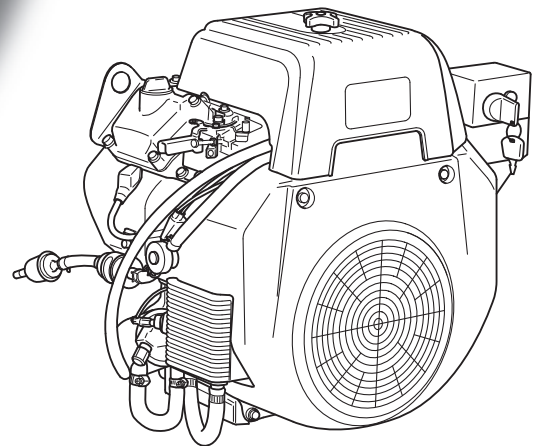




EH72 FI



Air-cooled, 4-cycle
Gasoline Engine



SERVICE INFORMATION

PREFACE

This manual covers the service information, trouble shooting procedures and so on of EH72 FI (Fuel injection) engine.

Careful observance of the instructions given herein will result in better, safer and faster service work.

For more detailed instructions of disassembling and reassembling procedures, please refer to the service manual for EH63, 64, 65 and 72.

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1. SPECIFICATIONS

Model		EH72 FI
Type		Air-Cooled, 4-Stroke, V-Twin Cylinder, Horizontal P.T.O. shaft, OHV Gasoline Engine
Number of Cylinders - Bore × Stroke	mm (in.)	2 - 84 × 65 (3.31 × 2.56)
Displacement	ml (cu.in.)	720 (43.9)
Compression Ratio		8.4
Continuous Output	kW(HP)/r.p.m.	14.9 (20.0) / 3600
Maximum Output	kW(HP)/r.p.m.	Net : 17.9 (24.0) / 3600 Gross : 19.4 (26.1) / 3600 20.9 (28.0) / 4000
Maximum Torque	N·m / r.p.m. (kgf·m / r.p.m.) (ft·lb. / r.p.m.)	52.2 / 2800 (5.32 / 2800) (38.5 / 2800)
Direction of Rotation		Counterclockwise as viewed from the P.T.O. shaft side
Cooling System		Forced air cooling
Valve Arrangement		Overhead Valve (OHV)
Lubrication		Full pressure type with oil Cooler
Lubricant		Automobile engine oil SAE #20, #30 or 10W-30; Class SE or higher
Capacity of Lubricant	L (U.S. gal.)	1.55 (0.41)
Throttle body		Electronic Fuel injection
Fuel		Automotive unleaded gasoline
Fuel Feed System		Electronic Fuel pump
Ignition System		Flywheel Magneto (Solid state)
Spark Plug		BPR5ES(NGK) or BPR4EY(NGK)
Charging Capacity	V - A	12 - 15 or 12 - 30 (Option)
Starting System		Electric Starter
Governor System		Centrifugal Flyweight type
Air cleaner		Double Element type
Dry Weight kg (lb.)	with out muffler and control box	46 (101.3)
	with STD muffler and control box	51.5 (113.4)
Dimensions (L×W×H) mm (in.)	with out muffler and control box	317×477×480 (12.5×18.8×18.9)
	with STD muffler and control box	464×499×480 (18.3×19.6×18.9)

* Specifications are subject to change without notice.

2. FEATURES

EH72 FI has been developed as a high performance model equipped with the electronic fuel injection system.

HIGHER POWER OUTPUT

has been achieved by increasing inlet air volume with larger venturi bore.

ENVIRONMENTALLY FRIENDLY

By optimizing the fuel injection management, EH72 FI has achieved approx. 11% improvement on the fuel efficiency, as well as drastic reduction on the exhaust emission.

Therefore, EH72 FI comply with CARB Tier 3 Emission Regulations in the USA.

COMPACT DESIGN

By adopting the Engine Control Unit (ECU) incorporated inside the throttle body of electronic fuel injection system, EH72 FI has achieved very compact design, which is same envelope size as carbureted engine, to keep superb mountability for machineries.

USER FRIENDLY

- Excellent startability

The newly developed electronic fuel injection system provides optimum fuel flow by sensing ambient temperature.

It realizes easy and surefire start-up performance with no choke operation, even in the low-temperature.

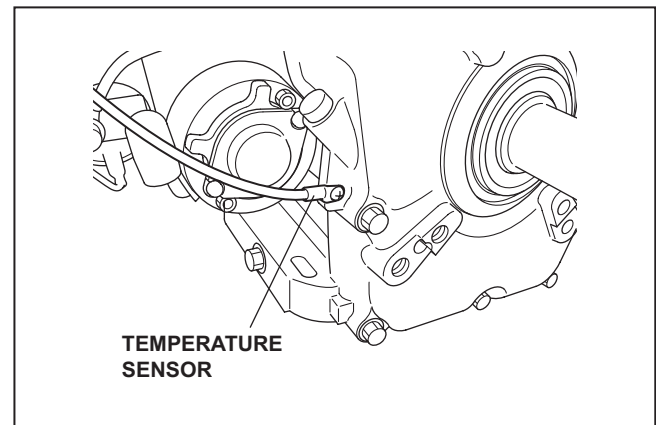
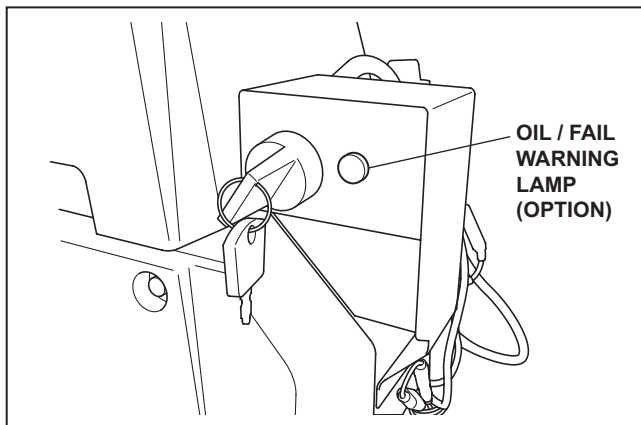
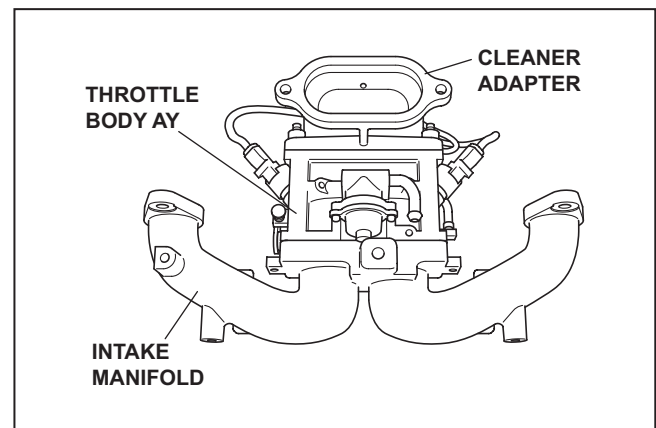
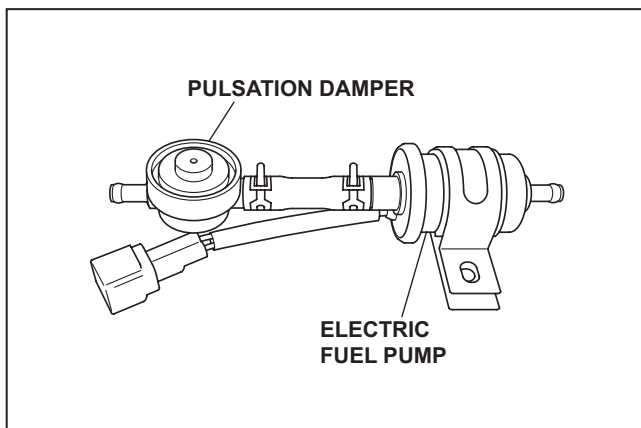
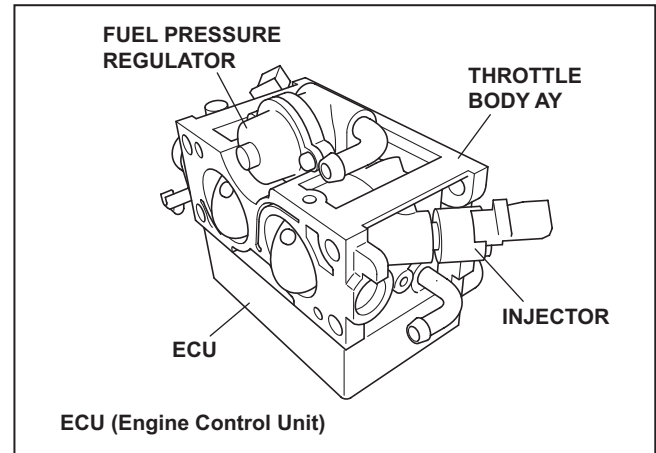
- Better response and acceleration

The electronic fuel injection system offers an excellent running performance which are less subject to external circumstances, such as changes of ambient temperature and atmospheric pressure. This means no need any manual adjustment at high altitude, such as changing main jet of carburetor.

3. DESCRIPTION OF FUEL SYSTEM

This engine is equipped with Electronic Fuel Injection system (FI system) integrated with ECU (Engine Control Unit).

The FI system consists of throttle body (2-barrel), ECU, MAP (Manifold Absolute Pressure) sensor, injector, fuel pressure regulator, temperature sensor, electric fuel pump, and pulsation damper.



The fuel system is calibrated after careful testing for optimum all-round performance (including starting, acceleration, fuel consumption, output power characteristics).

The throttle body monitors manifold absolute pressure and engine temperature at start up and performs the choke function automatically.

While the engine is in operation, the throttle body monitors engine speed, manifold absolute pressure, and engine temperature to ensure proper engine performance.

(For further information, refer to page 16, section “6 .THROTTLE BODY”.)

4. DISASSEMBLY AND REASSEMBLY

4-1 PREPARATIONS AND SUGGESTIONS

When disassembling the engine, memorize the locations of individual parts so that they can be reassembled correctly. If you are uncertain of identifying some parts, it is suggested that tags be attached to them.

Have boxes ready to keep disassembled parts by group.

To prevent losing and misplacing, temporarily assemble each group of disassembled parts.

Carefully handle disassembled parts, and clean them with washing oil if necessary.

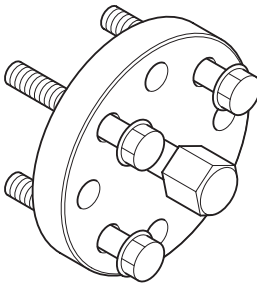
Use the correct tools in the correct way.

When disconnecting electric wirings, be sure to hold and disconnect the connector housing.

4-2 SPECIAL TOOLS

No Special Tool is needed for disassembling and reassembling the engine.

For pulling off the flywheel, universal type puller being popular in the market place as shown in the illustration is needed.

