CONTENTS

1. SAFETY

SAFETY FIRST 1-1
1. Working precautions 1-1
2. Preparing for emergencies 1-1
3. Working cautions 1-2
4. Starting machine safely 1-2
5. Preventing fires 1-3
6. Preventing acid burns 1-3
7. Avoiding high pressure fluid 1-3
8. Avoiding hot exhaust 1-4
9. Cleaning exhaust filter 1-4

2. GENERAL

GENERAL WORKING PRECAUTIONS 2-1
1. Tightening bolts and nuts 2-1
2. Applying thread-locking fluid 2-1
3. Installing circlips 2-2
4. Handling liquid gasket 2-2
5. Replacing O-rings 2-2
6. Replacing oil seals 2-3
7. Handling the battery 2-3
8. Handling wire harness 2-3
9. Handling fuses 2-5
10. Handling connectors 2-5
11. Wiring color 2-6
12. Dispose fluids correctly 2-6
ENGINE IDENTIFICATION 2-7
1. Engine model name and engine serial number 2-7
2. E4B engine 2-8
3. Cylinder number 2-9
INFORMATION 2-11
1. Specifications 2-11
1.1 Specification for D1005-E4B, D1105-E4B 2-11
1.2 Specification for D1305-E4B, V1505-E4B 2-13
1.3 Specification for D1005-E4BG, D1105-E4BG 2-14
1.4 Specification for D1305-E4BG, V1505-E4BG 2-15
2. Performance curves 2-16
2.1 Performance curve for D1005-E4B 2-16
2.2 Performance curve for D1005-E4B 2-18
2.3 Performance curve for D1105-E4B 2-19
2.4 Performance curve for D1305-E4B 2-20
2.5 Performance curve for V1505-E4B 2-21
3. Dimensions 2-22
3.1 Dimension for D1005-E4B, D1105-E4B 2-22
3.2 Dimension for D1305-E4B 2-23
3.3 Dimension for V1505-E4B 2-24
3.4 Dimension for D1005-E4BG, D1105-E4BG, V1505-E4BG 2-25
3.5 Dimension for D1305-E4BG 2-27
SPECIAL TOOLS 2-29
1. Diesel engine compression tester (for nozzle hole) 2-29
2. Injection pump pressure tester 2-29
3. Valve guide replacing tool 2-30
4. Bushing replacing tool 2-30
5. Flywheel stopper 2-31

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to assemble or use this unit.

DANGER
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

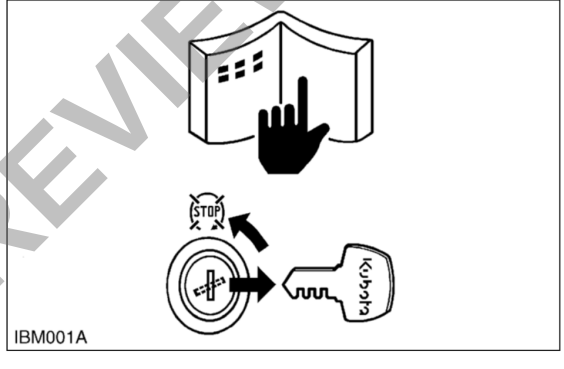
WARNING
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

CAUTION
- **Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.**

IMPORTANT
- **Indicates that equipment or property damage could result if instructions are not followed.**

