

Fuel System

Precautions

Precautions on Fuel System Service

ZAJ6111700001

▲ WARNING

Gasoline is extremely flammable and toxic. Always observe the following precautions when working around gasoline or servicing the fuel system.

- Disconnect battery cables except when battery power is required for servicing / inspection.
- Keep the working area well ventilated and away from open flame (such as gas heater) or sparks.
- Do not smoke or allow anyone else to smoke near the working areas.
Post a "NO SMOKING" sign.
- Keep a fully charged CO₂ fire extinguisher readily available for use.
- Always use appropriate safety equipment and wear safety glasses when working around a pressurized fuel system.
- To avoid potential fire hazards, do not allow fuel to spill on hot engine parts or on operating electrical components.
- Wipe up fuel spills immediately.
- Fuel components and fuel hoses, after the high pressure fuel pump, remain pressurized at all times.
To protect against fuel spray, relieve fuel line pressure before disconnecting or removing components.

CAUTION

- Do not over bend (kink) or twist hoses when installing.
- When installing hose clamps, position tabs to avoid contact with other parts.
- Be sure hoses do not contact rods, levers or other components with engine either operating or at rest.
- Extreme care should be taken not to cut, abrade or cause any other damage to hoses.
- Use care not to excessively compress hoses when tightening clamps.

General Description

Electronic Fuel Injection System Description

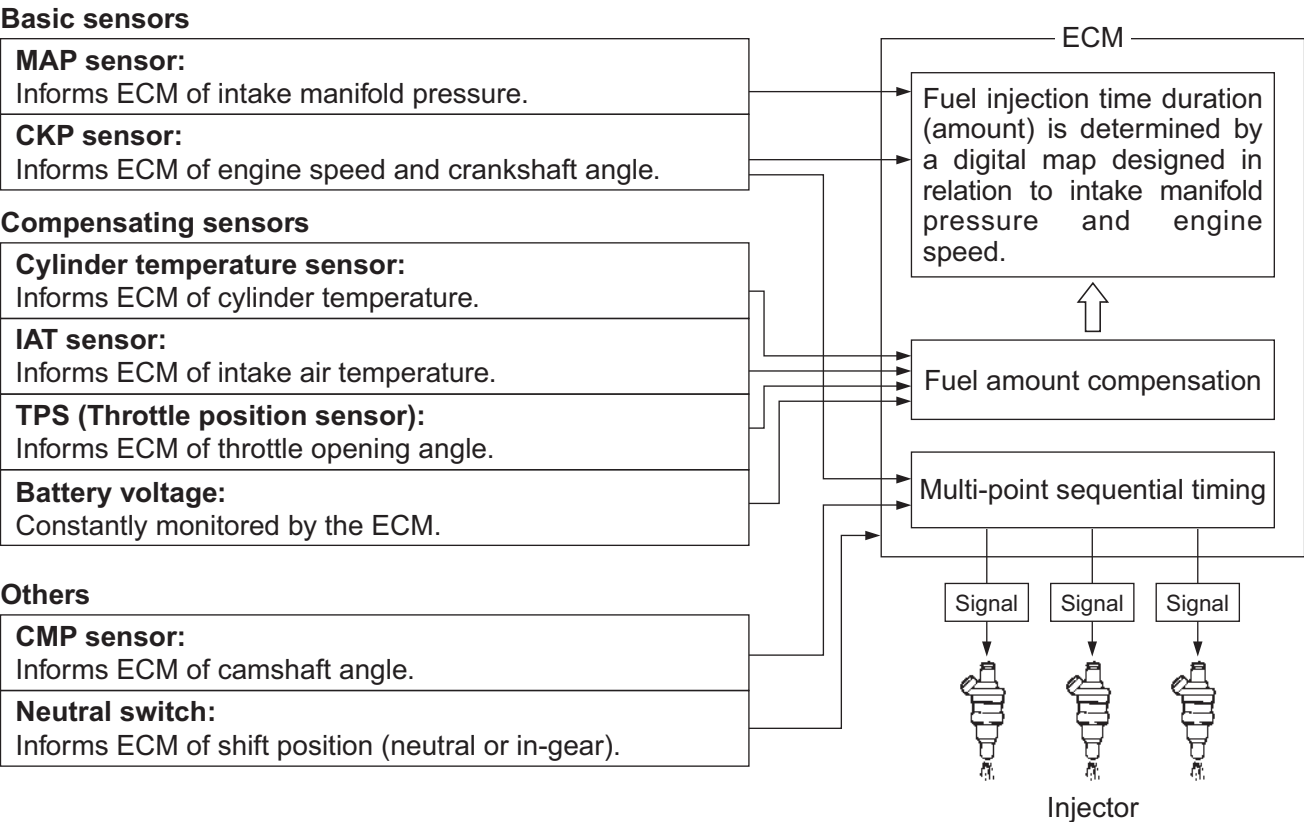
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The fuel injection system used by the DF60A is a speed-density, multi-point, sequential, electronic fuel injection type. The fuel injection system is composed of the fuel line components, air intake components, and components for system control (ECM, sensors, switches, etc.).

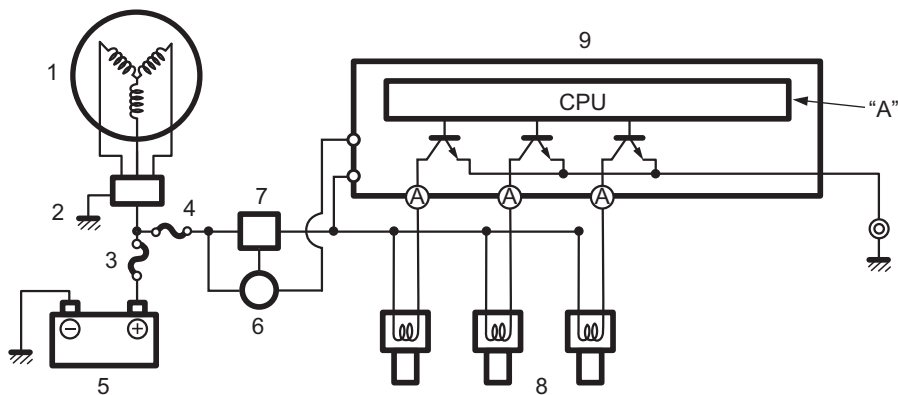
Fuel Injection Control System Outline

Sensors are mounted at precise locations on the motor to monitor the current conditions of engine operation and send signals to the ECM.

Based on these signals, the ECM determines the optimum fuel injection time duration (fuel amount), fuel injection timing (multi-point sequential timing) and controls the injector operating signals accordingly. In regards to fuel injection timing, the fuel injection end timing is set depending on engine rpm. The ECM calculates the amount of fuel injection based on the engines operating conditions, and determines the fuel injection start timing. In the injection timing chart below, the injection end timing is set at 60° BTCD on the exhaust stroke.



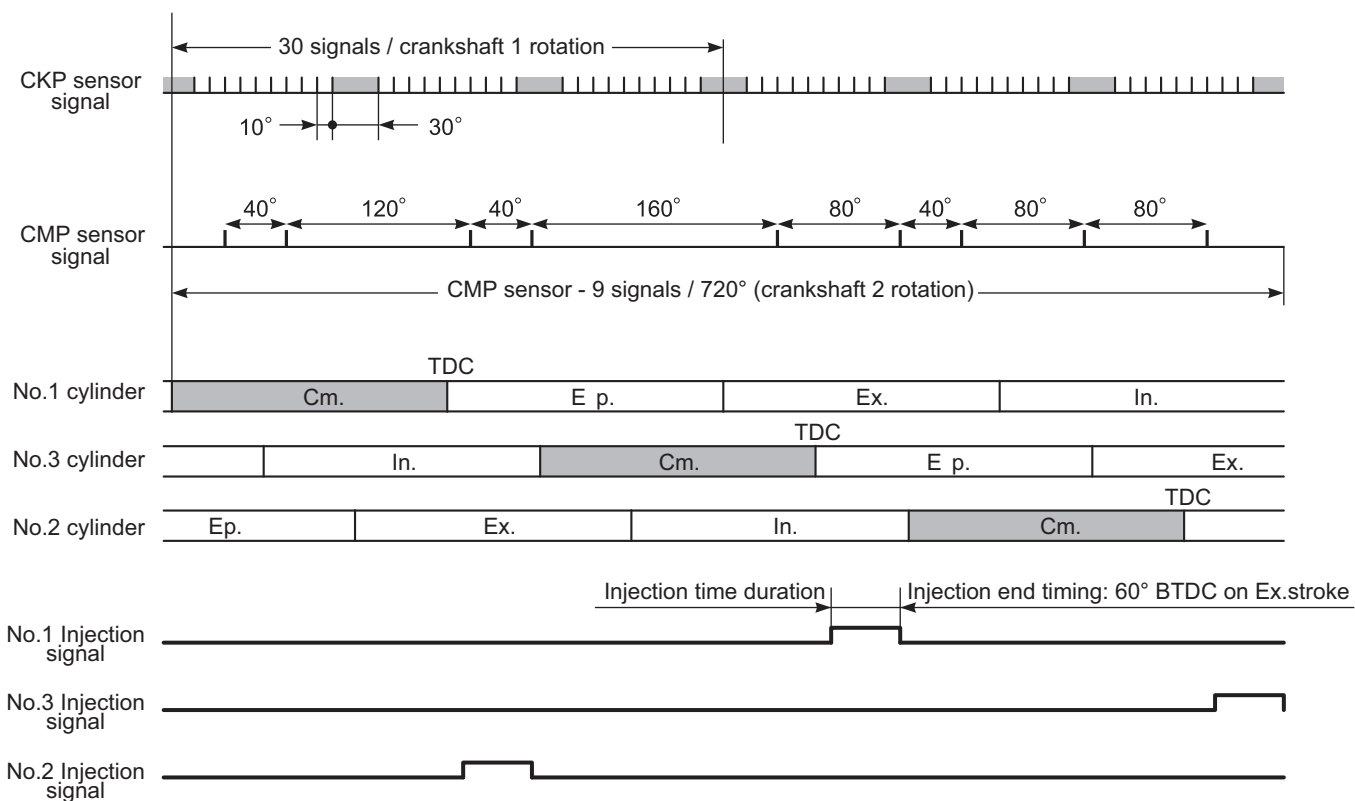
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1. Battery charge coil	3. 30 A fuse	5. Battery	7. ECM main relay	9. ECM
2. Rectifier / regulator	4. 30 A fuse	6. Ignition switch	8. Injector	"A": Sensor/switch signal input

Fuel Injection Timing Chart



Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake,

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Fuel Injection Control Mode

When cranking:

Fuel is injected in each cylinders according to the "Start up mode" map which is based on the cylinder temperature and intake air temperature (sequential injection).

After start (Fast-idle function):

The fuel injection amount is controlled so that the engine rpm stays within the fast idle speed map until the cylinder temperature reaches normal operating temperature.

When idling / trolling:

The fuel injection amount is controlled to maintain a stable engine speed at the specified idle / trolling rpm.

When accelerating:

The fuel injection amount is controlled to increase.

When decelerating:

The fuel injection amount is controlled to decrease.

The fuel injection is also cut off on very rapid engine deceleration.

