SHOP MANUAL

KOMATSU

12V140-1 SERIES

DIESEL ENGINE

Printed in Japan 09-08 (01)

HOISTING INSTRUCTIONS

HOISTING

> ⚠ 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 kg

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

WIRE ROPES

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

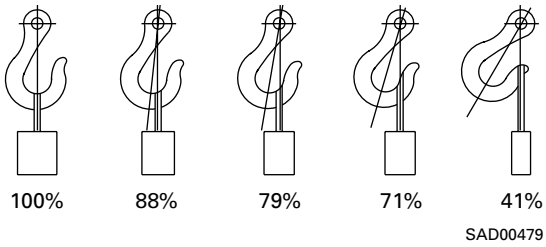
Wire ropes
(Standard "Z" or "S" twist ropes
without galvanizing)

Rope diameter	Allowable load	
mm	kN	tons
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.3	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

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

2) Sling wire ropes from the middle portion of the hook.

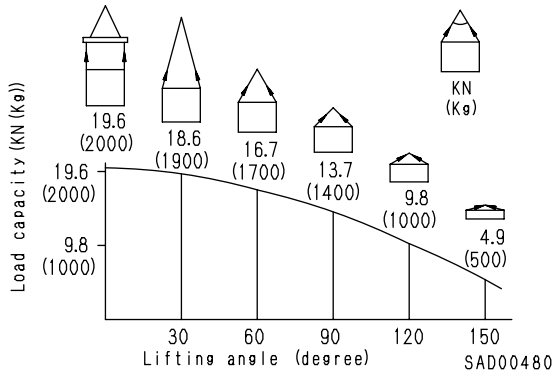
Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.

> ⚠ Slinging 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.

4) 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 kN {kg} when hoisting is made with two ropes, each of which is allowed to sling up to 9.8 kN {1000 kg} vertically, at various hanging angles.
When two ropes sling a load vertically, up to 19.6 kN {2000 kg} of total weight can be suspended. This weight becomes 9.8 kN {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 39.2 kN {4000 kg} if they sling a 19.6 kN {2000 kg} load at a lifting angle of 150°.



Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Engine model			SA12V140-1		
Applicable machine			HD785-5	HD785-5 (option) (With KOMATSU electronic governor)	
Number of cylinder - Bore x Stroke		mm	12 - 140 x 165		
Total piston displacement		ℓ {cc}	30.5 {30,480}		
Firing order			R1 - L1- R5 - L5 - R3 - L3 - R6 - L6 - R2 - L2 - R4 - L4		
Dimensions	Overall length	mm	2,036		
	Overall width	mm	1,252		
	Overall height (excluding exhaust pipe)	mm	-		
	Overall height (including exhaust pipe)	mm	1,514 1,874 (with retarder: option)		
Performance				High power mode	Economy mode
	Flywheel horsepower	kW/rpm {HP/rpm}	783/2,000 (Gross) {1,050/2,000} (Gross) 753/2,000 (Net) {1,010/2,000} (Net)	793/2,000 (Gross) {1,060/2,000} (Gross) 753/2,000 (Net) {1,010/2,000} (Net)	699/1,900 (Gross) {937/1,900} (Gross)
	Maximum torque	Nm/rpm {kgm/rpm}	4,170/1,400 (Gross) {425/1,400} (Gross) 4,120/1,400 (Net) {421/1,400} (Net)	4,170/1,400 (Gross) {425/1,400} (Gross) 4,130/1,400 (Net) {421/1,400} (Net)	4,050/1,300 (Gross) {413/1,300} (Gross)
	High idling speed	rpm	2,300 - 2,400	2,300 - 2,400	2,300
	Low idling speed	rpm	620 - 720	620 - 720	620 - 720
	Minimum fuel consumption ratio	g/kW•h {g/HP•h}	197 (Gross) {145} (Gross)	194 (Gross) {145} (Gross)	194 (Gross) {145} (Gross)
Dry weight		kg	3,100	3,100	3,100
Fuel injection pump			BOSCH PE-P (PS7S) type	KOMATSU KFE6S135 type	
Governor			BOSCH RFD min. max. speed control type	Electronic control type	
Lubricating oil amount (refill capacity)		ℓ	132 (120)	132 (120)	
Coolant amount		ℓ	(Engine only: 90)	(Engine: 90)	
Alternator			24 V, 75 A	24 V, 75 A	
Starting motor			24 V, 7.5 kW x 2	24 V, 7.5 kW x 2	
Battery			12 V 200 Ah x 4	12 V 200 Ah x 4	
Turbocharger			KOMATSU KTR110 type x 2	KOMATSU KTR110 type x 2	
Air compressor			ZEXEL reciprocation, single cylinder type x 2	ZEXEL reciprocation, single cylinder type x 2	
Others			With aftercooler, (option) retarder	With aftercooler, (option) retarder	

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SA12V140-1 View from rear (WA800-2)

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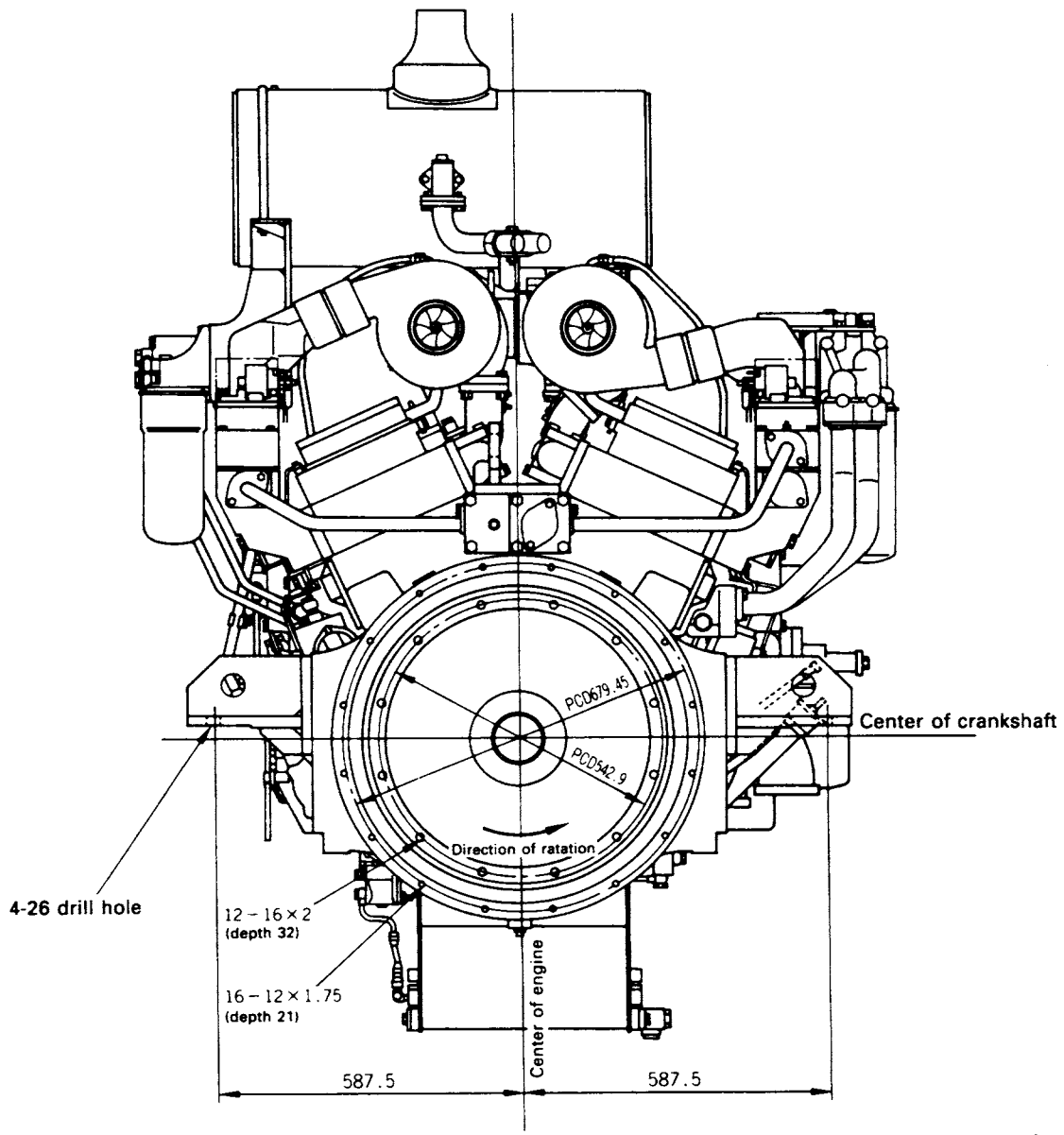

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ENGINE PERFORMANCE CURVE

Engine	Engine Serial No.	Machine model	page
SA12V140-1		D475A-2	01-014
		WA800-2	01-015
		HD785-3, HD985-3	01-016
		DCA800SPK	01-017
		INGERSOLL RAND crawler drill	01-018
		WA800-3	01-019
		WA900-3	01-019-1
		HD785-5 (with mechanical governor)	01-019-2
		HD785-5 (with electronic governor)	01-019-3
		DCA-800SSK	01-019-4
SDA12V140E-1		D475A-3	01-019-5
		D475A-5	01-019-6

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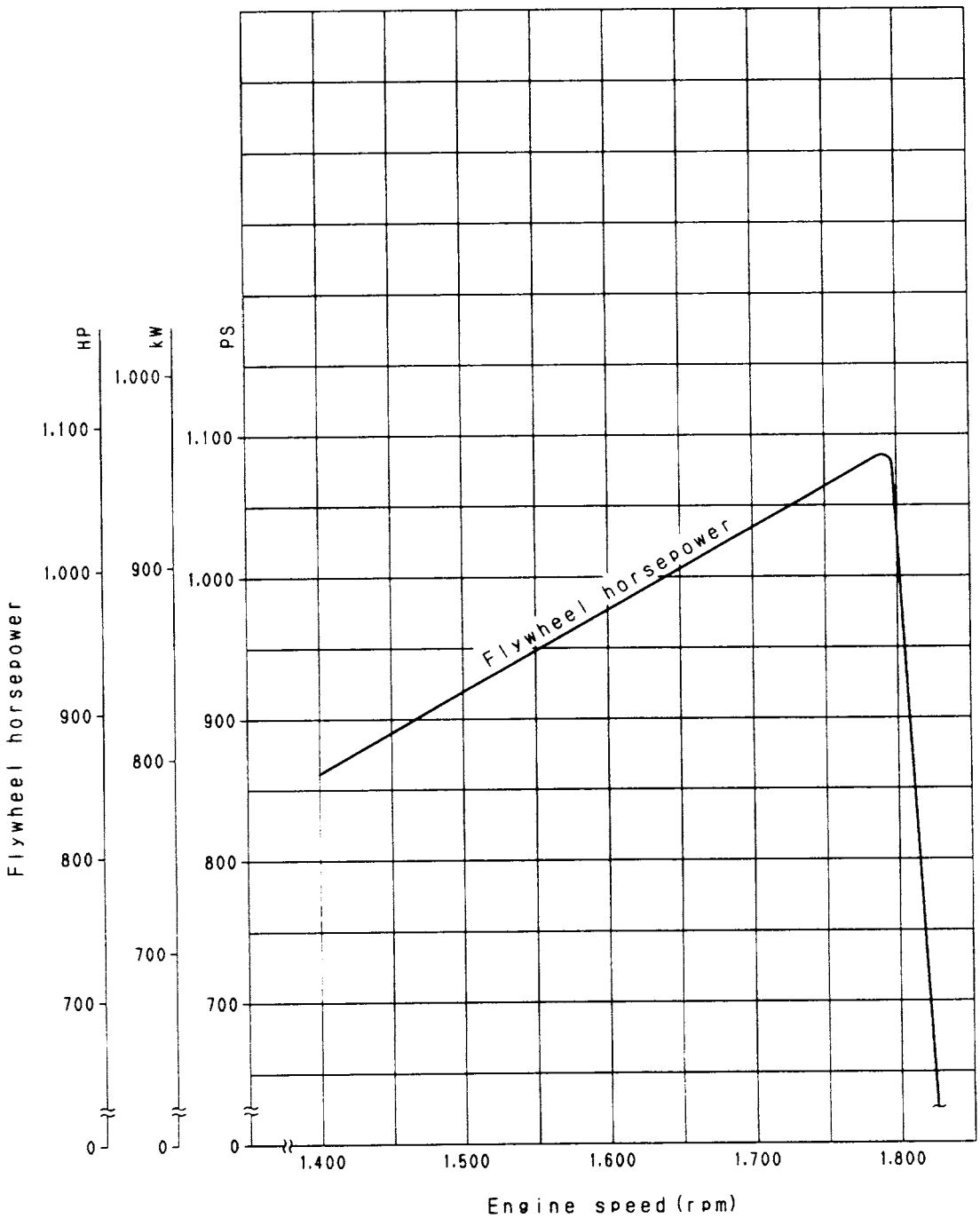
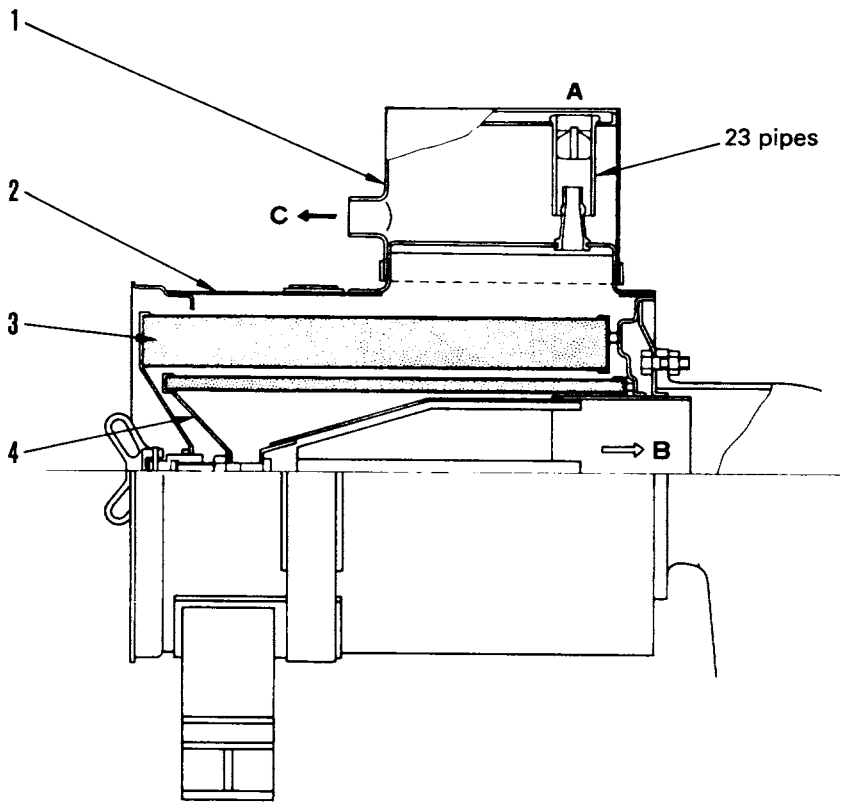
SA12V140-1 (For MQ generator DCA-800SSK)

Flywheel horsepower: 812 kW {1,088 HP}/1,800 rpm (60 Hz)



AIR CLEANER

Koma-clone (automatic discharge multicyclone) type



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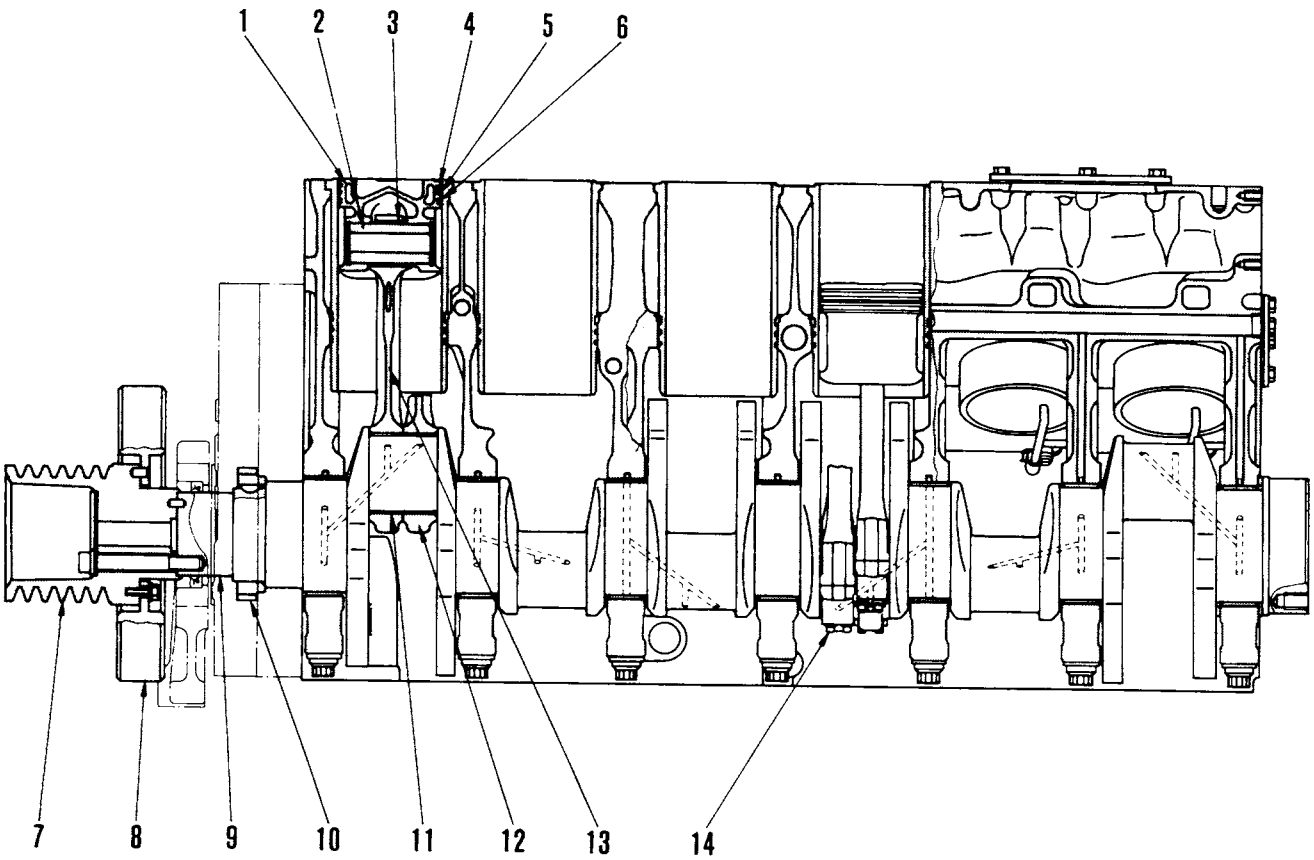
1. Precleaner
2. Air cleaner body
3. Outer element
4. Inner element

