

WSM

WORKSHOP MANUAL **KUBOTA EXCAVATOR**

U20-3
U25-3

Kubota

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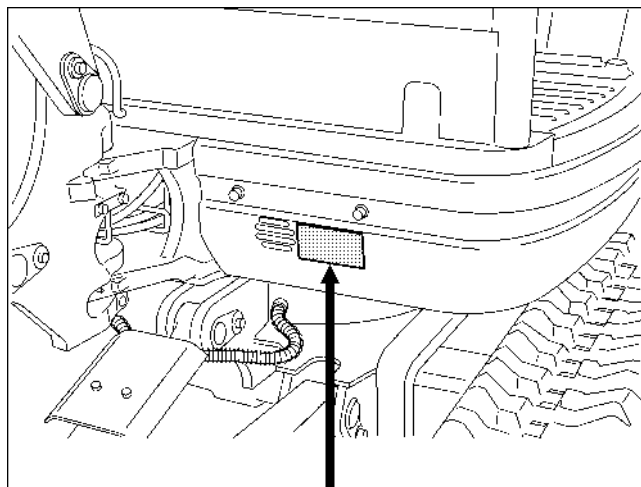
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A. Body and engine identification marks

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

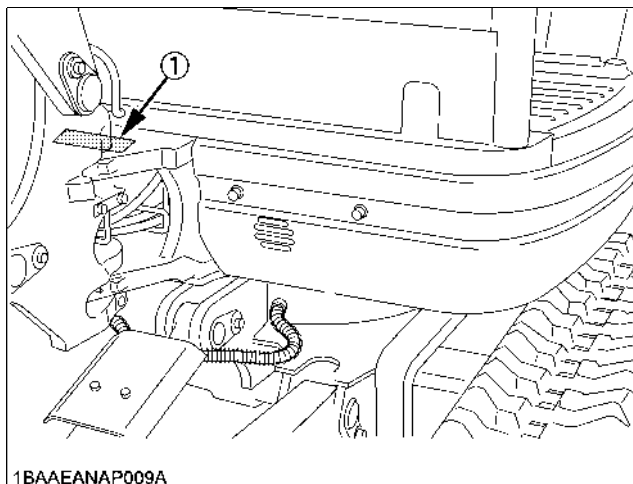
(1) Machine serial number



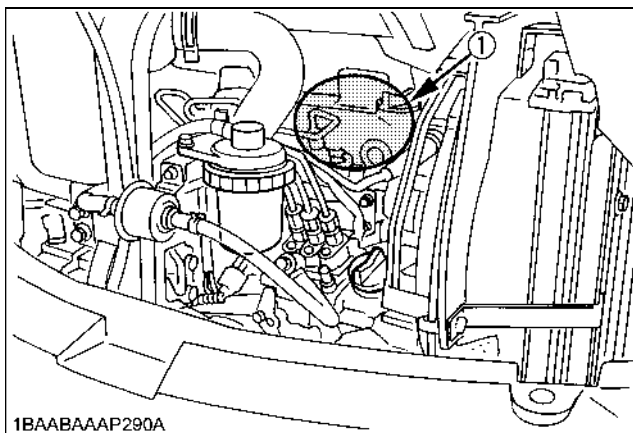
KUBOTA Corporation		CE	
2-47, Shikitsunigashi 1-Chome, Naniwa-ku, Osaka, 556-8601 JAPAN			
MODEL		SERIAL NO.	
MASS	kg	MAX. DRAW BAR PULL	kN
POWER	kW	MAX. VERT. LOAD	kN
PRODUCT IDENTIFICATION NUMBER			
MANUFACTURED YEAR			MADE IN JAPAN.

1BAABAAAP288A

(2) Engine serial number



1BAAEANAP009A



1BAABAAAP290A

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 hydraulic 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 hoisting 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 assembled only after removing the coating.
3. Separated parts must be correctly reassembled using alignment marks.
4. As a rule, use a press to reassemble bearings, bushing and oil seals. Use pads when using a hammer.

C.IMPORTANT SAFETY PROCESS AND CRITICAL FUNCTIONAL PROCESS

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

a. Essential Adhesives

Type of screw adhesive

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

Type of instantaneous adhesive

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

b. Important Safety Process **[S]**.

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

c. Important Critical Functional Process **[A]**.

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

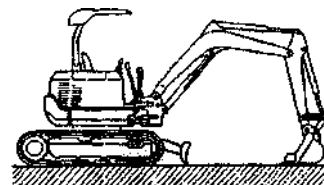
D.IMPORTANT INSPECTION ITEMS AFTER REASSEMBLING

- a Operate the Machine and check for Unusual Noise and Vibrations.
- b Make Sure the Safety decals and Wireharness Clamps are in their Specified Positions.
- c With the Machine Front in a Specified Posture, Check the Amount of Hydraulic Oil

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

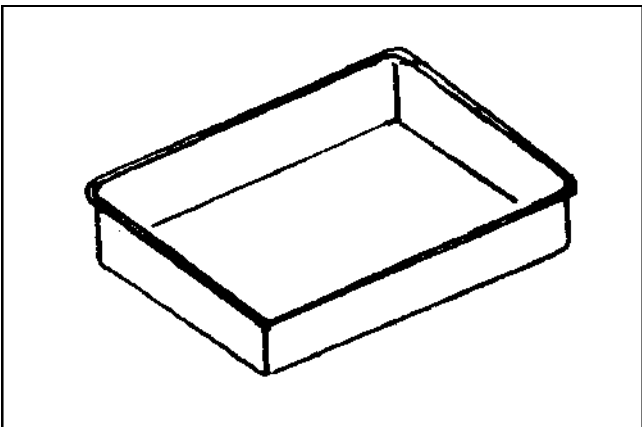
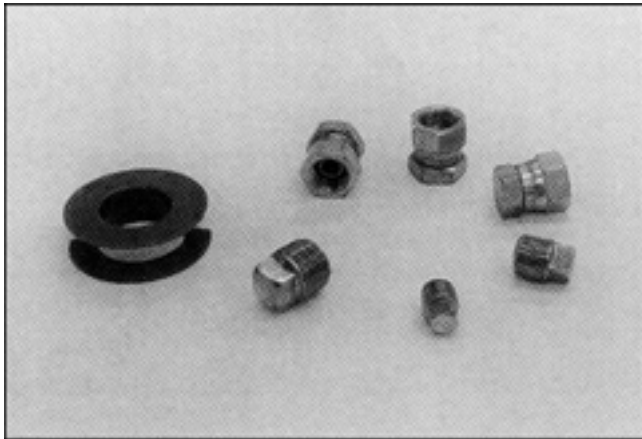
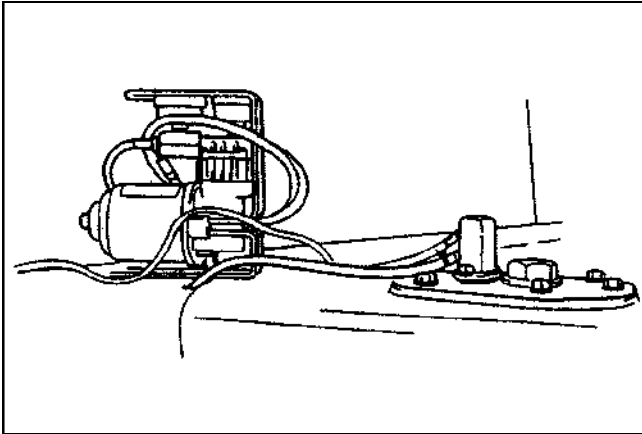
- (1) Park the machine on a level ground.
- (2) Make sure the hydraulic oil temperature is in the range of 10-30°C (50-86°F) and see if the oil level is within the specified zone of the oil level gauge.
- (3) Keep the machine front as shown as following posture.

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



E.SERVICING FUNDAMENTALS

Locking adhesive



a. Items for Servicing

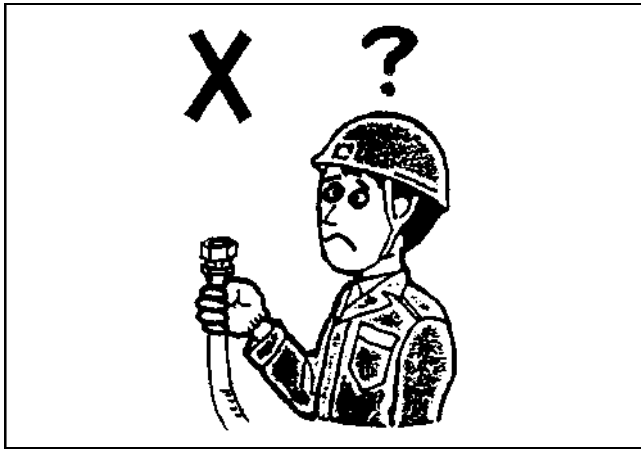
- (1) Tighten bolts, nuts, adapters, and similar parts to their specified torques which are given in the list of tightening torques and adhesive as well as in this manual. Be sure to observe the specified torques for important tightened parts and components.
- (2) Wipe out water, oil and grease off the screws on which LOCTITE adhesive is to be applied. Be sure to apply the adhesive to specified locations.

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

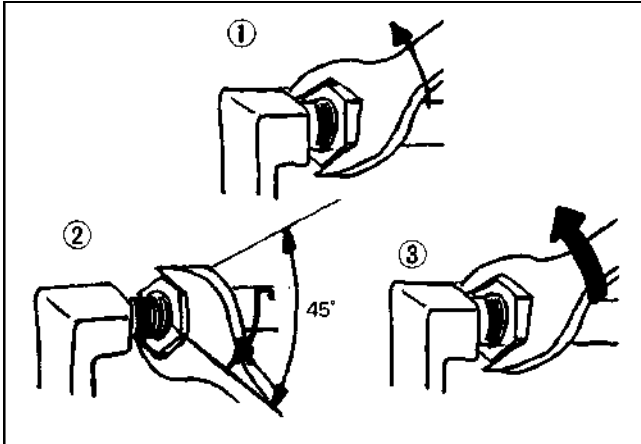
Type of instantaneous adhesive
Use THREE-BOND 1733 or 1741E

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

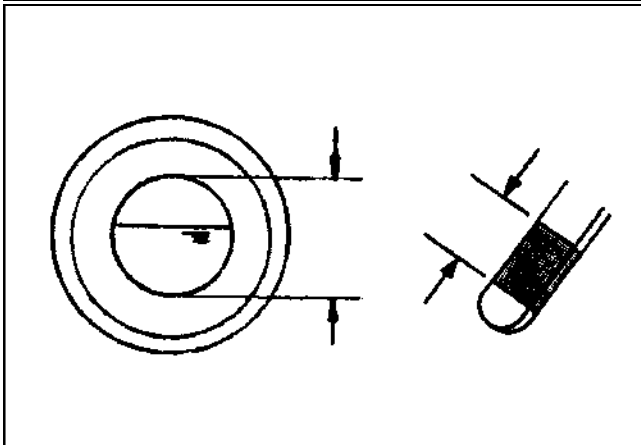
- (3) Precautions in disassembling the hydraulic equipment
 - Use a vacuum pump, plugs, oil pans, waste cloth and the like to prevent oil from running out or splashing. Wipe out leaking oil completely first and then add oil as required.
 - Protect the openings with plugs, covers or the like to keep off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



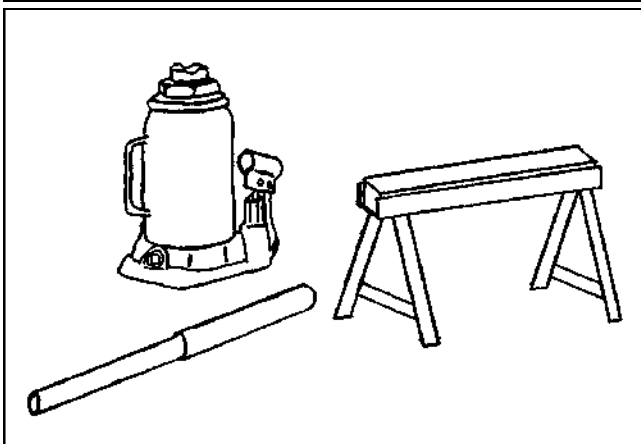
- (4) Precautions in tightening hoses and pipes.
- Flexible hoses have a slight natural bend of their own. Utilize the natural bend. Be also careful not to twist them.
 - Be careful not to confuse the routes of the hoses.
 - Do not hold the hoses in tight contact with their adjacent parts and surfaces.



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



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

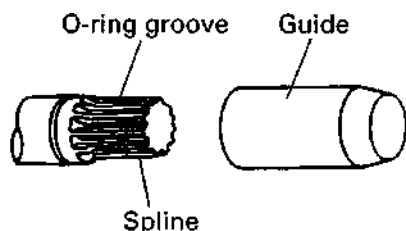


- (6) Security support the machine with a jack and a supporting jig when it is jacked up for servicing.
- (7) Be sure to use a crane in disassembling and reassembling heavy parts and components (frame, front attachment, crawler, etc.).

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

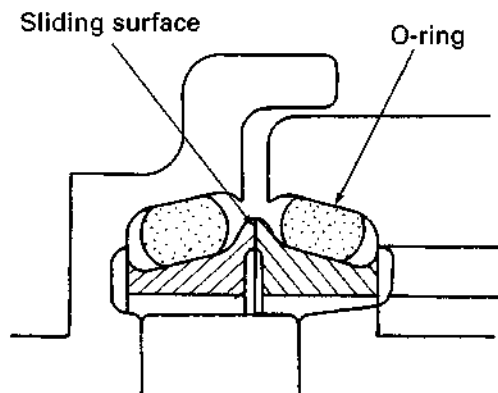
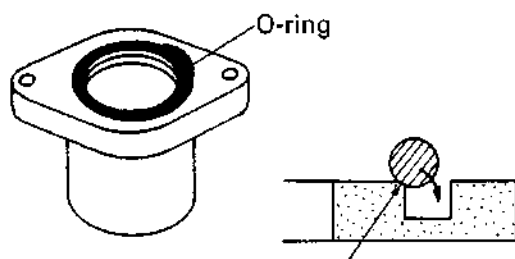
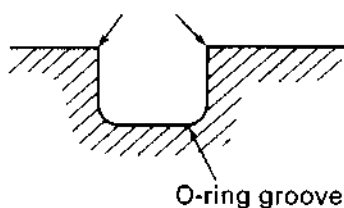
(1) General precautions

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



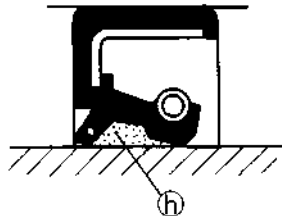
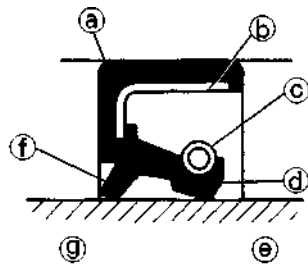
(2) O-ring

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



(3) Floating seal

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

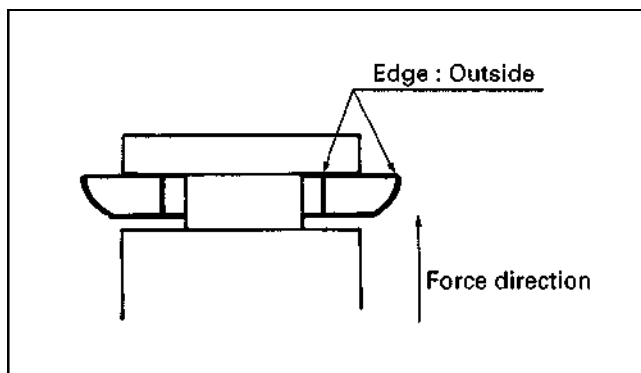


(4) Oil seal

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

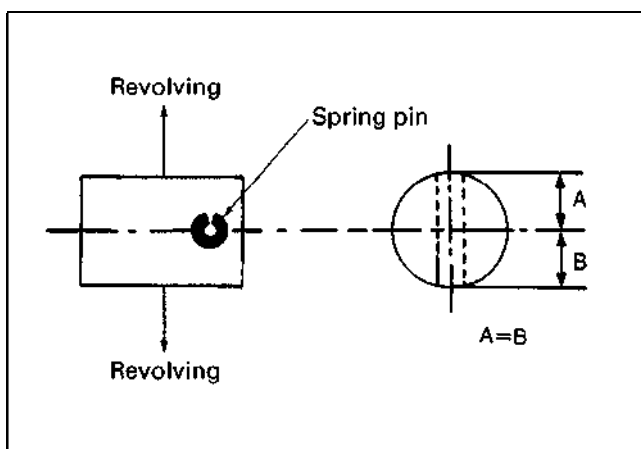
- | | |
|-------------------------|-------------------------|
| a. Packing | f. Dustproof lip |
| b. Metal ring | g. Atmosphere (outside) |
| c. Spring | h. Grease |
| d. Main lip | |
| e. Oil chamber (inside) | |

- 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. If 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.

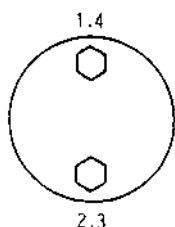
*Excessively tight contact

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.

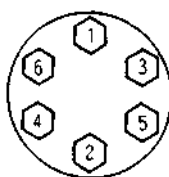
(3) Precautions in tightening the bolts and nuts

- 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.

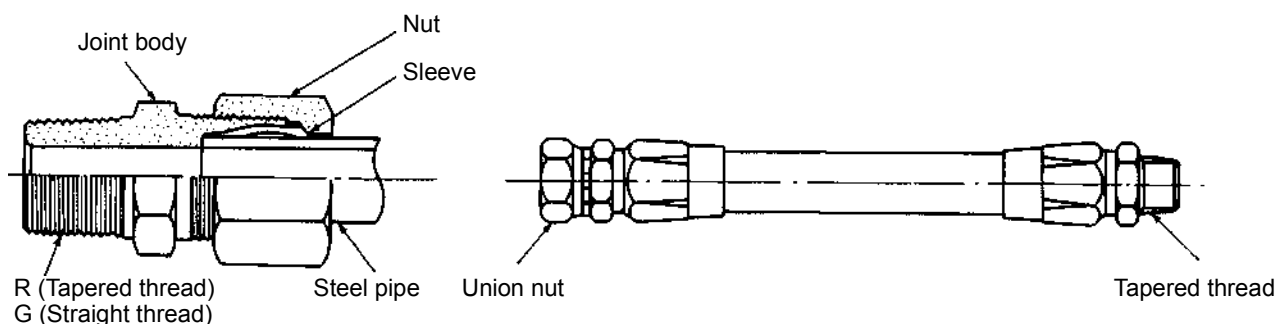
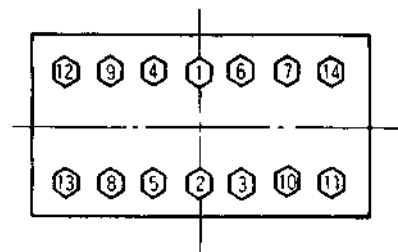
Top and bottom alternately



Diagonally



Diagonally starting from center



(4) Hose screw

Metric Size Hose

Thread size (piping screw)	Tightening torque N·m kgf·m		Wrench size	Thread size (piping screw)	Torque N·m kgf·m
	Union nut section	Taper thread section			
1/8"	7.8 ~ 11.8 N·m 0.8 ~ 1.2 kgf·m	14.71 ~ 19.61 N·m 1.5 ~ 2.0 kgf·m	17 mm	M12 × 1.5	20 ~ 30 2.0 ~ 3.1
1/4"	24.5 ~ 29.4 2.5 ~ 3.0	36.3 ~ 44.1 3.7 ~ 4.5	19 mm	M14 × 1.5	20 ~ 30 2.0 ~ 3.1
3/8"	49.0 ~ 53.9 5.0 ~ 5.5	49.0 ~ 68.6 5.0 ~ 7.0	22 mm	M16 × 1.5	30 ~ 50 3.1 ~ 5.1
1/2"	58.8 ~ 63.7 6.0 ~ 6.5	83.4 ~ 88.3 8.5 ~ 9.0	27 mm	M18 × 1.5	30 ~ 50 3.1 ~ 5.1
3/4"	117.7 ~ 127.5 12.0 ~ 13.0	127.5 ~ 147.1 13.0 ~ 15.0	36 mm	M22 × 1.5	40 ~ 60 4.1 ~ 6.1
1"	137.3 ~ 147.1 14.0 ~ 15.0	147.1 ~ 166.7 15.0 ~ 17.0	41 mm		

(5) Joint bodies

Thread size (piping screw)	Tightening torque N·m kgf·m		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	—	17 mm	When in steel pipe is in use.	8 mm
1/4"	36.3 ~ 44.1 3.7 ~ 4.5	W/O-ring Joint Torque 58.8 ~ 78.5 6 ~ 8	19 mm		12 mm
3/8"	39.2 ~ 49.0 4.0 ~ 5.0	W/O-ring Joint Torque 78.5 ~ 98.1 8 ~ 10	23 mm		15 mm
1/2"	49.0 ~ 68.6 5.0 ~ 7.0	W/O-ring Joint Torque 117.7 ~ 137.3 12 ~ 14	26 mm		16 mm

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

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

(7) Nuts for piping

Steel pipe size (O.D. × I.D. × Thickness)	Tightening torque N·m kgf·m	Spanner size (reference)	Remarks
8 × 6 × 1 mm	29.4 ~ 39.2 3.0 ~ 4.0	17 mm	When sleeve nut is in use.
10 × 7 × 1.5 mm	39.2 ~ 44.1 4.0 ~ 4.5	19 mm	
12 × 9 × 1.5 mm	53.9 ~ 63.7 5.5 ~ 6.5	21 mm	
16 × 12 × 2 mm	88.3 ~ 98.1 9.0 ~ 10.0	29 mm	
18 × 14 × 2 mm	127.5 ~ 137.3 13.0 ~ 14.0	32 mm	
27.2 × 21.6 × 2.8 mm	235.4 ~ 254.97 24.0 ~ 16.0	41 mm	

(8) Tightening torque of bolts and nuts

Refer to the tightness torque table below.

Bolts, Nuts Nominal Dia.	4T 	7T 	9T 
	SS41	S40C, S45C	SCr4
M6	7.8 ~ 9.3 N·m 0.80 ~ 0.95 kgf·m	9.8 ~ 11.3 N·m 1.00 ~ 1.15 kgf·m	12.3 ~ 14.2 N·m 1.25 ~ 1.45 kgf·m
M8	17.7 ~ 20.6 N·m 1.80 ~ 2.10 kgf·m	23.5 ~ 27.5 N·m 2.40 ~ 2.80 kgf·m	29.4 ~ 34.3 N·m 3.00 ~ 3.50 kgf·m
M10	39.2 ~ 45.1 N·m 4.00 ~ 4.60 kgf·m	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m	60.8 ~ 70.6 N·m 6.20 ~ 7.20 kgf·m
M12	62.8 ~ 72.6 N·m 6.40 ~ 7.40 kgf·m	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m	103.0 ~ 117.7 N·m 10.50 ~ 12.00 kgf·m
M14	107.9 ~ 125.5 N·m 11.00 ~ 12.80 kgf·m	123.6 ~ 147.1 N·m 12.60 ~ 15.0 kgf·m	166.7 ~ 196.1 N·m 17.00 ~ 20.00 kgf·m
M16	166.7 ~ 191.2 N·m 17.00 ~ 19.50 kgf·m	196.1 ~ 225.6 N·m 20.00 ~ 23.00 kgf·m	259.9 ~ 304.0 N·m 26.50 ~ 31.00 kgf·m
M18	245.2 ~ 284.4 N·m 25.00 ~ 29.0 kgf·m	274.6 ~ 318.7 N·m 28.00 ~ 32.50 kgf·m	343.2 ~ 402.1 N·m 35.00 ~ 41.00 kgf·m
M20	333.4 ~ 392.2 N·m 34.00 ~ 40.00 kgf·m	367.7 ~ 431.5 N·m 37.50 ~ 44.0 kgf·m	519.8 ~ 568.8 N·m 53.00 ~ 58.00 kgf·m

(9) Types and materials of bolts and nuts

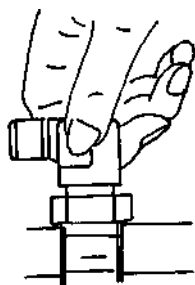
[ex. bolts]

Types	Material	Tensile strength	Hardness	Bolt head marking	
4T	SS41	Over 392 MPa 4000 kgf/cm ²	H _{RB} 62 ~ 98		No mark or marked 4
7T	S40C S45C	Over 686 MPa 7000 kgf/cm ²	H _{RC} 20 ~ 28		Marked 7
9T	SCr4	Over 882 MPa 9000 kgf/cm ²	H _{RC} 28 ~ 34		Marked 9

(10)Washer-equipped elbow

Tightening torque

Size	N·m	kgf·m
G1/4	25 ~ 30	2.5 ~ 3.0
G3/8	49 ~ 54	5.0 ~ 5.5
G1/2	59 ~ 64	6.0 ~ 6.5
G1/8	15 ~ 16.5	1.5 ~ 1.7

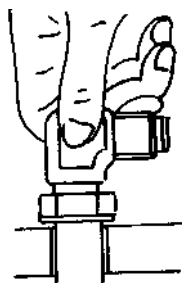


Tightening procedure

1. Connecting with the valve

- Screw in the elbow by hand until the washer comes into contact.

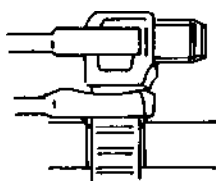
Note: Clean up the mating seal beforehand.



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

d. Machine Quality Specifications

Machine specification: Service port, Wrist rest, STD-arm, KBT-cab, KBT-bucket

No		Specifications Items			Unit	U20-3	U25-3	Remarks
Q1	Main Spec. JIS A8404							
1	1	Machine size	Total length (Transport)		mm	3848 ± 77	4107 ± 82	
	2		Total width		mm	1400 ± 14	1500 ± 15	
	3		Total height (Canopy)		mm	2375 ± 24	2420 ± 24	
	4		Total height (Cabin)		mm	2355 ± 24	2400 ± 24	
2	1	Weight	Machine weight (Canopy)		kg	2030 ± 102	2460 ± 123	Fuel tank
	2		Machine weight (Cabin)		kg	2120 ± 106	2540 ± 127	
3	1	Performance	Swivel speed	L	rpm	8.9 ± 0.9	9.5 ± 0.9	
	2			R	rpm	8.9 ± 0.9	9.5 ± 0.9	
	3		Travel speed	Rubber F1	km/h	2.2 ± 0.2	2.5 ± 0.2	
	4			Rubber F2	km/h	4.2 ± 0.4	4.5 ± 0.4	
	5			Iron F1	km/h	2.1 ± 0.2	2.4 ± 0.2	
	6			Iron F2	km/h	4.0 ± 0.4	4.4 ± 0.4	
	7		Gradeability		deg	30<	30<	
4	1	Rear end min. turning radius			mm	720 ± 14	765 ± 15	
	2	Swivel frame rear ground clearance			mm	490 ± 10	524 ± 10	
	3	Tambler center distance			mm	1474 ± 44	1561 ± 47	
	4	Crawler total length			mm	1851 ± 56	1996 ± 60	
	5	Crawler total width			mm	1400 ± 30	1500 ± 30	
	6	Min. ground clearance			mm	265 ± 8	300 ± 9	
5	1	Front attachment	Bucket heaped capacity	Heaped	m ³	0.066 ± 0.003	0.08 ± 0.003	SAE, JIS
	2			Struck	m ³	0.045 ± 0.002	0.053 ± 0.002	
	3		Bucket width		mm	450 ± 10	500 ± 10	Without side cutter
	4		Swing angle	Canopy L	deg	73 ± 2	73 ± 2	
	5			Canopy R	deg	55 ± 2	55 ± 2	
	6			Cabin L	deg		73 ± 2	
	7			Cabin R	deg		55 ± 2	

No		Specifications Items			Unit	U20-3	U25-3	Remarks
5	8	Front attachment	Max. digging radius		mm	4136 ± 62	4501 ± 68	
	9		Ground level Max. digging radius		mm	4023 ± 60	4386 ± 66	
	10		Ground level Min. finish radius		mm	1455 ± 44	1499 ± 30	Bucket bottom horizontal
	11		Max. digging depth		mm	2298 ± 46	2526 ± 51	
	12		Max. vertical digging depth		mm	1879 ± 56	2282 ± 68	
	13		Max. digging height	Conopy	mm	3965 ± 79	4353 ± 87	
	14			Cabin	mm	3655 ± 73	4125 ± 82	
	15		Max. dump height	Conopy	mm	2610 ± 52	2994 ± 60	
	16			Cabin	mm	2320 ± 46	2775 ± 55	
	17		Max. dump height (Arm vertical)	Conopy	mm	1100 ± 33	1192 ± 36	
	18			Cabin	mm	910 ± 27	1060 ± 32	
	19		Mini. turning radius	Conopy	mm	1760 ± 53	1798 ± 54	
	20			Cabin	mm	1945 ± 58	1945 ± 58	
	21		Mini. turning radius (Left swing)	Conopy	mm	1330 ± 40	1430 ± 43	
	22			Cabin	mm	1520 ± 46	1515 ± 45	
6	1	Dozer	Width		mm	1400 ± 5	1500 ± 5	
	2		Height		mm	292 ± 10	292 ± 10	
	3		Max. lift above GL		mm	318 ± 50	354 ± 50	
	4		Max. below GL		mm	440 ± 50	315 ± 50	
Q2	Main Specs JIS A8404							
1	1	Bucket tooth slaggish			mm	73.0>	73.0>	F = 30 kgf
	2	Tilt amount of front attachment			mm	10>	10>	
	3	Dozer's declination			mm	10>	10>	
2	1	Distance from tooth tip to cylinder protector			mm	20 ± 2.0	29 ± 3.0	
3	1	Approach angle			deg	32 ± 3	36 ± 4	
4	1	Crawler height			mm	386 ± 8	430 ± 9	Include grouser at the top of sprocket
	2	Max. crawler height			mm	425 ± 9	460 ± 9	Include grouser

No		Specifications Items			Unit	U20-3	U25-3	Remarks
Q3	Engine performance							
1	1	Max. engine rpm	no load		rpm	2400>	2600>	
	2		2 pump relief		rpm	2100<	2300<	
	3		Dozer+2 pump relief		rpm	2100<	1800<	
2	1	Idling rpm			rpm	1250 ± 50	1350 ± 50	
Q4	Travelling performance							
1	1	Travel motor block performance	L		mm	300>	300>	20 deg, 10 min Engine stop Oil
	2		R		mm	300>	300>	
2	1	Max, Traction force	F1		kgf	1582<	2071<	On the center
					kN	15.5<	20.3<	
	2		F2		kgf	827<	990<	
					kN	8.1<	9.7<	
3	1	Travel straightness	F1		mm	600>	600>	10m distance
	2		F2		mm	600>	600>	
	3		Dozer F1		mm	600>	600>	Dozer up & down 10m distance
	4		Dozer R1		mm	600>	600>	
4	1	Track shoe sag distance	Iron		mm	40 ~ 45	40 ~ 45	
	2		Rubber		mm	10 ~ 15	10 ~ 15	
Q5	Work performance							
1	1	Boom lifting capacity			kgf	450<	459<	Front end, Arm extend bucket crowd, at tooth
					kN	4.4<	4.5<	
	2	Arm digging force			kgf	1286<	1388<	Bucket tooth root
					kN	12.6<	13.6<	Machine stance to JIS bucket tooth root
	3	Bucket digging force			kgf	1786<	2092<	Cutting edge down force at ground level
					kN	17.5<	20.5<	
2	1	Boom speed	Canopy	up	sec	2.8 ± 0.3	2.4 ± 0.3	Ground to max.
	2			up	sec	4.4 ± 0.3	3.2 ± 0.3	Min. to max.
	3			down	sec	2.9 ± 0.3	2.7 ± 0.3	Max. to ground
	4			down	sec	4.5 ± 0.3	4.0 ± 0.3	Max.to min.
	5		Cabin	up	sec	2.4 ± 0.3	2.4 ± 0.3	Ground to max.
	6			up	sec	4.1 ± 0.3	3.7 ± 0.3	Min. to max.
	7			down	sec	2.5 ± 0.3	2.6 ± 0.3	Max. to ground
	8			down	sec	4.2 ± 0.3	4.0 ± 0.3	Max.to min.
3	1	Arm speed		crowd	sec	2.6 ± 0.3	2.5 ± 0.3	Oil temp. 50 ± 5°C (122 ± 41 °F)
	2			extend	sec	2.7 ± 0.3	2.7 ± 0.3	
4	1	Bucket speed		crowd	sec	3.2 ± 0.3	3 ± 0.3	Oil temp. 50 ± 5°C (122 ± 41 °F)
	2			dump	sec	2.1 ± 0.3	2.1 ± 0.3	

No		Specifications Items			Unit	U20-3	U25-3	Remarks
5	1	Dozer speed		up	sec	0.8 ± 0.3	1.0 ± 0.3	Ground to max. up
	2			up	sec	2.6 ± 0.3	2.3 ± 0.3	Max. down to max. up
	3			down	sec	1.0 ± 0.3	1.4 ± 0.3	Max. up to ground
	4			down	sec	3.3 ± 0.3	2.6 ± 0.3	Max. up to max. down
6	1	Arm cylinder cavitation			mm	5>	5>	Oil temp. 95 ± 5 °C (203 ± 41 °F) Engine: 1300rpm
7	1	Max. digging height radius	Canopy		mm	1990 ± 199	2039 ± 204	at bucket pin Bucket horizontal
	2		Cabin		mm	2635 ± 263	2545 ± 254	
	3	Max. dump height radius	Canopy		mm	1913 ± 115	2427 ± 146	
	4		Cabin		mm	2415 ± 145	2440 ± 146	
	5	Bucket bottom height at arm vertical	Canopy		mm	1405 ± 42	1510 ± 45	
	6		Cabin		mm	1215 ± 36	1360 ± 41	
	7	Bucket wrist angle			degree	184 ± 3	184 ± 3	
Q6	Swivel, swing performance							
1	1	Swivel torque		L	kgf·m	388<	429<	Arm extend,show/ Quick
					kN·m	3.8<	4.2<	
				R	kgf·m	388<	429<	
					kN.m	3.8<	4.2<	
2	1	Swivel capable angle		L	deg	22<	20<	Bucket: heaped
	2			R	deg	22<	20<	
3	1	Swivel block performance		L	deg	5>	5>	Engine stop
	2			R	deg	5>	5>	Engine idle rpm.
	3			L	deg	30>	30>	
	4			R	deg	30>	30>	
4	1	Swivel start-up speed		L	sec	2.1 ± 0.3	1.9 ± 0.3	0~90 deg swivel Bucket: heaped
	2			R	sec	2.1 ± 0.3	1.9 ± 0.3	
5	1	Swing speed	Canopy	L	sec	5.3 ± 0.5	4.6 ± 0.5	Bucket: empty
	2			R	sec	5.1 ± 0.5	5.1 ± 0.5	
	3		Cabin	L	sec	5.3 ± 0.5	4.6 ± 0.5	
	4			R	sec	5.1 ± 0.5	5.1 ± 0.5	
6	1	Swing Lock		Swivel R&L	mm	10>	10>	90 deg-swivel, 100 times.
Q7	Hydraulic performance							

No		Specifications Items			Unit	U20-3	U25-3	Remarks	
1	1	Relief pressure setting		P1	kgf/cm ²	220 ± 5	220 ± 5	Bench data 50 ± 5 °C (122 ± 41 °F)	
					MPa	21.6 ± 0.5	21.6 ± 0.5		
	2			P2	kgf/cm ²	220 ± 5	220 ± 5		
					MPa	21.6 ± 0.5	21.6 ± 0.5		
	3			P3	kgf/cm ²	210 ± 5	175 ± 5		
					MPa	20.6 ± 0.5	17.2 ± 0.5		
	4			P4	kgf/cm ²	40 ± 0.5	40 ± 0.5		
					MPa	3.9 ± 0.5	3.9 ± 0.5		
2	1	Cylinder oil sealing capacity	Boom	50 ± 5 °C	mm	20>	20>	Boom up Arm extend, bucket crowd bucket: heaped 10 min.	
	2			95 ± 5 °C	mm	20>	20>		
	3		Arm	50 ± 5 °C	mm	11>	11>		
	4		Bucket	50 ± 5 °C	mm	10>	10>		
	5		Dozer	50 ± 5 °C	mm	20>	20>		
3	1	Boom cushioning performance		30 °C(86 °F)	sec	3>	3>	Arm extended Bucket crowd Bucket empty Engine. Max. rpm	
	2			50 °C(122 °F)	sec	0.4~1.3	0.4~1.3		
	3			80 °C(176 °F)	sec	0.3<	0.3<		
Q8	Lever operating force & stroke								
1	1	Boom lever		up	kgf	1.47 ± 0.5	1.50 ± 0.5		
					N	14 ± 5	15 ± 5		
				2	down	kgf	1.47 ± 0.5		1.50 ± 0.5
						N	14 ± 5		15 ± 5
	3	Arm lever		crowd	kgf	1.47 ± 0.5	1.50 ± 0.5		
					N	14 ± 5	15 ± 5		
				4	extend	kgf	1.47 ± 0.5		1.50 ± 0.5
						N	14 ± 5		15 ± 5

No		Specifications Items			Unit	U20-3	U25-3	Remarks
1	5	Bucket lever		crowd	kgf	1.34 ± 0.5	1.50 ± 0.5	
					N	13 ± 5	15 ± 5	
	6			dump	kgf	1.34 ± 0.5	1.50 ± 0.5	
					N	13 ± 5	15 ± 5	
	7	Swivel lever		L	kgf	1.34 ± 0.5	1.50 ± 0.5	
					N	13 ± 5	15 ± 5	
	8			R	kgf	1.34 ± 0.5	1.50 ± 0.5	
					N	13 ± 5	15 ± 5	
	9	Dozer lever		up	kgf	1.34 ± 0.5	1.34 ± 0.5	
					N	13 ± 5	13 ± 5	
	10			down	kgf	1.34 ± 0.5	1.34 ± 0.5	
					N	13 ± 5	13 ± 5	
	11	Travel lever	L	Forward	kgf	1.27 ± 0.5	1.27 ± 0.5	
					N	12.0 ± 5	12.0 ± 5	
	12			Back	kgf	1.27 ± 0.5	1.27 ± 0.5	
					N	12.0 ± 5	12.0 ± 5	
	13		R	Forward	kgf	1.27 ± 0.5	1.27 ± 0.5	
					N	12.0 ± 5	12.0 ± 5	
	14			Back	kgf	1.27 ± 0.5	1.27 ± 0.5	
					N	12.0 ± 5	12.0 ± 5	
	15	Accelerator lever		up	kgf	7 ± 1	7 ± 1	
					N	69 ± 10	69 ± 10	
	16			down	kgf	7 ± 1	7 ± 1	
					N	69 ± 10	69 ± 10	
	17	Swing pedal		R	kgf	5 ± 1	5 ± 1	
					N	49 ± 10	49 ± 10	
	18			L	kgf	5 ± 1	5 ± 1	
					N	49 ± 10	49 ± 10	
	19	Safety lock lever	R	up	kgf	0.47 ± 0.2	0.47 ± 0.2	Up & down
					N	5 ± 2	5 ± 2	
	20			down	kgf	0.47 ± 0.2	0.47 ± 0.2	
					N	5 ± 2	5 ± 2	

No		Specifications Items			Unit	U20-3	U25-3	Remarks
1	21	Safety lock lever	L	up	kgf	1.2 ± 1	1.2 ± 1	Up & down
					N	12 ± 10	12 ± 10	
	22			down	kgf	3.5 ± 1.0	3.5 ± 1.0	
					N	34 ± 10	34 ± 10	
	23	Travel Hi-Lo change			kgf	1.5 ± 0.5	1.5 ± 0.5	
					N	15 ± 5	15 ± 5	
2	1	Boom lever stroke		up	mm	72 ± 10	72 ± 10	
	2			down	mm	72 ± 10	72 ± 10	
	3	Arm lever stroke		crowd	mm	72 ± 10	72 ± 10	
	4			extend	mm	72 ± 10	72 ± 10	
	5	Bucket lever stroke		crowd	mm	72 ± 10	72 ± 10	
	6			extend	mm	72 ± 10	72 ± 10	
	7	Swivel lever stroke		L	mm	72 ± 10	72 ± 10	
	8			R	mm	72 ± 10	72 ± 10	
	9	Dozer lever stroke		up	mm	60 ± 10	60 ± 10	
	10			down	mm	60 ± 10	60 ± 10	
	11	Travel lever stroke	L	Forward	mm	70 ± 10	70 ± 10	
	12			Back	mm	70 ± 10	70 ± 10	
	13		R	Forward	mm	70 ± 10	70 ± 10	
	14			Back	mm	70 ± 10	70 ± 10	
Q9	Stability							
1	1	Standard arm, Dynamic operation load limit	Bucket load to 10 degrees tipping	Side, dozer up	kgf	—	—	Arm extend, bucket crowd oil temp.50 ± 5 °C (122 ± 41 °F)
					N	—	—	
	2			Front, dozer up	kgf	—	—	
					N	—	—	
	3		Bucket load to tip fully	Side, dozer up	kgf	>178	>209	
					N	>1748	>2057	
	4			Front, dozer up	kgf	>226	>275	
					N	>2215	>2701	

No		Specifications Items			Unit	U20-3	U25-3	Remarks
1	5	Standard arm, static limited load	Bucket load to tip fully	Side	kgf	>223	>293	
					N	>2189	>2877	
	6			Front	kgf	>288	>372	
					N	>2833	>3654	
Q10	Comfortability							
1	1	Noise level	At operator's ear LPA	Canopy	db(A)	80>	81>	
	Cab			db(A)	80>	81>	Cab door close	
	3		Noise source;LWA	7m	db(A)	65.4>	65>	
	4			Power of noise level	db(A)	92.94>	92.94>	

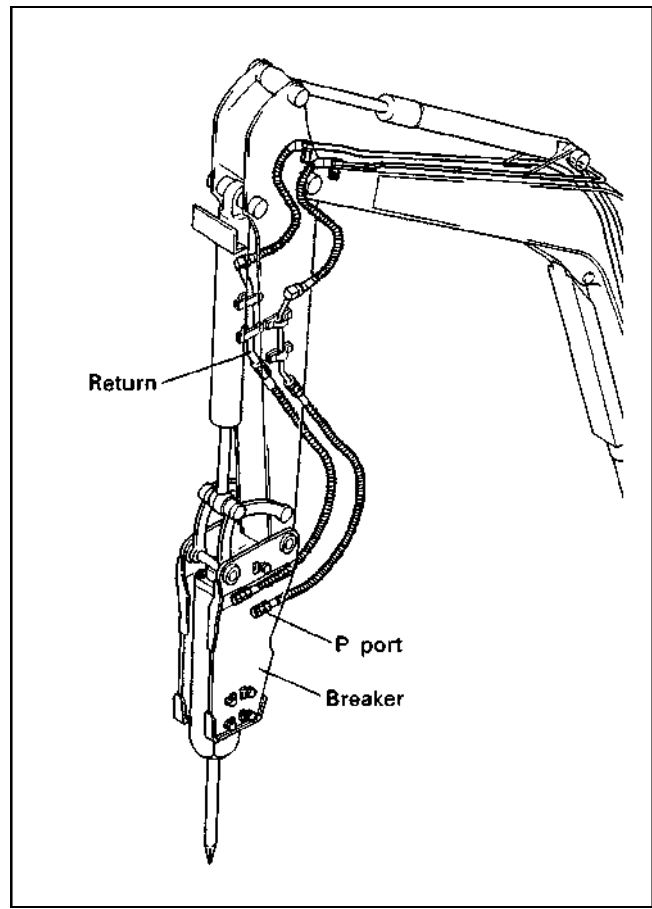
a. Maintenance intervals chart

* The services identified with ● must be carried out at the specified service hours after initial operation.

1.) Under dusty conditions the air filter must be cleaned more frequently or renewed.	
2.) When using a hydraulic hammer over 20% every 800h.	When using a hydraulic hammer over 60% every 300h.
When using a hydraulic hammer over 40% every 400h.	When using a hydraulic hammer over 80% every 200h.
3.) When using a hydraulic hammer over 50% every 200h.	When using a hydraulic hammer over 50% every 100h.
4.) Earlier if necessary.	
5.) At least annually.	

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b. Hydraulic Oil Check for machines with Hydraulic Breakers



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

- (1) Changing and filling up of hydraulic oil
 - 1. The hydraulic oil must be changed more often when breakers are used because the machine is subject to harder conditions than at normal excavating work.
 - 2. Use only the recommended oils mentioned in the operator's manual when changing or fill oil.
 - 3. When filling up oil, never mix oils of different makes.
- (2) Changing the return filter and oil
 - 1. The filter must be changed more often because of contamination resulting from the frequent assembly and disassembly of the hoses.
 - 2. Use the correct replacement filter.
 - 3. Oil change according to operating hours.

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

c. 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. Specifications II-M-2
 - a. Specifications II-M-2
 - b. Main dimensions II-M-3
- B. Components interchangeability II-M-4
 - a. Bucket II-M-4
- C. Machine structure II-M-5
 - a. Control linkage II-M-5
 - b. Engine mount II-M-9
 - c. Undercarriage II-M-11

A. Specifications

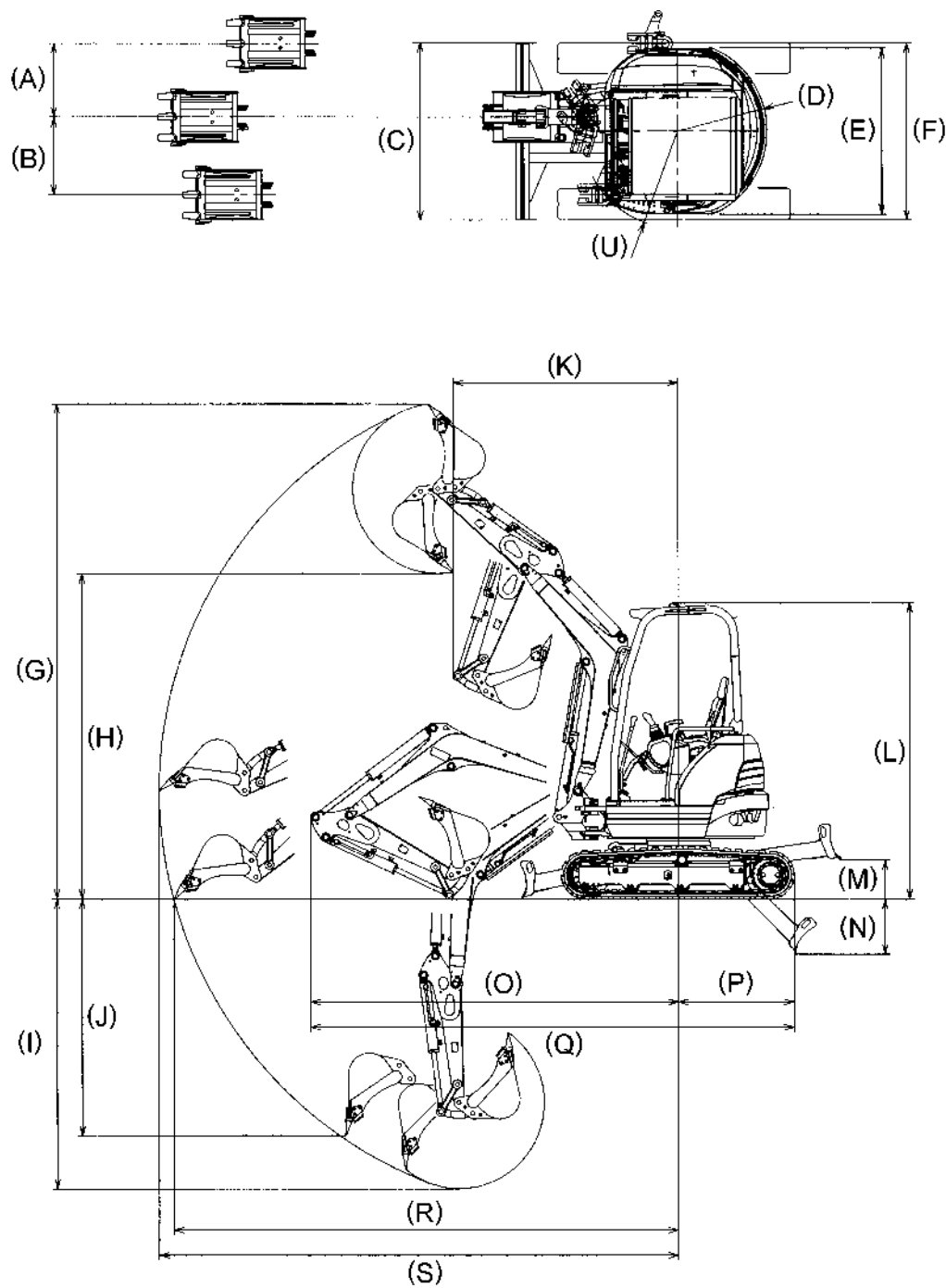
a. Specifications

		KUBOTA EXCAVATOR			
Model name		U20-3		U25-3	
Type		canopy	cabin	canopy	cabin
Machine weight		kg	2030	2120	2460
Standard bucket	Volume (CECE)	m ³	0.056		0.064
	width (with side cutter)	mm	450		500
Engine	Type (water cooled 4 cycle Diesel)	3 cylinder		3 cylinder	
	Model name	KUBOTA D1105-EBH-10		KUBOTA D1105-EBH-11	
	Total displacement	cm ³	1123		1123
	Output (ISO 9249)	kW	14.0		15.5
	Rated speed	rpm	2200		2400
Performance	Swing speed	rpm	9.6		9.8
	Travel speed	km/h	2.2/4.2		2.5/4.5
	Ground pressure	kPa (kgf/cm ²)	25.1 (0.26)	26.6 (0.27)	22.9 (0.23)
	Climbing angle	%(deg)	36 (20)		36 (20)
Dozer (width & height)		mm	1400 X 292		1500 X 292
Boom swing angle	left	rad (deg)	1.31 (75)		1.31 (75)
	Right	rad (deg)	0.96 (55)		0.96 (55)
Pressure connection for attachments	Max. displacement	L/min	35.8		48.0
	Max. pressure	MPa (kgf/cm ²)	21.6 (220)		
Fuel tank capacity		L	28		28

NOTE:

- Above dimensions are based on the machine with JPN bucket.
JPN = made in Japan
- Above dimensions are based on the machine with rubber tracks.
- Specifications subject to change without notice.

b. Main dimensions



1BAABAAAP412A

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(S)	mm (U)
U20-3 CANOPY	590	620	1400 [1300/1500]	710 (760)	1300	1400 [1300/1500]	3970 (3650)	2610 (2320)	2320	1900	1780 (1940)	2380 (2360)	320 [330]	440 [280]	2920	930	3850	4030	4140	800
U25-3 CANOPY	590	620	1500	760	1300	1500	4400 (4160)	3020 (2790)	2550	2300	1790 (1940)	2420 (2400)	360	320	3110	990	4100	4400	4510	800

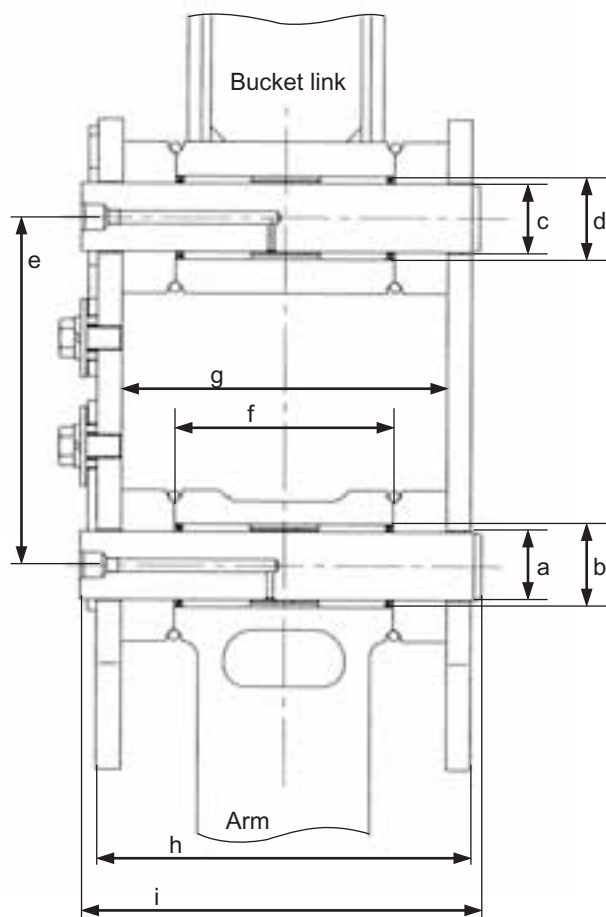
(Cabin type models) [Track width changes models]

B.Components interchangeability

a. Bucket

Bucket can be mounted between current and new series in each local bucket as shown in the below table. Also below dimensions are for your reference to process local bucket in your place. Still bucket size and weight should be considered for safety, stability and performance.

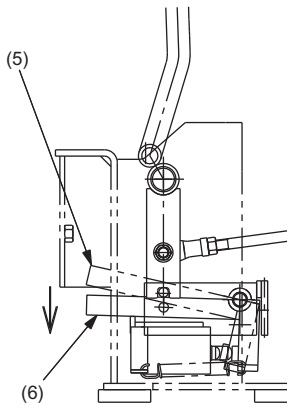
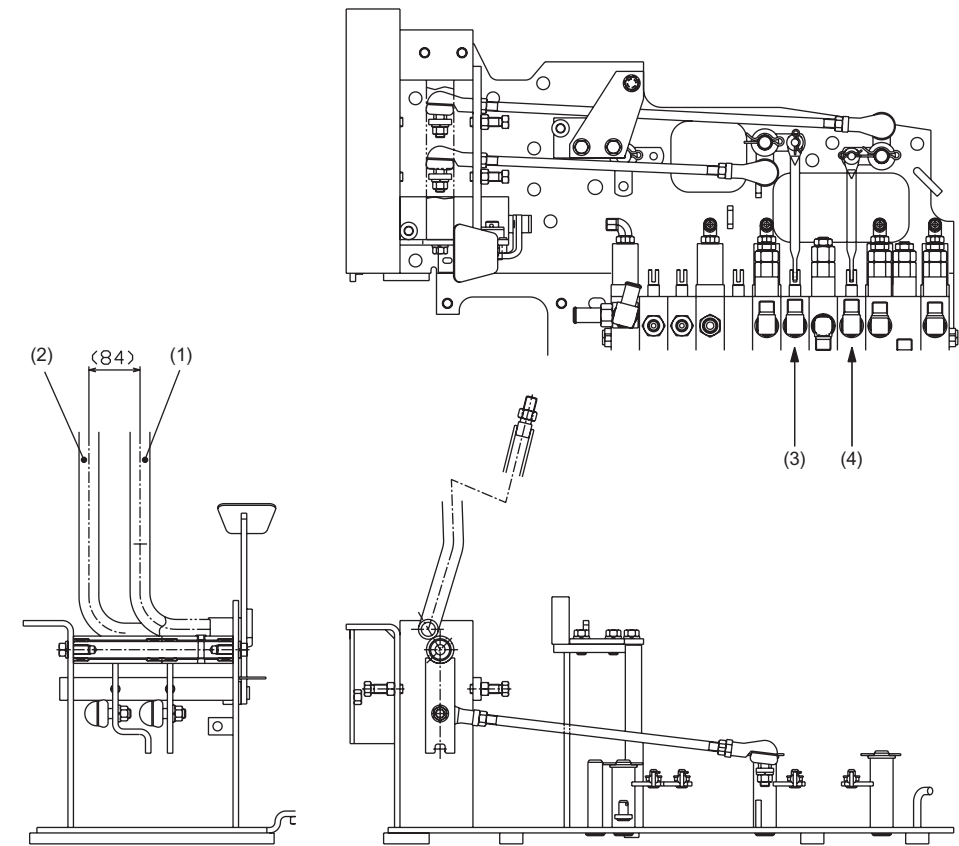
	U20	U20-3	U25-3
Bucket	• ↔	• ↔	•
a(Bush) inner dia.	30 ^{+0.13} _{+0.10}	30 ^{+0.13} _{+0.10}	←
b(Arm) boss inner dia.	38 ^{+0.05} ₊₀	38 ^{+0.05} ₀	45 ^{+0.05} ₀
c(Bucket) boss inner dia.	30 ^{+0.10} _{+0.05}	30 ^{+0.10} _{+0.05}	←
d(Link)	38 ^{+0.025} ₀	45 ^{+0.025} ₀	←
e	132 ^{±0.5}	139.8	←
f	110 ^{+1.0} ₀	110 ^{+1.0} ₀	←
g	166	154	←
h	190	178	←
i	217	194	←
j(pin dia.)	30 ^{-0.05} _{-0.07}	30 ^{-0.05} _{-0.07}	←



C.Machine structure

a. Control linkage

[1] Traveling lever

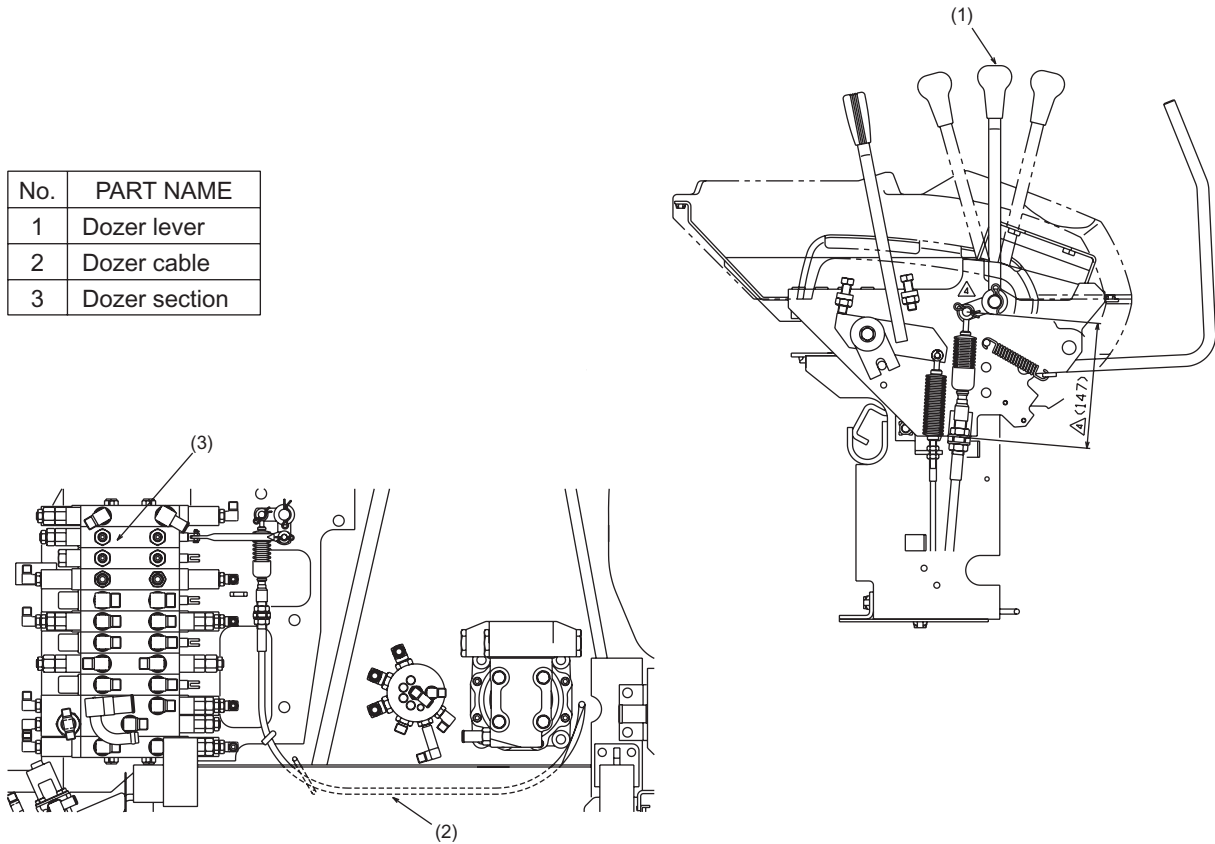


Traveling Lever Lock

No.	PART NAME
1	Traveling lever, left
2	Traveling lever, right
3	Travel left section
4	Travel right section
5	Lock position
6	Release position

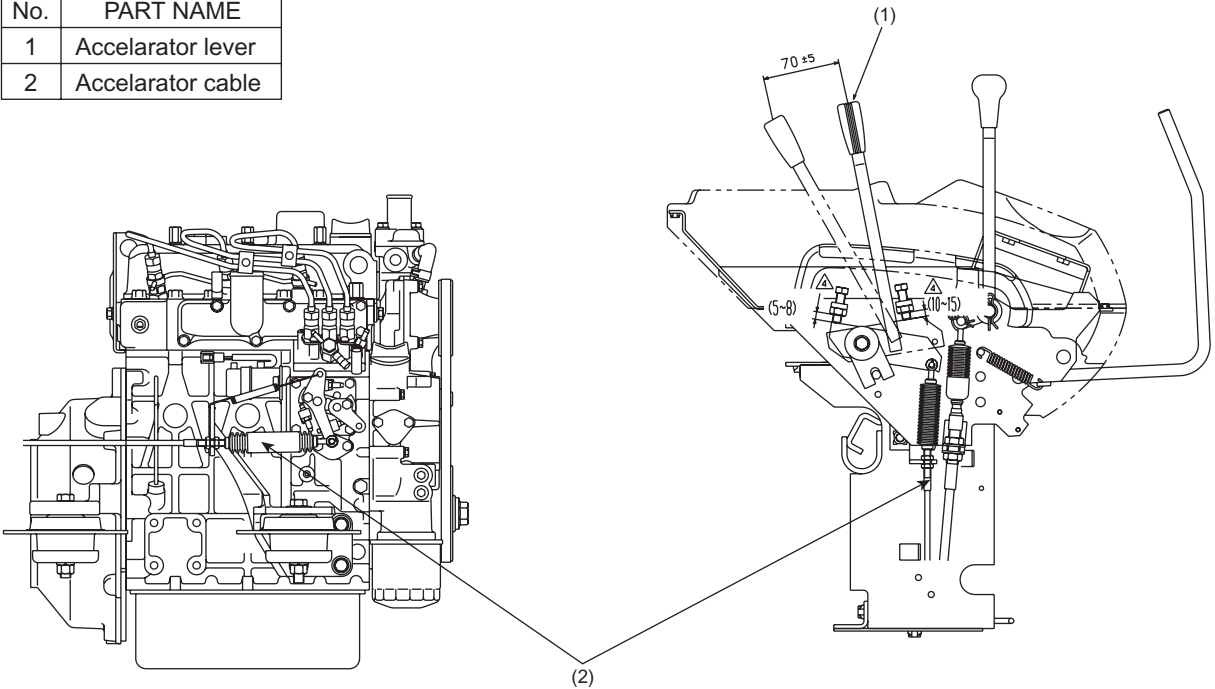
[2] Dozer lever

No.	PART NAME
1	Dozer lever
2	Dozer cable
3	Dozer section



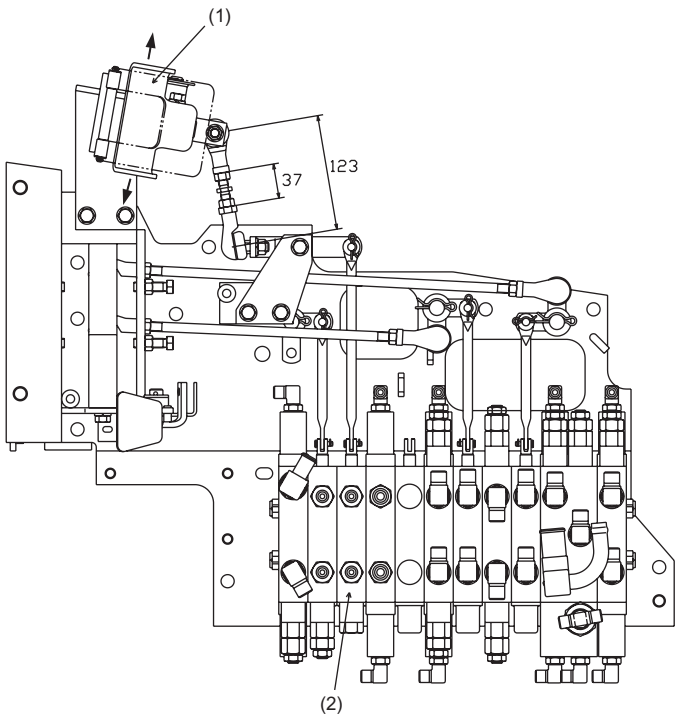
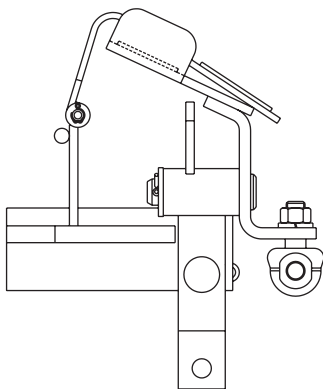
[3] Accelerator lever

No.	PART NAME
1	Accelerator lever
2	Accelerator cable

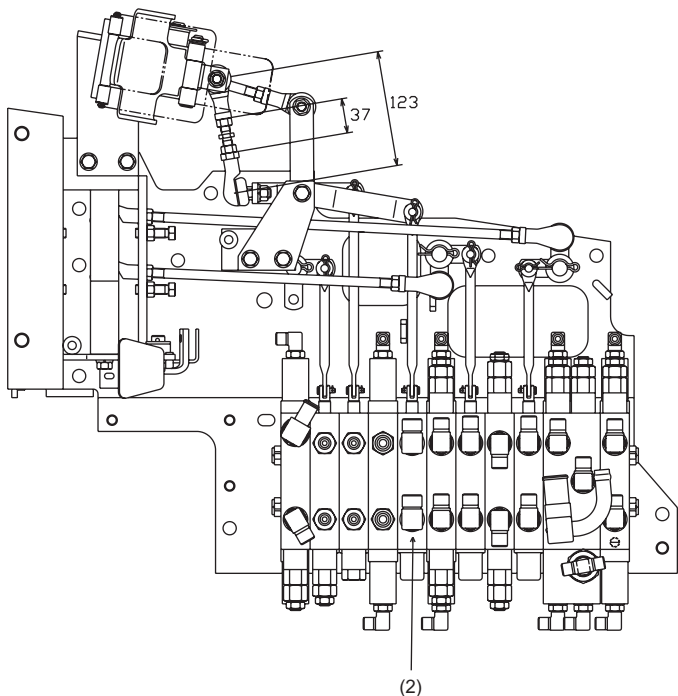
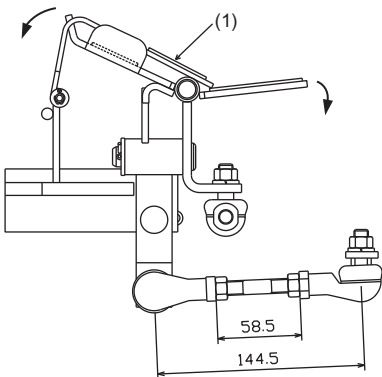


[4] Swing pedal

No.	PART NAME
1	Swing Pedal
2	Swing Section

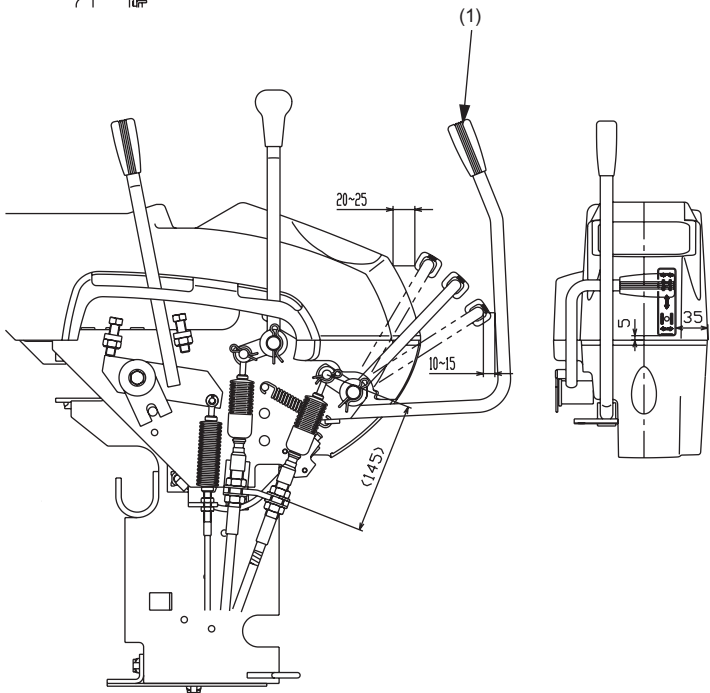
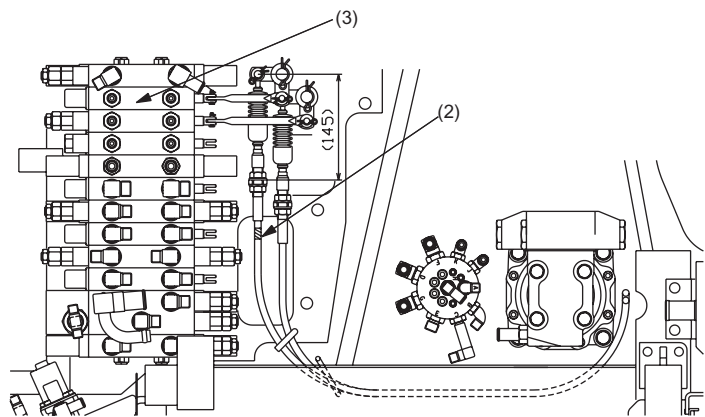


[5] Service port pedal



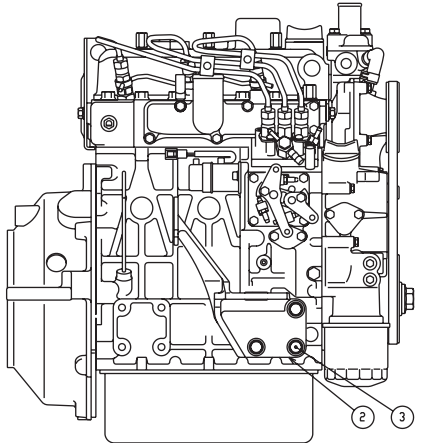
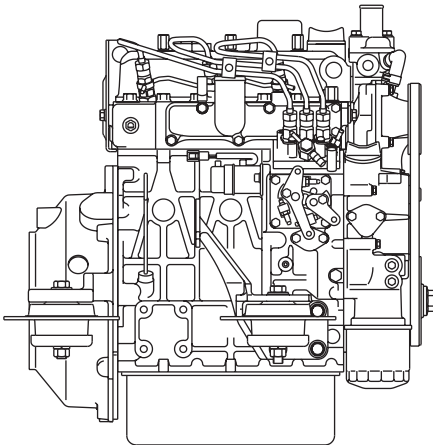
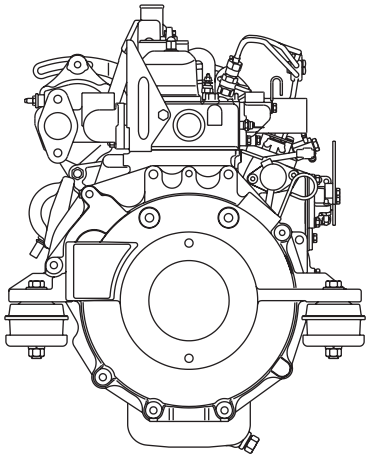
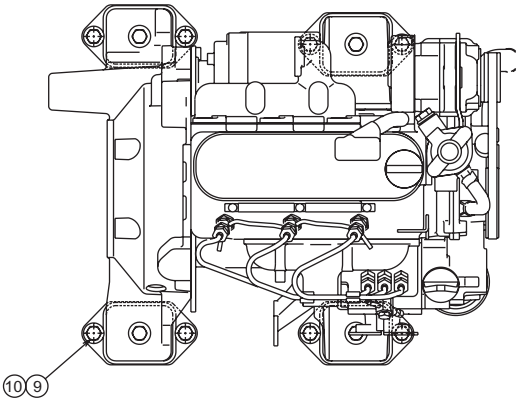
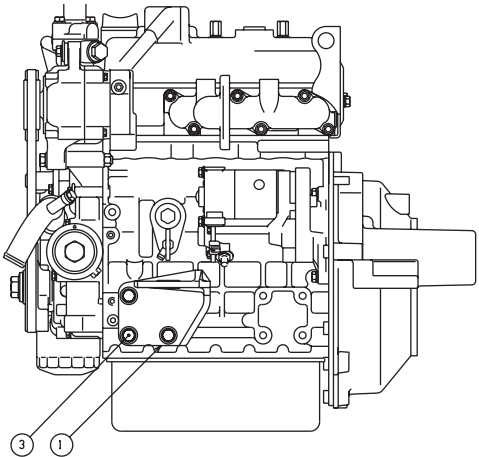
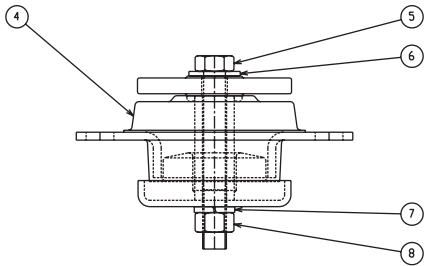
No.	PART NAME
1	Service port Pedal
2	Service port section

[6] Retractable track lever

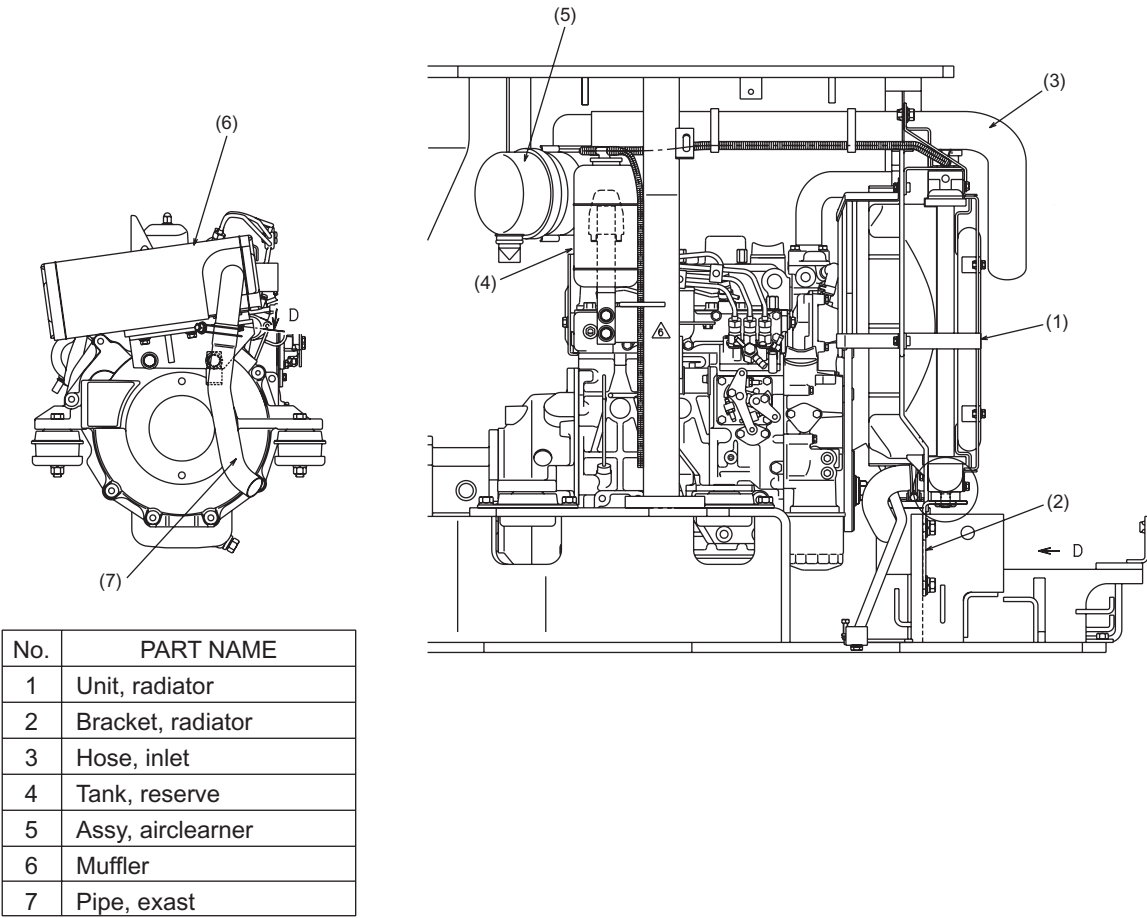


No.	PART NAME
1	Retractable track lever
2	Retractable track cable
3	Track section

b. Engine mount

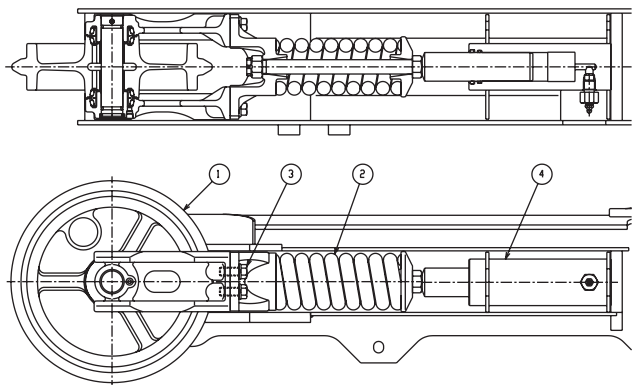


No.	PART NAME
1	Bracket (1, Engine)
2	Bracket (2, Engine)
3	Bolt
4	Rubber, cussionLock
5	Bolt
6	Washer, plain
7	Washer, spring
8	Nut
9	Bolt
10	Spring, plate



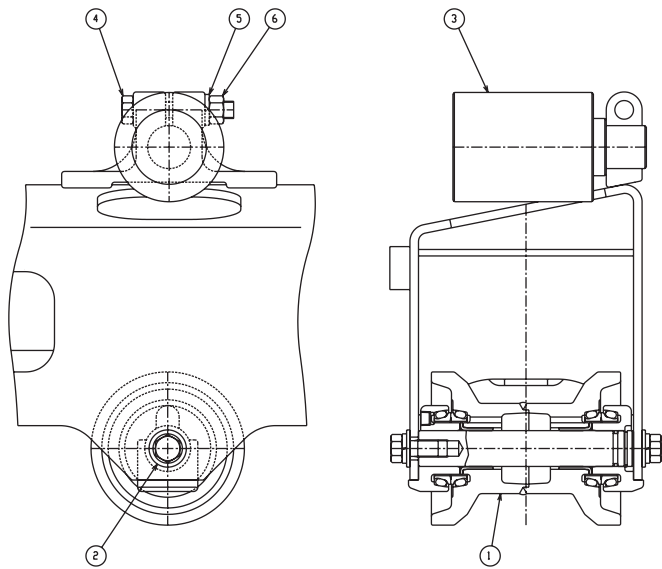
c. Undercarriage

[1] Tension spring



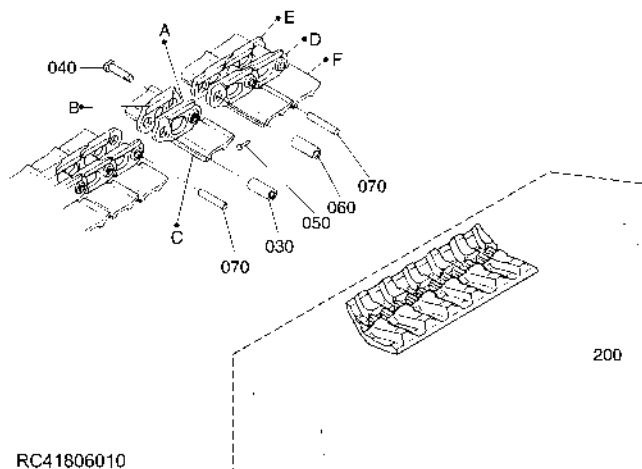
No.	PART NAME
1	Assy. idler
2	Assy. spring
3	Bolt
4	Assy. cylinder

[2] Upper roller and Track roller



No.	PART NAME
1	Assy. track roller
2	Bolt
3	Assy. upper roller
4	Bolt
5	Nut
6	Washer, spring

- Fixed undercarriage

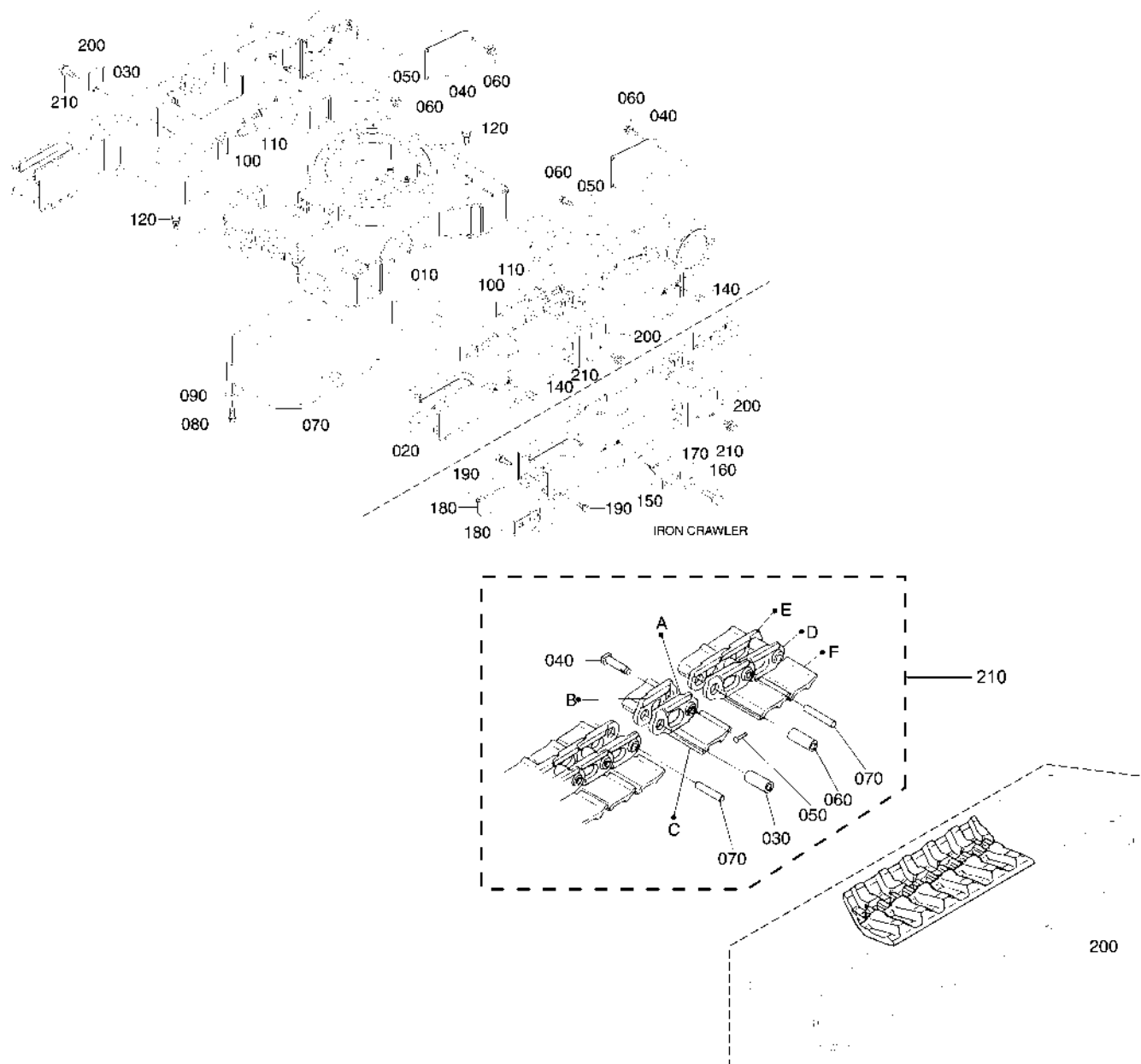


× : required — : not required

No.	PART No.	PART NAME	Q'ty	Rubber crawler	Steel crawler
070	06331-35012	Plug	8	×	—
080	RB411-21812	Plate	4	—	×
090	01133-61220	Bolt	8	—	×
095	04013-60120	Washer, plain	8	—	×
100	RB411-21820	Guide, crawler	4	—	×
110	01133-61020	Bolt	12	—	×
200	RB411-22310	Crawler, rubber	2	×	—
210	RB411-22100	Assy, crawler	2	—	×

No.	PART No.	PART NAME	Q'ty	Rubber crawler	Steel crawler
070	06331-35012	Plug	8	×	—
080	RB511-21812	Plate	4	—	×
090	01133-61220	Bolt	8	—	×
095	04013-60120	Washer, plain	8	—	×
100	RB511-21820	Guide, crawler	4	—	×
110	01133-61220	Bolt	12	—	×
200	RB511-22310	Crawler, rubber	2	×	—
210	RC308-22100	Assy, crawler	2	—	×

- Retractable undercarriage (U20-3 only)

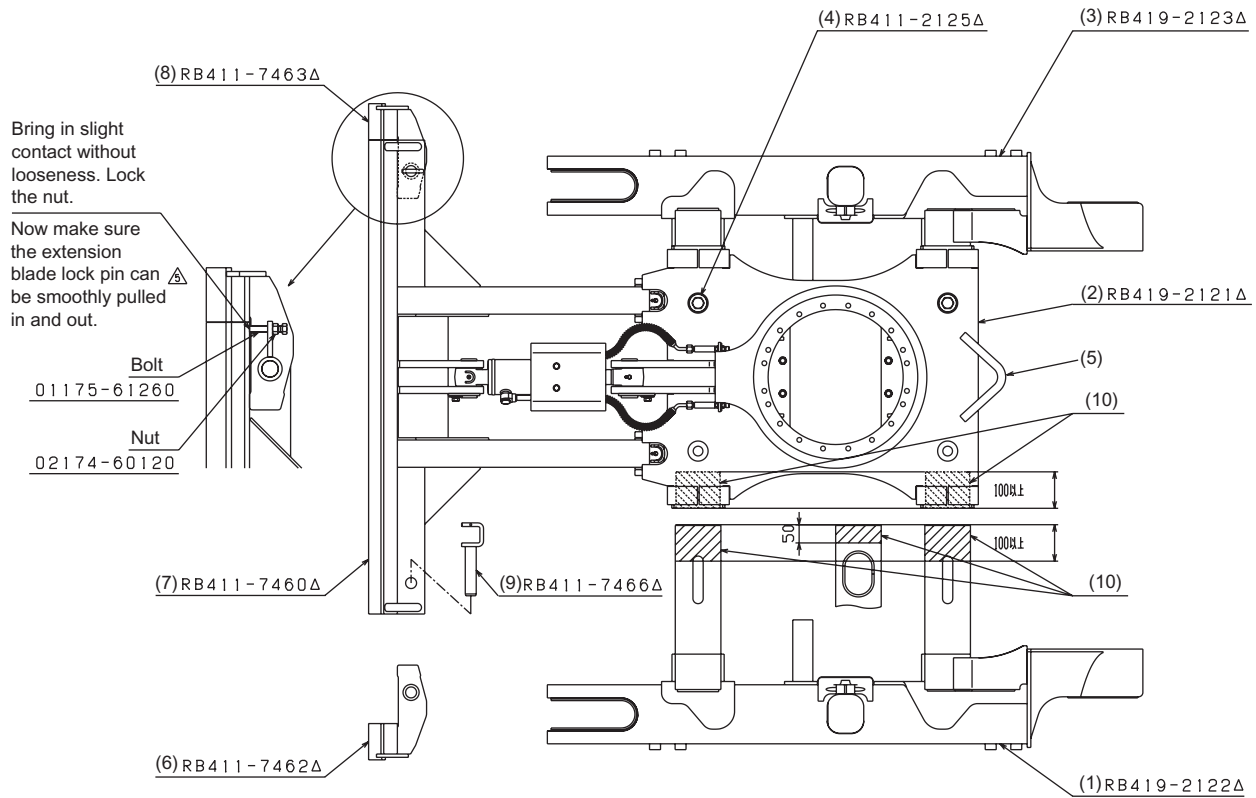


U20-3

× : required — : not required

No.	PART No.	PART NAME	Q'ty	Rubber crawler	Steel crawler
140	06331-35012	Plug	8	×	—
150	RB411-21812	Plate	4	—	×
160	01133-61220	Bolt	8	—	×
170	04013-60120	Washer, plain	8	—	×
180	RB411-21820	Guide, crawler	4	—	×
190	01133-61020	Bolt	12	—	×
200	RB411-22310	Crawler, rubber	2	×	—
210	RB411-22100	Assy, crawler	2	—	×

[4] Retractable undercarriage

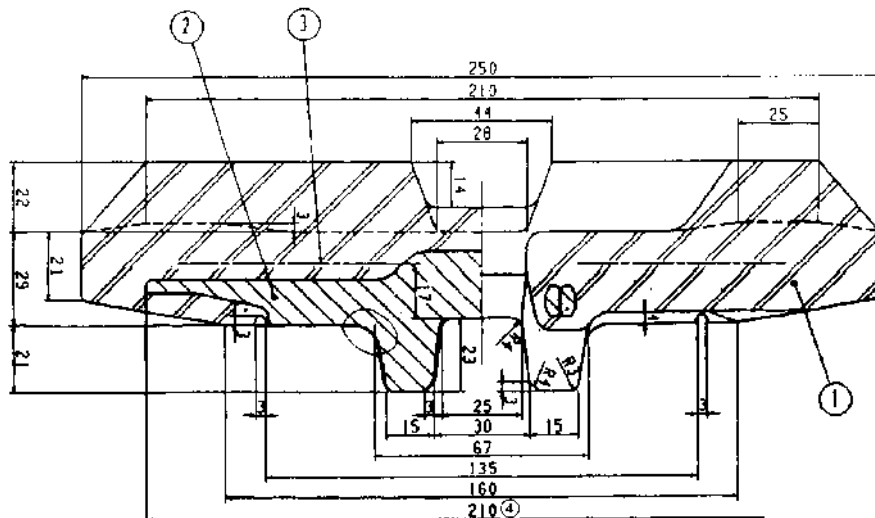


No.	PART NAME
1	Track frame, left
2	Track frame, center
3	Track frame, right
4	Bolt, stopper
5	Hock, towing
6	Blade, left
7	Blade, center
8	Blade, right
9	Pin
10	Apply grease all over the hatched  inner surfaces. (Do the same for the right inner surfaces.)