Fuel Delivery System Components Description

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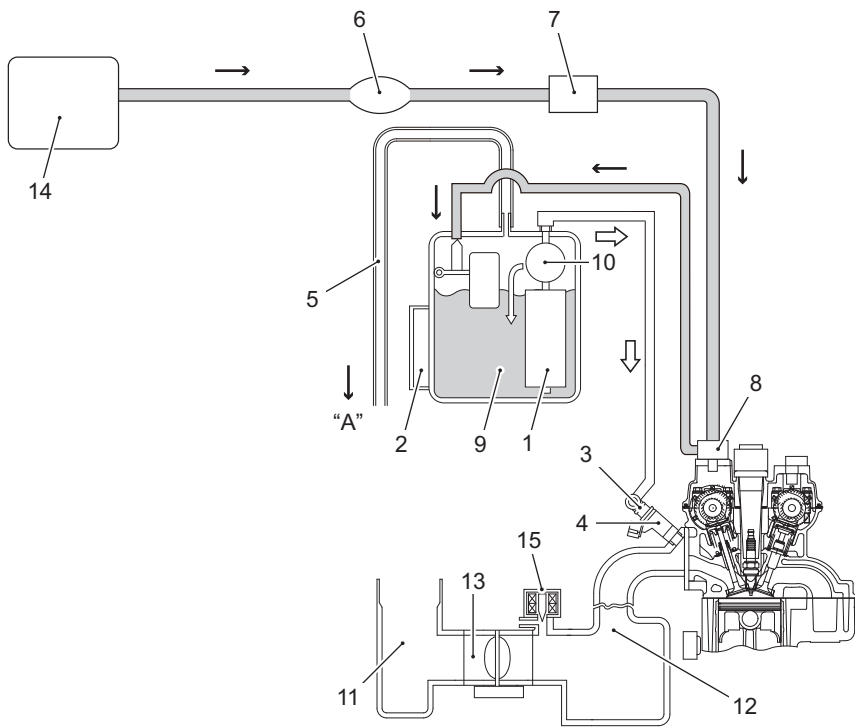
The fuel delivery system is composed of the low pressure fuel line components (fuel tank, filter, pump etc.), fuel vapor separator, high pressure fuel pump, fuel pressure regulator (located in the fuel vapor separator), delivery pipe, fuel injectors and hoses.

Fuel is supplied through the primer bulb, low pressure fuel filter, and low pressure fuel pump to the fuel vapor separator.

Fuel flow from the fuel vapor separator is pressurized by the high pressure fuel pump and supplied through the fuel filter and fuel delivery pipe to the fuel injectors.

The pressure regulator maintains fuel pressure in the feed line between the high pressure fuel pump and fuel injector. This pressure, maintained at a constant level, is higher than the pressure in the vapor separator chamber.

When fuel feed line pressure exceeds vapor separator chamber pressure by more than approx. 295 kPa (2.95 kg/cm², 42 psi.), the valve in the fuel pressure regulator will open and return the excess fuel to the vapor separator chamber. Pressurized fuel enters into the intake ports through the fuel injector based on the sequential signals supplied from the ECM.



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1. High pressure fuel pump	5. Evaporation hose	9. Fuel vapor separator	13. Throttle body
2. Fuel cooler	6. Primer bulb	10. Fuel pressure regulator	14. Fuel tank
3. Fuel delivery pipe	7. Low pressure fuel filter	11. Intake silencer	15. IAC valve
4. Fuel injector	8. Low pressure fuel pump	12. Intake manifold	"A": To atmosphere

Fuel Vapor Separator

The fuel vapor separator incorporates a float system that maintains a constant fuel level inside the separator chamber. As the fuel level decreases, fuel flows into the vapor separator from the low pressure fuel pump.

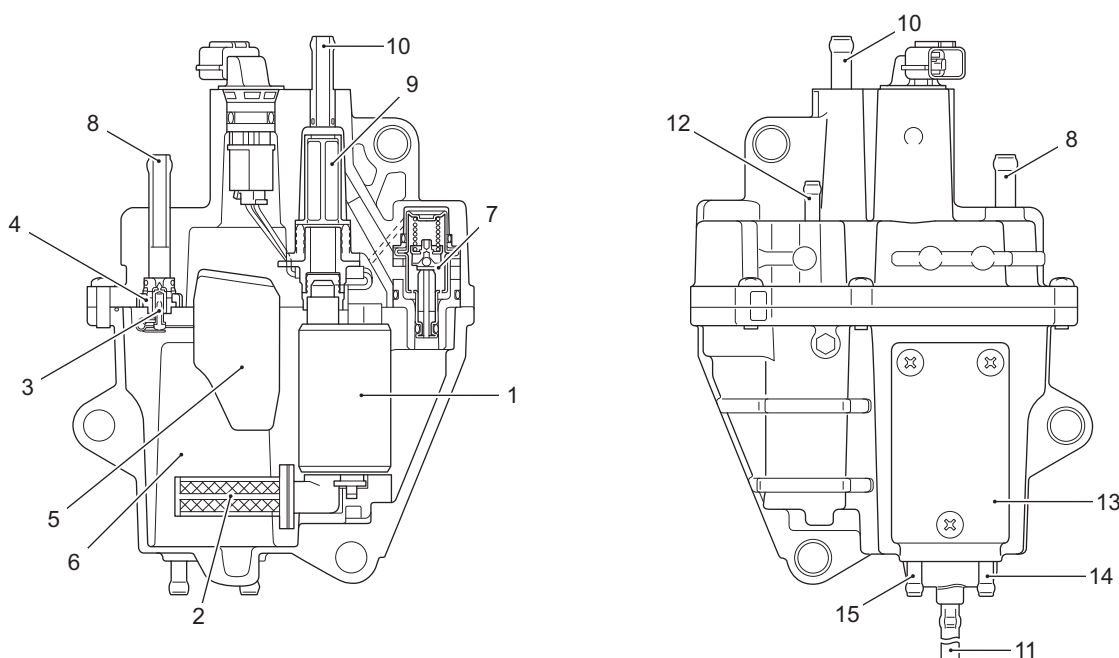
The function of this unit is to separate vapors from fuel delivered by the low pressure fuel pump or fuel returned from the fuel pressure regulator.

This vapor is routed through the evaporation hose to the atmosphere.

High Pressure Fuel Pump

The high pressure fuel pump is an “integral” type in which the pump mechanism is located within the fuel vapor separator.

To supply the optimum fuel amount, the pump is driven by the duty cycle signal from the ECM.



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1. High pressure fuel pump	5. Float	9. Fuel outlet filter	13. Fuel cooler
2. Suction filter	6. Chamber	10. Fuel outlet	14. Water inlet
3. Needle valve	7. Fuel pressure regulator	11. Fuel drain hose	15. Water outlet
4. Valve seat	8. Fuel inlet	12. Vapor outlet	

Fuel Pressure Regulator

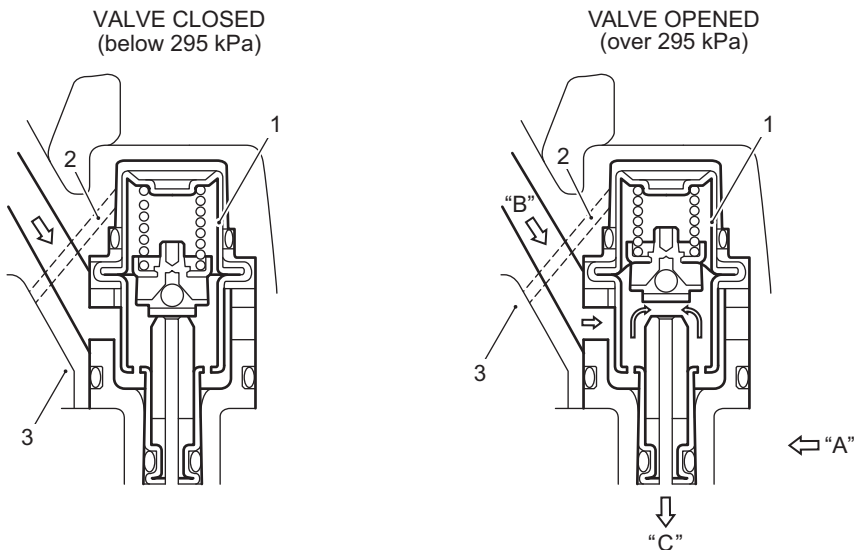
The fuel pressure regulator is located in the fuel vapor separator.

The regulator's function in the system is to maintain constant fuel pressure to the injectors while the engine is operating.

The regulator diaphragm chamber is open to the fuel vapor separator chamber to keep the pressure balanced.

Fuel pressure, adjusted by the regulator, is constantly maintained higher than the pressure in the fuel vapor separator chamber by approx. 295 kPa (2.95 kg/cm², 42 psi.).

By-pass fuel is returned to the fuel vapor separator chamber.



1. Fuel pressure regulator	3. Float chamber	"B": From high pressure fuel pump
2. Air passage	"A": By-pass fuel	"C": To float chamber

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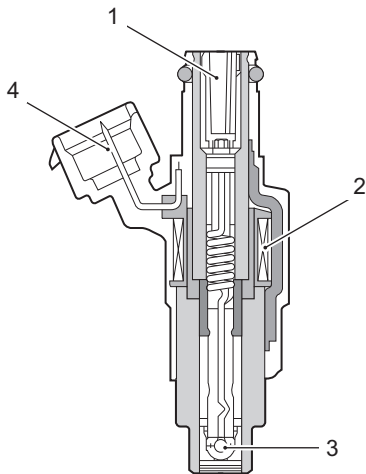
Fuel Injector

The fuel injector is an electromagnetic valve operated by a signal from the ECM.

When the injection signal is supplied to the fuel injector, the solenoid coil is energized pulling up the plunger.

This opens the injector valve and injects fuel.

Because the fuel pressure is kept constant, the amount of fuel injected is determined by the amount of time (duration) the electromagnetic valve is open.



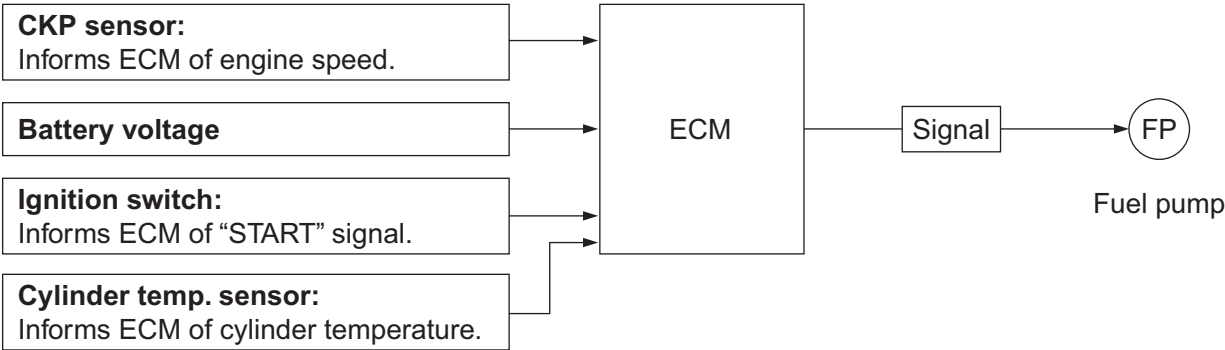
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1. Filter	3. Ball valve
2. Solenoid coil	4. Terminal

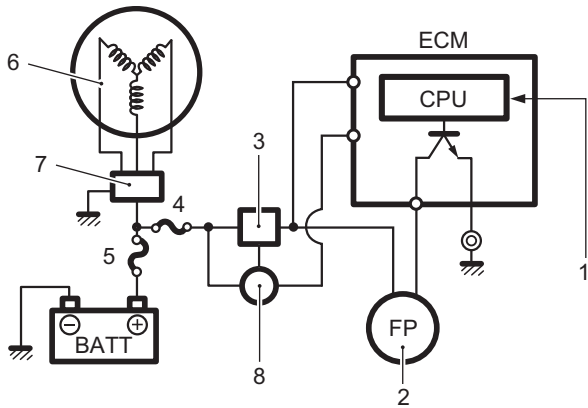
High Pressure Fuel Pump Control System Description

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To supply the optimum fuel amount, the ECM controls the fuel pump drive duty cycle, a repeated “ON” / “OFF” signal, at a specified rate (1 000 times a second). Based on engine speed and battery voltage, the ECM determines the optimum duty cycle (repeating “ON” time rate within a cycle) and sends this signal to the fuel pump.



