WSM

WORKSHOP MANUAL

KUBOTA EXCAVATOR

KX080-3

Kubota

Code No.97899-61620

Record of Revisions

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

CONTENTS

CONTENTS

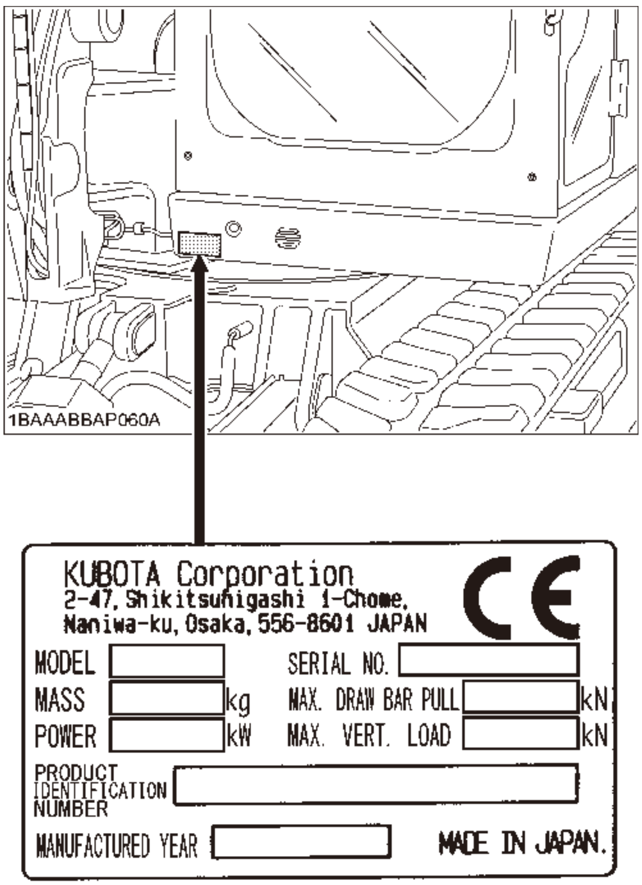
VI ir Conditioner

I General

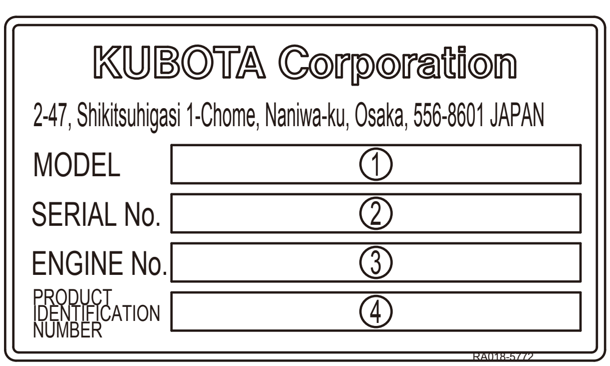
A.Body and engine identification marks

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)Product number plate



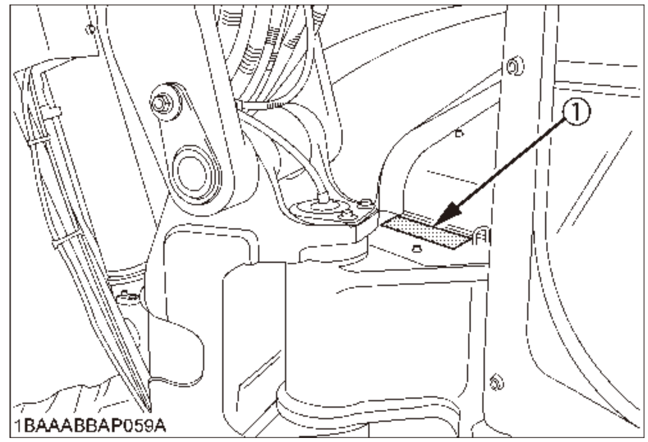
KTC, KCL, KTA-version



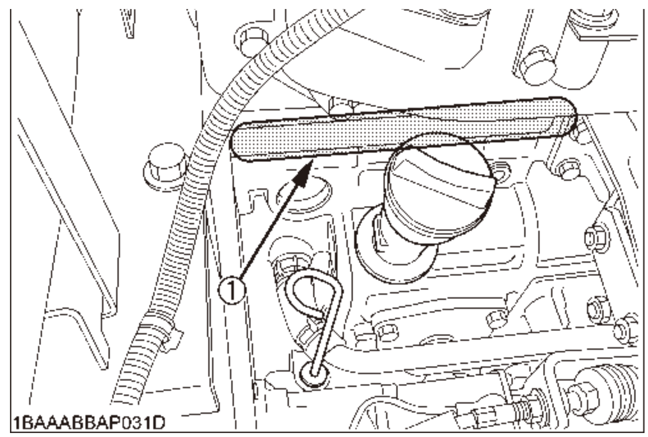
Name plate : Code No. RA018-57721

(3) 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.

(2)Machine and engine serial number



(1) Machine serial No.



(1) Engine serial No.

(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 $\boxed{S}$ and critical functional process $\boxed{A}$ .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 $\boxed{S}$.

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 $\boxed{A}$.

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.

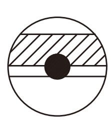
b Make Sure the Safety decals and Wireharness Clamps are in their Specified Positions.

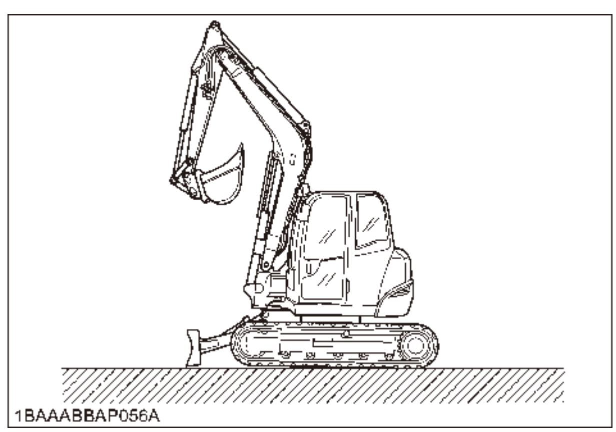
c With the Machine Front in a Specified Posture, Check the Amount of Hydrauric Oil

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.

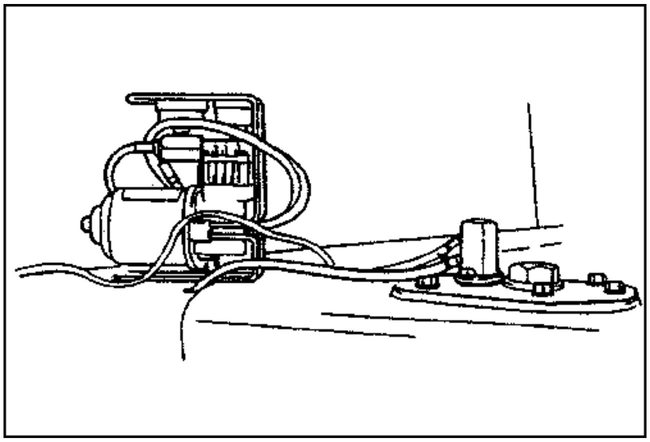
Place the front in the left swing position with the arm, boom and bucket cylinders stretched most.

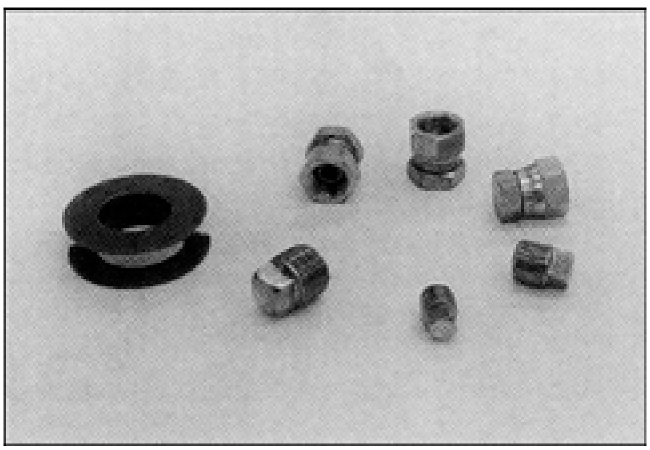


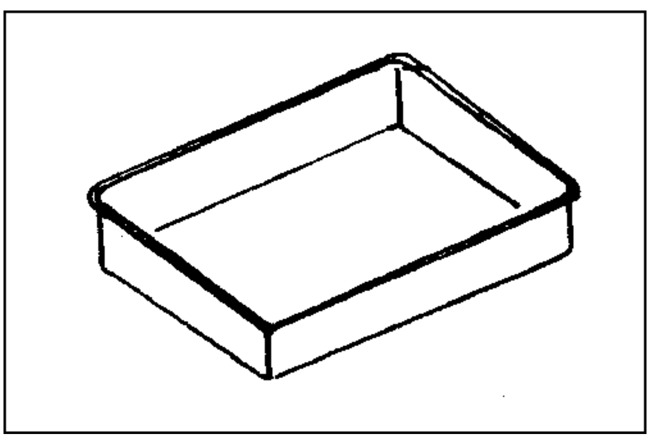


E.SERVICING FUNDAMENTALS

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.

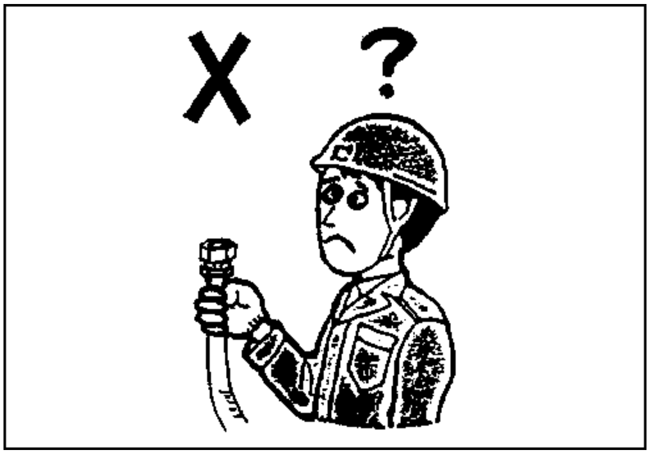
Types of screw adhesive
Equivalent to LOCTITE 271 (Heavy-duty) Equivalent to THREE-BOND 1305P (Heavy-duty) Equivalent to THREE-BOND TB1401B (Light-duty) Unless specified otherwise, use THREE-BOND 1324 (Medium-duty).

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

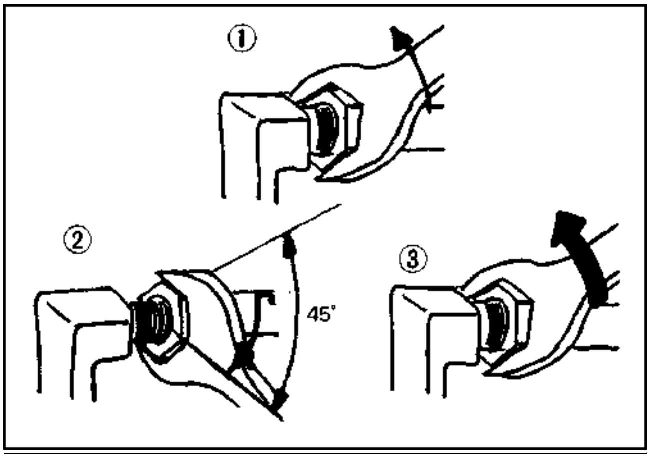
The word “LOCTITE“ in this manual denotes the red-color type.

(3) Precautions in disassembling the hydraulic equipment

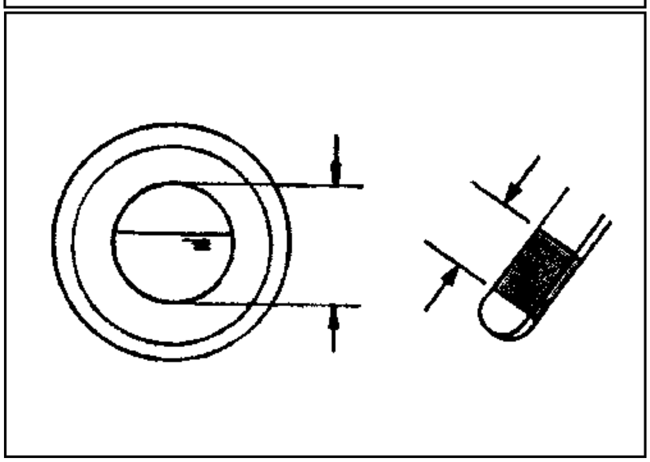
- Use a vacuum pump, plugs, oil pans, waste cloth and the like to prevent oil from running out or splashing.
  Wipe out leaking oil completely first and then add oil as required.
- Protect the openings with plugs, covers or the like to keep off foreign matters. Most of hydraulic system troubles are caused 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.



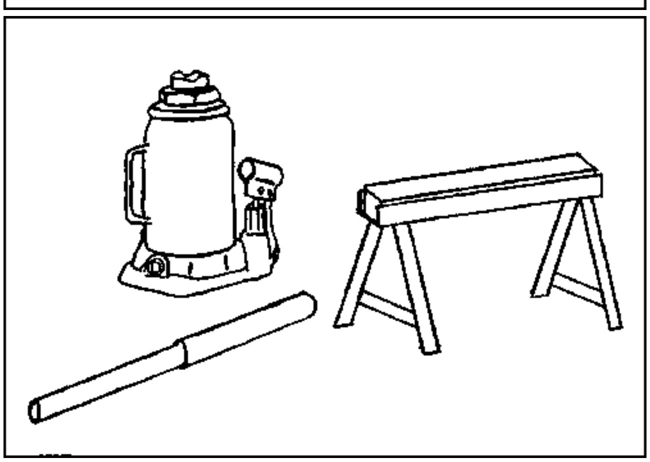
(4) Precautions in tightening hoses and pipes.
- Flexible hoses have a slight natural bend of their own. Utilize the natural bend. Be also careful not to twist them.
- Be careful not to confuse the routes of the hoses.
- Do not hold the hoses in tight contact with their adjacent parts and surfaces.



- 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.

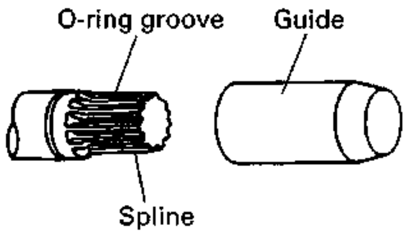


(5) The quantities of oil, fuel, water and others, except for the oil to be filled in the track rollers and idlers, are listed just as reference. Fill up the fluid up to the specified center level of a level gauge if it is provided.

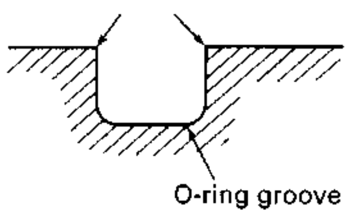


(6) Security support the machine with a jack and a supporting jig when it is jacked up for servicing.
(7) Be sure to use a crane in disassembling and reassembling heavy parts and components (frame, front attachment, crawler, etc.).

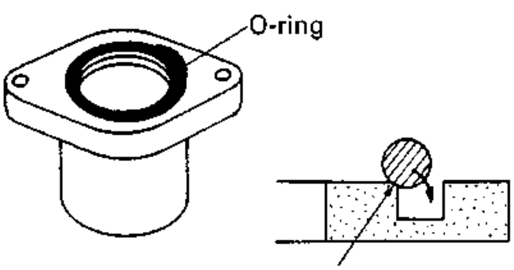
b. O-ring, Oil seal, Circlip and Roll Pin

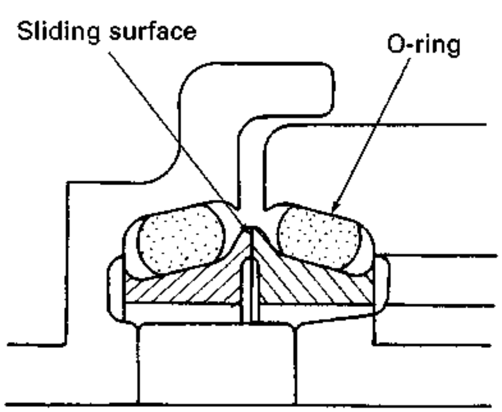


(1) General precautions
- Make sure the O-ring and the oil seal are free of anything unusual (uneven surface, scratches, chipping, etc.).
- Check the O-ring groove for burrs. Correct, if any, using an oil stone or the like.
- When putting a part past a sharp edge into position, protect such edge with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

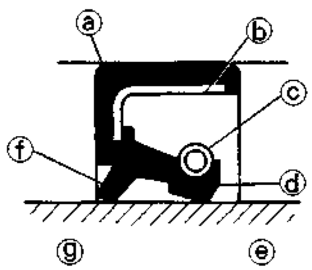


(2) O-ring
- Clean up the O-ring groove and deburr its edge as required.
- Before installing the ring, be sure to apply lubricant (grease) over it. (Do not do this to the floating seal.)
- Fit the O-ring into its groove without twist. With your fingertip, push the ring gently and evenly into the final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



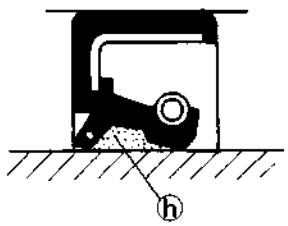


(3) Floating seal
- Be sure to wipe oil off the O-ring and the O-ring contact surface. (Note, however, that oil must be applied thinly over those of the wheel motor.)
- In fitting the O-ring into the floating seal, be careful not to twist the O-ring.
- Before installing the floating seal together with 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.

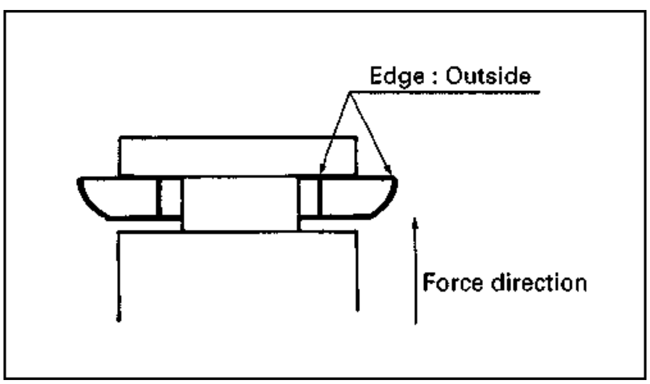


(4) Oil seal
- Do not confuse the orientation of the oil seal lips. Direct the main lip toward the oil chamber; in other word, toward what is to be sealed.

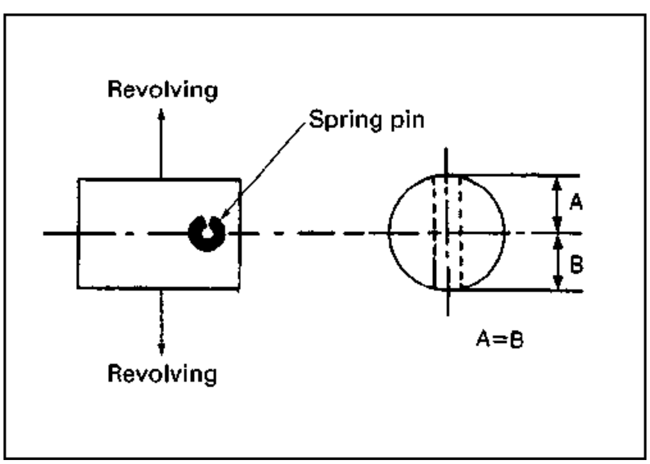
a.	Packing	f.	Dustpans lip
b.	Metal ring	g.	Atmosphere (outside)
c.	Spring	h.	Grease
d.	Main lip		
e.	Oil chamber (inside)		



- 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

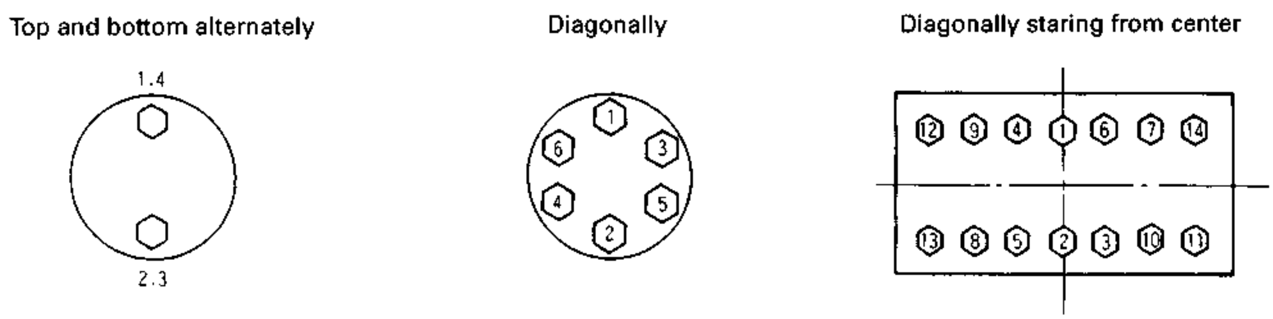
Check the hydraulic hose for too tight a connect or twist.

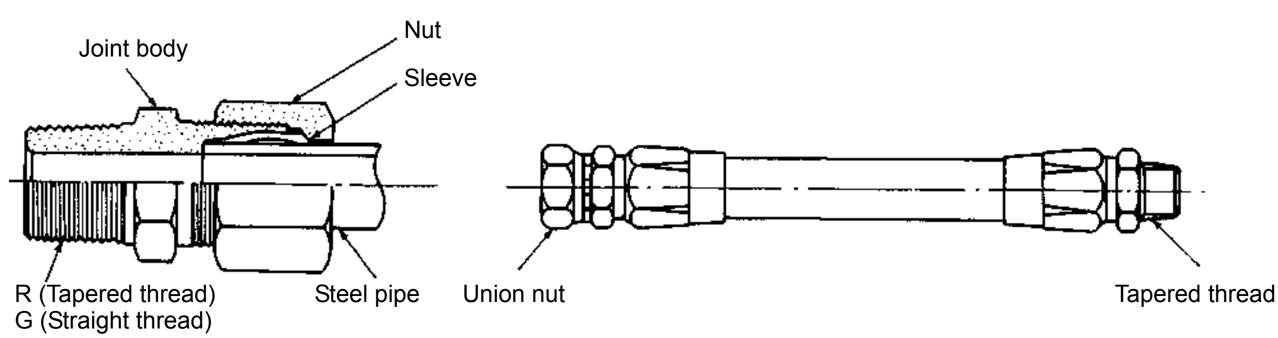
*Excessively tight contact

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) Hose clamp (screw-in type) tightening torque chart

Applicable diameter/Part code	Part name.	Tightening torque
(Ø10 ~ 14) 6C040-5872∆	Hose clamp (screw-in type 14)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø12 ~ 16) 09318-81916	Hose clamp (screw-in type)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø13 ~ 20) RB101-6363∆	Hose clamp (13-20)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø19 ~ 25) 09318-89024	Hose clamp (screw-in type)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø31 ~ 40) 09318-89039	Hose clamp (screw-in type)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø36 ~ 46) 09318-89045	Hose clamp (screw-in type)	2.5~3.4N.m (25~35kgf.cm)1.8~2.5ft.lbs
(Ø15 ~ 25) RC101-6458∆	Hose clamp (15-24)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø26 ~ 38) 68311-7282∆	Hose clamp (26-38)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø32 ~ 44) RD411-6382∆	Hose clamp (32-44)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø40 ~ 55) RD411-6318∆	Hose clamp (40-55)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø44~ 53) 09318-89052	Hose clamp (screw-in type)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø49 ~ 60) 67890-5828∆	Hose clamp (screw-in type 60)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø50 ~ 60) RC401-6319∆	Hose clamp (50-60)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø58 ~ 75) 36919-0459∆	Hose clamp (58-75)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø66 ~ 88) 3F740-0459∆	Hose clamp (66-88)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs
(Ø77 ~ 95) 69284-6137∆	Hose clamp (77-95)	4.9~5.9N.m (50~60kgf.cm) 3.6~4.4ft.lbs

(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.

Nomial Dia. \ Bolts, Nuts	4T (4)	7T (7)	9T (9)
	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

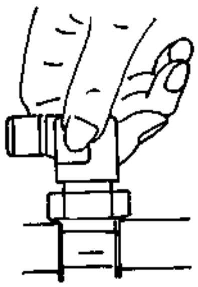
[ex. bolts]

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	4	No mark or marked 4
7T	S40C S45C	Over 686 MPa 7000 kgf/cm^2 99561 lbf/in^2	H_RC 20 ~ 28	7	Marked 7
9T	SCr4	Over 882 MPa 9000 kgf/cm^2 128007 lbf/in^2	H_RC 28 ~ 34	9	Marked 9

(10)Washer-equipped elbow

Tightening torque

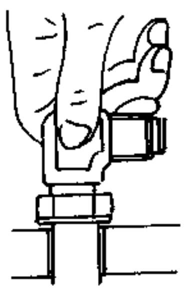
Size	N·m	kgf·m	ft·lbs
G1/8	15.0~16.5	1.5~1.7	11.1~12.2
G1/4	24.5~29.4	2.5~3.0	18.1~21.7
G3/8	49.0~53.9	5.0~5.5	36.1~39.8
G1/2	58.8~63.7	6.0~6.5	43.4~47.0
G3/4,G1	117.6~127.4	12.0~13.0	86.7~94.0
G1,1/4	220.5~230.3	22.5~23.5	162.6~169.9
7/8-14UNF	55.9~60.8	5.7~6.2	41.2~44.8



Tightening procedure

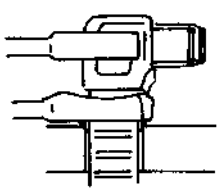
1. Connecting with the valve
   - Screw in the elbow by hand until the washer comes into contact.

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

1.Face sealing (ORS) type

Tighten to the specified torque.

9/16UNF size
35.2~43.1N.m (3.6~4.4kgf.m) 26.0~30.8ft.lbs

11/16UNF size
60.0~73.5N.m (6.1~7.5kgf.m) 44.3~54.2ft.lbs

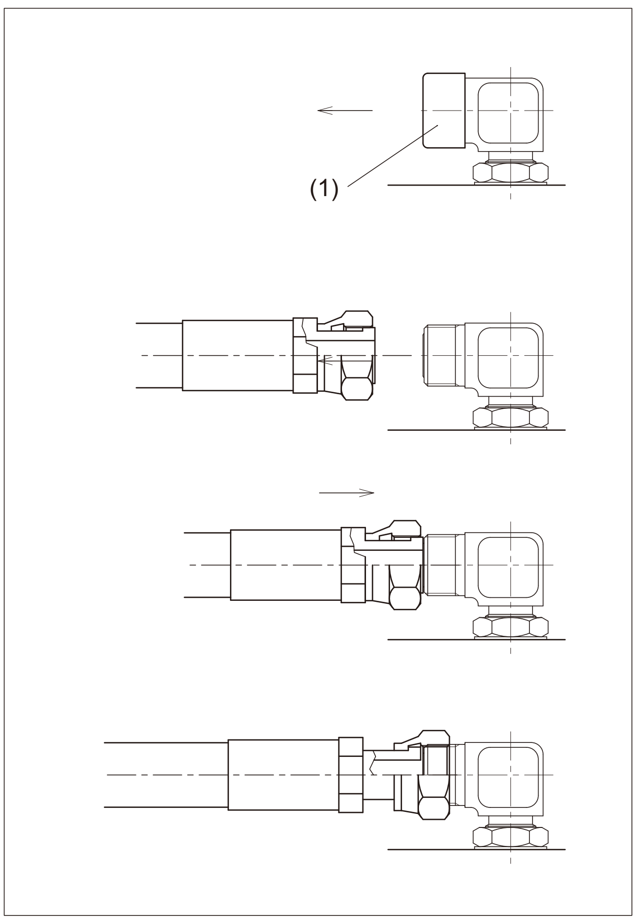
13/16UN size
70.6~86.2N.m (7.2~8.8kgf.m) 52.1~63.6ft.lbs

1-14/16UNS size
105.8~129.4N.m (10.8~13.2kgf.m)
78.0~95.4ft.lbs

Screw size	Part code of O ring
9/6UNF	RD809-6184∆
11/16UNF	RD809-6161∆
13/16UNF	RD809-6162∆
1-14UNS	RD809-6163∆

2.Connecting the face sealing (ORS) type hose

Take the procedure at left.



Connecting the face sealing (ORS) type hose

1)Remove the protective cap from the adaptor and make sure the O ring is installed in its groove. (If the O ring is missing, fit the specified-size one in position.)

(1)Protective cap

2)Shift the hose's cap nut in the direction of arrow until the O ring contact face stretched out of the cap nut.

3) Bring the hose's O ring contact face in close contact with the joint's O ring.
Make sure they do not come off each other.

4) Tighten up the cap nut to the specified torque.

Hose tightening torque chart

N.m (kgf.m) ft.lbs

Size (ORS)	Union nut (metal sealing type)	Union nut (ORS type)
1/8 (-)	7.8~11.8N.m(0.8~1.2kgf.m) 5.8~8.7ft.lbs	-
1/4 (9/16-18)	24.5~29.4N.m(2.5~3.0kgf.m) 18.1~21.7ft.lbs	35.2~43.1N.m(3.6~4.4kgf.m) 26.0~31.8ft.lbs
3/8 (11/16-16)	37.2~42.1N.m(3.8~4.3kgf.m) 27.4~31.1ft.lbs	60.0~73.5N.m(6.1~7.5kgf.m) 44.3~54.2ft.lbs
1/2 (13/16-16)	58.8~63.7N.m(6.0~6.5kgf.m) 43.4~47.0ft.lbs	70.6~86.2N.m(7.2~8.8kgf.m) 52.1~63.6ft.lbs
3/4 (1-14)	117.6~127.4N.m(12.0~13.0kgf.m) 86.7~94.0ft.lbs	105.8~129.4N.m(10.8~13.2kgf.m) 78.0~95.4ft.lbs
1, 1/4 (-)	220.5~230.3N.m(22.5~23.5kgf.m) 162.6~169.9ft.lbs	-

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 fuel level																					daily
	Check coolant level																					daily
	Check engine oil level																					daily
	Check hydraulic oil level																					daily
	Check V-belt																					daily
	Check washer liquid																					daily
	Check water separator																					daily
	Check, clean air filter	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	50 h
	Tracks and chassis: clean, visual inspection and check tension	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	50 h
	Grease swivel gear	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	50 h
	Grease front attachments: Bucket and bucket link pin, Boom swing fulcrum		○		○		○		○		○		○		○		○		○		○	100 h
	Grease front attachments: Others					○					○					○					○	250 h
	Grease swivel gear bearing				○				○				○				○				○	200 h
	Clean air conditioner filter				○				○				○				○				○	200 h
	Check air conditioner drive belt				○				○				○				○				○	200 h
	Clean air conditioner condenser				○				○				○				○				○	200 h
	Drain water in fuel tank										○										○	500 h
	Check battery electrolyte level										○										○	500 h
	Check air conditioner pipes and hoses																					every 2 years

Servicing by skilled personnel or KUBOTA dealer

Service	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	Interval
Inspect coolant hoses and clamps					○					○					○					○	250 h
Check/adjust V-belt tension					○					○					○					○	250 h
Grease pilot valve linkage					○					○					○					○	250 h
Change engine oil and oil filter										○										○	500 h
Change drive unit oil	●									○										○	500 h
Change fuel filter cartridge										○										○	500 h
Change hydraulic return line filter element					●					○										○	500 h
Renewing the pilot circuit filter																				○	1000 h
Change hydraulic oil and suction filter																				○	1000 h
Change air filter elements																				○	1000 h
Change air conditioner filter																					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 air conditioner pipes and hoses																					every 2 years
Change coolant																					every 2 years
Change hydraulic hoses						Please contact your KUBOTA dealer.															every 6 years
Check refrigerant (gas)																					Service as required
Safety inspection																					annually

● First operation

b. Maintenance interval chart : PP-version

To be announced soon.

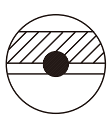
c. Water and oil quantity

	Unit			Remarks
Radiator	L gal	8.2 (2.17)		Kubota LLC-N-50F 50%
Reserve tank	L gal	1.3 (0.34)		
Engine oil with filter	L gal	10.7 (2.83)		Engine Oil SAE10W30(CF-4)
Hydraulic oil Full	L gal	146 (38.6)		ISO 46
Hydraulic oil Tank gauge center	L gal	75 (19.8)		ISO 46
Wheel motor	L gal	1.3 (0.34)		Gear Oil SAE90 (API GL-4)
Track roller	cc gal	80 (4.88)		Engine Oil SAE30(CD)
Upper roller	cc gal	60 (3.66)		SAE30(CD)
Front idler	cc gal	80 (4.88)		
Fuel tank	L gal	115 (30.4)		Diesel Fuel JIS #3 (Initial)

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

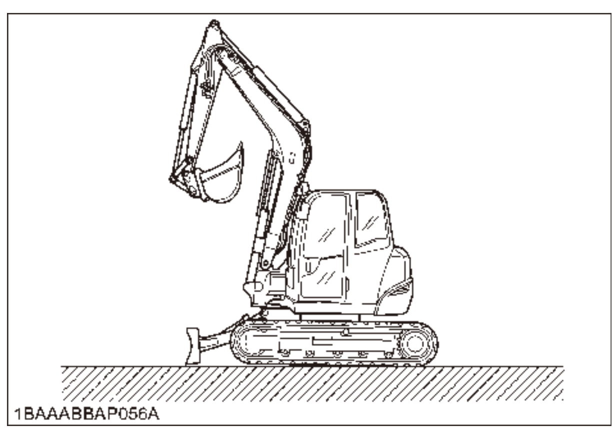
Inspection of hydraulic oil

The hydraulic tank of KX080-3 is pressurized type.
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 : Left end
   Dozer blade : Down to the ground
   Boom :The highest position
   Arm : Crowd to end
   Bucket : Crowd to end



In this way, large amount of the hydraulic oil in the cylinders when checking and replenishing is supposed to return back into the hydraulic tank in order to keep the tank pressurized.

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)			

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	

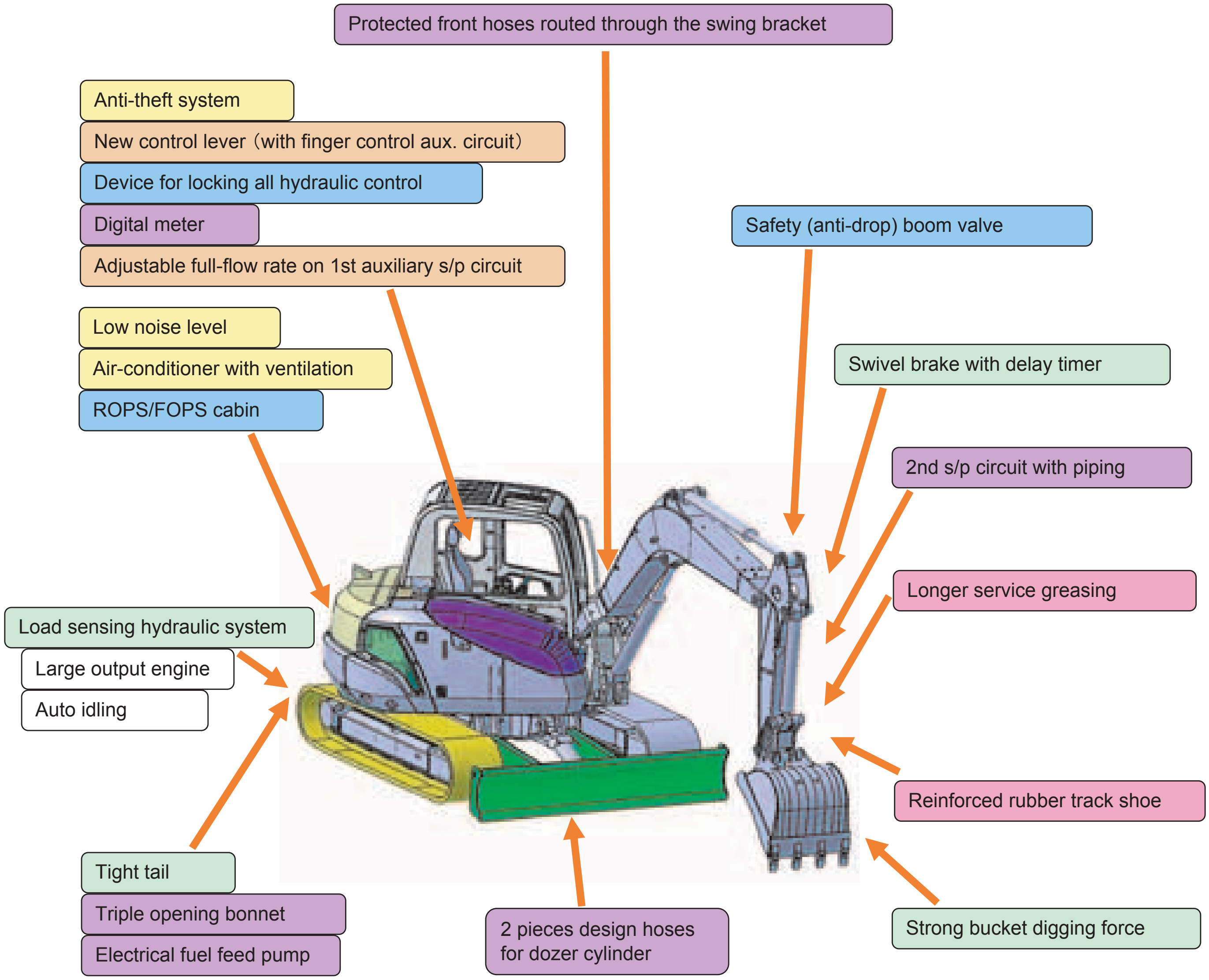
Note: The *-marked hydraulic hoses are Kubota's genuine ultra wear-resistant hoses. Be sure to use these parts.

II. Machine Body

Mechanism Section

A.New Product Feature

a. Feature, quick chart



1. Performance

1-1. Kubota original engine
1-2. Working range and stability
1-3. Digging force
1-4. Lifting capacity
1-5. Load sensing system
1-6. Auto Idling system
1-7. Max. Hydraulic flow adjustfor auxiliary circuit

2. Durability and service ability

2-1. Rubber crawler
2-2. Fuel refilling pump
2-3. Triple opening bonnet

3. Safety

3-1. ROPS / FOPS cabin
3-2. Anti-fall valve
3-3. Anti-theft system

4. Operator’s comfort

Air conditioner
Radio installation kit
Tight tail
Other accessories (Cup holder, etc)

b. Feature points

1. Performance

1-1. Kubota original engine

Kubota original new DI engine contributes for stronger digging force, lower noise level, and lower fuel consumption.

		Kubota KX080-3	Kubota KX251	Takeuchi TB175
Model		V3800DI	V3300-B	4TNE98-TB
Brand		Kubota	Kubota	Yanmar
Output	kW/rpm	47.8/2000	43.4/2300	43.5/2100
	PS/rpm	65/2000	59.0/2300	59.2/2100
Displacement	cc	3769	3318	3318

1-2. Working range and stability

Working range

		Kubota KX080-3	Kubota KX251	Takeuchi TB175	Difference with TB175	
Max. digging reach at ground level	mm	7170	6720	7245	-75mm	-1%
Max. digging depth	mm	4600	4220	4590	10mm	0%
Max. digging height	mm	7300	6665	7290	10mm	0%

Static stability

condition of measurement		long arm w/o QC	std arm w/o QC	long arm w/o QC		
Over side	kgf	734	895	724	10kg	1%
Over front	kgf	1062	1100	942	120kg	13%

QC : Quick coupler

Rear overhang

Track width	mm	2200	2150	2150	50mm	2%
Rear overhang with 90 degree swivel	mm	320	495	645	-325mm	-50%
TTL width	mm	2520	2645	2795	-275mm	-10%

Wide as conventional machine, more stable and compact than conventional machine.

1-3. Digging force

Realized strongest bucket digging force.

		Kubota KX080-3	Kubota KX251	Difference KX251	Takeuchi TB175	Difference
Bucket	kN	65.2	51.5	+27%	52.7	+24%
Arm	kN	38.1	37.2	+2%	36.7	+4%

1-4. Lifting capacity

Keeping better lifting capacity than TB175

Comparison with 1470kg load.

Kubota KX080-3 machine (EU-version)

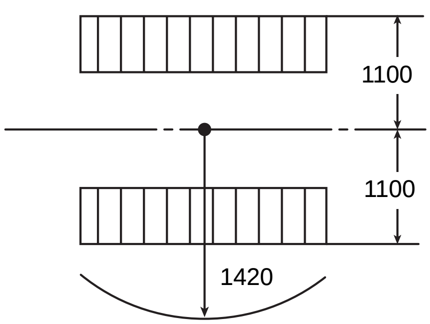
Takeuchi TB175

		Kubota KX080-3	Takeuchi TB175
condition of measurement		long arm w/o QC	long arm w/o QC
Lifting capacity	kgf	1534	1318

QC : Quick coupler

Difference with TB175	
216kgf	16%

(Total width and Overhang)



1) Total width : 2520
2) Over hang : 320

1-5. Load sensing system

Load sensing system enables smoother movement of each actuator. It means pump supplies required oil flow according to the lever stroke.

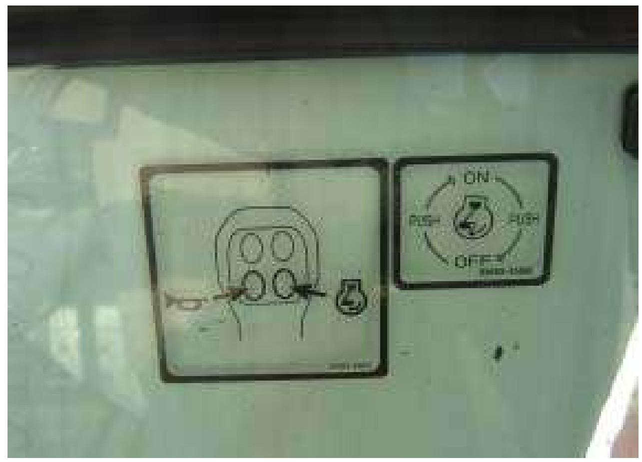
Especially when leveling or lifting, it lets you smoother operation.

Takeuchi TB175 does not adopt this system.

1-6. Auto Idling system

Engine speed will automatically reduced and Increased, operator doesn, have to push the button every time whey they wish...

Kubota KX080-3 machine



Have to push the AI button every time when increase/decrease the engine RPM.

Less possibility to use ??

Takeuchi TB175

It contributes saving cost for fuel

Fuel consumption of KX080-3 machine

9.73 liter (comes from average data of durability test)

Fuel consumption in idling time (1000 rpm)

6.00 liter/hour

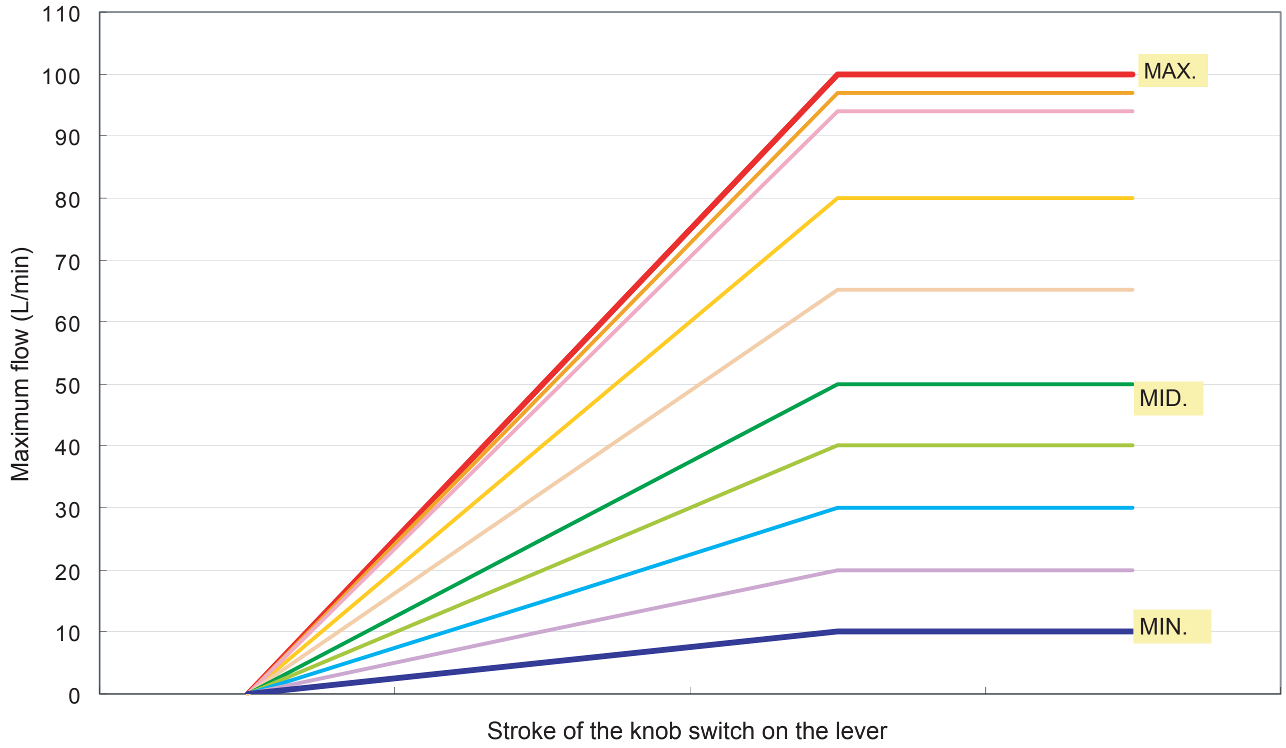
We calculate how AI contributes fuel consumption.
70% with full rpm / 30% with idling (1000rpm)
10 hours per day x 20days.

1-7. Max. Hydraulic flow adjustor auxiliary circuit (SP1)

Combined with Kubota Intelligent Control System, operator can adjust the maximum oil flow of SP1 according to the attachment you use.

Function :
You can adjust the Maximum oil flow of SP1.

Functional image chart



2. Durability and service ability

2-1. Rubber crawler

Kubota newly adopts reinforced rubber crawler, against by cutting edge.

We made a comparison test with TB175 of rubber crawler's durability at our supplier.

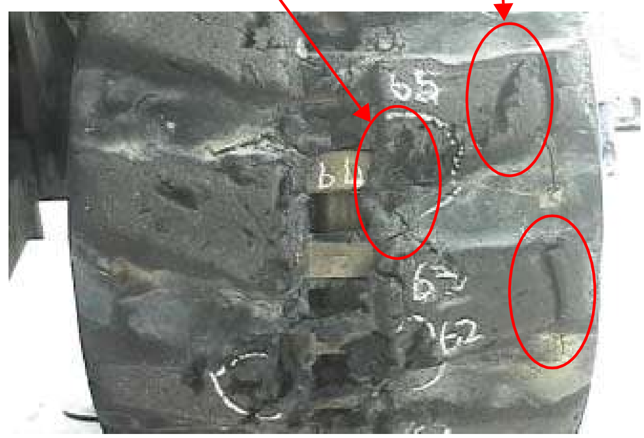
Test condition... 100h traveling test (10 times load = condition of after 1000h)

Comparison test results ;

Kubota KX080-3 machine

Steel code comes out
8 points

Cut on edge
12 points



Takeuchi TB175

2-2. Fuel refilling pump

Fuel refilling pump will be adopted as standard. In addition, we will adopt the auto-stop function.(TB175 does not adopt)

Kubota KX080-3 machine

Takeuchi TB175

2-3. Triple opening bonnet

For the easier access to the components for daily check and maintenance, new 8 ton machine is designed with triplebonnet.

Takeuchi TB175

Kubota KX080-3 machine

3. Safety

3-1. ROPS / FOPS cabin

For the maximum safety for operator, Kubota adopted ROPS/FOPS certified cabin.

ROPS certified cabin

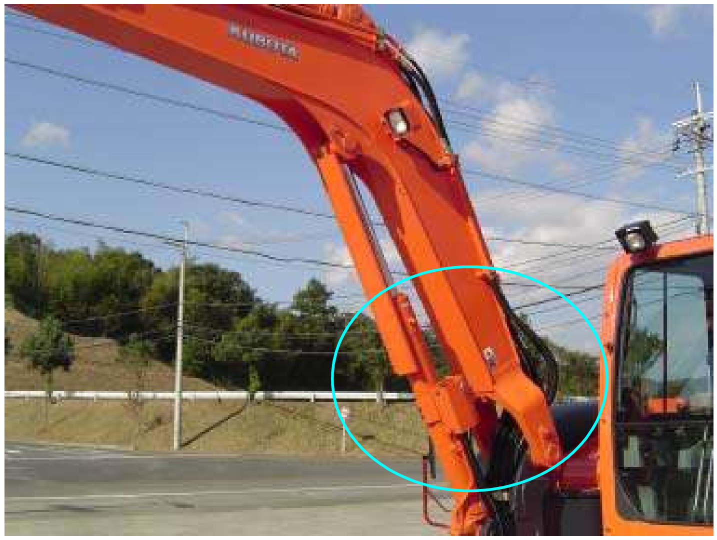
Kubota KX080-3 machine

FOPS certified cabin

Takeuchi TB175

3-2. Anti-fall valve (Holding valve)

Boom anti-fall valve will be adopted as standard.



3-3. Anti-theft system

Same as -3 series introduced in Europe, Kubota original anti-theft system will be equipped as standard.

★Easy operation

No special procedures needed. Just turn the key and the engine can be started.

Red programming key

Black operational key

★Safety / Security

☆With correct key

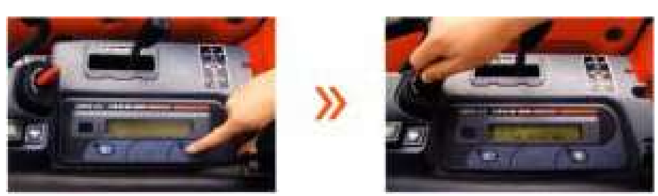
Only programmed keys will enable the engine to start.

☆With wrong key

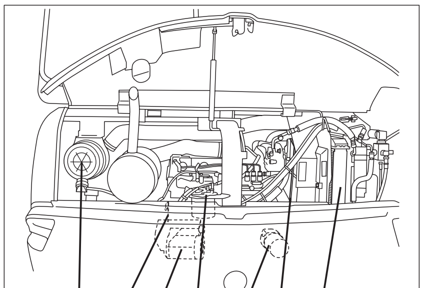
With wrong key, several attempting to start engine will activate the alarm.

★Easy operation

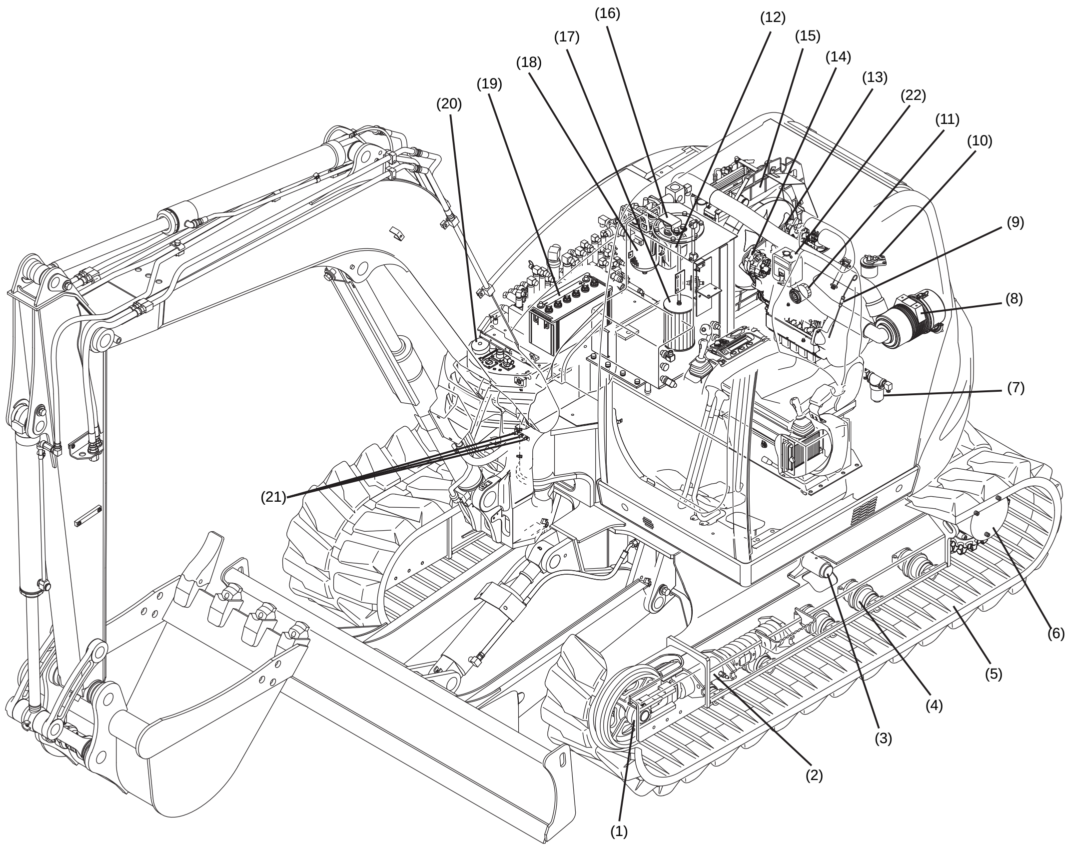
Combined with digital panel, it enables easier programming.



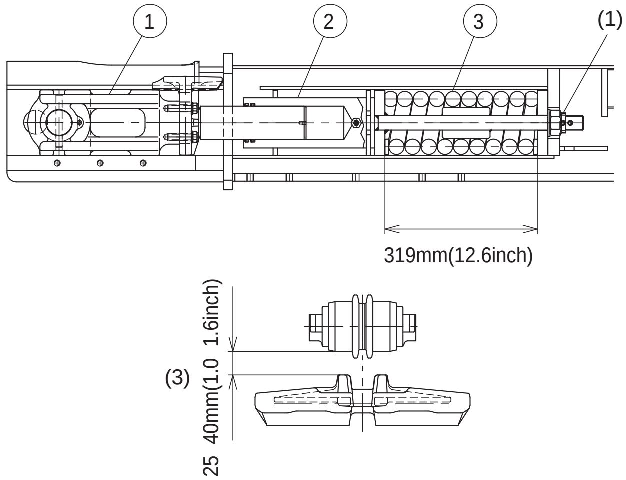
B.Maintenence components layout

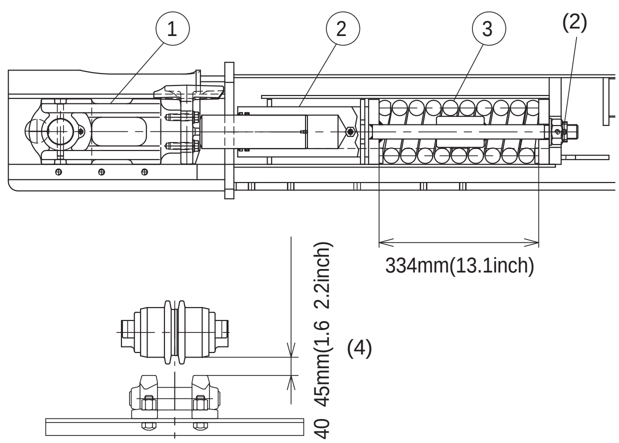


(1) Idler
(2) Grease tension cylinder
(3) Upper roller
(4) Track roller
(5) Rubber track
(6) Travel motor
(7) Pilot filter
(8) Air cleaner
(9) Oil gauge
(10) Fuel filter
(11) Engine oil filter
(12) Reserve tank
(13) Fan belt
(14) Alternator
(15) Radiator
(16) Oil tank
(17) Suction filter
(18) Return filter
(19) Battery
(20) Fuel tank
(21) Grease nipples
(22) Washer tank



C.Rubber track vs Iron track





Rubber track type

No.	Part name
1	Idler assembly
2	Cylinder assembly
3	Spring assembly (rubber)

Iron track type

No.	Part name
1	Idler assembly
2	Cylinder assembly
3	Spring assembly (rubber)

(1) Set the cotter pin into the hole inside.
(2) Set the cotter pin into the hole outside.
(3) Rubber track
(4) Iron track

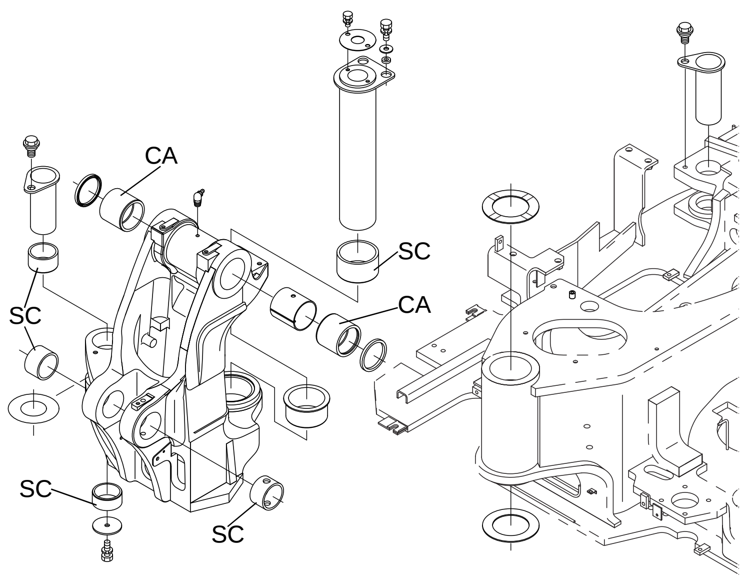
D.Greasing intervals

Greasing intervals are extended.

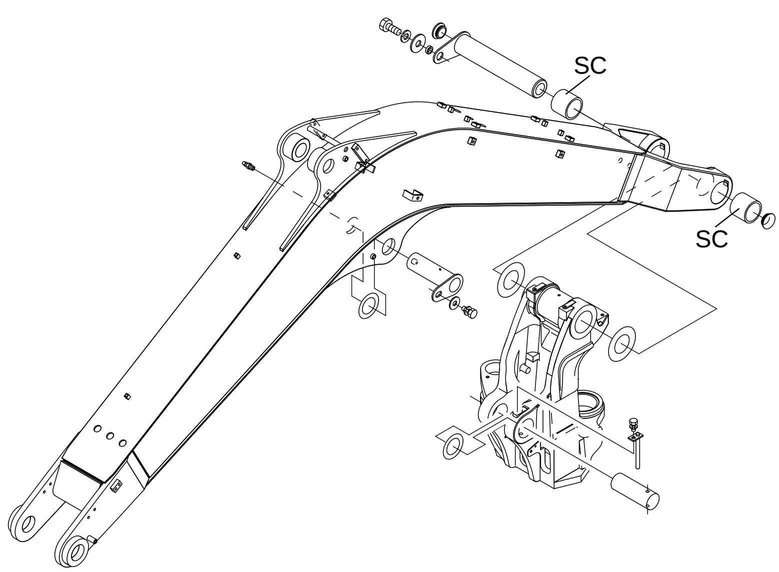
Bushing material has been changed from metal (carbon steel) to copper alloy castings (high strength brass).
High-strength brass is excellent in abrasion resistance.

1. Swivel gear : Every 50 hrs
2. Swivel gear bearing : Every 200 hrs
3. Bucket, bucket link pin and boom swing fulcrum : Every 100 hrs
4. Others : 250 hrs

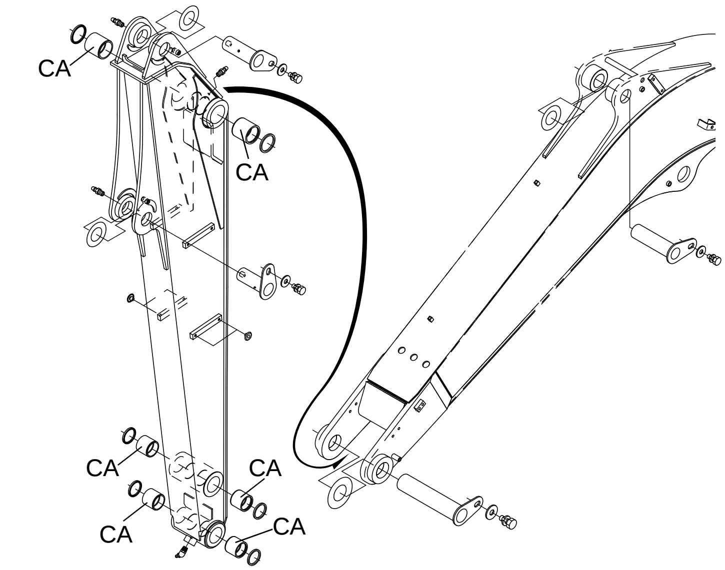
In each rotating area including cylinders, this new material bushing is installed.
In fixed areas, steel bushings are installed. (Materials used for main parts)
CA : Copper alloy casting
SC : Carbon steel



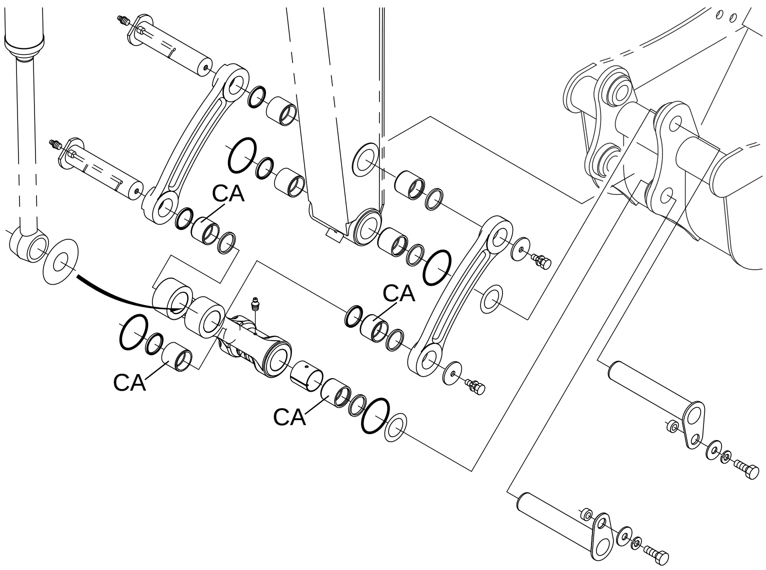
RD809-6645-0	BUSH	CA
RD809-6647-0	BUSH	SC
RD809-6648-0	BUSH	SC
RD809-6642-0	BUSH	SC
RD809-6643-0	BUSH	SC
RD809-6746-0	BUSH	SC
RD809-6747-0	BUSH	SC



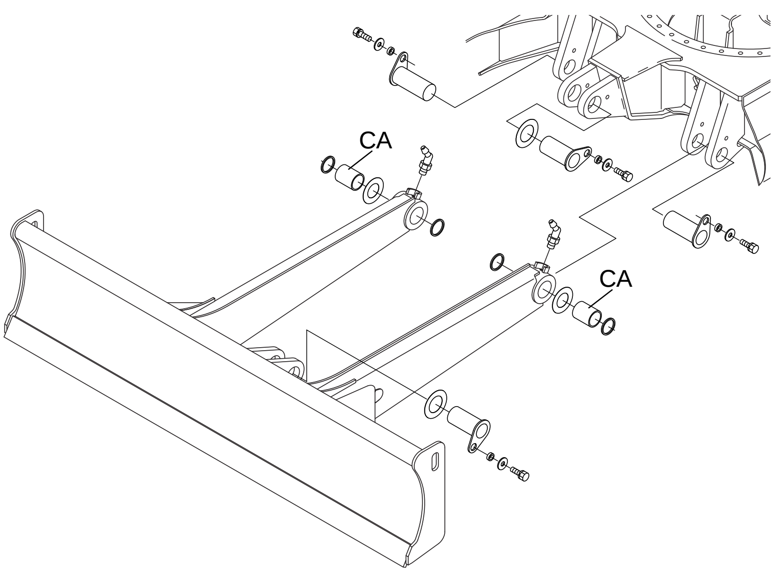
RD809-6659-0	BUSH	CA



RD809-6662-0 BUSH CA
RD809-6665-0 BUSH CA



RD809-6665-0 BUSH CA
RD809-6677-0 BUSH CA



RD809-7442-0 BUSH CA

FYI (For Your Information)

What is the material of bushing?
Answer : High strength brass

According to JIS, this is high strength brass continuous casting class 4.

CAC304C

- C — Continuous castings
- 4 — Class 4
- 3 — High strength brass
- CAC — Copper alloy castings

High-strength brass castings

This material, commonly called manganese brass, is made by adding iron, manganese, aluminum, nickel and tin to Cu60-Zn40 brass for improved mechanical properties and corrosion resistance. Its chemical components, mechanical properties and applications are listed in Table 1 (JIS H5102-1958).
High-strength brass castings are typically used for marine propellers. Highly anti-corrosive classes in particular are widely applied for mechanical parts.
It is molten in skull crucible furnace, electric furnace or reverberating furnace. The melting temperature is 1050-1100 °C.

Table 1 High-strength brass castings (JIS H5102-1979)

Class	Code	Chemical components (%)					Tensile test		Brinell hardness (HB)		Applications
		Cu	Zn	Mn	Fe	Al	Tensile strength	Elongation	10/ 1000	10/ 3000	
Class 4	HBsC4	60.0-65.0	22.0-28.0	2.5-5.0	2.0-4.0	5.0-7.5	Over 755	Over 14	-	Over 250	Stronger, harder and more abrasion-resistant than Class 3, Used for low-speed, high-load sliding parts, bridge bearing members, bearings, bushings, nuts, worm gears, hard-wearing plates, etc.

II Machine Body

Service Section

II-S-2

A. Specifications

a. Machine weight

	Truck	Arm	Unit	KX080-3
Cabin	Rubber	STD.	kgf (lbs)	7960 (17549)
		Long	kgf (lbs)	8020 (17681)
	Steel	STD.	kgf (lbs)	8060 (17769)
		Long	kgf (lbs)	8080 (17813)

b. Major specifications

		Unit		KX080-3	
Engine					
Type				Vertical, water-cooled 4 cycle, 4 cylinders diesel	
Model				V3800DI-E2-BH	
Rated engine output	ISO 3046 Net	kW/rpm		49.7/2000	
		PS/rpm		67.6/2000	
	SAE J1349 Net	HP/rpm			
	SAE J1995 Gross	HP/rpm			
Displacement		cc	in^3	3769	230.0
Dimensions					
Overall length		mm	in	6410	252.4
Overall width		mm	in	2200	86.6
Overall crawler width		mm	in	2200	86.6
Overall height	Canopy	mm	in	-	-
	Cabin	mm	in	2540	100.0
Min. ground clearance		mm	in	386	15.2
Max. digging depth	Canopy	mm	in	-	-
	Cabin	mm	in	4602	181.2
Max. digging height	Canopy	mm	in	-	-
	Cabin	mm	in	7300	287.4
Max. digging radius	Canopy	mm	in	-	-
	Cabin	mm	in	7332	288.7
Max. dumping height	Canopy	mm	in	-	-
	Cabin	mm	in	5252	206.8
Swing angle (left/right)		deg.		67/60	
Travel speed	Low speed	km/h	mph	3.1	1.9
	High speed	km/h	mph	4.6	2.9
Swivel speed		rpm		9.5	
Max. traction force	Low speed	kN	lbf	55.2	12.4
		kgf		5633	
	High speed	kN	lbf	34.3	7.7
		kgf		3500	
Performance					
Tumbler distance		mm	in	2296	90.4
Tread		mm	in	2200	86.6
Crawler width x No. of shoe x pitch (Rubber crawler)		mm		450 x 80 x 154	
		in		17.7 x 86 x 6.1	
Bucket					
Capacity CECE Heaped		m^3	yd^3	0.25	0.327
Width		mm	in	800	31.5
Blade					
Width x height		mm	in	2200 x 500	86.6 x 19.7
Life above GL / below GL		mm	in	491 / 502	19.3 / 19.8

c. Lever stroke and operating force

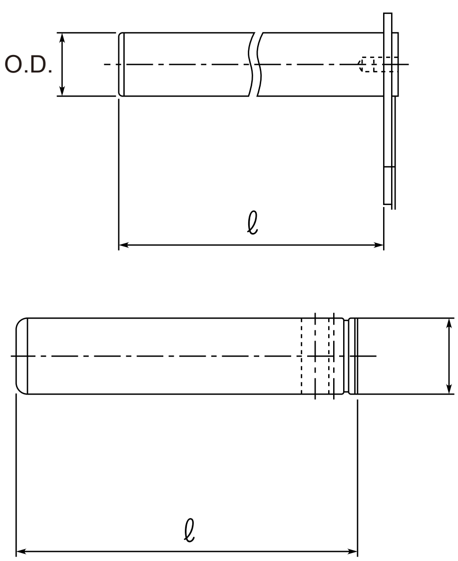
		Unit	KX080-3		Remarks
Boom	Stroke	mm	100	100	Up/Down
		in.	3.9	3.9	
	Force	N	14.7	14.7	
		kgf	1.5	1.5	
		lbf	3.3	3.3	
Arm	Stroke	mm	100	100	Crowd/Dump
		in.	3.9	3.9	
	Force	N	15.7	16.7	
		kgf	1.6	1.7	
		lbf	3.5	3.7	
Bucket	Stroke	mm	80	80	Crowd/Dump
		in.	3.1	3.1	
	Force	N	12.7	12.7	
		kgf	1.3	1.3	
		lbf	2.9	2.9	
Swivel	Stroke	mm	80	80	Left/Right
		in.	3.1	3.1	
	Force	N	12.7	12.7	
		kgf	1.3	1.3	
		lbf	2.9	2.9	
Travel(Left/Right)	Stroke	mm	80	80	F/R
		in.	3.1	3.1	
	Force	N	18.6	18.6	
		kgf	1.9	1.9	
		lbf	4.2	4.2	
Blade	Stroke	mm	73	72	Up/Down
		in.	2.9	2.8	
	Force	N	14.7	24.5	
		kgf	1.5	2.5	
		lbf	3.3	5.5	
Acceleration	Force	N	-	-	This machine has acceleration dial, not lever
		kgf	-	-	
		lbf	-	-	
Swing pedal	Force	N	56.9	56.9	Left/Right
		kgf	5.8	5.8	
		lbf	12.8	12.8	
Safety lock lever (Left)	Force	N	-	-	Up/Down
		kgf	-	-	
		lbf	-	-	

d. Dimensions of parts :

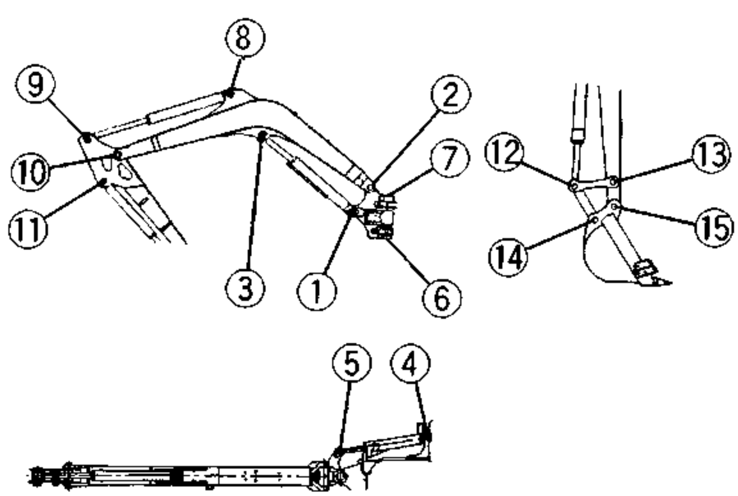
(1) Front pins

No.		Unit	KX080-3α	Position
1	Pin diameter x length	mm in.	Φ70 x 200 Φ2.76 x 7.87	Swing bracket -Boom cylinder
2	Pin diameter x length	mm in.	Φ80 x 437 Φ3.15 x 17.20	Swing bracket - Boom
3	Pin diameter x length	mm in.	Φ70 x 226 Φ2.76 x 8.90	Boom - Boom cylinder
4	Pin diameter x length	mm in.	Φ70 x 183 Φ2.76 x 7.20	Swivel frame -Swing cylinder
5	Pin diameter x length	mm in.	Φ70 x 168 Φ2.76 x 6.61	Swing bracket - Swing cylinder
6	Pin diameter x length	mm in.	Φ100 x 474 Φ3.94 x 18.66	Swing bracket - Swivel frame(Lower)
8	Pin diameter x length	mm in.	Φ60 x 226 Φ2.36 x 8.90	Boom - Arm cylinder
9	Pin diameter x length	mm in.	Φ60 x 175 Φ2.36 x 6.89	Arm - Arm cylinder
10	Pin diameter x length	mm in.	Φ70 x 332 Φ2.76 x 13.07	Boom - Arm
11	Pin diameter x length	mm in.	Φ60 x 151 Φ2.36 x 5.94	Arm - Bucket cylinder
12	Pin diameter x length	mm in.	Φ60 x 284 Φ2.36 x 11.18	Bucket links 1, 2, 3 - Bucket cylinder"
13	Pin diameter x length	mm in.	Φ60 x 284 Φ2.36 x 11.18	Arm - Bucket links 2, 3
14	Pin diameter x length	mm in.	Φ60 x 333 Φ2.36 x 13.11	Bucket - Bucket link 1
15	Pin diameter x length	mm in.	Φ60 x 333 Φ2.36 x 13.11	Arm - Bucket

Note : Service limit of pin and bushing is 1.0mm less and more than original diameter respectively.



ℓ : length

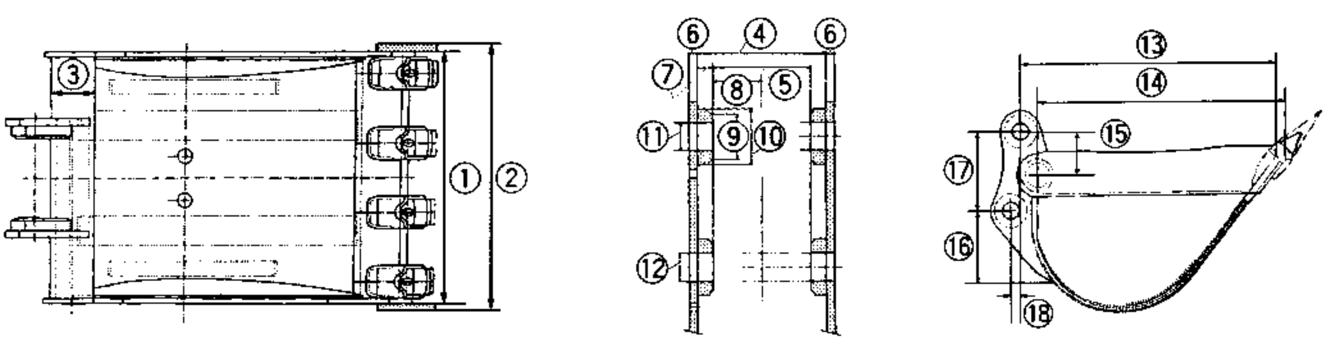


(2) Bucket

1) Bucket dimensions

No.	Unit		KX080-3
1	mm	676	
	in.	26.61	
2	mm	700	
	in.	27.56	
3	mm	Φ130 x t10	
	in.	Φ5.12 x t0.39	
4	mm	290	
	in.	11.42	
5	mm	200	
	in.	7.87	
6	mm	19	
	in.	0.75	
7	mm	45	
	in.	1.77	
8	mm	100	
	in.	3.94	
9	mm	Φ105	
	in.	Φ4.13	
10	mm	Φ120	
	in.	Φ4.72	
11	mm	Φ60	+0.10 +0.05
	in.	Φ2.36	+0.004 +0.002
12	mm	Φ60	+0.10 +0.05
	in.	Φ2.36	+0.004 +0.002
13	mm	890.5	
	in.	35.06	
14	mm	783	
	in.	30.83	
15	mm	135	
	in.	5.31	
16	mm	165	
	in.	6.50	
17	mm	297	
	in.	11.69	
18	mm	44	
	in.	1.73	

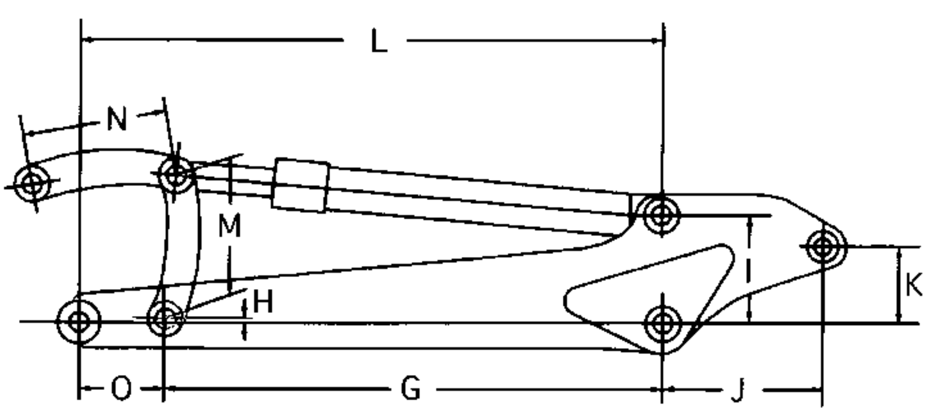
NOTE : BUCKET FOR STANDARD ARM,

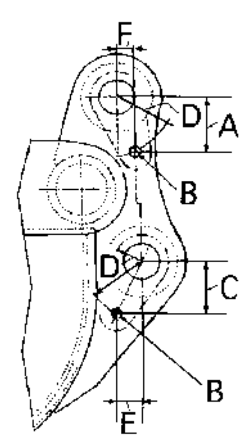


2) Bucket installation relevant dimensions

No.	Unit	KX080-3 Standard arm	KX080-3 Lomg arm
A	mm	-	-
	in.	-	-
B	mm	M20 x 1.5	←
	in.		
C	mm	90	←
	in.	3.54	←
D	mm	90	←
	in.	3.54	←
E	mm	0.0	←
	in.	0.00	←
F	mm	30.0	←
	in.	1.18	←
G	mm	1490	1840
	in.	58.66	72.44
H	mm	13	←
	in.	0.51	←
I	mm	370	←
	in.	14.57	←
J	mm	451	←
	in.	17.76	←
K	mm	279	←
	in.	10.98	←
L	mm	1745	←
	in.	68.70	←
M	mm	428	←
	in.	16.85	←
N	mm	403	←
	in.	15.87	←
O	mm	260	←
	in.	10.24	←

NOTE : KUBOTA JAPAN BUCKET, STANDARD ARM





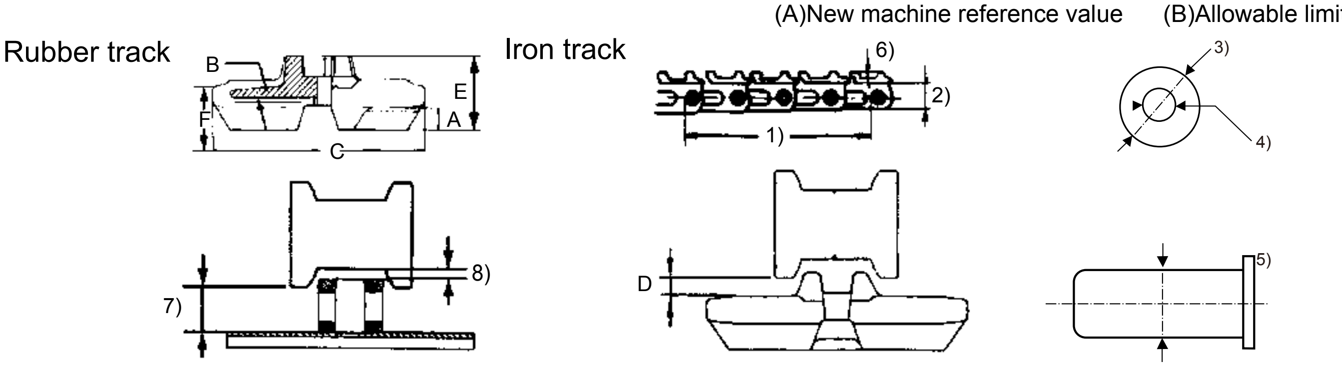
(3) Rubber crawler

	Unit	KX080-3
Crawler ass'y code No.		RD809-2231-0
Identification mark (Core metal rapping position)		∞
A : Lug height	mm in.	30 1.18
B : Link height	mm in.	52 2.05
C : Crawler width	mm in.	450 17.72
D : Crawler sag distance	mm in.	25 to 40 0.98 to 1.57
E : Crawler height	mm in.	105.5 4.15
Number of core metal		76
Circumference	mm in.	6194 243.9
Core metal pitch	mm in.	81.5 3.21
Steel coad strength	N/piece kgf/piece lbf/piece	16000 1632 3597
Number of steel cord		20
Rubber thickness (Regular / Joint part)	mm in.	52 2.05

(4) Steel crawler

	Unit	KX080-3(STD)	KX080-3(Wide)
Crawler ass'y code No.		RD809-2220-0	RD809-2240-0
Crawler width	mm in.	450 17.72	350.0 13.78
1) 4 links length	mm in.	616.0 24.25	← ←
2) Height	mm in.	74.0 2.91	← ←
3) Bushing O. D. (A)/(B)	mm in.	Φ41.26 / Φ40.26 Φ1.62 / Φ1.59	← ←
4) Bushing I. D. (A)/(B)	mm in.	Φ24.0 / Φ25.0 Φ0.94 / Φ0.98	← ←
5) Master pin O. D. (A)/(B)	mm in.	Φ24.0 / Φ23.0 Φ0.94 / Φ0.91	← ←
6) Grouser height	mm in.	20.0 0.79	← ←
7) Crawler sag distance	mm in.	40 to 45 1.57 to 1.77	← ←
Number of links		80	←

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

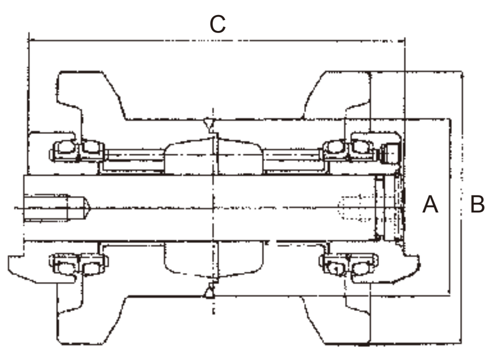


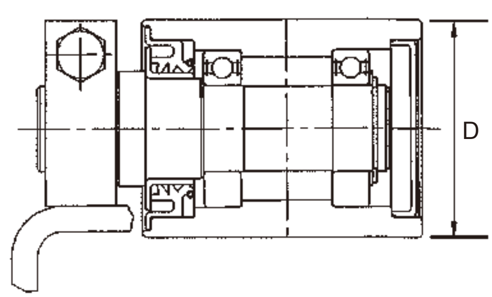
(5) Track roller, idler, sprocket

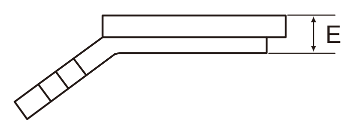
		Unit	KX080-3	Remark
A : Guide width	(A)/(B)	mm in.	Φ104 / Φ99 Φ4.09 / Φ3.89	
B : Outer diameter	(A)/(B)	mm in.	Φ132 / Φ128 Φ5.20 / Φ5.04	
C : Roller width		mm in.	228.5 / 220.5 9.00 / 8.68	
D : Upper roller diameter	(A)/(B)	mm in.	Φ80 / Φ76 Φ3.15 / Φ2.99	
E : Sliding plate thickness	(A)/(B)	mm in.		

		Unit	KX080-3	Remark
1) Idler O.D.	(A)/(B)	mm in.	Φ390 / Φ382 Φ15.35 / Φ15.05	
2) Guide width	(A)/(B)	mm in.	38 / 36 1.50 / 1.42	
3) Idler width	(A)/(B)	mm in.	98 / 93 3.86 / 3.67	
4) Sprocket wheel O.D.	(A)/(B)	mm in.	Φ493 / Φ468 Φ19.41 / Φ18.44	
5) Sprocket wheel width	(A)/(B)	mm in.	39 / 37 1.54 / 1.46	

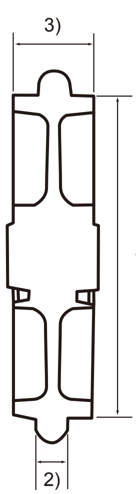
(A)New machine reference value
(B)Allowable limit

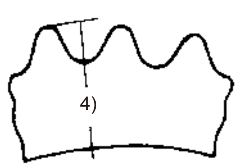


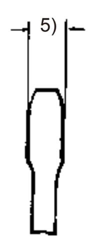




(A)New machine reference value
(B)Allowable limit

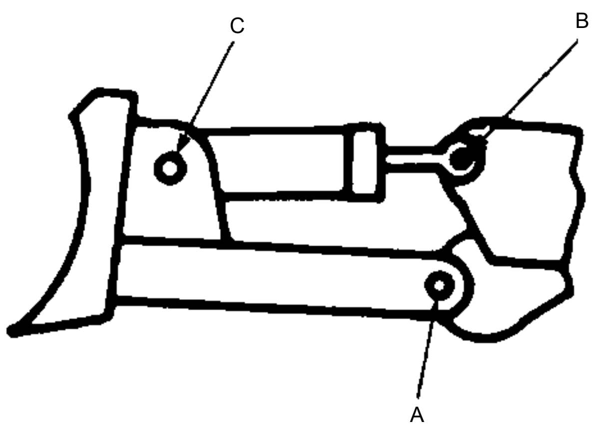


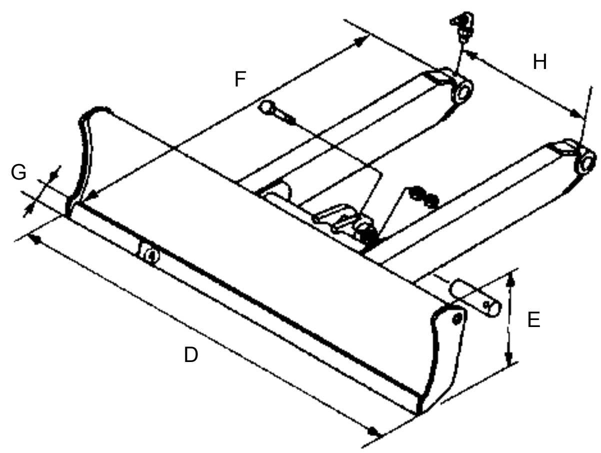




(6) Blade

	Unit	KX080-3 STD	Remark
Blade ass'y code No.		RD809-7441-0	
A : Pin diameter x length	mm in.	Φ60 x 167 Φ2.36 x 6.57	Blade am -Track frame
B : Pin diameter x length	mm in.	Φ70 x 147 Φ2.76 x 5.79	Blade cylinder -Track frame
C : Pin diameter x length	mm in.	Φ70 x 147 Φ2.76 x 5.79	Blade cylinder -Blade
D : Blade width	mm in.	2200 86.61	
E : Blade height	mm in.	500.0 19.69	
F : Blade length	mm in.	1448 57.01	
G : Blade tip plate height x thickness	mm in.	90 x 16 3.54 x 0.63	
H : Length between blade arms	mm in.	600 23.62	





(7) Parts weight

		Unit	KX080-3	Remarks
Truck frame		kgf	867	
		(lbs)	(1911.4)	
Swivel frame		kgf	970	
		(lbs)	(2137.4)	
Swing bracket		kgf	176	
		(lbs)	(388.0)	
Boom		kgf	362	
		(lbs)	(798.1)	
Arm	STD.	kgf	161	
		(lbs)	(354.9)	
	Long	kgf	182	
		(lbs)	(401.2)	
Bucket	For STD. arm	kgf		Japan STD.Bucket
		(lbs)		
	For Long arm	kgf		
		(lbs)		
Blade		kgf	295	
		(lbs)	(650.4)	
Weight (left)		kgf	-	
		(lbs)	-	
Weight (right)		kgf	-	
		(lbs)	-	
Weight (rear)		kgf	870	
		(lbs)	(1918.0)	
Rubber crawler		kgf		
		(lbs)		
Steel crawler (STD)		kgf		
		(lbs)		
Steel crawler (Wide)		kgf	-	
		(lbs)	-	
Arch frame 1		kgf	79	
		(lbs)	(174.2)	
Arch frame 2		kgf	8	
		(lbs)	(17.0)	
Engine		kgf		Dry weight
		(lbs)		
Hydraulic tank		kgf	52	With filter
		(lbs)	(114.4)	
Fuel tank		kgf	8	
		(lbs)	(17.6)	
Swivel bearing		kgf	113	
		(lbs)	(249.1)	
Battery		kgf	30	
		(lbs)	(66.1)	
Truck roller		kgf	12.0	
		(lbs)	(26.5)	
Upper roller		kgf		
		(lbs)		
ROPS/FOPS canopy		kgf	-	
		(lbs)	-	
ROPS/FOPS cabin		kgf	308	
		(lbs)	(679.0)	
Hydraulic pump		kgf	47	
		(lbs)	(103.6)	
Traveling motor		kgf	81	
		(lbs)	(178.6)	
Swivel motor		kgf	80	
		(lbs)	(176.4)	

	Unit	KX080-3	Remarks
Sprocket	kgf	22.0	
	(lbs)	(48.5)	
Idler ass'y	kgf	67	
	(lbs)	(147.7)	
Control valve	kgf	94	Without adaptors
	(lbs)	(207.2)	
Boom cylinder	kgf		Canopy / Cabin
	(lbs)		
Arm cylinder	kgf		
	(lbs)		
Bucket cylinder	kgf		
	(lbs)		
Swing cylinder	kgf	76	
	(lbs)	(168.4)	
Blade cylinder	kgf	56	
	(lbs)	(122.6)	
Rotary joint	kgf	42	
	(lbs)	(92.6)	

The above weight list is based on calculation and slightly different from actual ones.

e. Quality specification

KX080-3: KE, KUK, KBM Version

Machine specification : Auxiliary port,Wrist rest,STD-arm,japan-cab,KBM-bucket

No		Specificatios Items			Unit	KX080-3	Remarks
Q1		Main Speed JIS A8404					
1	1	Machine size	Total length (Transport)		mm	6410 ± 128	
					inch	252.4 ± 5.0	
	2		Total width		mm	2200 ± 22	
					inch	86.6 ± 0.9	
	3		Total height (Canopy)		mm	-	Include grouser height
					inch	-	
	4		Total height (Cabin)		mm	2540 ± 25	
					inch	100.0 ± 25	
2	1	Weight	Machine weight (Canopy)		kg	-	Fuel tank:Full
					lbs	-	
	2		Machine weight (Cabin)		kg	7960 ± 159	
					lbs	17548.6 ± 350.5	
3	1	Performance	Swivel speed	L	rpm	9.5 ± 1.0	
	2			R	rpm	9.5 ± 1.0	
	3		Travel speed	Rubber F1	km/h	3.1 ± 0.3	Traveling stance: Engine Max.speed Oil temp. : 50±5°C (122±9°F)
					mph	1.93 ± 0.19	
	4			Rubber F2	km/h	4.6 ± 0.5	
					mph	2.86 ± 0.31	
	5			Steel F1	km/h	±	
					mph	±	
	6			Steel F2	km/h	±	
					mph	±	
	7		Gradeability		deg	30	
4	1	Rear end min. turning radius			mm	1420 ± 28	
					inch	55.9 ± 1.1	
	2	Swivel frame rear ground clearance			mm	728 ± 15	
					inch	28.7 ± 0.6	
	3	Tumbler center distance			mm	2296 ± 69	
					inch	90.4 ± 2.7	
	4	Crawler total length			mm	2898 ± 87	
					inch	114.1 ± 3.4	
	5	Crawler total width			mm	2200 ± 44	
					inch	86.6 ± 1.7	
	6	Min. ground clearance			mm	386 ± 12	
					inch	15.2 ± 0.5	

No		Specificatios Items			Unit	KX080-3	Remarks
5	1	Front attachment	Bucket heaped capacity	CECE	m^3	±	
					yd^3	±	
	2			SAE, JIS	m^3	0.162 ± 0.009	Slope angle: 1x1
					yd^3	0.212 ± 0.012	
	2		Bucket struck capacity		m^3	0.162 ± 0.006	
					yd^3	0.212 ± 0.008	
	3		Bucket width		mm	700 ± 14	Without side cutter
					inch	27.6 ± 0.6	
	4		Swing angle	Canopy L	deg	-	
	5			Canopy R	deg	-	
	6			Cabin L	deg	67 ± 2	
	7			Cabin R	deg	60 ± 2	
	8		Max. digging radius		mm	7332 ± 110	
					inch	288.7 ± 4.3	
	9		Ground level Max. digging radius		mm	7173 ± 108	
					inch	282.4 ± 4.3	
	10		Ground level Min. finish radius		mm	2091 ± 42	Bucket bottom horizontal
					inch	82.3 ± 1.7	
	11		Max. digging depth		mm	4602 ± 92	
					inch	181.2 ± 3.6	
	12		Max. vertical digging depth		mm	3674 ± 110	
					inch	144.6 ± 4.3	
	13		Max. digging height	Canopy	mm	-	
					inch	-	
	14			Cabin	mm	7300 ± 146	
					inch	287.4 ± 5.7	
	15		Max. dump height	Canopy	mm	-	
					inch	-	
	16			Cabin	mm	5252 ± 105	
					inch	206.8 ± 4.1	
	17		Max. dump height (Arm vertical)	Canopy	mm	-	
					inch	-	
	18			Cabin	mm	1774 47	
					inch	69.8 1.9	
5	19	Front attachment	Mini. turning radius	Canopy	mm	-	
					inch	-	
	20			Cabin	mm	2490 ± 75	
					inch	98.0 ± 3.0	
	21		Mini. turning radius (Left swing)	Canopy	mm	-	
					inch	-	
	22			Cabin	mm	1997 ± 60	
					inch	78.6 ± 2.4	
6	1	Blade	Width		mm	2200 ± 5	
					inch	86.6 ± 0.2	
	2		Height		mm	500 ± 10	
					inch	19.7 ± 0.4	
	3		Max. lift above GL		mm	491 ± 50	
					inch	19.3 ± 2.0	
	4		Max. below GL		mm	502 ± 50	
					inch	19.8 ± 2.0	

No		Specificatios Items		Unit	KX080-3	Remarks
Q2		Main Specs JIS A8404				
1	1	Bucket tooth slaggish		mm		Without shockless F=30 kgf (66 lbf)
				inch		
	2	Front boom lateral declination		mm	10	
				inch	0.39	
	3	Blade's lateral declination		mm	10	
				inch	0.39	
2	1	Clearance between bucket crow and boom cylinder cover		mm	76 ± 19	From swivel center
				inch	3.0 ± 0.7	
	2	(Min.value; reference)		mm		
				inch		
3	1	Approach angle		deg	32 ± 3	
4	1	Crawler height		mm	602 ± 12	Include grouser on the spocket
				inch	23.70 ± 0.47	
	2	Max. crawler height		mm	634 ± 13	
				inch	24.96 ± 0.51	
Q3		Engine performance				
1	1	Max, engine rpm	no load	rpm	2000	
	2		1 pump relief	rpm	-	
	3		2 pump relief	rpm	-	
	4		3 pump relief	rpm	-	Boom, arm, swivel
	5		2 pump relief	rpm		
	6		Blade+2 pump relief	rpm		
2	1	Idling RPM	Canopy	rpm		
	2		Cabin	rpm	1050 ± 50	
Q4		Travelling performance				
1	1	Travel motor block performance	L	mm		20 deg. slope, 10min
				inch		
	2	Travel motor block performance	R	mm		
				inch		
2	1	Max, Traction force	F1	kgf.m	5633	Slip. This value is 70% of absolute traction force.
				kN.m	55.2	
				ft.lbf	40742	
	2		F2	kgf.m	3500	Relief. This value is 60% of absolute traction force.
				kN.m	34.30	
				ft.lbf	25314	
3	1	Travel straightness	F1	mm	600	10m distance Engine Max. speed
				inch	23.62	
	2		F2	mm	600	
				inch	23.62	
	3		Blade F1	mm	600	Blade up & down 10m distance
				inch	23.62	
	4		Blade R1	mm	600	
				inch	23.62	
4	1	Track shoe sag distance	Steel	mm	40 - 55	
				inch	1.57 - 2.17	
	2		Rubber	mm	25 - 40	
				inch	0.98 - 1.57	

No		Specificatios Items			Unit	KX080-3	Remarks
Q5		Work performance					
1	1	Boom lifting capacity			kgf	1529.6	Front end, Arm extend bucket crowd, at tooth
					kN	15.0	
					lbf	3372.1	
1	2	Arm digging force			kgf	3885.1	Bucket tooth root
					kN	38.1	
					lbf	8565.2	
	3	Bucket digging force			kgf	6648.6	Machine stance to JIS bucket tooth root
					kN	65.2	
					lbf	14657.5	
	4	Blade force		down	kgf		Cutting edge down force at ground level
					kN		
					lbf		
2	1	Boom speed	Canopy	up 1st	sec.	-	Oil temp. 50±5°C (122±9°F) Ground to max. height (exclude cushioning)
	2			up 2nd	sec.	-	
	3			down	sec.	-	
	4			down	sec.	-	
	5		Cabin	up 1st	sec.	3.4 ± 0.3	
	6			up 2nd	sec.	-	
	7			down	sec.	3.4 ± 0.3	
	8			down	sec.	-	
3	1	Arm speed		crowd	sec.	3.7 ± 0.3	
	2			dump	sec.	3.5 ± 0.3	
4	1	Bucket speed		crowd	sec.	3.5 ± 0.3	Oil temp. 50±5°C (122±9°F)
	2			dump	sec.	2.2 ± 0.3	
5	1	Blade speed		up 1st	sec.	±	Ground to max. up
	2			up 2nd	sec.	2.2 ± 0.3	Max. down to max. up
	3			down	sec.	±	Max. up to ground
	4			down	sec.	2.9 ± 0.3	Max. up to max. down
6	1	Arm cylinder cavitation			mm	5	Oil temp. 95±5°C(203±9°F) Engine speed : 1300 rpm
					inch	0.20	
7	1	Max. digging height radius	Canopy		mm	-	
					inch	-	
	2		Cabin		mm	3388 ± 339	
					inch	133.39 ± 13.35	
	3	Max. dump height radius	Canopy		mm	-	at bucket pin
					inch	-	
	4		Cabin		mm	3260 ± 196	
					inch	128.35 ± 7.72	
7	5	Bucket bottom height at arm vertical	Canopy		mm	-	Bucket horizontal
					inch	-	
	6		Cabin		mm	2271 ± 68	
					inch	89.41 ± 2.68	
	7	Bucket wrist angle			deg.	178.6 +3.4,-2.6	
Q6		Swivel, swing performance					
1	1	Swivel torque		L	kgf.m	2104	Arm extend, Slow/Quick operation
					kN.m	20.6	
					ft.lbf	15218	
	2			R	kgf.m	2104	
					kN.m	20.6	
					ft.lbf	15218	
2	1	Swivel capable slope angle		L	deg.	17	Bucket load=JIS heapedx1.8
	2			R	deg.	17	

No		Specificatios Items			Unit	KX080-3	Remarks
3	1	Swivel block performance		L	deg.		Bucket loaded at heaped. Slope angle at 20° for 1 min. Engine idling, lever lock released.
	2			R	deg.		
	3			L	deg.		
	4			R	deg.		
4	1	Swivel start-up speed		L	sec.	2.9 ± 0.3	0~90 deg. swivel
	2			R	sec.	2.9 ± 0.3	
5	1	Swing speed	Canopy	L	sec.	-	
	2			R	sec.	-	
	3		Cabin	L	sec.	6.9 ± 0.3	
	4			R	sec.	8.1 ± 0.3	
6	1	Swing Lock		Swivel R&L	mm	10	90 deg-swivel, 100 times actual digging cylinder dislocation
					inch	0.39	
	2	Reciprocating motion	L / R	Swing	mm		90 deg-swivel, 100 times
					inch		
Q7	Hydraulic performance						
1	1	Relief pressure setting		P1	kgf/cm²	280 ± 5.0	At pump delivery 50±5°C(122±9°F)
					MPa	27.5 ± 0.5	
					bar	275 ± 5.0	
					psi	3983 ± 71	
	2			P2	kgf/cm²	280 ± 5.0	
					MPa	27.5 ± 0.5	
					bar	275 ± 5.0	
					psi	3983 ± 71	
	3			P3	kgf/cm²	210 ± 5.0	
					MPa	20.6 ± 0.5	
					bar	206 ± 5.0	
					psi	2987 ± 71	
	4			P4	kgf/cm²	40 ± 5.0	
					MPa	3.9 ± 0.5	
					bar	39.2 ± 5.0	
					psi	569 ± 71	
2	1	Cylinder oil sealing capacity	Boom	50±5°C (122±9°F)	mm	20	Arm extend, Bucket height 1m, 10 min. Bucket load=JIS heapedx1.8
					inch	0.79	
	2			95±5°C (203±9°F)	mm	20	
					inch	0.79	
	3		Arm	50±5°C (122±9°F)	mm	11	
					inch	0.43	
	4		Bucket	50±5°C (122±°F)	mm	10	
					inch	0.39	
	5		Blade	50±5°C (122±9°F)	mm	20	Arm vertical, blade cylinder extended for 10 min. engine stop."
					inch	0.79	
3	1	Boom cushioning performance		30°C (86°F)	sec.	3	Arm extended, bucket crowd with no road. Engine Max. speed."
	2			50°C (122°F)	sec.	0.4 - 1.3	
	3			80°C (176°F)	sec.	0.3	
Q8		Lever operating force & stroke					

No		Specificatios Items			Unit	KX080-3		Remarks
1	1	Boom lever operating force		UP	kgf	1.5	-0.5,+0.5	Measuring point : 20 mm lower from the lever top. Pilot lever with engine Max. speed.
					N	14.7	-4.7,+5.3	
					lbf	3.3	-1.1,+1.2	
	2			down	kgf	1.5	-0.5,+0.5	
					N	14.7	-4.7,+5.3	
					lbf	3.3	-1.1,+1.2	
1	3	Arm lever		crowd	kgf	1.6	-1.1,+2.1	Dump & crowd
					N	15.7	-4.7,+5.3	
					lbf	3.5	-1.1,+1.2	
	4			dump	kgf	1.7	-1.1,+2.1	
					N	16.7	-4.7,+5.3	
					lbf	3.8	-1.1,+1.2	
	5	Bucket lever		crowd	kgf	1.3	-1.1,+2.1	Dump & crowd
					N	12.7	-4.7,+5.3	
					lbf	2.9	-1.1,+1.2	
	6			dump	kgf	1.3	-1.1,+2.1	
					N	12.7	-4.7,+5.3	
					lbf	2.9	-1.1,+1.2	
	7	Swivel lever		R	kgf	1.3	-1.1,+2.1	Left & right
					N	12.7	-4.7,+5.3	
					lbf	2.9	-1.1,+1.2	
	8			L	kgf	1.3	-1.1,+2.1	
					N	12.7	-4.7,+5.3	
					lbf	2.9	-1.1,+1.2	
	9	Blade lever		up	kgf	1.5	-0.5,+0.5	Up & down Measuring point : 15 mm lower from the lever top
					N	14.7	-4.7,+5.3	
					lbf	3.3	-1.1,+1.2	
	10			down	kgf	2.5	-0.5,+0.6	
					N	24.5	-4.5,+5.5	
					lbf	5.5	-1.0,+1.2	
	11	Travel lever	L	Forward	kgf	1.9	-0.5,+0.6	Measuring point : 20 mm lower from the lever top.
					N	18.6	-4.6,+5.4	
					lbf	4.2	-1.0,+1.2	
	12			Back	kgf	1.9	-0.5,+0.6	
					N	18.6	-4.6,+5.4	
					lbf	4.2	-1.0,+1.2	
	13		R	Forward	kgf	1.9	-0.5,+0.6	
					N	18.6	-4.6,+5.4	
					lbf	4.2	-1.0,+1.2	
	14			Back	kgf	1.9	-0.5,+0.6	
					N	18.6	-4.6,+5.4	
					lbf	4.2	-1.0,+1.2	

No		Specificatios Items			Unit	KX080-3			Remarks
1	15	Accelerator lever		up	kgf		-		This machine has accel dial not a lever.
					N		-		
					lbf		-		
	16			down	kgf		-		
					N		-		
					lbf		-		
	17	Swing pedal		R	kgf	5.8	±	-1.0,+1.0	Pedal edge. 45 degree inward
					N	56.9	±	-9.9,+10.1	
					lbf	12.8	±	-2.2,+2.3	
	18			L	kgf	5.8	±	-1.0,+1.1	
					N	56.9	±	-9.9,+10.1	
					lbf	12.8	±	-2.2,+2.3	
	19	Safety lock lever	R	up	kgf		-		Up & down
					N		-		
					lbf		-		
	20			down	kgf		-		
					N		-		
					lbf		-		
	21	Safety lock lever	L	up	kgf		±		Up & down
					N		±		
					lbf		±		
	22			down	kgf		±		
					N		±		
					lbf		±		
	23	Travel Hi-Lo change			kgf		-		This machine has a switch
					N		-		
					lbf		-		

No		Specificatios Items			Unit	KX080-3	Remarks
2	1	Boom lever stroke		up	mm	100 ± 10	
					inch	3.94 ± 0.39	
	2			down	mm	100 ± 10	
					inch	3.94 ± 0.39	
	3	Arm lever stroke		crowd	mm	100 ± 10	
					inch	3.94 ± 0.39	
	4			dump	mm	100 ± 10	
					inch	3.94 ± 0.39	
	5	Bucket lever stroke		crowd	mm	80 ± 10	
					inch	3.15 ± 0.39	
	6			dump	mm	80 ± 10	
					inch	3.15 ± 0.39	
	7	Swivel lever stroke		R	mm	80 ± 10	
					inch	3.15 ± 0.39	
	8			L	mm	80 ± 10	
					inch	3.15 ± 0.39	
	9	Blade lever stroke		up	mm	73 ± 10	
					inch	2.87 ± 0.39	
	10			down	mm	72 ± 10	
					inch	2.83 ± 0.39	
	11	Travel lever stroke	L	Forward	mm	80 ± 10	
					inch	3.15 ± 0.39	
	12			Back	mm	80 ± 10	
					inch	3.15 ± 0.39	
	13		R	Forward	mm	80 ± 10	
					inch	3.15 ± 0.39	
	14			Back	mm	80 ± 10	
					inch	3.15 ± 0.39	
Q9		Stability					
1	1	Standard arm, Dynamic operation load limit	Bucket load to 10 degrees tipping	Side, blade up	kgf.m	-	Arm extend, bucket crowd oil temp.50±5°C(122±9°F)
					N.m	-	
					ft.lbf	-	
	2			Front, blade up	kgf.m	-	
					N.m	-	
					ft.lbf	-	
	3		Bucket load to tip fully	Side, blade up	kgf.m	489	
					N.m	4795	
					ft.lbf	3537	
	4			Front, blade up	kgf.m	749	
					N.m	7345	
					ft.lbf	5417	
	5	Standard arm, static limited load	Bucket load to tip fully	Side	kgf.m	734	Front horizontal bucket crowd, load at arm tip end.
					N.m	7198	
					ft.lbf	5309	
	6			Front	kgf.m	1060	
					N.m	10395	
					ft.lbf	7667	
Q10		Comfortability					
1	1	Noise level	At operator's ear LPA	Canopy	dB(A)	-	
	2			Cabin	dB(A)	76	Cabin door close
	3		Noise source;LWA	7m	dB(A)	96.7 >	
	4		Sonic power level (JIS)		dB(A)		

B: Removing and reassembling

a. Front attachment removing

1. Dismount bracket and bracket link.

2. Disconnect bracket cylinder hose. Lifting the arm assy, tap out the pins and dismount arm assy.

3. Remove the pipe and hose connections.

4. While lifting the boom assy, remove the boom pin.

5. While lifting the swing bracket assy, remove the pin.

Shims

Bushings

b. Grease nipple set up

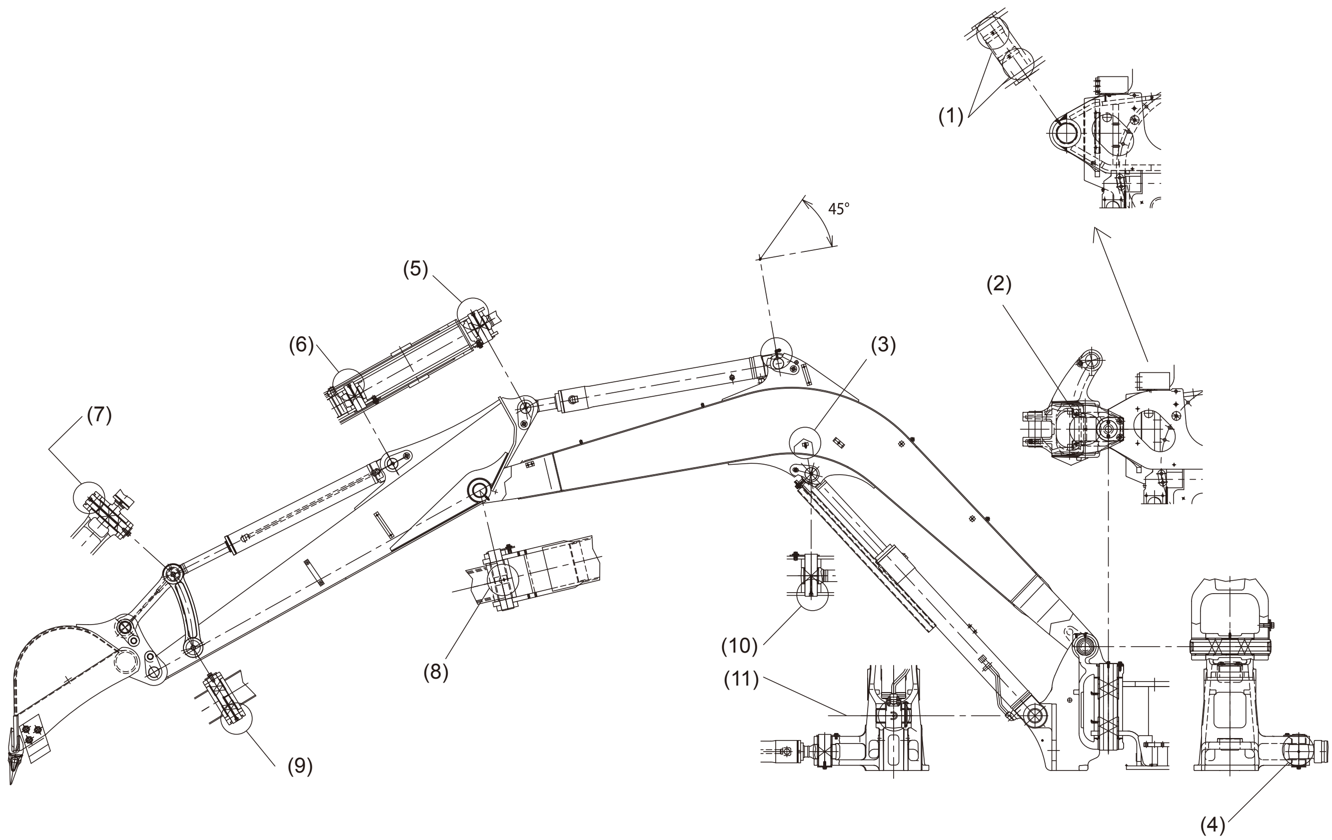
1.Grease nipple setup direction

Type A: Straight (06611-15010)
Type B: 67 degree (06616-25010)
Type C: 90 degree (06616-35010)

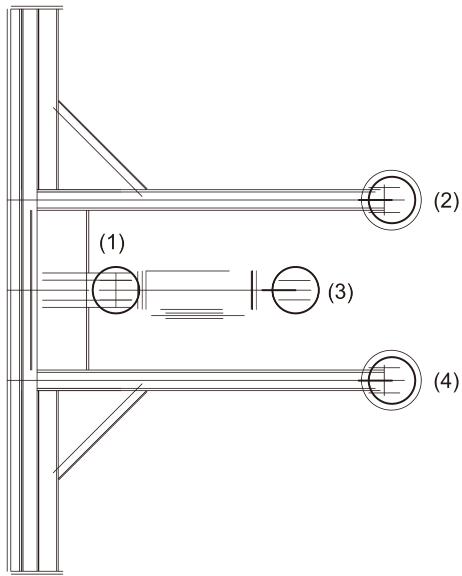
Mount the fittings as shown at left.

2.Greasing quantity

Apply grease until it comes out of the other end of the moving section.



(1)Type A (boss greasing)
(2)Type A (boss greasing)
(3)Type A
(4)Type A (boss greasing)
(5)Type A (pin greasing)
(6)Type A (pin greasing)
(7)Type A (pin greasing)
(8)Type A (boss greasing)
(9)Type A (pin greasing)
(10)Type A (pin greasing)
(11)Type A (boss greasing)



3.Grease nipple setup direction

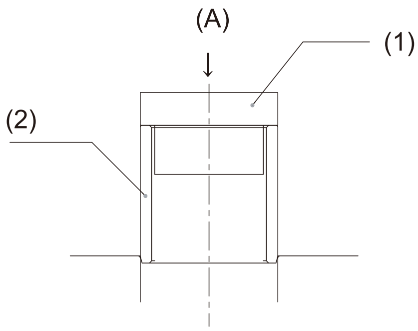
Type A: Straight (06611-15010)
Type B: 67°(06616-25010)

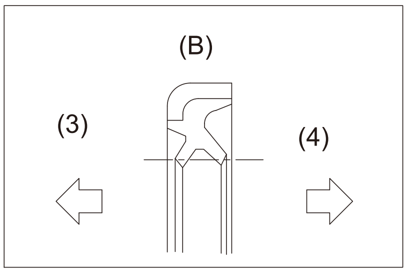
Mount the fittings as shown at left.

4.Greasing quantity

Apply grease until it comes out of the other end of the moving section.

(1)Type A
(2)Type B
(3)Type B
(4)Type B





C. Pin and bushing installation

1.Fitting the bushings

Using a block or the like, fit the bushings into position.
* Do not hit directly against the bushings.

2.Bushing setup dimensions

1) Without the dust seals
   Make sure the bushings do not stretch out of both sides.
2) With the dust seals
   Ensure the dust seal setup space at both sides.
   (It is possible to control the press-fitting dimension instead.)

3.Dust seal fitting direction

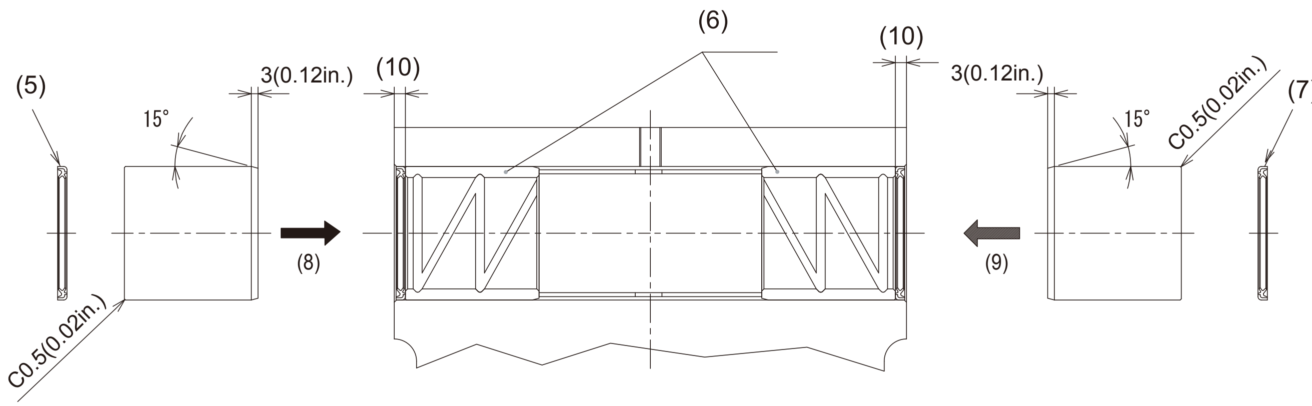
Fit the dust seals as specified in the figure.

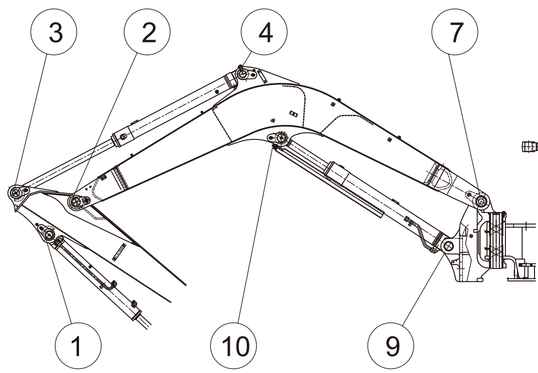
4.Bushing setup direction

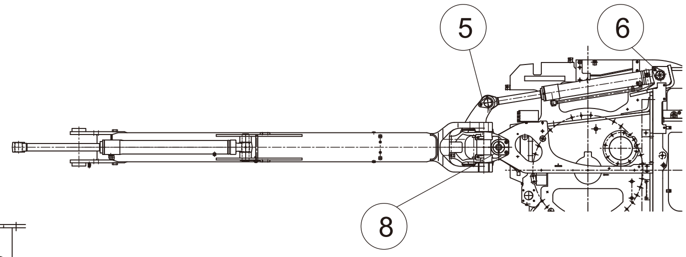
Insert the bushings from the 15×-chamfered side.

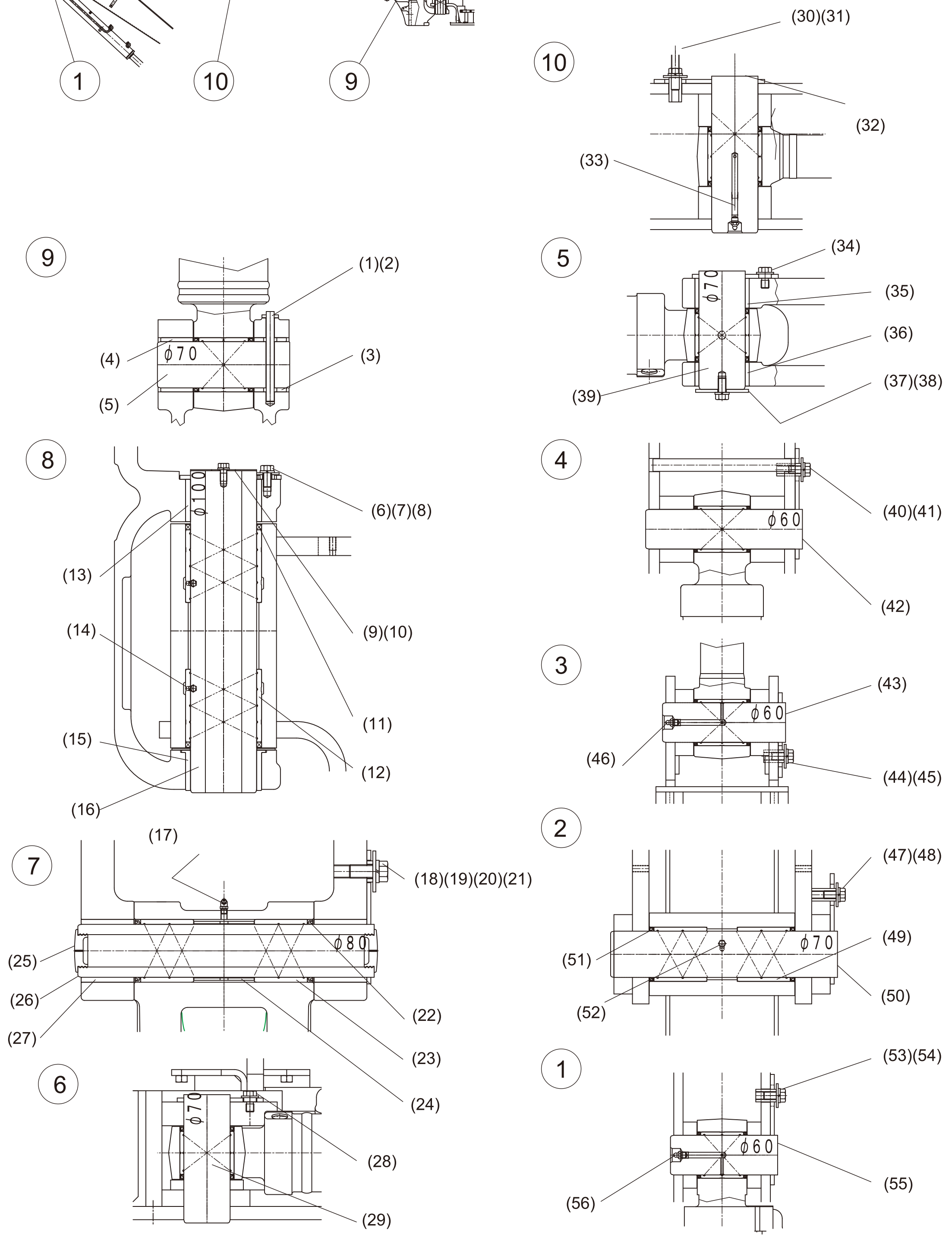
With the dust seals	S
* Bucket link 1, 6 pcs.	5.0mm(0.20in.)
* Swing bracket, 2 pcs. Boom support	10.0mm(0.39in.)
* Arm end, 4 pcs.	4.5mm(0.18in.)
* Arm support, 2 pcs.	6.5mm(0.26in.)

(A)Insert in this direction.
(B)Enlarged view of dust seal
(1)Block
(2)Bushing
(3)Bushing side
(4)Outside
(5)Dust seal
(6)Bushing
(7)Dust seal
(8)Bushing setup direction
(9)Bushing setup direction
(10)More than S









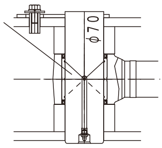
1.Arm assembly - Bucket cylinder
2.Boom assembly - Arm assembly
3.Arm assembly - Arm cylinder
4.Boom assembly - Arm cylinder
5.Swing bracket - Swing cylinder
6.Swivel frame ~Swing cylinder
7.Boom assembly - Swing bracket
8.Swing bracket -Swivel frame
9.Swing bracket - Boom cylinder
10.Boom assembly-Boom cylinder

(1)Pin (anti-rotation)
(2)Bolt
(3)Bushing
(4)Bushing
(5)Pin
(6)Spacer
(7)Bolt
(8)Plain washer
(9)Plate
(10)Bolt
(11)Dust seal (10011508)
(12)Bushing (100115110)
(13)Bushing
(14)Grease fitting (Type C)
(15)Bushing
(16)Pin
(17)Grease fitting (Type B)
(18)Spacer
(19)Bolt
(20)Spring washer
(21)Plain washer
(22)Dust seal(809508)
(23)Bushing(809580)
(24)Collar
(25)Grommet
(26)Pin
(27)Bushing
(28)Bolt (anti-rotation)
(29)Pin
(30)Bolt
(31)Plain washer
(32)Pin
(33)Grease fitting (Type A)
(34)Bolt (anti-rotation)
(35)Bushing
(36)Bushing
(37)Washer
(38)Bolt
(39)Pin
(40)Bolt
(41)Plain washer
(42)Pin
(43)Pin
(44)Bolt
(45)Plain washer
(46)Grease fitting (Type A)
(47)Bolt
(48)Plain washer
(49)Bushing(708280)
(50)Pin
(51)Dust seal (708260)
(52)Grease fitting (Type B)
(53)Bolt
(54)Plain washer
(55)Pin
(56)Grease fitting (Type A)

10

Boom assembly - Boom cylinder

(1)

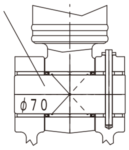


Shim (1.0, 140-71)
Shim (0.5, 140-71)
To be selected

9

Swing bracket - Boom cylinder

(1)

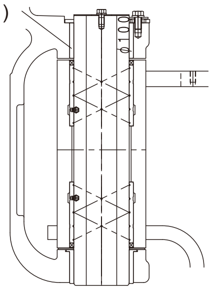


Shim (1.0, 140-71)
Shim (0.5, 140-71)
To be selected

8

Swing bracket - Swivel frame

(1)



Top
Thrust collar (3,2)

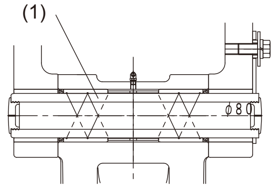
Fit with the groove downward.

Bottom
Shim (3.5)
Shim (3.2)
To be selected

7

Boom assembly - Swing bracket

(1)

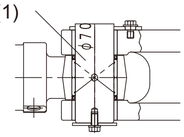


Shim (1.0, 150-81)
Shim (0.5, 150-81)
To be selected

5

Swing bracket - Swing cylinder

(1)

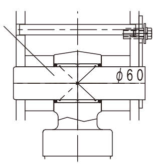


Shim (1.0, 140-71)
Shim (0.5, 140-71)
To be selected

4

Boom assembly - Arm cylinder

(1)

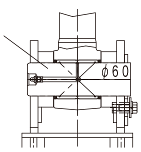


Shim (1.0, 110-61)
Shim (0.5, 110-61)
To be selected

3

Arm assembly - Arm cylinder

(1)

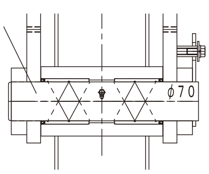


Shim (1.0, 110-61)
Shim (0.5, 110-61)
To be selected

2

Boom assembly - Arm assembly

(1)

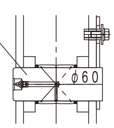


Shim (1.0, 140-71)
Shim (0.5, 140-71)
To be selected

1

Arm assembly - Bucket cylinder

(1)



Shim (1.0, 110-61)
Shim (0.5, 110-61)
To be selected

d.Shim installation

1.Clearance at the front

* Gap in thrust direction at each support pin Less than 0.6 mm(0.02inch)

*If over 0.6 mm(0.02inch), add a shim to readjust the gap. (See the figure for proper shims.)

2.Vertical clearance between swivel frame and swing bracket

+0.1~+1.1mm(0.004~0.04inch)

3.Pin lock bolt applying direction

Apply the bolts as shown at left.

4.Direction of the thrust collar on top of the swing support

Face the groove toward the swivel frame.

5.Fitting the thrust collars

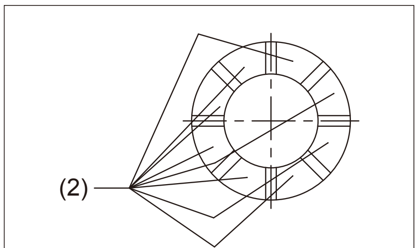
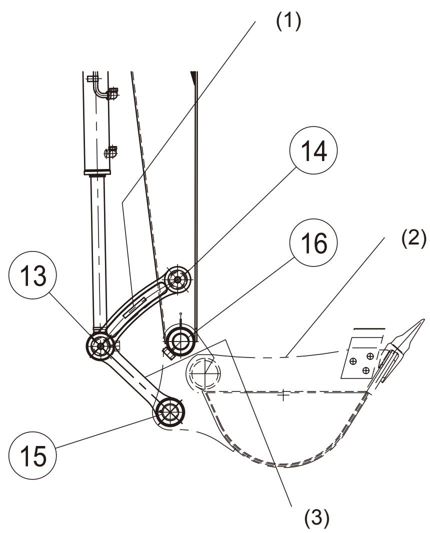


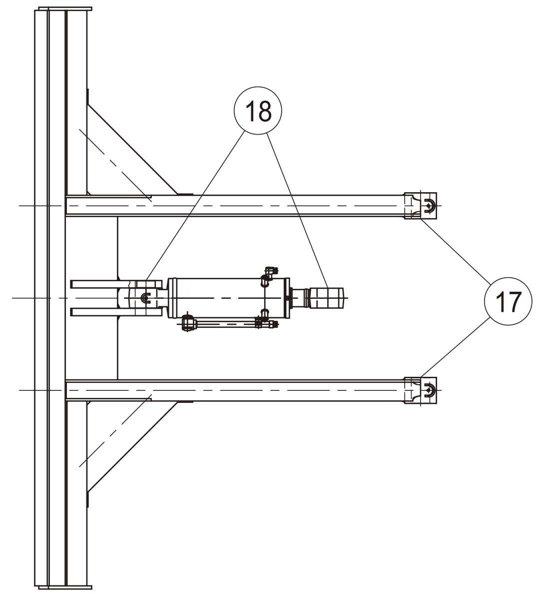
Fig. A

1)Install the grooved thrust collar (with the groove downward) at the top. Apply grease at 8 locations on both sides. (See Fig. A.) (Molybdenum anti-seizure compound may be used instead.)

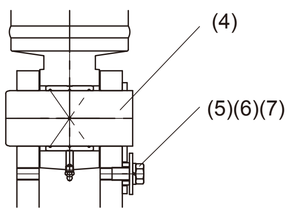
2)Prepare two different-thickness thrust collars for the bottom. Try the 3.5 mm thick one first to see if it fits on smoothly. If not, introduce the 3.2 mm thick one.
(Be sure to select a suitable thrust collar.)

