


9) Remove the piston.

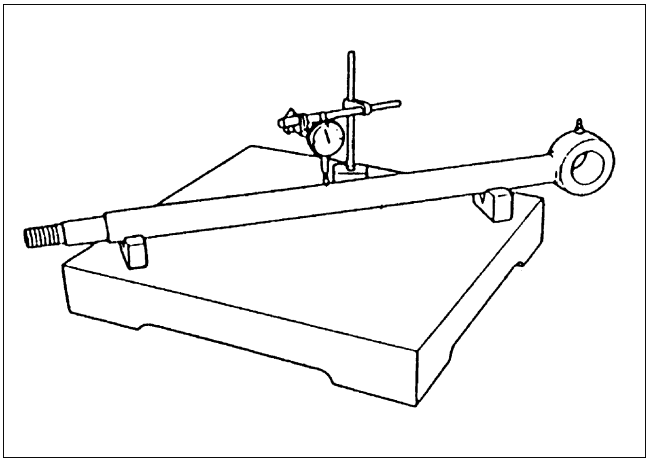
10) Remove the cushion bearing and holder.

11) Pull out the cylinder head.
Release the piston rod from the vise.

[2] Component parts of boom cylinder

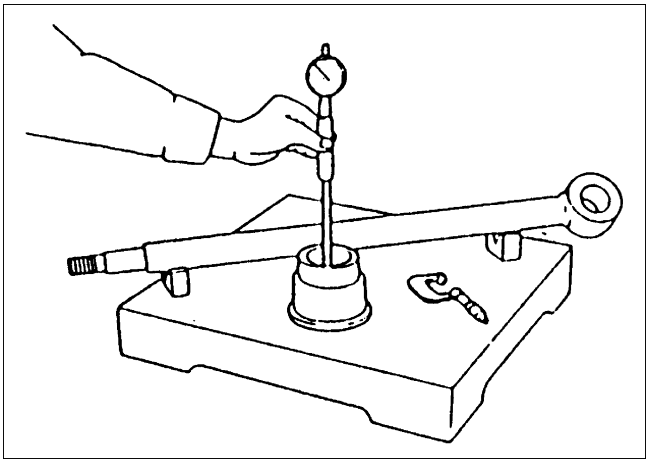


(1) Cylinder tube (2) Piston rod (3) Piston (4) Cushion bearing (5) Holder
(6) Cylinder head (7) Setscrew (8) Steel ball



[3] Measuring the bent in the piston rod

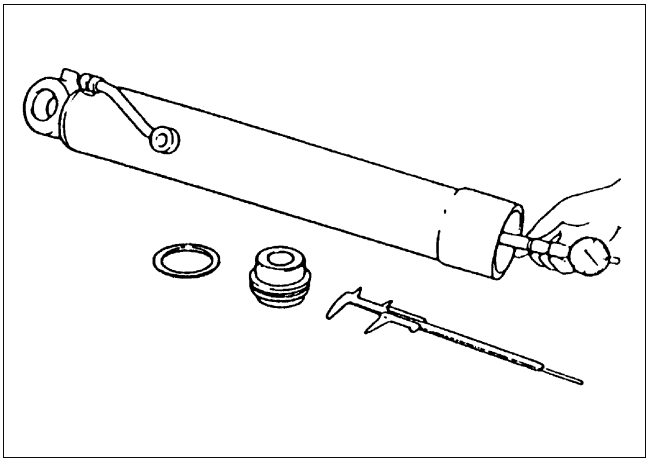
1. Place the piston rod on a V block.
2. Put a dial gauge on the center of the rod.
3. While turning the piston rod, read the value indicated by the dial gauge.
   The bend is one-half of the difference between the maximum and minimum readings.
4. If the bend exceeds the limit, replace the piston rod.
   Standard ..... value Bend: 0.05 mm (0.02in.) or less
   Limit ..... Bend: 0.5 mm (0.02in.)



[4] Measuring the wear in the rod and bush

1. Measure the outside diameter of the piston rod and the inside diameter of the bush of the cylinder head section and determine the clearance.

	Rod size	Gap
Standard value	ϕ25~40mm (ϕ0.98~ϕ1.58in)	0.25mm or less (0.01in. or less)
	ϕ45~75mm (ϕ1.17~ϕ2.95in.)	0.35mm or less (0.014in. or less)
Limit	ϕ25~40mm (ϕ0.98~ϕ1.58in)	0.4mm (0.016in.)
	ϕ45~75mm (ϕ1.17~ϕ2.95in.)	0.5mm (0.020in.)



[5] Measuring the wear in the tube and piston ring

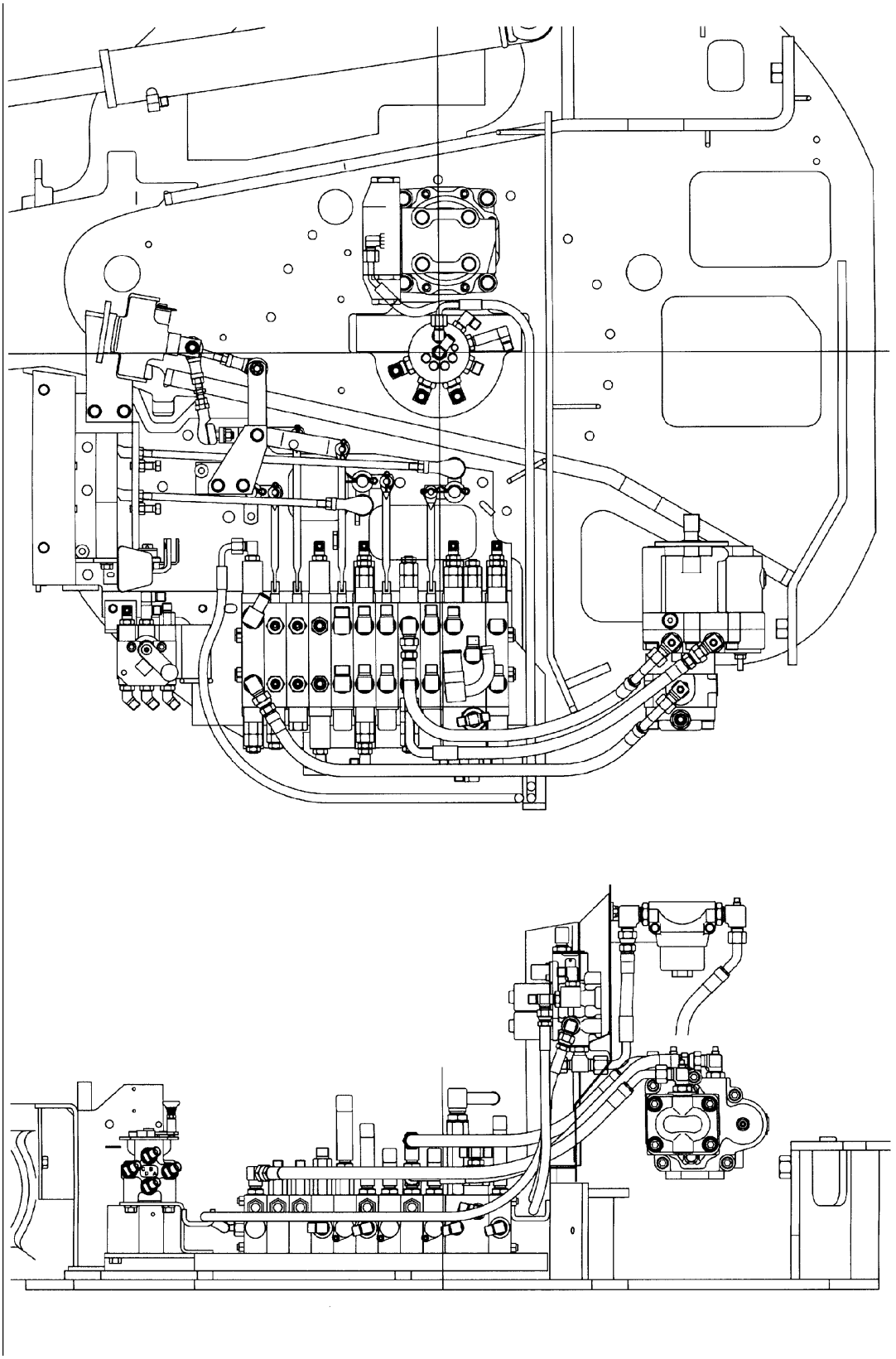
1. Measure the inside diameter of the cylinder tube.
2. Measure the outside diameter of the piston ring and determine the clearance.

	Rod size	Gap
Standard value	ϕ60mm or less (ϕ2.36in. or less)	0.05~0.30mm (0.002~0.012in.)
	ϕ65~115mm (ϕ2.56~ϕ4.53in.)	0.05~0.35mm (0.02~0.014in.)
	ϕ120mm or more (ϕ4.72in. or more)	0.05~0.40mm (0.02~0.016in.)
Limit	ϕ60mm or less (ϕ2.36in. or less)	0.60mm (0.024in.)
	ϕ65~115mm (ϕ2.56~ϕ4.53in.)	0.70mm (0.028in.)
	ϕ120mm (ϕ4.72in. or more)	0.80mm (0.031in.)

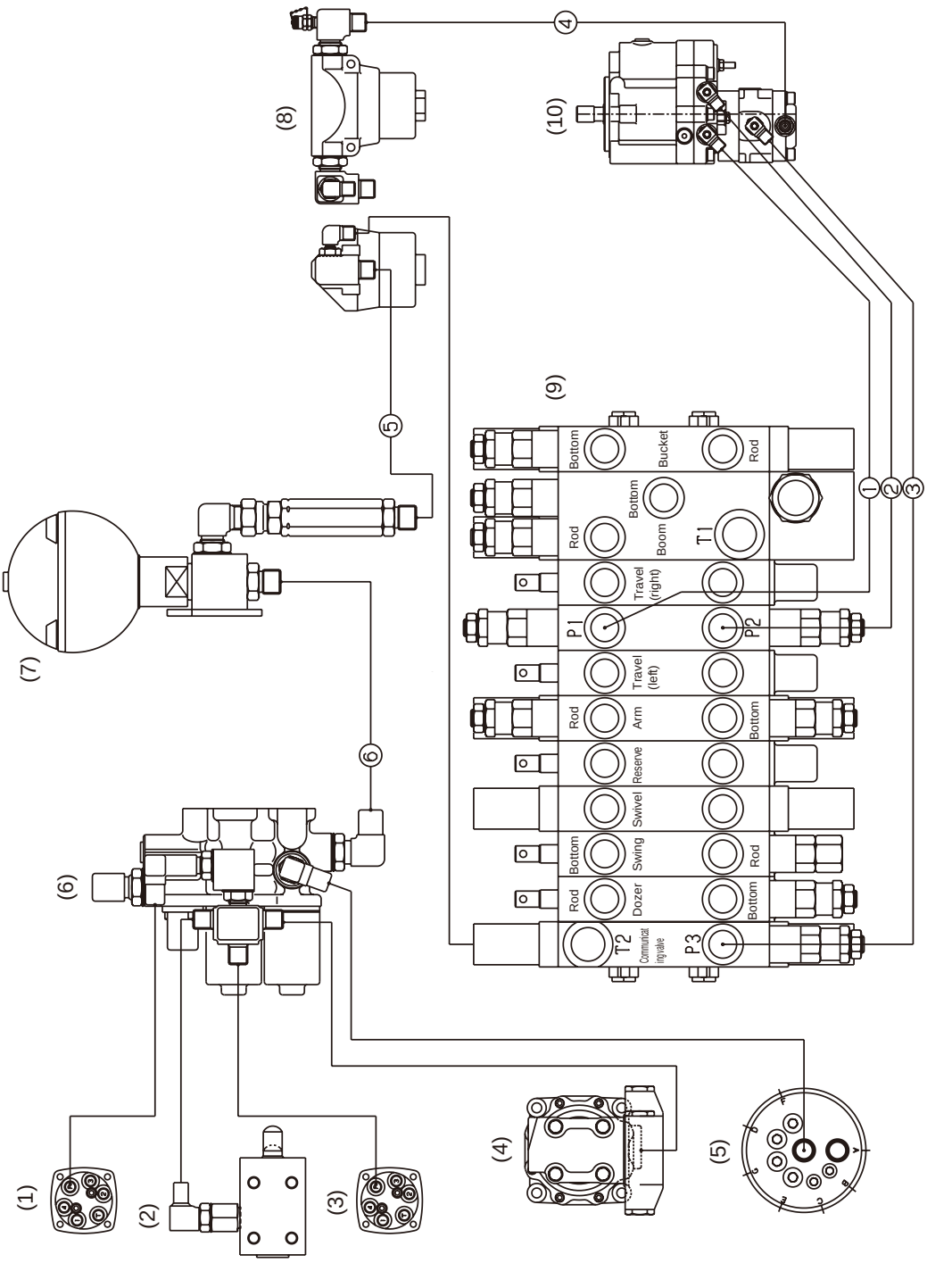
h. Hydraulic hose

[1] Delivery hose

(Important)
The hydraulic hose (main pump suction/delivery) should be replaced every two years or 400 hours of operation, whichever is earlier.



[2] Delivery hose routing



(1)Pilot valve(right)
(2)Travel lock cylinder
(3)Pilot valve(left)
(4)Swivel motor
(5)Swivel joint
(6)Unload valve
(7)Accumulator
(8)4th P:Line filter
(9)Control valve
(10)Pump

High-pressure hose

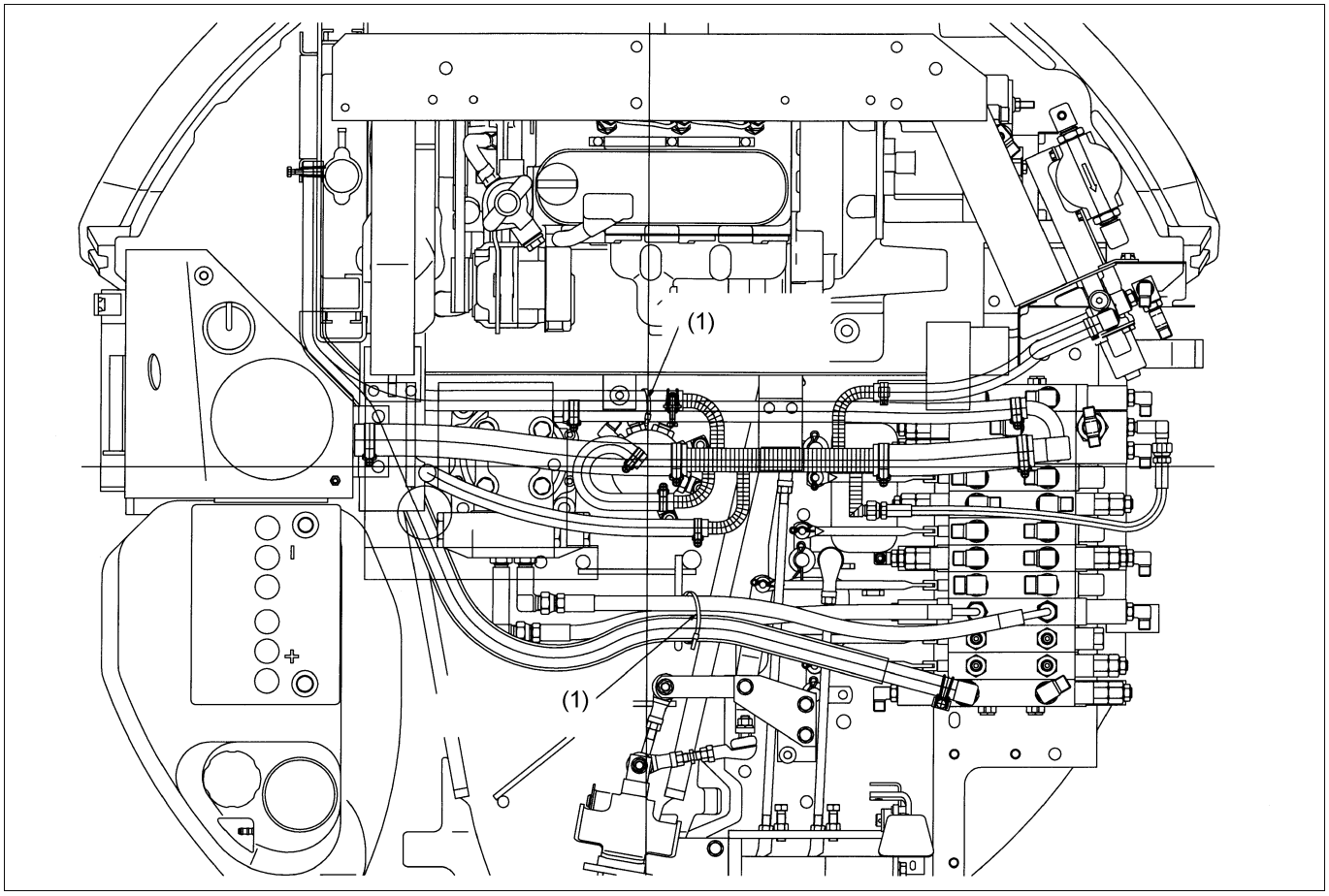
No.	Location		Part No. U20-3α EU	Part No. U25-3α EU	Q'ty	Remarks
1	Between pump and control valve	P1	RB411-6321Δ	←	1	
2	Between pump and control valve	P2	RB411-6322Δ	←	1	
3	Between pump and control valve	P3	RB411-6323Δ	←	1	Fixed foot

Pilot hose

4	Between pump and line filter	P4	RB411-6324Δ	←	1	
5	Between line filter and accumulator	P4	RB419-6325Δ	←	1	
6	Between accumulator and control valve	P4	RB419-6326Δ	←	1	

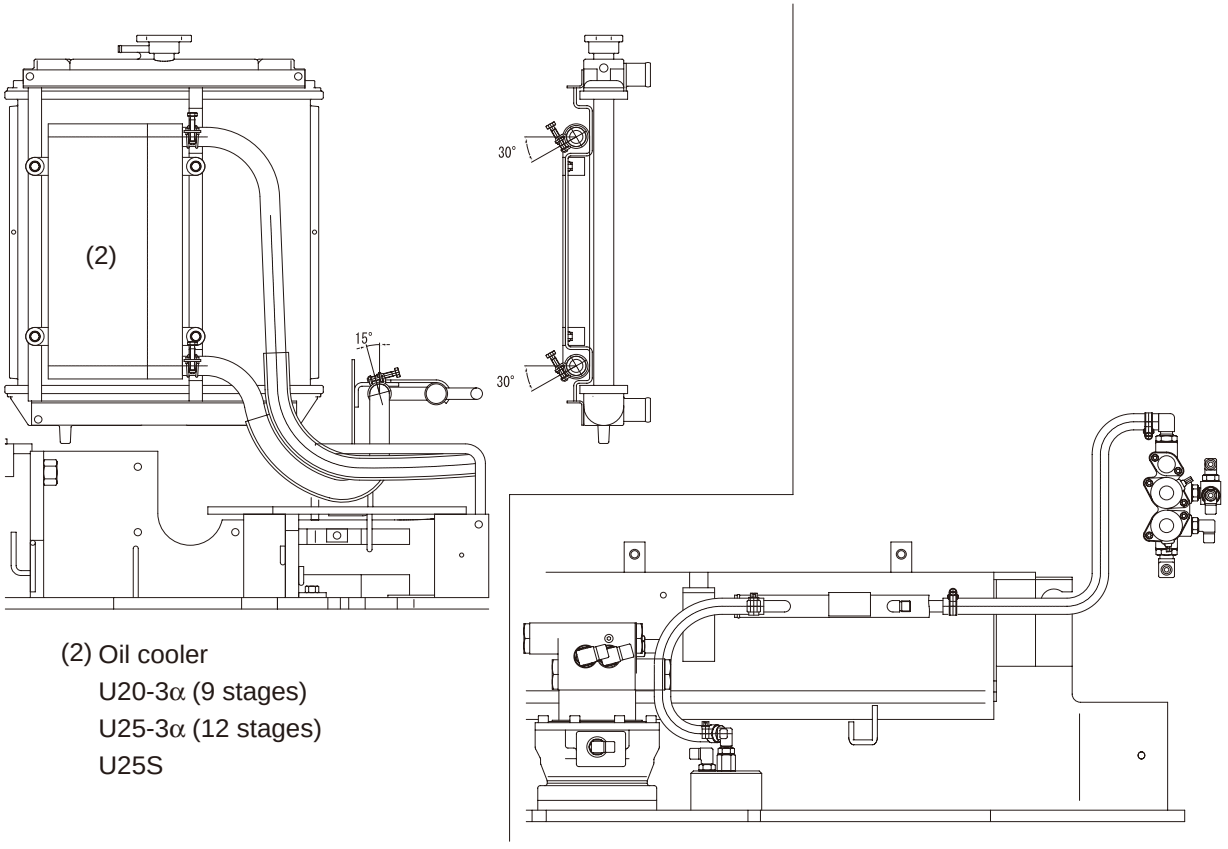
[2] Return drain hose

1) Return drain hose routing



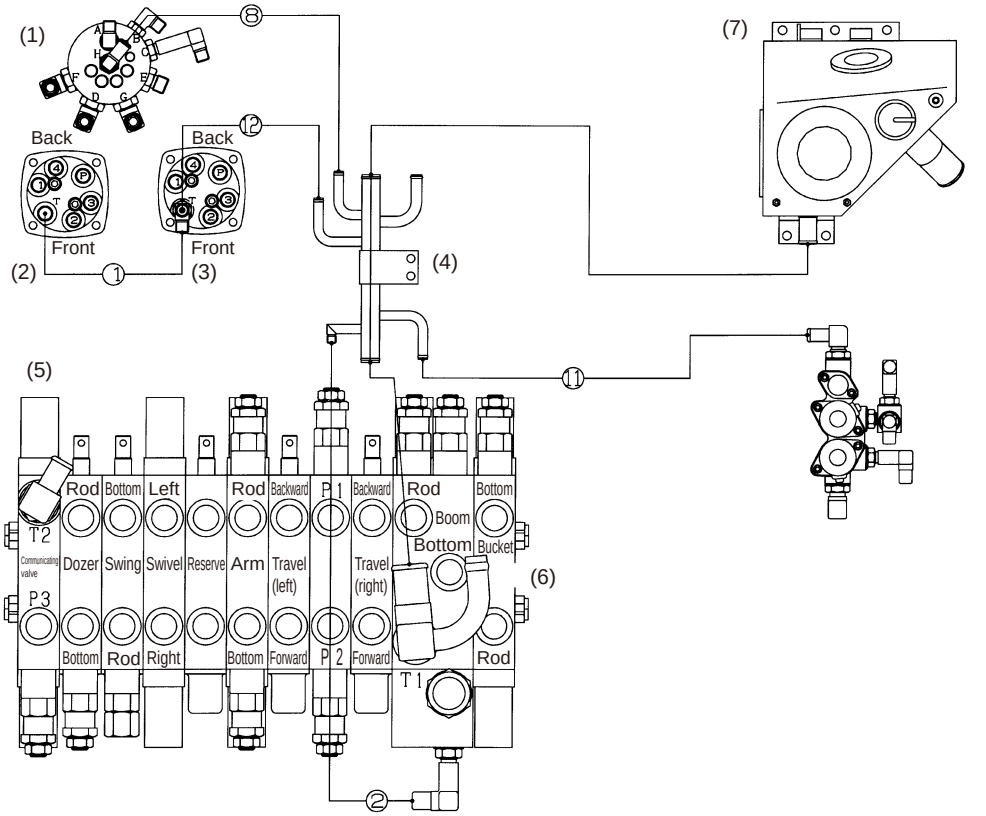
2) Return drain hose routing

(1)Code band 55311-4126Δ



(2) Oil cooler
U20-3α (9 stages)
U25-3α (12 stages)
U25S

3) Return drain hose routing



(1)Swivel joint
(2)Pilot valve(left)
(3)Pilot valve(right)
(4)Return valve
(5)Control valve
(6)C/V check valve
(7)Hydraulic tank

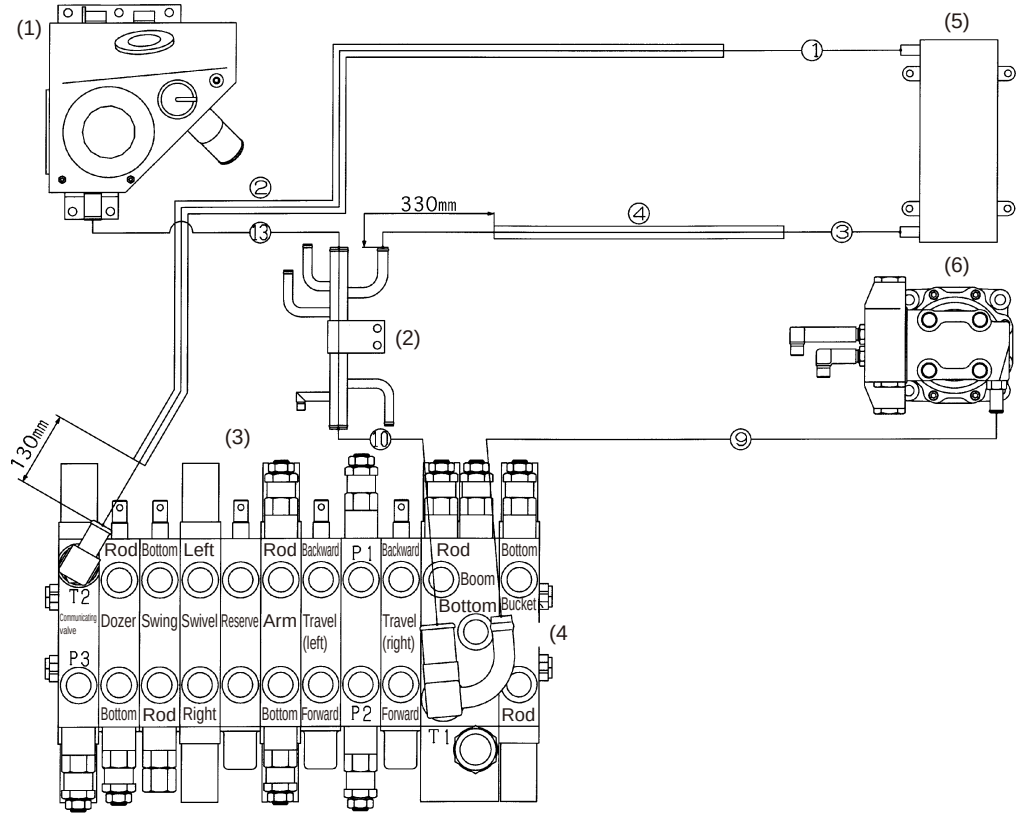
Low-pressure hose

NO.	Location	
8	Between R/J and return pipe	R/J drain
11	Between switching V and return pipe	Switching valve drain
12	Between right P/V and return pipe	P/V drain

Pilot hose

1	Between P/V (right) and P/V (left)	P/V drain
2	Between C/V and return pipe	Boom lock drain

4) Return drain hose routing



(1)Hydrauic tank
(2)Return pipe
(3)Control valve
(4)C/V check valve
(5)Oil cooler
(6)Swivel motor

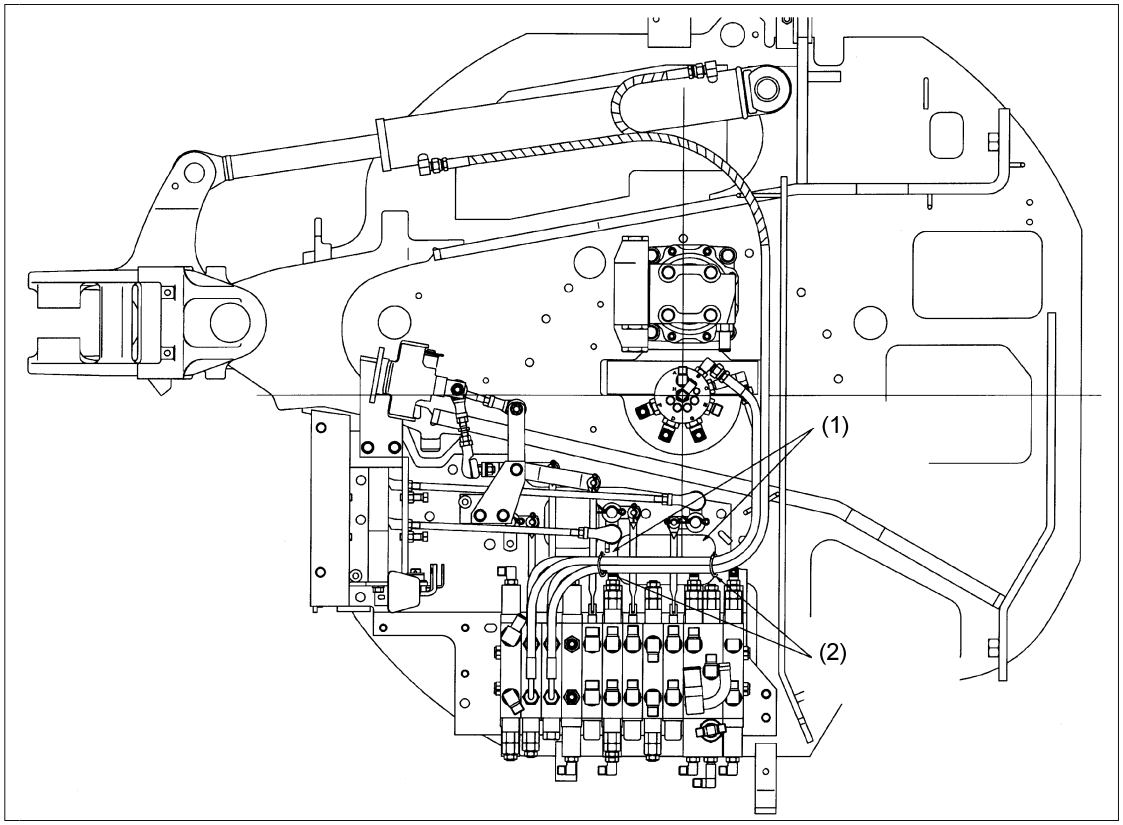
Low-pressure hose

NO.	Location	
1	Between C/VT2 and O/C upper	Oil cooler
2	└(Protective tube)	
3	Between O/C bottom and return pipe	Oil cooler
3	↑	↑
4	└(Protective tube)	
9	Between C/V check valve and swivel M	Swivel makeup
10	Between C/V check valve and return pipe	Return
13	Between return pipe and tank	Return

[3] Blade / travel hose

1) Blade/swing hose routing

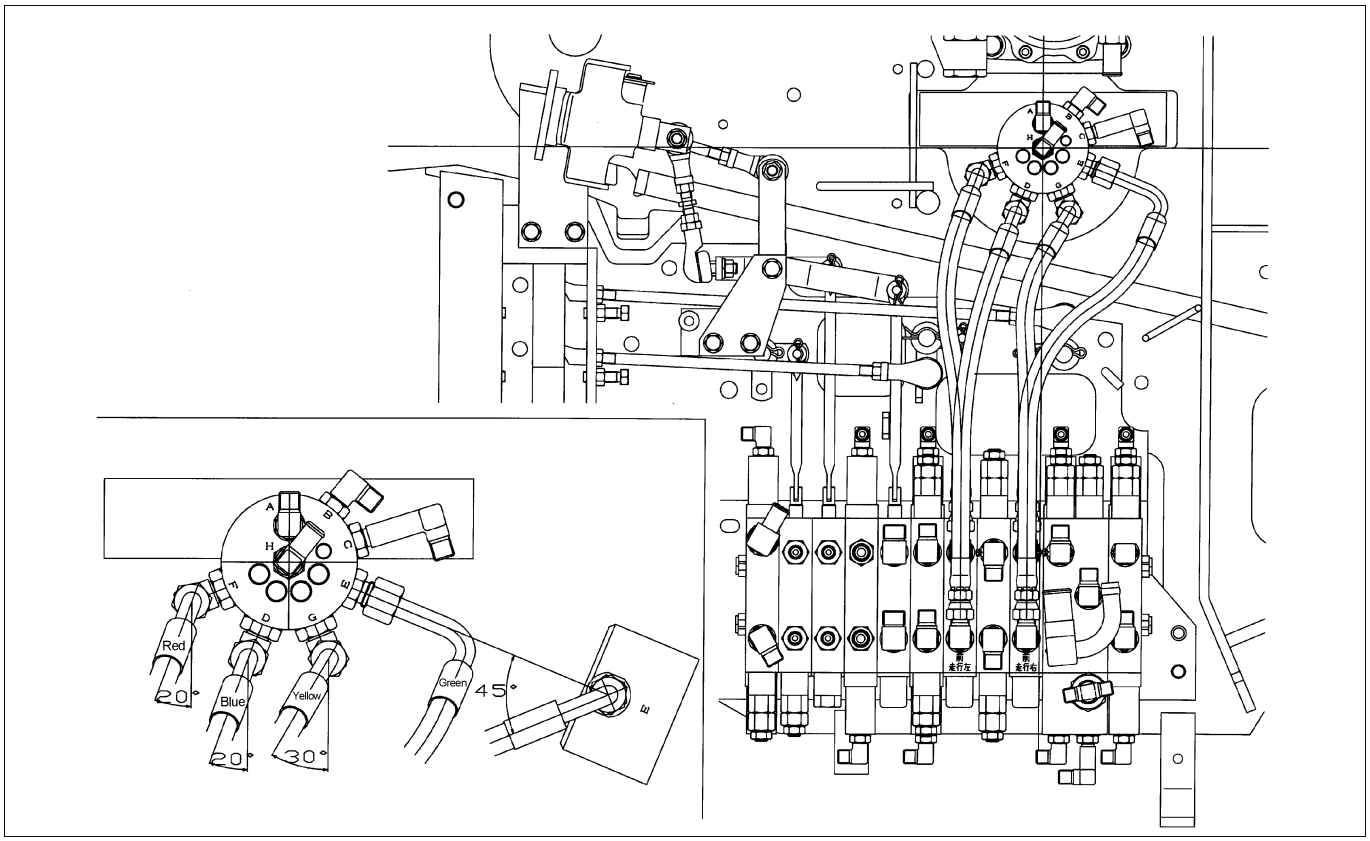
(Important)
The hydraulic hose (for blade/swing) should be replaced every two years or 400 hours of operation, whichever is earlier.



