SEBM036301

SHOP MANUAL

KOMATSU

PC130-7

MACHINE MODEL	SERIAL NUMBER
PC130-7	**70001 and up**

- This shop manual may contain attachiments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require.
  Materials and specifications are subject to change without notice.
- PC130-7 mounts the SAA4D95LE-3 engine.
  For details of the engine, see the 95-3 Series Engine Shop Manual.

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20 TESTING AND ADJUSTING

★ Note the following when making judgements using the standard value tables for testing, adjusting, or troubleshooting.

1. The standard value for a new machine given in the table is the value used when shipping the machine from the factory and is given for reference. It is used as a guideline for judging the progress of wear after the machine has been operated, and as a reference value when carrying out repairs.
2. The service limit value given in the tables is the estimated value for the shipped machine based on the results of various tests. It is used for reference together with the state of repair and the history of operation to judge if there is a failure.
3. These standard values are not the standards used in dealing with claims.

⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground, inset the safety pins, and use blocks to prevent the machine from moving.

⚠ When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.

⚠ When checking the water level, always wait for the water to cool down. If the radiator cap is removed when the water is still hot, the water will spurt out and cause burns.

⚠ Be careful not to get caught in the fan, fan belt or other rotating parts.

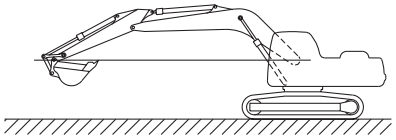
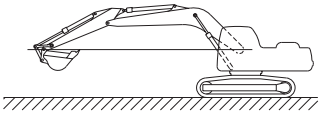
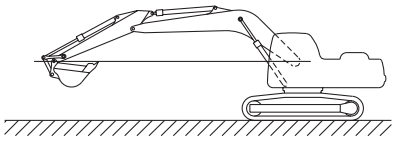
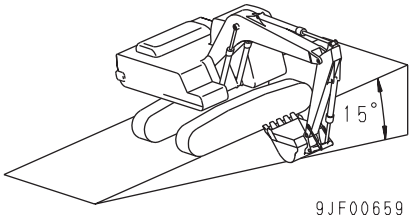
STANDARD VALUE TABLE FOR ENGINE

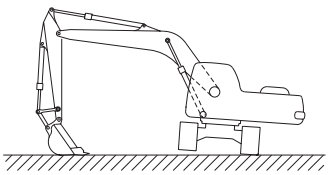
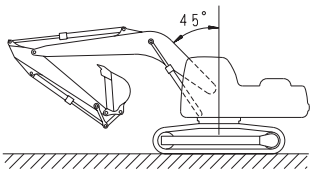
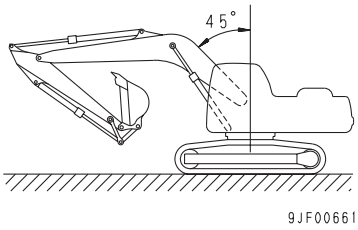
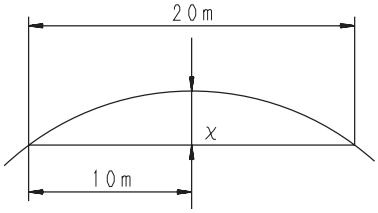
Model name			PC130-7	
Engine			SAA4D95LE-3	
Item	Measurement condition	Unit	Standard value	Permissible value
Engine speed	High idling	rpm	2,350 ± 100	2,350 ± 100
	Low idling		1,100 ± 50	1,100 ± 50
	Rated speed		2,200	—
Exhaust gas color	During sharp acceleration	Bosch index	Max. 4.5	Max. 6.5
	During high idling		Max. 1.0	Max. 2.0
Valve clearance (Cooled)	Intake valve	mm	0.35	—
	Exhaust valve		0.50	—
Compression pressure	Oil temperature: 40 – 60 °C (Engine speed)	MPa {kg/cm^2} (rpm)	Min. 2.9 {Min. 30} (320 – 360)	2.0 {20} (320 – 360)
Blow-by pressure	Coolant temperature: Within operating range At rated output	kPa {mmH_2O}	Max. 0.49 {Max. 50}	0.98 {100}
Oil pressure	Coolant temperature: Within operating range	MPa {kg/cm^2}		
	At high idling (SAE30)		0.34 – 0.59 {3.5 – 6.0}	0.25 {2.5}
	At high idling (SAE10W)		0.29 – 0.54 {3.0 – 5.5}	0.21 {2.1}
	At low idling (SAE30)		Min. 0.1 {Min. 1.0}	0.07 {0.7}
	At high idling (SAE10W)		Min. 0.08 {Min. 0.8}	0.07 {0.7}
Oil temperature	Through speed range (In oil pan)	°C	90 – 110	120
Fuel injection timing	Before top dead center (BTDC)	°	6 ± 0.75	6 ± 0.75
Fan belt tension	Deflection under finger pressure of 58.8 N {6 kg}	mm	6 – 10	6 – 10
Air conditioner compressor belt tension	Deflection under finger pressure of 58.8 N {6 kg}	mm	6 – 10	6 – 10

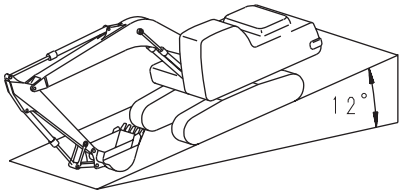
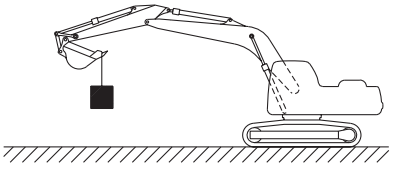
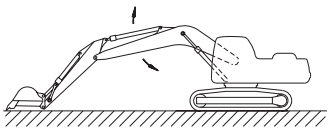
STANDARD VALUE TABLE FOR CHASSIS

