Fuel System

Precautions

Precautions on Fuel System Service

CENDK1111700001

⚠ WARNING

Service operation of any type performed on the fuel system involves a risk of fire and injury if proper precautions are not taken.

Be sure to take 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 CO_2 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.**
- **Before loosening or disconnecting the fuel feed line, be sure to relieve the fuel system of fuel pressure by following the fuel pressure relief procedure.**
- **When disconnecting a fitting on the fuel line, cover the fitting with a shop cloth to soak up the small amount of fuel that may flow out from the disconnected fuel line. Put the used cloth in an approved container.**
- **Since fuel hose connections vary with the pipe type, connect and clamp each hose using the correct method for each specific connection.**
  After connecting a hose, check that there is no twist or kink in the hose.
- **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.**

General Description

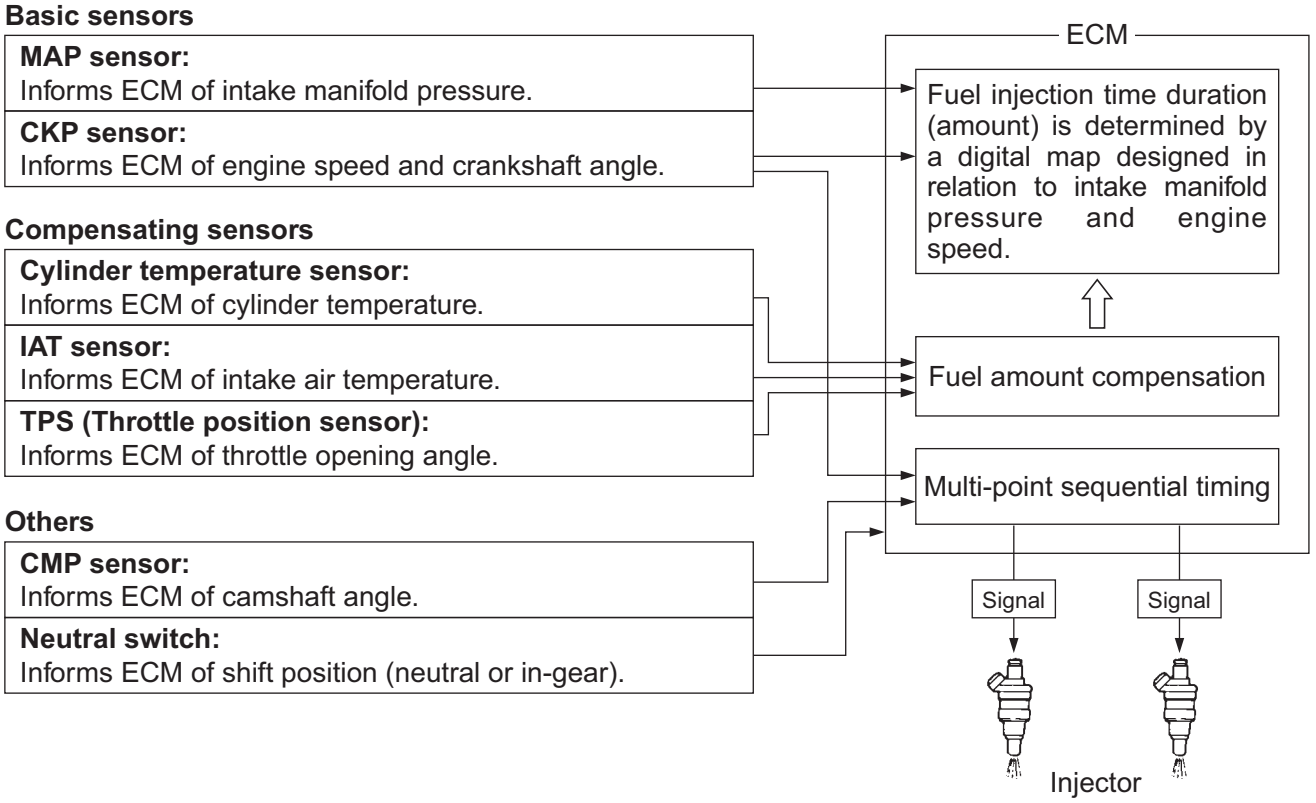
Electronic Fuel Injection System Description

CENDK1111701001

The fuel injection system used by the DF15A/20A 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 210° BTDC on the intake stroke.



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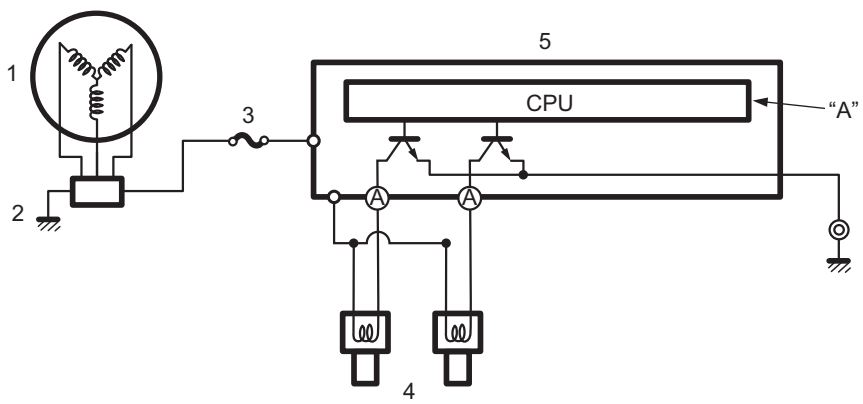
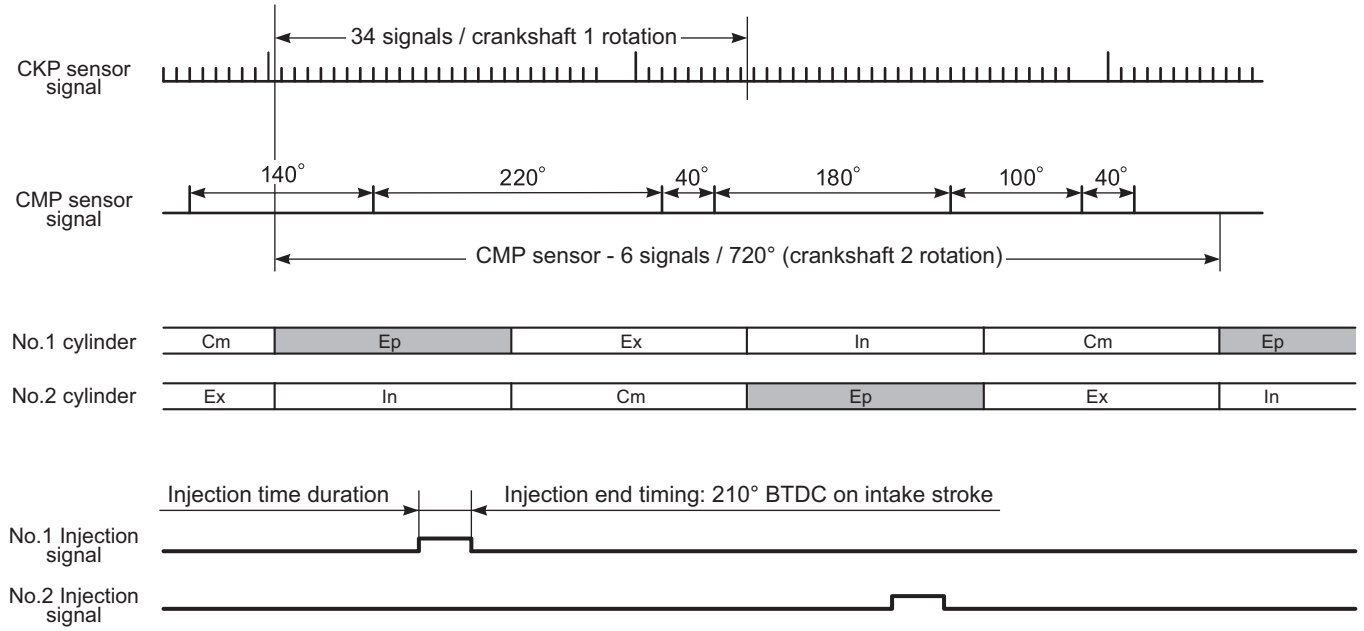


IDK111170002-03

1. Battery charge coil	3. 10 A fuse	5. ECM
2. Rectifier / Regulator	4. Injector	"A": Sensor/switch signal input

Fuel Injection Timing Chart



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

IDK111170003-02

Fuel Injection Control Mode

When cranking:

Fuel is simultaneously injected to all cylinders according to the “Start up mode” map in relation to crankshaft angle.

After start (Fast-idle function):

The fuel injection amount is controlled so that it is increased until the cylinder temperature comes to the 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

CENDK1111701002

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 high pressure fuel pump), delivery pipe, fuel injectors and hoses.

