A.F.C.

System Components

Checking/Adjusting

Troubleshooting Guidelines

- **Engine will not start or is hard starting**

  a. No fuel
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  - — Page 18 Air Flow Sensor

  b. No spark
  - — Page 33 Ignition System (Electronic)
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  c. Incorrect air/fuel mixture
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- **Poor idle**
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- **Poor performance or high fuel consumption**
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Minimum Requirement

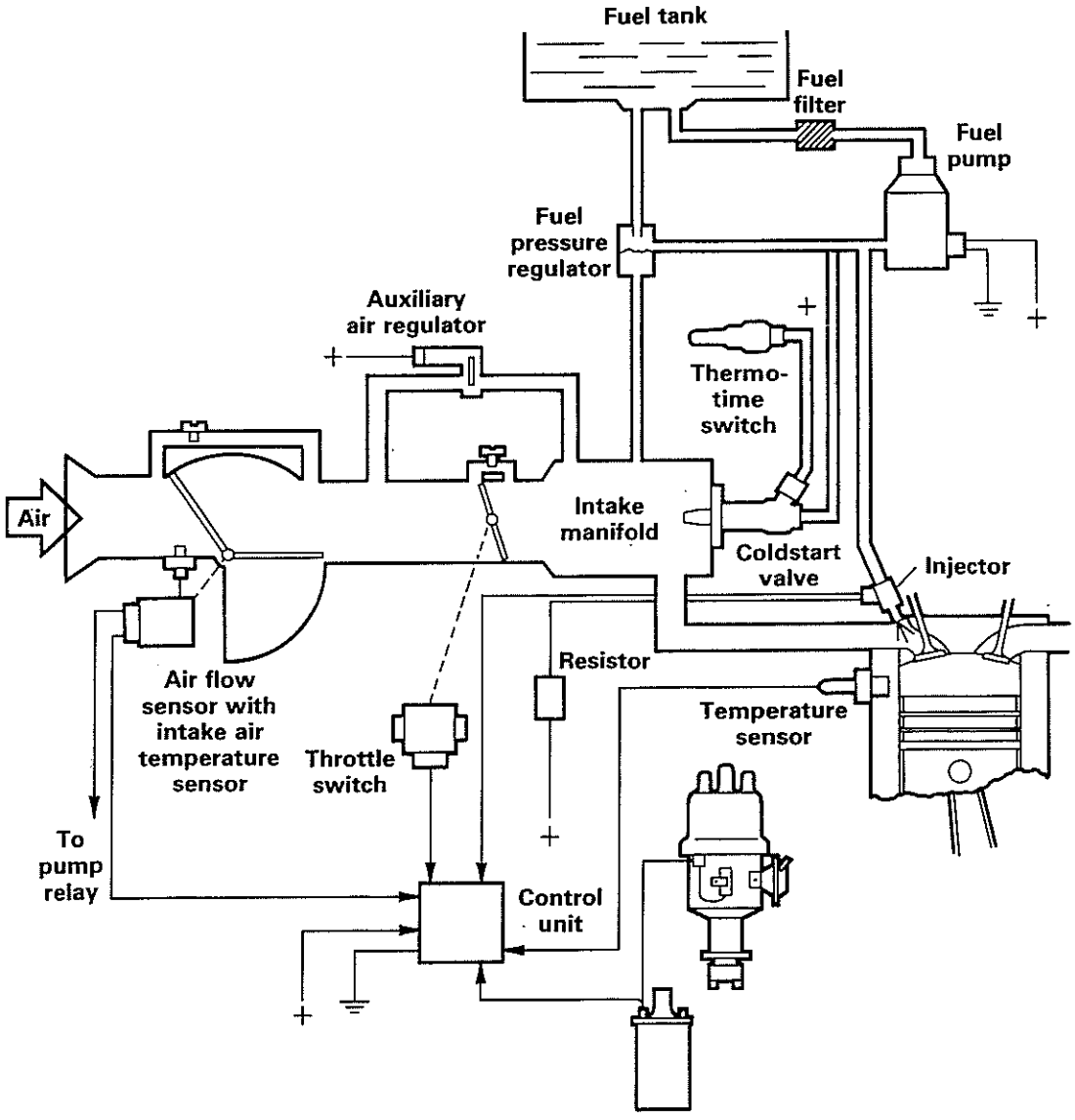
VW 1367 Tester
US1119 Multi-meter (Digital)
US 1076 or VW 1318 with Adapter VW 1318/17, Pressure Gauge
SUN 105 CO Tester
SUN 120.239 CO Adapter
US 4487 Evaporative System Leak Tester (Slack Tube)
US 1115 L.E.D. Test Light (Leads must be connected Red to Positive and Black to Negative) - (Standard 12V Test Light optional)

Obtain Locally

1 Liter Graduated Container

A.F.C. System Operation

Starting in 1974, VW introduced "Air Flow Controlled" (A.F.C.) Electronic Fuel Injection, a simplified version of "Manifold Pressure Controlled" (M.P.C.) injection used on earlier vehicles. Because the A.F.C. injection measures the intake air flow directly, the fuel mixture remains constant regardless of changes in exhaust back-pressure (a common result of add-on emission control devices such as air pumps and catalytic converters). A.F.C. injection was first incorporated on Type II (bus) vehicles as of the 1975 Model Year, and remained in use until the introduction of the water-cooled Vanagon and Digijet Injection in 1983.



System Operation

Basic operation of the A.F.C. Injection System is as follows:

— Air is drawn through the air cleaner and air flow sensor, then into the engine.

— The air flow sensor measures the amount of air entering the engine and sends a voltage signal to the electronic control unit (E.C.U.)

— The E.C.U. triggers the injectors to open, based on engine speed and the voltage signal from the air flow sensor.

— Injector opening duration is adjusted by the E.C.U., based on inputs from various other sensors, such as engine temperature and intake air temperature.

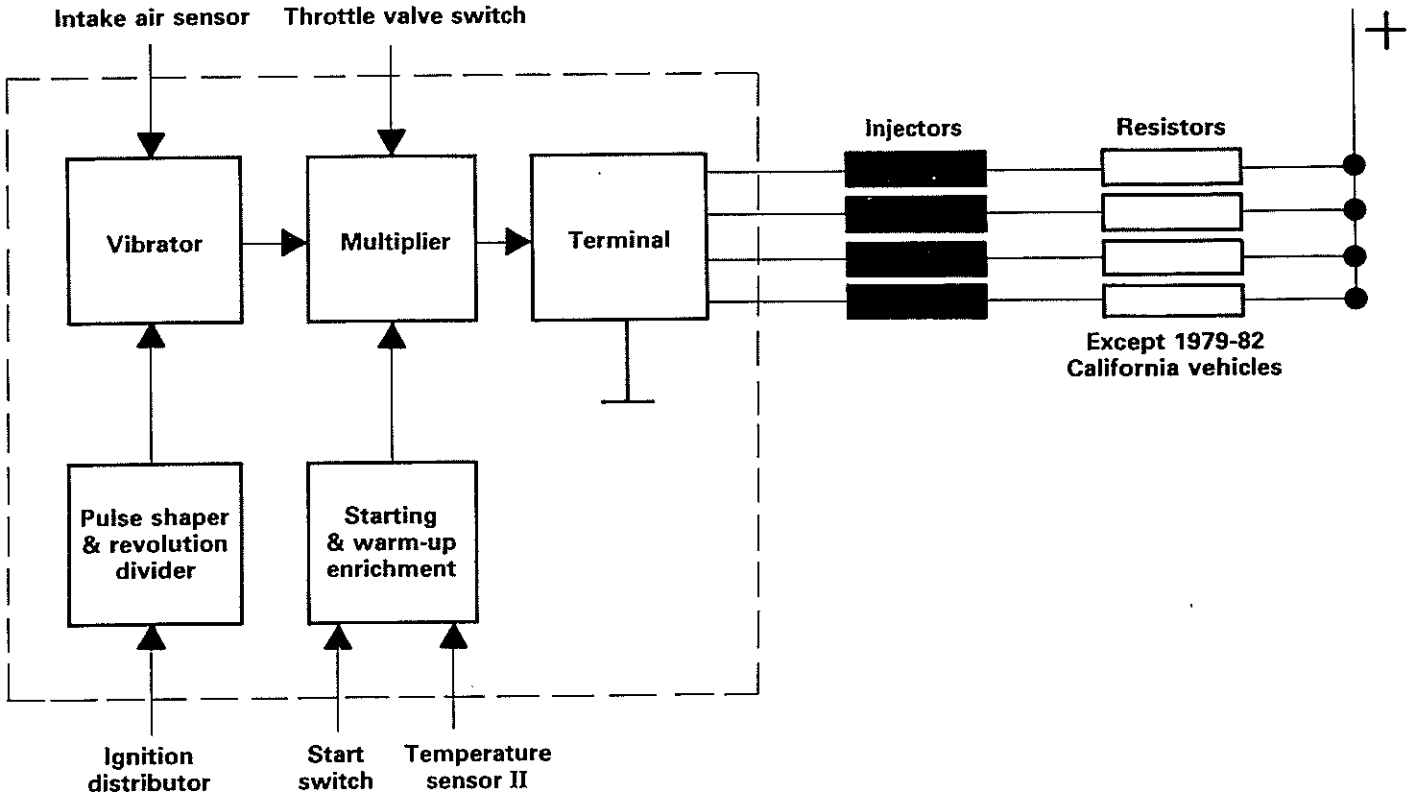
— Cold start enrichment is provided by a cold start valve (5th injector), which is controlled by the thermo-time switch.

— Cold start and warm-up enrichment are also affected by the cylinder head temperature sensor and the intake air temperature sensor.

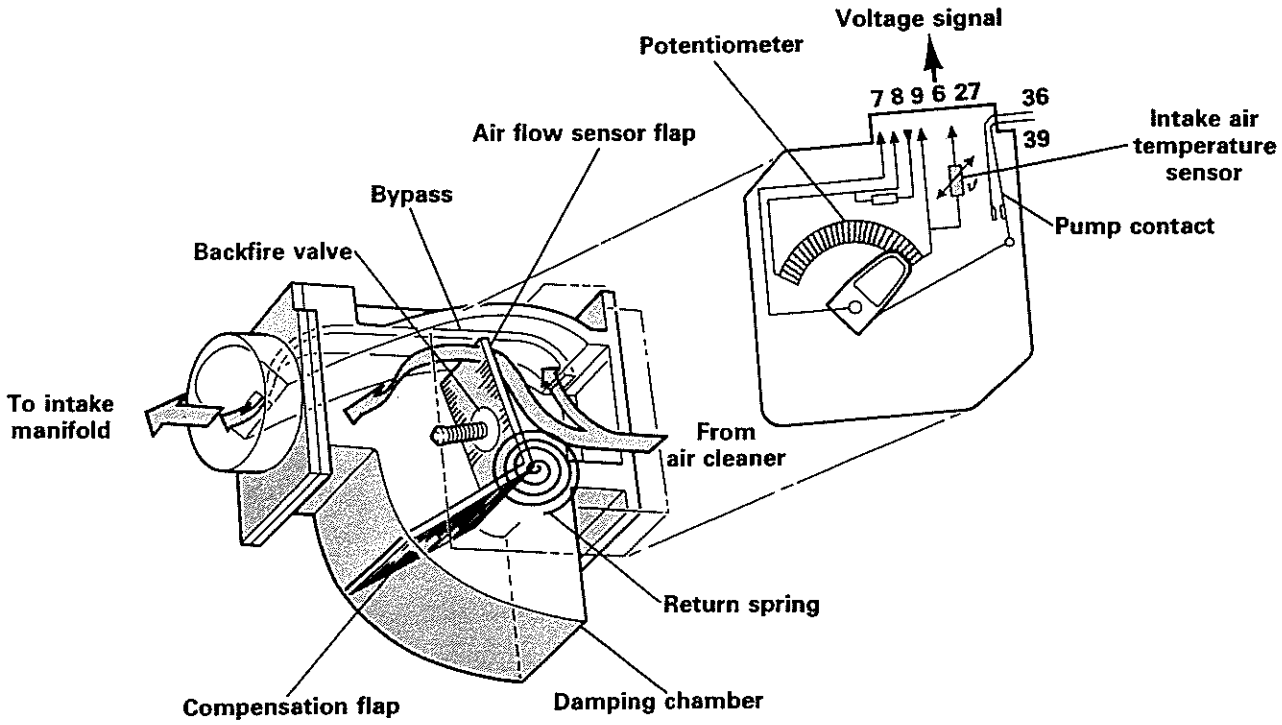
— The auxiliary air regulator supplies additional air to regulate idle speed during warm-up.