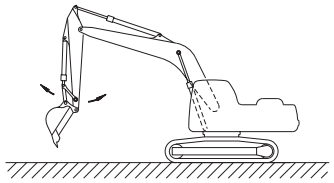
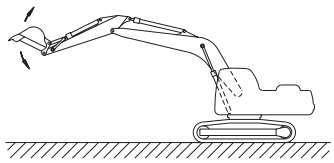
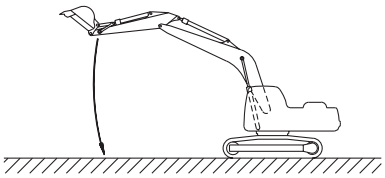
Model name				PC130-7	
Category	Item	Measurement condition	Unit	Standard value	Permissible value
Engine speed	Pump relief	• Engine coolant temperature: Within operating range • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Arm OUT relief	rpm	2,120 ± 100	2,120 ± 100
	Pump relief + One-touch power maximizing	• Engine coolant temperature: Within operating range • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Arm OUT relief + One-touch power maximizing switch ON	rpm	2,180 ± 100	2,180 ± 100
	During auto-deceleration	• Engine speed: High idling • Auto-decelerator switch: ON • All control levers in neutral	rpm	1,400 ± 100	1,400 ± 100
Control valve spool stroke	Boom control valve	• Engine: Stopped	mm	8.0 ± 0.5	8.0 ± 0.5
	Arm control valve	IN		9.5 ± 0.5	9.5 ± 0.5
		OUT		8.0 ± 0.5	8.0 ± 0.5
	Bucket control valve			8.0 ± 0.5	8.0 ± 0.5
	Swing control valve			8.0 ± 0.5	8.0 ± 0.5
	Travel control valve			8.0 ± 0.5	8.0 ± 0.5
Control lever stroke	Boom control lever	• Engine: Stopped • Center of lever grip • Read max. value to stroke end (Exclude play in neutral position).	mm	85 ± 10	85 ± 10
	Arm control lever			85 ± 10	85 ± 10
	Bucket control lever			85 ± 10	85 ± 10
	Swing control lever			85 ± 10	85 ± 10
	Travel control lever			112 ± 15	112 ± 15
	Play of control lever			10 ± 15	10 ± 15
Operating effort of control lever	Boom control lever	• Hydraulic oil temperature: Within operating range • Engine speed: High idling • Center of lever grip • Tip of pedal • Read max. value to stroke end	N {kg}	15.7 ± 3.9 {1.6 ± 0.4}	Max. 24.5 {Max. 2.5}
	Arm control lever			15.7 ± 3.9 {1.6 ± 0.4}	Max. 24.5 {Max. 2.5}
	Bucket control lever			12.7 ± 2.9 {1.3 ± 0.3}	Max. 21.6 {Max. 2.2}
	Swing control lever			12.7 ± 2.9 {1.3 ± 0.3}	Max. 21.6 {Max. 2.2}
	Travel control lever			24.5 ± 5.9 {2.5 ± 0.6}	Max. 39.2 {Max. 4.0}
	Travel control pedal			80.4 ± 20.1 {8.2 ± 2.0}	Max. 107.9 {Max. 11}

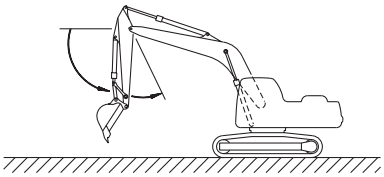
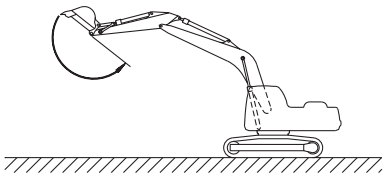
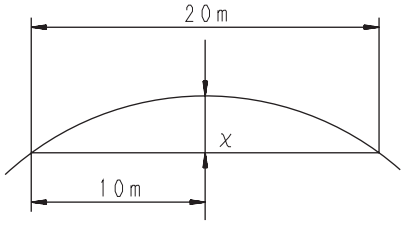
Model name					PC130-7	
Category	Item	Measurement condition		Unit	Standard value	Permissible value
Oil pressure	Unload pressure	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Pump outlet pressure when all levers are in neutral		MPa {kg/cm²}	2.9 ± 0.5 {30 ± 5}	2.9 ± 0.5 {30 ± 5}
	Boom relief pressure	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Pump outlet pressure when measured circuit is relieved	At normal relief	MPa {kg/cm²}	$31.9^{+2.0}_{0}$ $\{325^{+20}_{0}\}$	33.3 – 36.8 {340 – 375}
			At power max.		34.8 ± 1.0 {355 ± 10}	36.3 – 39.2 {370 – 400}
	Arm relief pressure		At normal relief		$31.9^{+2.0}_{0}$ $\{325^{+20}_{0}\}$	33.3 – 36.8 {340 – 375}
			At power max.		34.8 ± 1.0 {355 ± 10}	36.3 – 39.2 {370 – 400}
	Bucket relief pressure		At normal relief		$31.9^{+2.0}_{0}$ $\{325^{+20}_{0}\}$	33.3 – 36.8 {340 – 375}
			At power max.		34.8 ± 1.0 {355 ± 10}	36.3 – 39.2 {370 – 400}
	Swing relief pressure				28.9 ± 1.5 {295 ± 15}	28.9 – 32.9 {295– 335}
	Travel relief pressure				34.8 ± 1.0 {355 ± 10}	36.3 – 39.2 {370 – 400}
	Control circuit basic pressure	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Outlet pressure of self-reducing pressure valve when all levers are in neutral		MPa {kg/cm²}	3.23 ± 0.2 {33 ± 2}	2.84 – 3.43 {29 – 35}
	LS differential pressure	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Pump pressure - LS pressure	When all levers are in neutral	MPa {kg/cm²}	$2.7^{+1.0}_{-0.7}$ $\{28^{+10}_{-7}\}$	$2.7^{+1.0}_{-0.7}$ $\{28^{+10}_{-7}\}$
			When travel system runs idle at Hi		2.2 ± 0.1 {22.5 ± 1}	2.2 ± 0.1 {22.5 ± 1}

Model name				PC130-7	
Category	Item	Measurement condition	Unit	Standard value	Permissible value
Swing	Overrun of swing	 9JF00656 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Quantity of overrun of swing circle when it stops after 1 turn • ( ): Qty of overrun of periphery of swing circle	deg (mm)	75 ± 10 {730 ± 100}	Max. 90 (Max. 870)
	Time taken to start swinging	 9JF00656 90° 180° • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Time taken to swing 90° and 180° after starting	sec	2.9 ± 0.3 4.0 ± 0.4	Max. 3.5 Max. 8.5
	Time taken to swing	 9JF00656 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Time taken to swing 5 turns after swinging 1 turn	sec	28.6 ± 4.8	28.6 ± 5.8
	Hydraulic drift of swing	 9JF00659 • Hydraulic oil temperature: 45 – 55 °C • Engine: Stopped • Set upper structure at 90° to machine body on slope of 15°. • Make match marks on inner race and outer race of swing circle. • Measure deviation of match marks in 15 minutes.	mm	0	0

