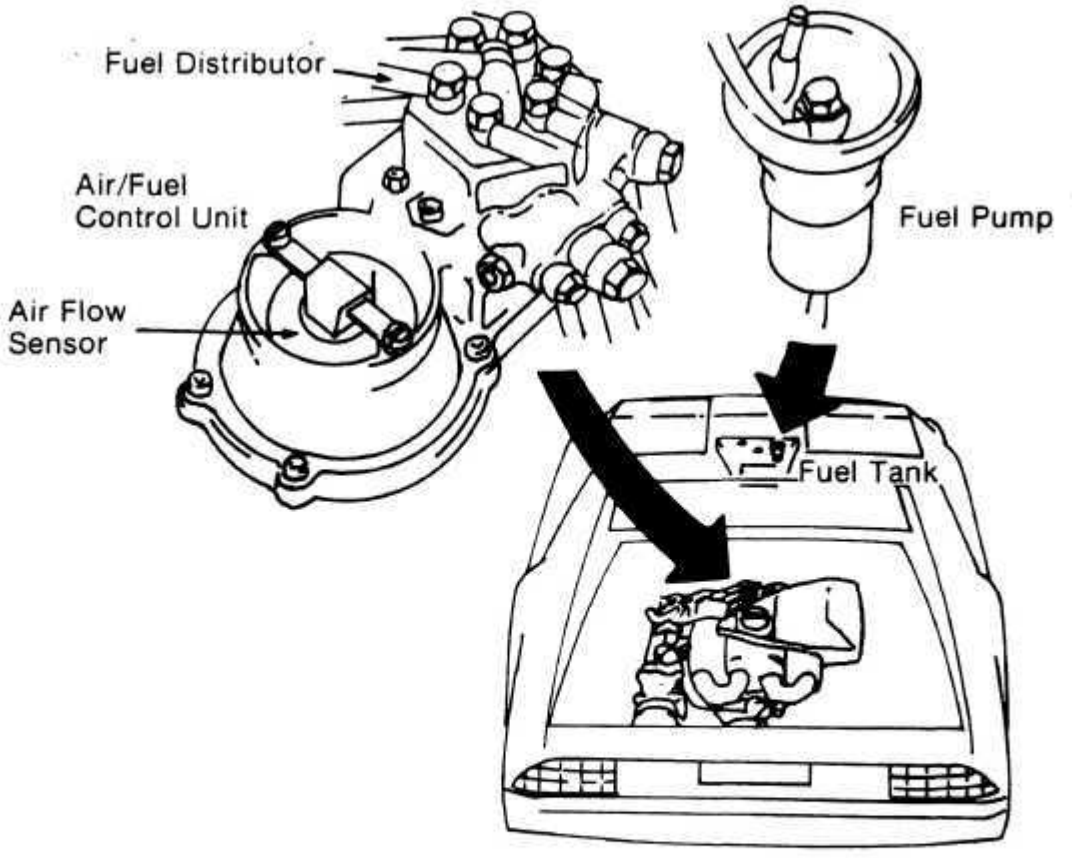
FUEL INJECTION

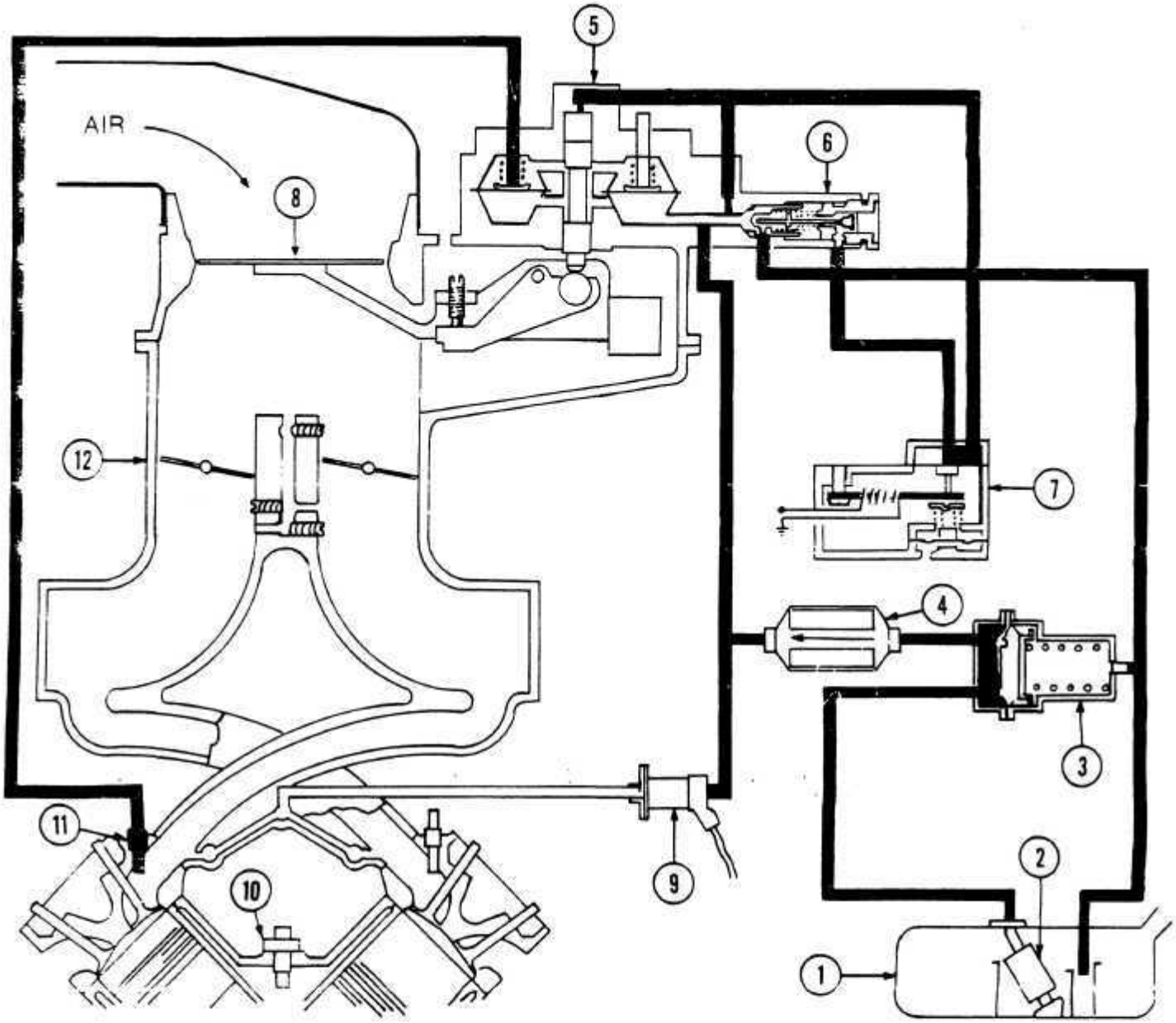
FUEL INJECTION

SYSTEM DESCRIPTION

The De Lorean is equipped with the Bosch K-Jetronic fuel injection system. This form of fuel induction by means of manifold injection permits the optimum adaptation of the air-fuel mixture to every operating phase of the engine. The K-Jetronic system ensures a lower pollutant level in the exhaust gas, high performance and increased fuel economy.

The K-Jetronic is a mechanical continuous fuel injection system which does not require any form of drive mechanism. An electric fuel pump mounted inside the tank provides fuel at a constant pressure to the mixture control unit. The control unit consists of an air flow sensor which measures the flow of air entering the engine, and a fuel distributor which is mechanically operated by the air flow sensor. The fuel distributor provides the injection valves with the correct amount of fuel. The fuel is injected into the inlet manifold immediately upstream of the intake valve. Injection takes place continuously, that is, without regard to the position of the intake valve. During the intake valve closed phase, the fuel is stored in the intake tubes of the manifold.





