

YANMAR

SERVICE MANUAL

EXCAVATOR

SV22

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1. GENERAL CAUTIONS FOR MAINTENANCE WORK

1-9 Specifications of Hydraulic Hose

Specifications of the hydraulic hoses can be known by the part descriptions as explained below. (For the parts number, please refer to our Parts Catalog.)

Description <u>Hose</u>	<u>P</u>	<u>2</u>	<u>06</u>	<u>AB</u>	<u>075</u>	<u>W</u>	<u> </u>	<u> </u>
	1	2	3	4	5	6	7	8


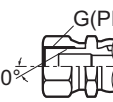

1 Part name

2 Hose material
 • Rubber hose G
 • Wear-resistant high pressure rubber hose H
 • Plastic hose P
 • Wear-resistant plastic hose F

3 Recommended working pressure
 psi(Mpa)
 Over 2986 (20.6) 1
 2489 to 2986 (17.2 to 20.6) 2
 1991 to 2489 (13.7 to 17.2) 3
 1564 to 1991 (10.8 to 13.7) 4
 995 to 1564 (6.9 to 10.8) 5
 427 to 995 (2.9 to 6.9) 6
 213 to 427 (1.5 to 2.9) 7
 Below 213 (1.5) 8

4 Nominal dia. (inch)
 1 / 8" 02
 3 / 16" 03
 1 / 4" 04
 3 / 8" 06
 1 / 2" 08
 5 / 8" 10
 3 / 4" 12
 1" 16

5 Combination of fitting

Fitting type	Code
 R(P/T) Taper pipe thread R (PT)	A
 G(PF) Straight pipe thread G (PF) with male 30 degrees seat	B
 90° G(PF) 30° 90 degrees bent type. Straight pipe thread G (PF) with male 30 degrees seat	C
Without fitting	Y

*For the combination of fitting, refer to the list on the following page.

6 Total length (Unit : cm)

7 Hose protector
 • Coil spring W
 • Coil tube S
 • Wire braid B
 • Tube (Rubber) R
 • Tube (Vinyl) V
 • Sponge rubber P
 • Hose cover K
 • No protection Blank

8 Other accessories
 • No accessories...Blank
 • O-ring 1

The example hose, P 2 06 AB 075 W stands for :

2 3 4 5 6 7

- 2 Material : Plastic
- 3 Working pressure : 2489 to 2986 psi (17.2 to 20.6 MPa)
- 4 Nominal dia. : 3 / 8"
- 5 Fitting type : Taper pipe thread R (PT) and straight pipe thread G (PF) with male 30 degrees seat.
- 6 Length : 29.5 in. (75 cm)
- 7 Hose protector : Coil spring

List of pipe threads

Symbol	Name
G (PF)	Straight pipe thread
R (PT)	Male taper pipe thread
Rc (PT)	Female taper pipe thread

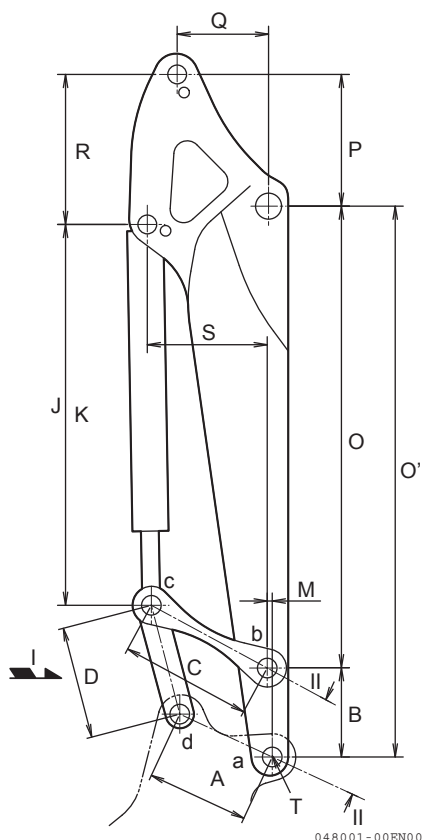
2. TECHNICAL DATA

Item	Unit	SV22			
Hydraulic equipment					
Cylinder					
Boom	Stroke		mm	475	
	Inside diameter		mm	70	
	Piston rod diameter		mm	40	
	Speed	Up (Ground - Max. height)		sec.	3,3
		Down (Max. height - Ground)		sec.	3,4
Arm	Stroke		mm	493	
	Inside diameter		mm	65	
	Piston rod diameter		mm	35	
	Speed	Full stroke for digging		sec.	2,4
		Full stroke for dumping		sec.	1,8
Bucket	Stroke		mm	431	
	Inside diameter		mm	55	
	Piston rod diameter		mm	35	
	Speed	Full stroke for digging		sec.	2,4
		Full stroke for dumping		sec.	1,9
Blade	Stroke		mm	168	
	Inside diameter		mm	70	
	Piston rod diameter		mm	40	
	Speed	Up (Ground - Max. height)		sec.	1,1
		Down (Max. height - Ground)		sec.	0,9
Boom swing	Stroke		mm	433	
	Inside diameter		mm	65	
	Piston rod diameter		mm	35	
	Speed	Full stroke to the right		sec.	4
		Full stroke to the left		sec.	3
Swivel joint					
Swivel joint port diameter × Number		inch × pcs.	top: 4xG1/4; 4xG3/8 bottom: 6xG1/4;4xG3/8		

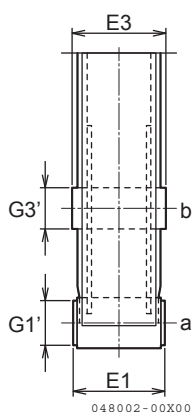
2. TECHNICAL DATA

2-5 Specifications for Attachment

Unit: (mm)

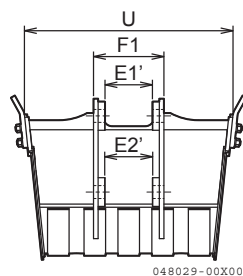


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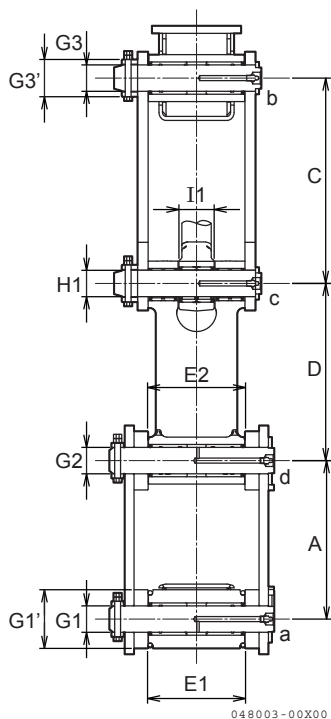


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View in the direction of an arrow I of the arm



048029-00X00


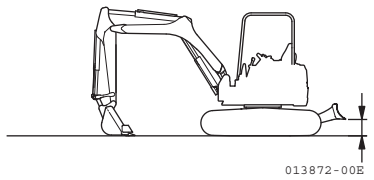
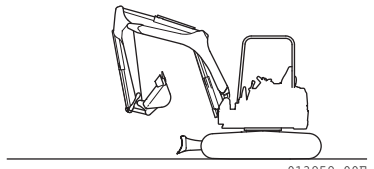
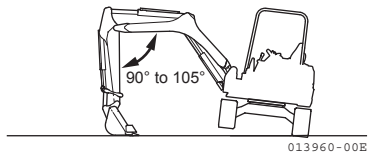


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Cross-sectional view along the line II-II (a-d-c-b)

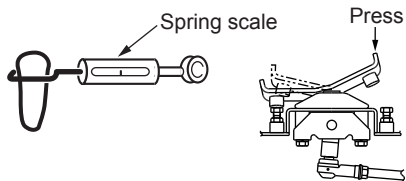
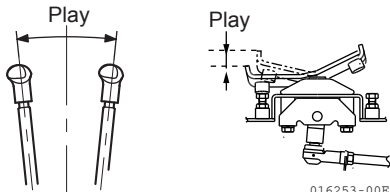
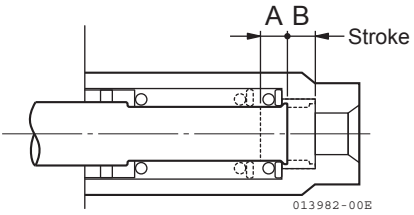
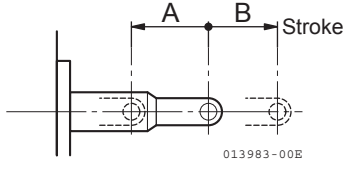
Item/Model		SV22
Dimensions		
A		180
B		175
C		245
D		255
E 1	External width of arm end boss	122
E 1'	Internal width of bucket pin boss	123
E 2	External width of bucket link boss	122
E 2'	Internal width of bucket pin boss	123
E 3	External width of bucket arm pivot pin boss	122
F 1	External width of bucket arm	154
G 1	Bucket pin diameter	35
G 1'	Arm end boss diameter	75
G 2	Bucket pin diameter	35
G 3	Bucket arm pivot pin diameter	35
G 3'	Bucket arm pivot pin boss diameter	48,6
H 1	Bucket cylinder rod end pin diameter	35
I 1	Bucket cylinder rod end boss thickness	40
H 2	Bucket cylinder bottom pin diameter	35
I 2	Bucket cylinder bottom boss thickness	40
J	Cylinder length when it is fully retracted	666
K	Cylinder length when it is fully extended	1097
M		14,5
O		1025
O'		1200
P		247
Q		147
R		408
S		218,5
T		-
Oil pressure specifications		
Hydraulic pump discharge volume P (L/min)		50
Total oil flow for P.T.O. (L/min)		41
Set pressure of system relief valve (MPa)		21
Set pressure of bucket circuit relief valve (MPa)		24

3. SERVICE STANDARDS

Applicable model			SV22		
Item	Measuring condition	Unit	Standard	Allowable	
Machine performance					
Working speed					
Blade speed Max. cylinder retraction  Blade grounded	Machine position  • Engine: Rated speed • Hydraulic oil temp.: 50 to 60°C • Site: Firm, flat ground	Up	sec.	1,3	1,4
		Down		1,3	1,4
Travel speed	Machine position  • Engine: Rated speed • Hydraulic oil temp.: 50 to 60°C • Traveling time for 20 m after an approach run of 5 m or more.	High speed	sec.	4	3,6
		Low speed		2,1	1,9
Track speed	Machine position  • Engine: Rated speed • Hydraulic oil temp.: 50 to 60°C • Site: Firm, flat ground • Travel lever: Full throttle (Floating crawler side) • Float one side of the crawler. Make a mark on the crawler. After turning the floating crawler side more than once, measure the time needed for 3 turns of the crawler.	High speed	sec.	10	11
		Low speed		20	22

3. SERVICE STANDARDS

3-4 Controls

Applicable model		SV22		
Item	Measuring conditions	Unit	Standard	Allowable limit
Controls				
Operating force				
Right control lever (Boom & Bucket)	<ul style="list-style-type: none"> • Engine : stopped • Hydraulic oil temp. : 50 to 60 °C • Lever operating force : Measure the force by hanging the spring scale on the lever grip. • Pedal operating force : Measure the force by applying load as shown below. <div style="text-align: center;">  <p style="margin: 0;">Spring scale Press</p> </div> <p style="text-align: center; margin-top: 10px;">high < low engine speed 50 low < high engine speed 60</p>	N	10	15
Left control lever (Arm & Swing)			10	15
Accelerator lever			68	58
Blade lever			25	35
Travel levers			14	18
Play of control lever & pedal				
Right control lever (Front & rear / left & right)	<ul style="list-style-type: none"> • Engine : stopped • Hydraulic oil temp. : 50 to 60 °C • Play of each control lever and pedal : Measure the total play (front, rear, left and right) at the lever grip end or the pedal end. <div style="text-align: center;">  <p style="margin: 0;">Play Play</p> <p style="margin: 0; font-size: small;">016253-00E</p> </div>	mm	180 / 140	190 / 150
Left control lever (Front & rear / left & right)			52	72
Blade lever			160	170
Travel levers			175	185
Accelerator lever				
Control valve				
Spool stroke				
Boom	 <p style="text-align: center; font-size: small;">013982-00E</p>	mm	6	6
Bucket				
Arm				
Swing				
Parallel-flow divider				
Inlet				
Right travel	 <p style="text-align: center; font-size: small;">013983-00E</p>			
Left travel				
Blade				
Boom swing				
Offset				

3. SERVICE STANDARDS

3-7-4 Hydraulic Fitting

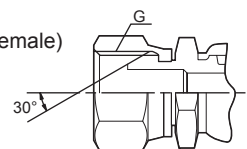
(1) Tightening torque of parallel pipe thread

For 30° sheet type joint and the O-ring sheet type joint.

