

WARRIOR GENERATORS

LDG4600E DIESEL GENERATOR OWNERS MANUAL



**BEFORE OPERATING THIS EQUIPMENT
PLEASE READ THESE INSTRUCTIONS CAREFULLY**

This manual contains information how to maintain and how to do troubleshooting.
Keep this owner's manual handy, so you can refer to it at any time.

This service manual describes correct method of the maintaining this equipment. As a result of this disregard of our rules caused by person casualty and equipment damaged, our company does not assume any responsibility.

NOTICE:

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SAFETY MESSAGES

Your safety and the safety of others are very important. We have provided important safety messages in this manual and on the generator. Please read these messages carefully.

A safety message reminds you to potential hazards that could hurt you or others. Each safety message is preceded by a safety alert symbol and one of three words: DANGER, WARNING, or CAUTION. These mean:

DANGER

You **WILL** be **KILLED** or **SERIOUSLY HURT** if you don't follow instructions.

WARNING

You **CAN** be **KILLED** or **SERIOUSLY HURT** if you don't follow instructions.

CAUTION

You **CAN** be **HURT** if you don't follow instructions.

NOTICE

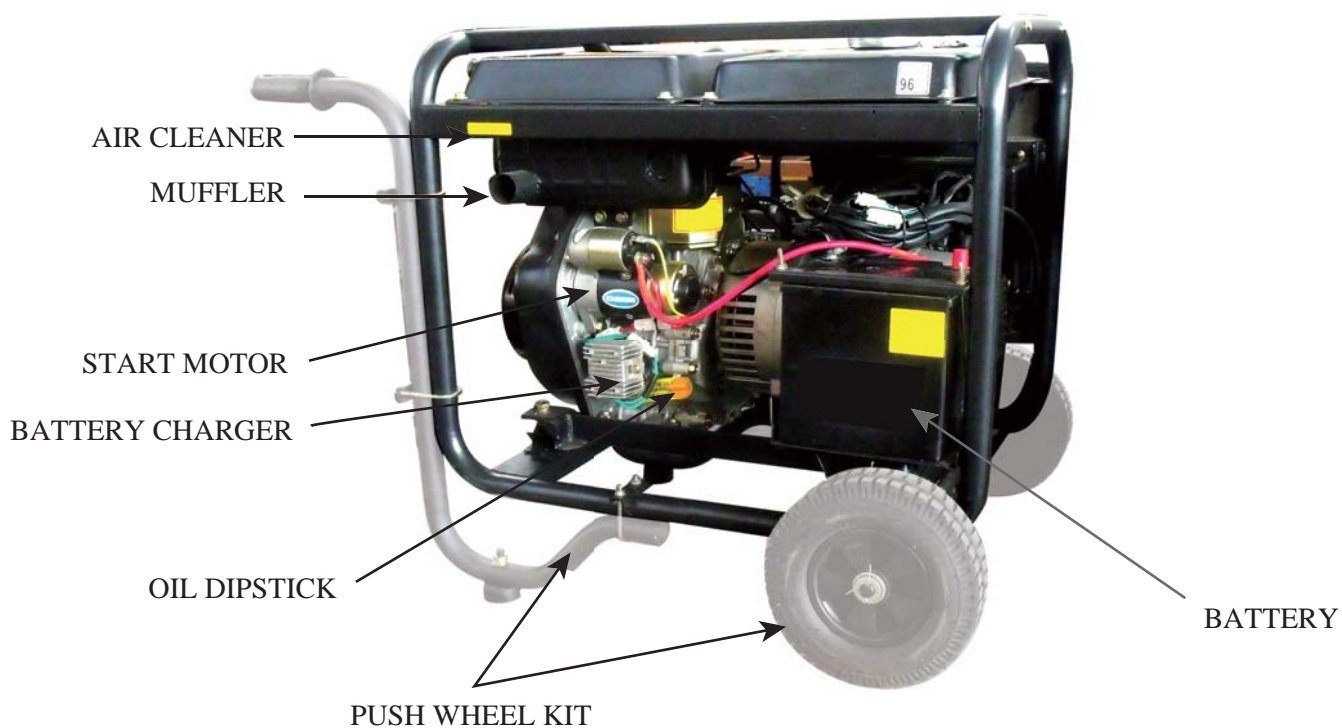
Your generator or other property could be damaged if you don't follow instructions.

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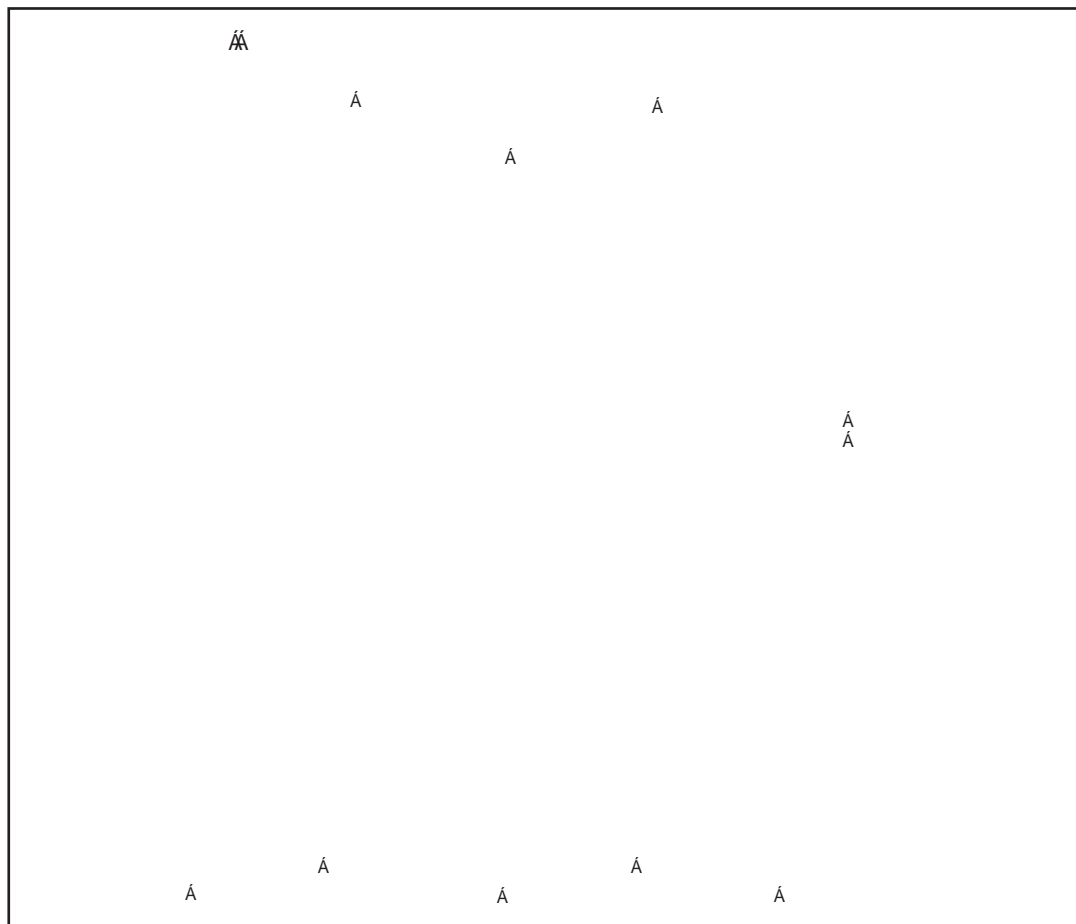
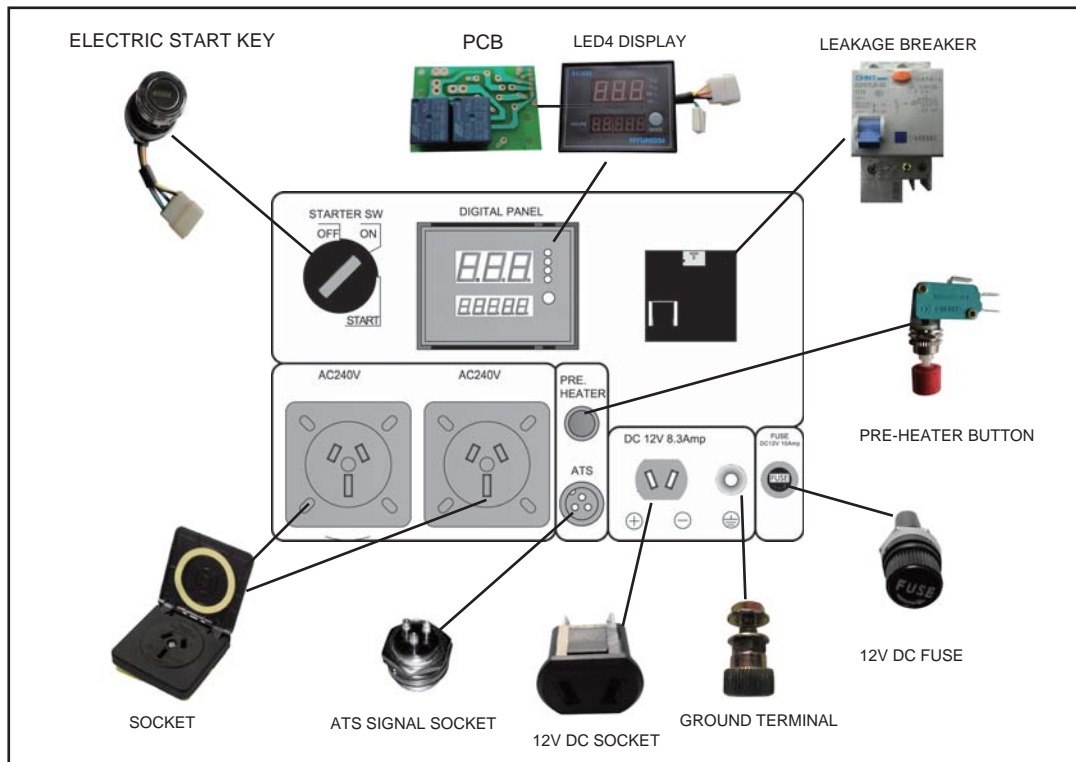
1. PREFACE

1-1 Generator Component Identification

Open Type: DÖI €€€



1-2 CONTROL PANEL



LDG4600E Specifications

Frequency (HZ)	50	Cooling system	Forced Air cooled
Starting Watts	4600	Lubricaton system	Forced lubrication
Running Watts	4200	Operation capacity (hr)	>12 hrs (25% load)
Voltage (V)	1 x 110v 32 Amp / 1 x 240v 32 Amp	Dimension L*W*H (mm)	720 x 492 x 650
DC output (VA)	12 / 8.3	Net Weight (kgs)	95
Pole Numbers	2	Noise Level dBa@7m	84-89
Insulation	B	Certification	ISO9001-2000, GS, TUV & CE
Engine Model	182FE	Start System	Electric Key
Engine Type	Single cyinder, vertical, 4 stroke air cooled direct injection diesel engine.	Fuel tank capacity (L)	15
Displacement (cc)	296	Lube oil capacity (L)	1.1 (SAE10x30)
Engine Speed (RPM)	3000		
Low oil pressure alarm system	Included		

1-5 Maintenance Standard

Diesel Engine

Parts	Item		Standard	Service limit
Diesel Engine	Maximum Speed (No Load)		3150~3180rpm	--
	Cylinder Compression		$\geq 1.17\text{Mpa}(1400\text{rpm})$	--
Cylinder	Sleeve I.D		$86.0\text{mm}^{+0.035}_0$	86.185mm
Cylinder Head Cover	Warpage		--	0.10mm
Piston	Skirt O.D.		85.94mm	85.80mm
	Piston-to-Cylinder Clearance		0.015-0.05mm	0.12mm
	Piston Pin Bore I.D.		$\varnothing 23\text{mm}^{+0.002}_{-0.008}$	$\varnothing 23.05\text{mm}$
	Piston Pin O.D		18.0mm	17.954mm
	Piston Pin-to-Piston Pin Bore Clearance		0.002-0.014mm	0.06mm
Piston Rings	Ring Side Clearance :		0.015-0.045mm	0.15mm
	Second		--	--
	Ring Enc Gap:		0.2-0.4mm	1.0mm
	Second		0.15-0.35mm	1.0mm
	Ring Width		1.5mm	1.37mm
Connecting Rod	Second		2.5mm	2.37mm
	Small End I.D		18.002mm	18.07mm
	Big End I.D		30.02mm	30.066mm
	Big Oil Clearance		0.040-0.063mm	0.12mm
	Big End Side Clearance		0.1-0.7mm	1.1mm
Crankshaft	Crankshaft pin O.D		29.98mm	29.92mm
Valve	Valve Clearance	IN	$0.15\pm 0.02\text{mm}$	--
		EX	$0.20\pm 0.02\text{mm}$	--
	Stem O.D	IN	5.48mm	5.318mm
		EX	5.44mm	5.275mm
	Guide I.D		5.50mm	5.572mm
	Stem Clearance	IN	0.02-0.044mm	0.1mm
		EX	0.06-0.087mm	0.12mm
	Seat Width		0.8mm	2.0mm
	Spring Free Length		34mm	32.5mm

Camshaft	Cam Height	IN	27.7mm	27.45mm
	Cam Height	EX	27.75mm	27.50mm
	Journal O.D		13.984mm	13.916mm
Crankcase Cover	Camshaft Bracket I.D		14.0mm	14.048mm
Carburetor	Main Jet		#68	--
	Float Height		13.7±1.5mm	--
	Pilot Screw Opening		2-1/8 turns	--
Spark Plug	Gap		0.7-0.8mm	--
Spark Plug Cap	Resistance		5kΩ	--
Ignition Coil	Resistance	Primary Coil	0.8-1.0Ω	--
		Secondary Coil	5.9-7.1kΩ	--
	Air gap		0.4-0.6mm	--

- Generator

Parts	Item		Standard	Service limit
Stator Winding	Resistance	Stator Winding	1.8±10%Ω at 20°C	--
		Stator Auxiliary Winding	3.5±10%Ω at 20°C	--
Rotor Excitation Winding	Resistance	Excitation Winding	51.3±10%Ω at 20°C	--
Carbon Brush	Carbon Brush Length		10mm	6mm

2. Periodic Maintenance

2.1 Service Intervals

Good maintenance is essential for safe, economical, and trouble-free operation. It will also help reduce air pollution.