A. Air intake
B. To turbocharger (Air)
C. To muffler (Dust)

MAIN REVOLVING SYSTEM



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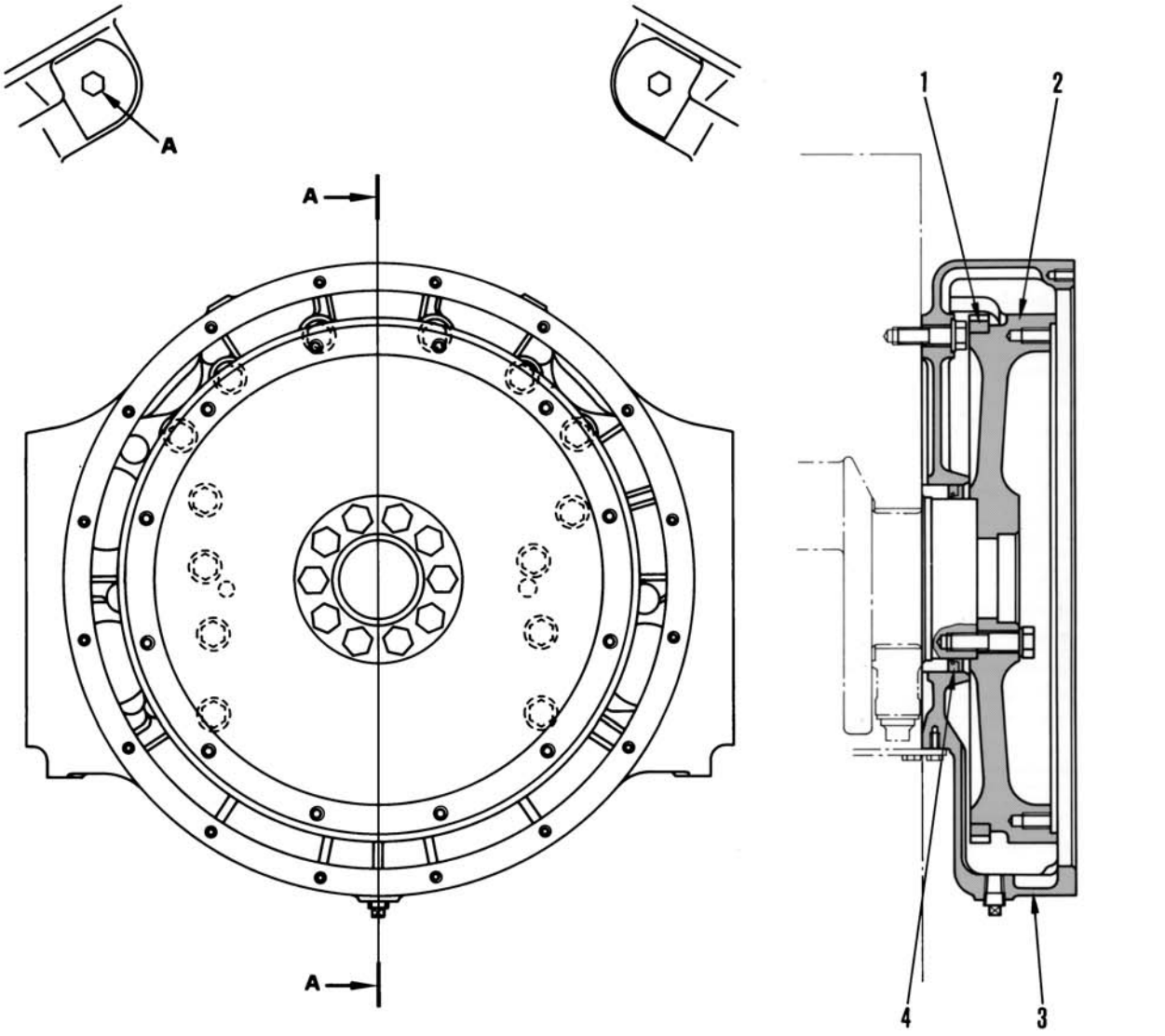
1. Piston
2. Piston pin
3. Conecting rod bushing
4. Top ring
5. Second ring
6. Oil ring
7. Crankshaft pulley
8. Vibration damper
9. Crankshaft
10. Crankshaft gear (No. of teeth: 45)
11. Connecting rod bearing
12. Connecting rod cap
13. Connecting rod
14. Conecting rod cap bolt

FLYWHEEL AND FLYWHEEL HOUSING

★ Details may differ according to the machine.



Section A – A

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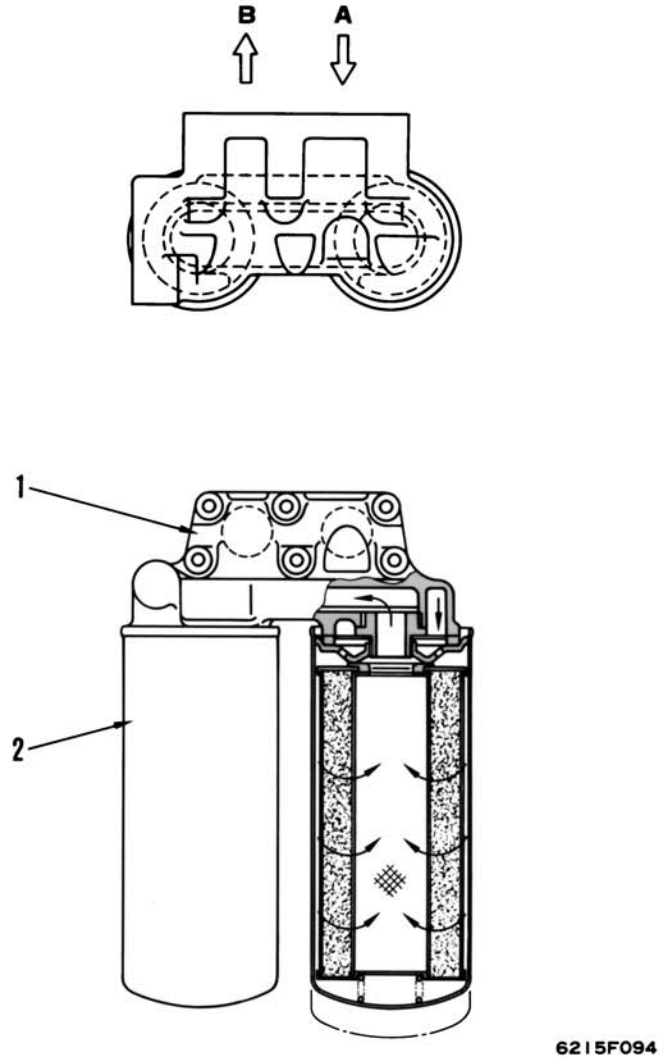
1. Ring gear (No. of teeth: 138)
2. Flywheel
3. Flywheel housing
4. Crankshaft rear seal

A. Rotation sensor pickup port (HD785-3)

REAR SEAL

- Dry type: Single lip oil seal
- Wet type: Double lip oil seal

BYPASS FILTER



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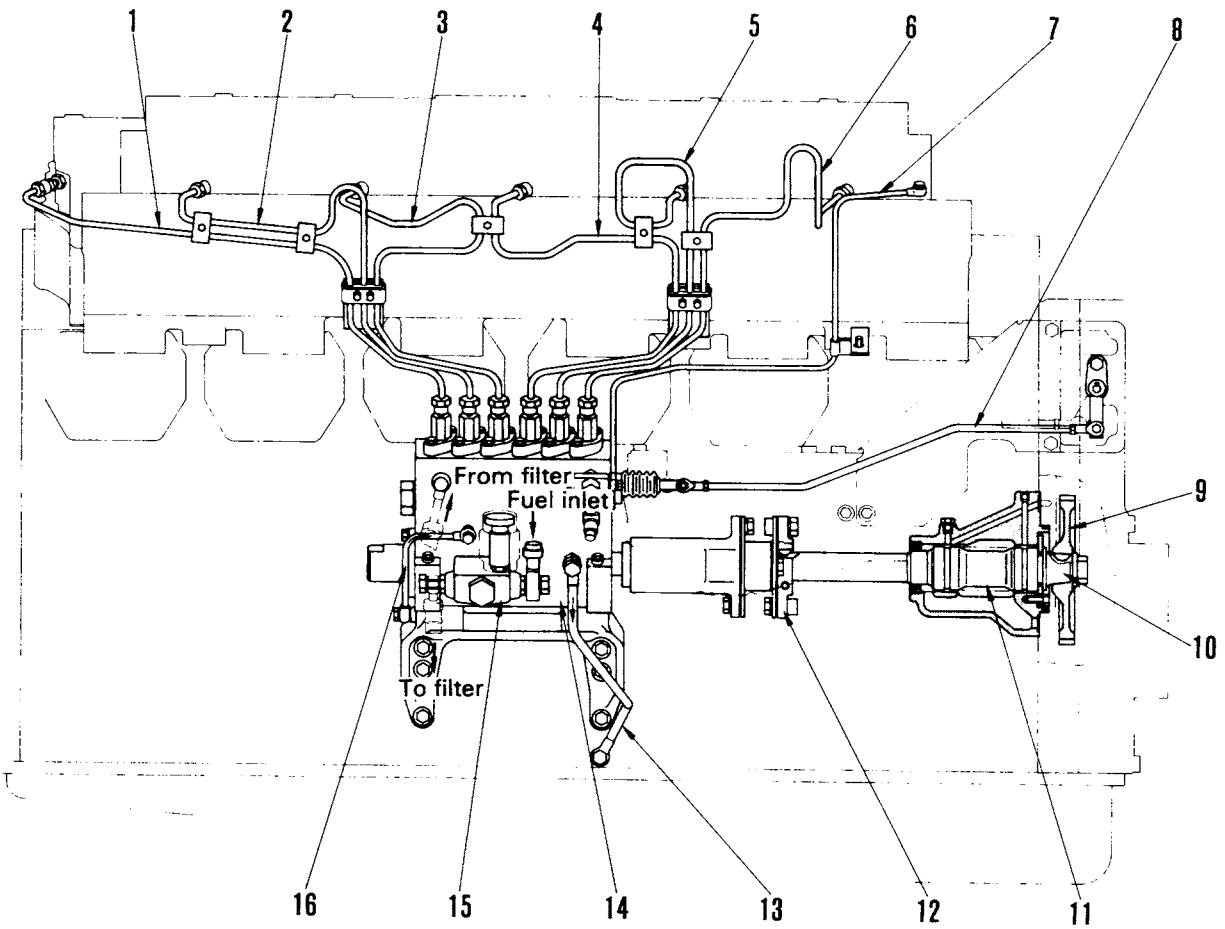
1. Filter head
2. Cartridge

A. Oil inlet port
B. Oil outlet port

BYPASS FILTER

- Filtering area: 2.8 m^2 (1.4 $m^2 \times 2$)
- Rated flow: 15 ± 1 ℓ/min

RIGHT BANK



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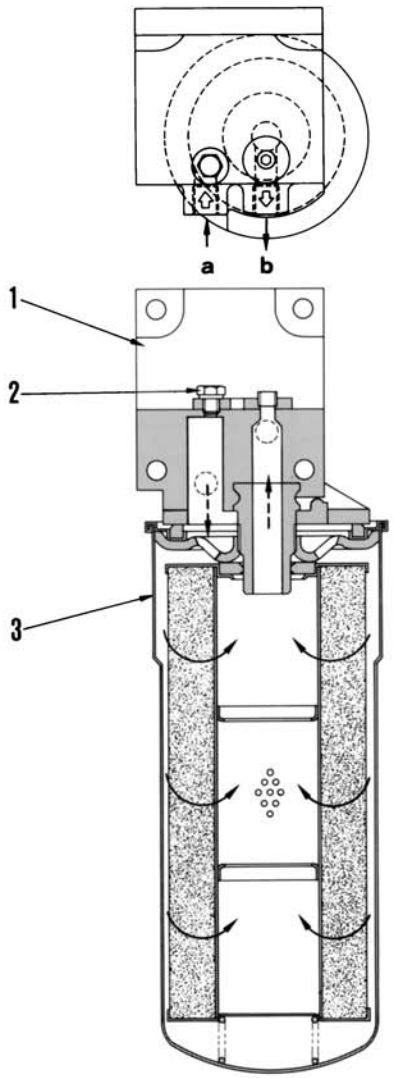
1. Fuel injection pipe (No. 6)
2. Fuel injection pipe (No. 5)
3. Fuel injection pipe (No. 4)
4. Fuel injection pipe (No. 3)
5. Fuel injection pipe (No. 2)
6. Fuel injection pipe (No. 1)
7. Spill tube
8. Governor rod (control link)
9. Fuel injection pump drive gear (No. of teeth: 48)
10. Fuel injection pump drive shaft
11. Bearing box
12. Coupling
13. Oil tube (outlet)
14. Fuel injection pump (without governor)
15. Feed pump
16. Oil tube (inlet)

FUEL FILTER

D475A-2, D475A-3, D475A-5, WA800-2



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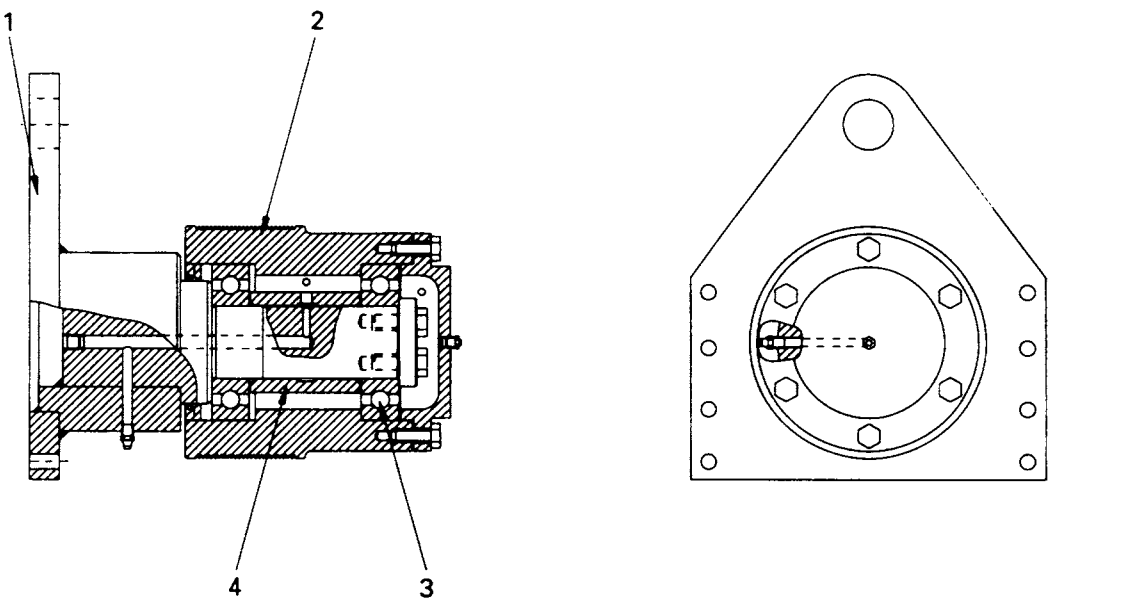
1. Filter head
2. Air bleed plug
3. Cartridge

a. Fuel inlet (From feed pump)
b. Fuel outlet (To injection pump)

FUEL FILTER

- Filtration area: 2.0 m^2

- **Fan pulley**



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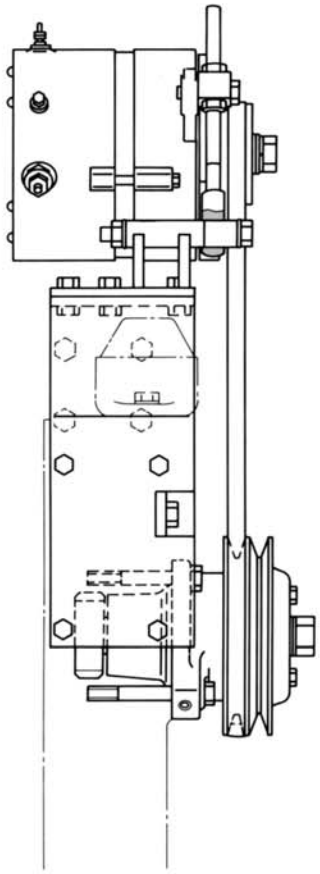
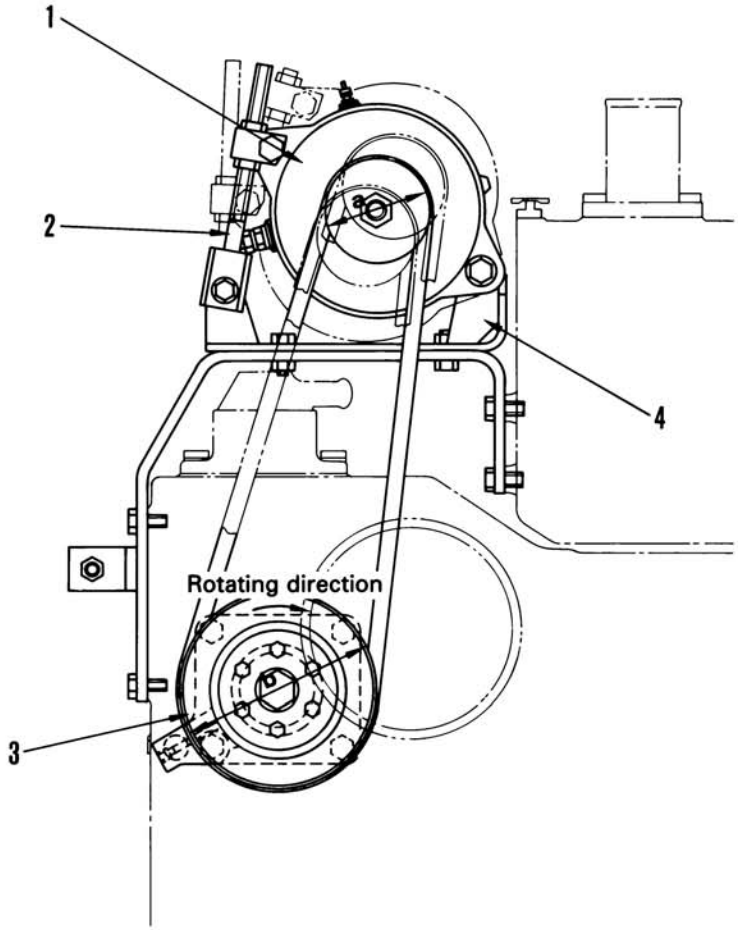
1. Bracket
2. Fan pulley
3. Ball bearing
4. Spacer

ELECTRICAL SYSTEM

ALTERNATOR

MOUNTING





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1. Alternator
2. Adjustment bolt
3. Alternator drive pulley
4. Alternator bracket

a. Alternator pulley
b. Alternator drive pulley

PULLEY O.D.