1 FUEL TANK
2 FUEL PUMP
3 FUEL ACCUMULATOR
4 FUEL FILTER
5 FUEL DISTRIBUTOR
6 PRIMARY PRESSURE REGULATOR
7 CONTROL PRESSURE REGULATOR
8 AIR FLOW SENSOR
9 COLD START VALVE
10 THERMO-TIME SWITCH
11 INJECTORS
12 THROTTLE VALVES

COMPONENTS AND DESCRIPTION

1 Fuel Tank
A molded plastic fuel tank is located in the front wishbone of the frame. Access to the tank components is gained by removing the inspection panel inside the trunk.

2 Fuel Pump
An electric rotary pump is used to provide fuel for the system. The pump is mounted inside the fuel tank.

3 Fuel Accumulator
The accumulator keeps the system under pressure when the pump is not running. The accumulator is mounted inside the rear section of the frame backbone.

4 Fuel Filter
A special filter is used to remove foreign particles from the fuel. The filter is mounted on the left rear frame rail.

5 Fuel Distributor
The fuel distributor determines the necessary volume of fuel to be delivered to each injector.

6 Primary Pressure Regulator
The primary pressure regulator controls the primary or main line fuel pressure in the system. The regulator is located inside the fuel distributor.

7 Control Pressure Regulator
The control pressure regulator provides fuel enrichment during warm up and cold acceleration. The regulator is mounted on the left valve cover.

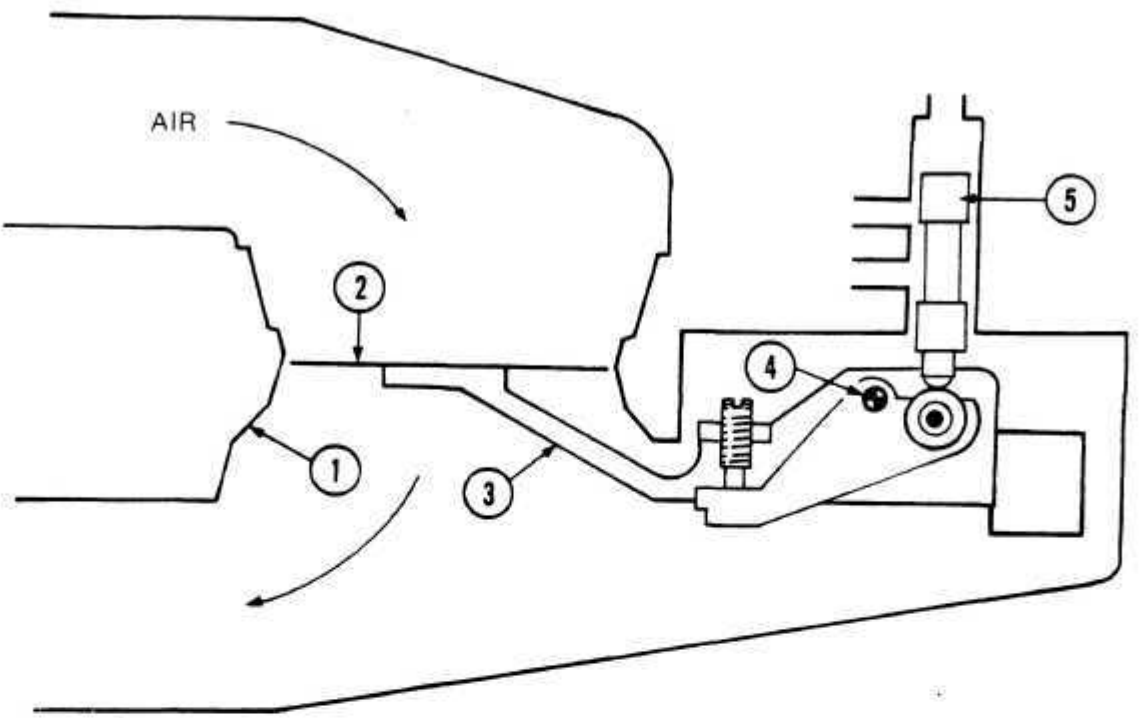
8 Air Flow Sensor
The air flow sensor measures the amount of air entering the engine.

9 Cold Start Valve
An electrically operated cold start valve is used to supply extra fuel to the engine during cold start conditions. The valve is mounted on the left side of the engine.

10 Thermo-Time Switch
The thermo-time switch regulates injection time of the cold start valve. The switch is mounted in the thermostat housing.

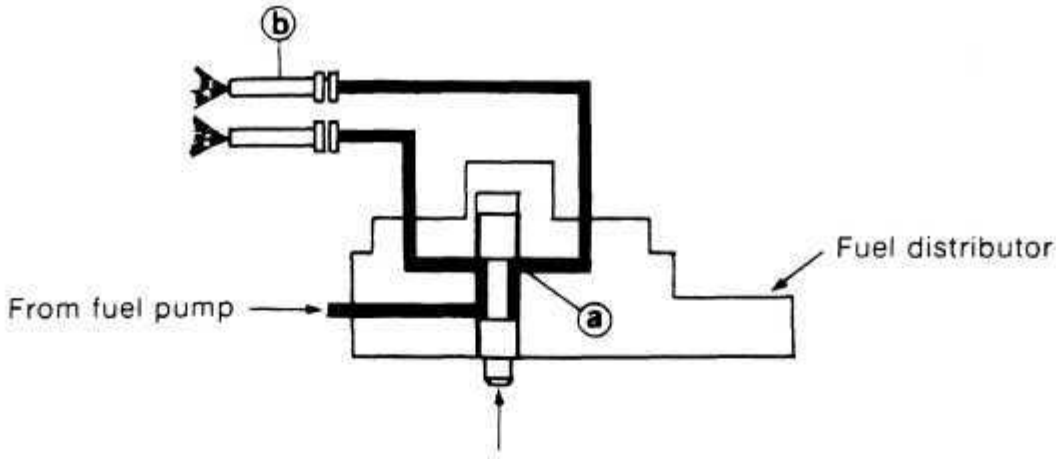
11 Injectors
The injectors are always open when the engine is running. Their main function is to atomize the fuel as it enters the intake chambers. The injectors are mounted in the cylinder heads.

12 Throttle Valves
The throttle valves control the amount of air entering the engine. The throttle valves are located between the mixture control unit and the intake manifold.

