WSM

WORKSHOP MANUAL
DIESEL ENGINE

03-M-DI-E2B SERIES

Kubota

KiSC issued 04, 2006 A

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SERVICING

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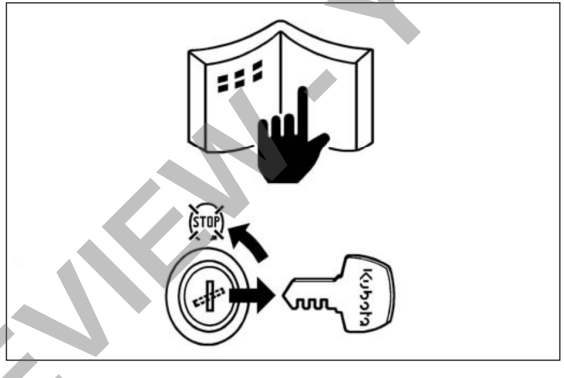
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SAFETY FIRST

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.

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SPECIFICATIONS

Model		D1503-M-DI	D1503-M-DI-T
Number of Cylinders		3	
Type		Vertical, Water-cooled, 4 cycle diesel engine	
Bore × Stroke		83 × 92.4 mm (3.27 × 3.64 in.)	
Total Displacement		1499 cm^3 (91.47 cu.in.)	
ISO Net Continuous		20.6 kW / 2800 min^{-1} (rpm) (27.6 HP / 2800 min^{-1} (rpm))	27.0 kW / 2800 min^{-1} (rpm) (36.2 HP / 2800 min^{-1} (rpm))
ISO/SAE Net Intermittent		23.7 kW / 2800 min^{-1} (rpm) (31.8 HP / 2800 min^{-1} (rpm))	31.1 kW / 2800 min^{-1} (rpm) (41.7 HP / 2800 min^{-1} (rpm))
SAE Gross Intermittent		24.9 kW / 2800 min^{-1} (rpm) (33.4 HP / 2800 min^{-1} (rpm))	32.4 kW / 2800 min^{-1} (rpm) (43.4 HP / 2800 min^{-1} (rpm))
Maximum Bare Speed		3000 min^{-1} (rpm)	
Minimum Bare Idling Speed		850 to 950 min^{-1} (rpm)	
Combustion Chamber		Reentrant Type (Direct Injection)	
Fuel Injection Pump		Bosch "**K**" Type Mini Pump	
Governor		All speed mechanical governor	
Direction of Rotation		Counter-clockwise (viewed from flywheel side)	
Injection Nozzle		Bosch "**P**" Type Hole Nozzle	
Injection Timing		0.127 rad (7.25 °) before T.D.C.	0.135 rad (7.75 °) before T.D.C.
Firing Order		1-2-3	
Injection Pressure	1st Stage	18.6 MPa (190 kgf/cm^2, 2702 psi)	
	2nd Stage	22.6 MPa (230 kgf/cm^2, 3271 psi)	
Compression Ratio		20 : 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	
Starting Motor		12 V, 1.2 kW	
Starting Support Device		By glow plug in combustion chamber	
Battery		12 V, 60 AH equivalent	
Charging Alternator		12 V, 360 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, 13.	
Lubricating Oil Capacity	Oil Pan Depth 90 mm (3.54 in.)	5.6 L (1.48 U.S.gals)	
	Oil Pan Depth 124 mm (4.88 in.)	7.0 L (1.85 U.S.gals)	
Weight (Dry)		148 kg (326 lbs)	152 kg (335 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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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	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 (depending on the oil pan)	(1) Oil pan depth (90 mm, 3.54 in.)											
	(2) Oil pan depth (124 mm, 4.88 in.)											
*Cleaning air cleaner element (replace the element after 6-times cleanings)												
*Cleaning fuel filter (Element type)												
Checking battery electrolyte level												
Checking fan belt tension and damage												
Replacing oil filter cartridge	(1) Oil pan depth (90 mm, 3.54 in.)											
	(2) Oil pan depth (124 mm, 4.88 in.)											
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												
Checking valve clearance												
* Checking injection nozzle pressure												
* Checking turbocharger												
* Checking injection pump												
* Replacing intake air line												
Replacing battery												
Replacing radiator hoses and clamp bands												
* Replacing fuel hoses and clamps												
Changing radiator coolant (L.L.C.)												

