WSM

WORKSHOP MANUAL
DIESEL ENGINE

SM-E2B SERIES

Kubota

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KiSC issued 06, 2006 A

GENERAL

CONTENTS

1. ENGINE IDENTIFICATION G-1
   [1] MODEL NAME AND ENGINE SERIAL NUMBER G-1
   [2] E2B ENGINE G-2
   [3] CYLINDER NUMBER G-2
2. GENERAL PRECAUTIONS G-3
3. MAINTENANCE CHECK LIST G-4
4. CHECK AND MAINTENANCE G-6
   [1] DAILY CHECK POINTS G-6
   [2] CHECK POINTS OF INITIAL 50 HOURS G-8
   [3] CHECK POINT OF EVERY 50 HOURS G-10
   [4] CHECK POINT OF EVERY 75 HOURS G-11
   [5] CHECK POINTS OF EVERY 100 HOURS G-12
   [6] CHECK POINT OF EVERY 150 HOURS G-15
   [7] CHECK POINTS OF EVERY 200 HOURS G-15
   [8] CHECK POINTS OF EVERY 400 HOURS G-16
   [9] CHECK POINTS OF EVERY 500 HOURS G-17
   [10]CHECK POINTS OF EVERY 1 OR 2 MONTHS G-19
   [11]CHECK POINT OF EVERY YEAR G-21
   [12]CHECK POINT OF EVERY 800 HOURS G-22
   [13]CHECK POINTS OF EVERY 1500 HOURS G-23
   [14]CHECK POINTS OF EVERY 3000 HOURS G-25
   [15]CHECK POINTS OF EVERY 2 YEARS G-28
5. SPECIAL TOOLS G-32

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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 repair or use this unit.

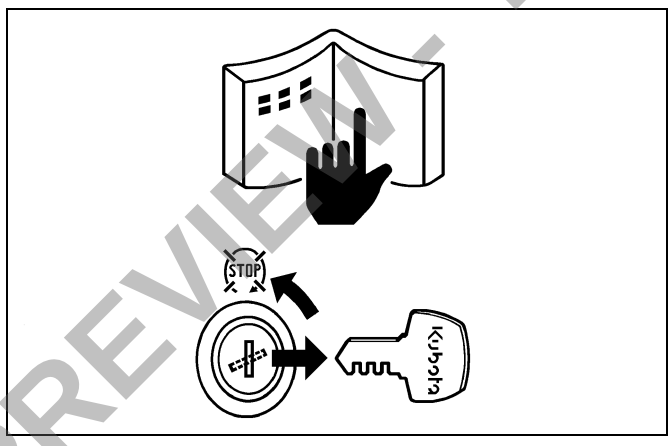
DANGER : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

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.



BEFORE SERVICING AND REPAIRING

- 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 firm and level ground.
- Allow the engine to cool before proceeding.
- Stop the engine, and remove the key.
- Disconnect the battery negative cable.
- Hang a "**DO NOT OPERATE**" tag in operator station.

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SPECIFICATIONS

Model	Z482-E2B	Z602-E2B	
Number of Cylinders	2		
Type	Vertical, Water-cooled, 4 cycle IDI diesel engine		
Bore × Stroke mm (in.)	67 × 68 (2.64 × 2.68)	72 × 73.6 (2.83 × 2.90)	
Total Displacement cm^3 (cu.in.)	479 (29.23)	599 (36.55)	
ISO Net Continous kW/min^{-1} (rpm) (HP/min^{-1} (rpm))	8.1 / 3600 (10.9 / 3600)	8.8 / 3200 (11.8 / 3200)	10.1 / 3600 (13.5 / 3600)
ISO / SAE Net Intermittent kW/min^{-1} (rpm) (HP/min^{-1} (rpm))	9.3 / 3600 (12.5 / 3600)	10.1 / 3200 (13.5 / 3200)	11.6 / 3600 (15.5 / 3600)
SAE Gross Intermittent kW/min^{-1} (rpm) (HP/min^{-1} (rpm))	9.9 / 3600 (13.3 / 3600)	10.8 / 3200 (14.5 / 3200)	12.5 / 3600 (16.8 / 3600)
Maximum Bare Speed (min^{-1} (rpm))	3800	3450	3800
Minimum Bare Idling Speed (min^{-1} (rpm))	900 to 1000		
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	0.35 rad (20 °) before T.D.C.	0.31 rad (18 °) before T.D.C.	0.35 rad (20 °) before T.D.C.
Firing Order	1-2		
Injection Pressure	13.73 MPa (140 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		
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. If this class of lubricating oil is not available, preferably use Class CD or CE lubricating oil. For details on recommended lubricating oils, see page G-5, 8.		
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)	
Lubricating Oil Capacity — Oil Pan Depth 121 mm (4.76 in.)	2.5 L (0.66 U.S.gals)	–	
Weight (Dry) kg (lbs)	53.1 (117.1)	57.0 (125.7)	

