

# SHOP MANUAL

## **KOMATSU**

# **PW20-1**

# **PW30-1**

MACHINE MODEL	SERIAL No.
<b>PW20-1</b>	<b>1001 and up</b>
<b>PW30-1</b>	<b>1001 and up</b>

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	21-6		○	23-20	②		61-7			62-5	①		○	63-12	②
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## IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed by Komatsu for the purpose.

To prevent injury to workers, the symbols  and  are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.



## SAFETY

### GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
  - Always wear safety glasses when hitting parts with a hammer.
  - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.

6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

### PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

## PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.  
Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.  
Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.  
Check that the wire rope, chains and hooks are free from damage.  
Always use lifting equipment which has ample capacity.  
Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.  
Replace any damaged parts with new parts.
  - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.  
When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

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## FOREWORD

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This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

### **STRUCTURE AND FUNCTION**

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

### **TESTING AND ADJUSTING**

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

### **DISASSEMBLY AND ASSEMBLY**

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

### **MAINTENANCE STANDARD**

This section gives the judgement standards when inspecting disassembled parts.

### **NOTICE**

**The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your KOMATSU distributor for the latest information.**

## HOW TO READ THE SHOP MANUAL

### VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

- Chassis volume:** Issued for every machine model
- Engine volume:** Issued for each engine series
- Electrical volume** : } Each issued as one
- Attachments volume** : } volume to cover all models

These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

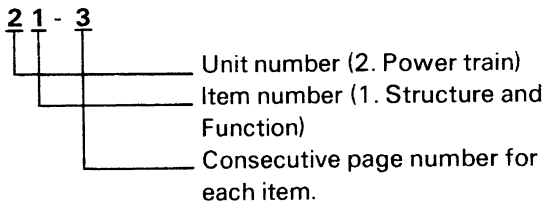
### DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

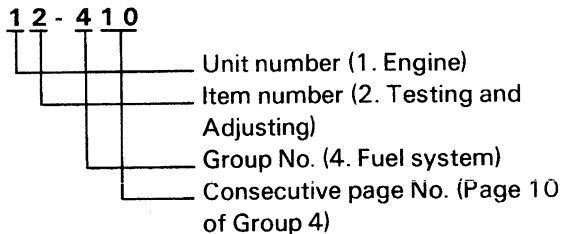
### FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.

Example 1 (Chassis volume):

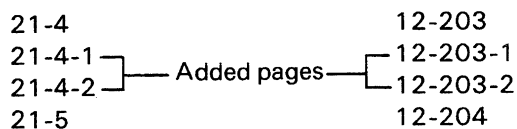


Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.

Example:



### REVISED EDITION MARK (①②③....)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

### REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

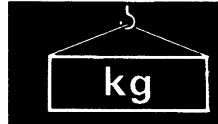
### SYMBOLS


So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.



# HOISTING INSTRUCTIONS



**!** Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol 

- If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
  - Check for removal of all bolts fastening the part to the relative parts.
  - Check for existence of another part causing interference with the part to be removed.

## 2. Wire ropes

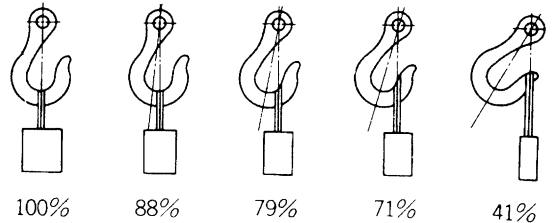
- Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes (Standard "Z" or "S" twist ropes without galvanizing)	
Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

- Sling wire ropes from the middle portion of the hook.

Slings near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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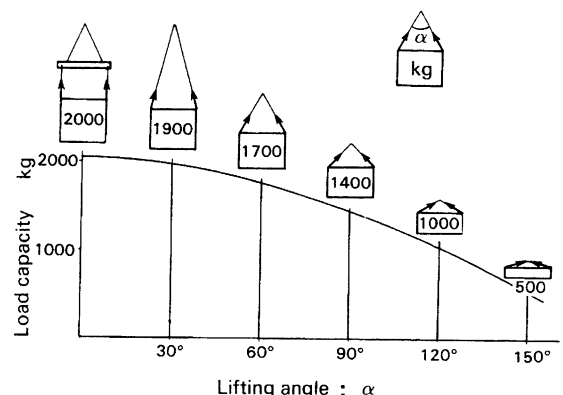
- Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

**!** Slings with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

- Do not sling a heavy load with ropes forming a wide hanging angle from the hook.

