Vanagon/Type II Fuel Systems

TW-03-02

WSP 521 148

DIGIJET FUEL INJECTION

ProTraining

39662

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WE ENCOURAGE PROFESSIONALISM
THROUGH TECHNICIAN CERTIFICATION

Volkswagen United States, Inc.
Service Training/Technical Service
Printed 3/87
Part #WSP 521 148 00

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The ProTraining booklets have been designed for the professional technician. This ProTraining program is designed to help you understand how fuel systems work and how to fix them. Our goal is to help you to be able to fix the customer's car right . . . the first time.

This booklet is divided into 3 sections; A.F.C., Digijet, and Digifant Fuel Injection Systems. Each section contains:

- System Operation
- Component Description
- Diagnoses and Repair Information

Fuel Systems can be repaired by following the step by step procedures shown in this book.

Make Sure You Understand The Customer's Complaint

— Identify the symptoms as you follow the diagnosis procedure. Try to locate the cause of the problem.

— Repair the problem after you have identified the symptoms.

— After completing the repairs, always road test the vehicle before returning the car to the customer.

Troubleshooting Guidelines

Preliminary Checks

A complaint may be caused by a minor detail. Before starting the fault finding procedure make a few visual checks, such as:

— Are all electrical plugs/spark plug wires correctly connected (hanging loose, etc.)?

— Are all hoses okay? Check vacuum, crankcase ventilation, fuel tank ventilation, air intake hoses for restrictions, cracks, or looseness.

— Are all the ground connections okay? (clean, tight, etc.)

— Is there adequate fuel supply?

Mechanical/Electrical Checks

— Before checking, determine that the engine is in sound condition.

— Check battery and charging system. Assure that both systems are functional and in good condition.

Symptom Oriented

— Due to the interactions of many components in these systems, the troubleshooting guidelines have been written in a progressive sequence which must be followed exactly as written unless otherwise indicated. When checking a problem in a system, the guide will take you through the complete system.

Do not skip any of the test steps in the procedures.

Pinpointing the Problem

Remember the basics:

— No matter how advanced the system, to start and run an engine, you need correct spark timing, and the proper fuel to air ratio.

— Get as much information as possible from the customer.

— Gather as many symptoms as possible:
- Look for spark
- Listen for the fuel pump
- Feel the injectors operating, etc.

— Make logical deducations, not assumptions.

— Follow the guide, don't shortcut!

Intermittent Engine Performance Complaints

Intermittent performance complaints can be caused by any part of the electrical, ignition or fuel system. Therefore, obtain as much information as possible from the customer. Try to find out under what conditions the problem occurs. For example: Engine cold, engine warm up, under load, deceleration, light acceleration, city or highway driving. If possible road test the vehicle to duplicate the condition.

When troubleshooting intermittent engine performance complaints:

- Pay very close attention to electrical connections on the fuel injection harness. Connectors which have insufficient tension or show signs of corrosion should be replaced and **not repaired**.
- Corroded and/or loose ground connections should be cleaned and tightened.
- The complete fuel system should be checked including the fuel quality.

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  b. No spark
  - — Page 76 Ignition System

- **Hard starting, hot or cold**

  a. No fuel or excessive fuel
  - — Page 65 Coolant Temperature Sensor
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  b. No spark
  - — Page 76 Ignition System and Idle Stabilizer

- **Poor idle**

  a. At operating temperature
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- **Engine stalls at highway speeds**

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- **Poor performance**

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- **High fuel consumption**

  a.
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Special Tools Required

Minimum Requirement

US 1115 L.E.D. Test Light (Leads must be connected RED to positive and BLACK to negative.)

VW 1367 Tester

US 1119 Multimeter (Digital)

US 1076 or VW 1318 with adapter VW 1318/17, Pressure Gauge

SUN 120.239 CO Adapter

SUN 105 CO Tester

US 8026 Hand Vacuum Pump

US 4487 Evaporative System Leak Tester (Slack Tube)

VW 1490 Resistance Block (18 k ohms/0 ohms)

US 4480/3 Fuel Pump Switch (Optional)

Obtain Locally

1-Liter Graduated Container

System Operation

Digijet injection is a refined version of AFC injection. The use of digital technology, instead of AFC's analog technology, has allowed many components and circuits to be simplified or otherwise improved as follows:

— **Electronic Control Unit (E.C.U.)**
The number of terminals was reduced from 35 to 25, while the number of control functions was increased.

— **Air flow Sensor**
Now requires only 4 terminals. The fuel pump contacts have been eliminated.

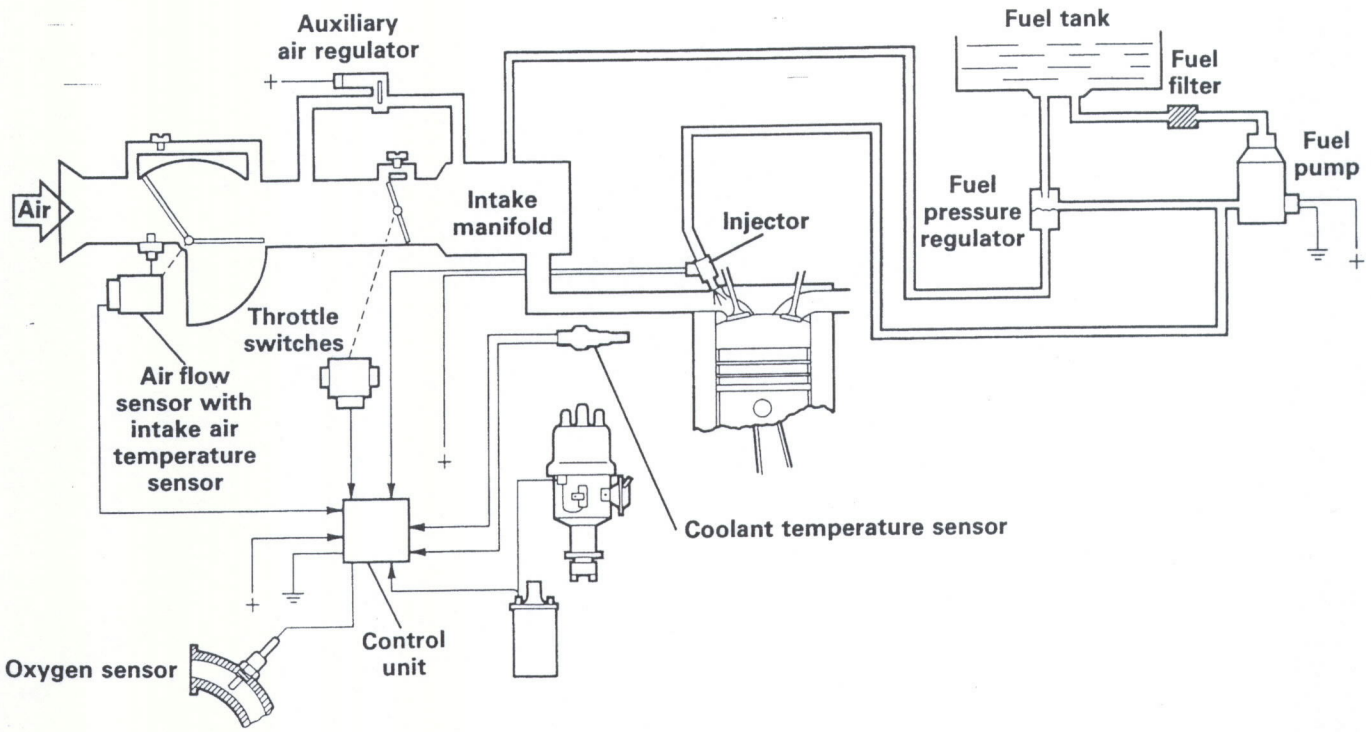
— **Coolant Temperature Sensor**
Is used in place of the cylinder head temperature sensor.

— **Fuel Injectors**
Internal resistance has been increased from 3 ohms to 16 ohms. This eliminates the need for the separate resistor pack.

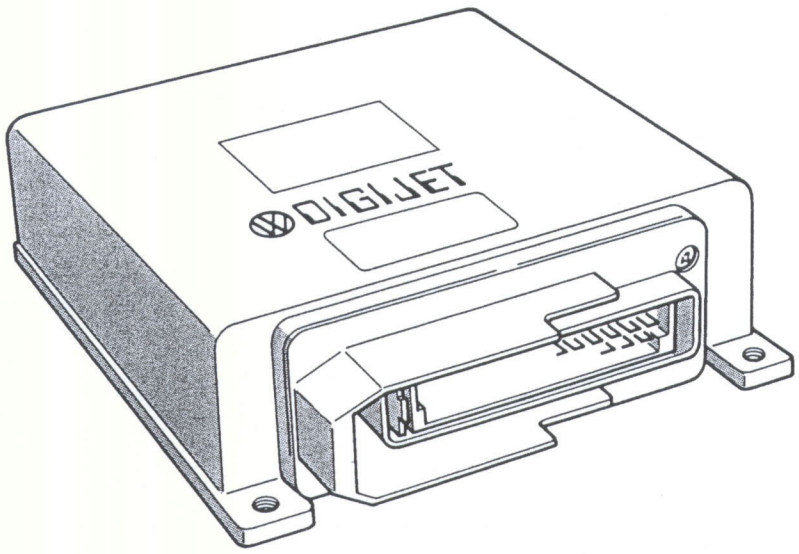
— **Oxygen Sensor**
Is now connected directly to the E.C.U., which adjusts the injector opening duration accordingly.