⚠ WARNING

Exhaust gas contains poisonous carbon monoxide. Shut off the engine before perform any maintenance. If the engine must be run, make sure the area is well ventilated.

Periodic maintenance and adjustment is necessary to keep the generator in good operating condition. Perform the service and inspection at the intervals shown in the Maintenance schedule below:

Item \ Time	Daily	After 20 hours or 1 month	100 Hours or Every 3 month	500 Hours Every 6 month	1000 Hours or Every year
Check and tighten the nut and screw	○				
Check and fill machine oil	○				
Change machine oil		○ (First time)	○ (Second time and later)		
Clean and change oil filter				○	● (Change)
Check oil-leakage	○				
Change the core of air filter		Cycle of check and main-tenance will be shortened at dusty place.		○	
Clean fuel tank	Every month				
Clean or change fuel filter				○ (Clean)	○ (Change)
Check nozzle				●	
Check injection pump				●	
Check pipeline of fuel				○ (Change if necessary)	
Adjust valve clearance of inlet and exhaust		● (First time)		●	
Grind valve holder of inlet and exhasust					●
Change piston ring					●
Check accumulator liquid	each month				
Clean the core of air filter		○ (Clean) every month or 50 hours			

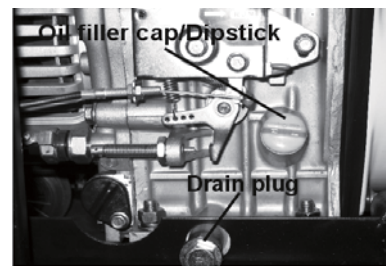
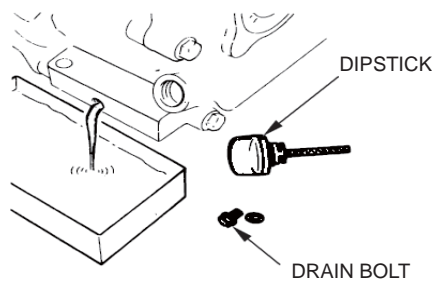
- (1) Service more frequently when used in dusty areas.
- (2) These items should be serviced by an authorized generator dealer.
- (3) When more often use, only servicing according to above correct intervals can insure the generator set long-term use.

2-2 Routine Maintenance Procedures

2.2.1 Oil Change

Drain the used oil while the engine is warm. Warm oil drains quickly and completely.

1. Place a suitable container below the engine to catch the used oil, and then remove the filler cap/dipstick and the drain plug.
2. Allow the used oil to drain completely, and then reinstall the drain plug, and tighten it securely.
3. With the engine in a level position, fill to the outer edge of the oil filler hole with the recommended oil.



2.2.2 Oil Filter Service

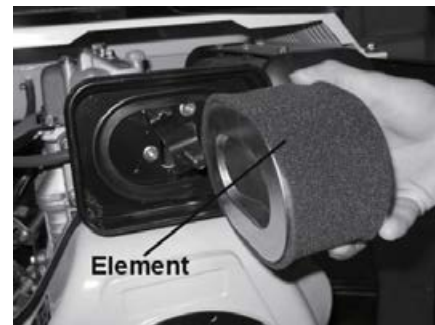
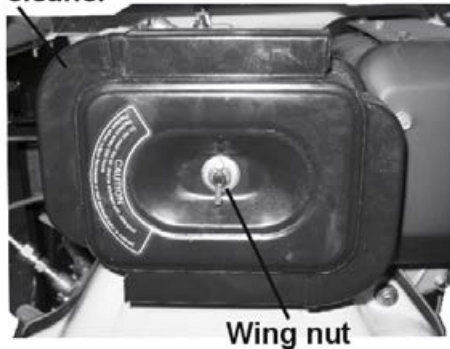
- Remove the bolt that secures the filter and carefully pull the assembly toward you.
- The filter may be immersed in solvent then blown dry with compressed air.
- Replace the filter at the scheduled service interval or anytime the screen is damaged or all deposits cannot be removed.



2.2.3 Air Filter Service

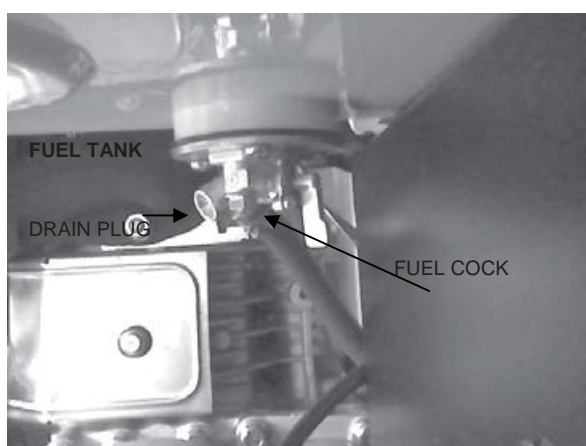
Remove the air cleaner cover and inspect the filter. Clean or replace dirty filter elements. Always replace damaged filter elements.

Air cleaner



2.2.4 Fuel Filter Service

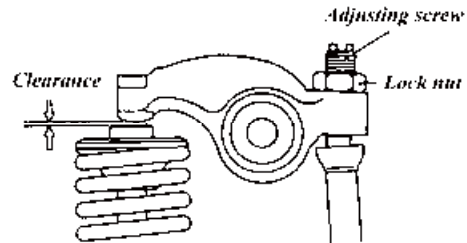
1. Drain out the fuel from the fuel tank. Turn the screw in the drain plug counter clockwise until fuel flows. Use a suitable container to catch the fuel.
2. Remove the three screws securing the fuel cock assembly and remove the filter from the housing.



**FUEL FILTER
ASSEMBLY**

2.2.5 Adjust the valve clearance

(1) The clearance must be adjusted when the engine is cold.



	Standard	Maintenance Limit
Intake/Exhaust clearance	.15 mm	--

(2) Valve timing

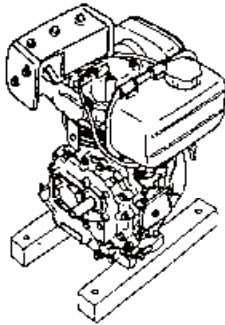
Intake	Open	14° before TDC
	Close	50° after BDC
Exhaust	Open	54° before BDC
	Close	10° after TDC

3. Engine disassembly and reassembly

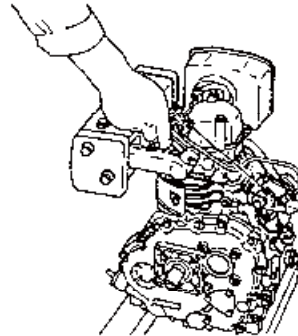
3.1 Disassembly

3.1.1 Fuel tank

1. Release the joint between the fuel line and fuel tank.
2. Release the hose clamp of the fuel line on the pump side.
3. Remove the tank.



Disassemble fuel tank



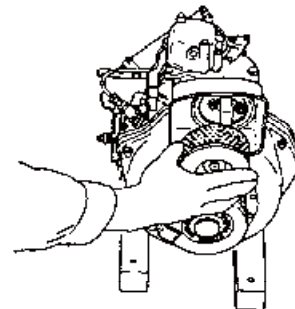
Remove exhaust muffler

3.1.2 Exhaust Muffler

1. Remove the flange bolt
2. Remove the set bolt
3. Discard the muffler gasket. Do not reuse.

3.1.3 Air cleaner

- (1). Disassemble the air cleaner cover.
- (2). Pull out the element.
- (3). Disassemble the air cleaner bottom case.



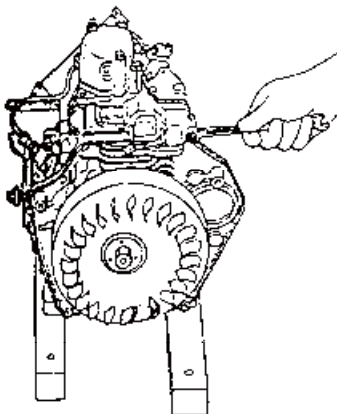
Remove air cleaner

3.1.4 Recoil starter unit

(do not disassemble)

3.1.5 Disassemble the fan cover

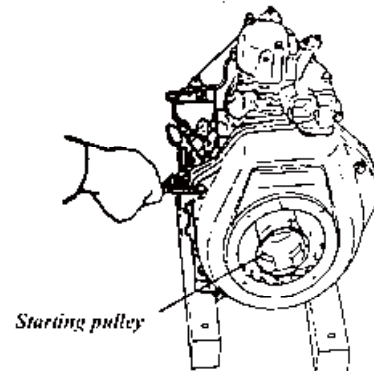
Unbolt and remove the fan cover.



Remove air inlet pipe

4.1.6 Starter pulley

Unbolt and remove



Starting pulley

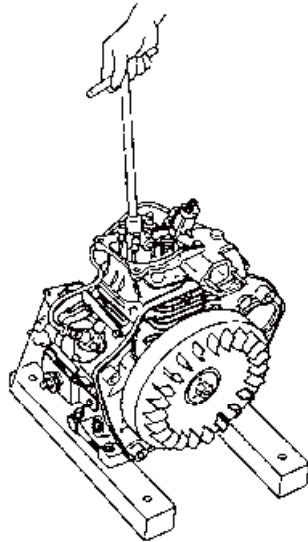
Remove the fan cover

3.1.7 Air inlet pipe

3.1.8 Remove electric starter motor

3.1.9 Remove cylinder head cover

3.1.10 Valve rocker arm seat

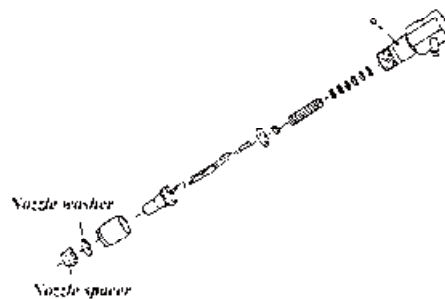


Remove valve rocker arm seat

3.1.11 Push rods

3.1.12 Fuel injector

- (1) Remove the high-pressure fuel line.
- (2) Remove fuel injector.
- (3) Be careful not to damage the nozzle washer and spacer.



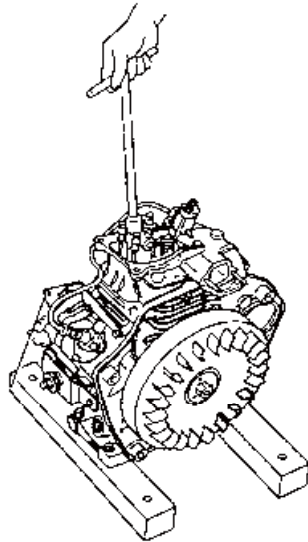
Fuel injection valve figure

3.1.7 Air inlet pipe

3.1.8 Remove electric starter motor

3.1.9 Remove cylinder head cover

3.1.10 Valve rocker arm seat

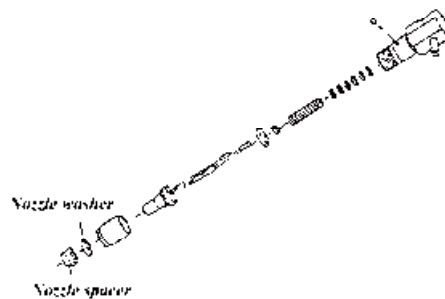


Remove valve rocker arm seat

3.1.11 Push rods

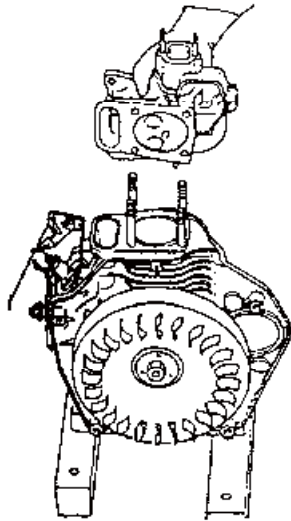
3.1.12 Fuel injector

- (1) Remove the high-pressure fuel line.
- (2) Remove fuel injector.
- (3) Be careful not to damage the nozzle washer and spacer.