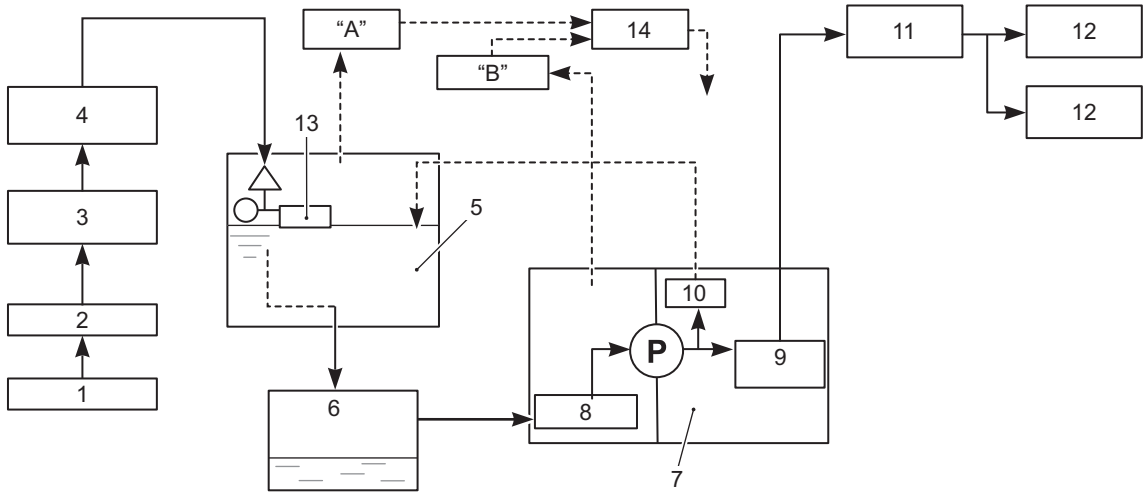
Fuel is supplied through the primer bulb, low pressure fuel filter, and low pressure fuel pump to the fuel vapor separator.

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

The pressure regulator maintains fuel pressure in the feed line at absolute fuel pressure of approx. 300 kPa (3.0 kg/cm^2, 43 psi.). This pressure is maintained at a constant level.

When fuel feed line pressure exceeds more than approx. 300 kPa (3.0 kg/cm^2, 43 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.



IDK111170004-04

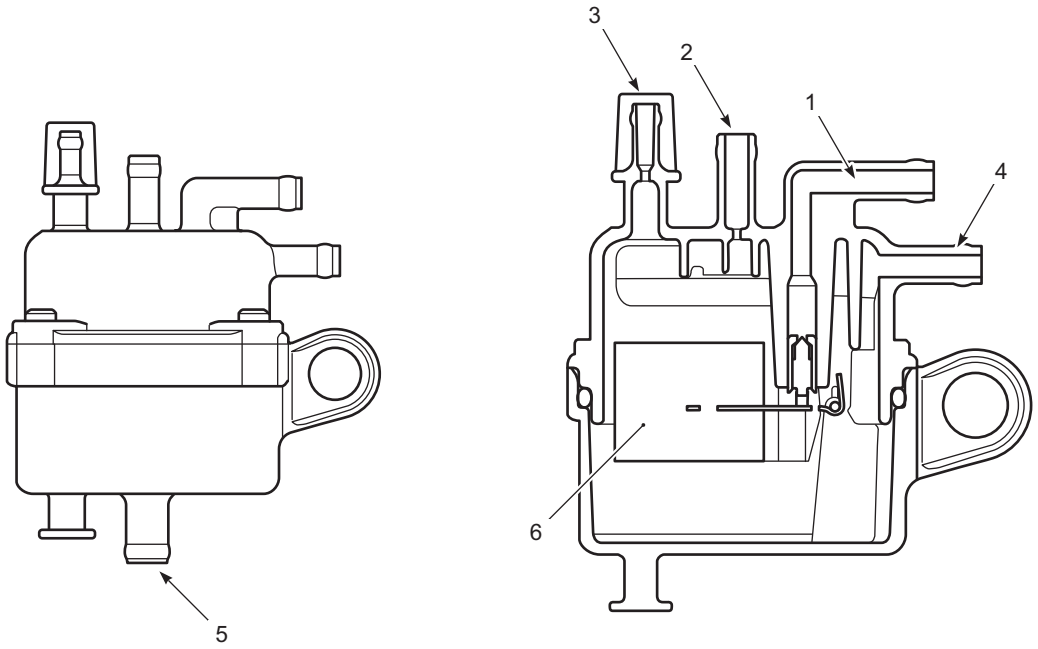
1. Fuel tank	7. High pressure fuel pump	13. float
2. Primer bulb	8. Mesh filter	14. Evaporation chamber
3. Low pressure fuel filter	9. Mesh filter	"A": Evaporation gas
4. Low pressure fuel pump	10. Fuel pressure regulator	"B": Fuel vapor
5. Fuel vapor separator	11. Fuel delivery pipe	
6. Fuel cooler	12. Fuel injector	

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.



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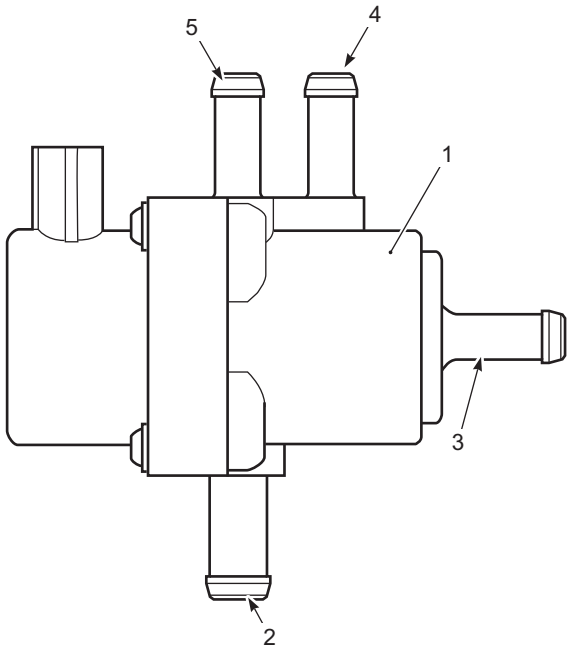
1. Fuel inlet (from low pressure fuel pump)	3. Cap	5. Fuel outlet (to fuel cooler)
2. Air vent	4. Return fuel inlet (from high pressure fuel pump / fuel pressure regulator)	6. Float

High Pressure Fuel Pump

The high pressure fuel pump is an “integral” type.

The pump is located on cylinder head cover.

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



IDK111170006-02

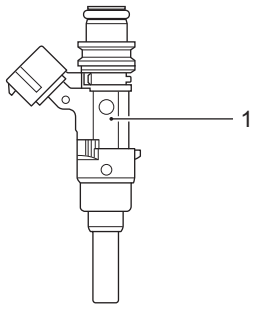
1. High pressure fuel pump	3. Fuel outlet	5. Bubble (air) outlet
2. Fuel inlet	4. Return fuel outlet	

Fuel Pressure Regulator

The fuel pressure regulator is located in the high pressure fuel pump.
The regulator's function in the system is to maintain a constant fuel pressure relative to the injector while the engine is operating.
Fuel pressure, adjusted by the regulator, is constantly maintained at absolute fuel pressure of approx. 300 kPa (3.0 kgf/cm^2, 43 psi.).
By-pass fuel is returned to the fuel vapor separator chamber.

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 valve is open.



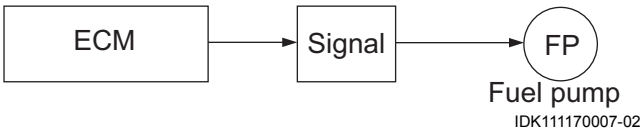
IDK111170060-03

1. Fuel injector	

High Pressure Fuel Pump Control System Description

CENDK1111701003

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 fuel injection amount, 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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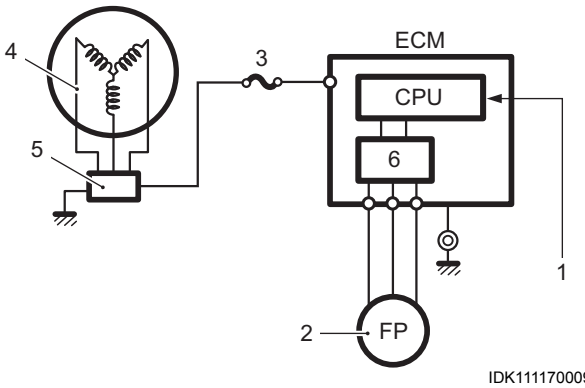
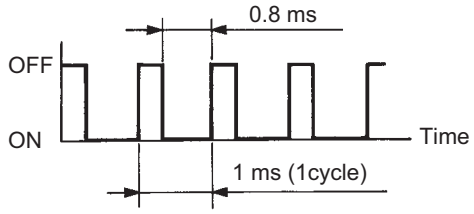


IDK111170009-02

1. Sensor/switch signal input	4. Battery charge coil
2. Fuel pump	5. Rectifier / Regulator
3. 10 A fuse	6. Pump driver

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

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



IDK111170011-01

Control Modes

When cranking:

The fuel pump is controlled to operate at “start-up” mode.