— **Cold Start Valve/Thermo-Time Switch**
Have been eliminated. Cold start enrichment is now controlled by the E.C.U., which increases injector opening duration during cranking based upon the input signal from the coolant temperature sensor. An internal time-limit factor prevents flooding.

— **Fuel Shut-Off On Deceleration**
Has been added as an auxiliary function of the E.C.U. for improved emissions and fuel economy.



Electronic Control Unit (E.C.U.)



The control unit generates two output signals to control the injection system. These are:

— Actuation signal for the fuel injectors

— Ground signal for the fuel pump relay

There are 256 signal operational points programmed in the E.C.U. memory. Comparisons are made between these points for a total of more than 65,000 injector opening duration signals based on various inputs to the control unit.

- Engine speed
- Intake air temperature
- Intake air volume
- Coolant temperature
- Throttle position
- Oxygen content in the exhaust gas
- Battery voltage
- Throttle valve position

An emergency operation function is incorporated into the E.C.U. circuit in the event of:

- Faulty air intake or coolant temperature sensor.

Internal function tests of the E.C.U. in the field are currently not possible. Proper/improper function of the E.C.U. can only be determined through testing of individual components and their input to the E.C.U.

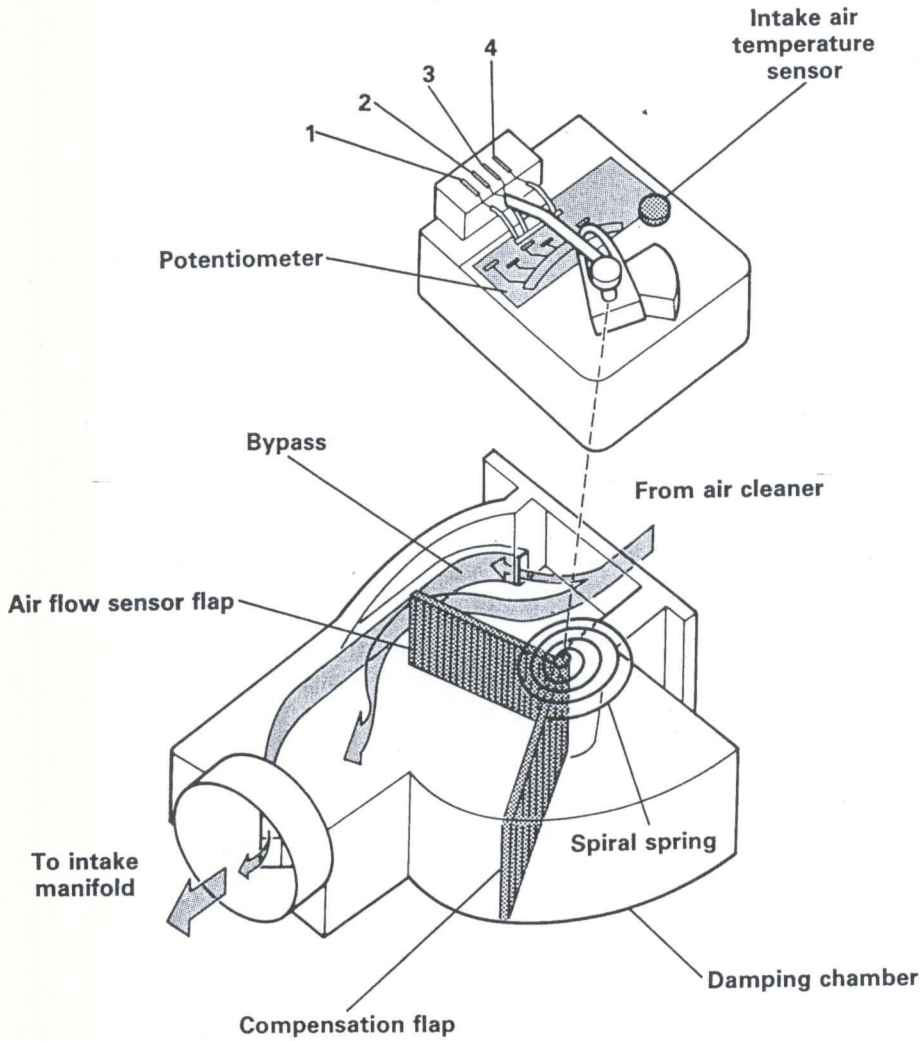
Air Flow Sensor/Intake Air Temperature Sensor

The air flow sensor measures the amount of air entering the intake manifold and sends a voltage signal to the control unit.

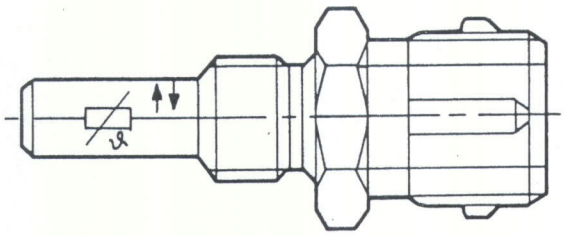
Intake air opens the air flow sensor flap which operates the potentiometer to determine the voltage signal. This signal and the engine speed information supplied by the Hall sender are used as the principal inputs for the determination of the fuel injector opening duration.

A compensation flap moves in a damping chamber to dampen sudden movements of the air flow sensor flap due to oscillations of the intake air.

An intake air temperature sensor is mounted in the air flow sensor housing. It is a negative temperature coefficient resistor (NTC), which means its resistance value drops as its temperature increases. The signal it supplies to the control unit is used to modify fuel injection rate depending on intake air temperature.



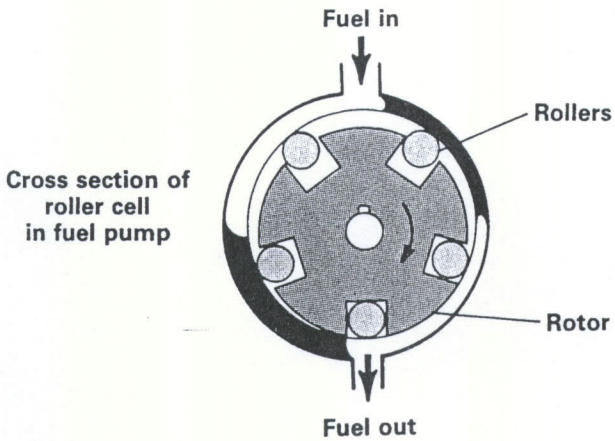
Coolant Temperature Sensor



The coolant temperature sensor is also a negative temperature coefficient resistor (NTC). The resistance signal it produces is used by the control unit to determine cold start enrichment. It also provides a signal to continue to enrich the mixture during engine warm up.

The sensor can be checked by measuring its resistance value at a given temperature and comparing it to a graph.

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. If the pump is allowed to run dry, it will suffer damage.

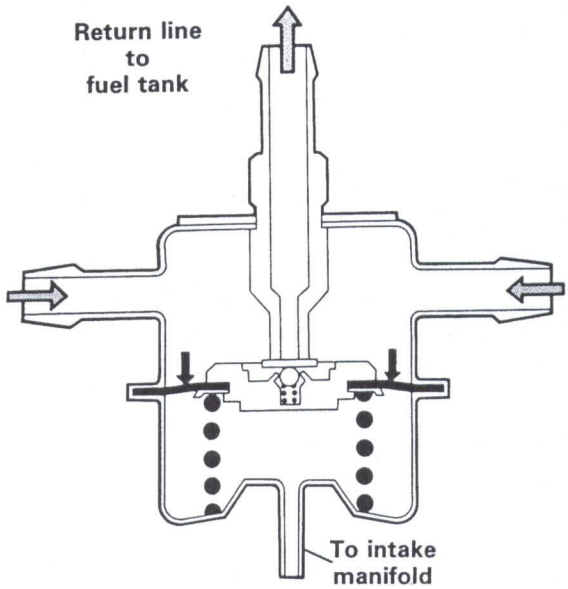
The pump delivers several times the amount of fuel required to operate the engine at any time. Excess fuel is diverted back to the tank via the fuel pressure regulator.