(1)Pin
(2)Apply grease



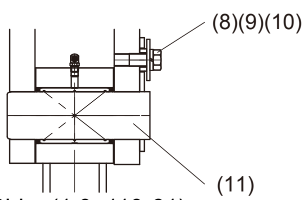


18 Cylinder (blade) - Blade



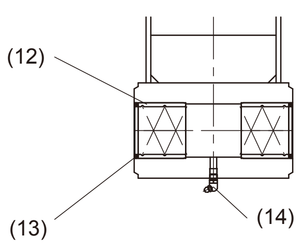
Shim (1.0, 120-71)
Shim (0.5, 120-71)
To be selected

17 Track frame - Blade

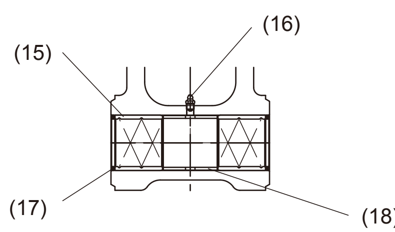


Shim (1.0, 110-61)
Shim (0.5, 110-61)
To be selected

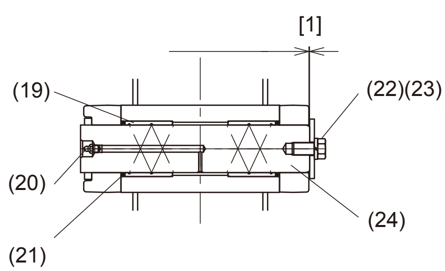
16 Arm assembly
Bucket support



15 Bucket link (1)
Bucket link support 1 (at the bucket)

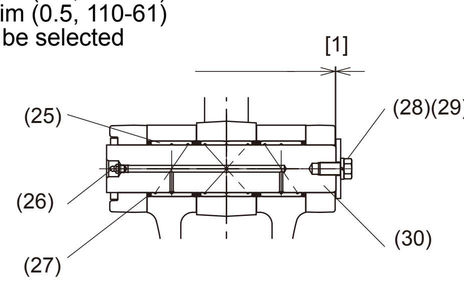


14 Bucket links (2) and (3) - Arm assembly
Bucket link support 2 (at the arm)



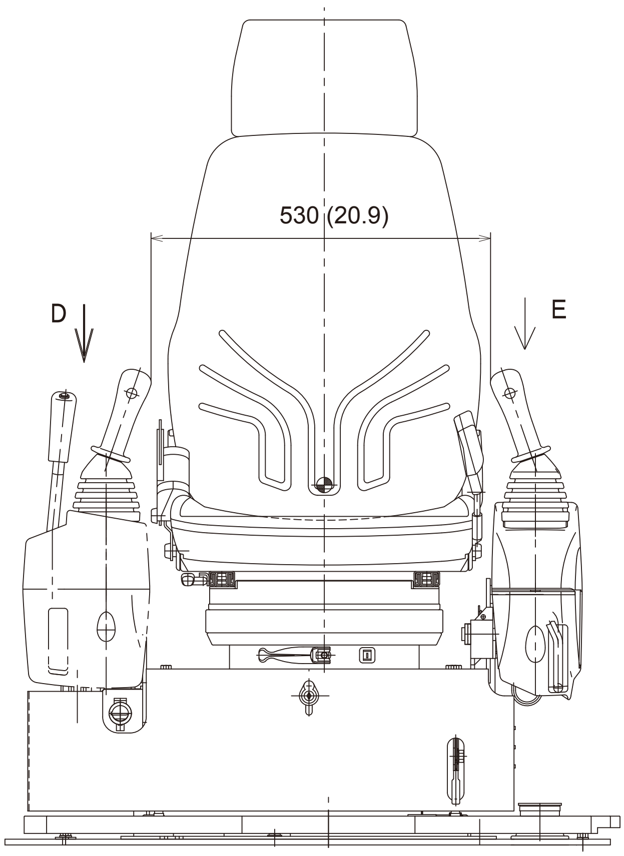
13 Bucket links 1, 2 and 3 - Bucket cylinder
Bucket link support 1 (at the bucket cylinder)

Shim (1.0, 110-61)
Shim (0.5, 110-61)
To be selected



(1)Connect the bucket links 2 and 3 with their markings inside.
(4)Pin
(5)Spacer
(6)Bolt
(7)Plain washer
(8)Spacer
(9)Bolt
(10)Plain washer
(11)Pin
(12)Bushing (607060)
(13)Dust seal (607040)
(14)Grease fitting (Type B)
(15)Bushing (607060)
(16)Grease fitting (Type A)
(17)Dust seal (607040)
(18)Collar
(19)Bushing (607060)
(20)Grease fitting(Type A)
(21)Dust seal (607040)
(22)Bolt
(23)Washer
(24)Pin
(25)Bushing (607052
(26)Grease fitting(Type A)
(27)Dust seal (607040)
(28)Bolt
(29)Washer
(30)Pin

[1]Clearance enough for smooth turning



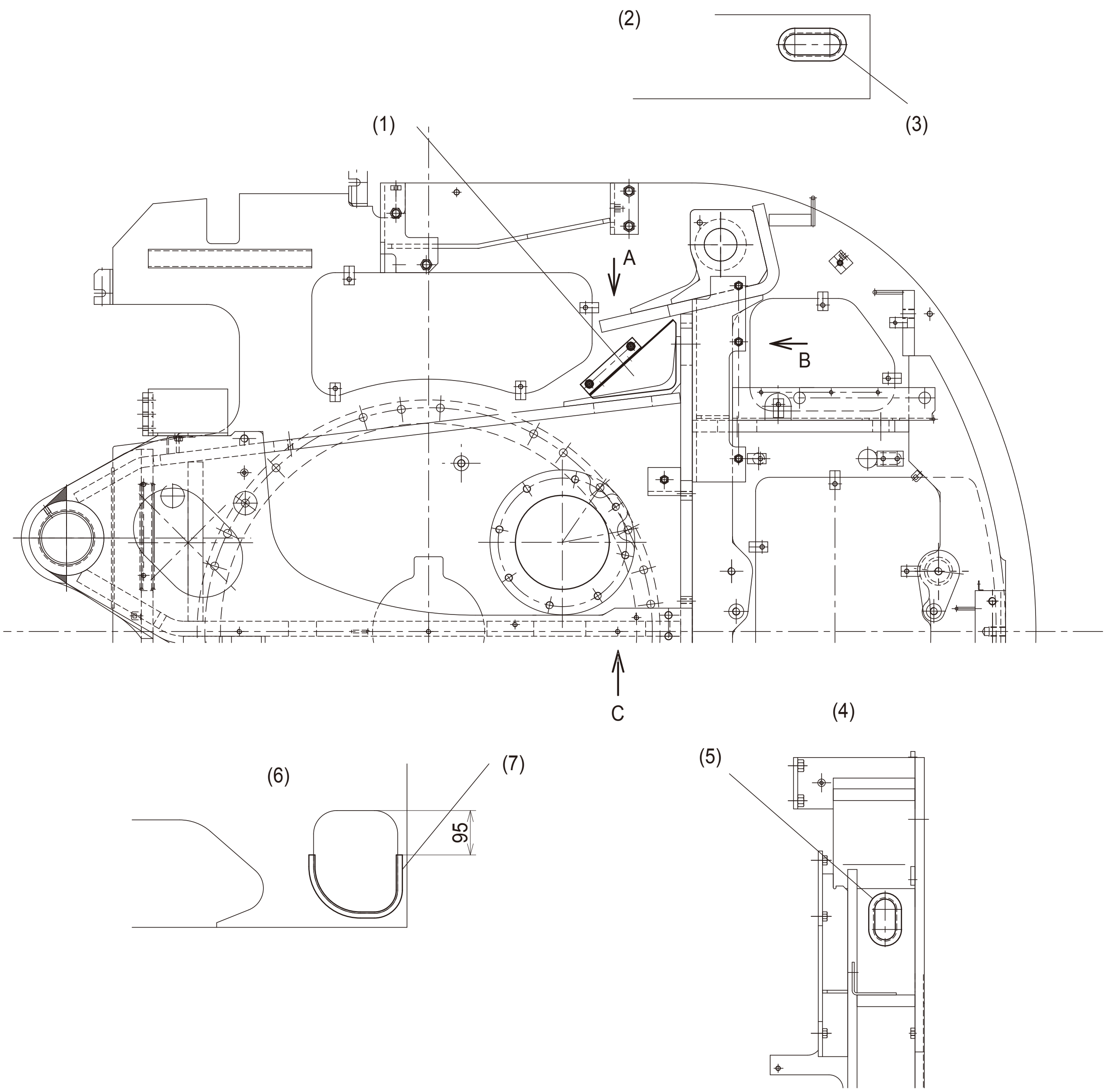
e.Fitting the control lever

With the control levers in place, make sure the distance between them is as specified at left.
Reference: 530 mm(20.9inch)

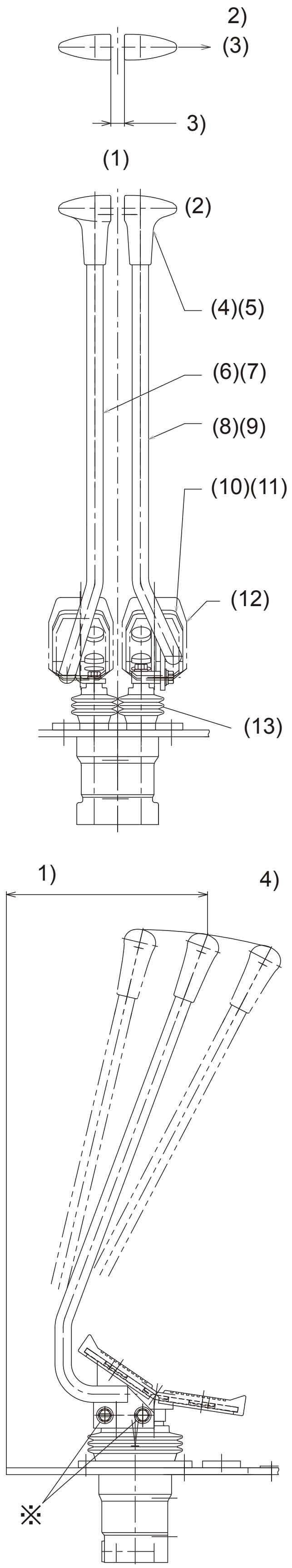
1.Fitting the grommets

(RD809-4143∆)
(RD809-4144∆)
(RD809-4145∆)

Fit the grommets in position as shown at left.
Apply an instant adhesive.



(1)Guide (hose, swing)
Bolt
(2)View of A
(3)Grommet (2, swivel)
(4)View of B
(5)Grommet (3, swivel)
(6)View of C
(7)Grommet (1, swivel)



unit:mm (inch)

f.Travel levers

1.Adjusting the lever neutral position

Fit the levers in position as shown at left.

2.Adjusting the travel levers

Keep them at the neutral position.

(1)Dimension from the step end
→ 265mm (10.4inch) (reference)

(2)To-and-fro difference between left and right levers → Less than 2 mm (0.08inch)

(Finely adjust the left lever with the *-marked bolts.)

(3)Clearance between left and right levers
15~21mm (0.59~0.83inch)

3.Checking the setup condition

Make sure the valve spool moves over its full stroke.
Make sure the valve spool moves smoothly.

4.Tightening torque for the pilot valve

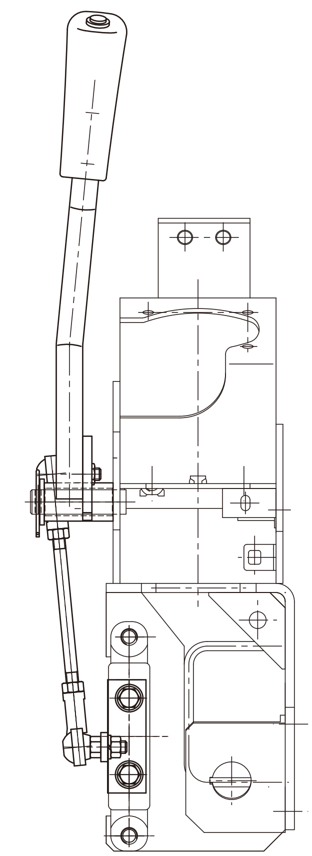
RD809-6536∆, RD809-6534∆ To be installed

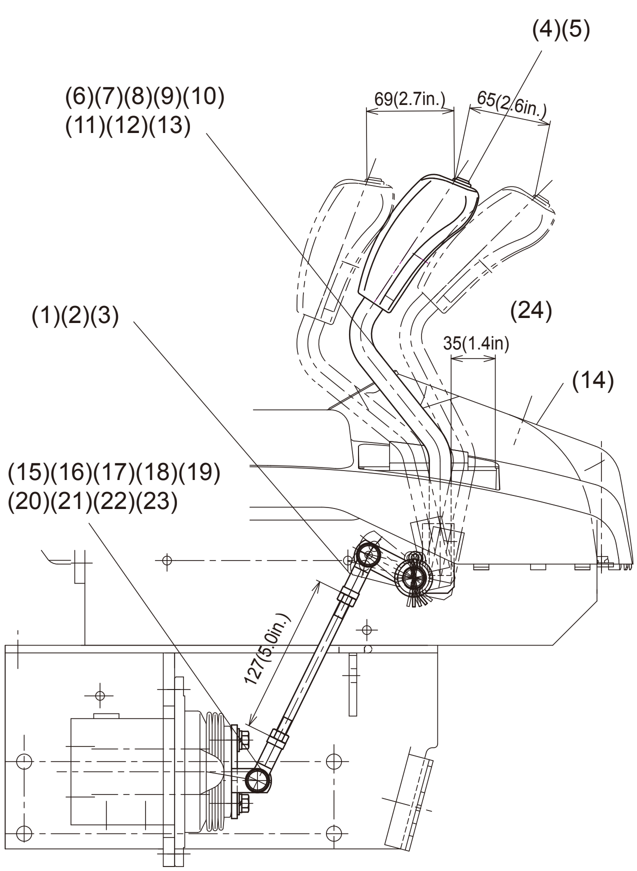
Tightening torque of *-marked bolts
RD809-6536D To be installed

Tightening torque
48.4~55.9N.m (4.9~5.7kgf.m) 35.7~41.2ft.lbs

(1)Right lever
(2)Left lever
(3)To-and-fro difference between left and right levers: Less than 2 mm(0.08inch)
(4)Grip (travel)
(5)Washer-fitted machine screw
(6)Lever (travel, right)
(7)Bolt
(8)Lever (travel, left)
(9)Bolt
(10)Pedal (travel, left)
(11)Bolt
(12)Cover (rubber,travel pedal)
(13)PV valve

1)265±5(10.4±0.20)
2)To-and-fro difference between left and right levers: Less than 2 mm(0.08inch)
3)15~21(0.59~0.83)
4)Neutral position





g.Dozer lever

1.Adjusting the dozer lever neutral position

Fit the lever in position as shown at left.

2.Checking the setup condition

Make sure the valve spool moves over its full stroke.
Make sure the valve spool moves smoothly.

3.DU bushing bearing

Apply grease.

4.Tightening torque of bracket (dozer pilot valve)

Tightening torque of rod end
Tightening torque =
23.5~27.5N.m(2.4~2.8kgf/m)17.3~20.3ft.lbs

(1)Rod end right-hand screw
(2)Nut
(3)Spring washer
(4)Grip (bi-speed)
(5)Pan-head machine screw
(6)Lever assembly (blade)
(7)Lever (blade)
(8)Bushing
(9)Plain washer
(10)Snap pin
(11)69mm(2.7inch)
(12)65mm(2.6inch)
(13)127mm(5.0inch)
(14)Cover (right, upper, A/C)
(15)Bracket (dozer PV)
(16)Bolt
(17)Rod end left-hand screw
(18)Nut
(19)Spring washer
(20)Rod assembly (blade)
(21)Rod (M8-150)
(22)Nut
(23)Left-hand screw 8
(24)Neutral position

h.Cab

1.Anti-vibration rubber (Cab)

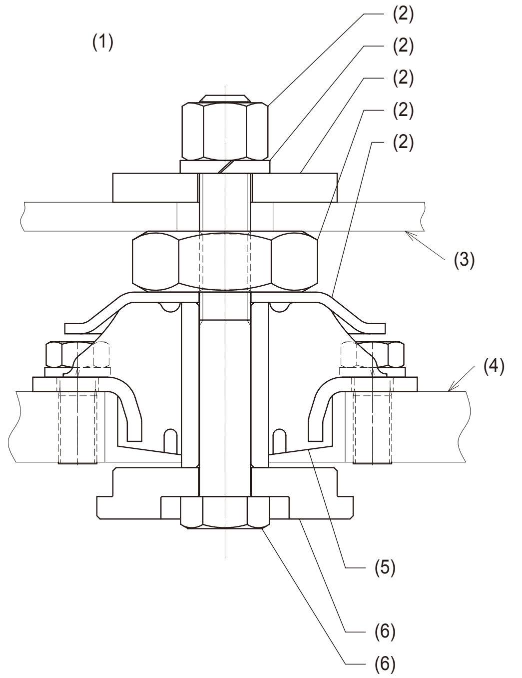
Tightening torque of mounting bolt
To be installed

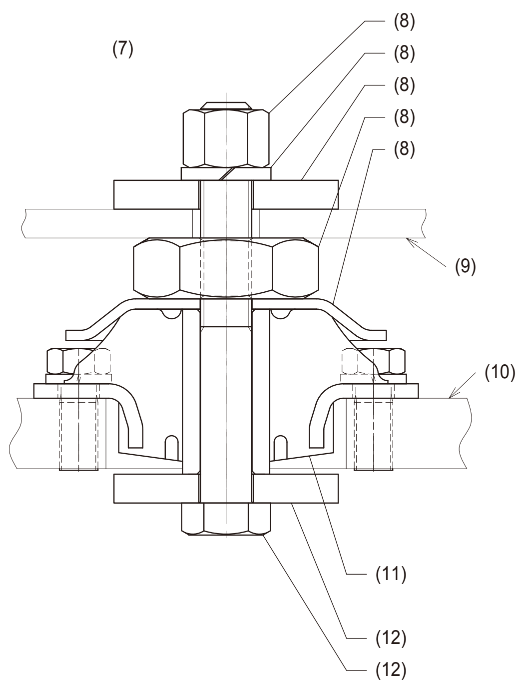
Tightening torque
103.0~117.7N.m (10.5~12.0kgf.m)
75.9~86.8ft.lbs

2.Nut (M16-6T, cab)

Rear rim lock nut Tightening torque
To be installed

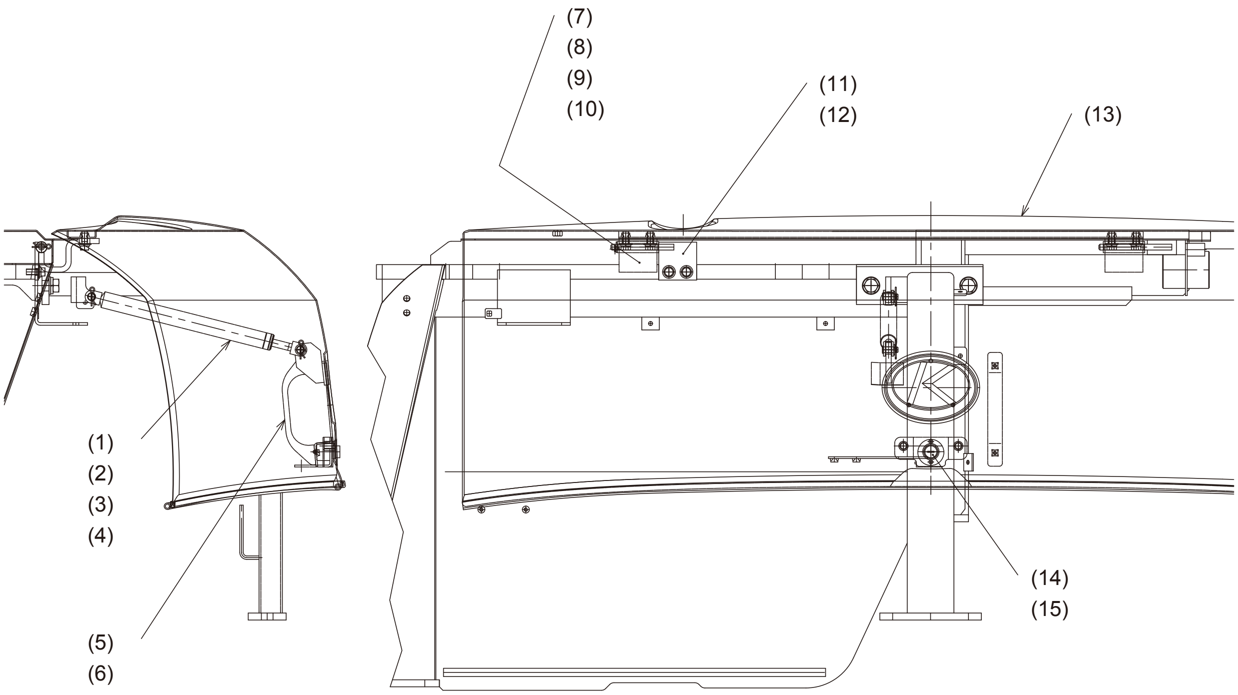
Tightening torque
107.9~127.4N.m (11.0~13.0kgf.m)
79.6~94.0ft.lbs



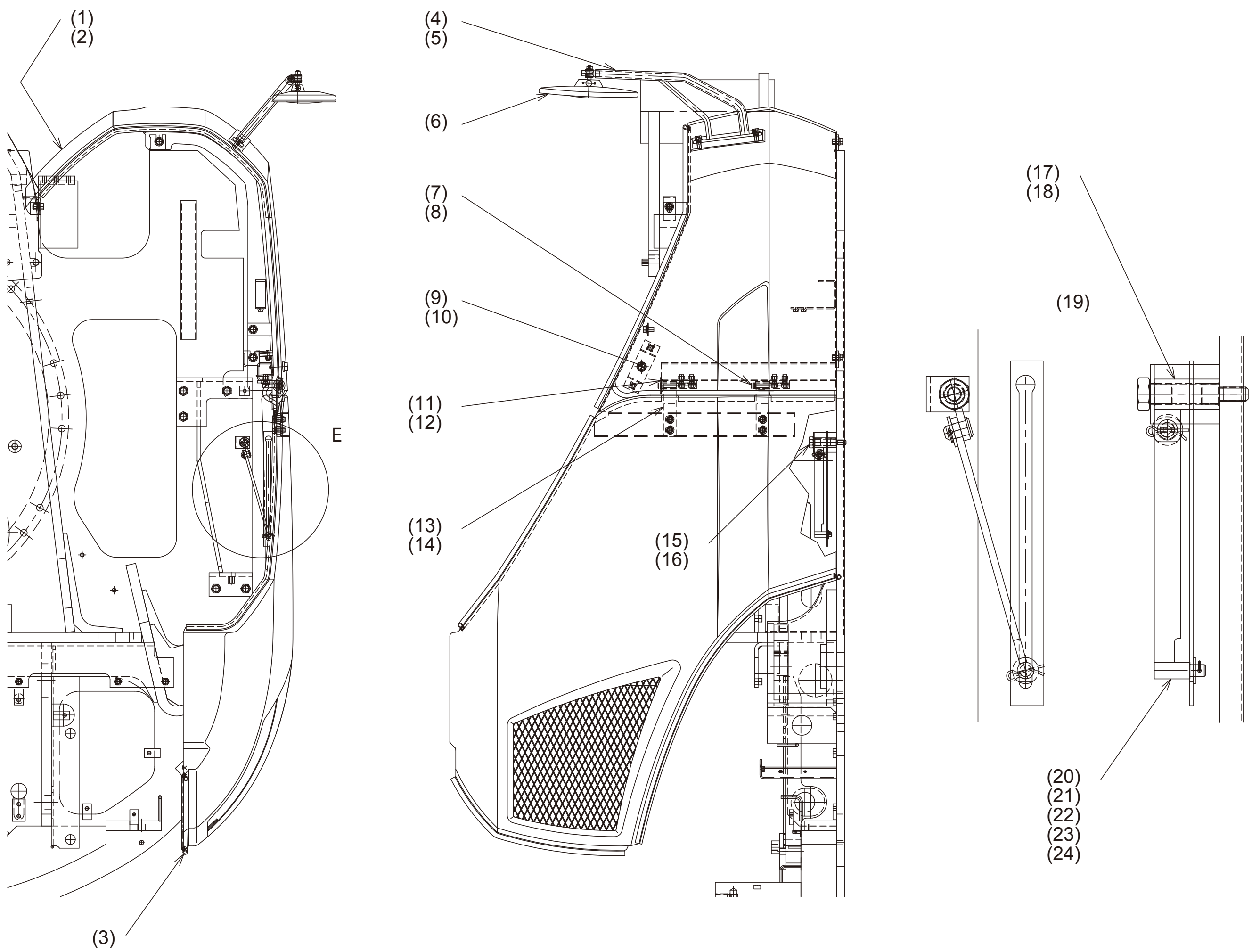


(1)Details of A and D (2 locations)
(2)Rear rim lock nut
Spring washer
Washer (fender)
Nut (M16-6T, cab)
Cup (mount rubber)
(3)Step (1)
(4)Frame (swivel)
(5)Anti-vibration rubber (Cab)
Bolt
(6)Washer (anti-vibration runner, ROPS)
Bolt (M16x125L-9T)
(7)Details of B and E (3 locations)
(8)Rear rim lock nut
Spring washer
Washer (fender)
Nut (M16-6T, cab)
Cup (mount rubber)
(9)Step (1)
(10)Frame (swivel)
(11)Anti-vibration rubber (Cab-70)
Bolt
(12)Washer (fender)
Bolt (M16x125L-9T)

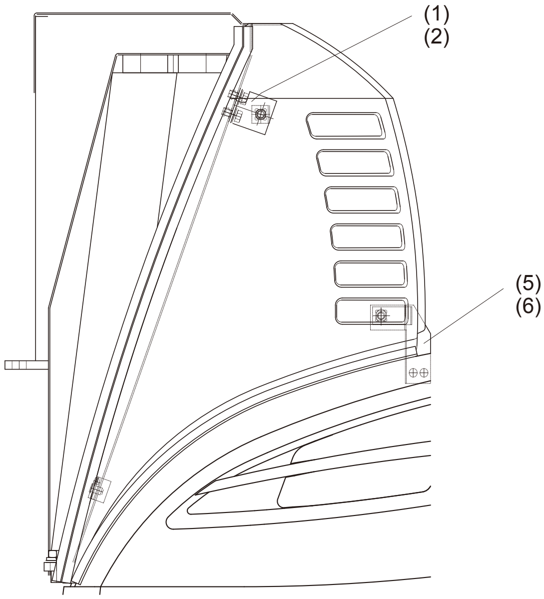
i.Bonnet

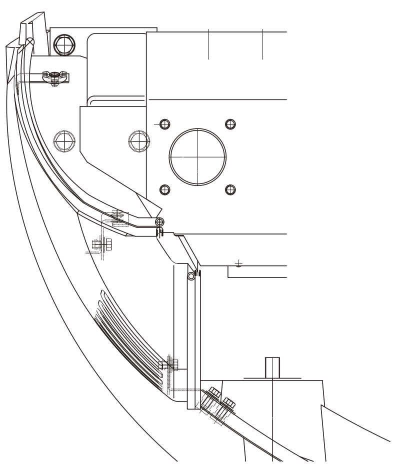


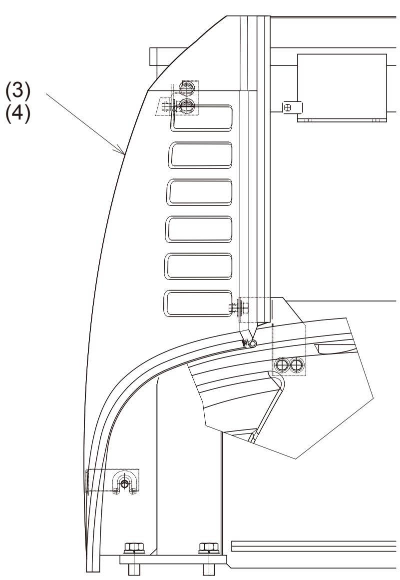
(1)Damper (gas)
(2)Headed pin
(3)Plain washer
(4)Snap pin
(5)Grip
(6)Bolt
(7)Hinge (1, hood back)
(8)Bolt
(9)Plain washer
(10)Snap pin
(11/)Hinge (2, hood back)
(12)Bolt
(13)Hood (back)
(14)Lock assembly (hood)
(15)Bolt



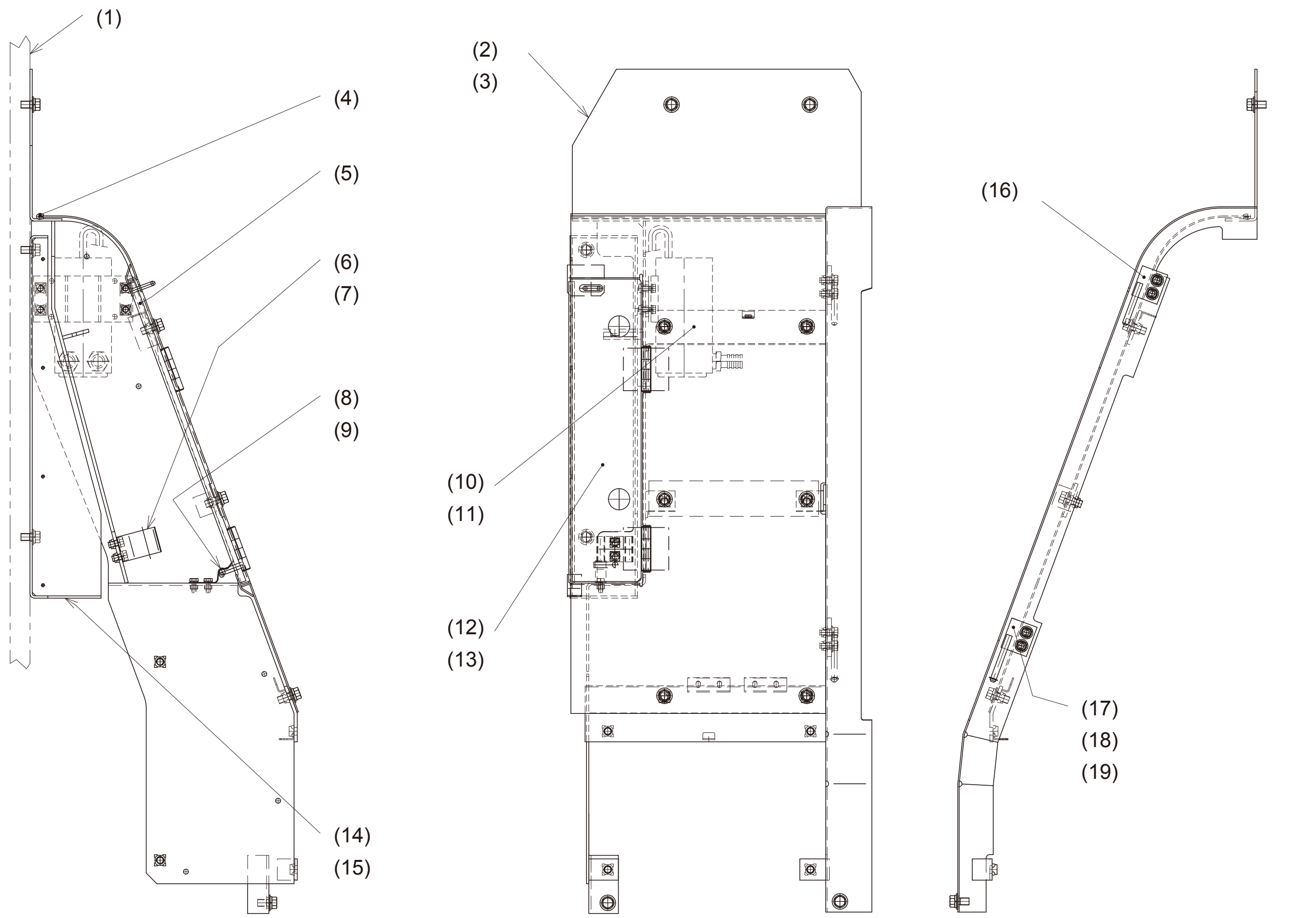
(1)Cover assembly (front)
(2)Bolt
(3)Cover assembly (right)
(4)Stay (rearview mirror)
(5)Bolt
(6)Rearview mirror assembly
(7)Hinge (1, right cover)
(8)Bolt
(9)Lock assembly
(10)Bolt
(11)Plain washer
(12)Snap pin
(13)Hinge (2, right cover)
(14)Bolt
(15)Stopper assembly (right cover)
(16)Reamer bolt
(17)Stopper assembly (right cover)
(18)Reamer bolt
(19)Details of E
(20)Stopper (2, right cover)
(21)Plain washer
(22)Snap pin
(23)Plain washer
(24)Snap pin



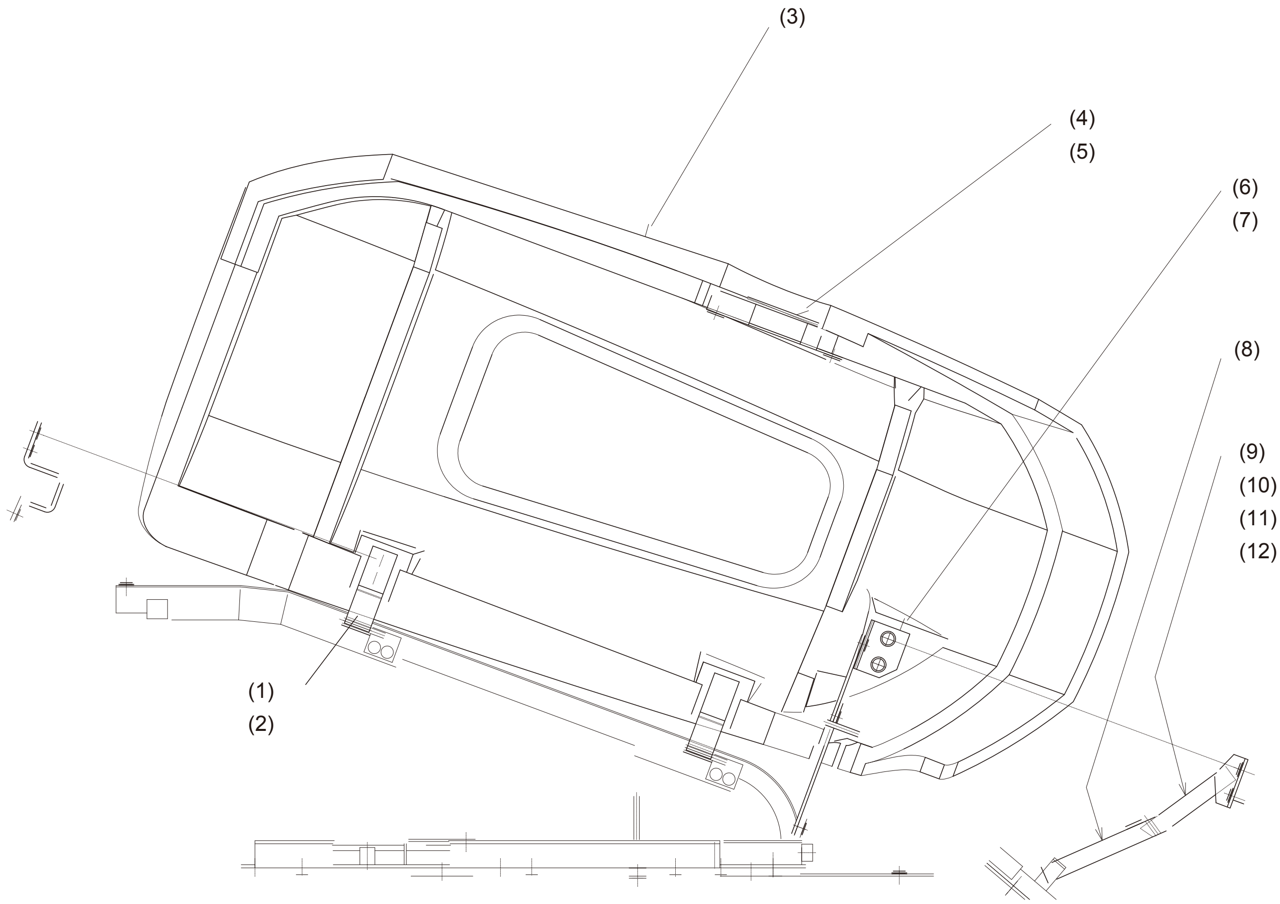




(1)Bracket (2, left cover)
(2)Bolt
(3)Cover (arch, left)
(4)Bolt
(5)Bracket (left cover)
(6)Bolt



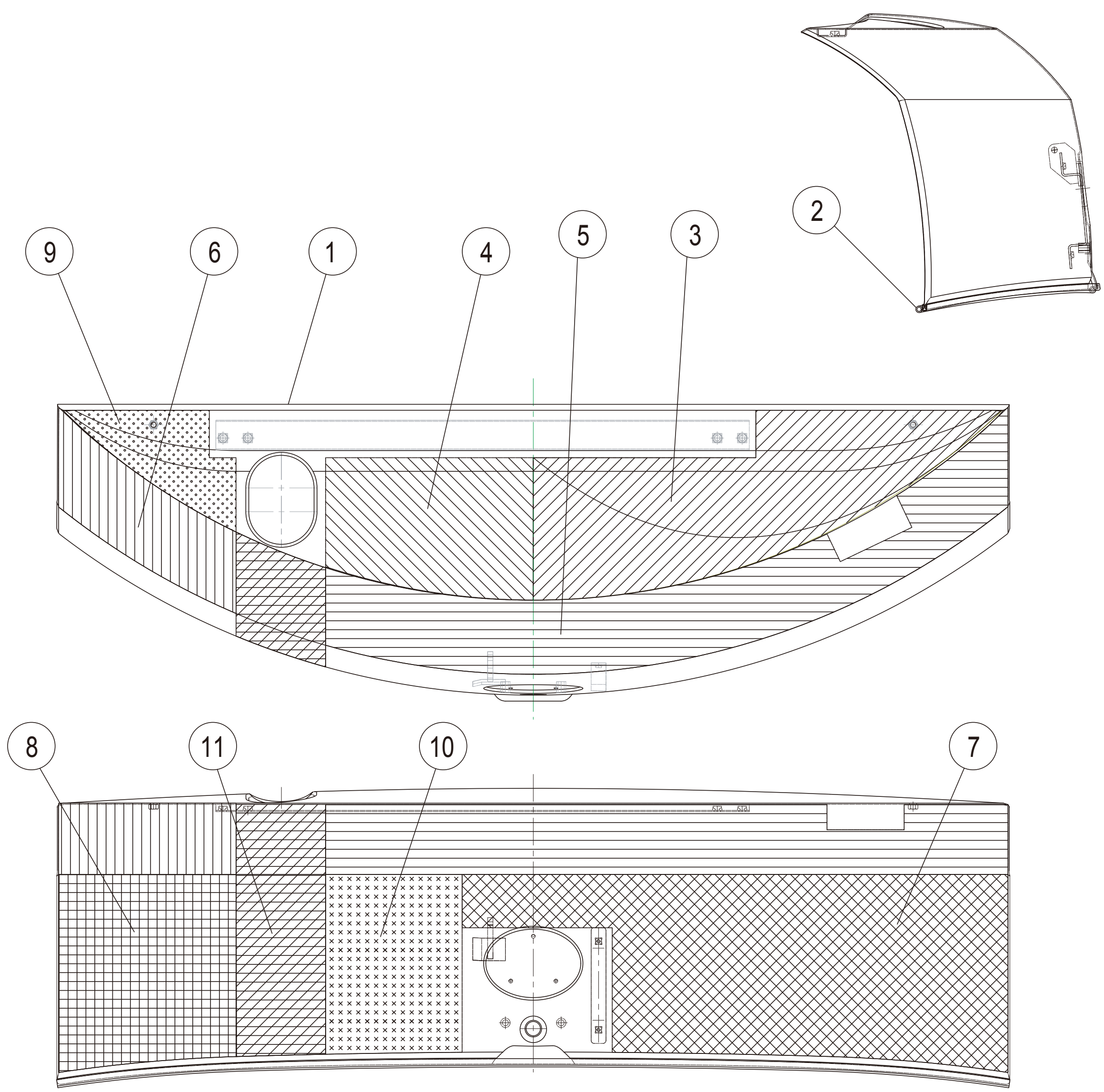
(1)Swivel frame
(2)Frame (center)
(3)Bolt
(4)Grommet (360)
(5)Grommet (450)
(6)Clamp
(7)Bolt
(8)Leaf spring
(9)Bolt
(10)Pump assembly (fuel, filler)
(11)Bolt
(12)Cover (center)
(13)Bolt
(14)Tool box (2)
(15)Bolt
(16)Hinge (1, center cover)
(17)Hinge (2, center cover)
(18)Shaft circlip
(19)Bolt

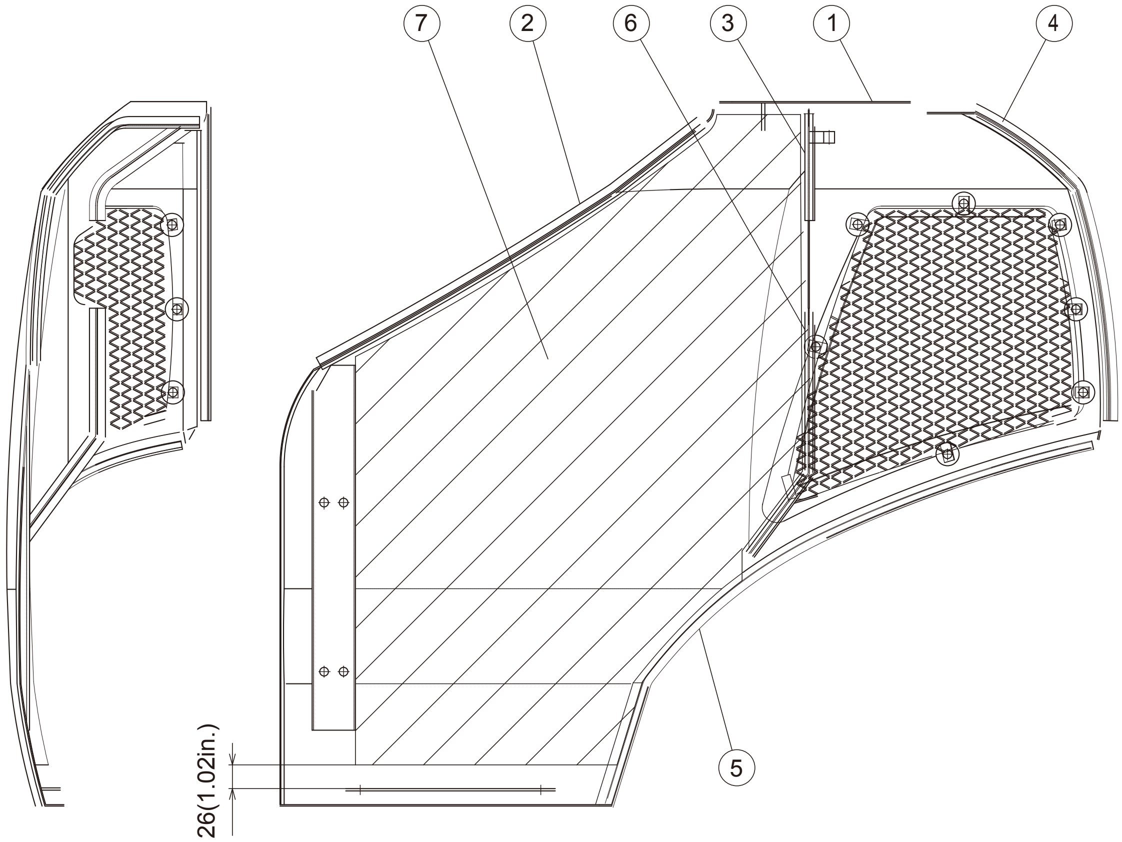


(1)Hinge (tank cover)
(2)Bolt
(3)Cover (tank)
(4)Guide (tank cover)
(5)Bolt
(6)Bracket (tank cover)
(7)Bolt
(8)Link (2, tank cover)
(9)Link (1, tank cover)
(10)Fuel tube
(11)Plain washer
(12)Snap pin

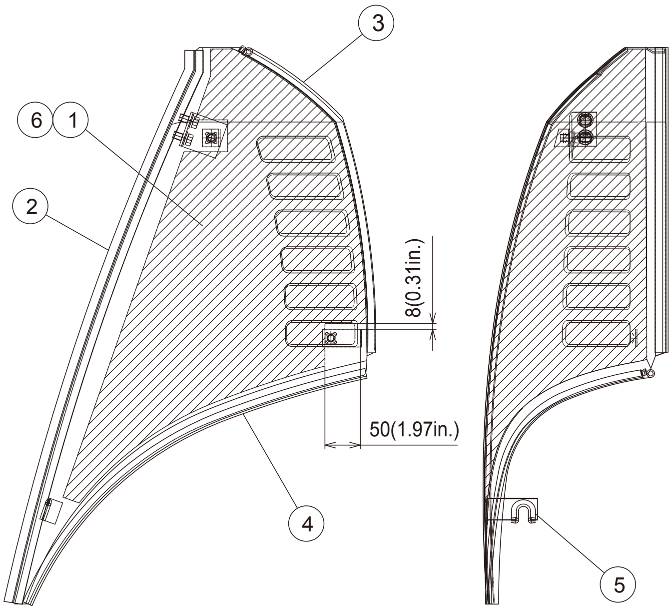
J.Sound absorber and insulator

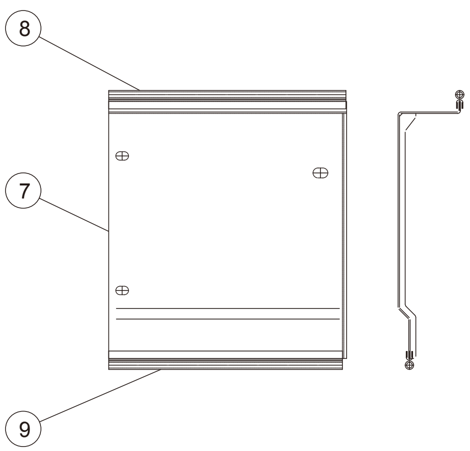
Part name	Q'ty	Location
Hood (back)	1	1
Trim (hood)	1	2
Sound absorber (1, hood)	1	3
Sound absorber (2 hood)	1	4
Sound absorber (3, hood)	1	5
Sound absorber (4, hood)	1	6
Sound absorber (5, hood)	1	7
Sound absorber (6, hood)	1	8
Sound absorber (7, hood)	1	9
Sound absorber (8, hood)	1	10
Thermal insulation (hood)	1	11





Part name	Q'ty	Location
Cover (right)	1	1
Trim (1, right cover)	1	2
Trim (2, right cover)	1	3
Trim (3, right cover)	1	4
Trim (4, right cover)	1	5
Trim (5, right cover)	1	6
Sound absorber (1, right cover)	1	7
Sound absorber (2, right cover)	1	8



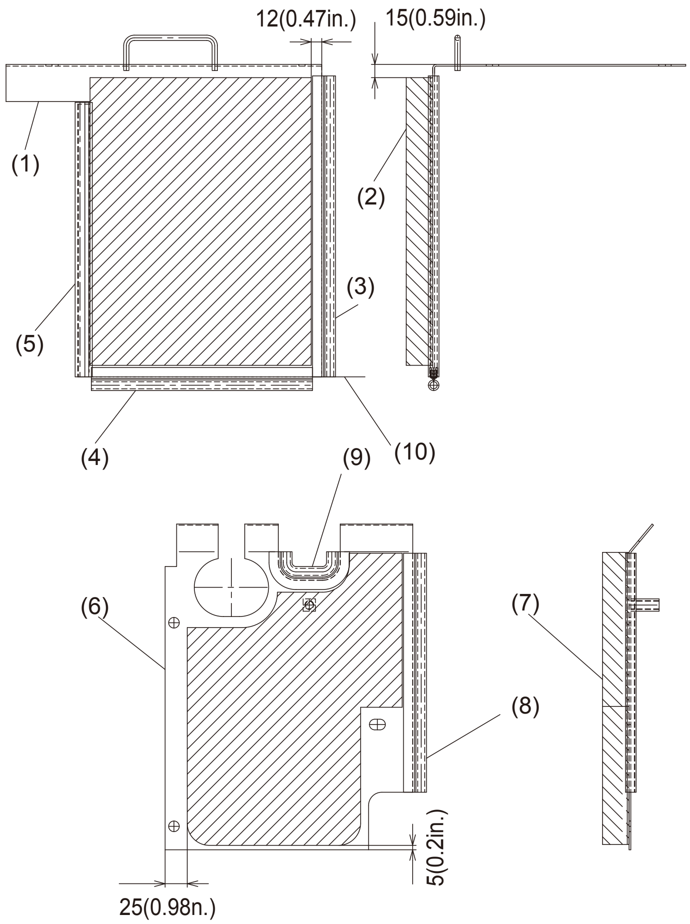


Cover (arch, left)

Part name	Q'ty	Location
Cover (arch, left)	1	1
Trim (1, arch cover L)	1	2
Trim (2, arch cover L)	1	3
Trim (3, arch cover L)	1	4
Grommet (50)	1	5
Sound absorber (left cover)	1	6

Cover (arch, top)

Part name	Q'ty	Location
Trim (1, arch top cover)	1	7
Trim (2, arch top cover)	1	8
Sound absorber (arch top cover)	1	9



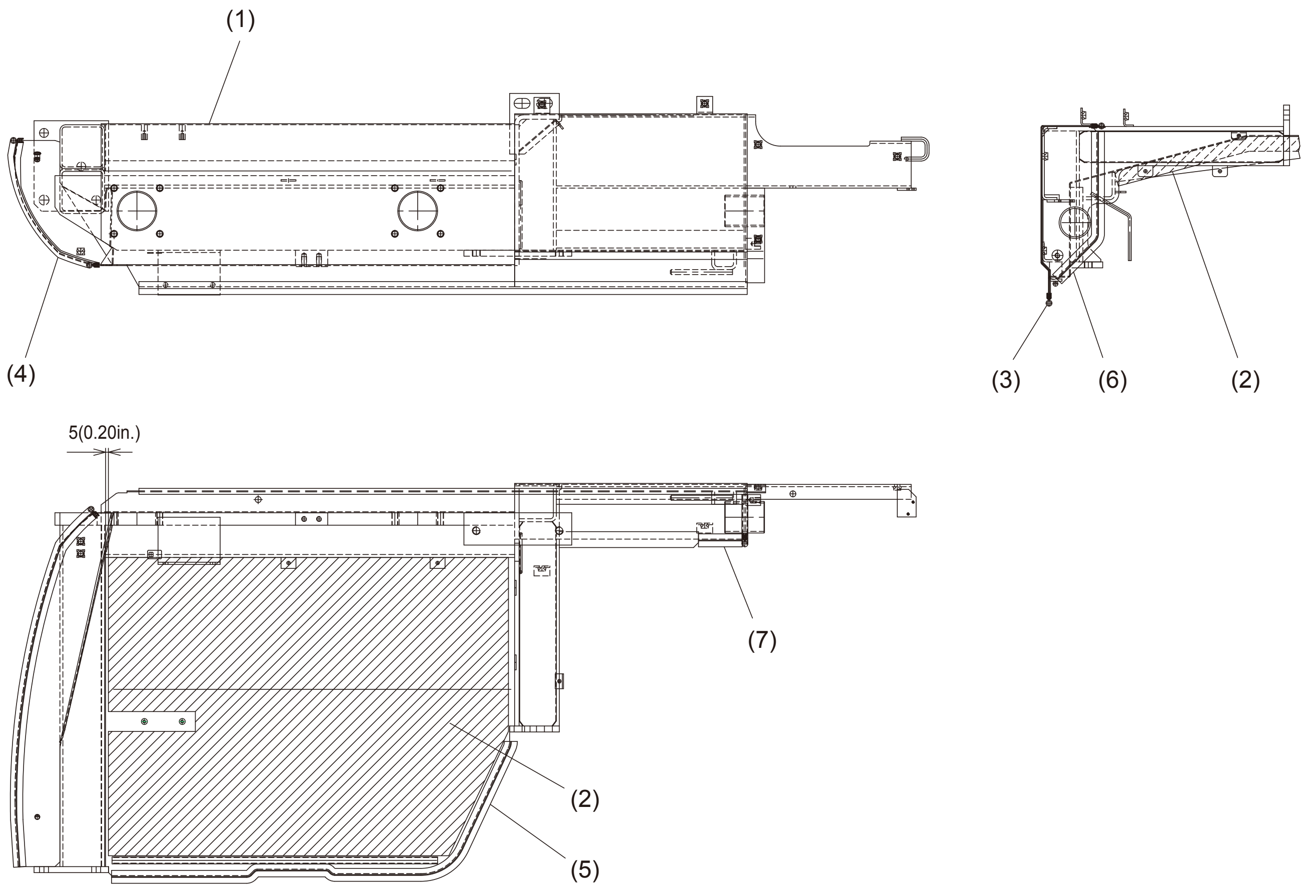
Cover (1, arch)

Part name	Q'ty	Location
Cover (1, arch)	1	(1)
Sound absorber (arch cover 1)	1	(2)
Trim (1, arch cover 1)	1	(3)
Trim (2, arch cover 1)	1	(4)
Trim (3, arch cover 1)	1	(5)

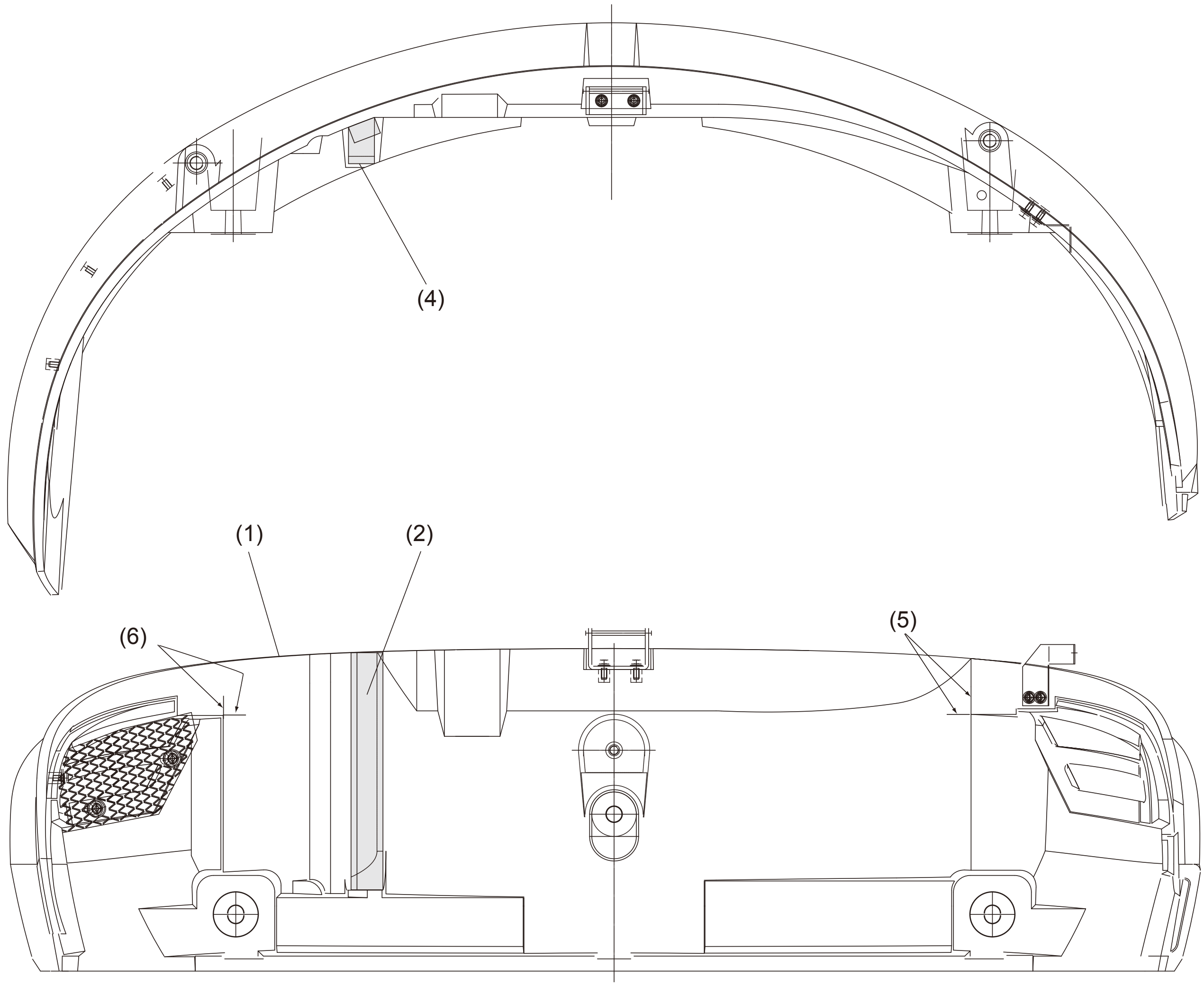
Cover (2, arch)

Part name	Q'ty	Location
Cover (2, arch)	1	(6)
Sound absorber (arch cover 2)	1	(7)
Trim (1, arch cover 2)	1	(8)
Trim (2, arch cover 2)	1	(9)

(10)To be aligned with this line

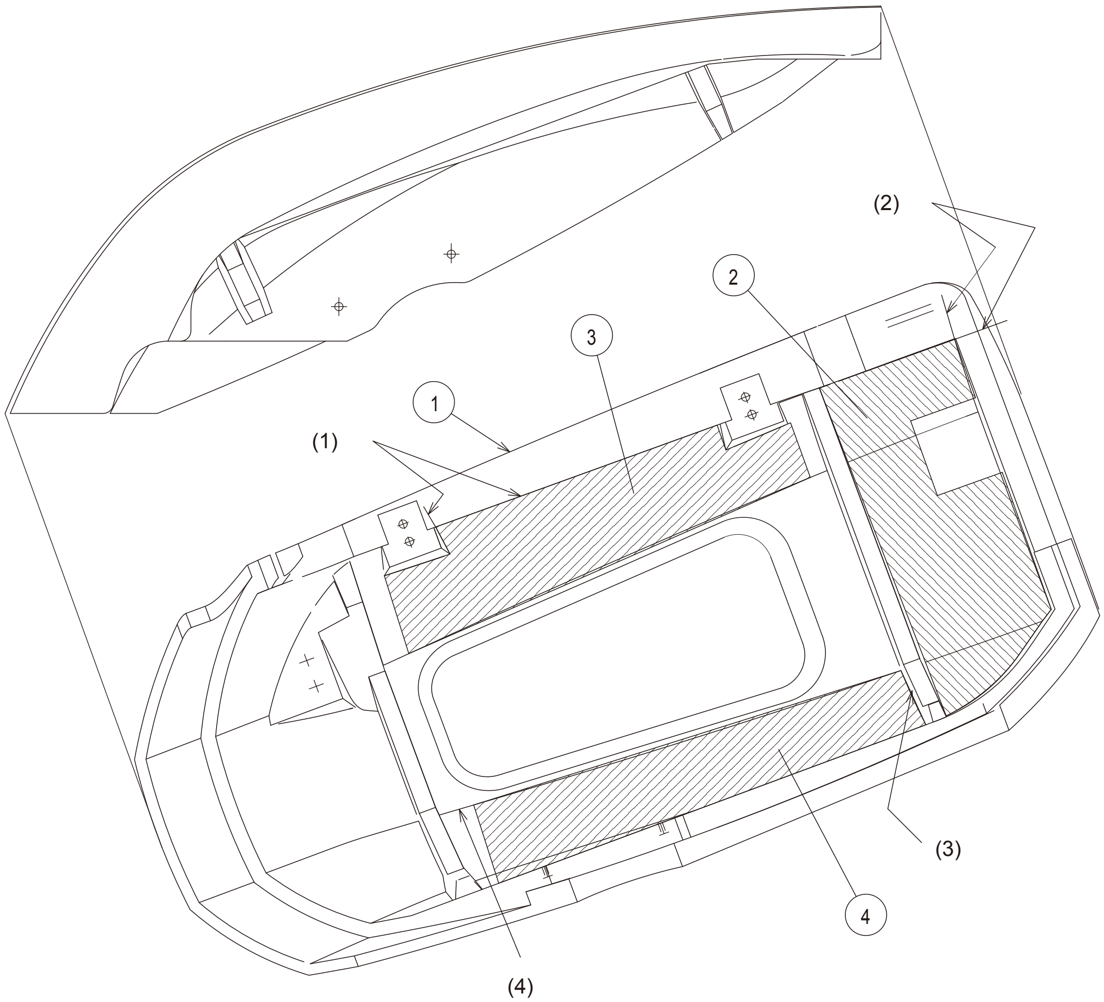


Part name	Q'ty	Location
Frame (1, arch)	1	(1)
Sound absorber (1, arch)	1	(2)
Trim (arch, top)	1	(3)
Trim (arch, left)	1	(4)
Trim (arch, bottom)	1	(5)
Trim (arch, shroud)	1	(6)
Trim (arch, hydraulic tank)	1	(7)



Part name	Q'ty	Location
Weight (870)	1	(1)
Sound absorber (weight)	1	(2)
Sound absorber (R, weight)	1	(3)
Sound absorber (L, weight)	1	(4)

(4)To be applied in the weight groove
(5)To be applied along these lines
(6)To be applied along these lines



(1)Part code
(2)Part name
(3)Q'ty
(4)Location
(5)Cover (tank)
Sound absorber (1, tank cover)
Sound absorber (2, tank cover)
Sound absorber (3, tank cover)
(6)To be applied along these lines
(7)To be applied along these lines
(8)To be applied along this line
(9)To be applied along this line

k. Counterweigt

1.Attaching the weight

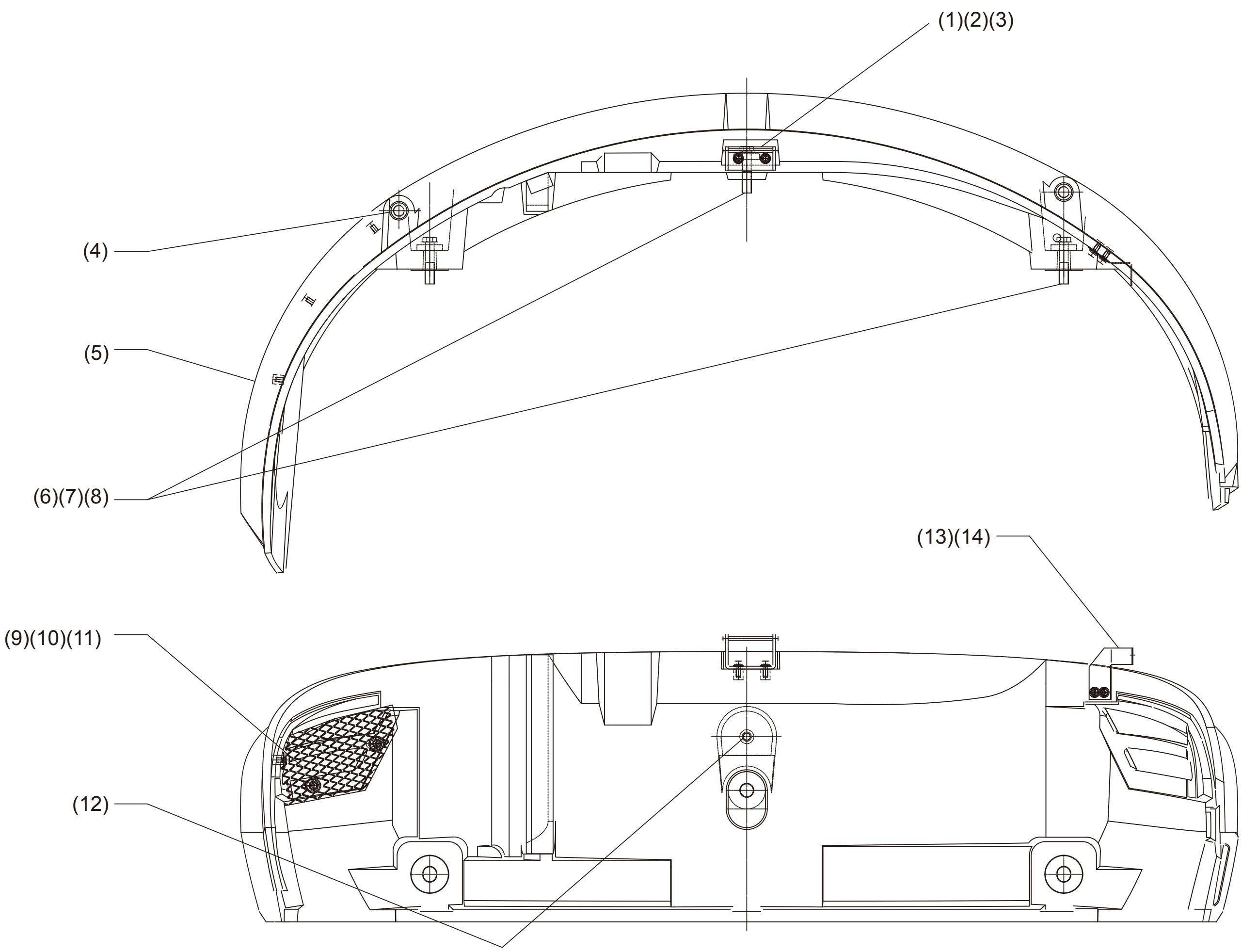
Tightening torque
Three M20 bolts at the back
367.7~431.5N.m (37.5~44.0kgf.m)
271.2~318.3ft.lbs

Apply screw adhesive (Loctite 271).

2.Fitting the stay (hook lock), cover (weight) and bracket (left cover)

Tightening torque
48.1~55.9N.m (4.9~5.7kgf.m) 35.5~41.2ft.lbs

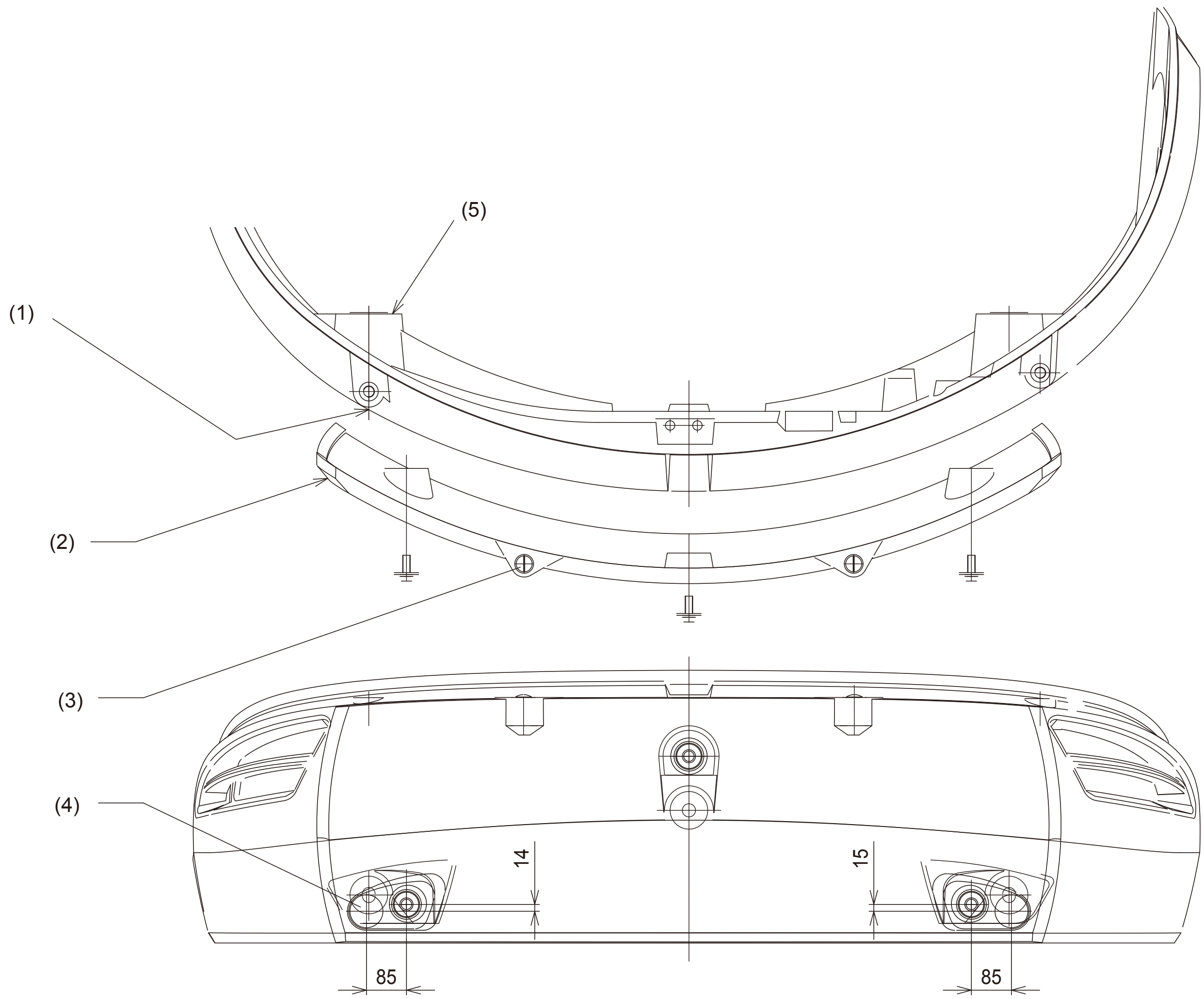
(1)Stay (hood lock)
(2)Shim (T2)
(3)Bolt
(4)Plug (M24)
(5)Weight (870)
(6)Bolt
(7)Washer
(8)Spring washer
(9)Cover (weight)
(10)Bolt
(11)Plain washer
(12)Plug
(13)Bracket (left cover)
(14)Bolt



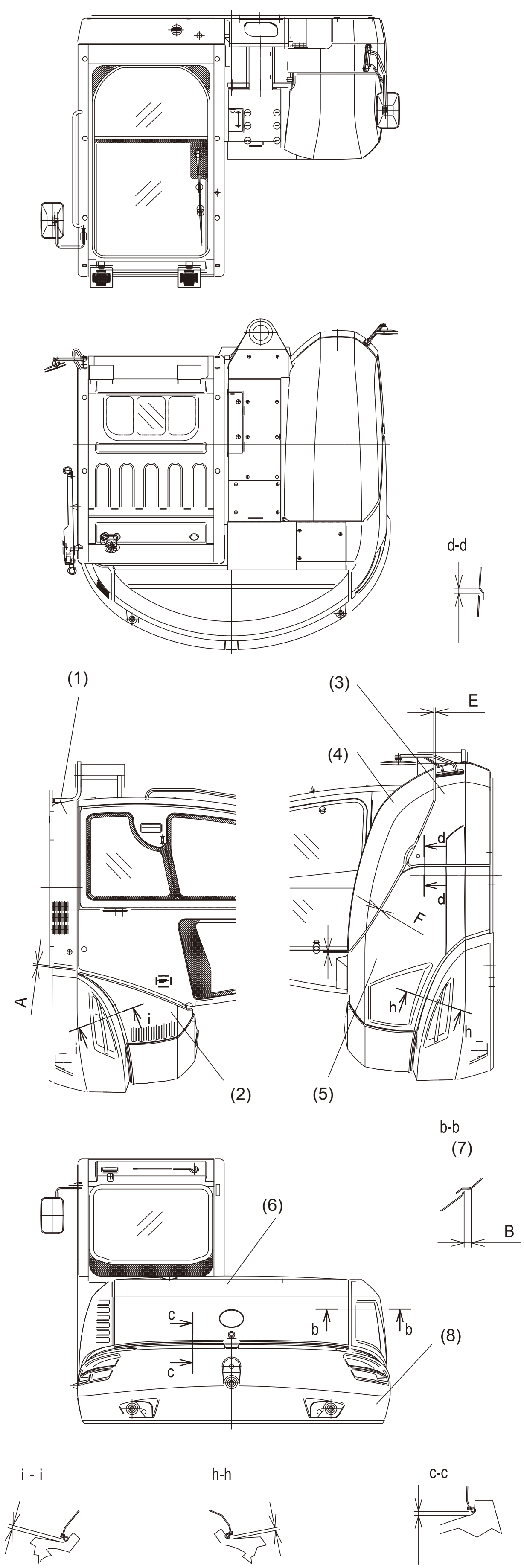
3.Attaching the additional weight

Tightening torque
Three M16 bolts
259.5~304.0N.m(26.5~31.0kgf.m)
191.4~224.2ft.lbs

Apply screw adhesive (Loctite 271).



(1)Before attaching the weight (200, additional), peel the label (reflector, red, EU) off the weight (870).
(2)Weight (200, additional)
Bolt
Plain washer
(3)Plug (M24)
(4)Label (reflector, red, EU)
(5)Weight (870)



I. Clearances of cover

1.Clearance between cover (left) and weight (870)
Clearance A shown at left
8~12mm(0.31~0.47inch)

2.Clearance between hood (back) and each side
Clearance B shown at left
16~20mm(0.63~0.79inch)

3.Clearance between hood (back) and weight
Clearance C shown at left
8~12mm(0.31~0.47inch)

4.Clearance between cover (front) and cover (right)
Clearance D shown at left
10~14mm(0.39~0.55inch)

5.Clearance between cover (front) and cover (tank)
Clearance E shown at left
8~12mm(0.31~0.47inch)

6.Clearance between cover (right) and cover (tank)
Clearance F shown at left
10~14mm(0.39~0.55inch)

7.Clearance between cover (right) and weight (870)
Clearance G shown at left
4~8mm(0.16~0.31inch)

8.Clearance between cover (arch, left) and weight (870)
Clearance H shown at left
5~9mm(0.20~0.35inch)

9.Level difference between corners
Clearance I shown at left
6~10mm(0.24~0.39inch)

10.Dimensional difference at clearances
Less than 3 mm
(0.12inch) 2mm(0.08inch)

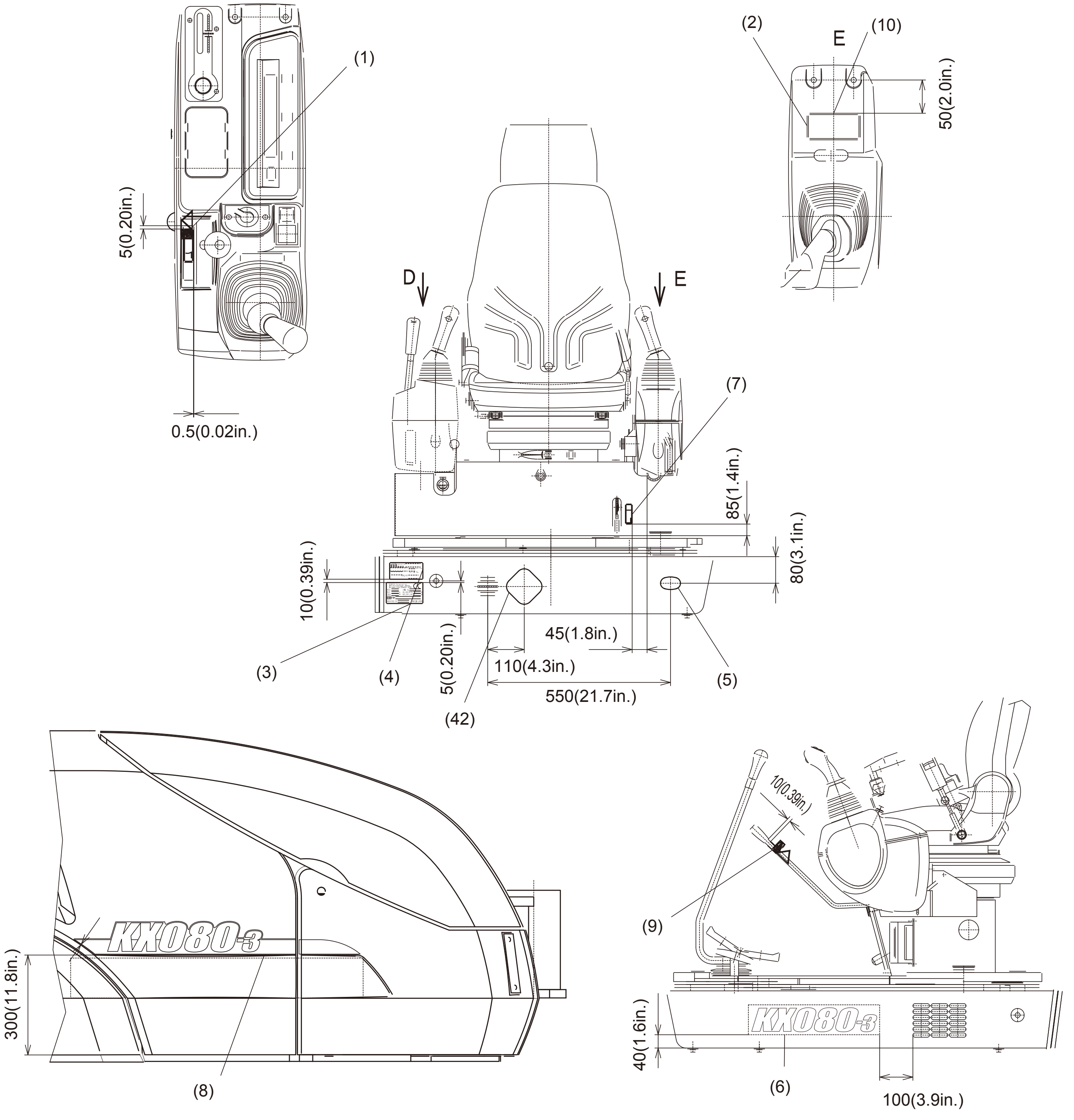
(1)Cover (left)
(2)Cover (arch, left)
(3)Cover (front)
(4)Cover (tank)
(5)Cover (right)
(6)Cover (back)
(7)(Same on the other side)
(8)Weight (870)

m. Labels

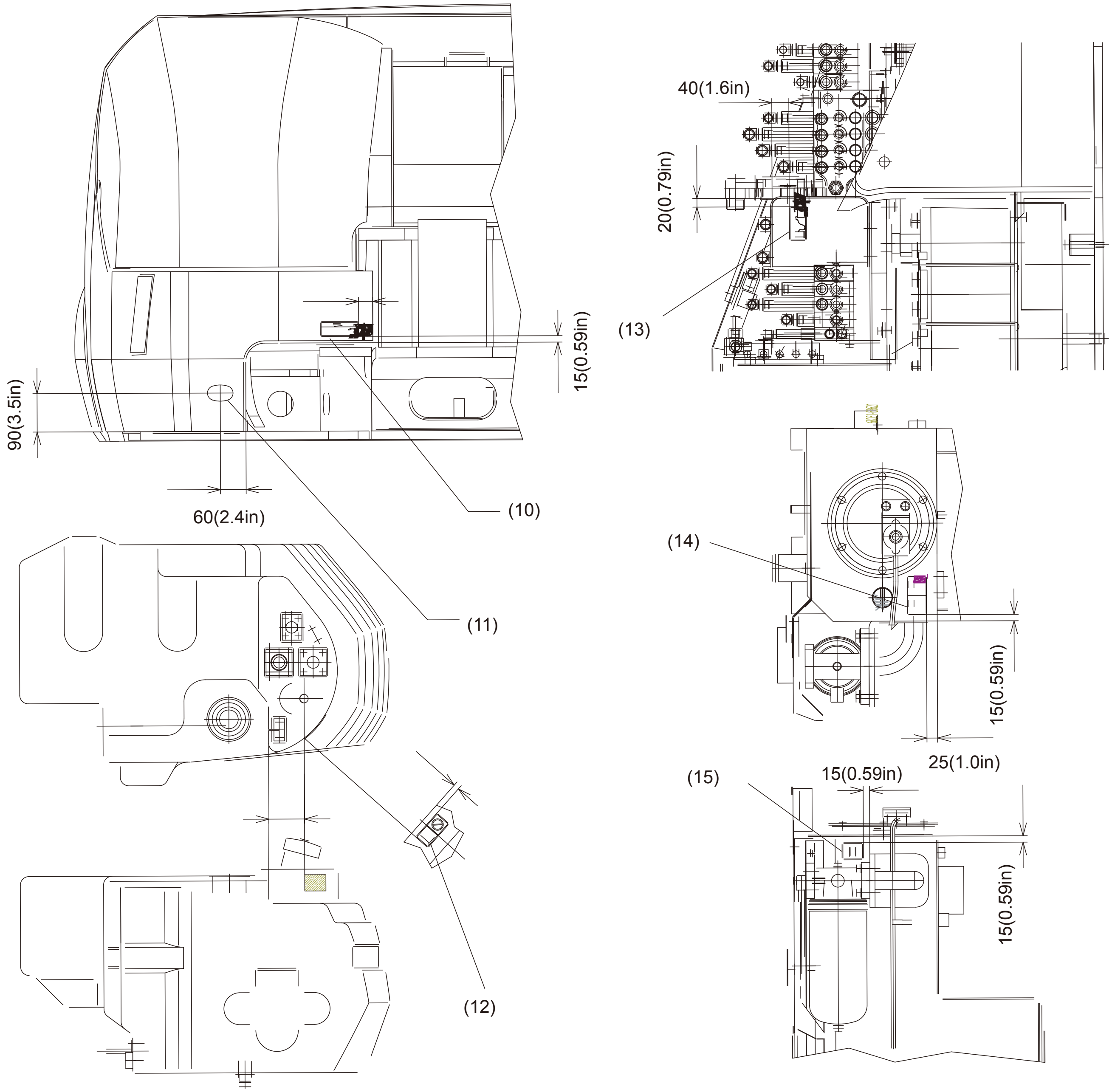
List of labels

No.	Location	Part name	Q'ty	Remarks
1	Control cover (right, top)	Label (blade)	1	
2	Control cover (left, top)	Label (control pattern A)	1	
3	↑	Nameplate (PC board, CE)	1	
4	Frame cover (left)	Label (bar code)	1	
5	↑	Label (reflector, white, EU)	1	
6	↑	Marking (model number, left)	1	
7	Cover (seat support)	Label (attachment switching)	1	
8	Hood cover (right)	Marking (model number, right)	1	
9	Lever (lock)	Label (lever lock)	1	
10	Frame cover (front)	Label (greasing)	1	
11	↑	Label (reflector, white, EU)	1	
12	Fuel tank	Label (fuel filler)	1	
13	Cover (switch, fuel filler)	Label (fuel pump)	1	
14	Hydraulic tank	Label (third line, EU)	1	
15	↑	Label (hydraulic 2)	1	
16	Frame (1, arch)	Label (muffler, warning)	1	
17	Shroud (fan)	Label (fan, warning)	1	
18	↑	Label (burn caution)	1	
19	Hood (back)	Label (muffler, warning)	1	
20	↑	Label (access prohibited)	2	
21	↑	Marking (K, emblem)	1	
22	↑	Label (control caution)	1	
23	Weight	Label (reflector, red, EU)	2	
24	Boom	Marking (Kubota 1)	2	
25	↑	Label (hoisting)	2	
26	↑	Label (swing caution)	2	
27	Blade	Label (hoisting)	2	
28	Frame (track)	Label (plug)	2	
29	Cabin	Label (windshield lock, EU)	1	
30	↑	Label (emergency exit)	1	
31	↑	Label (inspection)	1	
32	↑	Label (swing)	1	
33	↑	Nameplate (ROPS, cabin)	1	
34	↑	Label (anti-theft)	2	
35	↑	Label (seat belt)	1	
36	↑	Label (hoisting load, EU)	1	
37	↑	Label (manual)	1	
38	↑	Label (control, SP)	1	
39	↑	Label (hoisting prohibited, EU)	4	
40	↑	Marking (LPA)	1	

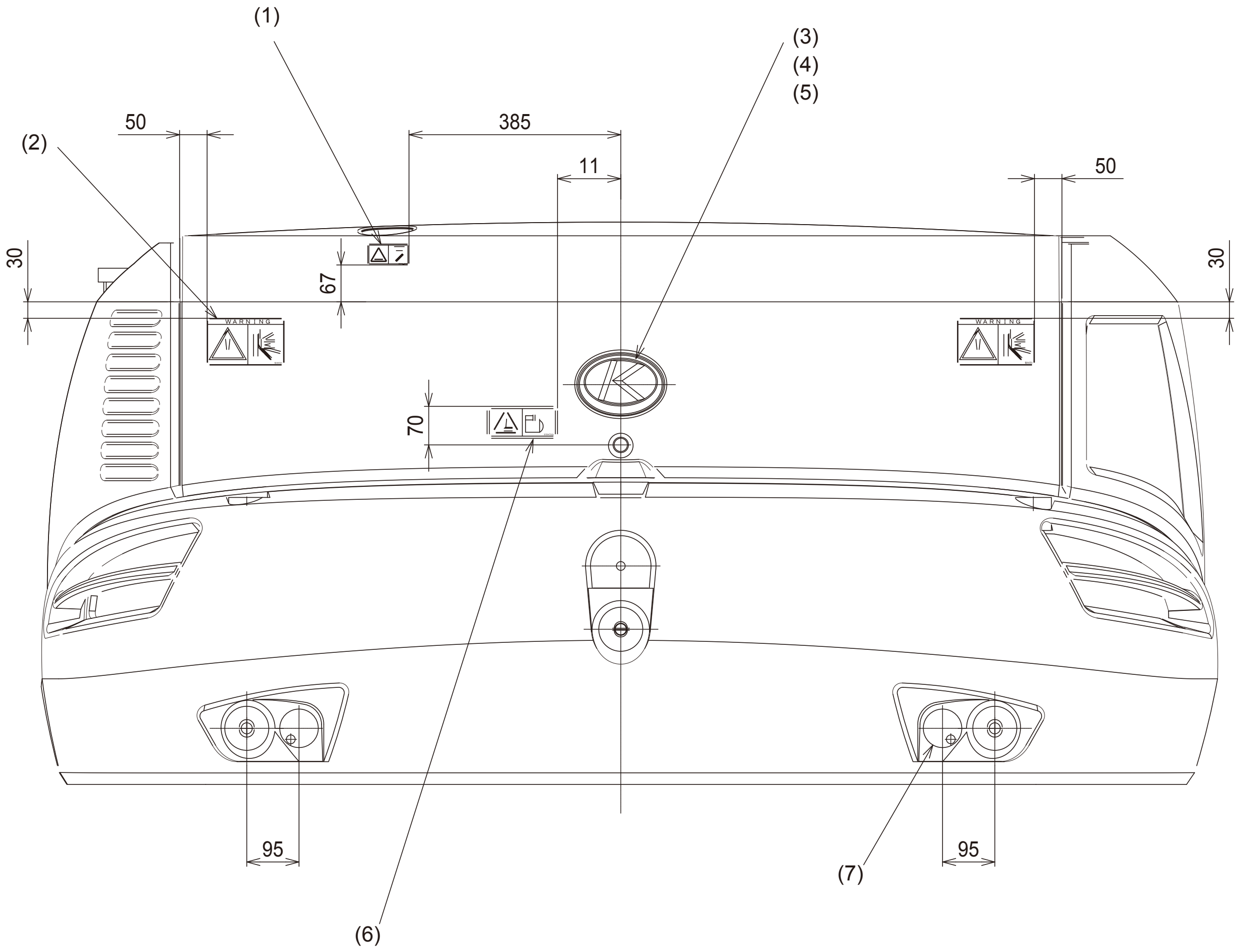
No.	Location	Part name	Q'ty	Remarks
41	↑	Marking (LWA)	1	
42	Frame cover (left)	Label (new-vehicle sticker)	1	



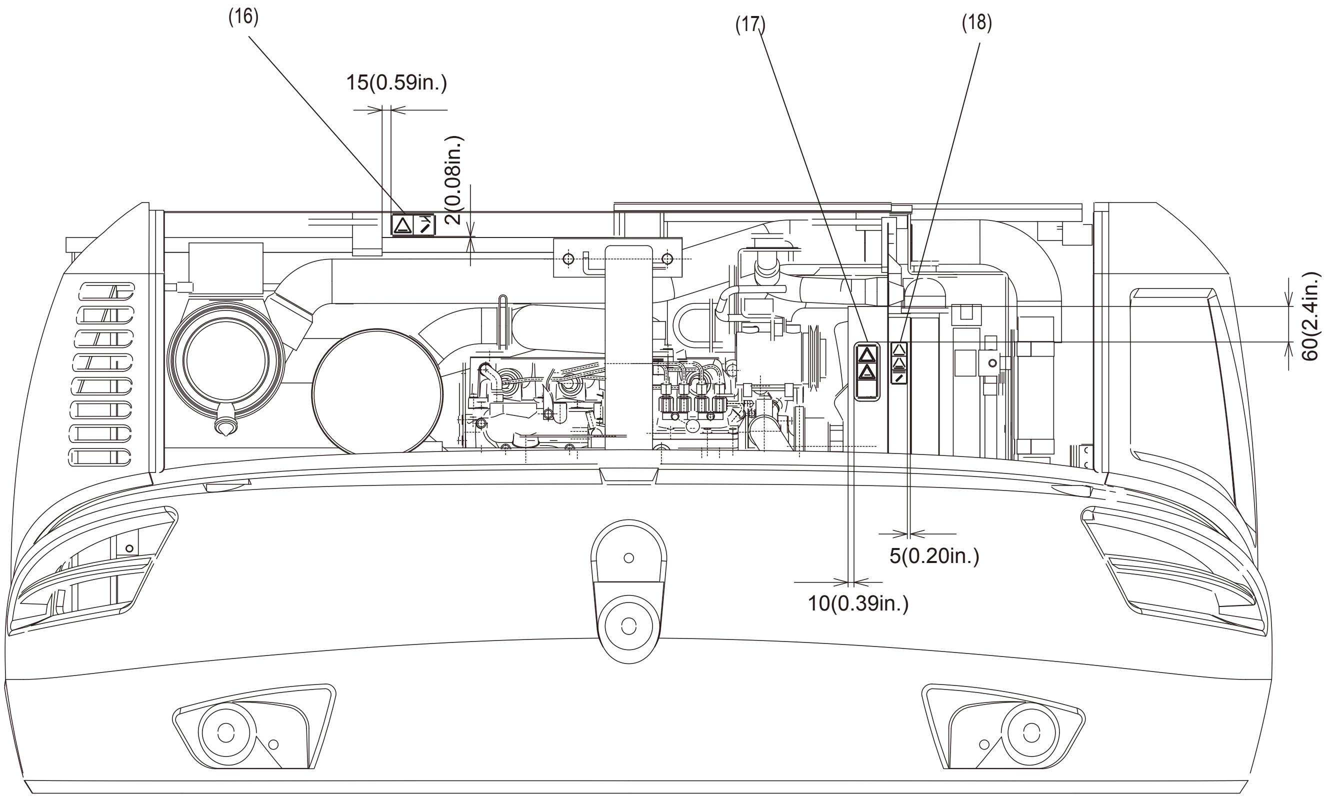
(1)Label (blade)
(2)Label (control pattern A)
(3)Nameplate (PC board, CE)
(4)Label (bar code)
(5)Label (reflector, white, EU)
(6)Marking (model number, left)
(7)Label (attachment switching)
(8)Marking(model number, right)
(9)Label (lever lock)
(10)To be applied at the center
(42)Label (new-vehicle sticker)



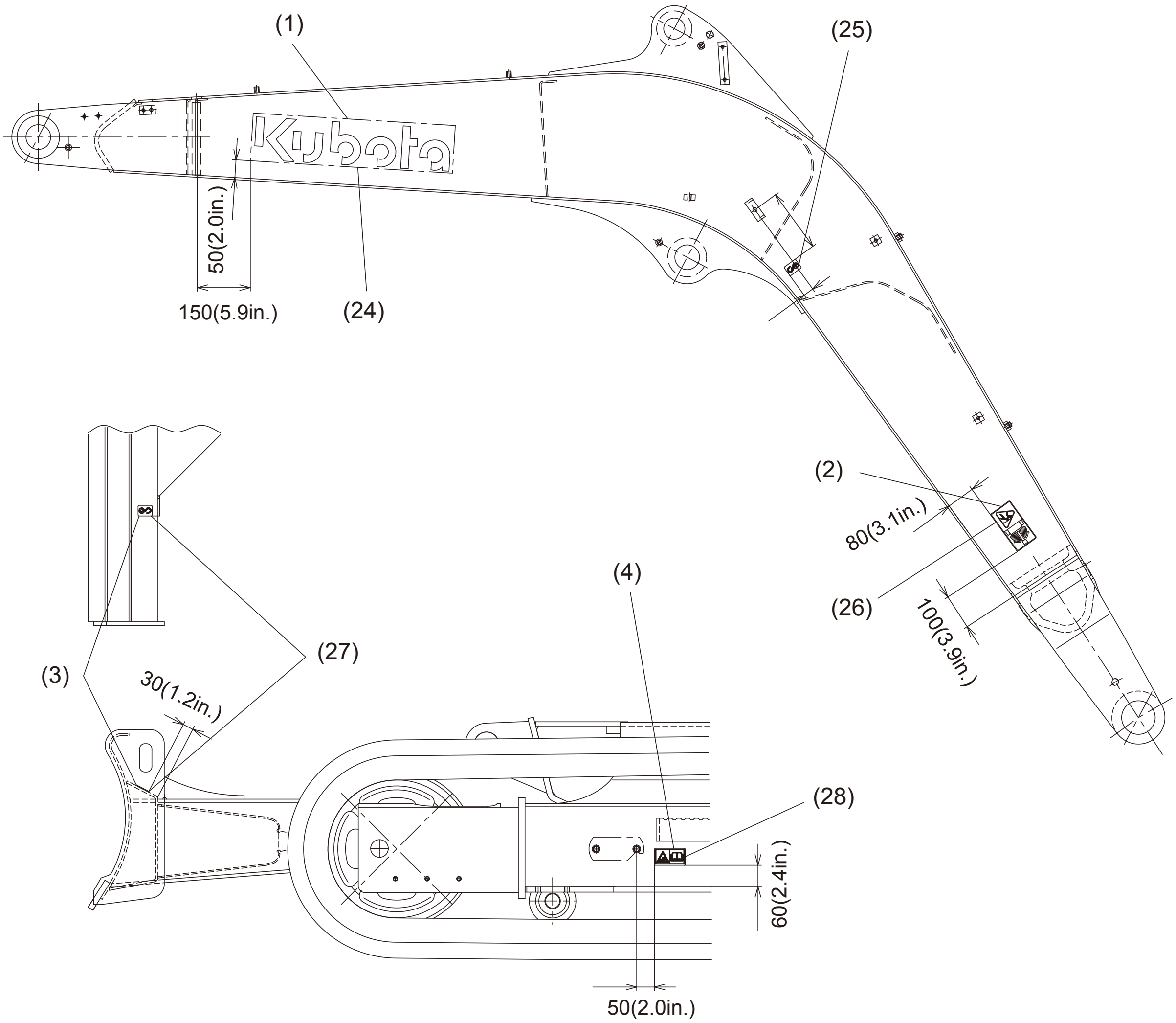
(10)Label (greasing)
(11)Label (reflector, white, EU)
(12)Label (fuel filler)
(13)Label (fuel pump)
(14)Label (third line, EU)
(15)Label (hydraulic 2)



(1)Label (muffler, warning)
(2)Label (access prohibited)
(2 locations: left and right)
(3)Marking (K, emblem)
(4)Nut (speed) (3 pcs.)
(5)Washer (plate) (3 pcs.)
(6)Label (control caution)
(7)Label (reflector, red, EU)
(2 locations: left and right)

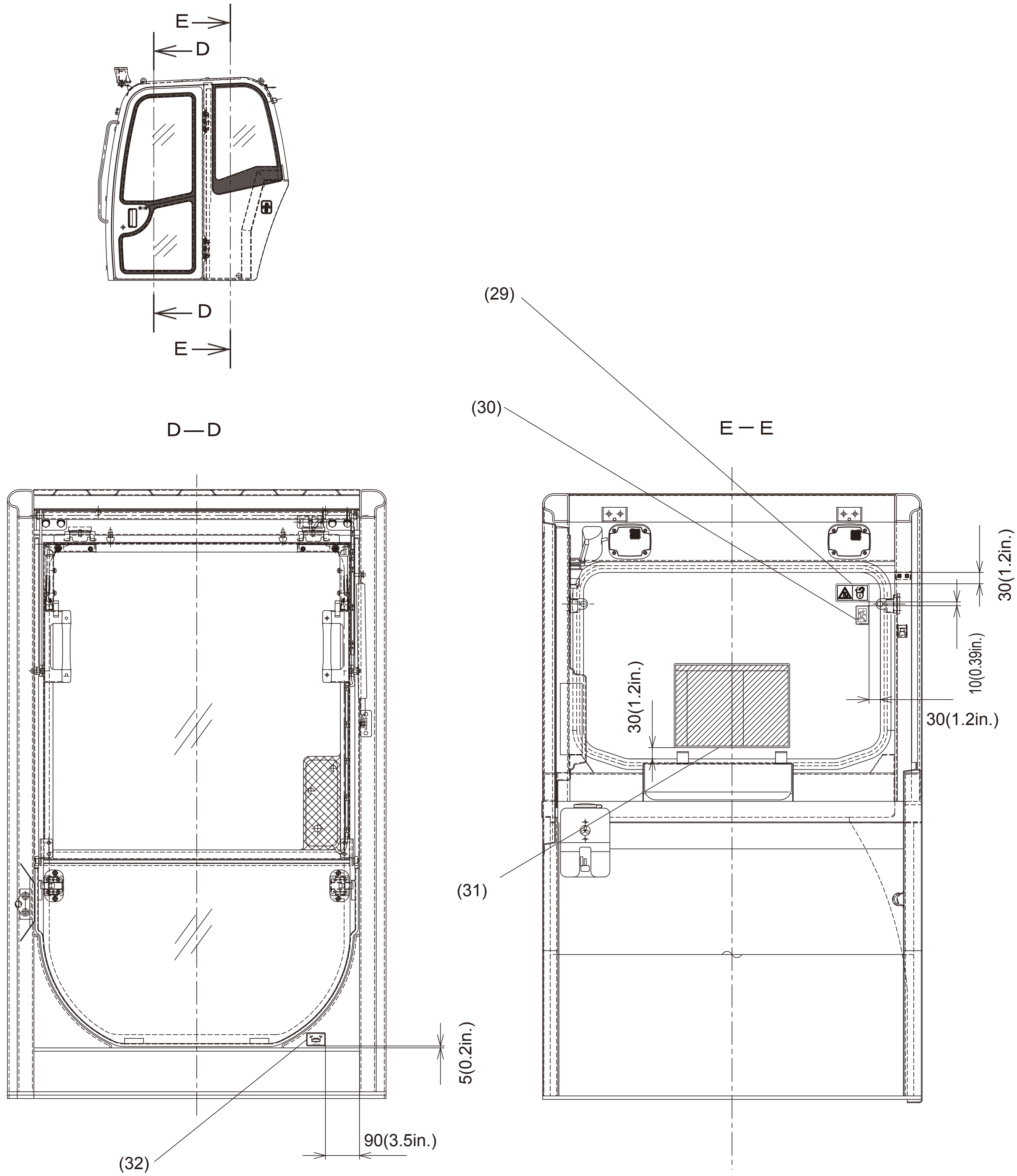


(16)Label (muffler, warning)
(17)Label (fan, warning)
(18)Label (burn caution)

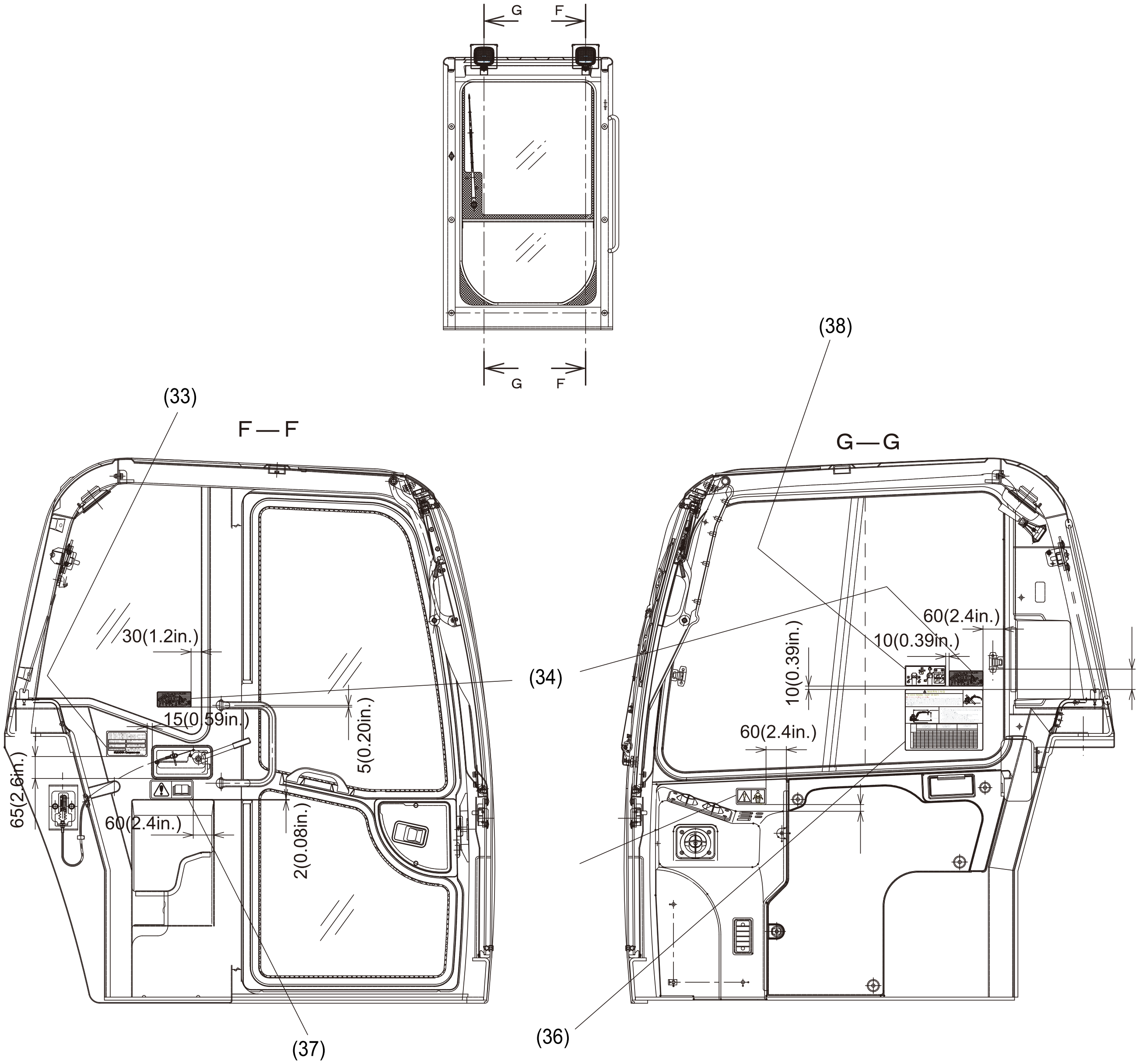


(24)Marking (Kubota 1)
(2 locations: on both sides)
(25)Label (hoisting)
(2 locations: on both sides)
(26)Label (swing caution)
(2 locations: on both sides)
(27)Label (hoisting)
(2 locations: on both sides)
(28)Label (plug)
(2 locations: on both sides)

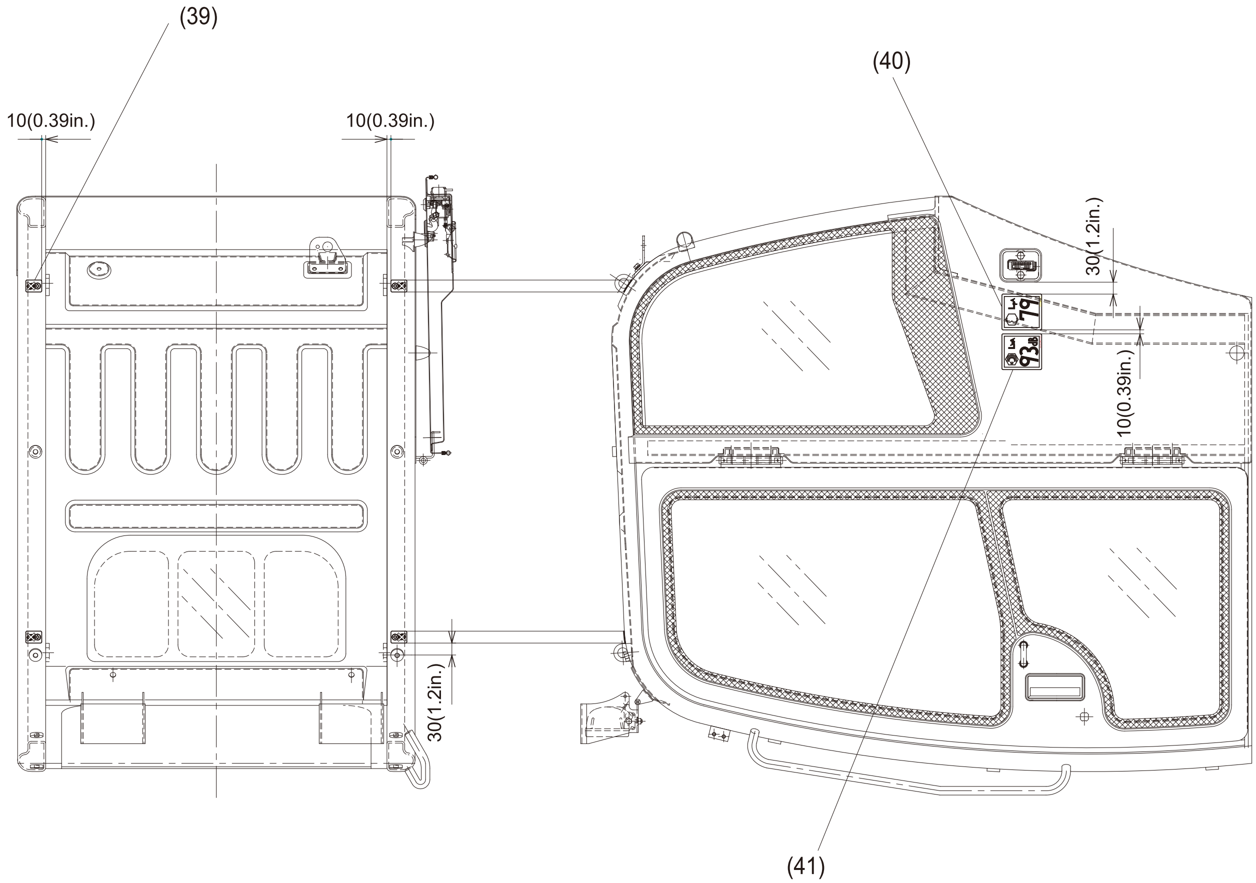
(1)Apply the same way on the other side too.
(2)Apply the same way on the other side too.
(3)Apply the same way on the other side too.
(4)Apply the same way on the other side too.



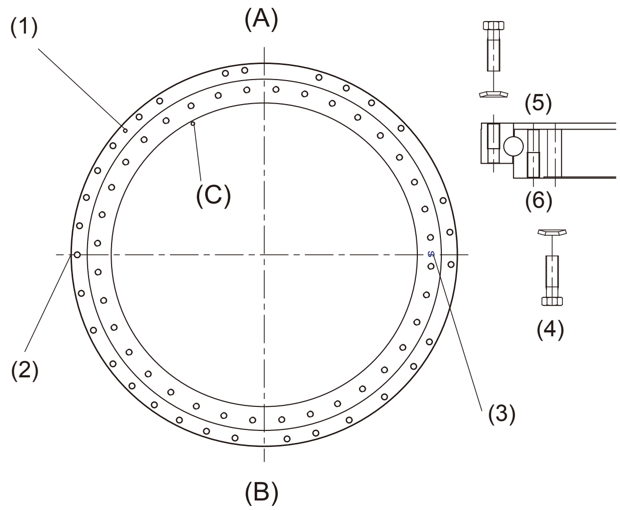
(29)Label (windshield lock, EU) (to be applied on the window pane's inner face)
(30)Label (emergency exit) (to be applied on the window pane's inner face)
(31)Label (inspection) (to be applied on the window pane's inner face)
(32)Label (swing) too.

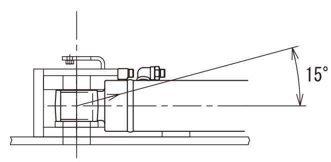


(33)Nameplate (ROPS, cabin)
(34)Label (anti-theft) (2 locations)
(to be applied on the window pane's inner face)
(35)Label (seat belt)
(36)Label (hoisting load, EU) (to be applied on the window pane's inner face)
(37)Label (manual)
(38)Label (control, SP)
(to be applied on the windshield's inner face)



(39)Label (hoisting prohibited, EU)
(4 locations)
(40)Marking (LPA)
(41)Marking (LWA)





Swing cylinder connector direction

(A)Machine front
(B)Machine back
(C)Tooth surface to be greased

(1)Ball greasing port
(to be aligned with swivel frame holes)
(2)Ball insertion hole
(Specific inner race zone)
(3)"S" mark
(Specific inner race zone)
(4)Pay attention to the disc spring direction.
(5)(Swivel frame side)
(6)(Track frame side)
(7)(Swivel bearing tooth surface)
(8)(Swivel bearing ball)
(9)(Swing cylinder bottom)
(10)(Point A)

n. Swivel bearing

(Pass through the left and right vertical rib holes and connect into position.)

1.Fitting the bearing (swivel)

Set the bearing with its specific inner race zone ("S" mark) at the right side of the machine.

2.Tightening torque

259.5~304.0N.m (26.5~31.0kgf.m)
191.4~224.2ft.lbs
Tighten temporarily first and then retighten diagonally.
Apply screw adhesive (Loctite 271).

3.Greasing the tooth surface

Apply grease evenly all over the bearing tooth surface.

Swivel bearing mounting bolt

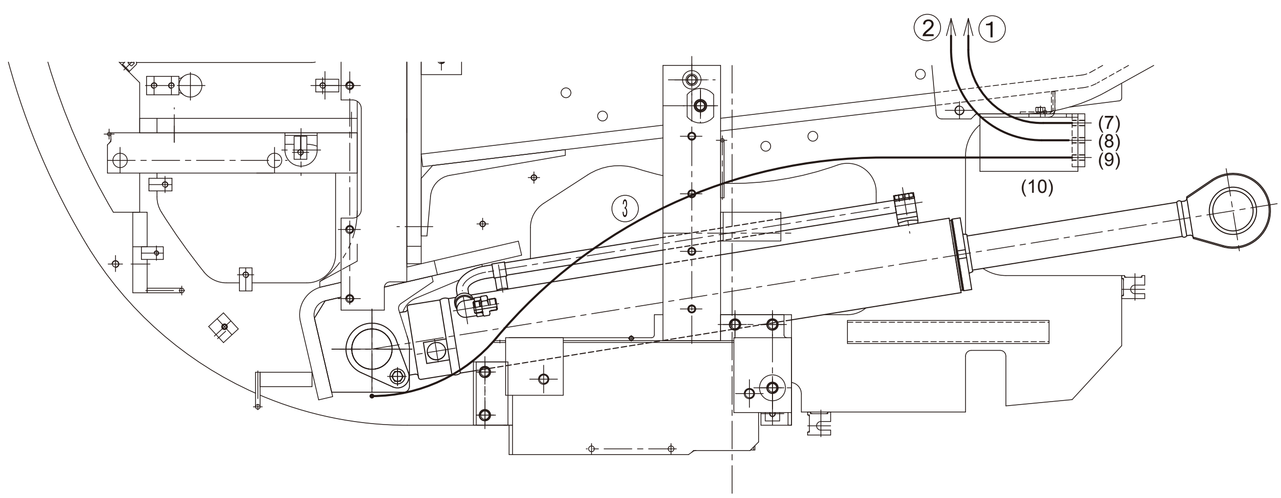
	Bolt	Washer
Track frame (lower)	01176-61660	36500-4941∆
Swivel frame (upper)		

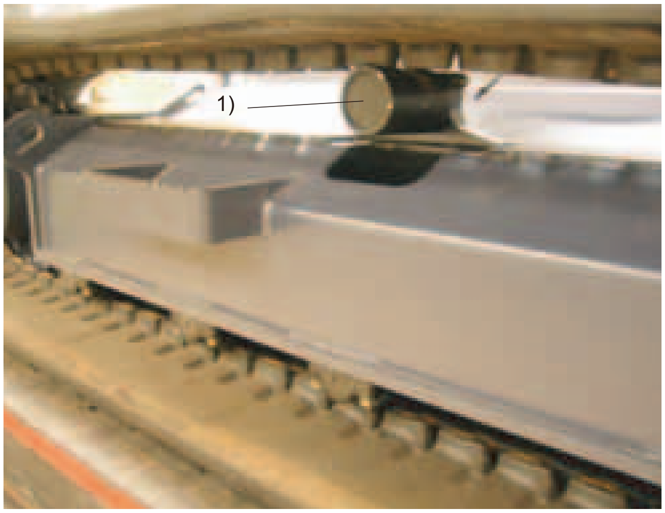
4.Routing the grease tubes up to the swivel bearing and swing cylinder, and connector tightening angle

Connect the tube as shown in the figure

Swivel bearing mounting bolt

No.	Grease tube length	Greasing adaptor
1	RD-809-1921∆ (L=900)	68721-6748∆
2	RD-809-1922∆ (L=1150)	68721-6748∆
3	RD-801-6743∆ (L=1300)	68721-6748∆



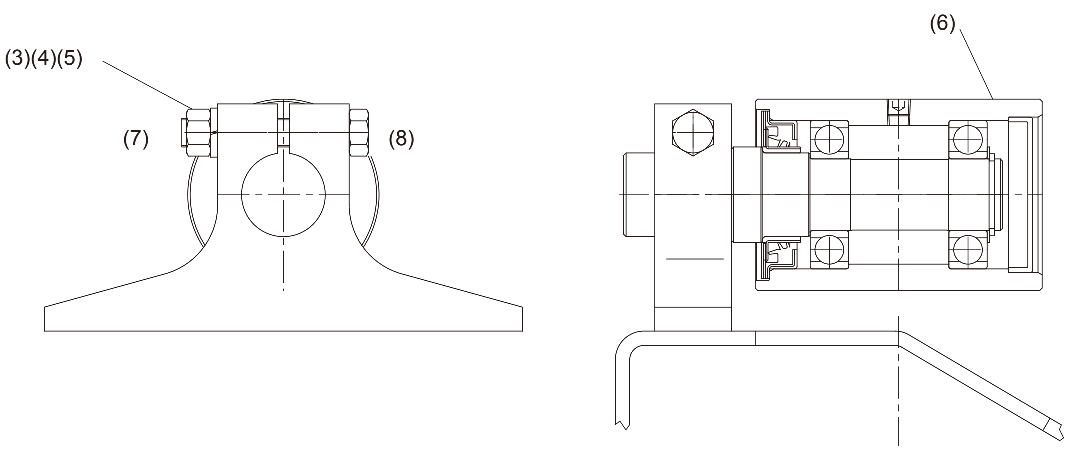


o. Undercarriage

1.Upper roller

1)Upper roller

2)Bolt
Bolt tightening torque
77.5~90.2N.m (7.9~9.2kgf.m)
57.2~66.5ft.lbs
Apply screw adhesive (Loctite 271).



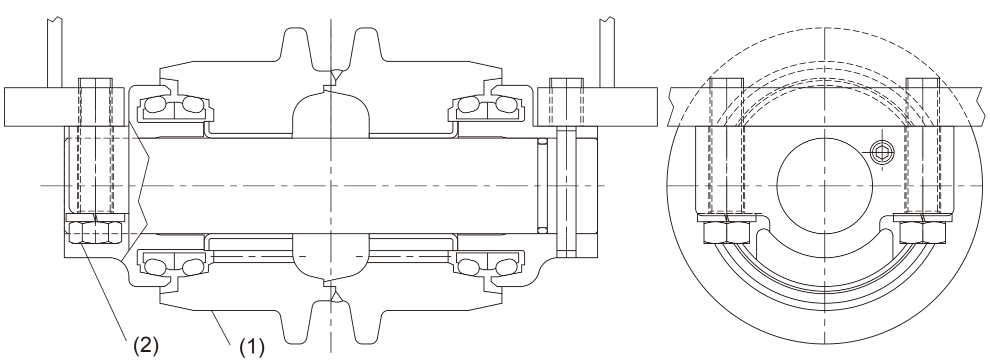
(3)Bolt
(4)Nut
(5)Spring washer
(6)Carrier roller
(7)Machine back
(8)Machine front

2.Track roller

Sprocket and track roller out of alignment
(Idler to be loosely in center)
Within ± 2 mm (0.08in.) (reference)

Bolt tightening torque
166.7~196.1N.m (17.0~20.0kgf.m)
123.0~144.6ft.lbs

* Apply screw adhesive (Loctite 271).
  Carefully remove oil, fat and paint.



(1)Track roller assembly
(2)Bolt

3. Front idler

4.Grease tension cylinder

5.Grease tension spring

6.Rubber track removing

p. Track adjustment

1.Grease management

No grease leak is allowed.
* Wipe off grease deposits around.

2.Fitting to the track frame

Make sure the crawler slides smoothly.
* Do not force it into position.

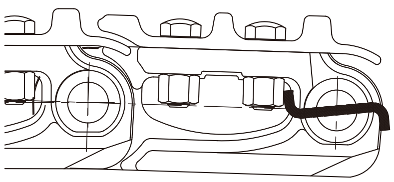
3.Spring preset length

*Set the cotter pin into the hole closest to the dimension specified at left.
(Rubber crawler type) 319mm(12.6inch)
(Iron crawler type) 334mm(13.1inch)

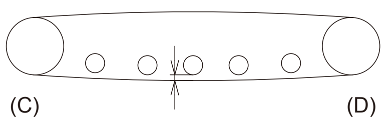
4.Adjusting the crawler tension

Measure at the third roller.
(Rubber crawler type) 25~40mm(1.0~1.6inch)
(Iron crawler type) 40~55mm(1.6~2.2inch)

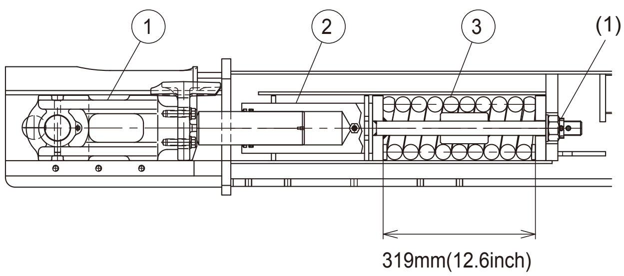
(A)

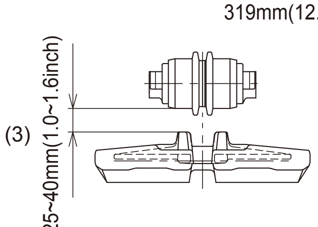


(B)



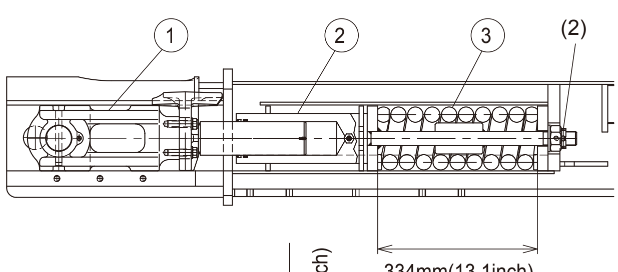
(A)Master pin insertion position: View from the lock pin side
(B)Be careful not to confuse the lock pin bending direction. Bend the lock pin as parallel as possible to avoid turning.
(C)Sprocket side
(D)Idler side

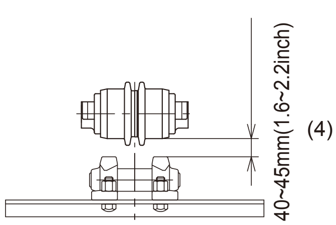




Rubber track type

No.	Part name
1	Idler assembly
2	Cylinder assembly
3	Spring assembly (rubber)





Iron track type

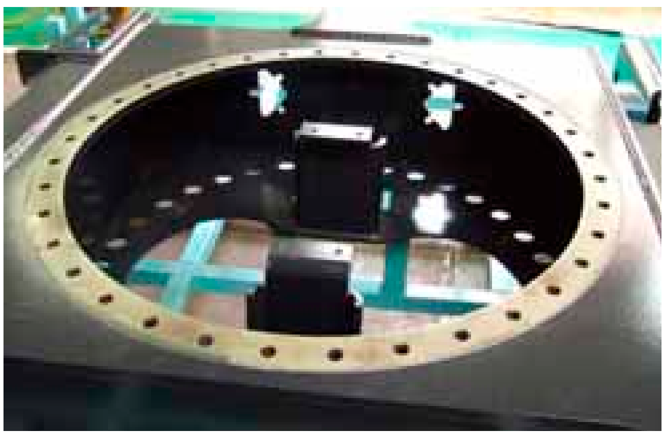
No.	Part name
1	Idler assembly
2	Cylinder assembly
3	Spring assembly (rubber)

(1)Set the cotter pin into the hole inside.
(2)Set the cotter pin into the hole outside.
(3)Rubber track
(4)Iron track

q. Swivel frame and track frame

1.Swivel frame assy

2.Swivel bearing



3.Track frame

III. Engine

Mechanism Section

A.Engine

a. Engine specifications

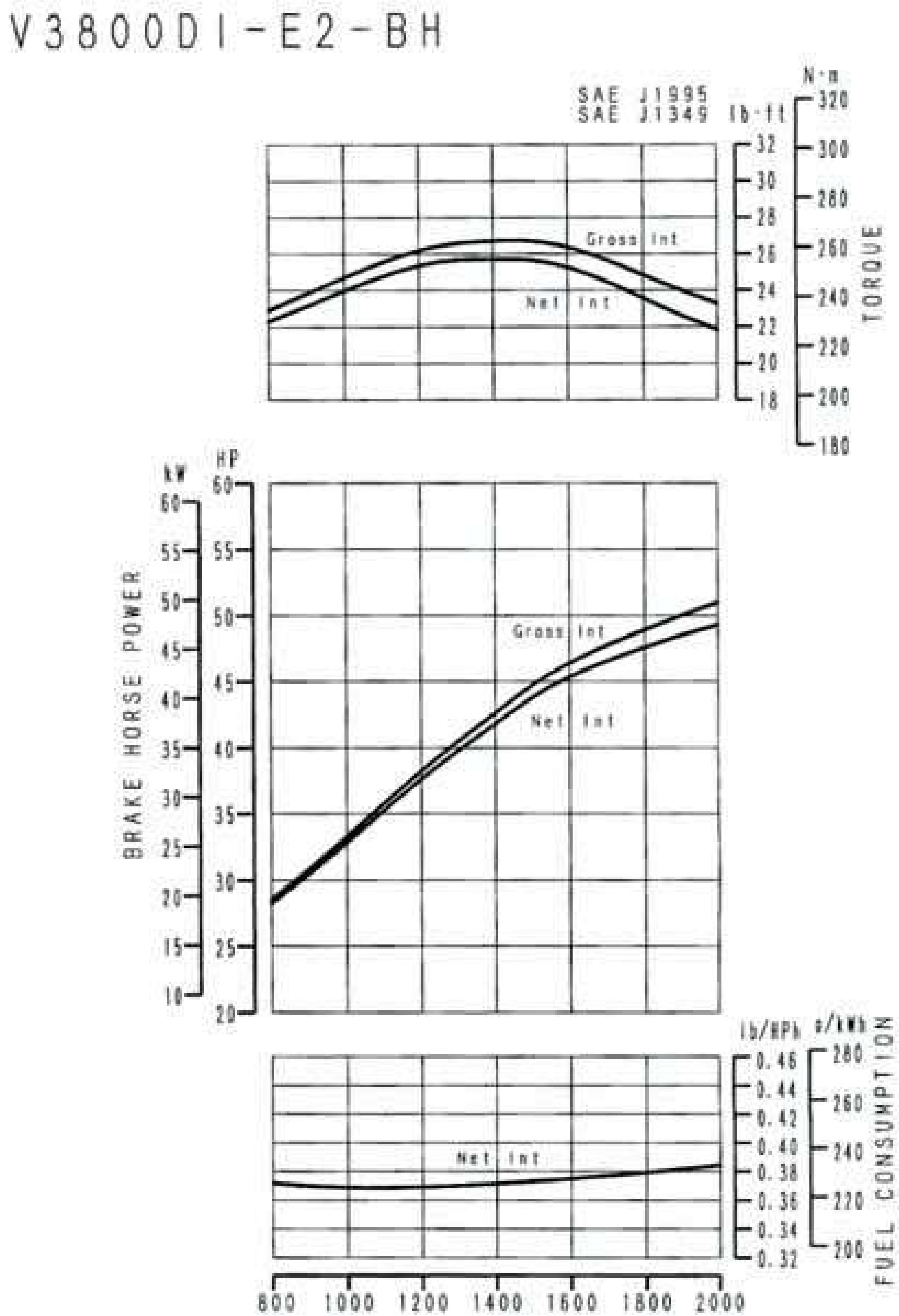
	Unit	KX080-3	Remarks
Model		V3800DI-E2-BH	
Number of cylinder		4	
Bore x Strok	mm	100 x 120	
	in	3.94 x 4.72	
Displacement	cc	3769	
	in^3	230.01	
Max. output/rpm	kW/rpm	47.8 / 2000	New engine s tolerance: 5%
	PS/rpm	65.0 / 2000	
	HP/rpm	64.1 / 2000	
Compression ratio		20	
Max. torque/rpm	N.m	262.7 / 1400	New engine s tolerance: 5%
	kgf.m	26.79 / 1400	
	ft.lbf	193.8 / 1400	
Dimensions: L x W x H	mm	798 x 548 x 789	
	in	31.4 x 21.6 x 31.1	
Dry weight	kg	278	
	lbs	612.9	
Valve clearance	mm	0.23 - 0.27	Cold condition
	in	0.0091 - 0.0106	
Firing sequence		1-3-4-2	
Combustion chamber		(Direct Injection)	
Compression pressure (A)/(B)	MPa	3.73 - 3.92 / 2.90	Ref. value/Service limit
	kgf/cm^2	38 - 40 / 29.6	
	psi	540 - 569 / 421	
Fan belt		Bando RPF3475	
Fuel consumption ratio	g/kWh	232	Net value
	g/PSh	171	
	lbs/HPh	0.382	
Fuel consumption	l/h	13.2	Load factor = 100% Fuel specific gravity = 0.88
	US gal/h	3.49	
Engine speed with idling	rmp	1050 50	On the machine
Engine oil pressure with rated engine rpm	kPa	196 - 392 / 98	
	kgf/cm^2	2.0 - 4.0 / 1.0	
	psi	28 - 57 / 14	
Fuel injection pressure 1st stage/2nd stage	MPa	18.6 / 23.5	
	kgf/cm^2	190 / 240	
	psi	2702 / 3414	
Engine oil consumption ratio	g/kWh	0.48	
	g/PSh	0.35	
	lbs/HPh	0.00078	

Engine electric components

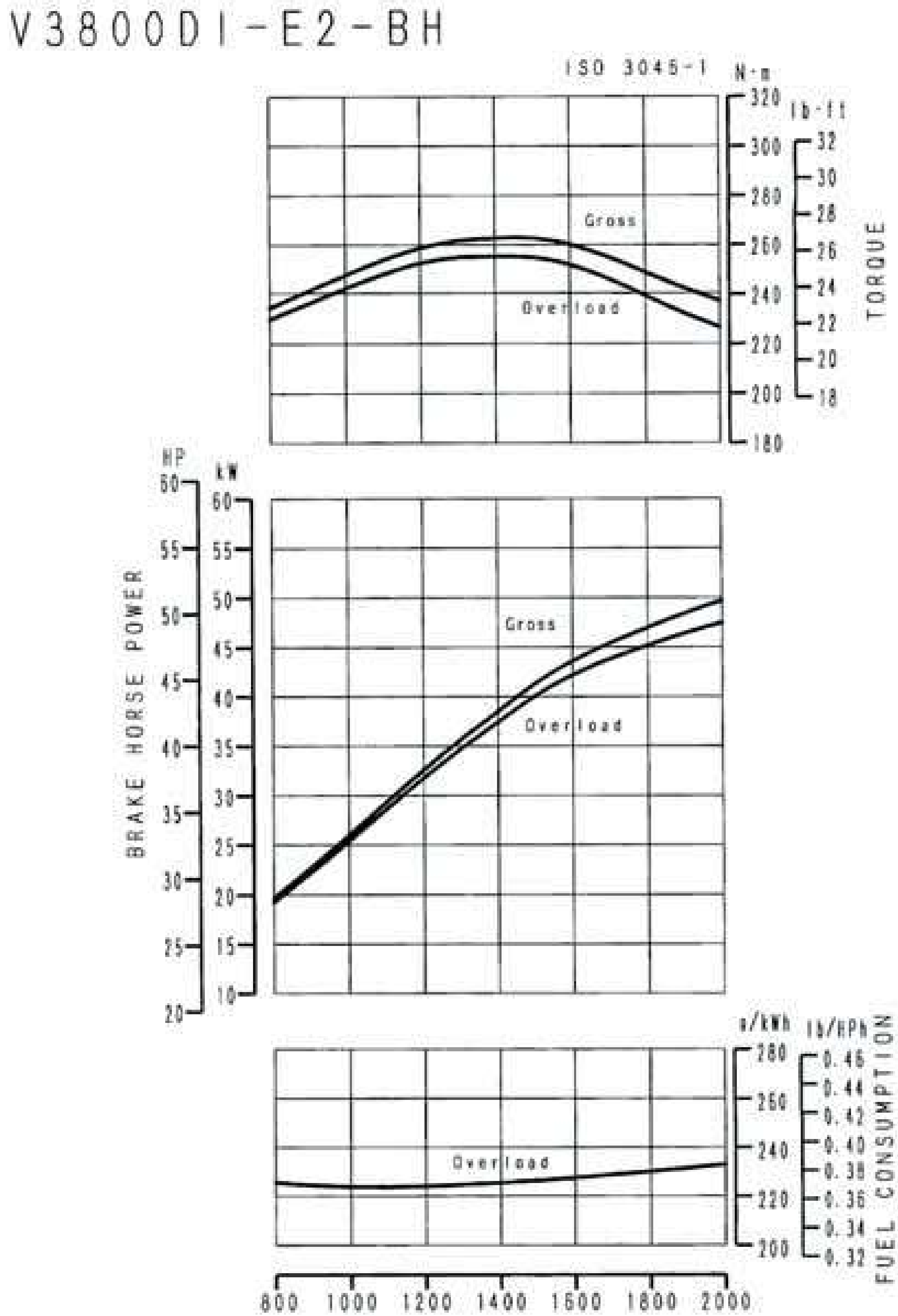
	Unit	KX080-3	Remarks
Engine model		V3800DI-E2-BH	
Fuel injection pump type		Bosch P type mini-pump	
Nozzle type		Bosch P type	
Fuel injection pressure 1st stage/2nd stage	MPa	18.6 / 23.5	
	kgf/cm^2	190 / 240	
	psi	2702 / 3414	
Alternator		12V 720W	
Kubota Part No.		1G524-6401-0	
Regulator adjusting voltage	V	14.4 - 15	at 20°C (68°F)
Battery type (JIS)		130E41R	
Nominal Capacity of 5 hrs rating	Ah	92	
Specific gravity of electrolite		1.28	
Starter motor		12V 2.7kW	
Manufacturer P/N		1G524-6301-0	
Starting support device		Intake air heater in intake manifold	

b. Performance curve

V3800DI-E2-BH (SAE)



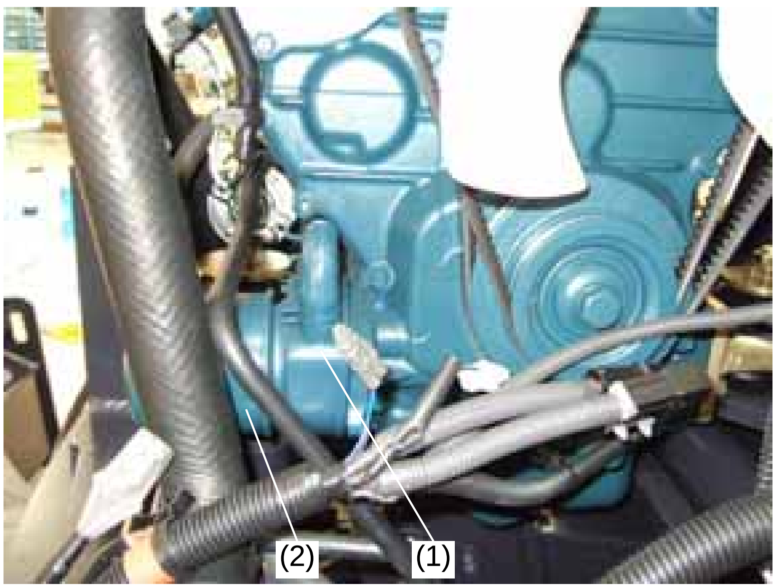
V3800DI-E2-BH (ISO)



c. Different installation from V3800 basic model.