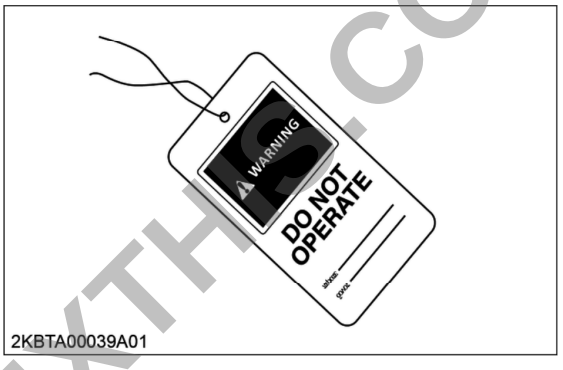
NOTE
- **Gives helpful information.**

1. Working precautions



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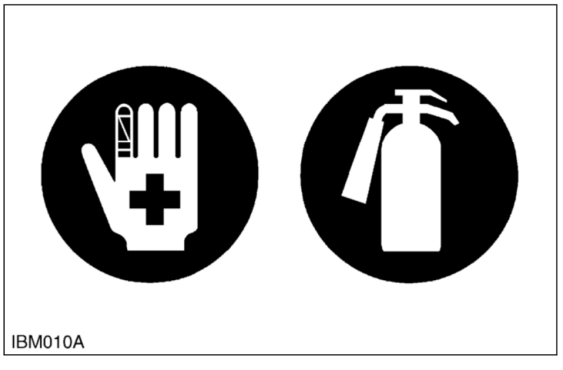
- Understand all safety instructions and safety labels in this manual.
- Park the machine on a stable and level ground then lower the attachment to check the machine safely.
- Stop the engine and remove the key when leaving the operator's seat for cleaning, maintenance, and servicing.



2KBTA00039A01

- Hang a DO NOT OPERATE tag near the operator's seat.
- Do not use worn or cracked tools. Use tools in a proper way with enough strength.
- In regards to the facility which is used in the workshop, follow each safety instruction.

2. Preparing for emergencies


IBM010A

- Keep a first aid kit and fire extinguisher ready at all times.
- Keep emergency numbers near your telephone at all times.

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INFORMATION

1. Specifications

1.1 Specification for D1005-E4B, D1105-E4B

Model	D1005-E4B		D1105-E4B
Number of cylinder	3		
Engine type	Vertical, water-cooled, 4-cycle diesel engine		
Bore × Stroke	76.0 × 73.6 mm (2.99 × 2.90 in.)		78.0 × 78.4 mm (3.07 × 3.09 in.)
Total displacement	1001 cm^3 (61.08 cu.in.)		1123 cm^3 (68.53 cu.in.)
ISO net continuous	14.6 kW / 3000 min^{-1} (rpm) (19.6 HP / 3000 min^{-1} (rpm))	15.4 kW / 3200 min^{-1} (rpm) (20.6 HP / 3200 min^{-1} (rpm))	15.4 kW / 3000 min^{-1} (rpm) (20.7 HP / 3000 min^{-1} (rpm))
ISO/SAE net intermittent	16.8 kW / 3000 min^{-1} (rpm) (22.5 HP / 3000 min^{-1} (rpm))	17.7 kW / 3200 min^{-1} (rpm) (23.7 HP / 3200 min^{-1} (rpm))	17.8 kW / 3000 min^{-1} (rpm) (23.9 HP / 3000 min^{-1} (rpm))
SAE gross intermittent	17.5 kW / 3000 min^{-1} (rpm) (23.5 HP / 3000 min^{-1} (rpm))	18.5 kW / 3200 min^{-1} (rpm) (24.8 HP / 3200 min^{-1} (rpm))	18.5 kW / 3000 min^{-1} (rpm) (24.8 HP / 3000 min^{-1} (rpm))
Maximum bare speed	3220 min^{-1} (rpm)	3420 min^{-1} (rpm)	3220 min^{-1} (rpm)
Minimum bare idling speed	900 min^{-1} (rpm)	1300 min^{-1} (rpm)	900 min^{-1} (rpm)
Combustion chamber	Spherical type (E-TVCS)		
Fuel injection pump	Bosch MD type mini pump		
Governor	All speed mechanical governor		
Direction of rotation	Counter-clockwise (viewed from flywheel side)		
Injection nozzle	Mini nozzle (DNOPD)		
Injection timing	0.3142 rad (18.00°) before T.D.C.	0.3491 rad (20.00°) before T.D.C.	0.3142 rad (18.00°) before T.D.C.
Firing order	1-2-3		
Injection pressure	13.73 MPa (140.0 kgf/cm^2, 1991 psi)		
Compression ratio	24 : 1		
Lubricating system	Forced lubrication by trochoid pump		
Oil pressure indicating	Electrical type switch		
Lubricating filter	Full flow paper filter (Cartridge type)		
Cooling system	Pressurized radiator, forced circulation with water pump		
Starting system	Electric starting with starter		
Starter motor	12 V, 1.2 kW		
Starting support device	By glow plug in combustion chamber		
EGR	None		
Battery	12 V, 65 AH, equivalent		
Charging alternator	12 V, 480 W		
Fuel	Diesel fuel No.2-D (ASTM D975)		

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MAINTENANCE CHECK LIST

To make sure that the engine operates safely for a long time, refer to the table below to do regular inspections.