[5] Rubber crawler

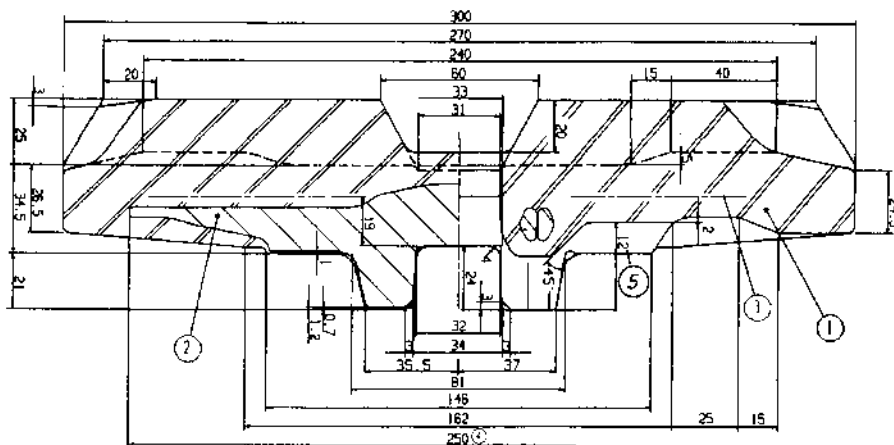
Model	U20-3	U25-3
Part No.	RB411-22311	RB511-22311
Normal size	250×47×84	300×53×80
Steel cord strength	5690 N/ Piece	9320 N/ Piece
Steel cord number	15×2	21×2
Core steel pitch	47	53
Core steel No.	84	80
Crawler width	250mm	300mm

U20-3



No.	PART NAME
1	Rubber
2	Core steel
3	Flexing center
4	Core steel length

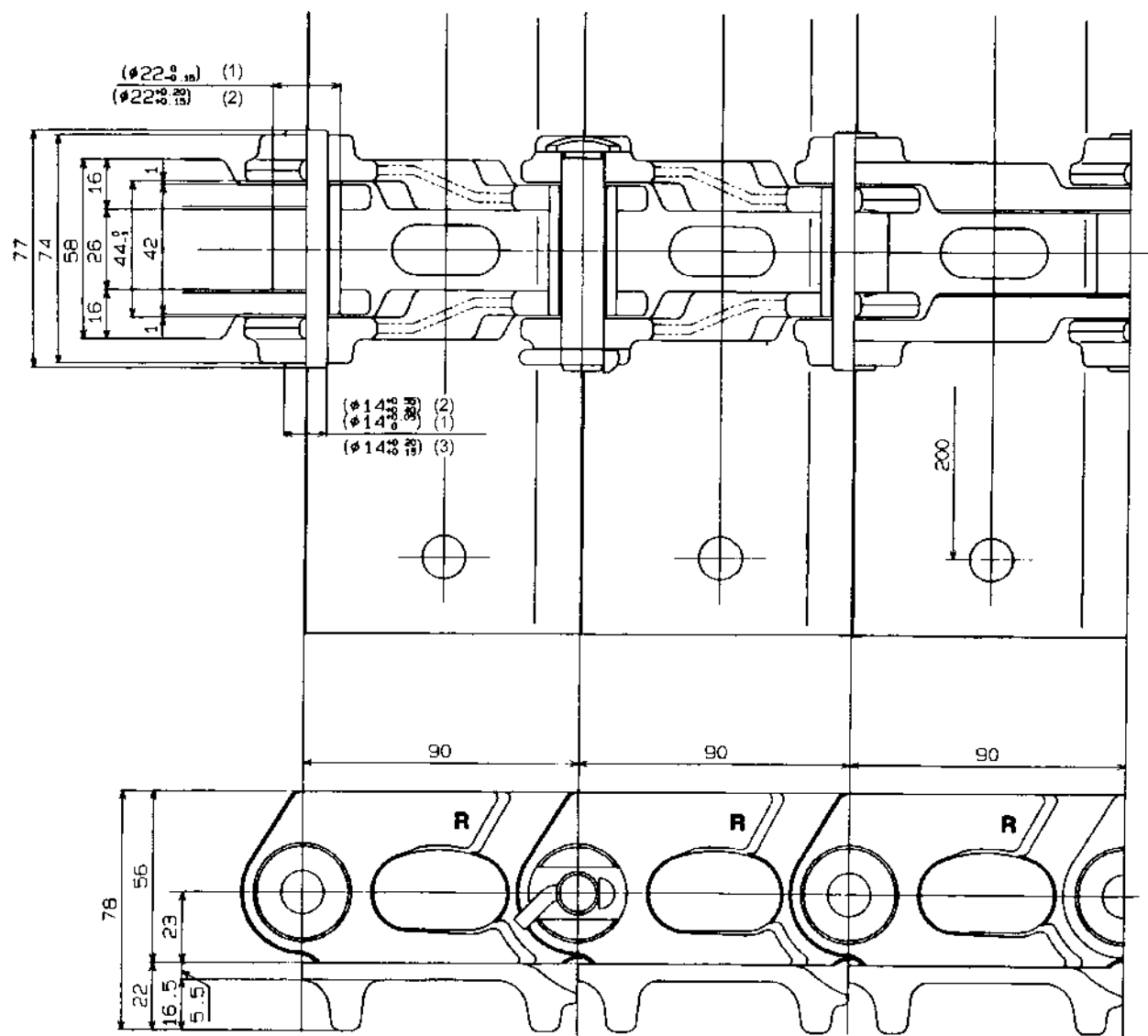
U25-3



No.	PART NAME
1	Rubber
2	Core steel
3	Flexing center
4	Core steel length
5	Track roller passage groove 9 mm deep at one joint only 21 (Groove 10 mm deep at other joints)

[6] Steel crawler

- U20-3



No.	
1	Link
2	Bush
3	Pin

[illegible]

No.	
1	Hole
2	shaft

II. Machine body (Service section)

A. Specifications	II-S-2
a. Machine weight	II-S-2
b. Machine specifications	II-S-3
c. Lever stroke and operating force	II-S-4
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c. Exchange of bucket teeth and side cutters [JPN bucket version]	II-S-17
d. Installing of dust seal and thrust collar	II-S-18
e. Installation of pin and bush	II-S-19
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a. Lever and pedal	II-S-23
b. Hydraulic oil tank	II-S-34
c. Fuel tank and hose	II-S-35
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b. Grease tube	II-S-46
c. Track tension device	II-S-47
d. Upper roller and track roller	II-S-49
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f. Variable track (U20-3)	II-S-54

A. Specifications

a. Machine weight

STD. Arm		unit	U20-3	U25-3	
Canopy	Rubber crawler	kg	2030	2460	
	Iron crawler	kg			
Cabin	Rubber crawler	kg	2120	2540	
	Iron crawler	kg			

b. Machine specifications

STD. Arm		Unit	U20-3	U25-3	
Engine					
Type			Vertical, water-cooled 4 cycle, 4 cylinders diesel		
Model		Kubota	D1105-EBH-10	D1105-EBH-11	
Output power (ISO9249)		kW PS	14.0/2200 19/2200	15.5/2400 21/2400	
Displacement		cc	1123		
Dimensions					
Overall length		mm	3848	4107	
Overall width		mm	1400	1500	
Overall crawler width		mm	1400	1500	
Overall height canopy/cabin		mm	2375/2355	2420/2400	
Min. ground clearance		mm	265	300	
Max. digging depth	canopy	mm	2298	2526	
	cabin	mm	2298	2526	
Max. digging height	canopy	mm	3965	4353	
	cabin	mm	3655	4125	
Max. digging radius	canopy	mm	4136	4501	
	cabin	mm	4136	4501	
Max. dumping height	canopy	mm	2610	2994	
	cabin	mm	2320	2775	
Swing angle (left/right)		deg	73/55	73/55	
Travel speed	Low speed	km/h	2.2	2.5	
	High speed	km/h	4.2	4.5	
Swing speed		rpm	8.9	9.2	
Max. traction force	Low speed	kN kgf	17.2 1754	22.5 2294	
	High speed	kN kgf	9.0 918	10.8 1101	
Performance					
Tumbler distance		mm	1474	1561	
Tread		mm	1150	1200	
Crawler width × No. of shoe × pitch		mm	250 × 84 × 47	300 × 80 × 53	Rubber crawler
Bucket					
Capacity CECE heaped		m3	0.056	0.064	
Width		mm	450	500	
Dozer					
Width × height		mm	1400 × 292	1500 × 292	
Lift above GL / below GL		mm	318/440	354/315	

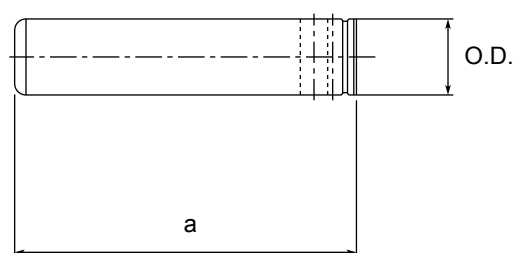
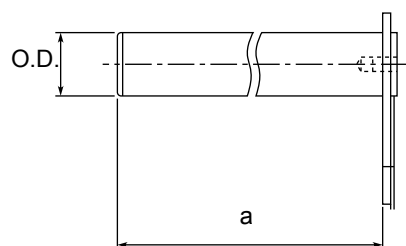
c. Lever stroke and operating force

		Unit	U20-3	U25-3		Remarks
Boom	Stroke	mm	72 / 72	72 / 72		Up / Down
	Force	N kgf	14 / 14 1.47 / 1.47	15 / 15 1.5 / 1.5		Up / Down
Arm	Stroke	mm	72 / 72	72 / 72		Crowd / Dump
	Force	N kgf	14 / 14 1.47 / 1.47	15 / 15 1.5 / 1.5		Crowd / Dump
Bucket	Stroke	mm	72 / 72	72 / 72		Crowd / Dump
	Force	N kgf	13 / 13 1.34 / 1.34	15 / 15 1.5 / 1.5		Crowd / Dump
Swivel	Stroke	mm	72 / 72	72 / 72		Right / Left
	Force	N kgf	13 / 13 1.34 / 1.34	15 / 15 1.5 / 1.5		Right / Left
Travel	Stroke	mm	70 / 70	70 / 70		F / R
	Force	N kgf	12 / 12 1.27 / 1.27	12 / 12 1.27 / 1.27		F / R
Dozer	Stroke	mm	60 / 60	60 / 60		Up / Down
	Force	N kgf	20 / 20 2.0 / 2.0	20 / 20 2.0 / 2.0		Up / Down
Acceleration	Force	N kgf	44 / 39 4.5 / 4.0	44 / 39 4.5 / 4.0		Up / Down
Swing pedal	Force	N kgf	44 / 44 4.5 / 4.5	44 / 44 4.5 / 4.5		Up / Down
Safety lock lever (Left)	Force	N kgf	8 / 4 0.8 / 0.4	8 / 4 0.8 / 0.4		Up / Down
Traveling Hi/Low change pedal	Force	N kgf	31.5 1.5	31.5 1.5		

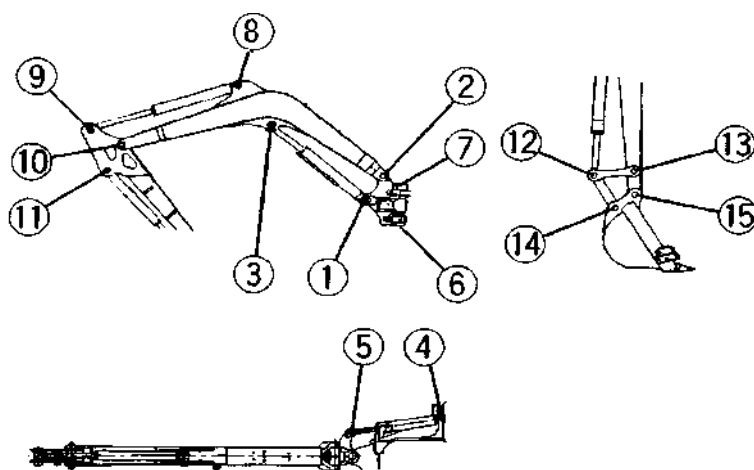
d. Dimensions of parts

[1] Front pins

No.		Unit	U20-3	U25-3		Allowable wear limit
1	Pin diameter × length	mm	40 × 164	40 × 164		
2	Pin diameter × length	mm	40 × 236	40 × 236		
3	Pin diameter × length	mm	40 × 177	40 × 177		
4	Pin diameter × length	mm	30 × 118	30 × 118		
5	Pin diameter × length	mm	30 × 83.5	30 × 83.5		
6	Pin diameter × length	mm	60 × 104	60 × 104		
7	Pin diameter × length	mm	60 × 137	60 × 137		
8	Pin diameter × length	mm	40 × 177	40 × 177		
9	Pin diameter × length	mm	40 × 145	40 × 163		
10	Pin diameter × length	mm	40 × 199	40 × 199		
11	Pin diameter × length	mm	40 × 145	40 × 163		
12	Pin diameter × length	mm	40 × 104	40 × 104		
13	Pin diameter × length	mm	30 × 170	30 × 170		
14	Pin diameter × length	mm	30 × 183	30 × 183		
15	Pin diameter × length	mm	30 × 183	30 × 183		



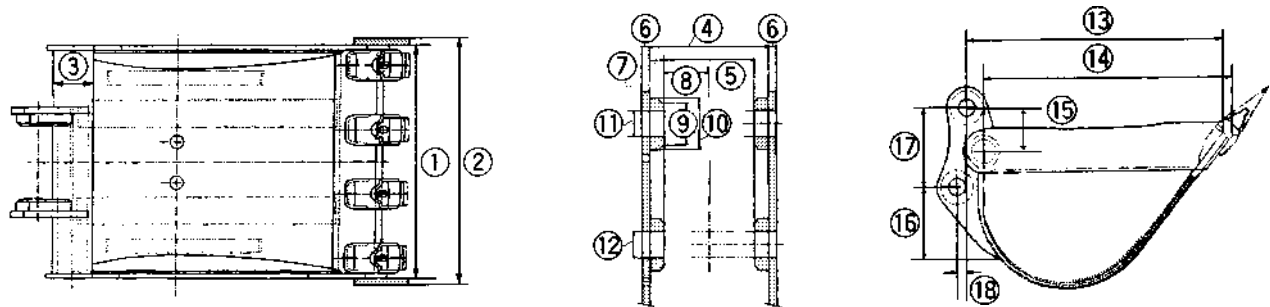
a : length



[2] Bucket
1) Bucket dimensions

No.	Unit	U20-3	U25-3		Remarks
1	mm	400	450		
2	mm	450	500		
3	mm	76.3 × 9.5	76.3 × 9.5		
4	mm	154	154		
5	mm	110	110		
6	mm	12	12		
7	mm	22	22		
8	mm	55	55		
9	mm	49	49		
10	mm	65	65		
11	mm	30	30		
12	mm	30	30		
13	mm	563.5	563.5		
14	mm	478	478		
15	mm	78.5	78.5		
16	mm	145.7	145.7		
17	mm	139	139		
18	mm	14.5	14.5		

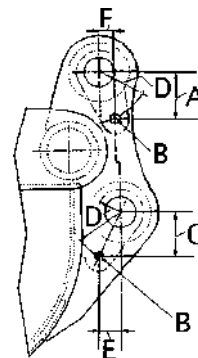
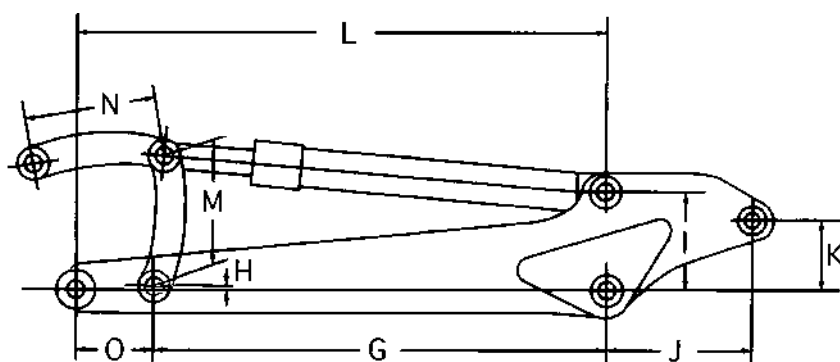
NOTE: KUBOTA JAPAN BUCKET



2) Bucket installation relevant dimensions

No.	Unit	U20-3	U25-3		Remarks
A	mm	59.8	59.8		
B	mm	M12 × 1.25	M12 × 1.25		
C	mm	52	52		
D	mm	60	60		
E	mm	30	30		
F	mm	5	5		
G	mm	795	905		
H	mm	10	10		
I	mm	250	259		
J	mm	225.5	225.5		
K	mm	157	157		
L	mm	1015	1076.5		
M	mm	250	250		
N	mm	255	255		
O	mm	145	145		

NOTE: KUBOTA JAPAN BUCKET
STANDARD ARM



[3] Rubber crawler

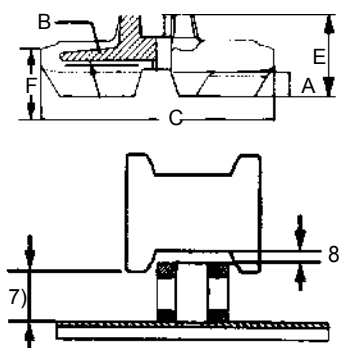
	Unit	U20-3	U25-3		Remarks
Crawler assy code No.		RB411-2231-0	RB511-2231-0		
Identification mark (Core steel rapping position)		∞	∞		
A : Lug height	mm	22	25		
B : Link height	mm	21	21		
C : Crawler width	mm	250	300		
D : Crawler sag distance	mm	10 ~ 15	10 ~ 15		
E : Crawler height	mm	72	80.5		
Number of Core Iron	mm	84	80	FCD450T	
Rubber crawler center round length	mm	3948	4240		
Core Iron pitch	mm	47	53		
Rubber thickness	mm	51	59.5		

[4] Iron crawler

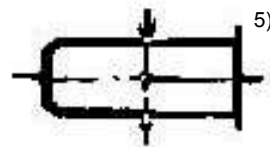
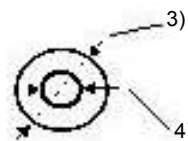
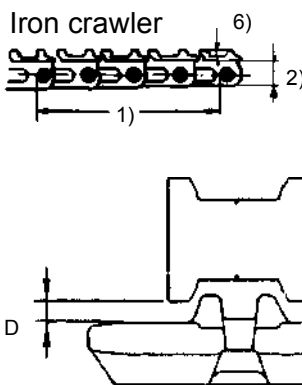
	Unit	U20-3	U25-3		Remarks
Crawler assy code No		RB411-2210-0	RC308-2210-0		
Crawler width	mm	250	300		
1) 4 links length (A)/(B)	mm	360/	406/		
2) Height (A)/(B)	mm	56/	68/		
3) Bushing O.D. (A)/(B)	mm	22/	28/		
4) Bushing I.D. (A)/(B)	mm	14/	17/		
5) Master pin O.D. (A)/(B)	mm	14/	17/		
6) Grouser Height (A)/(B)	mm	16.5/	16.5/		
7) Crawler sag distance (1)	mm	75 ~ 80	75 ~ 80		
Number of links		43	41		

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

Rubber crawler



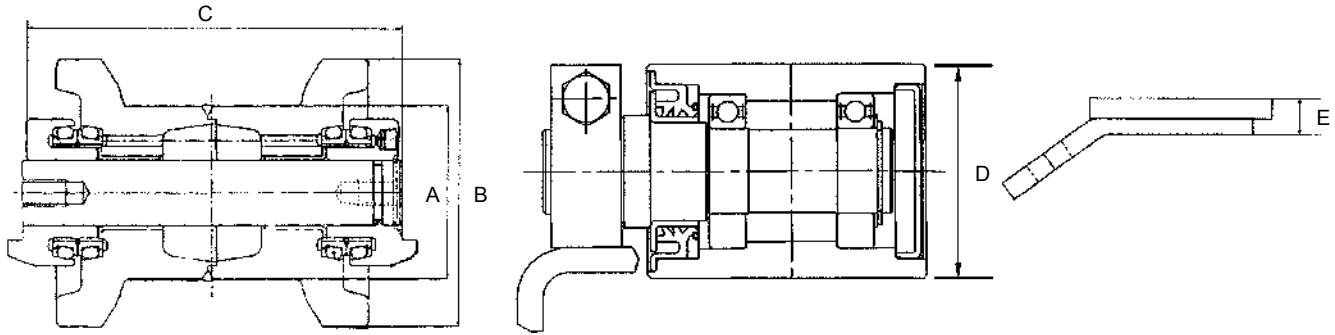
Iron crawler



[5] Track roller, idler, and sprocket

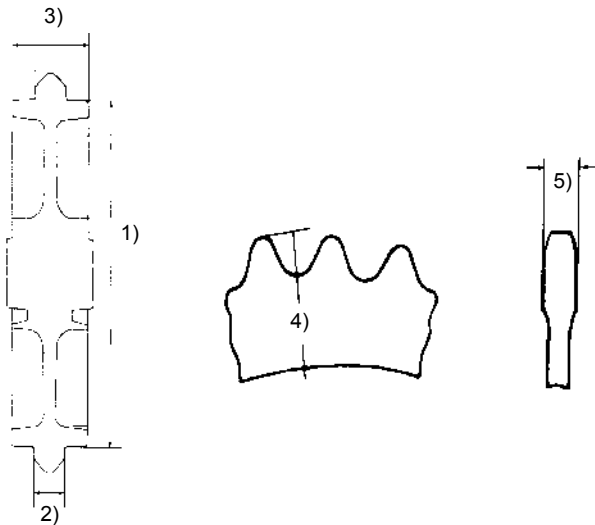
		Unit	U20-3	U25-3		Remarks
A : Guide width	(A)/(B)	mm	63 / 59	80 / 76		
B : Outer diameter	(A)/(B)	mm	107 / 103	124 / 120		
C : Roller width	(A)/(B)	mm	150 /	175 /		
D : Upper roller diameter	(A)/(B)	mm	76.3 /	76.3 /		
E : Sliding plate thickness	(A)/(B)	mm	22 / 11	22 / 11		

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



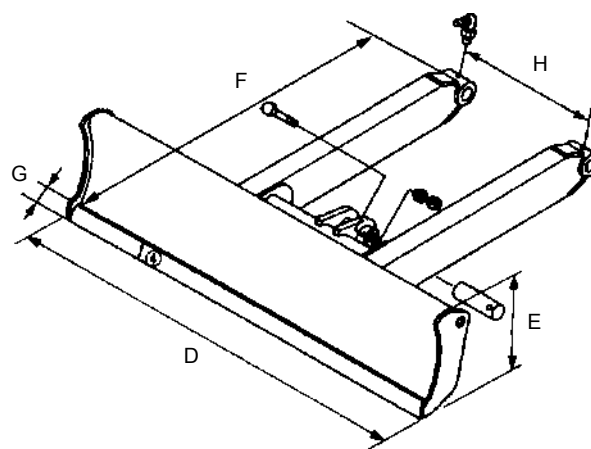
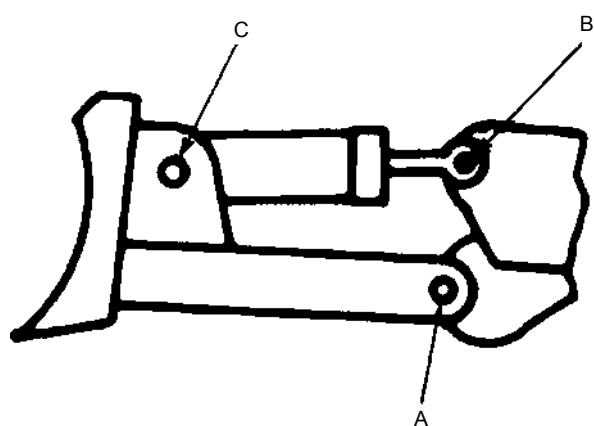
		Unit	U20-3	U25-3		Remarks
1) Idler O.D.	(A)/(B)	mm	238 / 230	272 / 264		
2) Guide width	(A)/(B)	mm	24 / 20	30 / 26		
3) Idler width	(A)/(B)	mm	88 / 84	113 / 109		
4) Sprocket wheel O.D.	(A)/(B)	mm	316 / 308	356 / 348		
5) Sprocket wheel width	(A)/(B)	mm	23 / 19	30 / 26		

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



[6] Dozer

	Unit	U20-3	U25-3		
Assy code No					
A : Pin diameter × length	mm	40 × 125	40 × 125		
B : Pin diameter × length	mm	45 × 95	45 × 95		
C : Pin diameter × length	mm	45 × 95	45 × 95		
D : Dozer width	mm	1400	1500		
E : Dozer height	mm	292	292		
F : Dozer length	mm	934	966		
G : Dozer tip plate height × thickness	mm	65 × 12	65 × 12		
H : Length between dozer arms	mm	420	420		



[7] Parts weight

	U20-3	U25-3		Remarks
Track frame	232	265		
Swivel frame	200			
Swing bracket	48	48		
Boom	72	100		
Standard arm	37	46		
Long arm				
Bucket	50	56		J.S.T.D
Dozer	92	95		
Weight (left)				
Weight (right)				
Weight (rear)	220	380		
Rubber crawler	86	125		
Iron crawler	88	168		
Arch	36	36		
Engine	89	89		Dry weight
Hydraulic tank	21	21		With filter
Fuel tank	4	4		
Swivel bearing	24	24		
Buttery	16	16		
Track roller	5	5		
Upper roller	3	3		
Rops/Fops canopy				
Rops/Fops cabin				
Pump	17	17		
Traveling motor	25	24		
Swivel motor	23	23		
Control valve	31	29		Without adaptor
Boom cylinder	201	261		Canopy / Cabin
Arm cylinder	18	21		
Bucket cylinder	16	18		
Swing cylinder	16	16		
Dozer cylinder	15	21		
Rotary joint	16	16		
Sprocket	5	8		
Idle assy	22	26		

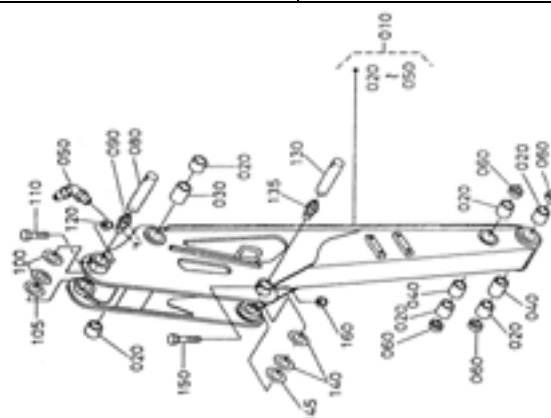
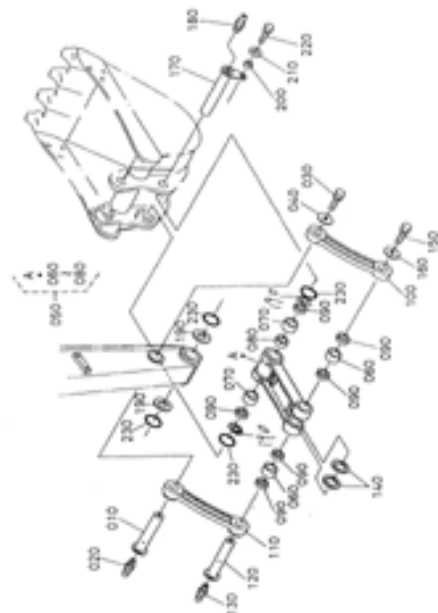
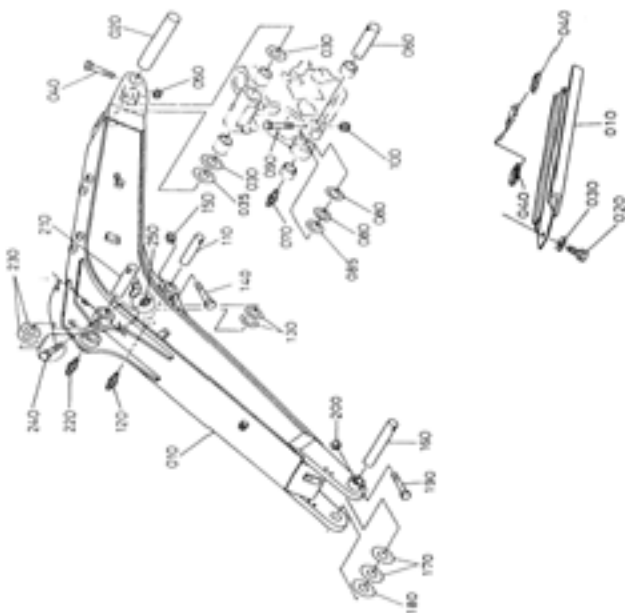
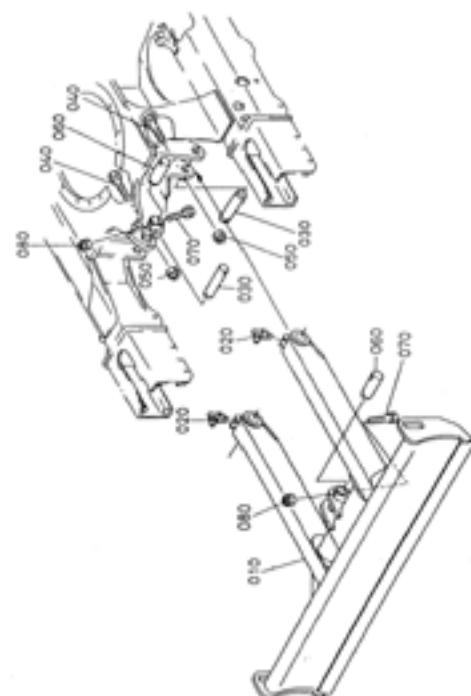
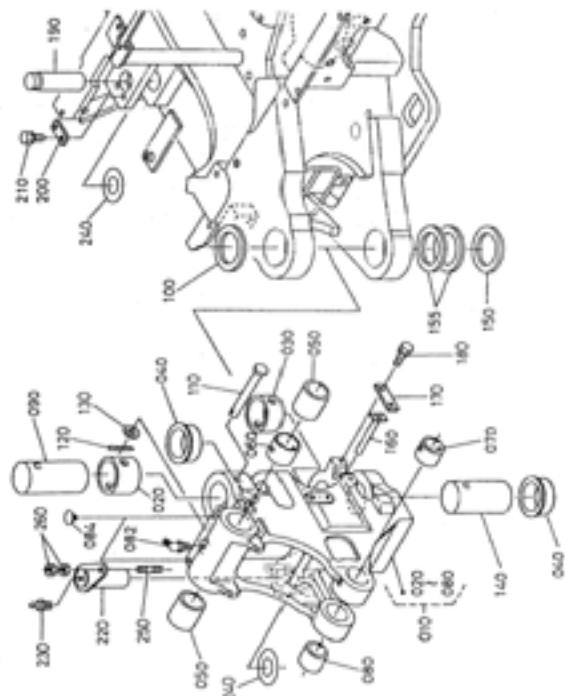
The weights listed above are based on calculations and slightly different from actual ones.

[8] Water and oil quantity

	Unit	U20-3	U25-3		Remarks
Radiator	L	31	31		Kubota LLC-N-50F 50%
Reserve tank	L	0.6	0.6		
Engine Crank case	L	3.8	3.8		SAE10W30(CD)
Hydraulic oil Full	L	37	37		ISO 46
Hydraulic oil Tank	L	22.5	22.5		ISO 46
Wheel motor	L	0.33	0.33		SAE90 (API GL-4)
Track roller	CC	50	80		SAE30(CD)
Upper roller	CC	60	60		SAE30(CD)
Front idler	CC	35	75		SAE30(CD)
Fuel tank	L	27.5	27.5		

B. Front attachment

a. Parts designation



(1) Swing bracket

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

(2) Boom

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

(3) Boom Cylinder Cover

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

(4) Arm

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

(5) Bracket Link

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

(6) Blade

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

b. Exchange of bucket (Kubota Japan Bucket)



CAUTION

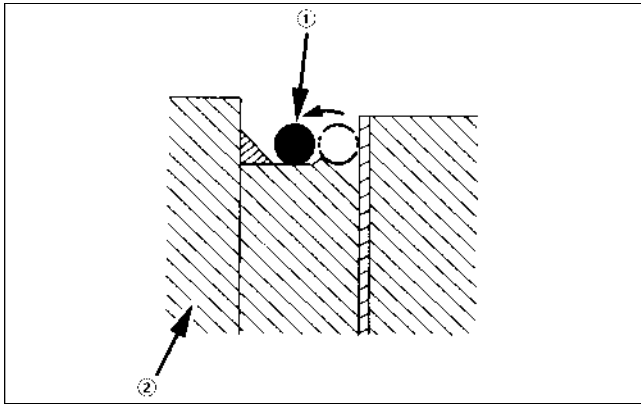
- * When replacing the bucket, wear a hard helmet, goggles and other protective gears.
- * When working in buddy system, fully understand signals from each other for added safety.

Take the following procedures to replace the bucket.

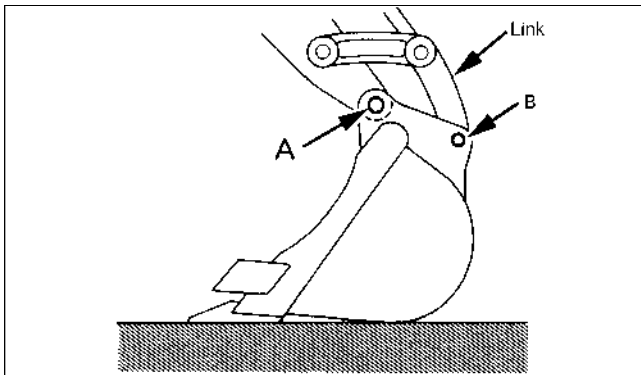


IMPORTANT

- * Be careful to keep the drawn-out pins free of sand and mud.
 - * A dust seal is attached at each end of the bushing. In removing and fitting the pins, be careful not to damage the dust seals.
- Removing the bucket
1. Place the bucket just on a flat, level ground.
 2. Stop the engine and let out pressure from the hydraulic system.
 3. Detach the O-ring from the groove and draw out the pins A and B.

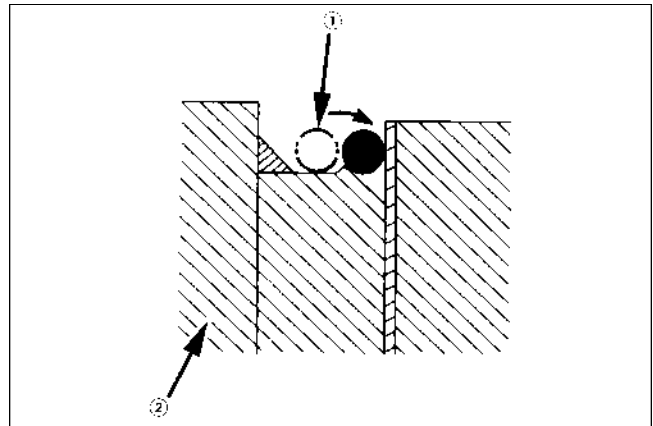


① Move the O-ring ② Bucket boss



■ Fitting the bucket

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



① Move the O-ring ② Bucket boss

5. Grease up the pins.

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

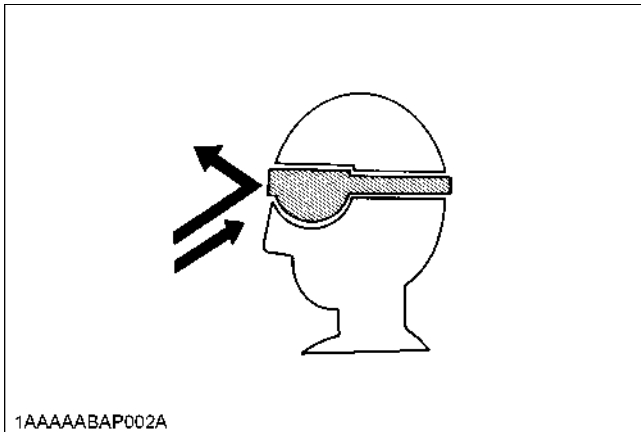
■ Bucket Tooth Replacement



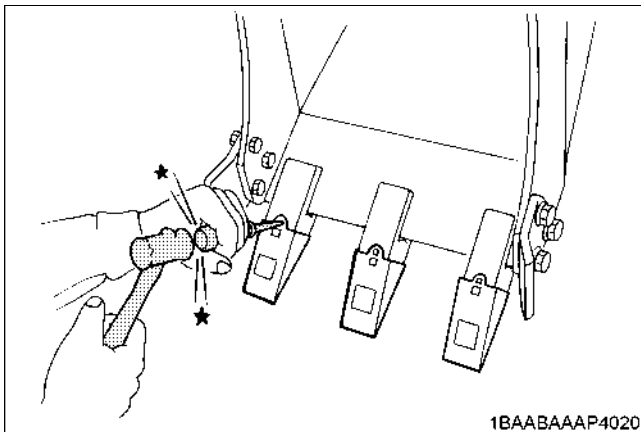
CAUTION

To avoid personal injury:

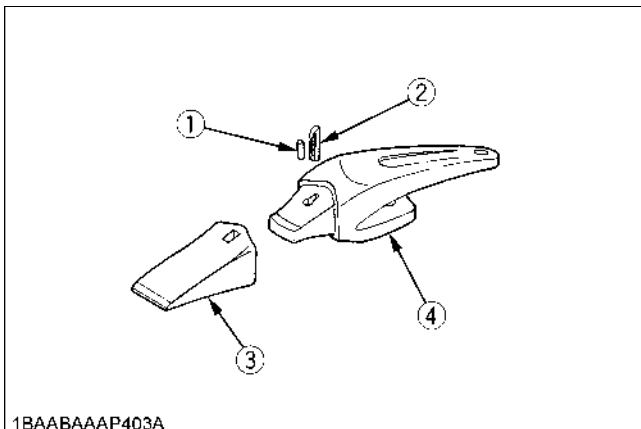
- Wear eye protection when changing the tooth points.



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



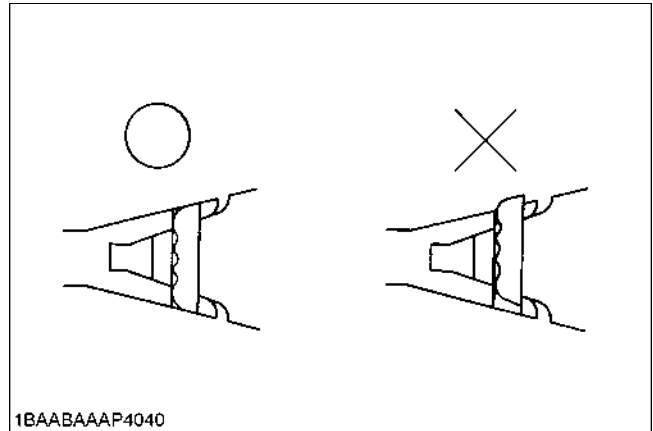
4. Mount a new point on the adapter.



- (1) Rubber plug (3) Point

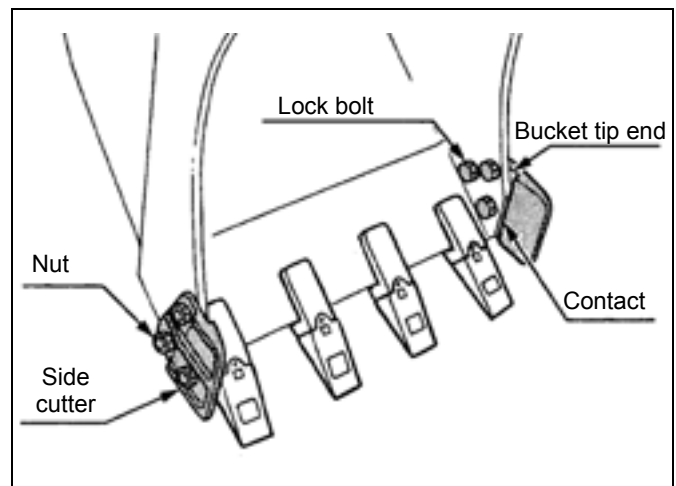
- (2) Lock pin (4) Tooth adapter

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



■ Replacing the side cutter

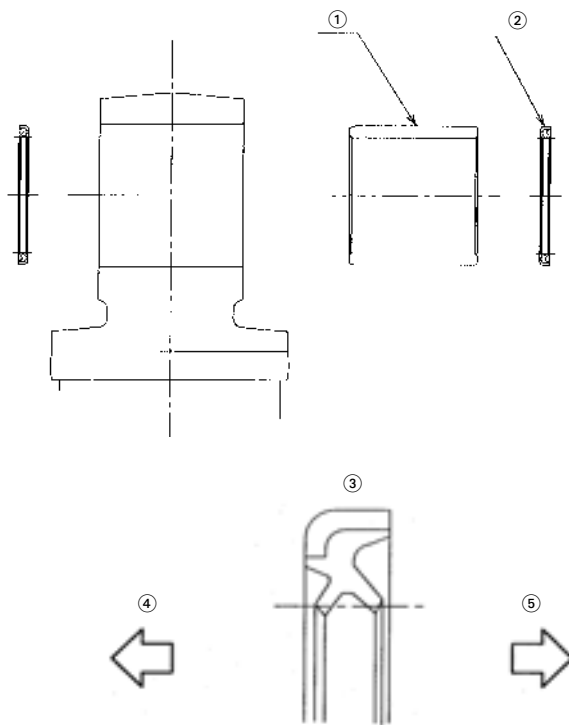
1. Using a box wrench and an adjustable wrench, remove the side cutter lock bolts.
2. Fit new side cutters. Temporarily tighten the bolts.
3. Make sure the side cutters are in close contact with the bucket tip ends. Then tighten up the bolts.



- Tighten the bolts to the torque of 260 to 304 Nm (26.5 to 31 kgf-m).
- If the side cutters are out of contact, or in poor contact with the bucket tip ends, the bolts may get loose.

d. Installing of dust seal and thrust collar

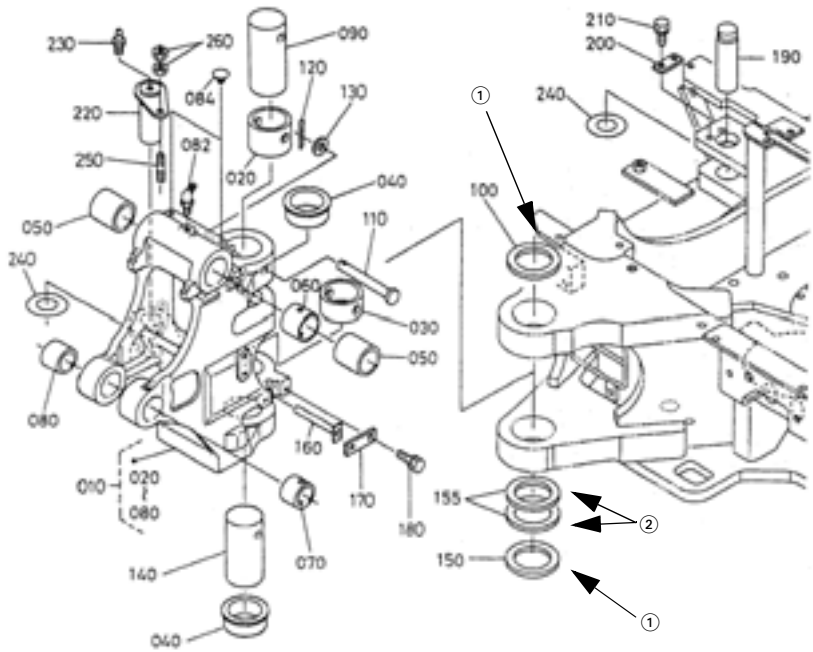
Installation of dust seal



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

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

Installation of thrust collar on the swing bracket



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

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

e. Installation of pin and bush

[1] Pin bush

1) Front clearances

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

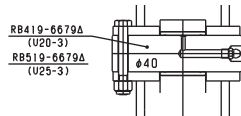
1. Apply grease to both sides. (See Figure A.)
(Molybdenum anti-seizing agent also applicable.)

Thrust collar
setup method

Apply grease.

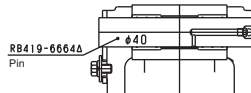


- (1)
Arm assembly
Bucket cylinder



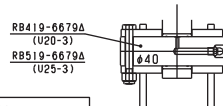
RC411-6694 Δ Shim(0.5, 65-41) | Use
RC411-6695 Δ Shim(1.0, 65-41) | selectively.

- (2)
Boom assembly
Arm assembly



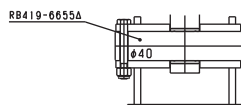
RC411-6694 Δ Shim(0.5, 65-41) | Use
RC411-6695 Δ Shim(1.0, 65-41) | selectively.

- (3)
Arm assembly
Arm cylinder



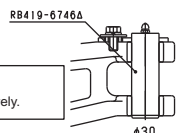
RC411-6694 Δ Pin(0.5, 65-41) | Use
RC411-6695 Δ Pin(1.0, 65-41) | selectively.

- (4)
Boom assembly
Arm cylinder

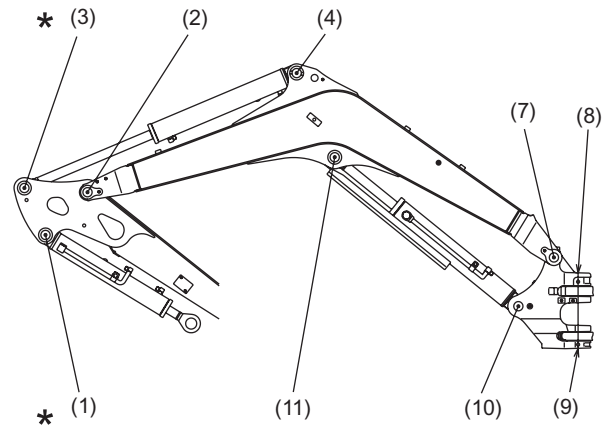


RC411-6694 Δ Pin(0.5, 65-41) | Use
RC411-6695 Δ Pin(1.0, 65-41) | selectively.

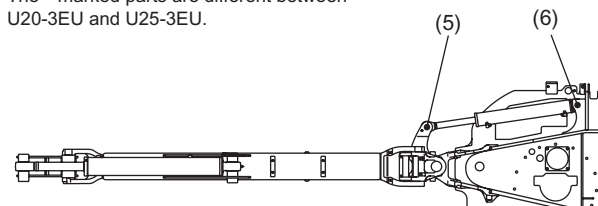
- (5)
Swing bracket
Swing cylinder



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



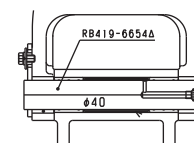
The *-marked parts are different between
U20-3EU and U25-3EU.



- (6)
Swivel frame
Swing cylinder

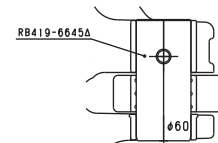
68721-6697 Δ Pin(0.5, 60-31) | Use
68051-6633 Δ Pin(1.0, 60-31) | Use
68051-6634 Δ Pin(1.6, 60-31) | selectively.

- (7)
Boom assembly
Swing bracket



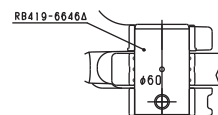
RC411-6694 Δ Shim(0.5, 65-41) | Use
RC411-6695 Δ Shim(1.0, 65-41) | selectively.

- (8)
Swing bracket
Swivel frame(Upper)



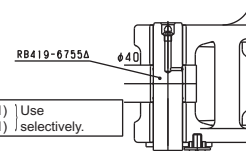
RB411-6687 Δ Thrust collar (0.5, 65-41) | Use
68351-6645 Δ Thrust collar (1.0, 65-41) | selectively.

- (9)
Swing bracket
Swivel frame(Lower)



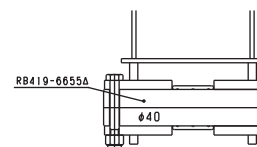
RC411-6874 Δ Thrust collar (0.5, 65-41) | Use
68351-6645 Δ Thrust collar (1.0, 65-41) | selectively.

- (10)
Swing bracket
Boom cylinder



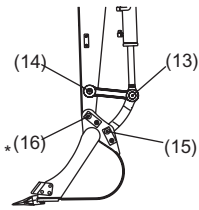
RC411-6694 Δ Shim(0.5, 65-41) | Use
RC411-6695 Δ Shim(1.0, 65-41) | selectively.

- (11)
Boom assembly
Boom cylinder

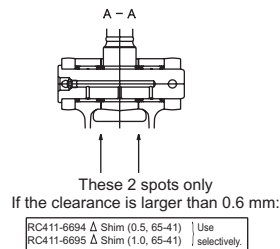
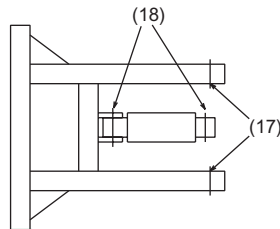
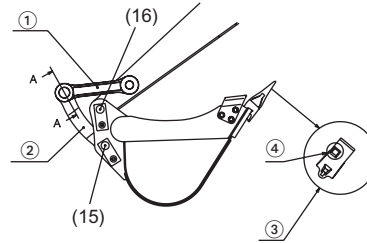


RC411-6694 Δ Shim(0.5, 65-41) | Use
RC411-6695 Δ Shim(1.0, 65-41) | selectively.

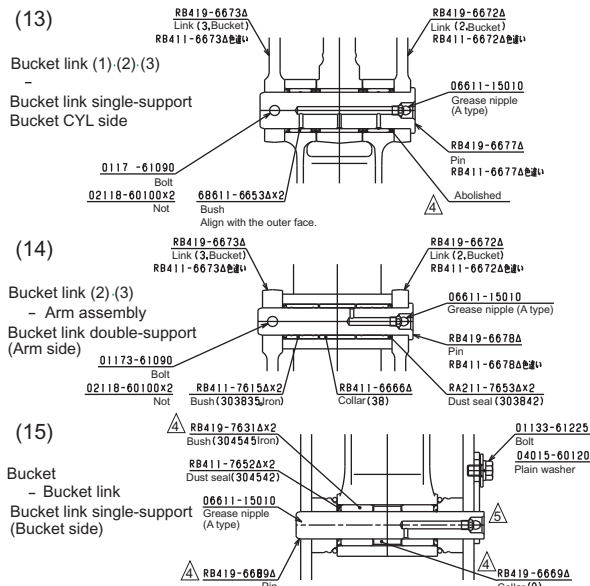
[2] Pin, bush-(2)



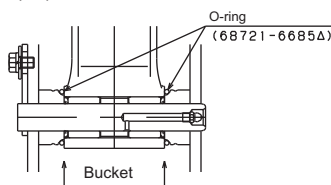
The *-marked parts are different between U20-3EU and U25-3EU.



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



(15) Bucker link (1)



If the clearance is larger than 0.6 mm:

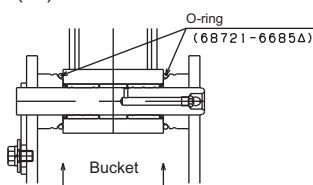
U20-3 EU

RP201-6646 Δ Shim (0.5) SKSM | Use
RB411-6633 Δ Shim (1.0, 70-31) SKSM | selectively.

U25-3 EU

RB511-6634 Δ Shim (0.5, 80-31) SKSM | Use
RB511-6633 Δ Shim (1.0, 80-31) SKSM | selectively.

(16) Arm



If the clearance is larger than 0.6 mm:

U-20-3

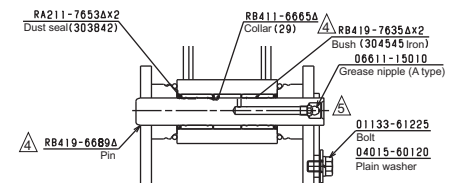
RP201-6646 Δ Shim (0.5) SKSM | Use
RB411-6633 Δ Shim (1.0, 70-31) SKSM | selectively.

U-25

RB511-6634 Δ Shim (0.5, 80-31) SKSM | Use
RB511-6633 Δ Shim (1.0, 80-31) SKSM | selectively.

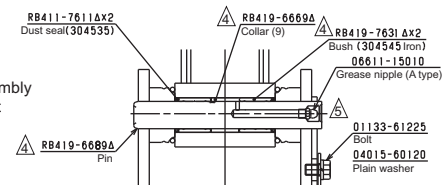
(16)-1

U20-3 only
Bucket
- Arm assembly
Bucket support



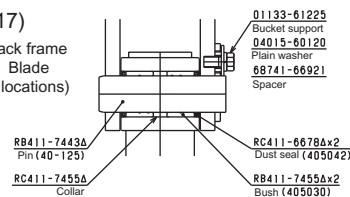
(16)-2

U25-3 only
Bucket
- Arm assembly
Bucket support



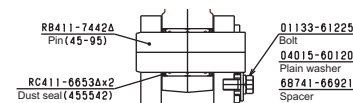
(17)

Track frame
- Blade
(2 locations)



(18)

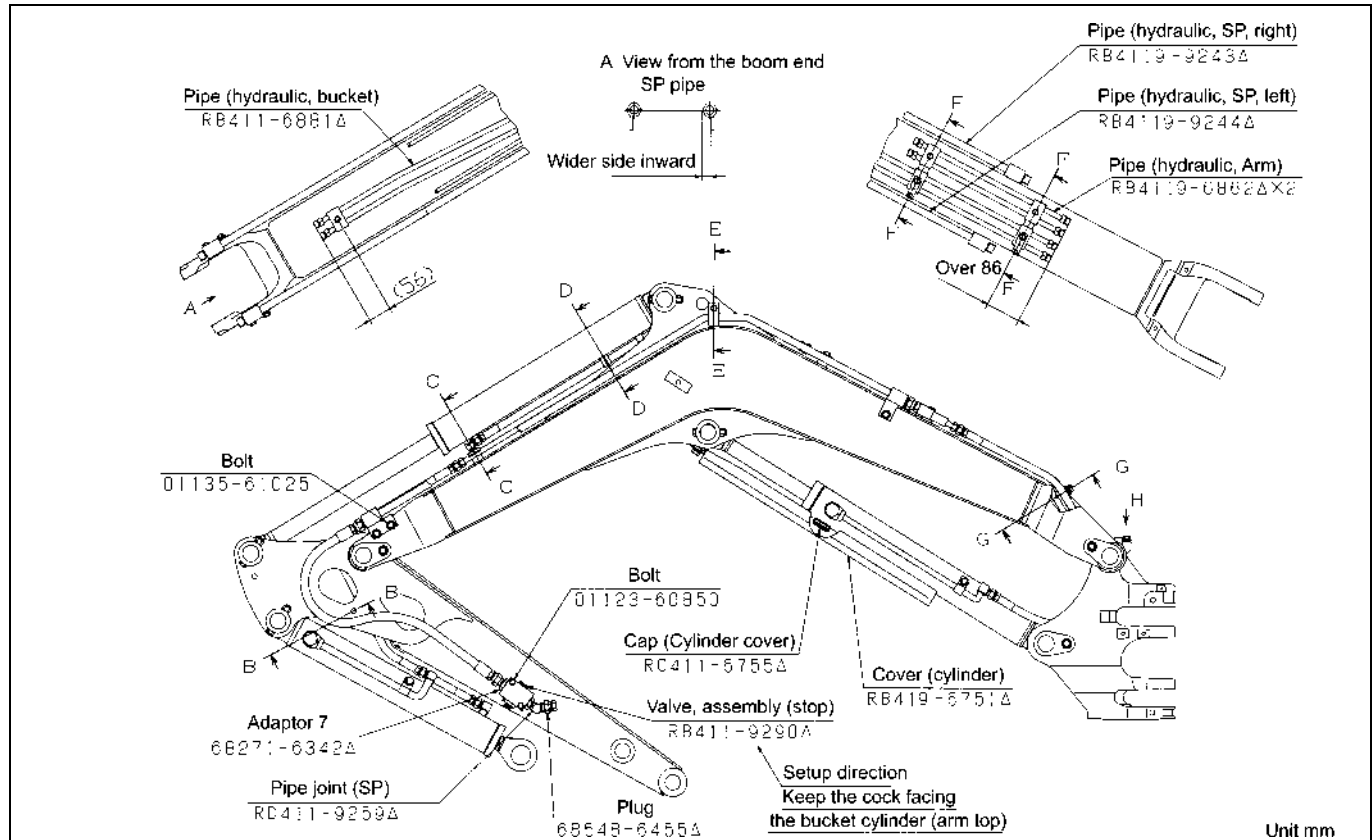
Cylinder
- Blade
- double-support
(2 locations)



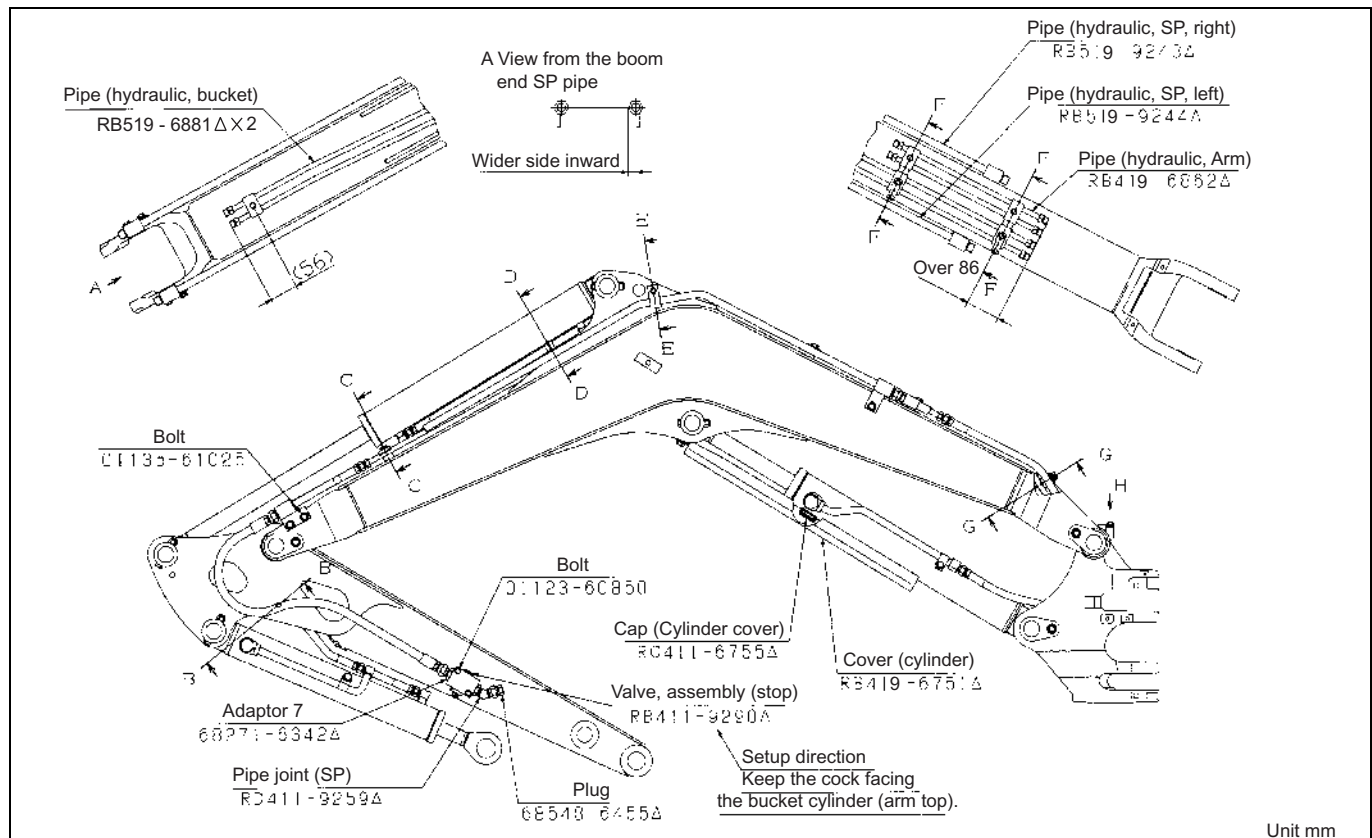
f. Front hose

[1] Front hose assembly (U20-3)

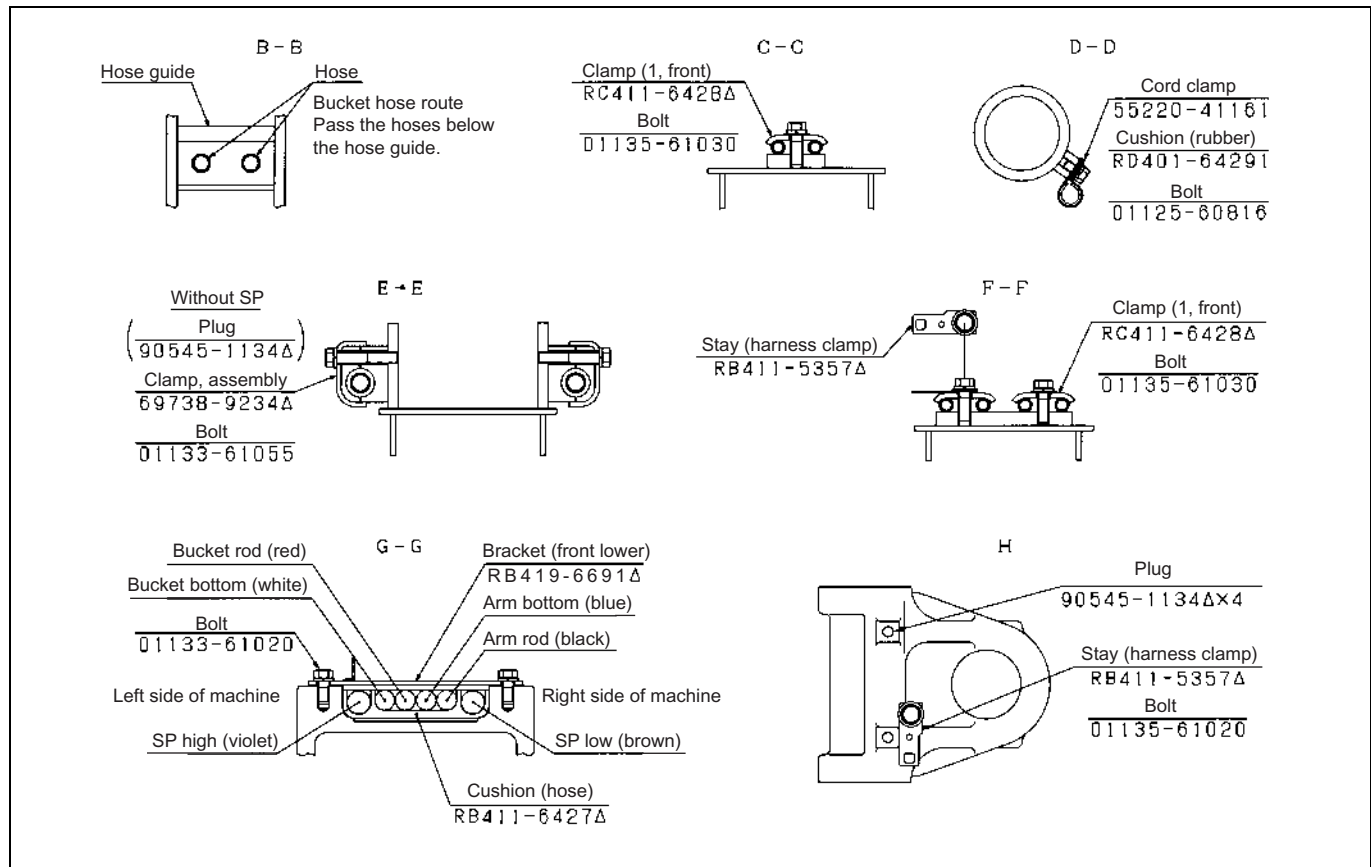
IMPORTANT: Replace the hydraulic hoses (boom, arm, bucket, swing, service port), after 2 years or 4000 operating hours, whichever comes earlier.



