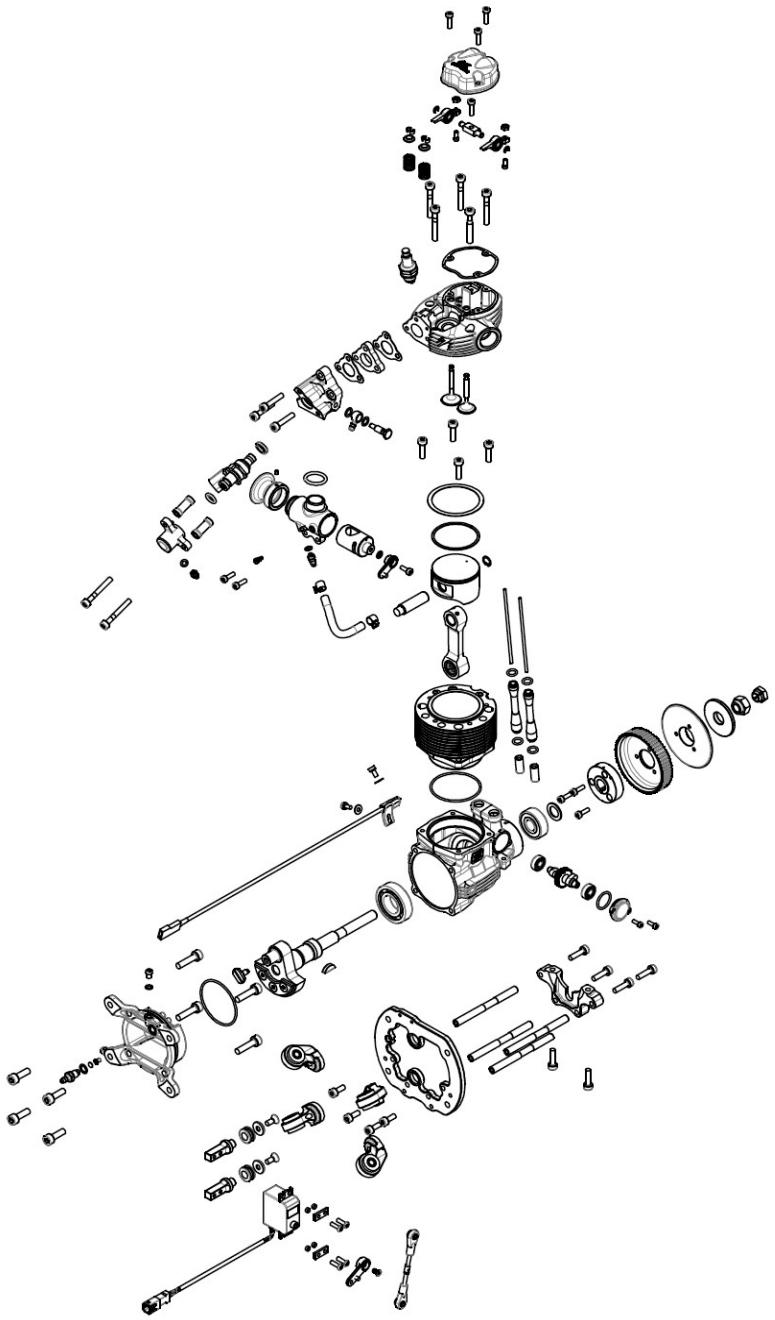
4 stroke gasoline engine for UAV

GF40U-FI

with EC11 (ECU)

Maintenance manual

version 1.51E
2021.08.01



O.S. ENGINES MFG. CO., LTD.

Content

1.0 Introduction

"GF40U-FI maintenance manual" explains periodical maintenance, disassembling, adjustment, and re-assembling the product.

Read the following three manuals carefully as well as this manual.
"GF40U-FI instruction manual"
"EC-11 instruction manual"
"OGA-100 kit for GF40U-FI instruction manual"

This manual is based on the latest version of GF40U-FI (October, 2018).
The specifications are subject to alteration for improvement without notice.
Consult us for any questions on this product and return for repair.

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1.1 NOTIFICATION ON INSPECTION, MAINTENSANCE, AND REPAIR OF THE ENGINE

The following are general instructions and precautions, which need to be followed upon engine inspection, maintenance and repair.

(1) Must use new genuine parts to replace any old ones.
(2) Clean the engine and its peripheral equipment before the work.
(3) Always use the right size tools in correct way. Do not use wrong size tools or tools for different purpose.
(4) Make sure the fuel tank has been removed from the aircraft before disassembling the engine.
(5) Make sure that all the system is turned off or batteries are removed before disassembling the engine otherwise specified.
(6) To avoid assembling wrong parts to the engine, keep the different parts grouped after disassembling.
(7) Keep your own memo to remind you how to re-assemble the engine as it was in case the “Exploded view” does not help you assembling the engine.
(8) Clean the dirt and old oil from the engine parts after disassembling, also remove the liquid gasket which has applied on joint parts.
(9) To avoid corrosion and rust, apply oil to the disassembled parts and store them in a plastic bag.
(10) Replace the O-rings, gaskets, C-clip retainers and stainless steel wire for binding and tie wraps with new ones after disassembling.
(11) Replace the screws and bolts if there are damages on them.
(12) Measure the parts periodically, which have operating limit size with calibrated instruments (calipers, micrometers, dial gauges, etc.).
(13) Since the gasoline or oil could cause damage to the resin parts such as rubber and plastic, make sure there is no any of it adheres to resin parts while working on the engine.
(14) When you remove a part like a cylinder head and a muffler, cover the hole with a plastic sheet not to dust come inside the engine.
(15) Replace the parts according to the criterion of each part to change explained in this manual if there are scratches, deformations, damages and cracks etc.
(16) Use new kerosene or washing oil (Parts cleaner, Brake cleaner etc.) to wash ball bearing taken out of the engine.
(17) When using an air blower to dry the ball bearing after cleaning them, hold the inner and outer races so that they cannot be rotated by the blowing air, or there is a possibility for it to rotate beyond the its limits and cause damage.
(18) Check the rotation of the ball bearing by using your fingers, hold the inner race and turn the outer race to check, or vice versa.
(19) When you remove a ball bearing pressing the steel balls, check and confirm smooth rotation with feeling of fingers. Replace it with new one if it feels rough.
(20) Apply oil to joint surface of the two parts when assembling (no special oil type designated, we recommend 2-cycle oil for gasoline engines.)
(21) When installing a ball bearing, in the case of single side sealed type, install it with the sealed side showing to the outside, in case of open type, with a model name engraved on the outer lace showing to the outside after assembling.
(22) When fixing parts with multiple screws, temporarily tighten all of them first, and make firm by tightening starting from the center area to outer area, next, hotter area to colder area, finally tighten the diagonal screws.

(23) After completing assembly, make sure that all the screws and bolts are tightened up in each process.
(24) There is no basic maintenance process stated in this maintenance manual. For more information, refer to the Federal Aviation Regulation Part 43 (13-1A and 13-2A).
（http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_43.13-1B_w-chg1.pdf）

1.2 Tightening torque

■Cap screw (Hex. Socket head bolts)

screw size	N・m
M2.6	1.1
M3.0	1.5
M4.0	3.6
M5.0	7.2

※Follow the above tightening torque otherwise specified.

2.0 Periodic inspection chart

Conduct inspection, overhauling, adjustment, and replacing parts according to the following chart.
Lifetime of this engine is 500 hours.

No.	Inspection items	Every time before the operation	50 hours	100 hours	150 hours	200 hours	250 hours	300 hours	350 hours	400 hours	450 hours
1	Visual inspection	○									
2	Inspection of the bolts and screws	○									
3	Fuel tubes	○									
4	Belt and pulleys of the generator	○		●		●		●		●	
5	Compression	○									
6	Wirings, harnesses, connectors	○									
7	Adjustment of the valve lifter gap		○	○	○	○	○	○	○	○	○
8	Inspection of the spark plug		○	○	○	●	○	○	○	●	○
9	Removing carbon build up on the cylinder head			◎		◎		◎		◎	
10	Inspection of valve seats			◎		◎		◎		◎	
11	Inspection of the valves			◎		◎		◎		◎	
12	Inspection of the piston, piston pin and connecting rod			◎		◎		◎		◎	
13	Inspection of the cylinder			◎		◎		◎		◎	
14	Inspection of the crankshaft			◎		◎		◎		◎	
15	Inspection of the crankpin stop screw			◎		◎		◎		◎	
16	Inspection of PCV valve			◎		◎		◎		◎	
17	Inspection of the front ball bearing			◎		●		◎		●	
18	Inspection of the rear ball bearing			◎		●		◎		●	
19	Inspection of Cam/cam bearing			◎		◎		◎		◎	
20	Inspection of Push rods			◎		◎		◎		◎	
21	Inspection of Rocker arms			◎		◎		◎		◎	
22	Inspection of Injector			◎		◎		◎		◎	
23	Replacing oil catch filter					●				●	
24	Inspection of generator/ regulate rectifier			○		○		○		○	
25	Inspection of fuel pump	○	○	○	○	○	○	○	○	○	○
26	Inspection of fuel pressure sensor unit	○	○	○	○	○	○	○	○	○	○
27	Inspection of fuel filter, disassembling and cleaning		◎	◎	◎	◎	◎	◎	◎	◎	◎
28	Inspection of throttle servo	○	○	○	○	○	○	○	○	○	○
29	Inspection of temperature sensor		○	○	○	○	○	○	○	○	○
30	Inspection of manifold pressure sensor		○	○	○	○	○	○	○	○	○
31	Inspection of the ignitor		○	○	○	○	○	○	○	○	○

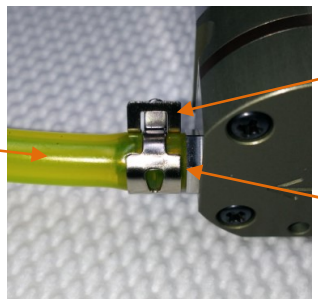
○ Inspection
◎ Disassembly · Cleaning · Inspection
● Periodic exchange

2.1 Visual inspection
[every time before the operation]
Always check the engine and other related equipment before flight, especially the engine mount, the crankcase, and the silencer to see if there is a crack, fuel leakage, or missing parts.

2.2 Inspection of the bolts and screws
[every time before the operation]
Check that the bolts and screws are properly tightened, especially those on the engine mount, the intake manifold, and the silencer.

2.3 Fuel tubes
[every time before the operation]
Do a visual inspection of the fuel tubes every time before the operation. Check if the fuel tubes are fully connected to the joint parts with clamps. Check for swelling, hardening, or damage on the tubes.

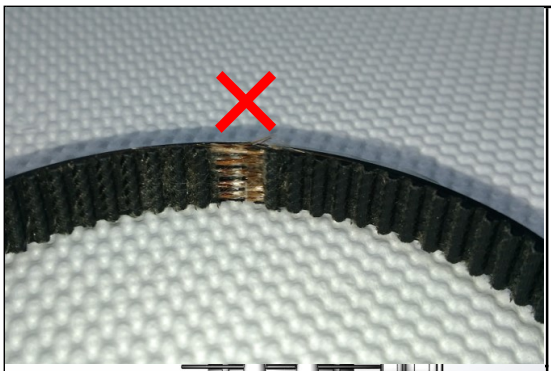
Check for swelling.
Check for damage.

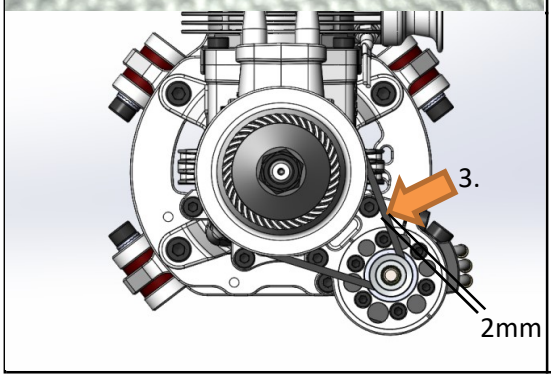


Check if all the tube joints after the fuel pump are secured with hose clamps.

Check if the fuel tubes are fully connected to the joint parts.

2.4 belt and pulleys of the generator
[every time before the operation], [after every 100-hour operation]
Do visual inspection of the belt, drive pulley, and driven pulley every time before operation. Check for cracks, missing teeth, peeling, and damage of the belt. Check if the belt has proper tension. Replace the belt after every 100-hour operation.

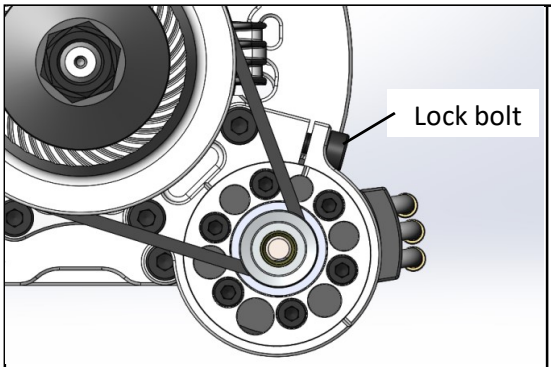




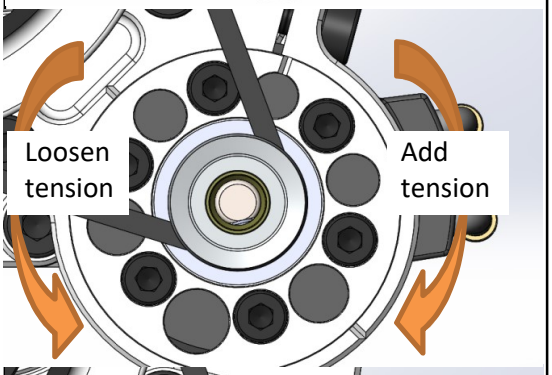
Points of inspection
(1) Check for cracks, missing teeth, peeling, and damage on the belt. Replace it if there is any damage on it.

(2) Inspect teeth of the drive pulley and the driven pulley. Replace them if there is damage or wear on them.

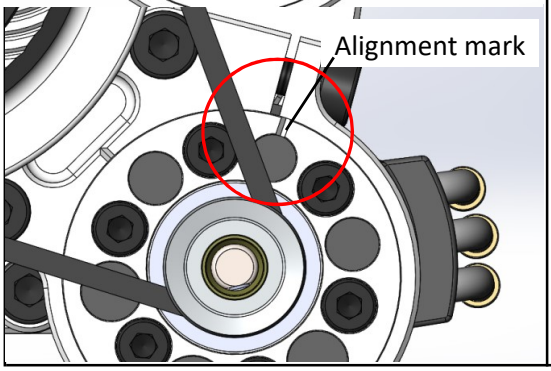
(3) Check the tension of the belt. Press the arrowed point in the picture on the left with an index finger and check if the belt bends 2mm. Adjust the tension in case it is too tight or too loose as shown in the next page.