Description	Parts number
<div>Flywheel puller for pulling off the flywheel</div> <div></div> <div>Flywheel puller with bolt</div>	<div>228-95001-17</div>

4-3 DISASSEMBLY PROCEDURES (DIFFERENCE)

Step	Parts to remove	Remarks and procedures	Parts Fasteners
8	Choke lever	Choke lever not applicable.	
9	Governor rod	(1) Remove the governor rod spring from rod holder. (2) Pick up the rod holder and remove the governor rod. (See Fig.4-1) (3) Remove the governor rod and the rod spring from the governor lever. (4) Loosen the bolt and remove the governor lever.	M6 bolt and washer : 1pc.

STEP 9

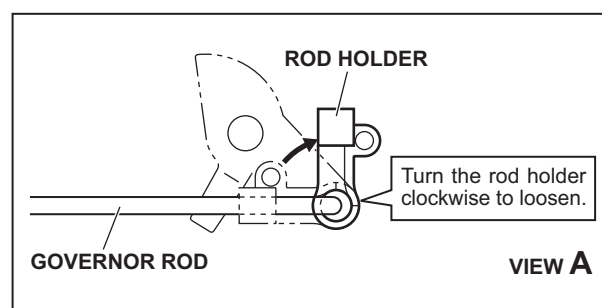
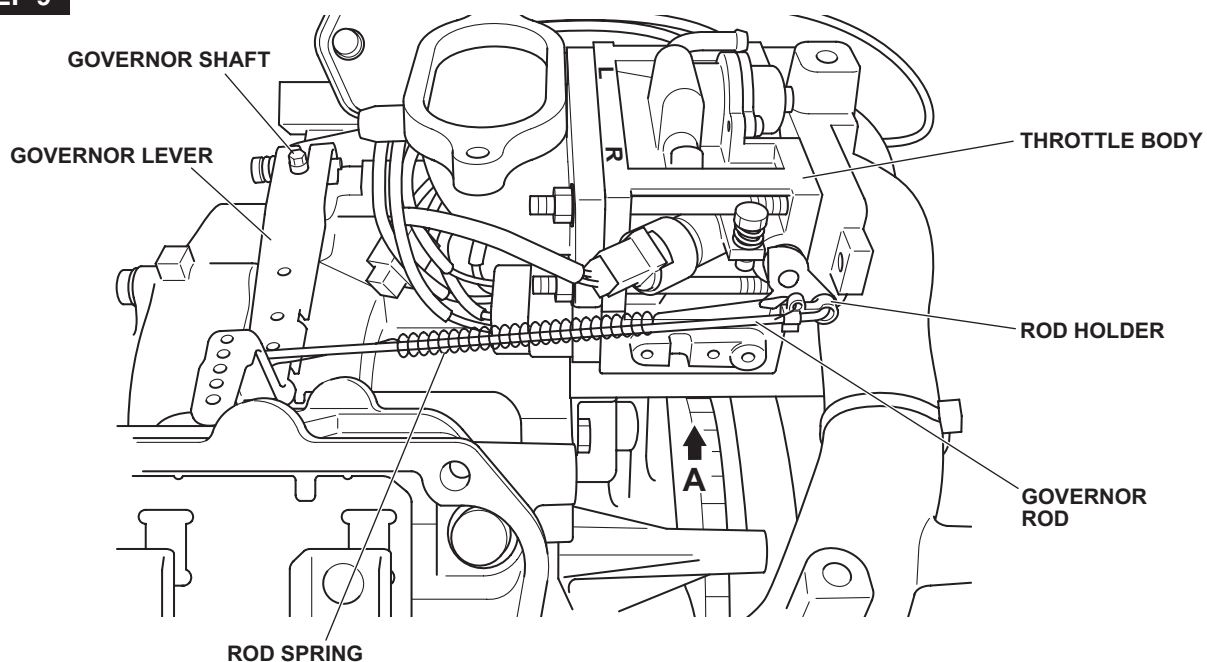
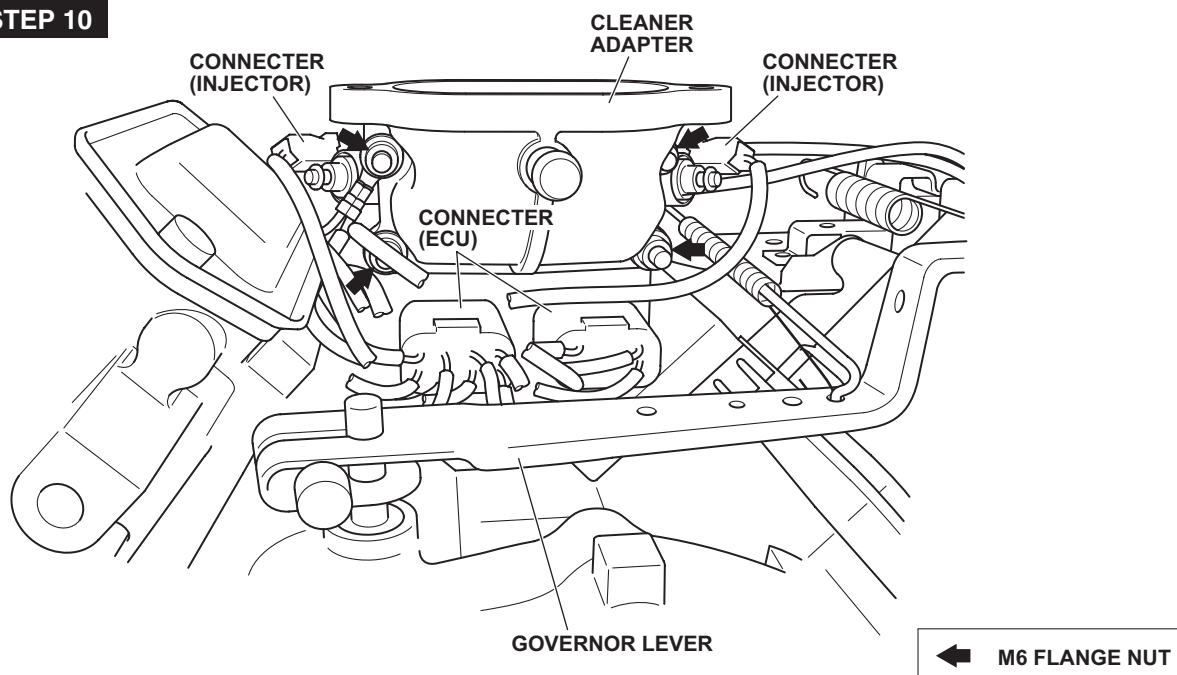


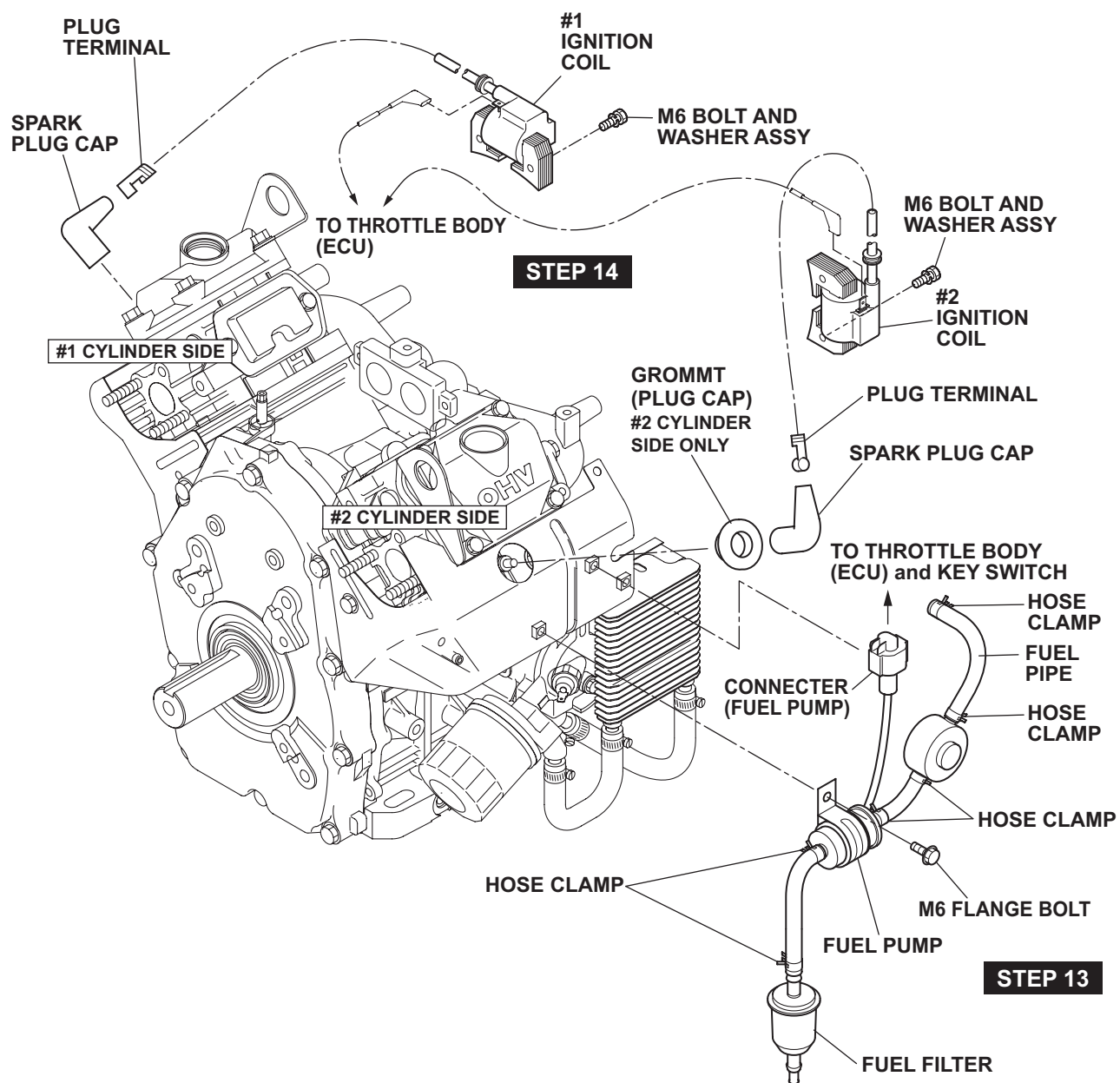
Fig. 4-1

Step	Parts to remove	Remarks and procedures	Parts Fasteners
10	Throttle body	<p>(1) Disconnect the two connectors from ECU under the throttle body.</p> <p>(2) Disconnect the two connectors from the two injectors on the throttle body.</p> <p>(3) Remove the nuts, adapter and throttle body from the intake manifold.</p>	M6 Flange nut : 4pcs.