When running (Normal operation):

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

Air Intake Components Description

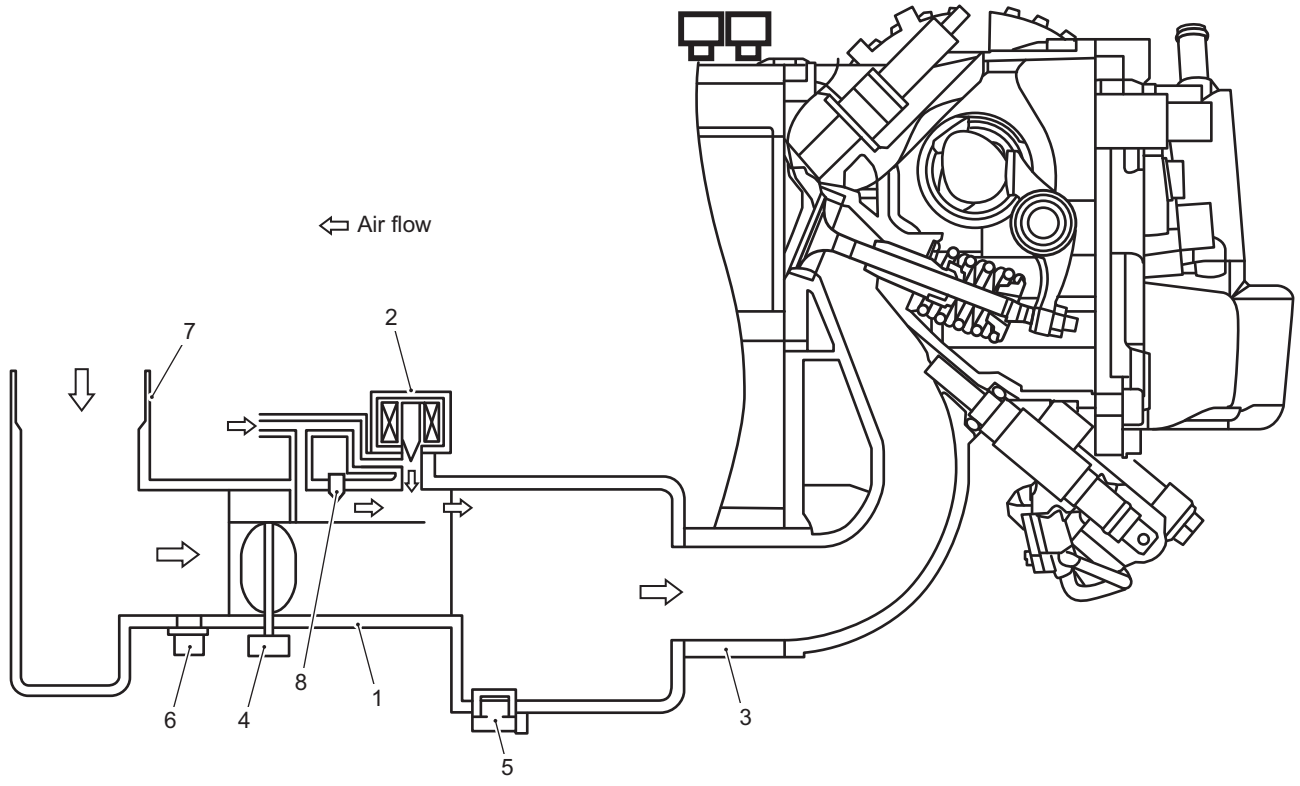
CENDK1111701004

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

Inlet 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.



IDK111170012-02

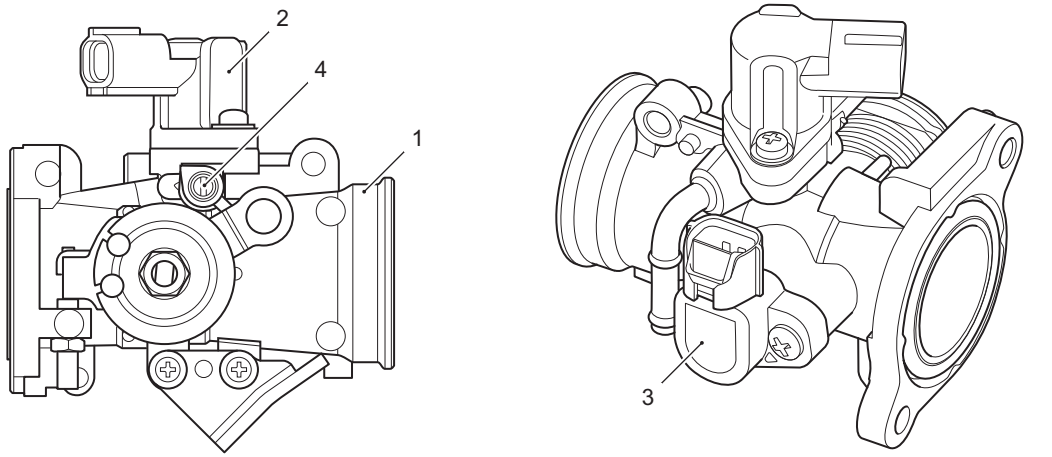
1. Throttle body	3. Intake manifold	5. MAP sensor	7. Air intake silencer
2. IAC valve	4. Throttle position sensor	6. IAT sensor	8. By-pass air screw

Throttle Body

- The throttle body assembly consists of the main bore, throttle valve, by-pass air passage, IAC passage, by-pass air screw and TPS (Throttle position sensor).
- The throttle body adjusts the intake air amount with the throttle valve which is connected to the throttle lever linkage.
- The TPS installed on the throttle body informs of throttle valve opening angle.

NOTE

Do not try to adjust or remove any of the throttle body component parts (Throttle position sensor, throttle valve, throttle stop screw, etc.).
These components have been factory adjusted to precise specifications.



IDK111170015-01

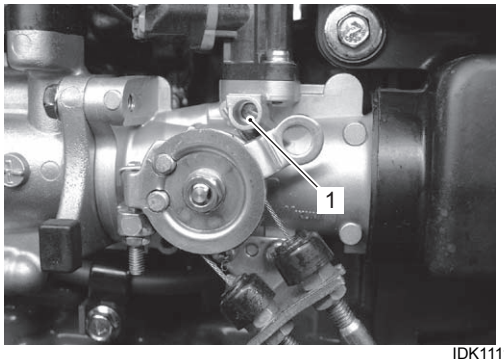
1. Throttle body assembly	2. IAC valve	3. TPS	4. By-pass air screw

By-pass air screw / passage

Since the throttle valve is almost fully closed when idling / trolling, the main flow of air necessary to maintain idling / trolling speed passes through the by-pass air passage.
The by-pass air adjustment screw controls the flow of air through the passage and provides a means of partially adjusting the total amount of air necessary for idling / trolling.

NOTE

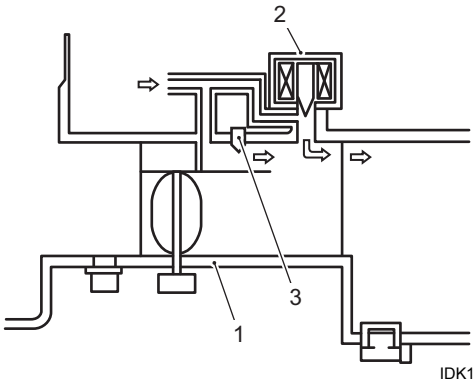
For the by-pass air screw adjustment procedure, refer to "Idle Speed and Idle Air Control (IAC) Duty Inspection" in Section 0B (Page 0B-14).



IDK111170020-01

1. By-pass air screw

IAC valve / passage
The IAC valve is a solenoid plunger type mounted on the throttle body.
Its purpose is to control the amount of intake air flowing from the IAC passage.
The IAC valve is driven by the duty cycle signal from the ECM.