Model name				PC130-7	
Category	Item	Measurement condition	Unit	Standard value	Permissible value
Swing	Leakage from swing motor	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Swing lock switch: LOCK • Measure leakage for 1 minutes while swing circuit is relieved.	ℓ/min	Max. 3	Max. 6
Travel	Travel speed (Idle run)	 9JF00660 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Measure time taken to rotate track shoe 5 turns after 1 turn.	Lo	46.1 ± 9.2	46.1 ± 9.2
			Hi	21.9 ± 2.2	23.1 ± 3.0
	Travel speed (Actual travel)	 9JF00661 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Hard and level place • Measure time taken to travel 20 m after running up 10 m.	Lo	27.6 ± 5.1	27.6 ± 7.1
			Hi	13.2 ± 1.2	13.2 ± 1.7
	Travel deviation	 9JF00661 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Travel speed: Lo • Hard and level place • Measure travel deviation in travel of 20 m after running up 10 m.  9JF00662	mm	Max. 200	Max. 220

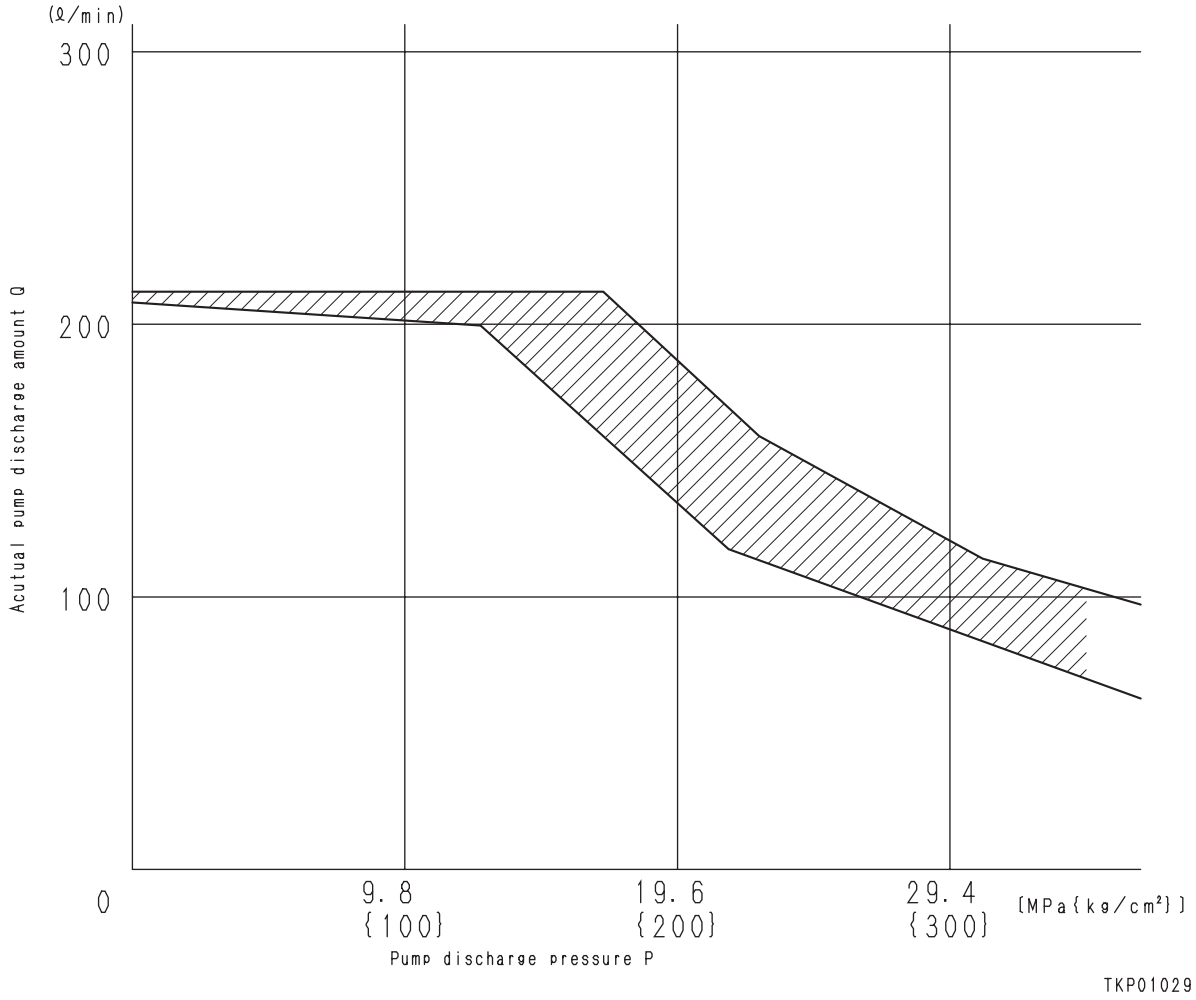
Model name					PC130-7	
Category	Item		Measurement condition	Unit	Standard value	Permissible value
Travel	Hydraulic drift of travel		 9JF00663 • Hydraulic oil temperature: 45 – 55 °C • Engine: Stopped • Stop machine on slope of 12 degrees with sprocket on upper side. • Measure hydraulic drift of travel in 5 minutes.	mm	0	0
	Leakage from travel motor		• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Lock sprocket. • Measure leakage for 1 minutes while travel circuit is relieved.	ℓ/min	Max. 5	Max. 10
Work equipment	Hydraulic drift of work equipment	Whole work equipment (Hydraulic drift of tooth tip)	 9JF00664 • Hydraulic oil temperature: 45 – 55 °C • Level and flat place • Bucket: Full of dirt and sand or filled with rated load (1,080 kg) • Level boom top, retract arm cylinder fully, and extract bucket cylinder fully. • Engine: Stopped • Work equipment control lever: Neutral • Start measuring hydraulic drift just after setting machine and measure every 5 minutes for 15 minutes.	mm	Max. 460	Max. 700
		Boom cylinder (Retraction of cylinder)			Max. 10	Max. 12
		Arm cylinder (Extension of cylinder)			Max. 80	Max. 90
		Bucket cylinder (Retraction of cylinder)			Max. 22	Max. 40
	Work equipment speed	Boom speed	 9JF00665 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Measure time taken to move bucket between RAISE stroke end and ground touch point of bucket.	RAISE	sec	3.7 ± 0.4	Max. 4.3
				LOWER		2.6 ± 0.5	Max. 3.2