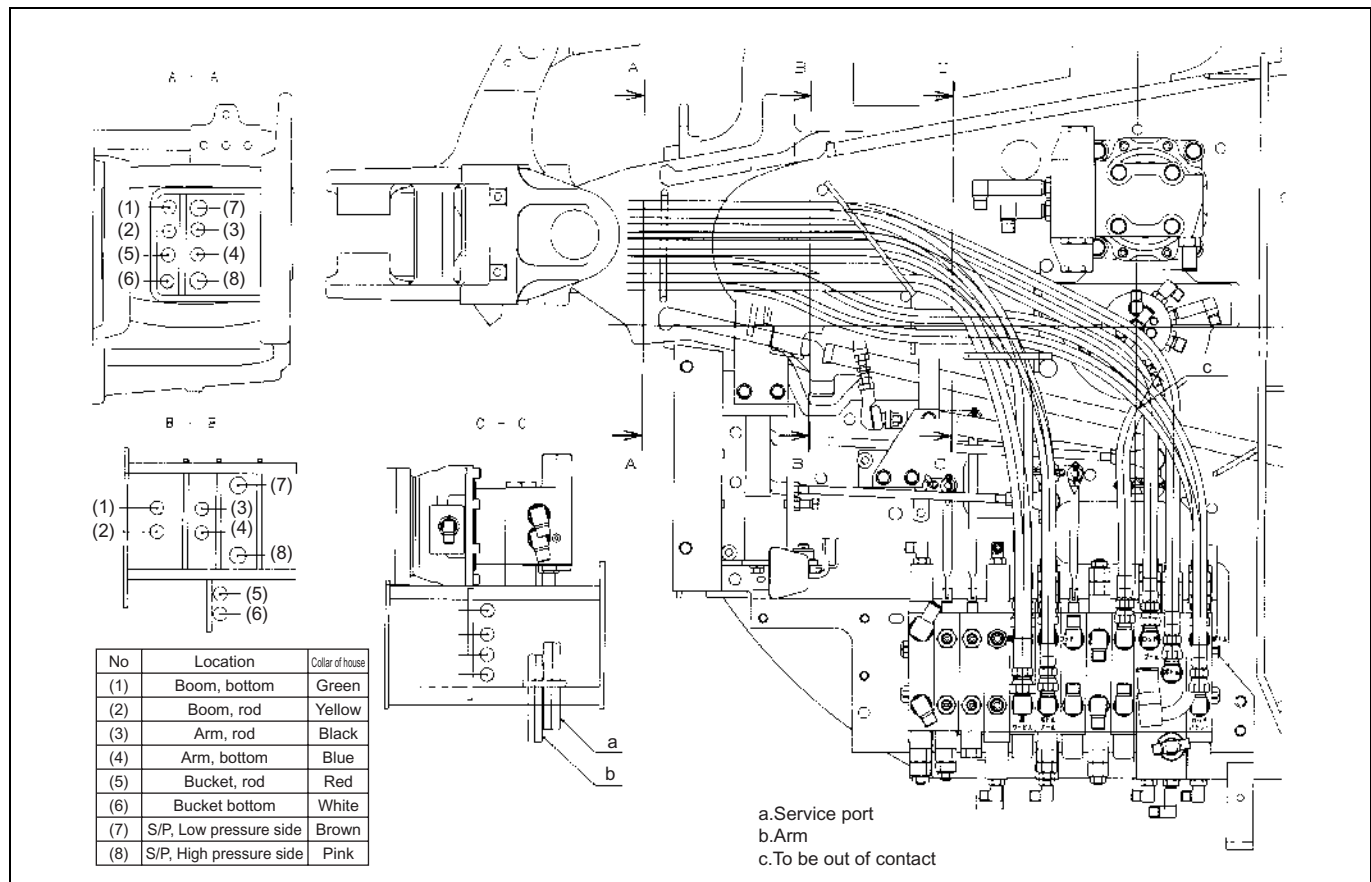
[2] Front hose assembly (U25-3)



[3] Hose clamp



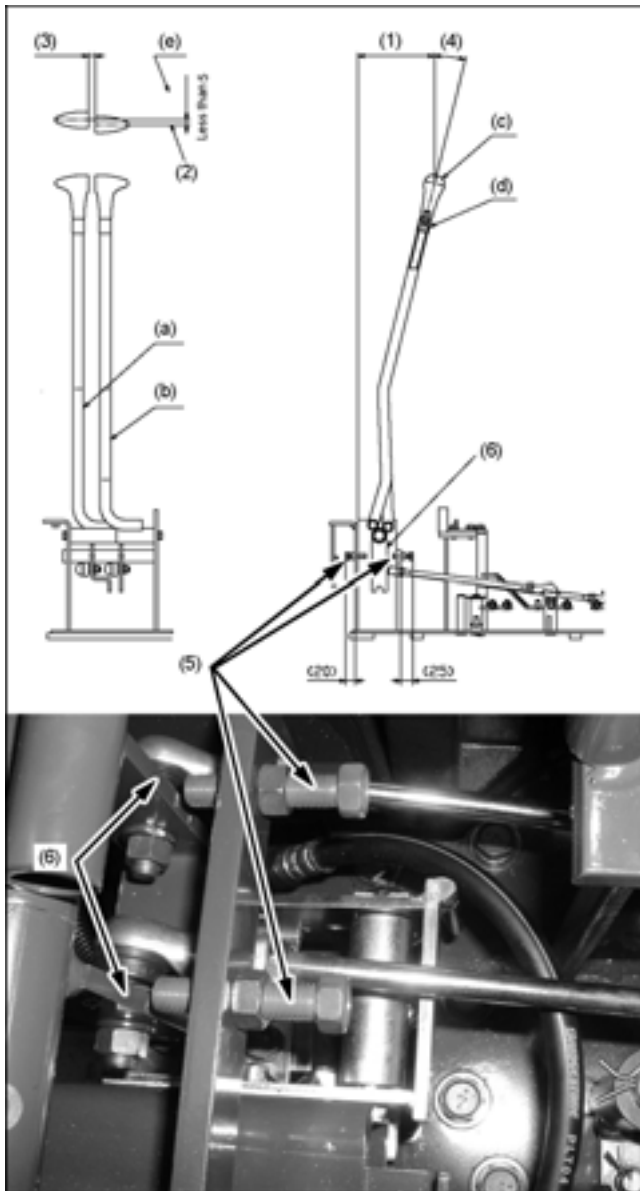
[4] Front hose control valve side



C.Upper structure

a. Lever and pedal

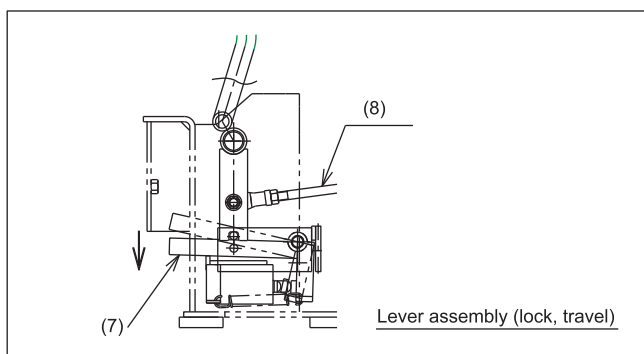
[1] Travel lever



1) Assembling procedure

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

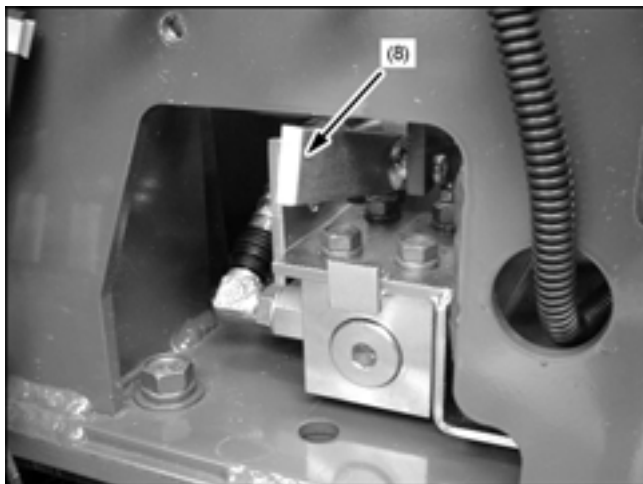
No.	
(a)	Lever (travel, right) RB419-6536Δ
(b)	Lever (travel, left) RB419-6531Δ
(c)	Grip (travel) RC101-65282
(d)	Cap RC101-65292
(e)	Misalignment between right and left levers



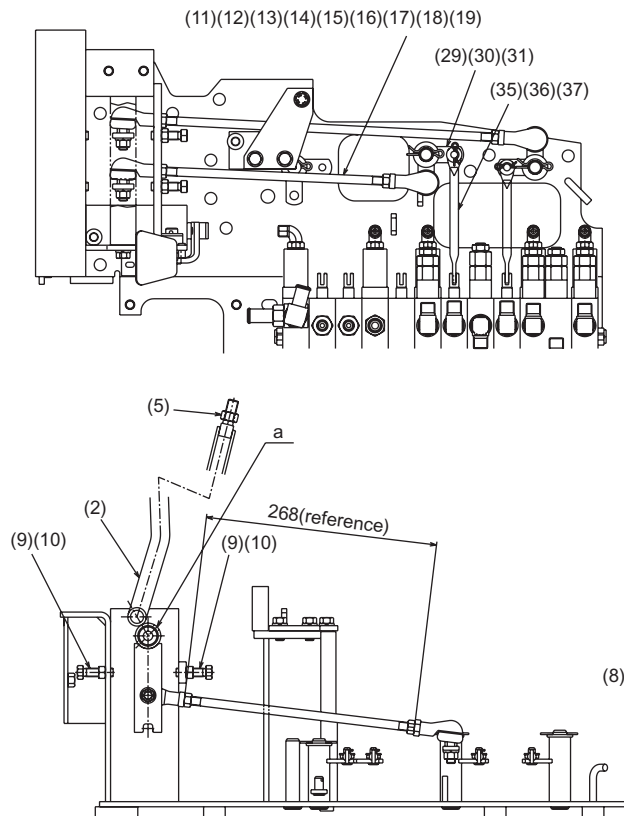
2) Check items after setup

Make sure the valve spool works all over the stroke.

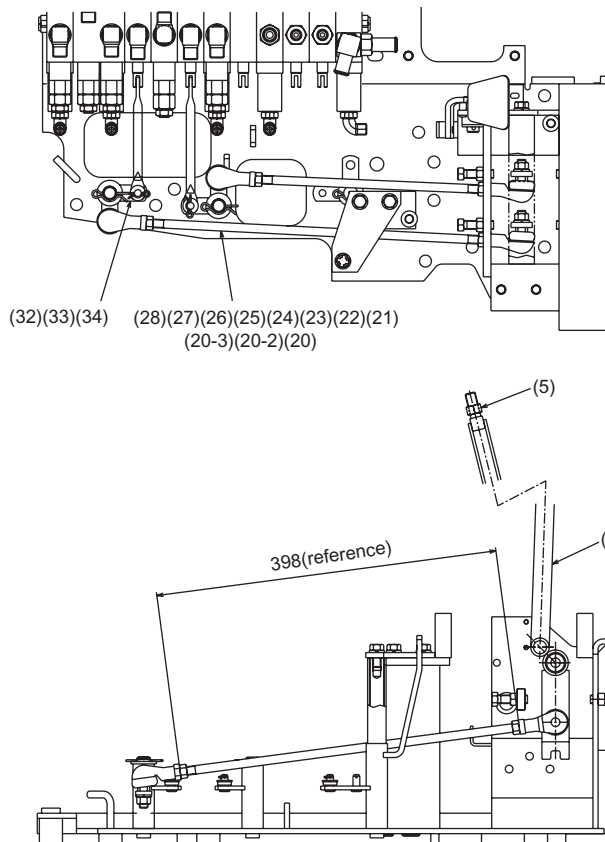
Make sure the valve spool moves smoothly.
Lock the stopper bolt and nut tight enough.



3) Travel lever assembly view



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



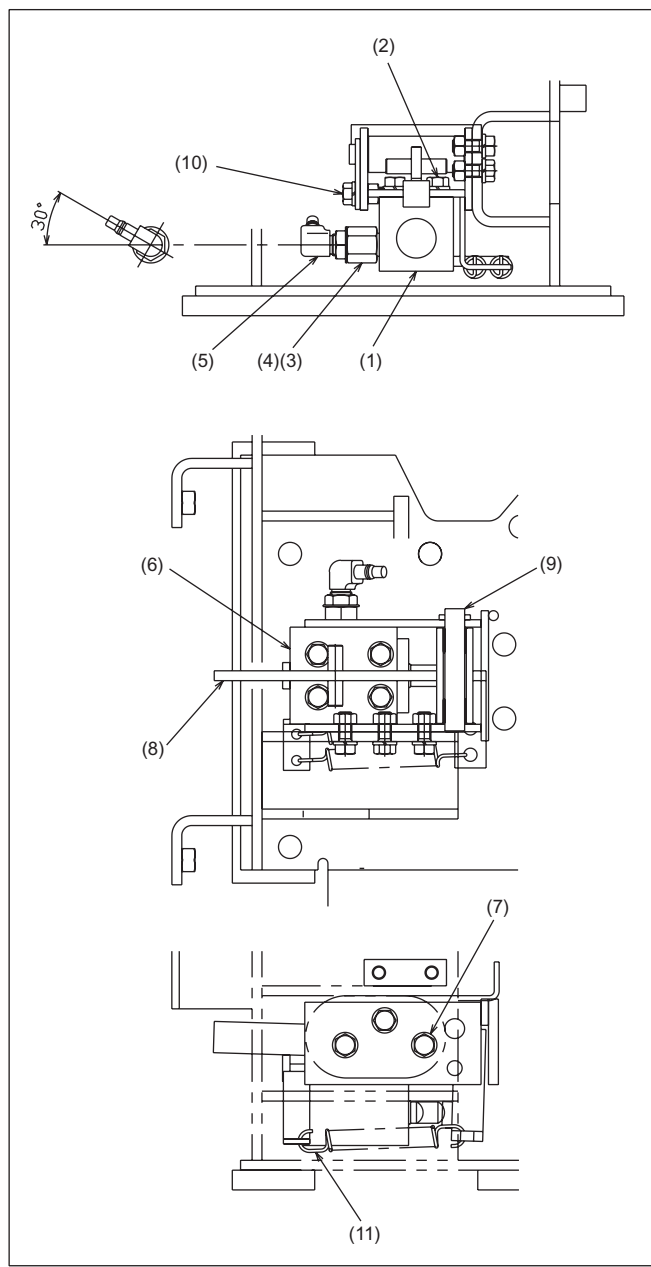
- (3) Fitting the plastic cap (3)
Install the cap tight enough.
Otherwise the turning part may get rusty.
- (4) Tightening torque of bolt (7)
60.8~70.6N·m (6.2~7.2kgf·m)

No.	Part No.	Part name	Q'ty	Remarks
2	RB419-6530△	Lever, assembly (travel, left)	1	
	RB419-6531△	Lever (travel, left)	1	
	68741-6536 △	Needle bearing	2	
3	68741-6543 △	Plastic cap	1	
5	02074-60120	Nut	1	M12 × 1.25 4T
6	RC411-6537△	Pin (travel)	1	
7	01176-61025	Bolt	2	M10 × 1.25 9T
8	04512-60100	Plain washer	2	
9	01175-61045	Bolt	4	M10 × 1.25 7T
10	02118-60100	Nut	4	M10 × 1.25 4T
11	RB411-6532△	Rod (10-305)	1	
12	52300-7517 △	Link ball 1	1	
13	04512-60100	Spring washer	1	
14	02118-60100	Nut	1	M10 × 1.25 4T
15	02116-50100	Nut	1	M10 × 1.25 4T
16	68011-3268 △	Left-threaded lock nut	1	
17	52300-7519 △	Link ball 2	1	
18	04512-60100	Spring washer	1	
19	02118-60100	Nut	1	M10 × 1.25 4T
29	RB411-6545△	Link, assembly (travel, left)	1	
	RB411-6546△	Link (travel, left)	1	
	08511-01615	Bushing	2	
30	04011-60160	Plain washer	1	
31	05525-51600	Snap pin	1	
35	RB411-6533△	Rod (145)	1	
36	04013-60080	Plain washer	1	
37	05525-50800	Snap pin	1	

- (5) Apply grease to the needle and DU bushing, and make sure the rotary shaft turns smoothly.
- (6) Tightening torque of link ball lock nut
39.2~45.1N·m (4.0~4.6kgf·m)

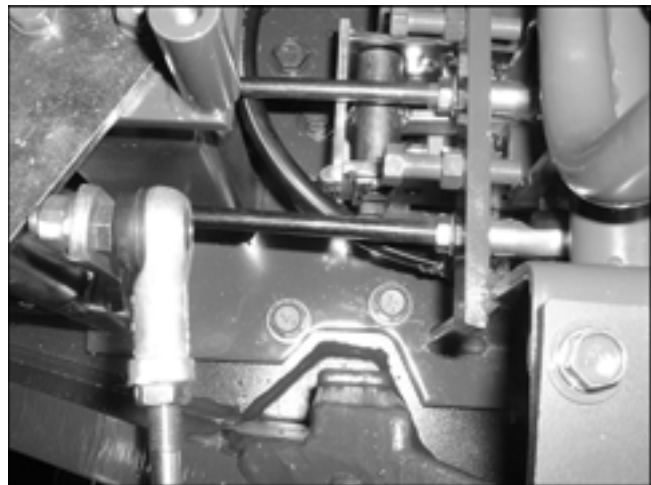
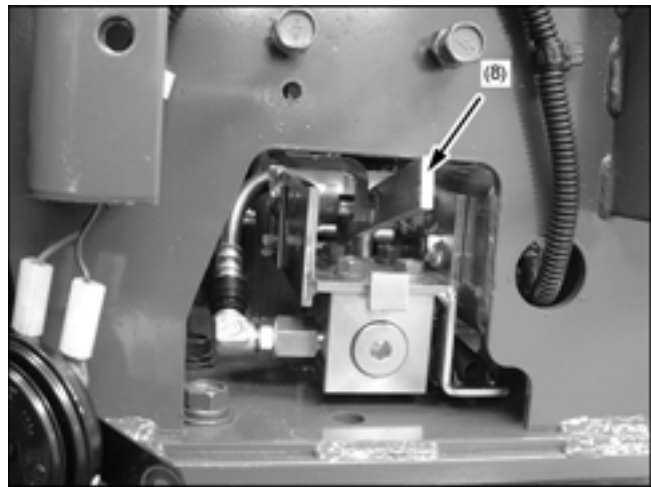
No.	Part No.	Part name	Q'ty	Remarks
4	RB419-6535△	Lever, assembly (travel, right)	1	
	RB419-6536△	Lever (travel, right)	1	
	68741-6536 △	Needle bearing	2	
5	02074-60120	Nut	1	M12 × 1.25 4T
20	RC601-6538△	Rod (10-225)	1	
20-2	37410-4218 △	Turnbuckle	1	
20-3	RP801-6556△	Rod (180)	1	
21	52300-7517 △	Link ball 1	1	
22	04512-60100	Spring washer	1	
23	02118-60100	Nut	1	M10 × 1.25 4T
24	02116-50100	Nut	2	M10 × 1.25 4T
25	68011-3268 △	Left-threaded lock nut	2	
26	52300-7519 △	Link ball 2	1	
27	04512-60100	Spring washer	1	
28	02118-60100	Nut	1	M10 × 1.25 4T
32	RB411-6547△	Link, assembly (travel, right)	1	
	RB411-6548△	Link (travel, right)	1	
	08511-01615	Bushing	2	
33	04011-60160	Plain washer	1	
34	05525-51600	Snap pin	1	

4) Travel lever lock



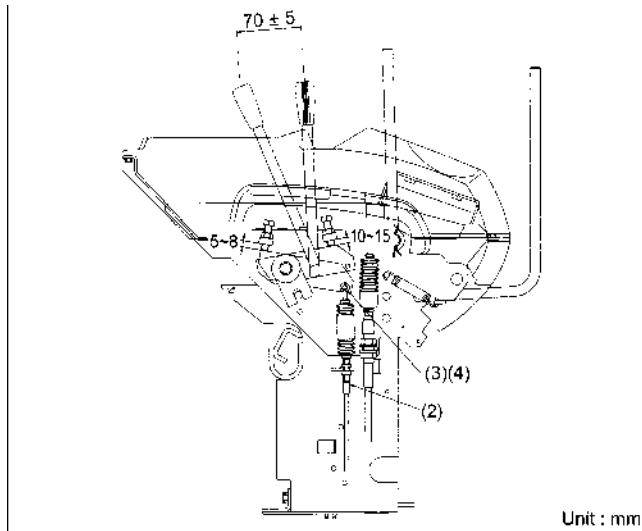
- (1) Apply grease to the DU bushing bearing.
- (2) Tightening torque of adaptor
G1/8:15.0~16.5N·m (1.5~1.7kgf·m)
G1/4:24.5~29.4N·m (2.5~3.0kgf·m)

No.	Part No.	Part name	Q'ty	Remarks
1	RG518-6611△	Assy Cylinder (TL)	1	
2	01123-60820	Bolt	4	
3	RC418-6613△	Pipe joint (S.G1/8-G1/4)	1	
4	04810-00080	O-ring	1	
5	RP821-6197△	Pipe joint (QL. G1/4-8.4)	1	
6	RB419-6607△	Bracket (lock, travel)	1	
7	01123-60820	Bolt	3	
8	RB419-6610△	Lever assembly (lock, travel)	1	
	RB419-6609△	Lever (lock, travel)	1	
	08511-01216	Bushing	2	
9	RC418-6608△	Shaft (lock, travel)	1	
10	01123-60820	Bolt	1	
11	50300-6128△	Tension spring	2	

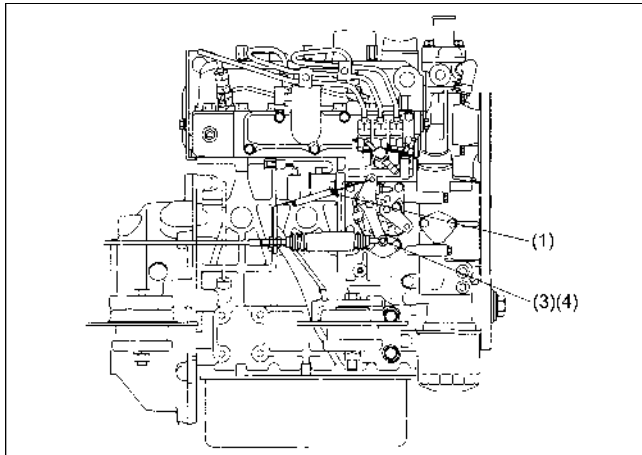


[2] Acceleration lever

Acceleration lever assembly view (lever side)



Acceleration / lever assembly view (Engine side)



1) Assembling procedure

1. Idling control
1250±50rpm
2. Set the engine rpm to maximum.
Make sure the lever is exactly at the engine maximum rpm position.
3. Lever stroke (idling to maximum rpm)
70±5mm

4. Parts list

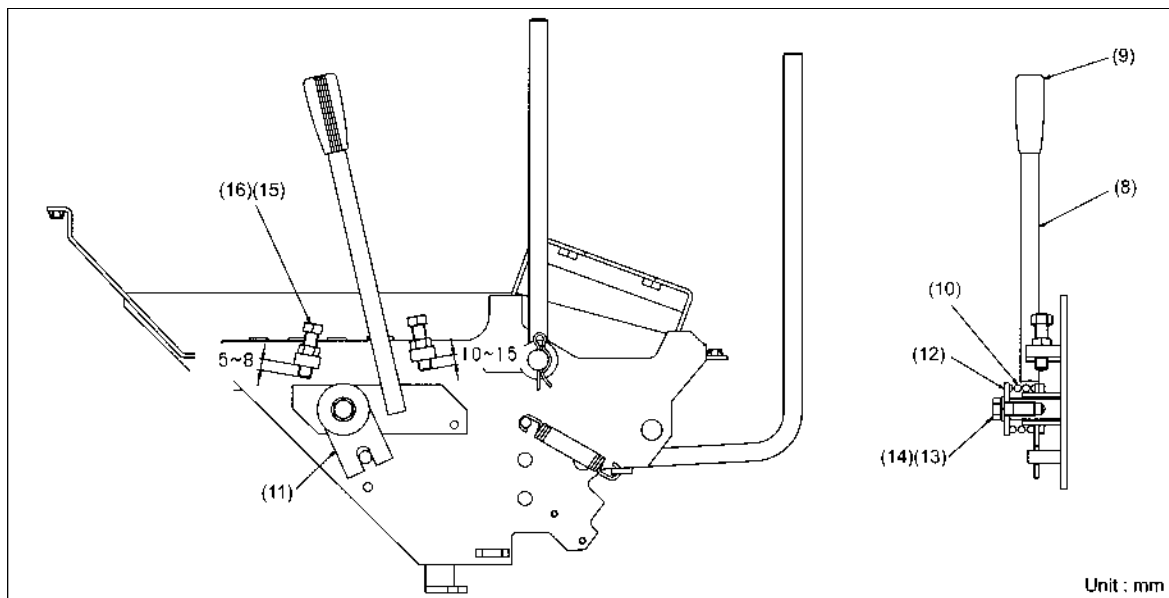
No.	Part No.	Part name	Q'ty	Remarks
1	RB411-3539 △	Spring (acceleration)	1	
2	RB411-3515 △	Cable (acceleration)	1	
3	04013-60060	Plain washer	2	
4	05511-51612	Split pin	2	

5. Apply grease to the DU bushing and make sure the rotary shaft turns smoothly.

6. Tightening torque of bolt (14)
48.1~55.9N·m (4.9~5.7kgf·m)

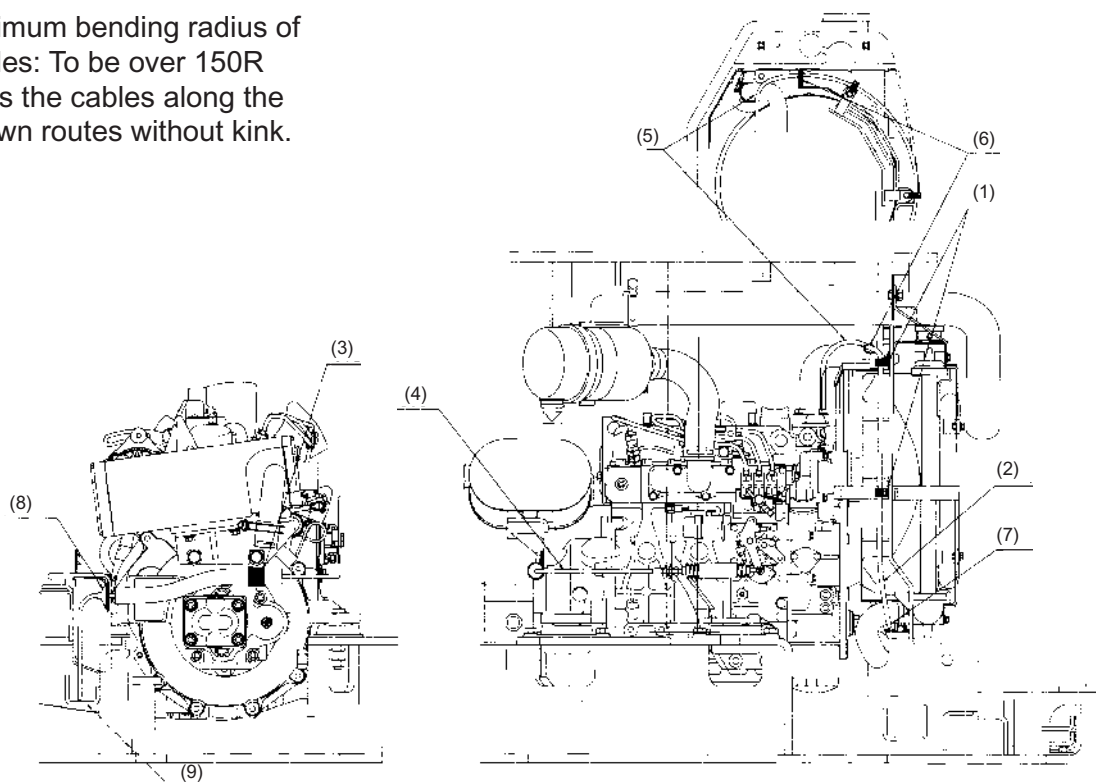
7. Parts list

No.	Part No.	Part name	Q'ty	Remarks
8	RB411-3510 △	Lever, assembly (acceleration)	1	
	RB411-3511 △	Lever (acceleration)	1	
	08511-01625	Bushing	1	
9	41233-7155 △	Lever grip	1	
10	RP411-3512 △	Compression spring	1	
11	RB401-3517 △	Plate	1	
12	RC101-3521 △	Plate	1	
13	04512-60100	Spring washer	1	
14	01173-61025	Bolt	1	M10×1.25 7T
15	01175-61045	Bolt	2	M10×1.25 7T
16	02116-60100	Nut	2	



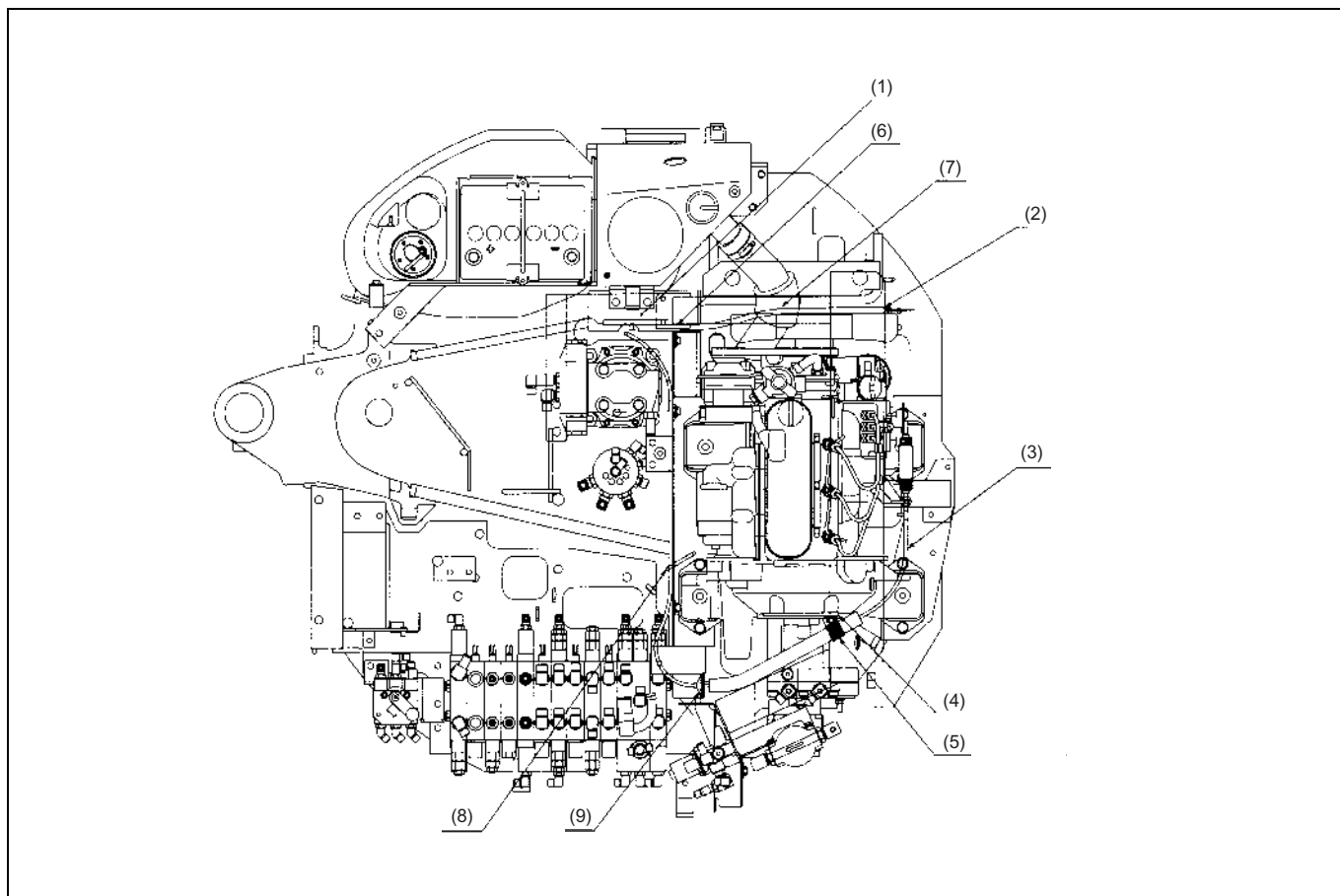
2) Acceleration cable and hour meter cable routes

- * Minimum bending radius of cables: To be over 150R
- * Pass the cables along the shown routes without kink.



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

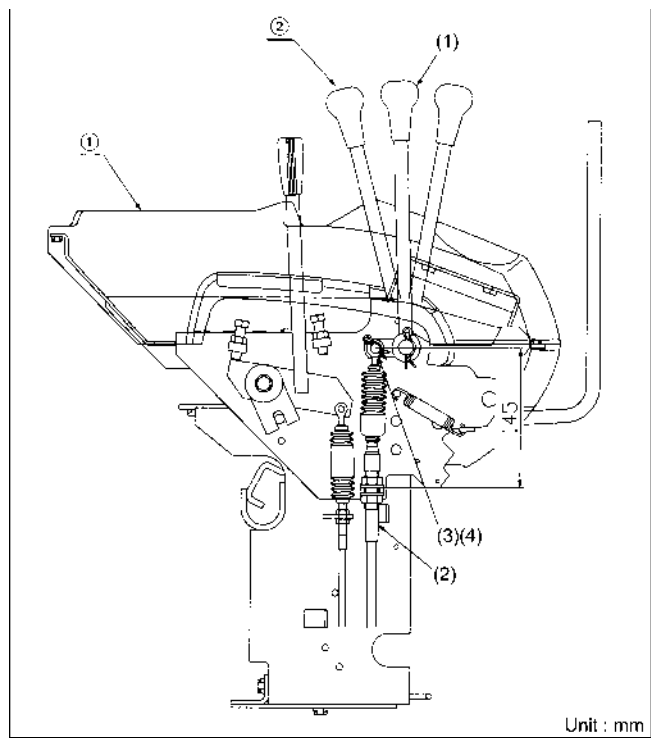
3) Acceleration cable and hour meter cable routes



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

[3] Dozer lever

Dozer lever assembly view

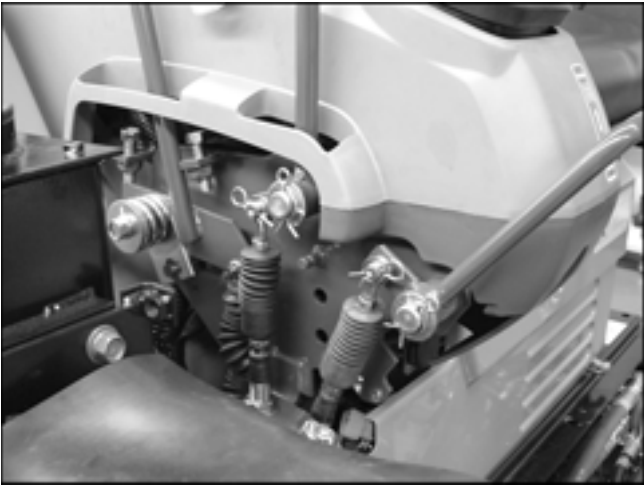


No.	
①	Cover (right, top) RB411-4476Δ
②	Move the lever full stroke to see if the lever does not hit the cover (right, top).

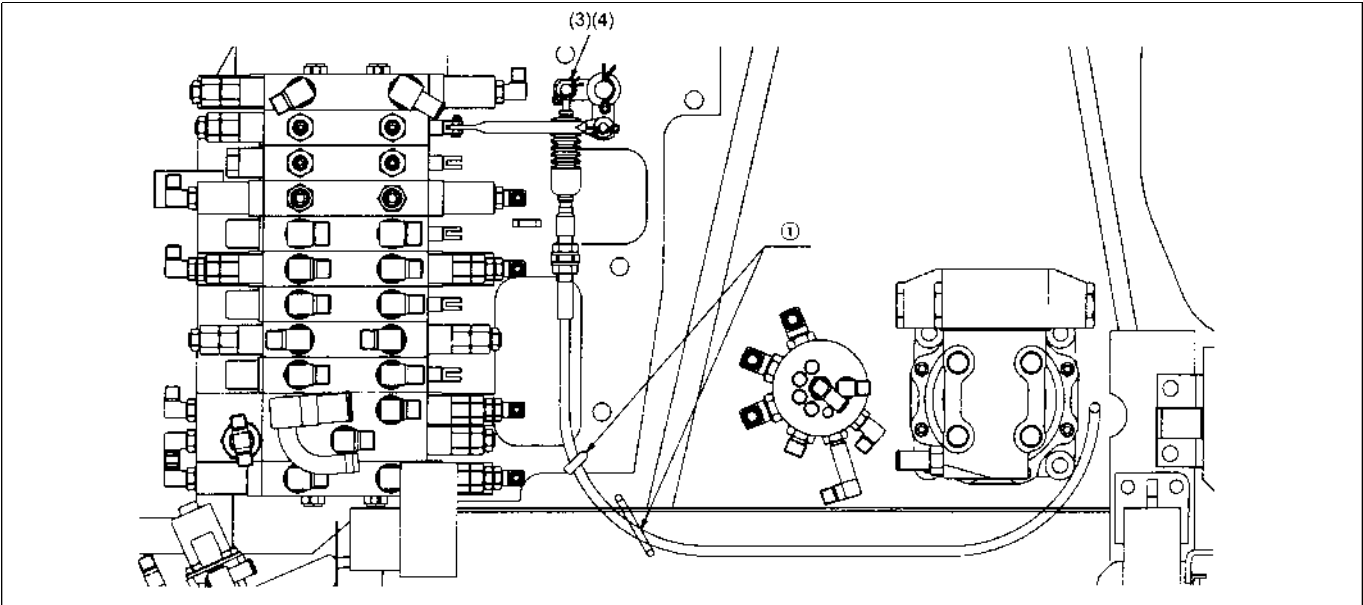
1) Assembling Procedure

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

No.	Part No.	Part name	Q'ty	Remarks
1	56501-17531	Grip	1	
2	RB411-6577 Δ	Cable (dozer)	1	
3	04013-60100	Plain washer	2	
4	05525-61000	Snap pin	2	



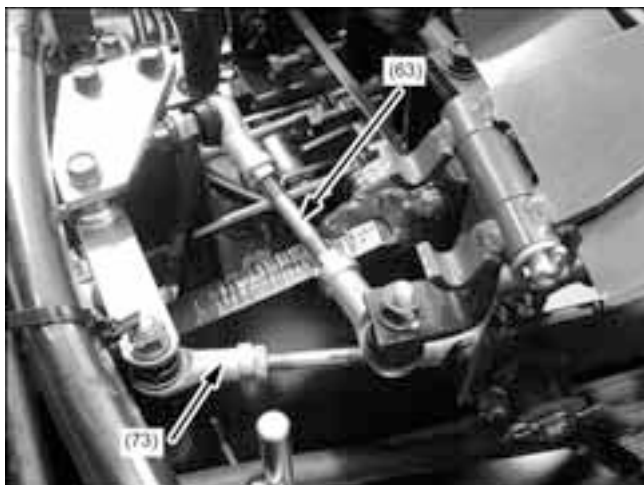
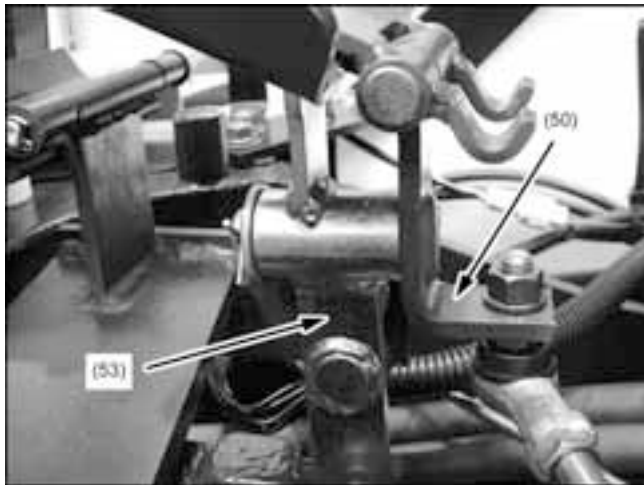
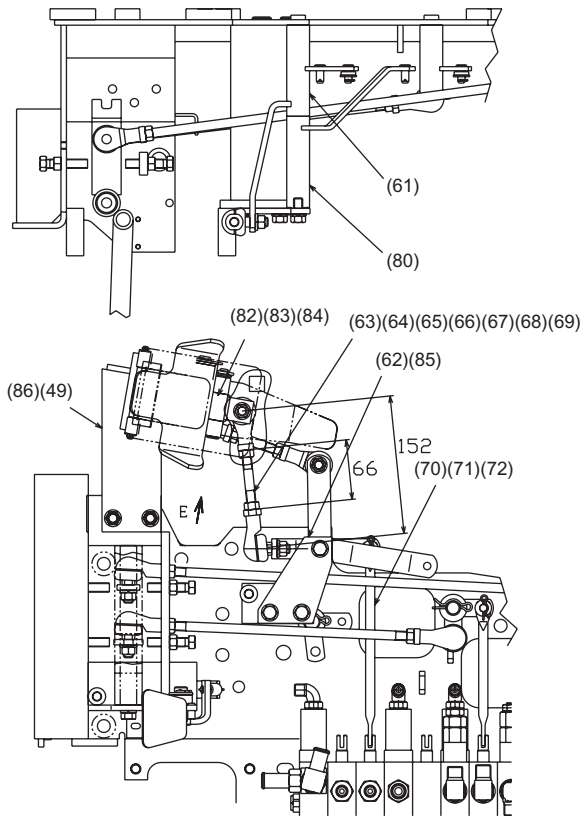
Dozer cable route



① Guide

[4] Swing and speed pedal

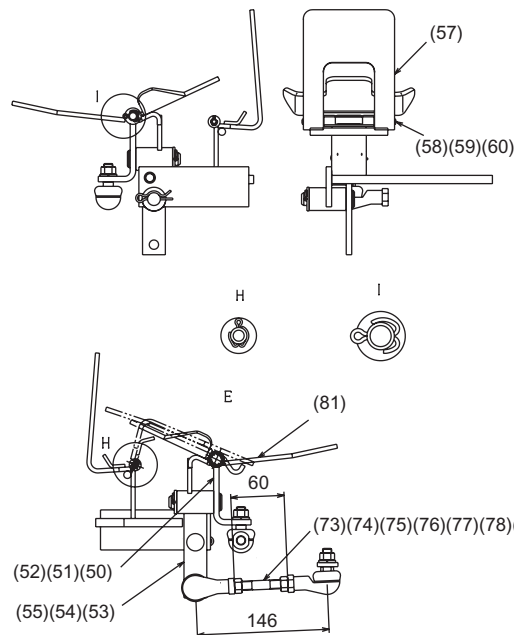
Swing pedal assembly view

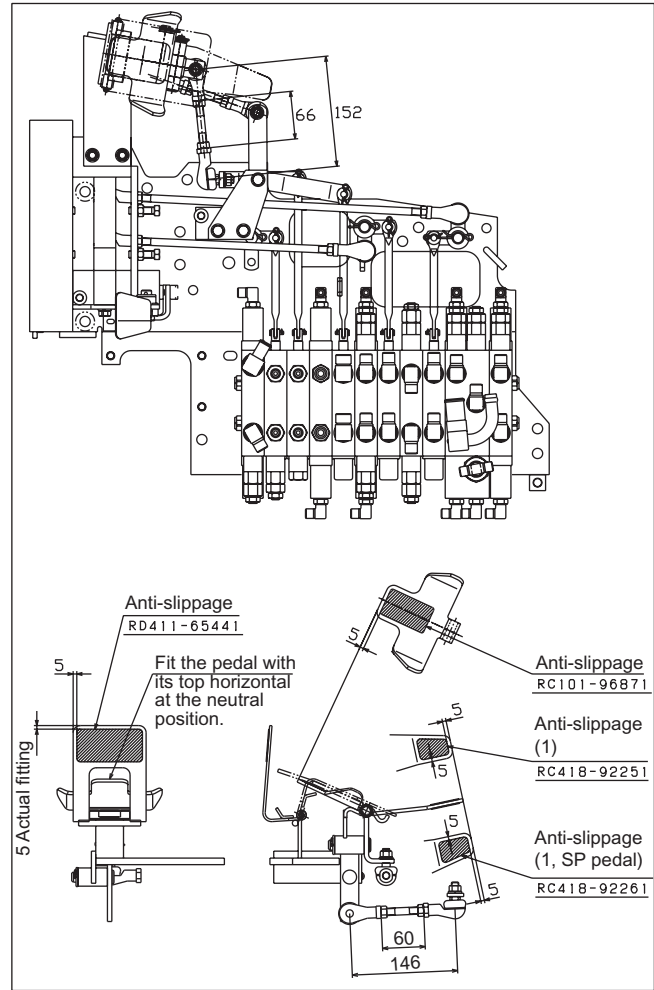


1. Apply grease to the DU bushing and makes sure the rotary shaft turns smoothly.
2. Tightening torque of link ball mock nut 39.2~45.1N·m (4.0~4.6kgf·m)
3. Tightening torque of bolts 85 and 86 48.1~55.9N·m (4.9~5.7kgf·m)

No.	Part No.	Part name	Q'ty	Remarks
49	RB411-6560 Δ	Bracket, assembly (pedal)	1	
	RB411-6559 Δ	Bracket (swing pedal)	1	
	08511-01415	Bushing	2	
50	RB419-9211 Δ	Pedal (swing)	1	
51	04013-60140	Plain washer	1	
52	05525-51400	Snap pin	1	
53	RB411-9215 Δ	Lever, assembly (SP)	1	
	RB411-9216 Δ	Lever (SP)	1	
	08511-01415	Bushing	2	
54	04013-60140	Plain washer	1	
55	05525-51400	Snap pin	1	
56		None		
57	RC418-6556 Δ	Cover (spring)	1	
58	RC101-6544 Δ	Pin (swing cover)	1	
59	04013-60060	Plain washer	2	
60	05511-51612	Split pin	2	
61	RB411-6553 Δ	Link, assembly (swing)	1	
	RB411-6554 Δ	Link (swing)	1	
	08511-01615	Bushing	2	
62	RB411-6552 Δ	Plate (link support)	1	
63	69254-7828 Δ	Rod (90)	1	
64	52300-7517 Δ	Link ball 1	1	
65	52300-7519 Δ	Link ball 2	1	

No.	Part No.	Part name	Q'ty	Remarks
66	02116-50100	Nut	1	M10 × 1.25 4T
67	68011-3268 Δ	Left-threaded lock nut	1	
68	04512-60100	Spring washer	2	
69	02118-60100	Nut	2	M10 × 1.25 4T
70	RB411-6534 Δ	Rod (210)	1	
71	04013-60080	Plain washer	1	
72	05525-50800	Snap pin	1	
73	69254-7828 Δ	Rod (90)	1	
74	52300-7517 Δ	Link ball 1	1	
75	52300-7519 Δ	Link ball 2	1	
76	02116-50100	Nut	1	M10 × 1.25 4T
77	04512-60100	Spring washer	2	
78	02118-60100	Nut	2	M10 × 1.25 4T
79	68011-3268 Δ	Left-threaded lock nut	1	
80	RB411-9214 Δ	Link, assembly (SP)	1	
	RB411-9213 Δ	Link (SP)	1	
	08511-01615	Bushing	2	
81	RC418-9217 Δ	Pedal (SP)	1	
82	05122-51075	Headed pin	1	
83	04011-50100	Plain washer	1	
84	05511-50318	Split pin	1	
85	01133-61020	Bolt	3	M10 × 1.25 7T
86	01135-61030	Bolt	2	M10 × 1.25 7T





4. Make sure the pedal swings equally right and left (horizontal at the center).
To and fro →Service port
Right and left →Swing
5. Fit the pedal with its top horizontal at the neutral position.
6. Move both the service port and swing port spools full stroke and release them. Now make sure the pedal goes back smoothly to its neutral position.

1) Assembling procedure

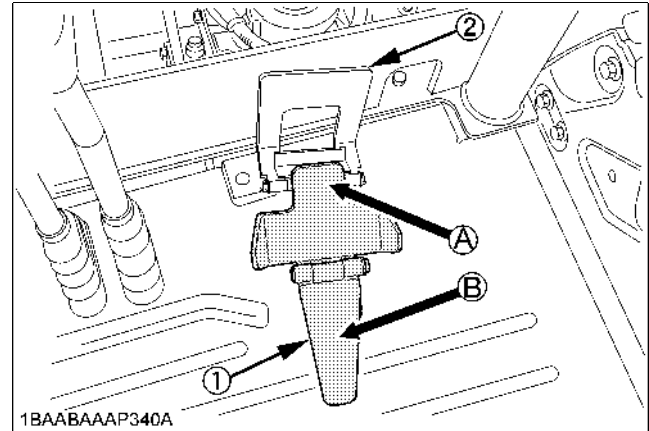
1. Adjusting the pedal
Make sure the pedal stays horizontal at the center and swings equally right and left.
To and fro→Service port
Right and left→Swing
2. Tightening torque of link ball lock nut
39.2~45.1N·m (4.0~4.6kgf·m)
3. Link fitting dimensions
Fit the link as shown at left.

SERVICE PORT OPERATION

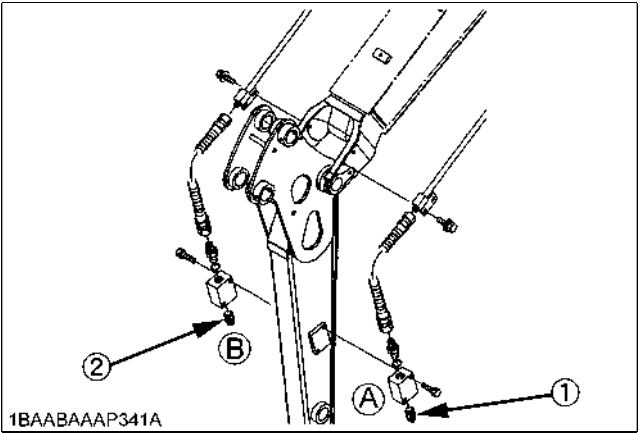
 CAUTION

To avoid personal injury:

- Tilt the service port pedal forward when the pedal is not used. Be sure to lock the pedal.
- This pedal is used to operate attachments such as breakers.



- (1) Service port pedal
(2) Pedal lock
(A) Sends oil to the port (A)
(B) Sends oil to the port (B)

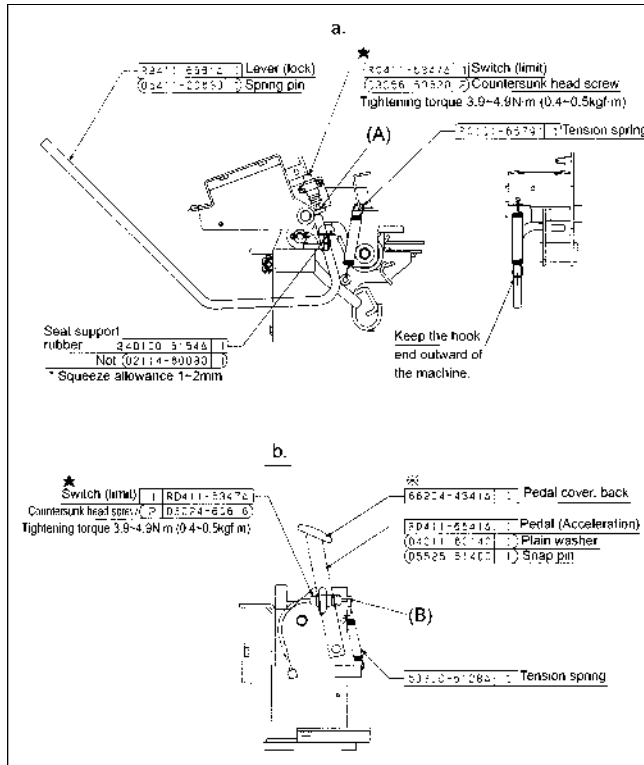


- (1) Port (A)
(2) Port (B)
- Push the back part of the pedal (↓) to send oil to the port (A).
 - Push the front part of the pedal (↓) to send oil the port (B).

Max. Flow Volume theoretical L. min.	U20-3	35.8
	U25-3	48.0
Max. Pressure MPa (kgf/cm ²)	U20-3	21.6 (220)
	U25-3	

[5] Limit switch

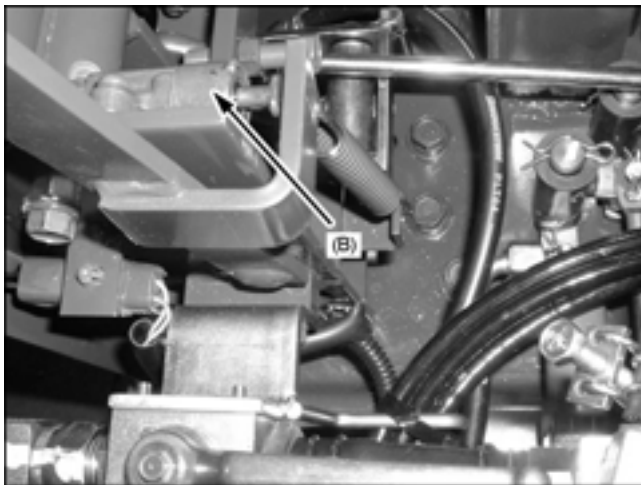
Limit switch setup view



a. Unload lever, left

b. High-speed traveling pedal

High-speed traveling pedal



1) Assembling procedure

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

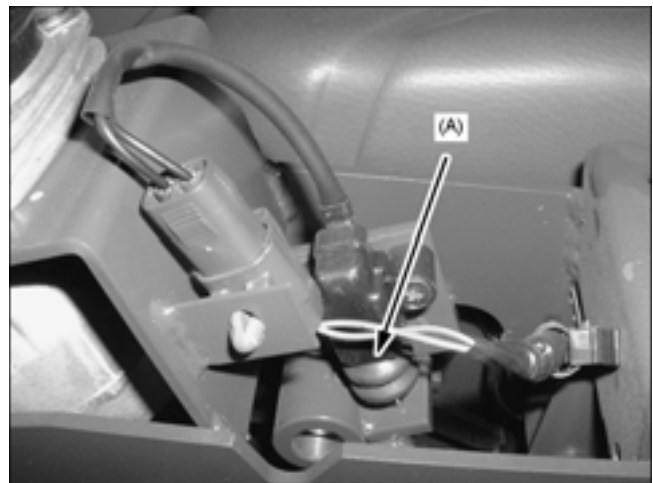


CAUTION

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

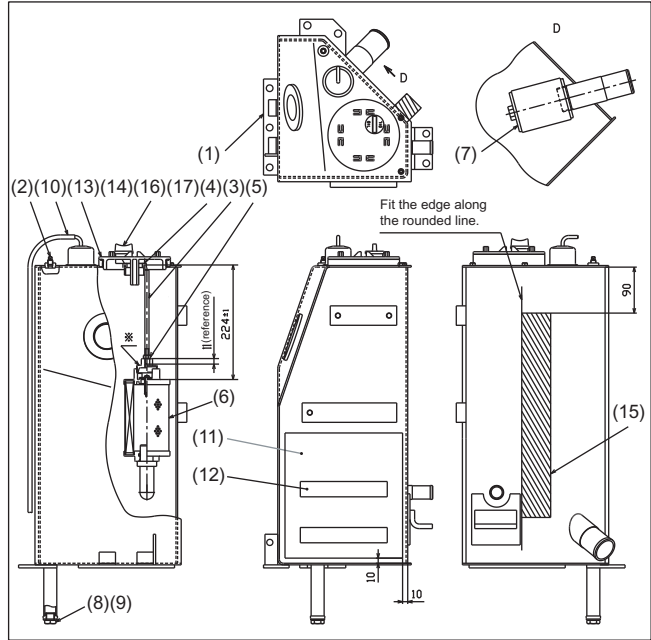
2. Apply instantaneous adhesive to the acceleration pedals rubber cover and attach it in place.
3. Hook the tension spring to the unload lever (left).
Make sure the end of the spring hook at the unload lever faces outward of the machine.
4. Squeeze allowance of seat support rubber 1~2mm
5. Apply grease to the DU bushing bearing.

Limit switch, left



b. Hydraulic oil tank

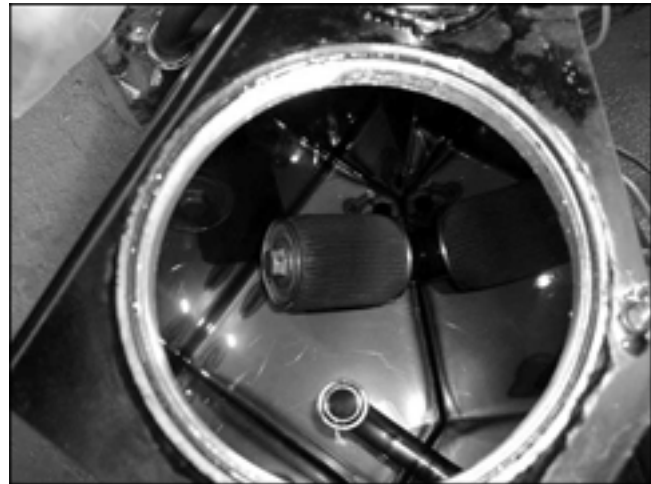
Hydraulic oil tank assembling view



Filter, assembly (return)



Filter (suction)



1) Assembling procedure

1. Installing the hydraulic oil tank assembly
Tightening torque of bolt (15)
77.5~90.2N·m (7.9~9.2kgf·m)
*Apply screw LOCTITE. (Loctite271)

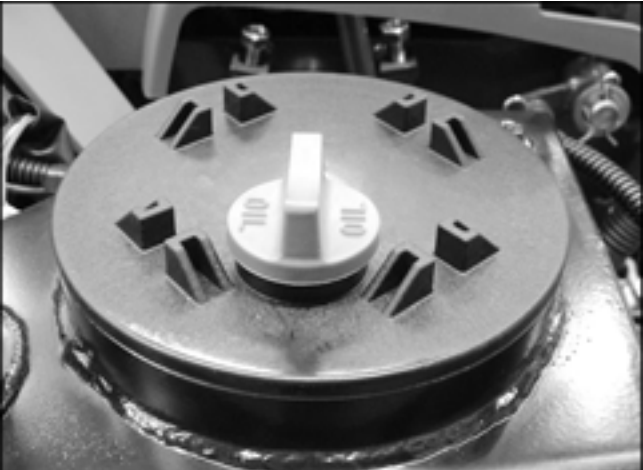
2. Attaching the plug (13)
Tightening torque
26.0~31.0N·m (2.7~3.2kgf·m)

3. Parts list

No.	Part No.	Part name	Q'ty	Remarks
1	RB411-6211△	Hydraulic oil tank	1	
2	06312-10010	Plug	1	
3	RB411-6216△	Support (filter)	1	
4	RC101-6223△	Gasket	1	
5	02114-60080	Nut	1	M8 4T
6	RB411-6219△	Filter, assembly (return)	1	
7	RB411-6215△	Filter (suction)	1	
8	06331-35016	Plug	1	
9	04717-01610	Rubber-fitted washer	1	
10	09664-40800	Fuel tube	1	
11	RB411-6221△	Thermal insulation (hydraulic oil tank)	1	
12	RB411-6223△	Cushion (hydraulic oil tank)	2	
13	RG208-6213△	Plug	1	
14	04811-11300	O-ring	1	
15	RB411-6225△	Sound-absorbing sheet (tank)	1	
16	13811-3314△	Fuel plug	1	
17	04811-06230	O-ring	1	

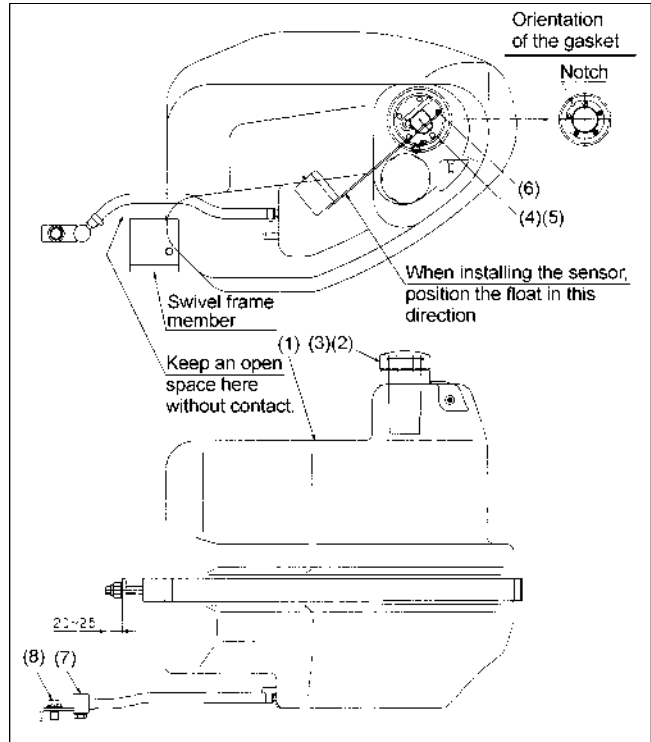
4. Tightening torque of filter assembly (return)
24~25N·m (2.0~3.0kgf·m)
*For the setup dimensions, see the top left figure.

5. Tightening torque of filter (suction)
58.8~68.6N·m (6.0~7.0kgf·m)



c. Fuel tank and hose

Fuel tank assembly view



1) Assembling procedure

1. Installing the sensor (fuel)
Tightening torque of washer-fitted machine screw (6) : 3~4N·m (0.3~0.4kgf·m)
2. Tightness of fuel band
Stretch allowance of fuel band out of the hydraulic oil tank: 23±1mm (reference)

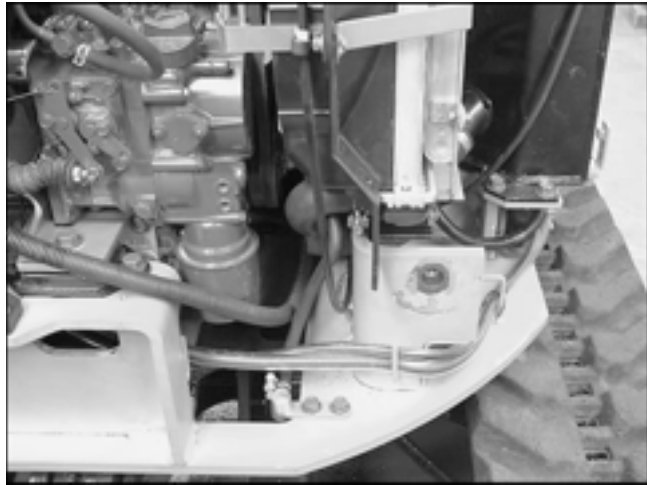
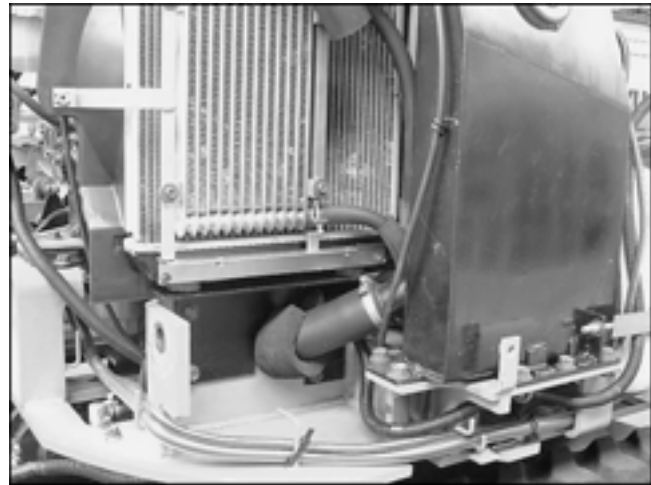
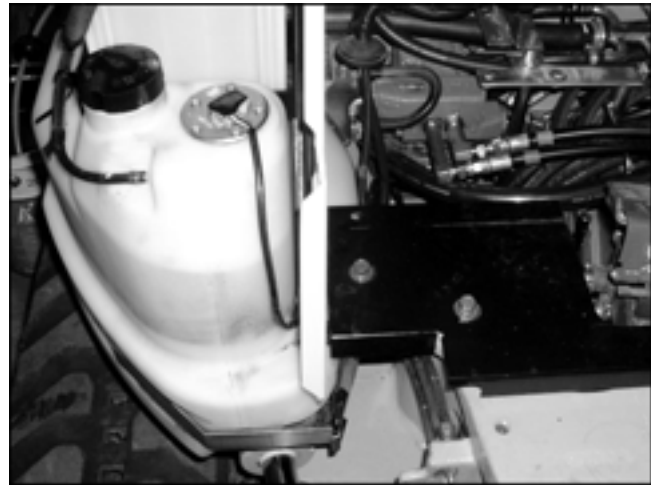


CAUTION

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

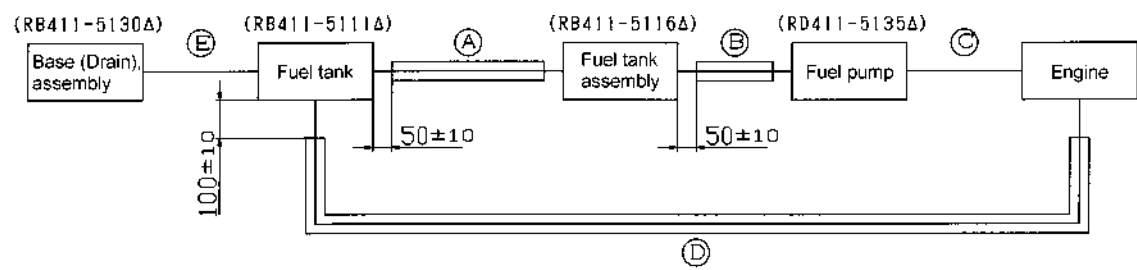
3. Parts list

No.	Part No.	Part name	Q'ty	Remarks
1	RB411-5111△	Fuel tank	1	(511)
2	68701-51121	Cap assembly (Fuel)	1	
3	35450-41061	Fuel filter assembly	1	
4	RB411-5114△	Sensor (Fuel)	1	
5	RC101-51343	Gasket	1	
6	03024-60512	Head screw with washer	5	M5 × 0.8
7	RB411-5130△	Base (drain) assembly	1	
8	01135-61020	Bolt	1	M10×1.25 7T



2) Fuel hose

IMPORTANT: Replace the fuel hose after 2 years or 4000 operating hours, whichever comes earlier.



Fuel tube	Fuel tube length	Protective tube length
(A)	1750 mm (09664-81750)	1650 mm (RB411-5141A)
(B)	350 mm (09664-80350)	250 mm (RB411-5144A)
(C)	320 mm (09664-80320)	—
(D)	2300 mm (RB411-5143A)	2100 mm (RB411-5142A)
(E)	280 mm (09664-80280)	—

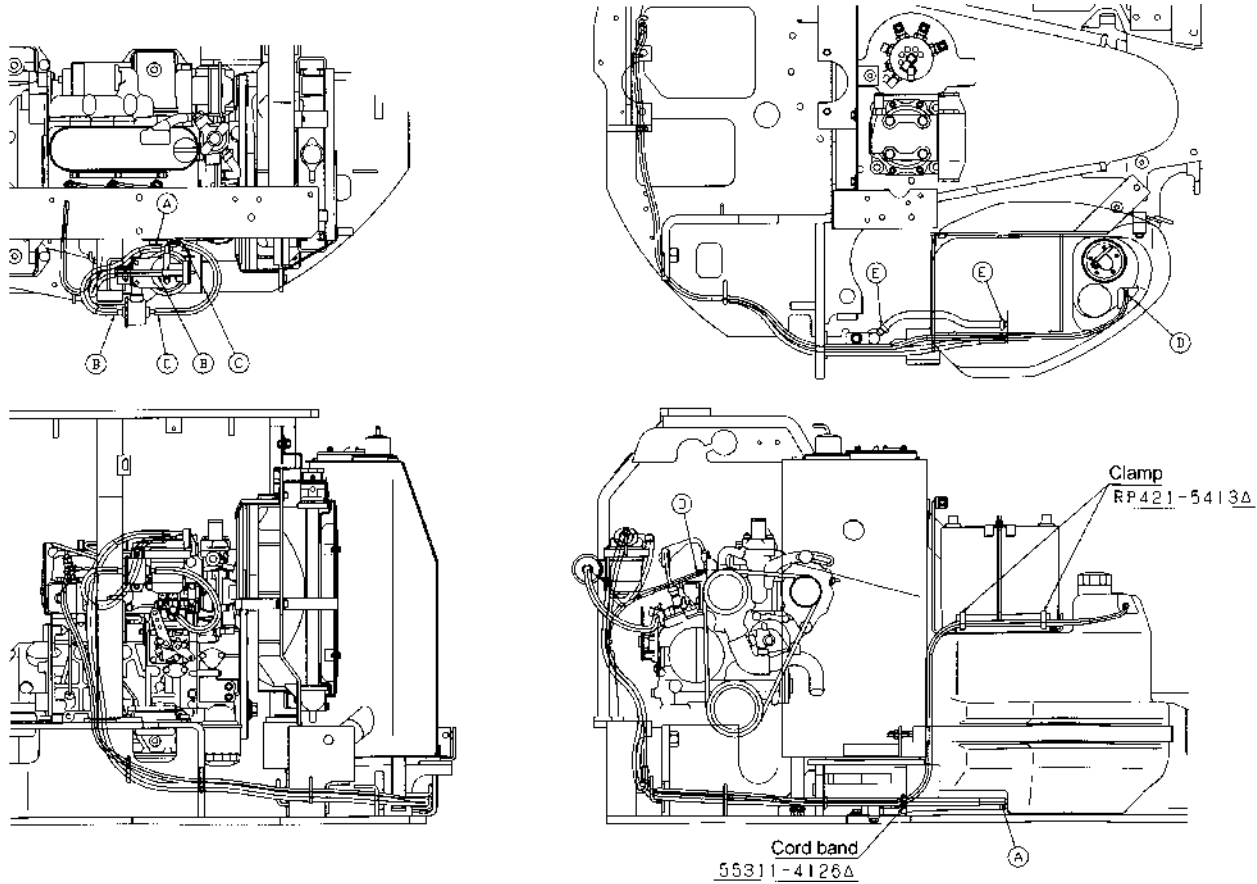
Hose clamp

(A)(B)(C) → 14911-4275Δ
Pipe clip

(D) → 14911-4275Δ
Pipe clip

(E) → 14911-4275Δ
Pipe clip

3) Fuel hose routes



d Counterweight

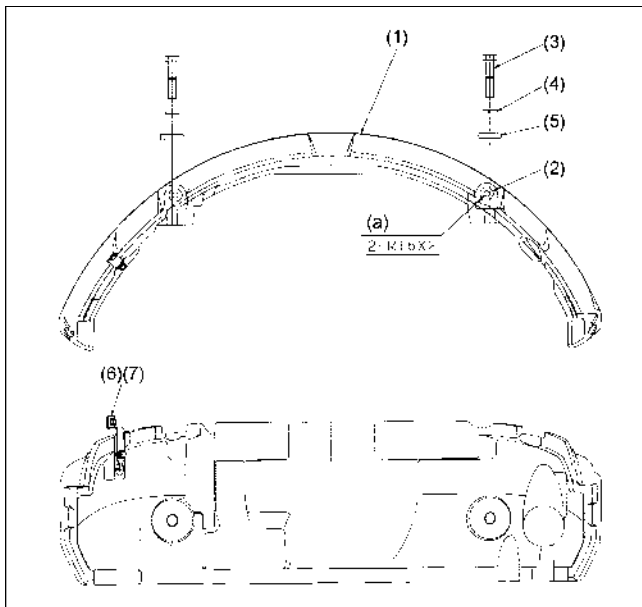


1) Counterweight removal procedure

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



Counterweight assembly view



a : Hook bolt

2) Assembling procedure

1. Tightening torque of counterweight mounting bolt:
367.7~431.5N·m(37.5~44.0kgf·m)
Apply screw loctite.(Loctite 271)
2. Parts list

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

Counterweight identification

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

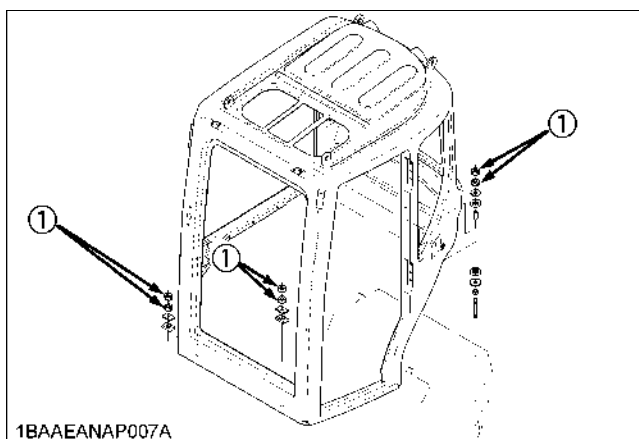
Cabin type

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

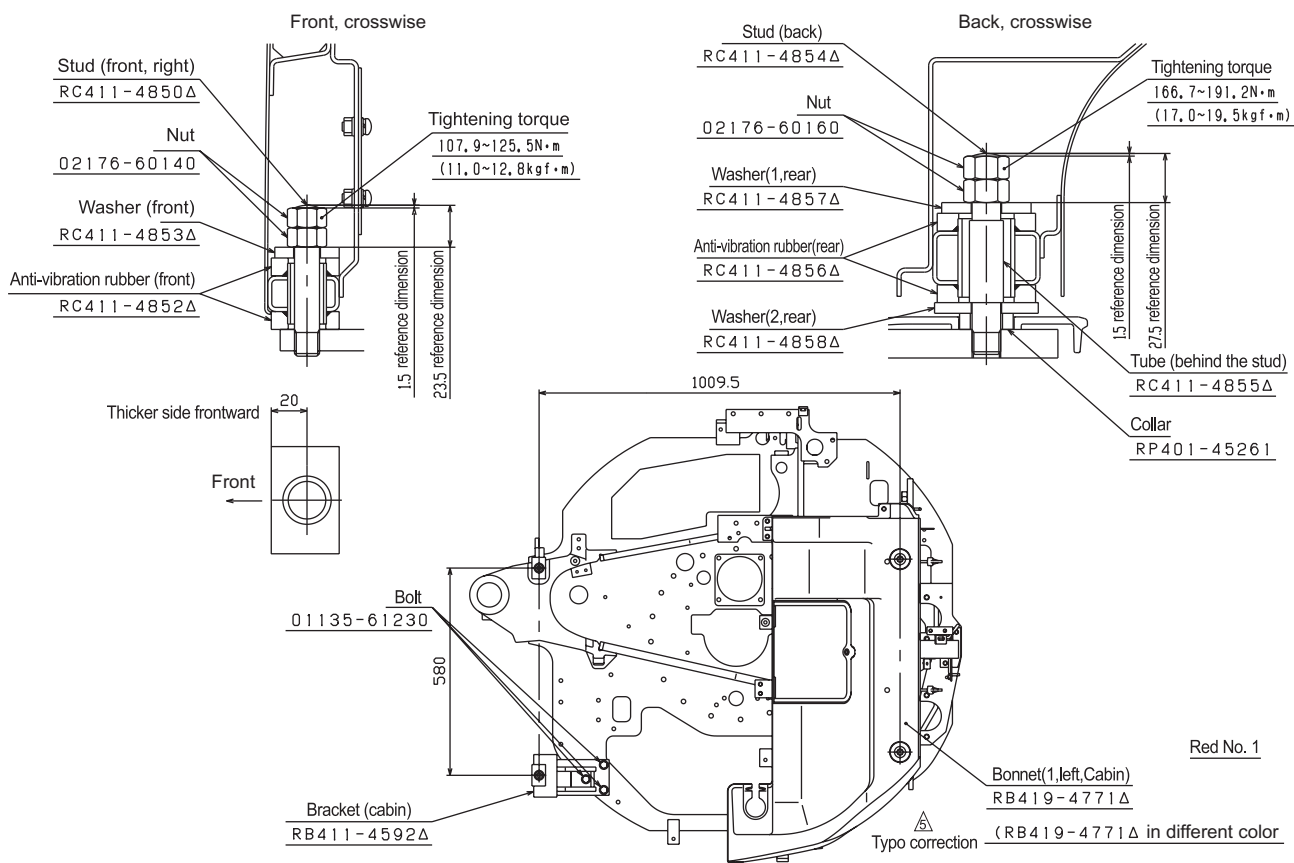
D.Cab canopy installation

a. Installing the cabin or canopy

[1] Installing the cabin



(1)Nut



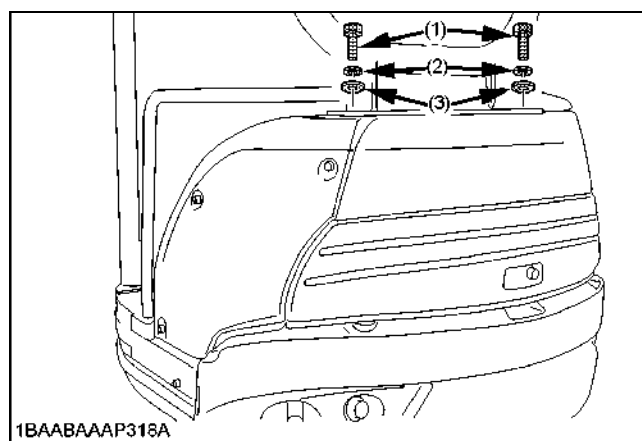


Tuck the front opening window in the ceiling to see if it can be tightly locked.