Electronic Control Unit (E.C.U.)

The control unit is an electronic computer. It receives incoming signals regarding air volume, engine revolutions, temperature and throttle position. From this information the computer calculates the correct **injection time** for the injectors.



Air Flow Sensor/Intake Air Temperature Sensor



The air flow sensor measures the amount of air entering the intake manifold and provides the control unit (E.C.U.) with voltage signals.

Intake air opens the air flow sensor flap which actuates the potentiometer to determine the voltage signal. This signal and the engine speed information supplied by terminal No. 1 of the ignition coil is used for the determination of fuel injector opening duration.

A compensation flap connected to the air sensor dampens sudden movements of the air sensor flap due to oscillations of the intake air.

The air flow sensor also has a set of contacts which controls the fuel pump. This circuit prevents the engine from flooding in the event of a leaking injector, by allowing the fuel pump to operate only when the engine is running or during cranking.

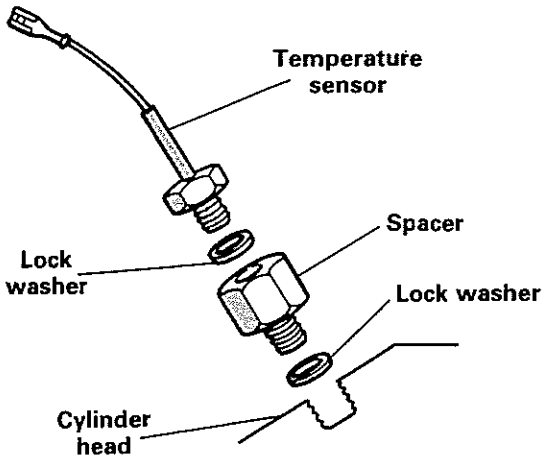
Component Description

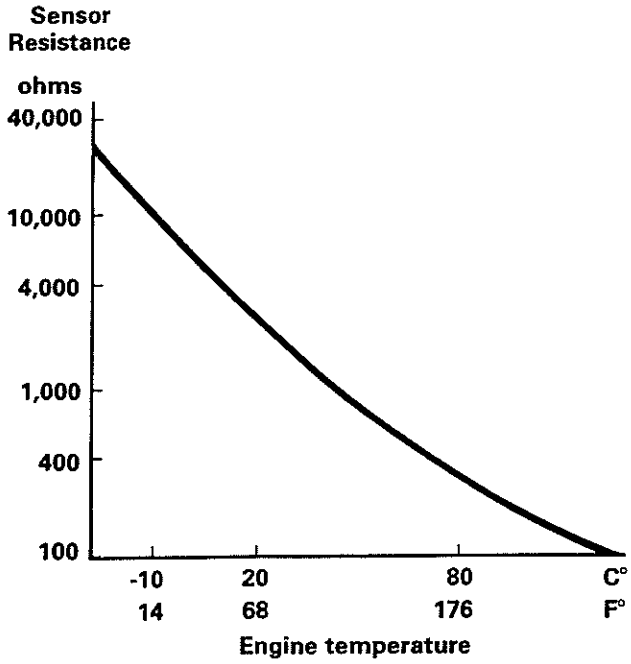
Intake Air Temperature Sensor

An intake air temperature sensor is mounted in the air flow sensor housing of most vehicles. This temperature sensor is an NTC resistor like the cylinder head temperature sensor, and is connected between terminals 6 and 27 of the air flow sensor. The signal it supplies the E.C.U. is used to modify the fuel injection rate depending on intake air temperature.

Some earlier production vehicles equipped with intake air pre-heating do not use an intake air temperature sensor. The air flow sensor used on these vehicles does not have a terminal 27.

Cylinder Head Temperature Sensor





The cylinder head temperature sensor is screwed into the left side cylinder head, and is connected to the control unit by a single wire. This sensor is critical to good engine performance, particularly during starting and warm-up.

The sensor resistance decreases as engine temperature increases. This input is used by the control unit (E.C.U.) to provide a richer mixture during cold start and warm-up, by lengthening the injector opening duration. The lower the temperature, the more fuel is provided to the engine.

A temperature sensor spacer P/N 022 133 079 is available for cars which run well on initial start-up and when fully warm, but have performance problems only during warm-up.

This spacer does not affect resistance values when the engine is cold or when it is fully warm, but it does delay the change in resistance during warm-up. The spacer temporarily insulates the temperature sensor housing from the heat of the cylinder head.

The spacer does not improve hard starting, or performance problems after the engine is at operating temperature.

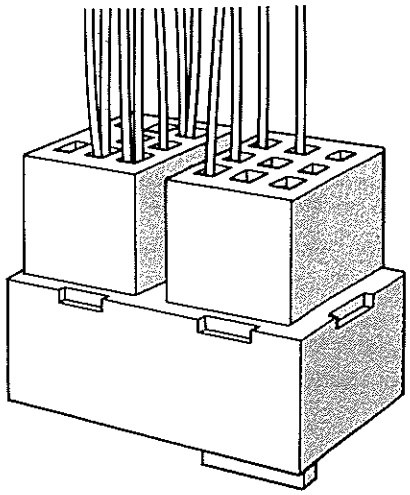
Double Relay

The double relay, or sometimes referred to as "dual relay," supplies current from the battery to the control unit and the injectors whenever the ignition key is on.

Whenever the starter is engaged, the relay activates the fuel pump and supplies current to the cold start system.

After the engine is started contacts in the intake air sensor control the relay so the fuel pump will run constantly during normal engine operation.

The relay is located in the left side of the engine compartment.

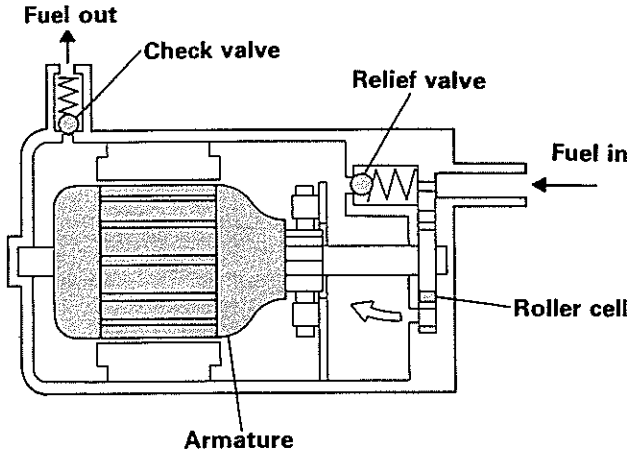


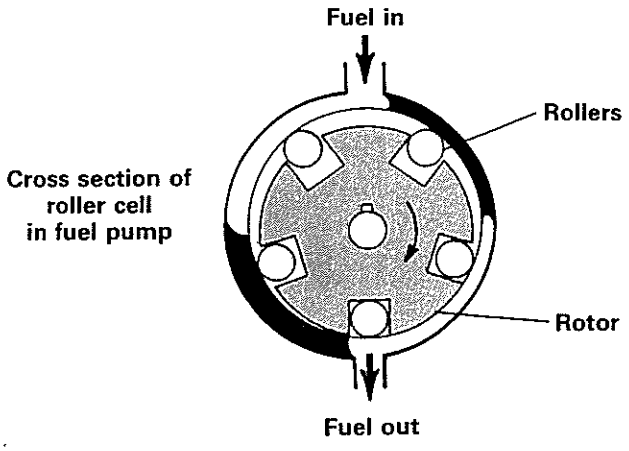
Fuel Pump

The roller-cell fuel pump is driven by a permanent magnet electric motor and is located near the fuel tank.

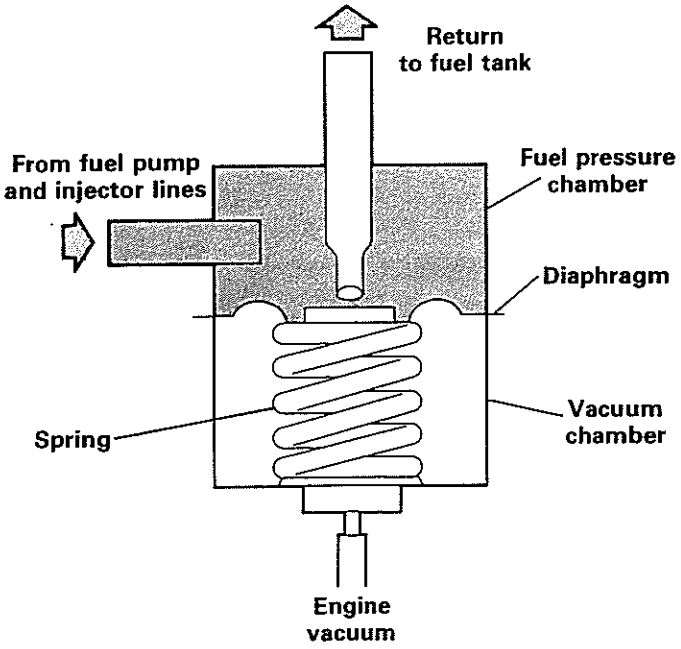
Steel rollers are held in "cut-outs" on the rotor. Centrifugal force seals the rollers against the walls of the pressure chamber as the rotor spins. Fuel that is trapped between the rollers is then forced out the delivery port. The pump is designed to be both cooled and lubricated by the fuel flowing through it.

The pump delivers several times the amount of fuel required to operate the engine at any time. Excess fuel is diverted back to the tank via the fuel pressure regulator.





Fuel Pressure Regulator



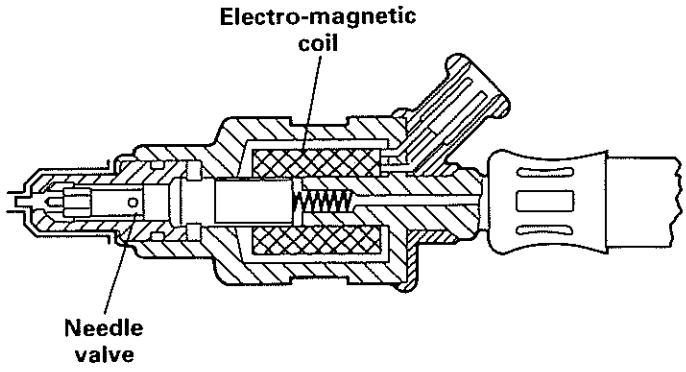
The system pressure regulator maintains a constant fuel pressure to all injectors by regulating the quantity of fuel returned to the fuel tank.

The regulator is connected to the intake manifold. It responds to manifold vacuum fluctuations, and thereby compensates for engine-load changes.

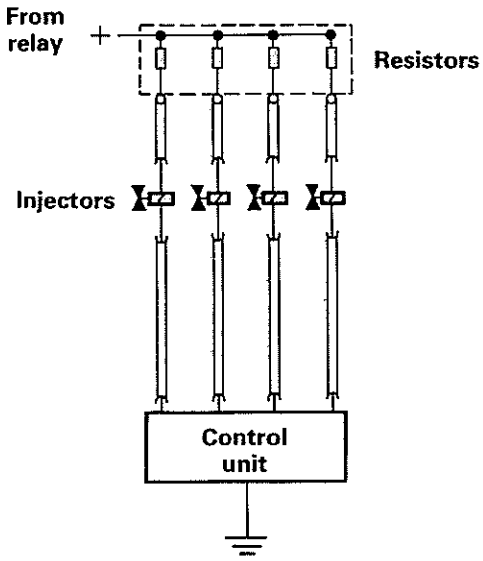
When the engine is shut off, the regulator closes and seals to maintain residual fuel pressure in the injector lines for improved hot-start capability.

Fuel Injectors

A.F.C. fuel injectors are electronically controlled on/off valves. A solenoid actuates a needle valve allowing fuel to be forced through the injector nozzle. All four injectors open at the same time and inject fuel directly into the intake manifold near the intake valve. Injection quantity is controlled by the amount of time the injectors stay open. Injector opening time is regulated by the E.C.U., based on inputs from the various engine sensors.



The injectors work best with about 3 - 5 volts. A resistor pack reduces the 12 volts available from the power relay whenever the engine is running. The resistors can only be replaced as a complete unit.