Applicable machine	Pulley O.D. (mm)	
	a	b
D475A-2 D475A-3 D475A-5 WA800-2 HD785-3 HD785-5 HD985-3 DCA800SPK HV700-1 HV700-2	95	167

MEASURING BLOW-BY

Method of measuring blow-by

⚠ When measuring the blow-by, be careful not to touch the exhaust manifold or muffler, or to get caught in rotating parts.

★ When measuring the blow-by, warm the engine up thoroughly (water temp.: 70°C), then stop the engine.

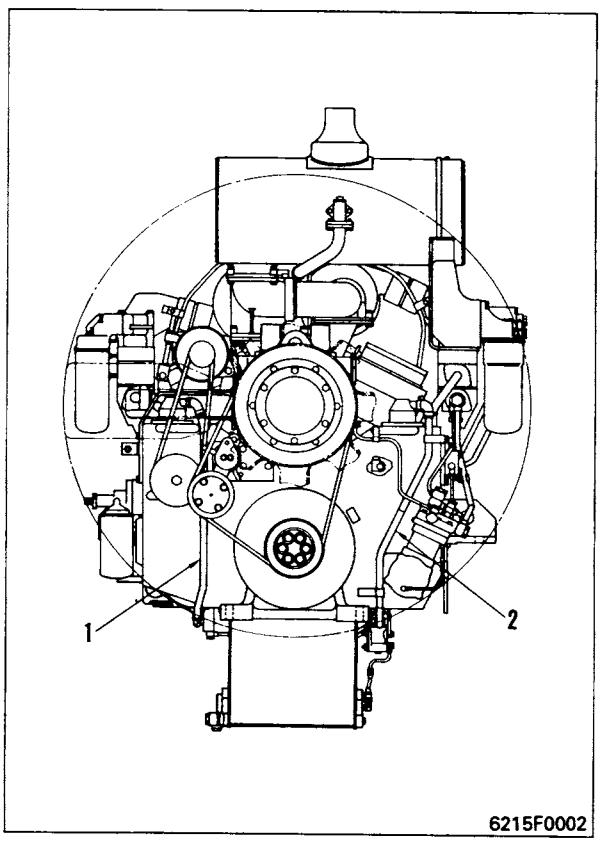
1) Install the adapter and tool of the blow-by checker to the tip of breather tube (1) of the bank on one side.

2) Install the adapter, tool, hose, and gauge of the blow-by checker to the tip of breather tube (2) of the bank on one side.

3) Run the engine at rated output and measure the pressure indicated by the gauge.
   ★ When measuring with the engine mounted on the machine, carry out full stall operation, and read the pressure indicated by the gauge.

★ If it is impossible to check at rated output or stall speed, measure at high idling.
In this case, the blow-by value will be about 80% of the value at rated output.

★ Blow-by varies greatly according to the condition of the engine. Therefore, if the blow-by value is considered abnormal, check for problems connected with defective blow-by, such as excessive oil consumption, defective exhaust gas color, and prematurely dirty or deteriorated oil.



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ADJUSTING INJECTION PUMP GOVERNOR LINK

(With mechanical governor)

- If there is lack of power or excessive power from one bank, and there is a difference in the exhaust color due to an imbalance in the amount of fuel injected in the left and right banks, adjust the governor link.

★ If the adjustment is carried out on a test bench, use the rated point, if the adjustment is carried out with the engine mounted on the machine, use the stall point. Adjust with the adjustment screw on the left bank side so that the exhaust gas temperature from the left and right banks is within the following standard.

- For D475A-2, WA800-2
  Adjust so that the exhaust temperature of the right bank is 10° – 30°C [50° – 86°F] lower than the exhaust temperature of the left bank. (To make the exhaust color from the two muffler pipes the same level.)
- For HD785-3, HV700-1
  Adjust so that the exhaust temperature for the left and right banks is the same (± 10°C [± 50°F]).

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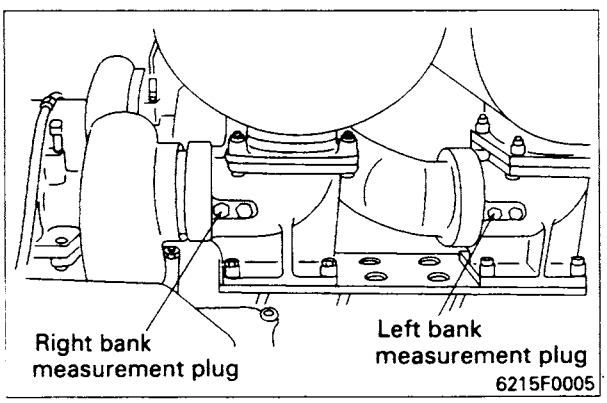
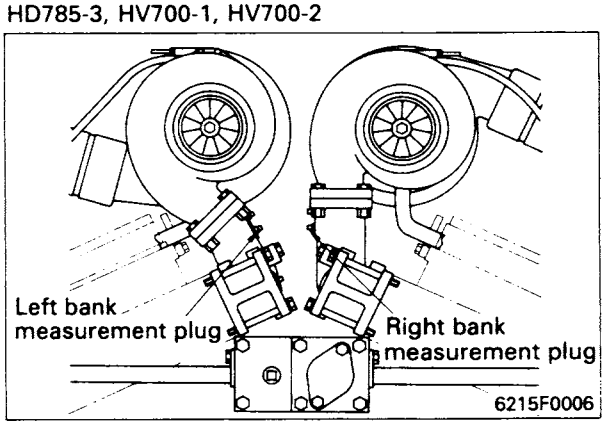
1. Loosen locknut (1).
2. Measure the exhaust temperature at the position shown in the diagram on the right, and adjust with adjustment screw (2) so that the temperature of the left and right banks is the standard temperature, then tighten locknut (1).
   ★ If the adjustment screw is turned in direction A, the rod will become longer: the exhaust temperature of the left bank (with governor) will go down, and the exhaust temperature of the right bank (without governor) will go up.
   - If the adjustment screw is turned in direction B, the rod will become shorter: the exhaust temperature of the left bank will go up, and the exhaust temperature of the right bank will go down.

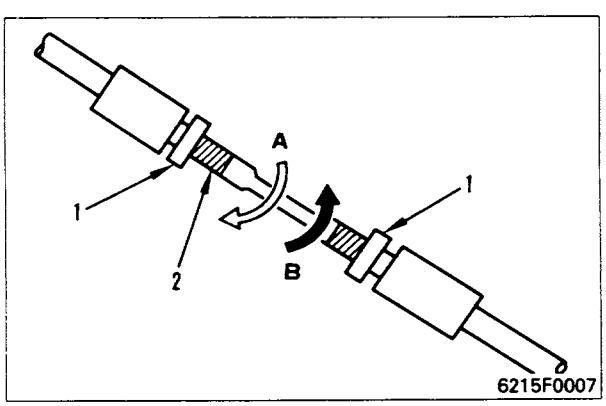
   ★ After adjusting with the adjustment screw, it will take 5 – 10 seconds for the exhaust temperature to change, so adjust gradually.

D475A-2, WA800-2



HD785-3, HV700-1, HV700-2





Injection Pump Assembly Number

6215-71-1171 (106682-4532) (Left bank)
6215-71-1172 (106682-4760) (Left bank)
6215-71-1181 (106684-4042) (Right bank)

( ): **Injection pump manufacturer's part No.**

Injection Pump Type	Injection pump Manufacturer
PE-P	ZEXEL

Applicable Machine		**Applicable Engine**	
Model	Serial No.	Model	Serial No.
D475A-2		SA12V140-1	

Injection pump specification

Rotating direction	Clockwise
Injection order	1 – 5 – 3 – 6 – 2 – 4
Injection interval	59°30' – 60°30'
Plunger pre-stroke (mm)	3.45 – 3.55
Delivery valve retraction volume (mm^3/st)	150

Engine Specification

Flywheel horsepower (kW {HP}) / rpm)	574 {770}/2,000 (Net)
Maximum torque (Nm {kgm}/ rpm)	3,350 {342}/1,400 (Net)
High idling speed (rpm)	2,100 – 2,200
Low idling speed (rpm)	600 – 680

Pump tester capacity for Service standard	Motor 7.5 kW

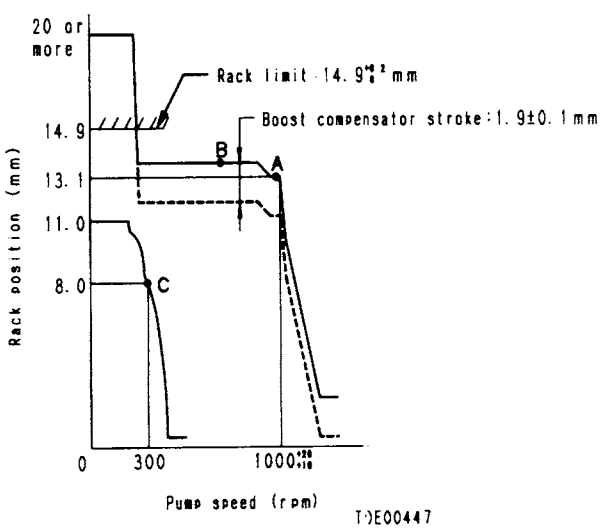
Calibration Standard

( ): **Injection pump manufacturer's part number**

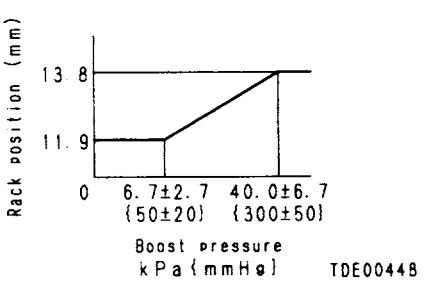
		Service standard	**Manufacturer's standard**
Conditions • **Service standard** indicates data using calibration test parts. • **Manufacturer standard** is data for factory test.	Nozzle & nozzle holder part No.		
	Nozzle part No.	(105780-0050)	6215-11-3220 (105015-6720)
	Nozzle holder part No.	(105780-2090)	6212-11-3211 (105041-7120)
	Injection pipe (mm) (Outside dia. x inside dia. x length)	6 x 3 x 600	6 x 2.2 x 725
	Test oil	ASTM D975 No. 2 diesel fuel or equivalent	
	Oil temperature (°C)	40 – 45	
	Nozzle opening pressure (MPa{kg/cm²})	17.2 {175}	27.5 {280}
	Transfer pump pressure (kPa{kg/cm²})	157 {1.60}	157 {1.60}

Injection volume • **Rack positions** B to E are the reference volume when adjusting the injection volume. • Marks ★ are average volumes.	Rack point	Rack position (mm)	Pump speed (rpm)	**Service standard** (cc/1000 st.)		**Manufacturer standard** (cc/1000 st.)	
				Injection volume	Maximum variance between cylinder	Injection volume	Maximum variance between cylinder
	A (Basic point)	13.1	1,000	Each cyl. 29.4 – 29.8	1.8	Each cyl. 23.0	
	B	13.8	700			★26.3	
	C	Approx. 8.0	300	★0.85 – 1.15	0.3	★2.0	
	D						
	E						

Governor performance curve



Boost compensator performance curve



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Injection Pump Assembly Number

6215-71-1223 (106684-4290) (Right bank)

Applicable Machine		Applicable Engine	
Model	Serial No.	Model	Serial No.
For MQ generator DCA-800SSK (Right bank pump)		SA12V140-1	

( ): **Injection pump manufacturer's part No.**

Injection Pump Type	Injection pump Manufacturer
PE-P (PS7S)	ZEXEL

Injection pump specification

Rotating direction	Clockwise
Injection order	1 – 5 – 3 – 6 – 2 – 4
Injection interval	59°30′ – 60°30′
Plunger pre-stroke (mm)	3.45 – 3.55
Delivery valve (mm³/st) retraction volume	120

Engine Specification

Flywheel horsepower (kW {HP}) / rpm	736 {986}/1,800 (Net)
Maximum torque (Nm {kgm}/ rpm)	
High idling speed (rpm)	Max. 1,890 (60 Hz)
Low idling speed (rpm)	700 – 900

Pump tester capacity for Service standard	Motor 7.5 kW

Calibration Standard

( ): **Injection pump manufacturer's part number**

Conditions

- **Service standard** indicates data using calibration test parts.
- **Manufacturer standard** is data for factory test.

	Service standard	Manufacturer's standard
Nozzle & nozzle holder part No.		
Nozzle part No.	(105780-0050)	6215-11-3220 (105015-8070)
Nozzle holder part No.	(105780-2090)	6212-11-3212 (105041-7122)
Injection pipe (mm) (Outside dia. x inside dia. x length)	8 x 4 x 1,000	6 x 2.2 x 725
Test oil	ASTM D975 No. 2 diesel fuel or equivalent	
Oil temperature (°C)	40 – 45	
Nozzle opening pressure (MPa{kg/cm²})	17.2 {175}	24.5 {250}
Transfer pump pressure (kPa{kg/cm²})	157 {1.6}	157 {1.6}

Injection volume

- **Rack positions** B to E are the reference volume when adjusting the injection volume.
- Marks ★ are average volumes.

	Rack position (mm)	Pump speed (rpm)	**Service standard** (cc/1000 st.)		**Manufacturer standard** (cc/1000 st.)	
			Injection volume	Maximum variance between cylinder	Injection volume	Maximum variance between cylinder
Rated point (60 Hz)	14.8	900			★287.5 – 290.5	± 3
Low idling point	7.7	400			★18.5 – 21.5	± 15

Governor performance curve

There is no Governor performance chart because of the mounting fuel injection pump with electronic governor.

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Injection Pump Assembly Number

6215-72-2110 (106685-4390)
(Left bank, electronic governor)
6215-72-2120 (106684-4440) (Right bank)

( ): **Injection pump manufacturer's part No.**

Injection Pump Type	Injection pump Manufacturer
PE-P (PS7S)	ZEXEL

Applicable Machine		Applicable Engine	
Model	Serial No.	Model	Serial No.
J12V140E-G1-1 (6 pole generator with electronic governor)		SA12V140-1	

Injection pump specification

Rotating direction	Clockwise
Injection order	1 – 5 – 3 – 6 – 2 – 4
Injection interval	59°30′ – 60°30′
Plunger pre-stroke (mm)	3.25 – 3.35
Delivery valve (mm^3/st) retraction volume	120

Engine Specification

Flywheel horsepower (kW {HP}) / rpm	390{538}/1,000 (Gross 50Hz) 463{638}/1,200 (Gross 60Hz)
Maximum torque (Nm {kgm}/ rpm)	
High idling speed (rpm)	Max. 1,050 (50Hz) Max. 1,260 (60Hz)
Low idling speed (rpm)	700 – 900

Pump tester capacity for Service standard	Motor 7.5 kW

Calibration Standard

( ): **Injection pump manufacturer's part number**

Conditions
- **Service standard** indicates data using calibration test parts.
- **Manufacturer standard** is data for factory test.

	Service standard	Manufacturer's standard
Nozzle & nozzle holder part No.	(105780-8130)	6215-11-3800 (105111-5020)
Nozzle part No.	(105780-0050)	6215-11-3820 (105025-3420)
Nozzle holder part No.	(105780-2090)	6212-11-3212 (105041-7122)
Injection pipe (mm) (Outside dia. x inside dia. x length)	8 x 4 x 1000	6 x 2.2 x 725
Test oil	ASTM D975 No. 2 diesel fuel or equivalent	
Oil temperature (°C)	40 – 45	
Nozzle opening pressure (MPa{kg/cm^2})	17.2 {175}	24.5 {250}
Transfer pump pressure (kPa{kg/cm^2})	255 {2.6}	255 {2.6}

Injection volume
- **Rack positions** B to E are the reference volume when adjusting the injection volume.
- Marks ★ are average volumes.

	Rack point	Rack voltage (V)	Pump speed (rpm)	**Service standard** (cc/1000 st.)		**Manufacturer standard** (cc/1000 st.)	
				Injection volume	Maximum variance between cylinder	Injection volume	Maximum variance between cylinder
Rated point			600			★293 – 303	± 3
Low idling point			400			★19.5 –22.5	± 15

Governor performance curve
There is no Governor performance chart because of the mounting fuel injection pump with electronic governor.