1. Starter moter

(1) Starter moter
1G524-6301-0



2. Oil filter

(1) Oil cooler
(2) oil filter

III Engine

Service Section

A. Troubleshooting

Refer to the following Engine WSM

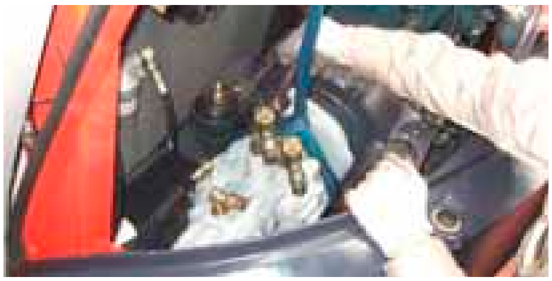
B. Serviceing specifications

Refer to the following Engine WSM

C. Disassemble and Reassmble

a. Pump coupling

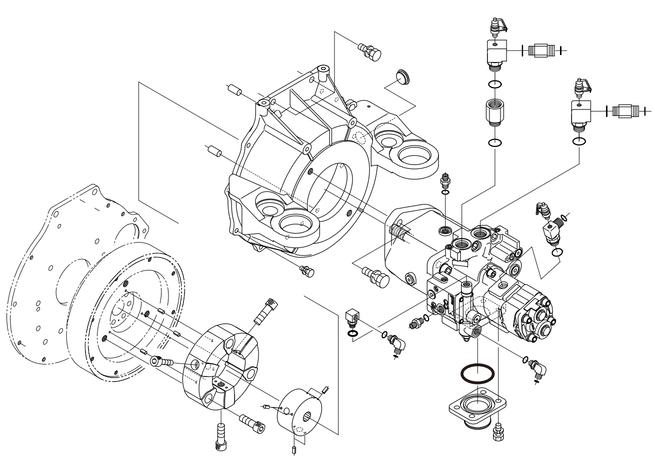
1.Disconnect the hoses and fit the plugs.



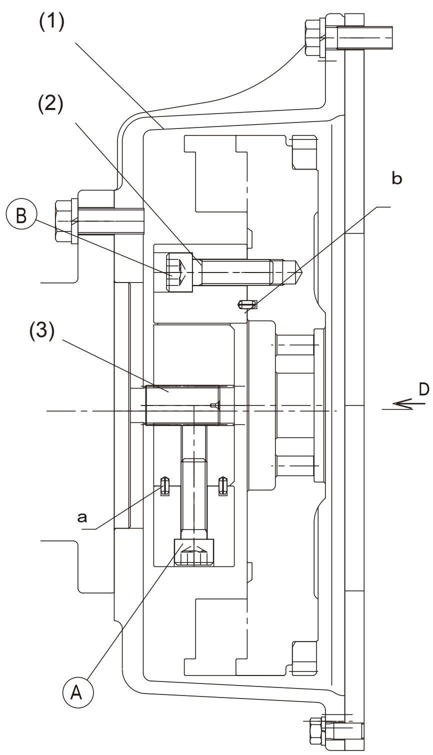
2.Hang the hydraulic pump with nylon sling.

3.Dismount the pump assy.

4.Pump housing.



5.Pump coupling.



6.When reassembling

1) Applying grease to the spline
Apply a proper amount of grease.
(Be careful not to allow it overflow.)

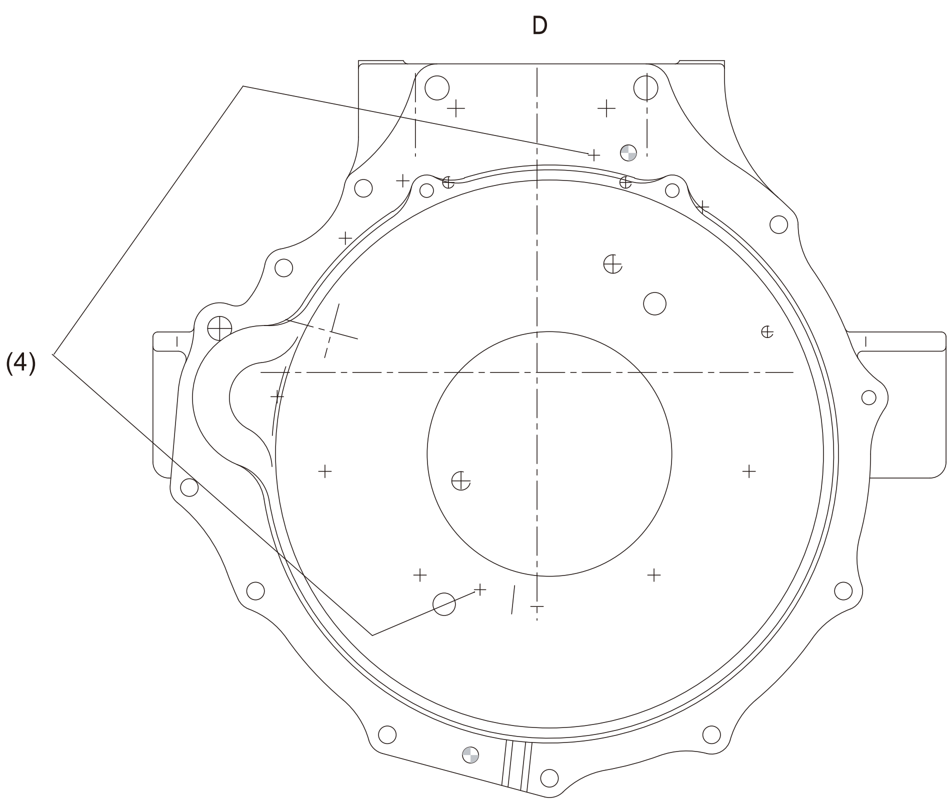
Be careful to keep the rubber free of grease.
Wipe off grease, if on the rubber, immediately.

2) Fitting sequence of the coupling **A**
(A): Tighten up first.
*Set the coupling to the spring pin (a) and tighten up.

(B): Tighten up second.
*Set the coupling to the spring pin (b) and tighten up.

Tightening torque
210~230N.m(21.4~23.5kgf.m)154.9~169.6ft.lbs
* Do not apply screw adhesive.

(1)Housing (pump)
(2)Coupling
(3)Apply grease to the spline.
(4)Parallel pin



b. Radiator

1. Overall view

(1) Receiver
(2) Condenser
(3) Oil cooler
(4) Radiator

3.Stretch (A) of the fan out of the shroud (fan)

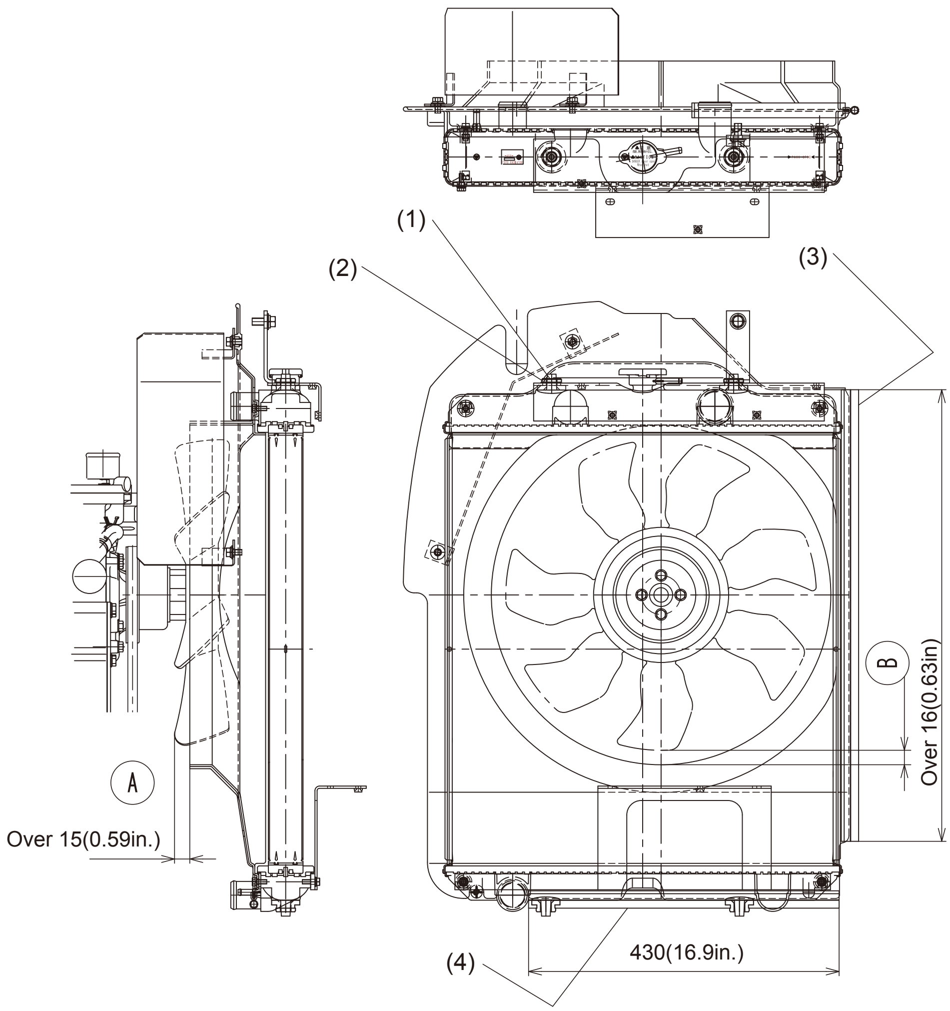
Around the fan
Reference dimension: 21 mm(0.83inch)
Minimum stretch: Over 15 mm(0.59inch)
Keep the entire stretch as small as possible.

4.Clearance (B) between fan and shroud (fan)

Around the fan
Reference dimension: 20 mm(0.79inch)
Minimum clearance: Over 16 mm(0.63inch)
Keep the entire clearance as small as possible.

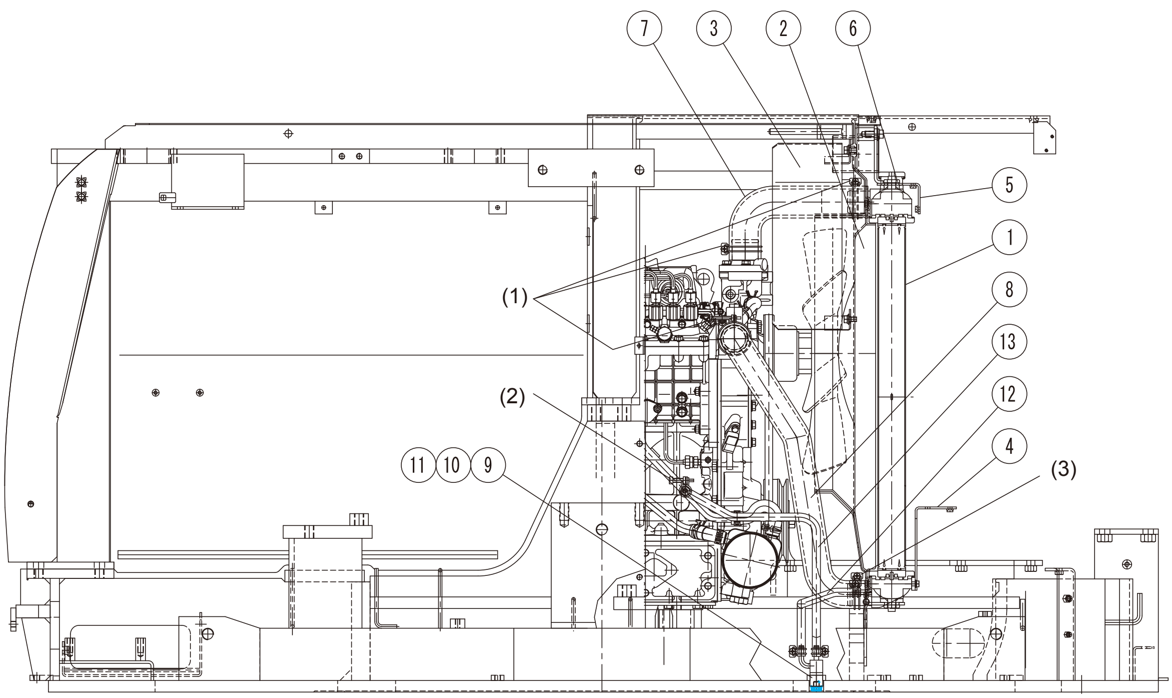
5.Install the rubber (radiator mount) to the bracket.

Place the rubber's claws tight into position
.



(1)Rubber (radiator mount)
(2)Make sure the claws are tight in their mating parts.
(3)Trim (625)
(4)Trim (430)

No.	Part name	Q'ty
1	Radiator assembly	1
2	Shroud (fan)	1
3	Cover (fan)	1
4	Bracket (1, oil cooler)	1
5	Bracket (2, oil cooler)	1
6	Rubber (radiator mount)	4
7	Hose (upper, WP)	1
8	Hose (lower, WP)	1
9	Base (drain)	1
10	Plug	1
11	Rubber-fitted washer	1
12	Hose (drain, 1)	1
13	Hose (drain, 2)	1



(1)Hose clamp (screw-in type 60)
(2)Hose clamp (screw-in type 14)
(3)Hose clamp (screw-in type)

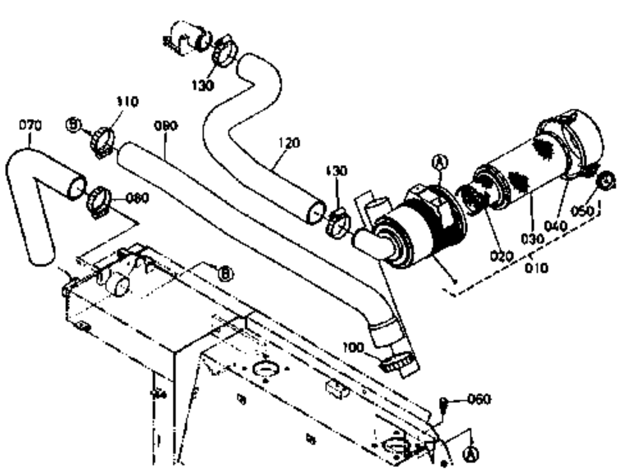
c. Air cleaner

1.Overall view, engine room.

(1)Air cleaner assy.

2.Air cleaner assy

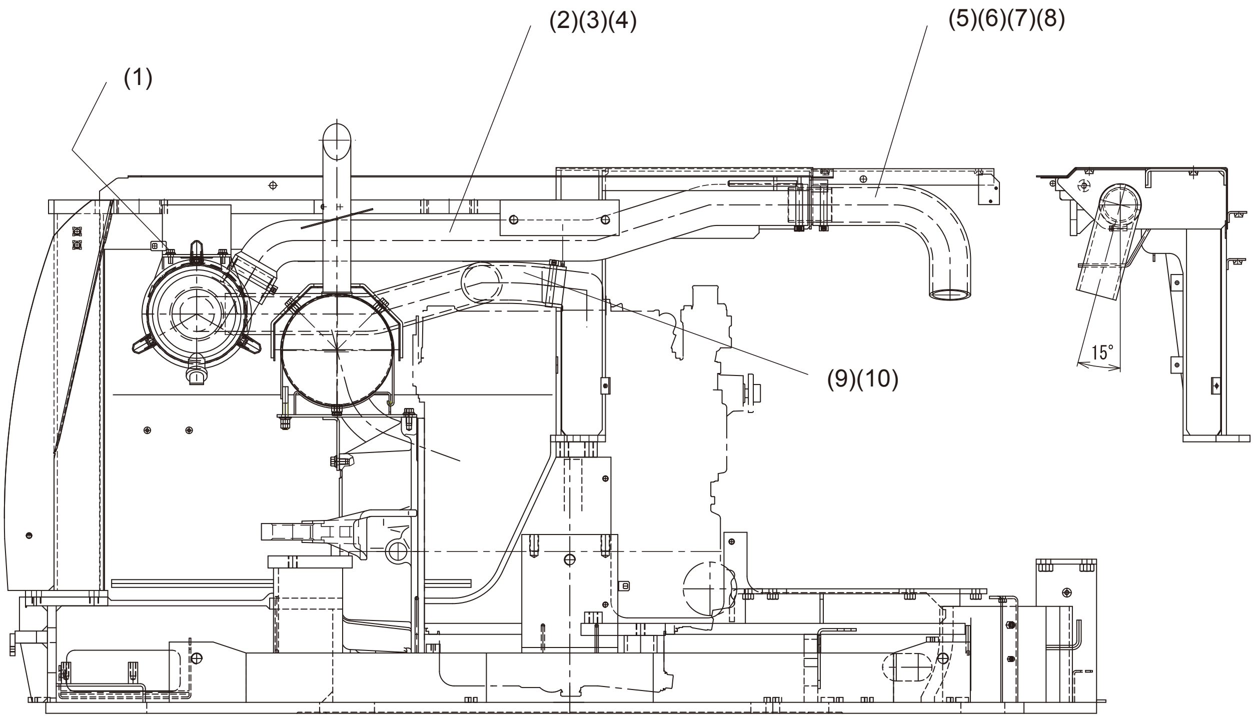
3.Inlet hoses



4.Double elements

5.Laying the hose (1, inlet)

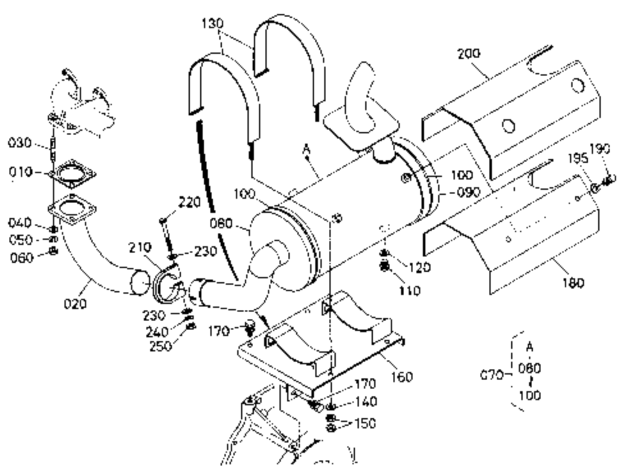
See the figure.



(1)Bolt
(2)Hose (2, inlet)
(3)Hose clamp (66-88)
(4)Hose clip (58-75)
(5)Hose (1, inlet)
(6)Hose clip (58-75)
(7)Hose (3, inlet)
(8)Hose clip (58-75)
(9)Hose (3, inlet)
(10)Hose clip (58-75)

d. Muffler

1.Overall view.



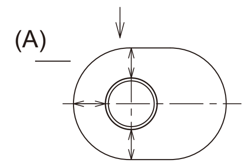
Note : After mounting the new muffler and starting engine, some smoke may wme out from the engine room.
This smoke is resulted from the initial burning of bandage around the muffler pipe.

2.Tightening the flange (muffler) clamp

Tightening torque
3.9~5.9N.m(0.4~0.6kgf.m)28.2~42.7ft.lbs

3.Ensuring the clearance at the pipe (muffler) outlet

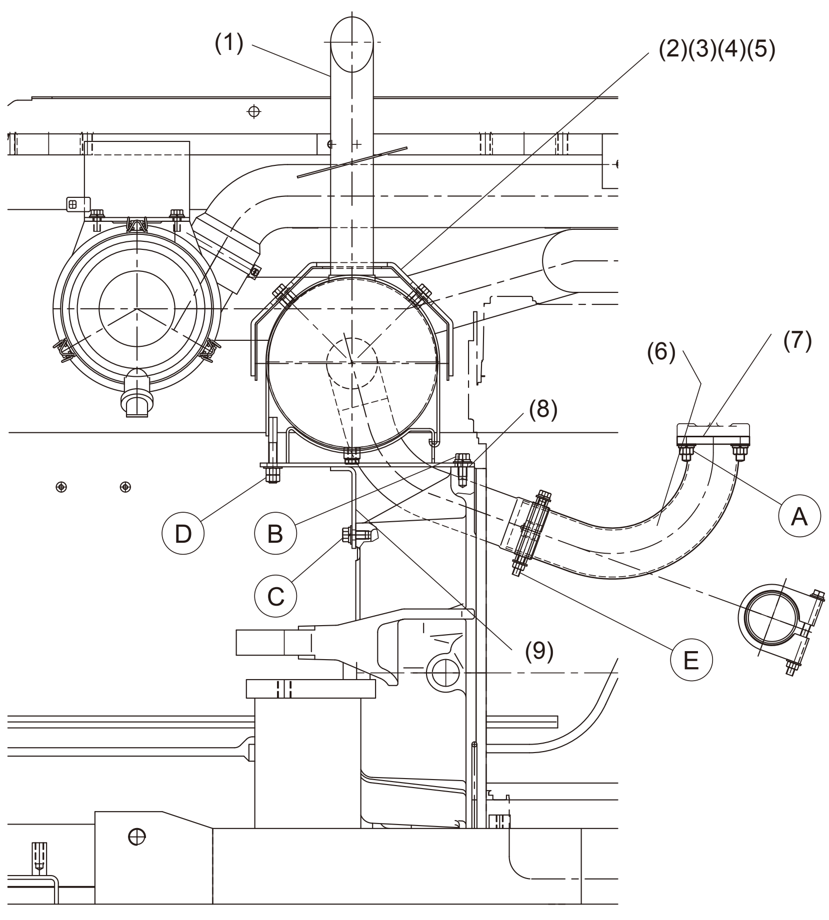
Clearance: Over 25 mm(1.0inch)



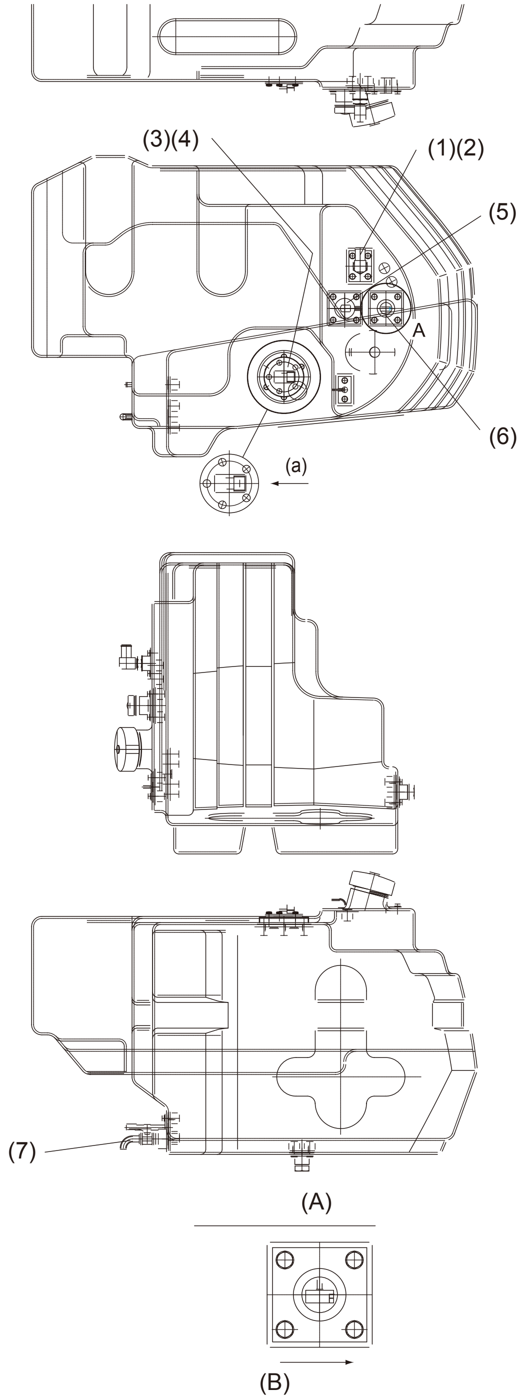
(A) Front

4.Tightening sequence

* (A): Tighten up first.
Tightening torque
39.2~45.1N.m(4.0~4.6kgf.m)28.9~33.3ft.lbs
* (B): Tighten up second.
* (C): Tighten up second.
Tightening torque
48.1~55.9N.m(4.9~5.7kgf.m)35.5~41.2ft.lbs
* (D): Tighten up third.
* (E): Tighten up fourth.



(1)Muffler assembly
(2)Cover (muffler)
(3)Bolt
(4)Plain washer
(5)Thermal insulation (muffler cover)
(6)Flange (muffler)
(7)Face b
(8)Face c
(9)Face d



(1)Washer-fitted elbow
(2)O ring (P18)
(3)Sensor assembly (fuel)
(4)Washer-fitted machine screw
(5)Sensor assembly (fuel filler)
(No specified fitting direction)
(6)Gauge (fuel)
(7)Cock (drain)

(a)Connector socket direction(to face the machine front)

(A)View A: Gauge (fuel) fitting direction
(B)Machine front

e.Fuel tank

1.Fitting the sensor assembly (fuel) (RD809-5114∆)

Tightening torque
3~4N.m(0.3~0.4kgf.m)2.2~3.0ft.lbs

Position the assembly so that the connector socket faces the machine front.

2.Fitting the sensor assembly (fuel filler) (RD809-5138∆) and gauge (fuel) (RD809-5112∆)

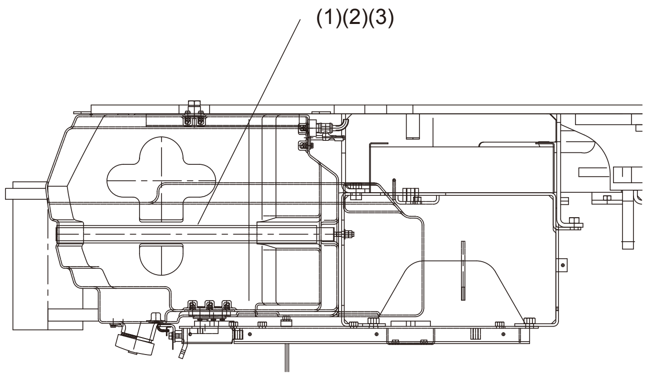
Do not force them into position. Apply some cleaning agent for smooth fitting.

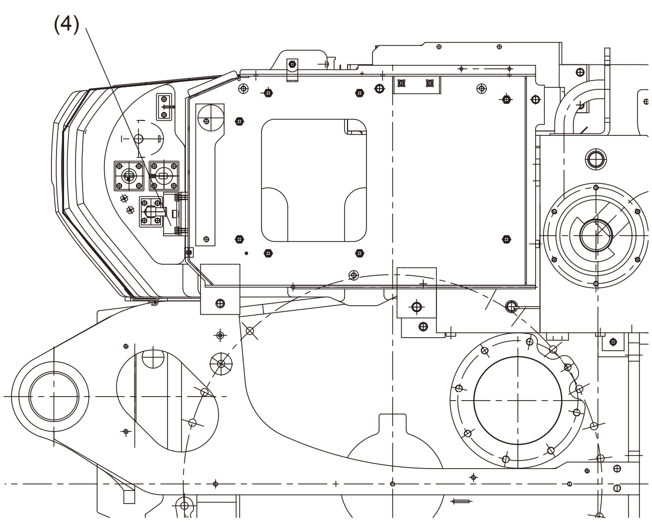
3.Fitting direction of the gauge (fuel) (RD809-5112∆)

Position the gauge as shown at left. (F mark to face the machine front)

4.Fitting the cock (drain) (RD809-5125∆)

Position the cock as shown at left. (Drain port to face downward)
After being fitted, close the cock.





5.Fitting the washer-fitted elbow (68881-6446∆)

Position the elbow as shown at left.
Note: Be careful not to confuse the O ring (fuel) setup.
(Part code of O ring)
RD809-5128∆
O ring (P18)

6.Adaptor tightening torque

G1/2 size
58.8~63.7N.m(6.0~6.5kgf.m)43.4~47.0ft.lbs

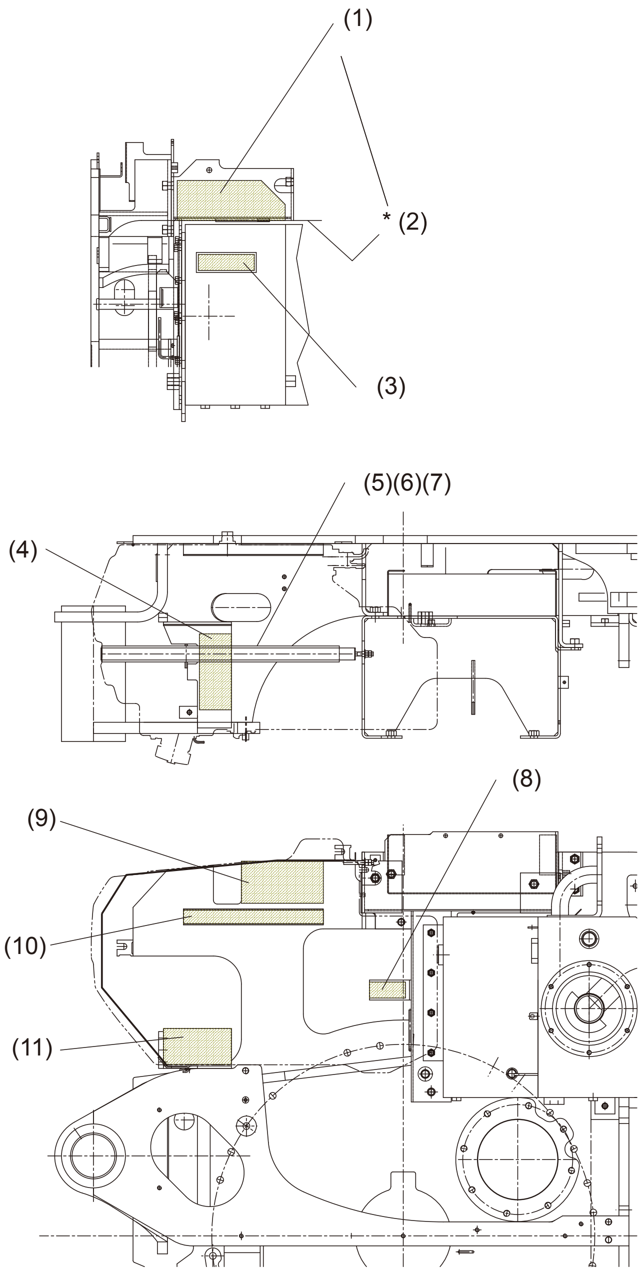
7.Tightening the band assembly (fuel tank)

Shake the tank by hand and make sure it does not wobble.

8.Fitting the plate assembly (fuel)

Tighten the assembly while holding the tank in position.
Tightening torque
48.1~55.9N.m(4.9~5.7kgf.m)35.5~41.2ft.lbs

(1)Band assembly (fuel tank)
(2)Plain washer
(3)Nut
(4)Plate assembly (fuel)



9.Attaching the cushions

Attach the cushions as shown in the figure.
* Wipe clean the cushions beforehand.

(1)Cushion (9, fuel tank)
* (2)To be attached along this line
(3)Cushion (3, fuel tank)
(4)Cushion (7, fuel tank)
(5)Band assembly (fuel tank)
(6)Plain washer
(7)Bolt
(8)Cushion (8, fuel tank)
(9)Cushion (2, fuel tank)
(10)Cushion (1, fuel tank)
(11)Cushion (6, fuel tank)

f. Fuel hose

1.Routing condition

Make sure the hoses are out of contact with sharp edges, hot zones and moving parts.
Do not clamp the fuel hose and electrical cable together.
See if the hoses are not too tight or locally sagging.
Be careful not to affect the hose diameter.

2.Installing the protective tubes

Strictly observe the dimensions specified in the figure.

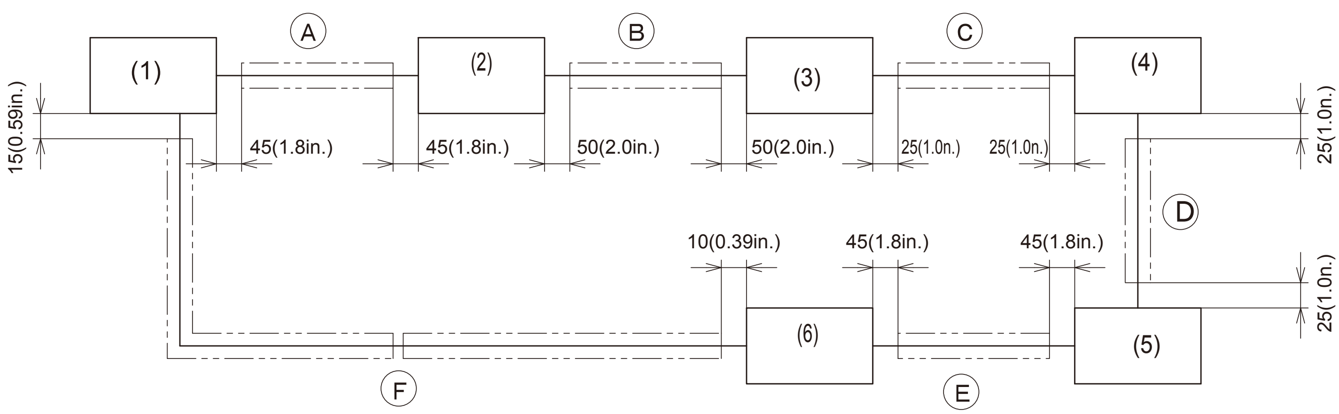
Fuel tube	Fuel tube length	Protective tube length
A	800mm(31.5in.)	705mm(27.8in.)
B	400mm(15.7in.)	300mm(11.8in.)
C	1700mm(66.9in.)	1650mm(65.0in.)
D	200mm(7.9in.)	150mm(5.9in.)
E	440mm(17.3in.)	350mm(13.8in.)
F	3800mm(149.6in.)	1450mm(57.1in.)
		2100mm(82.7in.)

(1)Fuel tank
(2)Fuel assembly separator
(3)Fuel pump
(4)Fuel filter assembly
(5)Engine
(6)T joint (fuel filter assembly)

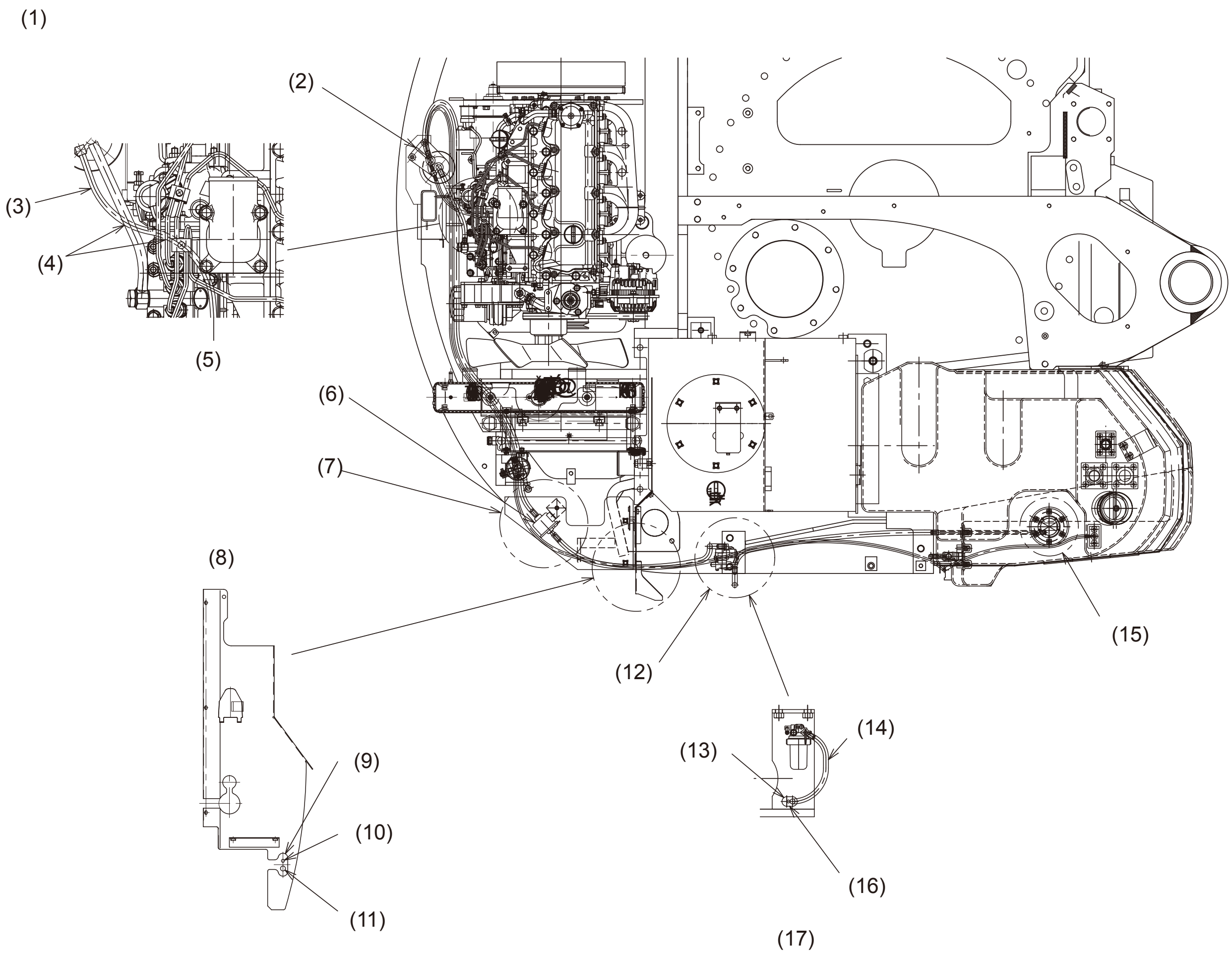
Hose clamp

A B C D → 14911-4275Δ Pipe clip

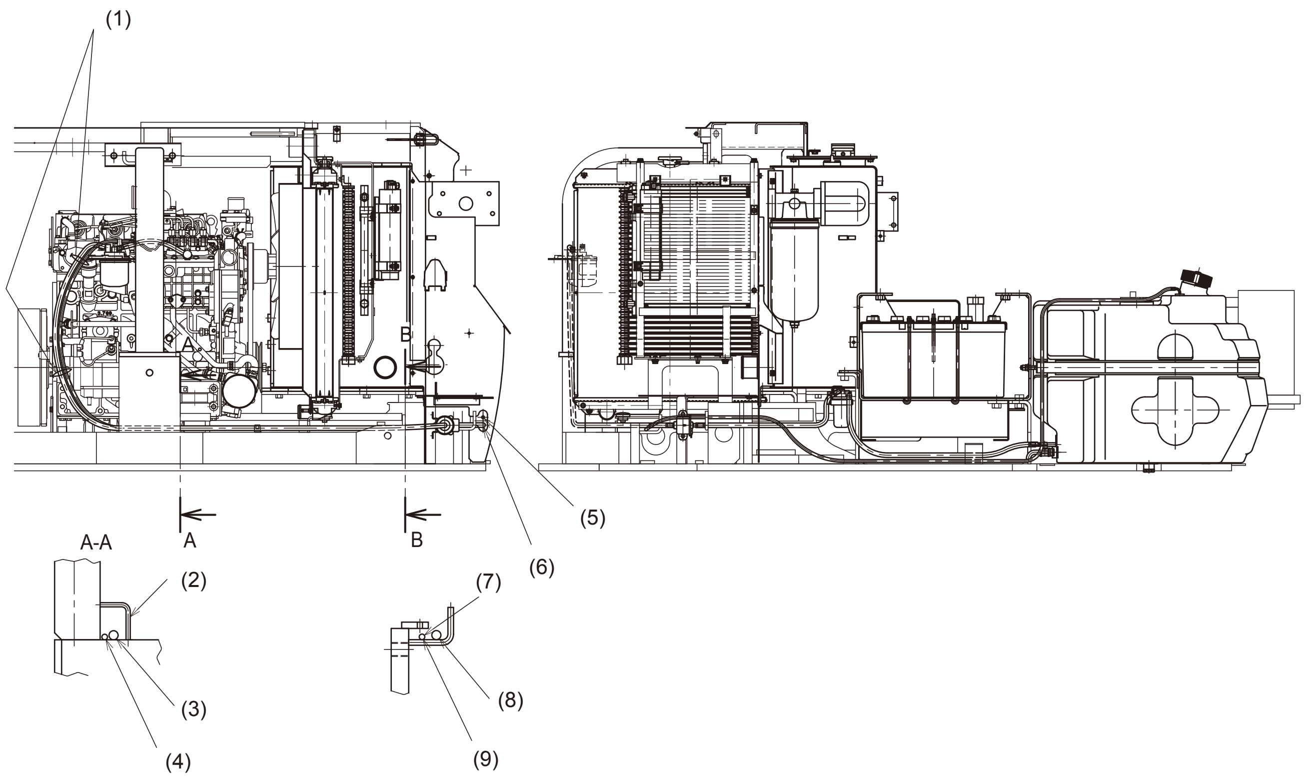
E F → 14971-4275Δ Pipe clip



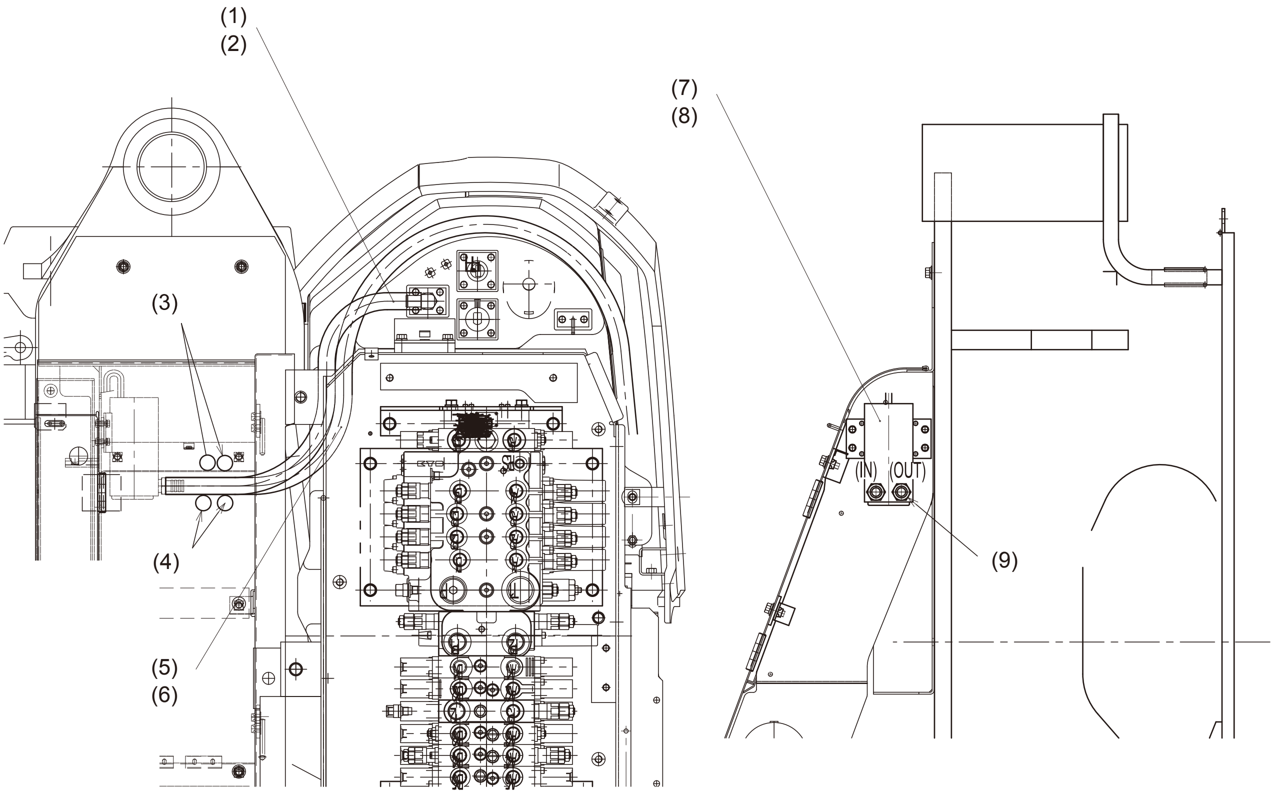
3.Routes of the fuel feed and return hoses



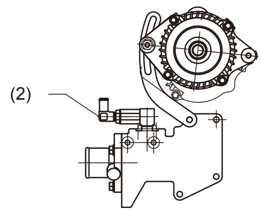
(1)
(2)Filter assembly (fuel)
(3)Fuel return hose
(4)Pass the fuel return hose below the fuel feed hose and the engine's injection pipe.
Then connect it to the engine.
(5)(Engine)
(6)Pump assembly (fuel)
(7)Pass the fuel return hose outside of the pump assembly (fuel) (RD411-5135Δ), as shown in the figure.
Note: Lay the fuel return hose out of contact with the pump.
(8)(Partition board)
(9)Pass through this notch of the partition board (RD809-4153Δ).
(10)Fuel return hose
(11)Fuel feed hose
(12)Filter assembly (separator)
(13)Fuel return hose
(14)Fuel feed hose
(15)Lay the fuel return hose out of contact with the sensor (fuel) connector.
(16)Pass through the oval hole of the swivel frame.
(17)(Battery mount of the swivel frame)

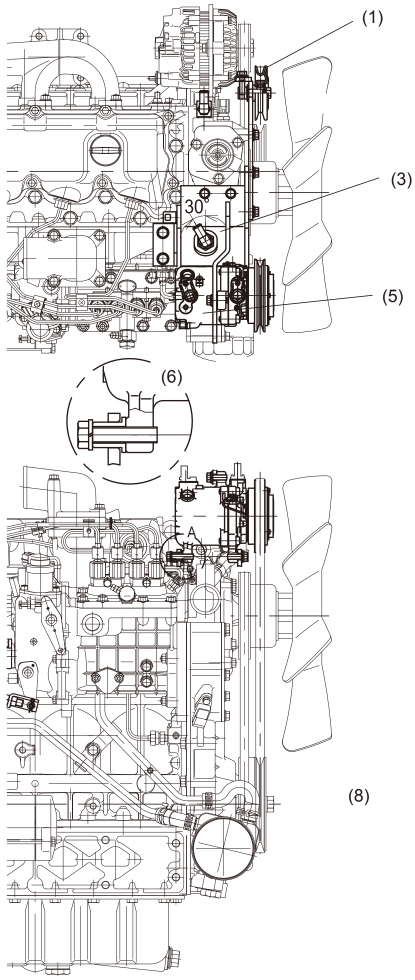


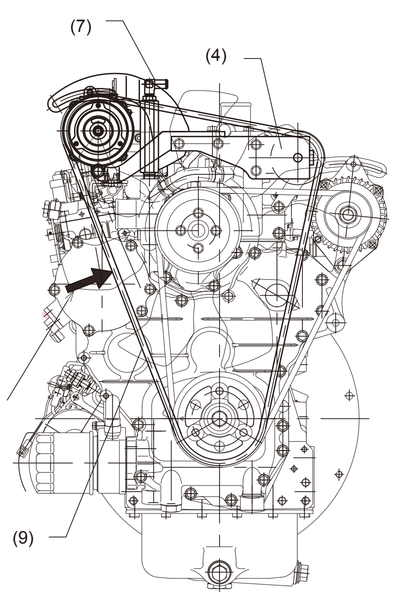
(1)Cord band
(2)Pass both the fuel feed and return hoses through the guide.
(3)Fuel feed hose
(4)Fuel return hose
(5)Fuel return hose
(6)Fuel feed hose
(7)Pass both the fuel feed and return hoses through the guide.
(8)Fuel feed hose
(9)Fuel return hose



(1)Hose (1, fuel, filler)
(2)Hose clamp (22-32)
(3)Swing hose
(4)Boom hose
(5)Hose (1, fuel, filler)
(6)Hose clamp (22-32)
(7)Pump assembly (fuel, filler)
(8)Bolt
(9)Connect to the fuel tank.







g. Compressor

1.Fitting the bracket (compressor) and bracket (pulley)

Fit the brackets in position as shown at left.
Tightening torque
17.7~20.6N.m(1.8~2.1kgf.m)13.1~15.2ft.lbs
M10
48.1~55.9N.m(4.9~5.7kgf.m)35.5~41.2ft.lbs

2.Fitting the compressor

Fitting the bushing (compressor)
Fit the parts in position as shown at left.
Tighten the bolts from the pulley side first.
Set the bushing with its collar inside.

3.Tightening the bolts

Tightening torque
17.7~20.6N.m(1.8~2.1kgf.m)13.1~15.2ft.lbs

4.Adjusting the tension of V belt (FM59)
Adjust the tension at the arrow-marked position as shown at left.
Belt deflection 12~15mm(0.47~0.59in.)
Pressing force
58.8~68.6N.m(6.0~7.0kgf.m)43.4~50.6ft.lbs

5.Fitting the joint (heat takeout), pipe joint (S, G1/4-G1/4) , elbow joint (G4-13) and joint (water return) for the heater hoses

Fit the joints as shown at left.
Adaptor tightening torque
R3/8
68.6~73.5N.m(7.0~7.5kgf.m)50.6~54.2ft.lbs
G1/4
24.5~29.4N.m(2.5~3.0kgf.m)18.1~21.7ft.lbs

(1)Tension pulley
 Bolt
 Bolt
(2)Joint (heat takeout)
 Pipe joint (S, G1/4-G1/4)
 O ring
 Elbow joint (G4-13)
 O ring
(3)Bracket (compressor)
 Bolt
 Bolt
(4)Bracket (pulley)
 Bolt
 Bolt
(5)Compressor
 Bushing (compressor)
 Bolt
 Plain washer
(6)Details of A
(7)Joint (water return)
 Elbow joint (G4-13)
 O ring
(8)Check the compressor V belt tension here.
(9)V belt (FM59)

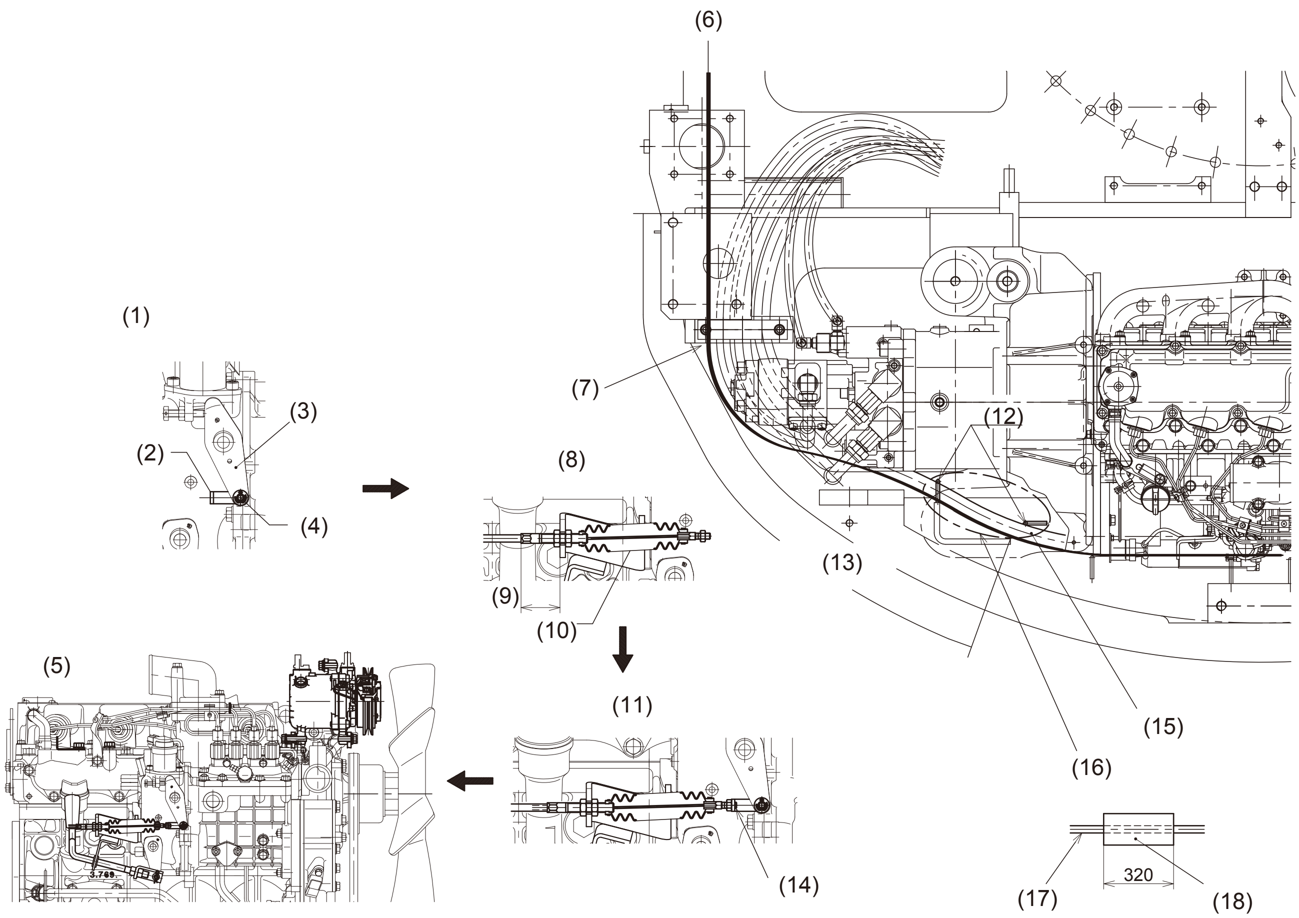
h.Control cable

1.Connecting the cable (acceleration)

Connect the cable in the order as shown in the figure.

2.Routing the cable (acceleration)

Lay the cable in the route as shown at left.



(1)Connecting the cable (acceleration)
1) Install the wire fixture (36919-1033∆) on the engine-side acceleration lever.
(2)Wire fixture
(3)Engine-side acceleration lever
(4)Plain washer
Cotter pin
(5) 4) Connections and routing complete
(6)To AI motor
(7)Pass outside of the A/C hose.
(8) 2) Connect the cableÅfs outer adjuster along the near center of the bracket (acceleration cable).
(9)32 (reference)
(10)Cable (acceleration)
(11) 3) Join the wire fixture and the cable together and tighten up the nut.
(12)Guide bar
(13)Take the same route along the A/C hose in this arrow-marked zone.
(14)Screw in until two threads or so (about 1 mm) stretch out.
(15)A/C hose
(16)Pass the cable so that the sponge (EPDM material) around the cable comes to these two guides (6 mm dia. round bars).
(17)A/C hose
(18)EPDM material (sponge)

i. Fan belt

1.Fitting the oil switch

Tightening the oil switch

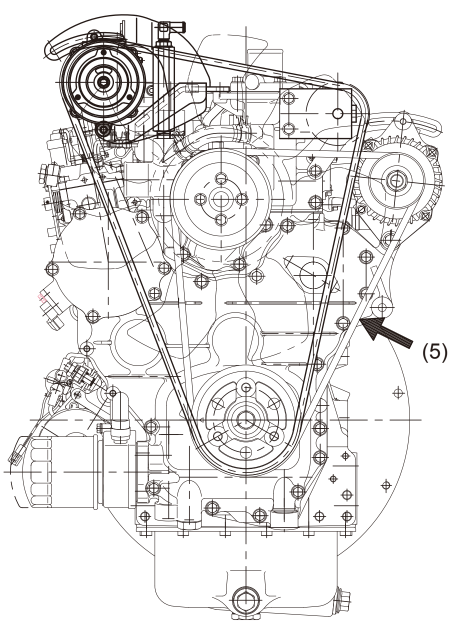
Fit the oil switch in position as shown at left.
PT1/8 size
7.8~9.3N.m(0.8~0.95kgf.m)5.8~6.9ft.lbs

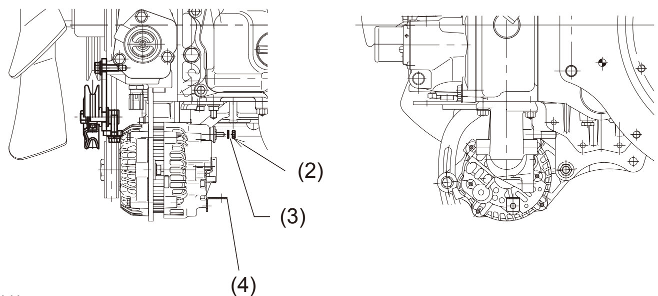
2.Fitting the plate (clamp,2)

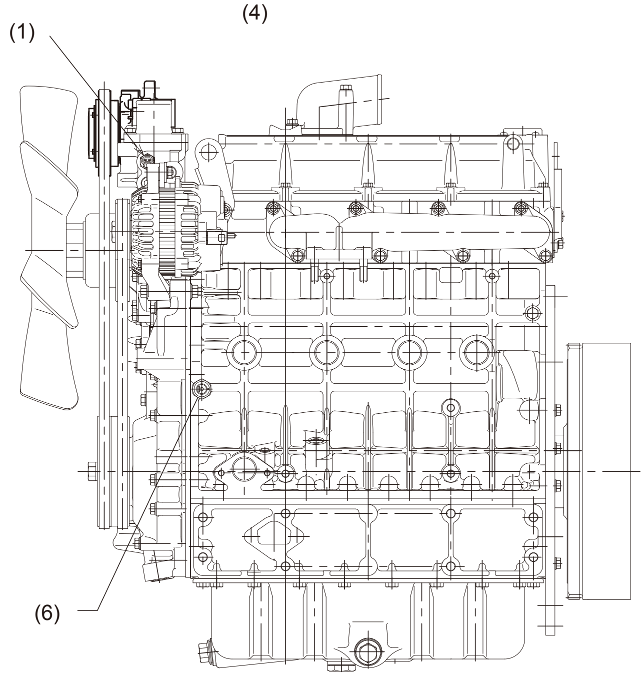
Fit the plate in position as shown at left.

3.Fan belt tension

Before mounting the engine, press on the arrow-marked position in the figure to see if the tension is proper.







(1)Water temperature switch
(to be installed at Engineering staff before shipping)
(2)Used in connecting the alternator wire harness
(3)Spring washer
Nut
(4)Plate (clamp, 2)
Plain washer
Washer-fitted machine screw
(5)Press with a force of 10 kgf to make sure the deflection is 6-8 mm.
(6)Oil switch

j. Engine stop lever

1.Fitting the sensor (rpm)

Tightening the flange bolt

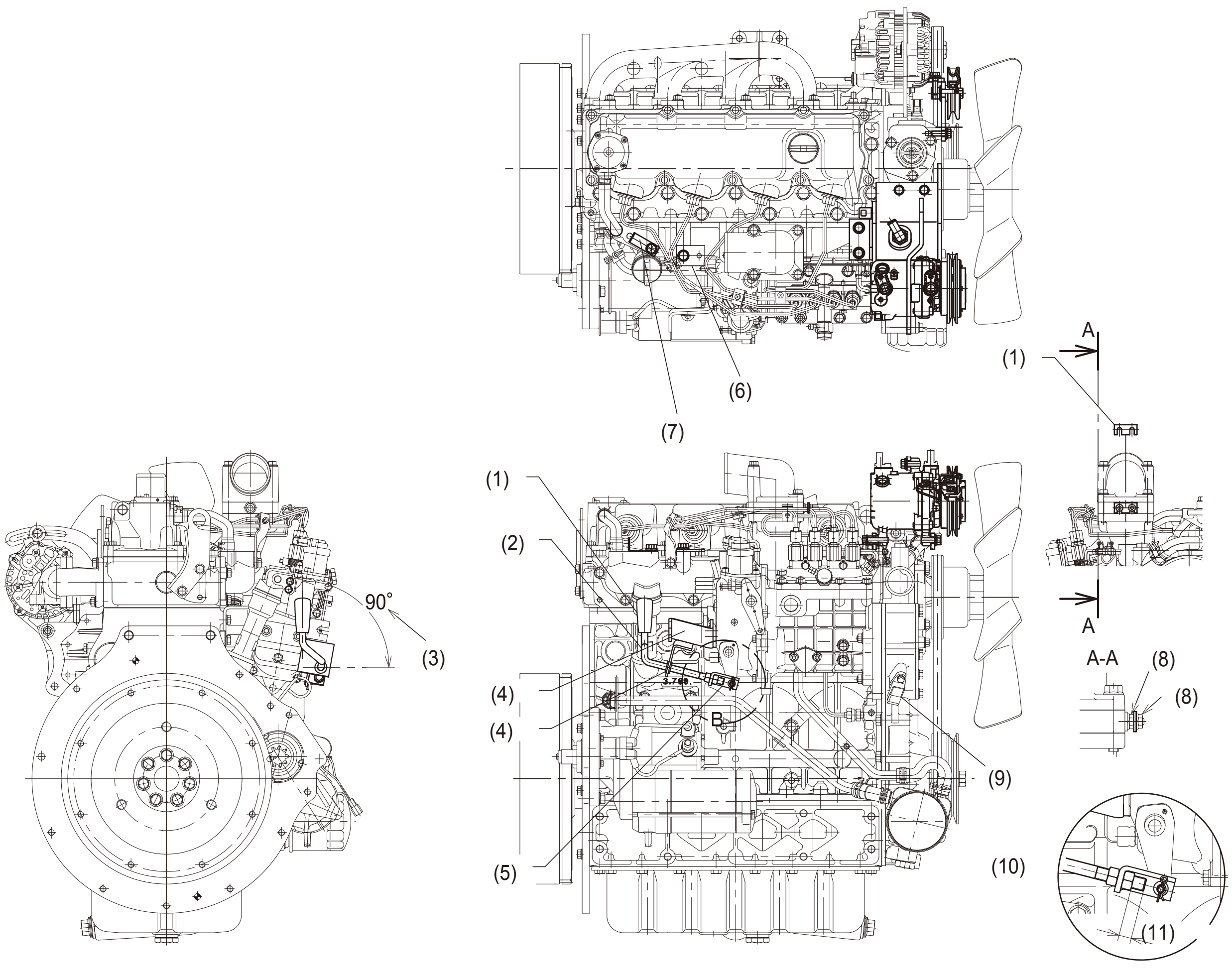
Fit the sensor in position as shown at left.
Tightening torque
7.8~9.3N.m(0.8~0.95kgf.m)5.8~6.9ft.lbs

2.Fitting the plate (bus bar)

Install the plate between No. 1 and No. 2 nuts at the air intake of the engine inlet, as shown at left.
Tightening torque

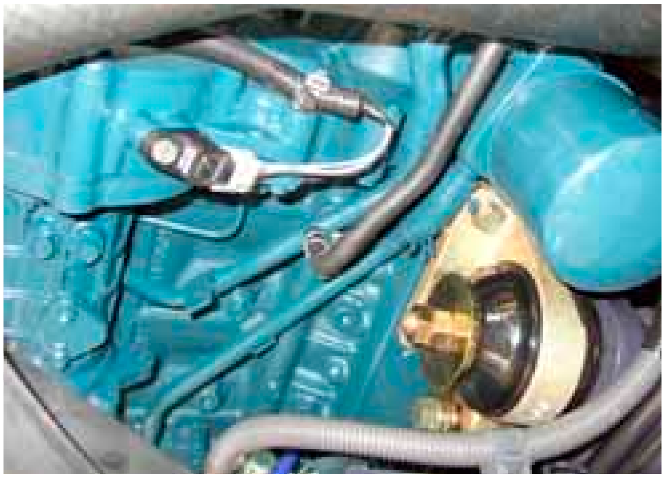
3.Fitting the engine stop lever

Fit the lever in position as shown at left.



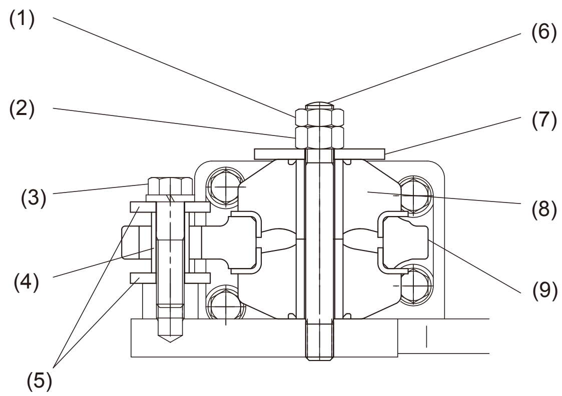
(1)Lever grip
(2)Lever (engine stop)
Nut
(3)Engine stop lever angle
10/Bracket (acceleration cable)
Grommet (engine stop)
(4)Link (engine stop)
Headed pin
Plain washer
Snap pin
(5)Plate (bus bar)

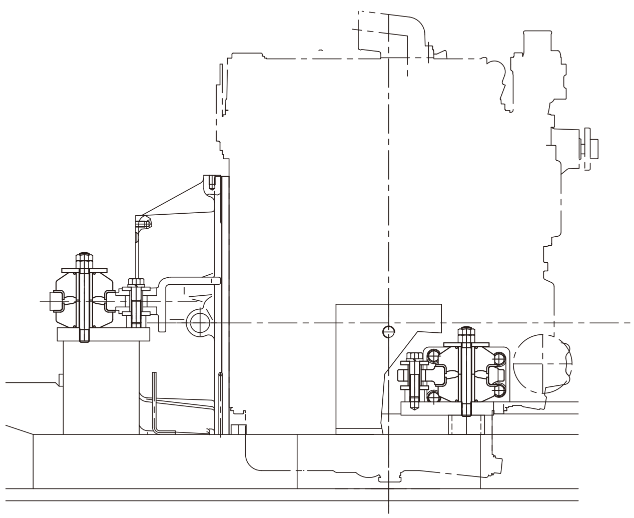
(6)Plate (clamp, 1)
Bolt
(7)Stay (wire harness clamp)
Bolt
(8)No. 1 nut
No. 2 nut
(9)Sensor (rpm)
Flange bolt
(10)Details of B
(11)10 (leverÅfs screw setting length)



k. Engine bracket

1. Overall view.





2.Fitting the engine bracket

Tightening torque
M12
77.5~90.2N.m(7.9~9.2kgf.m)57.2~66.5ft.lbs
M16
196.1~225.6N.m(20.0~23.0kgf.m)
144.6~166.4ft.lbs
Apply screw adhesive (Loctite 271).

3.Fitting the anti-vibration rubber

Fit the rubber as shown in the figure.
Double nut tightening torque
No. 1 nut
88.2~107.8N.m(9.0~11.0kgf.m)65.1~79.5ft.lbs
No. 2 nut
166~191N.m(17.0~19.5kgf.m)122.4~140.9ft.lbs
Apply screw adhesive (Loctite 271).

(1)(No. 2 nut)
(2)(No. 1 nut)
(3)Bolt
(4)Collar
(5)Washer
(6)Stud
(7)Washer
(8)Anti-vibration rubber
(9)(Right back)Bracket (1, engine)
(Right front)Bracket (2, engine)
Bolt

I. Engine assy

1. Remove and dismount the following parts.
   1)Radiator assy
   2)Air cleaner assy
   3)Bonnet and arch
   4)Wireharness
   5)Fuel hoses
   6)Mount bracket

D.Engine WSM

TO THE READER

The following engine WSM has been compiled after minor changing of original V3800DI engine WSM by eliminating some pages which doesn't apply to construction machinery model of KX080-3.
Still some pages contain common specifications on V3800DI series engine.
Therefore, some date may differ from the engine mounted on constructinon machinery.
In that case, please come to the specifications in the front pages of KX080-3 WSM engine chapter.

July 2006

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This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of V3800DI-E2B, V3800DI-T-E2B. It is divided into three parts, “General”, “Mechanism” and “Servicing”.

■ **General**

Information on the engine identification, the general precautions, maintenance check list, check and maintenance and special tools are described.

■ **Mechanism**

Information on the construction and function are included. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

Refer to Diesel Engine Mechanism Workshop Manual (Code No. 97897-01870) for the one which has not been described to this workshop manual.

■ **Servicing**

Information on the troubleshooting, servicing specification lists, tightening torque, 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.

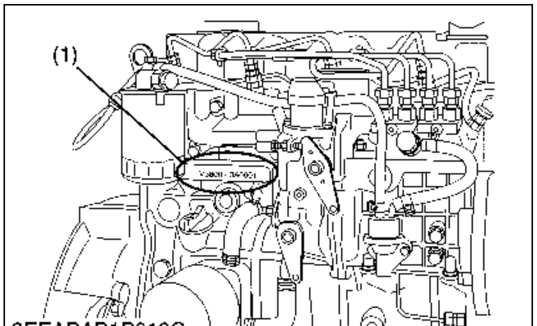
Due to covering many models of this manual, information or picture being used have not been specified as one model.

March 2004

General

1. ENGINE IDENTIFICATION

[1] MODEL NAME AND ENGINE SERIAL NUMBER



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

The engine model and its serial number need to be identified before the engine can be serviced or parts replaced.

■ **Engine Serial Number**

The engine serial number is an identified number for the engine. It is marked after the engine model number.

It indicates month and year of manufacture as follows.

- **Year of manufacture**

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

(1) Engine Model Name and Serial Number

W1010477

- **Month of manufacture**

Month	Engine Serial Number	
	0001 ~ 9999	10000 ~
January	A0001 ~ A9999	B0001 ~
February	C0001 ~ C9999	D0001 ~
March	E0001 ~ E9999	F0001 ~
April	G0001 ~ G9999	H0001 ~
May	J0001 ~ J9999	K0001 ~
June	L0001 ~ L9999	M0001 ~
July	N0001 ~ N9999	P0001 ~
August	Q0001 ~ Q9999	R0001 ~
September	S0001 ~ S9999	T0001 ~
October	U0001 ~ U9999	V0001 ~
November	W0001 ~ W9999	X0001 ~
December	Y0001 ~ Y9999	Z0001 ~

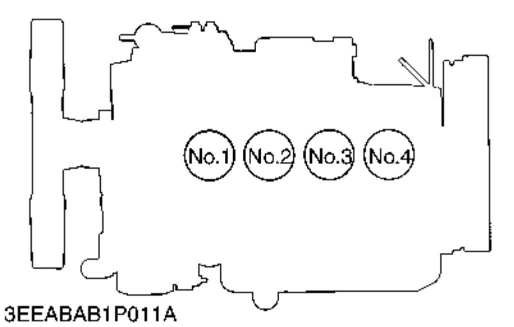
e.g. V3800-3A0001

"3" indicates 2003 and "A" indicates January.

So, 3A indicates that the engine was manufactured in January, 2003.

W1011076

[2] CYLINDER NUMBER



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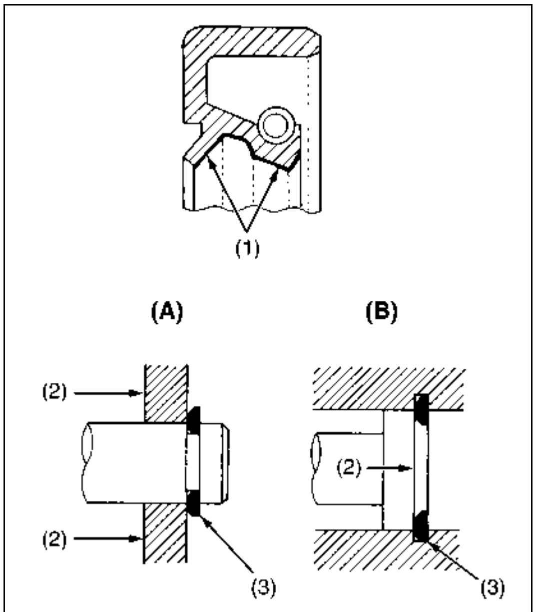
The cylinder numbers of kubota diesel engine are designated as shown in the figure.

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

W1011077

2. GENERAL PRECAUTIONS



- 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 made 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.

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

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

W1011734

3. 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									
	Initial 50 hrs	Every 50 hrs	Every 250 hrs	Every 500 hrs	Every 1000 hrs	Every 1 or 2 months	Every 1500 hrs	Every 3000 hrs	Every 1 year	Every 2 years
Changing engine oil	*			*					*	
Replacing oil filter cartridge	*			*						
*Checking fuel hoses and clamps		*								
*Cleaning air filter element (Replace the element after 6 times cleanings)			*							
*Cleaning fuel filter			*							
Checking battery electrolyte level			*							
Checking radiator hoses and clamps			*							
*Checking intake air line			*							
Checking fan belt tension and damage	*		*							
*Replacing fuel filter cartridge				*						
Replacing fan belt				*						*
Cleaning radiator interior				*						
Checking valve clearance					*					
Recharging battery						*				
*Checking injection nozzle condition							*			
*Checking turbocharger								*		
Checking fuel injection pump								*		
*Checking injection timing (spill timing)								*		
*Replacing air filter element									*	
Changing radiator coolant (L.L.C.)										*
Replacing radiator hoses and clamps										*
*Replacing fuel hoses and clamps										*
*Replacing intake air line										*
Replacing battery										*

* The items listed above (* marked) are registered as emission related critical parts by KUBOTA in the U.S.EPA nonroad emission regulation.
As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.

W1029462

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

■ **NOTE**

Lubricating Oil

With the emission control now in effect, the CF-4 and CG-4 lubricating oils have been developed for use of a low-sulfur fuel on-road vehicle engines. When an off-road vehicle engine runs on a high-sulfur fuel, it is advisable to employ the CF, CD or CE lubricating oil with a high total base number. If the CF-4 or CG-4 lubricating oil is used with a high-sulfur fuel, change the lubricating oil at shorter intervals.

- **Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.**

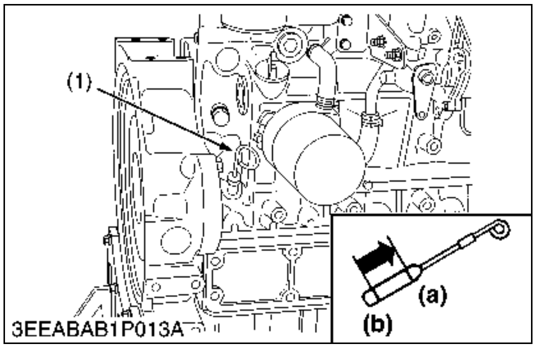
Fuel / Lubricating oil class	Low sulfur (0.5 % ≥)	High sulfur	Remarks
CF	O	O	TBN ≥ 10
CF-4	O	X	
CG-4	O	X	

O : Recommendable X : Not recommendable

W1035555

4. CHECK AND MAINTENANCE

[1] DAILY CHECK POINTS



Checking Engine Oil Level

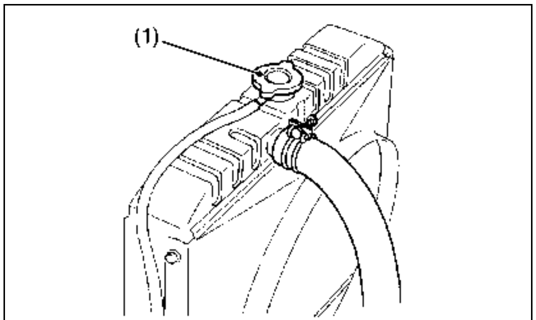
1. Level the engine.
2. To check the oil level, draw out the dipstick (1), wipe it clean, reinsert it, and draw it out again.
   Check to see that the oil level lies between the two notches.
3. If the level is too low, add new oil to the specified level.

- **When using an oil of different maker or viscosity from the previous one, drain old oil. Never mix two different types of oil.**
- **Be sure to inspect the engine, locating it on a horizontal place. If placed on gradients, accurately, oil quantity may not be measured.**
- **Be sure to keep the oil level between upper and lower limits of the dipstick. Too much oil may cause a drop in output or excessive blow-by gas. On the closed breather type engine in which mist is sucked through port, too much oil may caused oil hammer. While too little oil, may seize the engine's rotating and sliding parts.**

(1) Dipstick

(a) Maximum
(b) Minimum

W1035676



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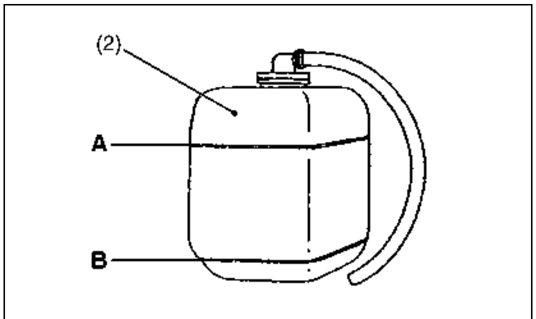

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Checking and Replenish Coolant

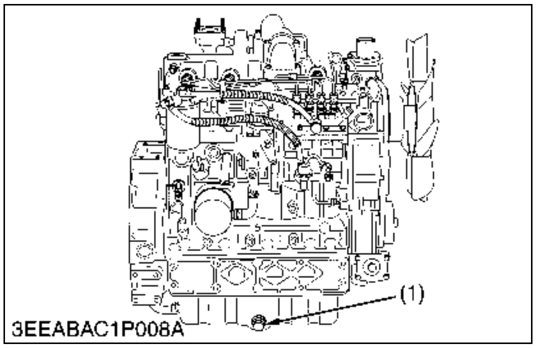
1. Without recovery tank :
   Remove the radiator cap (1) and check to see that the coolant level is just below the port.
   With recovery tank (2) :
   Check to see that the coolant level lies between **FULL** (**A**) and **LOW** (**B**).
2. If coolant level is too low, check the reason for decreasing coolant.
   (Case 1)
   If coolant is decreasing by evaporation, replenish only fresh, soft water.
   (Case 2)
   If coolant is decreasing by leak, replenish coolant of the same manufacture and type in the specified mixture ratio (fresh, soft water and L.L.C.). If the coolant brand cannot be identified, drain out all of the remaining coolant and refill with a totally new brand of coolant mix.

- **Do not remove the radiator cap until coolant temperature is below its boiling point. Then loosen the cap slightly to relieve any excess pressure before removing the cap completely.**
- **During filling the coolant, air must be vented from the engine coolant passages. The air vents by jiggling the radiator upper and lower hoses.**
- **Be sure to close the radiator cap securely. If the cap is loose or improperly closed, coolant may leak out and the engine could overheat.**
- **Do not use an antifreeze and scale inhibitor at the same time.**
- **Never mix the different type or brand of L.L.C..**

(1) Radiator Cap	**A: FULL**
(2) Recovery Tank	**B: LOW**

W1035779

[2] CHECK POINTS OF INITIAL 50 HOURS



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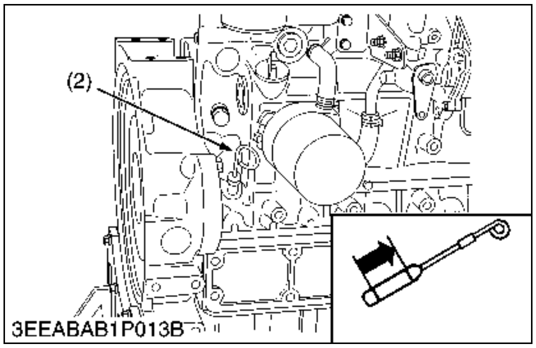

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Changing Engine Oil

- **Be sure to stop engine before changing engine oil.**

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. To drain the used oil, remove the drain plug (1) at the bottom of the engine and drain the oil completely.
4. Screw the drain plug (1).
5. Fill new oil up to upper line on the dipstick (2).

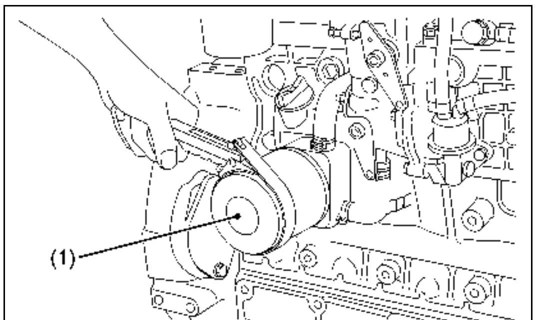
- **When using an oil of different maker or viscosity from the previous one, remove all of the old oil.**
- **Never mix two different types of oil.**
- **Engine oil should have properties of API classification CD/ CE/CF/CF-4/CG-4.**
- **Use the proper SAE Engine Oil according to ambient temperature.**

Above 25 °C (77 °F)	SAE 30 or SAE 10W-30 SAE 10W-40
0 °C to 25 °C (32 °F to 77 °F)	SAE 20 or SAE 10W-30 SAE 10W-40
Below 0 °C (32 °F)	SAE 10W or SAE 10W-30 SAE 10W-40

Engine oil capacity	13.2 L 3.49 U.S.gals

(1) Drain Plug (2) Dipstick

W1016604



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Replacing Oil Filter Cartridge

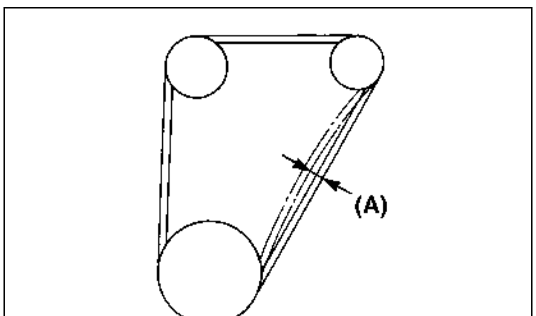
- **Be sure to stop the engine before changing filter cartridge.**

1. Remove the oil filter cartridge (1) with the filter wrench.
2. Apply a slight coart of oil onto the new cartridge gasket.
3. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
4. After the new cartridge has been replaced, the engine oil normally decrease a little. Thus see that the engine oil does not leak through the seal and be sure to read the oil level on the dipstick. Then, replenish the engine oil up to the specified level.

- **To prevent serious damage to the engine, replacement element must be highly efficient. Use only a KUBOTA genuine filter or its equivalent.**

(1) Engine Oil Filter Cartridge

W1017137



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Fan Belt Tension

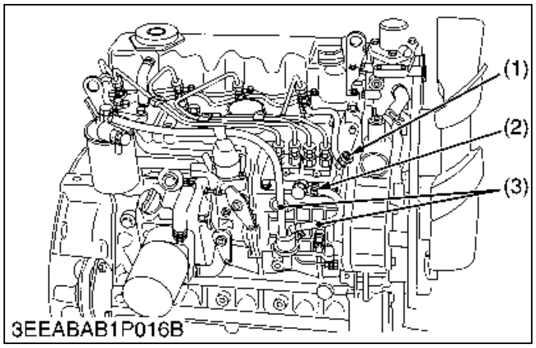
1. Measure the deflection **(A)**, depressing the belt halfway between the fan drive pulley and alternator pulley at specified force 98 N (10 kgf, 22 lbs).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

Deflection **(A)**	Factory spec.	10 to 12 mm 0.394 to 0.472 in.

(A) Deflection

W1208957

[3] CHECK POINT OF EVERY 50 HOURS



Checking Fuel Hose and Clamp Bands

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

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

(When bleeding fuel system)

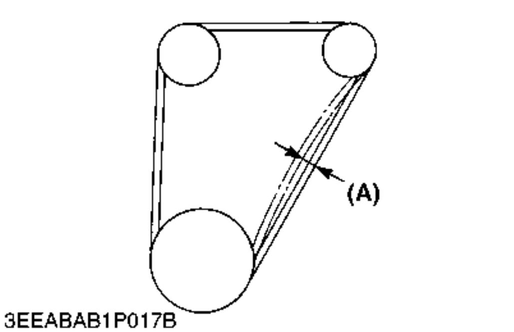
1. Fill the tank with fuel and open the cock.
2. Loosen the air vent coupling bolt of fuel filter a few turns.
3. When there is no more air bubbles in the fuel coming out of this coupling bolt, tighten the coupling bolt.
4. Open the air vent cock (1) on the top of fuel injection pump.
5. If equipped electrical fuel feed pump, turn the key on **AC** position and pump the fuel up for 10 to 15 seconds.
   If equipped mechanical fuel feed pump, set the stop lever on stop position and crank the engine for 10 to 15 seconds.
6. Close securely the air vent cock (1) after air bleeding.

- **Except when venting the air, be sure to keep closed the air vent coupling bolt of the fuel injection pump. Otherwise, the engine may stall.**

(1) Air Vent Cock
(2) Clamp
(3) Fuel Hose

W1035921

[4] CHECK POINTS OF EVERY 250 HOURS



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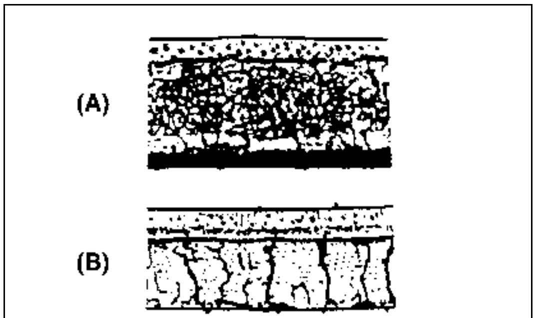
Fan Belt Tension

1. Measure the deflection **(A)**, depressing the belt halfway between the fan drive pulley and alternator pulley at specified force 98 N (10 kgf, 22 lbs).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

Deflection **(A)**	Factory spec.	10 to 12 mm 0.394 to 0.472 in.

(A) Deflection

W1014131



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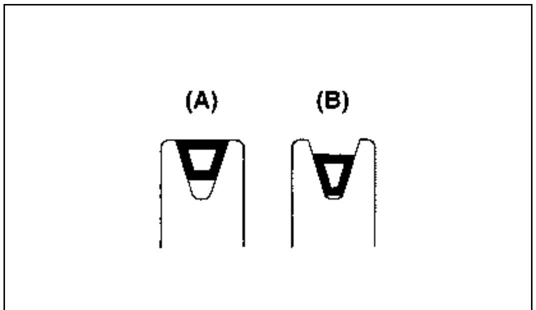

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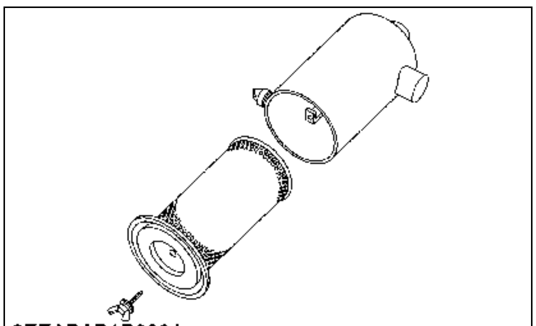
Fan Belt Damage and Wear

1. Check the fan belt for damage.
2. If the fan belt is damaged, replace it.
3. Check if the fan belt is worn and sunk in the pulley groove.
4. If the fan belt is nearly worn out and deeply sunk in the pulley groove, replace it.

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

W1209480



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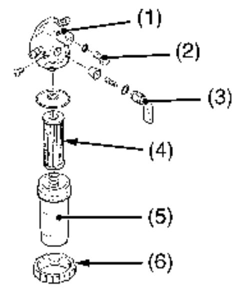
Cleaning Air Cleaner Element

1. Remove the air cleaner element.
2. Use clean dry compressed air on the inside of the element.
   Pressure of compressed air must be under 205 kPa (2.1 kgf/cm^2, 30 psi).
   Maintain reasonable distance between the nozzle and the filter.

- **The air cleaner uses a dry element. Never apply oil to it.**
- **Do not run the engine with filter element removed.**
- **Change the element once a year or every 6th cleaning.**

W1045746



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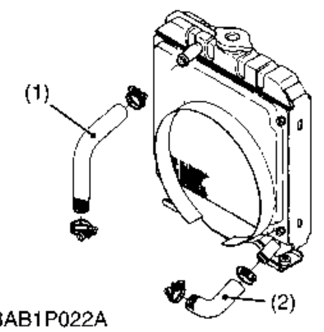
Cleaning Fuel Filter (Element Type only)

1. Close the fuel cock (3).
2. Unscrew the retaining ring (6) and remove the filter 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.

- **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 filter cup (5) periodically.**

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

W1046058



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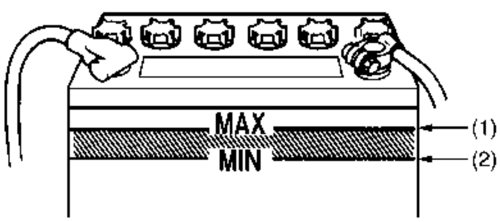
Checking Radiator Hoses and Clamp Bands

1. Check to see if the radiator hoses are properly fixed every 250 hours of operation or every six months, whichever comes first.
2. If the clamp is loose, apply oil to the threads and retighten it securely.
3. The water hose is made of rubber and tends to age. It must be replaced every two years. Also replace the clamp and tighten it securely.

(1) Upper Hose
(2) Lower Hose

W1029518



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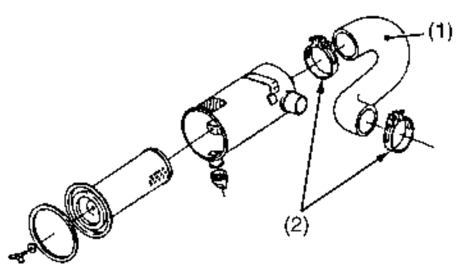
Checking Battery Electrolyte Level

1. Check the battery electrolyte level.
2. If the level is below than lower level line (2), and the distilled water to pour level of each cell.

(1) Upper Level Line
(2) Lower Level Line

W1047154



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Checking Intake Air Line

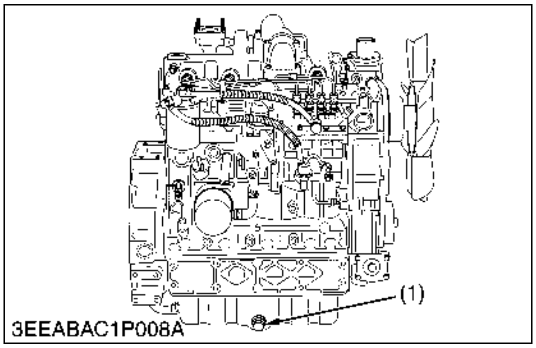
1. Check to see if the intake air hose(s) are properly fixed every 250 hours of operation.
2. If the clamp is loose, apply oil to the threads and retighten it securely.
3. The intake air hose(s) is made of rubber and tends to age. It must be change every two years. Also change the clamp and tighten it securely.

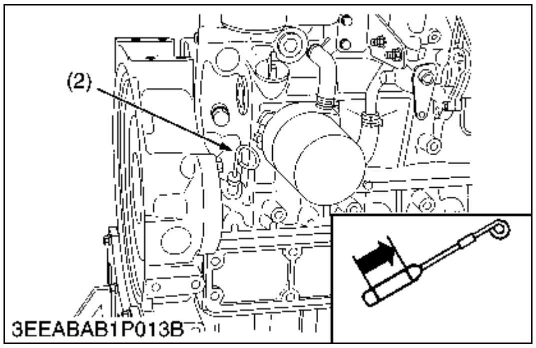
- **To prevent serious damage to the engine, keep out any dust inside the intake air line.**

(1) Intake Air Hose
(2) Clamp

W1029631

[5] CHECK POINTS OF EVERY 500 HOURS





Changing Engine Oil

- **Be sure to stop engine before changing engine oil.**

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. To drain the used oil, remove the drain plug (1) at the bottom of the engine and drain the oil completely.
4. Screw the drain plug (1).
5. Fill new oil up to upper line on the dipstick (2).

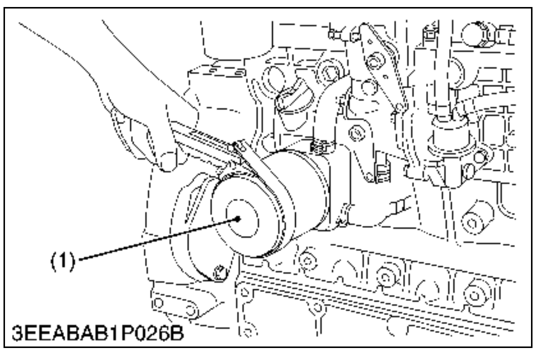
- **When using an oil of different maker or viscosity from the previous one, remove all of the old oil.**
- **Never mix two different types of oil.**
- **Engine oil should have properties of API classification CD/ CE/CF/CF-4/CG-4.**
- **Use the proper SAE Engine Oil according to ambient temperature.**

Above 25 °C (77 °F)	SAE 30 or SAE 10W-30 SAE 10W-40
0 °C to 25 °C (32 °F to 77 °F)	SAE 20 or SAE 10W-30 SAE 10W-40
Below 0 °C (32 °F)	SAE 10W or SAE 10W-30 SAE 10W-40

Engine oil capacity	13.2 L 3.49 U.S.gals

(1) Drain Plug (2) Dipstick

W1014590



Replacing Oil Filter Cartridge

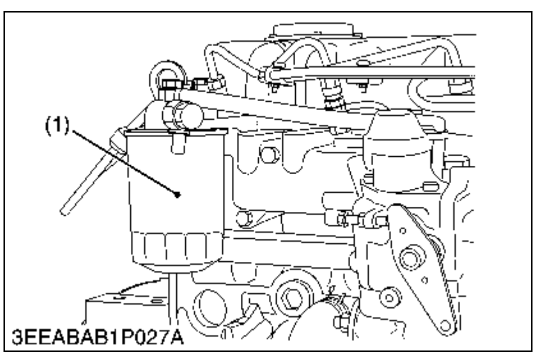
- **Be sure to stop the engine before changing filter cartridge.**

1. Remove the oil filter cartridge (1) with the filter wrench.
2. Apply a slight coart of oil onto the new cartridge gasket.
3. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
4. After the new cartridge has been replaced, the engine oil normally decrease a little. Thus see that the engine oil does not leak through the seal and be sure to read the oil level on the dipstick. Then, replenish the engine oil up to the specified level.

- **To prevent serious damage to the engine, replacement element must be highly efficient. Use only a KUBOTA genuine filter or its equivalent.**

(1) Engine Oil Filter Cartridge

W1015117



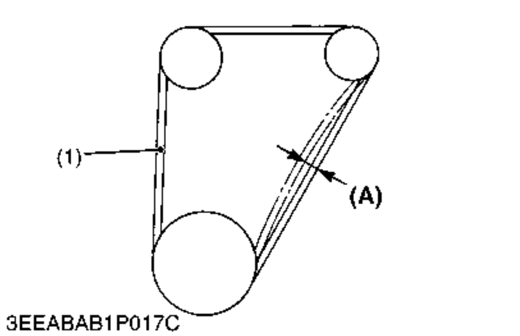
Replacing Fuel Filter Cartridge (Cartridge Type)

Water and dust in fuel are collected in the filter cartridge. So, change the filter cartridge every 500 hours service.

1. Remove the used filter cartridge with filter wrench.
2. Apply a thin film of fuel to the surface of new filter cartridge gasket before screwing on.
3. Then tighten enough by hand.
4. Loosen the air vent plug to let the air out.
5. Start engine and check for fuel leakage.

(1) Fuel Filter Cartridge

W1037062



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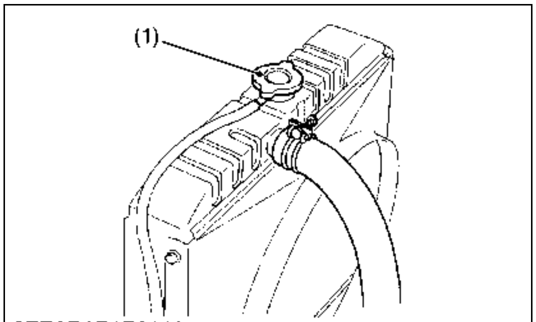
Replacing Fan Belt

1. Remove the alternator.
2. Remove the fan belt (1).
3. Replace new fan belt.
4. Install the alternator.
5. Check the fan belt tension.

Deflection **(A)**	Factory spec.	10.0 to 12.0 mm / 98 N 0.394 to 0.472 in. / 98 N (10 kgf, 22 lbs)

(1) Fan Belt **(A) Deflection**

W1052220



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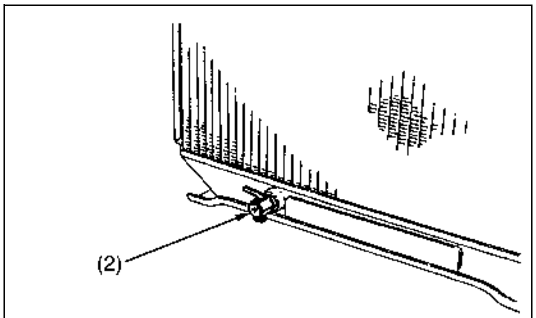

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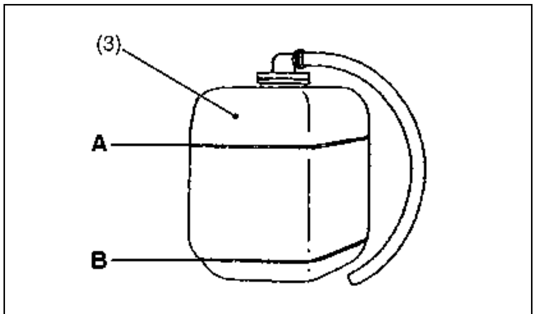

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Cleaning Water Jacket and Radiator Interior

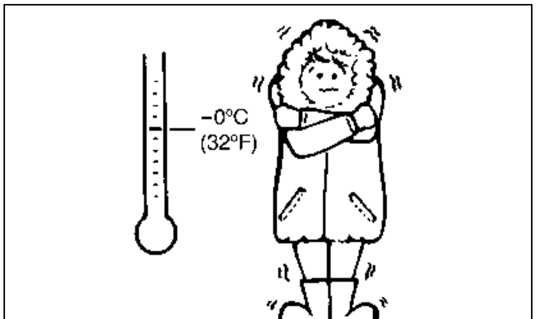
- **Do not remove the radiator cap when the engine is hot. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

1. Stop the engine and let cool down.
2. To drain the coolant, open the radiator drain plug (2) and remove the radiator cap (1). Then radiator cap (1) must be removed to completely drain the coolant. And open the drain cock of engine body.
3. After all coolant is drained, close the drain plug.
4. Fill with clean water and cooling system cleaner.
5. Follow directions of the cleaner instruction.
6. After flushing, fill with clean water and anti-freeze until the coolant level is just below the port. Install the radiator cap (1) securely.
7. Fill with coolant up to “FULL” (**A**) mark on the recovery tank (3).
8. Start and operate the engine for few minutes.
9. Stop the engine and let cool. Check coolant level of radiator and recovery tank (3) and add coolant if necessary.

- **Do not start engine without coolant.**
- **Use clean, fresh, soft water and anti-freeze to fill the radiator and recovery tank.**
- **When the anti-freeze is mixed with fresh, soft water, the anti-freeze mixing ratio must be less than 50 %.**
- **Securely tighten radiator cap. If the cap is loose or improperly fitted, water may leak out and the engine could overheat.**

(1) Radiator Cap **A : Full**
(2) Drain Plug **B : Low**
(3) Recovery Tank

W1038102



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Anti-Freeze

- There are two types of anti-freeze available: use the permanent type (PT) for this engine.
- Before adding anti-freeze for the first time, clean the radiator interior by pouring fresh, soft water and draining it a few times.
- The procedure for mixing water and anti-freeze differs according to the make of the anti-freeze and the ambient temperature. Basically, it should be referred to SAE J1034 standard, more specifically also to SAE J814c.
- Mix the anti-freeze with fresh, soft water, and then fill into the radiator.
- **When the anti-freeze is mixed with fresh, soft water, the anti-freeze mixing ratio must be less than 50 %.**

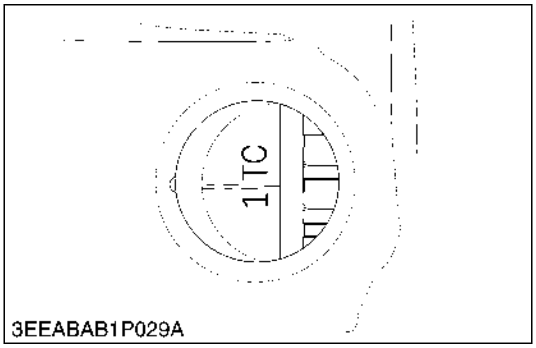
Vol % anti-freeze	Freezing point		Boiling point*	
	°C	°F	°C	°F
40	–24	–11.2	106	222.8
50	–37	–34.6	108	226.4

* At 1.013 × 100000 Pa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

- **The above data represents industrial standards that necessitate a minimum glycol content in the concentrated anti-freeze.**
- **When the coolant level drops due to evaporation, add fresh, soft water only to keep the anti-freeze mixing ratio less than 50 %. In case of leakage, add anti-freeze and fresh, soft water in the specified mixing ratio.**
- **Anti-freeze absorbs moisture. Keep unused anti-freeze in a tightly sealed container.**
- **Do not use radiator cleaning agents when anti-freeze has been added to the coolant.**
  (Anti-freeze contains an anti-corrosive agent, which will react with the radiator cleaning agent forming sludge which will affect the engine parts.)

W1039218

[6] CHECK POINT OF EVERY 1000 HOURS



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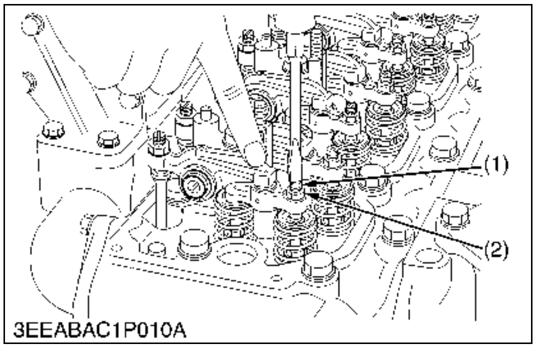

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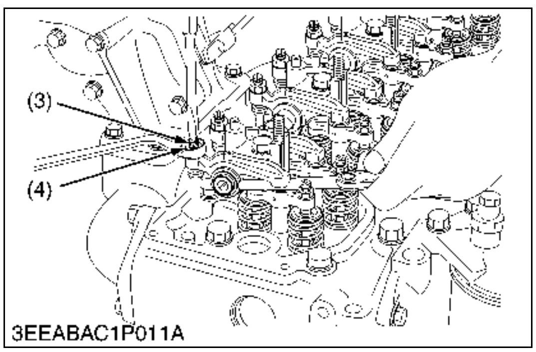

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Checking Valve Clearance

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

1. Remove the high pressure pipes and the head cover.
2. Align the 1TC mark of flywheel and the convex of flywheel housing timing windows so that the first piston (gear case side) comes to the compression top dead center.
3. Before adjusting the valve clearance, adjust the bridge evenly to the valve stem.
4. Loosen the lock nut (2) and adjust with screw (1).
5. Slightly push the rocker arm by your fingers and screw in the adjusting screw slowly until you feel the screw touch the top of valve stem, then tighten the lock nut.
6. Loosen the lock nut (4) of adjusting screw (3) (push rod side) and insert the thickness gauge between the rocker arm and the bridge head. Set the adjusting screw to the specified value, then tighten the lock nut.

Valve clearance	Factory spec.	0.23 to 0.27 mm 0.0091 to 0.0106 in.

- **After adjusting, tighten the lock nut (4) securely.**

Valve arrangement Adjustment cylinder Location of piston		IN.	EX
When No.1 piston is at compression top dead center	1st	*	*
	2nd	*	
	3rd		*
	4th		
When No.1 piston is at overlap position	1st		
	2nd		*
	3rd	*	
	4th	*	*

Tightening torque	Cylinder head cover screw	6.9 to 11.3 N·m 0.7 to 1.15 kgf·m 5.1 to 8.32 ft-lbs
	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs

(1) Adjusting Screw
(2) Lock Nut
(3) Adjusting Screw
(4) Lock Nut

W1037215

[7] CHECK POINTS OF EVERY 1 OR 2 MONTHS

Recharging

- **When the battery is being activated, hydrogen and oxygen gases in the battery are extremely explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.**
- **When charging battery, remove battery vent plugs.**
- **When disconnecting the cable from the battery, start with the negative terminal first. When connecting the cable to the battery, start with the positive terminal first.**
- **Never check battery charge by placing a metal object across the posts.**
  Use a voltmeter or hydrometer.

1) Slow Charging

1. Add distilled water if the electrolyte level is low. When charging, the amount of electrolyte should be slightly lower than the specified level to prevent overflow.
2. Connect the battery to the charging unit, following the manufacture's instructions.
3. As the electrolyte generates gas while charging, remove all port caps.
4. The electrolyte temperature must not exceed 40°C (104°F) during charging.
   If it exceed 40°C (104°F), decrease the charging amperage or stop charging for a while.
5. When charging several batteries in series, charge at the rate of the smallest battery in the line.

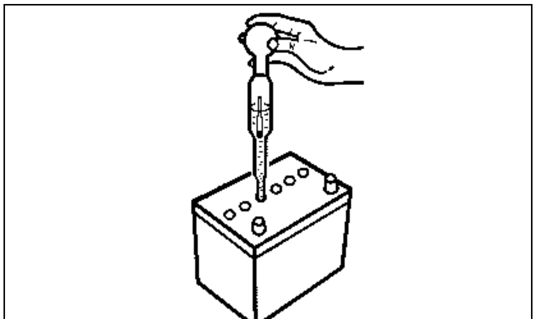
2) Quick Charging

1. Determine the proper charging current and charging time with the tester attached to the quick charger.
2. Determine the proper charging current as 1/1 of the battery capacity. If the battery capacity exceeds 50 Ah, consider 50 A as the maximum.

<Dingbats>n Precaution for Operating a Quick Charger

- Operate with a quick charger differs according to the type.
  Consult the instruction manual and use accordingly.

W1052658



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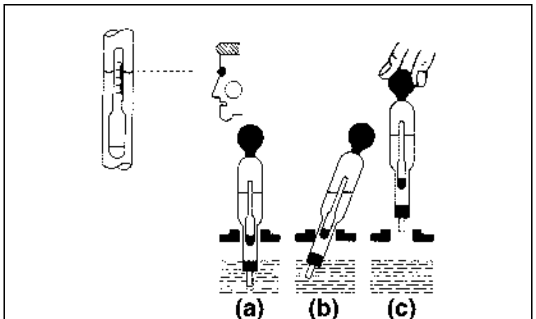

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Battery Specific Gravity

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in **(Reference)**.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

- **Hold the hydrometer tube vertical without removing it from the electrolyte.**
- **Do not suck too much electrolyte into the tube.**
- **Allow the float to move freely and hold the hydrometer at eye level.**
- **The hydrometer reading must be taken at the highest electrolyte level.**

(Reference)

- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1°C (0.0004 with an increase of 1°F) in temperature, and increases by 0.0007 with a decreases of 1°C (0.0004 with a decrease of 1°F).

  Therefore, using 20 °C (68°F) as a reference, the specific gravity reading must be corrected by the following formula :
  - Specific gravity at 20 °C = Measured value + 0.0007 × (electrolyte temperature : 20°C)
  - Specific gravity at 68°F = Measured value + 0.0004 × (electrolyte temperature : 68°F)

Specific Gravity	State of Charge
1.260 Sp. Gr.	100 % Charged
1.230 Sp. Gr.	75 % Charged
1.200 Sp. Gr.	50 % Charged
1.170 Sp. Gr.	25 % Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

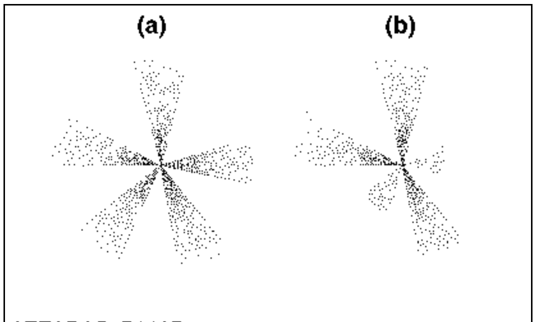
At an electrolyte temperature of 20 °C (68 °F)

(a) Good
(b) Bad
(c) Bad

W1012763

[8] CHECK POINTS OF EVERY 1500 HOURS

- **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.**



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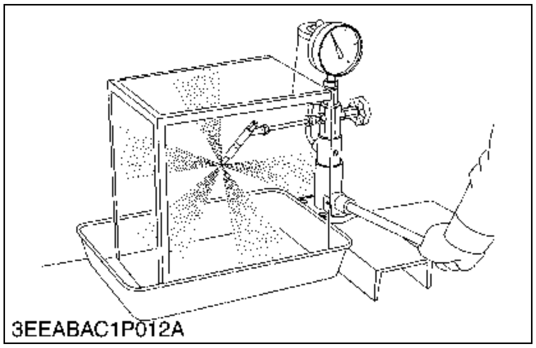
Nozzle Spraying Condition

1. Set the injection nozzle to a nozzle tester, and check the nozzle spraying condition.
2. If the spraying condition is defective, replace the injection nozzle assembly or repair at Denso service shop.

(a) Good **(b) Bad**

W10411400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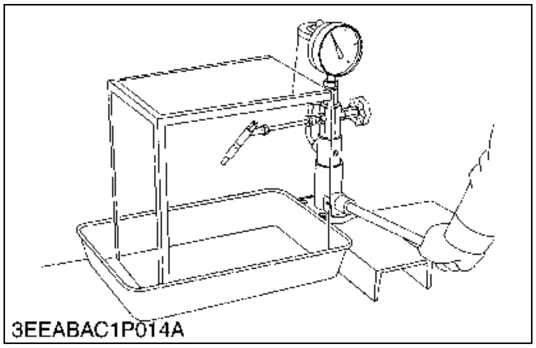
Checking Nozzle Injection Pressure

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, replace the injection nozzle assembly or repair at Denso service shop.

- **Injection nozzle gasket must be replaced when the injection nozzle is removed for checking.**

Injection pressure	Factory spec.	1st stage	18.63 to 19.61 MPa 190 to 200 kgf/cm^2 2702 to 2845 psi

W1024942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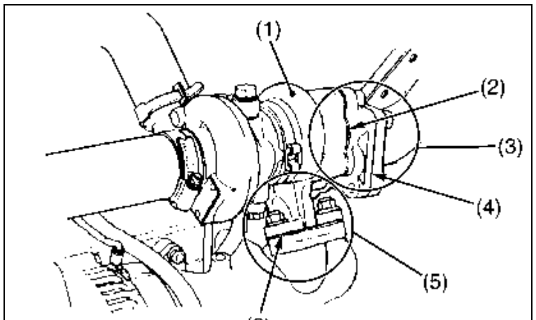
Valve Seat Tightness

1. Set the injection nozzle to a nozzle tester.
2. Raise the fuel pressure, and keep at 16.67 MPa (170 kgf/cm^2, 2418 psi) for 10 seconds.
3. If any fuel leak is found, replace the injection nozzle assembly or repair at Denso service shop.

Valve seat tightness	Factory spec.	No fuel leak at 16.67 MPa 170 kgf/cm^2 2418 psi

W10412730

[9] CHECK POINTS OF EVERY 3000 HOURS



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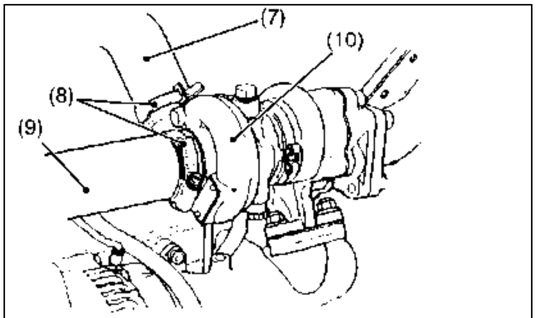

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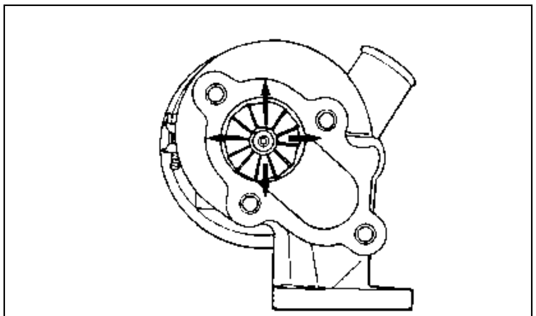

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Checking Turbocharger

(Turbine Side)

1. Check the exhaust port (3) and inlet port (5) side of 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 (2) / (4) / (6) with new one.

(Compressor Side)

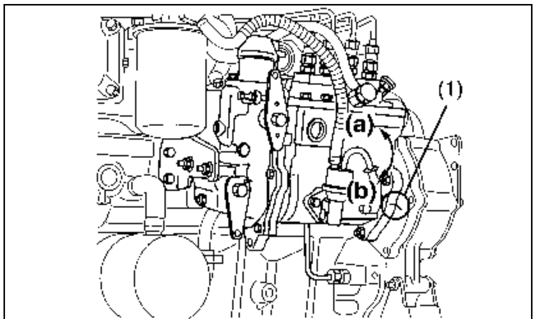
1. Check the inlet hose (9) of the compressor cover (10) to see if there is no air leak.
2. If any air leak is found, change the clamp (8) and / or inlet hoses.
3. Check the intake hose (7) and the clamp to see if there is not loose or crack.
4. If any loose or crack is found, tighten the cramp or change the hose to prevent dust from entry.

(Radial Clearance)

1. If the wheel contact to the housing, replace the turbocharger assembly with new one.

(1) Turbine Housing
(2) Gasket
(3) Exhaust Port
(4) Gasket
(5) Inlet Port
(6) Gasket
(7) Intake Hose
(8) Clamp
(9) Inlet Hose
(10) Compressor Cover

W1022082



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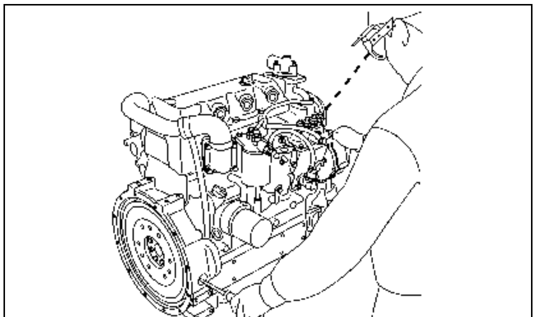
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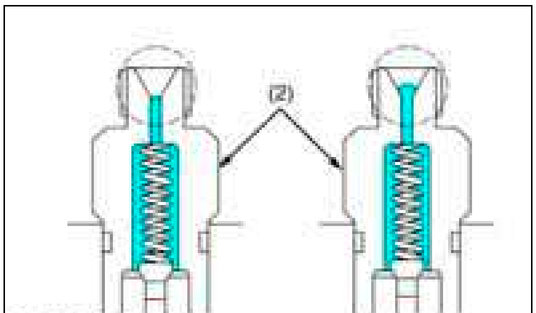

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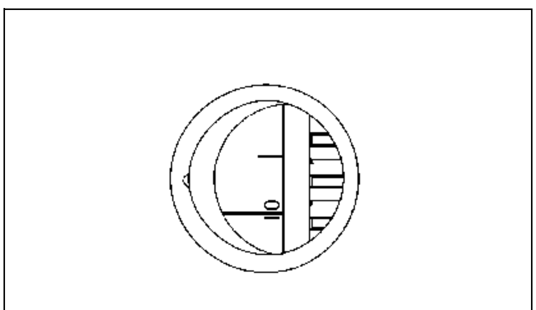

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Injection Timing

1. Make sure of matching the injection timing align mark (1) of the injection pump unit and the plate (gearcase), as shown in the illustration.
2. Remove the injection pipes.
3. Remove the stop solenoid.
4. Turn the flywheel counterclockwise (viewed from flywheel side) until the fuel fills up to the hole of the delivery valve holder (2) for No.1 cylinder.
5. After the fuel fills up to the hole of the delivery valve holder for No.1 cylinder, turn back (clockwise) the flywheel around 1.57 rad (90 °).
6. Turn the flywheel counterclockwise to set at around 0.35 rad (20 <Symbol>×) before T.D.C..
7. Slowly turn the flywheel counterclockwise and stop turning when the fuel begins to come up, to get the present injection timing.
8. Check to see the degree on flywheel.
   The flywheel has mark “1TC”, “10” and “20” for the crank angle before the top dead center of No.1 piston.
9. If the injection timing is not within the specification, rotate the injection pump unit to adjust the injection timing.

- **When installing the injection pump unit to the engine body, follow the correct procedure.**
  See the “Injection Pump Unit”.

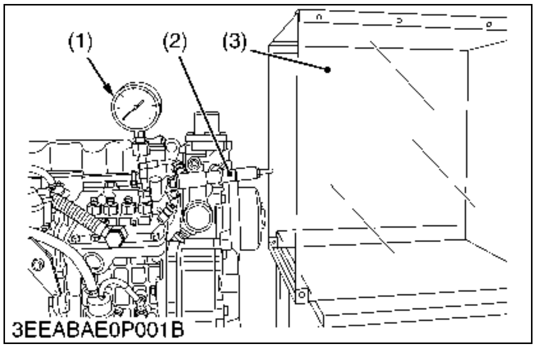
Injection timing	Factory spec.	0.21 to 0.24 rad (12 ° to 14 °) before T.D.C.

Tightening torque	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
	Injection pump unit mounting nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs

(1) Injection Timing Align Mark
(2) Delivery Valve Holder

(a) Injection Timing Advanced
(b) Injection Timing Retarded

W1072910



Checking Injection Pump

(Fuel Tightness of Pump Element)

1. Remove the engine stop solenoid.
2. Remove the injection pipes.
3. Install the injection pump pressure tester to the injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1). (Refer to the figure.)
5. Set the speed control lever to the maximum speed position.
6. Run the starter to increase the pressure.
7. If the pressure can not reach the allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

(Fuel Tightness of Delivery Valve)

1. Remove the engine stop solenoid.
2. Remove the injection pipes.
3. Set a pressure tester to the fuel injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1).
5. Run the starter to increase the pressure.
6. Stop the starter when the fuel jets from the injection nozzle. After that, turn the flywheel by the hand and raise the pressure to approx. 18.63 MPa (190 kgf/cm^2, 2702 psi).
7. 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 18.63 to 17.65 MPa (from 190 to 180 kgf/cm^2, from 2702 to 2560 psi).
8. Measure the time needed to decrease the pressure from 18.63 to 17.65 MPa (from 190 to 180 kgf/cm^2, from 2702 to 2560 psi).
9. If the measurement is less than allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

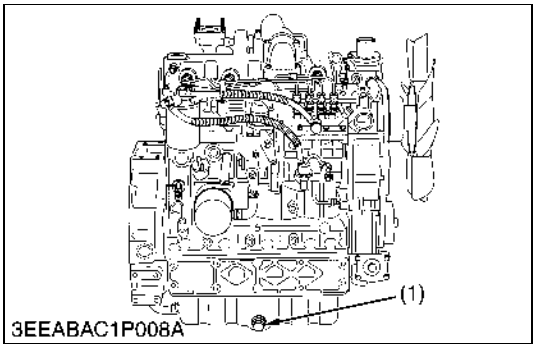
Fuel tightness of pump element	Allowable limit	18.63 MPa 190 kgf/cm^2 2702 psi
Fuel tightness of delivery valve	Factory spec.	10 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi
	Allowable limit	5 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi

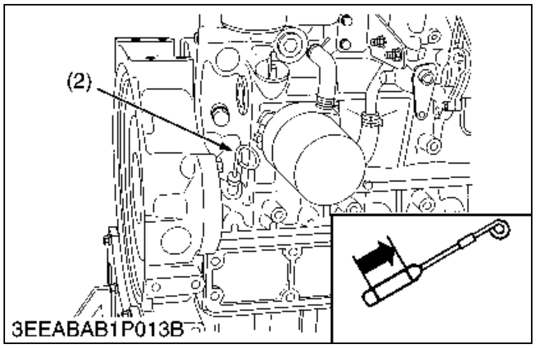
- **Never try to disassemble the injection pump assembly. For repairs, you are strongly requested to contact a Kubota-authorized pump service shop.**

(1) Injection Pump Pressure Tester
(2) Injection Nozzle
(3) Protection Cover for Jetted Fuel

W1022357

[10] CHECK POINTS OF EVERY 1 YEAR





Changing Engine Oil

- **Be sure to stop engine before changing engine oil.**

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. To drain the used oil, remove the drain plug (1) at the bottom of the engine and drain the oil completely.
4. Screw the drain plug (1).
5. Fill new oil up to upper line on the dipstick (2).

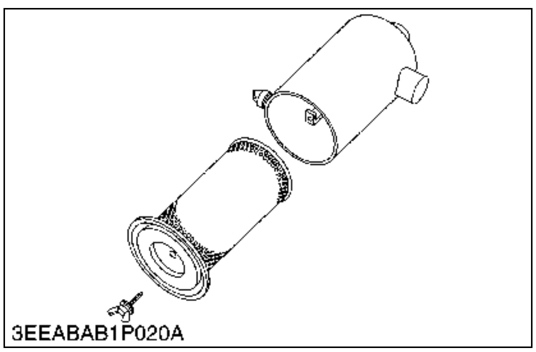
- **When using an oil of different maker or viscosity from the previous one, remove all of the old oil.**
- **Never mix two different types of oil.**
- **Engine oil should have properties of API classification CD/CE/CF/CF-4/CG-4.**
- **Use the proper SAE Engine Oil according to ambient temperature.**

Above 25 °C (77 °F)	SAE 30 or SAE 10W-30 SAE 10W-40
0 °C to 25 °C (32 °F to 77 °F)	SAE 20 or SAE 10W-30 SAE 10W-40
Below 0 °C (32 °F)	SAE 10W or SAE 10W-30 SAE 10W-40

Engine oil capacity	13.2 L 3.49 U.S.gals

(1) Drain Plug (2) Dipstick

W1019006



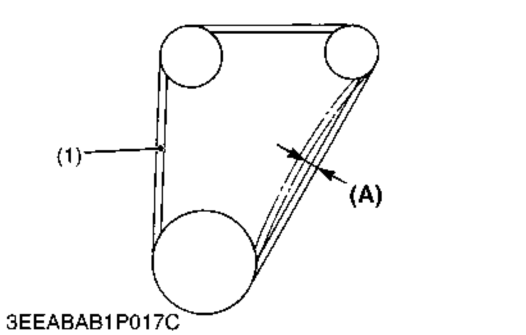
Replacing Air Cleaner Element

1. Remove used air cleaner element.
2. Replace new air cleaner element.

- **The air cleaner uses a dry element. Never apply oil to it.**
- **Do not run the engine with filter element removed.**

W1020554

[11] CHECK POINTS OF EVERY 2 YEARS



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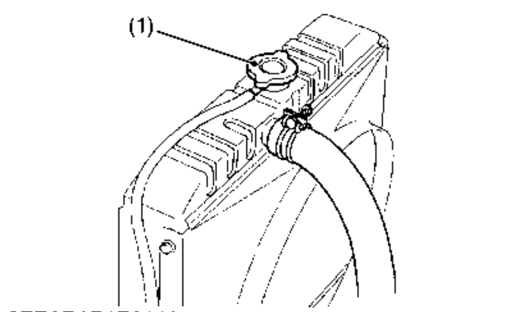
Replacing Fan Belt

1. Remove the alternator.
2. Remove the fan belt (1).
3. Replace new fan belt.
4. Install the alternator.
5. Check the fan belt tension.

Deflection **(A)**	Factory spec.	10.0 to 12.0 mm / 98 N 0.394 to 0.472 in. / 98 N (10 kgf, 22 lbs)

(1) Fan Belt **(A) Deflection**

W1019333



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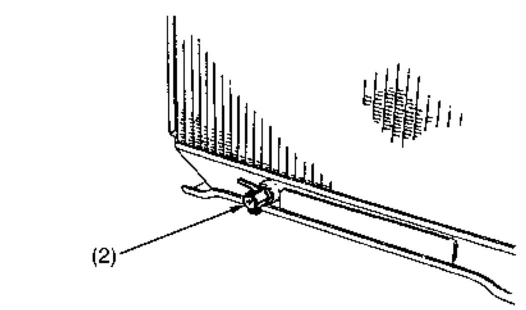

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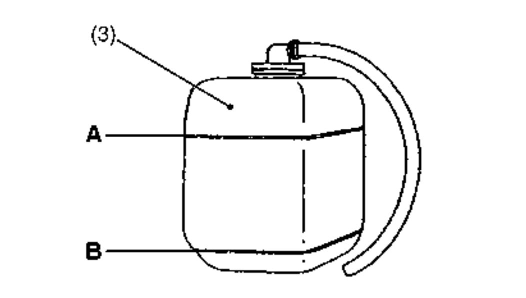


3EEABAB1P015B

Changing Radiator Coolant (L.L.C.)

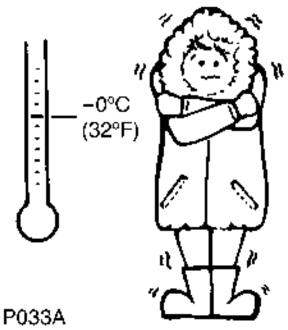
- **Do not remove the radiator cap when the engine is hot. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

1. Stop the engine and let cool down.
2. To drain the coolant, open the radiator drain plug (2) and remove the radiator cap (1). Then radiator cap (1) must be removed to completely drain the coolant. And open the drain cock of engine body.
3. After all coolant is drained, close the drain plug.
4. Fill with clean water and cooling system cleaner.
5. Follow directions of the cleaner instruction.
6. After flushing, fill with clean water and anti-freeze until the coolant level is just below the port. Install the radiator cap (1) securely.
7. Fill with coolant up to “FULL” (**A**) mark on the recovery tank (3).
8. Start and operate the engine for few minutes.
9. Stop the engine and let cool. Check coolant level of radiator and recovery tank (3) and add coolant if necessary.

- **Do not start engine without coolant.**
- **Use clean, fresh, soft water and anti-freeze to fill the radiator and recovery tank.**
- **When the anti-freeze is mixed with fresh, soft water, the anti-freeze mixing ratio must be less than 50 %.**
- **Securely tighten radiator cap. If the cap is loose or improperly fitted, water may leak out and the engine could overheat.**

(1) Radiator Cap **A : Full**
(2) Drain Plug **B : Low**
(3) Recovery Tank

W1024599



3EEABAB1P033A

Changing Radiator Coolant (L.L.C.) (Continued)

(Anti-freeze)

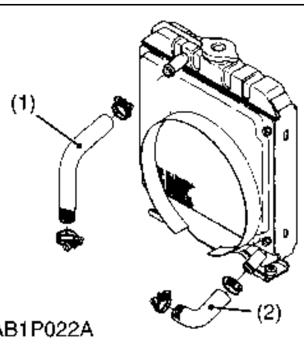
- There are two types of anti-freeze available: use the permanent type (PT) for this engine.
- Before adding anti-freeze for the first time, clean the radiator interior by pouring fresh, soft water and draining it a few times.
- The procedure for mixing water and anti-freeze differs according to the make of the anti-freeze and the ambient temperature. Basically, it should be referred to SAE J1034 standard, more specifically also to SAE J814c.
- Mix the anti-freeze with fresh, soft water, and then fill into the radiator.
- **When the anti-freeze is mixed with fresh, soft water, the anti-freeze mixing ratio must be less than 50 %.**

Vol % anti-freeze	Freezing point		Boiling point*	
	°C	°F	°C	°F
40	–24	–11.2	106	222.8
50	–37	–34.6	108	226.4

* At 1.013 × 100000 Pa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

- **The above data represents industrial standards that necessitate a minimum glycol content in the concentrated anti-freeze.**
- **When the coolant level drops due to evaporation, add fresh, soft water only to keep the anti-freeze mixing ratio less than 50 %. In case of leakage, add anti-freeze and fresh, soft water in the specified mixing ratio.**
- **Anti-freeze absorbs moisture. Keep unused anti-freeze in a tightly sealed container.**
- **Do not use radiator cleaning agents when anti-freeze has been added to the coolant.**
  (Anti-freeze contains an anti-corrosive agent, which will react with the radiator cleaning agent forming sludge which will affect the engine parts.)

W1024852



3EEABAB1P022A

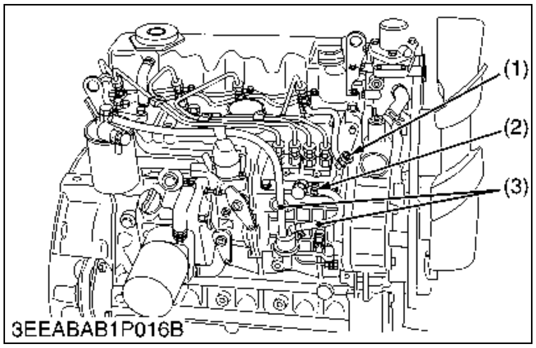
Replacing Radiator Hoses and Clamp Bands

- **Do not remove the radiator cap when the engine is hot. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

1. Drain the coolant.
2. Loosen the clamp bands.
3. Remove the upper hose (1) and lower hose (2).
4. Replace new upper / lower hose (1), (2) and clamp bands.
5. Tighten the clamp bands.
6. Fill with clean water and anti-freeze until the coolant level is just below the port. Install the radiator cap securely.

(1) Upper Hose (2) Lower Hose

W1024178



3EEABAB1P016B

Replacing Fuel Hose and Clamp Bands

1. Loosen the clamp (2) and remove the fuel hose (3).
2. Replace new fuel hose (3) and new clamp (2).
3. Tighten the clamp (2).

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

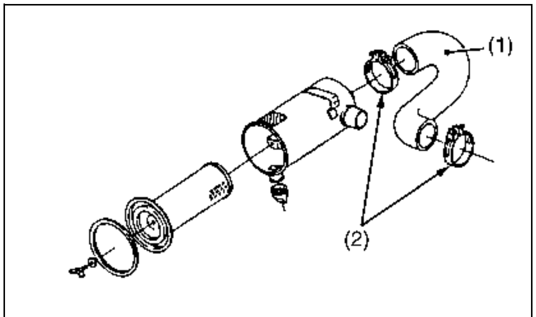
(When bleeding fuel system)

1. Fill the tank with fuel and open the cock.
2. Loosen the air vent coupling bolt of fuel filter a few turns.
3. When there is no more air bubbles in the fuel coming out of this coupling bolt, tighten the coupling bolt.
4. Open the air vent cock (1) on the top of fuel injection pump.
5. If equipped electrical fuel feed pump, turn the key on AC position and pump the fuel up for 10 to 15 seconds.
   If equipped mechanical fuel feed pump, set the stop lever on stop position and crank the engine for 10 to 15 seconds.
6. Close securely the air vent cock (1) after air bleeding.

- **Except when venting the air, be sure to keep closed the air vent coupling bolt of the fuel injection pump. Otherwise, the engine may stall.**

(1) Air Vent Cock
(2) Clamp
(3) Fuel Hose

W1020090



3EEABAB1P025A

Replacing Intake Air Line

1. Loosen the clamp (2).
2. Remove the intake air hose (1) and clamp (2).
3. Replace new intake air hose (1) and new clamp (2).
4. Tighten the clamp (2).