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.

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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	Vent air	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, 5, 6, G-8
	Fuel with low cetane number	Use specified fuel	4, 5, 6
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	S-31
	Incorrect injection timing	Adjust	S-21
	Fuel camshaft worn	Replace	S-45
	Injection nozzle clogged	Repair or replace	S-23, 32
	Injection pump malfunctioning	Repair or replace	S-22, 36, 37, 38
	Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	S-44 to 48 S-68 to 73
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	S-32, 33, 34
	Improper valve timing	Correct or replace timing gear	S-43, 44
	Piston ring and cylinder worn	Replace	S-16, 47, 48, 66, 67, 72
	Excessive valve clearance	Adjust	S-17
	Stop solenoid malfunctioning	Replace	S-28, 37
(Starter Does Not Run)	Battery discharged	Charge	G-19, 20
	Starter malfunctioning	Repair or replace	S-26, 29, 52, 74
	Key switch malfunctioning	Replace	–
	Wiring disconnected	Connect	–

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

NOTE

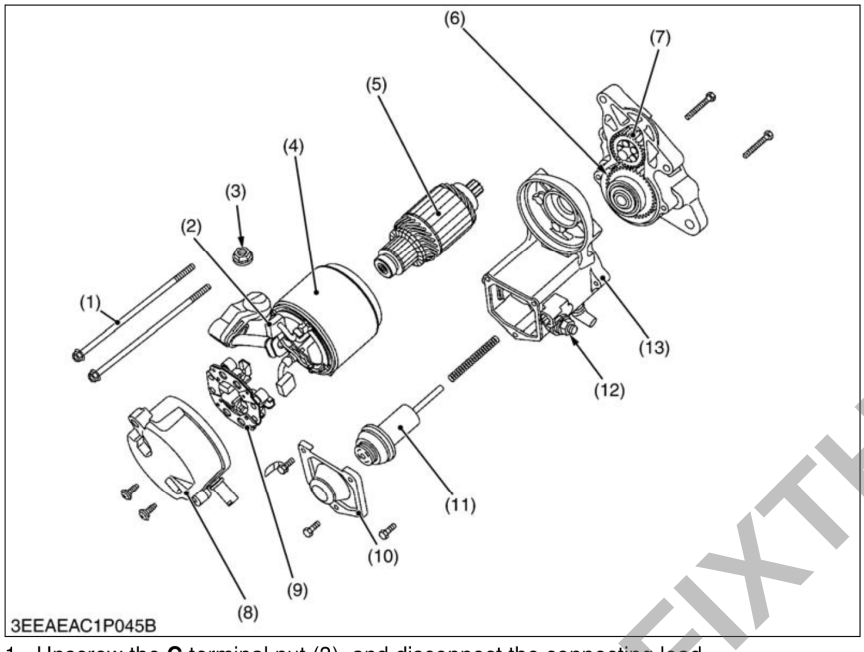
- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size x Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal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

