YANMAR

SERVICE MANUAL

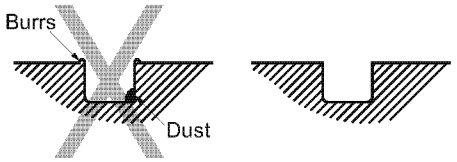
EXCAVATOR

ViO35-6A

1. GENERAL CAUTIONS FOR MAINTENANCE WORK

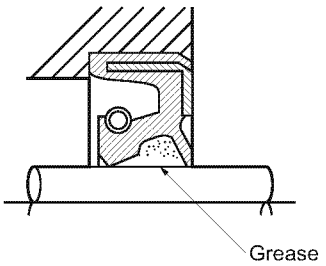
1-7 Cautions for Handling Seals

(1) Clean out grooves of O-rings. Remove burrs or dust if any.



(2) Take care not to twist O-rings. Correct by your finger if it is twisted.
(3) Take care not to damage seals when inserting.
(4) Handling of floating seals :
- Completely wipe off all the oil from the O-ring and housing after detaching the floating seals.
- Before installing, apply a little gear oil to the matching face of the housing.
- Turn the seals two or three times after installation to break them in.

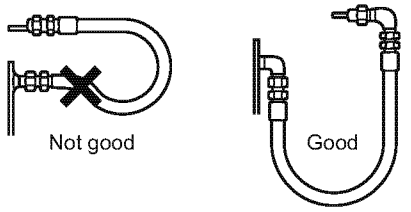
(5) Apply grease to the lip of the oil seals to prevent wear.



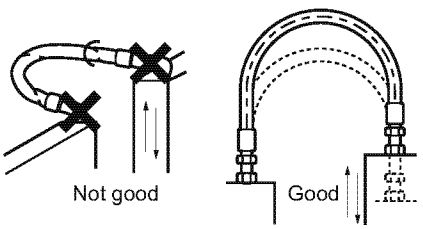
1-8 Correct Installation of Hydraulic Hose

In order to mount the hydraulic hose most effectively and economically, observe the following cautions.

(1) When a hose is used at the minimum bending radius, use elbows to avoid sharp bending.



(2) To prevent twisting, the hose should be bent in the same direction as it moves.

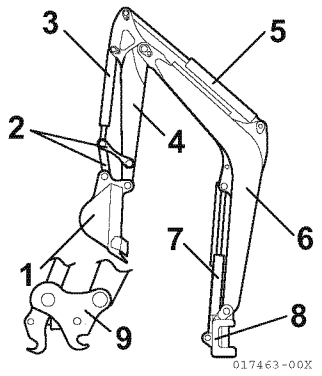
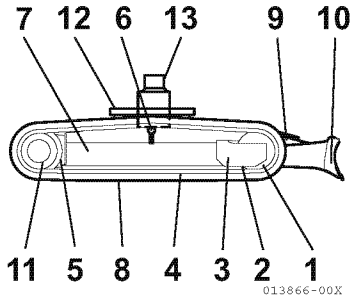
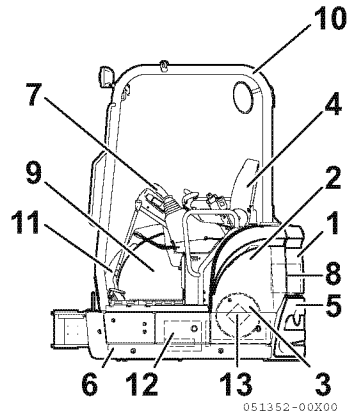


2. TECHNICAL DATA

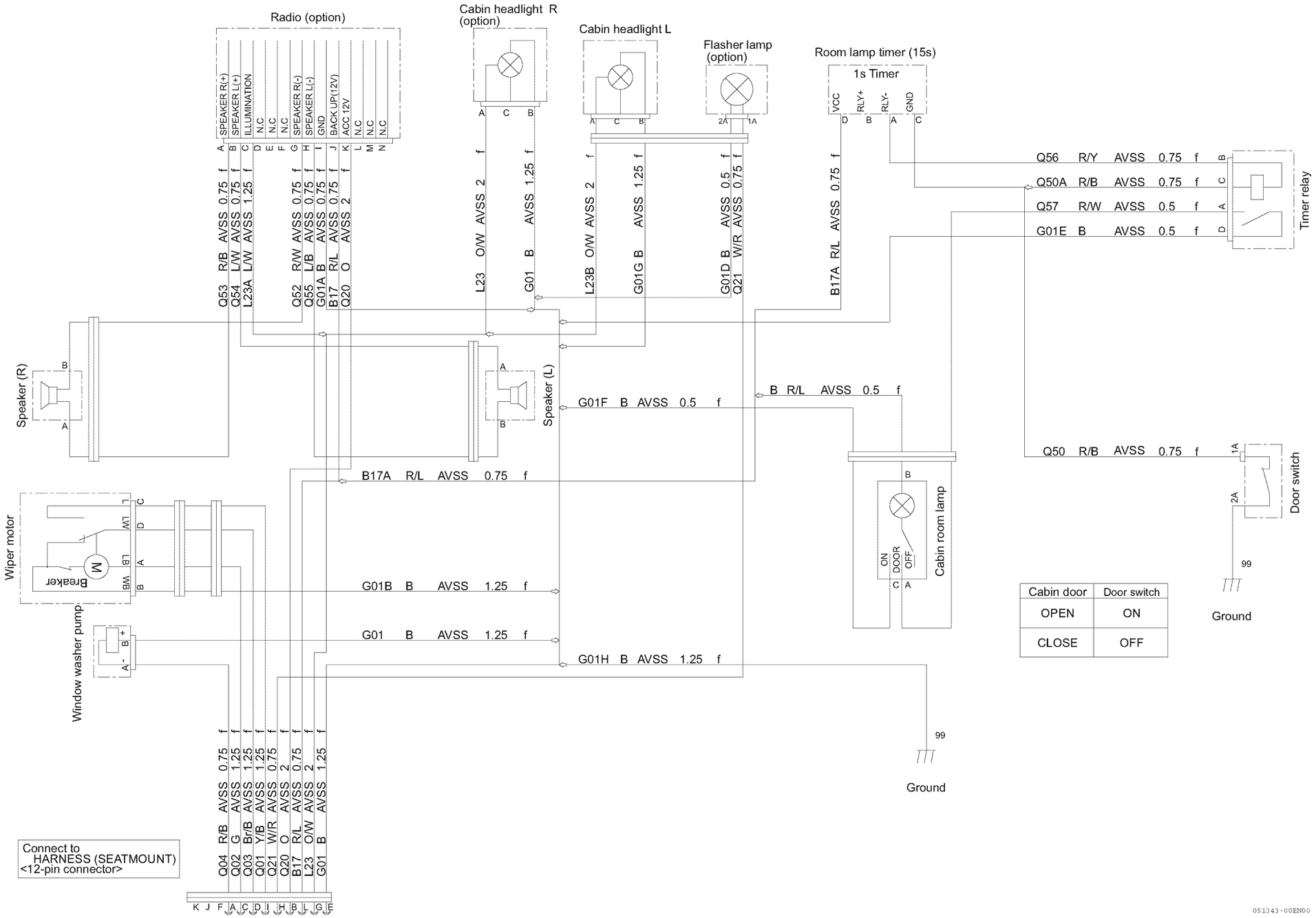
Item				Unit	ViO35-6A	
					W/O Quick coupler	Quick coupler
Hydraulic equipment						
Control valve						
	Circuit relief set pressure		Boom (at rod end)	PSI (MPa)	3626 (25.0)	
			Boom (at bottom end)	PSI (MPa)	4264 (29.4)	
			Arm (at rod end)	PSI (MPa)	3698 (25.5)	
			Arm (at bottom end)	PSI (MPa)	3626 (25.0)	
			Bucket (at rod end)	PSI (MPa)	3698 (25.5)	
			Bucket (at bottom end)	PSI (MPa)	3698 (25.5)	
			Boom swing (at rod end)	PSI (MPa)	3698 (25.5)	
			Boom swing (at bottom end)	PSI (MPa)	-	
			Blade (at rod end)	PSI (MPa)	1423 (9.81)	
			Blade (at bottom end)	PSI (MPa)	-	
Cylinder						
	Boom	Stroke		in. (mm)	24.8 (629)	
		Inside diameter		in. (mm)	Ø3.35 (Ø85)	
		Piston rod diameter		in. (mm)	Ø1.77 (Ø45)	
		Speed	Up (Ground to Max.)	sec.	2.2	
			Down (Max. to Ground)	sec.	2.2	
	Arm	Stroke		in. (mm)	21.9 (557)	21.2 (538)
		Inside diameter		in. (mm)	Ø3.35 (Ø85)	
		Piston rod diameter		in. (mm)	Ø1.97 (Ø50)	
		Speed	Full stroke for digging	sec.	3.1	
			Full stroke for dumping	sec.	2.1	
	Bucket	Stroke		in. (mm)	20.2 (512)	
		Inside diameter		in. (mm)	Ø2.76 (Ø70)	
		Piston rod diameter		in. (mm)	Ø1.57 (Ø40)	
		Speed	Full stroke for digging	sec.	3.3	
			Full stroke for dumping	sec.	2.2	
	Blade	Stroke		in. (mm)	7.09 (180)	
		Inside diameter		in. (mm)	Ø3.15 (Ø80)	
		Piston rod diameter		in. (mm)	Ø1.57 (Ø40)	
		Speed	Up (Ground to Max.)	sec.	1.0	
			Down (Max. to Ground)	sec.	1.0	
	Boom swing	Stroke		in. (mm)	16.5 (419.5)	
		Inside diameter		in. (mm)	Ø3.54 (Ø90)	
		Piston rod diameter		in. (mm)	Ø1.57 (Ø40)	
		Speed	Full stroke to the right	sec.	5.1	
			Full stroke to the left	sec.	5.4	

2-3 Weight List of Main Parts

[Unit : lbs. (kg)]

Equipment	No.	Part	ViO35-6A			
			Canopy		Cabin	
			Steel crawler	Rubber crawler	Steel crawler	Rubber crawler
Front implement						
	1	Bucket Ass'y	169.8 (77)			
	2	Bucket arm & link Ass'y	33.1 (15)			
	3	Bucket cylinder Ass'y	55.1 (25)			
	4	Arm Ass'y	132.3 (60)			
	5	Arm cylinder Ass'y	81.6 (37)			
	6	Boom Ass'y	293.2 (133)			
	7	Boom cylinder Ass'y	86.0 (39)			
	8	Boom bracket Ass'y	149.9 (68)			
	9	Quick coupler Ass'y	88.2 (40)			
Undercarriage						
	1	Idler Ass'y	46.3 (21) × 2	49.6 (22.5) × 2	46.3 (21) × 2	49.6 (22.5) × 2
	2	Crawler guard Ass'y	5.5 (2.5) × 2	-	5.5 (2.5) × 2	-
	3	Crawler adjuster Ass'y	37.5 (17) × 2			
	4	Track roller Ass'y	17.1 (7.75) × 8			
	5	Sprocket Ass'y	16.5 (7.5) × 2			
	6	Carrier roller Ass'y	6.6 (3) × 2			
	7	Track frame Ass'y	734.1 (333)			
	8	Steel crawler & Rubber crawler Ass'y	405.7 (184) × 2	302.0 (137) × 2	405.7 (184) × 2	302.0 (137) × 2
	9	Blade cylinder Ass'y	37.5 (17)			
	10	Blade Ass'y	436.5 (198)			
	11	Travel motor Ass'y	77.2 (35) × 2			
	12	Swing bearing Ass'y	103.6 (47)			
	13	Swivel & hose or fitting Ass'y	46.3 (21)			
Upperstructure						
	1	Engine hood Ass'y	57.3 (26)			
	2	Hydraulic oil tank with filter Ass'y	92.6 (42)			
	3	Engine Ass'y	383.6 (174)			
	4	Operator's seat & mount Ass'y	121.3 (55)			
	5	Counter weight Ass'y	418.9 (190)			
	6	Turning frame Ass'y	1395.5 (633)			
	7	Controls Ass'y	66.1 (30)			
	8	Battery Ass'y	27.6 (12.5)			
	9	Fuel tank & piping Ass'y	8.8 (4)			
	10	Canopy/Cabin Ass'y	196.2 (89)		485.0 (220)	
	11	Covers, steps and panels	41.9 (19)		19.8 (9)	
	12	Swing motor Ass'y	70.5 (32)			
	13	Pump, mount & hoses Ass'y	77.2 (35)			
	-	Control valve, fitting & hoses Ass'y	121.3 (55)			
	-	Canopy mount Ass'y	119.0 (54)			
	-	Boom swing cylinder Ass'y	59.5 (27)			

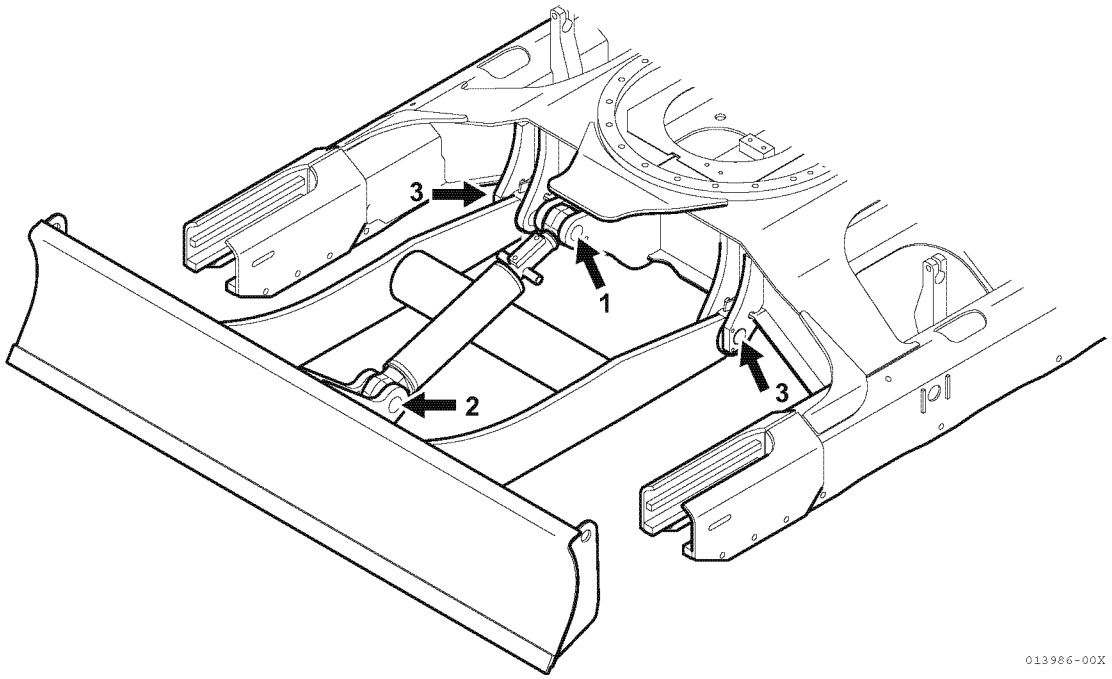
2) Cabin spec.


Radio (option)
SPEAKER R(+)
SPEAKER L(+)
ILLUMINATION
N.C
SPEAKER R(-)
SPEAKER L(-)
GND
BACK UP(12V)
ACC 12V
Q53 R/B AVSS 0.75 f
Q54 L/W AVSS 0.75 f
L23A L/W AVSS 1.25 f
Q52 R/W AVSS 0.75 f
Q55 L/B AVSS 0.75 f
G01A B AVSS 0.75 f
B17 R/L AVSS 0.75 f
Q20 O AVSS 2 f
Cabin headlight R (option)
L23 O/W AVSS 2 f
G01 B AVSS 1.25 f
Cabin headlight L
L23B O/W AVSS 2 f
G01G B AVSS 1.25 f
Flasher lamp (option)
G01D B AVSS 0.5 f
Q21 W/R AVSS 0.75 f
Room lamp timer (15s)
1s Timer
VCC
RLY+
RLY-
GND
B17A R/L AVSS 0.75 f
Q56 R/Y AVSS 0.75 f
Q50A R/B AVSS 0.75 f
Q57 R/W AVSS 0.5 f
G01E B AVSS 0.5 f
Timer relay
Speaker (R)
Speaker (L)
G01F B AVSS 0.5 f
B R/L AVSS 0.5 f
B17A R/L AVSS 0.75 f
Q50 R/B AVSS 0.75 f
Door switch
Wiper motor
Breaker
G01B B AVSS 1.25 f
Window washer pump
G01 B AVSS 1.25 f
G01H B AVSS 1.25 f
Cabin room lamp
ON
DOOR
OFF
99
Ground
Cabin door
Door switch
OPEN
ON
CLOSE
OFF
Connect to
HARNESS (SEATMOUNT)
<12-pin connector>
Q04 R/B AVSS 0.75 f
Q02 G AVSS 1.25 f
Q03 Br/B AVSS 1.25 f
Q01 Y/B AVSS 1.25 f
Q21 W/R AVSS 0.75 f
Q20 O AVSS 2 f
B17 R/L AVSS 0.75 f
L23 O/W AVSS 2 f
G01 B AVSS 1.25 f
K J F A C D I H B L G E
051343-00EN00

3. SERVICING STANDARDS

Applicable model				3TNV88F-ESBV	
Item			Unit	Standard	Allowable limit
Cam shaft and timing gear train					
	Cam shaft	End play	in. (mm)	0.0020 to 0.0079 (0.05 to 0.20)	0.0118 (0.030)
		Bend (1/2 the dial gauge reading)	in. (mm)	0 to 0.0008 (0 to 0.02)	0.0020 (0.05)
		Cam lobe height	in. (mm)	1.5197 to 1.5276 (38.600 to 38.800)	1.5098 (38.350)
		Gear end — Bush inside diameter	in. (mm)	1.7713 to 1.7738 (44.990 to 45.055)	1.7768 (45.130)
		Gear end — Cam shaft outside diameter	in. (mm)	1.7687 to 1.7697 (44.925 to 44.950)	1.7673 (44.890)
		Gear end — Oil clearance	in. (mm)	0.0016 to 0.0051 (0.040 to 0.130)	0.0094 (0.240)
		Intermediate — Bore inside diameter	in. (mm)	1.7716 to 1.7726 (45.000 to 45.025)	1.7756 (45.100)
		Intermediate — Cam shaft outside diameter	in. (mm)	1.7681 to 1.7691 (44.910 to 44.935)	1.7667 (44.875)
		Intermediate — Oil clearance	in. (mm)	0.0026 to 0.0045 (0.065 to 0.115)	0.0089 (0.225)
		Flywheel end — Bore inside diameter	in. (mm)	1.7716 to 1.7726 (45.000 to 45.025)	1.7756 (45.100)
		Flywheel end — Cam shaft outside diameter	in. (mm)	1.7687 to 1.7697 (44.925 to 44.950)	1.7673 (44.890)
		Flywheel end — Oil clearance	in. (mm)	0.0020 to 0.0039 (0.50 to 0.100)	0.0083 (0.210)
	Idle gear	Shaft outside diameter	in. (mm)	1.8091 to 1.8100 (45.950 to 45.975)	1.8071 (45.900)
		Bush inside diameter	in. (mm)	1.8110 to 1.8120 (46.000 to 46.025)	1.8140 (46.075)
		Oil clearance	in. (mm)	0.0010 to 0.0030 (0.025 to 0.075)	0.0069 (0.175)
	Timing gear backlash	Crank gear, cam gear, idle gear, fuel injection pump drive gear and P.T.O. gear	in. (mm)	0.0028 to 0.0059 (0.07 to 0.15)	0.0067 (0.17)
Crank shaft and piston					
	Crank shaft	Bend (1/2 dial gauge reading)	in. (mm)	-	0.0008 (0.02)
		Connecting rod journals — Journal outside diameter	in. (mm)	1.8879 to 1.8883 (47.952 to 47.962)	1.8859 (47.902)
		Connecting rod journals — Bearing inside diameter	in. (mm)	1.8898 to 1.8909 (48.000 to 48.026)	-
		Connecting rod journals — Bearing insert thickness	in. (mm)	0.0587 to 0.0591 (1.492 to 1.500)	-
		Connecting rod journals — Oil clearance	in. (mm)	0.0015 to 0.0029 (0.038 to 0.074)	0.0059 (0.150)
		Main bearing journal — Journal outside diameter	in. (mm)	1.9666 to 1.9670 (49.952 to 49.962)	1.9646 (49.902)
		Main bearing journal — Bearing inside diameter	in. (mm)	1.9685 to 1.9693 (50.000 to 50.020)	-
		Main bearing journal — Bearing insert thickness	in. (mm)	0.0785 to 0.0791 (1.995 to 2.010)	-
		Main bearing journal — Oil clearance	in. (mm)	0.0015 to 0.0027 (0.038 to 0.068)	0.0059 (0.150)
	Thrust bearing	Crank shaft end play	in. (mm)	0.0051 to 0.0091 (0.13 to 0.23)	0.0110 (0.28)

3-6-2 Blade Moving Device



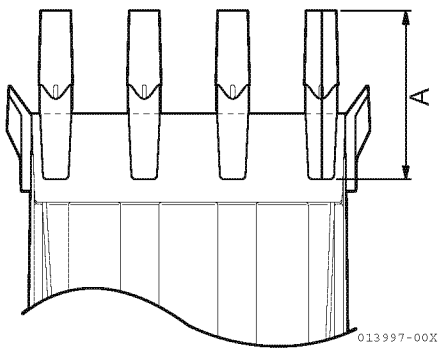
Unit : in. (mm)

No.	Applicable model : ViO35-6A Measuring point	Standard	Wear limit	
			Pin	Bore of bush or hole
1	Blade cylinder, rod	Ø1.57 (Ø40)	-0.02 (-0.5)	+0.02 (+0.5)
2	Blade cylinder, bottom	Ø1.57 (Ø40)		
3	Blade fulcrum	Ø1.50 (Ø38)		

Note : *Allowable clearance between pin and bore of bush or hole is 0.04 in. (1.0 mm).*

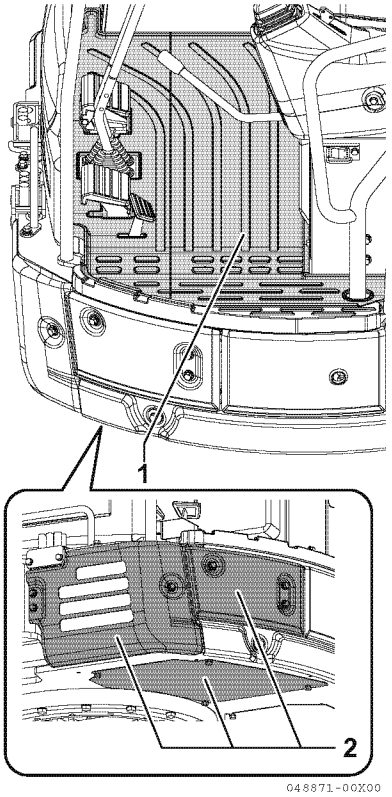
3-6-3 Bucket Teeth

Unit : in. (mm)

Measuring point	Standard	Wear limit	Measure
	10.3 (261)	8.07 (205)	Replace

4) Adjustment Procedure

(1) Remove step **1** and covers (front, side and lower) **2**.

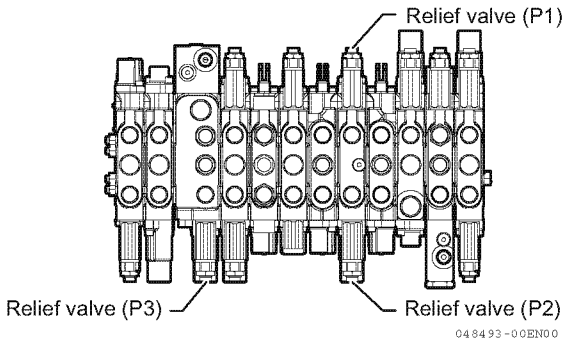


(2) To check the pressure of the system relief valve (P1) in the control valve, retract the bucket cylinder to its stroke end, hold the lever and read the gauge. Adjust the pressure if necessary.

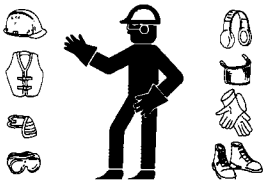
(3) To check the pressure of the system relief valve (P2), retract or extend the arm cylinder to its stroke end, hold the lever and read the gauge. Adjust the pressure if necessary.

(4) To check the pressure of the system relief valve (P3), extend the blade cylinder to its stroke end, hold the lever and read the gauge. Adjust the pressure if necessary.

System relief valve



⚠ WARNING



EXPOSURE HAZARD!

- Wear personal protective equipment such as gloves, work shoes, eye and hearing protection as required by the task at hand.
- NEVER wear jewelry, unbuttoned cuffs, ties or loose-fitting clothing when you are working near moving / rotating parts such as the cooling fan, flywheel or PTO shaft.
- ALWAYS tie back long hair when you are working near moving / rotating parts such as a cooling fan, flywheel, or PTO shaft.
- NEVER operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the alert signals.
- Failure to comply could result in death or serious injury.