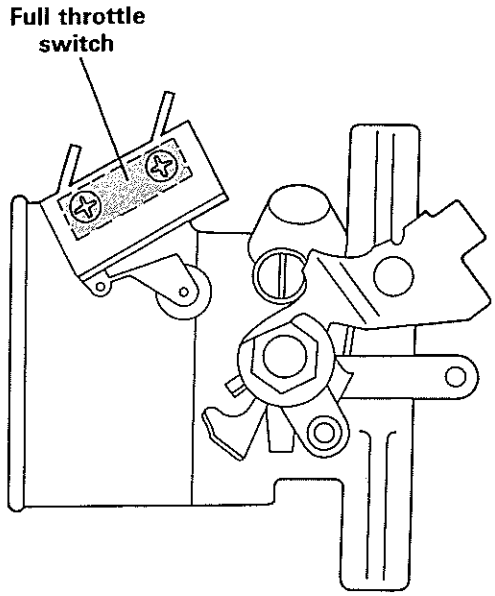


The control unit (E.C.U.) opens/closes the injectors by controlling the ground circuit.

Note: On California vehicles from 1979 model year, the resistors are built into the fuel injection control unit and cannot be checked.

PLEASE NOTE the A.F.C. injectors used on air-cooled engines produced up to 1983 **are not** interchangeable with Digijet/Digifant Injectors. A.F.C. injectors may be visually identified by their upper injector body color, which is blue.

Full Throttle Switch

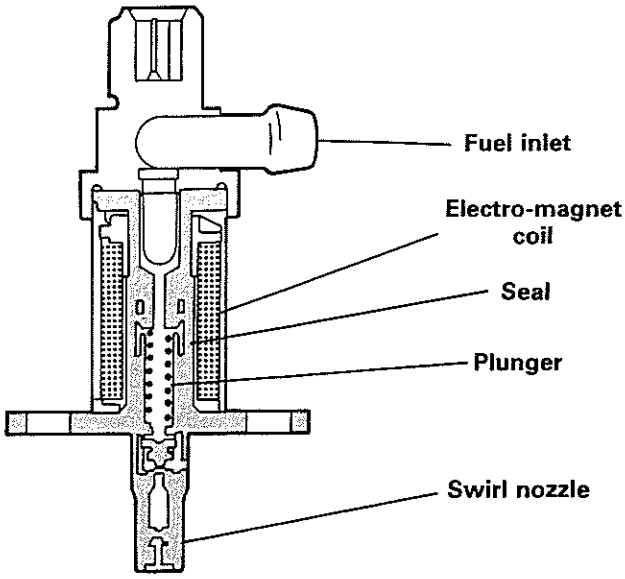


The full throttle switch is a micro-switch which mounts to the throttle valve housing. An arm on the throttle shaft actuates the switch as full throttle is approached, sending a signal to the control unit (E.C.U.). The control unit will then increase the duration signal to the injectors, enriching the air/fuel mixture during full throttle (heavy load) operation.

The control unit will also eliminate the oxygen sensor influence during full throttle operation on vehicles which are so equipped.

Note: Vehicles produced up to Chassis No. 226 2077 583 used a different throttle switch which incorporated a set of contacts for actuating the E.G.R. system in addition to the full throttle contacts. This type of switch, which has 4 terminals, is mounted to the underside of the throttle valve housing and is directly operated by the throttle shaft.

Cold Start Valve



The cold start valve is centrally located in the intake manifold to provide necessary fuel enrichment to all cylinders during starting.

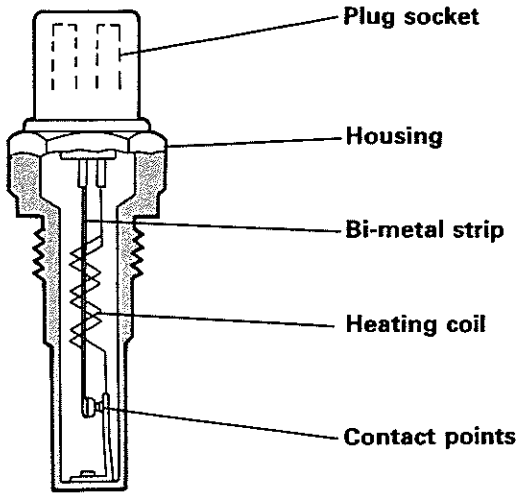
The electro-magnet coil inside the cold start valve receives current from the starter. It is grounded by the thermo-time switch so that it operates for only a short time during starting.

Thermo-Time Switch

The thermo-time switch controls opening time of the cold start valve. It is affected by starter current and engine temperature.

Depending on engine temperature conducted through the switch housing, the heating coil takes 3-10 seconds to deflect the bi-metal strip and open the contact points during starting. Opening the contact points interrupts the ground circuit of the cold start valve.

The bi-metal strip and contact points within the thermo-time switch are connected to the ground side of the cold start valve. The heating coil is connected to terminal 50 of the starter circuit. This insures that the cold start valve operates only for a short time during starting.

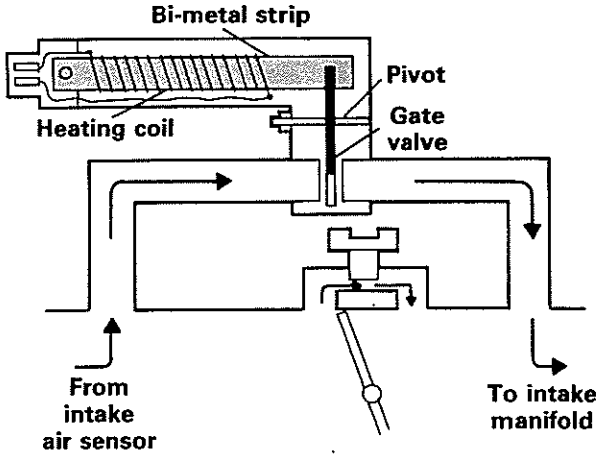


Auxiliary Air Regulator

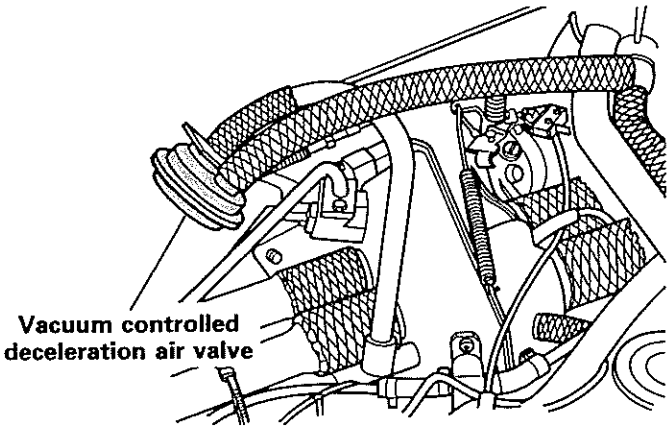
The auxiliary air regulator prevents stalling at idle during engine warm-up by supplying additional air to the engine.

Since any engine is less efficient when cold, a "fast-idle" is necessary. The auxiliary air regulator controls the amount of air bypassing the closed throttle valve — it is calibrated so there is little difference in the idle speed of a cold or warm engine.

When the engine is cold, the gate valve is open. The heating coil is connected to the fuel pump circuit so that as the engine runs, the bi-metal strip is heated. The deflection of the bi-metal strip closes the gate valve, gradually cutting off the passage for additional air as the engine warms up.



Deceleration Air Valve



The deceleration air valve allows air to bypass the throttle plate during deceleration for improved emissions. Two types were used in production. One is electrically controlled, and the other is vacuum controlled.

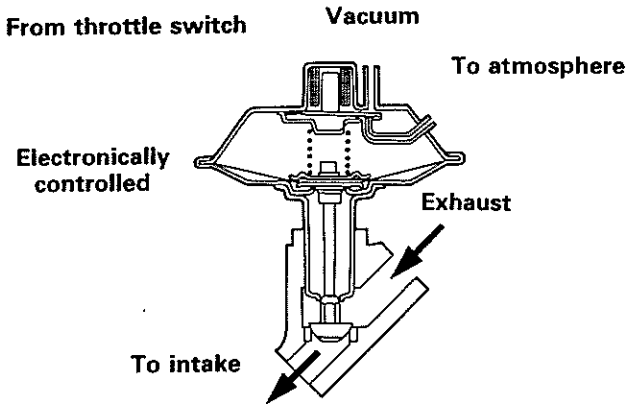
Automatic Transmission

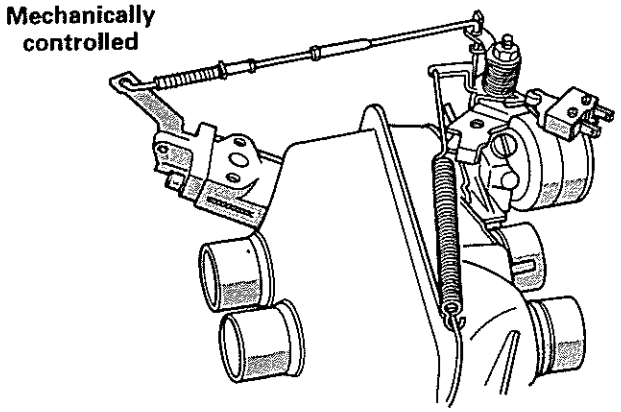
During deceleration in "Drive" a transmission switch opens the electrical deceleration valve. Vacuum in the intake air distributor will then open the valve allowing air to bypass the closed throttle plate.

Manual Transmission

During deceleration, vacuum in the intake air distributor opens the deceleration valve allowing air to bypass the closed throttle plate.

Exhaust Gas Recirculation



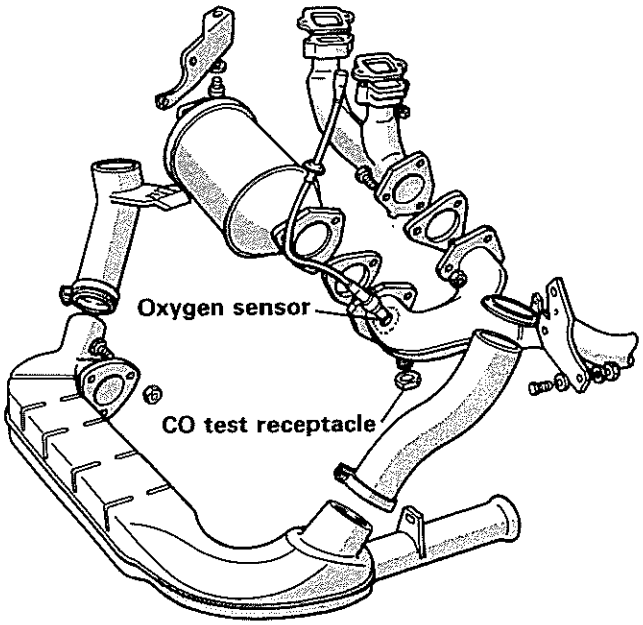


E.G.R. is a method of emission control in which a portion of the exhaust gas is filtered and then re-introduced into the intake manifold along with the incoming fresh air/fuel charge. The E.G.R. system is disabled at idle and at full throttle operation to ensure smooth idle and peak performance.

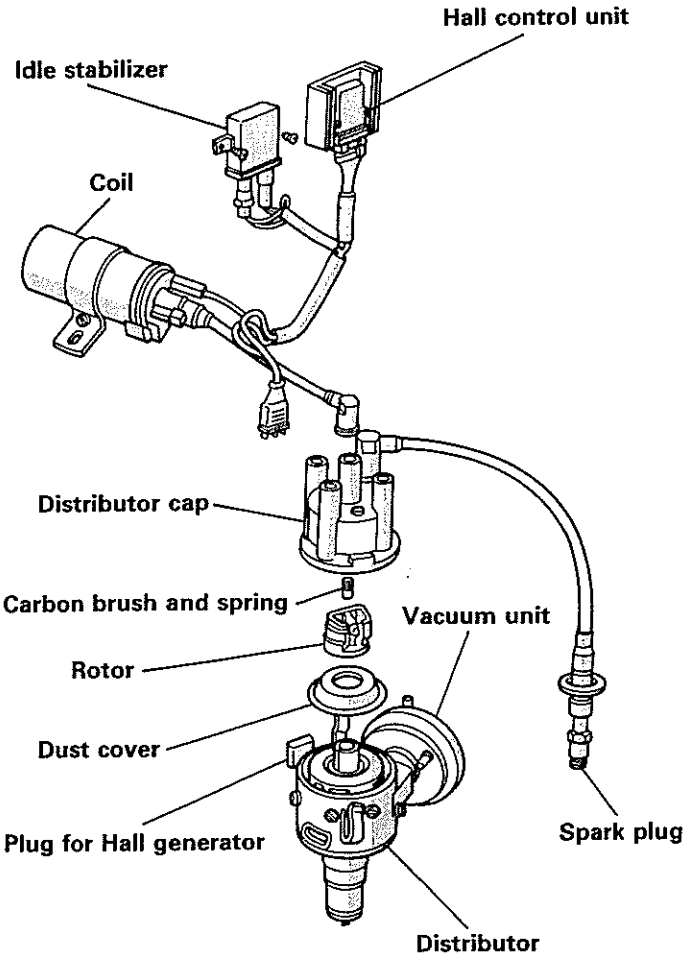
Two types of E.G.R. valves were used in production: One type is vacuum operated and controlled by a set of electrical contacts in the throttle switch. The other type is mechanically controlled by an adjustable rod which connects to the throttle valve linkage.