How to adjust the tension of the belt
(1) Loosen the lock bolt of the generator support.



(2) Adjust the tension of the belt by rotating the generator body. Adjust the tension until the belt bends 2mm when you press the center of the belt between the drive pulley and the driven pulley with an index finger.



(3) Tighten the lock bolt to fix the generator.

【reference】
The alignment mark is at the position shown in the picture on the left when the belt is new.

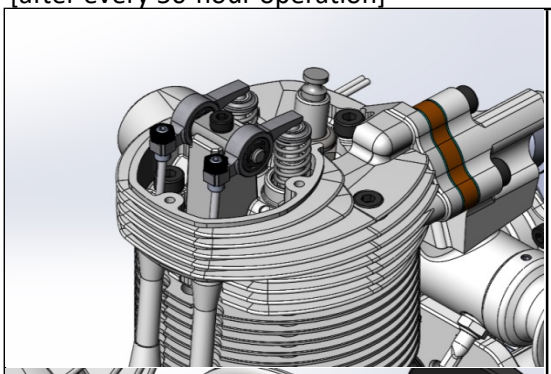
2.5 Compression
[every time before the operation]
Make sure that the switch is turned off when you check the ignitor and ESC. Turn the crankshaft counter-clockwise facing the propeller. Check if the compression occurs every two turns. In case there is no compression, inspect the engine according to the inspection points after 100-hour operation.

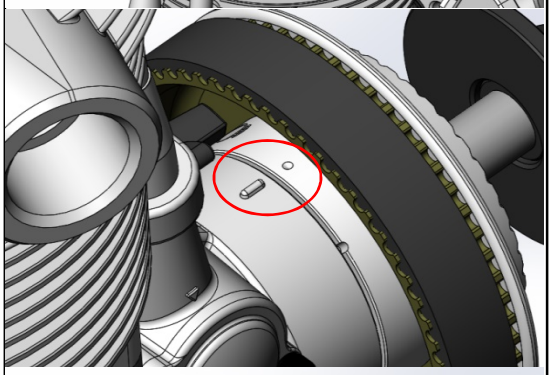
2.6 Wirings, harnesses, connectors
[every time before the operation]
Check for damage (disconnection, wear, deformation, hardening etc.) on wirings, harnesses, and connectors. Replace it if any are damaged.

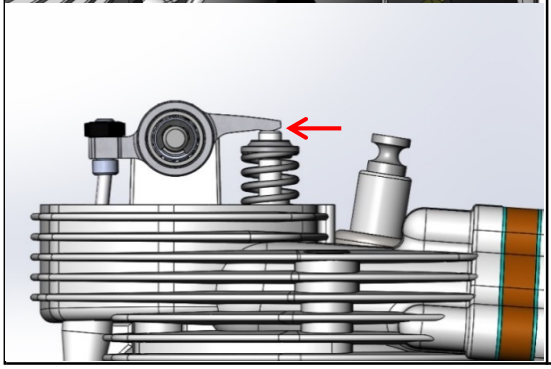
Check if the connectors are connected and firmly locked. Check for damage (loose connection, wear, deformation, crack etc.) on connectors. Replace it if any damages.

2.7 Adjustment of the valve lifter gap

[after every 50-hour operation]







Check the valve lifter gaps when the engine is cold. The valve lifter gaps cannot be measured precisely when the engine is hot because the cylinder is stretched and swollen by heat.

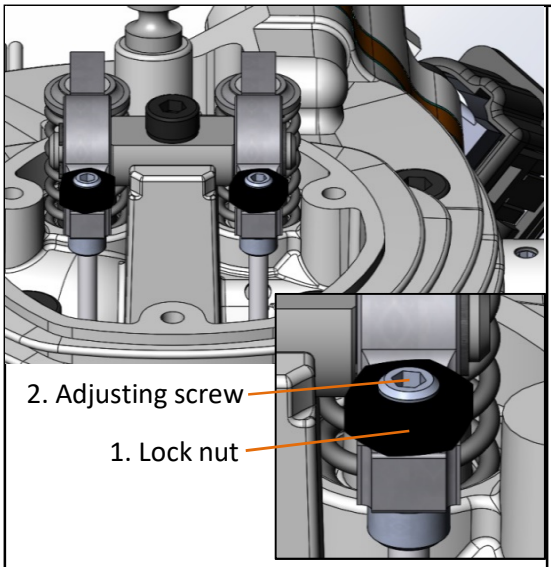
Points of inspections

(1) Remove the 3 pieces of M3 bolts from the locker cover and remove the locker cover.

(2) Turn the crankshaft counter-clockwise until the piston comes to the top dead center (TDC) in the process of compression. At this position, both the intake valve and the exhaust valve are closed and remain unmoved. The alignment mark on the drive washer should now at the top as shown in the picture on the left. In case the valves still moves when you rotate the crankshaft a little bit at the TDC, it is not the TDC in the process of compression. Turn counter-clockwise one more time.

(3) Check the valve lifter gaps at this position.You can insert 0.04mm thickness gauge and cannot insert 0.10mm if the clearances is within normal range. In case the clearance is our of the range, adjust the clearances as follows.

※ The valve adjusting tool kit (code no.72200060) is optional, which includes 0.04mm and 0.10mm thickness gauges.



How to adjust valve lifter gaps

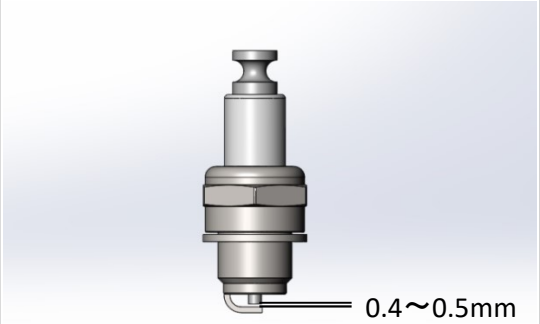
(1) Loosen the locknut with a 5.5mm wrench.

(2) Adjust the clearance by turning the adjusting screw with a 1.5mm hexagon wrench. Turning the adjusting screw clockwise makes the clearance narrower. Turning the adjusting screw counter-clockwise makes the clearance

The valve clearance should be between 0.04 and 0.10mm.

(3) Tighten the locknut after the adjustment. Measure the valve lifter gap after tightening the locknut to make sure if it is within the correct range.

2.8 Inspection of the spark plug
[after every 50-hour operation]



Inspect the spark plug every 50-hours of operation and replace it after every 200-hours operation.

Points of inspection

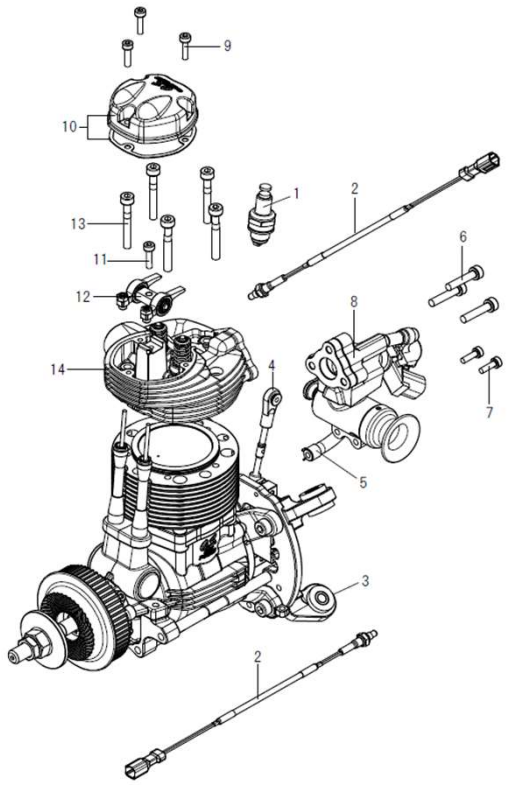
(1) Remove the spark plug with a 14mm deep-socket wrench.
(2) Check for damage or cracking on the terminal, the ceramic insulator, the body, the center electrode, and the ground electrode of the spark plug. Replace the spark plug if any damage.
(3) Measure the spark gap. The spark gap of the accessory CM-6 plug is 0.4 – 0.5mm. Adjust the gap within the range.
(4) Clean the center electrode and the ground electrode with a wire brush.
(5) Clean the center electrode and the ground electrode with a wire brush.
http://www.ngk-sparkplugs.jp/products/sparkplugs/troubleshooting/index.html
(6) Install the spark plug in the engine.
Tightening torque: 12N・m

2.9 Removing carbon build up on the cylinder head
[after every 100-hour operation]

Detach the cylinder head and remove the carbon build up accumulated on the combustion chamber after every 100-hour operation.

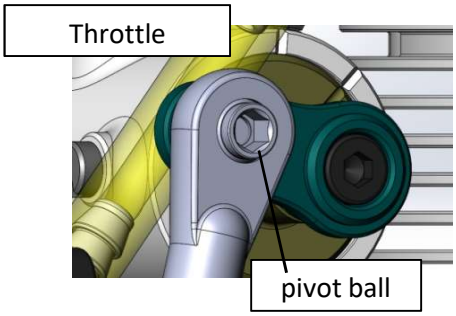
How to detach the cylinder head

(1) Unscrew the spark plug with the engine mounted on the engine mount. Taking out the spark plug after removing the cylinder head from the engine is more difficult because the cylinder moves when you try to detach the spark plug.
(2) Remove the cylinder head temperature sensor and the intake air temperature sensor from the engine with the accessory wrench.
(3) Dismount the engine from the engine mount. Refer to "Mounting & Dismounting" in the instruction manual.
(4) Disconnect the throttle linkage from the throttle arm. Refer to [the main point of disassembling/assembling] with a picture on the left.
(5) Disconnect the tube between the PCV valve and the throttle body.
(6) Unscrew the 3 pieces of M4 fixing bolts from the intake manifold.
(7) Unscrew the 2 pieces of M3 fixing bolts from the throttle body.
(8) Detach the intake manifold and the throttle body.
(9) Unscrew the 3 pieces of M3 fixing bolts from the locker cover.
(10) Detach the locker cover and the gasket.
(11) Remove the M3 fixing bolt from the locker arm support.
(12) Remove the locker arm with the locker arm support.
(13) Unscrew the 5 pieces of M4 fixing bolts from the cylinder head.



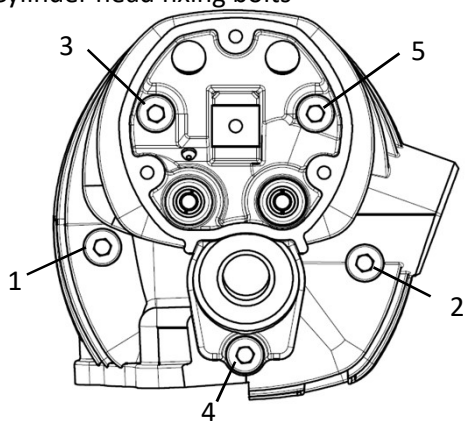
【main points of disassembling/assembling】

Turn counter-clockwise the hexagon hole located at the center of the pivot ball with a 3mm hexagon wrench, and the linkage rod will come off with the pivot ball. When you turn the pivot ball with a wrench, hold the throttle arm not to give tension to the throttle servo and the throttle valve. Tighten the pivot ball when you fix it.
Tightening torque: 1.6N・m



【main points of disassembling /assembling】

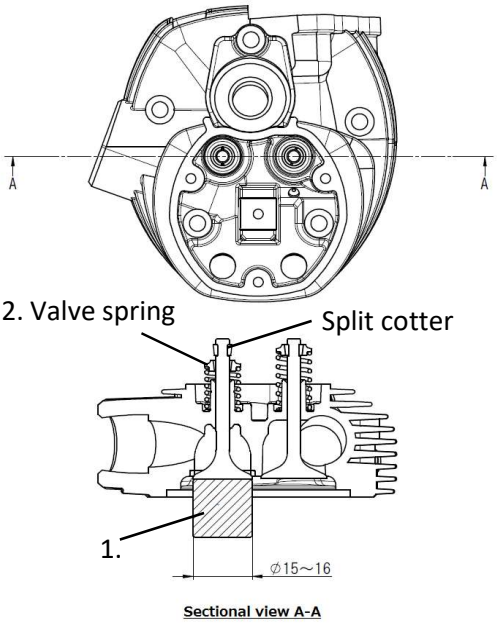
Cylinder head fixing bolts



(14) Remove the cylinder head.

※Do the same procedure in reverse order when you assembling the cylinder head.
※Refer to the picture on the left when you fit the cylinder head to the engine.

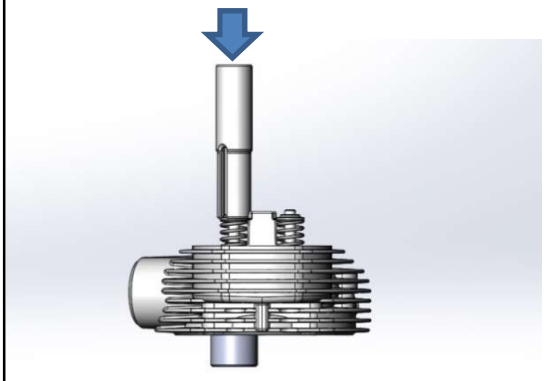
Temporarily screw the 5 pieces of bolts evenly. Then tighten the screws one by one in numerical order as shown above. Tightening torque: 3.6N・m



How to detach the valves

(1) Set a ϕ15－16㎜ cylindrical column to support the valve.
(2) Press down the valve spring retainer to remove the split cotter.
(3) Detach the valve.

※ The valve may not be easily pulled out of the valve stem guide when carbon build up sticks to the valve stem. In this case, do not pull out the valve until you remove the carbon build up on the valve stem with a knife.



