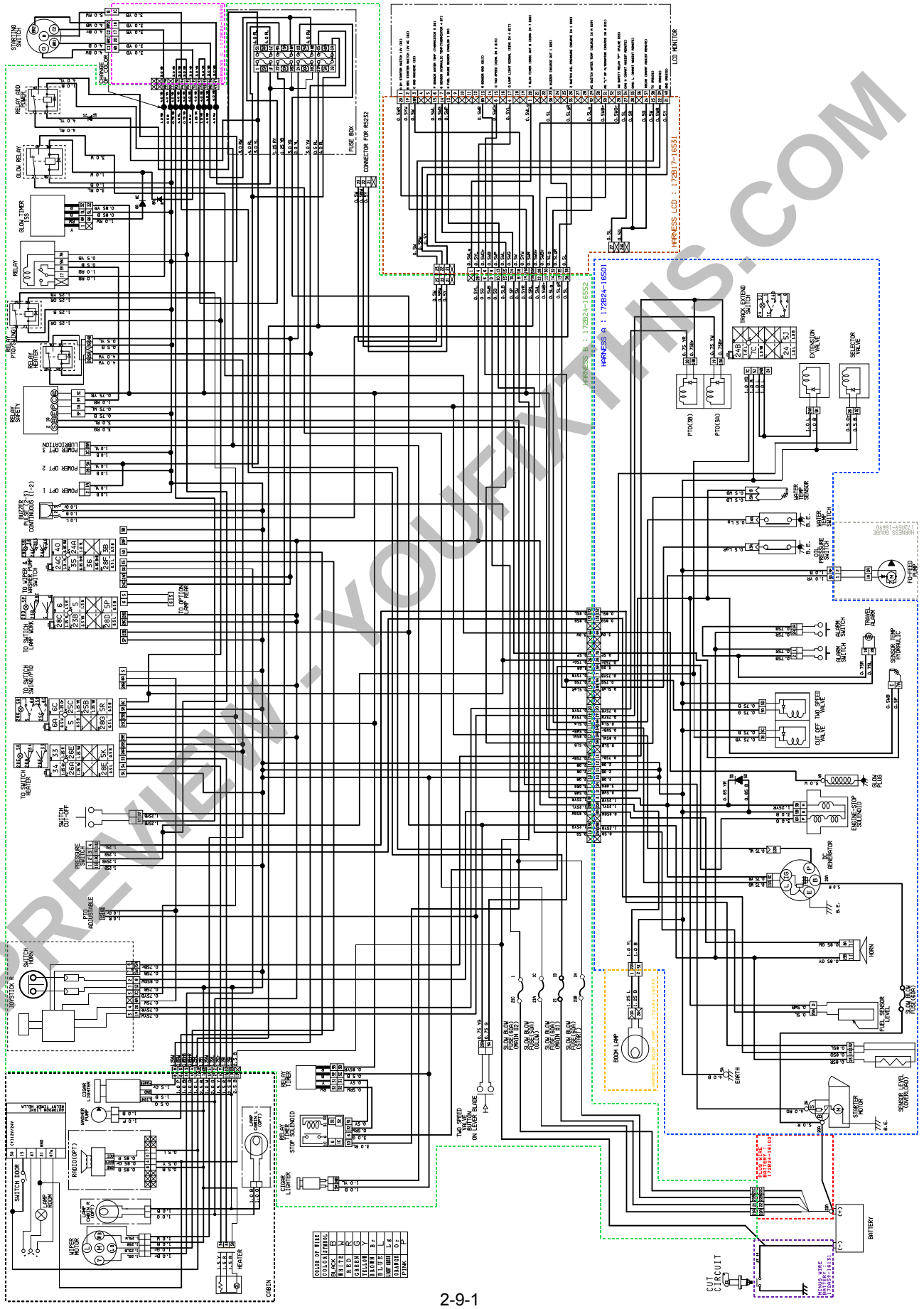
CHAPTER 1

GENERAL CAUTIONS FOR MAINTENANCE WORK

1-1 Correct Work 1-1
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1-3 Preparations 1-1
1-4 Cautions for Disassembly and Reassembly 1-1
1-5 Cautions for Removal and Installation of Hydraulic Equipment 1-2
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1-9 Specifications of Hydraulic Hose 1-6
1-10 Air Release of Hydraulic Equipment 1-8