- **To prevent serious damage to the engine, keep out any dust inside the intake air line.**

(1) Intake Air Hose
(2) Clamp

W1023867

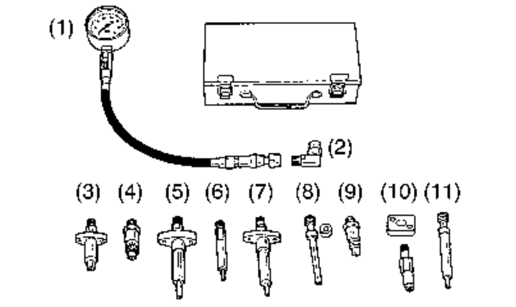
Replacing Battery

- **When the battery is being activated, hydrogen and oxygen gases in the battery are extremely explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.**
- **When charging battery, remove battery vent plugs.**
- **When disconnecting the cable from the battery, start with the negative terminal first. When connecting the cable to the battery, start with the positive terminal first.**
- **Never check battery charge by placing a metal object across the posts.**

1. Disconnect the negative terminal and positive terminal.
2. Remove the battery holder.
3. Remove the used battery.
4. Replace the new battery.
5. Tighten the battery holder.
6. Connect the positive terminal.
7. Connect the negative terminal.

W1023996

5. SPECIAL TOOLS



3EEABAE0P002A

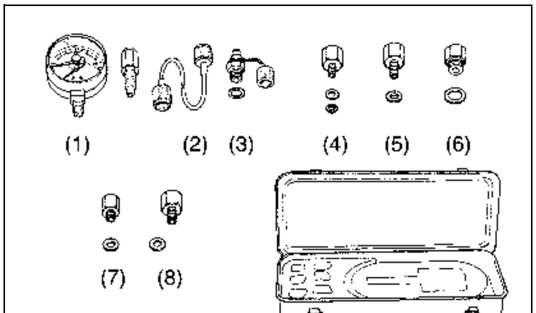
Diesel Engine Compression Tester

Code No: 07909-30208 (Assembly)
07909-30934 (A to F)
07909-31211 (E and F)
07909-31231 (H)
07909-31251 (G)
07909-31271 (I)
07909-31281 (J)

Application: Use to measure diesel engine compression and diagnostics of need for major overhaul.

(1) Gauge
(2) **L** Joint
(3) Adaptor **A**
(4) Adaptor **B**
(5) Adaptor **C**
(6) Adaptor **E**
(7) Adaptor **F**
(8) Adaptor **G**
(9) Adaptor **H**
(10) Adaptor **I**
(11) Adaptor **J**

W1024200



3TMABAB0P112A

Oil Pressure Tester

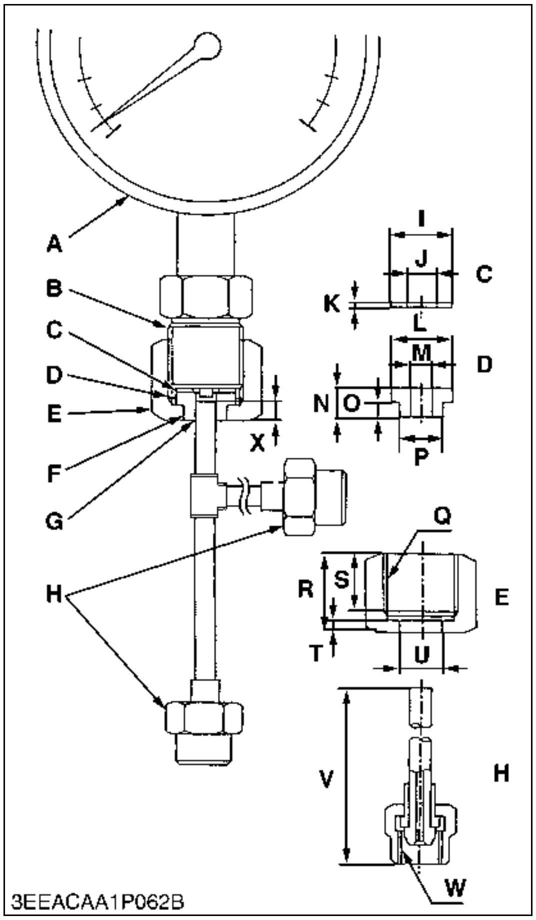
Code No: 07916-32032

Application: Use to measure lubricating oil pressure.

(1) Gauge
(2) Cable
(3) Threaded Joint
(4) Adaptor **1**
(5) Adaptor **2**
(6) Adaptor **3**
(7) Adaptor **4**
(8) Adaptor **5**

W1024318

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

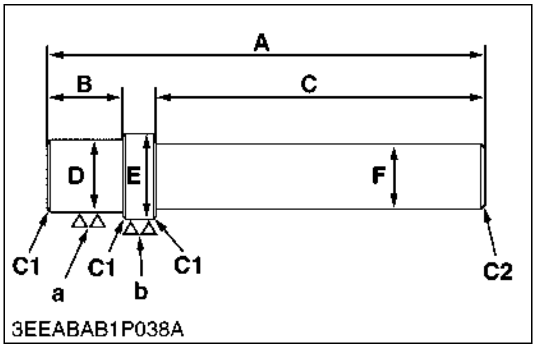


Injection Pump Pressure Tester

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	PF 1/2
C	Copper gasket
D	Flange (Material : Steel)
E	Hex. nut 27 mm (1.06 in.) across the plat
F	Adhesive application
G	Fillet welding on the enter circumference
H	Retaining nut
I	17 mm dia. (0.67 in. dia.)
J	8 mm dia. (0.31 in. dia.)
K	1.0 mm (0.039 in.)
L	17 mm dia. (0.67 in. dia.)
M	6.10 to 6.20 mm dia. (0.2402 to 0.2441 in. dia.)
N	8 mm (0.31 in.)
O	4 mm (0.16 in.)
P	11.97 to 11.99 mm dia. (0.4713 to 0.4720 in. dia.)
Q	PF 1/2
R	23 mm (0.91 in.)
S	17 mm (0.67 in.)
T	4 mm (0.16 in.)
U	12.00 to 12.02 mm dia. (0.4724 to 0.4732 in. dia.)
V	100 mm (3.94 in.)
W	M12 × P1.5
X	5 mm (0.20 in.)

W10252400



Small End Bushing Replacing Tool

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

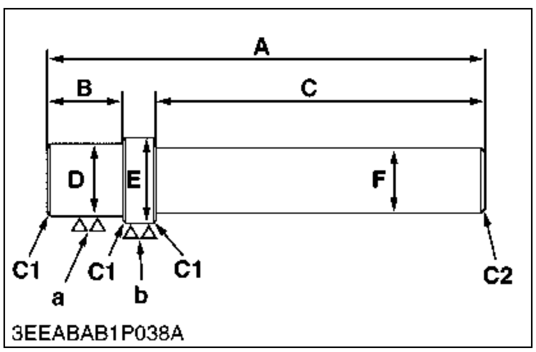
[Press out]

A	157 mm (6.181 in.)
B	14.5 mm (0.571 in.)
C	120 mm (4.7244 in.)
D	30.0 mm dia. (1.1811 in. dia.)
E	32.95 mm dia. (1.2972 in. dia.)
F	20 mm dia. (0.7874 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)

[Press fit]

A	157 mm (6.181 in.)
B	14.5 mm (0.571 in.)
C	120 mm (4.7244 in.)
D	30.0 mm dia. (1.1811 in. dia.)
E	42.000 mm dia. (1.6535 in. dia.)
F	20 mm dia. (0.7874 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)

W1040702

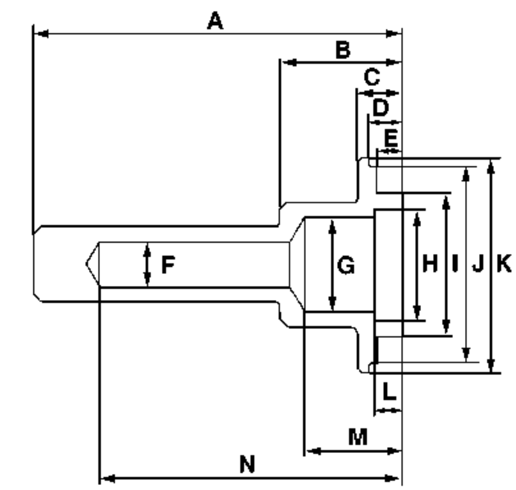


Idle Gear Bushing Replacing Tool

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

A	196 mm (7.7165 in.)
B	37.5 mm (1.476 in.)
C	150 mm (5.9055 in.)
D	44.95 mm dia. (1.7697 in. dia.)
E	48.075 to 48.100 mm dia. (1.8927 to 1.8937 in. dia.)
F	20 mm dia. (0.7874 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)

W1040289



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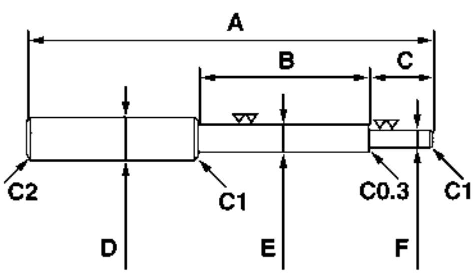
Gear Case Oil Seal Replacing Tool

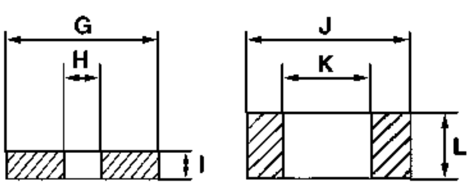
Application: Use to press fit the oil seal.

A	148.8 mm (5.8582 in.)
B	50 mm (1.9685 in.)
C	18.8 mm (0.7401 in.)
D	13.7 to 13.9 mm (0.5394 to 0.5472 in.)
E	11 mm (0.433 in.)
F	18 mm dia. (0.7087 in. dia.)
G	38 mm dia. (1.4961 in. dia.)
H	45 mm dia. (1.7716 in. dia.)
I	57.9 to 58.1 mm dia. (2.2795 to 2.2874 in. dia.)
J	79.5 mm dia. (3.1299 in. dia.)
K	87 mm dia. (3.425 in. dia.)
L	12 mm (0.4724 in.)
M	40 mm (1.5748 in.)
N	120 mm (4.7244 in.)

W1041529



3TMABAB0P063B



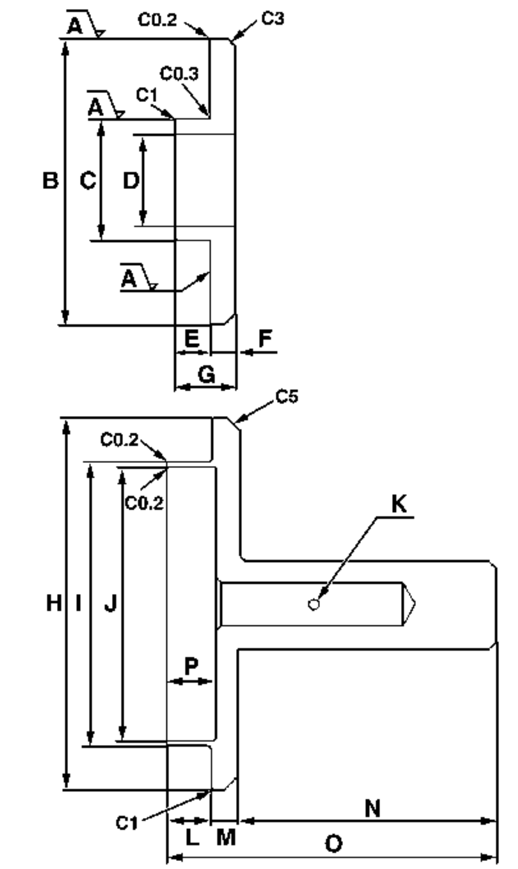
3TMABAB0P064B

Valve Guide Replacing Tool

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

A	225 mm (8.86 in.)
B	70 mm (2.76 in.)
C	45 mm (1.77 in.)
D	20 mm dia. (0.79 in dia.)
E	11.7 to 11.9 mm dia. (0.460 to 0.468 in. dia.)
F	6.5 to 6.6 mm dia. (0.256 to 0.259 in. dia.)
G	25 mm dia. (0.98 in. dia.)
H	6.7 to 7.0 mm dia. (0.263 to 0.275 in. dia.)
I	5 mm (0.197 in.)
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.)

W1038887



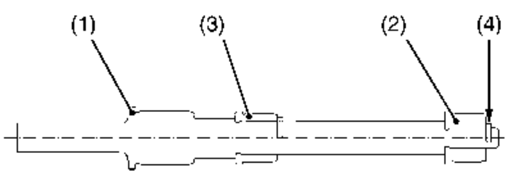
3EEABAB1P041A

Auxiliary Socket for Fixing Crankshaft Sleeve

Application: Use to fix the crankshaft sleeve of the diesel engine.

A	Rmax = 12.5 S
B	94.5 to 95.0 mm dia. (3.7205 to 3.7402 in. dia.)
C	40 mm dia. (1.5748 in. dia.)
D	30 mm dia. (1.1811 in. dia.)
E	12 mm (0.4724 in.)
F	7.9 to 8.1 mm (0.3110 to 0.3189 in.)
G	20 mm (0.7874 in.)
H	130 mm dia. (5.1181 in. dia.)
I	99.4 to 99.6 mm dia. (3.9134 to 3.9213 in. dia.)
J	95.05 to 95.20 mm dia. (3.7421 to 3.7480 in. dia.)
K	3 mm dia. (0.1181 in.dia.)
L	15 mm (0.5905 in.)
M	10 mm (0.3937 in.)
N	90 mm (3.5433 in.)
O	115 mm (4.5275 in.)
P	16.9 to 17.1 mm (0.6654 to 0.6732 in.)
C1	Chamfer 1.0 mm (0.039 in.)
C3	Chamfer 3.0 mm (0.1181 in.)
C5	Chamfer 5.0 mm (0.1969 in.)
C0.2	Chamfer 0.2 mm (0.0079 in.)
C0.3	Chamfer 0.3 mm (0.0118 in.)

W1041815



3EEABAB1P044A

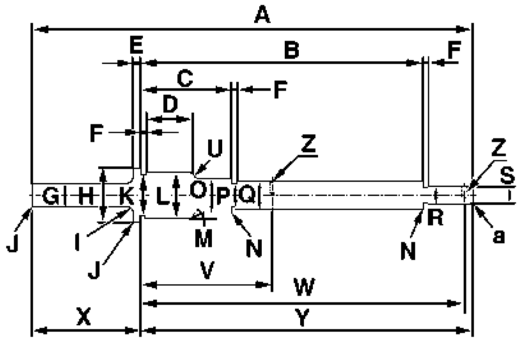
Balancer Bushing Replacing Tool 1 Assembly

Application: Use to press fit the bushing.

No.	Name of Part	Q'ty.	Remarks
(1)	Shaft	1	
(2)	Piece 1	1	
(3)	Piece 2	1	
(4)	Bolt	2	M6 × P1.0

W1042867

Balancer Bushing Replacing Tool 1 Components Parts



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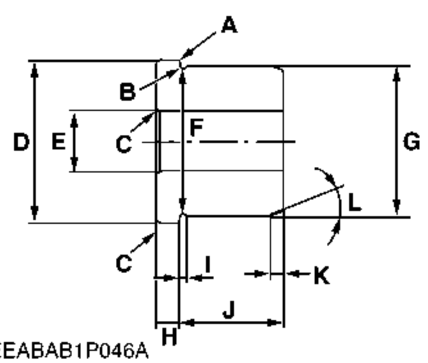
1) Shaft

A	498 mm (19.61 in.)
B	318.8 to 319.2 mm (12.5512 to 12.5669 in.)
C	102.8 to 103.2 mm (4.0472 to 4.0630 in.)
D	60 mm (2.36 in.)
E	8 mm (0.31 in.)
F	5 mm (0.20 in.)
G	30 mm dia. (1.18 in. dia.)
H	65 mm dia. (2.56 in. dia.)
I	6 mm (0.24 in.)
J	Chamfer 1 mm (0.04 in.)
K	53 mm dia. (2.09 in. dia.)
L	54.7 to 54.9 mm dia. (2.1535 to 2.1614 in. dia.)
M	0.26 rad (15 °)
N	Chamfer 0.5 mm (0.02 in.)
O	41 mm dia. (1.61 in. dia.)
P	32 mm dia. (1.26 in. dia.)
Q	33.96 to 34.0 mm dia. (1.3370 to 1.3386 in. dia.)
R	18 mm dia. (0.71 in. dia.)
S	19.967 to 20.0 mm dia. (0.7861 to 0.7874 in. dia.)
U	3 mm (0.12 in.)
V	149.1 to 149.4 mm (5.8701 to 5.8819 in.)
W	365.1 to 365.4 mm (14.3740 to 14.3858 in.)
X	123 mm (4.84 in.)
Y	375 mm (14.76 in.)
Z	M6 × P1.0 depth 7 mm (0.28 in.)
a	Chamfer 2 mm (0.08 in.)

W1043162

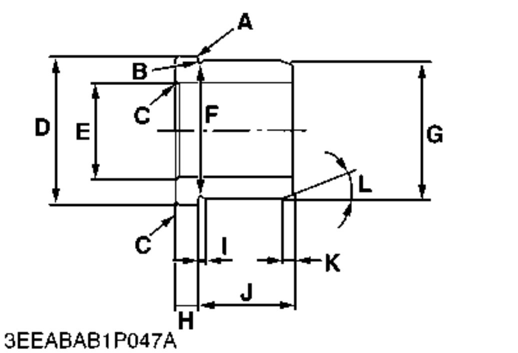


3EEABAB1P046A

2) Piece 1

A	Chamfer 0.1 mm (0.004 in.)
B	1 mm (0.04 in.)
C	Chamfer 1mm (0.04 in.)
D	53.8 to 53.9 mm dia. (2.1181 to 2.1220 in. dia.)
E	20.02 to 20.041 mm dia. (0.7882 to 0.7890 in. dia.)
F	48 mm dia. (1.89 in. dia.)
G	49.934 to 49.94 mm dia. (1.9659 to 1.9661 in. dia.)
H	8 mm (0.31 in.)
I	2 mm (0.08 in.)
J	35 mm dia. (1.38 in. dia.)
K	5 mm (0.20 in.)
L	0.26 rad (15 °)

W1044434

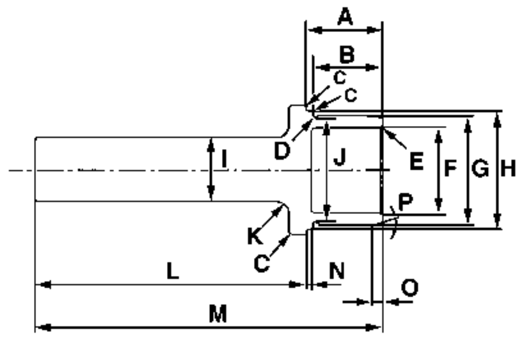


3EEABAB1P047A

3) Piece 2

A	Chamfer 0.1 mm (0.004 in.)
B	1 mm (0.04 in.)
C	Chamfer 1mm (0.04 in.)
D	54.3 to 54.4 mm dia. (2.1378 to 2.1417 in. dia.)
E	34.025 to 34.05 mm dia. (1.3396 to 1.3406 in. dia.)
F	48.5 mm dia. (1.9094 in. dia.)
G	50.421 to 50.44 mm dia. (1.9851 to 1.9858 in. dia.)
H	8 mm (0.31 in.)
I	2 mm (0.08 in.)
J	35 mm dia. (1.38 in. dia.)
K	5 mm (0.20 in.)
L	0.26 rad (15 °)

W1044620



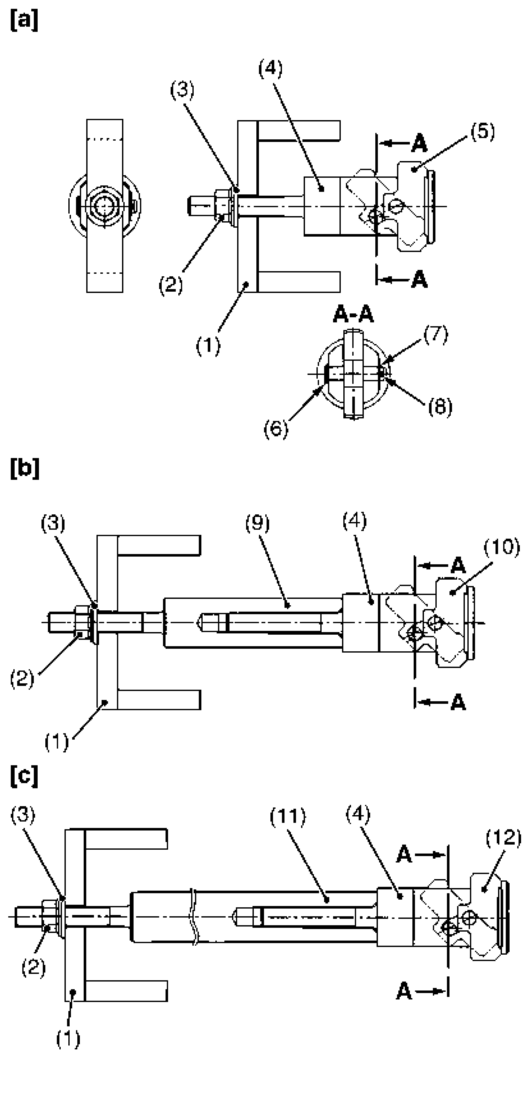
3EEABAB1P048A

Balancer Bushing Replacing Tool 2

Application: Use to press fit the bushing.

A	35 mm (1.38 in.)
B	33 mm (1.30 in.)
C	Chamfer 0.5 mm (0.02 in.)
D	1 mm (0.04 in.)
E	Chamfer 1 mm (0.04 in.)
F	40 mm dia. (1.57 in. dia.)
G	50.921 to 50.94 mm dia. (2.0048 to 2.0055 in. dia.)
H	54.8 to 54.9 mm dia. (2.1575 to 2.1614 in. dia.)
I	30 mm dia. (1.18 in. dia.)
J	49 mm dia. (1.93 in. dia.)
K	6 mm (0.24 in.)
L	125 mm (4.92 in.)
M	160 mm (6.30 in.)
N	3 mm (0.12 in.)
O	5 mm (0.20 in.)
P	0.26 rad (15 °)

W1044794



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Balancer Replacing Tools 3, 4, 5

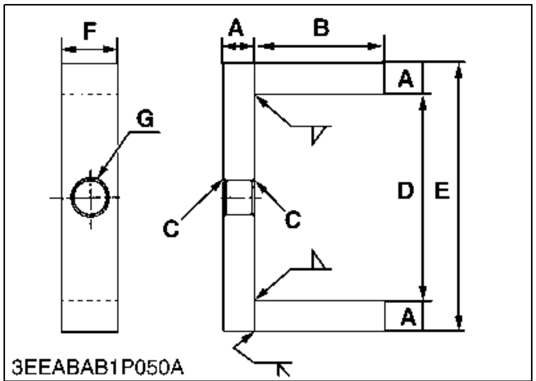
Application: Use to press fit the bushing.

- **This special tool is not provided, so make it referring to the figure.**

No.	Name of Part	Q'ty.
(1)	Bracket	1
(2)	Flange Nut	1
(3)	Washer	1
(4)	Shaft	1
(5)	Piece 1	1
(6)	Clevis	1
(7)	Washer	1
(8)	Cotter Pin	1
(9)	Joint 1	1
(10)	Piece 2	1
(11)	Joint 2	1
(12)	Piece 3	1

[a] :Tool 3
[b] :Tool 4
[c] :Tool 5
A : Section

W1045310



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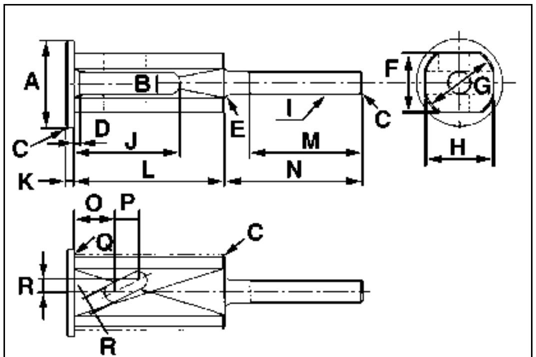
Balancer Replacing Tool Components Parts

1) Bracket

A	12 mm (0.47 in.)
B	50 mm (1.97 in.)
C	Chamfer 1 mm (0.04 in.)
D	80 mm (3.15 in.)
E	104 mm (4.09 in.)
F	22 mm (0.87 in.)
G	13 mm dia. (0.51 in. dia.)

W1167794



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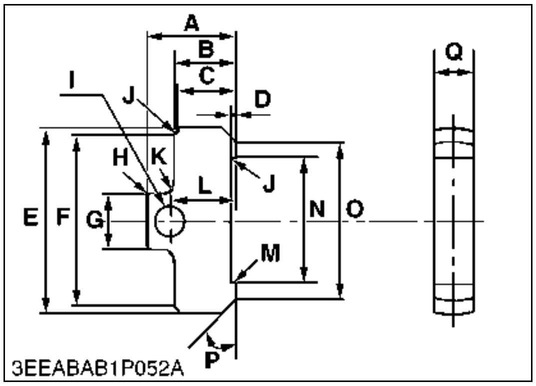
2) Shaft

A	44 mm dia. (1.73 in. dia.)
B	12 mm (0.47 in.)
C	Chamfer 1 mm (0.04 in.)
D	3 mm (0.12 in.)
E	3 mm (0.12 in.)
F	30 mm (1.18 in.)
G	38 mm (1.50 in.)
H	35 mm (1.38 in.)
I	M12 × P1.25
J	53 mm (2.09 in.)
K	4 mm (0.16 in.)
L	75 mm (2.95 in.)
M	57 mm (2.24 in.)
N	70 mm (2.76 in.)
O	19.5 mm (0.77 in.)
P	12 mm (0.47 in.)
Q	0.8 mm (0.03 in.)
R	6 mm (0.24 in.)

W1046146

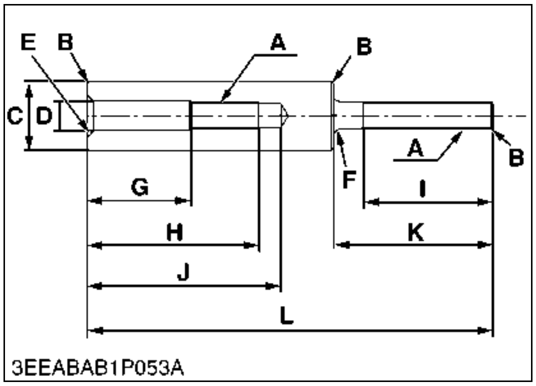


3EEABAB1P052A

3) Piece 1

A	26 mm (1.02 in.)
B	18 mm (0.71 in.)
C	16.5 to 17.0 mm (0.6496 to 0.6693 in.)
D	1.5 mm (0.06 in.)
E	54.0 to 54.2 mm dia. (2.1260 to 2.1339 in dia.)
F	50.55 to 50.75 mm dia. (1.9902 to 1.9980 in dia.)
G	16 mm (0.63 in.)
H	Chamfer 1 mm (0.04 in.)
I	8.5 mm dia. (0.33 in. dia.)
J	0.4 mm (0.0157 in.)
K	3 mm (0.12 in.)
L	19 mm (0.75 in.)
M	Chamfer 0.5 mm (0.02 in.)
N	36 mm (1.42 in.)
O	45 mm dia. (1.77 in. dia.)
P	0.78 rad (45 °)
Q	11.5 mm (0.45 in.)

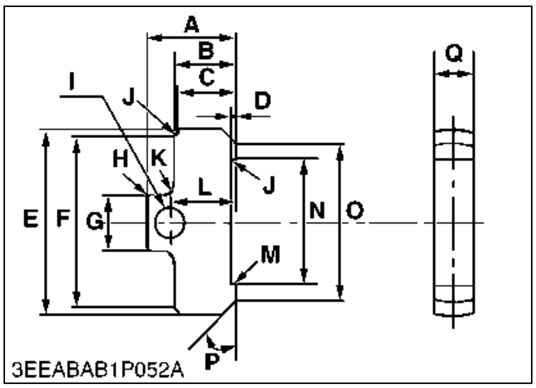
W1047263



4) Joint 1

A	M12 × P1.25
B	Chamfer 1 mm (0.04 in.)
C	30 mm dia. (1.18 in. dia.)
D	13 mm dia. (0.51 in. dia.)
E	Chamfer 3 mm (0.12 in.)
F	3 mm (0.12 in.)
G	45 mm (1.77 in.)
H	75 mm (2.95 in.)
I	57 mm (2.24 in.)
J	85 mm (3.35 in.)
K	70 mm (2.76 in.)
L	178 mm (7.01 in.)

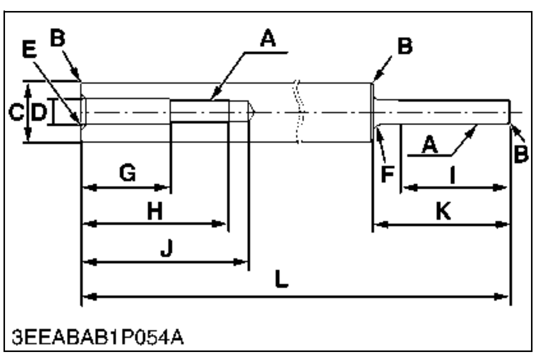
W1047709



5) Piece 2

A	26 mm (1.02 in.)
B	18 mm (0.71 in.)
C	16.5 to 17.0 mm (0.6496 to 0.6693 in.)
D	1.5 mm (0.06 in.)
E	53.5 to 53.7 mm dia. (2.1063 to 2.1142 in dia.)
F	50.05 to 50.25 mm dia. (1.9705 to 1.9783 in dia.)
G	16 mm (0.63 in.)
H	Chamfer 1 mm (0.04 in.)
I	8.5 mm dia. (0.33 in. dia.)
J	0.4 mm (0.0157 in.)
K	3 mm (0.12 in.)
L	19 mm (0.75 in.)
M	Chamfer 0.5 mm (0.02 in.)
N	36 mm (1.42 in.)
O	45 mm dia. (1.77 in. dia.)
P	0.78 rad (45 °)
Q	11.5 mm (0.45 in.)

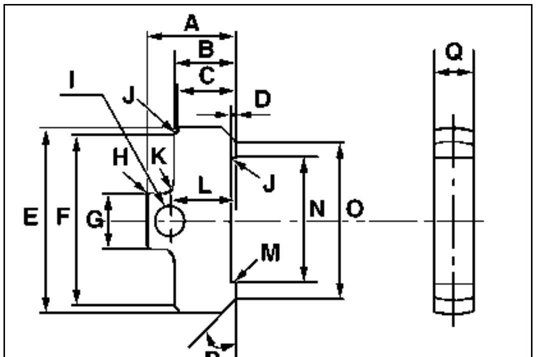
W1048068



6) Joint 2

A	M12 × P1.25
B	Chamfer 1 mm (0.04 in.)
C	30 mm dia. (1.18 in. dia.)
D	13 mm dia. (0.51 in. dia.)
E	Chamfer 3 mm (0.12 in.)
F	3 mm (0.12 in.)
G	45 mm (1.77 in.)
H	75 mm (2.95 in.)
I	57 mm (2.24 in.)
J	85 mm (3.35 in.)
K	70 mm (2.76 in.)
L	394 mm (15.51 in.)

W1048305

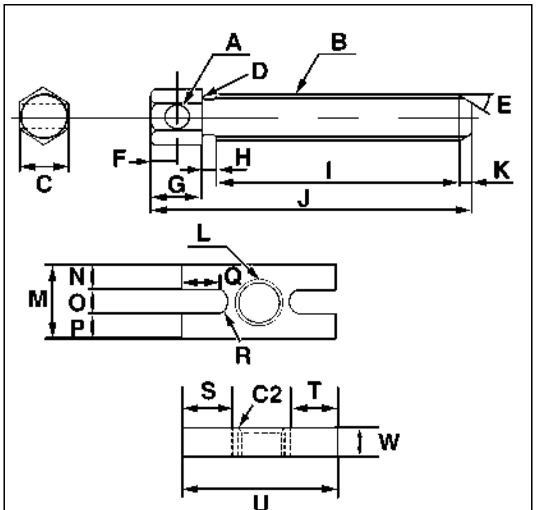


3EEABAB1P052A

7) Piece 3

A	26 mm (1.02 in.)
B	18 mm (0.71 in.)
C	16.5 to 17.0 mm (0.6496 to 0.6693 in.)
D	1.5 mm (0.06 in.)
E	53.0 to 53.2 mm dia. (2.0866 to 2.0945 in dia.)
F	49.55 to 49.75 mm dia. (1.9508 to 1.9587 in dia.)
G	16 mm (0.63 in.)
H	Chamfer 1 mm (0.04 in.)
I	8.5 mm dia. (0.33 in. dia.)
J	0.4 mm (0.0157 in.)
K	3 mm (0.12 in.)
L	19 mm (0.75 in.)
M	Chamfer 0.5 mm (0.02 in.)
N	36 mm (1.42 in.)
O	45 mm dia. (1.77 in. dia.)
P	0.78 rad (45 °)
Q	11.5 mm (0.45 in.)

W1048484



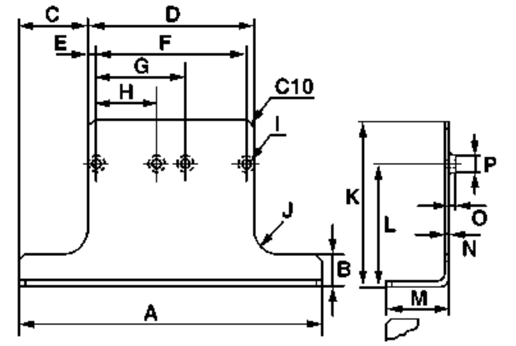
3EEABAB1P042A

Injection Pump Gear Puller

Application: Use for remove the injection pump gear from governor shaft.

A	10 mm dia. (0.39 in.dia.)
B	M16 × Pitch 1.5
C	19 mm (0.75 in.)
D	0.5 mm radius (0.02 in. radius)
E	0.87 rad (50 °)
F	10 mm (0.39 in.)
G	20 mm (0.79 in.)
H	5 mm (0.20 in.)
I	95 mm (3.74 in.)
J	125 mm (4.92 in.)
K	5 mm (0.20 in.)
L	M16 × Pitch 1.5
M	30 mm (1.18 in.)
N	9.5 mm (0.3740 in.)
O	11 mm (0.4331 in.)
P	9.5 mm (0.3740 in.)
Q	14.5 mm (0.57 in.)
R	5.5 mm radius (0.22 in. radius)
S	20 mm (0.79 in.)
T	20 mm (0.79 in.)
U	80 mm (3.1496 in.)
W	12 mm (0.47 in.)
C2	Chamfer 2.0 mm (0.079 in.)

W1042094



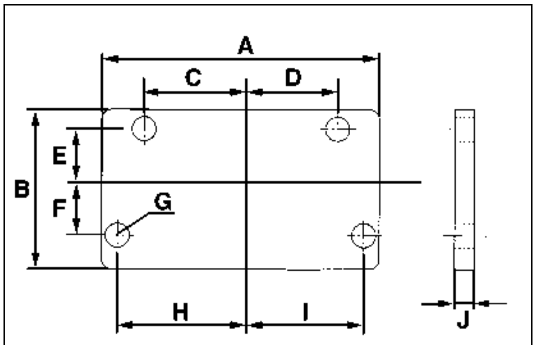
3TMACAB0P039A

Engine Stand

Application: Use to support engine.

A	480 mm (18.90 in.)
B	50 mm (1.97 in.)
C	108.5 mm (4.272 in.)
D	262.5 mm (10.33 in.)
E	12.5 mm (0.492 in.)
F	237.5 mm (9.350 in.)
G	142.5 mm (5.610 in.)
H	95 mm (3.74 in.)
I	14 mm dia. (0.55 in. dia.)
J	40 mm radius (1.57 in. radius)
K	210 mm (8.27 in.)
L	190 mm (7.48 in.)
M	100 mm (3.94 in.)
N	6 mm (0.24 in.)
O	6 mm (0.24 in.)
P	25 mm dia. (0.98 in. dia.)
C10	Chamfer 10 mm (0.394 in.)

W1033645



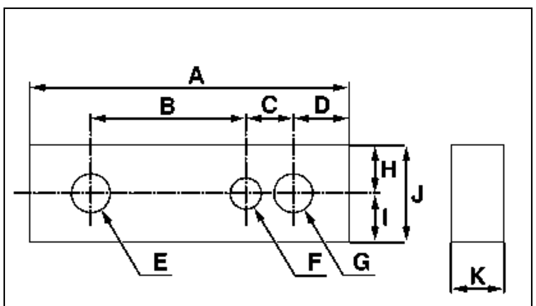
3EEABAB1P043A

Flywheel Stopper (for SAE Flywheel and Housing)

Application: Use to loosen and tighten the flywheel screw.

A	140 mm (5.5 in.)
B	80 mm (3.15 in.)
C	49.3 mm (1.94 in.)
D	49.3 mm (1.94 in.)
E	23.8 mm (0.94 in.)
F	23.8 mm (0.94 in.)
G	11 mm dia. (0.43 in. dia.)
H	56.5 mm (2.22 in.)
I	56.5 mm (2.22 in.)
J	8 mm (0.31 in.)

W1042515



3EEABAC1P115A

Tool for Aligning the Crankcase 1 and 2

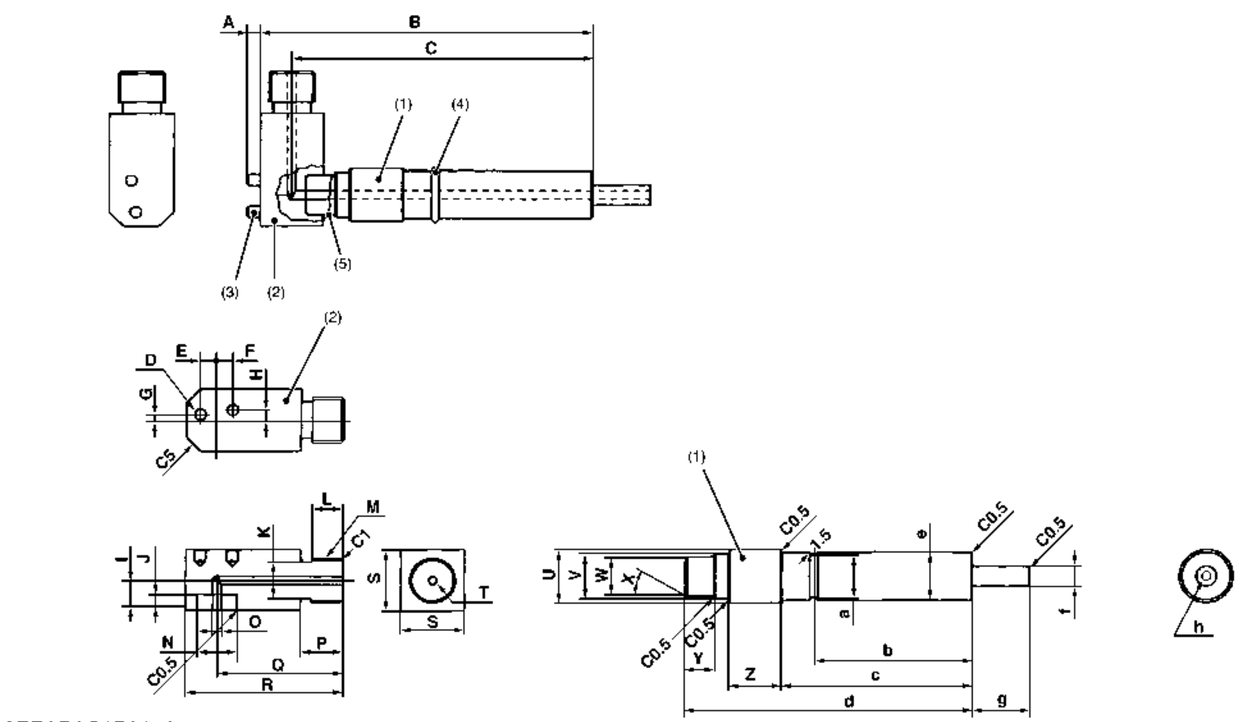
Application: Use for aligning the crankcase 1 and 2.

A	115 mm (4.5276 in.)
B	56 mm (2.2047 in.)
C	17 mm (0.6693 in.)
D	20 mm (0.7874 in.)
E	14 mm dia. (0.5512 in. dia.)
F	11 mm dia. (0.4331 in. dia.)
G	14 mm dia. (0.5512 in. dia.)
H	17.5 mm (0.6890 in.)
I	17.5 mm (0.6890 in.)
J	35 mm (1.3780 in.)
K	19 mm (0.7480 in.)

W1047882

Nozzle Adaptor for Measuring Cylinder Compression Pressure

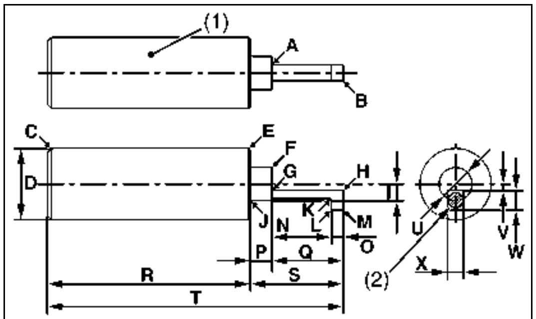
Application: Use for measuring diesel engine compression pressure.



3EEABAC1P015A

A	5 mm (0.1969 in.)	T	3 mm dia., 44.5 to 45 mm depth (0.1181 in. dia., 1.7520 to 1.7717 in. depth)
B	115.9 to 116.1 mm (4.5630 to 4.5709 in.)		
C	105 mm (4.1339 in.)	U	19 mm dia. (0.7480 in. dia.)
D	4 mm dia., 4 mm depth (0.1575 in dia., 0.1575 in. depth)	V	16 mm dia. (0.6299 in. dia.)
E	6 mm (0.2362 in.)	W	14 mm dia. (0.5512 in. dia.)
F	5.3 mm (0.2087 in.)	X	0.524 rad (30°)
G	1.9 mm (0.0748 in.)	Y	10 mm (0.3937 in.)
H	3.5 mm (0.1378 in.)	Z	19 mm (0.7480 in.)
I	11.6 to 12.1 mm (0.4567 to 0.4764 in.)	a	14.94 to 15 mm dia. (0.5882 to 0.5906 in. dia.)
J	6 to 6.1 mm (0.2362 to 0.2402 in.)	b	55 mm (2.1654 in.)
K	13 mm dia. (0.5118 in. dia.)	c	66 mm (2.5984 in.)
L	11 mm (0.4331 in.)	d	100 to 100.1 mm (3.9370 to 3.9409 in.)
M	5/8-18UNF-2B	e	16.89 to 17 mm dia. (0.6650 to 0.6693 in. dia.)
N	14.0 to 14.011 mm dia. (0.5512 to 0.5516 in. dia.)	f	7.1 to 7.2 mm dia. (0.2795 to 0.2835 in. dia.)
O	3 mm dia. (0.1181 in. dia.)	g	20.3 to 20.5 mm (0.7992 to 0.8071 in.)
P	15 mm (0.5906 in.)	h	3 mm dia. (0.1181 in. dia.)
Q	44 mm (1.7323 in.)	C0.5	Chamfer 0.5 mm (Chamfer 0.0197 in.)
R	55 mm (2.1654 in.)	C1	Chamfer 1 mm (Chamfer 0.0394 in.)
S	22 mm (0.8661 in.)	C5	Chamfer 5 mm (Chamfer 0.1969 in.)

(1) Material SS400
(2) Material S43C-D
(3) Pin 05012-00408
(4) O-ring 04811-00150
(5) Arc welding



Jig for Governor Connecting Rod

Application: Use for connecting the governor connecting rod to the rack pin of the fuel injection pump assembly.

A	1 mm radius (0.0394 in. radius)
B	Chamfer 0.2 mm (0.0079 in.)
C	Chamfer 2 mm (0.0787 in.)
D	35 mm dia. (1.3780 in. dia.)
E	Chamfer 1 mm (0.0394 in.)
F	Chamfer 0.1 mm (0.0039 in.)
G	1 mm radius (0.0394 in. radius)
H	Chamfer 0.2 mm (0.0079 in.)
I	8 mm radius (0.3150 in. radius)
J	1 mm radius (0.0394 in. radius)
K	1 mm radius (0.0394 in. radius)
L	Chamfer 0.2 mm (0.0079 in.)
M	Chamfer 0.2 mm (0.0079 in.)
N	29 mm (1.1417 in.)
O	6 mm (0.2362 in.)
P	10.7 mm (0.4213 in.)
Q	35 mm (1.3780 in.)
R	99.3 mm (3.9095 in.)
S	45.65 to 45.75 mm (1.7972 to 1.8012 in.)
T	145 mm (5.7087 in.)
U	16.15 to 16.35 mm (0.6358 to 0.6437 in.)
V	3 mm (0.1181 in.)
W	10 mm (0.3937 in.)
X	8 mm (0.3150 in.)

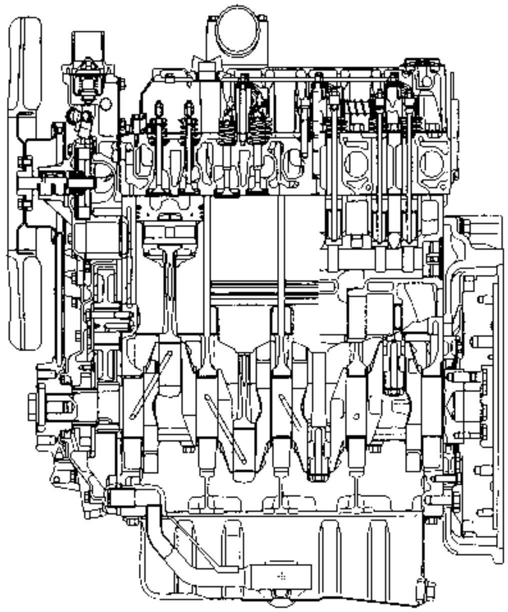
(1) Material: S45C-D
(2) Permanent Magnet: 8 mm dia. (0.3150 in. dia.)
Thickness: 3 mm (0.1181 in.)

W1115114

Mechanism

1. FEATURE

[V3800DI-E2B]



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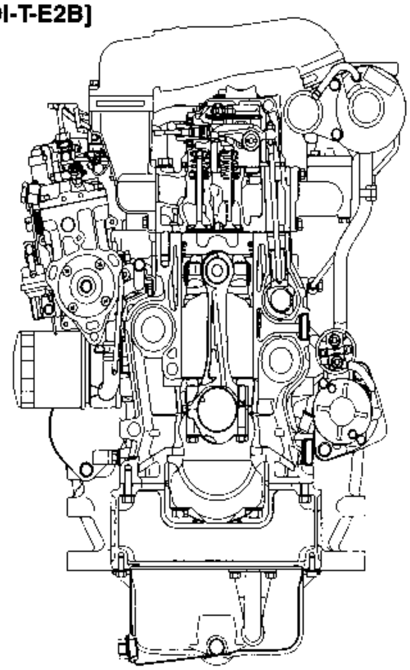
[V3800DI-T-E2B]



3EEABAC1P002C

The V3 series DI engine are the vertical type 4-cycle diesel engine featuring the advanced performances shown below.

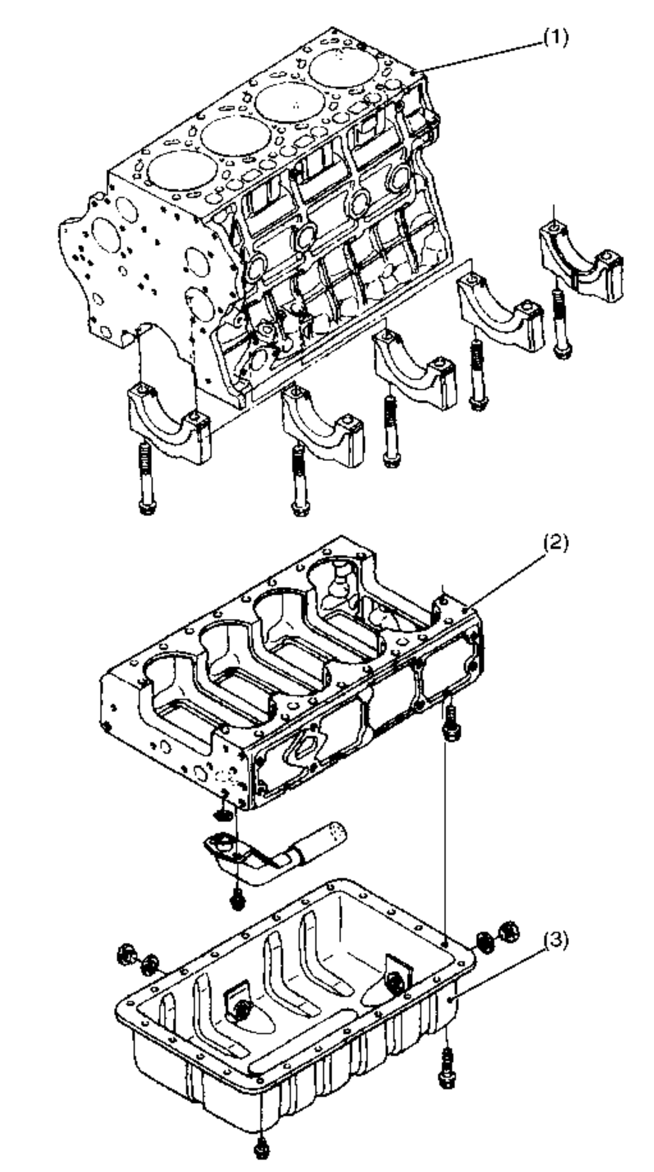
This is a small sized, high power and environment conscious engine, which employs the four valve system, two inlet valves with double ports, and two exhaust valves with the new E-CDIS. Thus, this engine achieves high combustion efficiency and complies with various regulations of exhaust gas.

Based upon the conventional model, Kubota developed a unique governor system and various new mechanisms which reduces exhaust emission, noise and vibration and realize durability and high torque.

W1013043

2. ENGINE BODY

[1] CYLINDER BLOCK



3EEABAB1P003B

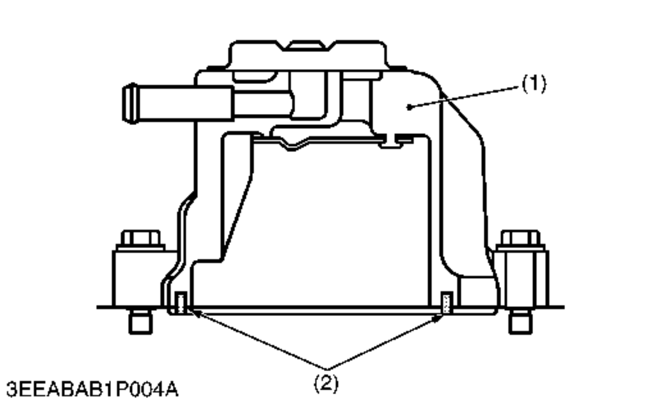
This engine employs separate type crankcases - the crankcase 1 (1) with combustion part and the crankcase 2 (2) which supports the crankcase 1 (1) and reduces noise.

Since it is a hanger type, you can easily assemble / disassemble it. The cylinder is a linerless type which enables good cooling operation, less strain and good abrasion resistance.

(1) Crankcase 1
(2) Crankcase 2
(3) Oil Pan

W1013119

[2] HALF-FLOATING HEAD COVER



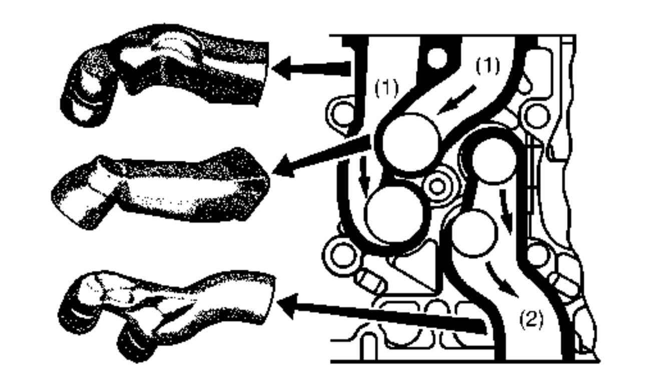
3EEABAB1P004A

The rubber packing is fitted in to maintain the head cover 0.5 mm (0.02 in.) or so off the cylinder head. This arrangement helps reduce noise coming from the cylinder head.

(1) Cylinder Head Cover
(2) Rubber Packing

W1013327

[3] CYLINDER HEAD



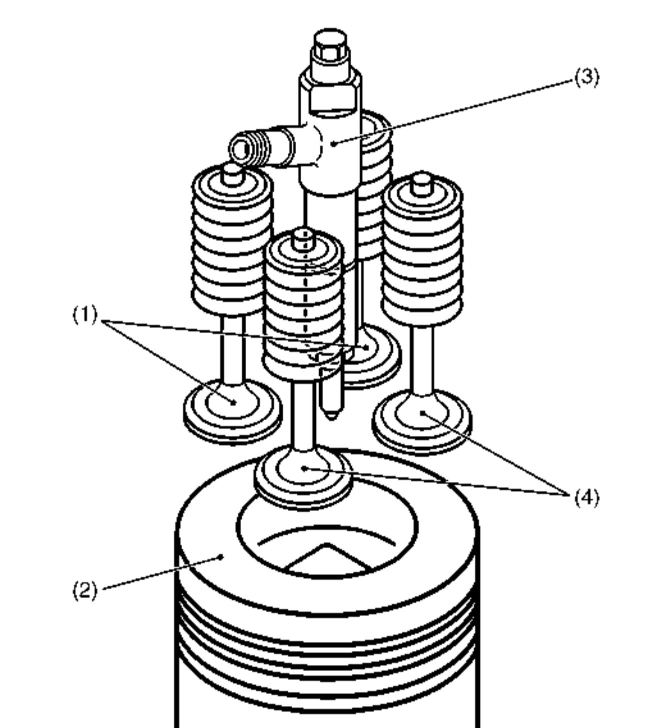
3EEAAAA1P012C

This engine employs four valve system, the cylinder head is provided with double intake passenge in order to ensure appropriate air suction and give an optimum swirl.

(1) Intake
(2) Exhaust

W1013336

[4] CENTER DIRECT INJECTION SYSTEM (E-CDIS)



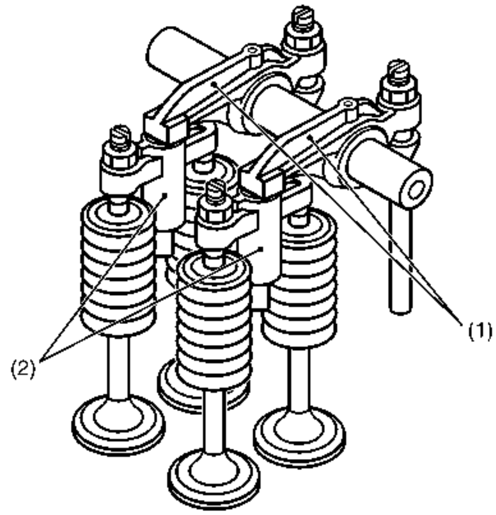
3EEAAAA1P014A

V3 series DI engine adopts the Center Direct Injection System (E-CDIS), in which the injection nozzle is positioned upright at the center of the cylinder.

This system serves to inject fuel directly at the center of the cylinder. By so doing, injected fuel and suction air can be mixed more uniformly, leading to more stable, higher combustion performance. In other words, cleaner emission, higher power output, lower fuel consumption, lower operating noise and higher start-up performance have been achieved.

(1) Exhaust Valves
(2) Piston
(3) Injection Nozzle
(4) Intake Valves

W11094950



3EEAAAA1P017B

V3 series DI engine has two intake valves and two exhaust valves per each cylinder.

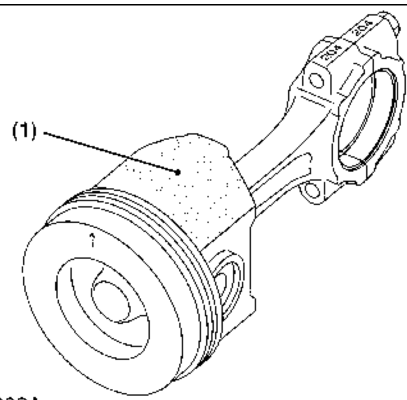
The rocker arm (1) contacts a bridge arm (2) instead of the valves stem tip.

The bridge arm then contacts both intake valves or bath exhaust valves and causes two valves to open simultaneously.

(1) Rocker Arm (2) Bridge Arm

W1014724

[5] PISTON



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Piston's skirt is coated with molybdenum disulfide<Dingbats>H, which reduces the piston slap noise and thus the entire operating noise.

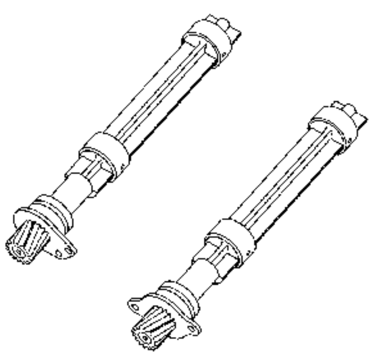
■ **Molybdenum disulfide (MoS_2)**

The molybdenum disulfied serves as a solid lubricant, like a Graphite or Teflon. This material helps resist metal wears even with little lube oil.

(1) Molybdenum Disulfide

W1015665

[6] BUILT-IN DYNAMIC BALANCER (BALANCER MODEL ONLY)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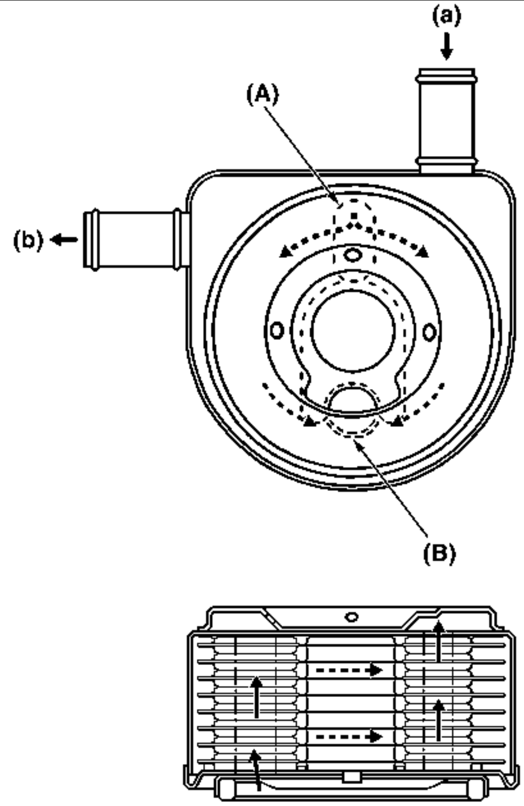
Engine are sure to vibrate by piston's reciprocation. Theoretically, three-cylinder engines are much less prone to cause vibration than four-cylinder ones (second inertia, etc.). However, any engine has many moving parts in addition to its pistons and cannot be completely free from vibration.

The four cylinder engine is fitted with balance weight on crankcase to absorb the second inertia mentioned above and reduce vibration.

W1013617

3. LUBRICATING SYSTEM

[1] OIL COOLER



3EEAAAA1P108A

V3 series engine has a water-cooled oil cooler that not only cools hot oil, but also warms the cool engine oil shoftly after start up.

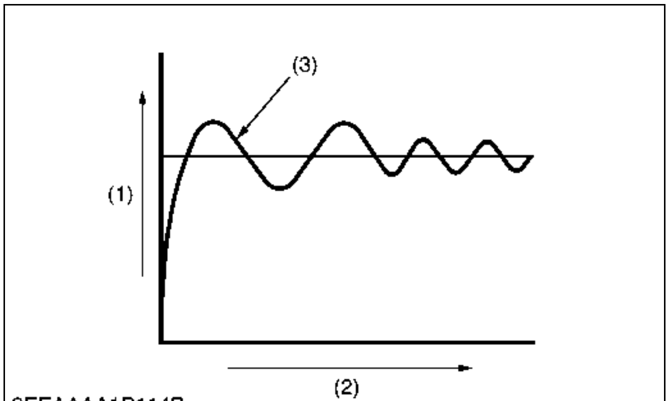
As shown in the figure, the oil flows inside the connected cooler plate, whereas coolant is kept circulating outside the cooler plate, thereby cooling down or warming the oil.

(A) Oil Inlet Port
(B) Oil Outlet Port
(a) Coolant Inlet Port
(b) Coolant Outlet Port

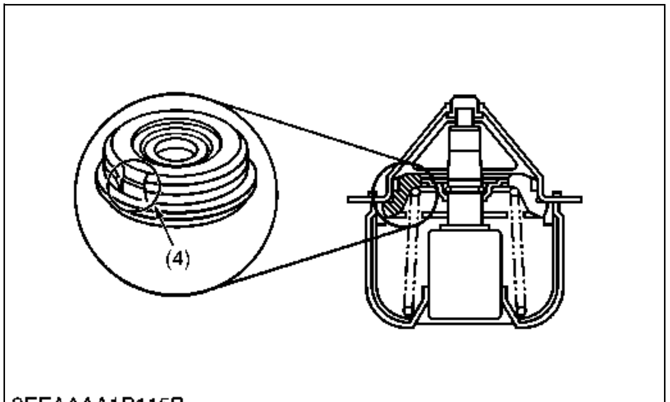
W10344770

4. COOLING SYSTEM

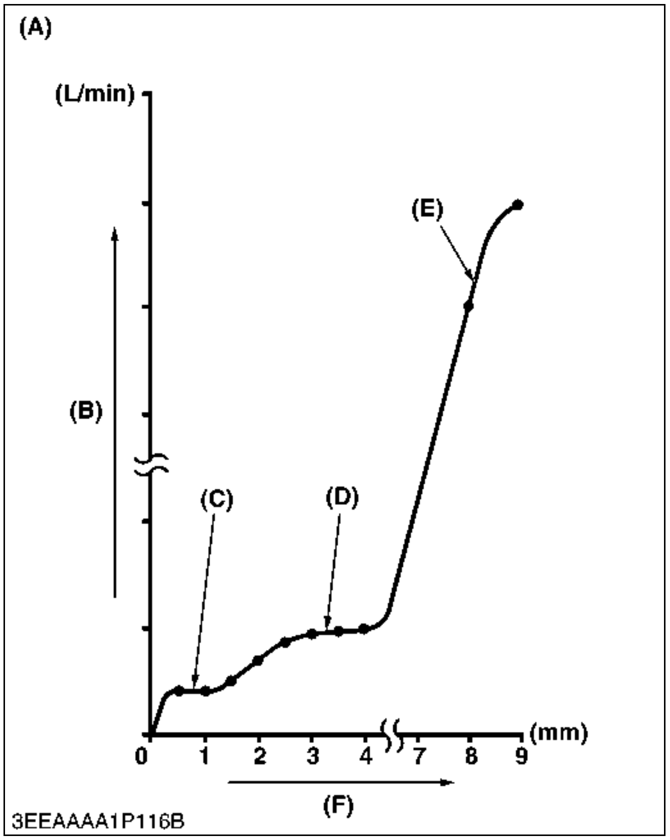
[1] THERMOSTAT



3EEAAAA1P114B



3EEAAAA1P115B



3EEAAAA1P116B

Conventional thermostatically-controlled valves (outlet water temperature control type) open against the flow of coolant. In this design, the pressure (steam pressure + water pump's discharge pressure) affects the open/close performance of such valve. In other words, the valve may be delayed in opening at a preset opening temperature opening suddenly, above the preset temperature. This is called the overshoot phenomenon.

The overshoot problem invites the undershoot phenomenon too. Too much water cooled by the radiator flows through the water passage, which suddenly closes the valve below the thermostat's preset valve closing temperature.

A repeated cycle of such overshoot and undershoot phenomena is called the water temperature hunting. This hunting problem may adversely affects the cooling system parts, and also the engine and its related components.

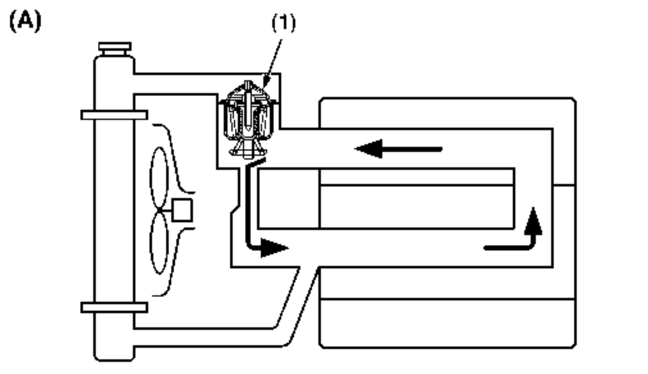
To cope with this trouble, the V3 series engine is equipped with the flow control thermostat. The valve has a notch to control the coolant flowrate smoothly in small steps.

(1) Coolant Temperature
(2) Time
(3) Overshoot
(4) Notch

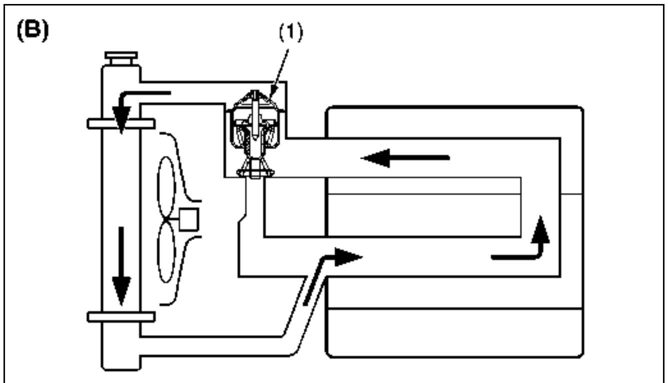
(A) Valve Lift Versus Flowrate
(B) Flowrate
(C) At Short Valve Lift
(D) At Medium Valve Lift
(E) At High Valve Lift
(F) Valve Lift

W1013684

[2] BOTTOM BYPASS SYSTEM



3EEAAAA1P110A



3EEAAAA1P111A

Bottom bypass system is introduced in V3 series for improving the cooling performance of the radiator.

While the temperature of coolant in the engine is low, the thermostat is held closed and the coolant is allowed to flow through the bypass pipe and to circulate in the engine.

When the temperature exceeds the thermostat valve opening level, the thermostat fully opens itself to prevent the hot coolant from flowing through the bypass into the engine.

In this way, the radiator can increase its cooling performance.

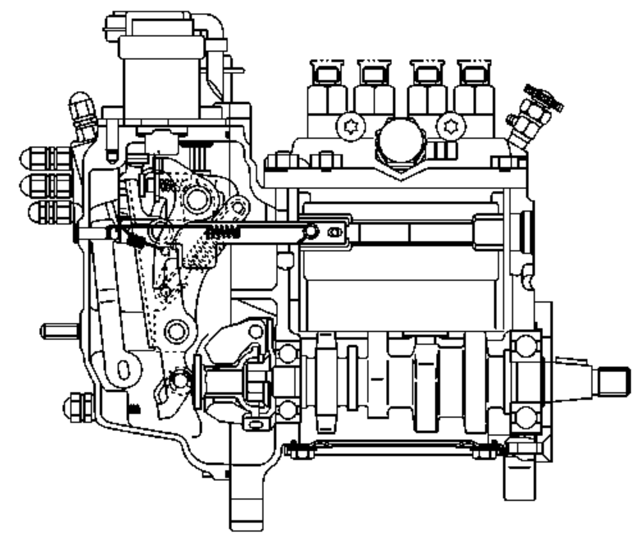
(1) Thermostat

(A) Bypass Opened
(B) Bypass Closed

W1013406

5. FUEL SYSTEM

[1] GOVERNOR


3EEAAAA1P064B

The engine employs the separated fuel injection pump in combination with Kubota's own small multi-function mechanical governor, which enable more dependability.

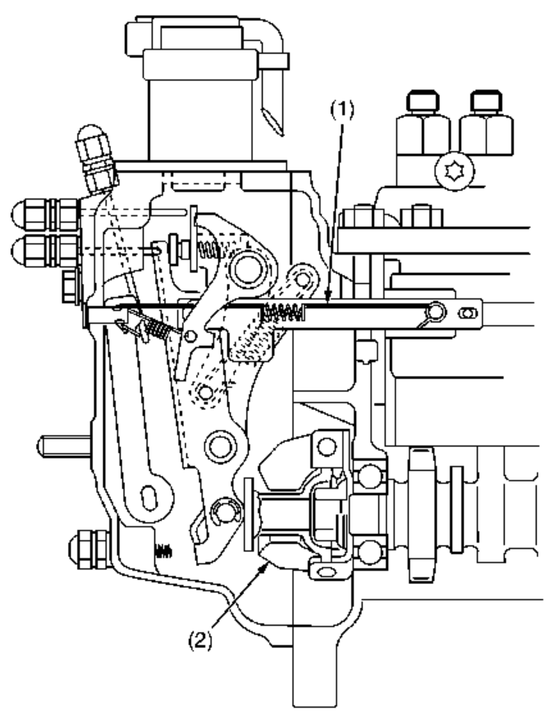
It also employs the torque limiting mechanism to control the maximum peak torque so that it complies with the regulations of exhaust gas.

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.

W1013830



3EEAAAA1P074B

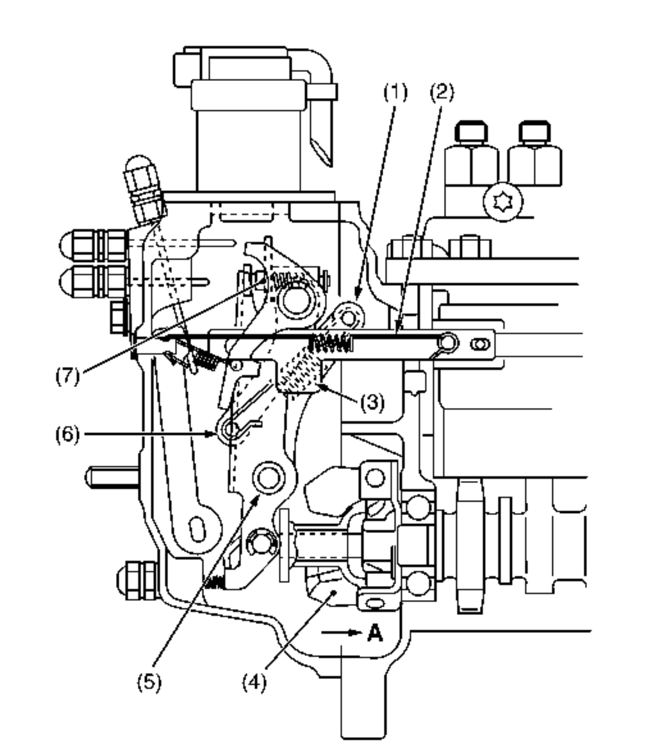
■ **At Start**

The stop solenoid (energized-to-run type) is powered to release the stop lever.

As no centrifugal force is applied to flyweight (2), low tension of start spring (1) permits control rack to move the starting position, supplying the amount of fuel required to start the engine.

(1) Start Spring (2) Flyweight

W1013967



3EEAAAA1P075B

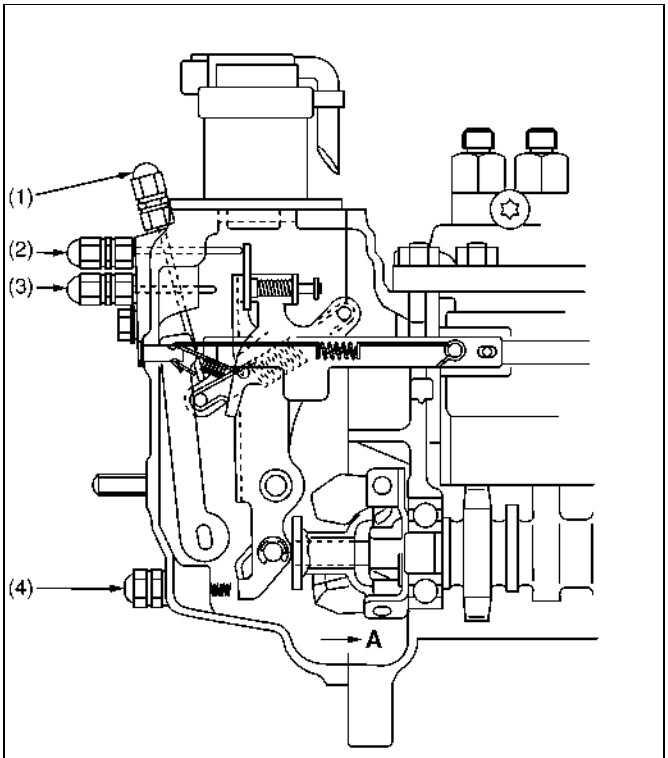
■ **At Idling**

Turn the speed control lever (6) clockwise to idle the engine. It tensions the governor spring (3) to pull the fork lever 2 (1).

When the fork lever 2 is pulled, it moves the torque spring pin (7) and the fork lever 1 (5) in the direction of the arrow **A** to restrain the weight. In combination with the start spring tension, it is balanced with the centrifugal force of flywheel weight to keep idling.

(1) Fork Lever 2
(2) Start Spring
(3) Governor Spring
(4) Flyweight
(5) Fork Lever 1
(6) Speed Control Lever
(7) Spring Pin

W1014034



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■ **At rated speed with full load and overload**

As the speed control lever is changed from the middle speed to high speed, the governor spring tension increases to compress the torque spring and move the fork lever 1 in the direction of the arrow **A**.

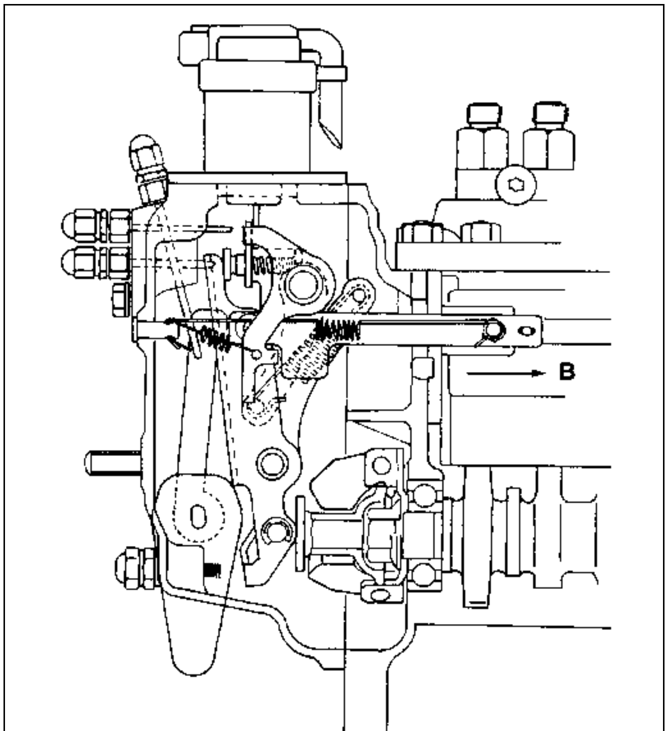
The fork lever 2 moves until it reaches the output limiting bolt to keep rated rotation and rated output.

When the engine is overloaded, the engine rotating speed decreases and the centrifugal force of flywheel weight decreases. Then the torque spring moves the fork lever 1 in the direction of arrow **A**.

The control rack moves in the direction that increases fuel supply to increase the output. It is balanced with the centrifugal force of the flywheel weight to produce low-speed output (torque output).

(1) No-load Maximum Rotation
(2) Output Limiting Bolt
(3) Torque Limiting Bolt
(4) Idling Adjusting Bolt

W1014276



3EEABAB1P008A

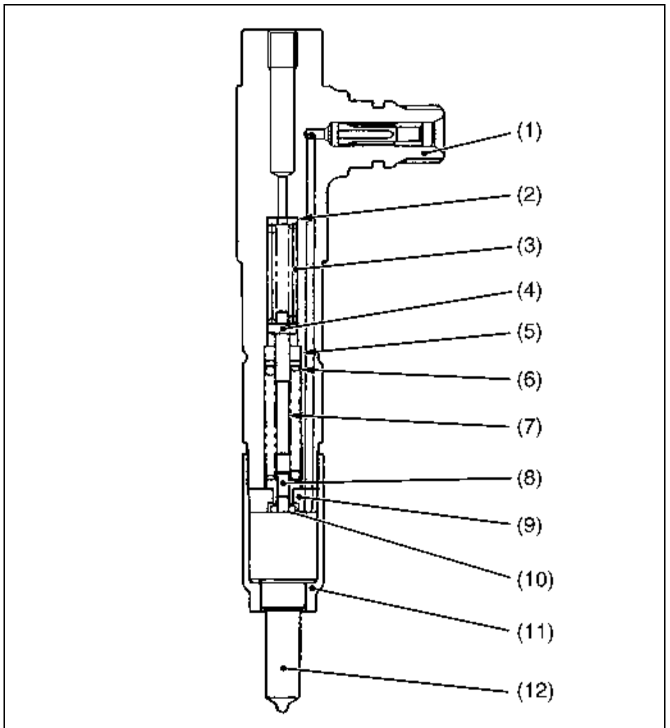
■ **To stop engine**

When the stop solenoid is turned off, the spring tension of the solenoid is released, the rod extrudes and the stop lever moves the control rack in the direction of the arrow **B** which stops the engine.

To stop the engine manually, move the external stop lever to the left.

W1014393

[2] 2 STAGE DI NOZZLE



Exhaust and noise regulations are becoming increasingly strict, particularly in regard to the reduction of NOx (nitrogen oxides) and particulates.

The two-spring nozzle holder has been developed to reduce NOx (nitrogen oxides) and particulates from direct injection diesel engine exhaust.

■ **Features**

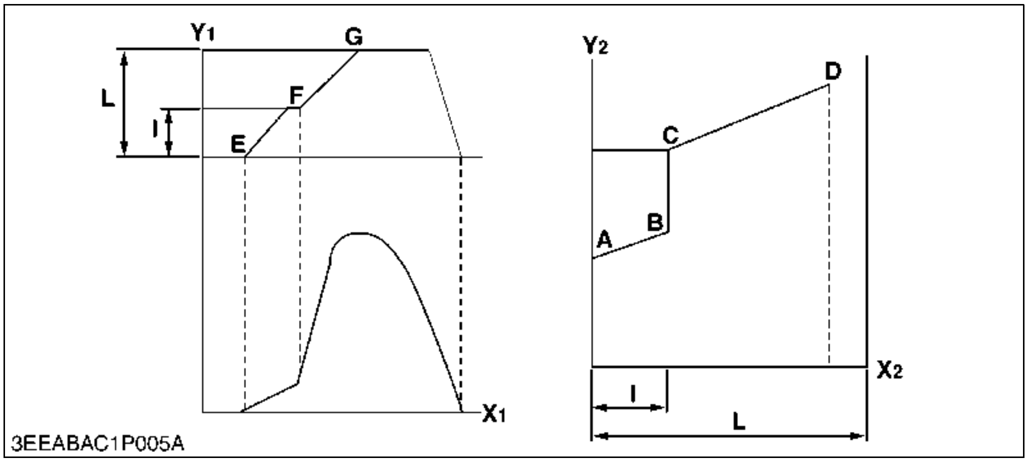
The two-spring nozzle holder limits needle valve lift at initial valve opening to throttle the injection quantity. Main injection occurs when the in-line pressure has increased sufficiently to move the needle valve through its full lift.

This gives the following features.

- Improved engine stability at low and intermediate speeds.
- Decreased engine hunting and surge.
- Decreased noise at idling.
- Decreased idling speed because of improved engine stability.
- Stabilized fuel injection characteristics from the injection pump and nozzle system, and easier matching of governor characteristics to engine demand.

(1) Nozzle Holder Body
(2) 1st Stage Injection Pressure Adjusting Shim
(3) First Spring
(4) Pressure Pin
(5) Spring Seat
(6) 2nd Stage Injection Pressure Adjusting Shim
(7) Second Spring
(8) Pre-lift Adjusting Spring Seat
(9) Chip-packing
(10) Max-lift Adjusting Washer
(11) Retaining Nut
(12) Nozzle

W1014568



A-B : First Spring's Set Force
B-C-D : Combined Force of First and Second Springs
P1 : First Opening Pressure
P2 : Second Opening Pressure

L : Full Needle Valve Lift
l : Needle Valve Pre-lift

X1 : Cam Angle (<Symbol>×)
Y1 : Injection Rate (mm3/ <Symbol>×)
X2 : Needle Valve Lift (mm)
Y2 : In-line Pressure

W1014795

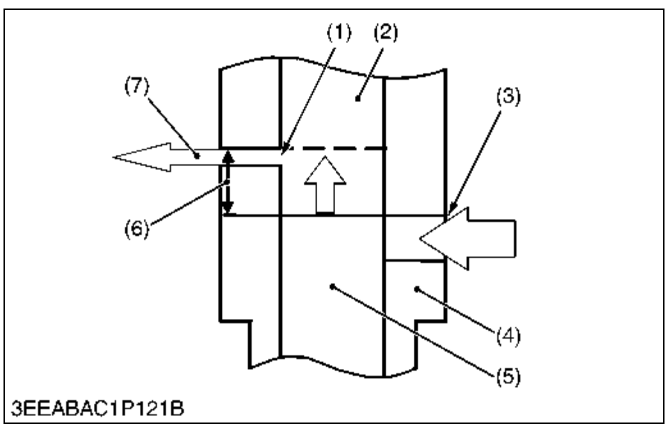
■ First opening pressure

The force of the high pressure fuel delivered by the injection pump acts to push the needle valve up. When this force exceeds the set force of the first spring, the nozzle's needle valve pushes the first pushrod up and the valve opens. (First opening pressure is represented by point **E** in the bottom left hand figure, and point **A** in the above figure.)

■ Second opening pressure

When the first pushrod has been lifted through the pre-lift, it contacts the second pushrod. As the set force of the second spring is acting on the second pushrod, the combined forces of both the first spring and the second spring then act on the needle valve, which will not lift unless these forces are overcome.

[3] INJECTION PUMP WITH F.S.P.



The fuel injection pump with F.S.P. (Fine Spill Port) mechanism is equipped with two functions: speed timer function and injection rate control function.

The former function works like this. As the rpm is low, the injection timing gets delayed. This helps cut down on NOx and operating noise.

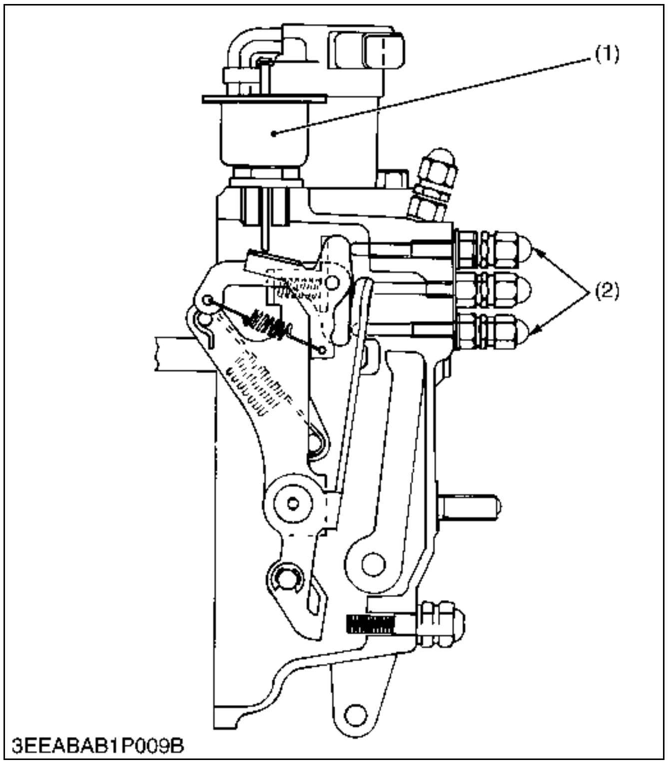
The latter function serves to keep down the initial injection rate and keep up the later injection rate, which cuts down on NOx and PM as well.

(1) Fine Spill Port (F.S.P.)
(2) Plunger Chamber
(3) Main Port
(4) Cylinder
(5) Plunger
(6) F.S.P. Stroke
(7) Leaking Fuel at Initial Fuel Pressure-Feed Stage

W1014969

6. TURBOCHARGER SYSTEM

[1] BOOST COMPENSATOR



The boost compensator is controlled by the boost pressure of the control mechanism which controls transient smoke caused by oversupply of fuel when the engine starts and accelerates.

When the boost pressure is lower than working pressure of the boost actuator (1), it prevents oversupply of fuel to reduce transient smoke.

When the boost pressure is higher than working pressure of the boost actuator (1), it controls the supply of fuel to the equivalent of maximum power / rated speed output.

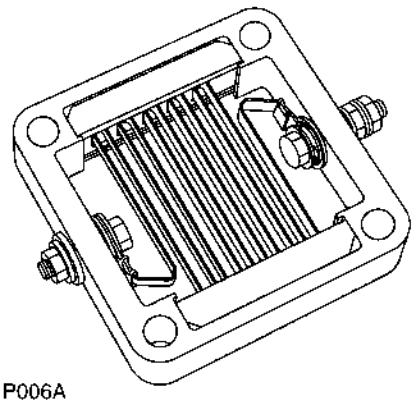
The boost compensator adjusting screws (2) are set and tamper-proof capped in factory, so never take off the tamper-proof cap and readjust the screws.

(1) Boost Actuator
(2) Boost Compensator Adjusting Screw

W1014569

7. INTAKE SYSTEM

[1] INTAKE AIR HEATER



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The intake air heater is introduced in order to further improve the starting performance and to reduce the white smoke at cold starting.

The intake air heater is mounted on the intake manifold. In this new construction, there is no need to arrange any glow plug on the cylinder head. This means that a multi-valve design can be implemented and that the starting performance and serviceability are enhanced.

W1015544

Service

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	No fuel	Replenish fuel	
	Air in the fuel system	Vent air	
	Water in the fuel system	Change fuel and repair or replace fuel system	
	Fuel hose clogged	Clean or replace	
	Fuel filter clogged	Replace	
	Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	
	Fuel with low cetane number	Use specified fuel	
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	
	Incorrect injection timing	Adjust	
	Fuel camshaft worn	Replace	
	Injection nozzle clogged	Repair or replace	
	Injection pump malfunctioning	Repair or replace	
	Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screw and nozzle holder	
	Improper valve timing	Correct or replace timing gear	
	Piston ring and cylinder worn	Replace	
	Excessive valve clearance	Adjust	
	Stop solenoid malfunctioning	Replace	
Starter Does Not Run	Battery discharged	Charge	
	Starter malfunctioning	Repair or replace	
	Key switch malfunctioning	Replace	
	Wiring disconnected	Connect	

W1014322

Symptom	Probable Cause	Solution	Reference Page
Engine Revolution Is Not Smooth	Fuel filter clogged or dirty	Replace	
	Air cleaner clogged	Clean or replace	
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	
	Injection pump malfunctioning	Repair or replace	
	Incorrect nozzle opening pressure	Repair or replace	
	Injection nozzle stuck or clogged	Repair or replace	
	Governor malfunctioning	Repair	
	Turbocharger bearing worn out	Replace the turbocharger assembly	
	Turbocharger shaft bent	Replace the turbocharger assembly	
	Turbocharger fin or other part damaged due to foreign matters	Replace the turbocharger assembly	
Either White or Blue Exhaust Gas Is Observed	Excessive engine oil	Reduce to specified level	
	Piston ring and cylinder worn or stuck	Repair or replace	
	Incorrect injection timing	Adjust	
Oil Leak into Exhaust Pipe or Suction Pipe	Waste oil pipe clogged or deformed	Repair or replace	
	Turbocharger's piston ring seal faulty	Replace the turbocharger assembly	
Either Black or Dark Gray Exhaust Gas Is Observed	Overload	Reduce the load	
	Low grade fuel used	Use specified fuel	
	Fuel filter clogged	Replace	
	Air cleaner clogged	Clean or replace	
	Deficient nozzle injection	Repair or replace nozzle	

W1014322

Symptom	Probable Cause	Solution	Reference Page
Deficient Output	Incorrect injection timing	Adjust	
	Engine's moving parts seem to be seizing	Repair or replace	
	Injection pump malfunctioning	Repair or replace	
	Deficient nozzle injection	Repair or replace nozzle	
	Compression leak	Check the compression pressure and repair	
	Gas leak from exhaust system	Repair or replace	
	Air leak from compressor discharge side	Repair or replace	
	Air cleaner dirty or clogged	Clean or replace	
	Compressor wheel turning heavily	Replace the turbocharger assembly	
Excessive Lubricant Oil Consumption	Piston ring's gap facing the same direction	Shift ring gap direction	
	Oil ring worn or stuck	Replace	
	Piston ring groove worn	Replace piston	
	Valve stem and valve guide worn	Replace	
	Crankshaft bearing and crank pin bearing worn	Replace	
	Oil leaking due to defective seals or packing	Replace	
Fuel Mixed into Lubricant Oil	Injection pump's plunger worn	Repair or replace	
	Deficient nozzle injection	Repair or replace nozzle	
	Injection pump broken	Replace	
Water Mixed into Lubricant Oil	Head gasket defective	Replace	
	Cylinder block or cylinder head flawed	Replace	
Low Oil Pressure	Engine oil insufficient	Replenish	
	Oil strainer clogged	Clean	
	Relief valve stuck with dirt	Clean	
	Relief valve spring weaken or broken	Replace	
	Excessive oil clearance of crankshaft bearing	Replace	
	Excessive oil clearance of crankpin bearing	Replace	
	Excessive oil clearance of rocker arm	Replace	
	Oil passage clogged	Clean	
	Different type of oil	Use specified type of oil	
	Oil pump defective	Replace	

W1014322

Symptom	Probable Cause	Solution	Reference Page
High Oil Pressure	Different type of oil	Use specified type of oil	
	Relief valve defective	Replace	
Engine Overheated	Engine oil insufficient	Replenish	
	Fan belt broken or elongated	Replace or adjust	
	Coolant insufficient	Replenish	
	Radiator net and radiator fin clogged with dust	Clean	
	Inside of radiator corroded	Clean or replace	
	Coolant flow route corroded	Clean or replace	
	Radiator cap defective	Replace	
	Overload running	Reduce the load	
	Head gasket defective	Replace	
	Incorrect injection timing	Adjust	
	Unsuitable fuel used	Use specified fuel	
Battery Quickly Discharged	Battery electrolyte insufficient	Replenish distilled water and charge	
	Fan belt slips	Adjust belt tension or replace	
	Wiring disconnected	Connect	
	Rectifier defective	Replace	
	Alternator defective	Replace	
	Battery defective	Replace	

W1014322

2. SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 in.
Top Clearance		0.72 to 0.90 mm 0.0283 to 0.0354 in.	–
Compression Pressure	V3800DI-E2B	3.92 MPa / 250 min^{-1} (rpm) 40.0 kgf/cm^2 / 250 min^{-1} (rpm) 569 psi / 250 min^{-1} (rpm)	2.90 MPa / 250 min^{-1} (rpm) 29.6 kgf/cm^2 / 250 min^{-1} (rpm) 421 psi / 250 min^{-1} (rpm)
	V3800DI-T-E2B	3.47 MPa / 250 min^{-1} (rpm) 35.4 kgf/cm^2 / 250 min^{-1} (rpm) 503 psi / 250 min^{-1} (rpm)	2.56 MPa / 250 min^{-1} (rpm) 26.1 kgf/cm^2 / 250 min^{-1} (rpm) 371 psi / 250 min^{-1} (rpm)
Variance Among Cylinders		–	10 % or less
Valve Seat	Angle (Intake)	1.047 rad 60 °	–
	Angle (Exhaust)	0.785 rad 45 °	–
	Width (Intake)	1.6 to 2.0 mm 0.0630 to 0.0790 in.	–
	Width (Exhaust)	2.3 to 2.6 mm 0.0906 to 0.1024 in.	–
Valve Face	Angle (Intake)	1.047 rad 60 °	–
	Angle (Exhaust)	0.785 rad 45 °	–
Valve Recessing	Intake	0.6 to 0.8 mm 0.0236 to 0.0315 in.	1.2 mm 0.0472 in.
	Exhaust	0.85 to 1.05 mm 0.0335 to 0.0413 in.	1.2 mm 0.0472 in.

W10138740

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Valve Stem to Valve Guide	Clearance (Intake)	0.055 to 0.085 mm 0.0022 to 0.0033 in.	0.1 mm 0.0039 in.
Valve Stem	O.D. (Intake)	6.960 to 6.975 mm 0.2740 to 0.2746 in.	–
Valve Guide	I.D. (Intake)	7.030 to 7.045 mm 0.2768 to 0.2774 in.	–
Valve Stem to Valve Guide	Clearance (Exhaust)	0.055 to 0.085 mm 0.0022 to 0.0033 in.	0.1 mm 0.0039 in.
Valve Stem	O.D. (Exhaust)	6.960 to 6.975 mm 0.2740 to 0.2746 in.	–
Valve Guide	I.D. (Exhaust)	7.030 to 7.045 mm 0.2768 to 0.2774 in.	–
Valve Clearance (Cold)		0.23 to 0.27 mm 0.0091 to 0.0106 in.	–
Intake Valve Timing	Open	0.24 rad (14 °) before T.D.C.	–
	Close	0.61 rad (36 °) after B.D.C.	–
Exhaust Valve Timing	Open	0.79 rad (45 °) before B.D.C.	–
	Close	0.29 rad (17 °) after T.D.C.	–
Valve Spring	Free Length (Intake)	35.1 to 35.6 mm 1.3819 to 1.4016 in.	34.6 mm 1.3622 in.
	Free Length (Exhaust)	35.1 to 35.6 mm 1.3819 to 1.4016 in.	34.6 mm 1.3622 in.
	Tilt	–	1.0 mm 0.039 in.
Valve Spring	Setting Load / Setting Length (Intake)	63.547 N / 31.5 mm 6.48 kgf / 31.5 mm 14.256 lbs / 1.2401 in.	45.864 N / 31.5 mm 4.68 kgf / 31.5 mm 10.296 lbs / 1.2401 in.
	Setting Load / Setting Length (Exhaust)	63.547 N / 31.5 mm 6.48 kgf / 31.5 mm 14.256 lbs / 1.2401 in.	45.864 N / 31.5 mm 4.68 kgf / 31.5 mm 10.296 lbs / 1.2401 in.

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Rocker Arm Shaft to Rocker Arm	Clearance	0.016 to 0.045 mm 0.0006 to 0.0018 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft	O.D.	15.973 to 15.984 mm 0.6289 to 0.6293 in.	–
Rocker Arm	I.D.	16.000 to 16.018 mm 0.6299 to 0.6306 in.	–
Valve Arm Bridge and Valve Arm Bridge Shaft	Clearance	0.018 to 0.042 mm 0.0007 to 0.0017 in.	0.15 mm 0.0059 in.
Valve Arm Bridge	I.D.	9.050 to 9.065 mm 0.3563 to 0.3569 in.	–
Valve Arm Bridge Shaft	O.D.	9.023 to 9.032 mm 0.3552 to 0.3556 in.	–
Push Rod	Alignment	–	0.25 mm 0.0098 in.
Tappet to Tappet Guide	Clearance	0.020 to 0.062 mm 0.0008 to 0.0024 in.	0.07 mm 0.0028 in.
Tappet Guide Bore	I.D.	24.000 to 24.021 mm 0.9449 to 0.9457 in.	–
Tappet	O.D.	23.959 to 23.980 mm 0.9433 to 0.9441 in.	–
Camshaft	Side Clearance	0.07 to 0.22 mm 0.0028 to 0.0087 in.	0.30 mm 0.0118 in.
	Alignment	–	0.01 mm 0.00039 in.
Cam Height	Intake	37.63 mm 1.4815 in.	37.13 mm 1.4618 in.
	Exhaust	38.96 mm 1.5338 in.	38.46 mm 1.5141 in.
Camshaft	Oil Clearance	0.050 to 0.091 mm 0.0020 to 0.0036 in.	0.15 mm 0.0059 in.
Camshaft Journal	O.D.	45.934 to 45.950 mm 1.8084 to 1.8091 in.	–
Camshaft Bearing	I.D.	46.000 to 46.025 mm 1.8110 to 1.8120 in.	–

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Timing Gear Idle Gear 1 to Crank Gear	Backlash	0.049 to 0.193 mm 0.0019 to 0.0076 in.	0.22 mm 0.0087 in.
Idle Gear 1 to Cam Gear	Backlash	0.049 to 0.189 mm 0.0019 to 0.0074 in.	0.22 mm 0.0087 in.
Idle Gear 1 to Idle Gear 2	Backlash	0.044 to 0.185 mm 0.0017 to 0.0073 in.	0.22 mm 0.0087 in.
Idle Gear 2 to Injection Pump Gear	Backlash	0.044 to 0.177 mm 0.0017 to 0.0070 in.	0.22 mm 0.0087 in.
Cam Gear to Balancer Gear 1 (Balancer Model Only)	Backlash	0.047 to 0.182 mm 0.0018 to 0.0072 in.	0.22 mm 0.0087 in.
Idle Gear 1 to Balancer Gear 2 (Balancer Model Only)	Backlash	0.044 to 0.183 mm 0.0017 to 0.0072 in.	0.22 mm 0.0087 in.
Idle Gear Shaft 1, 2 to Idle Gear 1, 2 Bushing	Oil Clearance	0.050 to 0.091 mm 0.0020 to 0.0036 in.	0.10 mm 0.0039 in.
Idle Gear 1, 2 Bushing	I.D.	45.025 to 45.050 mm 1.7726 to 1.7736 in.	–
Idle Gear 1, 2 Shaft	O.D.	44.959 to 44.975 mm 1.7700 to 1.7707 in.	–
Idle Gear	Side Clearance	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.9 mm 0.0354 in.
Balancer Shaft (Balancer Model Only)	Side Clearance	0.070 to 0.22 mm 0.0028 to 0.0087 in.	0.3 mm 0.0118 in.
Balancer Shaft (Balancer Model Only)	Alignment	–	0.02 mm 0.0008 in.
Balancer Shaft (Balancer Model Only)	Oil Clearance	0.070 to 0.159 mm 0.0028 to 0.0063 in.	0.2 mm 0.0079 in.
Balancer Shaft Journal	O.D.	50.92 to 50.94 mm 2.0047 to 2.0055 in.	–
Balancer Bearing	I.D.	51.01 to 51.08 mm 2.0083 to 2.0110 in.	–
Piston Pin Bore	I.D.	30.000 to 30.013 mm 1.1811 to 1.1816 in.	30.05 mm 1.1831 in.
Top Ring to Ring Groove	Clearance	0.05 to 0.09 mm 0.0020 to 0.0035 in.	0.15 mm 0.0059 in.
Second Ring to Ring Groove	Clearance	0.093 to 0.120 mm 0.0037 to 0.0047 in.	0.20 mm 0.0079 in.
Oil Ring to Ring Groove	Clearance	0.020 to 0.060 mm 0.0008 to 0.0023 in.	0.15 mm 0.0059 in.

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Piston Ring Gap	Top Ring	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
	Second Ring	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
	Oil Ring	0.25 to 0.45 mm 0.0098 to 0.0177 in.	1.25 mm 0.0492 in.
Connecting Rod	Alignment	–	0.05 mm 0.0020 in.
Piston Pin to Small End Bushing	Clearance	0.020 to 0.040 mm 0.0008 to 0.0016 in.	0.15 mm 0.0059 in.
Piston Pin	O.D.	30.006 to 30.011 mm 1.1813 to 1.1815 in.	–
Small End Bushing	I.D.	30.031 to 30.046 mm 1.1823 to 1.1829 in.	–
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
	Alignment	–	0.02 mm 0.00079 in.
Crankshaft Journal to Crankshaft Bearing	Oil Clearance	0.018 to 0.062 mm 0.0007 to 0.0024 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	74.977 to 74.990 mm 2.9518 to 2.9524 in.	–
Crank Pin to Pin Bearing	Oil Clearance	0.018 to 0.051 mm 0.0007 to 0.0020 in.	0.20 mm 0.0079 in.
Crank Pin	O.D.	52.977 to 52.990 mm 2.0857 to 2.0862 in.	–
Cylinder Bore	I.D.	100.000 to 100.022 mm 3.9370 to 3.9379 in.	100.15 mm 3.9429 in.
Cylinder Bore (Oversize)	I.D.	100.500 to 100.522 mm 3.9567 to 3.9576 in.	100.65 mm 3.9626 in.

W10138740

LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	–	49 kPa 0.5 kgf/cm^2 7 psi
	At Rated Speed	196 to 392 kPa 2.0 to 4.0 kgf/cm^2 28 to 57 psi	147.1 kPa 1.5 kgf/cm^2 21.3 psi
Engine Oil Pressure Switch	Working Pressure	39.2 to 58.8 kPa 0.4 to 0.6 kgf/cm^2 5.6 to 8.4 psi	–
Inner Rotor to Outer Rotor	Clearance	0.04 to 0.16 mm 0.0016 to 0.0063 in.	0.3 mm 0.0118 in.
Outer Rotor to Pump Body	Clearance	0.100 to 0.184 mm 0.0039 to 0.0072 in.	0.3 mm 0.0118 in.
Inner Rotor to Cover	Clearance	0.025 to 0.075 mm 0.0010 to 0.0030 in.	0.225 mm 0.0089 in.
Relief Valve	Working Pressure	885 kPa 9.04 kgf/cm^2 129 psi	–

W10139730

COOLING SYSTEM

Thermostat	Valve Opening Temperature	74.5 to 78.5 °C 166.1 to 173.3 °F	–
	Valve Opening Temperature (Opened Completely)	90 °C 194 °F	–
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	10.0 to 12.0 mm / 98 N 0.394 to 0.472 in. / 98 N (10 kgf, 22 lbs)	–

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FUEL SYSTEM

Item		Factory Specification	Allowable Limit
Injection Timing		0.21 to 0.24 rad (12 to 14 °) before T.D.C.	–
Pump Element	Fuel Tightness	–	18.63 MPa 190 kgf/cm^2 2702 psi
Delivery Valve	Fuel Tightness	10 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi	5 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi
Fuel Injection Nozzle	Injection Pressure (1st stage)	18.63 to 19.61 MPa 190 to 200 kgf/cm^2 2702 to 2845 psi	–
	Injection Pressure (2nd stage)	23.54 to 24.52 MPa 240 to 250 kgf/cm^2 3414 to 3556 psi	–
	Valve Seat Tightness	When the pressure is 16.67 MPa (170 kgf/cm^2, 2418 psi), the valve seat must be fuel tightness.	–

W10139730

ELECTRICAL SYSTEM

Commutator	O.D.	32 mm 1.2598 in.	31.4 mm 1.2362 in.
Mica	Undercut	0.5 mm 0.0197 in.	0.2 mm 0.0079 in.
Brush (Starter)	Length	18.0 mm 0.7086 in.	11.0 mm 0.4331 in.
Alternator	No-load Voltage	14 V at 4000 min^{-1} (rpm)	–
Rotor Coil	Resistance	2.8 to 3.3 Ω	–
Slip Ring	O.D.	22.7 mm 0.894 in.	22.1 mm 0.870 in.
Brush (Alternator)	Length	18.5 mm 0.728 in.	5.0 mm 0.197 in.
Intake Air Heater	Resistance (at cold occasion)	Approx. 0.3 Ω	–

W1013973

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 the proper torque.

[1] 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.

Grade / Nominal Diameter \ 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

W10371750

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)

W1012705

[2] TIGHTENING TORQUES FOR SPECIAL USE SCREWS, BOLTS AND NUTS

■ Note

- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size x 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 x Pitch	N·m	kgf·m	ft-lbs
Cylinder head cover screw	–	6.9 to 11.3	0.7 to 1.15	5.1 to 8.32
*Cylinder head screw	M12 x 1.25	98.1 to 107.9	10.0 to 11.0	72.3 to 79.6
*Connecting rod screw	M10 x 1.25	78.5 to 83.4	8.0 to 8.5	57.9 to 61.5
*Flywheel screw	M12 x 1.25	98.1 to 107.9	10.0 to 11.0	72.3 to 79.6
*Crankshaft screw	M16 x 1.5	255.0 to 274.6	26.0 to 28.0	188.1 to 202.5
*Main bearing case screw	M14 x 1.5	137.3 to 147.1	14.0 to 15.0	101.3 to 108.5
Rocker arm bracket screw	M10 x 1.25	49.0 to 55.9	5.0 to 5.7	36.2 to 41.2
Nozzle holder clamp nut	M8 x 1.25	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
Injection pipe retaining nut	M12 x 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Overflow pipe assembly retaining screw	M6 x 1.0	9.8 to 11.3	1.0 to 1.15	7.23 to 8.32
Oil switch taper screw	R 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Oil cooler joint screw	–	39.2 to 44.1	4.0 to 4.5	28.9 to 32.5
Oil pump cover screw	–	7.9 to 9.3	0.80 to 0.95	5.8 to 6.9
Starter's terminal **B** mounting nut	M8 x 1.25	9.8 to 11.8	1.0 to 1.2	7.2 to 8.7
Intake air heater terminal nut	M6 x 1.0	3.4 to 5.4	0.35 to 0.55	2.53 to 3.98
Injection pump gear mounting nut	M14 x 1.5	73.6 to 83.4	7.5 to 8.5	54.2 to 61.5
Injection pump unit mounting nut	M8 x 1.25	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
Gear case cover	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Relief valve retaining screw	–	68.6 to 78.4	7.0 to 8.0	50.6 to 57.9
Idle gear mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Plate mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Camshaft set screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Flywheel housing mounting screw	M12 x 1.25	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Crankcase 2 mounting screw	M10 x 1.25	49.0 to 55.9	5.0 to 5.7	36.2 to 41.2
Injection pump mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Injection pump mounting nut	M8 x 1.25	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
Boost actuator (Boost compensator model only)	–	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Governor weight mounting nut	M12 x 1.25	62.8 to 72.6	6.4 to 7.4	46.3 to 53.5
Fuel camshaft stopper mounting screw	–	7.9 to 9.3	0.80 to 0.95	5.8 to 6.9

W1013236

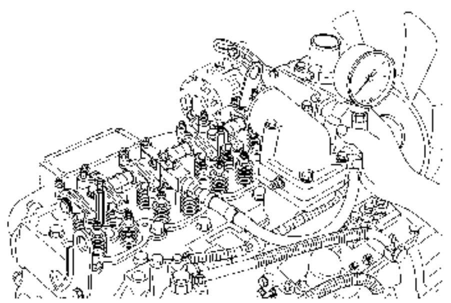
Item	Size x Pitch	N·m	kgf·m	ft-lbs
Governor housing mounting screw	M6 x 1.0	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
Anti-rotation nut	M5 x 0.8	2.8 to 4.0	0.29 to 0.41	2.1 to 3.0
Balancer shaft set screw (Balancer model only)	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Bearing case cover mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Alternator pulley nut	–	58.3 to 78.9	5.95 to 8.05	43.0 to 58.2

W1013236

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

(1) Engine Body



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Compression Pressure

1. After warming up the engine, stop it and remove the air cleaner, the muffler, high pressure pipes, cylinder head cover, overflow pipe, all nozzle holders and all nozzle gaskets.
2. Install a compression tester (Code No: 07909-30208) and nozzle adaptor for diesel engines to nozzle holder hole.
3. After making sure that the stop lever is set at the stop position (Non-injection), run the engine at 200 to 300 min^{-1} (rpm) with the starter.
4. Read the maximum pressure. Measure the pressure more than twice.

■ **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.	V3800DI-E2B	3.92 MPa / 250 min^{-1} (rpm) 40.0 kgf/cm^2 / 250 min^{-1} (rpm) 569 psi / 250 min^{-1} (rpm)
		V3800DI-T-E2B	3.47 MPa / 250 min^{-1} (rpm) 35.4 kgf/cm^2 / 250 min^{-1} (rpm) 503 psi / 250 min^{-1} (rpm)
	Allowable limit	V3800DI-E2B	2.90 MPa / 250 min^{-1} (rpm) 29.6 kgf/cm^2 / 250 min^{-1} (rpm) 421 psi / 250 min^{-1} (rpm)
		V3800DI-T-E2B	2.56 MPa / 250 min^{-1} (rpm) 26.1 kgf/cm^2 / 250 min^{-1} (rpm) 371 psi / 250 min^{-1} (rpm)

Tightening torque	Nozzle holder clamp nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs
	Overflow pipe assembly retaining screw	9.8 to 11.3 N·m 1.0 to 1.15 kgf·m 7.23 to 8.32 ft-lbs
	Cylinder head cover screw	6.9 to 11.3 N·m 0.7 to 1.15 kgf·m 5.1 to 8.32 ft-lbs
	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs

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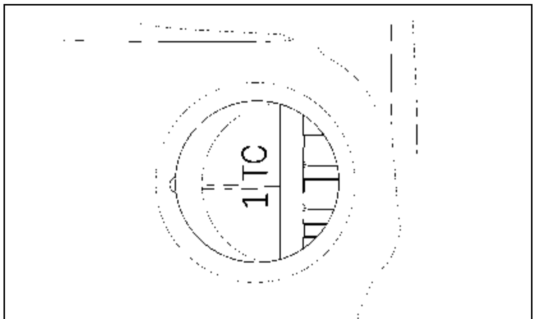

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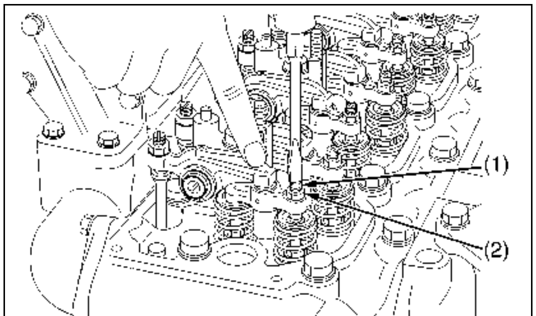

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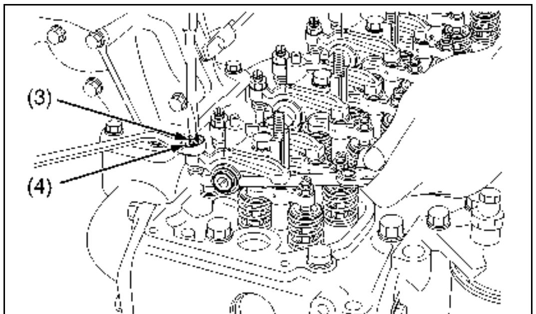

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Checking Valve Clearance

■ IMPORTANT

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

1. Remove the high pressure pipes and the head cover.
2. Align the 1TC mark of flywheel and the convex of flywheel housing timing windows so that the first piston (gear case side) comes to the compression top dead center.
3. Before adjusting the valve clearance, adjust the bridge evenly to the valve stem.
4. Loosen the lock nut (2) and adjust with screw (1).
5. Slightly push the rocker arm by your fingers and screw in the adjusting screw slowly until you feel the screw touch the top of valve stem, then tighten the lock nut.
6. Loosen the lock nut (4) of adjusting screw (3) (push rod side) and insert the thickness gauge between the rocker arm and the bridge head. Set the adjusting screw to the specified value, then tighten the lock nut.

Valve clearance	Factory spec.	0.23 to 0.27 mm 0.0091 to 0.0106 in.

■ Note

- **After adjusting, tighten the lock nut (4) securely.**

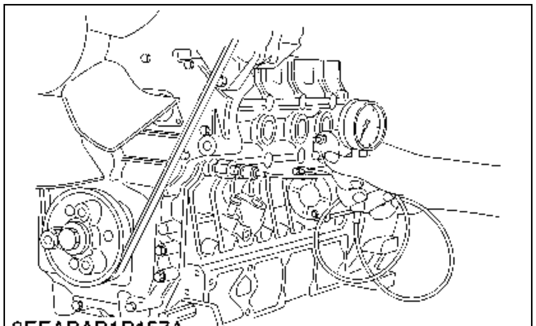
Valve arrangement Adjustment cylinder Location of piston		IN.	EX
When No.1 piston is at compression top dead center	1st	*	*
	2nd	*	
	3rd		*
	4th		
When No.1 piston is at overlap position	1st		
	2nd		*
	3rd	*	
	4th	*	*

Tightening torque	Cylinder head cover screw	6.9 to 11.3 N·m 0.7 to 1.15 kgf·m 5.1 to 8.32 ft-lbs
	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs

(1) Adjusting Screw
(2) Lock Nut
(3) Adjusting Screw
(4) Lock Nut

W1047000

(2) Lubricating System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Engine Oil Pressure

1. Remove the oil switch and set a pressure tester (Code No. 07916-32032).
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 clogged
- Oil gallery clogged
- Excessive oil clearance
- Foreign matter in the relief valve

(When reassembling)

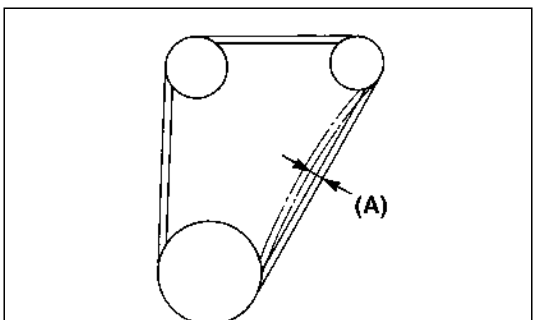
- After checking the engine oil pressure, tighten the engine oil pressure switch to the specified torque.

Engine oil pressure	At idle speed	Allowable limit	49 kPa 0.5 kgf/cm^2 7 psi
	At rated speed	Factory spec.	196 to 392 kPa 2.0 to 4.0 kgf/cm^2 28 to 57 psi
		Allowable limit	147.1 kPa 1.5 kgf/cm^2 21.3 psi

Tightening torque	Oil switch taper screw	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 ft-lbs

W10349520

(3) Cooling System



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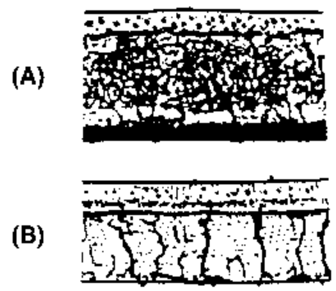
Fan Belt Tension

1. Measure the deflection **(A)**, depressing the belt halfway between the fan drive pulley and alternator pulley at specified force 98 N (10 kgf, 22 lbs).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

Deflection **(A)**	Factory spec.	10 to 12 mm 0.394 to 0.472 in.

(A) Deflection

W1021011



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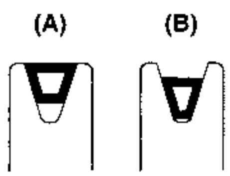

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Fan Belt Damage and Wear

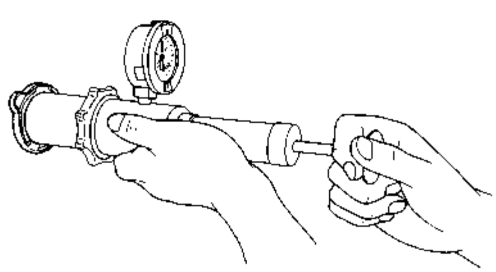
1. Check the fan belt for damage.
2. If the fan belt is damaged, replace it.
3. Check if the fan belt is worn and sunk in the pulley groove.
4. If the fan belt is nearly worn out and deeply sunk in the pulley groove, replace it.

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

W1021108

⚠ 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.**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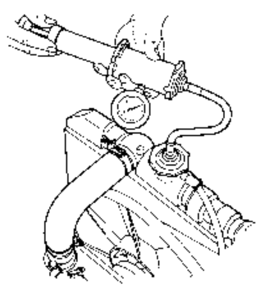
Radiator Cap Air Leakage

1. Set a radiator tester on the radiator cap.
2. Set a radiator tester.
   Apply the specified pressure of 88 kPa (0.9 kgf/cm^2, 13 psi).
3. Check if the pressure drop to less than 59 kPa (0.6 kgf/cm^2, 9 psi) in 10 seconds.
4. If the pressure is less than the factory specification, replace it.

W1021320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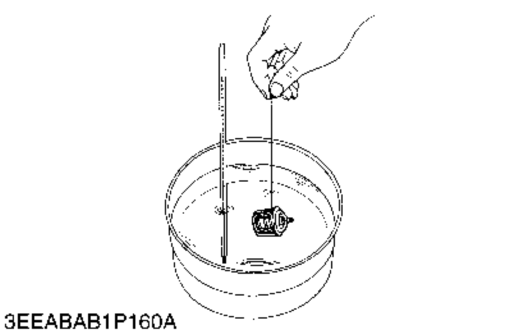
Radiator Water Leakage

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester.
   Increase water pressure to the specified pressure of 137 kPa (1.4 kgf/cm^2, 20 psi).
3. Check the radiator for water leaks.
4. When water leakage is excessive, replace the radiator. If water leakage is caused by a small pinhole, correct the radiator with radiator cement.

W1072497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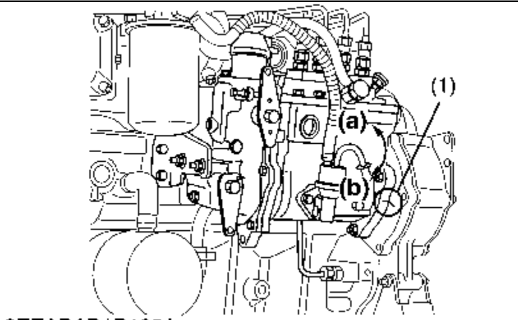
Thermostat Valve Opening Temperature

1. Push down the thermostat valve and insert a string between the valve and the valve seat.
2. Place the thermostat and a thermostat 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 8 mm (0.315 in.).
5. If the measurement is not acceptable, replace the thermostat.

Thermostat's valve opening temperature	Factory spec.	74.5 to 78.5 °C 166.1 to 173.3 °F
Temperature at which thermostat completely opens	Factory spec.	90 °C 194 °F

W1071639

(4) Fuel System



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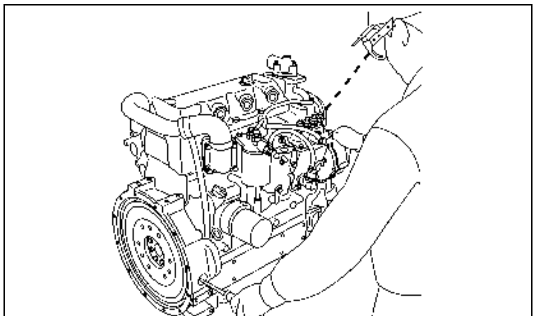
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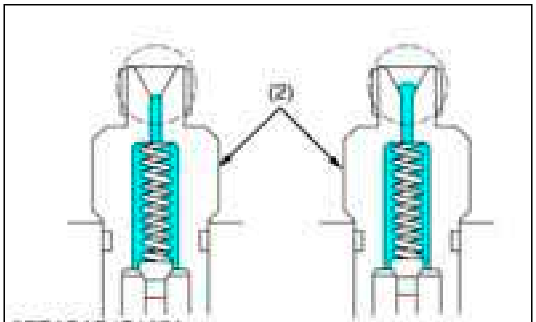

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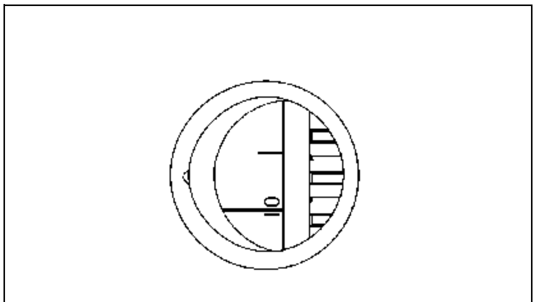

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Injection Timing

1. Make sure of matching the injection timing align mark (1) of the injection pump unit and the plate (gearcase), as shown in the illustration.
2. Remove the injection pipes.
3. Remove the stop solenoid.
4. Turn the flywheel counterclockwise (viewed from flywheel side) until the fuel fills up to the hole of the delivery valve holder (2) for No.1 cylinder.
5. After the fuel fills up to the hole of the delivery valve holder for No.1 cylinder, turn back (clockwise) the flywheel around 1.57 rad (90 °).
6. Turn the flywheel counterclockwise to set at around 0.35 rad (20 <Symbol>×) before T.D.C..
7. Slowly turn the flywheel counterclockwise and stop turning when the fuel begins to come up, to get the present injection timing.
8. Check to see the degree on flywheel.
   The flywheel has mark “1TC”, “10” and “20” for the crank angle before the top dead center of No.1 piston.
9. If the injection timing is not within the specification, rotate the injection pump unit to adjust the injection timing.

■ **IMPORTANT**

- **When installing the injection pump unit to the engine body, follow the correct procedure.**
  See the “Injection Pump Unit”.

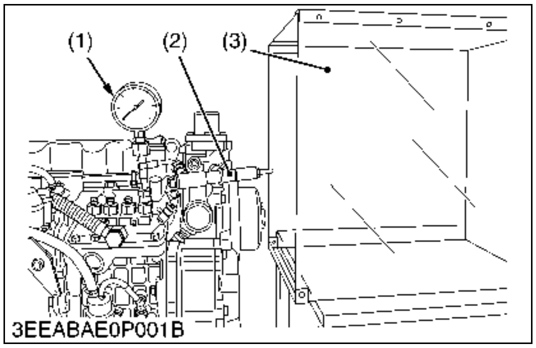
Injection timing	Factory spec.	0.21 to 0.24 rad (12 <Symbol>× to 14 <Symbol>×) before T.D.C.

Tightening torque	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
	Injection pump unit mounting nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs

(1) Injection Timing Align Mark
(2) Delivery Valve Holder

(a) Injection Timing Advanced
(b) Injection Timing Retarded

W1036105



Fuel Tightness of Pump Element

1. Remove the engine stop solenoid.
2. Remove the injection pipes.
3. Install the injection pump pressure tester to the injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1). (Refer to the figure.)
5. Set the speed control lever to the maximum speed position.
6. Run the starter to increase the pressure.
7. If the pressure can not reach the allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

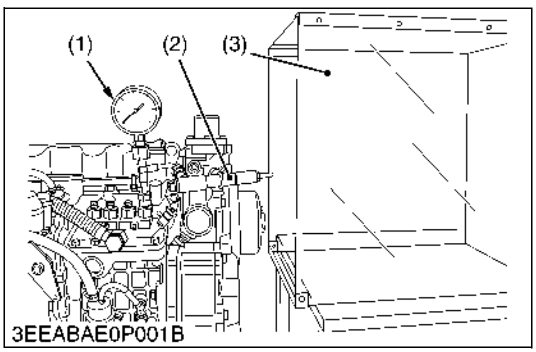
Fuel tightness of pump element	Allowable limit	18.63 MPa 190 kgf/cm^2 2702 psi

■ **Note**

- **Never try to disassemble the injection pump assembly. For repairs, you are strongly requested to contact a Kubota-authorized pump service shop.**

(1) Injection Pump Pressure Tester
(2) Injection Nozzle
(3) Protection Cover for Jetted Fuel

W1017430



Fuel Tightness of Delivery Valve

1. Remove the engine stop solenoid.
2. Remove the injection pipes.
3. Set a pressure tester to the fuel injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1).
5. Run the starter to increase the pressure.
6. Stop the starter when the fuel jets from the injection nozzle. After that, turn the flywheel by the hand and raise the pressure to approx. 18.63 MPa (190 kgf/cm^2, 2702 psi).
7. 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 18.63 to 17.65 MPa (from 190 to 180 kgf/cm^2, from 2702 to 2560 psi).
8. Measure the time needed to decrease the pressure from 18.63 to 17.65 MPa (from 190 to 180 kgf/cm^2, from 2702 to 2560 psi).
9. If the measurement is less than allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

Fuel tightness of delivery valve	Factory spec.	10 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi
	Allowable limit	5 seconds 18.63 → 17.65 MPa 190 → 180 kgf/cm^2 2702 → 2560 psi

■ **Note**

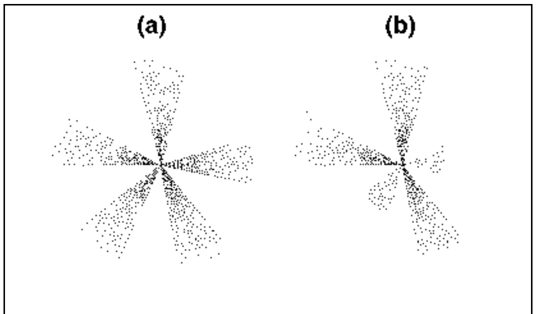
- **Never try to disassemble the injection pump assembly. For repairs, you are strongly requested to contact a Kubota-authorized pump service shop.**

(1) Injection Pump Pressure Tester
(2) Injection Nozzle
(3) Protection Cover for Jetted Fuel

W1017786

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.**



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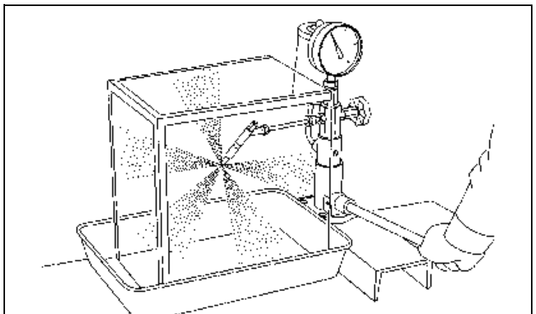
Nozzle Spraying Condition

1. Set the injection nozzle to a nozzle tester, and check the nozzle spraying condition.
2. If the spraying condition is defective, replace the injection nozzle assembly or repair at Denso service shop.

(a) Good **(b) Bad**

W10371670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Checking Nozzle Injection Pressure

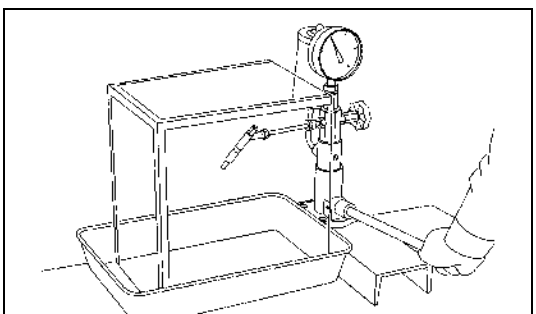
1. Set the injection nozzle to the nozzle tester.
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, replace the injection nozzle assembly or repair at Denso service shop.

■ **Note**

- **Injection nozzle gasket must be replaced when the injection nozzle is removed for checking.**

Injection pressure	Factory spec.	1st stage	18.63 to 19.61 MPa 190 to 200 kgf/cm^2 2702 to 2845 psi

W1037280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Valve Seat Tightness

1. Set the injection nozzle to a nozzle tester.
2. Raise the fuel pressure, and keep at 16.67 MPa (170 kgf/cm^2, 2418 psi) for 10 seconds.
3. If any fuel leak is found, replace the injection nozzle assembly or repair at Denso service shop.

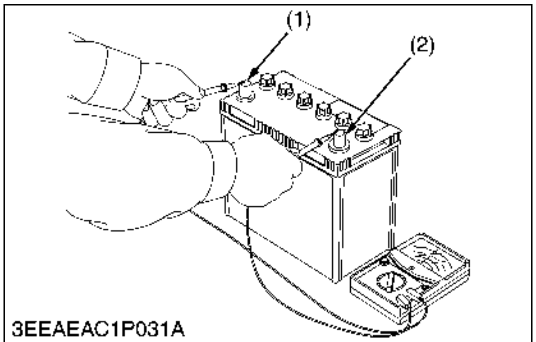
Valve seat tightness	Factory spec.	No fuel leak at 16.67 MPa 170 kgf/cm^2 2418 psi

W10374150

(5) Electrical System

Caution

- **To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.**
- **Never remove the battery cap while the engine is running.**
- **Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water immediately.**
- **Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.**
- **IMPORTANT**
- **If the machine is to be operated for a short time without battery (using a slave battery for starting), use additional current (lights) while engine is running and insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.**



3EEAEAC1P031A

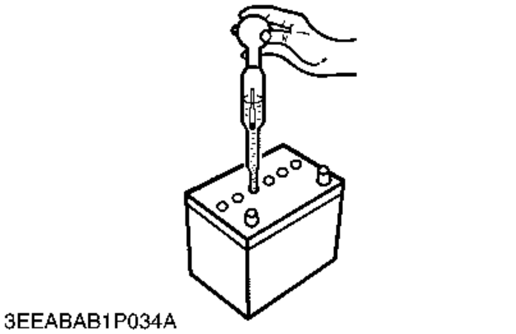
Battery Voltage

1. Stop the engine.
2. Measure the voltage with a circuit tester between the battery terminals.
3. If the battery voltage is less than the factory specification, check the battery specific gravity and recharge the battery.

Battery voltage	Factory spec.	More than 12 V

(1) Positive Terminal (2) Negative Terminal

W10125620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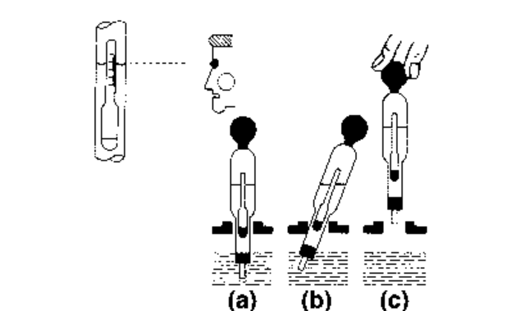

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Battery Specific Gravity

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in **(Reference)**.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

■ **NOTE**

- **Hold the hydrometer tube vertical without removing it from the electrolyte.**
- **Do not suck too much electrolyte into the tube.**
- **Allow the float to move freely and hold the hydrometer at eye level.**
- **The hydrometer reading must be taken at the highest electrolyte level.**

(Reference)

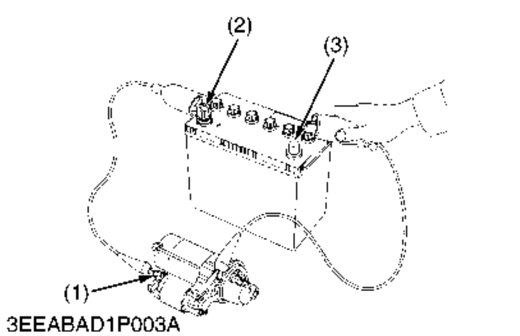
- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1 °C (0.0004 with an increase of 1 °F) in temperature, and increases by 0.0007 with a decreases of 1 °C (0.0004 with a decrease of 1 °F).
  Therefore, using 20 °C (68 °F) as a reference, the specific gravity reading must be corrected by the following formula :
  - Specific gravity at 20 °C = Measured value + 0.0007 × (electrolyte temperature : 20 °C)
  - Specific gravity at 68 °F = Measured value + 0.0004 × (electrolyte temperature : 68 °F)

Specific Gravity	State of Charge
1.260 Sp. Gr.	100 % Charged
1.230 Sp. Gr.	75 % Charged
1.200 Sp. Gr.	50 % Charged
1.170 Sp. Gr.	25 % Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

At an electrolyte temperature of 20 °C (68 °F)

(a) Good
(b) Bad
(c) Bad

W1019017



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Motor Test

Caution

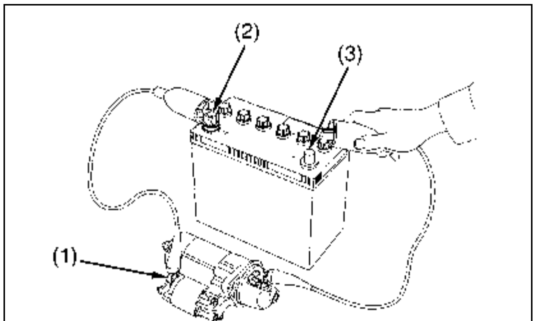
- **Secure the starter to prevent it from jumping up and down while testing the motor.**

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable from the battery.
3. Disconnect the leads from the starter **B** terminal.
4. Remove the starter from the engine.
5. Connect a jumper lead from the starter **C** terminal (1) to the battery positive terminal (2).
6. Connect a jumper lead momentarily between the starter's body and the battery negative terminal (3).
7. If the motor does not run, starter is failure. Repair or replace the starter.