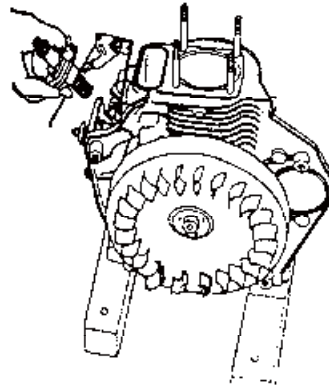


Fuel injection valve figure

3.1.13 Remove the cylinder head



Remove the cylinder head



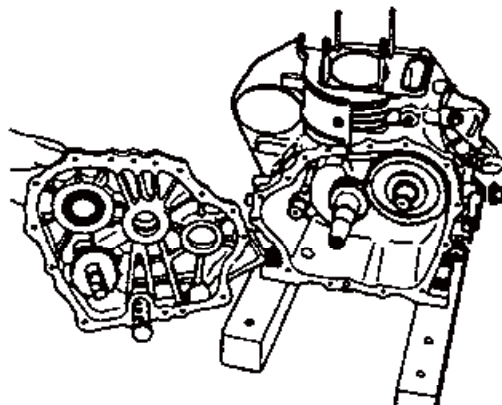
Remove the fuel oil pump

3.1.14 Remove the injection pump

- (1) Remove the pump together with the base.
- (2) Ensure the hooking part of control lever is at the meshing position before disassembling.
- (3) Pull out the flat tappet remaining inside the housing

3.1.15 Crankcase cover

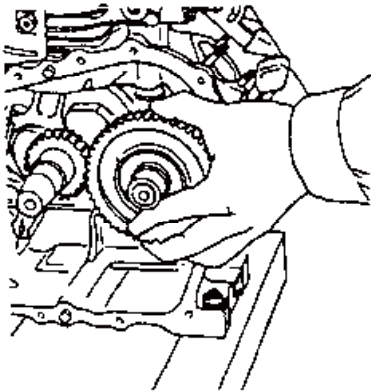
- (1) Remove the engine oil injection pump cover.
- (2) Remove the engine oil filter cover.
- (3). Remove crankcase cover.



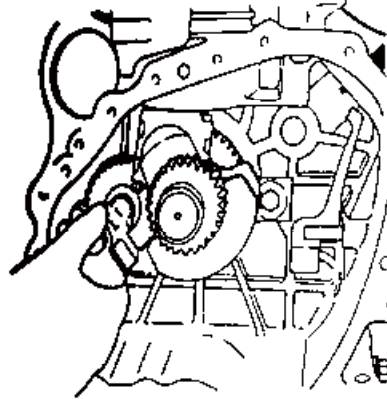
Remove crankcase cover

3.1.16 Camshaft

- (1) Remove the camshaft taking care not to damage the oil seal.
- (2) Note the position of the timing mark
- (3) Remove and store the intake and exhaust tappets separately.



Remove camshaft

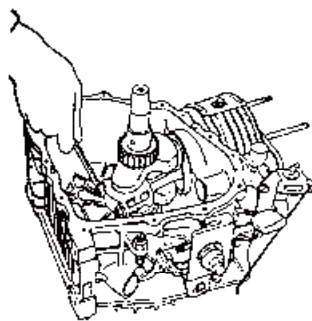


Remove balancer shaft

3.1.17 Remove balance shaft

3.1.18 Piston and connecting rod assembly

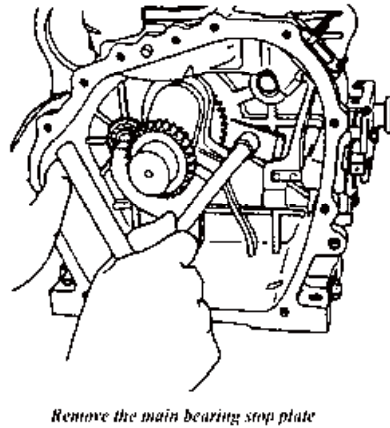
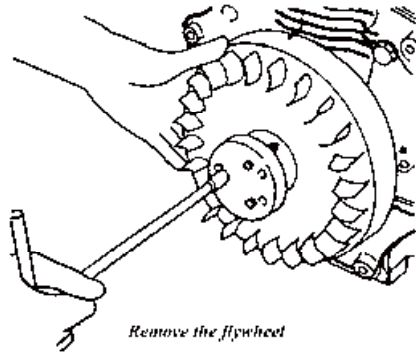
- (1) Dismount the forcing nut of connecting rod.
- (2) Remove the big end cap of connecting rod.
- (3) Turn the crankshaft to the top of stroke and take out the piston.
 - Remove carbon from the upper inner surface of cylinder barrel before removal.



Remove the bolts and nuts of connecting rods

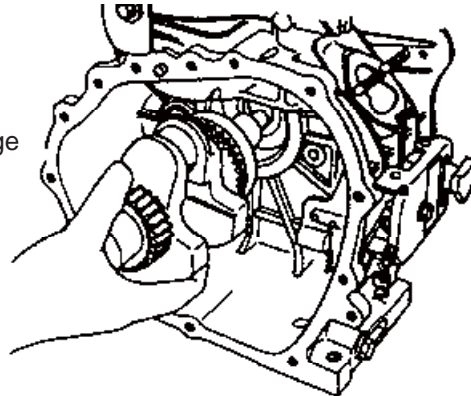
3.1.19 Flywheel

- (1) Loosen the flywheel nut.
 - (2) Remove the flywheel.
- Use flywheel extractor
 - Securely thread in the extractor bolts.



3.1.20 Crankshaft

- (1) Remove the flywheel key
- (2) Remove the main bearing thrust plate
- (3) Pull out the crankshaft taking care not to damage the oil seal.



3.1.21 Governor

- (1) Remove the governor or speed control device only if necessary.
- (2) Note the position of the governor spring before removal.

3.2 Reassembly

Reassembly procedures

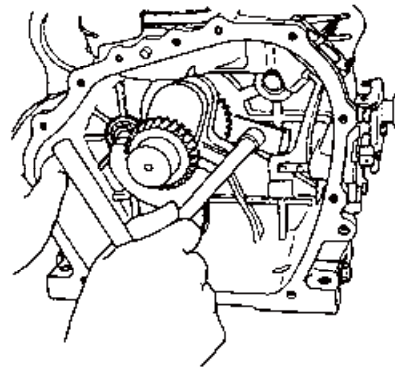
- Thoroughly check and clean all parts.
- Apply fresh engine oil or assembly lube to all moving and rotating parts.
- Use new O rings and gaskets.
- Apply liquid sealant when no gasket is specified
- Be sure all clearances and specifications among parts are observed.
- Align matching marks while reassembling.
- Use the correct bolts, nuts and washers. Apply proper torque values when specified.
- Apply lube oil to the thread parts and flange surfaces before tightening the major bolts to the specified torque.

3.2.1 Assemble governor or speed control device

- Reassemble the governor or speed control device if it has been removed.

3.2.2 Crankshaft

- (1) Insert the crankshaft.
 - (2) Install the main bearing thrust plate.
 - (3) Attach the flywheel key to crankshaft.
- Be sure crankshaft is in proper position.
 - Apply grease to the oil seal lips.
 - Apply lube oil to the crankshaft journal and crank pin.



Install the main bearing stop plate

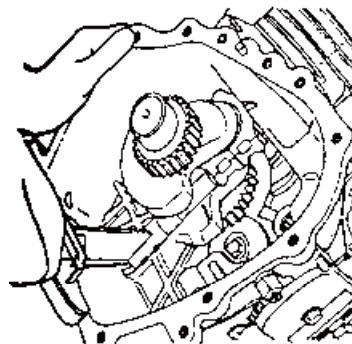
3.2.3 Flywheel

Tighten the flywheel nut with torque wrench after installation.

Flywheel Nut Torque Value
130-150 N.m

3.2.4 Piston and connecting rod

- (1) Move the crankshaft to the upper dead point then install the piston and connecting rod. Align the marks on the top surface of the piston with the crankcase cover side.
 - (2) Install connecting rod big end cap.
- Apply lube oil to crank pin.
 - Be sure every piston ring is in the correct position. (see 4.2.4)
 - Apply lube oil to the piston outer surface and the cylinder inner surface.
 - Be sure main bearing is at proper position.
 - Check whether the rod bolt retainer is at proper position.

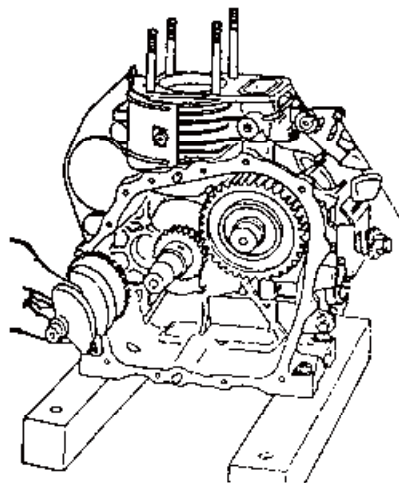


Install the connecting rod big-end cap

Connecting Rod Nut Torque Value
38-42 N.m

3.2. 5 Camshaft and balance shaft

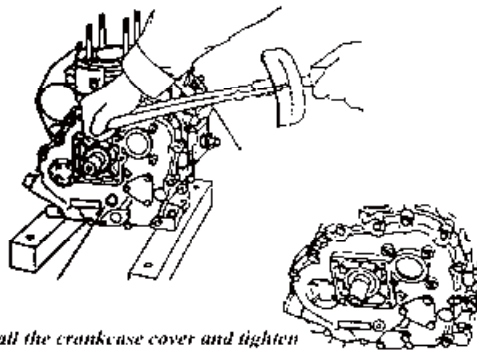
- (1) Insert the tappets.
 - (2) Insert the cam shaft.
 - (3) Insert the balance shaft.
- Do not confuse the intake and exhaust tappets.
 - Check whether the matching marks of gear are aligned correctly.



Insert the balancer shaft

3.2.6 Crankcase cover

- (1) Place an aluminum washer between the surface of crankcase and the cover.
 - (2) Reassemble the crankcase cover (Tighten bolts in a diagonal sequence)
- To protect the oil seal, attach a jig for inserting the oil seal to the shaft prior to insertion.
 - Apply grease to the oil seal lips.
 - Make sure that the engine oil pump drive gears are properly engaged.



Install the crankcase cover and tighten the bolts

Crankcase Cover Bolt and Stiffener Bolt Torque Value
20-23 N.m

(3). Add the stiffener bolts to the crankcase cover for reducing vibration and noise, which should be tightened after other bolts around crankcase cover tightened.

3.2.7 Reassemble the fuel injection pump (preliminary assembly)

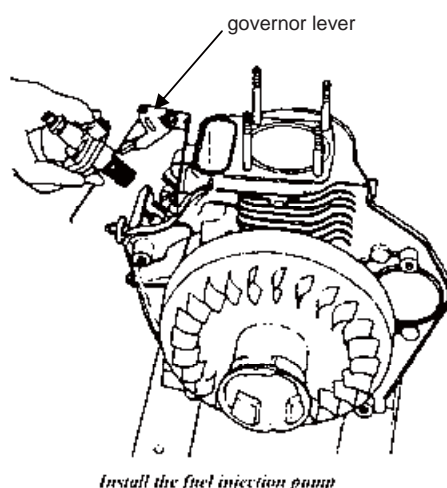
- (1) Align with the oil level marks on the injection pump
 - (2) Insert the governor lever into the fork groove of the governor.
 - (3) Install only one locating nut to the fuel injection pump.
- Be sure the quantity and thickness of spacer shims are correct.

3.2.8 Assemble the fuel injection pump (final assembling)

Tighten the lock bolt of the fuel injection pump.

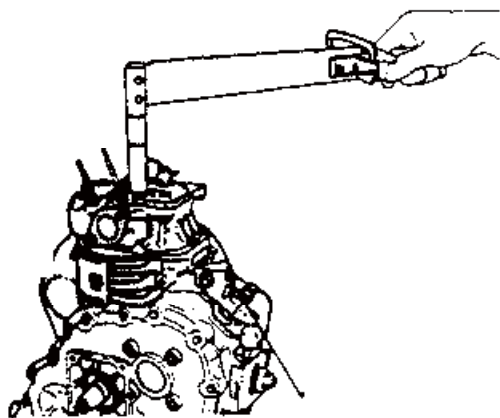
Fuel Injection Pump Lock Bolt Tightening Torque
10-12 N.m

Tightening torque of fuel injection pump lock bolts



3.2.9 Cylinder head

- (1. Place the cylinder head gasket on the cylinder block.
 - (2) Install the O-ring.
 - (3) Reassemble the cylinder head.
- Insure the nozzle washer and the fuel injection valve washer are in the correct position.
- Face the section with white marks of the air valve spring to the cylinder head before reassembling the spring
- (4) Tightening the cylinder head bolts should be performed at two steps.



