WSM

WORKSHOP MANUAL
DIESEL ENGINE

SM-E4B SERIES

Kubota

KiSC issued 01, 2013 A

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INFORMATION

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1. SAFETY FIRST

⚠ 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 try to repair or use this unit.**

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

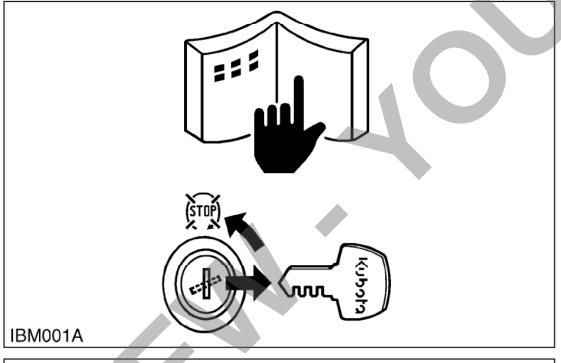
⚠ WARNING
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

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

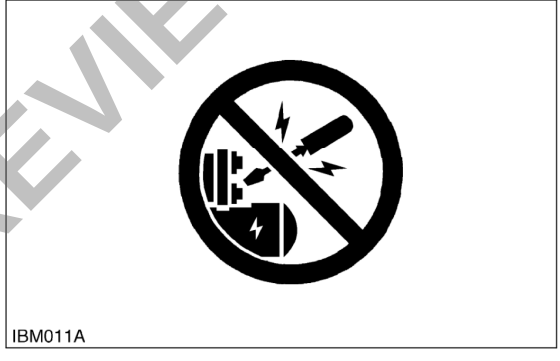
■ IMPORTANT
- **Indicates that equipment or property damage could result if instructions are not followed.**

■ NOTE
- **Gives helpful information.**

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IBM011A

BEFORE YOU START SERVICE

- Read all instructions and safety instructions in this manual and on your engine safety decals.
- Clean the work area and engine.
- Park the machine on a stable and level ground.
- Let the temperature of the engine decrease before you start a job.
- Stop the engine, then remove the key.
- Disconnect the battery negative cable.
- Hang a **"DO NOT OPERATE"** tag in the operator station.

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START SAFELY

- Do not do the procedures below when you start the engine.
  - short across starter terminals
  - bypass the safety start switch
- Do not make unauthorized modifications to the engine. This can cause damage and decrease the engine life.

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2. SPECIFICATIONS

Model		Z482-E4B	Z602-E4B
Number of Cylinder		2	
Type		Vertical, Water-cooled, 4 cycle IDI diesel engine	
Bore × Stroke		67.0 × 68.0 mm (2.64 × 2.68 in.)	72.0 × 73.6 mm (2.83 × 2.90 in.)
Total Displacement		479.0 cm^3 (29.23 cu.in.)	599.0 cm^3 (36.55 cu.in.)
ISO Net Continuous		8.10 kW / 3600 min^{-1} (rpm) (10.9 HP / 3600 min^{-1} (rpm))	10.1 kW / 3600 min^{-1} (rpm) (13.5 HP / 3600 min^{-1} (rpm))
ISO / SAE Net Intermittent		9.30 kW / 3600 min^{-1} (rpm) (12.5 HP / 3600 min^{-1} (rpm))	11.6 kW / 3600 min^{-1} (rpm) (15.5 HP / 3600 min^{-1} (rpm))
SAE Gross Intermittent		9.90 kW / 3600 min^{-1} (rpm) (13.3 HP / 3600 min^{-1} (rpm))	12.5 kW / 3600 min^{-1} (rpm) (16.8 HP / 3600 min^{-1} (rpm))
Maximum Bare Speed		3800 min^{-1} (rpm)	3850 min^{-1} (rpm)
Minimum Bare Idling Speed		1250 to 1350 min^{-1} (rpm)	1050 to 1150 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		Bosch "Throttle" type	
Injection Timing		0.33 rad (19 °) before T.D.C.	
Firing Order		1-2	
Injection Pressure		13.73 MPa (140.0 kgf/cm^2, 1991 psi)	
Compression Ratio		23.5 : 1	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 (not included in the basic engine)	
Starting System		Electric Starting with Starter	
Starting Motor		12 V, 0.8 kW	12 V, 1.0 kW
Starting Support Device		By glow plug in combustion chamber	
EGR		None	
Battery		12 V, 28 AH equivalent	12 V, 36 AH equivalent
Charging Alternator		12 V, 150 W	12 V, 480 W
Fuel		Diesel Fuel No.2-D (ASTM D975)	
Lubricating Oil		Class CF lubricating oil as per API classification is recommended. For details on recommended lubricating oils, see page G-6	
Lubricating Oil Capacity	Oil Pan Depth 101 mm (3.98 in.)	2.1 L (0.55 U.S.gals)	2.5 L (0.66 U.S.gals)
	Oil Pan Depth 121 mm (4.76 in.)	2.5 L (0.66 U.S.gals)	–
Weight (Dry)		53.1 kg (117 lbs)	57.0 kg (125.7 lbs)