- **B terminal : It is the terminal which connects the cable from the battery to the starter.**
- **C terminal : It is the terminal which connects the cable from the motor to the magnet switch.**

(1) **C** Terminal
(2) Positive Terminal
(3) Negative Terminal

W1019297



3EEABAD1P004A

Magnetic Switch Test

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable from the battery.
3. Disconnect the leads from the starter **B** terminal.
4. Remove the starter from the engine.
5. Connect a jumper lead from the starter **S** terminal (1) to the battery positive terminal (2).
6. Connect a jumper lead momentarily between the starter's body and the battery negative terminal (3).
7. If the pinion gear does not pop out, the magnetic switch is failure. Repair or replace the starter.

■ **NOTE**

- **B terminal : It is the terminal which connects the cable from the battery to the starter.**
- **S terminal : It is the terminal which connects the cable from the starter switch to the magnet switch.**

(1) **S** Terminal
(2) Positive Terminal
(3) Negative Terminal

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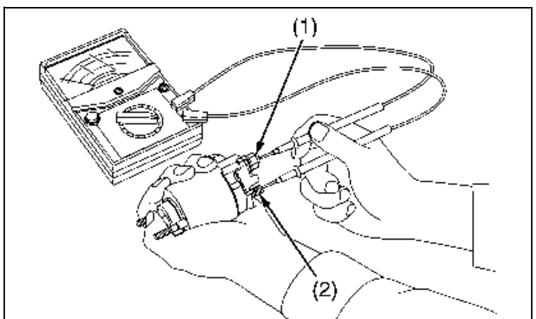

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Magnet Switch Continuity Test

1. Check the continuity across the **C** terminal (1) and the **B** terminal (2) with a circuit tester, pushing in the plunger.
2. If not continuous or if a certain value is indicated, replace the magnet switch.

(1) **C** Terminal
(2) **B** Terminal

0000010771E


3TMACAD9P012A

Alternator on Unit Test

(Before testing)

- Before alternator on unit test, check the battery terminal connections, circuit connection, fan belt tension, charging indicator lamp, fuses on the circuit, and abnormal noise from the alternator.
- Prepare full charged battery for the test.

■ **NOTE**

- **Be careful not to touch the rotating engine parts while engine is running.**
  Keep safety distance from the engine rotating parts.

1. Start the engine.
2. When the engine is operating measure the voltage between two battery terminals. If the voltage is between 13.8 V and 14.8 V, the alternator is operating normally.
3. If the results of alternator on unit test are not within the specifications, disassemble the alternator and check the each component part for finding out the failure. See the "DISASSEMBLING AND ASSEMBLING" and "SERVICING" for alternator.

Regulating voltage at no load	Factory spec.	13.8 to 14.8 V at 25 °C (77 °F)

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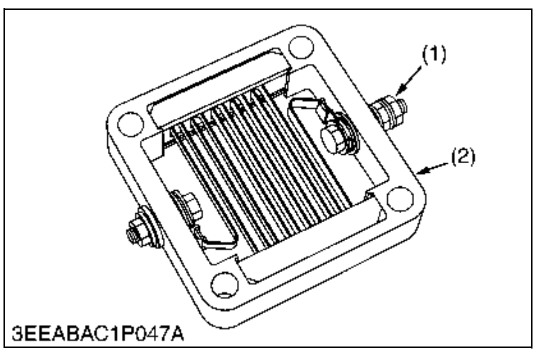

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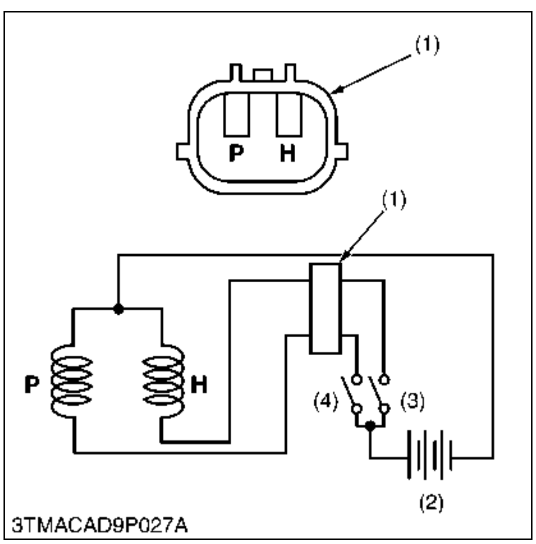
Intake Air Heater

1. Disconnect the lead.
2. Measure the resistance between + terminal (1) and intake air heater body (2).
3. If the resistance is infinity, the intake air heater is faulty.

Intake air heater resistance	Factory spec.	Approx. 0.3 <Symbol>W (At cold occasion)

(1) + Terminal
(2) Intake Air Heater Body

W1073774



3TMACAD9P027A

Engine Stop Solenoid

1. Remove the engine stop solenoid from the engine.
2. Connect the jumper leads from the pulling coil **P** terminal to the switch (3), and from switch (3) to the battery positive terminal.
3. Connect the jumper leads from the holding coil **H** terminal to the switch (4), and from switch (4) to the battery positive terminal.
4. Connect the jumper leads from the engine stop solenoid body to the battery negative terminal.
5. When switch (4) is turn on, the plunger pull into the solenoid body and then turn off the switch (4), the plunger comes out.
6. Turn on the switch (3) then turn on the switch (4), the plunger pull into the solenoid body and it keep in holding position after turn off the switch (4).
7. If the plunger is not attracted, the engine stop solenoid is faulty.

■ **IMPORTANT**

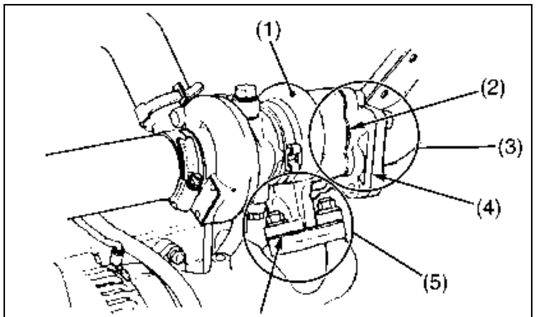
- **Never apply the current for pulling coil more than two seconds when inspecting.**

(1) Connector
(2) Battery
(3) Switch for Holding Coil
(4) Switch for Pulling Coil

P : Terminal for Pulling Coil
H : Terminal for Holding Coil

W1020600

(6) Turbocharger



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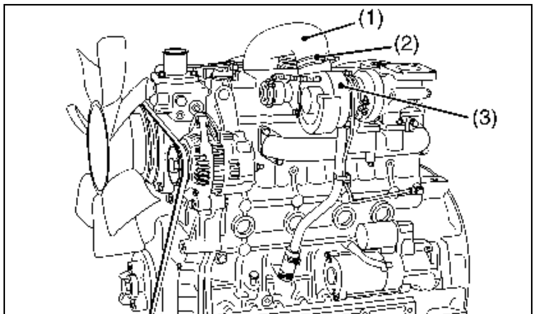
Turbine Side

1. Check the exhaust port (3) and inlet port (5) side of 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 (2) / (4) / (6) with new one.

(1) Turbine Housing	(4) Gasket
(2) Gasket	(5) Inlet Port
(3) Exhaust Port	(6) Gasket

W1076917



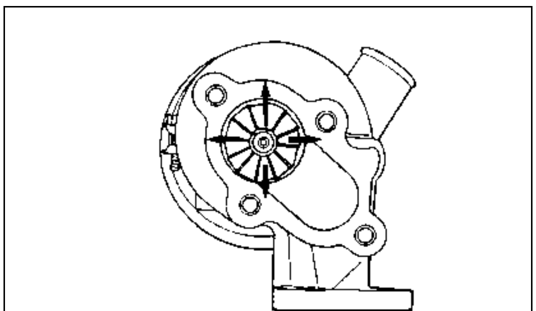
3EEABAB1P200C

Compressor Side

1. Check the inlet hose (1) of the compressor cover (3) to see if there is no air leak.
2. Check for loose connections or cracks in the suction side of the intake hose.
3. If any air leak is found, change the clamp (2) and or inlet hoses.

(1) Inlet Hose	(3) Compressor Cover
(2) Clamp	

W1077032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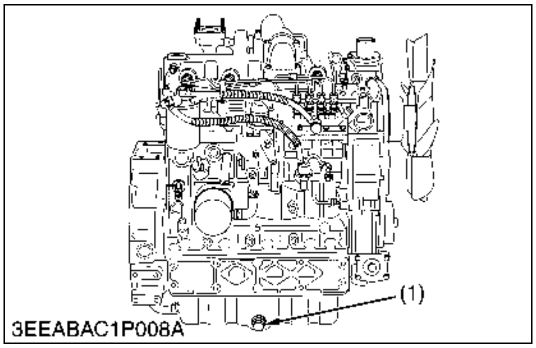
Radial Clearance

1. If the wheel contact to the housing, replace the turbocharger assembly with new one.

W1077353

[2] DISASSEMBLING AND ASSEMBLING

(1) Draining Oil and Coolant



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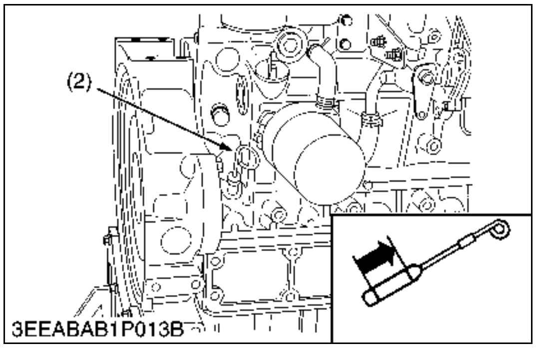

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Draining Engine Oil

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. Remove the drain plug (1) to drain oil.
4. After draining, screw in the drain plug.

(When refilling)

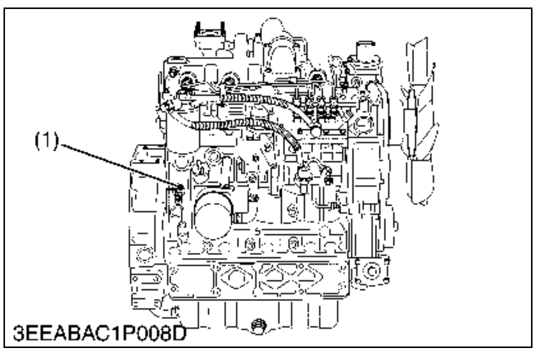
- Fill the engine oil up to the upper line on the dipstick (2).

■ **IMPORTANT**

- **Never mix two different type of oil.**
- **Use the proper SAE Engine Oil according to ambient temperature.**

(1) Drain Plug (2) Dipstick

W1023464



3EEABAC1P008D

Draining Coolant

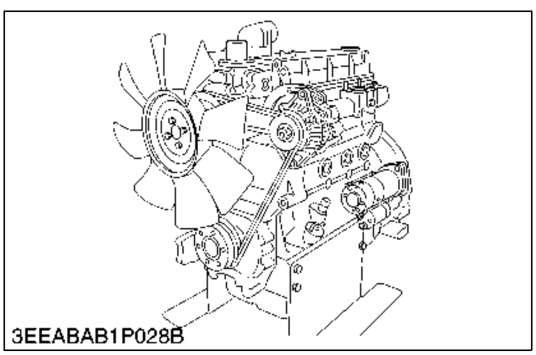
- **Never remove radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

1. Prepare a bucket. Open the coolant drain cock.

(1) Coolant Drain Cock

W1023496

(2) External Components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Air Cleaner, Muffler and Others

1. Remove the air cleaner and muffler.
2. Remove the fan, fan belt, alternator and starter.

(When reassembling)

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

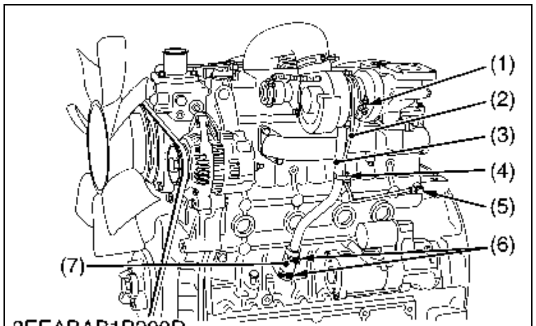
■ **IMPORTANT**

- **After reassembling the fan belt, be sure to adjust the fan belt tension.**
- **Do not confuse the direction of the fan. Attach the fan with its “1C010” marking facing frontward (toward the radiator).**

W1049622

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 matter in the oil pipes.**
- **When the turbocharger assembly has been replace, pour fresh engine oil through the oil filler port of the turbocharger.**
- **Before starting the engine, make sure that air cleaner is in position.**



3EEABAB1P200D

Oil Pipe

1. Remove the joint bolt (5) and clamp (4) and take off the pipe 1 (2).
2. Remove the bolts (1) and release the clamp (6).
3. Disconnect the oil pipe 2 (7) and pipe 4 (3).

(When reassembling)

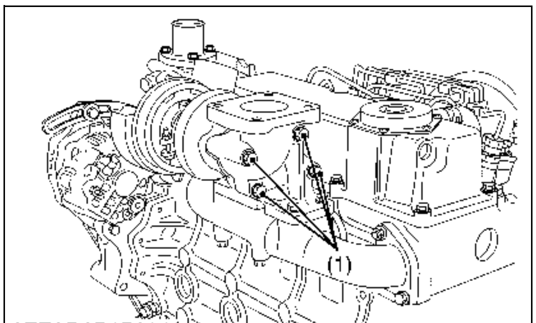
- Pour fresh engine oil through the oil filler port of the turbocharger.
- Replace the gasket with new one.
- Be careful not to allow dust, dirt and other foreign matters in the oil pipes.

■ **NOTE**

- **Tape or plug all openings to prevent foreign matters from damaging the oil cavities in the turbocharger.**

(1) Bolt	(5) Joint Bolt
(2) Oil Pipe 1	(6) Clamp
(3) Oil Pipe 4	(7) Oil Pipe 2
(4) Clamp	

W1025983



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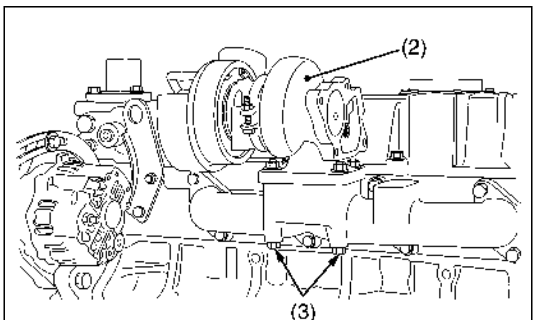

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Turbocharger

1. Remove the screw (1) and bolt (3).
2. Take off the turbocharger assembly (2).

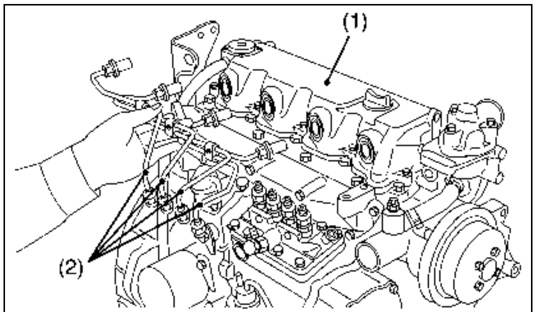
(When reassembling)

- Replace the gasket with new one.

(1) Screw	(3) Bolt
(2) Turbocharger Assembly	

W1078106

(3) Cylinder Head and Valves



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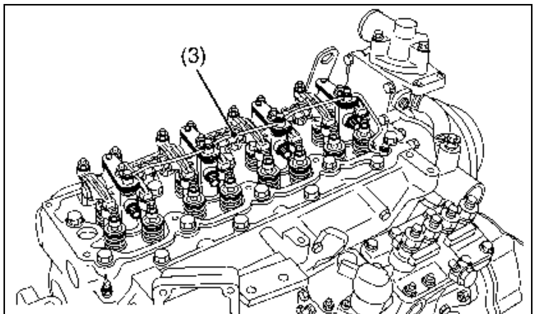

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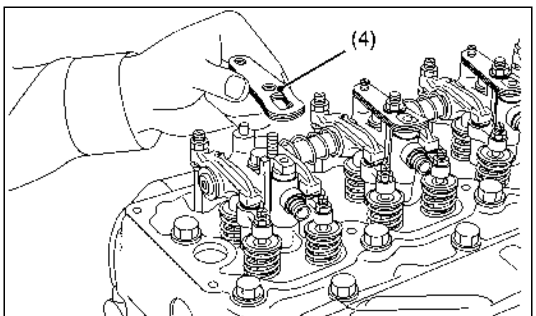

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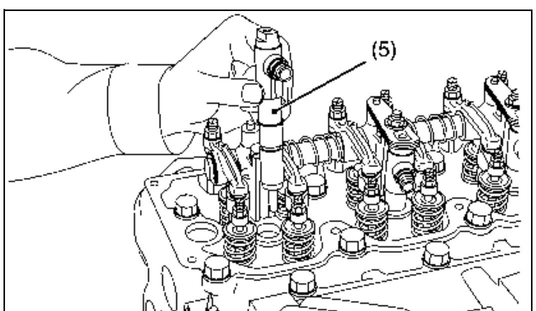

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Cylinder Head Cover and Nozzle Holder

1. Remove the injection pipes (2).
2. Remove the cylinder head cover (1).
3. Remove the over flow pipe (3).
4. Remove the nozzle holder clamps (4), nozzle holder assembly (5) and nozzle gaskets.

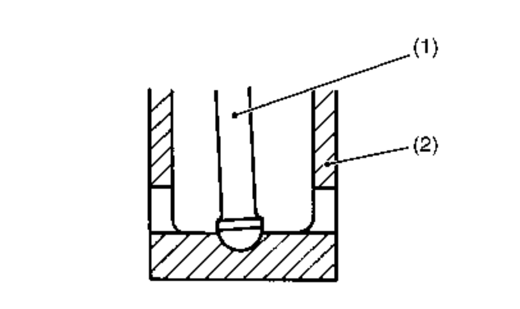
(When reassembling)

- Check to see that the cylinder head cover gasket is not defective.
- Be sure to place the nozzle gaskets.
- Tighten the head cover mounting bolts to specified torque.
- Mount the check valve with the <Symbol>Ø mark toward the tank.

Tightening torque	Nozzle holder clamp nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs
	Overflow pipe assembly retaining screw	9.8 to 11.3 N·m 1.0 to 1.15 kgf·m 7.23 to 8.32 ft-lbs
	Cylinder head cover screw	6.9 to 11.3 N·m 0.7 to 1.15 kgf·m 5.1 to 8.32 ft-lbs
	Injection pipe retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs

(1) Head Cover
(2) Injection Pipe
(3) Overflow Pipe
(4) Nozzle Holder Clamps
(5) Nozzle Holder Assembly

W1049737



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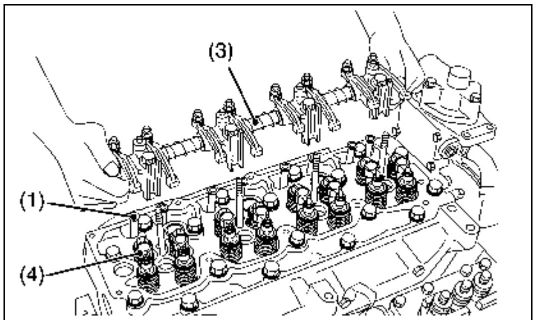

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Rocker Arm and Push Rod

1. Remove the rocker arm (3) as a unit.
2. Remove the push rods (1).
3. Remove the bridge arm (4).

(When reassembling)

- When putting the push rods onto the tappets (2), check to see if their ends are properly engaged with the grooves.

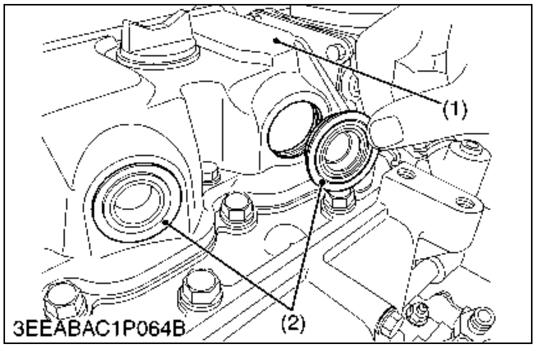
■ **IMPORTANT**

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

Tightening torque	Rocker arm bracket screw	49.0 to 55.9 N·m 5.0 to 5.7 kgf·m 36.2 to 41.2 ft-lbs

(1) Push Rod
(2) Tappet
(3) Rocker Arm
(4) Bridge Arm

W1050212



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Injection Nozzle Oil Seal (if necessary)

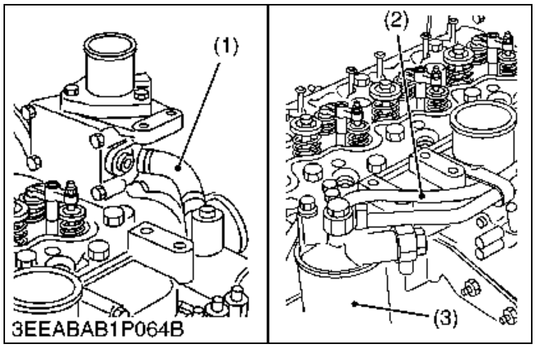
1. Remove the injection nozzle oil seal (2) from cylinder head cover (1).

(When reassembling)

- When install the injection nozzle oil seal, use the new one.

(1) Cylinder Head Cover
(2) Injection Nozzle Oil Seal

W1054100



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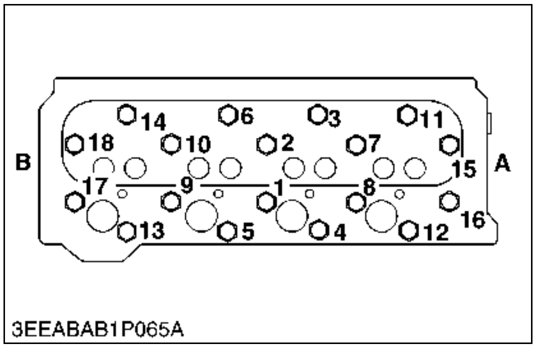

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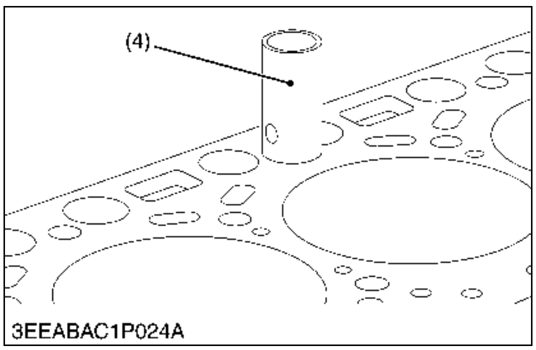

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Cylinder Head and Tappet

1. Loosen the pipe band, and remove the water return pipe (1).
2. Disconnect the fuel pipe (2) first and then the fuel filter (3).
3. Remove the IN. / EX. Manifold.
4. Remove the cylinder head screw in the order of (18) to (1), and remove the cylinder head.
5. Remove the cylinder head gasket.
6. Remove the tappets (4) from the crank case.

(When reassembling)

- Replace the head gasket with a new one.
- Before installing the tappets (4), apply engine oil thinly around them.
- When mounting the gasket, set it to the knock pin hole. Take care not to mount it reversely.
- The cylinder head should be free of scratches and dust.
- Take care for handling the gasket not to damage it.
- Install the cylinder head.
- Tighten the cylinder head screw gradually in the order of (1) to (18) after applying engine oil.
- Be sure to adjust the valve clearance. See the “Valve Clearance”.
- It is not necessary to retighten the cylinder head screw after running the engine for 30 minutes.

■ **IMPORTANT**

- **When replace the piston, piston pin bush, connecting rod or crankpin bearing, select the cylinder head gasket thickness to meet with the top clearance refer to the “Selecting Cylinder Head Gasket”.**

■ **NOTE**

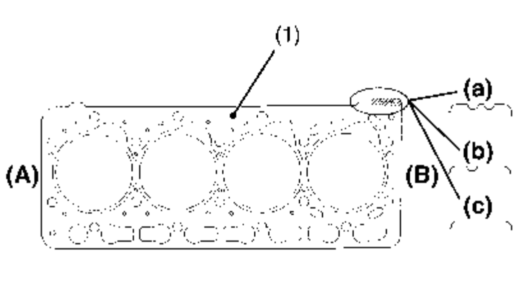
- **Mark the cylinder number to the tappets to prevent interchanging.**

Tightening torque	Cylinder head mounting screw	98.1 to 107.9 N·m 10.0 to 11.0 kgf·m 72.3 to 79.6 ft-lbs

(1) Return Pipe
(2) Fuel Pipe
(3) Fuel Filter
(4) Tappet

A : Gear Case Side
B : Flywheel Side

W1170923



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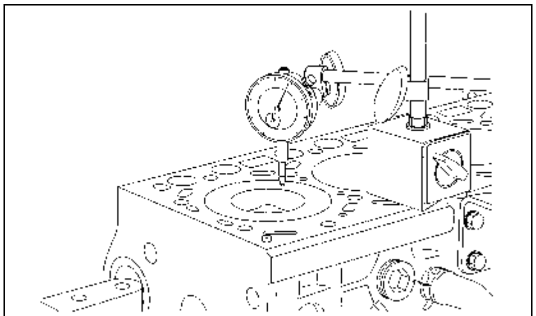
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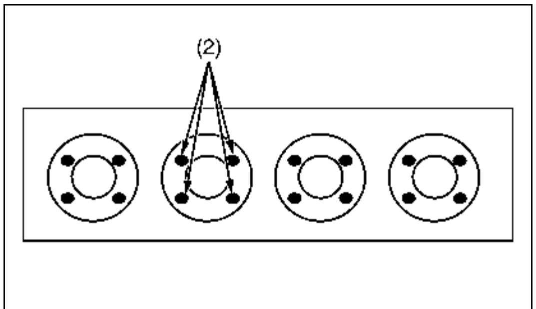

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Selecting Cylinder Head Gasket

■ Replacing the Cylinder Head Gasket

1. Make sure to note the notch **(a)**, **(b)** or **(c)** of cylinder head gasket (1) in advance.
2. Replace the same notch **(a)**, **(b)** or **(c)** as the original cylinder head gasket (1).

■ Selecting the Cylinder Head Gasket

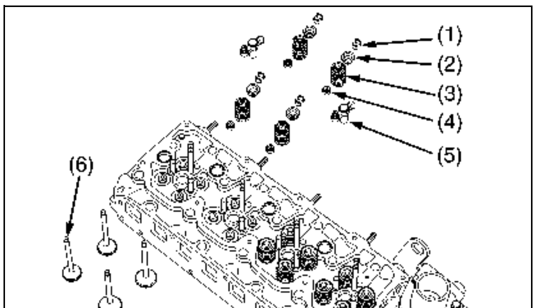
- Select the cylinder head gasket (1) thickness to meet with the top clearance when replacing the piston, piston pin bush, connecting rod or crankpin bearing.

1. Measure the piston head's protrusion or recessing from the crankcase cylinder face 4 spots per each piston and (average of four pistons) using the dial gauge as shown in figure.
2. Select the suitable cylinder head gasket refer to the table below.

Notch of Cylinder Head Gasket	Thickness of cylinder head gasket		Part Code	Piston Head's protrusion or recessing from the level of crankcase cylinder face. (average of 4 pistons)
	Before tightening	After tightening		
2 notches **(a)**	0.90 mm 0.0354 in.	0.80 mm 0.0315 in.	1G514-03310	-0.07 to +0.049 mm -0.0028 to +0.0019 in.
1 notch **(b)**	1.00 mm 0.0394 in.	0.90 mm 0.0354 in.	1G514-03600	+0.050 to +0.149 mm +0.0020 to +0.0058 in.
Without notch **(c)**	1.05 mm 0.0413 in.	0.95 mm 0.0374 in.	1G514-03610	+0.150 to +0.20 mm +0.0059 to +0.0078 in.

(1) Cylinder Head Gasket
(2) Measuring Point
(A) Gear Case Side
(B) Flywheel Side
(a) 2 Notches
(b) 1 Notch
(c) Without Notch

W1022965



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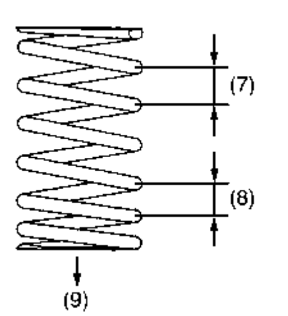

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Valve

1. Remove the valve spring collets (1) after compressing the valve spring (3) with the valve spring retainer (2).

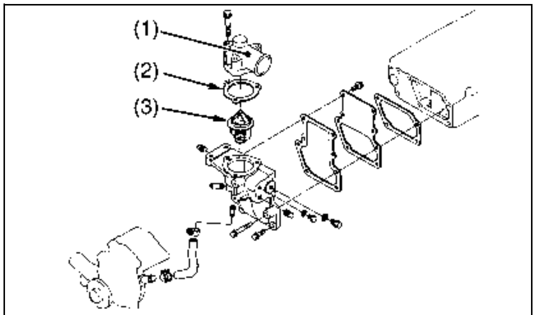
(When reassembling)

- Install the valve spring with its small-pitch end downward (at the head side).
- 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 Spring Collet
(2) Valve Spring Retainer
(3) Valve Spring
(4) Valve Stem Seal
(5) Arm Bridge
(6) Valve
(7) Large Pitch
(8) Smaller Pitch
(9) Install the spring with its smaller-pitch end downward (at the head side)

W1053044

(4) Thermostat



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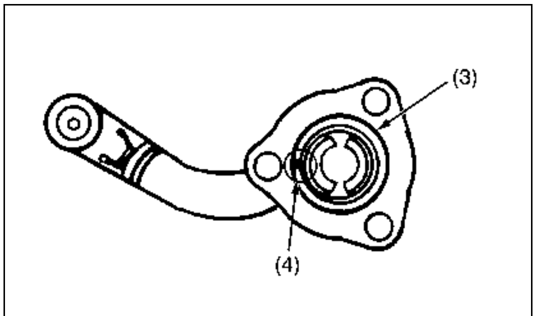

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Thermostat Assembly

1. Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
2. Remove the thermostat assembly (3).

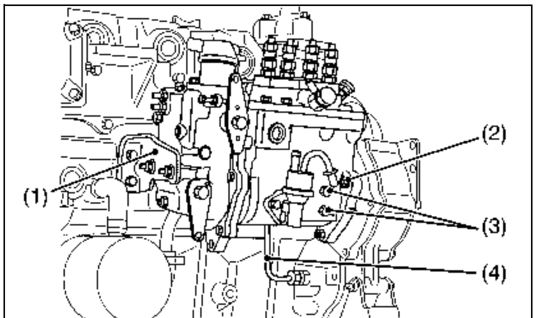
(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the gasket (2).
- Attach the thermostat with its hole facing toward the air suction side.

(1) Thermostat Cover
(2) Thermostat Cover Gasket
(3) Thermostat Assembly
(4) Hole

W1072747

(5) Injection Pump Unit



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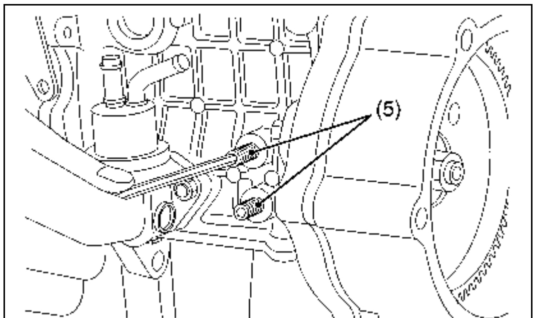

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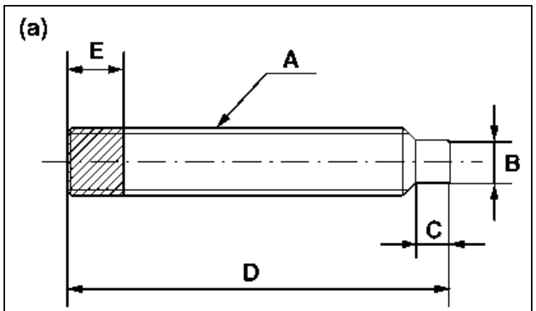

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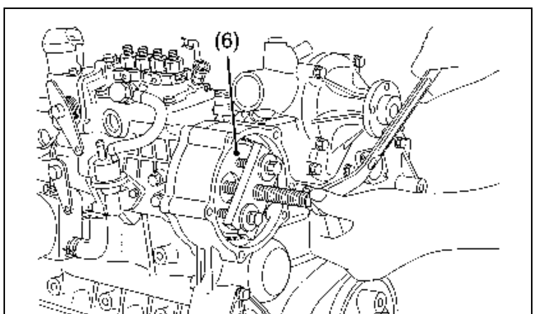

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Injection Pump Unit

(Removing the fuel injection pump unit)

1. Detach the gear cover for the fuel injection pump unit from the gearcase.
2. Place the piston of the 4th cylinder at the top dead center in the compression stroke. Fix the flywheel with the flywheel stopper.

■ **IMPORTANT**

- **Look for the align mark on the idle gear 2. Using a white marking pen or the like, put an align mark on the engaged tooth of the idle gear. This helps to reassemble these gears in mesh later.**

■ **NOTE**

- **When the already existing align marks align with each other, there is no need to put another align mark.**

3. Unscrew the two plugs (3) of the injection pump unit.
4. Tighten the upper fuel cam shaft lock screw (5) until it comes into contact with the fuel cam shaft. Make sure the cam shaft does not move any longer.
5. Tighten the lower fuel cam shaft lock screw (5) until it comes into contact with the fuel cam shaft.

■ **NOTE**

- **Never overtighten the lock screws when they have come into contact with the cam shaft. Otherwise the injection pump itself may get damaged.**
- **Use of a socket set screw (dog point type) in recommended for best results. Such screw can be constructed as shown in figure (a).**

6. Loosen the injection pump gear mounting nut. Using the specific gear puller, take out the gear (6).

■ **NOTE**

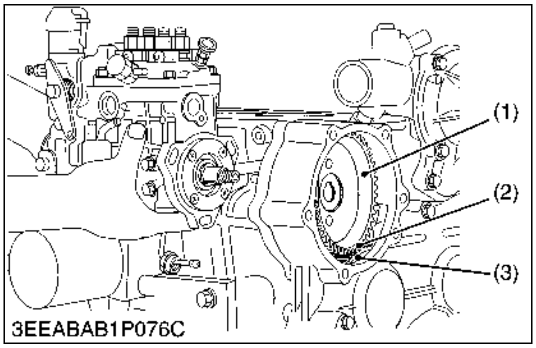
- **Be careful not to drop the key.**

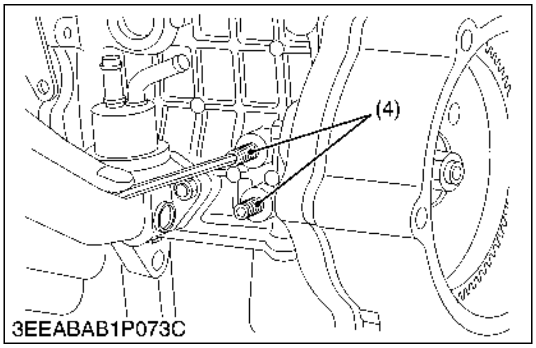
7. Disconnect the lubricating oil pipe (4).
8. Loosen the three injection pump unit mounting nut (2).
9. Remove the injection pump unit support (1) and take out the injection pump unit.

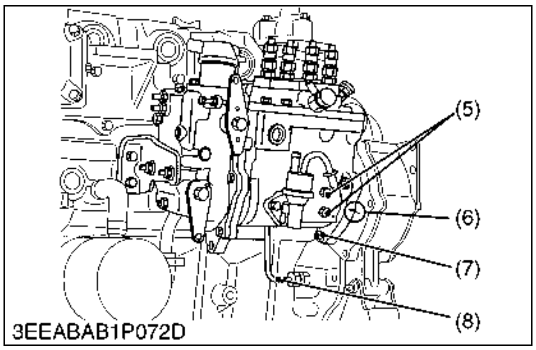
A	M8 × Pitch 1.25
B	5 mm dia. (0.197 in. dia.)
C	4 mm (0.157 in.)
D	45 mm (1.772 in.)
E	10 mm (0.39 in.) : Conspicuously Painted

(1) Injection Pump Unit Support
(2) Injection Pump Unit Mounting Nut
(3) Plug
(4) Lubricating Oil Pipe
(5) Fuel Cam Shaft Lock Screw (Socket Set Screw Dog Point Type)
(6) Injection Pump Gear

W1175054







Injection Pump Unit (Continued)

(Reassembling the fuel injection pump unit)

1. Place the piston of the 4th cylinder at the top dead center in the compression stroke. Fix the flywheel with the flywheel stopper.
2. Place the injection pump gear (1) back into the gear case position. Make sure of aligning the align marks of the injection pump gear (1) and the idle gear 2 (3).
3. Install the injection pump unit to the injection pump gear (1).

■ **NOTE**

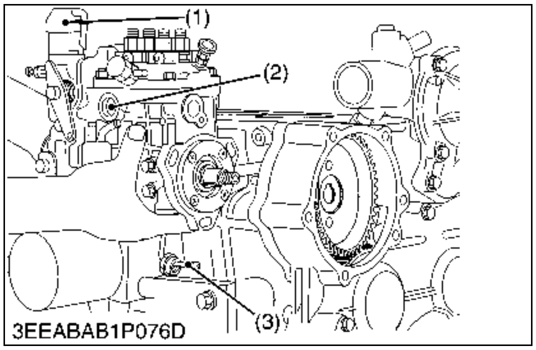
- **When installing the injection pump unit to the injection pump gear, make sure that the key is fit in the keyway of injection pump gear.**

4. Temporarily tighten the injection pump gear mounting nut by hand.
5. Fix the injection pump unit and tighten the injection pump gear mounting nut to the specified torque.
6. Take off the fuel cam shaft lock screws (4) and tighten the plugs (5) for plugging.
7. Loose the injection pump unit mounting nuts (7) for aligning the injection timing.
8. Moving the injection pump unit clockwise (viewed from gear case side), align the injection timing marks (6) on the injection pump unit and on the gear case.
9. Tighten the injection pump unit mounting nut (7) to the specified torque.
10. Reconnect the lubricating oil pipe (8) and place the injection pump unit support and the gear cover of the injection pump unit.
11. Remove the flywheel stopper.
12. Check the injection timing. (See the "Injection Timing".)
13. If the injection timing is not within the specification, repeat (7) to (12) again.

Tightening torque	Injection pump gear mounting nut	73.6 to 83.4 N·m 7.5 to 8.5 kgf·m 54.2 to 61.5 ft-lbs
	Injection pump unit mounting nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs

(1) Injection Pump Gear
(2) Align mark of the Injection Gear
(3) Idle Gear 2
(4) Fuel Cam Shaft Lock Screw (Socket Set Screw Dog Point Type)
(5) Plug
(6) Align Mark
(7) Injection Pump Unit Mounting Nut
(8) Lubricating Oil Pipe

W1176586



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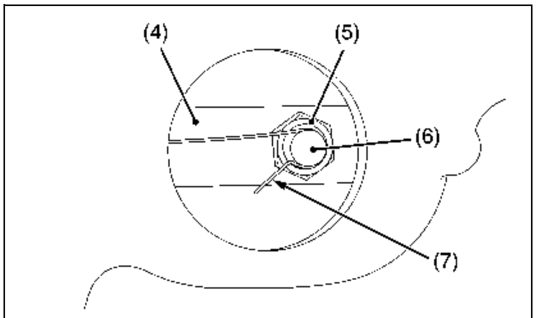

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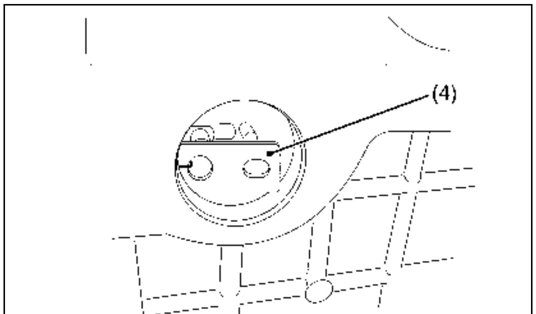

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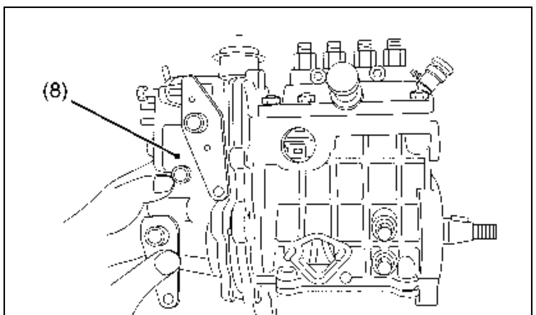

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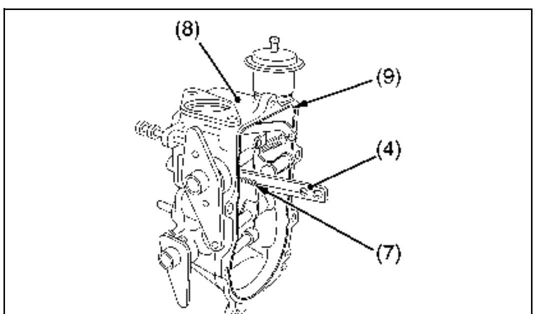

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Governor Housing Assembly

1. Remove the injection pump unit from the engine. (See the "Injection Pump Unit".)
2. Remove the governor lubricating pipe (3).
3. Remove the stop solenoid (1).
4. Detach the sight cover (2) from the injection pump unit.
5. Unhook the start spring (7) from the rack pin (6) of injection pump assembly.
6. Remove the nut (5).

■ **NOTE**

- **Be careful not to drop the nut inside.**

7. Slide off the governor connecting rod (4) from the rack pin of injection pump assembly.
8. For convenient sake, temporarily hook the start spring on the rack pin hole of the governor connecting rod.
9. Remove the governor housing mounting screws.
10. Detach the governor housing assembly (8) from the injection pump unit.

(When reassembling)

- When reassembling the inside parts, put the oil on each inside part slightly.
- After sliding on the governor connecting rod to the rack pin, tighten the nut with the specified torque with using the jig for keeping the governor connecting rod horizontal. (See the Replacing Injection Pump Assembly.)
- After tightening the nut, hook the start spring on the rack pin.
- Check the movement of control rack of injection pump assembly by the stop lever.

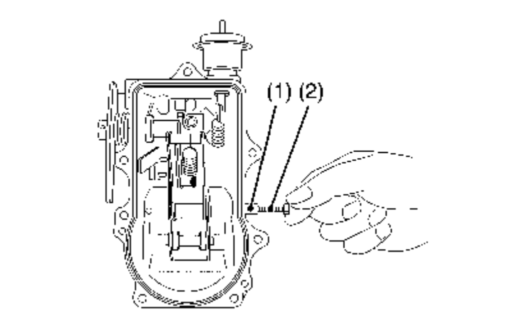
■ **NOTE**

- **When installing the governor housing assembly to the injection pump unit, be careful not to damage O-ring (9).**
- **When linking the governor connecting rod to the rack pin of injection pump, use the jig for keeping the governor connecting rod horizontal. Otherwise the control rack may be stuck, and causes to be difficult to start the engine or hunting of governor. (See the Replacing Injection Pump Assembly.)**

Tightening torque	Governor housing mounting screw	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.23 to 8.32 ft-lbs
	Anti-rotation nut	2.8 to 4.0 N·m 0.29 to 0.41 kgf·m 2.1 to 3.0 ft-lbs

(1) Stop Solenoid
(2) Sight Cover
(3) Governor Lubricating Pipe
(4) Governor Connecting Rod
(5) Anti-Rotation Nut
(6) Rack Pin
(7) Start Spring
(8) Governor Housing Assembly
(9) O-ring

W1137126



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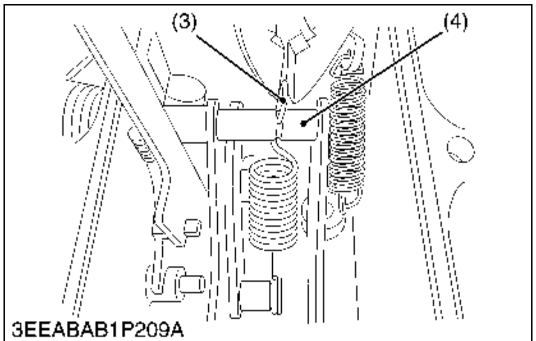

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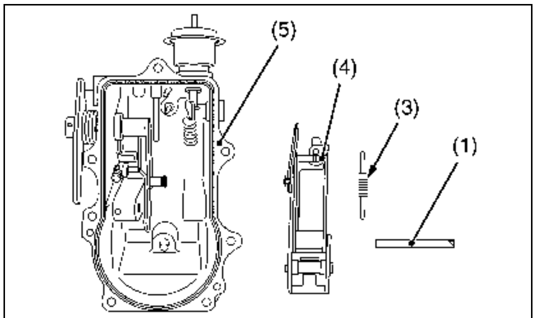

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Governor Fork Lever Assembly

1. Pull off the governor fork lever shaft (1) with the extra bolt (Dia : 4 mm, Pitch : 0.7 mm, Length : more than 25 mm) (2).
2. Unhook the governor spring (3) at the governor fork lever (4) side.
3. Remove the governor fork lever assembly from the governor housing (5).

(When reassembling)

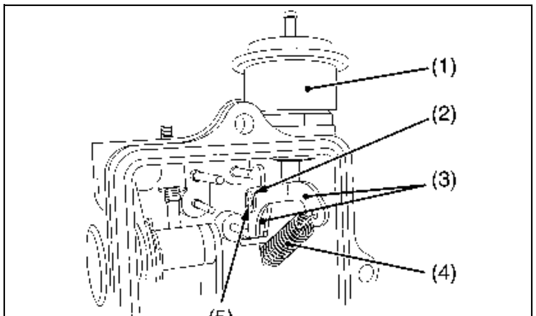
- After reassembling the governor housing assembly, check the movement of the governor fork lever assembly, the speed control lever and the stop lever.

■ NOTE

- **When assembling the inside parts, put the oil on each inside part slightly.**
- **Be careful not to deform the start spring.**

(1) Governor Fork Lever Shaft
(2) Extra Bolt
(Dia : 4 mm, Pitch : 0.7 mm, Length : more than 25 mm)
(3) Governor Spring
(4) Governor Fork Lever
(5) Governor Housing

W1139749



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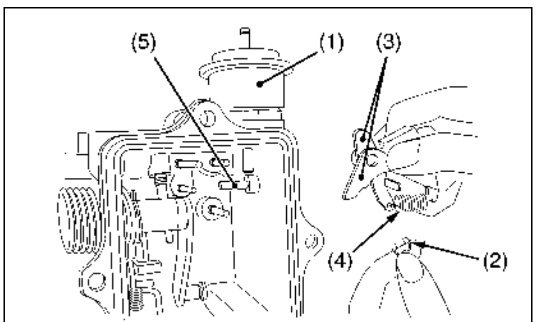

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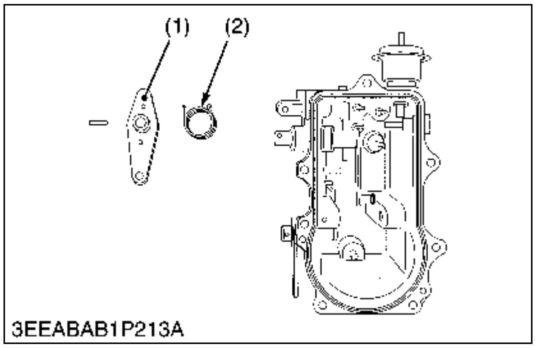
Boost Arms (If equipped Boost Compensator)

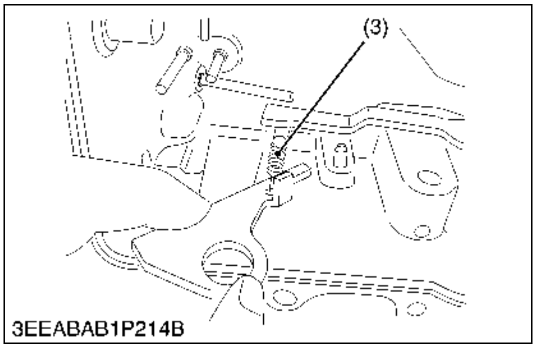
1. Remove the boost actuator (1).
2. Remove the cir-clip (2).
3. Remove the boost arms (3) and the boost spring (4) from the pin (5).

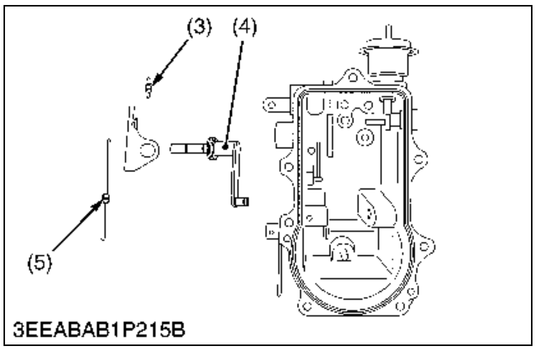
Tightening torque	Boost actuator	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 ft-lbs

(1) Boost Actuator
(2) Cir-clip
(3) Boost Arm
(4) Boost Spring
(5) Pin

W1141511







Governor Lever

1. Remove the speed control lever (1) and the return spring (2).
2. Remove the governor lever assembly (4) from the governor housing.
3. Remove the start spring (5) and the stop spring (3).

(1) Speed Control Lever
(2) Return Spring
(3) Stop Spring
(4) Governor Lever Assembly
(5) Start Spring

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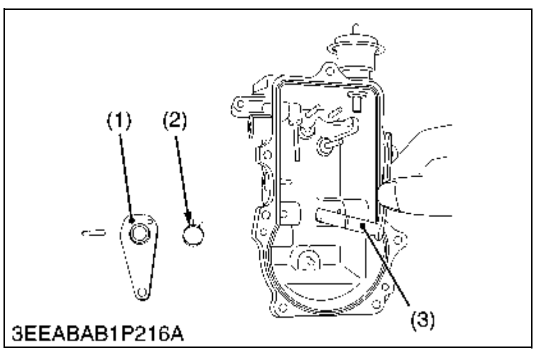
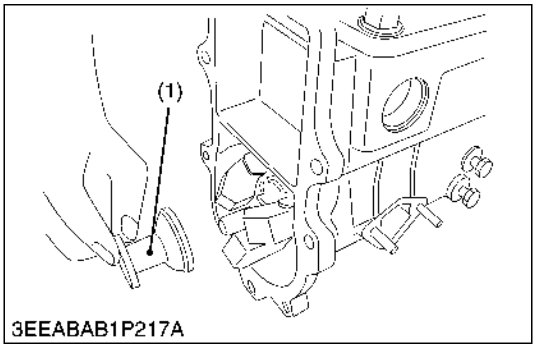


Stop Lever

1. Remove the stop lever (1) and the return spring (2).
2. Remove the stop lever shaft (3).

(1) Stop Lever
(2) Return Spring
(3) Stop Lever Shaft

W1143531



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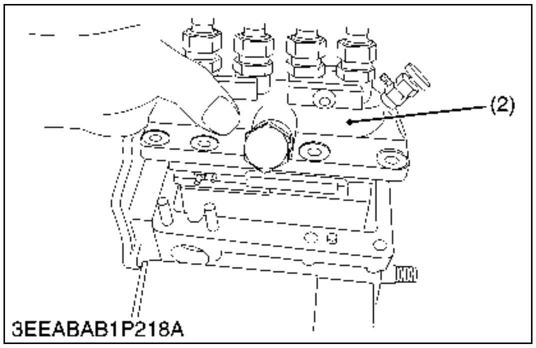

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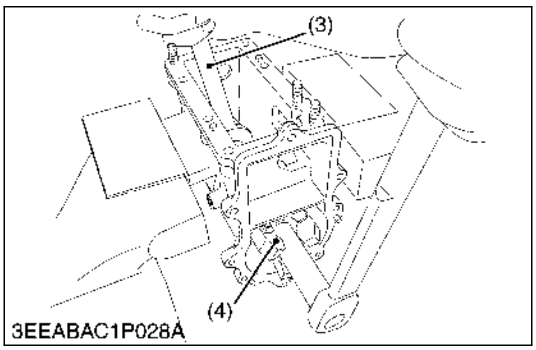

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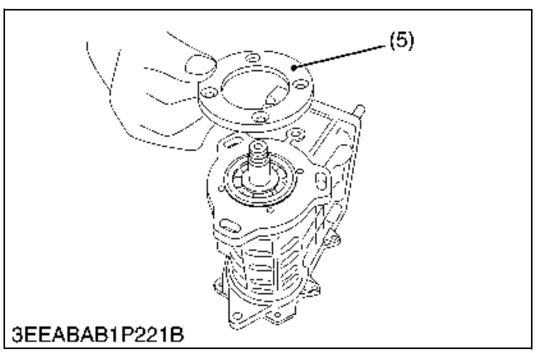

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Fuel Camshaft and Governor Weight

1. Separate the governor housing assembly from the injection pump unit. (See the “Injection Pump Unit”.)
2. Remove the governor sleeve (1).
3. Remove the injection pump assembly (2).
4. Remove the fuel camshaft lock screws.
5. Fix the fuel camshaft with open end wrench (3), and remove the governor weight mounting nut and the governor weight (4).
6. Loosen the fuel camshaft stopper mounting screws and remove the fuel camshaft stopper (5).
7. Pull out the fuel camshaft (8) and bearings (6) together.
8. After removing the bearing’s cir-clip (7), press out the bearings.

■ **NOTE**

- **Do not use the fuel camshaft lock bolts, when removing the governor weight mounting nut. Otherwise, the lock bolts or injection pump housing might get damage.**

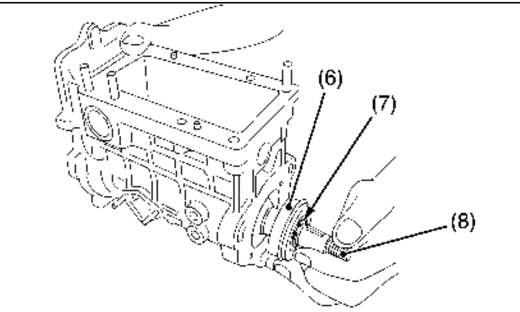
(When reassembling)

- Press the bearings into the fuel camshaft.
- Set the cir-clip at the gear side’s bearing.
- Install the fuel camshaft and bearings to the injection pump housing.
- Attach the fuel camshaft stopper and tighten the fuel camshaft stopper mounting screws with the specified torque.
- Attach the governor weight to the fuel camshaft and tighten the governor weight mounting nut with specified torque.

Tightening torque	Injection pump mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Injection pump mounting nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs

(1) Governor Sleeve
(2) Injection Pump Assembly
(3) Open End Wrench (22 mm)
(4) Governor Weight
(5) Fuel Camshaft Stopper
(6) Bearing
(7) Cir-clip
(8) Fuel Camshaft
(9) Key Way of Fuel Camshaft

W1144178



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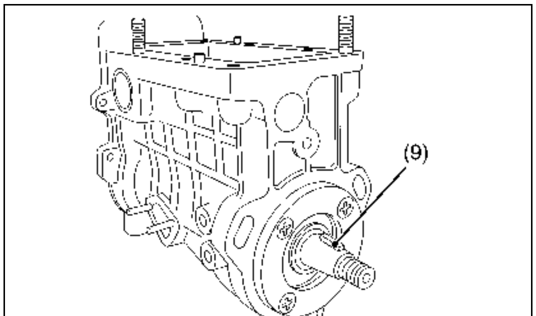

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Fuel Camshaft and Governor Weight (Continued)

(When reassembling)

- Fix the fuel camshaft with lock bolts as the key way of fuel camshaft (9) is upward.
- Install the injection pump assembly to the injection pump housing.
- Attach the O-ring and the cover and tighten the cover mounting bolts.
- Install the governor sleeve to the fuel camshaft.
- Check the movement of the governor sleeve.

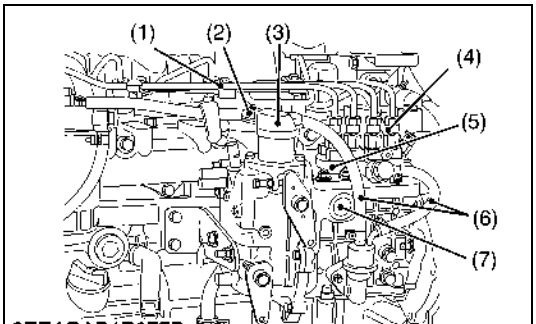
■ **NOTE**

- **Be careful not to damage the O-ring.**
- **Be careful the direction of the governor sleeve.**
- **When reassembling the inside parts, put the oil on each inside part slightly.**

Tightening torque	Fuel camshaft stopper mounting screw	7.9 to 9.3 N·m 0.80 to 0.95 kgf·m 5.8 to 6.9 ft-lbs
	Governor weight mounting nut	62.8 to 72.6 N·m 6.4 to 7.4 kgf·m 46.3 to 53.5 ft-lbs

(1) Governor Sleeve
(2) Injection Pump Assembly
(3) Open End Wrench (22 mm)
(4) Governor Weight
(5) Fuel Camshaft Stopper
(6) Bearing
(7) Cir-clip
(8) Fuel Camshaft
(9) Key Way of Fuel Camshaft

W1146489



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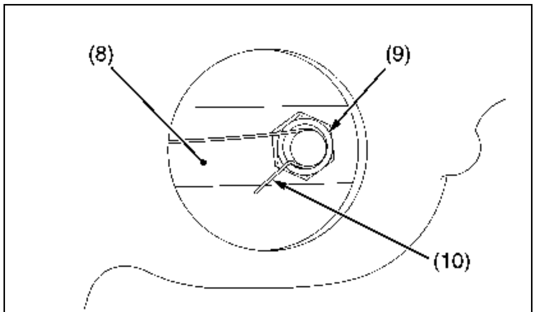

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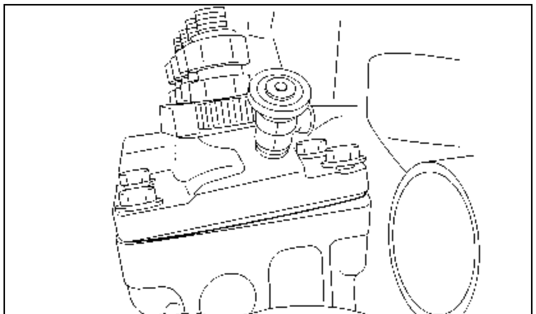

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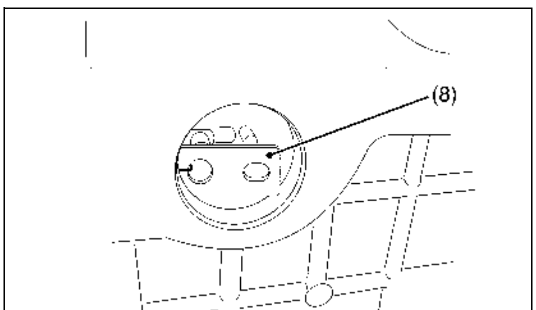

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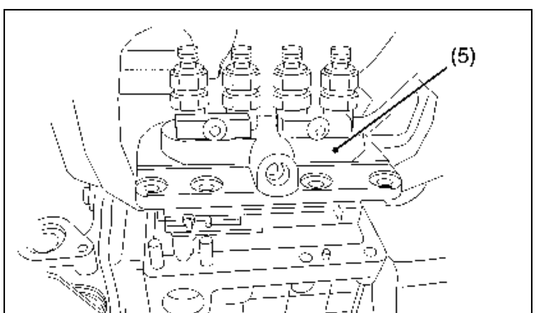

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Replacing Injection Pump Assembly (If necessary)

- **The injection pump can be replaced with the crankshaft in whatever position.**

1. Disconnect all injection pipes (1).
2. Disconnect the fuel pipe (6) and fuel overflow pipe (4).
3. Disconnect the connector (2) from the stop solenoid. Then remove the stop solenoid (3).
4. Detach the sight cover (7) from the injection pump unit.
5. Unhook the start spring (10), and remove the anti-rotation nut (9).
6. Just loosen the injection pump assembly mounting screws and nuts like the figure, which the injection pump assembly keeps tilted.
7. Slide off the governor connecting rod (8) from the rack pin of injection pump assembly.
8. Remove the injection pump mounting screws and nuts, and take out the injection pump assembly (5).

■ **NOTE**

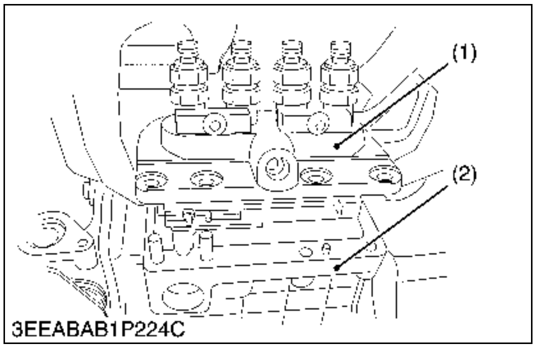
- **Be careful not to drop the anti-rotation nut (9).**
- **Be careful not to deform the start spring.**
- **When taking out the injection pump assembly, be careful not to hit it against the governor connecting rod.**

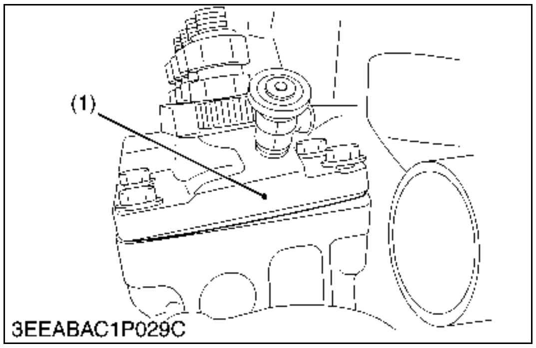
(When reassembling)

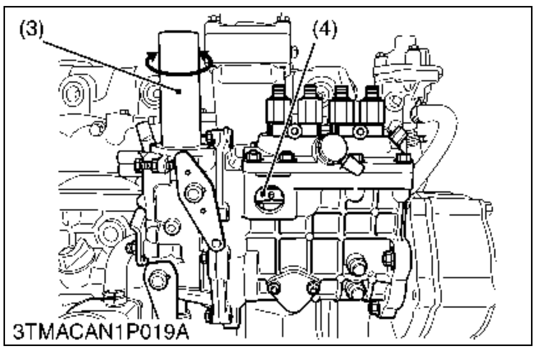
- Install the new injection pump according to the installing procedure.

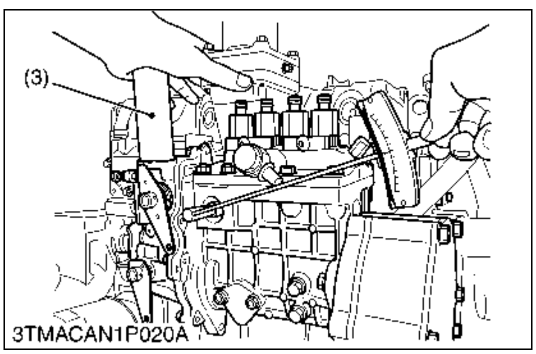
(1) Injection Pipe
(2) Connector
(3) Stop Solenoid
(4) Fuel Overflow Pipe
(5) Injection Pump Assembly
(6) Fuel Pipe
(7) Sight Cover
(8) Governor Connecting Rod
(9) Anti-Rotation Nut
(10) Start Spring

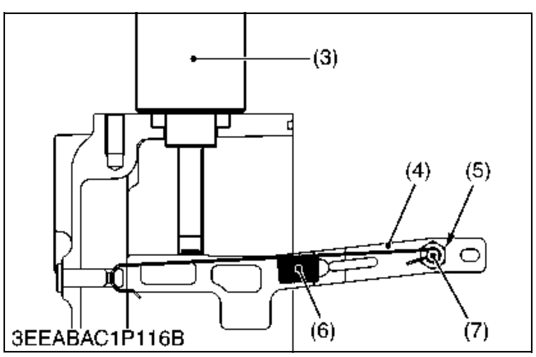
W1182379





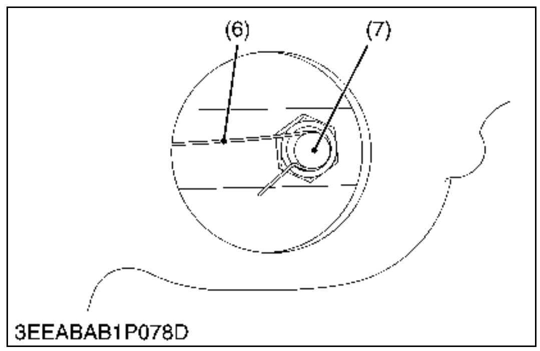






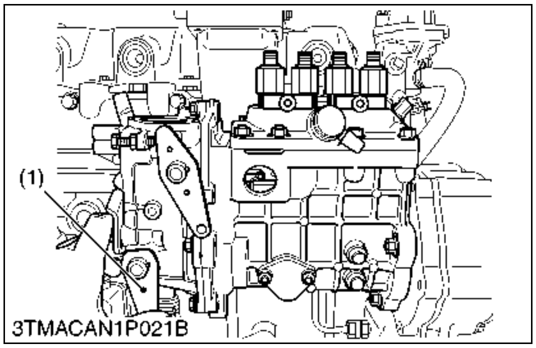
Installing Procedure of Injection Pump Assembly

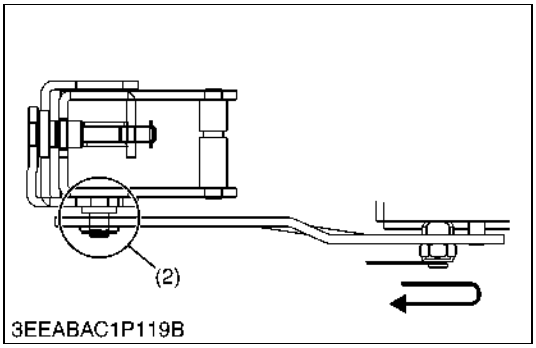
1. Install the fuel injection pump assembly (1) in its unit (2), and tighten the mounting screws and nuts like the figure, which the injection pump assembly (1) keeps tilted.
2. Hook the governor connecting rod (4) to the rack pin of the injection pump assembly (1).
3. Tighten the mounting screws and nuts with the specified torque, not to slide off the governor connecting rod (4) from the rack pin.
4. Place the service jig (3) in the stop solenoid mounting hole of the fuel injection pump unit.
5. Make sure the permanent magnet at the tip of the service jig is attracted to the governor connecting rod (4). To do this, turn the jig a little clockwise and counterclockwise and look into the fuel injection pump unit sight hole to see if the governor connecting rod (4) moves right and left accordingly.
6. Slightly tighten the anti-rotation nut of the governor connecting rod.
7. Holding down the service jig (3) by hand, tighten up the anti-rotation nut (5) to the specified torque.
8. Hook the start spring (6) to the rack pin (7).



(1) Fuel Injection Pump Assembly
(2) Fuel Injection Pump Unit
(3) Service Jig
(4) Governor Connecting Rod
(5) Anti-rotation Nut
(6) Start Spring
(7) Rack Pin

W1069371





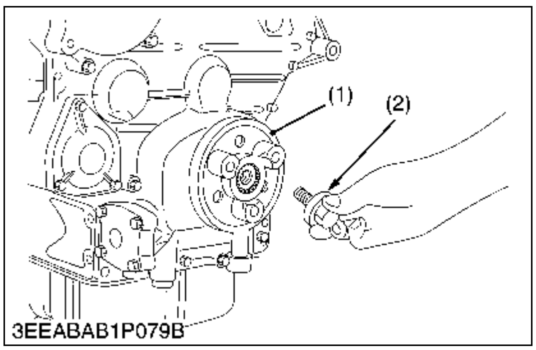
Installing Procedure (Continued)

1. Move the stop lever (1) and visually check to see if the fuel injection pump control rack comes smoothly back to the start position by the counter force of the start spring.
2. If the control rack fails to move back smoothly, remove the start spring and the anti-rotation nut, take the above steps from 2 of the former page again.
3. Finally fit the sight cover and the stop solenoid back into place.

Tightening torque	Anti-rotation nut	2.8 to 4.0 N·m 0.29 to 0.41 kgf·m 2.1 to 3.0 ft-lbs
	Injection pump mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Injection pump mounting nut	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs

(1) Stop Lever
(2) Sliding Point between Governor Fork Lever and Governor Connecting Rod

W1069772



Fan Drive Pulley

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

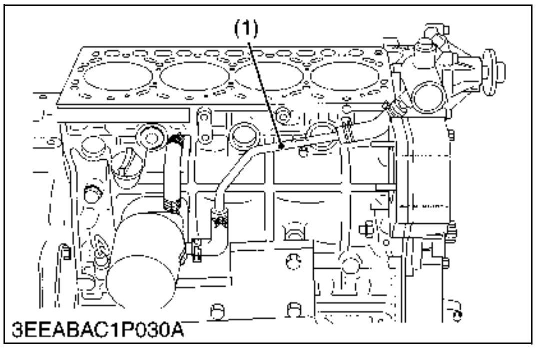
(When reassembling)

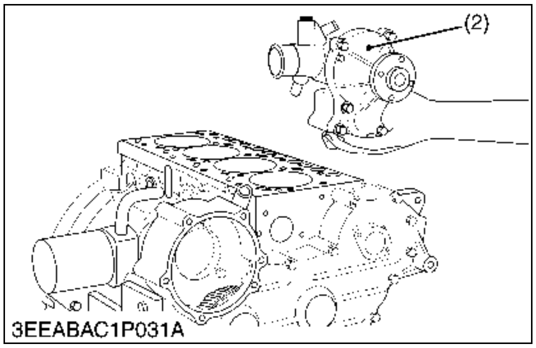
Tightening torque	Crankshaft screw	255.0 to 274.6 N·m 26.0 to 28.0 kgf·m 188.1 to 202.5 ft-lbs

(1) Fan Drive Pulley
(2) Crankshaft Screw

W1185033

(6) Water Pump and Oil Cooler





Water Pump

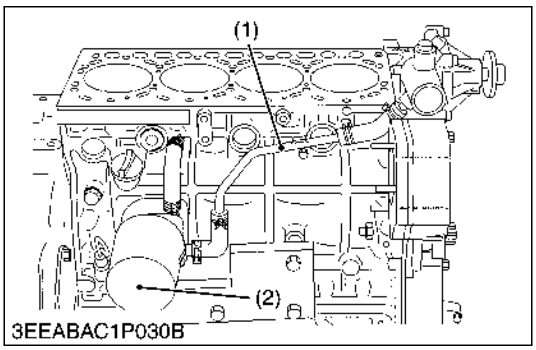
1. Remove the pipe band and the water pipe (1).
2. Remove the water pump (2).

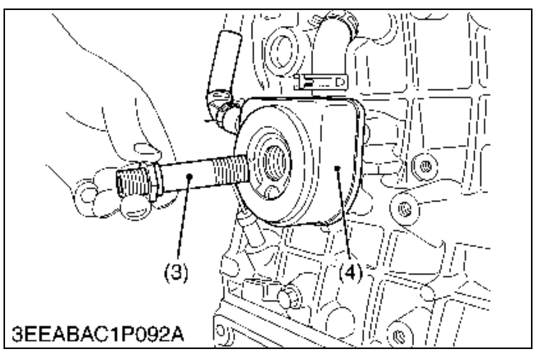
(When reassembling)

- When mounting the water pump, take care not to forget mounting the O-ring and not to let it out of position.

(1) Water Pipe
(2) Water Pump

W1187742





Oil Cooler

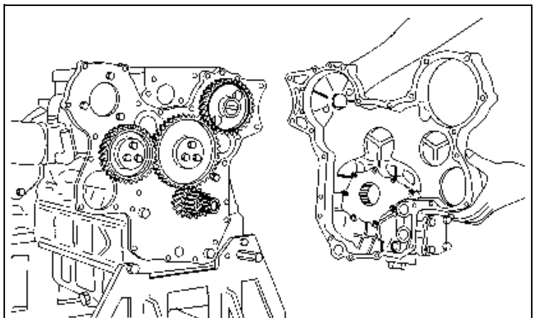
1. Remove the water pipe (1).
2. Remove the oil filter cartridge (2) and the oil cooler joint screw (3).
3. Remove the oil cooler (4).

Tightening torque	Oil cooler joint screw	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft-lbs

(1) Water Pipe
(2) Oil Filter Cartridge
(3) Oil Cooler Joint Screw
(4) Oil Cooler

W1032266

(7) Gear Case and Timing Gears



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Gear Case Cover

1. Remove the gear case cover.

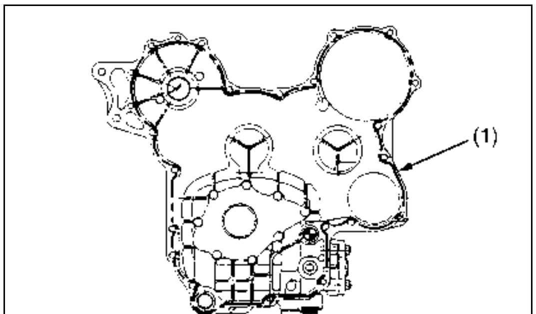
(When reassembling)

- Confirm that the liquid gasket coating surface is free of water, dust and oil in order to maintain sealing effect.
- Carefully apply the adhesive evenly. (Refer to the figure on the left.)

■ **NOTE**

- **When mounting the adhesive-applied parts, take care to fit them to the mating parts.**
- **Assemble the adhesive-applied parts within ten minutes.**
- **Apply a liquid gasket (Three Bond 1217D) to the gear case cover.**

Tightening torque	Gear case cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs



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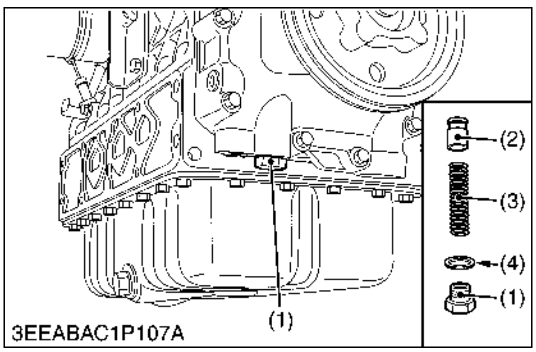
(1) Liquid Gasket

W1189218

Relief Valve

1. Remove the relief valve retaining screw (1).
2. Remove the relief valve (2), the spring (3) and the packing (4).

Tightening torque	Relief valve retaining screw	68.6 to 78.4 N·m 7.0 to 8.0 kgf·m 50.6 to 57.9 ft-lbs



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(1) Relief Valve Retaining Screw
(2) Relief Valve
(3) Spring
(4) Packing

W1081251

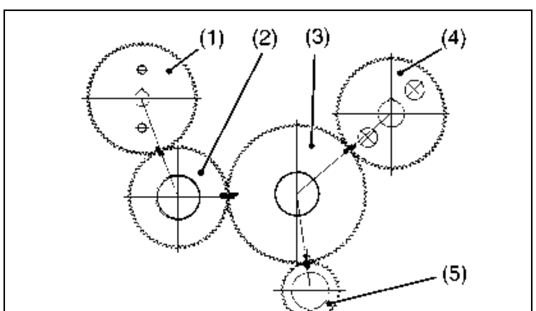
Idle Gear and Camshaft

1. Remove three set screws of the idle gear and draw out the idle gear 1, 2.
2. Remove two set screws of the camshaft stopper and draw out the camshaft.

(When reassembling)

- Set the crankshaft at the top dead center of No. 1 and 4 cylinder and the camshaft key to the top position and align the marks of idle gear 1 (3) and idle gear 2 (2) to assemble them. (Refer to the figure on the left.)
- Mount the injection pump gear (1) after installing the gear case.

Tightening torque	Camshaft set screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Idle gear mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs



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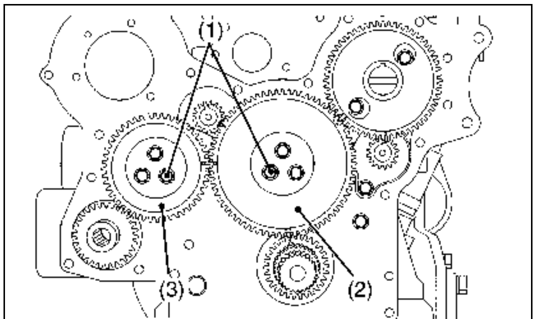
(1) Injection Pump Gear
(2) Idle Gear 2
(3) Idle Gear 1
(4) Cam Gear
(5) Crank Gear

W1189797



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Idle Gear 1 and Idle Gear 2 (for Balancer Model)

1. Remove the idle gear mounting screw (1).
2. Draw out the idle gear (2) and (3).

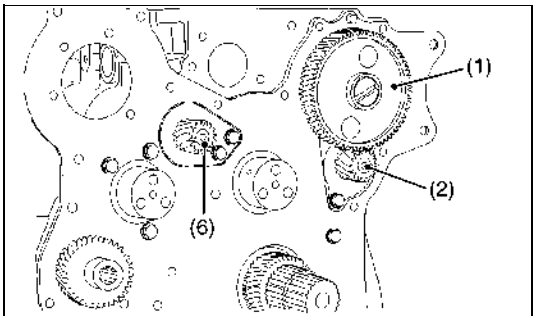
(When reassembling)

- When install the idle gear (2) and (3), be sure to place the 4th cylinder piston at the top dead center in compressio then, align all mating marks on each gear to assemble the timing gears, set the idle gear last.

Tightening torque	Idle gear mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

(1) Idle Gear Mounting Screw
(2) Idle Gear 1
(3) Idle Gear 2

W1032991



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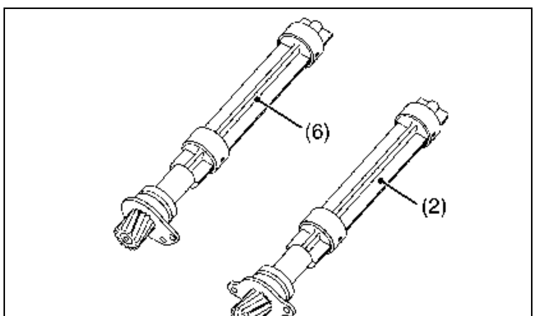

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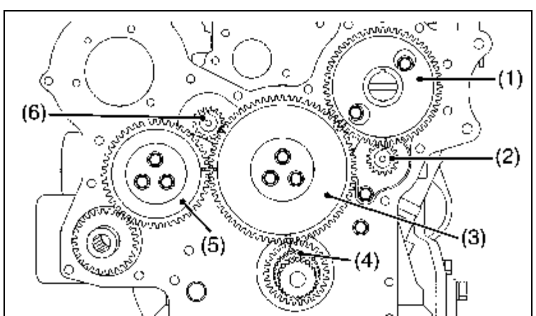

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Camshaft and Balancer Shaft (for Balancer Model)

1. Remove the camshaft set screws and draw out the camshaft (1).
2. Remove the balancer shaft 1 set screws and draw out the balancer shaft 1 (2).
3. Remove the balancer shaft 2 set screws and draw out the balancer shaft 2 (6).

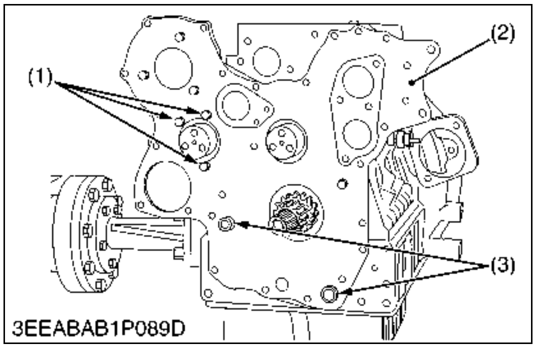
(When reassembling)

- When install the balancer shaft 1 and 2, be sure to place the 4th cylinders piston at the top dead center in compression then, align all mating marks on each gear to assemble the timing gears, set the idle gear last.

Tightening torque	Camshaft set screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Balancer shaft set screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

(1) Camshaft
(2) Balancer Shaft 1
(3) Idle Gear 1
(4) Crank Gear
(5) Idle Gear 2
(6) Balancer Shaft 2

W1191037



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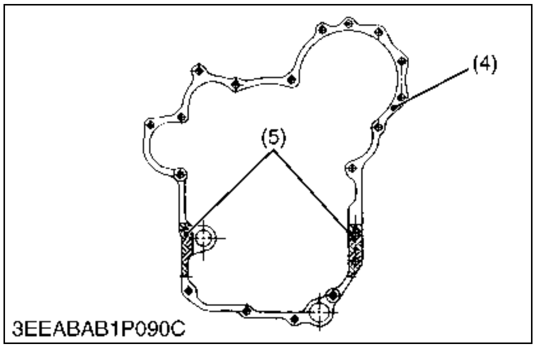

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Plate (Gear Case)

1. Remove the three plate mounting screws(1). Detach the plate (2).

(When reassembling)

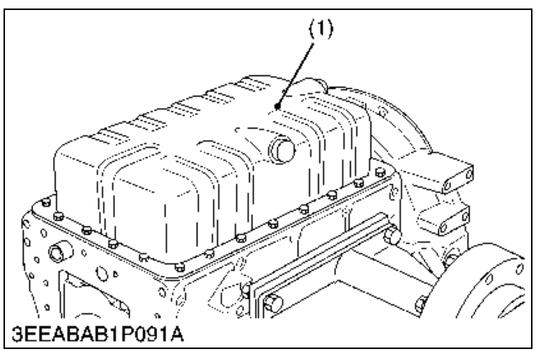
- Apply Three Bond 1217D adhesive or equivalent over the shaded zones on both sides of the gasket that will be sandwiched between the crankcase and plate.
- Be sure to fix the O-rings (3).

Tightening torque	Plate mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

(1) Plate Mounting Screw
(2) Plate
(3) O-ring
(4) Gasket
(5) Liquid Gasket

W1057656

(8) Piston and Connecting Rod



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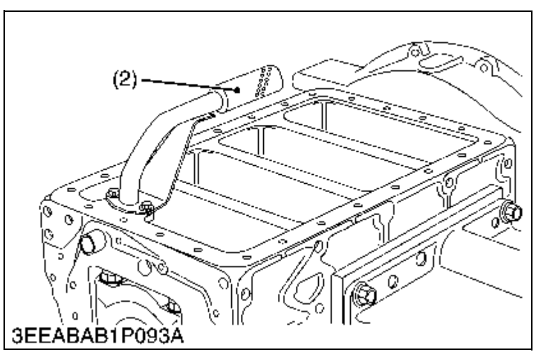

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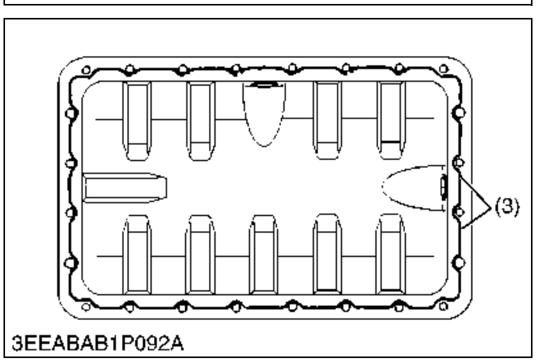

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Oil Pan and Oil Strainer

1. Unscrew the oil pan mounting screws and remove the oil pan (1).
2. Unscrew the oil strainer mounting screw, and remove the oil strainer (2).

(When reassembling)

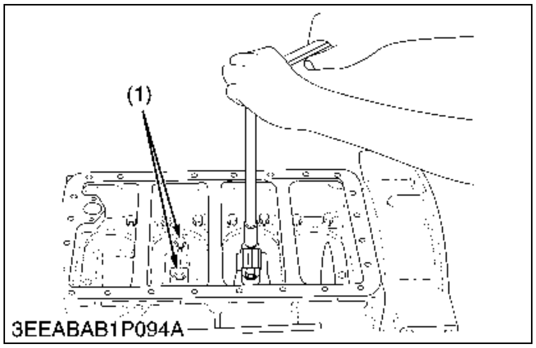
- Install the oil strainer, using care not to damage the O-ring.
- Apply liquid gasket (Three Bond 1217D) to the oil pan as shown in the figure.
- Confirm that the liquid gasket coating surface is free of water, dust and oil in order to maintain sealing effect.
- Carefully apply the adhesive evenly.

■ **NOTE**

- **When mounting the adhesive-applied parts, take care to fit them to the mating parts.**
- **Assemble the adhesive-applied parts within ten minutes.**
- **To avoid uneven tightening, tighten mounting screws in diagonal order from the center.**
- **After cleaning the oil strainer, install it.**
- **Attach the oil pan with its central drain plug facing toward the air suction side.**

(1) Oil Pan
(2) Oil Strainer
(3) Liquid Gasket

W1057949



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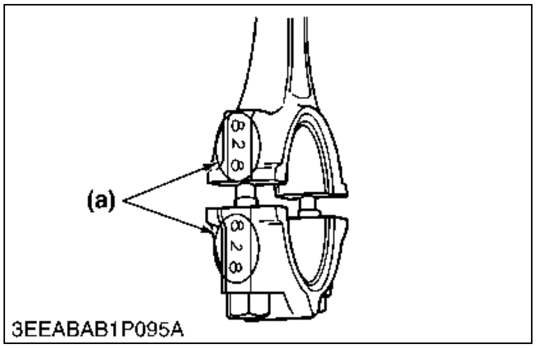

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Connecting Rod Cap

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

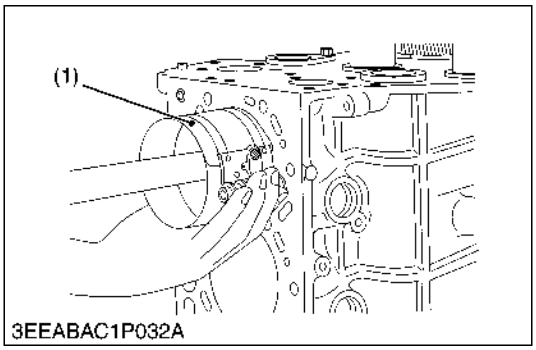
(When reassembling)

- 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.
- When using the existing crank pin metal again, put tally marks on the crank pin metal and the connecting rod in order to keep their positioning.
- Fit the crank pin metal in place : its centrally groove side toward the connecting rod, and the non-grooved side toward the cap.

Tightening torque	Connecting rod screw	78.5 to 83.4 N·m 8.0 to 8.5 kgf·m 57.9 to 61.5 ft-lbs

(1) Connecting Rod Screw
(a) Mark

W1058252



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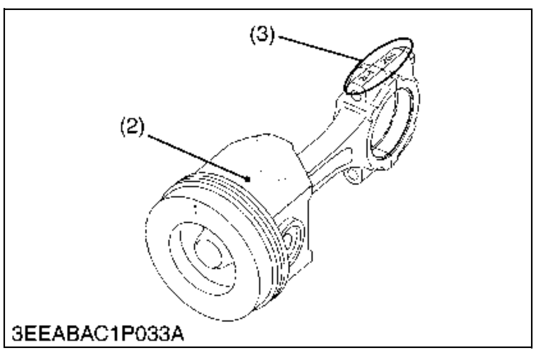

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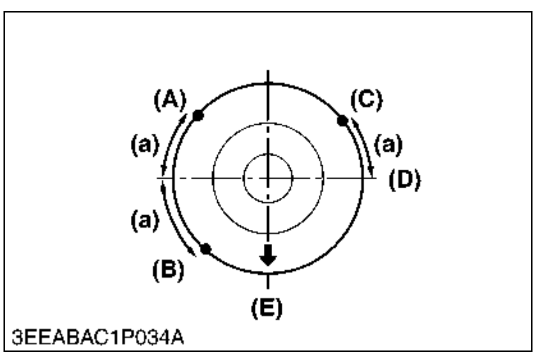

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Piston

1. Completely clean carbon in the cylinders.
2. Turn the flywheel and set a piston to the top dead center.
3. Pull out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.

(When reassembling)

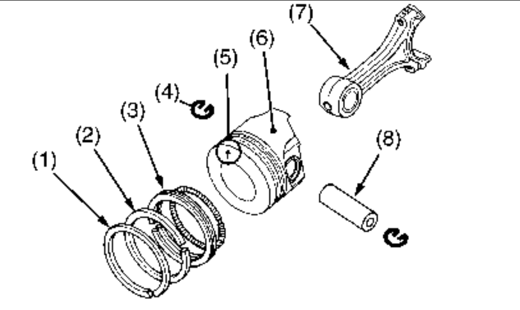
- Before inserting the piston into the cylinder, apply enough engine oil to the cylinder.
- When inserting the piston into the cylinder, face the mark (3) on the connecting rod to the injection pump.

■ 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 position.**
- **When inserting the piston into the cylinder, place the gap of each pison ring like the figure.**
- **Carefully insert the pistons using a piston ring compressor (1). Otherwise, their chrome-plated section of piston rings may be scratched, causing trouble inside the liner.**
- **When inserting the piston in place, be careful not to get the molybdenum disulfide coating torn off its skirt. This coating is useful in minimizing the clearance with the cylinder liner. Just after the piston pin has been press-fitted, in particular, the piston is still hot and the coating is easy to peel off. Wait until the piston cools down.**

(1) Piston Ring Compressor
(2) Molybdenum Disulfide Coating in piston skirt
(3) Mark
(a) 0.79 rad (45 <Symbol>×)
(A) Top Ring Gap
(B) Second Ring Gap
(C) Oil Ring Gap
(D) Piston Pin Hole
(E) Injection Pump Side

W1058433



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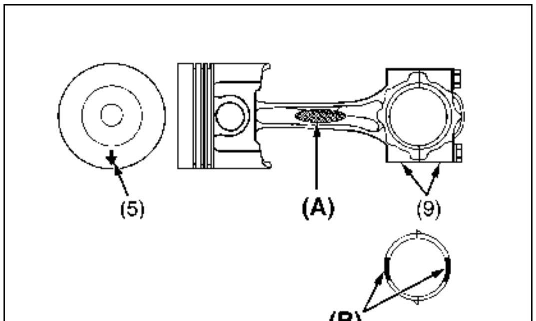

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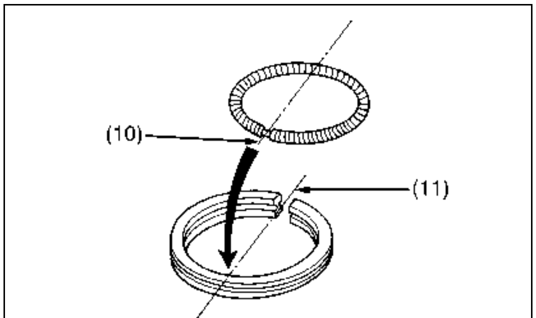

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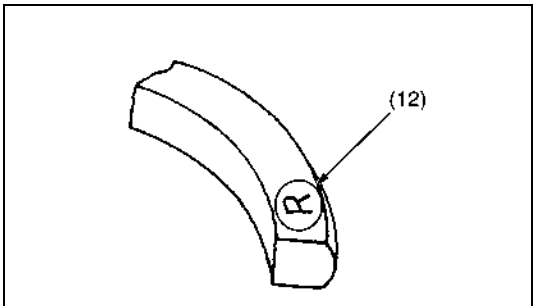

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Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Remove the piston pin (8), and separate the connecting rod (7) from the piston (6).

(When reassembling)

- Be sure to fix the crankpin bearing and the connecting rod are same I.D. colors.
- When installing the ring, assemble the rings so that the manufacture'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 <Symbol>×C (176 <Symbol>×F) oil for 10 to 15 minutes and insert the piston pin to the piston.
- Assemble the piston to the connecting rod with the <Symbol>¦ mark (5) and the connecting rod numbering mark (9) facing same side.
- The end faces of the oil ring are plated with hard chrome. In putting the piston into the cylinder, be careful not to get the oil ring scratched by the cylinder. Use the piston ring fitter to tighten up the oil ring. If the ring's planting is scratched, it may get stuck on the cylinder wall, causing a serious trouble.

■ IMPORTANT

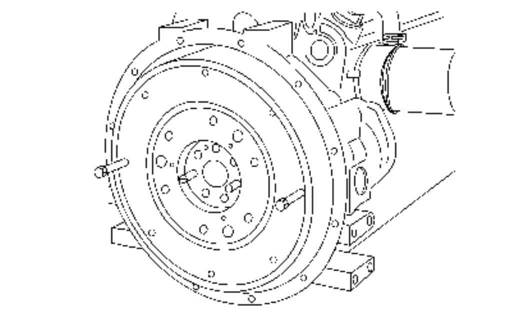
- **Mark the same number on the connecting rod and the piston so as not to change the combination.**

(1) Top Ring
(2) Second Ring
(3) Oil Ring
(4) Piston Pin Snap Pin
(5) Mark (<Symbol>¦)
(6) Piston
(7) Connecting Rod
(8) Piston Pin
(9) Numbering Mark
(10) Expander Joint
(11) Oil Ring Gap
(12) Manufacture's Mark

(A) Connecting Rod ID Color : Blue or without Color
(B) Crankpin Bearing ID Color : Blue or without Color

W1059589

(9) Flywheel and Crankshaft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Flywheel

1. Install the stopper to the flywheel so that the flywheel does not turn.

- **NOTE**
- **Do not use an impact wrench. Serious damage will occur.**

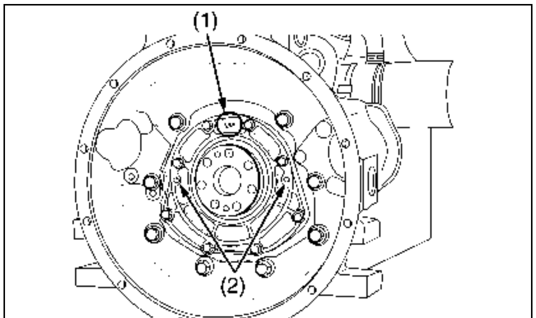
2. Detach the flywheel screws.
3. Remove the flywheel.

(When reassembling)

- Apply engine oil to the flywheel screws.
- Before fitting the flywheel and the crankshaft together, wipe oil, dust and other foreign substances off their mating faces.
- The flywheel and the crankshaft are fitting together in just one position. Make sure they are tightly fit and drive the bolts.

Tightening torque	Flywheel screw	98.1 to 107.9 N·m 10.0 to 11.0 kgf·m 72.3 to 79.6 ft-lbs

W1060354



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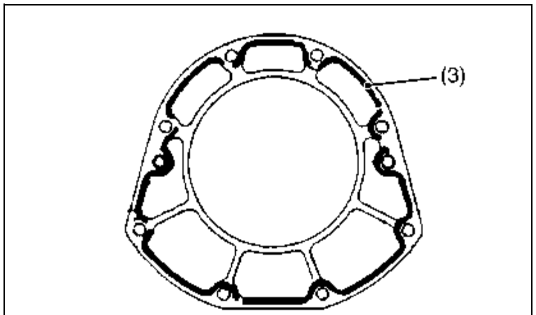

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Bearing Case Cover

■ **NOTE**

- **Before disassembling, check the side clearance of crankshaft. Also check it during reassembly.**

1. Remove the bearing case over mounting screws.
2. Screw two removed screws into the screw hole (2) of bearing case cover to remove it.

(When reassembling)

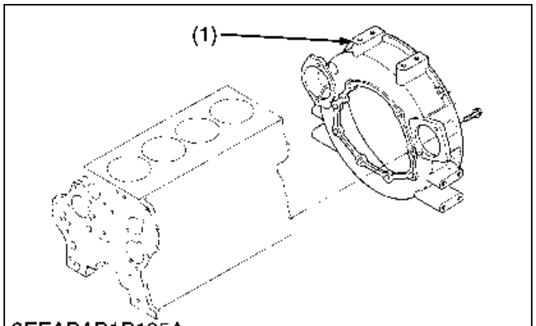
■ **IMPORTANT**

- **In case of replacing the oil seal, use caution when installing the seal in the bearing case cover as not to install it tilted. The seal should be flush with the cover.**
- **Confirm that the liquid gasket coating surface is free of water, dust and oil in order to maintain sealing effect.**
- **Apply liquid gasket (Three Bond 1217D) to the bearing case cover as shown in the figure.**
- **Before installing the bearing case cover / oil seal assembly, lube the seal tna be careful not to damage the seal while installing the assembly.**
  Install the bearing case cover / oil seal assembly to position the casting mark "UP" on it upward.
- **Tighten the bearing case cover mounting screws with even force on the diagonal line.**
- **When mounting the adhesive-applied parts, take care to fit them to the mating parts.**
- **Assemble the adhesive-applied parts within ten minutes.**

Tightening torque	Bearing case cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

(1) Top Mark **"UP"**
(2) Screw Hole
(3) Liquid Gasket

W1060482



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Flywheel Housing

1. Remove the flywheel housing.

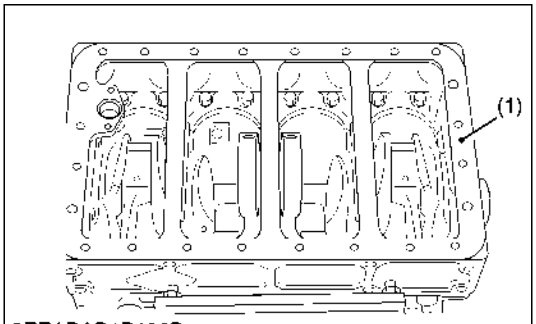
(When reassembling)

- Tighten the flywheel housing mounting screws with even force on the diagonal line.
- Make sure the crank cases 1 and 2 are clean. Install them in position, referring to the flywheel housing's contoured face.

Tightening torque	Flywheel housing mounting screw	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs

(1) Flywheel Housing

W1060705



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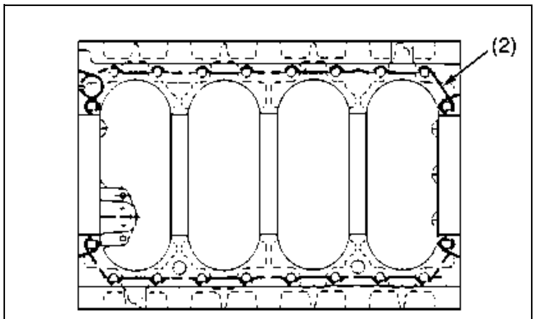

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Crankcase 2

1. Remove the crankcase 2 (1).

(When reassembling)

■ **IMPORTANT**

- **Make sure the crankcase 1 and 2 are clean.**
- **Apply liquid gasket (Three Bond 1217D) to the crankcase 2 as shown in the figure.**
- **Tighten the crankcase 2 mounting screws with even force on the diagonal line.**
- **Confirm that the liquid gasket coating surface is free of water, dust and oil in order to maintain sealing effect.**
- **Carefully apply the adhesive evenly.**

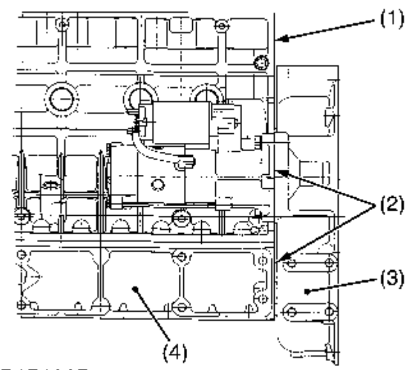
■ **NOTE**

- **When mounting the adhesive-applied parts, take care to fit them to the mating parts.**
- **Assemble the adhesive-applied parts within ten minutes.**

Tightening torque	Crankcase 2 mounting screw	49.0 to 55.9 N·m 5.0 to 5.7 kgf·m 36.2 to 41.2 ft-lbs

(1) Crankcase 2 (2) Liquid Gasket

W1060825



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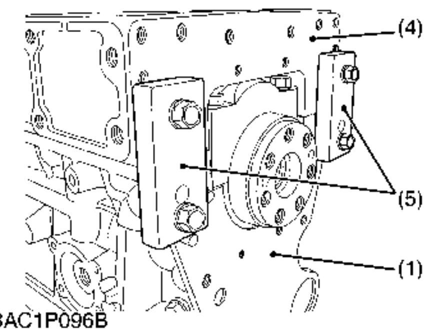

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Crankcase 1 and Crankcase 2

(When reassembling)

- Match the crankcase 1 and 2, referring to the flywheel housing's contoured face.
- Tighten the crankcase 2 mounting screws loosely.
- Tighten up the jig to the specified torque same as the flywheel housing screw. This helps to minimize the level difference between the crankcase 1 and the crankcase 2 (at the flywheel side). Possible gap must be 0.05 mm (0.0020 in.) or smaller.

Tightening torque	Crankcase 2 mounting screw	49.0 to 55.9 N·m 5.0 to 5.7 kgf·m 36.2 to 41.2 ft-lbs
	Flywheel housing mounting screw	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs

(1) Crankcase 1
(2) Gap to be smaller than 0.05 mm (0.0020 in.)
(3) Flywheel Housing
(4) Crankcase 2
(5) Jig

W1111351

Crankshaft

1. Remove the main bearing case.
2. Remove the crankshaft.

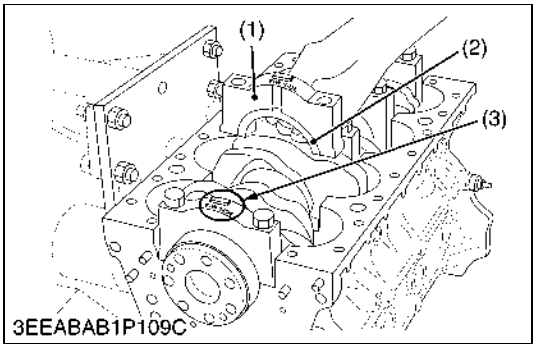
(When reassembling)

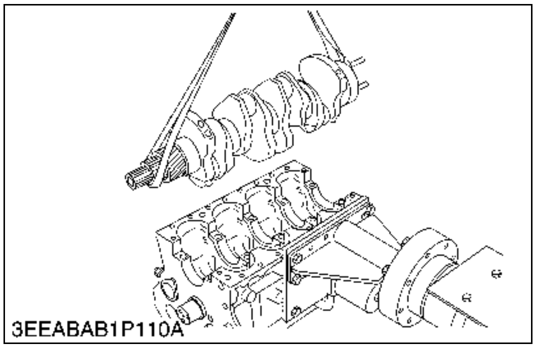
- Reassemble the main bearing case having the same number as the one engraved on the crankcase, and set the casting mark “F / W SIDE” on the main bearing case facing towards the flywheel side.
- Reassemble the thrust bearing (2), with the oil groove facing outside, into both side of the fourth main bearing case (1).
- Apply oil to the bearing case screws and tighten them to the specified torque.

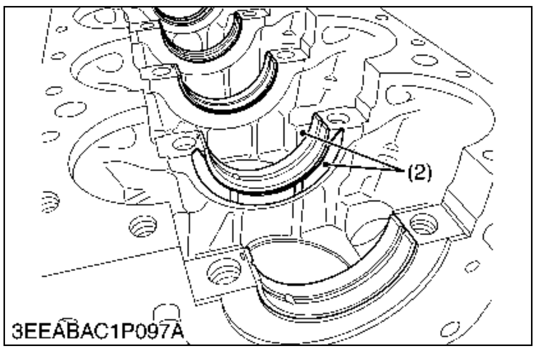
Tightening torque	Main bearing case screw	137.3 to 147.1 N·m 14.0 to 15.0 kgf·m 101.3 to 108.5 ft-lbs

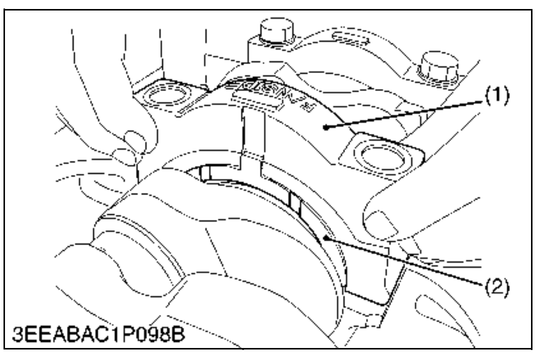
(1) 4th Main Bearing Case
(2) Thrust Bearing
(3) F / W SIDE Mark

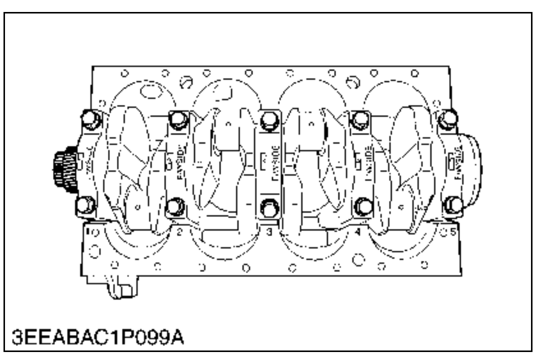
W1061157



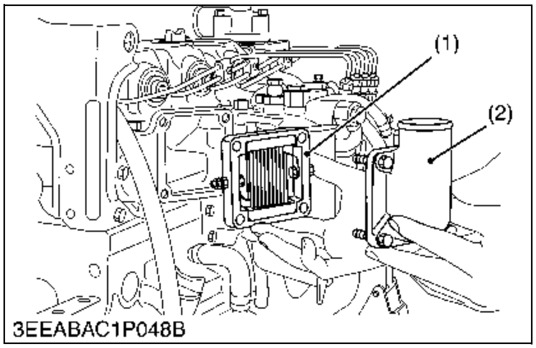








(10) Intake Air Heater



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Intake Air Heater

1. Remove the inlet hose.
2. Disconnect the lead.
3. Remove the flange and the intake air heater.

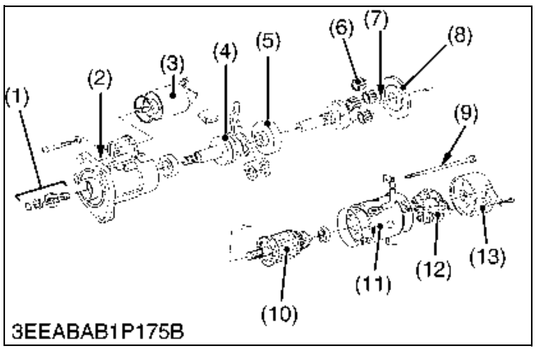
■ **NOTE**

- **When assembling the intake air heater at the side of intake manifold, assemble the intake air heater as the heater lines are vertical. Otherwise, it may be short-circuited.**

(1) Intake air heater (2) Flange

W1043265

(11) Starter



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Disassembling Motor

1. Disconnect the solenoid switch (3).
2. Remove the 2 through screws (9) and the 2 brush holder lock screws. Take out the rear end frame (13) and the brush holder (12).
3. Disconnect the armature (10) and the yoke (11). Remove also the ball (7) from the tip of the armature.
4. Remove the set of packings (8), the 4 planetary gears and another packing.
5. Take out the shaft assembly. Take note of the position of the lever.

■ **IMPORTANT**

- **Before disconnecting the yoke, put tally marks on the yoke and the front bracket.**
- **Take note of the positions of the set of packings and the setup bolt.**
- **Apply grease to the gears, bearings, shaft's sliding part and ball.**

■ **NOTE**

- **Do not damage to the brush and commutator.**

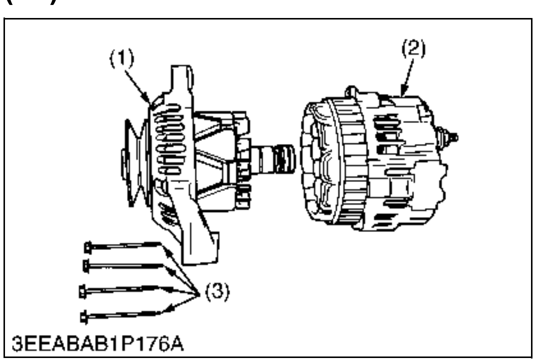
(When reassembling)

- Apply grease (DENSO CO. No.50 or equivalent) to the parts indicated in the figure.

(1) Gear
(2) Front Bracket
(3) Solenoid Switch
(4) Overrunning Clutch
(5) Internal Gear
(6) Planetary Gear
(7) Ball
(8) Set of Packings
(9) Through Bolt
(10) Armature
(11) Yoke
(12) Brush Holder
(13) Rear End Frame

W1074237

(12) Alternator



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Front Bracket

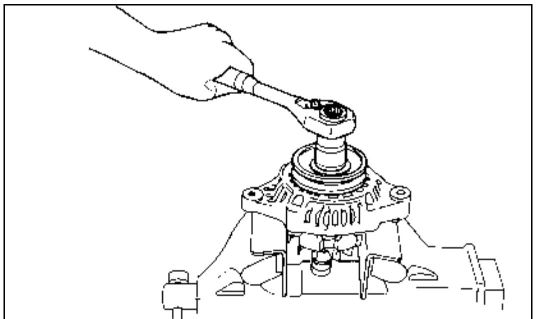
1. Remove the 4 screws (3).
2. Separate the front bracket (1) and the rear bracket (2) from each other.

■ **IMPORTANT**

- **Put a tally line on the front bracket and the rear bracket for reassembling them later.**

(1) Front Bracket (3) Screw
(2) Rear Bracket

W1074745



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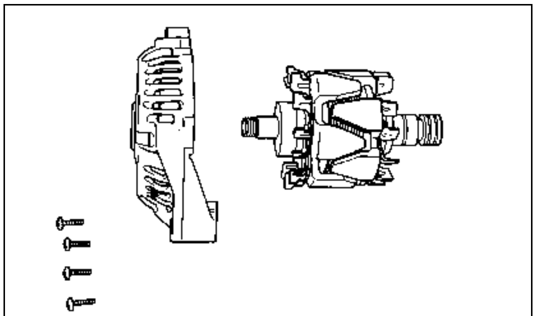
Pulley

1. Hold the rotor (base of the claw) in a vise. Loosen the lock nut using a M24 box wrench.

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

W1074849



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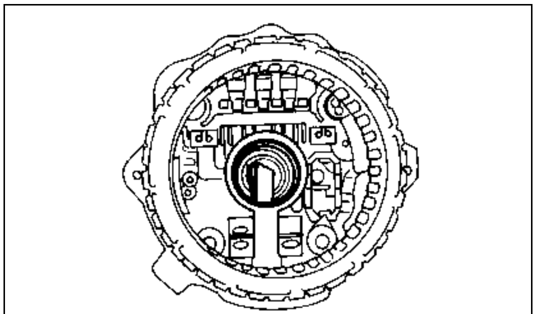
Rotor

1. Remove the 4 screws and detach the bearing retainer.
2. Temporarily install the nut on the pulley screw, and detach the rotor.

W1074920



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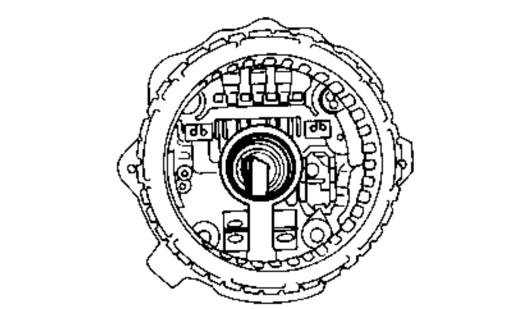
Brush

1. When the rotor is detached, the 2 brushes are found to stretch out of the shaft hole.

W1075045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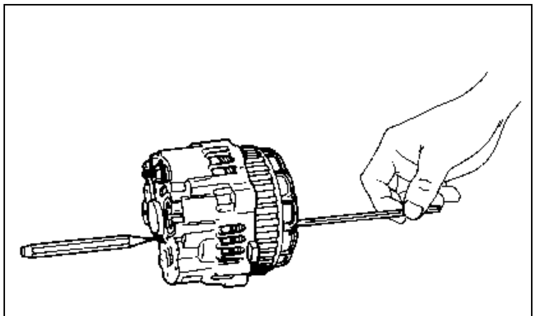
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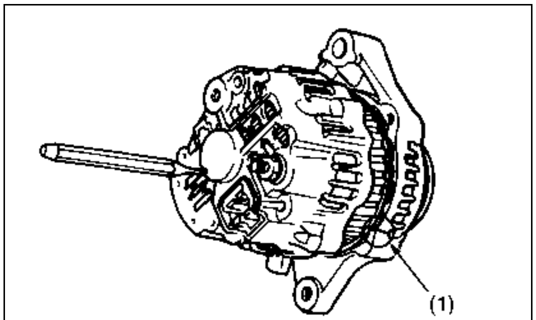

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Reassembling the Brush

1. Fit the brush with its sliding face in the clockwise direction when viewed from front.

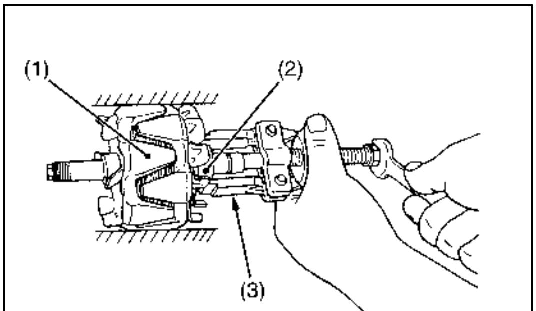
■ **IMPORTANT**

- **Be sure to keep the 2 brushes deep in the brush holder. Otherwise the rotor and the rear section can not be fitted into the position.**
- **Use a 4 mm hex. wrench to push the brushes into place.**
- **Using a pin-pointed (2 mm) punch, keep the brushes from popping out.**

2. Match the tally line of the front section with that of the rear section.
3. Tighten the 4 screws, and draw out the pin-pointed punch out of the brush holder.

(1) Marking

W1075117



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Bearing at Slip Ring Side

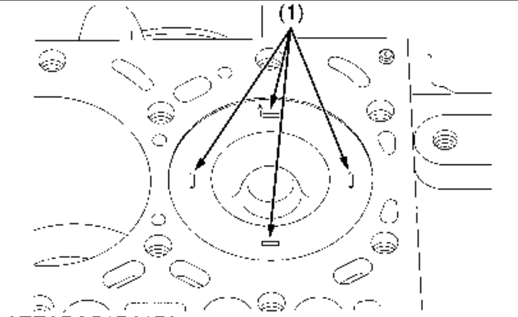
1. Lightly secure the rotor (1) with a vise to prevent damage, and remove the bearing (2) with a puller (3).

(1) Rotor
(2) Bearing
(3) Puller

W1019701

[3]SERVICING

(1) Cylinder Head



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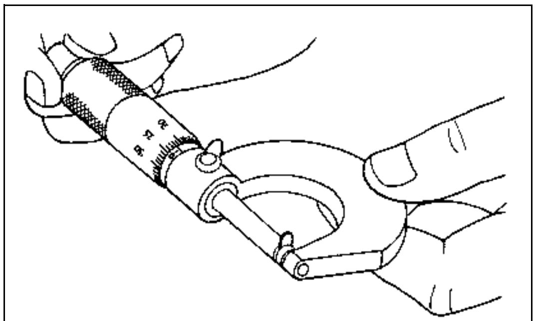

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Top Clearance

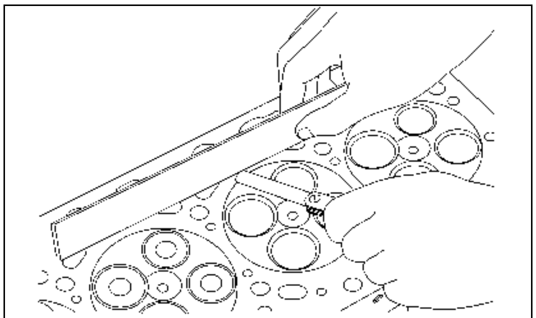
1. Remove the cylinder head (remove the cylinder head gasket completely).
2. Bring the piston to its top dead center fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the intake and exhaust valves and the combustion chamber ports.
3. Bring the piston to its middle position, install the cylinder head, and tighten the cylinder head screws 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.	0.72 to 0.90 mm 0.0283 to 0.0354 in.

Tightening torque	Cylinder head mounting screw	98.1 to 107.9 N·m 10.0 to 11.0 kgf·m 72.3 to 79.6 ft-lbs

(1) Fuse

W1049122



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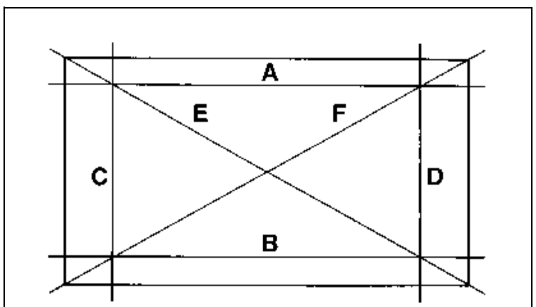

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Cylinder Head Surface Flatness

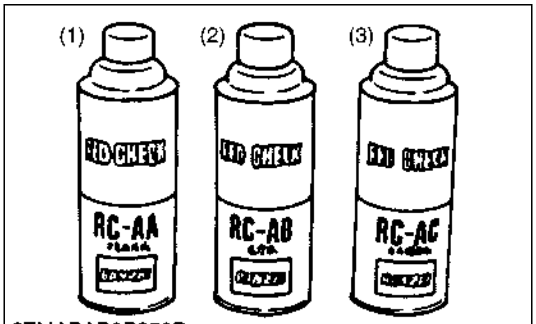
1. Clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides (**A**), (**B**), (**C**) and (**D**) and two diagonal (**E**) and (**F**) as shown in the figure. Measure the clearance with a feeler gauge.
3. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ **IMPORTANT**

- **Be sure to check the valve recessing after correcting.**

Cylinder head surface flatness	Allowable limit	0.05 mm 0.0020 in.

W1061323



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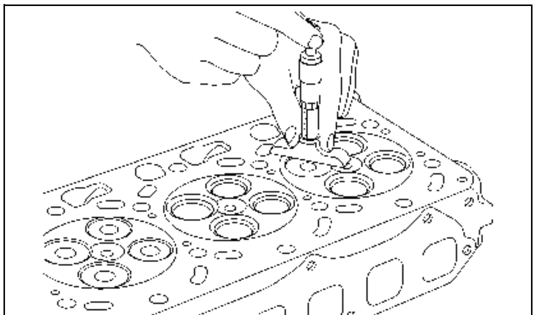
Cylinder Head Flaw

1. Prepare an air spray red check.
2. Clean the surface of the cylinder head with the 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 the white developer (3).
6. If flawed, it can be identified as red marks.

(1) Red Permeative Liquid
(2) Detergent
(3) White Developer

W1076542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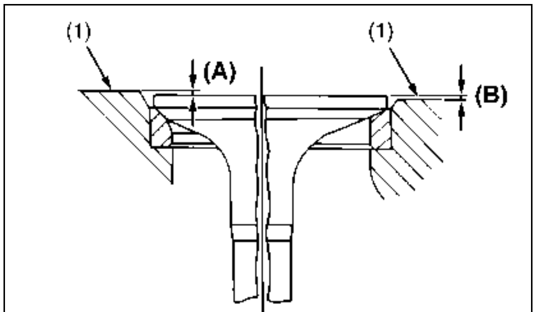

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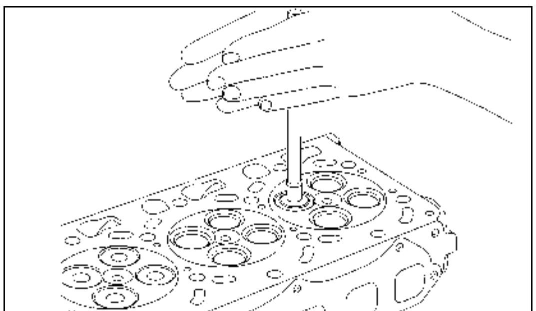
Valve Recessing

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, replace the cylinder head.

Valve recessing	Factory spec.	Intake valve	(recessing) 0.6 to 0.8 mm 0.0236 to 0.0315 in.
		Exhaust valve	(recessing) 0.85 to 1.05 mm 0.0335 to 0.0413 in.
	Allowable limit	(recessing) 1.2 mm 0.0472 in.	

(1) Cylinder Head Surface
(A) Recessing
(B) Protrusion

W1061543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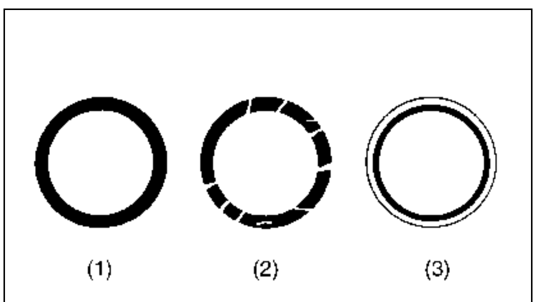

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Valve Lapping

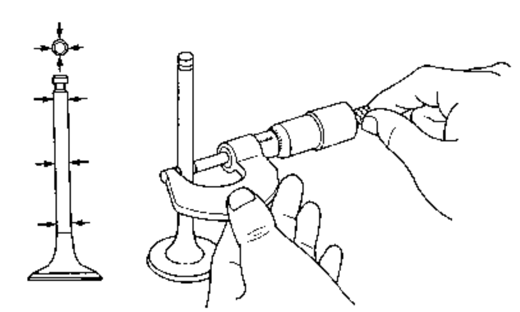
1. Apply compound evenly to the valve lapping surface.
2. Insert the valve into the valve guide. Lap the valve onto its seat with a valve flapper or screwdriver.
3. After lapping the valve, wash the compound away and apply oil, then repeat valve lapping with oil.
4. Apply prussian blue to the contact 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.**

(1) Correct
(2) Incorrect
(3) Incorrect

W1061709



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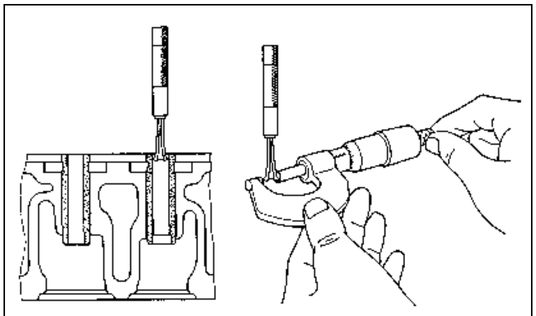

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Clearance between Valve Stem and Valve Guide

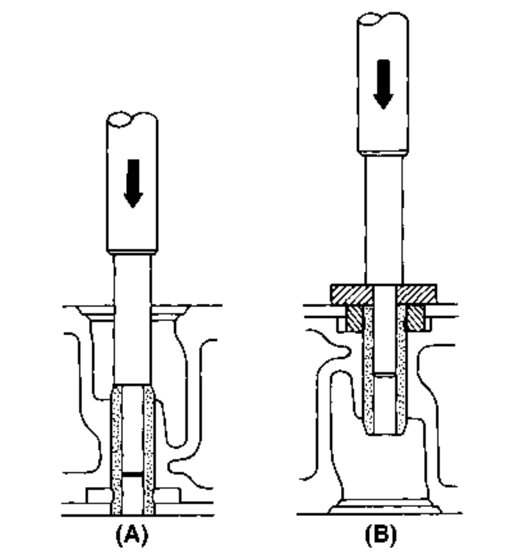
1. Remove carbon from the valve guide section.
2. Measure the valve stem O.D. with an outside micrometer.
3. Measure the valve guide I.D. of the cylinder head at the most wear part as shown in the figure below with a small hole gauge. And calculate the clearance.
4. If the clearance exceeds the allowable limit, replace the valves. If it still exceeds the allowable limit, replace the valve guide.

Clearance between valve stem and guide	Factory spec.	Intake valve	0.055 to 0.085 mm 0.0022 to 0.0033 in.
		Exhaust valve	0.055 to 0.085 mm 0.0022 to 0.0033 in.
	Allowable limit		0.1 mm 0.0039 in.

Valve stem O.D.	Factory spec.	Intake valve	6.960 to 6.975 mm 0.2740 to 0.2746 in.
		Exhaust valve	6.960 to 6.975 mm 0.2740 to 0.2746 in.

Valve guide I.D.	Factory spec.	Intake valve	7.030 to 7.045 mm 0.2768 to 0.2774 in.
		Exhaust valve	7.030 to 7.045 mm 0.2768 to 0.2774 in.

W1061883



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Replacing Valve Guide

(When removing)

1. Using a valve guide replacing tool, press out the used valve guide.

(When installing)

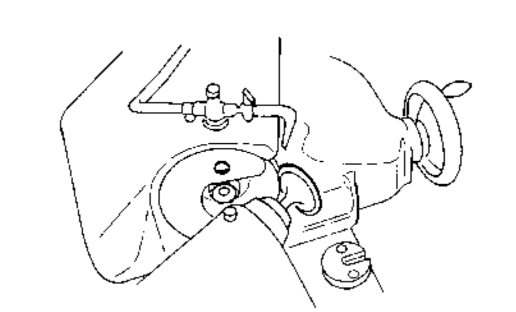
1. Clean a new valve guide, and apply engine oil to it.
2. Using a valve guide replacing tool, press in a new valve guide until it is flush with the cylinder head as shown in the figure.
3. Ream precisely the I.D. of the valve guide to the specified dimension.

■ **IMPORTANT**

- **Do not hit the valve guide with a hammer, etc. during replacement.**

(A) When Removing **(B) When Installing**

W1062212



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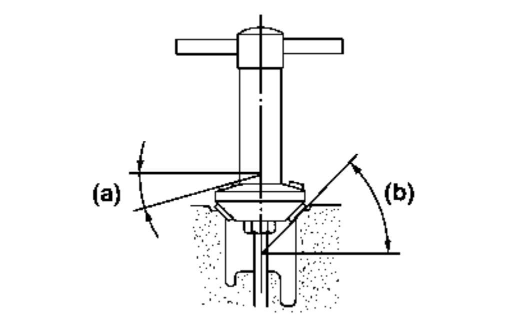

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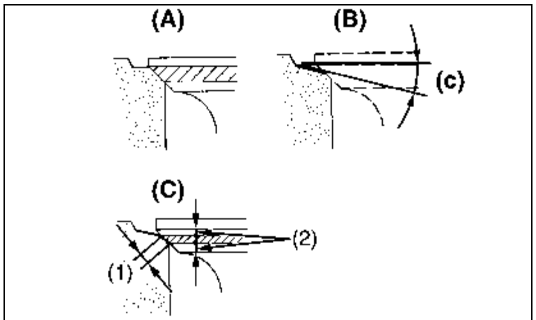

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Correcting Valve and Valve Seat

■ **NOTE**

- **Before correcting the valve and seat, check the valve stem and the I.D. of 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.

Valve face angle	Factory spec.	IN.	1.047 rad 60 °
		EX.	0.785 rad 45 °

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) valve seat cutter.
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.

Valve seat width	Factory spec.	IN.	1.6 to 2.0 mm 0.0630 to 0.0790 in.
		EX.	2.3 to 2.6 mm 0.0906 to 0.1024 in.

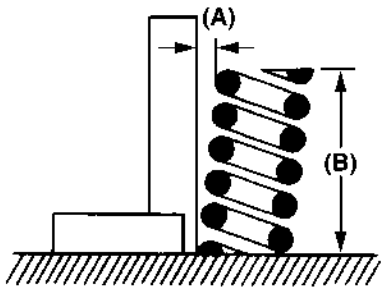
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.

Valve seat angle	Factory spec.	IN.	1.047 rad 60 °
		EX.	0.785 rad 45 °

(1) Valve Seat Width
(2) Identical Dimensions

(A) Check Contact
(B) Correct Seat Width
(C) Check Contact
(a) 0.262 rad (15 °) or 0.523 rad (30 °)
(b) 0.785 rad (45 °) or 1.047 rad (60 °)
(c) 0.523 rad (30 °) or 0.262 rad (15 °)

W10283500



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Free Length and Tilt of Valve Spring

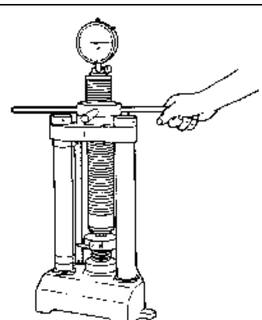
1. Measure the free length (**B**) with vernier calipers. If the measurement is less than the allowable limit, replace it.
2. Put the spring on a surface plate, place a square on the side of the spring, and check to see if the entire side is contact with the square. Rotate the spring and measure the maximum (**A**). If the measurement exceeds the allowable limit, replace.
3. Check the entire surface of the spring for scratches. Replace it, if any.

Tilt (**A**)	Allowable limit	1.0 mm 0.039 in.

Free length (**B**)	Factory spec.	Intake valve	35.1 to 35.6 mm 1.3819 to 1.4016 in.
		Exhaust valve	35.1 to 35.6 mm 1.3819 to 1.4016 in.
	Allowable limit	Intake valve	34.6 mm 1.3622 in.
		Exhaust valve	34.6 mm 1.3622 in.

(A) Tilt **(B) Free length**

W1063303



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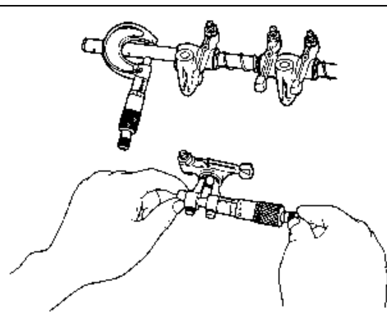
Valve Spring Setting Load

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.

Setting load / setting length	Factory spec.	Intake valve	63.547 N / 31.5 mm 6.48 kgf / 31.5 mm 14.256 lbs / 1.2401 in.
		Exhaust valve	63.547 N / 31.5 mm 6.48 kgf / 31.5 mm 14.256 lbs / 1.2401 in.
	Allowable limit	Intake valve	45.864 N / 31.5 mm 4.68 kgf / 31.5 mm 10.296 lbs / 1.2401 in.
		Exhaust valve	45.864 N / 31.5 mm 4.68 kgf / 31.5 mm 10.296 lbs / 1.2401 in.

W1063470



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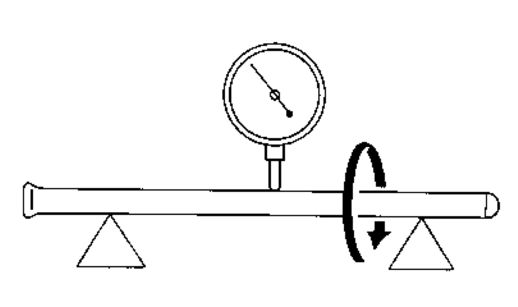
Oil Clearance between Rocker Arm Shaft and Bearing

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.

Oil clearance of rocker arm shaft and bearing	Factory spec.	0.016 to 0.045 mm 0.0006 to 0.0018 in.
	Allowable limit	0.15 mm 0.0059 in.

Rocker arm shaft O.D.	Factory spec.	15.973 to 15.984 mm 0.6289 to 0.6293 in.
Rocker arm I.D. for shaft	Factory spec.	16.000 to 16.018 mm 0.6299 to 0.6306 in.