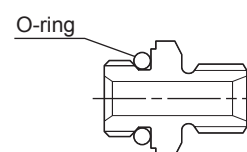
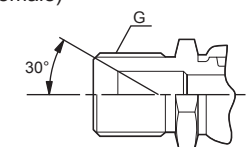
Unit : N•m

Nominal designation of screw thread G (PF)	Tightening torque
	Material : Steel, Cast iron
1/8	13,7 to 16,7
1/4	22,6 to 27,5
3/8	44,1 to 53,9
1/2	53,0 to 64,7
3/4	106 to 129
1	124 to 151
1 1/4	150 to 183
1 1/2	186 to 226

Example
Parallel pipe thread (female)
(male 30° sheet)



Parallel pipe thread (female)



017498-00E

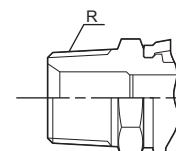
(2) Tightening torque of taper pipe thread

Apply seal tape

Unit : N•m

Nominal designation of screw thread G (PF)	Tightening torque
	Material : Steel, Cast iron
1/8	6,9 to 8,8
1/4	9,8 to 14,7
3/8	29,4 to 39,2
1/2	39,2 to 49,0
3/4	49,0 to 63,7
1	68,6 to 88,3
1 1/4	98,1 to 118

Example
Parallel pipe thread (female)



017501-00E

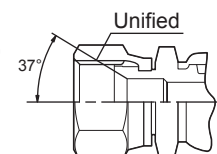
(3) Tightening torque of unified screw thread

For 30° sheet type joint and the O-ring sheet type joint.

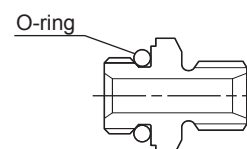
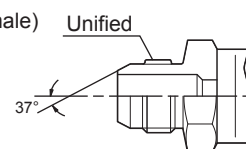
Unit : N•m

Nominal designation of screw thread G (PF)	Tightening torque
	Material : Steel, Cast iron
7/16-20UNF	17,7 to 21,6
9/16-18UNF	35,3 to 43,1
3/4-16UNF	44,1 to 53,9
7/8-14UNF	53 to 64,7
1 1-16-12UN	106 to 129
1 5/16-12UN	124 to 151
1 5/8-12UN	150 to 183

Example
Unified screw thread (female)
(male 37° sheet)



Example
Unified screw thread (female)
(male 37° sheet)



017502-00E

4. ENGINE

WARNING

EXHAUST HAZARD!



- NEVER operate the engine in an enclosed area such as a garage, tunnel, underground room, manhole or ship's hold without proper ventilation.
- NEVER block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death.
- Make sure that all connections are tightened to specifications after repair is made to the exhaust system.
- Failure to comply could result in death or serious injury.

WARNING

ALCOHOL AND DRUG HAZARD!



- NEVER operate the engine while you are under the influence of alcohol or drugs.
- NEVER operate the engine when you are feeling ill.
- Failure to comply could result in death or serious injury.

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.

WARNING

BURN HAZARD!

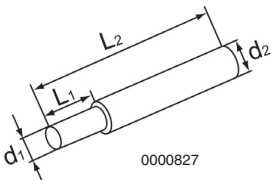
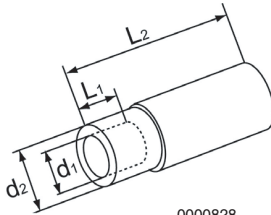
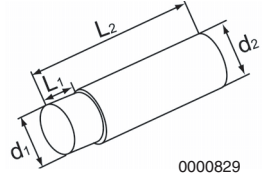
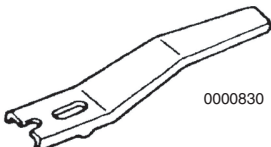
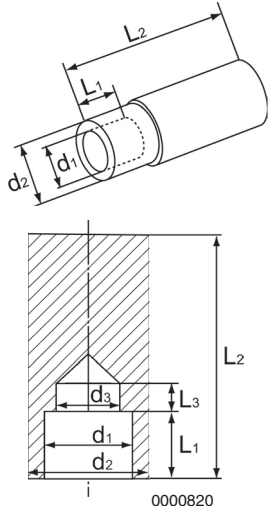


- If you must drain the engine oil while it is still hot, stay clear of the hot engine oil to avoid being burned.
- ALWAYS wear eye protection.
- Wait until the engine cools before you drain the engine coolant. Hot engine coolant may splash and burn you.
- Keep your hands and other body parts away from hot engine surfaces such as the muffler, exhaust pipe, turbocharger (if equipped) and engine block during operation and shortly after you shut the engine down. These surfaces are extremely hot while the engine is operating and could seriously burn you.
- Failure to comply could result in death or serious injury.

4. ENGINE

4-2-2 Special Service Tools

Note: Tools not having Yanmar part numbers must be acquired locally.

No	Tool Name	Applicable Model and Tool Size				Illustration		
1	Valve Guide Tool (For Removing Valve Guides)	L1	L2	d1	d2	 0000827		
		20 mm	75 mm	5,5 mm	9,5 mm			
		Locally Manufactured						
2	Valve Guide Tool (For Installing Valve Guides)	L1	L2	d1	d2	 0000828		
		10 mm	60 mm	11 mm	17 mm			
		Locally Manufactured		Allowance L1: 0 to -0.3 mm				
3	Wrist Pin Bushing Tool (For Removing / Installing of Wrist Pin Bushings)	L1	L2	d1	d2	 0000829		
		25 mm	85 mm	22 mm	25 mm			
		Locally Manufactured		Allowance d1: 0.3 to -0.6mm	Allowance d2: -0.3 to -0.6mm			
4	Valve Spring Compressor (For Removing / Installing Valve Springs)	Yanmar Part No. 129100-92630				 0000830		
5	Stem Seal Tool (for Installing Stem Seals)	d1	d2	d3	L1	L2	L3	 0000820
		15 mm	21 mm	12 mm	11 mm	65 mm	4 mm or more	
		Allowance: d1: ±0.2 mm L1: ±0.1 mm Locally Manufactured						

4. ENGINE

Inspection of Rocker Arm Assembly

Rocker Arm Shaft Hole Diameter

Use a telescoping gauge and micrometer to measure the inside diameter of all the rocker arm support brackets and the rocker arms (Figure 4-2-12). Record the measurements. See "3-2 Engine Service Standard" section for the service limit.

Inspect contact areas (Figure 4-2-12, (1)) for excessive wear or damage.

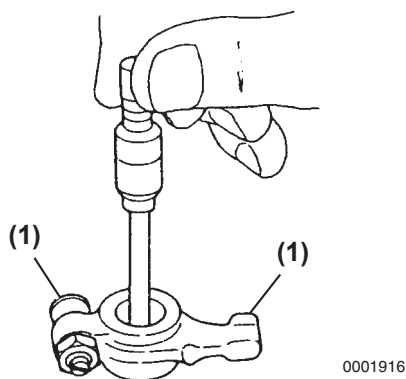


Figure 4-2-12

Rocker Arm Shaft Outside Diameter

Use a micrometer to measure rocker arm shaft diameter. Measure at each rocker arm location in two directions 90° apart (Figure 4-2-13). Record the measurements. See "3-2 Engine Service Standard" section for the service limit.

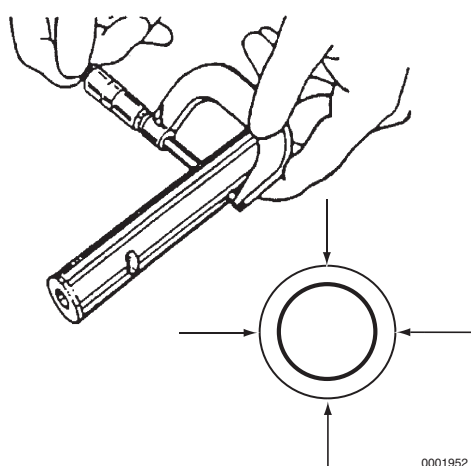


Figure 4-2-13

Inspection of Valve Guides

Visually inspect the valve guides for distortions, scoring or other damage.

Note: Measure valve guides while they are installed in cylinder head.

Use a telescoping gauge and micrometer to measure the inside diameter of the valve guide. Measure in three places and 90° apart (Figure 4-2-14). Record the measurements. See "3-2 Engine Service Standard" section for the service limit. Replace valve guides if not within specification.

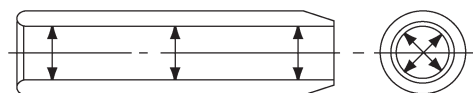


Figure 4-2-14

Inspection of Cylinder Head

Cylinder Head Distortion

Put the cylinder head flat and inverted (combustion side up) on the bench. Use a straightedge and feeler gauge to measure cylinder head distortion (Figure 4-2-15). Measure diagonally and along each side. Record the measurements. See "3-2 Engine Service Standard" section for the service limit.

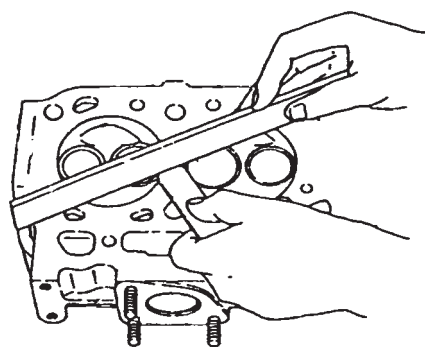


Figure 4-2-15

If distortion exceeds the service limit, resurface or replace the cylinder head. Remove only enough material to make the cylinder head flat, but do not remove more than 0.008 in. (0.20 mm).