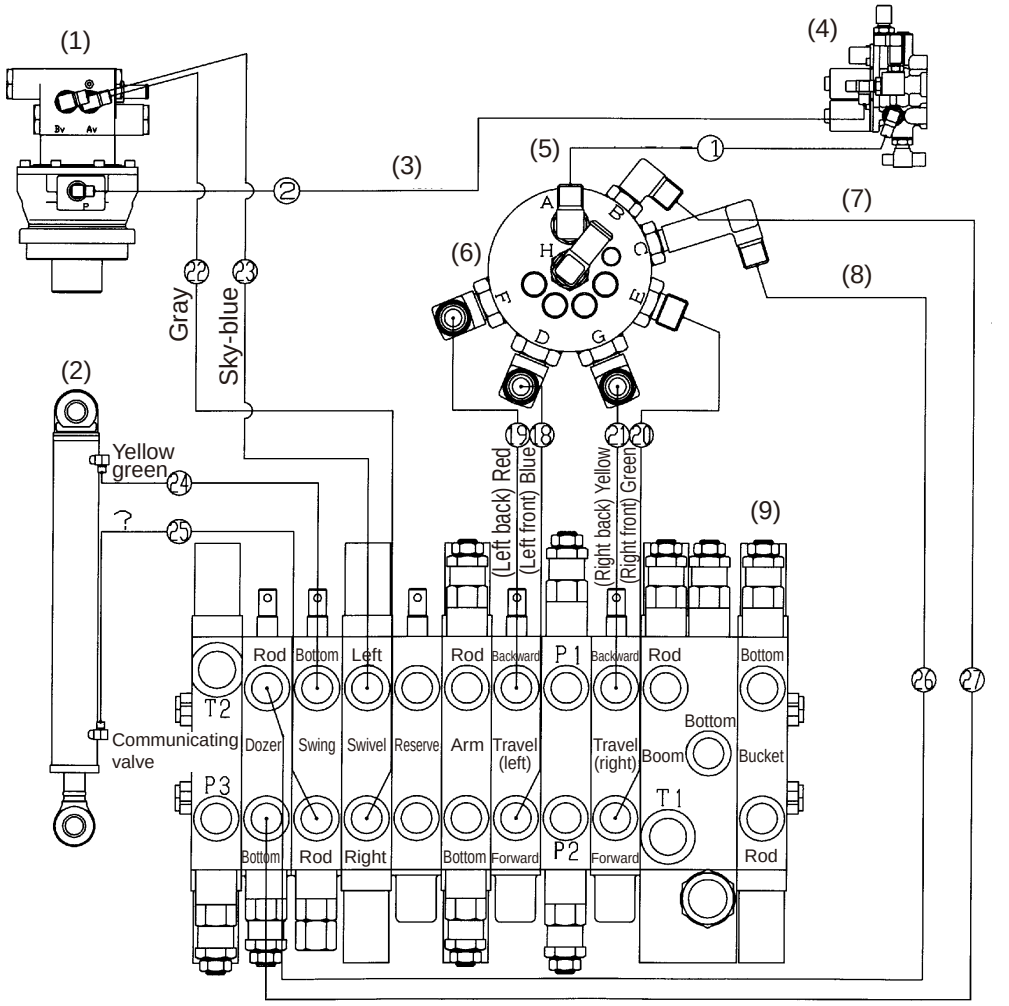
(1)Leave a clearance of 10mm or more between the hose and link ball.

(2)Code band 55311-4126Δ

2) Travel hose routing (rotary joint upper)



3) Travel, swivel, swing and blade hose routing (rotary joint upper)



(1)Swivel motor
(2)Swing cylinder
(3)Swivel brake release
(4)Unload valve
(5)(Two-speed)White
(6)Swivel joint
(7)(Dozer down)Brown
(8)(Dozer up)Pink
(9)Control valve

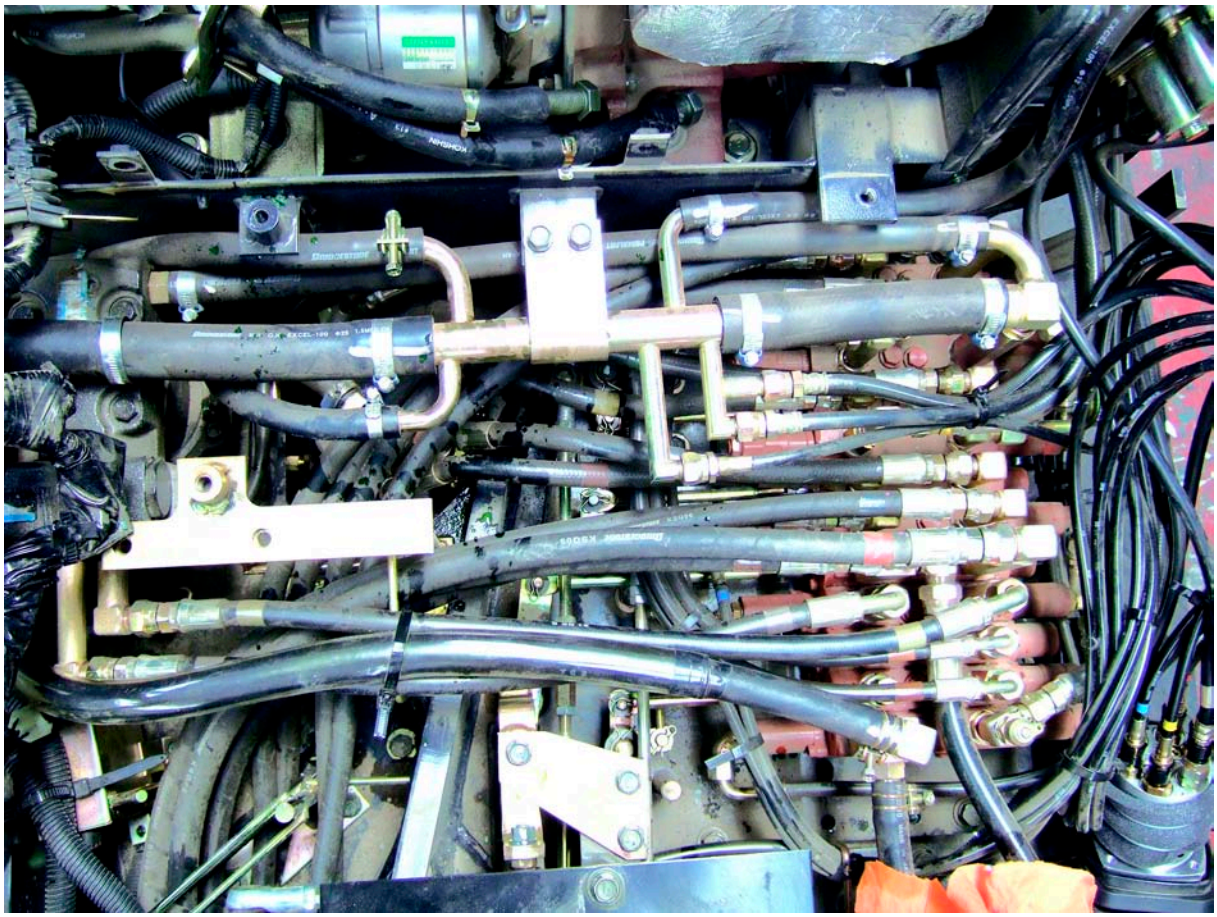
High-pressure hose

NO.	Location			Q'ty
18	C/V~R/J	Travel left forward	Blue	1
19	C/V~R/J	Travel left backward	Red	1
20	C/V~R/J	Travel right forward	Green	1
21	C/V~R/J	Travel right backward	Yellow	1
22	Between C/V and swivel M	Swivel left	Gray	1
23	Between C/V and swivel M	Swivel right	Sky-blue	1
24	Between C/V and swing cylinder bottom	Swing left	Yellow-green	1
25	Between C/V and swing cylinder rod	Swing right	?	1
26	C/V~R/J	Dozer up	Pink	1
27	C/V~R/J	Dozer down	Brown	1

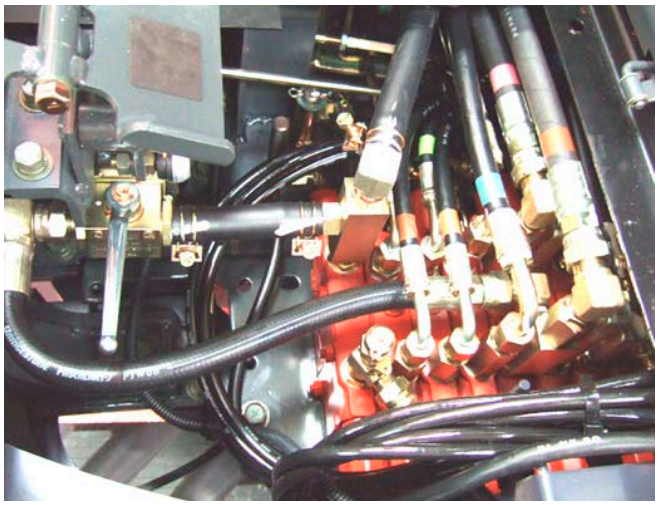
Pilot hose

1	Between selector V and R/J	Travel two-speed pressurization	White	1
2	Between selector V and R/J	Swivel brake release	——	1

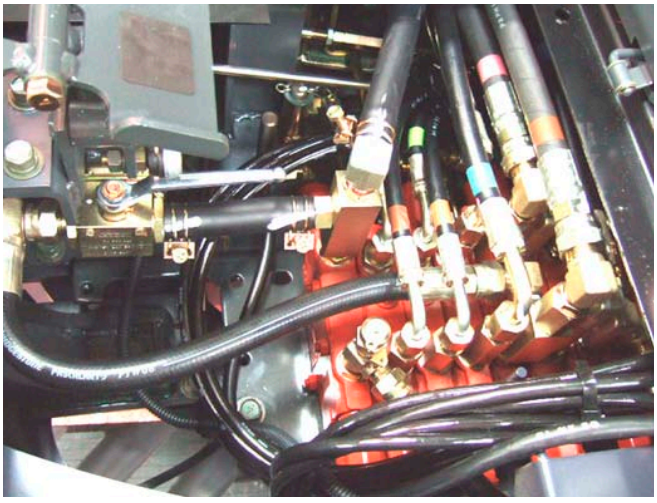
1. Return hoses and pipe



2. Third line : OFF

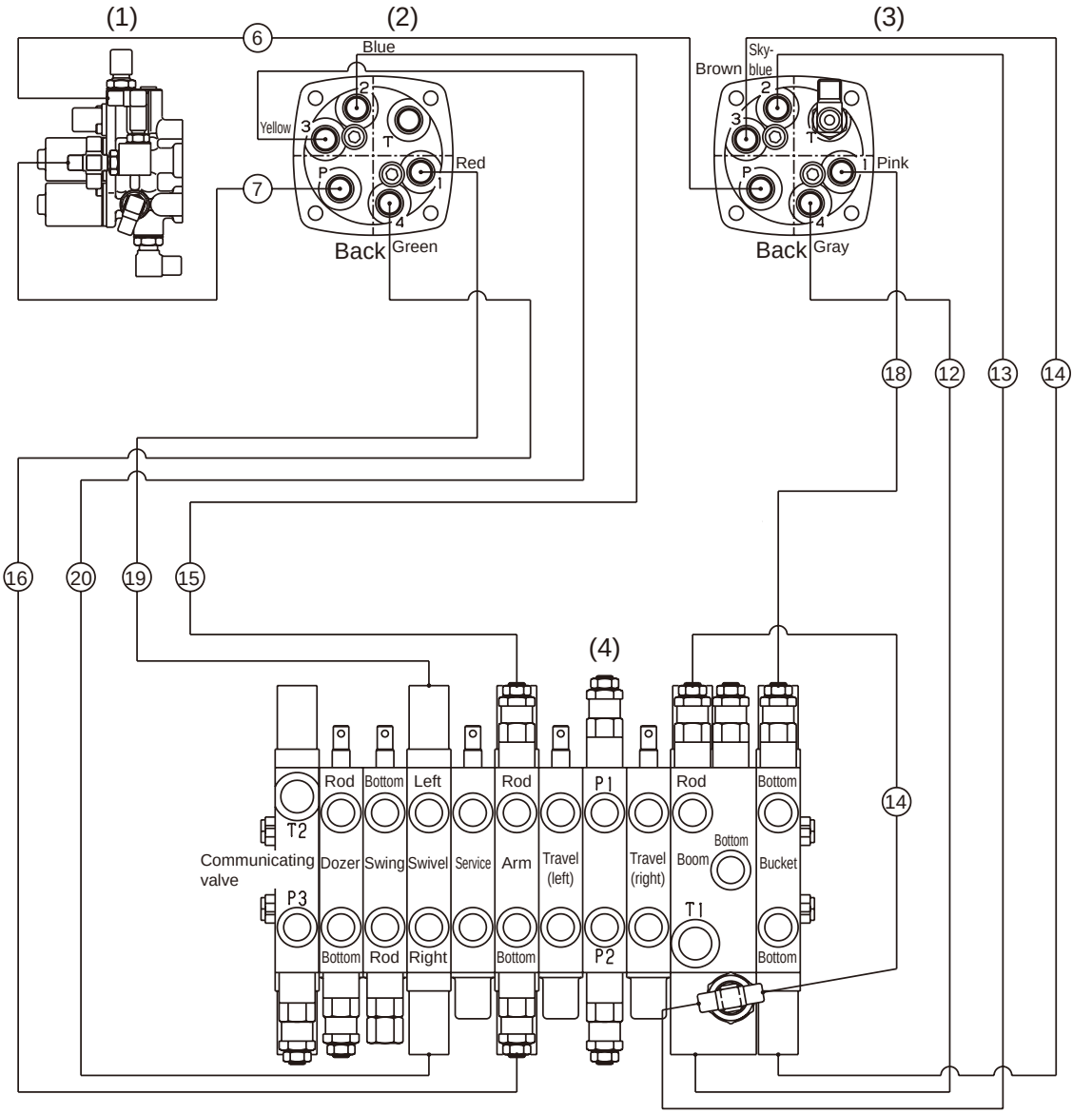


Third line : ON



[4] Pilot hose

1) Pilot hose routing 1 : EU-version

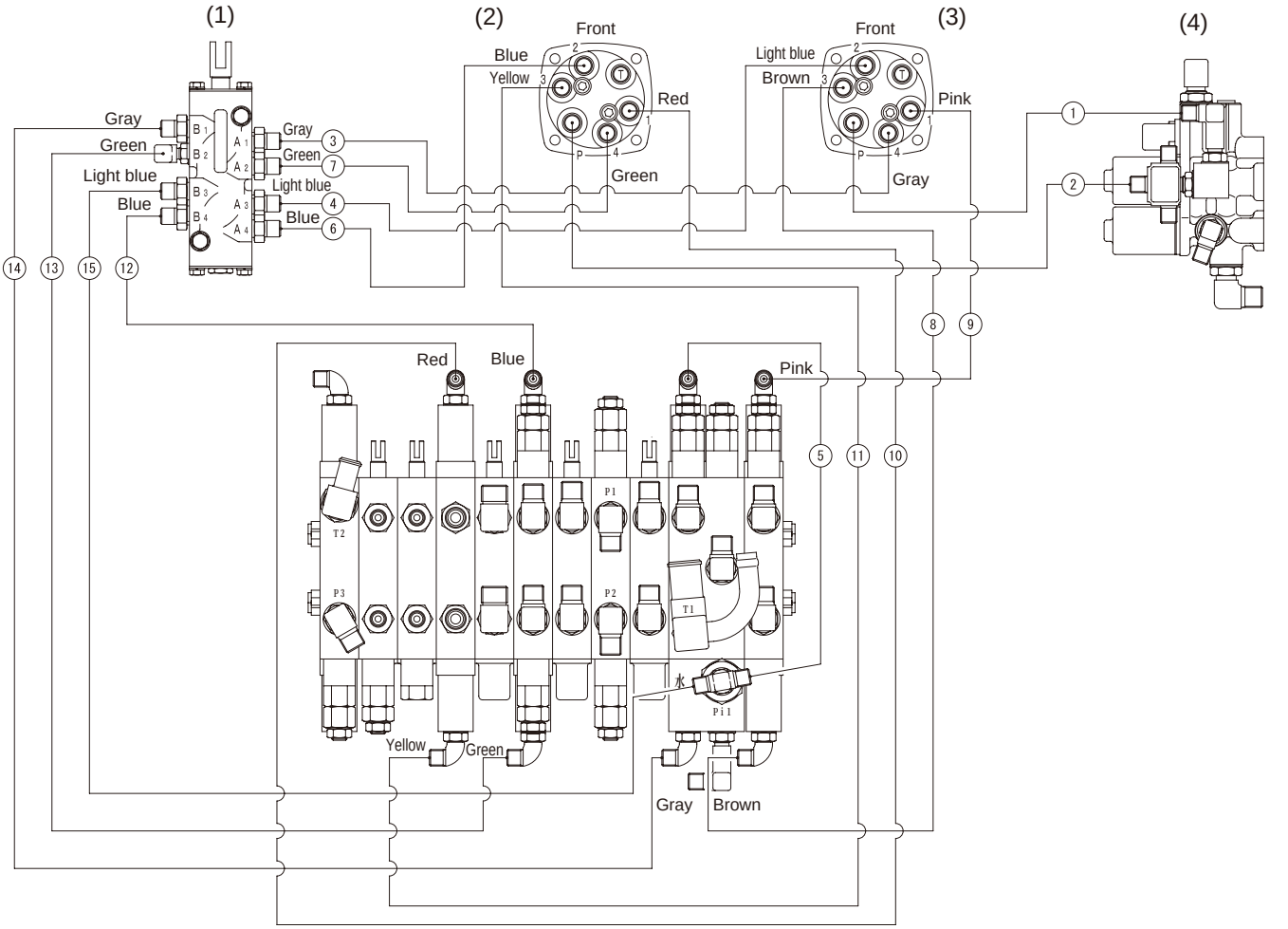


(1)Unload valve
(2)Front P/V(left)
(3)Front P/V(right)
(4)Control valve

List of pilot hoses : EU-version

No.	Location	Part No.		Part name	Q'ty	Dimension (mm)	Tape color	Hose shape	Remarks
		U20-3α EU	U25-3α EU						
1	Between pump and line filter P4	RB411-6324Δ	←	Hydraulic hose (3/8)	1	240 (9.45in.)		G3/8 PLT06 G3/8	BS-made 632-040
2	Between line filter and accumulator	RB419-6325Δ	←	Hydraulic hose (3/8, P4, 2-1)	1	300 (11.81in.)		G3/8 PLT06 G3/8	632-090
3	Between accumulator and selector valve	RB419-6326Δ	←	Hydraulic hose (3/8, P4, 2-2)	1	300 (11.81in.)		G3/8 PLT06 G3/8	632-100
4	Between line filter and CV (travel straight)	RB419-6328Δ	←	Hydraulic hose (1/4, travel straight)	1	1120 (44.09in.)		G1/4 PLT04 G1/4	632-080
5	Between change V and Swivel M Swivel brake release	RB411-6327Δ	←	Hydraulic hose (1/4)	1	1120 (44.09in.)		G1/4 PLT04 G1/4	632-070
6	Between change V and P/V (right) P	RB411-6331Δ	←	Hydraulic hose (1/4)	1	1360 (53.54in.)		G1/4 PLT04 Quick	633-090
7	Between change V and P/V (left) P	RB411-6332Δ	←	Hydraulic hose (1/4)	1	710 (27.95in.)		G1/4 PLT04 Quick	633-100
8	Between P/V (left) T and return pipe	RB411-6334Δ	←	Hydraulic hose (1/4)	1	890 (35.04)		G1/4 PLT04 Quick	633-110
9	Between change V and R/J Travel two-speed	RB411-6445Δ	←	Hydraulic hose (1/4)	1	970 (38.19)	White	G1/4 PLT04 G1/4	644-050
10	P/V (right) T and return pipe	RB411-6335Δ	←	Hydraulic hose (1/4)	1	1300 (51.18)	White	G1/4 PLT04 Quick	644-050
11	Between C/V and return pipe Boom lock drain	RB411-6356Δ	←	Hydraulic hose (1/4)	1	480 (18.90in.)		G1/4 1500-03 G1/4	Nitta-made 635-030
12	Between C/V and P/V (right) Boom up	RB411-6341Δ	←	Hydraulic hose (1/4)	1	1820 (71.65in.)	Gray	G1/4 1500-03 Quick	634-010
13	Between C/V and P/V (right) Boom down	RB411-6342Δ	←	Hydraulic hose (1/4)	1	1920 (75.59in.)	Sky-blue	G1/4 1500-03 Quick	634-020
14	Between C/V and C/V Lock valve release	RB411-6343Δ	←	Hydraulic hose (1/4)	1	320 (12.60in.)		G1/4 1500-03 G1/4	634-030
15	Between C/V and P/V (left) Arm dump	RB419-6344Δ	←	Hydraulic hose (1/4, arm D)	1	1440 (56.69in.)	Blue	G1/4 1500-03 Quick	634-040
16	Between C/V and P/V (left) Arm crawd	RB419-6345Δ	←	Hydraulic hose (1/4, arm C)	1	1220 (48.03in.)	Green	G1/4 1500-03 Quick	634-050
17	Between C/V and P/V (right) Bucket dump	RB411-6346Δ	←	Hydraulic hose (1/4)	1	1950 (76.77in.)	Brown	G1/4 1500-03 Quick	634-055
18	Between C/V and P/V (right) Bucket crawd	RB411-6347Δ	←	Hydraulic hose (1/4)	1	2020 (79.53in.)	Pink	G1/4 1500-03 Quick	634-060
19	Between C/V and P/V (left) Swivel left	RB419-6348Δ	←	Hydraulic hose (1/4, swivel L)	1	1330 (52.36in.)	Red	G1/4 1500-03 Quick	634-070
20	Between C/V and P/V (left) Swivel right	RB419-6349Δ	←	Hydraulic hose (1/4, swivel R)	1	1150 (45.28in.)	Yellow	G1/4 1500-03 Quick	634-080

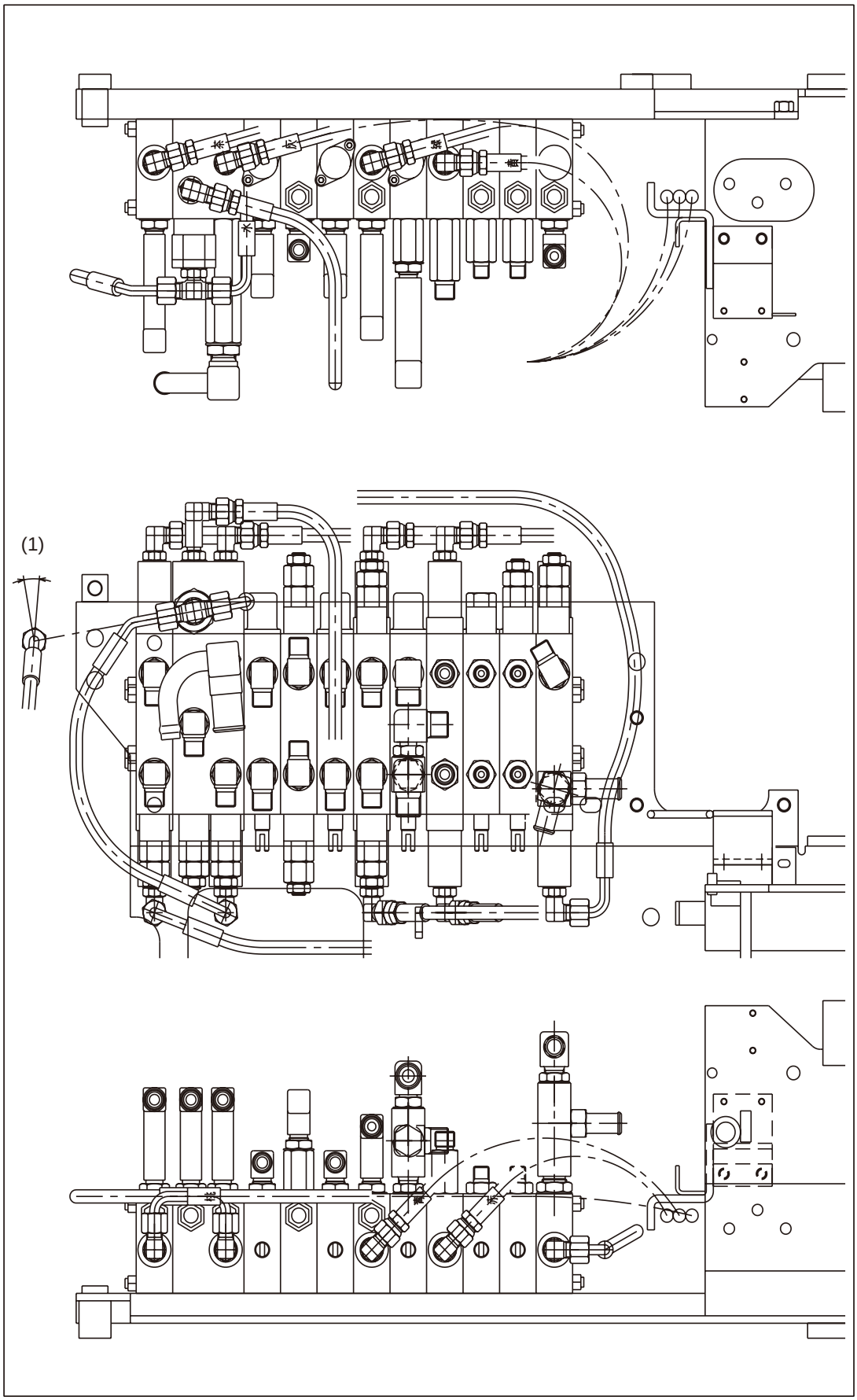
1)Pilot hose routing 1 : PP-version



		(Tape color)
1	Change V - P/V (right) P	
2	Change V - P/V (left) P	
3	TPSS - P/V (right), boom up	Gray
4	TPSS - P/V (right), boom dpwn	L.blue
5	C/V - C/V, lock valve release	
6	TPSS - P/V (left), arm dump	Blue
7	TPSS - P/V (left), arm crowd	Green
8	C/V - P/V (right), bucket dump	Brown
9	C/V - P/V (right), bucket crowd	Peach
10	C/V - P/V (left), left swing	Red
11	C/V - P/V (left), swing right	Yellow
12	C/V - TPSS, arm dump	Blue
13	C/V - TPSS, arm crowd	Green
14	C/V - TPSS, boom up	Gray
15	C/V - TPSS, boom down	L.blue

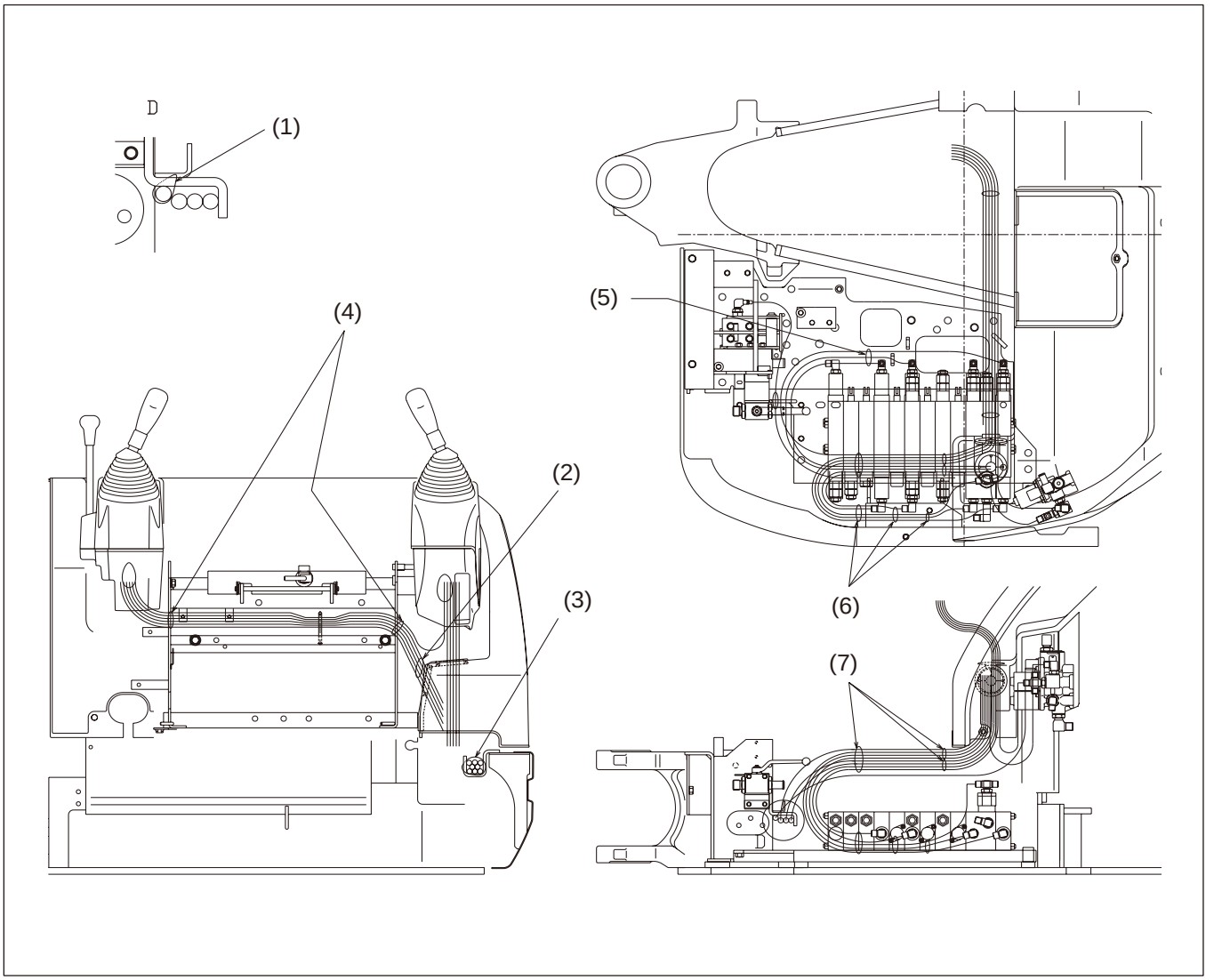
(1)TPSS valve
(2)P/V(left)
(3)P/V(right)
(4)Switch valve

2) Pilot hose routing 2 : EU-version



(1)downward 15°

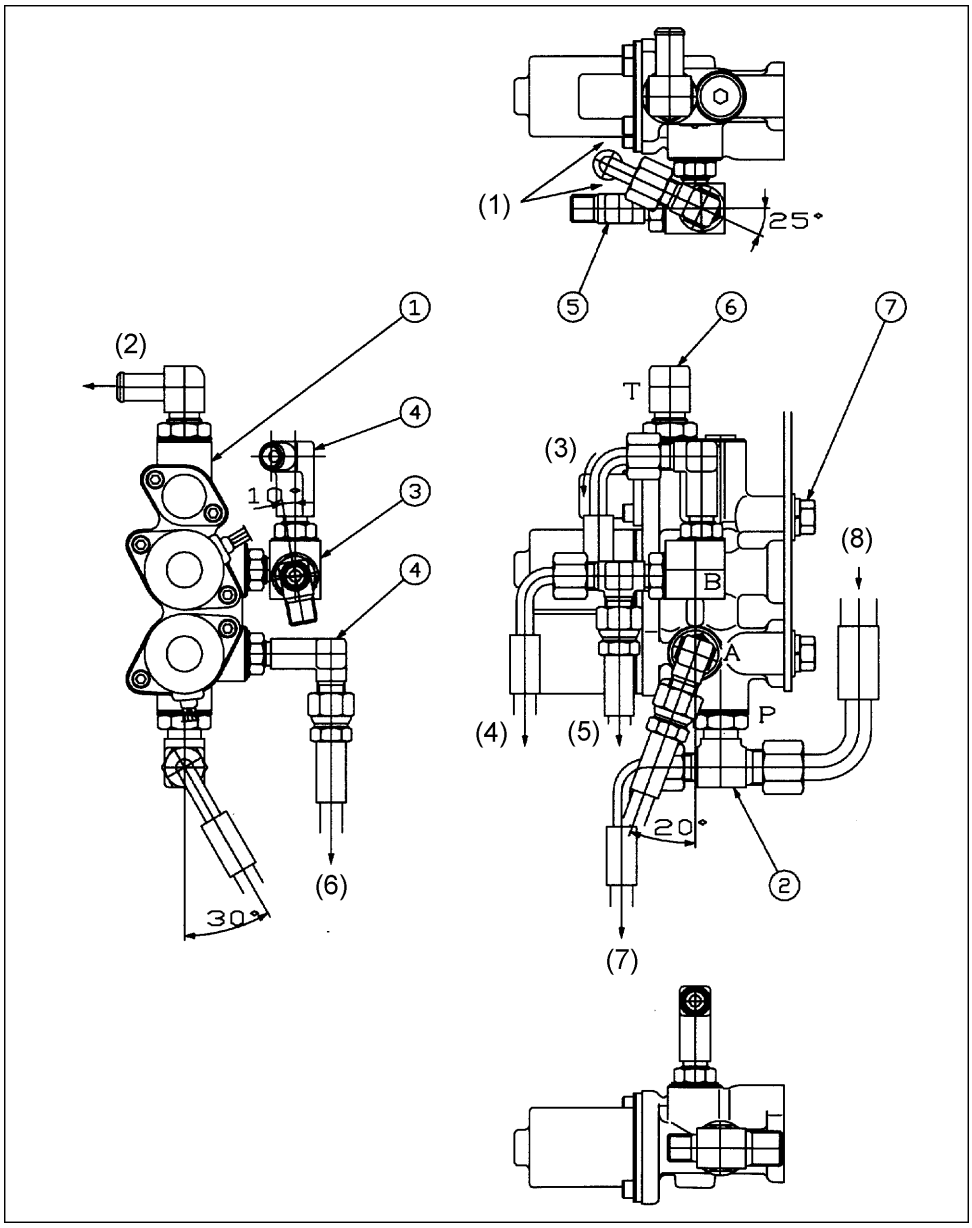
3) Pilot hose routing 3 : EU-version



(1)Cord band 55311-4126Δ
Clamp the travel lock hose,pilot hose and round bar guide together.
(2)Cord band 55311-4126Δ
Clamp at the taping(white) portion of the hose.
(3)Cord band 55311-4126Δ
Clamp the hose round bar guide(front only) together.
(4)Cord band 55311-4126Δ
(5)Cord band 55311-4126Δ
(6)Cord band 55311-4126Δ
(7)Cord band 55311-4126Δ

i. Other hydraulic valve

[1] Selector valve



(PP-version)

(1)Should not touch
(2)Return pipe
(3)P/V right P
(4)P/V left P
(5)Travel M brake release
(6)R/J travel tow-speed
Tape color:White
(7)C/V communicating valve
(8)Line filter

(PP-version)

1) Reassembling procedure:

1. Tightening torque of hydraulic adapter
G1/4 : 24.5~29.4N·m (2.5~3.0kgf·m)
18.1~21.7ft·lbs
G3/8 : 49.0~53.9N·m (5.0~5.5kgf·m)
36.2~39.8ft·lbs

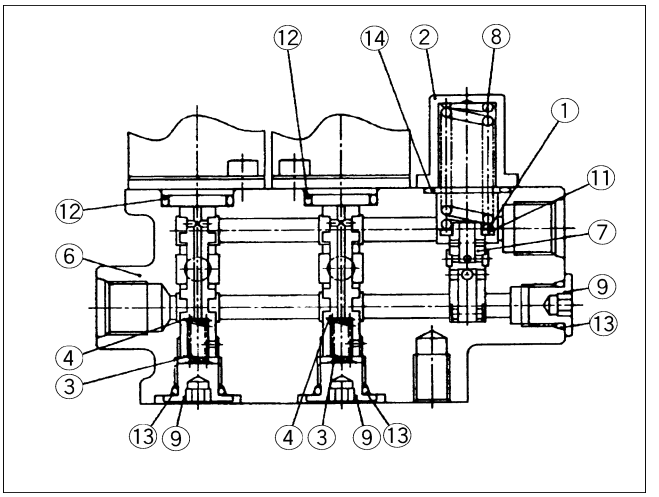
* For the mounting direction and angle of the hydraulic adapter, refer to the figure to the left.