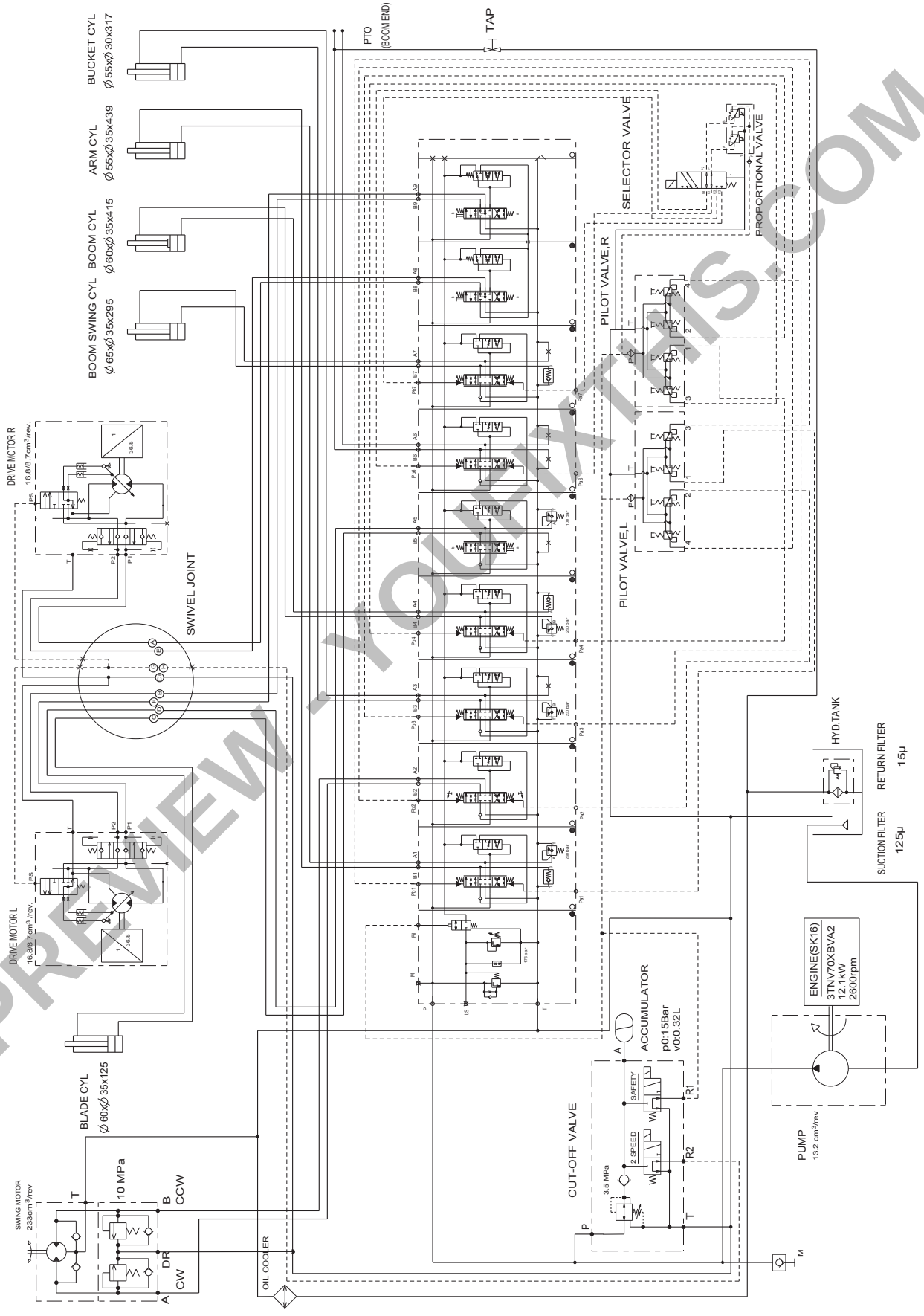
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2-9 Wiring Diagram



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2-8 Hydraulic Circuit Schematic



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4-2-4 Cylinder Head

Cylinder Head Components

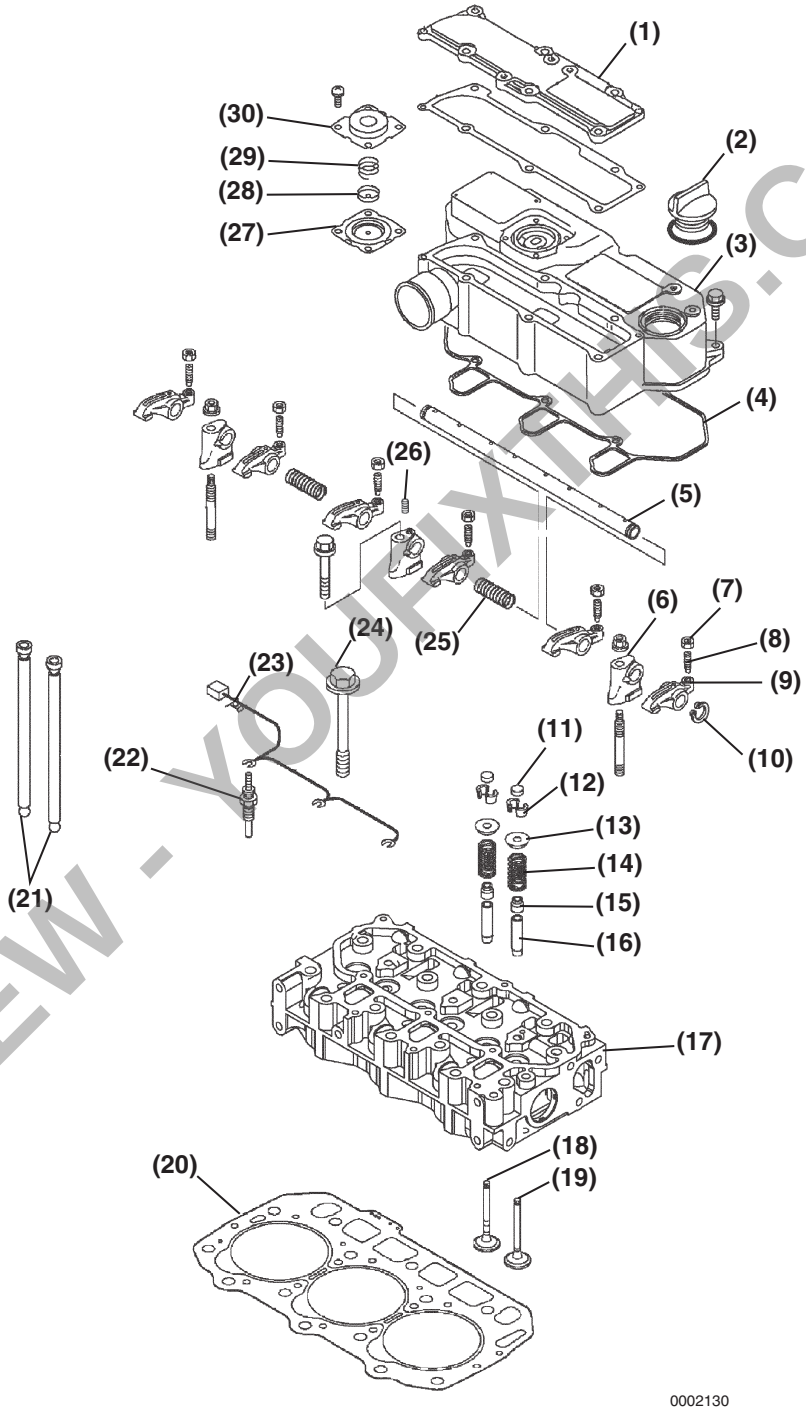


Figure 4-2-1

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3-7-3 Tightening Torque for General Bolts and Nuts