4. ENGINE

4-2-6 Crankshaft and Camshaft Components

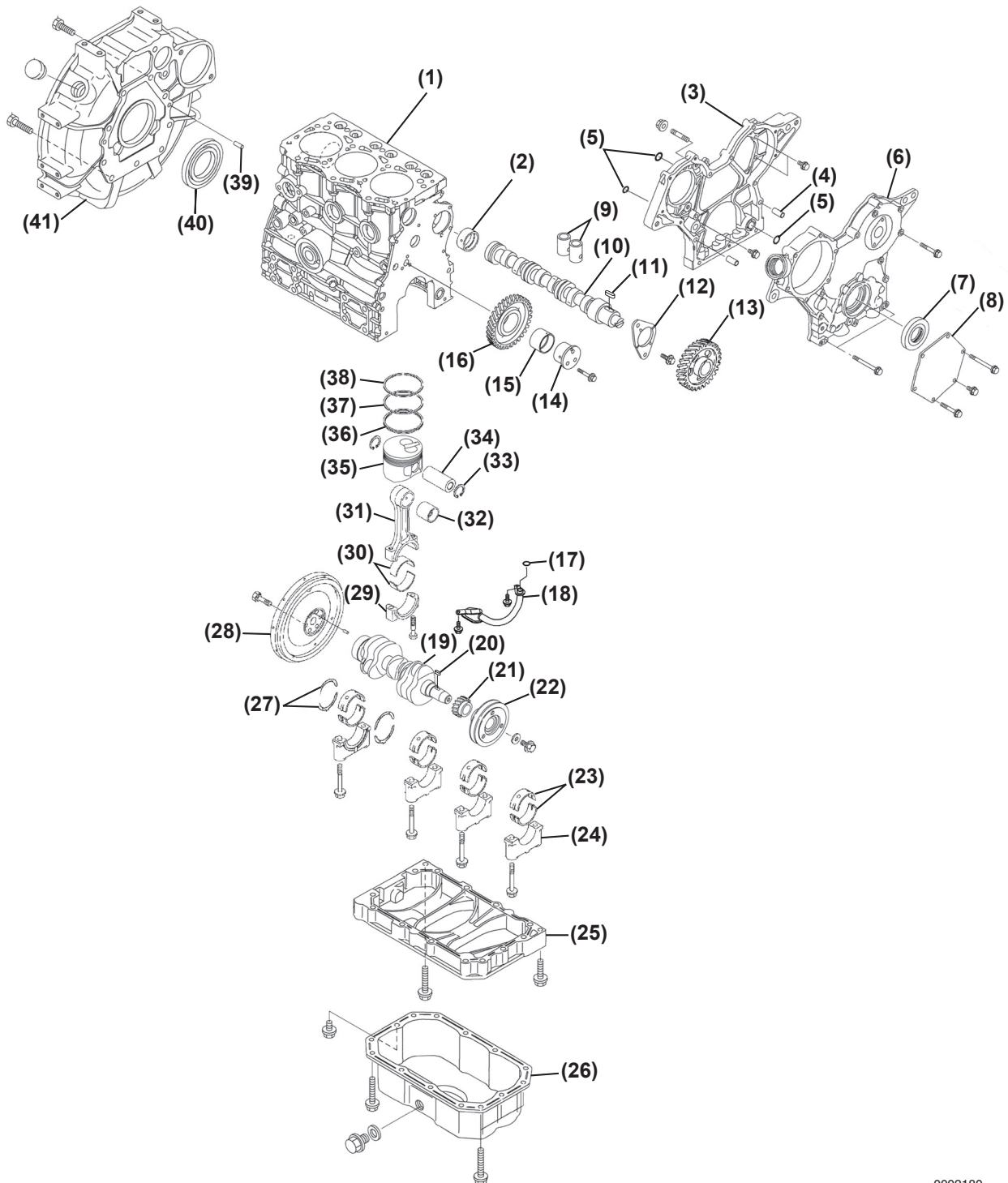


Figure 4-2-38

0002180

4. ENGINE

11. Remove the crankshaft from the engine.
12. Remove the bearing inserts (Figure 4-2-59, (1)) and thrust bearings (Figure 4-2-59, (2)).

Note: Do not remove the crankshaft gear unless the gear or crankshaft are damaged and require replacement.

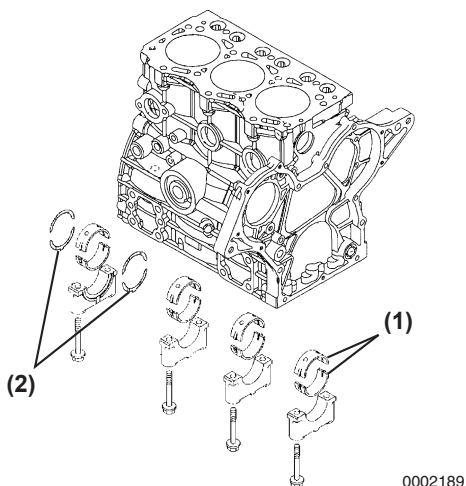


Figure 4-2-59

13. If necessary, remove the crankshaft gear (Figure 4-2-60, (1)) and key (Figure 4-2-60, (2)). If using a gear puller, be careful not to damage the threads in the end of the crankshaft.

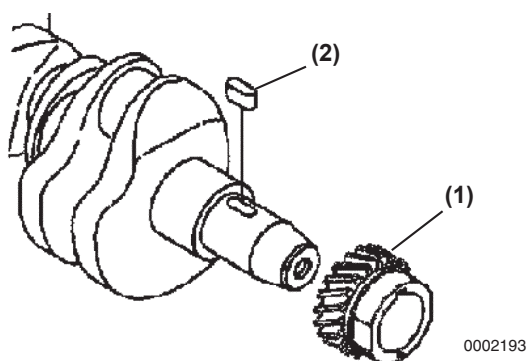
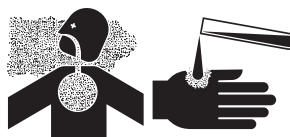


Figure 4-2-60

Inspection of Crankshaft and Camshaft Components

⚠ 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.

Thoroughly clean all components using a brush and appropriate solvent. Each part must be free of carbon, gasket material, metal filings and other debris.

Note: Record all measurements taken during inspection.

Replacement of Crankshaft Oil Seals

1. Remove the seal (Figure 4-2-61, (2)) from the gear case cover (Figure 4-2-61, (1)).
2. Apply a continuous bead of ThreeBond Liquid Gasket No. 1212, Yanmar Part No.977770-01212 to the outside diameter of a new oil seal (Figure 4-2-61, (2)).
3. Install a new seal in the gear case cover with the lip facing in away from the crankshaft pulley. Apply lithium grease to the lip of the seal.

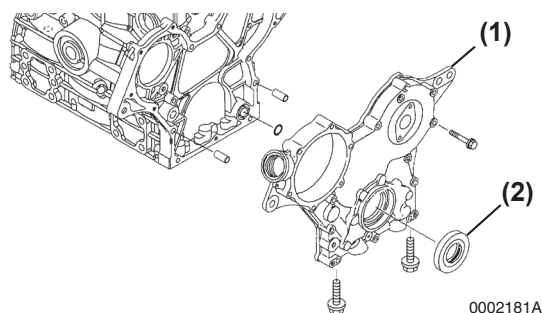


Figure 4-2-61

4. ENGINE

5. Lubricate and install the wrist pin (Figure 4-2-86, (6)) through the piston and connecting rod.
6. Reinstall the second circlip (Figure 4-2-86, (5)) and ensure it is securely seated in the groove.

Note: If installing new piston rings the end gap must be checked and adjusted as necessary. See *Inspection of Pistons, Piston Rings and Wrist Pin* on page 4-2-34. Use a piston ring end gap filing tool to adjust the piston ring end gap on new piston rings.

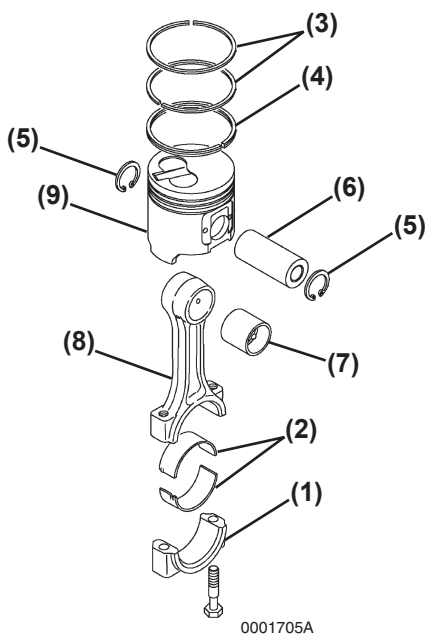


Figure 4-2-86

Note: Reinstall the top and second piston rings with the stamped “makers mark” (Figure 4-2-87, (1)) facing the top of the piston. The “makers mark” may vary in appearance but will always be located on the top surface of the piston ring adjacent to the piston ring gap. The oil ring and oil ring expander can be installed either side up.

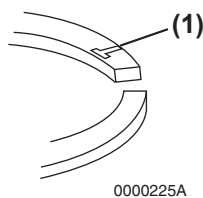


Figure 4-2-87

IMPORTANT

Always use a piston ring expander when installing piston rings. Never attempt to install piston rings by hand.

7. Reinstall the oil ring expander (Figure 4-2-88, (4)). Install the oil ring (Figure 4-2-88, (3)) with the end gap at 180° from the expander end gap.
8. Reinstall the second compression ring (Figure 4-2-88, (2)). This ring is identified by its dark color and tapered face profile.
9. Reinstall the top compression ring (Figure 4-2-88, (1)). This ring is identified by its silver color and barrel-shaped face profile.

IMPORTANT

The oil ring expander (Figure 4-2-88, (4)) end gap must be located 180° from the oil ring (Figure 4-2-88, (3)) end gap.

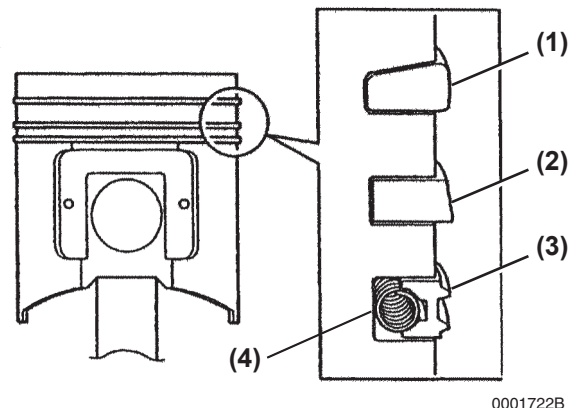
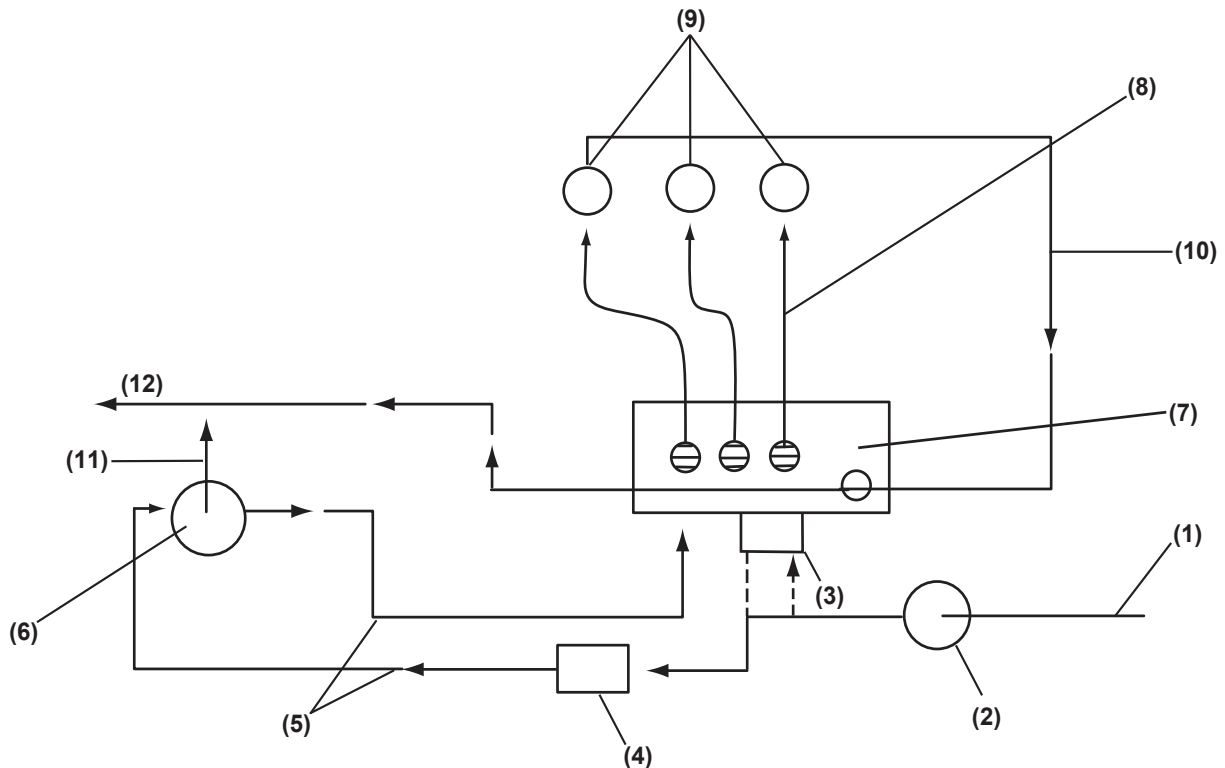