When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.

When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.





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## STANDARD TIGHTENING TORQUE

### 1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of "Disassembly and Assembly".

Thread diameter of bolt (mm)	Width across flat (mm)		
		kgm	Nm
6	10	1.35 ± 0.15	13.2 ± 1.4
8	13	3.2 ± 0.3	31.4 ± 2.9
10	17	6.7 ± 0.7	65.7 ± 6.8
12	19	11.5 ± 1.0	112 ± 9.8
14	22	18.0 ± 2.0	177 ± 19
16	24	28.5 ± 3	279 ± 29
18	27	39 ± 4	383 ± 39
20	30	56 ± 6	549 ± 58
22	32	76 ± 8	745 ± 78
24	36	94.5 ± 10	927 ± 98
27	41	135 ± 15	1320 ± 140
30	46	175 ± 20	1720 ± 190
33	50	225 ± 25	2210 ± 240
36	55	280 ± 30	2750 ± 290
39	60	335 ± 35	3280 ± 340

This torque table does not apply to the bolts with which nylon packings or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

★ Nm (newton meter): 1Nm ≅ 0.1 kgm

### 2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

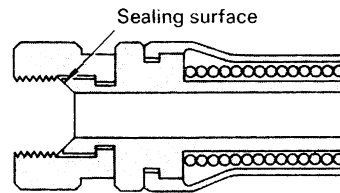
Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7 ± 0.7	65.7 ± 6.8
12	17	11.5 ± 1	112 ± 9.8
16	22	28.5 ± 3	279 ± 29

## STANDARD TIGHTENING TORQUE



### 3. TIGHTENING TORQUE FOR NUTS OF FLARED

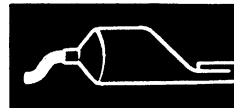
Use these torques for nut part of flared.



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Thread diameter of nut part (mm)	Width across flats of nut part (mm)	Tightening torque	
		kgm	Nm
14	19	2.5 ± 0.5	24.5 ± 4.9
18	24	5 ± 2	49 ± 19.6
22	27	8 ± 2	78.5 ± 19.6
24	32	14 ± 3	137.3 ± 29.4
30	36	18 ± 3	176.5 ± 29.4
33	41	20 ± 5	196.1 ± 49
36	46	25 ± 5	245.2 ± 49
42	55	30 ± 5	294.2 ± 49

## COATING MATERIALS



The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

Nomenclature	Komatsu code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs.
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.
	LT-2*	Preventing bolts, nuts and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
Liquid gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 – 0.08 mm)
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-LI	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	—	Used for protecting battery electrode terminals from corrosion.

\*LT-2 is also called LOCTITE in the shop manuals.



## ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.

This wire code table will help you understand WIRING DIAGRAMS.

Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

### CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	Dia. of strands (mm)	Cross section (mm <sup>2</sup> )			
01	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
02	26	0.32	2.09	3.1	20	Lighting, signal etc.
05	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

### CLASSIFICATION BY COLOR AND CODE

Priority	Circuits		Starting	Charging	Lighting	Signal	Instrument	Other
	Classification							
1	Primary	Code	B	W	R	G	Y	L
		Color	Black	White	Red	Green	Yellow	Blue
2	Auxiliary	Code	BW	WR	RW	GW	YR	LW
		Color	Black & White	White & Red	Red & White	Green & White	Yellow & Red	Blue & White
3		Code	BY	WB	RB	GR	YB	LR
		Color	Black & Yellow	White & Black	Red & Black	Green & Red	Yellow & Black	Blue & Red
4		Code	BR	WL	RY	GY	YG	LY
		Color	Black & Red	White & Blue	Red & Yellow	Green & Yellow	Yellow & Green	Blue & Yellow
5		Code	—	WY	RG	GB	YL	LB
		Color	—	White & Yellow	Red & Green	Green & Black	Yellow & Blue	Blue & Black
6		Code	—	WG	RL	GL	YW	
		Color	—	White & Green	Red & Blue	Green & Blue	Yellow & White	

