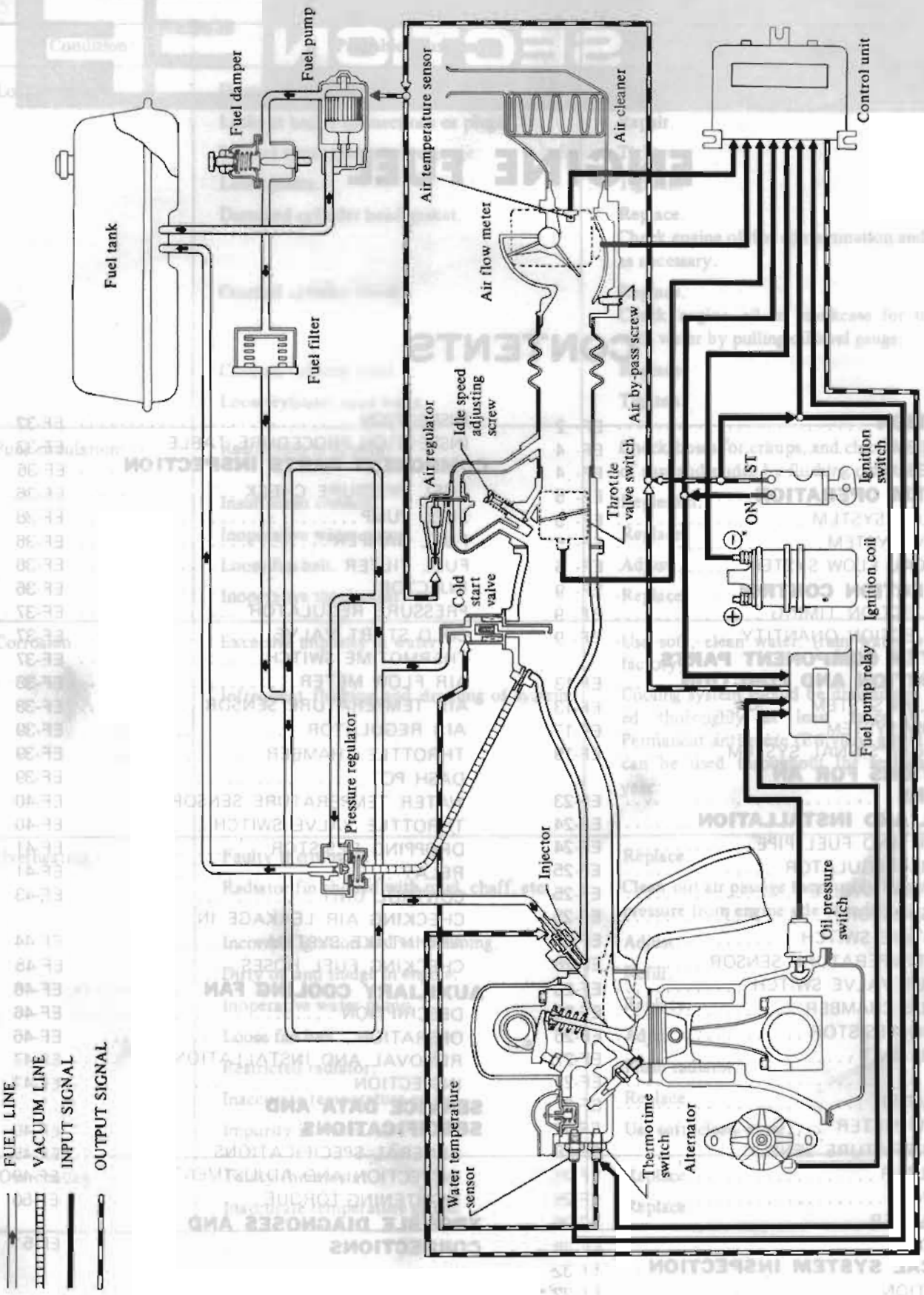
SECTION EF

ENGINE FUEL

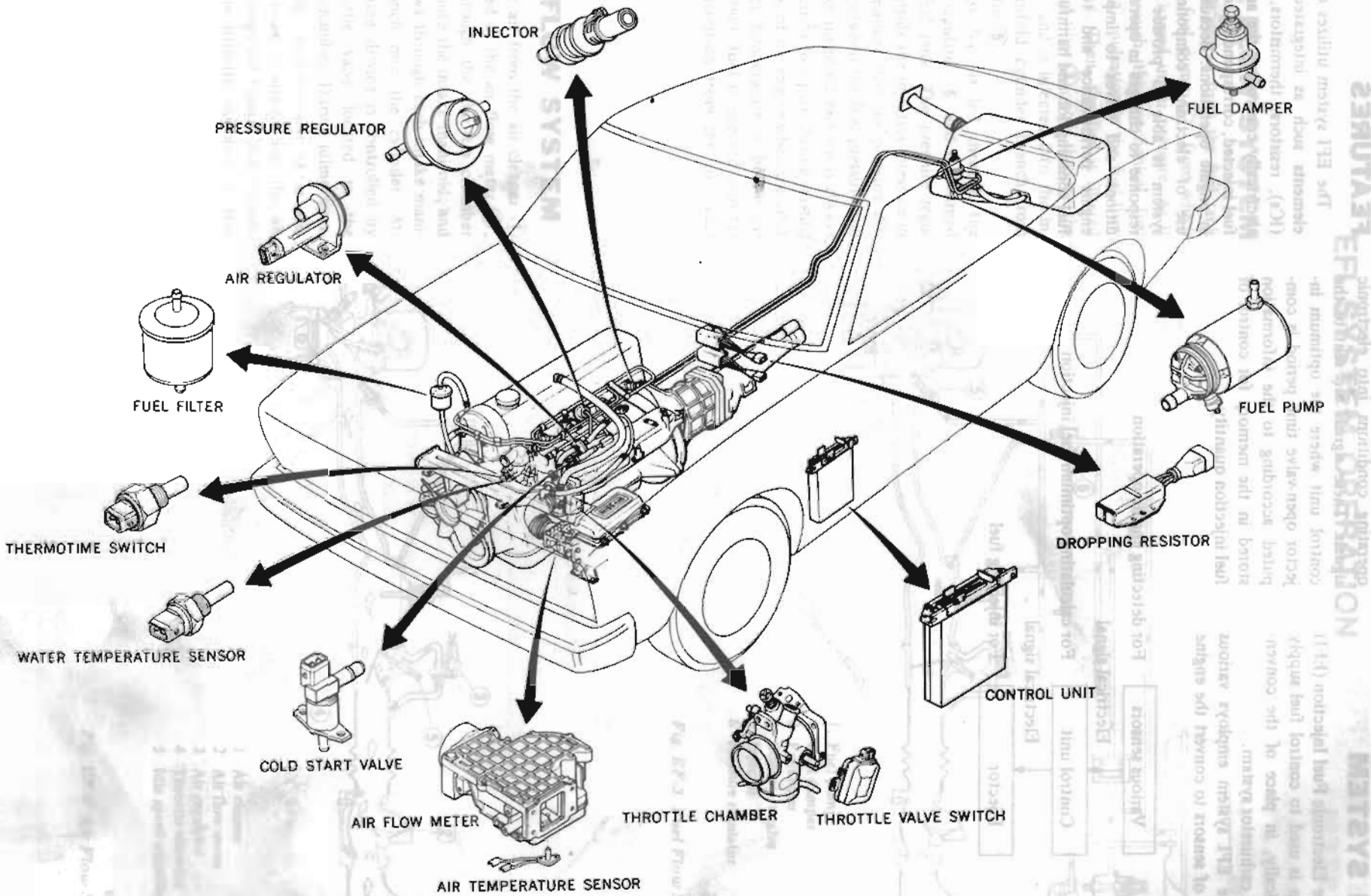
CONTENTS

DESCRIPTION



EF282A

Fig. EF-1 EFI System



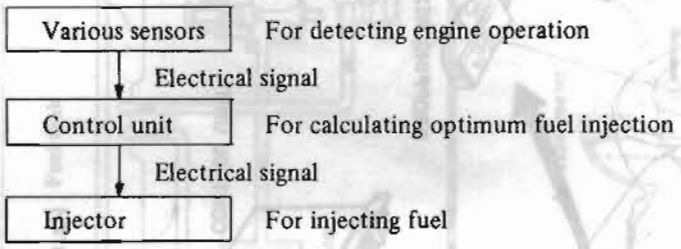
Note: Mounting method may differ according to model.

Fig. EF-2 Location of EFI Components

EFI SYSTEM

The Electronic Fuel Injection (EFI) system is used to control fuel supply electrically, in place of the conventional carburetor system.

The EFI system employs various types of sensors to convert the engine operating conditions into electronic signals. These signals are sent to the control unit where the optimum injector open-valve time period is computed according to the information stored in the memory for control of fuel injection quantity.



FEATURES

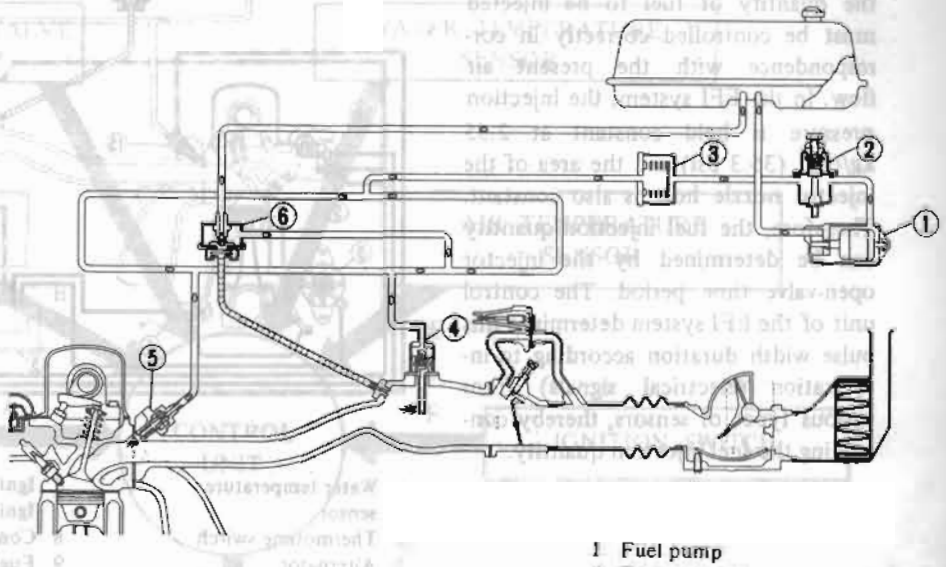
The EFI system utilizes electronic elements such as integrated circuits (ICs), resistors, thermistors, etc. for electrically controlling the amount of fuel injected, corresponding to changes in engine operations. Because of this use of electronic components, this system is able to provide a quick response to changes in operating conditions, and serves to improve the engine performance and to reduce fuel consumption and harmful gases.

EFI SYSTEM OPERATION

FUEL FLOW SYSTEM

Fuel is sucked from the fuel tank into the fuel pump ①, from which it is discharged under pressure. As it flows through the mechanical fuel damper ②, pulsation in the fuel flow is damped. Then, the fuel is filtered in the fuel filter ③, goes through the fuel line, and is injected into the intake manifold cylinder branch from the injector ⑤.

Surplus fuel is led through the pressure regulator ⑥ and is returned to the fuel tank. The pressure regulator controls the injection pressure in such a manner that the pressure difference between the fuel pressure and the intake manifold vacuum is always 2.55 kg/cm^2 (36.3 psi). During starting operation of the engine when the cooling water temperature is below the specification, fuel is injected into the intake manifold from the cold start valve ④.



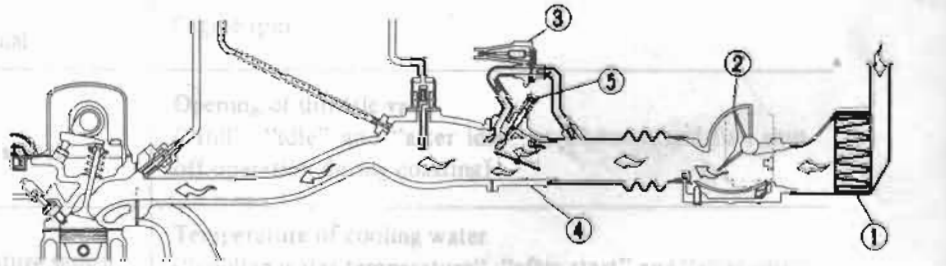
1 Fuel pump
2 Fuel damper
3 Fuel filter
4 Cold start valve
5 Injector
6 Pressure regulator

EF272A

Fig. EF-3 Fuel Flow System

AIR FLOW SYSTEM

Intake air from the air cleaner ① is metered at the air flow meter ②, flows through the throttle chamber ④ and into the intake manifold, and then flows through each intake manifold branch into the cylinder. Air flow during driving is controlled by the throttle valve located in the throttle chamber. During idling operation, the throttle valve is in the almost closed position, and the air is led through the bypass port mounted to the throttle chamber. In this case, the quantity of suction air is adjusted by means of the idle speed adjusting screw ⑤. During warming-up operation, the air flow is bypassed through the air regulator ③ to increase engine rpm.



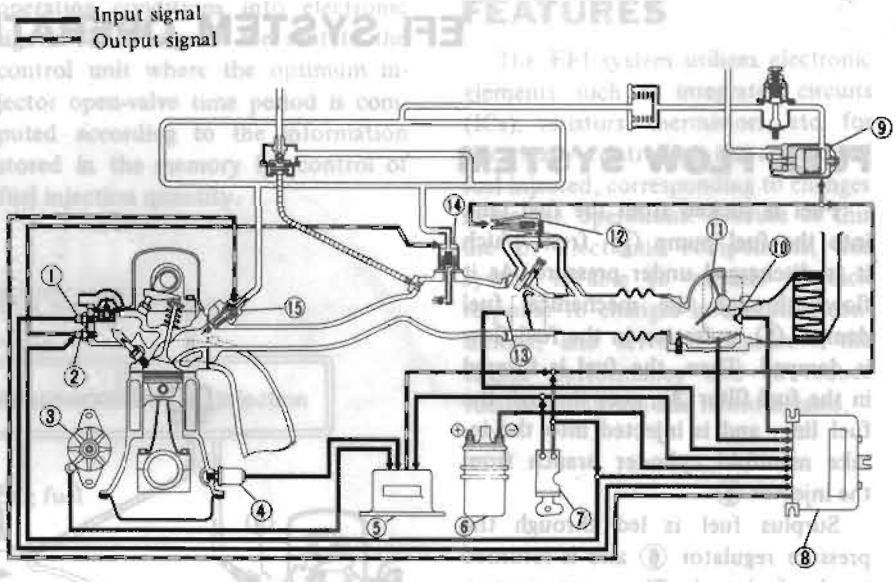
1 Air cleaner
2 Air flow meter
3 Air regulator
4 Throttle chamber
5 Idle speed adjusting screw

EF273A

Fig. EF-4 Air Flow System

ELECTRICAL FLOW SYSTEM

The suction air flow varies with the movement of the air flow meter, and the quantity of fuel to be injected must be controlled correctly in correspondence with the present air flow. In the EFI system, the injection pressure is held constant at 2.55 kg/cm^2 (36.3 psi) and the area of the injector nozzle hole is also constant. Therefore, the fuel injection quantity can be determined by the injector open-valve time period. The control unit of the EFI system determines this pulse width duration according to information (electrical signals) from various types of sensors, thereby controlling the fuel injection quantity.



1 Water temperature sensor
2 Thermotime switch
3 Alternator
4 Oil pressure switch
5 Fuel pump relay
6 Ignition coil
7 Ignition switch
8 Control unit
9 Fuel pump
10 Air temperature sensor
11 Air flow meter
12 Air regulator
13 Throttle valve switch
14 Cold start valve
15 Injector

EF274A

Fig. EF-5 Electrical Flow System

SIGNALS FOR CONTROL UNIT

An electrical signal from each sensor is introduced into the control unit for computation. The open-valve time period of the injector is controlled by the duration of the pulse computed in the control unit.

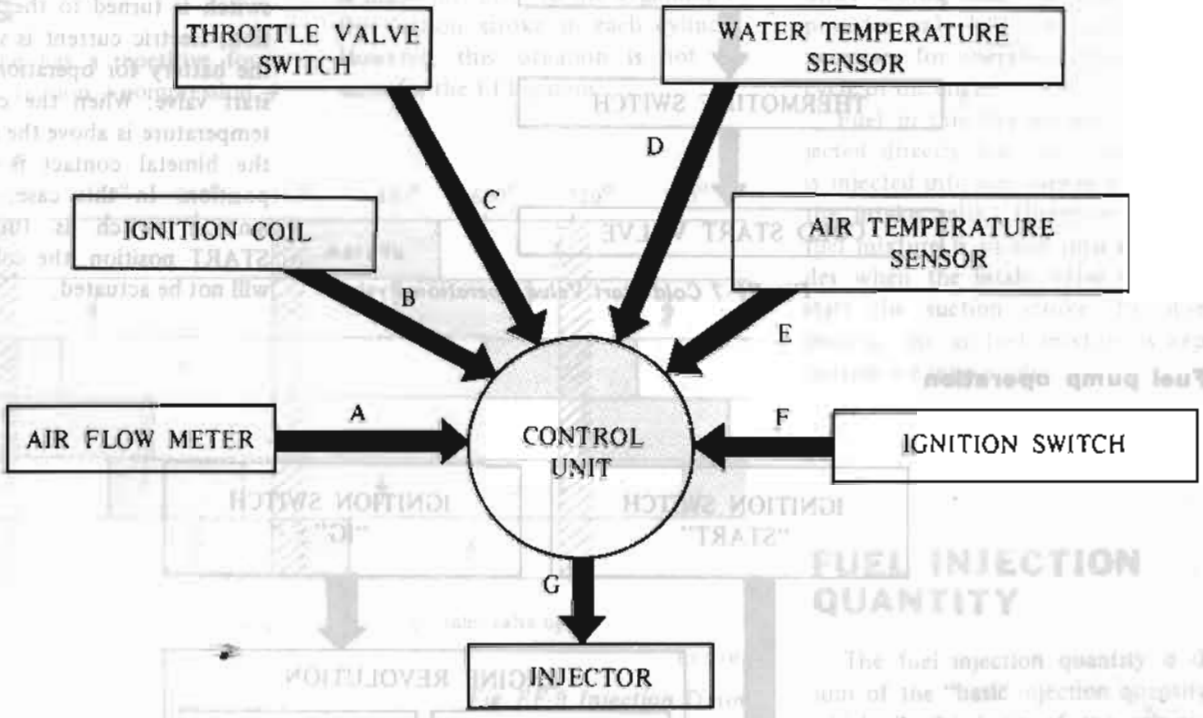


Fig. EF-6 Electronic Signals for Control Unit

Signal		Device	Item to be monitored or actuated
Input	A	Air flow meter	Quantity of intake air
	B	Ignition coil negative terminal	Engine rpm
	C	Throttle valve switch	Opening of throttle valve ("full", "idle" and "after idle" enrichment, and fuel shut off operation during coasting)
	D	Water temperature sensor	Temperature of cooling water ("cooling water temperature", "after start" and "after idle" enrichment)
	E	Air temperature sensor	Temperature of intake air ("intake air temperature" enrichment)
	F	Ignition switch "START" position	Starting operation ("start" and "after start" enrichment)
Output	G	Injector	Fuel injects into intake manifold

INDEPENDENT SIGNALS OF CONTROL UNIT

Cold start valve operation

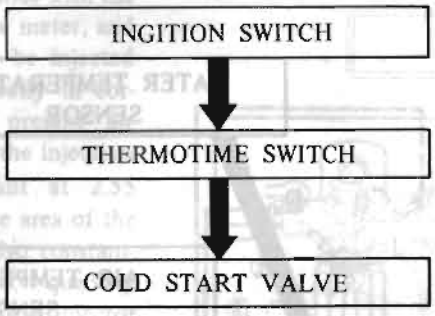


Fig. EF-7 Cold Start Valve Operation System

When the cooling water temperature is lower than the specification, the bimetal contact in the thermotime switch remains in the ON position. At this switch position, if the ignition switch is turned to the START position, electric current is supplied from the battery for operation of the cold start valve. When the cooling water temperature is above the specification, the bimetal contact is in the OFF position. In this case, even if the ignition switch is turned to the START position, the cold start valve will not be actuated.

Fuel pump operation

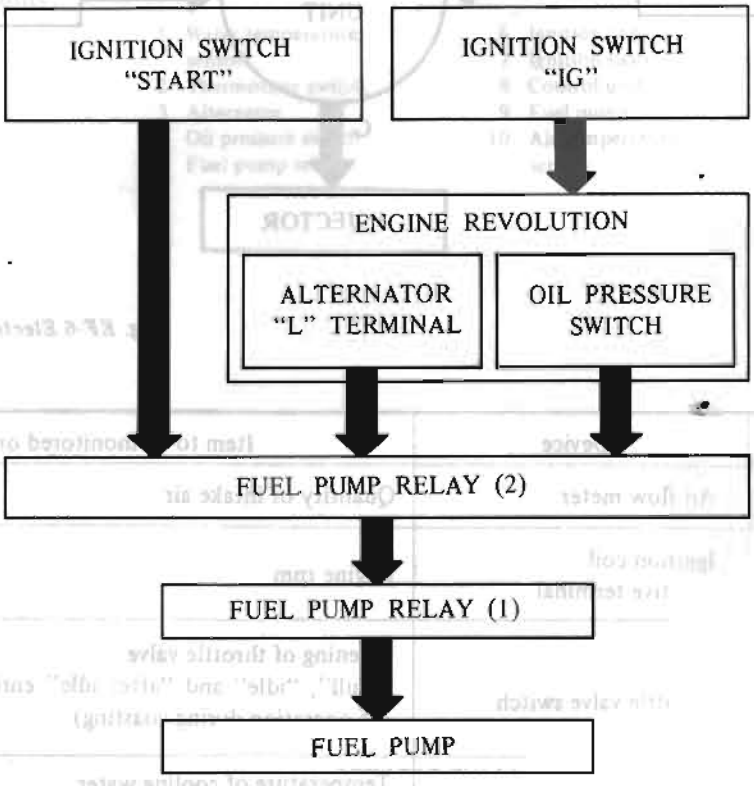


Fig. EF-8 Fuel Pump Operation System

When starting the engine, the fuel pump is operated by the current supplied through fuel pump relays (2) and (1). After the engine starts, the fuel pump continues to operate using current supplied from fuel pump relay (2) monitoring the engine revolution and fuel pump relay (1).

If the engine stalls for some reason, fuel pump relay (2) receives the "engine stall" signal, and stops feeding current, thereby stopping the operation of the fuel pump.

Rotation of the engine is detected by monitoring both the generation of the alternator and the engine oil pressure. Because of this dual monitoring system, fuel pump operation can be assured during engine rotation, even if one of these monitor units should fail.

If the engine stalls completely due to a malfuction, the supply of fuel is stopped at once; this system improves safety in case of engine malfunction.

FUEL INJECTION CONTROL

FUEL INJECTION TIMING

The engine has a repetitive four-stroke cycle: suction → compression → combustion → exhaust. Fuel injection is made just prior to the beginning of the suction stroke in each cylinder. However, this situation is not the same for the EFI system.

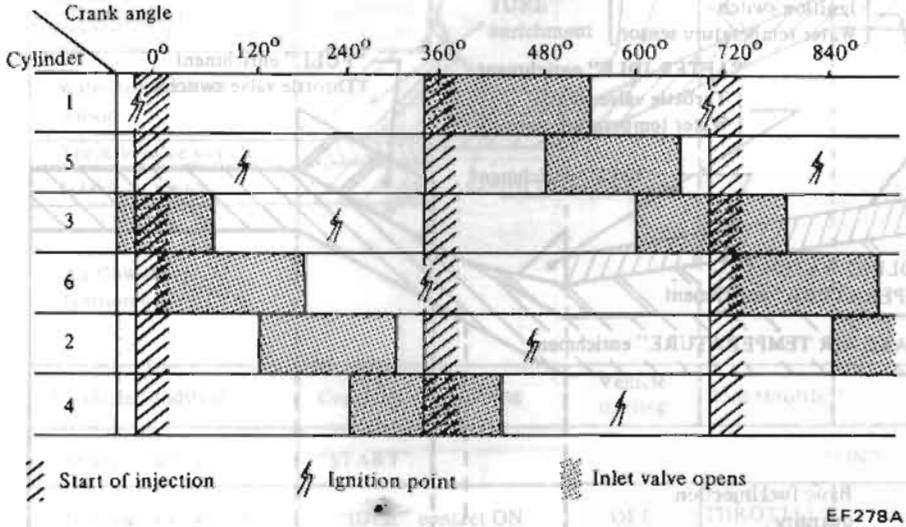


Fig. EF-9 Injection Timing

The fuel injectors are electrically connected, in parallel, in the control unit. All injectors receive the injection signal from the control unit simultaneously. Therefore, injection is made independently of the engine stroke cycle (suction, compression, combustion, and exhaust). In the six-cylinder engine, injection is made once after receiving the ignition signal from the ignition coil three times.

The required fuel quantity is attained after fuel injection is made twice during one stroke cycle (suction, compression, combustion, exhaust). In other words, one injection of fuel provides only half the fuel quantity necessary for operation of one stroke cycle of the engine.

Fuel in this EFI system is not injected directly into the cylinder, but is injected into the outside portion of the intake valve. Therefore, the air-fuel mixture is sucked into the cylinder when the intake valve opens to start the suction stroke. In other strokes, the air-fuel mixture is kept outside the intake valve.