Oxygen Sensor (California Only from 1979 Model Year)

The oxygen sensor is located in the exhaust system upstream of the catalytic converter. It produces varying voltage (up to 1 volt) dependent on the oxygen content of the exhaust gases. This voltage signal is sent to the E.C.U. which will then alter the injection time accordingly. The oxygen sensor operates at all times, except during warm-up or at full throttle.



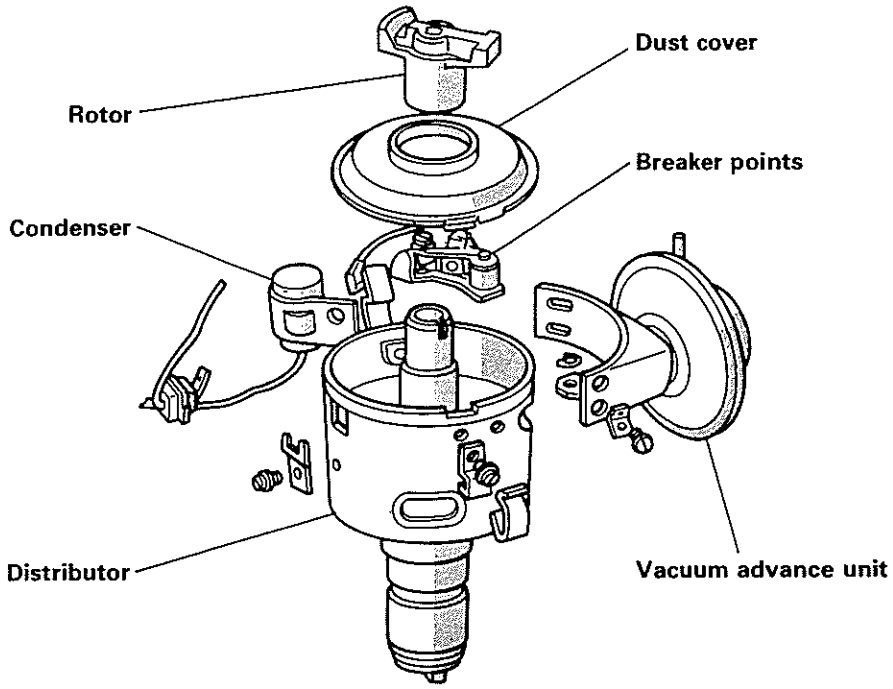
Electronic Ignition/Idle Stabilization (California Only)



As of 1979, California vehicles use Hall type transistorized ignition with idle stabilizer. The idle stabilizer has a switching point of 940 RPM. When idle speed drops below 940 RPM, the stabilizer will compensate by advancing the ignition timing enough to maintain the idle speed at approximately 940 RPM.

Breaker Point Ignition

Breaker point ignition systems were used on air-cooled engines with the exception of 1979 through 1982 California vehicles which used electronic ignition.



Air Flow Sensor/Intake Air Temperature Sensor — Checking

The entire circuit including wiring and connectors can be tested through the multi-pin connector at the E.C.U. This test is to ensure that the proper inputs are reaching the E.C.U.

— Open air cleaner housing and remove filter element.

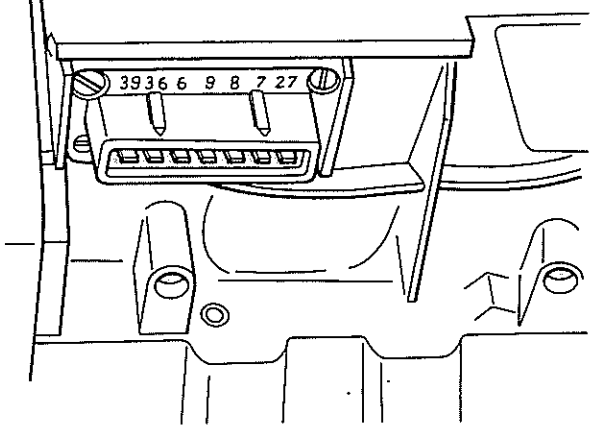
— Check that backfire valve in flap is fully closed, and that flap moves freely in both directions throughout its range of motion.

— Turn on ignition and push flap open: fuel pump should run after flap is opened slightly.

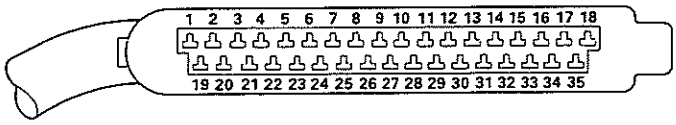
— Turn off ignition.

— Air flow sensor connected.

Air flow sensor



E.C.U. connector



— Disconnect multi-pin connector plug from E.C.U.

— Connect ohmmeter to the terminals of the multi-pin connector plug listed below.

If specifications are not reached:

— Unplug harness connector at air flow sensor.

— Using ohmmeter, check terminals of air flow sensor. The same terminal numbers and specifications are used on the air flow sensor as the multi-pin connector for the E.C.U.

If specifications are not reached, replace air flow sensor and retest.

If air sensor is okay, check wiring.

Terminal Nos.	Specification
6 and 9	200 - 400 Ohms
6 and 8	130 - 260 Ohms
8 and 9	70 - 140 Ohms
6 and 7	40 - 300 Ohms
7 and 8	100 - 500 Ohms
6 and 27 (if applicable)	Max. 2800 Ohms at 20° (68°F)

Cylinder Head Temperature Sensor — Checking

— Disconnect multi-pin connector plug from E.C.U.

— Connect ohmmeter to Terminal 13 of connector plug and ground. Resistance reading should correspond to chart for given engine temperature.

— If no, continue.

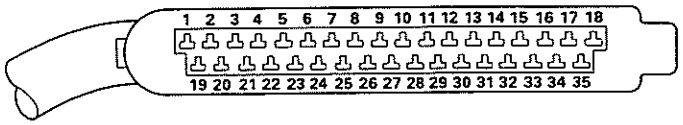
— Disconnect temperature sensor lead wire from harness connector.

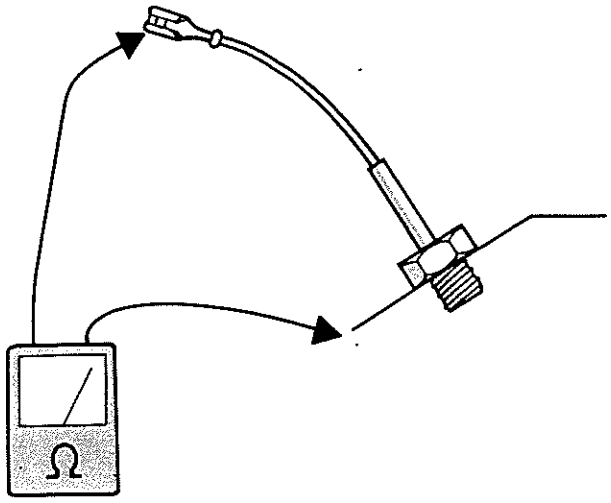
— Connect ohmmeter between electrical connector on temperature sensor and ground (cylinder head or engine case). Resistance value should correspond to chart.

— If yes, check wiring to E.C.U.

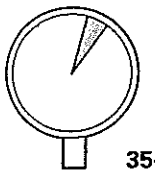
- If resistance reading is too high, transfer ground probe to steel shoulder of sensor and re-check resistance:
- Resistance now OK — clean corrosion between sensor and cylinder head.
- Resistance still too high — replace temperature sensor and retest.

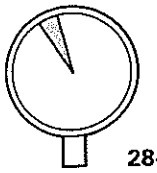
RESISTANCE VALUES (ohms)	
−10°C (14°F)	7,000 - 11,600 Ω
+20°C (68°F)	2,100 - 2,900 Ω
+80°C (176°F)	270 - 390 Ω





Fuel Pressure Regulator — Checking





— Fuel tank at least 1/2 full.

— Connect pressure gauge US 1076 or VW 1318 (or equivalent) to fuel line T-piece (between left side injectors)

— Turn on ignition and run pump with engine off (open air sensor flap or bridge Terminals 36 and 39 in air flow sensor connector plug).

— Fuel pressure should be 2.5 - 2.7 bar (35-38 PSI)

— Start engine with gauge still connected. Fuel pressure should now be 2.0 - 2.2 bar (28-31 PSI)

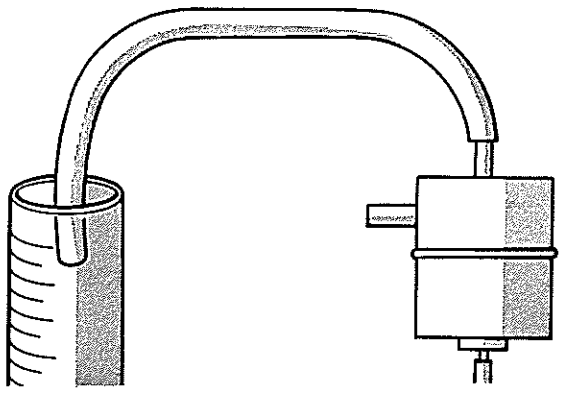
Note:

- If out of specifications, pressure regulator must be replaced as it is not adjustable.
- If fuel pressure is low, ensure that fuel pump delivery quantity is OK
- If fuel pressure is high, ensure that the return line to the fuel tank is not clogged or pinched.

Fuel Pump Volume Test (Delivery Quantity)

— Disconnect fuel return line at pressure regulator.

— Attach hose to return line fitting on pressure regulator.



— Place other end of hose in a 1 liter (1 quart) measuring container.

— Turn on ignition.

— Open air sensor (or bridge air sensor plug terminals 36 and 39), run fuel pump for 30 seconds.

Delivery quantity should be at least 500 cc (1/2 quart).

If delivery quantity is not to specifications:

- Check free flow from tank.
- Fuel filter is not blocked.
- Ground connections clean and tight.
- Available voltage is at least 11.5 volts.

Fuel Pump Checking — Cont'd.

Wiring Check

— Connect test light between terminals 86A and 85 of double relay.

— Operate starter briefly.

Test light does not light:

- Check for continuity in wire from starter terminal 50 and double relay terminal 86A.

Test light lights:

— Connect test light to terminal 88Y and 85.

— Operate starter briefly.

Test light does not light:

- Check for continuity in wire from battery and terminal 88Y.

Test light lights:

— Connect test light to terminals 88D and 85.

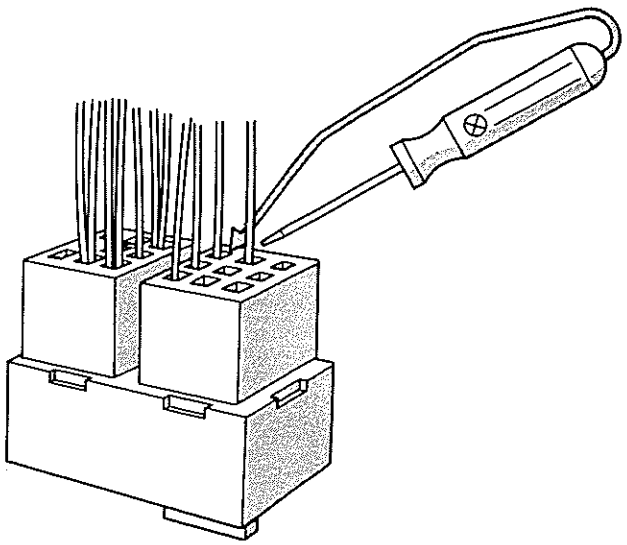
— Operate starter briefly.