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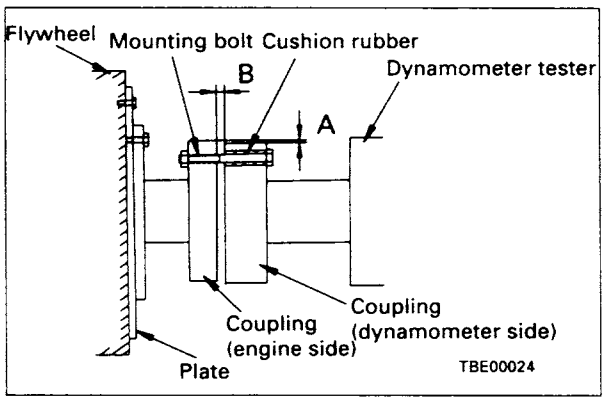
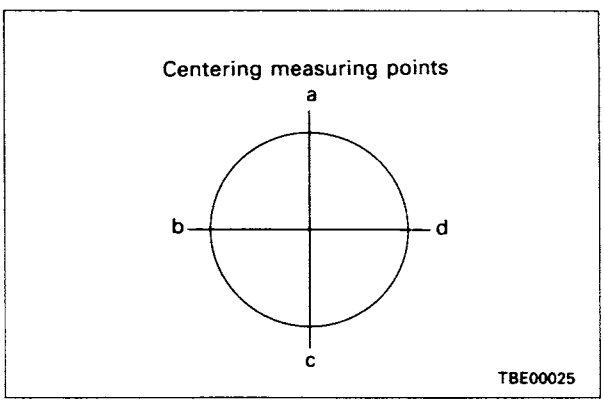
2. Perform centering of the engine in the following manner (when a rigid coupling is used).
   1) Place the engine on the engine stand.
   2) Align the engine's crankshaft with the dynamometer's shaft by making adjustment in up/down, right/left and fore/aft directions.
      Up/down direction: Make adjustment on the dynamometer side.
      Right/left direction: Make adjustment on the engine side.
      Fore/aft direction: Make adjustment on the engine side.
   3) Measure step difference **A** of the coupling using a thickness gauge.
      Standard step difference **A**:
      max. 0.13mm
      ★ Take measurement at two points, i.e., **a** and **b**.
      ★ The outside diameter of both couplings is identical.
   4) Measure clearance **B** between couplings using a thickness gauge.
      Standard clearance **B**: 3 ± 1 mm
      ★ The differences in the maximum values at four places, i.e., **a**, **b**, **c** and **d**, should be zero.
   5) Positively tighten the mounting bolts of the engine stand on termination of adjustment of centering.





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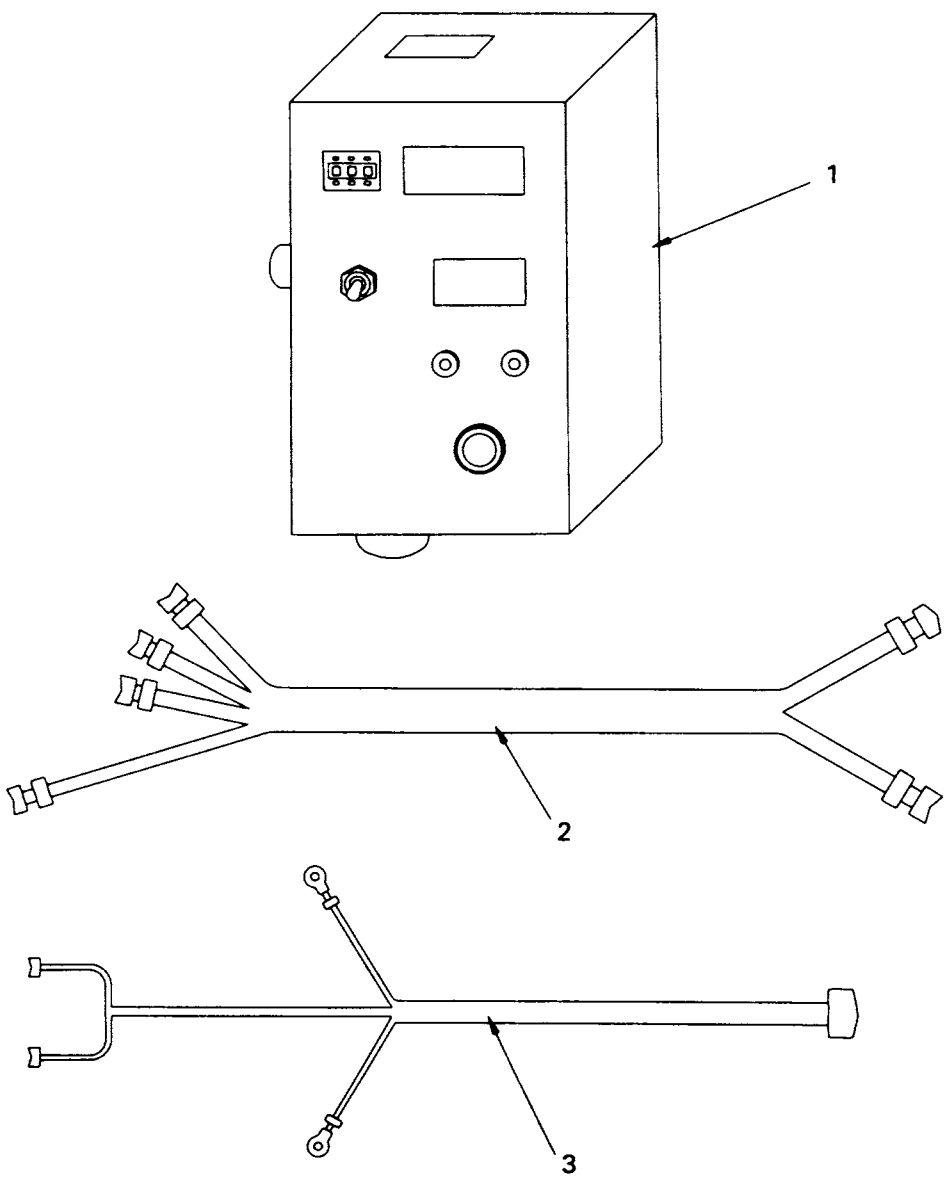
Wiring and piping

1) Connect the engine cooling system piping. (Perform air bleed with the blind plug removed from the water pipe.)
2) Connect the engine fuel system piping. Fill the fuel filter with fuel and perform air bleed.
3) Connect a battery power supply (24V•120Ah) to the key switch, starting motor, APS or preheater.

Components

	Part No.	Part name	Quantity	Weight (kg)	Remarks
—	799-605-5000	Throttle box assembly	1	7.4	KIT
1	799-605-5010	• Throttle box	1	1.5	
2	799-605-5020	• Harness	1	1.6	Connection of equipment
3	799-605-5040	• Harness	1	0.3	Connection of battery to throttle box
4	799-605-5030	• Case	1	4.0	Case for accommodation



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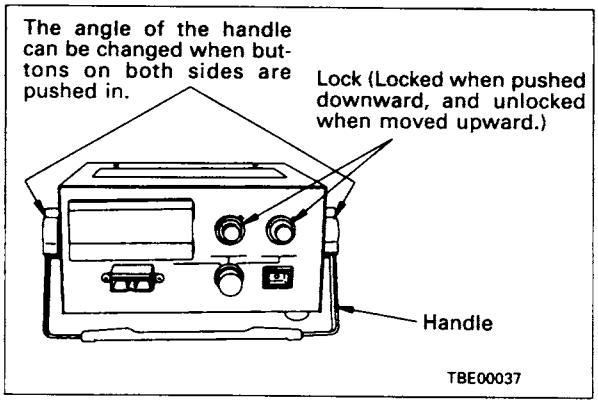
TBE00033

METHOD FOR USE

1. Method for connection of checker

1) Install the checker near the test bench.
   As the angle of the handle can be freely changed as shown, set the checker at an arbitrary position.
2) Set the pre-stroke command current set dial and governor command current set dial at "0" positions.
   ★ Each one of these dials makes ten turns. The dial value increases and the command current value also increases when the dial is turned counterclockwise.
   When the dial is turned clockwise, it reaches the stopped and the dial value becomes "0".
   ★ Unlock the dial before turning it. (Keep it unlocked until the test terminates.)
3) Connect the connectors of the harness to the checker and fuel injection pump.
4) Connect the power cable to an AC power outlet (AC 100V).



2. Setup of initial values

This measurement is taken for self-diagnosis of the checker main unit.

1) Turn ON the checker's power switch button, and assure that the green lamp lights up.
2) Assure that the checker's maximum value is as shown below when the select switch is located at each of the positions shown in the following table.

Select switch position	Maximum value (voltage/current)
GOVERNOR	Max. 0.05
PRE-STROKE	Max. 0.05
RACK SENSER	0.3 – 0.4

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★ Dynamometers are given for the case of the arm length 716 mm.
★ Fuel used: ASTM D975 No. 1 or No. 2 diesel fuel.
★ Lubrication oil used: CLASS-CD SAE30.

Output (kW {HP})	Torque (Nm {kgm})	Fuel consumption (sec./500cc)	Coolant temperature (°C)	Lubrication oil temperature (°C)	Lubrication oil pressure (MPa {kg/cm²})	Exhaust temperature (°C)
592 – 622 {805 – 845}	–	Min. 12.0	70 – 90	90 – 110	0.34 – 0.49 {3.0 – 5.0}	Max. 650
–	3,300 – 3,490 {336 – 356}	–	70 – 90	90 – 110	–	Max. 650
0	0	–	70 – 90	90 – 110	–	–
0	0	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
603 – 641 {819 – 871}	–	Min. 12.0	70 – 90	90 – 110	0.34 – 0.49 {3.0 – 5.0}	Max. 650
–	3,690 – 3,920 {376 – 400}	–	70 – 90	90 – 110	–	Max. 650
0	0	–	70 – 90	90 – 110	–	–
0	0	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
618 – 656 (Gross) {827 – 878} (Gross)	–	Min. 11.0	70 – 90	90 – 110	0.34 – 0.49 {3.5 – 5.0}	Max. 650
–	3,680 – 3,910 (Gross) {376 – 398} (Gross)	–	70 – 90	90 – 110	–	Max. 650
–	–	–	70 – 90	90 – 110	–	–
–	–	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
631 – 671 (Gross) {846 – 899} (Gross)	–	Min. 9.8	70 – 90	90 – 110	0.39 – 0.49 {3.5 – 5.0}	Max. 650
–	3,830 – 4,070 (Gross) {391 – 415} (Gross)	–	70 – 90	90 – 110	–	Max. 650
–	–	–	–	90 – 110	–	–
–	–	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
656 – 682 (Gross) {879 – 915} (Gross)	–	Min. 10.2	70 – 90	90 – 110	0.34 – 0.49 {3.5 – 5.0}	Max. 650
–	4,040 – 4,280 (Gross) {412 – 436} (Gross)	–	70 – 90	90 – 110	–	Max. 650
–	–	–	70 – 90	90 – 110	–	–
–	–	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
760 – 807 {1,030 – 1,100}	–	–	70 – 90	90 – 110	0.34 – 0.49 {3.5 – 5.0}	Max. 650
–	4,040 – 4,300 {412 – 438}	–	70 – 90	90 – 110	–	Max. 650
0	0	–	70 – 90	90 – 110	–	–
0	0	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–
759 – 806 (Gross) {1,020 – 1,080} (Gross)	–	Min. 8.8	70 – 90	90 – 110	0.34 – 0.49 {3.5 – 5.0}	Max. 650
–	4,040 – 4,290 (Gross) {412 – 438} (Gross)	–	70 – 90	90 – 110	–	Max. 650
–	–	–	70 – 90	90 – 110	–	–
–	–	–	70 – 90	80 – 110	Min. 0.1 {Min. 1.0}	–

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TESTING AND ADJUSTING DATA

Engine				SA12V140-1			
Applicable machine model				D475A-2		WA800-2	
Classification	Item	Condition, etc.	Unit	Standard value	Permissible value	Standard value	Permissible value
Performance	Engine speed	High idling speed	rpm	2,100 – 2,200	2,100 – 2,200	2,200 – 2,300	2,200 – 2,300
		Low idling speed		600 – 680	600 – 680	650 – 700	650 – 700
	Necessary starting speed	0°C	rpm	Min. 110	–	Min. 110	–
		–20°C (with starting aid)		Min. 100	–	Min. 110	–
Intake, exhaust system	Intake resistance	At all speed	kPa {mmH_2O}	Max. 2.94 {Max. 300}	6.22 {635}	Max. 2.94 {Max. 300}	7.11 {725}
	Intake pressure	At rated output	kPa {mmHg}	Min. 70.65 {Min. 530}	–	Min. 69.32 {Min. 520}	–
	Exhaust pressure (Turbine inlet pressure)	At rated output	kPa {mmHg}	–	–	–	–
	Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 25°C)	°C	Max. 750	750	Max. 750	750
	Exhaust gas color	Quick acceleration (Low idling → High idling)	Bosch scale	Max. 5.0	7.0	Max. 5.0	7.0
		At rated output		Max. 2.0	3.0	–	–
		At high idling		Max. 1.5	2.5	Max. 1.5	2.0
	Valve clearance (When engine is hot or cold)	Intake valve	mm	0.43	–	0.43	–
		Exhaust valve		0.80	–	0.80	–
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C (Engine speed:200 – 250 rpm)	MPa {kg/cm^2}	Min. 3.1 {Min. 32}	2.2 {22}	Min. 3.1 {Min. 32}	2.2 {22}
	Blow-by pressure (SAE30 oil)	At rated output (Water temperature: Min. 70°C)	kPa {mmH_2O}	Max. 1.47 {Max. 150}	2.94 {300}	Max. 1.47 {Max. 150}	2.94 {300}
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At high idling (SAE 30 oil)	MPa {kg/cm^2}	0.3 – 0.44 {3.0 – 4.5}	0.21 {2.1}	0.25 – 0.39 {2.5 – 4.0}	0.18 {1.8}
		At high idling (SAE 10W oil)		0.25 – 0.39 {2.5 – 4.0}	0.18 {1.8}	0.20 – 0.34 {2.0 – 3.5}	0.13 {1.3}
		At low idling (SAE 30 oil)		Min. 0.1 {Min. 1.0}	0.07 {0.7}	Min. 0.1 {Min. 1.0}	0.07 {0.7}
		At low idling (SAE 10W oil)		Min. 0.1 {Min. 1.0}	0.07 {0.7}	Min. 0.1 {Min. 1.0}	0.07 {0.7}
	Oil temperature	All speed (oil in oil pan)	°C	80 – 110	120	80 – 110	120
	Oil consumption ratio	At continuous rated output (Ratio for fuel consumption)	%	Max. 0.5	1.0	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa {kg/cm^2}	25.0 – 25.8 {255 – 263}	22.1 {225}	25.0 – 25.8 {255 – 263}	22.1 {225}
	Fuel injection timing	B.T.D.C.	degree	30	29 – 31	30	29 – 31
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm^2}	85 – 115 {0.85 – 1.15}	85 – 115 {0.85 – 1.15}	60 – 80 {0.6 – 0.8}	60 – 80 {0.6 – 0.8}
	Fan speed	At rated engine speed	rpm	590 – 630	590 – 630	884 – 944	884 – 944
	Fan belt tension	Deflects when pushed with a force of 58.8 N {6 kg}	mm	–		Automatic	

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★ The values given in the Testing and Adjusting data are NOT for adjustment of the output.
Do not use these values as a guide to change the setting of the fuel injection pump.

Engine				SAA12V140-1			
Applicable machine model				SAA12V140-P1030 (50 Hz)		SAA12V140-P1150 (50 Hz)	
Classification	Item	Condition, etc.	Unit	Standard value	Permissible value	Standard value	Permissible value
Performance	Engine speed	High idling speed (Prime)	rpm	Max. 1,568	Max. 1,568	Max. 1,568	Max. 1,568
		High idling speed (Standby)		Max. 1,575	Max. 1,575	Max. 1,575	Max. 1,575
		Low idling speed		800 – 900	800 – 900	800 – 900	800 – 900
	Necessary starting speed	0°C	rpm	Min. 110	–	Min. 110	–
		–20°C (with starting aid)		Min. 100	–	Min. 100	–
Intake, exhaust system	Intake resistance	At all speed	kPa {mmH_2O}	Max. 3.92 {Max. 400}	7.47 {762}	Max. 3.92 {Max. 400}	7.47 {762}
	Intake pressure	At rated output	kPa {mmHg}	–	–	–	–
	Exhaust pressure (Turbine inlet pressure)	At rated output	kPa {mmHg}	–	–	–	–
	Exhaust temperature (Turbine inlet temp.)	All speed (intake air temp.: 20°C)	°C	Max. 700	700	Max. 700	700
	Exhaust gas color	Quick acceleration (Low idling → High idling)	Bosch scale	–	–	–	–
		At rated output		Max. 1.5	2.5	Max. 1.5	2.5
		At high idling		Max. 1.0	2.0	Max. 1.0	2.0
	Valve clearance (When engine is hot or cold)	Intake valve	mm	0.43	–	0.43	–
		Exhaust valve		0.80	–	0.80	–
Engine body	Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C (Engine speed:200 – 250 rpm)	MkPa {kg/cm^2}	Min. 2.84 {Min. 29}	1.96 {20}	Min. 2.84 {Min. 29}	1.96 {20}
	Blow-by pressure (SAE30 oil)	At rated output (Water temperature: Min. 70°C)	kPa {mmH_2O}	Max. 2.94 {Max. 300}	5.88 {600}	Max. 2.94 {Max. 300}	5.88 {600}
Lubrication system	Oil pressure (Oil temperature: Min. 80°C)	At high idling (SAE 30 oil)	kPa {kg/cm^2}	372 – 441 {3.8 – 4.5}	265 {2.7}	372 – 441 {3.8 – 4.5}	265 {2.7}
		At high idling (SAE 10W oil)		323 – 392 {3.3 – 4.0}	225 {2.3}	323 – 392 {3.3 – 4.0}	225 {2.3}
		At low idling (SAE 30 oil)		Min. 196 {Min. 2.0}	137 {1.4}	Min. 196 {Min. 2.0}	137 {1.4}
		At low idling (SAE 10W oil)		Min. 147 {Min. 1.5}	98 {1.0}	Min. 147 {Min. 1.5}	98 {1.0}
	Oil temperature	All speed (oil in oil pan)	°C	90 – 110	120	90 – 110	120
	Oil consumption ratio	At continuous rated output (Ratio for fuel consumption)	%	Max. 0.5	1.0	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	MPa {kg/cm^2}	25.0 – 25.8 {255 – 263}	22.1 {225}	25.0 – 25.8 {255 – 263}	22.1 {225}
	Fuel injection timing	B.T.D.C.	degree	19 – 21	19 – 21	19 – 21	19 – 21
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	kPa {kg/cm^2}	59 – 78 {0.6 – 0.8}	59 – 78 {0.6 – 0.8}	59 – 78 {0.6 – 0.8}	59 – 78 {0.6 – 0.8}
	Fan speed	At rated engine speed	rpm	727 – 773	727 – 773	727 – 773	727 – 773
	Fan belt tension	Deflects when pushed with a force of 58.8 N {6 kg}	mm	Autotension	–	Autotension	–

★ The values given in the Testing and Adjusting data are NOT for adjustment of the output.
Do not use these values as a guide to change the setting of the fuel injection pump.