Model name						PC130-7	
Cate-gory	Item		Measurement condition		Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Arm speed	 9JF00666 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Measure time taken to move arm between OUT stroke end and IN stroke end (between starting points of cushion).	CURL	sec	3.2 ± 0.4	Max. 4.4
				DUMP		3.1 ± 0.3	Max. 3.7
		Bucket speed	 9JF00667 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Measure time taken to move bucket between DUMP stroke end and CURL stroke end	CURL	sec	2.9 ± 0.3	Max. 3.7
				DUMP		2.3 ± 0.2	Max. 2.9
	Time lag	Boom time lag	 9JF00668 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: Low idling • Working mode: A • Lower boom from RAISE stroke end and measure time taken to start raising front of machine after bucket touches ground.		sec	Max. 3.0	Max. 4.0

Model name					PC130-7	
Category	Item		Measurement condition	Unit	Standard value	Permissible value
Work equipment	Time lag	Arm time lag	 9JF00669 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: Low idling • Working mode: A • Move IN arm from OUT stroke end and measure time taken to start moving arm again after it is stopped. • For measuring posture, see WORK EQUIPMENT 6.	sec	Max. 2.0	Max. 3.0
		Bucket time lag	 9JF00670 • Hydraulic oil temperature: 45 – 55 °C • Engine speed: Low idling • Working mode: A • Curl bucket from DUMP stroke end and measure time taken to start moving bucket again after it is stopped. • For measuring posture, see WORK EQUIPMENT 7.	sec	Max. 2.0	Max. 3.0
	Oil leakage	Cylinder	• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Relieve cylinder to be measured or travel circuit and measure leakage in 1 minute.	cc/min	Max. 3.5	Max. 15
		Center swivel joint			Max. 10	Max. 50
Compound operation performance	Travel deviation in compound operation of work equipment and travel		• Hydraulic oil temperature: 45 – 55 °C • Engine speed: High idling • Working mode: A • Travel speed: Lo • Hard and level place • Measure travel deviation in travel of 20 m after running up 10 m.  9JF00662	mm	Max. 500	Max. 500

Model name				PC130-7	
Category	Item	Measurement condition	Unit	Standard value	Permissible value
PC flow control characteristics	Time taken to swing 90° in compound operation of raising boom and starting swinging	• Hydraulic oil temperature: 45 – 55 °C • Engine: High idling • Working mode: A • Bucket: Filled with rated load • Hard and level place • Set arm vertically and lower back of bucket to ground. • Raise boom and start swinging simultaneously from above posture and measure time taken to pass 90° point.	sec	4.0 (Reference value)	
Pump performance	Hydraulic pump capacity	• See graph.	ℓ/min	See graph.	

Model name				PC130-7	
Cate-gory	Item	Measurement condition	Unit	Standard value	Permissible value
Pump performance	Hydraulic pump performance				



- PC-EPC current: 400 mA
- Pump speed: 2,000 rpm

Check point	Test pump discharge pressure (MPa{kg/cm2})	Standard discharge (ℓ/min)	Lower limit of discharge (ℓ/min)
Any point	P	Q (See graph)	Q (See graph)

★ Avoid measuring near a broken point of the graph, since the error becomes large at that point.
★ When measuring without removing the pump from the machine, if the engine speed cannot be set to the specified speed with the fuel control dial, calculate the pump discharge pressure at the specified speed from the engine speed and pump discharge at the time of measurement.

TESTING AND ADJUSTING

TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING

Testing and adjusting item	Symbol		Part No.	Part name	Q'ty	Remarks
Measuring exhaust gas color	A	1	799-203-9000	Handy smoke checker	1	Pollution level: 0 – 70% (With standard color) (Pollution level x 1/10 ≒ Bosch index)
		2	Commercially available	Smoke meter	1	
Adjusting valve clearance	B		Commercially available	Feeler gauge	1	(Air intake side: 0.35 mm, Exhaust side: 0.50 mm)
Measuring compression pressure	C		795-502-1205	Compression gauge	1	0 – 6.9MPa {0 – 70kg/cm^2}
			795-502-1370	Adapter	1	For 95E-3 engine
			6204-11-3880	Gasket	1	
Measuring blow-by pressure	D		799-201-1504	Blow-by checker	1	—
Measuring engine oil pressure	E	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5,5.9,39.2,58.8MPa {25,60,400,600kg/cm^2}
			790-261-1203	Digital hydraulic tester	1	Pressure gauge: 58.8MPa {600kg/cm^2}
		2	799-401-2320	Hydraulic tester	1	Pressure gauge: 0.98MPa {10kg/cm^2}
		3	799-401-3500	Adapter	1	Size: 06
		4	799-101-5220	Nipple	1	Size: 10 x 1.25mm
			07002-11023	O-ring	1	
Measuring fuel injection timing	F	1	795-102-2103	Spring pusher	1	For delivery valve method
		2	Commercially available	Dial gauge	1	
Measuring clearance of swing circle bearing	G		Commercially available	Dial gauge	1	—
Testing and adjusting oil pressure in work equipment, swing, and travel circuits	H	1	799-101-5002	Hydraulic tester	1	* Same as E1
			790-261-1203	Digital hydraulic tester	1	
		2	799-101-5220	Nipple	1	* Same as E4
			07002-11023	O-ring	1	
Measuring control circuit basic pressure	J	1	799-101-5002	Hydraulic tester	1	* Same as E1
			790-261-1203	Digital hydraulic tester	1	
		2	799-101-5230	Nipple	1	Size: 14 x 1.5mm
			07002-11423	O-ring	1	
Testing and adjusting oil pressure in pump PC control circuit	K	1	799-101-5002	Hydraulic tester	1	* Same as H (Only quantity is different)
			790-261-1203	Digital hydraulic tester	1	
		2	799-101-5230	Nipple	2	
			07002-11423	O-ring	2	