STEP 10

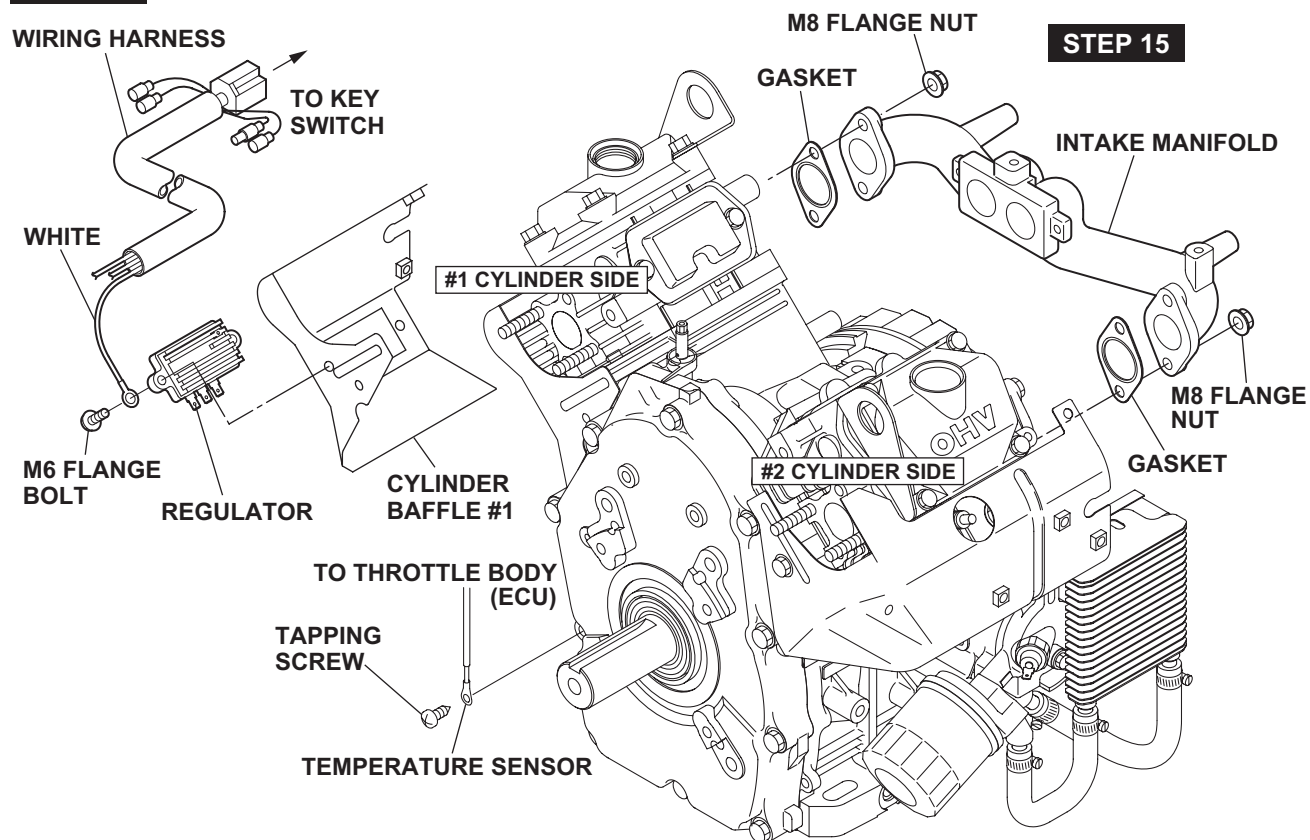


Step	Parts to remove	Remarks and procedures	Parts Fasteners
13	Fuel pump	(1) Disconnect the connector places from fuel pump wiring harness 2. (2) Remove fuel pump ASSY and detach bracket.	M6 x 12 Flange bolt : 1 pc.



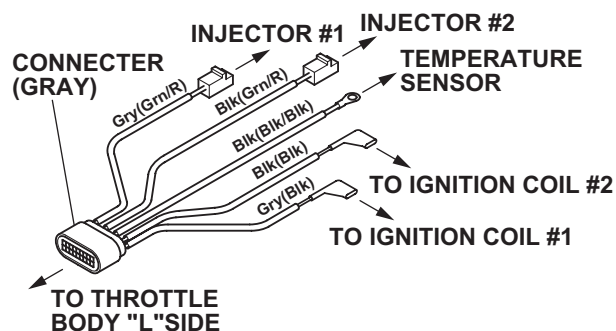
Step	Parts to remove	Remarks and procedures	Parts Fasteners
16	Regulator and Wire CP	(1) Disconnect wire connector from regulator, and then remove regulator from #1 cylinder baffle. (2) Remove temperature sensor from main bearing cover. (3) Disconnect the wiring harness 1. (injector #1 / 2, temperature sensor, ignition coil #1 / 2) (4) Disconnect the wiring harness 2 (fuel pump, ground, warning lamp, ignition coil ground)	M6 x 12 Flange bolt : 2 pcs. Tapping screw : 1pc.
21	Spark plug	Take care the spark plug is hot just after stopping engine.	NGK : BPR5ES or BPR4EY

STEP 16

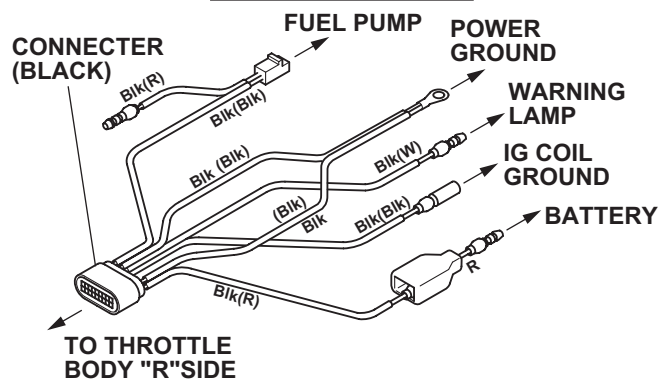


STEP 16

WIRING HARNESS 1



WIRING HARNESS 2



WIRING COLOR CODE

Blk : Black Gry : Gray R : Red Grn : Green W : White

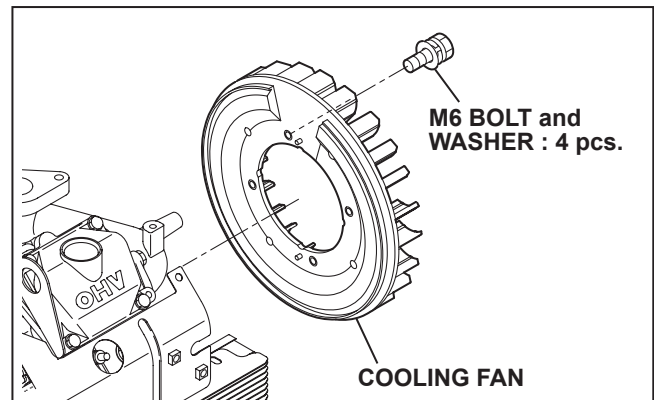
() is inside wiring color code.

4-4 REASSEMBLY PROCEDURES (DIFFERENCE)

20) COOLING FAN

Attach cooling fan onto flywheel.
M6 x 16 bolt & washer : 4 pcs.

Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.1 - 6.5 ft•lb.)

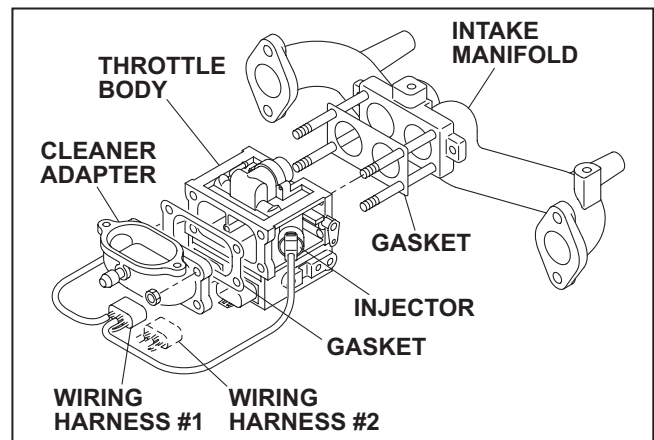


21) THROTTLE BODY

- (1) Replace the gasket of manifold with a new one and mount the throttle body on the intake manifold.
- (2) Replace the gasket of throttle body with a new one and mount the cleaner adapter on the throttle body.

M6 FLANGE NUT : 4pcs.

Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.1 - 6.5 ft•lb.)



- (3) Connect the connectors from ECU to the injectors.

22) IGNITION COIL and WIRE CP

- (1) Temporally fit ignition coil to crankcase.

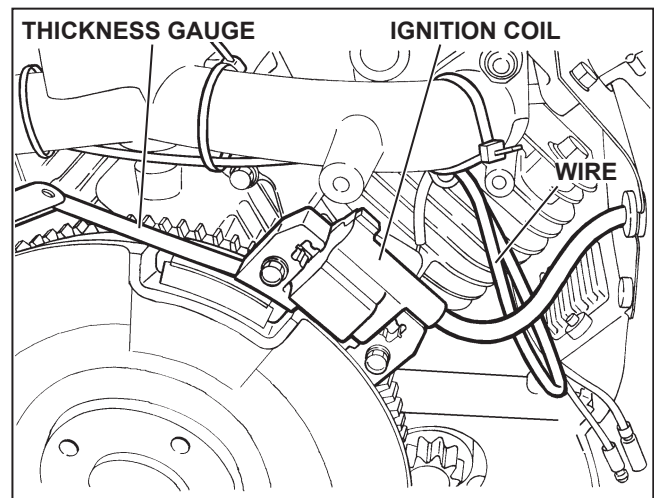
Adjust air gap between ignition coil and flywheel using a thickness gauge and tighten bolts.

Ignition coil air gap
0.3 - 0.5 mm (0.012 - 0.020 in.)

M6 x 30 bolt & washer : 4pcs.

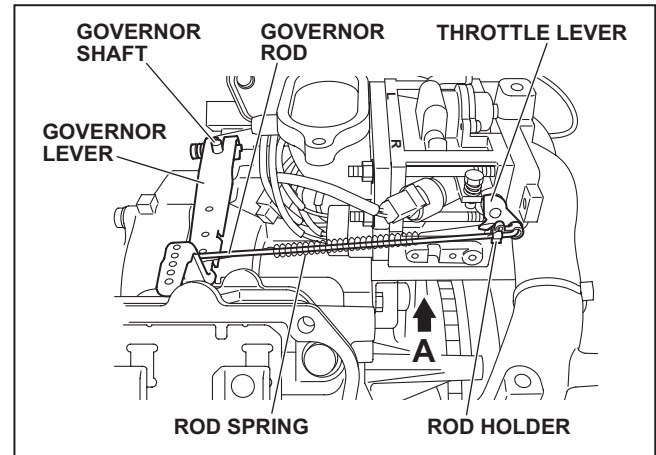
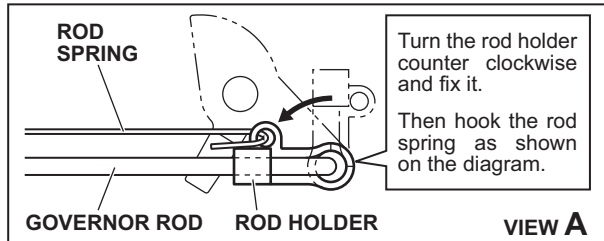
Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.1 - 6.5 ft•lb.)