	Item	Service interval										
		Every										
		50 hrs	100 hrs	200 hrs	400 hrs	500 hrs	1 or 2 months	1 year	800 hrs	1500 hrs	3000 hrs	2 years
*	Checking fuel hoses and clamp bands	☆										
*	Changing engine oil (Oil pan depth: 110 mm (4.33 in.), 125 mm (4.92 in.), 130 mm (5.12 in.))	★		☆								
*	Cleaning air cleaner element (Replace the element after 6 times cleaning)		☆									
	Cleaning fuel filter element		☆									
	Check fan belt tension and damage		☆									
	Checking battery electrolyte level		☆									
*	Replacing oil filter cartridge (Oil pan depth: 110 mm (4.33 in.), 125 mm (4.92 in.), 130 mm (5.12 in.))	★		☆	☆ (BG type)							
	Checking radiator hoses and clamp bands			☆								
*	Checking intake air line			☆								
	Replacing fuel filter cartridge				☆							
	Cleaning water jacket and radiator interior					☆						
	Replacing fan belt					☆						
	Recharging battery						☆					
*	Replacing air cleaner element							☆				

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SERVICING

1. Troubleshooting

1.1 Troubleshooting for 05-E4, 05-E4BG

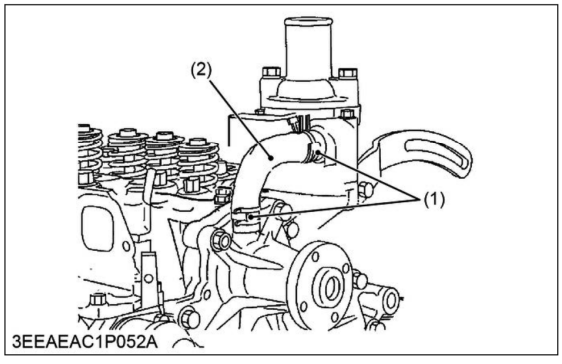
Symptom	Probable cause and checking procedure	Solution	Reference page
The engine does not start	1. No fuel	Fill up the fuel	—
	2. Air in the fuel system	Bleed the air	—
	3. Water in the fuel system	Change the fuel and repair or replace the fuel system	3-8 3-11 3-12 3-20
	4. The fuel pipe is damaged	Clean or replace	3-7
	5. The fuel filter is clogged	Replace	3-11
	6. The viscosity of fuel or engine oil at low temperature is too high	Replace the specified fuel or engine oil	3-1
	7. The cetane number of fuel is low	Replace the specified fuel	3-1
	8. Fuel leakage because of loose injection pipe retaining nut	Tighten the retaining nut	4-32
	9. Incorrect injection timing	Adjust	3-17
	10. The fuel camshaft is worn out	Replace	4-39
	11. The injection nozzle is clogged	Replace	3-16
	12. The injection pump is damaged	Replace	4-38
	13. Seizure of the crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	—
	14. Compression leakage from the cylinder	Replace the head gasket Tighten the cylinder head screw Tighten the glow plug and nozzle holder	4-34
	15. Incorrect valve timing	Check the timing gear	4-39
	16. Piston ring and cylinder are worn out	Replace	4-42 4-70
	17. Incorrect valve clearance	Adjust valve clearance	3-15
	18. The stop solenoid is damaged	Replace	4-38

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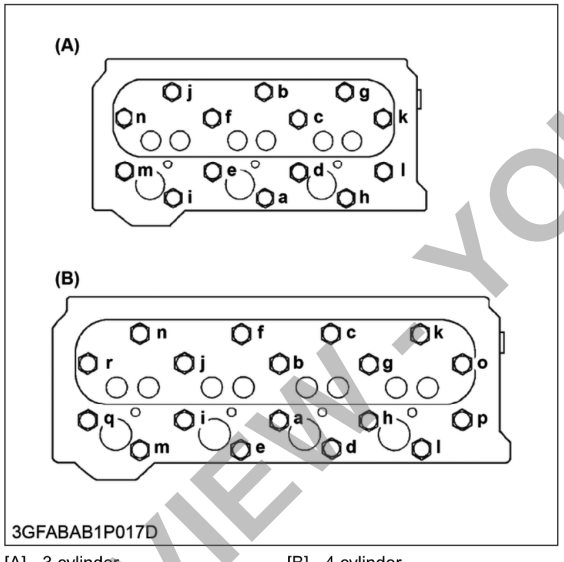
5.9 Removing cylinder head and cylinder head gasket

