SHOP MANUAL

KOMATSU

82E–98E SERIES

DIESEL ENGINE

Printed in Japan 06-05 (01)

HOW TO READ THIS MANUAL

1. Range of Operation Explanation

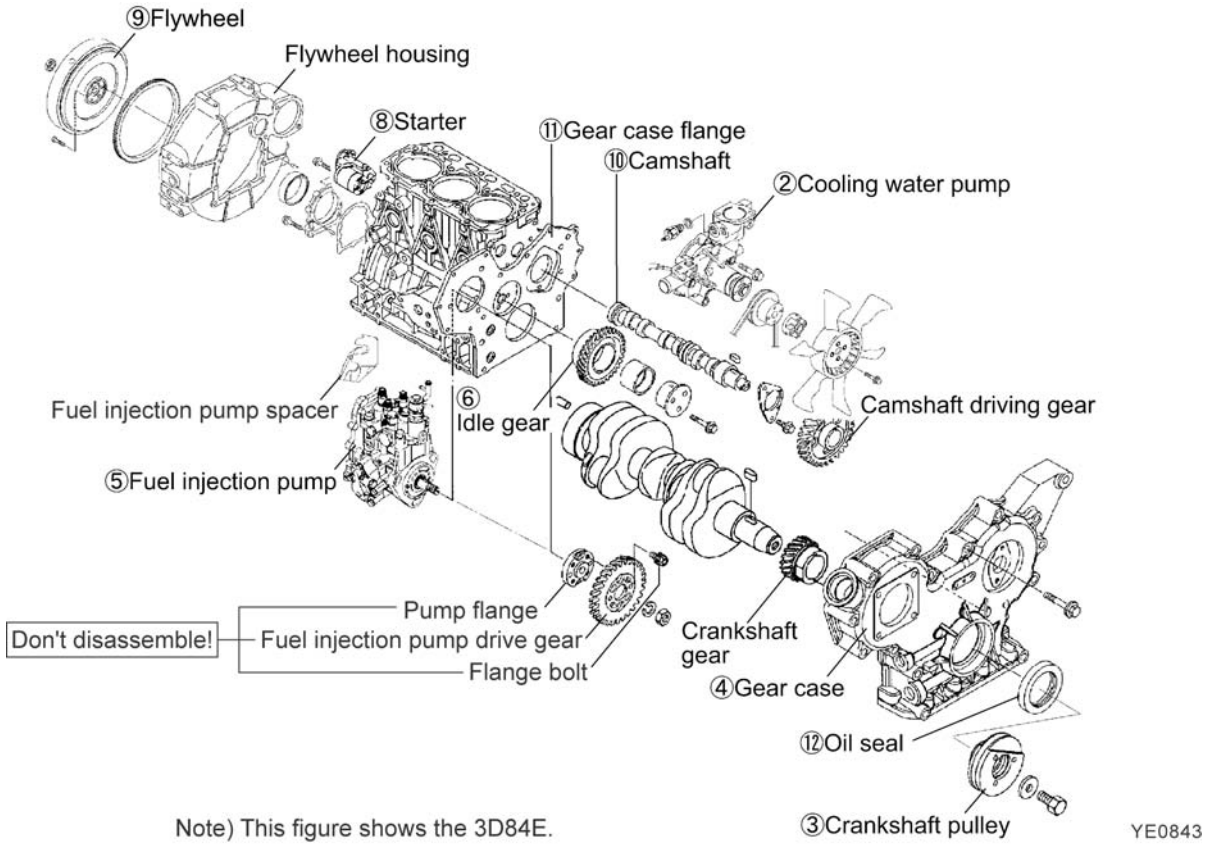
This manual explains the troubleshooting, installation/removal, replacement, disassemble/reassembly, inspection, adjustment and adjusting operation procedures for the 82E-5 to 98E-5 series engines with direct injection system.

Refer to the shop manual for each of the fuel injection pump, governor, starting motor and alternator except for their installation.

2. How to Read the Explanations

- An exploded view, sectional views, a system diagram, etc. are shown at the beginning of each section as required for easy understanding of the mounted states of the components.
- For the removal/installation of each part, the procedure is shown with the procedural step No. in the illustration.
- Precautions and key points for disassembly and reassembly of parts are described as **points**. In the explanation for each point, detailed operation method, information, standard and precautions are described.

Description Example



Note) This figure shows the 3D84E.

The job contents are described in the disassembly procedure for Nos. not shown in the illustration.

- Disassembly procedure
  1) Follow steps (1) to (15) of the cylinder head disassembly procedure.
  2) Remove the cooling water pump.
  3) Remove the crankshaft pulley. (**Point 1**) ← Operation point to be explained on a later page.

- Operation points
  Disassemble: Service point for removal
  Reassemble: Service point for installation
  Disassemble-Reassemble: Service point required in both removal and installation.