Figure 4-2-88

10. Stagger the piston ring end gaps at 120° intervals (Figure 4-2-89, (1, 2, and 3)). Do not position the top piston ring end gap in line with the wrist pin.

4. ENGINE

4-3-5 Fuel System Diagram



0001058A

- | | |
|---|--|
| 1 – Diesel Fuel Supply | 6 – Fuel Filter |
| 2 – Fuel Filter / Water Separator | 7 – Fuel Injection Pump |
| 3 – Mechanical Fuel Pump (Used in place of the electric fuel pump on some models) | 8 – High-Pressure Fuel Injection Lines |
| 4 – Electric Fuel Pump (Used on models without mechanical fuel pump) | 9 – Fuel Injectors |
| 5 – Low-Pressure Fuel Supply Lines | 10 – Fuel Return from Fuel Injectors |
| | 11 – Air Bleed Orifice |
| | 12 – Fuel Return to Tank |

Figure 4-3-2

4. ENGINE

4-3-9 Checking and Adjusting Fuel Injection Timing

Note: The following procedure is performed on the No. 1 cylinder. While checking and adjusting the timing on only No. 1 cylinder is usually sufficient, the same procedure can be performed on any or all cylinders.

Checking Fuel Injection Timing

Note: Some fuel may drain from the fuel injection pump during this process. Make provisions to contain and dispose of any such spillage.

1. Ensure the fuel injection pump is primed with fuel.
2. Clean the area around the fuel injection pump.

Note: The stop solenoid must be removed to allow fuel to flow through the fuel injection pump.

3. Remove two screws (**Figure 4-3-22, (1)**). Remove the stop solenoid (**Figure 4-3-22, (2)**) and O-ring (**Figure 4-3-22, (3)**).

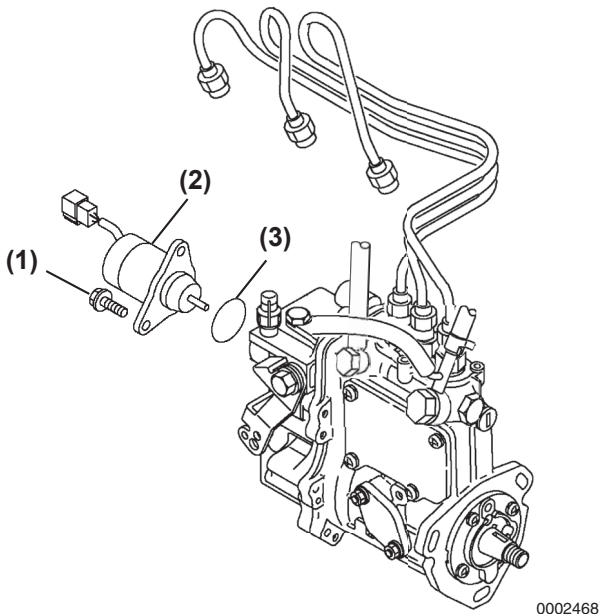


Figure 4-3-22

4. Set the throttle to the HIGH-IDLE position.

5. Using a wrench on the crankshaft pulley bolt, rotate the crankshaft in a clockwise direction while looking through the flywheel inspection port (**Figure 4-3-23, (1)**). Rotate the crankshaft until the injection timing marks on the flywheel are visible for No. 1 cylinder.

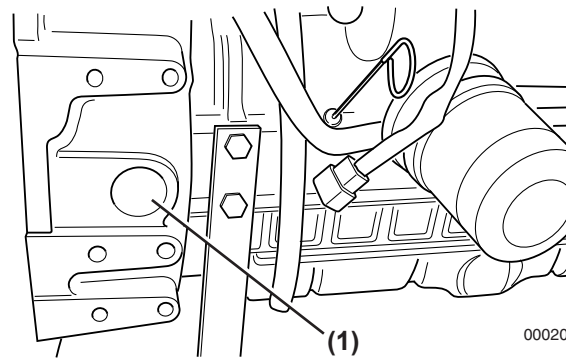
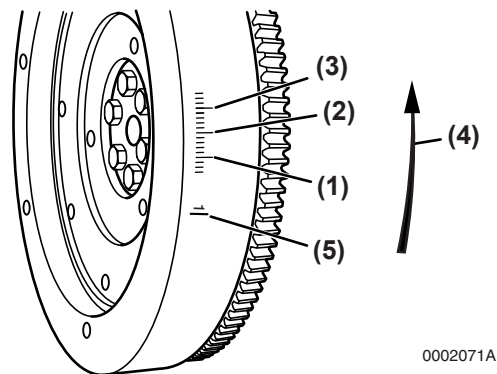


Figure 4-3-23

6. Typical flywheel markings are as shown in (**Figure 4-3-24**).

Note: A typical flywheel will have multiple timing grids depending on the number of cylinders. Any grid and its corresponding cylinder can be used to check the fuel injection timing.



- 1 – 15° BTDC (Before Top Dead Center)
- 2 – 20° BTDC
- 3 – 25° BTDC
- 4 – Direction of Rotation
- 5 – TDC (Top Dead Center)

Figure 4-3-24

7. The flywheel shown in (**Figure 4-3-24**) is for a Yanmar “Standard Specification” IDI engine. Flywheels used on some “OEM Specific” IDI engines may be marked differently. You should contact that specific OEM for information on the identification of the timing marks.

4. ENGINE

4-4 Cooling System

4-4-1 Before You Begin Servicing

Before performing any service procedures within this section, read the following safety information and review the *Safety* section on page 4-1-1.

4. ENGINE

Disassembly of Oil Pump

NOTICE

If the oil pump must be replaced, replace it as an assembly only. Do not replace individual components.

1. Remove the engine cooling fan guard (if equipped), engine cooling fan (**Figure 4-5-4, (1)**), spacer (**Figure 4-5-4, (2)**), engine coolant pump V-pulley (**Figure 4-5-4, (3)**) and V-belt.

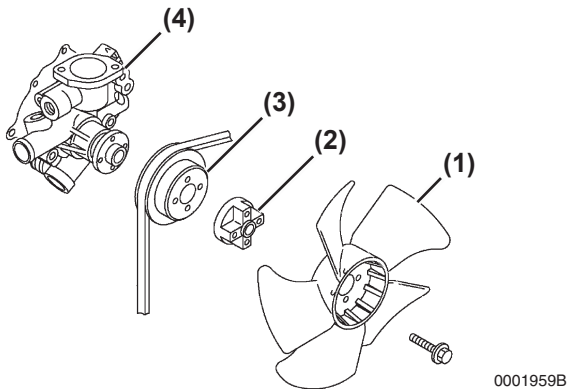


Figure 4-5-4

2. Remove the front crankshaft pulley and gear case cover. See *Removal of Timing Gear Case Cover* on page 4-2-24.
3. Remove the seven oil pump cover screws (**Figure 4-5-5, (2)**).

Note: The oil pump cover screws are installed using a liquid thread lock. It may be necessary to use “localized heat” (small propane torch) and an impact-type screwdriver to remove these screws.

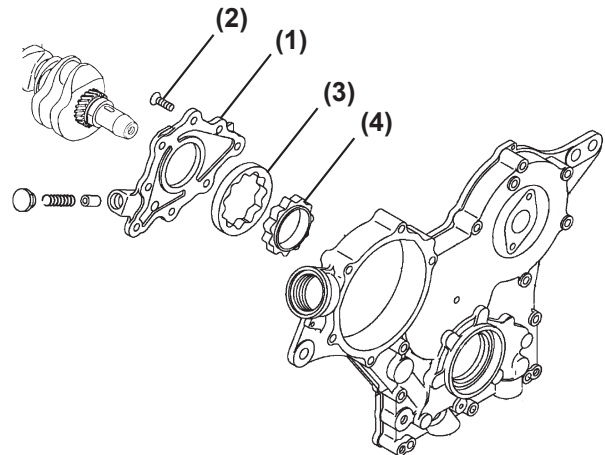


Figure 4-5-5

4. Remove the oil pump cover (**Figure 4-5-5, (1)**) from the gear case.
5. Remove the outer rotor (**Figure 4-5-5, (3)**) and inner rotor (**Figure 4-5-5, (4)**) from the gear case cover.
6. Remove the oil pressure regulator valve (**Figure 4-5-6, (1)**) from the oil pump cover (**Figure 4-5-6, (2)**).

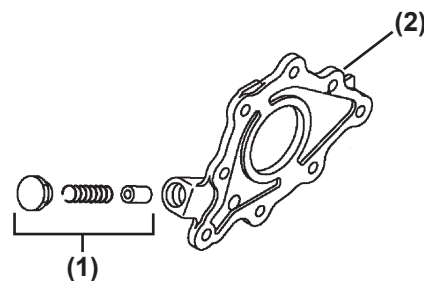


Figure 4-5-6

4. ENGINE

13. Remove the pinion stop (**Figure 4-6-10, (3)**), return spring (if equipped), and pinion clutch assembly (**Figure 4-6-10, (2)**), from the pinion shaft (**Figure 4-6-10, (1)**).

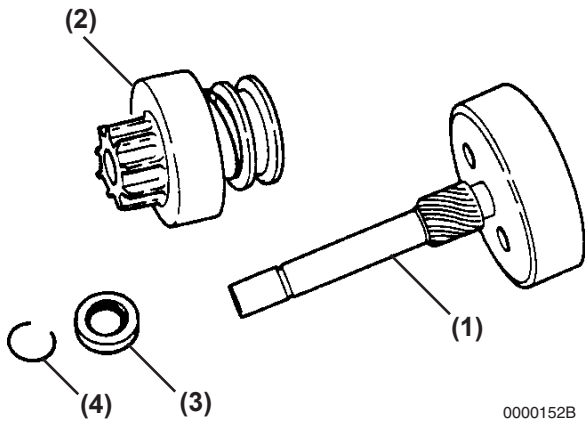


Figure 4-6-10

14. Remove the snap ring (**Figure 4-6-11, (1)**). Remove the pinion shaft (**Figure 4-6-11, (5)**), planetary gears (**Figure 4-6-11, (6)**), washers, and reduction gear (**Figure 4-6-11, (4)**) from the intermediate housing (**Figure 4-6-11, (3)**).