* 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-10
	Air in the fuel system	Bleed	G-10
	Water in the fuel system	Change fuel and repair or replace fuel system	–
	Fuel hose clogged	Clean or replace	G-10
	Fuel filter clogged	Replace	G-16
	Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	4, G-8
	Fuel with low cetane number	Use specified fuel	4
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	S-29
	Incorrect injection timing	Adjust	S-17, 18
	Fuel camshaft worn	Replace	S-41
	Injection nozzle clogged	Clean or replace	S-20, 21
	Injection pump malfunctioning	Repair or replace	S-19, 35, 36, 37
	Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	S-40 to 48 S-64 to 71
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	S-30, 31, 32
	Improper valve timing	Correct or replace timing gear	S-40
	Piston ring and cylinder worn	Replace	S-43, 44, 63
	Excessive valve clearance	Adjust	S-14
	Stop solenoid malfunctioning	Replace	S-26, 27, 29, 36
Starter Does Not Run	Battery discharged	Charge	G-19
	Starter malfunctioning	Repair or replace	S-29, 72 to 75
	Wiring disconnected	Connect	–
Engine Revolution Is Not Smooth	Fuel filter clogged or dirty	Replace	G-16
	Air cleaner clogged	Clean or replace	G-13, 16, 21
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	S-29
	Injection pump malfunctioning	Repair or replace	S-19, 35, 36, 37
	Incorrect nozzle injection pressure	Adjust	S-20
	Injection nozzle stuck or clogged	Repair or replace	S-20, 21
	Governor malfunctioning	Repair	S-41

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2. SERVICING SPECIFICATIONS

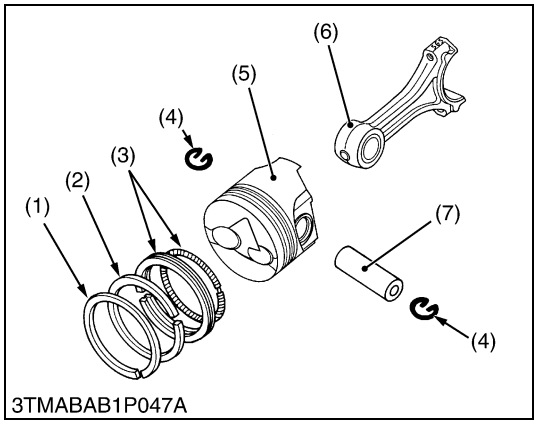
ENGINE BODY

Item		Factory Specification	Allowable Limit
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	–
Compression Pressure	Z482-E2B D662-E2B D722-E2B D782-E2B	2.84 to 3.24 MPa 29.0 to 33.0 kgf/cm^2 412 to 469 psi	2.26 MPa 23.0 kgf/cm^2 327 psi
	Z602-E2B D902-E2B	3.53 to 4.02 MPa 36.0 to 41.0 kgf/cm^2 512 to 583 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 0.0197 to 0.0276 in.	–
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 in.
Valve Recessing	Intake and Exhaust	–0.10 to 0.10 mm –0.0039 to 0.0039 in.	0.30 mm 0.0118 in.
Valve Stem to Valve Guide	Clearance	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	–
Valve Guide	I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	–
Valve Face	Angle	0.785 rad 45 °	–
Valve Seat	Angle	0.785 rad 45 °	–
	Width	2.12 mm 0.0835 in.	–
Valve Spring	Free Length	31.3 to 31.8 mm 1.232 to 1.252 in.	28.4 mm 1.118 in.
	Tilt	–	1.2 mm 0.047 in.
	Setting Load / Setting Length	64.7 N / 27.0 mm 6.6 kgf / 27.0 mm 14.6 lbs / 1.063 in.	54.9 N / 27.0 mm 5.6 kgf / 27.0 mm 12.3 lbs / 1.063 in.