Tighten the bolts of the cylinder head

Tightening torque of cylinder head bolts

Cylinder Head Torque Values	
Initial torque	30 N.m
Final torque	54-58 N.m

3.2.10 Push rod

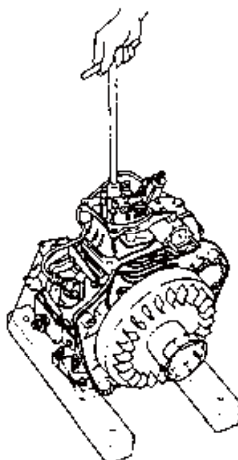
Insert the push rod and check whether it is in proper position.

3.2.11 Rocker arm assembly

- (1). Reassemble the rocker arm assembly.
- (2). Adjust the valve clearance to 0.0006in (.015mm)- cold.

Tightening torque of air valve rocker arm seat

Rocker Arm Seat Torque Value
40-45 N.m



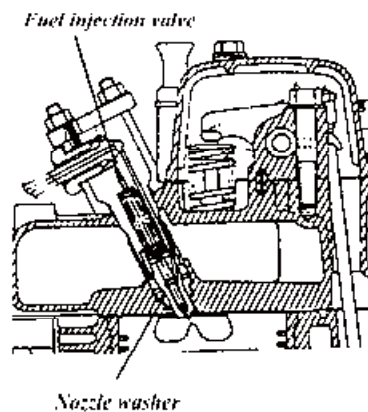
Tighten the valve rocker arm

3.2.12 Cylinder head cover

Install with a new gasket

3.2.13 Fuel injector

- (1) Install the fuel injector assembly.
 - (2) Tighten the lock bolts.
 - (3) Install the high-pressure fuel line.
- Be sure the installation direction of fuel injector is correct.
 - Replace the nozzle washer when reassembling.



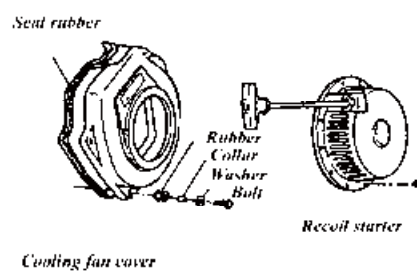
Injector Tightening Torque
10-12 N.m

3.2.14 Air inlet pipe

Install the air inlet pipe and ensure the washer is in proper position.

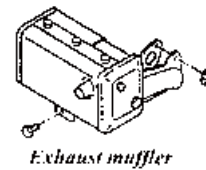
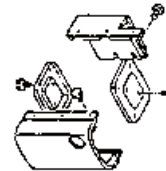
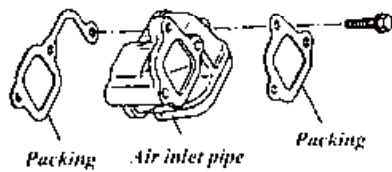
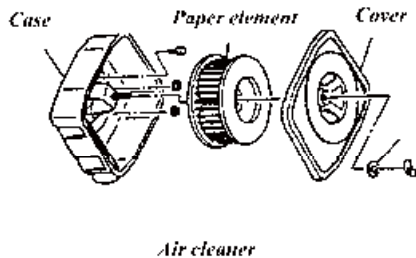
3.2.15 Cooling fan case

- (1). Install the starter reel.
 - (2). Install the cooling fan case.
- Apply the seal rubber to the case.
 - Be sure the collar and the fan case supporting are in right position.



3.2.16 Air cleaner

- (1) Install the air cleaner bottom case.
 - (2) Install the element.
 - (3) Install the air cleaner cover.
- Check whether the inlet pipe and gaskets are in the proper position.



3.2.17 Starting motor

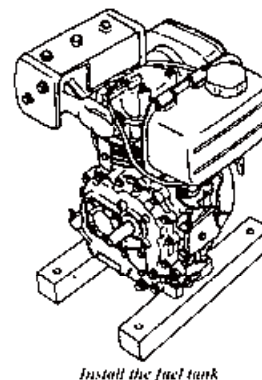
Install the electric starting motor.

3.2.18 Exhaust muffler

Install the exhaust muffler.

3.2.19 Fuel tank

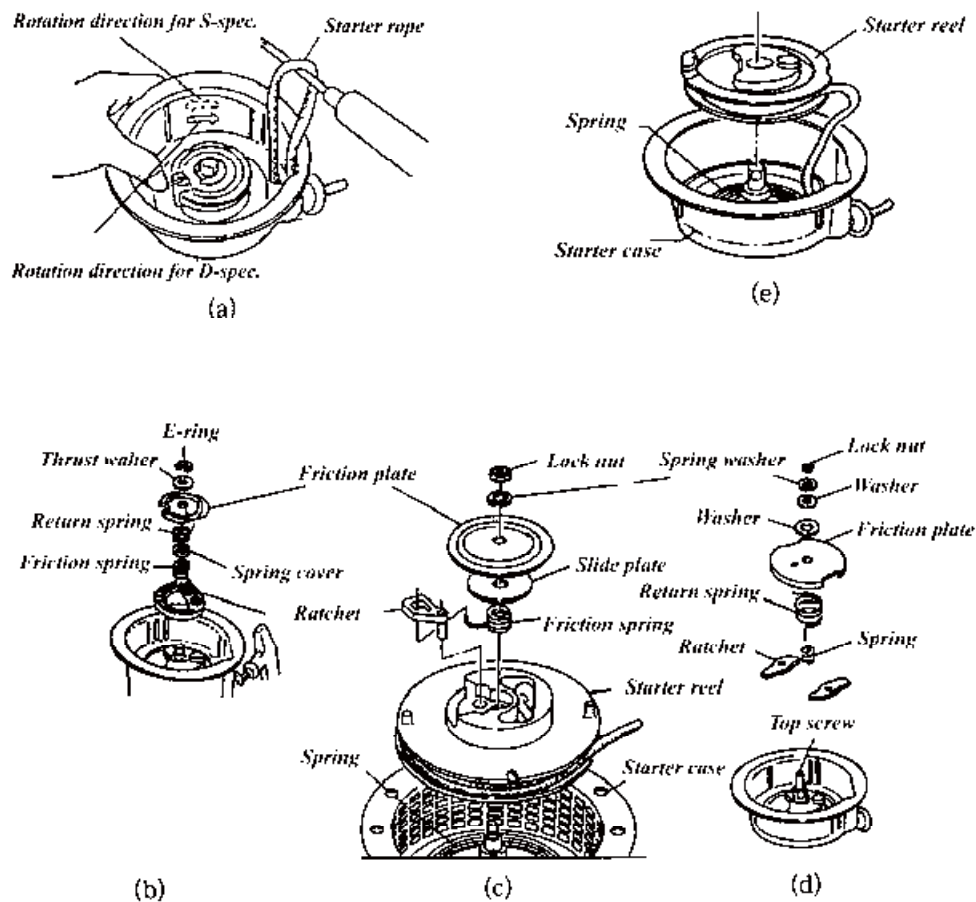
- (1). Join fuel line and the fuel injection pump.
 - (2). Fix the fuel tank with the upper support.
 - (3). Connect the fuel return-pipe to the fuel tank.
- Check whether the fuel tank supporting rubber (damping rubber) is in the proper position.



3.3 Recoil starter assembly

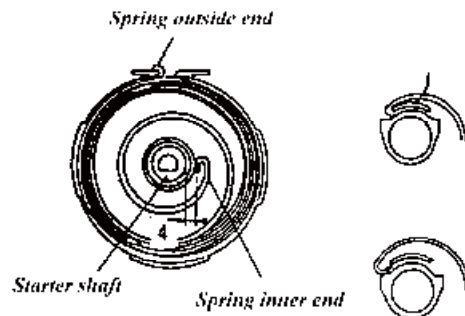
3.3.1 Disassembly

- (1) Remove the recoil starter assembly from the engine. Note the direction of rotation.
- (2) Pull the rope out about 12 inches or 30 cm. When the gap of starter reel attaches the end of the starter rope, stop the reel with your finger and pull the rope out with an awl as show below in figure (a). Put your finger on the gap to push the reel for returning the rope until the reel stop moving.
- (3) Disassemble all parts as shown in figures (b)-(d).
- (4) Remove the starter reel from the case as shown in figure (e) then remove the spring.



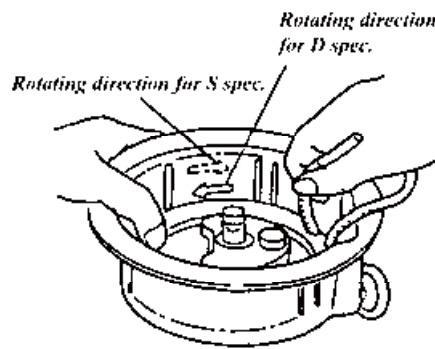
3.3.2 Reassembly

- (1) Check whether the spring is in proper position inside the case. Adjust the shape of inner end of the spring to engage it with the reel's hook mark correctly at the position 1 ½ inches or 4mm away from the starter reel shaft. (The 10mm inner end of the spring can be simply reshaped with pliers.)



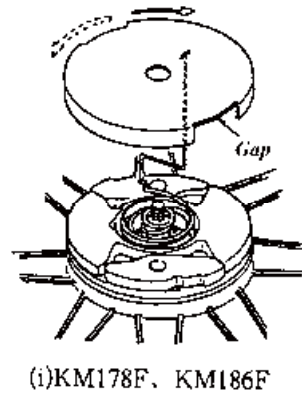
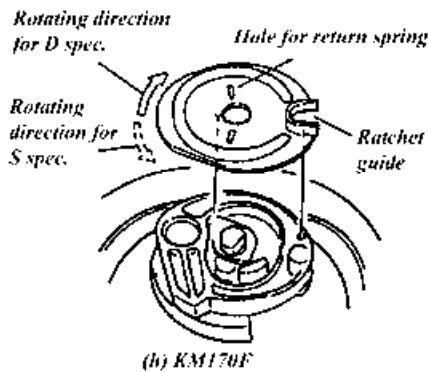
(f)

- (2) Wind the starter rope around the reel as per figure (g). Take the rope from the gap after two $\frac{1}{2}$ revolutions and engage the spring's inner end with the reel's hook. Place the reel into the case.



(g)

- (3) Hold the starter rope as shown in figure (h). Securely hold the reel so that the rope cannot reverse and wind the starter rope 4 revolutions in the arrow direction shown in figure (h). Cross the rope from the inside to outside. Run the reel slowly in an opposite direction of the arrow.
- (4) Reassemble the parts removed in figure (g) in the opposite order of disassembly. Pull the return spring while assembling the friction plate then insert it into the holes of friction plate respectively as figure (h), (i). Run the friction plate in the direction of the arrow. When the bulge in the ratchet wheel is aligned with the ratchet guide, press the friction plate into the starter reel. Assemble the lock pin and nut.



3.3.3 Inspection after reassembling

(1) Pull out the starter rope three times.

- Pull the rope slowly to check whether the parts are in proper position.
- If the ratchet wheel does not move check whether the spring is in proper position.

(2) Pull out the starter rope completely.

- If the rope blocks the starter reel or it does not return, it indicates that the spring has inadequate tension. Wind the rope one or two more revolutions per the procedure shown in figure (a).
- If the returning power of the starter rope is too low or the handle dropped in half way, it is necessary to lubricate the friction parts. If this fails, wind the rope one or two more revolutions.
- If the rope does not wind around the starter reel after the spring is disengaged from the reel's hook, disassemble the recoil starter assembly and reassemble.

4. INSPECTION AND MAINTENANCE

4.1 Cylinder head

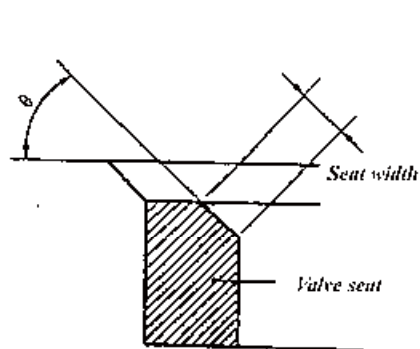
4.1.1 Combustion chamber surface

Disassemble the fuel injection valve, the intake valve and exhaust valve. Clean the combustion chamber surface and check for cracks and other damage.