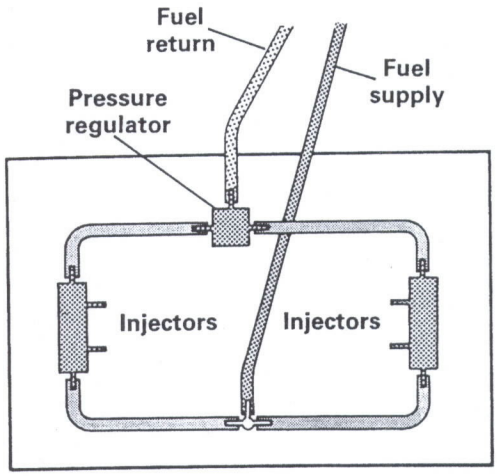
Fuel Pressure Regulator

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

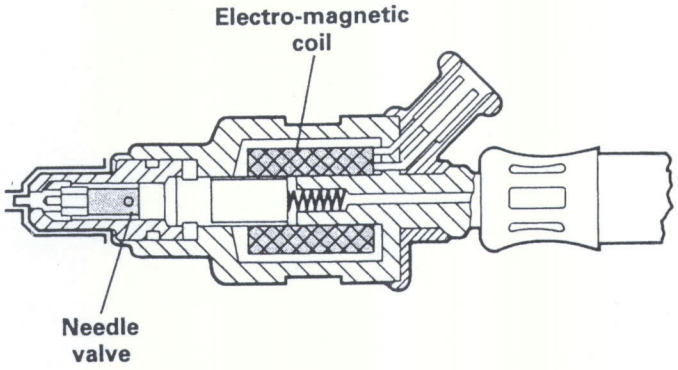
The regulator is connected to the intake manifold. It responds to manifold vacuum fluctuations, and thereby compensates for engine load changes.

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





Fuel Injectors



Digijet fuel injectors are electronically controlled on/off valves. An electro-magnetic solenoid actuates a needle valve allowing fuel to be forced through the injector nozzle at system pressure, where it is finely atomized for proper burning. All four injectors open simultaneously, and inject fuel directly into the intake manifold near each intake valve. Injector opening time is regulated by the E.C.U., based on inputs from the various engine sensors. The E.C.U. controls opening time by regulating the injector grounds. Power is supplied constantly to the injectors when the ignition is on.

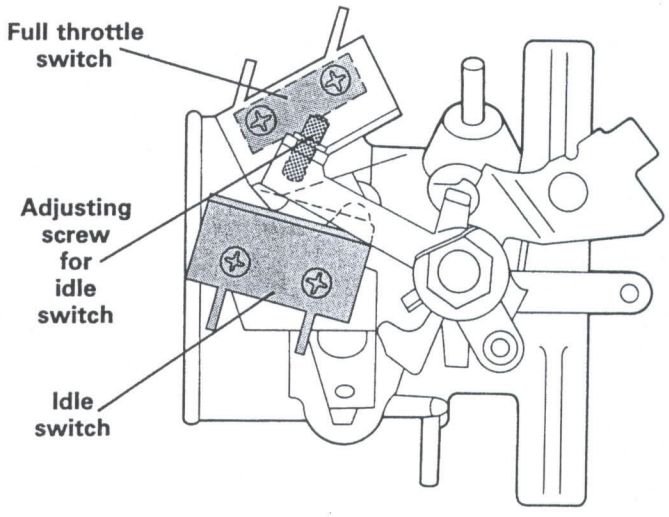
Note: Fuel injectors used for digijet/digifant systems **are not** interchangeable with AFC. Digijet/digifant injectors may be visually identified by their upper injector-body color, which is yellow. AFC injectors are blue.

Throttle Switches

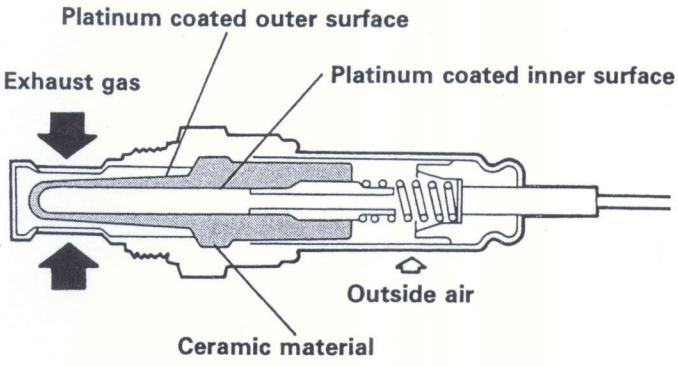
Two micro-switches are mounted on the throttle housing. The idle switch is adjusted to close 0°, 30' before the throttle closes. This sends a ground signal to the control unit in order to control fuel shut-off during deceleration.

The second switch closes at full throttle. The control unit will then enrich the fuel mixture until the throttle is released.

Note: As of engine #DH033353 (approximately mid-production for the 1985 M.Y.), the two switches were combined into a single switch which mounts to the underside of the throttle body.

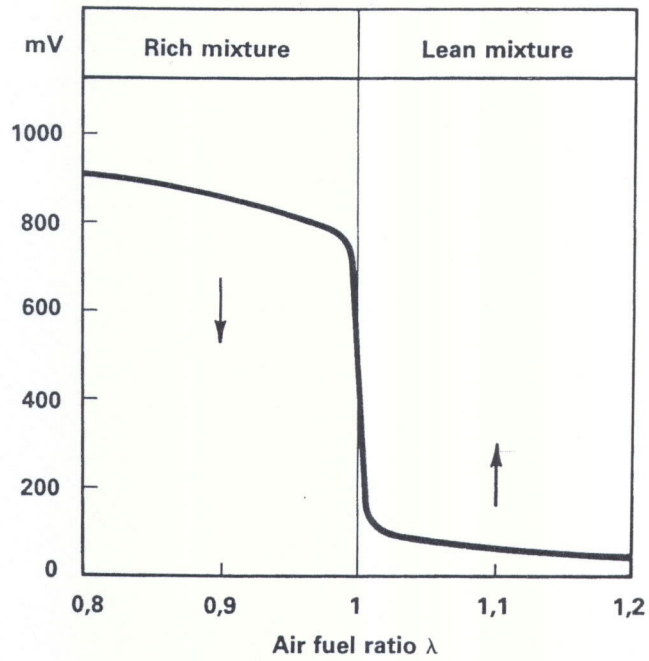


Oxygen Sensor



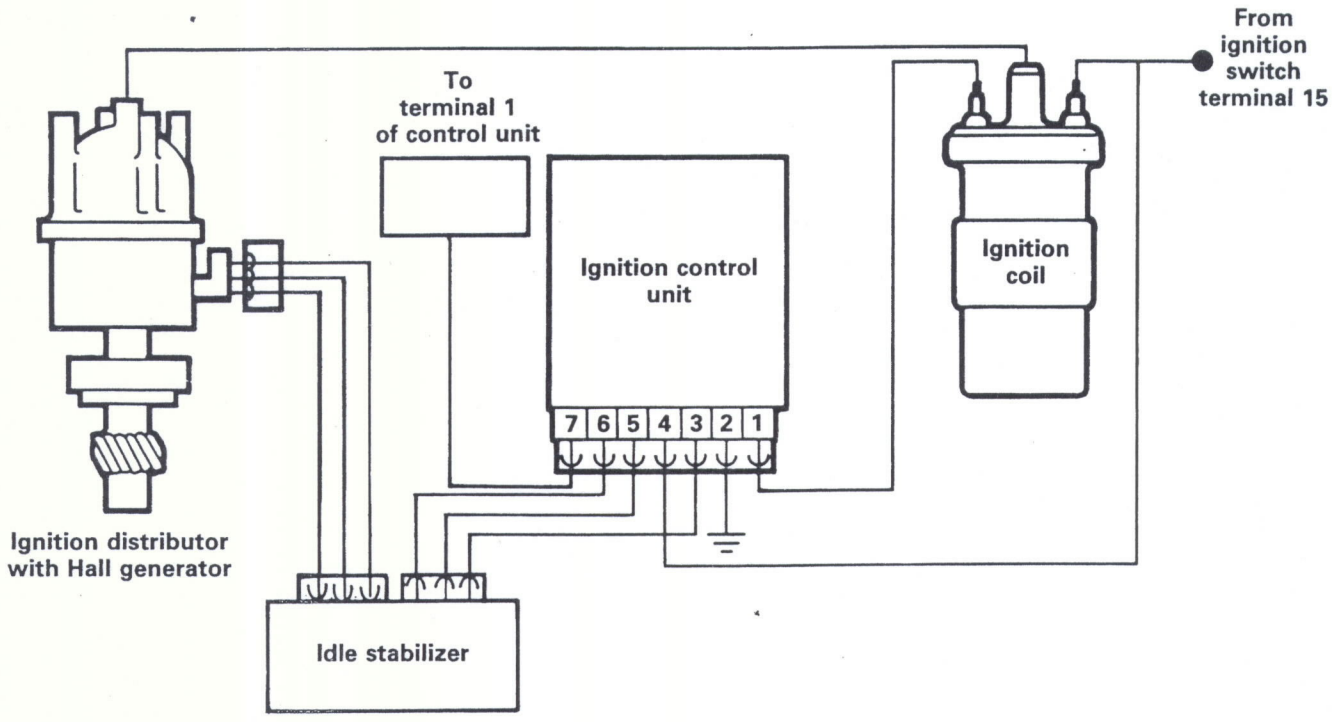
With digijet, a separate control unit and frequency valve are not needed to control the oxygen sensor system. The oxygen sensor is connected directly to the E.C.U. The E.C.U. processes the voltage signal from the oxygen sensor and adjusts the opening duration of the injectors. The oxygen sensor system is deactivated during engine warm-up, full throttle enrichment, and fuel cut-off on deceleration.