IDK111170016-01

1. Throttle body	2. IAC valve	3. By-pass air screw

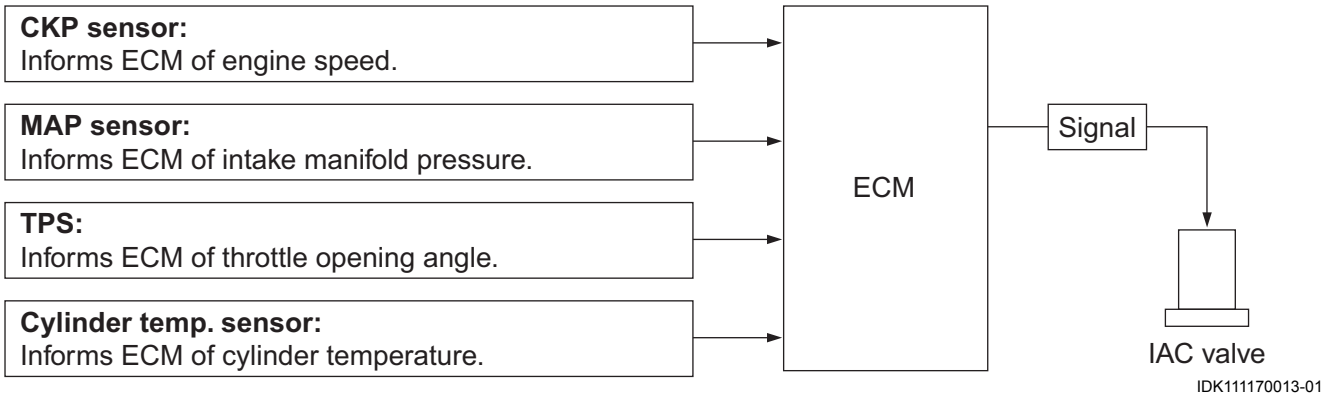
Idle Air Control System Description

CENDK1111701005

The ECM controls the duty cycle signal 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 / switch shown below monitor current engine condition and send signals to the ECM. Based on these signals, the ECM determines the optimum duty cycle (repeating “ON” time rate within a cycle).
A repeating ON/OFF signal at a specified rate (10 times a second) is then sent to the IAC valve.



IDK111170013-01

IAC Valve Control Mode
Before started:
The IAC valve is always closed when engine is not running. (0% duty)

When cranking:
The IAC valve is controlled to operate at 100% duty.

After start (fast-idle function):
The IAC valve is controlled to operate at 100% duty until the timer, which was set according to cylinder temperature at cranking, expires.

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 a duty cycle of approx. 10% but will vary slightly as idling / trolling conditions change.

When running (normal operation):
The IAC valve is controlled to operate at 10 – 100% duty, which depends on the current engine conditions.

When decelerating (dash-pot effect):
When the throttle valve is suddenly returned to full close and the throttle position sensor signal changes to “fully closed”, the IAC valve operates at a controlled gradual return to idle / troll operating duty 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 “Fast-idle function”, the by-pass air screw must be adjusted to provide IAC valve operation at 10 ± 5% duty at the engine idling / trolling specification.
For the by-pass air screw adjustment procedure, refer to “Idle Speed and Idle Air Control (IAC) Duty Inspection” in Section 0B (Page 0B-14).

Diagnostic Information and Procedures

Fuel Pressure Inspection

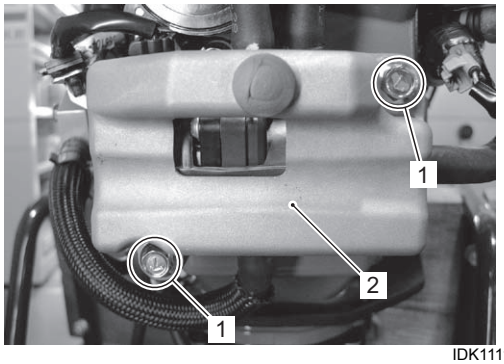
CENDK1111704002

⚠ WARNING

Gasoline is a flammable material that can cause fire hazard or burns.

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service:” in order to reduce the risk or fire and personal injury.

1) Relieve fuel pressure in fuel feed line.
Refer to “Fuel Pressure Relief Procedure” (Page 1G-14).
2) Remove the bolts (1) and high pressure fuel pump guard (2).



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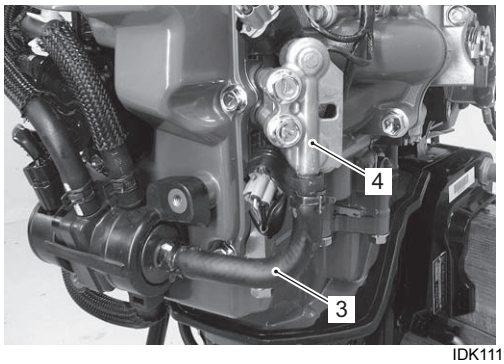
3) Disconnect high pressure fuel feed hose (3) from fuel delivery pipe (4).



IDK111170022-02

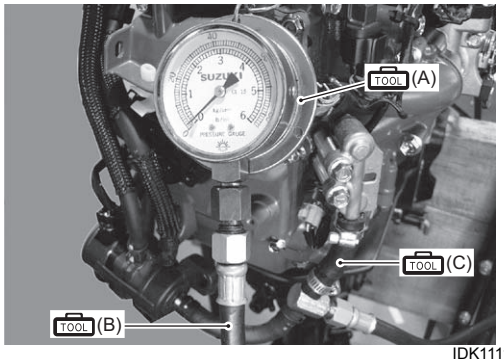
4) Connect special tools (pressure gauge, pressure hose and pressure joint) between fuel feed hose (3) and fuel delivery pipe as shown in figure.
Clamp the hose securely to ensure that no leaks occur during checking.

⚠ WARNING

Gasoline is a flammable material that can cause fire hazard or burns.

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



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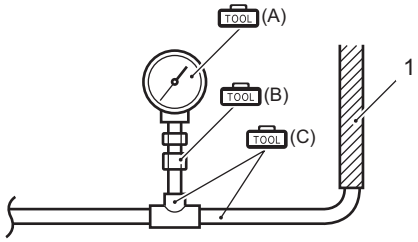
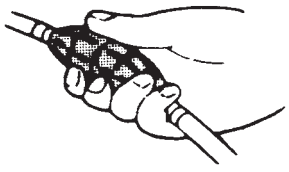


IDK111170014-01

1. Fuel delivery pipe

5) Squeeze fuel primer bulb until you feel resistance.
Pull the starter grip sharply several times to fill the high pressure fuel feed line with fuel.
Repeat this procedure 3 or 4 times to pressurize the fuel system and then check fuel pressure.



IAJ311170008-01

6) Check for any signs of fuel leakage.
7) 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. 300 kPa (3.0 kg/cm², 43 psi)

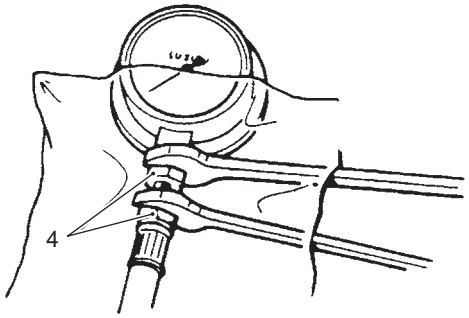
⚠ WARNING

Gasoline is a flammable material that can cause fire hazard or burns.

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.**

8) After checking fuel pressure, remove fuel pressure gauge.



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4. Joint nut

9) Reconnect fuel line.
10) Check the fuel system for leaks.

Fuel System Diagnosis

CENDK1111704001

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

Fuel Injection System Troubleshooting

CENDK1111704003

Before starting the troubleshooting, make sure that:

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

Step 1

Check fuel injector operating sound.

- Check each injector for operating sound at engine cranking. (Refer to page 1G-17.)

Do all injector make operating sound?

Yes — Fuel injector circuit is in good condition.

No — Go to step 2.

Step 2

Check fuel injector resistance.

- Stop the engine, disconnect connectors from fuel injectors.
- Check for proper connection to fuel injector at each terminal.
- If good condition, check all fuel injector for resistance. (Refer to page 1G-18.)

Are all injectors in good condition?

Yes — Go to step 3.

No — Faulty fuel injector.

Step 3

Check fuel injector power supply.

- Measure voltage between each “Gray/Red” wire terminal of fuel injector connector and engine body ground with engine cranking.

Special tool
CD-77 : Stevens peak reading voltmeter CD-77

Tester knob indication
POS50

Is voltage 5 V or over?

Yes — Go to step 4.

No
- “Gray/Red” wire open or shorted.
- If it is in good condition, check ECM power source and ground circuit.

Step 4

Check wire circuit.

- Disconnect connector from ECM.
- Measure resistance between each “O/B”, “B/Br” wire terminal of the fuel injector connector and body ground.

Is resistance infinity?

Yes — Go to step 5.

No — “O/B” and/or “B/Br” wire(s) are shorted to ground.