2. Tightening torque of valve assembly (selector): 48.1~55.9 N·m (4.9~5.7 kgf·m)
35.4~41.2ft·lbs

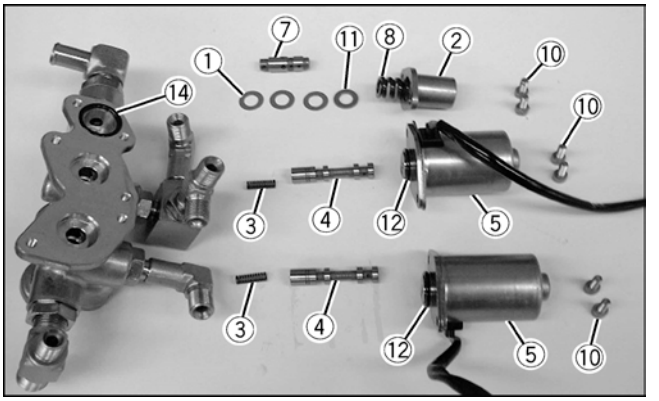
Parts list

No.	Part name	Q'ty	Remarks
1	Valve assembly (selector)	1	
2	Pipe joint (T, F2-F3)	1	P
3	Pipe joint (L, G1/4- G1/4)	1	B
4	Washer based elbow	2	A·B
5	T pipe joint (F2)	1	B
6	Elbow pipe joint (G3/8-13)	1	T
	O-ring	4	A·B for 1/4
	O-ring	2	P·T for 3/8
7	Bolt	2	M10×1.5 7T

Cross sectional view of selector valve

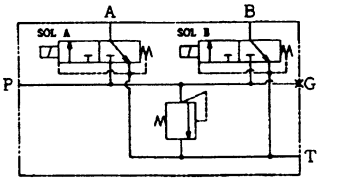


Disassembling the selector valve



Tightening torque of hex socket bolt (10):
3.92 N·m (0.4 kgf·m) 2.89ft·lbs
Relief valve set pressure: 3.9 MPa (40 kgf/cm^2)
569psi

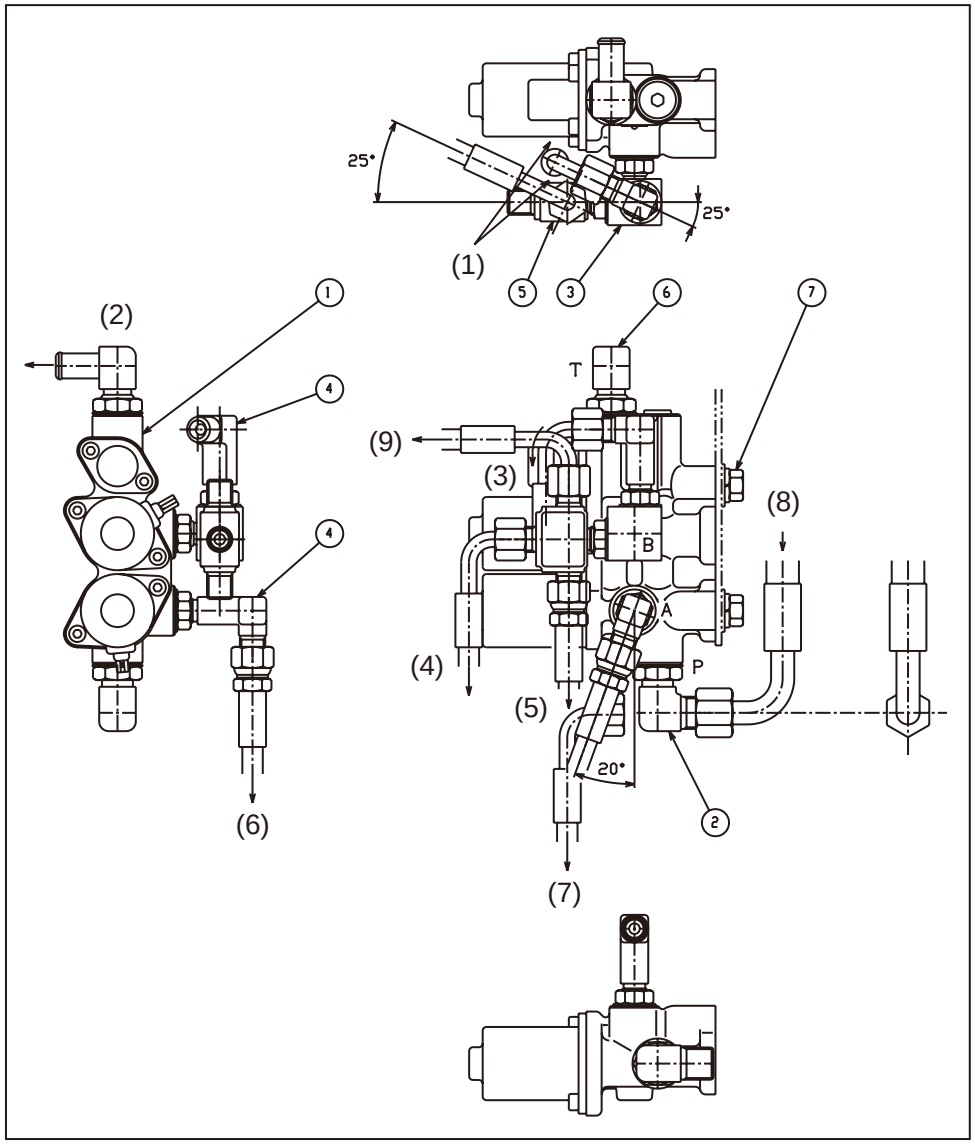
Hydraulic circuit diagram



Parts list

No.	Part name	Q'ty
1	Shim	3
2	Cover spring	1
3	Spring	2
4	Spool	2
5	Solenoid	2
6	Body	1
7	Plunger	1
8	Spring	1
9	Flanged plug	3
10	Hex socket bolt	6
11	Flat washer	1
12	O-ring	2
13	O-ring	3
14	O-ring	1

2) Installing the selector valve

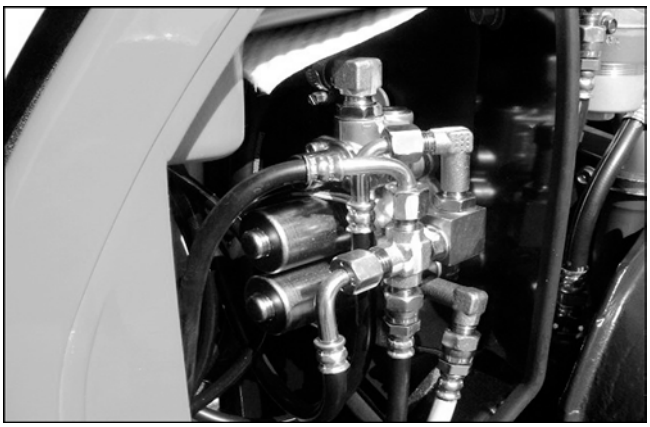


(EU-version)

(1)Should not touch
(2)Return pipe
(3)P/V right P
(4)P/V left P
(5)Travel M brake release
(6)R/J travel tow-speed
Tape color:White
(7)C/V communicating valve
(8)Line filter
(9)Travel lock cylinder

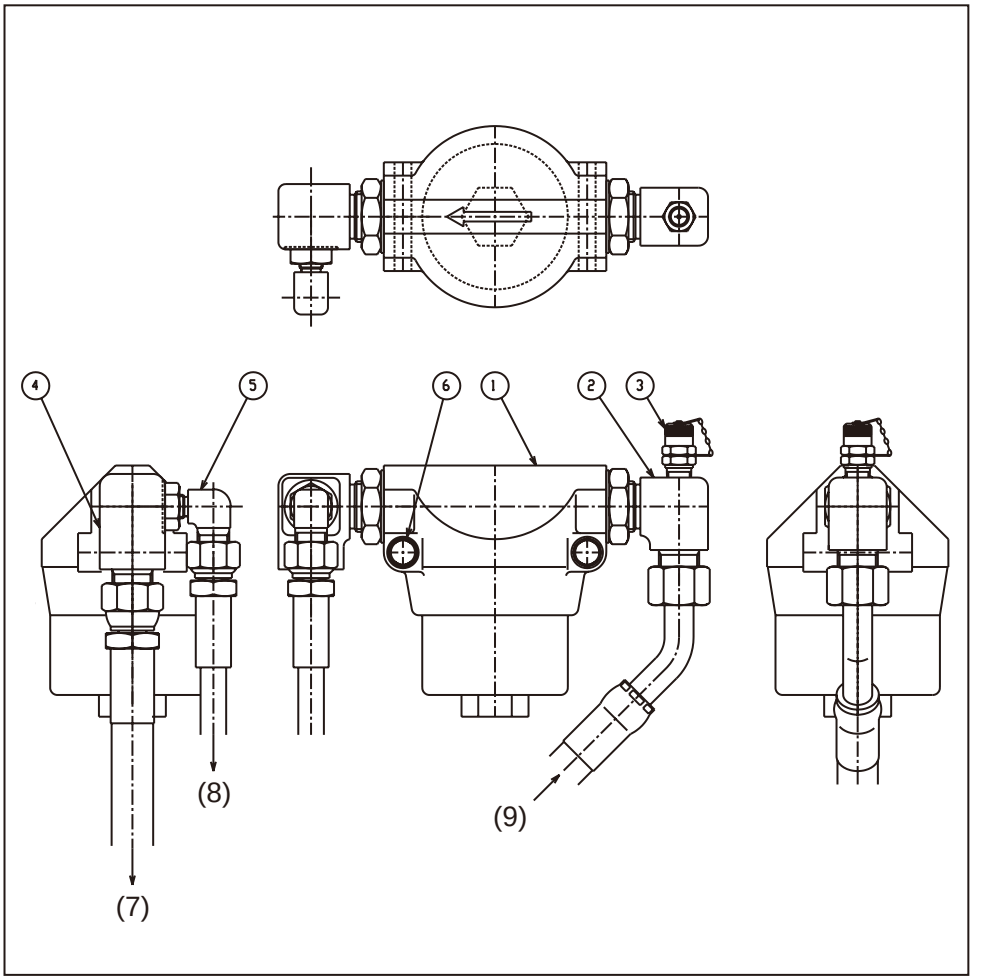
(EU-version)

(1) Tightening torque for installation of valve
48.1~55.9 N·m (4.9~5.7 kgf·m) <35.4~41.2ft·lbs>
(2) Tightening torque of adaptor
G3/8: 49.0~53.9 N·m (5.0~5.5 kgf·m)
<36.2~39.8ft·lbs>
G1/4: 24.5~29.4 N·m (2.5~3.0 kgf·m)
<18.1~21.7ftf·lbs>)



No.	Part No.	Part name	Q'ty	Remarks
1	RB411-6191Δ	Valve assembly (selector)	1	(633)
2	RP201-61812	Pipe joint (L, G3/8- G3/8)	1	P
3	RP201-61892	Pipe joint (L, G1/4- G1/4)	1	B
4	68591-63231	Washer based elbow	2	A·B
5	RP802-61931	Pipe joint (cross, G1/4)	1	B
6	RB411-6391Δ	Elbow pipe joint (G3/8-13)	1	T
7	01125-61020	Bolt	2	M10×1.5 7T
	04810-00110	O-ring		A·B for 1/4
	04810-00140	O-ring		P·T for 3/8

[2] Pilot filter

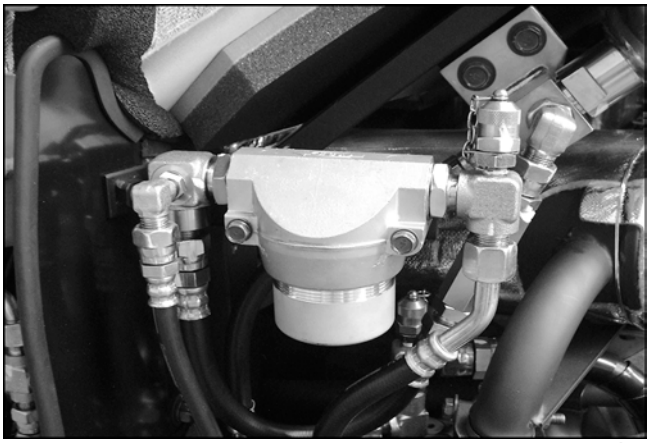


(EU-version)

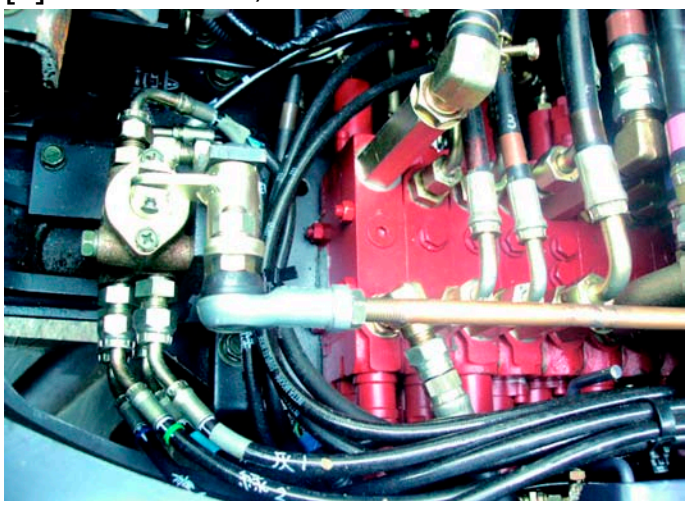
(1) Tightening torque for installation of filter:
9.8~11.3 N·m (1.0~1.15 kgf·m) <7.2~8.3ft·lbs>
(2) Tightening torque of adaptor:
G1/2: 58.8~63.7 N·m (6.0~6.5 kgf·m)
<43.4~47.0ft·lbs>
(3) Tightening torque of hydraulic hose:
G3/8: 49.0~53.9 N·m (5.0~5.5 kgf·m)
<36.2~39.8ft·lbs>

No.	Part No.	Part name	Q'ty	Remarks
1	RD401-6126Δ	Filter assembly (pilot)	1	(624)
2	RC401-6383Δ	Elbow pipe joint (F4-F3)	1	IN
3	RG908-86443	Adapter	1	R1/8
4	RB419-6381Δ	Pipe joint (L G4-G3-G1)	1	OUT
5	RP201-6962Δ	Pipe joint (L G1/8-G1/4)	1	
6	01025-60655	Bolt	2	M6×1 7T

(7) Accumulator
(8) C/V communicating valve
(9) Pump P4


EU-Version

[3] TPSS valve, PP-version



1.Fitting direction and angle of the hydraulic adaptor
Fit the adaptor as shown in the figure.

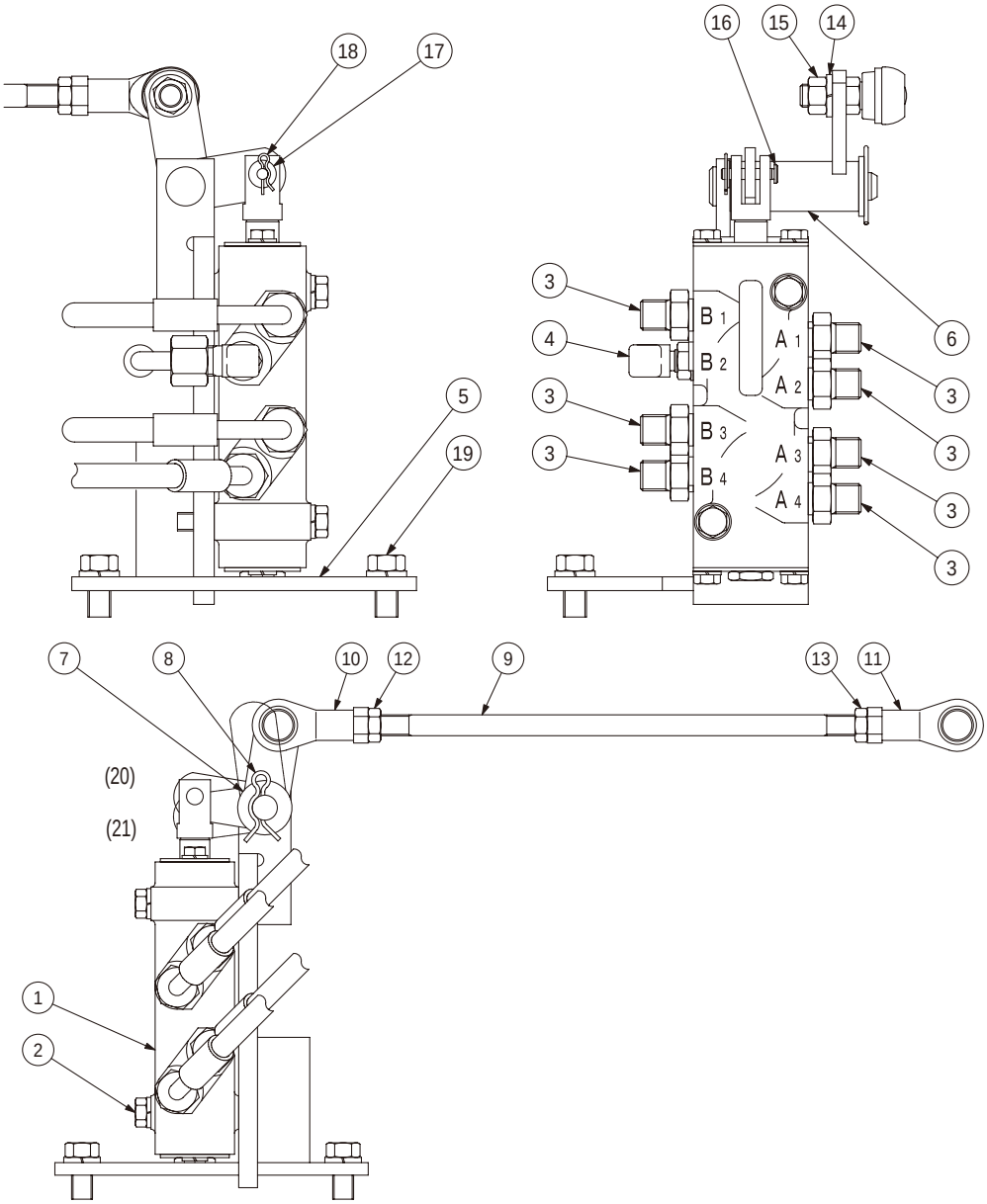
2.Tightening torque of the hydraulic adaptor
G1/8 7.8~11.8N·m (0.8~1.2kgf·m)

3.Applying grease on the DU bushing
Make sure the turning shaft moves smoothly.

4.Tightening torque of the link ball assembling nut
39.2~45.1N·m (4.0~4.6kgf·m)

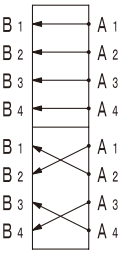
5.Fitting of the valve assembly (TPSS) and bracket (TPSS valve)
Tightening torque 23.5~27.5N·m (2.4~2.8kgf·m)

6.Fitting of the bracket (TPSS valve)
Tightening torque 48.1~55.9N·m (4.9~5.7kgf·m)



(1)Valve assembly (TPSS)
(2)Bolt, M8x1.25, 7T
(3)Adaptor
(4)Pipe joint (L.G1/8-G1/4)
O-ring
(5)Bracket (TPSS valve)
(6)Lever assembly (1, TPSS)
(7)Plain washer
(8)Snap pin
(9)Rod (1C-270)
(10)Link ball 1
(11)Link ball 2
(12)Nut
(13)Left-hand lock nut
(14)Spring washer
(15)Nut
(16)Headed pin
(17)Plain washer
(18)Snap pin
(19)Bolt, M10x1.25, 7T
(20)JD pattern
(21)JIS pattern

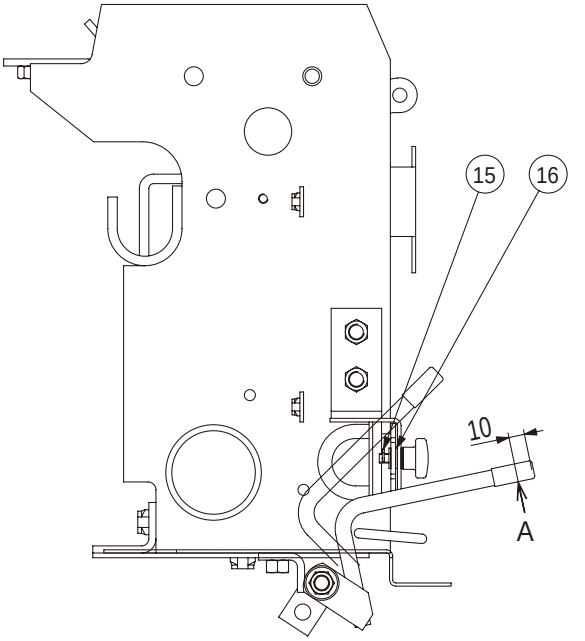
JD pattern

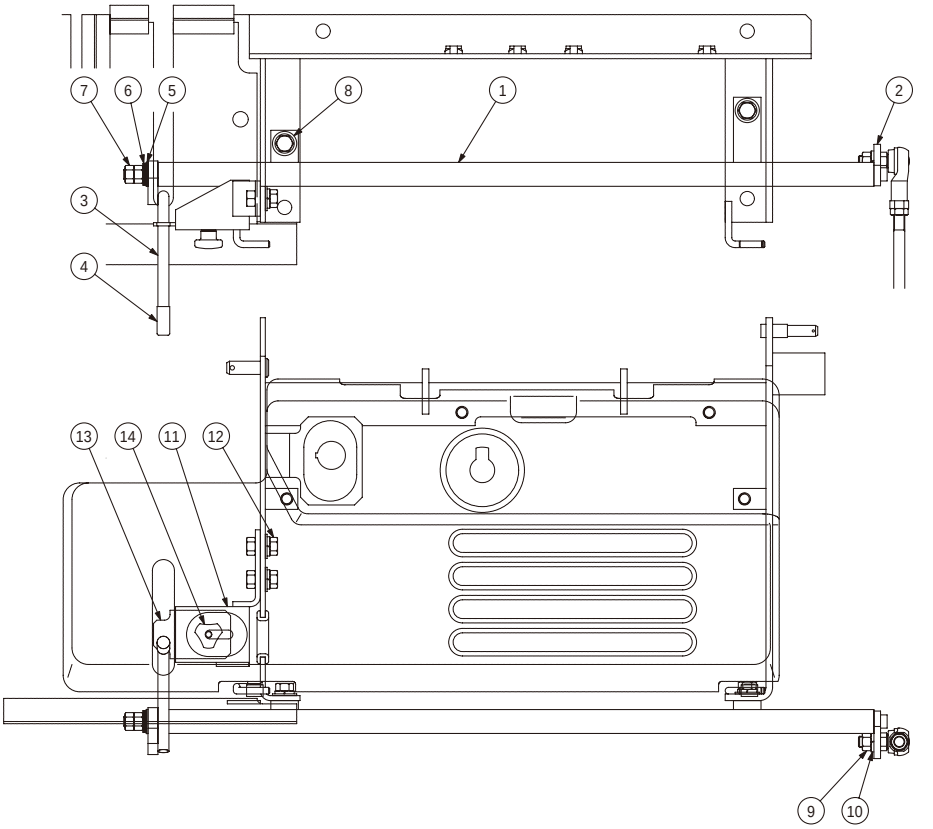


(Gray) boom up (C/V)	B 1	A 1	Left P/V (rear) (Gray)
(Green) arm crowded (C/V)	B 2	A 2	Right P/V (rear) (Green)
(Light-blue) boom down (C/V)	B 3	A 3	Left P/V (front) (Light-blue)
(Blue) arm dump (C/V)	B 4	A 4	Right P/V (front) (Blue)

1.Applying grease on the DU bushing
Make sure the turning shaft moves smoothly.

2.Operating force of the lever (3,TRSS) at part A
Tighten and lock the nut to achieve 20-40 N (2.0-4.1 kgf).



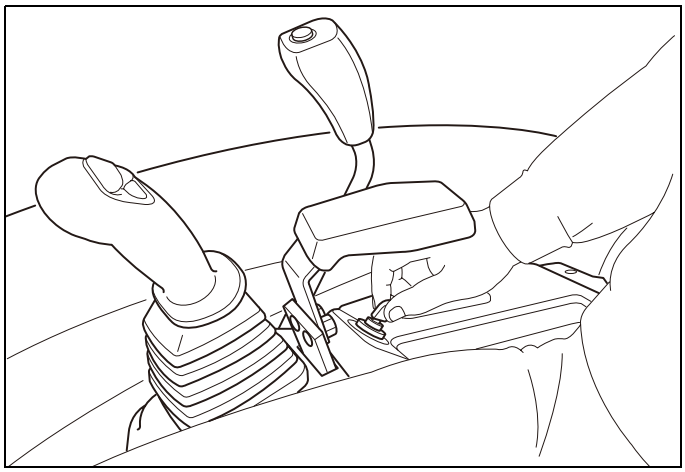


(1)Bracket assembly (TPSS lever)
(2)Lever (2, TPSS)
(3)Lever (3, TPSS)
(4)Cap
(5)Plain washer
(6)Disc spring
(7)Nut, M10x1.25, 4T
(8)Bolt, M10x1.25, 7T
(9)Nut, M10x1.25, 4T
(10)Spring washer
(11)Bracket (Plate JD)
(12)Bolt, M10x1.25, 4T
(13)Plate (JD)
(14)Knob bolt
(15)Snap pin
(16)Plain washer
(17)JIS pattern
(18)JD pattern

[4] Accumulator

1)Location of accumulator.

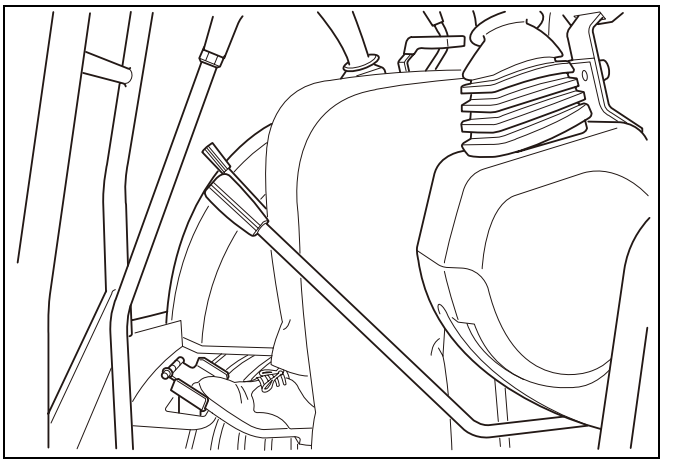
2)Accumulator discharge pressure test.

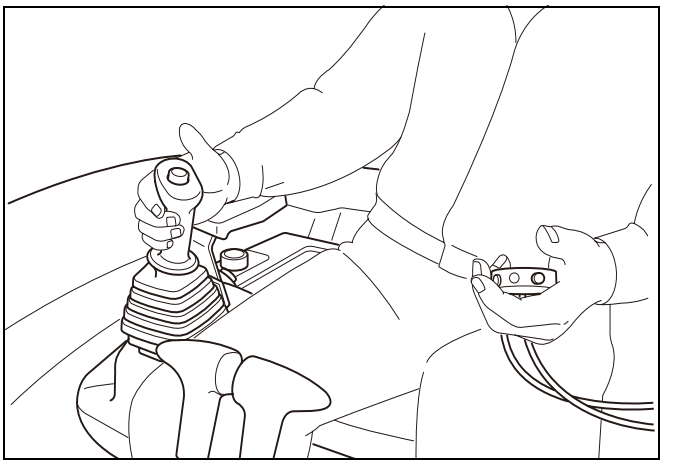


3)Accumulator performance test.

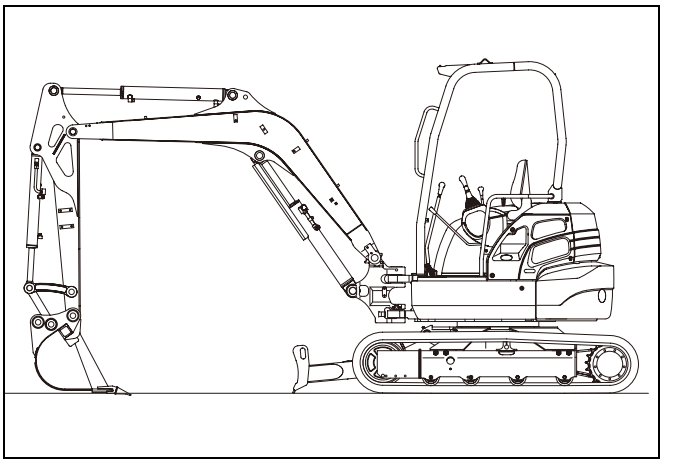
1.Raise the Boom, Arm and bucket, approx 1~2m (39.4~78.7in) above ground height.

2.With the safety lock lever in the operation position, turn main key to the OFF position to stop the engine.