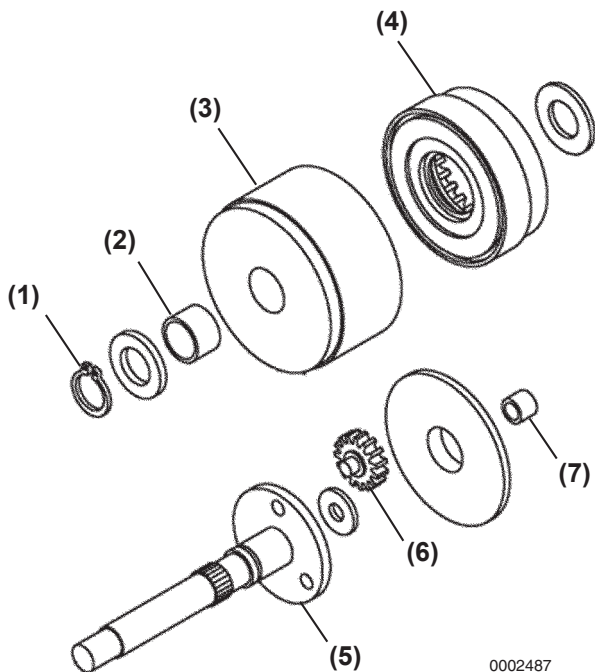


Figure 4-6-11

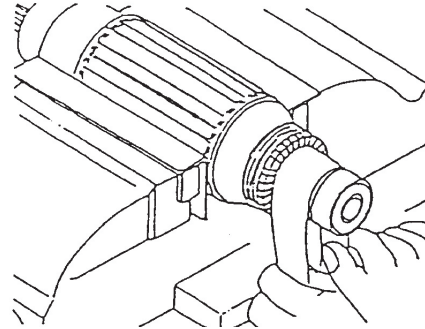
15. Inspect the intermediate bushing (**Figure 4-6-11, (2)**) and replace if worn or damaged.
16. Inspect armature bushing (**Figure 4-6-11, (7)**) and replace if worn or damaged.

Cleaning and Inspection

Armature

Commutator Surface Inspection

If the commutator surface is rough, polish the surface with a #500 to #600 emery cloth.

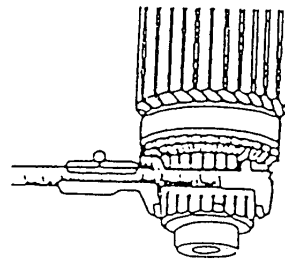


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Figure 4-6-12

Measure Commutator Outside Diameter

Measure the commutator outside diameter. Replace the armature if the measurement is less than the limit. See *Starter Motor Specifications* on page 4-6-2.



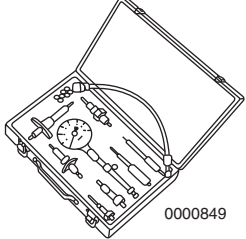
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Figure 4-6-13

4. ENGINE

4-9 Troubleshooting

4-9-1 Special Service Tools

<p>Compression Gauge Kit</p>	<p>For measuring compression pressure Yanmar Part No. TOL-97190080</p>	 <p>0000849</p>
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5. ELECTRIC SYSTEM

5-2 Circuit Description of Engine Start and Stop

5-2-1 Engine Start and Stop

1. Engine Start

Turn the starter switch to "ON" position.



The timer (1s) is supplied with power.



The relay is supplied with power from the timer (1s) and the relay solenoid is excited.



The relay works to connect its terminals 1C and 6.



The stop solenoid G (Pull) is supplied with power from the relay 6 to press the engine control lever.



Power supply to the stop solenoid P (Pull) stops.



Turn the starter switch to "START" position.



The safety relay works.



The safety relay S (2P coupler) and the starter motor S in order are charged to run the starter motor.



The primary function of the safety relay works.

The starter switch B is always supplied with power from the battery. (Battery → Slow blow fuse <Main> → Starter switch B)

Starter switch B → Starter switch BR1 → Lead wire B → Fuse 15A → Lead wire R/Y → Timer (1s) R

Timer (1s) R → Lead wire R/W & Y → Relay 31, Relay 32 → Timer (1s) A

The Relay timer 1C is always supplied with power from the battery through the slow blow fuse (Start).

The stop solenoid H (Hold) is supplied with power when the starter switch is in ON position.

In about one second after the starter switch is turned to ON position, the timer works to cut off power to the stop solenoid P. However, the stop solenoid H is still supplied with power as long as the starter switch is in ON position, so that the engine control lever stays pressed.

The starter motor B is always supplied with power from the battery. Also, the safety relay B (2P coupler) is supplied with power from the battery through the slow blow fuse (Starter) and lead wire R/L.

Starter switch BR1 → Fuse 10A → Safety relay ACC (4P coupler)
Starter switch C2 → Relay 17, 39 → Safety relay C (4P coupler)

The magnet switch of the starter motor works to allow the pinion gear to jump out and engage the ring gear on flywheel. At the same time, the crankshaft of the engine rotates and the engine starts to run.

The alternator 12A (P terminal) and safety relay P (4P coupler) are connected via the diode. When the engine speed reaches the rated one, the signal from the alternator flows to the safety relay and cuts off the connection between the safety relay S (2P coupler) and the starter motor S, which causes the pinion gear to be pulled back and the engine to be prevented from overrunning.

2. Engine Stop

Turn starter switch to "OFF" position.



The stop solenoid H (Hold) is stopped being supplied with power and the engine control lever is pulled back.

The engine control lever blocks fuel oil flow to stop the engine.

6. HYDRAULIC SYSTEM

6-2-4 Swing

1) Right Swing

(1) Pilot oil flow

When the swing control lever is moved to the right, the oil from the pump flows through the cut-off valve, the port 4 of the left pilot valve (L) to the port Pb2 of the swing section to move its spool.

(2) Oil flow from hydraulic pump

The oil discharged from the pump flows to the swing section through the port P of the inlet section. The oil flows through the port B2 to the port A of the brake valve of the swing motor, so that the swing motor is rotated.

The return oil from the port B of the brake valve flows back to the hydraulic oil tank through the port A2 and T of the control valve. Some return oil from the port T flows directly to the tank while the remaining flows back to the tank through the oil cooler and the return filter.

2) Left Swing

(1) Pilot oil flow

When the swing control lever is moved to the left, the oil from the pump flows through the cut-off valve, the port 2 of the left pilot valve (L) to the port Pa2 of the swing section to move its spool.

(2) Oil flow from hydraulic pump

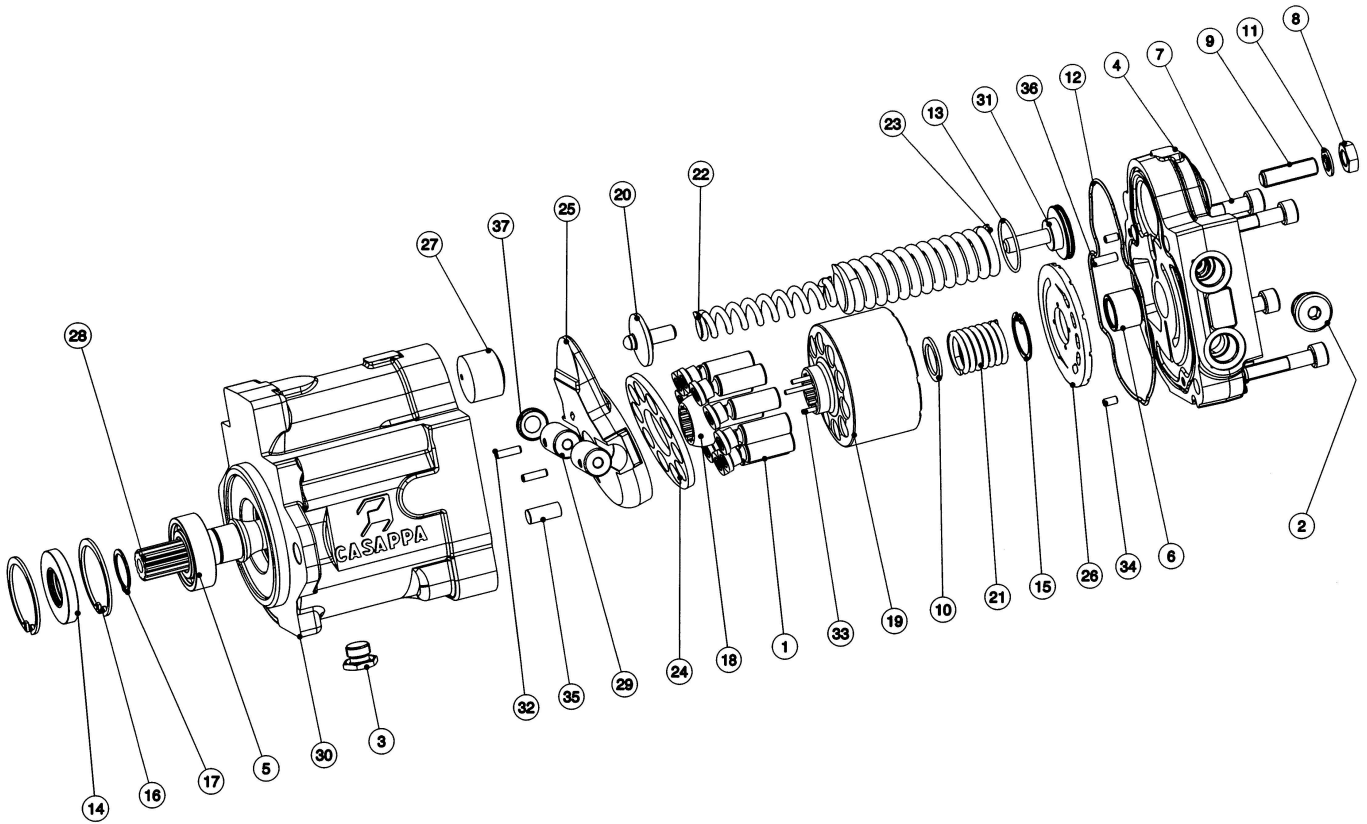
The oil discharged from the pump flows through the port P of the inlet section to the swing section.

In this operation, the oil flows in the opposite direction to the oil flow in the Right Swing operation with regard to the swing motor.