1. Loosen the pipe clamps (1), and remove the water return pipe (2).



(1) Clamp (2) Return pipe

2. Remove the cylinder head screw in the order of "n" or "r" to "a" and remove the cylinder head.



[A] 3 cylinder [B] 4 cylinder

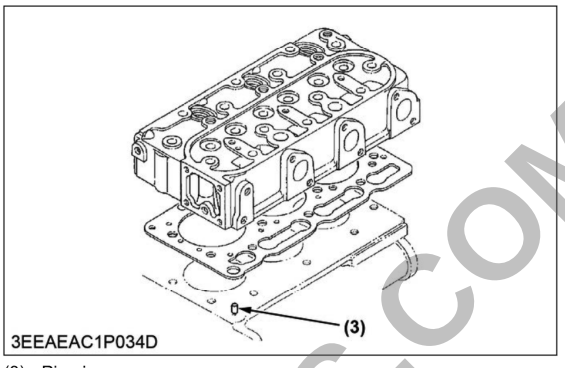
3. Remove the cylinder head gasket.

(When reassembling)

■ NOTE

- **Do not use O-ring on the pin pipe.**
- **It is not necessary to retighten the cylinder head screw and to readjust valve clearance after engine warmed up.**

- Replace the cylinder head gasket with a new one.
- When mounting the gasket, set it to the pin pipe holes. Be careful not to mount it reversely.



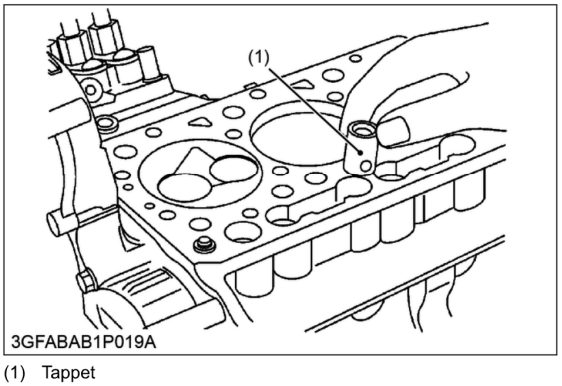
(3) Pin pipe

- The cylinder head should be free of scratches and dust.
- Install the cylinder head, using care not to damage the gasket.
- After applying engine oil to the thread of screws, tighten them in several steps and specified sequence "a" to "n" or "r".
- Tighten to the specified tightening torque.

Tightening torque	Cylinder head screw	64 to 68 N·m 6.5 to 7.0 kgf·m 47 to 50 lbf·ft

5.10 Removing tappets

1. Remove the tappets (1) from the crankcase.



(1) Tappet

(When reassembling)