Item		Thread size × Pitch	Tightening torque [Unit : N•m]	Remarks
Nut		M5	5,5 to 6,5	
		M6	9,5 to 11,5	
		M8	23 to 27	
		M10	46 to 54	
		M12	79 to 93	
		M14	127 to 149	
		M16	198 to 230	
		M18	283 to 329	
		M20	402 to 464	
		M22	552 to 634	
		M24	691 to 798	
Hexagon head bolt	8.8T	M5	5,5 to 6,5	
		M6	9,5 to 11,5	
		M8	23 to 27	
		M10	46 to 54	
		M12	79 to 93	
		M14	127 to 149	
		M16	198 to 230	
		M18	283 to 329	
		M20	402 to 464	
		M22	552 to 634	
		M24	691 to 798	
Hexagon head bolt	10.9T	M5	8 to 9	
		M6	14 to 16	
		M8	34 to 40	
		M10	67 to 79	
		M12	116 to 138	
		M14	187 to 219	
		M16	291 to 339	
		M18	402 to 470	
		M20	570 to 662	
		M22	783 to 905	
		M24	981 to 1137	
		M27	1452 to 1674	

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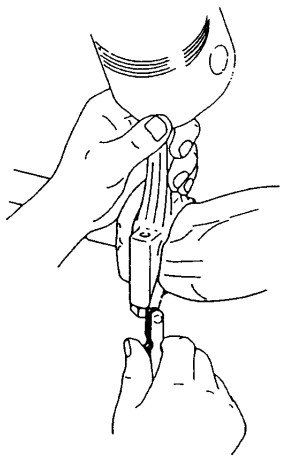
5-3 Error Code List

Error code	Classification	Error description	Detection condition	Causes	Corrective measures
00 000091.00	Caution	Accelerator sensor malfunction: above normal operating range (SAEJ1843)	Sensor voltage is 4.6 V or more, or 0.2 V or less.	• Connection failure of connectors • Defective accelerator sensor	Check the connectors, harnesses and engine control dial. Turn the starter switch to the “OFF” position and then to the “ON” position to check if the error code is displayed again.
00 000091.01	Caution	Accelerator sensor failure: below normal operating range (SAEJ1843)	Sensor voltage is 4.6 V or more, or 0.2 V or less.		
00 000091.02	Caution	Accelerator sensor malfunction: intermittent failure	Sensor voltage is 4.6 V or more, or 0.2 V or less.	• Connection failure of connectors • Harness wiring failure (nearly broken wiring of sensor signal line, sensor 5 V line or sensor GND line) • Defective accelerator sensor	Check the connectors, harnesses and accelerator sensor. Turn the starter switch to the “OFF” position and then to the “ON” position to check if the error code is displayed again.
00 000091.03	Caution	Accelerator sensor malfunction: short circuit to high voltage side	Sensor voltage is 4.6 V or more, or 0.2 V or less.	• Connection failure of connectors • Harness wiring failure (sensor GND line disconnected or sensor signal line short circuited to power supply) • Defective accelerator sensor	
00 000091.04	Caution	Accelerator sensor malfunction: short circuit to low voltage side	Sensor voltage is 4.6 V or more, or 0.2 V or less.	• Connection failure of connectors • Harness wiring failure (sensor signal line disconnected or short circuited to GND, or sensor 5V line disconnected or short circuited to GND) • Defective accelerator sensor	
00 000100.01	Warning	Abnormal engine oil pressure	Engine oil pressure switch is on after engine has started.	• Low engine oil pressure • Defective engine oil system • Harness wiring failure (engine oil pressure switch wiring short circuited to GND) • Defective engine oil pressure switch	Inspect the engine oil system. Check the harnesses and engine oil pressure switch. Turn the starter switch to the "OFF" position and then to the "ON" position to check if the error code is displayed again.
00 000100.04	Warning	Engine oil pressure switch failure	Engine oil pressure switch is off while engine is stopped with starter switch in the "ON" position.	• Connection failure of connectors • Harness wiring failure (engine oil pressure switch wiring disconnected or short circuited to power supply) • Defective engine oil pressure switch	Check the connectors, harnesses and engine oil pressure switch. Turn the starter switch to the "OFF" position and then to the "ON" position to check if the error code is displayed again.
00 000110.00	Warning	Engine coolant temperature sensor malfunction: too high	Sensor voltage is 4.8 V or more.	• Engine overheating • Insufficient amount of engine coolant • Defective engine cooling system • Defective coolant temperature sensor system	Inspect the engine cooling system. Check the connectors, harnesses and coolant temperature sensor. Turn the starter switch to the “OFF” position and then to the “ON” position to check if the error code is displayed again.
00 000110.02	Warning	Engine coolant temperature sensor malfunction: intermittent failure	Error undefined is detected 10 times.	• Connection failure of connectors • Harness wiring failure (nearly broken wiring of sensor signal line, sensor 5 V line or sensor GND line) • Defective coolant temperature sensor	Check the connectors, harnesses and coolant temperature sensor. Turn the starter switch to the “OFF” position and then to the “ON” position to check if the error code is displayed again.
00 000110.03	Warning	Engine coolant temperature sensor malfunction: short circuit to high voltage side	Sensor voltage is 4.8 V or more.	• Connection failure of connectors • Harness wiring failure (sensor signal line disconnected or short circuited topower supply, or sensor GND line disconnected) • Defective coolant temperature sensor	

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1. Using a feeler gauge, measure the connecting rod side clearance **(Figure 4-2-50)**. *See "3-2 Engine Service Standard" section for the service limit.* If the measurement is out of specification, replace the crankshaft, connecting rod, or both.



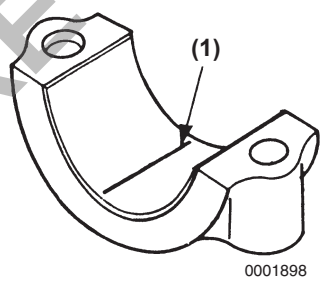
0000219

Figure 4-2-50

IMPORTANT

Mark the connecting rod caps and connecting rods so the caps and connecting rods stay together.