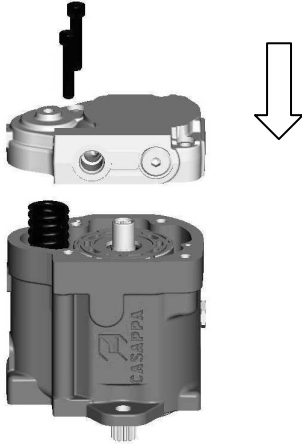
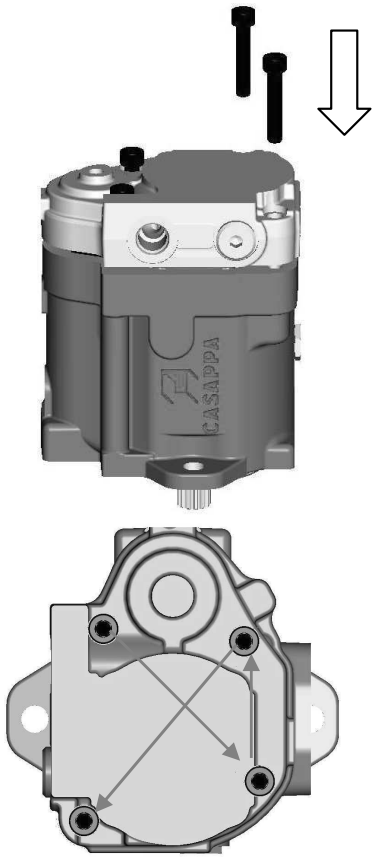
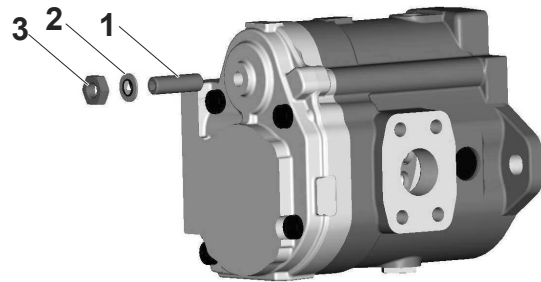
6. HYDRAULIC SYSTEM

6-3 Hydraulic Pump





6-3-1 Exploded View and Component Parts



6. HYDRAULIC SYSTEM

Procedure	
<p>9. To keep the rear cover and the spring in the correct position, first screw the two screws on the spring side of the cover.</p>	
<p>10. Tighten the screws with a torque wrench. The cover must be kept horizontal during this operations.</p> <p>Note Insert the screws following the sequence shown in the picture.</p> <p>Tightening torque: 70 Nm</p>	
<p>11. Put the pump on the working bench.</p> <p>12. Screw the washer (1) on the power limiter screw (2) to the plane of the cover.</p> <p>13. Lock the nut (3).</p> <p>Tightening torque: 50 Nm.</p>	

6. HYDRAULIC EQUIPMENT

Procedure	
<p>Anti-cavitation check valve replacement On the distribution element in question, unscrew the anticavitation</p> <p>Reassembly : torque : $32 \pm 10\%$ N.m.</p>	
<p>Remove: - plug, - anti-cavitation check valve.</p> <p>Replace seal of pressure relief valve plug.</p> <p>Reassemble parts in reverse order.</p>	
<p>Plug replacement On the distribution element in question, unscrew the plug (8 mm socket wrench).</p> <p>Reassembly : torque : $32 \pm 10\%$ N.m.</p>	
<p>Replace plug seal or plug.</p>	

6. HYDRAULIC EQUIPMENT

6-4-7 Maintenance Instruction of Inlet and Distribution element equipped with Translation Stand-by

1) Introduction

- This dedicated manual deals with the instructions relative to servicing and maintenance operations for SX10 Translation Inlet and distribution element (See maintenance instruction manual RE 64132-S for further information) .
- It is recommended that only qualified personnel perform the installation, connection and maintenance of this device, and that all operations shall be carried out in compliance with the technical standards in force and the cleanliness regulations specific to this type of installation.

To ensure maximum performance and safety during maintenance operations we advise you to

Read the manual RE64132-S together with this instruction thoroughly

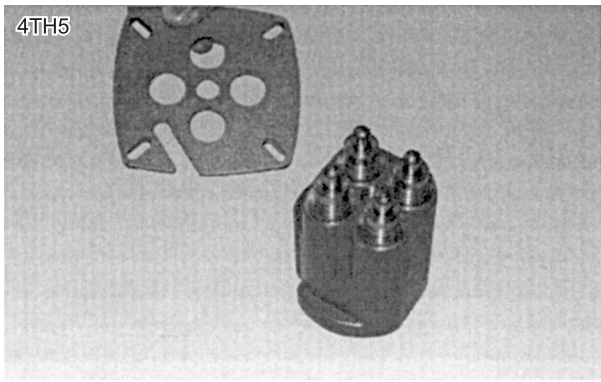
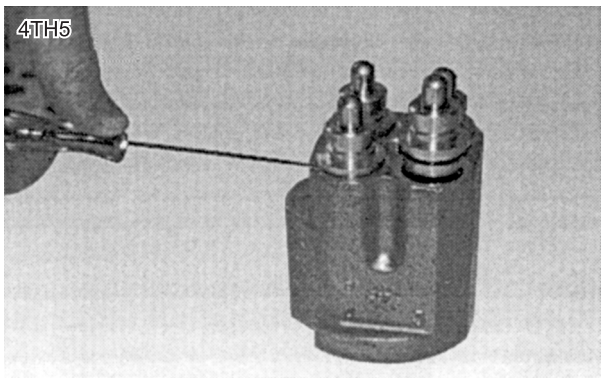

- All information, illustrations, instructions and characteristics contained in these documents are based on the latest product information available at the time of publication. In its attempts to maintain a high-quality product, BOSCH REXROTH reserves the right to make design or technical modifications at any time and without prior notification.

2) General Recommendations

- Before removing the parts, the unit and its surroundings must be thoroughly cleaned (Do not direct the jet of a pressure washing unit directly at the unit).
- No impurities must enter the hydraulic system.
- Make sure to collect any possible oil leakage in a suitable receptacle.
- Wear protective clothing and use suitable equipment to prevent accidents, particularly concerning the hydraulic fluid.
- Set all actuators connected to the machine in neutral position (on the ground, at lower limit...) to avoid accidents which could result from uncontrolled movements of the equipment when the hydraulic system is disconnected or open.
- With the machine off, release the pressure remaining in the system by manipulating all of the distribution spools.



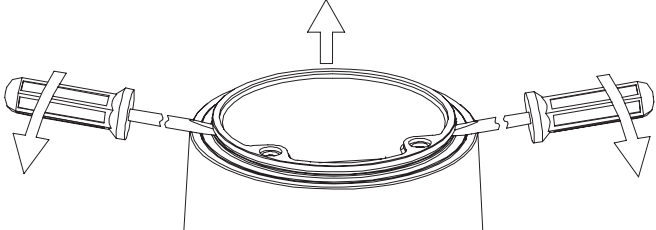
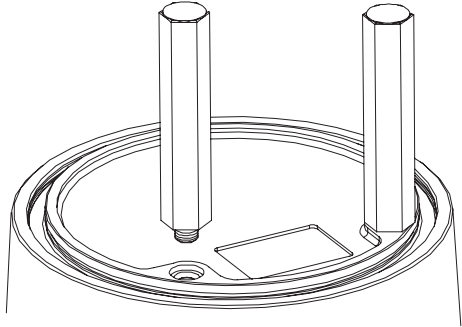
6. HYDRAULIC EQUIPMENT

3) Guide / Plunger and Regulation Unit Replacement

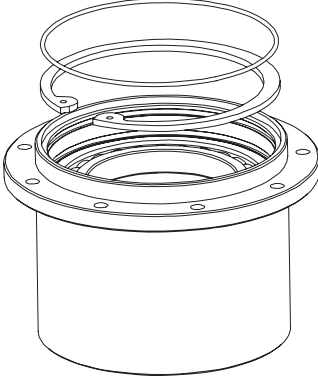
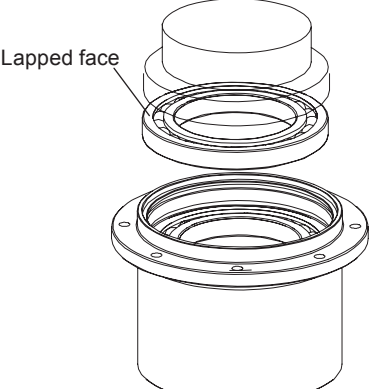
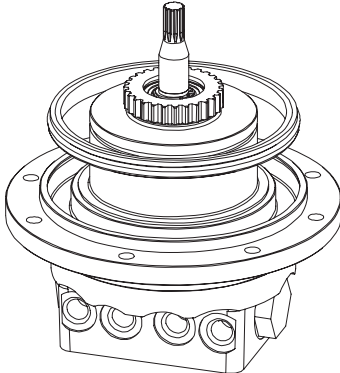
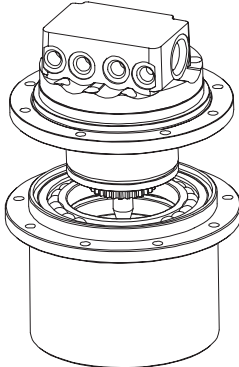
Procedure	
<p>Preliminary operations Remove the pilot control unit from the machine's arm rest. Remove the handle. Remove the cardan.</p> <p>Note : <i>It is recommended to remove the pilot control unit from the machine. Nevertheless, the servicing on machine is possible by securing the unit into a vice-grip wrench (65 opening). This is performed by extracting the body from the arm rest so as to clamp the vice-grip wrench onto the body in order to hold it above the arm rest.</i></p>	
<p>Removal Secure the pilot control unit to a vice. Remove the retaining plate. Reassembly : Line up the notches for the grommet in both the plate and the body.</p>	
<p>Insert the end of a thin screwdriver between the guide and the body, carefully lift the guide to remove it from the body.</p> <p>Note : <i>Hold the guide with the other hand during the extraction operation to limit the effect of the return spring.</i></p> <p>Remove the guide / plunger assembly. Repeat the operation for the other 3 sub-assemblies. Reassembly : Use the retaining plate to insert the 4 guides into the body simultaneously and perpendicularly. Reassemble in reverse order.</p>	
<p>Regulation unit verification Extract the regulation units from the body (using flat nose pliers).</p> <p>Visually check that the guides / plungers are in good condition. If defects are present, replace the 4 sub-assemblies. Inspect the regulation units and particularly their spring. If defects are detected, replace the 4 units.</p>	

6. HYDRAULIC EQUIPMENT

6-7-3 Disassembly

<p>Procedure</p> <p>After having drained the lubricant, unscrew the two drain plugs, remove the internal snap ring securing the reduction gear cover.</p>	
<p>Remove the reduction gear cover.</p>	
<p>To remove the reduction gear cover, insert two screwdriver into the upper groove and lift the cover from the housing.</p>	
<p><i>An alternative solution for removal of the cover.</i></p> <p>May be obtained by unscrew the two drain plugs and install two threaded pins (1/8" GAS) which will be used to lift the cover from the housing.</p>	

6. HYDRAULIC EQUIPMENT

Procedure	
<p>Secure the ball bearing by means of an internal retaining ring, install the O-ring.</p> <p>Note : <i>Be sure to use grease on the O-ring.</i></p>	
<p>Using the same tool (Code M725.000.16.01) mentioned for the first ball bearing, install the second ball bearing keeping the lapped part up and using extreme caution not to damage the lapped surface of the bearing.</p>	
<p>Install the front seal. See the installation procedure at page 6-5-17.</p>	
<p>Using a press, insert the reduction unit and motor assembly into the seat of the ball bearing.</p>	

6. HYDRAULIC EQUIPMENT

6-7-8 Technical Information

Liquid bonding agents (Loctite) must always be used in the following cases:

- (1) Screws assembled inside reduction gears.
- (2) Screws tightened on aluminum boxes.
- (3) Bearing adjustment ring nuts including ring nuts but not ring nuts with safety washers and ring nuts of axle wheel hubs which do not require adhesives.
- (4) Cranks and extensions.
- (5) Data Sheet requirements.