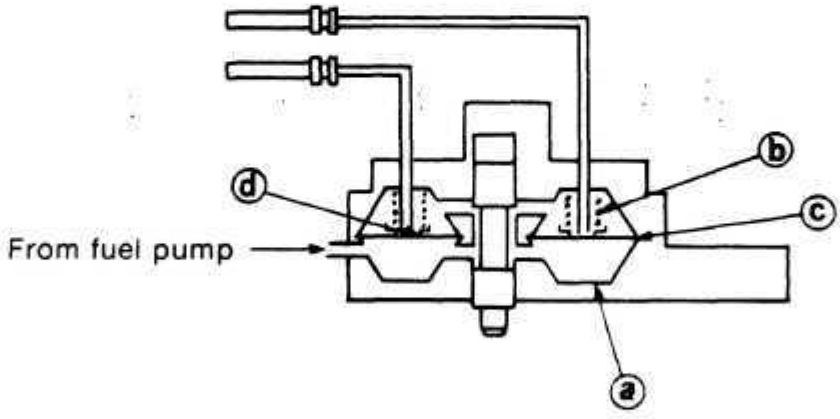


1 Air Funnel
2 Air Flow Sensor Plate
3 Balanced Lever Assembly
4 Pivot
5 Control Plunger

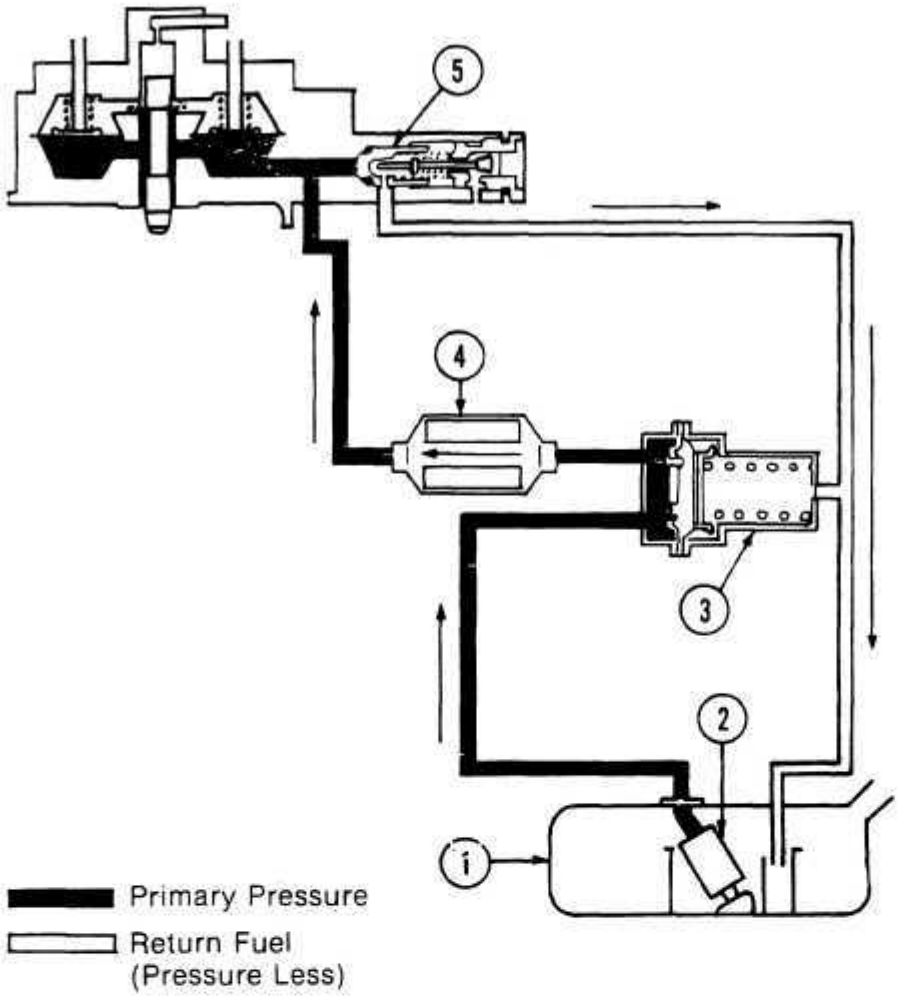
AIR MEASUREMENT: The amount of air entering the engine is controlled by the throttle valves, engine speed, and engine load. Air flowing through the air funnel (1) moves the sensor plate (2) downward in direct proportion to the air volume. This movement is transferred by the balanced lever assembly (3) to the control plunger (5) located in the fuel distributor.



FUEL DISTRIBUTION: Sensor plate movement causes the control plunger to move within a barrel containing one metering slot (a) per cylinder. As the control plunger rises, it allows an increased amount of fuel to be delivered to each injector (b) through the metering slots. The amount of fuel to the injectors is constantly controlled by the control plunger moving in relation to the amount of air entering the engine.



In the actual fuel distributor, there are six chambers that are separated by a diaphragm (c). The lower chambers (a) are connected together and the upper chambers (b) are separated with each one containing a pressure differential valve. The pressure differential valves (d) ensure that each cylinder will receive the same volume of fuel as the control plunger rises or lowers.



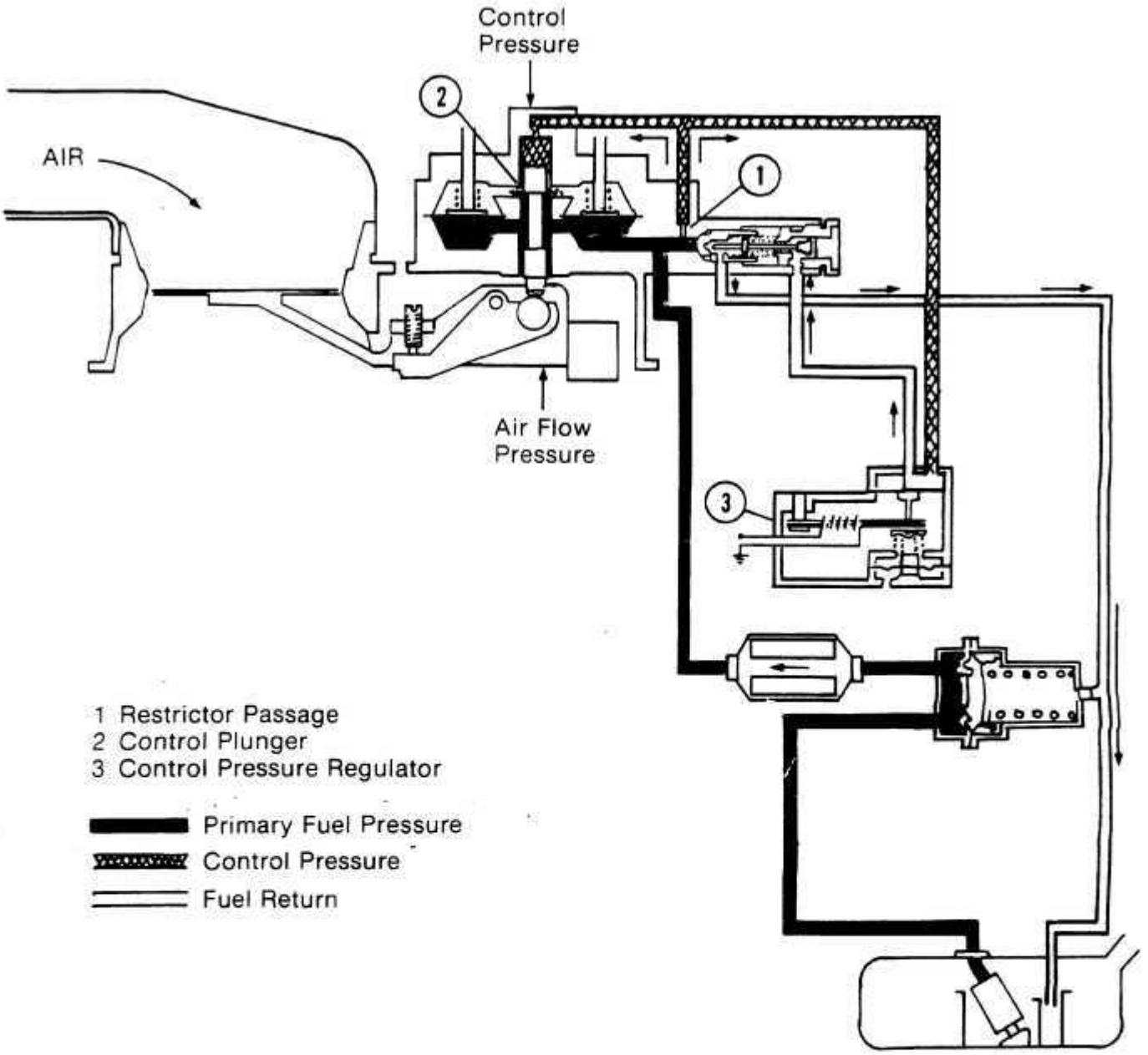
1 Fuel Tank
2 Fuel Pump
3 Accumulator
4 Filter
5 Primary Pressure Regulator

PRIMARY PRESSURE CIRCUIT: An electric fuel pump (2) runs constantly during cranking and when the engine is running. It supplies fuel to the lower chambers of the fuel distributor. Any fuel that is not used, returns to the fuel tank by passing through the primary pressure regulator (5).