Testing and adjusting item	Symbol		Part No.	Part name	Q'ty	Remarks
Testing and adjusting oil pressure in pump LS control circuit	L	1	799-101-5002	Hydraulic tester	1	* Same as H (Only quantity is different)
			790-261-1203	Digital hydraulic tester	1	
		2	799-101-5230	Nipple	2	
			07002-11423	O-ring	2	
		3	799-401-2701	Differential pressure gauge	1	—
Measuring solenoid valve output pressure	M	1	799-101-5002	Hydraulic tester	1	* Same as E1
			790-261-1203	Digital hydraulic tester	1	
		2	799-401-3100	Adapter	1	Size: 03
Measuring PPC valve output pressure	N	1	799-101-5002	Hydraulic tester	1	* Same as E1
			790-261-1203	Digital hydraulic tester	1	
		2	799-401-3100	Adapter	1	* Same as M2
Measuring oil leakage	P		Commercially available	Measuring cylinder	1	
Measuring water temperature and oil temperature	—		799-101-1502	Digital thermometer	1	-99.9 – 1,299°C
Measuring operating effort and pressing force	—		79A-264-0021	Push-pull scale	1	0 – 294N {0 – 30kg}
			79A-264-0091	Push-pull scale	1	0 – 490N {0 – 50kg}
Measuring stroke and hydraulic drift	—		Commercially available	Scale	1	—
Measuring work equipment speed	—		Commercially available	Stopwatch	1	—
Measuring voltage and resistance	—		Commercially available	Circuit tester	1	—

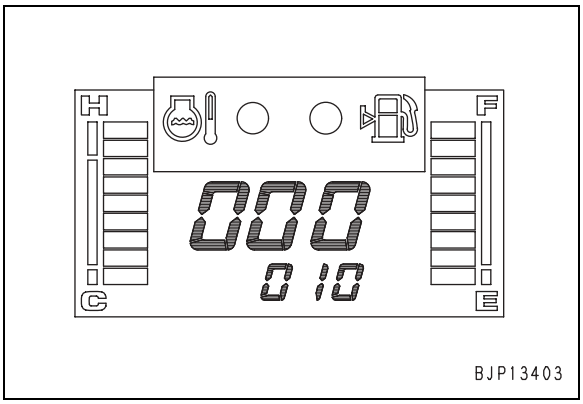
★ For the model names and part Nos. of the T-adapters and boxes used for troubleshooting for the monitor panel, controllers, sensors, actuators, and wiring harnesses, see TROUBLESHOOTING, Layout of connectors and electric circuit diagram of each system.

TESTING AND ADJUSTING ENGINE SPEED

MEASURING

1. Preparation work

1) Turn the starting switch ON and set the monitor panel in the "Monitoring function [02]" to prepare for measurement of the engine speed.
   - ★ For the operating method, see "Special functions of monitor panel".
   - • Monitoring code: 010 (Engine speed)
   - ★ The engine speed is displayed in rpm.
2) Warm up the engine to the following operating condition.
   - • Engine coolant temperature: Within operating range
   - • Hydraulic oil temperature: 45 – 55°C
   - ★ Measure the engine speed with the working mode switch in the A-mode position.



1. Measuring low idling speed

1) Set the fuel control dial in the low idling (MIN) position.
2) Set the work equipment control, swing control, and travel levers in neutral and measure the engine speed.

2. Measuring high idling speed

1) Turn the auto-decelerator switch OFF.
2) Set the fuel control dial in the high idling (MAX) position.
3) Set the work equipment control, swing control, and travel levers in neutral and measure the engine speed.

3. Measuring pump relief speed

1) Set the fuel control dial in the high idling (MAX) position.
2) Relieve the arm circuit by moving the arm IN and measure the engine speed.

4. Measuring pump relief and one-touch power maximizing speed

1) Set the fuel control dial in the high idling (MAX) position.
2) Relieve the arm circuit by moving the arm IN, keeping pressing the one-touch power maximizing switch, and measure the engine speed.
   - ★ The one-touch power maximizing function is reset automatically in about 8.5 seconds even if the switch is kept held. Accordingly, measure the engine speed in that period.

5. Measuring auto-deceleration speed

1) Start the engine and set the fuel control dial in the high idling position (MAX).
2) Set the work equipment control, swing control, and travel levers in neutral and measure the engine speed.
   - ★ The engine speed lowers to a certain level about 5 seconds after all the levers are set in neutral. This level is the auto-deceleration speed.

ADJUSTING

Adjusting governor spring

★ If the high idling speed is out of the standard range or the engine speed is unstable (the engine hunts), adjust the governor spring with "Governor adjustment function [03]" of the monitor panel.

★ For the adjustment procedure, see SPECIAL FUNCTIONS OF MONITOR PANEL.

MEASURING EXHAUST GAS COLOR

★ Measuring instruments for exhaust gas color

Symbol		Part No.	Part name
A	1	799-201-9000	Handy Smoke Checker
	2	Commercially available	Smoke Meter

⚠ When installing and removing the measuring instruments, take care not to touch a hot part.

★ If an air source and an electric power source are not available in the field, use handy smoke checker **A1**. When recording official data, use smoke meter **A2**.

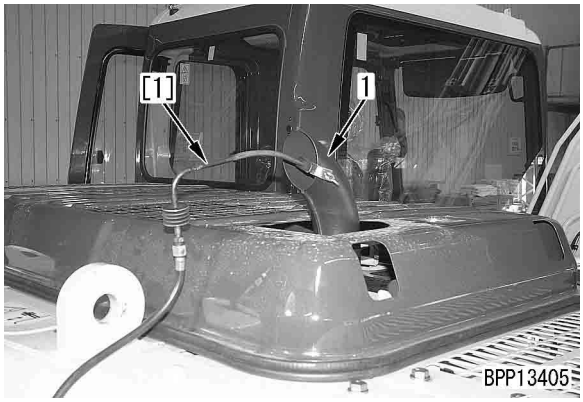
1. Measuring with handy smoke checker A1

1) Stick a sheet of filter paper to smoke checker **A1**.
2) Insert the exhaust gas intake pipe in exhaust pipe (1).
3) Run the engine.
4) Accelerate the engine suddenly or run it at high idling and operate the handle of smoke checker **A1** so that the filter paper will absorb the exhaust gas.

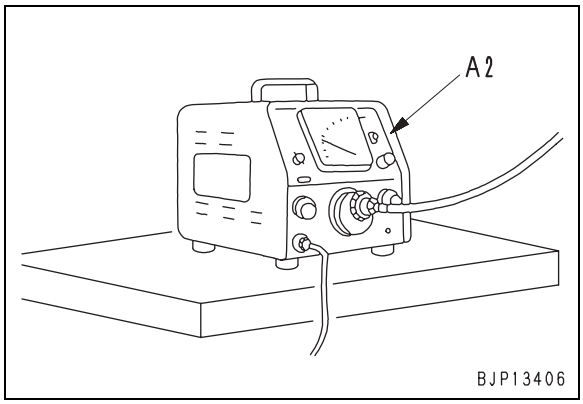
5) Remove the filter paper and compare it with the attached scale.
6) After finishing measurement, remove the measuring instrument and return the removed parts.