*The specification described above is of the standard engine of each model.
*Conversion Formula : HP = 0.746 kW, PS = 0.7355 kW

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1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	No fuel	Replenish fuel	G-11
	Air in the fuel system	Bleed	G-11
	Water in the fuel system	Change fuel and repair or replace fuel system	G-11
	Fuel hose clogged	Clean or replace	G-11
	Fuel filter clogged	Replace	G-17
	Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	I-4, G-6
	Fuel with low cetane number	Use specified fuel	I-4, G-6
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	1-S31
	Incorrect injection timing	Adjust	I-4, G-26
	Fuel camshaft worn	Replace	1-S57
	Injection nozzle clogged	Clean or replace	1-S22
	Injection pump malfunctioning	Repair or replace	G-28, 1-S21
	Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	1-S39, 1-S41, 1-S43
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	1-S14, 1-S32
	Improper valve timing	Correct or replace timing gear	1-S39
	Piston ring and cylinder worn	Replace	1-S60, 1-S61, 1-S67
	Excessive valve clearance	Adjust	G-23
	Stop solenoid malfunctioning	Replace	1-S28, 1-S29
Starter Does Not Run	Battery discharged	Charge	1-S23, 1-S24
	Starter malfunctioning	Repair or replace	1-S25, 1-S26
	Wiring disconnected	Connect	–

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2. SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	–
Compression Pressure	**Z482-E4B** **D722-E4B** **D782-E4B** **Z602-E4B** **D902-E4B**	2.85 to 3.23 MPa 29.0 to 33.0 kgf/cm^2 413 to 469 psi 3.53 to 4.02 MPa 36.0 to 41.0 kgf/cm^2 512 to 583 psi	2.26 MPa 23.0 kgf/cm^2 327 psi 2.55 MPa 26.0 kgf/cm^2 370 psi
• Difference among Cylinders		–	10 % or less
Top Clearance		0.50 to 0.70 mm 0.020 to 0.027 in.	–
Cylinder Head Surface	Flatness	–	0.05 mm 0.002 in.
Valve Recessing (Intake and Exhaust)		−0.10 to 0.10 mm −0.0039 to 0.0039 in.	0.30 mm 0.012 in.
Valve Stem to Valve Guide (Intake and Exhaust)	Clearance	0.030 to 0.057 mm 0.0012 to 0.0022 in.	0.10 mm 0.0039 in.
• Valve Stem	O.D.	5.968 to 5.980 mm 0.2350 to 0.2354 in.	–
• Valve Guide	I.D.	6.010 to 6.025 mm 0.2367 to 0.2372 in.	–
Valve Face (Intake and Exhaust)	Angle	0.79 rad 45 °	–
Valve Seat (Intake and Exhaust)	Angle	0.79 rad 45 °	–
	Width	2.12 mm 0.0835 in.	–
Intake Valve Timing **[Z482/D722/D782-E4B]**	Open	0.445 rad (25.5 °) before T.D.C.	–
	Close	0.881 rad (50.5 °) after B.D.C.	–
Exhaust Valve Timing **[Z482/D722/D782-E4B]**	Open	0.969 rad (55.5 °) before B.D.C.	–
	Close	0.201 rad (11.5 °) after T.D.C.	–
Intake Valve Timing **[Z602/D902-E4B]**	Open	0.35 rad (20 °) before T.D.C.	–
	Close	0.79 rad (45 °) after B.D.C.	–