Test light lights:

- Check for continuity in wire from 88D and fuel pump.

Test light does not light:

- Replace double relay.



Voltage at double relay, checking

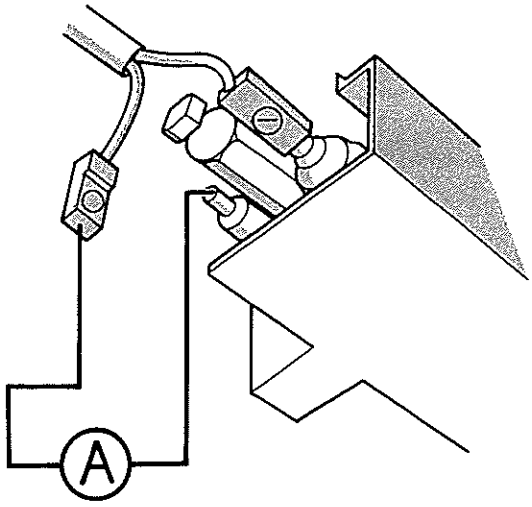
Fuel Pump Electrical

— Connect ammeter in series with pump and current supply source.

— Turn on ignition and open air sensor flap (or bridge air sensor plug terminals 36 and 39), run pump.

— Ammeter should read 2.5 - 3.5 amps.

- A lower amp reading may mean poor ground connections.
- A higher amp reading usually means a dragging pump motor.



Residual Pressure Test

— Fuel tank at least 1/2 full.

— Connect pressure gauge US 1076 or VW 1318 (or equivalent) to fuel line T-piece (between left side injectors)

— Turn on ignition and run pump with engine off (open air sensor flap or bridge Terminals 36 and 39 in air flow sensor connector plug).

— Fuel pressure should be 2.5 - 2.7 bar (35-38 PSI)

— Stop engine; wait 10 minutes.

- Pressure should be at least 1.0 - 1.5 bar (14-21 PSI). If not, there are three possible problems.
  - Fuel pump check valve — test by clamping off return line to fuel pump.
  - Fuel pressure regulator — test by clamping off return line to fuel tank.
  - Fuel injector(s) — test by clamping off line from injectors to pressure regulator. If necessary proceed to Page 23 for instructions on leak testing individual injectors.

— Observe pressure gauge while clamping off each of these individual lines. If pressure drop ceases or slows dramatically, problem is in the indicated component. Use care not to damage lines with clamping device.

Fuel Injectors — Checking

Quantity/Spray Pattern/Leak Checking

— Remove fuel injectors from intake manifolds. Leave fuel lines and wires connected.

— Place injectors from cylinders 1 and 2 in separate 150 cc containers.

— Disconnect harness plug from air flow sensor and bridge Terminals 36 and 39 in air flow sensor plug.

— Connect fuel pressure gauge VW 1318 or equivalent to test fitting between left side injectors.

— Turn ignition on and observe gauge. Fuel pump should run and pressure should be 2.5 - 2.7 bar (35 - 38 PSI): If no, go to Page 20, Fuel Pressure Regulator — Checking.

— Turn ignition switch off.

— Disconnect multi-pin connector plug from E.C.U.

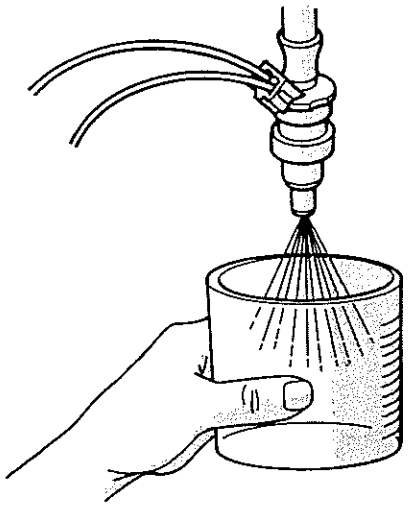
— Bridge connector plug Terminals 17 to 32 and 14 to 16 with jumper wires.

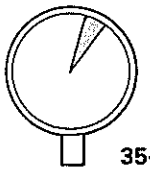
Note: On California vehicles, bridge terminal 28 to ground to activate fuel pump.

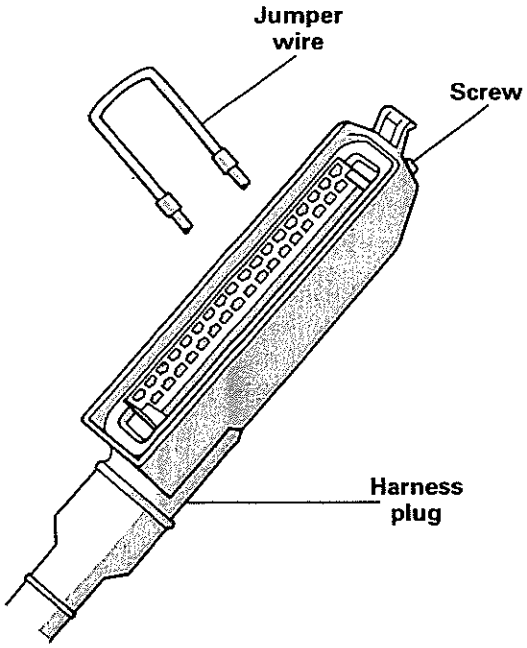
— Turn ignition on for exactly 30 seconds.

- Injector spray pattern must be even and cone-shaped. Measuring beakers should contain at least 87 cc after 30 seconds. With ignition turned off, not more than 2 drops should leak from each injector nozzle in 1 minute.

— Repeat procedure for injectors from cylinders 3 and 4. Bridge terminals 15 to 16 and 17 to 33 of multi-pin connector plug.

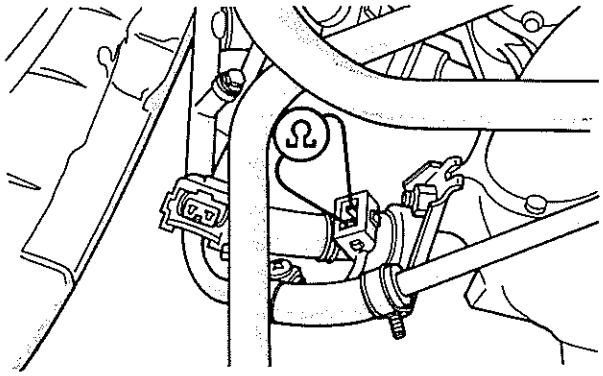






Fuel Injector Checking — Cont'd.

Component Tests



— Pull off electrical plugs from fuel injectors.

— Connect ohmmeter across injector terminals, resistance should be approximately 2 - 3 ohms.

Circuit Tests

— Pull off all electrical plugs from fuel injectors.

— Connect test light across contacts of one plug.

— Operate starter

Test light must flicker (3 to 5 volts)

If not: continue to next test.

— If test light stays on continuously:

- Check for terminal 1 signal from ignition plug to E.C.U. If OK, replace E.C.U.

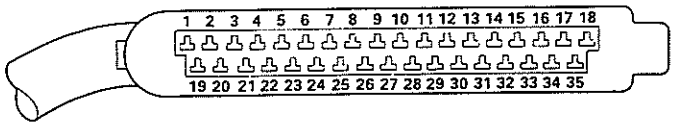
Test Light Does Not Light (Except 1979-82 M.Y. California Vehicles)

— Check for power (approx. 12 V) at terminal 88b of dual relay.

If not: troubleshoot dual relay as per Page 21.

— Check grounds from terminals 5, 16, and 17 of E.C.U. to engine case under left side intake manifold.

E.C.U. connector



— Check continuity of wire from terminal 1 of ignition coil to terminal 1 of E.C.U.

Continuity OK: replace E.C.U.

— With ignition OFF and electrical plugs to fuel injectors ON, disconnect multi-pin connector plug from E.C.U. Bridge ohmmeter across following terminals of E.C.U. connector plug in order to check all remaining injector circuits including injectors, wiring to E.C.U., and resistors.

Terminal No.	Description	Specification
14 and 10	Fuel Injector/wire/resistor-Cyl. 1	Approximately 7 ohms
32 and 10	Fuel Injector/wire/resistor-Cyl. 2	
33 and 10	Fuel Injector/wire/resistor-Cyl. 3	
15 and 10	Fuel Injector/wire/resistor-Cyl. 4	

Fuel Injector Checking — Cont'd.

Test Light Does Not Light — Cont'd. (Except 1979-82 M.Y. California Vehicles)

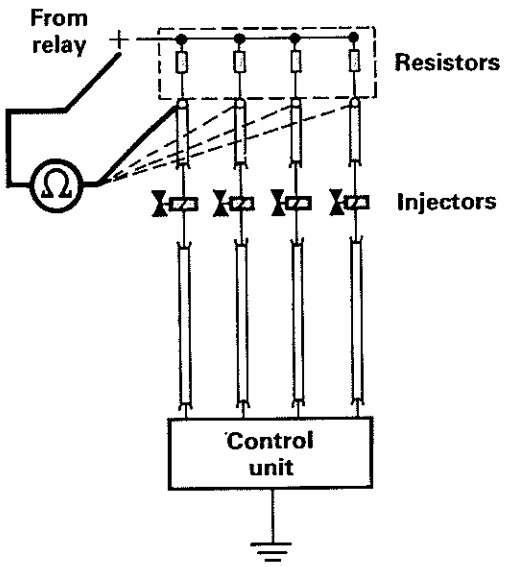
If specifications for injectors are not obtained:

— Disconnect resistor pack plug from harness.

— Check resistor pack by bridging ohmmeter leads from center terminal of connector plug to each outer terminal individually.

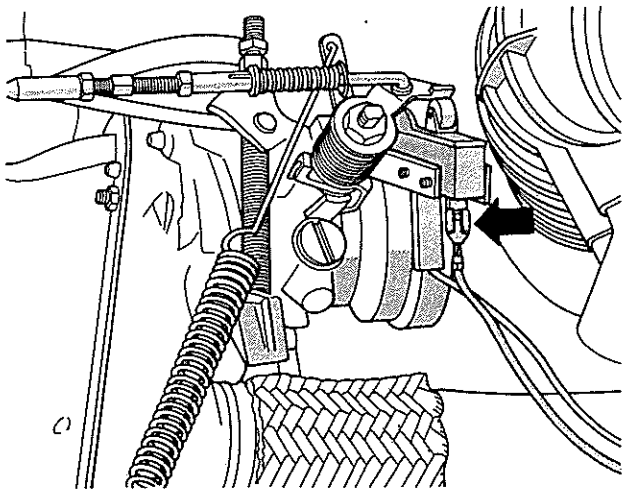
- Specifications: 5.5-6.5 ohms per injector.

If not: replace resistor pack.



Full Throttle Switch — Adjusting (as of Chassis No. 226 2077 584)

Vehicles produced up to Chassis No. 226 2077 583 used a different throttle switch which incorporated a set of contacts for actuating the E.G.R. system in addition to the full throttle contacts. This type of switch, which has 4 terminals, is mounted to the underside of the throttle valve housing and is directly operated by the throttle shaft.



— Ignition ON.

— Test light connected to non-insulated terminal of switch (arrow) and ground.

— Press accelerator pedal down fully.

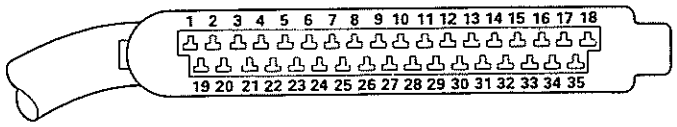
— Loosen switch and adjust to point where test light is on.

— Tighten switch: Roller should be in middle of curved plate.

Full Throttle Switch — Checking/Adjusting (Vehicles up to Chassis No. 226 2077 583)

Continuity Check

— Connect ohmmeter to terminals 3 and 18 of multi-pin connector of E.C.U.



— Open throttle valve slowly:
Shortly before full throttle is reached, ohmmeter must go from 0 to ∞ ohm.

— If no: check wiring to switch

— If okay: continue to next step

EGR Contact

— Connect ohmmeter to terminals 42 and 44 of full throttle switch

— Open throttle valve slowly:
Ohmmeter must go from 0 to ∞ ohm.

— If no: replace switch.

Adjusting

— Remove throttle valve housing.

— Loosen throttle valve switch mounting screws.

— Hold throttle valve in closed position.

