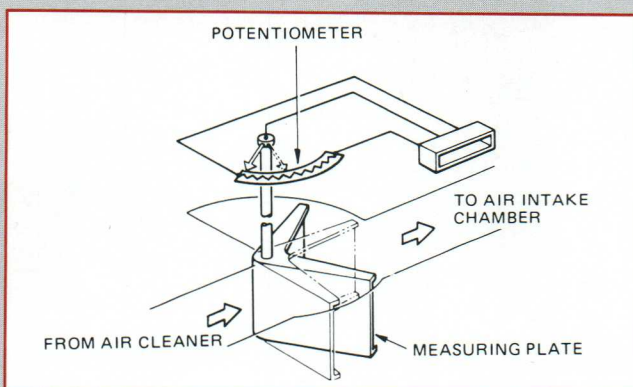
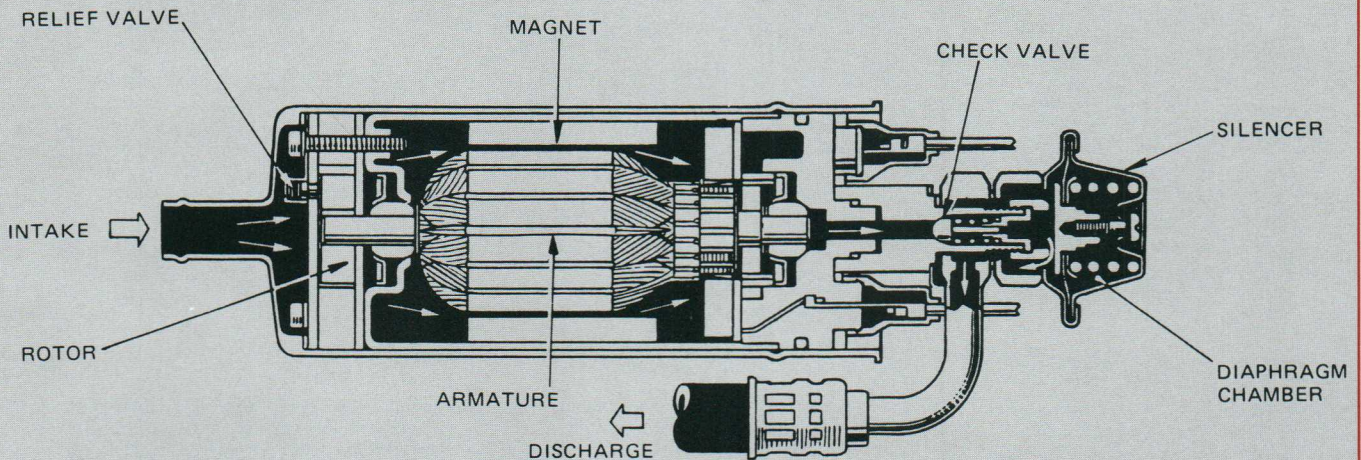


TOYOTA EFI

UNDERSTANDING ELECTRONIC FUEL INJECTION: CONSTRUCTION, FUNCTION & OPERATION



IN THIS ISSUE:

- General EFI Construction
- EFI Devices
- EFI Systems
- EFI Injector Cleaner

The only tool you need to clean EFI injectors



Clogged fuel injector nozzles can cause rough idling. Hesitation. Now there's an easy way to dissolve deposits that affect engine performance: Just open a can of Toyota EFI Injector Cleaner.

Pour the cleaner directly into your customer's half-full fuel tank and drive. Within an hour, the deposits will be gone. And the car will run clean. Because it is clean.

WE'VE
GOT MORE
FOR YOU!

TOYOTA
GENUINE PARTS



Follow label directions carefully to avoid possible damage to fuel hoses.

TOYOTA SERVICE NEWS

Spring 1987

Bulletin 23

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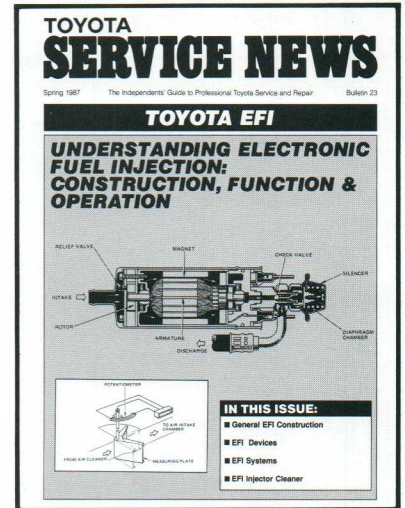
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Note: All technical information contained in this periodical on EFI (Electronic Fuel Injection) operations is basically the same for all models. EFI operations on vehicles equipped with TCCS (Toyota Computer Controlled Systems) varies slightly. Information on EFI for models equipped with TCCS is available through your local Toyota dealer.

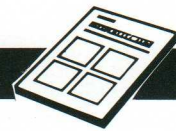
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On the Cover



Beginning with the basics and moving on to specific functions, this issue of *Toyota Service News* provides an extensive examination of Toyota Electronic Fuel Injection and how it works.

GET MORE FROM LIFE – BUCKLE UP!



Article No. 205

GENERAL EFI CONSTRUCTION AND EFI MODEL APPLICATION

TOYOTA EFI MODEL APPLICATION

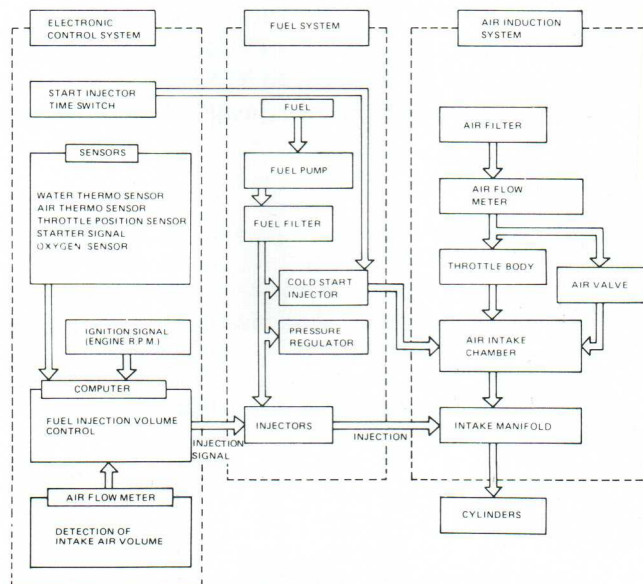
MODEL	ENGINE	1981	1982	1983	1984	1985	1986	1987
Tercel	N/A							
Corolla FF	N/A							
Corolla FR	4A-GE					•	•	•
Corolla FX16	4A-GE							•
MR2	4A-GE					•	•	•
Camry	2S-E				•	•	•	•
Camry	3S-FE							•
Celica*	22R-E			•	•	•		
Celica	3S-GE						•	•

MODEL	ENGINE	1981	1982	1983	1984	1985	1986	1987
Supra	5M-GE	•	•	•	•	•	•	
Supra	7M-GE						•	•
Supra	7M-GTE							•
Cressida	5M-E	•	•					
Cressida	5M-GE			•	•	•	•	•
Van	3YE				•	•		
Van	4YE							
Truck*	22R-E							
Truck	22R-TE							

* EFI does not apply to all models.

Electronic Fuel Injection (EFI) can be generally divided into three systems: the fuel system, air induction system and the electronic control system. Or, EFI can be broken down into two types of devices: basic fuel injection devices and correction devices.

The three systems are described in Toyota Service News. This is a description of the basic fuel injection correction devices.

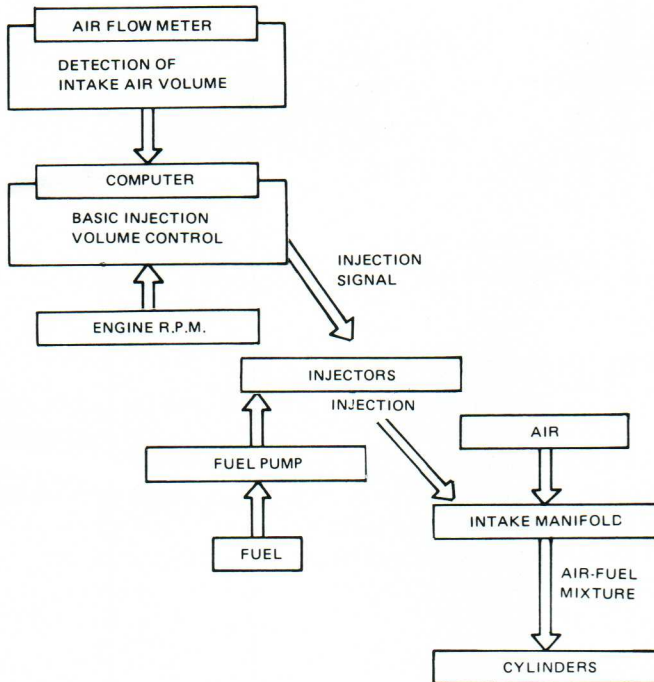
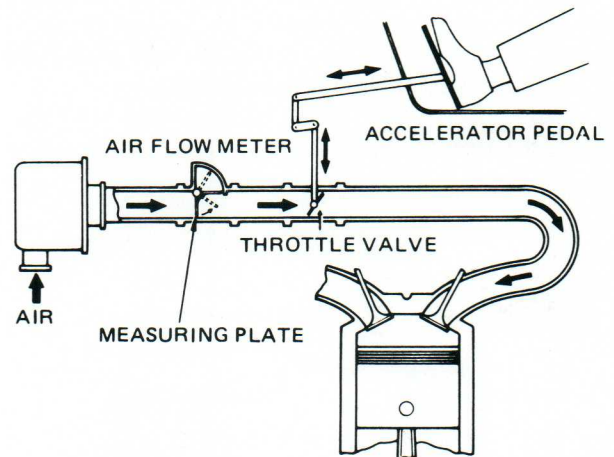




Article No. 206

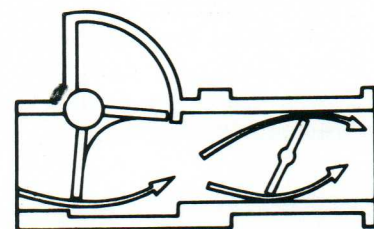
EFI: BASIC INJECTION DEVICES

The basic injection devices of EFI systems maintain an optimum proportion, or theoretical ratio, of the air and fuel mixture drawn into the cylinders. For instance, if there is an increase in the volume of intake air, fuel volume injected will be increased proportionally. Or, if there is a decrease in the intake air volume, fuel injection volume will be decreased proportionally.