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3. MAINTENANCE CHECK LIST

To maintain long-lasting and safe engine performance, make it a rule to carry out regular inspections by following the table below.

Item		Service Interval												
		Every												
		50 hrs	75 hrs	100 hrs	150 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	(1) Oil pan depth (101 mm, 3.98 in.)	★	☆											
	(2) Oil pan depth (121 mm, 4.76 in.)	★		☆										
	(3) Extended oil pan depth (101 mm, 3.98 in.)	★		☆										
Checking fan belt tension and damage				☆										
*Cleaning air cleaner element (Replace the element after 6 times cleaning)				☆										
Cleaning fuel filter (element type)				☆										
Checking battery electrolyte level				☆										
Replacing oil filter cartridge	(1) Oil pan depth (101 mm, 3.98 in.)	★			☆									
	(2) Oil pan depth (121 mm, 4.76 in.)	★				☆								
	(3) Extended oil pan depth (101 mm, 3.98 in.)	★				☆								
Checking radiator hoses and clamp bands						☆								
*Checking intake air line						☆								
*Replacing fuel filter							☆							
Cleaning water jacket and radiator interior								☆						
Replacing fan belt								☆						
Recharging battery									☆					
*Replacing air cleaner element										☆				
Checking valve clearance											☆			
*Checking injection nozzle condition												☆		
*Checking injection timing													☆	
*Checking injection pump													☆	
*Replacing intake air line														☆
Replacing battery														☆
Replacing radiator hoses and clamp bands														☆
*Replacing fuel hoses and clamp bands														☆
Changing radiator coolant (L.L.C.)														☆

- (1) : This oil pan depth is optional for Z482-E4B and D722-E4B.
- (2) : This oil pan depth is standard for Z482-E4B, D722-E4B and D782-E4B.
- (3) : This oil pan depth is standard for Z602-E4B and D902-E4B.
- ★ : Change engine oil and replace oil filter cartridge after the first 50 hours of operation.
- * : The items listed above (* marked) are registered as emission related critical parts by KUBOTA in the U.S. EPA nonroad emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.

⚠ CAUTION

- **When changing or inspecting, be sure to level and stop the engine.**

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[2] TIGHTENING TORQUES FOR SPECIAL USE SCREWS, BOLTS AND NUTS

■ **NOTE**

- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size × Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.**