[2] Canopy installation



1) Tightening torque of canopy lock screw



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

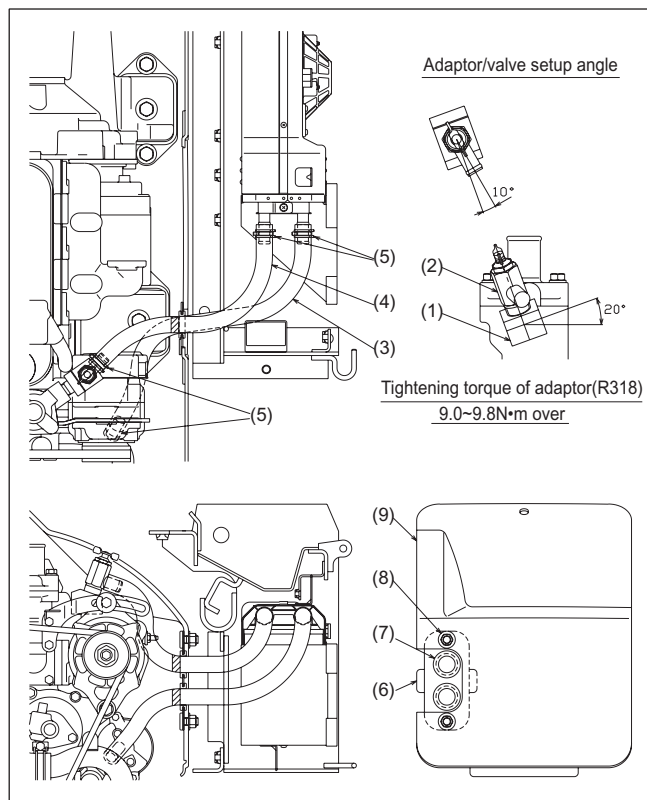


Front of the machine

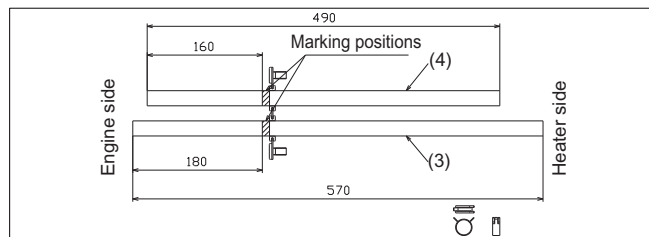


Back of the machine

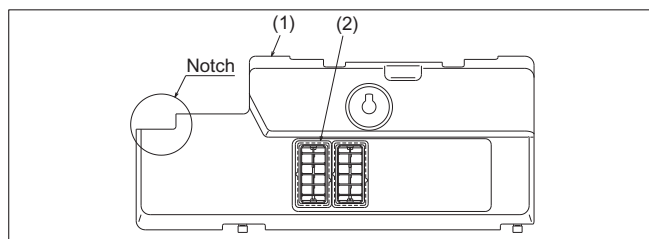
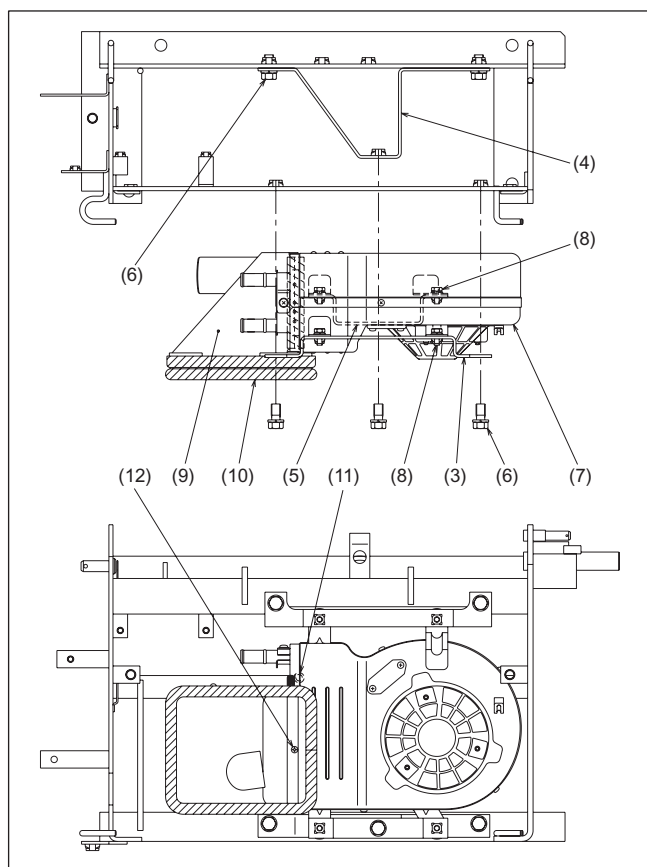
[3] Heater setup



No.	Part No.	Part name	Q'ty	Remarks
1	RC418-42582	Pipe joint (R3/8-R1/2)	1	(425)
2	RC601-53541	Valve	1	
3	RB411-4181Δ	Hose (1, WP heater)	1	L=570
4	RB411-4182Δ	Hose (2, WP heater)	1	L=490
5	09318-88185	Hose clump (spring type)	4	
6	RB411-4284Δ	Blade	1	
7	90407-11211	Grommet	2	
8	02131-50100	Nut	2	
9	RB419-4772Δ	Cover (1, cabin)	1	Red No.1 (433)
RB411-4772Δ in different color				



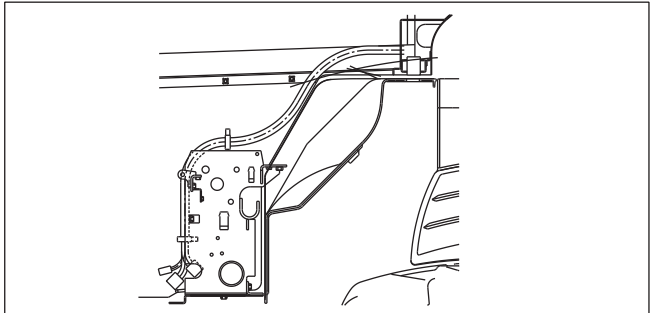
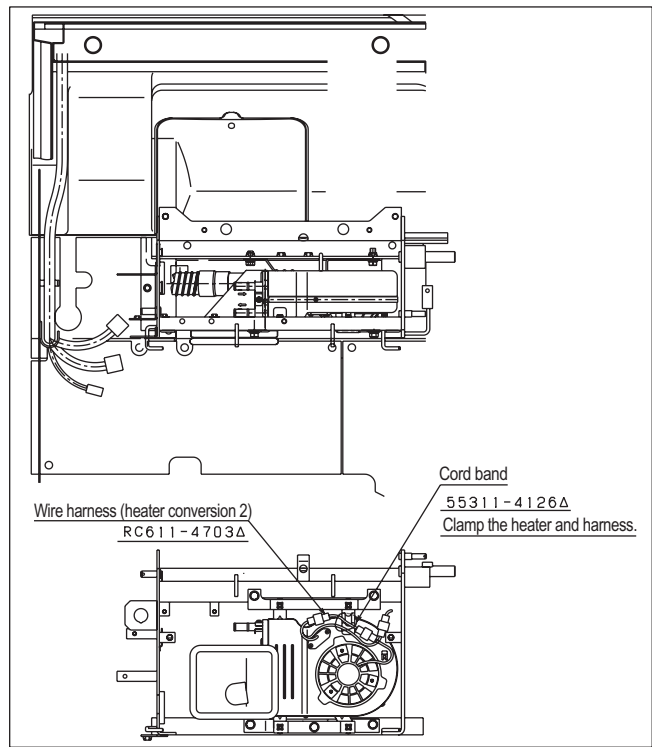
1. Make sure the heat hose is not kinked.
2. Tightening torque of adaptor 9.0~9.8N·m over (0.9~1.0kgf·m)



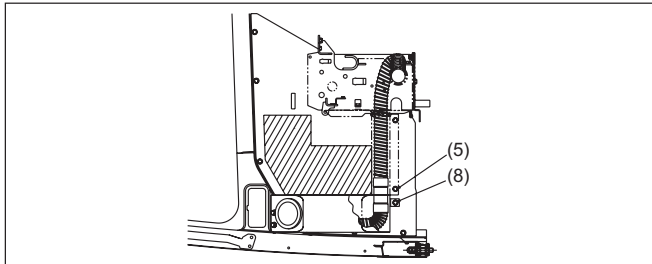
No.	Part No.	Part name	Q'ty	Remarks
1	RB411-3821Δ	Cover (Support Seat, heater)	1	Cabin type (381)
2	3F760-56052	Grille, assembly (airconditioner)	2	
3	RB411-4271Δ	Bracket (1, heater)	1	
4	RB411-4272Δ	Bracket (2, heater)	1	
5	RB411-4274Δ	Bracket (3, heater)	1	
6	01133-61020	Bolt	5	M10×1.25 7T
7	34070-72411	Heater, unit	1	(450)
8	01025-60614	Bolt	4	M6×1 7T
9	RB419-4273Δ	Cover (heater, defroster)	1	
10	RB411-4285Δ	Seal rubber (540)	1	L=540
11	RB411-4286Δ	Seal rubber (100)	1	L=100
12	03614-50410		3	Nominal diameten

Reference Cover (Seat support) identification

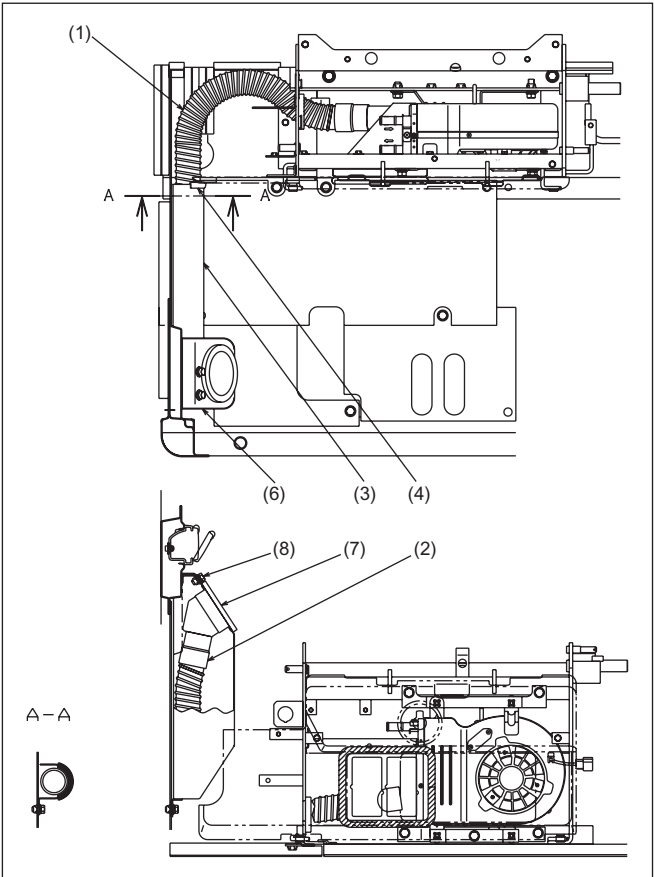
Type	Part No.	Notch	Grille installation
Canopy type + fixed track	RB419-3819Δ	None	None
Canopy type + variable track	RB419-3818Δ	Exist	None
Cabin type + fixed track variable track	RB411-3821Δ	Exist	Exist



[4]Defroster setup

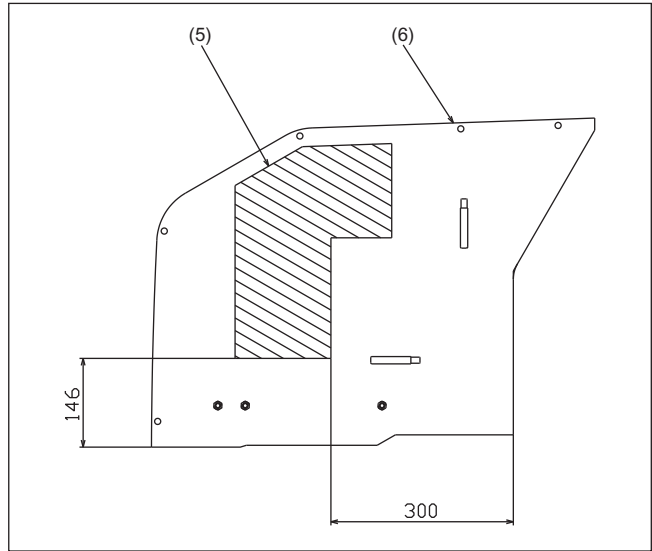


No.	Part No.	Part name	Q'ty	Remarks
1	RB419-4928Δ	Hose (defroster, 700)	1	
2	RB419-4927Δ	Hose (defroster, 400)	1	
3	RB419-4923Δ	Cover (duct)	1	
4	68768-4253Δ	Grommet + 3	1	
5	01125-60816	Bolt	2	
6	RB419-4921Δ	Duct (1, defroster)	1	
7	RC418-4924Δ	Grille (defroster)	1	
8	01125-60816	Bolt	3	



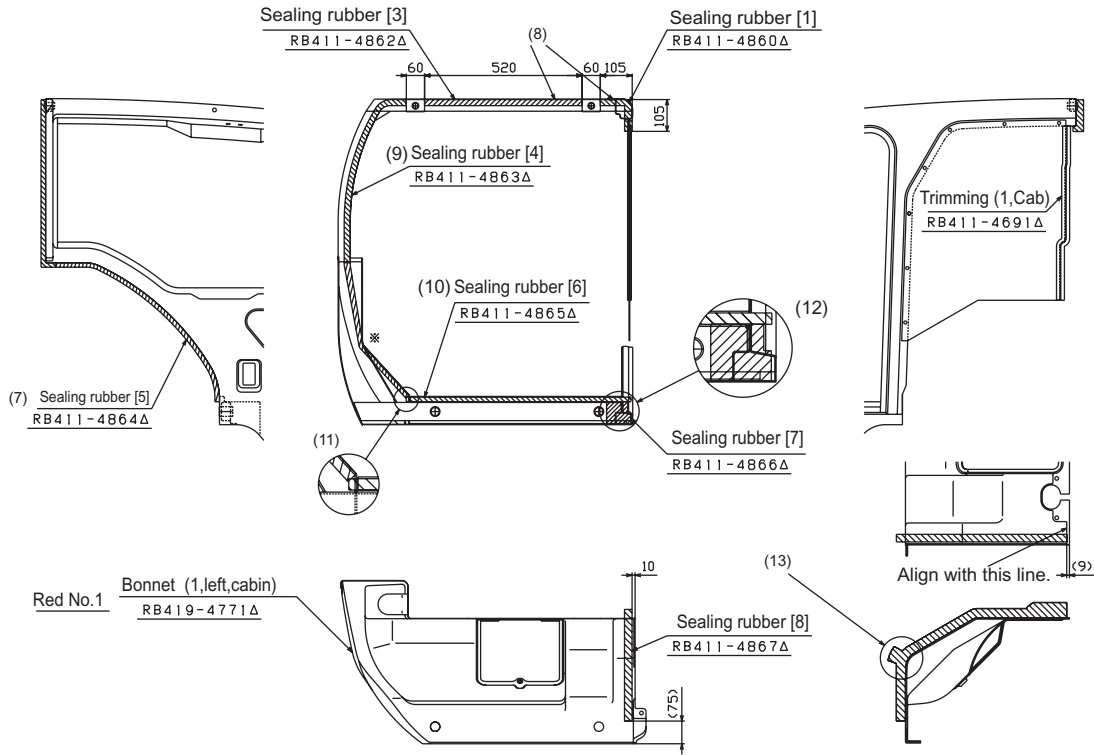
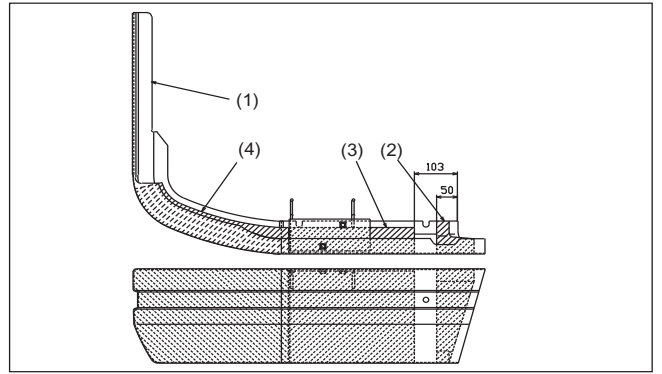
[5] Thermal insulation and sound absorber

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



No.	Part No.	Part name	Q'ty	Remarks
1	RB419-4591Δ	Cover (left, cabin)	1	Blue No.24
	RB411-4591Δ in different color			
2	RB411-4117Δ	sound absorber (cover, left)	1	
3	RB411-4127Δ	sound absorber (cover, left2)	1	
4	RB411-4128Δ	Sound absorber (cover, left3)	1	

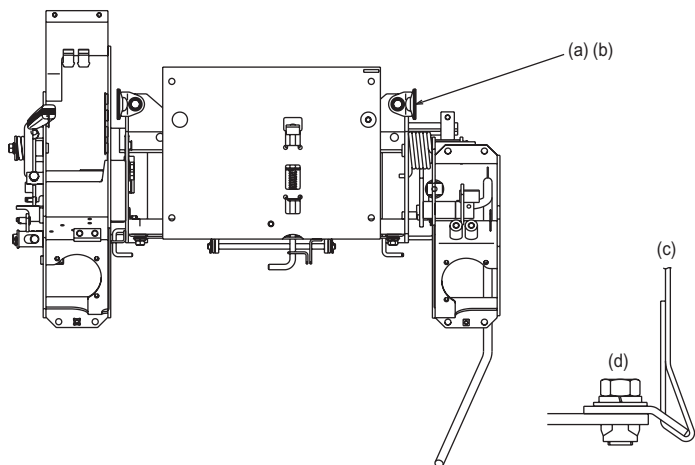
No.	Part No.	Part name	Q'ty
5	RB419-4690Δ	Cover (right)	1
6	RB411-4696Δ	Sound absorber (cover, right)	1



- 2.
- (7) Apply the material along the end of the sealing rubber [4]. Bring it in contact with the inner line at the *-marked point. Finally align it with the sealing rubber [6]. Make sure the soft side faces the sealing rubber [6].
- (8) Set the front sealing rubber in reference to the front of the frame.
- (9) Set to the inner line of the square pipe.
- (10) Apply along the inside of the groove. Keep the projected side to the right.
- (11) Be sure to join the sealing rubber [5] and [6] tight together.
- (12) Get the sealing rubber [6], [7] and [8] in close contact with each other.
- (13) Apply the two-layer section at the round center of the bonnet.

[6] Seat belt connection

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



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

a	Seat belt assembly 36330-8515Δ
b	Bolt 01135-61020
c	Orientation of seat belt fixture
d	Folded end downward

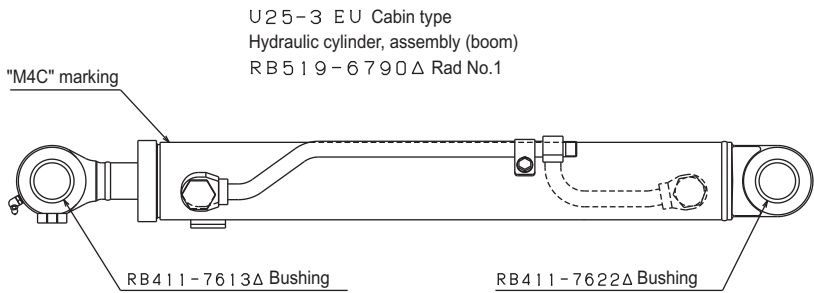
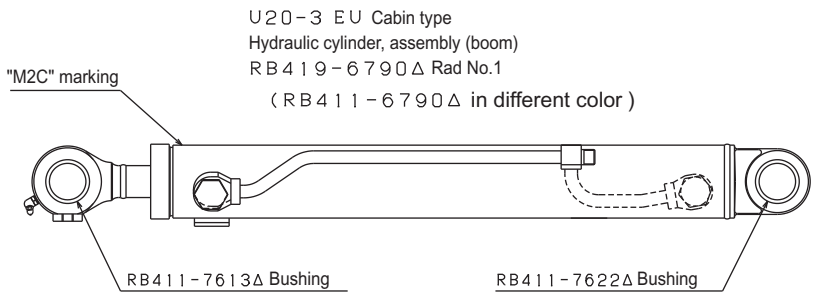


Left-hand setup



Right-hand setup

[7] Boom cylinder for cab type

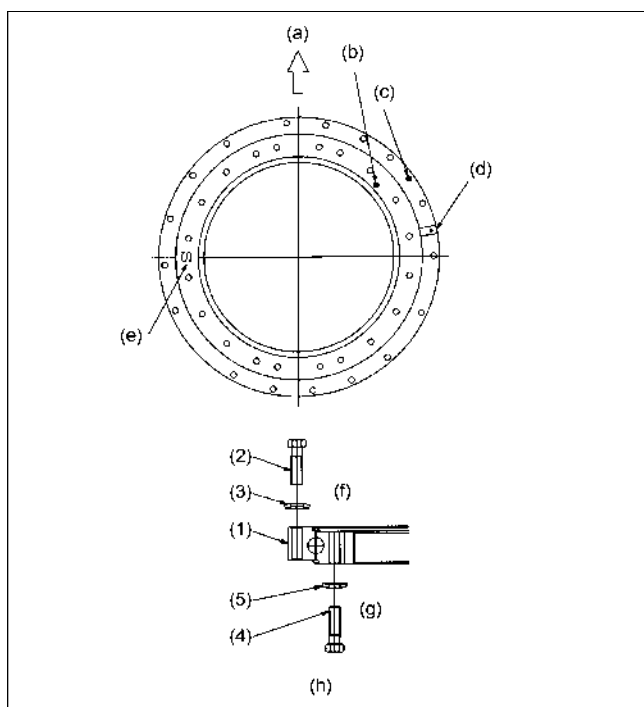


Cylinder identification	
Identified by markings	
U20-3 EU	M2E
U25-3 EU	M4
U20-3 EU Cabin	M2C
U25-3 EU Cabin	M4C

E. Under carriage

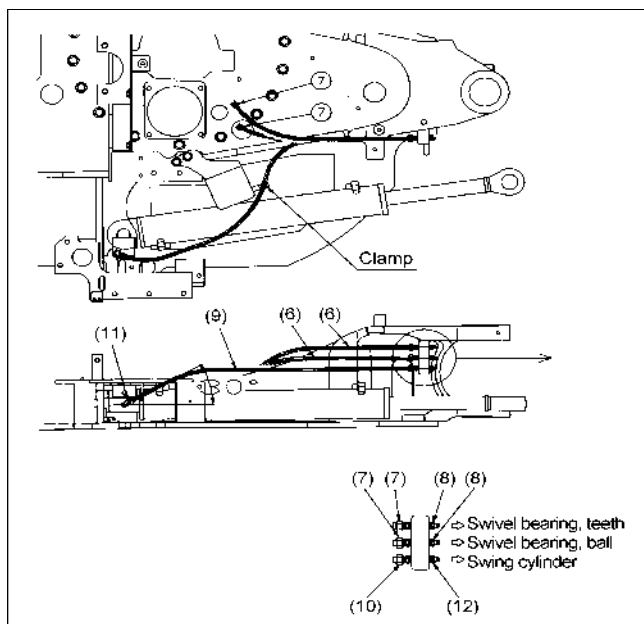
a Swivel bearing

Swivel bearing assembly view.



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

b Grease tube



1) Assembling procedure

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

U-20-3.

No.	Part No.	Part name	Q'ty	Remarks
1	RB411-1911Δ	Bearing (swivel)	1	
2	01176-61240	Bolt	17	M12×1.25 9T
3	35340-2737Δ	Plain spring	17	
4	01176-61240	Bolt	20	M12×1.25 9T
5	35340-2737Δ	Plain spring	20	

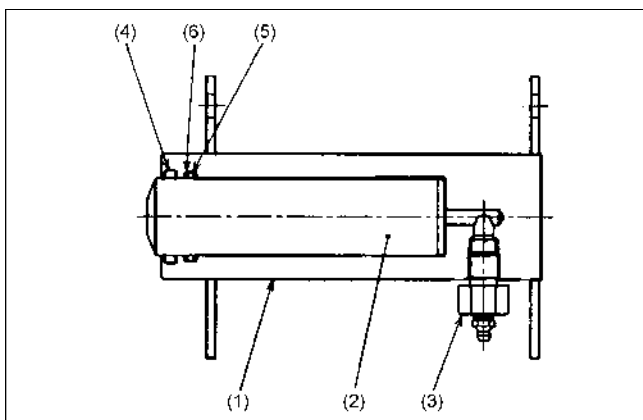
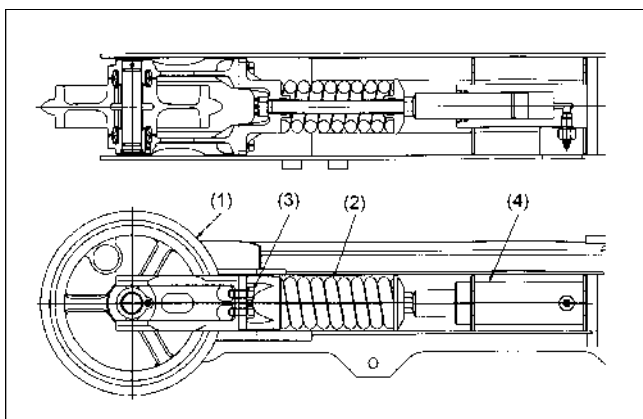
U-25.

No.	Part No.	Part name	Q'ty	Remarks
1	RB511-1911Δ	Bearing (swivel)	1	
2	01176-61240	Bolt	21	M12×1.25 9T
3	35340-2737Δ	Plain spring	21	
4	01176-61240	Bolt	24	M12×1.25 9T
5	35340-2737Δ	Plain spring	24	

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

No.	Part No.	Part name	Q'ty	Remarks
6	68671-6767Δ	Tube (grease)	2	
7	68721-5748Δ	Connector	4	
8	06611-15010	Grease nipple	2	
9	RC601-6643Δ	Tube (grease)	1	
10	68721-6748Δ	Connector	1	
11	68721-6739Δ	Connector	1	
12	06611-15011	Grease nipple	1	

c Track tension device



1) Assembling procedure

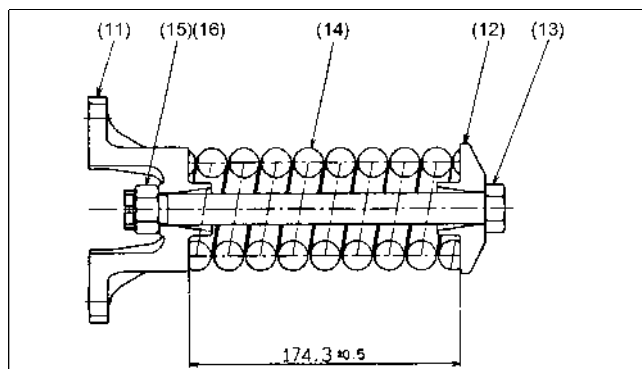
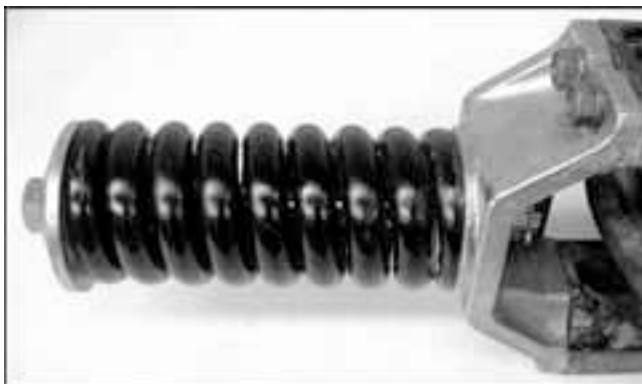
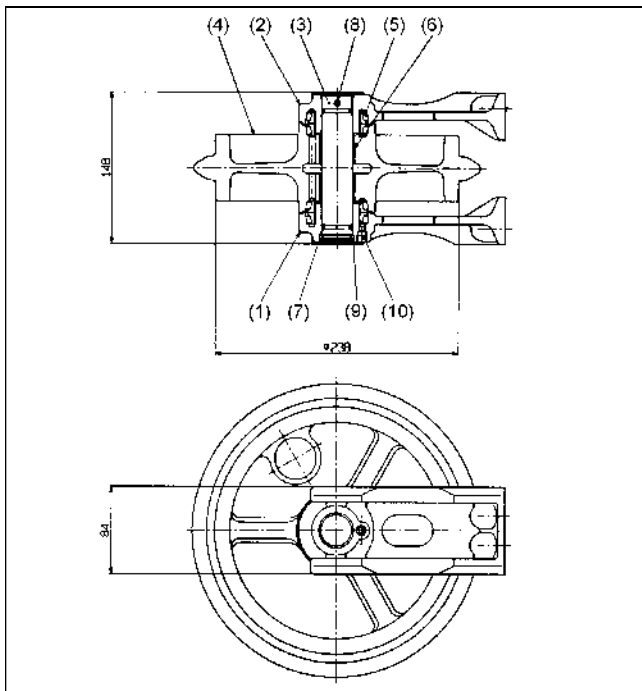
1. Make sure the unit slides smoothly in the track frame.
2. Tightening torque of idler assembly and tension spring plate:
77.5~90.2N·m(7.9~9.2kgf·m)
Apply screw LOCTITE. (Loctite 547)
3. Idler lubricant amount Engine Oil Release controller SAE#30CD U-20-3:35cc·U-25-3:75cc
4. Engine Oil Make the setting at split pin position nearest to 174.3±0.5 mm.
5. Parts list

No.	Part No.	Part name	Q'ty	Remarks
1	RB411-2130Δ	Idler, assembly	2	U-20-3
	RB511-2130Δ	Idler, assembly	2	U-25
2	RB411-2140Δ	Spring, assembly	2	U-20-3
	RB511-2140Δ	Spring, assembly	2	U-25
3	01133-61230	Bolt	8	M12×1.25
4	RB411-2150Δ	Cylinder, assembly	2	

2) Tension cylinder

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

No.	Part No.	Part name	Q'ty
1	RB411-2151Δ	Cylinder tube	1
2	RC101-21571	Rod	1
3	RC101-21553	Nipple, assembly	1
4	68241-21551	Rod seal	1
5	04810-00400	O-ring	1
6	68051-62371	Backup ring	1



3) Idler

1. Idler
2. Check the floating seal and the shafts O-ring for twist.
3. Apply lubricant to the floating seals sliding surface and the shafts O-ring.
4. The lube oil to pour is Engine Oil Class SAE#30CD. Its specified amount is 35 cc for U-20-3 and 75 cc for U-25
5. The U-20-3 and U-25 are the same in construction, but different in size.

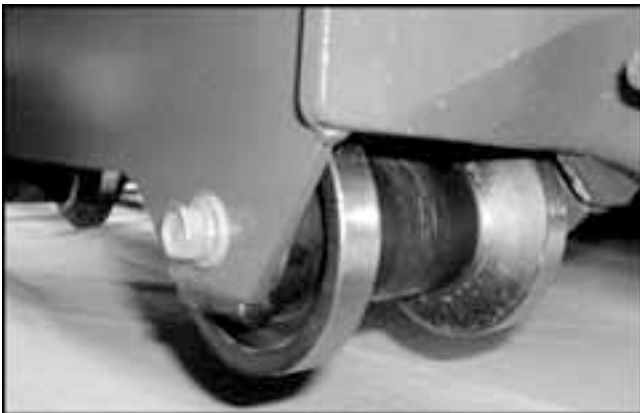
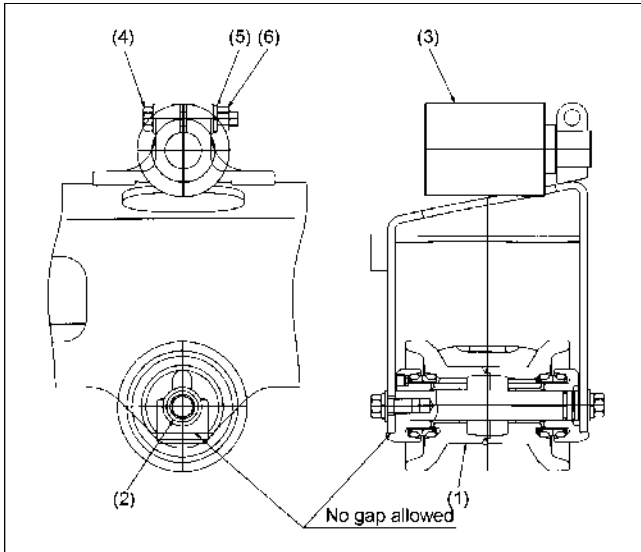
No.	Part No.	Part name	Q'ty	Remarks
10	15521-96023	Plug (R1/8)	1	
9	68171-21391	Wire	1	
8	05411-00663	Spring pin	1	φ6×L63
7	04811-50250	O-ring	2	G25
6	RC301-21961	Bushing	2	
5	RC301-21731	Seal (floating)	2	
4	RB411-2134Δ	Idler	1	
3	RB411-2133Δ	Shaft (Idler)	1	
2	RB411-2132Δ	Bracket (2, Idler)	1	
1	RB411-2131Δ	Bracket (1, Idler)	1	

4) Tension spring

1. Preset length of spring
174.3±0.5m
- * Make the setting at the split pin position nearest to the above length.

No.	Part No.	Part name	Q'ty	Remarks
16	05511-5043Δ	Split pin	1	φ4×L35
15	68741-2142Δ	Slotted nut	1	
14	68171-2142Δ	Spring	1	
13	RB411-2144Δ	Bolt (spring)	1	
12	RB411-2149Δ	Retainer	1	
11	RB511-2148Δ	Plate (idler)	1	

d Upper roller and track roller



1) Assembling procedure

1. Keep possible out-of-center between the sprocket, idler and track roller within $\pm 2\text{mm}$ (with the idler loosely fitted).



CAUTION

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

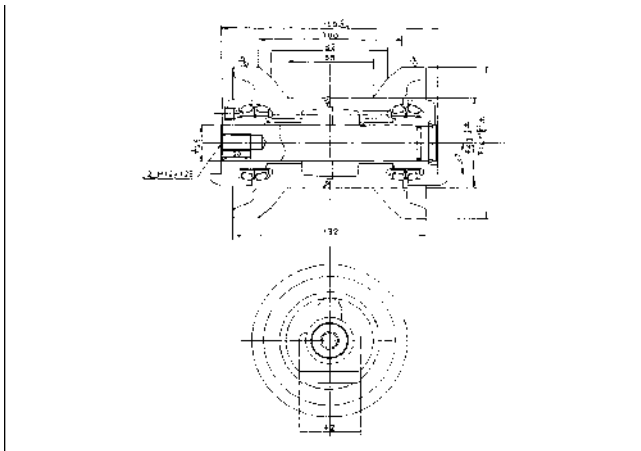
No.	Part No.	Part name	Q'ty	Remarks
1	RB411-2170Δ	Track roller, assembly	6	U-20-3
	RB511-2170Δ	Track roller, assembly	6	U-25
2	RC601-21851	Bolt	12	
3	RC411-21903	Carrier roller, assembly	2	
4	01173-61270	Bolt	2	M10×1.25 7T
5	02174-60120	Nut	2	
6	04512-60120	Spring washer	2	

2) Track roller

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

3) Carrier roller

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



4) Track roller disassembling procedure

1. Check the roller surface and shaft for wear, and measure the outside diameter, as required. If out of spec, replace them with new ones.
2. In reassembling, be careful to keep the roller inside and incoming parts free from dust, cuttings and other foreign matters.
3. The lube oil to pour is Engine Oil Class SAE#30CD. Its specified amount is 50 cc.
4. The U-20-3 and U-25 are the same in construction, but different in size.

Part No.	Part name	Q'ty
RB511-21751	Roller	1
	Roller A	1
	Roller B	1
RC411-21722	Shaft	1
RB511-21711	Collar A	1
RB511-21781	Collar B	1
RC301-21961	Backup ring	2
RC301-21731	Floating seal	2
RC301-21861	Ring, stopper	1
04811-50250	O-ring	1
15521-96023	Plug	1



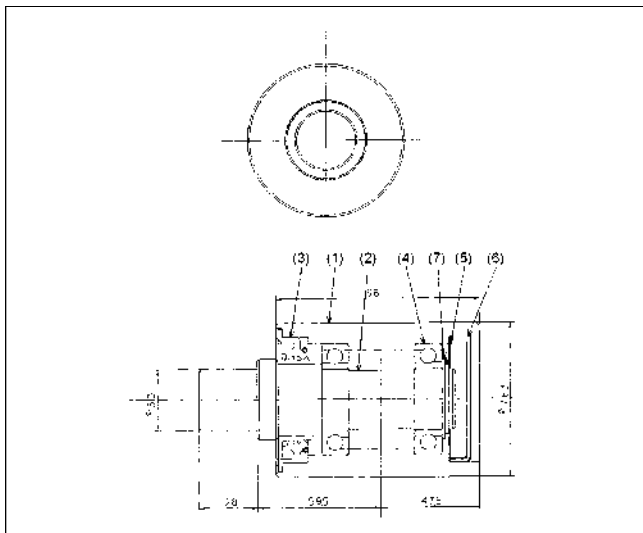
1. Press-fit the bushing in position.
2. The bracket and shaft are press-fitted in place at one side. A press is needed in order to detach and attach them.
3. Apply the lube oil to the O-ring of the shaft.



CAUTION

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

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



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

No.	Part No.	Part name	Q'ty
1	RC411-2195Δ	Carrier roller	1
2	RC411-2192Δ	Shaft	1
3	RC601-2193Δ	Oil seal	1
4	08101-06006	Ball bearing	2
5		Shaft circlip	1
6	RC601-2194Δ	Plug	1
7	RC601-2196Δ	Spacer	1



1. In reassembling, be careful to keep the roller inside and incoming parts free from dust, cuttings and other foreign matters.
2. The lube oil to pour is Engine Oil Class SAE#30CD. Its specified amount is 60cc.

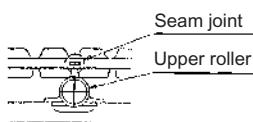
**CAUTION**

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

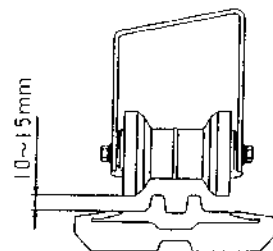
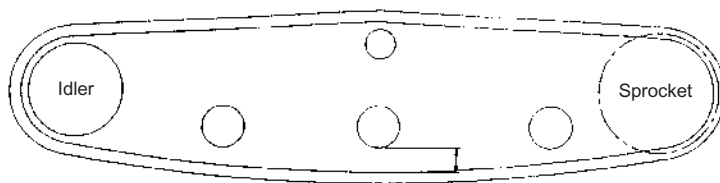


e. Crawler replacement and tension adjustment

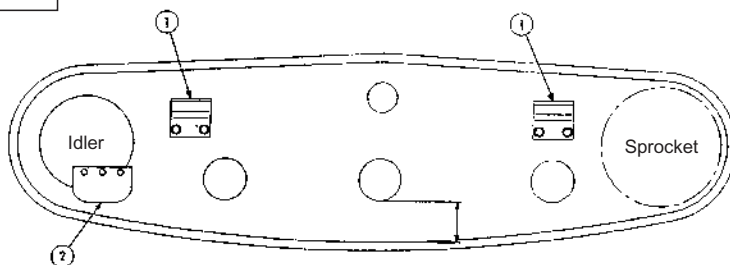
Rubber crawler



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



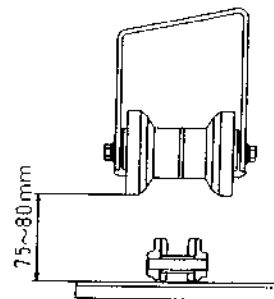
Iron crawler



No.	Part No.	Part name.	Q'ty	Remarks
1	RB411-2181Δ	Plate (sliding)	4	U-20-3
	RB611-2181Δ	Plate (sliding)	4	U-25
2	RB411-2182Δ	Guide (crawler)	4	U-20-3
	RB511-2182Δ	Guide (crawler)	4	U-25

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

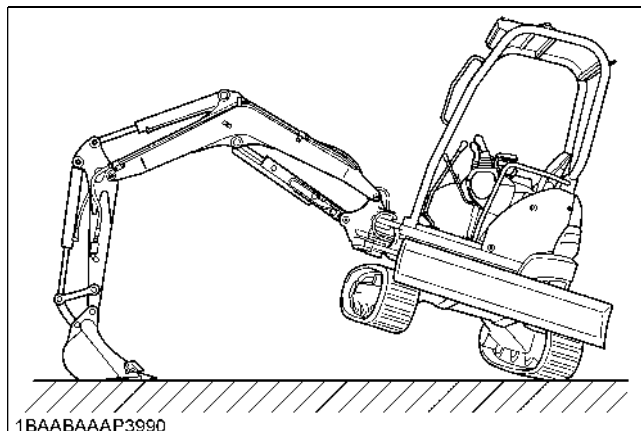
(To be removed when changing the iron crawler back to the rubber crawler)



DANGER

To avoid serious injury or death:

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



IMPORTANT:

- Make sure that on obstacles, such as stones are caught in the crawler. Remove such obstacles before adjusting the crawler tension.
- Crawler seam

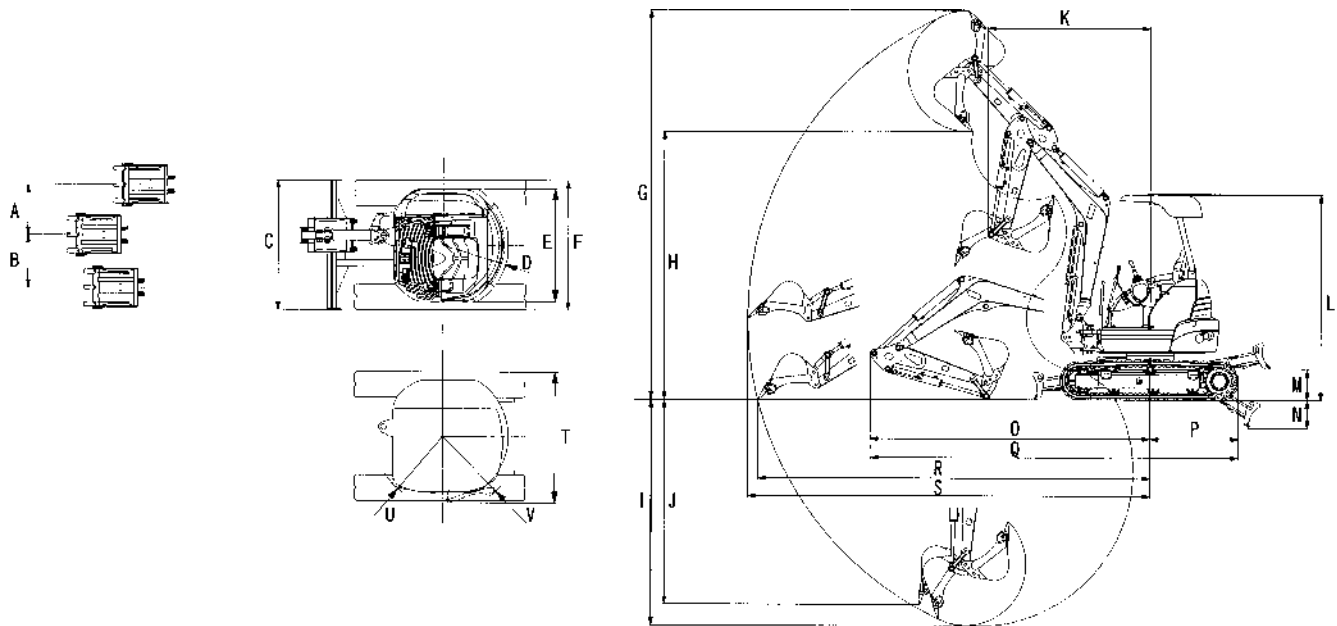
The ends of the rubber crawler are joined with a seam. When adjusting the crawlers, the seam must be positioned on the top centre between the idler and the sprocket.

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

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

f. Variable track (U20-3)

[1] Dimensional view



Unit:mm

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
U-20-3	590	620	1400 [1300/1500]	710 (760)	1300	1400 [1300/1500]	4070 (3655)	2700 (2320)	2320	1900	1690 (1955)	2250 (2355)	320 (345)	440 (274)	2920	925	3845	4030	4140	(1475)	(300)	(4395)
U-25	590	620	1500	760	1300	1500	4400 (4165)	3020 (2755)	2550	2300	1790 (1955)	2300 (2400)	360	320	3105	995	4100	4400	4510	(1525)		

() Cabin type [] Variable track

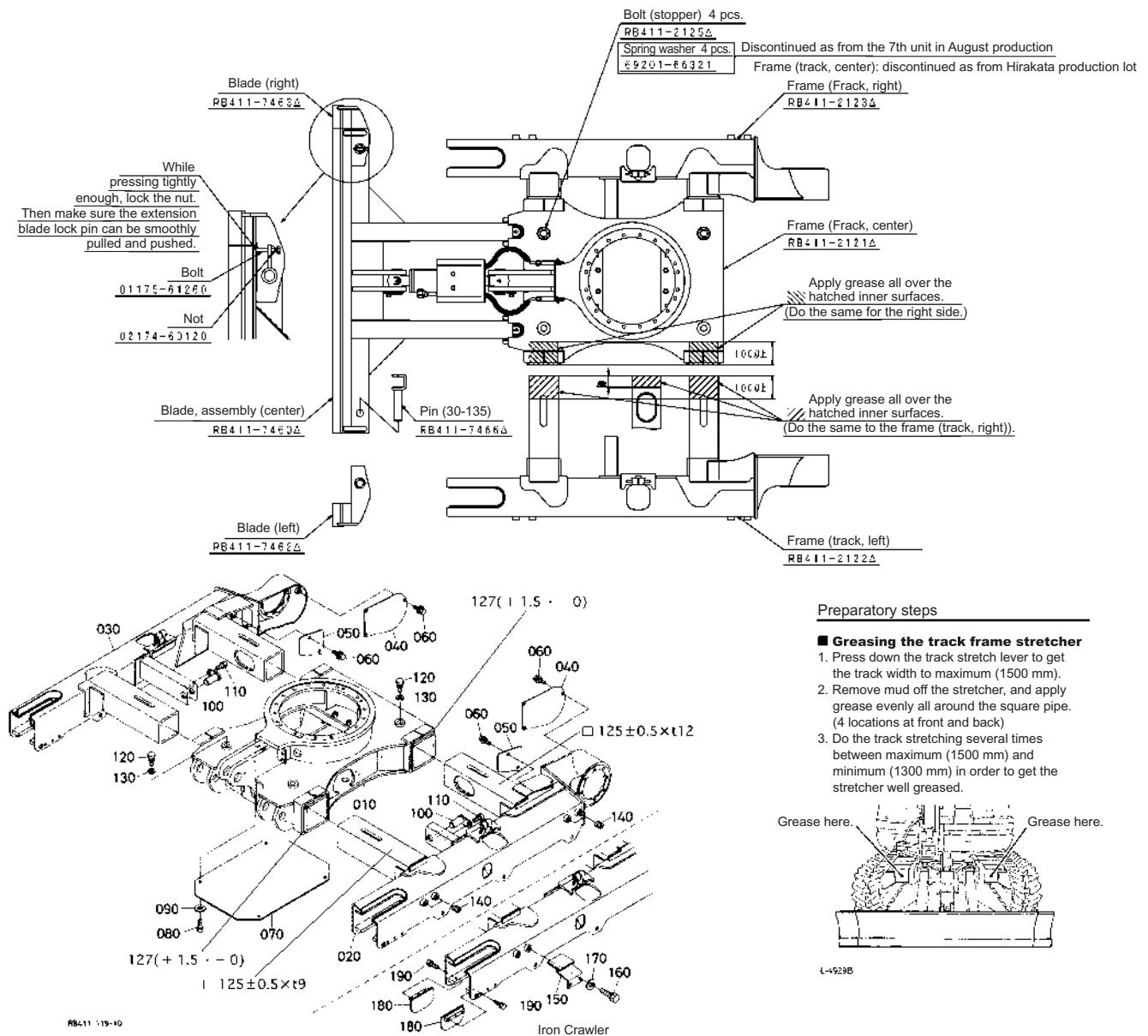
[2] Service data

(Items different from standard specifications only)

New-model delivery guideline

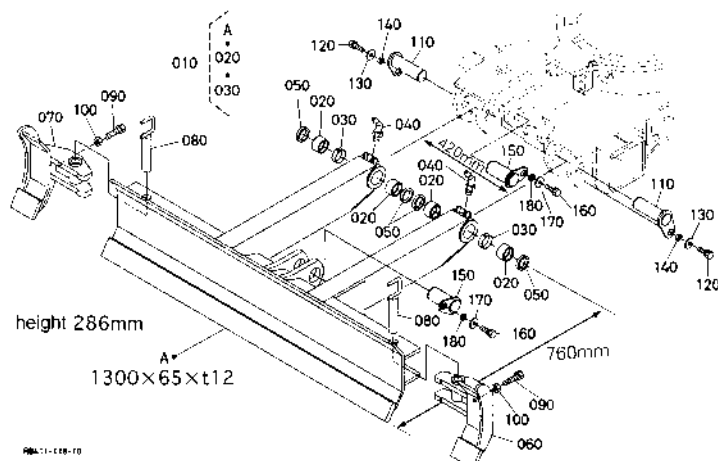
Item	Movement	Unit	Reference value	Allowable range	Remarks
Overall width (retracted)		mm	1300	1287~1313	
Overall width (extended)		mm	1500	1485~1515	
Machine weight	Canopy	kg	2030	1929~2132	Full fuel-Specified lubricant amount
Machine weight	Cabin	kg	2220	2109~2331	Full fuel-Specified lubricant amount
Crawler overall width	Overall width (retracted)	mm	1300	1274~1326	
Crawler overall width	Overall width (extended)	mm	1500	1470~1530	
Minimum road clearance		mm	164	159~169	Track frame center
Blade size	Stretchable width	mm	1300	1295~1305	
Blade size	Retractable width	mm	1500	1495~1505	
Blade size	Height	mm	293	283~303	
Blade upper limit		mm	333	283~383	
Blade lower limit		mm	277	227~327	
Blade approach angle		°	33.8	30~37	
Dozer speed Top(ground~upper limit)		Sec	1.1	0.8~1.4	
Dozer speed Top(lower limit~upper limit)		Sec	2.2	1.9~2.5	
Dozer speed Top(upper limit~ground)		Sec	1.5	1.2~1.8	
Dozer speed Top(upper limit~lower limit)		Sec	2.8	2.5~3.1	
Swiveling angle on slope	L-R	°	23.5	21.5 ≤	Front attachment horizontal, crowded, maximum rpm
Swivel block performance Engine idling	L-R	°	21	30 ≥	Lever unlocked
Swivel start-up speed	L-R	Sec	1.95	1.7~2.3	
Track stretch lever operating force	Up	N(kgf)	38(3.88)	33~43	
Track stretch lever operating force	Down	N(kgf)	39(3.98)	34~44	
Track stretch lever stroke	Up-Down	mm	37	27~47	

[3] Track frame



Dwg. No.	Part No.	Part name	Q'ty A	Interchangeability	Remarks
010	RB411-2121-3	Frame (track, center)	1		Weight about 152 kg
020	RB411-2122-2	Frame (track, left)	1 ~50185		
020	RB411-2122-4	Frame (track, left)	1 50186~	≠	Weight about 103 kg
030	RB-411-2123-2	Frame (track, right)	1 ~50185		
030	RB411-2123-4	Frame (track, right)	1 50186~	≠	
040	RB-411-2115-0	Cover (moter)	2		
050	RB411-2126-0	Cover (hose)	2		
060	01135-61020	Bolt	10		M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
070	RB411-2127-0	Plain washer	1		
080	01138-61020	Bolt	4		M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
090	04015-60100	???	4		
100	RB401-2122-0	Pin	2		φ30×62L
110	01133-61020	Bolt	2		M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
120	RB411-2125-0	Bolt (stopper)	4		Tipφ24 M32 fine-threaded 7T Tightning torque:294.2~343.2N·m(30~35kgf·m)
130	04512-60200	Spring washer	4		
140	06331-35012	Plug	8		Rubber crawler
150	RB411-2181-2	Plate (slide)	4		Iron crawler
160	01133-61220	Bolt	8		Iron crawler M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
170	04013-60120	Plain washer	8		Iron crawler
180	RB411-2182-0	Guide (crawler)	4		Iron crawler
190	01133-61020	Bolt	12		Iron crawler M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)

[4] Blade



Dwg. No.	Part No.	Part name	Q'ty	Interchange ability	Remarks
010	RB411-7460-0	Blade, assembly (center)	1		Weight about 93 kg
020	RB411-7455-0	Bushing (405030)	4		
030	RC411-7445-0	Collar	2		
040	06616-25010	Grease nipple	2		
050	RC411-6678-0	Dust seal (405042)	4		50 in out. dia. 40 in inn. dia high DR type dust seal (φ40)
060	RB411-7462-4	Blade (left)	1		
070	RB411-7463-4	Blade (right)	1		
080	RB411-7466-0	Pin (30-135)	2		φ30×135L
090	01175-61260	Bolt	2		M12×60L×1.25p 7T 77.5~90.2N·m(7.9~9.2kgf·m)
100	02174-60120	Nut	2		
110	RB411-7443-0	Pin (40-125)	2		φ40×125L
120	01133-61225	Bolt	2		M12×25L×1.25p 7T 77.5~90.2N·m(7.9~9.2kgf·m)
130	04015-60120	Plain washer	2		
140	68741-6692-0	Spacer	2		
150	RB411-7442-0	Pin (45-95)	2		φ45×95L
160	01133-61225	Bolt	2		M12×25L×1.25p 7T 77.5~90.2N·m(7.9~9.2kgf·m)
170	04105-60120	Plain washer	2		
180	68741-6692-0	Spacer	2		

Track width operation

**CAUTION:**

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

Change the track width using the track stretch lever.
Large track width: Tilt the track stretch lever forward.

.....The track width will be large.

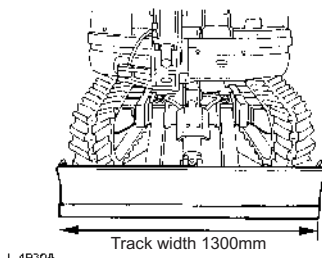
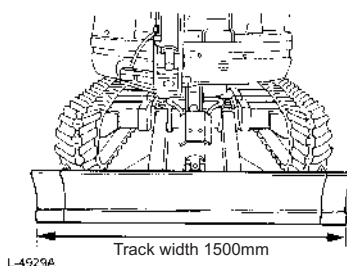
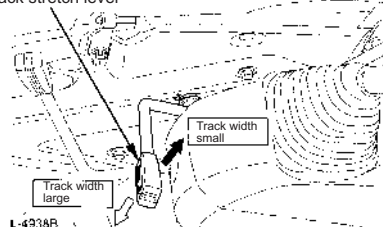
(1300mm→1500mm)

Small track width: Pull the track stretch lever toward yourself.

.....The track width will be small.

(1500mm→1300mm)

Track stretch lever

**IMPORTANT**

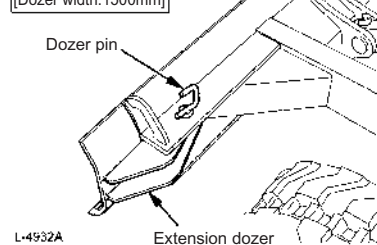
- * If an obstacle is in the way of track stretching, get rid of the obstacle or move the machine to a flat ground. If the track still cannot be stretched, use the attachment and the dozer to keep the crawlers off the ground. Now stretch the track in this posture. Check also the stretcher for mud and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

The dozer width can be changed by adding the extension dozer.

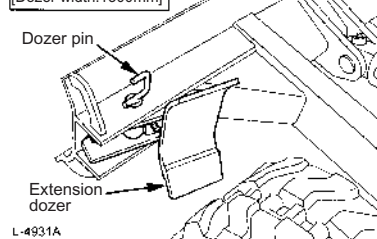
Large dozer width 1500mm

Small dozer width 1300mm

[Dozer width:1500mm]



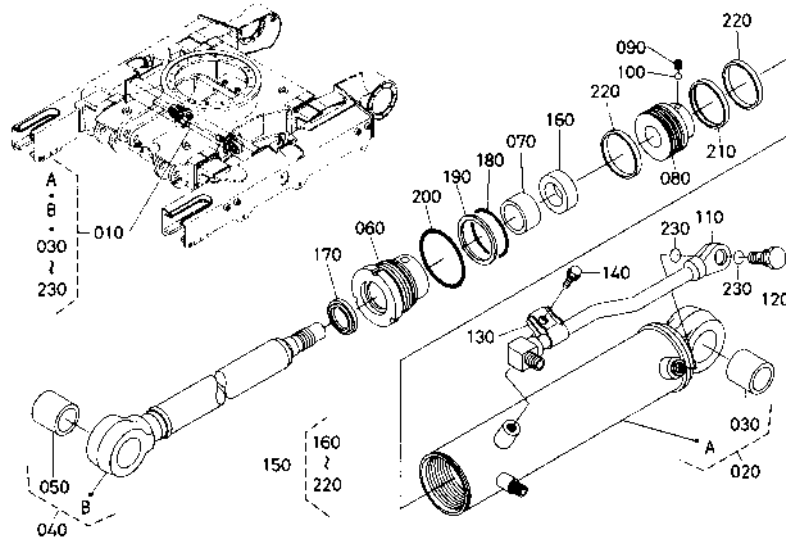
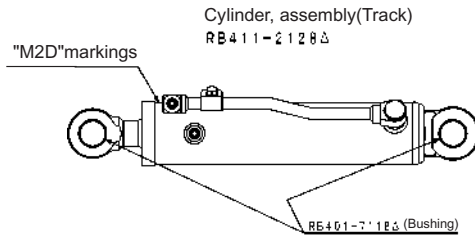
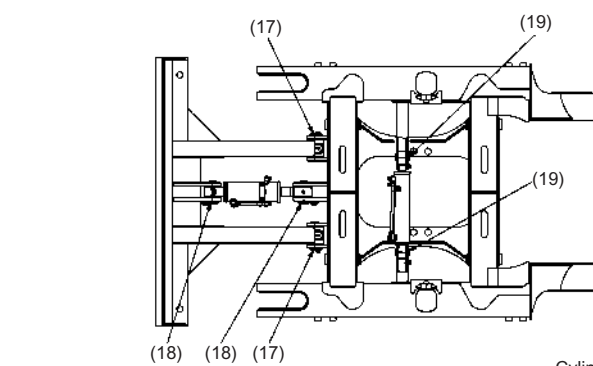
[Dozer width:1300mm]



To change the track width from large to small:

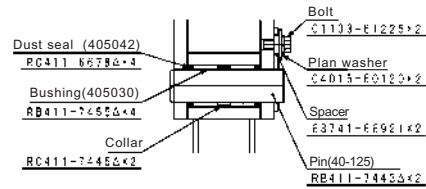
1. Pull out the dozer pin.
 2. Reverse the extension dozer and set its hole to the narrow-track hole. Put the dozer pin in this hole.
- Take similar steps to enlarge the track width.

[5] Track cylinder

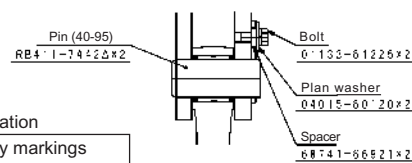


RB411-117-10

(17) Track frame Blade



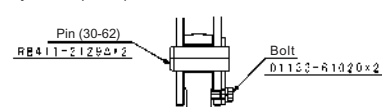
(18) Cylinder (blade)-Blade, track frame



Cylinder identification

Identified by markings	
U-20-3	M2
U-20-3 variable track	M2D

(19) Cylinder (track) Track frame



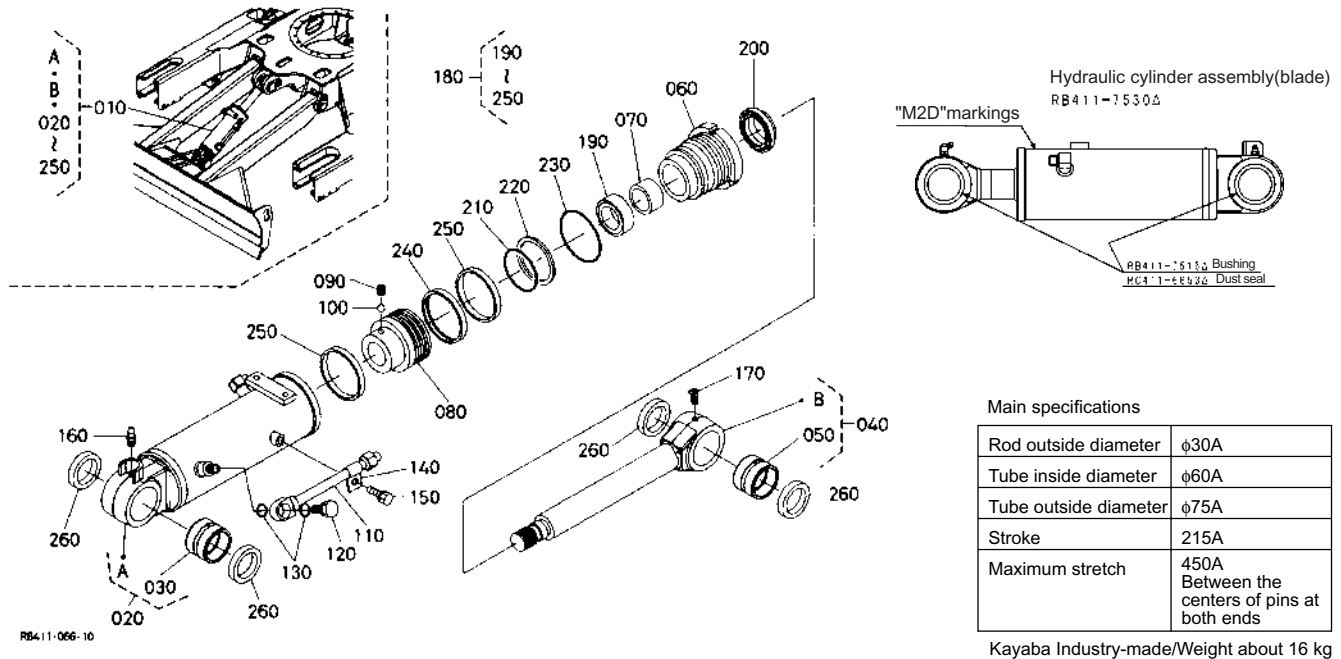
Main specifications

Rod outside diameter	φ30mm
Tube inside diameter	φ60mm
Tube outside diameter	φ75mm
Stroke	215mm
Maximum stretch	450mm Between the centers of pins at both ends

Kayaba Industry-made/Weight about 11 kg

Dwg. No.	Part No.	Part name	Q'ty A	Interchang eability	Remarks
010	RB411-2128-2	Cylinder, assembly (track)	1		
020	RB411-7348-0	Cylinder tube kit	1		
030	RB401-7114-0	Bushing	1		
040	RB411-7349-0	Piston rod kit	1		
050	RB401-7114-0	Bushing	1		
060	RB411-7323-0	Cylinder head	1		Tightening torque: 304N·m (M67×2p) Three-Bond#1901 to be applied
070	RB401-7118-0	Bushing	1		
080	RB411-7324-0	Piston	1		Tightening torque of piston: 333N·m (M24×2p) Hexagonal across 41mm
090	68701-7164-0	Set-screw	1		Tightening torque: 6.86N·m (M6×1p) Two spots to be then caulked with punch
100	68701-7165-0	Steel ball	1		
110	RB411-7345-0	Pipe assembly	1		φ13.8×t2.4mm
120	RB411-7144-0	Plug	1		Tightening torque of piston: 39.3N·m (M12×1.25p)
130	RB411-7146-0	Pipe holder	1		
140	RD411-7147-0	Bolt, assembly	1		
150	RB411-7327-0	Cylinder repair kit	1		
160	68051-6743-0	U-ring	1		
170	RB411-7113-0	Wiper ring	1		
180	04810-50550	O-ring	1		Class1B (hard) G (fixing) Nominal dia.
190	RB411-7174-0	Ring (backup)	1		
200	04811-50600	O-ring	1		Class1A (Soft) G (fixing) Nominal dia.
210	68811-9368-0	Seal ring assembly	1		
220	RB411-7176-0	Ring (slide)	2		
230	RB411-7145-0	O-ring	2		

[6] Blade cylinder



Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-7510-0	Hydraulic cylinder, assembly (blade)	1		Variable track not included
010	RB411-7530-0	Hydraulic cylinder, assembly (blade)	1		Variable track
020	RB411-7168-0	Cylinder tube kit	1		Variable track not included
020	RB411-7368-0	Cylinder tube kit	1		Variable track
030	RB411-7515-0	Bushing (455540)	1		
040	RB411-7169-0	Piston rod kit	1		Variable track not included
040	RB411-7369-0	Piston rod kit	1		Variable track
050	RB411-7515-0	Bushing (455540)	1		
060	RB411-7163-0	Cylinder head	1		Tightening torque:304N·m(M67×2p)Three-Bond#1901to be applied
070	RC101-7154-0	Bushing	1		
080	RB411-7164-0	Piston	1		Tightening torque:333N·m(M24×2p)Hexagonal across 41mm
090	68493-6765-0	Set-screw	1		Tightening torque:6.86N·m(M6×1p)Two spots to be then caulked with punch
100	68493-6767-0	Steel ball	1		
110	RB411-7165-0	Pipe assembly	1		Variable track not included
110	RB411-7193-0	Pipe assembly	1		Variable track φ13.8×t2.4mm
120	RB411-7144-0	Plug	1		Tightening torque:39.3N·m(M12×1.25p)
130	RB411-7145-0	O-ring	2		
140	RB411-7146-0	Pipe holder	1		
150	RD411-7147-0	Bolt, assembly	1		
160	06611-15010	Grease nipple	1		
170	06616-25010	Grease nipple	1		
180	RB411-7167-0	Cylinder repair kit	1		
190	68111-9214-0	U-ring	1		
200	RP401-7142-0	Ring (wiper)	1		
210	68817-9343-0	O-ring	1		
220	RD411-7155-0	Ring (backup)	1		
230	68817-9344-0	O-ring	1		
240	68741-7144-0	Seal ring assembly	1		
250	RD411-7157-0	Ring (slide)	2		
260	RC411-6653-0	Dust seal	4		

[7] Hydraulic hose

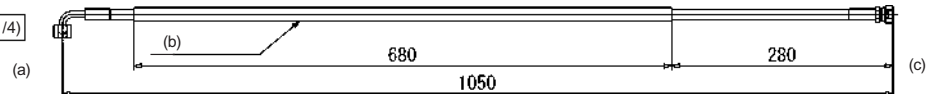
1) List of high-pressure hoses (Upper route)

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

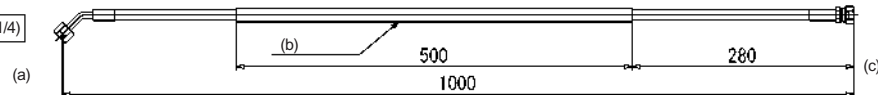
2) List of high-pressure hoses(Lower routes)

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

3 RB411-6469 Δ Hydraulic(bi-speed, 1/4)

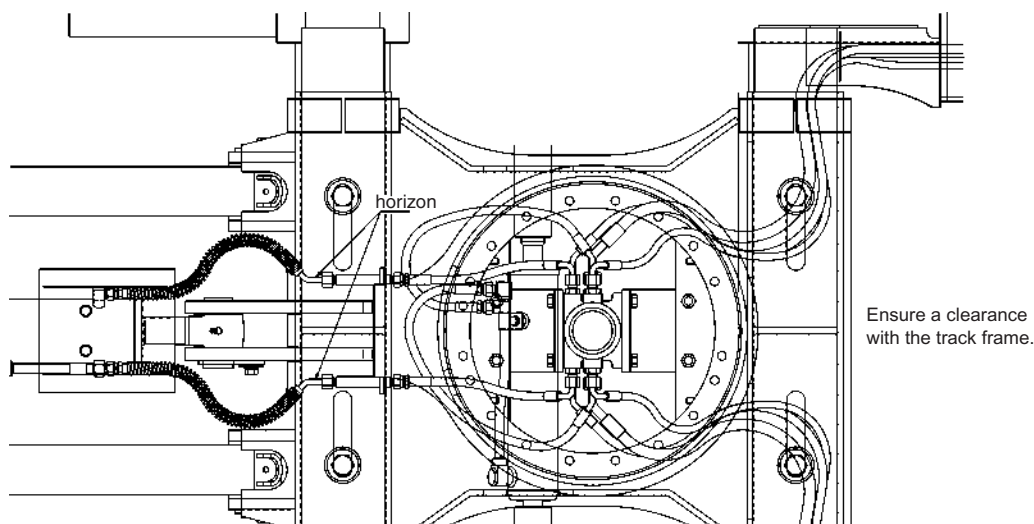


4 RB411-6479 Δ Hydraulic hose(drain, 1/4)

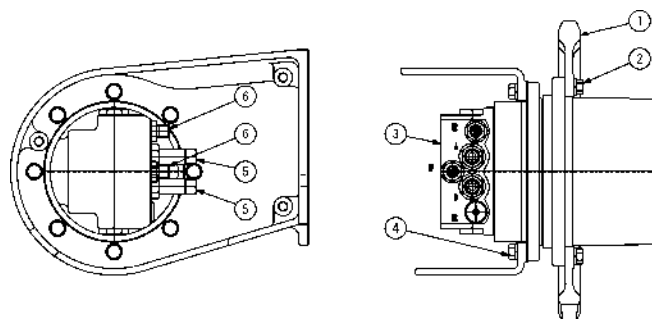
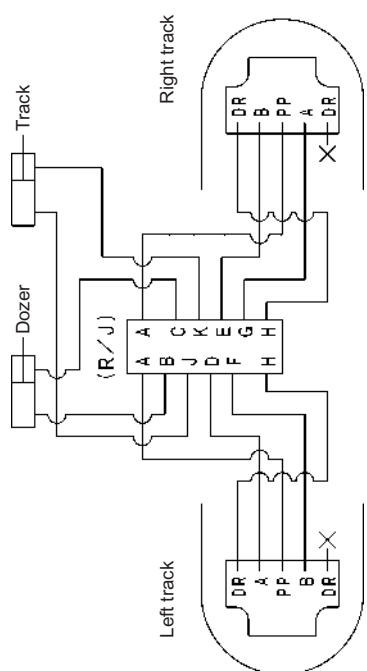


a	R/J side
b	Protective tube
c	Travel M bi-speed

3) Hydraulic hose routes



4) Travel wheel motor setup



No.	Part No.	Part name	Q'ty	Remarks
1	RB411-1443Δ	Drive sprocket	2	(111)
2	01128-61025	Bolt	18	M10×1.5 9T
3	RB411-6129Δ	Motor, assembly (wheel)	2	Fujikoshi-made (614)
4	01128-61025	Bolt	16	M10×1.5 9T
5	RB411-6394Δ	Straight pipe joint	4	A-B
6	68728-76151	Adaptor	4	Above PP and DR
	04810-00110	O-ring	4	For 1/4 : PP and DR
	04810-00140	O-ring	4	For 3/8 : A,B

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

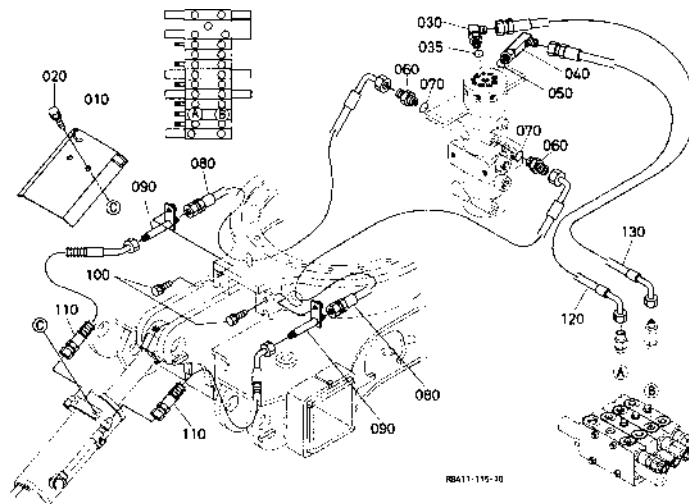
R/J Side	Travel motor, cylinder side
D Left forward	Left A (top)
E Right forward	Right B (top)
F Left backward	Left B (bottom)
G Right backward	Left A (bottom)
H Drain	Right / left drain port (top)

	Part No.	Part name	Q'ty	(mm)	Tape color
R/J-Travel M, Travel (top)	RB411-6467Δ	Hydraulic hose (travel 3/8)	2	940	Red
R/J-Travel M, Travel (Bottom)	RB411-6468Δ	Hydraulic hose (travel 3/8)	2	940	
R/J-Travel M, Bi-speed	RB411-6469Δ	Hydraulic hose (bi-speed 1/4)	2	1050	
R/J-Joint (Dozer)	RB411-6475Δ	Hydraulic hose (blade 1/4)	2	290	Brown
Joint-Dozer cylinder	RB411-6476Δ	Hydraulic hose (blade 1/4)	2	440	
R/J (J-K)-Track cylinder	RB411-6477Δ	Hydraulic hose (track 1/4)	2	560	
R/J -Travel M, Drain (top)	RB411-6479Δ	Hydraulic hose (drain 1/4)	2	1000	Red

Precautions in disassembling/reassembling

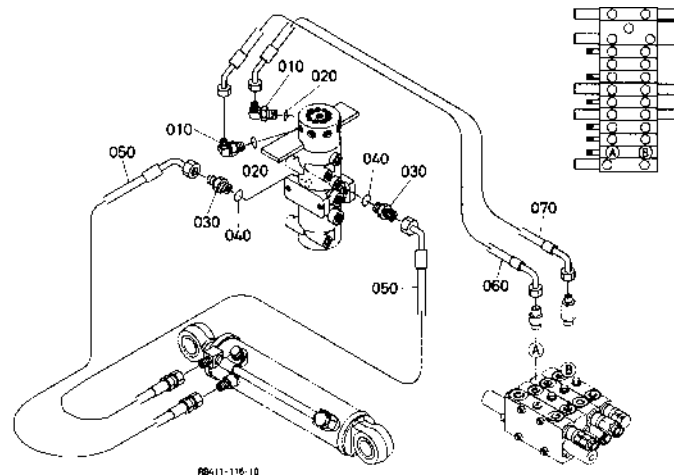
1. Install the motor to the track frame with the ports facing forward.
2. Tightening torque of travel motor (track frame, sprocket)
60.8~70.6N·m(6.2~7.2kgf·m)
Apply screw loctite.(Loctite 271)
3. Connect the motor drain hose to the top port and plug up its bottom end.
4. Keep the hoses inside the track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

5) Blade piping



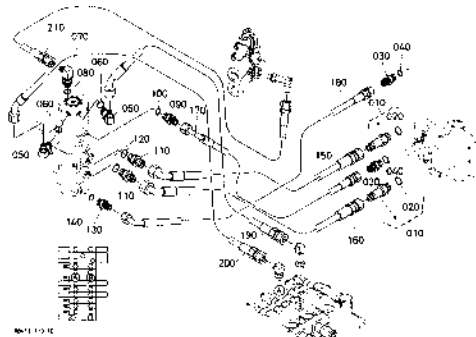
Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-7521-2	Cover (blade cylinder)	1		
020	01133-61016	Bolt	2		M10×16L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
030	RB411-6376-0	Pipe joint(L, G 1/4 - G 1/4)	1		
035	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
040	69254-7849-0	Pipe joint(L, G 1/4 - G 1/4)	1		
050	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
060	68728-7615-0	Adaptor	2		
070	04810-00110	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
080	RB411-6475-0	Hydraulic hose (blade, 1/4)	2		
090	RB411-6471-0	Joint (blade hose)	2		
100	01133-61020	Bolt	2		M10×20L×1.25p 7T 48.1~55.9N·m(4.9~5.7kgf·m)
110	RB411-6476-0	Hydraulic hose (blade, 1/4)	2		Length 440mm G1/4×CR4·G1/4
120	RB411-6487-0	Hydraulic hose (1/4)	1		Length 660mm G1/4×CR9·G1/4
130	RB411-6488-0	Hydraulic hose (1/4)	1		Length 800mm G1/4×CR4·G1/4

6) Track stretcher piping



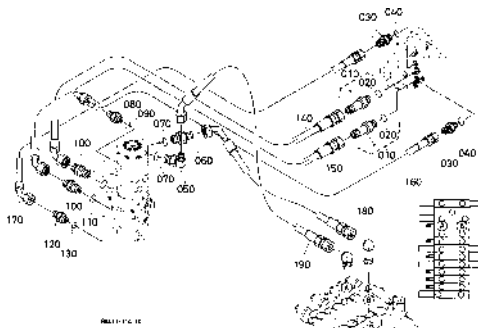
Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-6376-0	Pipe joint (L, G 1/4 - G 1/4)	2		
020	04810-00110	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
030	68728-7615-0X	Adaptor	2		
040	04810-00110	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
050	RB411-6477-0	Hydraulic hose (track, 1/4)	2		Length 560mm G1/4×CR4·G1/4
060	RB411-6465-0	Hydraulic hose (track, 1/4)	1		Length 800mm CR4·G1/4×CR9·G1/4
070	RB411-6466-0	Hydraulic hose (track, 1/4)	1		Length 900mm CR4·G1/4×CR9·G1/4

7) Left-travel piping



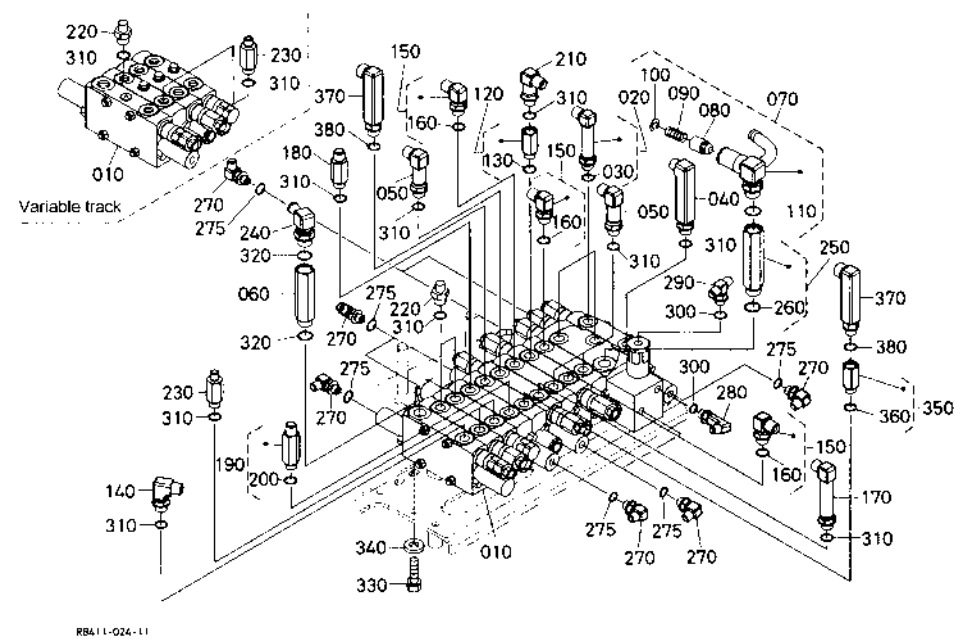
Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-6394-0	Straight pipe joint (3-3-50)	2		
020	04810-00140	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia14mm
030	68728-7615-0	Adaptor	2		
040	04810-00110	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
050	RP201-6181-0	Pipe joint (L, G 3/8 - G 3/8)	2		
060	04810-00140	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia14mm
070	RB411-6376-0	Pipe joint (L, G 1/4 - G 1/4)	1		
080	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
090	68728-7615-0	Adaptor	1		
100	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
110	68311-6432-0	Straight pipe joint	2		
120	04810-00140	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia14mm
130	68728-7615-0	Adaptor	1		
140	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
150	RB411-6467-0	Hydraulic hose (travel, 3/8)	1		Length 940mm G3/8×CR4-G3/8
160	RB411-6468-0	Hydraulic hose (travel, 3/8)	1		Length 940mm G3/8×CR4-G3/8
170	RB411-6469-0	Hydraulic hose (bi-speed, 1/4)	1		Length 1050mm G1/4×CR9-G1/4
180	RB411-6479-0	Hydraulic hose (drain, 1/4)	1		Length 1000mm G1/4×CR4-G1/4
190	RB411-6441-0	Hydraulic hose (3/8)	1		Length 440mm G3/8×CR4-G3/8
200	RB411-6442-0	Hydraulic hose (3/8)	1		Length 380mm G3/8×CR4-G3/8
210	RB411-6445-0	Hydraulic hose (1/4)	1		Length 970mm G1/4×CR9-G1/4

8) Right-travel piping



Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-6394-0	Straight pipe joint (3-3-50)	2		
020	04810-00140	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia14mm
030	68728-7615-0	Adaptor	2		
040	04810-00110	O-ring	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
050	RP201-6181-0	Pipe joint (L, G 3/8 - G 3/8)	2		
060	04810-00140	O-ring	2		
070	RB411-6376-0	Pipe joint (L, G 1/4 - G 1/4)	1		Class 1B (hard) P (fixing-movable) nominal dia14mm
080	04810-00110	O-ring	1		
090	68728-7615-0	Adaptor	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
100	04810-00110	O-ring	1		
110	68311-6432-0	Straight pipe joint	2		Class 1B (hard) P (fixing-movable) nominal dia11mm
120	04810-00140	O-ring	2		
130	68728-7615-0	Adaptor	1		Class 1B (hard) P (fixing-movable) nominal dia14mm
140	04810-00110	O-ring	1		Class 1B (hard) P (fixing-movable) nominal dia11mm
150	RB411-6467-0	Hydraulic hose (travel, 3/8)	1		Length 940mm G3/8×CR4-G3/8
160	RB411-6468-0	Hydraulic hose (travel, 3/8)	1		Length 940mm G3/8×CR4-G3/8
170	RB411-6469-0	Hydraulic hose (bi-speed, 1/4)	1		Length 1050mm G1/4×CR9-G1/4
180	RB411-6479-0	Hydraulic hose (drain, 1/4)	1		Length 1000mm G1/4×CR4-G1/4
190	RB411-6441-0	Hydraulic hose (3/8)	1		Length 440mm G3/8×CR4-G3/8

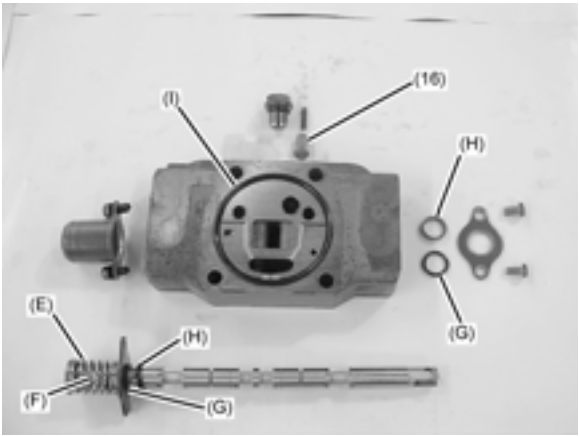
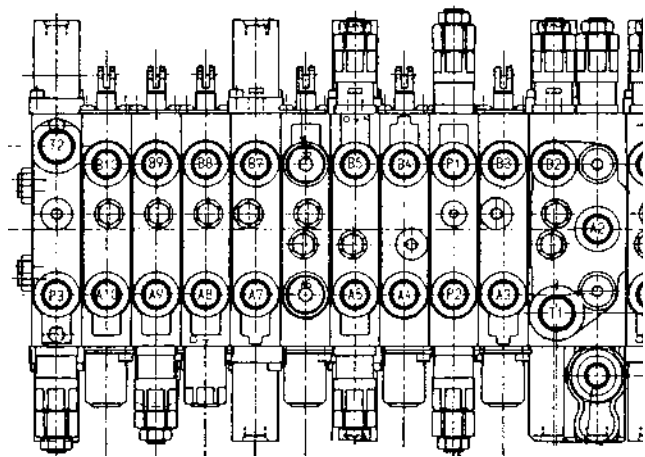
[8] Control valve



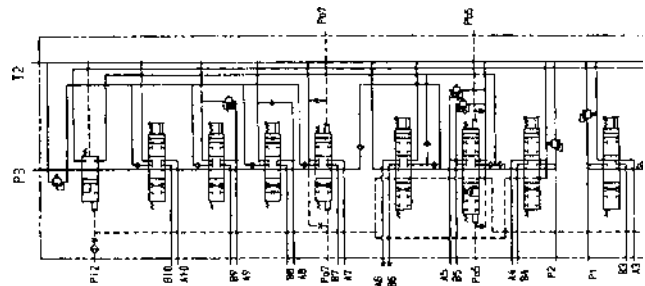
RB411-024-11

Maker: Kayaba Industry
Model: KVSE-36-11
Weight: About 34 kg

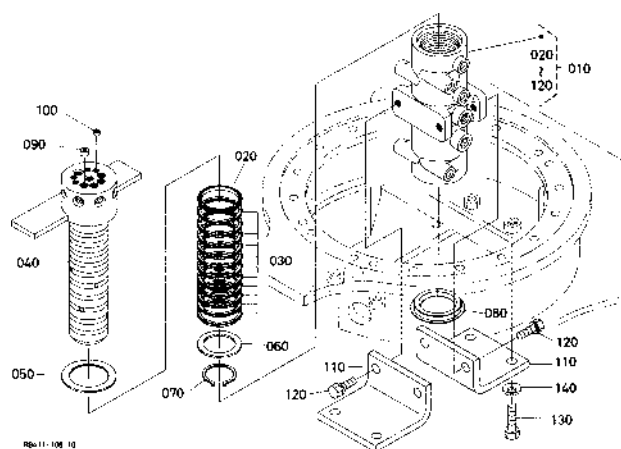
Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-6113-0	Control valve, assembly (variable)	1		Variable track
135	RB411-7012-0	Valve, assembly (width)	1		Variable track
310	04810-00140	O-ring	19		Variable track



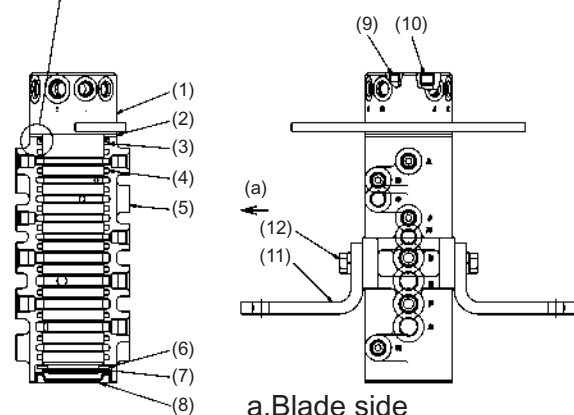
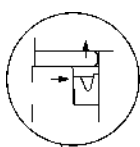
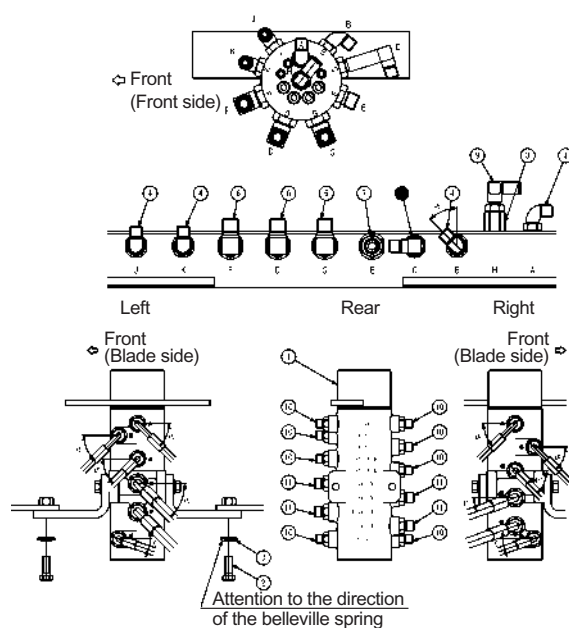
- Component parts**
- (16) Poppet
 - (E) Cap screw
 - (F) Spring
 - (G) Wiper
 - (H) O-ring
 - (I) O-ring



[9] Swivel joint



RB411-108 10

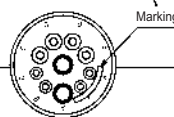
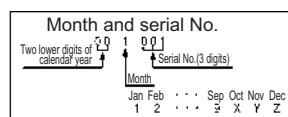


a. Blade side

1) Precautions in disassembling/reassembling

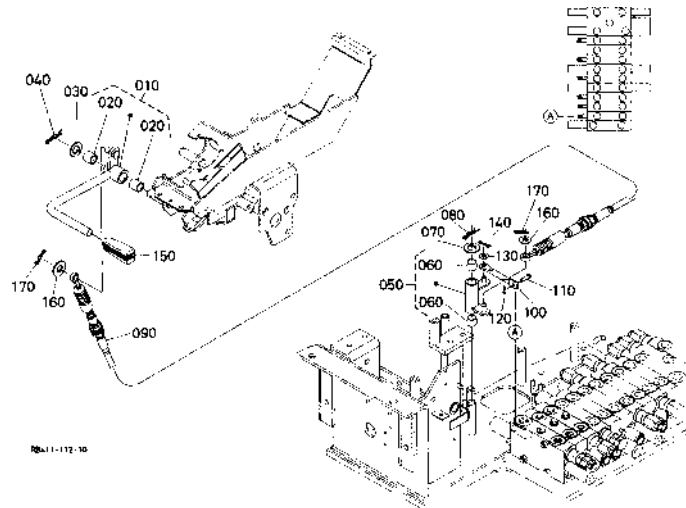
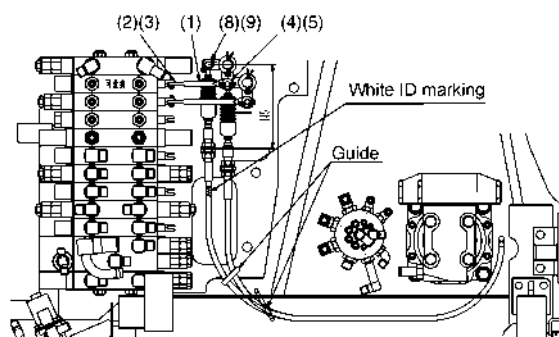
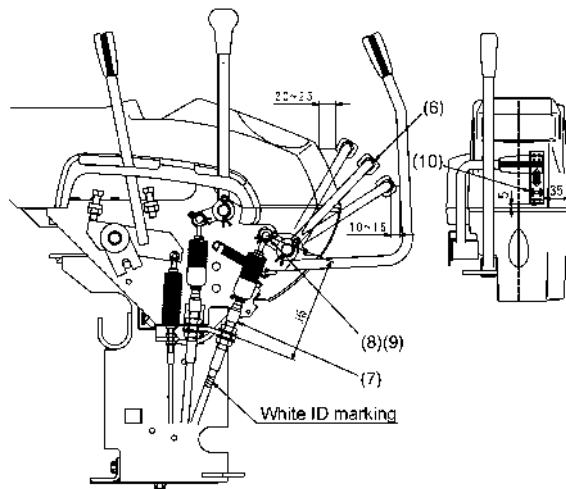
- (1) Tightening torque of hydraulic adaptor
G1/4: 24.5~29.4N·m (2.5~3.0kgf·m)
G3/8: 49.0~53.9N·m (5.0~5.5kgf·m)
- (2) Installing on the track frame
Tightening torque:
166.7~196.1N·m (17.0~20.0kgf·m)
Apply screw LOCTITE. (Loctite 271)
- (3) Before setting up, check the packings for scratches, deformation and other troubles.
Apply grease over the seals inner and outer surfaces. Mount the seal with its lip outward.
- (4) Before joining the body and shaft together, apply grease over the seals inner and outer surfaces. Join them together gently.
- (5) Installing the swivel joint assembly and stay
Tightening torque: 77.5~90.2N·m (7.9~9.2kgf)
Apply screw LOCTITE. (Loctite 271)
- (6) Place the plugs (PT1/8, PT1/4) so that they do not stretch out of the shaft end.