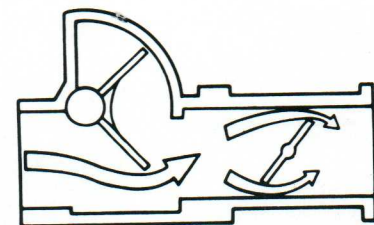


Detection of Intake Air Volume

As with carburetors, the throttle valve in EFI systems controls the volume of air taken in by the engine. The larger the valve opening, the greater the amount of air taken to the cylinders. At low engine speeds, the air flow will be less, and the measuring plate will open only a little. At high engine speeds, there will be more air flow, and the opening of the measuring plate will be correspondingly larger.



[LOW R.P.M.]



[HIGH R.P.M.]

Air Flow

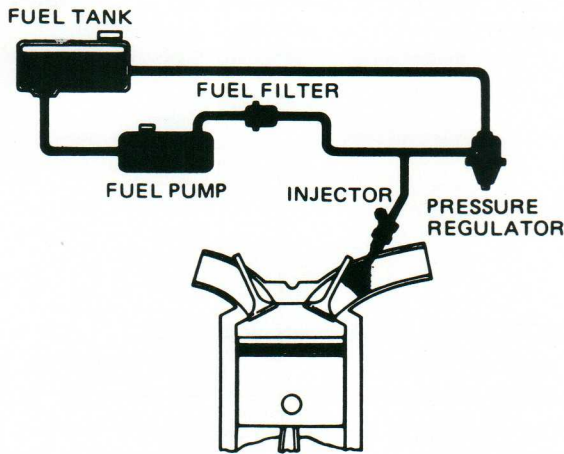
When the throttle valve opens, air flows to the cylinders from the air cleaner through the air-flow meter, throttle valve and intake manifold. As the air flows through the air-flow meter, it pushes the measuring plate open. The volume of air is sensed by the extent of this opening.



BASIC INJECTION DEVICES (Continued)

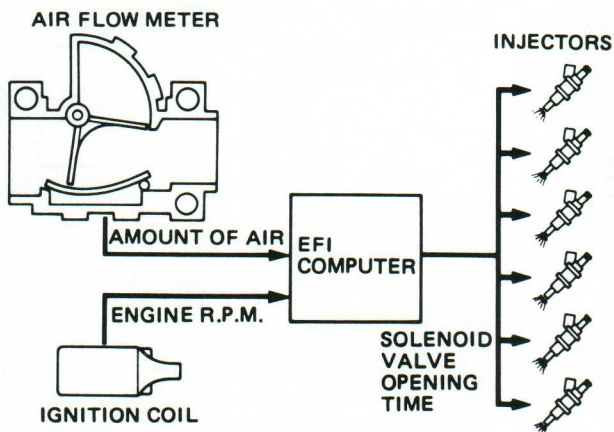
Fuel Flow

Fuel is pressurized by an electric pump and flows to the injectors through the filter. There is usually one injector for each cylinder, injecting fuel as its solenoid valve opens intermittently. Because the fuel pressure is kept constant by the pressure regulator, the injected volume is controlled by changing the duration of the injection. Thus, when there is little air intake volume, the duration is short, and when the air intake volume is large, the injection duration is longer.



Basic Injection Volume Control

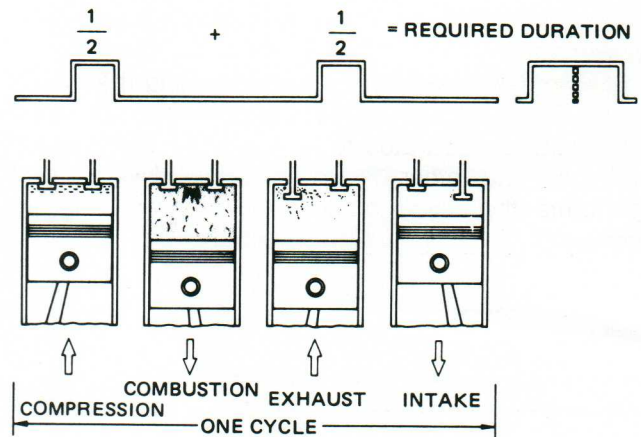
The air volume detected at the air-flow meter is converted to voltage and a signal is sent to the computer. Also, the ignition primary signal for engine rpm is sent to the computer from the ignition coil. The computer then calculates how much fuel is needed for that amount of air and informs each injector as to the opening time. When the solenoid valve of the injector opens, fuel is injected inside the intake port.



Injection Timing & Duration

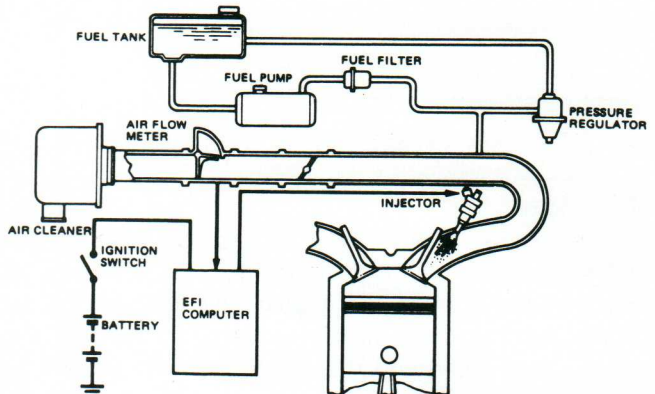
Computer control of injection timing is determined by an engine rpm signal along with other sensor input, causing the injectors to open simultaneously for every engine revolution. The duration of each injection is only half the required time, so it takes two injections to provide the right amount of fuel for one combustion cycle.

NOTE: Some Toyota EFI systems fire injection in pairs, or individually (sequentially) in firing order fashion.



In Summary

In accordance with engine rpm and the volume of air measured at the air flow meter, the computer informs the injector how much fuel to inject, and the air-fuel mixture is formed inside the intake port. The term "basic injection volume" is used to indicate the amount of injected fuel required to obtain a theoretical (or optimum) mixture ratio.





Article No. 207

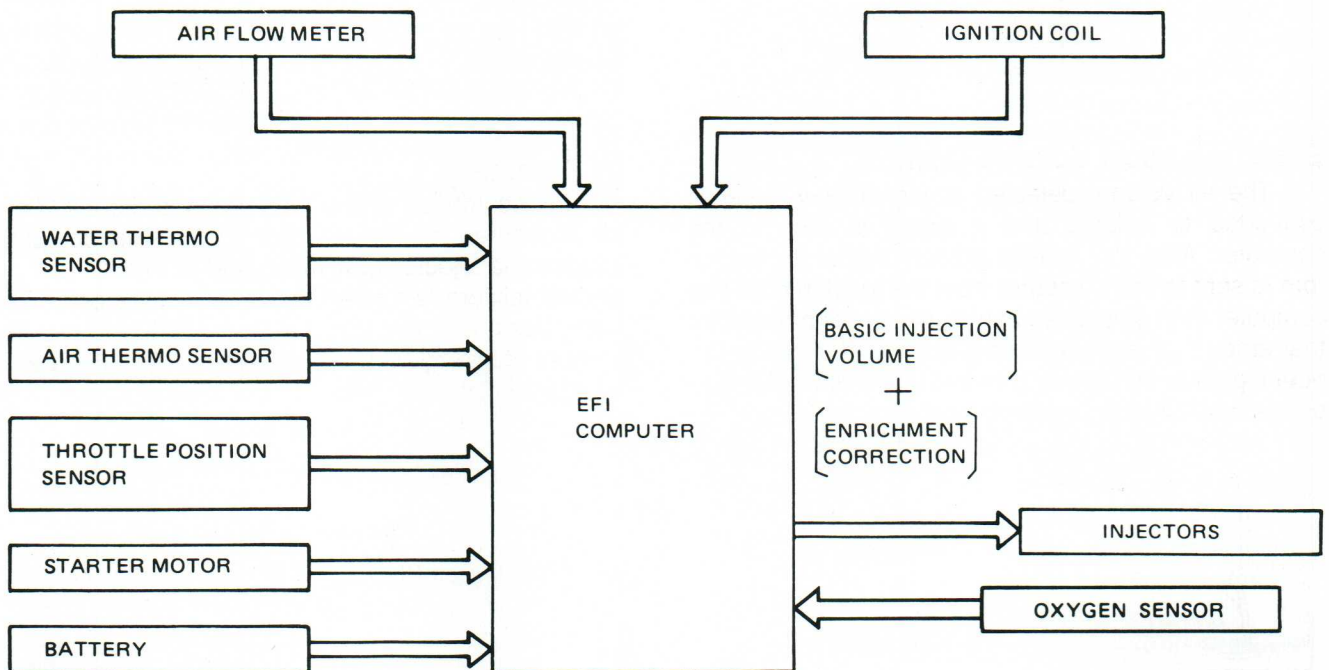
EFI: CORRECTION DEVICES

So far, the basic operation of the devices needed to obtain optimum air-fuel mixture has been described. However, the engine will not operate well with only the basic injection volume. This is because the engine must operate under varying conditions. Consequently, some form of correction device is needed to adjust the air-fuel ratio. For example, when the engine is cold or under a heavy load, a richer mixture is required. The EFI system modifies the air-fuel ratio in accordance with engine operating conditions in the same way that the carburetor changes the air-fuel mixture by means of the choke or power system.