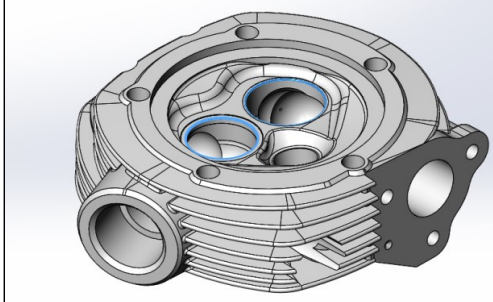
【main points of disassembling/assembling】

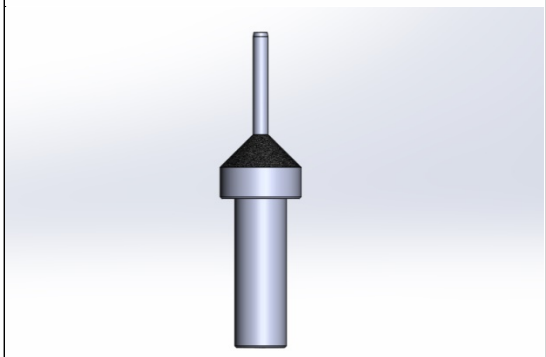
Valve spring retainer

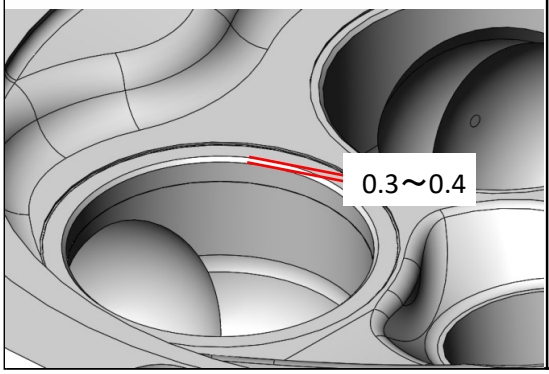
The split cotters are tapered and difficult to remove after operation. Put the accessory socket wrench for temperature sensor on the valve spring retainer as shown in the picture on the left. Tap the socket wrench diligently to release the sticking split cotters.

2.10 Inspection of valve seats

[after every 100-hour operation]







Inspect the valve seats when you disassemble the cylinder head after every 100-hour operation.

How to inspect the valve seats

(1) Check for damage on the valve seat especially the one across the contact width with a loupe. If there is no serious leakage by inspection in the article “2.5 Compression”, the engine can be used. In case of damage across the contact width of valve seat, or considerable leakage at the valve seat, replace the head or repair the valve seat with a valve seat repair tool, which is optional.

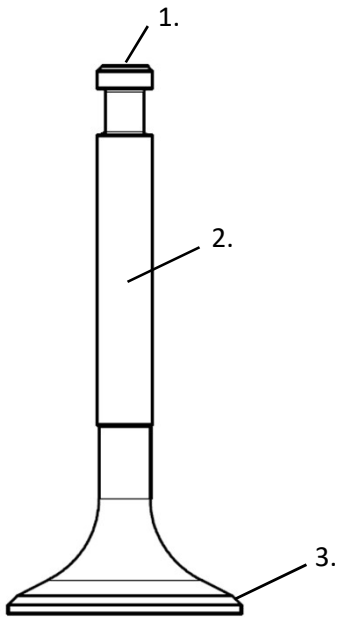
Code No.54073000
Valve seat repair tool
Applicable to both intake and exhaust
Cutter degree: 45 degrees

(2) Valve seats are worn and the contact width becomes wider as engine operation continues. Measure the contact width to make sure the width is within the range. Replace the cylinder head if it is out of range.

	Standard width	limit width
Intake side	0.3-0.4mm	0.5mm
Exhaust side	0.3-0.4mm	0.5mm

※Do not exceed the limit width when you repair the valve seat.

2.11 Inspection of the valves
[after every 100-hour operation]

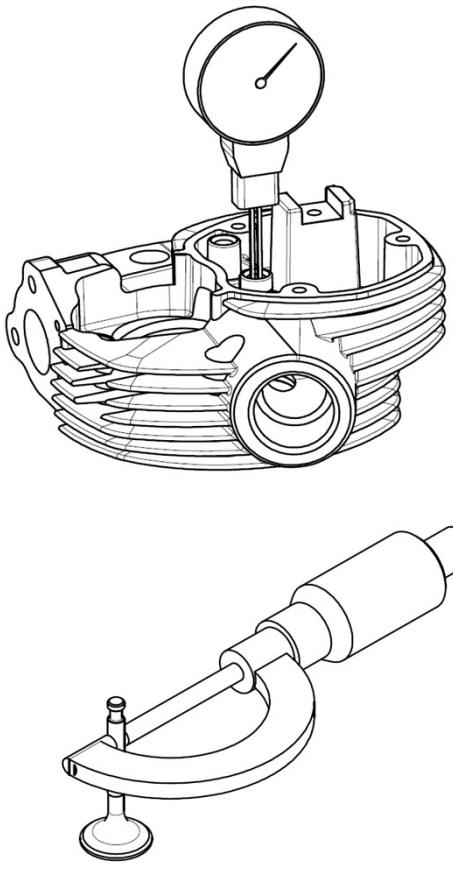


Detach and inspect the valves after every 100-hour operation.

Main points of inspection

(1) Check the valve stem end for wear or dents visually.
(2) Check the valve stem for overheating, scoring, or wear.
(3) Check if the valve seat contacts on the valve face and if there is no wear on the valve face.
(4) Remove the carbon build up sticking to the valve with a knife.

※If you find something wrong with the valve on the above inspections, replace the valve.



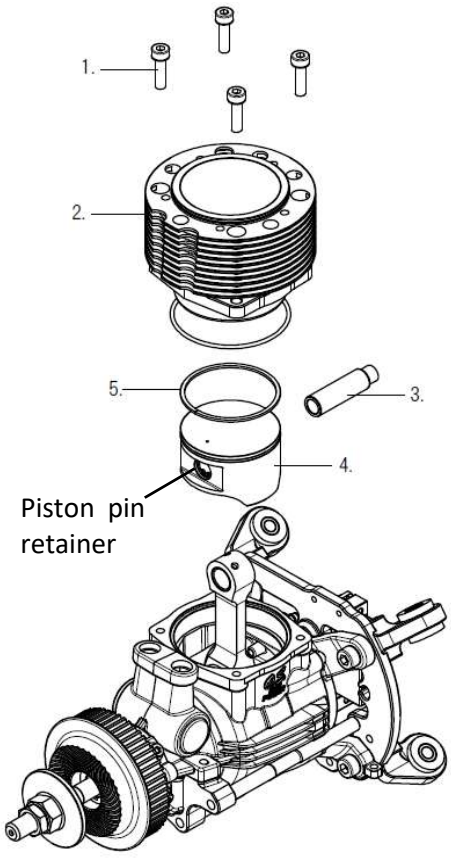
(5) Measure the gap between the valve guide and the valve stem. In case the gap exceeds the limit, replace the cylinder head, the valve, or both of them.

	Standard gap	limit gap
Intake side	ϕ0.02～ϕ0.05mm	ϕ0.1mm
Exhaust side	ϕ0.03～ϕ0.06mm	ϕ0.1mm

2.12 Inspection of the piston, piston pin and connecting rod

[after every 100-hour operation]

Detach the piston after every 100-hour operation and remove the carbon build up on it.



How to detach the cylinder and piston

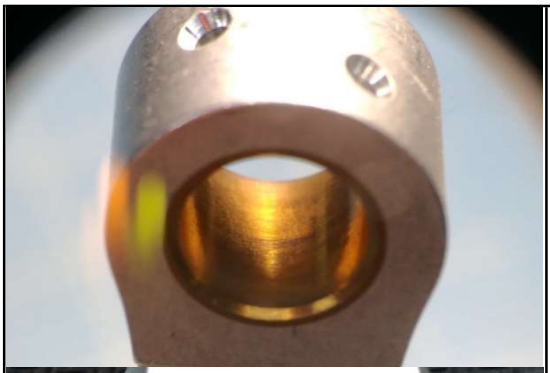
Refer to the concerned page to remove the cylinder head.

(1) Unscrew the 4 pieces of M4 bolts.
(2) Detach the cylinder.
(3) Pull out the piston pin from the rear side of the engine. There is a dot on the top of the piston to show the direction of piston. Place the dotted side in front. A piston pin retainer is set in only front side of piston.
(4) Detach the piston.
(5) Remove the piston ring from the piston. Do not open the piston ring more than piston bore to remove it from the groove.

Main points of inspection

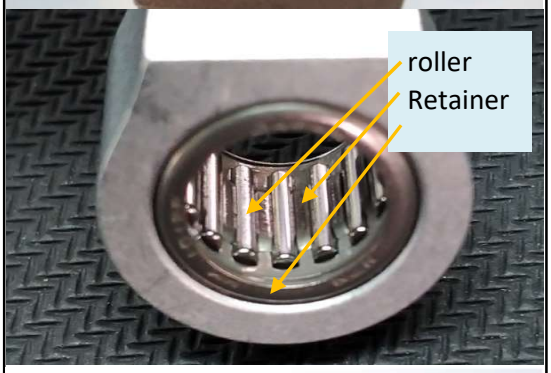
(1) Inspect the piston pin visually. In case of coarse surface due to overheating and scoring, replace it together with the piston and connecting rod.

*The piston pin can be used again even if temperature color is shown on the surface as in the picture as long as the surface is smooth.

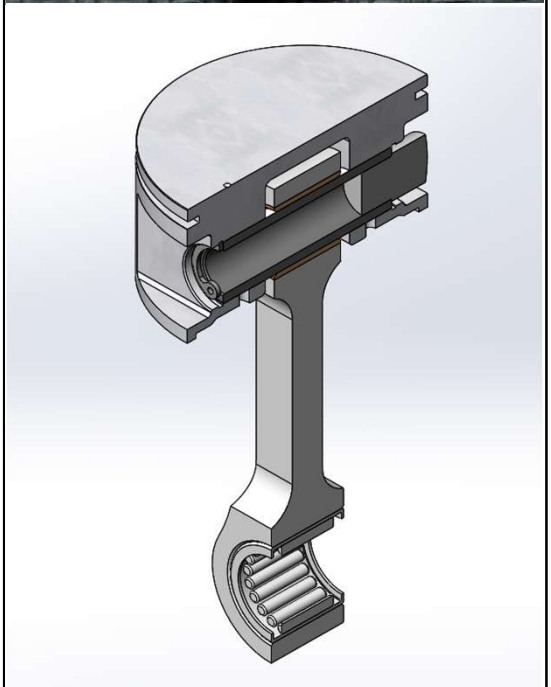


Main points of inspection

(2) Inspect the inner surface of the connecting rod small end with a loupe. In case there is coarse surface due to overheating and scoring, replace the connecting rod. If you can still see the honing crosshatch pattern on the inner surface of the connecting rod small end as shown in the picture on the left, the connecting rod can still be used even there is tempering color on the surface.

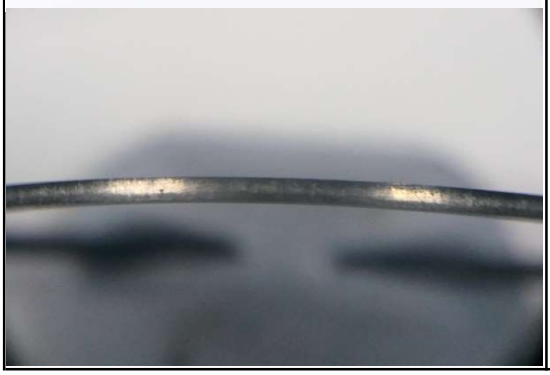


(3) Inspect the roller bearing in the big end of connecting rod with a magnifying glass. In case there is damage on the roller, retainer, or shell, replace the connecting rod.



(4) Check the clearance of the piston pin boss, piston pin diameter, connecting rod small end. In case the clearance is out of acceptable range, replace one of them or both of them.

	Standard clearance	limit clearance
Piston pin boss	ϕ0.005～ϕ0.020mm	ϕ0.030mm
Connecting rod small end	ϕ0.005～ϕ0.020mm	ϕ0.030mm

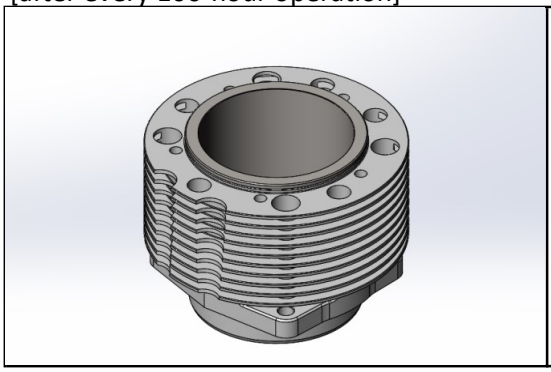


(5) Inspect the piston ring visually with a loupe. If the surface is coarse, or damaged, replace the piston ring. If the piston ring is barrel face type, so there is a mark in center of the face as shown in the picture.

A new piston ring doesn't have particular instruction of which side is top or bottom, but once it is used, always put it on the same side top or bottom after inspection. Usually bottom of the piston ring contacts piston groove, so there is a shine on the side.

2.13 Inspection of the cylinder

[after every 100-hour operation]



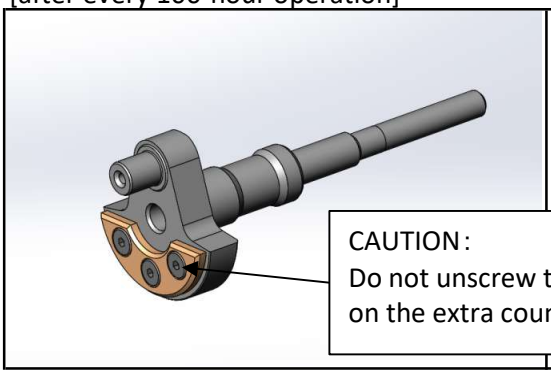
Detach the cylinder after every 100-hour operation and inspect it.

Main points of inspection

(1) Check the cylinder for peeled plating, scuffing on the surface. Replace the cylinder if it is damaged.