3D88E

Engine name		Unit	3D88E						
Engine specification class		–	VM						
Type		–	Vertical, in-line, 4-cycle, water-cooled diesel engine						
Combustion chamber		–	Direct injection						
Number of cylinders		–	3						
Cylinder bore x stroke		mm x mm	88 x 90						
Displacement		ℓ (cc)	1.642 (1,642)						
Continuous rating	Revolving speed	rpm	–						
	Output	kW {HP}	–						
Rated output	Revolving speed	rpm	2,000	2,200	2,400	2,500	2,600	2,800	3,000
	Output	kW {HP}	18.0 {24.2}	19.9 {26.6}	21.6 {29.0}	22.6 {30.3}	23.5 {31.5}	25.2 {33.7}	27.1 {36.3}
Max. no-load speed (± 25)		rpm	2,180	2,400	2,590	2,700	2,810	2,995	3,210
Ignition order		–	1-3-2-1(No.1 cylinder on flywheel side)						
Power take off		–	Flywheel						
Direction of rotation		–	Counterclockwise (viewed from flywheel)						
Cooling system		–	Radiator						
Lubrication system		–	Forced lubrication with trochoid pump						
Starting system		–	Electric						
Applicable fuel		–	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)						
Applicable lubricant		–	API grade class CD or CF						
Lubricant capacity (oil pan) (*1)	Total	ℓ	6.7						
	Effective	ℓ	2.8						
Cooling water capacity (engine only)		ℓ	2.0						
Engine dimensions (*2) (with flywheel housing) (*1)	Overall length	mm	564						
	Overall width	mm	486						
	Overall height	mm	622						
Engine dry weight (*1),(*2) (with flywheel housing)		kg	155						
Cooling fan (std.) (*1)		mm	335 mm O/D, 6 blades pusher type F						
Crankshaft V pulley diameter & Fan V pulley diameter (std.) (*1)		mm	120 x 90						

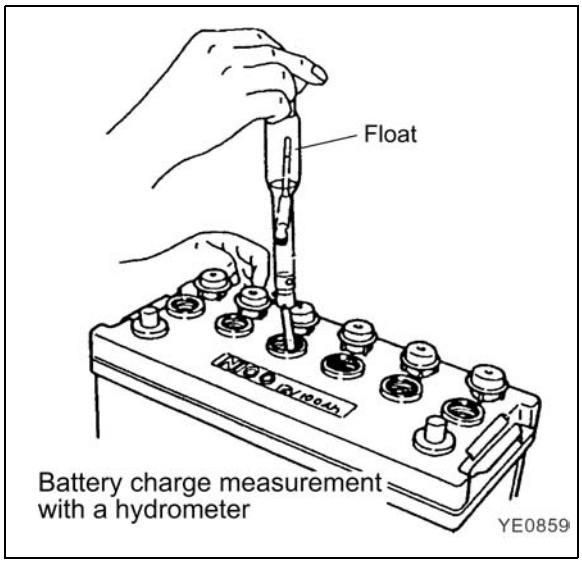
*1 : Items may differ from the above depending on an engine installed on a machine unit.
*2 : Engine weight and dimensions without radiator

2. INSPECTION AND ADJUSTMENT

(b) Measurement with hydrometer
When using a hydrometer, the measured specific gravity must be corrected according to the temperature at the time of measurement. The specific gravity of battery electrolyte is defined with 20°C as the standard. Since the specific gravity increases or decreases by 0.0007 when the temperature varies by 1°C, correct the value according to the equation below.

$$S20 = St + 0.007(t - 20)$$

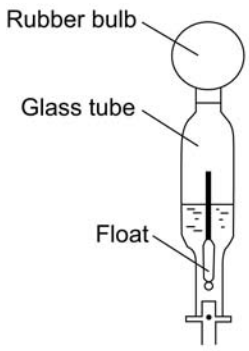
- St: Specific gravity at measurement
- t: Electrolyte temperature at measurement
- S20: Converted specific gravity at 20°C



Battery charge measurement with a hydrometer YE0859

(c) Specific gravity and remaining battery charge

Specific gravity (20°C)	Discharged quantity of electricity (%)	Remaining charge (%)
1.28	0	100
1.26	10	90
1.24	20	80
1.23	25	75

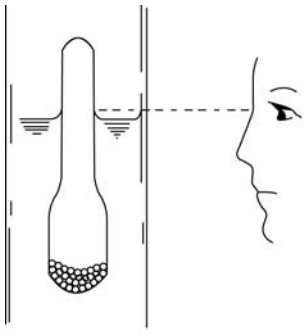


Hydrometer structure YE0860

(3) Terminals
Clean if corroded or soiled.

(4) Mounting bracket
Repair or replace it if corroded.
Retighten if loosened.

(5) Battery appearance
Replace the battery if cracked or deformed.
Clean with fresh water if contaminated.


How to read hydrometer YE0861

In case of 3-cylinder engines, turn the crankshaft 240° and make adjustment for the No.3 cylinder. Then adjust the No.2 cylinder in this order.
The cylinder to be adjusted first does not have to be the No.1 cylinder. Select and adjust the cylinder where the piston is the nearest to the top dead center after turning, and make adjustment for other cylinders in the order of ignition by turning the crankshaft 240° each time.

The adjustment method of reducing the flywheel turning numbers (for reference):
For 3 cylinder engines
Set No.1 cylinder to the compression T.D.C.and adjust the clearance of the ● mark of the below table. Next, turn the flywheel once (the suction / exhaust valve of No.1 cylinder is in the position of the overlap T.D.C. at this time), and adjust the clearance of the ○ mark.

Ignition order of 3 cylinder engines: 1→3→2

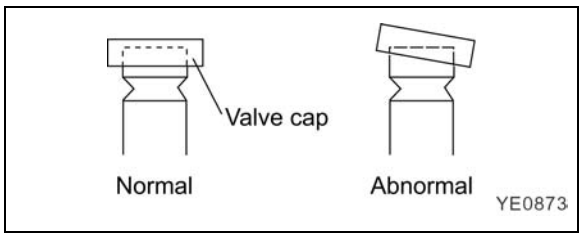
Cylinder No.	1		2		3		
Valve	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	
No.1 compression T.D.C.	●	●	●			●	The first time
No.1 overlap T.D.C.				○	○		The second time

For 4 cylinder engines
Set No.1 cylinder to the compression T.D.C. and adjust the clearance of the ● mark of the bottom table. Next, turn the flywheel once, and adjust the clearance of the ○ mark.