There are two methods of correcting the air-fuel ratio. One is called "enrichment correction" by which the computer operates to increase the fuel injection volume. The other is an auxiliary device which performs the same function without involving the computer.

Enrichment Correction

Various kinds of information about the engine operating condition are fed into the computer from several sensors in addition to information about the amount of air from the air-flow meter and engine rpm from the ignition coil. The computer has the ability to increase the amount of fuel on the basis of this information. In other words, even though the amount of intake air remains the same, the amount of fuel injected by the injectors is increased or decreased in accordance with engine operating conditions.

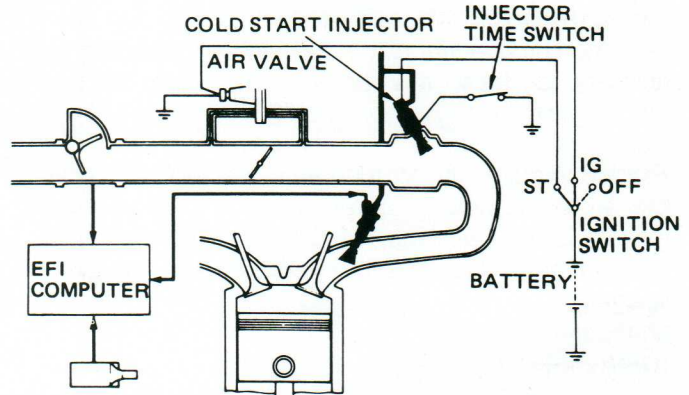
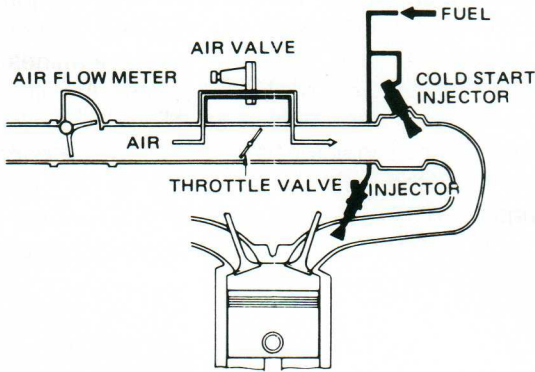




Article No. 208

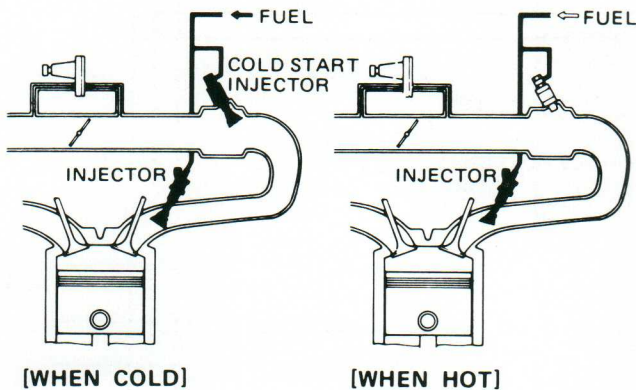
EFI: AUXILIARY DEVICES

There are two auxiliary devices: a Cold Start Injector and an Air Valve.



Cold Start Injector

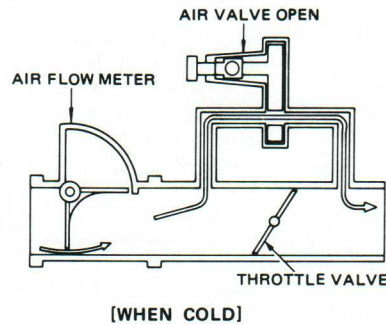
The cold start injector is for improved startability when the engine is cold. Starting a cold engine requires more fuel and a richer mixture. It is only when the engine is cold and is being cranked by the starter motor that the cold start injector injects fuel to enrich the mixture. In other words, during cold engine starting, fuel is supplied by both the cylinder injectors and the cold start injector. In this way, the ratio of fuel to the amount of air is increased by the amount injected by the cold start injector, producing a richer mixture.



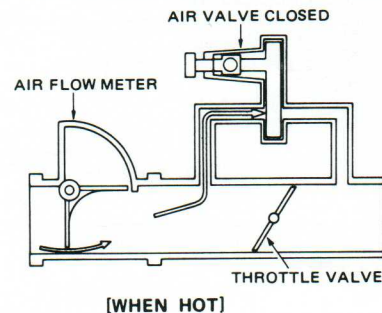
The cold start injector is a type of solenoid valve using power from the battery to open and close the valve inside and inject fuel. To prevent an overly rich mixture, the duration of injection time is controlled by a time switch composed of a bimetal and an electric heater coil.

Air Valve

When the temperature is low, the air valve speeds up the engine idle rpm to fast idling. When the engine is cold, even if the throttle valve is closed, the engine takes in air through the air valve. The volume of air passing through the air valve changes with the temperature. When the temperature is low, the air valve opens fully, allowing a large volume of air to pass through. As the temperature rises, the valve gradually closes until the engine reaches normal temperature, cutting off the flow of air. The fast idle rpm is in proportion to the volume of air flowing through the air valve — it is high when the temperature is low and drops to normal idling rpm as the temperature rises.



Opening and closing of the air valve is controlled internally, using a bimetal and an electric heater coil.





Article No. 209

EFI SYSTEM

EFI Components

The components of the EFI system, including the auxiliary devices, are divided according to their function as follows:

Fuel System

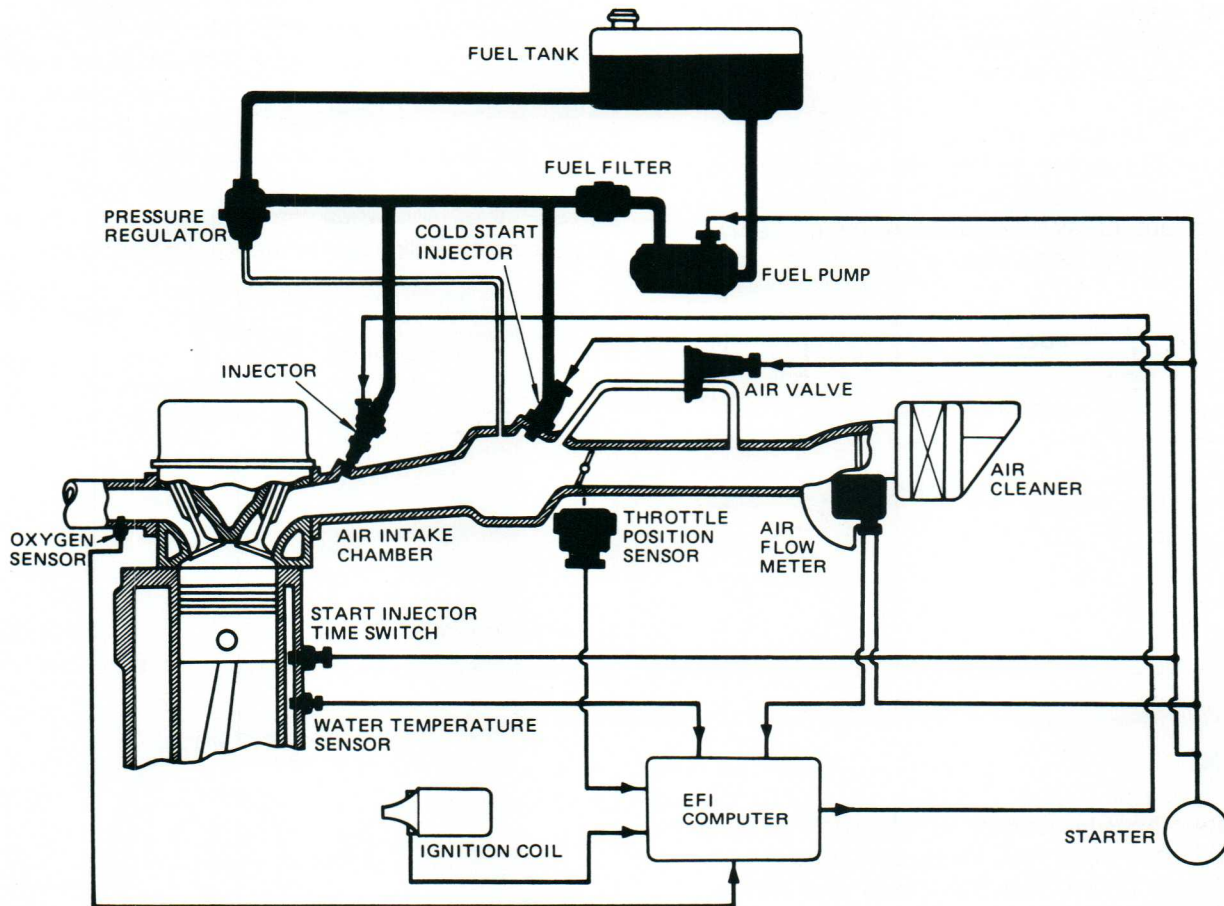
These components are used for transmitting fuel and consist of the fuel tank, fuel pump, fuel filter, delivery pipe, pressure regulator, pulsator damper, injectors, cold start injector, etc.

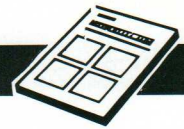
Air Induction System

These components supply a proper amount of air necessary for combustion and consist of the air cleaner, air-flow meter, throttle body, air valves, etc.

Electronic Control System

This is comprised of various sensors such as the air flow meter, water temperature sensor, throttle position sensor and intake air temperature sensor. And along with these, the computer determines the duration of operation of the injectors. Additionally, there is a main relay, which supplies power to the computer; a start injector time switch, which controls operation of the cold start injector during engine starting; a circuit opening relay, which controls fuel pump operation, and a resistor, which stabilizes injector operation.