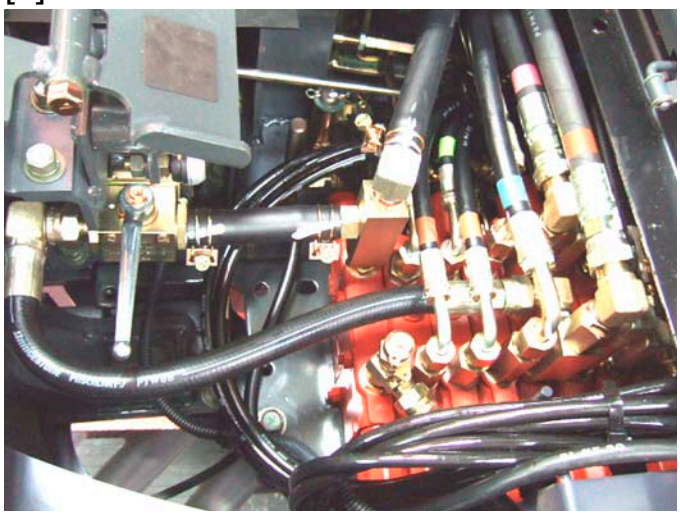
3.Once the engine has stopped, turn the main key to the ON position, stroke the boom pilot control to the Up position, start to record the time duration (using a stopwatch)



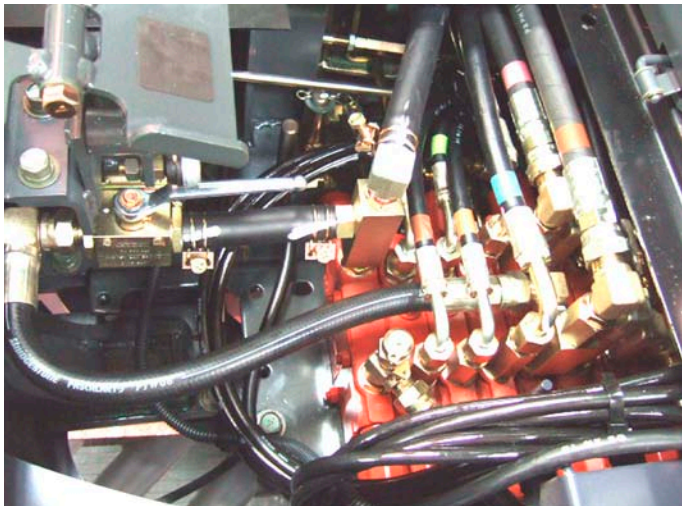
4.After 3 minutes, ensure boom, arm and bucket can be lowered to a safe position.

Specifications	Discharge time
New machine	3 min
Service limit	1 min

[5] Third line valve

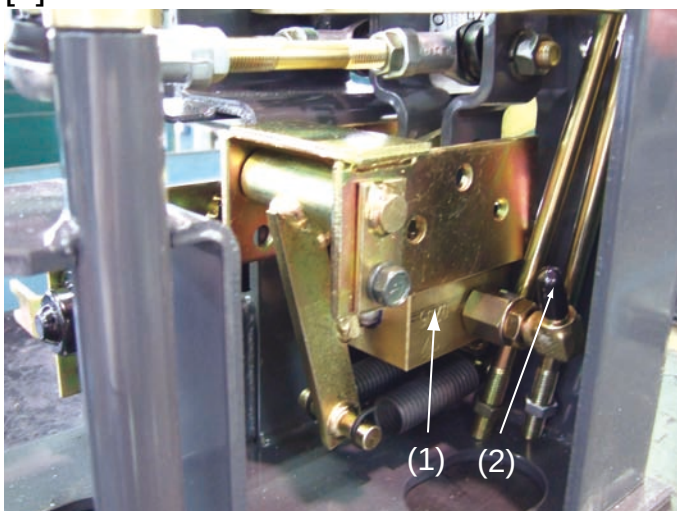


1)Third line is closed.



2)Third line is opened.

[6]Travel lock valve



(1) Travel lock valve
(2) Pilot primary pressure hose connection.

V. Electrical system (Service section)

A. Specifications

Fig.	Item	**U20-3α, U25-3α**	**U25S**		Remarks
Battery	Part No.	RB411-5323-0	RB411-5323-0		
	Manufacturer	Yuasa Corporation	Yuasa Corporation		
	Capacity (5 hr)	52 Ah	52 Ah		
	Type	JIS 75D23R	JIS 75D23R		
	Dimensions (L x W x H)(mm/in.)	171 x 230 x 223	171 x 230 x 223	6.73 x 9.06 x 8.78	
	Electrolyte specific gravity (20°C)"	1.28±0.01	1.28±0.01		
	Connection of battery cells	Anode:Φ19.5x17mm Cathode : Φ17.9x17mm	Anode : Φ19.5x17mm Cathode: Φ17.9x17mm	Anode : Φ0.77x0.67in. Cathode : Φ0.70x0.67in.	
	Amount of electrolyte	3.7L	3.7L	0.977US gal	
Alternator	Part No.	1G090-6401-0	1G090-6401-0		
	Manufacturer	Denso Corporation	Denso Corporation		
	Type	Regulator built-in	Regulator built-in		
	Nominal voltage	12V	12V		
	Max. output	40A at 5000 rpm	40A at 5000 rpm		
	Rotating direction	Clockwise	Clockwise		
	Polarity	Ground at cathode	Ground at cathode		
Starter motor	Part No.	19269-63013-0	19269-6301-0		
	Manufacturer	Denso Corporation	Denso Corporation		
	Type	Reduction type	Reduction type		
	Nominal voltage	12V	12V		
	Nominal output	1.4kW	1.4kW		
	Time rating	30 sec.	30 sec.		
	Rotating direction	Clockwise (viewed from pinion end)	Clockwise (viewed from pinion end)		
	Number of pinion gear	9	9		
Glow plug	Part No.	16851-6551-0	16851-6551-0		
	Manufacturer	NGK Spark Plug Co.,Ltd.	NGK Spark Plug Co.,Ltd.		
	Type	Two materials coil	Two materials coil		
	Resistance	1.5±0.15Ω	1.5±0.15Ω		
	Voltage / current	DC 11V	DC 11V		
	Tightening torque	M8x1.0 : 8 to 15 N·m	M8x1.0 : 8 to 15 N·m (1.8 to 3.4ft.lbs)		
		Nut (M4x0.7) : 1 to 1.8 N·m	Nut (M4x0.7) : 1 to 1.8 N·m (0.2 to 0.4ft.lbs)		
Oil pressure switch	Part No.	1A024-3901-0	1A024-3901-0		
	Manufacturer	Tokai Rika Co., Ltd.	Tokai Rika Co., Ltd.		
	Nominal voltage	DC 12V	DC 12V		
	Insulation resistance	>3MΩ	>3MΩ		
Fuel sensor unit	Part No.	RB441-5114-0	RB441-5114-0		
	Manufacturer	Yazaki Meter Co.,Ltd.	Yazaki Meter Co.,Ltd.		
	Sliding resistance value	Full : 3±1.2Ω	Full : 3±1.2Ω		
		Half : 32.5±1.5Ω	Half : 32.5±1.5Ω		
		Empty : 110±3.5Ω	Empty : 110±3.5Ω		

Fig.	Item	**U20-3α, U25-3α**	**U25S**		Remarks
Horn	Part No.	RD408-5336-0	RD408-5336-0		
	Manufacturer	Denso Corporation	Denso Corporation		
	Current ampare	3.0±1.0A	3.0±1.0A		
	Sound level	113±5 dB(A) at 2m	113±5 dB(A) at 2m		
	Frequency	420±30Hz	420±30Hz		
Fuel pump	Part No.	RD411-5135-0	RD411-5135-0		
	Manufacturer	U-SHIN	U-SHIN		
	Operating voltage range	DC 8.5 to 16.5V	DC 8.5 to 16.5V		
	Max. operating ampare	<1.5A	<1.5A		
	Full derivery amount at free flow	>400cm^3/min	>400cm^3/min	>24cu.in./min	
Change valve	Relief pressure setting	3.9MPa(40kgf/cm^2) at 6L/min	3.9MPa(40kgf/cm^2) at 6L/min	565.6psi at 1.58USGPM	U20-3α/ 25-3α : with accumrator
	Part No.	RB411-6191-0	RB411-6191-0		
	Manufacturer	Nishina Industrial	Nishina Industrial		
	Unload valve coil resistance	12Ω	12Ω		
	High-Low change valve coil resistance	12Ω	12Ω		
	Rated flow and pressure	7L/min, 4.9MPa (50 kgf/cm^2)	7L/min,4.9MPa (50 kgf/cm^2)	1.85USGPM, 710psi	
Engine stop solenoid	Part No.	17208-6001-0	17208-6001-0		
	Manufacturer	Kyosan Electric	Kyosan Electric		
	Pull-in coil resistance	0.375Ω	0.375Ω		
	Hold coil resistance	15.6Ω	15.6Ω		
Engine speed sensor	Part No.	T1060-3227-0	T1060-3227-0		
	Manufacturer	Matsushita Electronic Components	Matsushita Electronic Components		
	Operating voltage	DC 7 to 16V	DC 7 to 16V		
	Air gap(mm)	0.5 to 0.9 (0.7)	0.5 to 0.9 (0.7)		
	Sensing frequency	1Hz to 7kHz	1Hz to 7kHz		
	Output type	Open collector	Open collector		
	Output voltage	V_H = 4.8V, V_L=0.8V	V_H = 4.8V, V_L=0.8V		
	Gear RPM	600	600		
Thermostat unit	Part No.	T1063-6566-0	T1063-6566-0		
	Manufacturer	Keihin	Keihin		
	Resistance	-20°C : 18.80Ω	-20°C : 18.80Ω		
		40°C : 1.136Ω	40°C : 1.136Ω		
		100°C : 0.1553Ω	100°C : 0.1553Ω		
	Tightening torque	17.7±2.0 N·m	17.7±2.0 N·m	3.98±0.45 ft.lbs	

Fig.	Item	**U20-3α, U25-3α**	**U25S**		Remarks
Glow relay	Part No.	T1060-3371-0	T1060-3371-0		
	Manufacturer	Denso Corporation	Denso Corporation		
	Rated coil voltage and current"	12V, 0.19±0.04A (at 20°C)	12V, 0.19±0.04A (at 20°C)		
	Lowest operating voltage	6V	6V		
	Return voltage	1 to 5V	1 to 5V		
	Current capacity	0.1 to 40A	0.1 to 40A		
Meter panel	Part No.	RB449-5311-0	RB548-5312-0 (KTC)	RB548-5313-0 (KTA)	
	Manufacturer	Yazaki Meter Co.,Ltd.	Yazaki Meter Co.,Ltd.		
Work lamp (Boom)	Part No.	3G710-7591-0	3G710-75911-0		
	Manufacturer	Knight Beam (Imasen Electric Industrial Co., Ltd.)	Knight Beam (Imasen Electric Industrial Co., Ltd.)		
	Capacity	55W	55W		
	Type	Halogen lamp	Halogen lamp		
Work lamp (Cabin)	Part No.	T0270-7530-0	-		
	Manufacturer	Knight Beam (Imasen Electric Industrial Co., Ltd.)	-		
	Capacity	27W	-		
	Type	Halogen lamp	-		
Safety lock SW	Part No.	RC411-5347-0	RC411-5347-0		
	Manufacturer	Asahi Denso Co.,Ltd.	Asahi Denso Co.,Ltd.		
	Operating voltage, ampare	DC 14V, 1.5A	DC 14V, 1.5A		
	Continuity resistance	0.2Ω	0.2Ω		
	Operating stroke	9±0.5mm	9±0.5mm	0.35±0.02in.	
	Insulation resistance	1MΩ<	1MΩ		
	Operating force at full stroke	32±4 N	32±4N	7.2±0.9lbw	
	Switch type	Normal Open	Normal Open		
Wiper motor	Part No.	34673-8640-0 Toyoda Gosei Co.,Ltd. / Denso Corporation	-		
	Manufacturer		-		
	Operating voltage	DC 12V	-		
	No load current	<2A	-		
	Restricted current	<12A	-		
Heater	Part No.	34070-7241-0	-		
	Manufacturer	Denso Corporation	-		
	Operating voltage	DC 12V	-		
			-		

B Troubleshooting

a Engine

Trouble	Check item	Remedy	Remarks
1. The starter does not run.	(1) Check the slow-blow fuse (50A) and fuse (10A) for blowouts.	Check or replace.	
	(2) Check the battery terminal for looseness.	Retighten.	
	(3) Hold the starter switch in the starting position and check if a voltage of 10.5 V or more appears between the both ends (+, –) of the battery.	Charge or replace.	
	(4) Interchange the release relay and the light relay.	Check or replace.	
	(5) Check if the release controller is normal.	Check or replace.	
	(6) Check the starter M terminal for looseness.	Retighten.	
	(7) Hold the starter switch in the starting position and check if a voltage of 9V or more is applied to the starter 50 terminal.	Repair or replace.	
	(8) Check if the key switch is normal.	Check or replace.	
2. The starter runs but the engine does not start.	(1) Turn On the key switch and check if fuel overflows into the tank.	Check visually.	
	(2) Turn On the key switch and check by hand if the fuel pump is running.	Replace.	
	(3) Check the fuel pump fuse for blowouts.	Replace.	
	(4) Check if a voltage is applied to the Fuel pump coupler 1 and 2.	Repair or replace.	
	(5) Disconnect the stop solenoid and check if the engine starts.	Repair or replace.	
	(6) Turn On the key switch and check if a voltage is applied to the engine stop solenoid coupler.	Repair or replace.	
3. The cold-temperature starting property is poor.	(1) Check if the battery voltage is normal.	Charge or replace.	
	(2) Check the glow relay fuse (5A) for blowouts.	Replace.	
	(3) Check by hand if the glow relay is running.	Replace.	
	(4) Check if a voltage is applied to the glow relay coupler.	Repair or replace.	
	(5) Check if a voltage is applied to the glow plug.	Repair or replace.	
	(6) Check if the glow plug is normal.	Replace.	
	(7) Check the glow relay.	Replace.	

b Meter panel

Trouble	Check item	Remedy	Remarks
1. The glow lamp does not go on.	(1) Check by hand if the glow relay is running.	Replace	
	(2) Check the meter-side coupler for disconnection.	Repair or replace	
	(3) Interchange the disconnection check relay and the light relay.	Repair or replace	
	(4) Check if a voltage is applied to the bigger meter coupler (9).	Replace	
	(5) Check the lamp for blowouts.	Replace	
2. The charge lamp does not go on.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the coupler of the alternator for disconnection.	Repair or replace	
	(3) Check the meter-side coupler for disconnection.	Repair or replace	
	(4) Check the lamp for blowouts.	Replace	
3. The oil lamp does not go on.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the coupler of the oil switch for disconnection.	Repair or replace	
	(3) Check if a voltage is applied to the coupler of the oil switch.	Repair or replace	
	(4) Disconnect and body-earth the harness terminal of the oil switch and check if the lamp goes on.		
	(5) Measure the engine oil pressure.	Repair	
4. The fuel remaining amount alarm lamp does not go on.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check if the charge lamp and the oil lamp are lit up. Lit up: Normal Not lit up: Abnormal	Repair or replace	
	(3) Check by hand if the disconnection check relay is running, or interchange the disconnection check relay and the light relay.	Replace	
	(4) Body-earth the harness terminal of the fuel sensor. Lit up: Normal Not lit up: Harness broken	Repair or replace	
	(5) Check the panel lamp for blowouts.	Replace	

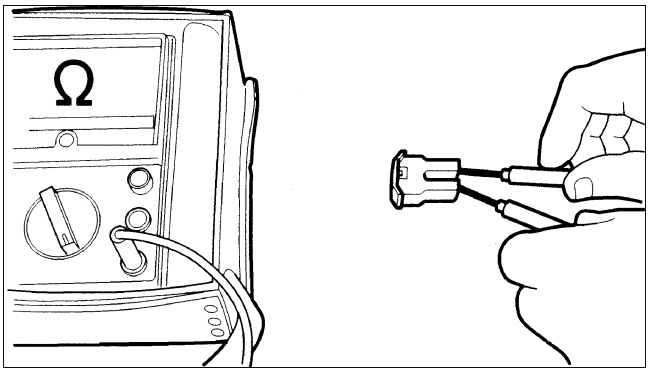
Trouble	Check item	Remedy	Remarks
5. The charge lamp does not go off.	(1) Check the 60A fuse for blowouts.	Replace	
	(2) Check the alternator B terminal or coupler for disconnection.	Repair or replace	
	(3) Check if the alternator is normal.	Repair or replace	
6. The oil lamp does not go off.	(1) Check if the specified amount of oil is supplied.	Refill	
	(2) Check the oil switch coupler for disconnection.	Repair or replace	
	(3) Check if a voltage is applied to the oil switch coupler.	Replace	
	(4) Measure the pressure of the engine oil.	Repair	
7. The water temperature gauge does not function.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the water temperature gauge coupler for disconnection.	Repair or replace	
	(3) Check the meter-side coupler for disconnection.	Repair or replace	
	(4) Check if a voltage is applied to the water temperature gauge coupler.	Repair	
	(5) Check if the water temperature sensor is normal.	Repair	
8. The fuel remaining amount alarm lamp does not go on.	(1) Check if fuel is supplied.		
	(2) Check if the fuel sensor is normal.	Replace	
9. The fuel gauge does not function.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the fuel sensor coupler for disconnection.	Repair or replace	
	(3) Check the meter-side coupler for disconnection.	Repair or replace	
	(4) Check if a voltage is applied to the fuel sensor coupler.	Replace	
	(5) Check if the fuel sensor is normal.	Replace	

c Others

Trouble	Check item	Remedy	Remarks
1. The machine does not run in spite of the machine lock lever being released.	(1) Check the fuse (5A) for blowouts.	Replace	
	(2) Check the lever lock solenoid coupler and switch coupler for disconnection.	Repair or replace	
	(3) Interchange the lever lock solenoid coupler and 2nd-speed solenoid coupler.	Repair or replace	
	(4) Check if a voltage is applied to the lever lock solenoid coupler and switch coupler.	Repair or replace	
	(5) Check the solenoid valve.	Repair or replace	
	(6) Check if the lever lock switch is normal.	Replace	
2. The travel speed does not change in spite of the two-speed switch being pressed.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the 2nd-speed solenoid coupler and switch coupler for disconnection.	Replace	
	(3) Interchange the 2nd-speed solenoid coupler and lever lock solenoid coupler.	Repair or replace	
	(4) Check if a voltage is applied to the 2nd-speed solenoid coupler and switch coupler.	Replace	
	(5) Check the solenoid valve.	Replace	
	(6) Check if the 2nd switch is normal.	Replace	
3. The horn does not sound in spite of the horn switch being pressed.	(1) Check the fuse (10A) for blowouts.	Replace	
	(2) Check the harness from the grip (horn switch) for breaking.	Repair or replace	
	(3) Check the horn coupler and grip (horn switch) coupler for disconnection.	Repair or replace	
	(4) Check if a voltage is applied to the horn terminal.	Replace	
	(5) Check if the horn switch is normal.	Replace	
	(6) Check if the horn is normal.	Replace	
4. The working light does not go on in spite of the working light switch being pressed.	(1) Check the fuse (20A) for blowouts.	Replace	
	(2) Check the working light terminal and switch coupler for disconnection.	Repair or replace	
	(3) Check if a voltage is applied to the working light terminal.	Replace	
	(4) Interchange the working light relay and release relay.	Replace	
	(5) Check the lamp for blowouts.		

d Check instructions

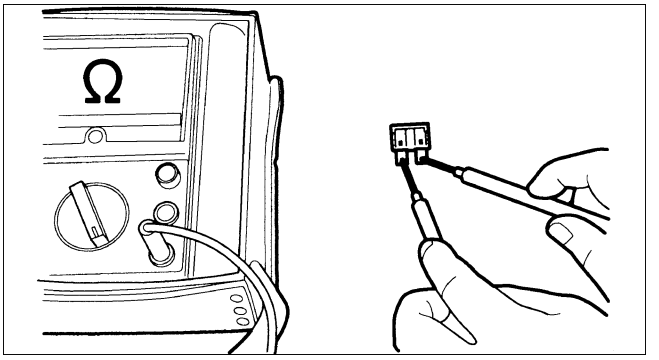
Fig.1



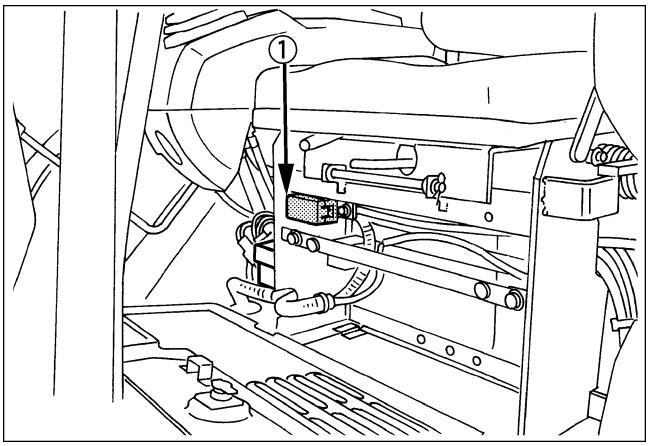
[1] Fuse

1 Check the continuity of the slow-blow fuse (50A) to see if the fuse is blown. (Fig.1)

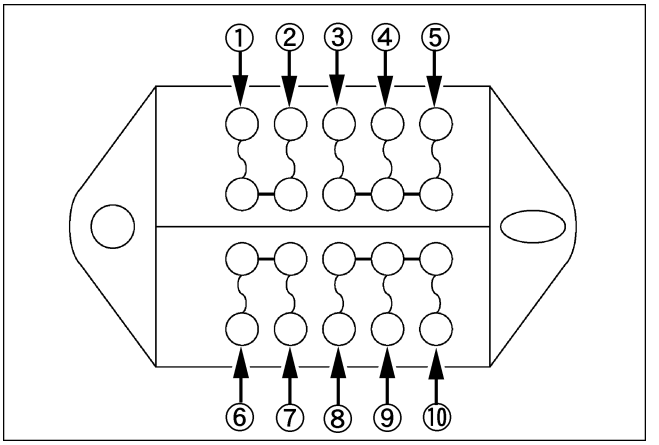
Fig.2



2 Check the continuity of the fuse (10A) to see if the fuse is blown. (Fig.2)



(1)Fuse box



FUSES

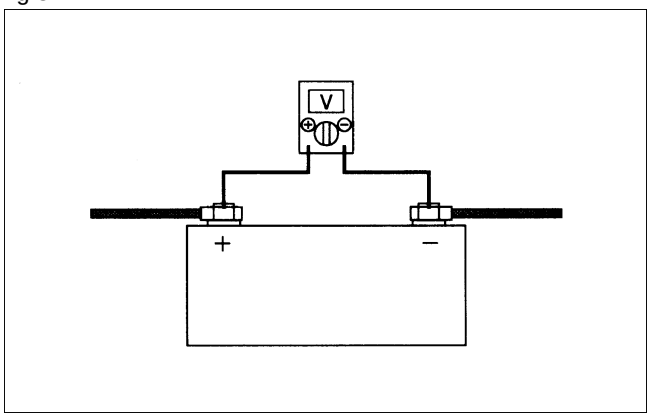
■ Replacing Fuses

1. Remove the cover of the fuse box.
2. Replace the burnt out fuse with a fuse having the same capacity.

■ Fuse Capacities and Circuits

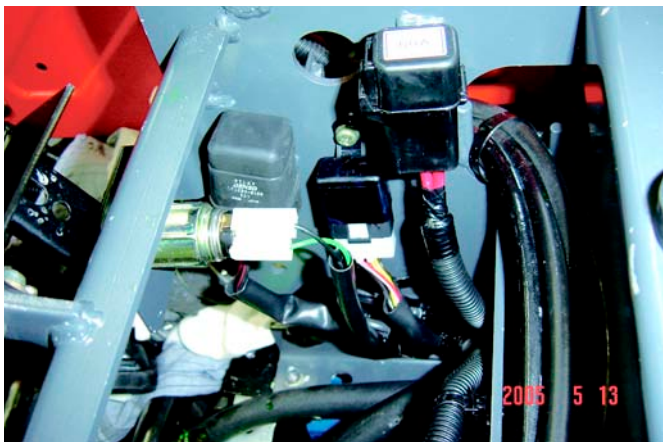
No.	Capacity	Circuit
(1)	15A	Cabin equipment
(2)	15A	Power source
(3)	5A	Lever lock
(4)	10A	Horn
(5)	5A	Glow
(6)	10A	Heater fan
(7)	20A	Work lamp
(8)	5A	Relay
(9)	10A	High speed Alternator
(10)	5A	Auto release
	5A, 10A, 15A, 20A	Spare fuses

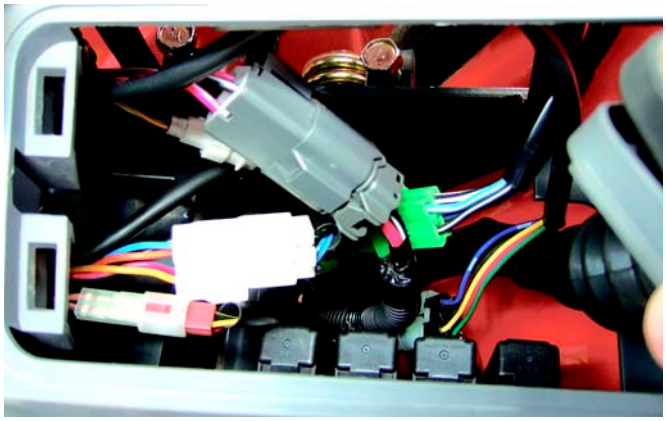
Fig.3



[2] Battery voltage

1. Start the engine.
2. Connect a circuit tester to the (+) terminal and (–) terminal of the battery and measure the voltage. (Fig.3)
   10.5 V or higher: The battery is normal.
   Lower than 10.5 V: Charge or replace the battery.





[3] Automatic release relay

Interchange the automatic release relay and light relay and start the engine.

Starting: The automatic release relay is faulty.

Not starting: The wire is broken, the key switch is faulty or the starter is faulty.

Fig. 5

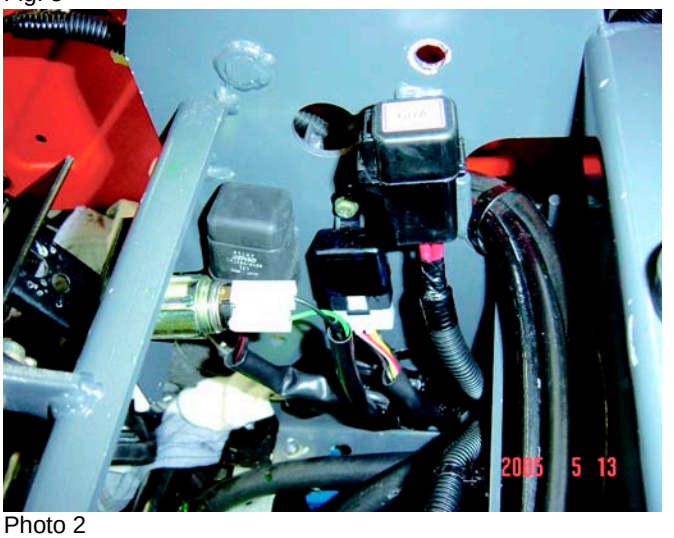


Photo 2

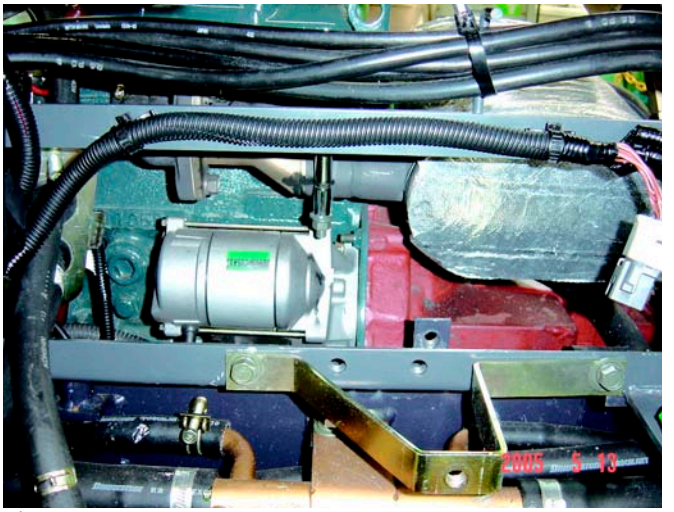
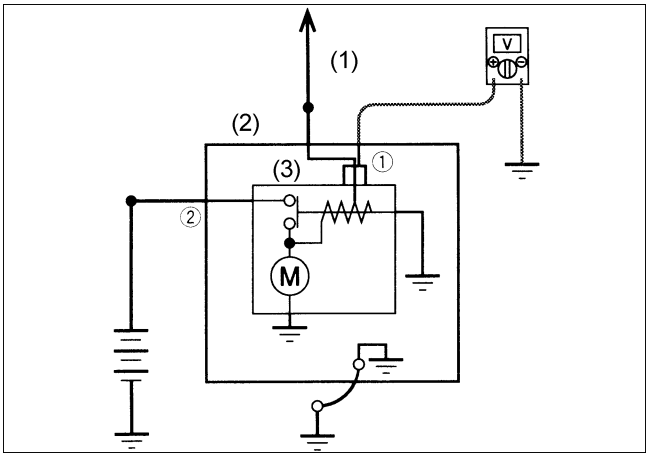


Fig. 6

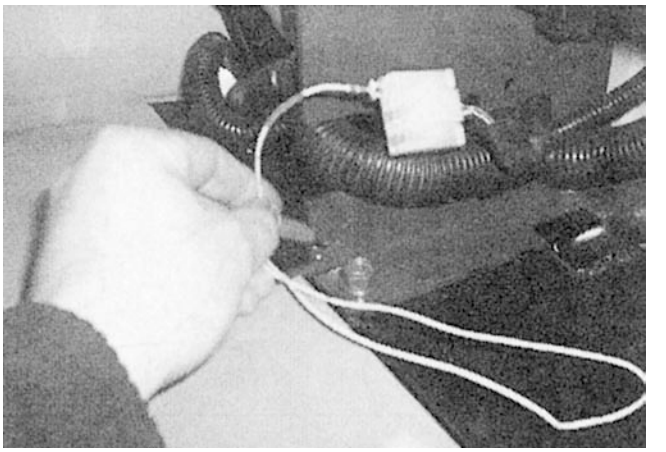


[4] Release controller

1. Disconnect the coupler CN310 from the controller.

2. Body-earth the controller coupler CN310-(6), set the key switch to the starting position and check if the engine starts. (Photo 1)
   Starting : The controller is faulty.
   Not starting : The key switch is faulty or the wire is broken.

Photo 1



[5] Starter motor

1. Check the B terminal of the starter motor for looseness. Check the starter coupler CN37 for disconnection. (Photo 2 (1))

2. Voltage check (Fig.6)

   1) From the back, connect the lead of a tester to the CN37 coupler terminal (1) connected to the starter motor

   2) Set the key switch to the starting position and check if a voltage is applied to the CN37 coupler terminal (1).
      12 V : Check the continuity of the harness.
      Other than 12 V : The key switch is faulty.

⚠ Caution:
Note that the starter motor could run suddenly.

(1) Auto release relay
(2) Engine
(3) Starter

Fig.7

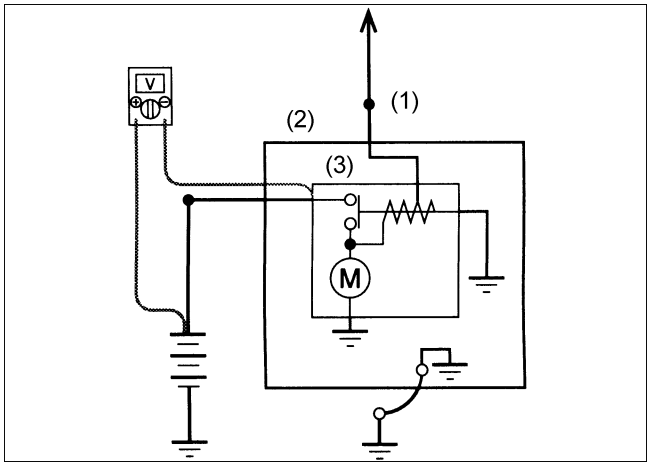


Fig.8

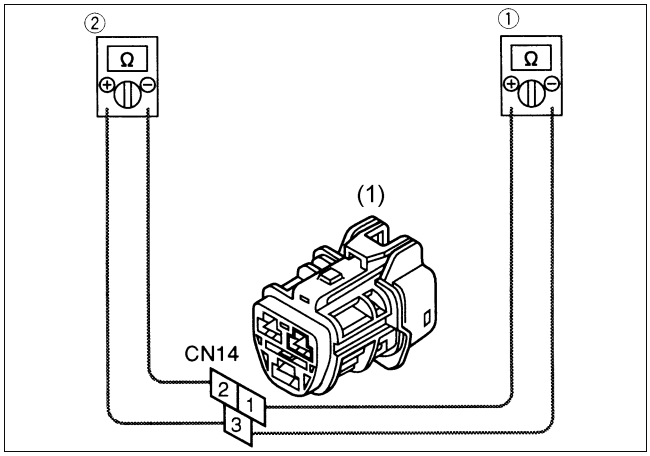


Fig.9

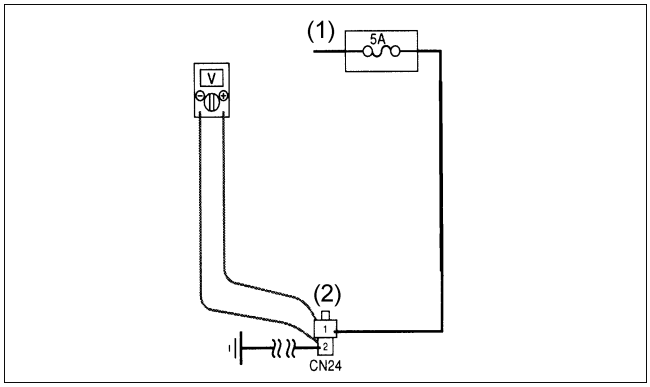
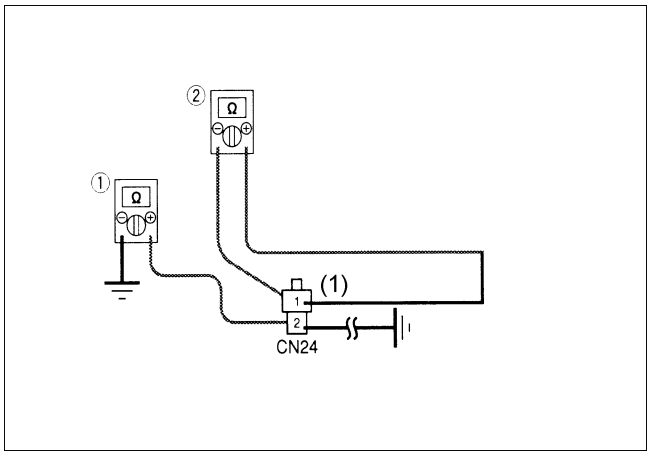


Fig.10



3. Continuity check (Fig.7)
   Key switch: OFF
   Check for continuity between the starter B terminal and battery (+) terminal.