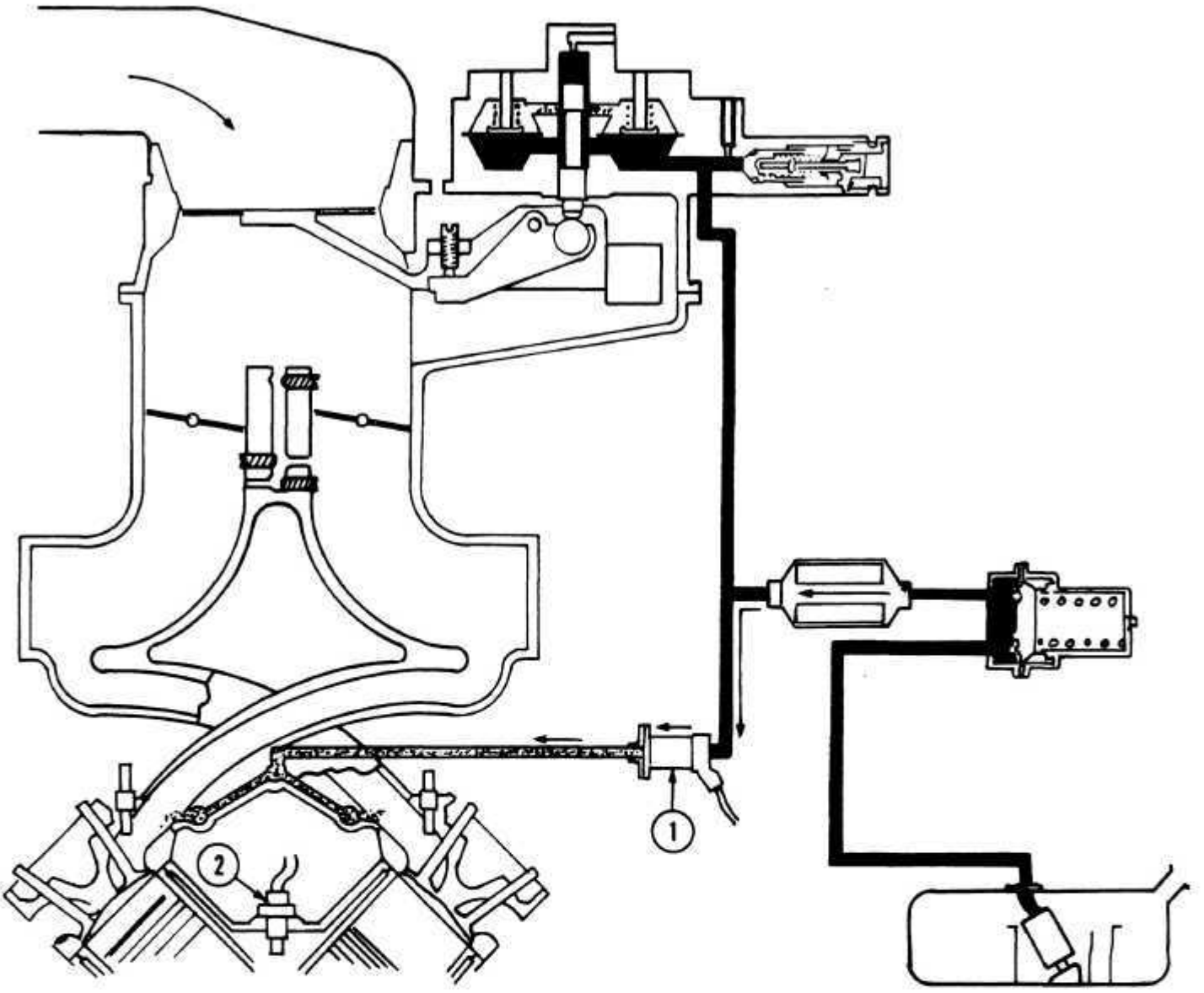
The primary pressure regulator controls main line fuel pressure. If the main line pressure increases above a pre-set value, the pressure forces the regulator open. This allows fuel to return to the tank, maintaining a constant main line pressure.

If the primary pressure decreases, the pressure regulator will close by opposing spring tension and restrict the amount of fuel returning to the tank. The movement of this regulator valve will maintain constant main line pressure and distributor lower chamber pressure regardless of engine fuel requirements or voltage fluxuations at the fuel pump. Main line pressure is regulated at approximately 5.2 Bar (75.4 PSI). The pump continuously circulates approximately 29 gallons of fuel per hour through the system.

The fuel accumulator (3) will charge during the first seconds of operation. This charging process will dampen initial fuel pump surge. When the engine is shut down, several check valves close throughout the system and prevent fuel from returning to the tank. The accumulator maintains pressure in the fuel system to prevent fuel vaporization while the vehicle is not in use.



CONTROL PRESSURE CIRCUIT: A portion of main line fuel is directed through a restrictor passage (1) to the top of the control plunger (2). This pressure circuit is referred to as the control pressure. The control pressure generates an opposing force to that originating from the air flow sensor plate. When the control pressure regulator (3) decreases the control pressure, the sensor plate will travel further downward per given air volume, thus increasing the amount of fuel injected to the engine (rich mixture). Increasing the control pressure will reduce the sensor plate travel with the same air volume reducing the amount of fuel injected to the engine (lean mixture).



Primary Pressure

1—Cold Start Valve 2—Thermo-Time Switch

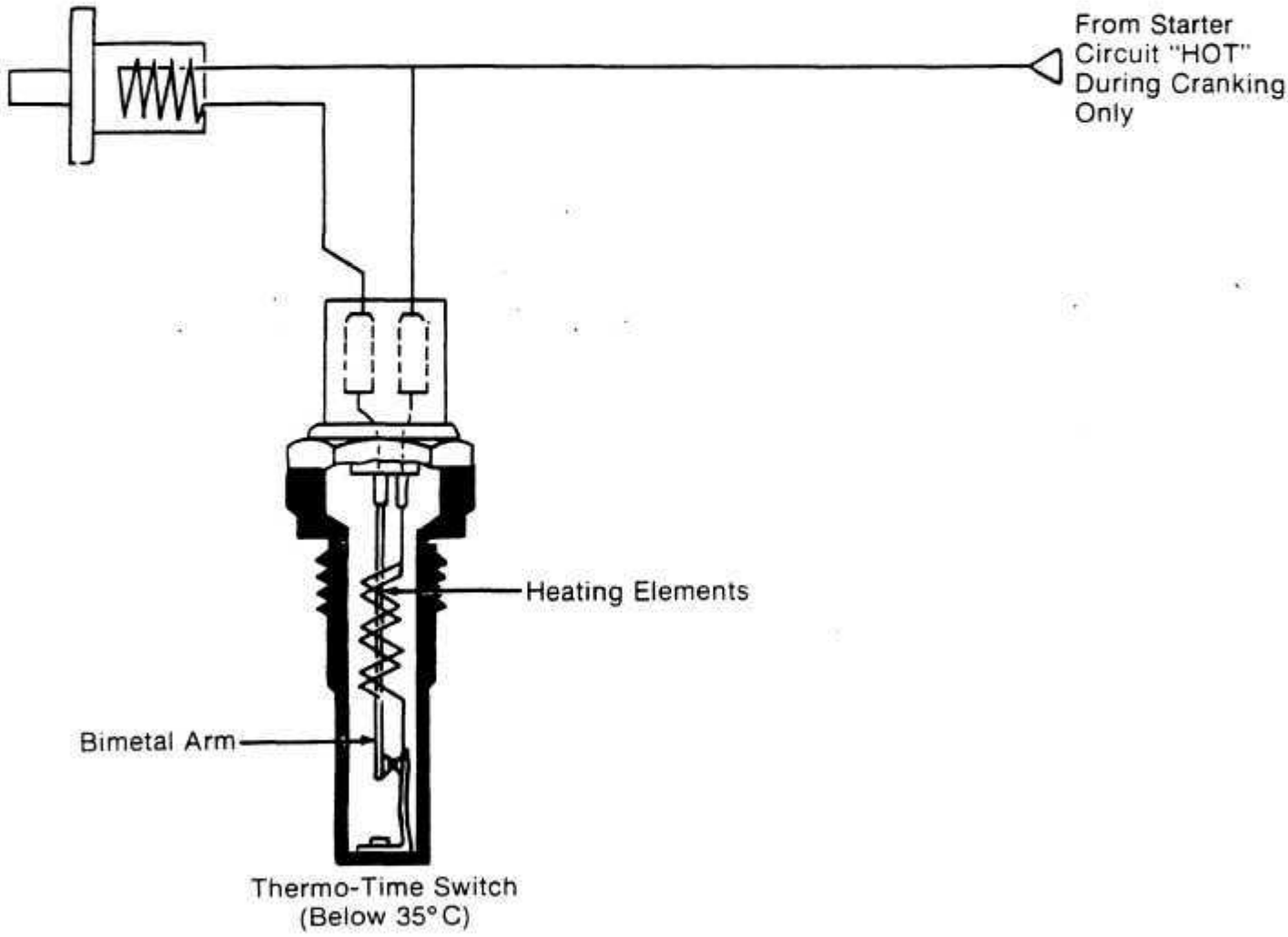
COLD START CIRCUIT: The cold start circuit provides a richer fuel mixture to facilitate starting a cold engine. The circuit operates only when the engine temperature is below +35°C (95°F) and during the cranking process.