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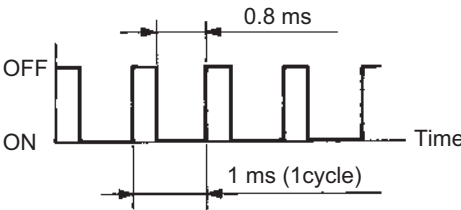


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1. Sensor/switch signal input	5. 30 A fuse
2. Fuel pump	6. Battery charge coil
3. ECM main relay	7. Rectifier/Regulator
4. 30 A fuse	8. Ignition switch

Duty cycle signal for fuel pump (example: 80% duty)

$$\frac{\text{“ON” time}}{1 \text{ cycle time}} \times 100 = \text{duty (\%)}$$



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Control Modes

Before start:

For 3 seconds after the ignition switch is turned “ON”, the fuel pump is controlled to operate at a 100% duty cycle to initially pressurize the high pressure fuel line.

When cranking:

The fuel pump is controlled to operate at a 50 – 100% duty cycle.
The duty cycle changes depending on cylinder temperature.

When running (normal operation):

The fuel pump is controlled to operate at a 50 – 100% duty cycle based on the current engine speed and battery voltage.

Air Intake Components Description

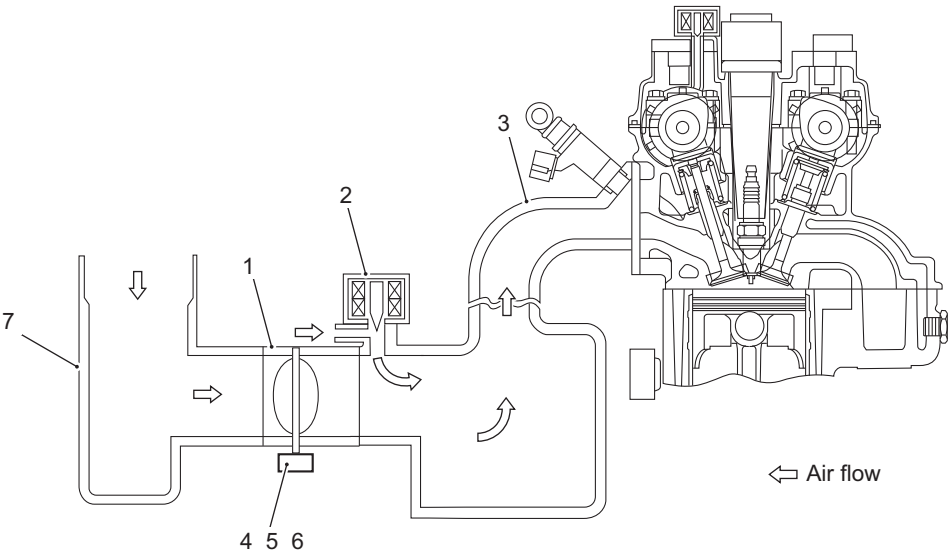
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Air, after entering through the silencer case, passes through the throttle body and flows into the surge tank where it is then distributed to the intake manifold.

Intake manifold pressure, monitored by the MAP sensor, is an indirect measurement of the intake air amount.

When the throttle is fully closed, the main supply of intake manifold air necessary to sustain engine idle passes through the by-pass air passage.

To maintain engine idle speed at specification, the ECM controlled IAC valve supplies a regulated amount of additional air through the IAC (Idle Air Control) passage.



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1. Throttle body	3. Intake manifold	5. MAP sensor	7. Air intake silencer
2. IAC valve	4. Throttle position sensor	6. IAT sensor	

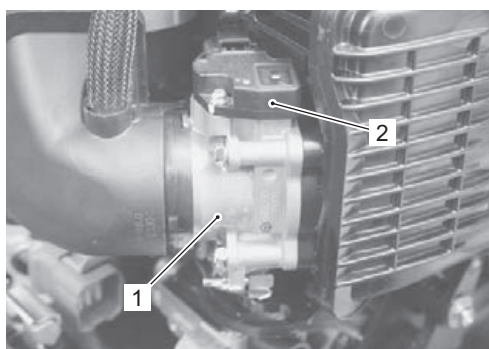
Throttle Body

- The throttle body assembly consists of the main bore, throttle valve and MAP sensor / TPS (Throttle Position Sensor) / IAT sensor.
- Three sensors (MAP sensor / TPS / IAT sensor) are combined into one unit that is installed on top of the throttle body.
- The throttle body adjusts the intake air amount with the throttle valve which is connected to the throttle lever linkage.
- The TPS informs the ECM of the throttle valve opening angle.
- The IAT sensor informs the ECM of the intake air temperature.
- The MAP sensor informs the ECM of the intake manifold pressure.

NOTE

Do not try to adjust or remove any of the throttle body component parts (Sensor, throttle valve, throttle stop screw, etc.).

These components have been factory adjusted to precise specifications.



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1. Throttle body assembly

2. MAP sensor / TPS / IAT sensor

Idle Air Control System Description

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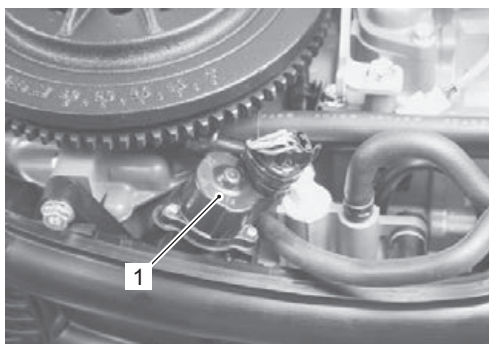
IAC Valve/Passage

The IAC valve is a stepper motor type mounted on the intake manifold.

Its purpose is to control the amount of intake air flowing through the IAC passage.

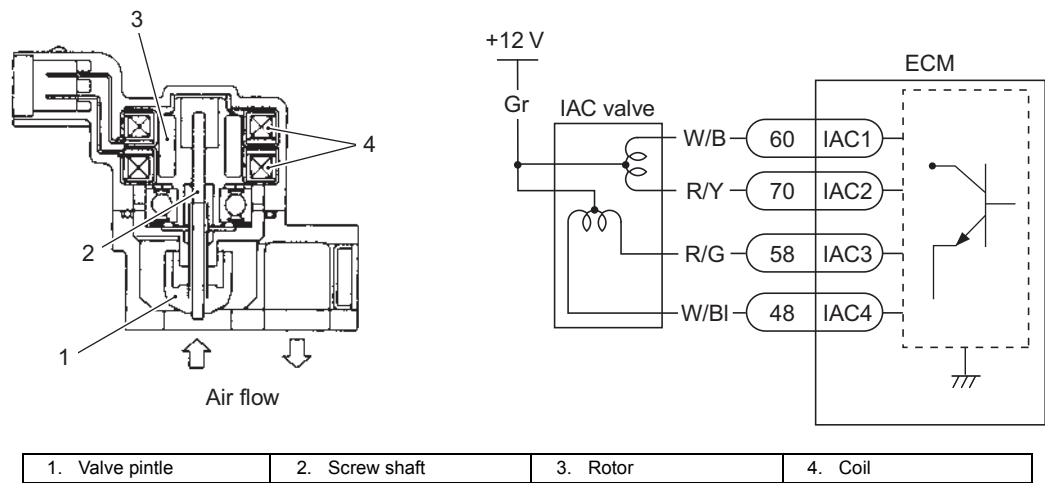
The IAC valve consists of a stepper motor, rod, valve and other parts.

As the stepper motor is controlled by signals from the ECM, valve position changes will increase or decrease the air flow through the IAC passage.



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1. IAC valve



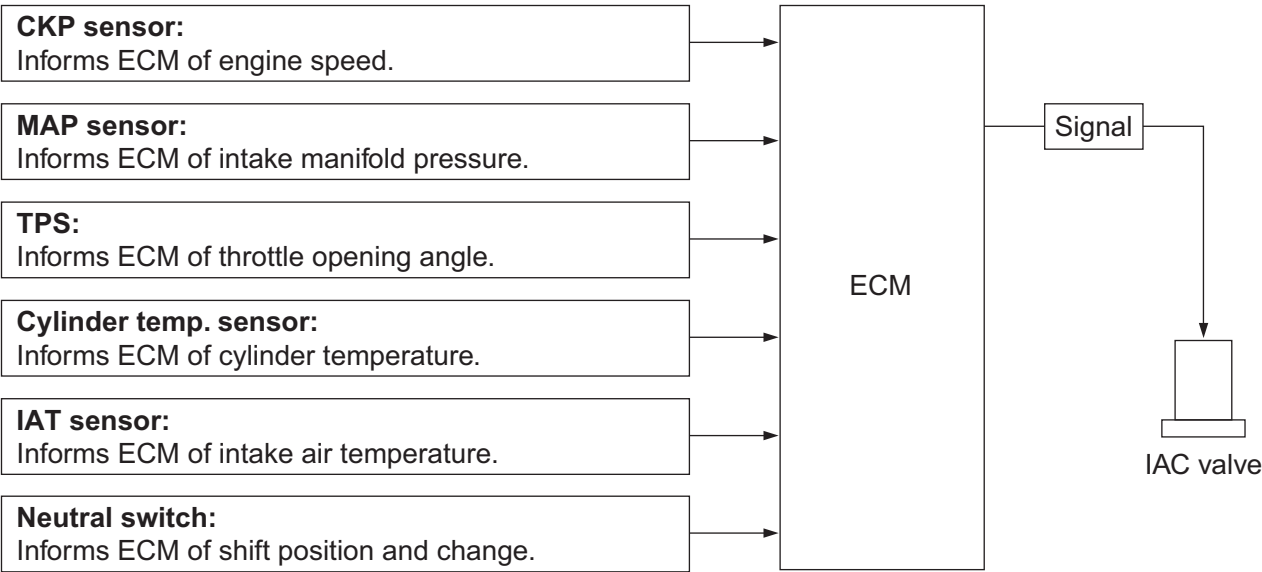
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Idle Air Control System Outline

The ECM controls the position of the IAC valve to regulate a portion of the intake air flow to the intake manifold. This system is used for the following purposes:

- To keep idling / trolling at the specified speed.
- To improve drivability when decelerating. (dash-pot effect)
- To improve engine starting and warm-up performance. (fast-idle function)

The sensors and switch shown below monitor the current engine condition and send signals to the ECM. Based on these signals, the ECM determines the IAC valve setting necessary to achieve the target engine speed and outputs the signal for actuating the stepper motor inside the IAC valve. The rotor of the stepper motor then turns in an amount equal to the steps of the signal supplied from the ECM, moving the valve via a screw shaft.



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IAC Valve Control Mode

Before started:

The IAC valve is initialized at a 70% opening position when engine is not running. (Ignition switch "OFF").