Article No. 210

EFI: FUEL SYSTEM

Fuel Flow

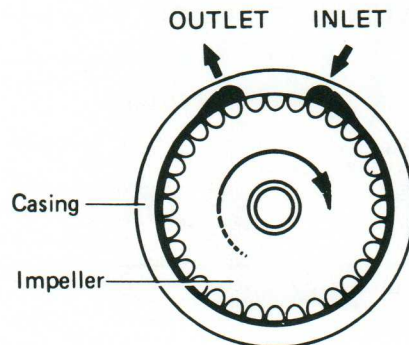
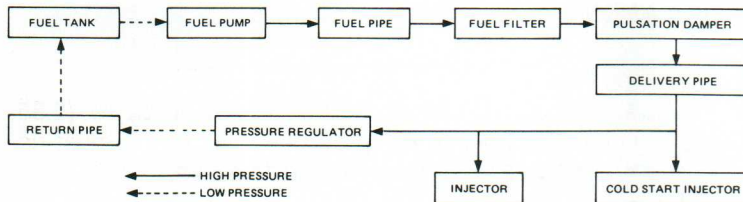
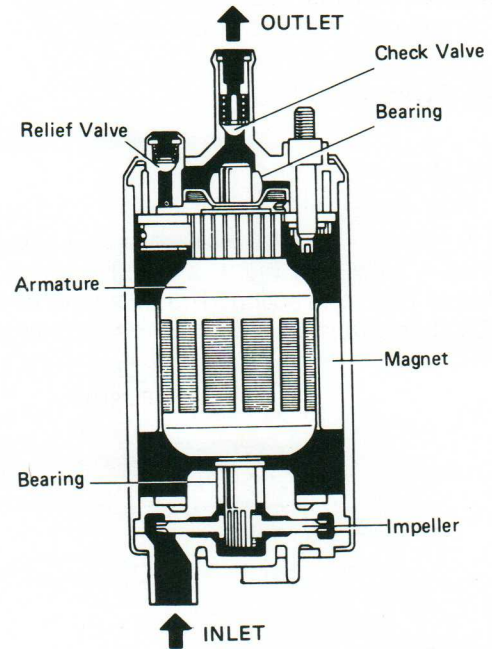
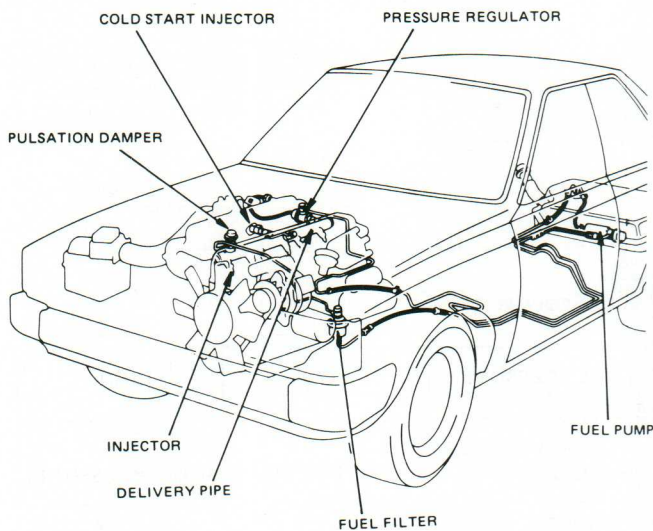
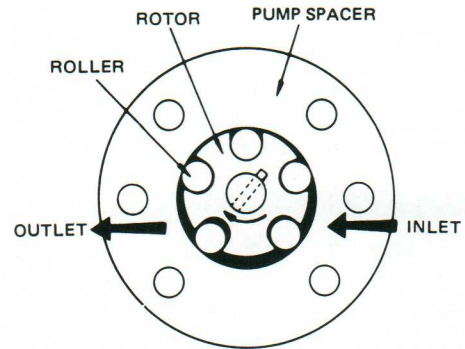
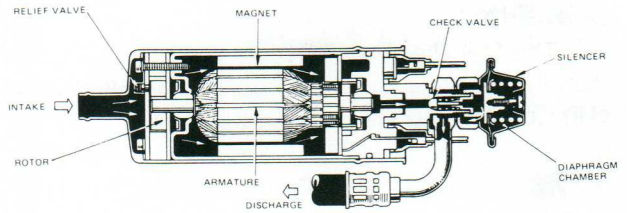
Fuel is drawn from the fuel tank by the fuel pump and sent, under pressure, through the fuel filter to the injectors and cold start injector.

The pressure regulator controls the pressure of the fuel line (high pressure side). Excess fuel is returned to the fuel tank through the return pipe.

The pulsation damper acts to absorb the slight fuel fluctuations due to fuel injection.

The injector performs fuel injection into the intake port in accordance with the computer-calculated injection signals.

The cold start injector is provided to improve starting by injecting fuel into the air intake chamber only when the coolant temperature is low.



Fuel Pump

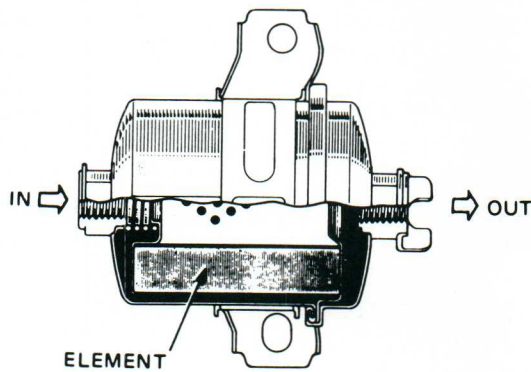
The fuel pump pumps fuel from the fuel tank and sends it to the injectors and cold start injector.



EFI: FUEL SYSTEM (Continued)

Fuel Filter

The fuel filter filters dirt and other foreign particles from the fuel and is installed at the high pressure side of the fuel pump.



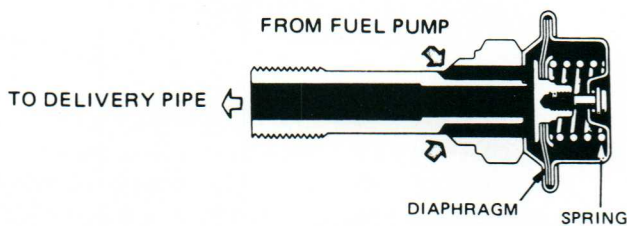
NOTE:

If the fuel filter becomes clogged, discharge pressure will be reduced, resulting in hard starting, etc.)

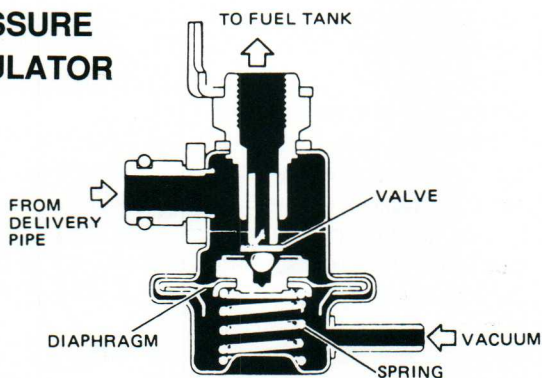
Fuel Pulsation Damper

FUNCTION

Fuel pressure is maintained at 2.55 kg/cm² (35 psi) in relation to the manifold vacuum by the pressure regulator. However, there is a slight variation in line pressure due to injection. The pulsation damper acts to absorb this variation by means of a diaphragm.

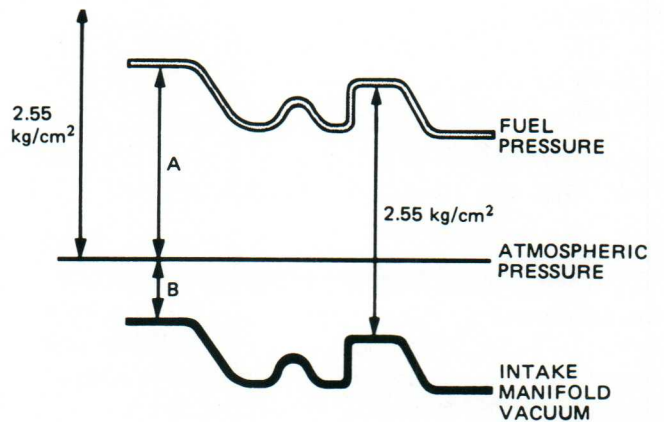




PRESSURE REGULATOR



FUNCTION

The pressure regulator regulates the fuel pressure to the injectors. Fuel injection quantity is regulated by the duration of the signal applied to the injectors so that a constant pressure must be maintained to the injectors. However, as fuel is injected into the intake port and manifold vacuum varies, the fuel injection quantity will vary slightly, even if the injection signal and fuel pressure are constant. Therefore, to acquire an accurate injection quantity, the sum of the fuel pressure (A) and intake manifold vacuum (B) must be maintained at 2.55 kg/cm² (35 psi).



FUEL PRESSURE	LOW	HIGH
INTAKE MANIFOLD VACUUM	HIGH (LOW PRESSURE)	LOW (HIGH PRESSURE)
INJECTION VOLUME	 (SAME)	 (SAME)

NOTE:

1. As it is impossible to adjust the pressure (2.55 kg/cm² [35 psi]) of the pressure regulator, it must be replaced as an assembly if found defective.

2. A defective pressure regulator, due to foreign matter stuck in the valve, etc., will cause a decrease in pressure, resulting in difficult starting, rough idle and lack of power.

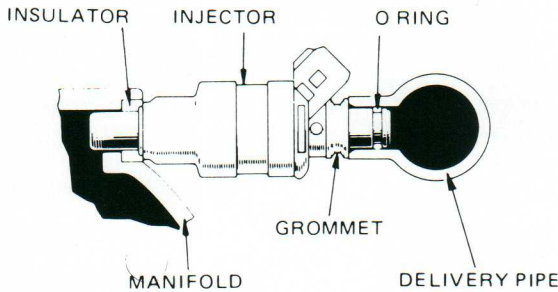


EFI: FUEL SYSTEM (Continued)

Injector

FUNCTION

The injector is an electromagnetic nozzle which injects fuel in accordance with a signal from the computer.