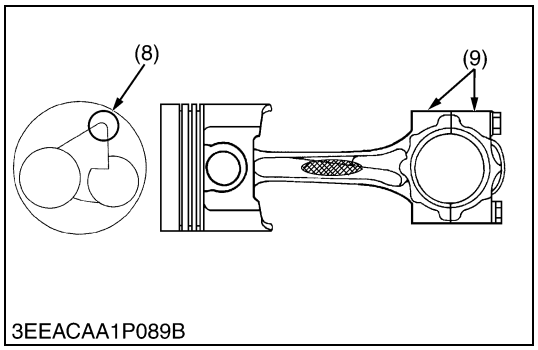
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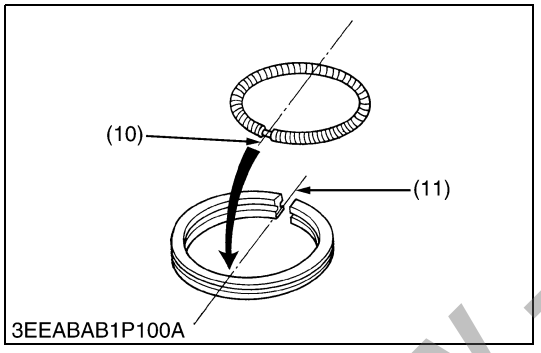
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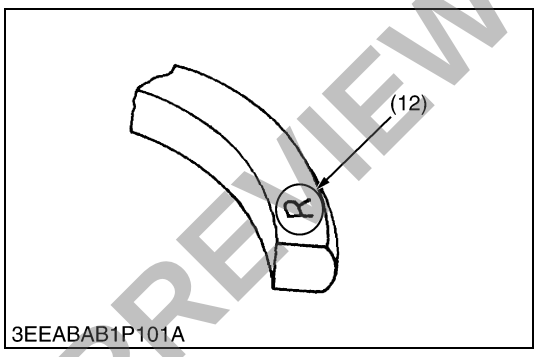
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3EEACAA1P089B



3EEABAB1P100A



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Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Remove the piston pin (7), and separate the connecting rod (6) from the piston (5).

(When reassembling)

- When installing the ring, assemble the rings so that the manufacturer's mark (12) near the gap faces the top of the piston.
- When installing the oil ring onto the piston, place the expander joint (10) on the opposite side of the oil ring gap (11).
- Apply engine oil to the piston pin.
- When installing the connecting rod to the piston, immerse the piston in 80 °C (176 °F) oil for 10 to 15 minutes and insert the piston pin to the piston.
- When installing the connecting rod to the piston, align the mark (9) on the connecting rod to the fan-shaped concave (8).

■ **IMPORTANT**

- **Mark the same number on the connecting rod and the piston so as not to change the combination.**

(1) Top Ring
(2) Second Ring
(3) Oil Ring
(4) Piston Pin Snap Ring
(5) Piston
(6) Connecting Rod
(7) Piston Pin
(8) Fan-Shaped Concave
(9) Mark
(10) Expander Joint
(11) Oil Ring Gap
(12) Manufacturer's Mark

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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 x 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	Size x Pitch	N·m	kgf·m	ft-lbs
*Cylinder head cover screw	M6 x 1	6.86 to 11.3	0.7 to 1.15	5.1 to 8.3
Injection pipe retaining nut	M12 x 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Overflow pipe retaining nut	M12 x 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Nozzle holder assembly	M20 x 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Glow plug	M8 x 1	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
*Rocker arm bracket nut	M6 x 1	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
*Cylinder head screw	M8 x 1.25	37.3 to 42.2	3.8 to 4.3	27.5 to 31.1
*Fan drive pulley screw	M12 x 1.5	117.7 to 127.5	12.0 to 13.0	86.8 to 94.0
*Idle gear shaft mounting screw	M6 x 1	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
Oil pump mounting screw	M8 x 1.25	17.7 to 21.6	1.80 to 2.20	13.0 to 15.9
*Connecting rod screw	M7 x 0.75	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
*Flywheel screw	M10 x 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
Bearing case cover mounting screw	M6 x 1	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
*Main bearing case screw 2	M7 x 1	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
*Main bearing case screw 1	M6 x 1	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil pressure switch	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Nozzle holder	–	34.3 to 39.2	3.5 to 4.0	25.3 to 28.9
Starter's terminal **B** mounting nut (Electromagnetic drive type)	M8	7.8 to 9.8	0.8 to 1.0	5.8 to 7.2
Starter's terminal **B** mounting nut (Planetary gear reduction type)	M8	5.9 to 11.8	0.6 to 1.2	4.3 to 8.7
Dynamo's pulley nut	M10 x 1.25	39.2 to 44.1	4.0 to 4.5	28.9 to 32.5
Alternator's pulley nut	–	58.3 to 78.9	5.95 to 8.05	43.0 to 58.2
Drain plug with copper gasket	M12 x 1.25	32.4 to 37.3	3.3 to 3.8	23.9 to 27.5
Drain plug with copper gasket	M22 x 1.5	63.7 to 73.5	6.5 to 7.5	47.0 to 54.2
Drain plug with rubber coated gasket	M22 x 1.5	44.1 to 53.9	4.5 to 5.5	32.5 to 39.8