Ignition order of 3 cylinder engines: 1→3→4→2

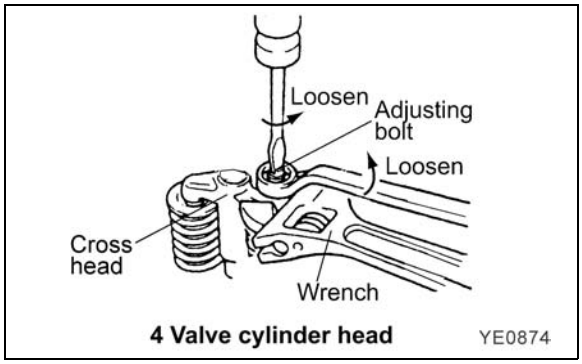
Cylinder No.	1		2		3		4		
Valve	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	
No.1 compression T.D.C.	●	●	●			●			The first time
No.4 compression T.D.C.				○	○		○	○	The second time

(b) Valve clearance inspection and adjustment
1) Loosen adjusting bolts
In case of 2-valve cylinder head loosen the lock nut and adjusting screw, and check the valve for any inclination of valve cap, entrance of dirt or wear.



In case of 4-valve cylinder head loosen the lock nut and adjusting screw of rocker arm. Be careful that excessive tension isn't applied to the cross head, and loosen a locknut of cross head.

[NOTICE]
When loosening a locknut of a cross head, loosen the locknut while fixing the cross head with a wrench so that the valve may not lean.

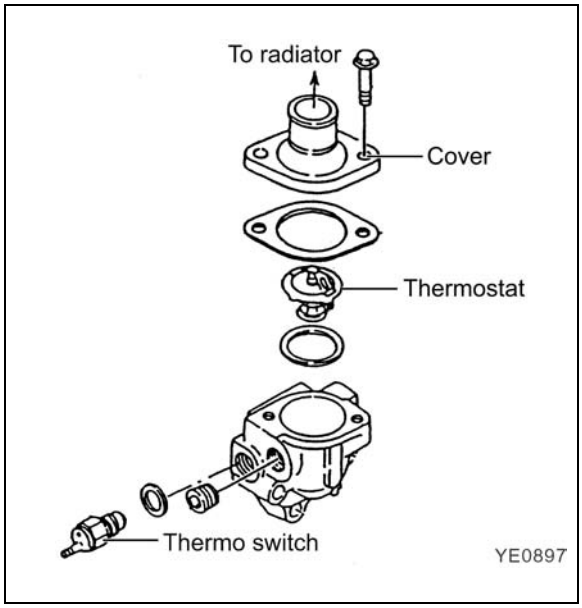


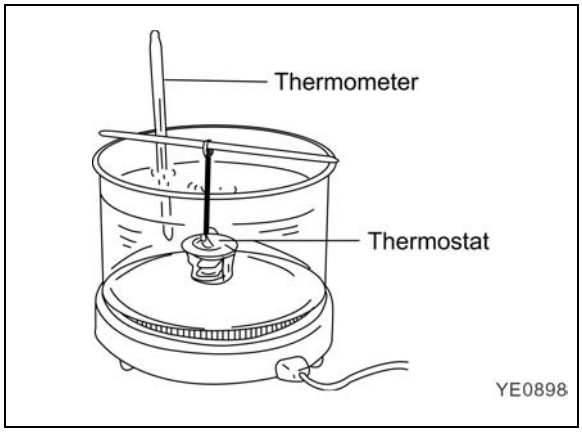
2.7 Thermostat Inspection

Place the thermostat in a container filled with water. Heat it while measuring the water temperature, and see that the thermostat is actuated at temperature of following table.

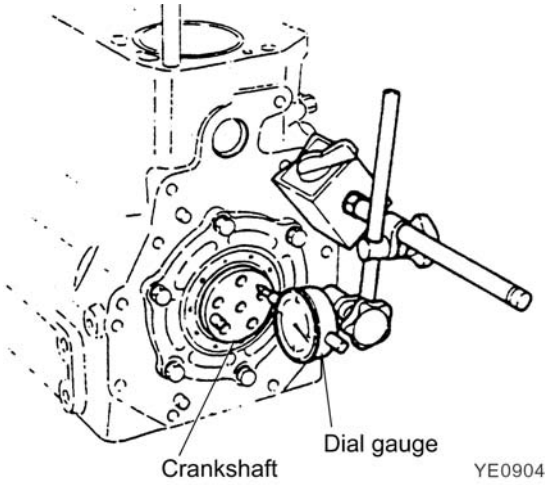
Model	Valve opening Temperature (°C)*	Full open lift (Temperature) (mm)
All models	69.5 – 72.5	8 or more (85°C)

* Valve opening temperature is carved on the flange.