W1063697



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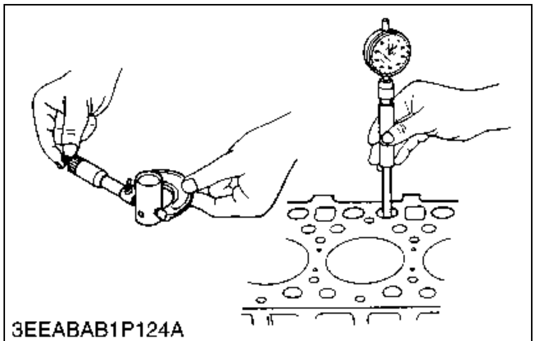
Push Rod Alignment

1. Place the push rod on V blocks.
2. Measure the push rod alignment.
3. If the measurement exceeds the allowable limit, replace the push rod.

Push rod alignment	Allowable limit	0.25 mm 0.0098 in.

W10292900



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Oil Clearance between Tappet and Tappet Guide Bore

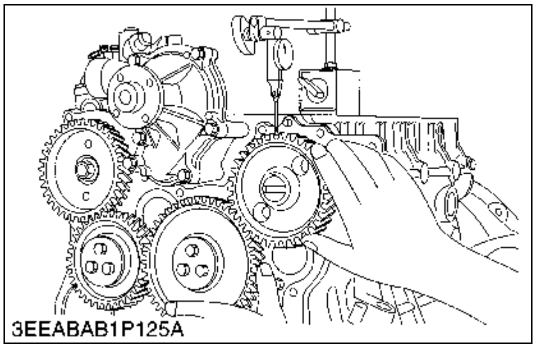
1. Measure the tappet O.D. with an outside micrometer.
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

Oil clearance between tappet and guide bore	Factory spec.	0.020 to 0.062 mm 0.0008 to 0.0024 in.
	Allowable limit	0.07 mm 0.0028 in.

Tappet O.D.	Factory spec.	23.959 to 23.980 mm 0.9433 to 0.9441 in.
Tappet guide bore I.D.	Factory spec.	24.000 to 24.021 mm 0.9449 to 0.9457 in.

W1063847

(2) Timing Gears



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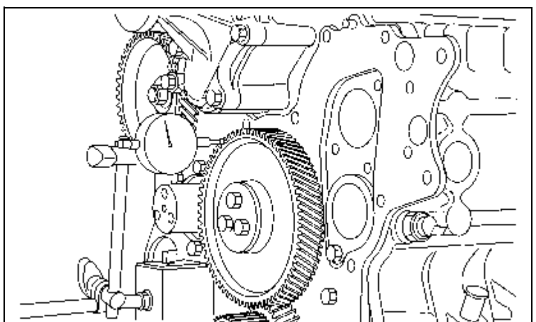
Timing Gear Backlash

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.

Backlash between crank gear and idle gear 1	Factory spec.	0.049 to 0.193 mm 0.0019 to 0.0076 in.
	Allowable limit	0.22 mm 0.0087 in.
Backlash between idle gear 1 and cam gear	Factory spec.	0.049 to 0.189 mm 0.0019 to 0.0074 in.
	Allowable limit	0.22 mm 0.0087 in.
Backlash between idle gear 1 and idle gear 2	Factory spec.	0.044 to 0.185 mm 0.0017 to 0.0073 in.
	Allowable limit	0.22 mm 0.0087 in.
Backlash between idle gear 2 and injection pump gear	Factory spec.	0.044 to 0.177 mm 0.0017 to 0.0070 in.
	Allowable limit	0.22 mm 0.0087 in.
Backlash between cam gear and balancer gear 1	Factory spec.	0.047 to 0.182 mm 0.0018 to 0.0072 in.
	Allowable limit	0.22 mm 0.0087 in.
Backlash between idle gear 1 and balancer gear 2	Factory spec.	0.044 to 0.183 mm 0.0017 to 0.0072 in.
	Allowable limit	0.22 mm 0.0087 in.

W1064048



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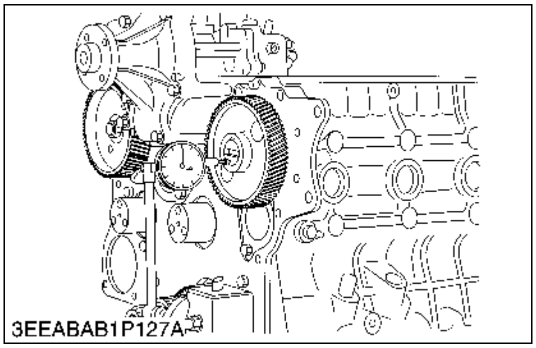
Idle Gear Side Clearance

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.

Idle gear side clearance	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.9 mm 0.0354 in.

W1064208



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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.

Side clearance	Factory spec.	0.07 to 0.22 mm 0.0028 to 0.0087 in.
	Allowable limit	0.30 mm 0.0118 in.

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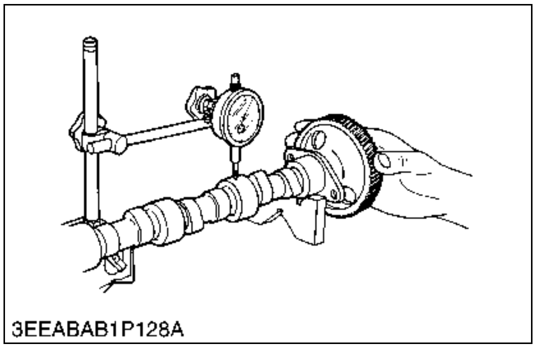

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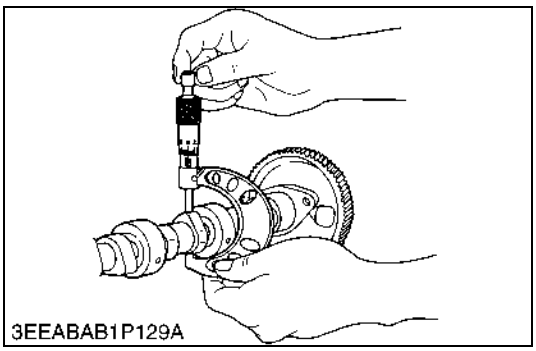
Camshaft Alignment

1. Support the camshaft with V block 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.

Camshaft alignment	Allowable limit	0.01 mm 0.00039 in.

W1064422



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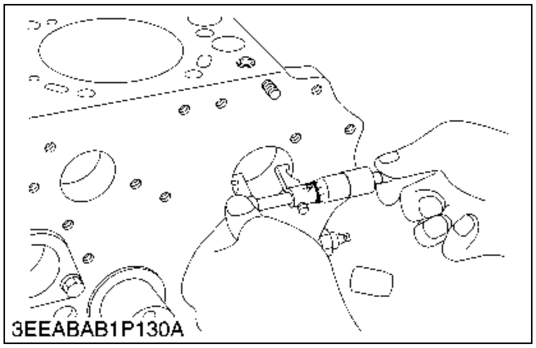
Cam Height

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.

Intake and exhaust cam height	Factory spec.	Intake valve	37.63 mm 1.4815 in.
		Exhaust valve	38.96 mm 1.5338 in.
	Allowable limit	Intake valve	37.13 mm 1.4618 in.
		Exhaust valve	38.46 mm 1.5141 in.

W1064551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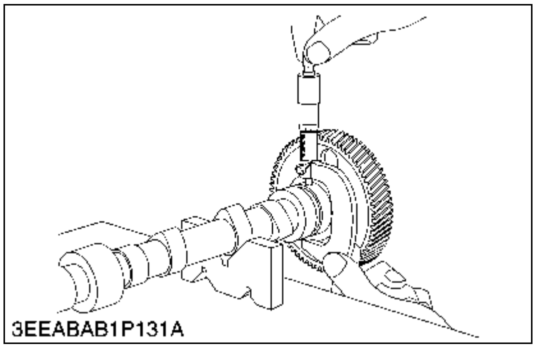
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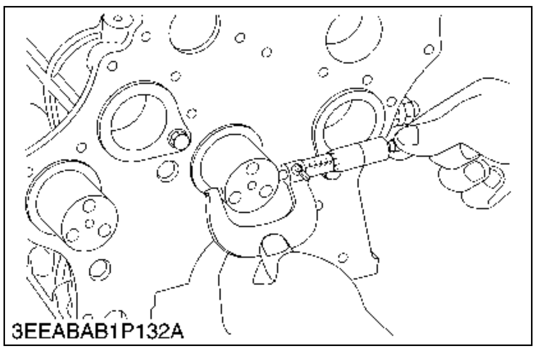
Oil Clearance of Camshaft Journal

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.
3. If the clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft journal	Factory spec.	0.050 to 0.091 mm 0.0020 to 0.0036 in.
	Allowable limit	0.15 mm 0.0059 in.

Camshaft journal O.D.	Factory spec.	45.934 to 45.950 mm 1.8084 to 1.8091 in.
Camshaft bearing I.D.	Factory spec.	46.000 to 46.025 mm 1.8110 to 1.8120 in.

W1064798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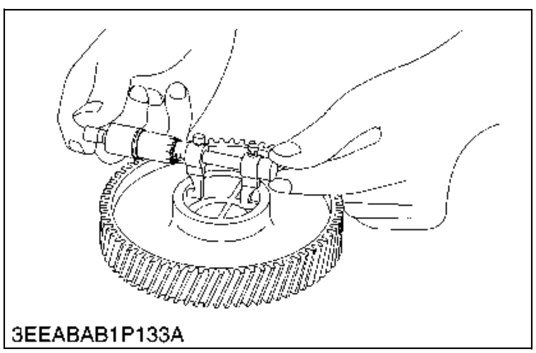
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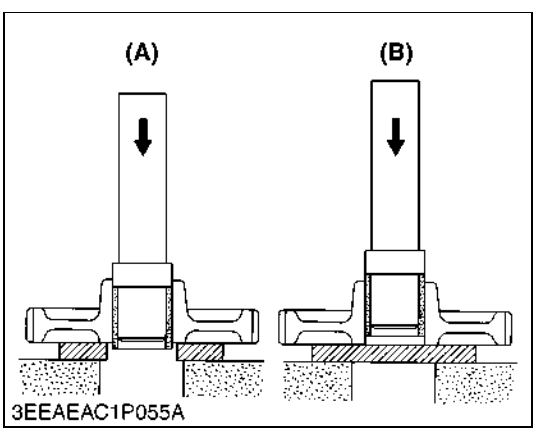
Oil Clearance between Idle Gear Shaft 1, 2 and Idle Gear 1, 2 Bushing

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.

Oil clearance between idle gear 1, 2 shaft and idle gear 1, 2 bushing	Factory spec.	0.050 to 0.091 mm 0.0020 to 0.0036 in.
	Allowable limit	0.10 mm 0.0039 in.

Idle gear 1, 2 bushing I.D.	Factory spec.	45.025 to 45.050 mm 1.7726 to 1.7736 in.
Idle gear 1, 2 shaft O.D.	Factory spec.	44.959 to 44.975 mm 1.7700 to 1.7707 in.

W1064968



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Replacing Idle Gear Bushing

(When removing)

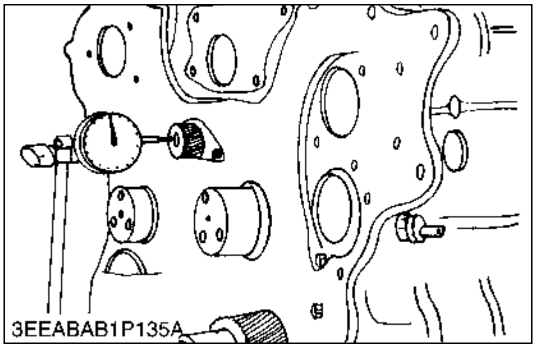
1. Using an idle gear bushing replacing tool, press out the used bushing.

(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.)

(A) When Removing **(B) When Installing**

W10302410

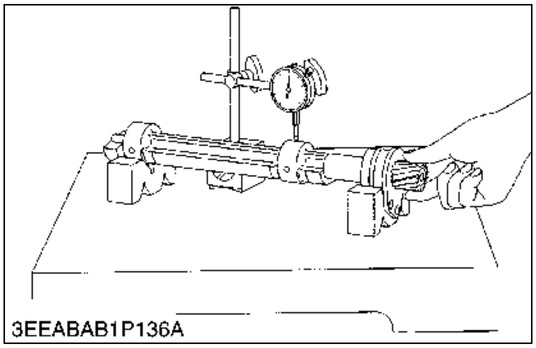


Balancer Shaft Side Clearance

1. Set a dial indicator with tip on the balancer shaft.
2. Measure the side clearance by moving the balancer shaft to the front and rear.
3. If the measurement exceeds the allowable limit, replace the balancer shaft.

Side clearance	Factory spec.	0.070 to 0.22 mm 0.0028 to 0.0087 in.
	Allowable limit	0.3 mm 0.0118 in.

W1065273

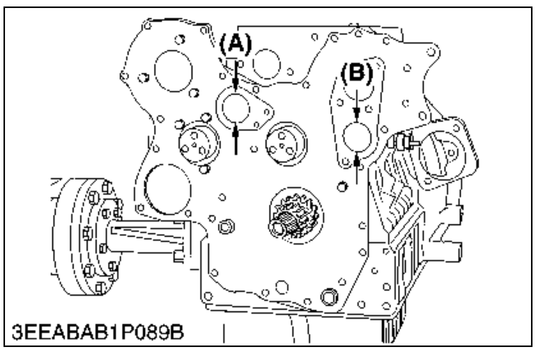


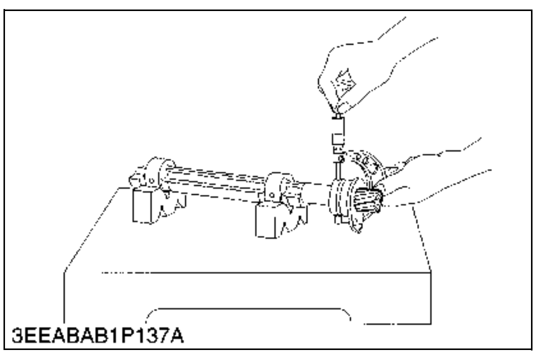
Balance Shaft Alignment

1. Support the balancer shaft with V blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at high angle.
2. Rotate the balancer shaft on the V block and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the balancer shaft.

Balancer shaft alignment	Allowable limit	0.02 mm 0.0008 in.

W1065448





Oil Clearance of Balancer Shaft Journal

1. Measure the balancer shaft journal O.D. with an outside micrometer.
2. Measure the cylinder block bore I.D. **(A)**, **(B)** for balancer shaft with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the balancer shaft.

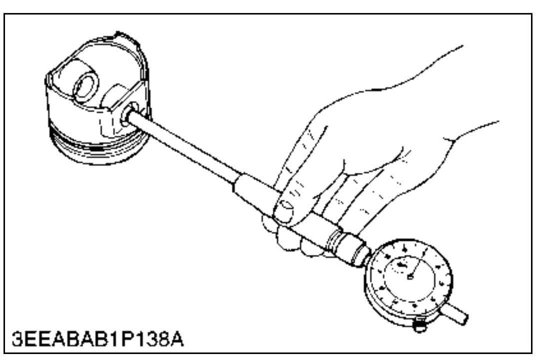
Oil clearance of balancer-shaft journal	Factory spec.	0.070 to 0.159 mm 0.0028 to 0.0063 in.
	Allowable limit	0.2 mm 0.0079 in.

Balancer-shaft journal O.D.	Factory spec.	50.92 to 50.94 mm 2.0047 to 2.0055 in.
Balancer-shaft bearing I.D. **(A), (B)**	Factory spec.	51.01 to 51.08 mm 2.0083 to 2.0110 in.

(A) Balancer-shaft Bearing I.D. **(B) Balancer-shaft Bearing I.D.**

W1065581

(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.

Piston pin bore I.D.	Factory spec.	30.000 to 30.013 mm 1.1811 to 1.1816 in.
	Allowable limit	30.05 mm 1.1831 in.

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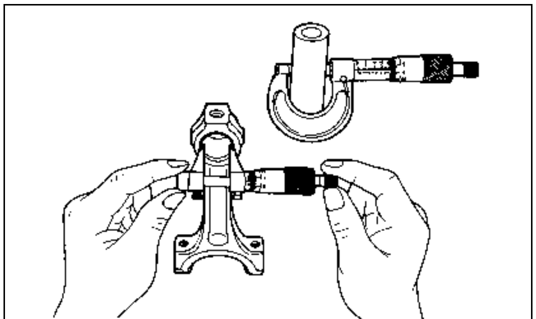

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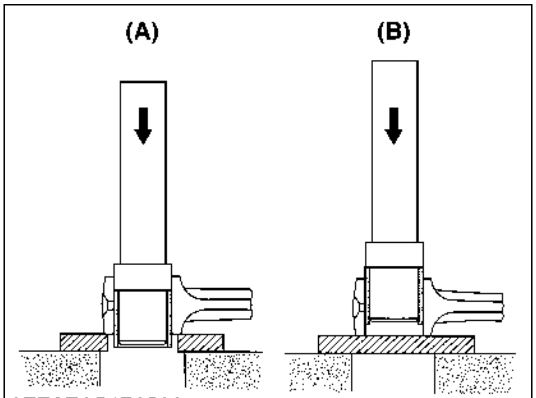
Oil Clearance between Piston Pin and Small End Bushing

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 cylinder 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.

Oil clearance between piston pin and small end bushing	Factory spec.	0.020 to 0.040 mm 0.0008 to 0.0016 in.
	Allowable limit	0.15 mm 0.0059 in.

Piston pin O.D.	Factory spec.	30.006 to 30.011 mm 1.1813 to 1.1815 in.
Small end bushing I.D.	Factory spec.	30.031 to 30.046 mm 1.1823 to 1.1829 in.

W1065897



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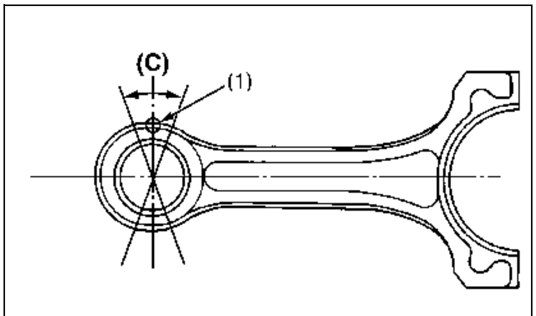

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Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool.

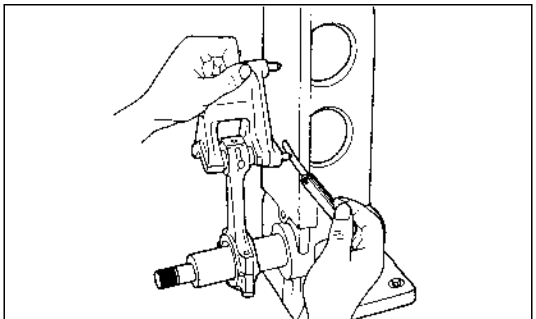
(When installing)

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 position as shown in the figure, until is flash with the connecting rod.

(1) Seam

(A) When Removing
(B) When Installing
(C) 0.26 rad (15 °)

W1066057



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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 piston pin from the piston.
2. Install the piston pin in the connecting rod.
3. Install the connecting rod on the connecting rod alignment tool.
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.

Connecting rod alignment	Allowable limit	0.05 mm 0.0020 in.

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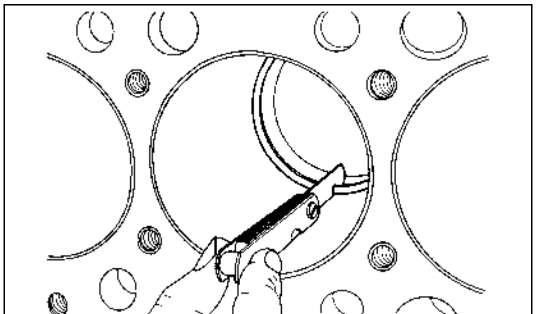

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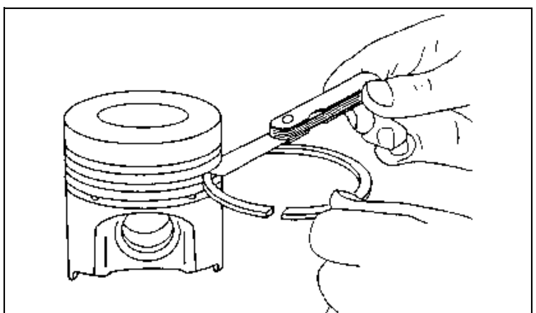
Piston Ring Gap

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.

Top ring and second ring	Factory spec.	0.30 to 0.45 mm 0.0118 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

Oil ring	Factory spec.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

W1066430



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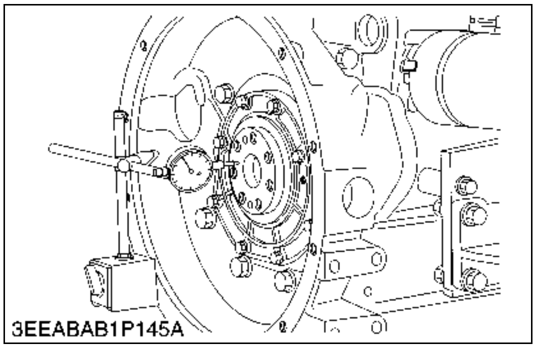
Clearance between Piston Ring and Groove

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, check the new ring since compression leak and oil shortage result.
4. If clearance still exceeds the allowable limit after replacing the ring, replace the piston.

Factory spec.	Top ring	0.05 to 0.09 mm 0.0020 to 0.0035 in.
	Second ring	0.093 to 0.120 mm 0.0037 to 0.0047 in.
	Oil ring	0.020 to 0.060 mm 0.0008 to 0.0023 in.
Allowable limit	Top ring	0.15 mm 0.0059 in.
	Second ring	0.20 mm 0.0079 in.
	Oil ring	0.15 mm 0.0059 in.

W1066183

(4) Crankshaft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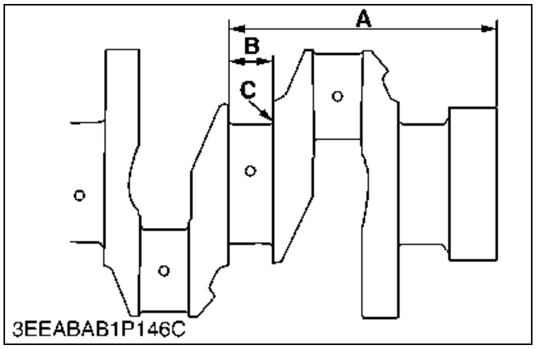

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Crankshaft Side Clearance

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.

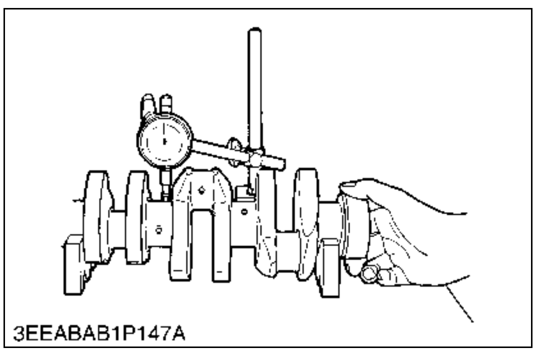
Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

- Oversize dimensions of crankshaft journal.

Oversize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **A**	169.1 to 169.15 mm 6.6575 to 6.6594 in.	169.2 to 169.25 mm 6.6614 to 6.6634 in.
Dimension **B**	29.20 to 29.25 mm 1.1496 to 1.1515 in.	29.40 to 29.45 mm 1.1574 to 1.1594 in.
Dimension **C**	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
(0.8S) The crankshaft journal must be fine-finished to higher than ▽▽▽▽.		

W1066738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Crankshaft Alignment

1. Support the crankshaft with V block 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 block and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the crankshaft.

Crankshaft alignment	Allowable limit	0.02 mm 0.00079 in.

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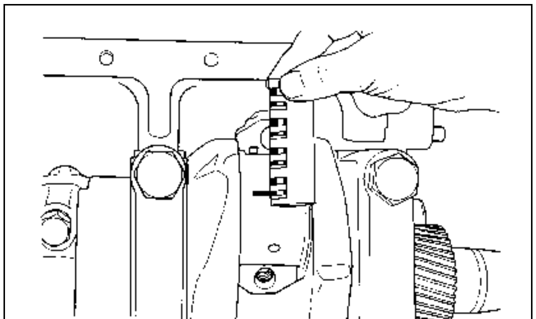
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Oil Clearance between Crankpin and Crankpin Bearing

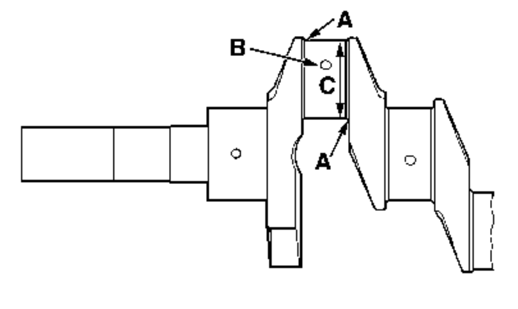
1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
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.**

Crankpin O.D.	Factory spec.	52.977 to 52.990 mm 2.0857 to 2.0862 in.

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.018 to 0.051 mm 0.0007 to 0.0020 in.
	Allowable limit	0.20 mm 0.0079 in.

W1067389



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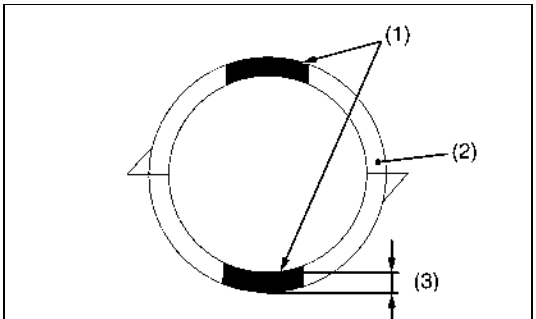

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Oil Clearance between Crankpin and Crankpin Bearing (Continued)

■ IMPORTANT

- **STD size crankpin bearing.**
  To replace it with a specific STD service part, make sure the crankpin bearing has the same ID color as the connecting rod.

ID Color	Connecting rod	Crankpin bearing		
	Large-end in. dia.	Class	Part code	Center wall thick
Blue	56.01 to 56.02 mm 2.2051 to 2.2055 in.	L	1C020-22311	1.496 to 1.501 mm 0.0589 to 0.0591 in.
Without color	56.00 to 56.01 mm 2.2047 to 2.2051 in.	S	1C020-22331	1.491 to 1.496 mm 0.0587 to 0.0589 in.

(Reference)

- Undersize dimensions of crankpin

Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **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
*Dimension **B**	1.0 to 1.5 mm relief 0.0394 to 0.0591 in. relief	1.0 to 1.5 mm relief 0.0394 to 0.0591 in. relief
Dimension **C**	52.777 to 52.790 mm dia. 2.0778 to 2.0783 in. dia.	52.577 to 52.590 mm dia. 2.0700 to 2.0705 in. dia.
(0.8S) The crankpin must be fine-finished to higher than ▽▽▽▽. *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

(1) ID Color
(2) Crankpin Bearing
(3) Center Wall Thick

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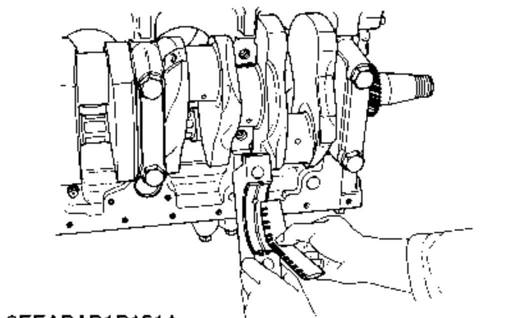
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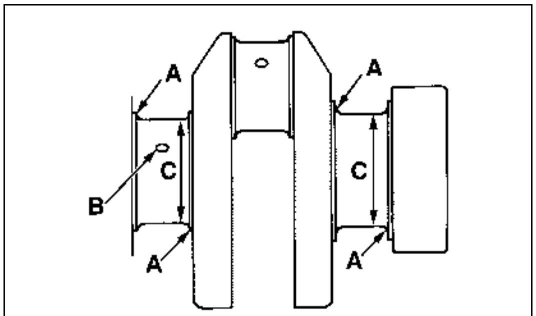

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing

1. Clean the crankshaft journal and crankshaft bearing.
2. Put a strip of press gauge on the center of the journal.

- **IMPORTANT**
- **Never insert the press gauge into the oil hole of the journal.**

3. Install the main bearing case and tighten the screws to the specified torque, and remove the cases again.
4. Measure the amount of the flattening with the scale and get the oil clearance.
5. If the clearance exceeds the allowable limit, replace the crankshaft bearing.

Crankshaft journal O.D.	Factory spec.	74.977 to 74.990 mm 2.9518 to 2.9524 in.

Oil clearance between crankshaft journal and crankshaft bearing	Factory spec.	0.018 to 0.062 mm 0.0007 to 0.0024 in.
	Allowable limit	0.20 mm 0.0079 in.

(Reference)

- Undersize dimensions of crankshaft journal.

Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **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
*Dimension **B**	1.0 to 1.5 mm relief 0.0394 to 0.0591 in. relief	1.0 to 1.5 mm relief 0.0394 to 0.0591 in. relief
Dimension **C**	74.777 to 74.790 mm dia. 2.9440 to 2.9445 in. dia.	74.577 to 74.590 mm dia. 2.9361 to 2.9366 in. dia.
(0.8S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇. *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

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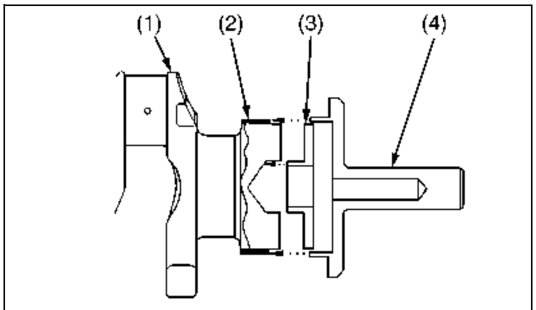

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Replacing Crankshaft Sleeve

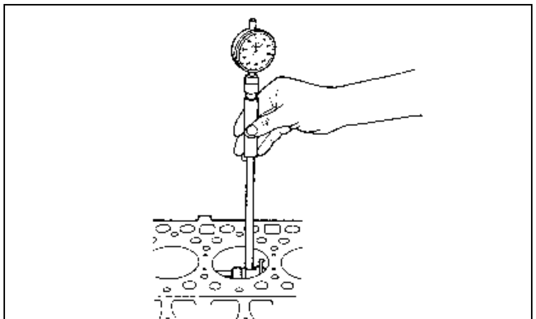
1. Remove the used crankshaft sleeve (2).
2. Set the sleeve guide (3) to the crankshaft (1).
3. Heat a new sleeve to a temperature between 150 to 200 <Symbol>×C (302 to 392 <Symbol>×F), and fix the sleeve to the crankshaft as shown in figure.
4. Press fit the sleeve using the auxiliary socket for pushing (4).

- **NOTE**
- **Mount the sleeve with its largely chamfered surface facing outward.**

(1) Crankshaft
(2) Crankshaft Sleeve
(3) Sleeve Guide
(4) Auxiliary Socket for Pushing

W1069911

(5) Cylinder



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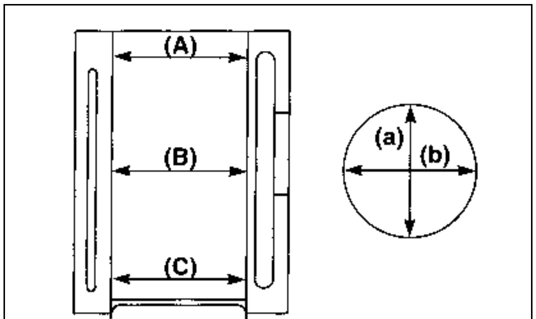
Cylinder Wear

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 Bore I.D.	Factory spec.	100.00 to 100.022 mm 3.9370 to 3.9379 in.
	Allowable limit	100.15 mm 3.9429 in.



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(A) Top
(B) Middle
(C) Bottom (Skirt)
(a) Right-angled to piston pin
(b) Piston pin direction

W1070089

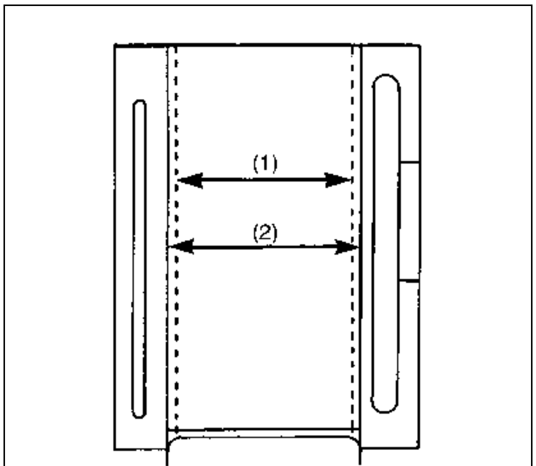
Correcting Cylinder (Oversize)

1. When the cylinder is worn beyond the allowable limit, bore and hone it to the specified dimension.

Cylinder I.D. (2)	Factory spec.	100.500 to 100.522 mm 3.9567 to 3.9576 in.
Maximum wear	Allowable limit	100.65 mm 3.9626 in.
Finishing	Hone to 1.2 to 3.0 μm Rz (0.000087 to 0.00012 in. Rz) ▽▽▽.	

2. Replace the piston and piston rings with oversize 0.5 mm (0.0197 in.) ones.

■ **NOTE**
- **When the oversize cylinder is worn beyond the allowable limit, replace the cylinder block with a new one.**



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(1) Cylinder I.D. (Before Correction)
(2) Oversize Cylinder I.D.

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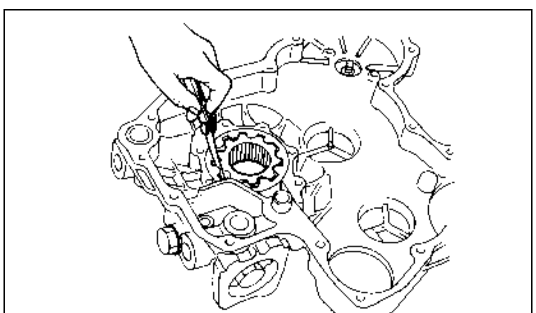
(6) Oil Pump



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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 allowable limit, replace the oil pump rotor assembly.

Clearance between inner rotor and outer rotor	Factory spec.	0.04 to 0.16 mm 0.0016 to 0.0063 in.
	Allowable limit	0.3 mm 0.0118 in.

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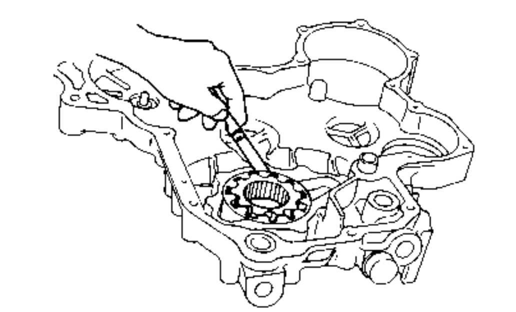

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Clearance between Outer Rotor and Pump Body

1. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
2. If the clearance exceeds the allowable limit, replace the oil pump rotor assembly.

Clearance between outer rotor and pump body	Factory spec.	0.100 to 0.184 mm 0.0039 to 0.0072 in.
	Allowable limit	0.3 mm 0.0118 in.

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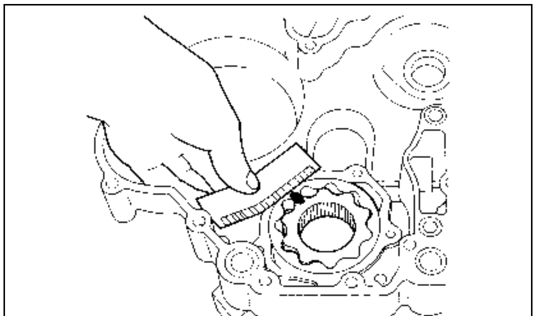

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Clearance between Rotor and Cover

1. Put a strip of plastigage onto the rotor face with grease.
2. Install the cover and tighten the screws with the specified torque.
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 allowable limit, replace oil pump rotor assembly and the cover.

Clearance between rotor and cover	Factory spec.	0.025 to 0.075 mm 0.0010 to 0.0030 in.
	Allowable limit	0.225 mm 0.0089 in.

Tightening torque	Oil pump cover screw	7.9 to 9.3 N·m 0.80 to 0.95 kgf·m 5.8 to 6.9 ft-lbs

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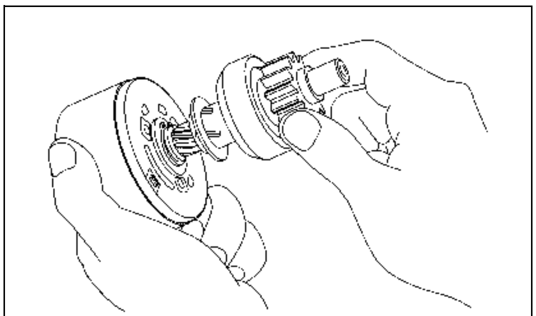
(7) Starter



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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 rotate in the both directions, replace the overrunning clutch assembly.

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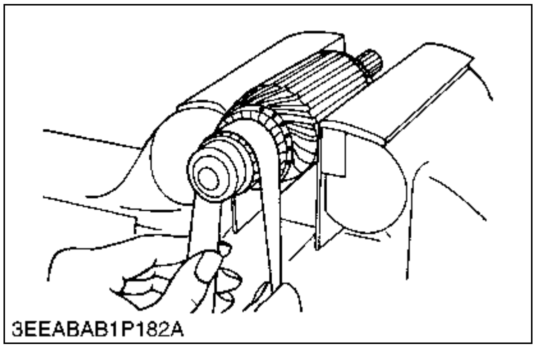

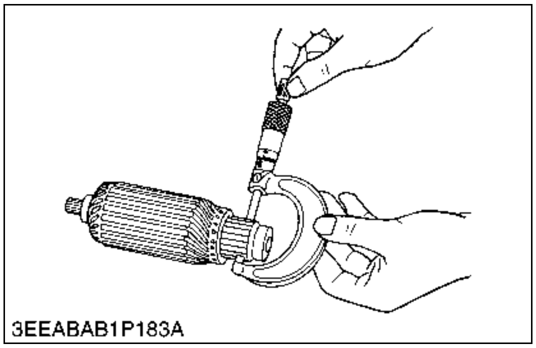

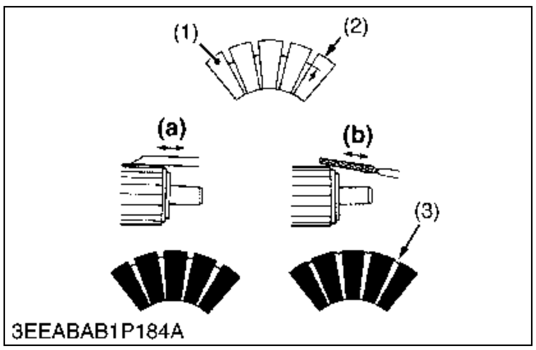

Commutator and Mica

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 if with a saw blade and chamfer the segment edges.

Commutator O.D.	Factory spec.	32 mm 1.2598 in.
	Allowable limit	31.4 mm 1.2362 in.

Mica under cut	Factory spec.	0.5 mm 0.0197 in.
	Allowable limit	0.20 mm 0.0079 in.

(1) Segment
(2) Depth of Mica
(3) Mica

(a) Good
(b) Bad

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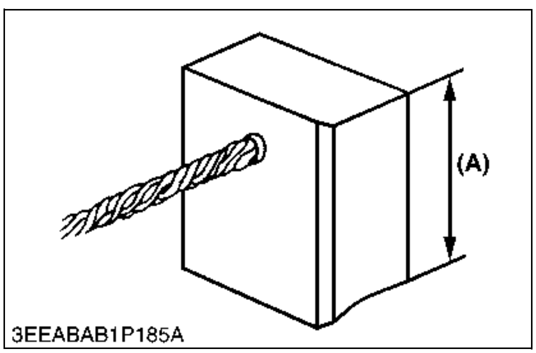

Brush Wear

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.

Brush length **(A)**	Factory spec.	18.0 mm 0.7086 in.
	Allowable limit	11.0 mm 0.4331 in.

(A) Brush Length

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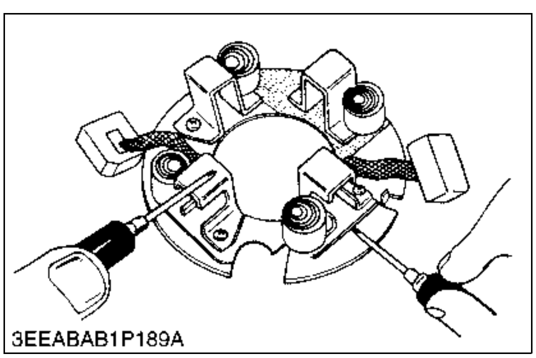

Brush Holder

1. Check the continuity across the brush holder and the holder support with an ohmmeter.
2. If it conducts, replace the brush holder.

Resistance	Brush holder – Holder support	Infinity

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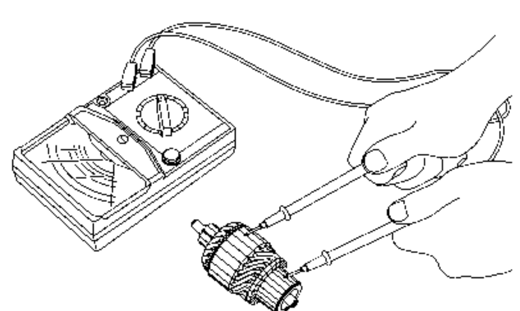
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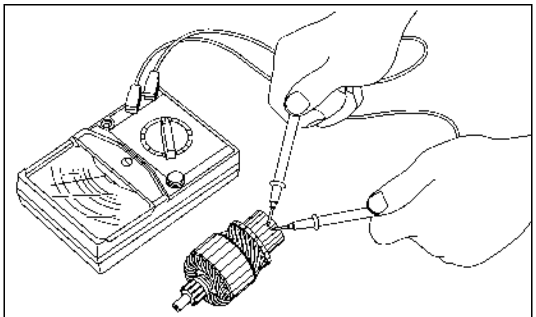
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Armature Coil

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.

Resistance	Commutator – Armature coil core	Infinity
	Commutator segment	0 Ω

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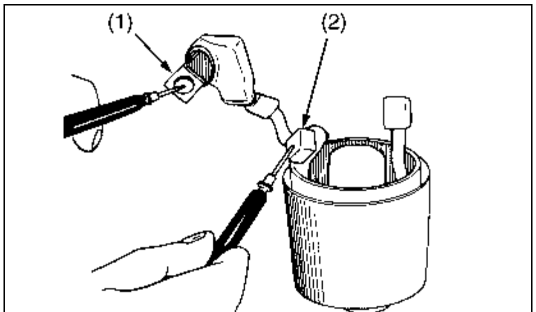

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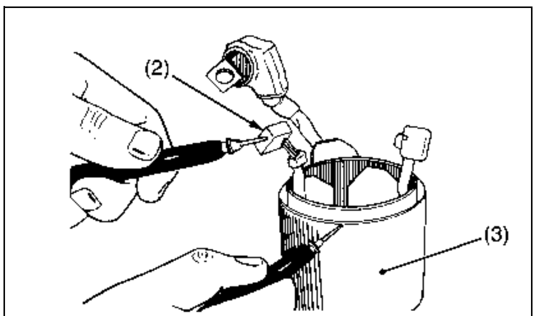

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Field Coil

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.

Resistance	Lead (1) – Brush (2)	0 Ω
	Brush (2) – Yoke (3)	Infinity

(1) Lead
(2) Brush
(3) Yoke

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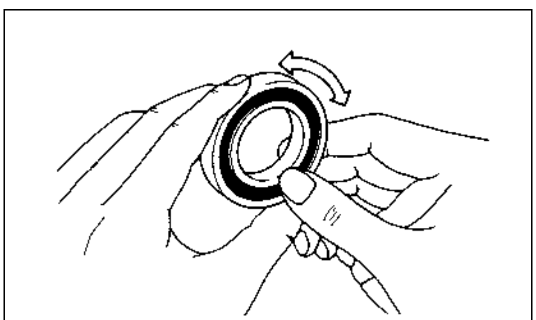
(8) Alternator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Bearing

1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.

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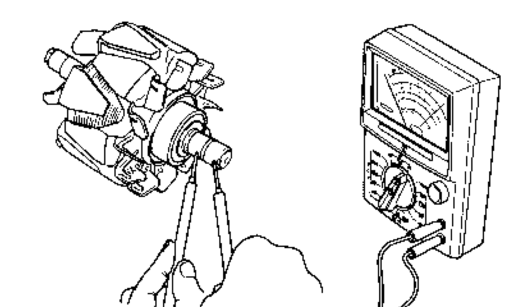
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Rotor

1. Measure the resistance across the slip rings with an ohmmeter.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip and core with an ohmmeter.
4. If infinity is not indicated, replace it.

Resistance	Factory spec.	2.8 to 3.3 Ω

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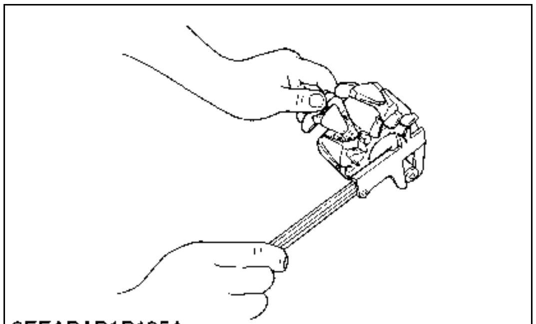
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Slip Ring

1. Check the slip ring for score.
2. If scored, correct with an sand paper or on a lathe.
3. Measure the O.D. of slip ring with vernier calipers.
4. If the measurement is less than the allowable limit, replace it.

Slip ring O.D.	Factory spec.	22.7 mm 0.894 in.
	Allowable limit	22.1 mm 0.870 in.

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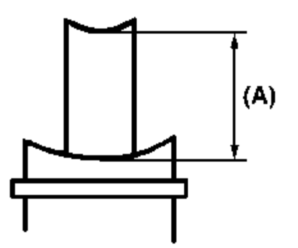

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Brush Wear

1. Measure the brush length **(A)** with vernier calipers.
2. If the measurement is less than allowable limit, replace it.
3. Make sure that the brush moves smoothly.
4. If the brush is defective, replace it.

Brush length **(A)**	Factory spec.	18.5 mm 0.728 in.
	Allowable limit	5.0 mm 0.197 in.

(A) Brush Length

W1076714

Ⅰ. Hydraulic system

Mechanism Section

A.General

a. Features of the hydraulic system

o.	Maiin feature points	Feature contents
	hree pump system ne cylin er bloc ith t o eli ery ports.	Travel: P1 right travel, P2 left travel
		Front attachment control: P1 and P2 confluence for LS circuit (Arm, bucket, SP1, boom, swing)
		Travel + front attachment control: P1 right travel, P2 left travel P3: To front attachment LS circuit
		P3 pump: Swivel, dozer, SP2
	ontrol al e ombination al e bloc	Monoblock ϕ18 (Arm, bucket, SP1, boom)
		LS ϕ14 (Swing, Option: two-piece boom, angle dozer)
		Open ϕ14 (Travel, SP2, dozer, swivel)
3	**System pressure (oost pressure for tra el)**	Travel: 29.4 MPa, 300 kgf/cm^2, 4267 psi
		LS system front attachment: 27.4 MPa, 280 kgf/cm^2, 3983 psi
		P3: 20.6 MPa, 210 kgf/cm^2, 2987 psi
		Travel + front attachment control: Travel: 29.4 MPa, 300 kgf/cm^2, 4267 psi, front attachment: 20.6 MP, 210 kgf/cm^2, 2987 psi
	u illiary port (Ma flo limit)	SP1: Electronic control for maximum flow limit
		SP2: CV pilot primary pressure chamber s mechanical stopper for maximum flow limit
	ll hy raulic pilot control	Safety ensured by lever lock in all sections
		(Residual pressure released by accumulator)
6	**Shoc less al e for boom cylin er**	To ease shocks in moving up and down the boom Thin-bladed orifice with pressure compensation With spool circuit to release return pressure in switching
7	**Stan ar e uippe ith hol ing al e**	With overload preventive switch Manual control type
	egati e s i el (High-pressure selector al e timer-controlle al e)	Brake released at left/right swivel and with arm crowded, swivel brake activated otherwise
		Brake activated in 5 seconds
9	**S i el re erse pre enti e al e**	To prevent shaking just after swivel
0	**ra el negati e bra e**	To prevent traveling slipage on slope
	ra el pilot al e	With damper and travel alarm detection port
	ressure regulating hy raulic tan	Pressure regulated 0.07 MPa, 0.7 kgf/cm^2, 10.2 psi at pressure side, 0.005 MPa, 0.05 kgf/cm^2, 0.73 psi at suction side
		Contamination level reduced (tank breathing reduced)
3	**High pressure hose an hose oint**	ORS (O ring fitting)
		With socket except suction port
	ccumulator	Main aim : Relieve residual pressure in the system.

b. Main specifications of hydraulic components

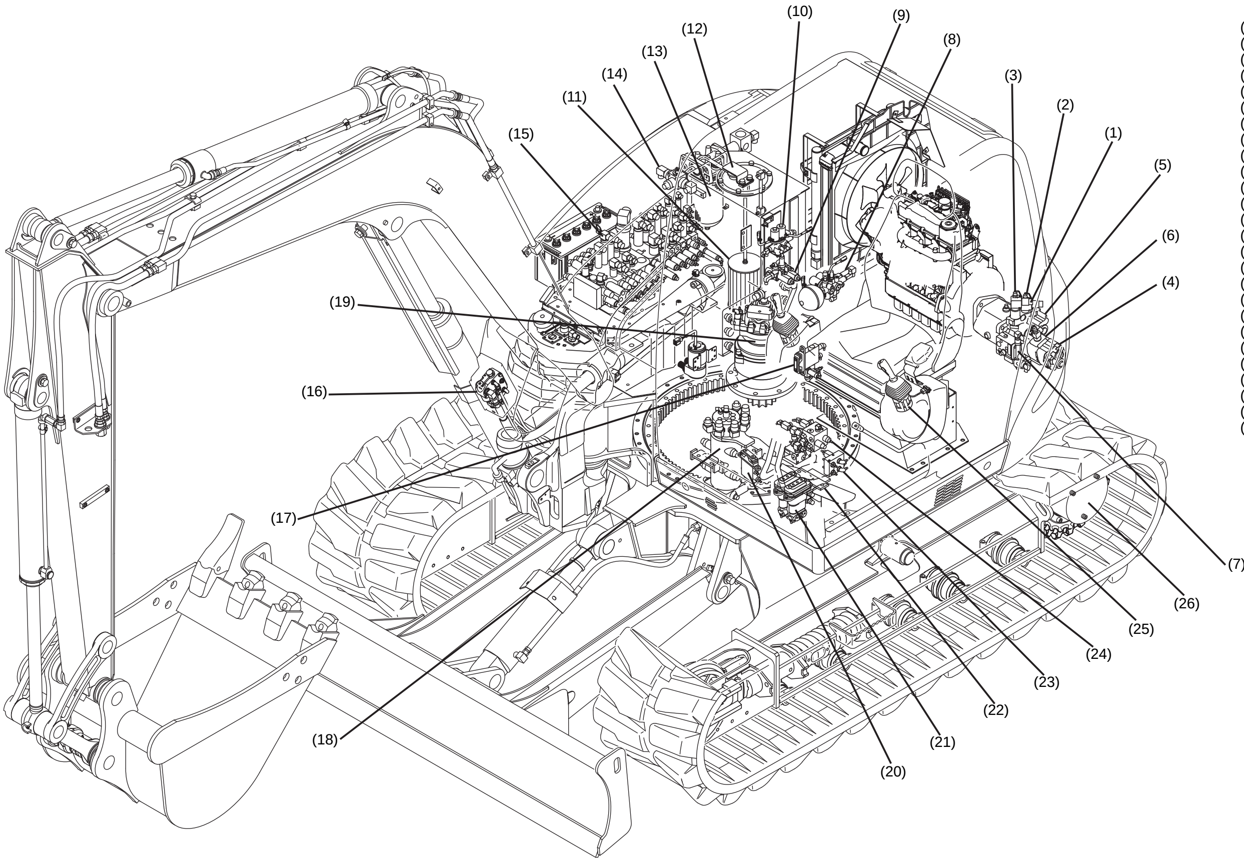
No.	Hydraulic component		Maker	Main specifications
1	Pump	RD809-6111	KYB	36 cc x 2 + 33 + 8.1 cc/rev
				72 x 2 + 67 + 16 L/min (19.0 x + 17.7 + 4.23 GPM)
				LS control valve: Differential pressure 1.5 MPa, 15.3 kgf/cm^2, 218 psi
				PC horsepower control valve: With P3 horsepower shift
				Rated speed: 2000 rpm
2	Control valve	RD809-6113	KYB	LS circuit (ϕ18): 4-valve (monoblock)
				LS circuit (ϕ14): 1-valve
				Open circuit (ϕ14): 3-valve
				P3 confluence valve (ϕ14)
				Travel selector valve (ϕ18)
				Pressure: Travel 29.4 MPa, 300 kgf/cm^2, 4267 psi, front attachment 27.4 MPa, 280 kgf/cm^2, 3983 psi P3: 20.6 MPa, 210 kgf/cm^2, 2987 psi
				Signal detection: AI, travel control detection, LS control detection
3	Travel motor	RD809-6129	Nabtesco	Motor: 36.3/21.3 cc/rev
				Reduction gears: RV reduction gears
				Reduction ratio: 61.6
				Relief: 2-stage shockless relief
				Relief pressure: 30.4 MPs, 310 kgf/cm^2, 4410 psi
				Negative brake
4	Swivel motor	RD809-6128	KYB	Motor: 44.1 cc/rev
				Reduction gears: Planetary reduction gears
				Reduction ratio: 20.615
				Pinion/swivel race: 13/100
				Relief: Shockless relief (0.03 sec)
				Relief pressure: 21.6 MPs, 220 kgf/cm^2, 3129 psi
				Negative brake (with timer, 5 1.5 sec)
				With anti-swivel back valve
5	Boom cylinder	RD809-6750	KYB	ϕ115 x ϕ65 x 878 (cushion at rod side)
6	Arm cylinder	RD809-6760	KYB	ϕ100 x ϕ60 x 914 (cushion at both sides)
7	Bucket cylinder	RD809-6780	KYB	ϕ90 x ϕ55 x 741
8	Swing cylinder	RD809-6740	Koretsune Seiko	ϕ110 x ϕ60 x 715
9	Dozer cylinder	RD809-7510	Koretsune Seiko	ϕ125 x ϕ65 x 250

No.	Hydraulic component		Maker	Main specifications
10	Left-right pilot valve	Right (common) RC448-6172 Left RD809-6140	KPM	Control angle: 19 deg.
				Pilot pressure: 0.83 2.65 MPa, 8.5 27.0 kgf/cm^2, 120 384 psi
				Right: Proportional control switch, left: ON-OFF
11	Travel pilot valve	RD809-9140	KPM	Control angle: 9 deg.
				Pilot pressure: 0.59 2.65 MPa, 6.0 27.0 kgf/cm^2, 86 384 psi
				Hydraulic damper: ϕ0.9 (temporary)
				Left/right high-pressure selector valve (for travel alarm)
12	Unload valve	RD809-6131	Nishina Ind.	Relief pressure: 4 MPa (40.8 kgf/cm^2, 580 psi) at 16 L/min (4.23PM)
				Check valve built-in (Accumulation effect at port B only)
				Accumulator directly connectable
13	Holding valve (boom)	RD809-6405	KPM	With inching spool
14	High-pressure selector valve	RD809-6127	Nishina Ind.	Pressure at left/right swivel with arm crowded $\rightarrow$ Swivel motor brake released Last chance filter built in at T-side adaptor
15	Hose (high pressure)		BS, THE YOKOHAMA RUBBER CO.,LTD	ORS (O ring seal, flat face)
16	Hose (pilot line)		BS	Metal fitting (conventional), quick type
17	Hose (band) without socket			For suction port only
18	Tank			Pressure regulating type (discharge: 0.07 MPa) (suction: 0.005 MPa) Breather without filter
19	Return filter	RD809-6212	WAKO	External cartridge type
20	Accumulator	RD809-6132	NOK	500 cc: Set pressure 1 MPa, 10.2 kgf/cm^2, 145 psi
21	Line filter	Common R1411-6492	Yamashin	Set pressure 0.25 MPa, 2.55 kgf/cm^2, 36.3 psi
22	SP1 solenoid valve	RD809-6137	KPM	Proportional control
23	SP2 solenoid valve	Common RC601-6191	Nishina Ind.	ON - OFF
24	Pressure switch	RD809-6408	Nagano Kogyo	11.8 MPa, 120 kgf/cm^2, 1712 psi
25	Shockless valve	RD809-6408	Nishina Ind.	Throttle orifice : Up ϕ1.0, down ϕ1.1
26	Back-pressure check valve	RD809-6351	Yamashin	0.4 MPa, 4.08 kgf/cm^2, 58 psi
27	TPSS (North America-version)		Nishina Ind.	Rotary type

Specifications subject to change

KTB : Kayaba industry Ltd
KPM : Kawasaki Precision Machinery LTD
NOK : Nippon Oil seal Kogyo
BS : Bridgestone Industry Co. Ltd

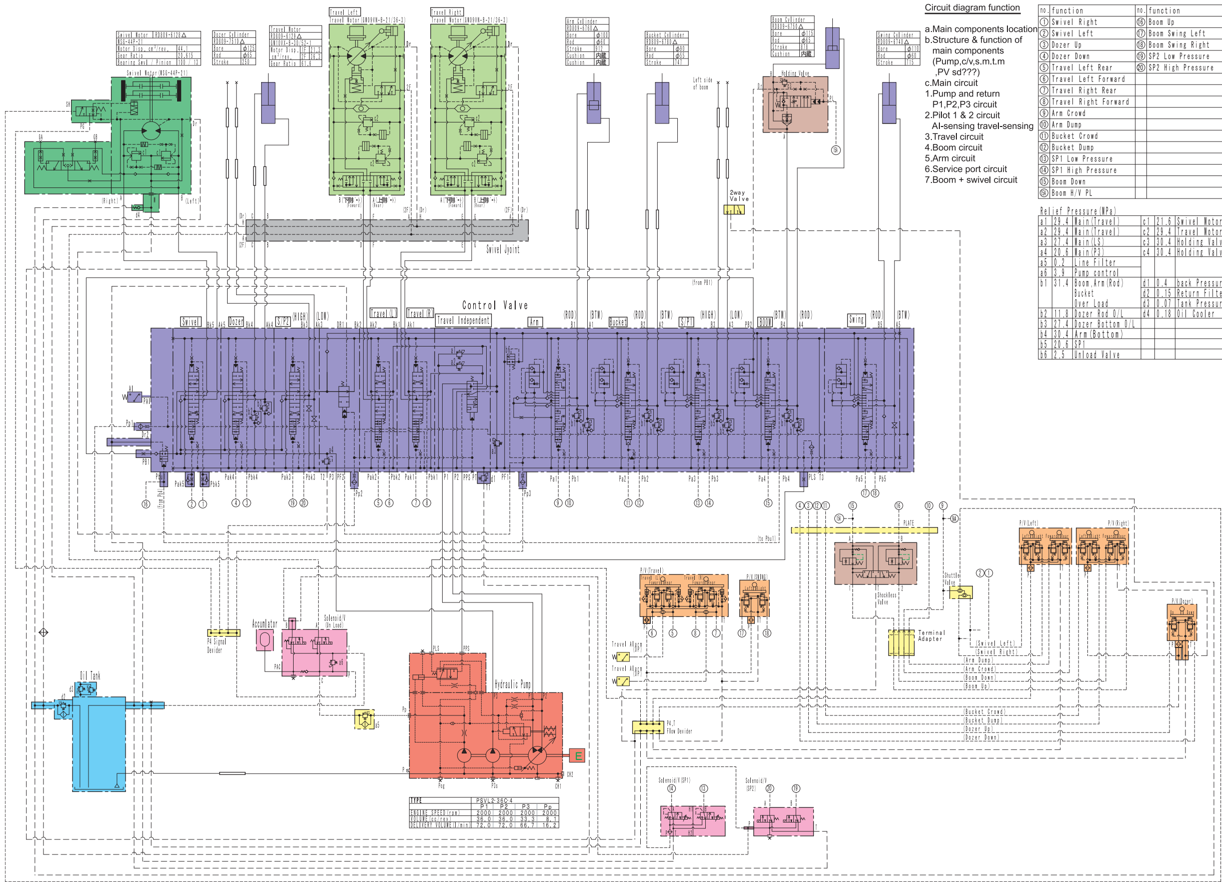
c. Hydraulic components layout



(1) Main pump
(2) P1 delivery port
(3) P2 delivery port
(4) P3 pump
(5) P3 delivery port
(6) Pilot pump
(7) LS valve
(8) Unload valve accumulator
(9) SP 1 proportional valve
(10) SP 2 solenoid valve
(11) Suction filter
(12) Tank cap(pressure regulator)
(13) Return filter
(14) Third line valve
(15) Control valve assy
(16) Holding valve
(17) Pilot valve, dozer
(18) Swivel joint
(19) Swivel motor
(20) Pilot valve. Swing
(21) Pilot valve, travel
(22) High pressure selector valve
(23) TPSS valve
(24) Shockless valve
(25) Pilot control valve,L
(26) Travel motor

d. Hydraulic Circuit Diagram

1. Main components location



Circuit diagram function

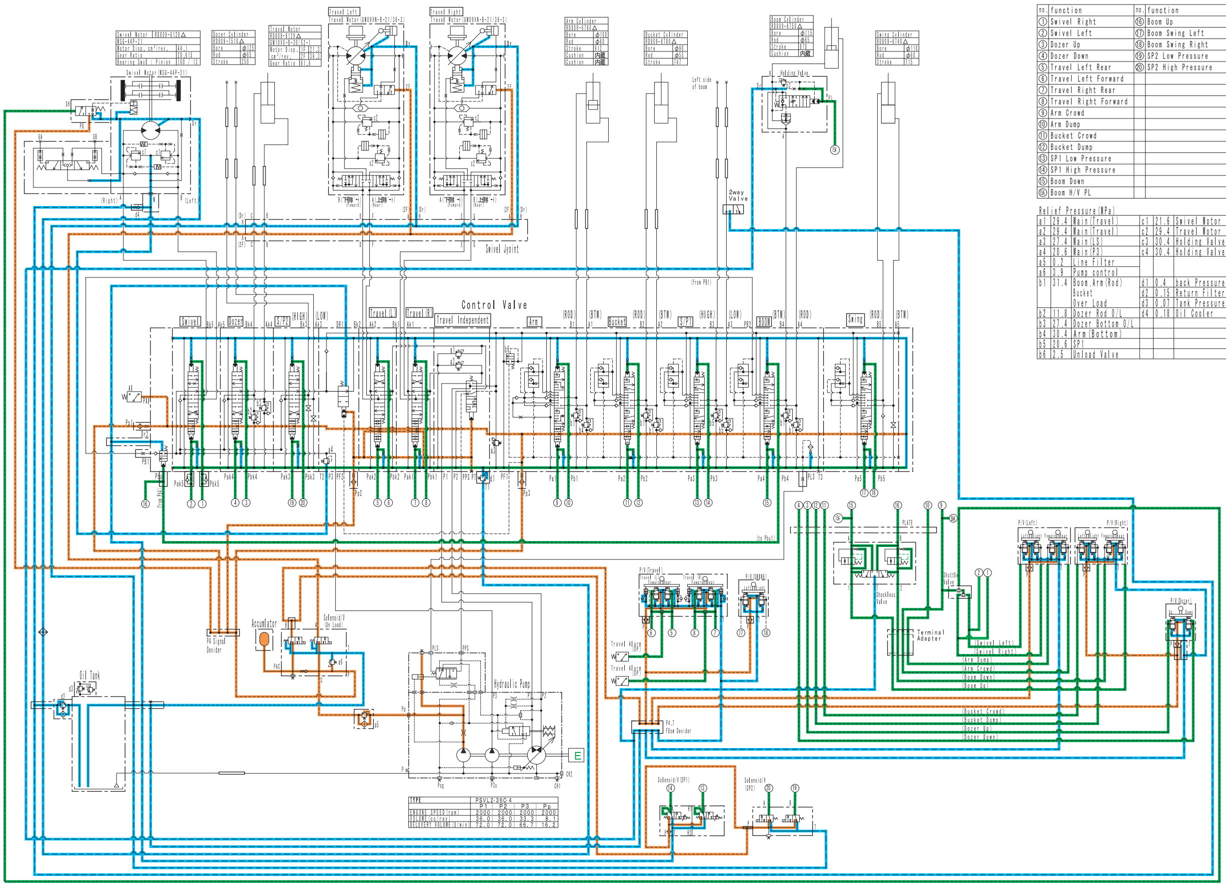
a.Main components location
b.Structure & function of main components (Pump,c/v,s.m.t.m ,PV sd???)
c.Main circuit
1.Pump and return P1,P2,P3 circuit
2.Pilot 1 & 2 circuit AI-sensing travel-sensing
3.Travel circuit
4.Boom circuit
5.Arm circuit
6.Service port circuit
7.Boom + swivel circuit

no.	function	no.	function
1	Swivel Right	16	Boom Up
2	Swivel Left	17	Boom Swing Left
3	Dozer Up	18	Boom Swing Right
4	Dozer Down	19	SP2 Low Pressure
5	Travel Left Rear	20	SP2 High Pressure
6	Travel Left Forward		
7	Travel Right Rear		
8	Travel Right Forward		
9	Arm Crowd		
10	Arm Dump		
11	Bucket Crowd		
12	Bucket Dump		
13	SP1 Low Pressure		
14	SP1 High Pressure		
15	Boom Down		
15A	Boom H/V PL		

Relief Pressure(MPa)

a1	29.4	Main(Travel)	c1	21.6	Swivel Motor
a2	29.4	Main(Travel)	c2	29.4	Travel Motor
a3	27.4	Main(LS)	c3	30.4	Holding Valve
a4	20.6	Main(P3)	c4	30.4	Holding Valve
a5	0.2	Line Filter			
a6	3.9	Pump control			
b1	31.4	Boom,Arm(Rod)	d1	0.4	back Pressure
		Bucket	d2	0.15	Return Filter
		Over Load	d3	0.07	Tank Pressure
b2	11.8	Dozer Rod O/L	d4	0.18	Oil Cooler
b3	27.4	Dozer Bottom O/L			
b4	30.4	Arm(Bottom)			
b5	20.6	SP1			
b6	2.5	Unload Valve			

2. Pilot pump circuit

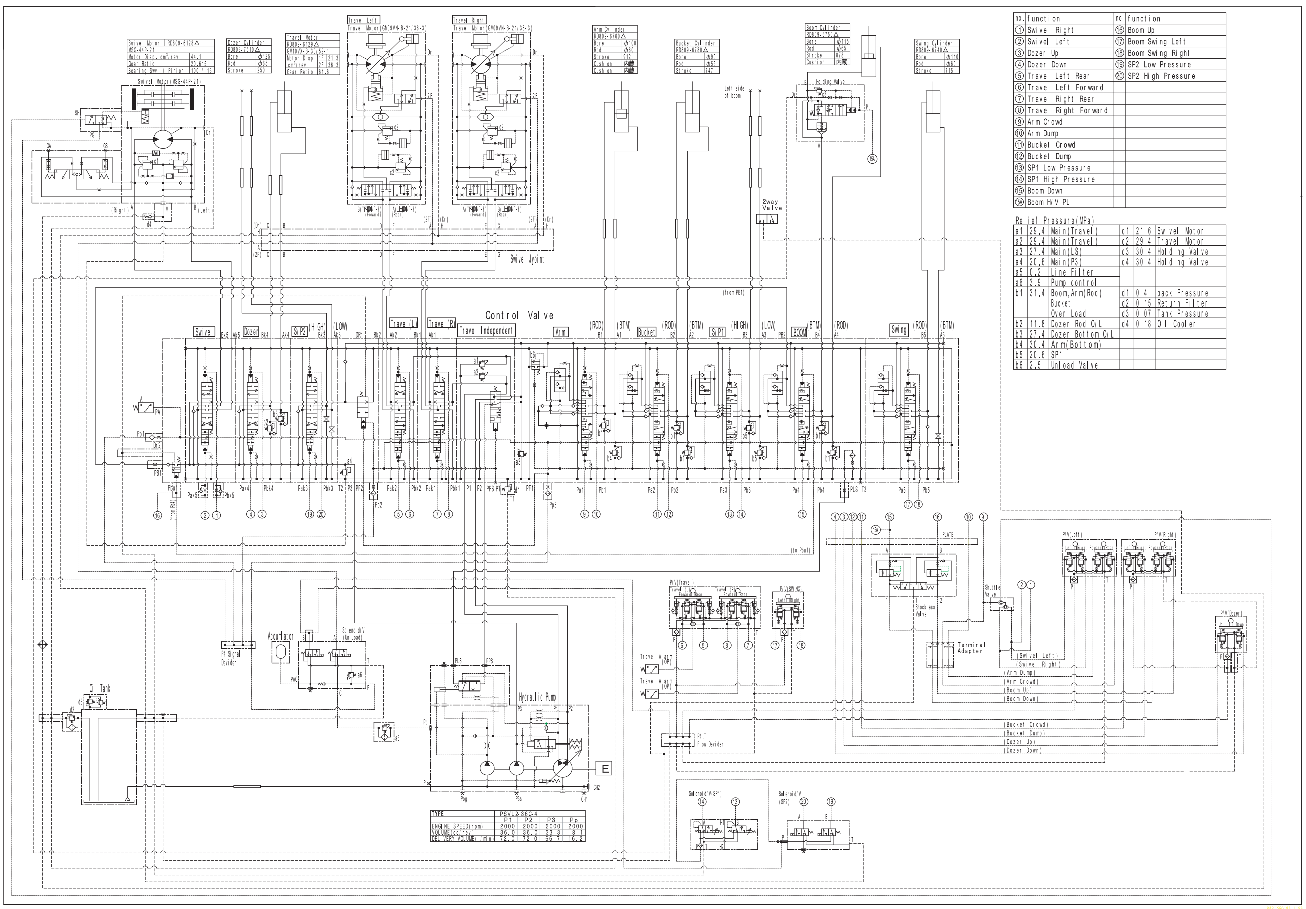


no.	function	no.	function
1	Swivel Right	16	Boom Up
2	Swivel Left	17	Boom Swing Left
3	Dozer Up	18	Boom Swing Right
4	Dozer Down	19	SP2 Low Pressure
5	Travel Left Rear	20	SP2 High Pressure
6	Travel Left Forward		
7	Travel Right Rear		
8	Travel Right Forward		
9	Arm Crowd		
10	Arm Dump		
11	Bucket Crowd		
12	Bucket Dump		
13	SP1 Low Pressure		
14	SP1 High Pressure		
15	Boom Down		
15A	Boom H/V PL		

Relief Pressure (MPa)

a1	29.4	Main (Travel)	c1	21.6	Swivel Motor
a2	29.4	Main (Travel)	c2	29.4	Travel Motor
a3	27.4	Main (LS)	c3	30.4	Holding Valve
a4	20.6	Main (P3)	c4	30.4	Holding Valve
a5	0.2	Line Filter			
a6	3.9	Pump control			
b1	31.4	Boom, Arm (Rod)	d1	0.4	back Pressure
		Bucket	d2	0.15	Return Filter
		Over Load	d3	0.07	Tank Pressure
b2	11.8	Dozer Rod O/L	d4	0.18	Oil Cooler
b3	27.4	Dozer Bottom O/L			
b4	30.4	Arm (Bottom)			
b5	20.6	SP1			
b6	2.5	Unload Valve			

3. Hydraulic Circuit Diagram



no.	function	no.	function
1	Swivel Right	16	Boom Up
2	Swivel Left	17	Boom Swing Left
3	Dozer Up	18	Boom Swing Right
4	Dozer Down	19	SP2 Low Pressure
5	Travel Left Rear	20	SP2 High Pressure
6	Travel Left Forward		
7	Travel Right Rear		
8	Travel Right Forward		
9	Arm Crowd		
10	Arm Dump		
11	Bucket Crowd		
12	Bucket Dump		
13	SP1 Low Pressure		
14	SP1 High Pressure		
15	Boom Down		
15A	Boom H/V PL		

Relief Pressure(MPa)

a1	29.4	Main(Travel)	c1	21.6	Swivel Motor
a2	29.4	Main(Travel)	c2	29.4	Travel Motor
a3	27.4	Main(LS)	c3	30.4	Holding Valve
a4	20.6	Main(P3)	c4	30.4	Holding Valve
a5	0.2	Line Filter			
a6	3.9	Pump control			
b1	31.4	Boom, Arm(Rod)	d1	0.4	back Pressure
		Bucket	d2	0.15	Return Filter
		Over Load	d3	0.07	Tank Pressure
b2	11.8	Dozer Rod O/L	d4	0.18	Oil Cooler
b3	27.4	Dozer Bottom O/L			
b4	30.4	Arm(Bottom)			
b5	20.6	SP1			
b6	2.5	Unload Valve			

.Hydraulic pump

a. Main specifications

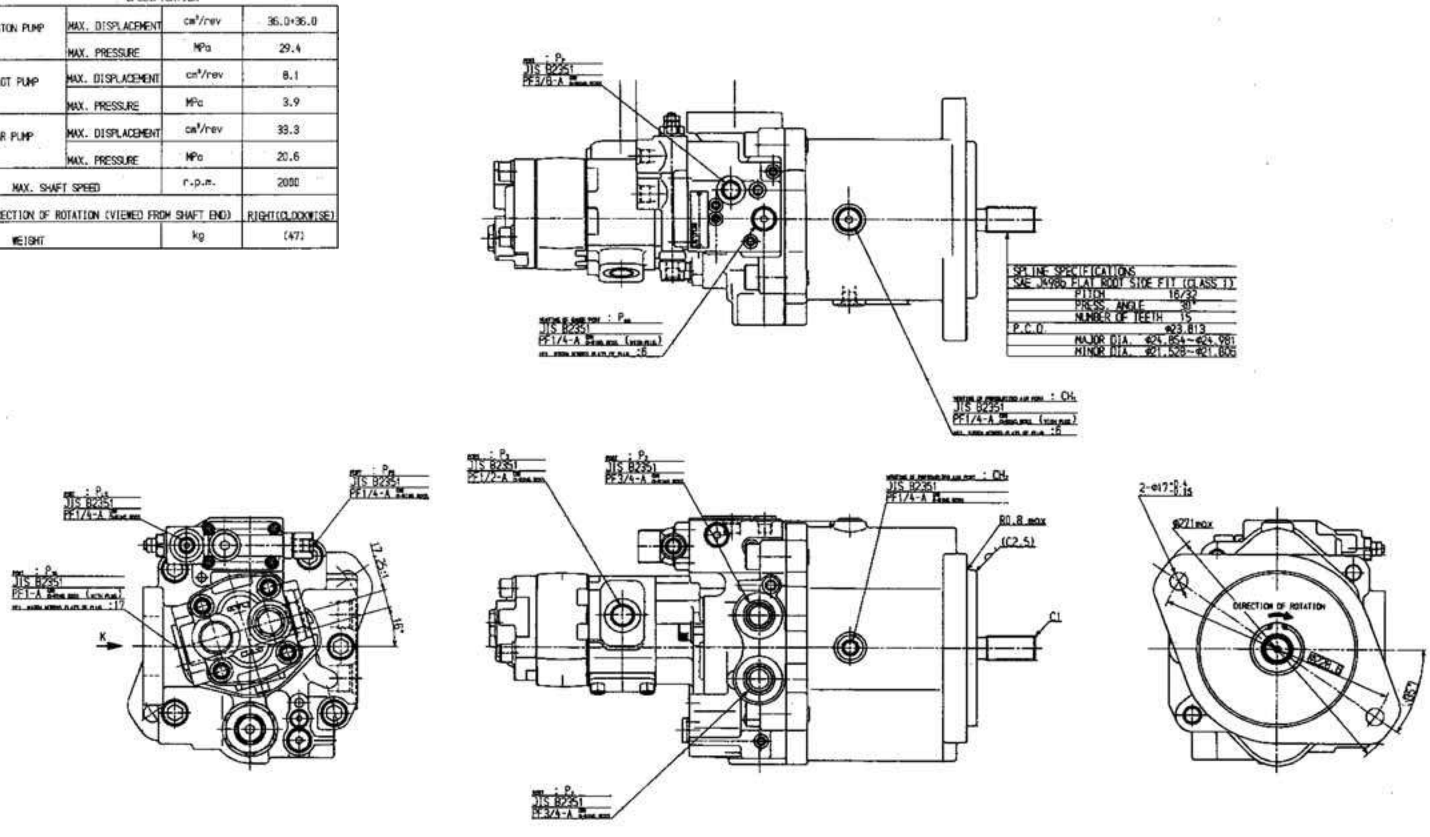
1	Pump displacement (CC rev)	36 2 33 8.1
	Pump flow rate (L min)	72 2 67 16 L min (19.0 2 17.7 4.23 PM)
2	Stand y flow rate (L min)	22 L min (5.81 PM)
3	Construction	P1, P2 Split flow of varia le displacement piston pump P3 P (ear pump) P4 P (ear pump)
4	Rated speed	2000 rpm
5	LS flow control	LS control valve Differential pressure 1.5 MPa ngine rpm proportional control at P4 Idling at rated flow rate out 60 70
6	Horsepower control	PC horsepower control valve With P3 horsepower shift Without small-diameter piston (self-tilting moment) P1 P2 pressure verage pressure y aperture
7	Construction	earing Cradle Shoe plate Spherical Large-diameter piston (with shoe)

Piston pump power constant characteristics (→To e announced later)

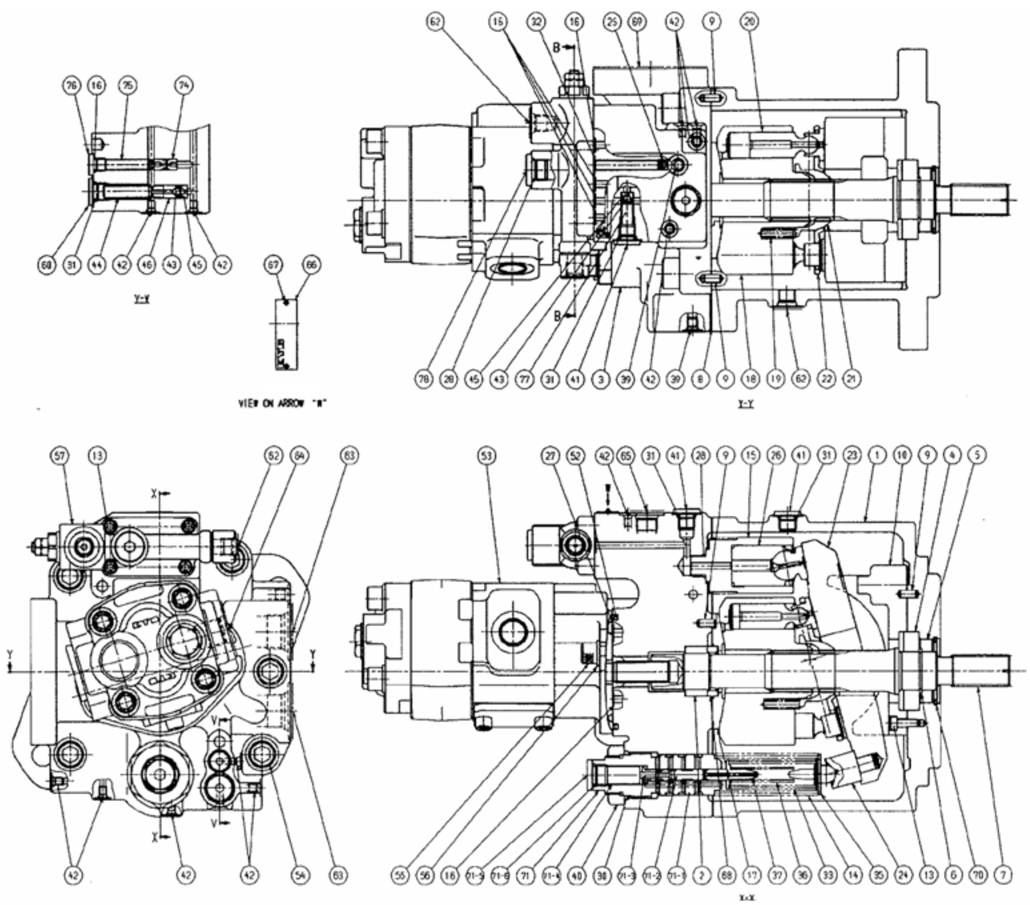
b. Outer view

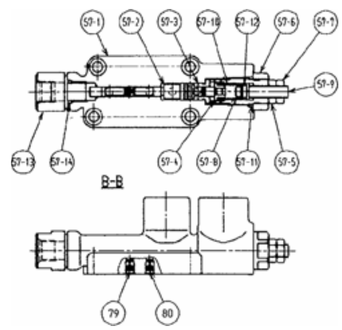
SPECIFICATION

PISTON PUMP	MAX. DISPLACEMENT	cm³/rev	36.0+36.0
	MAX. PRESSURE	MPa	29.4
PILOT PUMP	MAX. DISPLACEMENT	cm³/rev	8.1
	MAX. PRESSURE	MPa	3.9
GEAR PUMP	MAX. DISPLACEMENT	cm³/rev	33.3
	MAX. PRESSURE	MPa	20.6
MAX. SHAFT SPEED		r.p.m.	2000
DIRECTION OF ROTATION (VIEWED FROM SHAFT END)			RIGHT(CLOCKWISE)
WEIGHT		kg	(47)



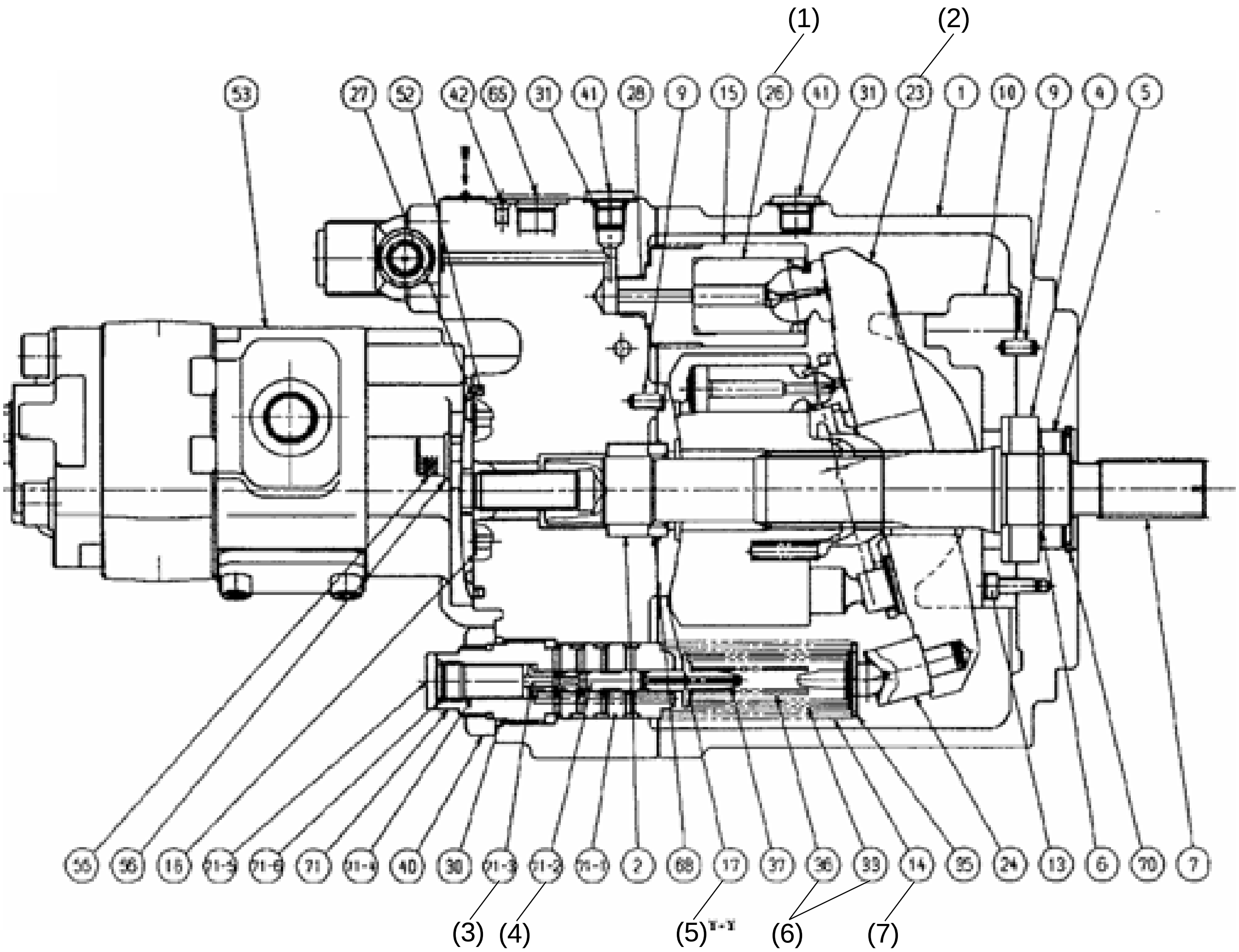
c. Structure

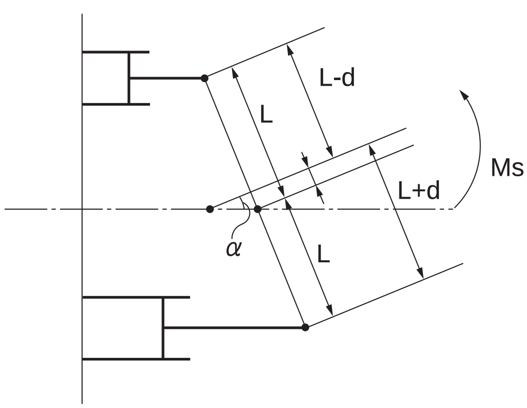




P1, P2
(Variable displacement pump + Horsepower control + LS control)
P3
Fixed gear pump (Swivel, dozer SP2)
P4 : Pilot pump
(Used also for LS engine rpm proportional control)

d. Functional parts 1

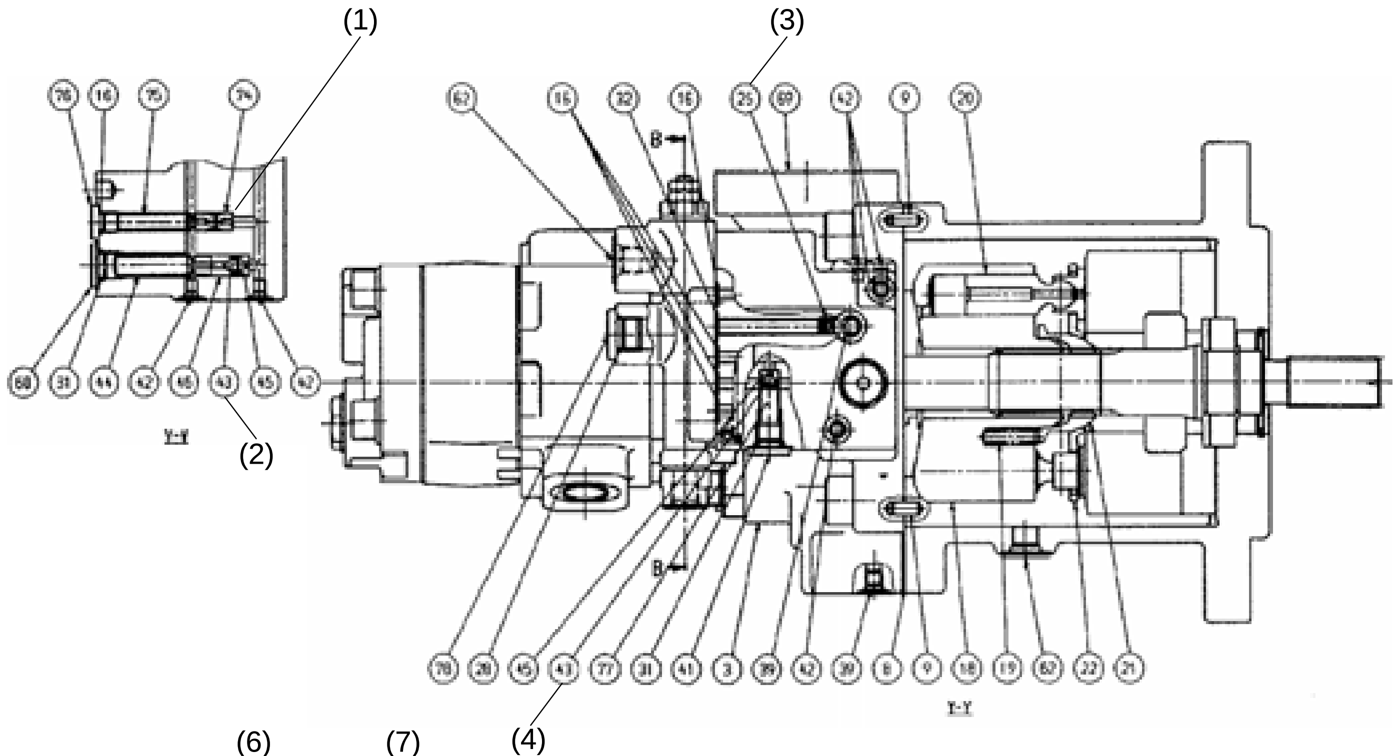


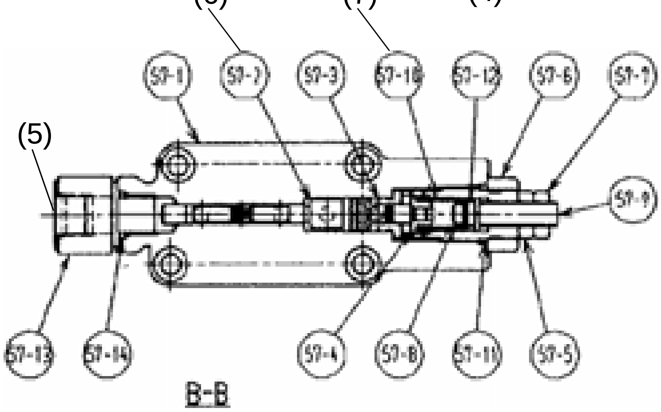


Function :
The force to tilt the tilting swash plate toward the large flow side is produced by repositioning the turning center of the tilting swash plate and generating the self-tilting moment. (The small-diameter piston adopted on KX121-3, KX161-3 is not used here.) The tilt return spring is applied to assist at low pressure.

(1) Large-diameter tilt control piston
(2) Tilting swash plate
(3) P3 pump horsepower shift pin
(4) PC horsepower control spool
(5) Spherical valve plate
(6) PC horsepower control spring
(7) Tilting moment assist spring

e. Functional parts 2



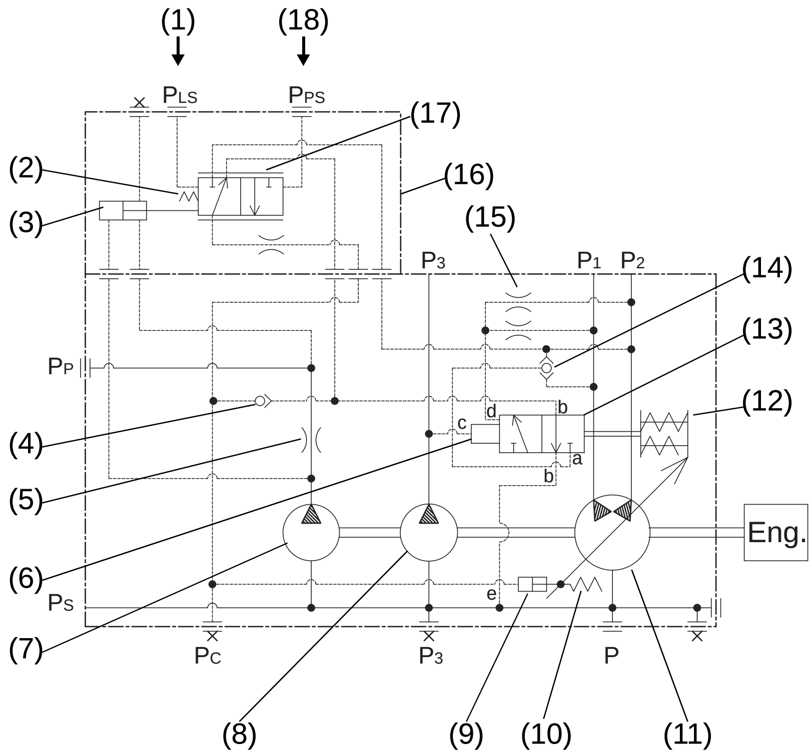


(1) Orifice for P1 + P2 average pressure
(2) High-pressure selector check valve
(3) Engine rpm proportional gain control orifice
(4) Response improvement check valve at P3 under pressure
(5) PPS control pressure from CV (Control valve)
(6) LS flow control spool
(7) LS differential pressure setting spring

S flo control al e

Basically common with KX121-3, KX161-3
Orifice and control differential pressure setting different, however

f. Pump control circuit



(1) PLS control pressure from CV
(2) LS differential pressure setting spring
(3) Engine rpm proportional gain control piston
(4) Response improvement check valve at P3 under pressure
(5) Engine rpm proportional gain control aperture
(6) P3 pump horsepower shift piston
(7) P4 pilot pump
(8) P3 pump
(9) Large-diameter tilt control piston
(10) Tilting moment assist spring
(11) P1, P2 pump
(12) Horsepower control spring
(13) PC horsepower control spool
(14) High-pressure selector check valve
(15) Aperture for P1 + P2 average pressure
(16) LS control regulator
Basically common with L3
(17) LS flow control spool
(18) PPS control pressure from CV

a : Pmax
b : Tank
c : P_3
d : $P = \frac{P_1+P_2}{2}$
e : PC

(ump structure)

P1, P2 : Variable displacement pump + PC horsepower control + LS flow control (Q1 = Q2) (Travel, arm, bucket, SP1, boom, swing, AUX)
: Split flow
: Spherical valve plate
: Cradle bearing
: No small-diameter piston provided (self-pressing moment used)

P3 : Gear pump (swivel, dozer, SP2) (Used for LS system in using the travel and LS control)

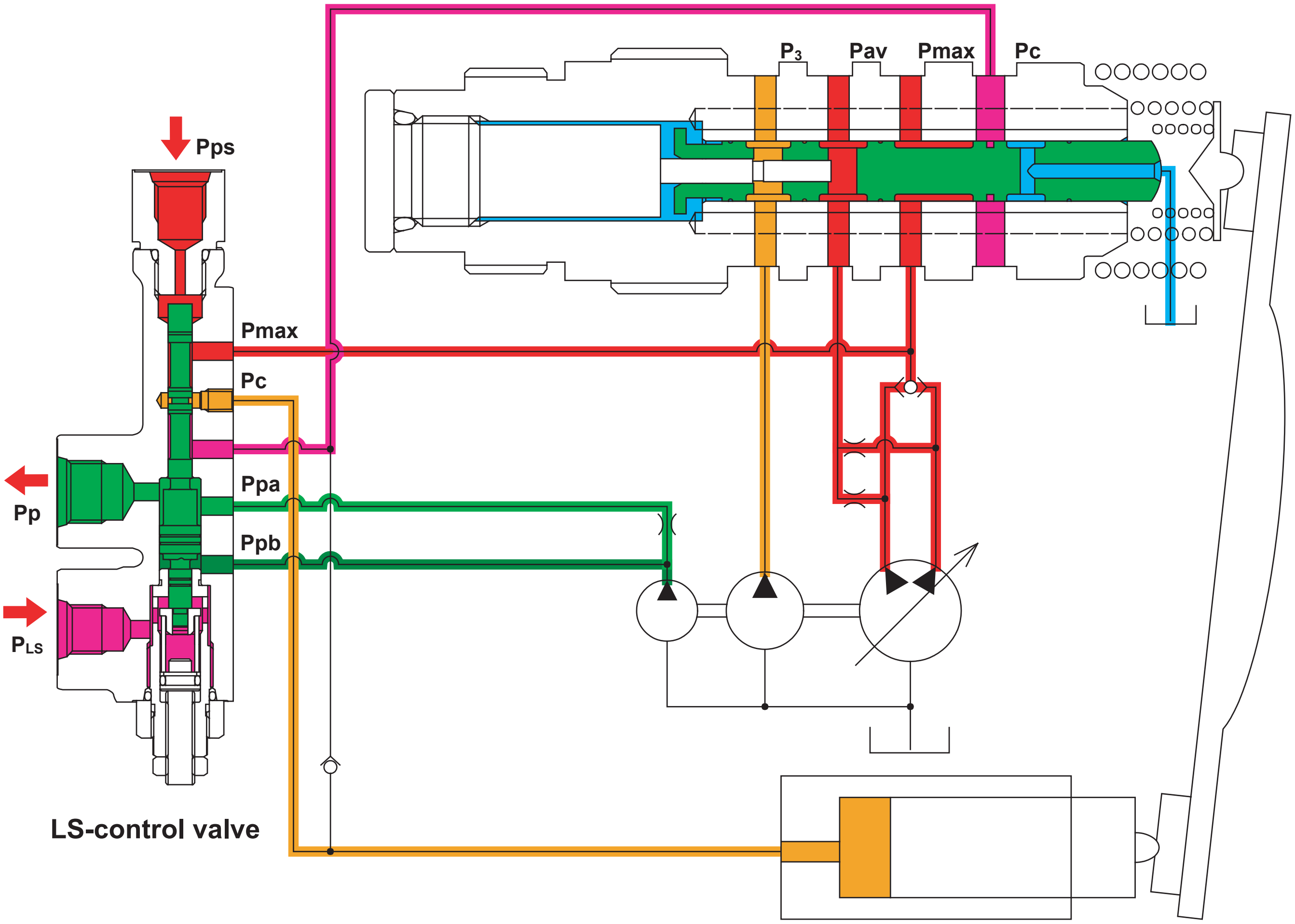
P4 : Gear pump ((Pilot pump) and to use also for LS engine rpm proportional control)

(ump control)

1. Horsepower: Orifice-controlled P1 + P2 average pressure to make the power double, instead of generating the P1 + P2 horsepower with a stepped piston. P3 also controlled together.
2. Engine rpm gain control: P4 pilot pump s discharge throttled, resulting in differential pressure. LS differential pressure modified accordingly. (Same mechanism as on KX121-3S/α and KX161-3S/α)
3. Introduction of response improvement check valve (LS flow control valve bypassed) at P3 under pressure. In this way, swivel horsepower control response quicker and engine drop reduced.
4. Tilting swash plate s moment for larger flow rate controlled by repositioning the turning center of the swash plate and generating the self-tilting moment. (The small-diameter piston on KX121-3S/α and KX161-3S/α is abolished out.) Tilt moment assist spring also adopted to boost the tilting moment at low pressure.

1. LS control 1

$P_{PS} = P_{LS} + P_F + \Delta P_P$



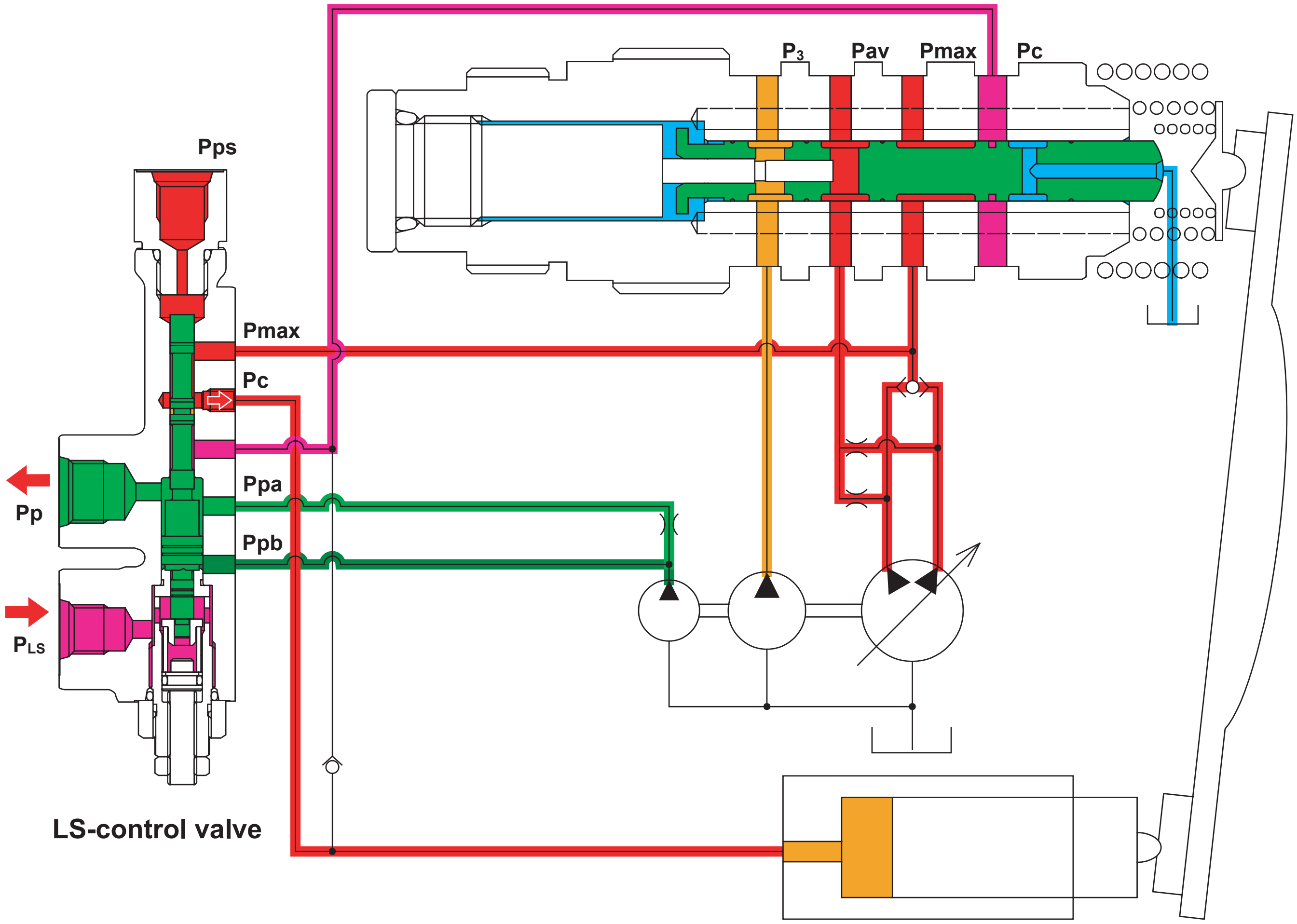
When the machine is working under the stable load condition, load sensing pressure (PLS) and pump swash plate angle are at certain stable values.
Therefore, LS control spool stays balancing according to the following equation.

$P_{PS} = P_{LS} + P_F + \Delta P_P \quad (\Delta P_P = P_{Pb} - P_{Pa})$

Then the control pin stays at the stable position to keep the swash plate for required pump delivery.

2. LS control 2

P_{PS} $P_{LS} + P_F + \Delta P_P$



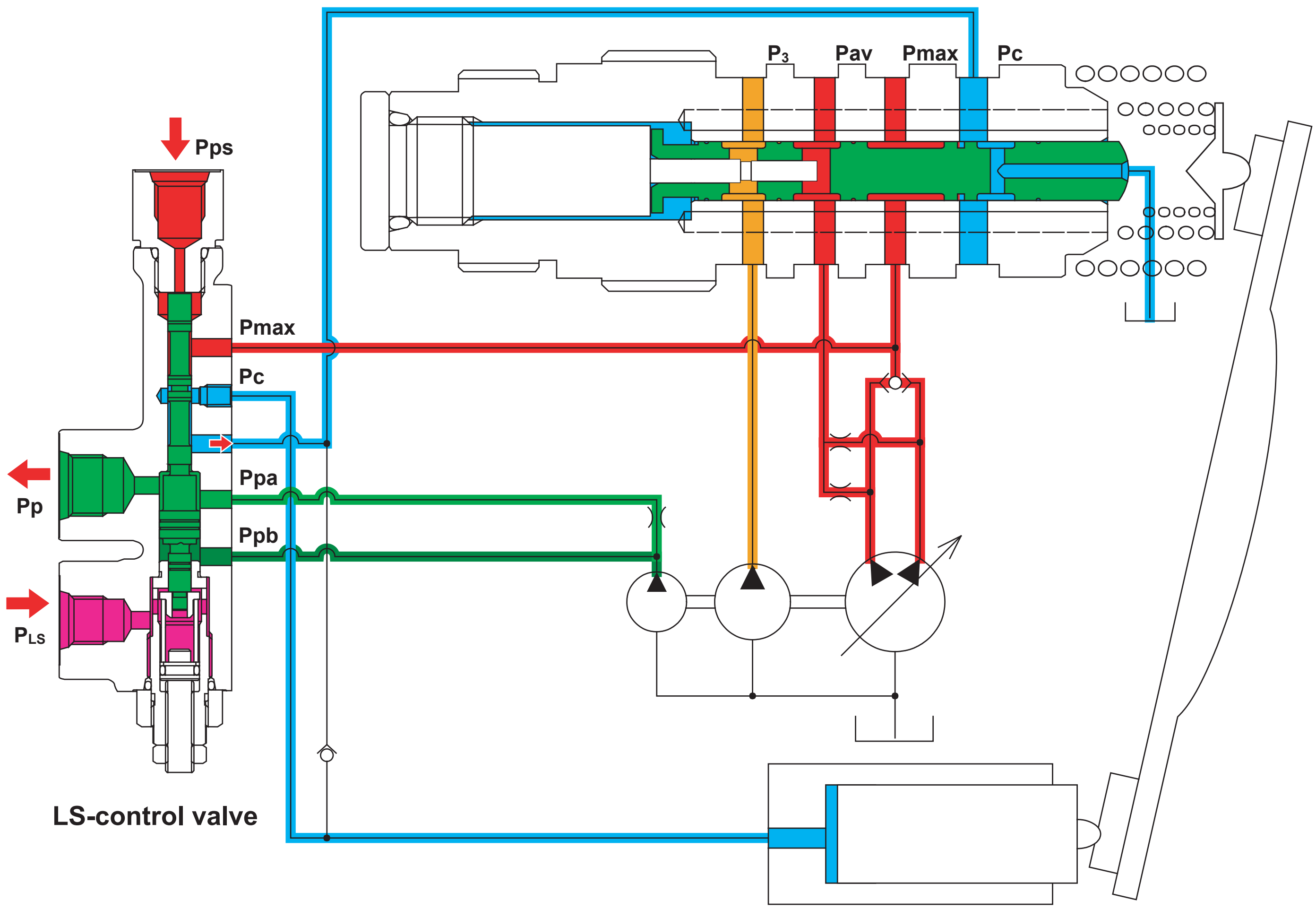
When an operator shifts the control lever to the inching movement of the front attachment, main spool notch opening area of the control valve is regurated to limit the oil flow through.

Therefore, pressure value before the spool notch (P_{PS}) becomes comparatively higher and the pressure difference between P_{PS} (pressure before the spool notch) and P_{LS} (pressure after the spool notch) increases momentarily.

Thus, pressure balance changes to shift down the LS control spool, which leads the high pressure (P_{max}) to push the control pin and decrease the swash plate angle.

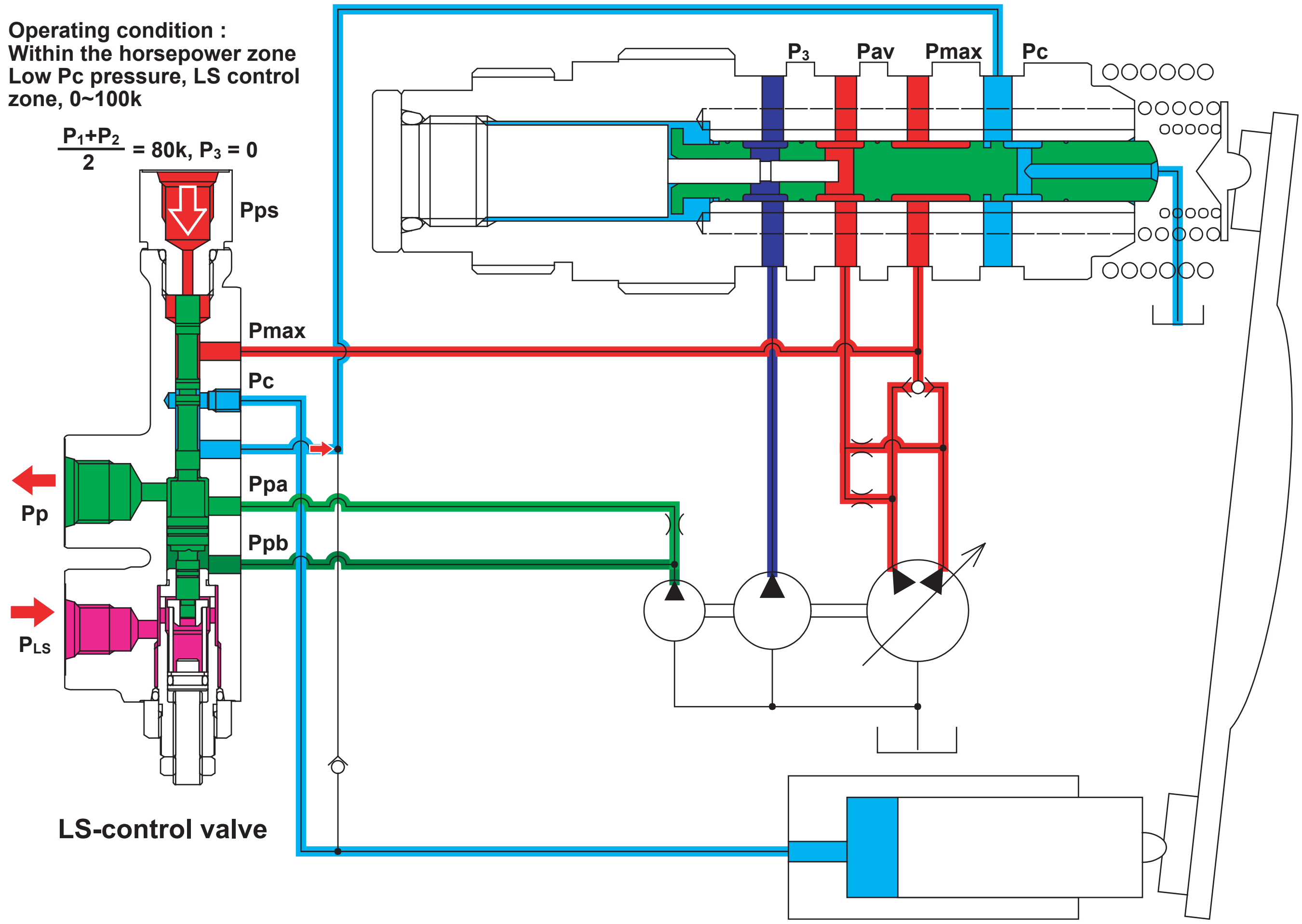
3. LS control 3

P_{PS} $P_{LS} + P_F + \Delta P_P$



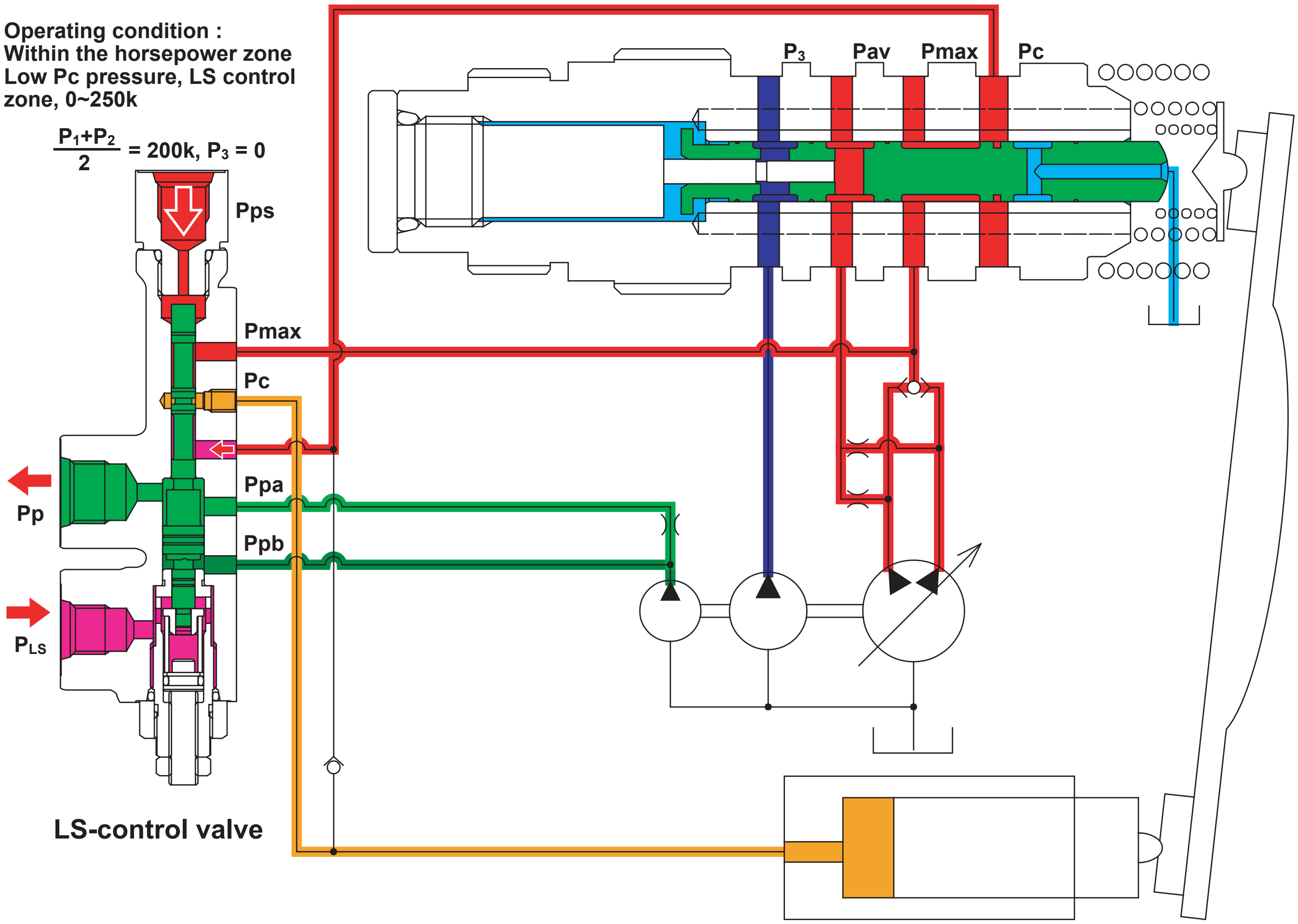
When an operator shifts the control lever to full stroke, main spool notch area of the control valve opens fully. Therefore, pressure value before the spool notch (P_{PS}) becomes comparatively lower and the pressure difference between P_{PS} (pressure before the spool notch) and P_{LS} (pressure after the spool notch) decreases momentarily.
Thus, pressure balance changes to shift up the LS control spool, which leads the control pressure (P_c) from the control pin to dump and increase the swash plate angle.

4. Hose power control 1



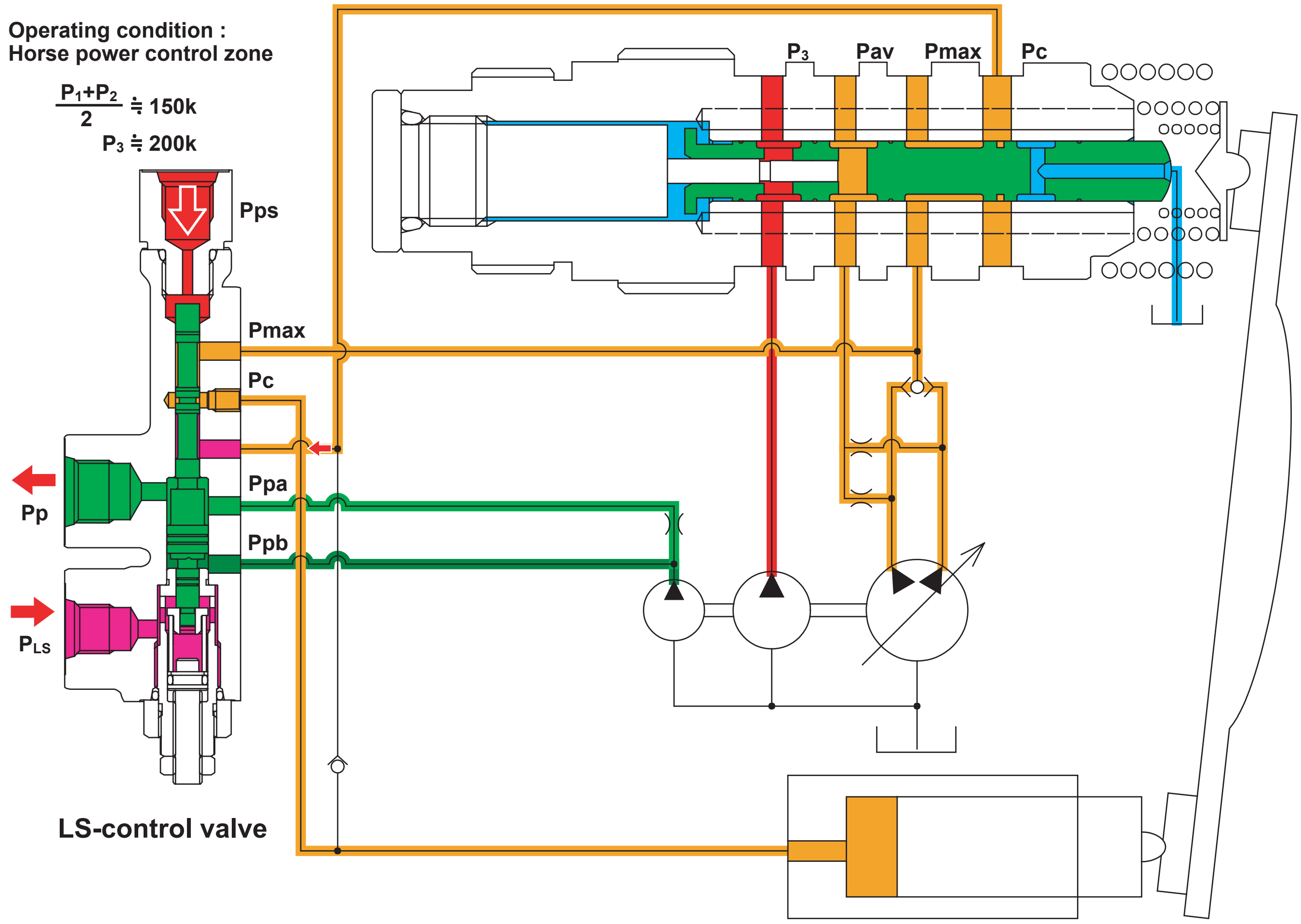
Under this operating condition, average pressure ($\frac{P_1+P_2}{2}$) is being applied the horse power spool to push the spring to increase the swash plate angle.
The control spool notch is opened the P_c port from the control pin chamber to tank.

5. Hose power control 2



Under this operating condition, average pressure ($\frac{P_1+P_2}{2}$) is being applied the horse power spool to push in the right direction and opens the oil passage of P_{max} port to P_c port.
This pressure oil is delivered to the control pin and push the swash plate, balancing against the horse power spool via two springs.

6. Hose power control 3

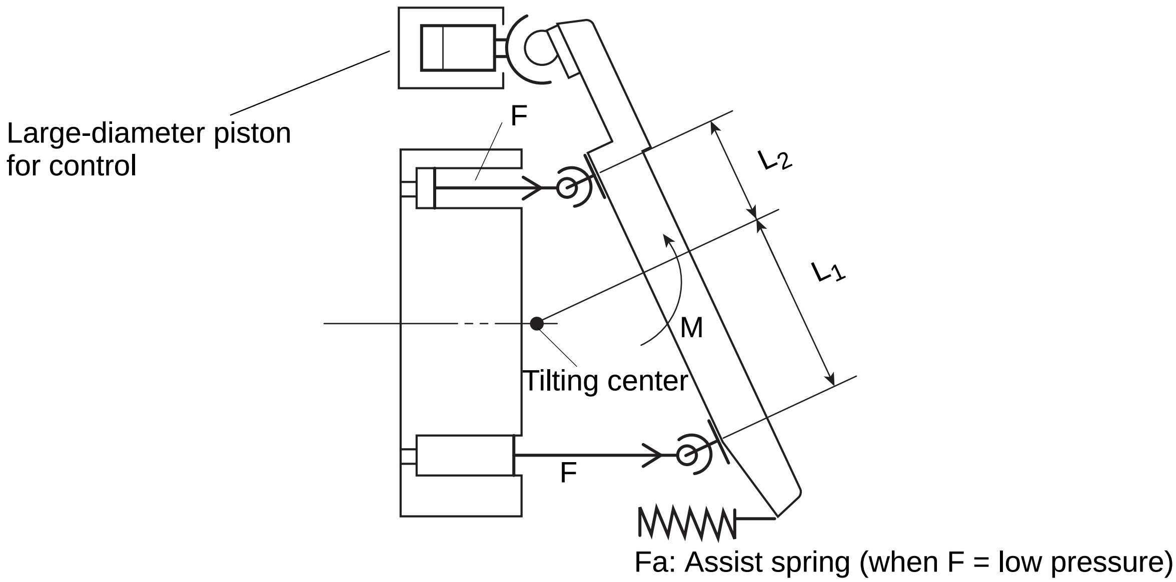


Under this heavy load operating condition, average pressure ($\frac{P_1+P_2}{2}$) and P_3 pressure are being applied the horse power spool to open the oil passage from P_{max} to P_c.
This control pressure is also applied to the control pin to decrease the swash plate angle, preventing the engine stall.

g. FYI (For Your Information)

1. LS pump swash plate control mechanism

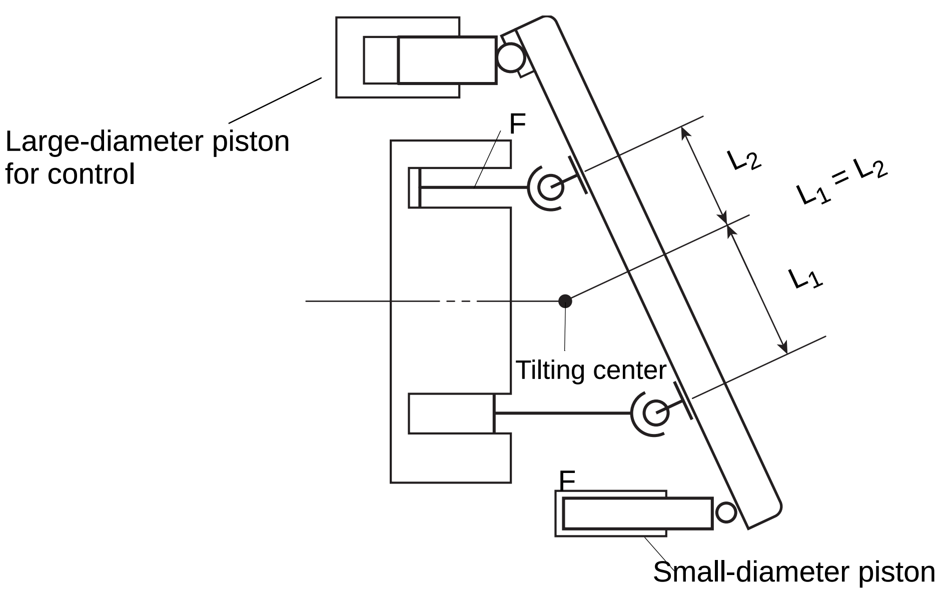
KX080-3



Clockwise moment of the cylinder block
$= (L_2 \times F - L_1 \times F) \times \cos\vartheta + Fa$

From this equation, the small-diameter piston with a counterclockwise moment has been left out.

Conventional type KX121-3/α, KX161-3/α

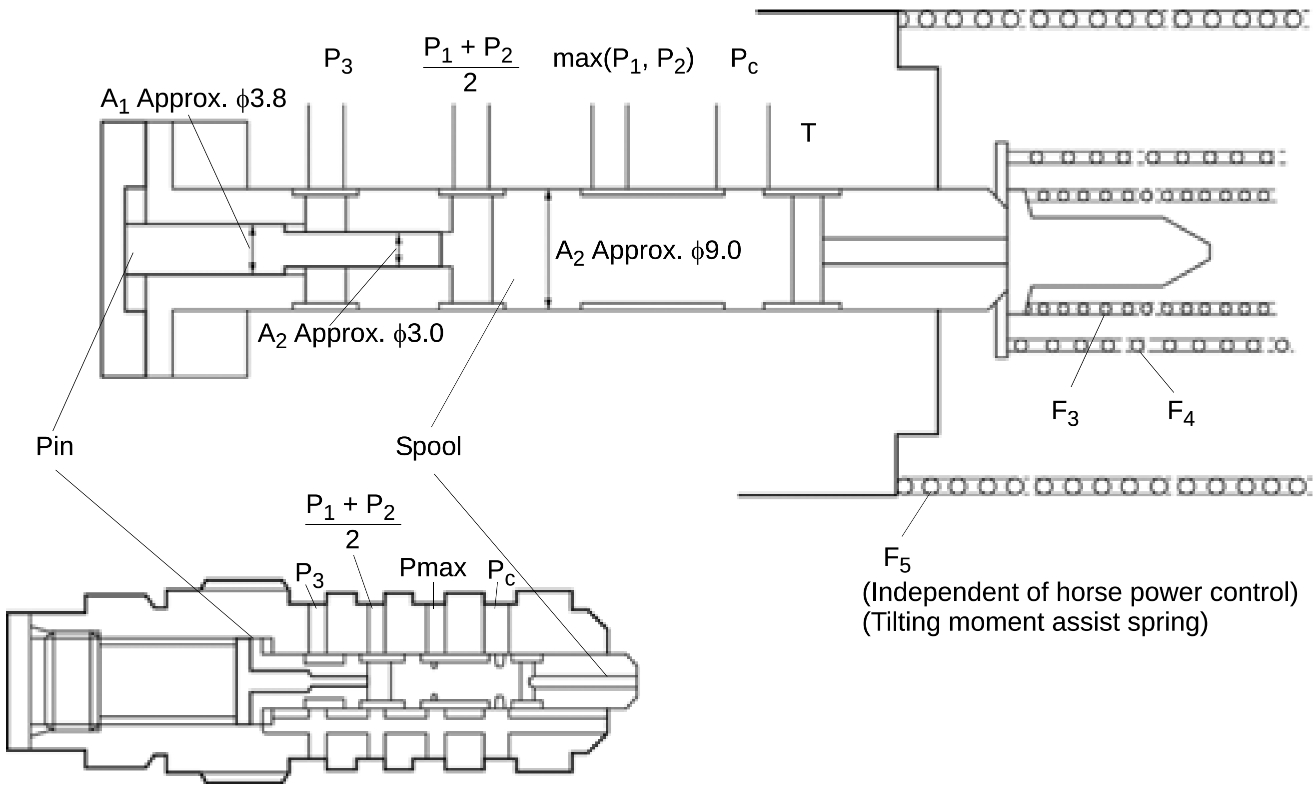


Clockwise moment of the cylinder block
$= (L_2 \times F - L_1 \times F) \times \cos\theta$

Because L1 is equal to L2, the above equation produces 0.

The small-diameter piston has been needed in order to make for greater tilting. (On the variable displacement type except for LS, a large spring has been employed instead of the small-diameter piston.)