# WEIGHT TABLE



This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine model	PW20-1	PW30-1
Engine ass'y	202	202
PTO	8	8
Tank ass'y (fuel tank, hydraulic tank)	59	59
Radiator (with oil cooler) (not including water or oil)	17	17
• Oil cooler	5	5
Transfer (with brake)	78	78
Drive shaft (front)	7	7
Drive shaft (rear)	10	10
Front axle	211	211
Rear axle	211	211
Tire (with rim)	41	54
Swing circle	46	46
Swing, machinery	32	32
Triple gear pump (with priority valve)	10	10
Steering valve	6	6
Suspension lock valve	3	3
Control valve (3-spool control valve)	8	8
• For swing, travel 3, blade		
• For travel 2, arm, swing	9	9
• For travel 1, bucket, boom	9	9
Center swivel joint	34	34

Machine model	PW20-1	PW30-1
Work equipment swivel joint	22	22
Travel motor (with brake valve)	83	83
• Brake valve	30	30
Swing motor	19	19
Steering cylinder	12	12
Suspension lock cylinder	14	14
Boom cylinder	26	26
Arm cylinder	24	26
Bucket cylinder	19	21
Swing cylinder	18	18
Blade cylinder	18	18
Boom ass'y (not including hydraulic equipment)	100	102
Arm ass'y (not including hydraulic equipment)	62	66
Bucket ass'y (not including hydraulic equipment)	54	60
Swing bracket	50	50
Blade ass'y	103	103
Chassis frame	510	510
Revolving frame and machine cab ass'y	468	726
Steel cab	180	180

# TABLE OF OIL AND COOLANT QUANTITIES

## PROPER SELECTION OF FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE					CAPACITY ( ℓ )	
		14 -10	32 0	50 10	68 20	86° F 30° C	Specified	Refill
Engine oil pan	Engine oil	SAE 30					4	4
		SAE 10W						
Swing machinery case Axle case (Front and rear on each side)		SAE 30					1.5	1.5
		SAE 10W						
Transfer case		SAE 10W					2.6	2.6
		SAE 10W						
Hydraulic tank		SAE 10W-30					56	36
		SAE 15W-40						
		SAE 10W						
Fuel tank		Diesel fuel	*					50
	ASTM D975 No. 2							
Cooling system	Water	Add antifreeze					5	-

※ ASTM D975 No. 1

ASTM: American Society of Testing and Material

SAE: Society of Automotive Engineers

Specified capacity: Total amount of oil including oil for components and oil in piping.

Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

### NOTE:

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual.  
Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

(2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, even though and atmospheric temperature goes up to 10°C more or less in the day time.

(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.

# ENGINE

## 12 TESTING AND ADJUSTING

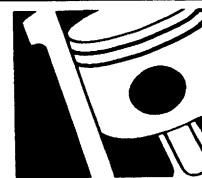



Table of judgement standard value .....	12- 2
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Measuring engine oil pressure .....	12- 4
Measuring engine oil, water temperature .....	12- 4
Adjusting valve clearance .....	12- 5
Measuring compression pressure .....	12- 6
Testing and adjusting fuel injection timing .....	12- 7
Fun belt tension .....	12- 8
Bleeding air from fuel line .....	12- 8

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★ The following precautions are necessary when using the Standard Value Tables to make judgements during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgement when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgements.