- (2) Connect wiring from ECU to the primary terminal of ignition coil.
- (3) Clamp the wiring harness with wire bands to the intake manifold.



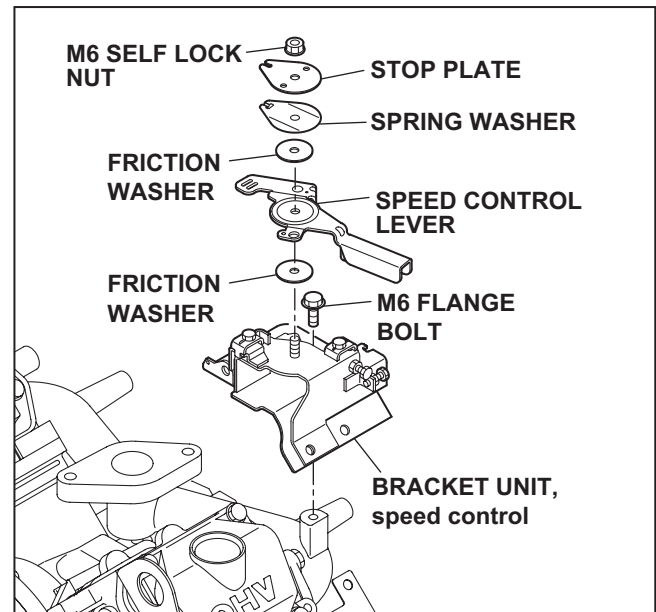
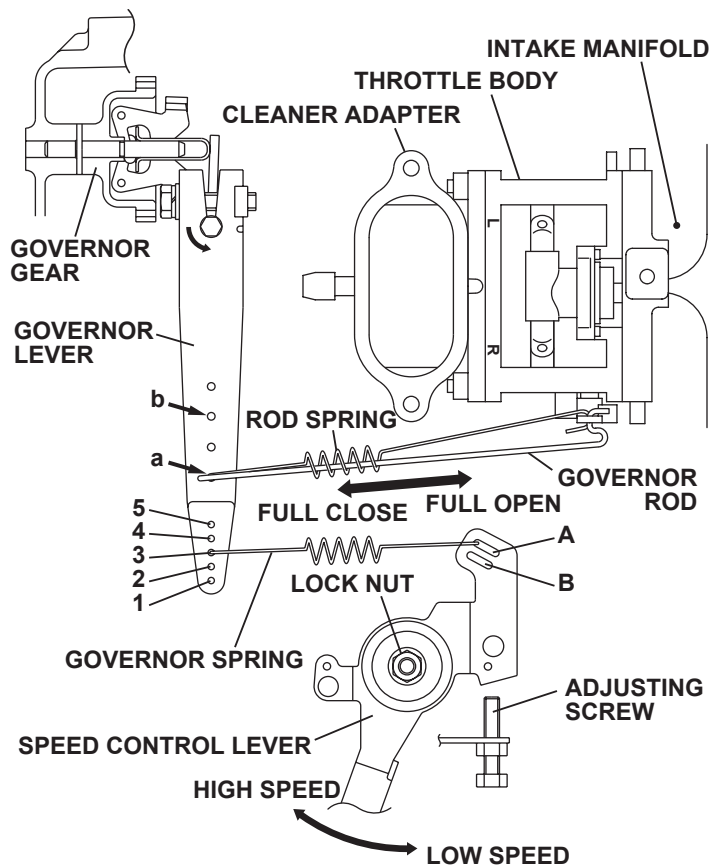
23) GOVERNOR LEVER

Attach governor rod and rod spring between governor lever and throttle body throttle lever, and insert the governor lever to governor lever shaft. Tighten locking bolt temporarily.



24) SPEED CONTROL LEVER

- (1) Install speed control bracket onto intake manifold.
- (2) Attach return spring, spacer, friction washer, wing nut, etc. to speed control lever as shown in the illustration.
- (3) Connect governor spring to governor lever and speed control lever.

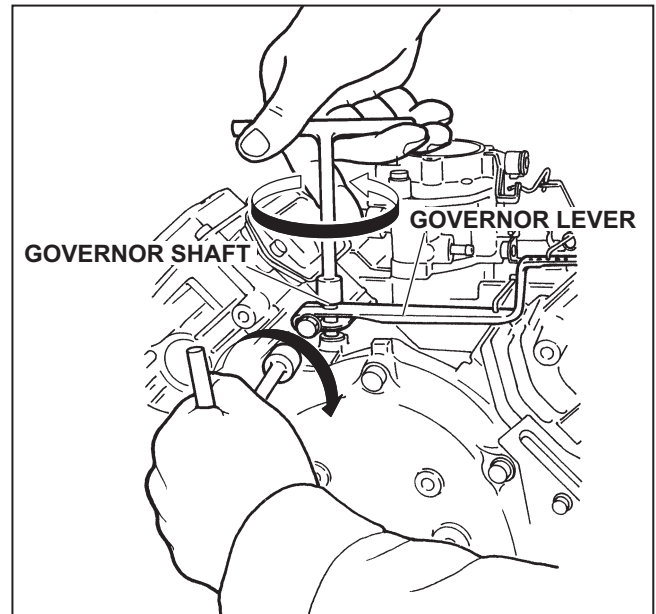


Fitting location of governor rod and governor spring

	50 Hz	60 Hz
EH72 FI	NA	A-2(a)

25) ADJUST GOVERNOR SYSTEM

- Governor system is centrifugal flyweight type. Governor weight is installed into governor gear driven by crankshaft. Governor weight movement is transferred to throttle lever via governor shaft and lever.
 - Engine speed is maintained at the constant speed by throttle valve opening and closing operation in accordance with load condition of engine.
- (1) Push speed control lever all the way to the high speed position and fix it by tightening nut.
 - (2) Check that governor lever is pulled by governor spring and throttle valve is fully open.
 - (3) Turn governor shaft counterclockwise all the way and tighten lock bolt to secure the lever on the shaft.



26) BLOWER HOUSING

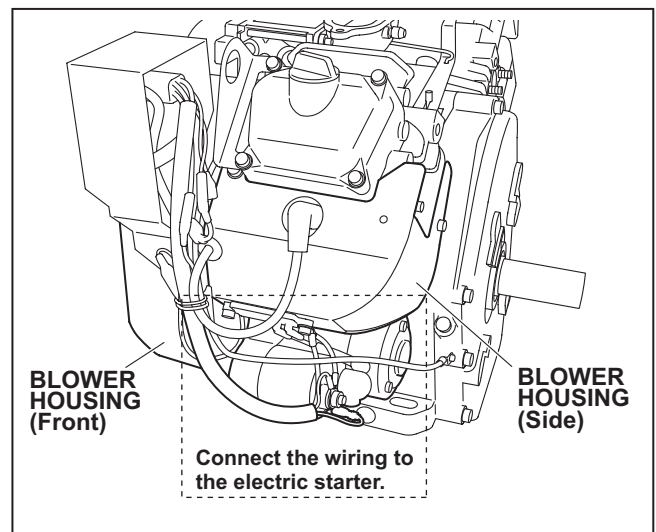
Attach blower housing to crankcase with control box commonly fixed.
Connect fuel pipes onto blower housing.

BLOWER HOUSING(Front)
M6 x 14 Flange bolt : 4 pcs.

Tightening torque
3.9 - 5.9 N•m (40 - 60 kgf•cm) (2.9 - 4.3 ft•lb.)

BLOWER HOUSING(Side)
M6 x 18 Flange bolt : 2 pcs.
M6 x 14 Flange bolt : 2 pcs.

Tightening torque
2.9 - 4.9 N•m (30 - 50 kgf•cm) (2.2 - 3.6 ft•lb.)



27) FUEL PUMP and FUEL PIPE

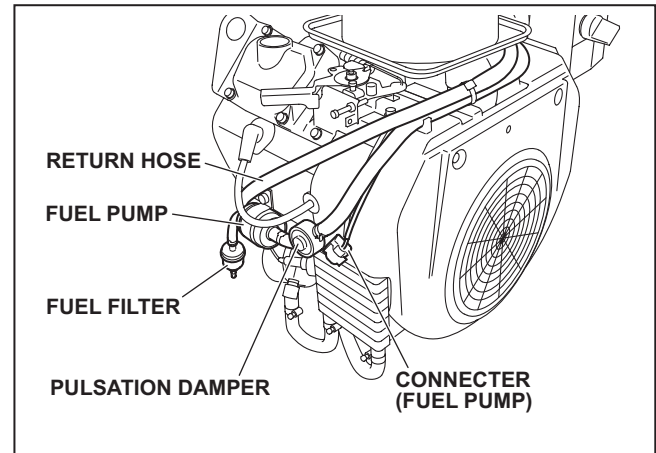
- (1) Install fuel pump bracket onto #2 cylinder baffle.

FUEL PUMP

M6 x 12 Flange bolt : 1 pc.

Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

- (2) Connect the wiring to the fuel pump.
- (3) Connect fuel pipe between throttle body and fuel pump.



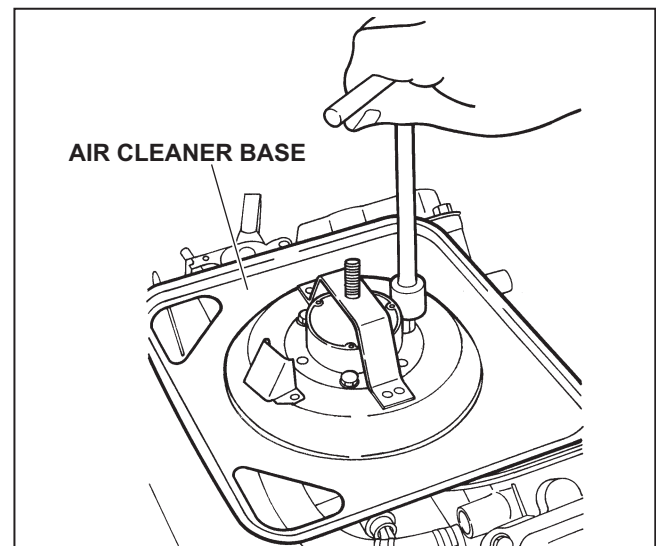
28) AIR CLEANER and BREATHER PIPE

- (1) Connect breather pipe to air cleaner base.
- (2) Fit air cleaner base onto throttle body.

M6 x 12 Flange bolt : 3 pcs.

Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

- (3) Connect breather pipe to #1 cylinder head.
- (4) Set air cleaner element along with urethane foam onto base.
- (5) Install air cleaner cover with knob.