When assembling with adhesives, the following must be degreased and free of washing residues:

- (1) Ring nuts, screws, stud bolts, nuts, cranks, and extensions if their surfaces are not protected by galvanizing or Dacromet 320.
- (2) Threads on shafts and boxes.

When liquid bonding agents are required, use:

Description	Size	Loctite
Screws tightened on cast iron or steel	up to and including M8	243
	over M8	270
Screws tightened on aluminum	all diameters	243
Stud bolt root (box)	up to and including M12	243
	over M12	270
Stud (nut)	up to and including M12	no
	over M12	243
Bearing adjustment ring nuts	all diameters	270
Cranks and extensions for caps	all diameters	243

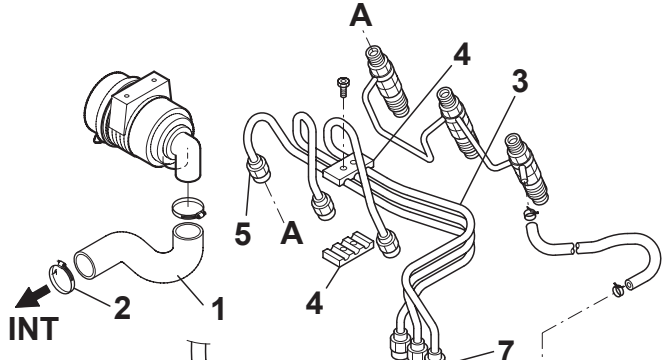
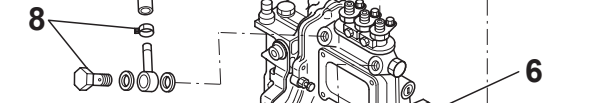
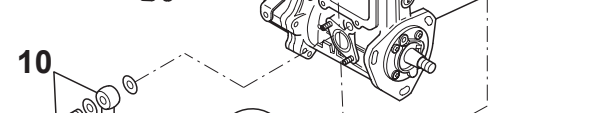
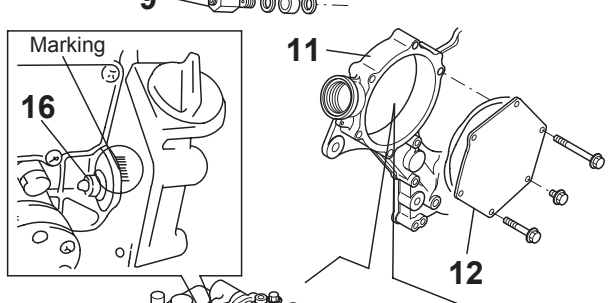
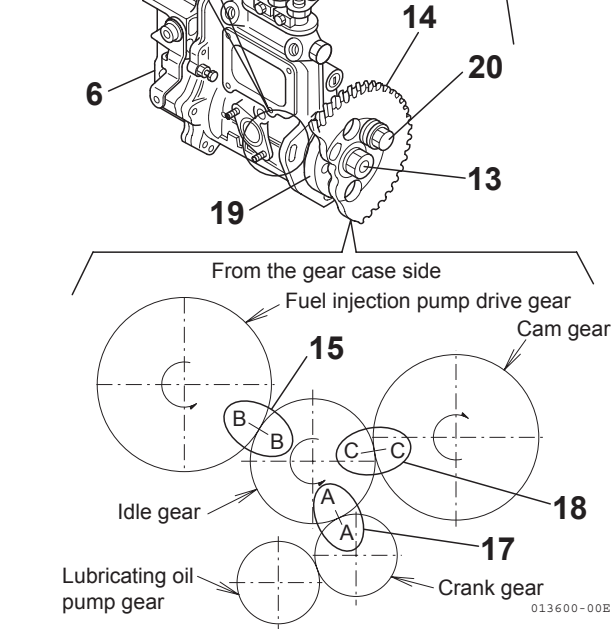
When there are no washers, O-rings, or other types of seals, use Loctite 518 as a sealer.

All of these instructions are valid unless otherwise specified in the "Technical Manual".

7. ADJUSTMENT AND REPAIR

7-1-3 Removal and Reinstallation of Fuel Injection Pump

1) Removal

Procedure	
<p>(1) Loosen the hose clip 2 of the air cleaner hose B 1 to disconnect with the air intake manifold of engine, and remove the air cleaner assembly with the hose B 1.</p>	
<p>(2) Loosen the sleeve nuts 5 at the fuel injectors after removing the retainers 4 from the fuel injection pipes 3 and then loosen the sleeve nuts 7 at the fuel injection pump 6.</p>	
<p>(3) Disconnect the fuel hoses 8 (filter-fuel injection pump) and 9 (fuel injection pump-filter).</p>	
<p>(4) Remove the engine oil pipe 10 (cylinder block-fuel injection pump).</p>	
<p>(5) Remove the end nut 13 after removing the cover 12 from the gear case 11.</p>	
<p>Note :</p> <ul style="list-style-type: none"> • Put a mark 15 on the engaging point of the FIP gear 14 and the idle gear. • Do not remove the FIP gear 14 from the gear case 11. 	
<p>(6) Remove three nuts 16 to remove the fuel injection pump 6 from the gear case 11.</p>	
<p>Note :</p> <ul style="list-style-type: none"> • Remove the fuel injection pump 6 after putting a mark on it and the gear case 11. • Do not turn the crankshaft after removing the fuel injection pump 6. When a mark 15 on the engaging point of the FIP gear 14 and the idle gear does not align, match the marks of the idle gear with the crankshaft gear 17, cam gear 18 and FIP gear 14. • Never loosen the FIP coupling 19 and FIP gear 14 holding screws 20. 	
	 <p style="text-align: right;">013600-00B</p>

7. ADJUSTMENT AND REPAIR

Procedure			
<p>(2) Remove the mounting bolts to remove the crawler adjusting spring.</p> <p>(3) Remove the snap ring C 9 and then remove the idler fork L 8, the seal 10 and the snap ring C 7.</p> <p>(4) Drain the lube oil inside the idler. Then, pull out the shaft 5 (with the bearing 11) using a press.</p> <table border="1" style="width: 100%; margin: 10px 0;"> <tr> <td style="width: 50%;">Oil quantity</td> <td style="width: 50%; text-align: center;">75 cc</td> </tr> </table> <p>Warning : Take care to put the lube oil in a container.</p> <p>(5) Remove the seal 4, and then remove the snap ring C 2 and the bearing 6.</p> <p>Note : The shaft 5 is press-fitted into the idler fork R 3.</p>	Oil quantity	75 cc	
Oil quantity	75 cc		

3) Reassembly

Reassemble the idler in the reverse order of the disassembly procedure.

Notes :

- [1] Clean all the parts and check them for damage or defects.
- [2] Replace the seals with new ones.
- [3] Apply multipurpose grease to the lips of seals **4** and **10**.
- [4] When installing the seal **10**, to release air from the inside of the idler, remove the sleeve from the seal and install the seal, then install the sleeve.

Crawler adjusting spring mounting bolt (M10)

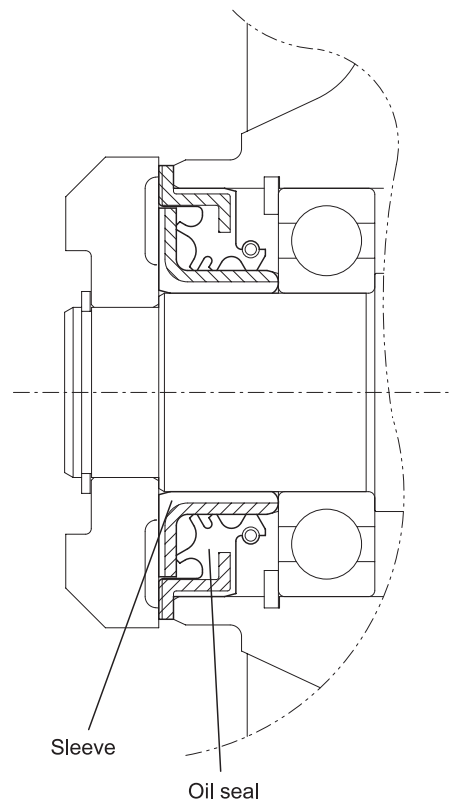
Adhesive : Three Bond 1324 or its equivalent.

Note :

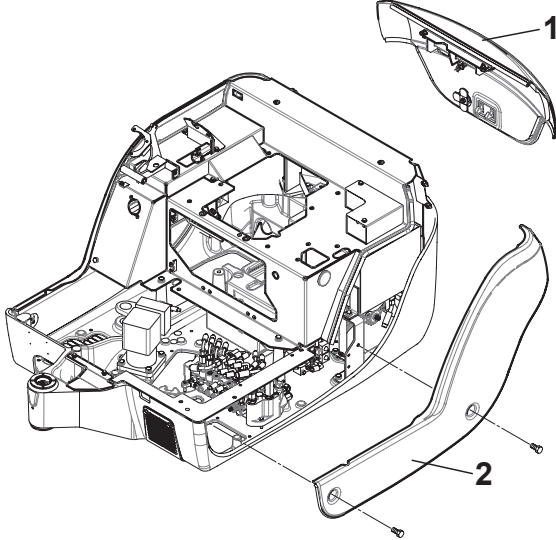
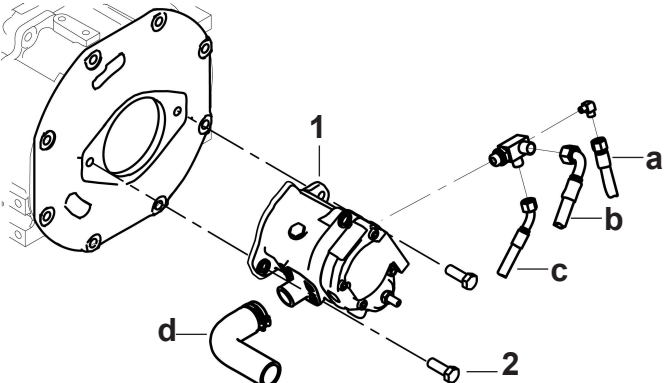
- For Tightening torque value, refer to Section "List of Tightening Torque" on page 3-7-1

[5] Oil to be used for idler:

Type	Engine oil SAE 30
Quantity	75 cc



7. ADJUSTMENT AND REPAIR

Procedure	
<p>(5) Open the bonnet center 1 and remove the cover L 2.</p>	
<p>(6) Remove the hydraulic hoses from the hydraulic pump 1.</p> <ul style="list-style-type: none">a. Hose (Measurement)b. Hose (control valve)c. Hose (cut-off valve)d. Hose (suction hose) <p>(7) Remove the mounting bolts 2 and remove the hydraulic pump 5.</p>	

7. ADJUSTMENT AND REPAIR

2) Reinstallation

Reinstall the swivel joint in the reverse order of the removal procedure.