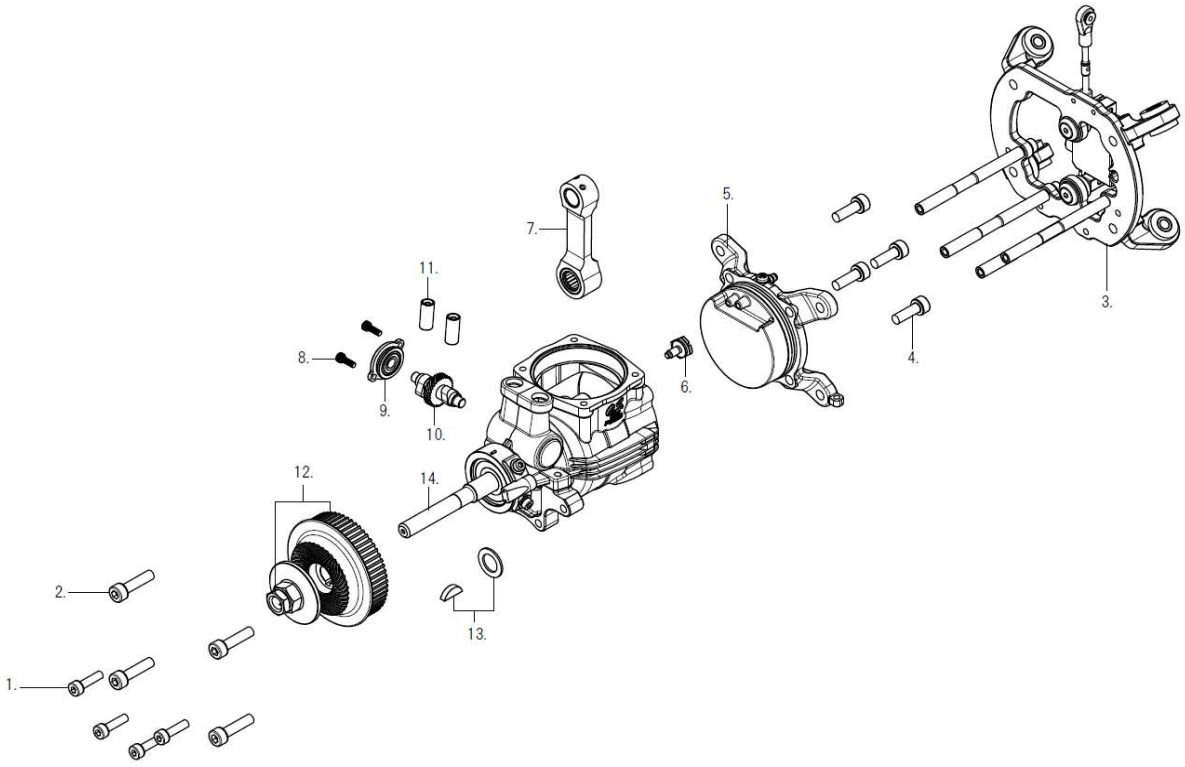
(2) Check the cylinder for cracks in the cooling fins and the flange. Replace the cylinder if it is damaged.

2.14 Inspection of the crankshaft
[after every 100-hour operation]



CAUTION:
Do not unscrew the 3 pieces of bolts on the extra counter weight.

Detach the crankshaft from the engine and inspect it.



How to detach the crankshaft

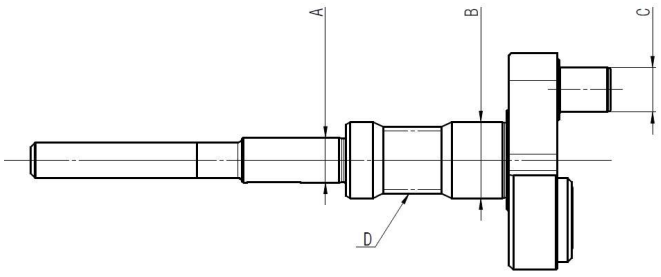
Refer to the concerned page to remove the cylinder head, cylinder, and piston.

(1) Remove the 4 pieces of M4 bolts which connect the generator mount with the reinforcement beam. The M4 bolts to be removed are 2 pieces in case you have a generator with the engine.
(2) Remove the 4 pieces of M5 bolts which connect the rear cover with the mount plate (F).
(3) Detach the mount plate (F) and the throttle servo assembly from the crankcase.
(4) Remove the 4 pieces of M5 bolts which connect the rear cover with the crankcase.
(5) Detach the rear cover from the crankcase. Apply oil to the O-ring of the rear cover to fit it to the crankcase smoothly.
(6.) Unscrew the crankpin stop screw, which is left-hand (reverse-thread). The crankshaft co-rotates when the crankpin stop screw is unscrewed, so attach a propeller or an alternative to the driver washer and hold it to prevent the crankshaft from co-rotating. Tightening torque of the crankpin stop screw is 0.8N・m.

(7) Detach the connecting rod from the crankpin. Attach the connecting rod with the roller bearing's model name engraved side out when it is attached again to the crankpin.
(8) Unscrew the 2 pieces of M2.6 bolts from the cam cover.
(9) Remove the cam cover.
(10) Remove the cam from the crankcase. Lift up the cam follower in the front and pull out the cam. Refer to "2.19 Inspection of the cam/the cam bearings" when you attach the cam.
(11) Remove the cam followers.
(12) Remove the lock nut, the propeller washer, and the drive washer. In case the drive washer is too rigid to pull out, use a gear puller.
(13) Remove the woodruff key and the thrust washer.
(14) Pull out the crankshaft from the crankcase.

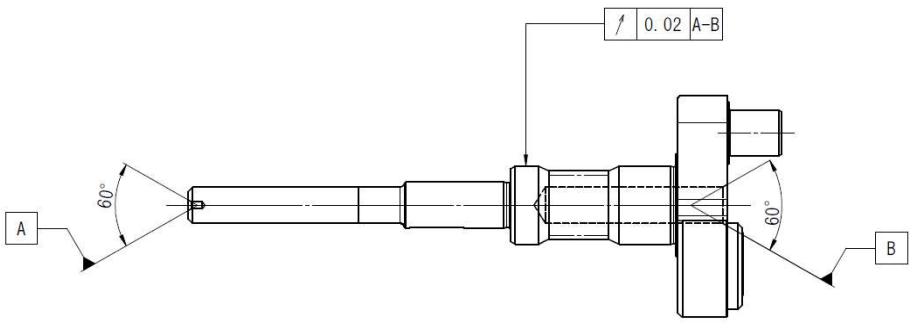
Main points of inspection
(1) Inspect the crankshaft visually
・Look for damage on the threaded part.
・Look for wear on the crankshaft where the front ball bearing inner race contacts.
・Look for wear on the crankshaft where the rear ball bearing inner race contacts.
・Look for damage on the timing gear on the crankshaft (D in the drawing).
・Look for wear and damage on the crank pin
If any damage, replace the crankshaft.

(2) Measure A, B, C in the drawing. Replace the crankshaft in case the measured size is out of the acceptable range.



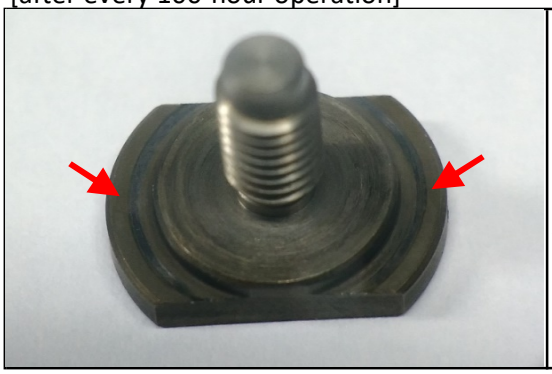
	Standard size	limit size
A ・・・	ϕ9.992～ϕ10.000 mm	ϕ9.987 mm
B ・・・	ϕ16.995～ϕ17.005 mm	ϕ16.990 mm
C ・・・	ϕ10.020～ϕ10.025 mm	ϕ10.018 mm

(3) Investigate crankshaft bending. Use a bench center holding the crankshaft at both ends shown in the picture with centers whose angle is 60 degrees. The value should be smaller than 0.02mm at the point shown in the drawing. In case the value is more than 0.02mm, replace the crankshaft.



2.15 Inspection of the crankpin stop screw

[after every 100-hour operation]



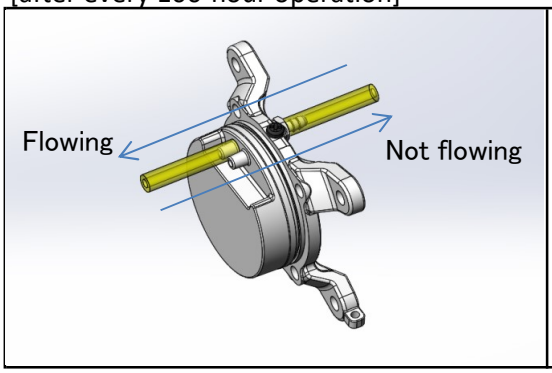
To be inspected every 100-hour operation when you disassemble the engine.

Points of inspections

(1) Inspect the crankpin stop screw visually to see if there is wear, overheating, or coarse surface on the points shown in the picture. Replace the crankpin stop screw if any damage. Replace the connecting rod in case it has considerable wear unable to recognize the model name of the needle bearing engraved on the outer race.

2.16 Inspection of PCV valve

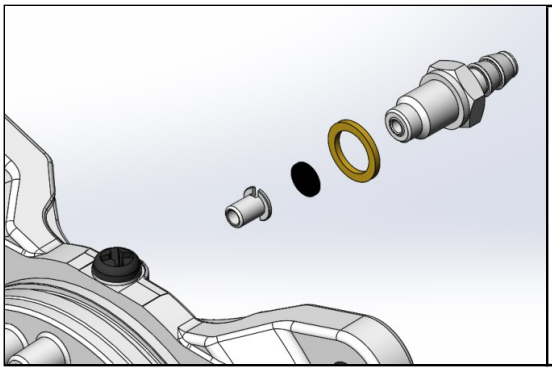
[after every 100-hour operation]



To be inspected every 100-hour operation when you disassemble the engine.

Points of inspections

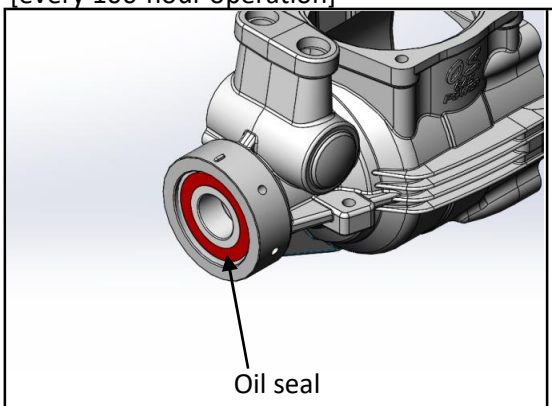
(1) Connect a short tube to inlet and outlet of the PCV valve and blow pressurized air (100kPa) to each tube end one by one. If the PCV valve works correctly, the air flows from outside to inside but never from inside to outside. In case of air leakage, disassemble the valve and clean it.



How to disassemble the PCV valve

(1) Loosen the PCV valve plug with a 8mm socket wrench turning counter clockwise. The PCV valve consists of a plug, a gasket, a valve (a rubber disc), and a valve seat (aluminum). There is no spring in it. Check if the rubber disc is torn. Clean all other parts and the hold of cover plate where the PCV valve is screwed in. Tightening torque of the plug is 2.5N・m.

2.17 Inspection of the front ball bearing
[every 100-hour operation]



Inspect it every 100-hour and replace it every 200-hour operation.

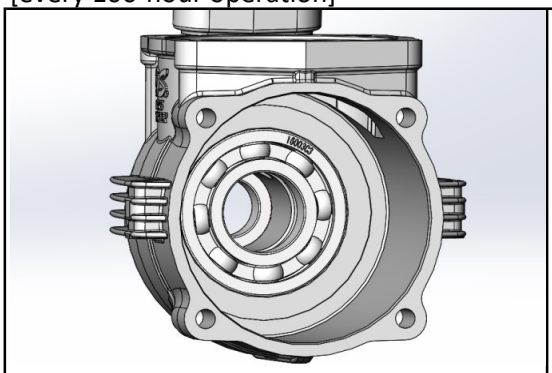
Points of inspections

(1) Check if there is oil leakage from the oil seal. Replace the ball bearing if oil spattered around. Oil seeps out a little even from a good oil seal. In this case, just wipe the oil off the oil seal.

(2) Rotate the inner race with a finger to check it rotates smoothly. In case it rotates roughly, replace it.

※You will find how to replace a ball bearing in the next page.

2.18 Inspection of the rear ball bearing
[every 100-hour operation]



Inspect it every 100-hour and replace it every 200-hour operation.

Points of inspections

(1) Wash the ball bearing with staying it in the crankcase. Before washing, remove the rotation sensor and the generator mount from the crankcase. Inspect the ball bearing with a magnifier to check for damages on it. Replace it if it is damaged.

(2) Rotate the inner race with a finger to check it rotates smoothly. In case it rotates roughly, replace it.

※You will find how to replace a ball bearing in the next page.

【How to remove and install a ball bearing】

How to remove

Warm up the crankcase with a hot air gun or some other methods and remove the ball bearing from the crankcase.

*Wear safety industrial gloves in this process to protect your hands.

(1) Wash the crankcase with kerosene or washing oil (Parts cleaner, Brake cleaner etc.) .

(2) Warm up the crankcase up to 150 degrees Celsius.

(3) Hit the crankcase to a piece of wood as shown in the picture. The rear ball bearing will come off after a few hits.

(4) Use a drift punch or flat-ended dowel of larger diameter than the inner ring and tap with a hammer from behind when the crankcase is still hot to remove the front ball bearing.

【How to remove and install a ball bearing】

How to install

Warm up the crankcase and install a new bearing when the crankcase if still hot.

*Wear safety industrial gloves in this process to protect your hands.

(1) Warm up the crankcase up to 150 degrees Celsius.

(2) Apply penetrating oil such as WD40 to the housing of the both ball bearings.

(3) Fit a rear ball bearing onto the crankshaft facing its model number engraving side to the inner side of the counter weight of crankshaft so that you can see the model number of the rear ball bearing when you remove the crankshaft in the future.

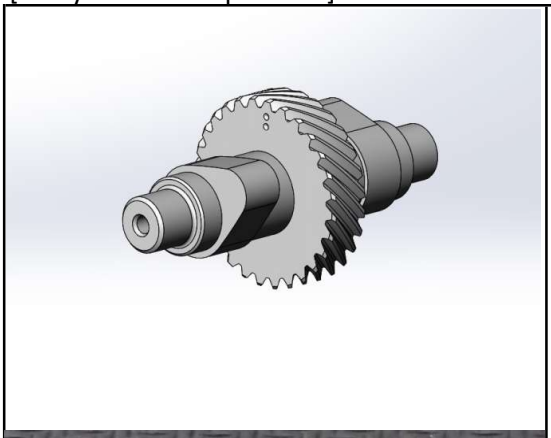
(4) Drop the rear ball bearing guided by the crankshaft into the housing. Weight of the crankshaft itself will press the rear ball bearing in the housing.

(5) Press a front ball bearing in the housing guided by the crankshaft as in the picture.

*Make sure the both bearings are fully and evenly seated in the housings. That is crucial.

*If you think removing and installing ball bearings are challenging and difficult, send us the crankcase for maintenance.