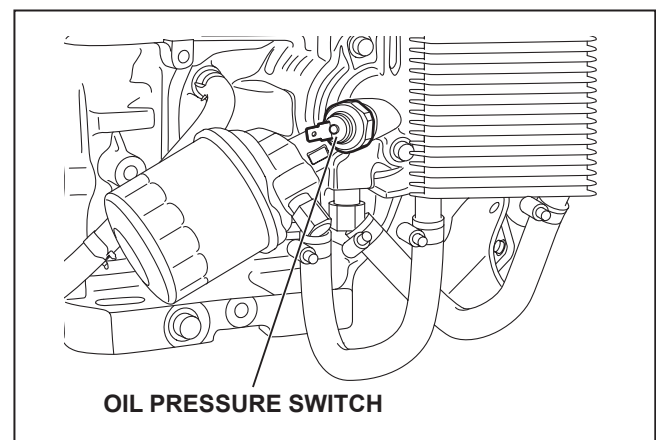
29) OIL PRESSURE SWITCH

- (1) Install oil pressure switch onto adapter (Oil cooler).

Tightening torque
5.9 - 9.8 N•m (60 - 100 kgf•cm) (4.3 - 7.2 ft•lb.)

NOTE ;
Not to tighten excessively.

- (2) Connect the wiring to the oil pressure switch.



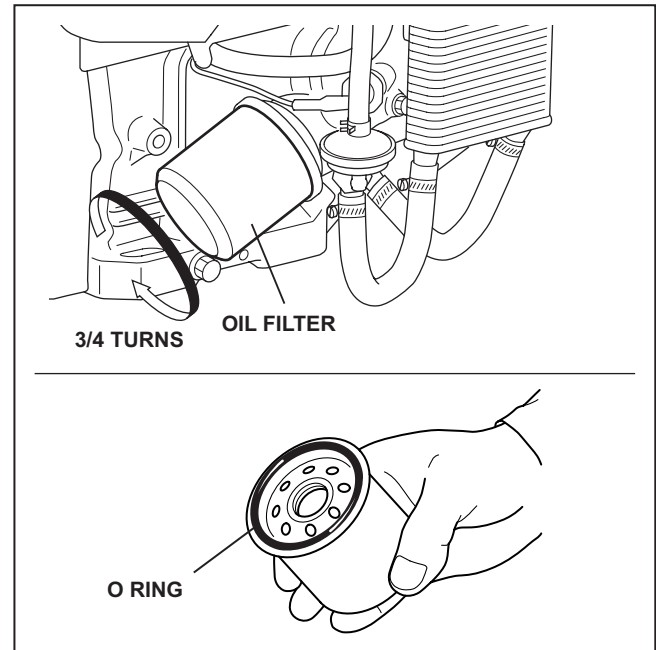
30) OIL FILTER

Apply oil to O-ring and install oil filter by tightening about 3/4 turns after attaching crankcase surface.

Tightening torque
9.9 - 14.7 N•m (100 - 150 kgf•cm) (16.3 - 19.8 ft•lb.)

NOTE ;

Start engine after assembling, and check for no oil leakage from oil filter.



31) MUFFLER

- (1) Install Muffler bracket onto Cylinder head.
M8 x 20 bolt & washer : 2 pcs.

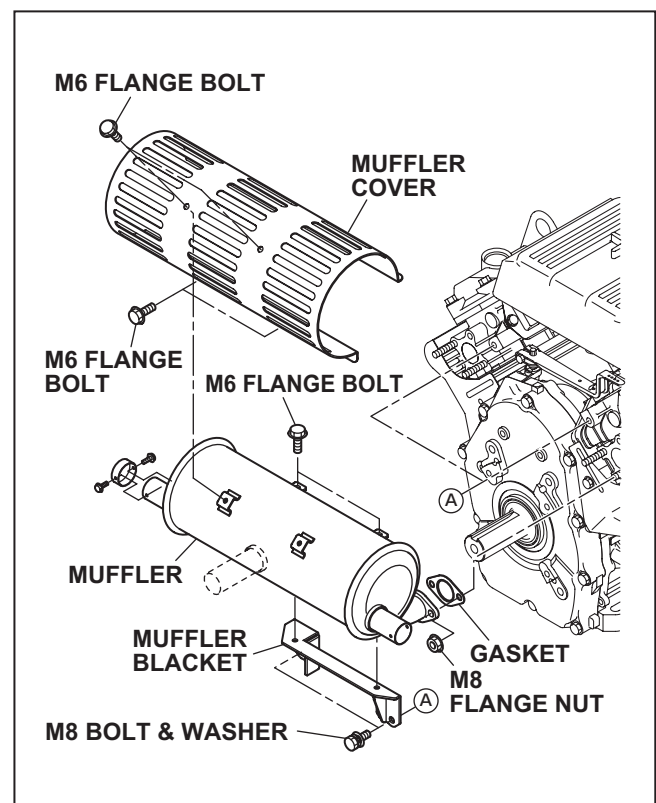
Tightening torque
16.6 - 18.6 N•m (170 - 190 kgf•cm) (12.3 - 13.7 ft•lb.)

- (2) Install Muffler onto Muffler bracket and Cylinder head.
M8 flange nut : 4 pcs.

Tightening torque
16.6 - 18.6 N•m (170 - 190 kgf•cm) (12.3 - 13.7 ft•lb.)

- (3) Install Muffler cover onto Muffler.
M6 Flange bolt : 6 pcs.

Tightening torque
6.8 - 8.8 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)



32) FINAL CHECK

Be sure to check loosen bolts and nuts, and also electric wiring connections.

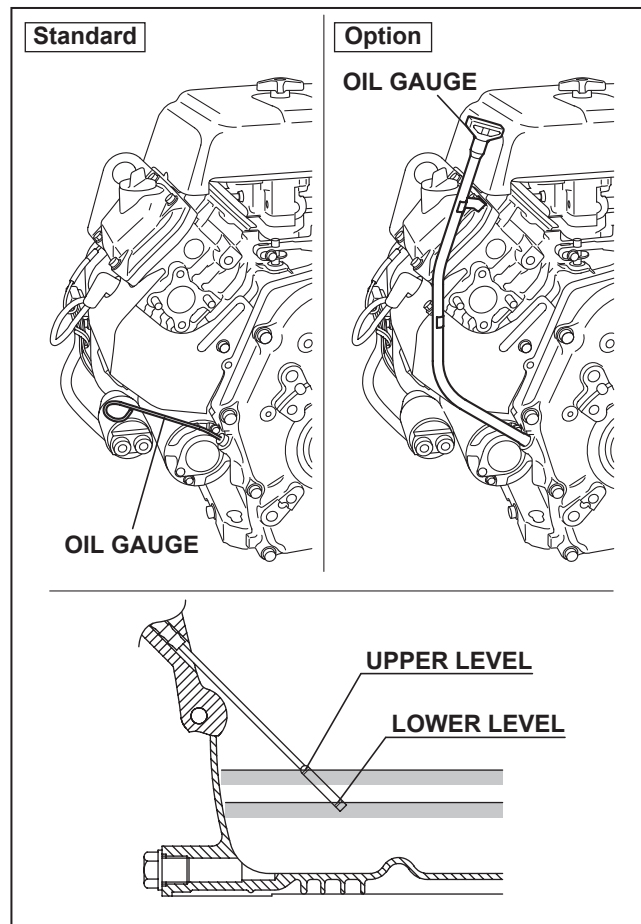
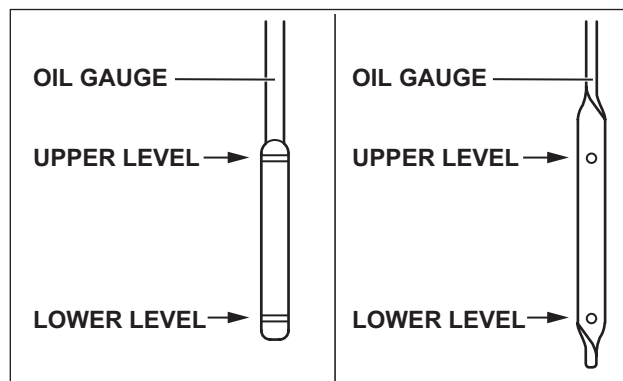
33) ENGINE OIL

Refill engine oil and start the engine. Engine oil will be lubricated oil passages and oil filter. Check the engine oil level and refill again to the upper level of oil level gauge.

Oil Capacity
1.55 liter (0.41 U.S. gal.)

NOTE ;

- * Check the oil level with the oil gauge inserted.
- * Use “SE” (API classification) or higher grade engine oil.



4-5 BREAK-IN OPERATION

An engine that has been completely overhauled by being fitted with a new piston, rings, valves and connecting rod should be thoroughly RUN-IN before being put back into service. Good bearing surfaces and running clearances between the various parts can only be established by operating the engine under reduced speed and loads for a short period of time.

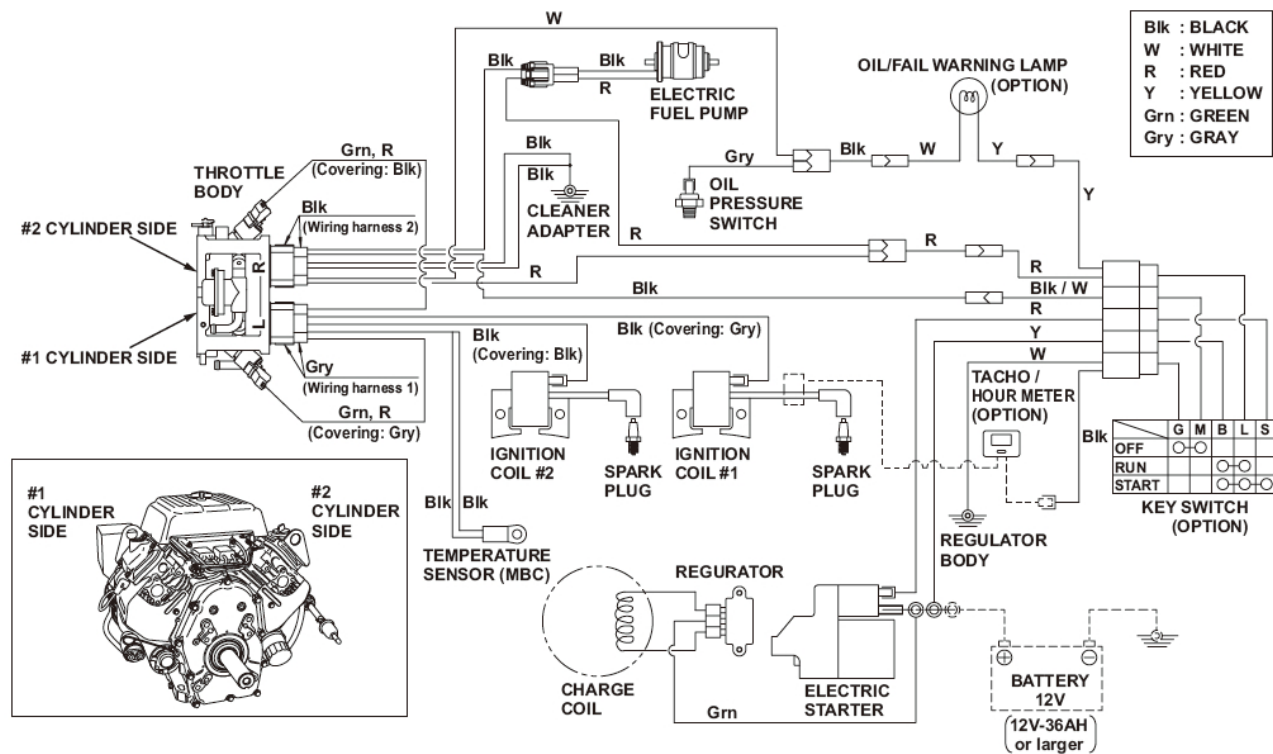
While the engine is being tested, check for oil leaks.