0000005en

⚠ WARNING

BURN HAZARD!

- If you must drain the engine oil while it is still hot, stay clear of the hot engine oil to avoid being burned.
- ALWAYS wear eye protection.
- Failure to comply could result in death or serious injury.

0000011en

⚠ WARNING

BURN HAZARD!

- Batteries contain sulfuric acid. NEVER allow battery fluid to come in contact with clothing, skin or eyes. Severe burns could result. ALWAYS wear safety goggles and protective clothing when servicing the battery. If battery fluid contacts the eyes and / or skin, immediately flush the affected area with a large amount of clean water and obtain prompt medical treatment.
- Failure to comply could result in death or serious injury.

0000007en

CAUTION

Do not operate the engine if the alternator is producing unusual sounds. Damage to the alternator will result.

0000039en

CAUTION

If the engine coolant pump must be replaced, replace the engine coolant pump as an assembly only. Do not attempt to repair the engine coolant pump or replace individual components.

0000041en

CAUTION

Use a new special O-ring between the engine coolant pump and the joint. Be sure to use the special O-ring for each engine model. Although the O-ring dimensions are the same as a commercially available O-ring, the material is different.

0000042en

CAUTION

Remove or install the high-pressure fuel injection lines as an assembly whenever possible. Disassembling the high-pressure fuel injection lines from the retainers or bending any of the fuel lines will make it difficult to reinstall the fuel lines.

0000047en

CAUTION

After marking the position of the pump drive gear, do not rotate the engine crankshaft. Rotating the crankshaft will cause the fuel injection pump to become misaligned.

0000048en

CAUTION

Do not use a high-pressure wash directly on the alternator. Water will damage the alternator and result in inadequate charging.

0000049en

CAUTION

Do not reverse the positive (+) and negative (-) ends of the battery cable. The alternator diode and stator coil will be damaged.

0000050en

CAUTION

When the battery indicator goes out, it should not come on again. The battery indicator only comes on during operation if the alternator fails. However, if an LED is used in the battery indicator, the LED will shine faintly during normal operation.

0000051en

CAUTION

Using a non-specified V-belt will cause inadequate charging and shorten the belt life. Use the specified belt.

0000052en

CAUTION

Agricultural or other chemicals, especially those with a high sulfur content, can adhere to the IC regulator. This will corrode the conductor and result in battery over-charging (boiling) and charging malfunctions. Consult Yanmar before using the equipment in such an environment or the warranty is voided.

0000053en

4-1-5 2-Valve Cylinder Head

2-Valve Cylinder Head Components

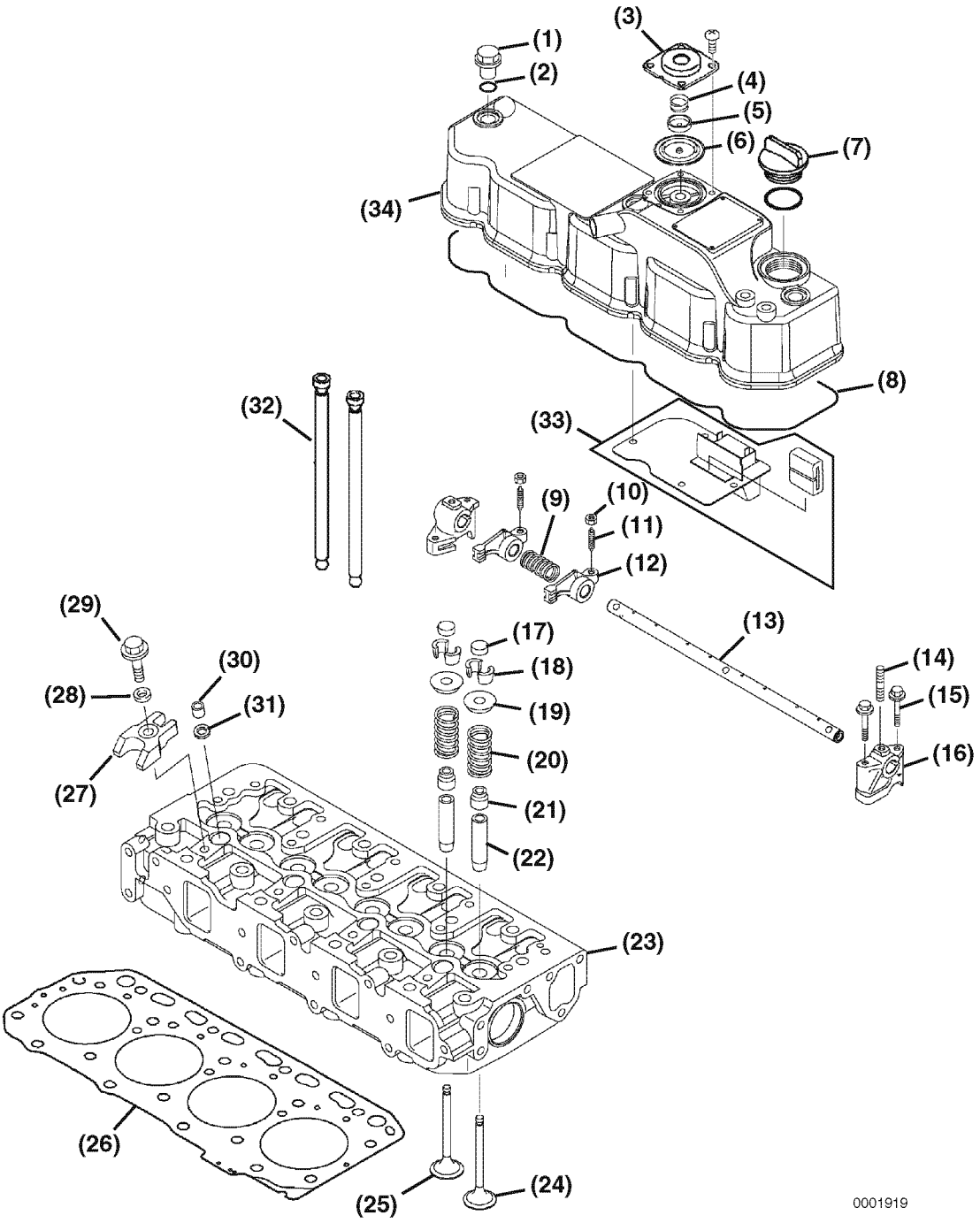


Figure 4-1-1

Grind the valve face and / or valve seat only enough to return them to serviceable condition. Grinding is needed if the valve and the valve seat do not contact correctly. Check the recession after grinding.

If the valve or seat require grinding, lap the valve after grinding. Lap the valve face to the valve seat using a mixture of valve lapping compound and engine oil.

Be sure to thoroughly wash all parts to remove all grinding powder or compound.

Inspection of Valve Springs

Inspect the valve springs. If damage or corrosion is seen, or if measurements exceed the specified limits, replace the springs.

Fractures

Check for fractures on the inside and outside portions of the springs. If the valve spring is fractured, replace the valve spring.

Corrosion

Check for corrosion of the spring material caused by oxidation.

Squareness

Use a flat surface and a square to check each spring for squareness **(Figure 4-1-26)**. *See "3-2 Engine Service Standard" section for the service limit.*

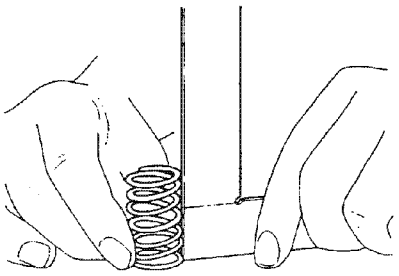


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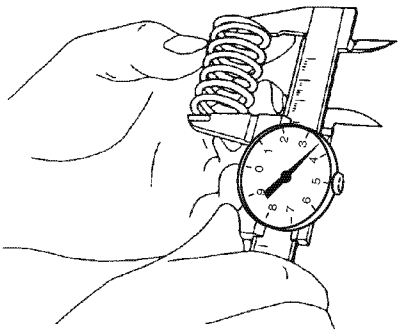
Figure 4-1-26

Free Length

Use a caliper to measure the length of the spring **(Figure 4-1-27)**. *See "3-2 Engine Service Standard" section for the service limit.*



0000200

Figure 4-1-27

Reassembly of Cylinder Head

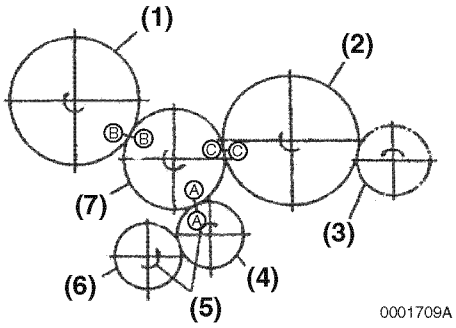
Use new gaskets, O-rings and seals for the reassembly of the cylinder head.

IMPORTANT

Liberally oil all components during reassembly to prevent premature wear or damage.

Reassembly of Valve Guides

1. The valve guides are installed into the cylinder head with an extremely tight press fit. Before installing the valve guides, place the valve guides in a freezer for at least twenty minutes This will cause the valve guides to contract, making it easier to install the valve guides into place.



1 – Fuel Injection Pump Drive Gear
2 – Camshaft Drive Gear
3 – Auxiliary Drive Gear (Optional)
4 – Crankshaft Drive Gear
5 – Direction of Rotation
6 – Oil Pump Drive Gear
7 – Idler Gear

Figure 4-1-44

Measuring Idler Gear-to-Crankshaft Gear Backlash

1. Install a dial indicator as shown in **Figure 4-1-45**.

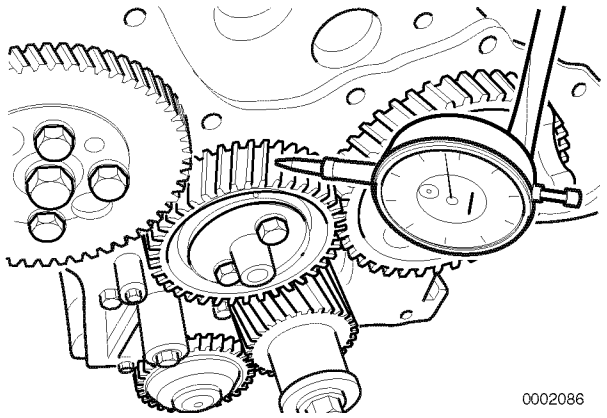


Figure 4-1-45

2. Rotate the idler gear back and forth to check the idler gear-to-crankshaft gear backlash. The total indicator reading is the backlash. Record the measurement.

Measuring Idler Gear-to-Camshaft Gear Backlash

1. Drive a small wooden wedge between the crankshaft gear and idler gear to prevent the idler gear from rotating.
2. Install the dial indicator to read the camshaft gear backlash. Rotate the camshaft drive gear against the idler gear to measure the backlash. Record the measurement.
3. Check the idler gear-to-fuel injection pump drive gear backlash in the same manner as the camshaft drive gear. Record the measurement.

Removal of Timing Gears

1. Remove the bolts from the idler gear shaft **(Figure 4-1-46, (1))**. Remove the idler gear shaft, idler gear **(Figure 4-1-46, (2))** and bushing **(Figure 4-1-46, (3)).**

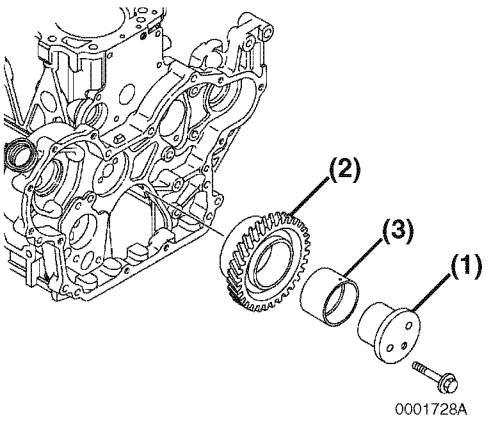


Figure 4-1-46

2. Do not remove the crankshaft gear unless it is damaged and requires replacement. If the gear must be removed, remove it using a gear puller.
3. Removal of the camshaft gear requires the camshaft be removed and placed in a press. Do not remove the camshaft gear unless it or the camshaft is damaged and requires replacement. *See Removal of Camshaf.*

7. Measure the outside diameter of the wrist pin in three places and at 90° **(Figure 4-1-70)**. *See "3-2 Engine Service Standard" section for the service limit.* Record the measurements.

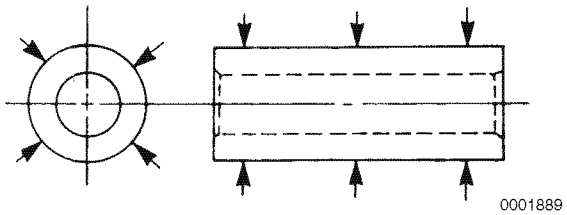


Figure 4-1-70

8. Using a micrometer, measure the thickness of each piston ring. *See "3-2 Engine Service Standard" section for the service limit.* Record the measurements.

   Notes:

   - On an engine with low hours, the pistons, piston rings and cylinders may be reused if they are found to be within specifications.
   - On an engine with high hours, the pistons rings should be replaced and the cylinder honed *(see Honing and Boring)* or replaced. The piston should be replaced as necessary.

9. Place each compression piston ring in the groove as shown **(Figure 4-1-71)**. Use a feeler gauge to measure the clearance between the piston ring and the piston ring land. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.* Replace the piston if not within specification.

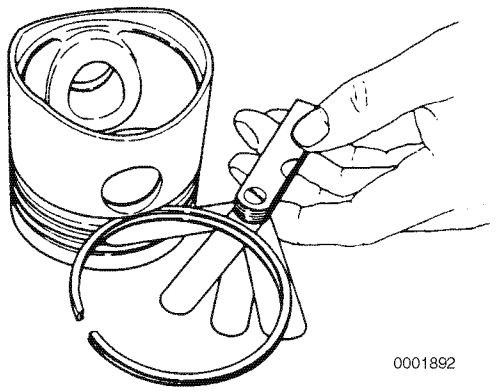


Figure 4-1-71

10. To measure piston ring end gap, insert each compression piston ring **(Figure 4-1-72, (1))**, one at a time, into the cylinder. Use a piston with the piston rings removed to slide the ring into the cylinder bore until it is approximately 1.18 in. (30 mm) **(Figure 4-1-72, (2))** from the bottom of the bore. Remove the piston. Measure the end gap **(Figure 4-1-72, (3))** of each piston ring. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*

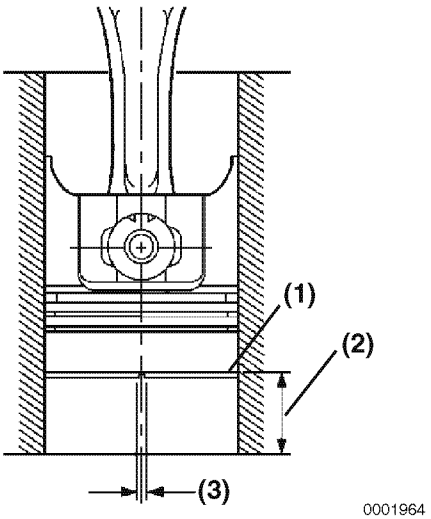


Figure 4-1-72

Note: Always check the piston ring end gap when installing new piston rings. *See "3-2 Engine Service Standard" section for the service limit.* Use a piston ring end gap filing tool to adjust the piston ring end gap on new piston rings.

11. Repeat the above steps for each cylinder and piston assembly.

4. Lubricate the camshaft **(Figure 4-1-97, (2))** with clean engine oil or assembly lube. Slowly insert the camshaft through the front of the engine.
5. Reinstall and tighten the cap screws **(Figure 4-1-97, (3))**.

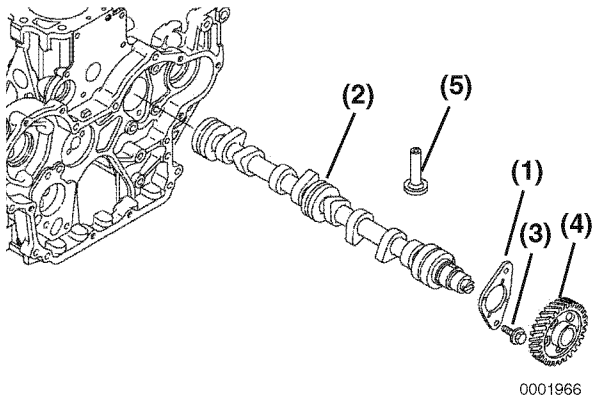
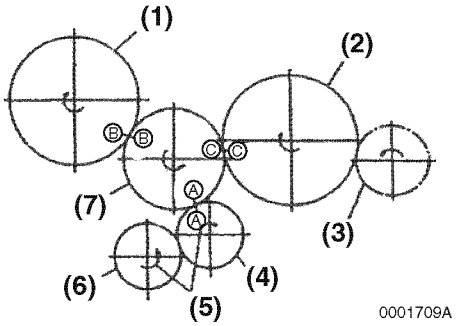


Figure 4-1-97

6. If removed, reinstall the fuel injection pump. Adjust the fuel injection timing the engine after installation. *See Adjusting Fuel Injection Timing.*

Installation of Timing Gears

1. Set the No. 1 piston to top dead center.
2. Rotate the camshaft until the mark **(Figure 4-1-98, (C))** is approximately at the 9 o'clock position.



1 – Fuel Injection Pump Gear
2 – Camshaft Gear
3 – Optional Accessory Drive Gear
4 – Crankshaft Gear
5 – Direction of Rotation
6 – Oil Pump Gear
7 – Idler Gear

Figure 4-1-98

3. Lubricate the idler gear **(Figure 4-1-99, (2))**, bushing **(Figure 4-1-99, (3))** and idler gear shaft **(Figure 4-1-99, (1))** with clean engine oil.

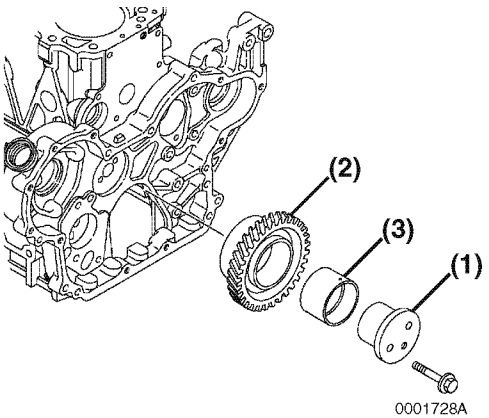


Figure 4-1-99

4. Align the timing gears as shown in **(Figure 4-1-98)**.
5. Reinstall the idler gear and idler gear shaft. Be sure the oil hole in the bushing is facing toward the top of the engine.
6. Ensure all three timing marks **(Figure 4-1-98, (A, B, C))** are aligned.

4-2 Fuel System

4-2-1 Before You Begin Servicing

⚠ WARNING

ENTANGLEMENT HAZARD!

- Stop the engine before you begin to service it.
- NEVER leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.
- If you must service the engine while it is operating, remove all jewelry, tie back long hair, and keep your hands, other body parts and clothing away from moving / rotating parts.
- Failure to comply could result in death or serious injury.

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⚠ WARNING

SUDDEN MOVEMENT HAZARD!

- Engaging the transmission or PTO at an elevated engine speed could result in unexpected movement of the equipment.
- Failure to comply could result in death or serious injury.

0000006en

⚠ WARNING

- Never inject fuel toward you. Since the fuel is injected at high pressure from the nozzle, it may penetrate the skin, resulting in injury.
- Never inject fuel toward a fire source. Atomized fuel is highly flammable and may cause a fire or burn skin.

0000028en

⚠ WARNING

FUME / BURN HAZARD!

- Always read and follow safety related precautions found on containers of hazardous substances like parts cleaners, primers, sealants and sealant removers.
- Failure to comply could result in death or serious injury.

0000014en

⚠ WARNING

- Never use the E-ECU for other purposes than intended or in other ways than specified by Yanmar. Doing so could result in the violation of emission control regulations and will void the product warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

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⚠ WARNING

- Be sure to use the E-ECU in conjunction with the engines whose models or serial numbers are specified by Yanmar.
  Other E-ECU/engine combinations than specified will void the engine warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

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4-2-6 Fuel System Components

2-Valve Cylinder Head

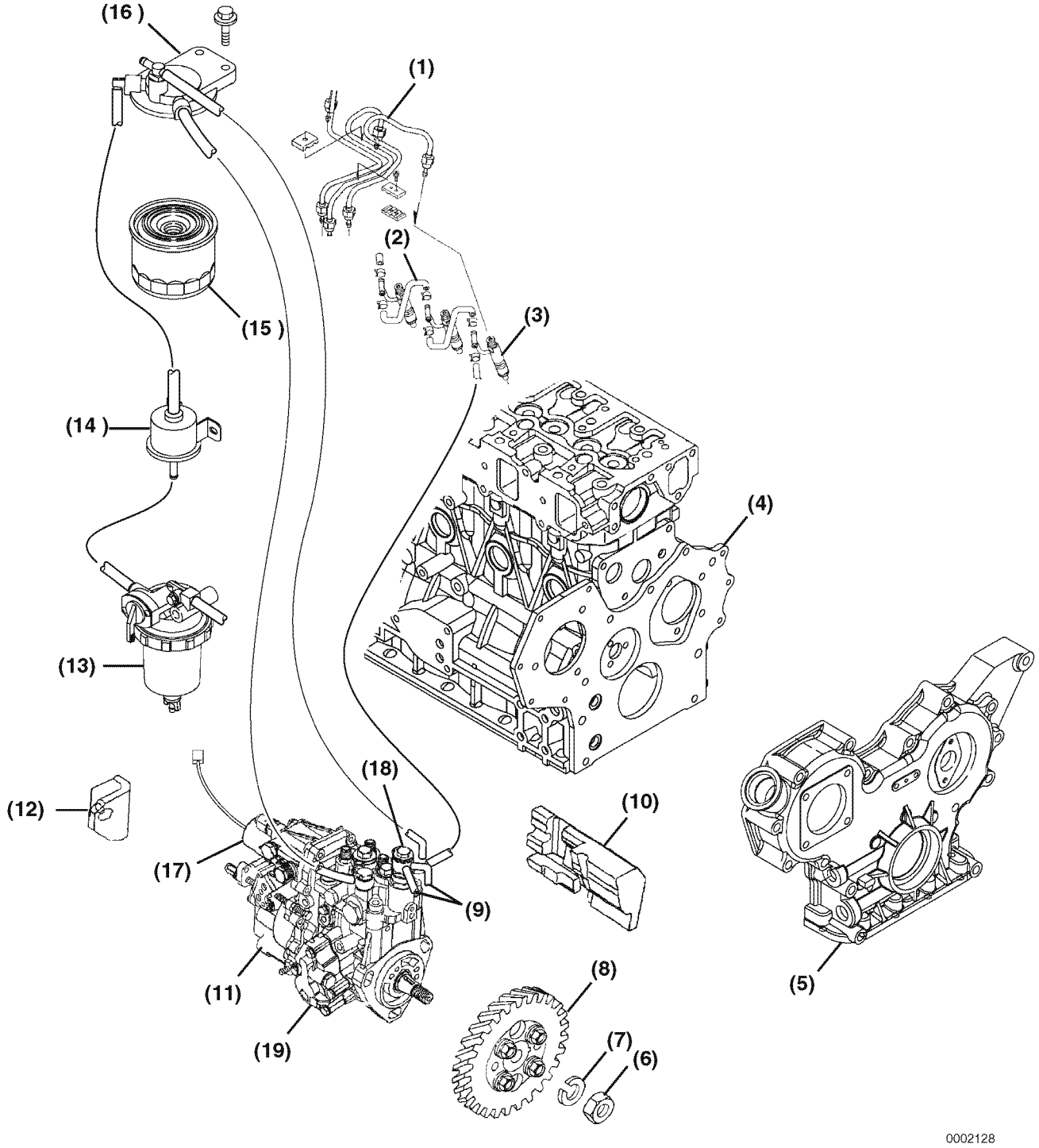

Figure 4-2-4

The above calculated difference indicates that the replacement fuel injection pump is to be installed at +0.5° (advanced) from the "Standard Mark" **(Figure 4-2-26, (1))** on the timing sticker.