■ IMPORTANT

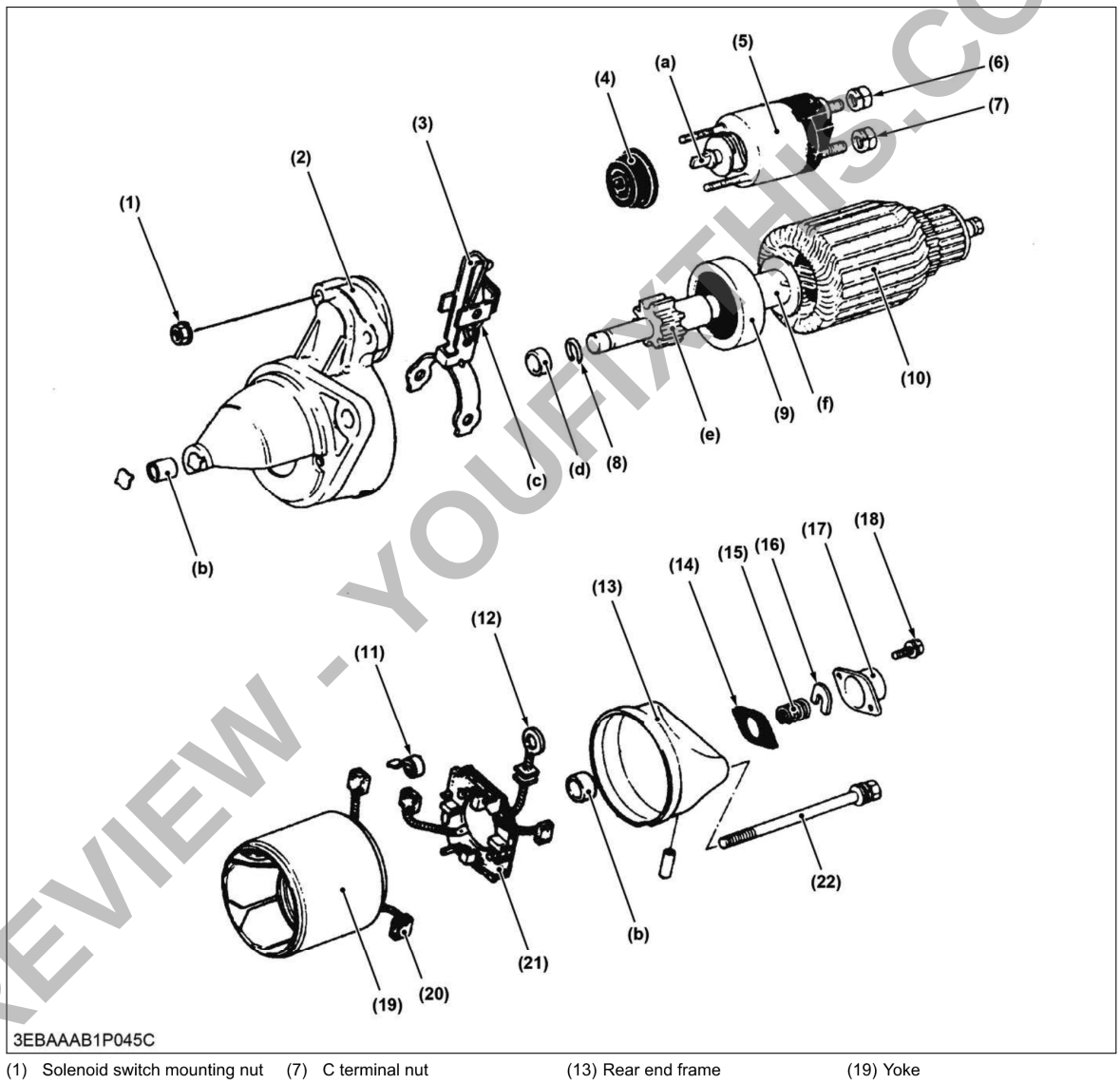
- **Do not change the combination of tappet and tappet guide.**

- Visually check the contact between tappets and cams for proper rotation. If problem is found, replace tappets.
- Before installing the tappets, apply engine oil thinly around them.

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2. Remove the solenoid switch mounting nuts (1) and solenoid switch (5).
3. Remove the end frame cap (17).
4. Remove the brake shoe (16), brake spring (15) and gasket (14).
5. Remove the through bolts (22) and rear end frame (13).
6. Remove the brush from the brush holder while holding the spring up.
7. Remove the brush holder (21).
8. Draw out the yoke (19) from the starter drive housing (2).
9. Draw out the armature (10) with the drive lever (3).



3EBAAAB1P045C

(1) Solenoid switch mounting nut
(2) Starter drive housing
(3) Drive lever
(4) Gasket
(5) Solenoid switch
(6) B terminal nut
(7) C terminal nut
(8) Snap ring
(9) Overrunning clutch
(10) Armature
(11) Brush spring
(12) Connecting lead
(13) Rear end frame
(14) Gasket
(15) Brake spring
(16) Brake shoe
(17) End frame cap
(18) Screw
(19) Yoke
(20) Brush
(21) Brush holder
(22) Through bolt

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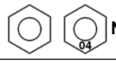
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3. Tightening torques

Refer to the following table if the tightening torques of screws, bolts and nuts are not specified in each part.

3.1 Tightening torques of screws, bolts and nuts for general use

If the tightening torque is not specified, refer to the table below for the none specified torques values.