Make final carburetor adjustment and regulate the engine operating speed.

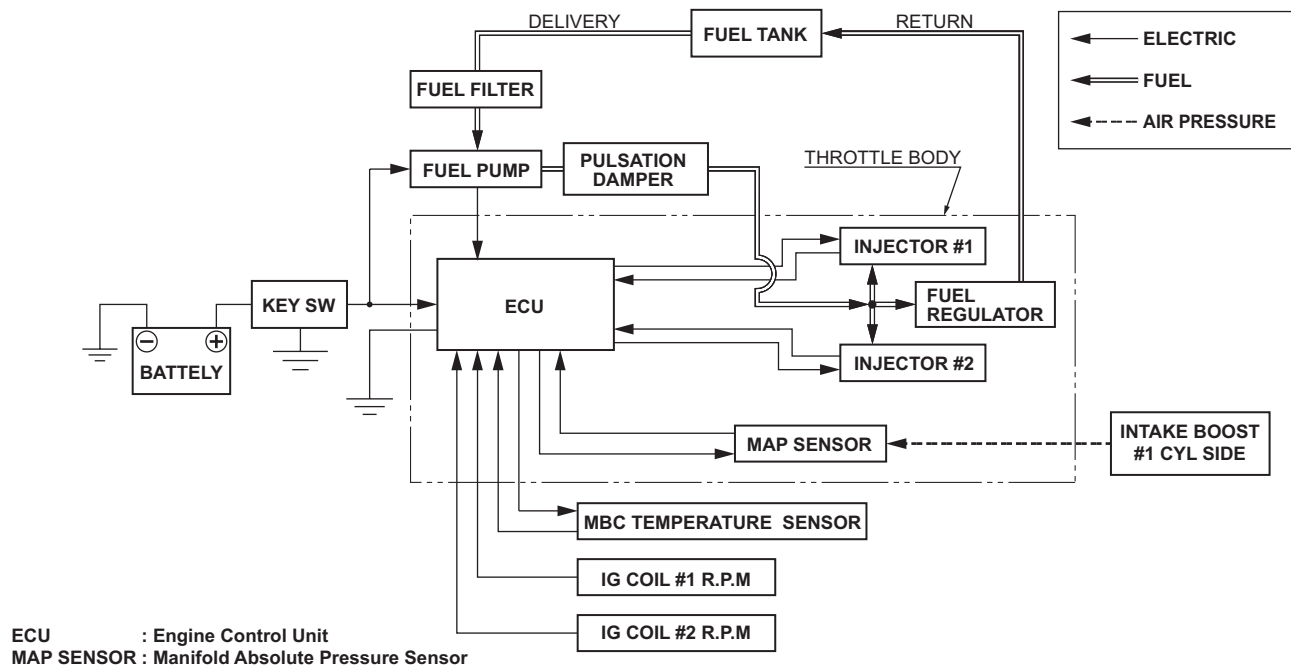
STEP	EH72 FI	Engine speed (rpm)	Time (minute)
1	No Load	2500	10
2		3000	10
3		3600	10
4	7.5kW (10.0HP)	3600	30
5	14.9kW (20.0HP)	3600	30

5. DIAGRAM

WIRING



SYSTEM BLOCK



6. THROTTLE BODY

6-1 SPECIFICATIONS

This engine is equipped with Electronic Fuel Injection system (FI system) integrated with ECU (Engine Control Unit).

The FI system consists of throttle body (2-barrel), ECU, MAP (Manifold Absolute Pressure) sensor, injector, pressure regulator, temperature sensor, electric fuel pump, and pulsation damper.

The fuel system is calibrated after careful testing for optimum all-round performance (including starting, acceleration, fuel consumption, output power characteristics).

The throttle body monitors air and engine temperature at start up and performs the choke function automatically.

While the engine is in operation, the throttle body monitors engine speed, manifold absolute pressure, and engine temperature to ensure proper engine performance.

6-2 FUNCTIONS AND CONSTRUCTION

6-2-1 ELECTRIC FUEL PUMP

The electric fuel pump is located below the throttle body, and actuated by power from the DC battery. The fuel flows from the tank into the fuel pump. When the fuel pump is actuated by DC battery, the fuel is pressurized by the pump and pushed into the throttle body pressure port.

6-2-2 FUEL PRESSURE REGULATOR

After the fuel pressure port is a diaphragm-type fuel pressure regulator.

The fuel pressure regulator relieves the throttle body of any excess fuel pressure and returns excess fuel pressure back to the fuel tank through the fuel pressure return pipe.

6-2-3 FUEL INJECTOR

The throttle body pressure port feeds fuel at a regulated pressure to the fuel injectors.

Fuel is metered by the fuel injector that is actuated electronically by ECU.

The fuel is injected into the throttle bore and mixed with air from the air cleaner.

6-2-3 ENGINE CONTROL UNIT (ECU)

The ECU (engine control unit) on bottom of the throttle body is powered by DC battery. The ECU monitors engine conditions such as engine speed, absolute pressure, and engine temperature.

With these inputs, the ECU actuates the fuel injector to ensure the fuel/air mixture is of optimum concentration and is fed into the combustion chamber of the engine at the correct timing. When engine speed reached to 4,200 rpm, the ECU cuts fuel to prevent over speed.

The ECU also controls the low oil sensor system and monitors voltage of DC battery, and each wiring whether disconnecting or electrical short circuit.

6-2-4 WIRE HARNESS

The wire harness for the FI system connects key system components to the ECU.

The FI wire harness contains a temperature sensor that measures engine temperature, and connects fuel injectors, ignition coils, electric fuel pump, pressure switch, and warning lamp.

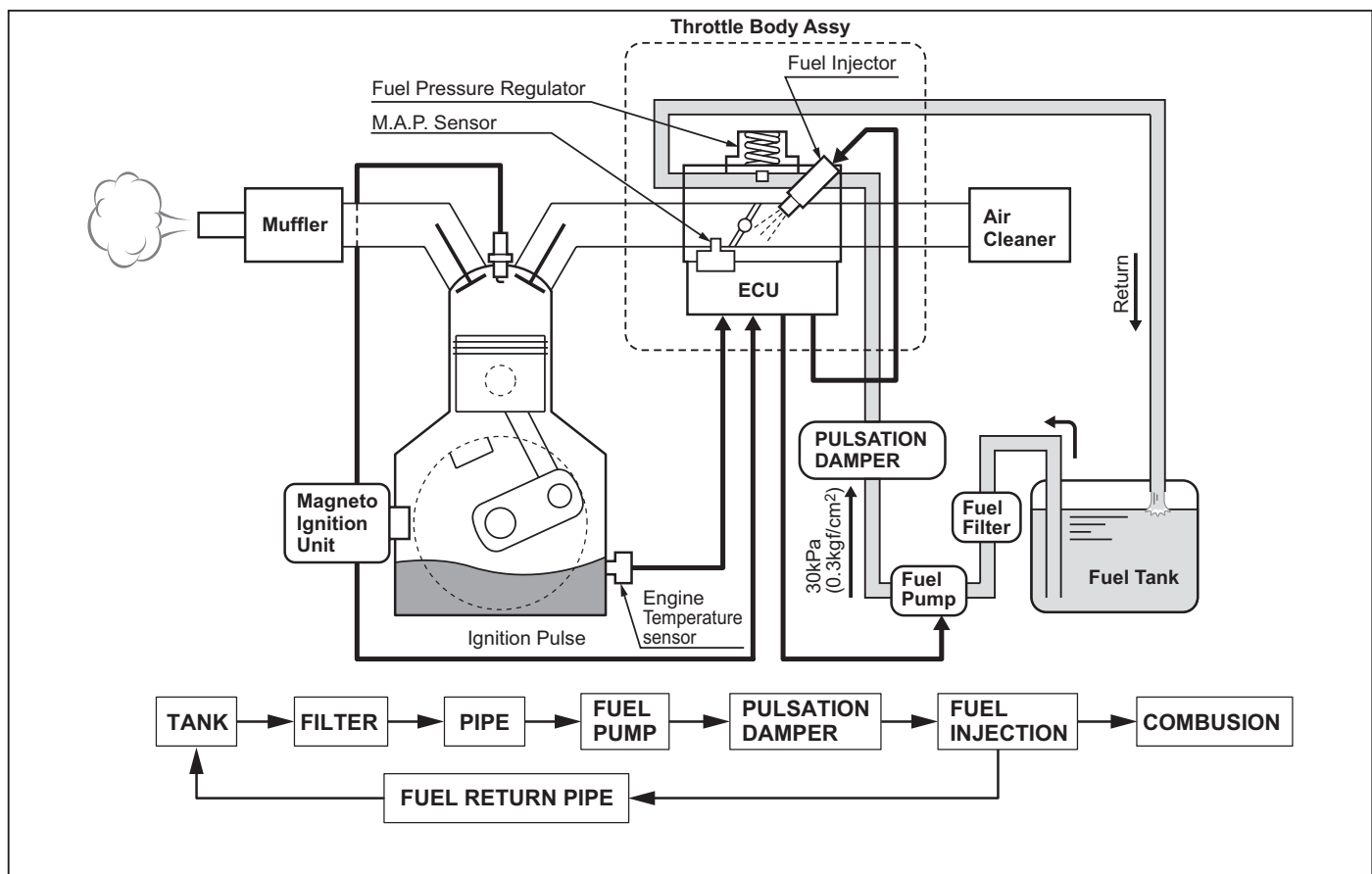
The ECU uses this input to adjust to engine various conditions and monitors for failure diagnosis.

6-2-5 CHOKE SYSTEM

The throttle body monitors air pressure and engine temperature at start up and performs the choke function automatically.

The choke system automatically adjusts for easier start of the engine in all weather conditions.

6-3 FUEL SYSTEM OUTLINE



6-4 FUEL SYSTEM TESTING AND DIAGNOSIS

Most fuel system malfunctions occur when the fuel/air ratio of the mixture is not correct.

This is usually caused by clogged fuel filters, air passages, fuel passages, or by variations in the fuel level.