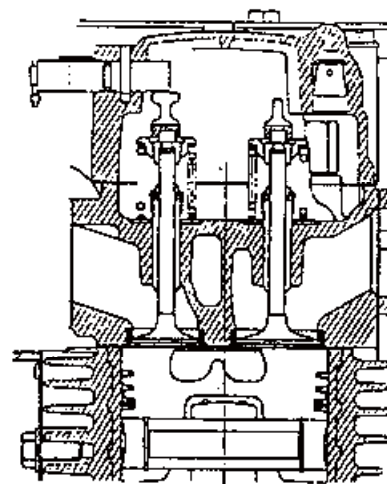
4.1.2 Inlet and exhaust valve seats

Freeze the valve seat with liquid nitrogen for improving durability, then insert it into the cylinder head. Wipe off the carbon deposit from the valve seat.

	Standard	Maintenance Limit
Seat surface angle	45°	--
Seat surface width	(1.5-3 mm)	--



KM170F, KM178F, KM186F



Inlet/exhaust valve assembly

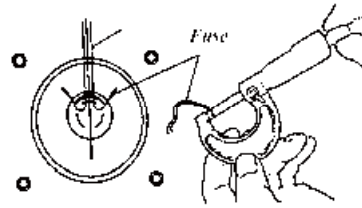
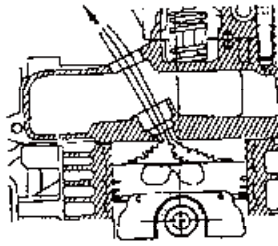
4.1.3 Inlet/exhaust valve and valve guides

- (1) Check the wearing and distortion of the valve stems and replace it if necessary.
- (2) Check the valve sinking. Replace the worn out valves.
- (3) Replace valve seals when replacing valves.

4.1.4 Valve springs

- (1) Check the springs for cracks and corrosion.
- (2) There is a white identity mark on one side of the spring. Face this side to the cylinder head.

4.1.5 Measure the top clearance of the piston



- (1) Remove the cylinder head and then place three $\phi 1.2 \times 10$ mm fuses of the same length at three points on the upper limit level of the piston.
- (2) Reassemble the cylinder head and the gaskets then tighten the nuts at the specified tightening torque and specified order.
- (3) Turn the crankshaft in its normal direction of rotation to flatten the fuse.
- (4) Remove the cylinder head and take out the flattened fuse, then measure the thickness of the fuse. On the other side, you can tie three fuses with three threads respectively then cross them out from the nozzle hole as per the below figure, thus it's not necessary to remove the cylinder head. Finally, measure the thickness of the flattened fuses as from (3).
- (5). The top clearance of the piston is the average value of three measured thickness values.

	Standard	Maintenance Limit
Top clearance of piston	(0.5-0.7 mm)	--

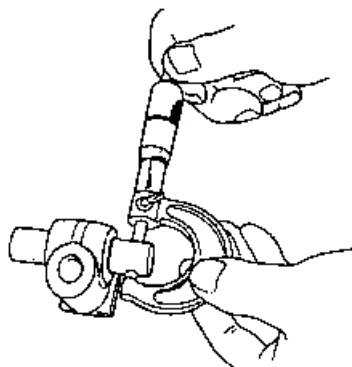
5.1.6 Inlet/exhaust valve rocker arm and push rod

(1). Valve rocker arm pivot

Measure the outer diameter of the valve rocker arm and the inner diameter of the valve rocker arm hole. If the dimension exceeds the maintenance limit, replace the valve rocker arm or the valve rocker.

(2). Push rod

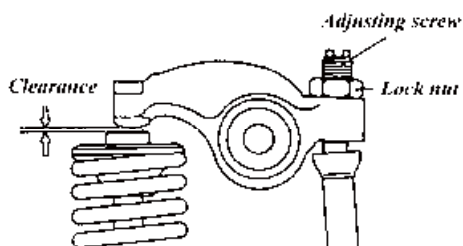
Check the length and distortion of the push rod.



	Standard	Maintenance Limit
Outer diameter of the inlet/exhaust valve rocker arm pivot	14.989-15.000 mm	14.94 mm
Inner diameter of the inlet/exhaust valve rocker arm hole	. 15.016-15.034 mm	15.10 mm

4.1.7 Adjust the valve clearance

(1) The clearance must be adjusted when the engine is cold.



	Standard	Maintenance Limit
Intake/Exhaust clearance	.15 mm	--

(2) Valve timing

Intake	Open	14° before TDC
	Close	50° after BDC
Exhaust	Open	54° before BDC
	Close	10° after TDC

4.2 Piston and piston pin

4.2.1 Piston

- (1). Check the top of piston and the surface of combustion chamber. To wipe off the carbon from the top of piston and the surface of combustion chamber with care not to scratch the surface, therefore to check whether there's any damage on the surface of combustion chamber.
- (2). Check the outer diameter of the piston
If the outer surface of piston and ring groove wear out beyond the limit, replace the piston.
- (3). Piston and piston pin
To disassemble the piston pin, heat the piston to 70°C-80°C, repeat this heating procedure while re-assembling the piston pin.

4.2.2 Piston and Piston pin

(1) Measure the piston pin outer diameter, if it worn out beyond the maintenance limit or already distorted into ladder shape, it should be replaced.

	Standard	Maintenance Limit
Outer diameter of the piston pin	22.991-23.000 mm	22.91 mm

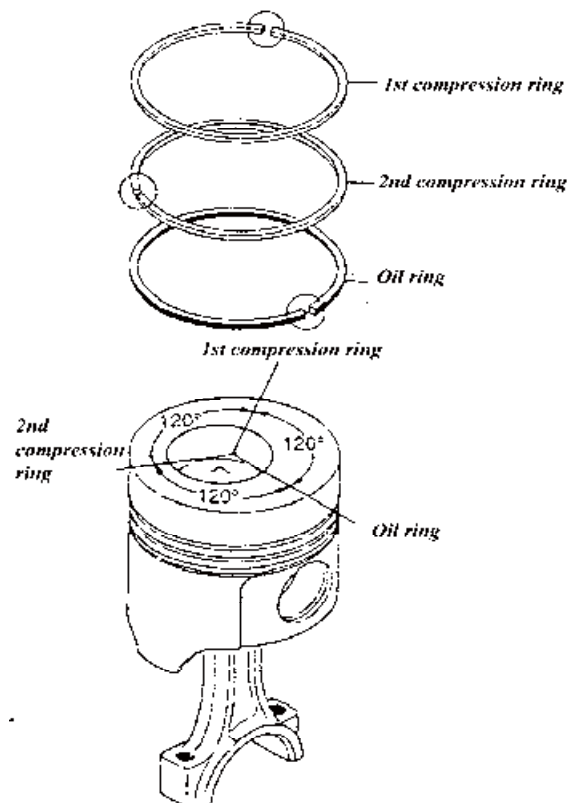
4.2.3 Piston Bore

(1) If the bore is warped, elongated or otherwise damaged, it must be replaced.

(2) Measure the inner diameter of the bore and replace it if the inner diameter exceeds the maintenance limit.

(3) Replacing piston

Heat the piston to 70°C-80°C, then align with the hole of piston pin and insert the pin.



4.2.4 Piston ring

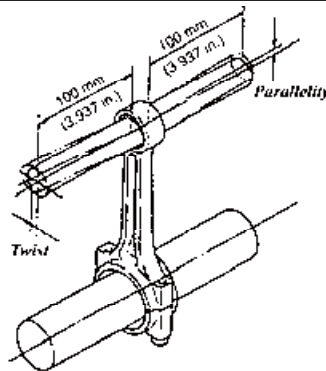
- (1) Assemble and disassemble the piston ring with a piston ring compressor.
- (2) Face the section with the marks upward while assembling the piston ring.
- (3) Be sure that piston ring rotates smoothly after installation.
- (4) When inserting the helical elastic collar into the oil ring, be sure the joint of the helical elastic is at the opposite of the opening of oil ring.
- (5). Space the open points of the piston rings 120 degrees apart.

4.3 Connecting rod

4.3.1 Check the connecting rod

- (1). Check distortion of the large end holes for being parallel and distortion. Pass the measuring jigs through the large end and small end holes of the connecting rod to measure if the jigs are parallel or distorted. Replace the connecting rod if it distorted beyond the permitted limit.

Parallelism or distortion	Standard	Maintenance Limit
	--	.05 mm

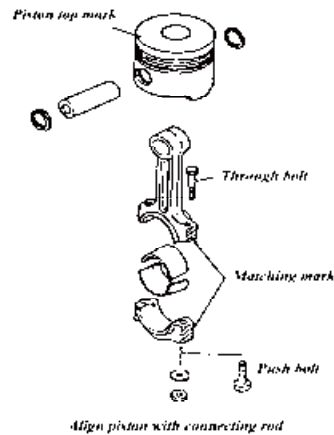


5.3.2 Check the crankshaft bushing

- (1) Check whether the surface of bushing between the connecting rod and the connecting rod neck. Replace the bush if peeling or damage occurred.
- (2). Insert the connecting rod to the shaft neck, and tighten the connecting rod nut with the specified tightening torque.

5.3.3 Connect the piston and the connecting rod

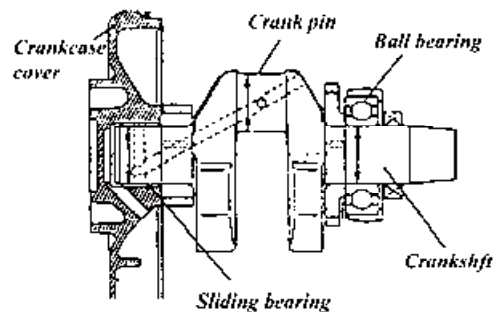
Adjust the piston position and align the top mark of the piston with the mark of the connecting rod as per the below figure. As the result, the top mark of the piston will align with the section of the crankcase cover (gear case) when insert the piston into the cylinder sheath.



4.4 Crankshaft, main bearing and flywheel

4.4.1 Crankshaft

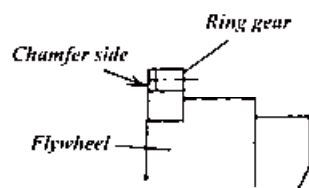
- (1). Coating check crank journals.
- clean the crankshaft then check for cracks by magnafluxing. Replace if any cracks are discovered.
- (2). Measure the crank pin and the main journal
Check the condition of the crank pin and the main journal. Replace the crankshaft assembly if the wear has exceeded the permitted limit.
- (3). The balling bearing on the flywheel side has been pressed onto the crankshaft and is an integral part of the crankshaft. Replace the crankshaft assembly if the balling bearing is



loose.

4.4.2 Flywheel

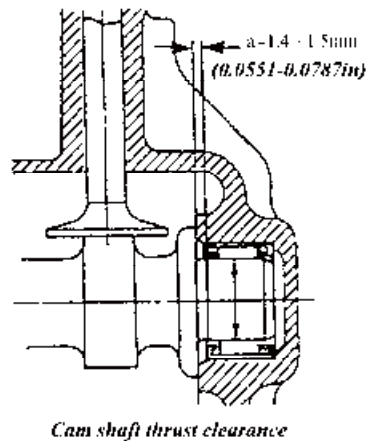
- (1) There are timing marks at the edge of the flywheel for measuring the fuel injection timing.
- (2) Heat the ring gear to 356° F (180 °C) then install on the flywheel.



4.5 Camshaft

4.5.1 Camshaft

- (1) Check the thrust clearance of the camshaft (cylinder block side). The crankshaft bearing has been pressed into the cylinder block. Maintain the sinking clearance between the end face of the pressed bearing and the thrust surface of the cylinder body at 1.4-1.5mm.



4.5.2 Tappet

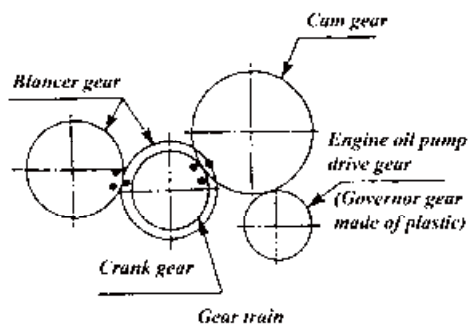
- (1) Check the condition of the tappet contacts. The tappet offsets from the cam center and rotates during operation to prevent uneven wearing. If the tappet is worn seriously or the contact with the cam is uneven, the tappet must be replaced.
- (2) Check the outer surface of tappet and replace it if the outer surface already is worn or damaged.

Note: Store the intake tappet and the exhaust tappet separately while disassembly and reassembly.

4.6 Timing gear

4.6.1 Check the timing gear

- (1). Check the gear for wear and replace if worn.
- (2). Align with the timing mark of all gear while re-assembling.