Notes :

- *Swing motor mounting bolt : Apply three bond 1324 or its equivalent.*
- *For bolts Tightening torque value, refer to Section “List of Tightening Torque” on page 3-7-1*
- *For fittings Tightening torque value, refer to Section “Hydraulic Fitting” on page 3-7-4*

[1] *Install each connector at a specified mounting angle.*

[2] *Hydraulic oil to be used :*

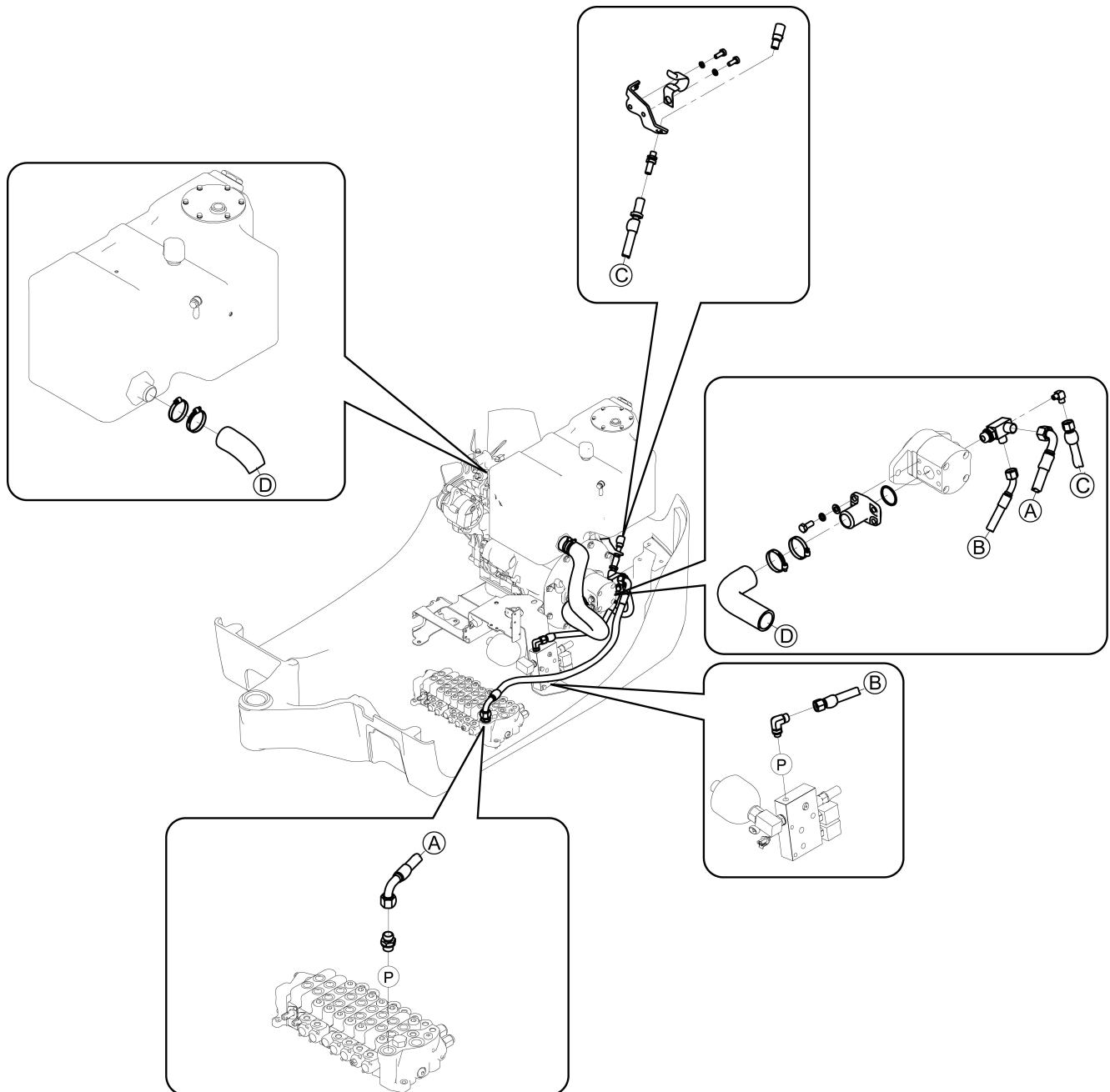
Type	YANMAR SUPER HYDRO OIL (VG 46 class) or its equivalent
Quantity	20 L (tank)

7. ADJUSTMENT AND REPAIR

7-5-8 Piping layout

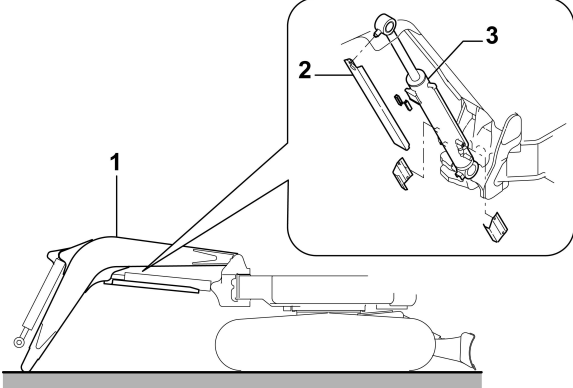
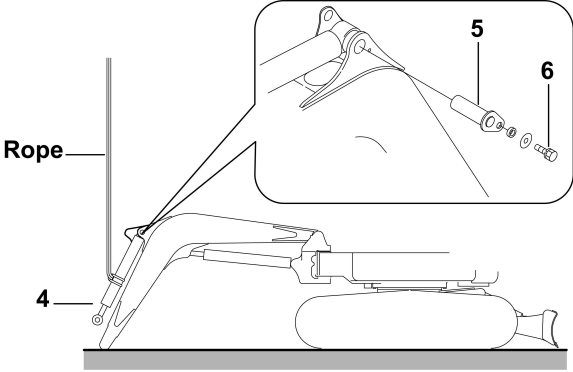
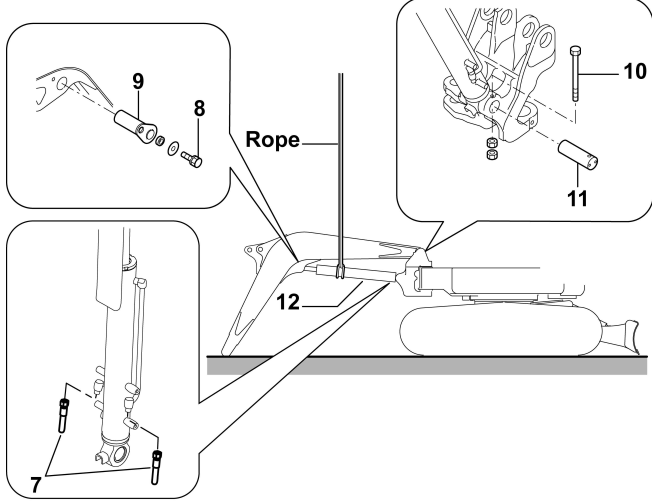
1) Upperstructure

(Hydraulic oil tank → Hydraulic pump → Control valve)

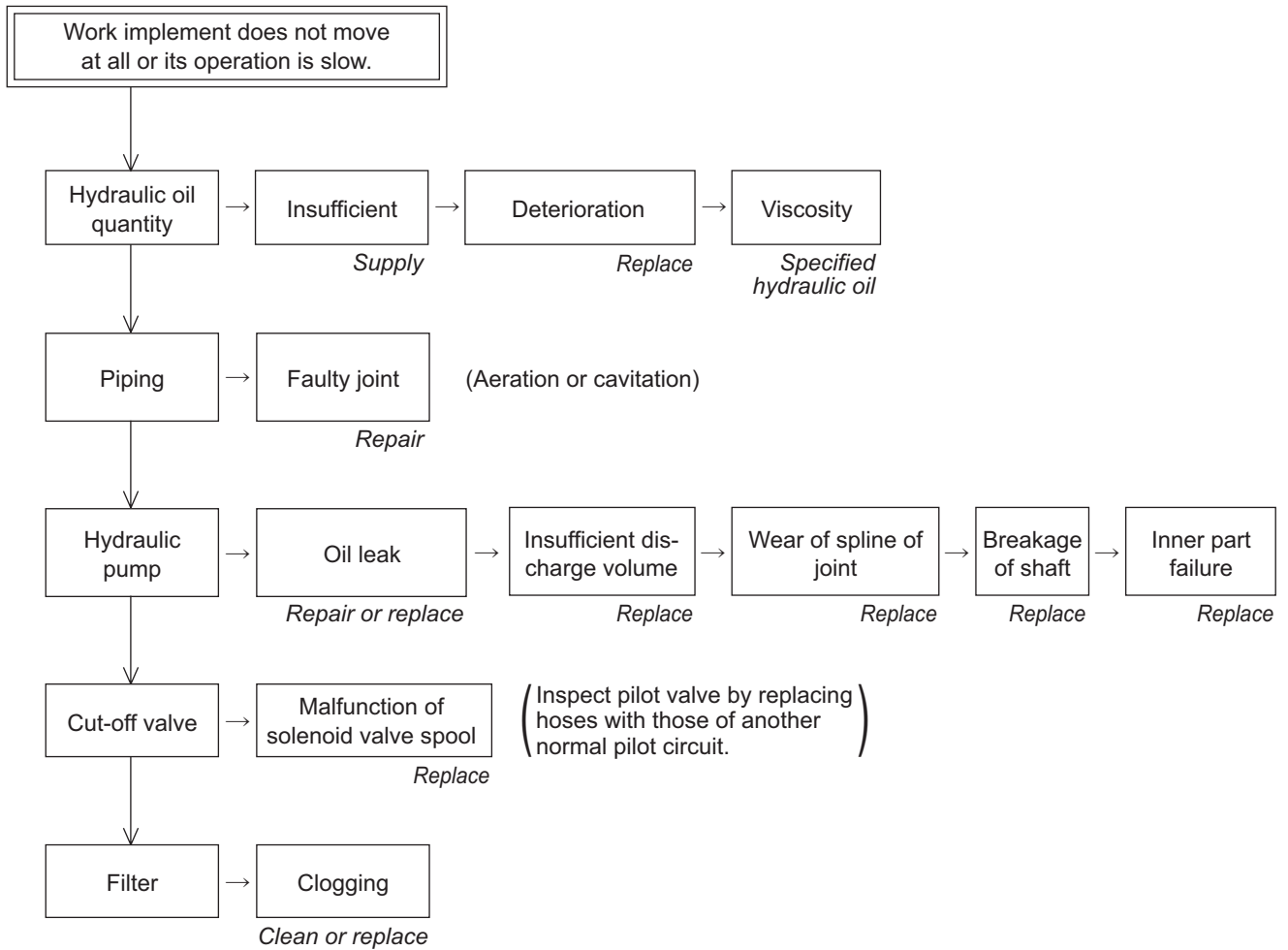


7. ADJUSTMENT AND REPAIR

3) Removal of Boom

Procedure	
<p>(1) After raising the boom 1 fully, remove the slide cover 2 from the boom cylinder 3.</p> <p>(2) Place the top end of the boom 1 on the ground.</p> <p>Note : Install an expansion plug to the connector from which the hydraulic hose has been removed and start the engine.</p>	
<p>(3) After roping the arm cylinder 4, remove the hydraulic hoses from the arm cylinder.</p> <p>(4) Remove the bolt 6 (M10) and pull out the pin 5. Then remove the arm cylinder 4.</p> <p>Note : Remove the arm cylinder using a lifting device.</p>	
<p>(5) After roping the boom cylinder 12, remove the hydraulic hoses 7 from the boom cylinder.</p> <p>(6) Remove the bolts 8 and 10 (M12) and pull out the pins 9 and 11. Then remove the boom cylinder 12.</p> <p>Note : Remove the boom cylinder using a lifting device.</p>	

8. TROUBLESHOOTING



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