Item	Size x Pitch	N·m	kgf·m	ft-lbs
Cylinder head cover screw	M6 x 1.0	6.9 to 11.3	0.7 to 1.15	5.1 to 8.32
*Cylinder head screw	M11 x 1.25	93.2 to 98.1	9.5 to 10.0	68.7 to 72.3
*Main bearing case screw 1	M9 x 1.25	46.1 to 51.0	4.7 to 5.2	34.0 to 37.6
*Main bearing case screw 2	M10 x 1.25	68.6 to 73.5	7.0 to 7.5	50.6 to 54.2
*Flywheel screw	M12 x 1.25	98.1 to 107.9	10.0 to 11.0	72.3 to 79.6
*Connecting rod screw	M8 x 1.0	44.1 to 49.0	4.5 to 5.0	32.5 to 36.2
*Rocker arm bracket screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
*Idle gear shaft screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Fan drive pulley mounting nut	M30 x 1.5	137.3 to 156.9	14.0 to 16.0	101.3 to 115.7
*Bearing case cover mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Glow plug	M10 x 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Nozzle holder clamp screw	M10 x 1.25	25.5 to 29.4	2.6 to 3.0	18.8 to 21.7
Oil pressure switch	R 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Injection pipe retaining nut	M12 x 1.5	14.7 to 24.5	1.5 to 2.5	10.8 to 18.1
Overflow pipe assembly retaining screw	M6 x 1.0	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
Camshaft set screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Hi-idling body	M14 x 1.0	44.1 to 49.0	4.5 to 5.0	32.5 to 36.2
Balancer shaft set bolt (Balancer model only)	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Alternator's pulley nut	–	58.3 to 78.9	5.95 to 8.05	43.0 to 58.2
Idle gear 2 stopper set screw (Side PTO model only)	–	49.0 to 55.9	5.0 to 5.7	36.2 to 41.2
Idle gear 2 shaft set screw (Side PTO model only)	–	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Starter's terminal **B** mounting nut	M8	5.9 to 11.8	0.6 to 1.2	4.3 to 8.7

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(7) Starter



(1) Through Bolt
(2) Brush
(3) **C** Terminal Nut
(4) Yoke
(5) Armature
(6) Overrunning Clutch
(7) Idle Gear
(8) End Frame
(9) Brush Holder
(10) Magnet Switch Cover
(11) Plunger
(12) **B** Terminal Nut
(13) Housing

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1. Unscrew the **C** terminal nut (3), and disconnect the connecting lead.
2. Remove the two through bolts (1).
3. Detach the motor.
4. Remove the end frame (8).
5. Remove the brush from the brush holder while holding the spring up.
6. Remove the brush holder (9).
7. Draw out the armature (5) from the yoke (4).
8. Remove the housing (13).
9. Remove the idle gear (7) and the overrunning clutch (6).
10. Remove the magnet switch cover (10).
11. Remove the plunger (11).

NOTE

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

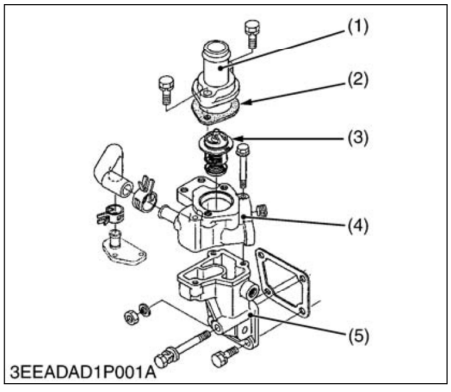
(When reassembling)

- Apply grease (DENSO No. 50 or equivalent) to the idle gear and overrunning clutch portions.

Tightening torque	**B** terminal nut	5.9 to 11.8 N·m 0.6 to 1.2 kgf·m 4.3 to 8.7 ft-lbs

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Thermostat Assembly

1. Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
2. Remove the thermostat assembly (3).

(When reassembling)

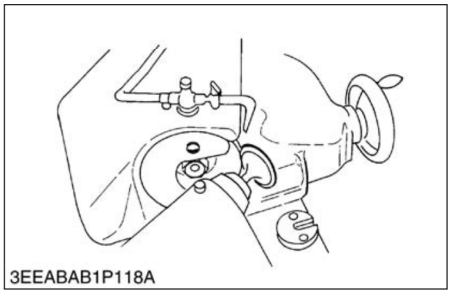
- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the thermostat cover gasket (2).
- Apply a liquid gasket (Three Bond 1215 or equivalent) to the thermostat flange 1 (4) and flange 2 (5)