2.19 Inspection of Cam/cam bearing
[every 100-hour operation]

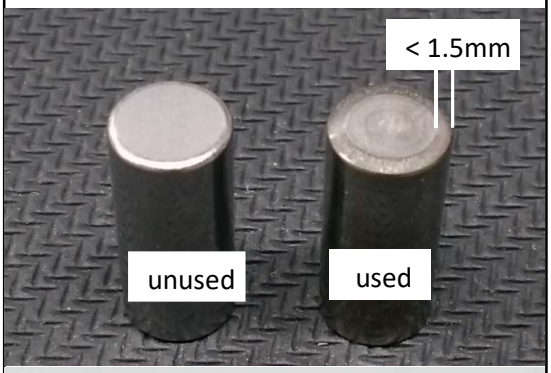


To be inspected every 100-hour operation when you disassemble the engine.

Points of inspections
(1) Check if any uneven wear or damage on the cams.
(2) Check if any uneven wear or damage to the gear teeth.
(3) Check the diameter of cam shaft

Standard diameter	limit diameter
ϕ4.97-ϕ4.99mm	ϕ4.96mm

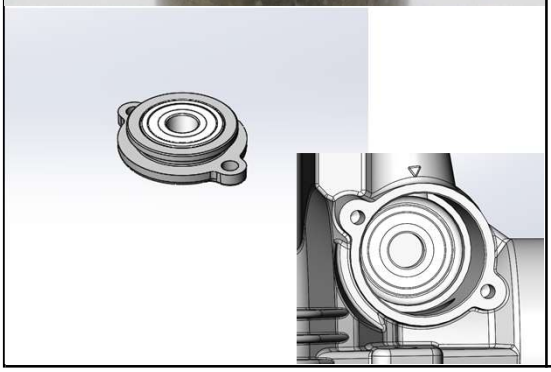
*Replace the camshaft if it is damaged.



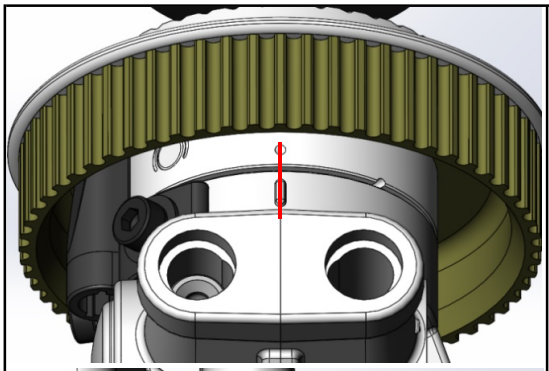
(4) Inspect the cam followers. Check if top of it is worn evenly. If not, replace it. Check if cam followers move smoothly in the tappet bores formed by the crankcase.
(5) In case the width of worn ring on top of the cam follower is more than 1.5mm, replace cam followers.

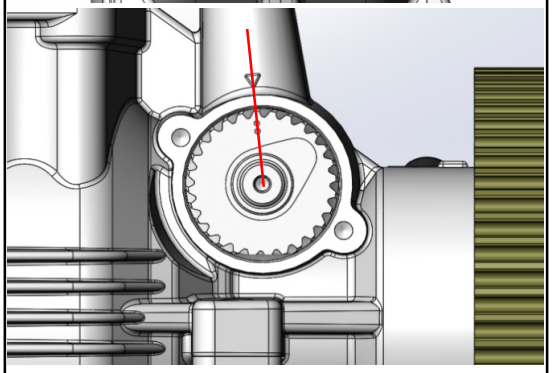
limit width
1.5mm

(6) Inspect the cylinder surface of cam follower. In case there is coarse surface due to overheating and scoring, replace the cam followers. Check the surface of tappet bores as well.
(7) Check the inner dome of cam follower where tip of pushrod contacts if there is any wear or coarse surface. If there is, replace the cam followers.



(8) Put a ϕ5mm stick in the inner ring of camshaft bearing and turn the stick to check if the bearing turns smoothly. If not, replace the bearing or cam cover with bearing.

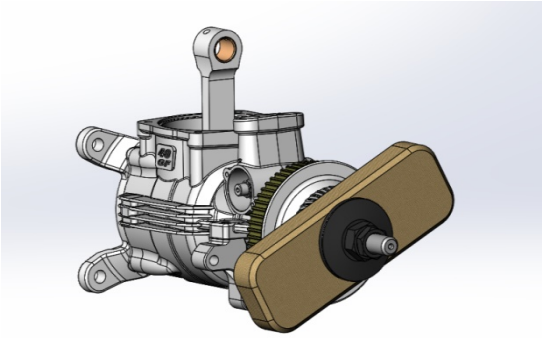




【How to remove and install a ball bearing】
How to install a cam shaft

(1) Rotate the crankshaft to top dead center at which a dot marked on the drive washer and the crankcase timing mark aligns.

(2) Put a cam shaft in the housing locating the timing mark as shown in the picture. The crankshaft should be fully pulled front and the cam shaft fully put in the end of the housing when you check the alignment. You can keep the crankshaft fully pulled front by attaching a piece of wood to the engine instead of a propeller.

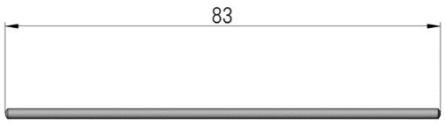


(3) Attach a cam cover to the crankcase.
(4) Put cam followers into the tappet bores with flat top down.

*Apply lubrication oil to a camshaft, camshaft bearings, and cam followers before assembling.

2.20 Inspection of Push rods

[every 100-hour operation]



To be inspected every 100-hour operation when you disassemble the engine.

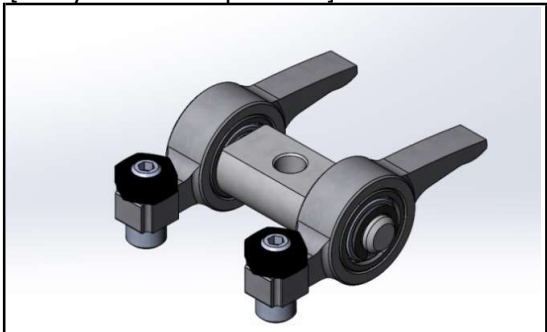
Points of inspections

(1) Check if there is wear, coarse surface on both spherical ends of the pushrod with a magnifier. If there is, replace it.
(2) Check if it is bent. Put it on a surface plate and roll it on it. Replace it if it bent more than 0.3mm.
(3) Measure its length. Replace it if it is shorter than the limit value.

Standard length	Limit length
82.8-83.0mm	82.7mm

2.21 Inspection of Rocker arms

[every 100-hour operation]



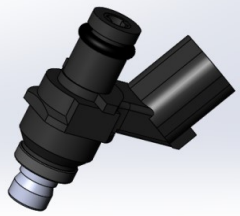
To be inspected every 100-hour operation when you disassemble the engine.

Points of inspections

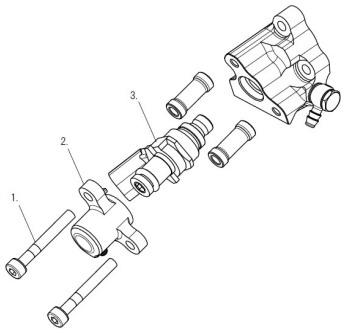
(1) Wash it and remove carbon build up on it.
(2) Move the rocker arms to check if they move smoothly. If not, replace them removing the e-clips. When you replace rocker arms, replace e-clips as well not using the old ones.
(3) Check the arrowed part in the picture. If there is wear or coarse surface, replace it.
(4) Check the concave dome of adjusting screw with a magnifier. If there is wear or coarse surface, replace it.

2.22 Inspection of Injector

[every 100-hour operation]



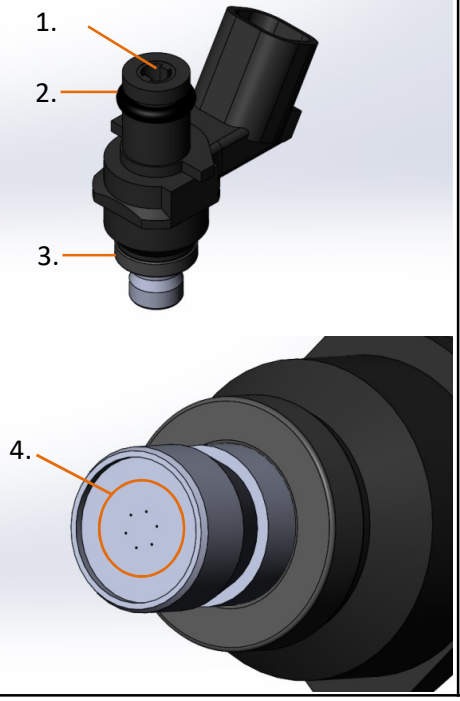
Check it every 100-hour operation.



How to detach the injector

(1) Remove the two pieces of M4 bolt from the injector coupler.
(2) Remove the injector coupler.
(3) Remove the injector.

*Assemble the injector in reverse order of disassembling. Apply 2-stroke oil to o-rings not to twist them during assembling.

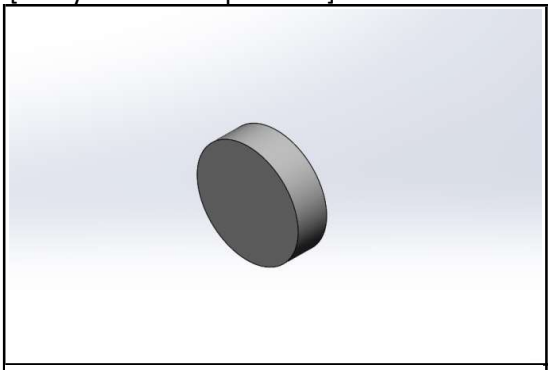
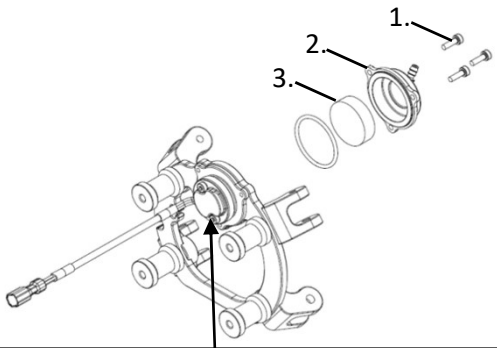


How to check

(1) Check the filter at the inlet and remove dust.
(2) Check the o-rings. Replace them if they are damaged. We recommend replacing o-rings once the injector unit is disassembled.
(3) Check the seal ring. Replace it if it is damaged. We recommend replacing a seal ring once the injector unit is disassembled.
(4) Check the injection holes on the nozzle. Replace it if the holes are clogged.

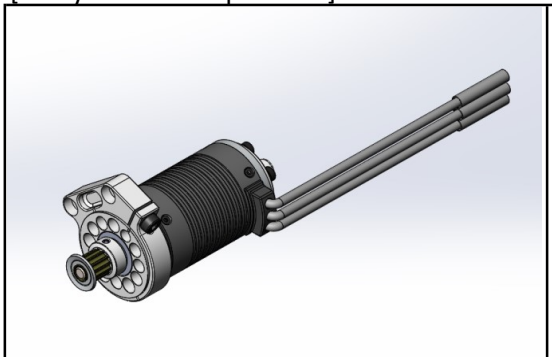
2.23 Replacing oil catch filter

[every 200-hour operation]

<table>
<tr>
<td>  </td>
<td>Replace the oil catch filter in the manifold pressure sensor every 200-hour operation..</td>
</tr>
<tr>
<td> 
</td>
<td>How to detach the oil catch filter
(1) Remove three pieces of M3 bolt.
(2) Detach the oil filter catch case.
(3) Detach the oil filter.
(4) Assemble the filter in reverse order of disassembling.
*Attach the oil catch filter case after attaching a new oil filter in it.</td>
</tr>
</table>

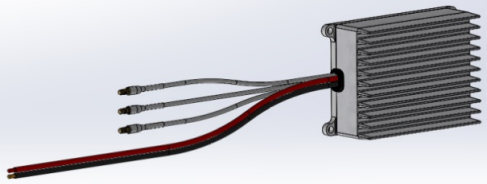
CAUTION:
Do not loosen the two pieces of M3 bolt which are fixing the manifold pressure sensor.

2.24 Inspection of generator/ regulate rectifier
[every 100-hour operation]



Inspect the generator every 100-hour operation.

How to check
(1) Check if each bolt and screw is properly tightened.
(2) Check the connectors and lead wires. If there is a crack or damage, replace the damaged part.
(3) Check if there is backlash in radial direction of the motor shaft. Replace ball bearings of the generator, and the front ball bearing of generator adapter. Glue the inner rings of bearings and the motor shaft with LOCTITE®601 or equivalent when ball bearings are replaced.
(4) Measure the resistance (Ω) between one of lead wires and tip of the motor shaft with an insulation resistance tester (AC125V). In case the measured value is less than 10MΩ, there is possibility of insulation failure. Replace the generator.
(5)Check phase-to-phase resistance of each lead wires (three combinations) with a digital mΩmeter. The phase-to phase resistance should be 60mΩ±10mΩ and deviation within 10mΩ. In case the value is out of the range, replace the generator.

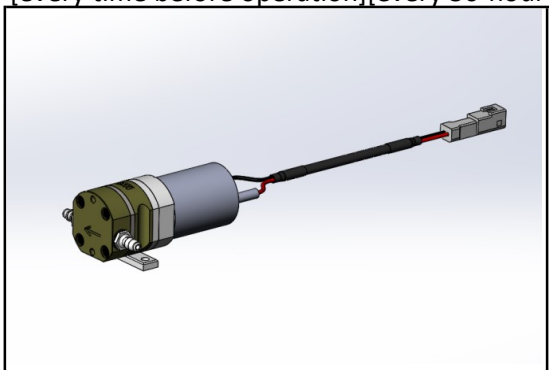


Inspect the regulate rectifier every 100-hour operation.

(1) Check the connectors and lead wires. If there is a crack or damage, replace the regulate rectifier.
(2) Connect the power source to the input lead wires (three white wires) to check.
The ideal power source is 3-phase AC (50Hz or 60Hz) and voltage is 35V – 60V. But if it is difficult to prepare such power source, a LI-Po battery with 10-12 cells, which can discharge 10A or more, can be used alternatively. In this case, test three combination of three input wires changing positive (+) and negative (-) connection, so total six patterns.
Connect the power source to the input wires and measure the voltage of output wires (red and black), when no load and when 5A load. If the difference of voltage when no load and when 5A load is less than 1.0V, the regulate rectifier is working normally. If the difference is more than 1.0V, replace the regulate rectifier.