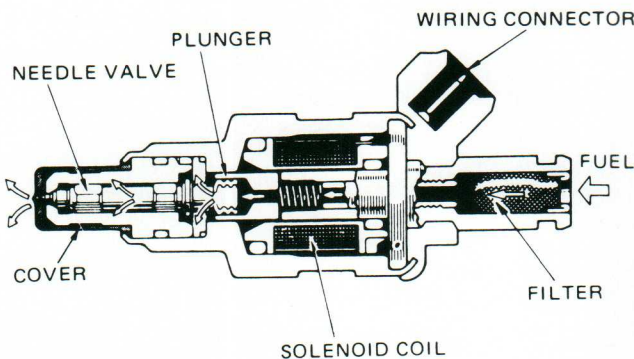


CONSTRUCTION

The injectors are installed with a heat insulator at the intake manifold or cylinder head near the cylinder head intake port, and secured by a delivery pipe.

OPERATION

When a pulse from the computer is received by the solenoid coil, the plunger is pulled against spring tension. Because the needle valve and plunger are a single unit, the valve is also pulled from its seat and fuel is injected as shown in the illustration below.



Fuel volume is controlled by the duration of the electrical pulse. Because the needle valve stroke is fixed, injection continues as long as the needle valve is open.

HANDLING PRECAUTIONS

Do not remove the cover on the tip of the injector and be careful to prevent dirt or foreign particles from entering the needle valve.

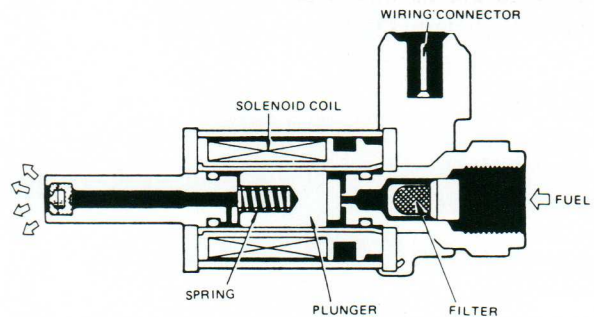
NOTE:

1. If gasoline with a high sulfur content is used, sulfur carbon deposits will accumulate on the needle valve, causing reduced injection volume and resulting in lack of power, backfire, sluggishness, rough idling, etc.
2. Foreign matter stuck in the injector valve will cause fuel leakage, resulting in rough idle, decreased injection volume, lack of power and acceleration, backfire, etc. For this reason, the injector also has a fuel filter.
3. Direct battery power will cause seizure of the coil. Always use a resistor to lower the voltage during inspection.

Cold Start Injector

FUNCTION

The cold start injector is installed in the center of the air intake chamber and functions to improve cold engine starting.



CONSTRUCTION & OPERATION

The injector operates only during cranking (startup) when the coolant temperature is below 35° C. Maximum duration is limited by the start injector time switch to prevent flooding (wet spark plugs) due to the continued injection of the cold start injector.

The injector tip employs a special design to improve the mist spray.

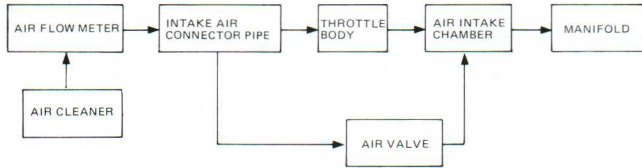
When the ignition switch is tuned to the "START" position, the current flows to the solenoid coil, and the plunger is pulled against spring tension. Thus, the valve will open and fuel will flow over the plunger and through the injector tip. After the engine is started, current to the cold start injector is cut off and injection terminated.



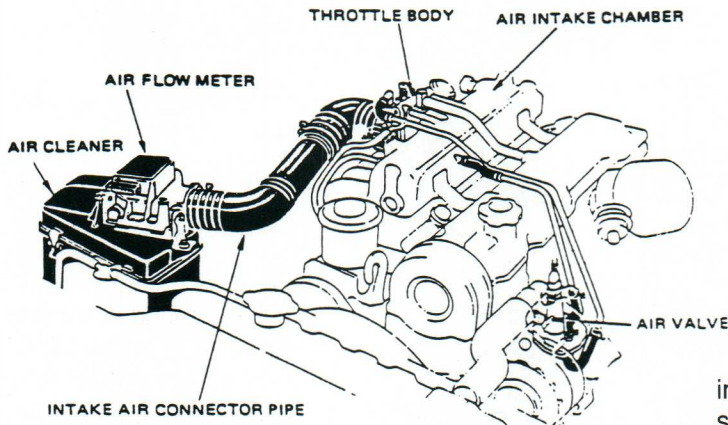
Article No. 211

EFI: AIR INDUCTION SYSTEM

Intake air flow



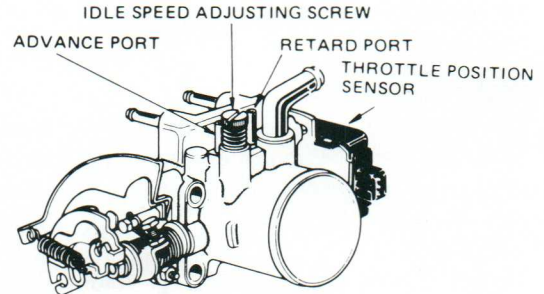
Air from the air cleaner will pass through the air flow meter and push open the measuring plate and then flow to the air intake chamber. The volume of the air flow to the air intake chamber is determined by the angle of the throttle valve opening. From the air intake chamber, the air is distributed to each manifold and drawn into the combustion chamber. When the engine is cold, the air valve will open and air will flow through to the air intake chamber. Therefore, even if the throttle valve is in the closed position, air will flow to the air intake chamber, thereby increasing the engine idle speed (called fast idle).



THROTTLE BODY

CONSTRUCTION

The throttle body contains a throttle valve to control intake air, an air bypass system which allows an adjustable flow of air at idle and a throttle position sensor which indicates the angle of the throttle valve opening.



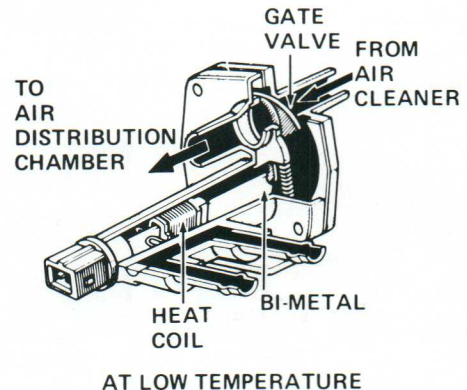
Air Valve

CONSTRUCTION

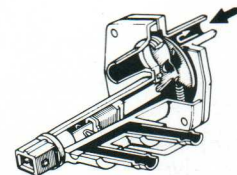
The air valve is a fast idle device operated by a bimetal and heat coil to increase engine rpm when the engine is cold.

OPERATION

When starting a cold engine, the gate valve is open, allowing air from the intake air connector pipe to bypass the throttle valve and flow directly through the air valve to the air intake chamber.



Thus, even though the throttle valve is closed, intake air volume is increased and idle speed will be slightly higher than normal (fast idle). After the engine is started, current begins to flow to the heat coil. As the bimetal is heated, the gate valve will gradually close and engine rpm will decrease.





Article No. 212

EFI: ELECTRONIC CONTROL SYSTEM

General

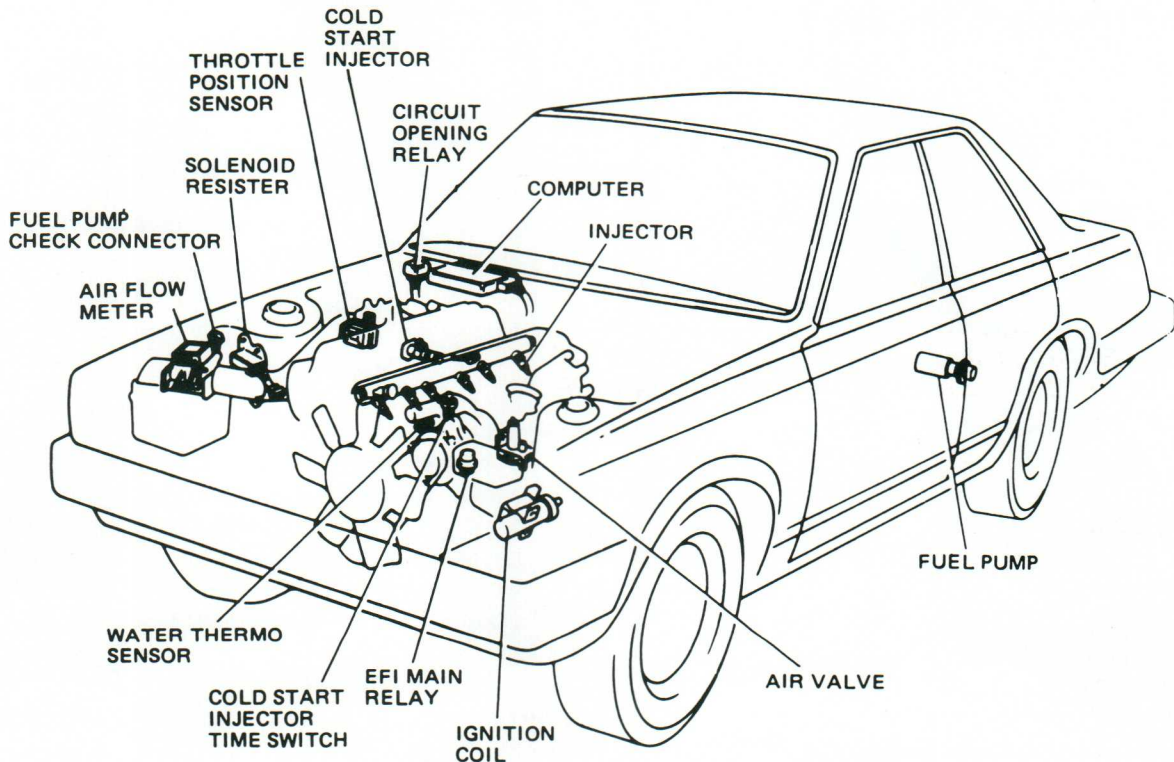
The electronic control system is composed of sensors which detect various engine conditions, and the computer — which calculates the injection volume (duration) in accordance with a signal (information) from the sensors.