When cranking:

The IAC valve is controlled to operate at approx. 30 – 80% open position.

The open position changes depending on the cylinder temperature.

After start (fast-idle function):

The IAC valve is controlled to operate at approx. 40 – 80% open position until the timer, (set according to cylinder temperature at cranking) expires. Then the open position gradually decreases until the engine rpm slows to the preset idle speed.

When idling / trolling:

The IAC valve is controlled so that the engine speed is stable at the idling / trolling speed specified.

During this period, the IAC valve has an open position of approx. 0 – 30%, but will vary slightly as idling / trolling conditions change.

When running (normal operation):

The IAC valve is controlled to operate at a 0 – 90% open position, dependent on current engine operating conditions.

When decelerating (dash-pot effect):

When the throttle valve is suddenly returned to fully closed, and the throttle position sensor signal changes to "fully closed", the IAC valve is controlled to gradually return to an idle / troll operating position to prevent engine stalling or unstable running.

NOTE

Due to the limited intake air flow from the IAC passage, and in order to effectively use both the "Dash-pot effect" and the "Fast-idle function", an IAC valve operating position of 0 – 30% at idling / trolling speed is required.

Diagnostic Information and Procedures

Fuel Pressure Inspection

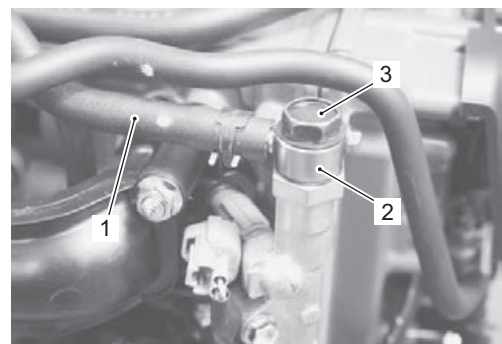
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▲ WARNING

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service" (Page 1G-1) in order to reduce the risk of fire and personal injury.

- 1) Relieve fuel pressure in fuel feed line.
Refer to "Fuel Pressure Relief Procedure" (Page 1G-15).

- 2) Disconnect the high pressure fuel feed hose (1) from the fuel delivery pipe upper union (2).
Loosen the delivery pipe upper plug (3).



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1G-12 Fuel System:




- 3) Connect special tools (pressure gauge, pressure hose and pressure joint) between fuel feed hose (1) and fuel delivery pipe upper union as shown in figure. Tighten the delivery pipe upper plug (3) to specified torque.
Clamp the hose securely to ensure that no leaks occur during checking.

CAUTION

A small amount of fuel may be released when the fuel feed hose is disconnected.

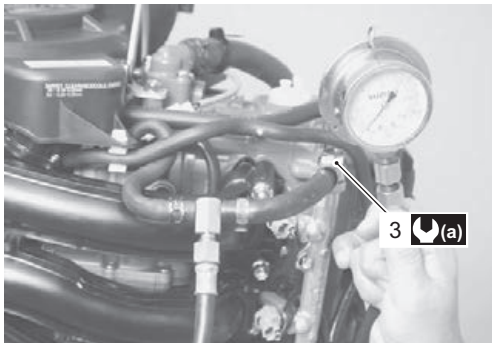
Place container under the fuel feed hose or fuel delivery pipe upper union with a shop cloth so that the released fuel is caught in the container or absorbed by the cloth. Place the fuel soaked cloth in an approved container.

Special tool

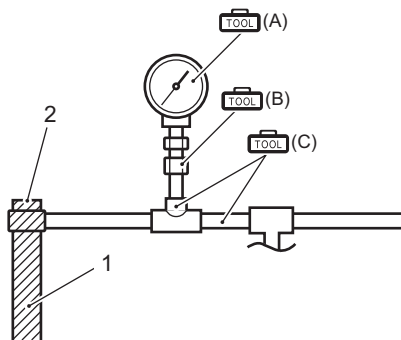
-  (A): 09912-58442 (Fuel pressure gauge)
 (B): 09912-58432 (Fuel pressure hose)
 (C): 09912-58490 (3-way joint & hose)

Tightening torque

Delivery pipe upper plug (a): 35 N·m (3.5 kgf-m, 25.5 lbf-ft)



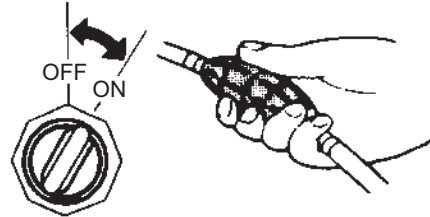
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- | | |
|-----------------------|------------------------------|
| 1. Fuel delivery pipe | 2. Delivery pipe upper union |
|-----------------------|------------------------------|

- 4) Ensure the emergency stop switch lock plate is in place.
Shift into "Neutral" position.
- 5) Squeeze fuel primer bulb until you feel resistance.
- 6) Turn ignition switch "ON" for 3 seconds (to operate the fuel pump), then turn it "OFF".
- 7) Repeat this ("ON" and "OFF") procedure 3 or 4 times to pressurize the fuel system and then check the fuel pressure.



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- 8) Check for any signs of fuel leakage.

▲ WARNING

When the engine is running, keep your hands, hair, clothing, etc., away from the engine.

- 9) Measure fuel pressure at cranking or idle speed operation.
If out of specification, check each possibly defective parts (high pressure fuel pump, fuel pressure regulator, fuel injector, etc.).
Replace if found defective.

Fuel pressure

Standard: Approx. 295 kPa (2.95 kg/cm², 42 psi.)

- 10) Stop engine and wait 5 minutes.
Check the residual fuel pressure in line.

Residual fuel pressure

Standard: 200 kPa (2.0 kg/cm², 28.4 psi.) or more

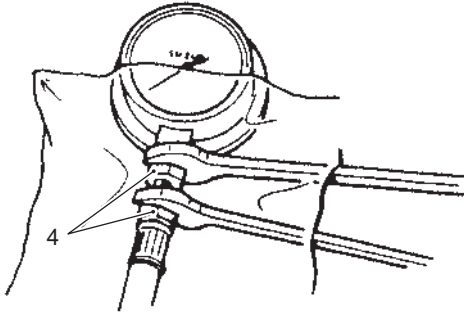
CAUTION

The fuel feed line is under high fuel pressure, make sure to release fuel pressure according to the fuel pressure relief procedures mentioned earlier.

Use the following procedures to remove the fuel pressure gauge.

- Place a container under the joint to catch the fuel.
- Cover the joint with rag and loosen joint nut slowly to gradually release any residual fuel pressure.

- 11) After checking fuel pressure, remove fuel pressure gauge.



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4. Joint nut

- 12) Reconnect fuel line.
13) With the engine not running and ignition switch "ON", check the fuel system for leaks.

Fuel System Diagnosis

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Condition	Possible cause	Correction / Reference Item
Engine will not start or hard to start (Fuel does not reach the fuel delivery pipe).	Clogging, bending or improper routing of fuel hose.	<i>Clean, repair or replace.</i>
	Fuel pump failure.	<i>Replace.</i>
	Fuel pressure regulator failure.	<i>Replace.</i>
	Fuel injector(s) failure.	<i>Replace.</i>
	Wiring connection failure.	<i>Repair or replace.</i>
Engine will not start or hard to start.	Throttle position sensor failure.	<i>Replace.</i>
	MAP sensor failure.	<i>Replace.</i>
	ECM failure.	<i>Replace.</i>
	Cylinder temp. sensor failure.	<i>Replace.</i>
	IAT sensor failure.	<i>Replace.</i>
	High pressure fuel pump failure.	<i>Replace.</i>
	Fuel hose improperly routed.	<i>Reroute properly.</i>
Unstable idling / trolling or engine tends to stall.	Neutral switch failure.	<i>Replace.</i>
	Throttle position sensor failure.	<i>Replace.</i>
	IAC control system failure.	<i>Check idle air control system.</i>
	IAC passage clogged.	<i>Clean.</i>
	ECM failure.	<i>Replace.</i>
	Wire continuity / connection failure.	<i>Repair or replace.</i>
	Fuel injector(s) clogged.	<i>Clean.</i>
	Fuel pressure regulator failure.	<i>Check fuel pressure. Replace if necessary.</i>
	High pressure fuel pump failure.	<i>Check fuel pump and its circuit. Replace.</i>
	Fuel filter clogged.	<i>Clean or replace.</i>
	Clogging, bending or improper routing of fuel hose.	<i>Clean, reroute, repair or replace.</i>
Insufficient engine power in high speed range (Air intake system failure).	Air leakage from air intake system.	<i>Repair or replace.</i>
Insufficient engine power in high speed range (Control circuit or sensor failure).	Fuel pressure too low.	<i>Check fuel pressure. Repair or replace.</i>
	Throttle position sensor failure.	<i>Replace.</i>
	ECM failure.	<i>Replace.</i>
Insufficient engine power in high speed range (Engine internal parts or electrical equipment failure).	Fuel injector(s) clogged.	<i>Clean.</i>
	Throttle position sensor failure.	<i>Replace.</i>
	ECM failure.	<i>Replace.</i>

Fuel Injection System Troubleshooting

Before starting the troubleshooting, make sure that:

- There is no self-diagnostic code indication.
- Emergency stop switch plate is set in place.

Step	Action	Yes	No
1	Check fuel injector operating sound. <ul style="list-style-type: none"> • Check each injector for operating sound at engine cranking. (☞(Page 1G-22)) <i>Do all 3 injector make operating sound?</i>	Fuel injector circuit is in good condition.	Go to step 2.
2	Check fuel injector resistance. <ul style="list-style-type: none"> • Turn ignition switch off, disconnect connectors from fuel injectors. • Check for proper connection to fuel injector at each terminal. • If good condition, check all fuel injector for resistance. (☞(Page 1G-22)) <i>Are all injectors in good condition?</i>	Go to step 3.	Faulty fuel injector.
3	Check fuel injector power supply. <ul style="list-style-type: none"> • Measure voltage between each "Gray" wire terminal of fuel injector connector and engine body ground with ignition switch turned "ON". <i>Is voltage 10 – 14 V?</i>	Go to step 4.	<ul style="list-style-type: none"> • "Gray" wire open or shorted. • If it is in good condition, check ECM power source and ground circuit.
4	Check Wire circuit. <ul style="list-style-type: none"> • Turn "OFF" ignition switch. • Disconnect connector from ECM. • Measure resistance between each "O/B", "B/Br", "R/W" wire terminal of the fuel injector connector and body ground. <i>Is resistance infinity?</i>	Go to step 5.	"O/B", "B/Br" and/or "R/W" wire(s) are shorted to ground.
5	Check Wire circuit. <ul style="list-style-type: none"> • Connect connector to ECM. • Measure voltage between each "O/B", "B/Br", "R/W" wire terminal of fuel injector connector and body ground with ignition switch turned "ON". <i>Is voltage 0 V?</i>	Go to step 6.	"O/B", "B/Br" and/or "R/W" wire(s) are shorted to power supply circuit.
6	Check fuel injector operating signal. <ul style="list-style-type: none"> • Connect connectors to each fuel injector and ECM with ignition switch turned "OFF". • Measure fuel injector operating signal between each "45", "71", "47" terminal of ECM and body ground. (☞(Page 1G-23)) <i>Is voltage 4 – 10 V or over?</i>	If check result is satisfactory, substitute a known-good ECM and recheck.	"O/B", "B/Br" and/or "R/W" wire(s) are open circuit.