# TABLE OF JUDGEMENT STANDARD VALUE

Engine model				3D84-1H (PW20) 3D84-1J (PW30)		
Category	Item	Measuring conditions	Unit	Standard value	Permissible value	
Engine	Engine speed	High idling	rpm	$3,100 \pm 50$	$3,100 \pm 50$	
		Low idling	rpm	$900^{+100}_0$	$900^{+100}_0$	
		Rated speed	rpm	2,850	2,850	
	Exhaust color	Sudden acceleration	Bosch index	3.2 – 3.5		
		Low idling	Bosch index	1.0		
	Valve clearance (cold)	Both intake and exhaust valves	mm	0.2	–	
	Compression pressure (SAE30 oil)	Oil temperature: Min. 60°C Engine speed: 250 rpm	kg/cm <sup>2</sup>	Min. 35	30	
	Blow-by pressure (SAE30 oil)	(Water temperature operating range) at high idling	mmH <sub>2</sub> O	–	–	
	Oil pressure (SAE30 oil)	Engine speed: 1200 rpm Oil temperature: 100 – 110°C	kg/cm <sup>2</sup>	Min. 1.5	Min. 1.5	
Oil temperature	All speed ranges (inside oil pan)	°C	100 – 110	–		
Fuel injection timing	Before compression TDC	°	19	19		
Belt tension	Deflection when pressed with finger force of 6 kg	mm	7.5	5 – 10		
Fuel control	Stroke	Fuel control pedal	Position 150 mm from fulcrum  F21E01102	mm	$80 \pm 15$	
		Fuel control lever	STOP → low idling	mm	$50 \pm 10$	
	Low idling → FULL		$90 \pm 20$			
	Operating force	Fuel control pedal		kg	$5 \pm 3$	$5 \pm 3$
		Fuel control lever	Low → stop	kg	$7 \pm 3$	$7 \pm 3$
	Low → high		$4 \pm 2$		$4 \pm 2$	

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## TOOL LIST FOR TESTING AND ADJUSTING

No.	Check item	Tool	Part No.	Remarks
1	Engine speed	Multi-tachometer	799-203-8000	Digital display: L: 60–2,000rpm H: 60–20,000rpm
2	Water, oil temperature	Digital temperature gauge	799-101-6000	–50 – 1,200°C
3	Lubricant pressure	Hydraulic tester	799-101-5000	Pressure gauge: 25, 60, 400, 600 kg/cm <sup>2</sup>
		Digital hydraulic tester	790-261-1100	Pressure gauge: 500 kg/cm <sup>2</sup>
4	Compression pressure	Compression gauge	795-502-1590	0 – 70 kg/cm <sup>2</sup> Kit Part No. 795-502-1205
		Adapter	795-414-1110	
5	Blow-by pressure	Blow-by checker	799-201-1504	0 – 500 mmH <sub>2</sub> O
6	Valve clearance	Feeler gauge	Commercially available	Intake: 0.2 mm Exhaust: 0.2 mm
7	Exhaust color	Hand smoke checker	799-201-9000	Contamination 0 – 70% (with standard color)
		Smoke meter	Commercially available	(Contamination x 1/10 = Bosch index)

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# MEASURING ENGINE OIL PRESSURE

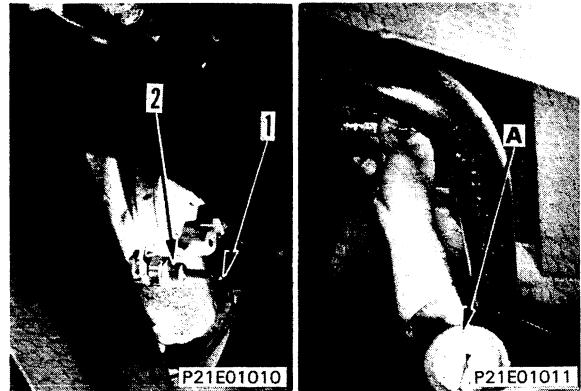
 When taking measurements, be careful not to get your clothes caught in rotating parts.

 Install and remove the plugs and oil pressure gauge with the engine stopped.

★ Measure the engine oil pressure when the oil is at the specified temperature.

### Special tools required

	Part No.	Part name	Q'ty
A	799-101-5000	Hydraulic tester	1



### 1. Measuring engine oil pressure

- 1) Disconnect wiring (1), then remove switch (2).
- 2) Install oil pressure gauge A (25 kg/cm<sup>2</sup>).
- 3) Start the engine and measure the oil pressure.