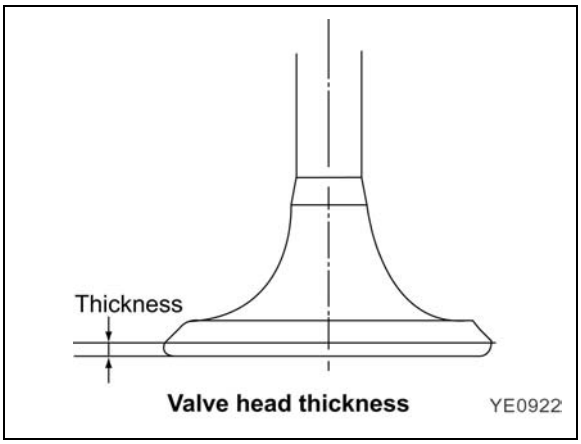
4. DISASSEMBLY, INSPECTION AND REASSEMBLY OF ENGINES

Step	Removal Parts	Remarks
23	1) Remove main bearing cap bolt. While shaking main bearing cap, remove main bearing cap together with lower main bearing metal. 2) Extract crankshaft, taking care not to damage it. 3) Remove upper main bearing metal.	1) Before extracting crankshaft, measure the side gap around it.  Apply a dial gauge to the end of crankshaft. Force the crankshaft on both sides in the axial direction to measure the thrust gap. Alternatively, insert a thickness gauge directly between the base thrust metal and the thrust surface of the crankshaft to measure the gap. If the limit size is exceeded, replace the thrust metal with a new one. Thrust gap (All models) 2) Notice on the removal of thrust metal. (a) When removing thrust metal, ascertain the position and direction where thrust metal is installed in relation to the cap. (b) Make sure that the thrust metal groove is outward in relation to the cap.
24	1) Remove piston and connecting rod assembly.	1) To selectively remove a desired piston and connecting rod assembly without extracting crankshaft, take the steps itemized below: (a) Remove carbon deposits from the upper wall of the cylinder using fine sandpaper, taking care not to damage the inner surface of the cylinder. (b) While turning the crankshaft, with the connecting rod cap removed, raise the piston up to the top dead center (TDC). (c) Extract the piston/connecting rod assembly while tapping the connecting rod at the large end with the handle of a plastic hammer or the like.
25	1) Remove tappet.	

(3) Intake/exhaust valve
Mainly clean and check damage and wear at the valve stem and seat.
(a) Seat contact: See (1)-(d) above.
(b) Stem outside diameter: See (2) above.
(c) Valve head thickness

mm

Model	Part	Standard	Limit
3D82AE – 3D88E (2-valve head)	Intake	1.24 – 1.44	0.8
	Exhaust	1.35 – 1.55	0.8
S4D84E (4-valve head)	Intake	1.00 – 1.20	0.6
	Exhaust	1.00 – 1.20	0.6
4D94LE (S)4D98E (4-valve head)	Intake	1.44 – 1.84	1.0
	Exhaust	1.70 – 2.10	1.0

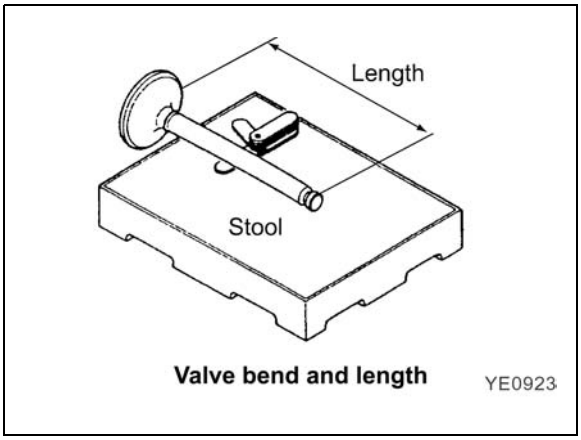


Valve head thickness YE0922

(d) Valve stem bend

mm

Limit	0.01

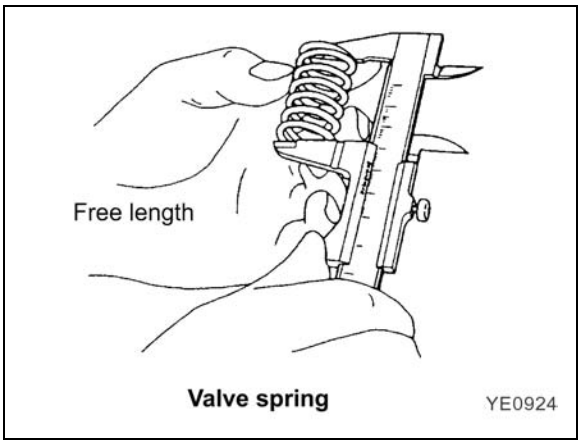


Valve bend and length YE0923

(e) Overall length

mm

		Standard	Limit
3D82AE	Intake/ Exhaust	97.2 – 97.8	97.0
3D84E – 3D88E 4D84E – 4D88E	Intake/ Exhaust	108.7 – 109.3	108.5
S4D84E	Intake/ Exhaust	100.0 – 100.6	99.8
4D84LE (S)4D98E	Intake	102.3 – 103.1	102.1
	Exhaust	102.4 – 103.2	102.2

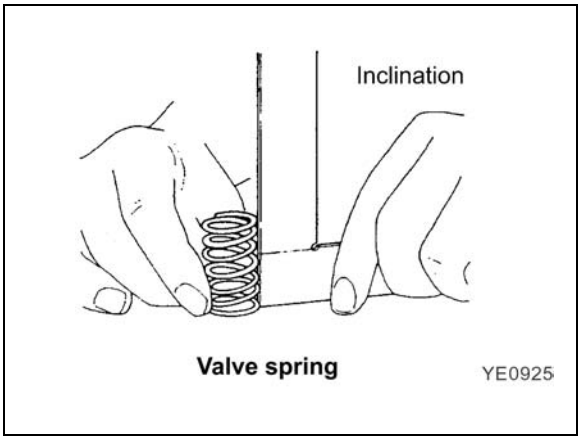


Valve spring YE0924

(4) Valve spring
Mainly inspect damage and corrosion.