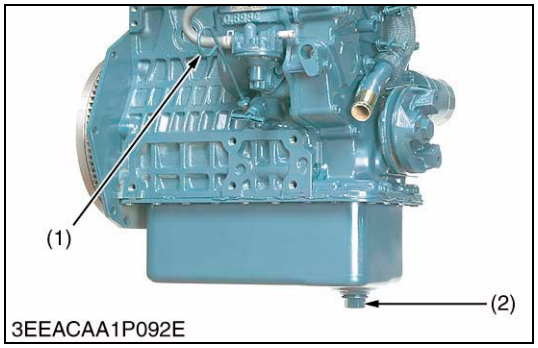
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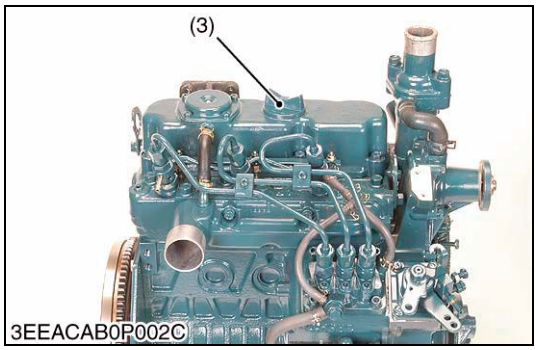
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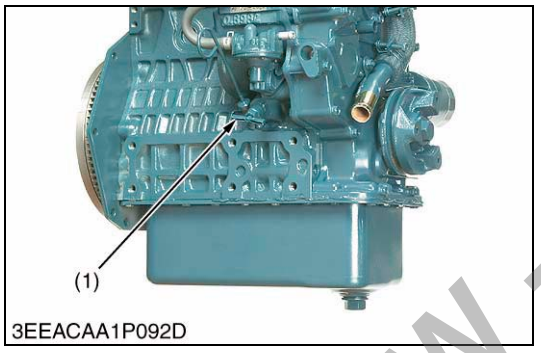
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[2] DISASSEMBLING AND ASSEMBLING

(1) Draining Engine Oil and Coolant







Draining Engine Oil

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. Remove the drain plug (2) to drain oil.
4. After draining, screw in the drain plug.

(When refilling)

- Fill the engine oil up to the upper line on the dipstick (1).

■ **IMPORTANT**

- **Never mix two different types of oil.**
- **Use the proper SAE Engine Oil according to ambient temperature.**

(1) Dipstick
(2) Drain Plug
(3) Oil Inlet Plug

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Draining Coolant

CAUTION

- **Never remove radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

1. Prepare a bucket. Open the coolant drain cock.

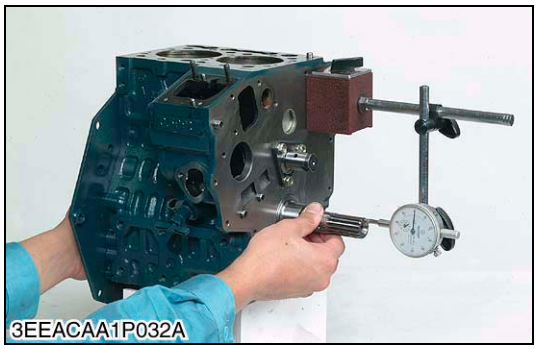
(1) Coolant Drain Cock

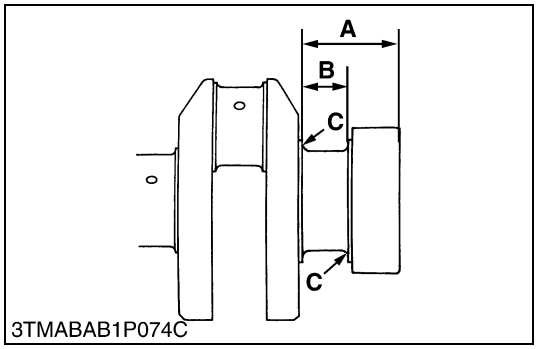
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(4) Crankshaft


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Crankshaft Side Clearance

1. Set a dial indicator with its tip on the end of the crankshaft.
2. Measure the side clearance by moving the crankshaft to the front and rear.
3. If the measurement exceeds the allowable limit, replace the thrust bearings.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an oversize one referring to the table and figure.