The cold start valve (1) is of the solenoid-operated type. The winding of an electromagnet is fitted inside the valve. In the "off" position, the moveable armature of the electromagnet is forced against a seal by means of a spring. When the magnet is energized, the armature is pulled away from the seat and fuel is allowed to flow through the valve. A special nozzle atomizes the fuel as it leaves the valve and enters directly into the intake manifold.

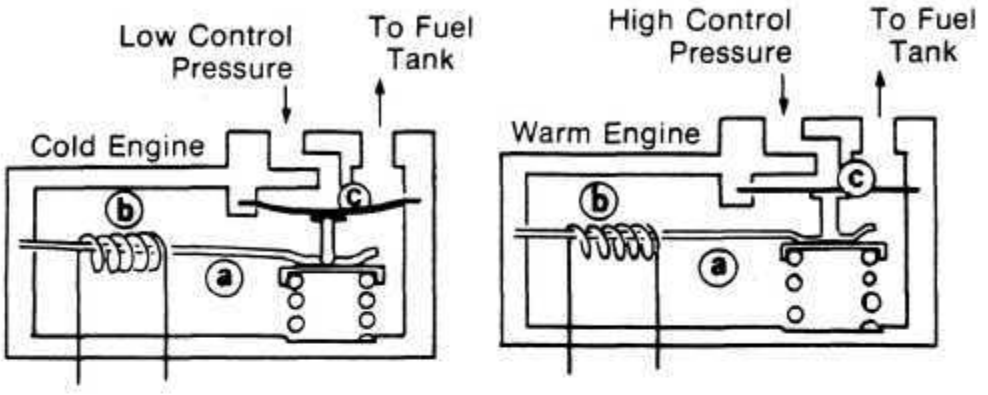
COLD START CIRCUIT (con't):

The thermo-time switch regulates the cold start valve injection time in relation to coolant temperature. When the coolant temperature is below approximately +35°C (95°F) the bimetal arm will bend enough to close the contact points. The closed contact points will provide a ground for the cold start valve, energizing the electro-magnet and injecting additional fuel to the engine while it is being cranked. During cranking, voltage is also applied to the heating element in the thermo-time switch. The heating element will warm the bimetal arm and open the contact points to prevent excessive cold start injection (flooding). The length of time that it takes the heating element to open the contact points is dependent on the engine coolant temperature.

Cold Start Valve

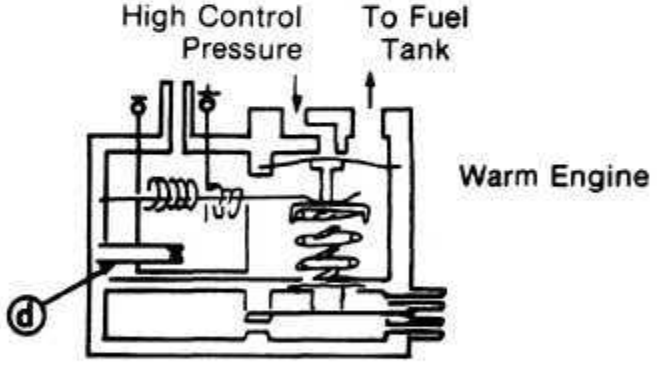


WARM-UP CIRCUIT: During the engine warm up period, it is necessary to provide a richer fuel mixture to improve driveability and eliminate hesitation during acceleration. The warm up circuit performs this function by lowering the control pressure which allows the air sensor plate to move further downward for a given volume of air.

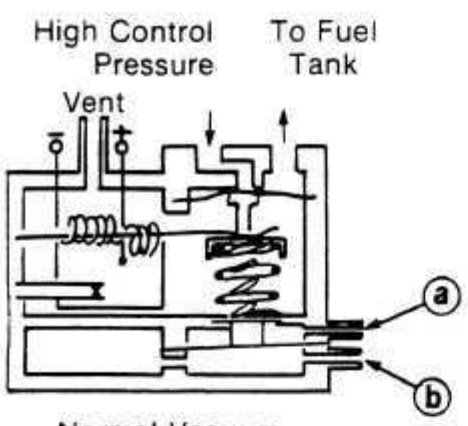


CONTROL PRESSURE REGULATOR

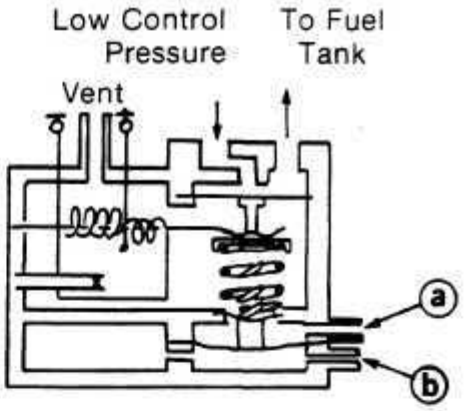
Control pressure is determined by the control pressure regulator and varies between approximately 1.5 Bar (22 PSI) and 3.8 Bar (55 PSI). The control pressure regulator is mounted on the left valve cover and is affected by engine radiant temperature. At engine start-up the control pressure is determined by engine radiant temperature rather than ambient air temperature. The regulator contains both a bimetal arm (a) which reacts to the engine temperature, and an electrical heating element (b). As the bimetal arm bends, the circuit pressure changes by opening or closing a passage (c) which allows fuel to return to the tank. On a cold engine, the bimetal arm will open the passage allowing more fuel to return to the tank, lowering the control pressure. This enriches the fuel mixture. As the heating element warms the bimetal arm, the passage will gradually close and allow the control pressure to build to its maximum valve.



In the actual control pressure regulator, a dual heating element is used with the bi-metal arm, plus an additional bimetal switch (d) is used. When the regulator temperature is below 15° C (59° F), the bimetal switch will open allowing only one heater to operate thus increasing the engine warm-up time. Closing of the bimetal switch above 15° C will permit both heaters to operate which in turn will reduce the engine warm-up time.