# MEASURING ENGINE OIL, WATER TEMPERATURE


### Special tools required


	Part No.	Part name	Q'ty
A	799-101-6000	Digital temperature gauge	1

### 1. Measuring engine oil temperature

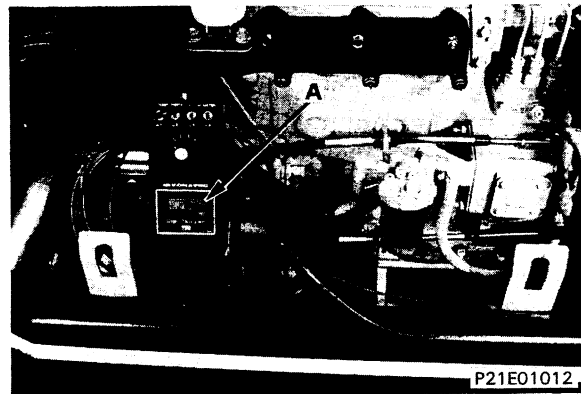
- 1) Remove dipstick.
- 2) Insert sensor end of thermistor temperature gauge through dipstick opening. Then, connect sensor to thermistor temperature gauge proper (Tool A) and measure oil temperature in engine oil pan.

### 2. Measuring coolant temperature

 When checking the water level in the radiator wait for the water to cool. Do not remove the radiator cap while the water is hot. Boiling water may spurt out. Be sure to turn radiator cap slowly to release pressure inside radiator.

 When measuring the temperature of the coolant, be careful not to get your fingers, clothing or the sensor cable caught in the rotating parts.

- 1) Disconnect cable (1) and remove sensor (2).
- 2) Install adapter and sensor of tool A into the water temperature pick-up port.
- 3) Connect sensor cable to tool A (thermistor temperature gauge proper).
- 4) Fill radiator with water.  
Start engine and measure water temperature.



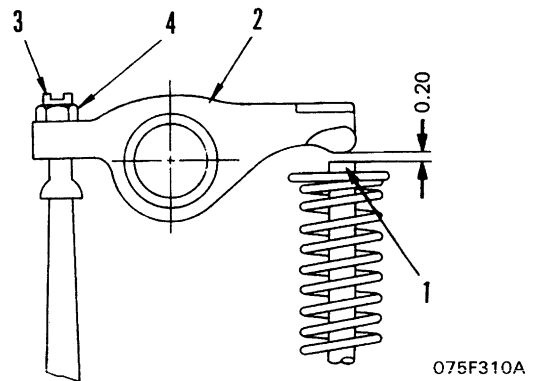
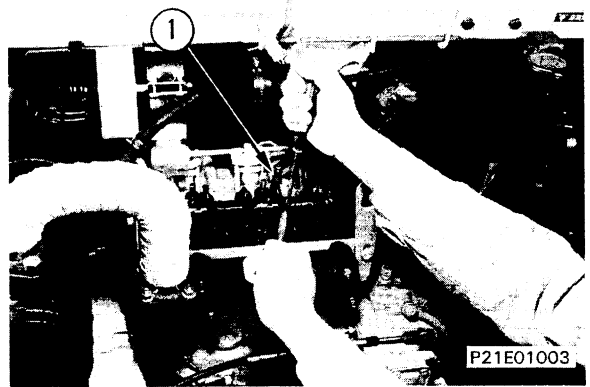
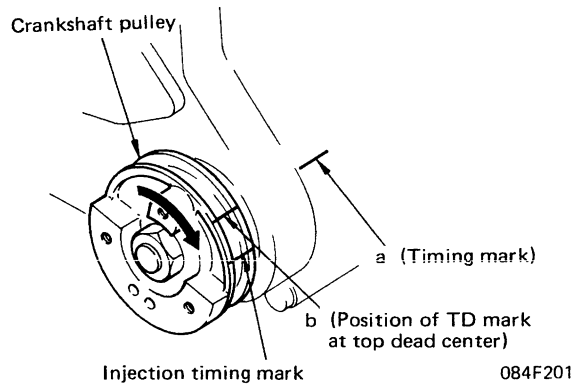
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# ADJUSTING VALVE CLEARANCE