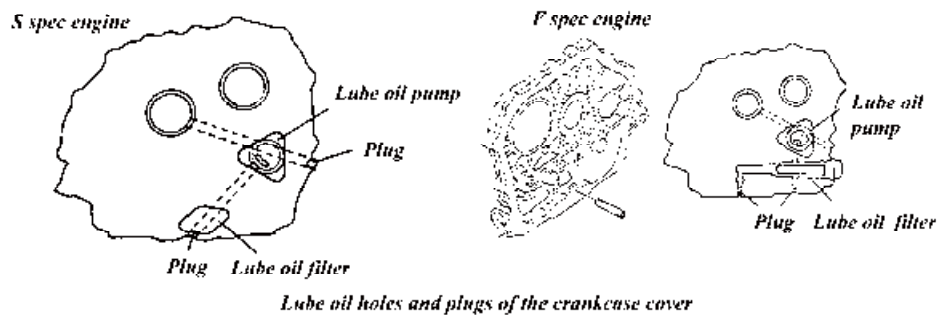
4.7 Crankcase cover

Be careful of the aluminum gasket while disassembling, replace it if it damaged or distorted. Furthermore, be sure to tighten the crankcase cover bolts with the specified tightening torque below.

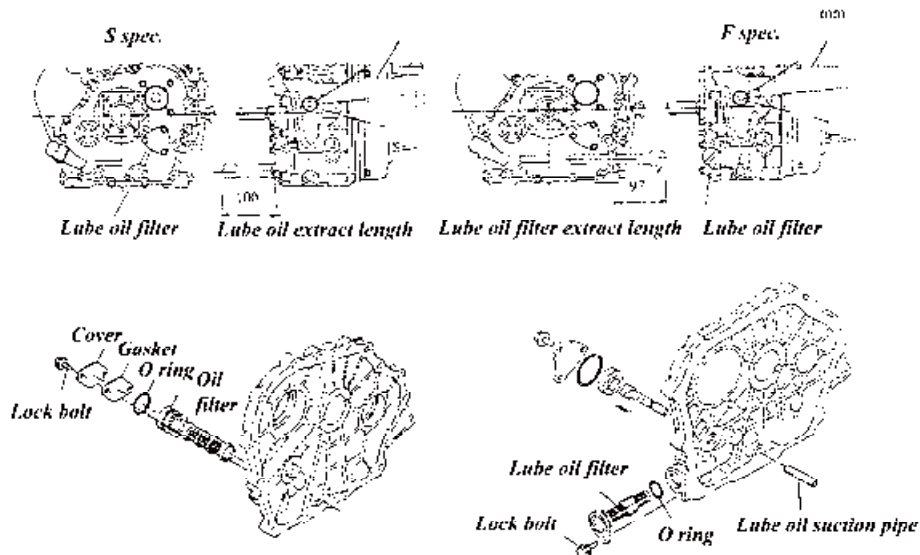
Crankcase cover bolt tightening torque	20-23 N.m
--	-----------

4.7.1 Cleaning and inspection

Rinse the cylinder block before reassembly. Thoroughly clean every oil passage to ensure there is no debris. Do not remove the plug under any circumstances.



Rotating direction of S spec engine and that of F spec engine are different . In order to maintain the crankcase cover, pull out the lube oil filter.



LO flow path

LO filter → LO pump → Main bearing/Crank neck journal
LO pump

→ Connecting rod shaft journal
journal

journal

LO flow path

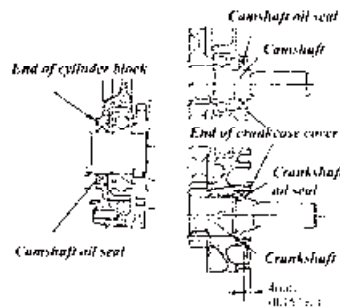
Intake pipe → LO filter →

→ Main bearing → Crank neck

→ Connecting rod shaft

4.7.2 Replace the crankshaft oil seal and the camshaft oil seal

Replace the oil seal with a seal installation tool. Push the crankshaft oil seal into the crankcase cover until the both faces are even. Push the rear oil seal of the crankshaft into the cylinder body ensuring both faces are even.



4.8 Cylinder sleeve and cylinder block

4.8.1 Cylinder sleeve

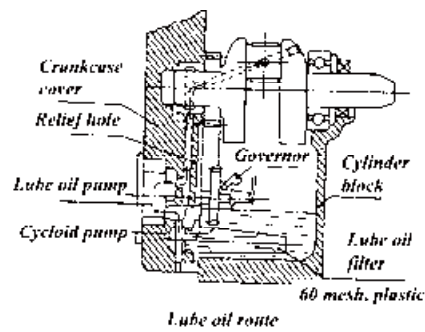
Measure the inner diameter of cylinder sleeve, bore if it exceeds the permitted limit and replaced by an oversized piston. Oversized pistons are available in both .25 and .50 mm.

4.9 Lubricating system

The lubricating system of this engine is a forced-lubricating system driven by a cycloid rotator pump.

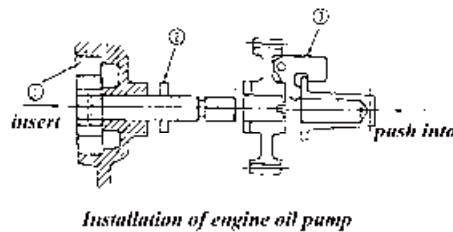
Regarding the lube oil route, please see the below figure; but the air valve rocker chamber is lubricated by the atomizing.

Lube oil filter → Cycloid rotator pump → Crankshaft → Bushing of the connecting rod shaft journal

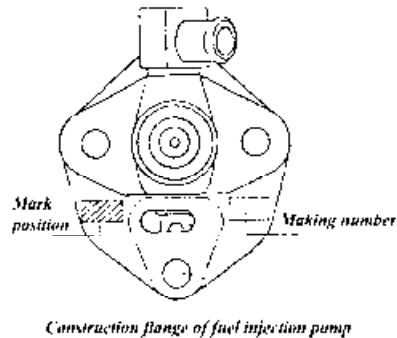


4.9.1 Lube oil pump

- (1). Measure the clearance between the outer rotator of the lube oil pump and the lube oil pump body on the crankcase cover. Replace the lube oil pump if the clearance exceeds the permitted limit.
- (2). Measure the clearance between the outer rotator and the inner rotator of the lube oil pump with feeler gauge and replace the full set of lube oil pump if the clearance exceeds the permitted limit.
- (3). Assemble the lube oil pump.
 - ① Insert the lube oil pump① from the outside of the crankcase cover.
 - ② Insert the pin② into the lube oil pump shaft.
 - ③ Set the governor flying block③ on the gear.
 - ④ Insert the spindle into the flying block, and then push the spindle into the shaft. Once in place, the spindle can not be removed.



4.10 Fuel System



4.10.1 Fuel injection pump

4.10.2 Fuel injection valve

(1) Clean the nozzle orifice when disassemble the fuel injection valve, what more, do not place the injection nozzle on the dirty ground.

(2) Inspection:

① Carbon deposit

(Flowering)

The carbon on the injection nozzle will seriously reduce the combustion efficiency so avoid any pollution of the injection nozzle.

② Shape of the spray

Put the fuel injection valve on a fuel injection valve test stand and run the handle of the tester at the speed of approx. 1.2 times/second to check the spray pattern.

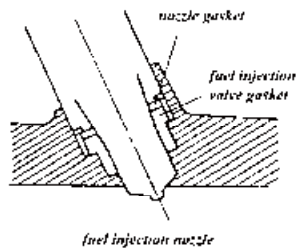
(3) Normal shape of injection spray

1. The injection spray angle injected from all four orifices should be same.
2. Sprayed oil should resemble a fine mist.
3. Injection spray from all four orifices should be steady and smooth.
4. Take the following items into consideration while assembling the fuel injection valve.
 - ① Tighten the fuel injection valve to the specified torque.
 - ② Clean the sleeve of the fuel injection valve and replace the nozzle gasket.

Note:

If the gasket blocked in the cylinder while disassembling the fuel injection valve, insert a M8 or M9 stud bolt longer than 100mm into the orifice, thus pull out the nozzle gasket and the bolt together.

Injection nozzle lock nut torque	40-45 N.m
----------------------------------	-----------



(5) Disassembly and reassembly

Disassemble the fuel injection valve lock nut with a 15mm box wrench.

(6) Adjustment

The nominal fuel pressure is 2840 psi or 200kg/cm², but the fuel spraying pressure can be adjusted by adding or reducing spacer shims.

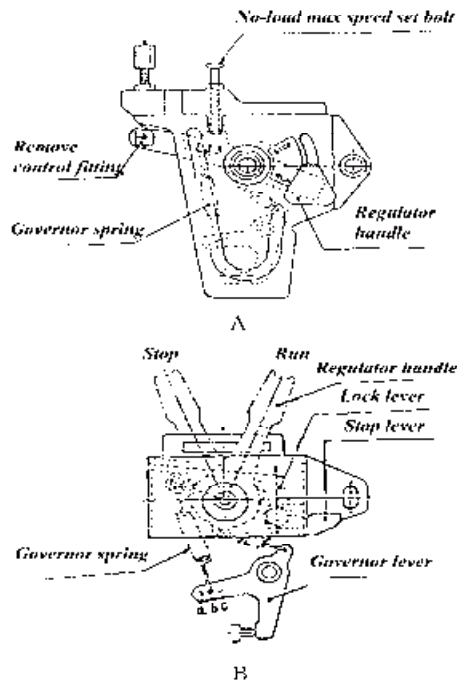
The fuel spraying pressure will change 28.4 psi or 20kg/cm² when adding or removing one 0.1mm shim. Shims are available in 0.1mm, 0.3mm, 0.4mm, 0.5mm and 0.6mm.

4.10.3 Fuel filter

Check the element whether it cracked, varnished or clogged during the periodic check and replace it if any fault found. To disassemble the fuel filter, pull out the filter screen cup and then take out the filter from the bottom of the fuel tank.

4.11 Governor

For a 60 Hz generator set, the position of the governor spring in the governor lever is always in hole b as shown below:

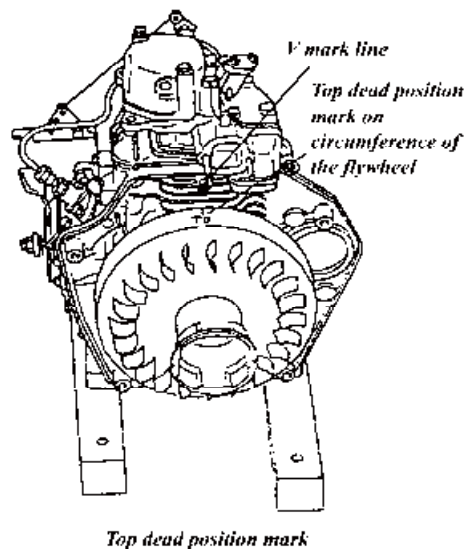


4.12 Adjustments

4.12.1 Fuel injection timing

(1) Checking fuel injection timing:

- Set the governor lever on “RUN” position.
- Disassemble the high-pressure fuel line and install a line used for testing the fuel injection timing.
- Turn the flywheel till the upper limit mark is aligned with the “V” scale mark on the radiating fin of the cylinder.
- Turn the flywheel clockwise 15 degrees then turn 30 degrees counterclockwise from the upper limit mark. Fuel should start to flow. If there is no fuel flow, turn the flywheel one complete revolution.
- Turn the flywheel slowly until the fuel flows from the testing pipe. Immediately check the mark angle of the flywheel with the scale mark of cylinder.
- Repeat the foregoing process three times to ensure the validity of the final value.



(2. How to adjust the fuel injection timing

- * Disassemble the fuel injection pump and the construction flange.
- * Add spacer shims if the fuel injection timing is too early otherwise reduce the shims. The fuel injection timing will change one degree every 0.1mm spacer shim thickness changed.

4.12.2 Bleeding air from the fuel system

Following fuel system maintenance and whenever the unit runs out of fuel, air will enter the system and possibly prevent the engine from starting. It will be necessary to bleed the fuel system in the following manner:

- (1) Set the governor lever on “RUN” position.
- (2) Place the fuel cock in the Start position.
- (3) Set the decompression handle on decompression position.

- (4) Remove the fitting that connects the fuel line from the injection pump to the injector. Pull the recoil starter or engage the electric starter until the fuel flow is steady. Retorque the fuel line. Repeat this step until the unit starts and runs. Be sure to contain any diesel fuel that spills as a result of this process.

4.12.3 Adjust the valve clearance

Check the valve clearance every time after disassembly or after 500 hours operation. Readjust as necessary.

Note: See 5.1.17 Confirm that the cylinder is at TDC before adjusting the valve clearance.

5. TROUBLESHOOTING

5.1 No fuel delivery to injection pump

- a. Check there is sufficient fuel in the tank and the fuel valve is in the open position
- b. Ensure the governor lever is in the “Run” Position
- c. Check that the fuel filter is not clogged.
- d. Bleed air from fuel system

5.2 No fuel flow from the drain valve

- a. Clean the drain valve
- b. Check the governor adjustment
- c. Check the injection pump stud. If worn, replace the pump
- d. Clogged injector nozzle- test and clean
- e. Check torque of injector nut
- f. Verify proper injection pressure- adjust or replace injector

5.3 Low engine compression

- a. Intake or exhaust valve leaking- adjust valve clearance
- b. Valve seats worn- replace
- c. Fuel injector not properly torqued- retorque.
- d. Fuel injection nozzle gasket leaking
- d. Cylinder head gasket leak- check tightening torque. If correct, check gasket for leakage.
- e. Lubrication oil issue- check viscosity
- f. Piston rings not seated or worn. Also check ring groove.
- g. Check inner cylinder diameter.