To get the best possible performance from the throttle body, make sure that the fuel feed and air feed passages are free so air and fuel can flow freely through them.

The procedure for inspecting the fuel system is described below.

Run all system tests with a full tank of fresh, clean fuel.

7. INSTALLATION

Engine life, ease of maintenance and inspection, frequency of checks and repairs, and operating cost all depend on the way in which the engine is installed. Review the following instructions carefully for installing the engine.

7-1 INSTALLING

When mounting the engine, carefully examine its position, the method of connecting it to a machine, the foundation, and the method of supporting the engine.

When determining its mounting position, in particular, make sure that gasoline and oil can easily be supplied and checked, the spark plug can easily be checked, the air cleaner can easily be serviced, and that the oil can easily be discharged.

7-2 VENTILATION

Fresh air is necessary for cooling the engine and burning the fuel.

In the case the engine is operated under a hood or in a small room, temperature rise in the engine room can cause vapor lock, oil deterioration, increased oil consumption, loss of power, piston seizure, shorter engine life, etc., making it impossible to operate the engine properly. It is necessary, therefore, to provide a duct or baffle to guide cooling air to the engine to prevent recirculation of the hot air used for engine cooling, and temperature rise of the machine.

Keep the engine room temperature below 50°C even in the hottest period of the year.

7-3 EXHAUST GAS DISCHARGE

Exhaust gas is noxious. When operating the engine indoors, be sure to discharge the exhaust gas outdoors. If a long exhaust pipe is used in such a case, the internal resistance increases causing loss of engine power. Thus pipe inside diameter must be increased in proportion to exhaust pipe length.

Exhaust pipe : Less than 3 m long --- pipe inside diameter 30 mm.

Less than 5 m long --- pipe inside diameter 33 mm.

7-4 FUEL SYSTEM

When the fuel tank is mounted remote position from the engine, the height from the bottom of the fuel tank to the fuel joint of the throttle body should be 500 mm and less.

The bottom of the fuel tank can be up to 400 mm below the throttle body.

Position the fuel tank carefully because, when it is low, fuel is not fed to the throttle body, and when it is high, it can cause high pressure in the throttle body then fuel rich and high fuel consumption.

When piping the fuel, the hose should be as short as possible and attention should be paid to heat transmission, size, bending, and leakage at hose joints and so on.

Care should also be taken to prevent air lock and vapor lock. It is required that return piping to the fuel tank from the fuel pressure regulator on throttle body.

7-5 POWER TRANSMISSION TO DRIVEN MACHINES

7-5-1 BELT DRIVE

Take the following notes into consideration.

- * V-belts are preferable to flat belts.
- * The driving shaft of the engine must be parallel to the driven shaft of the machine.
- * The driving pulley of the engine must be in line with the driven pulley of the machine.
- * Install the engine pulley as close to the engine as possible.
- * If possible, span the belt horizontally.
- * Disengage the load when starting the engine.

If no clutch is used, use a belt tension pulley or the like.

7-5-2 FLEXIBLE COUPLING

When using a flexible coupling, run out and misalignment between the driven shaft and engine shaft must be minimized. Run out and misalignment tolerance are specified by the coupling manufacturer.

8. TROUBLESHOOTING

The following three conditions must be fulfilled for satisfactory engine start.

- (1) The cylinder filled with a proper fuel-air mixture.
- (2) Good compression in the cylinder.
- (3) Good spark, properly timed, to ignite the mixture.

The engine cannot be started unless these three conditions are met.

There are also other factors which make engine start difficult, e.g., a heavy load on the engine when it is about to start at low speed, and a high back pressure due to a long exhaust pipe.

The most common causes of engine troubles are given below:

8-1 NO ENGINE OPERATION

Phenomenon	Possible causes	Remedy
1. Electric starter does not operate.	1) Poor connection of key switch wiring	Check, repair or replace
	2) Wiring discontinuity between key switch and starter motor	Replace
	3) Wiring discontinuity between battery and starter motor	Replace
	4) Improper battery (low capacity) or discharged battery	Charge or replace battery
	5) Poor connection of battery terminal	Check, clean or replace
	6) Starter magnetic switch faulty	Check, clean, repair or replace
	7) Starter motor faulty	Repair or replace
	8) Crankshaft seizure	Check, repair or replace
	9) Seizure between piston and cylinder	Check, repair or replace
2. Electric starter operates, but engine does not start.	1) No fuel	Refill
	2) Poor connection or discontinuity of ignition system wirings	Check, repair or replace
	3) Electric starter faulty	Repair or replace

8-2 STARTING DIFFICULTIES

Phenomenon	Possible causes	Remedy
1. Low engine speed at starting	1) Battery discharged	Charge battery
	2) Poor connection between battery and starter motor	Clean or repair
	3) Poor connection between battery and ground	Clean or repair
	4) Electric starter faulty	Repair or replace
	5) Improper engine oil	Replace with recommended engine oil
2. Ignition system malfunction	Spark plug * Improper spark plug gap * No insulation * Carbon deposits	Adjust Replace Clean
	Ignition coil * No insulation or discontinuity * Poor connection or discontinuity of ignition code	Check with failure diagnosis system Replace Repair or replace
	Improper air gap between ignition coil and flywheel	Adjust
3. Fuel system malfunction	1) No fuel in fuel tank	Refill
	2) Fuel pump clogged	Clean or replace
	3) Fuel hose clogged or pinched	Clean or replace
	4) Air mixing into fuel lines	Check and adjust connecting portion
	5) Improper gasoline or water infiltration	Replace
	6) Throttle body * Poor connection or discontinuity of throttle body (ECU). * Clogged or damaged * Improper operation of throttle valve	Repair or replace. Check with failure diagnosis system Clean or replace Check and adjust or replace
	7) Poor connection of fuel pump wiring	Check with failure diagnosis system
	8) Improper pulsation damper	Replace
	9) Improper temperature sensor	Check with failure diagnosis system and replace
4. Engine core components malfunction	1) Insufficient tightening of cylinder head bolts	Check and retighten
	2) Wear of piston, piston ring and/or cylinder	Repair or replace
	3) Improper contact of valve and seat	Repair
	4) Valve seizure	Repair
	5) Improper valve clearance	Adjust
	6) Intake manifold gasket leakage	Retighten intake manifold bolts or replace gasket
	7) Throttle body gasket leakage	Retighten cleaner adapter flange nut or replace gasket
	8) Insufficient tightening of spark plug	Retighten

8-3 INSUFFICIENT OUTPUT

Phenomenon	Possible causes	Remedy
1. Low compression	1) Loosen spark plug	Retighten or replace gasket
	2) Cylinder head gasket leakage	Retighten or replace gasket
	3) Piston ring(s) seizure or wear	Replace
	4) Piston or cylinder wear	Repair or replace
	5) Incorrect valve and seat contact	Repair or replace
	6) Valve stem seizure	Repair or replace
	7) Improper valve clearance	Adjust
2. Ignition system malfunction	1) Spark plug faulty	Replace
	2) Ignition coil faulty	Replace
	3) Improper air gap between ignition coil and flywheel	Adjust
	4) Magneto demagnetization	Replace
3. Fuel system malfunction	1) Throttle body clogged	Check and replace
	2) Improper fuel pump operation	Check and replace
	3) Fuel strainer or fuel hose clogged	Clean or replace
	4) Air mixing into fuel lines	Check and adjust connecting portion
	5) Improper gasoline or water infiltration	Replace
	6) Improper pulsation damper operation	Replace
4. Low intake air volume	1) Air cleaner clogged	Clean or replace
	2) Throttle valve faulty	Repair or replace

8-4 OVERHEAT

Phenomenon	Possible causes	Remedy
Overheating	1) Cooling air flow obstructed at inlet or cylinder baffle portion	Clean
	2) Improper engine oil	Replace
	3) Lean air/fuel mixture	Check and replace throttle body, and pulsation damper
	4) Excessive back pressure of exhaust system	Check, clean or replace
	5) Over-load	Change to rated load
	6) Clogged oil cooler	Check and clean or replace
	7) Loosen or missing spark plug cap	Check and connect properly

8-5 ROUGH IDLING

Phenomenon	Possible causes	Remedy
1. Throttle body	1) Low idling speed	Adjust
	2) Throttle body slow system passage clogged	Check, clean and replace
2. Intake system	1) Air mixing from connecting portion of air intake system	Check, tighten or replace gasket
3. Cylinder head	1) Cylinder head gasket faulty (blow-by)	Replace
4. Valve system	1) Improper valve clearance	Adjust
	2) Leakage from valve seat	Adjust valve seat contact
	3) Excessive clearance between valve stem and guide	Replace
5. Ignition system	1) Weak ignition spark	Check and replace spark plug

8-6 HIGH ENGINE OIL CONSUMPTION

Phenomenon	Possible causes	Remedy
1. Oil leakage	1) Loosen drain plug	Tighten
	2) Drain plug gasket damaged	Replace
	3) Incorrect oil filter fitting	Repair
	4) Loosen main bearing cover bolts	Tighten
	5) Main bearing cover gasket damaged	Replace
	6) Crankshaft oil seal damaged	Replace
2. Oil dilution	1) Piston oil ring faulty	Replace
	2) Piston rings seizure, wear or poor contact	Replace
	3) Excessive wear of piston and cylinder	Replace
	4) Excessive wear of valve stem	Replace
	5) High oil level	Adjust oil level
	6) Breather faulty	Repair or replace

8-7 HIGH FUEL CONSUMPTION

Phenomenon	Possible causes	Remedy
1. Fuel system	1) Throttle body faulty	Check or replace
	2) Pulsation damper faulty	Check or replace
	3) Fuel pump faulty	Check or replace
2. Engine core components	1) Low compression	Check or repair
	2) Over cooling	Check and adjust load and/or engine speed

8-8 DETONATION

Phenomenon	Possible causes	Remedy
1. Ignition system malfunction	1) Poor connection of ignition system wirings	Check with failure diagnosis system and connect properly
	2) Improper or damaged spark plug	Clean or replace
2. Fuel system malfunction	1) Lean or rich air/fuel mixture	Check or replace throttle body
	2) Throttle body damaged	Check or replace throttle body
	3) Fuel lines clogged or damaged	Clean or replace
	4) Air mixing from connecting portion of air intake system	Connect properly or replace gasket
3. Cylinder head	1) Carbon deposit in combustion chamber	Remove and clean
	2) Cylinder head gasket faulty (blow-by)	Replace
4. Valve system	1) Improper valve clearance	Adjust
	2) Valve heat deterioration	Replace
	3) Valve spring deterioration	Replace
	4) Improper valve timing	Adjust

8-9 ENGINE MISFIRE

Phenomenon	Possible causes	Remedy
1. Ignition system	1) Improper spark plug gap or damaged electrode	Cealn, adjust or replace
	2) Ignition coil faulty	Replace
	3) Damaged ignition system wirings	Check with failure diagnosis system and replace
	4) Poor connection of ignition system wirings	Check with failure diagnosis system and connect properly
2. Fuel system	1) Lean or rich air/fuel mixture	Check and replace throttle body
	2) Clogged throttle body	Check and replace
	3) Throttle body faulty	Check and replace
	4) Pulsation damper faulty	Check and replace
	5) Fuel pump faulty	Check and replace
	6) Improper gasoline or water infiltration	Replace
3. Engine core componets	1) Valve heat deterioration or improper valve adjustment	Adjust or replace
	2) Valve spring deterioration	Replace
	3) Low compression	Check, adjust or replace

8-10 DIAGNOSIS CODE

This engine has the failure diagnosis system to know that low voltage of DC battery and each wiring whether disconnecting or electrical short circuit. The ECU monitors engine various conditions for the system when tune the key to the “RUN” (ON) position, “START” (cranking) or after start the engine. However, this is required the warning lamp or a lamp for DC12V to indicate of the failure code. The warning lamp and so on is prepared as optional.