FUEL INJECTION QUANTITY

The fuel injection quantity is the sum of the "basic injection quantity" which is the basis of the injection quantity and the "enrichment" that is used to correct the basic injection quantity in correspondence with the various conditions.

Fuel injection quantity	=	Basic injection quantity	+	Enrichment

Example of fuel injection quantity (Cold start)

Intake air temperature at 0°C (32°F) (constant) and water temperature rises from 0°C (32°F)

Note: Fuel increase by cold start valve is accomplished only when starting engine in cold weather [Cooling water temperatures below 14°C (57°F)]

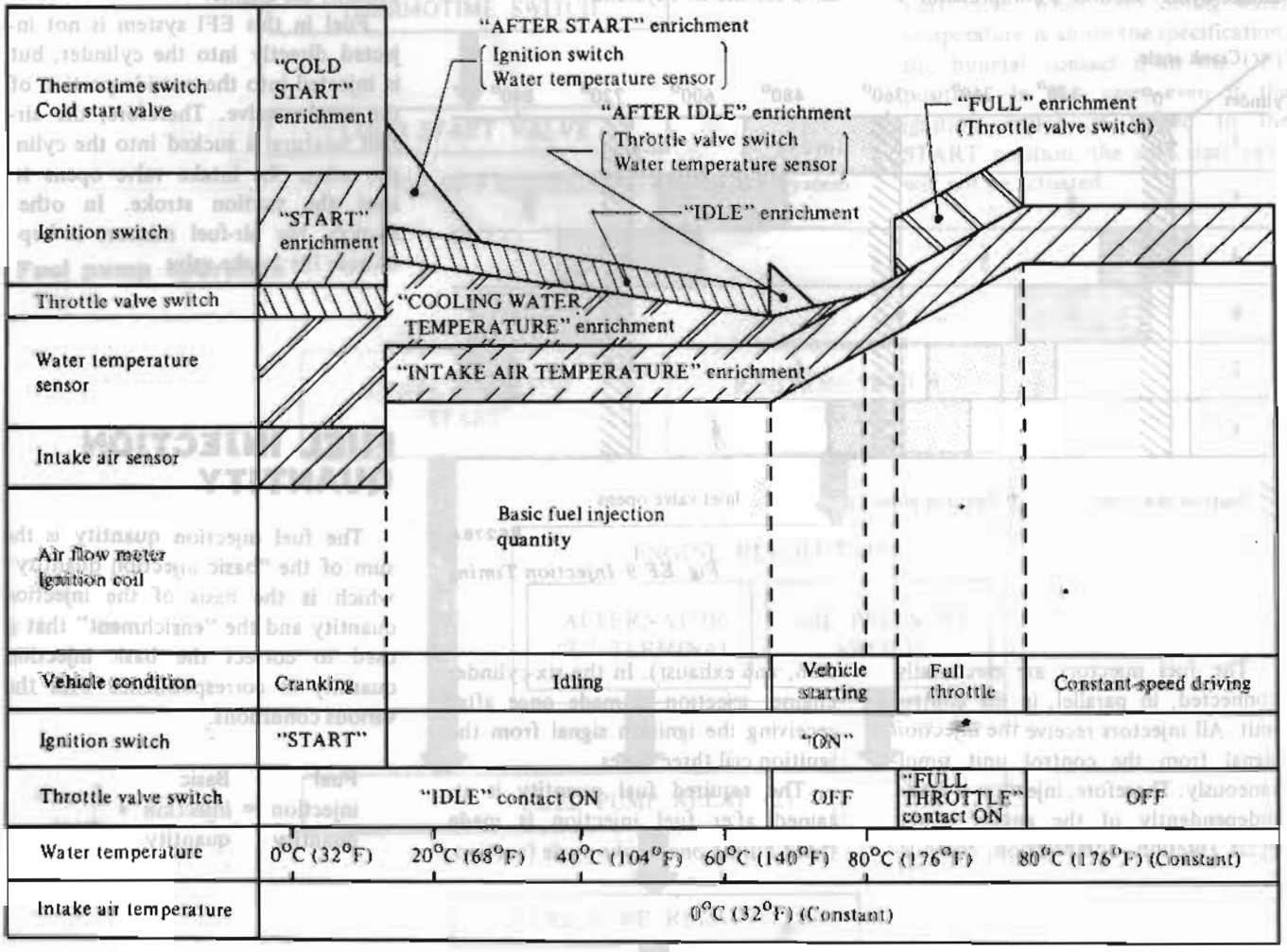


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Fig. EF-10 Fuel Injection Quantity (Cold start)

BASIC INJECTION QUANTITY

The "engine rpm" information and "load state" information are created by two signals which provide for the rotation of the engine. One of these two signals is sent out from the ignition coil that detects the engine rpms. The other one is the signal sent from the air flow meter which monitors the suction air quantity. The injection quantity determined by these signals is called the basic injection quantity.

ENRICHMENT

The basic injection quantity is used as the basis for providing engine rotation, but the injector is not controlled by this factor alone. For example, the fuel must be enriched when starting the engine or in the full-throttle position. For providing this enrichment, the control unit computes the quantity of fuel to be added to the basic injection quantity by using signals sent from each sensor. It causes the total quantity of fuel to be injected. Enrichment may also be made by the injection from the cold start valve, which functions independently of the control unit.

The following sensors and switches are used to generate the fuel enrichment signal:

Example of fuel injection quantity (Hot restart)

Intake air temperature at 15°C (59°F) (constant) and water temperature rises from 60°C (140°F)

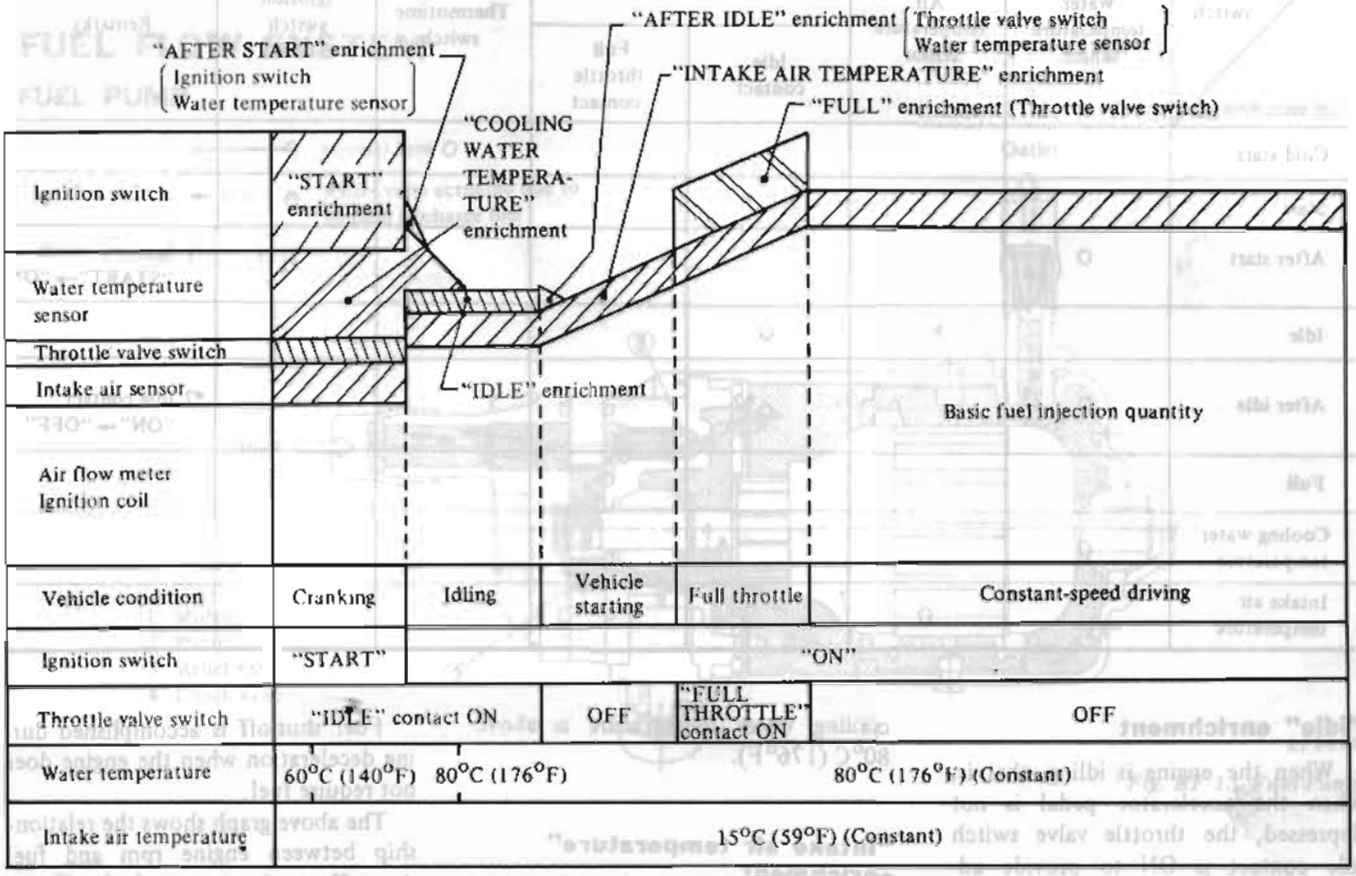

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Fig. EF-11 Fuel Injection Quantity (Hot restart)

1) Water temperature sensor:
The enrichment signal is generated in correspondence with the cooling water temperature when it is below 80°C (176°F).

2) Air temperature sensor:
The enrichment signal is generated in correspondence with the intake air temperature when it is below 20°C (68°F).

3) Throttle valve switch:
The idle contact and full throttle contact in this switch detect the open angle of the throttle valve and generate the enrichment signal.

4) Thermotime switch:
This switch generates the enrichment signal when the cooling water temperature is below 14°C (57°F).

5) Ignition switch:
The enrichment signal is generated in the START position of the ignition switch.

Various fuel enrichment corrections are made by these signals in order to provide optimum fuel injection under any engine operating conditions.

"Cold start" enrichment

The cold start valve operates when the ignition switch is turned to the "START" position and the thermotime switch is turned "ON", and injects fuel into the intake manifold.

"Start" enrichment

When the ignition switch is in the "START" position during cranking operation, a constant amount of fuel is increased irrespective of the cooling water temperature.

"After start" enrichment

When the ignition switch is turned from the "START" to "ON" position after cranking operation, the "start" enrichment becomes zero. The "after start" enrichment is provided to compensate for this sudden decrease in fuel quantity. The "after start" enrichment decreases gradually as time passes, finally becoming zero, and is determined by cooling water temperature.

Enrichment signal and signal source chart

Sensor & switch / Fuel enrichment	Water temperature sensor	Air temperature sensor	Throttle valve switch		Thermotime switch	Ignition switch "START"	Remarks
			Idle contact	Full throttle contact			
Cold start					O	O	
Start						O	
After start	O					O *1	*1: Ignition switch "START" → "ON"
Idle			O				
After idle	O		O *2				*2: Idle contact "ON" → "OFF"
Full				O			
Cooling water temperature	O						
Intake air temperature		O					

"Idle" enrichment

When the engine is idling, that is, when the accelerator pedal is not depressed, the throttle valve switch idle contact is ON to provide additional fuel injection.

"After idle" enrichment

The "after idle" enrichment provides smooth acceleration when the accelerator pedal is depressed to start the vehicle. This enrichment is determined by cooling water temperature.

"Full" enrichment

The "full" enrichment provides smooth full throttle driving performance when the throttle valve opening is more than 34°. With this enrichment, about 27% of fuel is increased from the level determined by the base pulse.

"Cooling water temperature" enrichment

Fuel is increased according to the cooling water temperature monitored by the cooling water temperature sensor. This enrichment is zero when the cooling water temperature is above 80°C (176°F).

"Intake air temperature" enrichment

Fuel injection is increased according to the intake air temperature monitored by the intake air temperature sensor. This enrichment is zero when the intake air temperature is above 20°C (68°F).

FUEL SHUT-OFF

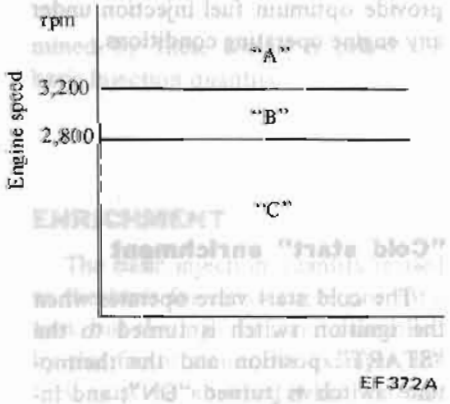


Fig. EF-12 Fuel Shut-off

Fuel shut-off is accomplished during deceleration when the engine does not require fuel.

The above graph shows the relationship between engine rpm and fuel shut-off range.

1. Fuel shut-off is operated ("A" zone) when engine speed is above 3,200) rpm and the throttle valve is closed. The fuel shut-off condition continues ("A" and "B" zones) until engine speed drops to 2,800 rpm even if the throttle valve is kept closed. The fuel injection recovers when engine speed becomes below 2,800 rpm ("C" zone) even if the throttle valve is closed.
2. Fuel shut-off is not operated when the engine speed is below 3,200 rpm even if the throttle valve returns to the closed position from the open position. However, fuel shut-off is operated when engine speed increases above 3,200 rpm ("A" zone) and throttle valve remains closed.

EFI SYSTEM COMPONENT PARTS CONSTRUCTION AND FUNCTION

FUEL FLOW SYSTEM

FUEL PUMP

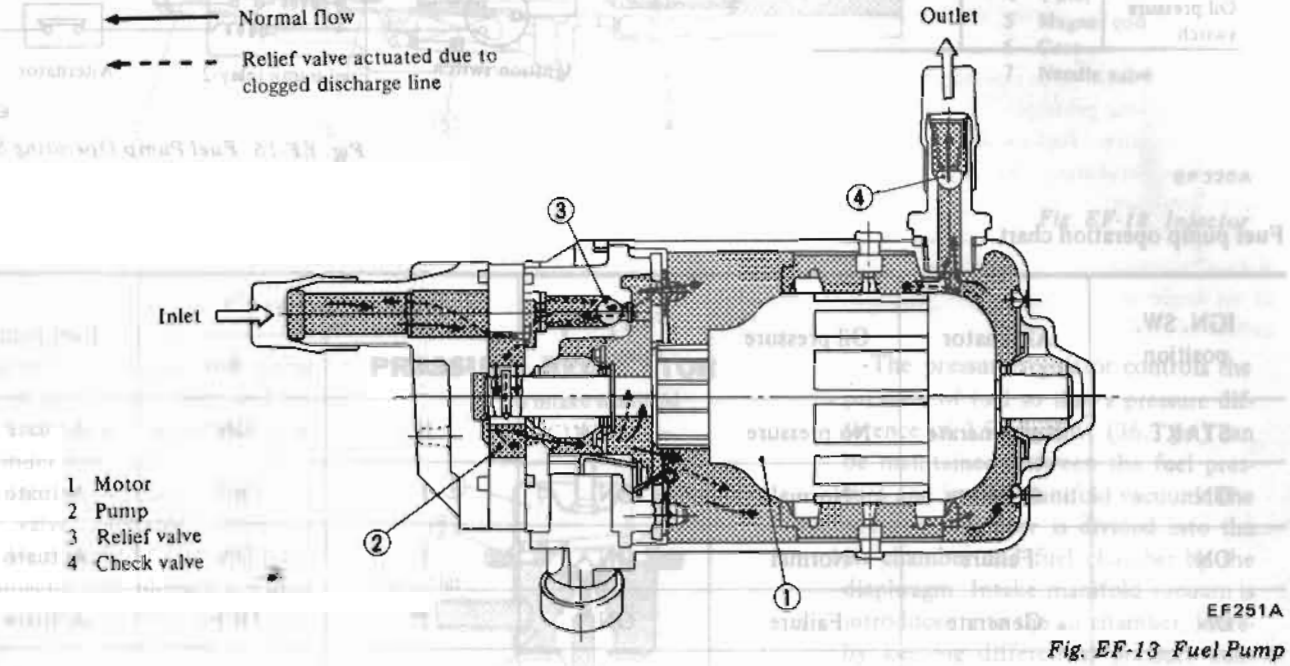


Fig. EF-13 Fuel Pump

The fuel pump employs a wet type construction where a vane pump with roller is directly coupled to a motor filled with fuel. This construction provides superior coupling characteristics between the pump and motor, and greater safety in case of fire.

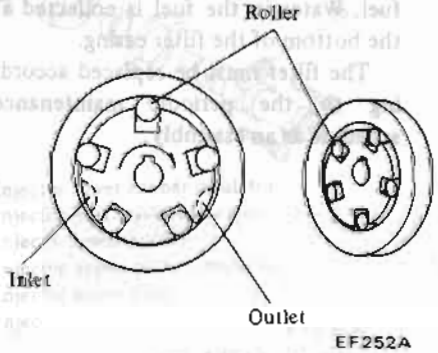


Fig. EF-14 Vane Pump

In the vane pump, the roller is pushed outward by centrifugal force when the pump rotates, and is pressed against the outer wall. This rotary portion and surrounding wall are not co-axial, and pumping is performed by the change in clearance between the wall and the rotary portion. Thus, when the clearance is large, fuel is sucked in; when it decreases, fuel is discharged.

The relief valve in the pump is designed to open when the pressure in the fuel line rises over 3.0 to 4.5 kg/cm^2 (43 to 64 psi) due to malfunction in the pressure system.

The check valve prevents abrupt drop of pressure in the fuel pipe when stopping the engine.

The fuel pump operating system is shown in Fig. EF-15.

When the ignition switch is turned to the "START" position for cranking operation, the fuel pump is actuated irrespective of the conditions of the alternator and the engine oil pressure switch.

After starting the engine (the ignition switch is "ON"), the alternator operates and the engine oil pressure switch is open through rotation of the engine, thereby actuating the fuel pump.

If the alternator stops and the engine oil pressure decreases for some reason, the fuel pump relay-2 "A" contact is turned to "II", and the fuel pump relay-1 is turned "OFF". Then the fuel pump is stopped, though the ignition switch remains in the "ON" position. In this manner, fuel supply is cut off for safety purposes when the engine accidentally stops during driving.

Normal switch position

	When engine is stopped	When engine is in operation
Alternator "L" terminal	ON	OFF
Oil pressure switch		

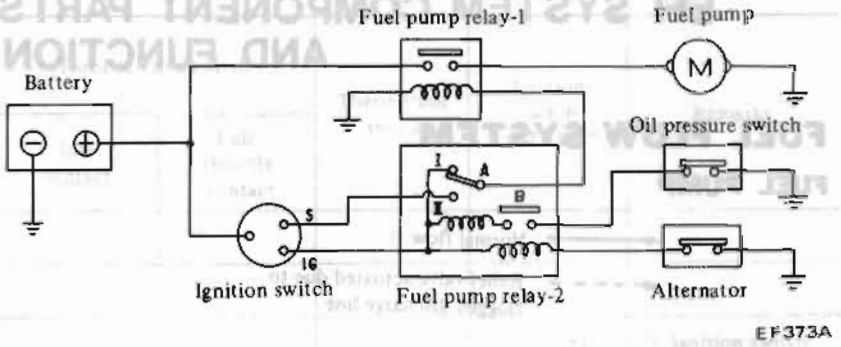


Fig. EF-15 Fuel Pump Operating System

Fuel pump operation chart

IGN. SW. position	Alternator	Oil pressure	Fuel pump relay (1)	Fuel pump relay (2)		Fuel pump
				A	B	
START	Not generate	No pressure	ON	II	ON	Actuate
ON	Generate	Normal	ON	I	OFF	Actuate
ON	Failure	Normal	ON	I	ON	Actuate
ON	Generate	Failure	ON	I	OFF	Actuate
ON	Failure	Failure	OFF	II	ON	Not actuate
OFF	Not generate	No pressure	OFF	I	OFF	Not actuate

FUEL DAMPER

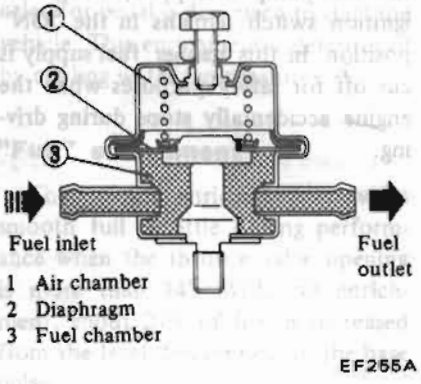


Fig. EF-16 Fuel Damper

The fuel damper is provided to suppress pulsation in fuel flow discharged from the fuel pump. No adjustment is allowed on this damper.

The construction of the fuel damper is shown in Fig. EF-16.

Change in the pump discharge pressure is monitored by the diaphragm and spring, which vary the volume of the fuel chamber for suppressing pulsation.

FUEL FILTER

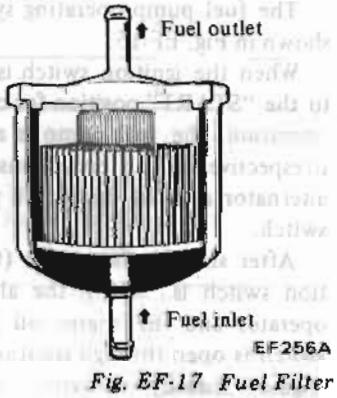
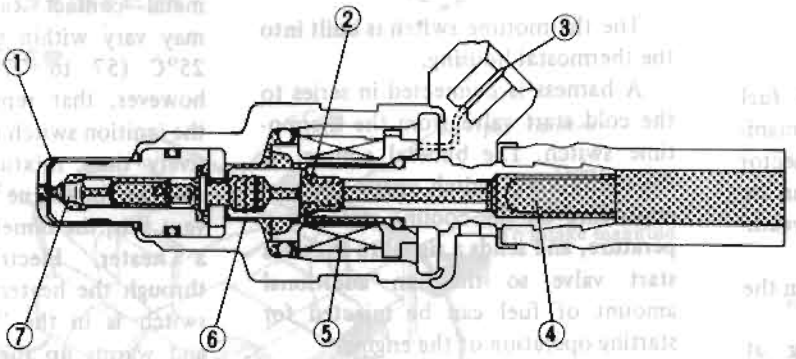


Fig. EF-17 Fuel Filter

The fuel filter is placed between the fuel damper and the injector, and is used to remove foreign matter in the fuel. Water in the fuel is collected at the bottom of the filter casing.

The filter must be replaced according to the periodic maintenance schedule as an assembly.

INJECTOR



1 Nozzle
2 Return spring
3 Electric terminal
4 Filter
5 Magnet coil
6 Core
7 Needle valve

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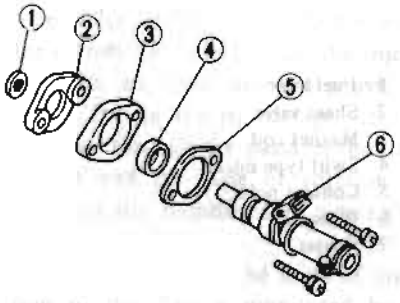
Fig. EF-18 Injector

The injector receives the pulse signal from the control unit, and injects the fuel toward the intake valve in the cylinder head.

The injector operates on the solenoid valve principle. When a driving pulse is applied to the coil built into the injector, the plunger is pulled into the solenoid, thereby opening the needle valve for fuel injection. The quantity of injected fuel is in proportion to the duration of the pulse applied from the control unit.

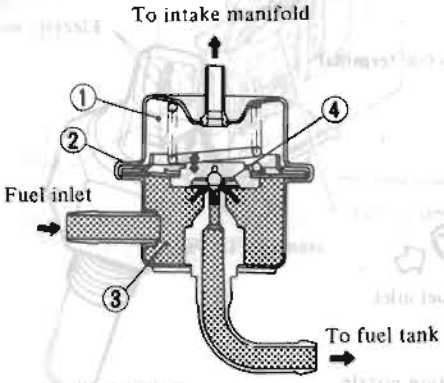


1 Injector lower rubber insulator
2 Injector heat insulator holder
3 Injector lower holder
4 Injector upper rubber insulator
5 Injector upper holder
6 Injector

EF231A

Fig. EF-19 Injector

PRESSURE REGULATOR

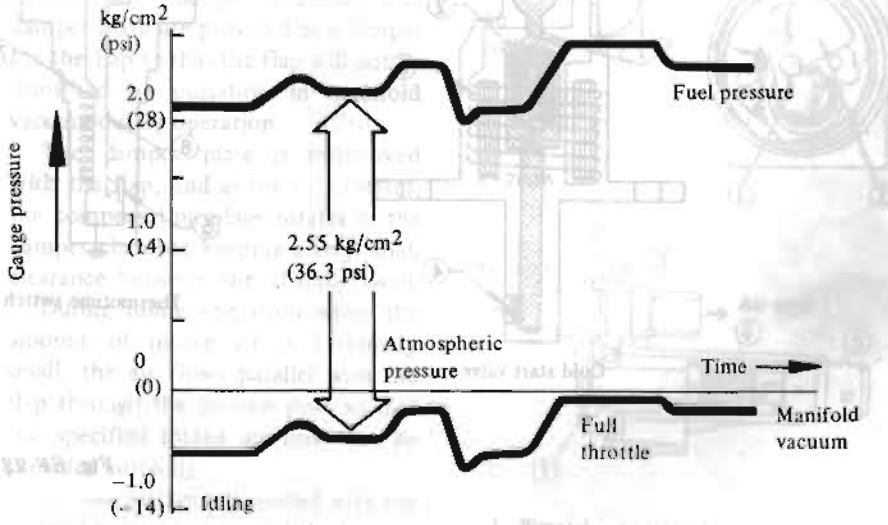


1 Air chamber
2 Diaphragm
3 Fuel chamber
4 Valve

EF257A

Fig. EF-20 Pressure Regulator

The pressure regulator controls the pressure of fuel so that a pressure difference of 2.55 kg/cm^2 (36.3 psi) can be maintained between the fuel pressure and intake manifold vacuum. The pressure regulator is divided into the air chamber and fuel chamber by the diaphragm. Intake manifold vacuum is introduced into the air chamber, thereby keeping differential pressure constant causing excessive fuel to return to the fuel tank through the return side port. This constant differential pressure provides optimum fuel injection in every mode of engine operation.