Step 5

Check wire circuit.

- Connect the connector to ECM.
- Measure voltage between each “O/B”, “B/Br” wire terminal of fuel injector connector and body ground with engine cranking.

Special tool
CD-77 : Stevens peak reading voltmeter CD-77

Tester knob indication
POS50

Is voltage 0 V?

Yes — Go to step 6.

No — “O/B” and/or “B/Br” wire(s) are shorted to power supply circuit.

Step 6

Check fuel injector operating signal.

- Connect connectors to each fuel injector and ECM.
- Measure fuel injector operating signal between each “2”, “15”, terminal of ECM and body ground. (Refer to page 1G-19.)

Is voltage approx. 20 V or over?

Yes — If check result is satisfactory, substitute a known-good ECM and recheck.

No — “O/B” and/or “B/Br” wire(s) are open circuit.

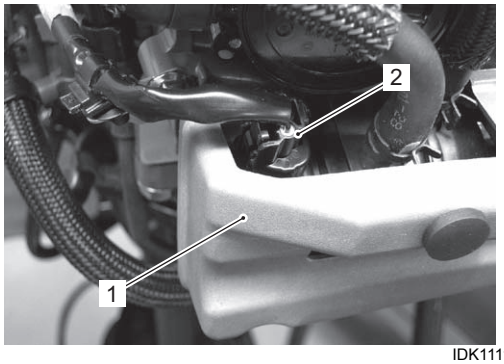
Service Instructions

Fuel Pressure Relief Procedure

CENDK1111706016

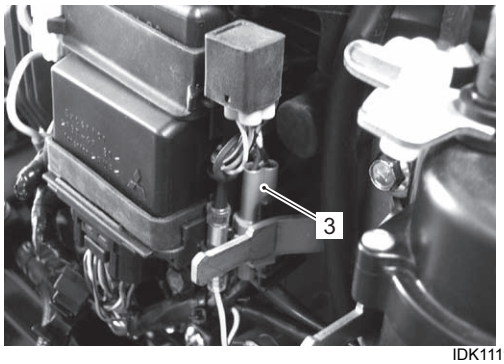
After making sure that engine is cold, relieve fuel pressure as follows.

1) Stop the engine.
2) Loosen the bolts securing high pressure fuel pump guard (1).
   Disconnect high pressure fuel pump lead wire connector (2) at high pressure fuel pump.



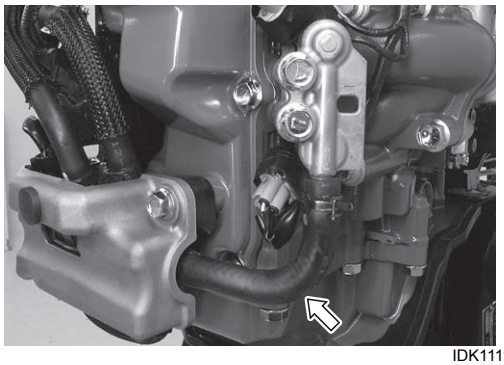
IDK111170024-01

3) Disconnect the ignition coil primary lead wire (3).



IDK111170025-01

4) Crank the engine several times to dissipate fuel pressure in lines.
5) Make sure fuel pressure has been removed by pinching high pressure fuel hose between finger tips (line should feel soft without pressure).



IDK111170054-01

6) Upon completion of servicing, connect ignition coil primary lead wire and high pressure fuel pump lead wire. Tighten the fuel pump guard bolts.

Fuel Line Removal and Installation

CENDK1111706001

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

⚠ WARNING

Gasoline is a flammable material that can cause fire hazard or burns.

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service:" in order to reduce the risk or fire and personal injury.

- 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-2).
  – Check for fuel leakage.
    Refer to "Fuel Leakage Check Procedure" (Page 1G-14).

Fuel Line Inspection

CENDK1111706002

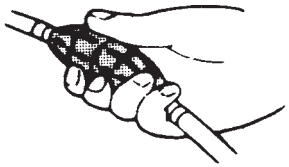
Visually inspect fuel lines for evidence of fuel leakage, cracking, deterioration, or damage. Make sure all clamps are secure. Replace parts as needed.

Fuel Leakage Check Procedure

CENDK1111706003

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

1) Shift into "Neutral" position.
2) Ensure emergency stop switch lock plate is in place.
3) Squeeze fuel primer bulb until you feel resistance.
4) Pull the starter grip sharply several times.
5) Repeat step 3 and 4 to fill the high pressure fuel feed line with fuel.
6) Once pressurized, check all connections and components for any signs of leakage.



IAJ311170008-01

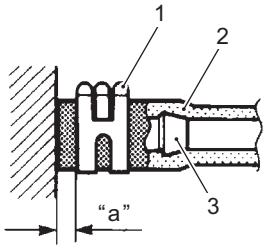
Inspection of Fuel Hose Connections

CENDK1111706004

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”

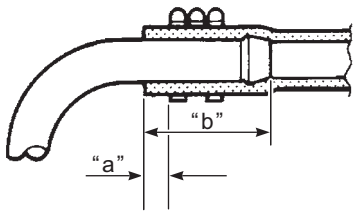


I9J011170012-01

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”

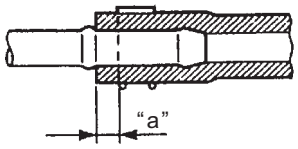


I9J011170013-01

“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”

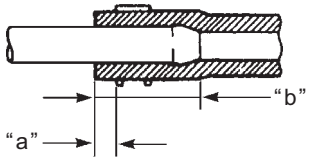


I9J011170014-01

“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)

Fuel Vapor Separator Removal and Installation

CENDK1111706017

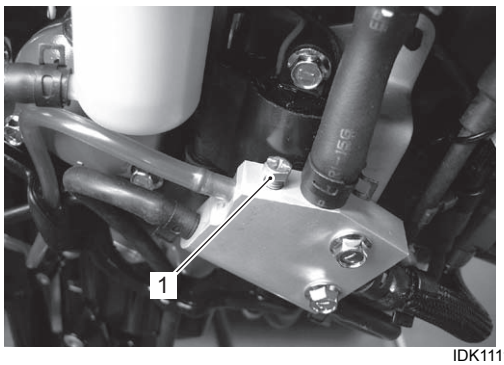
NOTICE

Disassembling the fuel vapor separator can lead to troubles.

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

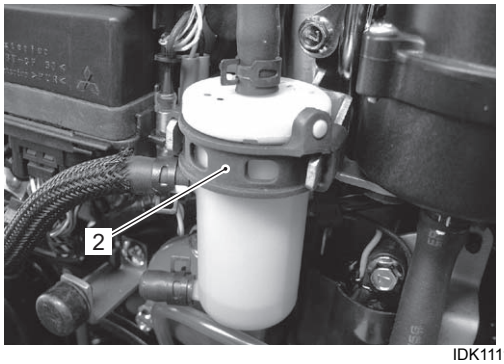
Removal

1) Loosen the fuel drain screw (1) and drain the gasoline into a suitable container.



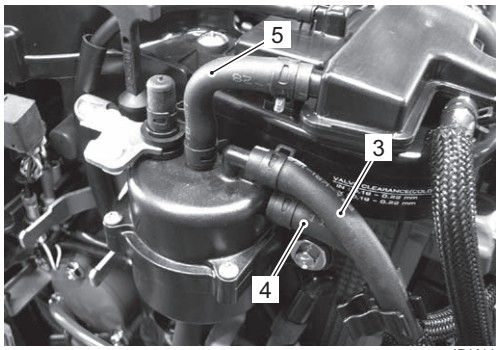
IDK111170027-01

2) Remove the low pressure fuel filter (2) from filter bracket.



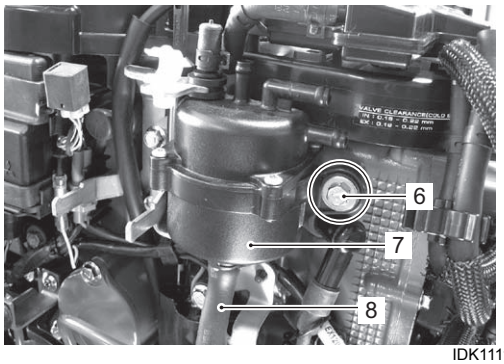
IDK111170028-02

3) Disconnect the fuel inlet hose (3), fuel return hose (4) and evaporation hose (5) from fuel vapor separator.



IDK111170029-01

4) Remove the bolt (6) and fuel vapor separator (7). Disconnect the fuel outlet hose (8) from fuel vapor separator.



IDK111170030-01

Installation

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

- Install the fuel vapor separator, then tighten the bolt securely.
- 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-2).
- Check for fuel leakage.
  Refer to “Fuel Leakage Check Procedure” (Page 1G-14).