Indication on top of bolt	 No-grade or 4T			 7T		
Indication on top of nut	 No-grade or 4T					
Unit	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M6	7.8 to 9.3	0.80 to 0.94	5.8 to 6.8	9.80 to 11.3	1.00 to 1.15	7.23 to 8.33
M8	17.7 to 20.6	1.81 to 2.10	13.1 to 15.1	23.5 to 27.5	2.40 to 2.80	17.4 to 20.2
M10	39.2 to 45.1	4.00 to 4.59	29.0 to 33.2	49.0 to 55.9	5.00 to 5.70	36.2 to 41.2
M12	62.8 to 72.6	6.41 to 7.40	46.4 to 53.5	77.5 to 90.2	7.91 to 9.19	57.2 to 66.5

3.2 Tightening torques of screws, bolts and nuts for special use

■ NOTE

- **For the screws, bolts and nuts with the mark "*", apply engine oil to their threads and seats before you tighten.**
- **The alphabet "M" in Dimension × Pitch shows that the screw, bolt or nut dimensions are in the metric system. The dimension is the nominal external diameter in mm of the threads. The pitch is the nominal distance in mm between 2 threads.**

Disassembling and assembling

Item	Dimension × Pitch	N·m	kgf·m	lbf·ft
Cylinder head cover screw [D1005-E4B/E4BG, D1105-E4B/E4BG, V1505-E4B/E4BG]	M7 × 1.0	7 to 8	0.7 to 0.9	5 to 6
Cylinder head cover screw [D1305-E4B/E4BG]	M6 × 1.0	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
*Cylinder head mounting screw	M10 × 1.25	64 to 68	6.5 to 7.0	47 to 50
*Main bearing case screw 1	M8 × 1.25	30 to 34	3.0 to 3.5	22 to 25
*Main bearing case screw 2	M9 × 1.25	49 to 53	5.0 to 5.5	37 to 39
*Flywheel screw	M10 × 1.25	54 to 58	5.5 to 6.0	40 to 43
*Connecting rod screw	M8 × 1.0	42 to 46	4.2 to 4.7	31 to 33
*Rocker arm bracket nut [D1005-E4B/E4BG, D1105-E4B/E4BG, V1505-E4B/E4BG]	M7 × 1.0	16.6 to 21.6	1.70 to 2.20	12.3 to 15.9
*Rocker arm bracket screw [D1305-E4B/E4BG]	M7 × 1.0	16.6 to 21.6	1.70 to 2.20	12.3 to 15.9

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2. Servicing specifications

2.1 Servicing specification for engine

Engine body

Item		Service specification	Service limit
Cylinder head surface	Flatness	—	0.05 mm 0.002 in.
Top clearance	D1005-E4B / E4BG D1105-E4B / E4BG V1505-E4B / E4BG	0.55 to 0.75 mm 0.022 to 0.029 in.	—
	D1305-E4B / E4BG	0.80 to 1.0 mm 0.032 to 0.039 in.	—
Compression pressure		(Reference value) 3.73 to 4.11 MPa / 200 min^{-1} (rpm) 38.0 to 42.0 kgf/cm^2 / 200 min^{-1} (rpm) 541 to 597 psi / 200 min^{-1} (rpm)	2.26 MPa / 200 min^{-1} (rpm) 23.0 kgf/cm^2 / 200 min^{-1} (rpm) 327 psi / 200 min^{-1} (rpm)
Variance among cylinders		—	10 % or less
Valve seat	Angle (Intake)	1.0 rad 60°	—
	Angle (Exhaust)	0.79 rad 45°	—
	Width	2.12 mm 0.0835 in.	—
Valve face	Angle (Intake)	1.0 rad 60°	—
	Angle (Exhaust)	0.79 rad 45°	—
Valve recessing		-0.050 to 0.25 mm -0.0020 to 0.0098 in.	0.10 mm 0.0039 in.
Valve stem to valve guide	Clearance	0.035 to 0.065 mm 0.0014 to 0.0025 in.	0.10 mm 0.0039 in.
• Valve stem	O.D.	6.960 to 6.975 mm 0.2741 to 0.2746 in.	—
• Valve guide	I.D.	7.010 to 7.025 mm 0.2760 to 0.2765 in.	—
Valve clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	—
Valve spring	Free length	31.3 to 31.8 mm 1.24 to 1.25 in.	30.3 mm 1.19 in.
	Tilt	—	1.0 mm 0.039 in.
	Setting load / Setting length (Intake)	117.4 N / 31.0 mm 11.97 kgf /31.0 mm 26.39 lbf / 1.22 in.	100 N / 31.0 mm 10.20 kgf / 31.0 mm 22.48 lbf / 1.22 in.
Rocker arm shaft to rocker arm	Oil clearance	0.016 to 0.045 mm 0.00063 to 0.0017 in.	0.10 mm 0.0039 in.
• Rocker arm shaft	O.D.	11.973 to 11.984 mm 0.47138 to 0.47181 in.	—
• Rocker arm	I.D.	12.000 to 12.018 mm 0.47244 to 0.47314 in.	—