EF258A

Fig. EF-21 Fuel Pressure Changes

COLD START VALVE AND THERMOTIME SWITCH

Cold start valve

The cold start valve causes fuel to be injected into the intake manifold independently of the injector operation so that the engine can be started smoothly during cold weather.

The cold start valve operates on the electromagnetic principle.

To improve fuel-air mixing at lower temperatures, the cold start valve employs a swirl type nozzle which has a turn chamber at the end. With this construction, fuel is injected at an angle of 60° and better atomization of fuel can be obtained.

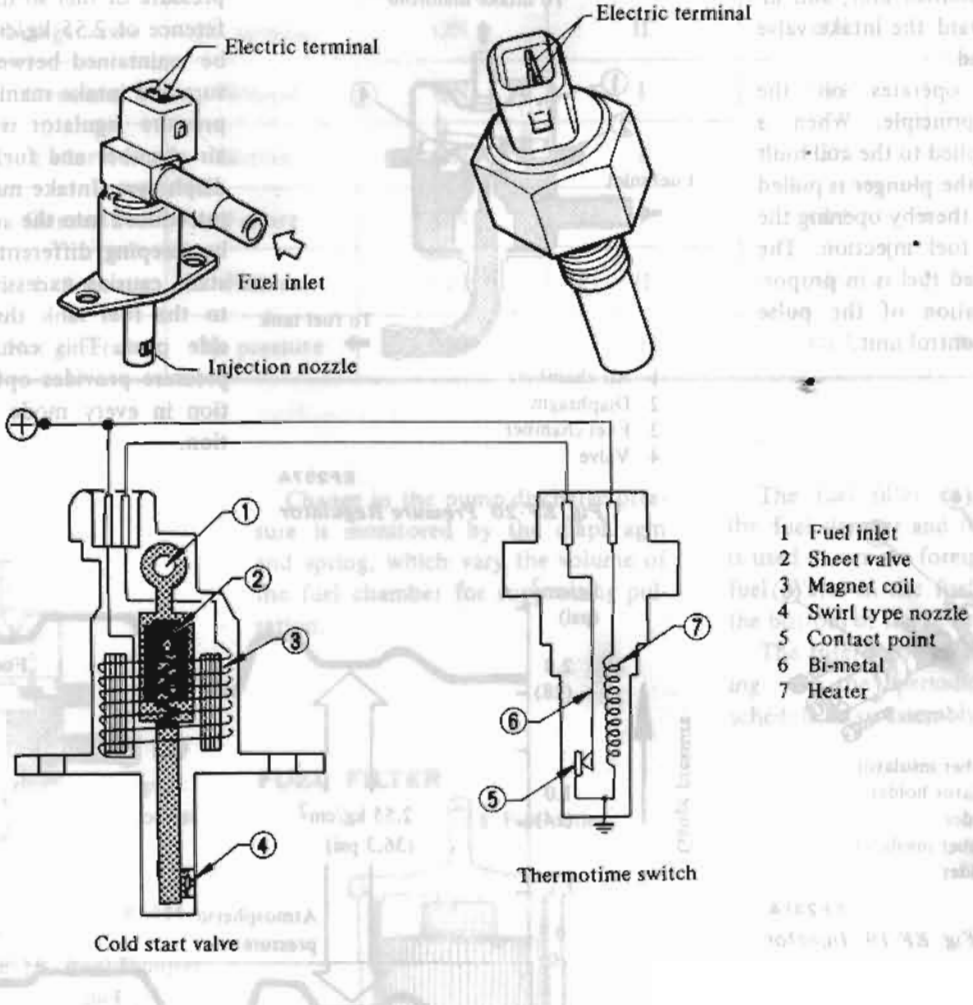
Thermotime switch

The thermotime switch is built into the thermostat housing.

A harness is connected in series to the cold start valve from the thermotime switch. The bimetal contact in the thermotime switch opens or closes depending on the cooling water temperature, and sends a signal to the cold start valve so that an additional amount of fuel can be injected for starting operation of the engine.

The thermotime switch is ON when the cooling water temperature is lower than 14°C (57°F), and the thermotime switch is OFF when the cooling water temperature is higher than 25°C (77°F).

The temperature at which the bimetal contact turns ON or OFF may vary within the range of 14 to 25°C (57 to 77°F). This implies, however, that repeated operation of the ignition switch may result in excessively thick mixture and consequent troubles in engine operation. To prevent this, the bimetal is equipped with a heater. Electric current flows through the heater while the ignition switch is in the "START" position, and warms up the bimetal. Through repeated operation of the ignition switch, then, the bimetal is sufficiently warmed up to open the thermotime switch, thus stopping excessive injection of fuel from the cold start valve.



1 Fuel inlet
2 Sheet valve
3 Magnet coil
4 Swirl type nozzle
5 Contact point
6 Bi-metal
7 Heater

EF259A

Fig. EF-22 Cold Start Valve and Thermotime Switch

AIR FLOW SYSTEM

AIR FLOW METER

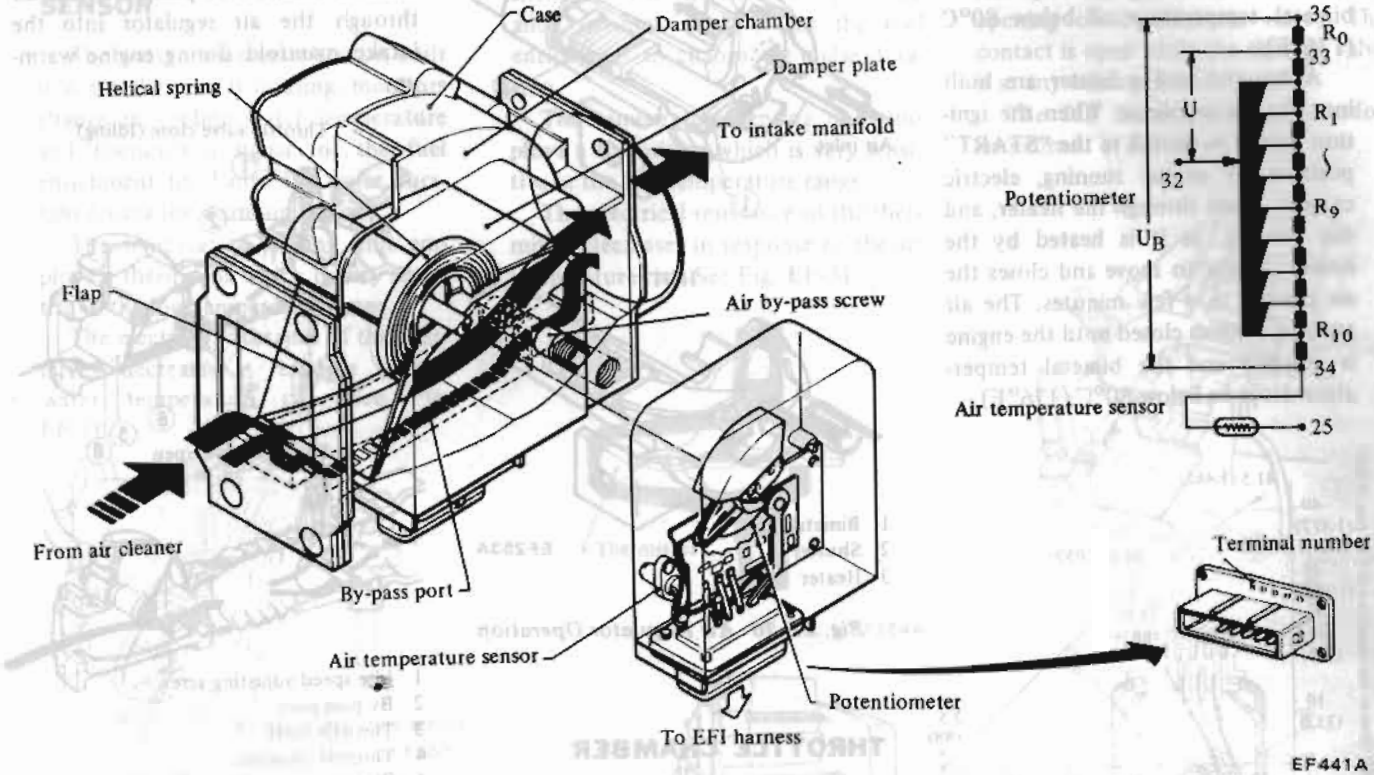


Fig. EF-23 Air Flow Meter

The air flow meter measures the quantity of intake air, and sends a signal to the control unit so that the base pulse width can be determined for correct fuel injection by the injector. The air flow meter is provided with a flap in the air passage. As the air flows through the passage, the flap rotates and its angle of rotation is electronically monitored to count the air flow rate.

More specifically, the angle of rotation of the flap is monitored by a potentiometer provided inside as a potential difference U. A circuit diagram of the potentiometer is shown in Fig. EF-23. When the flap deflects along with a change in the intake air flow rate, the terminal ㉜ mounted to the flap shaft slides on the variable resistor R from R1 to R9, causing the voltage across terminals ㉜ and ㉝ to change.

A constant voltage U_B (battery voltage) is applied across terminals ㉞ and ㉟. Then the air flow rate is converted into the voltage ratio signal U/U_B, which in turn is sent to the control unit for computation.

The flap is able to rotate to an angle where an equilibrium between the air flow pressure and the return torque of the coil spring can be maintained. The damper chamber and damper plate are provided as a damper for the flap so that the flap will not be disturbed by pulsation in manifold vacuum during operation.

The damper plate is interlinked with the flap, and as the flap rotates, the compensating plate rotates in the damper chamber keeping a very small clearance between the chamber wall.

During idling operation when the amount of intake air is extremely small, the air flows parallel with the flap through the by-pass port so that the specified intake air flow can be provided correctly.

The air passage is provided with the air temperature sensor, and the by-pass port has the air by-pass screw which regulates the idle mixture ratio.

AIR REGULATOR

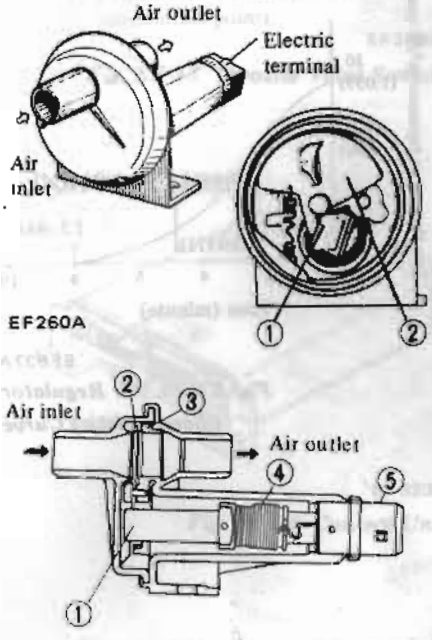
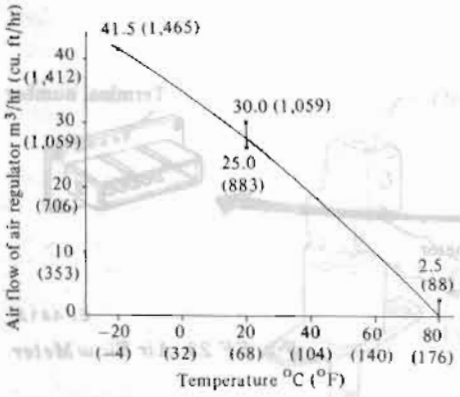


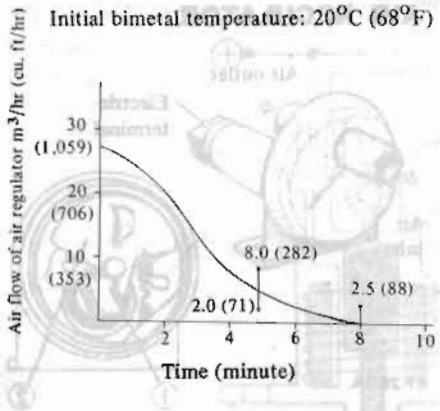
Fig. EF-24 Air Regulator

The air regulator by-passes the throttle valve to control the quantity of air for increasing the engine idling speed when starting the engine at a bimetal temperature of below 80°C (176°F).

A bimetal and a heater are built into the air regulator. When the ignition switch is turned to the "START" position or engine running, electric current flows through the heater, and the bimetal, as it is heated by the heater, begins to move and closes the air passage in a few minutes. The air passage remains closed until the engine is stopped and the bimetal temperature drops to below 80°C (176°F).



Initial bimetal temperature: 20°C (68°F)



EF537A

Fig. EF-25 Air Regulator Characteristics Curve

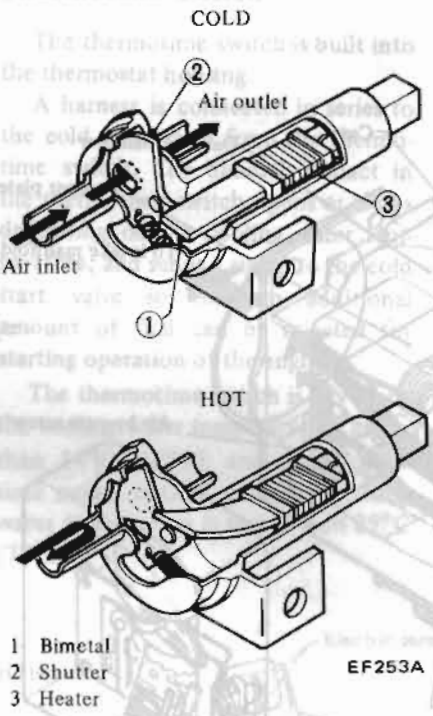
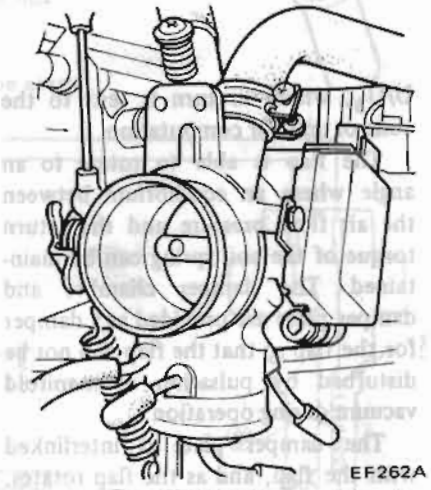


Fig. EF-26 Air Regulator Operation

THROTTLE CHAMBER

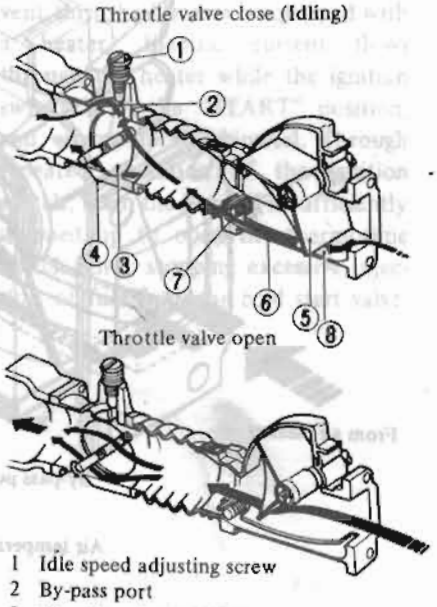


EF262A

Fig. EF-27 Throttle Chamber

The throttle chamber, located between the air flow meter and the intake manifold, is equipped with a valve. This valve controls the intake air flow in response to accelerator pedal movement. The rotary shaft of this valve is connected to the throttle valve switch.

This valve remains closed during engine idling, and the air required for idling passes through the by-pass port into the intake manifold. Idle adjustment is made by the idle speed adjusting screw located in the by-pass port. There is another by-pass line in this throttle chamber to pass sufficient air through the air regulator into the intake manifold during engine warm-up.



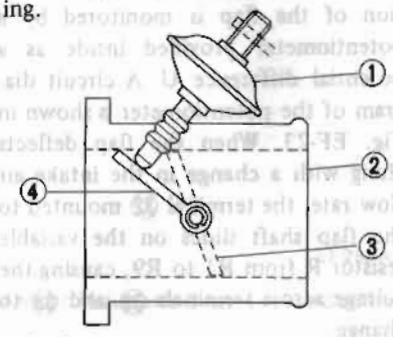
1 Idle speed adjusting screw
2 By-pass port
3 Throttle valve
4 Throttle chamber
5 Flap
6 Air flow meter
7 Air by-pass screw
8 By-pass port

EF337A

Fig. EF-28 Air Flow in Air Flow Meter and Throttle Chamber

DASH POT

The dash pot is attached to the throttle chamber. The dash pot prevents the throttle valve from closing abruptly, thereby reducing HC emission during deceleration or gear shifting.



1 Dash pot
2 Throttle chamber
3 Throttle valve
4 Throttle lever

EF453A

Fig. EF-29 Dash Pot

ELECTRICAL SIGNAL SYSTEM

WATER TEMPERATURE SENSOR

The water temperature sensor, built into the thermostat housing, monitors change in cooling water temperature and transmits a signal for the fuel enrichment to change the pulse duration during the warm-up period.

The temperature sensing unit employs a thermistor which is very sensitive in the low temperature range.

The electrical resistance of the thermistor decreases in response to the water temperature rise. See Fig. EF-31.

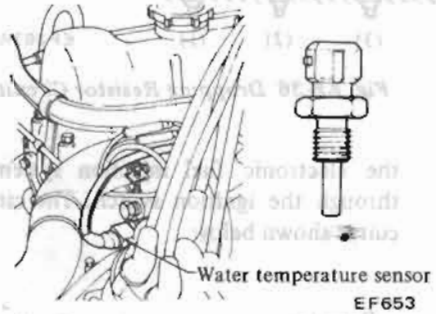


Fig. EF-30 Water Temperature Sensor

WATER TEMPERATURE SENSOR AND AIR TEMPERATURE SENSOR CHARACTERISTIC CURVE

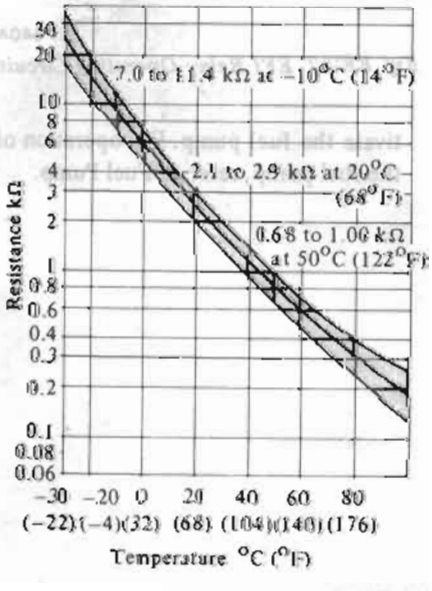


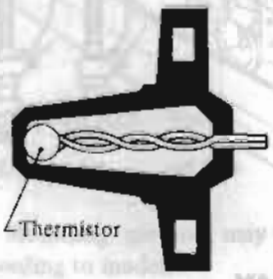
Fig. EF-31 Water Temperature Sensor and Air Temperature Sensor Characteristics Curve

AIR TEMPERATURE SENSOR

The air temperature sensor, built into the air flow meter, monitors change in the intake air temperature and transmits a signal for the fuel enrichment to change the pulse duration.

The temperature sensing unit employs a thermistor which is very sensitive in the low temperature range.

The electrical resistance of the thermistor decreases in response to the air temperature rise. See Fig. EF-31.



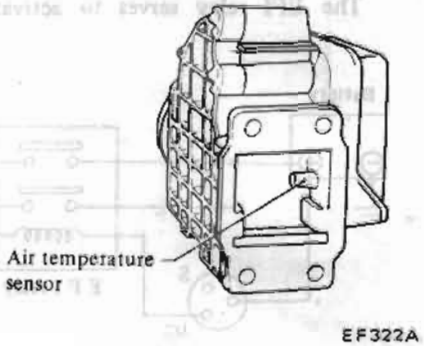


Fig. EF-32 Air Temperature Sensor

THROTTLE VALVE SWITCH

The throttle valve switch is attached to the throttle chamber and actuates in response to accelerator pedal movement. This switch has two sets of contact points. One set monitors the idle position and the other set monitors full throttle position.

Idle contact

The idle contact closes when the throttle valve is positioned at idle and opens when it is at any other position. The idle contact compensates for idle and after idle enrichment, and sends the fuel shut-off signal.

Full throttle contact

The full throttle contact closes only when the throttle valve is positioned at full throttle (more than 34 degree opening of the throttle valve). The contact is open while the throttle valve is at any other position.

The full contact compensates for enrichment in full throttle.

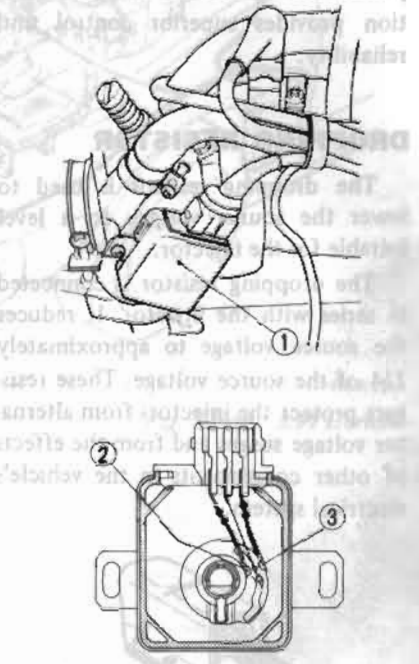


Fig. EF-33 Throttle Valve Switch

CONTROL UNIT

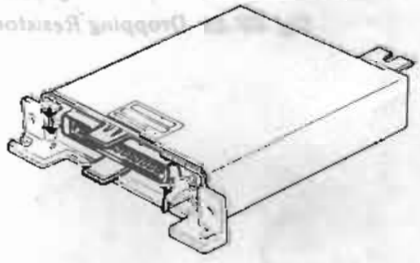


Fig. EF-34 Control Unit

The control unit is connected to the EFI harness by means of a multi-connector, and the EFI harness is connected to other sensors.

The essential role of the control unit is to generate a pulse. Upon receiving an electrical signal from each sensor, the control unit generates a pulse whose duration (injector open-valve time period) is controlled to provide an optimum quantity of fuel according to the engine characteristics.

The control unit consists mainly of three integrated circuits formed on the printed circuit board. This construction provides superior control unit reliability.

DROPPING RESISTOR

The dropping resistor is used to lower the source voltage to a level suitable for the injector.

The dropping resistor is connected in series with the injector. It reduces the source voltage to approximately 1/4 of the source voltage. These resistors protect the injectors from alternator voltage surges and from the effects of other components in the vehicle's electrical system.

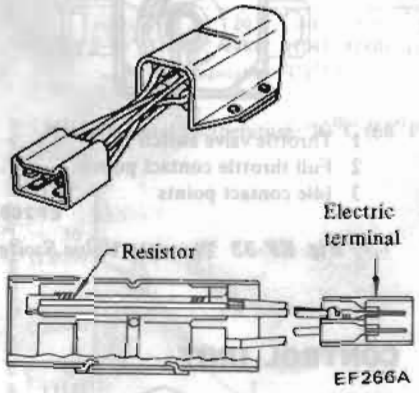


Fig. EF-35 Dropping Resistor

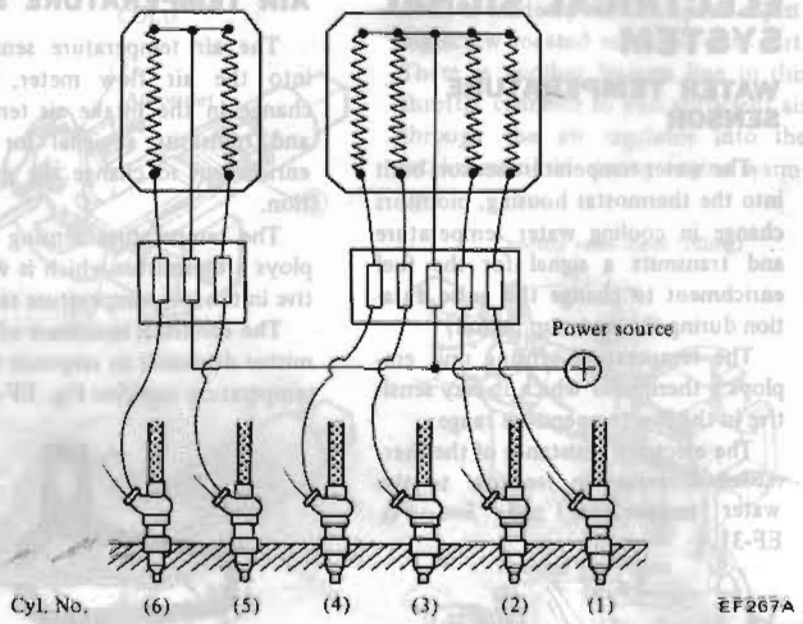


Fig. EF-36 Dropping Resistor Circuit

RELAY

EFI relay

The EFI relay serves to activate the electronic fuel injection system through the ignition switch. The circuit is shown below.