— Turn throttle valve switch in direction of "Open Throttle" until slight resistance is felt.

— Tighten throttle valve switch mounting screws.

— Check that throttle valve is not held open by adjustment made on throttle valve switch.

Cold Start Valve — Checking

— Connect fuel pressure gauge VW 1318 or equivalent: Use test fitting between left side injectors.

— Run pump:

Turn on ignition and open air sensor flap (or bridge air sensor plug terminals 36 and 39).

— With ignition on, turn pump off by closing air sensor flap or removing bridge.

- Fuel pressure should stabilize at 15-20 PSI minimum if fuel pump check valve is OK.

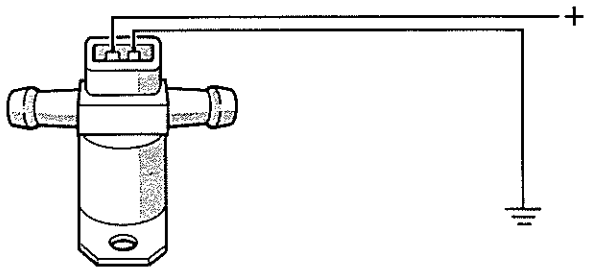
— Connect jumper wire from one cold start valve terminal to ignition coil 15.

— Connect second jumper wire from other cold start valve terminal to ground.

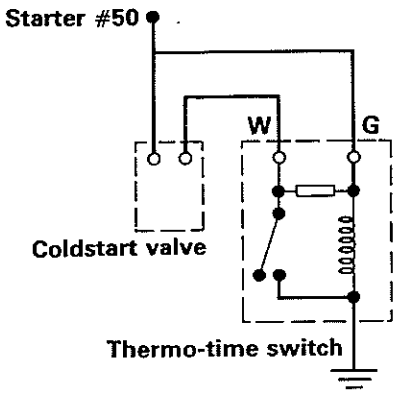
- Fuel pressure should decrease steadily if cold valve is working.

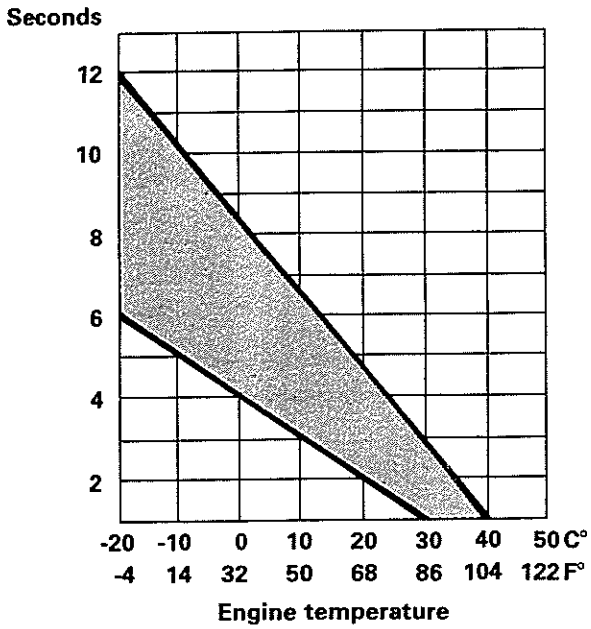
Note: Do not let the cold start valve run for more than 5 sec.

— Disconnect jumper wire. Pressure gauge needle should stop moving immediately if cold start valve is not leaking.



Thermo-Time Switch — Checking





Make sure the engine is cold (at room temperature or less).

— Remove electrical harness plug from cold start valve.

— Disconnect green distributor wire (Terminal 1) from ignition coil to prevent starting.

— Bridge cold start valve harness plug connections with a test light.

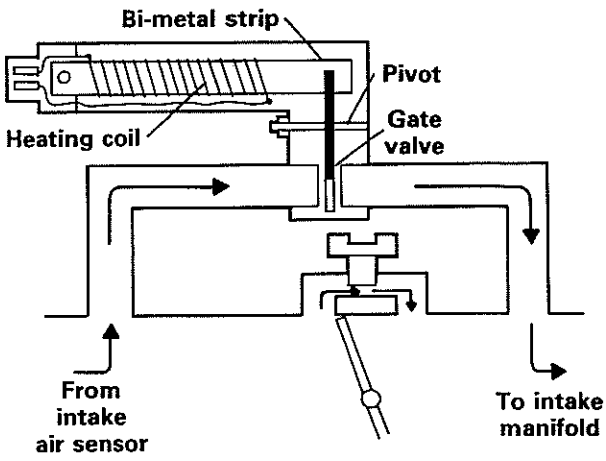
— Operate starter.

The test light should go on for several seconds and then go out if thermo-time switch and harness are OK: the graph shows the time that the test light should be on.

Auxiliary Air Regulator — Checking

Cold Engine

— Pinch either connecting hose: idle speed should drop if gate valve is **open**.



Warm Engine

— Pinch either connecting hose: idle speed should not change if gate valve is **closed**.

— Disconnect harness plug from auxiliary air regulator and bridge ohmmeter across terminals of heating coil.

• Specification: Approximately 20-30 ohms.

If OK: Reconnect auxiliary air regulator. Disconnect multi-pin connector plug from E.C.U. and connect ohmmeter from terminal 88c of double relay (wire #37) to terminal 34 of E.C.U. connector plug. Ohmmeter reading should be approximately the same (20-30 ohms).

If not: Check and repair wiring to auxiliary air regulator.

If OK:

— Disconnect harness plug from auxiliary air regulator and bridge test light across harness plug connections to check power supply and ground. Start engine: test light must light.

If OK: Replace auxiliary air regulator.

If not: Reconnect harness plug to auxiliary air regulator.

— Connect test light to terminal 88b of double relay and ground. Switch on ignition: test light must light.

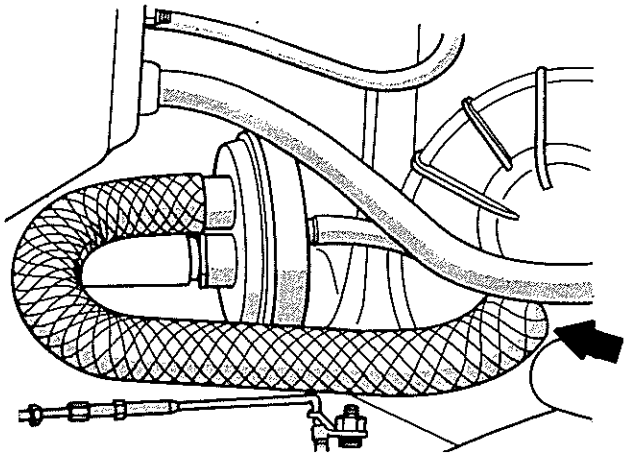
— **If yes:** connect test light to terminal 88d of double relay and ground. Start engine: test light must not go out when engine starts. If it does: replace double relay.

— **If not:** Switch on ignition and connect test light to terminal 88z of double relay and to ground: test light must light on both terminals.

If yes: replace double relay.

If no: check and repair wiring.

Deceleration Air Valve — Checking



Vacuum controlled:

(All vehicles with manual transmission)

(Vehicles with automatic trans. as of Chassis No. 226 2077 584)

— Pull off hose from deceleration valve at air flow sensor elbow and plug hole in elbow.

— Start engine and run for a few seconds at about 3000 RPM.

— Allow throttle valve to snap closed: at same moment, check for suction at disconnected hose.

If no suction is present, replace deceleration valve.

Electrically controlled:

(Vehicles with automatic trans. up to Chassis No. 226 2077 583)

— Ignition ON.

— Disconnect wire from deceleration valve at ATF pressure switch.

— Ground disconnected wire to unpainted and clean surface.

• Decel valve should "click"

If no — turn off ignition and check continuity of wire.

Continuity okay — replace valve and retest.

— Repeat above test but ground disconnected wire briefly to terminal of A.T.F. switch.

• Decel valve should "click"

In no — replace A.T.F. switch and retest.

E.G.R. Valve — Checking/Adjusting

Electro/Vacuum Controlled:
(up to Chassis No. 226 2077 583)

Ignition ON:

Open throttle valve slowly by hand. Just off closed throttle, E.G.R. valve must click audibly.

If no:

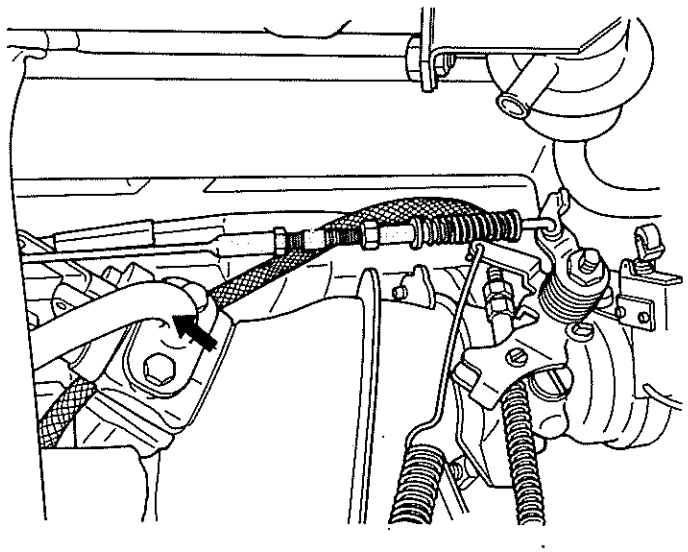
— Turn on ignition.

— Pull off connector from E.G.R. valve and connect test light to connector.

— Open throttle valve slowly by hand. Check that test light lights up at idle and full throttle position (with engine not running). If test light does not light up, check following: double relay, throttle valve switch and wires. If necessary, replace defective part. Feel pipe (arrow) with hand — If hot, E.G.R. valve is working.

If no — replace E.G.R. valve and retest.

Note: Also see full throttle switch-checking/adjusting: Page 25 and 26.



Mechanically Controlled:
(as of Chassis No. 226 2077 584)

— Idle engine.

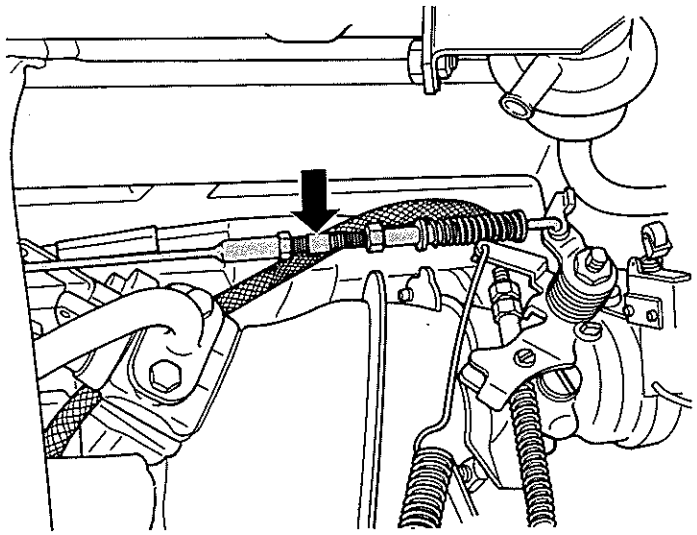
Manual transmission - 900 ± 50 RPM
Automatic transmission - 950 ± RPM

— Shorten linkage by turning hex (arrow) until idle drops suddenly (valve opens).

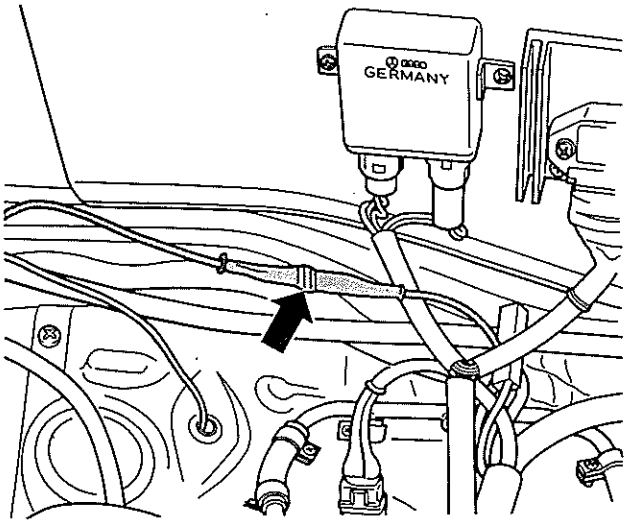
— Turn hex in opposite direction.