The oxygen sensor is made of a ceramic material called zirconium dioxide. The inner and outer surfaces of the ceramic material are coated with platinum. The outer platinum surface is exposed to the exhaust gas, while the inner surface is exposed to the outside air. The difference in the amount of oxygen contacting the inner and outer surfaces of the sensor creates a pressure differential which results in a small voltage signal, 0.1 to 1.1 volts (175 to 1100 mV), being supplied to the control unit. A high voltage signal indicates a rich mixture, whereas a low voltage signal indicates a lean mixture.



The oxygen sensor has a 30,000 mile replacement interval. A mileage counter, which is located in the front of the vehicle next to the left side radius rod, will activate a warning light on the dash at 30,000 miles. At this time, the oxygen sensor should be replaced and the mileage counter reset.

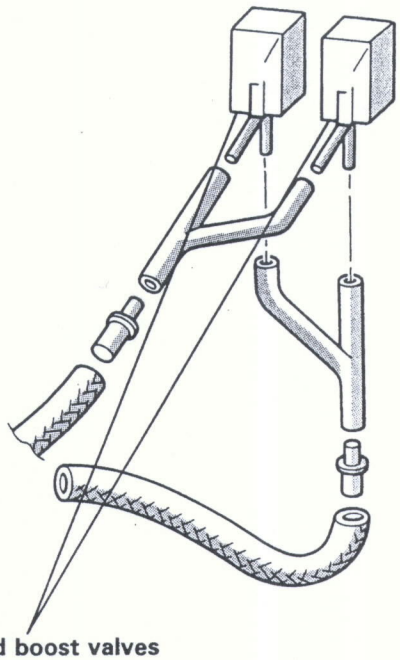
Ignition System/Idle Stabilization



The water-cooled engine uses 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 an idle speed of approximately 940 RPM.

The fuel injection control unit receives the engine speed signal from terminal 7 of the ignition control unit. The fuel injection control unit will limit engine speed to 5,400 RPM. If the engine speed increases above 5,400 RPM, the injection control unit shuts off the fuel supply by switching off the fuel injectors.

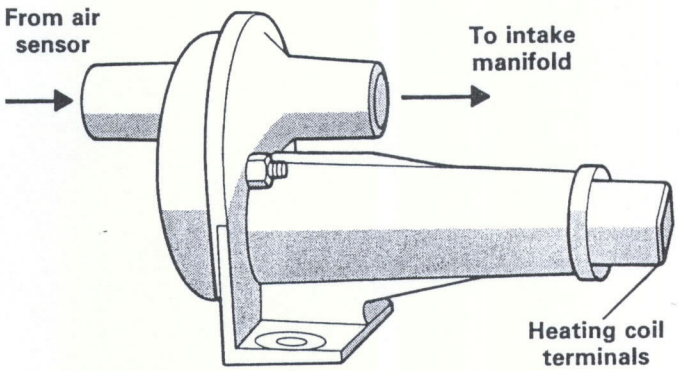
Idle Speed Boost Valves



Idle speed boost valves
- power steering boost valve: open when engine is running with steering turned to lock (pressure switch on P/S pump closed)
- A/C boost valve: open when engine is running with A/C on, and compressor clutch engaged

The idle speed boost valves compensate for the additional engine loads created by operation of the A/C compressor or power steering pump at idle. The boost valves are operated by electro-magnetic solenoids, one of which is activated when the A/C clutch is engaged, and one which is activated by the power steering pump pressure switch when the steering is turned to full lock. When activated, the idle speed is increased by allowing additional air to bypass the throttle plate.

Auxiliary Air Regulator



An auxiliary air regulator similar to the L-jetronic system is used in the Digijet system. The regulator controls the amount of air by-passing the throttle valve when the engine is cold. This gives the engine a "fast idle" which helps the engine during the warm-up period.

Current for the heating element is supplied by the fuel pump relay.

Starting/Warm-Up Enrichment

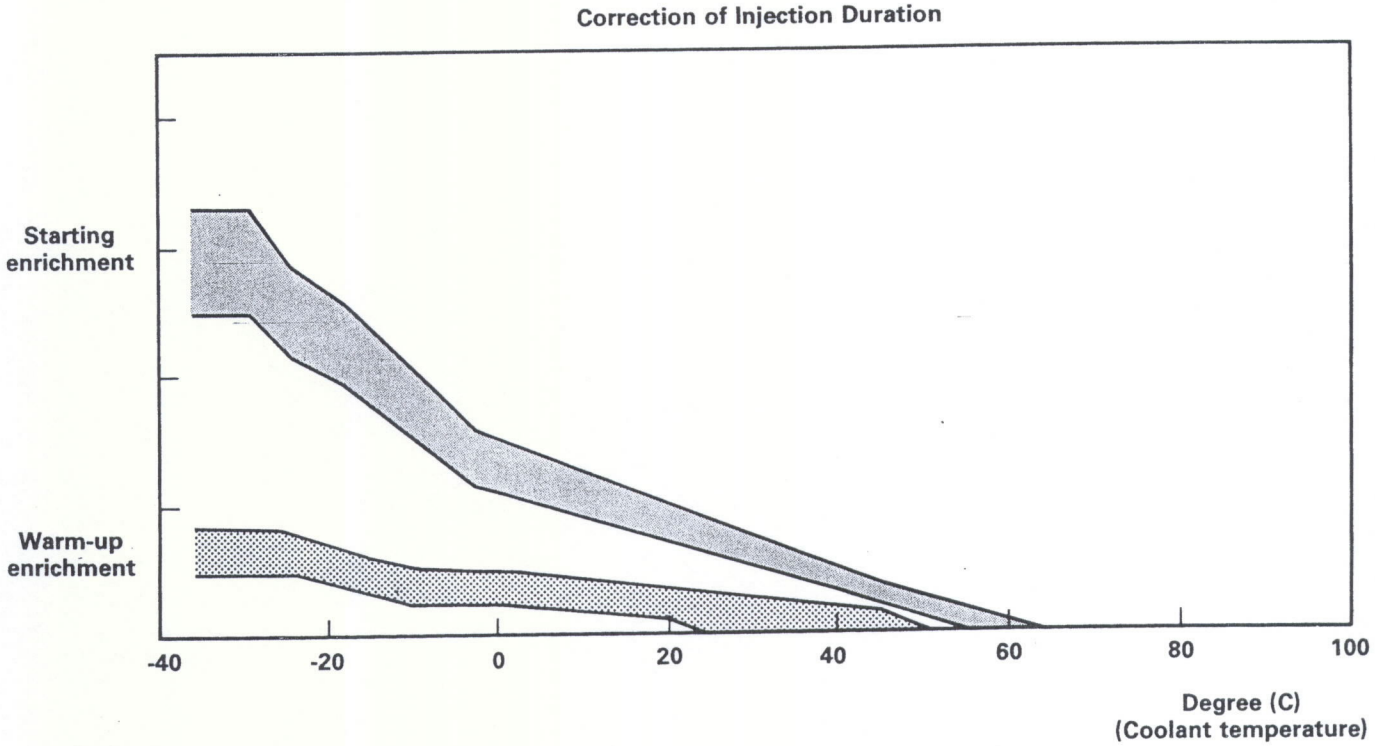
Starting Enrichment Time

The cold start valve and thermo-time switch have been eliminated on the Digijet System. Cold start enrichment is controlled by the coolant temperature sensor.

When the starter is activated, terminal 21 on the control unit is energized. The control unit will then lengthen the opening signal to the injectors and supply more fuel. The amount of enrichment is determined by the resistance of the coolant temperature sensor. This will occur for a fixed amount of time to prevent flooding the engine with gasoline if it fails to start.

Warm-Up Enrichment

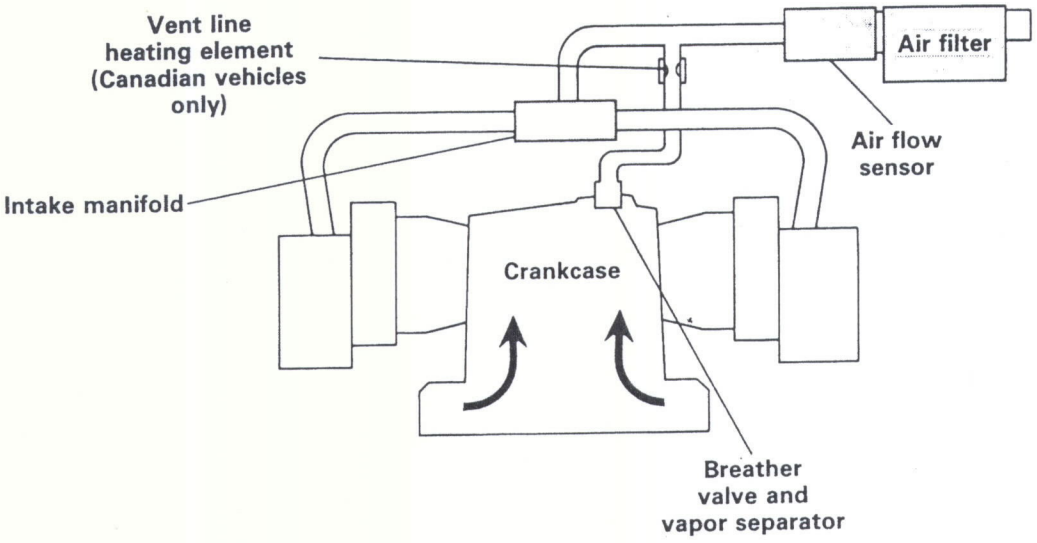
After the engine has started, the control unit maintains a richer fuel/air mixture based upon coolant temperature until the engine reaches operating temperature.