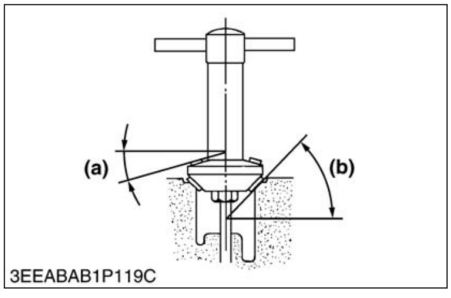
(1) Thermostat Cover
(2) Thermostat Cover Gasket
(3) Thermostat Assembly
(4) Water Flange 1
(5) Water Flange 2

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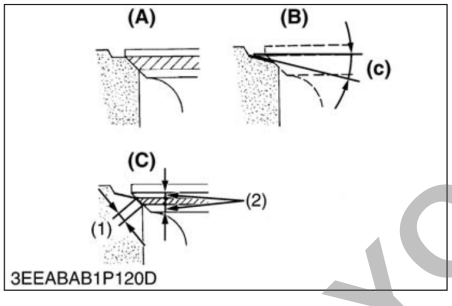
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3EEABAB1P120D

Correcting Valve and Valve Seat

NOTE

- **Before correcting the valve and seat, check the valve stem and the I.D. of valve guide section, and repair them if necessary.**
- **After correcting the valve seat, be sure to check the valve recessing.**

1) Correcting Valve

1. Correct the valve with a valve refacer.

Valve face angle	Factory spec.	IN.	1.047 rad 60 °
		EX.	0.785 rad 45 °

2) Correcting Valve Seat

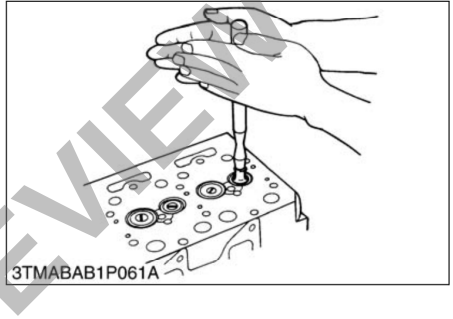
1. Slightly correct the seat surface with a 1.047 rad (60 °) (intake valve) or 0.785 rad (45 °) (exhaust valve) valve seat cutter.
2. Resurface the seat surface with a 0.523 rad (30 °) valve seat cutter to intake valve seat and with a 0.262 rad (15 °) valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width (2.12 mm, 0.0835 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.

Valve seat angle	Factory spec.	IN.	1.047 rad 60 °
		EX.	0.785 rad 45 °

(1) Valve Seat Width
(2) Identical Dimensions

(A) Check Contact
(B) Correct Seat Width
(C) Check Contact
(a) 0.262 rad (15 °) or 0.523 rad (30 °)
(b) 0.785 rad (45 °) or 1.047 rad (60 °)
(c) 0.523 rad (30 °) or 0.262 rad (15 °)

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Valve Lapping

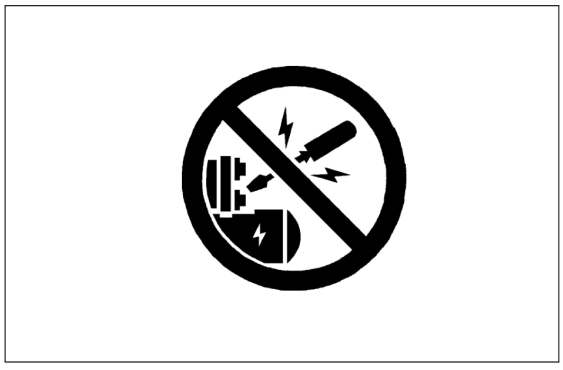
1. Apply compound evenly to the valve lapping surface.
2. Insert the valve into the valve guide. Lap the valve onto its seat with a valve flapper or screwdriver.
3. After lapping the valve, wash the compound away and apply oil, then repeat valve lapping with oil.
4. Apply prussian blue to the contact surface to check the seated rate. If it is less than 70 %, repeat valve lapping again.