Inspection of Fuel Vapor Separator

CENDK1111706018

NOTICE

Disassembling the fuel vapor separator can lead to troubles.

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

Fuel Vapor Separator Assembly

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

IDK111170055-01

High Pressure Fuel Pump Removal and Installation

CENDK1111706019

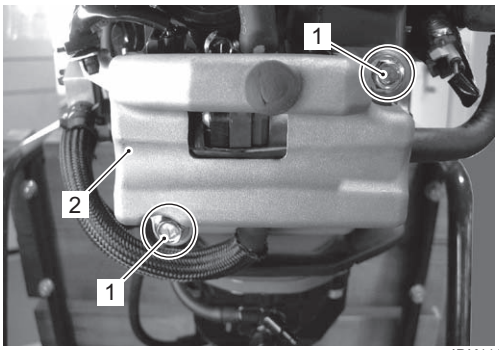
NOTICE

Disassembling the high pressure fuel pump can lead to troubles.

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

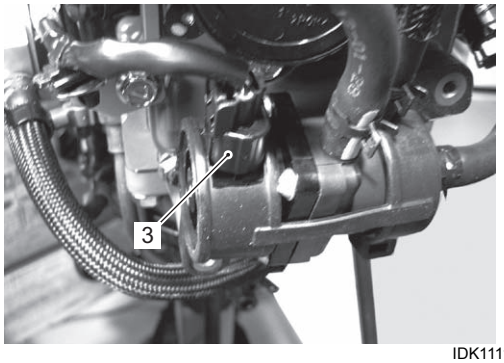
Removal

1) Relieve the fuel pressure in the fuel feed line according to “Fuel Pressure Relief Procedure”.
   Refer to “Fuel Pressure Relief Procedure” (Page 1G-14).
2) Remove both lower side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-2).
3) Remove the bolts (1) and fuel pump guard (2).



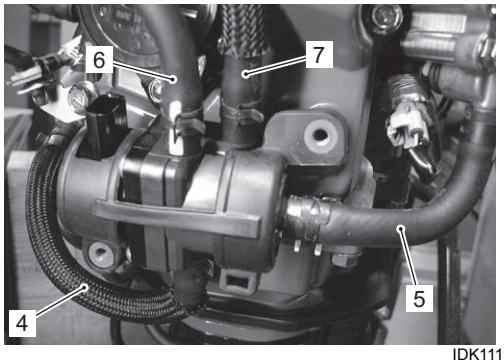
IDK111170031-01

4) Disconnect the pump lead wire connector (3) at high pressure fuel pump.



IDK111170032-01

5) Disconnect the fuel inlet hose (4) / outlet hose (5). Disconnect the fuel vapor hose (6) and fuel return hose (7).
6) Remove the high pressure fuel pump from cylinder head cover.



IDK111170033-01

Installation

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

- Install the high pressure fuel pump, pump guard, then tighten bolt securely.
- 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-2).
- Check for fuel leakage.
  Refer to “Fuel Leakage Check Procedure” (Page 1G-14).

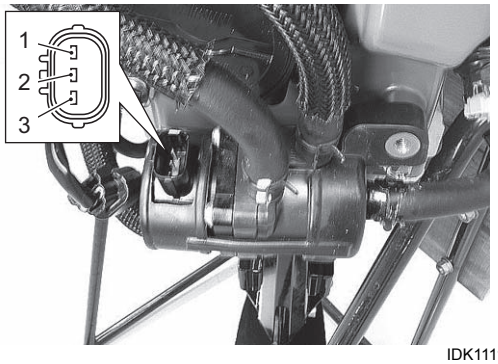
High Pressure Fuel Pump Inspection

CENDK1111706026

1) Disconnect pump lead wire connector from high pressure fuel pump.
2) Check each coil of fuel pump for resistance.

Fuel pump resistance

Terminals	Resistance
Between “1” and “2”	2.0 – 2.6 Ω
Between “2” and “3”	
Between “3” and “1”	



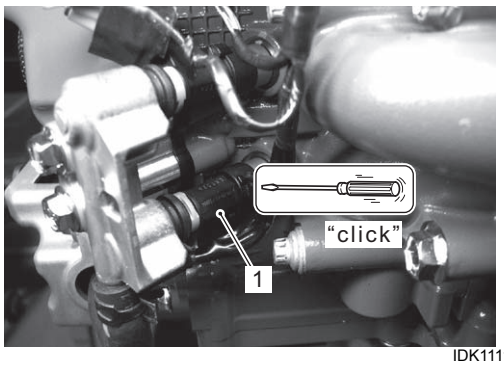
IDK111170056-01

If out of specification, replace high pressure fuel pump.

Fuel Injector Inspection with Injector in Place

CENDK1111706020

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.



IDK111170034-02

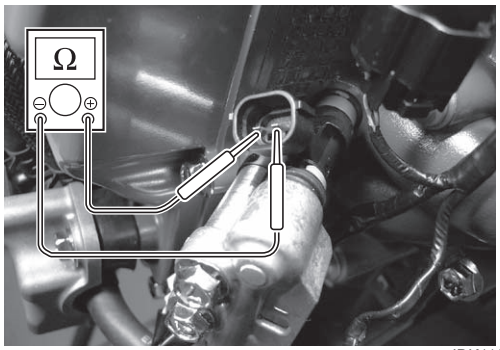
1. Injector body

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



IDK111170035-01

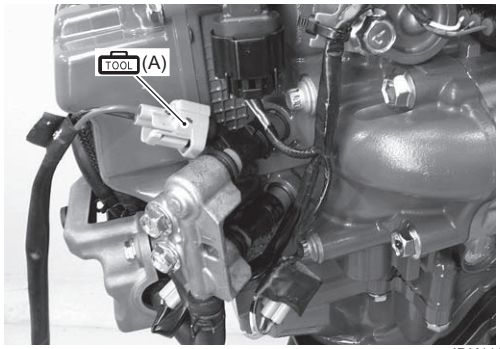
4) Connect the lead wire connector to the fuel injector securely.

Individual Fuel Injector Operating Sound Inspection

CENDK1111706021

1) Disconnect the ignition coil lead wire connector from the ignition coil.
2) Disconnect the fuel injector lead wire connector and connect the test cord.

Special tool
TOOL (A): 09930–89260 (Injector test cord (A))



IDK111170036-03

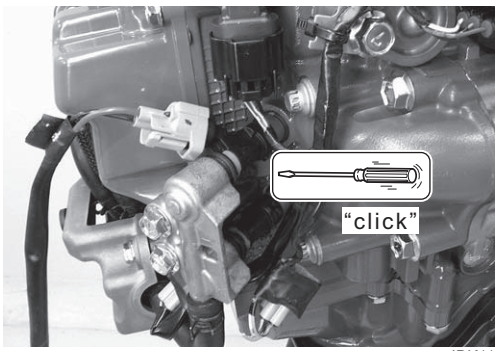
3) Connect the Gray wire to battery negative terminal.
4) Momentarily touch the Black/ Yellow wire to battery positive (+) terminal and check for injector operating sound.
If out of specification, replace fuel injector.

NOTICE

If battery power is applied too long in any of the following tests, the coil of the fuel injector may burn.

Fuel injector test must be completed within few seconds to avoid burning of the coil.

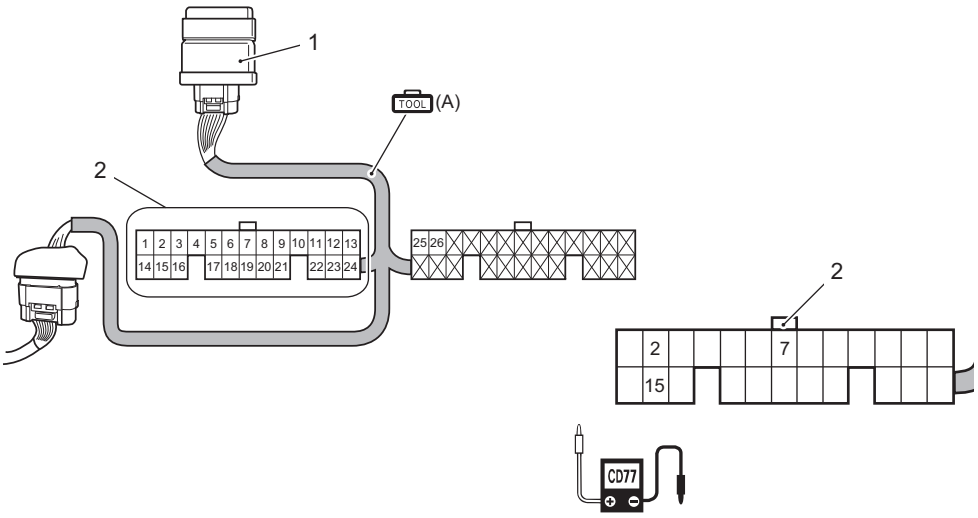
Fuel injector operating sound
“click”



IDK111170057-01

Fuel Injector Operating Signal Inspection

CENDK1111706022



IDK111170017-04

1. ECM	2. White connector

Special tool
TOOL (A): 09930–88940 (26-pin test cord)
CD-77 : Stevens peak reading voltmeter CD-77

Tester knob indication
POS 50

1) Disconnect ignition coil lead wire connector from the ignition coil.
2) Connect the test cord between the ECM and wire harness as shown in figure.
3) Connect the tester probe (“–”, Black) to No.7 terminal (or to body ground) as shown in figure.
4) Connect the tester probe (“+”, Red) to each terminal.