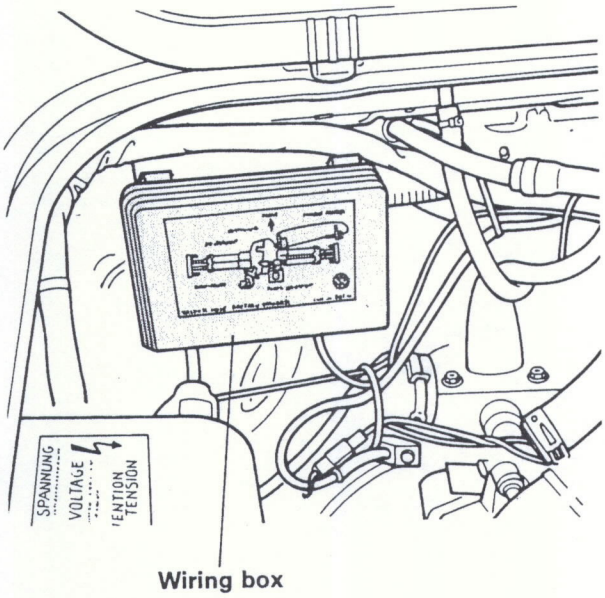
Crankcase Emission Control

Crankcase vapors are drawn through a breather valve and vapor separator into the intake manifold where they are distributed to all cylinders.

The breather valve operates via intake manifold vacuum. When manifold vacuum is high, such as at idle and during deceleration, the valve is closed as spring pressure on the valve seat is overcome. As manifold vacuum drops, such as at highway speeds, the valve opens to allow more vapors to be admitted into the intake manifold.

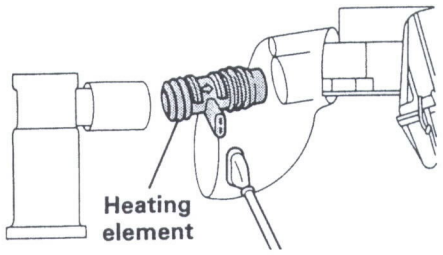


Vent Line Heating Element (Canadian Vehicles Only)



A heating element is used in the crankcase vent line to prevent icing during cold engine operation. The element can be checked with an ohmmeter.

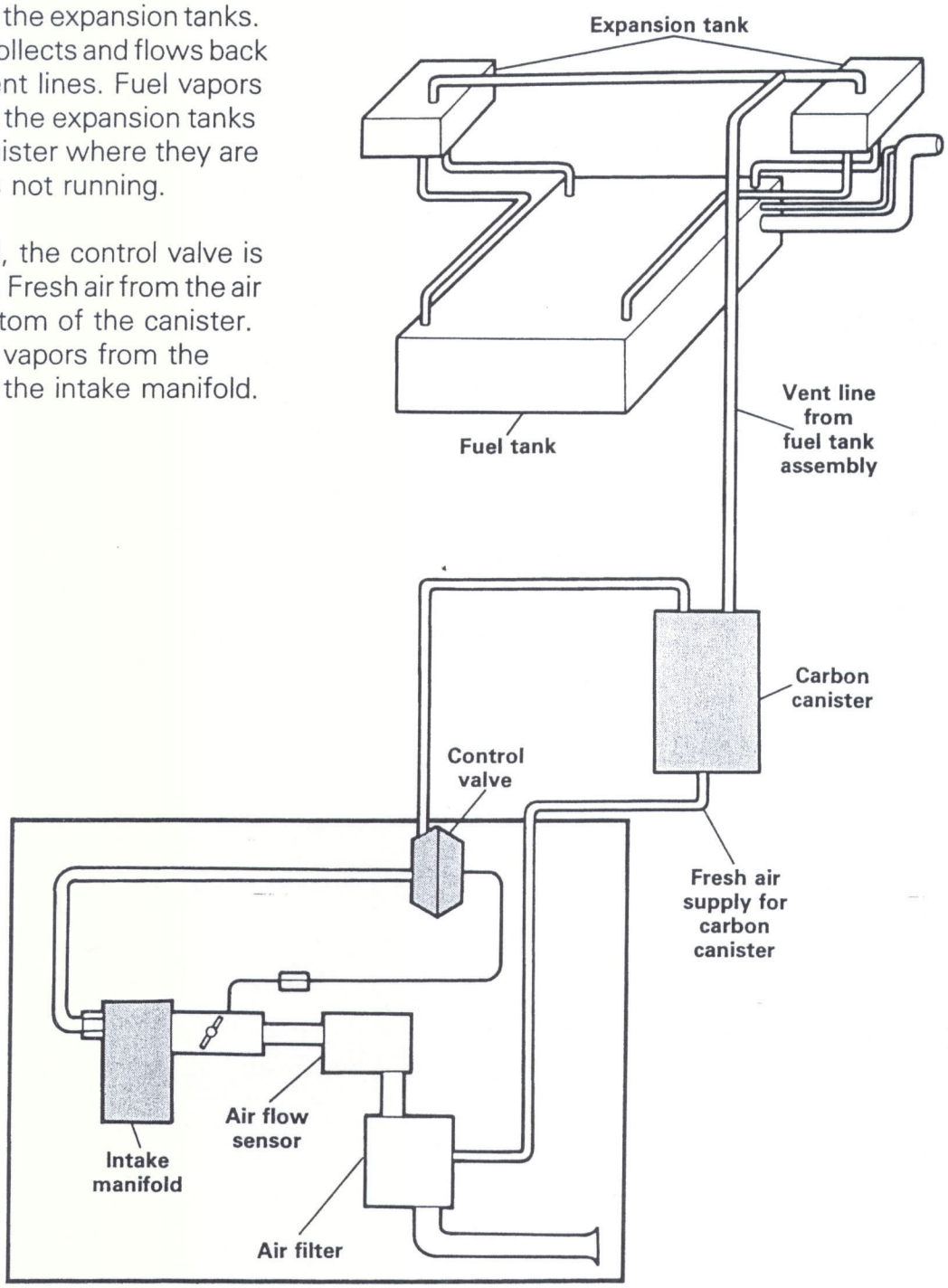
The circuitry to operate the heating element is protected by an in-line, 5 amp fuse located in the wiring connector box in the engine compartment.



Evaporative Emission System

Fuel vapors are collected in the expansion tanks. There, any liquid gasoline collects and flows back to the tank through the vent lines. Fuel vapors are drawn from the tops of the expansion tanks and flow to the carbon canister where they are stored when the engine is not running.

After the engine is started, the control valve is opened by throttle vacuum. Fresh air from the air filter is drawn into the bottom of the canister. From there it collects fuel vapors from the canister and is drawn into the intake manifold.



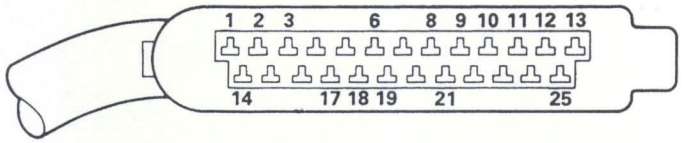
Engine Compartment

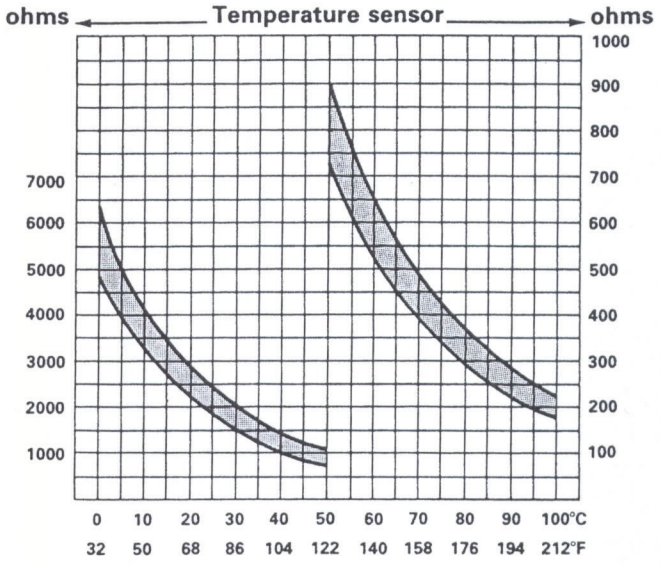
Air Flow Sensor/Intake Air Temperature Sensor Checking

The following tests are to verify proper function of the air flow sensor/intake air temperature sensor, related wiring and connectors.