   (1) To auto release (2) Engine (3) Starter

[6] Key switch

Disconnect the key switch and the key switch coupler CN14.

1. Set the key switch to the ON position (key right 1st step) and check for continuity between (1) and (3).
2. Hold the key switch in the starting position (key right 2nd step) and check for continuity between (2) and (3).
   Continuity :The key switch is normal.
   No continuity :The key switch is faulty.

   (1) Starter key switch

[7] Fuel pump coupler

1. Measuring the voltage of the fuel pump coupler (Fig.9)
   Disconnect the fuel pump coupler CN24.
   Key switch: ON
   Measure the voltage between (1) and (2) of the coupler CN24.
   12 V : The fuel pump is faulty.
   Other than 12 V: Check for continuity. (Fig.10)
   (1)Fuse box (2)Fuel pump

2. Continuity check (Fig.10)
   Key switch: ON
   Disconnect the coupler.

(1) Check for continuity between the fuel sensor coupler CN24-(2) and body earth.
(2) Check for continuity between the fuel sensor coupler CN24-(1) and coupler CN24-(2).

(1)Fuel pump

Fig.11

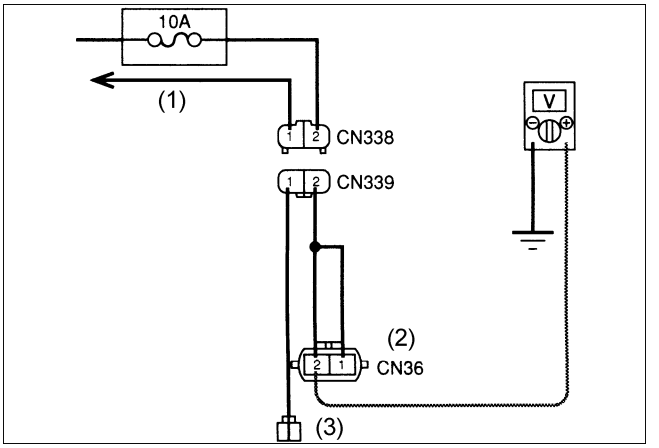


Fig.12

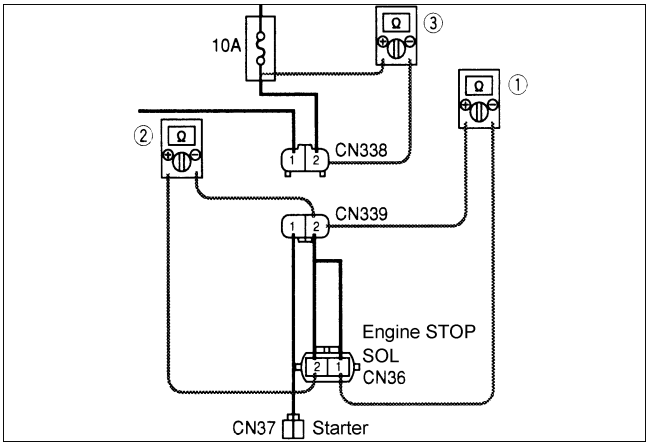


Fig.13

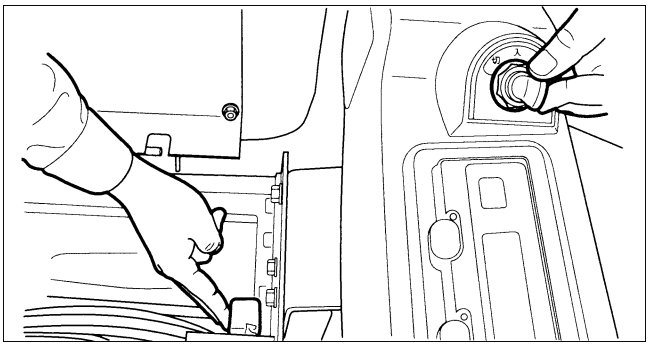
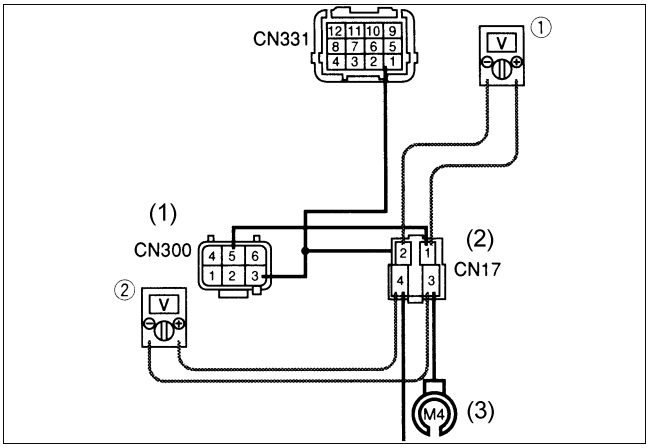


Fig.14



[8] Engine stop solenoid

1. Measuring the voltage of the engine stop solenoid (Fig.11)
   Disconnect the engine stop solenoid coupler CN36.
   Measure the voltage between the coupler CN36-(1) or (2) and the body earth.
   12 V : The stop solenoid is faulty.
   Other than 12 V : Check for continuity. (Fig.12)

2. Continuity check (Fig.12)
   Key switch: OFF
   Disconnect the coupler.
   (1) Check for continuity between the solenoid coupler CN36-(1) and relay coupler CN339-(2).
   (2) Check for continuity between the solenoid coupler CN36-(2) and relay coupler CN339-(2).
   (3) Check for continuity between the 10A fuse and relay coupler CN338-(2).

   (1) To auto release relay
   (2) Engine stop SOL
   (3) Starter

[9] Glow relay

1. Checking the operation of the glow relay (Fig.13)
   (1) Lightly touch the glow relay with your hand.
   (2) Key switch: ON
   (3) Check if the glow relay operates with a click.
   Clicking : The glow relay is normal. Check the glow plug voltage.
   Not clicking : Measure the voltage, check for continuity and inspect the glow relay (Fig.17).

2. Measuring the voltage of the glow relay coupler (Fig.14)
   Disconnect the glow relay coupler CN17.
   Key switch: ON
   Measure the voltage between (1) and (2) and between (3) and (4) of the coupler CN17.
   12 V for both (1) and (2) : The glow relay is faulty.
   Other than 12 V : The harness is broken.
   (1) Auto glow controller
   (2) Glow relay
   (3) Glow plug

Fig.15

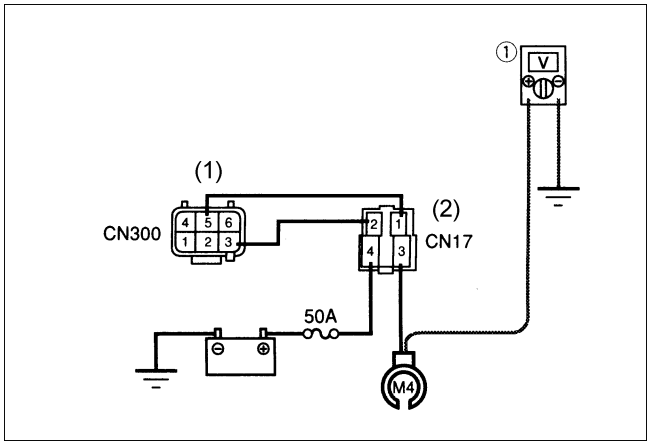


Fig.16

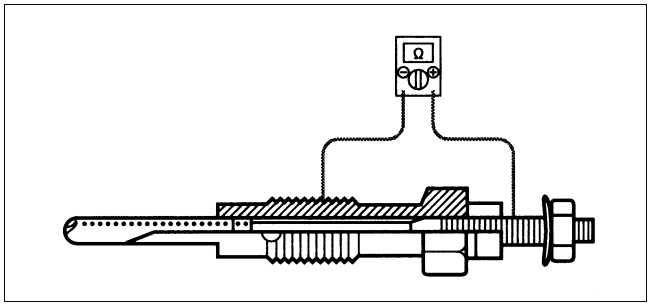
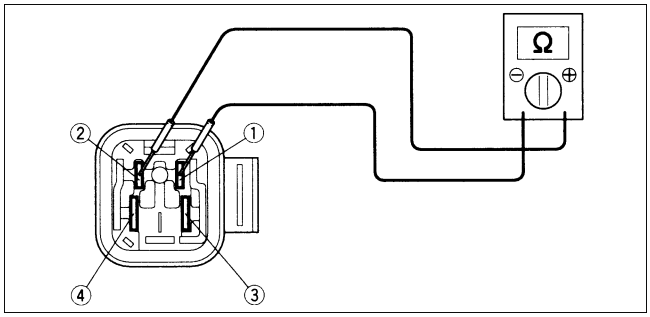


Fig.17



3. Measuring the voltage of the glow plug (Fig.15)
   Disconnect the glow plug LE terminal.
   Key switch: ON
   Measure the voltage between the LE terminal and body earth.

* 12 V is indicated and then 0 V is indicated 10 seconds later.
   12 V→0 V : The glow lamp is faulty.
   Other than 12 V: The glow controller is faulty.
   The glow relay is faulty.
   The harness is broken.

   (1)Auto glow controller
   (2)Glow relay

4. Inspection of glow plug (Fig.16)
   Remove the plate between the cylinders.
   Measure the resistance of the glow plug alone.
   1Ω or less :Normal
   More than 1Ω :Faulty

5. Inspection of glow relay (Fig.17)
   (1)Measure the glow relay alone.

Standard value	52 to 80Ω
Measured value	About 78Ω

   Apply 12 V between (1) and (2) of the glow relay and check for continuity between (3) and (4).
   Continuity :Normal
   No continuity:Faulty

Fig.20

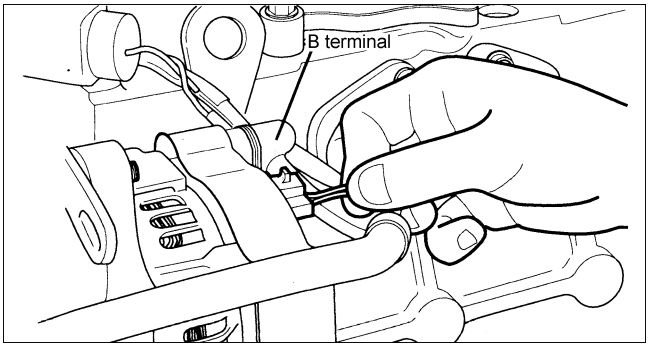


Fig.21

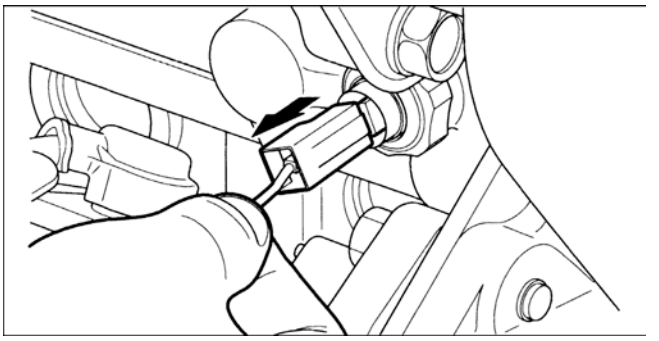
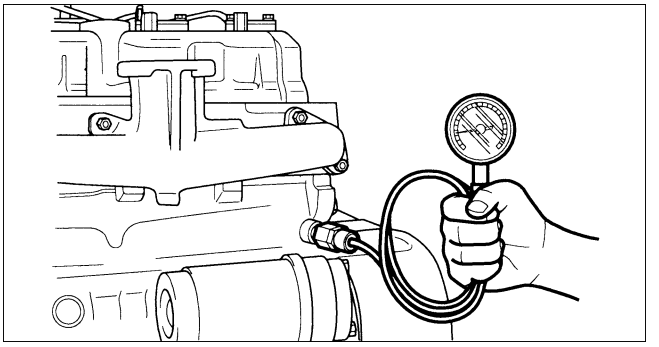


Fig.24



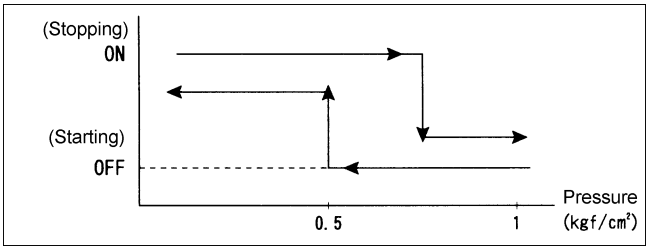
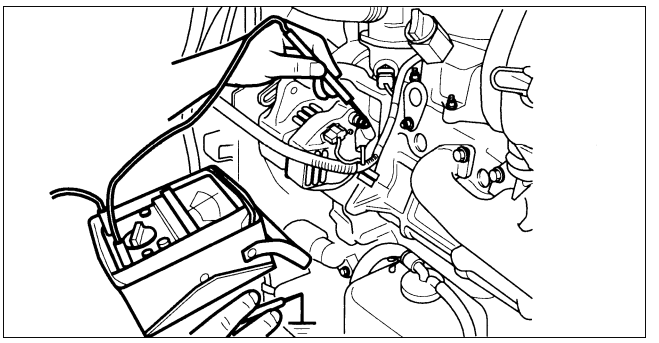


Fig.25-1



[10] Charge and engine oil lamp

1. Check the alternator coupler and B terminal for disconnection. (Fig.20)

2. Check the oil switch coupler CN28-(1) for disconnection. (Fig.21)

3. Measurement of engine oil pressure
   Measure the engine oil pressure.

Idling	0.4MPa (4kgf / cm^2)
MAX	0.6MPa (6kgf / cm^2)

* Oil switch actuating pressure
Standard value:0.05 ± 0.01MPa
(0.5 ± 0.1kg f / cm^2)

4. Inspection of alternator (general-purpose tester) (Fig.25-1)
   (1) Measure the voltage between the B terminal of the alternator and the body earth.
   If the measured voltage is about 12 V, it is normal.
   If the measured voltage is lower, the battery capacity is insufficient or a wire connection before the alternator is loosened.
   (2) Start the engine and measure the voltage generated during the operation of the alternator.
   Measure the voltage between the B terminal of the alternator and the body earth.
   If the measured voltage is about 14 V (alternator-generated voltage), the alternator is normal.
   If the measured voltage is equal to the battery voltage (about 12 V), the alternator main body or regulator is faulty.

Fig.28

[11] Water temperature gauge

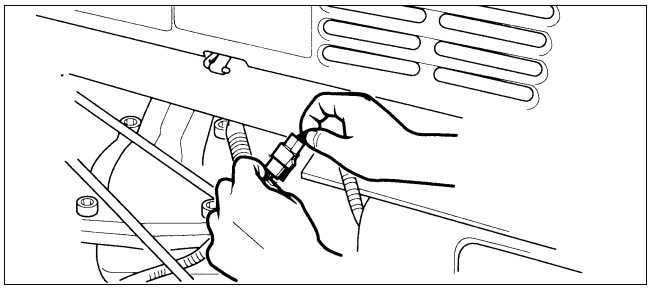
1. Inspection of water temperature gauge (Fig.28)

Performance ( )Values in parentheses are for reference

Temperature	7V, 55f gauge	
	Resistance	Current
(50)°C	(153.9 $^{+25.0}_{-20.0}$ Ω)	(33.5±1.6 mA)
80°C	81.9 $^{+4.9}_{-4.4}$ Ω	(65.5 $^{+2.8}_{-2.9}$ mA)
100°C	27.4 $^{+1.9}_{-1.7}$ Ω	(85.0 $^{+1.5}_{-2.0}$ mA)
(120°C)	(161±1.2 Ω)	(98.5±1.6 mA)

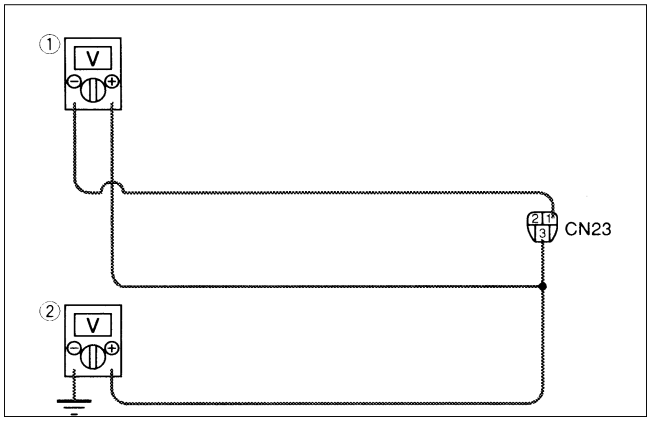
* Measurement should be made with the coupler connected.

Fig.29



[12]Fuel sensor

1. Check the relay coupler CN23 of the fuel sensor for disconnection. (Fig.29)



2. Measuring the voltage of the fuel sensor coupler (Fig.30)
   - Disconnect the coupler CN23.
   - Key switch: ON

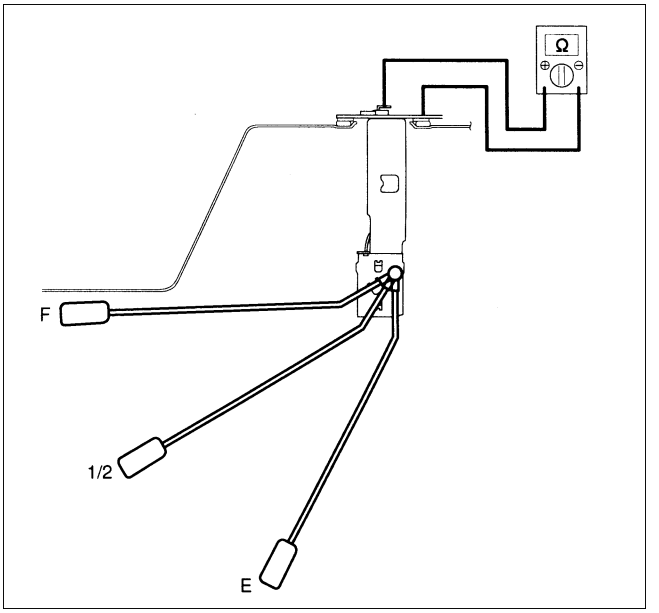
   12 V : Normal. Inspect the sensor.
   Other than 12 V : Measure the voltage of (2).

3. Continuity check
   (1) Measure the voltage between the sensor coupler CN23-(3) and CN23-(1).
   (2) Measure the voltage between the sensor coupler CN23-(3) and body earth.

4. Continuity check (Fig.31)
   Key switch: OFF
   - Disconnect the meter coupler CN1 and CN2.

   (1) Check for continuity between the sensor coupler CN23-(2) and meter coupler CN1-(11).
   (2) Check for continuity between the sensor coupler CN23-(3) and meter coupler CN2-(2).

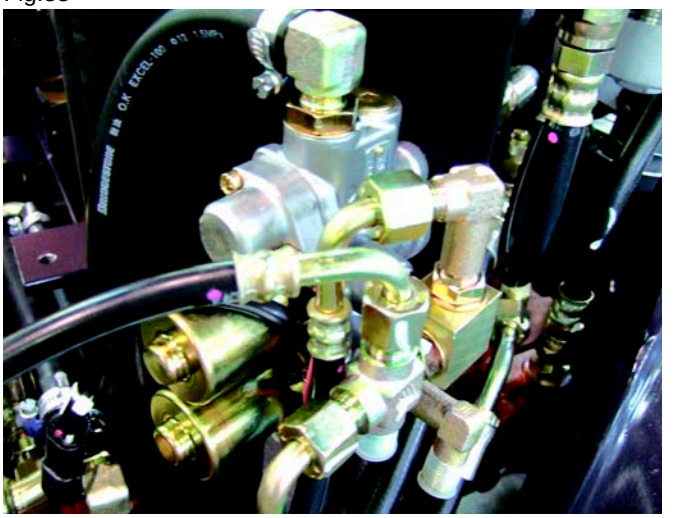
Fig.32



5. Inspection of fuel sensor (Fig.32)
   - Remove the fuel sensor from the tank and inspect it.
   - Put the (+) test lead on the coupler CN23 (3) terminal.
   - Put the (–) test lead on the plated portion and measure the resistance.
   - Standard value

Float position	F	1/2	E
Resistance(Ω)	3±2	32.5±4	110±7

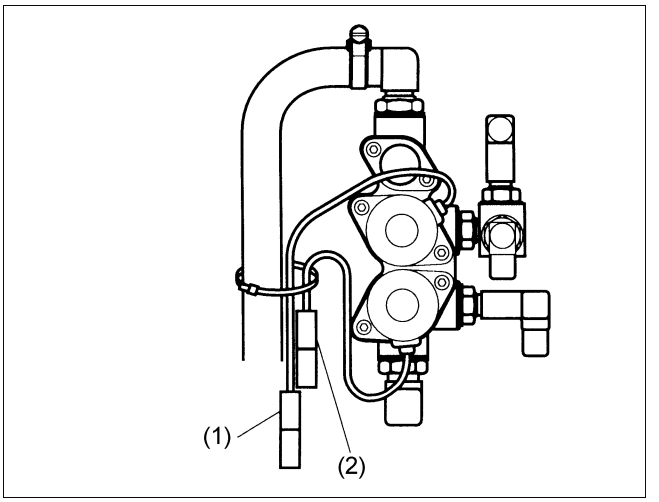
Fig.33



[13]Solenoid valve

1. Check the lever lock coupler and lever lock switch coupler for disconnection. (Fig.33)
   - Yellow for two-speed
   - Green for lever lock

Fig.34

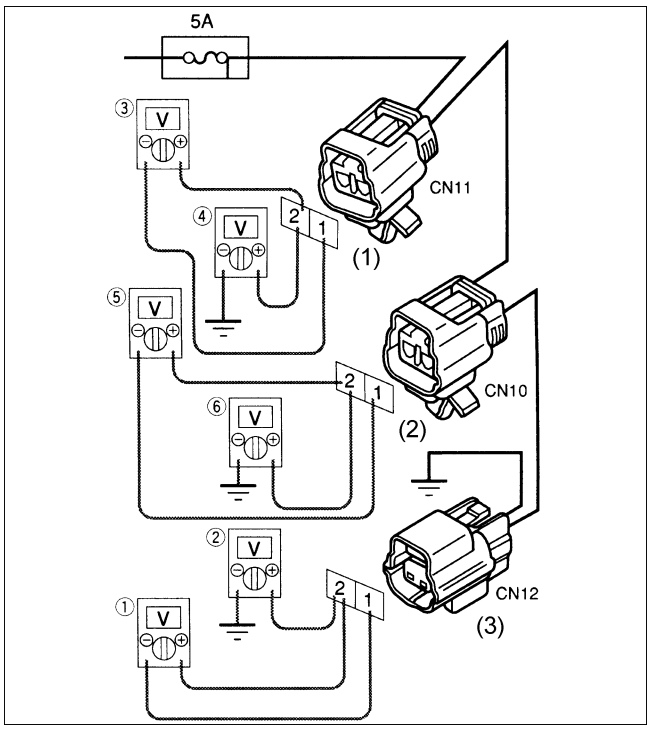


2. Interchanging of lever lock coupler (Fig. 34)
   - Interchange the lever lock coupler and two-speed coupler.
   - Engine start
   - While pressing the two-speed pedal, check if the machine runs.

   Running : The solenoid valve is faulty.
   The lever lock switch is faulty.
   Not running : The wire is broken.
   The lever lock switch is faulty.

(1) For safety lever lock
(2) For travel two speed

Fig.35

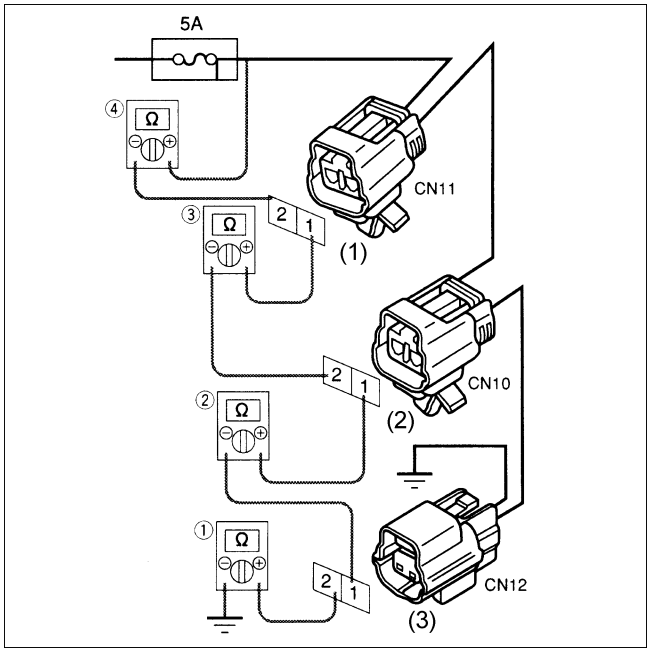


3. Check if a voltage is applied to the lever lock solenoid coupler and lever lock switch coupler.
   - Disconnect the coupler.
   - Key switch: ON

   (1) Measure the voltage between the solenoid valve coupler CN12-(1) and (2).
   (2) Measure the voltage between the solenoid valve coupler CN12-(2) and body earth.
   (3) Measure the voltage between the left lever lock coupler CN11-(1) and (2).
   (4) Measure the voltage between the left lever lock coupler CN11-(2) and body earth.
   (5) Measure the voltage between the right lever lock coupler CN10-(1) and (2).
   (6) Measure the voltage between the right lever lock coupler CN10-(2) and body earth.

   12 V : (1), (3) and (5) are normal. Inspect the solenoid valve.
   Other than 12 V : Check for continuity ((2), (4) and (6)). Inspect the lever lock switch.

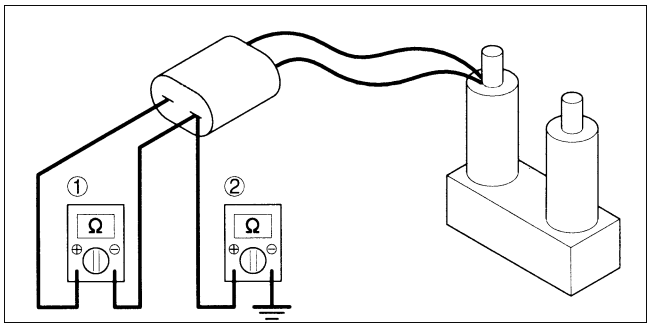
Fig.36



4. Continuity check (Fig.36)
   (1) Check for continuity between the solenoid valve coupler CN12-(2) and body earth.
   (2) Check for continuity between the solenoid valve coupler CN12-(1) and CN00-(2).
   (3) Check for continuity between the right lever lock coupler CN10-(1) and CN00-(1).
   (4) Check for continuity between the left lever lock coupler CN11-(2) and 5A fuse.

(1)Left lever lock SW
(2)Right lever lock SW
(3)Lever lock solenoid valve

Fig.37



5. Inspection of solenoid valve (Fig.37)
   (1) Coil resistance
   Standard value: 6 to15Ω
   - A digital meter is used in the figure. (Note that the direction of (+) and (–) is reversed when a analog meter is used.)

   (2) Coil insulation
   Standard value: 1MΩor more

Fig.38

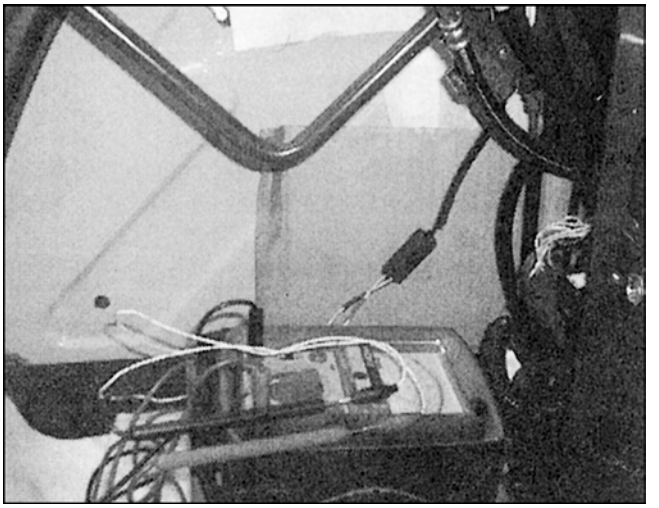


Fig.39

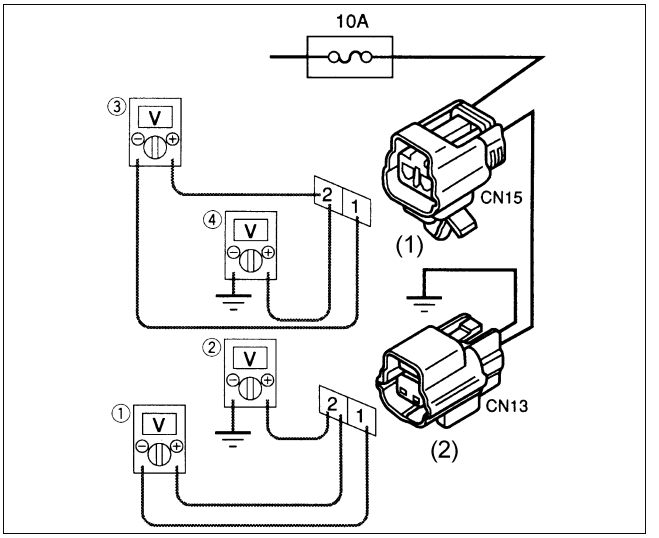
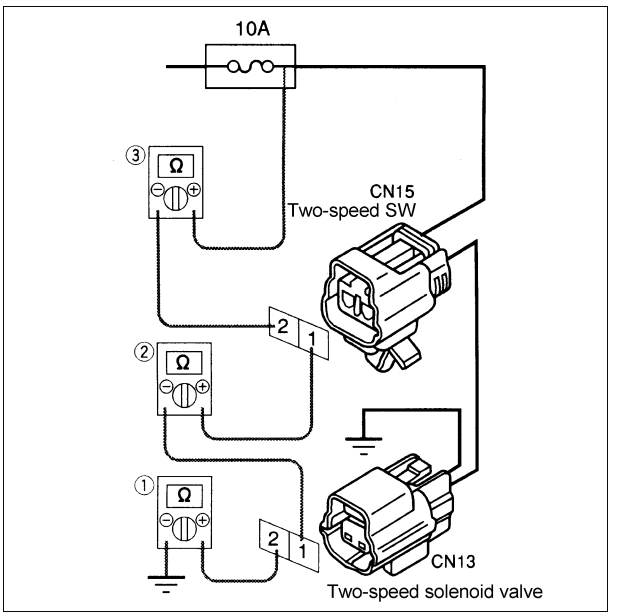


Fig.40



6. Inspection of lever lock switch (Fig.38)
   Key switch: OFF
   Turn ON/OFF the lever lock switch by moving the unload lever of the right control lever and check if the pointer of the tester shakes.
   Shaking : Normal
   Not shaking : Faulty

* In the case of the two-speed switch, use the speed-up pedal.

7. Check if a voltage is applied to the two-speed solenoid valve and two-speed switch coupler.
   • Disconnect the coupler.
   • Key switch: ON
   (1) Measure the voltage between the solenoid valve coupler CN13-(1) and (2).
   (2) Measure the voltage between the solenoid valve coupler CN13-(2) and body earth.
   (3) Measure the voltage between the two-speed switch coupler CN15-(1) and (2).
   (4) Measure the voltage between the solenoid valve coupler CN15-(2) and body earth.

(1)Two-speed SW
(2)Two-speed solenoid valve

8. Continuity check (Fig.40)
   Disconnect the coupler from the part.
   (1) Check for continuity between the CN13-(2) and body earth.
   (2) Check for continuity between the CN13-(1) and CN15-(2).
   (3) Check for continuity between the CN15-(2) and body earth.