2. Remove the bearing cap. Do not remove the bearing inserts at this time.
3. Wipe oil from the bearing insert and crankshaft journal surfaces.
4. Place a piece of PLASTIGAGE® **(Figure 4- 2-51, (1))** along the full width of the bearing insert.



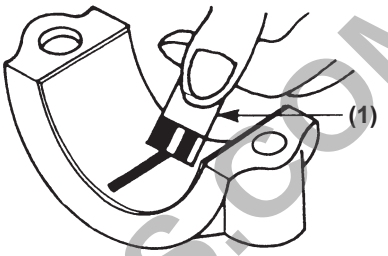
0001898

Figure 4-2-51

IMPORTANT

Do not rotate crankshaft when using PLASTIGAGE. A false reading may result.

5. Reinstall the bearing cap and tighten to specification. *See "3-7-2 Engine Tightening Torque" section for tightening torque.*
6. Remove the bearing cap.



0001899

Figure 4-2-52

7. Compare the width of the flattened PLASTIGAGE **(Figure 4-2-52, (1))** to the graduation marks on the package. The mark that most closely matches the width of the flattened PLASTIGAGE will indicate the bearing oil clearance. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*
8. Repeat with the remaining connecting rods.

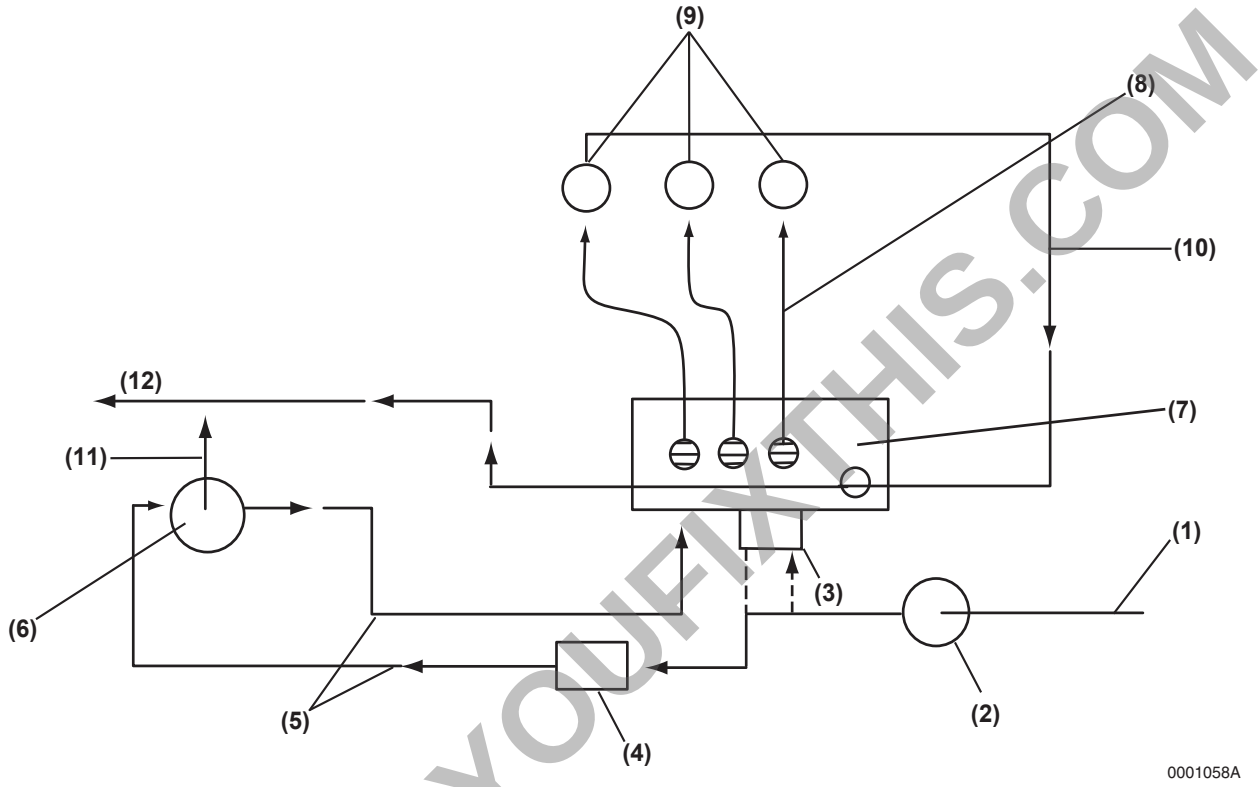
IMPORTANT

Do not allow the connecting rod to contact the crankshaft journal during piston removal. Damage to the bearing journal may result.

9. Use a wooden dowel against the connecting rod and tap the piston / connecting rod assembly out of the cylinder.
10. Mark the cylinder number on the piston and connecting rod.

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4-3-5 Fuel System Diagram



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

Figure 4-3-2

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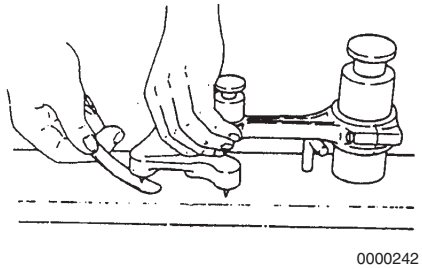


Figure 4-2-71

3. Place the connecting rod bearing inserts into the connecting rod and connecting rod cap. Install the rod cap and tighten the bolts to the specified torque.
4. Measure the inside diameter. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*

Inspection of Tappets

1. Inspect the tappet contact surfaces for abnormal wear **(Figure 4-2-72, (1))**. Normal wear will be even as shown in **(Figure 4- 2-72, (2)).** Slight surface defects can be corrected using an oilstone.