5.4 Hard starting (fuel delivery and compression normal)

- a. Poor fuel quality- check specification.
- b. Water in diesel fuel- drain and refill
- c. Valve clearance needs adjustment
- d. Low injection pressure or timing
- d. Poor fuel atomization- check injector

5.5 No start or hard starting (engine cranks)

Cause and remedy

Main cause	Remedy	Special explanation
Improper fuel (1) Poor quality fuel or wrong blend (2) There's water in the diesel	(1) Use the specified diesel (2) Replace the fuel	(1).Use the recommend fuel oil (2) Follow the proper transport, storage and water draining procedure.
Improper valve clearance	Adjust the valve clearance	
Wrong fuel injection timing (1) Improper spacer shim thickness (2). The fuel injection pressure is false (3). The plunger worn out	(1) Adjust the thickness of the spacer shim. (2) Adjust the fuel injection pressure (3) Replace the plunger	(1) Adjust the fuel injection timing (2) Dispose of diesel fuel properly.
Bad atomization of the injection nozzle (1) The injection nozzle clogged (2) The fuel injection nozzle has a bad spray pattern (3) Low fuel injection pressure (4)The injection nozzle is worn out (5) The injection hole clogged	(1) Clean or replace nozzle (2) Replace the nozzle (3) Adjust the fuel injection pressure (4) Replace the nozzle (5) Clean or replace the nozzle	(1). Follow the proper diesel fuel disposal, storage and water draining procedure. (2). Adjust the fuel injection pressure
The compression clearance at the top of the piston is too great.	Replace the bearing	

5.6 Engine over speed

If the engine over speeds while starting or operating, stop the engine immediately with the governor handle or decompression lever. A malfunction of the governing system will cause over speeding.

Possible cause:

Cause and remedy

Main cause	Remedy	Special explanation
Over controlling of the governor handle.	Adjust the governor handle. Check and adjust the installation position of the governor spring.	
Improper adjustment for the governor lever (1) Improper adjustment (2) The governor lever bolt is loose (3) The governor flying block is defective.	(1) Adjust the governor lever (2) Retorque bolt. (3) Replace defective part	Follow the proper method of adjusting the governor lever.

5.7 Unsteady engine speed

Cause and remedy

Main cause	Remedy
Governor fault	See governor adjustment above
Low quality diesel fuel or dirty fuel	See section 6.5 on hard starting
Bad atomization of the injection nozzle	See section 6.5 on hard starting
Bad fuel injection timing	See section 6.5 on hard starting
Internal engine problem (1) end face clearance of the camshaft is too large (2) flywheel nut is loose	(1) Check the clearance and adjust as necessary. (2) Retorque to proper value.

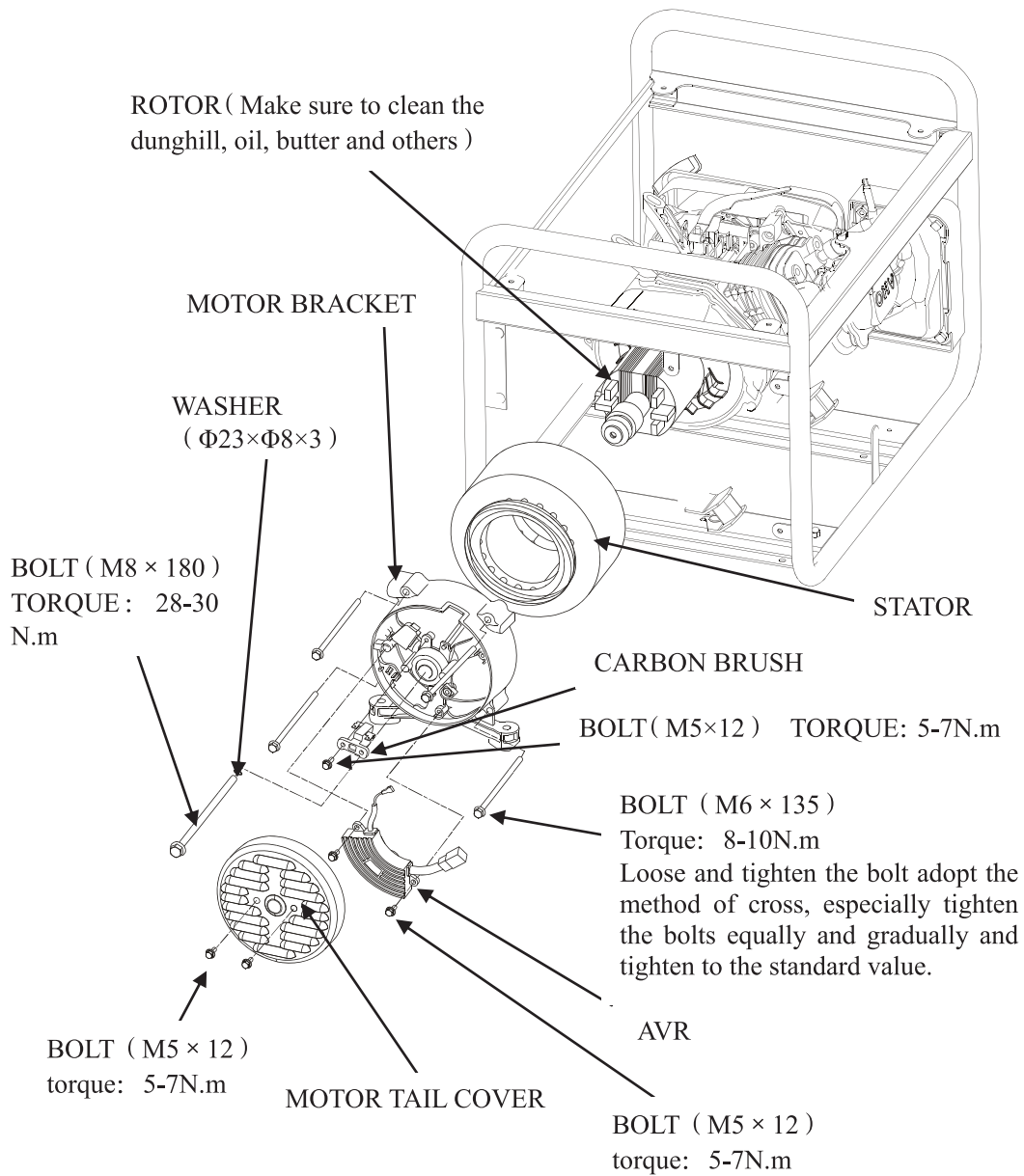
5.8 Unexpected shutdown (fuel delivery normal)

This fault may caused by the bad cooling or insufficient lubrication. Please be care to service the engine to prevent it from damage.

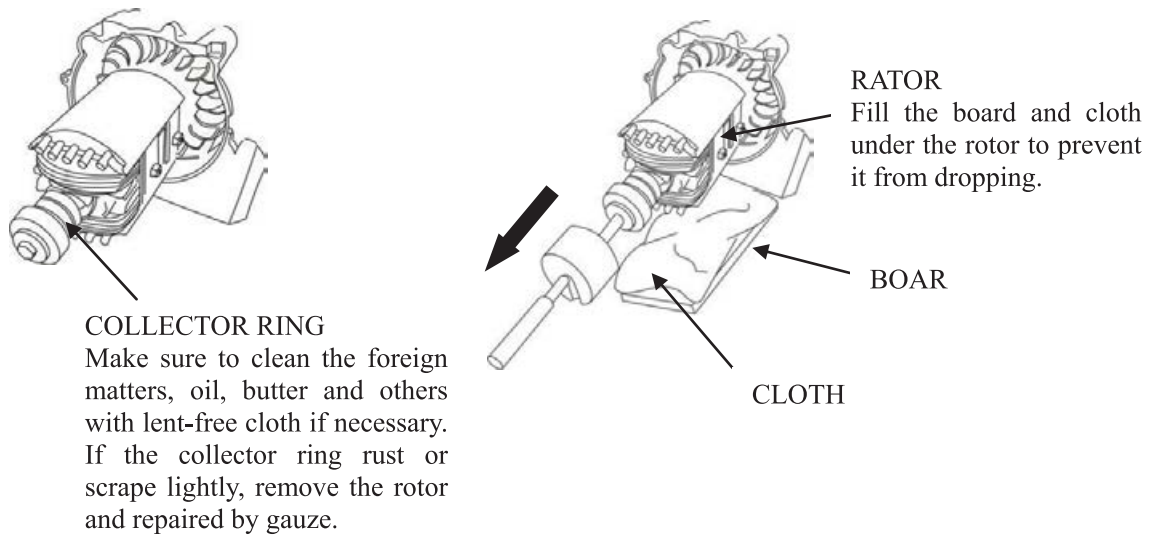
Main cause	Remedy
Engine seized - crank bearing seizure - crank pin seizure - piston seized	Repair or replace damaged parts
Improper fuel oil blend, dirty fuel or water in the fuel	Drain the tank and add the proper fuel

6 Generators

6-1 Removal/Installation :

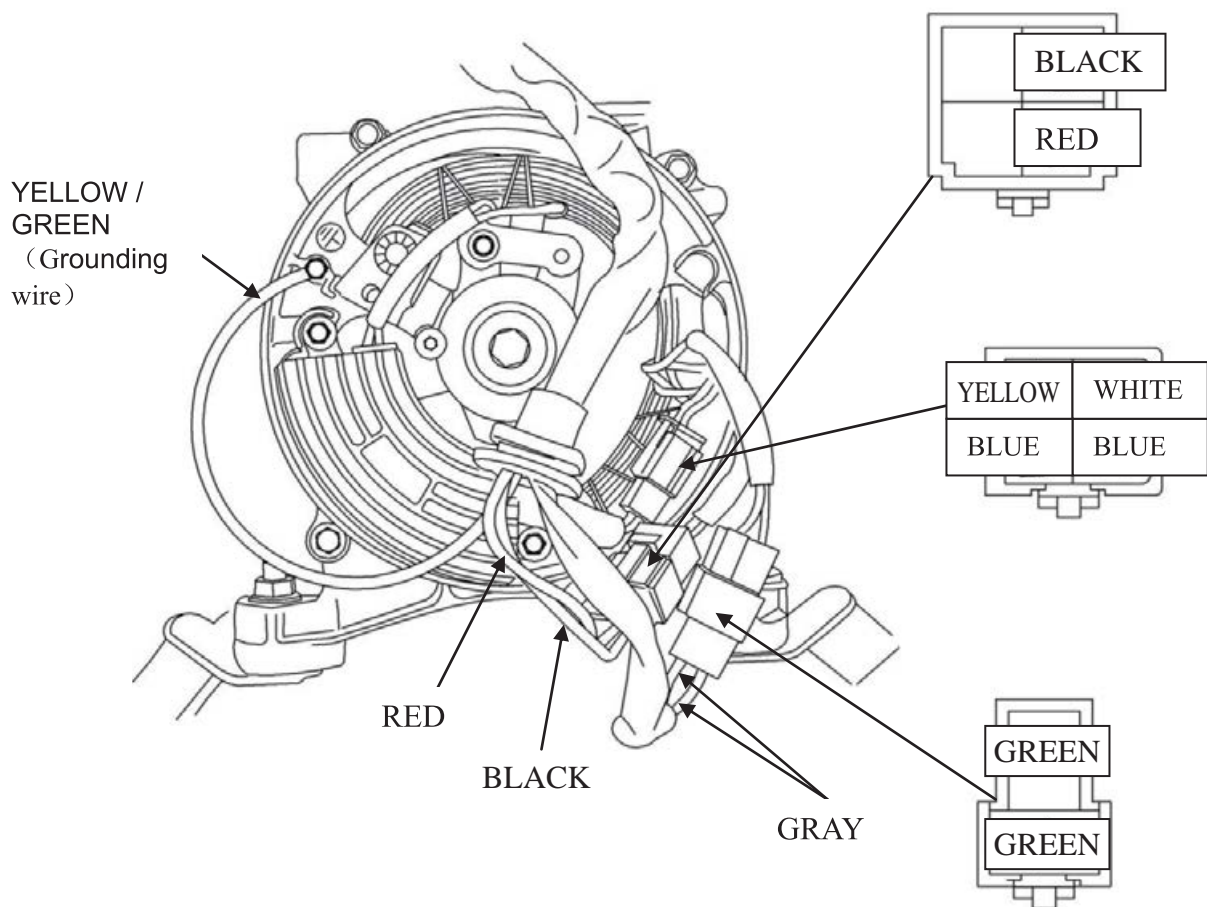


Rotor Removal



If rotating the tool can't remove the rotor, please knock the handle end with hammer in order to remove the rotor.