The sensors detect the intake air volume, engine load, coolant and intake air temperature, acceleration/deceleration, and send signals to the computer. The computer relies on this sensor input to calculate injection duration (mixture enrichment), and sends a signal to the injectors. After receiving this signal, the injectors inject fuel into the intake port. The injection volume depends on the duration of the signal from the computer.

A resistor is installed in the injector circuit to protect from overheating and to stabilize injection operation.

When the coolant temperature is low, the cold start injector operates during engine cranking to improve startability. The operation time of the cold start injector is controlled by a start injector switch. (The computer circuit has a main relay which acts to prevent a voltage drop of the computer circuit.)

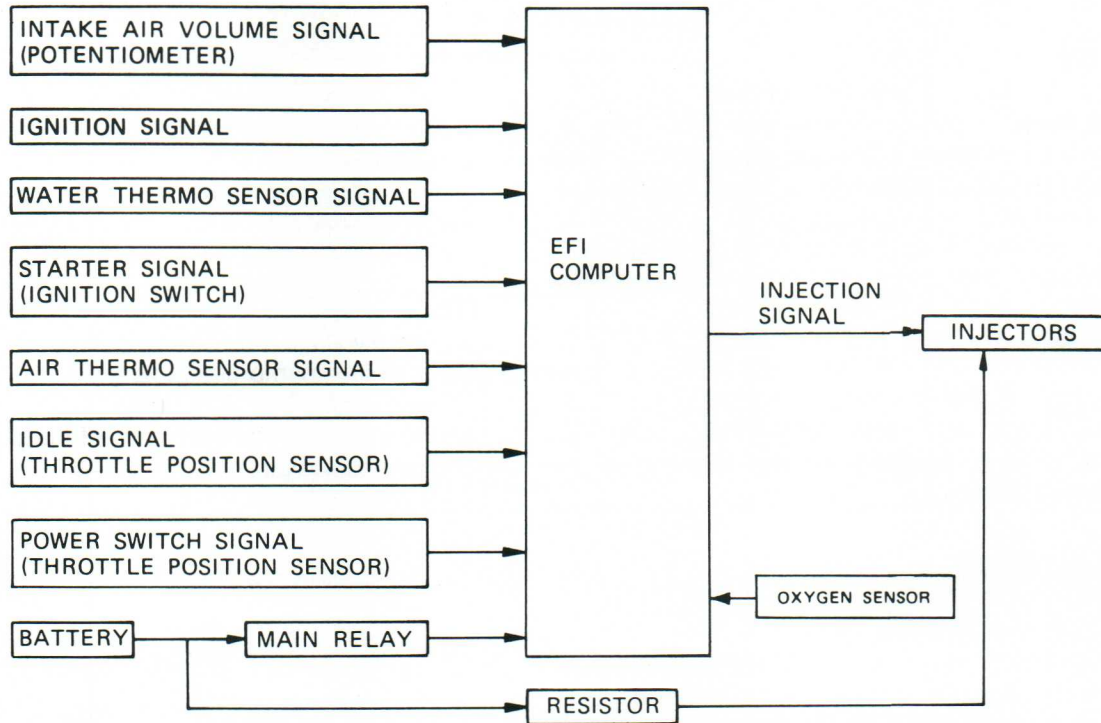
The fuel pump circuit has a circuit opening relay for operation of the fuel pump during engine starting and running, and for shutdown of the pump when the engine is turned off.





EFI : ELECTRONIC CONTROL SYSTEM (Continued)

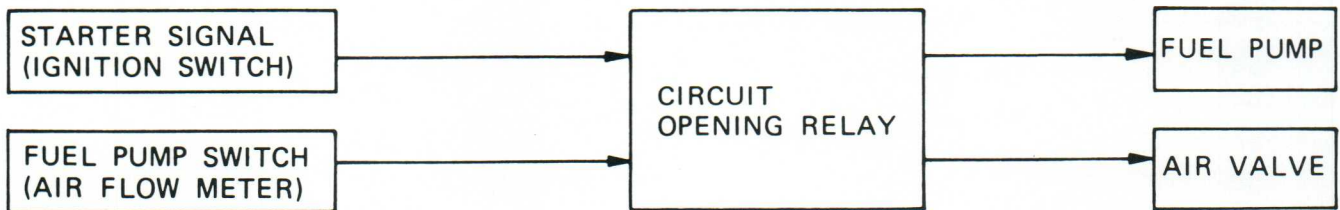
Injection Volume Control



Start Control



Fuel Pump Control





EFI : ELECTRONIC CONTROL SYSTEM (Continued)

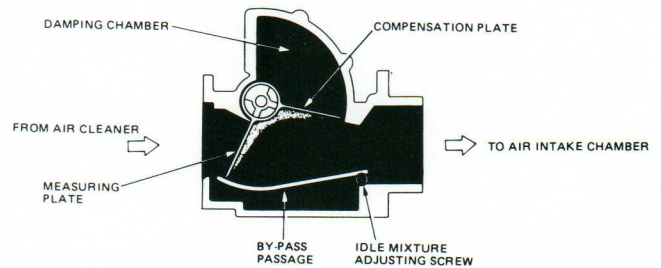
Sensors and Function

SENSOR	FUNCTION
Air Flow Meter	Detects intake air volume as a voltage ratio using a potentiometer.
Throttle Position Sensor	Detects the heavy load and idle conditions according to the throttle valve opening.
Water Thermo Sensor	Detects coolant temperature.
Air Thermo Sensor	Detects the intake air temperature.
O ₂ Sensor	Detects the oxygen density inside the exhaust pipe.
Start Injector Time Switch	Is activated when the coolant temperature is low and signals the computer operate to the cold start injector during starting.
Ignition Primary Signal	Detects injection timing and engine rpm by means of an ignition primary signal.
Starter Signal	Detects engine cranking.

Air Flow Meter

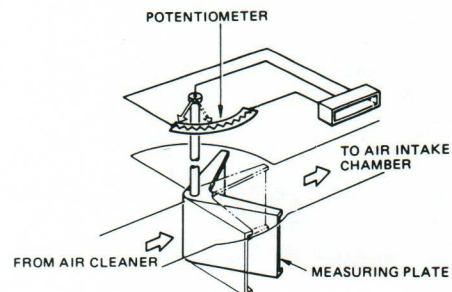
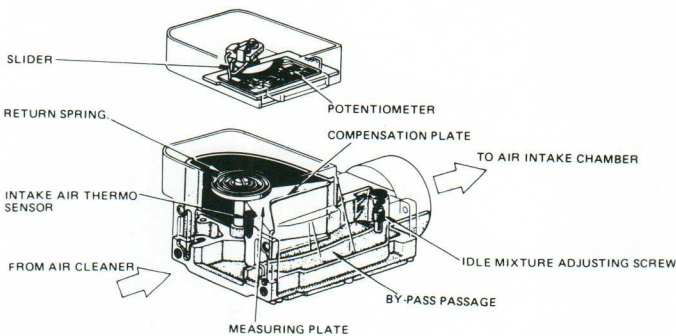
FUNCTION & CONSTRUCTION

The air flow meter detects intake air volume and sends a signal to the computer (which determines the base injection volume). The air flow meter consists of the measuring plate, return spring and potentiometer. The meter also includes an idle mixture screw, an air thermo sensor (which detects intake air temperature), a fuel pump switch, damping chamber, compensation plate, and a full-load stopper.



How Intake Air Volume is Detected

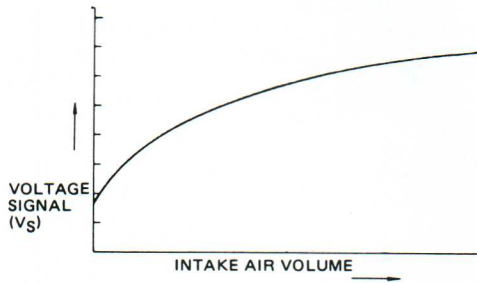
Intake air volume drawn into the cylinder is determined by the throttle valve opening and engine rpm. Intake air drawn through the air flow meter opens the measuring plate against spring tension. The measuring plate and potentiometer move on the same axis so the angle at which the measuring plate is open is converted to a voltage signal by the potentiometer.





EFI: ELECTRONIC CONTROL SYSTEM (Continued)

The computer then detects this voltage signal (Vs) from the potentiometer.



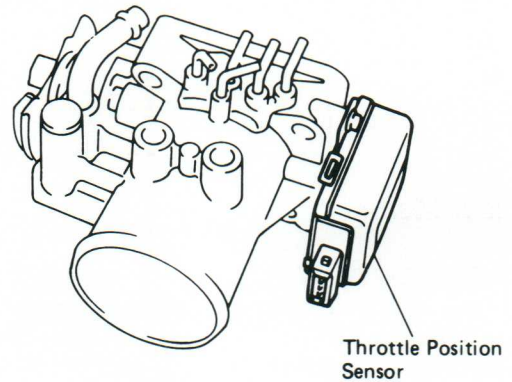
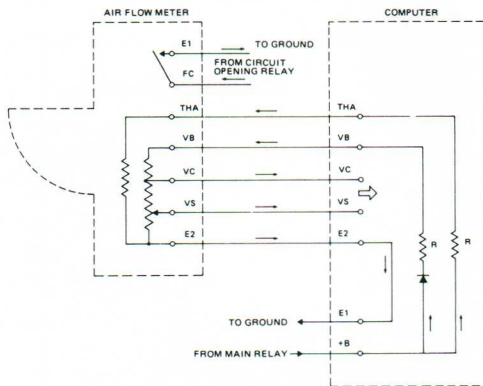
Vc voltage and Vs voltage (which detects intake air volume) are applied to the computer Vc and Vs terminals, respectively, and these become the input signal for calculation of the injection signal.

Throttle Position Sensor

FUNCTION

The throttle position sensor is attached to the throttle body. It senses the degrees of throttle valve opening to detect engine load conditions. In accordance with this signal, the computer determines whether to increase or decrease fuel injection volume.