No.	Part No.	Part name	Q'ty	Remarks
1	RB411-6240Δ	Swivel joint, assembly	1	(623)
2	01176-61440	Bolt	4	M14×1.5 9T
3	35358-27371	Plain spring	4	
4	RB411-6376Δ	Pipe joint (L, G 1/4 - G 1/4)	4	A·B·J·K
5	69254-78491	Pipe joint (L, G 1/4 - G 1/4)	1	C
6	RP201-61812	Pipe joint (L, G 3/8 - G 3/8)	3	D·F·G
7	68311-64321	Straight pipe joint	1	E
8	RC411-63881	Pipe joint (bushing G 3/4)	1	H
9	RD401-63951	Elbow pipe joint (G 4-13)	1	H
	04810-00110	O-ring	7	For 1/4 A·B·C·H·J·K
	04810-00140	O-ring	4	For 3/8 D·E·F·G
10	68728-76151	Adaptor	8	A·B·C·H·J·K
11	68311-64321	Straight pipe joint	4	D·E·F·G
	04810-00110	O-ring	8	For 1/4 A·B·C·H·J·K
	04810-00140	O-ring	4	For 3/8 D·E·F·G



No.	Part No.	Part name	Q'ty	Remarks
1	RB411-6242Δ	Shaft (swivel joint)	1	
2	RC411-9234Δ	Collar (swivel joint)	1	
3	RC411-6241Δ	Gasket	1	
4	RC411-6238Δ	Gasket (swivel joint)	11	
5	RB411-6241Δ	Body (swivel joint)	1	
6	RC411-6237Δ	Collar (swivel joint)	1	
7	04612-00500	Shaft circlip	1	
8	31353-4385Δ	Plug	1	
9	68311-1338Δ	Plug (PT 1/8)	4	
10	68311-1335Δ	Plug (PT 1/4)	4	
11	RB411-6246Δ	Collar (swivel joint)	2	
12	01133-61230	Bolt	4	M12×1.25 7T

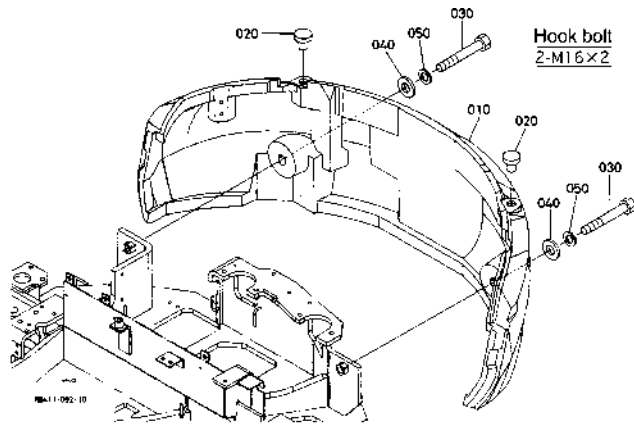
[10] Track stretch lever



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

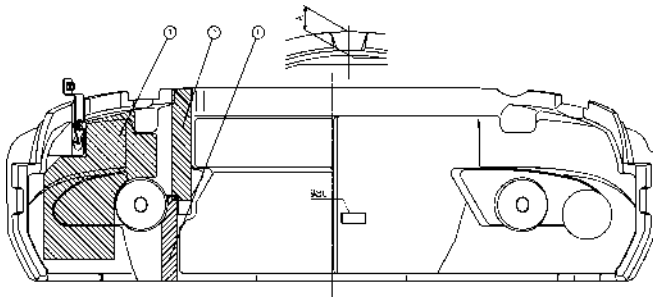
Dwg. No.	Part No.	Part name	Q'ty	Interchange ability	Remarks
			A		
010	RB411-6590-0	Lever, assembly (track stretching)	1		
020	08511-01615	Bushing	2		
030	04011-60160	Flat washer	1		
040	05525-51600	Snap pin	1		
050	RB411-6512-0	Link, assembly (dozer)	1		
060	08511-01615	Bushing	2		
070	04011-60160	Flat washer	1		
080	05525-51600	Snap pin	1		
090	RB411-6578-0	Cable (track stretching)	1		White ID marking
100	RB411-6535-0	Rod (95)	1		
110	68021-3279-0	Pin	1		
120	05525-60500	Snap pin	1		
130	04013-60080	Flat washer	1		
140	05525-50800	Snap pin	1		
150	55611-3145-0	Lever grip 1	1		
160	04013-60100	Flat washer	2		
170	05525-61000	Snap pin	2		

[11] Counterweight



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

Dwg. No.	Part No.	Part name	Q'ty	Interchangeability	Remarks
			A		
010	RB411-4811-0	Counterweight	1		Canopy fixed track
010	RB411-4821-0	Counterweight (variable)	1		Canopy fixed track
010	RB411-4831-0	Counterweight (cabin)	1		Cabin
020	90585-1199-0	Plug	2		
030	RC411-4841-0	Bolt	2		M10×1.25 7T
040	RP801-4812-0	Washer	2		
050	04512-60200	Spring washer	2		



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

Counterweight identification

Model		Part No.	Dimension A
U-20-3	Fixed track + canopy type	RB411-4811 Δ	70
	Variable track + canopy type	RB411-4821 Δ	70
	Fixed track, variable track + cabin type	RB411-4831 Δ	115
U-25 (Canopy, cabin type)		RB411-4811 Δ	115

Variable type

Model		Part No.	Casting
U-20-3	Variable track + canopy type	RB411-4821 Δ	U-20D
	Variable track + cabin type	RB411-4831 Δ	U-20C

III. Engine

A. 05-M Series Engine WSMIII-2

 a. Engine Specifications for construction machineryIII-4

 b. DimensionsIII-8



A.05-M Series Engine WSM

TO THE READER

The following engine WSM has been compiled after minor changing of original -05 series engine WSM by eliminating some pages which doesn't apply to construction machinery model of V-3 series.

Still some pages contain common specifications on -05 series engine. Therefore, some data may differ from the engine mounted on construction machinery. In that case, please come to a. Engine specifications for construction machinery.

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

■ Mechanism

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

■ Servicing

The heading "General" includes general precautions, check and maintenance and special tools. There are troubleshooting, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. The right is reserved to make changes in all information at any time without notice.

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

⚠ SAFETY FIRST

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

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



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



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



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

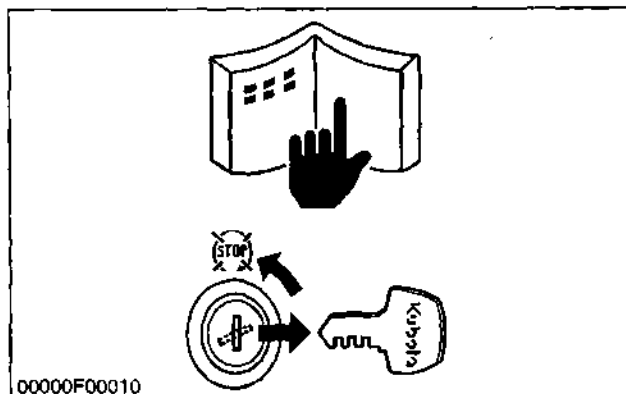


IMPORTANT : Indicates that equipment or property damage could result if instructions are not followed.



NOTE : Gives helpful information.

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00000F00010

BEFORE SERVICING AND REPAIRING

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

00000Z00021

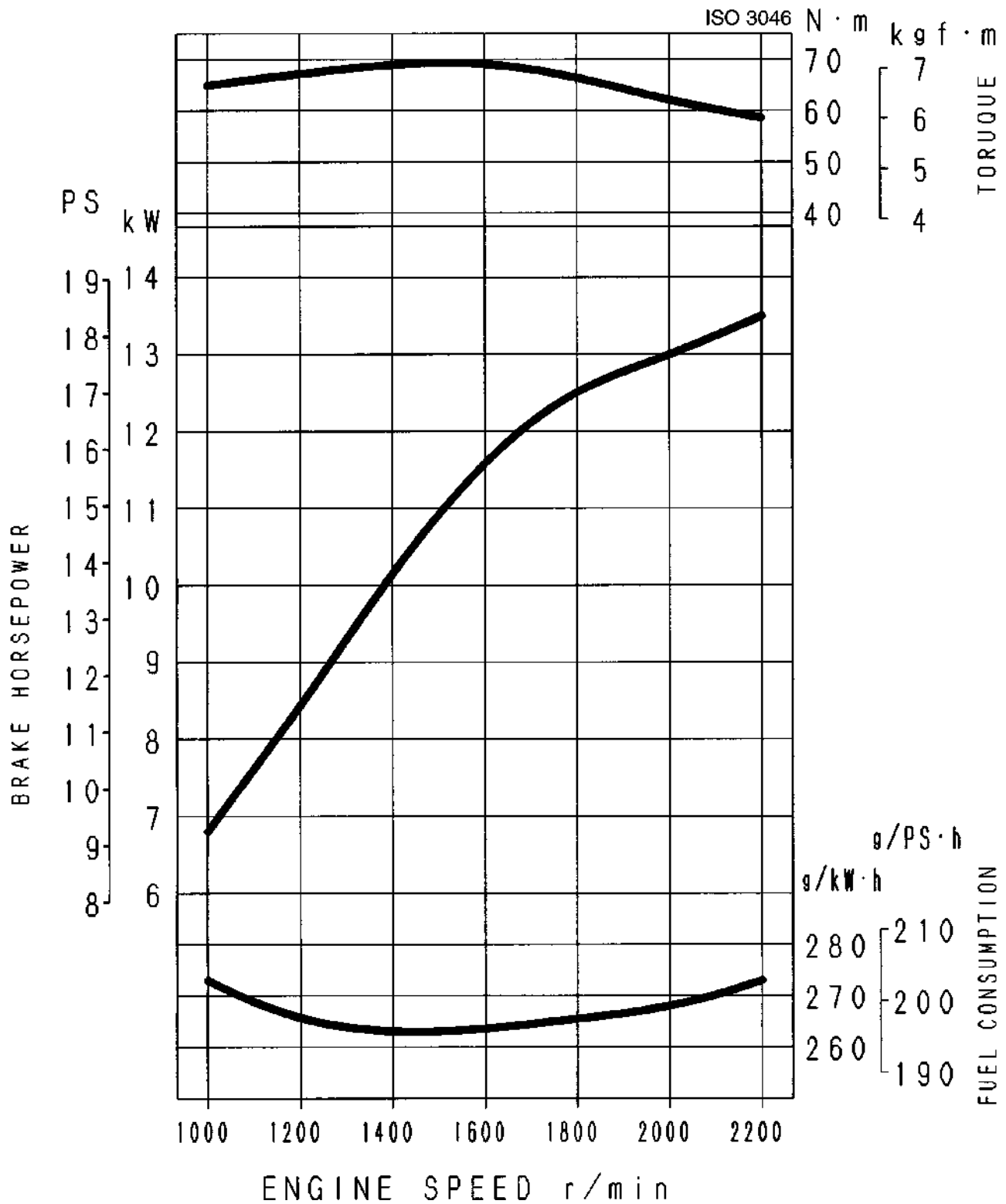
a. Engine Specifications for construction machinery

		U20-3EU	U25-3EU
Model		D1105-EBH-10	D1105-EBH-11
No. of cylinder		3	←
Bore × Stroke	mm	78.0 × 78.4	←
	in	3.07 × 3.09	←
Displacement	cc	1123	←
	in ³	68.53	←
Max. output/rpm	kW/rpm	14.0/2200	15.5/2400
	PS/rpm	19/2200	21/2400
	HP/rpm	18.7/2200	20.7/2400
Compression ratio		24	←
Max. torque	N·m	66.2	65.8
	kgf·m	6.8	6.7
	ft·lbf	49.2	48.5
Dimensions:L×W×H	mm	462 × 394 × 616	←
	in.	18.2 × 15.5 × 24.3	←
Dry weight	kg	89	←
	lbs	196.2	←
Valve clearance	mm	0.145-0.185	←
	in.	0.0057-0.0073	←
Firing sequence		1-2-3	←
Compression pressure (A)/(B)	MPa	3.23-3.63/2.3	←
	kgf/cm ²	33-37/23	←
	psi	469-526/327	←
Fan belt		Bando RPF2370	←
Fuel consumption ratio	g/kWh	286	←
	g/Psh	210	←
	lbs/Hph	0.47	←
Fuel consumption	l/h	4.6	5.0
	gal/h	1.22	1.32
Max. speed without load	rpm	2600≥	←
Speed with 2 pumps relief	rpm	2200≥	←
Speed with idling	rpm	1200-1300	←
Engine oil pressure with rated engine rpm	kPa	196-441/10	←
	kgf/cm ²	2.0-4.5/1.0	←
	psi	28.4-64.0/14.2	←
Injection pressure	MPa	13.7-14.7	←
	kgf/cm ²	140-150	←
	psi	1991-2133	←
Engine oil consumption ratio	g/kWh	0.95	←
	g/Psh	0.7	←
	lbs/Hph	0.71	←

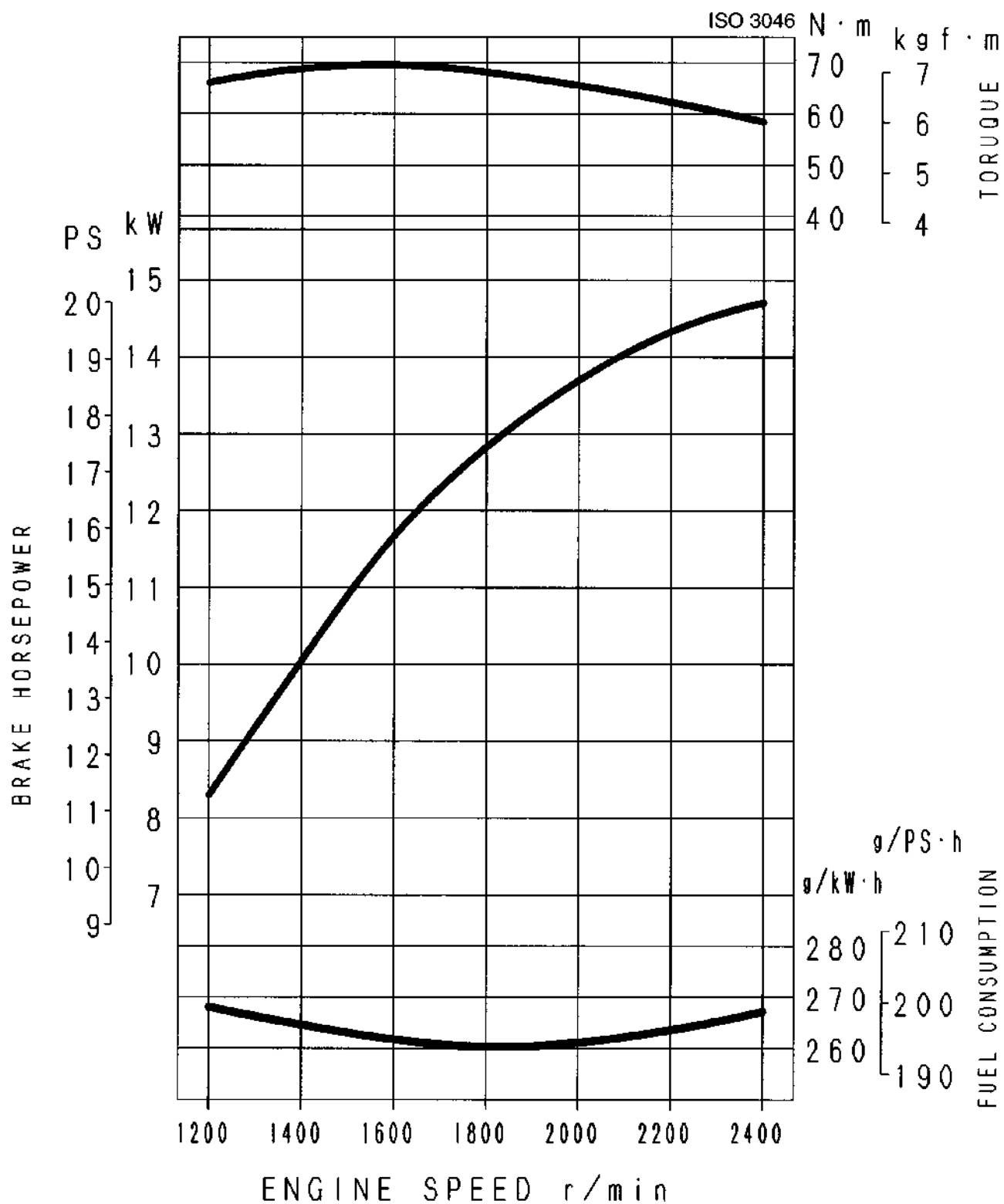
Engine electric components

		U20-3EU	U25-3EU
		D1105-EBH-10	D1105-EBH-11
Fuel injection pump type		BoschMDtype mini-pump	←
Nozzle type		DN4PDN mini-nozzle	←
Injection pressure	MPa	13.7-14.7	←
	kgf/cm ²	140-150	←
	psi	1991-2133	←
Dynamo		12V360W	←
Manufacturer P/N		1G070-6401Δ	←
Regulator adjusting voltage	V	12V14A	←
Battery type		75D23RMF	←
Nominal capacity of 5hrs rating	Ah	52	←
Specific gravity of electrolyte		1.26≤	←
Starter motor		12V1.0kW	←
Manufacturer P/N		19269-6301Δ	←
Glow plug	Ω	0.9	←

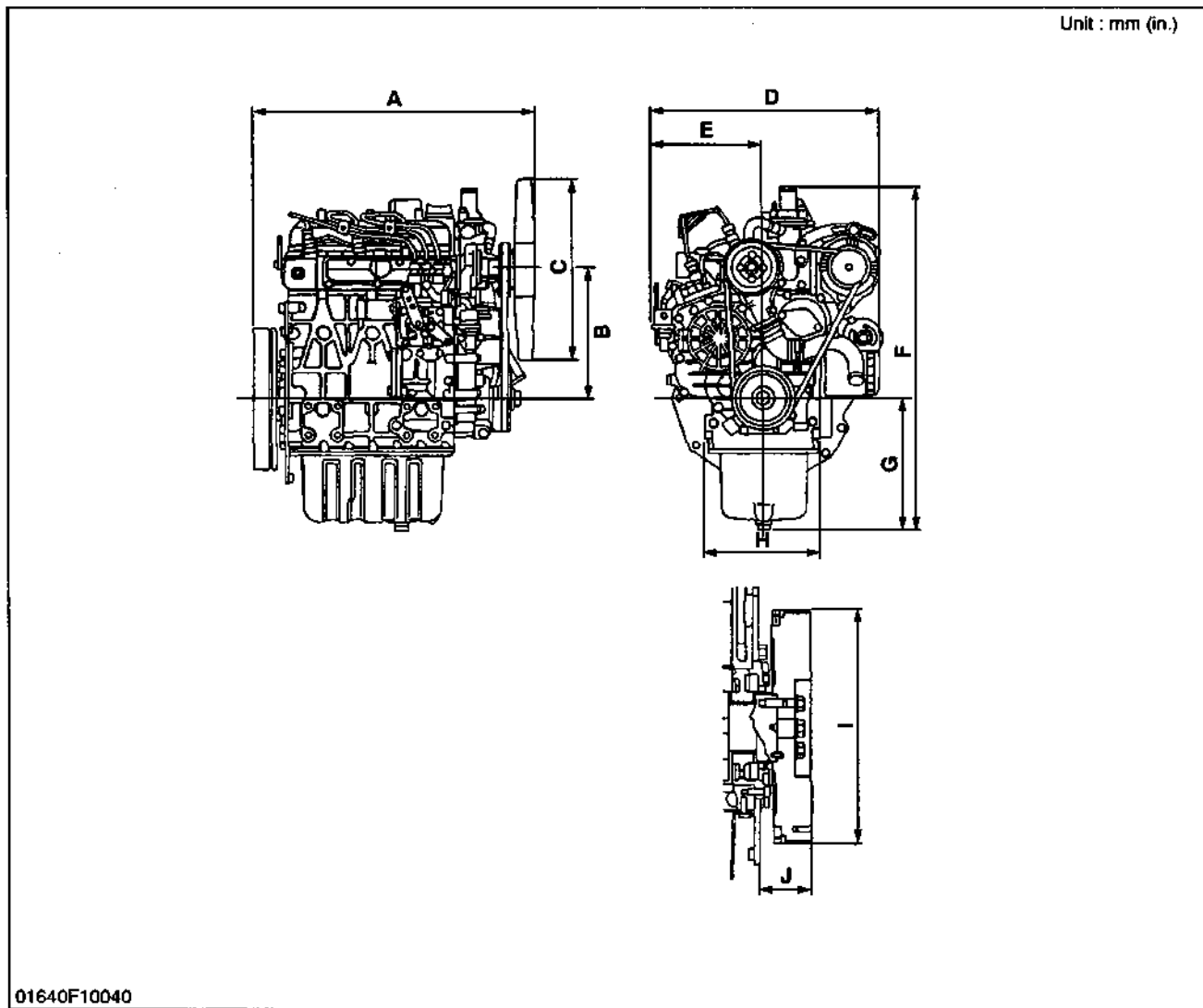
Performance curves Model D1105-EBH-10



Performance curves Model D1105-EBH-11



b. Dimensions



~ = to = à = bis

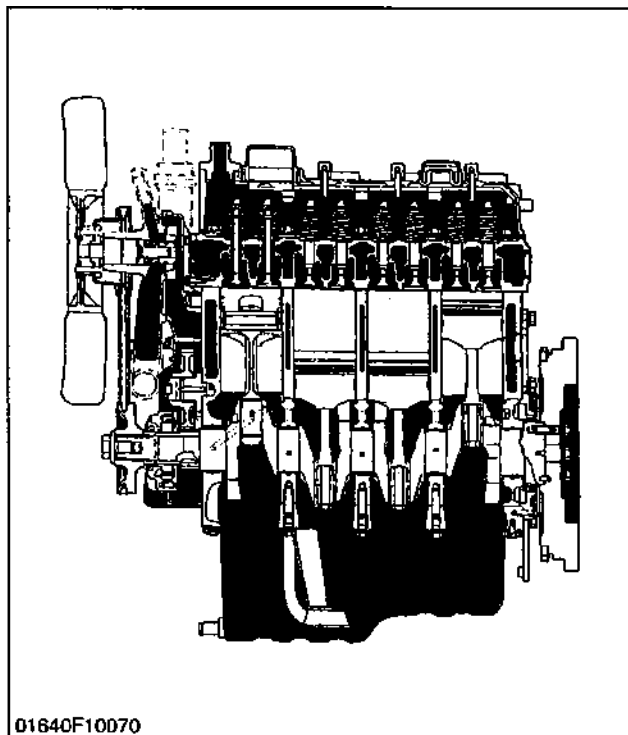
	D905-B (E)	D1005-B (E)	D1105-B (E)	D1105-T-B (E)
A	497.8 (19.60)	497.8 (19.60)	497.8 (19.60)	497.8 (19.60)
B	230 (9.06)	230 (9.06)	230 (9.06)	230 (9.06)
C	Ø320 (Ø12.60)	Ø330 (Ø12.99)	Ø330 (Ø12.99)	Ø330 (Ø12.99)
D	396 (15.59)	396 (15.59)	396 (15.59)	396 (15.59)
E	194 (7.64)	194 (7.64)	194 (7.64)	194 (7.64)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

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III. Engine (Mechanism section)

A. Feature	III-M-2
B. Engine body	III-M-3
[1] Cylinder block	III-M-3
[2] Cylinder head	III-M-3
[3] Crankshaft	III-M-4
[4] Piston and piston rings	III-M-4
[5] Connecting rod	III-M-5
[6] Rocker arm	III-M-5
[7] Camshaft	III-M-5
[8] Fuel camshaft	III-M-6
[9] Flywheel	III-M-6
C. Lubricating system	III-M-7
[1] General	III-M-7
[2] Oil pump	III-M-8
[3] Relief valve	III-M-8
[4] Oil filter cartridge	III-M-9
[5] Oil pressure switch	III-M-9
D. Cooling system	III-M-10
[1] General	III-M-10
[2] Water pump	III-M-10
[3] Thermostat	III-M-11
[4] Radiator (not included in the basic engine)	III-M-11
[5] Radiator cap	III-M-12
E. Intake / exhaust system	III-M-13
[1] Air cleaner (not included in the basic engine)	III-M-13
[2] Muffler (not included in the basic engine)	III-M-13
F. Fuel system	III-M-14
[1] General	III-M-14
[2] Injection pump	III-M-14
[3] Injection nozzle	III-M-17
[4] Fuel filter (not included in the basic model)	III-M-17
[5] Governor	III-M-18
[6] Automatic advance timer (not included in the basic model)	III-M-20
G. Electrical system	III-M-22
[1] Charging system	III-M-22
H. Turbo charger system	III-M-23

A.Feature



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

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

■ NOTE

- Since January 1994, E-TVCS has been used for the combustion chamber of our products instead of traditional N-TVCS.

E-TVCS was developed with an eye toward clean exhaust gas which is more environmentally friendly.

The combustion chamber models mentioned hereinafter refers to E-TVCS.

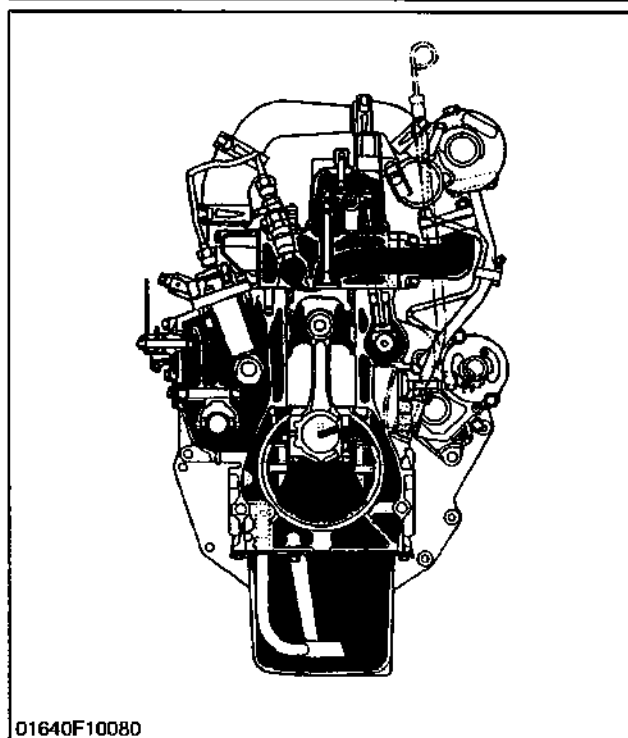
Model of combustion chamber :

N-TVCS

(Engine Serial Number ; 489290 or lower)

E-TVCS

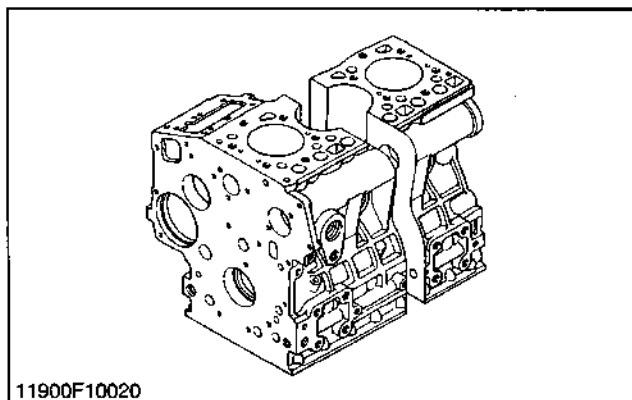
(Engine Serial Number ; 489291 or higher)



11900M10011

B.Engine body

[1] Cylinder block



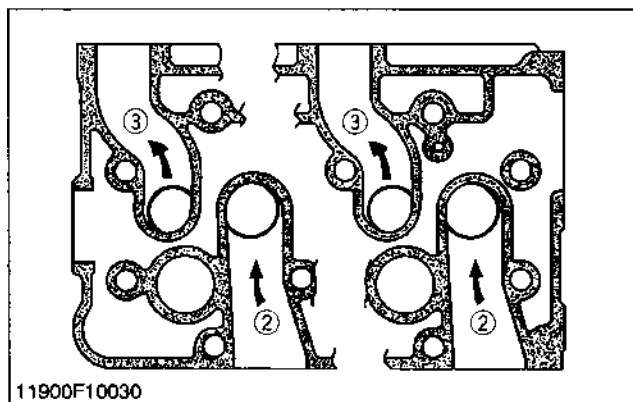
The engine has a high durability tunnel-type cylinder block in which the crank bearing component is a constructed body.

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

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

11900M10020

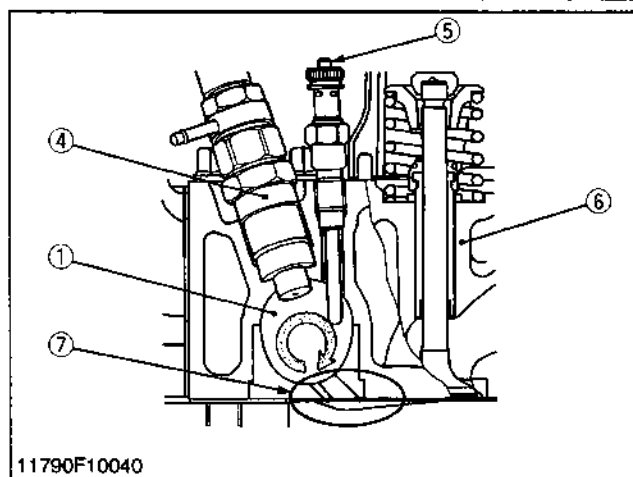
[2] Cylinder head



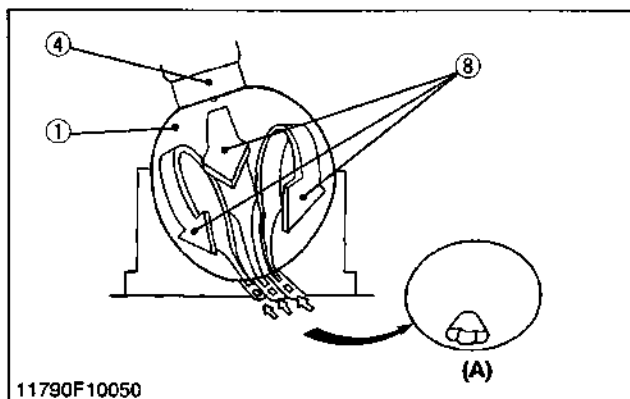
The cross-flow type intake / exhaust ports in this engine have their openings at both sides of the cylinder head. Because overlaps of intake / exhaust ports are smaller than in ports of other types which have openings on one side, the suction air can be protected from being heated and expanded by heated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

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

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

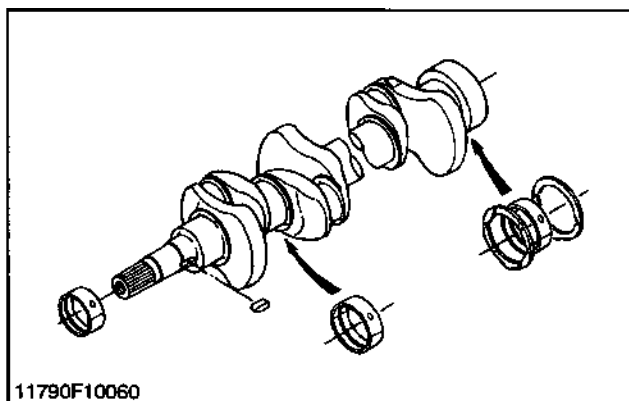


- | | |
|------------------------|-----------------------------------|
| (1) Combustion Chamber | (7) Depression |
| (2) Intake Port | (8) Compressed Air |
| (3) Exhaust Port | (A) Connect to Combustion Chamber |
| (4) Nozzle Assembly | |
| (5) Glow Plug | |
| (6) Cylinder Head | |



11900M10031

[3] Crankshaft



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

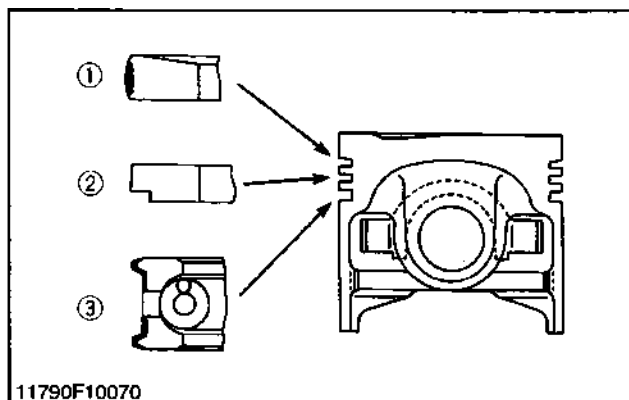
The crankshaft is made of tough special alloy steel, and the journals, pins and oil seal sliding portions are induction hardened to increase the hardness for higher wear resistance.

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

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

11790M10040

[4] Piston and piston rings



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

Three rings are installed in grooves in the piston.

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

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

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

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

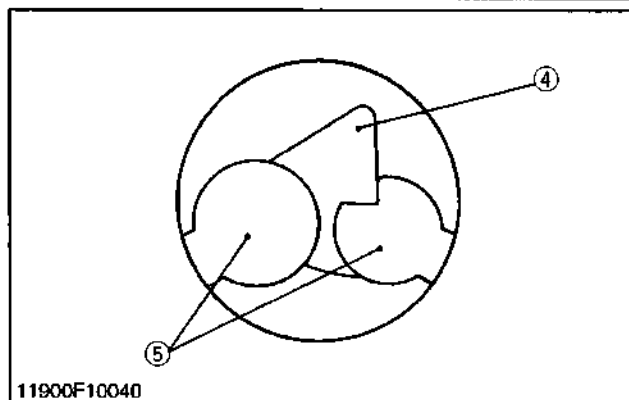
(1) Top Ring

(2) Second Ring

(3) Oil Ring

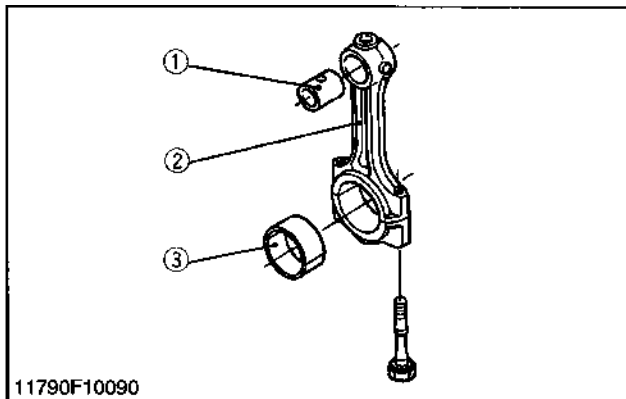
(4) Depression

(5) Valve Recess



11900M10041

[5] Connecting rod



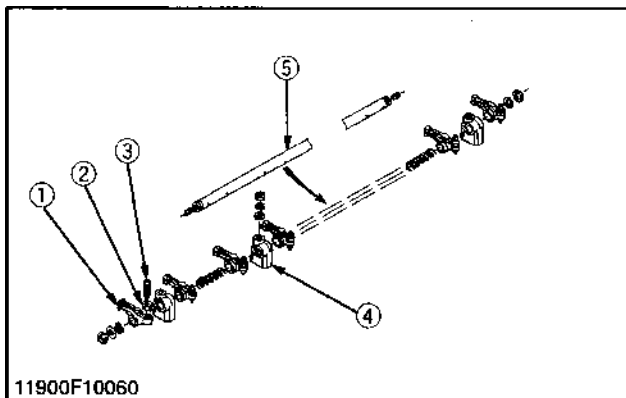
The connecting rod (2) is used to connect the piston with the crankshaft.

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

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

11790M10060

[6] Rocker arm



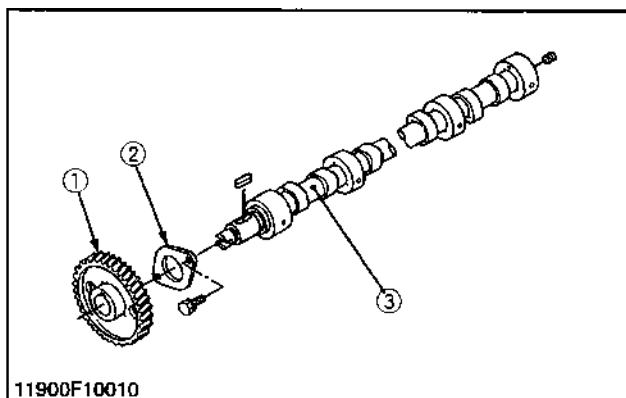
The rocker arm assembly includes the rocker arms (1), rocker arm brackets (4) and rocker arm shaft (5), and converts the reciprocating movement of the push rods to an open / close movement of the intake and exhaust valves.

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

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

11900M10070

[7] Camshaft



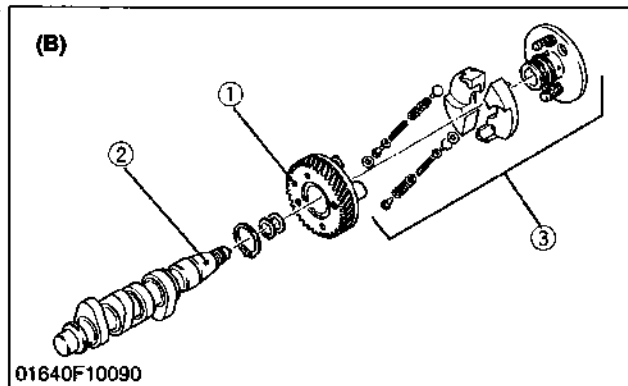
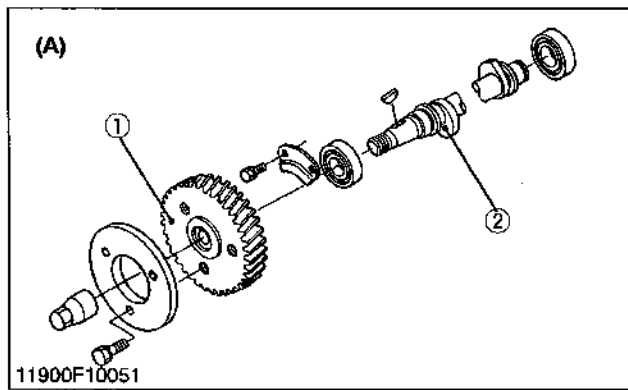
The camshaft (3) is made of special cast iron, and the journal and cam sections are chilled to resist wear.

The journal sections are force-lubricated.

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

11900M10050

[8] Fuel camshaft



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

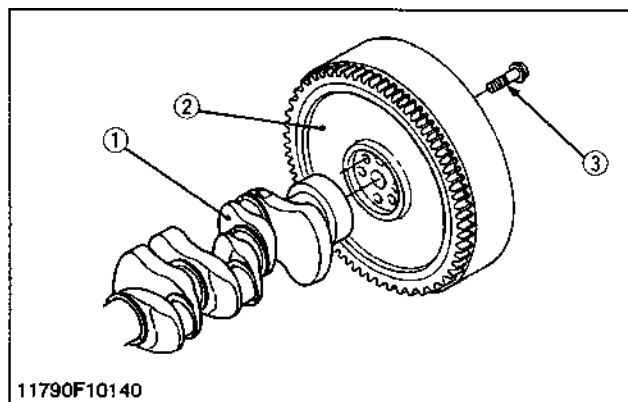
The fuel camshaft is made of carbon steel and the cam sections are quenched and tempered to provide greater wear resistance.

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

- (A) Without Timer
- (B) With Timer

11900M10061

[9] Flywheel



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

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

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

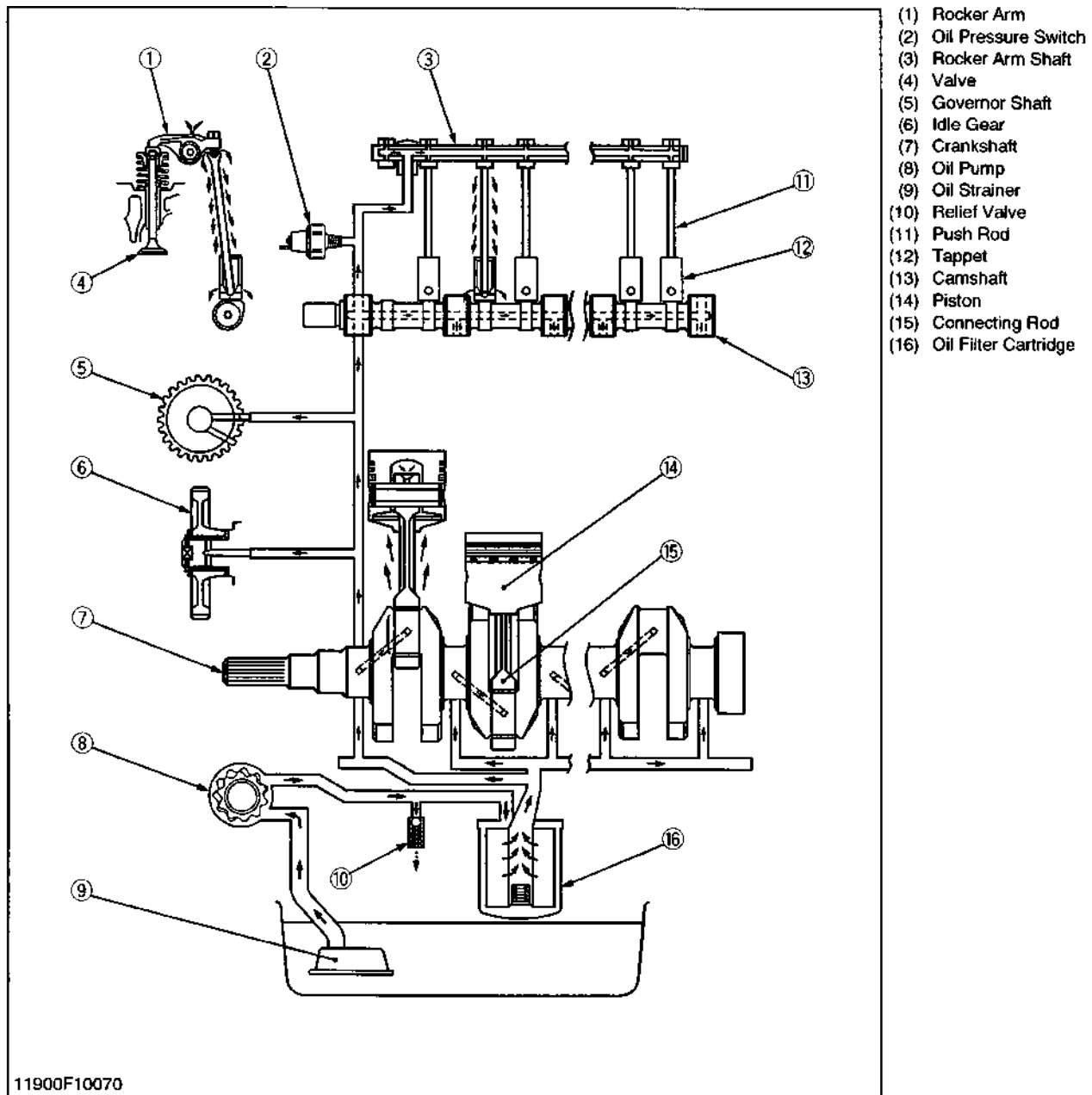
- (1) Crankshaft
- (2) Flywheel

- (3) Flywheel Screw

11900M10081

C.Lubricating system

[1] General



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

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

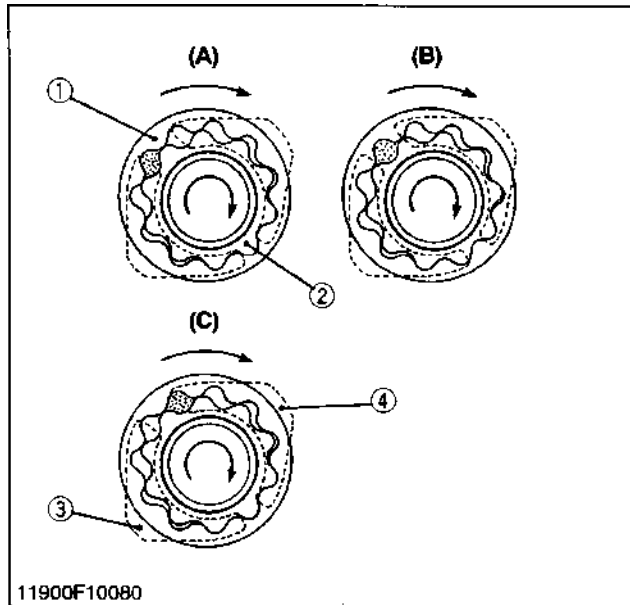
The oil pump sucks lubricating oil from the oil pan through the oil strainer and the oil flows down to the filter cartridge, where it is further filtered. Then the oil is forced to crankshaft (7), connecting rods (15), idle gear

(6), governor shaft (5), camshaft (13) and rocker arm shaft (3) to lubricate each part.

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

11900M10090

[2] Oil pump



The oil pump in this engine is a trochoid pump.

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

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

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

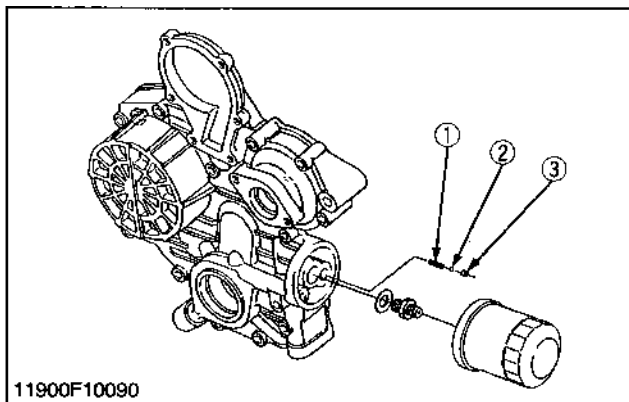
Outside the inlet port, as shown in position (B), the space between the lobes becomes gradually smaller, and oil pressure increases. At position (C), oil is discharged from the outlet port.

- (1) Outer Rotor
(2) Inner Rotor

- (3) Inlet Port
(4) Outlet Port

11900M10101

[3] Relief valve



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

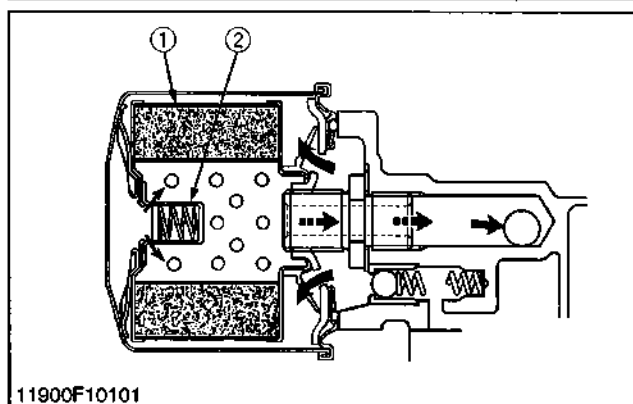
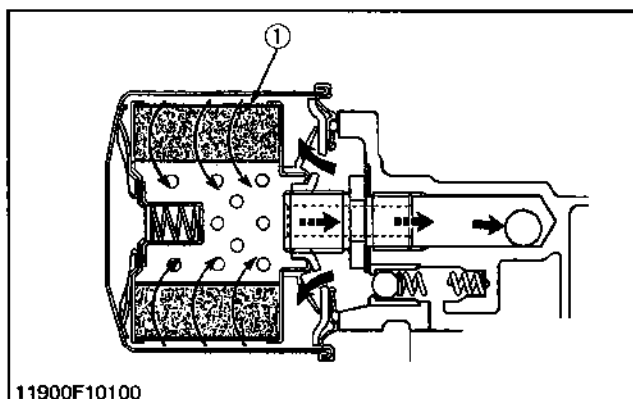
When oil pressure exceeds the upper limit, the ball (2) is pushed back by the pressure oil and the oil escapes.

- (1) Spring
(2) Steel Ball

- (3) Valve Seat

11900M10111

[4] Oil filter cartridge



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

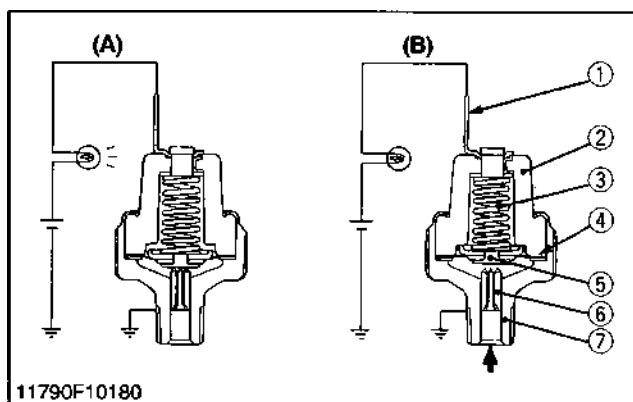
When the filter element is clogged and the oil pressure in inlet line builds up by 98 kPa (1.0 kgf/cm², 14 psi) more than the outlet line, the bypass valve (2) opens and the oil flows from inlet to outlet bypassing the filter element.

(1) Filter Element

(2) Bypass Valve

11900M10120

[5] Oil pressure switch



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

If the oil pressure falls below 49 kPa (0.5 kgf/cm², 7 psi), the oil warning lamp will light up, warning the operator. In this case, stop the engine immediately and check the cause of pressure drop.

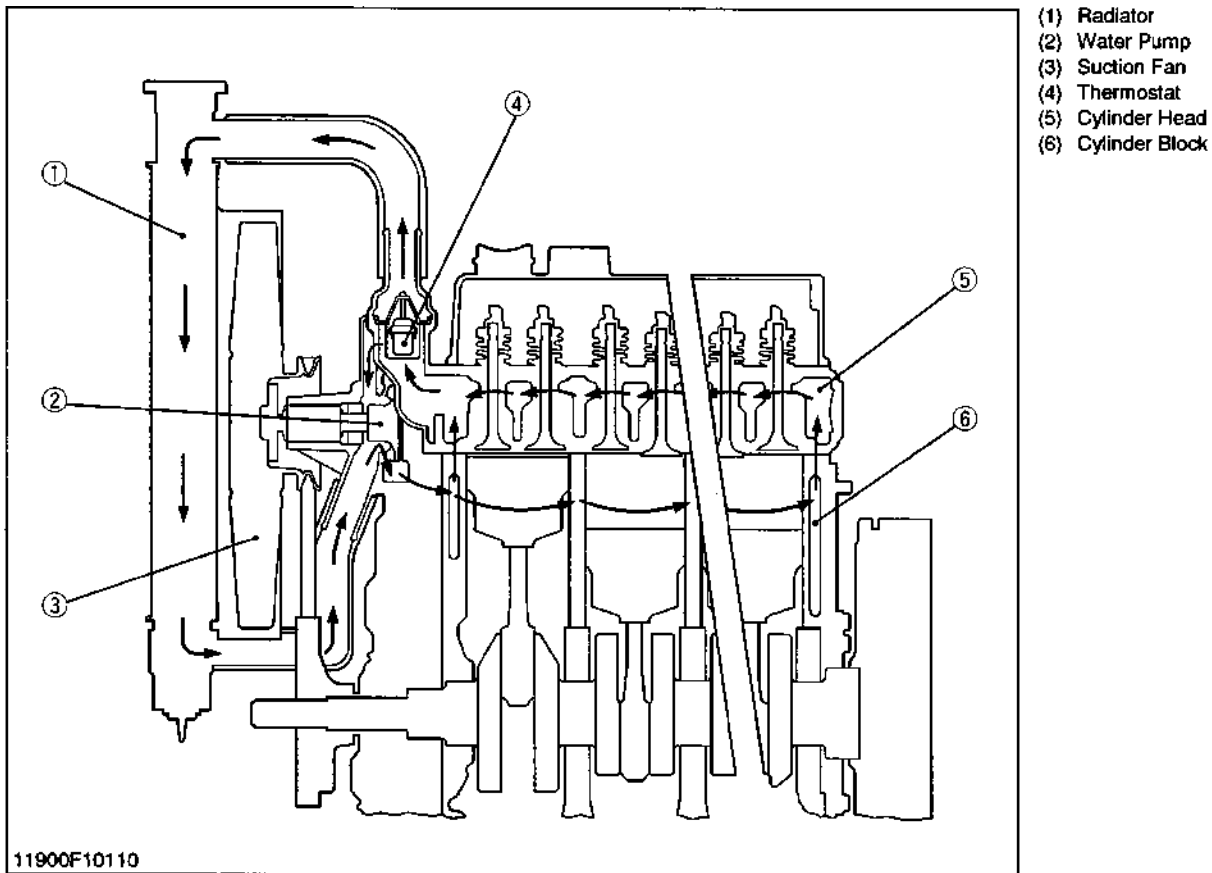
- (1) Terminal
- (2) Insulator
- (3) Spring
- (4) Rubber Gasket
- (5) Contact Rivet
- (6) Contact
- (7) Oil Switch Body

- (A) At Oil Pressures of 49 kPa (0.5 kgf/cm², 7 psi) or Less
- (B) At Proper Oil Pressure

11790M10152

D.Cooling system

[1] General



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

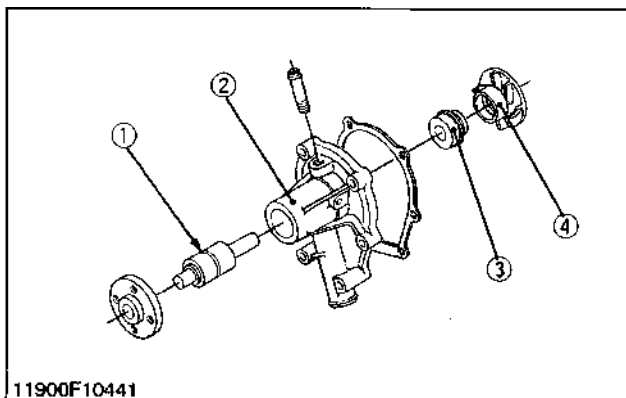
The water is cooled through the radiator core, and the fan set behind the radiator pulls cooling air through the core to improve cooling.

The water pump sucks the cooled water, forces it into the cylinder block and draws out the hot water. Then the

cooling is repeated. Furthermore, to control temperature of water, a thermostat is provided in the system. When the thermostat opens, the water moves directly to radiator, but when it closes, the water moves toward the water pump through the bypass between thermostat and water pump. The opening temperature of thermostat is approx. 71 °C (160 °F).

11900M10131

[2] Water pump

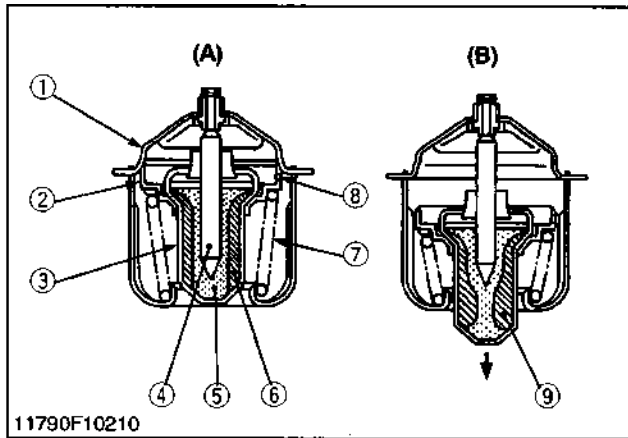


The water pump is driven by the crankshaft via a V belt. Water cooled in the radiator is sucked into the water pump from its lower portion and is sent from the center of the water pump impeller (4) radially outward into the water jacket in the crankcase.

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

11900M10141

[3] Thermostat



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

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

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

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

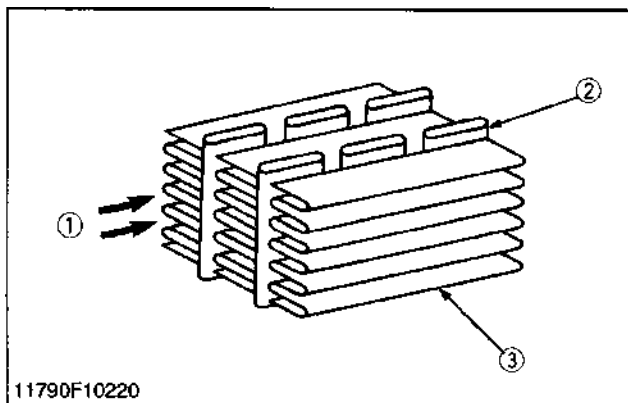
(B) At high temperature (higher than 71 °C, 160 °F)

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

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

11790M10182

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

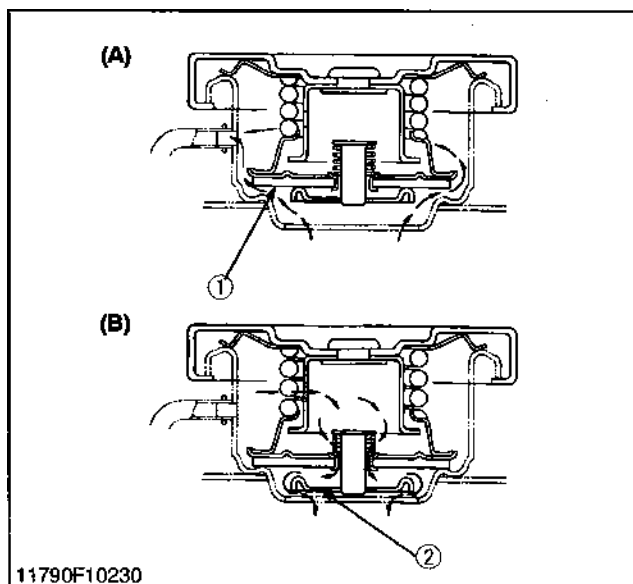


The radiator core consists of water carrying tubes (2) and fins (3) at a right angle to the tubes (2). Heat of hot water in the tubes is radiated from the tube walls and fins. KUBOTA's engine uses corrugated fin type core which has a light weight and high heat transfer rate. Clogging is minimized by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

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

11790M10191

[5] Radiator cap



The radiator cap is for sustaining the internal pressure of the cooling system at the specified level 88 kPa (0.9 kgf/cm², 13 psi) when the engine is in operation. The cap consists of a pressure valve (1) a vacuum valve (2), valve springs, gasket, etc.

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

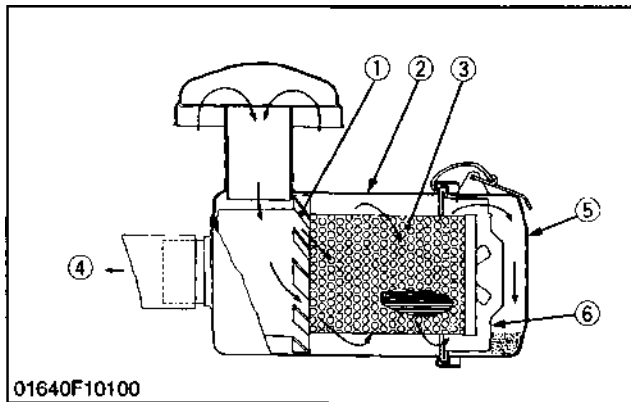
- (1) Pressure Valve
- (2) Vacuum Valve

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

11790M10201

E.Intake / exhaust system

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



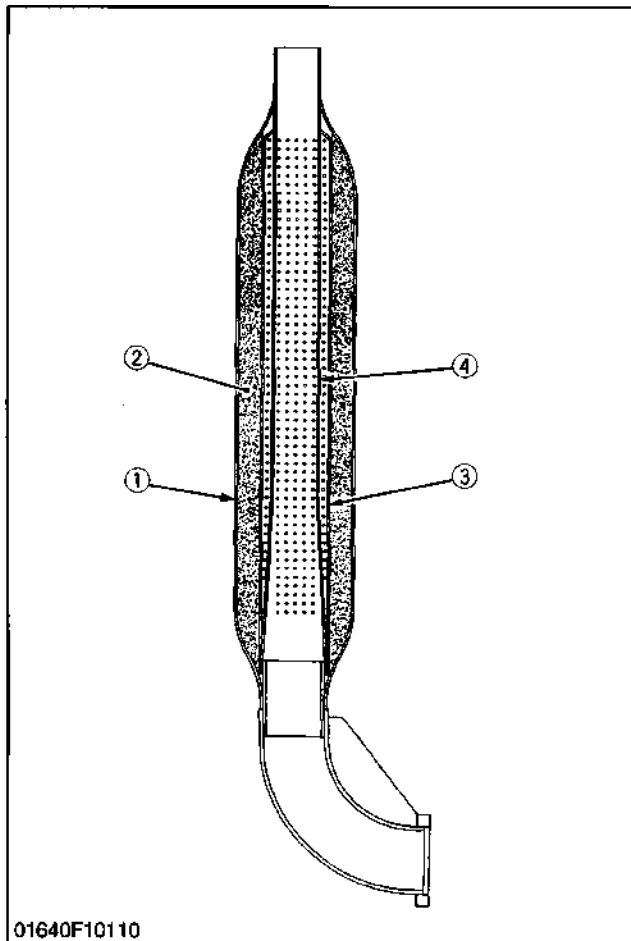
The air cleaner is a dry-cyclone type for easy maintenance. Sucked air is caused to flow in a whirling way with fin (1). As a result, heavier dust particles circulate around the circumference and enter the holes in the baffle cover (6) and accumulate in the dust cup (5). Minute dust, while circulating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

- (1) Fin
- (2) Air Cleaner Body
- (3) Air Filter Element

- (4) To Cylinder
- (5) Dust Cup
- (6) Baffle Cover

01640M10010

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



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

The muffler is used to reduce this noise.

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

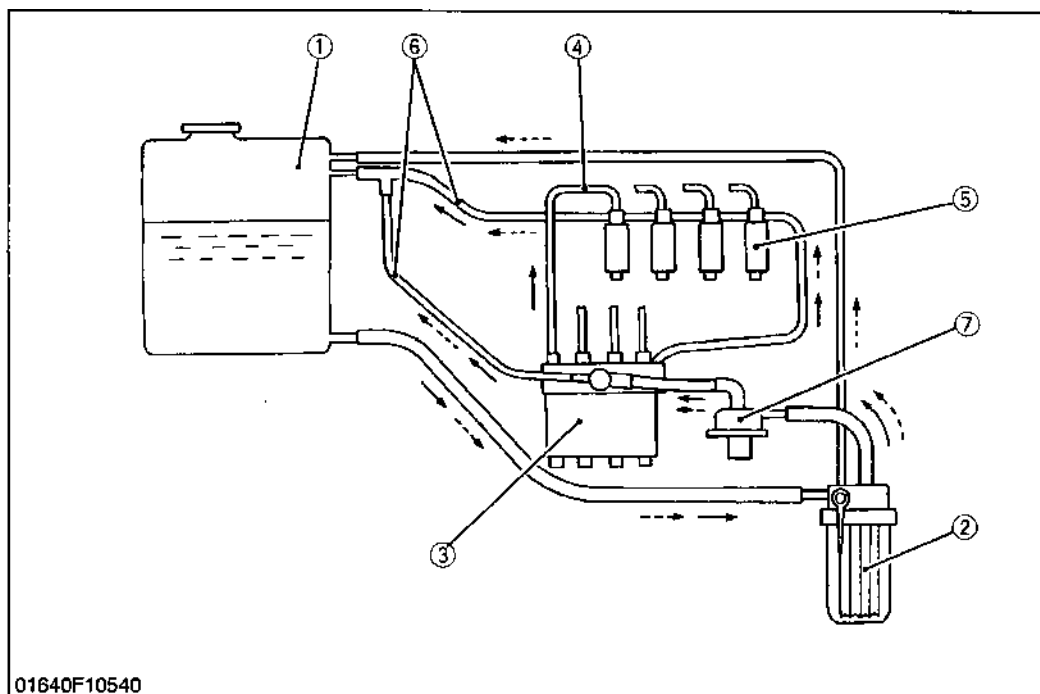
- (1) Main Body
- (2) Glass Wool

- (3) Outer Tube
- (4) Inner Tube

01640M10020

F. Fuel system

[1] General



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

01640F10540

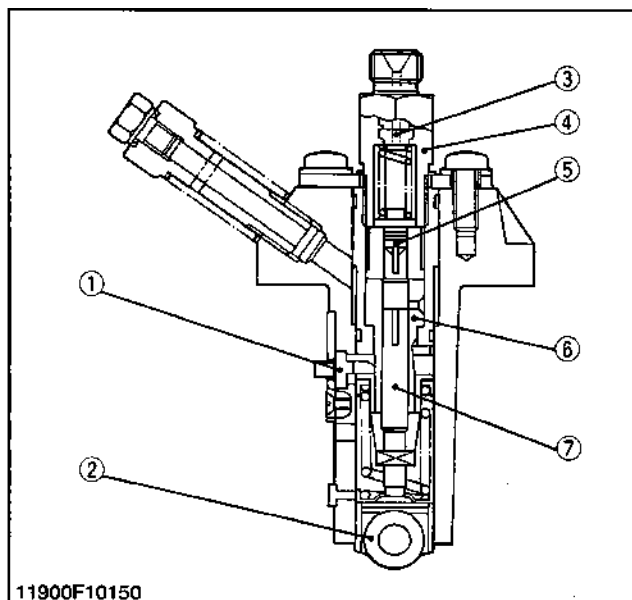
Fuel from the fuel tank (1) passes through the fuel filter (2), and then enters the injection pump (3) after impurities such as dirt, water, etc. are removed.

The fuel pressurized by the injection pump to the opening pressure (13.73 to 14.71 MPa, 140 to 150 kgf/cm², 1991 to 2133 psi), of the injection nozzle (5) is injected into the combustion chamber.

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

11900M10151

[2] Injection pump



11900F10150

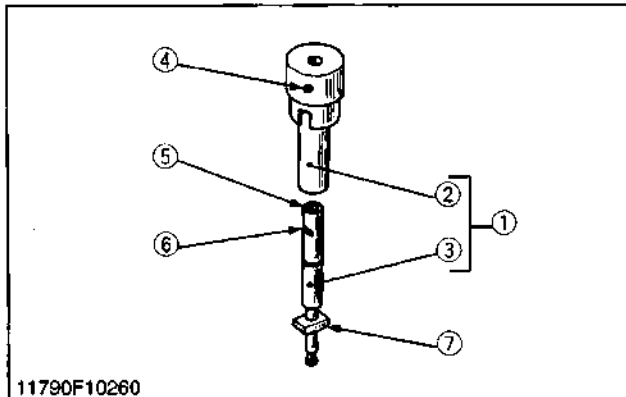
A Bosch MD type mini pump is used for the injection pump. It is small, lightweight and easy to handle.

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

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

11900M10170

(1) Pump Element



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

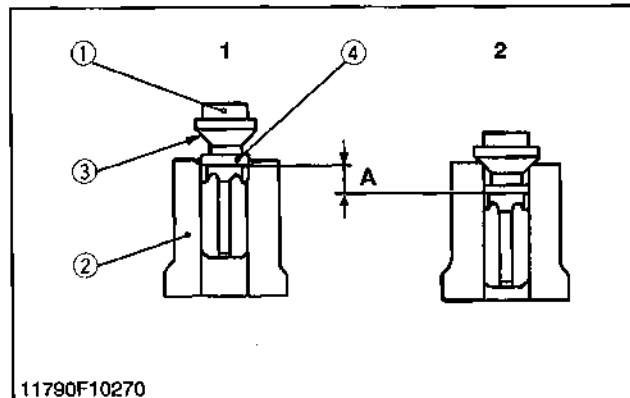
The sliding surfaces are super-precision machined to maintain injection pressure at engine low speeds. Since the driving face (7) fits in the control sleeve, the plunger (3) is rotated by the movement of the control rack to increase or decrease of fuel delivery.

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

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

11790M10231

(2) Delivery Valve



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

The delivery valve performs the following functions.

1. Reverse flow preventing function

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

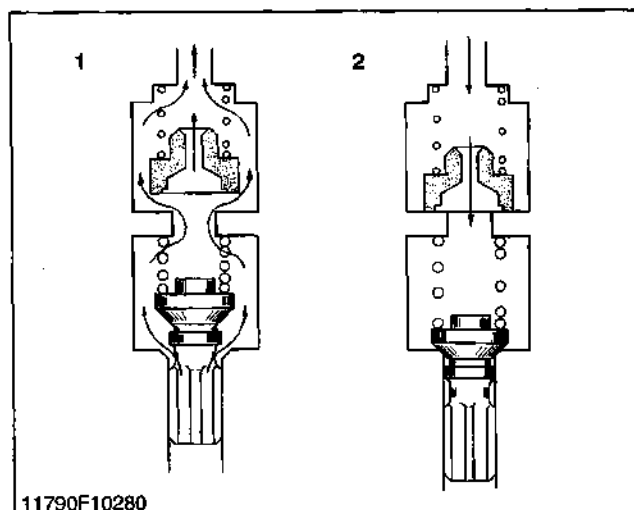
2. Suck-back function

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

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

11790M10241

(3) Dumping Valve



1. At fuel injection

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

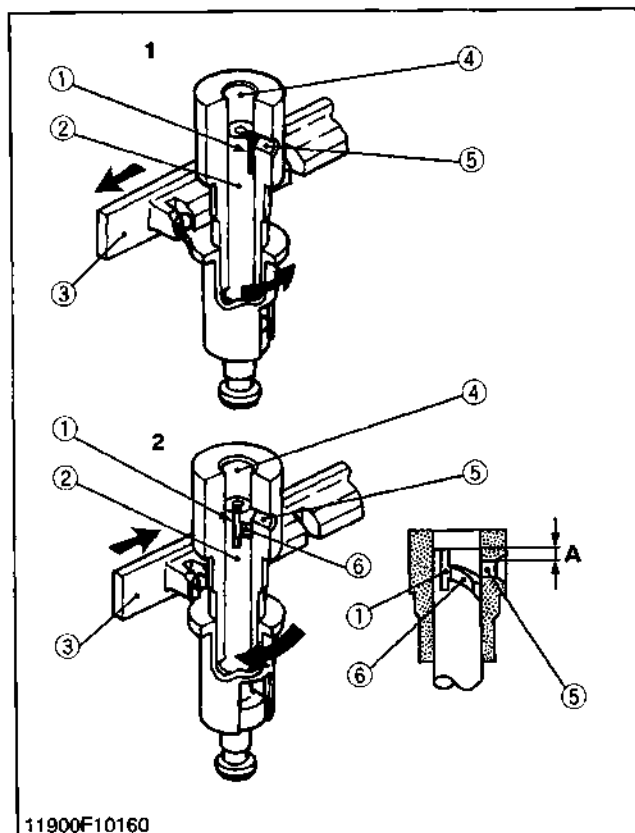
2. At suck-back

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

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

11790M10251

(4) Injection Control



1. No fuel delivery

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

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

2. Fuel delivery

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

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

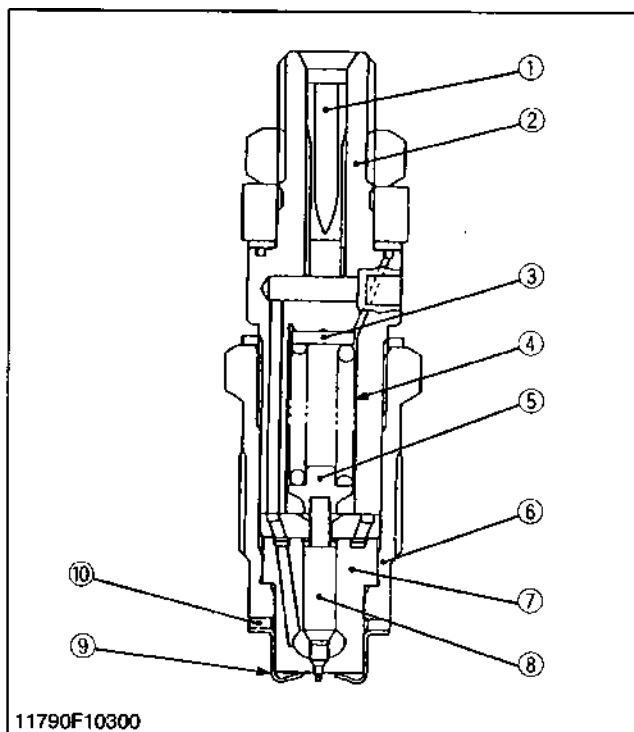
The amount of the fuel corresponds to the distance "A".