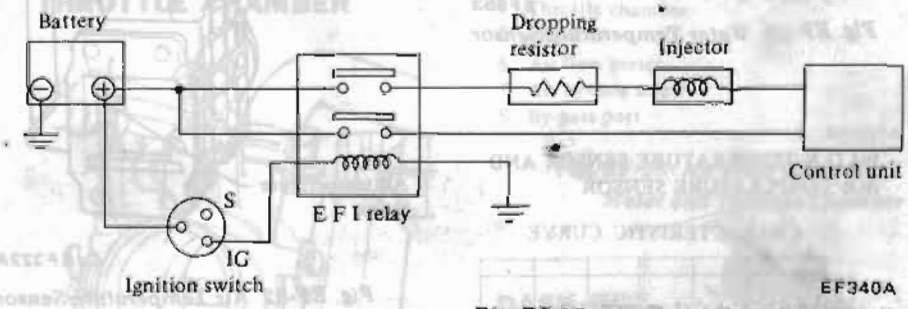


Fig. EF-37 EFI Relay Operating Circuit

Fuel pump relay

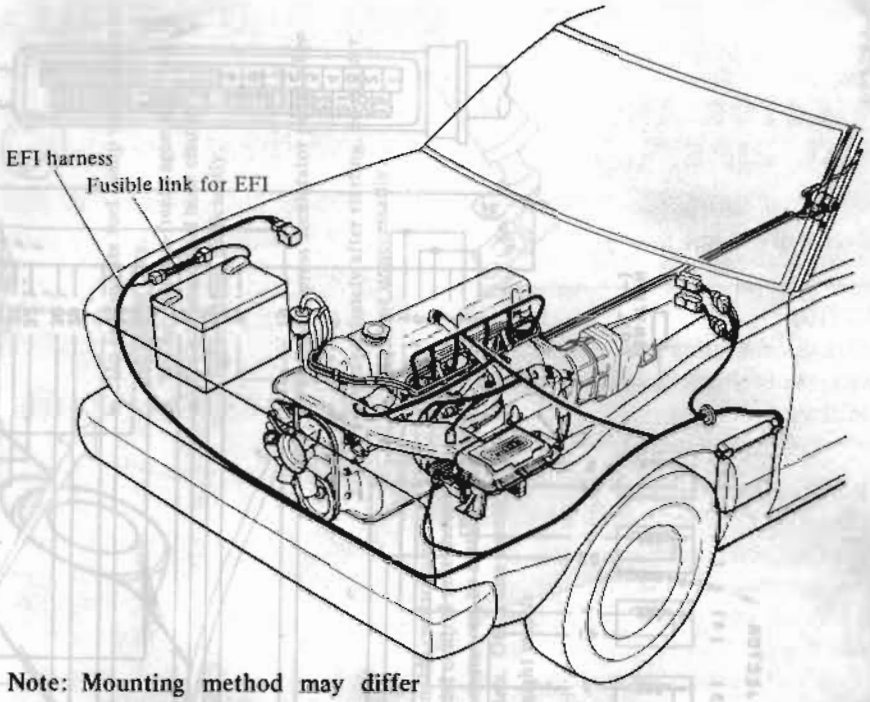
The fuel pump relay serves to activate the fuel pump. For operation of the fuel pump, refer to Fuel Pump.

EFI HARNESS

One wiring harness is used to connect lines between the control unit and the related major units.

The 35-pin connector of the EFI harness is connected to the control unit at the left dash side, and runs to the engine compartment. The harness runs to various units: the air flow meter, throttle valve switch, cold start valve, air regulator, thermotime switch, water temperature sensor, dropping resistor and injector, etc.

Battery supplies power to injector and control unit through fusible link designed especially for EFI.

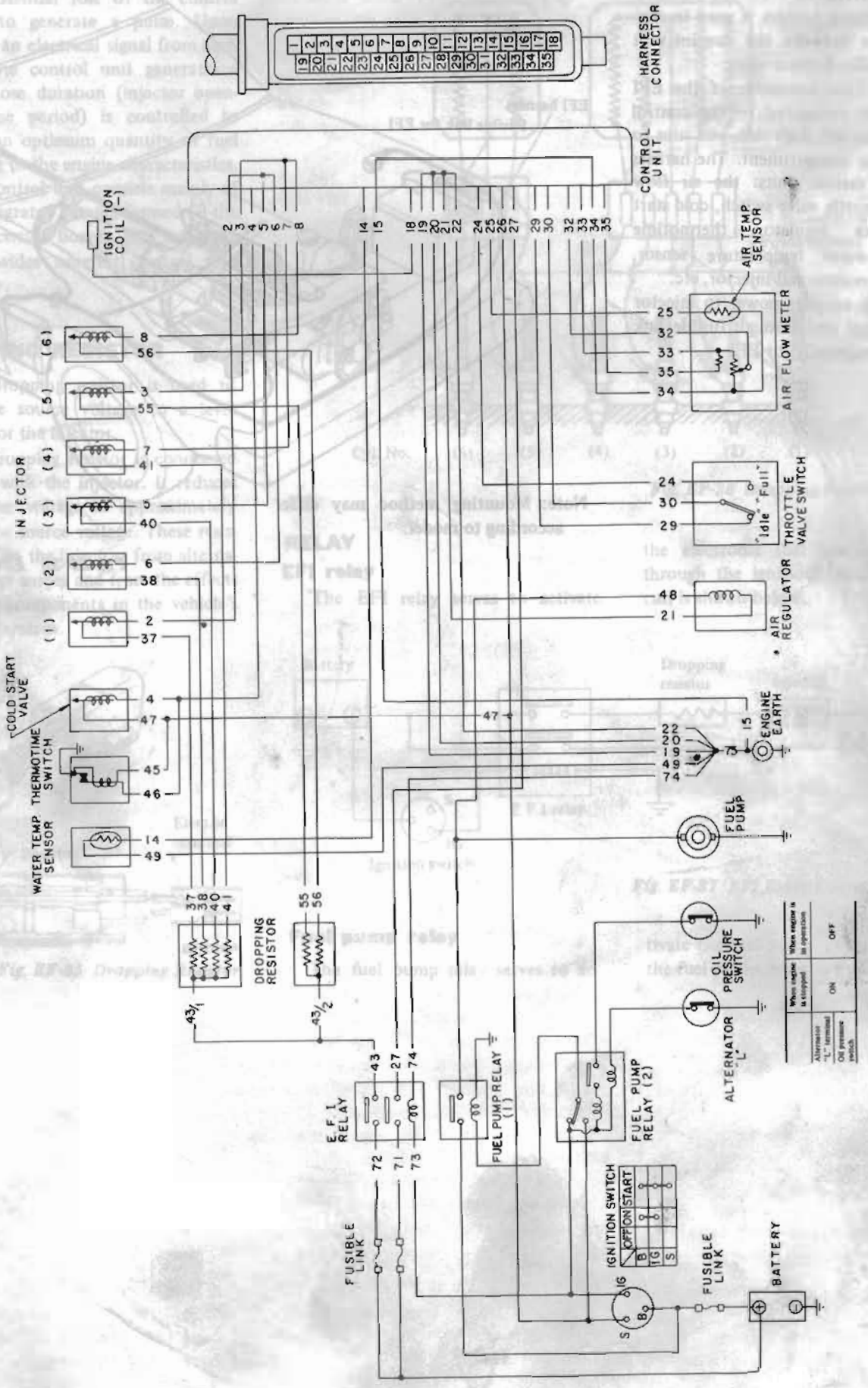


Note: Mounting method may differ according to model.

EF528A

Fig. EF-38 EFI Harness

EFI Circuit Diagram for model S130 Series



EF439A

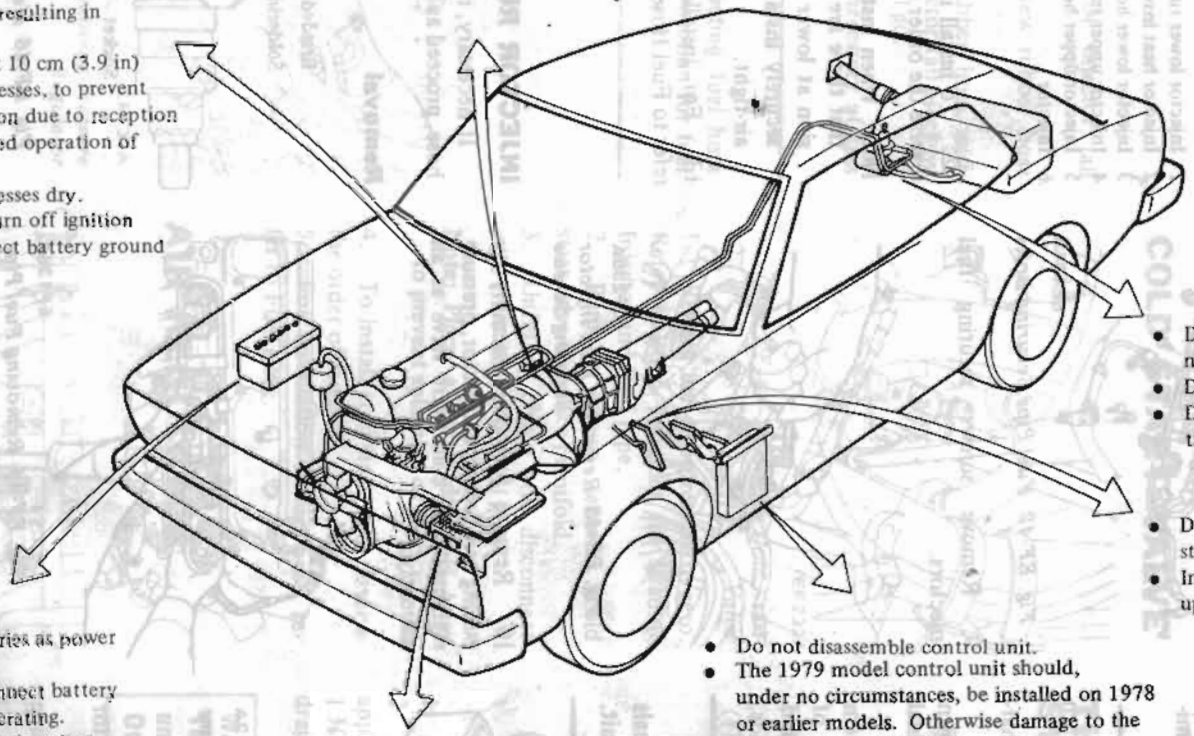
Fig. EF-39 EFI Circuit Diagram

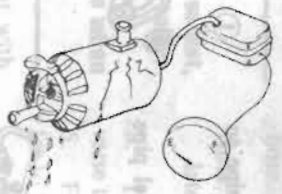
PRECAUTIONS FOR AN EFI ENGINE

Pay close attention to the following points when inspecting or servicing an EFI car.

- Securely connect EFI harness connector. A poor connection can cause an extremely high (surge) voltage to develop in coil and condenser, thus resulting in damage to IC circuit.
- Keep EFI harness at least 10 cm (3.9 in) away from adjacent harnesses, to prevent an EFI system malfunction due to reception of external noise, degraded operation of IC circuit, etc.
- Keep EFI parts and harnesses dry.
- Before removing parts, turn off ignition switch and then disconnect battery ground cable.

- Do not apply battery power directly to injectors.

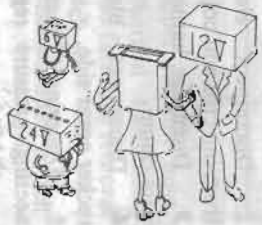




- Do not operate fuel pump when there is no fuel in lines.
- Do not use anti-freeze agents in fuel.
- Do not reuse fuel hose clamps and tighten them sufficiently.

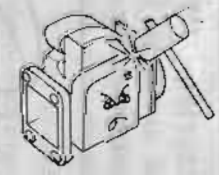
- Do not depress accelerator pedal when starting.
- Immediately after starting, do not rev up engine unnecessarily.

- Always use 12-volt batteries as power source.
- Do not attempt to disconnect battery cables while engine is operating.
- If a receiver-transmitter is installed, route antenna feeder cable along opposite side from EFI harness and control unit. Make sure that there is no interference while engine is idling.



- Do not disassemble control unit.
- The 1979 model control unit should, under no circumstances, be installed on 1978 or earlier models. Otherwise damage to the control unit might result.

- Handle air flow meter carefully to avoid damage.
- There should not occur even a slight leak in air intake system.



EF5529A

Fig. EF-40 Precautions for an EFI Engine

REMOVAL AND INSTALLATION

INJECTOR AND FUEL PIPE

1. Follow the procedure below to reduce fuel pressure to zero.

CAUTION:
Before disconnecting fuel hose, release fuel pressure from fuel line to eliminate danger.

(1) Disconnect ground cable from battery.
(2) Disconnect cold start valve harness connector.
(3) Using two jumper wires shown in illustration, connect each terminal to cold start valve connector.
(4) Release pressure in fuel system by connecting other terminals of jumper wires to battery positive and negative terminals for a few seconds.

CAUTION:
Be careful to keep both terminals separate in order to avoid short circuit.

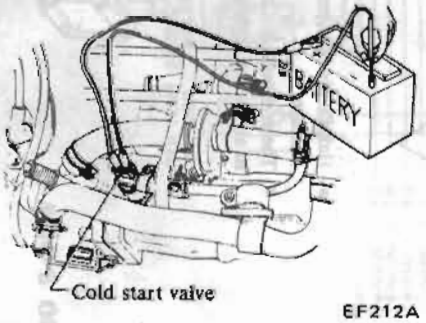


Fig. EF-41 Reducing Fuel Pressure

2. Disconnect electric connector from injector and cold start valve.
3. Disengage harness from fuel pipe wire clamp.
4. Disconnect blow-by hose at rocker cover side.
5. Disconnect vacuum tube (connecting pressure regulator to intake manifold) from pressure regulator.
6. Remove air regulator pipe.
7. Disconnect fuel feed hose and fuel return hose from fuel pipe.

Note: Place a rag under fuel pipe to prevent splashing of fuel.

8. Remove bolts securing fuel pipe and cold start valve.

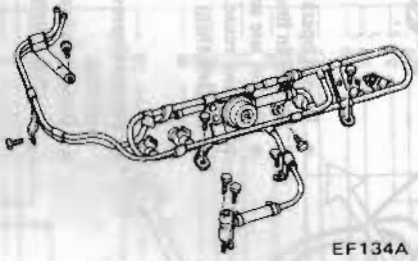


Fig. EF-42 Fuel Pipe Securing Bolts

9. Remove screws securing fuel injectors.

Fig. EF-43 Removing Fuel Injector Securing Screws

10. Remove fuel pipe assembly by pulling out fuel pipe, injector, pressure regulator and cold start valve as an assembly.

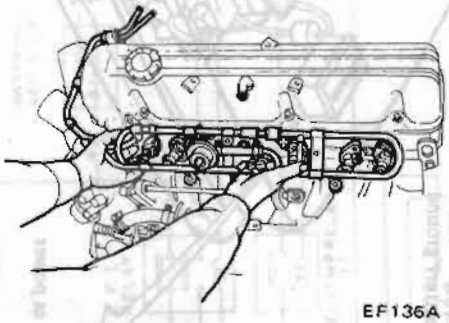
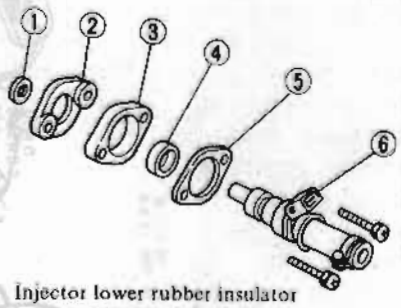


Fig. EF-44 Removing Fuel Pipe

11. Unfasten hose clamp on fuel injector and remove fuel injector from fuel pipe.

Note: Place a rag under injector when disconnecting fuel pipe to prevent splashing of fuel.



1 Injector lower rubber insulator
2 Injector heat insulator holder
3 Injector lower holder
4 Injector upper rubber insulator
5 Injector upper holder
6 Injector

Fig. EF-45 Injector

12. To install injector and fuel pipe, reverse the order of removal.

Note: When installing injector, check that there are no scratches or abrasion at lower rubber insulator, and securely install it, making sure it is air-tight.

13. For installation of fuel hose, refer to Fuel Hose.

INJECTOR RUBBER HOSE

If necessary, replace injector rubber hose, proceed as follows:

Removal

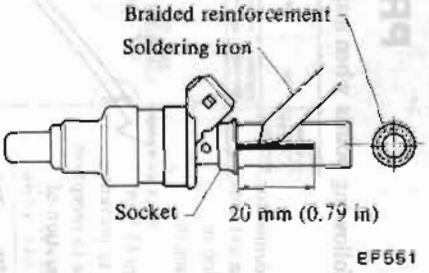


Fig. EF-46 Melting Injector Rubber Hose

1. On injector rubber hose, measure off a point approx. 20 mm (0.79 in) from socket end.
2. Heat soldering iron (150 watt) for 15 minutes. Cut hose into braided reinforcement from mark to socket end.

Note: Do not feed soldering iron until it touches injector tail piece.

CAUTION:
a. Be careful not to damage socket, plastic connector, etc. with soldering iron.
b. Never place injector in a vise when disconnecting rubber hose.

3. Then pull rubber hose out with hand.

Installation

1. Clean exterior of injector tail piece.
2. Wet inside of new rubber hose with fuel.
3. Push end of rubber hose with hose socket onto injector tail piece by hand as far as they will go.

Note: Clamp is not necessary at this connection.

CAUTION:
After properly connecting fuel hose to injector, check connection for fuel leakage.

PRESSURE REGULATOR

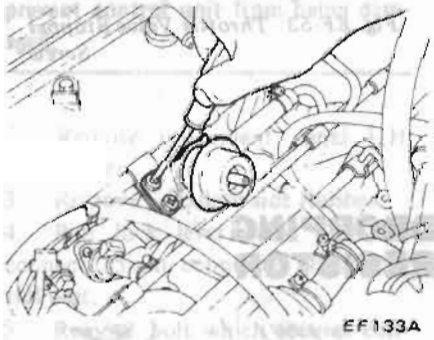


Fig. EF-47 Removing Pressure Regulator

1. Reduce fuel line pressure to zero. Refer to item 1. under the heading Injector and Fuel pipe.
2. Disengage vacuum tube connecting regulator to intake manifold from pressure regulator.
3. Remove screws securing pressure regulator.
4. Unfasten hose clamps, and disconnect pressure regulator from fuel hose.

Note: Place a rag under pressure regulator to prevent splashing of fuel.

5. To install pressure regulator, reverse the order of removal.
6. For installation of fuel hose, refer to Fuel Hose.

COLD START VALVE

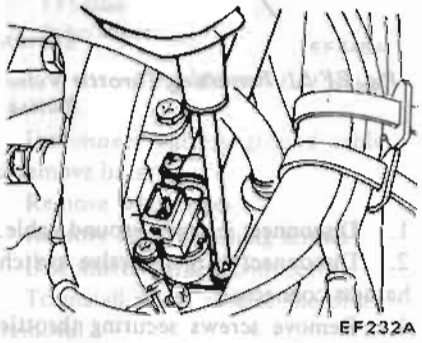


Fig. EF-48 Removing Cold Start Valve

1. Reduce fuel line pressure to zero. Refer to item 1. under the heading Injector and Fuel pipe.
2. Remove screws securing cold start valve to intake manifold.
3. Unfasten clamp and disconnect cold start valve from fuel hose.

Note: Place a rag under fuel hose to prevent splashing of fuel.

4. To install cold start valve, reverse the order of removal.
5. For installation of fuel hose, refer to Fuel Hose.

AIR REGULATOR

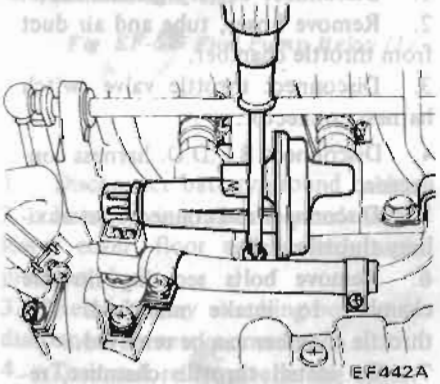
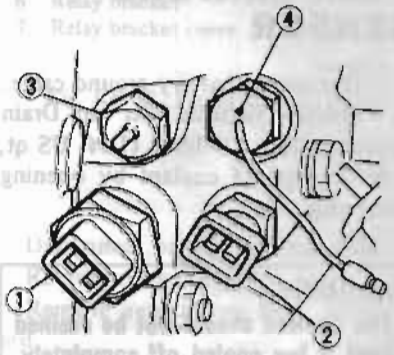


Fig. EF-49 Removing Air Regulator

1. Disconnect ground cable from battery.
2. Disconnect electric connector from air regulator.
3. Unfasten clamp on each side of hose, and disconnect hose.
4. Remove setscrews, and remove air regulator.
5. To install air regulator, reverse the order of removal.

Note: On Canada models, a rubber cover is provided on air regulator.

THERMOTIME SWITCH



1 Thermotime switch
2 Water temperature sensor
3 Thermal transmitter
4 Water temperature sensing switch

EF492A

Fig. EF-50 Thermotime Switch

1. Disconnect battery ground cable.
2. Remove radiator filler cap. Drain approximately 1.5 liters (1 5/8 US qt, 1 3/8 Imp qt) of coolant by opening drain plug.

WARNING:
The coolant should not be drained until it has cooled off completely. Otherwise, burns may be incurred.

3. Disconnect upper radiator hose.
4. Disconnect thermal transmitter harness connector to facilitate removal of thermotime switch.
5. Disconnect thermotime switch harness connector.
6. Remove thermotime switch by turning it counterclockwise.
7. To install thermotime switch, reverse the order of removal.

Note:
a. Be sure to install copper washer when installing thermotime switch.
b. After installing thermotime switch, add the same amount of coolant as was drained.

WATER TEMPERATURE SENSOR

1. Disconnect battery ground cable.
2. Remove radiator filler cap. Drain approximately 1.5 liters (1 5/8 US qt, 1 3/8 Imp qt) of coolant by opening drain plug.

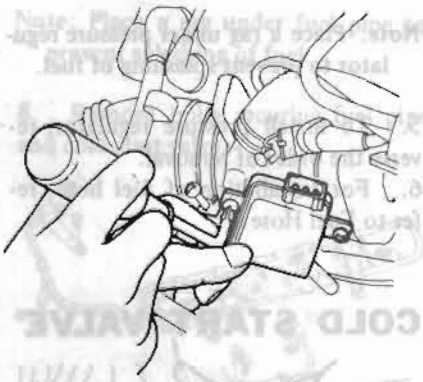
WARNING:
The coolant should not be drained until it has cooled off completely. Otherwise, burns may be incurred.

3. Disconnect radiator upper hose.
4. Disconnect water temperature sensor harness connector. Refer to Fig. EF-49.
5. Remove blind plug to facilitate removal of water temperature sensor.
6. Remove water temperature sensor by turning it counterclockwise.
7. To install water temperature sensor, reverse the order of removal.

CAUTION:
When connecting water temperature sensor harness, always keep it away from high tension wire.

Note:
a. Be sure to install copper washer when installing water temperature sensor.
b. After installing water temperature sensor, add the same amount of coolant as was drained.

THROTTLE VALVE SWITCH



EF218A

Fig. EF-51 Removing Throttle Valve Switch

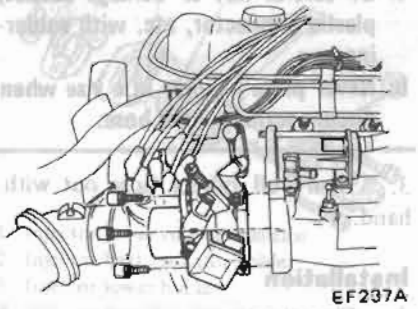
1. Disconnect battery ground cable.
2. Disconnect throttle valve switch harness connector.
3. Remove screws securing throttle valve switch to throttle chamber.
4. Slowly pull throttle valve switch toward you.
5. To install throttle valve switch, reverse the order of removal.
6. After installation, adjust position of throttle valve switch.

Refer to Throttle Valve Switch, under the heading Component Parts Inspection.

THROTTLE CHAMBER

1. Disconnect battery ground cable.
2. Remove hoses, tube and air duct from throttle chamber.
3. Disconnect throttle valve switch harness connector.
4. Disconnect B.C.D.D. harness connector.
5. Disconnect rod connector at auxiliary throttle shaft.
6. Remove bolts securing throttle chamber to intake manifold. The throttle chamber can be removed.
7. To install throttle chamber, reverse the order of removal.

Ⓣ Tightening torque:
Throttle chamber securing screw
1.5 to 2.0 kg-m
(11 to 14 ft-lb)



EF237A

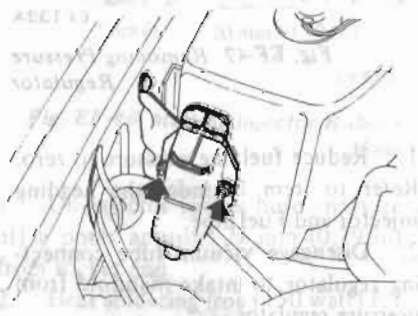
Fig. EF-52 Removing Throttle Chamber

Note: Do not adjust throttle valve stopper screw as it is properly adjusted at factory.