★ Adjust the clearance between the valve and rocker lever as follows.

	mm	
	Intake valve	Exhaust valve
Cold	0.20	0.20

1. Remove cylinder head cover.
2. Rotate the crankshaft in the normal direction to align timing mark "a" on the gear case with the TD mark "b" on the crankshaft pulley. When rotating, check the movement of the valves of No.3 cylinder. When the marks are in line, No.3 cylinder should be at compression top dead center.
  - ★ When the crankshaft is rotating, the valves of the cylinder at compression top dead center do not move.
  - ★ If the valves of No.3 cylinder are moving, rotate the crankshaft one more turn in the normal direction and align the marks.
  - ★ If this is done, No.3 cylinder (flywheel end) will be at compression top dead center.
3. To adjust, insert feeler gauge ① between rocker lever (2) and valve stem (1) and turn adjustment screw (3) until the clearance is a sliding fit. Then tighten locknut (4) to hold the adjustment screw in position.
  - ★ After tightening the locknut, check the clearance again.
4. Next, rotate the crankshaft 240° in the normal direction and adjust the valve clearance of the valves of the remaining cylinders.
  - ★ Firing order: 3-1-2



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## MEASURING COMPRESSION PRESSURE

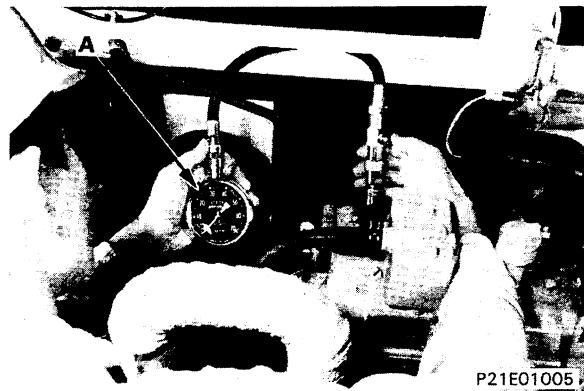
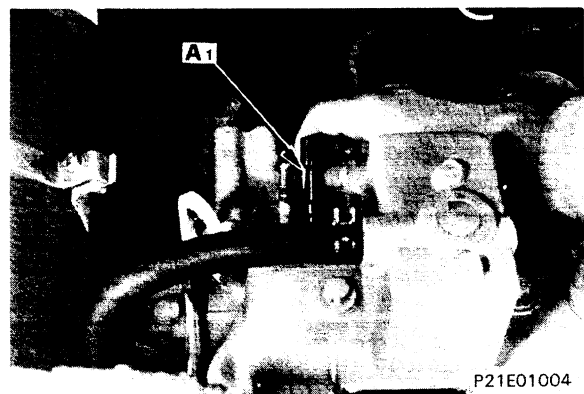
### Special tools required

	Part No.	Part name	Q'ty
A	795-502-1590	Compression gauge	1
A <sub>1</sub>	795-414-1110	Adapter	1

- ★ If performance tests or troubleshooting shows that the piston, piston ring or cylinder liner may be worn, measure the compression pressure.

**!** When measuring the compression pressure, be careful not to touch the fan or fan belt, or to get caught in rotating parts.

1. Adjust the valve clearance.
2. Warm up the engine until the oil temperature is over 60°C.
3. Remove the nozzle holder assembly.
  - ★ For details, see 13 REMOVAL OF NOZZLE HOLDER ASSEMBLY.
4. Install adapter A<sub>1</sub> in the mount of the nozzle holder assembly.
5. Connect tool A to adapter A<sub>1</sub>.
6. Place the fuel control lever in the NO INJECTION position. Crank the engine with the starting motor and measure the compression pressure.
  - ★ When measuring the compression pressure, measure the engine speed to confirm that it is within the specified range.
  - ★ Measure the compression pressure at the point where the pressure gauge indicator remains steady.



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