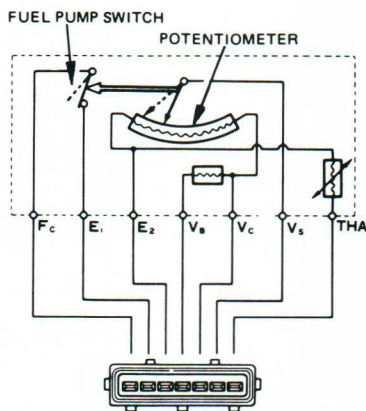
Air Flow Meter Electrical Circuit



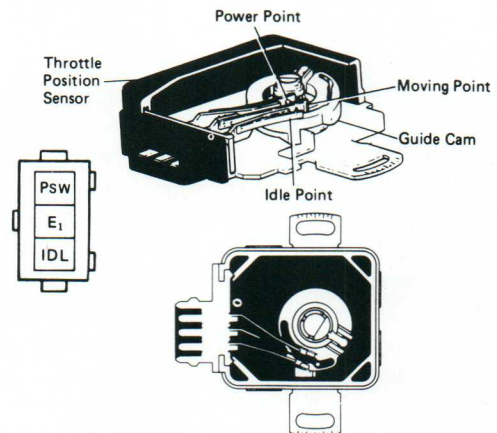
Adjustment of Installation Position

The installation position of the throttle position sensor is very important to ensure proper point closing and opening. Refer to the appropriate Toyota Repair Manual for adjustment procedures.

Battery voltage is applied to the VB terminal of the air flow meter as follows:
 Battery — main relay — +B terminal — diode — resistance (R) — VB terminal.



AIR FLOW METER WIRING CONNECTIONS





EFI : ELECTRONIC CONTROL SYSTEM (Continued)

Water Thermo Sensor

FUNCTION

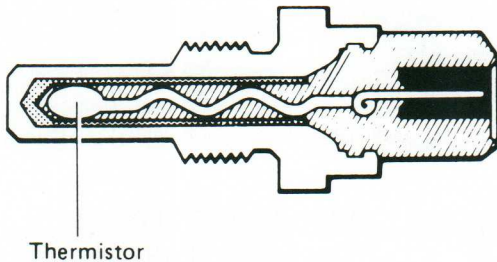
This sensor, which is installed at the water outlet, detects coolant temperature by means of an internal thermister.

Thermister resistance increases when the coolant temperature is low, and gradually decreases as the coolant temperature rises.

Based on a signal from this sensor, the computer increases fuel injection volume to improve drivability during cold engine operation.

Water Temperature Sensor

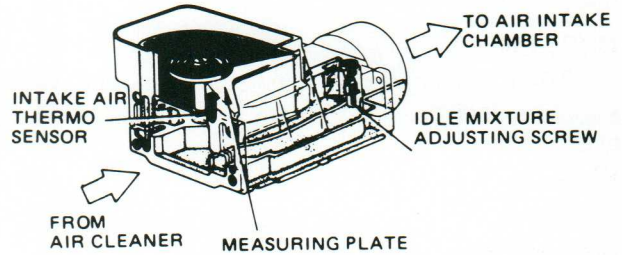
WATER TEMP. SENSOR



Air Thermo Sensor

FUNCTION

The air thermo sensor detects the temperature of the intake air. Like the water thermo sensor, it is composed of a thermister and is mounted on the air flow meter. The volume and density of air changes with the temperature. Therefore, even though the volume of air measured by the air flow meter may be the same, the volume of injected fuel will vary with the temperature. The computer uses a temperature of 20° C (68° F) as a standard, decreasing the injection volume when the temperature is above 20° C, and increasing injection volume when the temperature is lower than 20° C. In this way, the proper air-fuel ratio is ensured regardless of the temperature.



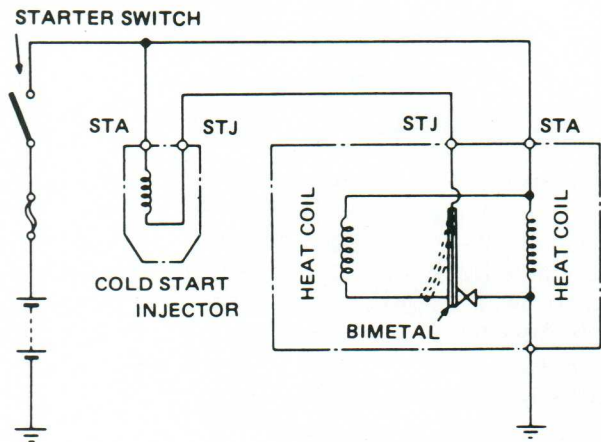
Start Injector Time Switch

The start injector time switch is mounted in the intake manifold water jacket.

When starting a cold engine (coolant is below 35° C or 110° F), starting performance is improved by fuel injected from the cold start injector.

However, when the engine is cranked over for some time, this start injector time switch controls the injection duration to prevent flooding (wet plugs). When the starter is turned, the heat coil is actuated during the time there is current to the cold start injector.

Therefore, the bimetal will gradually be heated and the points will open to cut off the current to the cold start injector. Fuel injection duration to the cold start injector is determined by the water temperature and the duration of the current to the heat coil.



START INJECTOR TIME SWITCH



EFI : ELECTRONIC CONTROL SYSTEM (Continued)

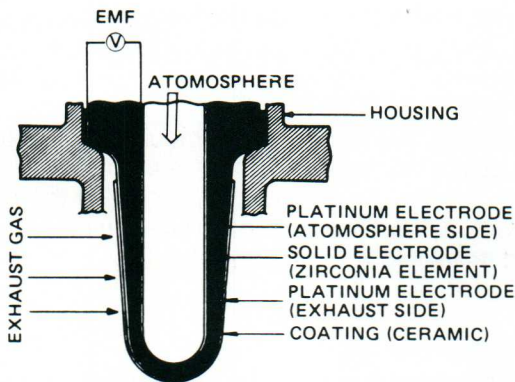
Engine Ignition Signal

FUNCTION

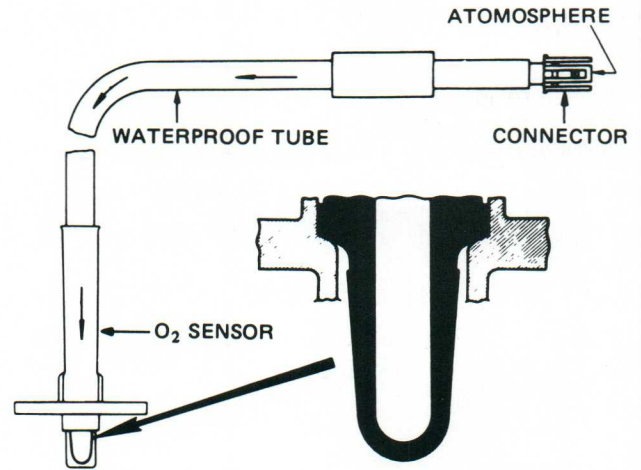
This is an important signal for the computer to determine ignition timing and rpm. It is used to calculate the predetermined injection quantity and for fuel cut.

Oxygen Sensor

1. This solid electrolyte-type oxygen sensor, which is installed in the exhaust manifold, utilizes the oxygen concentration cell principle to produce electromotive force (EMF) by means of the oxygen density difference in the exhaust gas. A thin layer of platinum is bonded to both surfaces of the test tube-shaped zirconia element. Atmospheric air is directed to the inner surface while the outer surface is exposed to the exhaust gas. The electromotive force (signal) is sent to the computer.

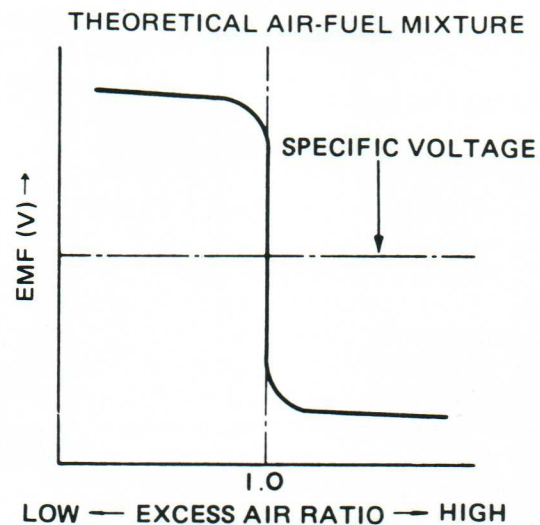


2. If there is an oxygen density difference on both surfaces of the zirconia element, it will produce electromotive power. If the air-fuel ratio is leaner than the theoretical air-fuel ratio, the electromotive power will be low. If it is richer, the electromotive force will be high. Also, the EMF indicates the characteristic of the theoretical air-fuel mixture surrounding when it suddenly changes toward the boundary.



3. Characteristics of the oxygen sensor generating power:

$$\text{Excess air ratio} = \frac{\text{Actual Air - Fuel Ratio}}{\text{Theoretical Air - Fuel Ratio}}$$





Article No. 213

TOYOTA EFI CLEANER FOR IN-TANK USE

Deposits in the fuel injectors of EFI vehicles may cause erratic engine operation such as rough idle, hesitation or backfire.

An in-tank injector cleaner has been developed for cleaning these injector nozzle deposits during engine operation.