Injector	Terminal	Wire color (Engine harness)
No.1	2	O/B
No.2	15	B/Br

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-12) and “Fuel Injection System Troubleshooting” (Page 1G-13).

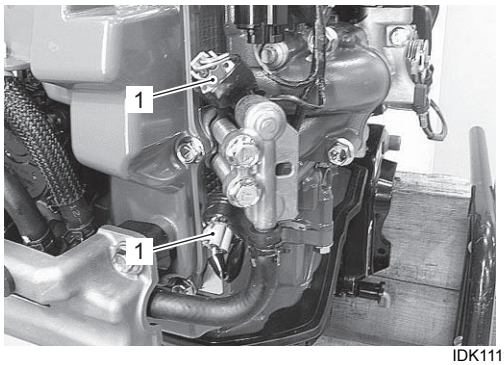
Fuel injector operating signal
Standard: Approx. 20 V or over

Fuel Injector Removal and Installation

CENDK1111706023

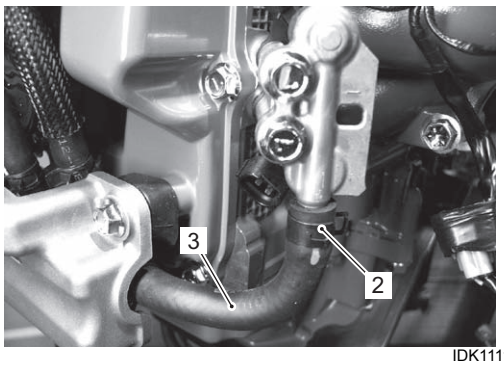
Removal

1) Relieve the fuel pressure in the fuel feed line according to “Fuel Pressure Relief Procedure.” Refer to “Fuel Pressure Relief Procedure” (Page 1G-14).
2) Disconnect the two fuel injector connectors (1).



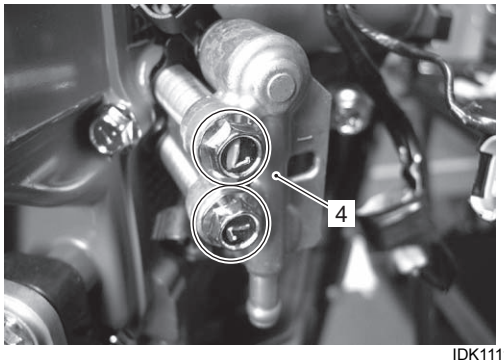
IDK111170058-01

3) Loosen the clamp (2) and place a large cloth over the end of fuel feed hose (3).
Slowly pull the fuel feed hose from the fuel delivery pipe.
Drain any excess fuel in the hose into a small container.



IDK111170038-01

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



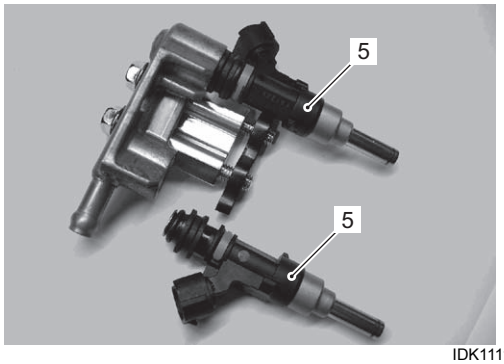
IDK111170039-01

⚠ WARNING

Gasoline is a flammable material that can cause fire hazard or burns.

A small amount of fuel may be released when the fuel injector is removed from delivery pipe.
Place a shop cloth under fuel injector before removal to absorb any fuel released.
Dispose of fuel soaked cloth in appropriate container.

5) Remove each injector (5) from delivery pipe.



IDK111170040-01

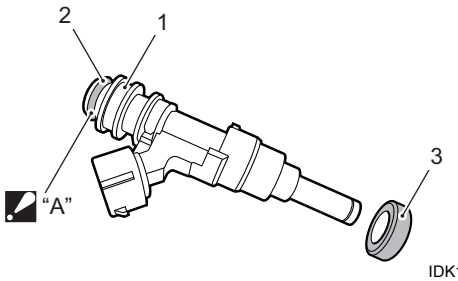
Installation
Installation is in the reverse order of removal with special attention to the following steps.

⚠ WARNING

Failure to take proper precaution when reinstalling fuel injector can result in fuel leakage or damage.

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

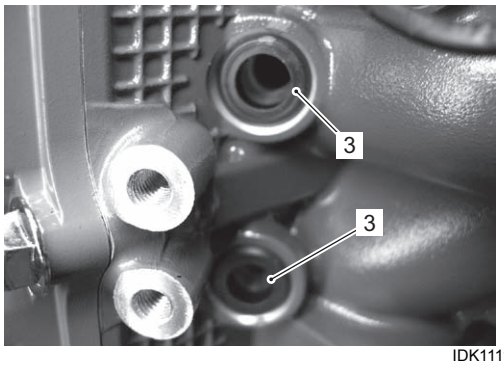
1) Install grommet (1) to injector.
Replace the injector O-ring (2) with new one using care to avoid nicks or cuts during installation.



IDK111170018-01

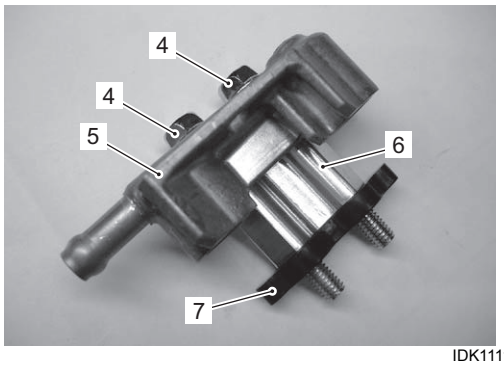
"A": Apply fuel to O-ring.

2) Replace the injector cushion (3) with a new one and install to the cylinder head.



IDK111170041-01

3) Assemble the bolts (4), delivery pipe (5), spacer (6) and insulator (7).

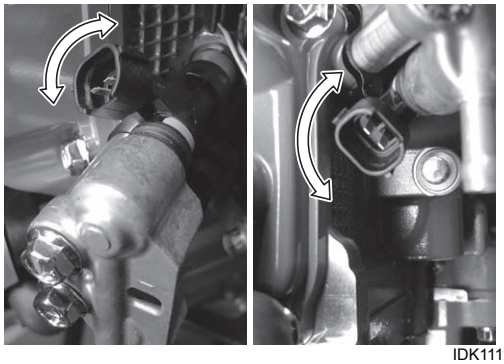


IDK111170042-01

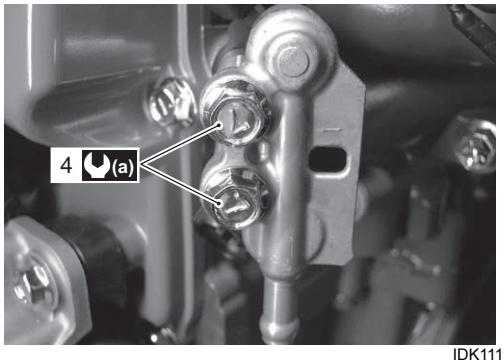
4) Apply a thin coat of fuel to injector O-rings, then install the injectors into the delivery pipe and cylinder head.
Make sure that the injectors rotate smoothly.

5) Tighten the delivery pipe bolts (4) 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)



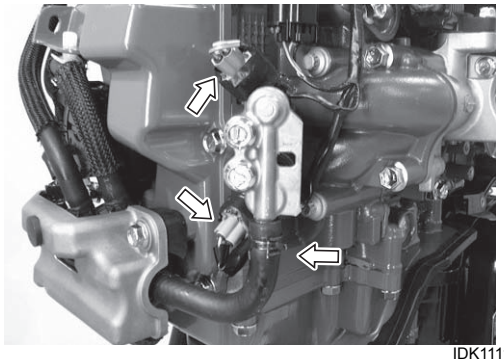
IDK111170043-01



IDK111170044-01

6) Reconnect the fuel feed hose and fuel line securely.