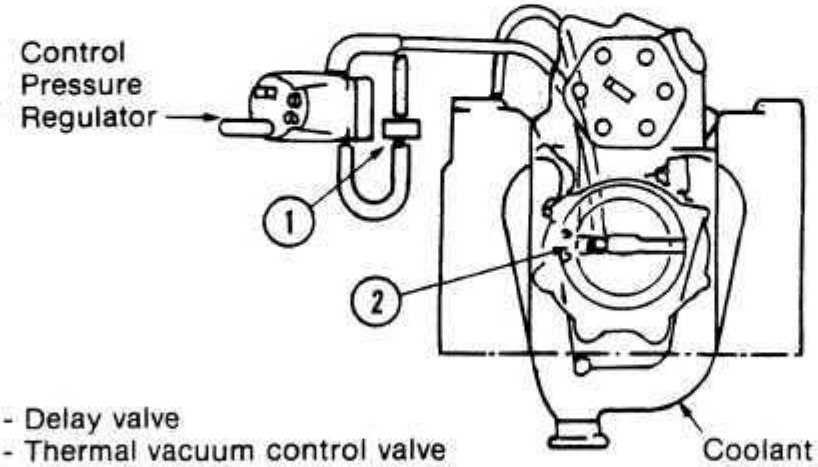


Normal Vacuum



Acceleration

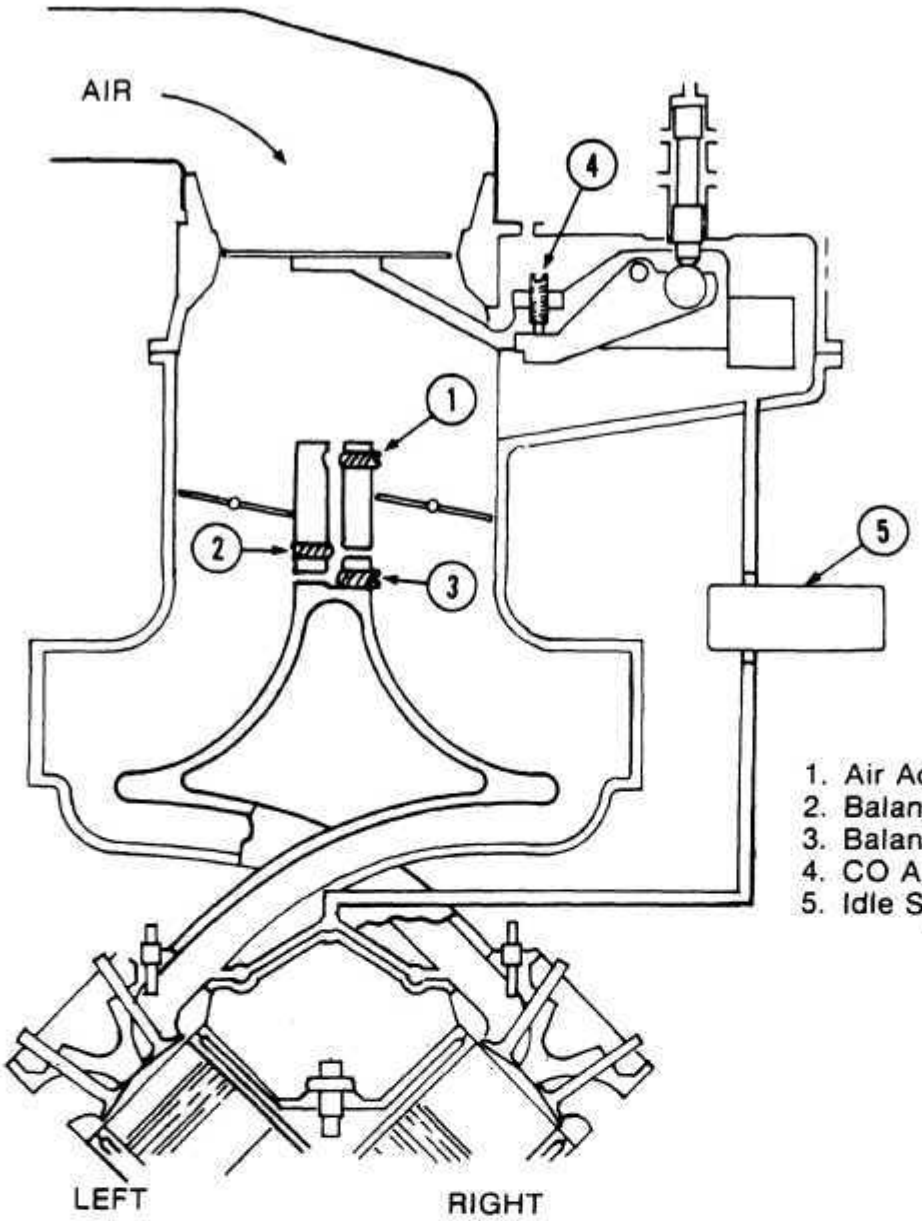
ACCELERATION ENRICHMENT CIRCUIT: The control pressure regulator is affected by engine manifold vacuum when the coolant temperature is below 40° C (104° F). Outlets (a) and (b) are both connected to the engine intake manifold. The hose to outlet (b) contains a delay valve. At coolant temperatures below 40° C the pressure increase (loss of vacuum) in the intake manifold during acceleration reaches the lower vacuum chamber later than it reaches the upper chamber due to the delay valve. The diaphram separating these two chambers then deflects downwards opening the pressure regulator momentarily. This results in a very short "enrichment spike" in the air-fuel mixture.



1 - Delay valve
2 - Thermal vacuum control valve

The vacuum delay valve (1) located in the hose connected to outlet (b) provides a 10 second delay during acceleration. After 10 seconds, the pressures above and below the diaphram will equalize and the control pressure will return to normal.

The thermal vacuum control valve (2) opens at coolant temperatures below 40° C (104° F) to allow manifold vacuum to reach the control pressure regulator. Above 40° C, the acceleration enrichment circuit is inoperative.

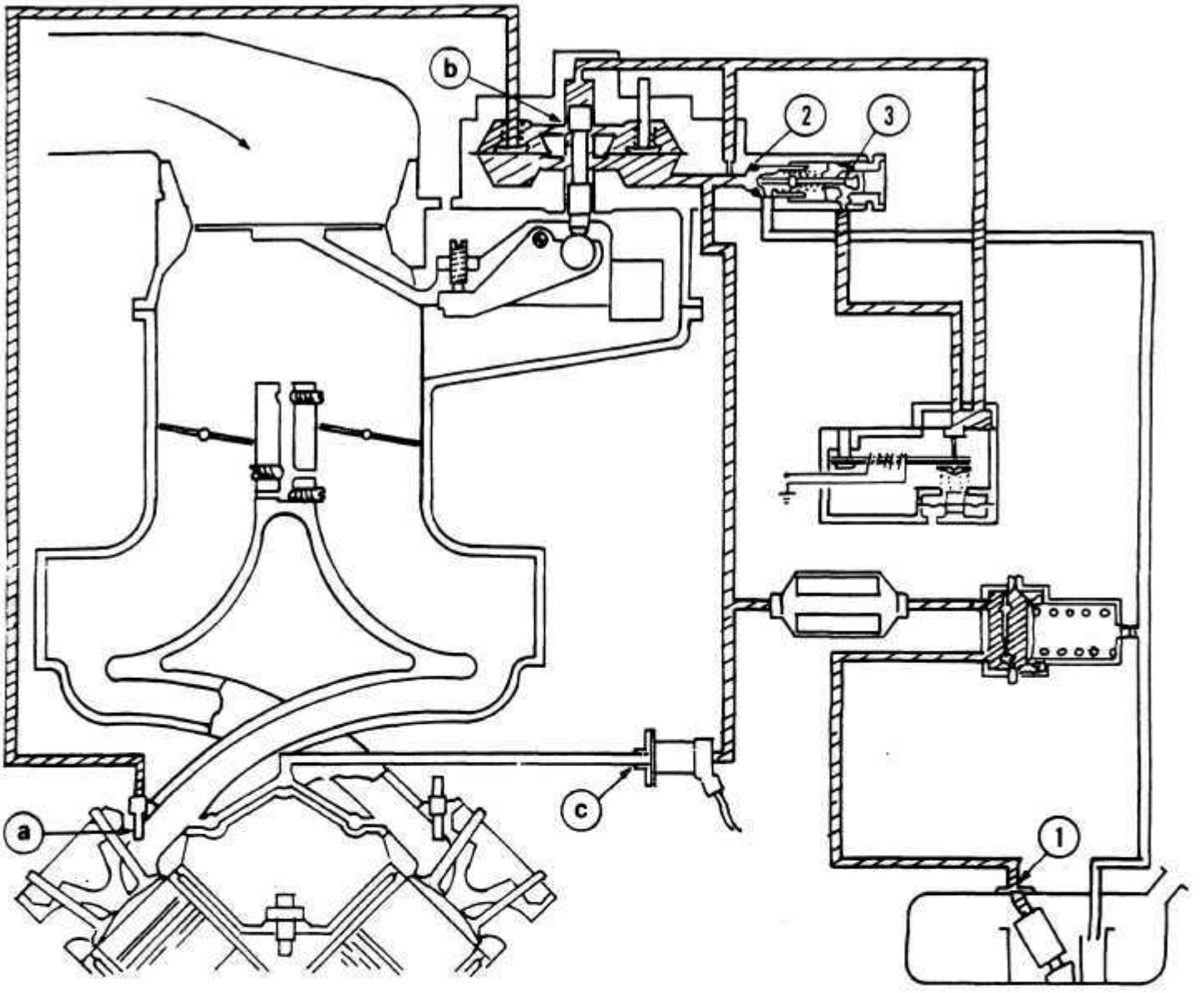


1. Air Adjusting Screw
2. Balancing Screw-Left Bank
3. Balancing Screw-Right Bank
4. CO Adjustment Screw
5. Idle Speed Regulator

IDLE CIRCUIT: The throttle body on the PRV V-6 engine contains an air adjusting screw (1) and two air balancing screws (2 and 3). These adjustment screws are not used on the De Lorean since an electronic idle speed control system is used. The air adjusting screw (1) should be fully seated to eliminate any air bypass at the throttle plates.