2. Measuring with smoke meter A2

1) Insert probe [1] of smoke meter **A2** in the outlet of exhaust pipe (1) and fix it to the exhaust pipe with a clip.



2) Connect the probe hose, receptacle of the accelerator switch, and air hose to smoke meter **A2**.
   ★ Limit the supplied air pressure to 1.5 MPa {15 kg/cm^2}.
3) Connect the power cable to a receptacle of AC 100 V.
   ★ Before connecting the cable, check that the power switch of the smoke meter is turned OFF.
4) Loosen the cap nut of the suction pump and fit the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas will not leak.
5) Turn on the power switch of smoke meter **A2**.



6) Start the engine and heighten the engine coolant temperature to the operating range.

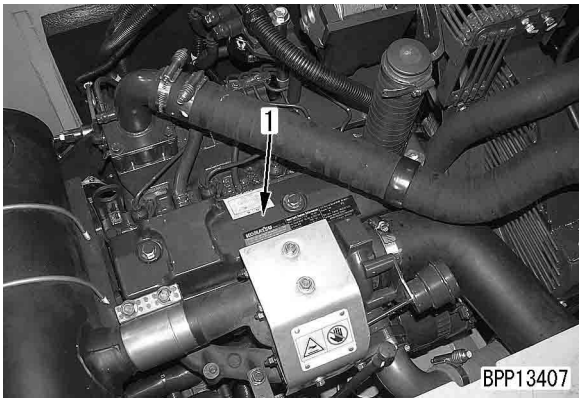
7) Accelerate the engine suddenly or run it at high idling and press the accelerator pedal of smoke meter **A2** and collect the exhaust gas into the filter paper.
8) Place the contaminated filter paper on the clean filter paper (at least 10 sheets) in the filter paper holder and read the indicated value.
9) After finishing measurement, remove the measuring instrument and return the removed parts.

ADJUSTING VALVE CLEARANCE

★ Adjusting instrument for valve clearance

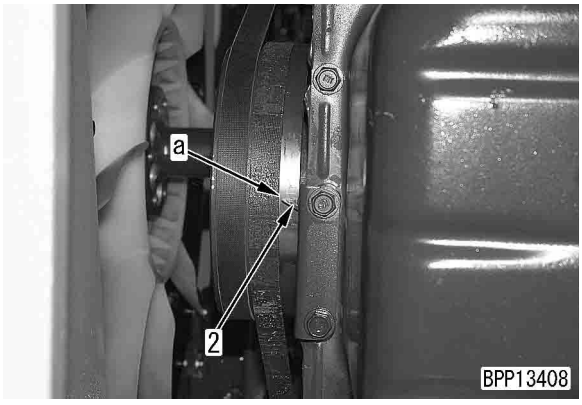
Symbol	Part No.	Part name
B	Commercially available	Feeler gauger

1. Open the engine hood and remove all cylinder head covers (1).

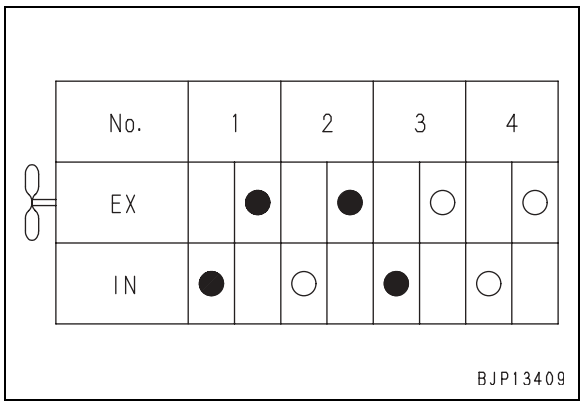


2. Remove the engine undercover (on the radiator side).

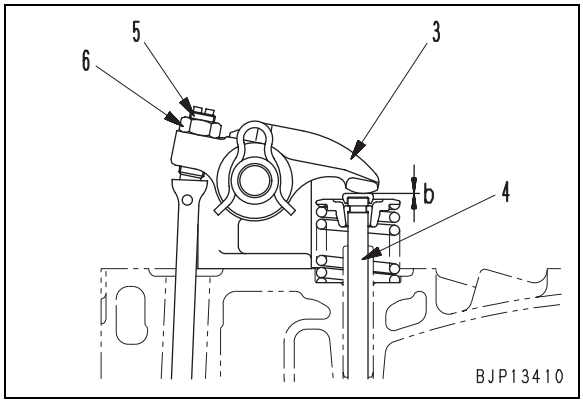
3. Rotate the crankshaft forward to bring the stamped "1.4TOP" line (a) of the crank pulley to pointer (2) and set the No. 1 cylinder to the compression top dead center.
   ★ Crank the crankshaft with the crank pulley mounting bolt.
   ★ There are 2 stamped "1.4TOP" lines on the crank pulley. Use the one at the diagonal position of "2.3TOP".
   ★ When the No. 1 cylinder is at the compression top dead center, the rocker arm of the No. 1 cylinder can be moved by the valve clearance with the hand. If the rocker arm cannot be moved, the No. 1 cylinder is not at the compression top dead center. In this case, rotate the crankshaft one more turn.



4. While the No. 1 cylinder is at the compression top dead center, adjust the valve clearances marked with ● in the valve arrangement drawing according to the following procedure.



   1) Insert feeler gauge **B** in clearance (b) between rocker arm (3) and valve stem (4) and adjust the clearance with adjustment screw (5).
      ★ With the feeler gauge inserted, turn the adjustment screw to a degree that you can move the filler gauge lightly.
   2) Secure adjustment screw (5) and tighten locknut (6).
      Locknut: **39.2 – 49 Nm {4 – 5 kgm}**
      ★ After tightening the locknut, check the valve clearance again.
      ★ After adjusting all of the valves marked with ●, go to the next procedure.



5. Rotate the crankshaft forward to bring the stamped "1.4TOP" line (a) of the crank pulley to pointer (2) and set the No. 4 cylinder to the compression top dead center.

6. While the No. 4 cylinder is at the compression top dead center, adjust the valve clearances marked with ○ in the valve arrangement drawing.
   ★ Adjust the valve clearance according to step **4** above.