7) Connect the lead wire connector to the injectors securely.



IDK111170045-02

8) Make sure the emergency stop switch lock plate is in place.
Shift into "NEUTRAL" position.

9) Squeeze the fuel primer bulb until you feel resistance.

10) Pull the starter grip sharply several times.

11) Repeat step 9 and 10 to fill the high pressure fuel feed line with fuel.
Check for fuel leaks around the fuel injector.

Low Pressure Fuel Pump Removal and Installation

CENDK1111706024

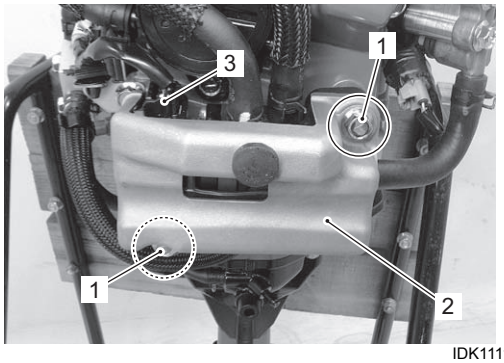
NOTICE

Disassembling the low pressure fuel pump can lead to troubles.

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.

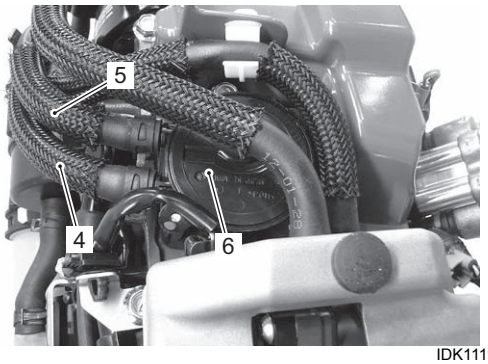
Removal

1) Remove both lower side covers.
   Refer to “Lower Side Cover Removal and Installation” in Section 2A (Page 2A-2).
2) Remove the bolts (1) and high pressure fuel pump guard (2).
3) Disconnect the lead wire connector (3) at high pressure fuel pump.



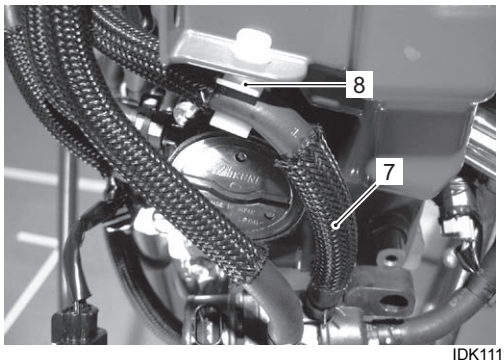
IDK111170046-02

4) Disconnect inlet hose (4) and outlet hose (5) from low pressure fuel pump (6).



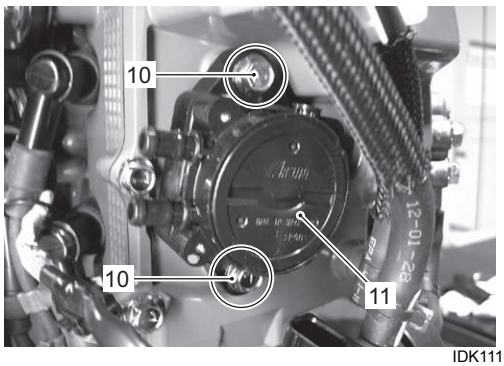
IDK111170059-01

5) Pull off the fuel return hose (7) from hose clamp (8). Remove the hose clamp (8) from cylinder head cover by releasing clamps’ lock.



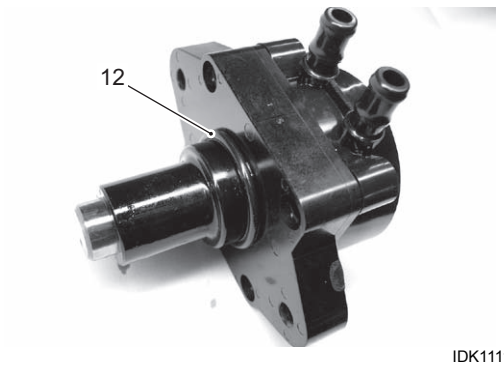
IDK111170048-01

6) Remove two bolts (10).
7) Remove fuel pump (11).



IDK111170049-01

Note position before removing O-ring (12).



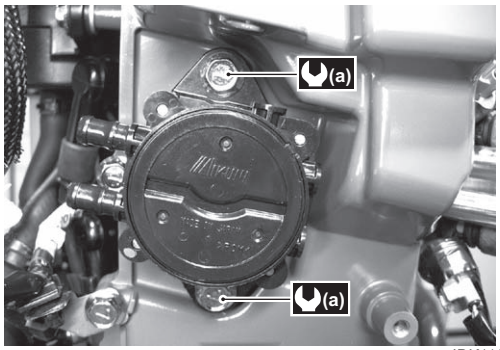
IDK111170050-01

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

NOTE

- **Before installing the fuel pump, rotate the crankshaft to bring 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)



IDK111170051-01

Low Pressure Fuel Pump Inspection

CENDK1111706025

NOTICE

Disassembling the low pressure fuel pump can lead to troubles.

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.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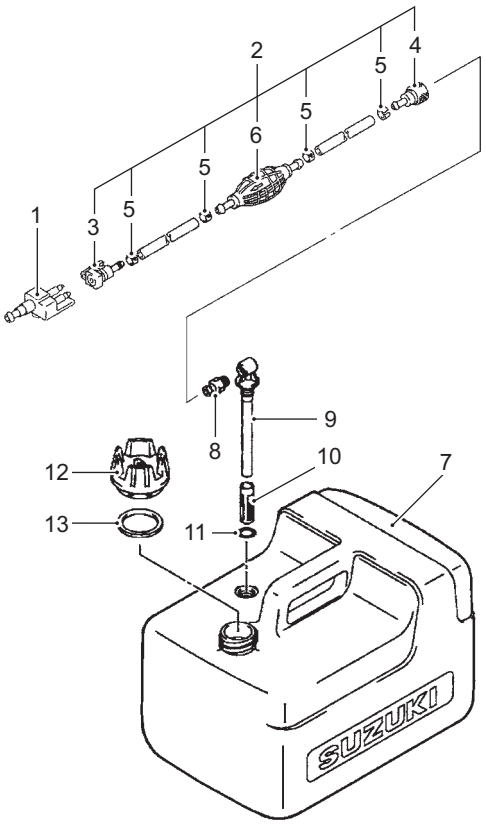
IDK111170053-01

Fuel Tank Construction

CENDK1111706027



IAJ311170014-02

1. Fuel plug	5. Clip	9. Outlet	13. Fuel tank cap gasket
2. Fuel hose assembly	6. Primer bulb	10. Outlet filter	
3. Socket	7. Fuel tank body	11. O-ring	
4. Socket	8. Fuel connector plug	12. Fuel tank cap	

Fuel Tank Disassembly and Reassembly

CENDK1111706028

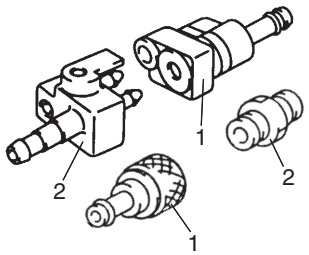
When disassembling or reassembling the fuel tank, refer to “Fuel Tank Construction” (Page 1G-24).

Fuel Tank Components Inspection

CENDK1111706029

Fuel Connector

Inspect the fuel connector and connector plug. If leakage, deterioration or other damage is found, replace the connector and/or plug.



IAJ311170015-01

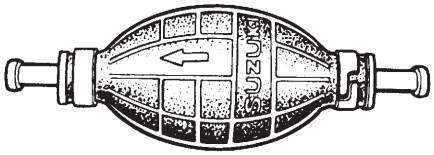
1. Connector	2. Connector plug

Fuel Primer Bulb

Inspect the fuel primer bulb.

If crack, leakage or deterioration is found, replace the bulb.

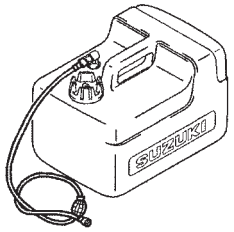
If the check valve function is defective, replace the bulb.



IAJ311170016-01

Fuel Hose
Inspect the fuel hoses. If cut, crack, leakage, abrasion, tear or deterioration is found, replace the hoses.

Fuel Tank Body
Inspect the fuel tank. If crack, leakage or deterioration is found, replace the tank.
If water or other contamination is found, drain and clean the tank.



IAJ311170017-01

Fuel Tank Cap
Check that the fuel tank vent opens and relieves internal tank pressure properly.
If vent is suspect, replace the tank cap.

IAJ311170018-01