2.25 Inspection of fuel pump

[every time before operation][every 50-hour operation]

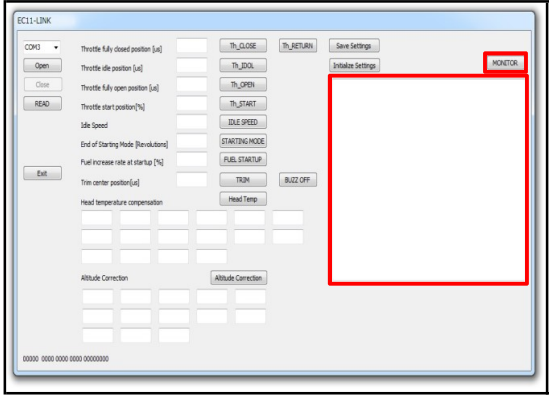


Check the fuel pump every time before operation and every 50-hour operation.

How to check [every time before operation]

(1) Check the pump from outside. If there is leakage or damage on the wire, replace the pump or consult us for repair.

(2) Check the tubes from the fuel tank to the pump. If there is air bubbles in the tube, open the pressure release valve to release the air. Close the valve after releasing the air.



How to check [every 50-hour operation]

(1)Check the fuel pressure during operation using 《MONITOR》function in EC11-LINK. The value should be 300kPa±10kPa when full throttle. In case the fuel pressure fluctuates beyond the limit, replace the fuel pump, or send it back to us for repair.

CAUTION:

Always connect/disconnect the fuel tube to/from the nipples turning the tube clockwise. If you turn the tube counter-clockwise when you connect/disconnect the tube, the nipple will become loose.

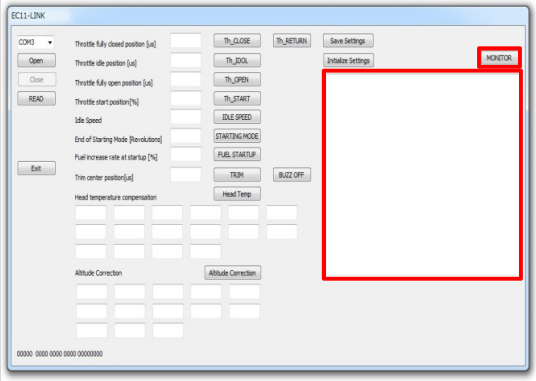
2.26 Inspection of fuel pressure sensor unit

[every time before operation][every 50-hour operation]

Check the fuel pressure sensor every time before operation and every 50-hour operation.

How to check [every time before operation]

(1) Check the fuel pressure sensor from outside. If there is leakage or damage on the wire, replace it or consult us for repair.



How to check [every 50-hour operation]

(1) Check the fuel pressure sensor using《MONITOR》function in EC-11 LINK. Disconnect the connector of fuel pressure sensor. Open the pressure release valve and turn on the switch of ECU. Monitor the fuel pressure in the display. If the fuel pressure is 0kPa±3kPa, the sensor is correctly working.

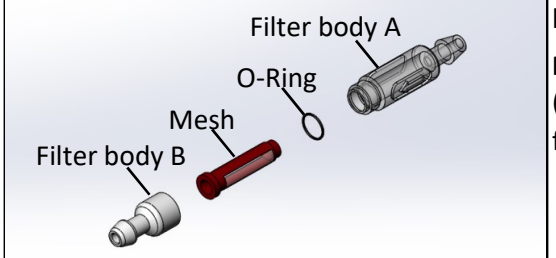
(2) Turn off the switch of ECU. Connect the connector of fuel pressure sensor. Turn of the switch of ECU again with fuel full in the fuel tank. When the fuel pump starts, the fuel circulates through the fuel tank, the fuel pump, and the fuel tank again because the pressure release valve is still open. Using《MONITOR》function in EC-11 LINK, monitor the fuel pressure as you close the pressure valve. If the fuel pressure rises, it is working correctly.

Replace the fuel pressure sensor if there is any malfunction.

CAUTION:

Always connect/disconnect the fuel tube to/from the nipples turning the tube clockwise. If you turn the tube counter-clockwise when you connect/disconnect the tube, the nipple will become loose.

2.27 Inspection of fuel filter, disassembling and cleaning
[every 50-hour operation]



Disassemble, inspect, and clean the fuel filter every 50 hour-operation.

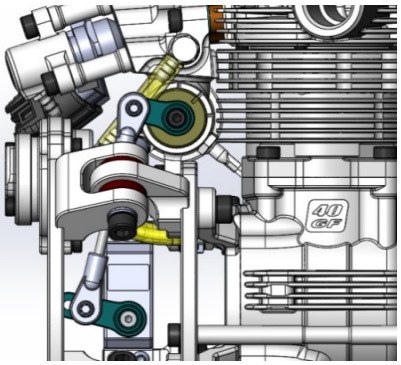
How to check [every 50-hour operation]
(1) Filter body A is transparent to check for the dust in the filter. Wash the filter following the processes below.

CAUTION:
Parts cleaner and kerosene are highly flammable. Carry out washing the fuel filter only outdoors or in well ventilated area away from any source of fire.

How to clean a fuel filter
(1) Disconnect the fuel filter from the fuel tubes putting a piece of towel under the filter to catch and absorb remaining fuel that will run out of the tubes when they are disconnected.
(2) Disassemble the filter. Filter body A is screwed in filter body B. Turn the body counter-clockwise to disassemble.
(3) Remove the mesh from Filter body A.
(4) Remove the o-ring from Filter body A.
(5) Wash the mesh, the Filter body A and B with Parts cleaner (Brake cleaner) or kerosene. Blow off the dust and dirt with compressed air.
(6) Check each part with a magnifier. If there is some damage, crack, wear, or deformation, replace it.
(7) Do not give damage or twist the o-ring when you assemble the fuel filter. The tightening torque of filter A to filter B is 0.8N・m.

2.28 Inspection of throttle servo

[every time before operation] [every 50-hour operation]



Check the throttle servo every time before operation and every 50-hour operation.

How to check [every time before operation]

(1) Check the throttle servo. Replace it if there is damage or crack on the case, flange, and lead wire.

(2) Tighten the pivot ball screw on the throttle link rod if it is loose.

(3) Check the throttle link rod. Replace it if there is backlash.

(4) Check if the throttle servo moves smoothly according to signals from a receiver or a flight controller, if the servo holds its position when throttle signal input says stop. Replace the servo if it chatters, or does not hold its position.

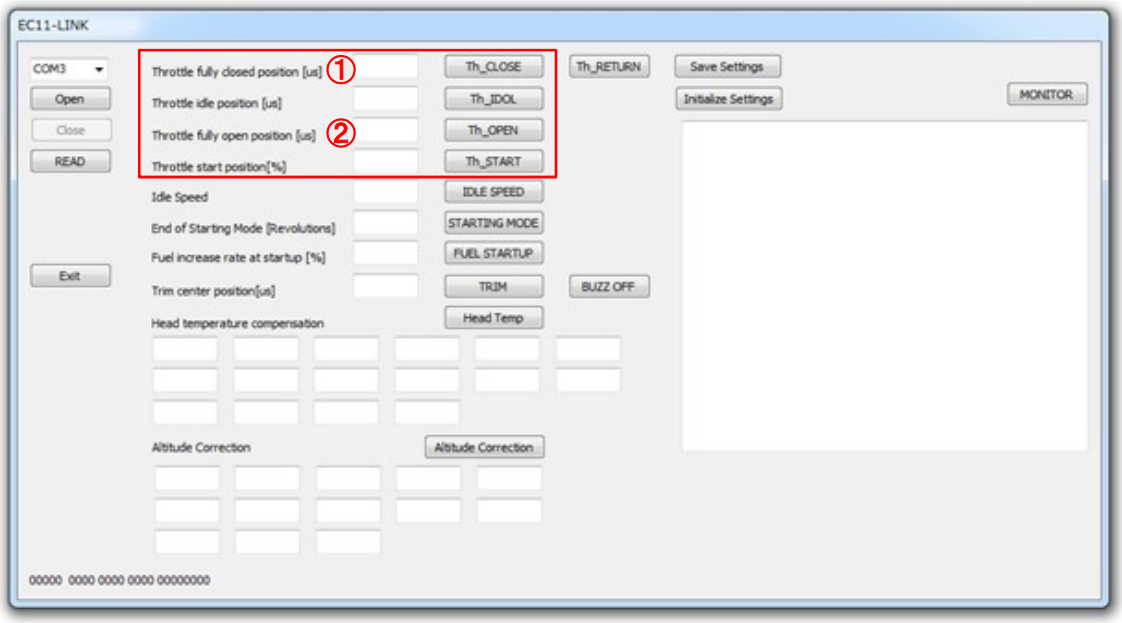
*When the engine is in START MODE, the throttle cannot be fully closed otherwise the engine cannot get started. For the detail, read EC-11 instruction manual.

How to check [every 50-hour operation]

(1) Check the throttle positions of fully close and fully open position in display (① and ②). If there is any discrepancy, readjust the set value.

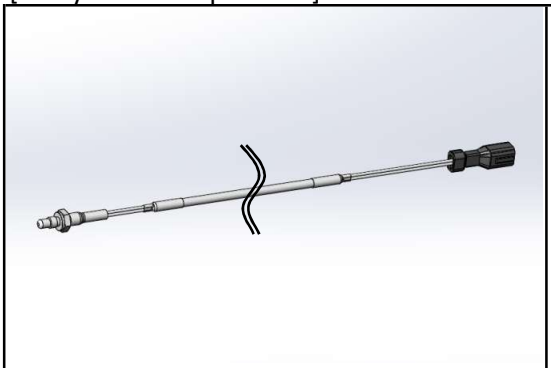
(2) Readjust of the throttle position is a must every 100-hour operation using EC11-LINK.

*Refer to EC-11 instruction manual for further information regarding setting of throttle position.



2.29 Inspection of temperature sensor

[every 50-hour operation]



Inspect the temperature sensor every 50-hour operation.

How to check [every 50-hour operation]

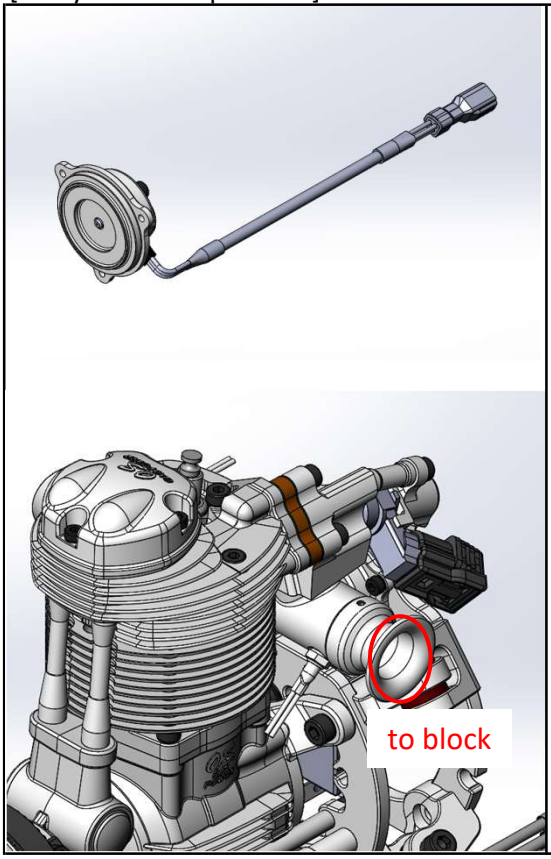
(1) Check the temperature sensor if it is connected to ECU using《MONITOR》function in EC11-LINK. When the wire is broken down, the display always shows 350℃ even in normal temperature. Replace the sensor in this case.

(2) Measure electric resistance between two pins in the connector if the temperature sensor is taken out. The sensor is a resistance thermometer made of platinum (Pt 100). If measured value is around 110Ω in normal temperature, it is working correctly.Replace it if the value shows abnormal value.

※The same temperature sensor is used for the cylinder head temperature sensor and the intake air temperature

2.30 Inspection of manifold pressure sensor

[every 50-hour operation]



Inspect the manifold pressure sensor every 50-hour operation.

How to check [every 50-hour operation]

(1) Check the manifold pressure sensor with connecting it to ECU using《MONITOR》function in EC11-LINK if it is working.

(2) Inspect the sensor only after turning OFF the ignitor switch. Attach a piece of wood to the crankshaft to turn it (see the picture in page 22).

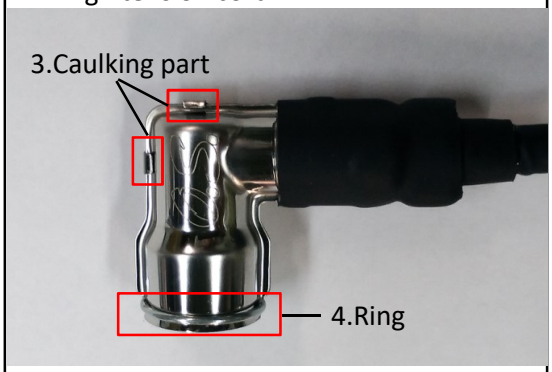
(3) Turn on the switch of ECU and connect the ECU and EC11-LINK. Turn ON the《MONITOR》function. If the value of “Negative Pressure” shows 0hPa±5hPa, it’s working correctly. Replace it if it shows abnormal value.

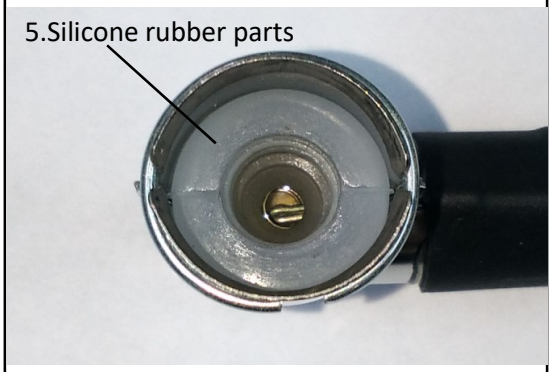
(4) Rotate the crankshaft with blocking the velocity stack of air inlet with a thumb. If value of “Negative Pressure” in EC11-LINK《MONITOR》turns to negative value when you feel negative pressure on the thumb during the suction stroke, the manifold pressure sensor is working correctly. If not, replace it.

2.31 Inspection of the ignitor

[after every 50-hour operation]

2.High tension cord





*A special spark plug for spark check is available from us.

Code No.54072000

CM-6 SPARK PLUG FOR SPARK CHECK

Inspect the ignitor every 50-hour operation.

Inspection procedures [every 50-hour operation]

(1) Remove the plug cap from the spark plug holding the plug cap body firmly. Pull the plug cap with a twist when it is firmly fixed to the spark plug. Do not pull the high tension cord. Do not use a screw driver to remove the plug cap from the spark plug. It may ruin the plug cap.