- (1) Slot
- (2) Plunger
- (3) Control Rack

- (4) Delivery Chamber
- (5) Feed Hole
- (6) Control Groove

11900M10181

[3] Injection nozzle



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

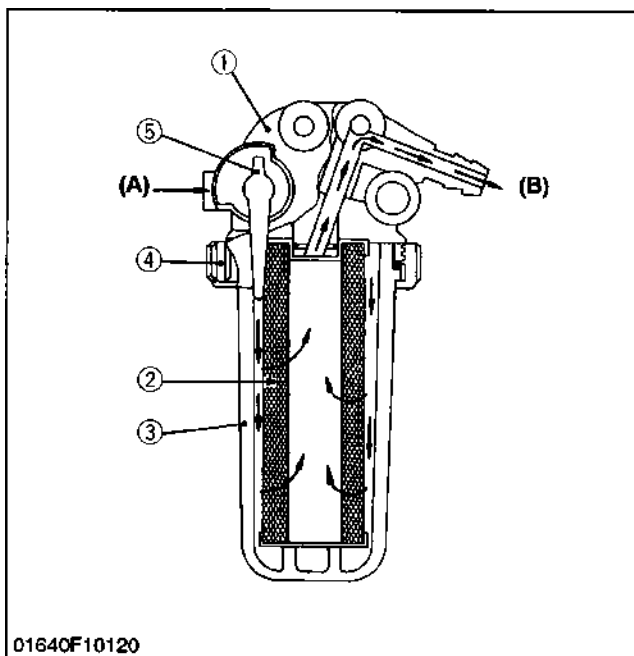
Excessive flow passes from nozzle holder center through the eye joint and the fuel overflow pipe to the fuel tank.

The injection pressure is 13.73 to 14.71 MPa (140 to 150 kgf/cm², 1991 to 2133 psi), and is adjusted with adjusting washers (3).

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

11790M10272

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



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

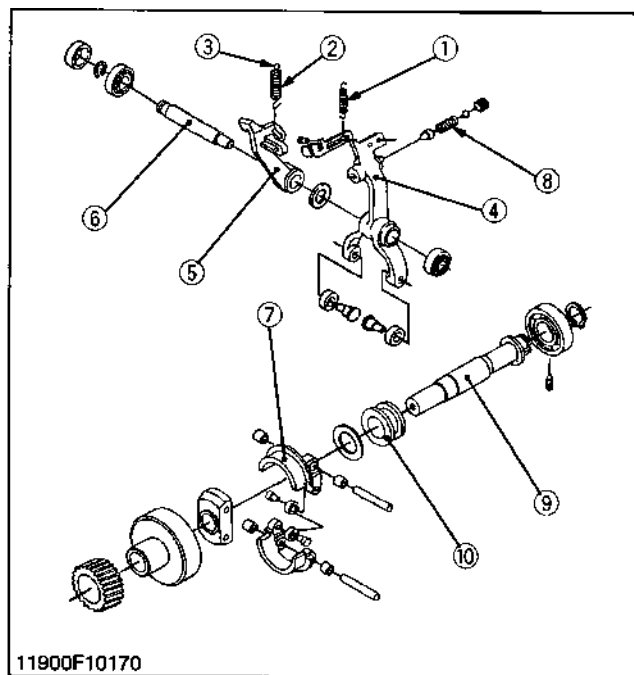
This fuel filter, which uses very fine filter paper, serves to separate and filter dirt in fuel and water accumulated in the tank.

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

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

01640M10030

[5] Governor



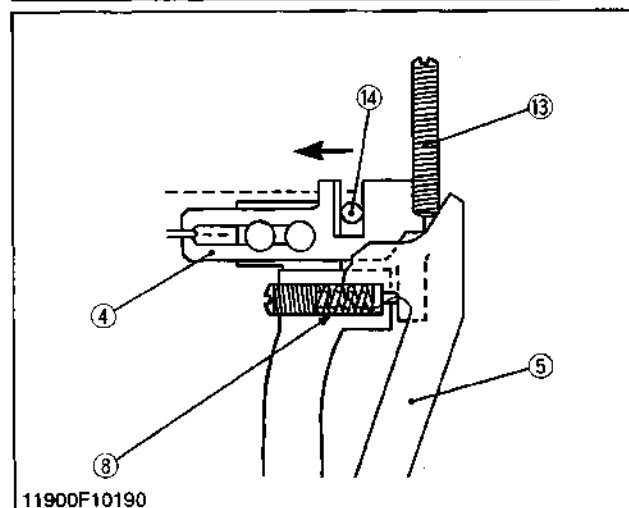
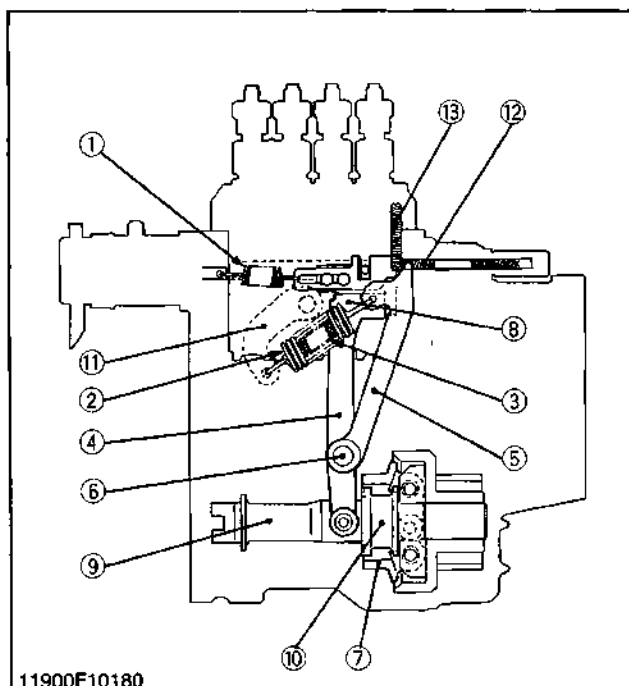
This mechanism maintains engine speed at a constant level even under fluctuating loads, provides stable idling and regulates maximum engine speed by controlling the fuel injection rate.

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

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

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

11900M10190



■ At Start

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

■ At Idling

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

■ At High Speed Running with Overload

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

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

■ During Overload

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

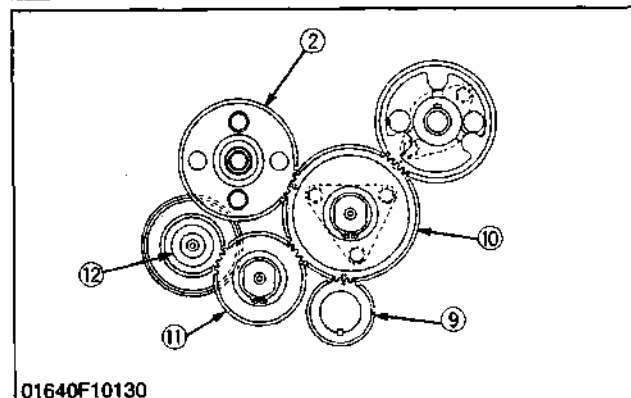
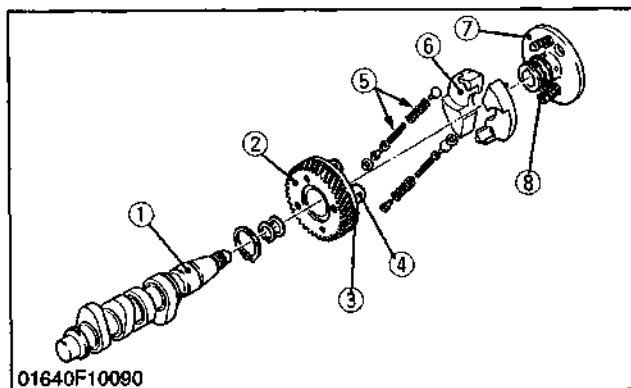
If engine speed decreases due to a further increase in load, fork lever 2 (5) will come in contact with the fuel limit bolt, stopping a further increase in the fuel injection rate.

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

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

11900M10200

[6] Automatic advance timer (not included in the basic model)



Fuel fed by the injection pump passes through the injection pipe to the injection nozzle. The time required for fuel to flow from the injection pump to the nozzle is almost constant, irrespective of enginespeed. The time required for injected fuel to ignite, burn and reach the maximum pressure is also virtually constant, irrespective of engine speed. Therefore, as engine speed increases, ignition timing is delayed, and vice versa. If fuel injection timing is fixed, it is impossible to provide optimum injection timing at each engine speed. To solve this problem, an automatic injection advance timer is used to control fuel injection timing automatically. This engine uses a mechanical timer for this purpose which utilizes the balance between the flyweight's centrifugal force (generated by engine rotation) and spring tension.

The structure of the timer is as illustrated in the figure.

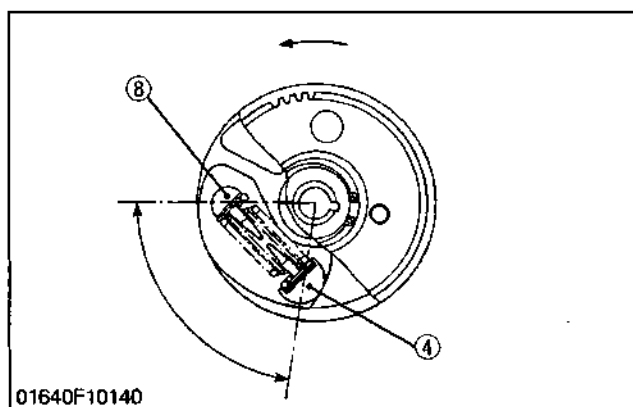
Hub bolt (8) is inserted into the hole located on one side of flyweight (6). Hub (7) is secured to fuel camshaft (1) by key and nut. Driving plate (3) is bolted to injection pump gear (2). Driving bolt (4) securing driving plate (3) is in contact with the curved surface of flyweight (6). Timer spring (5) is installed between driving bolt (4) and hub bolt (8).

Therefore, torque is transmitted from the crankshaft to the fuel camshaft via the following route :

Crank gear (9) → Idle gear 1 (10) → Injection pump gear (2) → Driving plate (3) → Driving bolt (4) → Flyweight (6) → Hub bolt (8) → Hub (7) → Fuel camshaft (1)

- | | |
|-------------------------|--------------------|
| (1) Fuel Camshaft | (7) Hub |
| (2) Injection Pump Gear | (8) Hub Bolt |
| (3) Driving Plate | (9) Crank Gear |
| (4) Driving Bolt | (10) Idle Gear 1 |
| (5) Timer Spring | (11) Idle Gear 2 |
| (6) Flyweight | (12) Governor Gear |

01640M10040



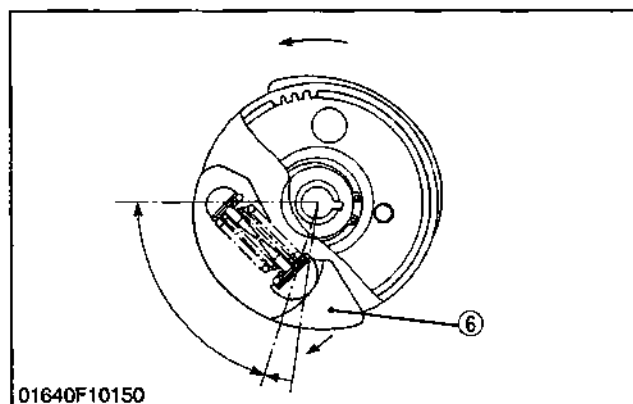
■ During low-speed travel

As the centrifugal force applied to flyweight (6) is small, spring force presses the flyweight inward, permitting driving bolt (4) to come in contact with flyweight at the position shown in the figure.

(4)Driving Bolt

(8)Hub Bolt

01640M10050



■ During medium- to high-speed travel

As engine speed increases, the centrifugal force applied to flyweight (6) increases, expanding it around hub bolt (8) in the direction of the arrow, thereby rotating the position (where driving bolt (4) is in contact with flyweight (6)) through angle θ as shown in the figure.

Therefore, since the fuel camshaft rotates from injection pump gear (2) in the rotational direction through angle θ , injection timing is advanced.

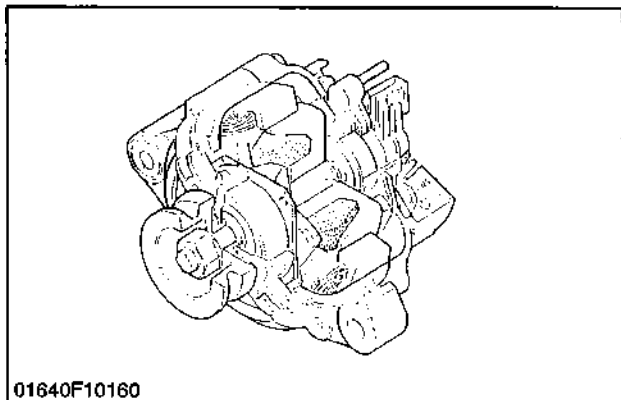
(6)Flyweight

01640M10060

G.Electrical system

[1] Charging system

(1) Alternator

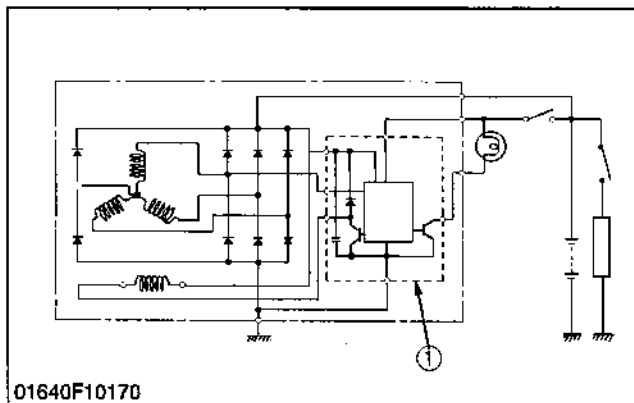


A compact alternator with an IC regulator is used, having the following characteristics:

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

01640M90010

(2) IC Regulator



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

IC regulators have the following characteristics:

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

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

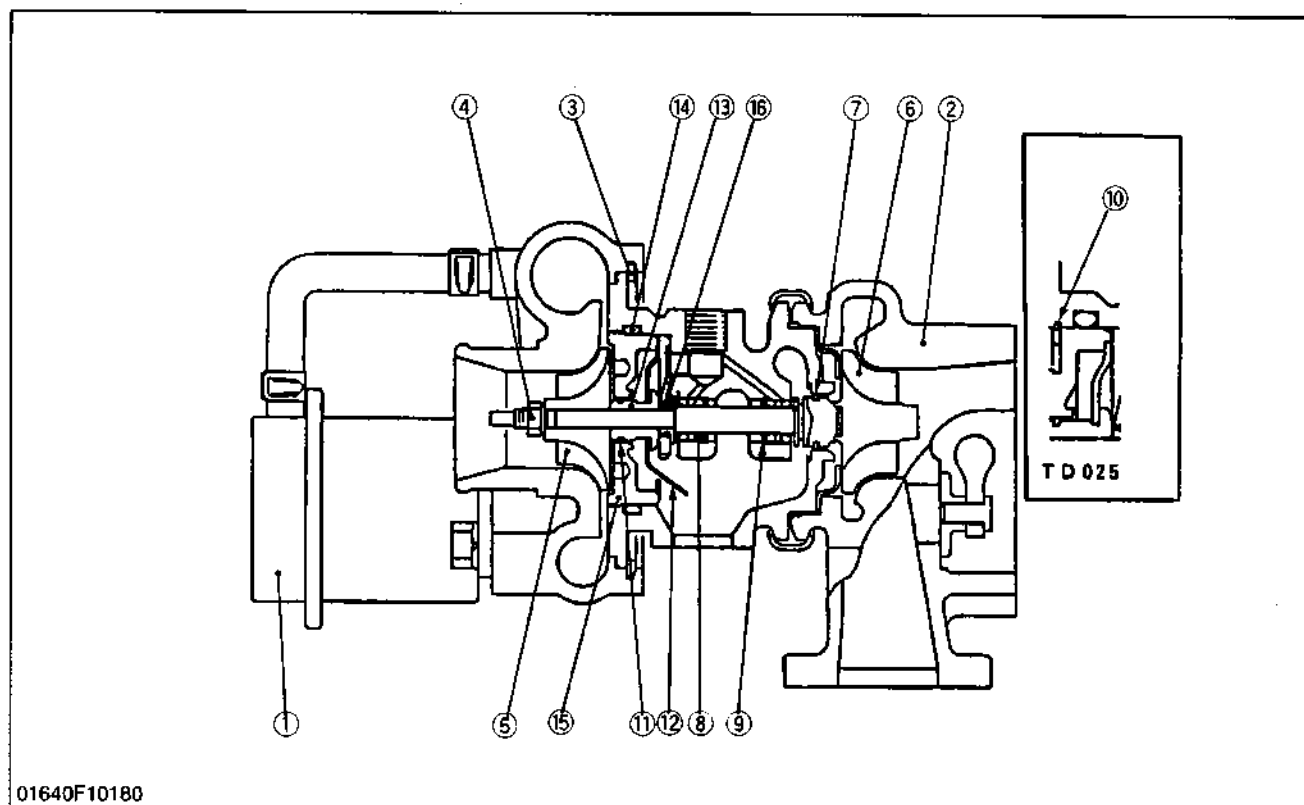
Tr1 acts as the contacts controlling the field current, and **Tr2** acts as the charge lamp relay controlling the flashing of the charge lamp.

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

(1) IC Regulator

01640M90020

H.Turbo charger system



01640F10180

- | | | | |
|---------------------|----------------------|------------------------|---------------------|
| (1) Actuator | (5) Compressor Wheel | (9) Snap Ring | (13) Thrust Sleeve |
| (2) Turbine Housing | (6) Turbine Wheel | (10) Snap Ring (TD025) | (14) O-ring |
| (3) Snap Ring | (7) Piston Ring | (11) Piston Ring | (15) Thrust Bearing |
| (4) Lock Nut | (8) Bearing | (12) Oil Deflector | (16) Thrust Ring |

This turbo charger consists basically of a centrifugal compressor mounted on a common shaft with a double flow turbine driven by exhaust gas from the engine.

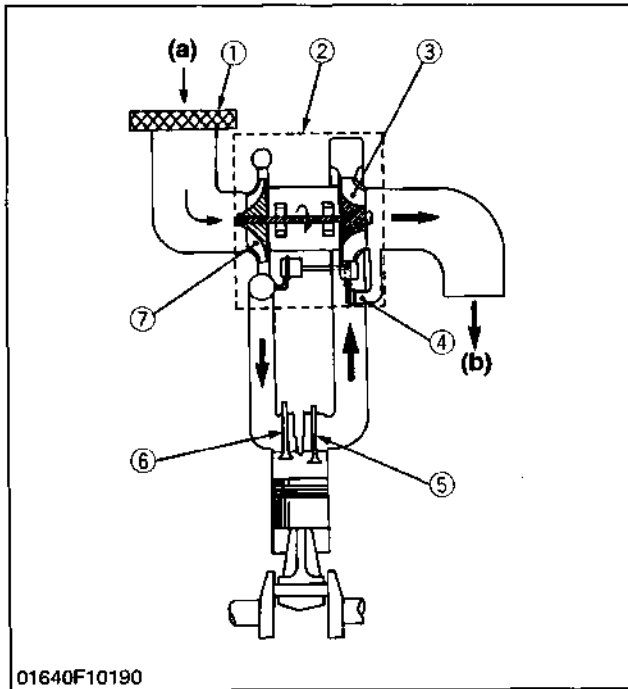
The turbo charger is capable of supplying far more air to the engine than for a non-supercharged engine, which is without such a charger.

In applications where the boost pressure is relatively low, the turbo charger is capable of reducing the smoke

concentration, the concentration in the cylinder, fuel consumption, and deterioration in performance at elevated terrain by increasing the amount of air to the engine.

In applications where the boost pressure is high, the charger is capable of providing a large increase in engine output by increasing the amount of air into the engine, in addition to the above mentioned advantages.

01640M10070

(1) Mechanism**■ Turbocharger Works**

While the engine is running, exhaust gas passes through the exhaust manifold to rotate the turbine wheel (3) of the turbocharger (2) at high speed.

Rotation of the turbine wheel rotates the compressor wheel (7) at the same speed because both wheels are on the same shaft. As the compressor wheel rotates, air is sucked in, compressed, and sent into the cylinder.

The higher density of the compressed air per cylinder volume results in increased output compared with non-turbocharged engines of the same displacement.

■ Advantages

Turbocharged engine have the following advantages:

1. Despite the increase in output, there is little increase in friction loss. Therefore, good mechanical efficiency is insured.
2. During overlap (when both the suction and exhaust valves are open), compressed air forces out exhaust gas and fills the cylinder with fresh air. This increases combustion efficiency.
3. Improvements in mechanical and combustion efficiency lead to a lower fuel consumption.

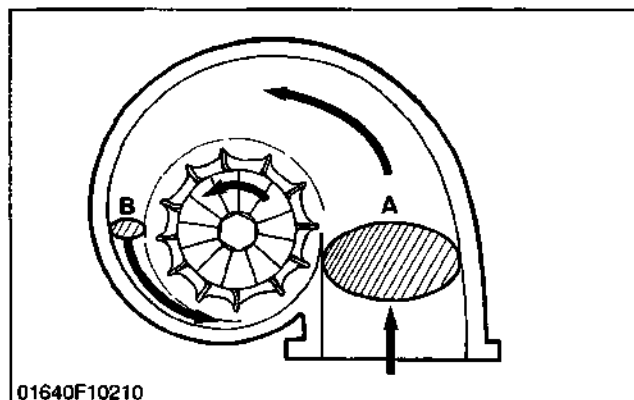
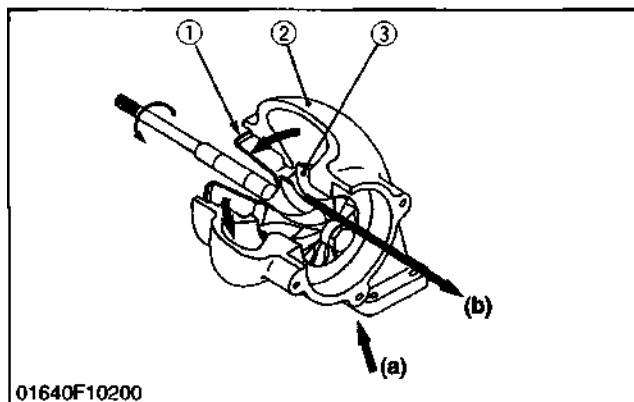
- (1) Air Cleaner
- (2) Turbocharger
- (3) Turbine Wheel
- (4) Waste Gate Valve
- (5) Exhaust Valve

- (6) Intake Valve
- (7) Compressor Wheel

- (a) Air
- (b) Exhaust Gas

01640M10080

(2) Turbine



This is a radial flow turbine.

The turbine wheel assembly (3) uniting the turbine wheel and shaft is designed to balance even at high speeds.

The turbine housing (2) has a vortex gas passage. As the passage becomes smaller (from "A" to "B"), the gas flow rate increases so that the turbine is rotated at high speeds.

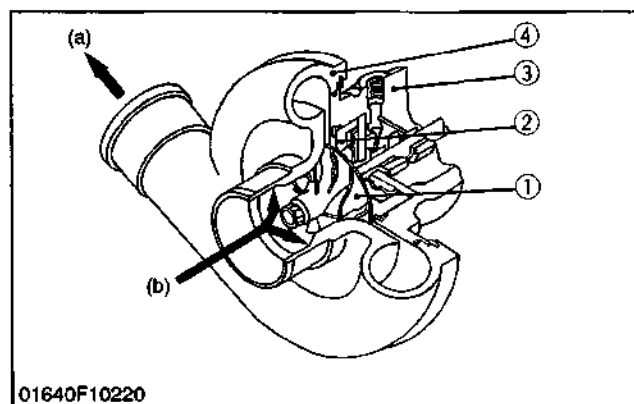
The turbine back plate (1) prevents the bearing housing and bearing (floating metal) inside from being directly exposed to the heat of the exhaust gas on the turbine wheel side.

- (1) Turbine Back Plate
- (2) Turbine Housing
- (3) Turbine Wheel Assembly

- (a) From Cylinder
- (b) To Exhaust Muffler

01640M10090

(3) Compressor



A radial flow compressor is used.

The compressor consists of a cast compressor wheel (1), bearing housing (3), insert (2), compressor cover (4).

Air is sucked at high speed by the compressor wheel. As it passes through the spiral passage in the housing, its speed is reduced to the proper level and forced into the cylinder.

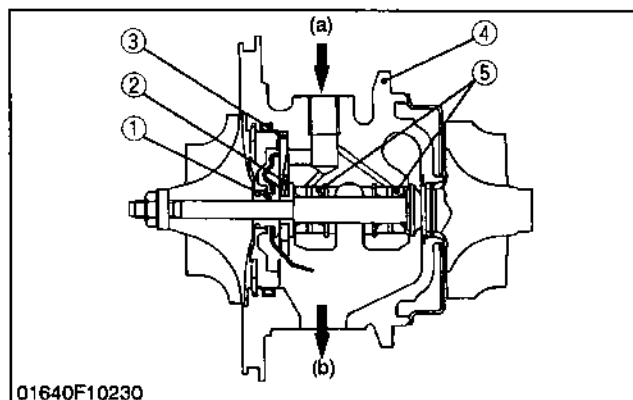
The compressor wheel is a precision-cast component, which maintains the proper balance even at high speeds. Its blades are curved backward to ensure the highest performance.

The compressor housing is designed to regulate the air flow drawn by the wheel and increase its pressure.

- (1) Compressor Wheel
- (2) Insert
- (3) Bearing Housing
- (4) Compressor Cover

- (a) To Cylinder
- (b) From the Air Cleaner

01640M10100

(4) Bearing

01640F10230

The shaft rotates at a very high speed-tens of thousands of revolutions per minute. To withstand high speeds, the bearings (5) use floating metals. These bearings float on a film oil between the shaft and bearing housing (4) and rotate to reduce the sliding friction.

The shaft also receives thrust force (in the axial direction) on the compressor side from both the turbine and compressor wheels. This load is borne by the thrust bearing (3) fitted between the thrust sleeve (1) and thrust ring (2) which is secured to the shaft and turns together with the shaft.

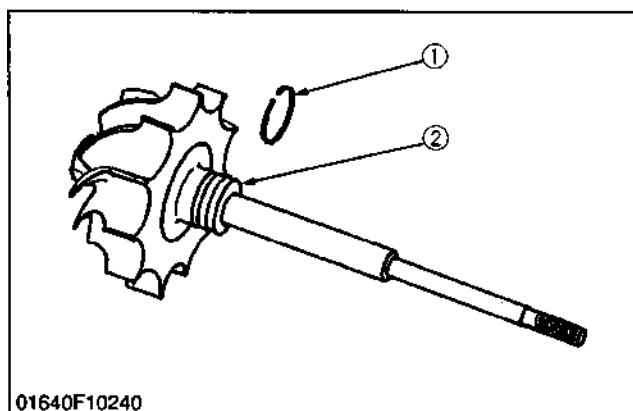
Lubricating oil fed from the engine's oil pump enters the bearing section through the top of the bearing housing and passes through the internal passages, lubricating the bearings. After that, it returns to the engine from the bottom of the bearing housing.

- (1) Thrust Sleeve
- (2) Thrust Ring
- (3) Thrust Bearing
- (4) Bearing Housing
- (5) Bearing

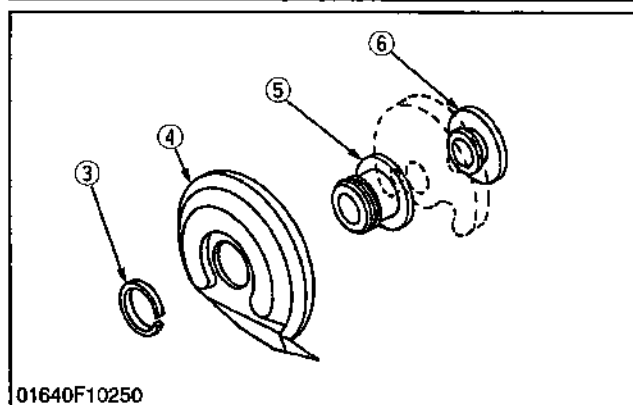
- (a) From Engine Oil Pump
- (b) To the Engine

01640M10110

(5) Seals (Piston Rings)



01640F10240



01640F10250

When lubricating oil leaks on the turbine or compressor wheel side, it will adhere to the wheel or housing. The oil may then be contaminated with dust or carbon. Such contamination will destroy the balance of the rotating shaft and prevent normal operation.

To prevent this problem, lubricating oil is sealed by the following parts:

On the turbine wheel side

- * A piston ring (1) is placed over the shaft.
- * The shaft itself has an oil fling portion (2).

On the compressor wheel side

- * A piston ring (3) is placed over the thrust sleeve (5).
- * The oil deflector (4), which is placed on the thrust sleeve (5), prevents oil from leaking to the piston ring side.

In addition, oil is prevented from leaking to the outside by a seal ring (square rubber ring) placed between the center housing and the back plate.

- | | |
|--|-------------------|
| (1) Piston Ring
(on the Turbine Side) | (4) Oil Deflector |
| (2) Oil Fling Portion | (5) Thrust Sleeve |
| (3) Piston Ring
(Compressor Side) | (6) Thrust Ring |

01640M10120

III. Engine (Service section)

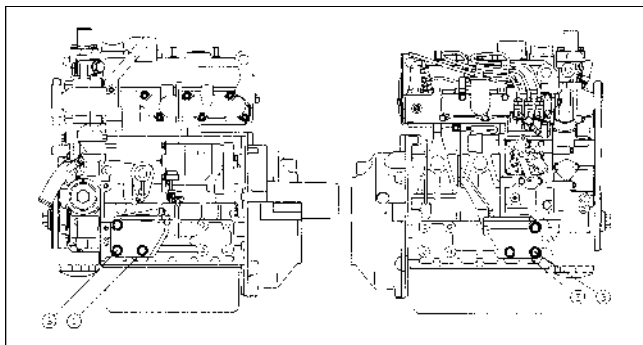
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[3] Tightening torques	III-S-12
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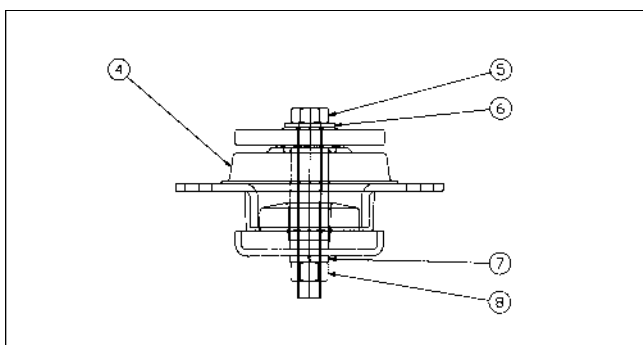
A.Engine mount on the machine

(1) Engine bracket

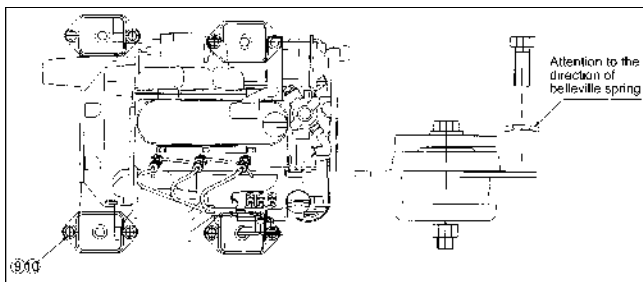
Engine bracket assembly view



Anti-vibration rubber assembly view



Engine setup view



[1] Assembling procedure

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

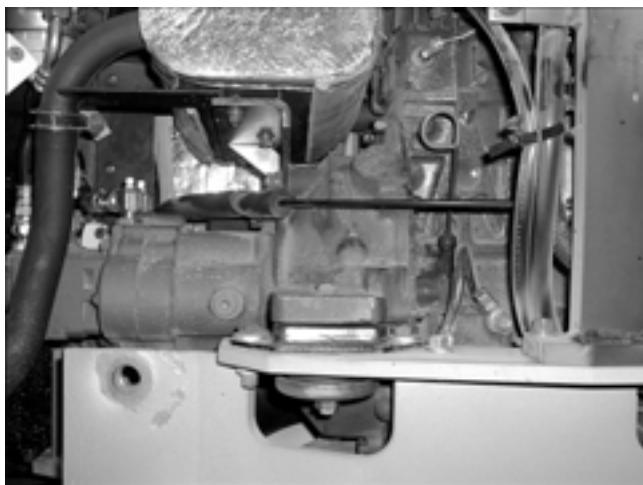
3) Parts list

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

- 4) Tightening torque of engine mounting bolt:
103.0~117.7N·m
(10.5~12.0kgf·m)
* Apply screw loctite (Loctite 271).

5) Parts list

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



Engine front side



Engine rear side

(2) Radiator

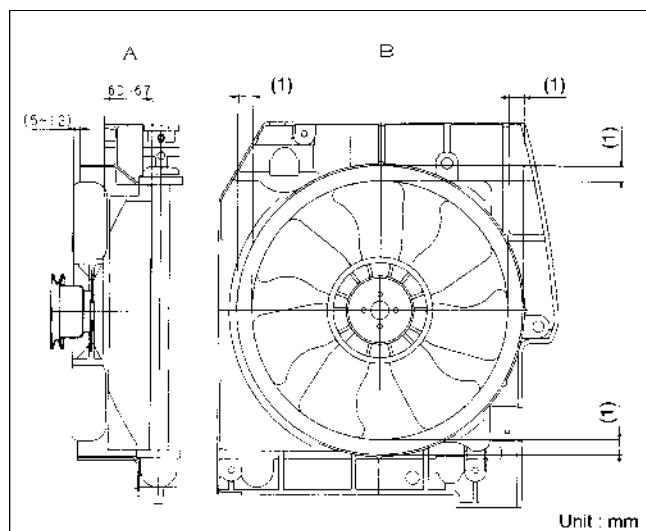


[1] Detaching the radiator

- 1) Park the machine on a level floor. Bring down the front attachment and blade on the floor.
- 2) Remove the bonnet and the right side cover.
- 3) Remove the drain plug from the bottom of the radiator to let out all cooling water. (For changing the cooling water, refer to page A-31.)
- 4) Using a vacuum pump, detach the oil cooler.
- 5) Disconnect the two radiator hoses from the radiator. Take out the radiator.



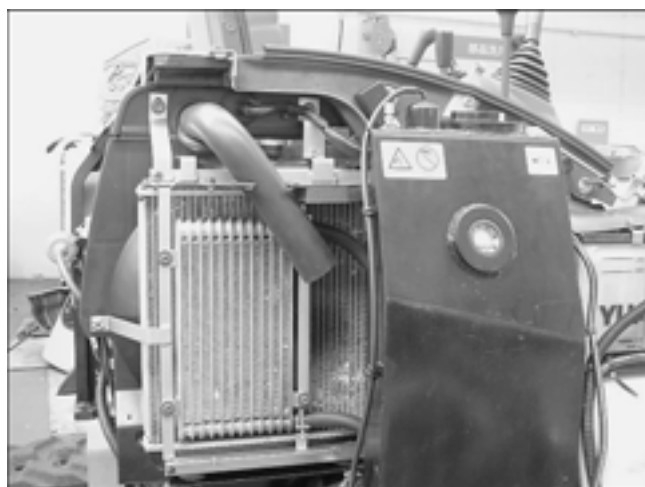
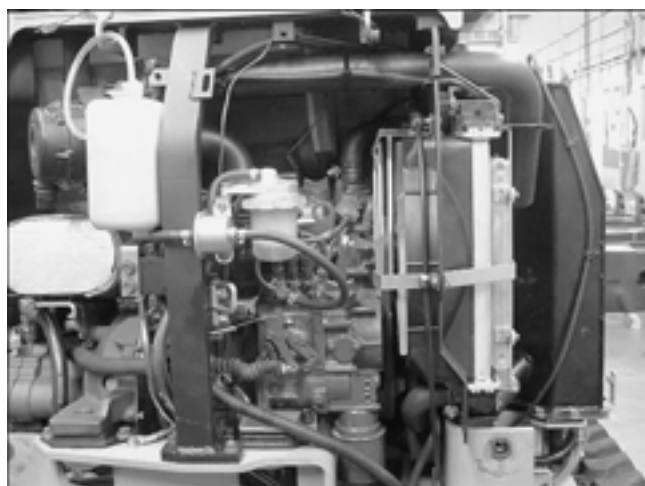
Radiator assembly view 1



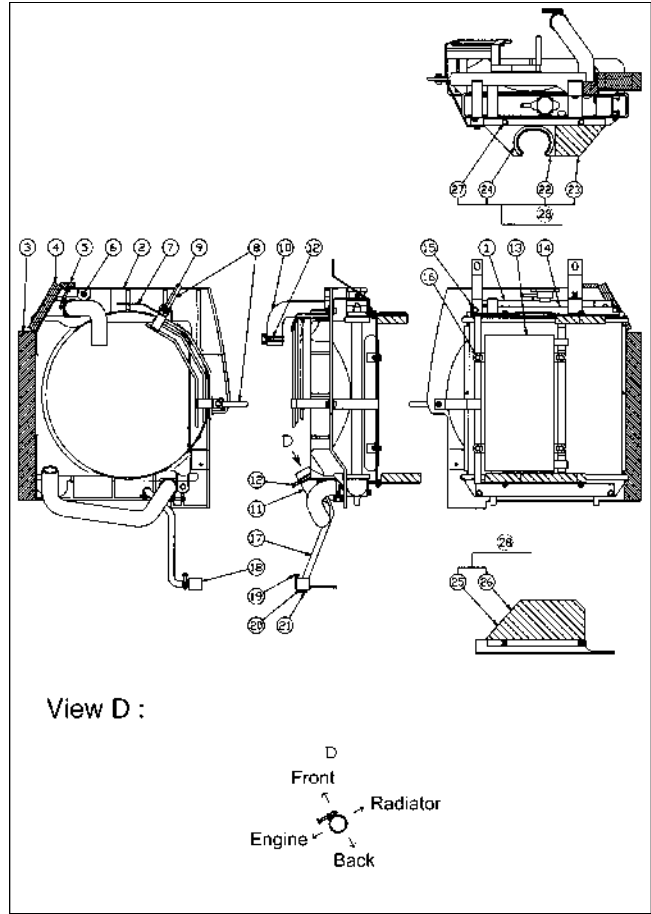
[2] Reassembling the radiator

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

(1)10 over



Radiator assembly view 2

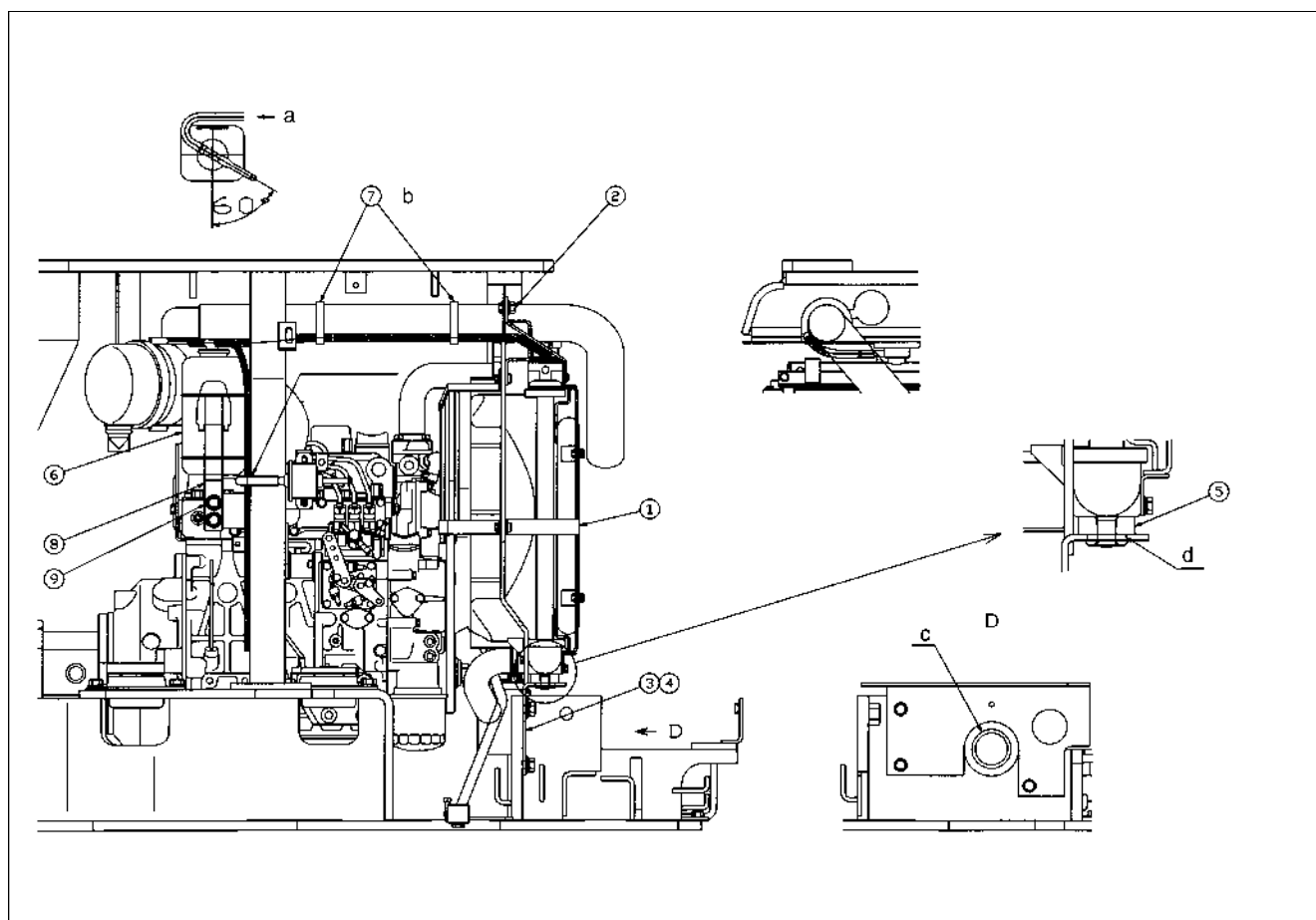


28 U-25 only

3) Parts list

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

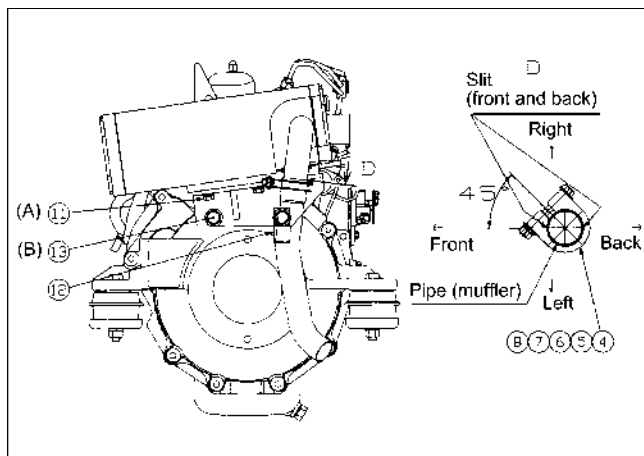
Radiator assembly view 3



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

(3) Muffler

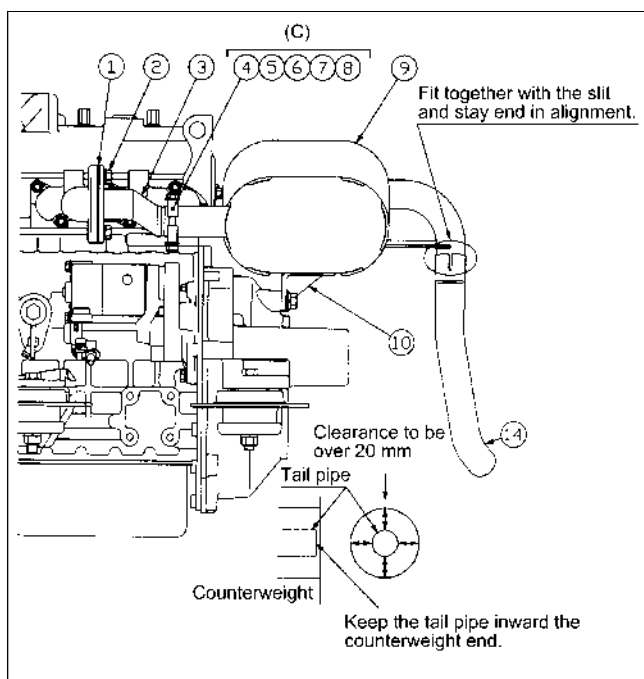
Muffler assembly view 1



[1] Reassembling procedure

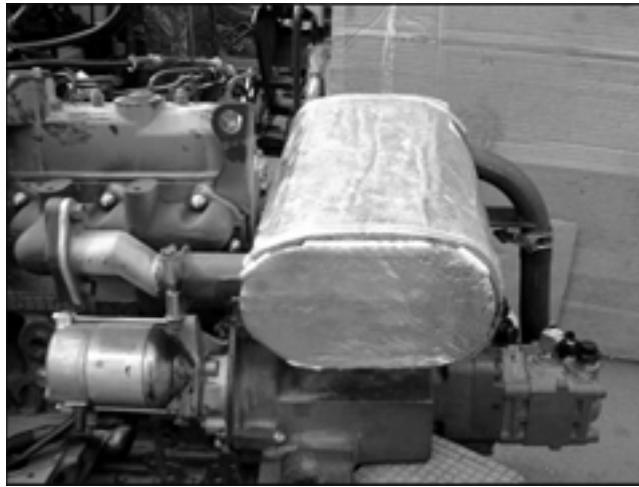
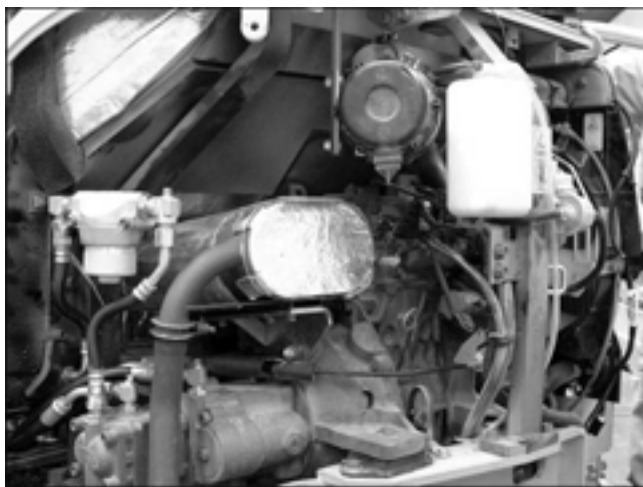
- 1) Reassembling steps
 - Temporarily tighten the bolts (A), (B) and (C).
→ Make sure there is no gap at the bolts.
First tighten up the bolt (A).
→ Tightening torque
23.5~27.5N·m (2.4~2.8kgf·m)
 - Second tighten up the bolt (B).
→ Tightening torque
77.5~90.2N·m (7.9~9.2kgf·m)
 - Third tighten up the bolt (C).
→ Tightening torque
3.9~5.9N·m (0.4~0.6kgf·m)
- 2) Keep a clearance of over 20 mm between the tail pipe and counterweight.

Muffler assembly view 2

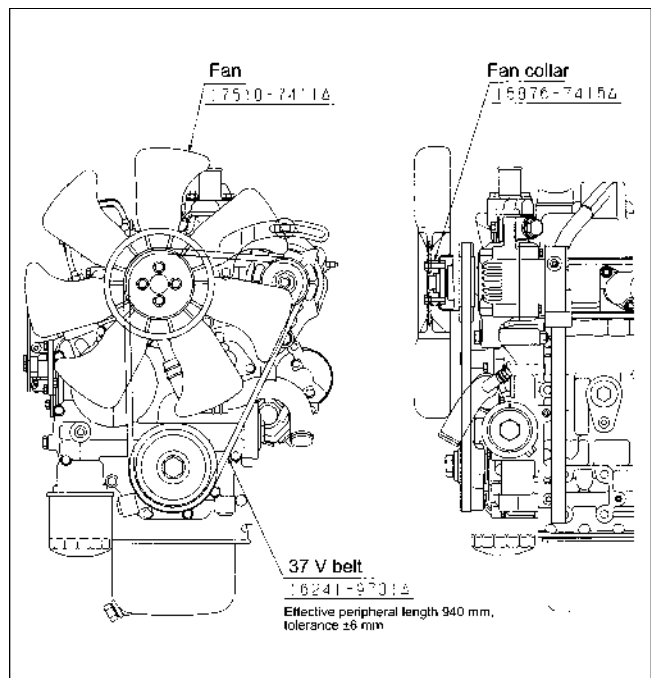


3) Parts list

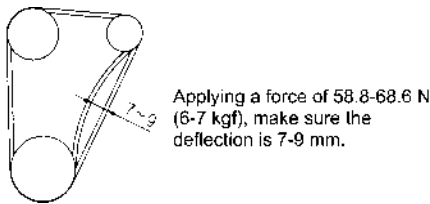
No.	Part name	Q'ty	Remarks
1	Packing (non-asbestos)	1	(424)
2	Bolt	2	M10×1.25 7T
3	Flange (muffler)	1	
4	Exhaust pipe band	2	
5	Bolt	2	M10×1.25 7T
6	Plain washer	4	
7	Spring washer	2	
8	Nut	2	
9	Muffler, assembly	1	
10	Bracket (muffler)	1	
11	Bolt	3	
12	Cord clamp assembly 2	1	
13	Bolt	2	M10×1.25 7T
14	Pipe (muffler)	1	U-20-3
	Pipe (muffler)	1	U-25



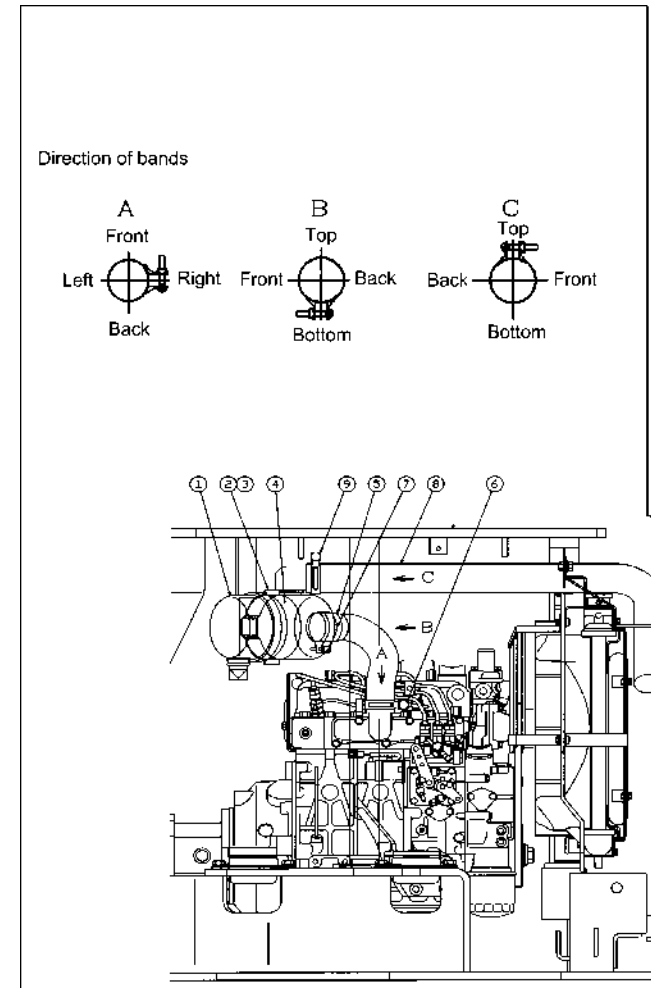
(4) Fan belt
Engine assembly view



- [1] Reassembling procedure
- 1) Tightening torque of fan flange bolt:
7.8~8.8N·m (0.8~0.9kgf·m)
Fit the fan in position, referring to the figure at left.
 - 2) Tightening torque of sensor (temperature):
62.7~72.5N·m (6.4~7.4kgf·m)
 - 3) Tightening torque of alternator assembly mounting bolt:
39.2~44.1N·m (4.0~4.5kgf·m)
 - 4) Adjusting the V belt tension
Pressing the belt with a force of 58.8-68.6 N (6~7 kgf·m), readjust the deflection to 7~9 mm.

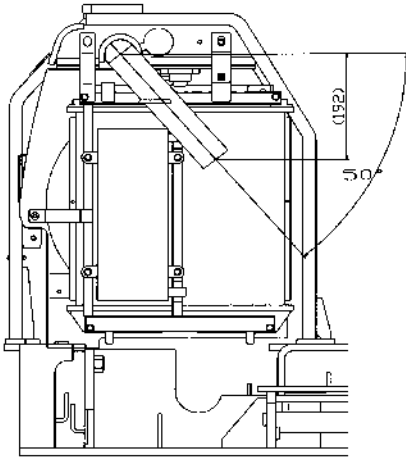


(5) Air cleaner
Air cleaner assembly view



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

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



B. General

[1] Engine identification

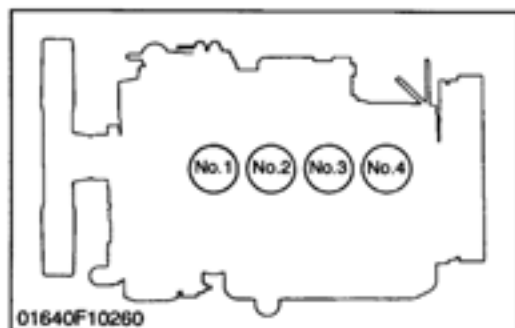
(1) Model Name and Engine Serial Number



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

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(2) Cylinder Number

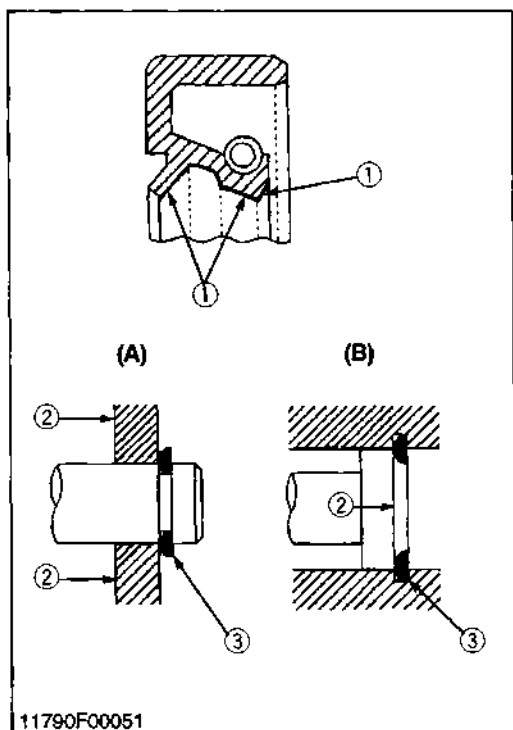


The cylinder numbers of 05 SERIES diesel engine are designated as shown in the figure.

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

01640S10020

[2] General precaution



- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be replaced in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently used should be 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.



CAUTION

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

(1) Grease

(2) Force

(3) Place the Sharp Edge against the Direction of Force

(A) External Snap Ring

(B) Internal Snap Ring

01640S10030

[3] Tightening torques

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

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

■ NOTE

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

Item	Size × Pitch	N·m	kgf·m	ft-lbs
* Cylinder head cover cap nuts	M7 × 1.0	6.9 to 8.8	0.7 to 0.9	5.1 to 6.5
* Cylinder head screws	M10 × 1.25	63.7 to 68.6	6.5 to 7.0	47.0 to 50.6
* Main bearing case screws 1	M8 × 1.25	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
* Main bearing case screws 2	M9 × 1.25	49.0 to 53.9	5.0 to 5.5	36.2 to 39.8
* Flywheel screws	M10 × 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Connecting rod screws	M8 × 1.0	41.2 to 46.1	4.2 to 4.7	30.4 to 34.0
* Rocker arm bracket nuts	M7 × 1.0	21.6 to 26.5	2.2 to 2.7	15.9 to 19.5
* Idle gear shaft screws	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Crankshaft (Serial No: ~ 604086)	M14 × 1.5	142.2 to 152.0	14.5 to 15.5	104.9 to 112.1
end bolt (Serial No: 604087 ~)	M14 × 1.5	235.4 to 245.2	24.0 to 25.0	173.6 to 180.8
* Bearing case cover screws	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
Glow plugs (Serial No: ~ 489290)	M10 × 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
(Serial No: 489291 ~)	M8 × 1.0	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
Nozzle holder assembly	M20 × 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Oil switch taper screw	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Injection pipe retaining nuts	M12 × 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Overflow pipe assembly retaining nuts	M12 × 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Starter's terminal B mounting nut	M8	8.8 to 11.8	0.9 to 1.2	6.5 to 8.7

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

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

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

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

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

01640S10040

[4] Troubleshooting

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

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

11790S10562

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

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[5] Servicing specifications

(1) Engine Body

Cylinder Head

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

Valves

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

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Valve Timing

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

Valve Spring

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

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Rocker Arm

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

Tappet

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

Camshaft

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

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Timing Gear

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

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Piston · Piston Ring

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

Connecting Rod

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

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Crankshaft

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

Cylinder Liner

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

01642S10500

(2) Lubricating System**Oil Pump**

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

01642S10510

(3) Cooling System**Thermostat**

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

Radiator

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

01640S10520

(4) Fuel System**Injection Pump**

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

Injection Nozzle

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

01642S10530

(5) Electrical System**Starter**

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

Alternator

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

Glow Plug

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

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

01640S10540

[6] Maintenance check list

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

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

(1), (2) For generators (3000 / 3600 rpm)

(3), (4) For generators (1800 / 1500 rpm) and general construction / industrial machinery and farm equipment

(5), (6) For generators (3000 / 3600 rpm) and general construction / industrial machinery and farm equipment

(7), (8) For generators (1800 / 1500 rpm)

* Change engine oil and oil cartridge after the first 50 hours of operation.

** Maintenance intervals as per EPA instructions.



CAUTION

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

01640510730

[7] Check and maintenance

(1) Daily Check Points

Checking Engine Oil Level

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

■ IMPORTANT

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

01640S10050

Checking and Replenish Cooling Water

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



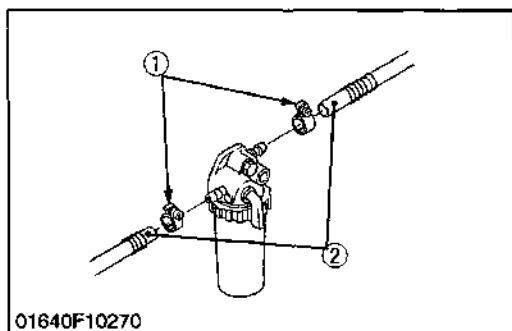
CAUTION

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

■ IMPORTANT

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

01640S10060

(2) Check Point of Every 50 hours**Checking Fuel Pipe**

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

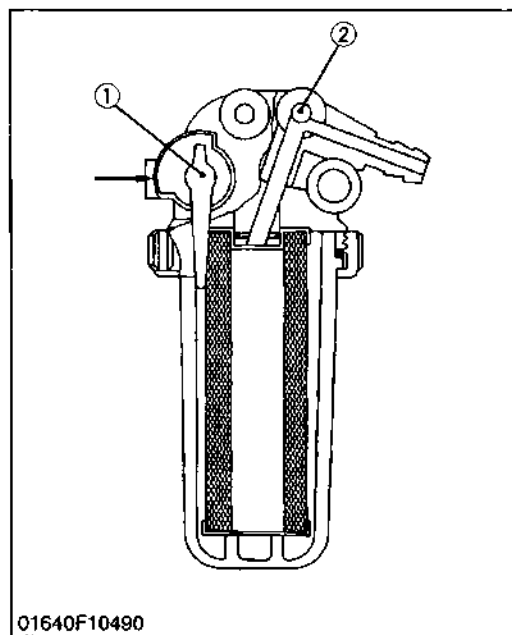
**CAUTION**

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

(1) Clamp

(2) Fuel Pipe

01640S10070

**(When bleeding fuel system)**

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

NOTE

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

(1) Fuel Cock

(2) Air Vent Plug

01640S10080

(3) Check Point of Every 100 hours**Changing Engine Oil**

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

■ IMPORTANT

- Engine oil should be MIL-L-46152 / MIL-L-2104C or have properties of API classification CD / CE grades.
- Change the type of engine according to the ambient temperature.

Above 25 °C (77 °F)..... SAE 30 or 10W-30

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

Below 0 °C (32 °F)..... SAE 10W or 10W-30

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

01640S10090

Changing Engine Oil Filter Cartridge

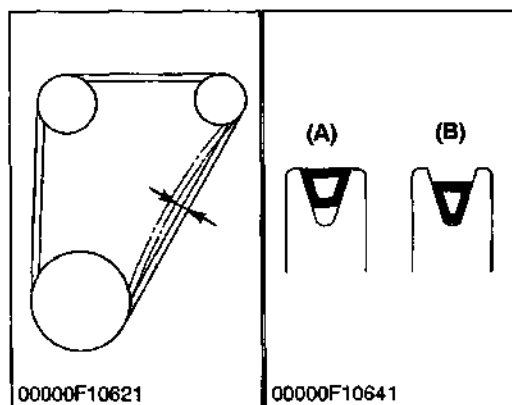
1. Remove the oil filter cartridge with a filter wrench.
2. Apply engine oil to the rubber gasket on the new cartridge.
3. Screw the new cartridge in by hand. (See page S-44.)

■ NOTE

- Over-tightening may cause deformation of rubber gasket.
- After cartridge has been replaced, engine oil normally decreases a little.

Check the oil level and add new oil to the specified level.

01640S10100



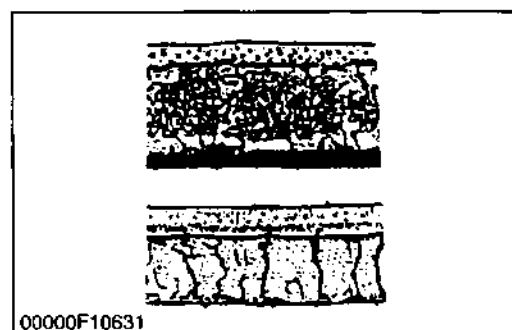
Checking Fan Belt Tension

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

(A) Good

(B) Bad

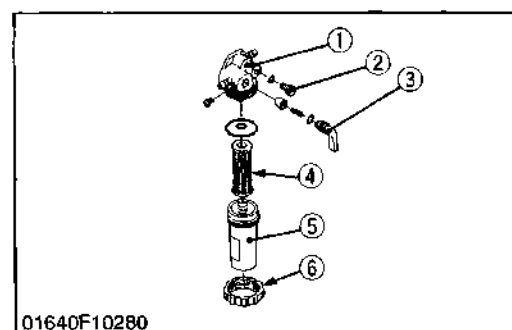
01640S10110



Checking Fan Belt Damage

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

00000S10461



Cleaning Fuel Filter

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

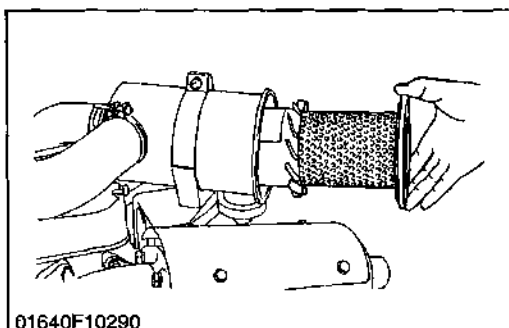
■ IMPORTANT

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

- (1) Cock Body
(2) Air Vent Plug
(3) Filter Cock

- (4) Filter Element
(5) Filter Cup
(6) Retaining Ring

01640S10120



Cleaning Air Cleaner

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

■ NOTE

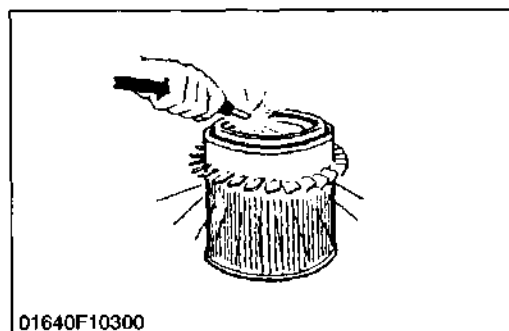
- Change the element once a year or every 6th cleaning.

■ IMPORTANT

- Install the air cleaner dust cup with "TOP" indicated on the rear of the cup in the upside.

If the dust cup is mounted incorrectly, dust or dirt does not collect in the cup, and direct attachment of the dust to the element will cause its life time to shorten to a great extent.

01640S10130



Cleaning Air Filter Element

- **When dry dust adheres**

Use clean dry compressed air on the inside of the element.

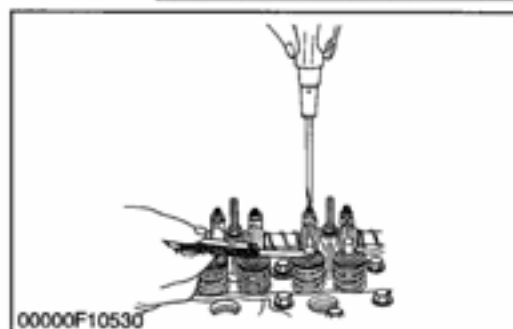
Air pressure at the nozzle must not exceed 690 kPa (7 kgf/cm², 100 psi).

Maintain reasonable distance between the nozzle and the filter.

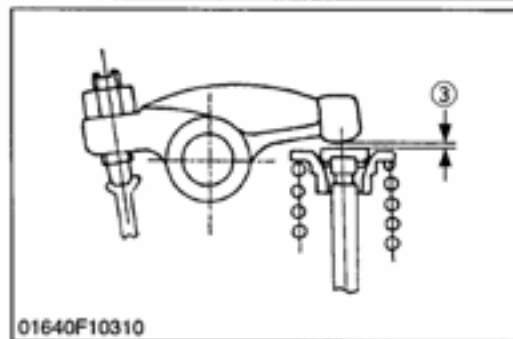
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(4) Check Point of Every 800 hours

01640P10020



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01640F10310

Checking Valve Clearance**■ IMPORTANT**

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

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

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

■ NOTE

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

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

(1) Projection
(2) TC Mark Line

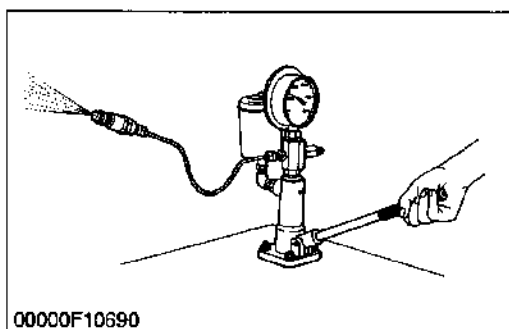
(3) Valve Clearance

01640S10150

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

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

01640S10160



00000F10690

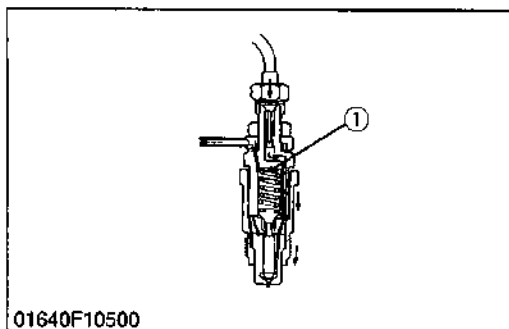
Checking Nozzle Injection Pressure

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

(Reference)

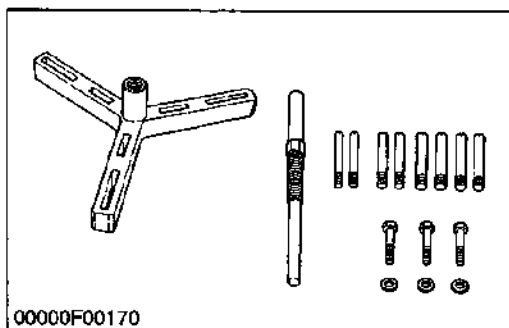
- Pressure variation with 0.025 mm (0.001 in.) difference of adjusting washer thickness.
Approx. 59 kPa (6 kgf/cm², 85 psi)

(1) Adjusting Washer



01640F10500

01640S10170

[8] SPECIAL TOOLS

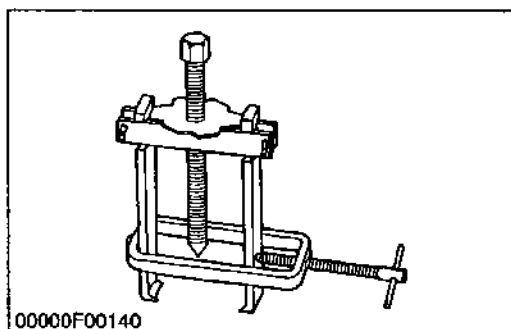
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Flywheel Puller

Code No: 07916-32011

Application: Use to remove the flywheel.

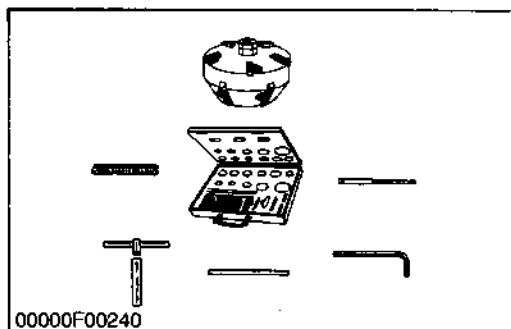
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**Special-use Puller Set**

Code No: 07916-09032

Application: Use for pulling out bearings, gears and other parts.

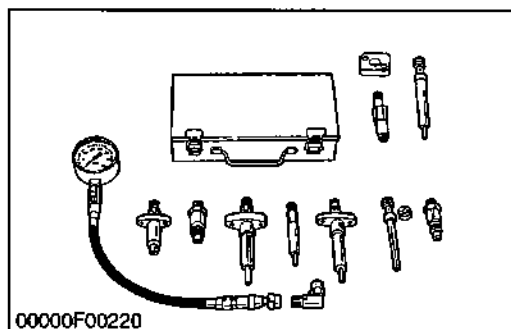
01640S10190

**Valve Seat Cutter Set**

Code No: 07909-33102

Application: Use for correcting valve seats.

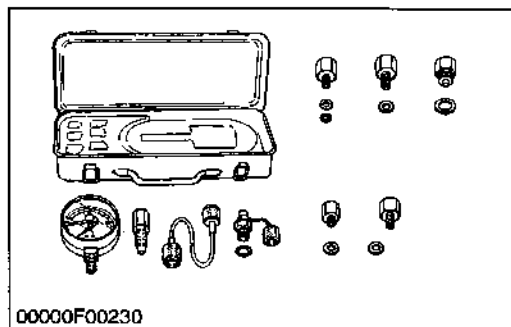
01640S10200

**Diesel Engine Compression Tester**

Code No: 07909-30207

Application: Use for measuring diesel engine compression pressure.

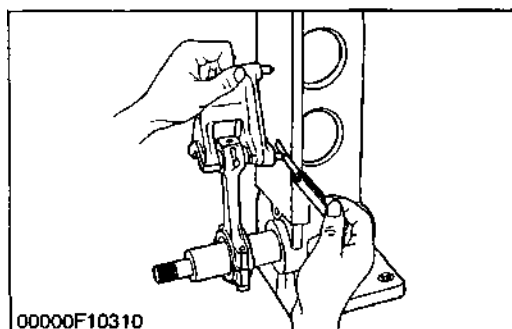
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**Oil Pressure Tester**

Code No: 07916-32031

Application: Use for measuring lubricating oil pressure.

01640S10220

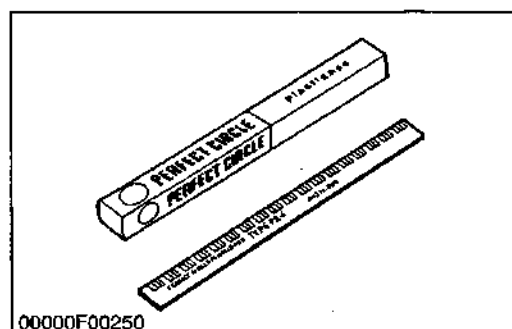
**Connecting Rod Alignment Tool**

Code No: 07909-31661

Application: Use for checking the connecting rod alignment.

Applicable range: Connecting rod big end I.D. 30 to 75 mm (1.18 to 2.95 in.dia.). Connecting rod length 65 to 330 mm (2.56 to 12.99 in.).

01640S10230

**Press Gauge**

Code No: 07909-30241

Application: Use for checking the oil clearance between crankshaft and bearing, etc.

Measuring range: Green ---- 0.025 to 0.076 mm
(0.001 to 0.003 in.)Red ----- 0.051 to 0.152 mm
(0.002 to 0.006 in.)Blue----- 0.102 to 0.229 mm
(0.004 to 0.009 in.)

01640S10240

**Red Check (Crack Check Liquid)**

Code No: 07909-31371

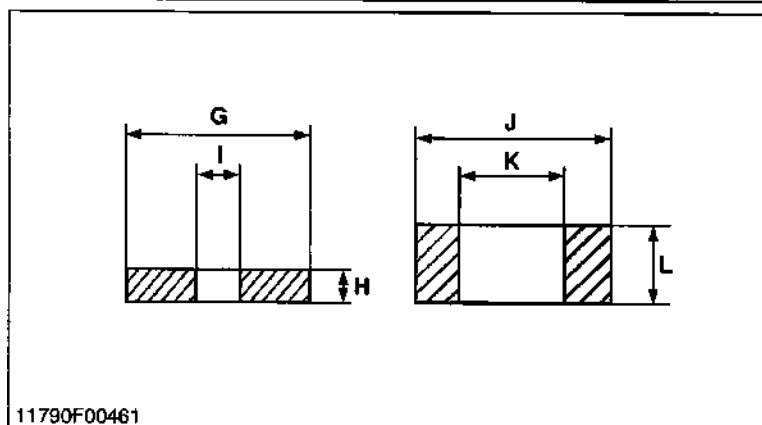
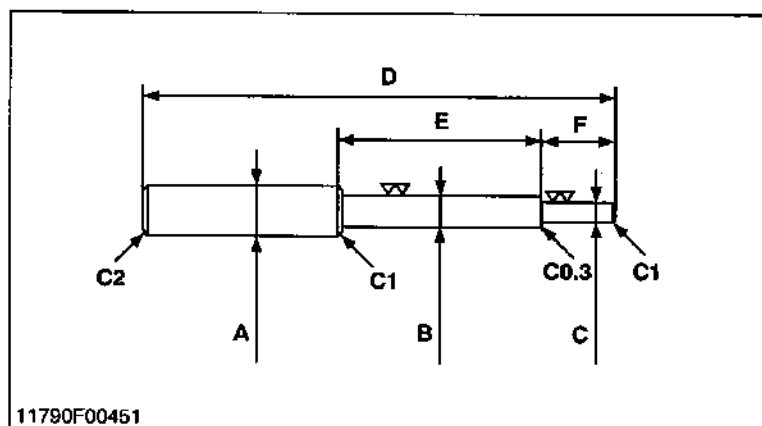
Application: Use for checking cracks on cylinder head, cylinder block, etc.

01640S10250

NOTE

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

01640S10910

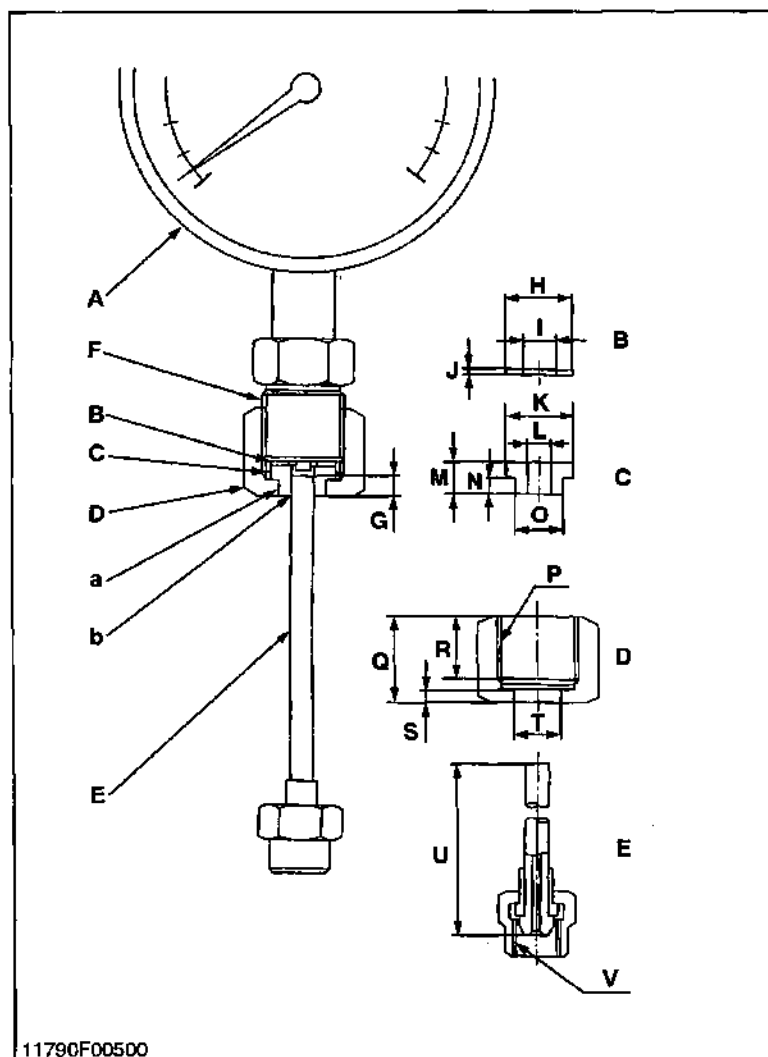


Valve Guide Replacing Tool

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

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

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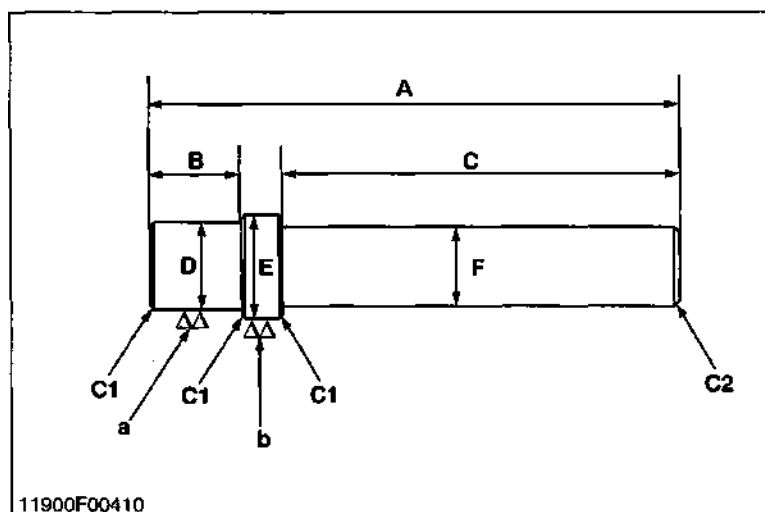


Injection Pump Pressure Tester

Application: Use to check fuel tightness of injection pumps.