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S-2 Engine does not start

① Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Failure in power train
- Defective electrical system

Legend

○ : Possible causes (judging from Questions and check items)
◌ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective adjustment of engine stop motor wire	Defective engine stop motor	Defective starting switch
Questions	Confirm recent repair history											
	Degree of use	Operated for long period		△		△						
	Condition of horn when starting switch is turned ON	Horn does not sound	◌					○				○
		Horn sound level is low		◌								
	When starting switch is turned to START, pinion moves out, but	Rotating speed is slow		◌								
		Makes grating noise			◌	◌						
		Soon disengages again					◌					
		Makes rattling noise and does not turn		○	○		○					
Check items	When starting switch is turned to START, pinion does not move out		◌	○								○
	When starting switch is turned to ON, there is no clicking sound			○				◌				
	Battery terminal is loose								◌			
	When starting switch is turned to ON, linkage does not move									◌	◌	
	When battery is checked, battery electrolyte is found to be low			◌								
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low			●								
	For the following conditions 1) — 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON		Carry out troubleshooting for defective wiring of starting circuit									●
	1) When terminal B and terminal C of starting switch are connected, engine starts											
	2) Even when terminal B and terminal C of starting motor are connected, engine does not start				●							
	3) When terminal B and terminal C of safety relay are connected, engine starts					●						
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts					●						
	5) There is no 24V voltage between battery relay terminal B and terminal E						●					
	When ring gear is inspected directly, tooth surface is found to be chipped				●							
	Does not move even when engine stop motor linkage is disconnected								●	●		
		Remedy	—	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Replace

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S-6 Engine lacks output (no power) (with mechanical governor)

(With V-type engine, for cases where there is injection for only one bank, go to troubleshooting S-2-② or S-4.)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used
  (if non-specified fuel is used, output drops)
- Lack of output due to overheating
  - * If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve, valve seat	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective injection pump boost compensator
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	△		△	△	△			△				
	Power was lost	Suddenly												○
		Gradually	○		○	○	○	○			○			
	Engine oil must be added more frequently													
	Replacement of filters has not been carried out according to operation manual					◎	◎							
	Non-specified fuel is being used						◎	◎	◎					
	Dust indicator is red													
Check items	Color of exhaust gas	Black	◎	◎										
		Blue under light load			◎									
	Noise of interference is heard from around turbocharger			◎										
	Blow-by gas is excessive				◎									○
	Engine pickup is poor and combustion is irregular			◎			○				○	○		
	High idling speed under no load is normal, but speed suddenly drops when load is applied					◎	◎					○	○	○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low						◎	○						
	There is hunting from engine (rotation is irregular)				○	○					○	○		
	Clanging sound is heard from around cylinder head								◎					
	High idling speed of engine is low							○						
	Leakage from fuel piping										◎			
Troubleshooting	When air element is inspected directly, it is found to be clogged		●											
	When trubocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●						●			
	When fuel filter, strainer are inspected directly, they are found to be clogged					●								
	When feed pump strainer is inspected directly, it is found to be clogged						●							
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working							●						
	When control rack is pushed, it is found to be heavy, or does not return								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	When feed pump is operated, operation is too light or too heavy											●		
	When fuel cap is inspected directly, it is found to be clogged												●	
	When injection pump boost compensator is inspected, it does not work													●
		Remedy	Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Repair	Clean	Replace

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S-14 Water temperature becomes too high (overheating)

General causes why water temperature becomes too high

- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature of power train

★ Carry out troubleshooting for chassis.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken cylinder head, head gasket	Damaged cylinder liner O-ring, holes made by pitting	Rise in torque converter oil temperature
Questions	Confirm recent repair history													
	Degree of use	Operated for long period		△	△						△	△		
	Condition of overheating	Suddenly overheated	◎					○	○					
		Always tends to overheat		◎	◎	○			○					
	Water temperature gauge	Rises quickly				◎		○						
		Does not go down from red range					◎							
	Radiator water level sensor lights up							◎						
Check items	Fan belt whines under sudden load								○					
	Cloudy white oil is floating on cooling water									◎				
	Cooling water flows out from overflow hose										◎			
	Excessive air bubbles inside radiator, water spurts back											◎		
	Engine oil level has risen, oil is cloudy white									○			◎	
	There is play when fan pulley is rotated		◎											
	Radiator shroud, inside of underguard are clogged with dirt or mud			◎					○					
	When light bulb is held behind radiator, no light passes through			◎										
	Water is leaking because of cracks in hose or loose clamps							◎						
	Belt tension is found to be slack								○					
	Power train oil temperature enters red range before engine water temperature													◎
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive		●											
	Temperature difference between top and bottom radiator tanks is slight			●										
	When water filler port is inspected, the core is found to be clogged				●									
	When a function test is carried out on the thermostat, it does not open even at the cracking temperature					●								
	When water temperature is measured, it is found to be normal						●							
	When oil cooler is inspected directly, it is found to be clogged								●					
	When measurement is made with radiator cap tester, set pressure is found to be low									●				
	When compression pressure is measured, it is found to be low										●			
	Remove oil pan and check directly											●		
		Remedy	Replace	Repair	Repair	Replace	Replace	Add	Repair	Replace	Replace	Replace	Replace	Carry out troubleshooting for chassis

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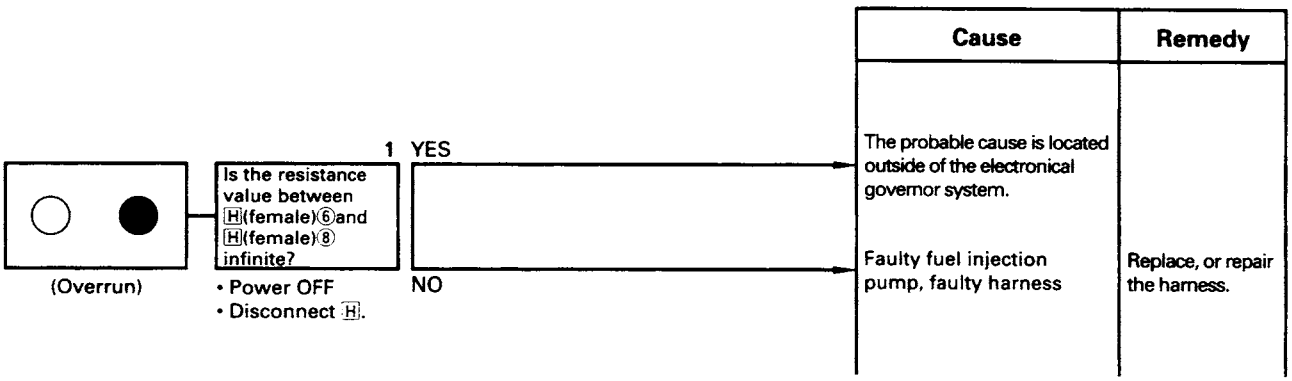
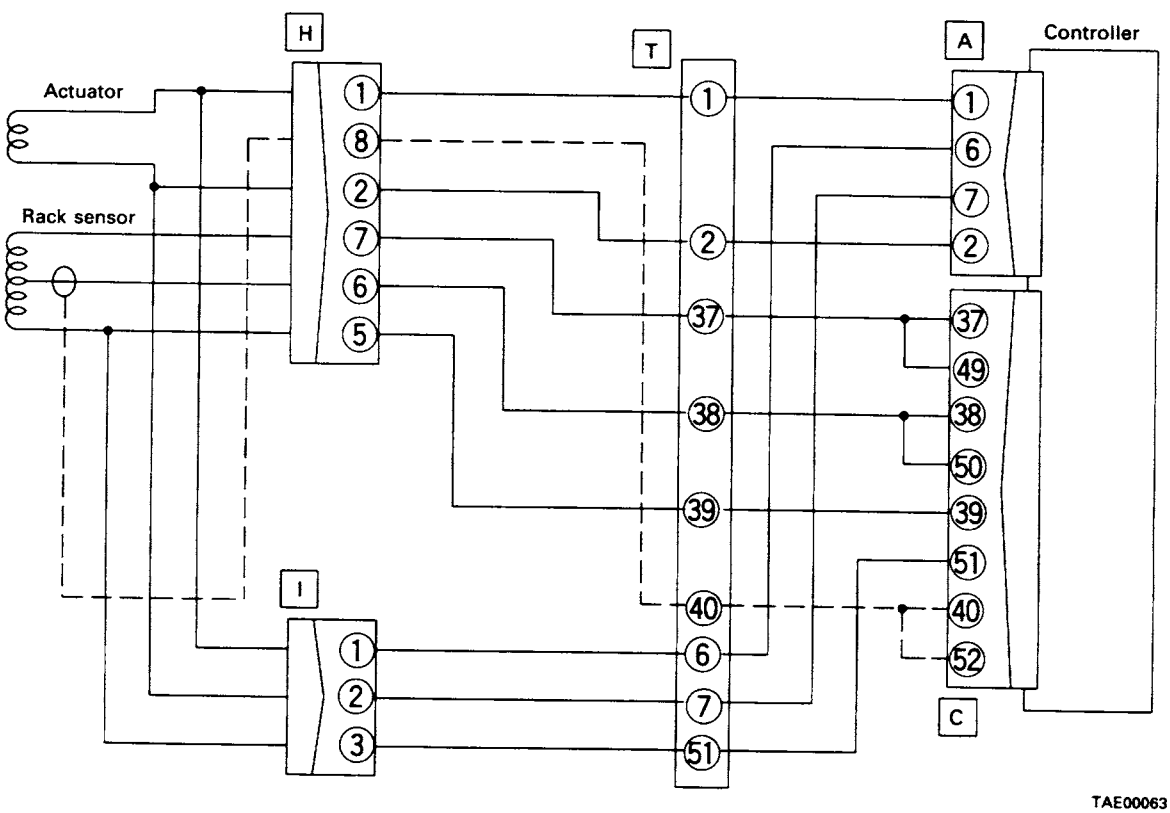
4. Overrun abnormality



Cause	Remedy
The probable cause is located outside of the electronical governor system.	
Faulty fuel injection pump, faulty harness	Replace, or repair the harness.

Electrical circuit diagram related to 4. above



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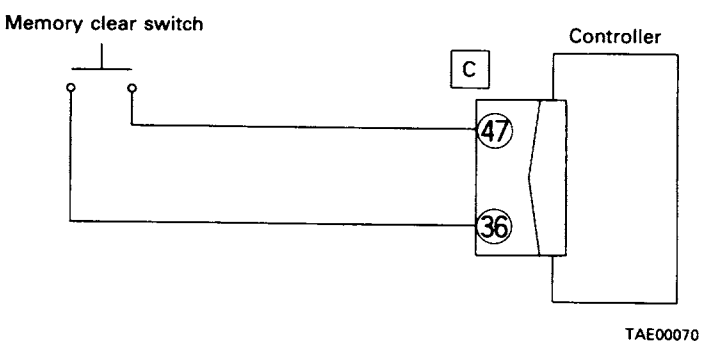
11. Memory clear cannot be achieved by pressing the memory clear switch (when failure indication is made by diagnosis lamp).

★ To execute memory clear, keep pressing the memory clear switch for 5 seconds or longer. (Memory clear cannot be achieved when the memory clear switch is pressed momentarily.)
★ If memory clear cannot be achieved even if the memory clear switch was kept pressed for 5 seconds or longer, implement the diagnosis indicated below.

		Cause	Remedy
1 If the continuity between C(female) ㊼ and ㊱ normal?	YES	Faulty controller	Replace.
• Disconnect C. • Power OFF • When memory clear switch is ON: Continuity is observed. • When memory clear switch is OFF: Continuity is not observed.	NO	Faulty memory clear switch or faulty harness (between memory clear switch and controller)	Replace the switch or repair the harness.

Electrical circuit diagram related to 11. above



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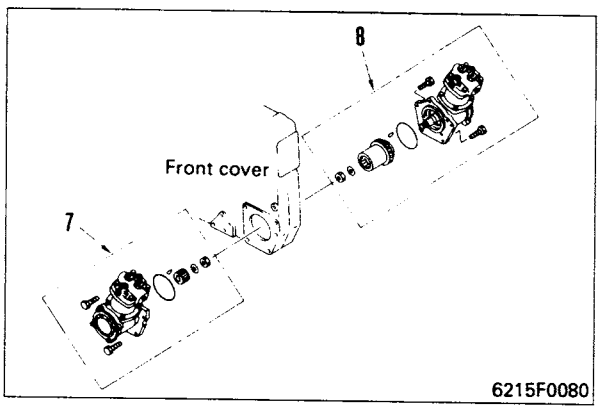
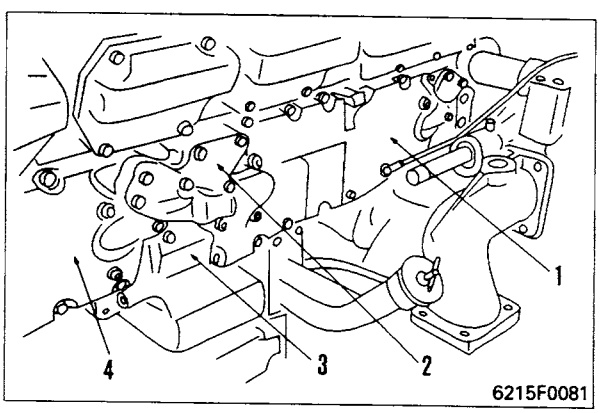
3) Remove front compressor (7).
   ★ With spline shaft
4) Remove rear compressor (8).
   ★ With gear



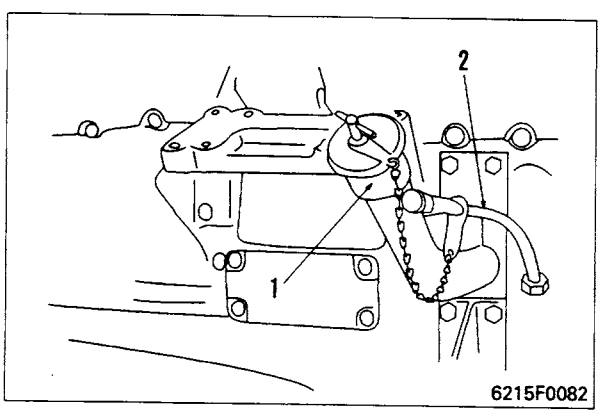
19. Oil cooler assembly

1) Remove front oil cooler assembly (1).
2) Remove manifolds (2) and (3).
3) Remove rear oil cooler assembly (4).



20. Oil filler, oil level gauge

1) Remove bracket, then oil filler (1).
2) Remove oil level gauge guide (2).
   ★ Loosen the nut at the root of the level guide, then remove the guide.



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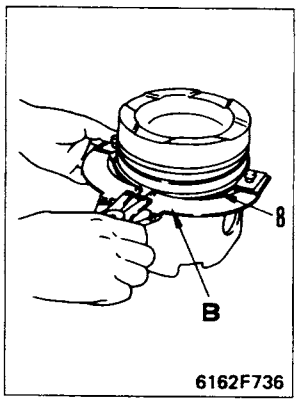
iv) Using piston ring tool **B**, remove piston ring (8).
v) Remove oil ring expander (9).
★ Keep the piston, connecting rod, connecting rod bearing, piston ring, and piston pin in sets for each cylinder.



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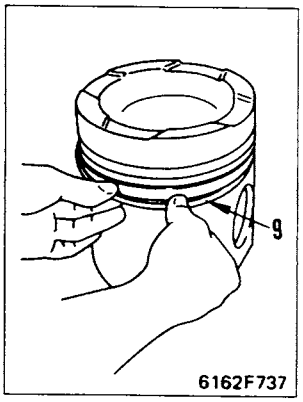

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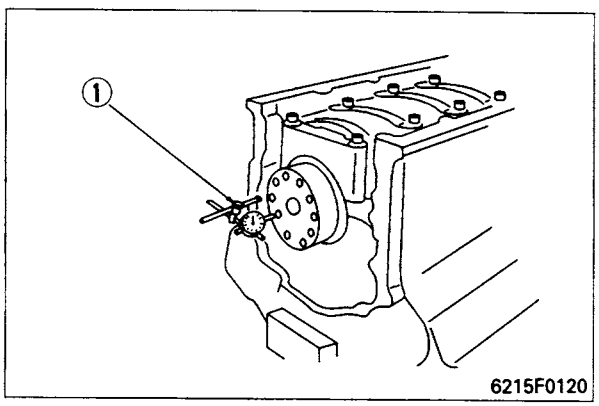
47. Crankshaft

1) Before removing the crankshaft, using dial gauge ① to measure end play of crankshaft, and use it as a guide when assembling.