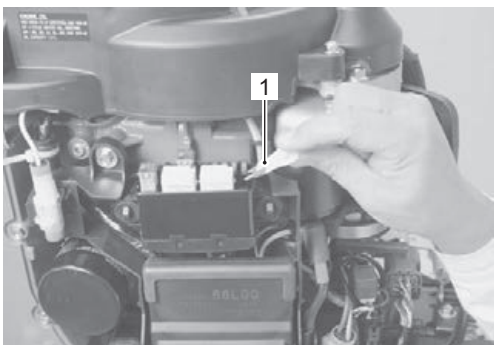
Service Instructions

Fuel Pressure Relief Procedure

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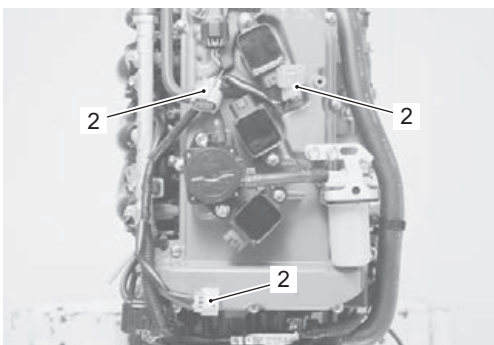
After making sure that engine is cold, relieve fuel pressure as follows:

- 1) Turn "OFF" ignition switch.
- 2) Remove the fuse box cover, then pull off the 15 amp. fuel pump fuse (1).



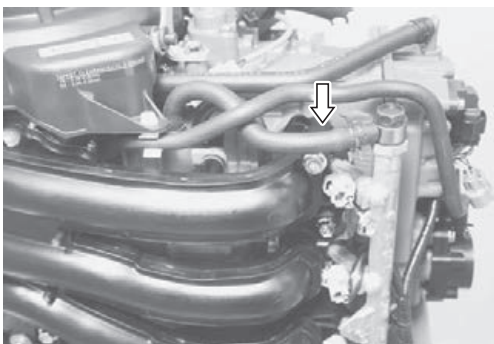
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- 3) Disconnect the ignition coil primary lead wire connectors (2) from all of the ignition coils.



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- 4) Crank the engine 5 – 10 times (3 seconds each time) to dissipate the fuel pressure in lines.
- 5) Make sure fuel pressure has been relieved by pinching the high pressure fuel hose between finger tips (the line should feel soft, without pressure).



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- 6) Upon completion of servicing, connect the ignition coil primary lead wire.
- 7) Install the 15 amp. fuel pump fuse.

Fuel Line Removal and Installation

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Pay special attention to the following points when removing or installing fuel hoses.

⚠ WARNING

Fuel components and fuel hoses after the high pressure fuel pump remain pressurized at all times.

To protect against fuel spray, relieve the fuel line pressure before disconnecting or removing components.

CAUTION

- Do not over bend (kink) or twist hoses when installing.
 - When installing hose clamps, position the tabs to avoid contact with other parts.
 - Be sure hoses do not contact rods, levers or other components with engine either operating or at rest.
 - Extreme care should be taken not to cut, abrade or cause any other damage to hoses.
 - Use care not to excessively compress hoses when tightening the clamps.
- The fuel feed line is under high pressure, use special care when servicing it.
 - Spilled gasoline should be wiped off immediately.
 - Perform the following checks to ensure proper and safe operation of the repaired unit.
 - Check fuel hose routing.
Refer to "Fuel Hose Routing" in Section 4B (Page 4B-1).
 - Check for fuel leakage.
Refer to "Fuel Leakage Check Procedure" (Page 1G-16).

Fuel Line Inspection

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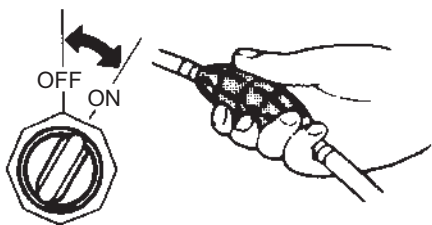
Visually inspect fuel lines for evidence of fuel leakage, cracking, deterioration, or damage. Make sure all clamps are secure. Replace parts as needed.

Fuel Leakage Check Procedure

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After performing any fuel system service, always be sure there is no fuel leakage by checking as follows.

- 1) Squeeze fuel primer bulb until you feel resistance.
- 2) Shift into "Neutral" position.
- 3) Ensure emergency stop switch lock plate is in place.
- 4) Turn ignition switch "ON" for 3 seconds (to operate fuel pump), then turn it "OFF".
Repeat this ("ON" and "OFF") procedure 3 or 4 times to pressurize the fuel system.
- 5) Once pressurized, check all connections and components for any signs of leakage.



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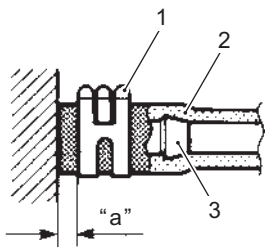
Inspection of Fuel Hose Connections

ZAJ6111706005

Note that the fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly by referring to the figure.

- For type "A" (short barbed end) pipe, the hose must completely cover pipe.

Type "A"

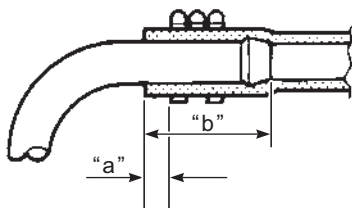


I9J011170012-01

1. Clamp (Clip)	3. Joint pipe
2. Hose	"a": 3 – 7 mm (0.1 – 0.3 in)

- For type "B" (bent end) pipe, hose must cover the straight part of pipe by 20 – 30 mm (0.8 – 1.2 in.).

Type "B"

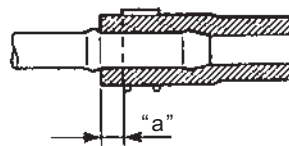


I9J011170013-01

"a": 3 – 7 mm (0.1 – 0.3 in)	"b": 20 – 30 mm (0.8 – 1.2 in)
------------------------------	--------------------------------

- For type "C" pipe, hose must fit up against the flanged part of pipe.

Type "C"

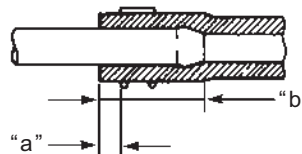


I9J011170014-01

"a": 3 – 7 mm (0.1 – 0.3 in)

- For type "D" pipe, the hose must cover the pipe by 20 – 30 mm (0.8 – 1.2 in.).

Type "D"



I9J011170015-01

"a": 3 – 7 mm (0.1 – 0.3 in) "b": 20 – 30 mm (0.8 – 1.2 in)

High Pressure Fuel Pump Operating Sound Inspection

ZAJ6111706006

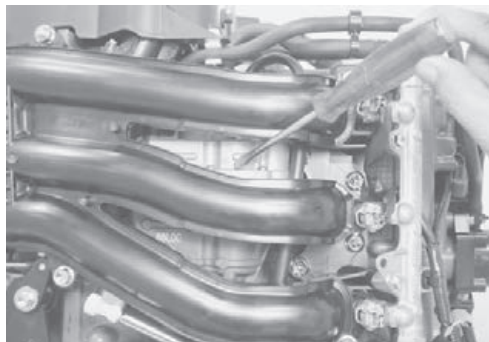
- 1) Install the emergency stop switch lock plate into position.
- 2) Shift into "Neutral".
- 3) Turn ignition switch "ON" and check for fuel pump operating sound.

NOTE

Fuel pump operating sound is low because the pump is inside the fuel vapor separator. If you cannot hear the pump sound clearly, use a sound scope or long blade screw driver.

Fuel pump operating sound

Sounds for approx. 3 seconds only (each time the ignition is turned to the "ON" position)



IAJ611170021-01

4) If no pump operating sound is heard:

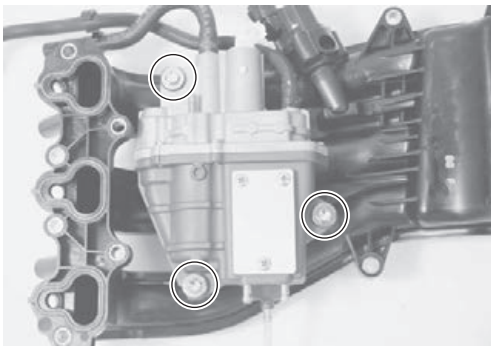
- a) Turn ignition key to the "OFF" position, check for contact failure in the lead wire connector.
- b) Check that the drive voltage is outputting from the ECM and no abnormal conditions exist in the engine main wiring harness.
- c) If inspection in steps "a" and "b" are OK, replace the high pressure fuel pump.

Fuel Vapor Separator Removal and Installation

ZAJ6111706007

Removal

- 1) Remove the intake manifold assembly.
Refer to "Intake Manifold Removal and Installation" in Section 1D (Page 1D-11).
- 2) Remove the bolts and fuel vapor separator.
Disconnect fuel outlet hose and fuel inlet hose from fuel vapor separator.



IAJ611170022-01

Installation

Installation is in the reverse order of removal with special attention to the following steps.

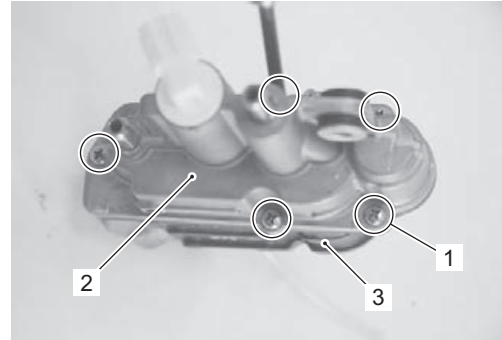
- Install the fuel vapor separator, then tighten the bolts securely.
- Install the intake manifold assembly.
Refer to "Intake Manifold Removal and Installation" in Section 1D (Page 1D-11).
- Check to ensure that all removed parts are back in place.
- Check hose and wire routing.
Refer to "Fuel Hose Routing" in Section 4B (Page 4B-1) and "Water Hose Routing" in Section 4B (Page 4B-4).
- Check for fuel leakage.
Refer to "Fuel Leakage Check Procedure" (Page 1G-16).

Fuel Vapor Separator Disassembly and Assembly

ZAJ6111706008

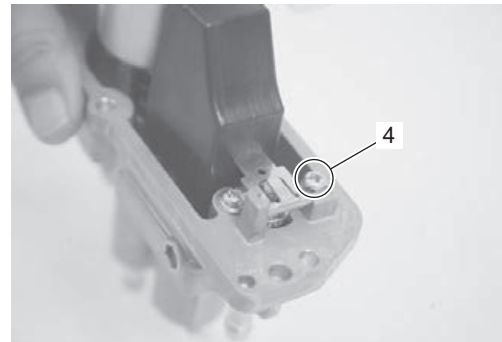
Disassembly

- 1) Remove five screws (1).
Remove the separator cover (2) with the high pressure fuel pump from separator case (3).

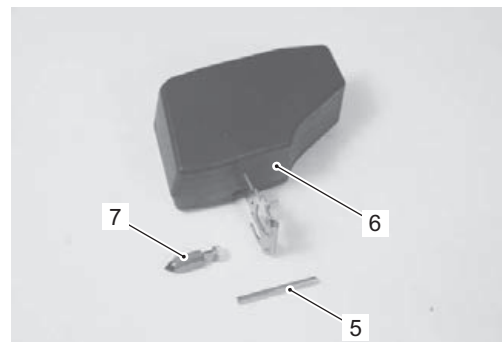


IAJ611170023-01

- 2) Remove the screw (4) and float pin (5).
Remove the float (6) and needle valve (7).