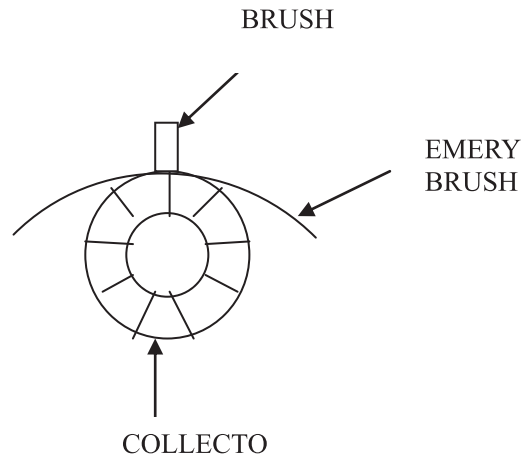
2) Motor Wiring Diagram



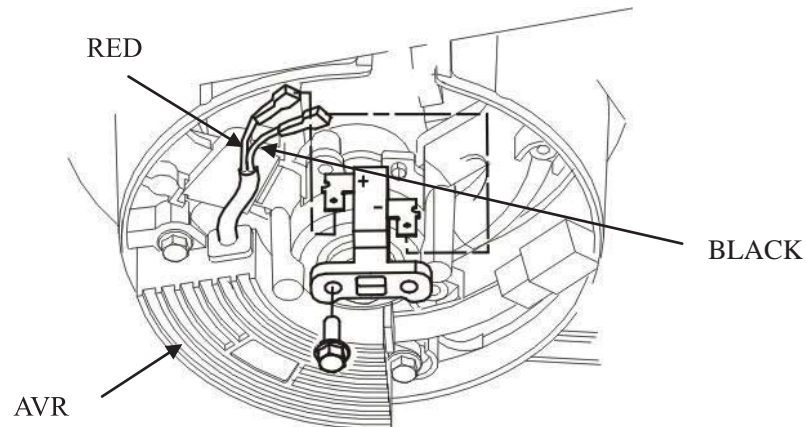
3) Carbon Brush

Carbon Brush Grinding

Check the contacting face between the carbon brush and the collector ring for contacting faceless than 75% of the cross section of the carbon brush after the running about 150hrs, If contacting face less than, grind the carbon brush contacting face. Put the No.00 emery cloth between the carbon brush with the grinding face facing up brush. Pull it come-and-go until up to the standard value.



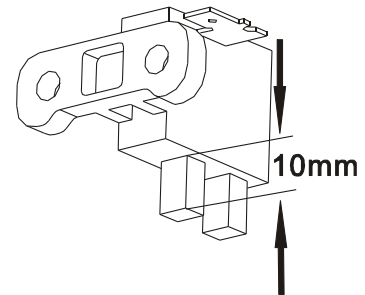
- Carbon brush installation



- The Length of the Carbon Brush

Check the length of the carbon brush for other obvious defective.

If the length less than 6MM, please replace.

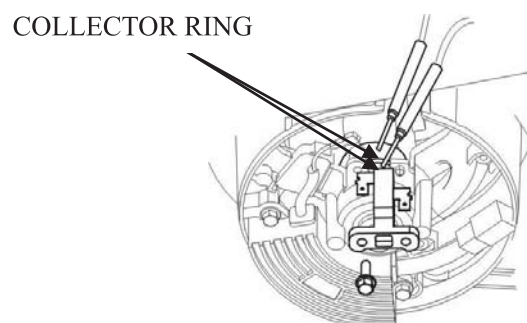


4) Check the Generator

Field Winding

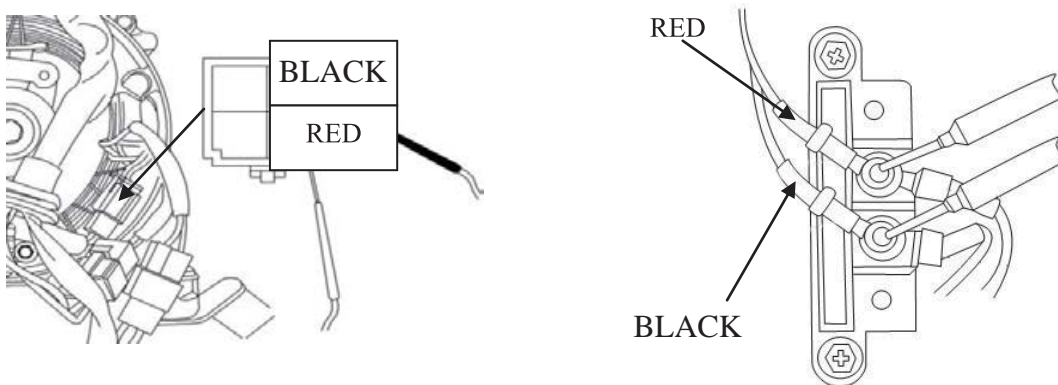
Dismount the carbon brush, measure the resistance of collector ring.

Model	Resistance
D400	$51.3 \pm 5\% \Omega$ at 20 degrees centigrade



If the result isn't accord with the standard value, please clean the collector ring thoroughly.
Replace the rotor if necessary.

① Main Winding



Test the resistance of alternating current output terminal with ohmmeter.

Model	Resistance
D400	$1.8 \pm 5\% \Omega$ at 20℃

② Engine Insulation Resistance Testing

Insulation resistance means resistance between the engine winding and the grounding. Owing to isolated by insulation material between them, if only the insulation isn't damaged, the resistance is rather high.

WARNING

If the insulation resistance decreased obviously, it means that the insulation is damaged. If you don't repair it in time, it will result in creepage and endanger the man and equipment security. Make sure often test the insulation resistance of the winding to understand the insulation instance.

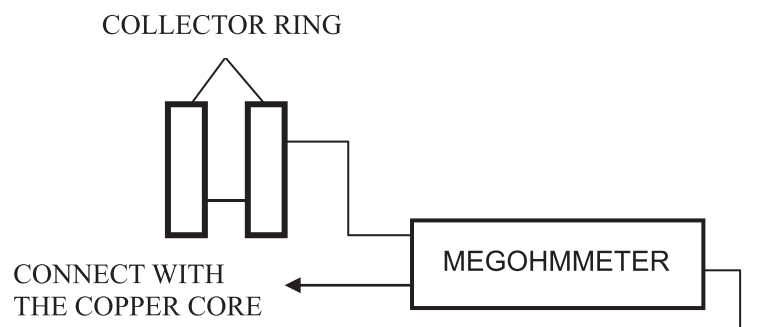
Winding to Grounding Insulation Resistance Testing

- One of the megohmmeter's terminals is connected through the insulation wire with any wire of the tested winding, and another is connected with iron core. Next wave the

megohmmeter from slowly to fast, and the meter needle follows wave. When the meter needle is stable, the value indicated by the needle is the winding to ground insulation resistance value.

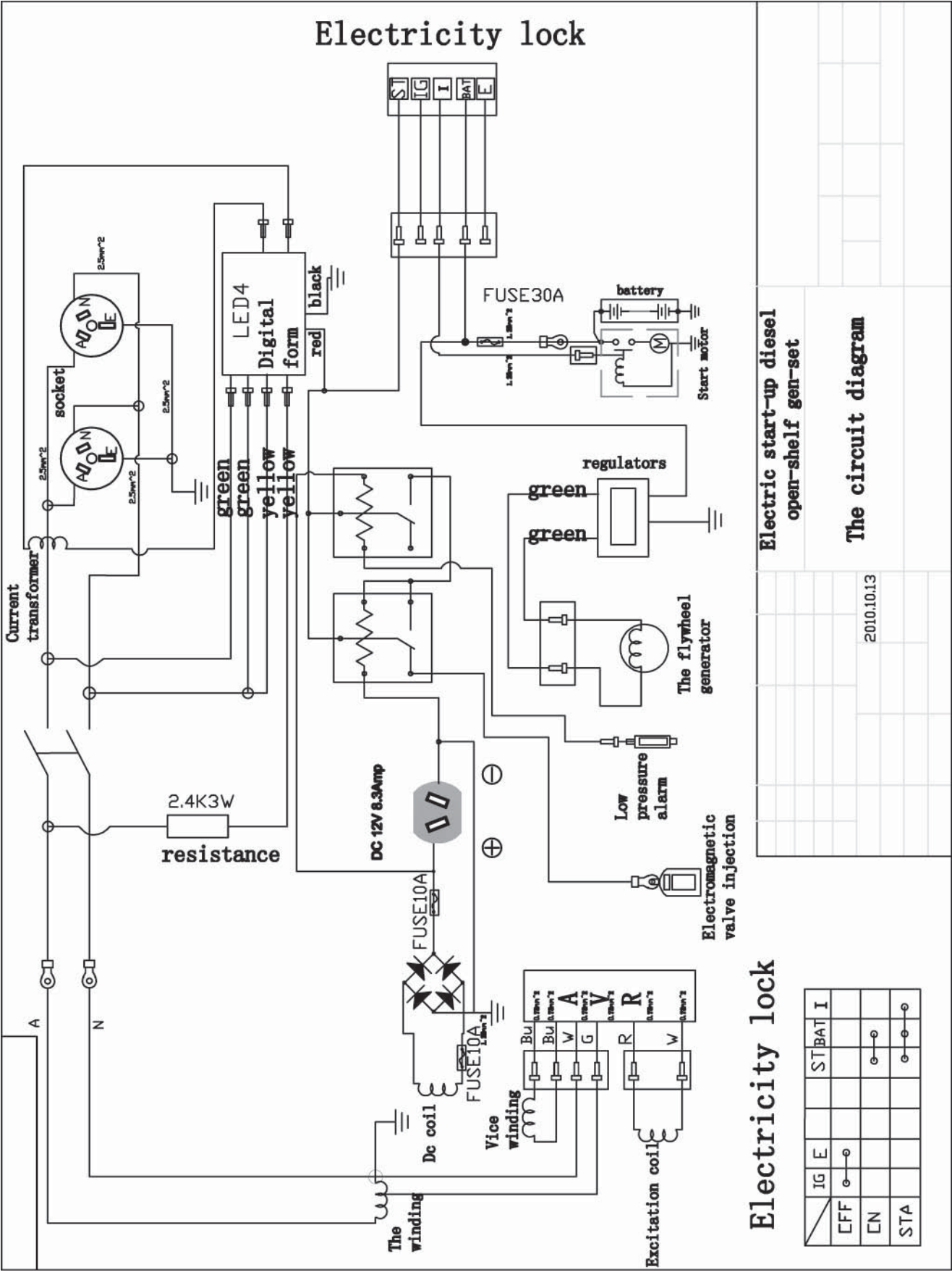
Collector Ring to Ground Insulation Resistance Testing

- One of the megohmmeter's terminals is connected through the insulation wire with a copper ring of the connecting ring, and another is connected with iron core. Next wave the megohmmetr from slowly to fast, and the meter needle follows wave. When the meter needle is stable, the value indicated by the needle is the insulation value of the tested copper ring.



- Generator Winding Breaker Circuit Testing

Use the multimeter to test. Put the red pen and the black pen to the winding's terminal. If the meter wave normally, it means the winding isn't broken; if the meter needle is quiet, it means the tested winding is broken.



APPENDIX

TORQUE

No.	Item	Size	Performance Grade	Torque (N·m)
1	Fuel Tank Assembly	M6×25	8.8-B	10±2
2	Leveler Assy. Oil Assembly	M5×10	8.8-B	6±1
3	Muffler Assy.	M8×16	8-A	24±2
4		M8×30	8.8-A	26±2
5	Muffler Outer Cover	M6×12	8.8-B	10±2
6	Muffler Side Cover	M6×12	8.8-B	10±2
7	Muffler Shield	M6×12	8.8-A	10±2
8	Muffler Block	M8×12	8.8-A	20±2
9	Panel Subassembly Control	M6×12	8.8-B	10±2
10	Panel Control	M4×10	8.8-A	2.5±0.5
11	Case Panel Rear	M4	8.8-A	2.5±0.5
12	Bracket Motor	M6×12	8.8-B	10±2
13	Stator Comp.	M6×180	8.8-A	10±2
14	Brush Subassembly Carbon	M5×12	8.8-A	5±1
15	Rotor Comp.	M10×265	8.8-B	44±2
16	Regulator Voltage	M5×12	8.8-A	6±1
17	Band	M5×14	8.8-A	5±1
18	Engine	M10	8-A	30±2
19	Cushion Engine Frame	M8	8-A	20±2
20	Seat Engine Frame Shock Absorption	M6×10	8.8-B	10±2
21		M6	8.8-B	10±2

8 APPENDIX

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17	Band	M5×14	8.8-A	5±1
18	Engine	M10	8-A	30±2
19	Cushion Engine Frame	M8	8-A	20±2
20	Seat Engine Frame Shock Absorption	M6×10	8.8-B	10±2
21		M6	8.8-B	10±2

WARRIOR GENERATORS

CONTACT WARRIOR TECH DEPARTMENT

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YOUR LOCAL DEALER