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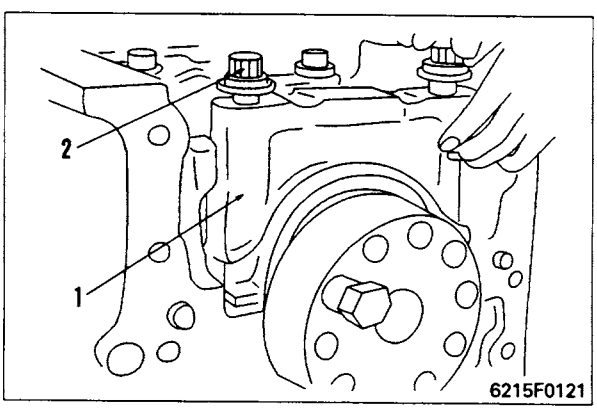
2) Remove mounting bolts (2) of main cap (1).
3) Insert bolt in hole of main cap, and move the main cap from side to side to remove it.



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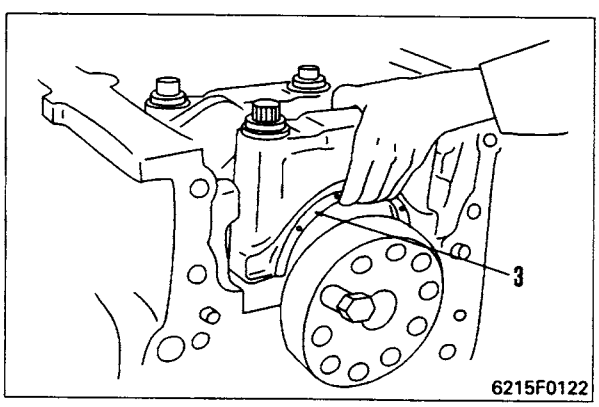
★ Lower thrust bearing (3) is installed to the No. 7 main cap, so after removing it, mark the assembly position.



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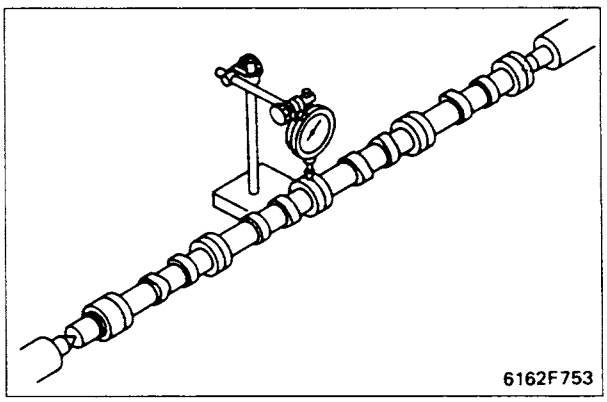
MEASURING CURVATURE OF CAMSHAFT

1) Support the center of both ends of the camshaft with lathes, put the indicator of the dial gauge perpendicularly in contact with the journal at the center, and set it to 0.
2) Rotate the camshaft one turn, and measure the difference between the maximum reading and minimum reading of the dial gauge.
   ★ Do not measure with both ends of the camshaft supported on V blocks. This method produces an error because of the eccentric wear of the journal.



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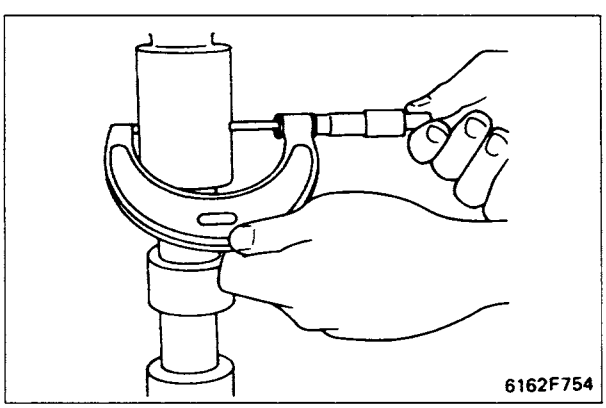
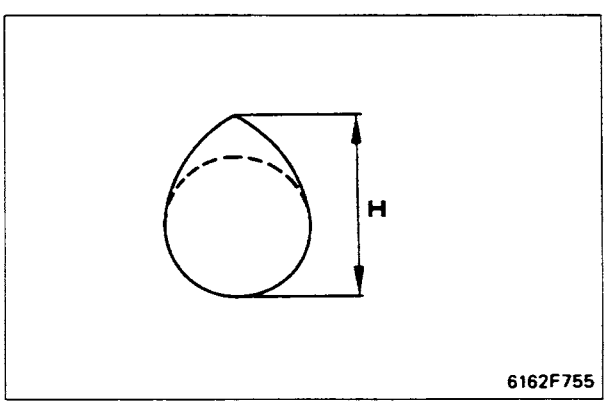
MEASURING OUTSIDE DIAMETER OF JOURNAL

1) Using a micrometer, measure the outside diameter of the journal.

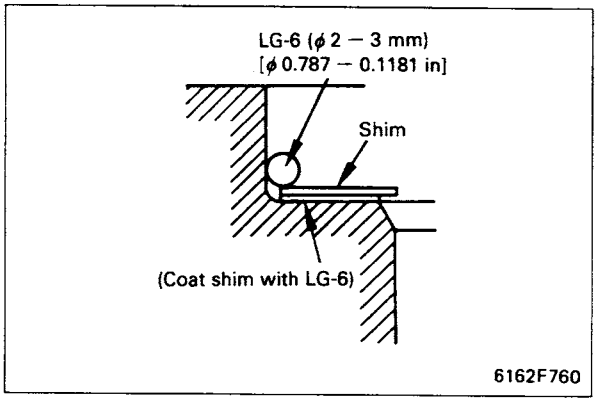


MEASURING HEIGHT OF CAM

1) Using a micrometer, measure cam height **H** for the intake and exhaust.

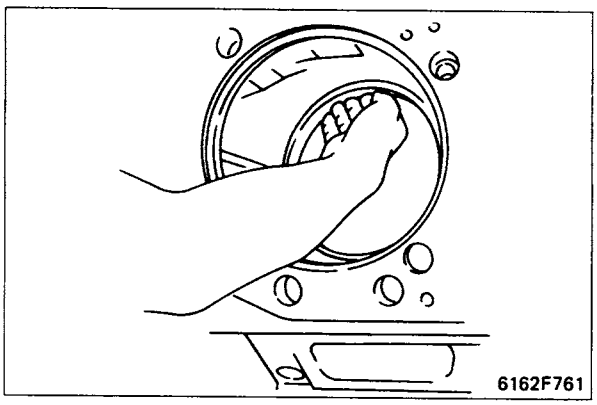


- When machining the bottom contact surface of the counterbore liner lip and using a shim.
  i) Coat the bottom of the shim thinly with gasket sealant LG-6, then assemble the shim.
  ii) Next, coat with gasket sealant LG-6 in the same way as when not using a shim.



6) Coat the liner O-ring, clevis seal, and cylinder block contact surface with a small amount of engine oil (SAE #30) immediately before press fitting the liner.

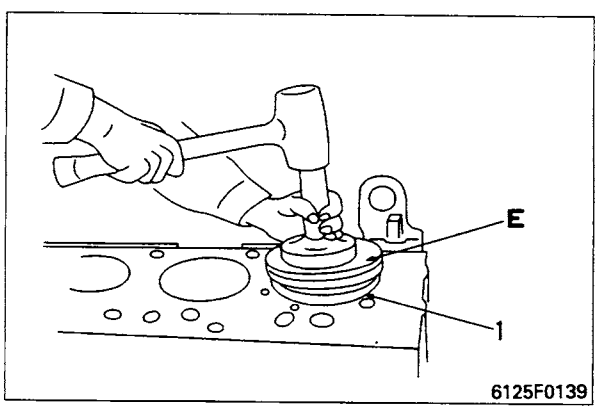
★ Coat the contact surface of the cylinder block uniformly around the whole circumference by hand.



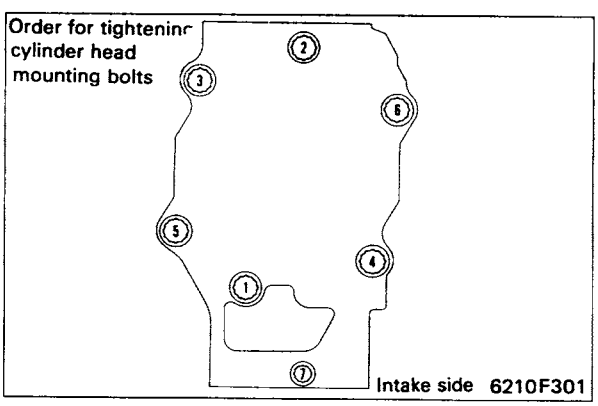
7) Set the "T" mark on the top surface of the liner facing the front, then insert cylinder liner (1) into the cylinder block, taking care not to damage the O-ring.

8) Use your weight and push the liner in with both hands.
   ★ If the liner does not go in smoothly when you apply your weight, there is danger that the O-ring may be damaged, so check the cylinder block for burrs or flashes.

9) Using a liner driver **E**, press fit cylinder liner (1) into the cylinder block.



★ Using the following procedure, squeeze out the gasket sealant coated on the counterbore.
   i) Tighten the cylinder head temporarily with a used head gasket.
      ★ Bolt ⑦ may be tightened partially.



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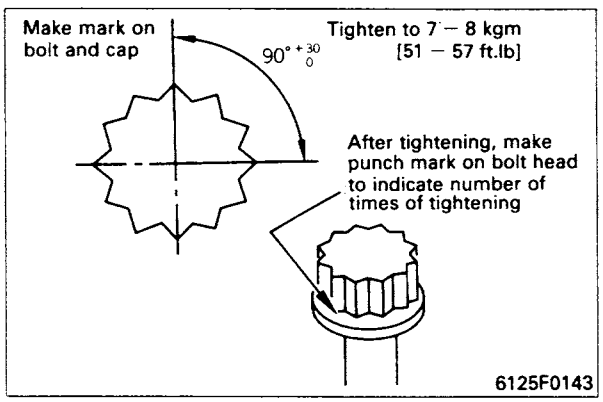
- When not using wrench **G**, tighten as follows.

kgm Connecting rod bolt:

Step	Procedure
1st	Tighten to 69 – 78 Nm {7 – 8 kgm} in order shown in diagram.
2nd	Tighten again to 69 – 78 Nm {7 – 8 kgm} in order shown in diagram.
3rd	Put a mark on the bolt and cap with a felt pen, then turn the bolt a further $90°^{+30}_{0}$

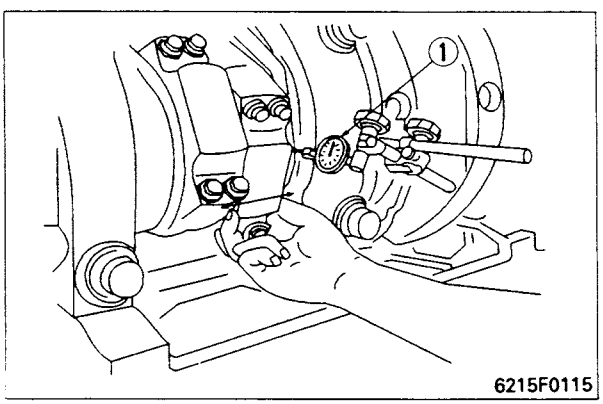


★ After tightening, make one punch mark on the bolt head. If the bolt head has five punch marks, do not reuse it. Replace the bolt with a new bolt.

★ After assembling the connecting rod, check that the crankshaft rotates smoothly.

14) Using dial gauge ①, measure side clearance of connecting rod.
- Standard for side clearance:
  0.3 – 0.454 mm

★ If the connecting rod does not move, remove the connecting rod cap and check that there is no mistake in assembly, and that there are no burrs, or dirt caught anywhere.



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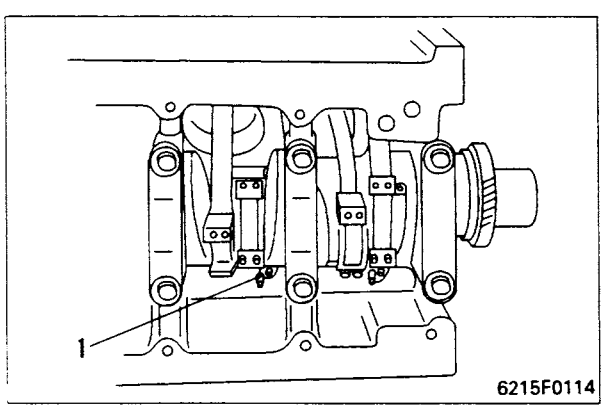


4. Piston cooling nozzle

1) Install cooling nozzle (1).

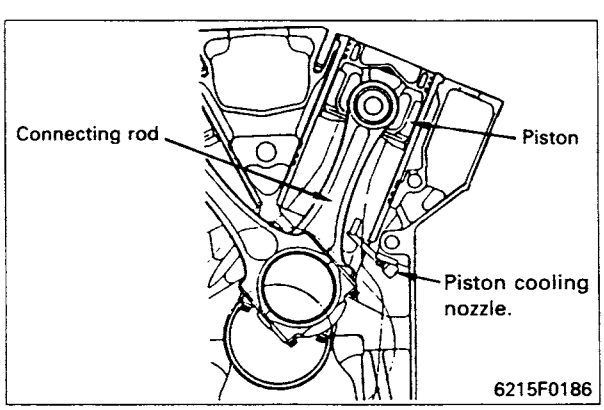
kgm Mounting bolt:
54 ± 20 Nm {5.5 ± 2.0 kgm}

★ Before installing, check for cracks in the nozzle, and check that there is no clogging inside the nozzle.

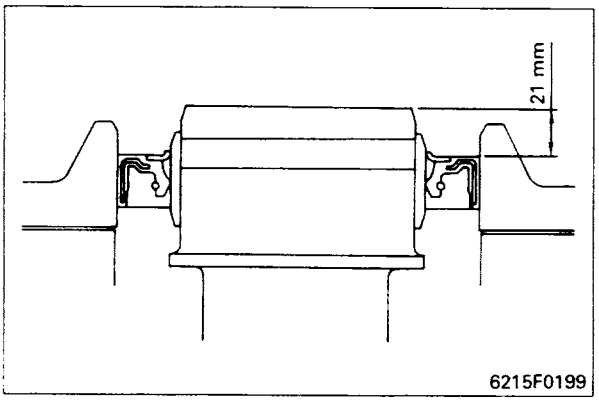
★ Face the tip of the nozzle to the side with the mounting hole at the top, insert into the piston, taking care that it does not hit the piston, then turn 90° to install.

★ Before installing, check for cracks in the nozzle, and check that there is no clogging inside the nozzle.

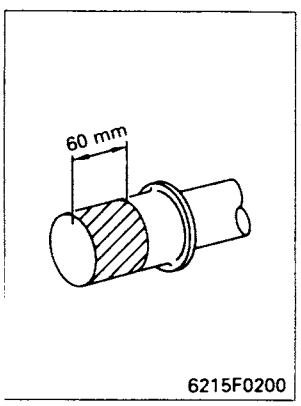
2) Rotate crankshaft slowly and check that there is no interference between piston cooling nozzle and piston, crankshaft.



3) If crankshaft has already been corrected in Step 2)
   - Install sleeve to crankshaft, then install oversize oil seal.



4) Install sleeve as follows.
   i) Remove all rust from sleeve press-fitting portion of crankshaft (range of 60 mm from tip).
   ii) Coat whole of inside surface of sleeve with gasket sealant (LG-7).



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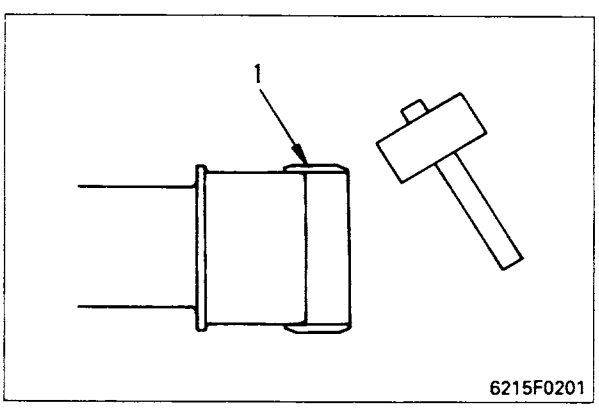
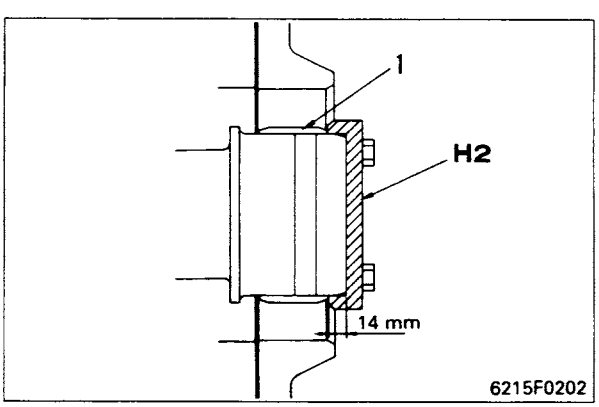
   iii) Using a plastic hammer, tap end face of sleeve around circumference and install sleeve (1) parallel to crankshaft.
      ★ The sleeve is symmetrical, so it can be installed in either direction.

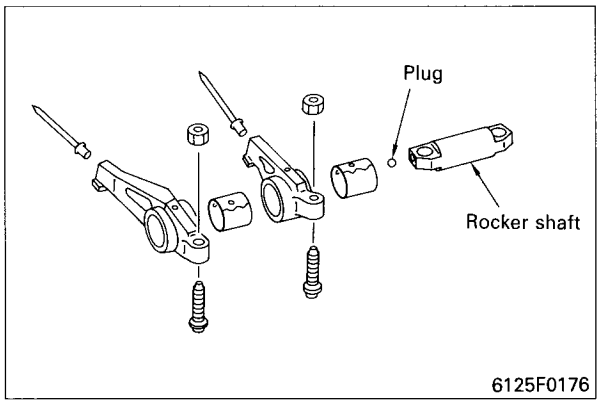


   iv) Using tool **H2**, press fit sleeve (1) to specified position.
      ★ Tighten the bolts uniformly.
      ★ After press fitting the sleeve, wipe off the gasket sealant that has been squeezed out. (If the gasket sealant that has been squeezed out gets on the seal lip, it will cause oil leakage.)