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

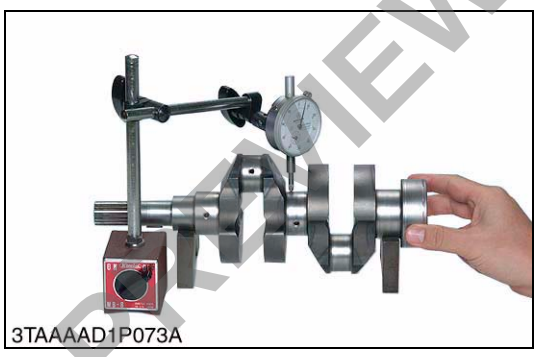
- Oversize thrust bearing

Oversize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Thrust bearing 1 02	15261-23950	020 OS
	Thrust bearing 2 02	15261-23970	020 OS
0.4 mm 0.016 in.	Thrust bearing 1 04	15261-23960	040 OS
	Thrust bearing 2 04	15261-23980	040 OS

- Oversize dimensions of crankshaft journal

Oversize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **A**	46.1 to 46.3 mm 1.815 to 1.823 in.	46.3 to 46.5 mm 1.823 to 1.831 in.
Dimension **B**	23.40 to 23.45 mm 0.9213 to 0.9232 in.	23.80 to 23.85 mm 0.9370 to 0.9390 in.
Dimension **C**	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
The crankshaft journal must be fine-finished to higher than ∇∇∇.		(0.8S)

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Crankshaft Alignment

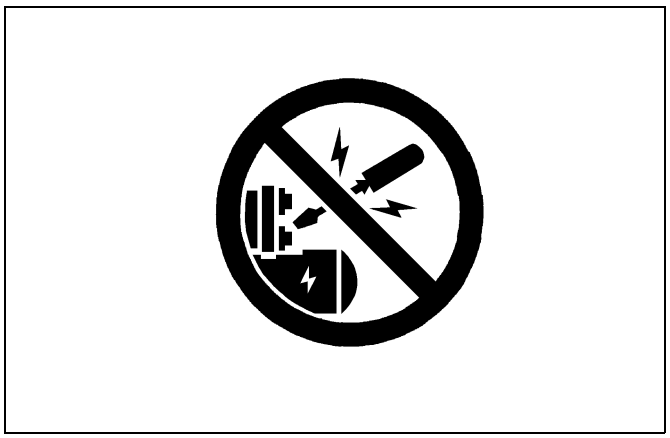
1. Support the crankshaft with V blocks on the surface plate at both end journals.
2. Set a dial indicator with its tip on the intermediate journal.
3. Measure the crankshaft alignment.
4. If the measurement exceeds the allowable limit, replace the crankshaft.

Crankshaft alignment	Allowable limit	0.02 mm 0.0008 in.

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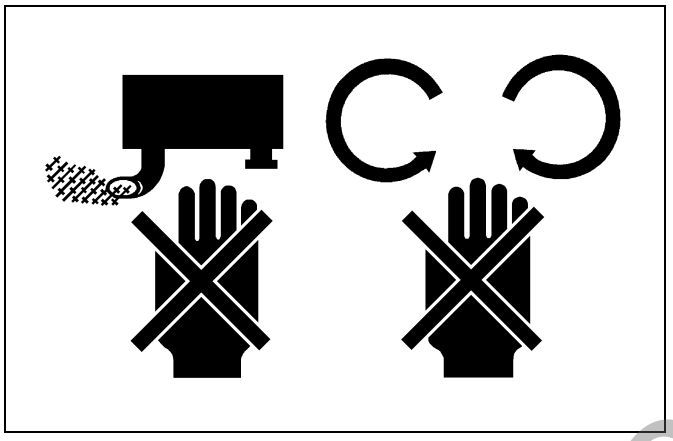
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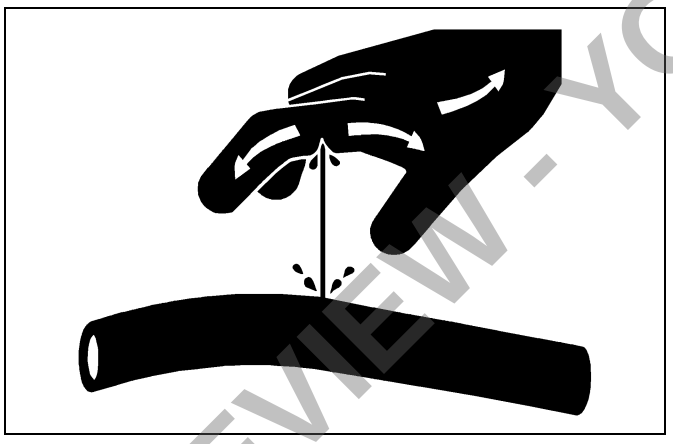
SAFETY STARTING