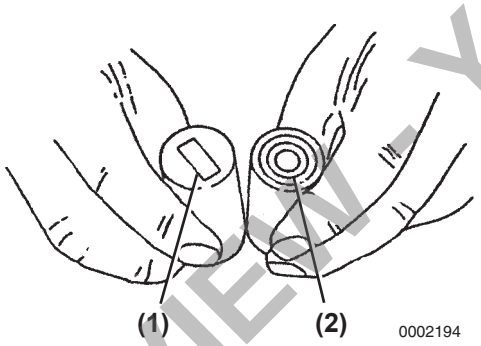


Figure 4-2-72

2. Measure the outside diameter of the tappet stem **(Figure 4-2-73, (1))**. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*

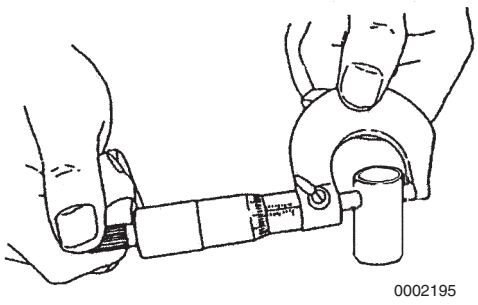


Figure 4-2-73

3. Measure the tappet bores in the cylinder block. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*

Inspection of Crankshaft

1. Put the crankshaft end journals **(Figure 4- 2-74, (4))** on V-blocks.
2. Place a dial indicator **(Figure 4-2-74, (3))** on a center main bearing surface.

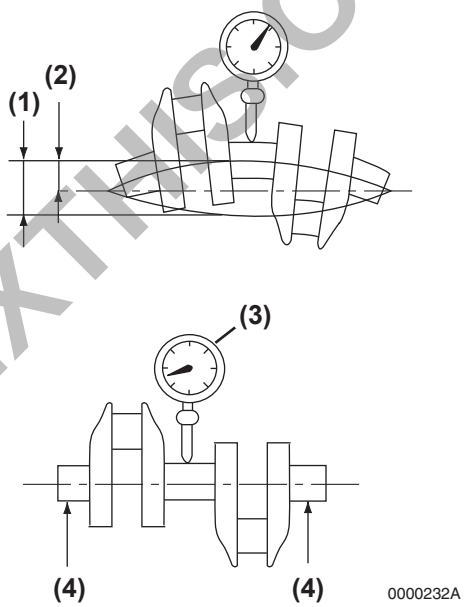


Figure 4-2-74

3. Rotate the crankshaft and observe runout. Record the measurements. *See "3-2 Engine Service Standard" section for the service limit.*
4. Use the color check method or MAGNAFLUX to inspect the crankshaft for cracks. Replace the crankshaft if evidence of fractures is found.

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2. TECHNICAL DATA

2. Technical Data

2-1 Specifications

Item			Unit	SK16
Main specifications of machine				
Dimensions				
Overall length (Transportation position)		Standard	mm	3450
		W/ long arm		3485
Cabin	Overall height	Transportation position		2280
		Traveling position		2280
	Overall width	Full machine width		980
Canopy	Overall height	Transportation position		2205
		Traveling position		2205
	Overall width	Full machine width		980
Tumbler center distance (Steel track / rubber track)				1200
Track gauge				750
Minimum ground clearance				190
Traveling performance				
Travel speed	Steel track	Low speed (Forward/Reverse)	km/hr	1,7
		High speed (Forward/Reverse)	km/hr	3,3
	Rubber track	Low speed (Forward/Reverse)	km/hr	1,7
		High speed (Forward/Reverse)	km/hr	3,3
Permissible water depth limit			mm	300
Work performance				
Bucket	Width (Standard)		mm	300
	[Standard. JIS heaped capacity]		m^3	0,03
	Number of teeth / Installation method		pcs.	3 / Rubber pin lock type
Work range				
Maximum digging depth	With blade raised (cabin <canopy>)		mm	2360 <2160>
	With blade on the ground (cabin <canopy>)		mm	2205 <2005>
Maximum depth of vertically digging (cabin <canopy>)			mm	1920 <1710>
Maximum dumping height (cabin <canopy>)			mm	2575 <2440>
Minimum front swing radius (with boom in front center)		Cabin	mm	1520
		Canopy	mm	1480
Minimum front swing radius (with boom in full swing)		Cabin	mm	1320
		Canopy	mm	1290

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2-7 Fuel, Lube Oil and Grease Recommended

Components	Fluid	Temperatures °C								Quantity prescribed (L)	
		-	-20	-10	0	10	20	30	+		
Thermal engine	Engine oil		SAE 10W CD							2,8	Oil filter
			SAE 10W-30CD								
				SAE 15W-40CD							
Side movement reducers	Box oil	SAE 90 (GL-4)								0,5	by reducer
Hydraulic circuit	Hydraulic oil			ISO VG46						20,0	in the tank
										8,5	the rest
Fuel tank	Diesel				N° 2-D					24,5	–
			N° 3-D								
			N° 3-D (S)								
Cooling system	Diluted long lasting cooling fluid **KOBELCO POWER COOLANT B–36**									2,8	radiator
										0,4	expansion flask

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2-6 Periodic Inspection and Servicing

○ : Verification and adjustment ● : Replacement □ : Cleaning ■ : Greasing

Parts & Operations		Daily	Every 50h	Every 250h	Every 500h	Every 1000h / Every year	Every 2000h / Every two years
General.	Missing or broken parts	○					
	Tightening of nuts and bolts	○					
	Motor state	○					
	Machine	□					
Transmissions	Oil for travel gears		● 1st time		○	●	
Hydraulic circuit	Hydraulic oil	○				●	
	Aspiration filter					□	
	Hydraulic oil return filter		● 1st time		●		
	Operation of the accumulator	○					
Greasing	Greasing points	■					
	Rotation pin and crown		■				
Chassis	Bearing rollers and bearings, idler wheels	○				■	
	Track tension	○					
Electrical equipment	Headlights, horn, travel alarm	○					
	Dashboard and indicators	○					
	System state	○					
Engine	Water separator	○					
	GO filter			●	●		
	Air filter (dusty atmosphere every 250 h)				●		
	Engine oil	○	● 1st time		●*		
	Oil filter		● 1st time		●*		
	Cooling fluid	○					●
	Belt	○				●	
	Radiator vents	○			□		
	Fuel hose, coolant hose						●
	Intake and exhaust valves					○	
	Injectors and injection pressure						○
Heating						○	

* Every 500h / Every year

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1. GENERAL CAUTIONS FOR MAINTENANCE WORK

1. General Cautions for Maintenance Work

1-1 Correct Work

Correct work means the quickest possible completion of according to the correct procedures and the specified standards.