A	Pressure gauge full scale : More than 29.4 MPa (300 kgf/cm ² , 4267 psi)
B	Copper gasket
C	Flange (Material : Steel)
D	Hex. nut 27 mm (1.06 in.) across the plat
E	Injection pipe
F	PF 1/2
G	5 mm (0.20 in.)
H	17 mm dia. (0.67 in. dia.)
I	8 mm dia. (0.31 in. dia.)
J	1.0 mm (0.039 in.)
K	17 mm dia. (0.67 in. dia.)
L	6.10 to 6.20 mm dia. 0.2402 to 0.2441 in. dia.
M	8 mm (0.31 in.)
N	4 mm (0.16 in.)
O	11.97 to 11.99 mm dia. 0.4713 to 0.4721 in. dia.
P	PF 1/2
Q	23 mm (0.91 in.)
R	17 mm (0.67 in.)
S	4 mm (0.16 in.)
T	12.00 to 12.02 mm dia. 0.4724 to 0.4732 in. dia.
U	100 mm (3.94 in.)
V	M12 x P1.5
a	Adhesive application
b	Fillet welding on the enter circumference

11790G00811



Bushing Replacing Tool

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

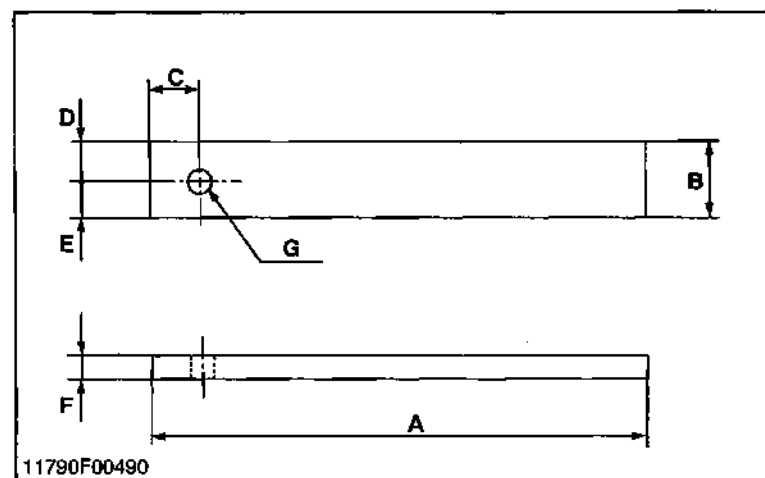
1. For small end bushing

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

2. For idle gear bushing

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

11900G00441

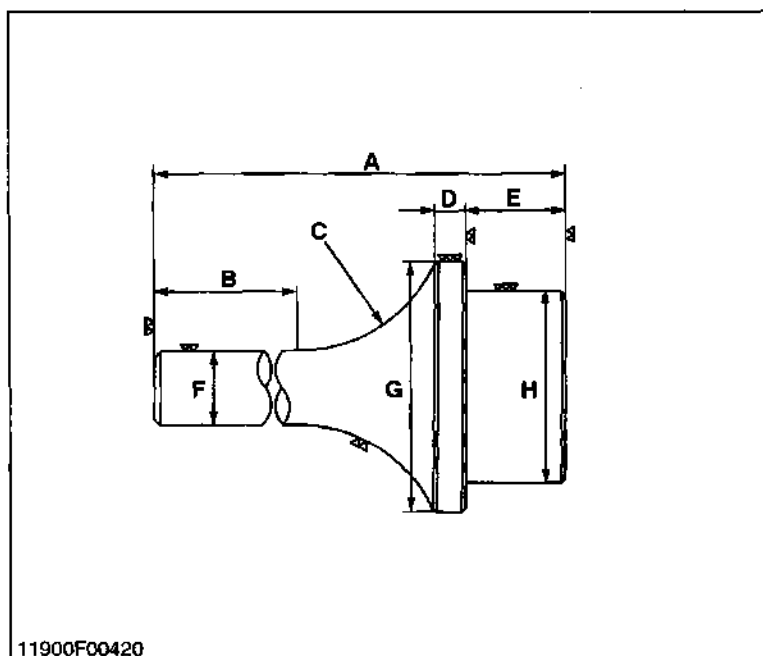


Flywheel Stopper

Application: Use to loosen and tighten the flywheel screw.

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

11790G00801

**Crankshaft Bearing 1 Replacing Tool**

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

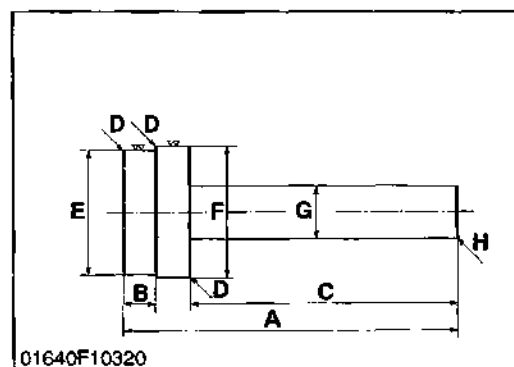
[Press Out]

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

[Press Fit]

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

11900G00451

**Governor Gear Holder Bushing Replacing Tool**

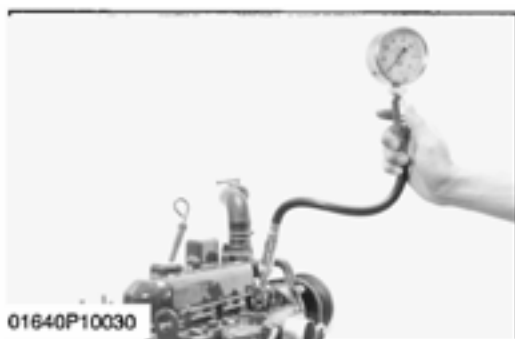
Application: Use to press out and to press fit the governor gear holder bushing.

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

01640S10260

C.Engine body

CHECKING AND ADJUSTING



Compression Pressure

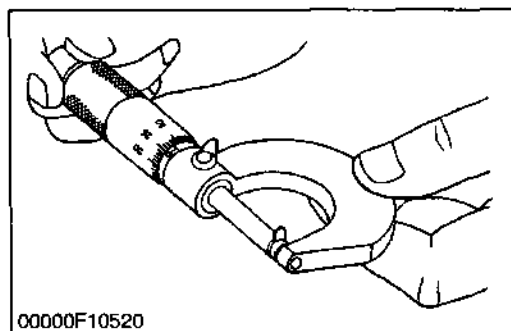
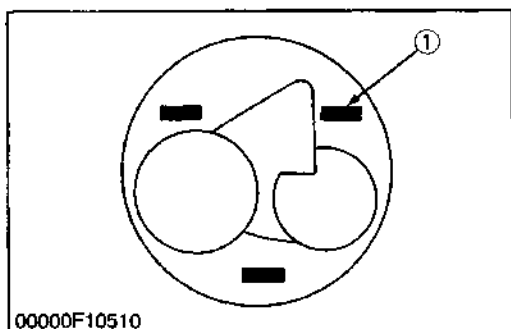
1. After warming up the engine, stop it and remove the air cleaner, the muffler and all nozzle holders.
2. Install a compression tester (Code No: 07909-30204) for diesel engines to nozzle holder hole.
3. After making sure that the speed control lever is set at the stop position (Non-injection), run the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

NOTE

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

Compression pressure	Factory spec.	2.84 to 3.24 MPa 29 to 33 kgf/cm ² 412 to 489 psi
	Allowable limit	2.26 MPa 23 kgf/cm ² 327 psi

11900S10011



Top Clearance

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

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

Tightening torque	Cylinder head mounting bolts	63.7 to 68.6 N·m 6.5 to 7.0 kgf·m 47.0 to 50.6 ft·lbs
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(1) Fuse

01640S10270

DISASSEMBLING AND ASSEMBLING

NOTE

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

01640S10280

[1] Draining water and oil

Draining Cooling Water and Engine Oil



CAUTION

- **Never remove radiator cap until cooling water temperature is below its boiling point. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**
- 1. Prepare a bucket. Open the drain cock to drain cooling water.
- 2. Prepare an oil pan. Remove the drain plug to drain engine oil in the pan.

01640S10290

[2] External components

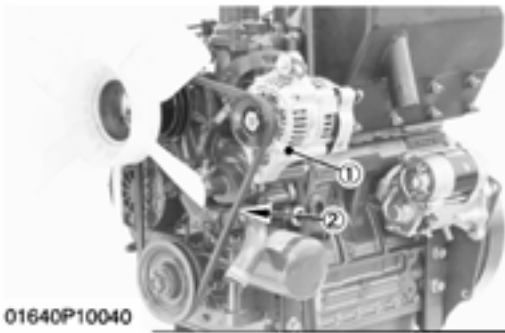
Air Cleaner and Muffler

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

(When reassembling)

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

01640S10300



01640P10040

Alternator and Fan Belt

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

(When reassembling)

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

■ **IMPORTANT**

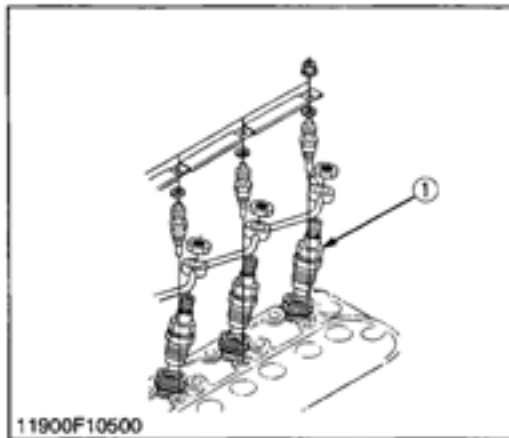
- **After reassembling the fan belt, be sure to adjust the fan belt tension.**

(1) Alternator

(2) Fan Belt

01640S10310

[3] Cylinder head and valves



Nozzle Holder Assembly

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

(1) Nozzle Holder Assembly

01640S10320



Cylinder Head Cover

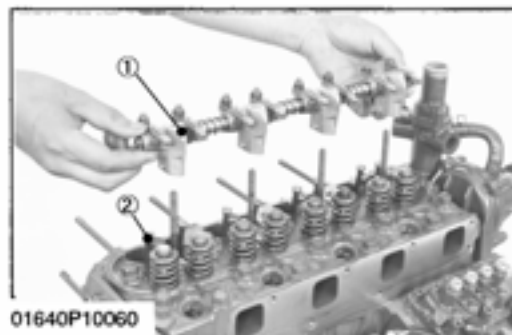
1. Remove the head cover cap nuts.
2. Remove the cylinder head cover (1).

(When reassembling)

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

(1) Head Cover

01640S10330



Rocker Arm and Push Rod

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

■ **IMPORTANT**

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

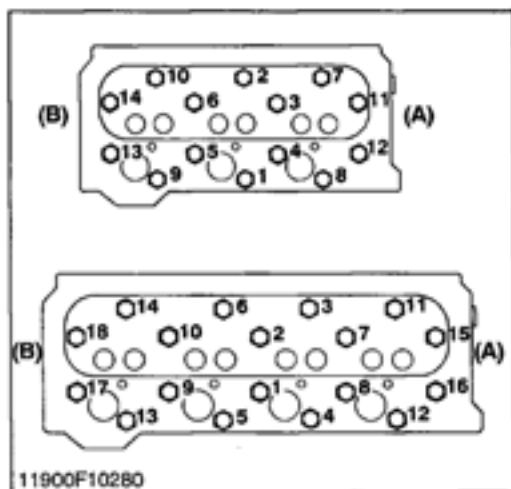
(When reassembling)

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

(1) Rocker Arm Assembly

(2) Push Rod

11900S10061



Cylinder Head

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

(When reassembling)

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

(A) Gear Case Side

(B) Flywheel Side

11900S10072



Tappets

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

(When reassembling)

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

■ IMPORTANT

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

(1) Tappet

11900S10081



Valves

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

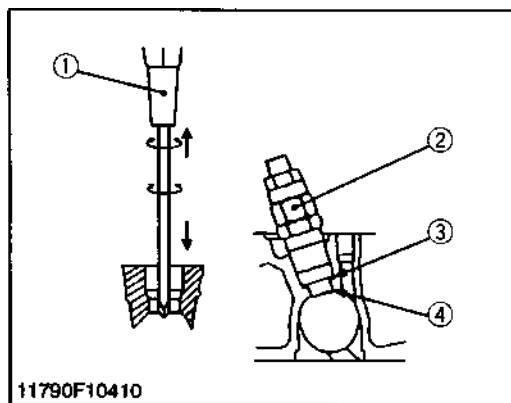
(When reassembling)

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

(1) Valve Lifter
 (2) Valve Cap
 (3) Valve Spring Collet
 (4) Valve Spring Retainer

(5) Valve Spring
 (6) Valve Stem Seal
 (7) Valve

11900S10091



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

■ IMPORTANT

- Use a plus (phillips head) screw driver that has a Dia. which is bigger than the heat seal hole (Approx. 6 mm) 1/4 in.
1. Drive screw driver lightly into the heat seal hole.
 2. Turn screw driver three or four times each way.
 3. While turning the screw driver, slowly pull the heat seal out together with the injection nozzle gasket.

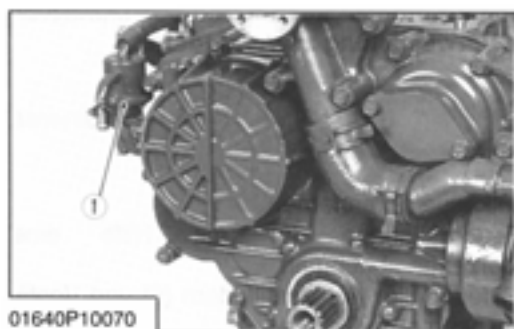
If the heat seal drops, repeat the above procedure. Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.

- (1) Plus Screw Driver
 (2) Injection Nozzle

- (3) Injection Nozzle Packin
 (4) Heat Seal

11790S10131

[4] Gear case



Fuel Feed Pump and Hour Meter Gear Case

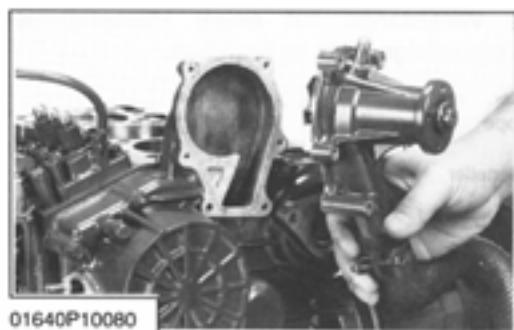
1. Loosen the pipe clamp and remove the fuel pipe from the injection pump side.
2. Remove the fuel feed pump mounting nuts.
3. Remove the fuel feed pump (1).

(When reassembling)

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

- (1) Fuel Feed Pump

01640S10340



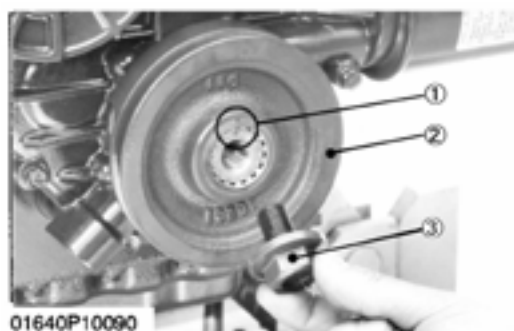
Water Pump

1. Remove the water pump flange.

(When reassembling)

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

01640S10350



01640P10090

Fan Drive Pulley

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

(When reassembling)

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

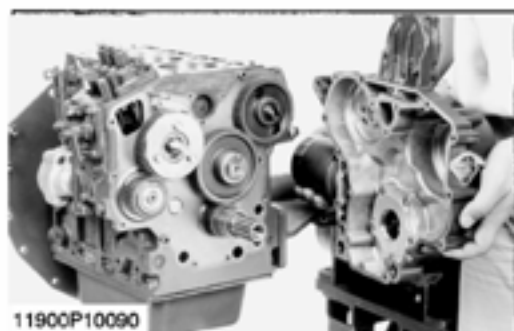
Tightening torque	Crankshaft screw (Serial No : ~ 604086)	142.2 to 152.0 N·m 14.5 to 15.5 kgf·m 104.9 to 112.1 ft·lbs
	Crankshaft screw (Serial No : 604087 ~)	235.4 to 245.2 N·m 24.0 to 25.0 kgf·m 173.6 to 180.8 ft·lbs

(1) Crankshaft Screw

(3) Aligning Marks

(2) Fan Drive Pulley

01640S10360



11900P10090

Gear Case

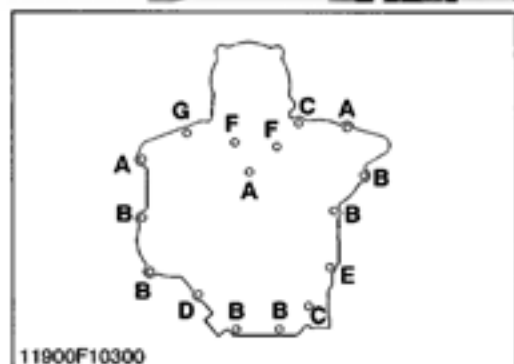
1. Remove the gear case.

(When reassembling)

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

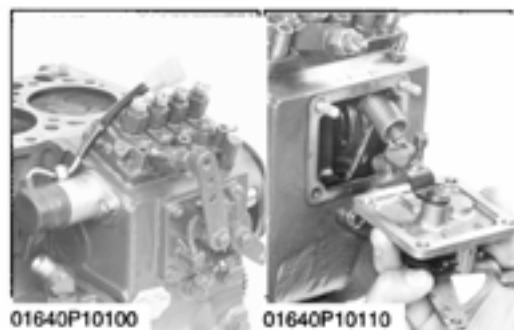
Length of the gear case mounting bolts (refer to the figure)

- A : 45 mm E : 68 mm
B : 50 mm F : 80 mm
C : 55 mm G : Nut
D : 59 mm



11900F10300

01640S10370



01640P10100

01640P10110

Engine Stop Solenoid and Speed Control Plate

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

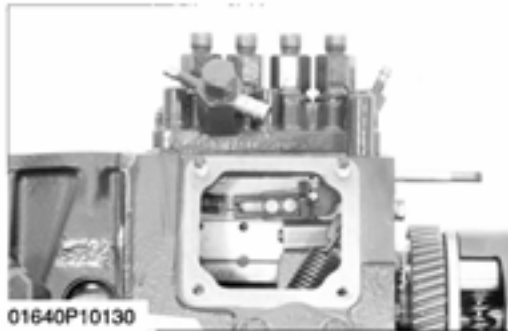
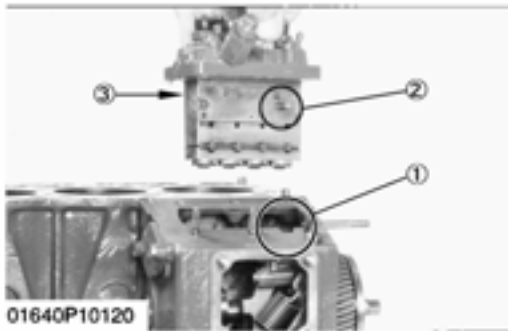
(When reassembling)

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

(1) Engine Stop Solenoid

(2) Governor Spring 1

11900S10121



Injection Pump

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

(When reassembling)

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

■ NOTE

(Engine serial number : ~ 489290)

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

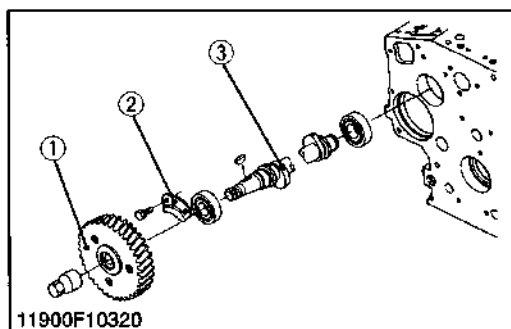
(Engine serial number : 489291 ~)

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

- (1) Notch
(2) Injection Pump

- (3) Control Rack Pin

11900S10131



Fuel Camshaft

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

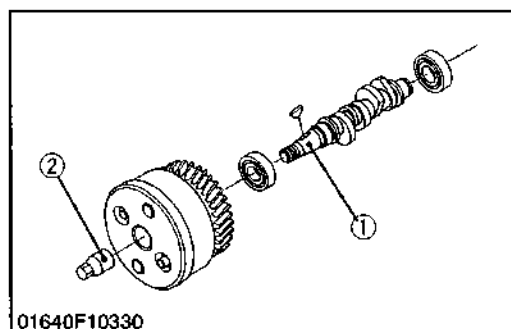
(When reassembling)

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

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

- (3) Fuel Camshaft

11900S10140



Timer

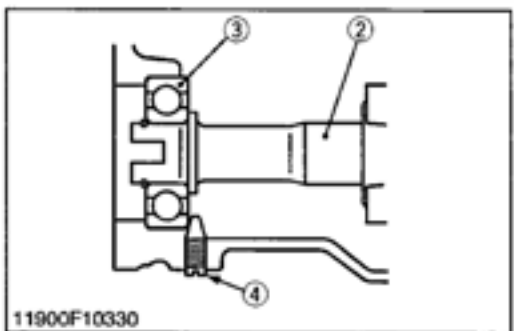
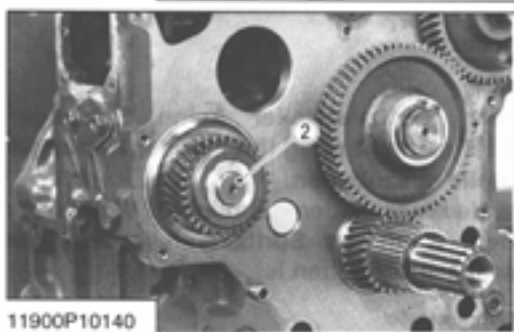
■ IMPORTANT

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

- (1) Fuel Camshaft

- (2) Timer Mounting Nut

01640S10380



Governor Shaft

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

(When reassembling)

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

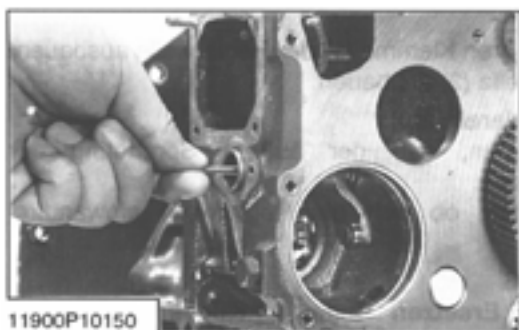
■ IMPORTANT

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

- (1) External Snap Ring
(2) Governor Shaft

- (3) Ball Bearing
(4) Set Screw

11900S10151



Fork Lever

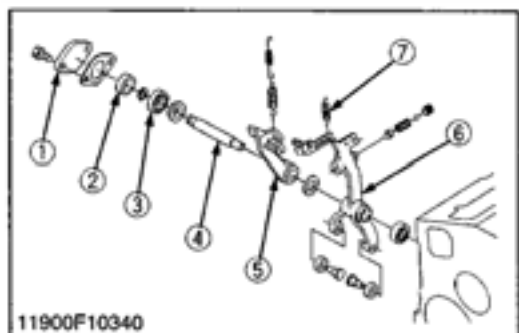
1. Remove the start spring (7).
2. Remove the fork lever shaft cover (1).
3. Remove the fork lever shaft (4).
4. Remove the spacer (2), bearing (3) and fork lever 1, 2.

(When reassembling)

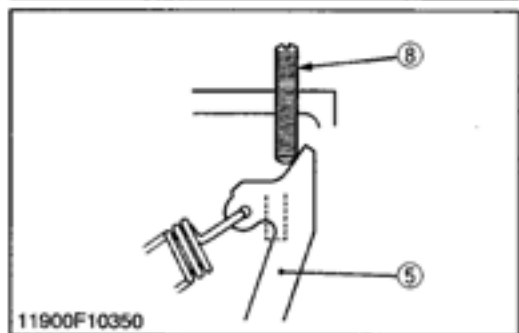
- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the fork lever shaft cover.
- to assembling the fork lever shaft cover to position the mark "UP" on it upwards.
- Make sure assembling the start spring.

■ IMPORTANT

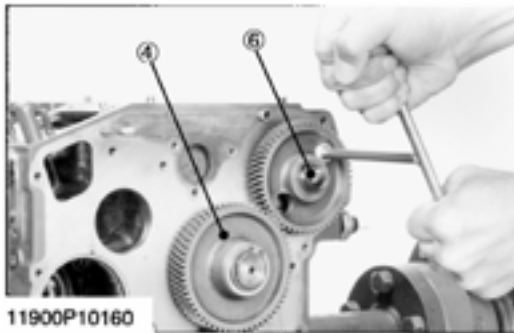
- To assembling the fork lever 2 to the right side of fuel limit bolts as shown in the figure.



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



11900S10161



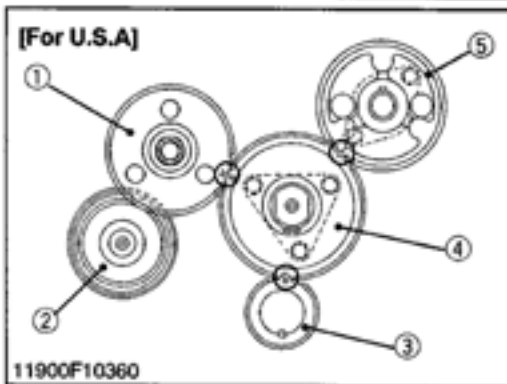
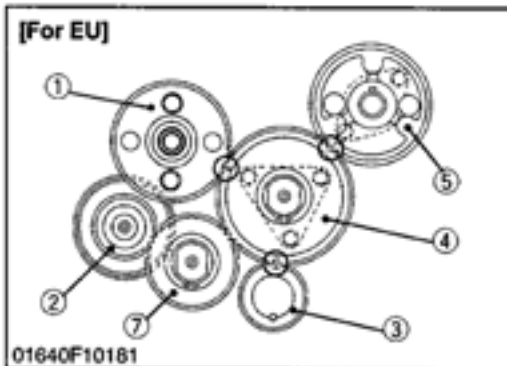
Cam Gear and Idle Gear 1, 2

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

■ IMPORTANT

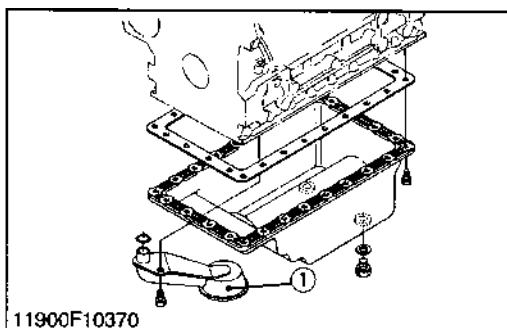
- When installing the idle gear, be sure to align the alignment marks on gears.
- Make sure assembling the external snap ring and stopper.

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



11900S10171

[5] Piston and connecting rod



Oil Pan and Oil Strainer

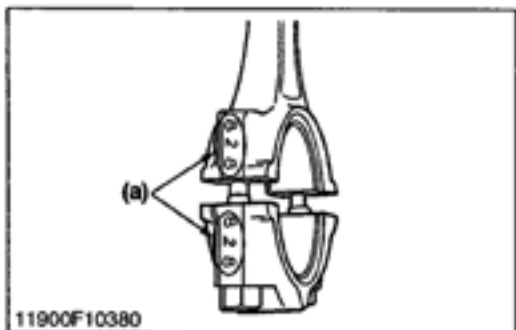
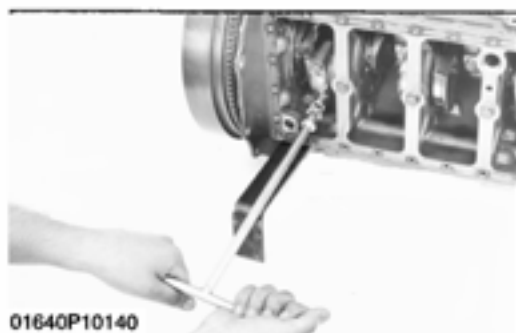
1. Remove the oil pan mounting screws.
2. Remove the oil pan by lightly tapping the rim of the pan with a wooden hammer.
3. Remove the oil strainer (1).

(When reassembling)

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

- (1) Oil Strainer

11900S10181



Connecting Rod Cap

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

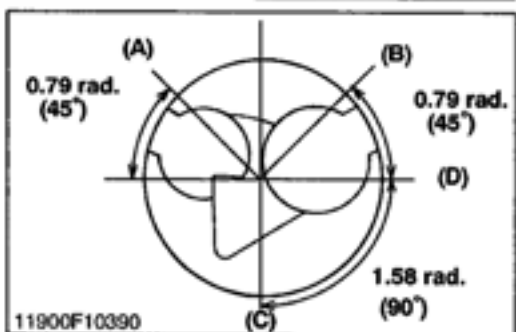
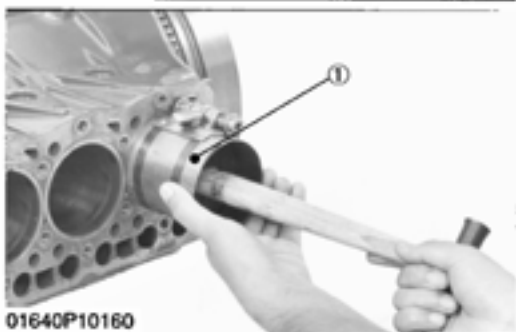
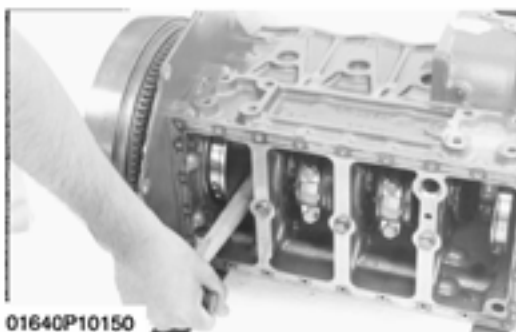
(When reassembling)

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

Tightening torque	Connecting rod screw	41.2 to 46.1 N·m 4.2 to 4.7 kgf·m 30.3 to 33.9 ft·lbs
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(a) Mark

11900S10191



Piston

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

(When reassembling)

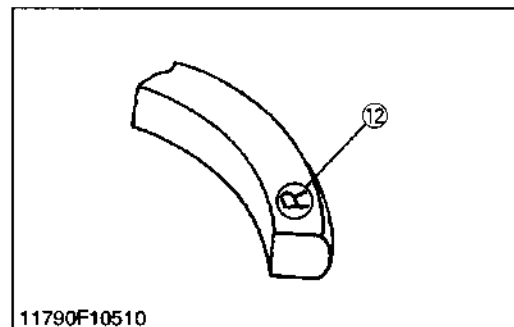
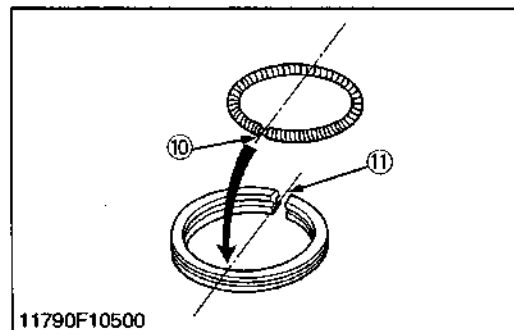
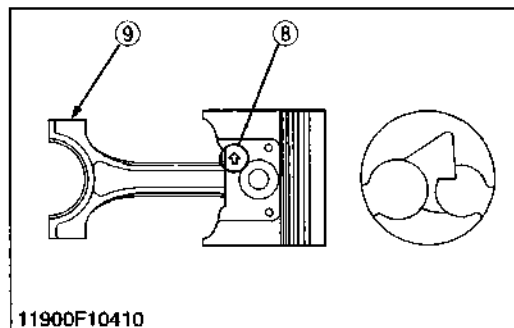
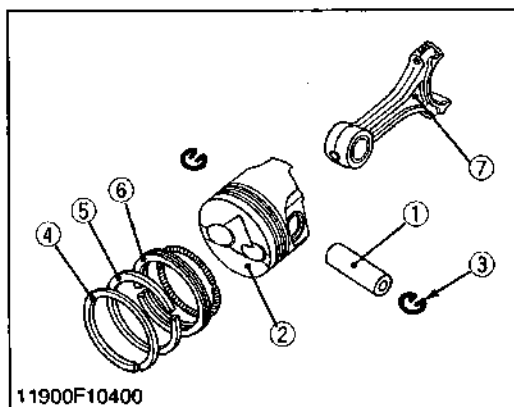
- Before inserting the piston into the cylinder, apply enough engine oil to the cylinder.
- When inserting the piston into the cylinder, face the mark on the connecting rod to the injection pump.

■ IMPORTANT

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

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

11900S10201



Piston Ring and Connecting Rod

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

(When reassembling)

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

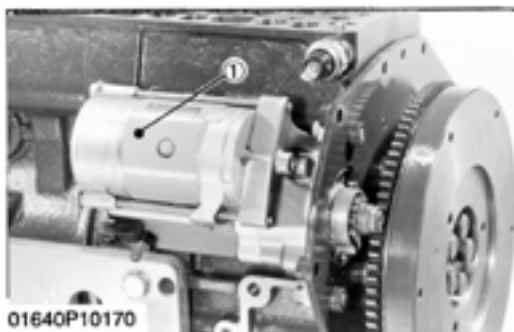
■ IMPORTANT

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

- | | |
|--------------------------|--------------------------|
| (1) Piston Pin | (7) Connecting Rod |
| (2) Piston | (8) Casting Mark |
| (3) Piston Pin Snap Ring | (9) Mark |
| (4) Compression Ring 1 | (10) Expander Joint |
| (5) Compression Ring 2 | (11) Oil Ring Gap |
| (6) Oil Ring | (12) Manufacturer's Mark |

11900S10211

[6] Flywheel and crankshaft

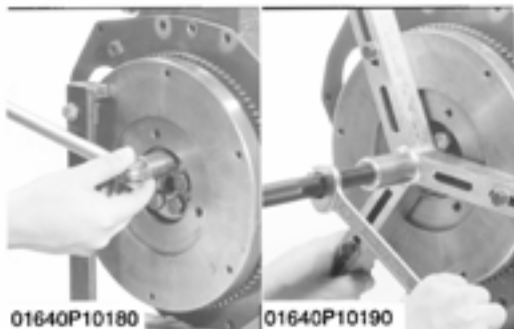


Starter

1. Remove the starter (1).

(1) Starter

01640S10390



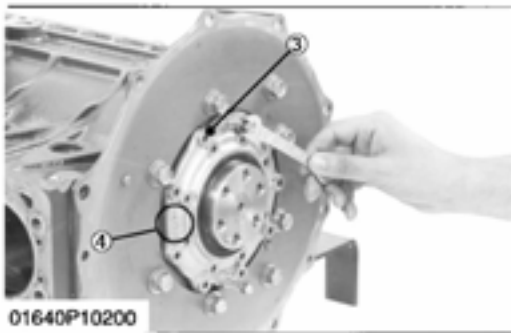
Flywheel

1. Lock the flywheel not to turn using the flywheel stopper.
2. Remove the flywheel screws, except for two which must be loosened and left as they are.
3. Set a flywheel puller (Code No: 07916-32011), and remove the flywheel.

(When reassembling)

- Apply engine oil to the flywheel screws.

01640S10400



Bearing Case Cover and Crankshaft

NOTE

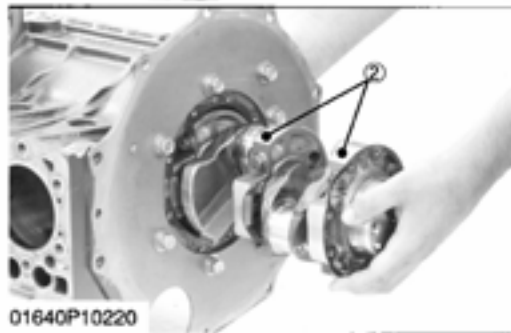
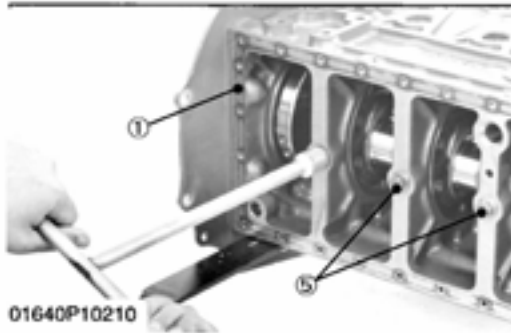
- Before disassembling, check the side clearance of crankshaft. Also check it during reassembly.

1. Remove the bearing case cover mounting screws.
2. Screw two removed screws into the screw hole of bearing case cover to remove it.
3. Remove the bearing case screw 2 (5).
4. Pull out the crankshaft.

(When reassembling)

IMPORTANT

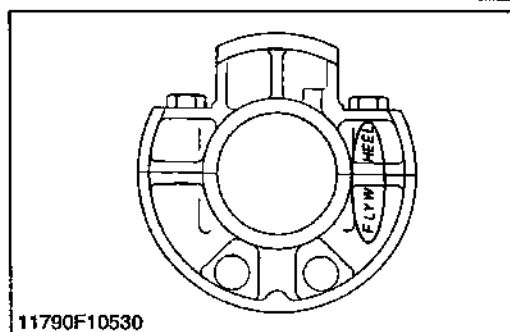
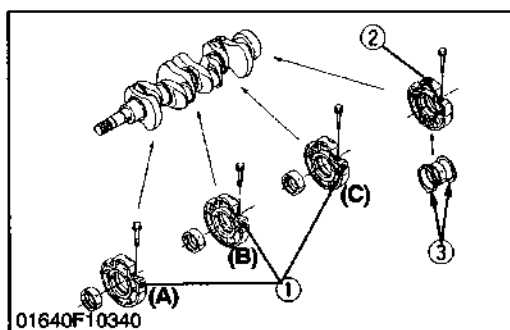
- Install the crankshaft sub assembly, aligning the screw hole of main bearing case 2 (2) with the screw hole of cylinder block (1).
- Apply engine oil to the seat and thread of bearing case screw 2 (5) and tightening it.
- Install the bearing case cover (3) to position the casting mark "UP" (4) on it upward.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.



- (1) Cylinder Block
- (2) Main Bearing Case 2
- (3) Bearing Case Cover

- (4) Top Mark "UP"
- (5) Bearing Case Screw 2

01640S10410



Main Bearing Case Assembly

1. Remove the two main bearing case screws 1, and remove the main bearing case assembly (2), being careful with the thrust bearing (3) and crankshaft bearing 2.
2. Remove the main bearing case assemblies 1, 2 and 3 as above.

(When reassembling)

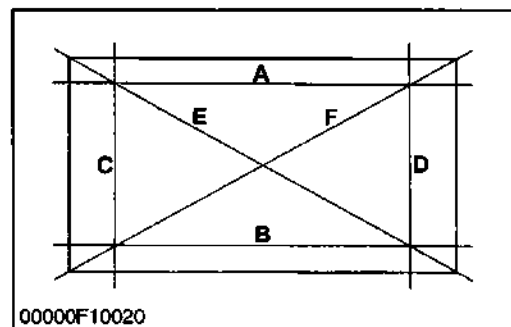
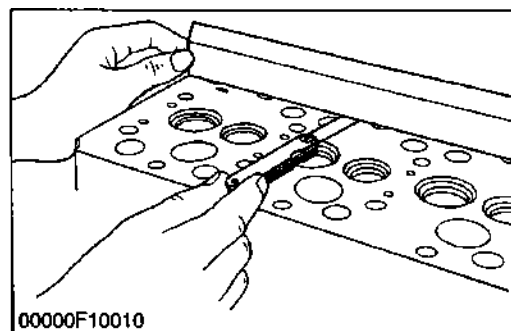
- Clean the oil passage in the main bearing case.
- Apply clean engine oil on the crankshaft bearing 2 and thrust bearings.
- Since diameters of main bearing case vary, install them in order of markings (A, B, C) from the gear case side.
- When installing the main bearing case assemblies 1, 2 and 3, face the mark "FLYWHEEL" to the flywheel.
- Be sure to install the thrust bearing with its oil groove facing outward.

- (1) Main Bearing Case Assembly 1, 2 and 3 (2) Main Bearing Case Assembly
(3) Thrust Bearing

11900S10251

SERVICING

[1] Cylinder head



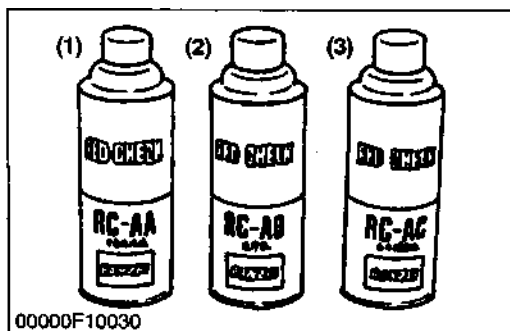
Cylinder Head Surface Flatness

1. Thoroughly clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure. Measure the clearance with a feeler gauge.
3. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ IMPORTANT

- Do not place the straight edge on the combustion chamber.
- Be sure to check the valve recessing after correcting.

00000S10011



Cylinder Head Flaw

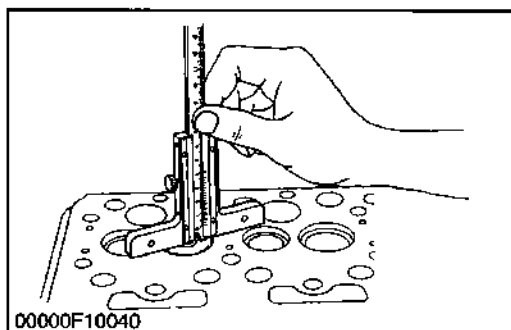
1. Prepare an air spray red check (Code No. 07909-31371).
2. Clean the surface of the cylinder head with detergent (2).
3. Spray the cylinder head surface with the red permeative liquid (1). Leave it five to ten minutes after spraying.
4. Wash away the red permeative liquid on the cylinder head surface with the detergent (2).
5. Spray the cylinder head surface with white developer (3).
6. If flawed, it can be identified as red marks.

(1) Red Permeative Liquid

(2) Detergent

(3) White Developer

00000S10020



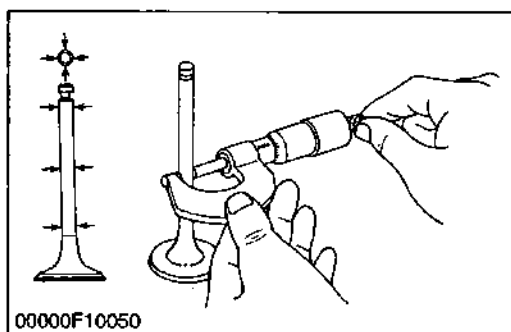
Valve Recessing

1. Clean the cylinder head, the valve face and seat.
2. Insert the valve into the valve guide.
3. Measure the valve recessing with a depth gauge.
4. If the measurement exceeds the allowable limit, replace the valve.

If it still exceeds the allowable limit after replacing the valve, correct the valve seat face of the cylinder head with a valve seat cutter (Code No. 07909-33102) or valve seat grinder.

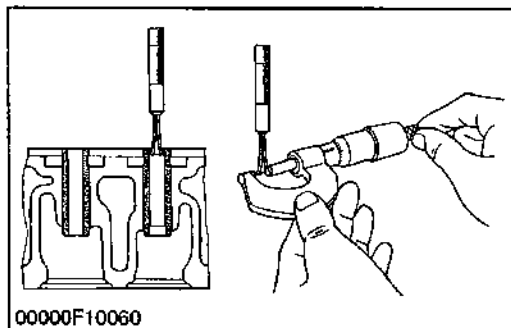
Then, correct the cylinder head surface with a surface grinder, or replace the cylinder head.

00000S10031

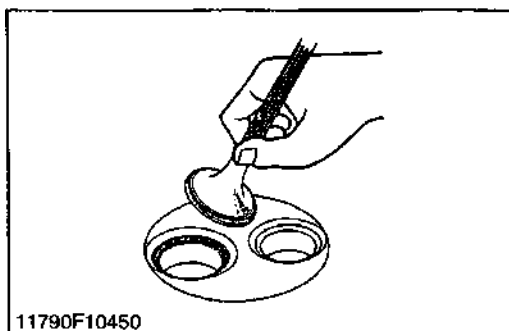


Clearance between Valve Stem and Valve Guide

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.



00000S10042

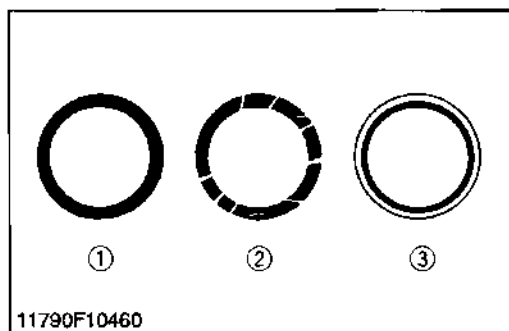


Valve Seating

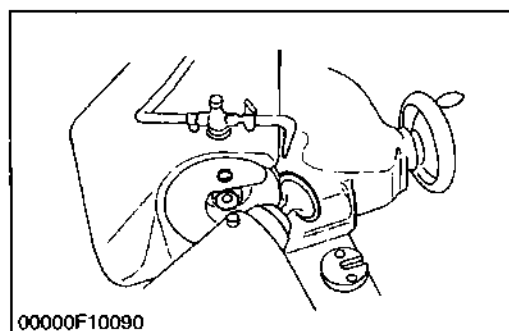
1. Coat the valve face lightly with prussian blue and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70 %, correct the valve seating as follows.
3. If the valve contact does not comply with the reference value, replace the valve or correct the contact of valve seating.

(1) Correct
(2) Incorrect

(3) Incorrect



11790S10230



Correcting Valve and Valve Seat

NOTE

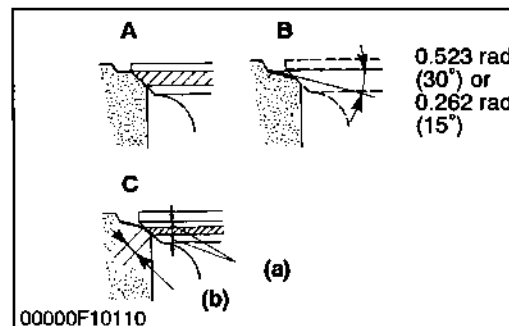
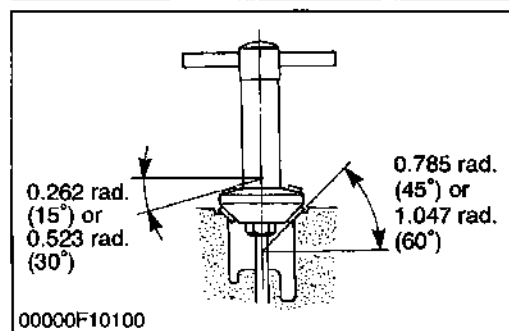
- Before correcting the valve and seat, check the valve stem and the I.D. of the valve guide section, and repair them if necessary.
- After correcting the valve seat, be sure to check the valve recessing.

1) Correcting Valve

1. Correct the valve with a valve refacer.

2) Correcting Valve Seat

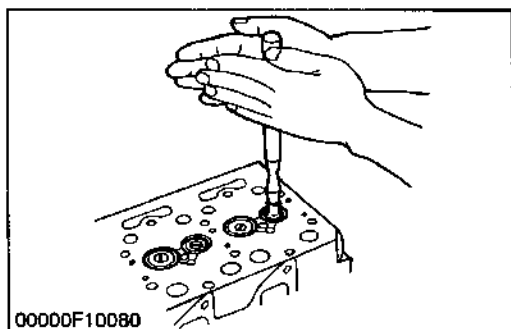
1. Slightly correct the seat surface with a 1.047 rad. (60°) (intake valve) or 0.785 rad. (45°) (exhaust valve) seat cutter (Code No. 07909-33102).
2. Resurface the seat surface with a 0.523 rad. (30°) valve seat cutter to intake valve seat and with a 0.262 rad. (15°) valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width (2.12 mm, 0.0835 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.



(a) Identical Dimensions
(b) Valve Seat Width

(A) Check Contact
(B) Correct Seat Width
(C) Check Contact

00000S10070



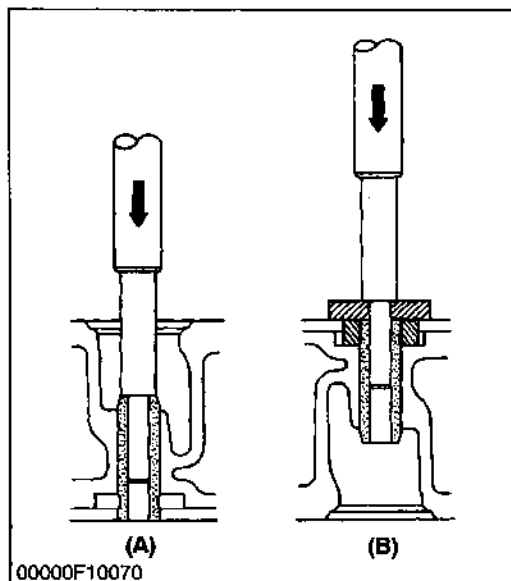
Valve Lapping

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.

00000S10060



Replacing Valve Guide

(When removing)

1. Using a valve guide replacing tool (see page S-65), press out the used valve guide.

(When installing)

1. Clean a new valve guide, and apply engine oil to it.
2. Using a valve guide replacing tool, press in a new valve guide until it is flush with the cylinder head as shown in the figure.
3. Ream precisely the I.D. of the valve guide to the specified dimension.

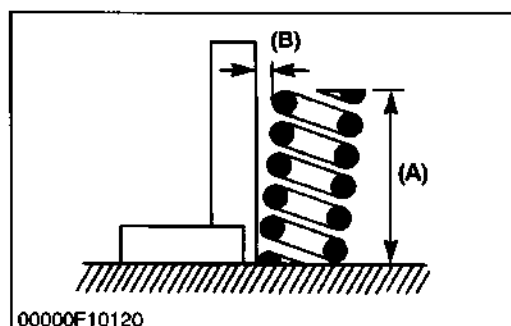
■ IMPORTANT

- Do not hit the valve guide with a hammer, etc. during replacement.

(A) When Removing

(B) When Installing

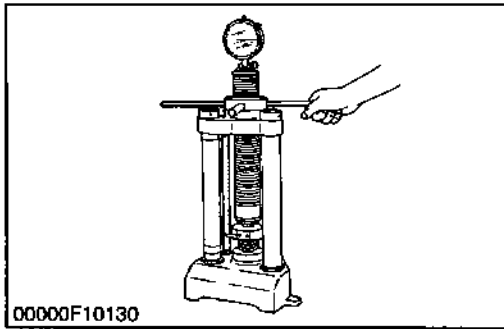
00000S10052



Free Length and Tilt of Valve Spring

1. Measure the free length (A) with vernier calipers. If the measurement is less than the allowable limit, replace it.
2. Put the spring on a surface plate, place a square on the side of the spring, and check to see if the entire side is in contact with the square. Rotate the spring and measure the maximum (B). If the measurement exceeds the allowable limit, replace.
3. Check the entire surface of the spring for scratches. Replace it, if any.

00000S10082

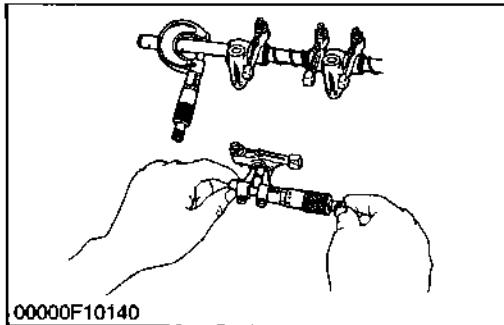


00000F10130

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.

00000S10092

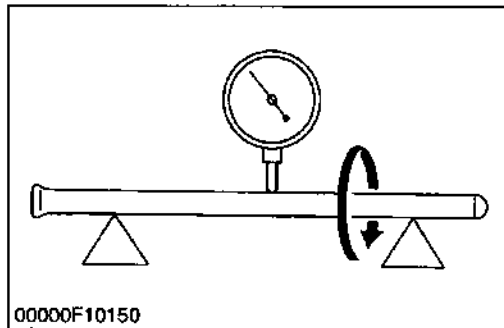


00000F10140

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.

00000S10102

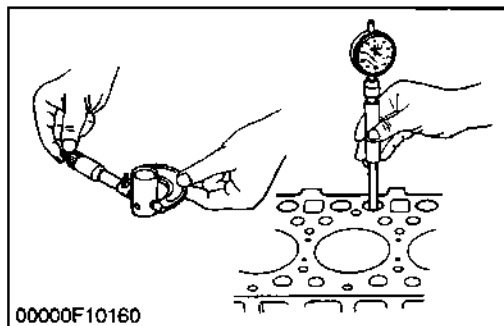


00000F10150

Push Rod Alignment

1. Check the both end of the push rod for cracks, damage and unusual wear.
2. Measure the bending of the push rod with a dial indicator.
3. If the measurement exceeds the allowable limit, replace the push rod.

00000S10111



00000F10160

Oil Clearance between Tappet and Tappet Guide Bore

1. Measure the tappet O.D. with an outside micrometer
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

00000S10122

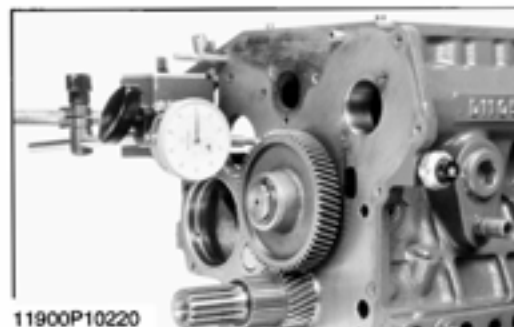
[2] Timing gear and camshaft



Timing Gear Backlash

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the gear to measure the backlash, holding its mating gear.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shafts and the gear.
4. If the oil clearance is proper, replace the gear.

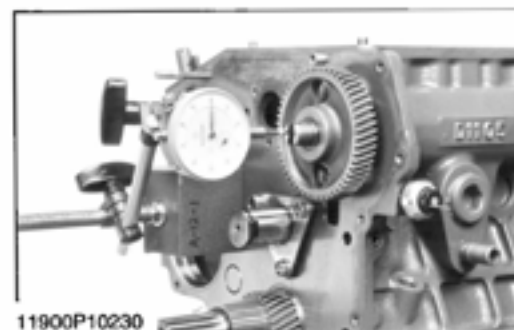
00000S10132



Idle Gear Side Clearance

1. Set a dial indicator with its tip on the idle gear.
2. Measure the side clearance by moving the idle gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the idle gear collar.

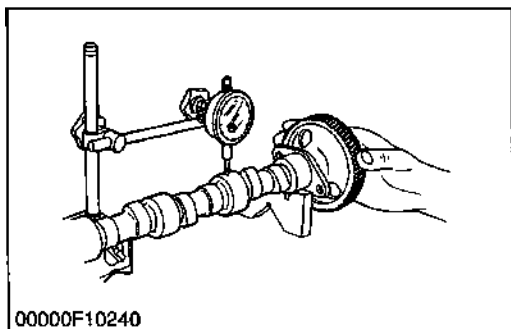
00000S10142



Camshaft Side Clearance

1. Set a dial indicator with its tip on the camshaft.
2. Measure the side clearance by moving the cam gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the camshaft stopper.

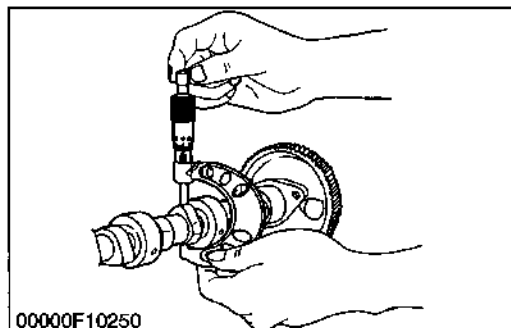
00000S10182



Camshaft Alignment

1. Support the camshaft with V blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. rotate the camshaft on the V blocks and get the misalignment (half of the measurement).
3. if the misalignment exceeds the allowable limit, replace the camshaft.

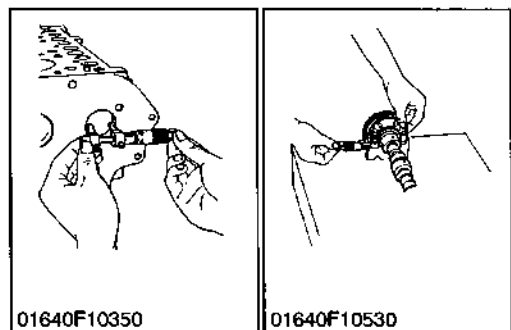
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Cam Height

1. Measure the height of the cam at its highest point with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the camshaft.

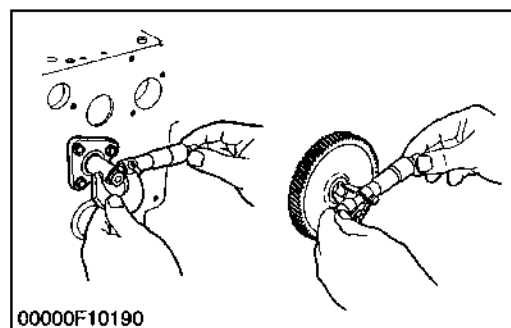
00000S10202



Oil Clearance of Camshaft Journal

1. Measure the camshaft journal O.D. with an outside micrometer
2. Measure the cylinder block bore I.D. for camshaft with an inside micrometer.
Calculate the oil clearance.
3. If the clearance exceeds the allowable limit, replace the camshaft.

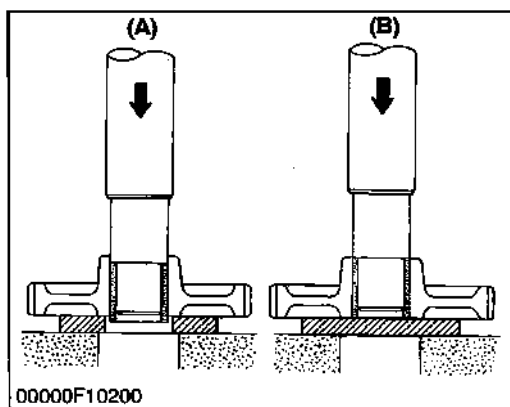
00000S10172



Oil Clearance between Idle Gear Shaft and Idle Gear Bushing

1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing.

00000S10152



Replacing Idle Gear Bushing

(A) (When removing)

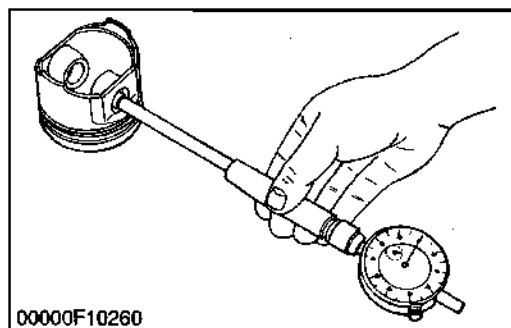
1. Using an idle gear bushing replacing tool (see page S-69), press out the used bushing.

(B) (When installing)

1. Clean a new idle gear bushing and idle gear bore, and apply engine oil to them.
2. Using an idle gear bushing replacing tool, press in a new bushing (service parts) to the specified dimension. (See figure.)

00000S10161

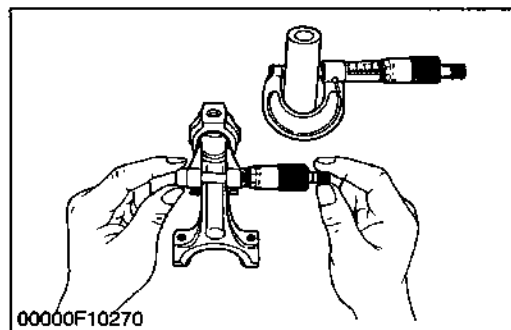
[3] Piston and connecting rod



Piston Pin Bore I.D.

1. Measure the piston pin bore I.D. in both the horizontal and vertical directions with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the piston.

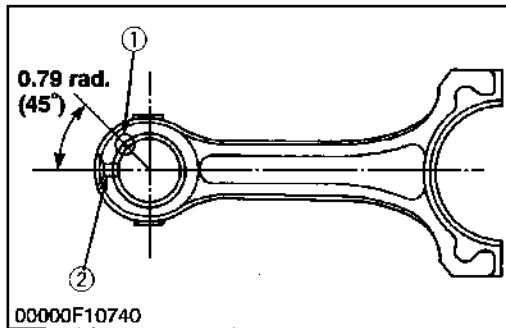
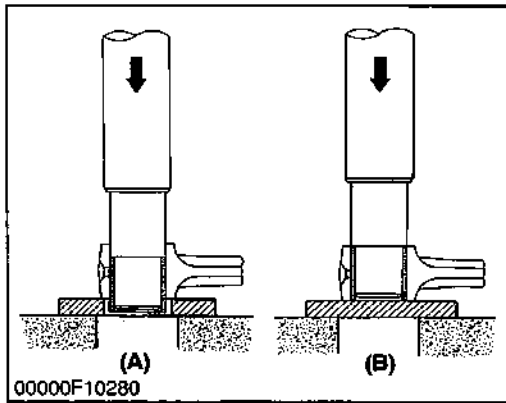
00000S10212



Oil Clearance between Piston Pin and Small End Bushing

1. Measure the O.D. of the piston pin where it contacts the bushing with an outside micrometer.
2. Measure the I.D. of the piston pin bushing at the connecting rod small end with a 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.

00000S10222



Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool.

(When installing)

1. Clean a new small end bushing and bore, and apply engine oil to them.
2. Insert a new bushing onto the tool and press-fit it with a press so that the seam (1) of bushing positions as shown in the figure, until it is flush with the connecting rod.
3. Drill a hole to the bushing with aligning the oil hole (2) of connecting rod using 4.0 mm dia. (0.157 in. dia.) drill.

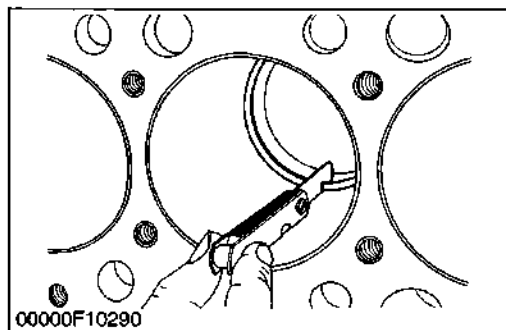
NOTE

- Be sure to chamfer the oil hole circumference with an oil stone.

- (1) Seam
(2) Oil Hole

- (A) When Removing
(B) When Installing

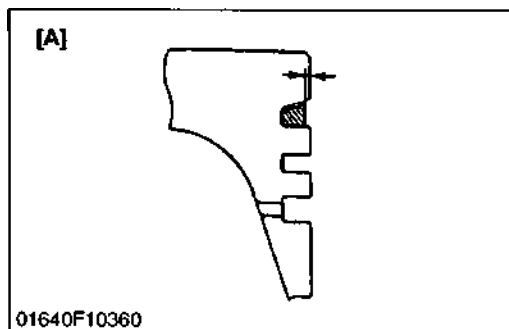
00000S10231



Piston Ring Gap

1. Insert the piston ring into the lower part of the liner (the least worn out part) with the piston.
2. Measure the ring gap with a feeler gauge.
3. If the gap exceeds the allowable limit, replace the piston ring.

00000S10242

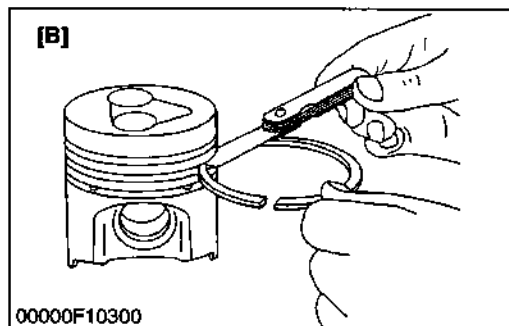


Clearance between Piston Ring and Groove

1. Remove carbon from the ring grooves.
2. Measure the clearance between the ring and the groove with a feeler gauge or depth gauge.
3. If the clearance exceeds allowable limit, replace the ring since compression leak and oil shortage result.
4. If the clearance still exceeds the allowable limit after replacing the ring, replace the piston.

Factory spec : A

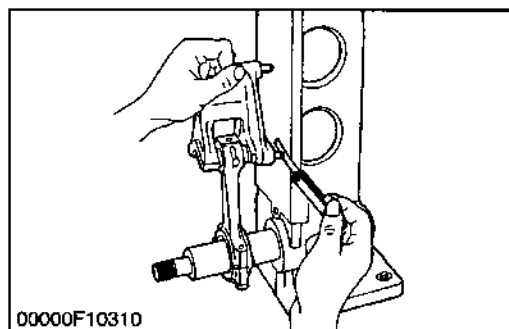
More than 0.2 mm
0.079 in.



(A) Top Ring (Key Stone Type)

(B) 2nd, Oil Ring

00000S10252



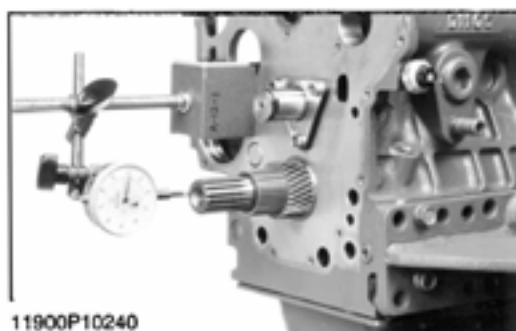
Connecting Rod Alignment

NOTE

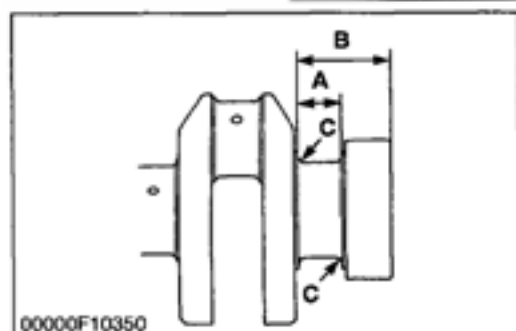
- Since the I.D. of the connecting rod small end bushing is the basis of this check, check the bushing for wear beforehand.
1. Remove the crankpin bearing, and install the connecting rod cap.
 2. Install the piston pin in the connecting rod.
 3. Install the connecting rod on the connecting rod alignment tool (Code No. 07909-31661).
 4. Put a gauge over the piston pin, and move it against the face plate.
 5. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
 6. If the measurement exceeds the allowable limit, replace the connecting rod.

00000S10261

[4] Crankshaft



11900P10240



00000F10350

Crankshaft Side Clearance

1. Set a dial indicator with its tip on the end of the crankshaft.
2. Measure the side clearance by moving the crankshaft to the front and rear.
3. If the measurement exceeds the allowable limit, replace the thrust bearings.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an oversize one referring to the table and figure.

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

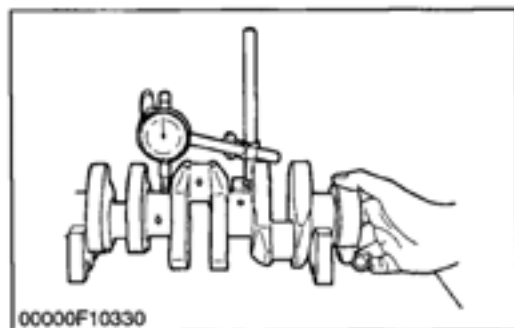
• Oversize thrust bearing

Oversize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Thrust bearing 1 02	15521-23951	020 OS
	Thrust bearing 2 02	19202-23971	020 OS
0.4 mm 0.016 in.	Thrust bearing 1 04	15521-23961	040 OS
	Thrust bearing 2 04	19202-23981	040 OS

• Oversize dimensions of crankshaft journal

Over-size Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	28.20 to 28.25 mm 1.1102 to 1.1122 in.	28.40 to 28.45 mm 1.1181 to 1.1201 in.
B	51.5 to 51.7 mm 2.028 to 2.035 in.	51.6 to 51.8 mm 2.031 to 2.039 in.
C	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius
(0.8-S) The crankshaft journal must be fine-finished to higher than VVVV.		

00000S10291

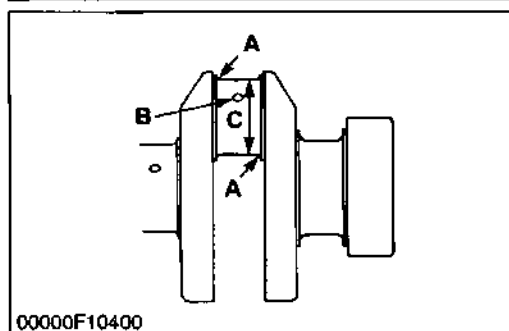
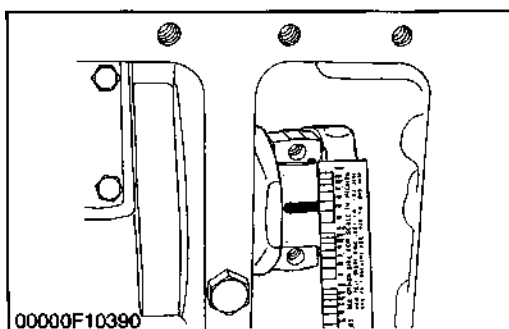


00000F10330

Crankshaft Alignment

1. Support the crankshaft with V blocks on the surface plate and set a dial indicator with its tip on the intermediate journal at right angle.
2. Rotate the crankshaft on the V blocks and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the crankshaft.

00000S10281



Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage (Code No. 07909-30241) on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
5. If the oil clearance exceeds the allowable limit, replace the crankpin bearing.
6. If the same size bearing is useless because of the crankpin wear, replace it with an undersize one referring to the table and figure.

NOTE

- Never insert the plastigage into the crankpin oil hole.
- Be sure not to move the crankshaft while the connecting rod screws are tightened.

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.029 to 0.091 mm 0.00114 to 0.00358 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankpin O.D.	Factory spec.	39.959 to 39.975 mm 1.57319 to 1.57382 in.
Crankpin bearing I.D.	Factory spec.	40.004 to 40.050 mm 1.57496 to 1.57677 in.

(Reference)

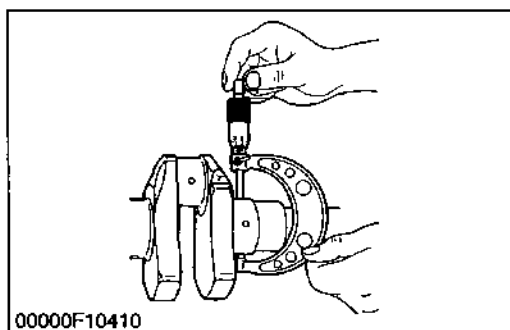
- Undersize crankpin bearing

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankpin bearing 02	16241-22971	020 US
0.4 mm 0.016 in.	Crankpin bearing 04	16241-22981	040 US

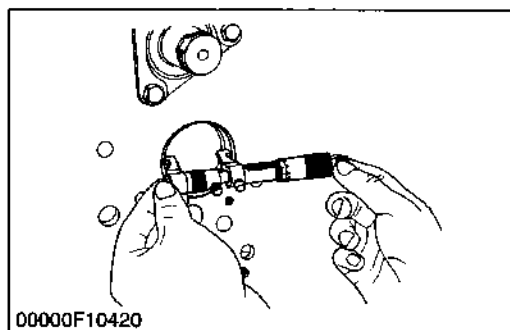
- Undersize dimensions of crankpin

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.8 to 3.2 mm radius 0.1102 to 0.1260 in. radius	2.8 to 3.2 mm radius 0.1102 to 0.1260 in. radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	39.759 to 39.775 mm 1.56531 to 1.56594 in.	39.559 to 39.575 mm 1.55744 to 1.55807 in.
(0.8-S) The crankpin must be fine-finished to higher than VVVV.		

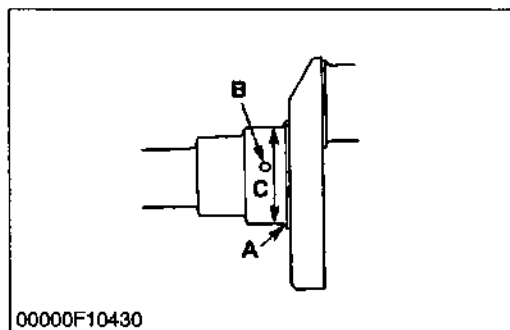
00000S10321



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00000F10420



00000F10430

Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

1. Measure the O.D. of the crankshaft front journal with an outside micrometer.
2. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 1.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.034 to 0.114 mm 0.00134 to 0.00449 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D.	Factory spec.	47.934 to 47.950 mm 1.88716 to 1.88779 in.
Crankshaft bearing 1 I.D.	Factory spec.	47.984 to 48.048 mm 1.88913 to 1.89165 in.

(Reference)

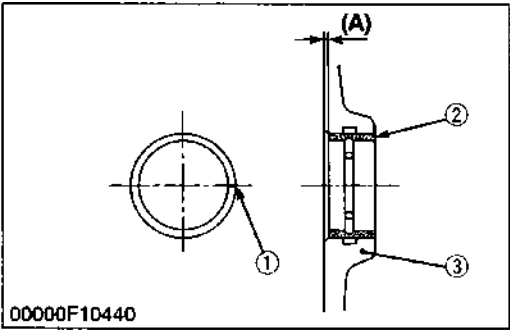
• Undersize crankshaft bearing 1

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 1 02	16241-23911	020 US
0.4 mm 0.016 in.	Crankshaft bearing 1 04	16241-23921	040 US

• Undersize dimensions of crankshaft journal

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.0906 to 0.1063 in. radius	2.3 to 2.7 mm radius 0.0906 to 0.1063 in. radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	47.734 to 47.750 mm 1.87929 to 1.87992 in.	47.534 to 47.550 mm 1.87142 to 1.87204 in.
The crankshaft journal must be fine-finished to higher than $\nabla\nabla\nabla\nabla$ ^(0.8 S) .		

00000S10331



Replacing Crankshaft Bearing 1

(When removing)

- 1. Press out the used crankshaft bearing 1 using a crankshaft bearing 1 replacing tool.

(When installing)

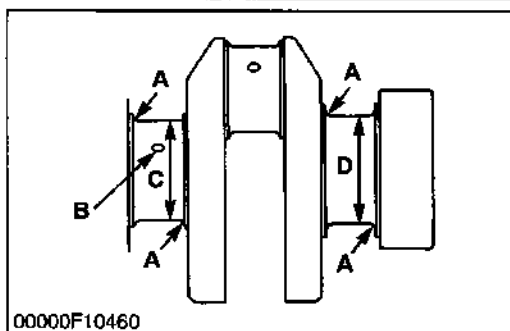
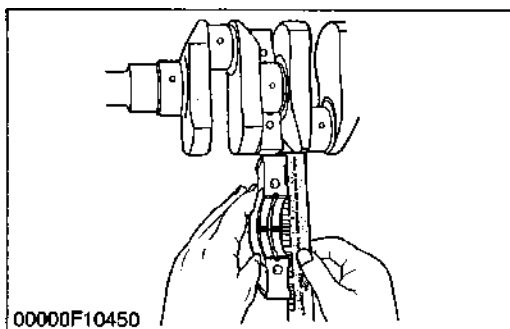
- 1. Clean a new crankshaft bearing 1 and crankshaft journal bore, and apply engine oil to them.
- 2. Using a crankshaft bearing 1 replacing tool, press in a new bearing 1 (2) so that its seam (1) directs toward the exhaust manifold side. (See figure)

Dimension (A)	Factory spec.	0 to 0.3 mm 0 to 0.0118 in.
---------------	---------------	--------------------------------

- (1) Seam
- (2) Crankshaft Bearing 1

- (3) Cylinder Block

00000S10341



Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 (Crankshaft Bearing 3)

1. Put a strip of plastigage (Code No. 07909-30241) on the center of the journal.
2. Install the bearing case and tighten the bearing case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale, and get the oil clearance.
4. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 2 (crankshaft bearing 3).
5. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

NOTE

- Be sure not to move the crankshaft while the bearing case screws are tightened.

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.034 to 0.095 mm 0.00134 to 0.00374 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D. (Intermediate)	Factory spec.	47.934 to 47.950 mm 1.88716 to 1.88779 in.
Crankshaft bearing 2 I.D.	Factory spec.	47.984 to 48.029 mm 1.88913 to 1.89091 in.

Oil clearance between crankshaft journal and crankshaft bearing 3	Factory spec.	0.034 to 0.098 mm 0.00134 to 0.00386 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D. (Flywheel side)	Factory spec.	51.921 to 51.940 mm 2.04413 to 2.04488 in.
Crankshaft bearing 3 I.D.	Factory spec.	51.974 to 52.019 mm 2.04622 to 2.04799 in.

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 and 3 (Continue)

(Reference)

- Undersize crankshaft bearing 2 and 3

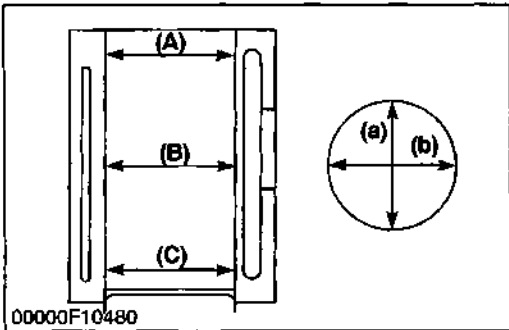
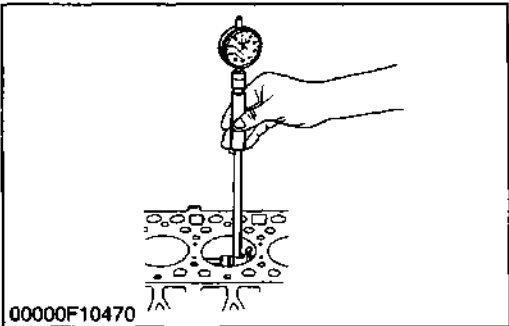
Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 2 02	16241-23931	020 US
	Crankshaft bearing 3 02	16241-23861	020 US
0.4 mm 0.016 in.	Crankshaft bearing 2 04	16241-23941	040 US
	Crankshaft bearing 3 04	16241-23871	040 US

- Undersize dimensions of crankshaft journal

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.0906 to 0.1063 in. radius	2.3 to 2.7 mm radius 0.0906 to 0.1063 in. radius
B	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius	1.0 to 1.5 mm radius 0.0394 to 0.0591 in. radius
C	47.734 to 47.750 mm 1.87929 to 1.87992 in.	47.534 to 47.550 mm 1.87141 to 1.87204 in.
D	51.721 to 51.740 mm 2.03626 to 2.03700 in.	51.521 to 51.540 mm 2.02838 to 2.02913 in.
• The crankpin journal must be fine-finished to higher than $\nabla\nabla\nabla\nabla$ (0.8 S).		