- Ignition OFF
- Disconnect multi-pin connector from fuel injection E.C.U.
- Connect ohmmeter to terminals (in Column "A") of multi-pin connector to test wiring and component.
- If readings in column "A" do not meet specifications, continue.
- Disconnect electrical connector at air flow sensor.
- Connect ohmmeter to terminals shown in column "B" of air flow sensor to test component.
- If okay — check wiring
- If not — replace air flow sensor and retest

Column "A" Connections at E.C.U. Multi-Pin Connector	Column "B" Connections at Air Flow Sensor		
Terminal Nos.	**Terminal Nos.**	**Description**	**Specification**
6 and 19	6 and 9	Potentiometer - Total Resistance	500 - 1000 Ohms
15 and 19	7 and 9	Potentiometer - Resistance Measured Through Wiper Arm	Ohms Change As Sensor Flap Is Opened (Flap Must Move Freely)
6 and 14	6 and 22	Intake Air Temperature Sensor	Ohmmeter Reading Should Correspond To The Graph Below

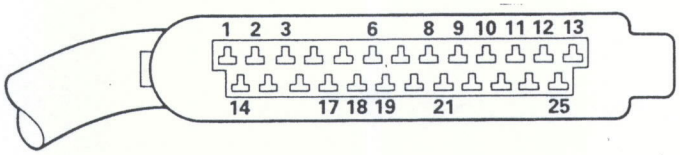


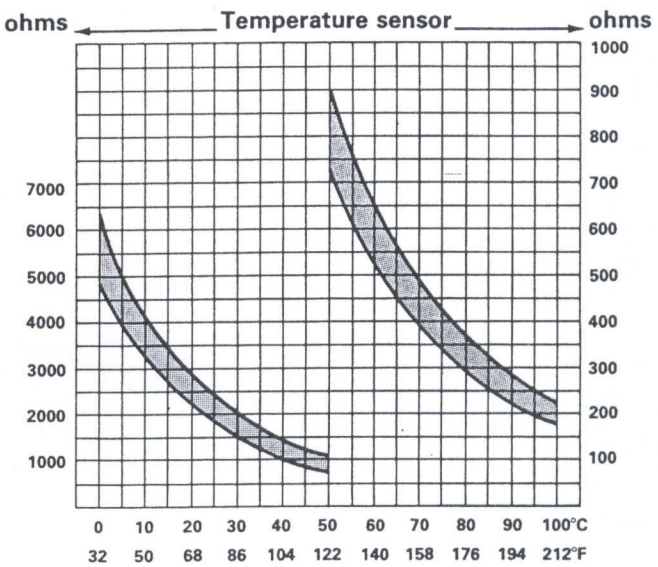


Coolant Temperature Sensor — Checking

The following tests are to verify proper function of the coolant temperature sensor, related wiring and connectors.

- Ignition OFF
- Disconnect multi-pin connector from fuel injection E.C.U.
- Measure temperature sensor with probe type thermometer at sensor.
- Connect ohmmeter to terminals 2 and 7 of multi-pin connector. The resistance value should correspond to graph below.
- If resistance value is not within specifications, go directly to sensor.
- Disconnect connector from coolant temperature sensor. Caution, do not let connector come in contact with exhaust manifold.
- Connect ohmmeter to terminals of coolant temperature sensor. Resistance should correspond to graph below.
- If okay — check wiring
- If not, replace sensor and retest





Fuel Pump Checking

Pressure Test

— Connect pressure gauge US 1076 or VW 1318 (or equivalent) to fuel line T-piece.

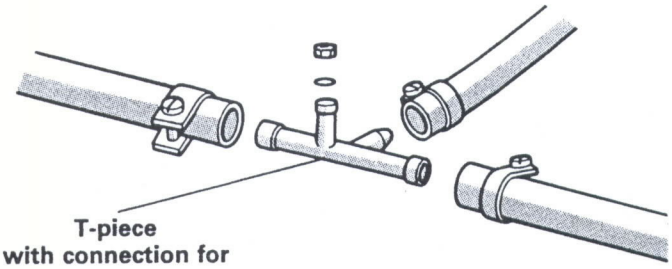
Note: If using VW 1318 pressure gauge, the lever must be in a closed position.

— Remove fuel pump relay and bridge terminals 30 and 87 with US 4480/3.

— Run fuel pump and observe pressure

- Pressure must be a minimum of 2.5 bar (36 PSI)

If not — continue with next test



T-piece with connection for pressure gauge

Volume Test (Fuel Tank At Least Half Full)

— Disconnect fuel return line at pressure regulator.

— Attach approx. 4 feet of fuel line to return line of pressure regulator. Place other end of fuel line into a 1 liter measuring container.

— Remove fuel pump relay and bridge terminals 30 and 87 with tool US 4480/3.

— Run fuel pump exactly 30 seconds.

— Delivery quantity should be at least 500 cc.

- If delivery quantity is not to specifications, check fuel flow from tank before and after fuel filter.
- If fuel flow from tank is not obstructed, continue to Fuel Pump Electrical Testing below.

Fuel Pump Electrical

— Battery fully charged.

— Connect ammeter to fuel pump in series with power supply to fuel pump.

— Remove fuel pump relay, bridge terminals 30 and 87 with tool US 4480/3.

— Run pump.

- Ammeter readings should be approximately 2.5 - 3.5 amps.
- Lower reading may indicate poor ground.
- Higher reading may indicate dragging pump motor, pump must be replaced.

Fuel Pump — Checking (Cont'd.)

— Switch on ignition

— Check terminal 85 of fuel pump relay for battery voltage; check terminal 30 for battery voltage.

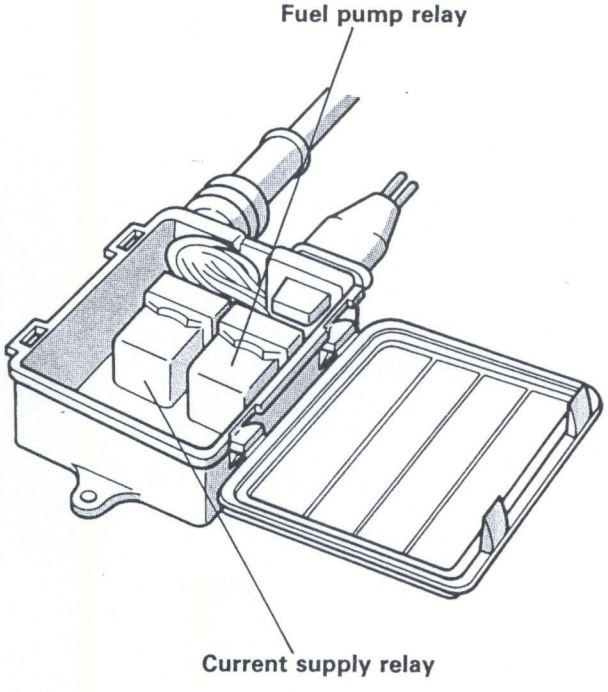
— Remove fuel pump relay and check terminal 86 for ground from terminal 20 of E.C.U. while cranking.

If not: Check continuity of wire from terminal 86 of relay holder to terminal 20 of E.C.U. (ground circuit).

If O.K.: Check continuity of wire from terminal 7 of Hall ignition control unit to terminal 1 of E.C.U. (Hall signal).

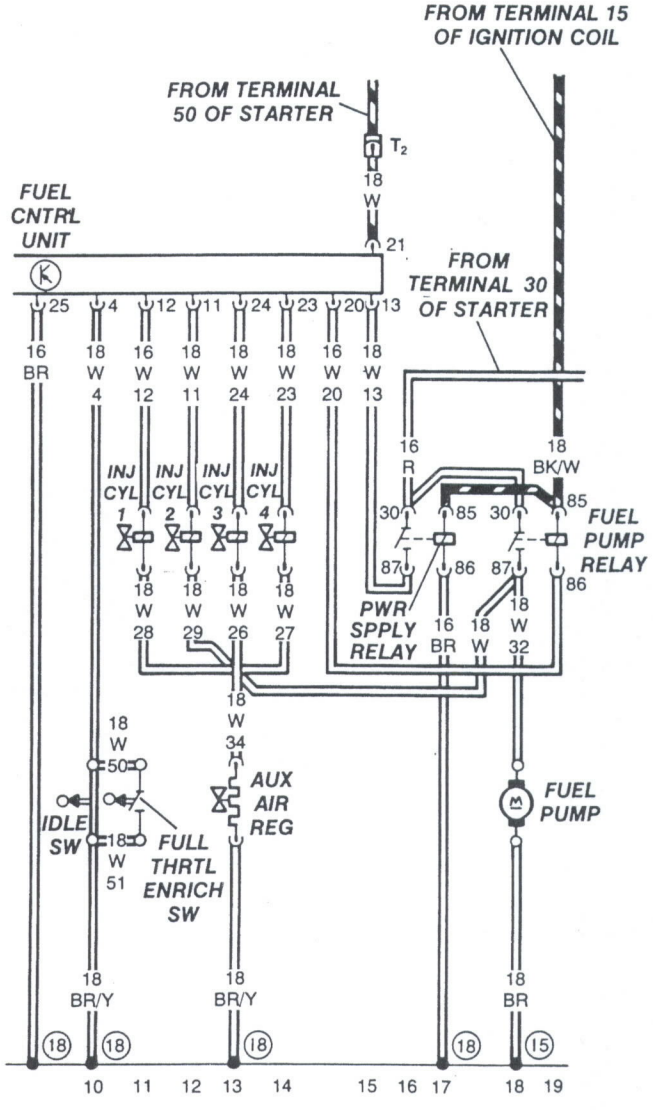
If O.K.: Check continuity of wire from terminal 7 of E.C.U. to ground cluster at left cylinder head (E.C.U. ground).