Item	Dimension × Pitch	N·m	kgf·m	lbf·ft
*Cylinder head cover screw	M6 × 1	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
Injection pipe retaining nut	M12 × 1.5	25 to 34	2.5 to 3.5	18 to 25
Overflow pipe retaining nut	M12 × 1.5	20 to 24	2.0 to 2.5	15 to 18
Nozzle holder assembly	M20 × 1.5	49 to 68	5.0 to 7.0	37 to 50
Glow plug	M8 × 1	7.9 to 14	0.80 to 1.5	5.8 to 10
*Rocker arm bracket nut	M6 × 1	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
*Cylinder head screw	M8 × 1.25	38 to 42	3.8 to 4.3	28 to 31
*Fan drive pulley screw	M12 × 1.5	118 to 127	12.0 to 13.0	86.8 to 94.0
*Idle gear shaft mounting screw	M6 × 1	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
Oil pump mounting screw	M8 × 1.25	17.7 to 21.5	1.80 to 2.20	13.1 to 15.9
*Connecting rod screw	M7 × 0.75	27 to 30	2.7 to 3.1	20 to 22
*Flywheel screw	M10 × 1.25	54 to 58	5.5 to 6.0	40 to 43
Bearing case cover mounting screw	M6 × 1	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
*Main bearing case screw 2	M7 × 1	27 to 30	2.7 to 3.1	20 to 22
*Main bearing case screw 1	M6 × 1	13 to 15	1.3 to 1.6	9.4 to 11
Oil pressure switch	PT 1/8	15 to 19	1.5 to 2.0	11 to 14
Nozzle holder	–	35 to 39	3.5 to 4.0	26 to 28
Starter's terminal **B** mounting nut (Electromagnetic drive type)	M8	7.9 to 9.8	0.80 to 1.0	5.8 to 7.2
Starter's terminal **B** mounting nut (Planetary gear reduction type)	M8	5.9 to 11	0.60 to 1.2	4.4 to 8.6
Dynamo's pulley nut	M10 × 1.25	40 to 44	4.0 to 4.5	29 to 32
Alternator's pulley nut	–	58.4 to 78.9	5.95 to 8.05	43.1 to 58.2
Drain plug with copper gasket	M12 × 1.25	33 to 37	3.3 to 3.8	24 to 27
Drain plug with copper gasket	M22 × 1.5	64 to 73	6.5 to 7.5	47 to 54
Drain plug with rubber coated gasket	M22 × 1.5	45 to 53	4.5 to 5.5	33 to 39

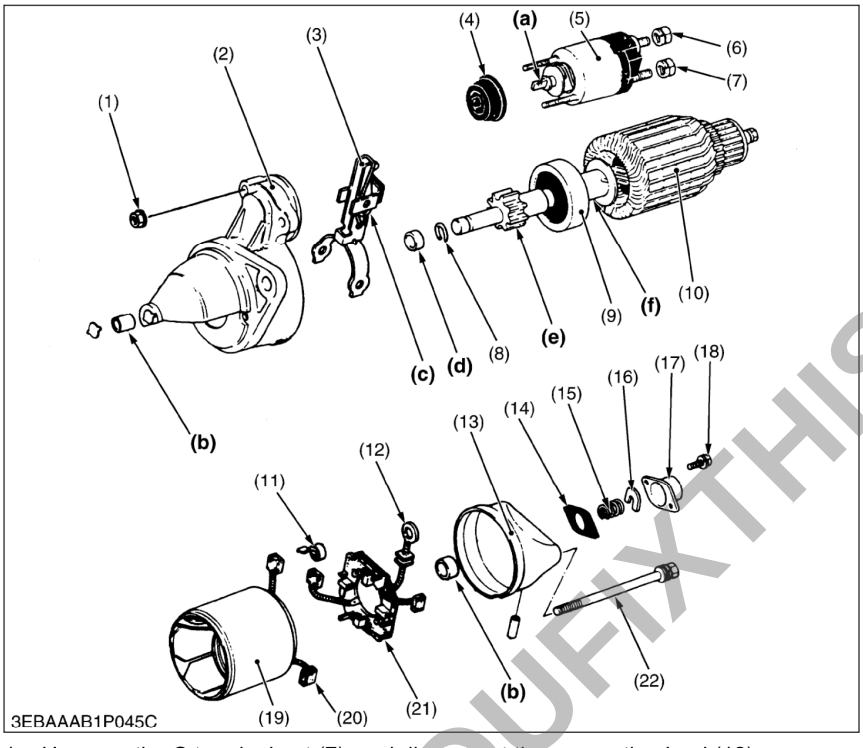
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(7) Starter

Electromagnetic Drive Type



(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

1. Unscrew the **C** terminal nut (7), and disconnect the connecting lead (12).
2. Unscrew the solenoid switch mounting nuts (1), and remove the solenoid switch (5).
3. Remove the end frame cap (17).
4. Remove the brake shoe (16), brake spring (15) and gasket (14).
5. Unscrew the through bolts (22), and remove the 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).