EF270A

Fig. EF-53 Throttle Valve Stopper Screw

DROPPING RESISTOR

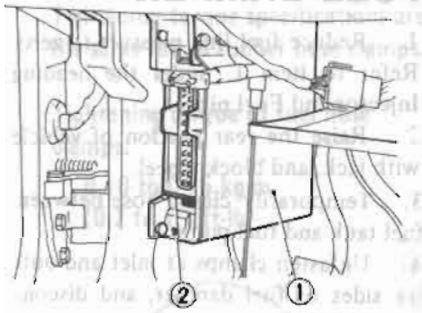


EF443A

Fig. EF-54 Dropping Resistor

1. Disconnect ground cable from battery.
2. Disconnect electric connector from dropping resistor.
3. Remove dropping resistor attaching screws.
4. To install dropping resistor, reverse the order of removal.

CONTROL UNIT



1 Control unit
2 Lock lever
EF444A

Fig. EF- 55 Control Unit

1. Turn ignition switch OFF and then disconnect ground cable from battery.

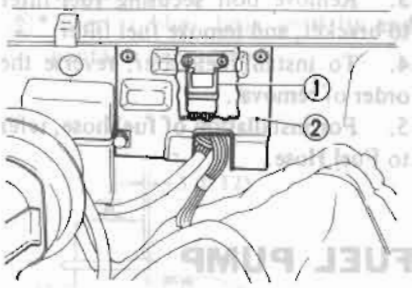
CAUTION:
Before disconnecting EFI harness at 35-pin connector, be sure to turn ignition switch "OFF" and then disconnect ground cable from battery to prevent control unit from being damaged.

2. Remove instrument panel L.H. lower cover.
3. Remove L.H. dash side finisher.
4. Pull lock lever back, and disconnect 35-pin connector from control unit.
5. Remove bolt which secures control unit to L.H. dash side panel, and remove control unit.
6. To install control unit, reverse the order of removal.

CAUTION:
When inserting 35-pin connector into control unit, be careful not to bend or break terminals.

RELAY

EFI RELAY

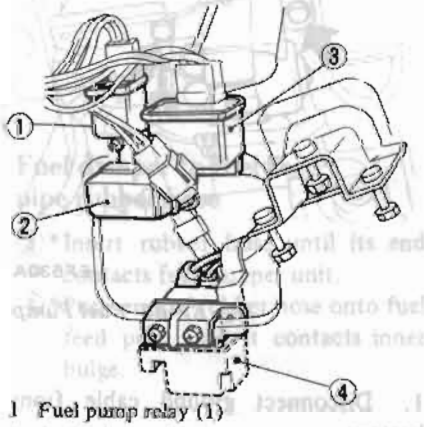


1 EFI relay
2 Relay cover
EF445A

Fig. EF-56 EFI Relay

1. Disconnect battery ground cable and remove battery.
2. Remove relay cover.
3. Remove relay attaching screws.
4. Disconnect harness connector.
5. To install relay, reverse the order of removal.

FUEL PUMP RELAY (1)

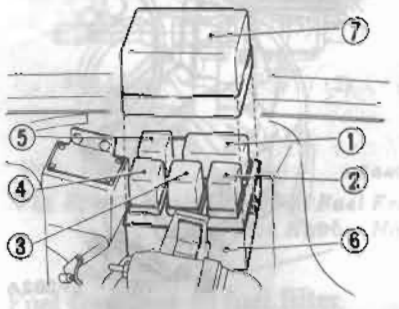


1 Fuel pump relay (1)
2 Seat belt warning timer unit
3 Ignition accessory relay
4 Fan motor timer unit
EF545A

Fig. EF-57 Fuel Pump Relay (1)

1. Disconnect battery ground cable.
2. Remove instrument panel R.H. lower cover, floor assist nozzle and junction block.
3. Remove relay attaching bolts and disconnect harness connector.
4. To install relay, reverse the order of removal.

FUEL PUMP RELAY (2)

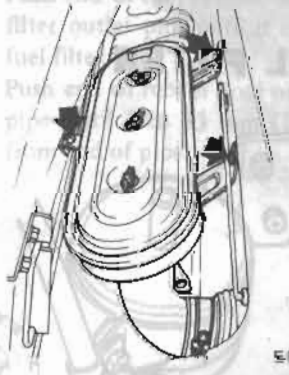


1 Fuel pump relay (2)
2 Dimmer relay
3 Bulb check relay
4 Air conditioner relay
5 Inhibitor relay
6 Relay bracket
7 Relay bracket cover
EF380A

Fig. EF-58 Fuel Pump Relay (2)

1. Disconnect battery ground cable.
2. Remove relay cover.
3. Remove relay from relay fixing board.
4. To install relay, reverse the order of removal.

AIR CLEANER



EF381A

Fig. EF-59 Air Cleaner

1. Unfasten clamp securing air duct between air cleaner and air flow meter.
2. Remove air cleaner securing screw.
3. Separate air cleaner from air ducts.
4. To install air cleaner, reverse the order of removal.

AIR FLOW METER

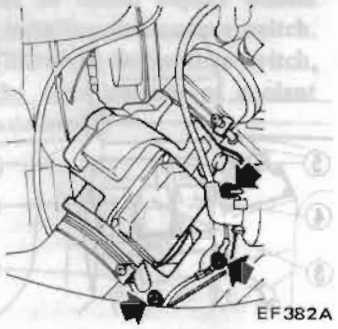


Fig. EF-60 Air Flow Meter

1. Disconnect battery ground cable.
2. Unfasten clamps securing air ducts at air flow meter and remove air ducts.
3. Remove bolts securing air flow meter bracket to body.
4. Remove air flow meter with bracket and disconnect harness connector.
5. To install air flow meter, reverse the order of removal.

AIR TEMPERATURE SENSOR

The air temperature sensor is built into the air flow meter and cannot be removed as a single unit. When replacement of air temperature sensor is necessary, the entire air flow meter assembly should be replaced.

FUEL FILTER

Fig. EF-61 Removing Fuel Filter

1. Reduce fuel line pressure to zero. Refer to item 1, under the heading Injector and Fuel pipe.
2. Unfasten clamps securing fuel hoses to the outlet and inlet sides of fuel filter, and disengage fuel hoses.

Note: Be careful not to spill fuel over engine compartment. Place a rag to absorb fuel.

3. Remove bolt securing fuel filter to bracket, and remove fuel filter.
4. To install fuel filter, reverse the order of removal.
5. For installation of fuel hose, refer to Fuel Hose.

FUEL PUMP

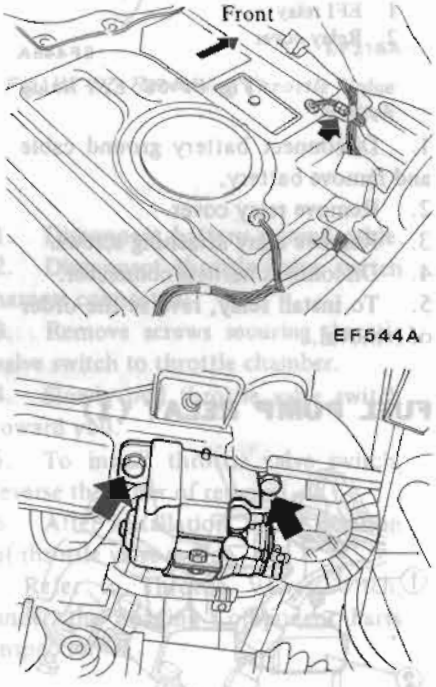


Fig. EF-62 Fuel Pump

1. Disconnect ground cable from battery.
2. Reduce fuel line pressure to zero. Refer to item 1, under the heading Injector and Fuel pipe.
3. Disconnect harness connector of fuel pump at rear luggage compartment.
4. Raise the rear portion of vehicle with a jack, and block wheels.
5. Temporarily clamp hose between fuel tank and fuel pump.
6. Unfasten clamps at the suction and outlet sides of fuel pump, and disconnect fuel hoses.

Note: Be sure to receive fuel into a suitable container.

7. Remove bolts which secure fuel pump bracket to body, and remove screws which secure bracket to pump.
8. To install fuel pump, reverse the order of removal.
9. For installation of fuel hose, refer to Fuel Hose.

FUEL DAMPER

1. Reduce fuel line pressure to zero. Refer to item 1, under the heading Injector and Fuel pipe.
2. Raise the rear portion of vehicle with jack, and block wheel.
3. Temporarily clamp hose between fuel tank and fuel pump.
4. Unfasten clamps at inlet and outlet sides of fuel damper, and disconnect fuel hoses.

Note: Be sure to receive fuel into a suitable container.

5. Remove nut which secures fuel damper to bracket.

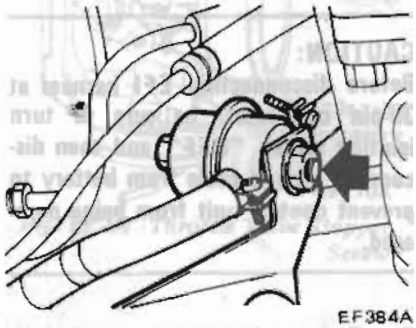


Fig. EF-63 Removing Fuel Damper

6. To install fuel damper, reverse the order of removal.
7. For installation of fuel hose, refer to Fuel Hose.

FUEL HOSE

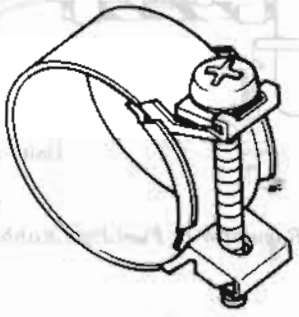
Make sure that all low pressure fuel hoses are fully inserted and are free from undue strain before clamping.

When removing or installing high pressure fuel hose, observe the following.

CAUTION:

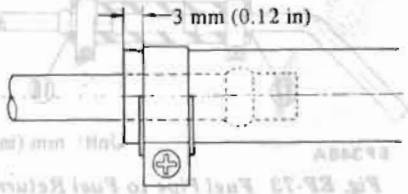
a. Do not reuse fuel hose clamps after loosening.
b. Clean dust and dirt from parts with compressed air when assembling.
c. Tighten high pressure rubber hose clamp so that clamp end is 3 mm (0.12 in) from hose end or screw position (wider than other portions of clamp) is flush with hose end.
Tightening torque specifications are the same for all rubber hose clamps.

Tightening torque of fuel hose clamps:
0.10 to 0.15 kg-m
(0.7 to 1.1 ft-lb)



EF976

Fig. EF-64 Fuel Hose Clamp



EF336A

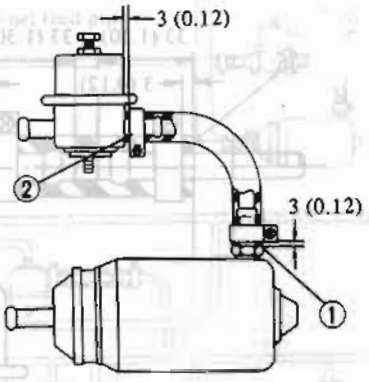
Fig. EF-65 Fuel Hose Clamp Position

When tightening hose clamp, ensure that screw does not come into contact with adjacent parts.

d. Insertion length of high pressure fuel rubber hoses is not the same for conventional pipes and those for electronic fuel injection unit. For details, refer to items ① through ⑱ below. Items with an asterisk mark "*" indicate hoses whose ends should bottom or be pushed until they contact bulges, electronic fuel injection unit, etc.

Rubber hoses between fuel pump and damper

① *Insert rubber hose until its end contacts pump.
② *Insert rubber hose until its end contacts damper unit.



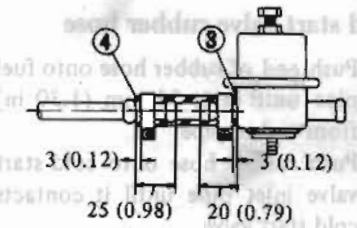
Unit: mm (in)

EF448A

Fig. EF-66 Rubber Hoses between Pump and Damper

Fuel damper to fuel feed pipe rubber hose

③ *Insert rubber hose until its end contacts fuel damper unit.
④ *Push end of rubber hose onto fuel feed pipe until it contacts inner bulge.



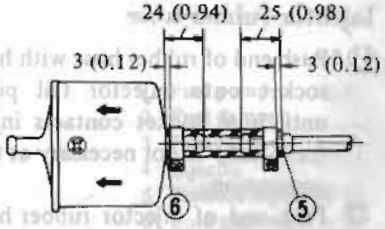
Unit: mm (in)

EF449A

Fig. EF-67 Fuel Damper to Fuel Feed Pipe Rubber Hose

Fuel feed pipe to fuel filter inlet pipe rubber hose

⑤ *Push end of rubber hose onto fuel feed pipe until it contacts inner bulge.
⑥ *Push end of rubber hose onto fuel filter inlet pipe until it contacts fuel filter unit.



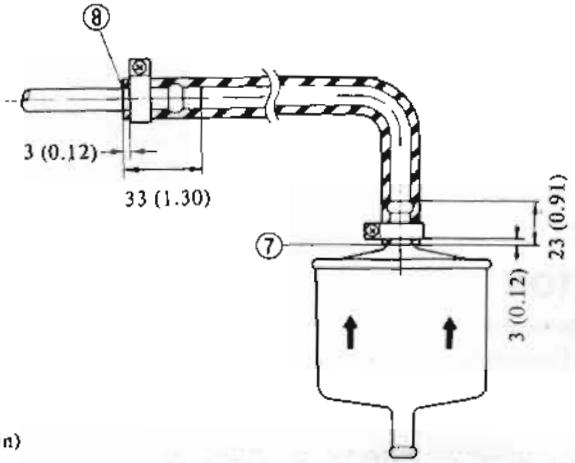
Unit: mm (in)

EF343A

Fig. EF-68 Fuel Feed Pipe to Fuel Filter Inlet Pipe Rubber Hose

Fuel filter outlet to fuel pipe rubber hose

⑦ *Push end of rubber hose onto fuel filter outlet pipe until it contacts fuel filter unit.
⑧ Push end of rubber hose onto fuel pipe until it is 33 mm (1.30 in) from end of pipe.



Unit: mm (in)

EF344A

Fig. EF-69 Fuel Filter Outlet to Fuel Pipe Rubber Hose

Cold start valve rubber hose

⑨ Push end of rubber hose onto fuel pipe until it is 33 mm (1.30 in) from end of pipe.

⑩ *Push rubber hose onto cold start valve inlet pipe until it contacts cold start valve.

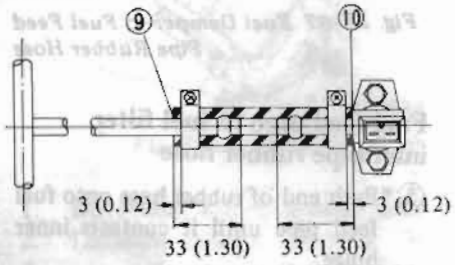


Fig. EF-70 Cold Start Valve Rubber Hose

Injector rubber hose

⑪ *Push end of rubber hose with hose socket onto injector tail piece until hose socket contacts injector. Clamp is not necessary at this connection.

⑫ Push end of injector rubber hose onto fuel pipe until it is 28 mm (1.10 in) from end of pipe.

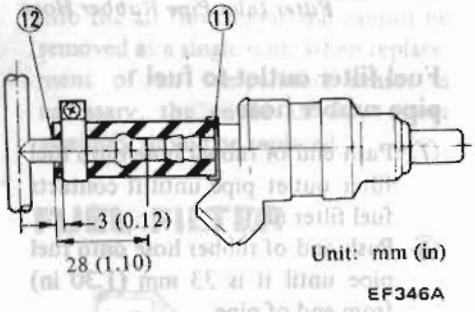


Fig. EF-71 Injector Rubber Hose

Pressure regulator to fuel pipe rubber hose

⑬ Push end of rubber hose onto fuel pipe until it is 33 mm (1.30 in) from end of pipe.

⑭ *Push end of rubber hose onto pressure regulator inlet pipe until it contacts pressure regulator.

⑮ Push end of rubber hose onto pressure regulator outlet pipe until it is 33 mm (1.30 in) from end of pipe.

⑯ *Push end of rubber hose onto fuel pipe until it contacts fuel pipe stay.

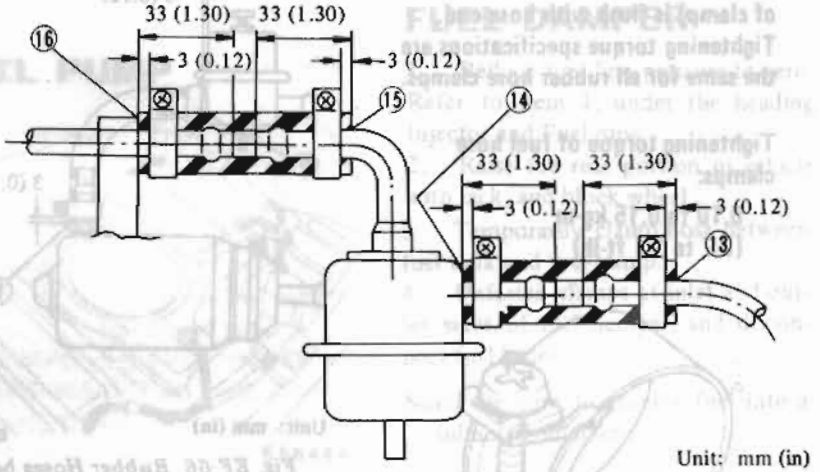


Fig. EF-72 Pressure Regulator to Fuel Pipe Rubber Hose

Fuel pipe to fuel return pipe rubber hose

⑰ Push end of rubber hose onto fuel pipe until it is 33 mm (1.30 in) from end of pipe.

⑱ *Push end of rubber hose onto fuel return pipe until it contacts inner bulge.

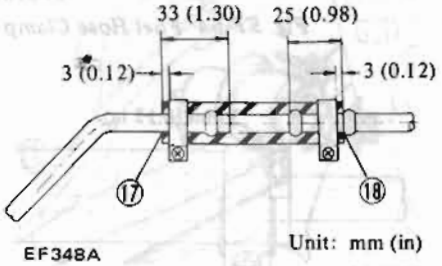
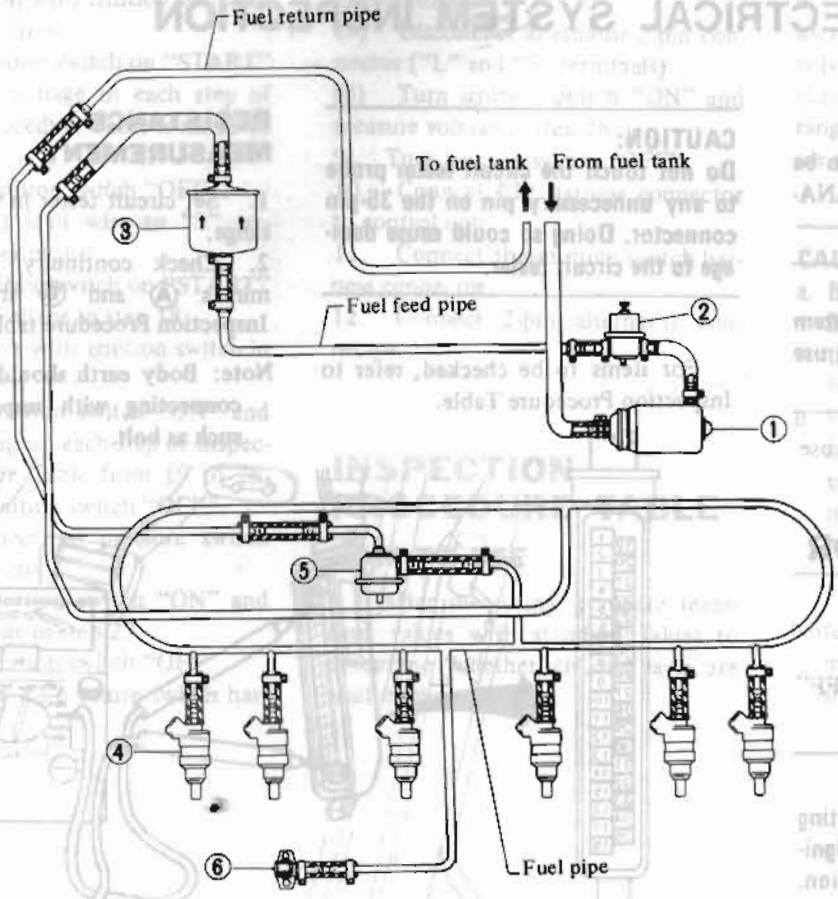
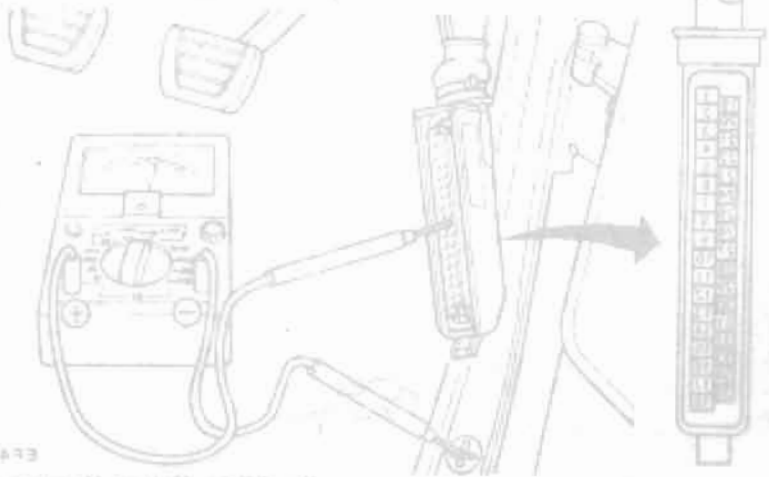


Fig. EF-73 Fuel Pipe to Fuel Return Pipe Rubber Hose



1 Fuel pump
2 Fuel damper
3 Fuel filter
4 Injector
5 Pressure regulator
6 Cold start valve

Fig. EF-74 Fuel Hoses



ELECTRICAL SYSTEM INSPECTION

DESCRIPTION

Electrical system inspection can be performed by using the E.F.I. ANALYZER (J-25400).

CAUTION:
When checking the electrical system with EFI ANALYZER, be sure to use the proper adapter harness.

If the analyzer is not available, use the following procedures.

PREPARATIONS FOR INSPECTION

VEHICLE PREPARATIONS

1. Turn ignition switch to "OFF" position.

CAUTION:
Before disconnecting and connecting electrical connectors, ensure that ignition switch is in the "OFF" position.

2. Disconnect battery ground cable.
3. Disconnect lead wire from "S" terminal of starter motor.
4. Disconnect cold start valve harness connector.
5. Arrange so that air flow meter flap can be pushed manually from air cleaner side.
6. Disconnect 35-pin EFI harness connector from control unit.

CAUTION:
a. Before disconnecting EFI harness at 35-pin connector, ensure that ignition switch is in the "OFF" position.
b. Be extremely careful not to break or bend 35-pin when disconnecting terminal.

INSPECTION

To inspect the electrical system, use a circuit tester. Continuity test can be performed easily by measuring resistance and voltage between terminals of 35-pin EFI harness connector installed on car.

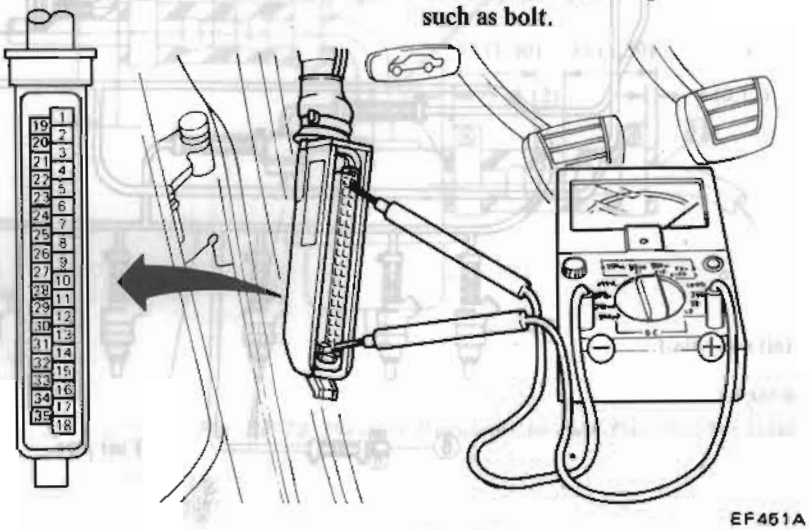
CAUTION:
Do not touch the circuit tester probe to any unnecessary pin on the 35-pin connector. Doing so could cause damage to the circuit tester.

For items to be checked, refer to Inspection Procedure Table.

RESISTANCE MEASUREMENT

1. Set circuit tester in the Ohm "R" range.
2. Check continuity between terminals Ⓐ and Ⓑ shown in the Inspection Procedure table.

Note: Body earth should be made by connecting with unpainted metal such as bolt.



EF451A

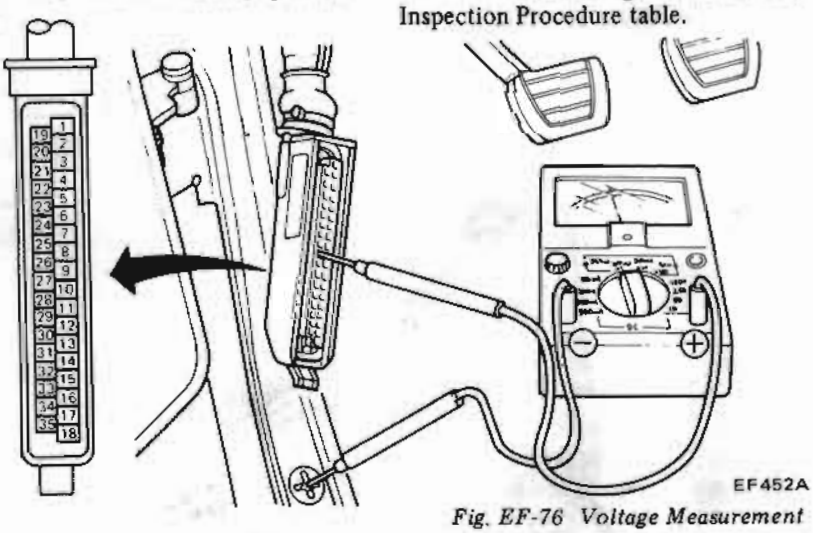
Fig. EF-75 Resistance Measurement

VOLTAGE MEASUREMENT

1. Set circuit tester in the DC Volt (DC "V") range.
2. Disconnect thermotime switch harness connector.
3. Connect cold start valve harness connector.
4. Securely connect battery ground cable.
5. Connect negative probe of circuit tester to body metal.