It is important when conducting certain operations always to bear in mind the equipment, tools, gauges, materials, oil and grease, etc. that you must have ready, as well as items to be checked, adjusted, or disassembled, and cautions to watch out for.

1-2 Safety Precautions

(1) Never attempt servicing while engine is running or immediately after stopping operation.
(2) Wear work cloths, safety shoes and helmet.
(3) Check the equipment and tools before use. Especially, be sure to check the crane, lifting equipment and tools.
(4) When working together with other persons, allocate everyone's share of job, arrange the signals and act in concert with the other persons.
(5) The operation of the crane and slinging work must be performed by qualified persons.
(6) Do not enter or pass under the raised load.
(7) Lift and support the massive parts by crane before removing the installation bolts.
(8) Disconnect cables from battery before repairing the electric system.
(9) Remove the battery when welding the machine.

1-3 Preparations

(1) Check the service record of the machine. (That is, check how many months or hours the machine has been used since the preceding overhaul, what was the trouble then and what parts were replaced.)
(2) Have all servicing tools ready, i.e., tools, measuring devices (which have received periodic maintenance), containers, oil & grease, etc.
(3) Have the service literature (operation manual, parts catalog, etc.) ready.

1-4 Cautions for Disassembly and Reassembly

(1) Clean the machine before disassembly.
(2) Check and record the condition of the machine before disassembly :
  • Model, machine number, operation hours
  • Reasons for repair, history of repair
  • Contamination of filters
  • Fuel and oil condition
  • Damage to parts, etc.
(3) Place alignment marks on the necessary parts to facilitate reassembly.
(4) Clean all the removed parts and new replacement parts and put them in order.
(5) Use new seals, split pins, etc. for reassembly.

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⚠ 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.

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15. Do not loosen or remove the four bolts **(Figure 4-3-12, (3))** holding the pump drive gear to the hub. Only remove the single drive gear nut **(Figure 4-3-12, (1))** and washer **(Figure 4-3-12, (2))**, leaving the hub attached to the gear.

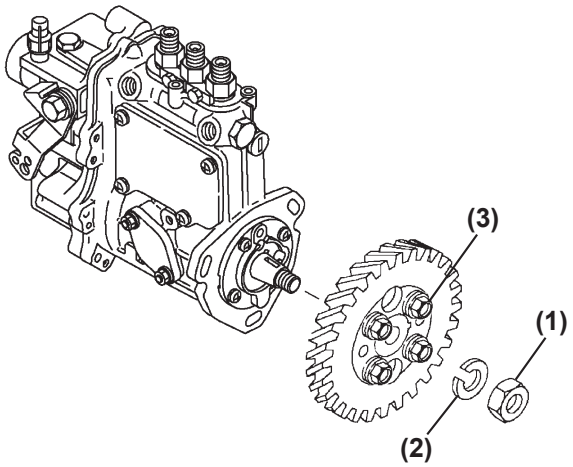


Figure 4-3-12

16. Hold the gear train stationary using a large socket wrench on the crankshaft pulley bolt. Loosen the fuel injection pump drive gear retaining nut **(Figure 4-3-12, (1))** and turn it out to the end of the fuel injection pump shaft.
17. Remove the injection pump drive gear and hub from the injection pump drive shaft as an assembly using an appropriate gear puller **(Figure 4-3-13)**.

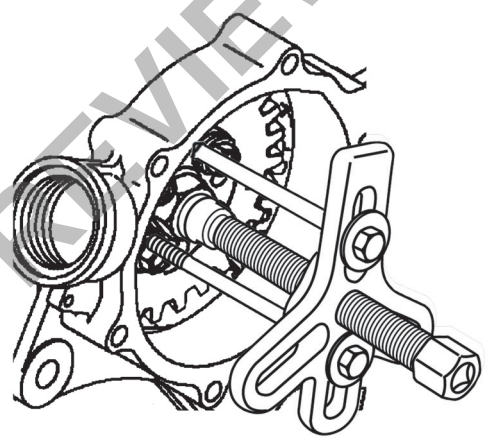


Figure 4-3-13

Note: The injection pump drive gear can be removed from the gear case; however, it is best to let it remain in the gear case.

18. Once the fuel injection pump drive gear and hub assembly have “popped” loose from the tapered fuel injection pump drive shaft, carefully remove the drive gear nut **(Figure 4-3-14, (1))** and lock washer **(Figure 4-3-14, (2))**.

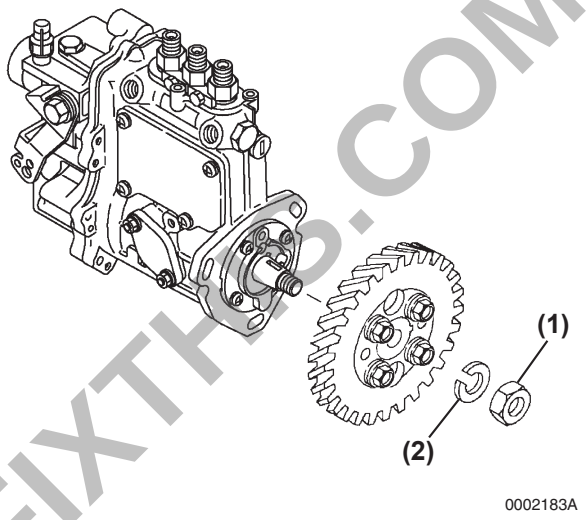


Figure 4-3-14

19. Locate the mark **(Figure 4-3-15, (1))** stamped into the upper outside mounting boss of the fuel injection pump. Highlight this mark and make a corresponding mark on the gear case or front plate.