■ **NOTE**

- **Do not damage to the brush and commutator.**

(When reassembling)

- Apply grease (DENSO.CO.LTD. No. 50 or equivalent) to the parts indicated in the figure.
  - Joint of solenoid switch **(a)**
  - Bushing **(b)**
  - Drive lever **(c)**
  - Collar **(d)**
  - Teeth of pinion gear **(e)**
  - Armature shaft **(f)**

Tightening torque	**B** terminal nut	7.8 to 9.8 N·m 0.80 to 1.0 kgf·m 5.8 to 7.2 lbf·ft

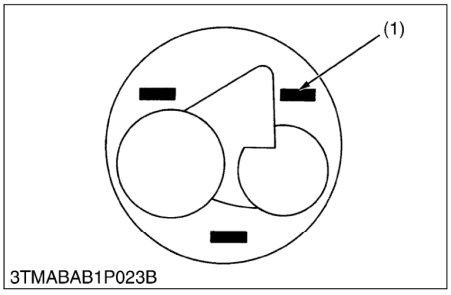
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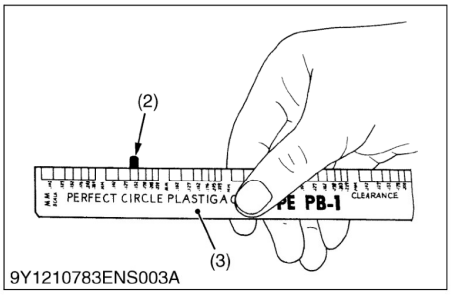
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[3] SERVICING

(1) Cylinder Head and Valves



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Top Clearance

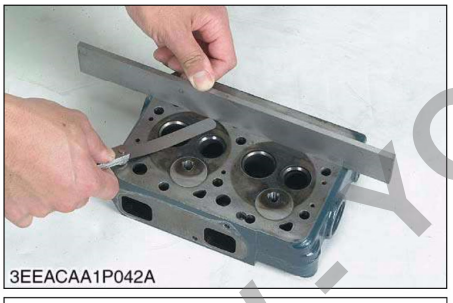
1. Remove the cylinder head.
2. With the piston at TDC, use grease to affix three or four plastigauges of a diameter 1.5 mm (0.059 in.) x 5.0 to 7.0 mm (0.20 to 0.27 in.) long to the crown of the piston; keep the gauges away from the intake valve and combustion chamber fittings.
3. Take the piston to an intermediate position, install the cylinder head and tighten the head bolts to the specified torque.
4. Turn the crankshaft so the piston goes through TDC.
5. Remove the cylinder head and measure the thickness of the plastigauges.
6. If they are out of spec, check the oil clearance of the crank pin journal and piston pins.

Top clearance	Factory specification	0.50 to 0.70 mm 0.020 to 0.027 in.

Tightening torque	Cylinder head screw	38 to 42 N·m 3.8 to 4.3 kgf·m 28 to 31 lbf·ft

(1) Plastigauge
(2) Crushed Plastigauge
(3) Scale

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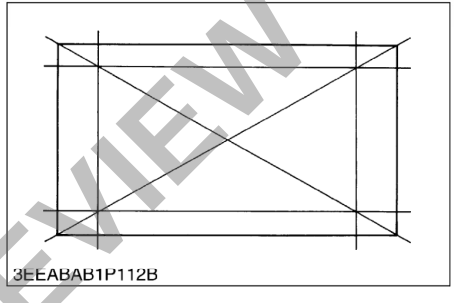

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Cylinder Head Surface Flatness

1. Clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure.
3. Measure the clearance with a thickness gauge.
4. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ **IMPORTANT**

- **Do not place the straightedge on the combustion chamber.**
- **Be sure to check the valve recessing after correcting.**


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Cylinder head surface flatness	Allowable limit	0.05 mm 0.002 in.