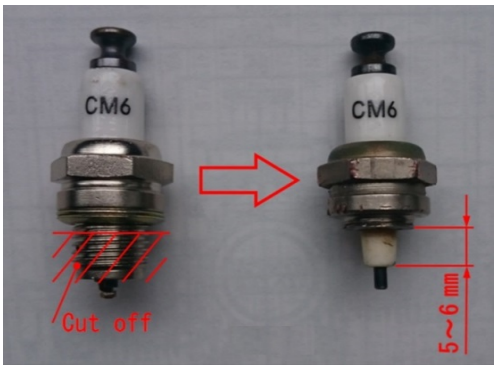
(2) Check for tear and worn on the surface of the high-tension cord. In case outer metal mesh is worn more than 1/2 of its thickness, replace the whole ignition system. The high-tension cord cannot be replaced itself alone. In case it is worn less than 1/2, use a spiral cord protector. In case string of the outer metal mesh is cut considerable, more than 5 strings per 10mm cord length, replace the ignition system. If less, reinforce the cord with a spiral cord protector.

(3) Check if the caulking parts come off. Make sure to caulk the parts firmly. Send back the ignition system for repair to us if it is requested.

(4) Check if the ring is placed at the right position. If the ring is damaged or lost, replace it. (code No. 74002200 PLUG CAP SET)

(5) Check for damage of the silicon part in the plug cap. In case of damage, replace it. (code No. 74002200 PLUG CAP SET)

(6) Generally, spark ignition is more difficult in a combustion chamber of an engine, where fuel mixture is compressed, than under atmospheric pressure. The discharge distance (the spark plug gap) is 0.4 – 0.5mm in the engine, which is equivalent to the discharge distance of 5-6mm under atmospheric pressure. So make a spark plug for spark check under atmospheric pressure as shown below, whose discharge distance is more than 5mm. Make a spark check away from inflammable such as gasoline.To ignite the special-made plug, connect the crankshaft rotation sensor directly to the ignition signal connector of the ignition module (IG-08), and pass the magnet of the drive washer under the crankshaft rotation sensor swiftly to get the spark plug to spark. Change the connection as it was.



How to make a special spark plug for spark check

(1) Prepare CM-6 spark plug. It doesn't have to be a new one but a used one.

(2) Cut off a part of the spark plug body as shown in the picture.

■ENGINE PARTS LIST / GF40U-FI (1/3)

No.	Code No.	Description	
1	4AD01000	CRANKCASE GF40U	
2	74002A20	ROTATION SENSOR IG-10	
3	74002321	ROTATION SENSOR FIXING SCREW (2pcs.)	
4	29431000	BALL BEARING(F)	
5	4AD30000	BALL BEARING(R) GF40U	
6	45231100	CAMSHAFT BEARING (1pcs.)	
7	4AD02000	CRANKSHAFT GF40U	
8	49402100	CRANK PIN STOP SCREW GF40	
9	4AD62000	CAMSHAFT GF40U	
10	49401100	CAM COVER	
11	44514110	CAM COVER O-RING	
12	4AD08000	DRIVE WASHER (A) GF40U	
13	4AD08001	DRIVE WASHER (B) GF40U	
14	4AD08002	DRIVE PULLEY (60T) GF40U	
15	29208200	WOODRUFF KEY	
16	45520000	THRUST WASHER	
17	28310000	LOCK NUT SET	
17-1	45910101	LOCK NUT 1 (UNF5/16-24)	
17-2	45910102	LOCK NUT 2 (UNF5/16-24)	
18	28309000	PROPELLER WASHER	
19	4AD03300	CYLINDER GF40U	
20	49403200	PISTON	
21	49403400	PISTON RING	
22	49406010	PISTON PIN	
23	29717000	PISTON PIN RETAINER (2pcs.)	
24	49405000	CONNECTING ROD	
25	4AD07000	COVER PLATE GF40U	
26	29122540	COVER GASKET (1pcs.)	
27	4AD07001	PCV VALVE SET GF40U	
28	4AD04100	CYLINDER HEAD GF40U	
29	49404160	HEAD GASKET	
30	49404200	ROCKER COVER	
31	49414300	ROCKER COVER GASKET	
32	45761600	ROCKER ARM RETAINER (2pcs./1pair)	
33	49464000	ROCKER SUPPORT	
34	4AD61100	ROCKER ARM GF40U (1pcs.)	
35	44561200	TAPPET ADJUSTING SCREW (1pcs.)	
36	45560410	SPLIT COTTER (2pcs./1pair)	
37	49460400	VALVE SPRING RETAINER (1pcs.)	
38	49460200	VALVE SPRING (1pcs)	
39	49460100	INTAKE VALVE	
40	49460110	EXHAUST VALVE	
41	4AD66000	PUSH ROD GF40U (2pcs.)	
42	49466100	PUSH ROD COVER (1pcs.)	
43	45566310	PUSH-ROD COVER O-RING (2pcs.)	
44	44564000	CAM FOLLOWER (2pcs.)	
45	49469450	THERMO INSULATOR	
46	49414010	INTAKE MANIFOLD GASKET (2pcs.)	
47	4AD69400	INTAKE MANIFOLD GF40U	
48	4AA07410	O-RING	
49	4AD81952	MANIFOLD PRESSURE OUTLET	
50	4AD84000	INJECTOR GF40U	
50-1	4AD84003	INJECTOR RING SEAL	
50-2	4AD84004	INJECTOR O-RING	

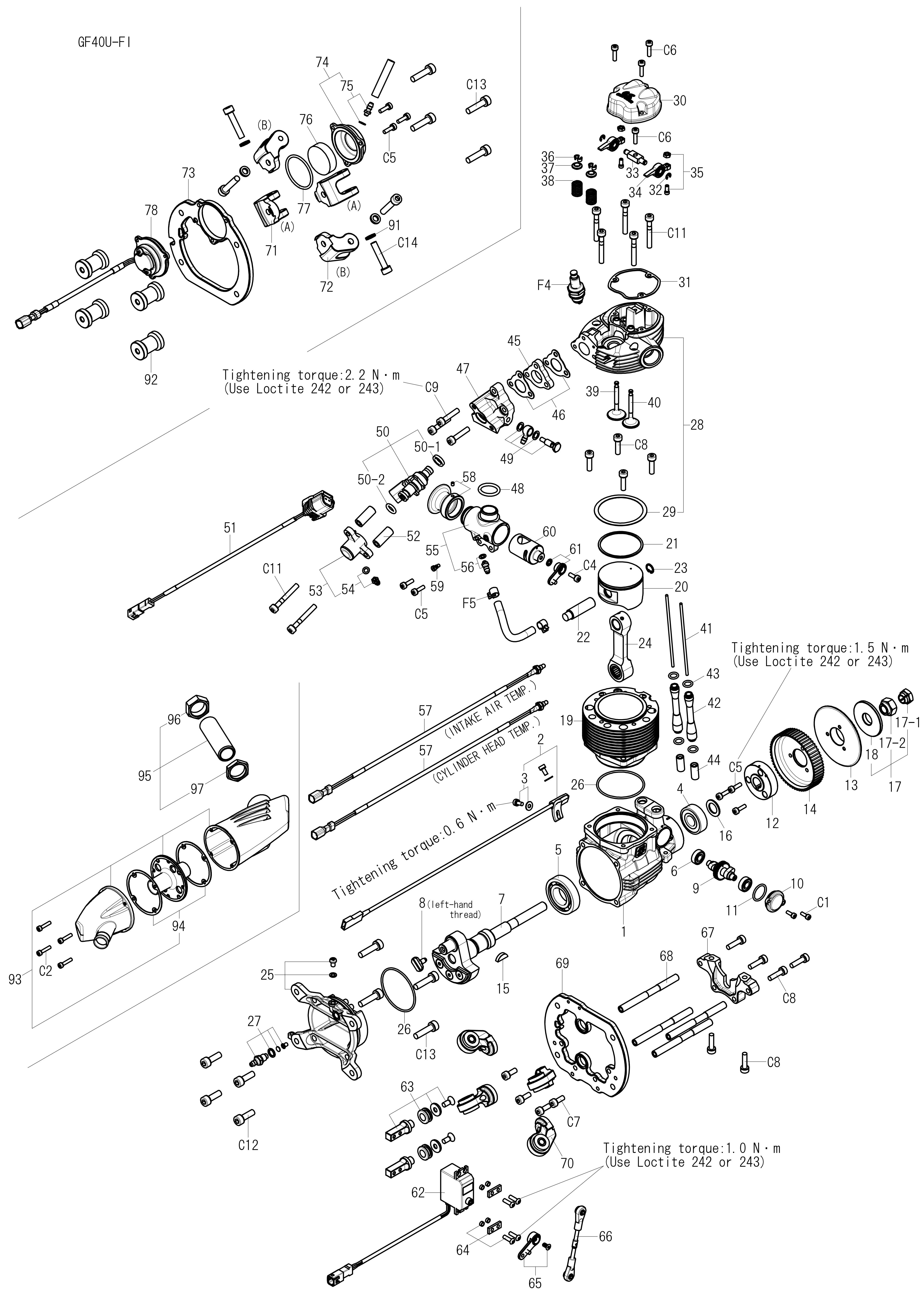
■ENGINE PARTS LIST / GF40U-FI (2/3)

No.	Code No.	Description	
51	4AD84014	INJECTOR WIRE HARNESS	
52	4AD84005	INJECTOR SPACER (2pcs.)	
53	4AD83300	INJECTOR COUPLER GF40U	
54	4AD81950	FUEL INLET (1set)	
55	4AD81100	THROTTLE BODY GF40U	
56	4AD81950	FUEL INLET (1set)	
57	54056014	ST-02 TEMPERATURE SENSOR (1pcs.)	
58	4AD12000	VELOCITY STACK GF40U	
59	45581820	ROTOR GUIDE SCREW	
60	4AD81200	THROTTLE VALVE	
61	4AD81400	THROTTLE ARM	
62	4AD81221	THROTTLE SERVO	
63	4AD81202	THROTTLE SERVO MOUNT (1pcs.)	
64	4AD81205	THROTTLE SERVO PLATE (1pcs.)	
65	4AD81401	THROTTLE SERVO HORN	
66	4AD81225	THROTTLE LINK ROD	
67	4AD50010	GENERATOR MOUNT GF40U	
68	4AD50011	REINFOCING BEAM (1pcs.)	
69	4AD28000	MOUNTING PLATE (F)	
70	4AD28002	ENGINE MOUNT GF40U (1pcs.)	
71	4AD28003	ENGINE BRACKET (A) (1pcs.)	
72	4AD28004	ENGINE BRACKET (B) (1pcs.)	
73	4AD28001	MOUNTING PLATE (R)	
74	4AD69401	OIL CATCH FILTER CASE	
75	4AD81950	FUEL INLET (1set)	
76	72403121	OIL CATCH FILTER (3pcs.)	
77	84323000	O-RING	
78	4AD69409	MANIFOLD PRESSURE SENSOR	
91	55500004	NORD LOCK WASHER M5 (10pcs.)	
92	74003540	M5 STAND OFF ENGINE MOUNT 1″ 25.4mm (4pcs./1sets)	
93	49425100	SILENCER BODY F-6040	
94	44525110	SILENCER BODY GASKET (2pcs.)	
95	4AD25200	EXHAUST HEADER PIPE ASSY GF40U	
96	4AD26000	EXHAUST HEADER PIPE NUT(M16) t=7mm	
97	44525210	EXHAUST HEADER PIPE NUT(M16) t=4mm	
C1	79871020	CAP SCREW SET M2.6X7 (10pcs./set)	
C2	79871040	CAP SCREW SET M2.6X12 (10pcs./set)	
C3	79871109	CAP SCREW SET M3.0X 6 (10pcs./set)	
C4	79871110	CAP SCREW SET M3.0X 8 (10pcs./set)	
C5	79871120	CAP SCREW SET M3.0X10 (10pcs./set)	
C6	79871140	CAP SCREW SET M3.0X12 (10pcs./set)	
C7	79871410	CAP SCREW SET M4.0X10 (10pcs./set)	
C8	79871415	CAP SCREW SET M4.0X15 (10pcs./set)	
C9	79871420	CAP SCREW SET M4.0X20 (10pcs./set)	
C10	79871425	CAP SCREW SET M4.0X25 (10pcs./set)	
C11	79871430	CAP SCREW SET M4.0X30 (10pcs./set)	
C12	79871515	CAP SCREW SET M5.0X15 (10pcs./set)	
C13	79871520	CAP SCREW SET M5.0X20 (10pcs./set)	
C14	79871525	CAP SCREW SET M5.0X25 (10pcs./set)	
E1	75003200	EC-11 ENGINE CONTROL UNIT	
E2	75000007	MOUNT COLLAR EC-11 (4pcs.)	
E3	75000204	ECU WIRE HARNESS (A) EC-11	
E4	75000205	ECU WIRE HARNESS (B) EC-11	
E5	75001010	POWER SUPPLY CORD EC-11	

■ENGINE PARTS LIST / GF40U-FI (3/3)

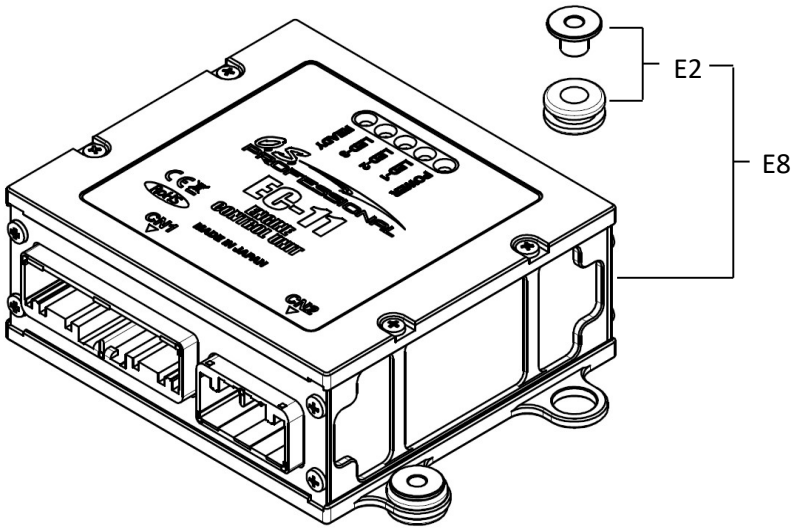
No.	Code No.	Description	
E6	75001013	SERIAL SIGNAL CONVERTER	
E7	75000206	CAN COMMUNICATION CORD	
E8	75003201	EC-11 ECU	
F1	75001009	PUMP CONNECTION CORD (50cm)	
F2	74002F10	IGNITION MODULE (IG-08A)	
F3	54056001	SOCKET WRENCH FOR TEMPERATURE SENSOR	
F4	71669000	SPARK PLUG CM-6(NGK)	
F5	70000001	HOSE CLIP 6 (5pcs.)	
F6	78300000	GASOLINE FUEL FILTER S	
F7	71531010	NON-BUBBLE WEIGHT S	
F8	70000002	CONECTOR LOCK (5pcs.)	
F9	28382303	FLUORINE(ETFE) RESIN TUBING (2m)	
F10	72200210	VALVE ADJUSTING TOOL KIT GF	
G1	54062000	OGA-100 KIT FOR GF40U-FI	
G2	51040120	OGA-100A GENERATOR	
G3	54059001	GENERATOR ADAPTOR (F)	
G4	4A632000	BEARING	
G5	54059002	GENERATOR ADAPTER (R) OGA-100A	
G6	4AD50012	GENERATOR SUPPORT 100W (F) GF40U	
G7	4AD50016	GENERATOR SPACER 4.5 (2pcs.)	
G8	4AD50013	GENERATOR SUPPORT 100W (R) GF40U	
G9	54059006	URETHANE BUSH	
G10	4AD50017	GENERATOR SPACER 15 (2PCS)	
G11	54062003	DRIVEN PULLEY (12T) OGA-100	
G12	54062005	BELT	
G13	54055000	REGULATE RECTIFIER ORF-200	
P1	54057032	PM-02 FUEL PUMP UNIT	
P2	72500010	PUMP MOUNTING PLATE (1set)	
S1	54058013	SP-01 FUEL PRESSURE SENSOR UNIT	
S2	54058014	PRESSURE SENSOR	
S3	54058006	PRESSURE SENSOR ADAPTER	
S4	54058007	PRESSURE SENSOR BLOCK	
S5	54058010	PRESSURE RELEASE VALVE	
S6	4AD81950	FUEL INLET (1set)	