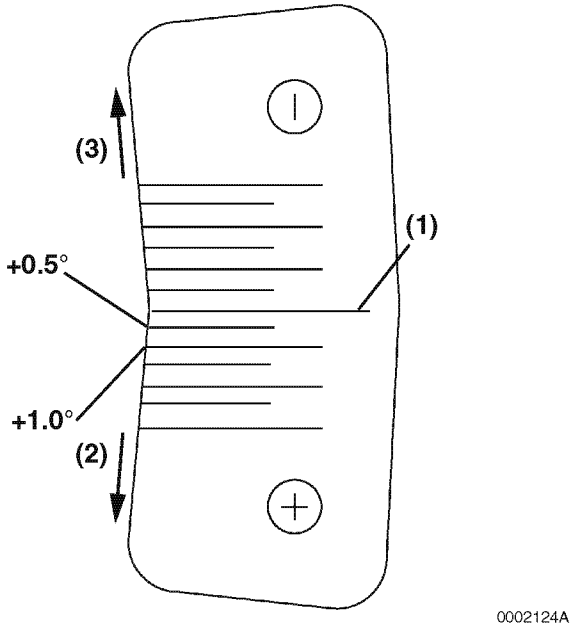

Figure 4-2-26

In this case, rotate the top of the fuel injection pump away from the cylinder block until the mark on the outside upper mounting boss **(Figure 4-2-27, (1))** of the fuel injection pump aligns with the +0.5° mark on the timing sticker.

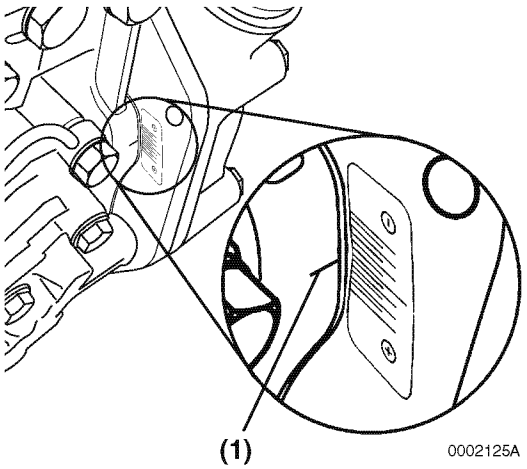

Figure 4-2-27

Tighten the fuel injection pump mounting nuts to specification. *See "3-7-2 Engine Tightening Torque" section for tightening torque.*

6. Reinstall the rear bracket(s) **(Figure 4-2-28, (1))** to the fuel injection pump. Tighten the rear support bolts.

Note: Configuration of the fuel injection pump rear brackets may vary depending on the model.

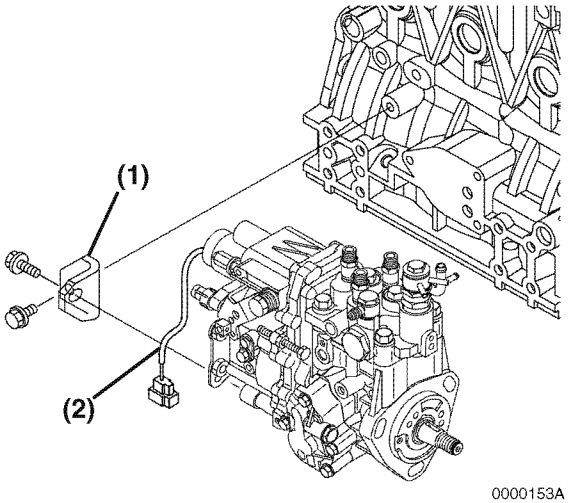

Figure 4-2-28

7. Reconnect the throttle linkage and the stop solenoid connector **(Figure 4-2-29, (2))**.
8. Reconnect the lube oil line **(Figure 4-2-29, (1))** and clamp **(Figure 4-2-29, (2))**.

Testing of Fuel Injectors

⚠ CAUTION

Never use a steel wire brush to clean fuel injectors. Damage to the nozzle and other components is likely to result.

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1. Thoroughly clean the fuel injector nozzle using clean diesel fuel and a brass wire brush.
2. Visually inspect the fuel injectors and nozzle protectors for deposits or damage. Clean, repair or replace as necessary.

Note: For testing the fuel injector using an injection nozzle tester. Operate the tester following the information provided by the tester manufacturer. Use clean, filtered fuel or FIE calibration fluid for the test.

3. Using the correct adapter, connect a fuel injector to a nozzle tester. Aim the fuel injector into a suitable container to catch the fuel spray.

⚠ WARNING

- **Never inject fuel toward you. Since the fuel is injected at high pressure from the nozzle, it may penetrate the skin, resulting in injury.**
- **Never inject fuel toward a fire source. Atomized fuel is highly flammable and may cause a fire or burn skin.**

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⚠ CAUTION

FLYING OBJECT HAZARD!

- **ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.**
- **Failure to comply may result in minor or moderate injury.**

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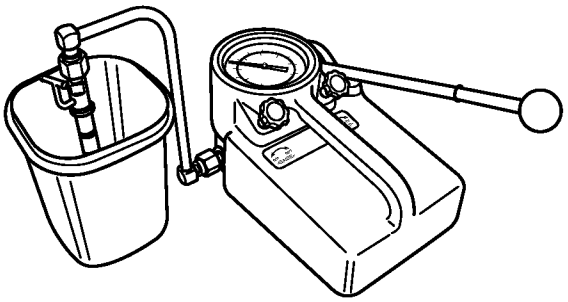

Figure 4-2-46

4. Pump the operating lever of the tester slowly, observing the pressure reading at the point where the fuel injector begins spraying fuel **(Figure 4-2-46)**.

   See **Figure 4-2-49** for injector ID location.

   See "3-2 Engine Service Standard" section for correct pressure readings.

Note: The opening pressure of a new fuel injector will be approximately 725 psi (5 MPa; 51 kgf/cm^2) higher than one that has been operated for five hours or longer.

- On models not equipped with an oil cooler, remove the coolant drain plug **(Figure 4-3-6, (1))** from the engine block.

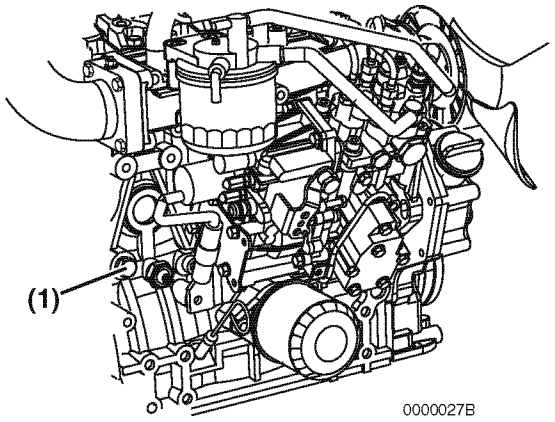

Figure 4-3-6

5. Loosen the alternator mounting bolts. Loosen and remove the V-belt and rotate the alternator away from the engine and out of the way.

⚠ CAUTION

PINCH HAZARD!

Carefully rotate the alternator toward the cylinder block while loosening the V-belt. Failure to comply may result in minor or moderate injury.

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6. Remove the engine coolant fan guard (if equipped), engine coolant fan **(Figure 4-3-7, (1))**, spacer **(Figure 4-3-7, (2))** and engine coolant pump V-pulley **(Figure 4-3-7, (3))**.

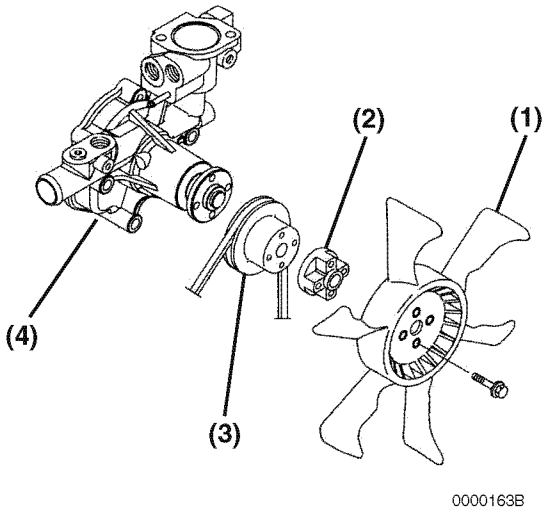


Figure 4-3-7

7. Disconnect the coolant hoses and the temperature switch lead wire from the engine coolant pump.
8. Remove the engine coolant pump **(Figure 4-3-7, (4))**. Discard the gasket.

Reassembly of Oil Pump

1. Apply clean lubricating oil to the lubricating oil pump body and inner rotor assembly as well as to the outer rotor.
2. Insert the outer rotor into the lubricating oil pump body and inner rotor assembly and install the cover.
3. Replace the packing with new one.
4. Install the lubricating oil pump assembly to the gear case flange by tightening the bolts with the specified torque.
5. Install the gear case cover. For more information, See Installation of Gear Case Cover.
6. Install the crank shaft pulley.
7. Install the cooling water pump V-pulley **(Figure 4-4-10, (1))**, spacer **(Figure 4-4-10, (2))**, cooling water fan **(Figure 4-4-10, (3))**, and fan guard (if equipped).

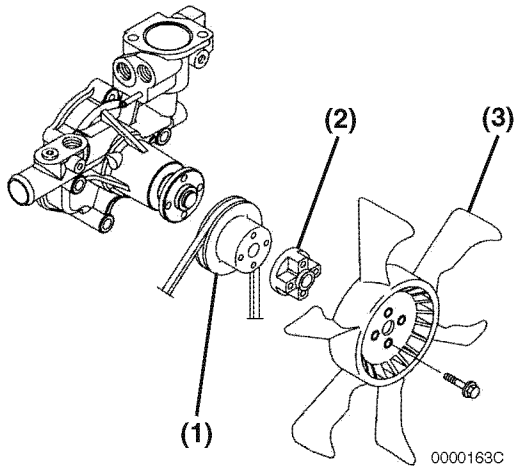


Figure 4-4-10

8. Install the V-belt. Adjust the belt to uniform tensile strength.

Field Coil Insulation Test

Check for continuity between the field coil terminal and the yoke using a multimeter **(Figure 4-5-19)**. The multimeter should not indicate continuity.

If the multimeter indicates continuity, replace the field coil assembly.

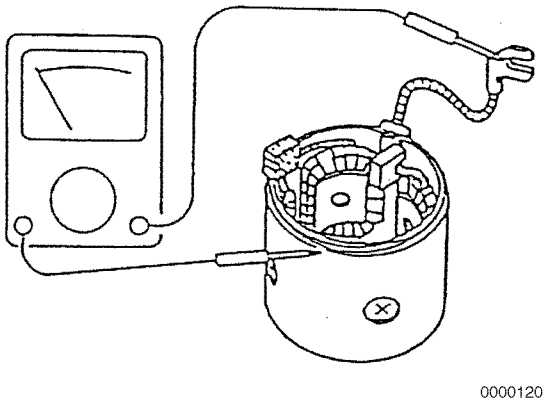


Figure 4-5-19

Measure Brush Length

Measure the length of the brush **(Figure 4-5-20)**. Replace the brush if the length is less than the limit.

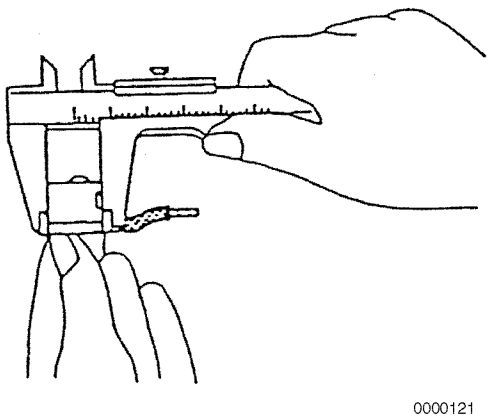


Figure 4-5-20

See Starter Motor Specifications for the service limit.

Magnetic Switch

If the starter motor becomes wet, replace the magnetic switch even if the magnetic switch assembly function is normal.

Shunt Coil Continuity Test

Check for continuity between the "S" terminal and the switch body using a multimeter **(Figure 4-5-21)**. The multimeter should indicate continuity.

If the multimeter does not indicate continuity, replace the magnetic switch.

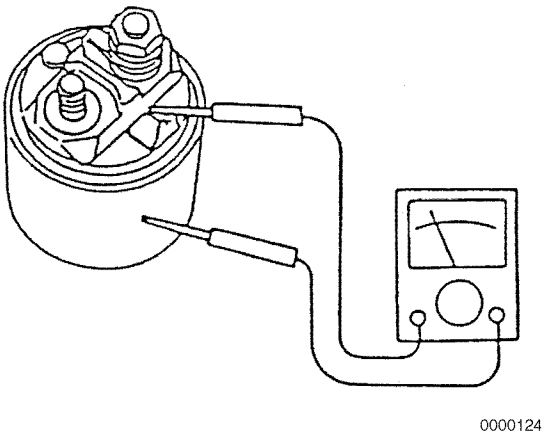
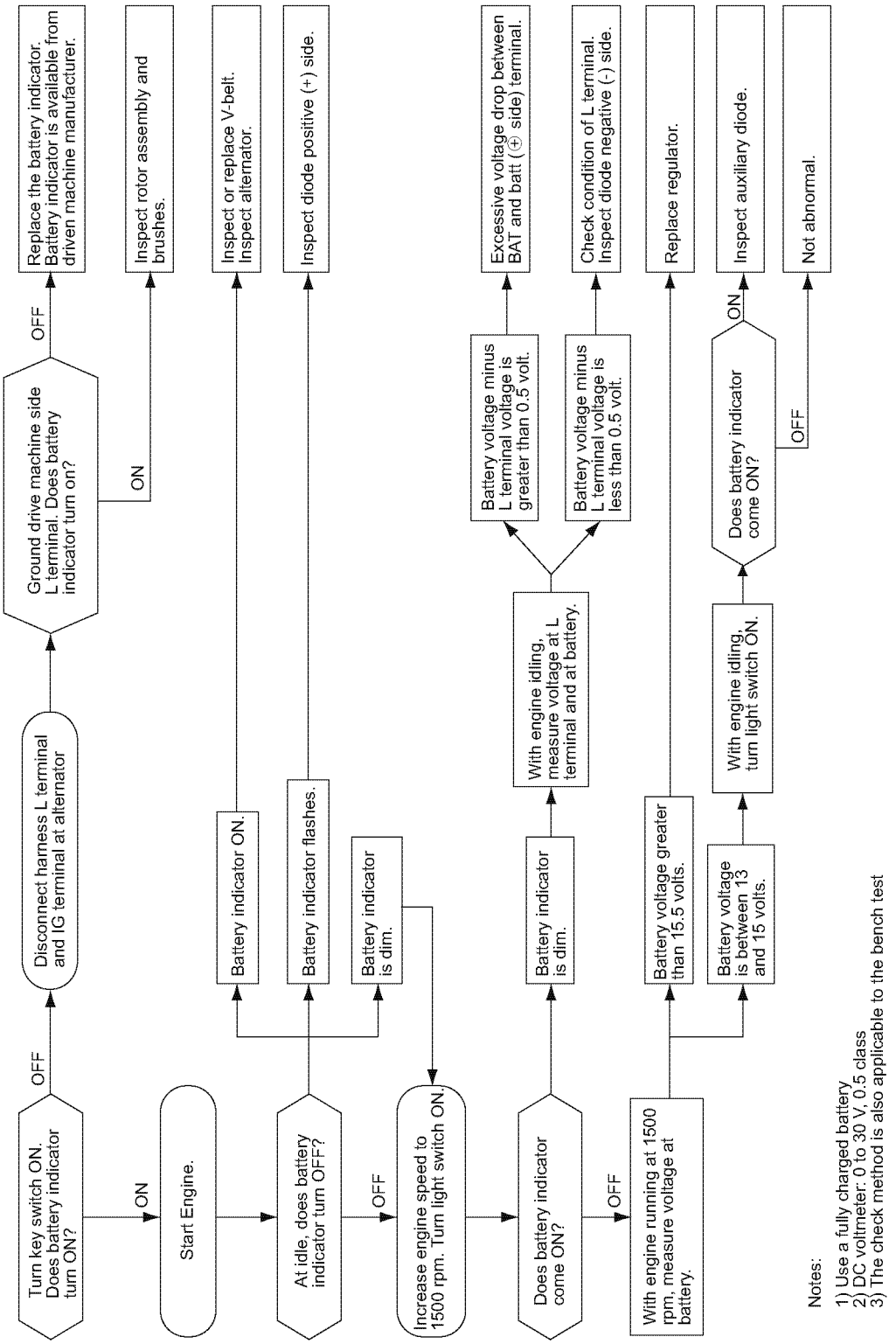


Figure 4-5-21

4-6-4 Alternator Troubleshooting



CAUTION

Shut down the engine if the fault indicator comes on.

Continuing running the engine with the fault indicator being on may result in a serious malfunction of or damage to the engine, and will void the engine warranty.

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CAUTION

Do not energize the starter for a period of longer than 15 seconds.

Take a pause of at least 30 seconds between energization of the starter.

Otherwise the starter could suffer damage.

9999998en

CAUTION

- High-pressure washing not recommended.
- Avoid using high-pressure washing for electronic or electric devices installed in, on or around the engine, including the E-ECU, relays and harness couplers.

Otherwise such devices may suffer malfunction due to water ingress into them.

9999997en

CAUTION

- Do not plug or unplug the E-ECU for a period of at least 6 seconds after power to the unit has been turned on or off.
- Do not touch connector pins of the E-ECU with bare hands.
  Doing so may result in corrosion of the connector pins and/or damage to the internal circuits of the E-ECU due to static electricity.
- Do not force a measuring probe into the female coupler.
  Doing so may cause contact failure of the connector pins, resulting in malfunction of the E-ECU.
- Take care to prevent water from entering the couplers when plugging or unplugging the connector.
  Water inside the couplers may cause corrosion, resulting in malfunction of the E-ECU.
- Avoid plugging/unplugging the connector more than approx. 10 times.
  Frequent plugging/unplugging of the connector may cause contact failure of the connector pins, resulting in malfunction of the E-ECU.
- Do not use the E-ECU that has ever suffered drop impact.

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CAUTION

Always check the battery for proper charge.

Otherwise the electronically controlled engines may fail to start.

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Cause \ Symptoms and conditions of failures	Defective start: Starter not rotate: ECU indicator lamp not on just after key-on	Defective start: Starter not rotate: ECU indicator lamp on just after key-on (2 seconds)	Defective start: Starter rotates: Engine not start (not even initial combustion)	Defective start: Starter rotates: Engine not start (stall after serial combustion)	Defective start: Starter rotates: Engine starts later then ever	Engine stall after start: Exhaust fume: None	Engine stall after start: Exhaust fume: Little	Engine stall after start: Exhaust fume: Much	Defective rotation control: Speed change by accelerator not available (constant speed)	Defective rotation control: Without load: Specified speed setting not available	Defective rotation control: Without load: Poor acceleration	Defective rotation control: Without load: Return to low speed not smooth	Defective rotation control: Without load: Hunting	Defective rotation control: At work: Hunting	Insufficient engine output: Exhaust color: Normal	Insufficient engine output: Exhaust color: White	Insufficient engine output: Exhaust color: Black	Noise/vibration: Knocking noise at combustion too high	Noise/vibration: Combustion noise uneven	Noise/vibration: Noise other than combustion from engine	Noise/vibration: Engine vibration too big	Lubricant: Lubricant consumption too much	Lubricant: Lubricant diluted with fuel	Lubricant: Lubricant mixed with water	Lubricant: Oil pressure too low (oil pressure lamp on)	Cooling water: Overheated (water temperature lamp on)	Cooling water: Water temperature too low	Intake: Pressure down (air cleaner lamp on)	Intake: Pressure up	Exhaust: At work: White exhaust color	Exhaust: At work: Black exhaust color	Exhaust: Blow-by too much	Exhaust: Exhaust temperature up	Fuel: Fuel consumption too much	Fuel: Fuel mixed with water (oil-water separator lamp on)	Fuel: Fuel filter contaminated too early	Electrics/electronics: Battery charge defect (charge lamp on)	Electrics/electronics: ECU indicator lamp flashing	Electrics/electronics: ECU indicator lamp not on just after key-on (2 seconds)	Electrics/electronics: Prescribed ECU control function not operate	Electrics/electronics: Fuse meltdown, disconnection (repeated)	Action
Lubricant system: Incorrect lubricant			○			○									○								○			○						○										Usage of correct lubricant
Lubricant system: Lubricant system leakage																							○			○						○										Repair
Lubricant system: Insufficient discharge rate of trochoid pump																										○																Inspection and repair
Lubricant system: Lubricant filter clogged																										○						○										Cleaning or replacement
Lubricant system: Regulator valve fault																										○																Cleaning, adjustment or replacement
Lubricant system: Insufficient lubricant quantity						○																				○																Replenishment of correct lubricant
Lubricant system: Excess filling into crankcase																							○			○					○												Engine oil check
Fuel system: Stopper solenoid fault			○				○																																		Inspection and replacement
Fuel system: Fuel injection pump with injection timing excessively advanced																		○			○									○	○											Inspection and adjustment
Fuel system: Fuel injection pump with injection timing excessively retarded																○	○													○	○		○	○								Inspection and adjustment
Fuel system: Incorrect fuel															○	○	○		○											○	○				○	○							Usage of correct fuel
Fuel system: Water entered into fuel system			○	○				○					○	○		○			○											○					○								Drainage of fuel filter
Fuel system: Fuel filter clogged			○		○	○					○				○																											Cleaning or replacement
Fuel system: Air entered into fuel system			○	○		○							○	○	○																											Bleeding
Fuel system: Fuel pipe clogged, cracked			○			○									○																											Cleaning or replacement
Fuel system: Insufficient fuel feeding to fuel injection pump			○	○		○					○				○																											Check of fuel tank cock, fuel filter, fuel pipe, fuel feed pump
Fuel system: Uneven injection quantity of fuel injection pimp													○	○		○	○		○		○									○	○		○									Inspection and adjustment
Fuel system: Fuel injection quatity too much																							○			○			○		○	○	○	○								Inspection and adjustment
Fuel system: Defective spray of fuel injection nozzle													○	○		○	○		○		○									○	○			○								Inspection and adjustment
Fuel system: Priming not available			○																																							Valve in priming pump pinched dust (disassembled cleaning)
Fuel system: Strainer at feed pump inlet clogged					○						○				○																											Cleaning of strainer
Fuel system: Operation defect of CSD valve			○		○													○																								Replacing the Pump Replacement of CSD valve
Fuel system: Sealing defect of fuel tank																																				○	○					Check of fuel tank and cap, as well as installation of genuine parts
Intake: Air filter clogged								○			○							○		○			○					○				○		○								Cleaning of air filter
Intake: Engine operation at high temperature or high land																		○										○				○			○								Consideration of matching output reduction with load
Intake: Exhaust pipe clogged							○				○							○		○								○				○		○								Cleaning of exhaust pipe

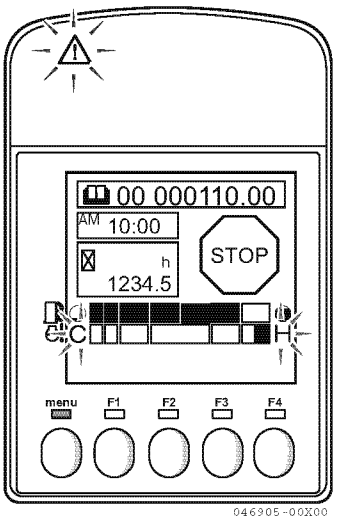
2) Alarm Sensor Function

- When the starter switch is turned to the ON position, relevant LED lamps should come on and the buzzer should sound for a few seconds, then the lamps should go out and the buzzer should stop.
- The battery charge and engine oil pressure lamps should stay on until the engine is started.
- All the LED lamps should remain off while the engine is running.

3) In the event of Machine Failure

In the event of machine failure, icon(s) and error code(s) corresponding to the failure(s) are displayed on the LCD screen and the warning and/or caution lamps flash, where applicable.

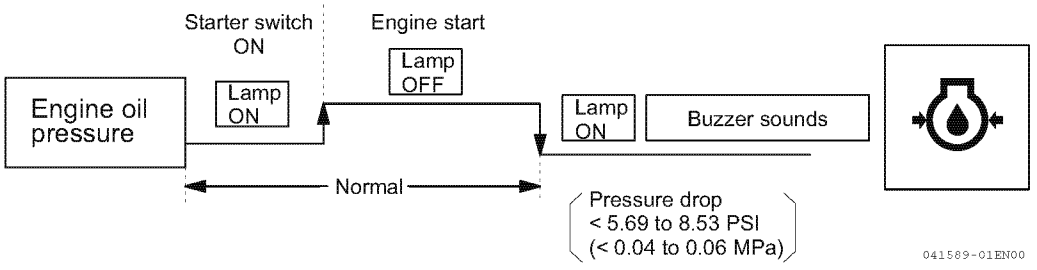
For details of error codes, refer to Section 5-5.



4) Sensor Operation

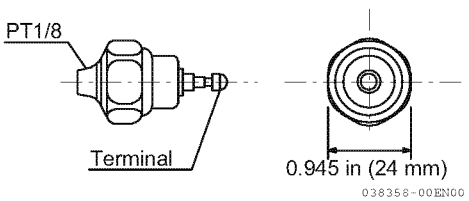
(1) Oil pressure switch (for detecting low engine oil pressure)

When the engine oil pressure falls, the lamp comes on and the buzzer sounds.