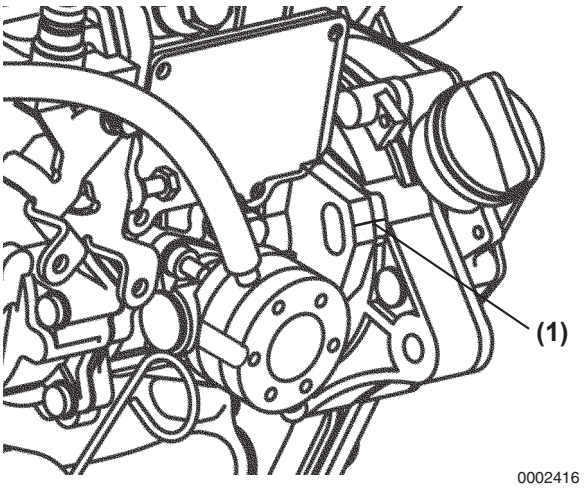


Figure 4-3-15

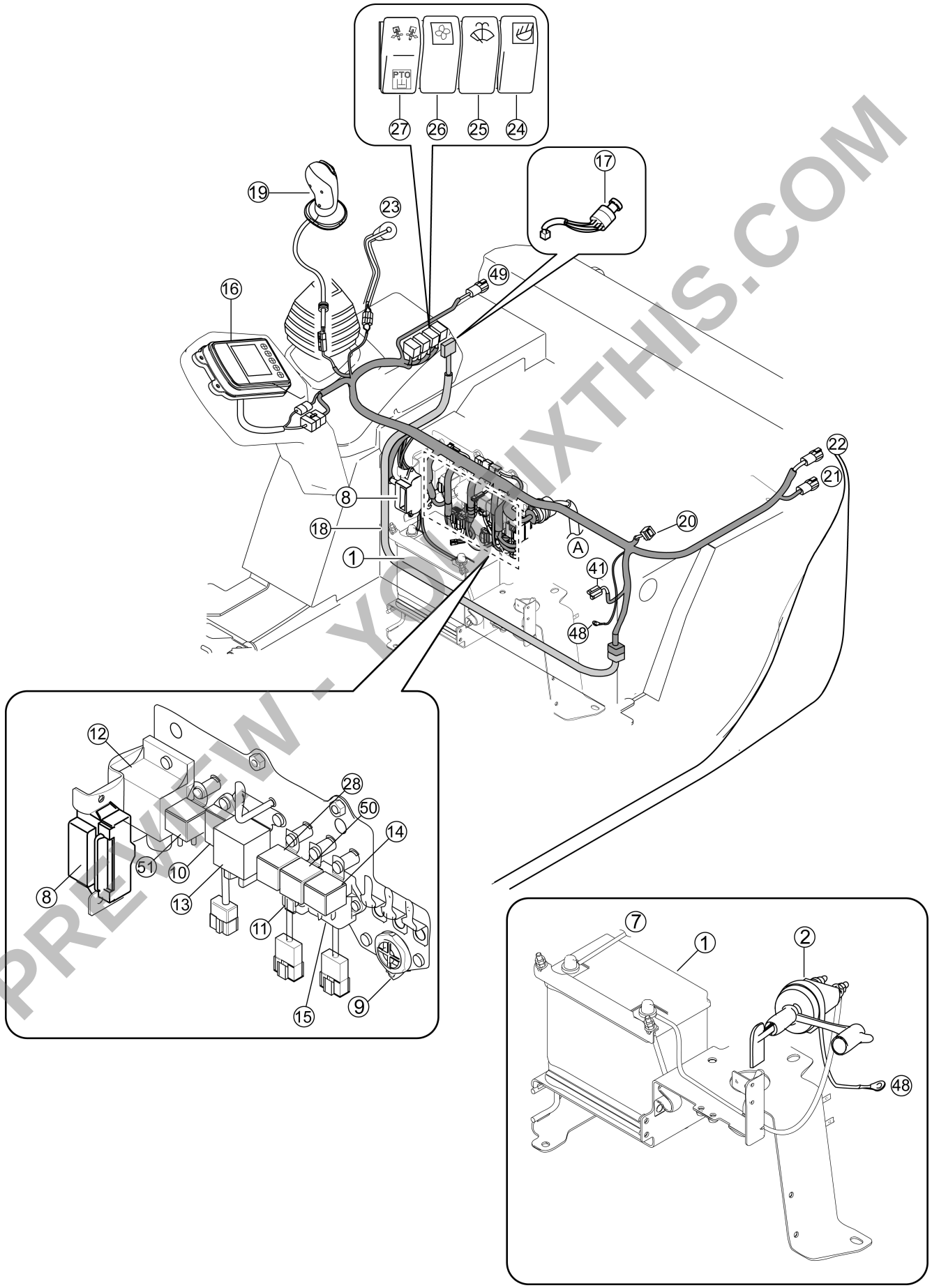
20. Remove the three nuts fastening the fuel injection pump to the gear case. Remove the fuel injection pump. Leave the fuel injection pump drive gear in the gear case and meshed with the idler gear.