2. Horse power control mechanism



$$F_1 = P_3 \times (A_1 - A_2)$$

$$F_2 = \frac{P_1 + P_2}{2} \times A_2$$

$$F_1 + F_2 = F_3 + F_4$$

$$F_3 = K_3 \times \chi + \alpha$$

$$F_3 = K_4 \times (\chi - L_4)$$

C.Control Valve

a. Feature

1	Section composition	Center open valve (ϕ14): 3-gang; Swivel, dozer, SP2 P3 confluence valve (ϕ14) Center open valve (ϕ14): 2-gang; Travel left and right Travel selector valve (ϕ18) Center closed valve (LS) (ϕ18): 4-gang monoblock; Arm, bucket, SP1, boom Center closed valve (LS) (ϕ14): 1-gang; Swing Center closed valve (LS) (other spec.) (ϕ14): 2-gang; Future option Angle blade, 2-piece boom
2	Maximum load pressure selection (system change)	High pressure selection = Check valve + LS bleed orifice (ϕ0.5)
3	Spare port	SP1 maximum flow limit: By proportional valve SP1 flow rate: 100 L/min ,26.4 GPM SP2 maximum flow limit: Mechanical stopper SP2 flow rate: 67 L/min, 17.7 GPM
4	Signal circuit	AI signal: PP1 Travel control signal: PP2 (P1 and P2 to the left or right travel section) LS control signal: PP3 P3 pump flow to join the LS system circuit by PP2 + PP3 (travel + LS front system control)
5	Travel speed change when using the dozer	Similar to a variable displacement pump system (speed change by P3 horsepower shift)
6	Traveling	Left/right travel pumps acting independently
7	Others	Boom s anti-drift valve: None (Leak reduction thanks to the holding valve)

b. Outline

(1) Hydraulic circuit

1	Three-pump LS	Front attachment (Boom, arm, bucket, swing, SP1)	P1 + P2
		Traveling	P1, P2
		Travel + Front attachment	Travel : P1, P2 Front attachment : P3
		Swivel: Dozer, SP2	P3
2	Pressure	Travel	29.4 MPa, 300 kgf/cm^2, 4267 psi
		Front attachment	27.4 MPa, 280 kgf/cm^2, 3983 psi
		Swivel, dozer, SP2 (Service port 2)	20.6 MPa, 210 kgf/cm^2, 2987 psi
		Travel + Front attachment	Travel : 29.4 MPa, 300 kgf/cm^2, 4267 psi Front attachment : 20.6 MPa, 210 kgf/cm^2, 2987 psi
3	Checking the back pressure	Main back-pressure check valve	0.4 MPa, 4.1 kgf/cm^2, 58.0 psi
		Oil cooler back-pressure check valve	0.1 MPa, 1.0 kgf/cm^2, 14.5 psi
4	Overload relief	Arm (bottom)	30.4 MPa, 310 kgf/cm^2, 4410 psi
		Arm (R), boom (B/R), bucket (B/R)	31.4 MPa, 320 kgf/cm^2, 4555 psi
		Dozer (B)	27.5 MPa, 280 kgf/cm^2, 3990 psi
		Dozer (R)	11.8 MPa, 120 kgf/cm^2, 1712 psi
		SP1 (Service port 1)	20.6 Mpa, 210 kgf/cm^2, 2987 psi
5	Others	Swing (R)	Anti-void
		SP2, swing (B)	Stop valve

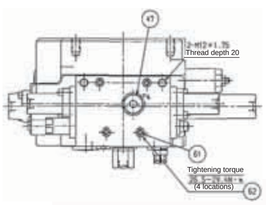
(2) Flow rate

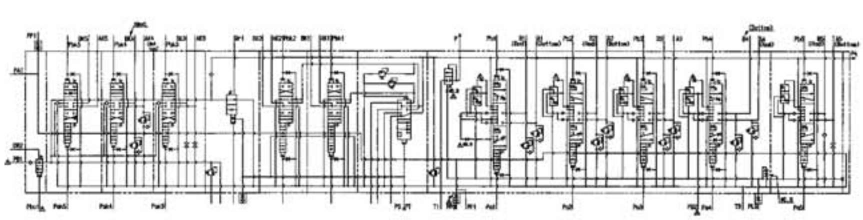
		Approx. flow rate : LPM (GPM)
Boom	Up	110 (29.1)
	Down	68 (18.0)
Arm	Crowded	130 (34.3)
	Dump	95 (25.1)
Bucket	Crowded	90 (23.8)
	Dump	90 (23.8)
SP1		100 (26.4)
Swing	Right	38 (10.0)
	Left	55 (14.5)
Swivel		67 (17.7)
Travel	R L	72 (19.0) each
Dozer	Up	67 (17.7)
	Down	67 (17.7)
SP2		67 (17.7)

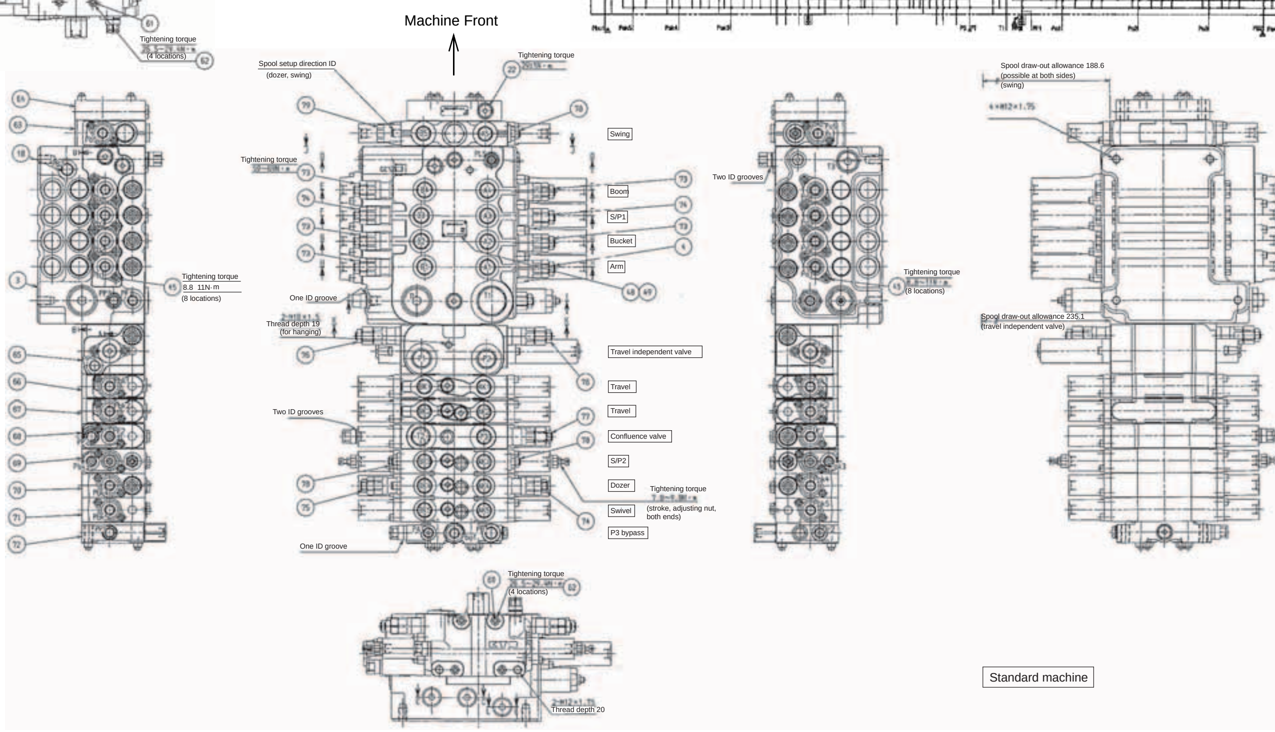
Note : Above flow amount varies according to the load pressure.

c. Ccontrol valve

1. Overall view of control valve







ID No.	Part name	Q'ty	Remarks
1			
2			
3	Valve housing	1	
4	Relief valve kit	1	A1 30.4 0.3MPa at 5L/min
5	Spool	1	
6	Spool	1	
7	Spool	1	
8	Spool	1	
9	Cap	4	
10	Cap	4	
11	Spool end	4	
12	Spring	4	
13	Spring seat	8	
14	Plug	8	
15	Spool	1	
16	Spool	1	
17	Poppet	4	
18	Plug assembly	3	
19	Poppet	1	
20	Spring	1	
21	Plug assembly	1	
22	Plug assembly	6	
23	O-ring	16	
24	Plug	8	
25	Poppet	8	
26	Spring	8	
27	Spool	1	
28	Spool	1	
29	O-ring	8	JISB2401,1A, P26
30	Plug assembly	1	
31	Relief valve kit	1	P(L5) 27.4 0.3MPa at 48L/min
32	Spool	1	
33	Plug	1	
34	Stopper	1	
35	Set-screw	1	JISB1177, M8x25L
36	Nut	1	JISB1181, M8
37	Spring	1	
38	O-ring	1	JISB2401,1B, P12
39	Backup ring	1	JISB2407,P12, T2
40	O-ring	1	JISB2401,1B, P24
41	Sleeve	1	
42	Plug assembly	2	
43	O-ring	1	JISB2401,1B, P16
44	Backup ring	2	JISB2407,P16, T2
45	Socket head bolt	16	JISB1176, M6x20L
46	Plug assembly	1	
47	Plug assembly	2	
48	Nameplate	1	
49	Drive screw	2	
50			

ID No.	Part name	Q'ty	Remarks
51			
52			
53			
54	O-ring	1	JISB2401, 1A, G70
55	O-ring	1	JISB2401, 1A, G75
56	O-ring	1	JISB2401, 1B, P7
57	Spring seat	1	
58			
59			
60	Tie-rod	4	
61	Tie-rod	4	
62	Nut	8	
63	Spool section assembly	1	Swing
64	Outlet housing	1	Outlet
65	Spool section assembly	1	Travel independent valve
66	Spool section assembly	1	Travel
67	Spool section assembly	1	Travel
68	Spool section assembly	1	Confluence valve
69	Spool section assembly	1	S/PS
70	Spool section assembly	1	Dozer
71	Spool section assembly	1	Swivel
72	Outlet section assembly	1	P3 bypass valve
73	Relief valve kit	5	B1,A2,B2,A4,B4 31.4 0.3MPa at 5L/min
74	Relief valve kit	3	A3,B3,AK4 20.6 0.3MPa at 5L/min
75	Relief valve kit	1	BK4 11.8 0.3MPa at 5L/min
76	Relief valve kit	2	P1,P2 29.4 0.3MPa at 43L/min
77	Relief valve kit	1	P3 20.6 0.3MPa at 66L/min
78	Shut-off valve assembly	3	AK3, BK3, A5
79	Anti-void valve assembly	1	B5

2. Control valve specifications

1.	Maximum flow rate:		P1, P2; 72 L/min, P3; 66 L/min
2.	Maximum pressure:		P1, P2; 29.4 MPa, P3; 20.6 MPa
3.	Operating oil temperature range:		253 to 368 °K (-20 to 100°C)
4.	Operating hydraulic oil type:		ISO VG46 or equivalent
5.	Main relief vale pressure setting:	P1, P2 (travel independent valve);	29.4 0.3 MPa at 43 L/min
		P LS ;	27.4 0.3 MPa at 48 L/min
		P3;	20.6 0.3 MPa at 66 L/min
6.	Unload valve pressure setting:		2.45 0.1 MPa at 26 L/min
7.	Overload relief valve pressure setting:	Arm	A1; 30.4 0.3 MPa at 5 L/min
			B1; 31.4 0.3 MPa at 5 L/min
		Bucket	A2; 31.4 0.3 MPa at 5 L/min
			B2; 31.4 0.3 MPa at 5 L/min
		S/P	A3; 20.6 0.3 MPa at 5 L/min
			B3; 20.6 0.3 MPa at 5 L/min
		Boom	A4; 31.4 0.3 MPa at 5 L/min
			B4; 31.4 0.3 MPa at 5 L/min
		Blade	AK4; 27.4 0.3 MPa at 5 L/min
			BK4; 11.8 0.3 MPa at 5 L/min
8.	Pilot air bleeding area		Swivel, dozer, travel, swing, S/P2, arm, S/P1, bucket, boom
9	Equipped with S/P2 spool stroke adjustment mechanism:		Adjustable range; 2 8 mm
10	Pump LS control pressure difference setting:		1.5 MPa
11.	Genuine Kubota part code:		RO809-61131

Tightening torque for aluminum cap/port joint (pipe)

Port size	PF1/4
Ports applied	pa5, pb5, pak1 2, pak 4 5, pbk 1 2, pbk 4 5
Recommended tightening torque	34.3 N m
Maximum torque	39.2 N m
Thread breaking torque	44.1 N m
Conditions	Standard-size joint (threaded-part length 12)
Remarks	Be careful not to apply any torque over maximum one.

Port name	Port size
T1	PF1-1/4
P1, P2, T2, P	PF3/4
A1 A4, B1 B4	7/8-14UNF
P3, P4, A5, B5, AK1 AK5, BK1 BK5, T3	PF1/2
PB1 , PB2	PF3/8
Pa1 Pa5, Pb1 Pb5, Pak1 Pak5, Pbk1 Pbk5, PP1 PP3, PPS, PLS, PAI, PF1, PF2, PT, Dr1, Dr2, Pbu1	PF1/4

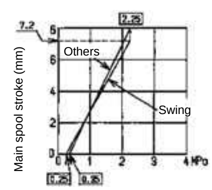


Fig. 1 Pressure receiving characteristic of main spool

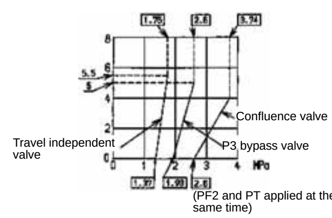
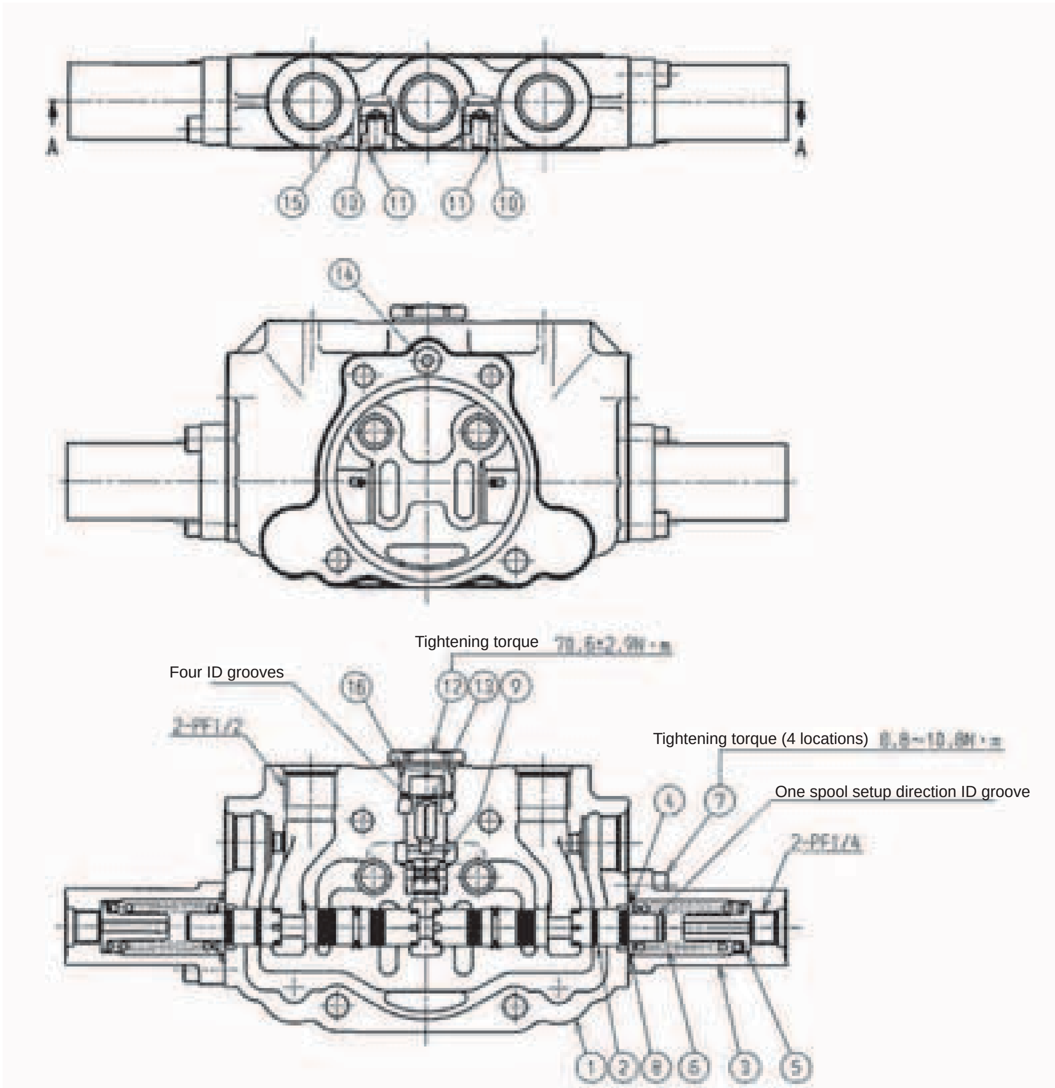


Fig. 2 Pressure receiving characteristic of travel independent and other valves

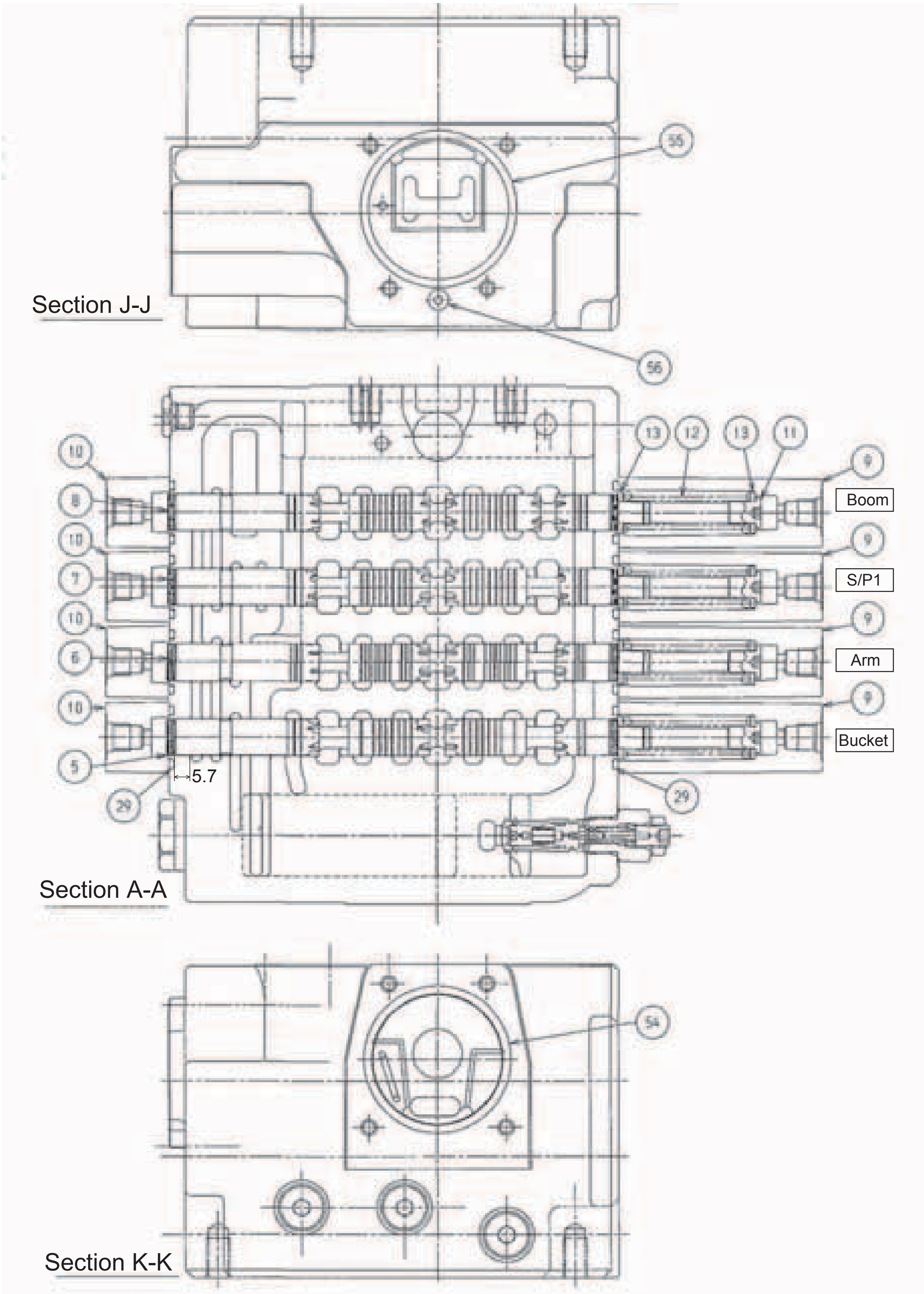
3. Swing section

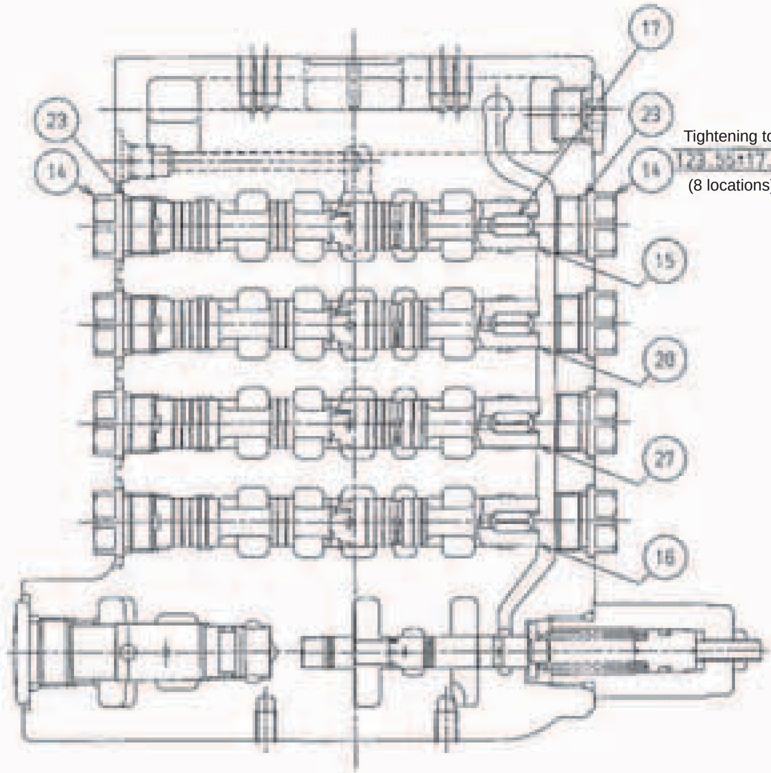


Section A-A

ID No.	Part name	Q'ty	Remarks
1	Valve housing		
2	Spool		
3	Cap	1	
4	Spring seat	1	
5	Spring seat	1	
6	Spring	1	
7	Socket head bolt	1	JISB1176, M6x18L
8	O-ring	1	JISB2401,1A, S24
9	Spool (compensation valve)	4	
10	Poppet (check valve)	4	
11	Spring (check valve)	4	
12	Plug	4	
13	Poppet	8	
14	O-ring	8	JISB2401,18, P7
15	O-ring	1	
16	O-ring	1	JISB2401,1B, P18

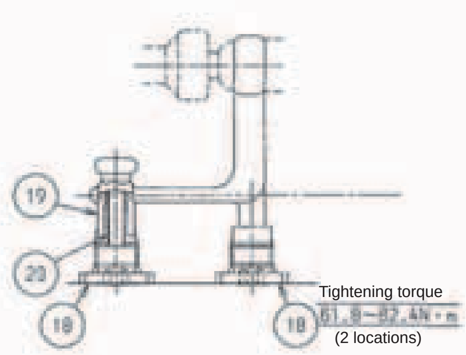
4. Control valve; Uni-block section assy



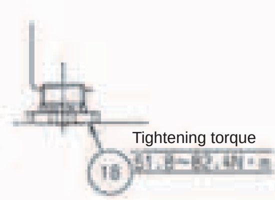


Section B-B

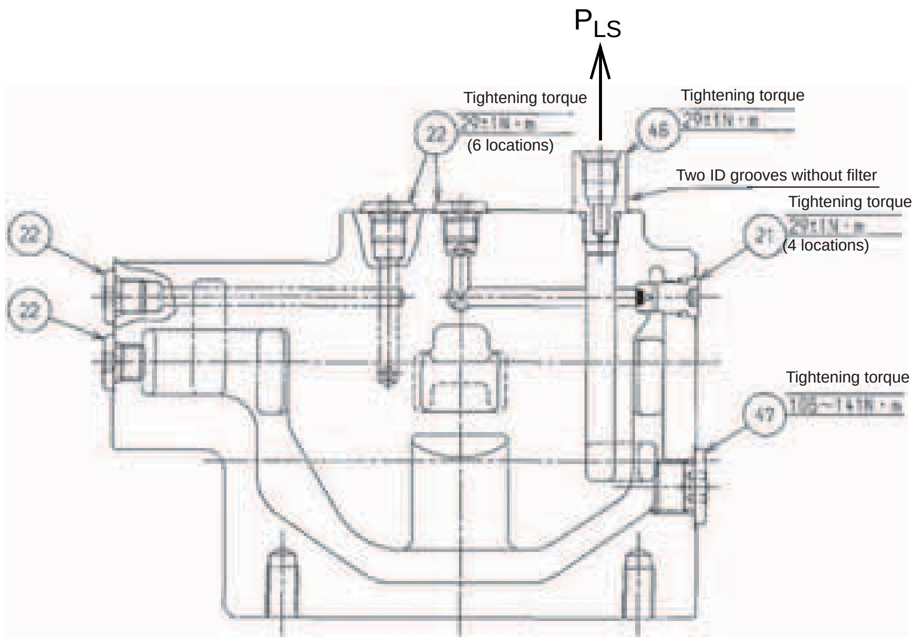
(Check poppet for arm regeneration)



Section C-C

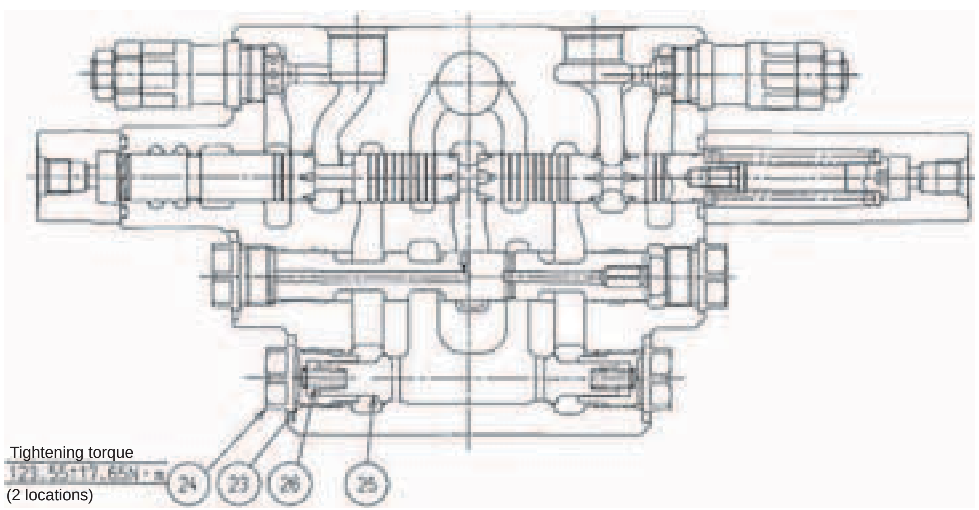


Section L-L



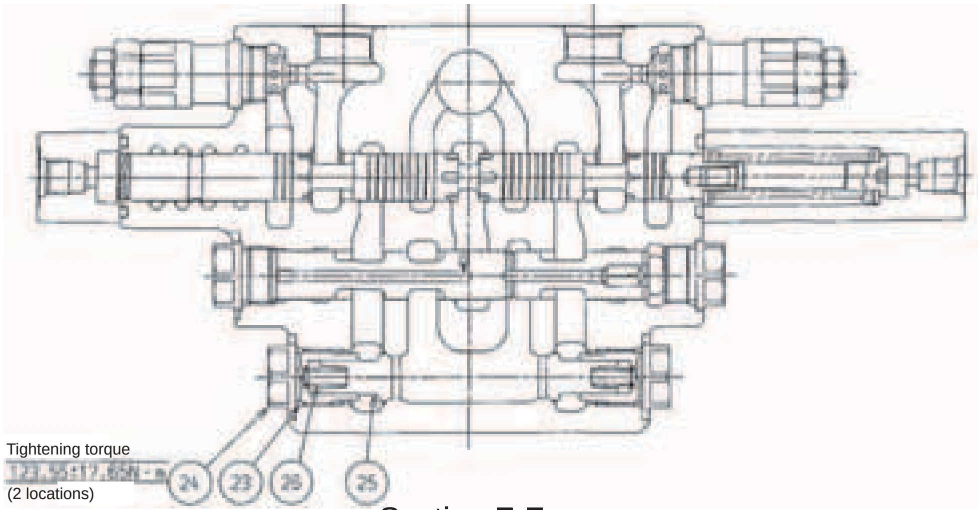
Section D-D

5. Boom



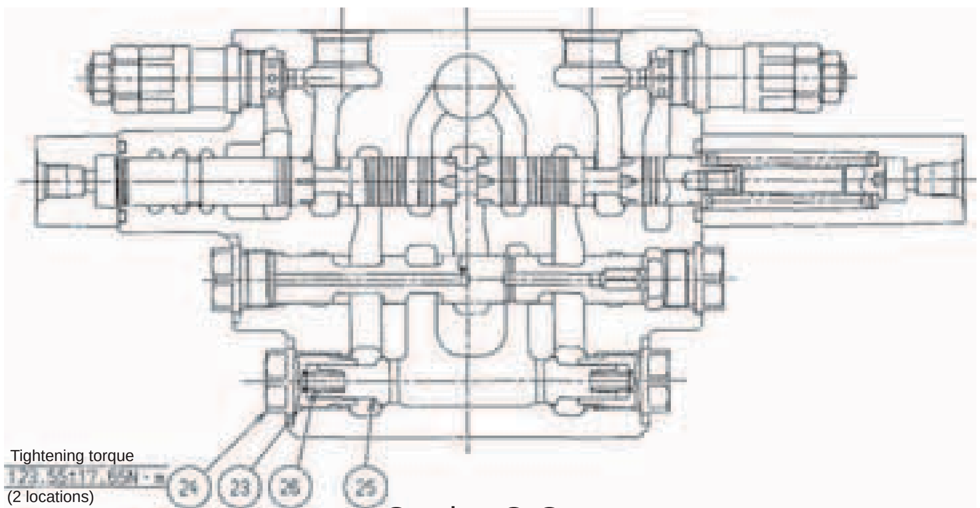
Section E-E

6. S/P1



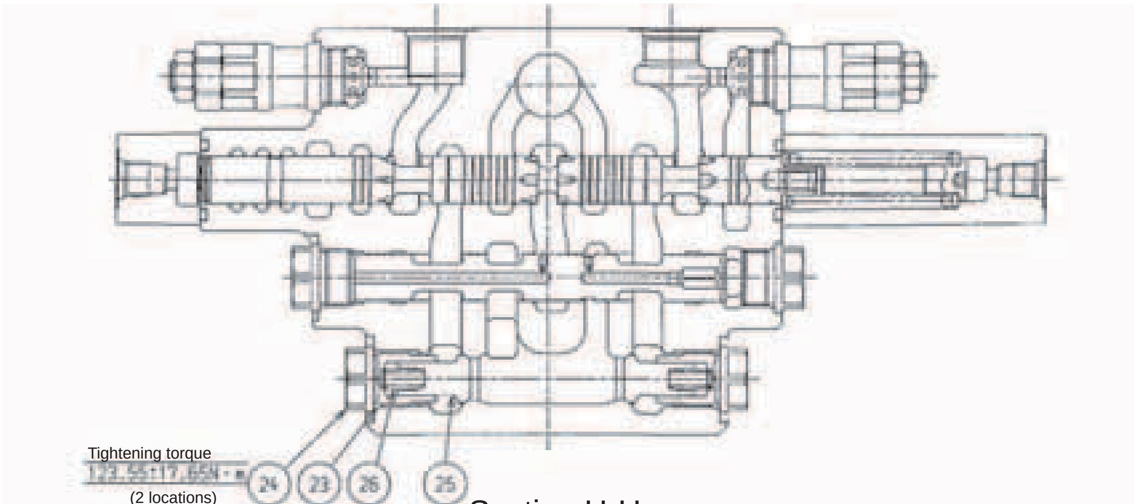
Section F-F

7. Bucket

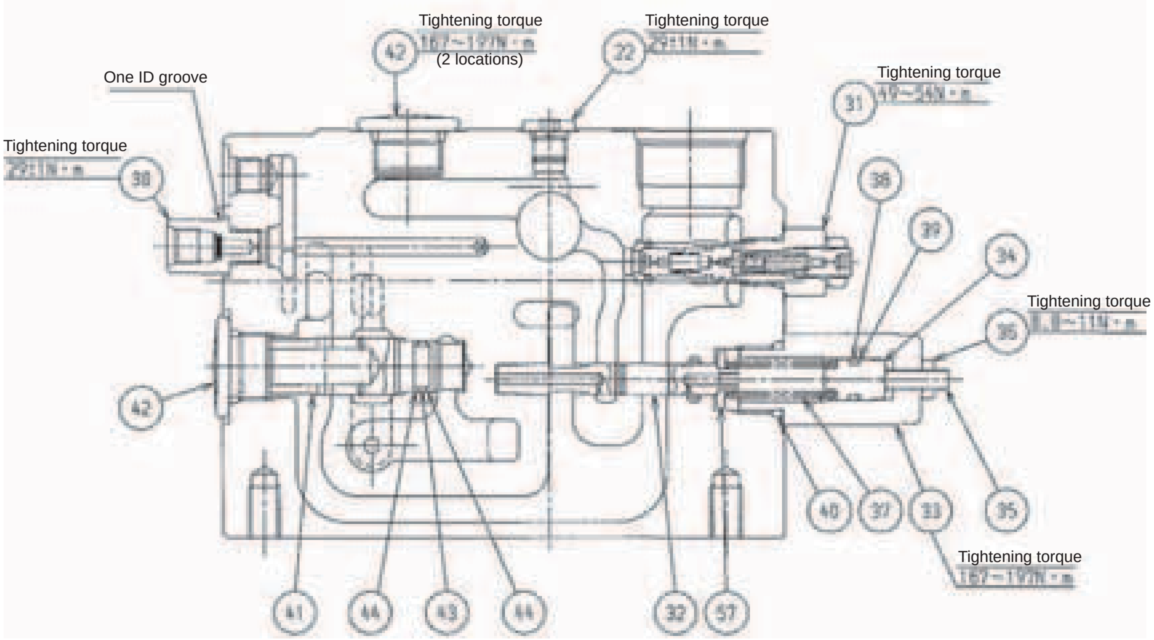


Section G-G

8. Arm

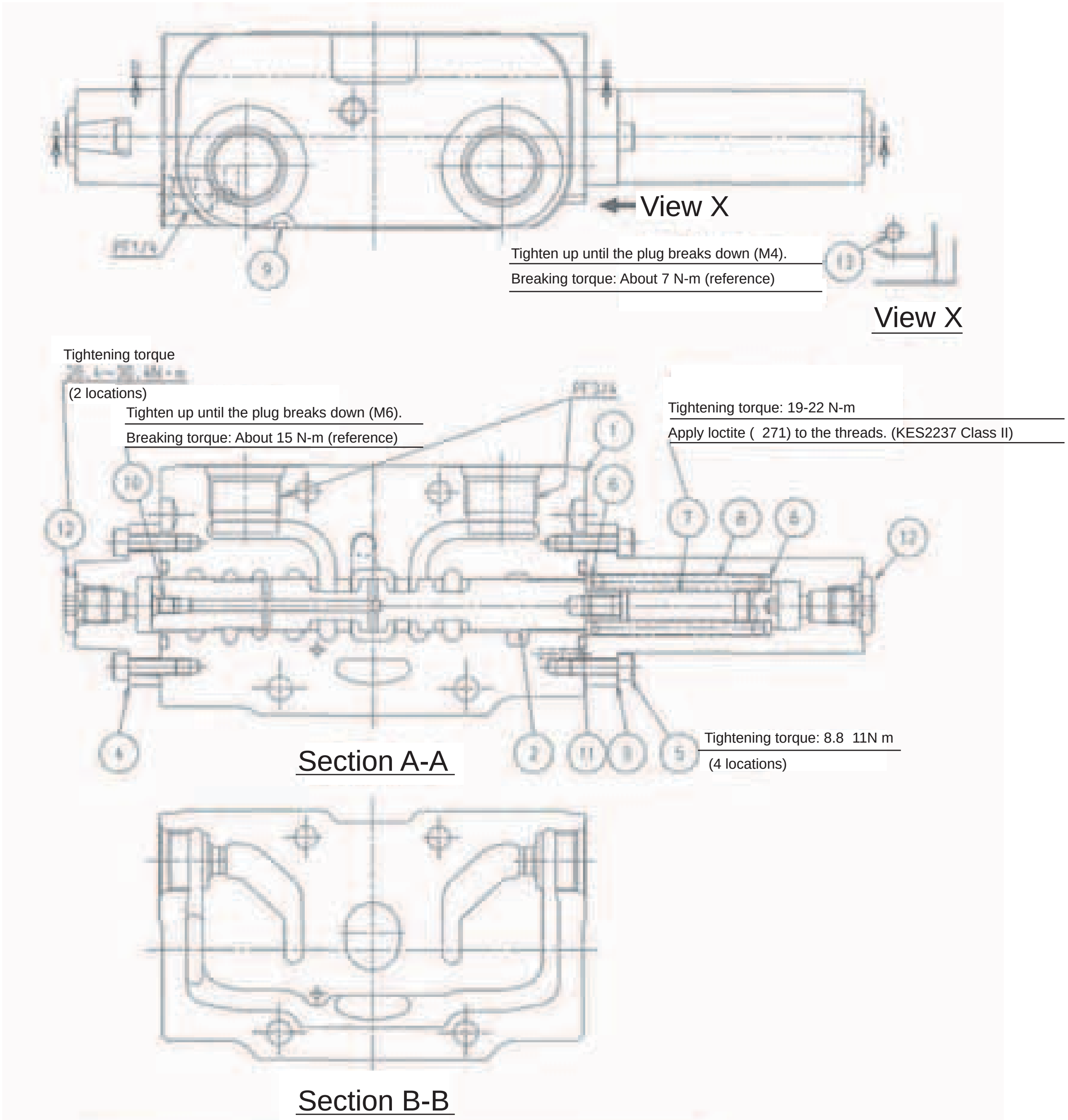


Section H-H



Section I-I

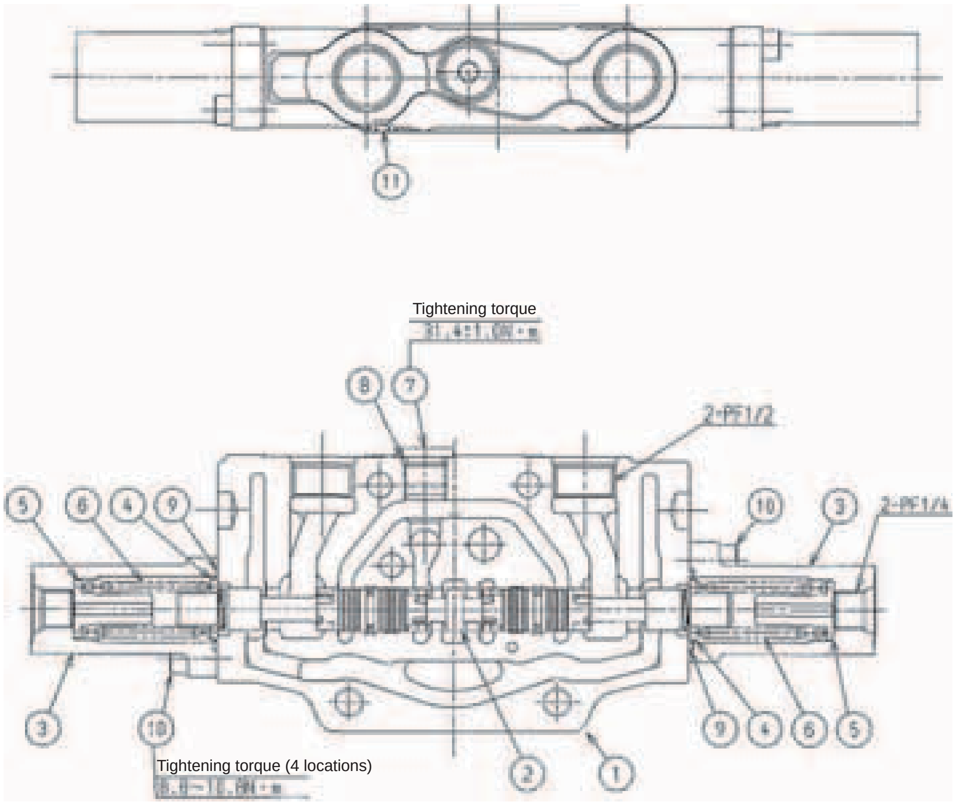
9. Travel independent valve



ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap	1	
4	Cap	1	
5	Socket head bolt	4	JISB1176, M6x18L
6	Spring seat	2	
7	Spool end	1	
8	Spring	1	
9	O-ring	1	JISB2401,1A, G70
10	Plug	1	
11	O-ring	2	JISB2401,1A, P26
12	Plug assembly	2	
13	Plug	1	

10.Travel, R section

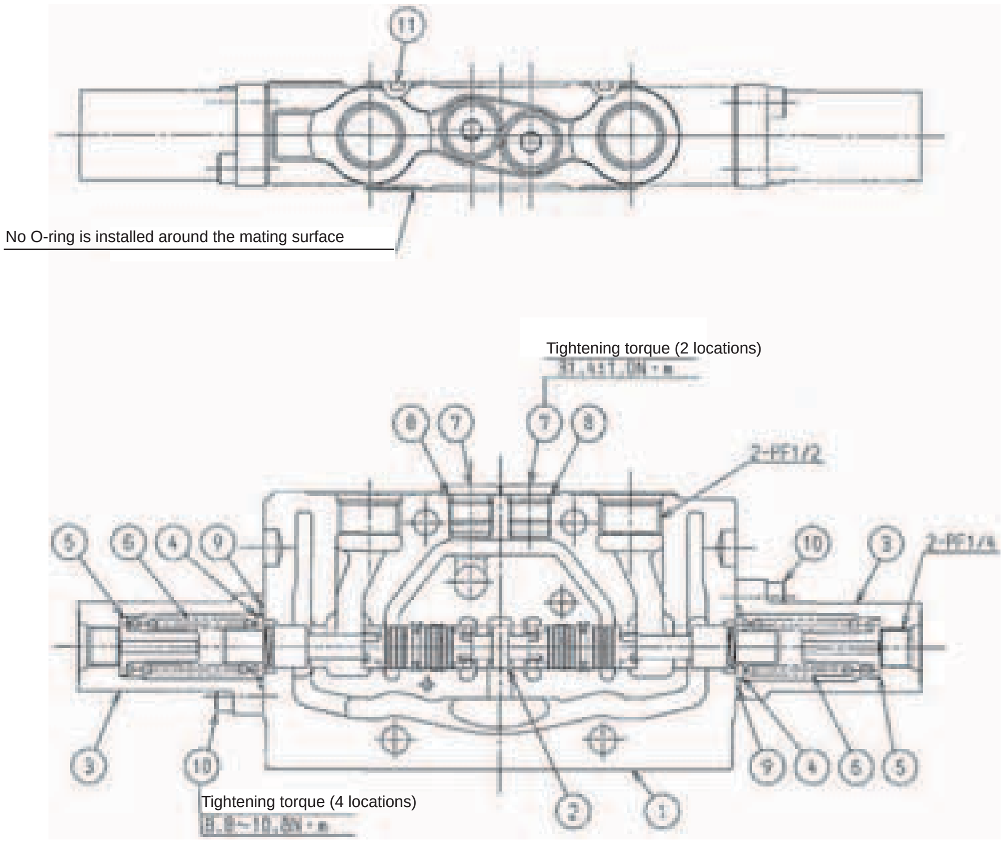
Travel upstream (next to travel independent valve)



ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap	2	
4	Spring seat	2	
5	Spring seat	2	
6	Spring	2	
7	Plug	1	
8	O-ring	1	
9	O-ring	2	JISB2401,1A, G70
10	Socket head bolt	4	JISB1176, M6x18L
11	O-ring	1	JISB2401,1A, G70

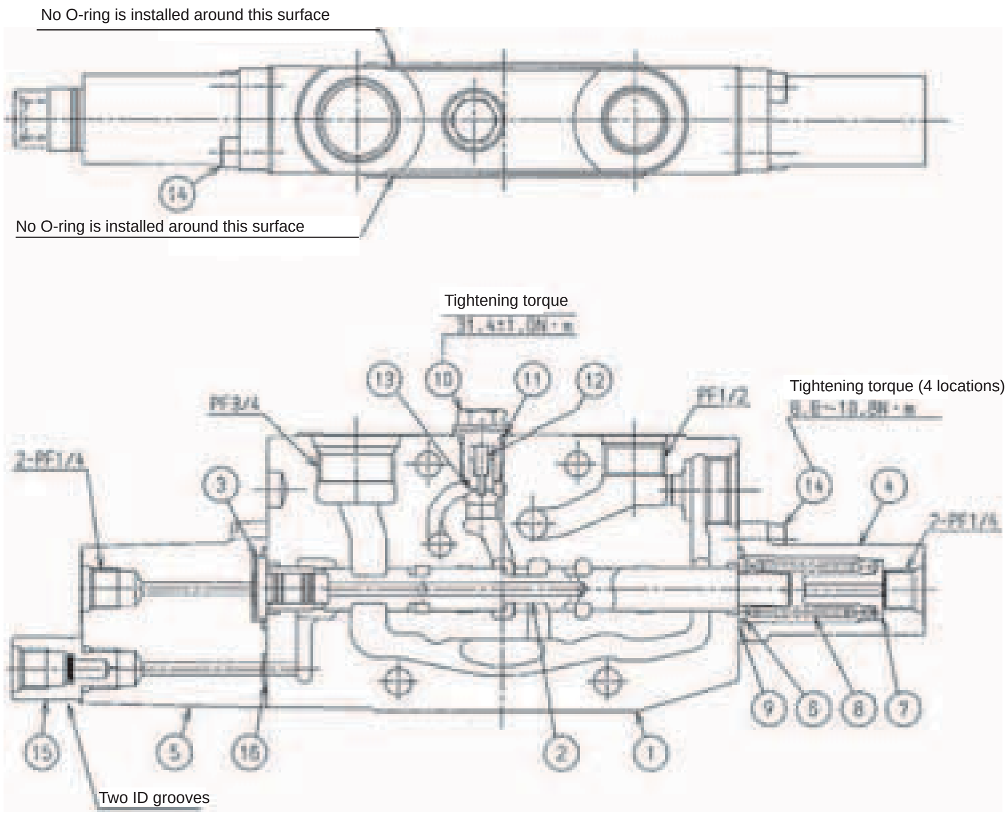
11.Travel, L section

Travel downstream (next to confluence valve)



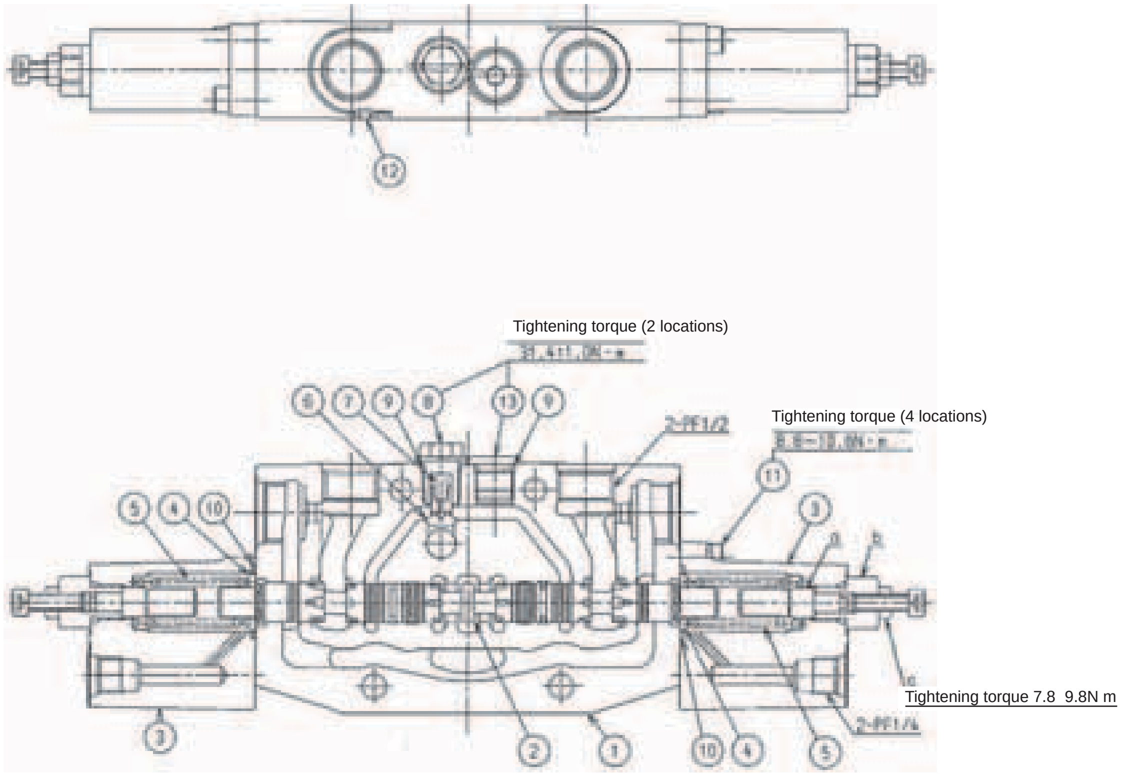
ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap	2	
4	Spring seat	2	
5	Spring seat	2	
6	Spring	2	
7	Plug	2	
8	O-ring	2	
9	O-ring	2	JISB2401,1A, P24
10	Socket head bolt	4	JISB1176, M6x18L
11	O-ring	1	JISB2401,1A, G70

12.Combined valve

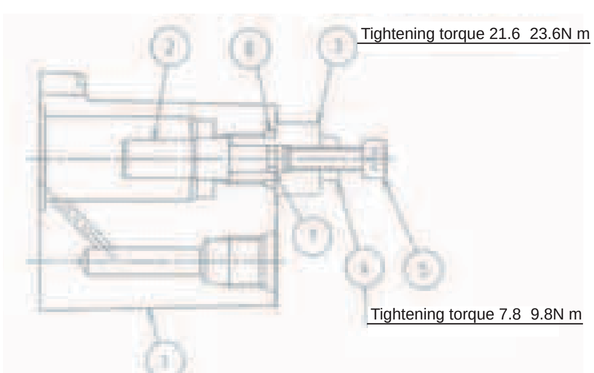


ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Piston	1	
4	Cap	1	
5	Cap	1	
6	Spring seat	1	
7	Spring seat	1	
8	Spring	1	
9	O-ring	2	JISB2401,1A, P24
10	Plug (check valve)	1	
11	O-ring	1	
12	Spring	1	
13	Poppet (check valve)	1	
14	Socket head bolt	4	JISB1176, M6x18L
15	Plug assembly	1	
16	O-ring	1	JISB2401,1A, G70

13.S/P2 valve



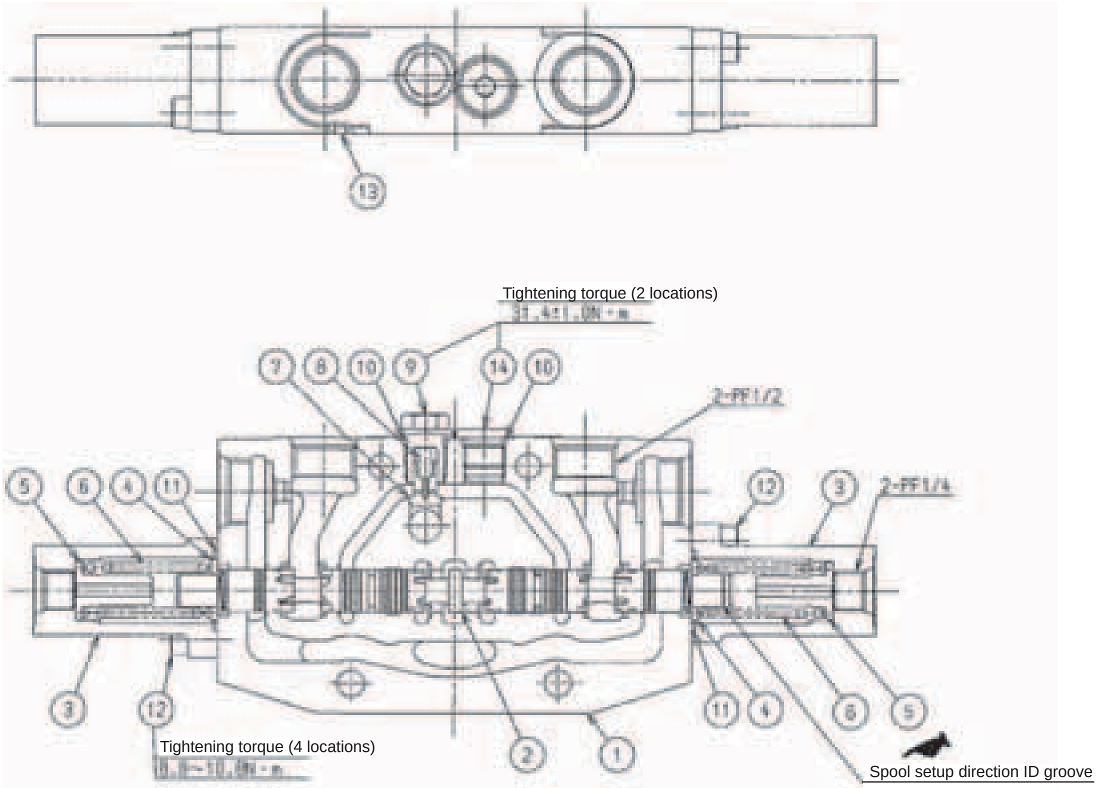
ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap assembly	2	
4	Spring seat	2	
5	Spring	2	
6	Poppet (check valve)	1	
7	Spring (check valve)	1	
8	Plug (check valve)	1	
9	O-ring	2	
10	O-ring	2	JISB2401,1A, P24
11	Socket head bolt	4	JISB1176, M6x18L
12	O-ring	1	JISB2401,1A, G70
13	Plug	1	



ID No.	Part name	Q'ty	Remarks
1	Cap	1	
2	Piston	1	
3	Plug	1	
4	Nut	1	JISB1181, M16
5	Socket head bolt	1	JISB1176, M6x20L
6	O-ring	1	JISB2401,1B, P11
7	O-ring	1	JISB2401,1A, P4

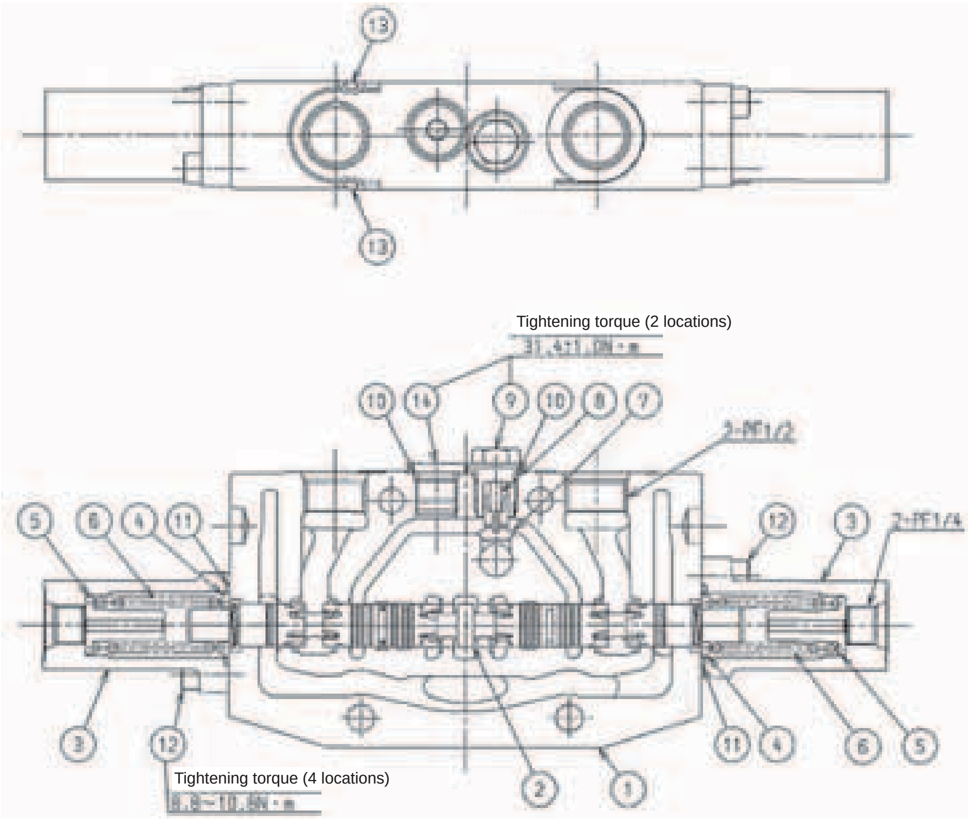
(Note : This part is compatible with KX161-3S/α)

14.Dozer section



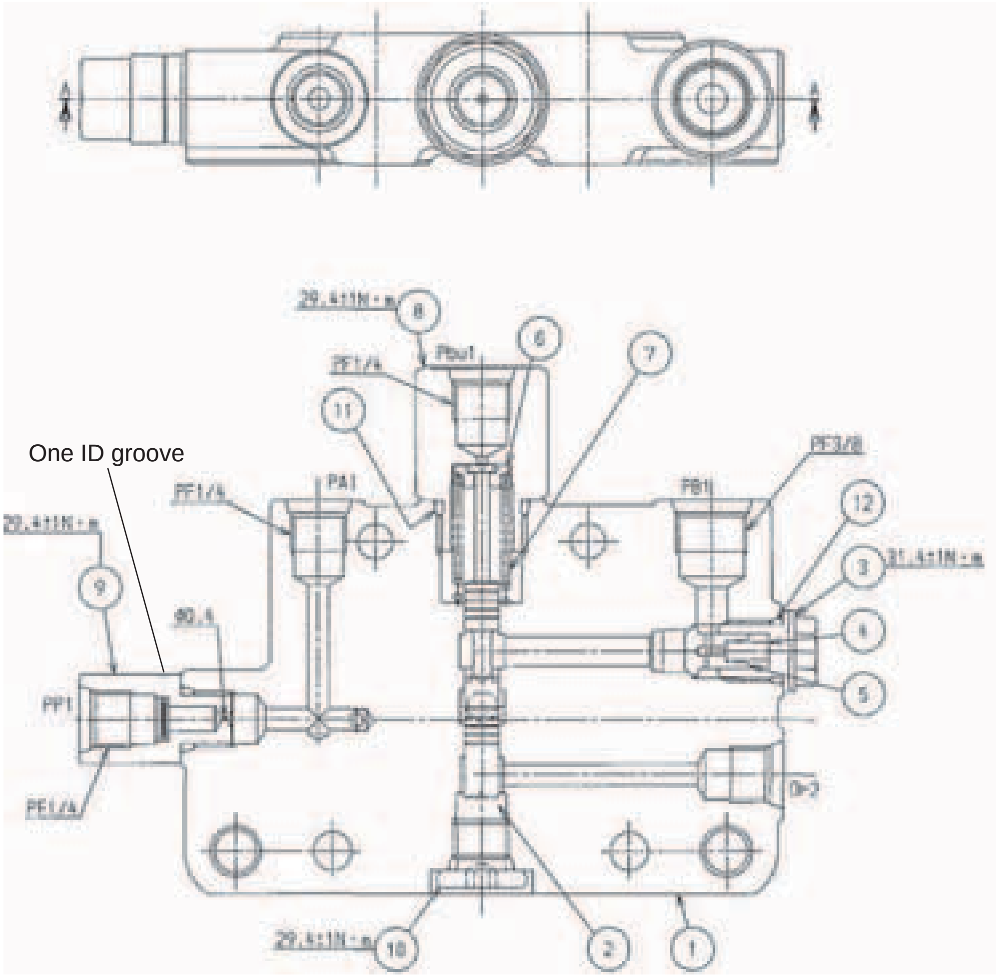
ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap	2	
4	Spring seat	2	
5	Spring seat	2	
6	Spring	2	
7	Poppet (check valve)	1	
8	Spring (check valve)	1	
9	Plug (check valve)	1	
10	O-ring	2	
11	O-ring	2	JISB2401,1A, P24
12	Socket head bolt	4	JISB1176, M6x18L
13	O-ring	1	JISB2401,1A, G70
14	Plug	1	

15.Swivel section



ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Cap	2	
4	Spring seat	2	
5	Spring seat	2	
6	Spring	2	
7	Poppet (check valve)	1	
8	Spring (check valve)	1	
9	Plug (check valve)	1	
10	O-ring	2	
11	O-ring	2	JISB2401,1A, P24
12	Socket head bolt	4	JISB1176, M6x18L
13	O-ring	2	JISB2401,1A, G70
14	Plug	1	

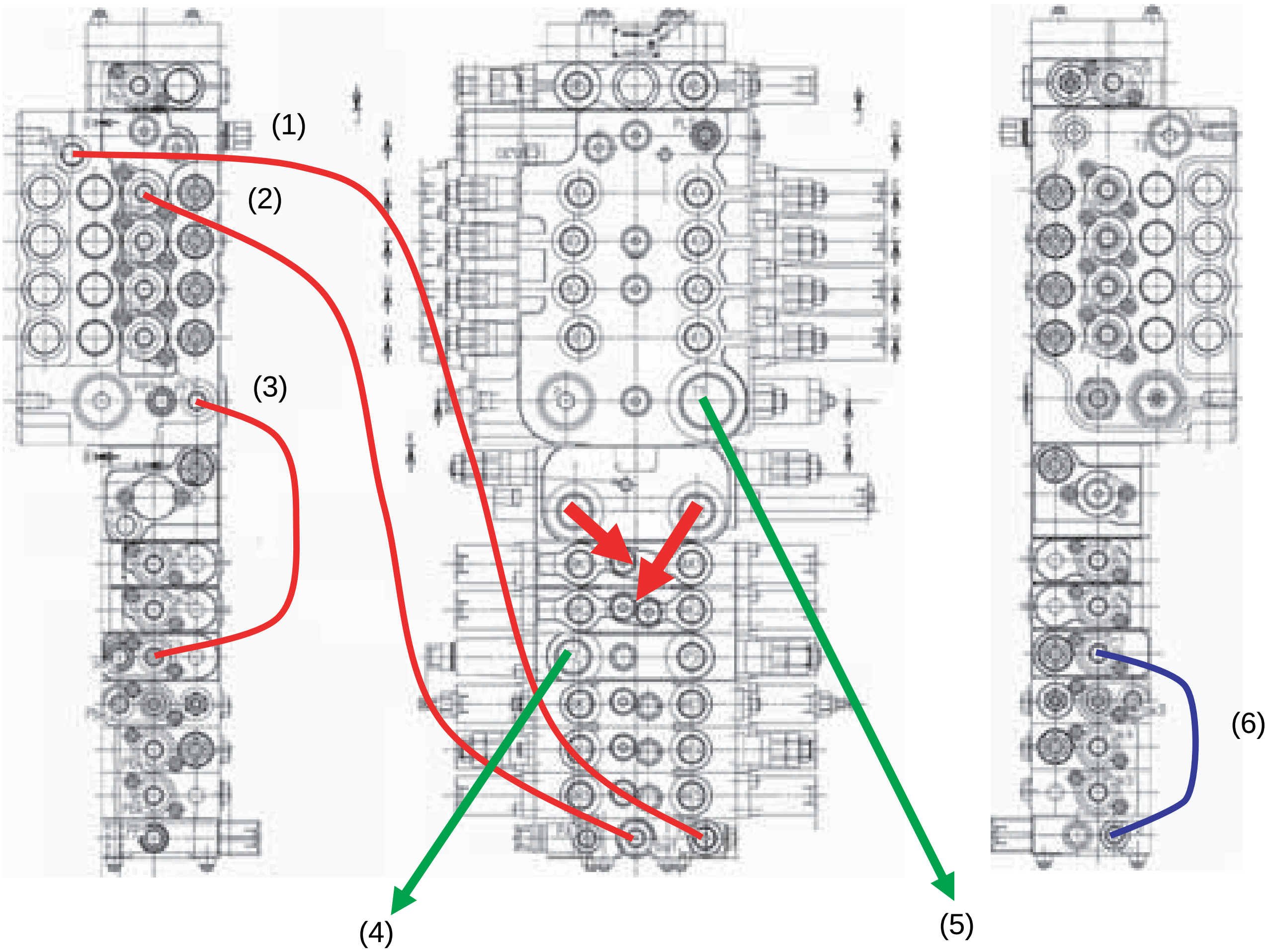
16.Outlet section, P3 bypass valve



Section A-A

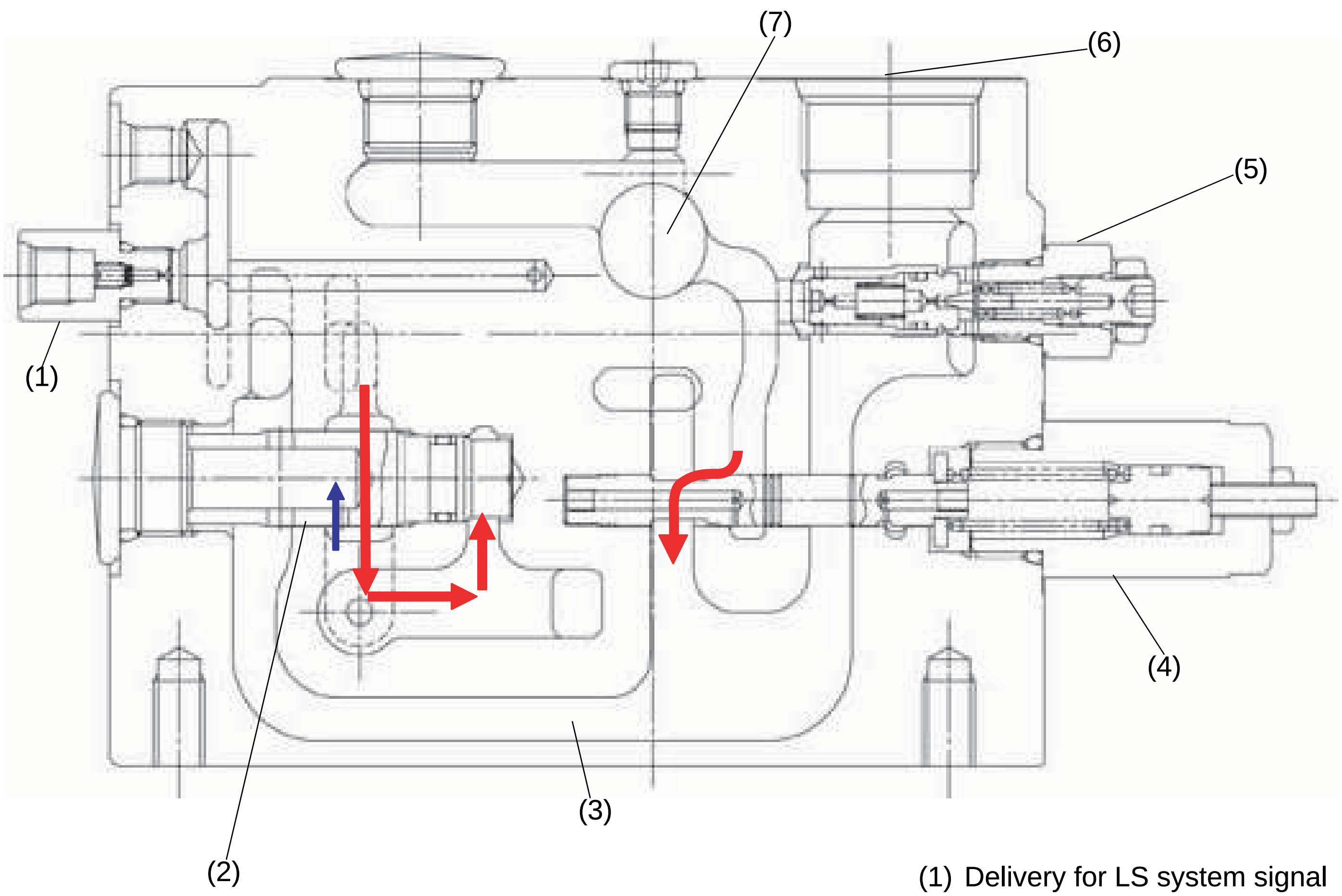
ID No.	Part name	Q'ty	Remarks
1	Valve housing	1	
2	Spool	1	
3	Plug	2	
4	Spring	2	
5	Poppet	2	
6	Spring seat	1	
7	Spring	1	
8	Plug	1	
9	Plug assembly	2	
10	Plug assembly	2	
11	O-ring	4	JISB2401,1B, P18
12	O-ring	1	

d. Layout, delivery circuit and external pipe flow



(1) P3 bypass confluence
(2) P3 bypass signal branch
(3) LS system detection external circuit
(4) To oil cooler via swivel motor and back-pressure check valve
(5) Return filter via back-pressure check valve
(6) Drain

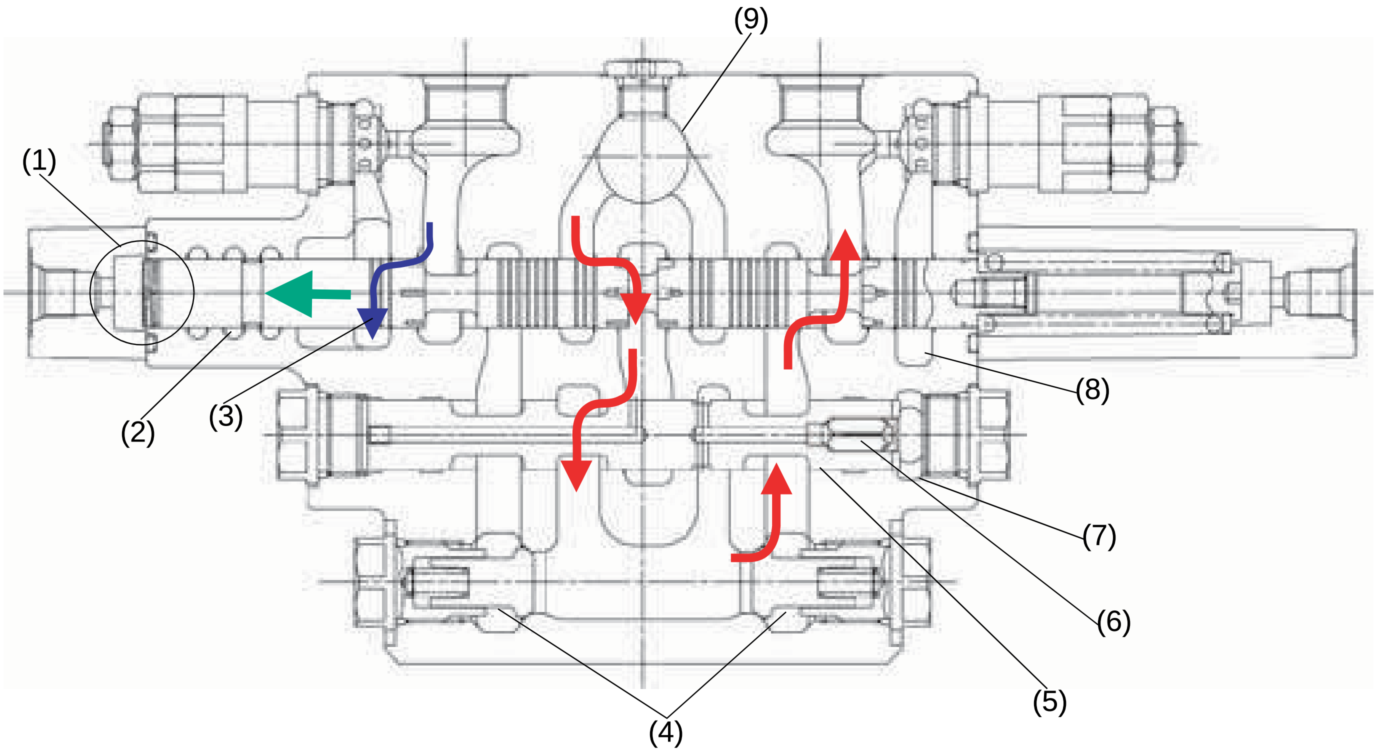
e. Inlet section of mono-block valve



Monoblock inlet
LS relief, unload relief, arm regenerative spool

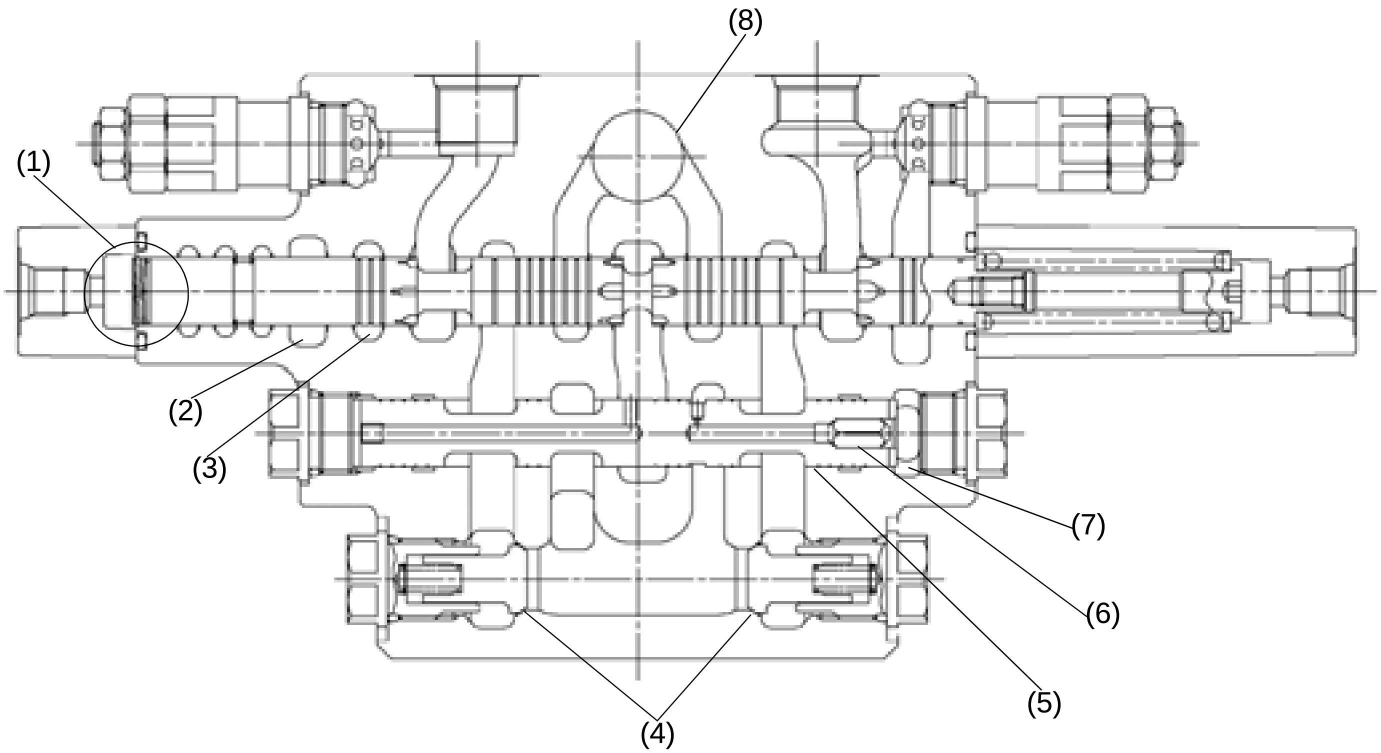
(1) Delivery for LS system signal (PP3) (LS system control detected)
(2) Arm s regenerative spool
(3) Tank circuit
(4) LS system unload relief 2.5 MPa
(5) LS system main relief 27.4 MPa
(6) Tank circuit to back-pressure check valve
(7) Pump circuit

f. Center closed valve section (Bucket, S/P 1, Boom)



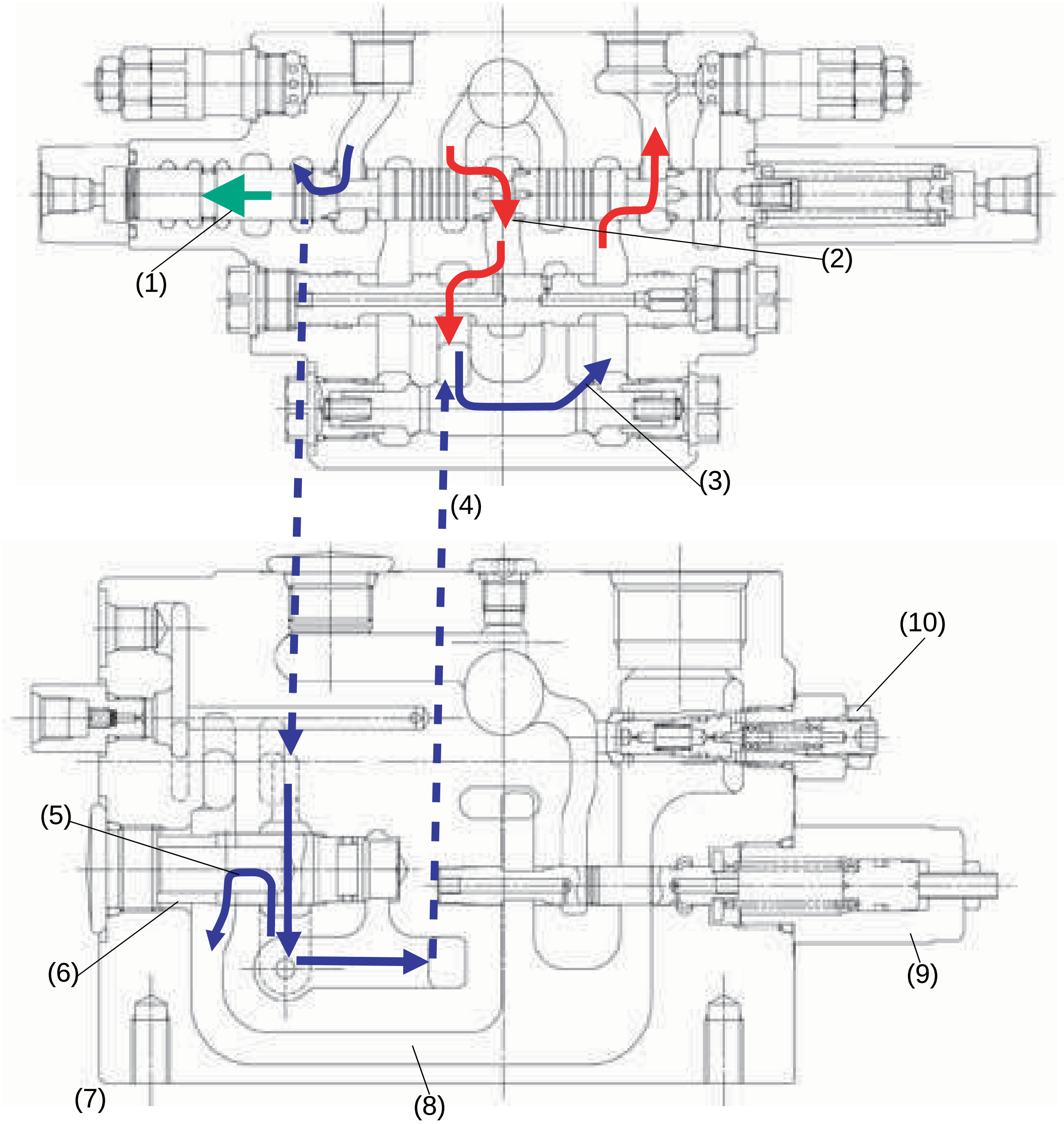
(1) Spiral groove air bleeding circuit
(2) AI signal circuit
(3) Tank circuit
(4) Return check valve
(5) Pressure compensating valve (Compensating spool)
(6) Check valve for PLS signal high-pressure selection
(7) LS signal circuit
(8) Tank circuit
(9) Pump circuit

g. Center closed valve section (Arm)



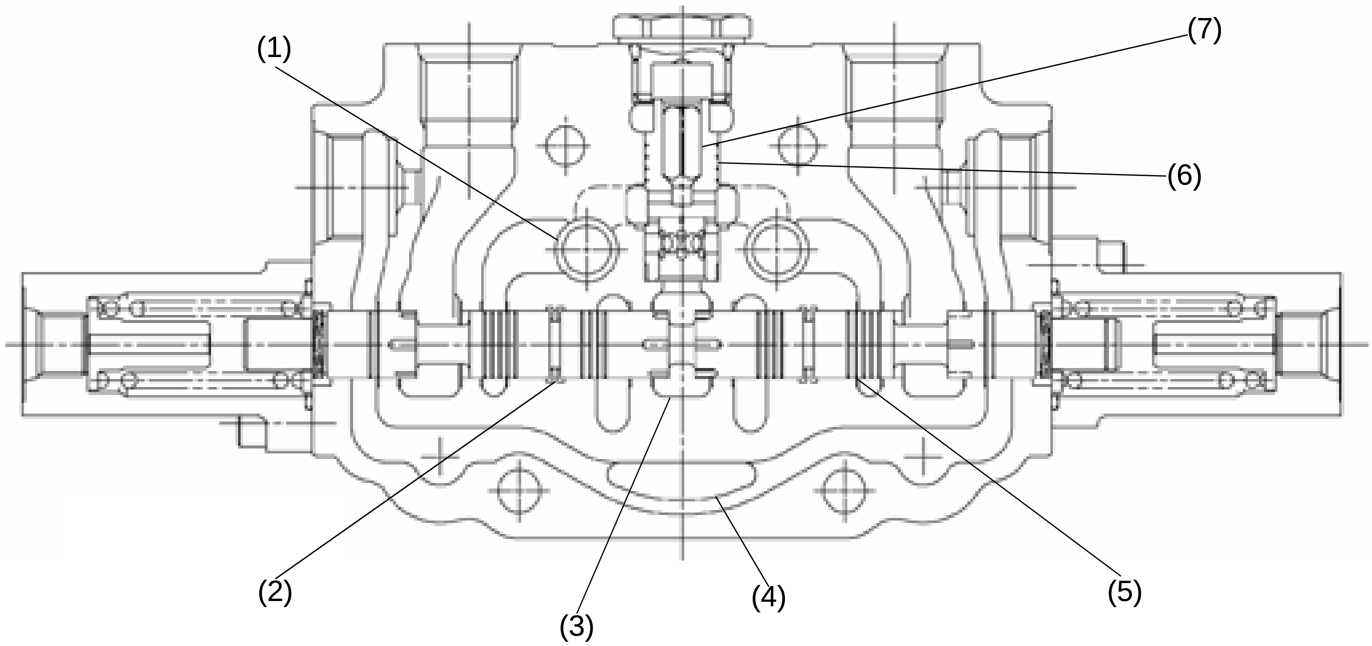
(1) Spiral groove air bleeding circuit
(2) Tank circuit
(3) Main spool with arm regeneration
(4) Return check valve
(Load check valve)
(5) Pressure compensating valve
(Compensating spool)
(6) Check valve for PLS signal high-pressure selection
(7) LS signal circuit
(8) Pump circuit

h. Arm regenerative flow



(1) Spool shift direction at arm crowding regeneration
(2) PC flow
(3) PC flow + Regenerative flow
(4) Regenerative flow
(5) Tank flow
(6) Regenerative spool
(7) Relief, unload section
(8) Tank circuit
(9) Unload valve
(10) LS, main

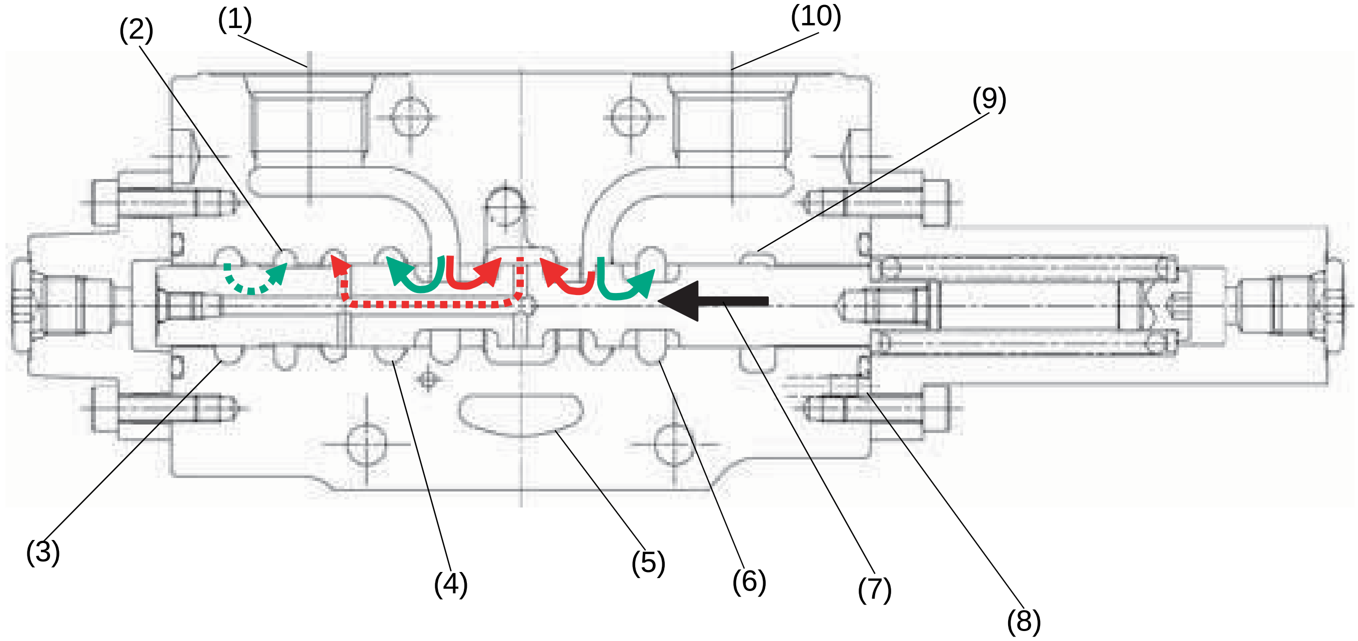
i. Swing section (Center closed valve)



S : enter close type section (Spool ia. ϕ)

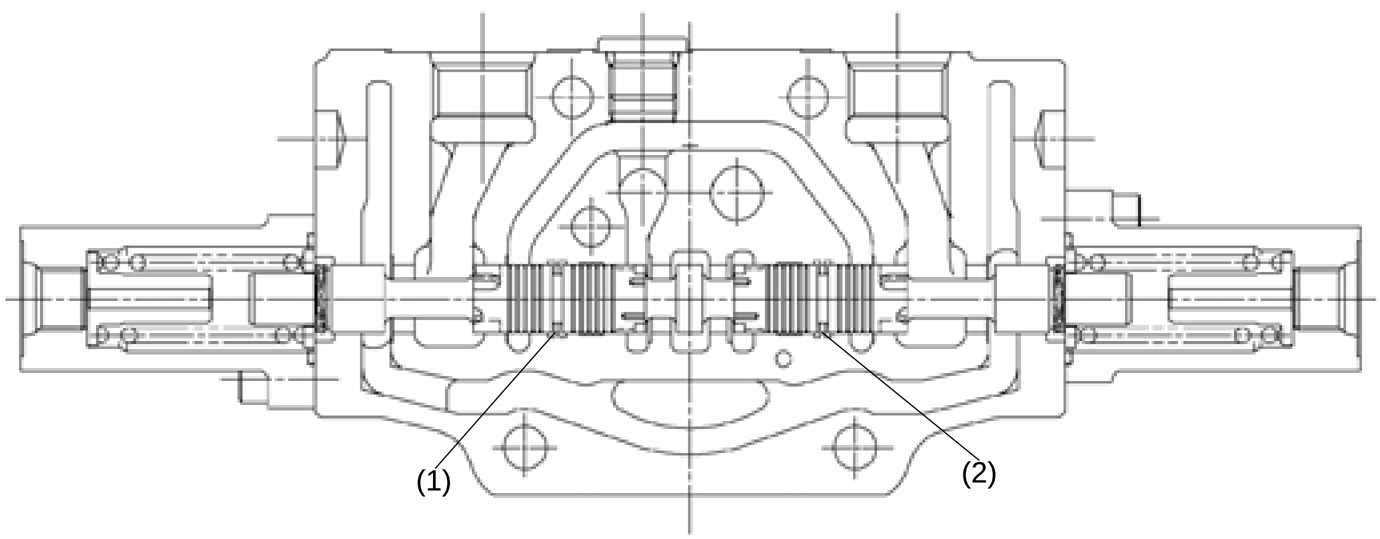
(1) Return check valve
(Load check valve)
(2) AI signal circuit
(3) Pump circuit
(4) Tank circuit
(5) Neutral-position pressure relief land abolished
(unlike conventional LS system)
(6) Pressure compensating valve
(Compensating spool)
(7) Check valve for PLS signal high-pressure selection

j. P1 and P2 inlets and travel selector valve



(1) P2 inlet
(2) Signal circuit to pump PPS
(3) Tank circuit
(4) To left-travel P circuit
(5) Tank circuit
(6) To Travel Right
(7) When traveling
(8)
(9) Travel selector signal circuit
(10) P1 inlet

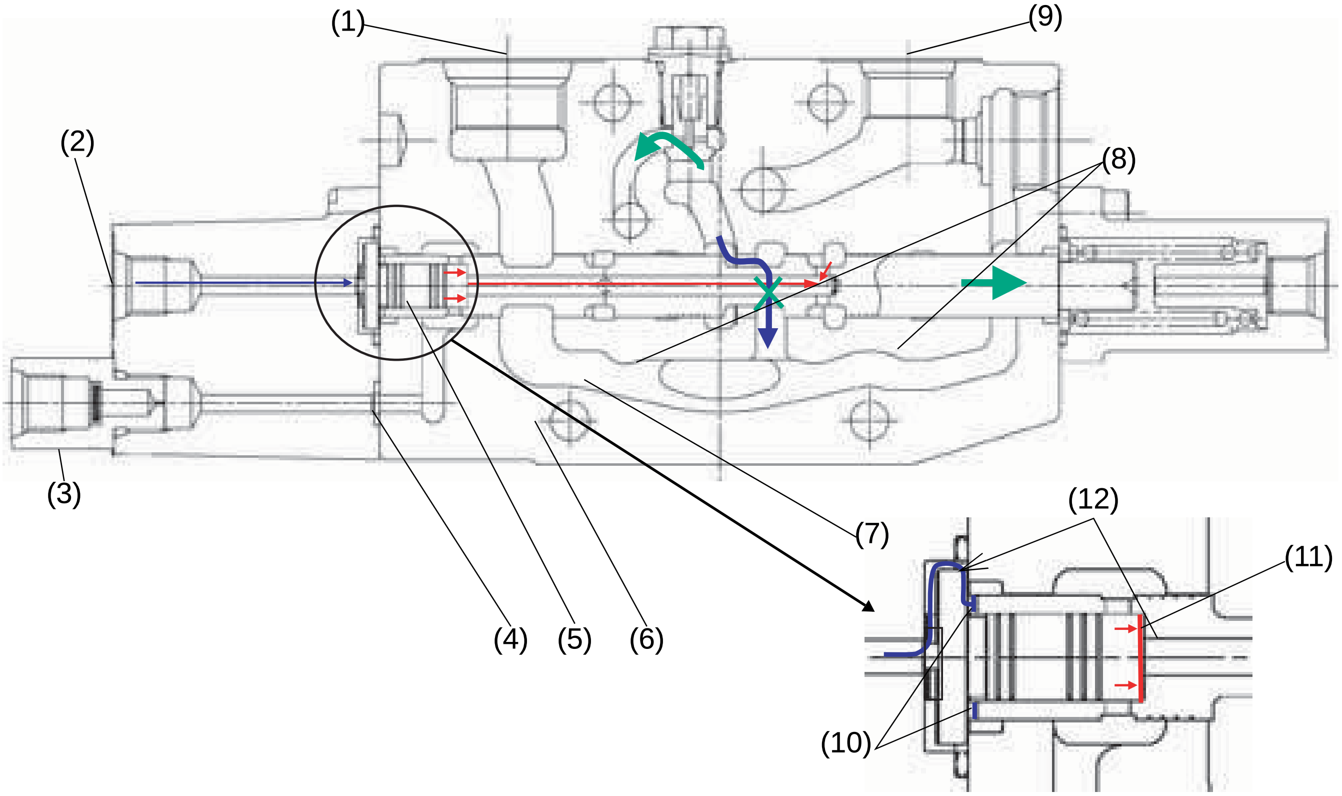
k. Travel section (Center open type)



pen circuit section

(1) AI signal circuit
(2) Travel detection signal circuit

I. P3 inlet and P3 confluence section

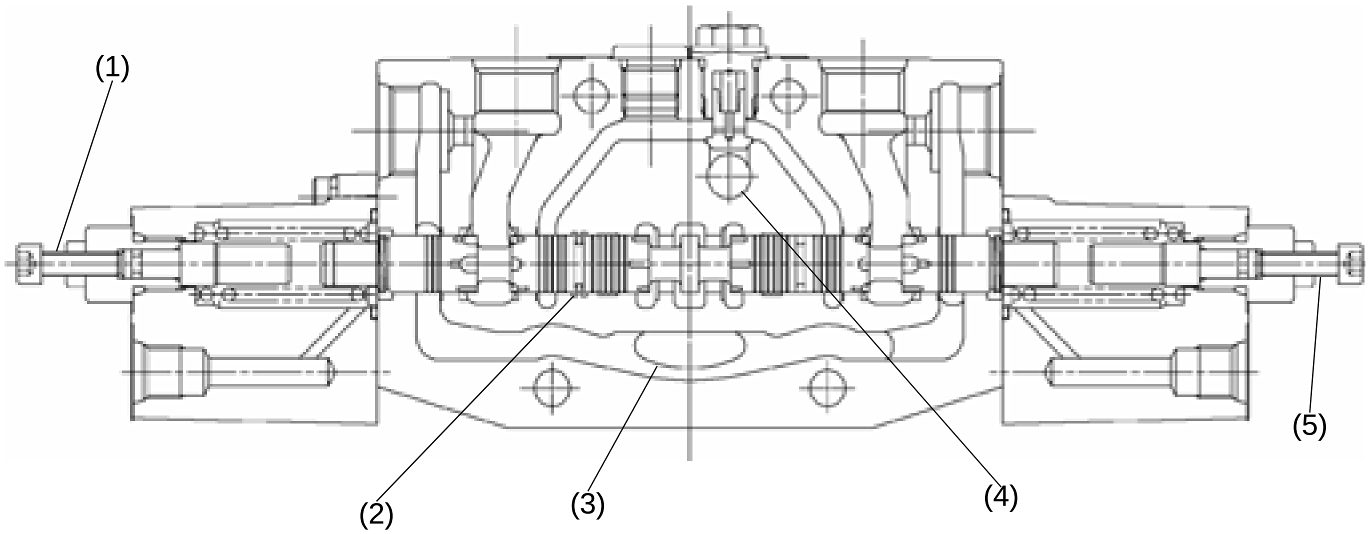


Travel + LS system control to get the spool switched and the P3 center circuit and circuit (A) interconnected.

LS system signal pressure to go to pressure receiver face a2, and travel signal pressure to a1.
Areas a1 and a2 equal to each other.

(1) Tank circuit to swivel motor and oil cooler
(2) LS system action signal inlet port (External pipe)
(3) Delivery port for travel detection (PP2)
(4) AI signal circuit
(5) Circuit (A): LS system delivery circuit
(6) P3 center circuit
(7) Travel detection signal circuit
(8) P3 confluence spool
When not switched: Tank circuit open and no flow to LS system
When switched: Tank circuit closed and flow to LS system
(9) P3 delivery circuit
(10) Pressure receiver a2
(11) Pressure receiver a1
(12) Pilot primary pressure

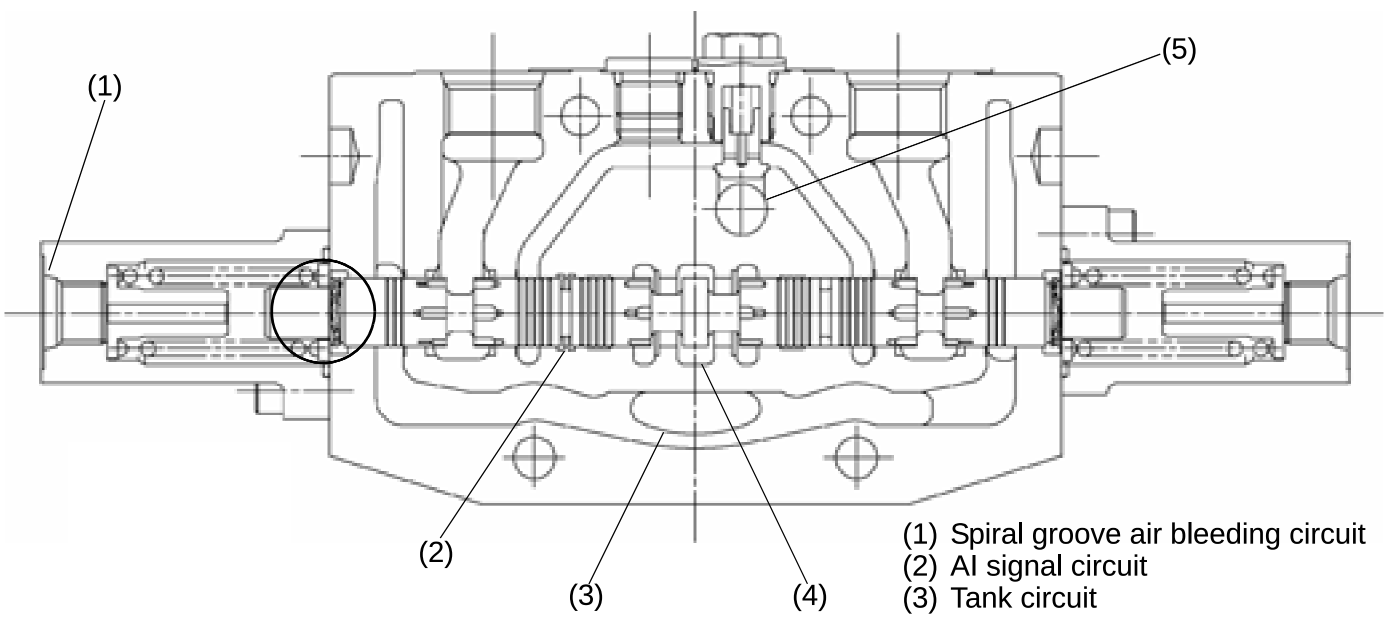
m.SP2 section (Mechanical flow adjustment)



enter open type al e section ith mechanical ma imum flo a uster

(1) Mechanical maximum flow adjuster
(2) AI signal circuit
(3) Tank circuit
(4) P3 parallel feeder circuit
(5) Mechanical maximum flow adjuster

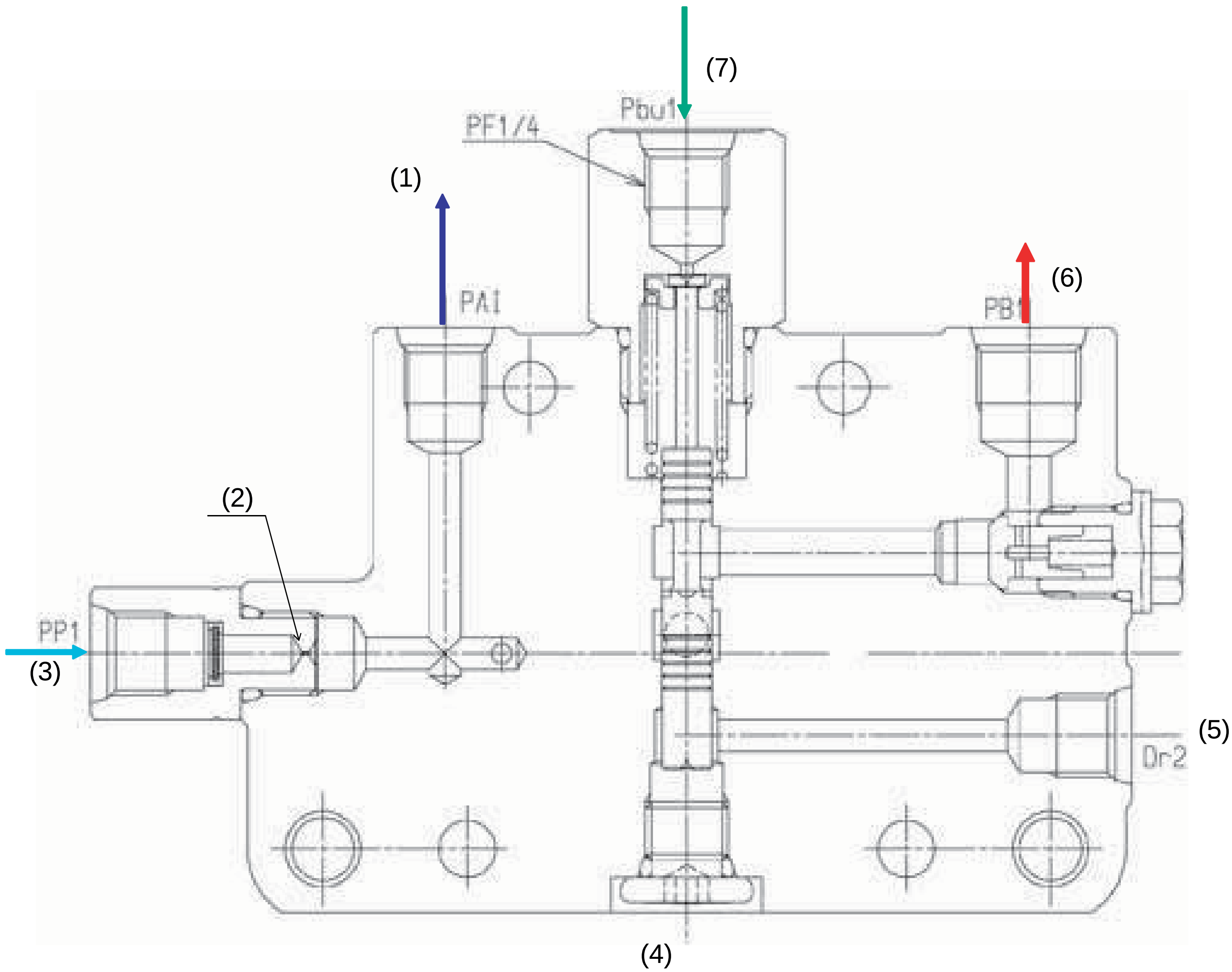
n. Swivel section



enter open type al e section

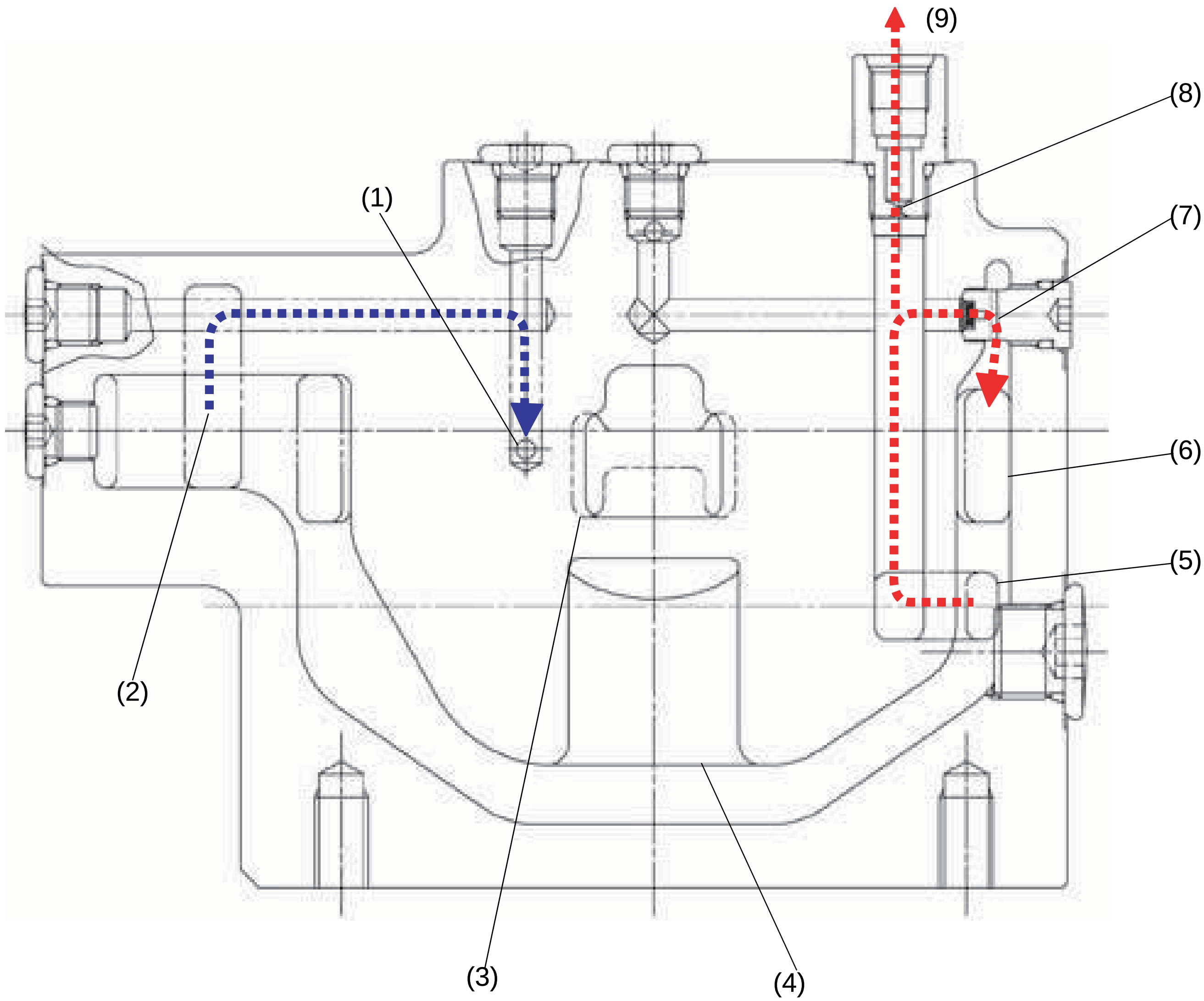
(1) Spiral groove air bleeding circuit
(2) AI signal circuit
(3) Tank circuit
(4) P3 center circuit
(5) P3 parallel feeder circuit

o. P3 bypass confluence valve



(1) To AI pressure switch
(2) AI aperture
(3) AI signal delivery (PP1)
(4) P3 bypass confluence valve
(5) Drain
(6) P3 bypass circuit to monoblock P2
(7) Boom up signal

p. LS bleed



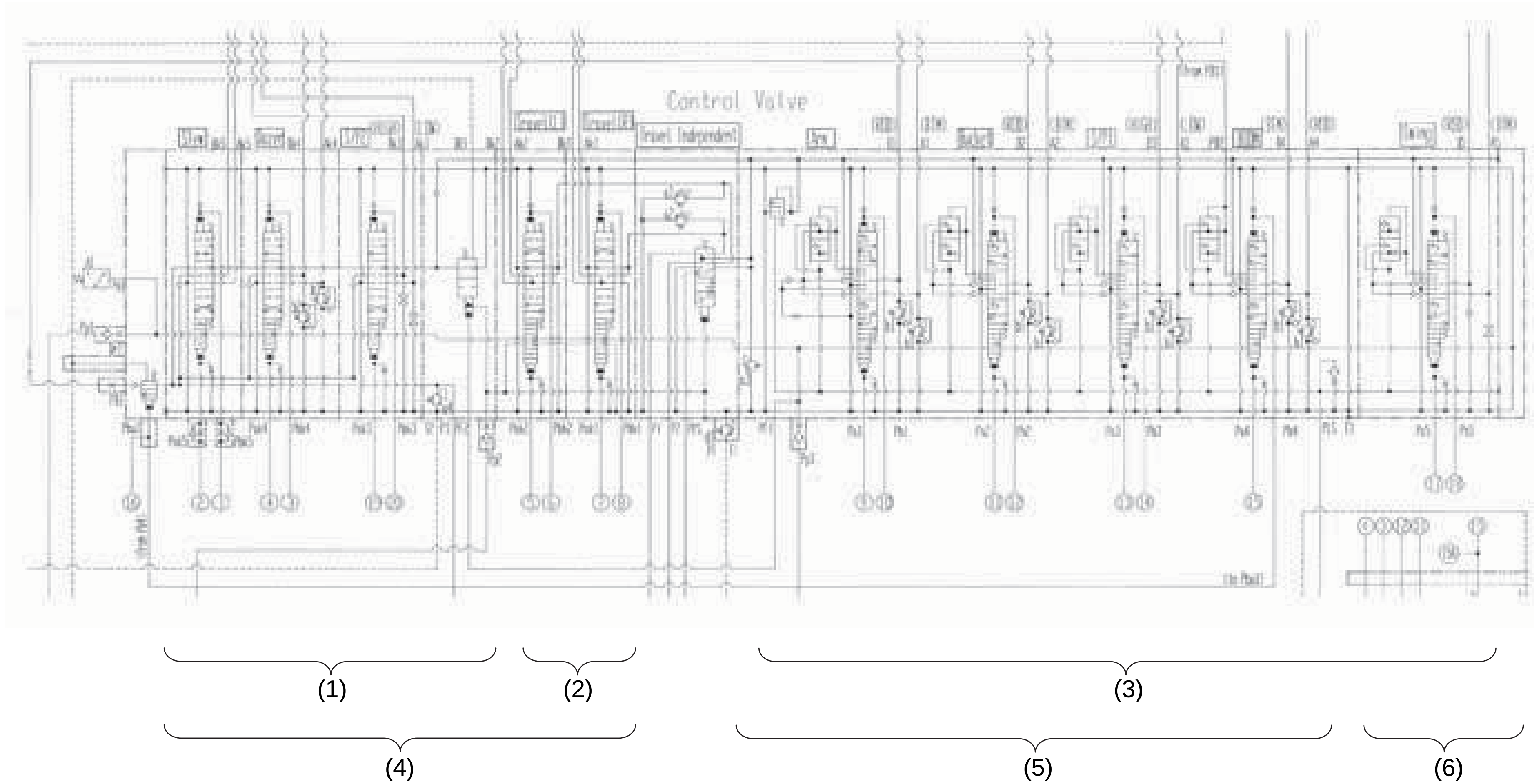
Monobloc en (ircuit bet een S signal processing an ϕ)

This section is located between boom and swing section.

(1) Passage to LS system (ϕ14) AI circuit
(2) AI signal circuit
(3) P circuit
(4) Tank circuit
(5) CV PLS signal circuit
(6) Tank circuit
(7) PLS signal bleed orifice
(8) PLS orifice
(9) PLS signal circuit to pump PLS

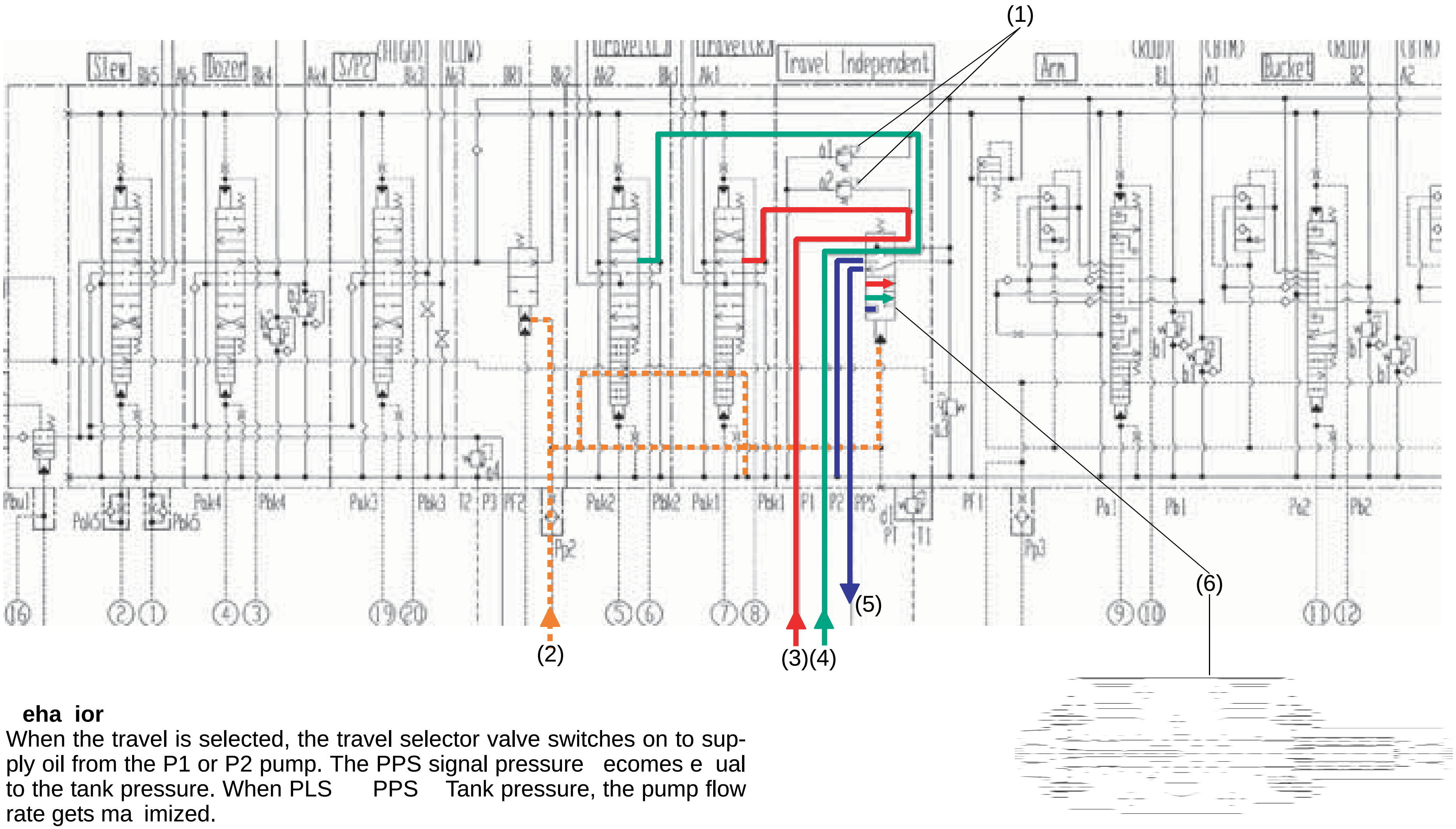
D.Control valve circuit

a. Control valve hydraulic circuit diagram



(1) P3 pump
(2) Travel system (P1 or P2 pump)
(3) LS system (P1 and P2 pumps)
(4) ϕ14 section
(5) ϕ18 section monoblock section
(6) ϕ14 section

. Control valve hydraulic circuit in traveling

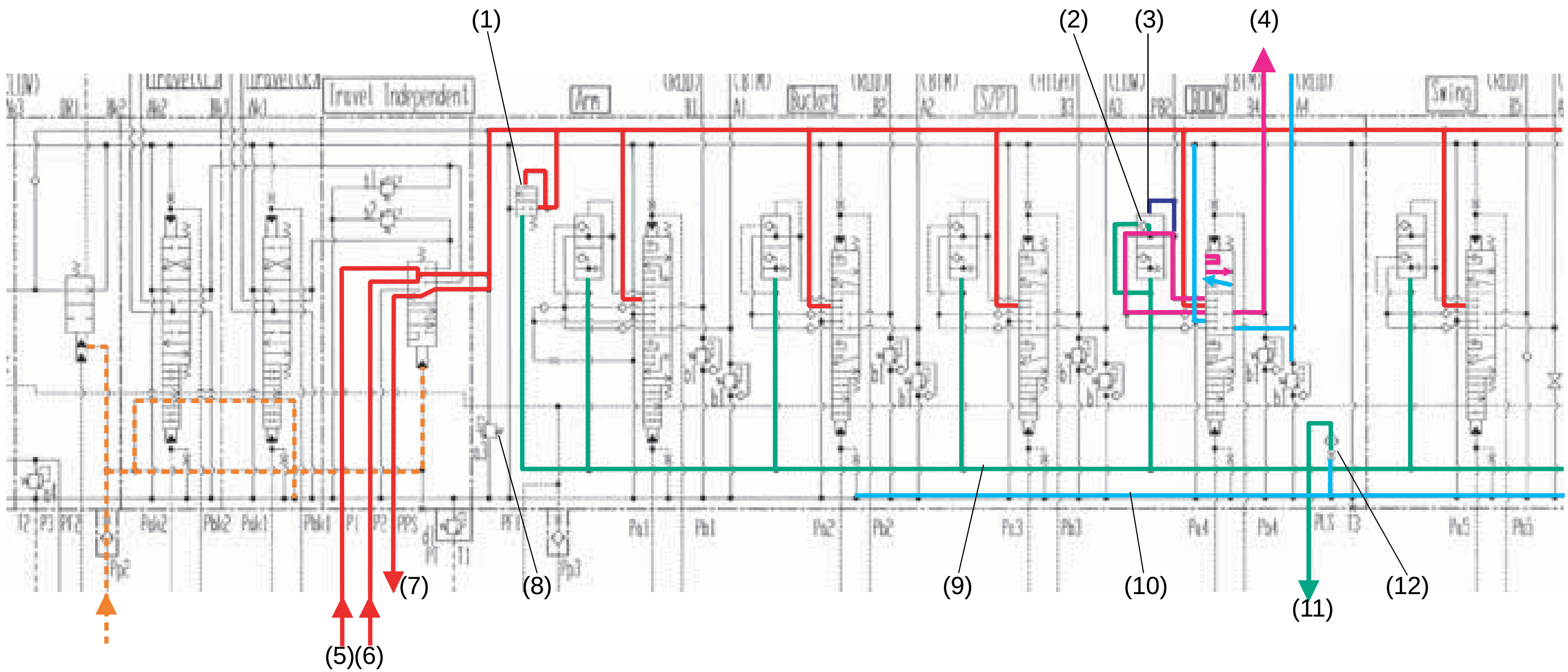


eha ior

When the travel is selected, the travel selector valve switches on to sup-ply oil from the P1 or P2 pump. The PPS signal pressure ecomes e ual to the tank pressure. When PLS PPS Tank pressure, the pump flow rate gets ma imized.

(1) Travel main relief valve (29.4 MPa)
(2) Travel select signal detection pressure from P4 pump
(3) P1 pump
(4) P2 pump
(5) PPS signal (to pump) ≒ 0
(6) Travel selector valve
(7) Travel selector valve

c. Control valve hydraulic circuit under LS system control without traveling

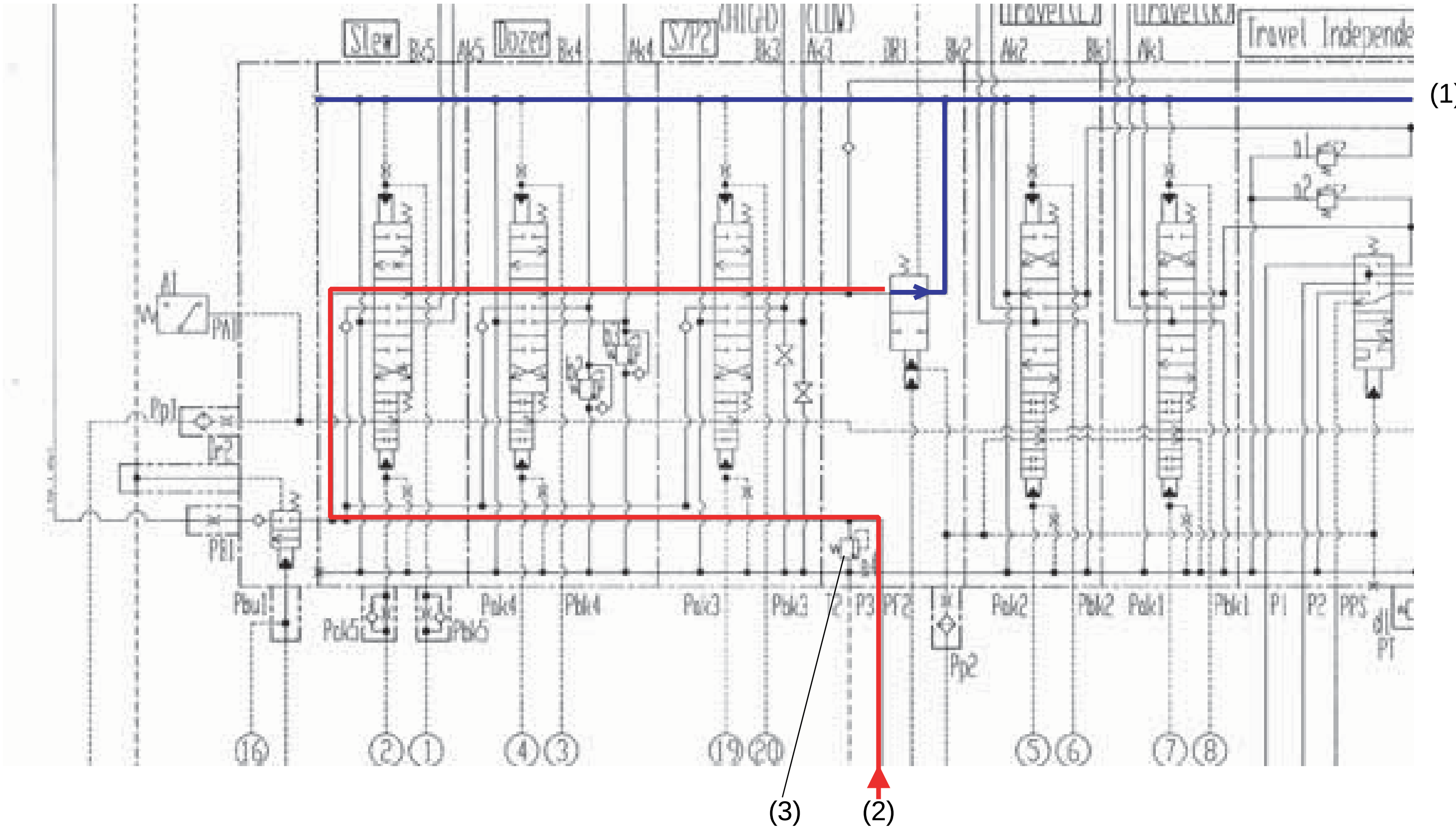


eha ior

When the travel is not selected, the travel selector valve does not switch on with the LS system. The oil is supplied from the P1 and P2 pumps. The PPS signal pressure becomes equal to the delivery pressure and the pumps are controlled at the LS flow rate.

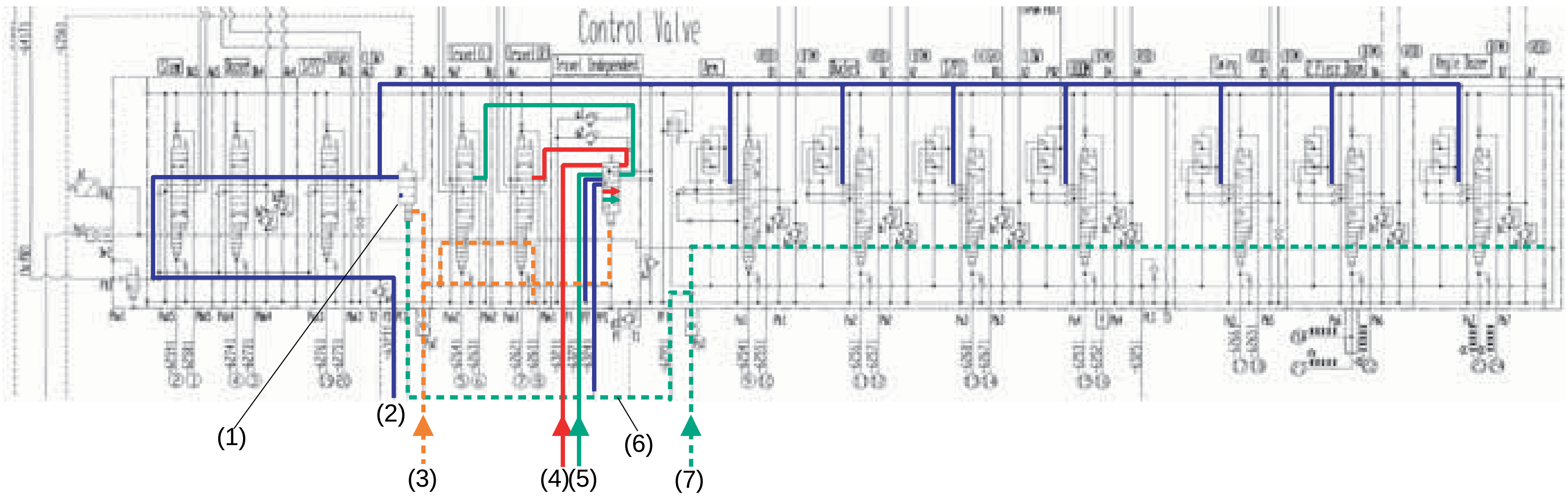
(1) Unload valve
(2) PLS signal high-pressure select check valve
(3) Pressure compensating valve
(4) To cylinder
(5) P1 pump
(6) P2 pump
(7) PPS signal (to pump)
(8) LS system main relief valve
(9) PLS signal
(10) Tank circuit
(11) PPS signal (to pump)
(12) PLS signal bleed aperture

d. Control valve P3 hydraulic circuit



(1) Tank circuit
(2) P3 pump
(3) P3 line main relief vale (20.6 MPa)

e. Control valve P3 confluence hydraulic circuit

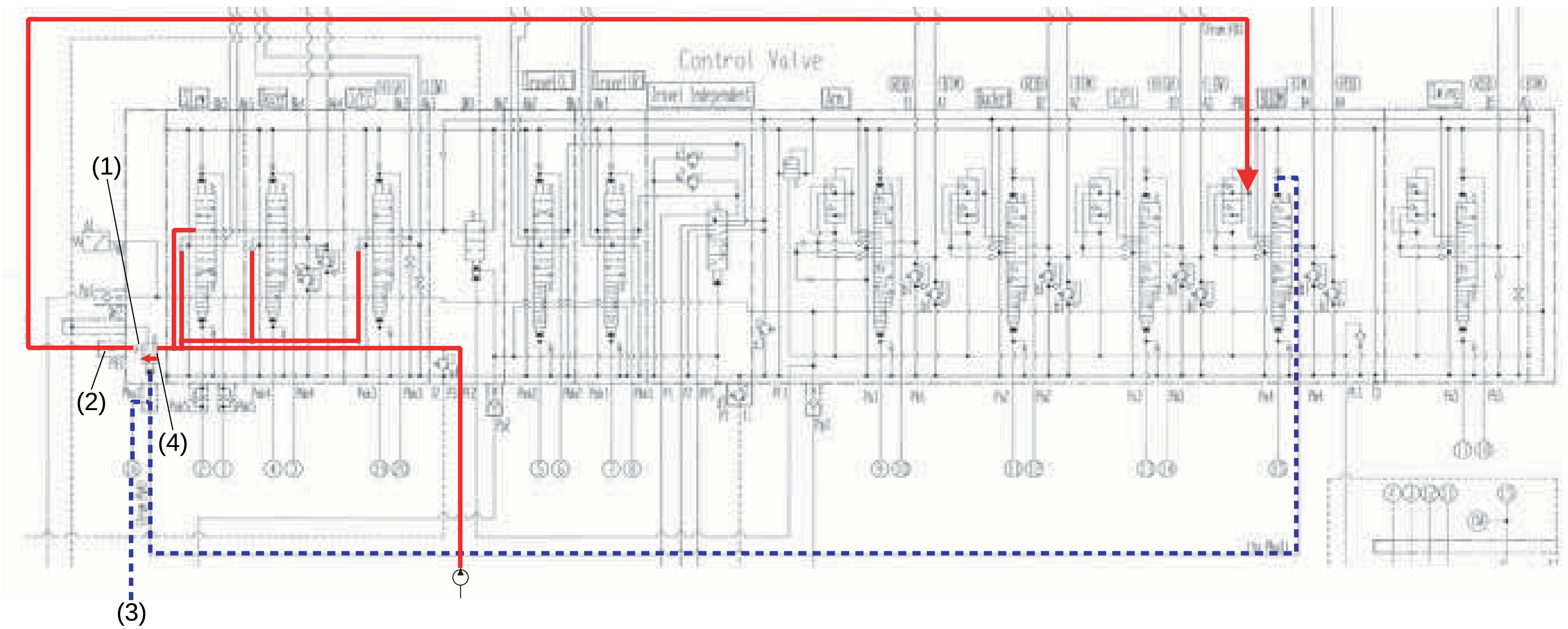


eha ior

When the travel is selected and the LS system is operated, the oil is supplied from the P1 or P2 pump for the travel system (The P1 and P2 pumps give their maximum flow rate within the horsepower range.) The P3 selector valve serves for the LS system in order to supply the oil from the P3 pump. (The P3 pump is of fixed displacement type to provide a constant flow rate. Extra oil is let out through the unload valve.)

(1) P3 confluence valve
(2) P3 delivery port
(3) Travel select signal detection pressure from P4 pump
(4) P1 pump
(5) P2 pump
(6) CV internal signal detection pressure from P4 pump
(7) LS system control detection signal

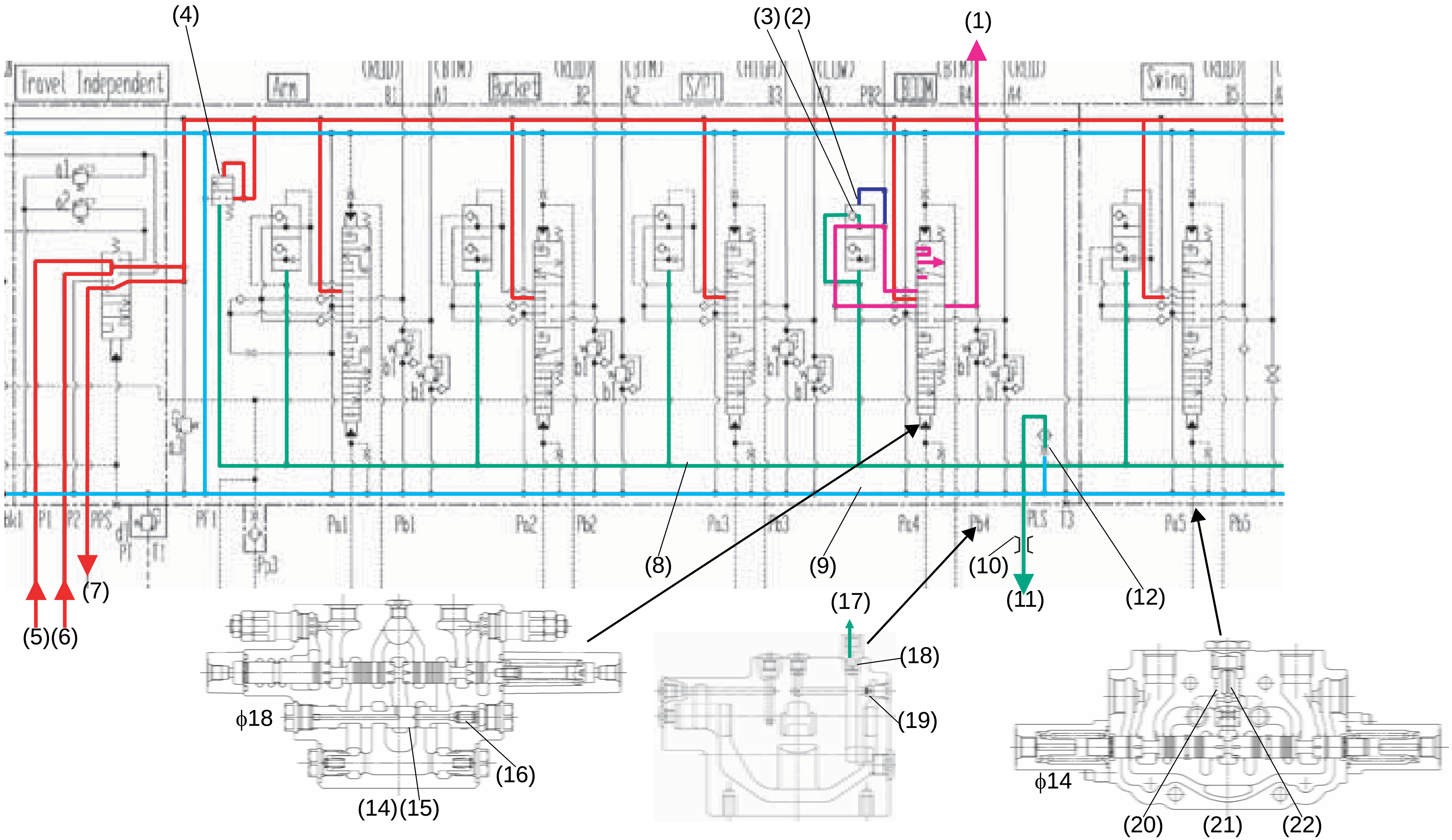
f. Control valve P3 bypass circuit



(1) Check valve
(2) P3 bypass confluence valve
(3) Confluence orifice
(4) Boom up signal

Function
When the swivel, boom, (arm) and (bucket) are activated at once, the boom-up pilot pressure works to switch the P3 bypass confluence valve. (The boom pilot pressure joins at 2.2 MPa.) The swivel P3 pump branches the flow for the boom to assist in moving up the boom. When the swivel pressure is greater than the boom operating pressure (at a start of swivel), the confluence occurs.
As the swivel pump pressure drops, the variable displacement pump's horsepower characteristic varies accordingly, which increases the flow rate from this valve. With a drop in the swivel starting pressure, the swivel does not speed up too high. This way, the boom can be moved up speedily compared with the swivel rate.