7. After finishing adjustment, return the removed parts.
   Cylinder head cover mounting bolt:
   7.84 – 9.8 Nm {0.8 – 1.0 kgm}

MEASURING COMPRESSION PRESSURE

★ Measuring instruments for compression pressure

Symbol	Part No.	Part name
C	795-502-1205	Compression gauge
	795-502-1370	Adapter
	6204-11-3880	Gasket

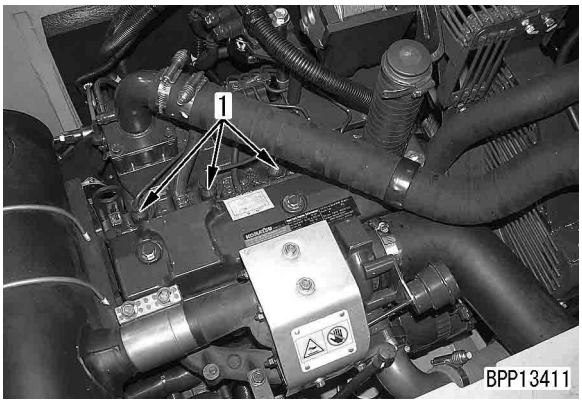
★ When measuring the compression pressure, take care not to burn yourself on the exhaust manifold, muffler, etc. or get caught in a rotating part.

1. Adjust the valve clearance.
   ★ See Adjusting valve clearance.

2. Warm up the engine until the engine oil temperature is 40 – 60°C.

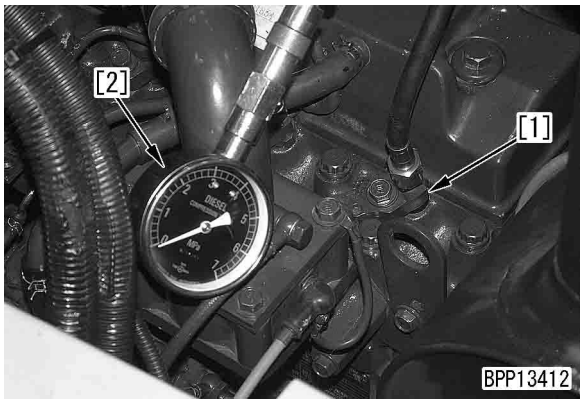
3. Prepare for measuring the engine speed.
   ★ See Testing and adjusting engine speed.

4. Open the engine hood and remove nozzle holder (1) of the cylinder to measure the compression pressure.



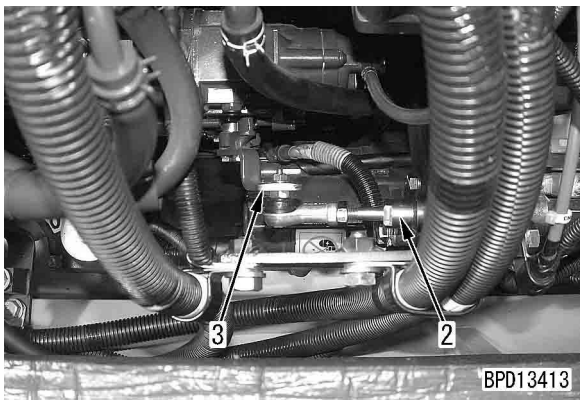
5. Install adapter [1] of compression gauge **C** to the mounting part of the nozzle holder and connect gauge [2].
   ★ Install the gasket to the end of the adapter.
   ★ Secure the adapter with the clamping holder and mounting bolt for the nozzle holder.

   Mounting bolt: **39.2 – 49 Nm {4 – 5 kgm}**



6. Remove governor spring (2).

7. Put governor lever (3) of the fuel injection pump to the STOP side stopper and fix it.



8. Crank the engine with the starting motor and measure the compression pressure.
   ★ Read the compression gauge when its pointer is stabilized.
   ★ When measuring the compression pressure, measure the engine speed, too, and check that it is in the measurement condition range.

9. After finishing measurement, remove the measuring instruments and return the removed parts.
   ★ Check that the fulcrum of the clamping holder for the nozzle holder is seated on the cylinder head, and then tighten the mounting bolt.

   Mounting bolt: **39.2 – 49 Nm {4 – 5 kgm}**

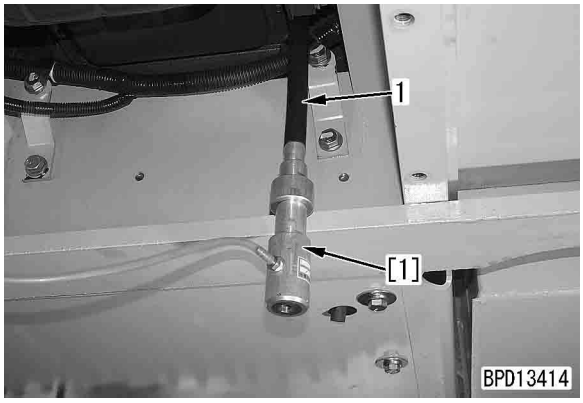
MEASURING BLOW-BY PRESSURE

★ Measuring instruments for blow-by pressure

Symbol	Part No.	Part name
D	799-201-1504	Blow-by checker

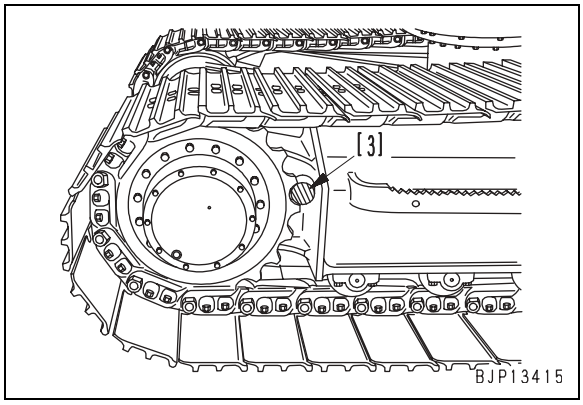
1. Remove the engine undercover (on the flywheel side).

2. Install nozzle [1] of blow-by checker **C** to the end of blow-by hose (1) and connect it to gauge [2].



3. Start the engine and lock the travel mechanism.

   ⚠ Put pin [3] between the sprocket and track frame to lock the travel mechanism securely.



4. Start the engine and warm it up to the operating range.
   - Engine coolant temperature: Within operating range
   - Hydraulic oil temperature: 45 – 55°C

5. Run the engine at high idling and measure the blow-by pressure.
   - Working mode: A
   - Work equipment, swing, and travel circuit: Relieve the travel circuit.