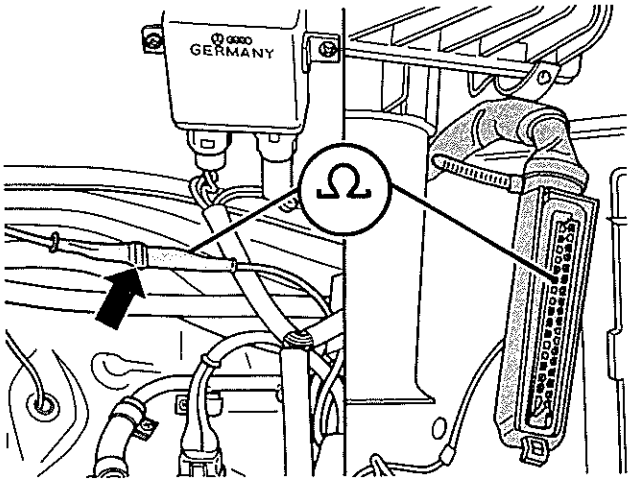
Manual transmission - 1-1/6 turns
Automatic transmission - 5/6 turn

— Use pin in hex as starting mark when turning. Tighten lock nuts.



Oxygen Sensor — Checking (California Only from 1979 Model Year)





Preliminary conditions:

Engine oil temperature at least 60°C/140°F.

— Connect tachometer and CO meter according to manufacturer's instructions.

Note: Connect CO meter to test receptacle, not at tailpipe.

— Start engine.

— Disconnect oxygen sensor wire to control unit (arrow)

— Check idle speed (850-950 RPM). If necessary, adjust.

CO reading should be 0.7 ± 0.4%.

— Reconnect oxygen sensor wire to control unit.

At 2000 RPM, CO should be 0.6 ± 0.2%.

— If CO reading is too low, check for leak in exhaust system and repair.

— If CO reading is too high, check oxygen sensor wiring.

— Connect an ohmmeter between oxygen sensor (arrow) and plug terminal 24 for control unit.

Meter reads 0 ohm, sensor wiring OK.

Meter reads ∞ ohm, sensor wiring is defective. Replace.

— If sensor wiring is OK, replace oxygen sensor and recheck CO.

Ignition System/Idle Stabilization — Checking/Adjusting (California Only from 1979 Model Year)

Caution: When working on vehicles with a transistorized ignition system, observe following precautions to prevent injury or damage to ignition system.

- — Do not touch or take off high tension wire when running or cranking engine.
- — Only disconnect wires of ignition system when ignition is turned OFF.
- — Only connect/disconnect test equipment with ignition OFF.
- — Do not connect a condenser/suppressor or test light to terminal 1 of ignition coil.
- — Do not connect test equipment needing a 12 volt supply on terminal 15 of ignition coil.
- — Do not crank engine before high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check, etc.).
- — Do not replace installed coil with conventional type.
- — Do not leave battery connected when electric welding on car.
- — Do not start engine after heating up to more than 80°C (176°F); example: paint drying booth.
- — Do not wash engine when it is running.
- — Do not use battery booster longer than 15 sec. nor exceed 16.5 volts with booster. Allow 1 minute pause between boosting attempts.
- — Do not disconnect battery while engine is running.

Hall Generator, Checking
(California)

WORK SEQUENCE:

Test condition:

Current must be present at terminal 15 (+) of coil with ignition turned ON.

- — Disconnect high voltage (center) cable between coil and distributor.
- — Connect free end of cable to ground.
- — Connect test light between coil terminals 15(+) and 1(−).
- — Operate starter for approximately 5 seconds. Test light must flicker.

  If NO, replace ignition distributor.

Hall Control Unit, Checking
(California)

- — Remove connector from distributor.
- — Connect positive lead of voltmeter to terminal 15 of ignition coil.
- — Connect negative lead to terminal 1.
- — Turn ON ignition switch.

  Voltage should be about 6 V, dropping to 0 within 1 or 2 seconds.

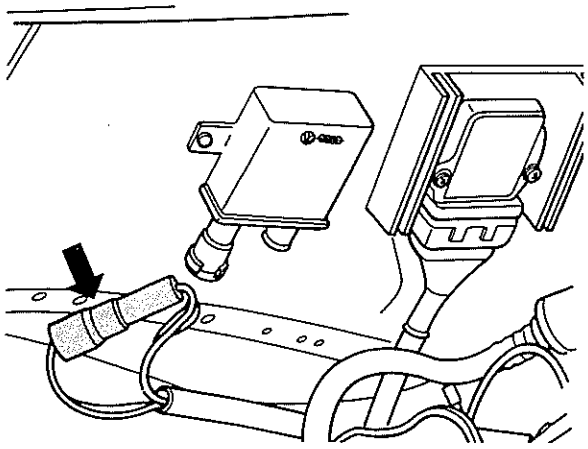
  If NO, replace control unit.

Idle Stabilizer, Checking
(California)

- — Check ignition timing at idle (± 3° variation is normal).
- — Turn ON all electrical accessories to load engine. Ignition timing will advance if idle stabilizer is working.

  If NO, replace idle stabilizer.

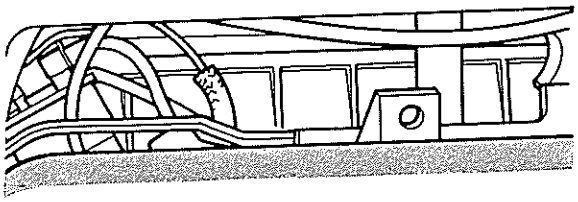
Ignition Timing, Adjusting With Timing Light (California Only from 1979 Model Year)



Note: Oil temperature must be at least 60°C/140°F.

— Disconnect leads from idle stabilizer.

— Connect leads together (arrow).

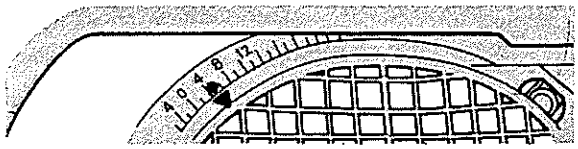


— Start engine.

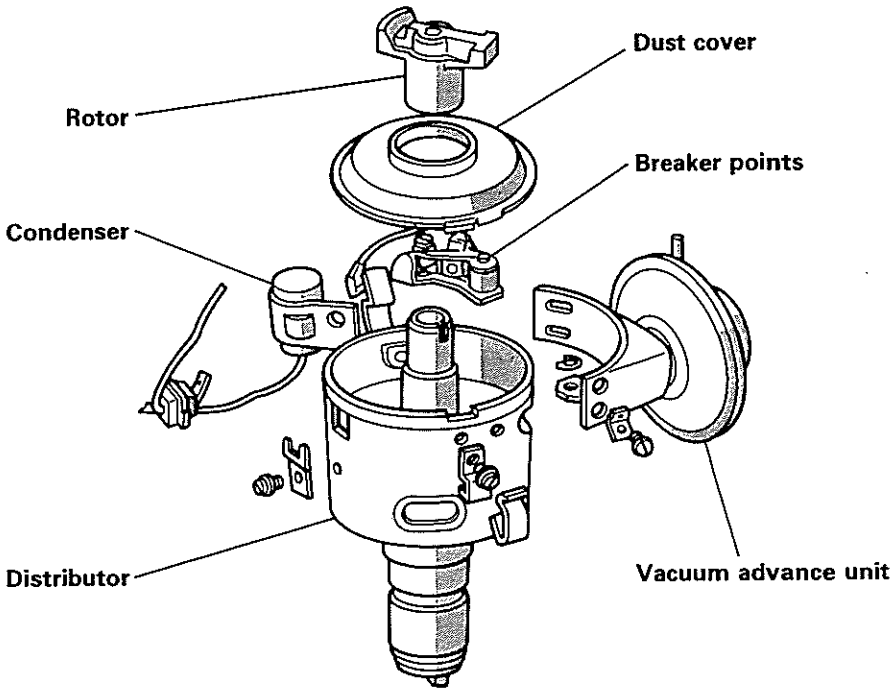
— Adjust engine idle to 850-950 RPM

— Flash timing mark with strobe light.

Mark on pulley must align with red mark on scale.



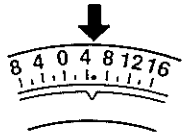
Breaker Point Ignition



Breaker Point Ignition Systems were used on air-cooled engines with the exception of 1979-82 California vehicles which used Electronic Ignition.

Specifications for checking and adjusting Breaker Point Ignition system can be found on the following pages.

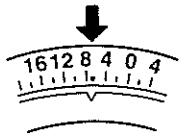
Specifications/Adjustments

Engine 1973-75		1.8 liter (1800)	
Engine code letters		ED	
CO%		Max. 2%	
Ignition timing		5° after TDC	
Timing marks			
Speed	RPM	850-950 (Automatic)	900-1000 (Manual)
Vacuum hose		on	
Dwell angle	set to	44-50°	
	wear limit	42-55°	
Centrifugal spark control			
Begin	RPM	1000-1225	1000-1250
	RPM	2000	2000
	degrees	11-17	11-17
End	RPM	3600	
	degrees	21-15	
Vacuum spark control advance	mbar	93-173	93-173
	(mmHg)	(70-130)	(70-130)
End	mbar	240-267	187-213
	(mmHg)	(180-200)	(140-160)
	degrees	8-11	3-7
Vacuum spark control retard	mbar	67-160	67-160
	(mmHg)	(50-120)	(50-120)
End	mbar	213-280	213-280
	(mmHg)	(160-200)	(160-210)
	degrees	11-13	11-13
Speed limiter* cut-in speed	RPM	5400 USA/Canada	5400 USA/Canada

* For California: speed limiter is in control unit.

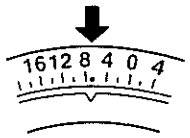
Specifications/Adjustments

Distributor and settings:

Engine 1975-78		2.0 liter (2000)
Engine code letters		GD
CO%		Min. 1.0% Max. 1.5%
Ignition timing		7.5° before TDC
Timing marks		
Speed	RPM	800-950 (Manual Trans.) 900-1000 (Automatic Trans.)
Vacuum hose		pulled off
Dwell angle	set to	44-50°
	wear limit	42-58°
Centrifugal spark control Begin	RPM	1000-1200
	RPM degrees	1600 9-14
End	RPM degrees	3400 21-25
Vacuum spark control advance	mbar (mmHg)	107-147 (80-110)
End	mbar (mmHg) degrees	266 (200) 8-12
Speed limiter in control unit cut-in speed	RPM	5400

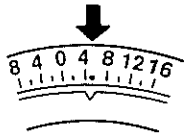
Specifications/Adjustments

U.S.A. except California/Canada.

Engine code letters 1979-82		CV
CO%		1.0 ± 0.5%
Ignition timing		7.5° BTDC
Timing mark: crankshaft pulley		
Idle adjustment: RPM Manual Automatic Vacuum hoses		 850-950 850-1000 disconnected
Dwell angle setting		44-50°
Centrifugal advance, crankshaft degrees Start	RPM	1000-1200
	degrees at RPM	9-14 at 1600
End	degrees at RPM	21-25 at 3400
Vacuum advance Start	mbar (mmHg)	107-147 (80-110)
End	mbar (mmHg) degrees	266 (200) 8-12
Spark plug gap	0.7 mm (0.028 in.)	
Firing order	1-4-3-2	

Specifications/Adjustments

California only

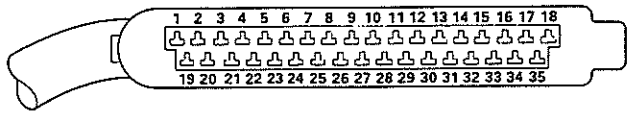
Engine code letters 1979-82		CV
Transmission code letters		DK/NG
Distributor		071 905 205
Ignition timing		5° ATDC
Timing mark: crankshaft pulley		
CO% (Oxygen Sensor Disconnected)		0.7 ± 0.4%
Idle adjustment: RPM Vacuum hoses Idle stabilizer plugs		850-950 connected Removed & connected together
Dwell angle setting		Not adjustable
Centrifugal advance, crankshaft degrees		
Start	RPM	1050-1300
	degrees at RPM	9-13 at 1600
End	degrees at RPM	21-25 at 3400
Vacuum advance		
Start	mbar (mmHg)	90-160 (80-110)
End	mbar (mmHg) degrees	240-280 (180-210) 9-12
Vacuum retard		
Start	mbar (mmHg)	90-160 (70-120)
End	mbar (mmHg) degrees	200-280 (150-210) 11-13
Spark plug gap		0.7 mm (0.028 in.)
Firing order		1-4-3-2

System Check With Volt/Ohmmeter

The entire A.F.C. System can be checked electrically at the control unit plug using an ohmmeter or volt meter according to the following chart.