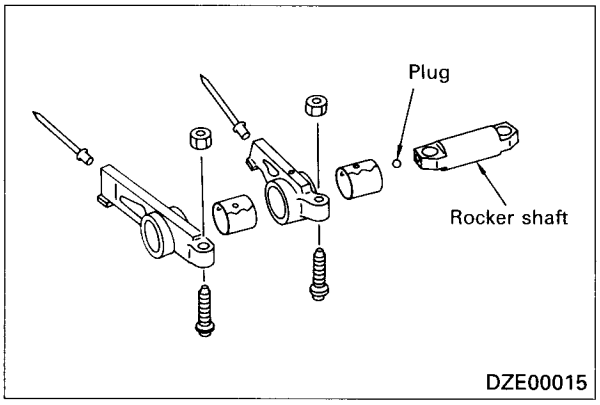


iii) Coat rocker shaft with engine oil (SAE #30), set side with plug facing exhaust rocker arm, then insert rocker shaft.
★ Exhaust end rocker arm: Long
★ Intake end rocker arm: Short

Engine No. 10001 – 10779



Engine No. 10780 and up



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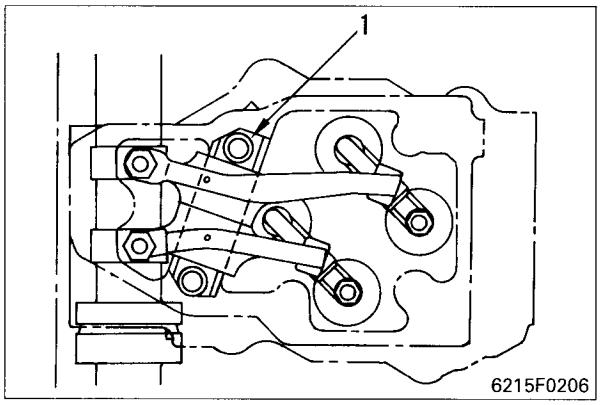
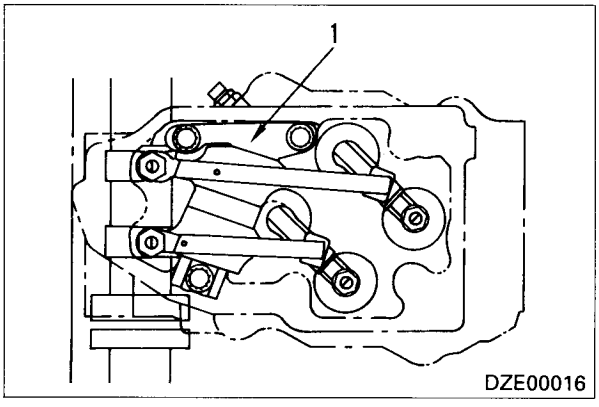
iv) Install rocker arm (1).
★ Install with the wide end face of the rocker arm shaft facing down.
★ Check that the ball of the adjustment screw is fitted securely into the socket of the push rod, then tighen the mounting bolts.

kgm Mounting bolt:
98 ± 5 Nm {10 ± 0.5 kgm}

Engine No. 10001 – 10779



Engine No. 10780 and up

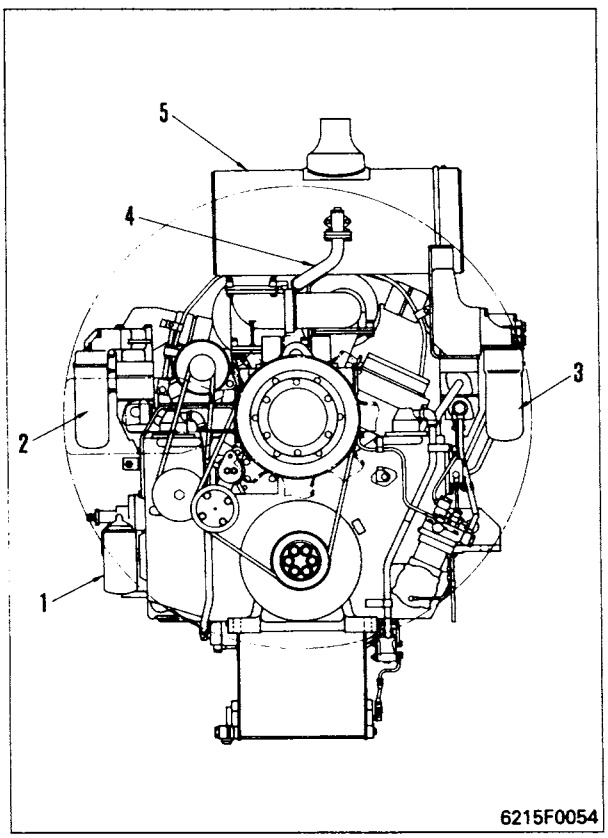


49. Muffler assembly

1) Install muffler bracket.
2) Put muffler assembly (5) on bracket and secure with band.
3) Fit gasket and install Komaclone tube (4).

50. Filter

1) Install bypass filter. (D475A-2 specification only)
2) Install fuel filter (3), oil filter (2), and corrosion resistor (1).
   ★ Install each filter as follows.
   i) Coat seal portion and thread portion of filter cartridge thinly with engine oil (SAE#30).
   ii) Tighten until packing surface contacts seal surface of filter holder, then tighten further by hand as follows:
   Bypass filter: 3/4 – 1 turn
   Oil filter: 3/4 – 1 turn
   Fuel filter: 1/2 – 3/4 turn
   Corrosion resistor: 2/3 turn



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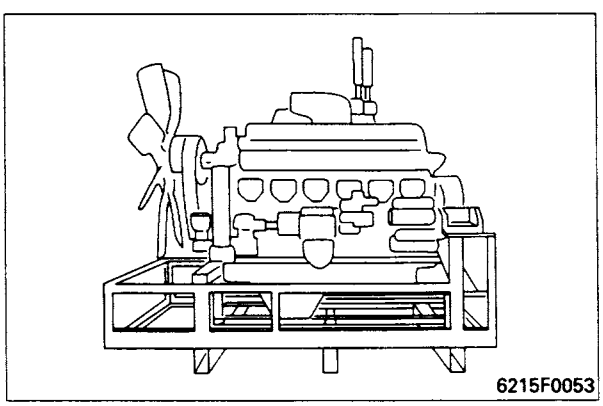
51. Setting on engine stand

- Prepare a stable engine stand, then set the engine assembly on the stand and secure it in position so that it does not fall over.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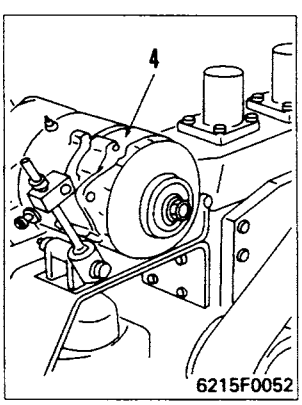
52. Alternator assembly

1) Install alternator assembly (4), tighten lock bolt (2) and adjustment bolt (1) temporarily, then install belt (3).
2) Set so that locknut of adjustment bolt (1) faces in direction of extension of belt (3), then adjust so that deflection is approx. 15 mm when belt (3) is pressed at mid-point with a force of approx. 59 N {6 kg}. After adjusting, tighten lock bolt (2) and locknut of adjustment bolt.



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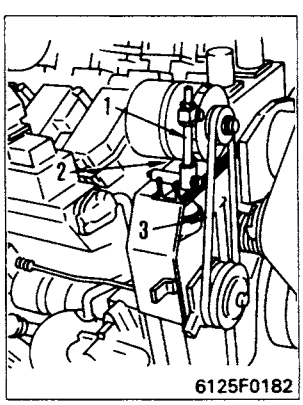

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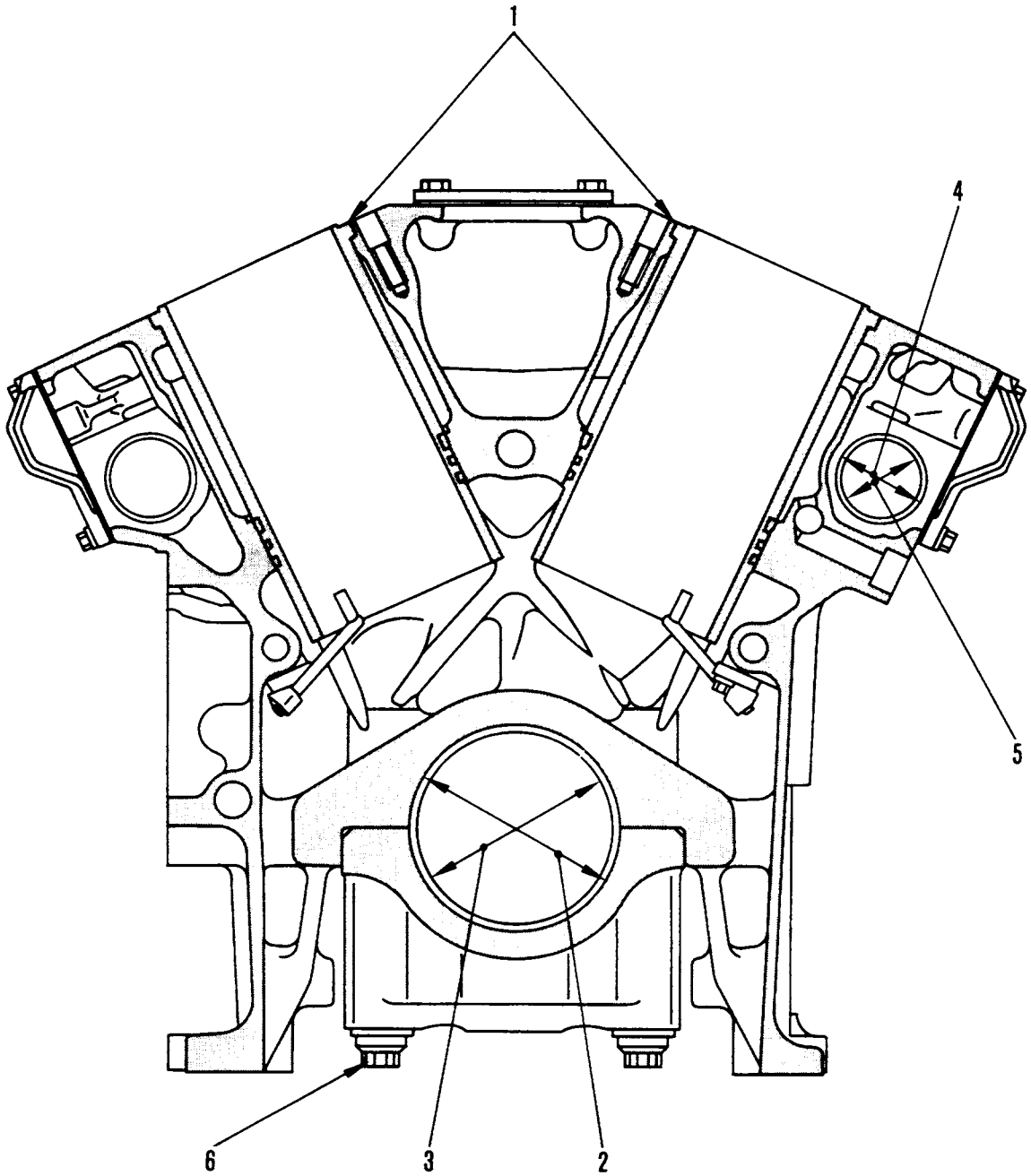
CYLINDER BLOCK



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Unit: mm

No.	Check item	Criteria							Remedy
1	Outside diameter of piston (at right angles to boss)	Rank	Standard size		Tolerance		Repair limit		Replace piston (only S is supplied)
		S	140		−0.070 −0.085		139.85		
		L	140		−0.055 −0.070		139.85		
2	Clearance at piston ring end gap	No.	Measurement location		Standard clerance		Clearance limit		Replace piston ring
		2	Top ring		0.42 – 0.57		1.0		
		3	2nd ring		0.42 – 0.57		1.0		
		4	Oil ring		0.37 – 0.52		1.0		
1 4	Clearance between piston ring groove and piston ring	No.	Measure-ment location	Standard size	Tolerance		Standard clearance	Clearance limit	Replace piston ring or piston
					Ring	Piston			
		2	Top ring	2.4	−0.015 −0.035	Judge with groove wear gauge			
		3	2nd ring	2.4	−0.010 −0.035	Judge with groove wear gauge			
		4	Oil ring	4	−0.010 −0.030	+0.030 +0.010	0.02 – 0.06	0.14	
5	Clearance between piston and piston pin	Standard size	Tolerance		Standard clearance		Clearance limit		Replace piston ring or piston pin
			Shaft	Hole					
		52	0 −0.006	+0.045 +0.035	0.035 – 0.051		0.10		
–	Piston portion B	Carbon deposit (Thickness: 1 mm or more)							Replace piston (if thickness is less than 1 mm, it is possible to clean off carbon at A and B and use again)

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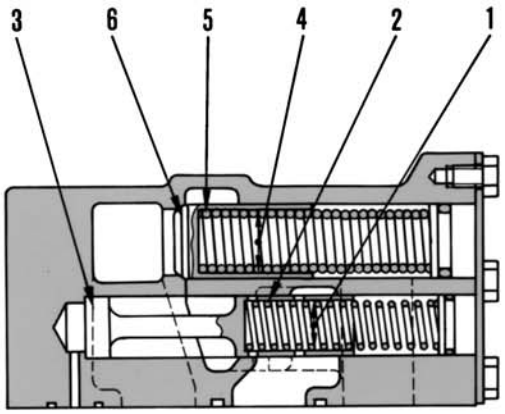
D475A-2 Engine Serial No.: 11034 and up
D475A-3 Engine Serial No.: 11797 and up
D475A-5 Engine Serial No.: 11436 and up
WA800-2 Engine Serial No.: 11042 and up
HD785-3 Engine Serial No.: 11024 and up
HD785-5 Engine Serial No.: 11755 and up
HD985-3 Engine Serial No.: 10909 and up
HV700-1, 2 Engine Serial No.: 11024 and up

Part No.: 6215-51-5601



Unit: mm

No.	Check item	Criteria				Remedy
1	Clearance between regulator valve and body	Standard size	Tolerance		Standard clearance	Replace valve or body
			Valve O.D	Body I.D		
		22	–0.020 –0.041	+0.033 0	0.020 – 0.074	
2	Regulator valve spring	Standard size			Repair limit	Replace spring
		Free length	Installed length	Installed load	Installed load	
		111.5	75	136.0 N {13.87 kg}	239 N {24.4 kg}	
3	Regulator valve set pressure	402 ± 49 kPa {4.1 ± 0.5 kg/cm²}				Adjust or replace spring
4	Clearance between oil cooler by-pass valve and body	Standard size	Tolerance		Standard clearance	Replace valve or body
			Valve O.D	Body I.D		
		28	–0.020 –0.053	+0.033 0	0.020 – 0.086	
5	Oil cooler by-pass valve spring	Standard size			Repair limit	Replace spring
		Free length	Installed length	Installed load	Installed load	
		125.8	89.8	186 N {19 kg}	–	
6	Oil cooler by-pass valve set pressure	392 ± 20 kPa {4.0 ± 0.2 kg/cm²}				Adjust or replace spring

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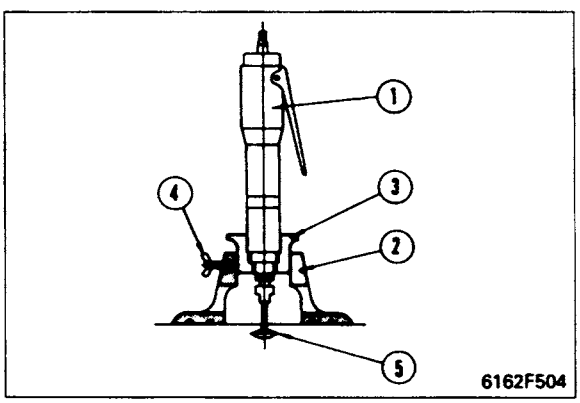
REPLACING VALVE SEAT

1. Removal of valve seat

⚠ When using a grinder to carry out this work, carry out a test run for one minute before starting the operation to check that there is no abnormality.
- If the grindstone has been replaced, carry out the test run for 3 minutes.

⚠ Check that there is no damage to the grindstone, fit it to the grinder spindle so that there is play, and wear safety glasses when using the grinder.

- **When removing with a valve seat puller**
  1) Install grindstone ⑤ to grinder ①.
  2) Align the groove of sleeve ③ with holder ②, and insert.
     ★ Adjust the position of the grinder with set screw ④.