The idle speed regulator (5) allows the proper amount of air to bypass the closed throttle plates during an idle condition.

The CO adjusting screw (4) is used to control the amount of injected fuel in relation to the position of the air sensor plate. Turning this screw will increase or decrease the air-fuel ratio. This adjustment is performed at the factory and the access hole is plugged.



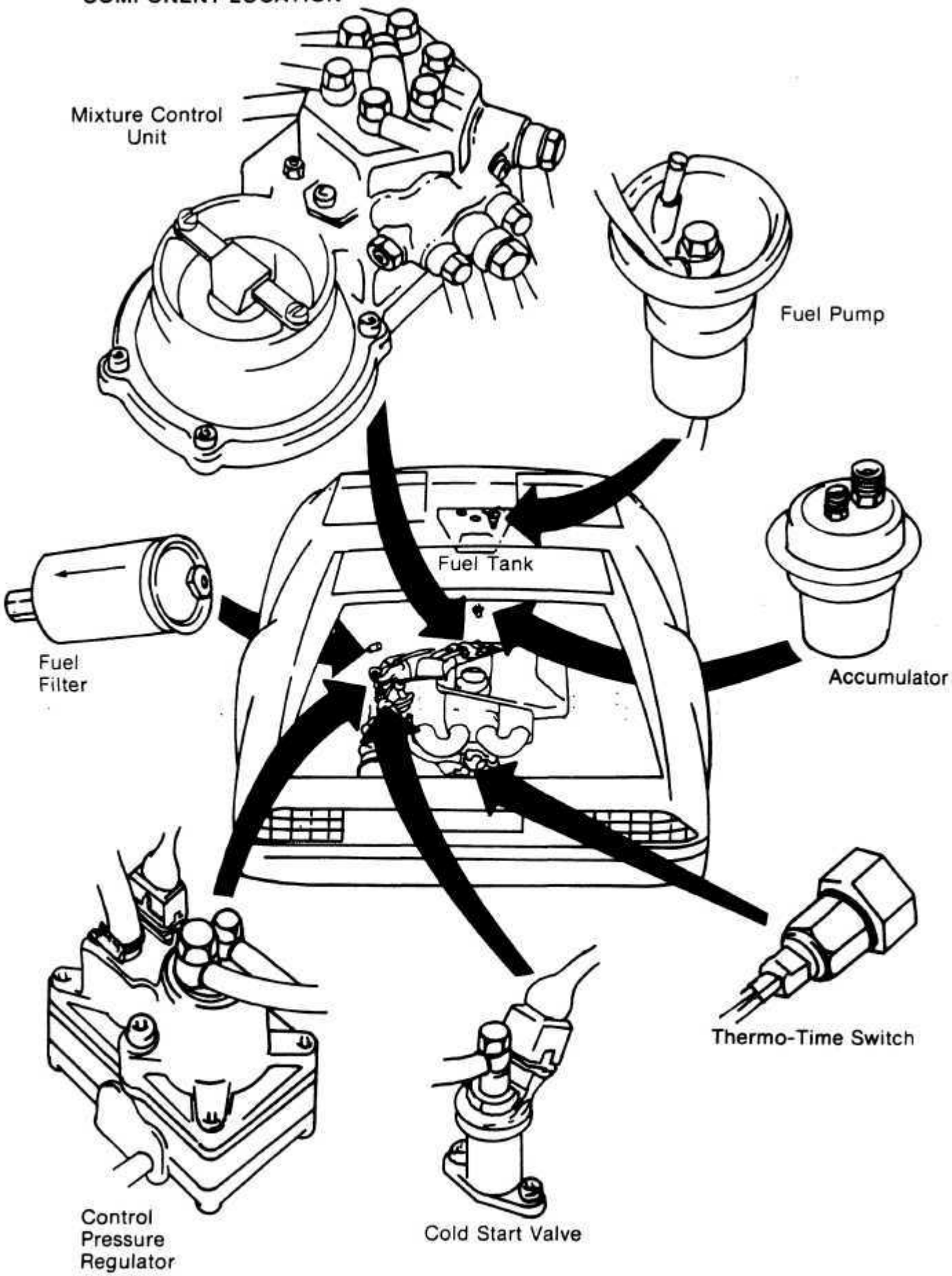
REST PRESSURE

1 - Fuel Pump Check Valve
2 - Primary Circuit Seal
3 - Control Pressure Circuit Seal

REST PRESSURE: When the fuel pump is not operating, it is necessary to retain fuel under pressure in all lines. This "rest" pressure will prevent vapor from forming in the lines and insure instant restarting. When the fuel pump stops, a check valve (1) and two seals (2 & 3) close, sealing off the fuel return lines to the tank. The accumulator will then maintain pressure in the system to prevent vaporization.

In addition to the check valves and seals, it is important that the control plunger (b) returns to the closed position, all injectors (a) close tightly, cold start valve (c) closes tightly and all fuel connections are tight and leak free.

COMPONENT LOCATION



SYSTEM REPAIR NOTES

1. The majority of the fuel injection components are sealed units and cannot be adjusted or repaired. Tampering with a sealed component will automatically void the component warranty. The following guide indicates component serviceability and authorized repairs:

Fuel Pump:	The fuel pump is not serviceable. The return check valve located in the fuel inlet cannot be replaced.
Accumulator:	Not serviceable.
Fuel Filter:	Not serviceable, replace when contaminated.
Mixture Control Unit:	
• Fuel Distributor:	The fuel distributor can be removed from the mixture control unit for replacement. Fuel distributor is not serviceable.
• Primary Pressure Regulator:	The regulator O-ring seals are replaceable and the primary pressure may be adjusted by adding or subtracting spring shims.
• Air Flow Sensor Assembly:	Sensor plate and arm assembly can be centered if a binding condition exists. Rest position of sensor plate can also be adjusted.
Control Pressure Regulator:	Not serviceable.
Cold Start Valve:	Not serviceable.
Thermo-time Switch:	Not serviceable.
Fuel Injectors:	Not serviceable.
Throttle valves:	Throttle idle stop position is preset and should not be tampered with.

2. The largest problem affecting the operation of fuel injection components is dirt and moisture contamination. Therefore, precautions should be taken when working on the system to avoid contamination.

3. When replacing fuel lines or components, use only approved replacement parts that were designed for this system. Due to the high fuel pressures used in this system, do not attempt to splice fuel hoses.

ELECTRICAL CIRCUIT FUNCTION: If the engine coolant temperature is below 35° C (95° F) the thermo-time switch is closed providing a ground for the cold start valve. During cranking conditions, power is supplied to the cold start valve from the starter solenoid, activating the valve to inject additional fuel to the engine. If the cranking process takes longer than 8 to 15 seconds, the thermo-time switch heating element opens the switch, deactivating the cold start valve to prevent the engine from flooding. In this case, the thermo-time switch functions as a time switch.

If the temperature of the engine coolant is above 35° C (95° F) when the starting process is commenced, the thermo-time switch is open eliminating the cold start valve ground. In this case the thermo-time switch functions as an engine coolant temperature switch.

This circuit is equipped with an RPM relay which receives power from the main relay through fuse #1. The rotational speed of the engine produces ignition pulses at terminal #1 of the ignition coil. These pulses are processed by an electronic circuit in the RPM relay which closes the relay contacts. Current from #7 fuse is then supplied to the fuel pump and control pressure regulator.

The RPM relay remains closed as long as the ignition switch is "on" and the engine is running. If the pulses from terminal #1 of the ignition coil stop because the engine has stopped turning, the RPM relay opens about one second after the last pulse is received. This safety circuit prevents the fuel pump from pumping when the ignition switch is "on" but the engine is not running.