00000S10352

[5] Cylinder



Cylinder Wear

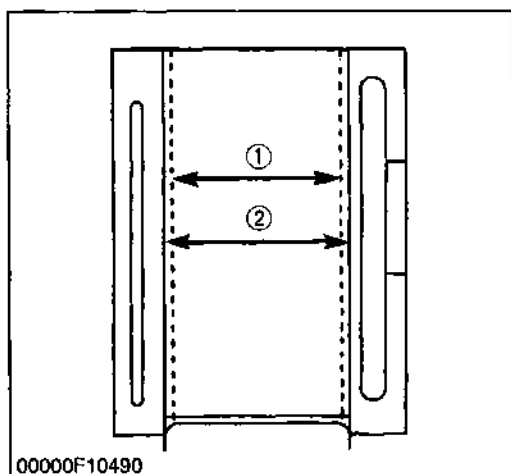
1. Measure the I.D. of the cylinder at the six positions (see figure) with a cylinder gauge to find the maximum and minimum I.D.'s.
2. Get the difference (Maximum wear) between the maximum and the minimum I.D.'s
3. If the wear exceeds the allowable limit, bore and hone to the oversize dimension. (Refer to **"Correcting Cylinder"**.)
4. Visually check the cylinder wall for scratches. If deep scratches are found, the cylinder should be bored. (Refer to **"Correcting Cylinder"**.)

Cylinder I.D.	Factory spec.	D905-B (E) V1205-B (E) V1205-T-B (E)	72.000 to 72.019 mm 2.8346 to 2.8353 in.
		D1005-B (E) V1305-B (E)	76.000 to 76.019mm 2.9921 to 2.9929 in.
		D1105-B (E) D1105-T-B (E) V1505-B (E) V1505-T-B (E)	78.000 to 78.019 mm 3.0709 to 3.0716 in.
Maximum wear	Allowable limit	0.15 mm 0.0059 in.	

- (A) Top
(B) Middle
(C) Bottom (Skirt)

- (a) Right-angled to Piston Pin
(b) Piston Pin Direction

01642S10362



Correcting Cylinder

1. When the cylinder is worn beyond the allowable limit, bore and hone it to the specified dimension.

Cylinder I.D.	Factory spec.	D905-B (E) V1205-B (E) V1205-T-B (E)	72.500 to 72.519 mm 2.8346 to 2.8551 in.
		D1005-B (E) V1305-B (E)	76.500 to 76.519mm 3.0118 to 3.0126 in.
		D1105-B (E) D1105-T-B (E) V1505-B (E) V1505-T-B (E)	78.500 to 78.519 mm 3.0906 to 3.0913 in.
Maximum wear	Allowable limit		0.15 mm 0.0059 in.
Finishing	Hone to 1.2 to 2.0 μR max. (0.00047 to 0.00079 in.R max.)		

2. Replace the piston and piston rings with oversize (0.5 mm) ones.

Part Name	Model	Code Number	Marking
Piston	D905-B (E), V1205-B (E)	16224-2191-0	05 OS
	V1205-T-B (E)	16295-2191-0	
	D1005-B (E), V1305-B (E)	16050-2191-0	
	D1105-B (E), V1505-B (E)	16060-2191-0	
	D1105-T-B (E) V1505-T-B (E)	16292-2191-0	
Piston ring assembly	D905-B (E), V1205-B (E)	15901-2109-0	05 OS
	V1205-T-B (E)	16269-2109-0	
	D1005-B (E), V1305-B (E)	16271-2109-0	
	D1105-B (E), V1505-B (E)	16261-2109-0	
	D1105-T-B (E) V1505-T-B (E)	16292-2109-0	

NOTE

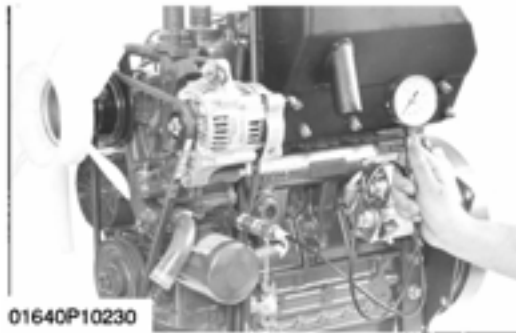
- When the oversize cylinder is worn beyond the allowable limit, replace the cylinder block with a new one.

(1) Cylinder I.D. (Before Correction) (2) Oversize Cylinder I.D.

01642S10372

D.Lubricating system

CHECKING



Engine Oil Pressure

1. Remove the oil switch and set a pressure tester (Code No. 07916-32031).
2. Start the engine. After warming up, measure the oil pressure of both idling and rated speeds.
3. If the oil pressure is less than the allowable limit, check the following.
 - Engine oil insufficient
 - Oil pump defective
 - Oil strainer clogged
 - Oil filter cartridge
 - Oil gallery clogged
 - Excessive oil clearance of bearing
 - Foreign matter in the relief valve

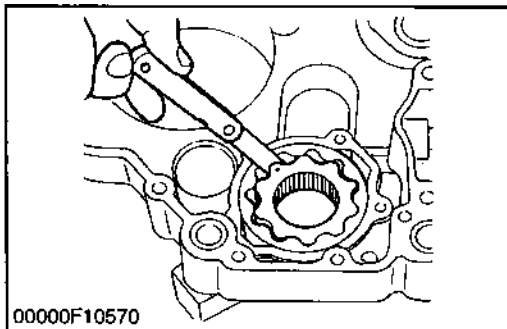
(When reassembling)

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

11900S10261

SERVICING

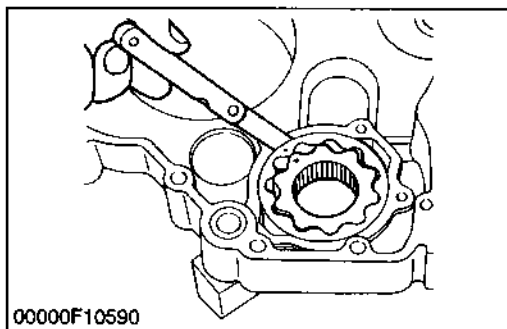
[1] Oil pump



Rotor Lobe Clearance

1. Measure the clearance between lobes of the inner rotor and the outer rotor with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

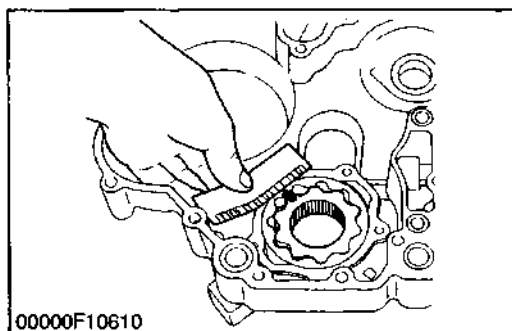
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Clearance between Outer Rotor and Pump Body

1. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

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**Clearance between Rotor and Cover**

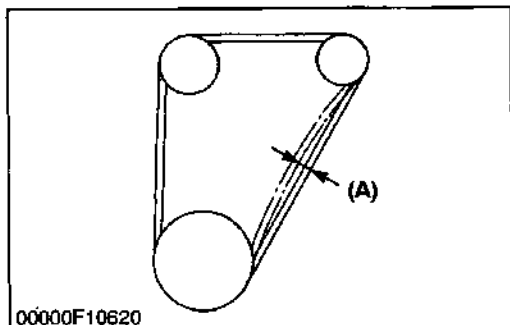
1. Put a strip of plastigage (Code No. 07909-30241) onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully, and measure the amount of the flattening with the scale and get the clearance.
4. If the clearance exceeds the factory specifications, replace oil pump rotor assembly.

00000S10442

E.Cooling system

CHECKING

[1] Fan belt



Fan Belt Tension

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

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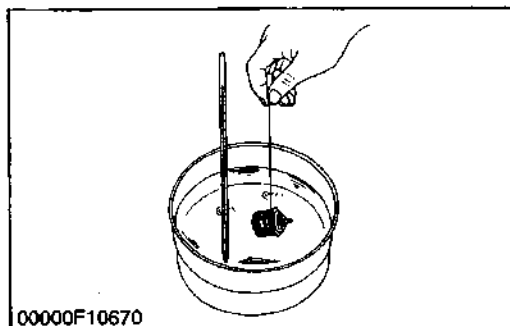
[2] Radiator



CAUTION

- When removing the radiator cap, wait at least ten minutes after the engine has stopped and cooled down. Otherwise, hot water may gush out, scalding nearby people.

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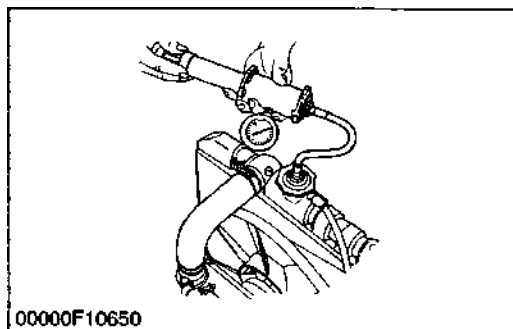


Thermostat Valve Opening Temperature

1. Push down the thermostat valve and insert a string between the valve and the valve seat.
2. Place the thermostat and a thermometer in a container with water and gradually heat the water.
3. Hold the string to suspend the thermostat in the water. When the water temperature rises, the thermostat valve will open, allowing it to fall down from the string.
Read the temperature at this moment on the thermometer.
4. Continue heating the water and read the temperature when the valve has risen by about 6 mm (0.236 in.).
5. If the measurement is not acceptable, replace the thermostat.

Thermostat's valve opening temperature	Factory spec.	69.5 to 72.5 °C 157.1 to 162.5 °F
Temperature at which thermostat completely opens	Factory spec.	85 °C 185 °F

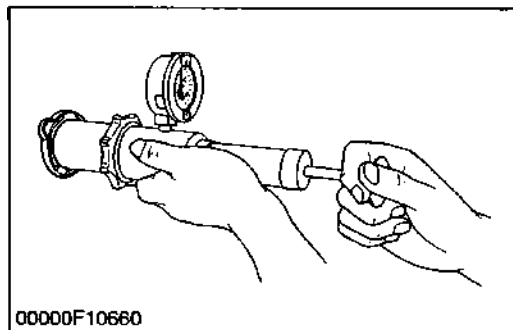
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Radiator Water Leakage

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (Code No. 07909-31551). Increase water pressure to the specified pressure of 1.4 kgf/cm² (137 kPa, 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.

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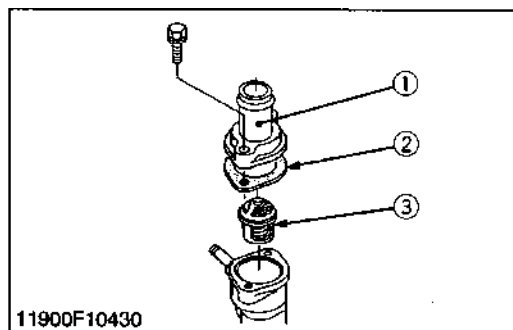


Radiator Cap Air Leakage

1. Set a radiator tester (Code No. 07909-31551) on the radiator cap.
2. Apply the specified pressure of 0.9 kgf/cm² (98.1 kPa, 12.8 psi).
3. Check if the pressure drop to less than 0.6 kgf/cm² (59 kPa, 9 psi) in 10 seconds.
4. If the pressure is less than the factory specification, replace it.

00000S10481

DISASSEMBLING AND ASSEMBLING



Thermostat Assembly

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

(When reassembling)

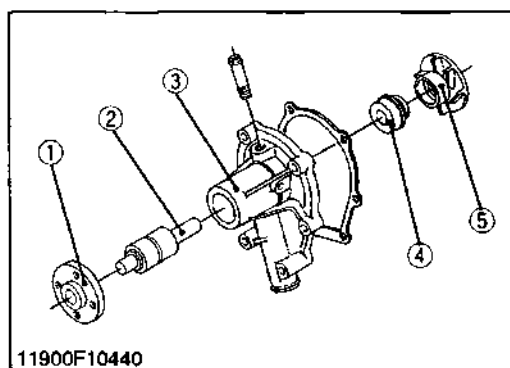
- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the gasket (2).

(1) Thermostat Cover

(3) Thermostat Assembly

(2) Thermostat Cover Gasket

11900S10270



Water Pump Assembly

1. Loosen the alternator mounting bolts, and remove the fan belt.
2. Remove the fan and fan pulley.
3. Remove the water pump assembly from the gear case cover.
4. Remove the water pump flange (1).
5. Press out the water pump shaft (2) with the impeller (5) on it.
6. Remove the impeller from the water pump shaft.
7. Remove the mechanical seal (4).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of gasket.
- Replace the mechanical seal with new one.

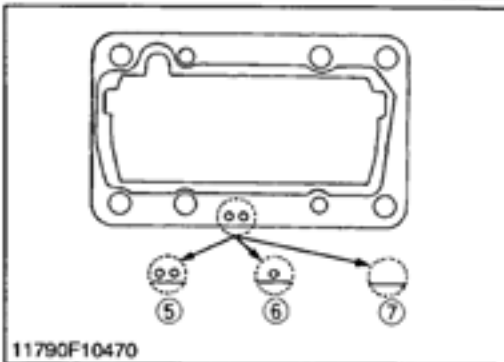
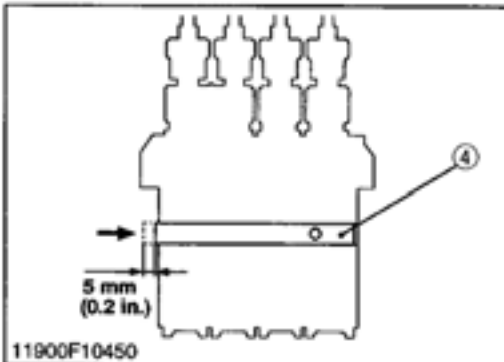
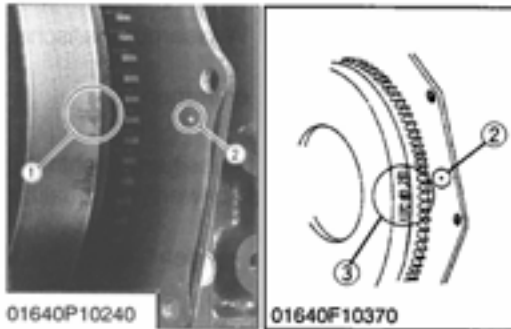
- | | |
|-----------------------|---------------------|
| (1) Water Pump Flange | (4) Mechanical Seal |
| (2) Water Pump Shaft | (5) Impeller |
| (3) Water Pump Body | |

11900S10280

F. Fuel system

CHECKING AND ADJUSTING

[1] Injection pump



Injection Timing

■ IMPORTANT

- When inspecting the fuel injection timing, the timing control actuates during starting and the correct fuel injection timing cannot be measured.

- Remove the injection pipes.
- Remove the engine stop solenoid, push in the control rack of the injection pump by 5 mm (0.2 in.) and hold it at that position.
- Turn the flywheel counterclockwise until fuel flows from the delivery valve holder.
- Continue to turn the flywheel slowly, and stop it as soon as the fuel level at the tip of the delivery valve holder begins to increase.
- Check to see if the mark "FI" (1) or timing angle lines on the flywheel is aligned with the punch mark (2).
- If the timing is out of adjustment, readjust the timing with shims.

- (1) Mark "FI"
(2) Punch Mark
(3) Timing Mark
(4) Control Rack

- (5) Two-holes : 0.20 mm (0.0079 in.)
(6) One-hole : 0.25 mm (0.0098 in.)
(7) Without hole : 0.30 mm (0.0118 in.)

11900S10291

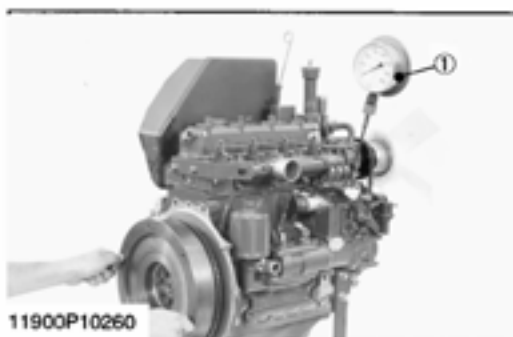
Injection Timing (Continue)**■ NOTE****(Engine serial number : ~ 489290)**

- Shims are available in thickness of 0.15 mm (0.0059 in.), 0.30 mm (0.0118 in.). Combine these shims for adjustments.
- Addition or reduction of shim (0.15 mm, 0.0059 in.) delays or advances the injection timing by approx. 0.026 rad. (1.5°).
- After adjusting the injection timing, apply liquid-type gasket (Three Bond 1215 or its equivalent) to both sides of the injection pump shim before reassembling.

(Engine serial number : 489291 ~)

- The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.
- Shims are available in thickness of 0.20 mm (0.0079 in.), 0.25 mm (0.0098 in.) and 0.30 mm (0.0118 in.). Combine these shims for adjustments.
- Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad. (0.5°).
- In disassembling and replacing, be sure to use the same number of new gasket shims with the same thickness.

11900S10292



11900P10260

Fuel Tightness of Pump Element

1. Remove the injection pipes and glow plugs.
2. Install the injection pump pressure tester (1) to the injection pump.
3. Set the speed control lever to the maximum speed position.
4. Turn the flywheel ten times or more to increase the pressure.
5. If the pressure can not reach the allowable limit, replace the pump element or injection pump assembly.

■ NOTE

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket.

(1) Injection Pump Pressure Tester

11900S10301



Fuel Tightness of Delivery Valve

1. Remove the injection pipes and glow plugs.
2. Set a pressure tester to the fuel injection pump.
3. Turn the flywheel and raise the pressure to approx. 14.7 MPa (150 kgf/cm², 2133 psi).
4. Now turn the flywheel back about half a turn (to keep the plunger free). Maintain the flywheel at this position and clock the time taken for the pressure to drop from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm², from 2133 to 1990 psi).
5. Measure the time needed to decrease the pressure from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm², from 2133 to 1990 psi).
6. If the measurement is less than allowable limit, replace the delivery valve.

NOTE

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket.

11900S10311

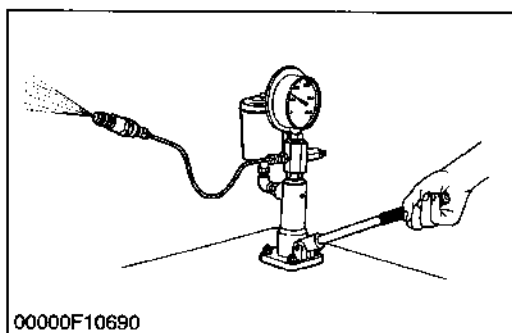
[2] Injection nozzle



CAUTION

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

11790S10690



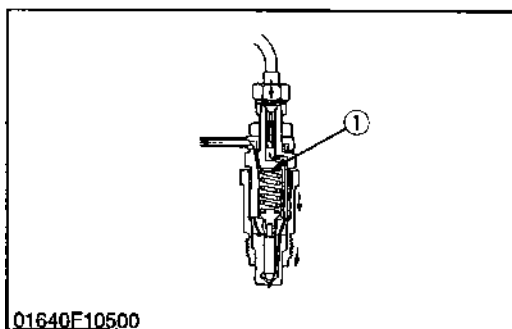
Nozzle Injection Pressure

1. Set the injection nozzle to the nozzle tester.
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, disassemble the injection nozzle, and change adjusting washer (1) until the proper injection pressure is obtained.

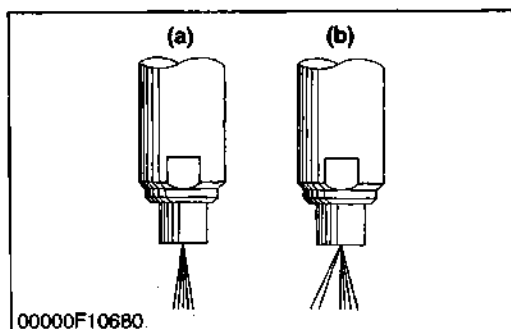
(Reference)

- Pressure variation with 0.025 mm (0.001 in.) difference of adjusting washer thickness.
Approx. 59 kPa (6 kgf/cm², 85 psi)

(1) Adjusting Washer



00000S10512



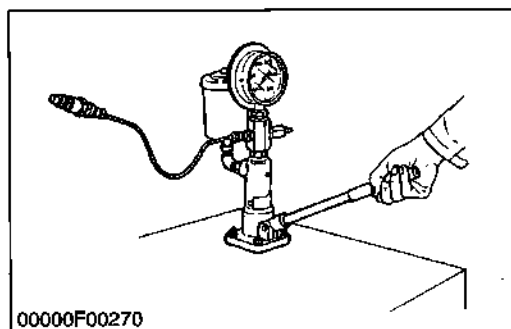
Nozzle Spraying Condition

1. Set the injection nozzle to a nozzle tester (Code No. 07909-31361), and check the nozzle spraying condition.
2. If the spraying condition is defective, replace the nozzle piece.

(a) Good

(b) Bad

00000S10500



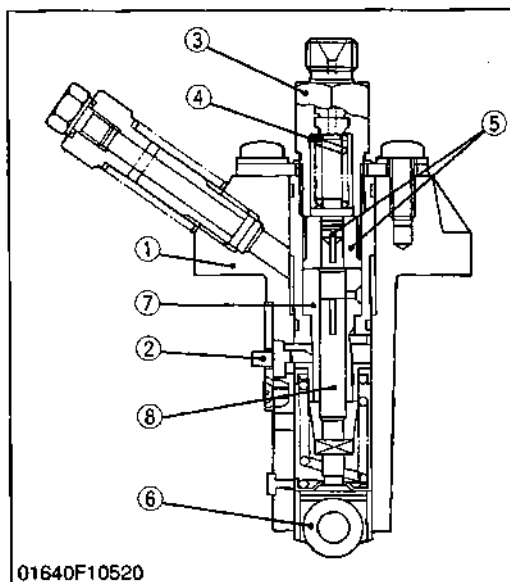
Valve Seat Tightness

1. Set the injection nozzle to a nozzle tester (Code No. 07909-31361).
2. Raise the fuel pressure, and keep at 12.75 MPa (130 kgf/cm², 1849 psi) for 10 seconds.
3. If any fuel leak is found, replace the nozzle piece.

00000S10521

DISASSEMBLING AND ASSEMBLING

[1] Injection pump



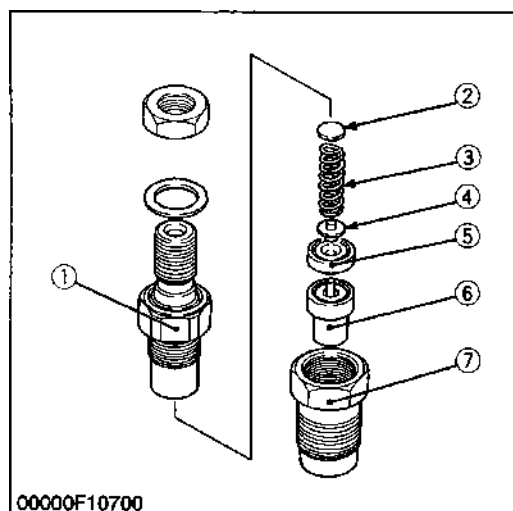
■ IMPORTANT

- If replacing the pump element, the amount of fuel injection should be adjusted on a specified bench.

- | | |
|---------------------------|--------------------|
| (1) Pump Body | (5) Delivery Valve |
| (2) Control Rack | (6) Tappet Roller |
| (3) Delivery Valve Holder | (7) Cylinder |
| (4) Delivery Valve Spring | (8) Plunger |

01640S10440

[2] Injection nozzle



Nozzle Holder

1. Secure the nozzle retaining nut (7) with a vise.
2. Remove the nozzle holder (1), and take out parts inside.

(When reassembling)

- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), noting its direction.
- After assembling the nozzle, be sure to adjust the fuel injection pressure.

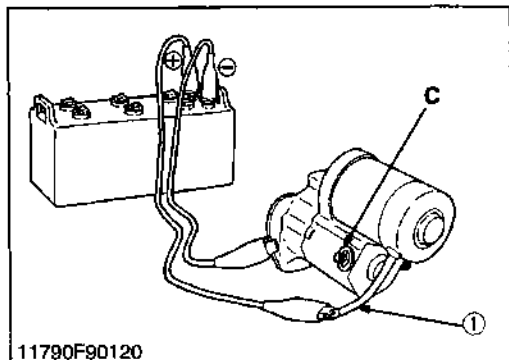
- | | |
|----------------------|--------------------------|
| (1) Nozzle Holder | (5) Distance Piece |
| (2) Adjusting Washer | (6) Nozzle Piece |
| (3) Nozzle Spring | (7) Nozzle Retaining Nut |
| (4) Push Rod | |

00000S10531

G.Electrical system

CHECKING

[1] Starter



11790F90120

Motor Test



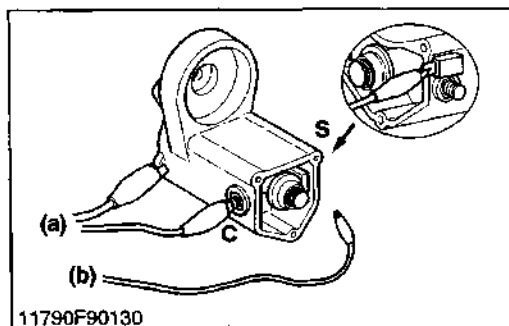
CAUTION

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

1. Disconnect the ground cable clamp from the battery negative terminal post.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter motor from the engine.
4. Disconnect the connecting lead (1) from the starter C terminal.
5. Connect a jumper lead from the connecting lead (1) to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

(1) Connecting Lead

11790S90180



11790F90130

Magnet Switch Test (Pull-In, Holding Coils)

1. Remove the motor from the starter housing.
2. Prepare a 6 V battery for the test.
3. Connect jumper leads from the battery negative terminal to the housing and the starter C terminal.
4. The plunger should be attached and the pinion gear should pop out when a jumper lead is connected from the battery positive terminal to the S terminal. It's a correct.
5. Disconnect the jumper lead to the starter C terminal. Then the pinion gear should remain popped out. It's a correct.

■ IMPORTANT

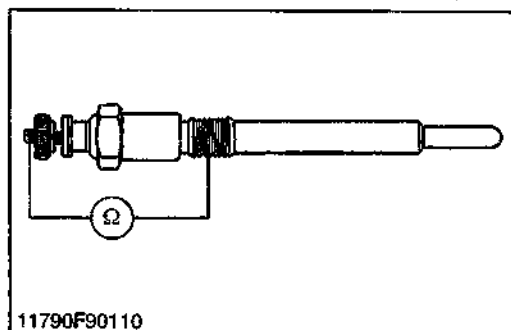
- **Testing time must be 3 to 5 sec.**

(a) To Negative Terminal

(b) To Positive Terminal

11790S90190

[2] Glow plug



Glow Plug

1. Disconnect the leads from the glow plugs.
2. Measure the resistance with a circuit tester across the glow plug terminal and the housing.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the reference value is not indicated, the glow plug is faulty, replace the glow plug.

[S / No. 489290 and below]

Glow plug resistance	Factory spec.	Approx. 1.0 to 1.2 ohms
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[S / No. 489291 and above]

Glow plug resistance	Factory spec.	Approx. 0.9 ohms
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11790S90161

DISASSEMBLING AND ASSEMBLING

[1] Starter



Disassembling Motor

1. Disconnect the connecting lead (8) from the magnet switch (1).
2. Remove the through screws (6), and then separate the end frame (5), yoke (3) and armature (2).
3. Remove the two screws (7), and then take out the brush holder (4) from the end frame (5).

(When reassembling)

- Apply grease to the spline teeth (A) of the armature (2).

- | | |
|-------------------|---------------------|
| (1) Magnet Switch | (7) Screws |
| (2) Armature | (8) Connecting Lead |
| (3) Yoke | (9) Nut |
| (4) Brush Holder | |
| (5) End Frame | (A) Spline Teeth |
| (6) Screws | |

11790S90200



Disassembling Magnet Switch

- 1. Remove the drive end frame (1) mounting screws.
- 2. Take out the over running clutch (2), ball (3), spring (4), gear (5), rollers (6) and retainer (7).

(When reassembling)

- Apply grease to the gear teeth of the gear (5) and over running clutch (2), and ball (3).

- | | |
|-------------------------|--------------|
| (1) Drive End Frame | (5) Gear |
| (2) Over Running Clutch | (6) Roller |
| (3) Ball | (7) Retainer |
| (4) Spring | |

11790S90210



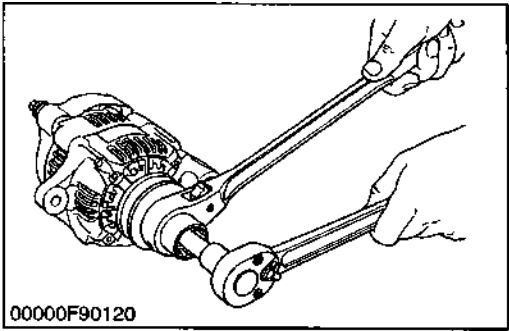
Plunger

- 1. Remove the end cover (1).
- 2. Take out the plunger (2).

- | | |
|---------------|-------------|
| (1) End Cover | (2) Plunger |
|---------------|-------------|

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[2] Alternator



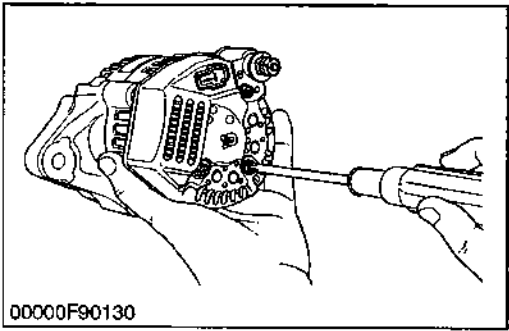
Pulley

- 1. Secure the hexagonal end of the pulley shaft with a double-ended ratchet wrench as shown in the figure, loosen the pulley nut with a socket wrench and remove it.

(When reassembling)

Tightening torque	Pulley nut	58.3 to 78.9 N·m 5.95 to 8.05 kgf·m 43.0 to 58.2 ft·lbs
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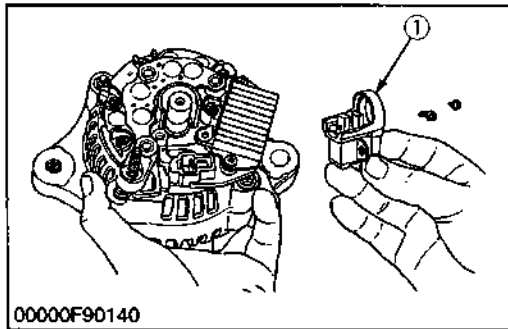
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Rear End Cover

- 1. Unscrew the three rear end cover screws and the B terminal nut, and remove the rear end cover.

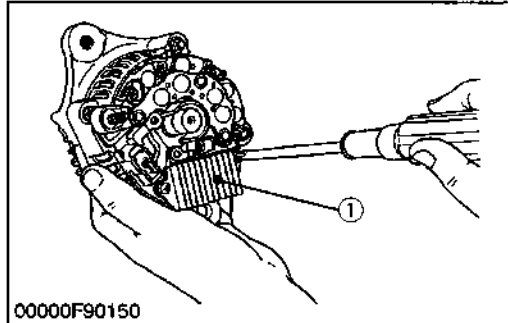
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**Brush Holder**

1. Unscrew the two screws holding the brush holder, and remove the brush holder (1).

(1) Brush Holder

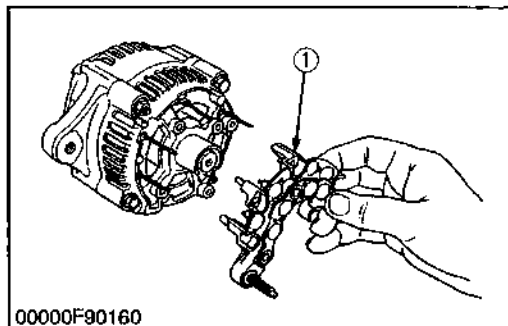
00000S90100

**IC Regulator**

1. Unscrew the three screws holding the IC regulator, and remove the IC regulator (1).

(1) IC Regulator

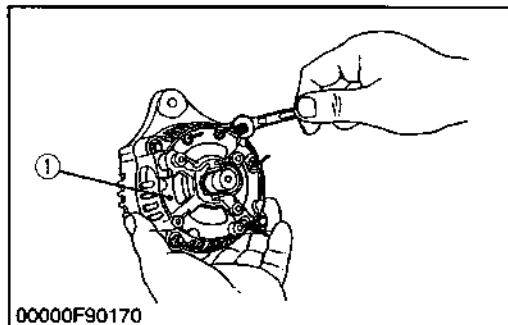
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**Rectifier**

1. Remove the four screws holding the rectifier and the stator lead wires.
2. Remove the rectifier (1).

(1) Rectifier

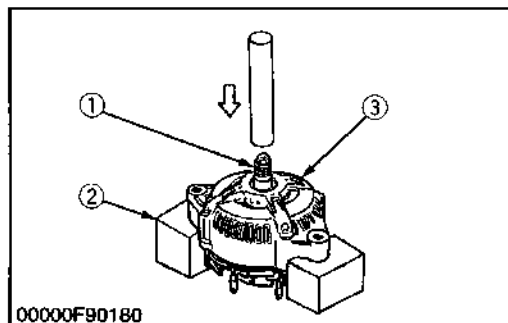
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**Rear End Frame**

1. Unscrew the two nuts and two screws holding the drive end frame and the rear end frame.
2. Remove the rear end frame (1).

(1) Rear End Frame

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**Rotor**

1. Press out the rotor (1) from drive end frame (3).

■ IMPORTANT

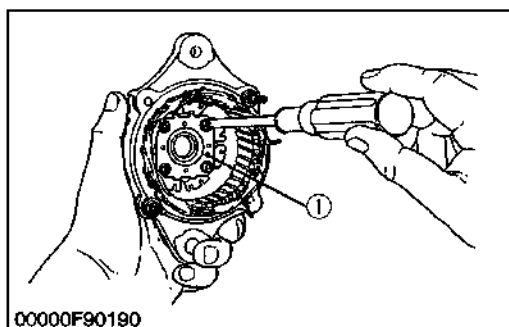
- Take special care not to drop the rotor and damage the slip ring or fan, etc.

(1) Rotor

(3) Drive End Frame

(2) Block

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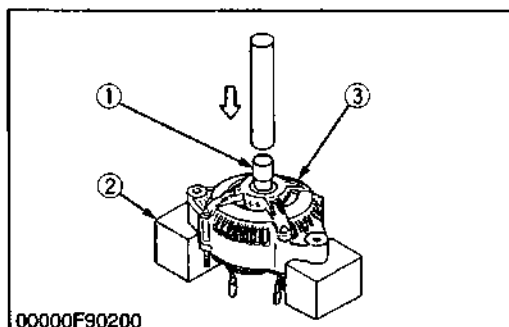


Retainer Plate

1. Unscrew the four screws holding the retainer plate, and remove the retainer plate (1).

(1) Retainer Plate

00000S90150



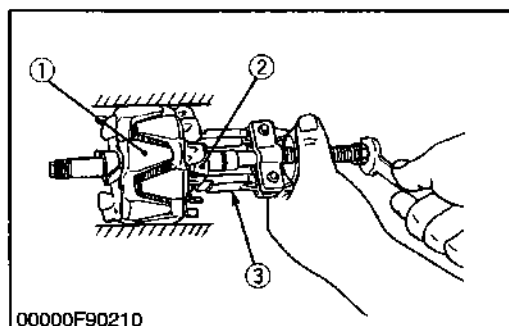
Bearing on Drive End Side

1. Press out the bearing from drive end frame (3) with a press and jig (1).

(1) Jig
(2) Block

(3) Drive End Frame

00000S90160



Bearing at Slip Ring Side

1. Lightly secure the rotor (1) with a vise to prevent damage, and remove the bearing (2) with a puller (3).

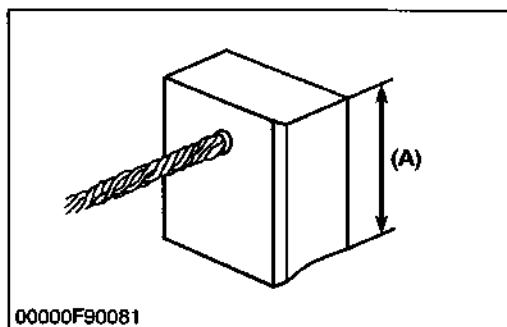
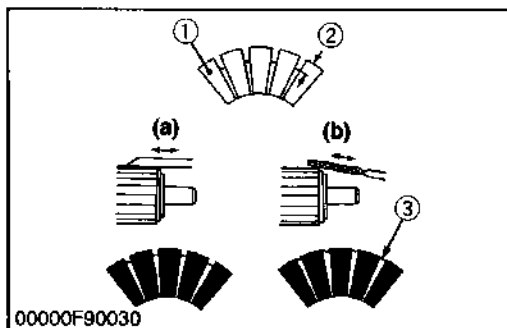
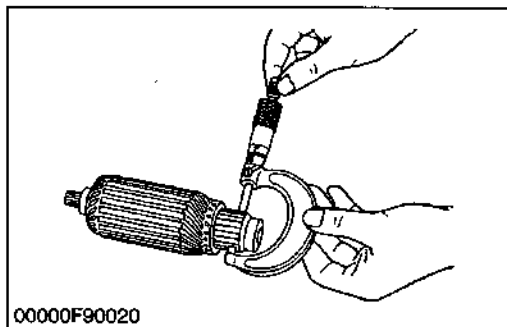
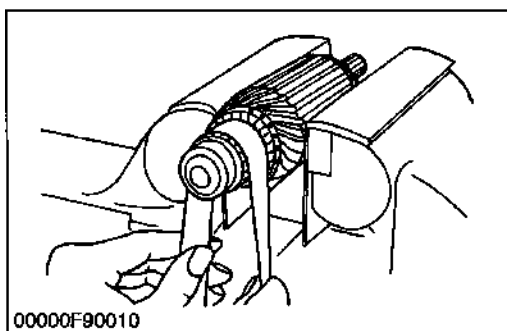
(1) Rotor
(2) Bearing

(3) Puller

00000S90170

SERVICING

[1] Starter

**Commutator and Mica**

1. Check the contact face of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

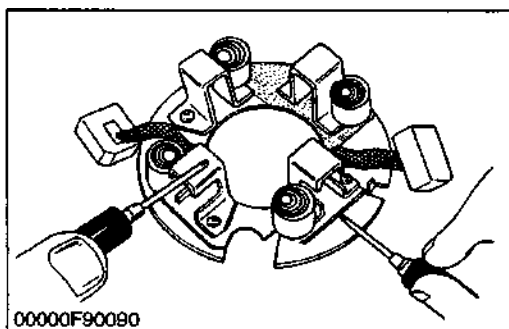
- | | |
|-------------------|----------|
| (1) Segment | (a) Good |
| (2) Depth of Mica | (b) Bad |
| (3) Mica | |

00000S90011

Brush Wear

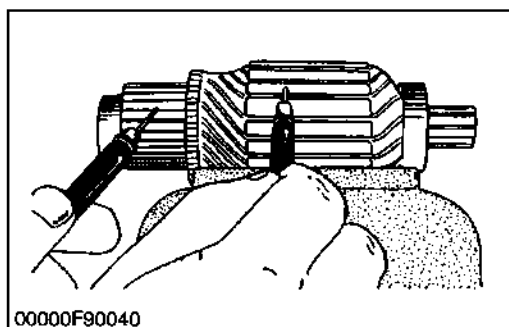
1. If the contact face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length (A) with vernier calipers.
3. If the length is less than the allowable limit, replace the yoke assembly and brush holder.

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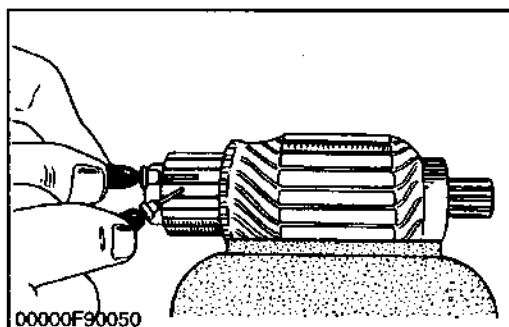
**Brush Holder**

1. Check the continuity across the brush holder and the holder support with an ohmmeter.
2. If it conducts, replace the brush holder.

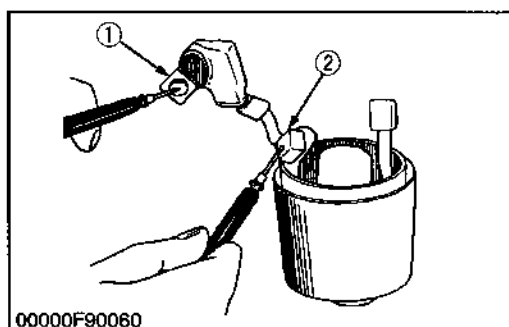
00000S90050

**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.



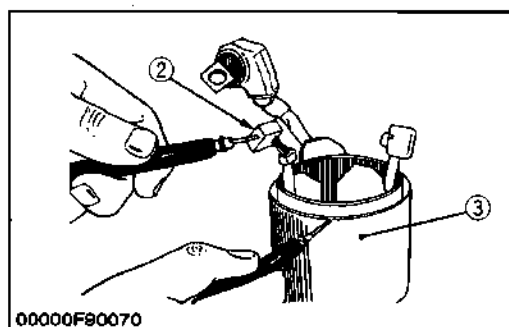
00000S90020

**Field Coil**

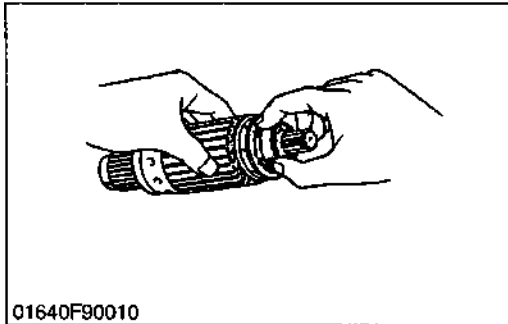
1. Check the continuity across the lead (1) and brush (2) with an ohmmeter.
2. If it does not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with an ohmmeter.
4. If it conducts, replace the yoke assembly.

(1) Lead
(2) Brush

(3) Yoke

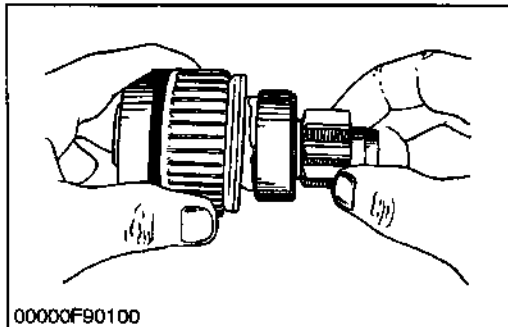


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**Armature Bearing**

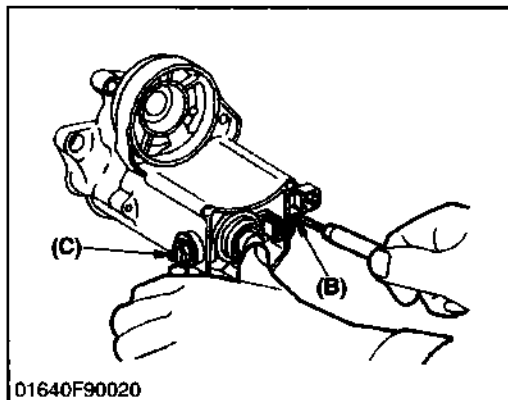
1. Check the bearing for smooth rotation.
2. If it does not smooth rotation, replace it.

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**Overrunning Clutch**

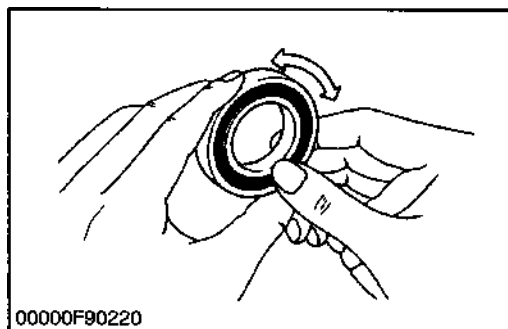
1. Inspect the pinion for wear or damage.
2. If there is any defect, replace the overrunning clutch assembly.
3. Check that the pinion turns freely and smoothly in the overrunning direction and does not slip in the cranking direction.
4. If the pinion slips or does not turn in the both directions, replace the overrunning clutch assembly.

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**Magnet Switch**

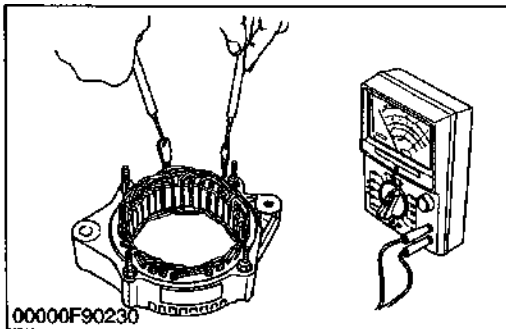
1. Check the continuity across the "C" terminal and the "B" terminal with an ohmmeter pushing the plunger.
2. If it does not conduct, check the contacts.

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[2] Alternator**Bearing**

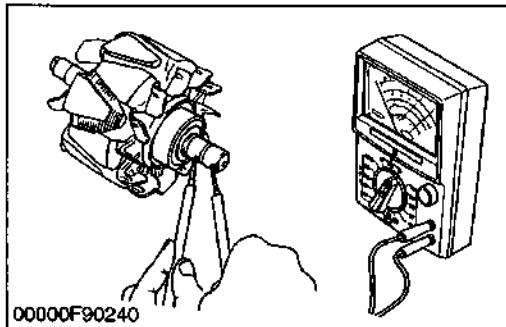
1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.

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**Stator**

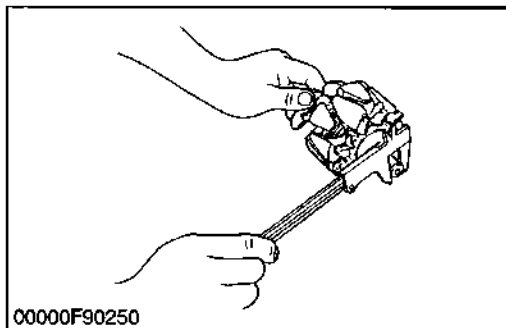
1. Measure the resistance across each lead of the stator coil with an ohmmeter.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

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**Rotor**

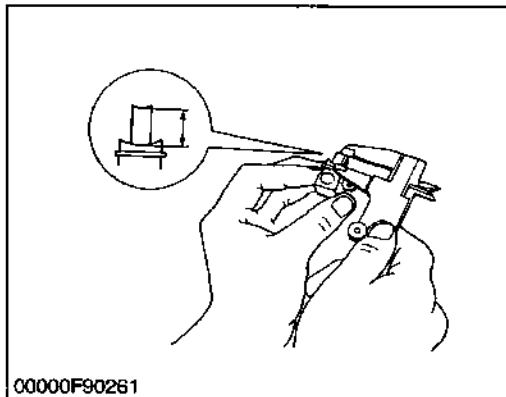
1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If continuous, replace it.

00000S90201

**Slip Ring**

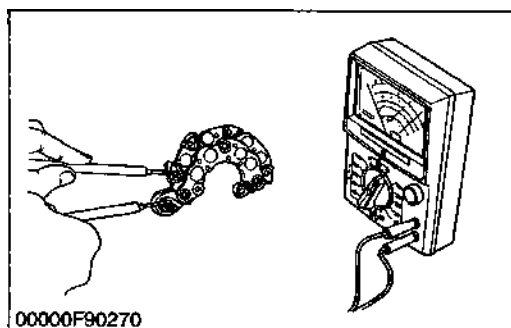
1. Check the slip ring for score.
2. If scored, correct with an sand paper or on a lathe.

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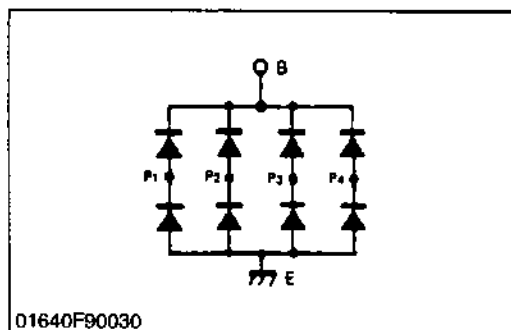
**Brush Wear**

1. Check the length of the brush, if the length is shorter than the allowable limit, replace it.
2. Make sure that the brush moves smoothly.
3. If the brush is defective, replace it.

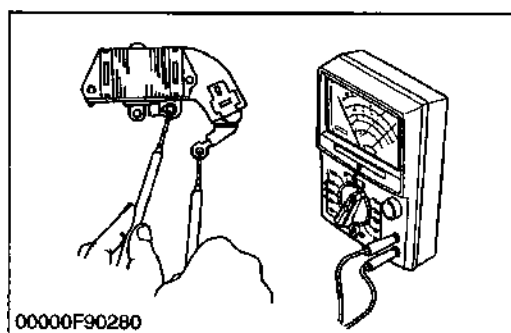
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**Rectifier**

1. Check the continuity across each diode of rectifier with an ohmmeter.
2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.



01640S90050

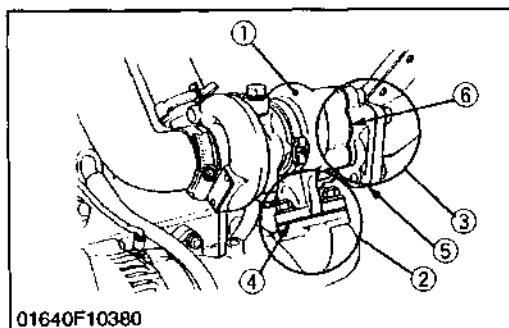
**IC Regulator**

1. Check the continuity across the "B" terminal and the "F" terminal of IC regulator with an ohmmeter.
2. The IC regulator is normal if it conducts in one direction and does not conduct in the reverse direction.

01640S90060

H.Turbo charger system

CHECKING

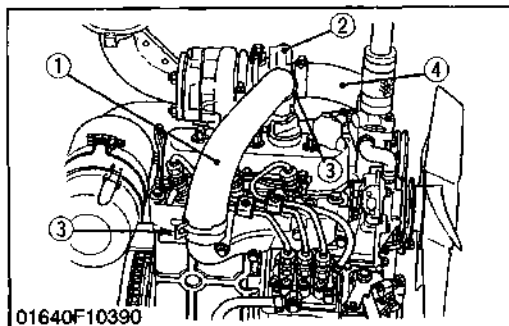


Turbine Side

1. Check the exhaust port (3) and inlet port (2) side of the turbine housing (1) to see if there is no exhaust gas leak.
2. If any gas leak is found, retighten the bolts and nuts or replace the gasket (4) / (5) / (6) with new one.

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

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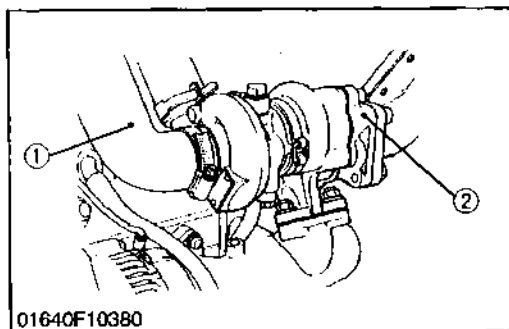


Compressor Side

1. Check the inlet pipe 1 (1) of the compressor cover (2) to see if there is no air leak.
2. Check for loose connections or cracks in the suction side of the intake pipe (4).
3. If any air leak is found, change the clamp (3) and or inlet pipes.

- | | |
|----------------------|-----------------|
| (1) Inlet Pipe 1 | (3) Clamp |
| (2) Compressor Cover | (4) Intake Pipe |

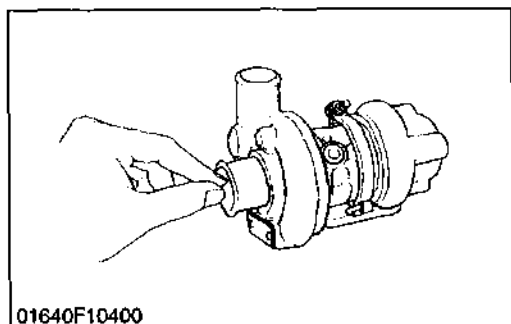
01640S10820



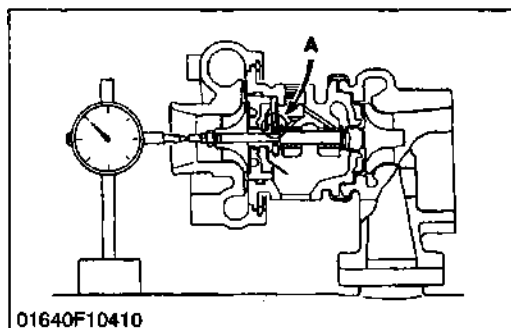
Wheel Shaft

1. Remove the intake pipe (1) and flange (2).
2. Turn the compressor wheel gently with a finger and check for contact.
3. If the wheel does not turn smoothly and / or found the damage, and abnormal sound, check the axial and radial clearance.
4. If the compressor / turbine wheel and housing is found to be damaged, replace the turbocharger assembly with new one.

- | | |
|-----------------|------------|
| (1) Intake Pipe | (2) Flange |
|-----------------|------------|



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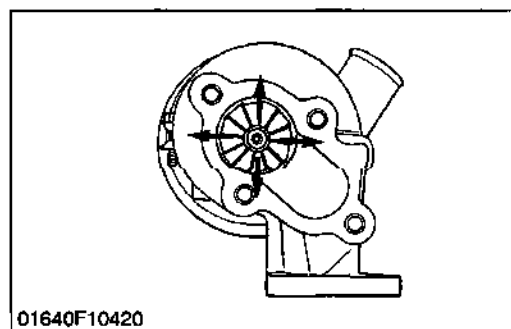


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Axial Clearance

1. Set the dial gauge.
2. Move the shaft in the axial direction, and measure the end play.
3. If the end play (A) exceeds 0.12 mm (0.0047 in.), replace the turbocharger assembly with new one.

01640S10840

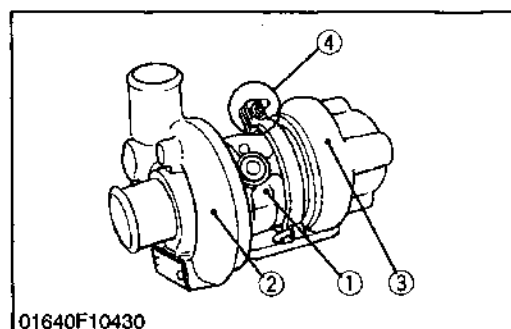


01640F10420

Radial Clearance

1. Move the compressor / turbine wheel (up and down / right and left).
2. If the wheel contact to the housing, replace the turbocharger assembly with new one.

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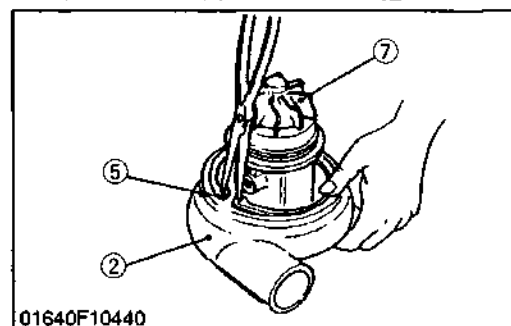


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Turbine / Compressor Wheel**NOTE**

- When carbon or oil adheres to the wheel remove the carbon or oil adheres with a brass brush or other soft tools.
- Do not scratch or damage the wheel with a brass brush or any other soft tools.
- Do not disassembling the compressor wheel and turbine shaft.
- After cleaning the compressor / turbine wheel, be sure to check the axial and radial clearance.

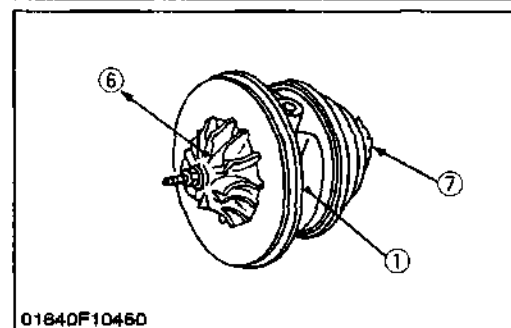
1. Parting marks must be marked on the bearing housing (1) and compressor (2) / turbine housing (3).
2. Remove the coupling (4) and turbine housing.
3. Remove the snap ring (5) and compressor housing (2).
4. Clean the compressor wheel (6) and turbine wheel (7) with a brass brush or other soft tools.



01640F10440

Tightening torque	Housing clamp bolt	1.47 to 2.45 N·m 0.15 to 0.25 kgf·m 1.09 to 1.91 ft·lbs
-------------------	--------------------	---

- | | |
|------------------------|------------------------|
| (1) Bearing Housing | (5) Snap Ring |
| (2) Compressor Housing | (6) Compressor / Wheel |
| (3) Turbine Housing | (7) Turbine Wheel |
| (4) Coupling | |



01640F10460

01640S10860

DISASSEMBLING AND ASSEMBLING

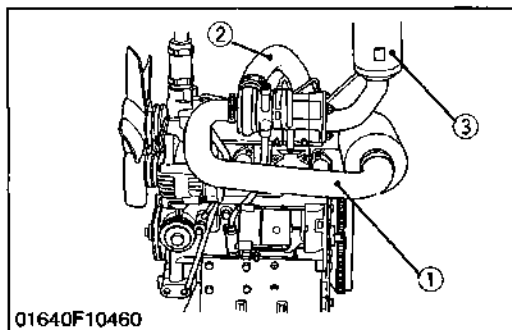
CAUTION

- While the engine is running and or just after it stops, the turbocharger is hot, be careful not to touch the turbocharger.

NOTE

- When detaching and attaching the turbocharger assembly, be very careful not to allow dust, dirt and other foreign matters in the oil pipes.
- When the turbocharger assembly has been replaced, pour fresh engine oil through the oil filter port of the turbocharger.
- Before starting the engine, make sure that the air cleaner is in position.

01640S10870



Air Cleaner and Muffler

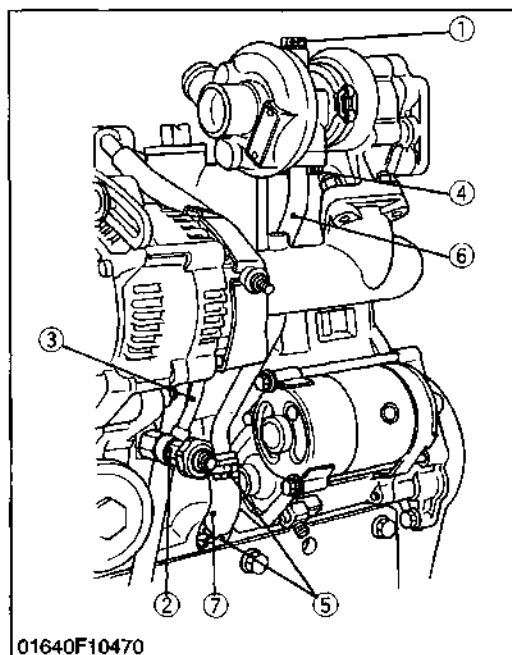
1. Remove the intake pipe (1).
2. Remove the inlet pipe 1 (2).
3. Remove the muffler (3).

(When reassembling)

- Replace the gaskets with new one.

- | | |
|------------------|-------------|
| (1) Intake Pipe | (3) Muffler |
| (2) Inlet Pipe 1 | |

01640S10880



Oil Pipe

1. Remove the joint bolt (2), (3) and take off the pipe 1 (4).
2. Remove the bolts (5) and release the clamp (6).
3. Disconnect the oil pipe 2 (7) and pipe 4 (8).

(When reassembling)

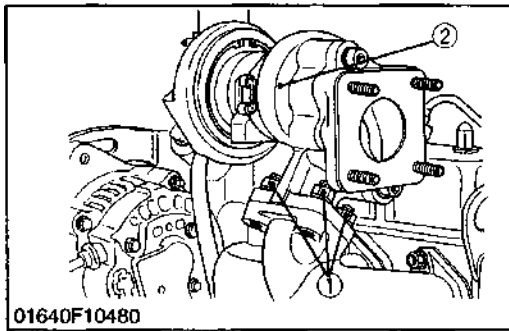
- Pour fresh engine oil through the oil filter port of the turbocharger.
- Replace the gaskets with new one.
- Be careful not to allow dust, dirt and other foreign matters in the oil pipes.

NOTE

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

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

01640S10890

**Turbocharger**

1. Remove the bolt (1).
2. Take off the turbocharger assemble (2).

(When reassembling)

- Replace the gasket with new one.

(1) Bolt

(2) Turbocharger Assemble

01640S10900

IV. Hydraulic system (Mechanism section)

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A.Features of hydraulic system

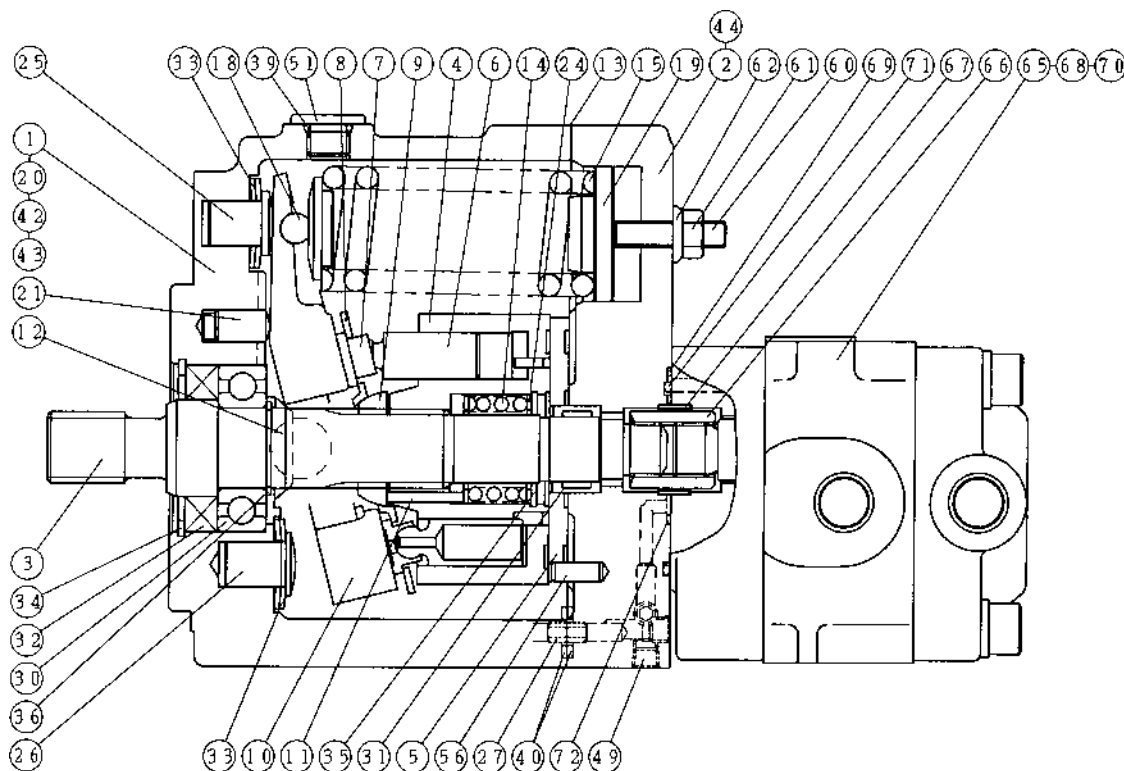
No	Function	Detail
1	Arm regeneration.	Part of return oil from the arm cylinder rod is allowed to flow to the arm cylinder bottom, speeding up the arm's crowding and preventing the arm's getting stuck.
2	Redesigned boom anti-drift valve.	The minimum boom down speed can be controlled by the main spool, which helps inch the attachment more finely. (On conventional types, the inching is limited by the drain circuit's minimum leak amount.)
3	Straight travel circuit adopted.	In traveling and moving the front attachment at once, the third pump's flow rate serves to control the attachment. This circuit is activated once the machine travels to the right or left and the front attachment is moved.
4	Pilot valve (Kawasaki-made) redesigned.	The vertical stroke is made greater from 5.2 mm to 6.4 mm (to eliminate jerking at vertical rotation). The secondary pressure is also made higher from 19.5 kgf/cm ² to 27.0 kgf/cm ² for improved controllability.
5	Swivel negative brake adopted.	Release the lever lock, and the negative brake gets activated to keep the parked machine even on a slope.
6	Priority throttle of boom-bucket simultaneous operation.	The throttle check valve added between the boom and bucket sections enables operating the boom and bucket at once.
7	Travel lock for safety.	Raise the left operation lever, and oil from the hydraulic pilot pump gets unloaded and the spring force gets the travel lever locked.
8	Anti-cavitation valve in travel motor.	Cavitation noise can be kept low at stop.
9	Line filter adopted in hydraulic pilot line.	A specific filter is introduced to keep out contamination.

B. Hydraulic system specifications

Machine model			U20-3	U25-3
Engine RPM			2,200	2,400
Pump	Maker		Fujikoshi	Fujikoshi
	Type		PVD-OB-24P-6G3-4694A	PVD-OB-24P-8G3-4837B
			Variable Displacement Pump	Variable Displacement Pump
			+Gear Pump	+Gear Pump
	Delivery rate	P1, P2	23.0 L / min	28.8 L / min
		P3	12.8 L / min	19.2 L / min
		P _P	5.9 L / min	6.5 L / min
Control valve	Maker		KAYABA	KAYABA
	Type		KVSE-36-10	KVSE-36-10
	Main relief pressure	P1, P2	21.6 MPa	21.6 MPa
		P3	20.6 MPa	17.2 MPa
		P _P	3.9 MPa	3.9 MPa
Swivel motor	Maker		Eaton Fluid Power	Eaton Fluid Power
	Type		25PB20A1124-C	25PB25A1125-C
			VNS200S310A	VNS165S320A
	Equivalent capacity		195 cm ³ /rev	244 cm ³ /rev
	Relief pressure		19.6 MPa	16.2 MPa
	Swivel speed		8.9 rpm	9.2 rpm
	Torque Theoretical		609 N·m	629 N·m
Travel motor	Maker		Fujikoshi	KAYABA
	Type		PHV-190-39-1-8944A	MAG-18V-230E
	Equivalent capacity		628/328 cm ³ /rev	774/430 cm ³ /rev
	Speed (R)		2.2/4.2 km/h	2.5/4.5 km/h
Cylinder	Boom	Bore dia.	65	70
		Rod dia	35	40
		Stroke	490	476
	Arm	Bore dia.	65	70
		Rod dia	40	40
		Stroke	450	484
	Bucket	Bore dia.	60	65
		Rod dia	35	35
		Stroke	416	416
	Swing	Bore dia.	60	60
		Rod dia	35	35
		Stroke	420	420
	Dozer	Bore dia.	80	90
		Rod dia	40	45
		Stroke	138	126
	Truck	Bore dia.	60	—
		Rod dia	30	—
		Stroke	215	—

C.Main pump

a. Structure & specifications



No.	PARTS NAME	Q'ty	No.	PARTS NAME	Q'ty	No.	PARTS NAME	Q'ty	No.	PARTS NAME	Q'ty
	Body S	1	21	Rod G	1	41	None		61	Hex nut	1
2	Body H	1	22	None		42	Plug	1	62	Sealing washer	1
3	Shaft	1	23	None		43	O-ring	1	63	None	
4	Cylinder barrel	1	24	Retainer	2	44	Hex socket bolt	5	64	None	
5	Valve plate	1	25	Stopper pin A	1	45	None		65	Gear pump	1
6	Piston	10	26	Stopper pin B	1	46	None		66	Coupling	1
7	Shoe	10	27	Socket pin	1	47	None		67	Collar	1
8	Shoe holder	1	28	None		48	None		68	Hex bolt	2
9	Barrel holder	1	29	None		49	Hex socket plug	5	69	O-ring	1
10	Swash plate	1	30	Ball bearing	1	50	None		70	Washer	2
11	Needle	3	31	Needle bearing	1	51	Plug	1	71	O-ring	1
12	Oscillating pin	2	32	Oil seal	1	52	None		72	O-ring	1
13	Packing	1	33	Plate spring	4	53	None				
14	Spring C	1	34	Snap ring	1	54	None				
15	Spring T1	1	35	Snap ring	1	55	None				
16	None		36	Snap ring	1	56	Spring pin	1			
17	None		37	None		57	None				
18	Spring holder	1	38	None		58	None				
19	Spring guide	1	39	O-ring	1	59	None				
20	Pin	1	40	O-ring	2	60	Hex socket lock screw	1			

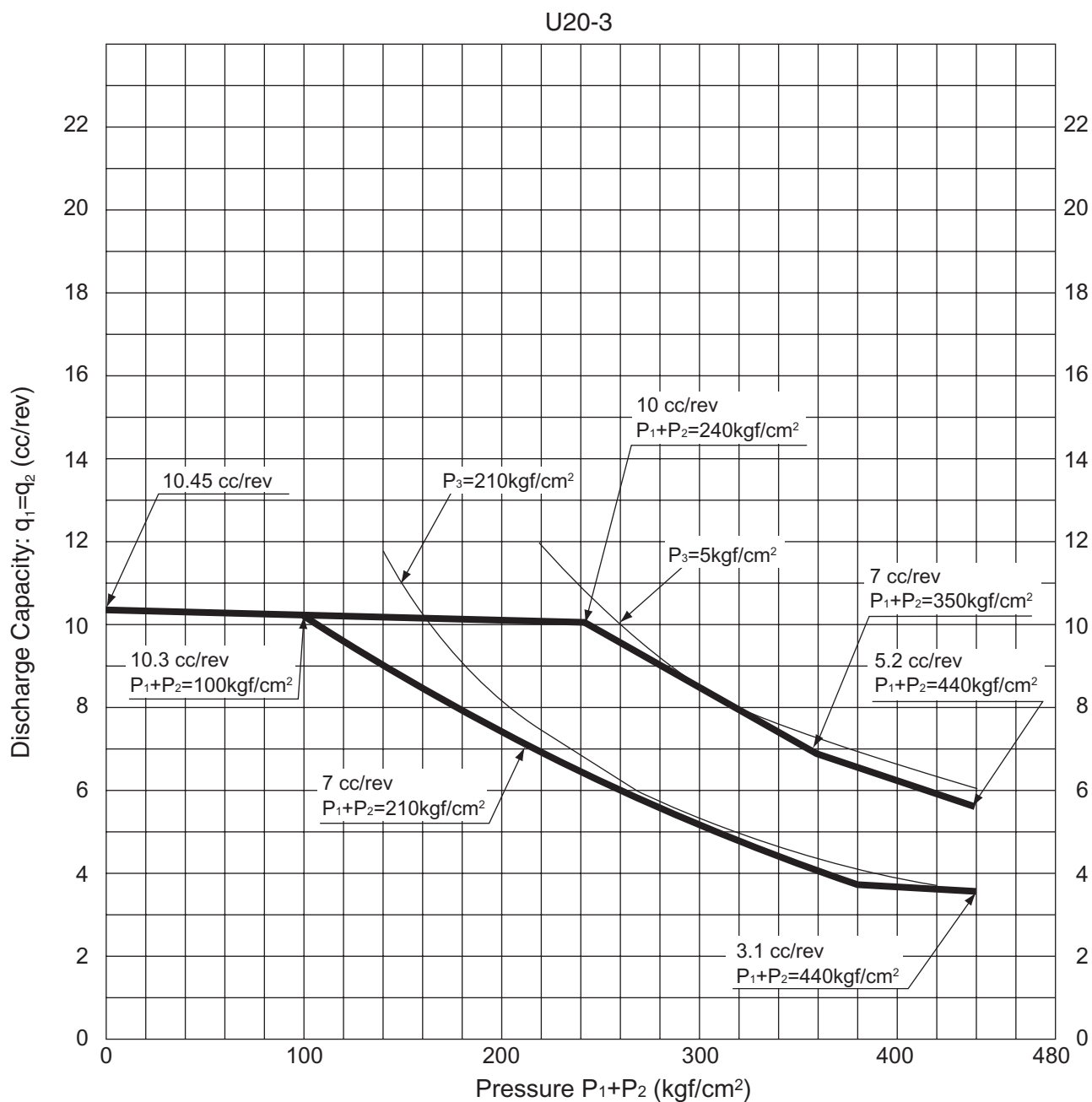
Machine model		U20-3	U25-3
Engine RPM		2200	2400
Discharge Capacity	Manufacturer	Fujikoshi	Fujikoshi
	Type	PVD-OB-24P-6G3-4694A	PVD-OB-24P-8G3-4837B
		Variable displacement pump + Gear pump	Variable displacement pump + Gear pump
Discharge Capacity	P ₁ , P ₂	23.0 L / min 6.1 GPM	28.8 L / min 7.6 GPM
	P ₃	12.8 L / min 3.4 GPM	19.2 L / min 5.1 GPM
	P _P	5.9 L / min 1.6 GPM	6.5 L / min 1.7 GPM

b. Performance curve

U20-3

Type: PVD-OB-24P-6G3-4649A

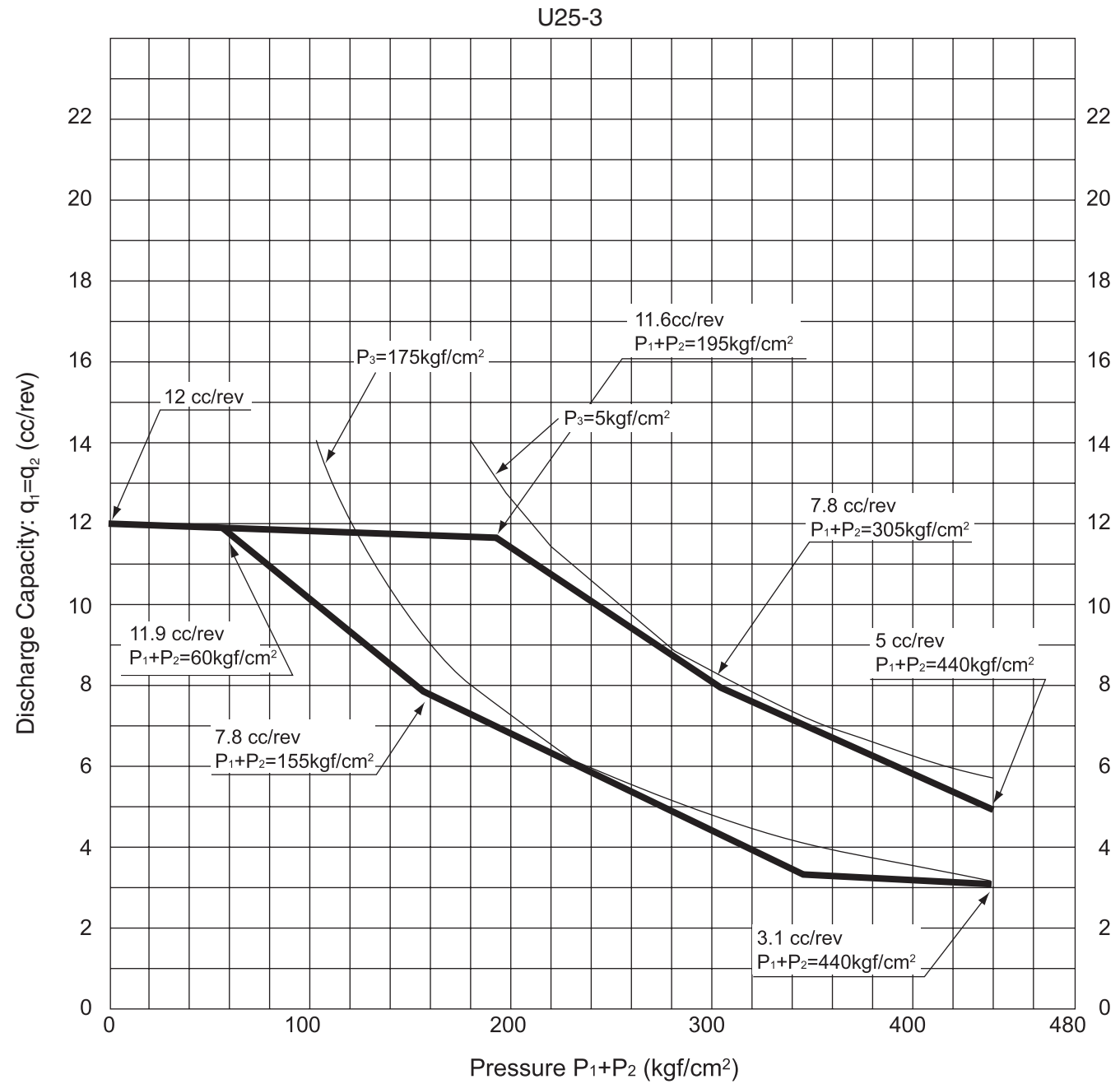
		P_1, P_2	P_3	P_P
Operating Pressure	MPa	21.6	20.6	3.9
	kg / cm ²	220	210	40
Displacement	cc / rev	10.5	5.8	2.7
Discharge Capacity	L / min	23.0	12.8	5.9
P_3 shift pressure	MPa	0.5 → 20.6		
	kg / cm ²	5 → 210		
Operating RPM		2,200		
Rotating direction		Clockwise, viewed from input shaft side		
Weight		about 16kg		



Test conditions		Legend		Remarks	
Hydraulic tempt.	50 ± 5°C				
Input shaft rpm	2,200 rpm				
Q_3	5.8 cc/rev				
Q_4	2.7 cc/rev				
P_4	40 kgf/cm ²				

U25-3
Type: PVD-08-24P-8G3-4837B

		P ₁ , P ₂	P ₃	P _P
Operating Pressure	MPa	21.6	17.2	3.9
	kg/cm ²	220	175	40
Displacement	cc/rev	12.0	8.0	2.7
Discharge Capacity		28.8	19.2	6.5
P ₃ shift pressure	MPa	0.5 → 17.2		
	kg/cm ²	5 → 175		
Operating RPM		2,400		
Rotating direction				
Weight				



Test conditions		Legend		Remarks	
Hydraulic tempt.	50 ± 5°C				
Input shaft rpm	2,400 rpm				
Q ₃	8 cc/rev				
Q ₄	2.7 cc/rev				
P ₄	40 kgf/cm ²				