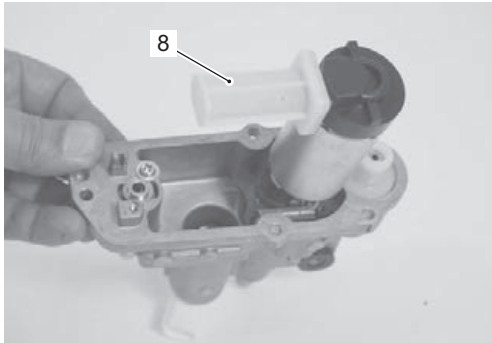
IAJ611170024-01



IAJ611170025-01

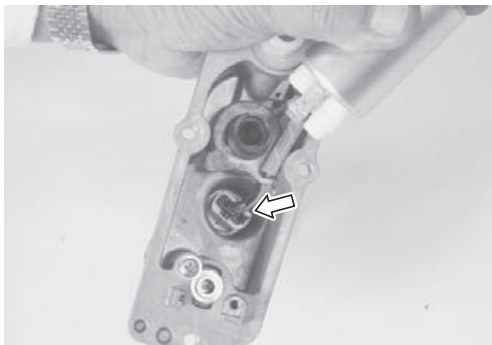
1G-18 Fuel System:

3) Remove the suction filter (8).

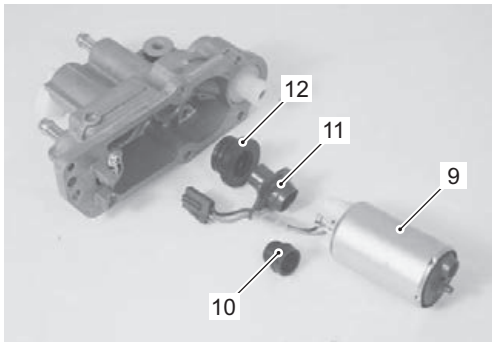


IAJ611170026-01

4) Disconnect the pump lead wire connector. Remove the high pressure fuel pump (9), bush (10), joint (11) and bush (12) from the separator cover.

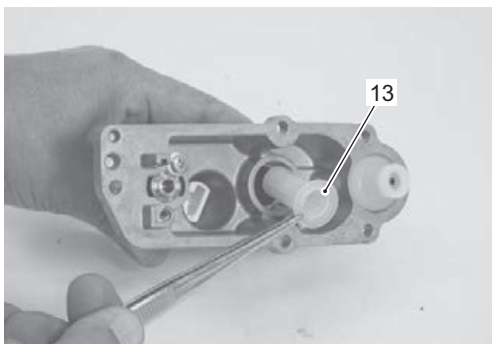


IAJ611170027-01



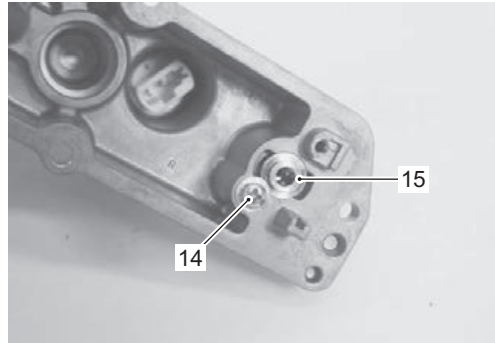
IAJ611170028-01

5) Remove the fuel outlet filter (13) from separator cover.



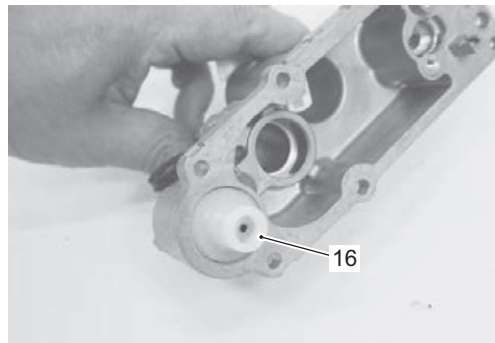
IAJ611170029-01

6) Remove the screw (14) and valve seat (15).

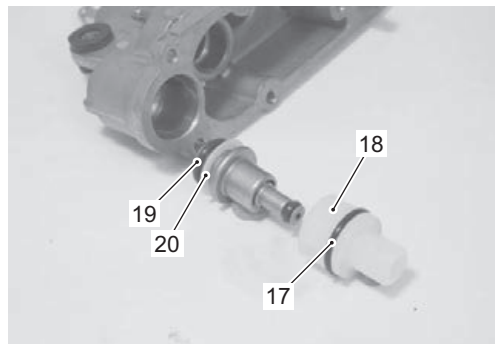


IAJ611170030-01

7) Remove the fuel pressure regulator assembly (16) from separator cover. Remove in sequence the large O-ring (17), holder (18), O-ring (19) and washer (20).



IAJ611170032-01



IAJ611170031-01

Assembly

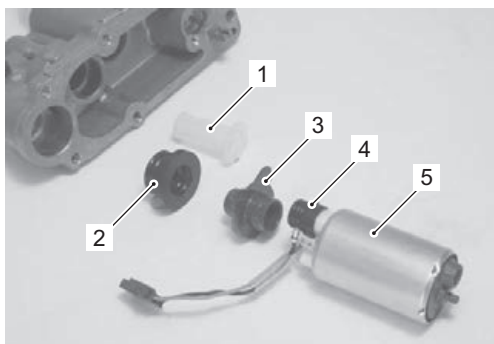
Assembly is in the reverse order of disassembly with special attention to the following steps.

High pressure fuel pump

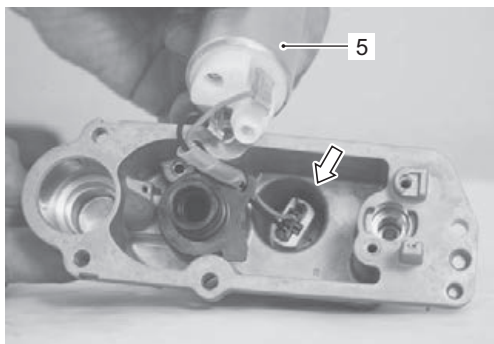
Connect the pump lead wire connector, then install the filter (1), bush (2), joint (3), bush (4) and fuel pump (5).

NOTE

Apply fuel to the grommet, joint and bush before installing.



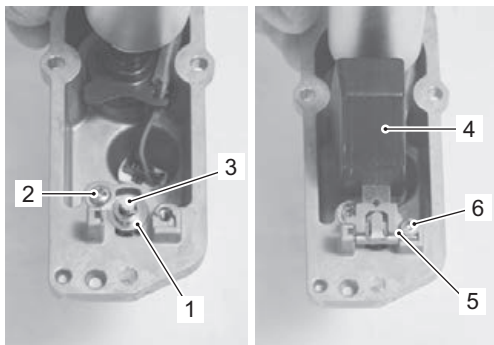
IAJ611170033-01



IAJ611170034-01

Float / Float pin

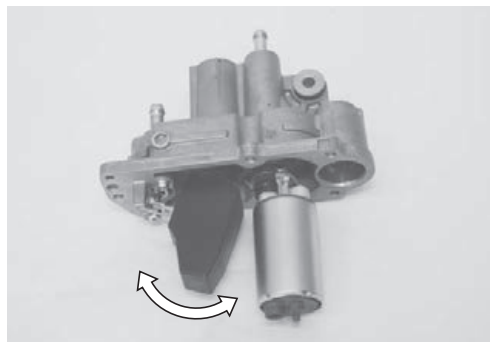
- Install the valve seat (1), then tighten screw (2) securely.
- Install the needle valve (3), float (4) and float pin (5), then tighten screw (6) securely.



IAJ611170035-01

NOTE

After assembling, check for smooth and free float movement.



IAJ611170036-01

Checking float height

Measure the float height.

Special tool

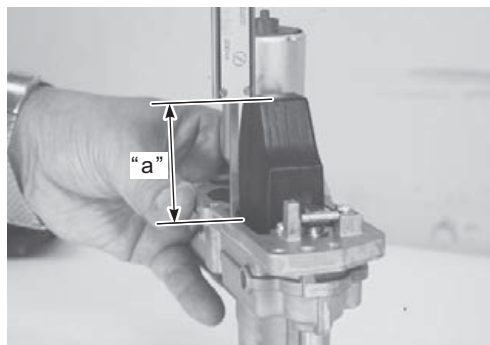
 : 09900-20101 (Vernier calipers (150 mm))

Float height "a"

Standard: 47 ± 3.0 mm

NOTE

Make sure that the float weight is not applied to the needle valve.



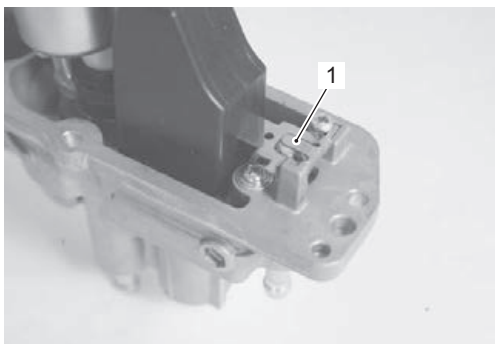
IAJ611170037-01

Setting float height

To correct specification, bend only adjustment tab (1).

CAUTION

When adjusting the tab, do not bend to the point that it applies pressure to the needle and seat.



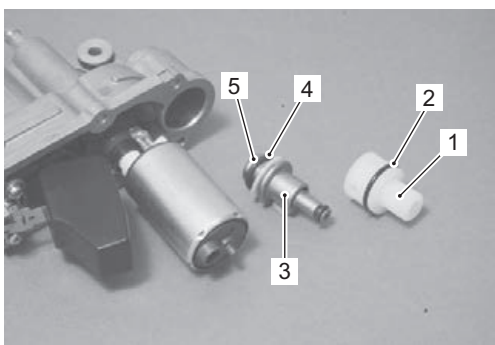
IAJ611170038-01

Fuel pressure regulator

- 1) Assemble the fuel pressure regulator in the following sequence: holder (1), O-ring (2), fuel pressure regulator (3), washer (4) and O-ring (5).

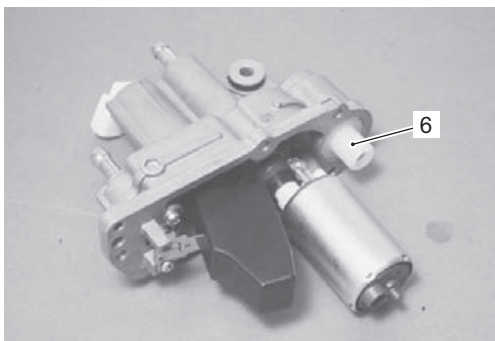
NOTE

Apply fuel to the O-ring before installing.



IAJ611170039-01

- 2) Install the fuel pressure regulator assembly (6) to separator cover.



IAJ611170040-01

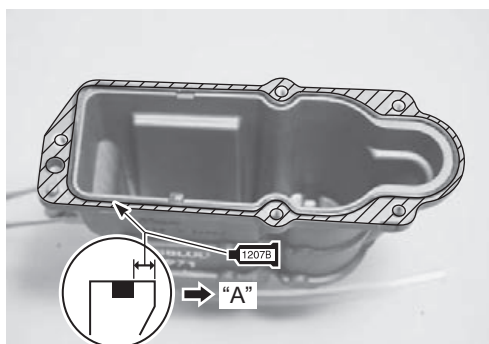
Separator cover / Separator case

- 1) Install the seal ring (1) and then apply Suzuki Bond evenly to only the outside mating surface of the separator case as shown in figure.