Fig.41

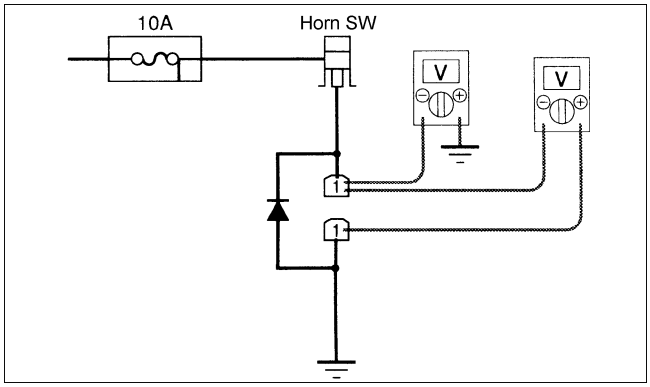


Fig.42

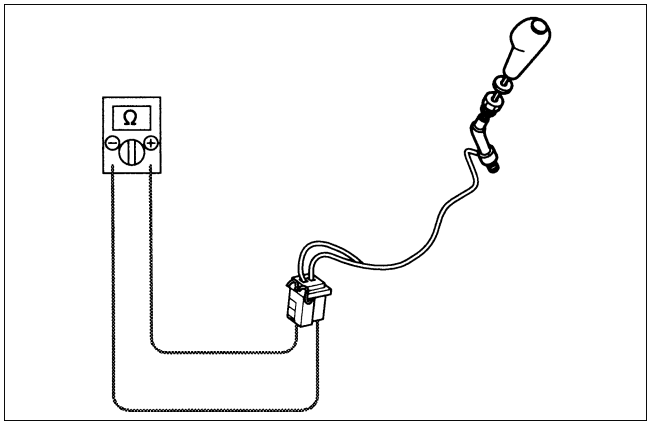


Fig.43

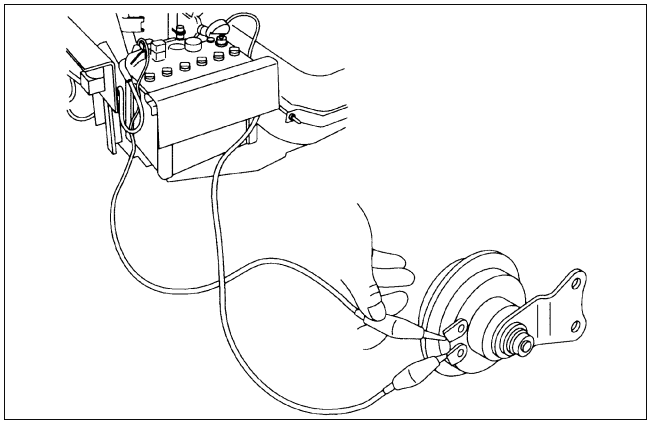
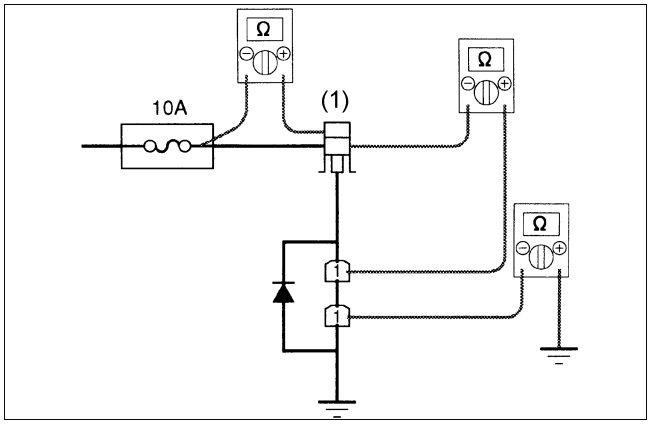


Fig.44



[14]Horn

1. Measuring the voltage of the horn terminal (Fig.14)
   - Key switch : ON
   - Horn switch: ON

   12 V : Normal. Inspect the horn.
   Other than 12 V : Check for continuity. Inspect the horn switch

2. Inspection of horn switch (Fig.42)
   - Turn ON/OFF the horn switch and check if the pointer of the tester shakes.

   Shaking : Normal
   Not shaking : Faulty

3. Inspection of horn (Fig.43)
   - Apply 12 V between the horn terminals and check if the horn sounds.

   Sounding : Normal
   Not sounding : Faulty

4. Continuity check (Fig.44)
   - Disconnect the coupler
   - Key switch: OFF

   (1) Check for continuity between the horn coupler (1) and body earth.
   (2) Check for continuity between the horn coupler (1) and horn switch coupler 2.
   (3) Check for continuity between the horn coupler (1) and fuse BOX10A.

(1)Horn SW

Fig.45

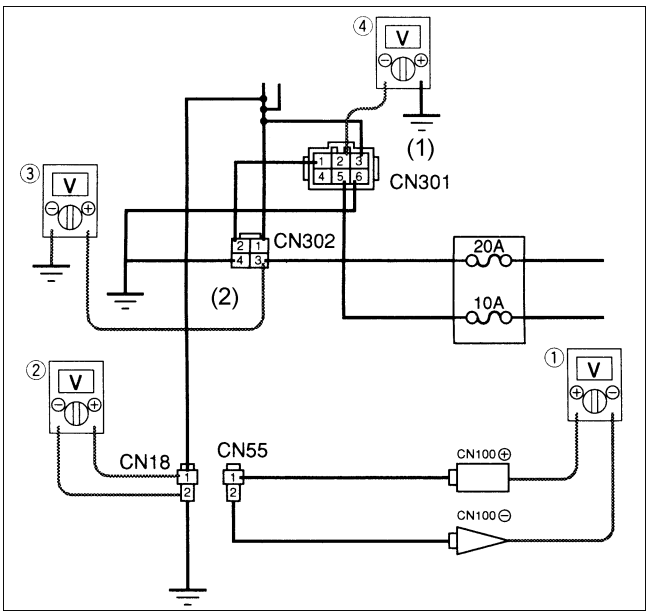


Fig.46

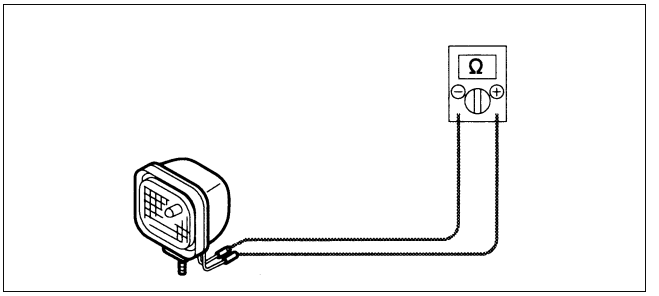
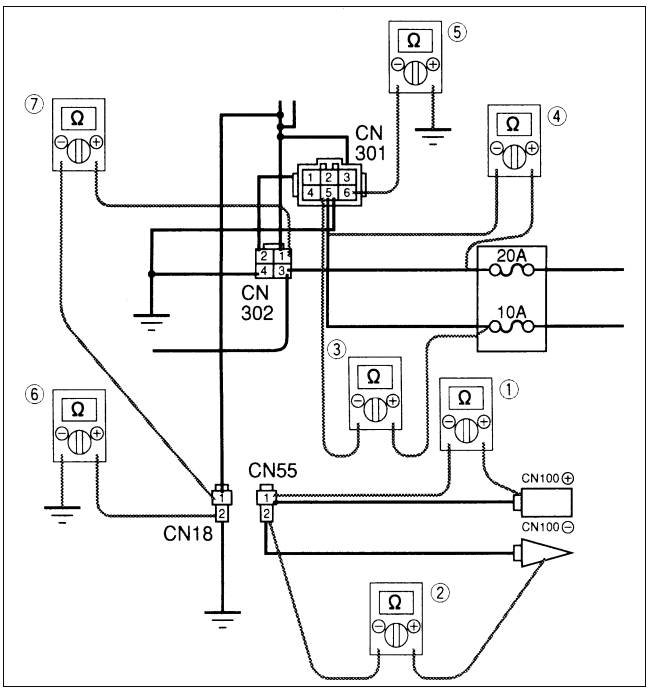


Fig.47



[15]working light

1. Measuring the voltage of the working light
   - Key switch : ON
   - Light switch : ON

     12 V : Normal. Inspect the light.

     Other than 12 V : Check for continuity.

   (1) Measure the voltage between the working light terminal CN100 (+) and CN100 (–) .
   (2) Measure the voltage between the coupler CN18-(1) and (2).
   (3) Measure the voltage between the light relay coupler CN302-(3) and body earth.
   (4) Measure the voltage between the light switch coupler CN301-(5) and body earth.

(1)Light SW
(2)Light relay

2. Continuity check
   - Disconnect the terminal.
   - Key switch: OFF

   Check for continuity between the working light terminal (1) and (2).

3. Continuity check
   - Disconnect each coupler.
   - Key switch: OFF

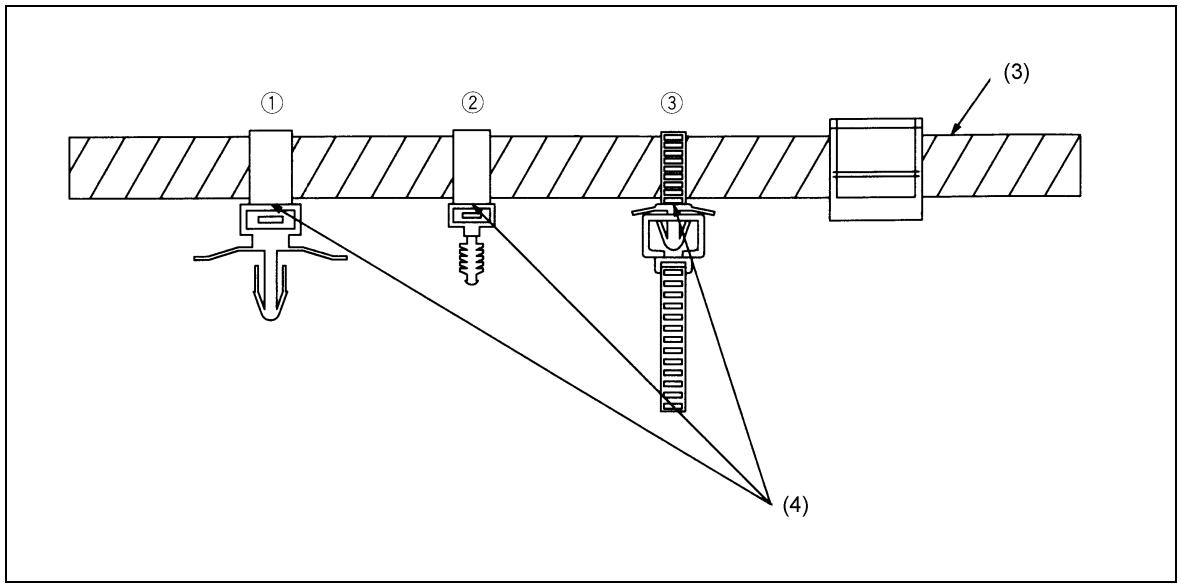
   (1) Check for continuity between the working light terminal CN100 (+) and CN55 coupler (1).
   (2) Check for continuity between the working light terminal CN100 (–) and CN55 coupler (2).
   (3) Check for continuity between the light switch coupler CN301-(5) and 10A fuse.
   (4) Check for continuity between the light switch coupler CN301-(5) and 20A fuse.
   (5) Check for continuity between the light switch coupler CN301-(6) and body earth.
   (6) Check for continuity between the working light coupler CN18-(2) and body earth.
   (7) Check for continuity between the working light coupler CN18-(1) and light relay coupler CN302-(1).

C Wireharness installation

S Precautions in clamping the electric wires

1. Do not allow the wire to touch things around the path.
   Do not touch the wire to a place where protective material is not used.
2. Do not clamp the wire together with the fuel hose.
3. Securely connect the coupler, terminal, etc. so that they will not be disconnected when pulled by some force.
4. Securely clamp the harness at the clamping position.
5. Harness-fixed clamp
   (1) Anchor type
   Insert to the engaging section.
   (2) Screw type
   Insert to the bottom of threaded portion.
   (3) Plug-in type
   Insert until locked

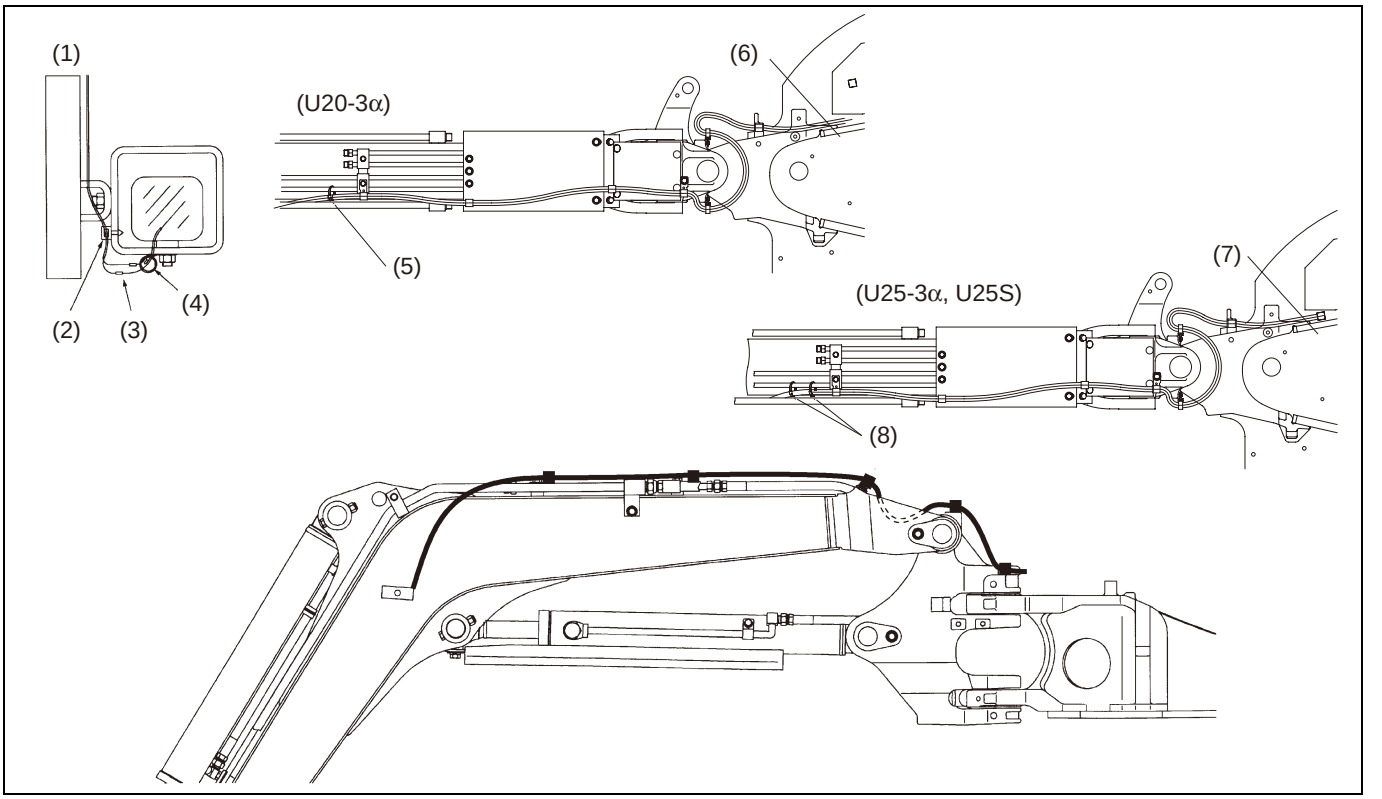
.



1) Insert the band clip into the counterpart hole and clamp the harness.
2) Clamp the harness so theat it will not be displaced or moved.
(3)Harness
(4)Clamp

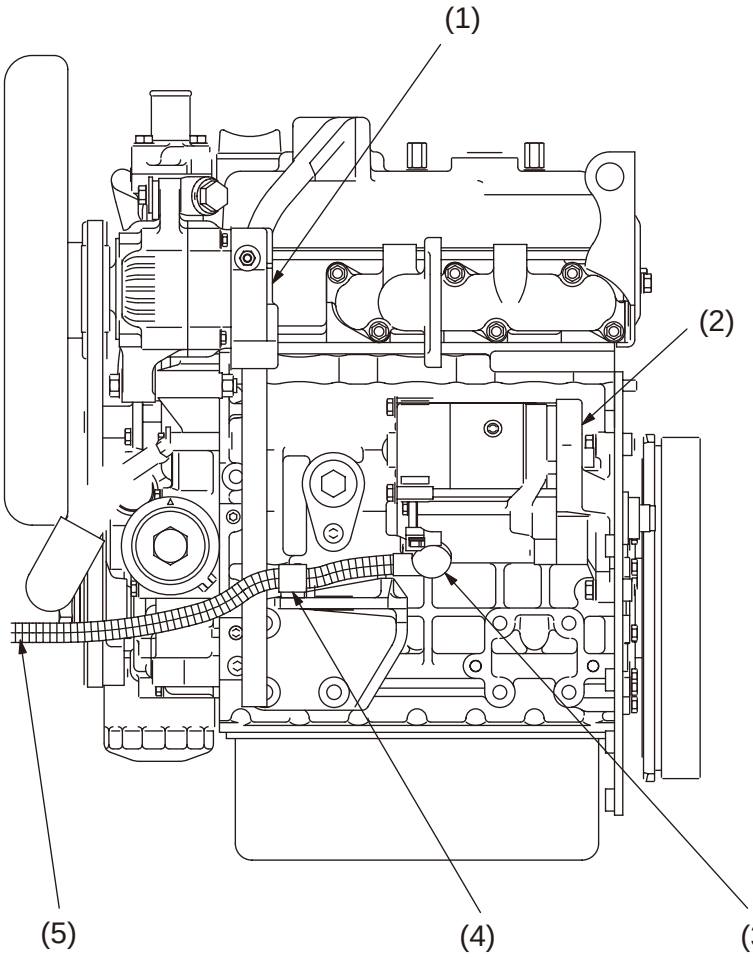
* The harness should not protrude from the corrugate slit section of the
* The cord clamp should clamp at the corrugate winding section.

a Front wireharness



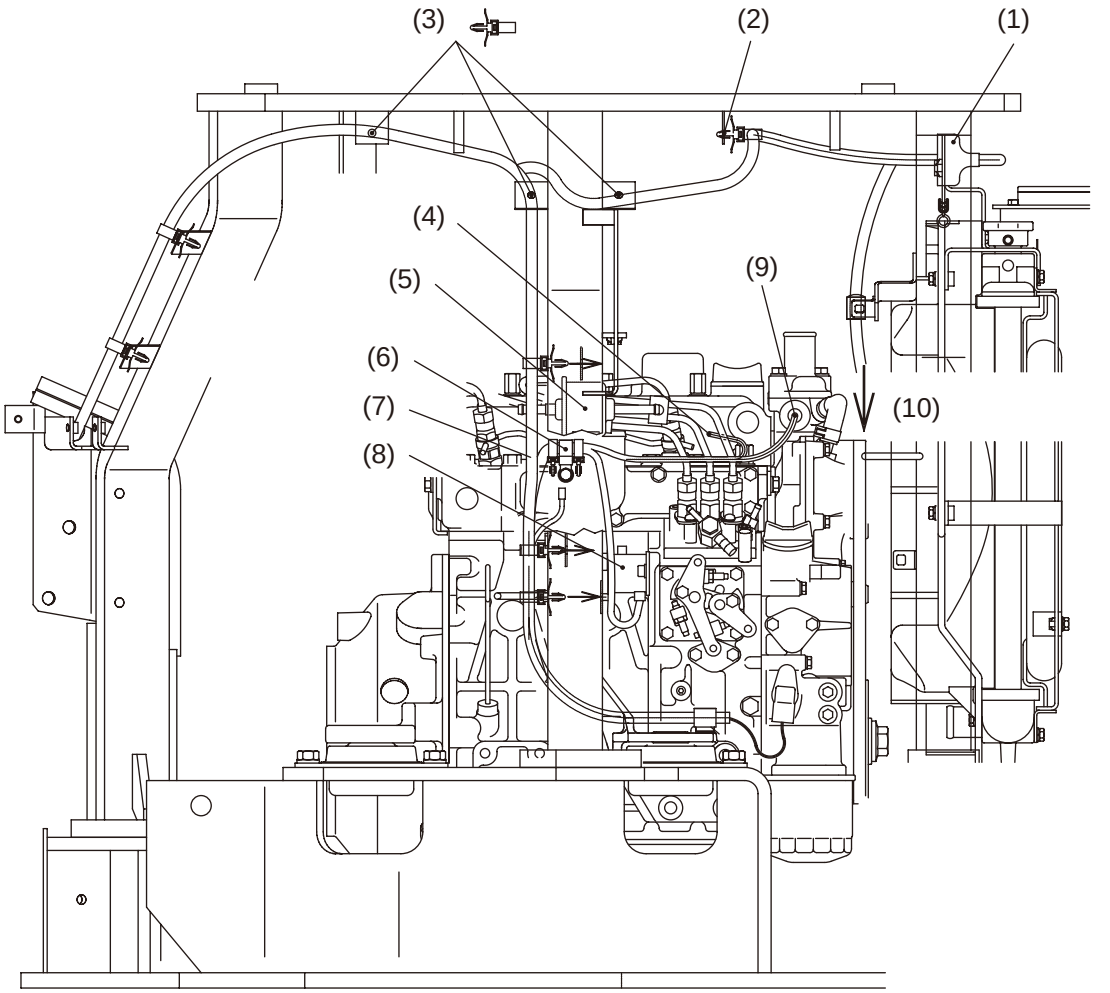
(1) Harness clamp of light section
(2) Insert into the hole.
(3) After connecting the terminal,put it in the corrugate section.
(4) Cord clamp 37150-3446Δ
(5) Clamp the hose at blue-taped part.
(6) Insert this into the hole at the backside of the step.
(7) Insert this into the hole at the backside of the step.
(8) Clamp the hose at (2) white-taped parts.

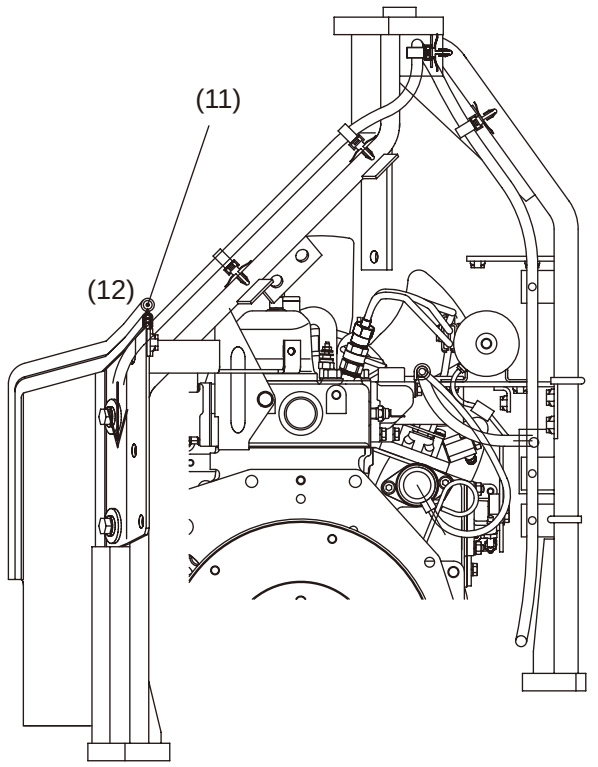
b Wireharness around engine



(1)Alternator,ass'y(40) 1G090-6401Δ
(2)Starter,ass'y 19269-6301?
(3)Battery cord(+) RB411-5322Δ
(4)Fix this by insertion-type clamp.
(5)Pass this under radiator hose.

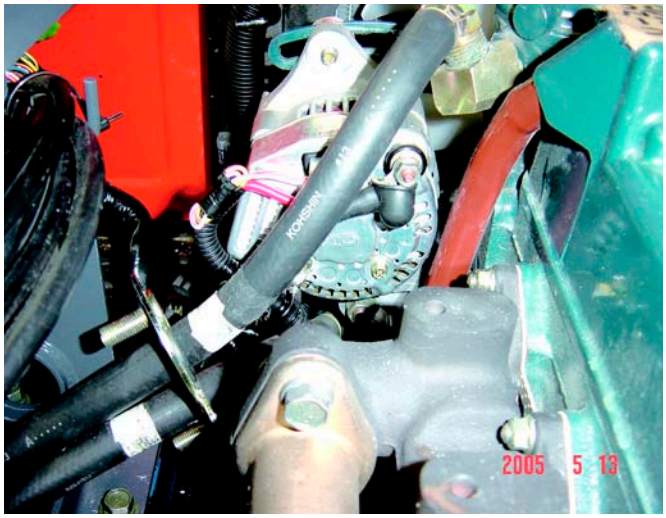
1	S	Tightening torque of the nut for connecting cable to the starter motor terminal	Tightening torque 5．9～11．8N・m (0．6～1．2kgf・m) 4.33~8.67ft·lbs
2	S	Starter switch (RC411-5346Δ) mounting	Align the groove of the starter switch with the projection of the cover (right, upper). Nut tightening torque 4．0～5．0N・m (0．4~0．51kgf・m) 2.89~3.68ft·lbs
3	S	Checking of the starte auto-disengagemen function	Switch must be held at starting position and turned OFF mmediately after engine starts.

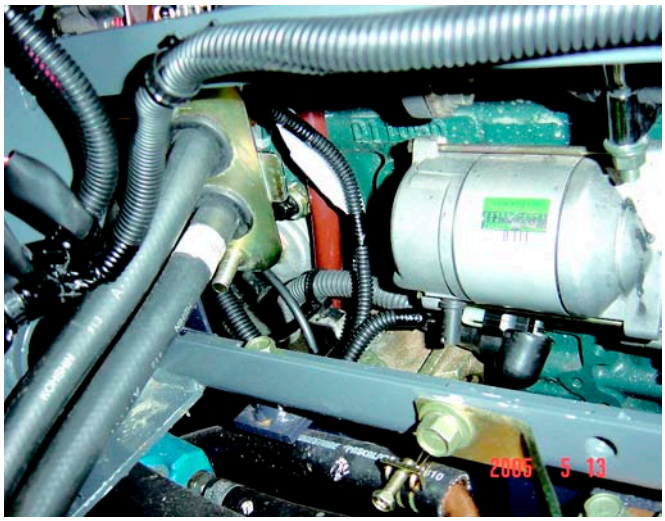




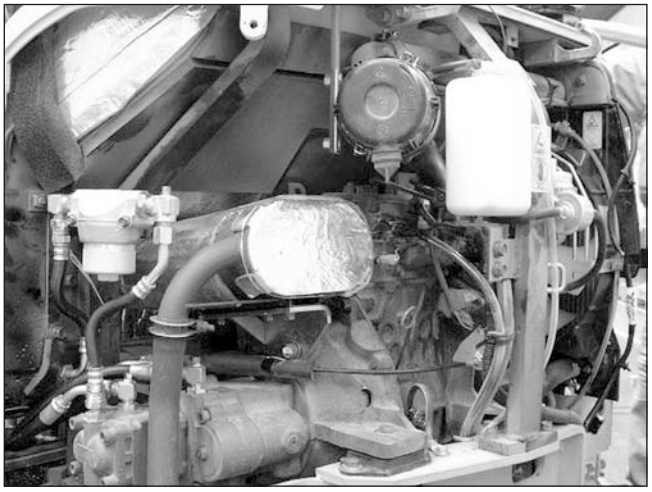
(1)Grommet
(2)From right
(3)From front
(4)Glow plug
(5)Fuel pump
(6)Fill the gap of insertion-type clamp securely.
(7)Insert this toward you.
(8)Engine stop SOL
(9)Water temp. sensor
(10)Grommet at bonnet
(11)Once remove the trim and pass the wireharness.
(12)To unload valve

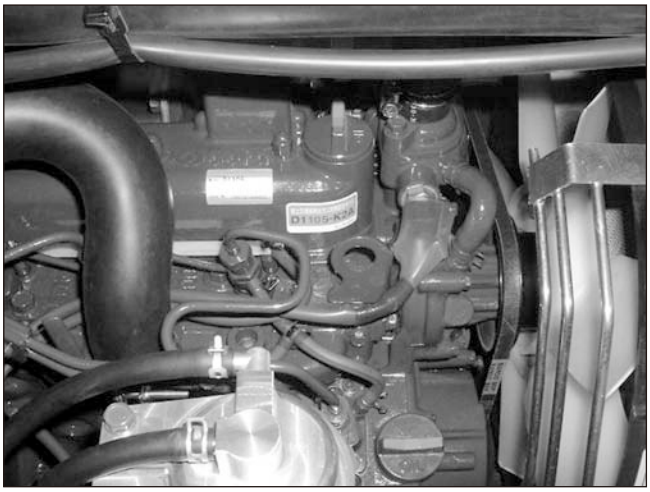
(Relevant photos around engine)

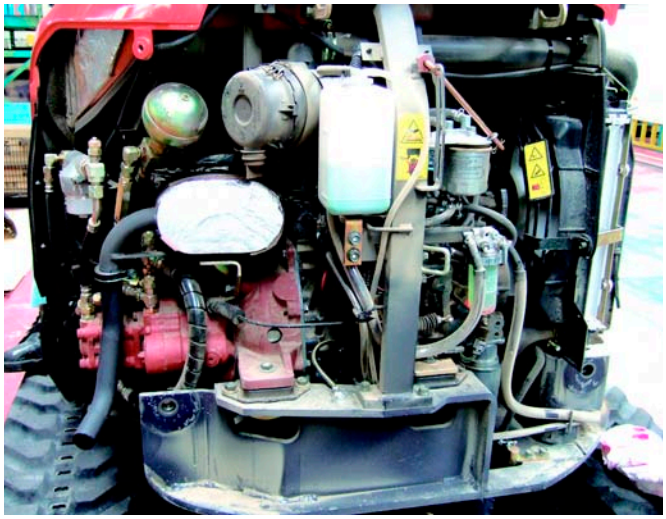


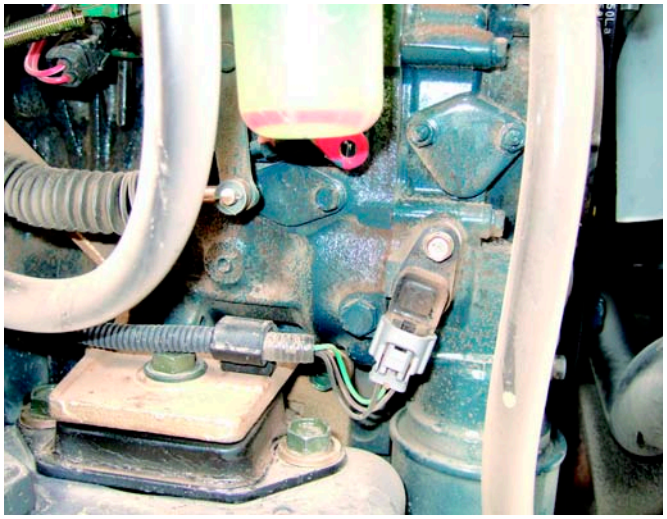


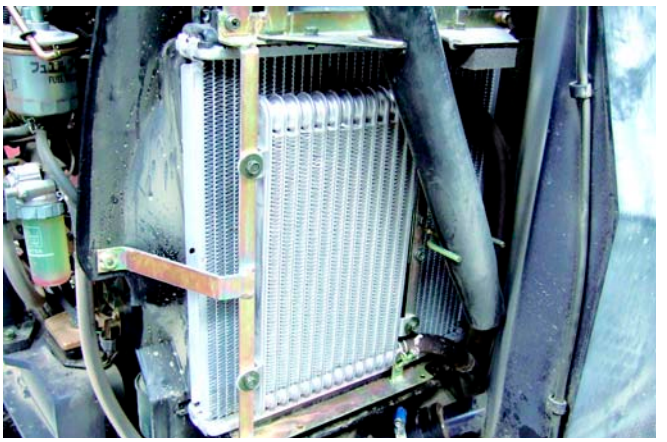
(1) Nut tightening torque for connecting cable to starter terminal
5.9~11.8N·m (0.6~1.2kgf·m) 4.34~8.68ft·lbs