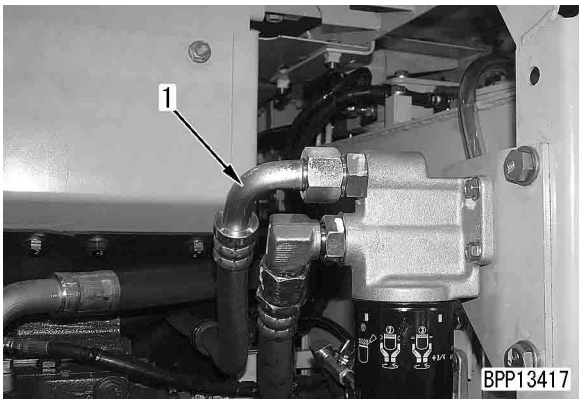
6. After finishing measurement, remove the measuring instruments and return the removed parts.

MEASURING ENGINE OIL PRESSURE

★ Measuring instruments for engine oil pressure

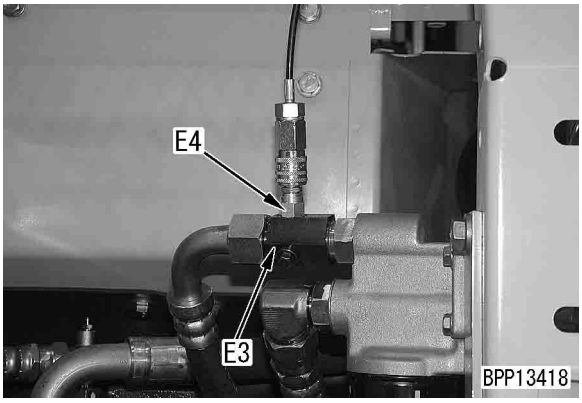
Symbol		Part No.	Part name
E	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester
	3	799-401-3500	Adapter (Size: 06)
	4	799-101-5220	Nipple (10 x 1.25 mm)
		07002-11023	O-ring

1. Open the pump room cover and disconnect outlet hose (1) of the engine oil filter.



2. Install adapter **E3** and connect the disconnected hose again.

3. Install nipple **E4** and connect it to hydraulic tester **E2**.



4. Start the engine and heighten the engine coolant temperature to the operating range.

5. Measure the oil pressure during low idling and high idling.

6. After finishing measurement, remove the measuring instruments and return the removed parts.

TESTING AND ADJUSTING FOR FUEL INJECTION TIMING

★ Testing and adjusting instruments for fuel injection timing (for delivery valve method)

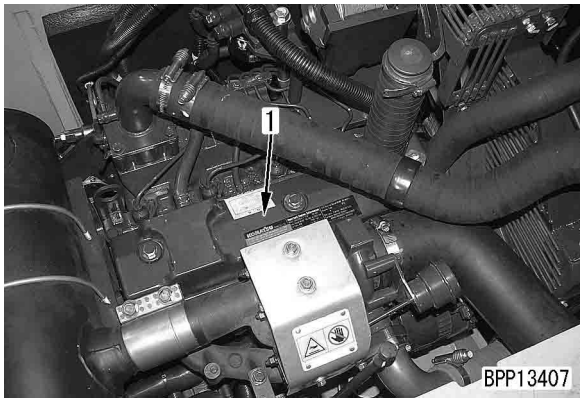
Symbol		Part No.	Part name
F	1	795-102-2103	Spring pusher
	2	Commercially available	Dial gauge

TESTING AND ADJUSTING BY MATCH MARK METHOD

★ After removing and installing the fuel injection pump without repairing it or when only checking the injection timing, test and adjust the injection timing according to the following procedure.

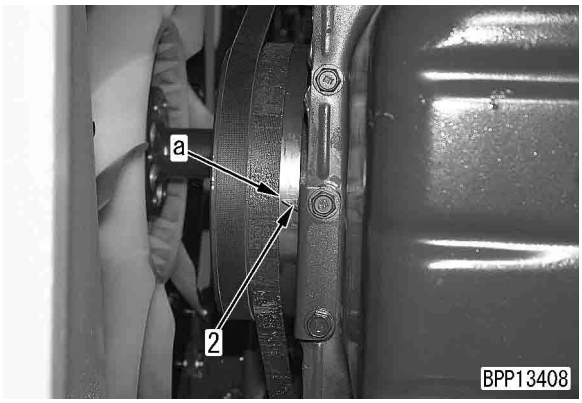
TESTING

1. Open the engine hood and remove all cylinder head covers (1).



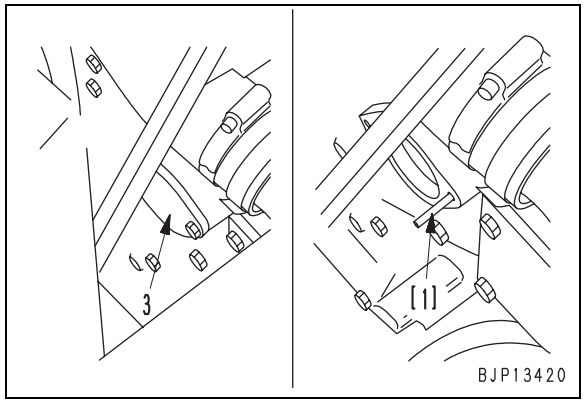
2. Remove the engine undercover (on the radiator side).

3. Rotate the crankshaft forward to bring the stamped "1.4TOP" line (a) of the crank pulley to pointer (2) and set the No. 1 cylinder to the compression top dead center.
   ★ Crank the crankshaft with the crank pulley mounting bolt.
   ★ There are 2 stamped "1.4TOP" lines on the crank pulley. Use the one at the diagonal position of "2.3TOP".
   ★ When the No. 1 cylinder is at the compression top dead center, the rocker arm of the No. 1 cylinder can be moved by the valve clearance with the hand. If the rocker arm cannot be moved, the No. 1 cylinder is not at the compression top dead center. In this case, rotate the crankshaft one more turn.



4. Remove cover (3) of the fuel injection pump drive shaft.

5. Insert pin [1] in the mounting bolt hole of the front cover (on the outside of the engine) to check the fuel injection timing.
   ★ Use a pin 4.0 – 4.5 mm in diameter and about 80 mm in length.
   ★ If the pin enters smoothly to inside of the drive gear of the fuel injection pump, the fuel injection timing is normal. In this case, return the removed parts.
   ★ If the pin touches the drive gear of the fuel pump, the fuel injection timing is abnormal. In this case, adjust the fuel injection timing.



ADJUSTING

★ If the fuel injection timing is abnormal, adjust it according to the following procedure.

1. Remove the fuel pump, holder, and drive gear together.
   ★ See DISASSEMBLY AND ASSEMBLY, Removal, installation of fuel pump assembly.