1207B: Sealant 99000-31140 (SUZUKI Bond 1207B (100 g))

NOTE

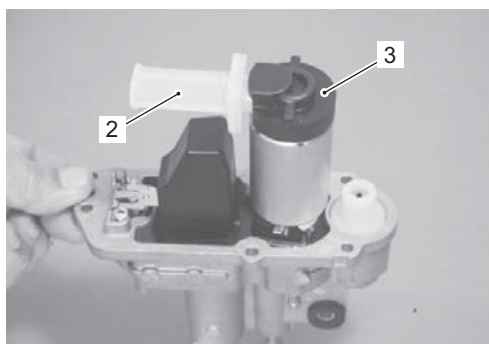
- Clean mating surfaces before applying bond.
- Do not apply bond to seal ring, groove or inside mating surface.



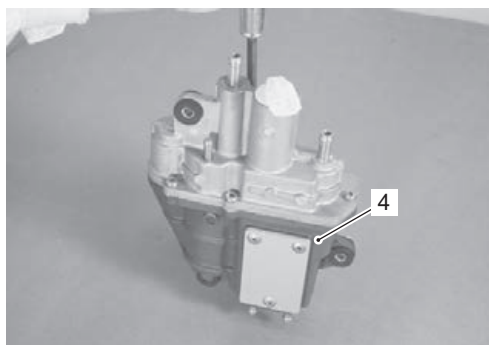
IAJ611170041-03

"A": Outside

- 2) Install the suction filter (2), spacer (3) and separator case (4) and then tighten the screws securely.



IAJ611170042-01



IAJ611170043-01

Final assembly check

- Check to ensure that all removed parts are back in place.

Inspection of Fuel Vapor Separator Component Parts

ZAJ6111706009

NOTE

If cracks, excessive wear or other damage is found on any component, replace the component.

Needle Valve / Valve Seat

Inspect the needle valve and valve seat for grooves, other damage or dirt.
Replace or clean if necessary.



IAJ611170044-01

Float

Inspect the float for cracks or other damage.
Replace if necessary.



IAJ611170045-01

Filter

Check fuel suction filter and fuel outlet filter for evidence of dirt and contamination.
If present, replace or clean and check for presence of dirt in fuel tank.



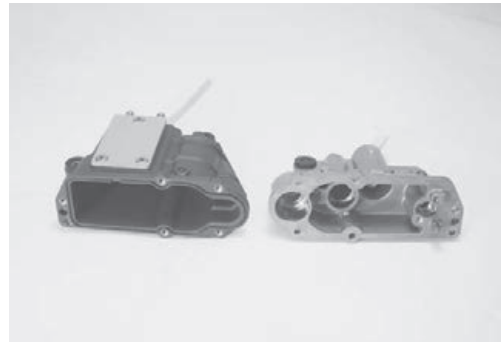
IAJ611170046-01

Separator Cover and Case

Inspect the separator cover and case.
Replace if cracked, damaged or other abnormal conditions.

NOTE

**Separator cover and case are a set.
If any repair is required on the cover or case, replace them as a fuel vapor separator assembly.**



IAJ611170047-01

Fuel Pressure Regulator

Inspect the fuel pressure regulator for damage or corrosion.
Replace if cracked, damaged or other abnormal conditions.

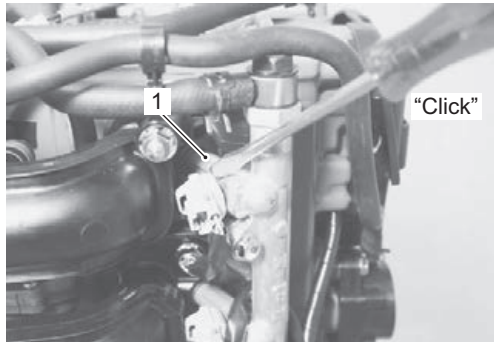


IAJ611170048-01

Fuel Injector Inspection with Injector in place

ZAJ6111706010

- 1) Using a sound scope or equivalent, check the operating sound of the fuel injector when the engine is running or cranking.
Injector operating sound cycle should vary according to engine speed.
If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector.



IAJ611170049-01

1. Injector body

- 2) Disconnect the lead wire connector from the fuel injector.
- 3) Connect a digital tester between the terminals of the injector and measure resistance.
If out of specification, replace the fuel injector.

Special tool

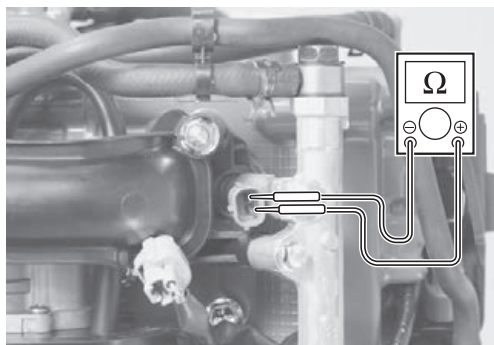
TOOL : 09930-99320 (Digital tester)

Tester knob indication

Resistance (Ω)

Fuel injector resistance

Standard: 10 – 14.0 Ω



IAJ611170050-01

- 4) Connect the lead wire connector to the fuel injector securely.

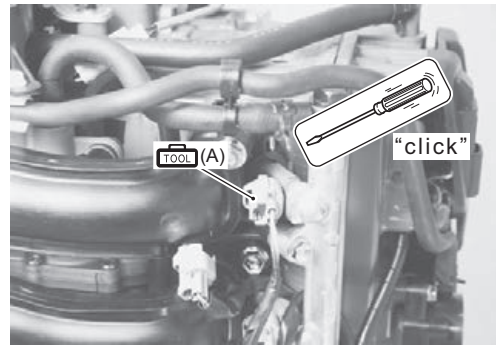
Individual Fuel Injector Operating Sound Inspection

ZAJ6111706011

- 1) Disconnect the ignition coil lead wire connectors from all of the ignition coils.
- 2) Disconnect the fuel injector lead wire connector and connect the test cord.

Special tool

TOOL (A): 09930-89260 (Injector test cord (A))



IAJ611170051-01

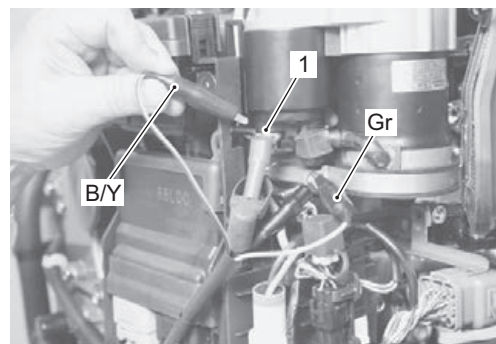
- 3) Connect the Gray wire to body ground.
- 4) Momentarily touch the Black/Yellow wire to the starter motor magnetic switch terminal "B" (connected to battery positive (+) terminal) and check for injector operating sound.
If out of specification, replace fuel injector.

CAUTION

Connecting the fuel injector to battery positive for more than a few seconds may cause injector overheating and possible injector solenoid failure.

Fuel injector operating sound

"click"

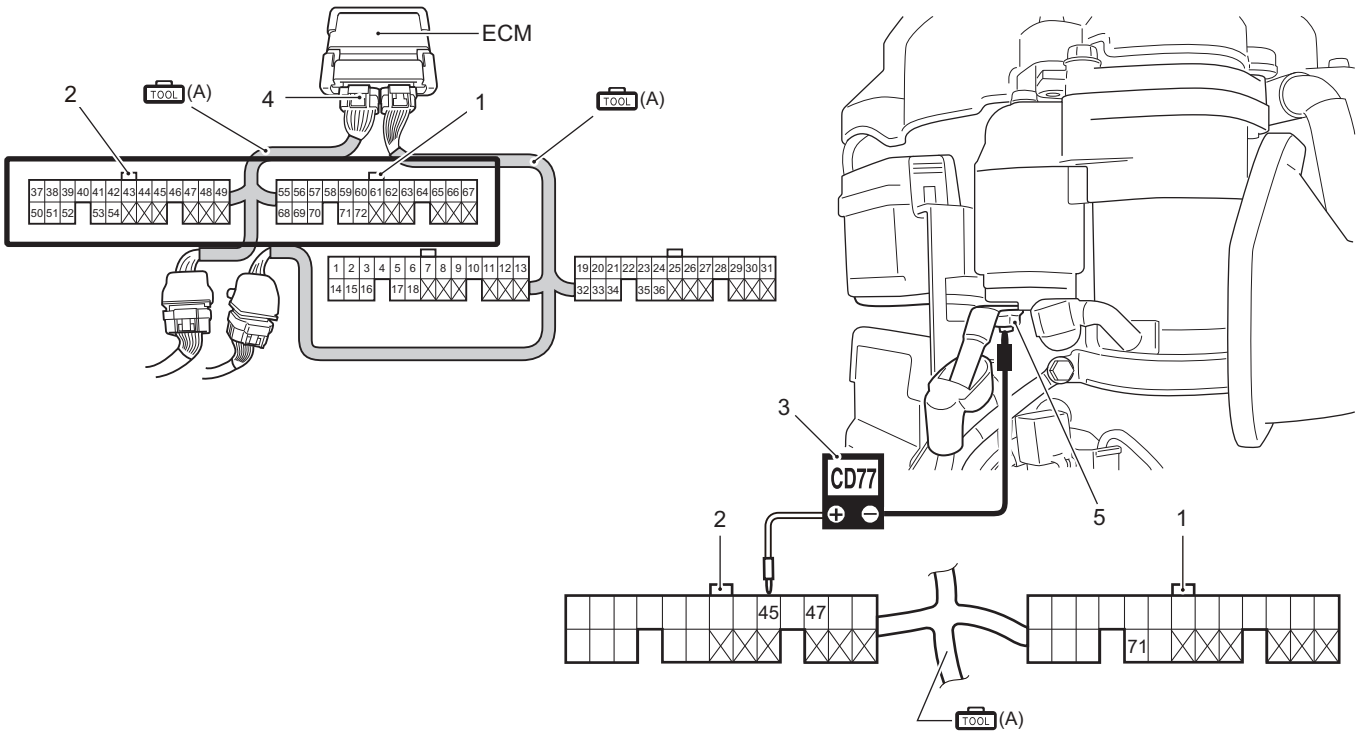


IAJ611170052-01

1. Starter motor magnetic switch "B" terminal

Fuel Injector Operating Signal Inspection

ZAJ6111706012



IAJ611170053-01

1. Black connector	3. Peak voltmeter stevens CD-77	5. Starter motor magnetic switch "B" terminal
2. White connector	4. Gray test cord connector side	

Special tool

- (A): 09930-88730 (36-pin test cord set)
- : Stevens peak reading voltmeter CD-77

Tester knob indication

NEG 50

- 1) Disconnect all ignition coil connectors from the ignition coils.
- 2) Connect the test cord between the ECM and wire harness as shown in figure, then turn ignition switch "ON".
- 3) Connect the tester probe ("−", Black) to the starter motor magnetic switch terminal "B" (connected to battery positive (+) terminal) as shown in figure.
- 4) Connect the tester probe ("+", Red) to each terminal.