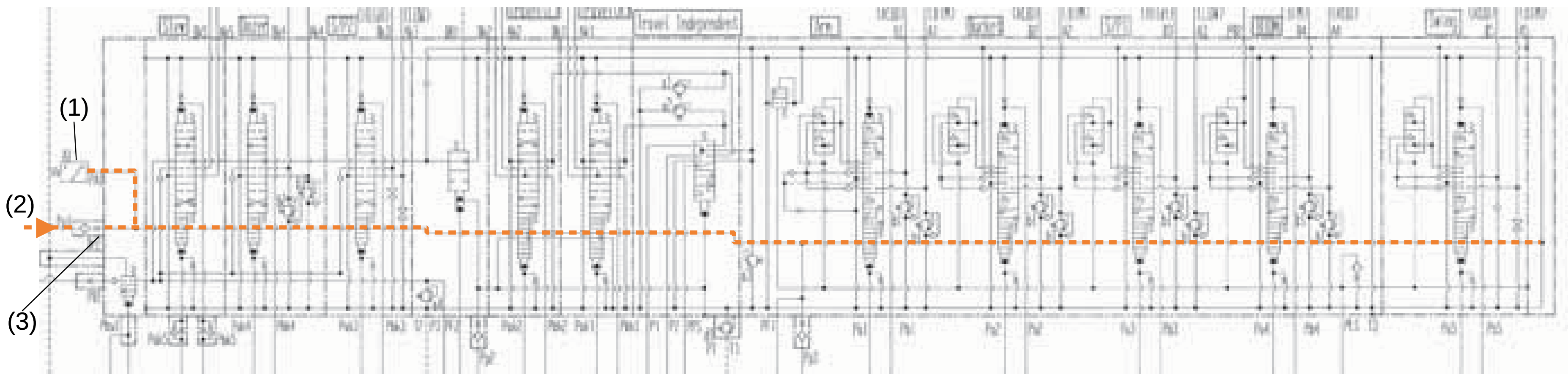
g. Control valve high-pressure selection function



hanging the high-pressure select system
Formerly, the high-pressure side was selected by a high-pressure selector valve (-<○>-). On the new system, the high pressure is introduced by the check valve that is incorporated in the pressure compensating valve. The LS bleeder lets the high-pressure oil into the tank.

(1) To cylinder
(2) Pressure compensating valve
(3) PLS signal high-pressure select check valve
(4) Unload valve
(5) P1 pump
(6) P2 pump
(7) PPS signal (to pump)
(8) PLS signal
(9) Tank circuit
(10) PLS signal aperture
(11) PLS signal (to pump)
(12) PLS signal bleed aperture
(13) Pressure compensating valve
(14) Boom section
(15) PLS signal high-pressure select check valve
(16) PLS signal (to pump)
(17) PLS signal aperture
(18) PLS signal bleed aperture
(19) Pressure compensating valve
(20) PLS signal high-pressure select check valve
(21) Swing section

h. Control valve AI signal hydraulic circuit

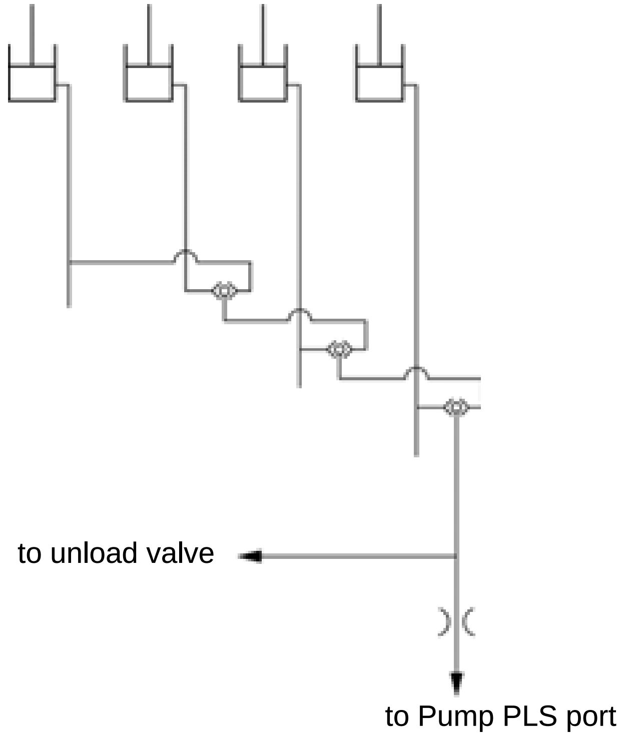


(1) AI pressure switch
(2) AI signal detection aperture
(3) CV internal AI signal detection pressure from P4 pump

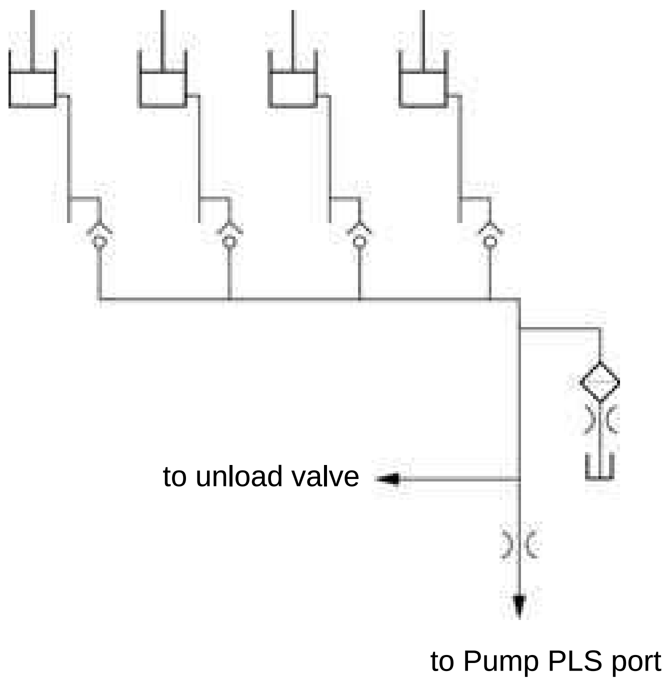
i. FYI (For Your Information)

1. LS load s maximum pressure detection method

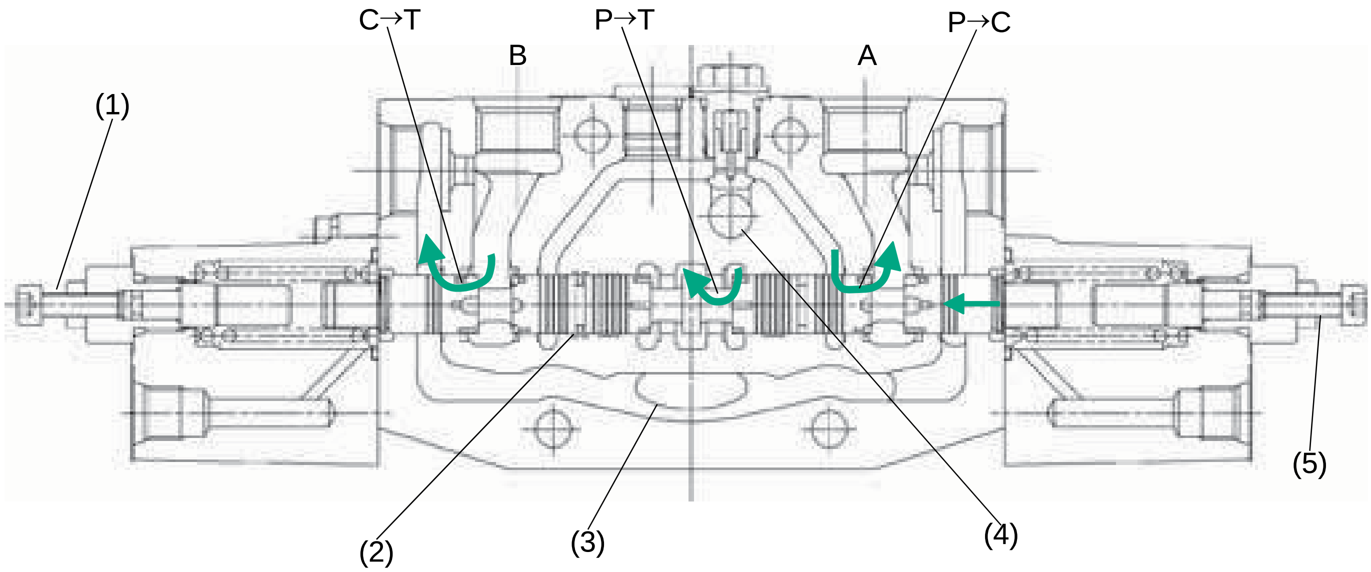
(KX121-3, α/s, KX161-3α/s, U45-3α)



(KX080-3)



2. SP2 flow control : Mechanical oil flow adjustment

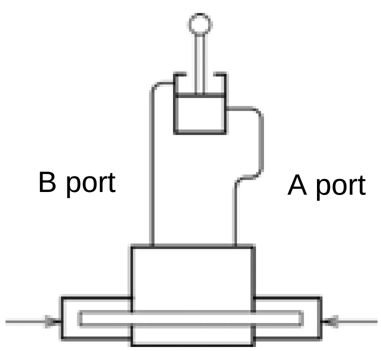


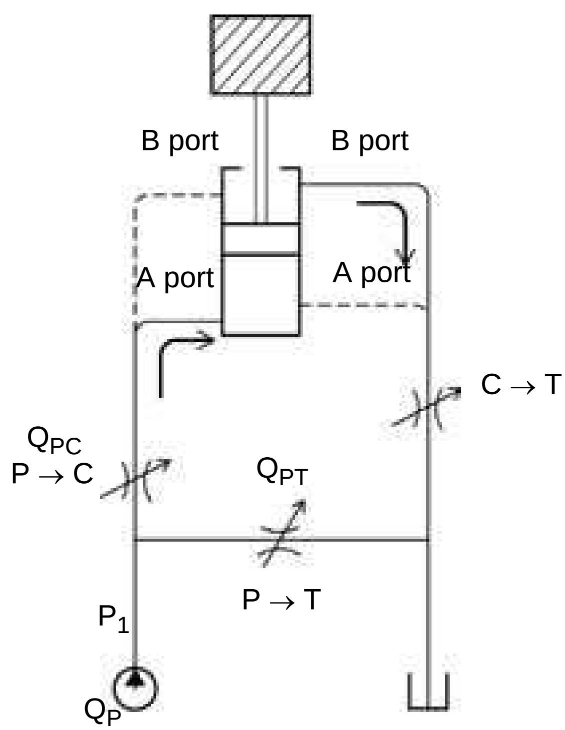
enter open type al e section ith mechanical ma imum flo a uster

(1) Mechanical maximum flow adjuster
(2) AI signal circuit
(3) Tank circuit
(4) P3 parallel feeder circuit
(5) Mechanical maximum flow adjuster

3. S/P2 flow control mechanism

depend on load, Pump flow (P3) ($\propto$ rotation) (non linear)





$Q_P = 0.6 \times A_{(P \to T)} \times \sqrt{P_1}$

$Q_{PC} = Q_P - Q_{P \to T}$

Motion started when the load becomes higher than P (load P)

E.Travel pilot valve (with damper)

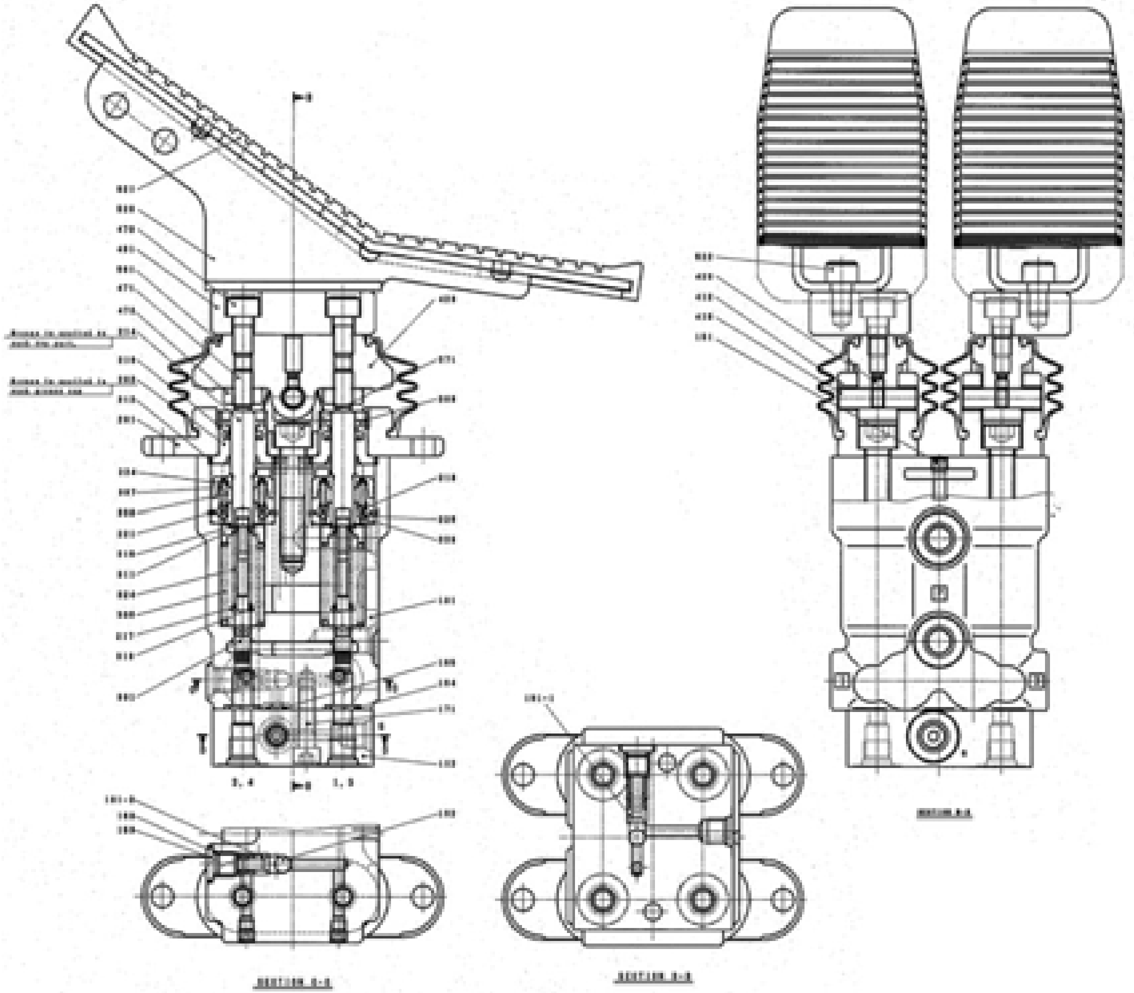
a. Outline

The damper-embedded pilot valve, RCVD8C, is a reducing-type valve using 4 secondary-pressure-controlling reducing valves contained in a single valve casing. The outlet pressure varies according to the angle of the operating section. The RCVD8C also includes a damping mechanism coupled to the valve casing, a mechanism which prevents hunting (lever-hunting) in the man-machine system.
In addition to a damping mechanism, the RCVD8CC also includes shuttle valves which select and output higher pressure from secondary pressures.

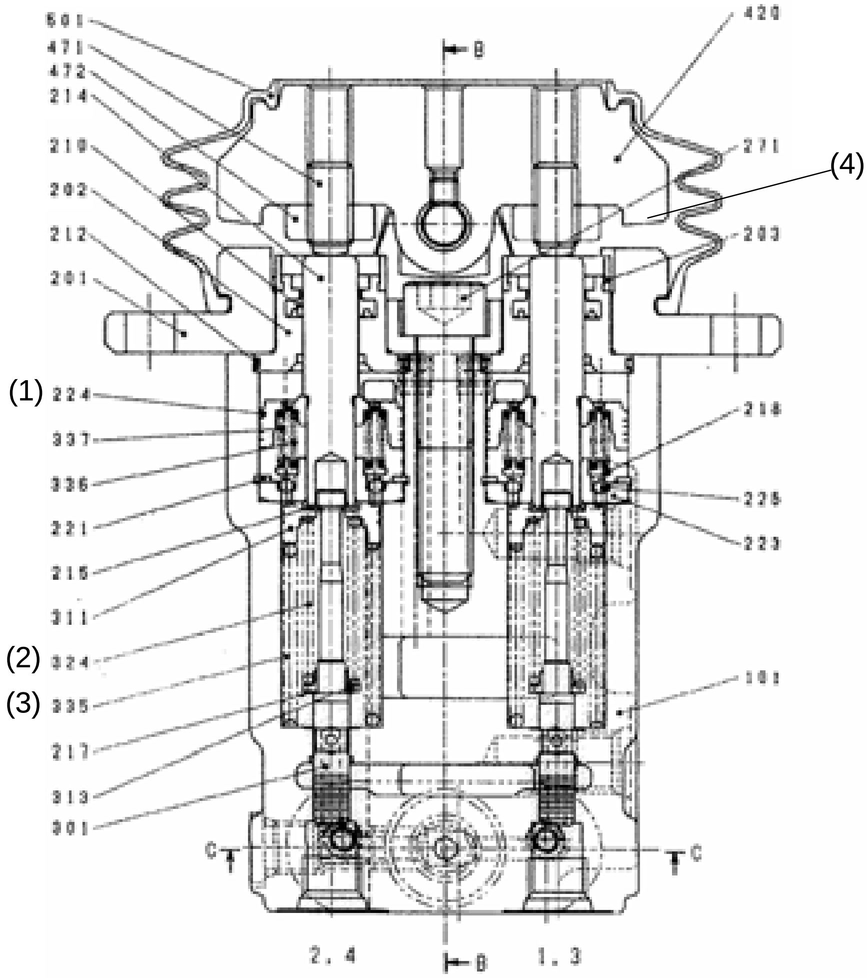
b. Specifications

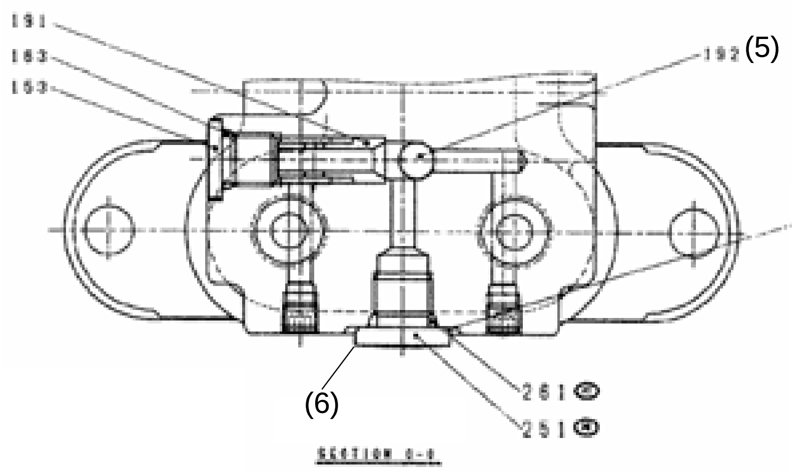
Maximum primary pressure	9.8 MPa 100 kgf/cm^2
Secondary pressure	0-4.4 (maximum control pressure) MPa 0-45 kgf/cm^2
Allowable back pressure	At maximum 0.29 MPa 3 kgf/cm^2
Rated flow volume	10 L/min
Operating angle	12.4°
Mass	Approx. 7.8 kg per set
Piping	For favorable response, the internal diameter and the length of the pipe should be approx. ϕ8 and 3 mm respectively. To prevent an effect of the back pressure, return the return oil to the tank directly.
Filter	To prevent the spool from being stuck, install a 40-mesh or more filter at the inlet of the P port.

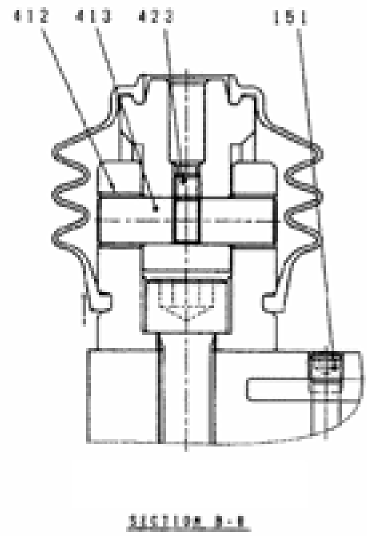
c. Structure

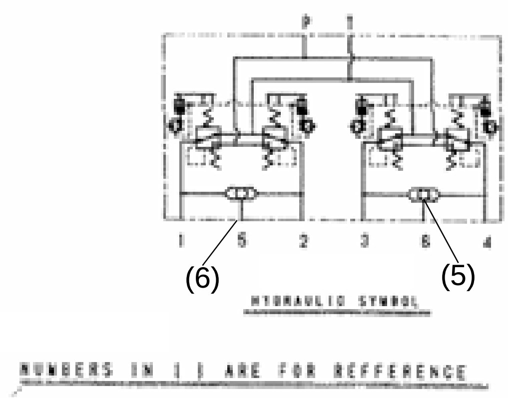


101	Casing	1	212	O-ring	4	336	Spring	4
102	Plate, part	1	214	Rod, push	4	337	Spring	4
151	Plug	2	215	Washer 1	3	412	Bush	4
153	Plug	3	217	Washer 2	4	413	Cam shaft	2
163	O-ring	3	218	Seat, spring	4	420	Cam	2
164	O-ring	4	221	Retaining rings	4	423	Set screw	2
165	O-ring	2	223	Bush	4	431	Block	2
171	Screw, hex. S. H. O.	2	224	Piston	4	471	Set screw	4
191-1	Sheet	1	225	Ball, steel	12	472	Lock nut	4
191-2	Sheet	2	271	Screw, hex. S. H. O.	2	473	Screw, hex. S. H. O.	4
192	Ball, steel	3	301	Spool	4	501	Bellows	2
201	Cover	2	311	Seat, spring	4	520	Pedal	2
202	Plug	4	313	Washer 3	4	521	Cover, pedal	2
203	Grease gap	4	324	Spring	4	522	Screw, hex S. H. O.	4
210	NHU packing	4	335	Spring	4			





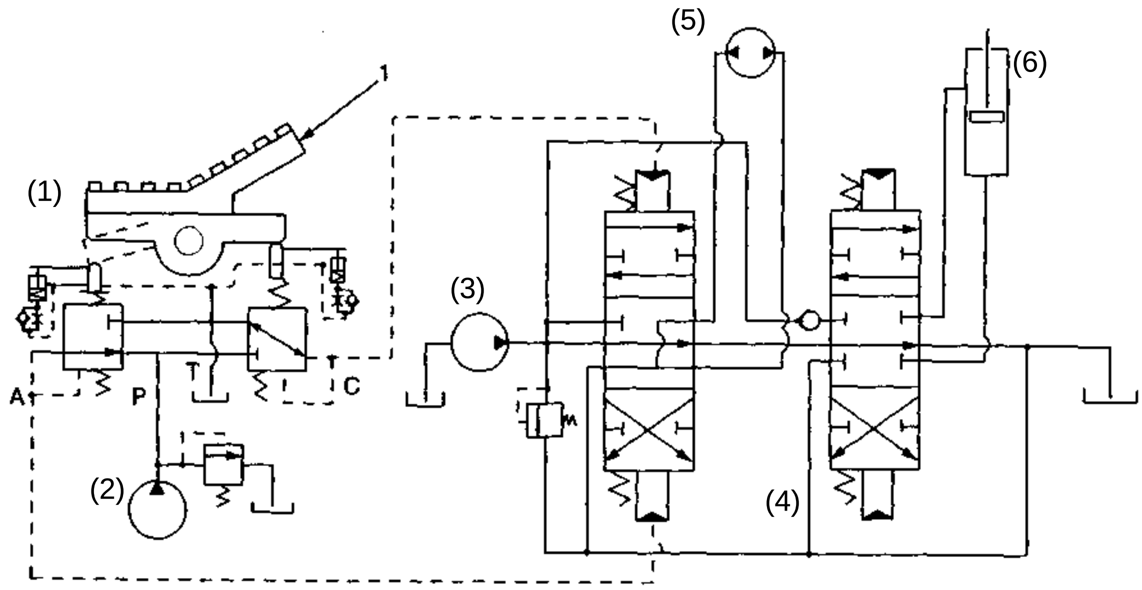




(1) Damper narrowed
(2) Secondary pressure spring
(3) Operating force spring
(4) Operating angle control: 9 deg.
(5) Shuttle valve
(6) Travel alarm switching port
2 locations

d. Function

The damper-embedded pilot valve includes in its main body a damping function to prevent hunting (lever hunting) in the man-machine system.
The following explains the operation of the damper-embedded pilot valve, separating it into 2 sections: a. reducing valve and b. operation section damping mechanism based on the hydraulic circuit diagram below, the assembly cross-section drawing in 31(RCVD8C), 32(RCVD8CC), and the damping operation explanation drawing in 9. The following figure shows a typical usage of the pilot valve.



Hydraulic circuit diagram

(1) Pilot valve
(2) Pilot pump
(3) Main pump
(4) Control valve
(5) Hydraulic motor
(6) Hydraulic cylinder
(7) Shuttle valve(RCVD8CC only)

1. Reducing valve section

1.1 When the pilot valve operating section is at the neutral position

The spool (301), pushed upward by the return spring (335), washer 1(215) through the spring seat (311), is at its neutral position as shown in the assembly cross-section drawing. Since the outlet port is joined only with the tank port T as a result of the spool switching function, the pressure at the outlet ports 1 and 2 is the same as the pressure at the tank port T.

1.2 When the pilot valve operating section is tilted from the neutral position

As shown in the assembly cross-section drawing, when the cam (420) is rotated clockwise, the push rod (214) at the port 1 is pressed downward, which pushed the spool downward with the help of the washer 1, the spring seat, the secondary-pressure-setting spring (324), the washer 2 (217), and the washer 3 (313).
As a result, the port P and the port 1 are joined each other and the oil supplied from the pilot pump starts to flow into the port 1, generating a flow pressure.
When the pressure at the port 1 increases to a pressure equivalent to the force of the secondary-pressure-setting spring, having been set by the tilted operating section, the oil pressure applied to the spool and the spring force are kept in balance, which keeps the port 1 outlet pressure constant.
Since the spool at the port 2 remains neutral, the return oil from the control valve flows out through the tank port T.
Depending on the specifications, the push rod touches the top of the spool directly when the operating section is tilted fully, which forcefully pushes down the spool, joining the port P and the outlet port, resulting in an equal pressure at both ports.

2. Operation section damping mechanism

2.1 When the operating section is at the neutral position

As shown in the assemble cross-section drawing, the push rod is pushed upward by the damping spring (336, 337) through the piston (224).

2.2 When the operating section is tilted from the neutral position (Refer to the damping operation explanation drawing (1))

As you see in the drawing, when the cam is rotated clockwise, the push rod at the port 1 is pressed downward and the piston moves downward.
At this moment, the oil in the damping piston chamber passes out through the orifice in the piston, producing a pressure used for damping.
On the other hand, the push rod at the port 2 is moved upward by the damping spring through the piston.
At this moment, the oil in the tank room is absorbed into the damping piston chamber through the 3 ball check valve portions (using the ball (225) and the bush(223)).
The oil outside the piston chamber flows through the path that joins with the port T at the top of the casing.

2.3 When fully tilted operating section is tilted in reverse direction (Refer to the damping operation explanation drawing (2))

In the operation explanation drawing, if the cam, having been fully tilted clockwise, is tilted anticlockwise, the push rod at the port 2 is pushed downward and the piston moves downward. At this moment, as in the case above, the oil inside the damping piston passes out through the orifice in the piston, producing a pressure used for damping.
On the other hand, the push rod at the port 1 is moved upward by the return spring (335) and the damping spring.
As in the case above, the oil in the tank room is absorbed into the damping piston chamber through the 3 ball check valve portions (using the ball (225) and the bush (223)). The oil outside the piston chamber flows through the path that joins to the tank port from the casing top.
In other words, the damping force is generated in both cases when the operating section is tilted from the neutral position to the fully tilted position and from the fully tilted position to the neutral position.

3. Shuttle valve section

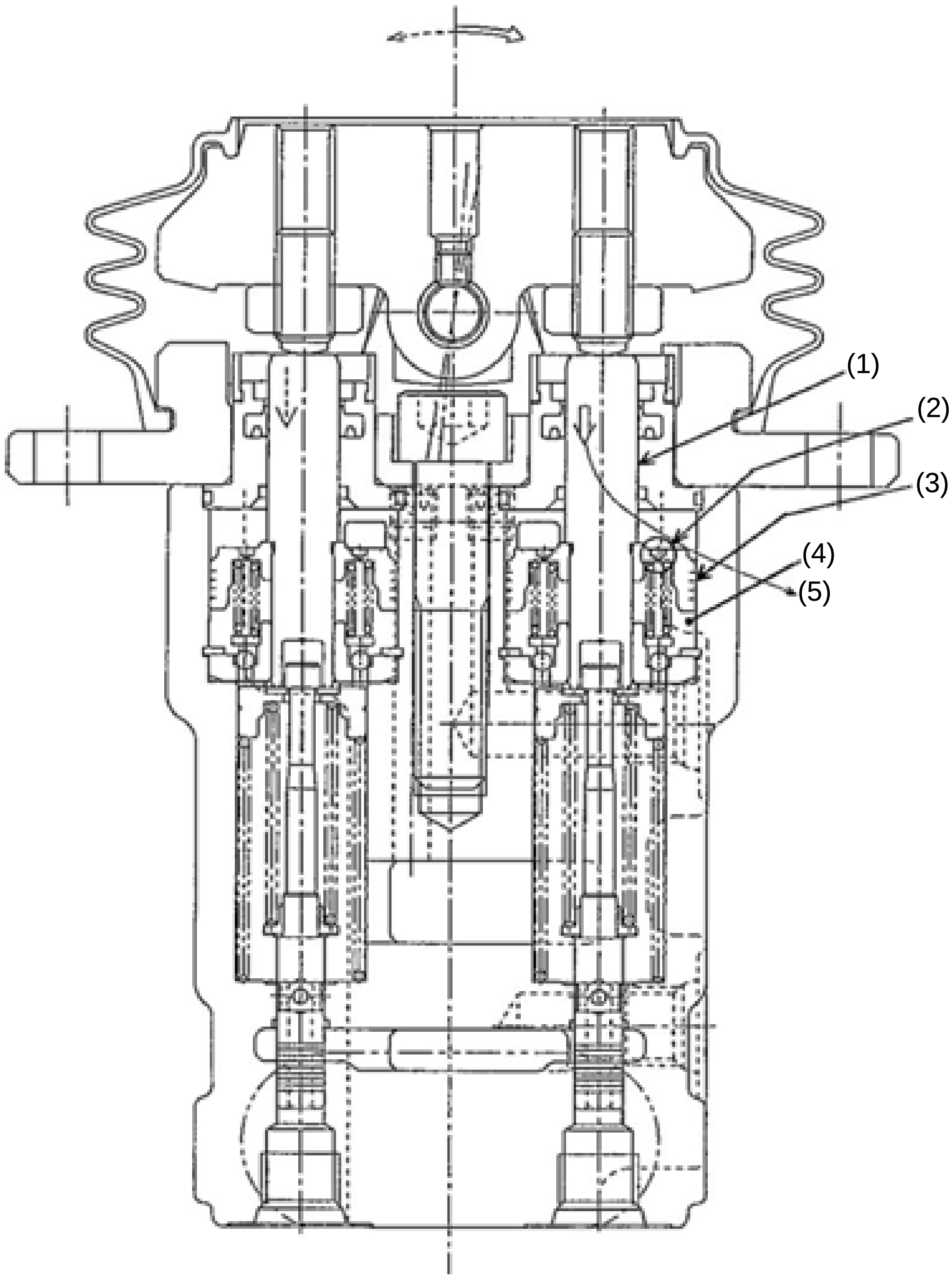
3.1 When the operating section is at the neutral position

The secondary pressure ports are both the same as the tank port T, so the shuttle valve outlet port is also the same as the tank port T.

3.2 When the pilot valve operating section is tilted from the neutral position

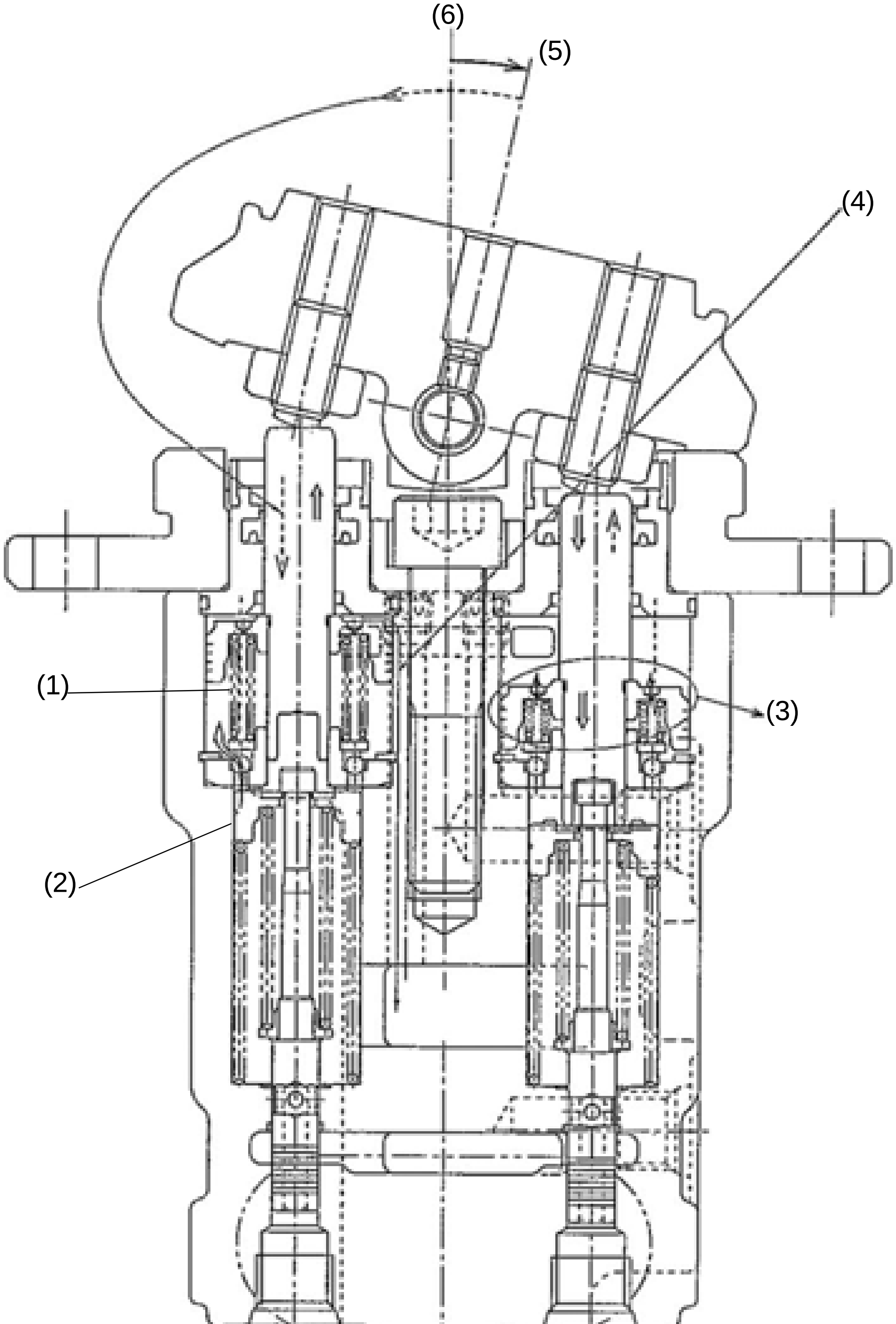
When the one secondary pressure port generate the pressure, the ball(192) is pressed to the other secondary pressure port and closed the port. The shuttle valve outlet port pressure is the same as the one secondary pressure port. In other words, the higher secondary pressure is selected and output from the shuttle valve outlet port.

Operation when the lever is tilted from the neutral position



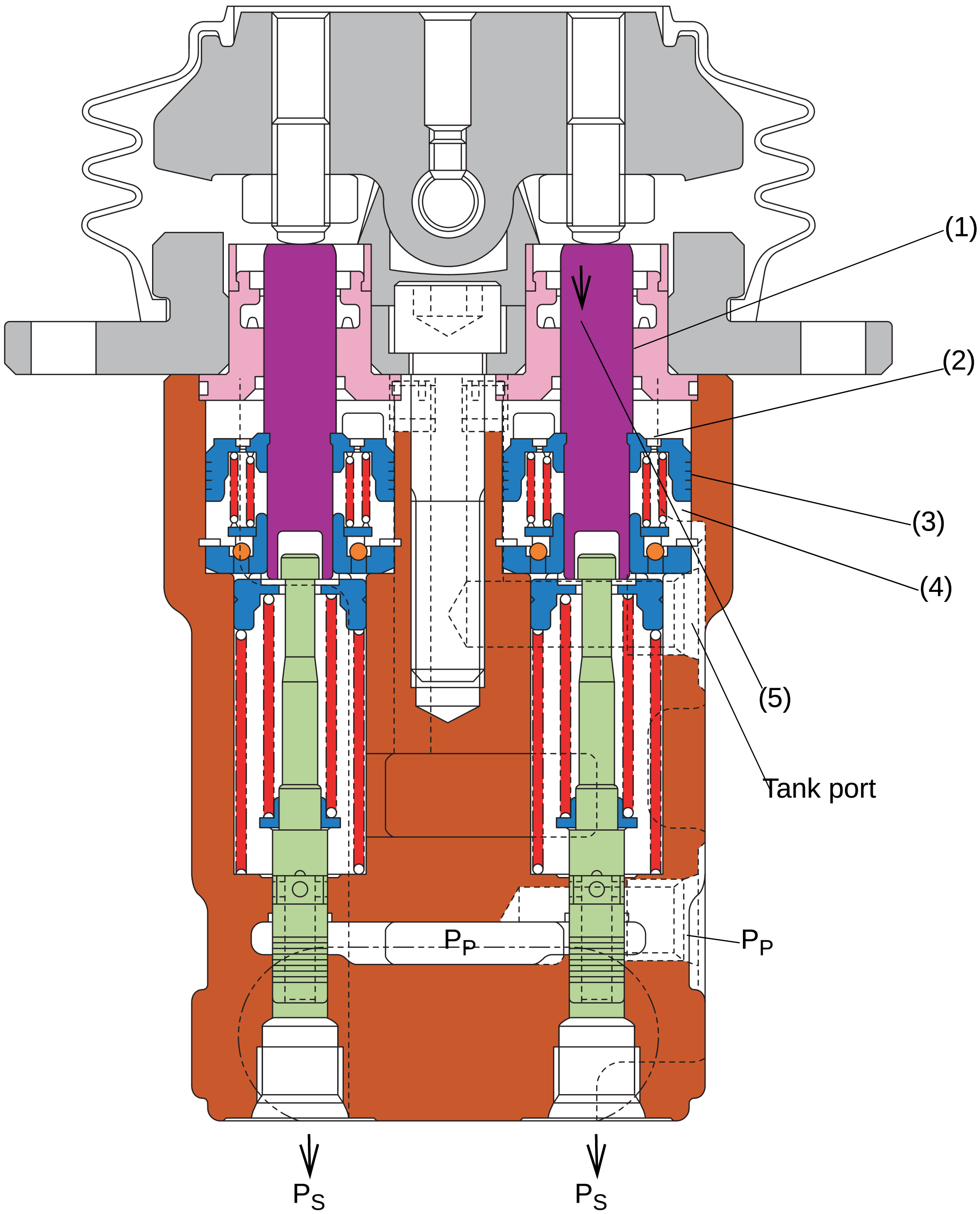
(1) Push rod
(2) Orifice
(3) Piston
(4) Piston chamber
(5) When the lever is tilted from the neutral position toward direction, the oil in the right (left) piston chamber passes out the orifice.

Lever stroke state and the operation when the lever is tilted in reverse direction



(1) When the lever is tilted from the neutral position to the reverse position, the push rod is pushed upward by the damping spring (⇒ Operation direction)
(2) The oil in the T line is absorbed into the damper room through the 3 ball check valve portions.
If the lever is tilted in reverse direction from ⇒ to →, the left piston immediately acts as a damper piston
The damping force is generated in both directions
(3) The oil inside the piston chamber passes out through the orifice. The pressure generated at this moment is used for damping pressure (⇒ Operation direction)
(4) The oil outside the piston chamber flows through the pass that joins to the tank port at the top of the casing. (⇒ Operation direction)
(5) Full stroke
(6) Neutral

Operation when the lever is tilted from the neutral position

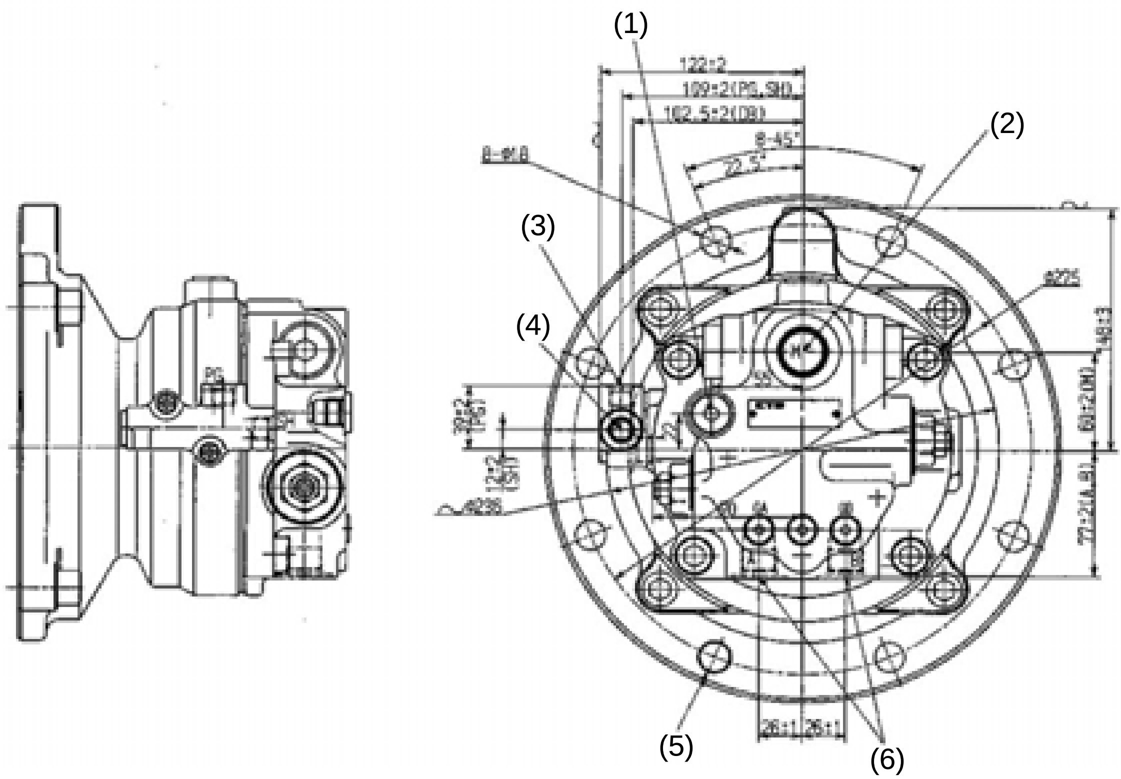


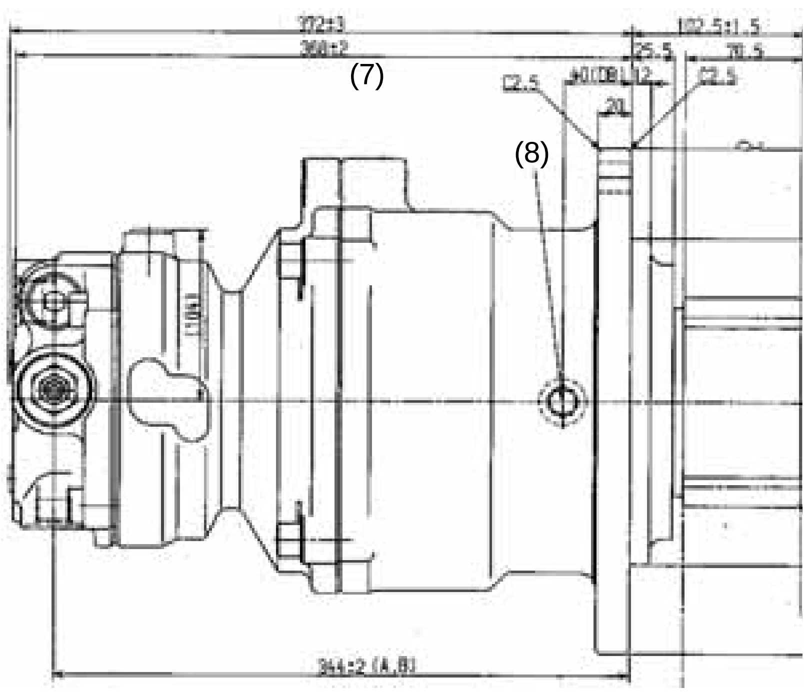
(1) Push rod
(2) Orifice
(3) Piston
(4) Piston chamber
(5) When the lever is tilted from the neutral position toward direction, the oil in the right (left) piston chamber passes out the orifice.

F. Swivel motor

a. General

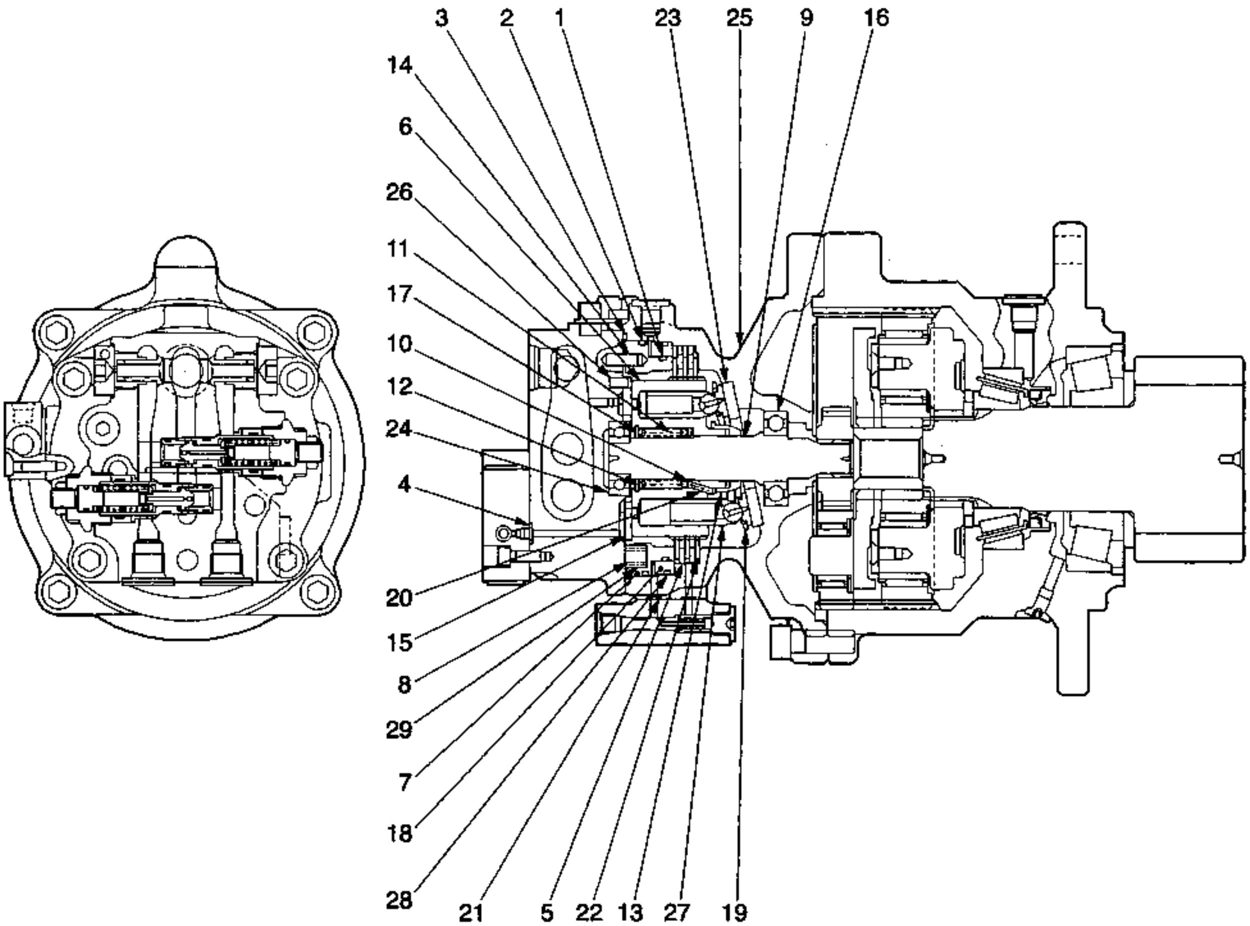
1. Swivel motor outer view





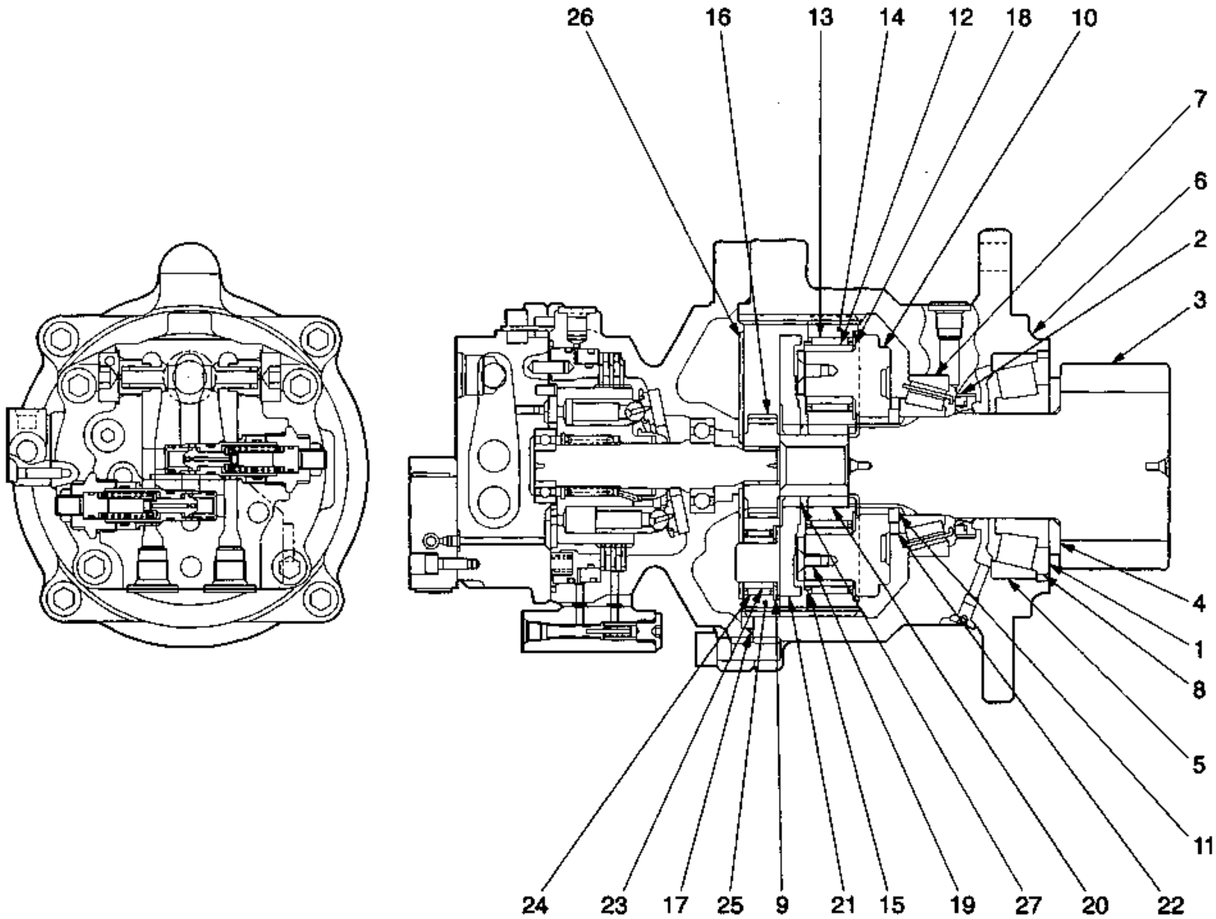
(1) PF3/8(G3/8) Vent port
(2) PF3/4-A G3/4 JIS B2351 O-type
(3) PF1/4-A G1/4
(4) PF1/4-A G1/4
(5) 1-M20x2.5 Drilled hole-ϕ18
(6) 2-PF1/2-A G1/2
(7) Vent port
(8) PF3/8-A G3/8

2. Swivel motor structure

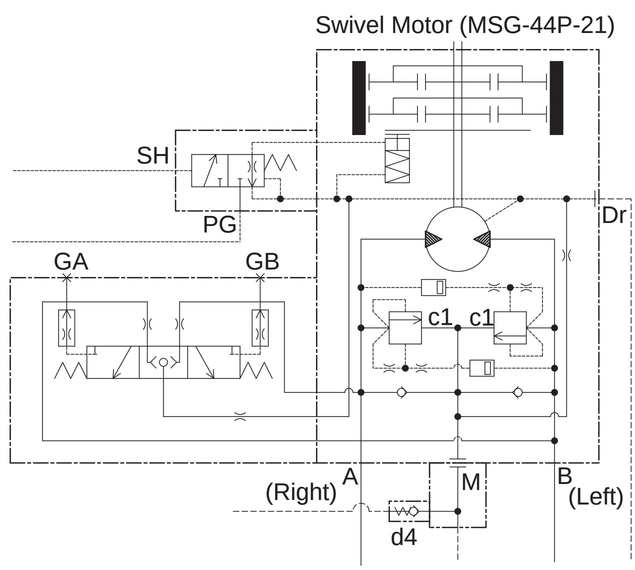


1.	O-ring	11.	Spring	21.	O-ring
2.	O-ring	12.	Holder	22.	Intermediate disc
3.	O-ring	13.	Guide	23.	Swash-plate
4.	O-ring	14.	Pin	24.	Bearing
5.	Friction disc	15.	Valve plate	25.	Housing
6.	Cylinder block	16.	Bearing	26.	Pin
7.	Brake piston	17.	Snap ring	27.	Piston
8.	Spring	18.	Sleeve	28.	O-ring
9.	Shaft	19.	Shoe holder	29.	Spring
10.	Holder	20.	Pin		

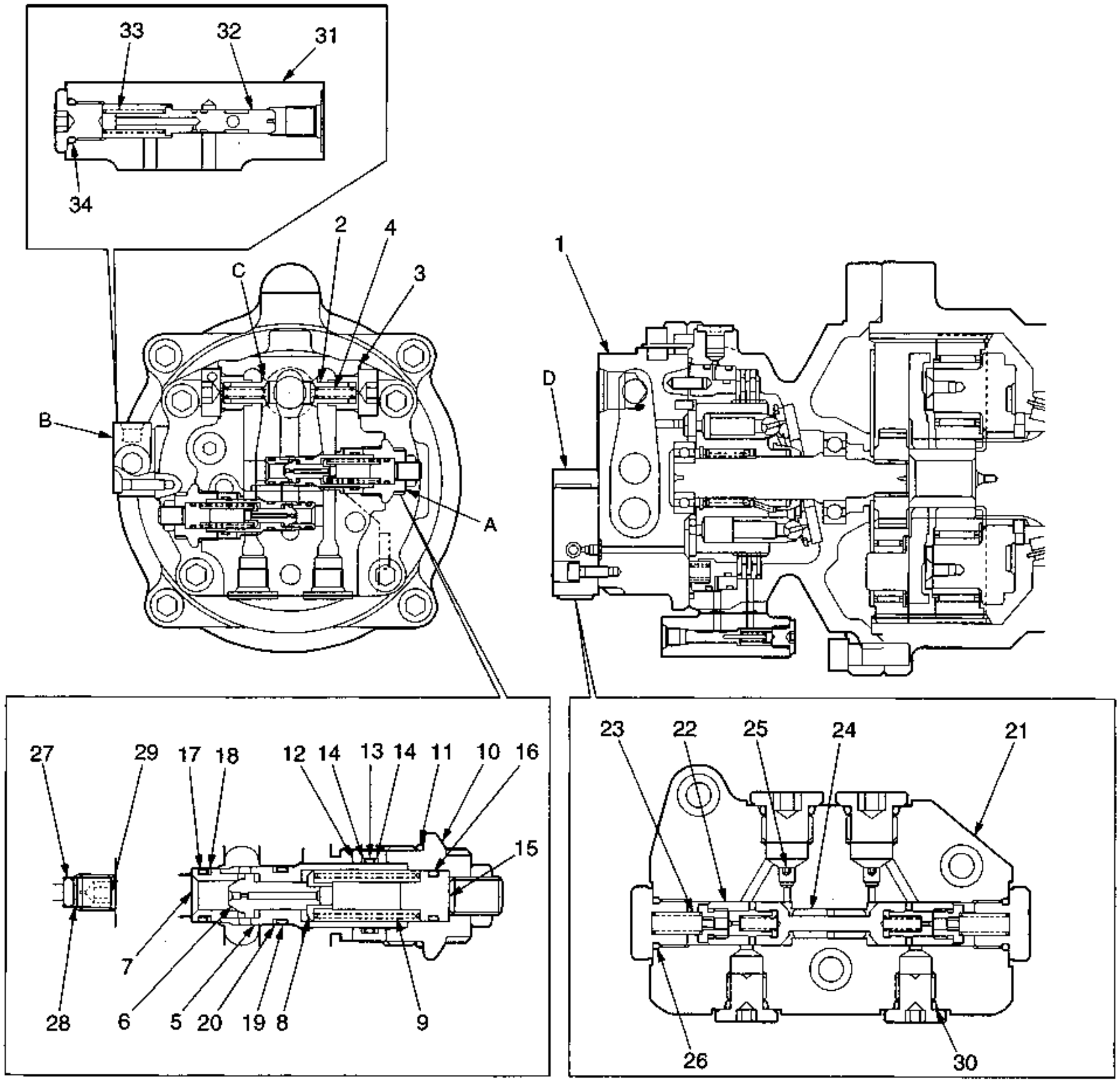
3. Structure of reduction gear case



1. Plate
2. Oil seal
3. Shaft
4. Sleeve
5. Bearing
6. Housing
7. Bearing
8. Plate
9. Thrust washer
10. Support 2
11. Plate
12. Race
13. Pin
14. Planetary gear
15. Thrust washer
16. Drive gear
17. O-ring
18. Thrust washer
19. Screw
20. Sun gear
21. Support 1
22. Sleeve
23. Race
24. Pin
25. Planetary gear A
26. Impact plate
27. Snap ring



4. Structure of brake valve

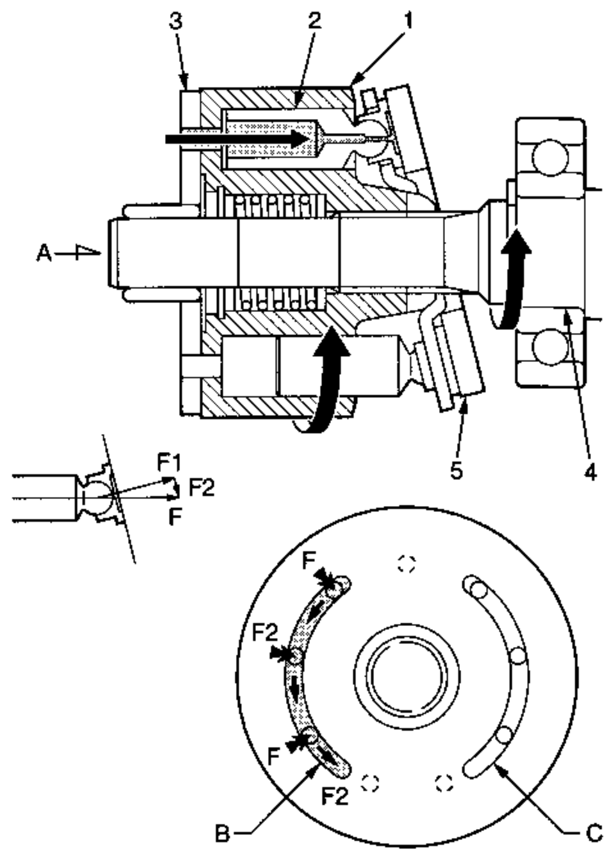


A: Counterbalance valve
B: Delay valve
C: Check valve
D: Shock-absorbing valve

1.	Covering	10.	Stopper	19.	O-ring	28.	Washer
2.	Valve cone	11.	O-ring	20.	Retaining ring	29.	Discharge port
3.	O-ring	12.	Piston	21.	Housing	30.	O-ring
4.	Spring	13.	O-ring	22.	Check valve fixture	31.	Housing
5.	Housing	14.	Retaining ring	23.	Spring	32.	Sliding valve
6.	Valve cone	15.	Guide	24.	Sleeve	33.	Spring
7.	Sheet	16.	O-ring	25.	Discharge port	34.	O-ring
8.	Sheet	17.	O-ring	26.	O-ring		
9.	Spring	18.	Retaining ring	27.	Filter		

b. Function of swivel motor

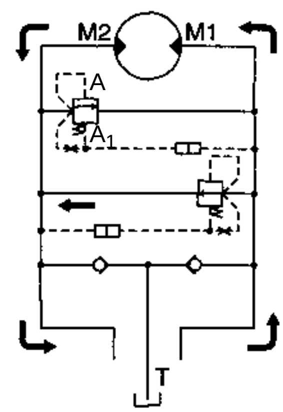
1. Hydraulic motor



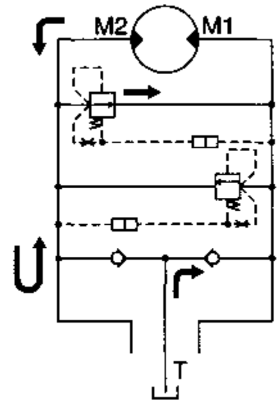
Nine pistons (2) are fitted in the cylinder block (1), and the valve plate (3) is attached at the end with two half-moon-shaped ports B and C. The cylinder block (1) turns itself and is connected by the key with the shaft (4). On the other hand, the swash-plate (5) is secured on the housing.
When pressure oil is introduced through the port B, the swash-late (5) is pushed by each piston (2) with the force F.
F = P x A
P: Pressure, A: Piston cross-sectional area
The force F, which pushes the pistons (2) onto the swash-plate (5), is divided in force F1 and 2: Force F1 pushes against the swash-plate and F2 pushes on the cylinder block (1). The total force of the components in the turning direction of the pistons at the high-pressure side produces a rotational force in the cylinder block (1). This force is transmitted through the key onto the shaft (4), which is turned. When the pressure oil is introduced into the port C, on the other hand, the turning takes place in the opposite direction.

2. Relief valve

Function 1



When the motor gets started:
When the motor gets started, the inertial load becomes greater, so that the pressure of the oil required for acceleration rises. If this oil pressure has reached the preset level of the counterbalance valve, the counterbalance valve is activated and the oil returns to the port M2.
In this way, the motor starts running, while the pressure is balanced by the counterbalance valve. With the rpm increasing, the balancing rate decreases until finally the balancing does not take place any longer. In this manner the shock at the startup is absorbed.



When the motor gets stopped:
When the motor gets stopped, the return circuit is interrupted. Because the motor still turns itself by the inertial force, however, the pressure at port M2 rises. If this oil pressure has reached the preset level of the counterbalance valve, the counterbalance valve is activated and the oil starts flowing to the port M1. In this way, the oil flow to the port M1 prevents cavitation that would occur in shock absorbing during stopping.

Function 2

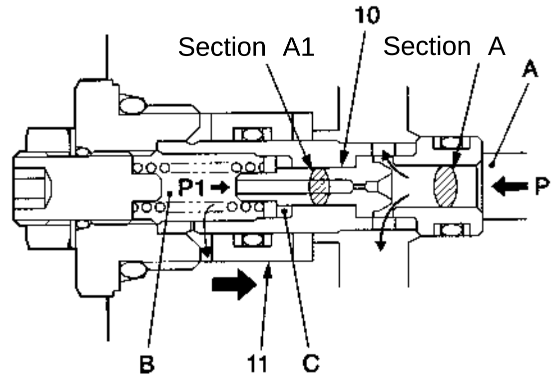
This brake valve has a shock-free mechanism and works in two stages.

First stage

When the brake valve is activated, the pressure in chamber B (P1) is kept lower than that in chamber C. The pressure in chamber A (P), on the other hand, becomes higher than that of the incoming oil.

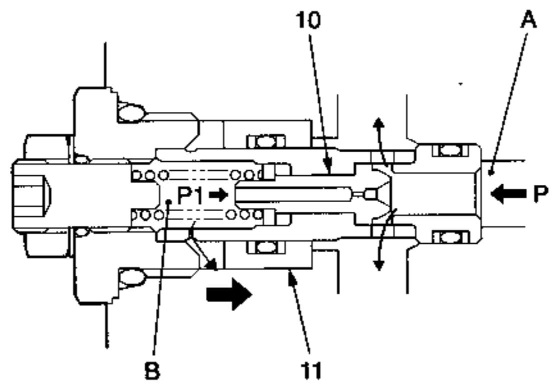
At this time, two forces act on the disc (10). The force F moves the disc (10) to the left, whereas the force F1 pushes against the seat to the right side.

Because F = P x A, F1 = P1 x A1, P P1 and A A1, the disc (10) is moved to the left by the force F - F1 . Thereby, the supply-side circuit starting from the chamber A gets open in order to let the pressure escape. That is to say, the brake valve is activated at low pressure (about 1/3 of the preset pressure), while the piston (11) is moved to its stroke end.



Second stage

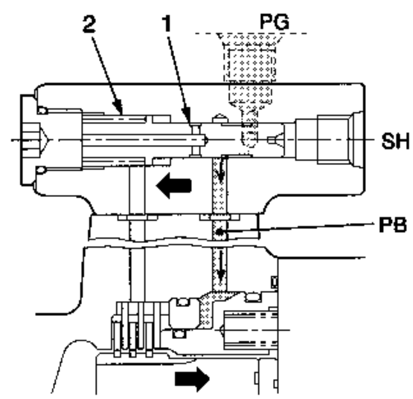
When the piston (11) has reached the stroke end, the pressure in chamber B rises and the pressures in the chambers A and B counterbalance each other. At this time, the force that moves the disc (10) to the left becomes P = P1 , which refers to A - A1 . At the specified pressure setting, the counterbalance valve is then activated.



3. Negative brake release

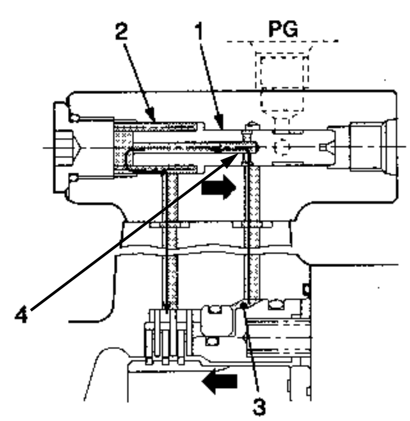
This valve prevents an abrupt movement of the negative brake, when the motor stops.

When the negative brake is applied, oil under pressure is supplied from port P4 to port PG. The sliding valve (1) is pushed to the right by the spring (2), by which the port PG gets closed.



When the pilot pressure is applied at the port for swiveling or arm movement, the sliding valve (1) surpasses the spring (2) and slides itself to the left, by which the port PG gets open. The pressure at port PG is then applied through the hole in the center of the sliding valve (1) to the release port (PB) of the hand brake. In dosing so, the negative brake is now disengaged.

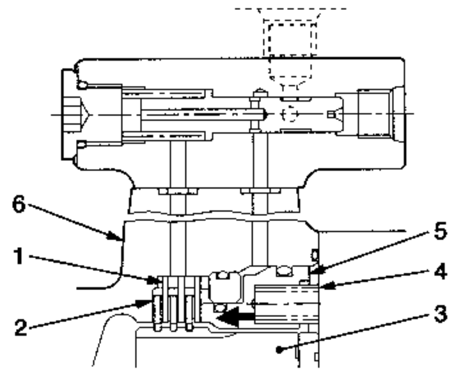
When the pilot pressure is reduced at port SH, the sliding valve (1) is pushed to the right by the spring (2), by which the port PG gets closed. Consequently the hydraulic oil in the brake piston chamber (3) cannot escape any longer. The oil gradually flows from the chamber through the orifice (4) in the range of sliding valve (1) up to the outlet port. In dosing so, the negative brake is now engaged with some delay.



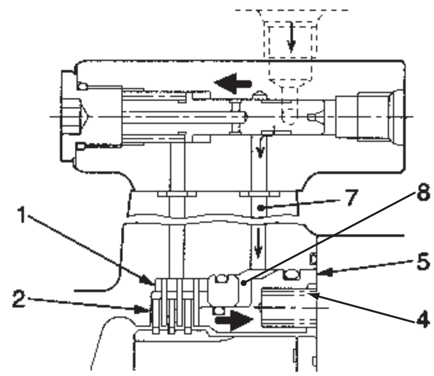
4. Negative brake function

Parking brake

The separator discs (1) are in mesh with the housing, and the friction discs (2) with the cylinder barrel (3). The separator discs (1) and the friction discs (2) are pushed against the housing (6) by the springs (4) and the brake piston (5). The friction between these discs produces a braking moment, preventing the turning of the cylinder barrel (3).

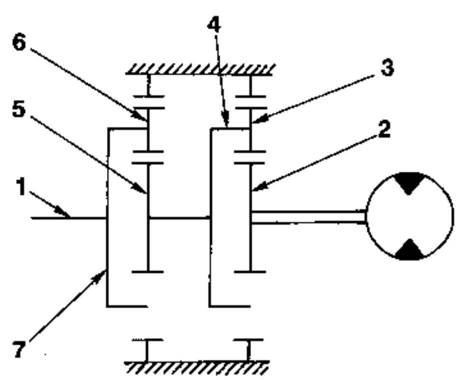


When hydraulic oil is required by the motor, the oil flows from the release port (7) of the parking brake to the brake piston chamber (8). The oil pressure surpasses the spring force and moves the brake piston (5) to the right. By this, free play is produced between the separator discs (1) and friction discs (2), and the parking brake is disengaged. When the motor stops, the sliding valve (9) goes back to the neutral position and closes the release port (7) of the parking brake. Thereby, the pressure oil drains from the brake piston chamber (8) into the motor housing, by which the spring (4) gets the parking brake (4) reengaged.



5. Planetary reduction ratio

The reduction gears consist of a two-stage planetary gear, in order to convert the high speed of the motor to low speed and high torque for the pinion shaft (1). In the figure at right, the motor-generated driving force is transmitted in this way: from the drive shaft of the motor, through the drive gear in the first stage (2), the planetary gear (3) and the support 1 (4), to the sun gear in the second stage (5). The sun gear in the second stage (5) then transmits the driving force through the planetary gear (6) and the support 2 (7) onto the pinion shaft (1), to carry out a swivel motion.



c. Parking brake and hydraulic timer

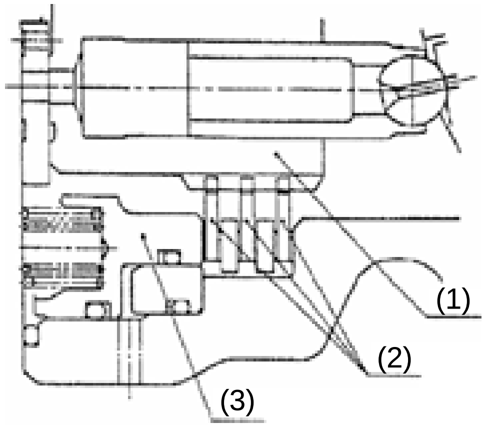
(1) Parking brake (if equipped with parking brake)

The parking brake is of wet multi-disk type and hydraulically released. With shaft-lock mechanism, the brake is engaged and disengaged by switching the external signal pressure.

1. Parking brake ON

Refer to the construction view Fig. 1 .
When the brake releasing hydraulic pressure is cut off, the discs that are spline-coupled around the cylinder block are pressed on the brake piston (fixed not to turn itself) by a spring force. The frictional force works to retain the cylinder block and the case, which gets the shaft locked.

(1) Cylinder block
(2) Disc plate
(3) Brake piston

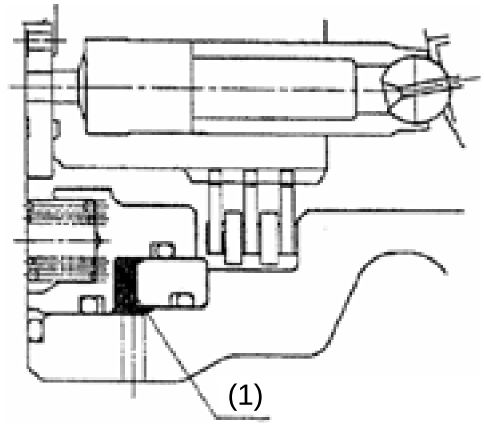


( ) bra e release pressure FF
Fig.

2. Parking brake OFF

Refer to the construction view Fig. 2 .
When the brake releasing hydraulic pressure is introduced through port PB (port PG if equipped with the parking plate) into the brake cylinder chamber (C), the brake piston acts against the spring force, which gets rid of the frictional force against the discs. Now the shaft can turn itself freely.

(1) Brake cylinder chamber C

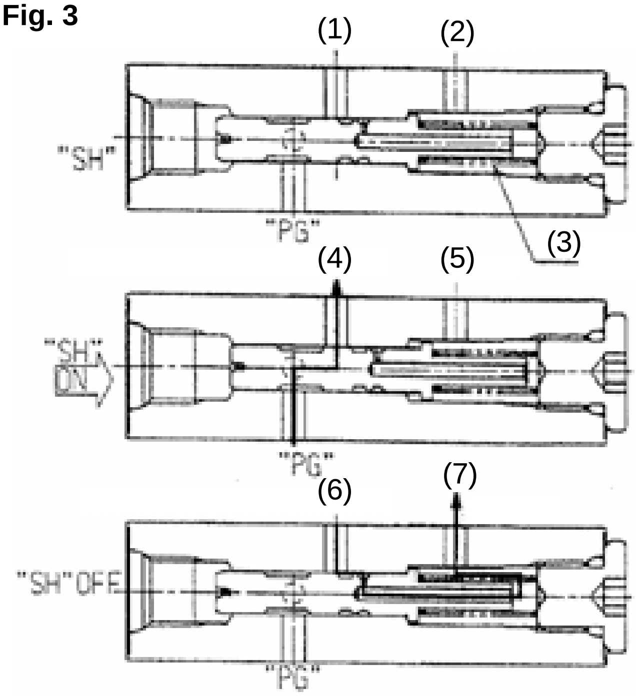


( ) bra e release pressure
Fig.

3. Hydraulic timer

Refer to the construction view Fig. 3 .
The hydraulic timer is designed to prevent a drag of the parking brake in braking the swivel motion. While the swivel inertial force is absorbed by the hydraulic dynamic brake, a delay time is ensured to disable the parking brake. The delay time is realized by narrowing the orifice to control the flow of the oil coming out of the brake cylinder chamber.
Keep the motor running and return the control valve to the neutral position. Now the valve switching pressure SH, which is interlocked with the control valve s switching signal, becomes low. The valve acts by the spring force as shown below. Through this valve, the brake cylinder chamber connects to the drain. (In this state, the upper swivel structure s energy is converted to thermal energy and absorbed. To do this, the relief valve, as discussed later, provides for hydraulic dynamic braking effect.) On the other hand, the oil in the brake cylinder chamber A tends to flow, by the spring force upon the brake piston, toward the disc-pressing direction. But the flow of the oil out of the brake cylinder chamber is controlled by the orifice of the valve. In a specified time, therefore, the brake piston comes into contact with the discs for braking effect.

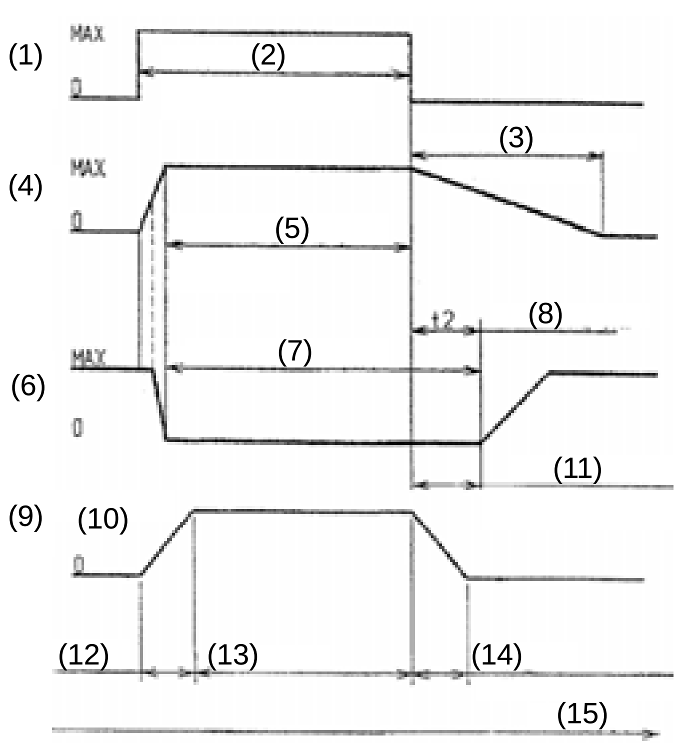
Fig. 3



(1) To brake cylinder chamber C
(2) Drain
(3) Spring
(4) To brake cylinder chamber C
(5) Drain
(6) To brake cylinder chamber C
(7) Drain

The above function is explained in a diagram below.

iagram



(1) Shuttle valve switching external signal pressure SH
(2) Valve switched for main control during this period
(3) Time zone in which the flow is controlled by the orifice
(4) Parking brake cylinder chamber pressure
(5) PG feed pressure acting during this period
(6) Parking brake torque
(7) Parking brake released
(8) Timer setting
(9) Parking brake disabled during this period. No drag allowed.
(10) Swiveling speed
(11) Preset swiveling speed
(12) Acceleration
(13) Constant swiveling speed
(14) Deceleration
(15) Time (t) : 5   1.5 seconds

d. Anti Swivel Back Valve

1. Outline

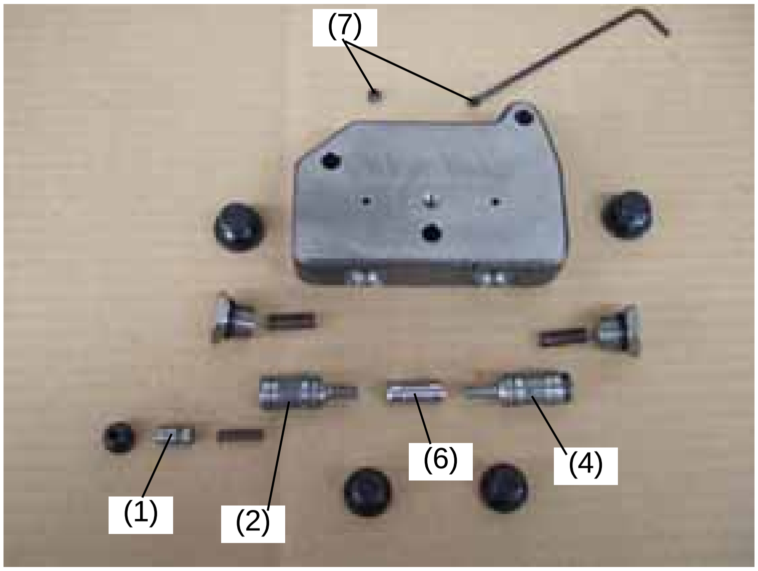
Anti swivel back valve makes the Main port connect to Drain line in a second in order to prevent Swivel back of upper carriage at swing stop motion.

2. Structure

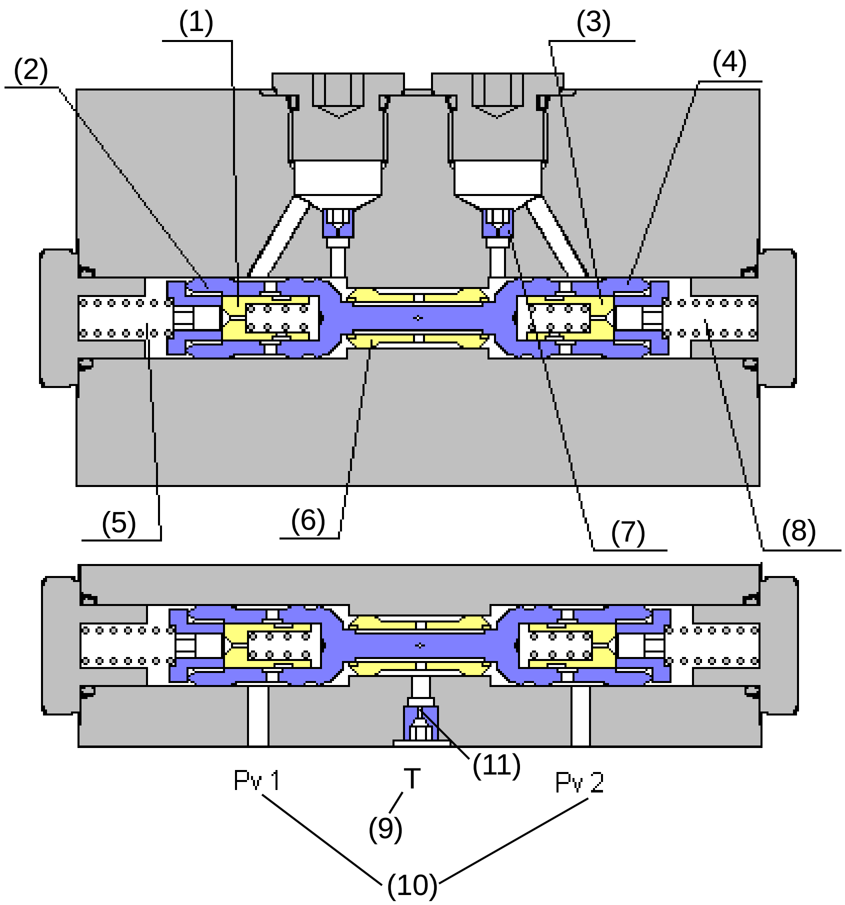
This valve consists of following items.

A) Check valve
B) Flow control valve
C) Sleeve
D) Orifice A (Inside two plugs, ϕ1.0)
E) Orifice B (Inside Cv, ϕ0.6)

(11)Orifice B



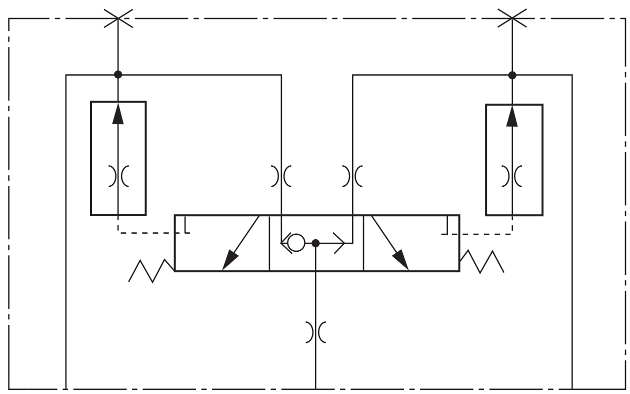
(1) Flow control valve 1
(2) Check valve 1
(4) Check valve 2
(6) Sleeve
(7) Orifice A



(1) Flow control valve 1
(2) Check valve 1
(3) Flow control valve 2
(4) Check valve 2
(5) Damping chamber 1
(6) Sleeve
(7) Orifice A
(8) Damping chamber 2
(9) To make-up valve (This serves as drain on this motor.)
(10) To main ports
(11) Orifice B

3. Function

Hy raulic circuit iagram



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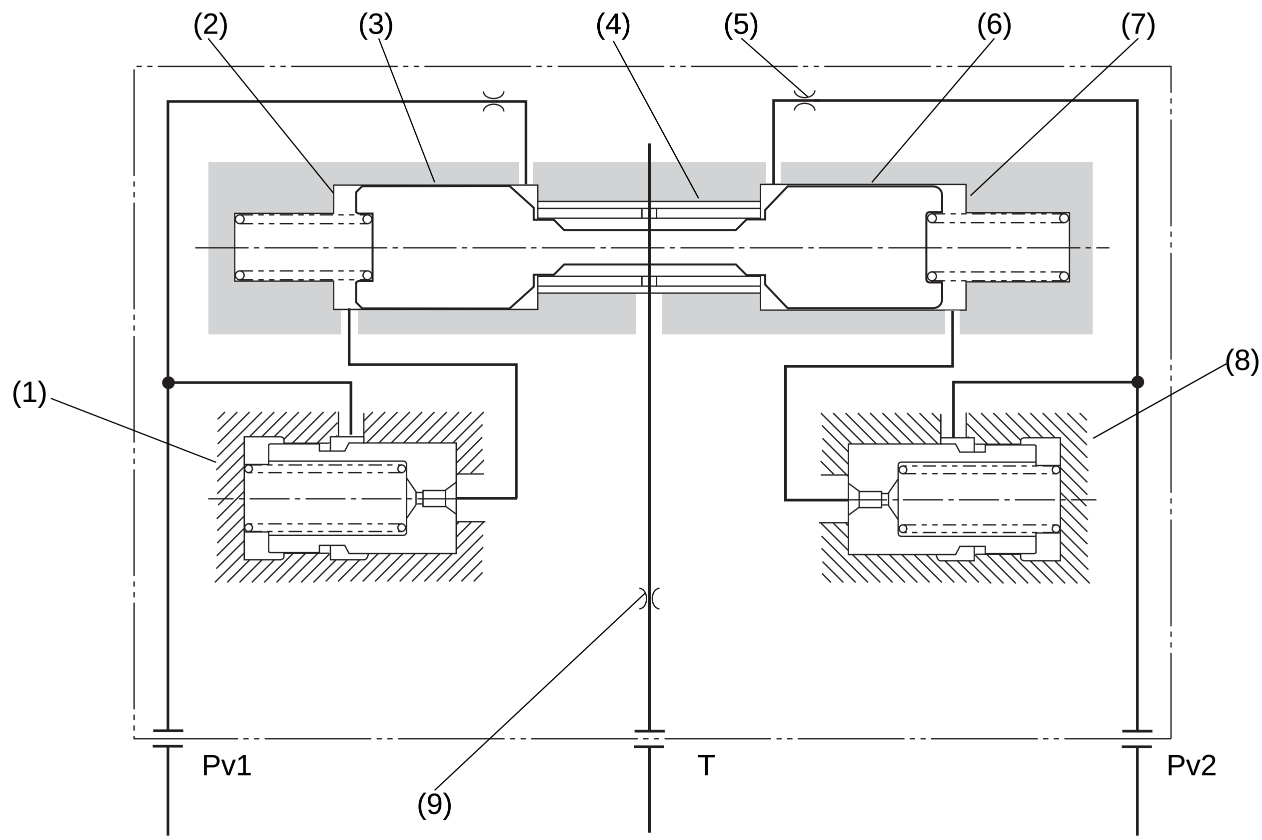
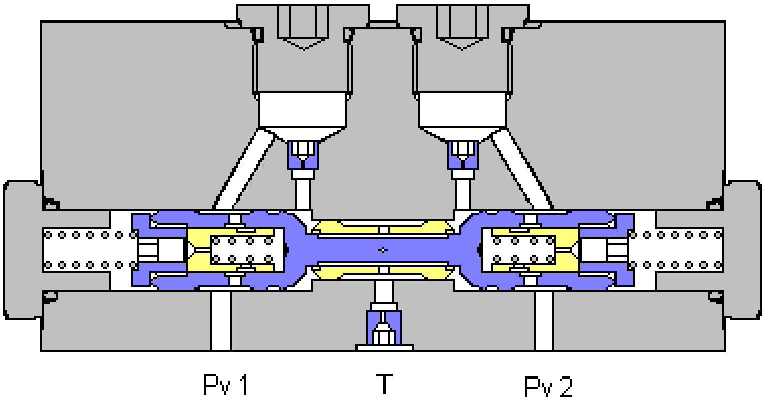
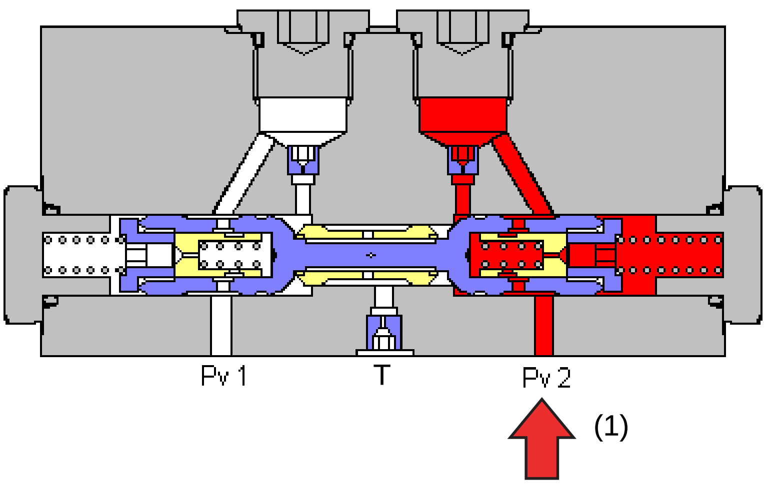


(1) Flow control valve 1
(2) Damper chamber 1
(3) Check valve 1
(4) Sleeve
(5) Orifice A
(6) Check valve 2
(7) Damper chamber 2
(8) Flow control valve 2
(9) Orifice B



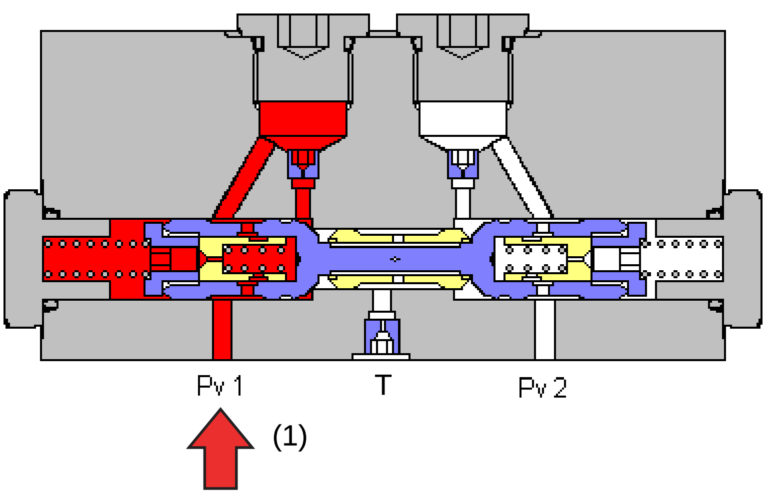
① (Neutral condition)
Check valve stands in center position by spring force when control valve is not operated.
(P1 and P2 have same pressure.)



② (Acceleration and operating condition)
Check valve is pushed and block the passage when swivel motor is operated.

(1) Operating pressure

Internal pressure pushes the poppet and seal.

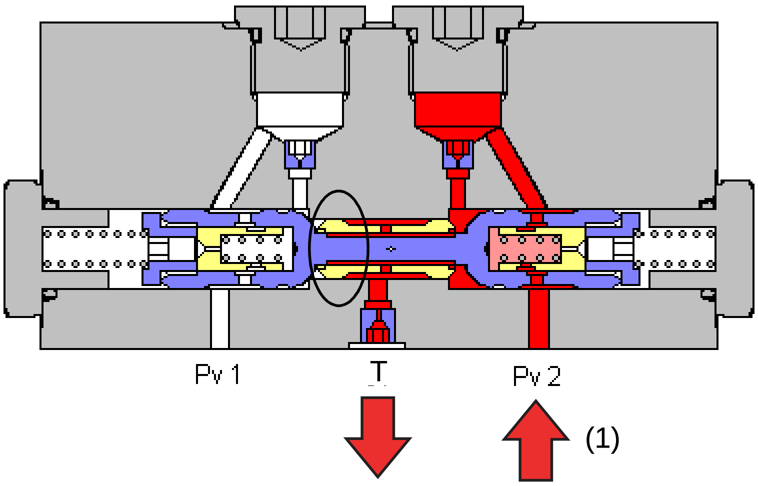


③ (Braking condition)
Check valve is pushed and block the passage by brake pressure.

(1) Brake pressure of motor's pumping function

Note :
This brake pressure is generated by the pumping function of the swivel motor's inertia force when the control lever is returned to neutral position while swiveling.

On this stage, swivel motor is turning a little.

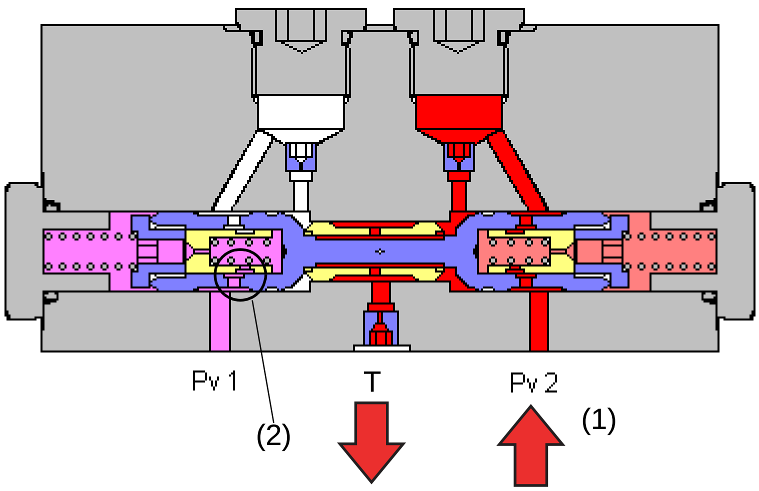


④ (Swivel back condition 1)

After swivel stop, the swivel motor start to swivel back due to the swivel back pressure.
This pressure pushes the sleeve in the direction of the check valve (Low pressure side) and makes sleeve contact with check valve.
At the same time, the passage from Pv2 to T is opened.
The pressure is led to T through this passage.

(1) Swivel back pressure.

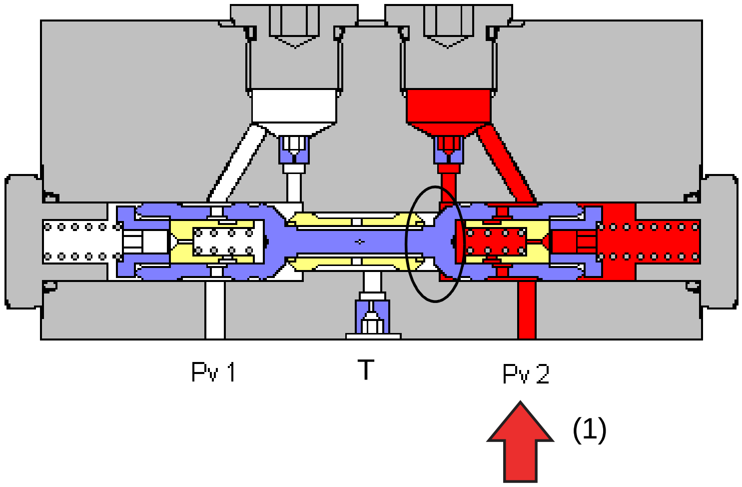
(Instantaneous pressure oil)



⑤ (Swivel back condition 2)

Swivel back pressure pushes also the check valve in the direction of the arrow.
Check valve moves constant speed because flow control valve restricts the flow from damping chamber 1.

(1) Swivel back pressure.
(2) Flow control valve

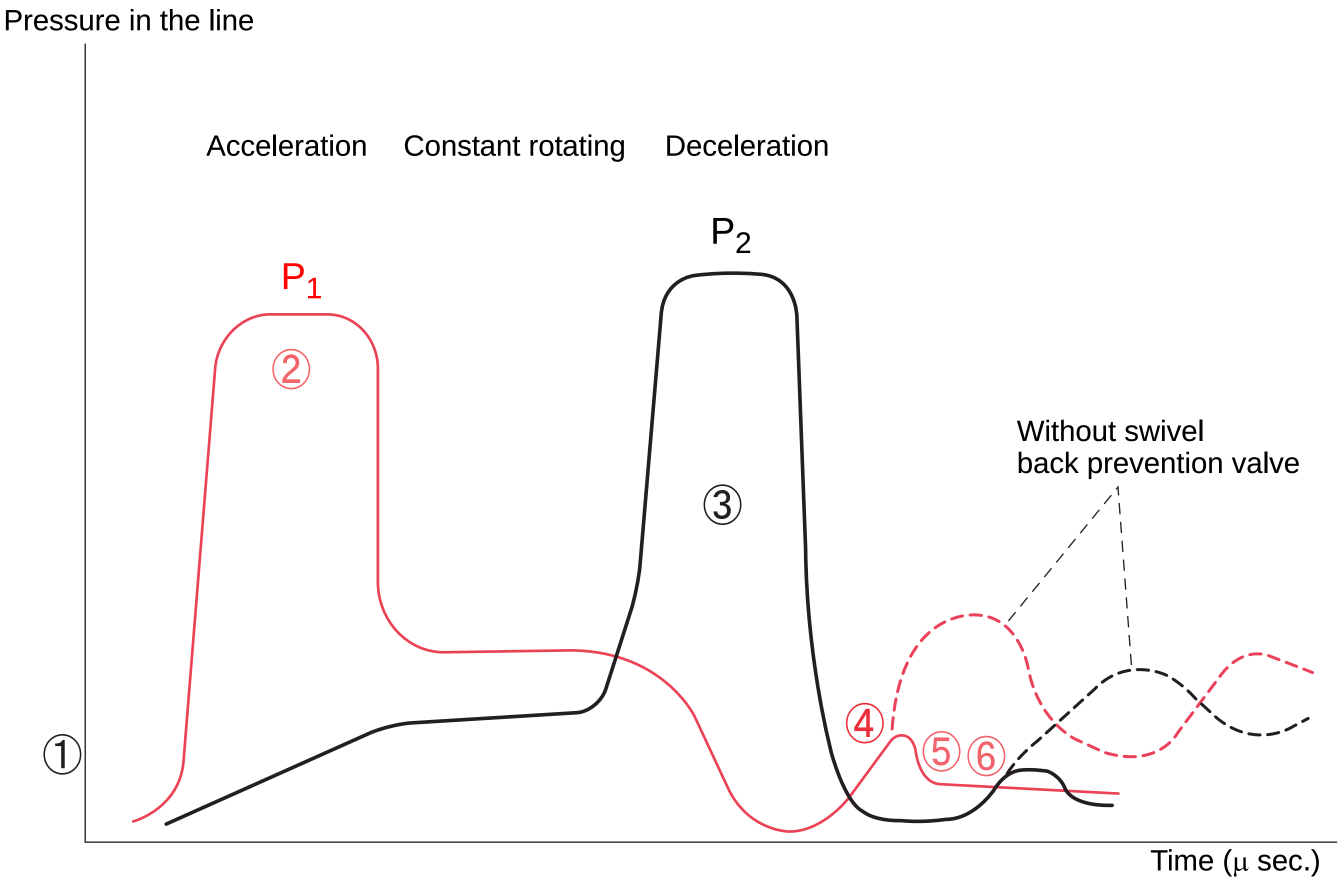


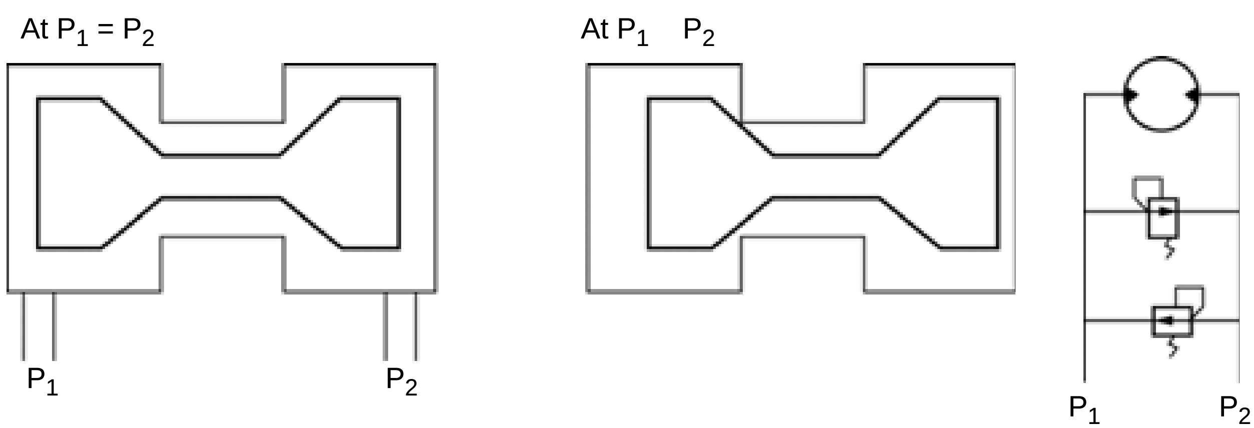
⑥ (Swivel back condition 3)

Finally, Check valve shut the passage between Pv2 and T2.

(1) Swivel back pressure.

4. Swivel motor, swivel back prevention mechanism



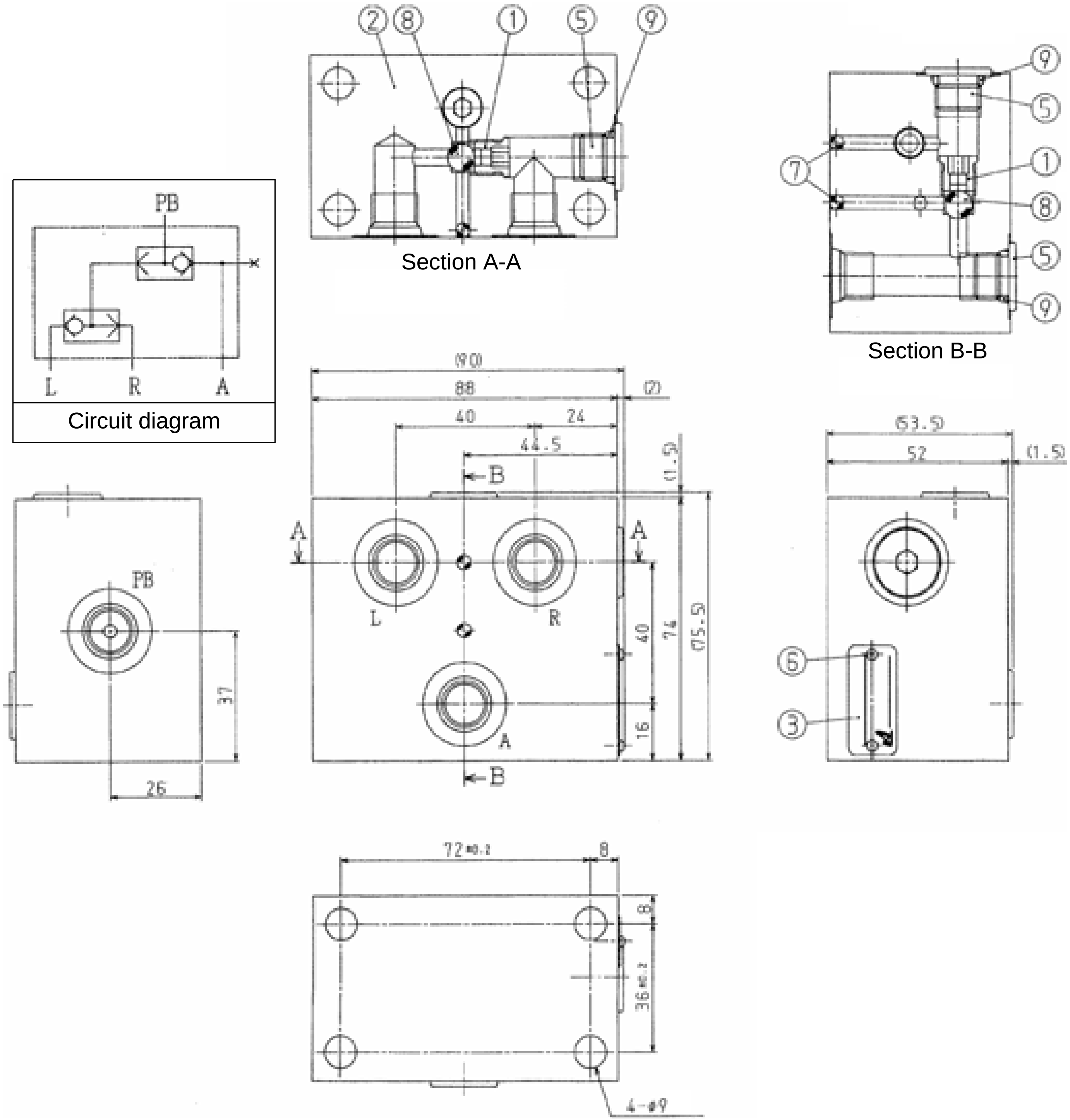


P_1 and P_2 become same pressure and prevent swivel shock.

P_1 and P_2 are blocked by the valve seat.

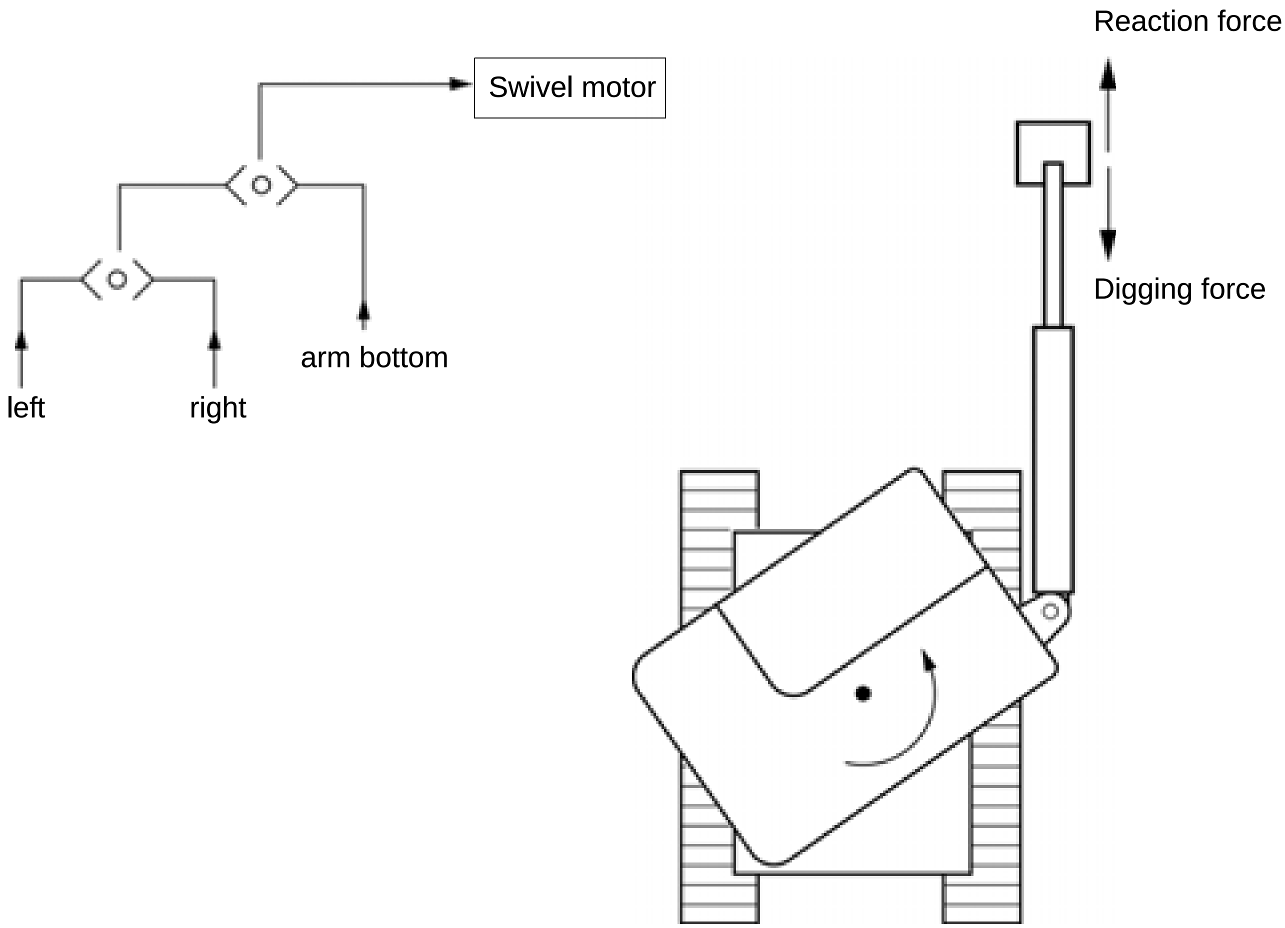
e. High-pressure selector valve (for swivel brake release signal)

1. Outline



Used to select maximum pressure of the pilot signal for left/right swivel and arm crowd.
Used to release the swivel motor's negative brake at maximum pressure.
Used to release the maximum pressure signal on the timer-controlled valve of the swivel motor first and then to get the negative brake activated with a delay (about 5 seconds to allow for enough swivel relief).

2. Release function of negative valve



If, Moment by digging force   Swivel motor negative braking force ; Friction plates might be burned out.

G.Travel motor

a. General

1. GM motor

This product is a rotary hydraulic actuator. The reduction gears, hydraulic motor, brake valve and parking brake are compactly integrated in this actuator. It has been developed and manufactured for construction machinery that requires low-speed rotations and high-level torques. This product is called GM motor in this manual.

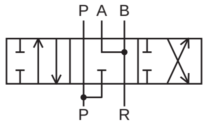
2. Specifications

			Characteristics	Working condition
Motor type			GM09VN-B-21/36-3	
User model			KX080-3	
Reduction gears	Gear ratio		MAX. 75.4	61.6
	Rating torque	N m (kgf m)	Rating 8830 (900)	5160/9000 (526/918)
	Output speed	r.p.m.	MAX. 60.0	52.7/31.6
Hyd. motor	MAX. capacity	cm^3/rev.	MAX. 36.3	21.3/36.3
	MAX. working pressure	MPa (kgf/cm^2)	MAX. 31.38 (320)	29.4 (300)
	MAX. speed	r.p.m.	MAX. 3600	3245/1944
	Flow rate	l/min.		72
	2 speed control pressrue	MPa (kgf/cm^2)	1.96 6.86 (20 70)	1.96 6.86 (20 70)
Parking brake	Braking torque	N m (kgf m)	MIN. 97.1 (9.9)	97.1 (9.9)
	Release pressure	MPa (kgf/cm^2)	MIN. 0.47 (4.8)	0.47 (4.8)
System pressure		MPa (kgf/cm^2)		29.4 (300)

Note

1. One side (D1 or D2) of the motor drain ports is plugged. When mounting the GM motor to the excavator, connect the drain piping to the upper drain port.
2. The allowable pressure of the motor case is 0.20 MPa (2 kgf/cm^2) below. The drain piping should be properly sized to keep the inner pressure of the motor case is not over 0.20 MPa (2 kgf/cm^2).
   Allowable surge pressure is 0.69 MPa (7 kgf/cm^2).
3. Motor case should be filled with working oil. Use non-pluged drain port for filling. The volume of the working oil is about 0.5 L.
4. Gear case is filled in advance with oil's SAE 90 GL4.
5. For mounting GM, use bolts classified JIS B 1501 strength class 12.9. Use of lock compound on bolts threads is recommended.
6. When neutral, the control valve should be the position of following chart.

Chart



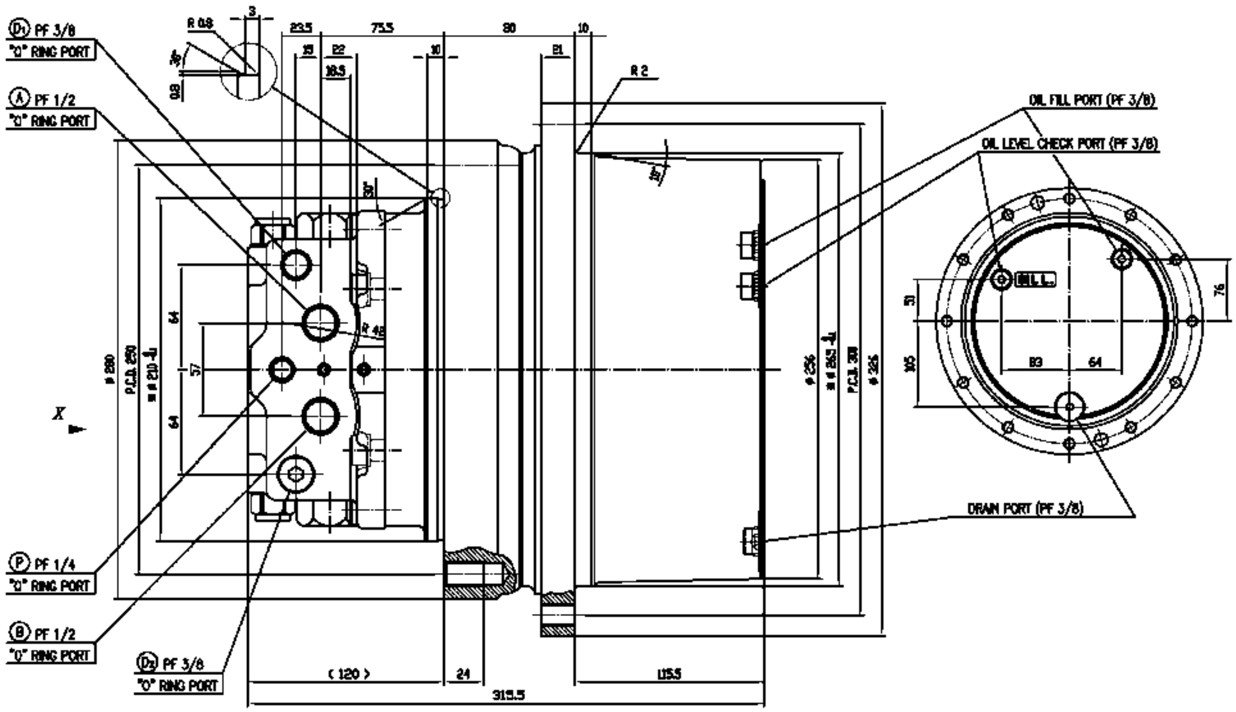
3. Motor type

The type of motor is marked on the product label.

M 09 ___ - ___ - ___/36 - 3
(1) (2) (3) (4) (5) (6)

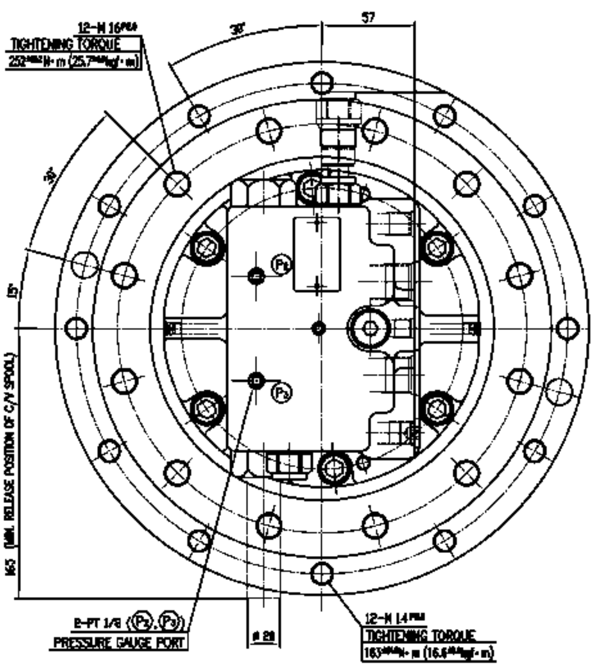
(1) Type code
(2) Size code
(3) Model code
(4) Reduction ratio code
(5) Hydraulic motor displacement rate (cm^3/rev.)
(6) Design number (product classification number)

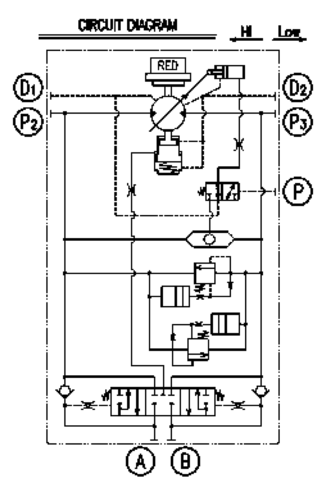
b. Outer view



Direction of rotation

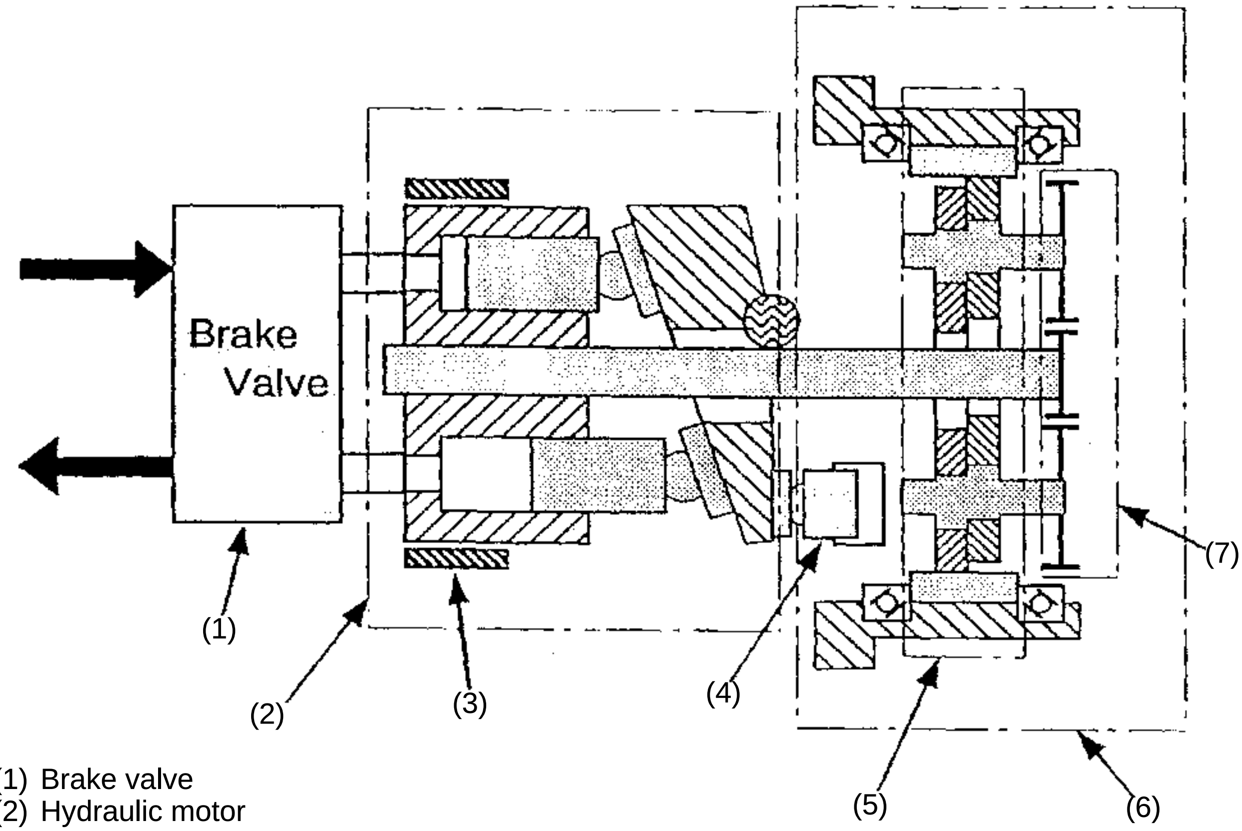
Direction (view X)	Inlet port	Outlet port
Clockwise	Ⓑ	Ⓐ
Counter clockwise	Ⓐ	Ⓑ





c. Structure

1. Basic structure of GM motor



(1) Brake valve
(2) Hydraulic motor
(3) Parking brake
(4) Two-speed select mechanism
(5) Second reduction section
(6) Reduction gears
(7) First reduction section

1) Reduction gears

The speed reducer consists of two sections: first reduction section with spur gears and second reduction section with pericycloid-toothed differential gears. The high speed of the hydraulic motor is reduced for low-speed, large-torque rotation.

2) Hydraulic motor

The hydraulic motor is of swash-plate axial piston type. The force of pressure oil coming from the pump is converted to rotational movement.

3) Brake valve

This valve is equipped with various component valves. It is designed to bring the hydraulic motor to a smooth stop, to prevent it from running out of control, and to keep off an excessive pressure that would occur in case of a sudden hydraulic motor halt.

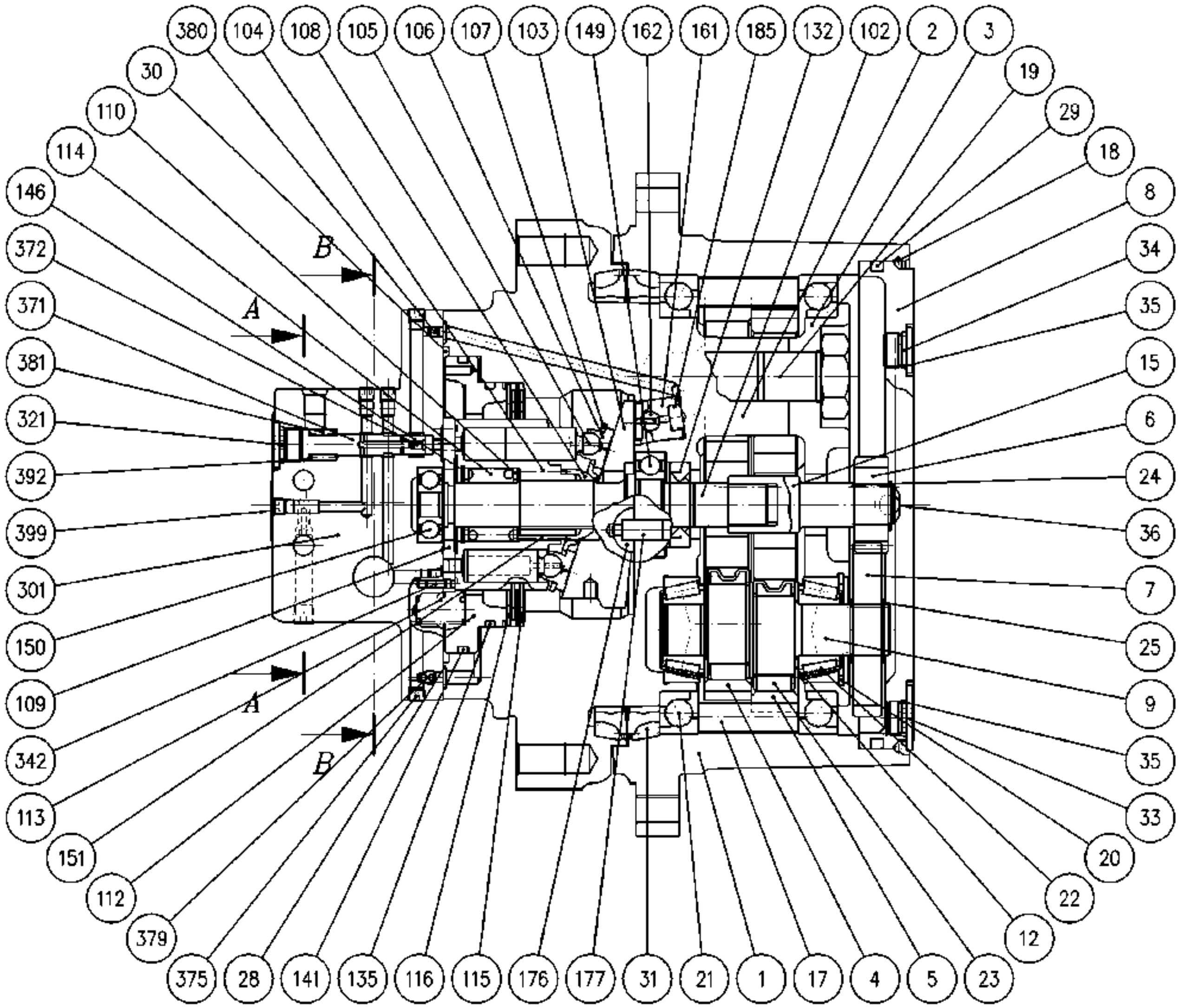
4) Two-speed select mechanism

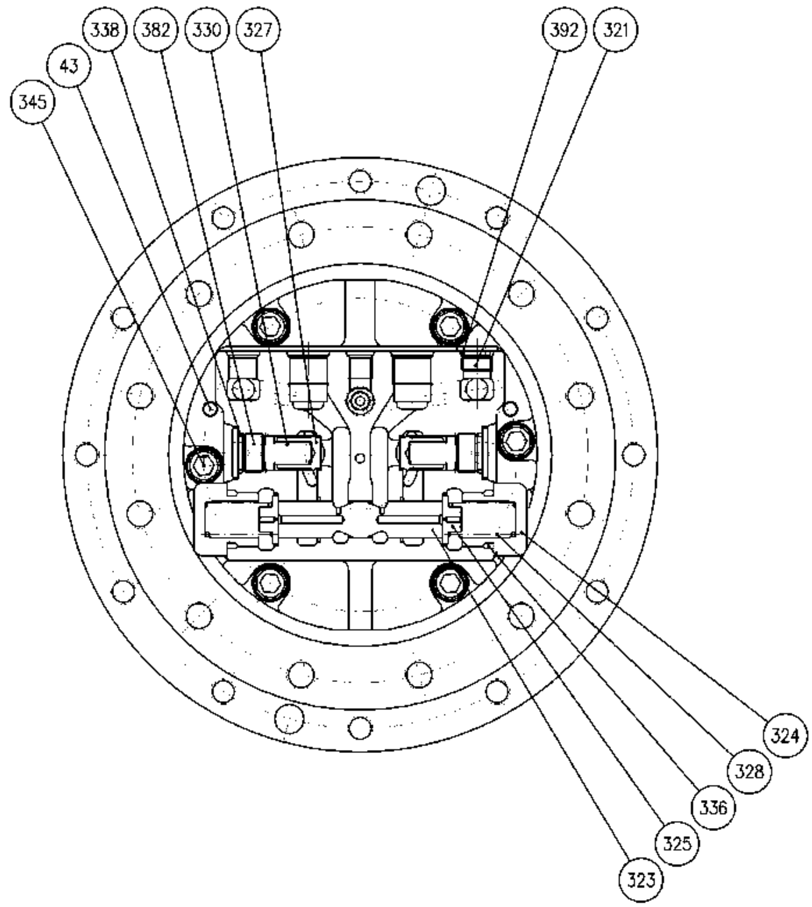
Composed of a selector valve and a piston, this mechanism switches between two different stroke displacements of the hydraulic motor.

5) Parking brake

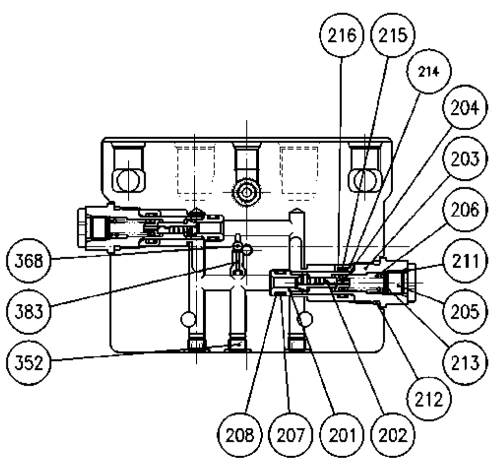
This friction disc type brake is integrated with the hydraulic motor.

2. Sectional view





Section A-A



Section B-B

3. Parts list

No.	Parts name	Q'ty
1	Hub	1
	Spindle kit	
	Spindle assembly	1
2	Spindle	1
3	Hold flange	1
19	Reamer bolt	3
	RV gear assembly	
	RV gear kit	1
4	RV gear A	1
5	RV gear B	1
9	Crank shaft	3
12	Spacer	6
22	Tapered roller bearing	6
23	Needle roller bearing	6
6	Input gear	1
	Spur gear kit	1
7	Spur gear	3
	F-Seal kit	1
31	Floating seal	2
8	Cover	1
15	Shaft	1
17	Pin	28
18	Ring	1
20	Snap ring	3
21	Ball bearing	2
24		1
25		6
28	O-ring	2
29	O-ring	1
30	O-ring	1
33		1
34	Plug	2
35	O-ring	3
36	Steel ball	1
43	Parallel pin	2
	Piston kit	1
	Piston assembly	9
105	Piston	1
	Rear flange assembly	1
	Rear flange kit	1
301	Rear flange	1
323	Spool	1
352	Hex. socket plug	5
368	Steel ball	1
375	Hex. socket plug	5
379	Filter	1
380	Orifice	1
383		1
399	Name plate	1
	Spool kit	1
371	Spool	1
372	Oil stopper	1

No.	Parts name	Q'ty
106	Shoe	1
	Piston assembly	1
161	Piston	1
162	Shoe	1
102	Shaft	1
103	Swash plate	1
104	Cylinder block	1
107	Retainer plate	1
108	Thrust ball	1
109	Timing plate	1
110	Washer	2
112	Piston	1
113	Spring	8
114	Spring	1
115	Friction plate	2
116	Mating plate	2
132	Oil seal	1
135	O-ring	1
141	O-ring	1
146		2
149		1
150		1
151	Needle roller	3
176	Pivot	2
177	Parallel pin	2
185	Spring	1
		2
201		1
202	Valve	1
203	Sleeve	1
204		1
205	Plug	1
206	Spring	1
207	O-ring	1
208	Back up ring	2
211	O-ring	1
212	O-ring	1
213		1
214	Piston	1
215	O-ring	1
216	Back up ring	2
321	Plug	2
324	Plug	2
325	Spring retainer	2
327	Valve	2
328	Spring	2
330	Spring	2
336	O-ring	2
338	O-ring	2
381	Spring	1
382	Plug	2
392	O-ring	2
342	Parallel pin	2
345	Hex. socket bolt	6