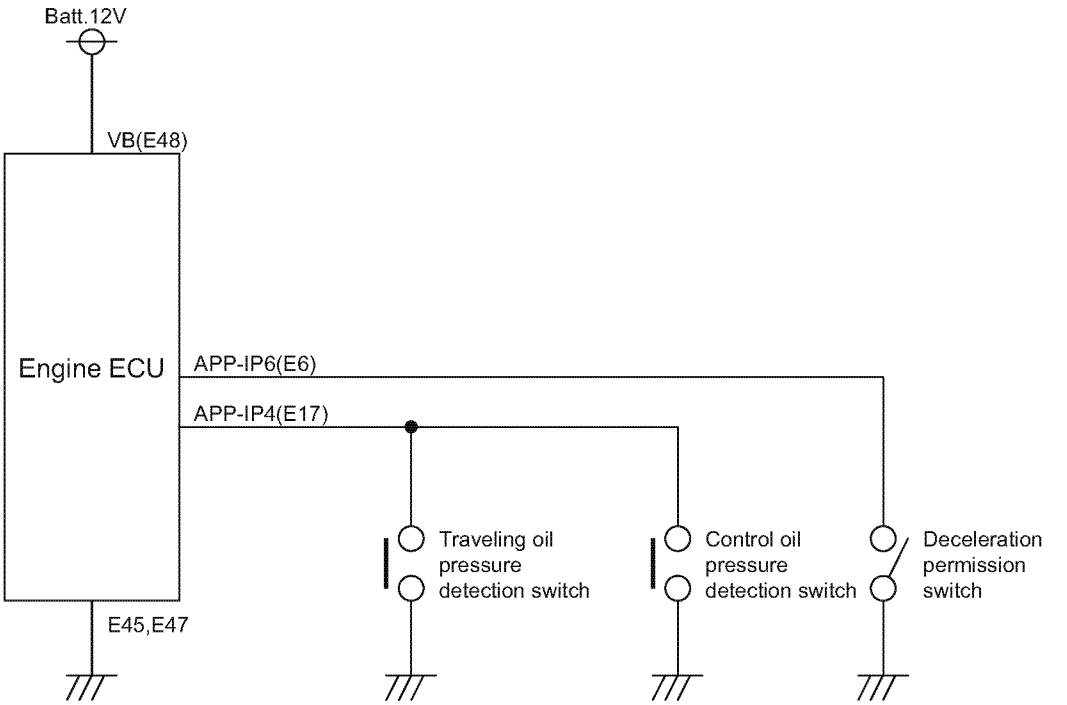
When this switch detects low engine oil pressure, it causes the engine oil pressure warning lamp on the LCD monitor to come on and the buzzer to sound.

- Working pressure: 5.69 to 8.53 PSI (0.04 to 0.06 MPa)
- Installation position: Engine block



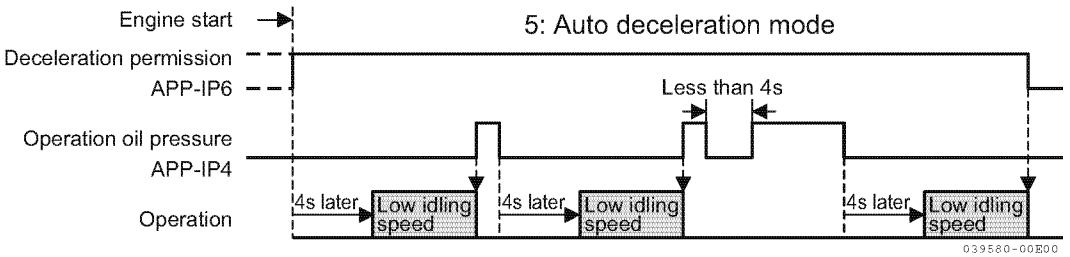
5-3-2 Circuit Description of Auto Deceleration Mode

The figure below shows the connection diagram for auto deceleration mode.



Connection diagram for auto deceleration

The figure below shows the operation timing for auto deceleration mode.



Deceleration permission switch: when APP-IP6=ON, operation oil pressure switch: APP-IP4=OFF (in non-operational condition) is continued over 4s, the auto deceleration is affected and the engine target speed is fixed without depending on the accelerator sensor input voltage.

Error code	Classification	Error description	Detection condition	Causes	Corrective measures
00 522242.02	Caution	Cold start device: intermittent failure (Intermittent failure of CSD solenoid valve)	• ON signal is detected although CSD solenoid valve OFF command has been received. • OFF signal is detected although CSD solenoid valve ON command has been received.	• Connection failure of connectors • Harness wiring failure (nearly broken CSD solenoid valve line) • Engine ECU internal circuit failure	Check the connectors, harnesses and CSD solenoid valve. Turn the starter switch to the “OFF” position and then the “ON” position. Then check that the error code is displayed again.
00 522242.03	Caution	Cold start device: circuit fault B (CSD solenoid valve malfunction)		• Connection failure of connectors • Harness wiring failure (CSD solenoid valve line short circuited to GND) • Defective CSD solenoid valve • Engine ECU internal circuit failure	
00 522242.04	Caution	Cold start device: circuit fault A (CSD solenoid valve malfunction)		• Connection failure of connectors • Harness wiring failure (CSD solenoid valve line disconnected or short circuited to power supply) • Defective CSD solenoid valve • Engine ECU internal circuit failure	
00 522243.02	Caution	Intermittent failure of air heater relay (Intermittent failure of starting aid relay)	• ON signal is detected although air heater relay OFF command has been received. • OFF signal is detected although air heater relay ON command has been received.	• Connection failure of connectors • Harness wiring failure (nearly broken starting aid relay line) • Engine ECU internal circuit failure	Check the connectors, harnesses and starting aid relay. Turn the starter switch to the “OFF” position and then the “ON” position. Then check that the error code is displayed again.
00 522243.03	Caution	Air heater relay circuit fault B (Starting aid relay malfunction)		• Connection failure of connectors • Harness wiring failure (starting aid relay line short circuited to GND) • Defective starting aid relay • Engine ECU internal circuit failure	
00 522243.04	Caution	Air heater relay circuit fault A (Starting aid relay malfunction)		• Connection failure of connectors • Harness wiring failure (starting aid relay line disconnected or short circuited to power supply) • Defective starting aid relay • Engine ECU internal circuit failure	

6-2-2 Arm

1) Arm “Retract”

(1) Pilot oil flow

When the arm control lever is pulled back to retract the arm, the oil from the pilot pump P4 flows through the cut-off valve and the port 3 of the pilot valve (LH) to the port Pa3 of the arm section and the port Pa3' of the parallel-flow divider to move their spools.

(2) Oil flow from hydraulic pump

The oil from the piston pump P1 flows through the port P2 of the inlet section to the arm section. The oil from the gear pump P3 flows through the port P3 of the parallel-flow divider and the parallel passage to the arm section and combines with the oil from the piston pump P1. The combined oil flows through the port A3 of the control valve to A3 of the arm cylinder to extend its cylinder rod. The return oil from B3 of the arm cylinder flows back to the hydraulic oil tank through the port B3 of the arm section, the ports T1 and T2 of the control valve and the oil cooler.

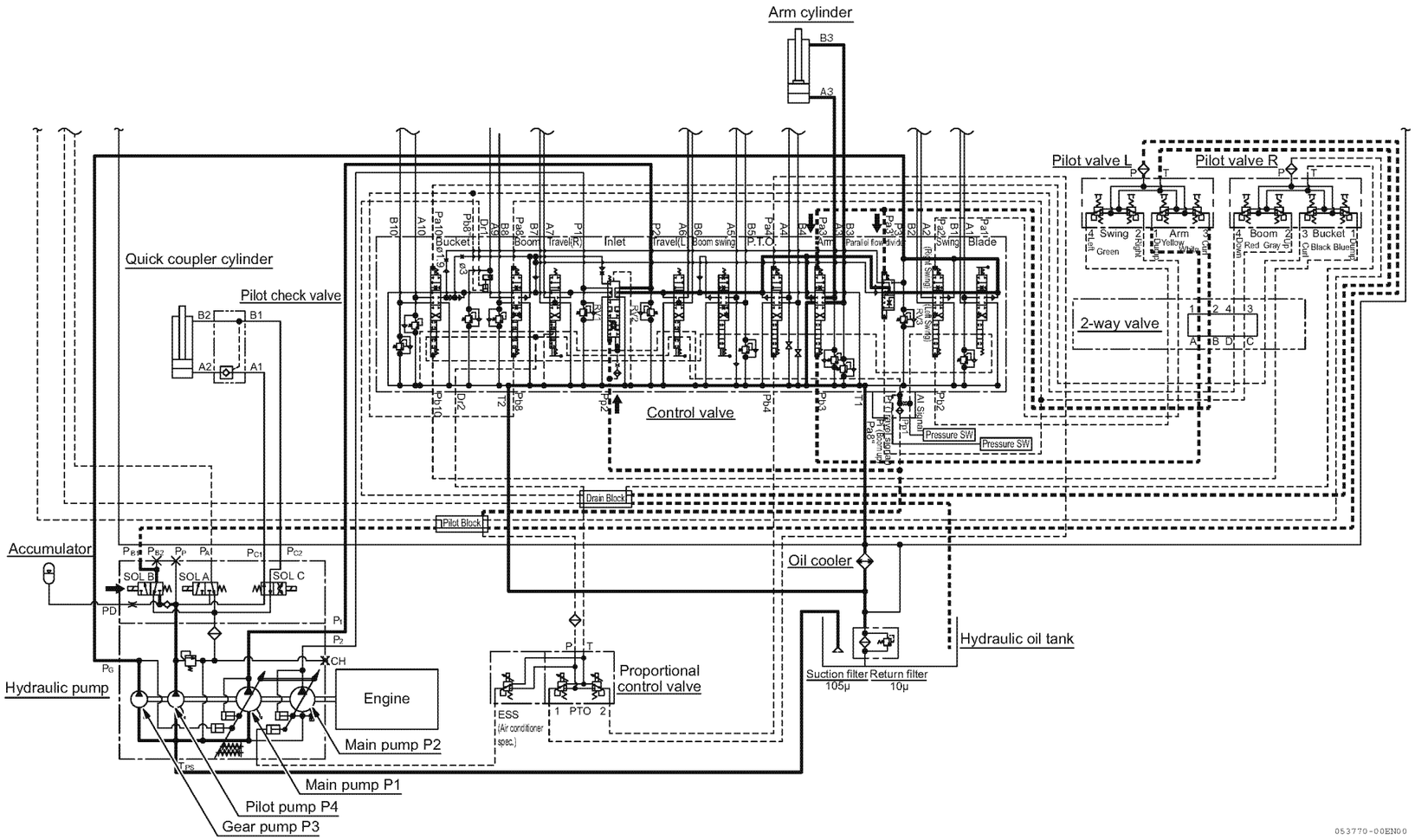
2) Arm "Extend"

(1) Pilot oil flow

When the arm control lever is pushed forward to extend the arm, the oil from the pilot pump P4 flows through the cut-off valve and the port 1 of the pilot valve (LH) to the arm section through the port Pb3 of the arm section to move its spool.

(2) Oil flow from hydraulic pump

The oil from the piston pump P1 flows through the port P2 of the inlet section to the arm section. The oil from the gear pump P3 flows through the port P3 of the parallel-flow divider and the parallel passage to the arm section and combines with the oil from the port P2. The combined oil flows in the opposite direction to the oil flow in the arm retract operation with regard to the arm cylinder.



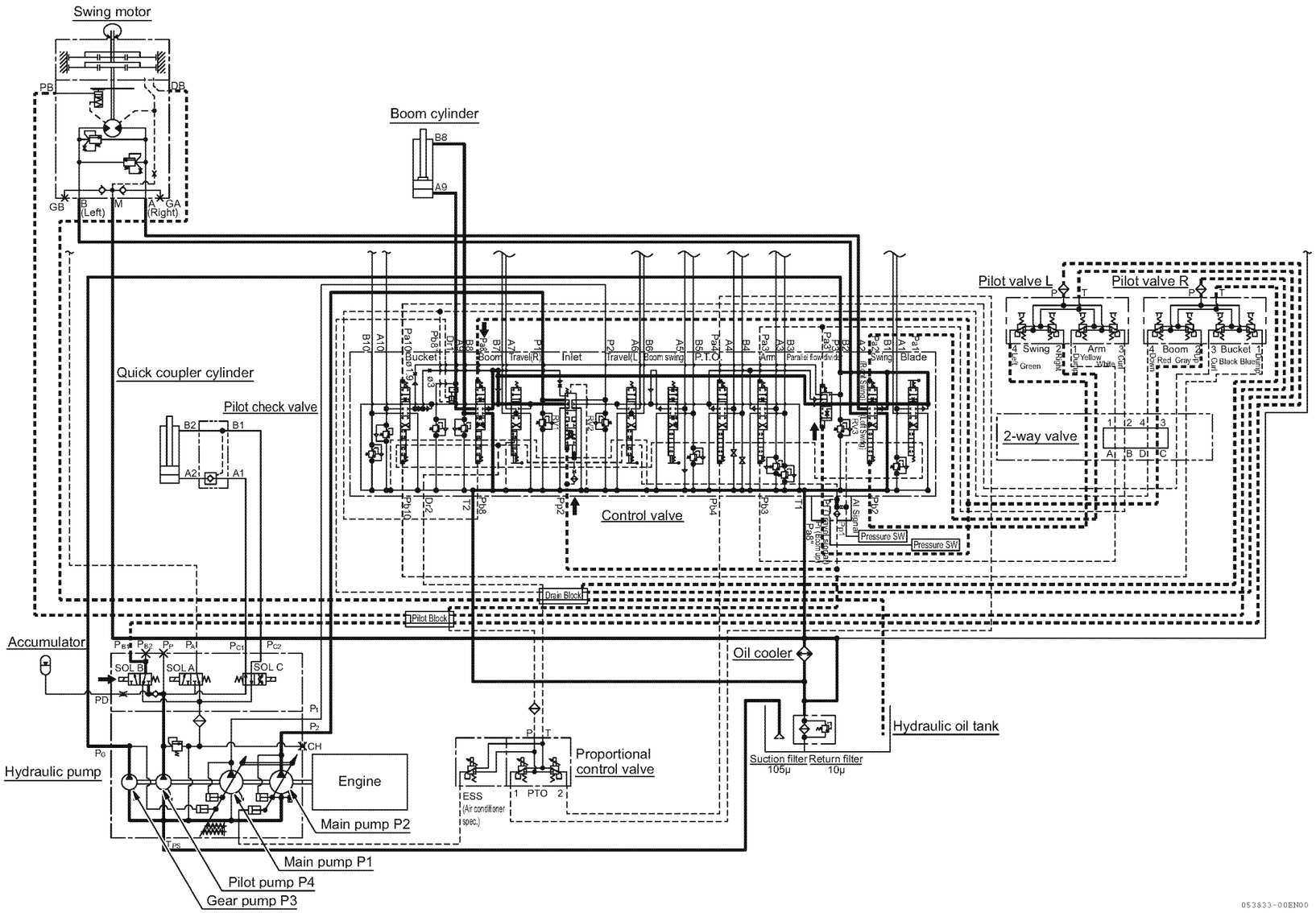
6-2-12 Simultaneous Operation of Boom Up and Swing

Oil Flow from Hydraulic Pump

The oil from the gear pump P3 flows to the port P3 of the parallel-flow divider and is divided into two oil flows. One of them flows to the swing section through the parallel passage, and the other flows to the boom section through the parallel passage to combine with the oil from the piston pump P2.

Throttles and a check valve are installed in the swing section so as to match the swing speed to the boom-up speed.

Refer to Section "6-2-1 Boom" and Section "6-2-4 Swing" for the oil flow with regard to the boom cylinder and the swing motor.



3) Horsepower Control for Engine Speed Sensing spec. (with Air Conditioner)

Control the discharge volume of the piston pumps so that the amount of load in the piston pumps P1 and P2, the trochoid pump and the gear pump does not exceed the set torque.

The oil pressure from the piston pumps P1 and P2 flows to the control pin (A) through the oil passage inside the port block. The discharge pressure of the gear pump flows to the control pin (B) through the inner passage of the piston pump body.

The oil pressure discharged from the piston pumps P1 and P2 and the gear pump rises and presses the respective control pins, causing the inclination angle of the swash plate to decrease and the discharge volume of the pumps to reduce.

The one side of the swash plate is held with springs. The spring force is adjusted according to the discharge pressure of each pump. The amount of horsepower (torque) of the pumps is controlled by the springs not to exceed the set torque.

In addition, the piston pumps are provided with a horsepower reduction control function, which reduces a fixed amount of horsepower upon reception of an external pilot pressure signal.

External pilot pressure is led to the larger-diameter portion of the control pin (B) through the oil passages in the body and the piston pump body, pushes the control pin (B) and resists the force of the control springs, thus reducing the inclination angle of the swash plate to reduce the oil flow.

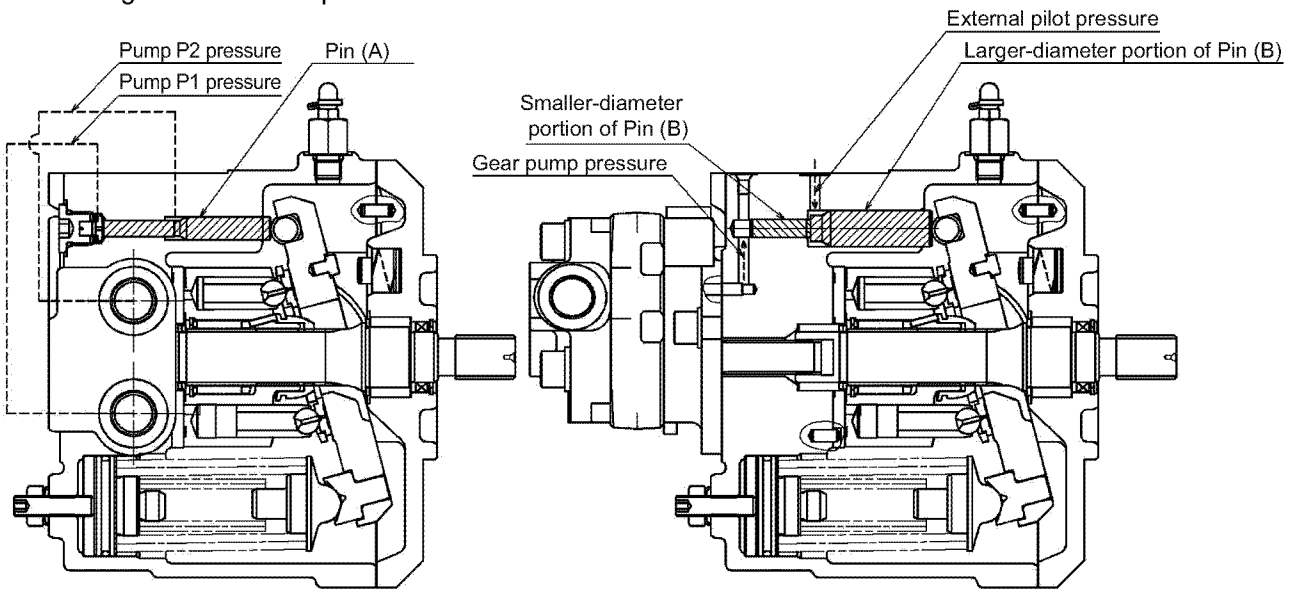
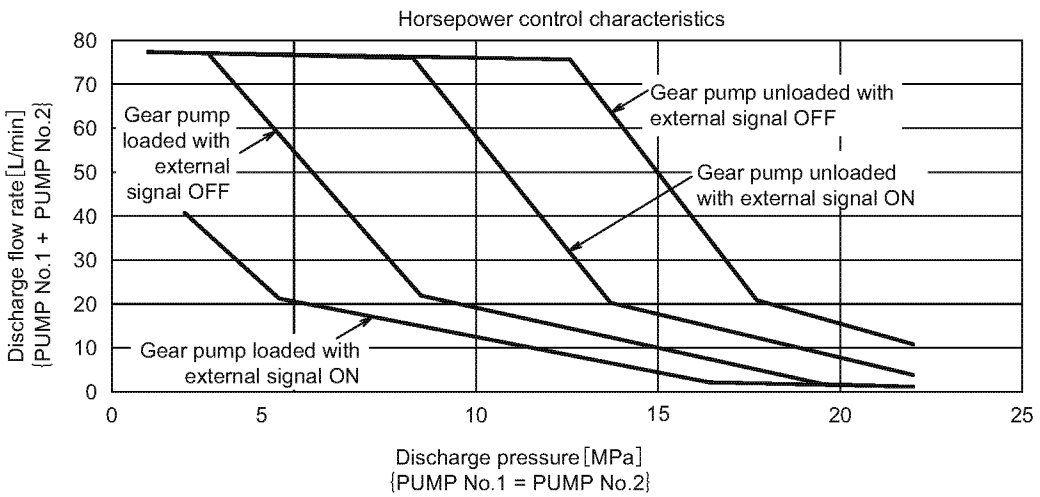


Illustration of horsepower control

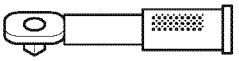
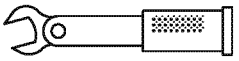
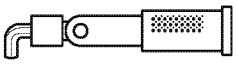
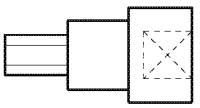
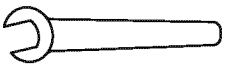
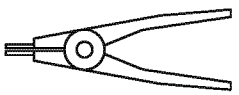
051872-00EN00

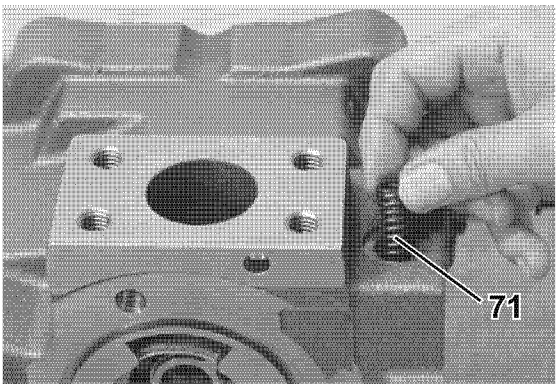
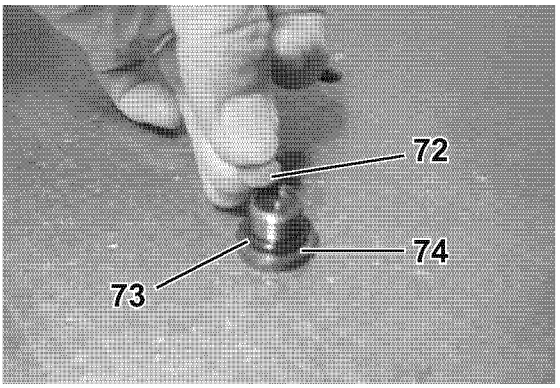
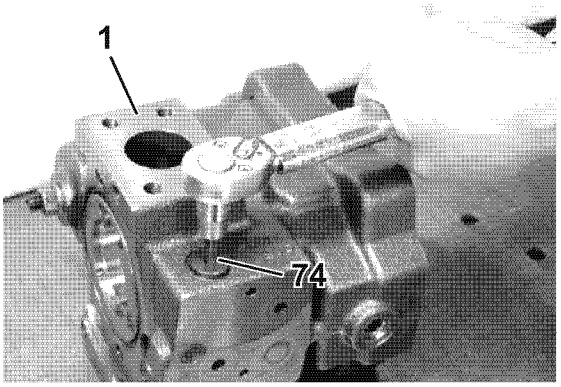
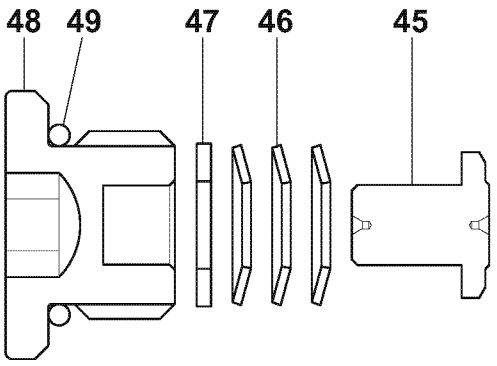


Horsepower control characteristic curves

051873-00EN00

2) Tools for Disassembly and Reassembly

Tools		Applicable part	Form
Torque wrench	Tightening torque : 4.35 ft·lbf (5.9 N·m)	(15) Screw	
	Tightening torque : 37.6 ft·lbf (51.0 N·m)	(48) Plug	
	Tightening torque : 78.8 ft·lbf (106.9 N·m)	(50) Socket head bolt	
	Tightening torque : 21.7 ft·lbf (29.4 N·m)	(52), (74) Plug	
	Tightening torque : 9.33 ft·lbf (12.65 N·m)	(21) Socket head bolt (for valve assembly)	
	Tightening torque : 11.6 ft·lbf (15.7 N·m) Width across flats : 0.67 in. (17 mm)	(41) Nut	
	Tightening torque : 32.5 ft·lbf (44.1 N·m) Width across flats : 0.31 in. (8 mm)	(85) Socket head bolt	
Hexagon socket for torque wrench	Width across flats : 0.12 in. (3 mm)	(15) Screw	
	Width across flats : 0.31 in. (8 mm)	(48) Plug	
	Width across flats : 0.39 in. (10 mm)	(50) Socket head bolt	
	Width across flats : 0.24 in. (6 mm)	(52), (74) Plug	
	Width across flats : 0.20 in. (5 mm)	(21) Socket head bolt (for valve assembly)	
Wrench	Width across flats : 0.67 in. (17 mm)	(41) Nut	
Hexagon bar wrench	Width across flats : 0.12 in. (3 mm)	(15) Screw	
	Width across flats : 0.20 in. (5 mm)	(39) Set screw	
	Width across flats : 0.31 in. (8 mm)	(48) Plug	
	Width across flats : 0.39 in. (10 mm)	(50) Socket head bolt	
	Width across flats : 0.24 in. (6 mm)	(52), (74) Plug	
	Width across flats : 0.20 in. (5 mm)	(21) Socket head bolt (for valve assembly)	
Snap ring pliers	For internal snap ring	For internal snap ring	
Vice		(1) Housing (for holding housing)	
Hand press		(12) Oil seal (13) Bearing	

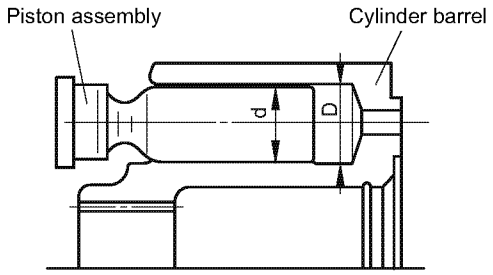
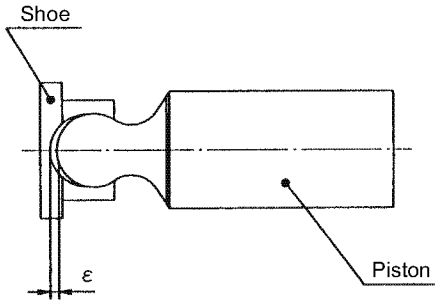
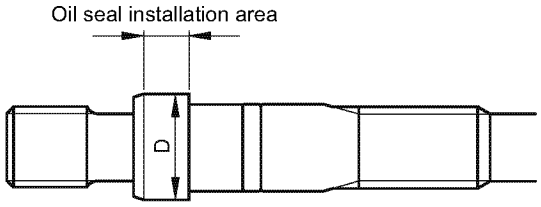
Procedure	
(5) Install the spring **71** into the housing **1**.	
(6) Install the O-ring **73** and the shims **72** onto the plug **74**. ***Note :*** *If the shim drops, the relief set pressure of the pilot pump decreases. Therefor, apply the grease to the shims before installing them to the plug to prevent them from dropping.*	
(7) Install the plug **74** in the housing **1**. Tightening torque : 21.7 ft·lbf (29.4 N·m) ***Note :*** *When installing the plug, be careful not to drop the shims installed on the plug.*	
(8) Install the O-ring **49**, the washer **47**, the disc springs **46** and the stopper **45** onto the plug. ***Note :*** *Take care about the direction of disc springs.*	

6. Service Standards

Clean the parts to be checked and completely dry them.