Injector	Terminal	Wire color (Engine harness)
No.1	45	O/B
No.2	71	B/Br
No.3	47	R/W

- 5) Crank the engine and measure the voltage.
If out of specification, inspect the related parts as described in "Fuel System Diagnostic Information / Fuel Injection System Troubleshooting".
Refer to "Fuel System Diagnosis" (Page 1G-13) and "Fuel Injection System Troubleshooting" (Page 1G-14).

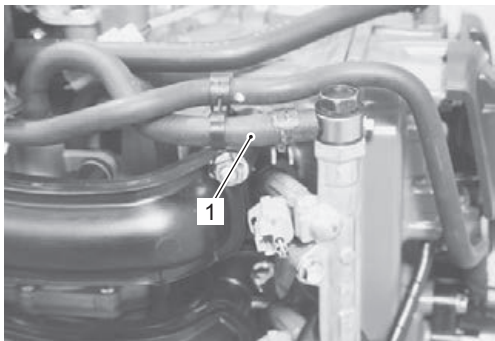
Fuel injector operating signal
Standard: Approx. 4 – 10 V or over

Fuel Injector Removal and Installation

ZAJ6111706013

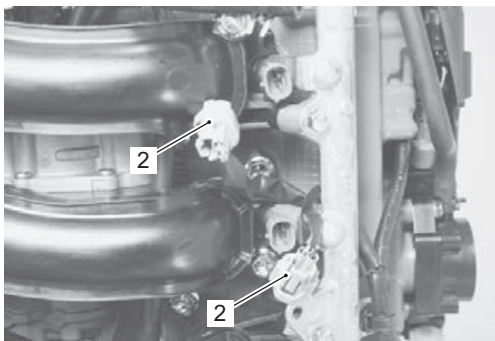
Removal

- 1) Relieve the fuel pressure in the fuel feed line according to "Fuel Pressure Relief Procedure". Refer to "Fuel Pressure Relief Procedure" (Page 1G-15).
- 2) Loosen the clamp and place a large cloth over the end of the fuel feed hose (1). Slowly pull the fuel feed hose from the fuel delivery pipe. Drain any excess fuel in the hose into a small container.



IAJ611170054-01

- 3) Disconnect the three fuel injector connectors (2).



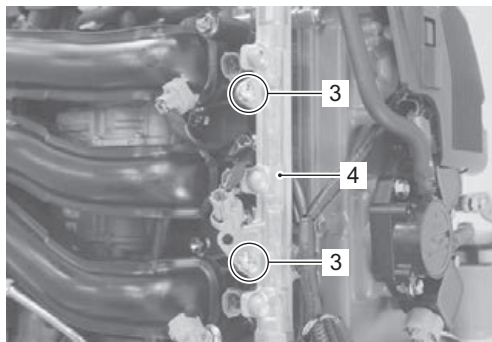
IAJ611170055-01

- 4) Remove the two bolts (3) and the fuel delivery pipe (4) (with the fuel injectors).

CAUTION

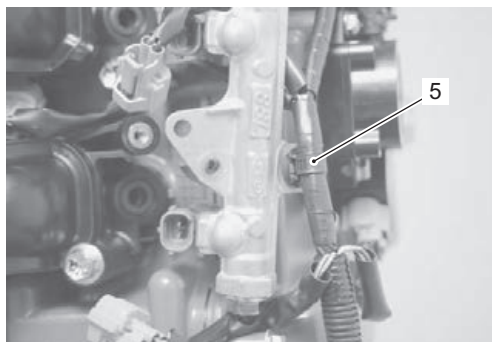
A small amount of fuel may be released when the fuel injector is removed from delivery pipe.

Place a shop cloth under the fuel injector before removal to absorb any fuel released. Dispose of the fuel soaked cloth in appropriate container.



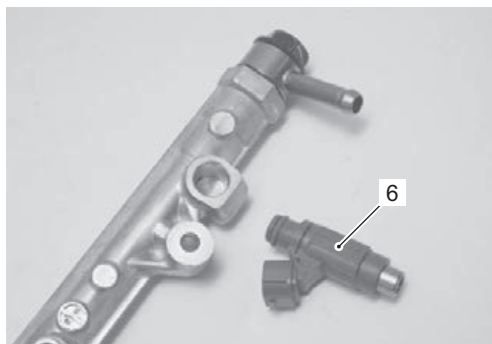
IAJ611170056-01

- 5) Remove the lead wire clamp (5) from delivery pipe by releasing clamps' lock.



IAJ611170057-01

- 6) Remove each injector (6) from the delivery pipe.



IAJ611170058-01

Installation

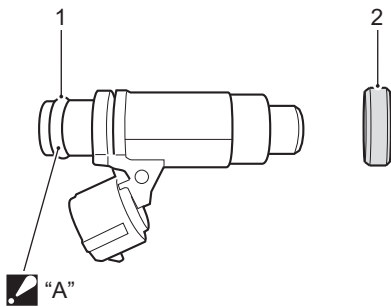
Installation is in the reverse order of removal with special attention to the following steps.

CAUTION

Do not re-use O-ring and cushion once removed.

Always use new parts.

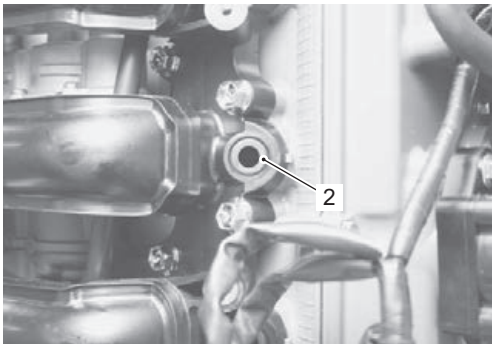
- 1) Replace the injector O-ring (1) with a new one using care to avoid nicks or cuts during installation.



I9J011170024-01

"A": Apply fuel to O-ring.

- 2) Replace the injector cushion (2) with a new one and install to the intake manifold.



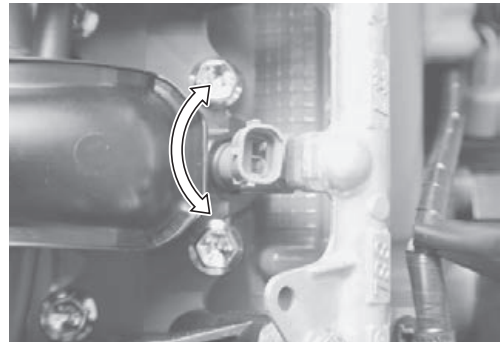
IAJ611170059-01

- 3) Apply a thin coat of fuel to injector O-rings, then install the injectors into the delivery pipe and intake manifold. Make sure that the injectors rotate smoothly.

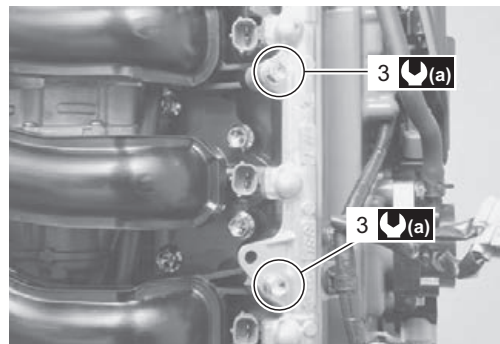
- 4) Tighten the delivery pipe bolts (3) and make sure that the injectors rotate smoothly.

Tightening torque

Fuel delivery pipe bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)

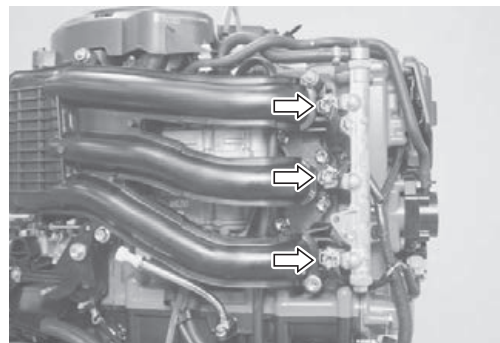


IAJ611170060-01



IAJ611170061-01

- 5) Reconnect the fuel feed hose and fuel line securely.
- 6) Connect the lead wire connector to the injectors securely.



IAJ611170062-01

- 7) Make sure the emergency stop switch lock plate is in place. Shift into "Neutral" position.
- 8) Squeeze the fuel primer bulb until you feel resistance. Turn ignition switch "ON" for 3 seconds (to operate fuel pump), then turn it "OFF". Repeat this ("ON" and "OFF") procedure 3 or 4 times to pressurize the fuel system. Check for fuel leaks around the fuel injectors.

Low Pressure Fuel Pump Removal and Installation

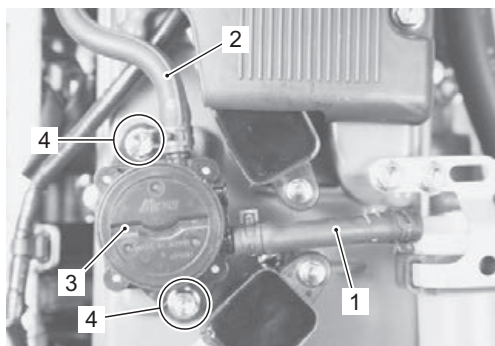
ZAJ6111706014

NOTE

The low pressure fuel pump is a non-repairable component.
Do not attempt to disassemble the low pressure fuel pump.
It must be replaced as a complete unit if it is defective.

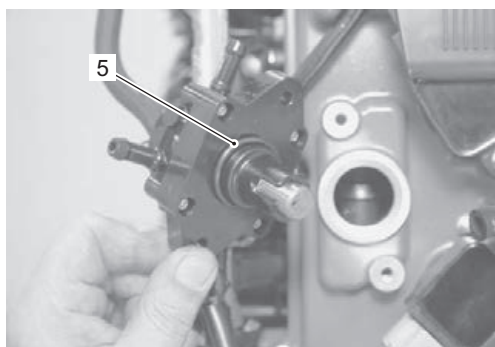
Removal

- 1) Disconnect the inlet hose (1) and outlet hose (2) from low pressure fuel pump (3).
- 2) Remove two bolts (4).



IAJ611170063-01

- 3) Remove fuel pump. Note the position before removing the O-ring (5).



IAJ611170064-01

Installation

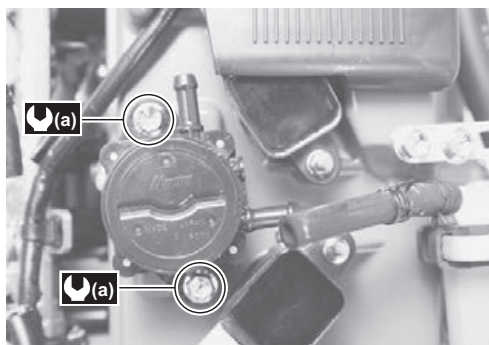
Installation is in the reverse order of removal with special attention to the following steps.

CAUTION

- Before installing the fuel pump, rotate the crankshaft to bring the No.1 (top cylinder) piston to Top Dead Center on the compression stroke.
- Do not reuse O-ring once removed. Always use a new O-ring.

Tightening torque

Low pressure fuel pump bolt (a): 10 N·m (1.0 kgf-m, 7.2 lbf-ft)



IAJ611170065-01

Low Pressure Fuel Pump Inspection

ZAJ6111706015

NOTE

The low pressure fuel pump is a non-repairable component.
Do not attempt to disassemble the low pressure fuel pump.
It must be replaced as a complete unit if it is defective.

Fuel Pump Assembly

Inspect the fuel pump.
If leakage, cracks, damage or other abnormal condition is found, replace fuel pump assembly.



I9J011170071-01



I9J011170072-01