If O.K.: Replace E.C.U.

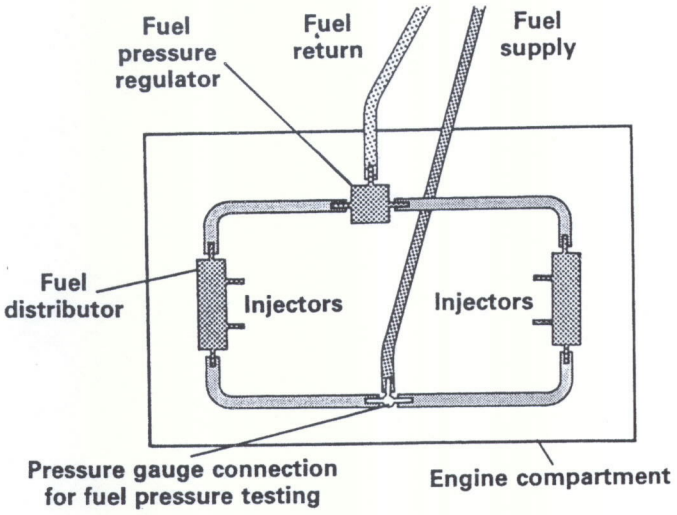


— Reinstall fuel pump relay, check terminal 87 for battery voltage. If not, replace fuel pump relay.

— If voltage is present, check the continuity of the wire from terminal 87 to the positive terminal of the fuel pump. If wire has continuity, replace the fuel pump.



Fuel Pressure Regulator — Checking



— Connect pressure gauge US 1076 or VW 1318 (or equivalent) to fuel line T-piece.

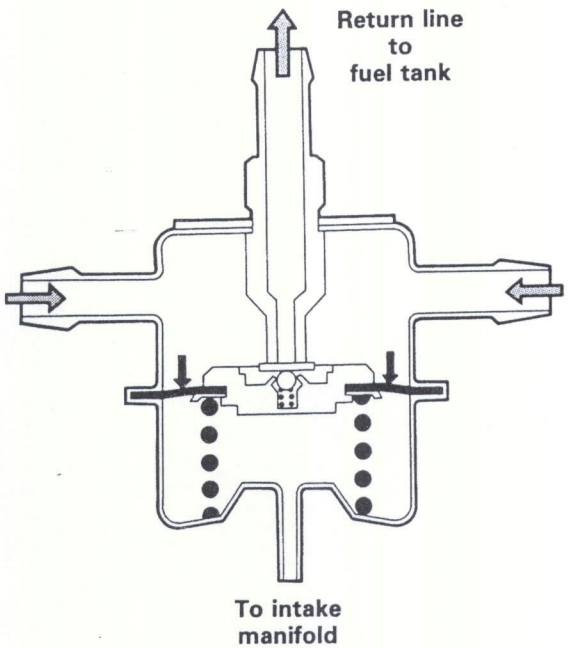
Note: If using VW 1318 pressure gauge, the lever must be in a closed position during measurement procedure.

— Run engine at idle speed and check pressure.

Specifications:

Bar (P.S.I.)	Vacuum Hose on Pressure Regulator
2.2 (33)	Connected
2.5 (36)	Disconnected

Residual Pressure Test



— Stop engine, wait 10 minutes.

Pressure should be 2.0 - 2.5 bar (29-36 PSI). If not, there are three possible problems:

- Fuel pump check valve - Test by clamping off line from fuel pump.
- Fuel pressure regulator - Test by clamping off return line to tank.
- Fuel injector(s) - Test by clamping off lines from injectors to pressure regulator. If necessary, proceed to Page 70 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

Spray Pattern

— Pull out fuel injectors in pairs (left blank or right). Leave wires connected to injectors which were removed.

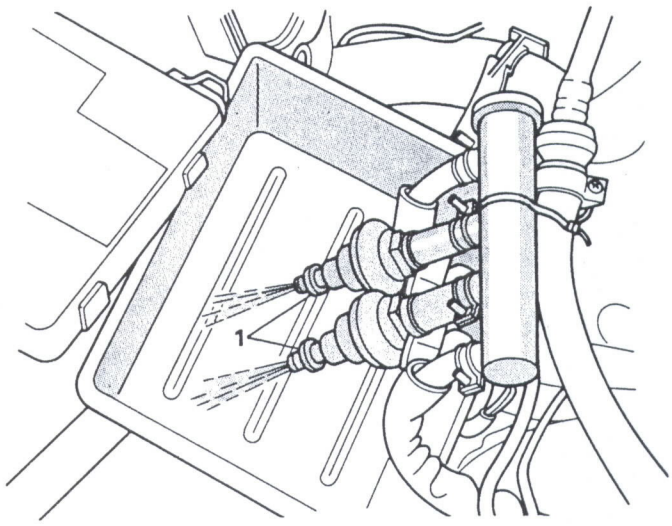
— Disconnect electrical plugs from injectors which remained installed.

— Hold injectors in jar or pan.

— Operate starter briefly. Spray pattern must be an even, cone-shaped spray.

— Reinstall fuel injectors with new sealing rings 1.

— Repeat procedure for remaining pair of injectors.



Quantity

— Pull out fuel injectors.

— Disconnect electrical plugs from injectors.

— Place No. 1 injector into graduated container of at least 100cc.

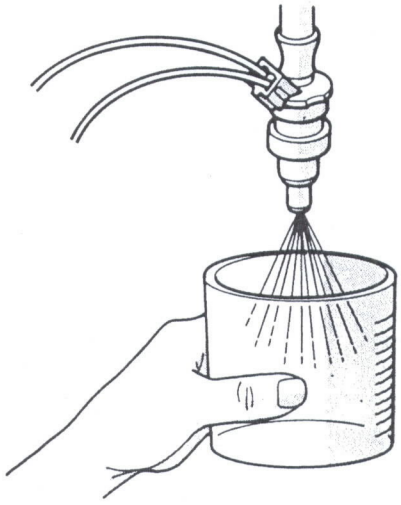
— Connect one jumper wire to terminal 15 of ignition coil and injector, and a second jumper wire from ground to the injector.

— Remove fuel pump relay, bridge terminals 30 and 87 with tool US 4480/3.

— Switch on ignition.

— Using US 4480/3, run pump for exactly 30 seconds, delivery quantity must be a minimum of 87 cc. If not, replace injector and retest.

— Continue test for remaining injectors.



Fuel Injectors — Checking (Cont'd.)

Leak Checking

— Pull off electrical plugs at fuel injectors.

— Pull out injectors in pairs but leave connected to fuel ring line.

— Turn ignition ON for about 5 seconds (fuel pump operates briefly).

— Check that no more than 2 drops leak from each injector in one minute.

Component Tests

— Pull off electrical plugs at fuel injectors.

— Connect ohmmeter across injector terminals, reading should be approximately 16 ohms (14-18 ohms).

Wiring Test

Touch the injectors while cranking the engine. You can feel the mechanical operation of the injector, and the function of the electro-magnetic solenoid.

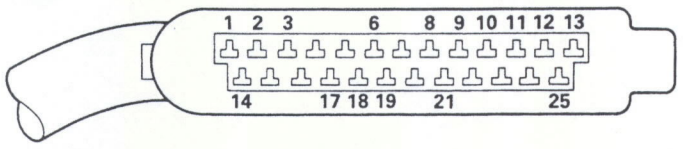
If the injectors are not working, the troubleshooting is as follows:

— Disconnect all electrical plugs from fuel injectors; bridge contacts of one plug with US 1115 L.E.D. tester. Operate starter briefly (the diode must flicker) and repeat procedure on remaining plug contacts.

Note: If diode does not flicker, reverse test leads and repeat procedure to insure correct polarity of tester connections.

— If not: Reconnect electrical plugs to fuel injectors and disconnect multi-pin connector plug from E.C.U. With ignition switched OFF, bridge ohmmeter across following terminals of E.C.U. connector plug to check continuity of injector wiring and connections.

Caution: To prevent damage to control unit, **do not** short-circuit connector contacts.



Terminal Nos.	Description	Specification
12 and 7	Fuel Injector - Cyl. 1	Approx. 16 Ohms (14-18 Ohms)
24 and 7	Fuel Injector - Cyl. 2	
11 and 7	Fuel Injector - Cyl. 3	
23 and 7	Fuel Injector - Cyl. 4	

Throttle Valve/Deceleration/Idle Switch — Checking

This switch supplies the E.C.U. with information that the throttle valve is **closed**.

If engine is above 1500 RPM with the throttle closed, fuel will be shut off to the injectors.