Part Name	Capacity	Part Number
Injector Cleaner	150 cc/can	08813-00080

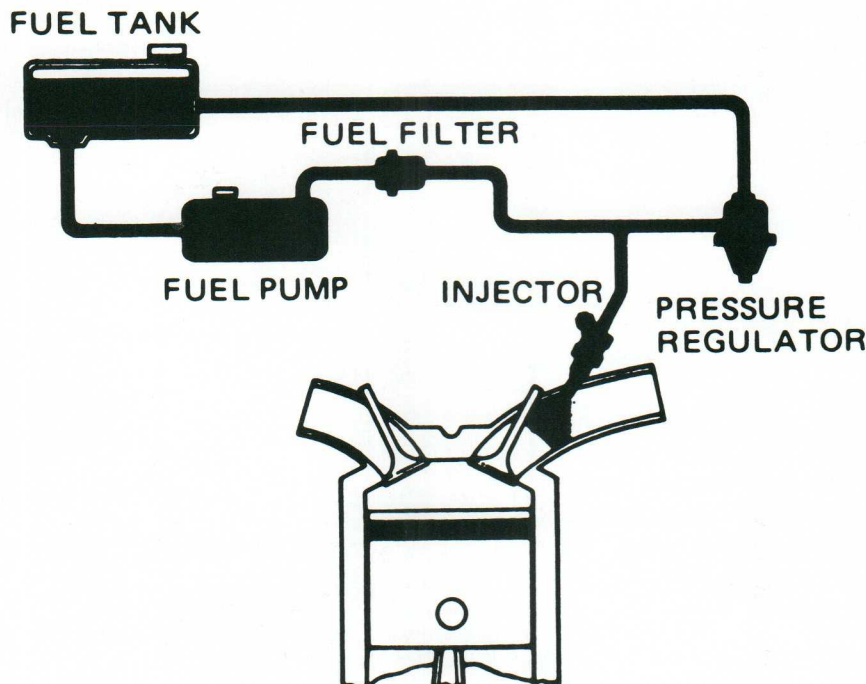
Directions For Use

1. Confirm the customer's complaint before using the cleaner.
2. Empty entire contents of a full can into the fuel tank. Add injector cleaner only when fuel tank is half full.
3. Use as much of the cleaner/fuel mixture as possible within one week.

Deposits on the injector nozzles will be cleaned off after about one hour of test driving. Use as much of the remaining fuel/cleaner mix as possible before refueling. This should be done within one week as the cleaner can have an adverse effect on fuel hoses if it's allowed to remain in the fuel system for an extended period of time.

Caution

- Never use more cleaner than the amount specified.
- If the cleaner is spilled on a painted surface, wipe or wash off immediately.
- Keep the cleaner away from heat or flame.
- Use only in a well-ventilated area.
- Avoid contact with eyes or skin.
- If swallowed, do not induce vomiting.
- If swallowed, call physician immediately.
- Keep out of reach of children.



WE'D LIKE TO HEAR FROM YOU !

As part of our continuing effort to improve Toyota Service News, Toyota Motor Sales would like you to tell us how we're doing and what you'd like to see in upcoming issues. Please take a moment and fill out the survey below. Thank you.

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NO

_____ • Each issue of TSN focuses on one primary topic. Do you feel you received sufficient information on this issue's subject?

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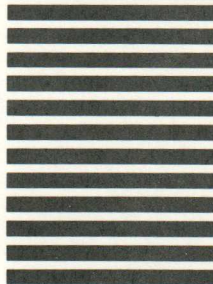
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Article No. 214

WHAT YOU SHOULD KNOW ABOUT GLASS

Automotive window glass serves several purposes: protects from the elements, provides a clear unobstructed view in all directions, and affords the occupants some measure of protection during a collision. There are two basic types of glass being used in today's automobiles: Laminated Safety Plate glass and Heat Tempered glass. The type of glass that is used depends upon the specific laws of any particular country.

NOTE:

Whenever major body damage is being repaired, be sure to remove all glass in the area of major damage to prevent glass breakage.

TYPES OF GLASS

(1) Tempered Glass

Plate glass is heated to approximately 600° C (1,112° F) — the temperature at which glass softens. It is then cooled rapidly by blowing air on both flat surfaces. This process adds compressive stress to the surface of the glass, which strengthens the glass. This type of glass is used for side and rear window glass.

Zone Tempered Glass

Uniformly tempered glass will usually develop thin fractures or cracks when it breaks, making it difficult to see through the glass. Therefore, zone-tempered windshield glass that has a lesser degree of tempering directly in front of the driver prevents these small cracks from developing in the prescribed area (in the event of glass breakage).

(2) Laminated Glass

This type of glass has a sheet of clear plastic (middle film) sandwiched between two panels of glass. When this glass is broken by an external force, the middle layer acts to prevent most of the glass from scattering. This type of glass is used for windshields.

(3) Other Glass

1. DE-FROST GLASS

Before heat treatment, metal powder that conducts electricity is printed on the glass surface in the form of heating wires. The metal powder is baked onto the surface during the tempering process. This glass is used in the rear window only.

2. TINTED GLASS (HEAT RAY ABSORBING)

Minute quantities of cobalt (blue), iron (reddish-brown) or other metals are added to the normal ingredients of glass to give it a desired color. This glass is used in all windows.

3. TOP BAND SHADED WINDSHIELD

The upper portion of glass is shaded to reduce the visible light seen through the glass. The top of the glass is very dark — changing abruptly to the normal field of vision. This glass is used in the windshield only.

4. GLASS WITH ANTENNA

An antenna wire for radio reception is either placed between the layers of laminated glass (windshield) or printed on the surface of the glass (rear window). Some windows have antenna wires and heating wires side-by-side. This glass is used in the rear window and front windshield.

5. ANTI-LACERATIVE WINDSHIELD

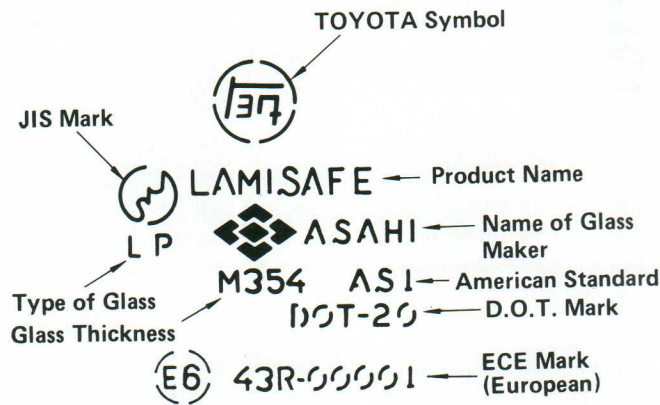
This glass is similar to conventional multi-layered glass, but it has one or more additional layers of plastic affixed to the passenger compartment side of the glass. This glass is used in the front windshield only.



WHAT YOU SHOULD KNOW ABOUT GLASS (Continued)

2. WINDSHIELD GLASS MARKINGS

The TOYOTA symbol, the name of the glass manufacturer, the type of the glass, the glass thickness, the product name, JIS mark, ECE mark, and D.O.T. mark are in the lower left corner of the windshield glass.



GLASS IDENTIFICATION MARKINGS

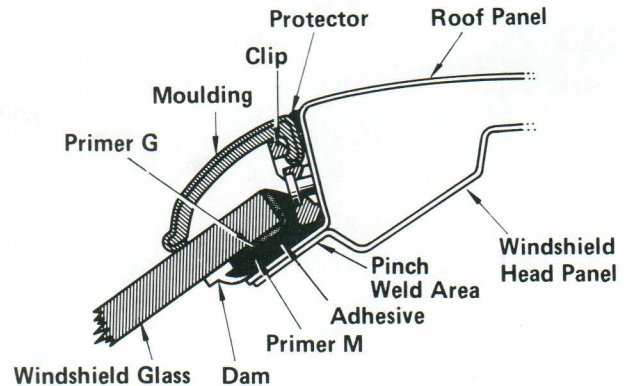
LP: Laminated Glass
 Z: Zone Tempered Glass
 TP: Tempered Glass

3. GLASS INSTALLATION METHOD

The windshield and rear window glass installation areas are sealed to keep out wind, rain, dust, noise, outside air, etc. It must also provide for the additional body rigidity and must remain in place during a collision. Installation of the glass is by adhesives or weatherstrips holding the windshield and rear window in place.

Adhesive Method

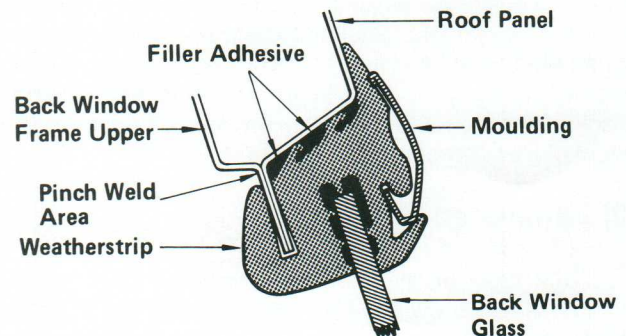
The glass is installed directly into the pinch weld area on the body with adhesives. A urethane or thiokol sealer is used as an adhesive. As previously mentioned, the glass serves an important function as a reinforcement structure. The superior bonding characteristics of this method minimize body twist and help keep the glass in place during a collision.



ADHESIVE METHOD (WINDSHIELD GLASS)

Weatherstrip Method

A weatherstrip provides excellent weather resistance, formability, and is resistant to staining from paint, etc. The surface of the rubber is weatherized during the manufacturing process. The gaps between the weatherstrip and the body are filled with adhesive to improve water and dust resistance.



WEATHERSTRIP METHOD (BACK WINDOW GLASS)



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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

The spring registration deadline is April 3, 1987.

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Toyota Vehicle Identification Chart 1976-1986

to help you order the correct Toyota part for the job

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Model Number Information

To determine the correct model type and body, locate the appropriate Vehicle Identification Number (VIN) plate on either of the illustrations below.

Production Date Information

To determine year of vehicle production, locate the production date plate as shown in the illustration below.

Van

Corolla

Tercel

MR2

Trucks

Corona

Toyota Truck Beds

Celica

4-Runner

Camry

Supra

Cressida

Landcruiser

This chart illustrates major Toyota body changes only. It is not meant to show every model.

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Toyota's Vehicle Identification Chart helps you order the right part. Right away. It has engine numbers, model numbers and production dates for most Toyota models from 1976 through 1986. Ask your dedicated STAR dealer for your copy. And ask about other items that will make life at your shop easier: the STAR parts cabinet, Toyota parts signage and Toyota Service News.