mm

	Free length		Inclination limit
	Standard	Limit	
3D82AE	44.4	43.9	1.4
3D84E – 3D88E 4D84E – 4D88E	42.0	41.5	
S4D84E	37.4	36.9	1.3
4D84LE (S)4D98E	39.7	39.2	1.4



Valve spring YE0925

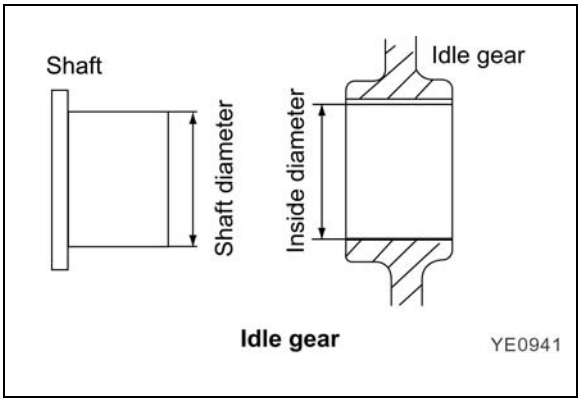
mm

Model	Place	Item	Standard	Limit
3D82AE – 4D88E	Gear side	Bushing I.D.	44.990 – 45.055	45.130
		Camshaft O.D.	44.925 – 44.950	44.890
		Oil clearance	0.040 – 0.130	0.240
	Intermediate position	Bushing I.D.	45.000 – 45.025	45.100
		Camshaft O.D.	44.910 – 44.935	44.875
		Oil clearance	0.065 – 0.115	0.225
	Wheel side	Bushing I.D.	45.000 – 45.025	45.100
		Camshaft O.D.	44.925 – 44.950	44.890
		Oil clearance	0.050 – 0.100	0.210
4D94LE, (S)4D98E	Gear side	Bushing I.D.	49.990 – 50.055	50.130
		Camshaft O.D.	49.925 – 49.950	49.890
		Oil clearance	0.040 – 0.130	0.240
	Intermediate position	Bushing I.D.	50.000 – 50.025	50.100
		Camshaft O.D.	49.910 – 49.935	49.875
		Oil clearance	0.065 – 0.115	0.225
	Wheel side	Bushing I.D.	50.000 – 50.025	50.100
		Camshaft O.D.	49.925 – 49.950	49.890
		Oil clearance	0.05 – 0.100	0.210

(2) Idle gear
Mainly check the bushing seizure and wear, and gear damage.

Shaft outside diameter and bushing inside diameter measurement mm

Item	Standard	Limit
Shaft outside diameter	45.950 – 49.975	45.900
Bushing inside diameter	46.000 – 46.025	46.075
Clearance	0.025 – 0.075	0.175



(3) PTO drive gear
Mainly check sticking of bearings on both sides, gear damage and looseness, and gear shaft damage and wear.

Crankpin mm

Model & Item		Standard	Limit
3D82AE	Pin outside diameter	42.952 – 42.962	42.902
	Metal thickness	1.487 – 1.500	—
	Oil clearance	0.038 – 0.090	0.150
(S)3D84E – 4D88E	Pin outside diameter	47.952 – 47.962	47.902
	Metal thickness	1.492 – 1.500	—
	Oil clearance	0.038 – 0.074	0.150
4D94LE, (S)4D98E	Pin outside diameter	57.952 – 57.962	57.902
	Metal thickness	1.492 – 1.500	—
	Oil clearance	0.038 – 0.074	0.150

If the oil clearance exceeds the limit, use an undersized bearing.

Undersized crankpin bearing (0.25 mm)

Model	Part No.	Standard thickness (mm)
3D82AE	YM119810-23610	1.612 – 1.625
(S)3D84E – 4D88E	YM129150-23610	1.617 – 1.625
4D94LE, (S)4D98E	YM129900-23610	1.617 – 1.625

Pin machining dimension

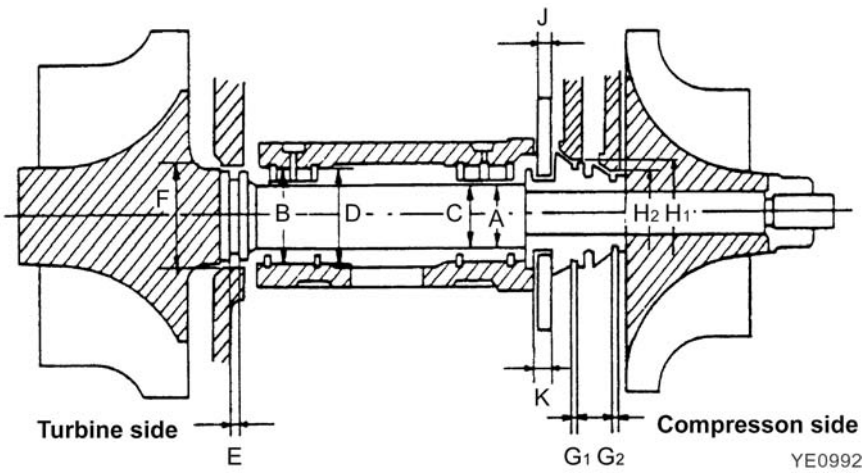
Model	Pin machining dimension (mm)
3D82AE	ø42.702 – 42.712
(S)3D84E – 4D88E	ø47.702 – 47.712
4D94LE, (S)4D98E	ø57.702 – 57.712