NOTICE

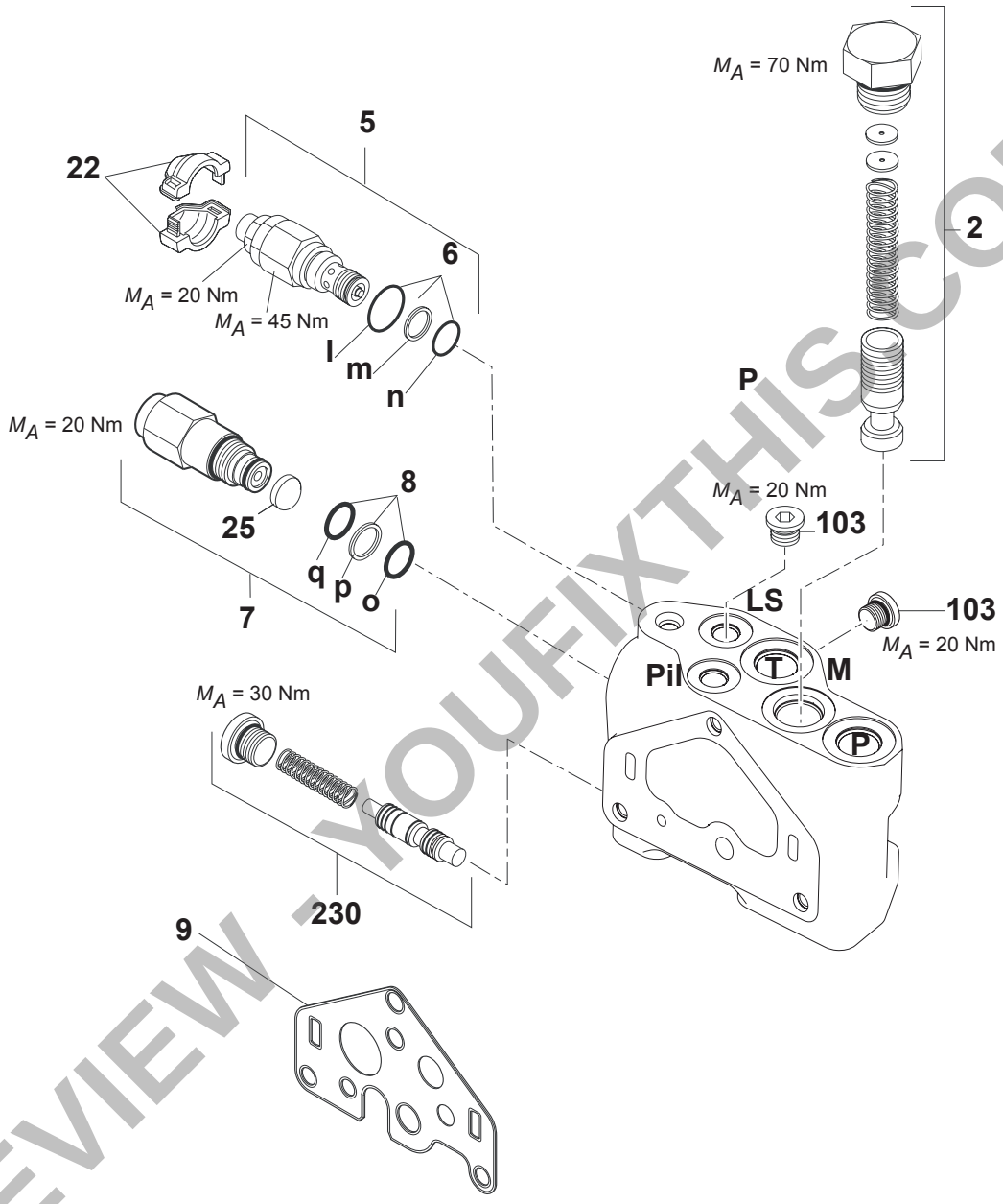
Do not rotate the crankshaft with the injection pump removed.

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2) Harness B and C



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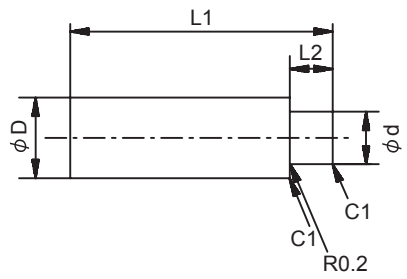
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7-3-3 Mechanical Control Linkage

1) Points of Assembly

(1) Use a jig to install the bushing into the link.

Bushing press-fitting jig

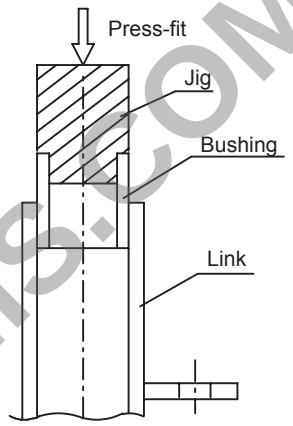


Unit : mm

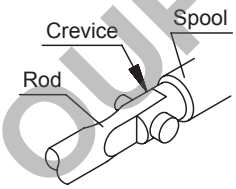
	Jig No.	
	F-001	F-002
ϕD	30	←
ϕd	14	20
L1	120	←
L2	14	←

Notes : F-001 : Blade lever
F-002 : Cut-off lever (L), Travel lever

Bushing installation

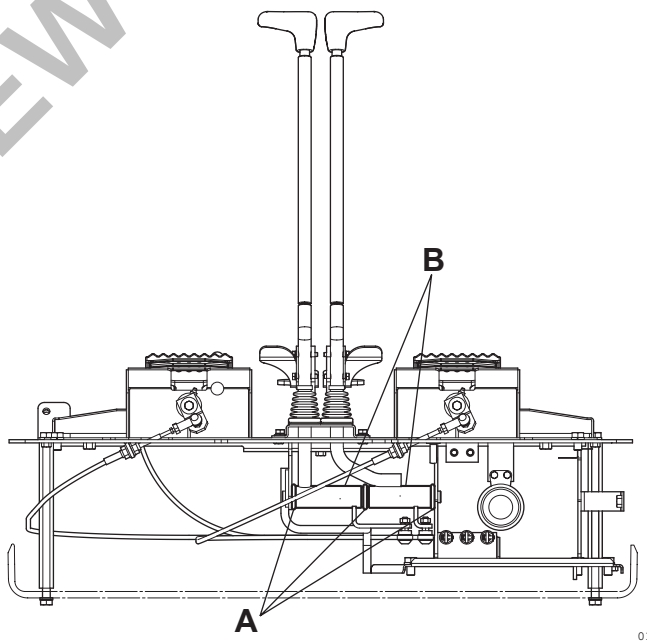


(2) Set the crevices of the control valve spools vertically.



(3) Apply grease to the links and take care not to damage the O-rings **A** when installing the links.

(4) Add grease to the grease nipples **B** after installation.



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