IMPORTANT

- **When valve lapping is performed, be sure to check the valve recessing and adjust the valve clearance after assembling the valve.**

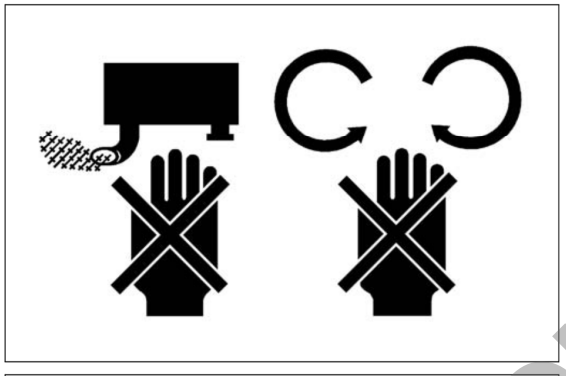
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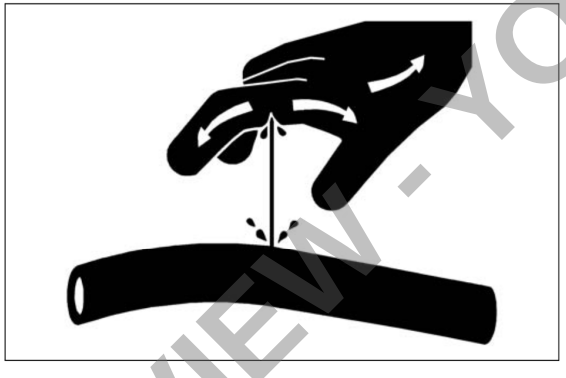
SAFETY STARTING

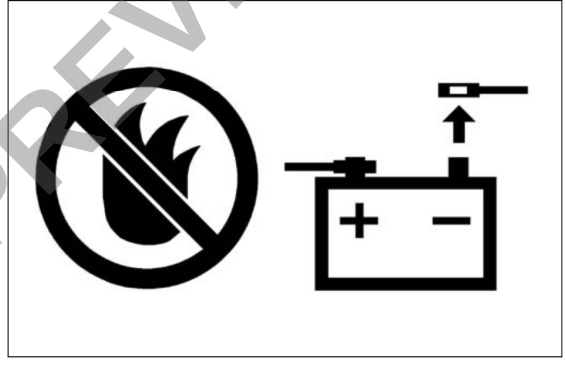
- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Unauthorized modifications to the engine may impair the function and / or safety and affect engine life.



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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ELECTRICAL SYSTEM

Item		Factory Specification	Allowable Limit
Starter			
Commutator **[D1503-M-DI]** **[D1503-M-DI-T]** **[D1703-M-DI]** **[D1803-M-DI]** **[V2203-M-DI]** **[V2003-M-DI-T]**	O.D.	30.0 mm 1.181 in.	29.0 mm 1.142 in.
Commutator **[V2403-M-DI]**	O.D.	35.0 mm 1.378 in.	34.0 mm 1.339 in.
Mica	Under Cut	0.45 to 0.75 mm 0.0177 to 0.0295 in.	0.20 mm 0.0079 in.
Brush **[D1503-M-DI]** **[D1503-M-DI-T]** **[D1703-M-DI]** **[D1803-M-DI]** **[V2203-M-DI]** **[V2003-M-DI-T]**	Length	15.0 mm 0.591 in.	11.0 mm 0.433 in.
Brush **[V2403-M-DI]**	Length	15.0 mm 0.591 in.	9.0 mm 0.354 in.
Brush Holder and Holder Support	Resistance	Infinity	–
Alternator	No-load voltage	More than 13.5 V	–
Stator	Resistance	Less than 1.0 Ω	–
Rotor	Resistance	2.9 Ω	–
Slip Ring	O.D.	14.4 mm 0.567 in.	14.0 mm 0.551 in.
Brush	Length	10.5 mm 0.413 in.	8.4 mm 0.331 in.
Glow Plug	Resistance	Approx. 0.9 Ω	–

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