5. LUBRICATION SYSTEM

7. FUEL INJECTION PUMP/GOVERNOR

8.2 Service Standards and Tightening Torque

8.2.1 Service standards



RHB31/RHB51 type

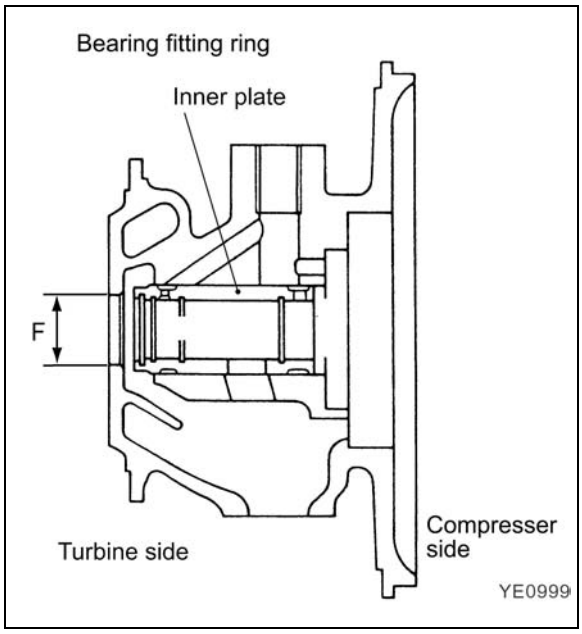
Unit: mm

		Standard dimension		Wear limit	
		RHB31	RHB51	RHB31	RHB51
Turbine shaft	Turbine shaft journal outside diameter (A)	6.257 – 6.263	7.99 – 8.00	6.25	7.98
	Turbine shaft seal ring groove width (E)	1.038 – 1.062	1.25 – 1.28	1.07	1.29
	Compressor side seal ring groove width (G_1)	1.02 – 1.03	1.22 – 1.23	1.04	1.31
	Compressor side seal ring groove width (G_2)	0.82 – 0.83	1.02 – 1.03	0.84	1.11
	Turbine shaft run-out	0.002	0.002	0.005	0.011
Bearing	Journal bearing inside diameter (C)	6.275 – 6.285	8.01 – 8.03	6.29	8.04
	Journal bearing outside diameter (D)	9.940 – 9.946	12.32 – 12.33	9.93	12.31
	Bearing housing inside diameter (B)	9.995 – 10.005	12.40 – 12.41	10.01	12.42
Thrust bearing	Thrust bearing width (J)	3.59 – 3.61	3.99 – 4.01	3.58	3.98
	Thrust bushing groove dimension (K)	3.632 – 3.642	4.04 – 4.05	3.65	4.07
Seal ring fix-ing area	Turbine side (bearing housing)(F)	11.00 – 11.018	15.00 – 15.02	11.03	15.05
	Compressor side (seal ring)(H_1)	9.987 – 10.025	12.40 – 12.42	10.04	12.45
	Compressor side (seal ring)(H_2)	7.968 – 8.00	10.00 – 10.02	8.01	10.05
Rotor play in axial direction		0.022 – 0.053	0.03 – 0.06	0.07	0.09
Rotor play in radial direction		0.061 – 0.093	0.08 – 0.13	0.12	0.17

(8) Bearing housing (15)
1) Inspect the housing for cast surface exfoliation due to oxidation and degradation, dent or crack.
2) Inspect circlip (16) for chipping or crack, and replace with a new one if defective.
3) Measure the (B) and (F) portions of the bearing housing shown in the figure below. Replace with a new one if either wear limit is exceeded.

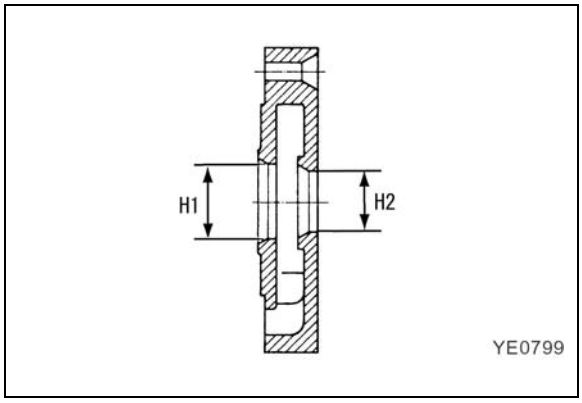
Wear limit of bearing housing inside diameter (B)
RHB51.....12.42 mm
RHB31.....10.01 mm

Wear limit of turbine side seal ring inserting portion (F)
RHB51.....15.05 mm
RHB31.....11.03 mm



(9) Seal plate(4)
1) Inspect the seal plate for any contact trace, joint surface defect, dent or crack. Replace it if defective.
2) Measure the seal ring inserting dimensions (H1 and H2) on the compressor side, and replace the seal ring with a new one if either wear limit is exceeded.