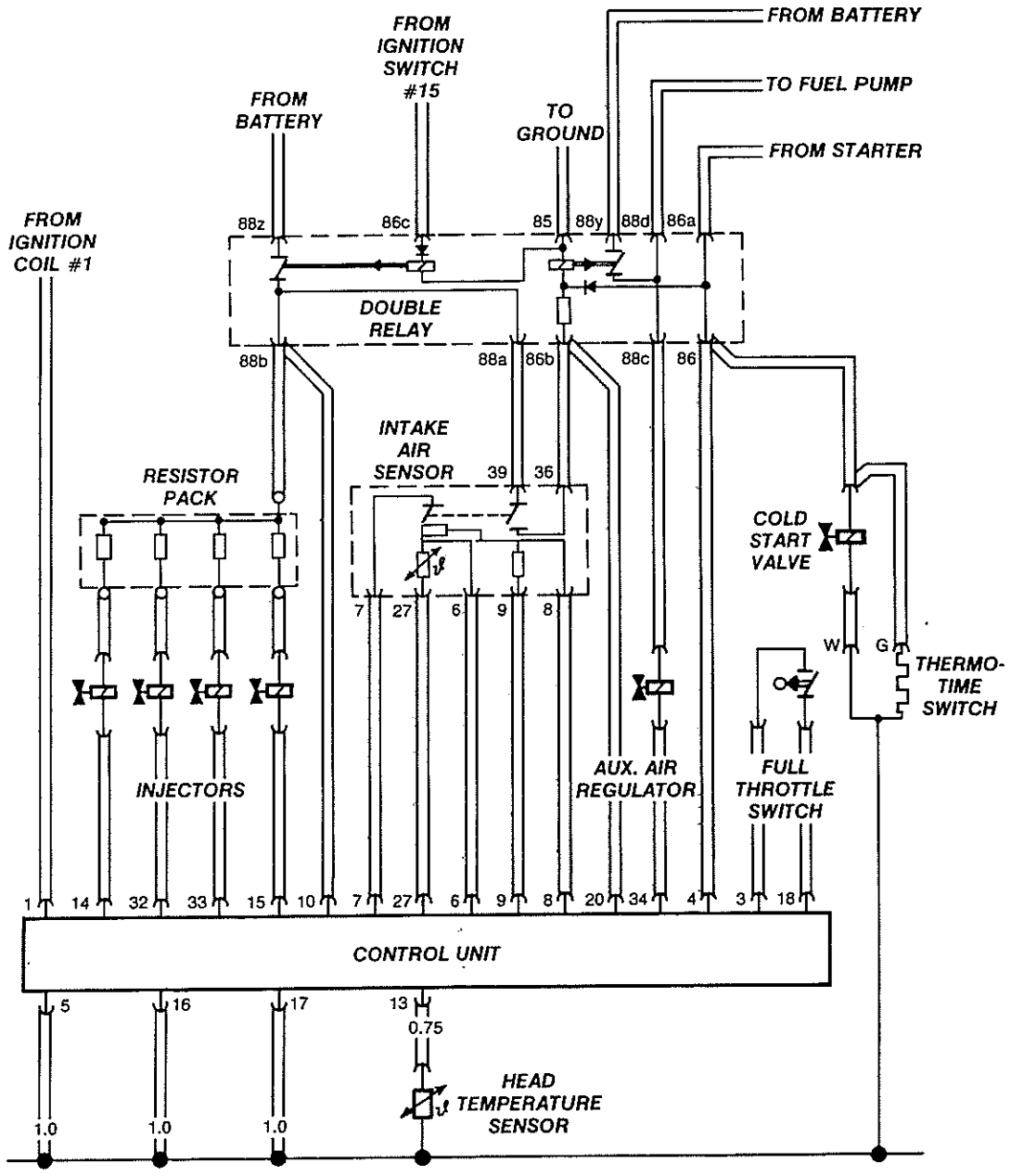
OHMMETER TO TERMINAL	SPECIFICATIONS	CHECKS
1 and Ground	Disconnect white injection wire at coil ohms: hook wire to ground 0 ohms.	Wire to #1 terminal on coil.
3 and 18	Press accelerator pedal down fully. 0 ohms	Full throttle enrichment circuit thru throttle switch.
5 and Ground	0 ohms	Ground Circuit
6 and 9	200-400 ohms	Air Sensor Circuit
6 and 8	130-260 ohms	Air Sensor Circuit
8 and 9	70-140 ohms	Air Sensor Circuit
6 and 7	40-300 ohms	Air Sensor Circuit
7 and 8	100-500 ohms	Air Sensor Circuit
6 and 27	Max. 2800 ohms at 68°F	Air Sensor Circuit
13 and Ground	2100-2900 ohms at 68°F 270-390 at 176°F	Head Sensor
14 and 10	Approx. 7 to 9 ohms	Injector wire and resistor
15 and 10	Approx. 7 to 9 ohms	Injector wire and resistor
32 and 10	Approx. 7 to 9 ohms	Injector wire and resistor
33 and 10	Approx. 7 to 9 ohms	Injector wire and resistor
16 and Ground	0 ohms	Ground Circuit
17 and Ground	0 ohms	Ground Circuit
34 at control unit and 37 on the double relay	Approx. 30 ohms	Auxiliary air regulator and wires.
VOLTMETER TO TERMINAL	**SPECIFICATIONS**	**CHECKS**
4 and Ground	Min. 9.5 volts during cranking 0 volts at all other times	Signal from starter
10 and Ground	12 volts with key ON 0 volts with key OFF	Voltage supply to computer
*20 and Ground	12 volts with key ON and sensor flap open (or bridge terminal 36 to terminal 39 of air flow sensor plug)	Pump Circuit

*California vehicles use terminal 28 and ground.



Functional Wiring Diagram

Wiring in the fuel injection harness is not color-coded, but identification numbers are printed on each wire near the connectors.

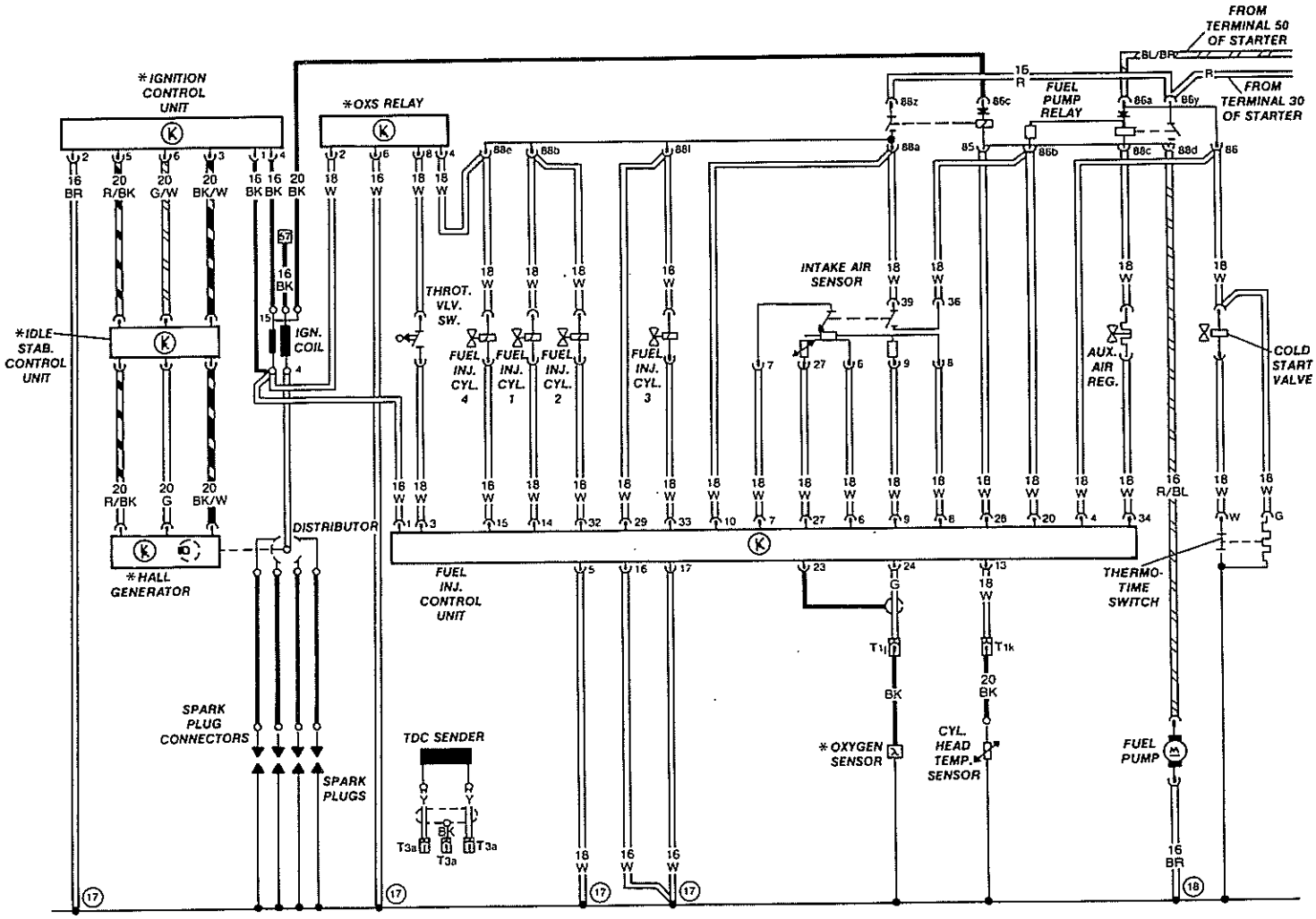


The three ground wires for the A.F.C. fuel injection system are usually connected to the engine case under the left intake manifold pipes.

Wiring Diagram (California Only 1979-82)

Functional Wiring Diagram

Wiring in the fuel injection harness is not color-coded, but identification numbers are printed on each wire near the connectors.



The three ground wires for the A.F.C. fuel injection system are usually connected to the engine case under the left intake manifold pipes.

WIRING COLOR CODE	
Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- LT. G
Blue	- BL
Violet	- V
Gray	- GY
White	- W

Glossary Of Terms

AIR FLOW SENSOR

Electro-mechanical sensor which supplies control unit with signals about intake air volume and temperature. Location: Attached to air filter housing.

AUXILIARY AIR REGULATOR

A rotary-gate valve which stabilizes idle speed during warm-up. Location: Top of engine between crankcase breather valve and #2 intake pipe.

COLD START VALVE

An electro-magnet valve which sprays extra fuel into the engine during starting. Location: Mounts to left rear of intake air distributor, directly adjacent to ignition distributor.

ELECTRONIC CONTROL UNIT (E.C.U.)

A solid-state electronic computer which controls injectors by processing signals about temperature, air volume and engine speed. Location: Mounted to luggage compartment floor in right rear corner of engine compartment.

DOUBLE (DUAL) RELAY

A compound relay which directs battery current to the fuel injection components. Location: Mounts to upper left side of front panel in engine compartment.

FUEL FILTER

Filter which removes foreign particles from the fuel system. Location: Inboard side of left frame member, between fuel tank and fuel pump.

FUEL PRESSURE REGULATOR

Vacuum modulated diaphragm valve which controls fuel pressure to the injectors. Location: Lower left side of front panel in engine compartment in front of #3 intake pipe.

FUEL PUMP

An electric pump which supplies fuel to the injectors. Location: Inboard side of left frame member to rear of fuel tank.

INJECTORS

Electro-magnet valves which spray fuel into each intake port. Location: Mounts into intake manifold at cylinder head.

RESISTOR PACK

External cluster of resistors which reduces voltage supplied to injectors. Location: Mounts to upper left side of front panel in engine compartment.

TEMPERATURE SENSOR

Solid-state thermistor element which signals control unit about engine temperature. Location: Screws into left side cylinder head, directly in front of #3 intake port.

THERMO-TIME SWITCH

Temperature switch which allows cold start valve to work only for a short time during starting. Location: Directly under #4 intake pipe connection to intake air distributor.

Notes