Check the major parts carefully and replace any ones on which excessive wear or damage that may cause malfunction is found.

Replace deformed or damaged seals.

Procedure	
(1) Piston assembly and cylinder barrel • Perform visual inspections for any flaws, scuffing or excessive wear (especially on the sliding parts). • Check the clearance between the outside diameter of each piston and the inside diameter of the cylinder barrel. D–d = 0.00197 in. (0.05 mm)	
(2) Piston shoes and pistons • Check the axial play of each piston and shoe. ε ≤ 0.00787 in. (0.2 mm)	
(3) Shaft • Check the oil seal installation area. Wear ≤ 0.00098 in. (0.025 mm) (Difference between contact and noncontact parts with oil seal in radius.)	

(2) Boom down operation

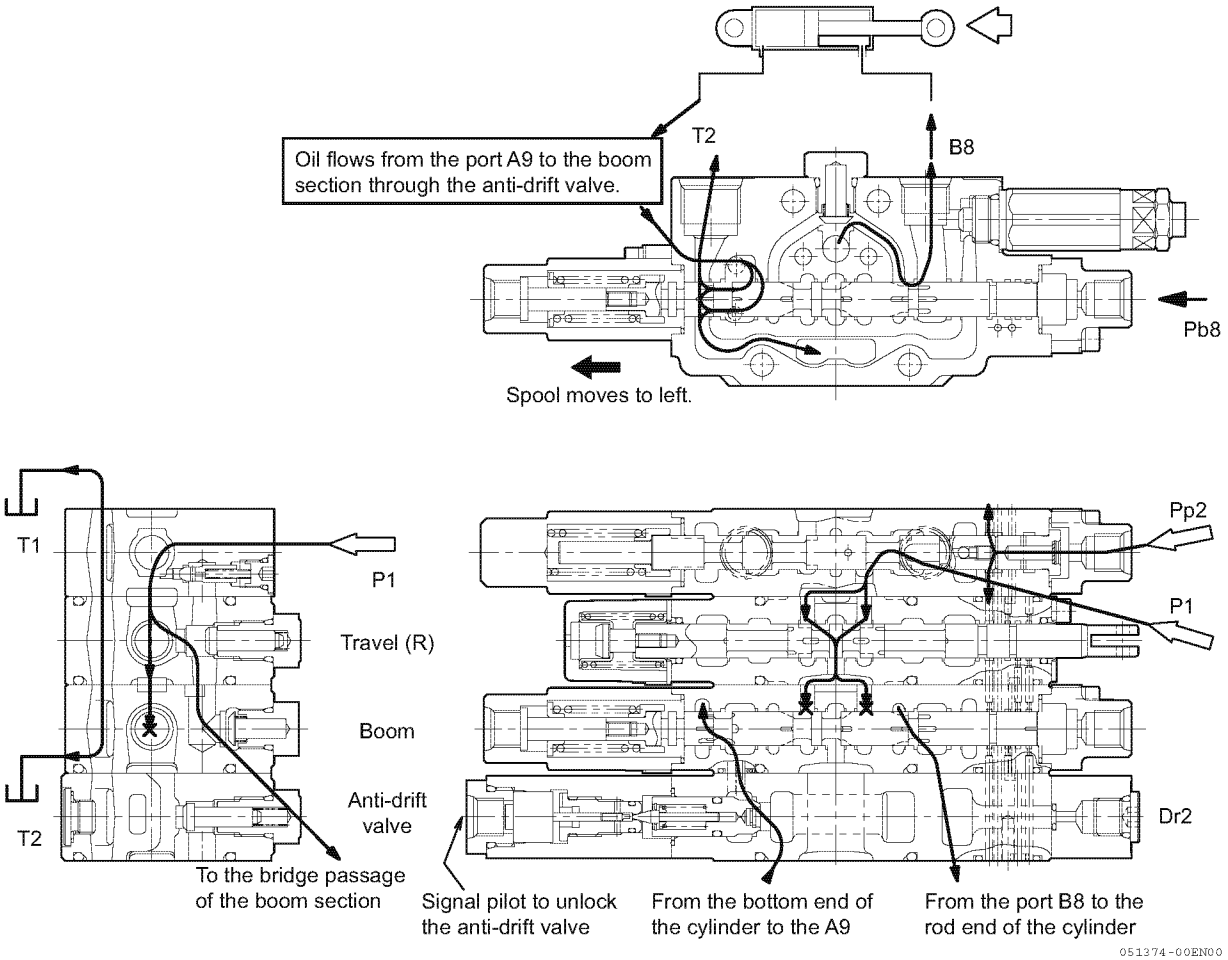
When the boom control lever is pushed forward to lower the boom, the oil from the pilot valve flows to the port Pb8 to move the spool of the boom section and to the port Pb8' through the port Pb8 to unlock the anti-drift valve.

Owing to the boom spool movement, the P1 by-pass passage is blocked (a part of oil flows out to the by-pass oil passage through the notches on the spool), so that the oil from the port P1 flows through the parallel oil passage via a check valve in the by-pass oil passage in the travel section to the parallel passage of the boom section.

The passage between the port B8 and the bridge passage is opened through the notch in the boom spool as the spool has been moved. Therefore the oil in the parallel passage flows through the load check valve of the boom section and the bridge passage to the port B8 and is fed to the rod end of the boom cylinder.

Meanwhile, the return oil from the bottom end of the boom cylinder flows to the return oil passage through the port A9 on the anti-drift section, the anti-drift valve, which is opened by the pilot pressure from the port Pb8', and the notch in the boom spool which opens the return oil passage as the spool has been moved.

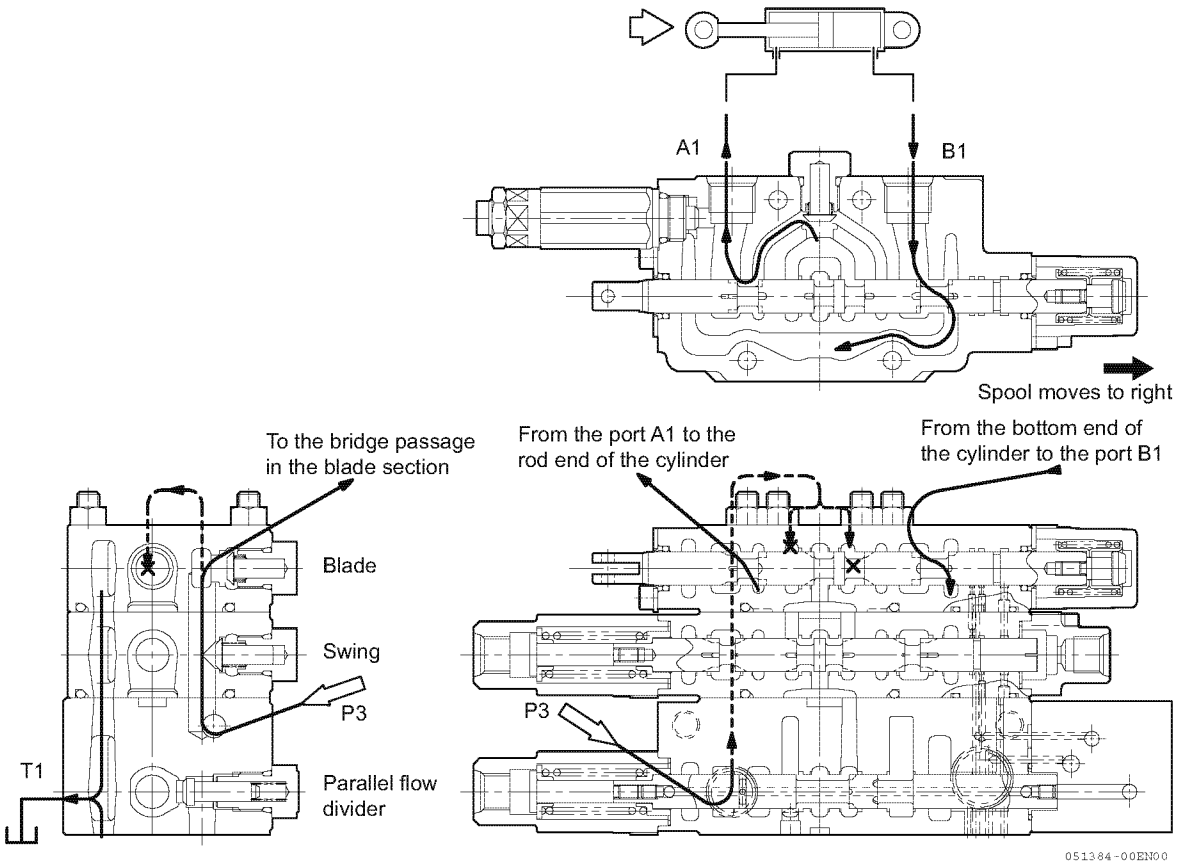
Thus, the boom cylinder is retracted to lower the boom.



8) Blade Operation

(1) Blade up operation

When the blade lever is pulled back to raise the blade, the spool of the blade section is pushed. Because the P3 by-pass passage is blocked by the blade spool and the passage between the port A1 and the bridge passage is opened as the blade spool has been moved, the oil from the port P3 flows through the P3 parallel passage, the load check valve in the blade section and the bridge passage to the port A1 and is fed to the rod end of the blade cylinder.
Meanwhile, the return oil from the bottom end of the blade cylinder flows through the port B1 to the return oil passage, which is opened as the blade spool has been moved.
Thus, the blade cylinder is retracted to raise the blade.



4. Disassembly and Reassembly

1) Precautions for Disassembly and Reassembly

(1) Precautions for disassembly

[1] Since the parts of the hydraulic equipment are generally precision-made for tight clearances, be sure to perform disassembly and reassembly in a clean area that is free from dust.

[2] Prepare clean tools and treated oil, and handle them carefully.

[3] First clean the external surface of removed assemblies.

[4] Before beginning, review the drawings of the internal construction and prepare the required parts according to the purpose and extent of the disassembly. After disassembly, replace the removed seals and O-rings with new ones in principle. As some replacement parts are available only as subassemblies, see the parts catalogue to prepare the necessary subassemblies in advance.

(2) Precautions for reassembly

[1] Handling the O-rings

1] Lubricate the O-rings and the O-ring fitting seats with clean grease or hydraulic oil.

2] The O-rings may not have any defects in molding, or be damaged in handling or distorted by heat.

3] Do not stretch any O-rings with such great force as to permanently deform them.
Prevent any O-ring from being damaged when it is set to the spool from its sharp end.

4] Avoid rolling the O-rings when fitting them.
A distorted O-ring may not return to its original shape; therefore it may cause oil leakage.

[2] Before beginning reassembly, check that there is no treated oil or hydraulic oil on the outer surface of the O-ring groove in the mating face of each section. If reassembly is performed without cleaning such oil, it may be mistaken for oil leakage.

[3] Reassembly of control valve sections
Put the control valve sections with the actuator port down in the order shown in the figure below.

Note :

The symbol representing for each valve section is as follows and is carved on the upper surface (the actuator port side) of each valve body except the end cover.

Section	Symbol
Blade	SZ
Swing	ga
Parallel flow divider	US
Arm	TX
P.T.O.	fP
Boom swing	fQ
Travel (L)	cF
P1, P2 inlet	AV
Travel (R)	BZ
Boom	EW
Anti-drift valve	KZ
Bucket	VR

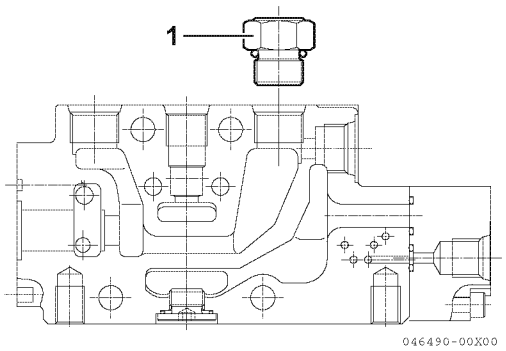
3)-5. Disassembly of other parts

Perform disassembly of the remaining parts according to the procedures below.

(1) Anti-drift valve actuator port plug

[1] Securely hold the anti-drift valve body with the actuator port side facing up.

[2] Remove plug **1** from the anti-drift valve body with a wrench or a socket wrench (21 mm).



Sectional view of anti-drift valve

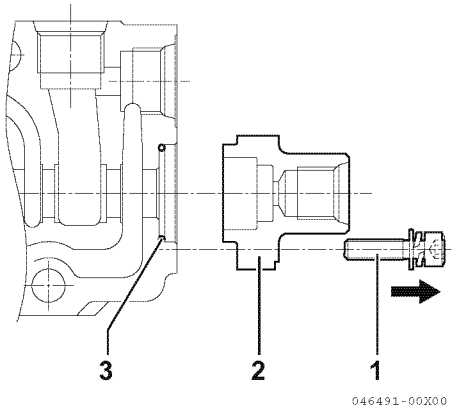
(2) Pilot oil chamber case 1 of pilot operated type valve section

[1] Remove two hexagon socket head bolts (w/washer) **1**. with a hexagon bar wrench (4 mm).

[2] Remove pilot oil chamber case **2**.

Note:

*After removal of the case, check that O-ring **3** stays on the flanged bottom of the valve body.*

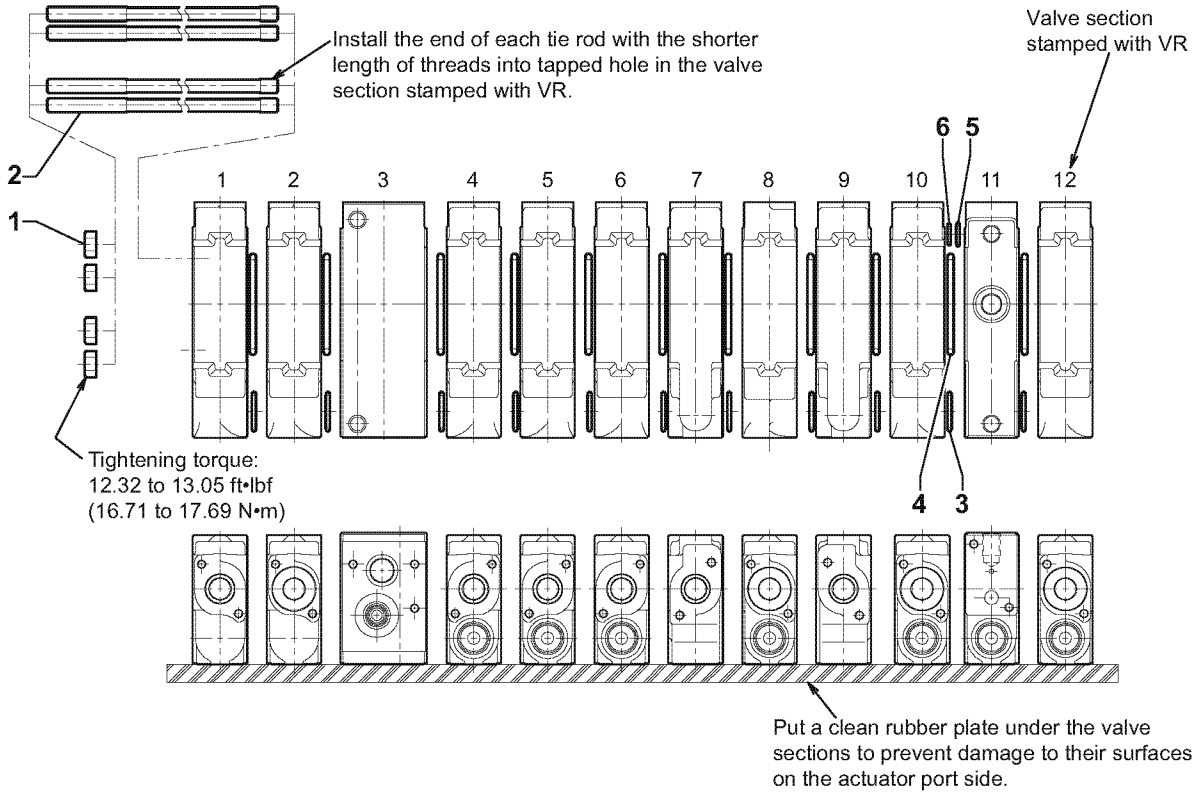


Pilot operated type 1

Order of assembly of valve sections

No.	1	2	3	4	5	6	7	8	9	10	11	12
Identification symbol	SZ	ga	US	TX	fP	fQ	cF	AV	BZ	EW	KZ	VR

Note: Identification symbols are stamped on the top surfaces (on the actuator port side) of the vale sections.



Valve sections before assembly

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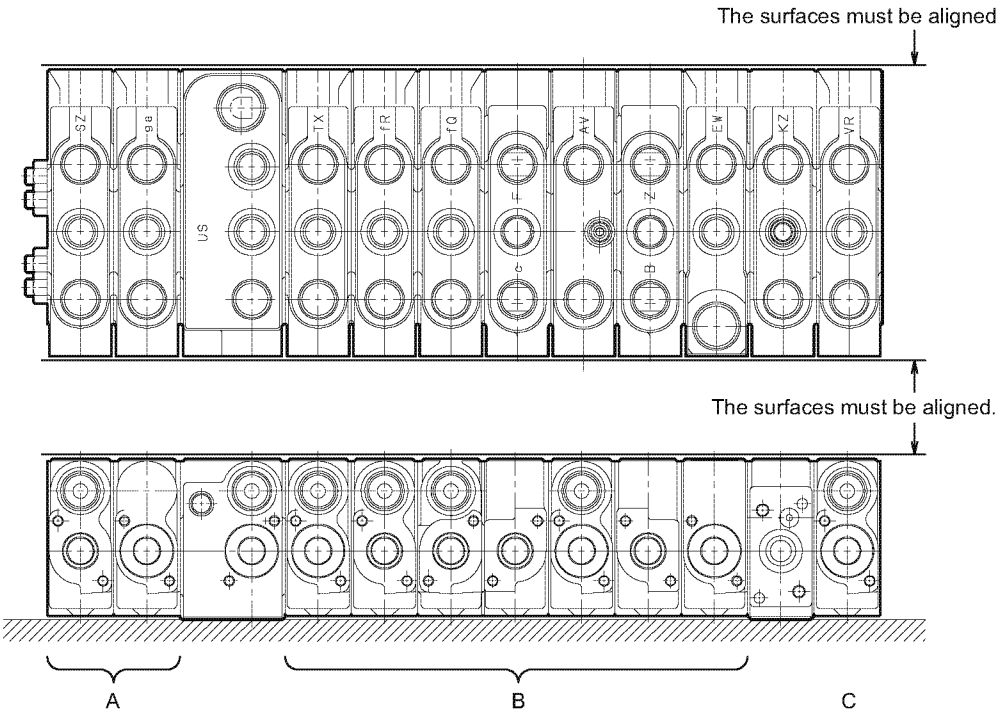


Note: When the control valve assembly is placed with the actuator port side up, there is a clearance of 1.5 mm between the end faces of the valve sections marked with A, B and C in the figure above and the contact surface of the control valve assembly with the surface plate.

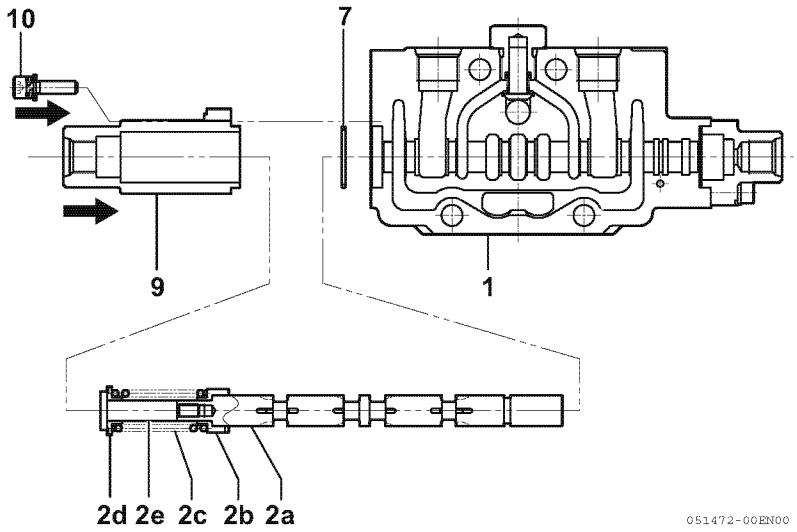
Control valve assembly

051465-00EN00

4)-6. Reassembly of spools

(1) Pilot operated type

Taking the swing spool as an example, the assembly procedure is described below.



Pilot operated type

[1] Check that no dirt or any other foreign matter is attached to the spool assembly or around the spool bore of the valve body and that O-ring **7** is securely installed on the flanged bottom of the valve body. Then insert the spool assembly into the spool bore of the valve body in the correct position and direction.

Note:

Before inserting the spool assembly, apply a small amount of hydraulic oil to the spool.

CAUTION:

Carefully insert the spool assembly horizontally into the bore.

If the spool assembly is not inserted easily, do not force it into the bore. Doing so may cause dents inside the bore or on the spool, resulting in malfunction of the machine.

If the spool assembly is not installed into the bore smoothly, do not forcibly insert it. Remove it and check it for dirt, flaws and burrs.

If there are any flaws or burrs, be sure to replace the spool assembly together with the valve body to avoid malfunctions.

Note:

Even if the spool assembly is inserted smoothly, take it in and out several times to check again that it moves smoothly.

[2] Install pilot oil chamber case **9** so that it fits securely onto the flange portion of the valve body from which the spring of the spool assembly is protruding. Then install and tighten hexagon socket head bolts (w/washer) **10** to the specified torque with a hexagon bar wrench (4 mm).
[Tightening torque: 4.4 to 5.1 ft·lbf (5.9 to 6.9 N·m)]

[3] To assemble other spools of the same pilot operated type, follow the same procedure as above.