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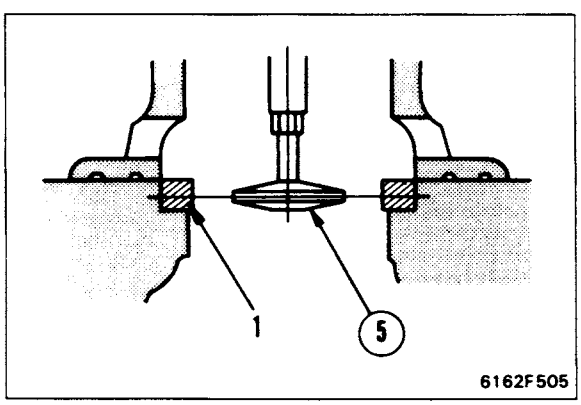
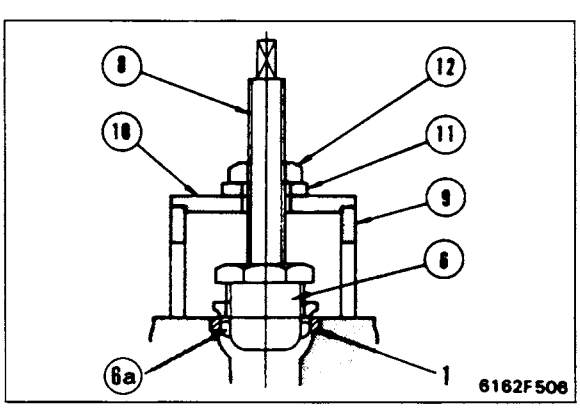
  3) Adjust the position of the grinder so that the center of grindstone ⑤ is at the center of valve seat (1), then tighten the set screw to fix the grinder in place.
  4) Rotate the grindstone and move it slowly until it contacts valve seat (1).
  5) Press the grindstone lightly against the inside face of the valve seat and make a groove around the whole circumference of the inside face of the valve seat.
     ★ Depth of groove: Approx. 1 mm

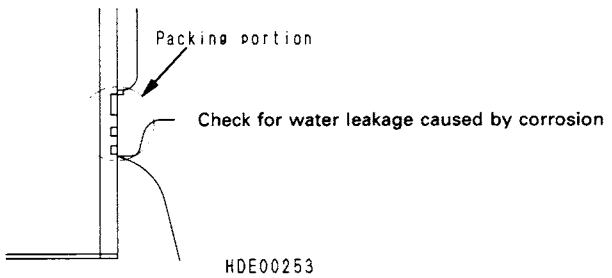
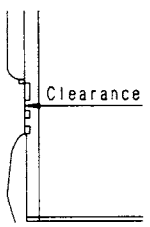


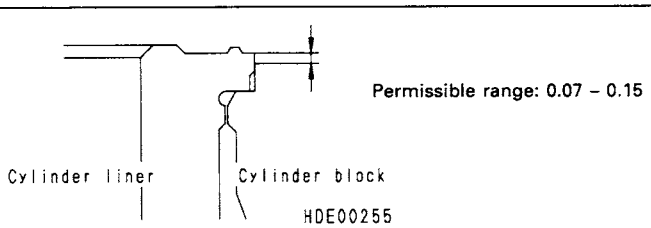
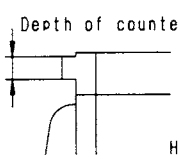
  6) Push the three claws ⑥a of puller head ⑥ of tool **A** inwards by hand, and fit into valve seat (1).
  7) Tighten screw ⑧ to push the three claws into the groove on the inside face of the valve seat.
     ★ When the claws are completely in contact with the groove, stop tightening.
  8) Insert bridge ⑨ on the outside of the puller head, set plates ⑩ and ⑪ on top of the bridge, and tighten nut ⑫ to pull out the valve seat.



TESTING AND INSPECTING CYLINDER BLOCK

Unit: mm

<table>
<tr><th>Symbol</th><th>Inspection item</th><th>Judgement standards</th><th>Remedy</th></tr>
<tr><td>A.</td><td>Cracks</td><td>Check for cracks (external color check)
Cylinder head bolt hole portion, etc.</td><td>Replace</td></tr>
<tr><td>B.</td><td>Correction of contact at packing portion</td><td> 
</td><td>Replace</td></tr>
<tr><td>C.</td><td>Clearance from cylinder liner</td><td> 

<table>
<tr><th rowspan="2">Standard size</th><th colspan="2">Standard value</th><th rowspan="2">Standard clearance</th></tr>
<tr><th>Inside diameter of cylinder block</th><th>Outside diameter of cylinder block</th></tr>
<tr><td>158.00</td><td>158.00 – 158.04</td><td>157.946 – 157.976</td><td>0.024 – 0.094</td></tr>
</table></td><td>Replace cylinder liner or cylinder block</td></tr>
<tr><td>D.</td><td>Inside diameter of camshaft bushing</td><td>• Inside diameter
<table>
<tr><th>Standard size</th><th>Standard value</th><th>Standard limit</th></tr>
<tr><td>69</td><td>69.000 – 69.025</td><td>69.10</td></tr>
</table>
• Clearance from camshaft bearing
<table>
<tr><th>Standard clearance</th><th>Clearance limit</th></tr>
<tr><td>0.016 – 0.096</td><td>0.15</td></tr>
</table></td><td>Replace bushing</td></tr>
<tr><td>E.</td><td>Protrusion of liner</td><td> 
</td><td>Replace cylinder liner or correct cylinder block</td></tr>
<tr><td>F.</td><td>Depth of counterbore and corrosion of bottom surface</td><td> 

<table>
<tr><th>Standard size</th><th>Standard value</th></tr>
<tr><td>11</td><td>11.00 – 11.05</td></tr>
</table>
• Check for corrosion</td><td>Repair by machining, add shim</td></tr>
<tr><td>G.</td><td>Distortion, wear of cylinder head mounting surface</td><td><table>
<tr><th colspan="2">Tolerance</th><th>Repair limit</th></tr>
<tr><td>Overall top surface of block:</td><td>Max. 0.09</td><td>0.135</td></tr>
<tr><td>For one cylinder:</td><td>Max. 0.05</td><td>0.100</td></tr>
</table></td><td>Repair by machining</td></tr>
</table>

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5) Loosen the cylinder head mounting bolts, remove the cylinder head, then wipe off the excess gasket sealant that has come out from the counterbore.
   ★ The gasket sealant that comes out may cause deformation of the head gasket grommet, so always carry out Steps 4) and 5) without fail.
   ★ After carrying out Steps 4) and 5), use a new head gasket to install the cylinder head.

5. Standard for rebuilding cylinder liner O-ring portion of cylinder block

- If the bushing of the cylinder liner O-ring of the cylinder block has been corrected, make the finishing dimensions as follows.

★ Concentricity of ⑥ in relation to standard Ⓐ: Max. 0.05 mm

Table 6

Unit: mm

No.	Finishing dimensions
①	ø167
②	ø161.45 ± 0.25
③	ø160.67 ± 0.064
④	176 ± 0.25
⑤	184.94 ± 0.18
⑥	ø158 $^{+0.040}_{0}$
⑦	ø159.03 (Gauge diameter)

Fig. 16

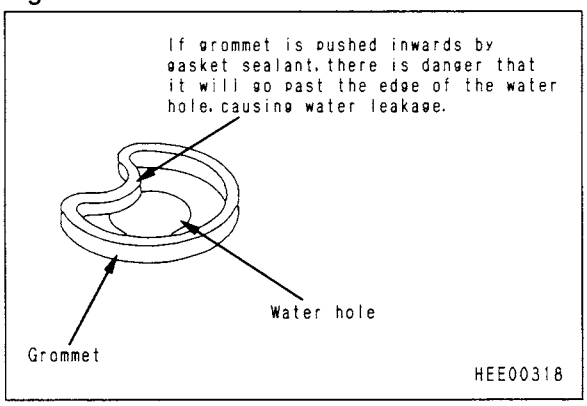


Fig. 17

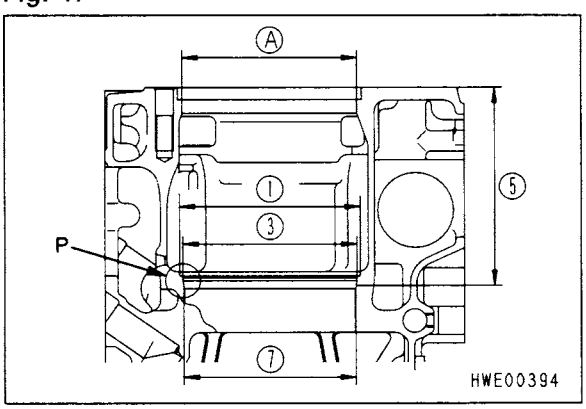
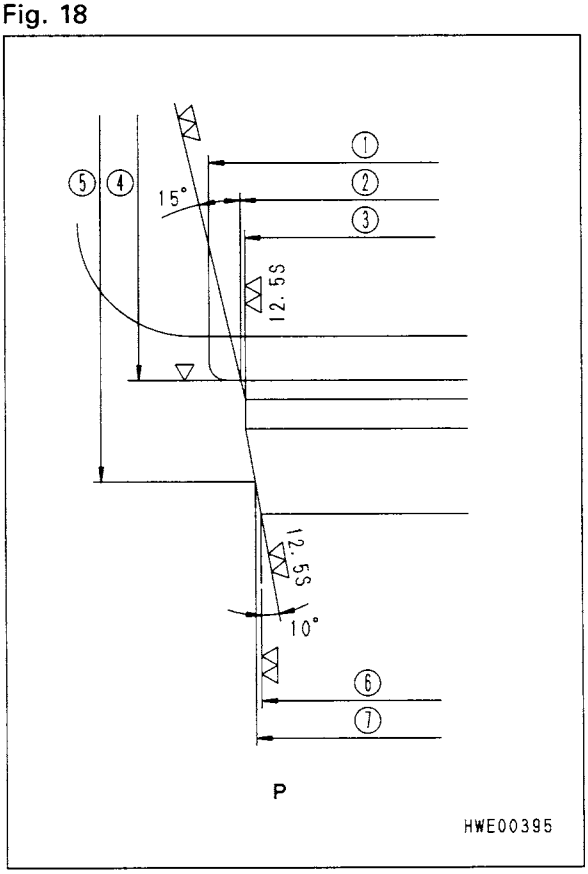


Fig. 18



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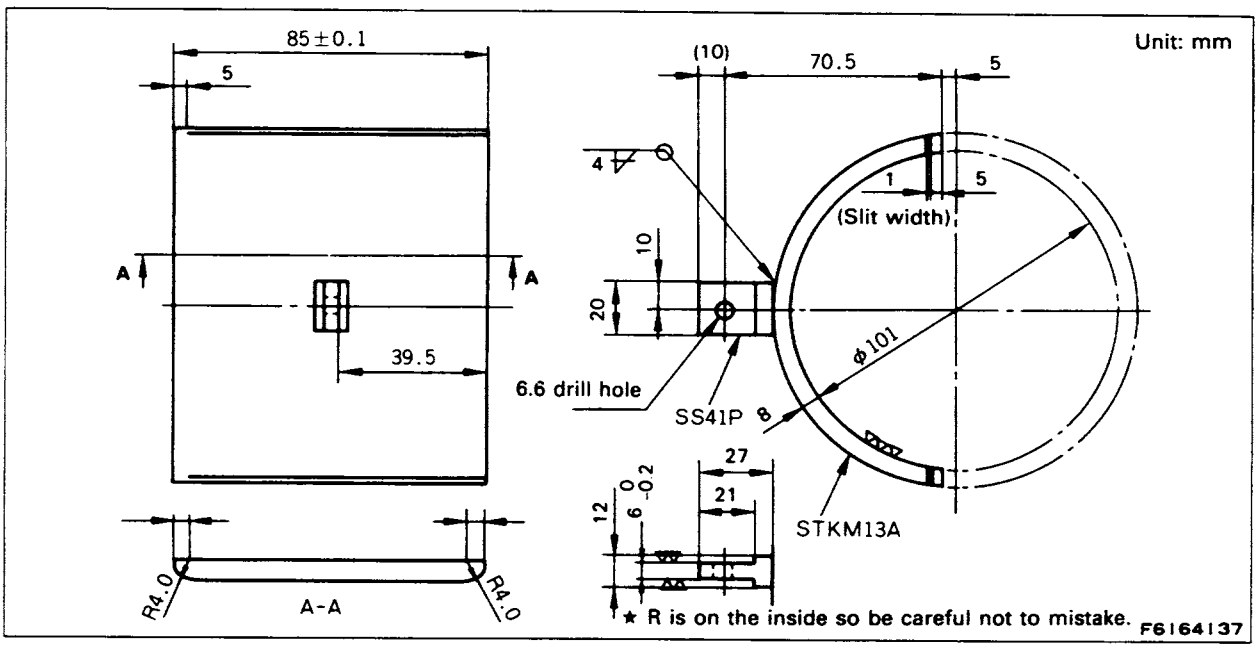
Polishing jig

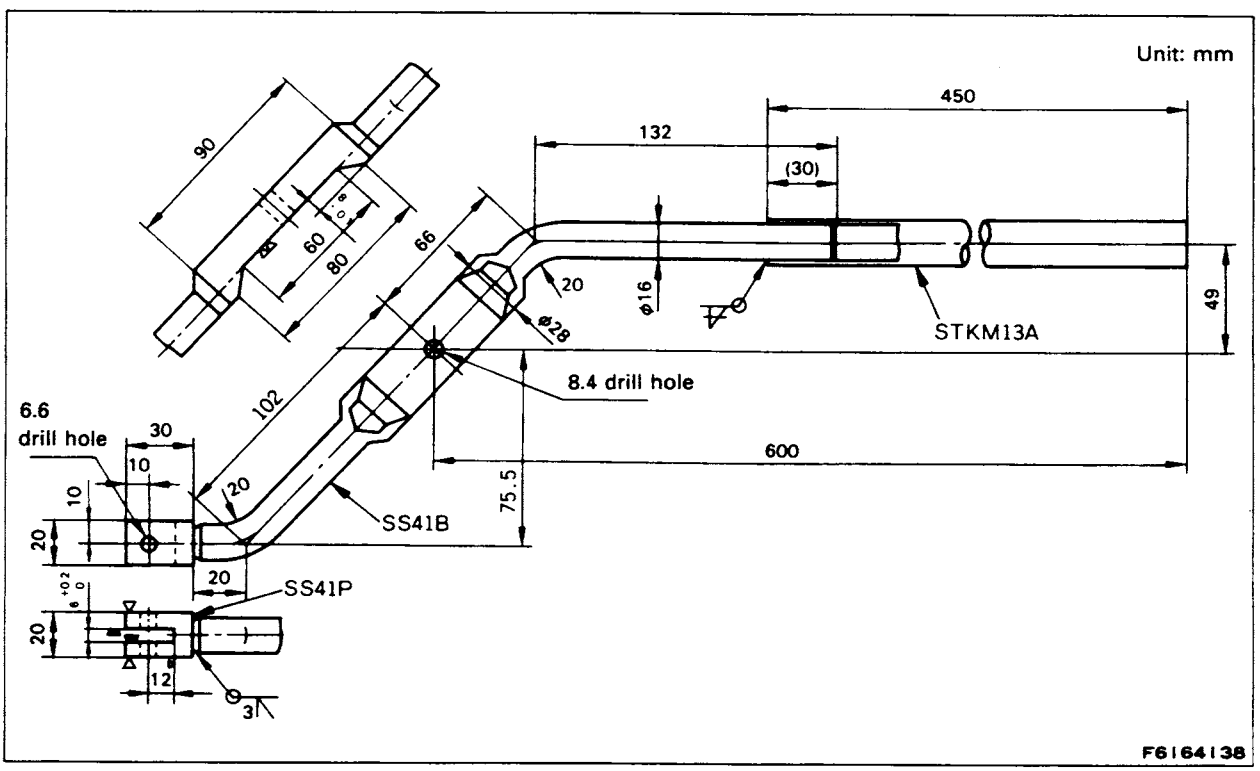
★ Make a polishing jig according to the diagram below.

1. Polishing jig (for pin journal)

Plate ① (2 are used for each jig)

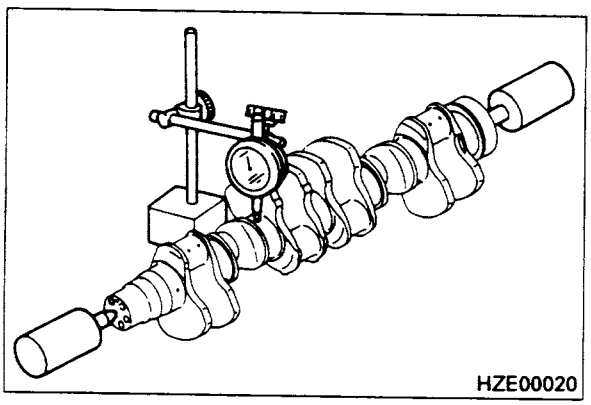


Lever ② (2 are used for each jig)

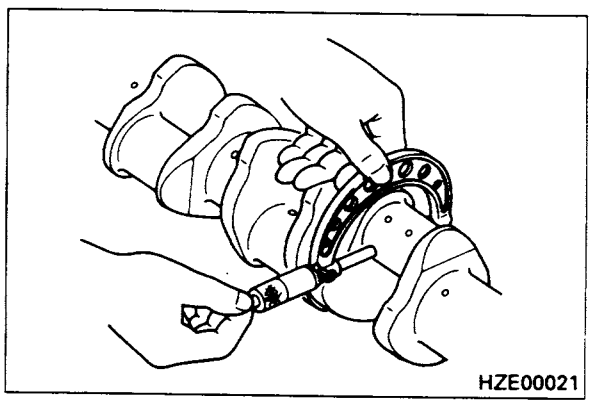


12. Procedure for measuring curvature of crankshaft and outside diameter of journal

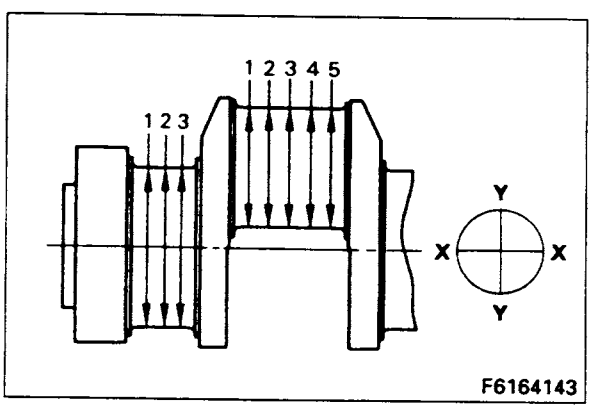
1) Support the center of both ends of the crankshaft with lathes. Put the probe of a dial gauge perpendicularly in contact with the center journal (No. 4), and set the dial to 0 at the peak. Then rotate one turn and read the minimum and maximum values.
   ★ If no lathes are available, support the No. 1 and No. 7 journals on a V block.



2) Measure the outside diameter of the main journal and the outside diameter of the pin journal with a micrometer or air micrometer.



- Locations for measuring journal
  Pin journal: X, Y directions, 5 places
  Main journal: X, Y directions, 3 places



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