(Continued)

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INDEX

Symbols

05-E4
troubleshooting..... 4-5
05-E4BG
troubleshooting..... 4-5

A

air cleaner
removing..... 4-31
air cleaner element
cleaning.....3-8
replacing..... 3-15
alternator
checking (on unit).....4-29
checking bearing.....4-77
checking brush wear.....4-78
checking rotor..... 4-77
checking slip ring..... 4-78
checking stator.....4-77
removing.....4-31,4-45

B

battery
checking electrolyte level.....3-10
checking specific gravity..... 4-26
checking voltage..... 4-25
handling.....2-3
recharging.....3-14
replacing..... 3-19
battery specific gravity
checking.....3-15
bearing case cover
removing..... 4-43
bolt
tightening torques..... 4-16
tightening torques for general use..... 4-16
bolt and nut
tightening..... 2-1
boost compensator
function..... 4-4
boost compensator (equipped with R24 model)
removing..... 4-37
bushing replacing tool..... 2-30

C

cam
checking height.....4-59
cam gear
removing..... 4-39
camshaft
checking alignment..... 4-59
checking side clearance.....4-59
camshaft journal
checking oil clearance.....4-60
circlip
installing.....2-2
clamp band
checking.....3-11
replacing.....3-19,3-20
closed breather
function..... 4-1
commutator
checking.....4-74
connecting rod
checking alignment..... 4-62
removing.....4-41,4-42
connector
handling..... 2-5
coolant
checking.....3-5
draining..... 4-31
fill.....3-5
cover
checking clearance..... 4-73
crank sleeve setter.....2-32
crankcase bore
checking oil clearance.....4-60
crankpin
checking oil clearance.....4-65
crankpin bearing
checking oil clearance.....4-65
crankshaft
checking side clearance.....4-64
crankshaft alignment
checking.....4-65
crankshaft assembly (D1305-E4B/E4BG)
removing..... 4-44
crankshaft assembly (except D1305-E4B/E4BG)
removing..... 4-44
crankshaft bearing 1
checking oil clearance.....4-66
replacing..... 4-68
crankshaft bearing 1 replacing tool..... 2-31
crankshaft bearing 2
checking oil clearance.....4-68
crankshaft bearing 3
checking oil clearance.....4-68
crankshaft journal
checking oil clearance..... 4-66,4-68
crankshaft sleeve
replacing..... 4-70
cylinder
checking compression pressure..... 4-17
checking wear.....4-70
cylinder correction (over size)
adjusting.....4-71

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Symptom	Probable cause and checking procedure	Solution	Reference page
The starter does not operate	1. Discharged battery	Charge or replace	4-25
	2. The starter is damaged	Repair or replace	4-27
	3. The key switch is damaged	Replace	—
	4. The wiring harness is disconnected	Connect	—
The engine revolution is not smooth	1. The fuel filter is clogged	Replace	3-11 3-12
	2. The air cleaner is clogged	Clean or replace the air cleaner element	3-8 3-15
	3. Fuel leakage because of loose injection pipe retaining nut	Tighten the retaining nut	4-32
	4. The injection pump is damaged	Replace	4-22 4-38
	5. The injection nozzle pressure is incorrect	Adjust	4-25
	6. The injection nozzle is stuck or clogged	Repair or replace	4-25 4-32
	7. The governor is damaged	Replace	4-39
The exhaust gas is white or blue	1. Too much engine oil	Reduce it to the specified level	3-5
	2. The piston ring, piston and cylinder is worn out	Replace the piston ring or piston, or repair the cylinder	4-62 4-64 4-70
	3. Incorrect injection timing	Adjust	3-17
The exhaust gas is black or dark gray	1. Overload	Reduce the load	—
	2. The grade of the fuel is low	Replace the specified fuel	3-1
	3. The fuel filter is clogged	Replace	3-11 3-12
	4. The air cleaner is clogged	Clean or replace the element	3-8 3-15
	5. Deficient nozzle injection	Repair or replace nozzle	4-25 4-32
The output is deficient	1. Incorrect injection timing	Adjust	3-17
	2. The moving parts of engine have a seizure	Repair or replace	—
	3. The injection pump is damaged	Replace	4-22 4-38
	4. Deficient nozzle injection	Repair or replace nozzle	4-25 4-32

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