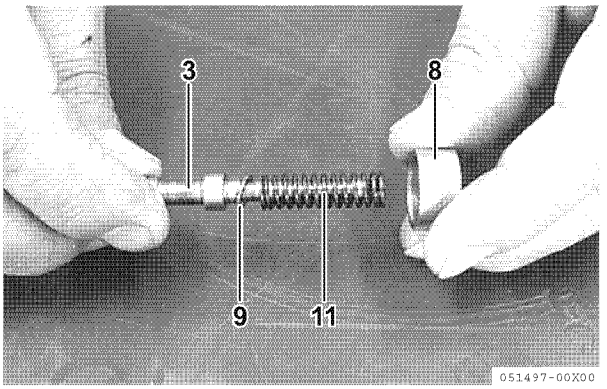
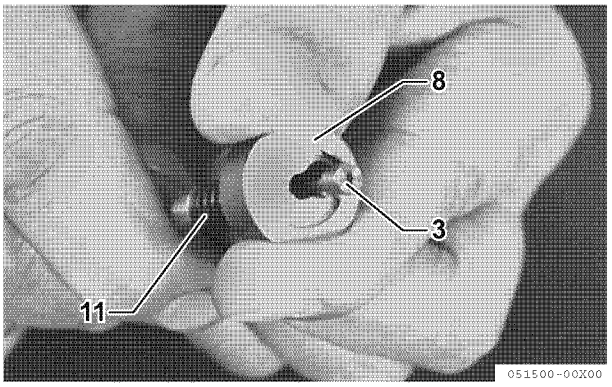
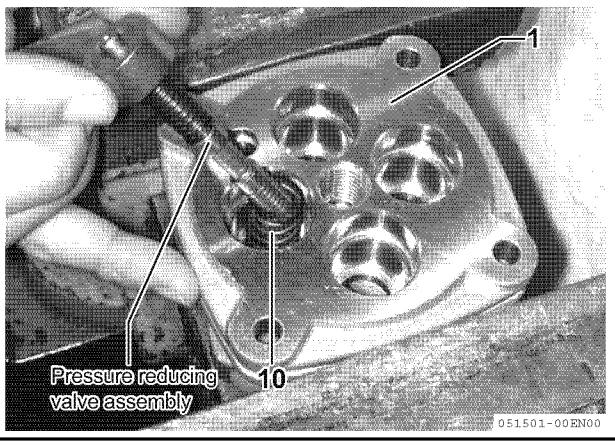
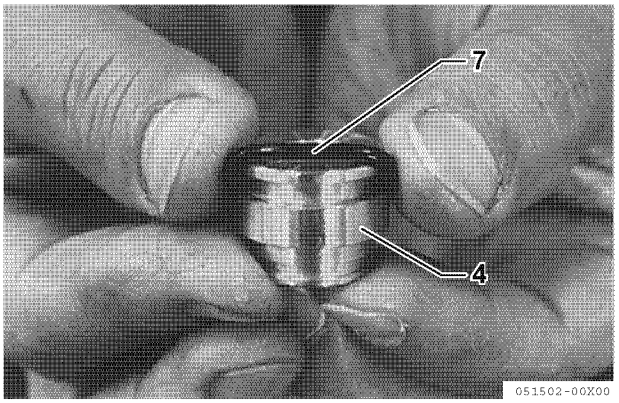
2) Relief valve

Relief valves are the most essential parts in terms of performance and safety. In addition, maintenance including resetting of relief valve pressures is extremely difficult at locations other than well-equipped maintenance factories. If any of the failures listed below occurs, replace the whole relief valve assembly.

The corrective measures shown below are just for reference. In principle, replace the whole assembly.

Phenomenon	Causes	Corrective Measures
Pressure does not increase at all.	Relief valve stays open due to stuck valve, poppet and/or piston, or foreign matter is caught in valve seat.	• Check if foreign matter is caught in engagement portions of the relief valve. • Check that all parts slide smoothly. • Completely clean all parts.
Relief pressure is unstable.	Flaws in poppet of relief valve.Piston stuck to valve.	• Replace the damaged part. • Completely clean all parts. • Remove all surface flaws.
Relief pressure is outside the preset range.	(1) Wear due to foreign matter (2) Loose lock nut and adjust screw • Spring breakage or fatigue (3) Malfunction of system relief valve or circuit relief valve	(1) Disassemble and clean. (2) Adjust the pressure. • Replace the spring. (3) Measure the set pressure of the system relief valve or circuit relief valve
Oil leak	(1) Damage to seat portion Wear of O-ring (2) Part sticking due to foreign matter	(1) Replace the damaged or worn part. Check that each part can move smoothly during reassembly. (2) Check that there are no scratches, dents or foreign matter and then reassemble the parts.

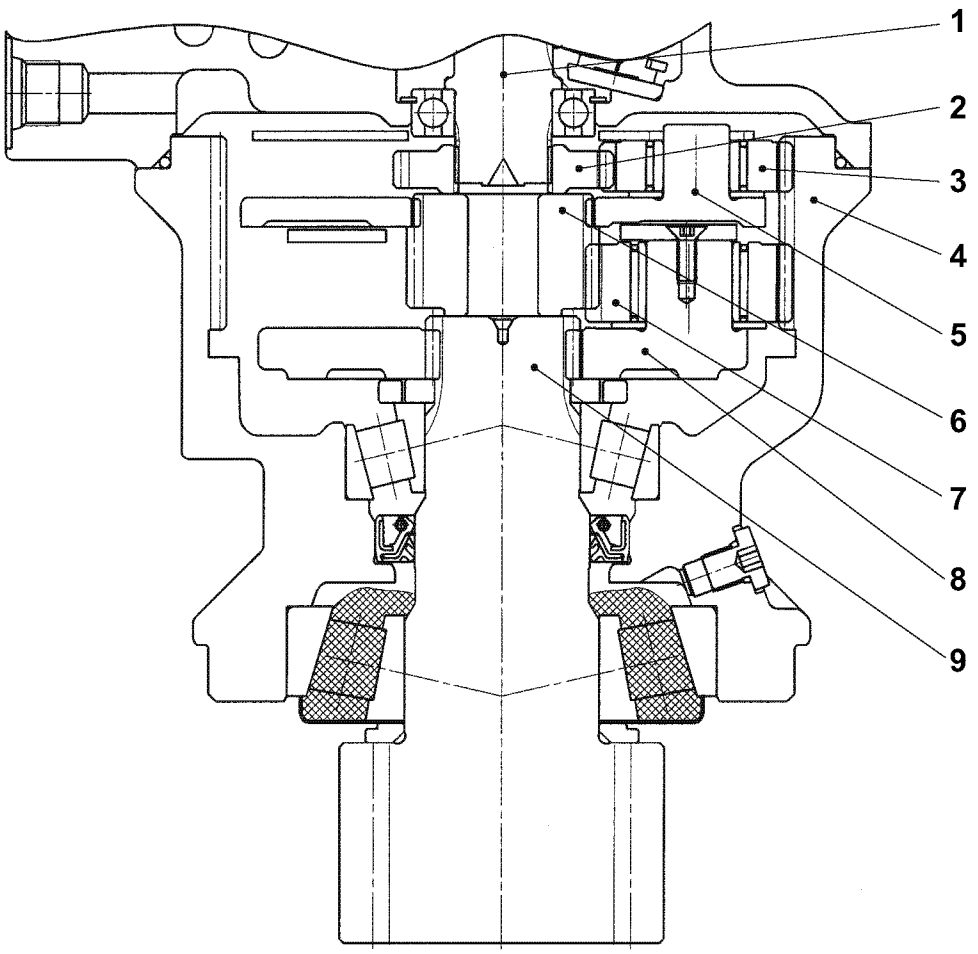
4) Reassembly

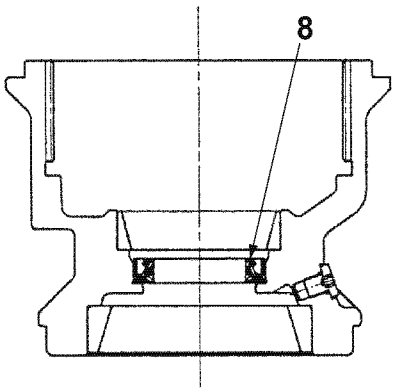
Procedure	
(1) Install washer 2 **9**, spring **11** and spring seat **8** in this order onto spool **3**.	
(2) Depress spring seat **8** and, while compressing spring **11**, move spring seat **8** to the side to pass spool **3** through the larger hole in it and install it on spool **3**. ***Note:*** *Do not depress spring seat **8** more than 0.24 in. (6 mm).*	
(3) Install return springs **10** into holes in casing **1**. (4) Install pressure reducing valve assemblies into holes in casing **1**. ***Note:*** *Be sure to install them in the same holes in casing **1** they were removed from.*	
(5) Install O-ring **7** onto plug **4**.	

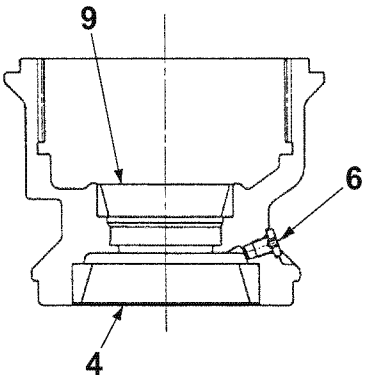
5) Reduction Gear

(1) Planetary double reduction gear

The motor shaft **1** is splined to the drive gear **2**. The driving force of the hydraulic motor is transmitted to the planetary gears **3** engaging with drive gear **2**. The planetary gears **3** are engaging with the ring gear of the reduction gear housing **4**. Therefore, the planetary gears **3** revolve along the ring gear, as they rotate on their own axis. The planetary gears **3** are held by the holder **5** through the bearing, and the holder **5** transmits the revolution movement of the planetary gears **3** to the sun gear **6** splined to the holder. The sun gear **6** engages with the planetary gears **7**and the rotation movement is transmitted to the planetary gears **3** as in the first gear. The planetary gears **7** engages with the ring gear of the reduction gear housing **4**, so that the planetary gears **7** revolve along the ring gear, as they rotate on their own axis. The planetary gears **7** are held by the holder **8** through the bearing. Therefore, the holder **8** transmits the revolution movement of the planetary gears **7** to the pinion shaft **9** splined to the holder **8**.



Procedure	
(25) Remove the oil seal **8**. ***Notes :*** • *Do not use the removed oil seal again.* • *Take care not to damage the outer races of taper-roller bearings **4** and **9**.*	

(26) Remove the outer races of taper-roller bearings **4** and **9** and the plug **6**.	

3) Valve

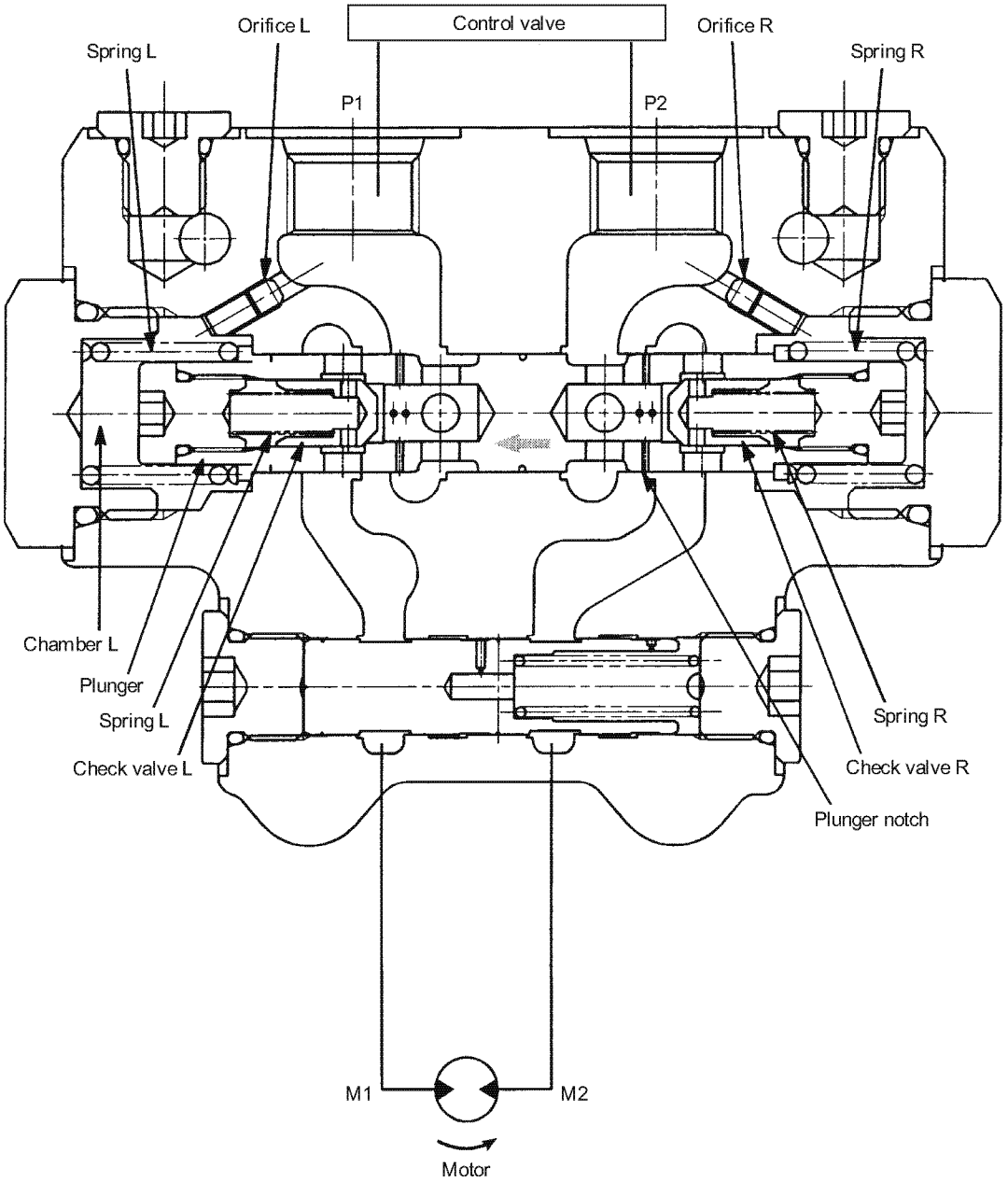
No.	Part	Service standard
1	Spring **62**	• Deep damage or large distortion.
2	Plug **64, 73** Check valve **61** O-ring **63, 66, 72, 74** Backup ring **65**	• Flaws causing oil leak or loss seal characteristic. • Permanent set.

4) Others

No.	Part	Service standard
1	Others plugs, O-rings	• Flaws causing oil leak or loss of seal characteristic. • Permanent set.

(2) Brake Function

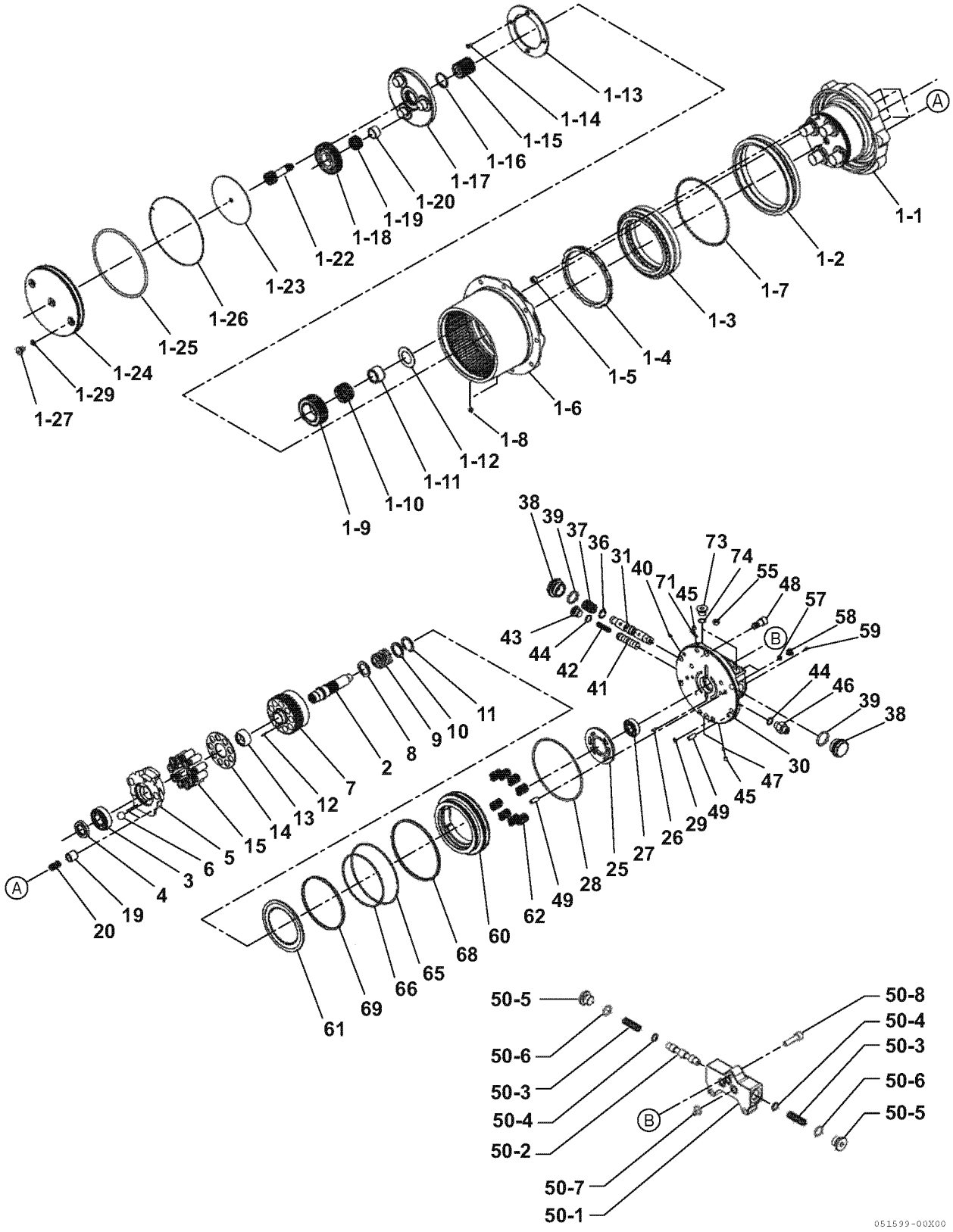
When the control valve is returned to the neutral position, the flow of pressure oil from the pump is blocked and the pressures at the ports P1 and P2 become equal. Consequently, the plunger starts returning to the neutral position through the force of the spring R. When the plunger moves, the opening of the plunger notch becomes small, and since the piston motor still continues to rotate through the inertial force (the pumping of the motor), the pressure at the port M2 rises. By moving the plunger to the left, the pilot oil flows from the chamber L through the orifice L to reduce the speed of the plunger. This function controls the speed of the plunger, absorbs the shock due to the inertial force of the piston motor and prevents the cavitation to stop motor smoothly.

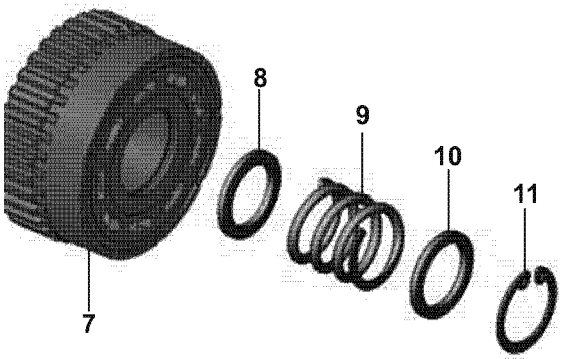
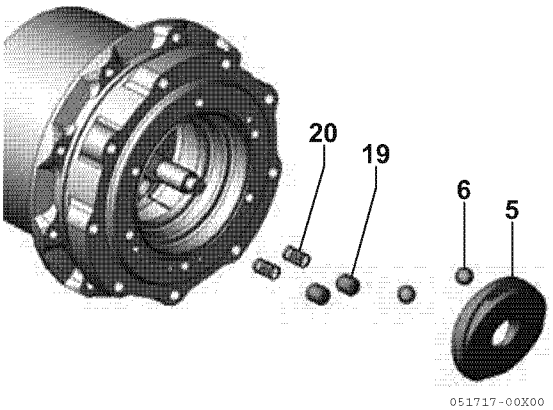
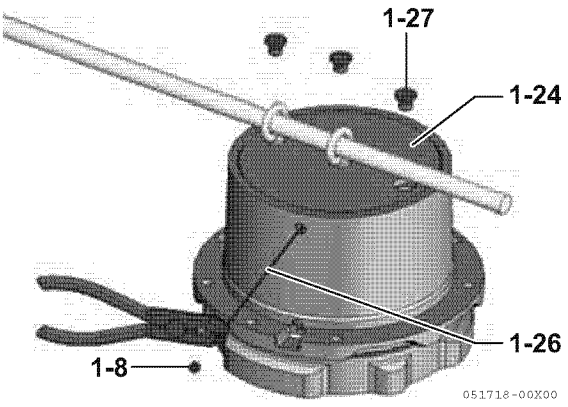
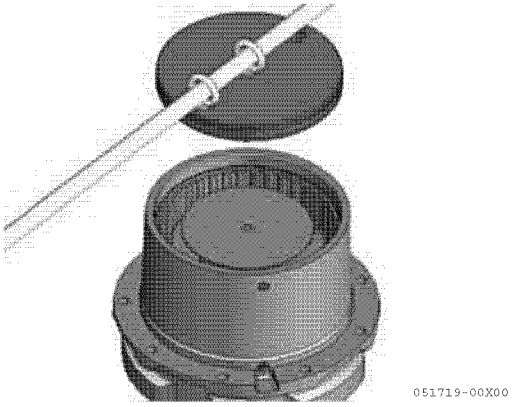


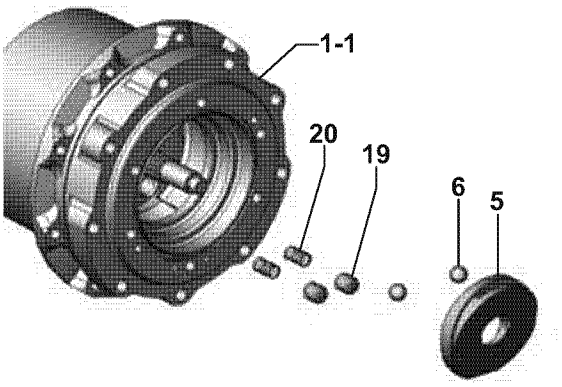
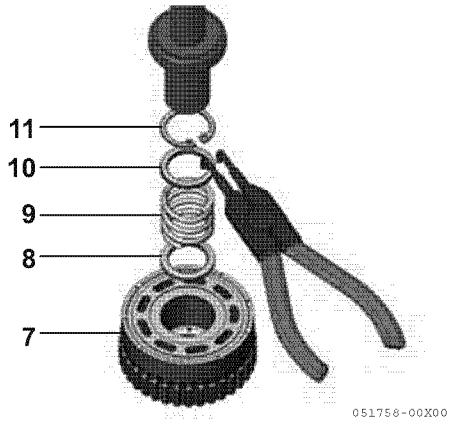
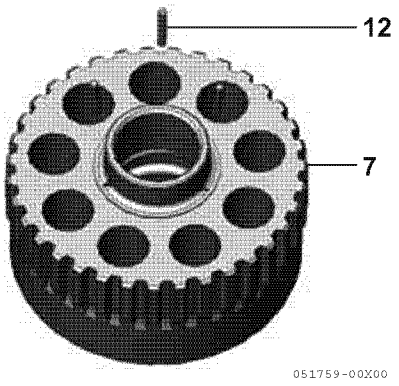
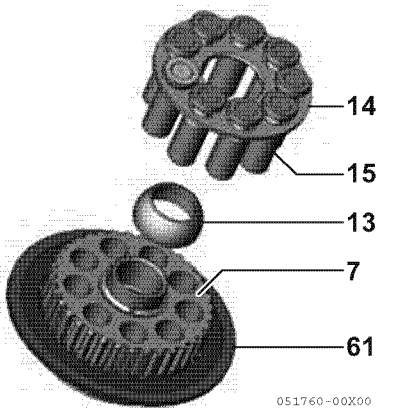
Counter balance valve (Braking operation)

051695-00EN00

3. Exploded View and Parts Comprised



Procedure	
(15) Remove snap ring **11**. Then remove washer **8**, spring **9** and spring seat **10**. **Tool:** • Snap ring pliers 16 ***CAUTION*** *Be careful not to get your fingers caught because the internal spring may suddenly jump out when removing the snap ring.*	
(16) Remove swash plate **5**, steel balls **6**, pistons **19** and springs **20**.	
(17) Remove plugs **1-27** and upper plug **1-8**. Install the eye bolts (PF3/8) into the screw holes for plugs **1-27** and put a round bar [about 39.37 in. (1 m) in length] through the eye bolts. Then turn the cover until wire **1-26** can be seen through the screw hole for plug **1-8** and pull the wire out of the hole using a screwdriver. **Tools:** • Torque wrenches 1, 2 • Hexagon bits 6, 8 for above • Eye bolts S-2 • Round bar S-3 • Screwdriver 12 • Pliers 15	
(18) Put hooks through the eye bolts and remove the cover, or remove it using the round bar. **Tools:** • Eye bolts S-2 • Round bar S-3	