Another safety feature in the fuel pump circuit is the inertia switch. This switch provides the ground circuit for the electric fuel pump. In the case of an accident where high impact is involved, the inertia switch will open the circuit between the fuel pump and ground. This will prevent the fuel pump from pumping fuel out of a possible ruptured hose. The inertia switch also activates the door lock circuit to unlock the doors upon high impact.

The control pressure regulator receives power from the RPM relay when the engine is rotating. Thus current will heat the bimetal arm in the pressure regulator for proper engine warm-up operation.

The car is wired for a hot start relay. This relay can be installed if a hot starting problem is experienced in excessively hot regions of the country. When this relay is used, the cold start valve will inject intermittently during cranking when engine is hot.

SYSTEM REPAIR NOTES

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Throttle valves:	Throttle idle stop position is preset and should not be tampered with.

2. The largest problem affecting the operation of fuel injection components is dirt and moisture contamination. Therefore, precautions should be taken when working on the system to avoid contamination.

3. When replacing fuel lines or components, use only approved replacement parts that were designed for this system. Due to the high fuel pressures used in this system, do not attempt to splice fuel hoses.

4. After replacing any major fuel injection component, the engine idle speed and CO level should be checked and adjusted if necessary.
5. The RPM relay is located in the relay compartment behind the passenger seat. (See "Chassis Electrical" section)
6. The inertia switch is located under the left side of the dash panel and is mounted to the Lambda mileage counter bracket. When the button on the inertia switch is in the "up" position the switch is in the "open" position. In this position the fuel pump will not operate and the door locks will move to the unlock position. To reset the inertia switch, depress the button or move to the "down" position.
7. Excessively high fuel pressures can be caused by a plugged fuel return line.
8. Positive pressure buildup in the fuel tank is normal for this system.
9. If it is necessary to adjust the CO level, the adjusting hole plug can be removed by drilling down to the hardened steel insert and threading a pulling tool into the plug.

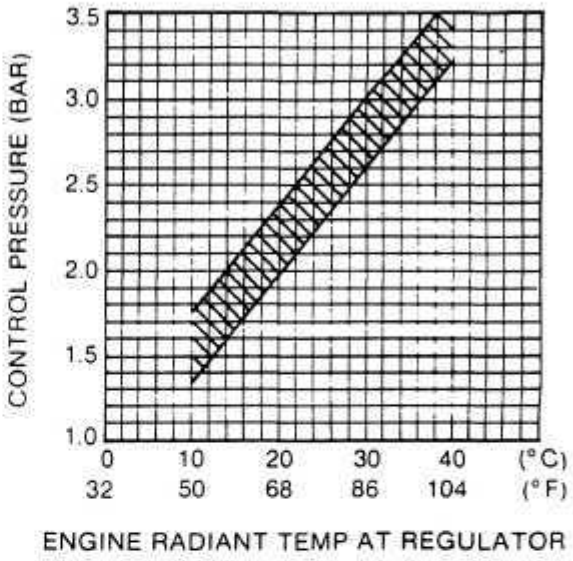
SPECIFICATIONS

1. Electric fuel pump

   Fuel Delivery: Minimum 850 cm^3/30 sec. (1.8 pints/30 sec.)

2. Control pressure "COLD" (Regulator temp. below 40° C)

   Test with intake manifold vacuum hoses disconnected from control pressure regulator



NOTE: 1 Bar = 14.5 PSI

3. Control Pressure "WARM" (Regulator temp. above 40° C)

   a. Test with intake manifold vacuum hoses disconnected from control pressure regulator — 3.4 - 3.8 Bar

   b. Connect vacuum pump to vacuum port on control pressure regulator which contains the delay valve — 1.4 - 1.8 Bar

   Vacuum Setting Value: 450-550 mbar (13.3-16.2 in Hg)

4. Primary Pressure

   Checking value — 4.9 - 5.5 Bar
   Setting value — 5.1 - 5.3 Bar

5. Rest pressure leakage test

   Rest Pressure — 3.3 Bar
   Minimum pressure after 10 min. — 1.7 Bar

6. Injection valves

   Opening pressure — 3.5 - 4.1 Bar

7. Control pressure regulator delay valve

   Time required to bleed-down from 16 in. Hg vacuum to 8 in. Hg — 10 ± 2 seconds

8. Acceleration enrichment thermal vacuum control valve

   a. Fully closed at temperatures above 53°C (127°F).
   b. Must start to open at 48°C (118°F) when temperature is decreasing.

9. Thermo-time Switch

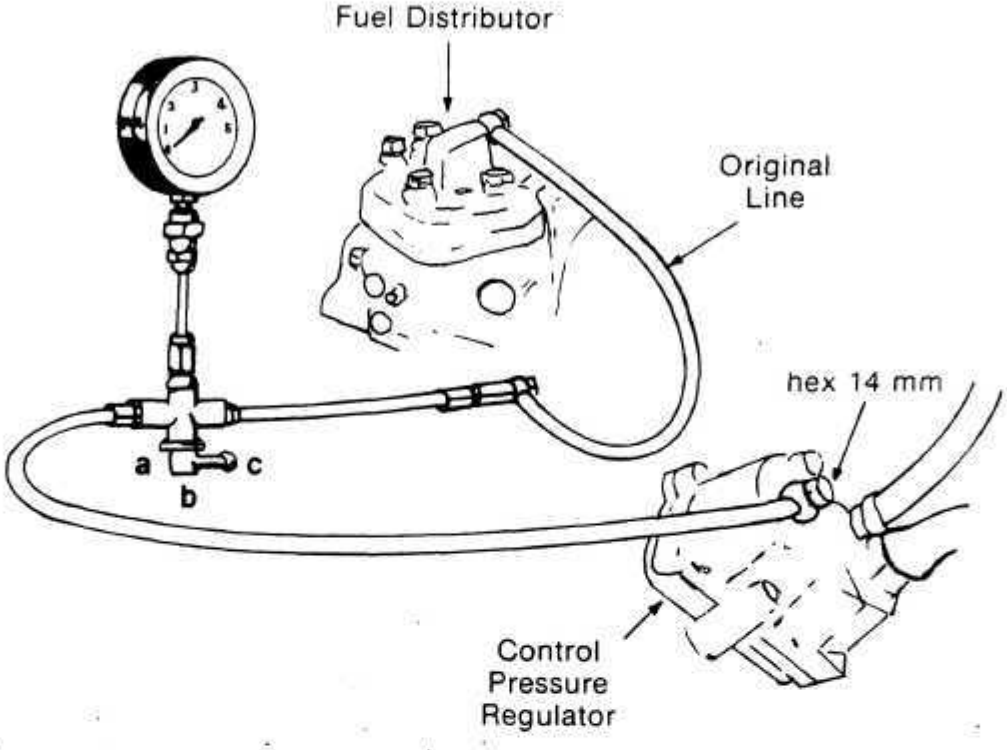
Coolant Temperature	Contact Opening Time
-20°C (-5°F)	7.5 ± 2 seconds
35 ± 4°C (95°F)	0

10. Fuel line tightening torques:

M8 Bolt	10-12 Nm	(7-9 FT Lb.)
M10 Bolt	13-15 Nm	(9-11 FT Lb.)
M12 Bolt	20-24 Nm	(14-17 FT Lb.)
M14 Bolt	15-20 Nm	(11-14 FT Lb.)
M12 Cap Nut	15-20 Nm	(11-14 FT Lb.)
M14 Cap Nut	25-30 NM	(18-22 FT Lb.)

11. Throttle idle stop adjustment: See "Engine adjustment, tests and diagnosis" section.

TEST GAUGE CONNECTION



VALVE POSITION

"A"	Off
"B"	Check control pressure
"C"	Check primary pressure

NOTE: When checking fuel pressures, it is necessary to operate the fuel pump without the engine running. To by-pass the RPM relay, remove relay and connect a jumper wire between terminals #87 and #30 in the connector. The RPM relay is located in the relay compartment behind the passenger seat. (See "Chassis Electrical" section)

CAUTION: When connecting or disconnecting the test gauge, rest pressure will be present in the fuel system. Fuel fittings should be loosened slowly to avoid fuel spray in the engine compartment and a container should be available to drain fuel into.