Note: Body earth should be made by connecting with unpainted metal such as bolt.

6. Contact positive probe of circuit tester to terminal Ⓐ shown in the Inspection Procedure table.



EF452A

Fig. EF-76 Voltage Measurement

7. Inspection with ignition switch in "START" position.
(1) Set ignition switch on "START" and measure voltage in each step of Inspection Procedure Table from 15 to 17.
(2) Turn ignition switch "OFF".
(3) Connect lead wire to "S" terminal of starter motor.
(4) Set ignition switch on "START" and measure voltage in step 18.
8. Inspection with ignition switch in "ON" position.
(1) Turn ignition switch "ON" and measure voltage in each step of Inspection Procedure Table from 19 to 26.
(2) Turn ignition switch "OFF".
(3) Disconnect oil pressure switch harness connector.
(4) Turn ignition switch "ON" and measure voltage in step 27.
(5) Turn ignition switch "OFF".
(6) Connect oil pressure switch harness connector.
(7) Disconnect alternator 2-pin connector ("L" and "S" terminals).
(8) Turn ignition switch "ON" and measure voltage in step 28.
9. Turn ignition switch "OFF".
10. Conncet EFI harness connector to control unit.
11. Connect thermotime switch harness connector.
12. Connect 2-pin alternator connector.

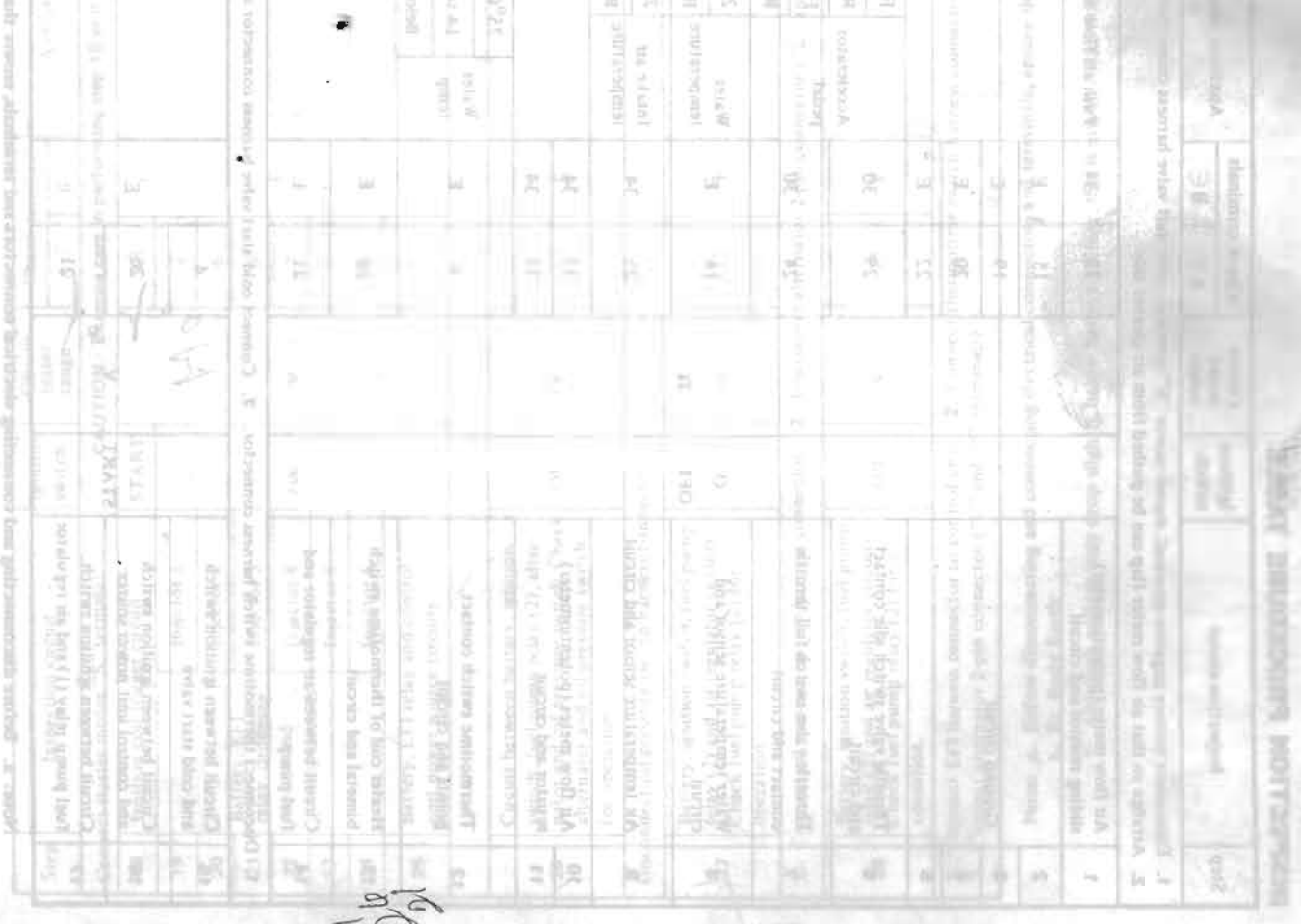
INSPECTION PROCEDURE TABLE

HOW TO USE

1. After measuring, compare measured values with standard values to determine whether circuits/parts are malfunctioning or not.
2. When a malfunctioning circuit is located, again check measurements involved in that circuit. In this case, check ignition switch, circuit tester range, probe, etc. to be certain they are set at proper positions.

CAUTION:
a. Before connecting EFI harness at 35-pin connector, ensure that ignition switch is in the "OFF" position.
b. When inserting 35-pin connector into control unit, insert slowly, securely and straight, being careful not to bend or break 35-pin terminals.

Note: Fig. No. in "Refer to" column means the circuit diagram for each step.



INSPECTION PROCEDURE TABLE

Step	Inspection circuit	Ignition switch	Circuit tester range	Check terminals A ⊕	Check terminals B ⊖	Auxiliary operation or condition		Standard value	Measured value	Judgment	Remarks
1. Disconnect battery negative terminal, starter motor "S" terminal, cold start valve harness connector, 35-pin EFI harness connector from control unit. 2. Arrange so that air flow meter flap can be pushed from air cleaner side.											
1	Air flow meter (potentiometer) sliding resistor and circuit	OFF	Ω	32	34	Push air flow meter flap.		Except 0 and ∞ Ω			
2	Ground circuit			15	E			0Ω			
3				19	E						
4				20	E						
5				22	E						
6	Throttle valve switch idle contact and circuit			29	30	Accelerator pedal	Fully depressed	∞ Ω			
							Released	0 Ω			
7	Throttle valve switch full throttle contact and circuit			24	30		Fully depressed	0 Ω			
							Released	∞ Ω			
8	Water temperature sensor and circuit			14	E	Water temperature	20°C (68°F) or above	Below 2.5kΩ			
							Below 20°C (68°F)	2.5kΩ or above			
9	Air temperature sensor and circuit			25	34	Intake air temperature	20°C (68°F) or above	Below 2.5kΩ			
							Below 20°C (68°F)	2.5kΩ or above			
10	Air flow meter (potentiometer) resistor and circuit			33	34			100 to 400 Ω			
11				35	34			200 to 500 Ω			
12	Thermotime switch contact points and circuit			4	E	Water temp.	25°C (77°F) or above	∞ Ω			
							14 to 25°C (57 to 77°F)	0 or ∞ Ω			
							Below 14°C (57°F)	0 Ω			
13	Heater coil of thermotime switch bimetal and circuit			26	E			40 to 70 Ω			
14	Circuit between air regulator and fuel pump			21	E			25 to 90 Ω			
1. Disconnect thermotime switch harness connector. 2. Connect cold start valve harness connector and battery negative terminal.											
15	Circuit between ignition switch and cold start valve	START	V	4	E			Battery voltage*			
16	Circuit between ignition switch and control unit power source			26							
17	Circuit between ignition switch, fuel pump relay (1) and air regulator			21							

Note: a. Before disconnecting and connecting electrical connectors and terminals, ensure that ignition switch is in "OFF" position.
b. E: Body Earth
*: Although voltage may drop slightly below battery voltage, this is not an indication of abnormality.

Step	Inspection circuit		Ignition switch	Circuit tester range	Check terminal A ⊕	Check terminal B ⊖	Auxiliary operation	Standard value	Measured value	Judgment	Remarks
Connect starter motor "S" terminal.			CAUTION: Exercise care in performing step 18 as it involves turning engine.								
18	Ignition coil trigger circuit		START		18	E		Pointer deflects.			
19	Battery, EFI relay, dropping resistor and injector circuits	Injector 1	ON	V	2	E		Battery voltage			
20		Injector 2			6						
21		Injector 3			5						
22		Injector 4			7						
23		Injector 5			3						
24		Injector 6			8						
25	Battery, EFI relay and control unit power source circuits				27						
26	Circuit between battery, ignition switch, fuel pump relay (2), alternator and oil pressure switch. Check alternator and oil pressure switch for operation.		ON	V	21	E		0V			
Disconnect oil pressure switch harness connector.											
27	Battery, ignition switch, fuel pump relay (2) and air regulator circuits. Check fuel pump relay (2) for operation.		ON	V	21	E		Battery voltage*			
1. Connect oil pressure switch harness connector. 2. Disconnect alternator 2-pin connector ("L" and "S" terminals).											
28	Battery, ignition switch, fuel pump relay (2) and air regulator circuits. Check fuel pump relay (2) for operation.		ON	V	21	E		Battery voltage*			
1. Connect EFI harness connector to control unit. 2. Connect thermotime switch harness connector. 3. Connect alternator 2-pin connector ("L" and "S" terminals).											

Note: a. Before disconnecting and connecting electrical connectors and terminals, ensure that ignition switch is in "OFF" position.
b. E: Body Earth

*: Although voltage may drop slightly below battery voltage, this is not an indication of abnormality.

COMPONENT PARTS INSPECTION

FUEL PRESSURE CHECK

1. Follow the procedure below to reduce fuel pressure to zero.

CAUTION:
Before disconnecting fuel hose, release fuel pressure from fuel line to eliminate danger.

(1) Disconnect ground cable from battery.
(2) Disconnect cold start valve harness connector.
(3) Using two jumper wires shown in illustration, connect each terminal to cold start valve connector.
(4) Release pressure in fuel system by connecting other terminals of jumper wires to battery positive and negative terminals for a few seconds.

CAUTION:
Be careful to keep both terminals separate in order to avoid short circuit.

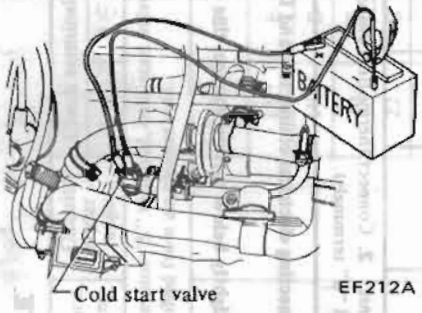


Fig. EF-77 Releasing Pressure in Fuel System

2. Connect a fuel pressure gauge between fuel pipe and fuel hose of fuel filter.

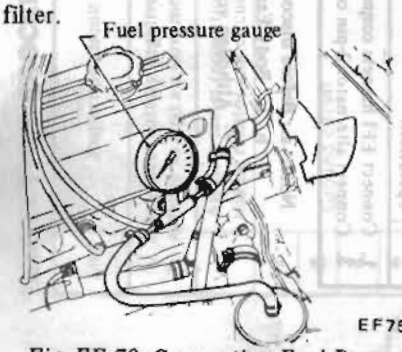


Fig. EF-78 Connecting Fuel Pressure Gauge

3. Start engine and read fuel pressure gauge.

- **At idling:**
  Approximately
  2.1 kg/cm^2 (30 psi)
- **The moment accelerator pedal is fully depressed:**
  Approximately
  2.6 kg/cm^2 (37 psi)

4. If fuel pressure is not as specified, replace pressure regulator, and repeat fuel pressure check.

If below the specified value, check for clogged or deformed fuel lines, and if necessary, replace fuel pump as an assembly or check valve.

FUEL PUMP

FUNCTIONAL TEST

After disconnecting alternator "L" terminal or oil pressure switch connector, set ignition switch at "ON" position. Then make sure that fuel pump operating sound is heard. If not, check all fuel pump circuits. If all circuits are checked out OK, replace fuel pump.

FUEL DAMPER

If noise from fuel pump is abnormally loud, replace fuel damper and recheck for noise.

FUEL FILTER

The filter must be replaced in accordance with the periodic maintenance schedule as an assembly.

If the filter is clogged or cracked, replace it.

INJECTOR

CONTINUITY CHECK

1. Disconnect ground cable from battery.
2. Disconnect electric connectors from injectors.
3. Check continuity between the two terminals. Continuity should exist. If not, injector(s) are faulty.

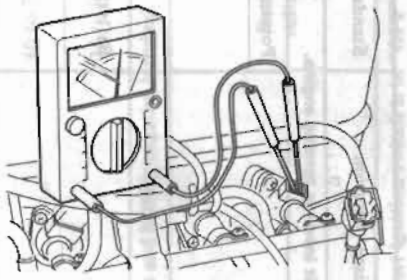


Fig. EF-79 Injector Continuity Check

OPERATING SOUND CHECK

Engine can run

1. Start the engine and run it at idle. Attach the tip of a screwdriver to each injector to ensure that it sounds while operating.

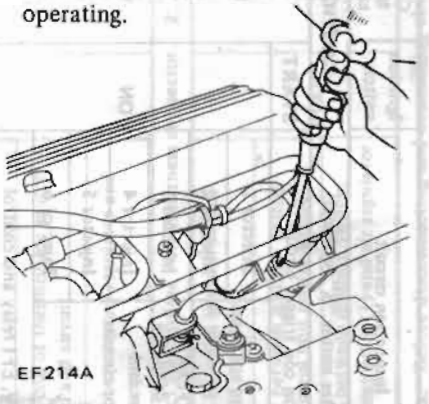


Fig. EF-80 Injector Operating Sound

2. All injectors are functioning properly if "click" sound is heard at regular intervals. Note, however, that as engine speed increases, "click" intervals shorten.

Engine cannot run

1. If the engine fails to run, disconnect electric connector of cold start valve.
2. Crank the engine and check that injectors produce operating sounds to indicate operation.
3. If a different sound is produced from any particular injector, that injector is faulty.
4. If no sound is heard from all injectors, check harnesses referring to Electrical System Inspection.
5. If harnesses are normal, check operation of control unit.
6. If sounds are heard from either No. 1, 2 and 3 injectors or No. 4, 5 and 6, replace control unit.

Note: Two power transistors are used – one for No. 1, No. 2 and No. 3 cylinders; and one for No. 4, No. 5 and No. 6 cylinders.

7. When replacing injector, refer to Removal and Installation.

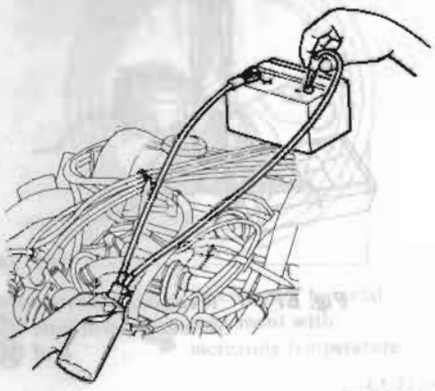
PRESSURE REGULATOR

Refer to Fuel Pressure Check for inspection.

COLD START VALVE

1. Disconnect ground cable from battery.
2. Remove two screws securing cold start valve to intake manifold, and extract cold start valve.
3. Put cold start valve into a transparent glass container, plug the transparent glass container opening with a clean rag.
4. Disconnect connector of oil pressure switch or alternator "L" terminal.
5. Connect ground cable to battery.
6. Turn ignition switch to "ON" position. Make sure cold start valve should not inject or leak fuel while fuel pump operates.
7. Using two jumper wires, connect each terminal to cold start valve connector.

CAUTION:
Be careful to keep both terminals separate in order to avoid short circuit.



EF324A

Fig. EF-81 Fuel Injection from Cold Start Valve

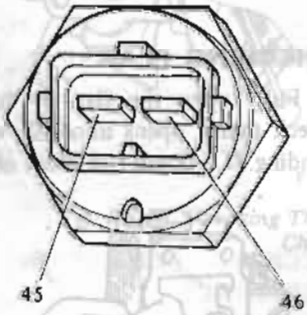
8. Connect other terminals of jumper wire to battery positive and negative terminals.

- Fuel is injected ..... OK
- Fuel is not injected ..... N.G.

THERMOTIME SWITCH

STATIC CHECK

1. Disconnect ground cable from battery.
2. Disconnect electric connector of thermotime switch.
3. Measure the resistance between terminal 46 and switch body.



EF335

Fig. EF-82 Thermotime Switch Terminal Number

- The resistance is zero when the cooling water temperature is less than 14°C (57°F) ..... OK
- The resistance is infinite when the cooling water temperature is more than 25°C (77°F). ..... OK

Note: The resistance is zero or infinite when the cooling water temperature is between 14 to 25°C (57 to 77°F).

4. Measure the resistance between terminal 45 and switch body.
   The ohmmeter reading is
   40 to 70 ohms ..... OK

DYNAMIC CHECK

1. Disconnect ground cable from battery.
2. Disconnect electric connector of thermotime switch.
3. Remove thermotime switch from thermostat housing.
4. Dip heat-sensing portion of thermotime switch into cooling water maintained at 10°C (50°F).
5. When the thermotime switch temperature is just about the same as the cooling water temperature, measure the resistance between terminals 45 and 46 .

- The resistance should be about 40 to 70 ohms.

6. Increase cooling water temperature until it is more than 30°C (86°F), then check continuity between terminal 45 and 46 .

- The ohmmeter reading changes to infinite at a temperature within the range of 14 to 25°C (57 to 77°F) ..... OK

EF325A

Fig. EF-83 Checking Thermotime Switch

AIR FLOW METER

CHECKING POTENTIOMETER

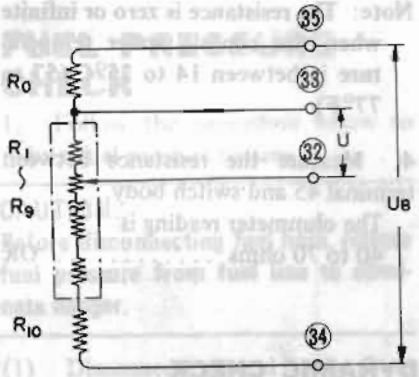


Fig. EF-84 Air Flow Meter Potentiometer

1. Measure the resistance between terminals ㉝ and ㉞. The standard resistance is 100 to 400 ohms.

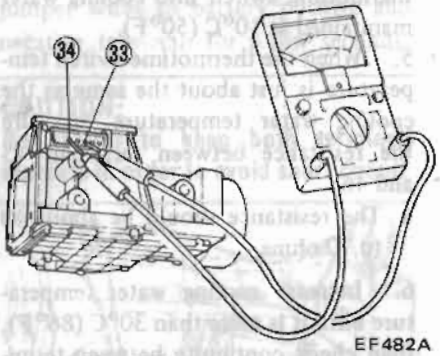


Fig. EF-85 Measuring Resistance between Terminals ㉝ and ㉞

2. Measure the resistance between terminals ㉞ and ㉟. The standard resistance is 200 to 500 ohms.

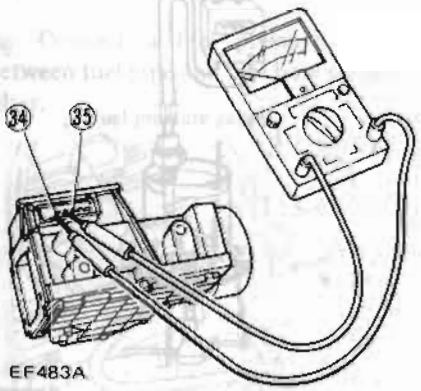


Fig. EF-86 Measuring Resistance between Terminals ㉞ and ㉟

3. While sliding flap, measure resistance between terminals ㉜ and ㉞. If resistance is at any value other than 0 and ∞ ohm, air flow meter is normal.

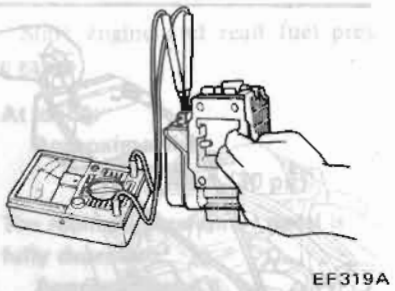


Fig. EF-87 Measuring Resistance between Terminals ㉜ and ㉞

CHECKING INSULATION RESISTANCE

Check insulation resistance between the air flow meter body and any one of the terminals ㉜, ㉝, ㉞ and ㉟. If continuity exists, the air flow meter is out of order.

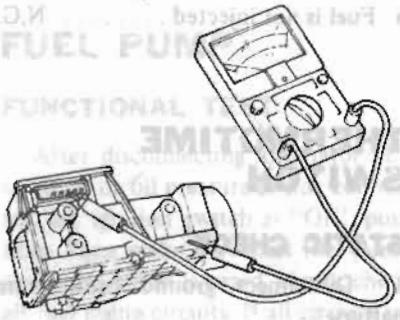


Fig. EF-88 Checking Insulation Resistance

CHECKING FLAP

Fully open the flap by hand to check that it opens smoothly without binding. If it doesn't, it is out of order.

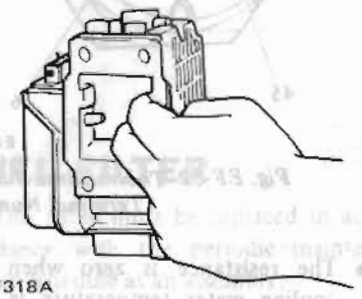


Fig. EF-89 Checking Flap

AIR TEMPERATURE SENSOR

Note: The following checks can also be performed with the air flow meter installed on the car.

CHECKING CONTINUITY

1. Disconnect battery ground cable.
2. Measure the outside air temperature.
3. Measure resistance between terminals ㉕ and ㉞ of the air flow meter connector.

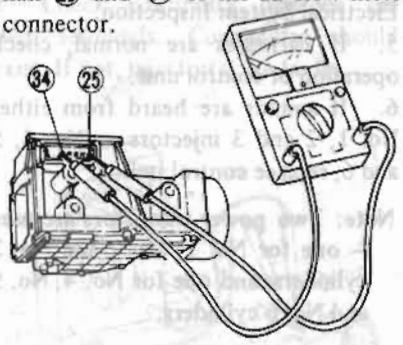


Fig. EF-90 Measuring Resistance of Air Temperature Sensor

The relationship between the outside air temperature and resistance is shown in the following graph (Fig. EF-91).

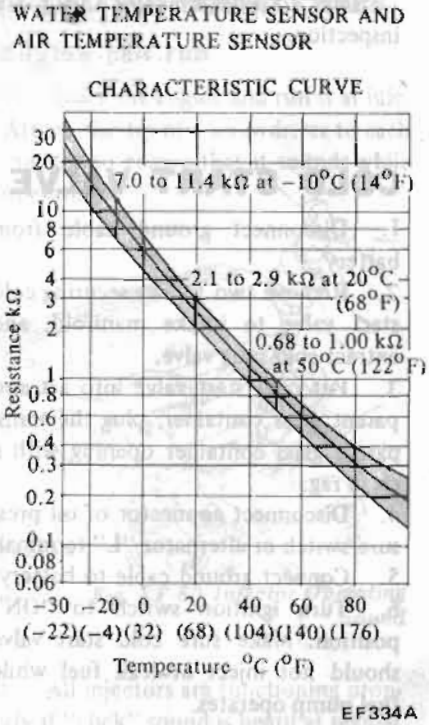
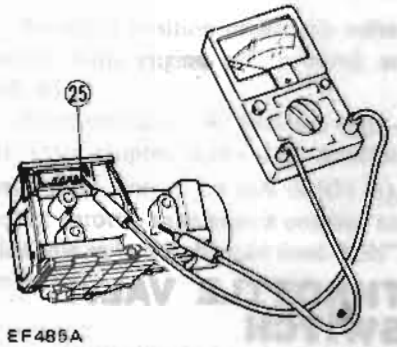


Fig. EF-91 Water Temperature Sensor and Air Temperature Sensor Characteristics Curve

If test results are far from the range indicated in the graph, the air temperature sensor is out of order. The air temperature sensor and air flow meter should be replaced as an assembly.

CHECKING INSULATION RESISTANCE

Check insulation resistance between terminal ㉕ and air flow meter body. If continuity exists, the air temperature sensor is out of order. The air temperature sensor and air flow meter should be replaced as an assembly.