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LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	More than 49 kPa 0.50 kgf/cm^2 7.1 psi	–
	At Rated Speed	197 to 441 kPa 2.00 to 4.50 kgf/cm^2 28.5 to 64.0 psi	147 kPa 1.50 kgf/cm^2 21.3 psi
Inner Rotor to Outer Rotor	Clearance	0.030 to 0.14 mm 0.0012 to 0.0055 in.	–
Outer Rotor to Pump Body	Clearance	0.070 to 0.15 mm 0.0028 to 0.0059 in.	–
Inner Rotor to Cover	Clearance	0.0750 to 0.135 mm 0.00296 to 0.00531 in.	–

COOLING SYSTEM

Item		Factory Specification	Allowable Limit
Fan Belt	Tension	7.0 to 9.0 mm / 98 N 0.28 to 0.35 in. / 98 N (10 kgf, 22 lbf)	–
Thermostat	Valve Opening Temperature (At Beginning)	69.5 to 72.5 °C 157.1 to 162.5 °F	–
	Valve Opening Temperature (Opened Completely)	85 °C 185 °F	–
Radiator Cap	Pressure Falling Time	10 seconds or more 88 → 59 kPa 0.90 → 0.60 kgf/cm^2 13 → 8.5 psi	–
Radiator	Water Leakage Test Pressure	No leak at specified pressure	–

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Item		Factory Specification	Allowable Limit
Cam Height **[Z482/D722/D782-E4B]**	Intake	26.88 mm 1.058 in.	26.83 mm 1.056 in.
[Z482/D722/D782-E4B]	Exhaust	25.88 mm 1.019 in.	25.83 mm 1.017 in.
[Z602/D902-E4B]	Intake and Exhaust	26.88 mm 1.058 in.	26.83 mm 1.056 in.
Camshaft Journal to Cylinder Block Bore	Oil Clearance	0.050 to 0.091 mm 0.0020 to 0.0035 in.	0.15 mm 0.0059 in.
• Camshaft Journal	O.D.	32.934 to 32.950 mm 1.2967 to 1.2972 in.	–
• Cylinder Block Bore	I.D.	33.000 to 33.025 mm 1.2993 to 1.3001 in.	–
Idle Gear Shaft to Idle Gear Bushing	Oil Clearance	0.020 to 0.084 mm 0.00079 to 0.0033 in.	0.10 mm 0.0039 in.
• Idle Gear Shaft	O.D.	19.967 to 19.980 mm 0.78611 to 0.78661 in.	–
• Idle Gear Bushing	I.D.	20.000 to 20.051 mm 0.78740 to 0.78940 in.	–
Piston Pin Bore	I.D.	20.000 to 20.013 mm 0.78741 to 0.78791 in.	20.05 mm 0.7894 in.
Piston Pin to Small End Bushing	Oil Clearance	0.014 to 0.038 mm 0.00056 to 0.0014 in.	0.10 mm 0.0039 in.
• Piston Pin	O.D.	20.002 to 20.011 mm 0.78748 to 0.78783 in.	–
• Small End Bushing	I.D.	20.025 to 20.040 mm 0.78839 to 0.78897 in.	–
Piston Pin to Small End Bushing (Spare Parts)	Oil Clearance	0.015 to 0.075 mm 0.00059 to 0.0029 in.	0.15 mm 0.0059 in.
• Small End Bushing	I.D.	20.026 to 20.077 mm 0.78843 to 0.79043 in.	–
Piston Ring Gap **[Z482/D722/D782-E4B]**	Top Ring	0.12 to 0.27 mm 0.0047 to 0.010 in.	1.15 mm 0.0453 in.
	Second Ring	0.30 to 0.45 mm 0.012 to 0.017 in.	1.20 mm 0.0472 in.
	Oil Ring	0.15 to 0.35 mm 0.0059 to 0.013 in.	1.20 mm 0.0472 in.
Piston Ring Gap **[Z602/D902-E4B]**	Top Ring	0.15 to 0.30 mm 0.0059 to 0.011 in.	1.25 mm 0.0472 in.
	Second Ring	0.35 to 0.50 mm 0.014 to 0.019 in.	1.25 mm 0.0492 in.
	Oil Ring	0.15 to 0.35 mm 0.0059 to 0.013 in.	1.20 mm 0.0472 in.

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