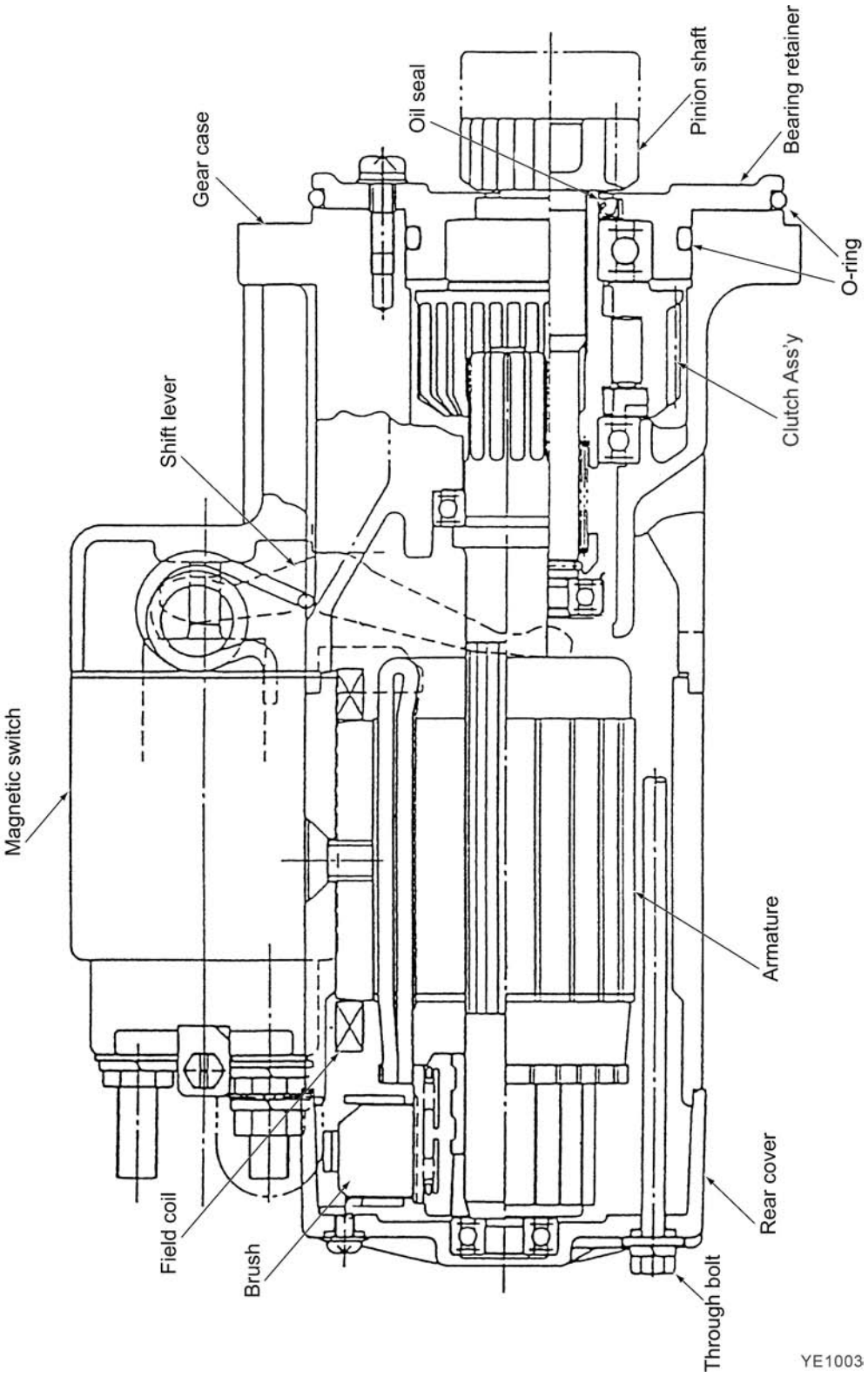
Wear limits
RHB51.....H1: 12.45 mm, H2: 10.05 mm
RHB31.....H1: 10.04 mm, H2: 8.01 mm



(10) Seal rings
Replace seal rings with new ones.

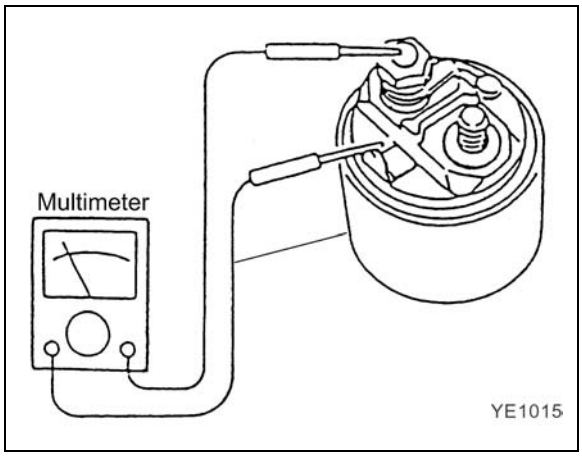
(11) Inspect keep plates (10), (13) and bolts for any deformation, and replace defective parts with new ones. Also replace M3 Torx machine screws with new ones.

9.1.2 Components



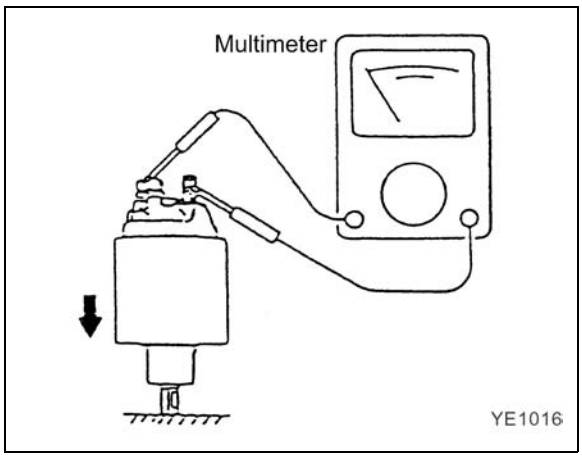
(b) Series coil continuity test
Check continuity between the S and M terminals. Good if continuity exists.