EF485A

Fig. EF-92 Checking Insulation Resistance

AIR REGULATOR

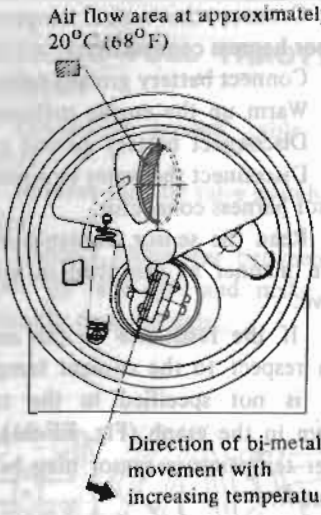
1. Starting engine, and pinch rubber hose between throttle chamber and air regulator.

- Engine speed decreases during warm-up ..... OK
- Engine speed remains unchanged after warm-up. ..... OK

Note: Shutter is opened during engine warm-up, thereby increasing quantity of intake air causing engine speed to increase. Engine speed decreases when passage is narrowed by pinching hose during warm-up. After warm-up, shutter closes. Therefore, engine speed remains unchanged when passage is narrowed by pinching hose after warmp-up.

2. Disconnect hoses from both ends of air regulator, and visually check to see if air regulator shutter opens.

The shutter opening at a temperature of 20°C (68°F) is as shown in Fig. EF-93.

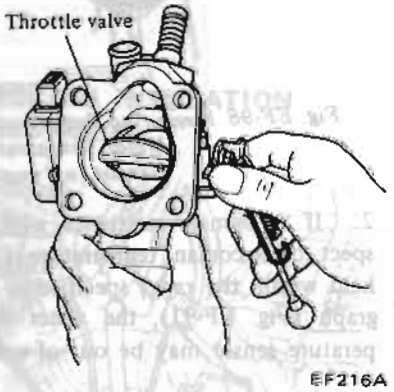


EF328A

Fig. EF-93 Air Regulator

3. Disconnect electric connector of air regulator, and check continuity. Continuity should exist. If not, air regulator is faulty.
4. Pry air regulator shutter to open with a flat-blade screwdriver, then close. If shutter opens and closes smoothly, it is operating properly. If not, replace.

THROTTLE CHAMBER



EF216A

Fig. EF-94 Checking Throttle Chamber

1. Make sure that throttle valve moves smoothly when throttle lever is manipulated.
2. Make sure that by-pass port is free from obstacles and is clean.
3. Make sure that idle speed adjusting screw moves smoothly.

Note:

a. After throttle chamber has beeen installed, warm up engine sufficiently and adjust engine speed to specified idle rpm with idle speed adjusting screw. Specified idle rpm should be reached if idle speed adjusting screw is turned back about 4 to 6 rotations from the "fully closed" (throttle valve) position. If more than 6 rotations are required to obtain specified rpm, throttle valve is closed excessively at idle; if less than 4 rotations are required, throttle valve is opened excessively or working parts are faulty.

b. Do not adjust throttle valve stopper screw as it is factory-adjusted.

EF270A

Fig. EF-95 Throttle Valve Stopper Screw

DASH POT

Set engine speed to 2,000 rpm under no load. An engine speed of 2,000 rpm under no load corresponds to the clearance of 1.9 mm (0.075 in) between idle setscrew (preset at the factory) and throttle lever.

Check that the dash pot rod end closely touches throttle lever when dash pot rod is fully extended (or when no back pressure is present at diaphragm). If necessary, loosen nut (shown by an arrow) and turn dash pot assembly until correct adjustment is made.

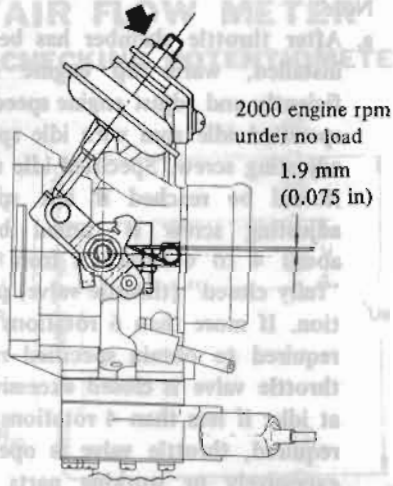


Fig. EF-96 Dash Pot Adjustment

WATER TEMPERATURE SENSOR

CHECKING WATER TEMPERATURE SENSOR ON ENGINE

Check the resistance of the water temperature sensor before and after engine warm-up.

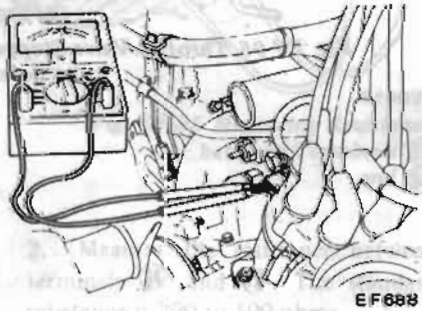


Fig. EF-97 Measuring Resistance of Water Temperature Sensor (on engine)

1. Disconnect battery ground cable.
2. Disconnect the water temperature sensor harness connector.
3. Place a thermometer in the radiator coolant when the engine is cold, and read the coolant temperature (which is used as a reference sensor temperature) and sensor resistance.

Note: When measuring cooling temperature, insert a rod type thermometer into the radiator.

4. Connect the water temperature sensor hanress connector.
5. Connect battery ground cable.
6. Warm up the engine sufficiently.
7. Disconnect battery ground cable.
8. Disconnect the water temperature sensor harness connector.
9. Read the sensor resistance in the same manner as described in step 3 above.
10. If the resistance of the sensor with respect to the coolant temperature is not specified in the range shown in the graph (Fig. EF-91), the water temperature sensor may be out of order.

CHECKING WATER TEMPERATURE SENSOR OFF THE ENGINE

1. Dip the sensor into water maintained at a temperature of 20°C (68° F), 80°C (176°F), etc., and read its resistance.

Fig. EF-98 Measuring Resistance of Water Temperature Sensor (off engine)

2. If the sensor resistance with respect to the coolant temperature is not held within the range specified in the graph (Fig. EF-91), the water temperature sensor may be out of order.

CHECKING INSULATION RESISTANCE

This test is done on the engine.

1. Disconnect battery ground cable.
2. Disconnect the sensor harness connector.
3. Check continuity between the engine block and each of the terminals at sensor.

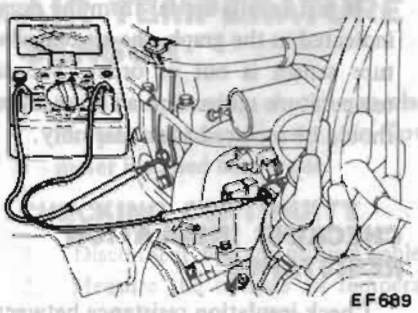


Fig. EF-99 Checking Insulation Resistance

If continuity exists, the sensor is out of order.

THROTTLE VALVE SWITCH

ADJUSTING SWITCH POSITION

1. Disconnect throttle valve switch connector.
2. Connect ohmmeter between terminals ㉙ and ㉚, and make sure continuity exists.

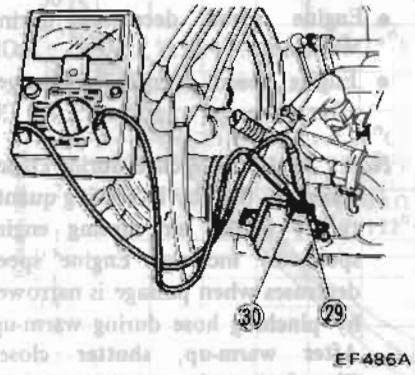


Fig. EF-100 Checking Idle Contact

3. Adjust throttle valve switch position, with retaining screw, so that idle switch may be changed from "ON" to "OFF" when engine speed is about 1,400 rpm under no load.

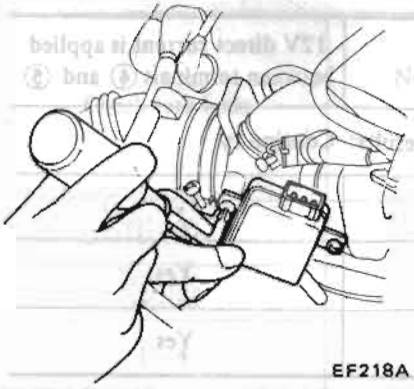


Fig. EF-101 Adjusting Throttle Valve Switch Position

To adjust position of throttle valve switch with engine off, proceed as follows:

When clearance "A" between throttle valve stopper screw and throttle valve shaft lever is 1.3 mm (0.051 in), adjust throttle valve switch position so that idle switch is changed from "ON" to "OFF".

Note: If clearance between throttle valve stopper screw and throttle valve shaft lever is 1.3 mm (0.051 in), engine speed will become about 1,400 rpm.

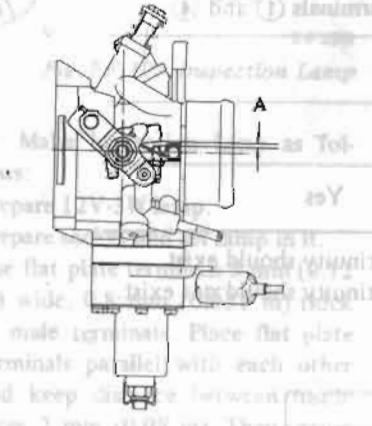


Fig. EF-102 Adjusting Throttle Valve Switch Position

Note: Changing idle switch from "ON" to "OFF" corresponds to change from 0 to ∞ (infinite) ohms in resistance between terminals ㉙ and ㉚.

CHECKING FULL THROTTLE CONTACT

1. Disconnect ground cable from battery.
2. Remove throttle valve switch connector.
3. Connect ohmmeter between terminals ㉔ and ㉚, and make sure continuity does not exist.

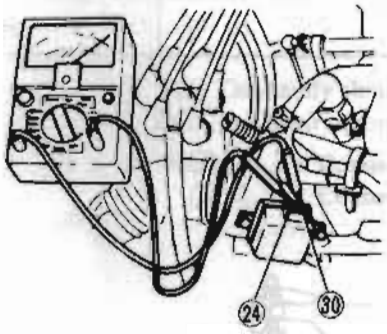


Fig. EF-103 Checking Full Throttle Contact

4. Depress accelerator pedal to floor. If continuity exists between terminals ㉔ and ㉚, full throttle contact is functioning properly.

CHECKING INSULATION RESISTANCE

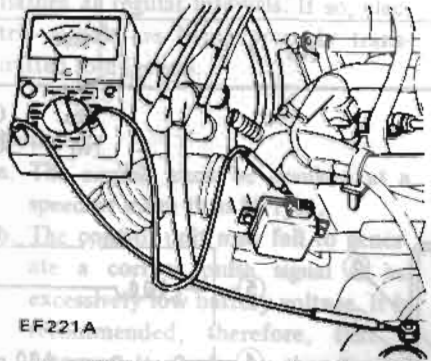


Fig. EF-104 Checking Throttle Valve Switch Insulation

Connect ohmmeter between vehicle body metal and terminals ㉙, ㉔ and ㉚. Ohmmeter reading should be infinite.

DROPPING RESISTOR

1. Disconnect ground cable from battery.
2. Disconnect connectors of dropping resistors.
3. Conduct resistance checks on dropping resistor (6-pin connector side) between the following points.

- 43/1 and 41 (No. 4 cylinder)
- 43/1 and 40 (No. 3 cylinder)
- 43/1 and 38 (No. 2 cylinder)
- 43/1 and 37 (No. 1 cylinder)

The resistance should be approximately 6 ohms ..... OK

4. Conduct resistance checks on dropping resistor (4-pin connector side) between the following points.

- 43/2 and 56 (No. 6 cylinder)
- 43/2 and 55 (No. 5 cylinder)

The resistance should be approximately 6 ohms ..... OK

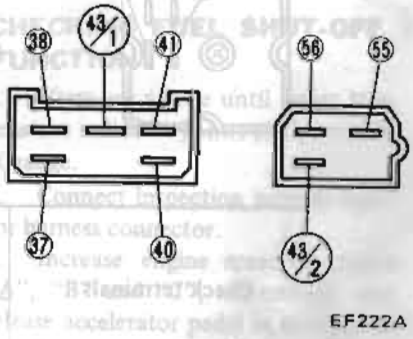


Fig. EF-105 Dropping Resistor Connector

RELAY

CAUTION:
Before applying test voltage to relay, connect a fuse in series with lead wire to prevent damage to the circuit.

1. Disconnect battery ground cable.
2. Remove relay from car.
3. Test continuity through relay with an ohmmeter in accordance with the following chart.

EFI RELAY

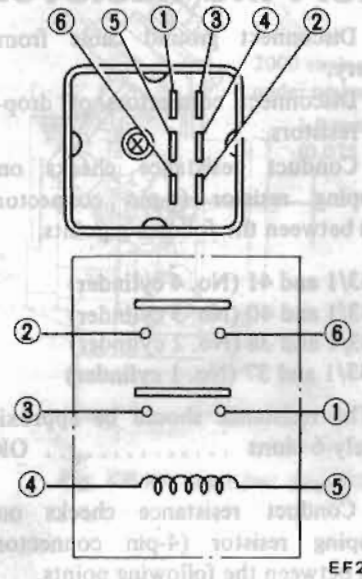


Fig. EF-106 EFI Relay

Check terminals	Normal condition	12V direct current is applied between terminals ④ and ⑤
	Test results: Continuity	
④-⑤	Yes	–
①-③	No	Yes
②-⑥	No	Yes

Yes : Continuity should exist.
No : Continuity should not exist.

FUEL PUMP RELAY (1)

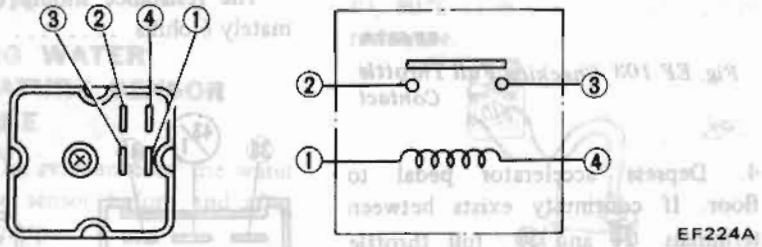


Fig. EF-107 Fuel Pump Relay (1)

Check terminals	Normal condition	12V direct current is applied between terminals ① and ④
	Test results: Continuity	
①-④	Yes	–
②-③	No	Yes

Yes : Continuity should exist.
No : Continuity should not exist.

FUEL PUMP RELAY (2)

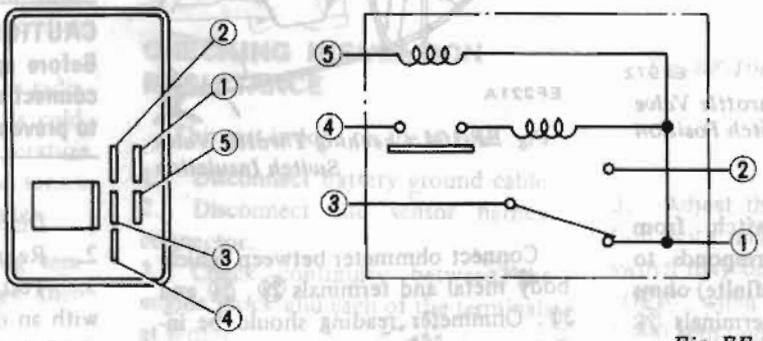


Fig. EF-108 Fuel Pump Relay (2)

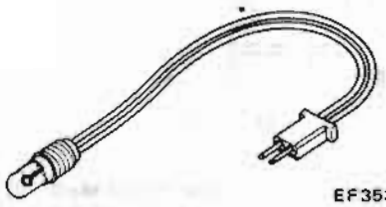
Check terminals	Normal condition	12V direct current is applied between terminals ① and ⑤ *	
		Not grounded ④	Grounded ④
	Test results: Continuity		
①-③	Yes	Yes	No
②-③	No	No	Yes
①-④	No	Yes	–
①-⑤	Yes	–	–

Yes: Continuity should exist.
No: Continuity should not exist.
*: ① ..... Connect positive (+) terminal
⑤ ..... Connect negative (–) terminal

CONTROL UNIT

CHECKING ELECTRIC SIGNAL TO INJECTORS

1. Inspection lamp, as shown in figure below, is required for this test.

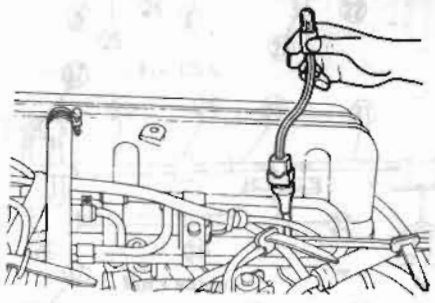


EF353

Fig. EF-109 Inspection Lamp

Note: Make inspection lamp as follows:
1) Prepare 12V-3W lamp.
2) Prepare socket and set lamp in it.
3) Use flat plate terminals 3 mm (0.12 in) wide, 0.8 mm (0.031 in) thick as male terminals. Place flat plate terminals parallel with each other and keep distance between inside faces 2 mm (0.08 in). Then secure terminals by wrapping insulation tape or with suitable terminal body.

2. Disconnect injector harness connector.
3. Disconnect cold start valve harness connector.
4. Connect inspection lamp to injector harness connector.



EF128A

Fig. EF-110 Checking Electric Signal

5. Starting engine or cranking engine, check inspection lamp to see if it flashes at regular intervals. If so, electric signals are being properly transmitted to injectors.

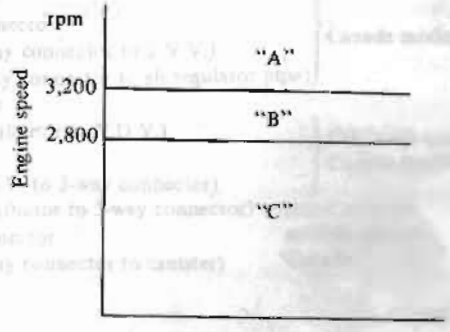
Note:
a. The engine must be cranked at a speed of more than 80 rpm.
b. The control unit may fail to generate a correct pulse signal at an excessively low battery voltage. It is recommended, therefore, that a battery voltage of more than 9 volts be applied during the cranking operation.

If flashing differs between front and rear cylinders, one of the two power transistors in control unit is malfunctioning.

Note: Two power transistors are used – one for No. 1, No. 2 and No. 3 cylinders; and one for No. 4, No. 5 and No. 6 cylinders.

CHECKING FUEL SHUT-OFF FUNCTION

1. Warm up engine until water temperature indicator points to the middle of gauge.
2. Connect inspection lamp to injector harness connector.
3. Increase engine speed to zones "A", "B" and "C", respectively, and release accelerator pedal in each zone. Check inspection lamp illumination.



EF372A

Fig. EF-111 Fuel Shut-off Characteristics

Check inspection lamp with engine speed in each zone, as shown in chart below.

Note: While inspection lamp is off, fuel shut-off is operational.

	"A"	"B"	"C"
Deceleration from zone "A"	OFF	OFF	ON
Deceleration from zone "B"	–	ON	ON
Deceleration from zone "C"	–	–	ON
Engine rpm increases in order of "C", "B" and "A". (Idle switch ON, downhill driving, etc.)	OFF	ON	ON

ON: Lamp on
OFF: Lamp off

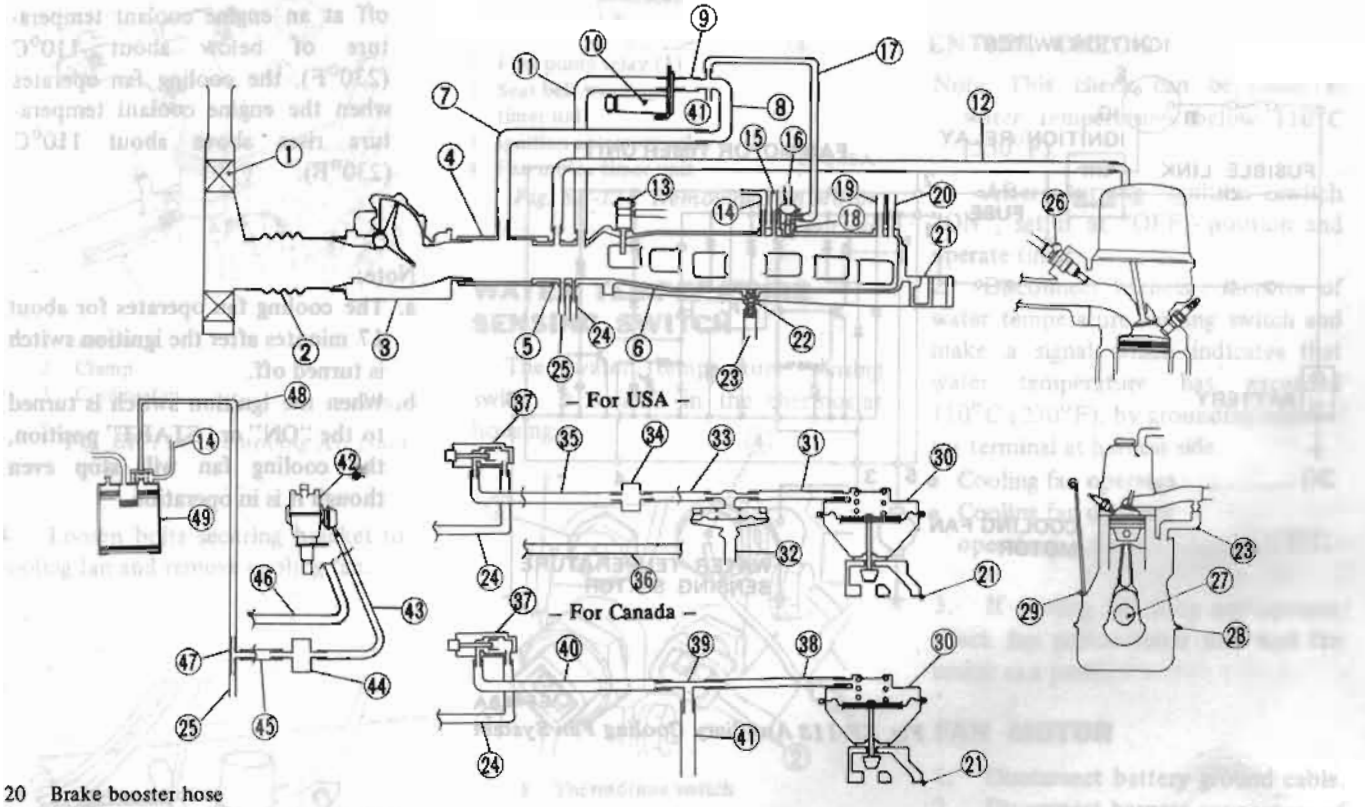
CHECKING AIR LEAKAGE IN AIR INTAKE SYSTEM

Make sure even a slight air leak does not occur.

When inspecting the electronic fuel injection system, pay particular attention to hose connections, dipstick, oil filler cap, etc. for any indication of air leaks.

Note: Since the air flow meter used in the electronic fuel injection system directly measures the quantity of intake air to permit the supply of the optimum fuel quantity for each cylinder.

1 Air cleaner filter
2 Air duct (Air cleaner to A.F.M.)
3 Air flow meter
4 Air duct (A.F.M. to throttle chamber)
5 Throttle chamber
6 Intake manifold
7 Hose (Air duct to air regulator pipe)
8 Air regulator pipe
9 Hose (Air regulator pipe to air regulator)
10 Air regulator
11 Hose (Air regulator to throttle chamber)
12 Hose (Throttle chamber to rocker cover)
13 Cold start valve
14 Canister purge line
15 Hose (Intake manifold to pressure regulator)
16 Hose (F.I.C.D. actuator to vacuum tank)
17 Hose (F.I.C.D. actuator to air regulator pipe)
18 F.I.C.D. actuator
19 Vacuum line (For automatic transmission, air conditioner and A.S.C.D.)



20 Brake booster hose
21 E.G.R. control valve mounting surface
22 P.C.V. valve
23 Hose (P.C.V. valve to cylinder block)
24 Hose (Throttle chamber to T.V.V.)
25 Hose (Throttle chamber to 3-way connector)
26 Fuel injector
27 Oil seal (on front and rear of crankshaft)
28 Oil pan gasket
29 Oil level gauge
30 E.G.R. control valve
31 Hose (E.G.R. control valve to B.P.T. valve) } For U.S.A.
32 B.P.T. valve
33 Hose (B.P.T. valve to V.D.V.) } California models
34 V.D.V.
35 Hose (V.D.V. to T.V.V.)
36 Hose (B.P.T. valve to T.V.V.) – Non-California models except Canada
37 Thermal vacuum valve
38 Hose (E.G.R. control valve to 3-way connector) } Canada models
39 3-way connector
40 Hose (3-way connector to T.V.V.)
41 Hose (3-way connector to air regulator pipe)
42 Distributor
43 Hose (Distributor to V.D.V.) } California and Canada models
44 V.D.V.
45 Hose (V.D.V. to 3-way connector)
46 Hose (Distributor to 3-way connector) – Non-California models except Canada
47 3-way connector
48 Hose (3-way connector to canister)
49 Canister

ET495

Fig. EF-112 Checking Air Leakage in Air Intake System

CHECKING FUEL HOSES

Check fuel hoses for leakage, loose connections, cracks or deterioration. Retighten loose connections and replace any damaged or deformed parts. Replace any fuel hose whose inner surface is deformed, scratched or chafed.

For replacement of high pressure fuel hose, refer to Fuel Hose under the heading Removal and Installation.

AUXILIARY COOLING FAN

DESCRIPTION

The auxiliary cooling fan is located in the engine compartment.

The cooling fan operates after ignition switch is turned off, and thereby cooling down the temperature of fuel inside the injector and fuel hoses in the engine compartment.