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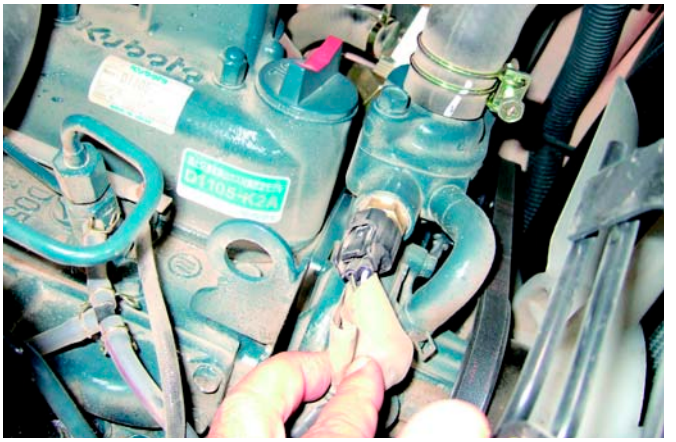
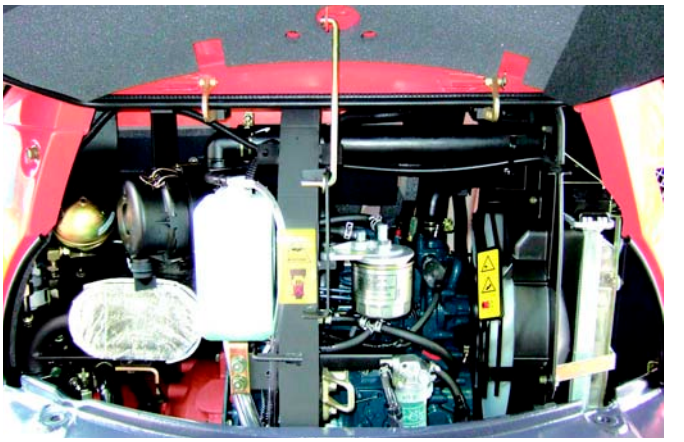
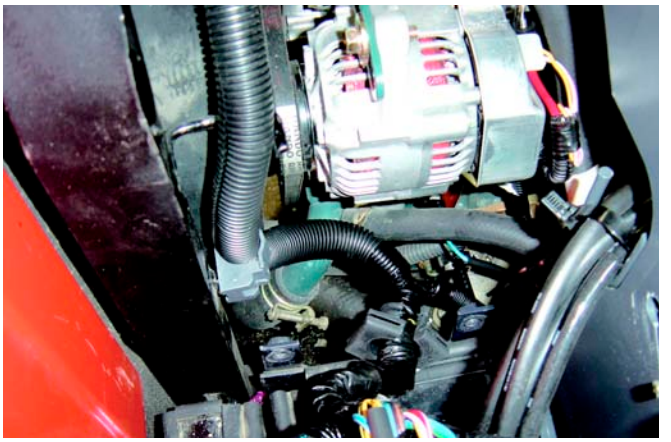
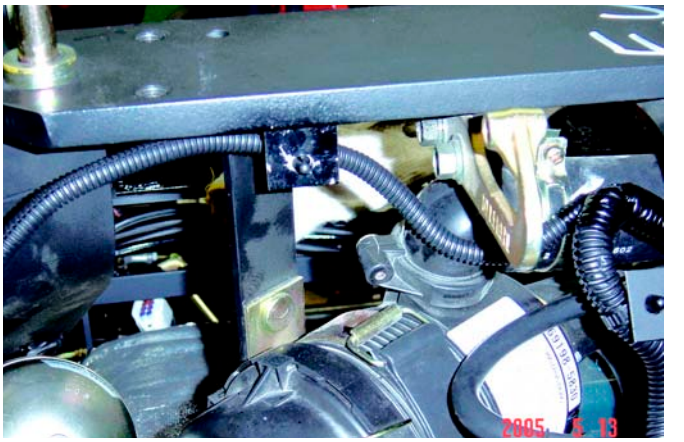
FILTER


Kubota



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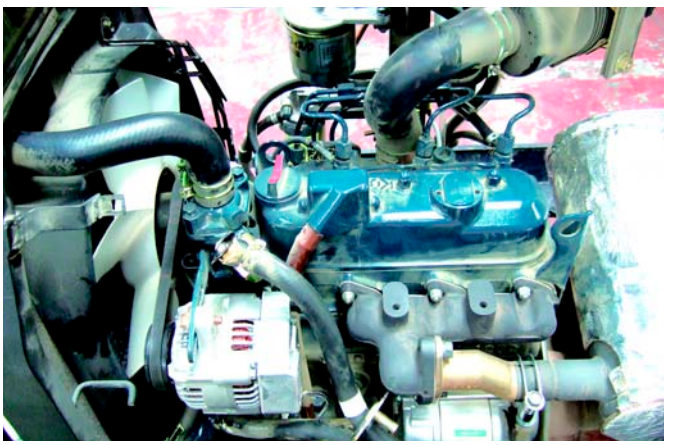
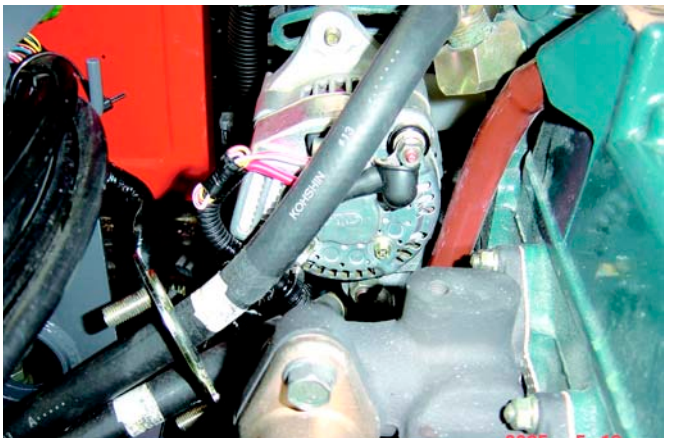
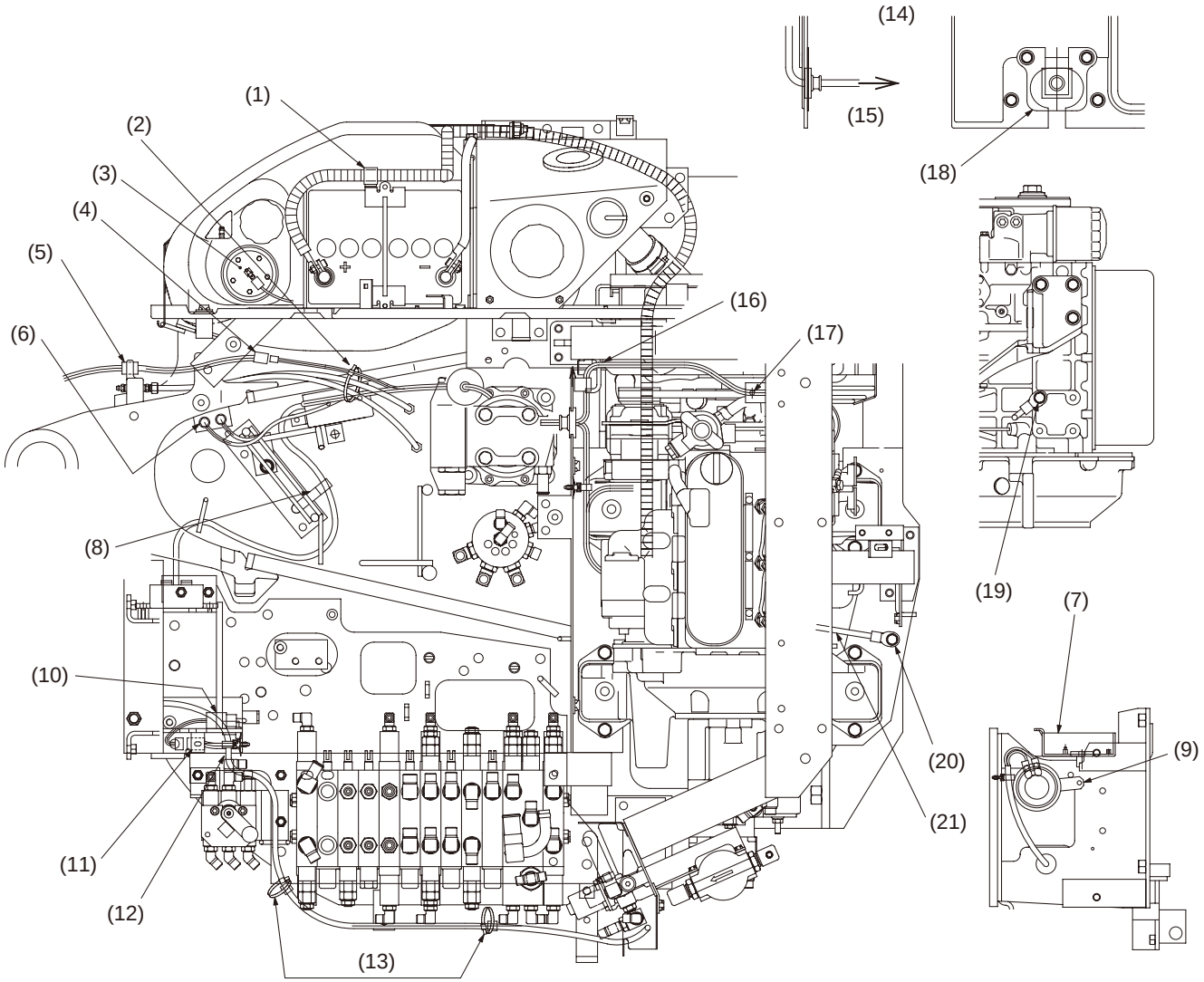
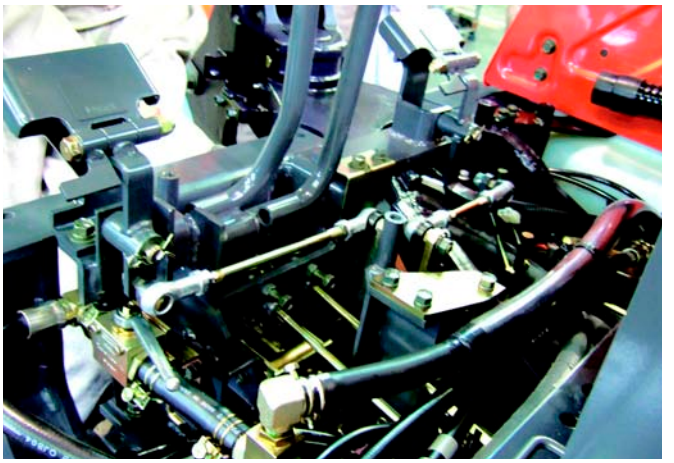


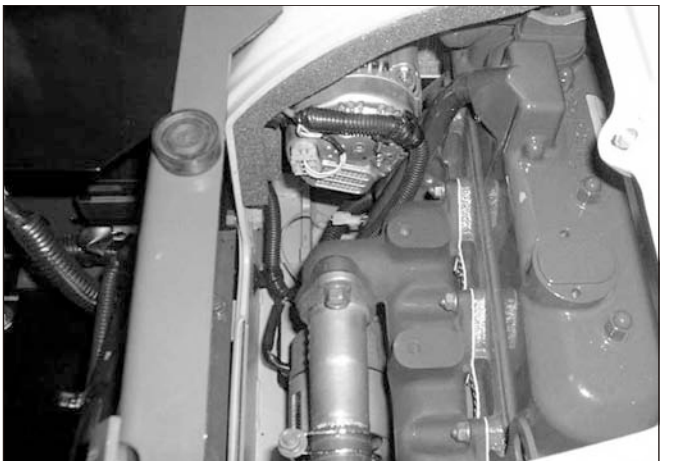


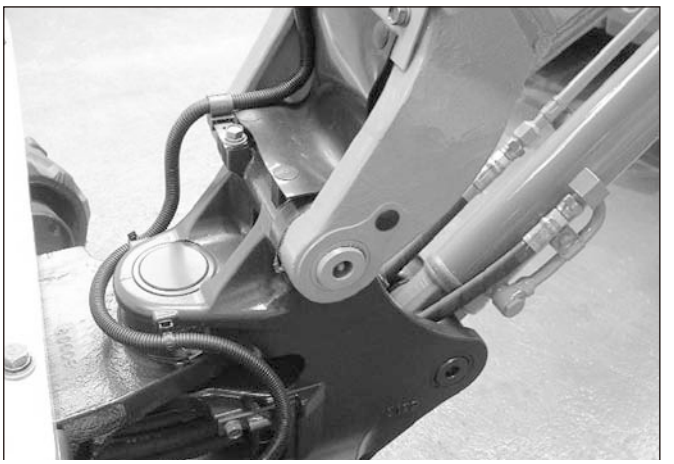
C Swivel frame wireharness

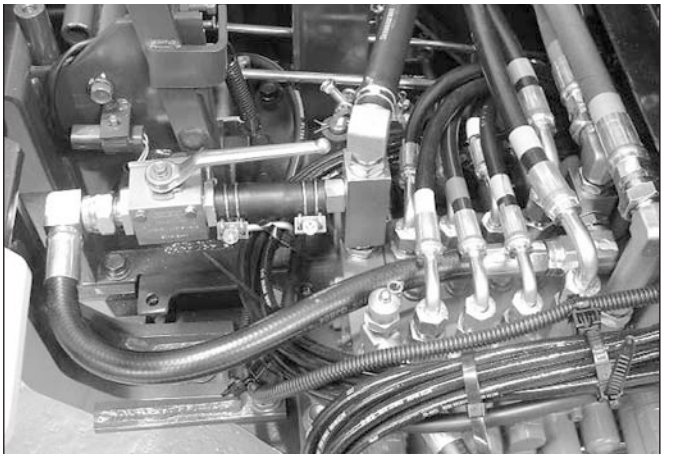


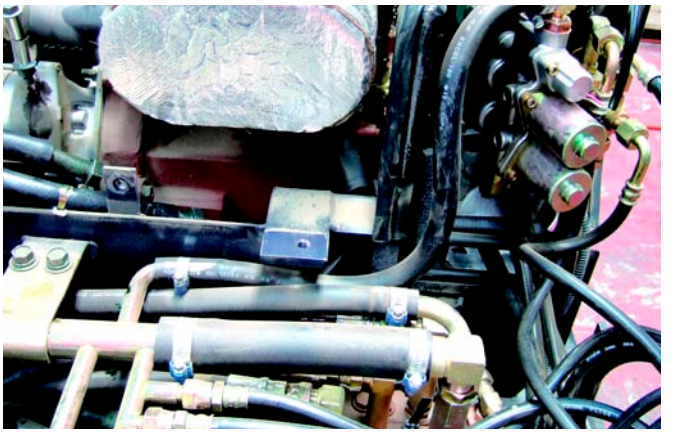
(1) Clamp to the battery fixture.
(2) Clamp with the grease tube.
(3) Fuel sensor
(4) Connect with the working light wire harness.
(5) Fit the clip to the swivel frame member from below.
(6) Bolt (VT, M8) T1060-30372 2 locations
(7) ECU (anti-theft device) RC477-9316Δ
Bolt 01205-60616x2
(8) Fix with the cord clamp 37150-3446Δ
(9) Horn RD408-5336Δ
Use the round contact bar for fitting.
(10) Bi-speed travel switch
(11) From below the coupler
(12) Allow no contact with the pilot hose.
(13) Clamp with the pilot hose.
(14) Details of hood
(15) To the operator' seat
(16) Pass through the front of the round bar.
(17) Insert upward.
(18) Plate (grommet)
RB441-4323Δ
Fit the grommet first and then the plate.
(19) Bolt 01135-61020
(20) Bolt (VT, M8) T1060-30372
(21) Cord (body ground)
RB441-5325Δ

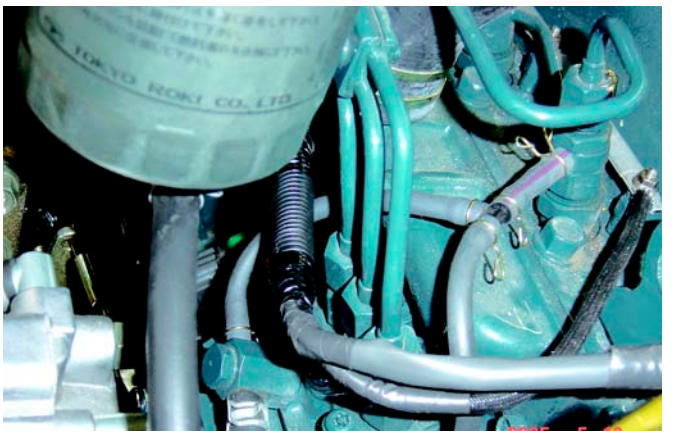








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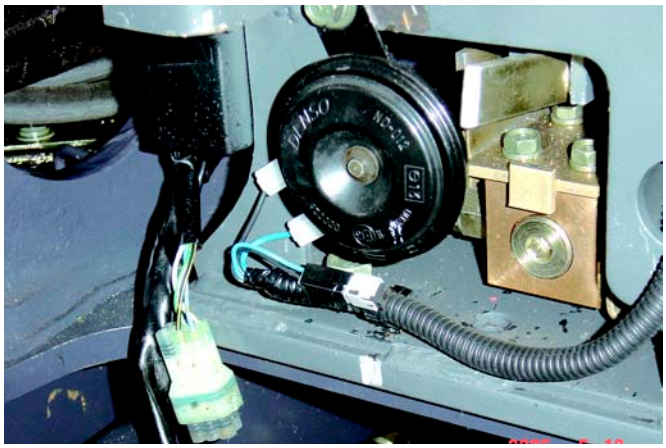
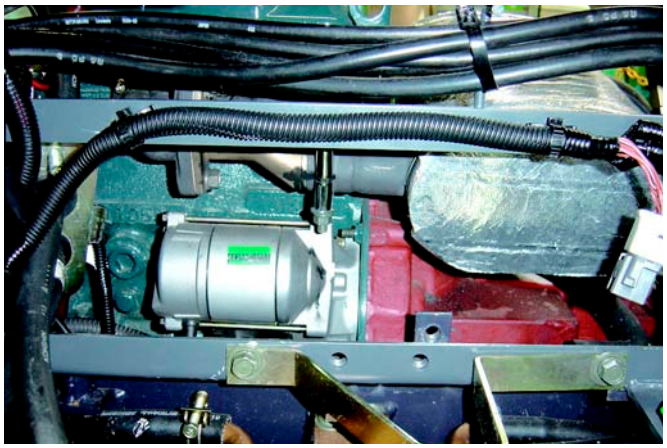
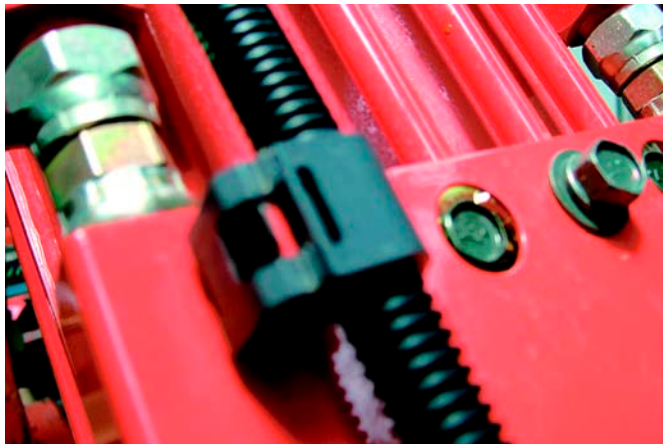
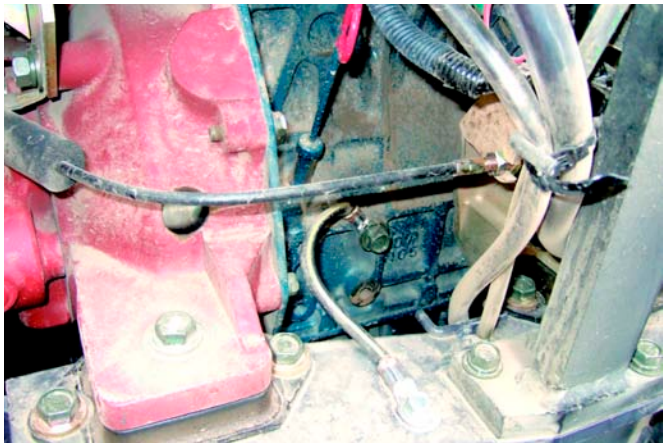
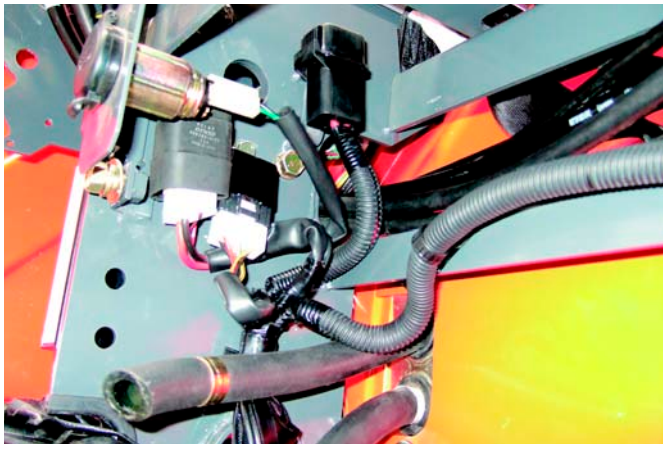
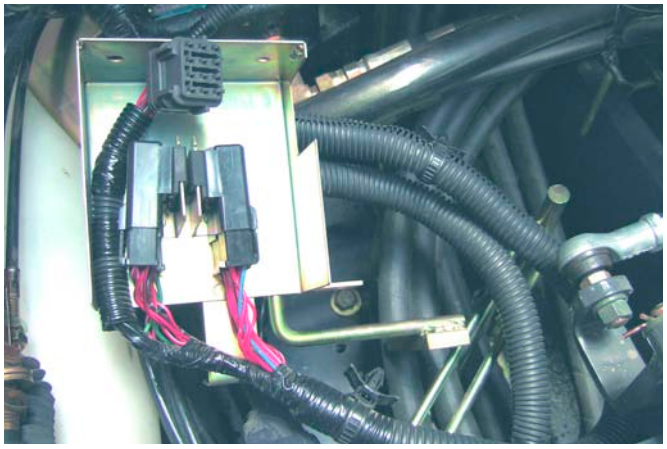




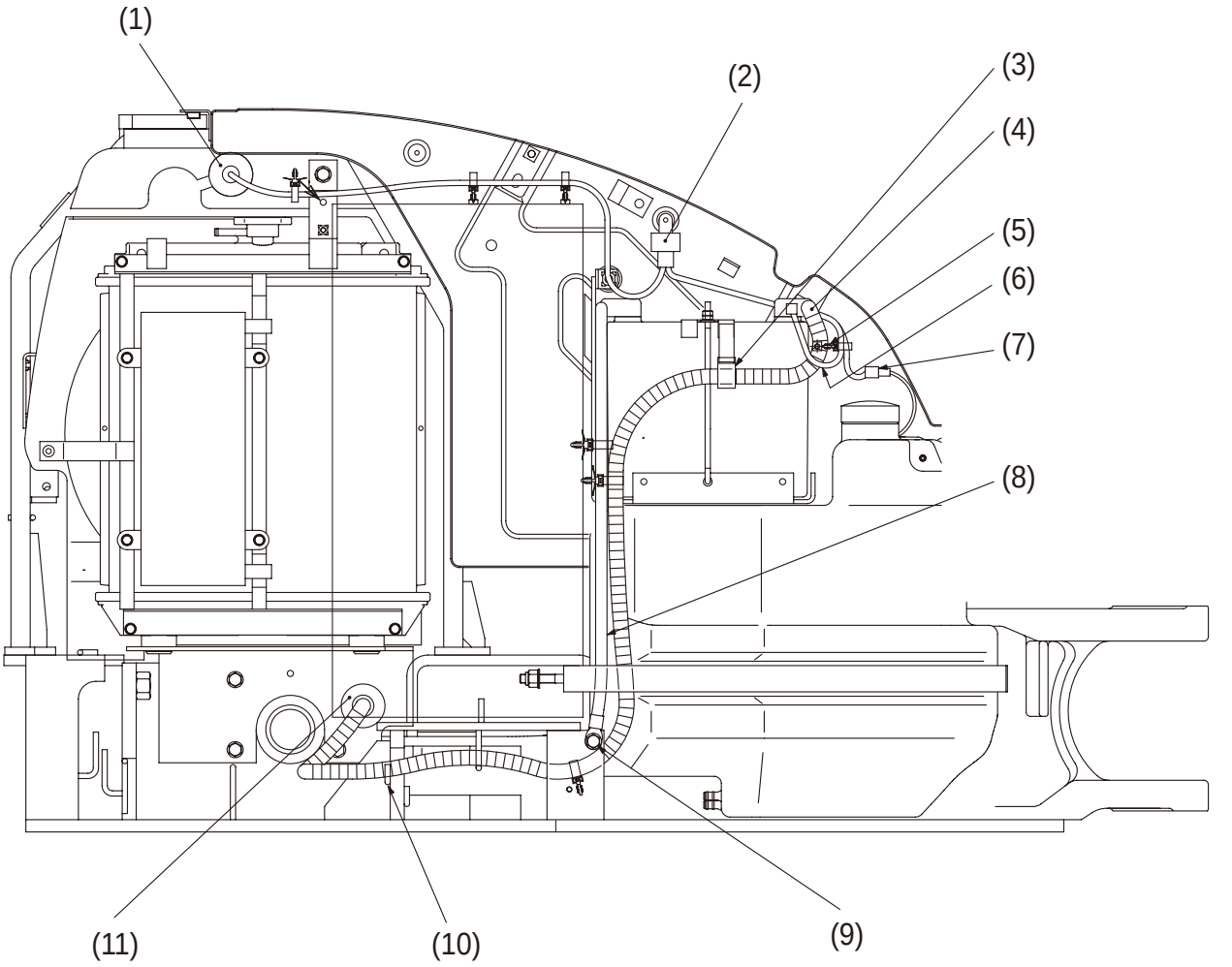




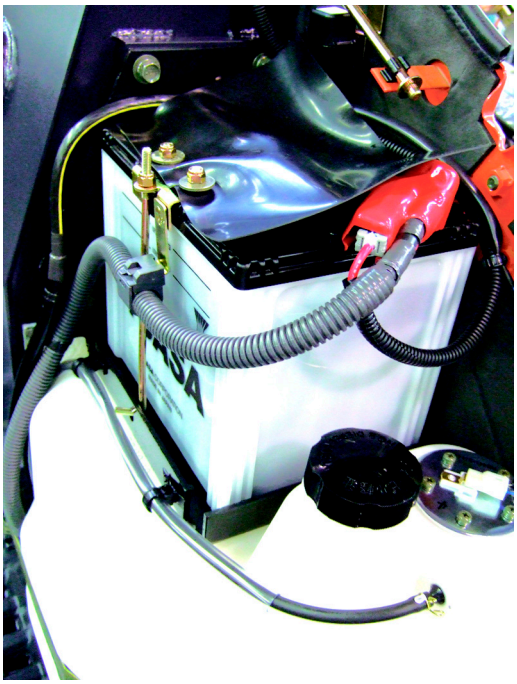


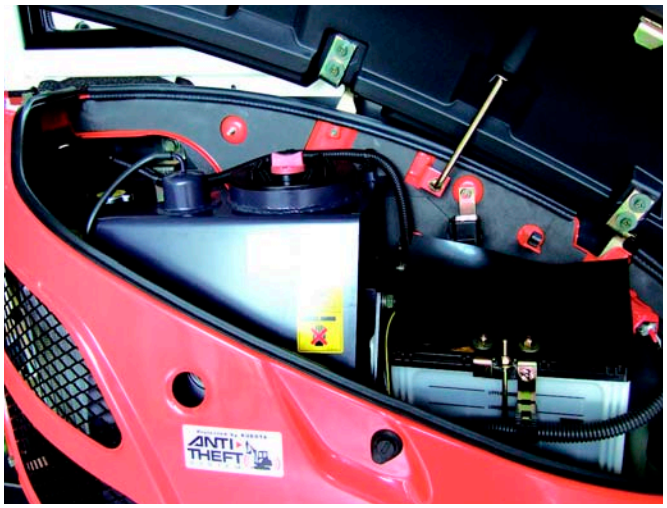


d. Wireharness around battery



(1)Grommet
(2)Insert the slow-blow fuse.
(3)Clamp this to the battery retainer.
(4)Battery cord (+) RB411-5322Δ
(5)Insert this into the nut at the side of the battery.
(6)Pass this outside of the battery.
(7)Wireharness(Fule) Connect this with RB237-5331Δ
(8)Battery cord (-) RB411-5326Δ
(9)Bolt (VT,M8) T1060-30372
(10)Pass this through the guide above the fuel hose.
(11)Grommet

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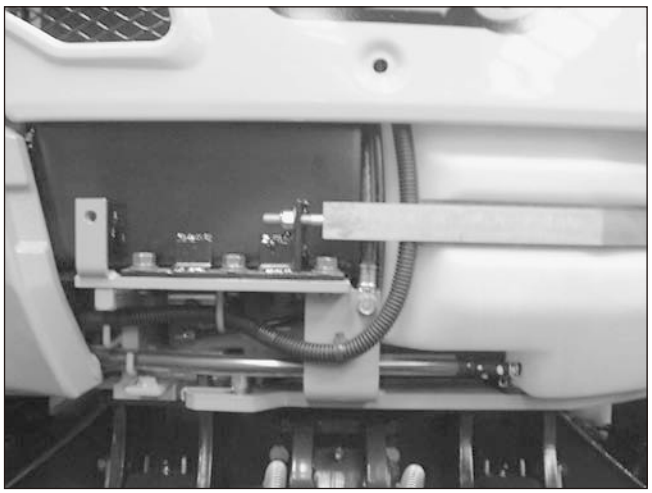
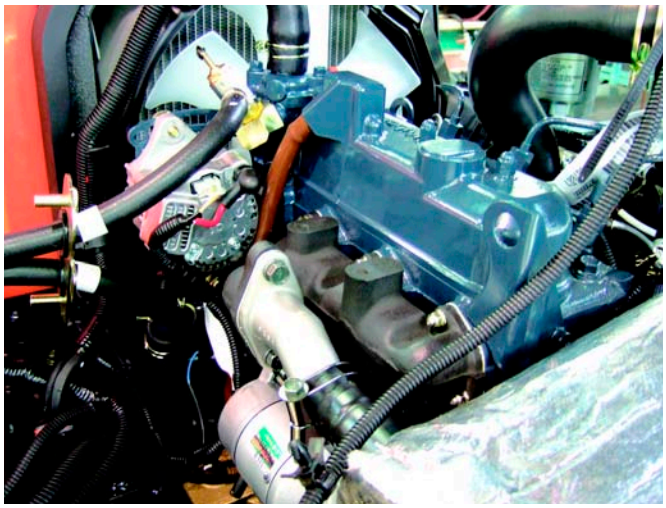
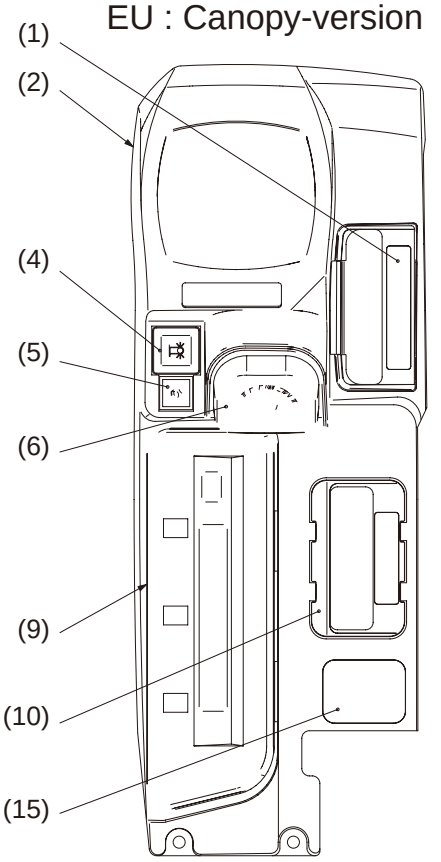