Procedure	
(19) Install steel balls **6**, springs **20**, pistons **19** and swash plate **5** into flange holder **1-1**. Before installation, apply grease to springs **20** and install them to pistons **19**. Also, apply hydraulic oil to the sliding surface of the swash plate and the pistons in advance.	
(20) Install spring seat **8**, spring **9**, washer **10** and snap ring **11** into cylinder block **7**. **Tools:** • Snap ring pliers 16 • Snap ring press fitting jig S-15	
(21) Apply grease to pins **12** and install them into three holes in the cylinder block.	
(22) Install retainer holder **13**, retainer plate **14** and piston ASSYS **15**. Before installation, apply hydraulic oil to nine bores in the cylinder block. Then, install disc **61** to the cylinder block. ***Note:*** *For easier installation, align the spline teeth of cylinder block **7** with those of retainer holder **13** before installation.*	

7. Troubleshooting

1) Motor

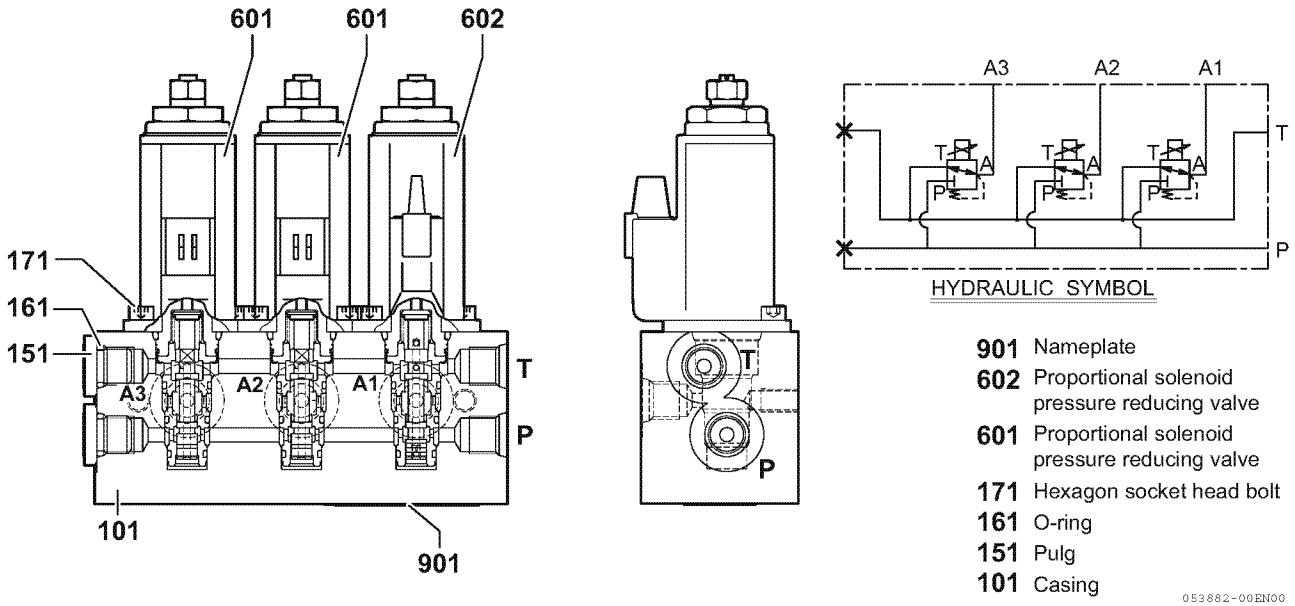
Trouble	Causes	Measures
1. Motor does not rotate.	• Malfunction of equipment other than motor, counter balance valve and reduction gear	Check whether the specified volume of hydraulic oil is fed to the inlet side of motor. Then, check and repair the equipment.
	• Escape of pressure oil due to excessive wear of motor's sliding parts	• Replace any excessively worn parts. • Repair any flaw or burr on the surfaces, clean all the parts and reassemble them.
	• Malfunction due to breakage of main part of motor.	• Disassemble the motor and replace any broken parts. • Clean all the parts and reassemble them, being careful not to allow foreign substances to enter.
2. Motor speed is low.	• Specified volume of oil is not being supplied to motor due to failure of hydraulic pump, system relief valve, or other equipment.	Check whether the specified volume of hydraulic oil is fed to the inlet side of motor. Then, check and repair the equipment.
	• Specified speed is not obtained due to drop of motor displacement.	After disassembling the motor, check them for excessive wear of the sliding parts. Repair or replace any worn parts.
3. Large fluctuation in motor revolutions	• A large volume of high pressure oil leaks and flows out from drain port due to wear of motor sliding portion, causing a large drop and fluctuation in motor revolutions. • Worn bearing.	• Disassemble the motor and replace any worn parts. • Clean all the parts and reassemble them, being careful not to allow foreign substances to enter.
4. Oil leak	• Breakage of oil seals or O-rings	• Replace any broken oil seals or O-rings with new ones. Take care not to damage the oil seal lip. • Apply a small amount of grease to O-rings before installation.

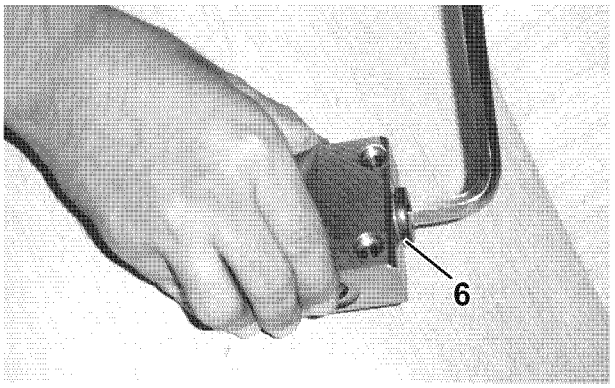
6-8-2 Proportional Solenoid Valve for P.T.O. and Engine Speed Sensing (Air Conditioner spec.)

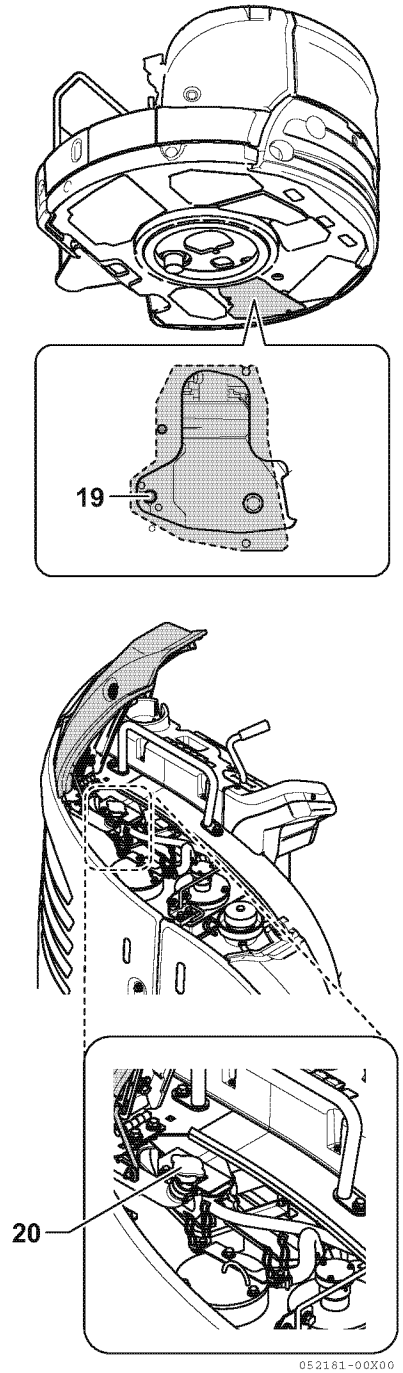
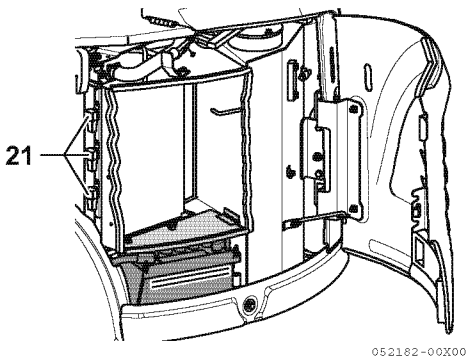
1. Overview

- Three cartridge-type proportional solenoid pressure reducing valves are incorporated in this solenoid valve block, which has pump port P, tank port T and secondary pressure ports A1, A2 and A3.
- The proportional solenoid pressure reducing valve generates secondary pressure proportional to the input current to the solenoid.

2. Main Components

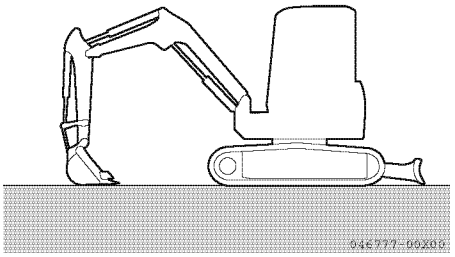


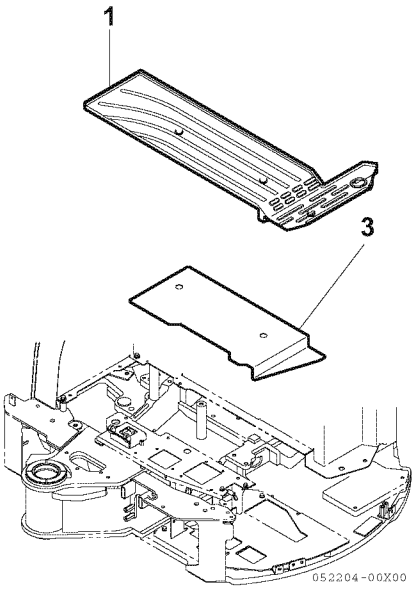
Procedure	
5. Installing hexagon socket head plug Install the hexagon socket head plug **6** into the valve body **1**. **Tool :** • Hexagon socket screw key (8) ***Notes :*** • *No foreign substances adhering* • *Make sure that the spool **3** has been installed.* Tightening torque : 51.0 ft·lbf. (69.0 N·m)	

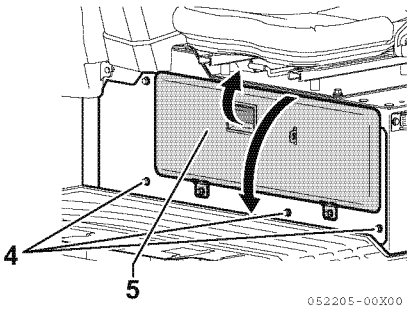
Procedure	
(11) Put a container under the cooling water two-way cock. (12) Remove drain plug **19** of the cooling water two-way cock and drain the cooling water. Quantity: 4.4 Qts. (4.2 L) Remove radiator cap **20** to drain the cooling water smoothly.	
(13) Remove slow blow fuses **21**.	

7-1-2 Removal and Reinstallation of Starter Motor

1) Removal

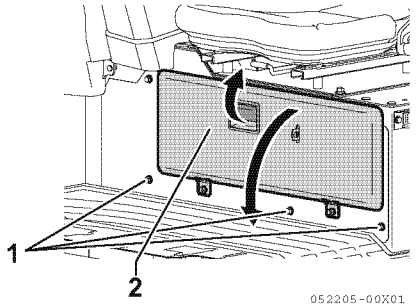
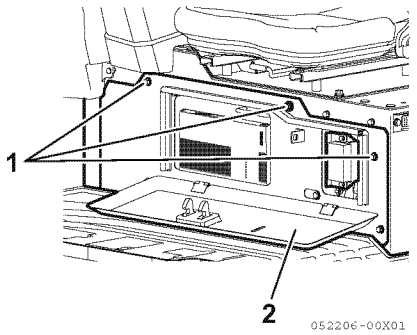
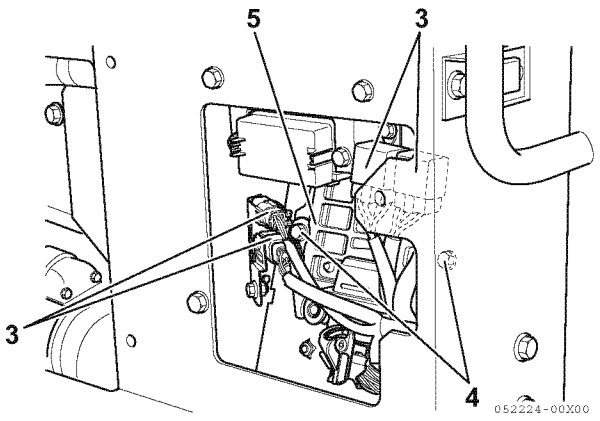
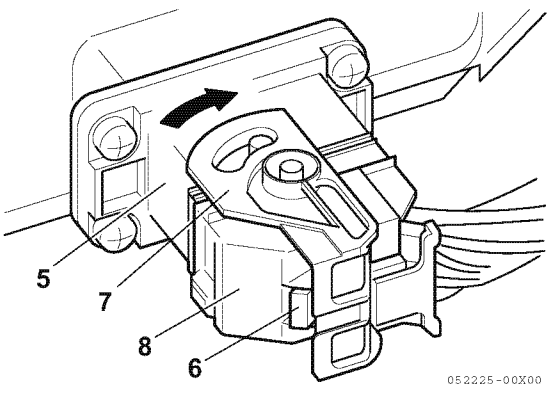
Procedure	
(1) Lower the bucket to the ground and stop the engine.	

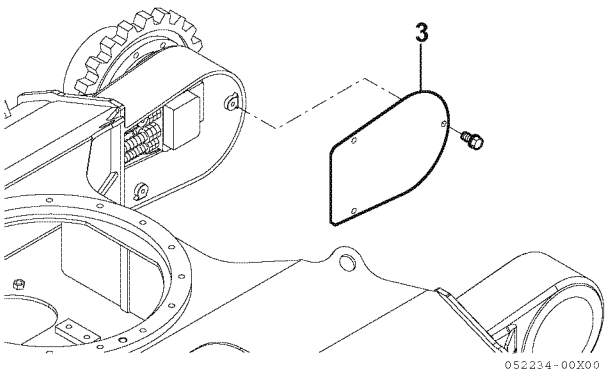
(2) Remove floor mat A **1** and step **3**.	

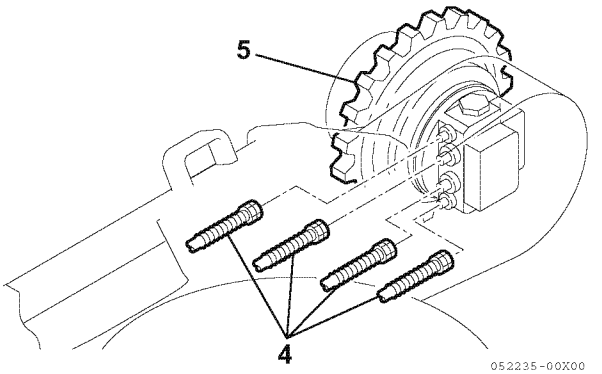
(3) Remove three bolts **4** and open cover **5**.	

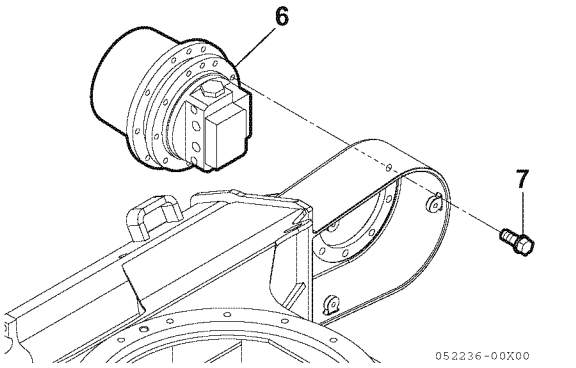
7-1-5 Removal and Reinstallation of Engine ECU

1) Removal

Procedure	
(1) Remove three bolts **1** and open cover **2**.	
(2) Remove three bolts **1** and remove cover **2**.	
(3) Disconnect four connectors **3**. (4) Remove two bolts **4** and remove engine ECU **5**.	
(5) While pressing lock button **6**, turn cover **7** in the direction of the arrow shown in the figure on the right. (6) Disconnect harness connector **8** from engine ECU **5**.	

Procedure	
(4) Remove travel motor cover **3** on the side of the travel motor to be removed.	

(5) Disconnect four hoses **4** from the travel motor to be removed. ***Note:*** *Put a mark on the removed hoses to reinstall them to the correct positions.* (6) Remove sprocket **5**.	

(7) Remove nine mounting bolt (M12) **7** and remove travel motor **6**. Weight of travel motor: 77 lbs. (35 kg)	

2) Reinstallation

Reinstall the travel motor in the reverse order to the removal procedure.

Note :

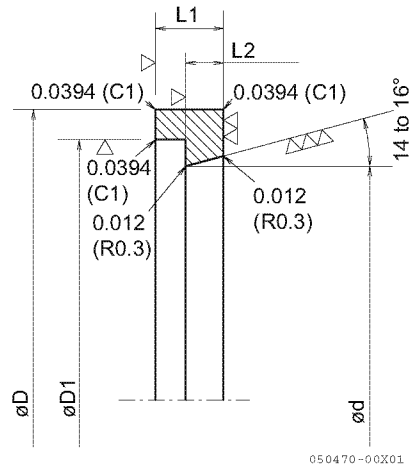
Apply Three Bond 1324 or its equivalent to the mounting bolts for the travel motor and sprocket.

Travel motor mounting bolt (M12)	
Tightening torque	57.9 to 72.3 ft·lbf (78.5 to 98.0 N·m)

7-2-11 Drawings of Jigs

Floating seal insertion jig (Guide Jig)

Material : S45C (Equivalent to SAE 1045)

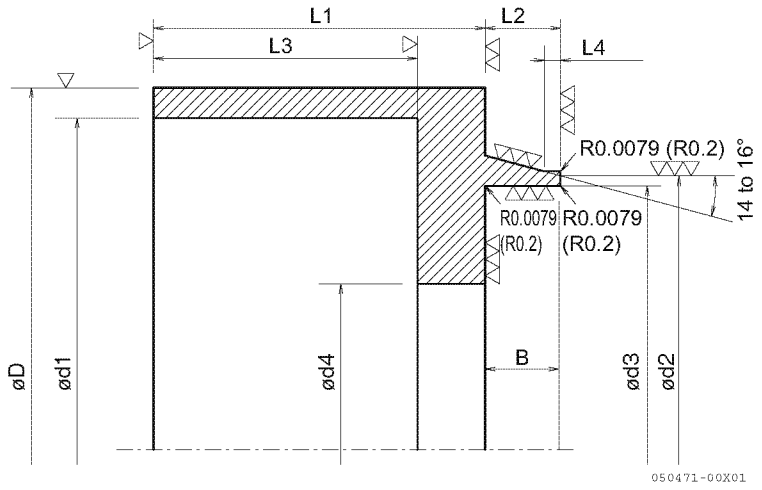


Unit: in. (mm)

Jig	A-016
ϕ D	4.33 (110)
ϕ D1	3.62 (92)
ϕ d	3.29 to 3.3 (83.5 to 83.7)
L1	0.47 (12)
L2	0.26 to 0.29 (6.7 to 7.3)
Used for	Idler

Floating seal insertion jig (Thrusting jig)

Material : S45C (Equivalent to SAE 1045)

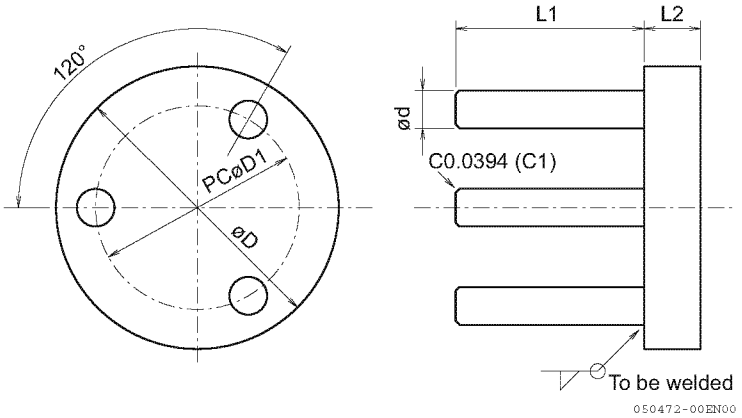


Unit: in. (mm)

Jig	A-018
ϕ D	4.33 (110)
ϕ d1	3.54 (90)
ϕ d2	3.28 to 3.29 (83.3 to 83.5)
ϕ d3	3.185 to 3.193 (80.9 to 81.1)
ϕ d4	1.97 (50)
L1	1.97 (50)
L2	0.3 to 0.31 (7.6 to 8.0)
L3	1.57 (40)
L4	0.024 to 0.032 (0.6 to 0.8)
B	0.378 to 0.386 (9.6 to 9.8)
Used for	Idler

Seal cover holding jig

Material : S25C (Equivalent to SAE 1025)

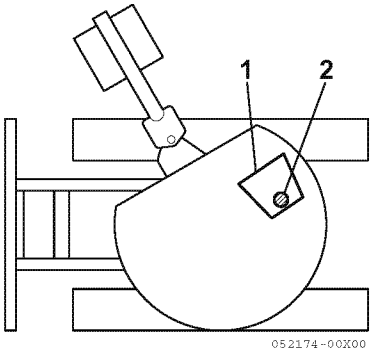


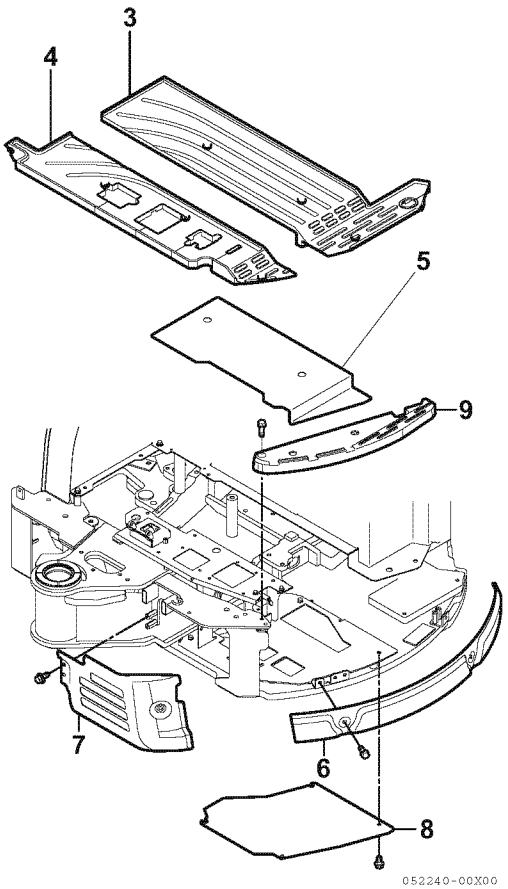
Unit: in. (mm)

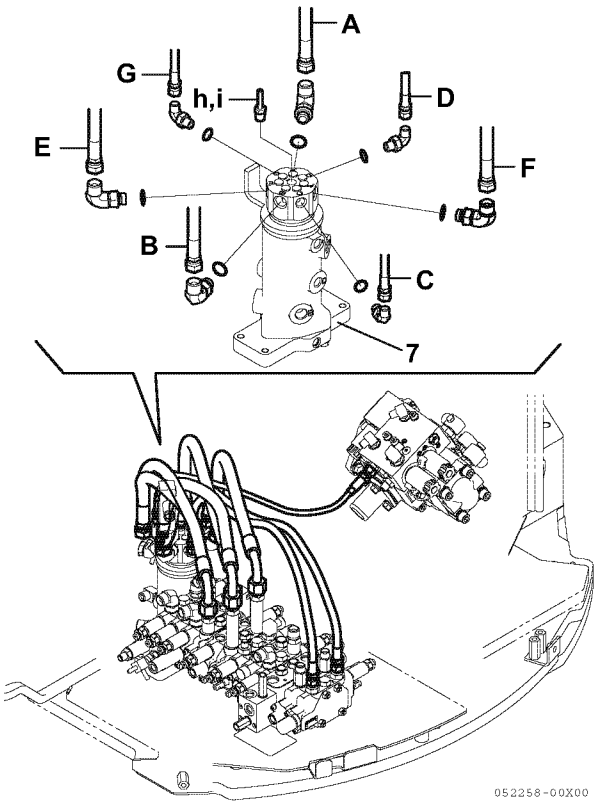
Jig	A-014
ϕ D	3.54 (90)
PC ϕ D1	2.95 (75)
ϕ d	0.47 (12)
L1	2.95 (75)
L2	0.59 (15)
Used for	Idler

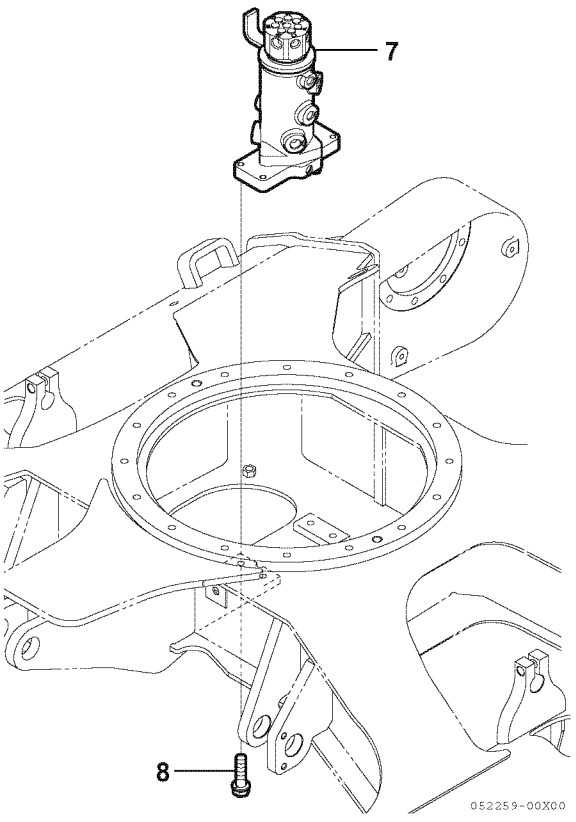
7-5-2 Removal and Reinstallation of Control Valve

1) Removal

Procedure	
(1) Swing the upperstructure so that drain plug **2** of hydraulic oil tank **1** is positioned halfway between the right and left crawlers. Then lower the bucket to the ground and stop the engine. (2) Drain the hydraulic oil from the hydraulic oil tank or evacuate the hydraulic oil tank using the compression vacuum. (Refer to Section "7-5-8 Removal and Reinstallation of Hydraulic Oil Tank" for the procedure for draining the hydraulic oil.)	