GF40U-FI



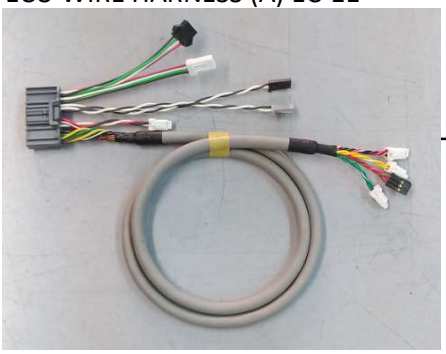
Tightening torque:2.2 N・m
(Use Loctite 242 or 243)
Tightening torque:1.5 N・m
(Use Loctite 242 or 243)
Tightening torque:0.6 N・m
Tightening torque:1.0 N・m
(Use Loctite 242 or 243)
(INTAKE AIR TEMP.)
(CYLINDER HEAD TEMP.)
8 (left-hand thread)
(A)
(B)

EC-11 ENGINE CONTROL UNIT



E1

ECU WIRE HARNESS (A) EC-11

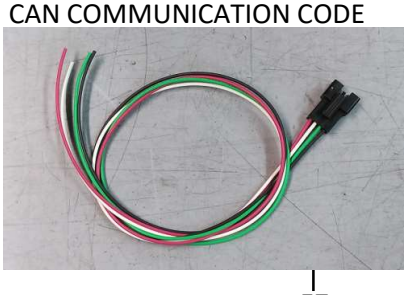


E3

POWER SUPPLY CORD EC-11

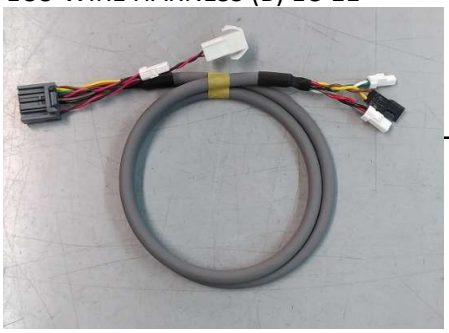
E5

CAN COMMUNICATION CODE



E7

ECU WIRE HARNESS (B) EC-11

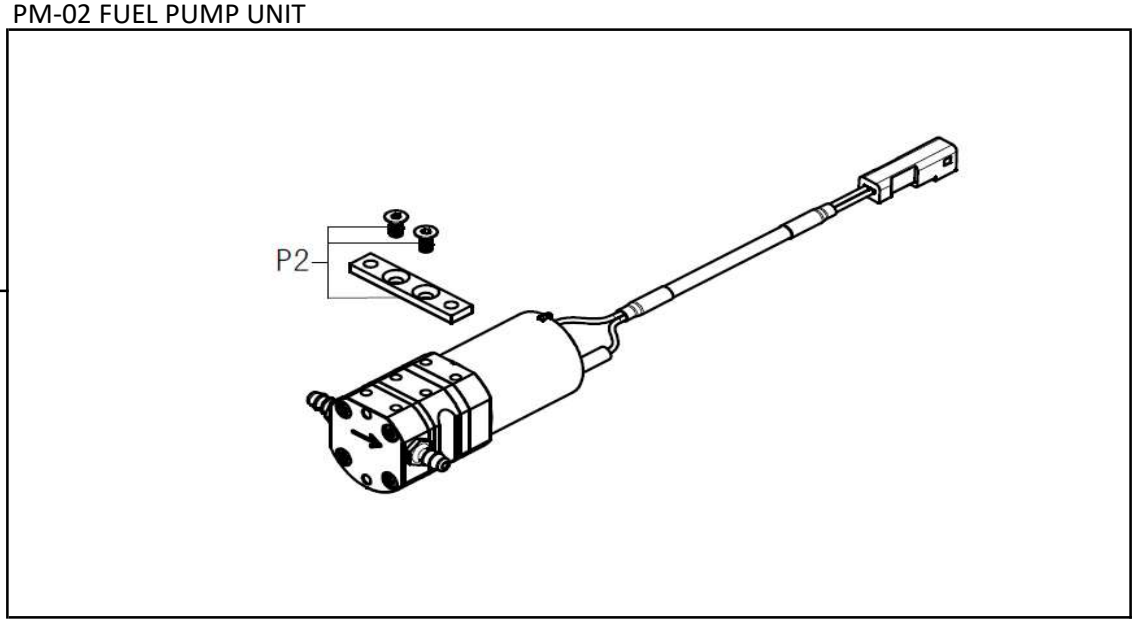


E4

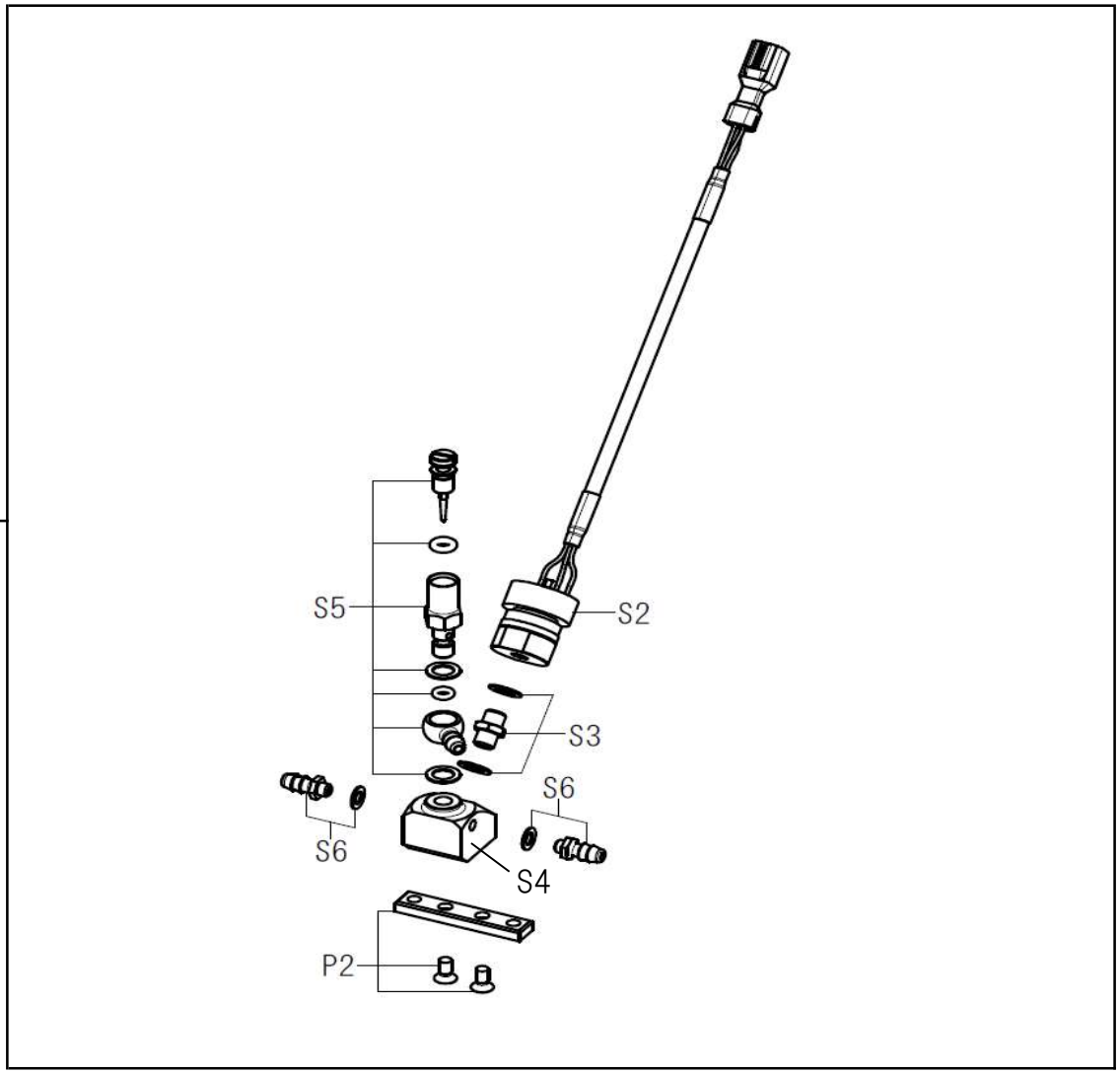
SERIAL SIGNAL CONVERTER

E6

PM-02 FUEL PUMP UNIT



SP-01 FUEL PRESSURE SENSOR UNIT



F1

PUMP CONNECTION CORD (50cm)

F2

IGNITION MODULE (IG-08A)

F3

SOCKET WRENCH FOR TEMPERATURE SENSOR

F4

SPARK PLUG CM-6(NGK)

F5

HOSE CLIP 6 (5pcs.)

F6

F7

GASOLINE FUEL FILTER S

NON-BUBBLE WEIGHT S

F8

CONECTOR LOCK (5pcs.)

F9

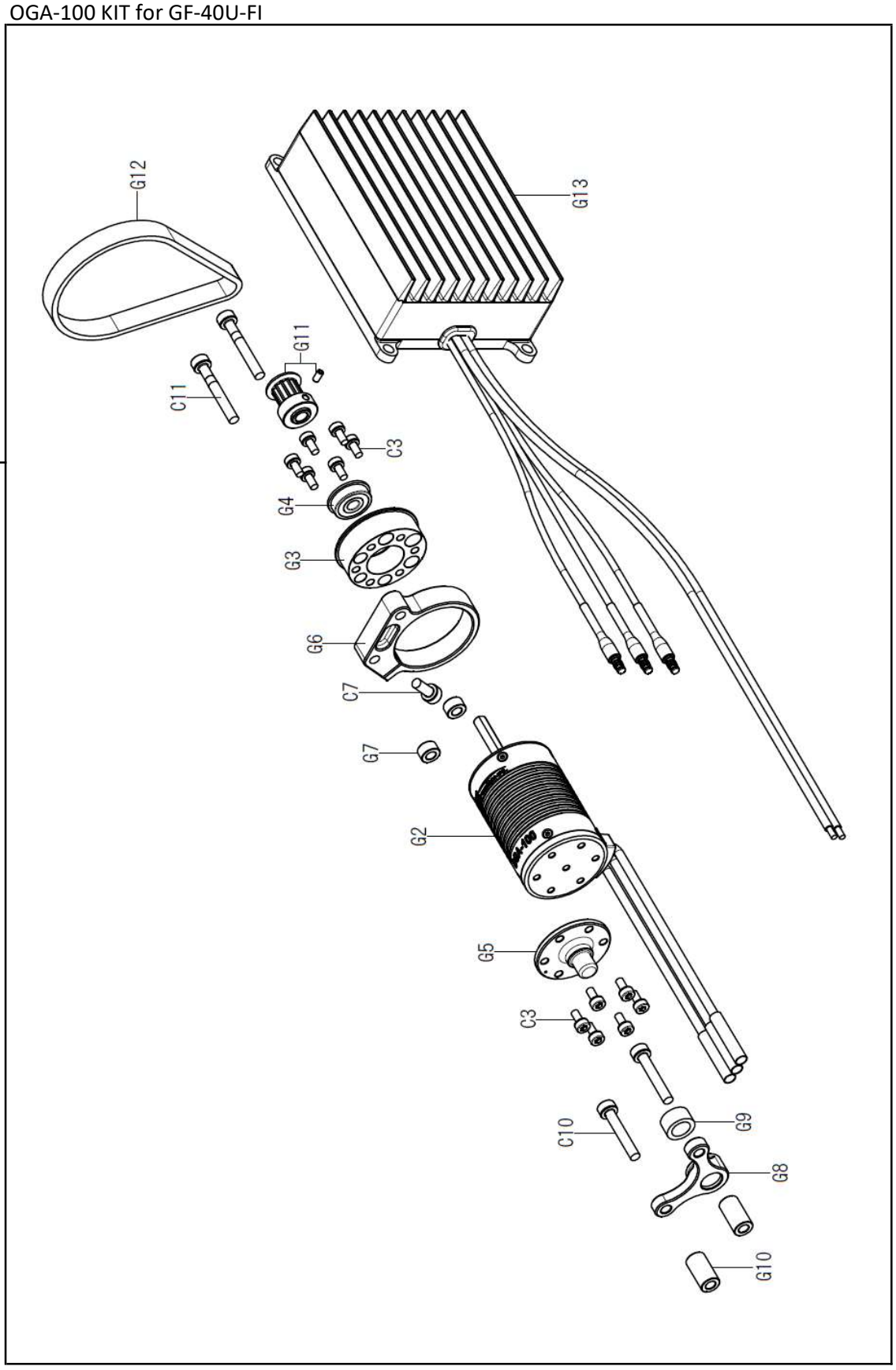
FLUORINE(ETFE) RESIN TUBING (2m)
(EIGHTRON Flexible Fluorine (ETFE) Resin Tubing Clear made by HAKKO CORPORATION / JAPAN)

F10

VALVE ADJUSTING TOOL KIT GF

OGA-100 KIT for GF-40U-FI

G1



MEMO