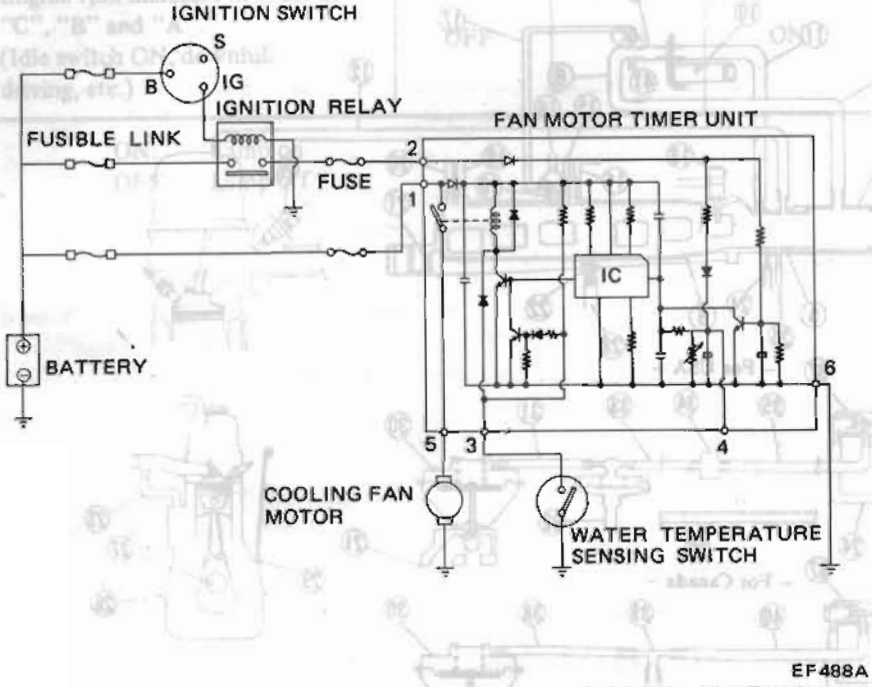


Fig. EF-113 Auxiliary Cooling Fan System

OPERATION

- As soon as the ignition switch is turned off at an engine coolant temperature of above about 110°C (230°F), the cooling fan operates.
- When the ignition switch is turned off at an engine coolant temperature of below about 110°C (230°F), the cooling fan operates when the engine coolant temperature rises above about 110°C (230°F).

Note:

a. The cooling fan operates for about 17 minutes after the ignition switch is turned off.

b. When the ignition switch is turned to the "ON" or "START" position, the cooling fan will stop even though it is in operation.

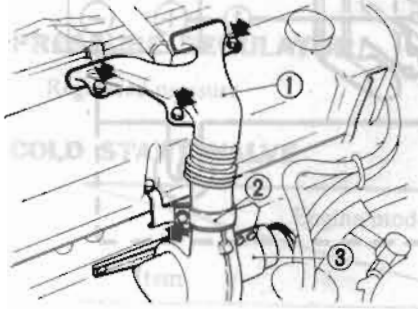
Auxiliary cooling fan operation chart.

Cooling water temperature °C (°F)	Water temperature sensing switch	Ignition switch	Auxiliary cooling fan
above about 110 (230)	ON	"OFF" "ACC"	Operates
below about 110 (230)	OFF		Does not operate
—	—	"ON" "START"	

REMOVAL AND INSTALLATION

COOLING FAN

1. Disconnect battery ground cable.
2. Disconnect harness connector of fan motor.
3. Remove bolts securing air duct and disconnect air duct from cooling fan.

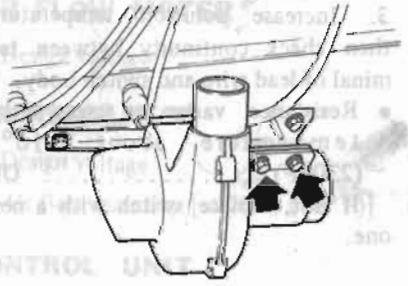


1 Air duct
2 Clamp
3 Cooling fan

EF489A

Fig. EF-114 Removing Air Duct

4. Loosen bolts securing bracket to cooling fan and remove cooling fan.



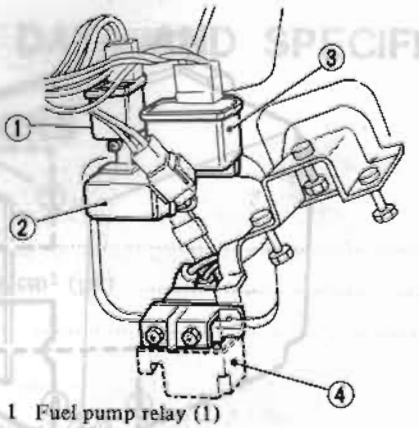
EF534A

Fig. EF-115 Removing Cooling Fan

FAN MOTOR TIMER UNIT

The fan motor timer unit is located inside the R.H. dash side panel.

1. Disconnect battery ground cable.
2. Remove instrument panel R.H. lower cover and junction block.
3. Remove timer unit attaching screws.
4. Disconnect harness connector.
5. To install timer unit, reverse the order of removal.



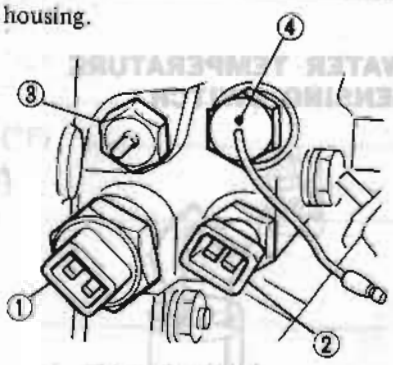
1 Fuel pump relay (1)
2 Seat belt warning timer unit
3 Ignition accessory relay
4 Fan motor timer unit

EF545A

Fig. EF-116 Removing Fan Motor Timer Unit

WATER TEMPERATURE SENSING SWITCH

The water temperature sensing switch is located in the thermostat housing.



1 Thermotime switch
2 Water temperature sensor
3 Thermal transmitter
4 Water temperature sensing switch

EF492A

Fig. EF-117 Water Temperature Sensing Switch

1. Disconnect battery ground cable.
2. Remove radiator filler cap. Drain approximately 1.5 liters (1 5/8 US qt, 1 3/8 Imp qt) of coolant by opening drain plug.

WARNING:
The coolant should not be drained until it has cooled off completely. Otherwise, burns may be incurred.

3. Disconnect upper radiator hose.
4. Disconnect water temperature sensing switch harness connector.
5. Remove water temperature sensing switch by turning it counterclockwise.
6. To install water temperature sensing switch, reverse the order of removal.

INSPECTION

ENTIRE CHECK

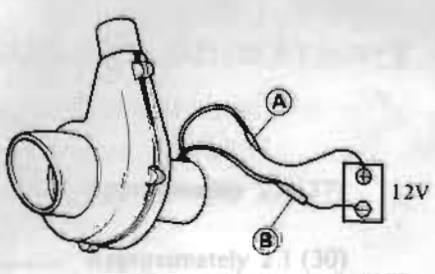
Note: This check can be made at water temperatures below 110°C (230°F).

1. After turning ignition switch "ON", set it at "OFF" position and operate timer.
2. Disconnect harness connector of water temperature sensing switch and make a signal which indicates that water temperature has exceeded 110°C (230°F), by grounding connector terminal at harness side.
   - Cooling fan operates ..... OK
   - Cooling fan does not operate ..... N.G.
3. If cooling fan does not operate, check fan motor timer unit and fan motor as a part.

FAN MOTOR

1. Disconnect battery ground cable.
2. Disconnect harness connectors of fan motor.
3. Make sure continuity exists between connector terminals Ⓐ and Ⓑ.
4. Then securely connect positive terminal of a 12-volt DC power supply to terminal Ⓐ, and ground terminal Ⓑ.

Fan motor should run. If not running, the motor is out of order.



EF493A

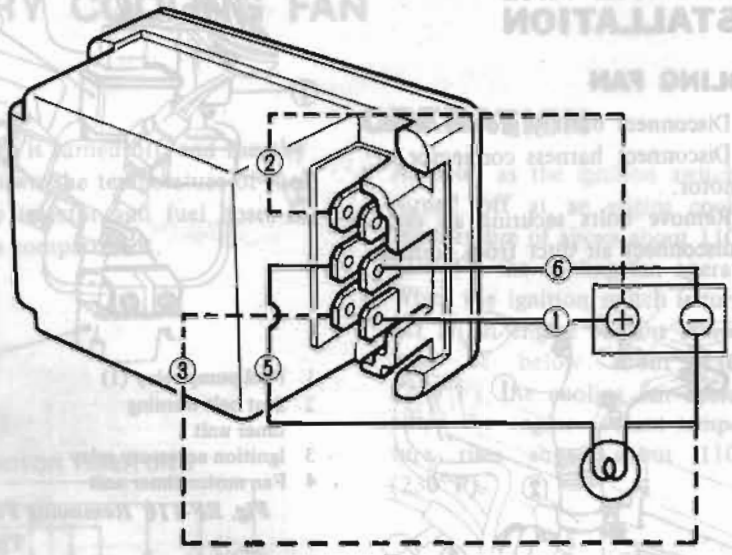
Fig. EF-118 Checking Fan Motor

FAN MOTOR TIMER UNIT

Test timer unit with a power source of 12-volt DC and test lamp following the procedure below.

Note: Prepare 12V-3W lamp.

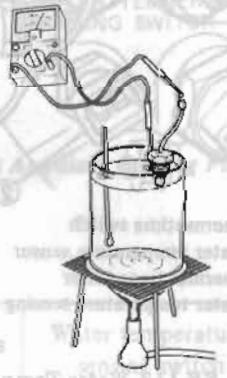
1. Connect terminal ⑥ to negative terminal of power source, terminal ⑤ to test lamp terminal and the other test lamp terminal to negative terminal of the power source.
2. Connect terminal ① to positive terminal of power source.
   - Test lamp does not glow ..... OK
   - Test lamp glows ..... N.G.
3. Connect terminal ② to positive terminal of power source and disconnect it. (Operate timer)
4. Connect terminal ③ to negative terminal of power source.
   - Test lamp glows ..... OK
   - Test lamp does not glow ..... N.G.
5. Make sure that test lamp should remain on for about 17 minutes after step 3 is performed, and then go out.
6. While test lamp is on, connect terminal ② to positive terminal of power source.
   - Test lamp goes out ..... OK
   - Test lamp does not go out ..... N.G.



EF494A

Fig. EF-119 Checking Fan Motor Timer Unit

WATER TEMPERATURE SENSING SWITCH



EF495A

Fig. EF-120 Checking Water Temperature Sensing Switch

1. Dip sensing portion of water temperature sensing switch into proper solution maintained at 80°C (176°F).
2. Measure resistance between terminal of lead wire and switch body.
   - Resistance is infinite ..... OK
3. Increase solution temperature, then check continuity between terminal of lead wire and switch body.
   - Resistance varies to zero at a temperature about 110°C (230°F) ..... OK

   If not, replace switch with a new one.

SERVICE DATA AND SPECIFICATIONS

GENERAL SPECIFICATIONS

FUEL PUMP

Design voltage	V	12
Cut-off discharge pressure	kg/cm² (psi)	3.0 to 4.5 (43 to 64)
Design current	A	5.1

PRESSURE REGULATOR

Regulated pressure	kg/cm² (psi)	2.55 (36.3)

COLD START VALVE

Item \ Engine model		For Canada	For U.S.A.
Injection quantity	cc (cu in)/min	85 (5.19)	135 (8.24)
Design voltage	V	12	

THERMOTIME SWITCH

Design voltage	V	12
Switch-over temperature	°C (°F)	19.5 (67)
Switch-over time [at −20°C (−4°F), 10V]	sec.	9

AIR FLOW METER

Design voltage	V	12

AIR REGULATOR

Design voltage	V	12
Air flow quantity [at 20°C (68°F)]	m³ (cu ft)/hr	27.5 (971)

CONTROL UNIT

Design voltage	V	12
Consumption wattage		
at idling	W	15
at full throttle	W	140

INSPECTION AND ADJUSTMENT

FUEL PRESSURE

(Measuring point: between fuel filter and fuel pipe)

At idling	kg/cm² (psi)	Approximately 2.6 (37)
The moment accelerator pedal is fully depressed	kg/cm² (psi)	Approximately 2.1 (30)

FUEL INJECTOR

Coil resistance	Ω	2.35

THERMOTIME SWITCH

Cooling water temperature		Switch
below 14°C (57°F)		ON
14 to 25°C (57 to 77°F)		ON or OFF
above 25°C (77°F)		OFF
Coil resistance	Ω	40 to 70

AIR FLOW METER

Potentiometer resistance		
between terminals ㉝ and ㉞	Ω	100 to 400
between terminals ㉞ and ㉟	Ω	200 to 500
between terminals ㉜ and ㉞	Ω	Except 0 and ∞

AIR TEMPERATURE SENSOR

Thermistor resistance		
at −10°C (14°F)	kΩ	7.0 to 11.4
at 20°C (68°F)	kΩ	2.1 to 2.9
at 50°C (122°F)	kΩ	0.68 to 1.0

THROTTLE VALVE SWITCH

Engine speed when idle switch is changed from "ON" to "OFF"	rpm	Approximately 1,400

DASH POT

Touch speed	rpm	Approximately 2,000

WATER TEMPERATURE SENSOR

Thermistor resistance		
at −10°C (14°F)	kΩ	7.0 to 11.4
at 20°C (68°F)	kΩ	2.1 to 2.9
at 50°C (122°F)	kΩ	0.68 to 1.0

DROPPING RESISTOR

Resistance (per resistor)	Ω	Approximately 6

WATER TEMPERATURE SENSING SWITCH (For Auxiliary Cooling Fan)

Cooling water temperature	Switch
Below about 110°C (230°F)	OFF
Above about 110°C (230°F)	ON

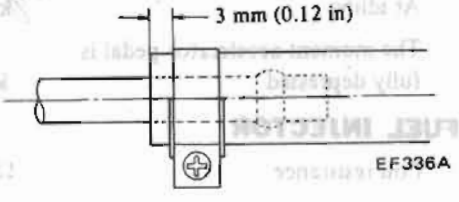
FAN MOTOR TIMER UNIT (For Auxiliary Cooling Fan)

Operating period minutes	about 17

TIGHTENING TORQUE

Throttle chamber securing screw	kg-m (ft-lb)	1.5 to 2.0 (11 to 14)
Fuel hose clamp	kg-m (ft-lb)	0.10 to 0.15 (0.7 to 1.1)

Note: Fuel hose clamping position



TROUBLE DIAGNOSES AND CORRECTIONS

The EFI system can be checked in accordance with the trouble shooting chart.

If any abnormality is found in any inspection item, refer to the "Inspection" section and carry out further inspection following the procedures described therein.

Note that any component part, excepting some, of the EFI system must be replaced as an assembly if it is found to be faulty, since no repairing is allowed.

Checks before Inspection

Before attempting any test, check the following items to ensure that nothing has been overlooked.

1. The greatest problem source with a system of this type lies in the connections between components. Save time by performing a quick check if all harness connectors (especially the 35-pin connector and air flow meter connector) are securely in place. Connector terminals are free from corrosion and deformation.

   Pull all connectors off and reconnect after inspecting terminals.

2. Since the EFI system accurately meters the intake air flow through an air flow meter, even a slight air leak will cause an improper air-fuel ratio, resulting in faulty engine operation due to excessive air.

   For this reason, a thorough inspection for leaks should be made at the oil filler cap, dipstick, blow-by hoses, air flow meter to throttle chamber air duct, etc.

3. Make sure the ignition and starting systems are satisfactory and the battery is in good condition.

Inspection Instructions

Before checking the EFI system, be sure to observe the instructions below. Failure to do so could result in damage to the control unit or cause fuel line leakage.

CAUTION:
When connecting or disconnecting EFI harness connector to or from any EFI unit, ensure that the ignition switch is in the "OFF" position and that the negative battery terminal is disconnected. Removing and installing these connectors with the ignition switch left in the "ON" position will damage control unit.

Replace fuel hoses if they are deformed, scratched or chafed. Do not reuse fuel hose clamps after removal.

Condition	Probable cause	Check and corrective action
Engine will not start.	Improper ignition system.	Disconnect high tension cable from one spark plug and check for hot spark.
	Intake air leakage at following points: • PCV valve, dipstick seal, oil filler cap, blow-by hoses • Air flow meter hoses and clamps • Manifold gaskets, etc.	Check for intake air leaks and repair or replace if necessary.
	Fuel pump does not work.	Disconnect starter motor "S" terminal and ignition switch in "START" position. Listen for fuel pump and pressure regulator operating sound. If no sound is heard, check fuel pump control circuit. Then proceed to the following checks: • Fuel pump • Alternator "L" terminal • Oil pressure switch • Fuel pump relays 1 and 2
	Improper ignition signal input.	Check ignition signal input.

Condition	Probable cause	Check and corrective action
	Malfunctioning EFI relay or control unit or injector.	Connect a lead wire to ignition coil negative terminal. With ignition switch "ON", attach other end of lead wire to engine body for a short period, and repeat it rapidly. Listen to each injector sound with a screwdriver. Results: a) Injectors click every third break, check the following circuits. • Water temperature sensor • Air flow meter potentiometer • Cold start valve and thermotime switch • "Start" signal circuit • Air regulator b) Injectors do not click, check the following circuits. • Control unit power input circuit • Ignition coil trigger input circuit • Control unit ground circuit • Injector circuit
	Problem in the following circuits: • Water temperature sensor • Air flow meter potentiometer • Cold start valve and thermotime switch • "Start" signal circuit	Check each circuit. Then proceed to "Component checks".
Engine hard to start only when cold.	Poorly charged battery. Improper cold start system circuit.	Check charge circuit. Recharge battery if necessary. Check cold start system circuit. If circuit is normal, check cold start valve. **Note: If both these tests are satisfactory, proceed to "Engine will not start".**
Engine hard to start only when hot.	Malfunctioning cold start valve and thermotime switch.	To clean out excess fuel, proceed to the following steps: • Disconnect cold start valve. • Disconnect ignition coil trigger input lead wire and ground it. • Crank engine a few times to clean out excess fuel. • Reconnect ignition coil trigger input lead wire and try to start engine. Results: a) If engine is still hard to start, perform the following checks. • Check water temperature sensor and air flow meter circuit. • Check fuel pressure and injector. If no problem is found, proceed to "Engine will not start".

Condition	Probable cause	Check and corrective action
		b) If engine starts easily, proceed to the following steps. • Reconnect cold start valve. • Disconnect thermotime switch. • Try to start engine. Results: b-1) If engine is hard to start, check cold start valve and replace if necessary. b-2) If engine starts easily, check thermotime switch and replace if necessary.
Engine starts, then stalls.	Improper ignition signal input.	Check ignition signal input.
	Malfunctioning EFI relay or control unit or injector.	Connect a lead wire to ignition coil negative terminal. With ignition switch "ON", attach other end of lead wire to engine body for a short period, and repeat it rapidly. Listen to each injector sound with a screwdriver. Results: a) Injectors click every third break, check fuel pump circuit. b) Injectors do not click, check the following circuits. • "Start" signal circuit • Control unit power input circuit • Ignition coil trigger input circuit • Control unit ground circuit • Injector circuit
	Fuel pump does not work.	With ignition switch in "ON" position, disconnect oil pressure switch harness connector or alternator "L" terminal. Listen for fuel pump and pressure regulator operating sound. If no sound is heard, check fuel pump control circuit. Then proceed to the following checks: • Fuel pump • Alternator "L" terminal • Oil pressure switch • Fuel pump relays 1 and 2.
	Improper water temperature sensor circuit.	Check circuit.
	Malfunctioning air regulator.	Check air regulator and replace if necessary. **Note: If these tests are satisfactory, proceed to "Engine will not start".**
Engine idles too fast – cannot be adjusted with idle speed screw or engine idle is unstable.	Improper intake and exhaust valve clearance.	Adjust valve clearance.
	Malfunctioning throttle valve.	Check that plate is closing when throttle is released and replace if necessary.

Condition	Probable cause	Check and corrective action
	Malfunctioning air regulator.	To check air regulator, proceed to the following steps: • Start engine. • Pinch off hose to air regulator. Results: a) If idle speed drops, perform circuit test. If no fault is found, replace air regulator. b) If idle speed remains high or unstable, perform the following checks. Check for manifold vacuum leaks, including at PCV valve, dipstick and oil filler cap seals. If no problem is found, perform the following circuit tests. • Throttle valve switch (idle contact and full throttle contact) • Air temperature sensor • Water temperature sensor • Control unit ground circuit • Air flow meter potentiometer • Air regulator and fuel pump circuit • Air regulator circuit • Ignition coil trigger input circuit • Control unit power input circuit • Injector circuit Then proceed to "Component checks".
Engine misfires.	Improper ignition circuit.	Check ignition circuit.
	Improper EFI harness connectors.	Pull EFI harness connectors apart and check for looseness and corrosion (including ground circuits). Do not forget ignition input lead.
	Improper fuel line.	Check fuel line for blockage. • Fuel tank fuel filter. • Fuel filter • Injectors • Fuel pipes
	Malfunctioning control unit.	Tap control unit while driving to see if this aggravates or alleviates the problem. If so, try another control unit.
	Improper fuel pressure.	Perform fuel pressure test.
	Improper EFI circuit.	Perform all circuit tests. Then perform "Component checks".
Engine will not revolve — lack of power.	Improper ignition system.	Check IC ignition unit, pick-up coil and ignition coil.
	Malfunctioning throttle valve.	Make sure throttle plate is opening fully when accelerator is fully depressed.
	Malfunctioning air flow meter.	Check air flow meter mechanical movement. Using a finger, push flap open, checking that it opens smoothly and fully.

Condition	Probable cause	Check and corrective action
	Improper fuel line.	Check fuel line for blockage. • Fuel tank fuel filter. • Fuel filter • Fuel pipes
	Improper fuel pressure.	Perform fuel pressure test.
	Problem in the following circuits: • Ignition coil trigger input circuit • Control unit power input circuit • Injector circuit • Air flow meter potentiometer • Throttle valve switch, idle contact and full throttle contact • Air temperature sensor • Water temperature sensor • Air regulator and fuel pump circuit	Check each circuit. Then perform "Component checks".
Hesitation – stumble on acceleration.	Improper ignition system.	Check ignition system.
	Malfunctioning air flow meter.	Check air flow meter mechanical movement. Using a finger, check for smooth flap movement.
	Intake air leakage at following points: • PCV valve • Dipstick and oil filler cap seals • Manifold gaskets • Air flow meter hoses	Check for intake air leaks.
	Improper fuel pressure.	Perform fuel pressure test.
	Improper idle CO% adjustment.	Check idle CO%, if necessary adjust it.
	Improper EFI circuit.	Perform complete circuit test. Then perform "Components checks".
Poor gas mileage, or CO reading too high.	Improper ignition timing or ignition system.	Check ignition timing. Check ignition system for hot spark.
	Improper air cleaner filter.	Check air cleaner filter and replace if necessary.
	Improper fuel pressure.	Perform fuel pressure test.
	Problem in the following circuits: • Water temperature sensor • Air temperature sensor • Throttle valve switch, idle contact and full throttle contact • Air flow meter potentiometer • Air regulator circuit • Air regulator and fuel pump circuit • Injector circuits	Check each circuit. Then proceed to "Component checks".

Condition	Probable cause	Check and corrective action
Surge.	Malfunctioning air flow meter.	Check air flow meter mechanical movement. Using a finger, check flap movement for smooth operation.
	Intake air leakage at the following points: • PCV valve • Dipstick and oil filler cap seals • Manifold gaskets • Air flow meter hoses	Check for intake air leaks.
	Improper fuel pressure.	Perform fuel pressure test.
	Improper idle CO% adjustment.	Check idle CO%; if necessary, adjust it.
	Problem in the following circuits: • Throttle valve switch, idle contact and full throttle contact • Air flow meter potentiometer • Control unit ground circuit • Air temperature sensor • Water temperature sensor • Air regulator and fuel pump circuit • Ignition coil trigger input circuit • Control unit power input circuit • Injector circuit	Check each circuit. Then proceed to "Component checks".
Backfiring.	Intake air leakage at the following points: • PCV valve • Dipstick and oil filler cap seals • Manifold gaskets • Air flow meter hoses	Check for intake air leaks.
	Improper fuel pressure.	Perform fuel pressure test.
	Improper idle CO% adjustment.	Check idle CO%; if necessary, adjust it.
	Problem in the following circuits: • Throttle valve switch, idle contact and full throttle contact • Air flow meter potentiometer • Air temperature sensor • Water temperature sensor • Ignition coil trigger input circuit • Control unit power input circuit • Injector circuit	Check each circuit. Then proceed to the "Component checks".
Afterfire or afterburning.	Problem in the following circuits: • Throttle valve switch, idle contact and full throttle contact. • Air flow meter potentiometer • Air temperature sensor • Water temperature sensor • Injector circuit • "START" signal input	Check each circuit. Then proceed to "Component checks".

COMPONENT CHECKS

(To be performed only after circuit tests are completed)

Problem	Injector sound	Cold start valve	Air regulator	Relay	Control unit replacement	Air flow meter		Fuel system		
						Flap operation	Resistance meas.	Fuel pressure test	Injector leakage	Cold start valve leakage
Engine will not start	X	X	X	X	X	X	X	X	X	X
Idle too high or too rough	X		X					X	X	X
Engine misfires	X				X	X	X	X		
Lack of power – engine will not rev.	X					X	X	X	X	X
Hesitation – stumble						X	X	X	X	X
Poor gas mileage, or CO too high					X	X	X	X	X	X
Engine surges					X	X	X	X	X	X
Backfiring					X	X	X	X		
Afterburning					X	X	X	X	X	X