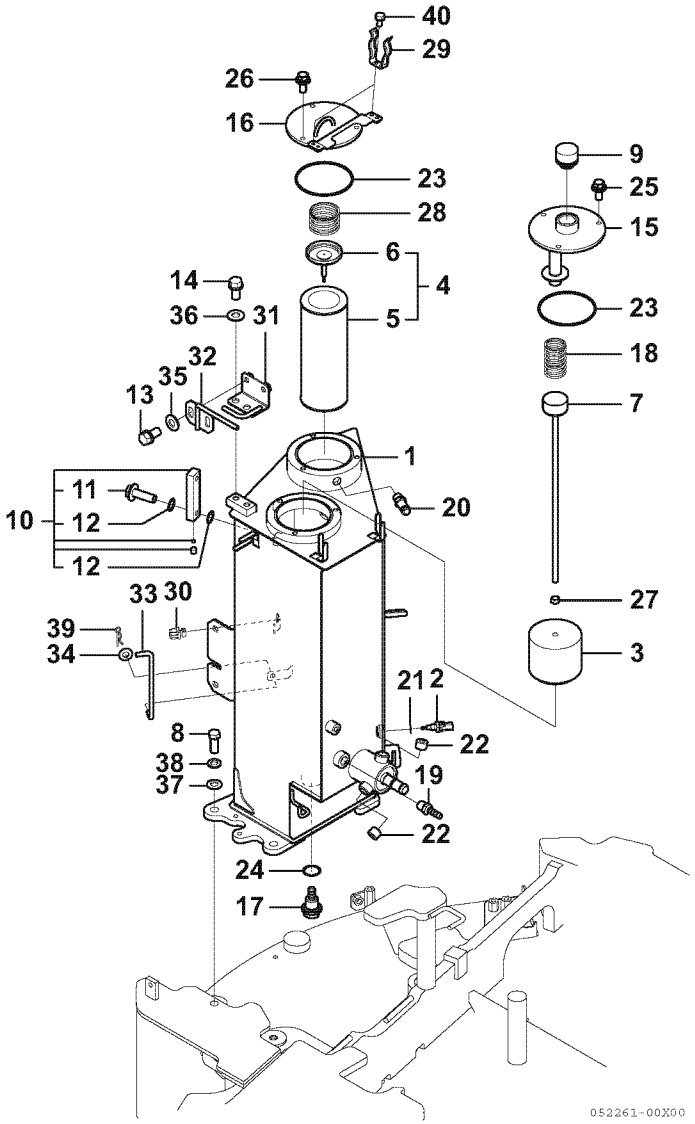
(3) Remove floor mat A **3**, floor mat B **4** and step **5**. (4) Remove frame guard L **6**, T/F cover L **7** and valve stand cover **8**. ***Note:*** *For the canopy type, removing non-slip step **9** makes it easy to remove the control valve.*	

Procedure	
(9) Disconnect the hydraulic hoses on the turning frame side of swivel joint **7**. A: Travel motor (R) B: Travel motor (L) C: Blade D: Blade E: Travel motor (L) F: Travel motor (R) G: High-speed travel pilot (R) h, i: Drain ***Notes:*** *Put a mark on the removed hoses to reinstall them to the correct positions.*	

(10) Remove four installation bolts (M10) **8** and remove swivel joint **7**. Take out the swivel joint from the bottom of the lower frame. ***Note:*** *Put a match mark on the lower frame and the swivel joint to reinstall them in the correct direction.*	

7-5-8 Removal and Reinstallation of Hydraulic Oil Tank

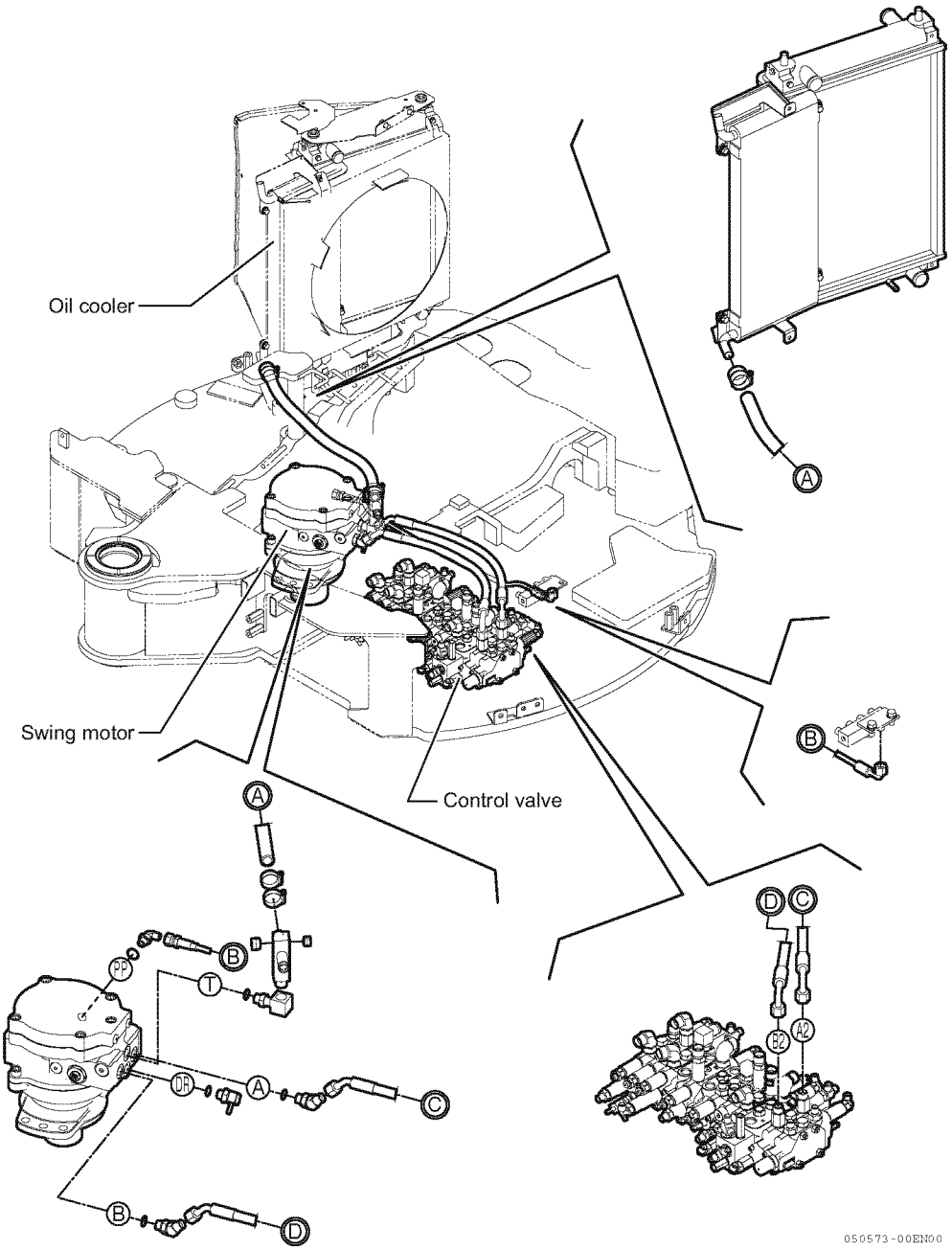
1. Structure



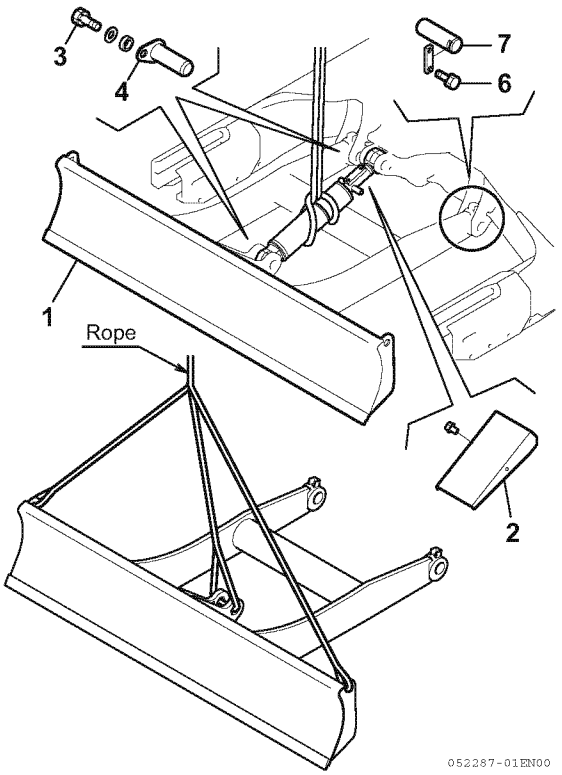
No.	Part	No.	Part	No.	Part
1	Hydraulic oil tank	15	Cover A CMP	29	Support plate (for grease pump)
2	Oil temperature sensor	16	Cover B CMP	30	Rod holder
3	Oil suction filter	17	Magnet plug	31	Key lock CMP (for cover B)
4	Return filter CMP	18	Filter pressure spring	32	Catch CMP (for cover B)
5	Filter element	19	Nipple	33	Hook (for bonnet R)
6	By-pass valve CMP	20	Drain adopter	34	Polished washer
7	Filter support rod CMP	21	Seal washer	35	Polished washer
8	Bolt	22	Screw plug	36	Polished washer
9	Oil filler cap	23	O-ring	37	Polished washer
10	Oil level gauge CPM	24	O-ring	38	Spring washer
11	Bolt	25	Bolt (with plane washer)	39	Snap pin
12	O-ring	26	Bolt (with plane washer)	40	Bolt (with spring washer)
13	Bolt (with spring washer)	27	Nut		
14	Bolt (with spring washer)	28	Clutch spring		

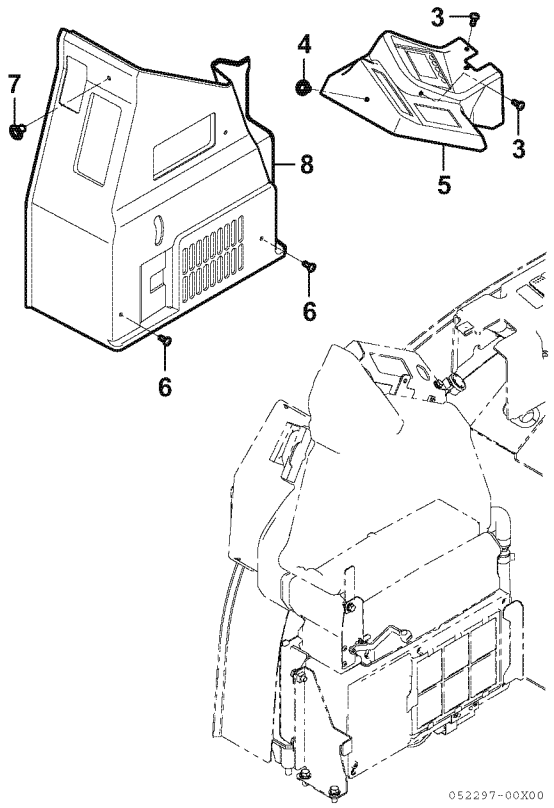
2) Upperstructure

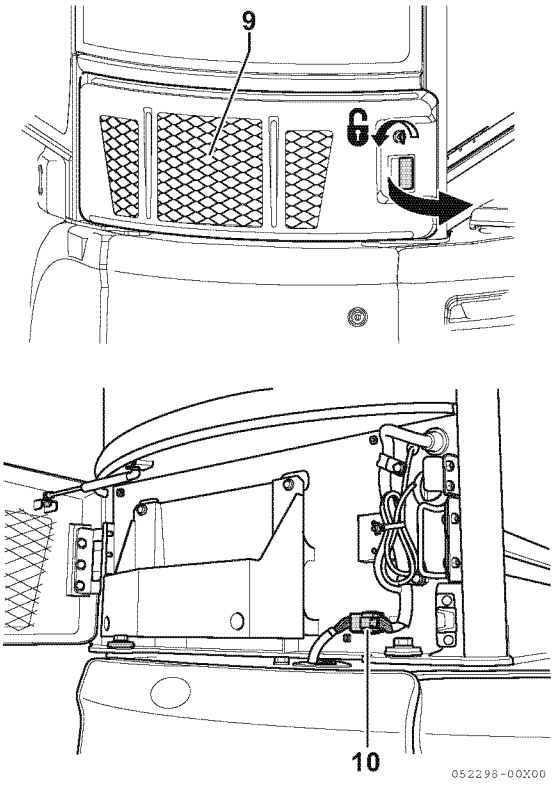
(Control valve – Swing motor)



4) Removal of Blade

Procedure	
(1) Turn the implement to the blade side, lower the bucket and the blade **1** to the ground and stop the engine. (2) Remove the blade cover **2**, and then the hydraulic hose. (3) After putting rope round the blade cylinder **5**, remove the bolt **3** (M10) to pull out the pin 4 and remove the blade cylinder **5**. (4) After putting rope onto the blade **1**, remove the bolt **6** (M10) to pull out the pin **7** and remove the blade. ***Note :*** *Use a lifting device to remove the blade cylinder or the blade.*	

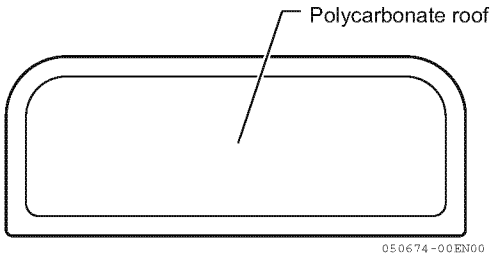
Procedure	
(5) Remove two screws **3** and tree clip **4** and slightly move the monitor cover **5**. (6) Remove two screws **6** and tree clip **7** and remove the A/C cover **5**.	

(7) Open the cabin rear cover **9**. (8) Disconnect connector **10**.	

2) Application of primer to sunroof

Key points for procedure

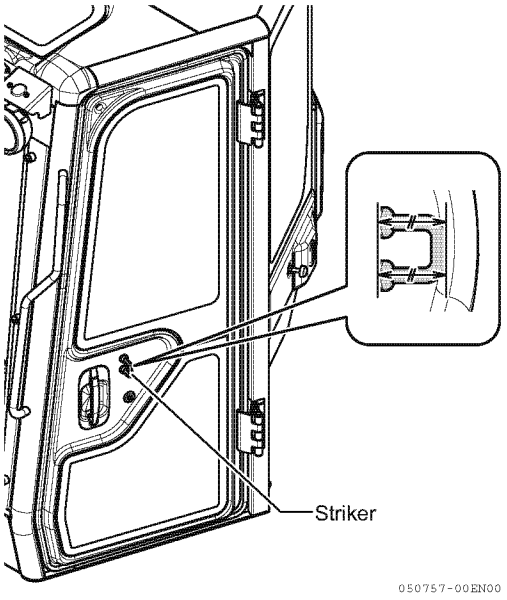
- Identify the surface where the primer is to be applied. (The surface where the primer is to be applied is opposite to the side on which the stamped characters can be read normally.)
- Clean the surface where the primer is to be applied using isopropyl alcohol to remove grease and foreign matter such as dust.
- Use SUNSTAR Glass Primer 435-41.
- Make sure that there are no places where the primer is not applied or it is applied too thinly or thickly in the entire application area and that the primer does not drip off.
- Be careful not to put too much primer on the brush to prevent the primer from flowing to the other side of the sunroof.
- Do not over-apply the primer to the same place excessively. Apply the primer to the entire application area in a continuous manner to avoid melting of the silk-screen print by the primer solvent.



7) Adjusting the U-bolt

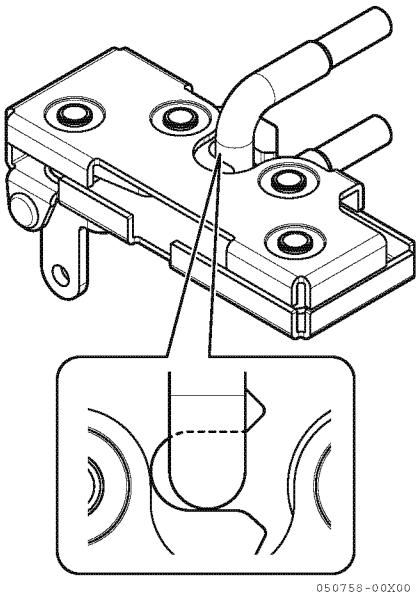
Adjustment procedure

(1) Make sure that the U-bolt is in its lowest position (with the nuts tightened). (The U-bolt's lowest position means a position where all threads of the U-bolt are not exposed. Also, make sure that the seal washer is installed.)
(2) Operate the hold-open lock and temporarily tighten the U-bolt at a position where it is locked smoothly. (See the figure on the right.) The U-bolt moves to the specified lock position following the lock of the cabin body.
(3) Tighten the U-bolt until it is secured in a vertical position while being careful not to tilt the U-bolt and checking the position of lock claw. When doing this, make sure that the claw is hooked roughly on the center of the U-bolt. Also, adjust the U-bolt position so that it is in the center of the U-bolt insertion hole (elongated hole) in the cabin body.
(4) Use a torque wrench to tighten the U-bolt to the specified torque.
Tightening torque: 36.9 ft•lbf (50 N•m)
(5) Operate the hold-open lock and make sure that the U-bolt is released from the lock.
(6) If the Un-bolt is not locked or unlocked smoothly, make fine adjustments.



Key points for procedure

- Be careful not to tilt the U-bolt during final tightening.
- During final tightening of the U-bolt, make sure that the seal washers are in place to prevent water from entering the door.
- After making fine adjustments to the U-bolt, be sure to retighten it to the specified torque.



9. Adjustment of front door

1) Installation of front door (1)

Key points for procedure

- Be sure to prevent damage due to contact of the door with the cabin body when installing the door.
- After installation of the front door, always make sure that the door is locked before proceeding to the next step.

Installation procedure

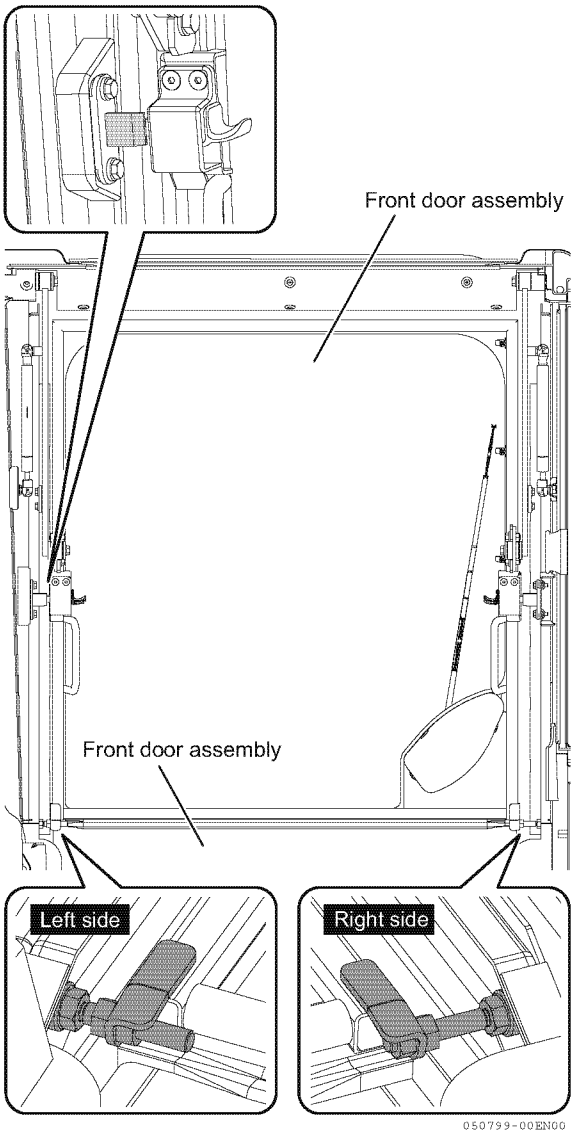
(1) Install the lower glass being careful of the installation direction. (The side on which the stamped characters can be read normally must be on the outside.)

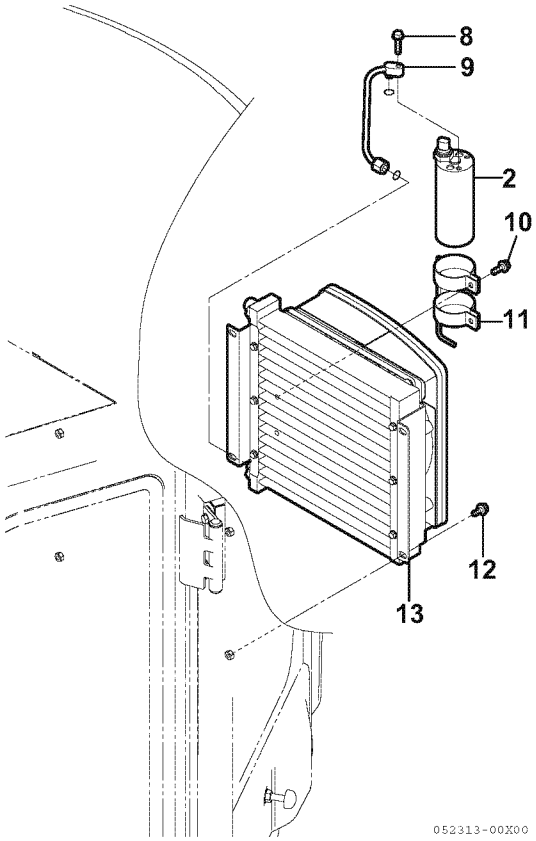
(2) Apply grease to the lock striker. (See the enlarged view shown above the figure on the right.)

(3) Install the rollers on the front door and carry the front door into the cabin after checking the following items.
- Grease has been applied to the rollers and roller shafts.
- The left roller pin has been fully screwed into the bolt hole. (See the left-hand enlarged view shown below the figure on the right.)
- The right roller pin is in the maximum protruding position. (See the right-hand enlarged view shown below the figure on the right.)

(4) Put the front door on the lower glass, being careful to avoid contact with the cabin. When installing the front door, fit the rollers into their rails while tilting the front door.

(5) Be sure to lock the front door to prevent it from falling down. (See the enlarged view shown above the figure on the right.)



Procedure	
(6) Remove bolt **8** and remove pipe (COND-R/D) **9**. (7) Remove bolts **10** and remove R/D brackets **11**. (8) Remove bolts **12** and remove A/C condenser assembly **13**.	

Item			Specifications
Control unit	A/C switch		Push type (ON / OFF)
	Temperature control switch		Dial type (40 level control)
	Airflow control switch	Fan switch (manual)	Dial type (3 level control)
Refrigerant high pressure piping	Auxiliary device	Dual pressure switch	OFF: 28.4 PSI (0.196 MPa) [G] or lower OFF: 455.4 PSI (3.14 MPa) [G] or higher
Refrigerant		Type	HFC-134a
		Quantity	1.54 ± 0.11 lbs (700 ± 50 g)