If no continuity (coil disconnection), replace the magnetic switch.

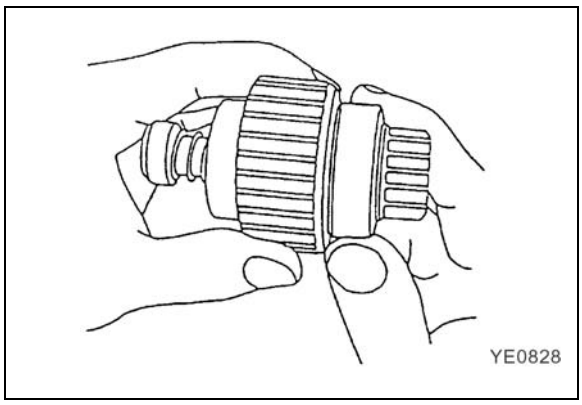


(c) Contact continuity test
Depress the magnetic switch with the plunger at the bottom. Check continuity between the B and M terminals with a multimeter. Good if continuity exists.

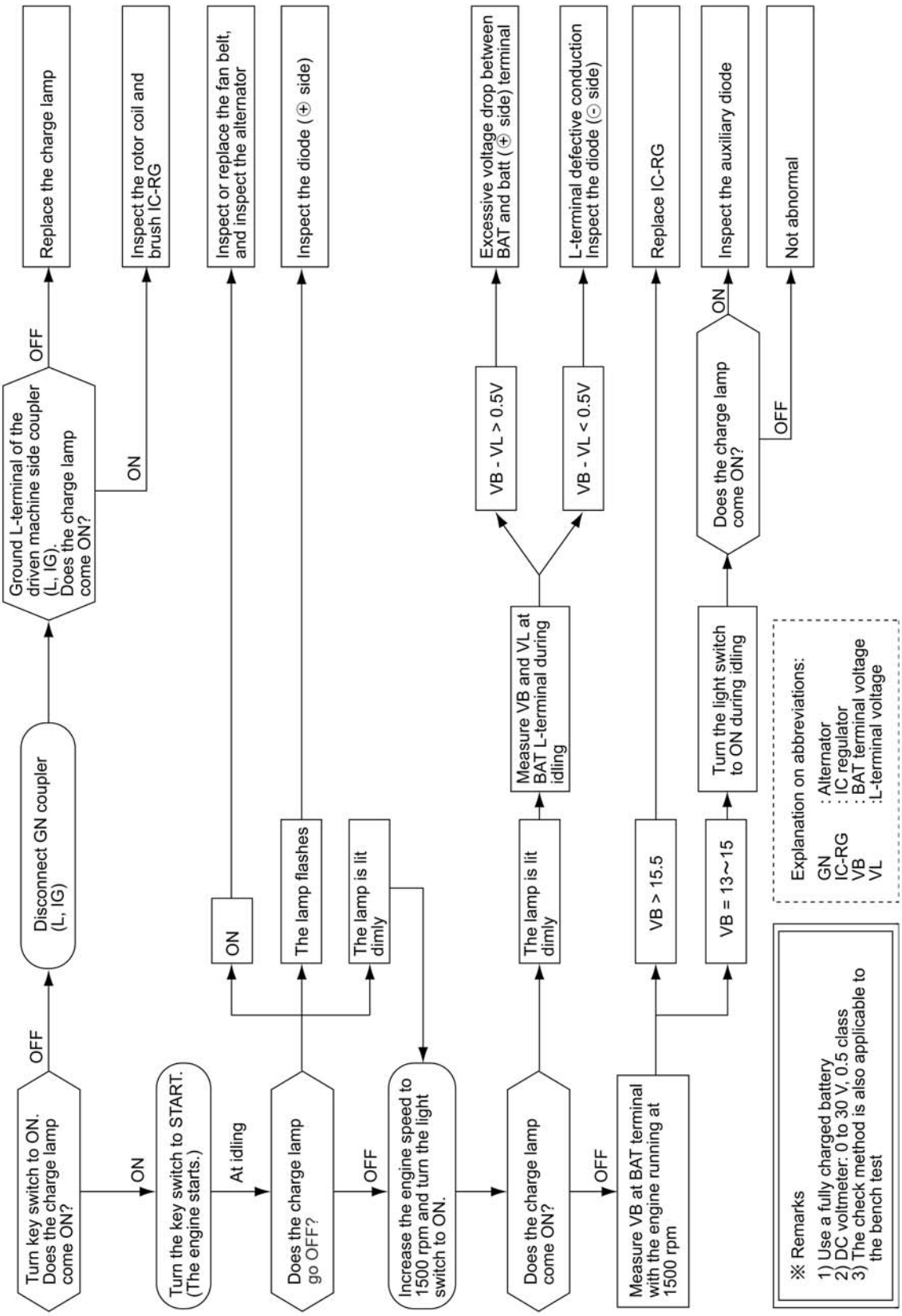
If no continuity (coil continuity defect), replace the magnetic switch.



(6) Pinion clutch
(a) Pinion inspection
Manually rotate the pinion. Inspect if it is rotated smoothly in the driving direction, and is locked in the opposite direction. Replace the pinion clutch if abnormal.



10.1.6 Troubleshooting



12. SERVICE STANDARDS