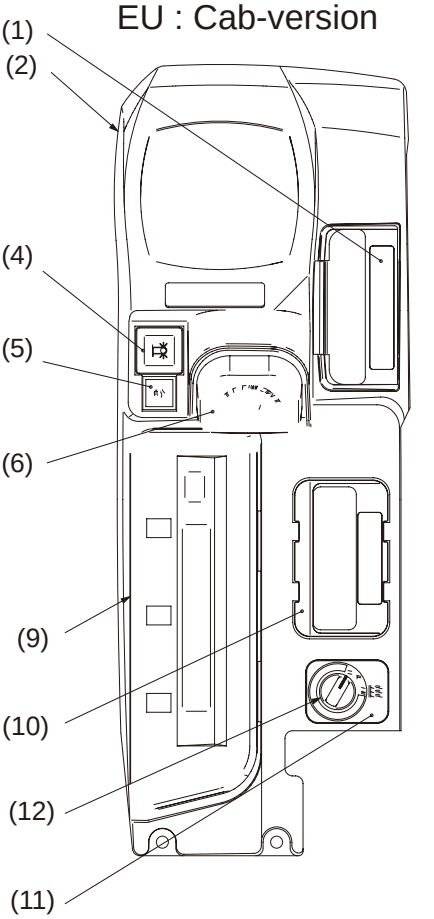
e Wireharness around seat

(1) Around seat

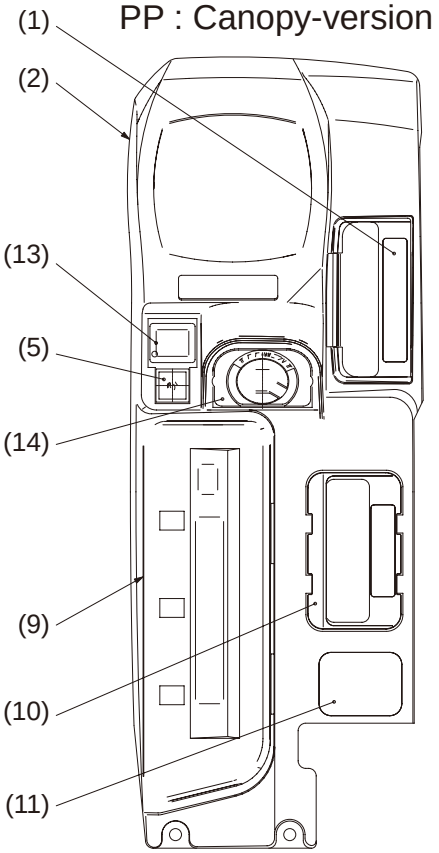
EU : Canopy-version



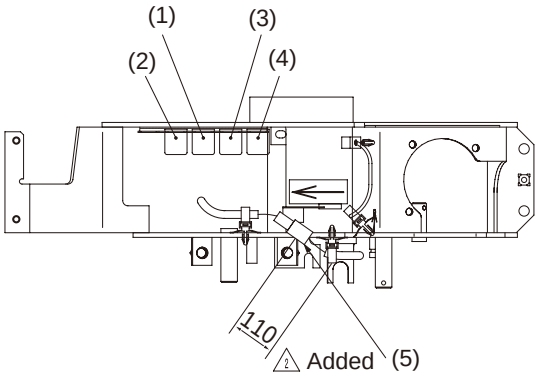
EU : Cab-version



PP : Canopy-version

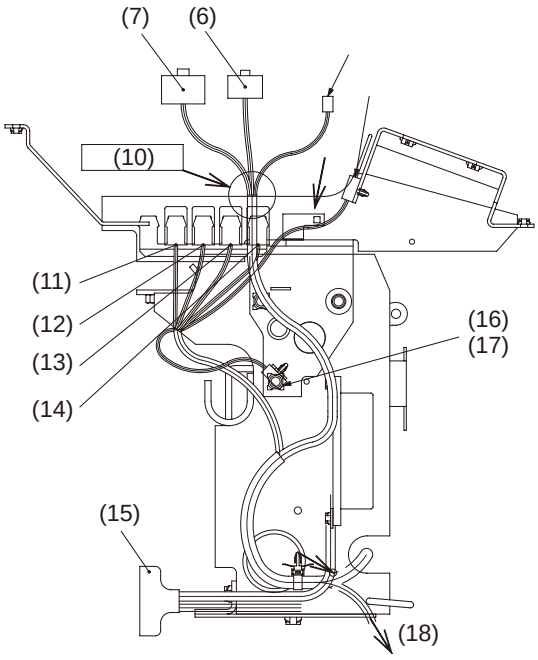


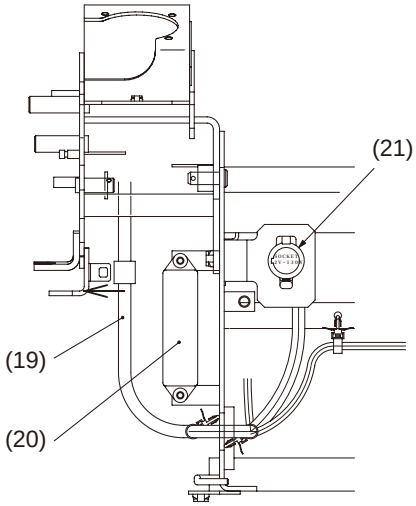
(1)Plate(right,blade) RB237-4478Δ
(2)Cover(right,upper) RB411-4486Δ
(4)Switch(Beacon) RB237-5341Δ
(5)Lamp(HI) RB237-5343Δ
(6)Antenna(Anti-theft, EU) RC441-9315Δ
(8)Bolts(2pcs.) 01205-60612
(9)Meter ass'y RB449-5311Δ
(10)Plate(right,accelerator) RB237-4477Δ
(11)Label(Panel) RB238-5744Δ
(12)Switch,ass'y(Heater) 6811-5354Δ
(13)Cap(Switch) RB238-4491Δ
(14)Lable(Main switch) RB238-5775Δ
(15)Label(Panel) RB238-5744Δ

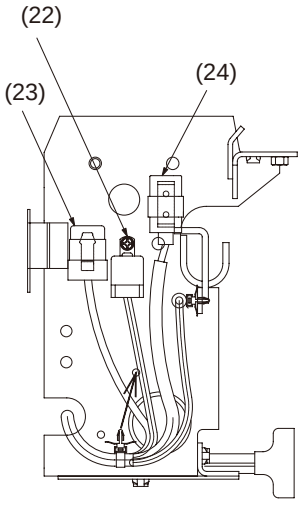


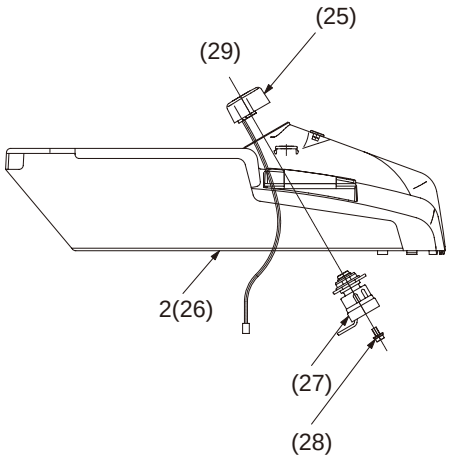
Branching of Section A
(Except for starter switch and horn switch)

	4 P	Cab
EU-version	Antenna (Burglarproof) Travel 2-speed lamp Travel 2-speed switch Beacon switch	Antenna (Burglarproof) Travel 2-speed lamp Travel 2-speed switch Beacon switch Heater switch
PP-version	Travel 2-speed lamp Travel 2-speed switch	



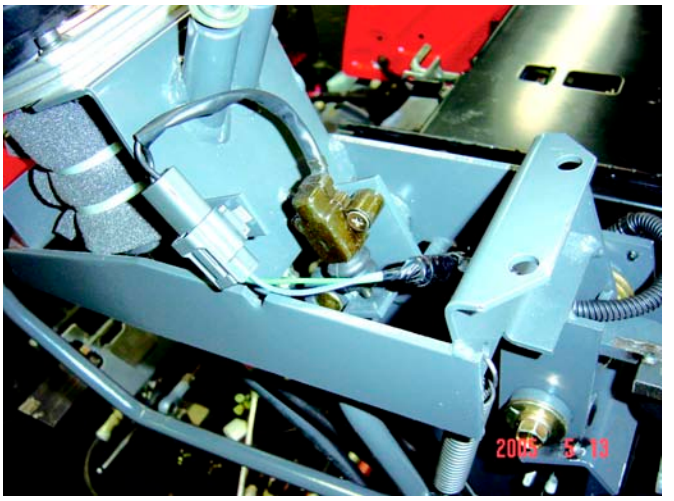


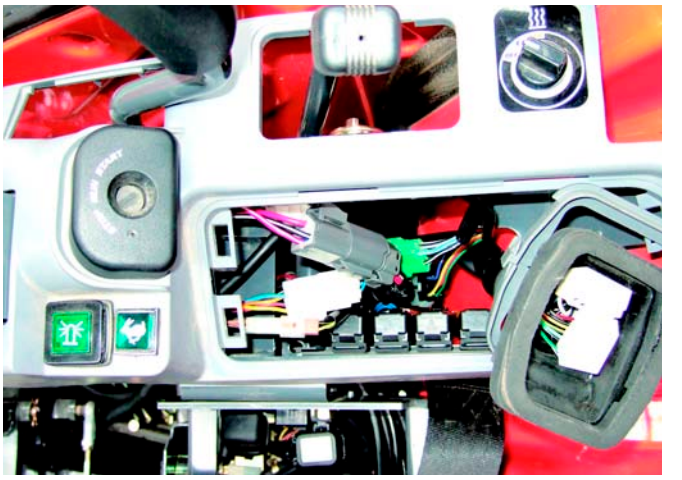


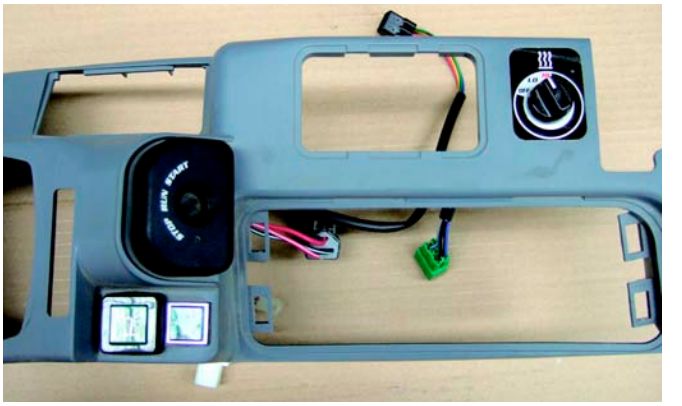


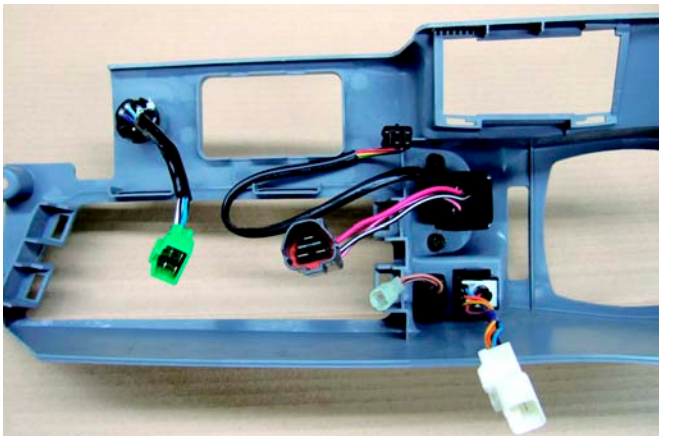
(1)Light relay
(2)Auto-disengaging relay
(3)Horn relay
(4)Cabin relay
(5)Travel 2-speed switch coupler
For overseas model only
(6)Connect this to the panel.
(7)Connect this to the panel.
(8)Insert this into the stay sfter connecting to the key switch.
(9)Connect this to the horn switch.
(10)Section A
(11)Black tape
(12)Yellow tape
(13)Green tape
(14)Brown tape
(15)Grommet
(16)Remove the cap and connect this to the lever lock switch.
(17)*For 2P canopy version only
(18)To the Anti-theft (EU) beacon wireharness
(19)Pass this outside of the pilot hose.
(20)Fuse box
(21)RC418-53451 Socket, ass'y
(22)*For cabin version only
PL503-68591 Relay(PTO)
(23)Glow relay
(24)Slow-blow fuse
(25)Antenna (Anti-theft, EU)
RC441-9315Δ
(26)Cover(right,upper) RB441-4486Δ
(27)Starter switch RC411-5396Δ
(28)Bolts (2pcs.) 01205-60612
(29)*Mount the starter switch after passing the antenna (Anti-theft, EU) wire.

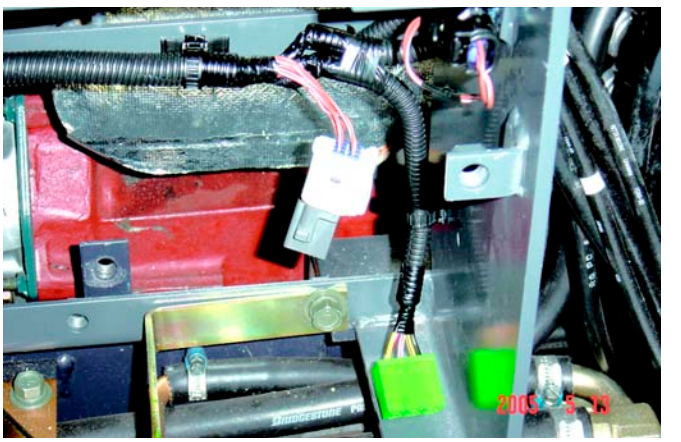
(1) EU-version, antenna

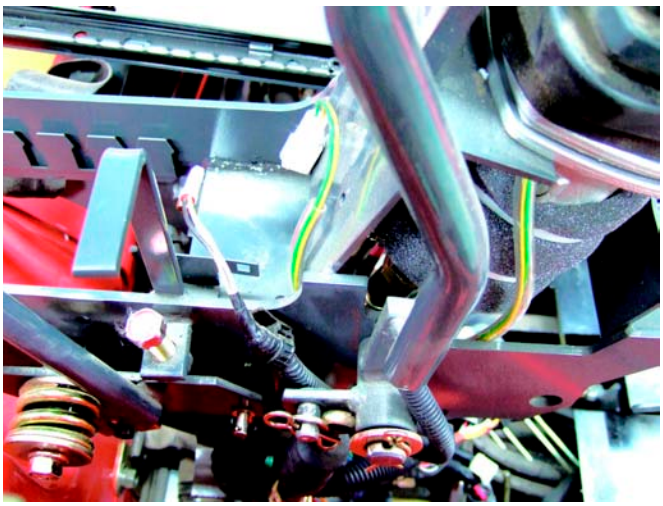


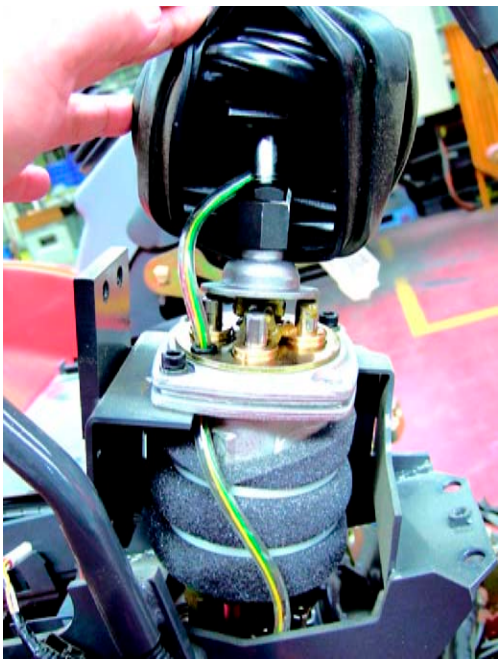


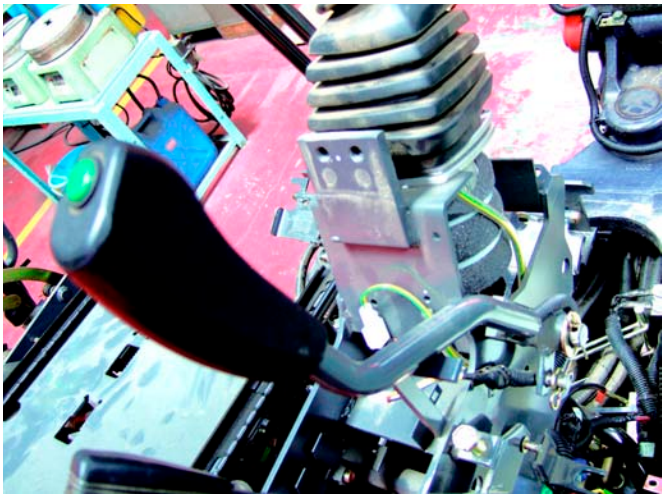


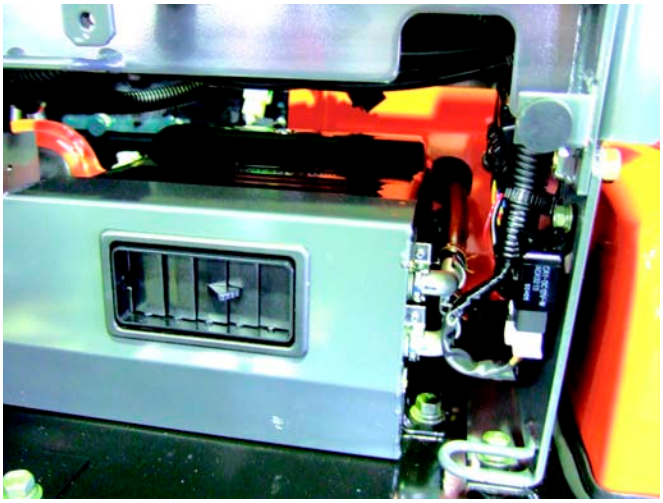


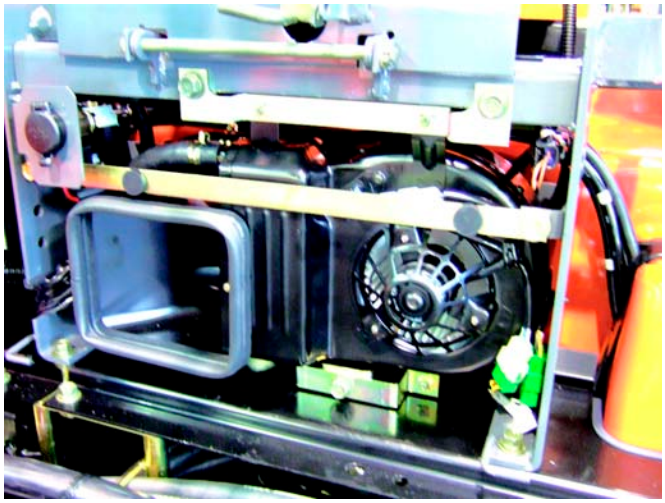


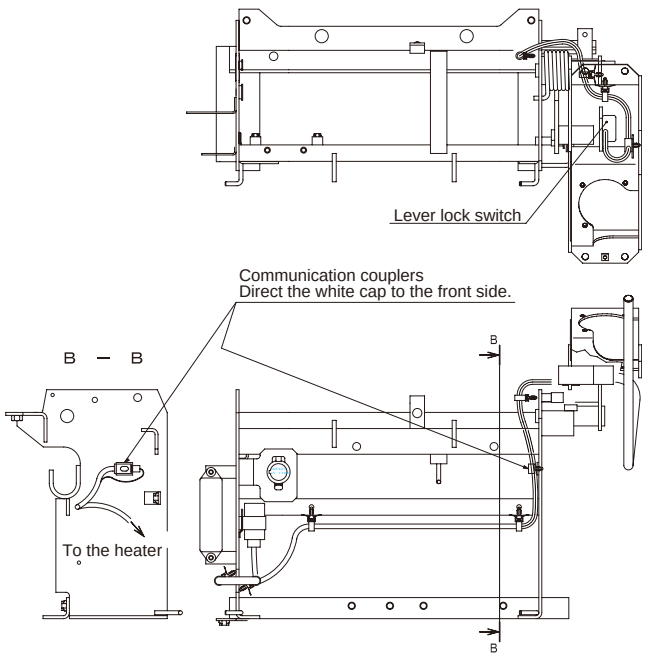






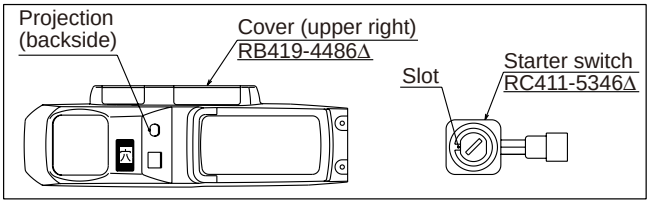






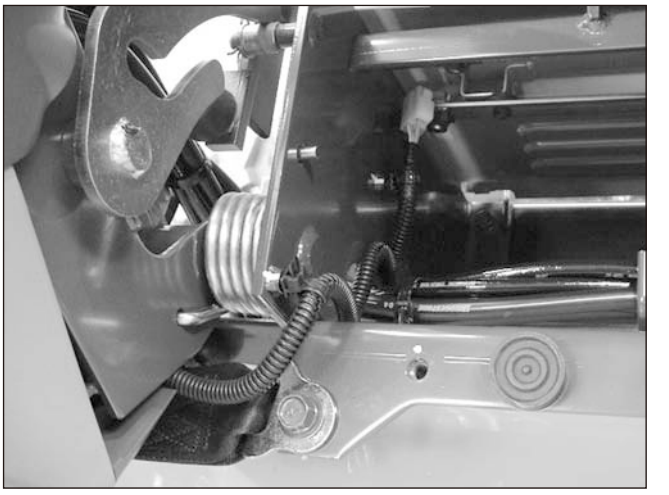
(1)Lever lock switch
(2)Communication couplers Direct the white cap to the front side.
(3)To the heater

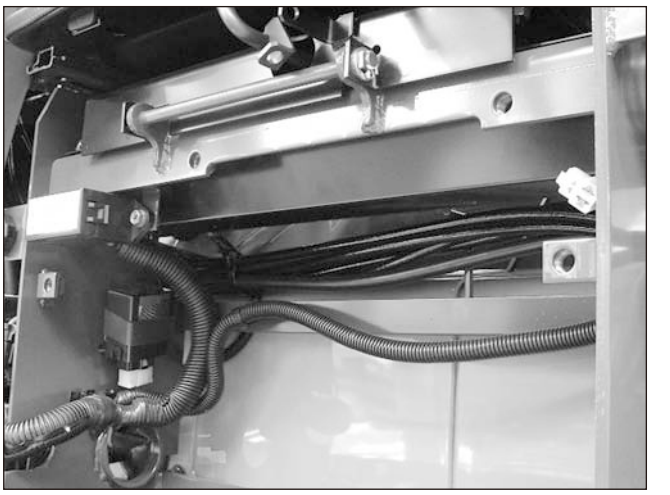
[2] Starter switch



(1)Projection (backside)
(2)Cove r (upper right) RB419-4486Δ
(3)Slot
(4)Starter switch RC41-5346Δ

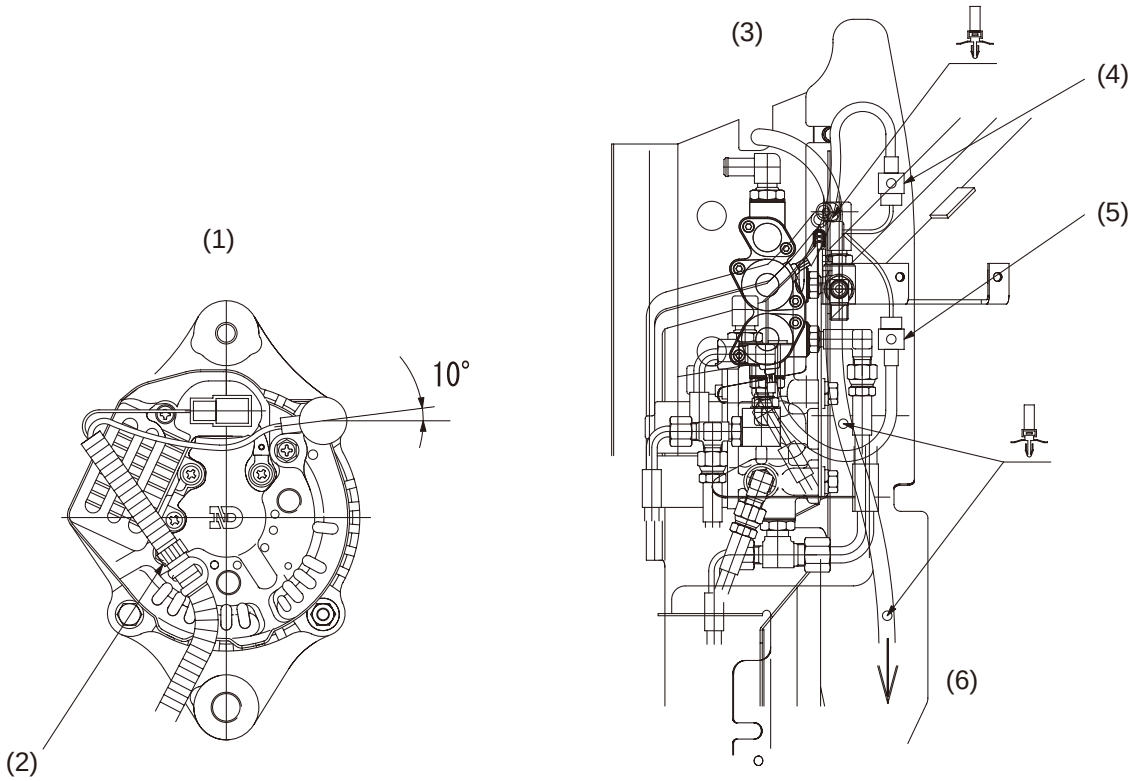
(4)Starter switch RC411-53461



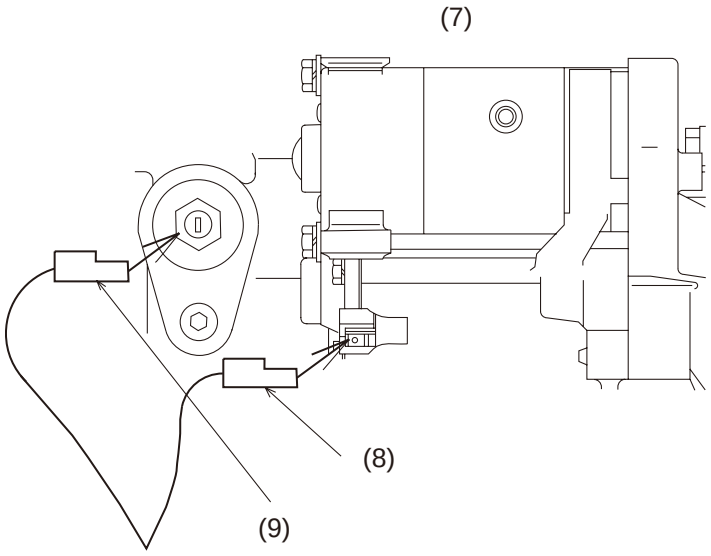


(1) Align the slot in the starter switch with the projection on the cover (upper right).
(2) Tightening torque for installation of starter switch
4.0 ~ 5.0 N·m (0.4 ~ 0.51 kgf·m)
2.89~3.69ft·lbs
(3) Hold the starter switch in the starting position and check that the starter stops immediately after engine startup (automatic release).

(3) Around selector valve and alternator



(1) Alternator
(2) Use to prevent sagging.
(3) Selector valve
(4) To the green wire harness (lever lock)
Insert into the partition board.
(5) To the yellow wire harness (two-speed travel)
Insert into the partition board.
(6) To the two-speed travel and horn



(7) Oil switch・Starter
(8) To the starter
Coupler: White
Cord: Black
(9) To the oil switch
Coupler: Black
Cord: Blue

Conversion Tables

Conversion Tables, *Tableaux Conversions,* Umrechnungstabelle

a. Length *Longueur* Loenge

mm	cm	m	ınch	ft	yd
1	0.1	0.001	0.03937	0.0032808	0.001094
10	1	0.01	0.39370	0.0328080	0.010940
1000	100	1	39.370	3.2808	1.0936
25.400	2.540	0.02540	1	0.083333	0.02778
304.800	30.480	0.30480	12	1	0.3333
914.4	91 44	0.9144	36	3	1

Ex. 1㎜=0.03937in 120㎜=120×0.03937=4.7244in 1mile = 1.609km

b. Area *Aire* Areal

cm^2	m^2	sq.ın	sq.ft	sq.yd
1	0.0001	0.15500	0.0010764	0.0001196
10000	1	1550.0	10.764	1 1960
6.4516	0.00064516	1	0.006944	0.0007716
929.03	0.092903	144	1	0.11111
8361.0	0.8361	1296	9	1

Ex. 1㎡=1.1960 sq.yd 1.2㎡=1.2×1.1960=1.4352 sq.yd

c. Volume *Volume* Volume

dm^3(l)	m^3	cu.ın	cu.ft	cu.yd	Imperıal gal	US gal
1	0.001	61.027	0.035317	0.0013	0.21998	0.26418
1000	1	61027	35.317	1.3079	219.98	264.18
0.016387	0.00001639	1	0.578697	0.0000214	0.003605	0.00433
28.3153	0.028315	0.000464	1	0.037026	6.22786	7 4006
764.584	0.764584	46656	27	1	168.152	199.816
4.5465	0.0045465	277 4207	0.16057	0.0059	1	1.20114
3.7852	0.0037852	231.005	0.13368	0.0050	0.83254	1

Ex. 0.04㎥=0.04×1.3097=0.052316 cu.yd 1liter=1000cc=1000㎤

d. Flow amount *Decharge internes* Entladung

L/sec	m^3/mın	m^3/h	Inp.gal/mın	US gal/mın	cu.yd/mın	L/mın
1	0.060	3.6	13.197	15.8514	21 192	60
16.666	1	60.0	219.98	264.1833	35.3165	999.96
0.2778	0.016668	1	3.6658	4.4032	0.58806	16.668
0.075775	0.0045465	0.27279	1	1.2011	0.16065	4.5465
0.06309	0.0037824	0.2271	0.8325	1	0.17768	3.7854
0.47192	1.6989	0.02832	6.22787	7 4855	1	28.3152
0.016667	0.001	0.06	0.21995	0.264173	0.035317	1

Ex. 25.6l/sec=25.6×0.06=1.53㎥/mın=25.6×15.8514=405.79584Usgal/mın

e. Force(Weıght) *Foece(Contrepoids)* Kraft(Gewıcht)

N	dyn	kgf	lbw
1	1×10^5	1.01972×10^{-1}	2.24809×10^{-1}
1×10^{-5}	1	1.01972×10^{-6}	2.24809×10^{-6}
9.80665	9.80665×10^5	1	2.20462
4.44822	4.44822×10^5	4.53592×10^{-1}	1

Ex 1.2kgf=1.2×9.80665=11.76798N=11.76798×2.24809×10^{-1}=2.64555lbw

f. Stress ***Emphase*** **Betonen**

Pa	MPa or N/mm²	kgf/mm²	kgf/cm²
1	1×10^{-6}	1.01972×10^{-7}	1.01972×10^{-5}
1×10^{6}	1	1.01972×10^{-1}	1.01972×10
9.80665×10^{6}	9.80665	1	1×10^{2}
9.80665×10^{4}	9.80665×10^{-2}	1×10^{-2}	1

Ex. 1.2kgf/cm²=1.2×9.80665×10⁻²=0.1176798 MPa

g. Pressure ***Pression*** **Pruefdruck**

MPa	Pa	Bar	kgf/cm²	atm	mmH²O	psi(lbw/in²)
1×10^{-6}	1	1×10^{-5}	1.01972×10^{-5}	9.86923×10^{-6}	1.01972×10^{-1}	$1\ 45038\times10^{-4}$
1	1×10^{6}	10	10.1972	9.86923	1.01972×10^{5}	$1\ 45038\times10^{2}$
0.0980665	9.80665×10^{4}	9.80665×10^{-1}	1	9.67841×10^{-1}	1.0×10^{4}	$1\ 42233\times10$
1.01325×10^{-1}	1.01325×10^{5}	1.01325	1.03323	1	1.03324×10^{4}	$1\ 46959\times10$
9.80665×10^{-6}	9.80665	9.80665×10^{-5}	1.0×10^{-4}	9.67841×10^{-5}	1	1.42233×10^{-3}
1.33322×10^{-4}	1.33322×10^{2}	1.33322×10^{-3}	1.35951×10^{-3}	1.31579×10^{-3}	1.35951×10	1.93368×10^{-2}
6.89474×10^{-3}	6.89474×10^{3}	6.89474×10^{-2}	7.03070×10^{-2}	6.80460×10^{-2}	7.03070×10^{2}	1

Ex. 120 kgf/cm²=120×9.80665×10⁴=11767980Pa=11.76798MPa 1Pa=1N/m², 1MPa=1×10⁶Pa

h. Work energy amount ***Equivalent travail mecanique de lachaleur*** **Leistung**

J	kW.h	kgf.m	kcal	ft.lb
1	2.77778×10^{-7}	1.01972×10^{-1}	2.38889×10^{-4}	7.37555×10^{-1}
3.6×10^{5}	1	3.67098×10^{5}	8.6×10^{2}	2.65519×10^{5}
9.80665	2.72407×10^{-6}	1	2.34270×10^{-3}	7.23292
4.18605×10^{3}	$1\ 16279\times10^{-3}$	4.26858×10^{2}	1	3.08743×10^{3}
1.35583	3.76621×10^{-4}	1.38257×10^{-1}	3.23899×10^{-4}	1

Ex. 12kgf.m=12×9.80665=117.6798J, 1J=1W·S, 1W·h=3600W·S, 1cal=4.1865J

ı.Work efficıency ***Puıssance*** **Wirkungsgrad**

kW	kgf.m/s	PS	HP	kcal/h
1	1.01922×10^{2}	1.35962	1.34048	8.6000×10^{2}
9.80665×10^{-3}	1	1.33333×10^{-2}	1.31456×10^{-2}	8.43371
7.355×10^{-1}	7.5×10	1	9.85925×10^{-1}	6.32529×10^{2}
$7\ 46\times10^{-1}$	7.60707×10	1.01428	1	6.41564×10^{2}
$1\ 16279\times10^{-3}$	$1\ 18572\times10^{-1}$	1.58095×10^{-3}	1.55869×10^{-3}	1

Ex. 10.2PS=10.2×7.355×10⁻¹=7.5021kW

ȷ.Torque ***Couple*** **Drehmoment**

kgf.m	ft.lbs	N.m
1	7.233	9.80665
0.1383	1	1.35582
0.1020	0.7376	1

Ex. 12kgf.m=12×9.80665=117.6798N.m

k.Velocity ***Vitesse*** **Geschwındigkeit**

m/sec	km/h	ft/mın	mile/h
1	3.6	3.2808	2.2370
0.2778	1	54.68	0.6214
0.00508	18.288	1	11.639
0.447	1.6093	0.19398	1

l. Temperature
Temperature
Temperatur

°F	°C
0	-17.8
10	-12.2
20	-6.7
30	-1 1
32	0
40	4.4
50	10.0
60	15.6
70	21.1
80	26.7
90	32.2
100	37.8
110	43.3
120	48.9
130	54.4
140	60.0
150	65.6
160	71.1
170	76.7
180	82.2
190	87.8
200	93.3
210	98.9
212	100.0
220	104.4
230	110.0
240	115.6

F=32+9/5×C
C=5/9×(F−32)

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