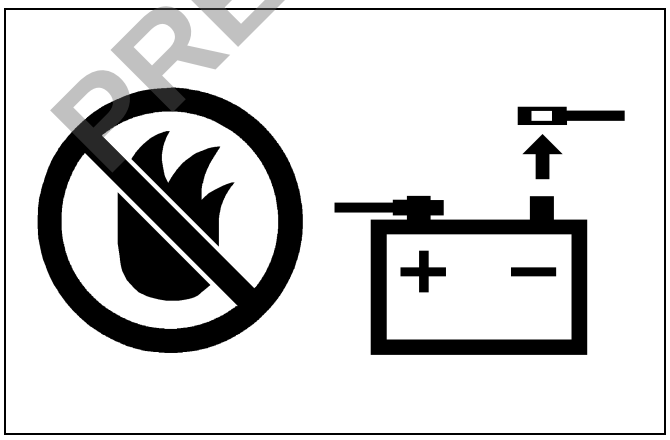
- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Unauthorized modifications to the engine may impair the function and / or safety and affect engine life.



SAFETY WORKING

- Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- Wear close fitting clothing and safety equipment appropriate to the job.
- Use tools appropriate to the work. Makeshift tools, parts, and procedures are not recommended.
- When servicing is performed together by two or more persons, take care to perform all work safely.
- Do not touch the rotating or hot parts while the engine is running.
- Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Only remove radiator cap when cool enough to touch with bare hands. Slowly loosen the cap to first stop to relieve pressure before removing completely.
- Escaping fluid (fuel or hydraulic oil) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.





AVOID FIRES

- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- Make sure that no fuel has been spilled on the engine.

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ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Crankpin to Crankpin Bearing	Oil Clearance	0.020 to 0.051 mm 0.00079 to 0.00201 in.	0.15 mm 0.0059 in.
Crankpin	O.D.	33.959 to 33.975 mm 1.33697 to 1.33760 in.	–
Crankpin Bearing	I.D.	33.995 to 34.010 mm 1.33839 to 1.33898 in.	–
Crankshaft Journal to Crankshaft Bearing 1 **[Z482/D662/D722/D782-E2B]**	Oil Clearance	0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 1	I.D.	39.984 to 40.040 mm 1.57417 to 1.57638 in.	–
Crankshaft Journal to Crankshaft Bearing 1 **[Z602/D902-E2B]**	Oil Clearance	0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.934 to 43.950 mm 1.72968 to 1.73031 in.	–
Crankshaft Bearing 1	I.D.	43.984 to 44.040 mm 1.73165 to 1.73386 in.	–
Crankshaft Journal to Crankshaft Bearing 2 (Flywheel Side)	Oil Clearance	0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.934 to 43.950 mm 1.72968 to 1.73031 in.	–
Crankshaft Bearing 2	I.D.	43.978 to 43.993 mm 1.73142 to 1.73201 in.	–
Crankshaft Journal to Crankshaft Bearing 3 (Intermediate) **[Z482/D662/D722/D782-E2B]**	Oil Clearance	0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 3	I.D.	39.978 to 39.993 mm 1.57394 to 1.57453 in.	–
Crankshaft Journal to Crankshaft Bearing 3 (Intermediate) **[Z602/D902-E2B]**	Oil Clearance	0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.934 to 43.950 mm 1.72968 to 1.73031 in.	–
Crankshaft Bearing 3	I.D.	43.978 to 43.993 mm 1.73142 to 1.73201 in.	–

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