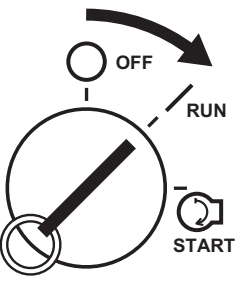
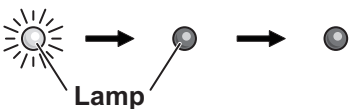
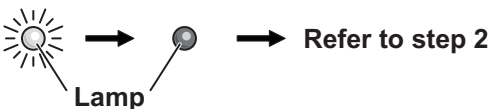
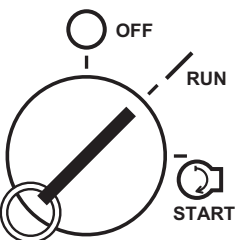

8-10-1 HOW TO OPERATION

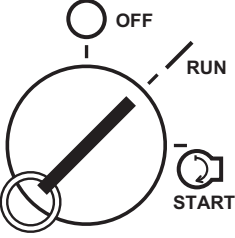

When troubleshooting with the failure diagnosis, disconnect the grey wire to oil pressure switch. If the wire will be not disconnected, the lamp will be lightning cause of the engine stopped and no oil pressure.

If there is failure the components wiring, the warning lamp repeats turning on and off.

Finally, re-connect the grey wire to the oil pressure switch, after troubleshooting with failure diagnosis system.

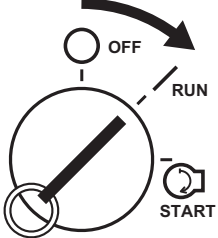
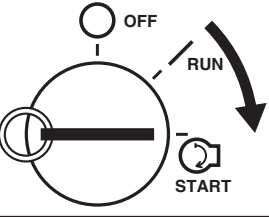
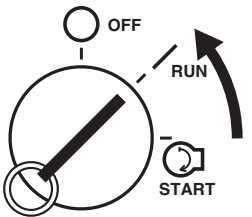
8-10-2 INDICATION MEANS and PROCEDURE

Step	Key position	Description
1		(a) Lightning 2 sec and go out forever. Not see any problem. 
		(b) Lightning 2 sec and go out 4 sec, then lightning again. There is some problem. 
2		(a) After the 4 sec the lamp repeats turning on and off.  This sample, failure code is “2-1”. Two (2) turning on and off, and go out 2 sec then turning on 0.4 sec. After this go out 4 sec and repeat the code again. (b) If there is another failure, the lamp indicates continuity with new code. Refer to step 3.

Step	Key position	Description
3		<p>In case of another failure, after the 4 sec the lamp repeats turning on and off. This sample is failure code means "4-2".</p>  <p>Fore (4) turning on and off, and go out 2 sec then turning on 0.4 sec. After this go out 4 sec and repeat the code again. If there is another failure, the lamp indicates continuity with new code.</p>

8-10-3 FAILURE CODE

Please refer to the following table for the failure diagnosis code.

Key position	Failure code	Possible causes
	2-1	Low voltage of battery Charging system failure
	2-2	Disconnecting or short circuit internal of throttle body between MAP sensor and ECU
	2-3	Disconnecting or short circuit between temperature sensor and ECU
	3-1	Disconnecting between fuel pump and ECU
	4-1	Disconnecting between fuel injector #1 and ECU
	4-2	Disconnecting between fuel injector #2 and ECU
	5-1	Disconnecting between ignition coil #1 and ECU
	5-2	Disconnecting between ignition coil #2 and ECU
	After starting the engine, the above codes also will be indicated.	

9. MAINTENANCE AND STORAGE

9-1 DAILY MAINTENANCE

Every day before operating engine, check the following items :

MAINTENANCE ITEMS	REMARKS
1) Clean away dust and chaff from engine.	Governor linkage is especially sensitive to dust.
2) Check fuel leakage from fuel system. If any, retighten fasteners or replace necessary parts.	
3) Inspect for loose hardware and retighten if necessary.	Loose bolts and nuts may come off and result in breakage of other parts.
4) Check oil level and add to full level.	

9-2 PERIODIC MAINTENANCE SCHEDULE

Periodic maintenance is vital to safe and efficient operation of engine.

Check the table below for periodic maintenance intervals.

It is also necessary to conduct the maintenance and adjustments on the emission-related parts listed below to keep the emission control system effective;

- | | | |
|-------------------------------------------------|------------------------------------------------|----------------------------------------------|
| (1) Throttle body and internal parts | (4) Air cleaner elements | (8) Exhaust manifold, if applicable |
| (2) Cold start enrichment system, if applicable | (5) Spark plug | (9) Hoses, belts, connectors, and assemblies |
| (3) Intake manifold, if applicable | (6) Magneto or electronic ignition system | |
| | (7) Spark advance/retard system, if applicable | |

The following maintenance schedule is based on the normal engine operation.

Should the engine be operated in extremely dusty condition or in heavier loading condition, the maintenance interval must be shortened depending on the contamination of oil, clogging of filter elements, wear of parts, and so on.

Periodic Maintenance Schedule table

Maintenance Items	Every 8 hours (Daily)	Every 50 hours (Weekly)	Every 200 hours (Monthly)	Every 500 hours	Every 1000 hours
Clean engine and check bolts and nuts	● (Daily)				
Check and refill engine oil	● (Refill daily up to upper level)				
Change engine oil (*Note : 1)	● (Initial 20 hours)	● (Every 100 hours)			
Replace engine oil filter (*Note 1)	● (Initial 20 hours)		●		
Check battery electrolyte fluid level		●			
Clean spark plug		●			
Clean air cleaner		●			
Clean spark arrester (Optional part)		● (Every 100 hours)			
Replace air cleaner element			●		
Clean fuel strainer			●		
Clean and adjust spark plug and electrodes			●		
Replace spark plug				●	
Remove carbon from cylinder head				●	
Clean throttle body				●	
Clean engine base (oil pan)				●	
Check and adjust valve clearance				●	
Replace fuel lines					● (Yearly)
Overhaul engine (*Note : 2)					●

*Note : 1. Initial oil change and oil filter replacement should be performed after 20 hours of operation. Thereafter change oil every hundred (100) hours and replace oil filter 200 hours. Before changing oil, check for a suitable way to dispose of old oil. Do not pour it down into sewage drains, onto garden soil or into open streams. Your local zoning or environmental regulations will give you more detailed instructions on proper disposal.

*Note : 2. As to the procedures, please refer to the Service Manual or consult your nearest service dealer.

*Note : 3. More frequent oil changing, oil filter replacement and air cleaner service on replacement may be necessary depending on operating conditions. This would include dusty environment, high ambient temperature, heavy engine loading.

9-3 SPARK ARRESTER (OPTIONAL)

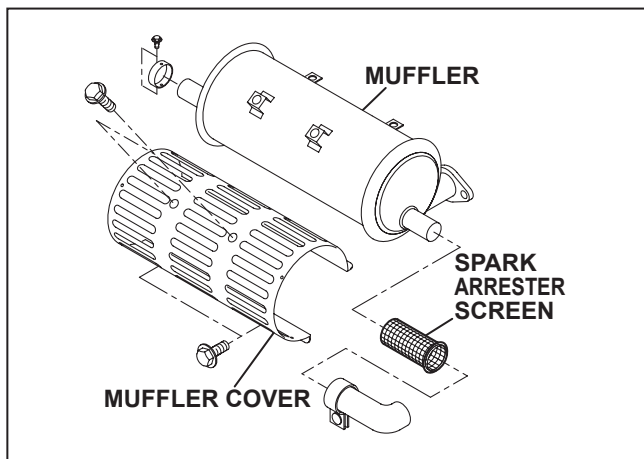
In a dry or wooded area, it is recommendable to use the product with a spark arrester. Some areas require the use of a spark arrester. Please check your local laws and regulations before operating your product.

The spark arrester must be cleaned regularly to keep it functioning as designed.

A clogged spark arrester :

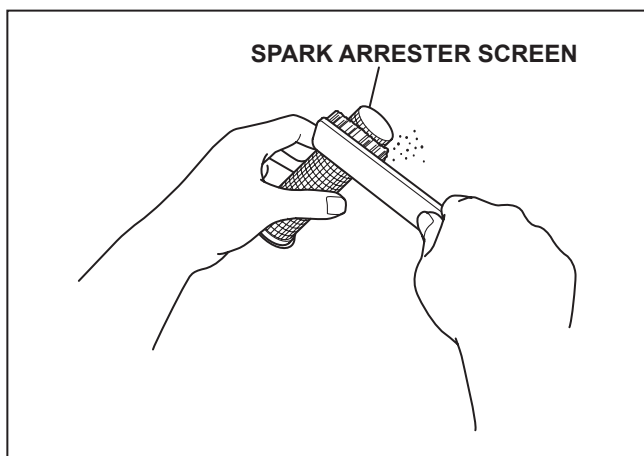
- Prevents the flow of exhaust gas
- Reduces engine output
- Increases fuel consumption
- Makes starting difficult

If the engine has been running, the muffler and the spark arrester will be very hot. Allow the muffler to cool before cleaning the spark arrester.



How to remove the spark arrester

1. Remove the flange bolts from the muffler cover and remove the muffler cover.
2. Remove the special screw from the spark arrester and remove the spark arrester from the muffler.



Clean the spark arrester screen

Use a brush to remove carbon deposits from the spark arrester screen.

Be careful to avoid damaging the screen.

The spark arrester must be free of breaks and holes. Replace the spark arrester if it is damaged.

Install the spark arrester, and muffler protector in the reverse order of disassembly.

9-4 ENGINE STORAGE

- (1) Drain fuel from fuel tank and run the engine until there is no fuel left.
- (2) Change the engine oil and perform the daily maintenance items above mentioned.
- (3) To prevent rust in the cylinder bore, apply oil through the spark plug hole and turn the crankshaft several turns by hand. Reinstall the plug.
- (4) Turn the crankshaft by hand and leave it where the resistance is the heaviest.
- (5) Clean outside of the engine with oiled cloth.
- (6) Put a plastic cover or the like over the engine and store the engine in dry place.

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