At idle speed, this switch signals control unit to regulate amount of fuel injected.

Note: As of engine #DH033353 (approximately mid-production for the 1985 M.Y.), the two switches were combined into a single switch which mounts to the underside of the throttle body.

For checking/adjusting procedures on this switch, refer to Digifant Section, Page 115. Remember to use terminals 4 and 7 of multi-pin connector plug when performing wiring and E.C.U. checks.

First Check

— Coolant temperature sensor must be a minimum of 60°C (140°F)

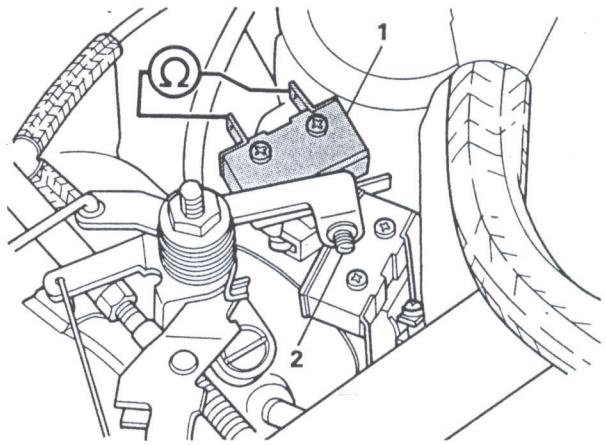
— Run engine at idle for short time (2-3 minutes)

— Stop engine and turn ignition ON

— Remove connectors for both throttle valve switches.

— Using voltmeter, measure voltage at harness connector for throttle valve idle switch

- Voltage should be approximately 5 volts



Wiring and E.C.U.

Second Check

— Remove connectors from both throttle valve switches.

— Attach ohmmeter to switch 1.

- Throttle valve in idle position idle switch closed = 0 ohm
- Throttle valve halfway open idle switch open = ∞ ohm

— Reconnect connectors

— Turn ignition OFF

— If not; check for continuity from switch to terminal 4 of multi-pin connector plug of E.C.U., and from switch to ground cluster on left cylinder head.

Throttle Valve/Deceleration/Idle Switch Checking (Cont'd.)

Third Check (Deceleration Fuel Shut-Off)

— Results of previous checks must be okay

— Start engine

— Raise engine speed above 3000 RPM and return to idle

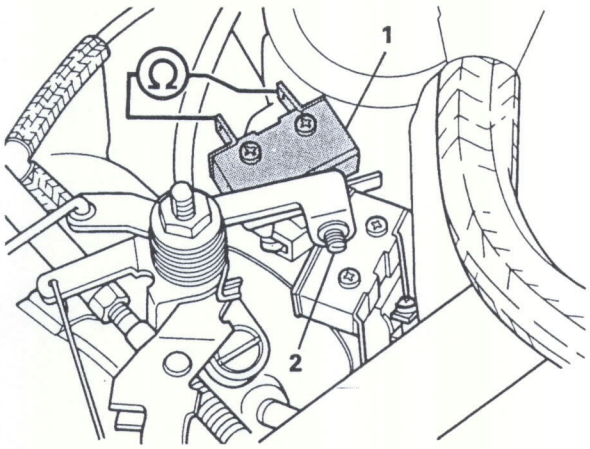
— Hold throttle valve deceleration/idle switch closed by hand

Note: Engine must be at operating temperature.

— Raise engine speed slowly

— Engine speed must fluctuate, if not replace fuel injection E.C.U. and retest

Adjusting Deceleration/Idle Switch



— Throttle valve closed

— Adjust screw 2 so that switch just closes

— From this position turn adjusting screw **exactly** one turn inward

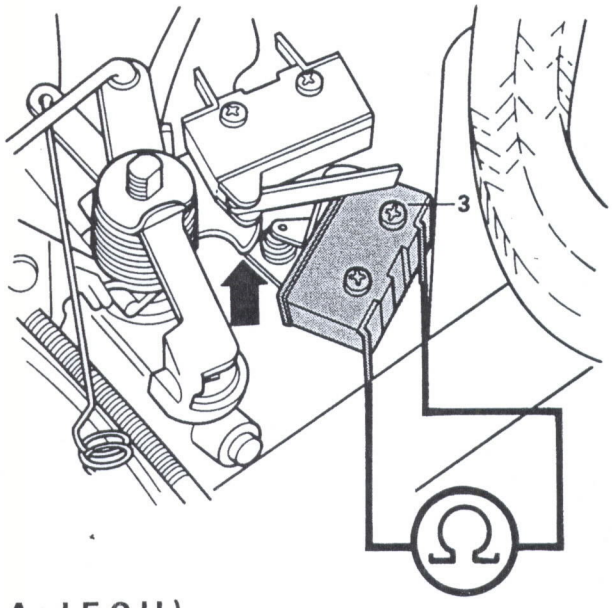
— Secure adjusting screw with paint

Note: Correct adjustment is very important, if switch is mis-adjusted, engine may surge or cut-out while driving.

Full Throttle Enrichment Switch — Checking

First Check (Throttle Valve Switch)

Full throttle enrichment switch supplies the E.C.U. with information to increase the amount of fuel injected at full throttle.



— Remove wiring connectors from both throttle valve switches

— Attach ohmmeter to switch **3**

- Throttle valve in idle position full throttle switch open = ∞ ohm
- Throttle valve fully open full throttle switch closed = 0 ohm

— Reconnect connectors

Second Check (Wiring And E.C.U.)

— Coolant temperature sensor must be a minimum of 60°C (140°F)

— Run the engine at idle speed for a short time (2-3 minutes)

— Stop the engine and turn ignition ON.

— Remove wiring connectors from both throttle valve switches.

— Using voltmeter measure voltage at harness connector for full throttle switch.

- Voltage should be approximately 5 volts.

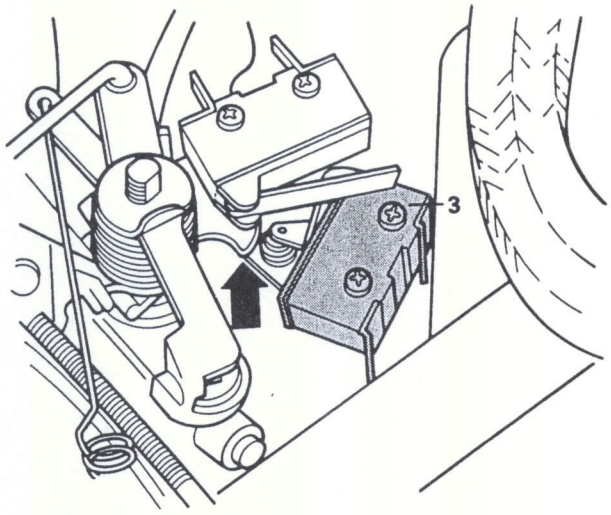
— Turn ignition OFF

— If not: Check for continuity from switch to terminal 4 of E.C.U. connector plug, and from switch to ground cluster on left cylinder head.

— If okay, replace E.C.U.

Full Throttle Enrichment Switch — Checking

Third Check (Full Throttle Enrichment)



Result of first and second check must be okay.

Throttle valve switch connectors are connected.

Coolant temperature sensor must be a minimum of 60°C (140°F) and the resistance below 550 ohms.

CO tester and tachometer connected.

— Run engine for about 2 minutes at idle speed.

— Increase idle speed slowly until tachometer reads about 4,000 RPM. CO should be between 0.3 to 1.1%.

— With engine at about 4,000 RPM, operate full throttle enrichment switch **3** by hand for about 15 seconds.

- CO must increase to about 1.5%. If not, the E.C.U. is defective.

Full Throttle Enrichment Switch, Adjusting

— Loosen the retaining screw for the switch.

— Open the throttle valve fully and move switch until cut-in position is reached.

— Position of roller should be nearly in center of cam disk (arrow in above illustration)

— Retighten the retaining screw for the switch

Crankcase Ventilation Heater — Checking (Canadian Vehicles Only)

— Switch ignition ON

— Unplug connector 4 from heater connector 3

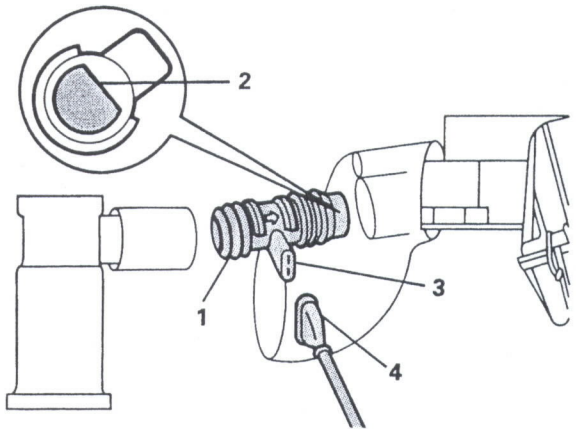
— Using voltmeter, check voltage across terminals of connector 4

- Must be approx. battery voltage

— Turn OFF ignition

— Using ohmmeter, check resistance across terminals of connector 3

- Must be 4-17 ohms at approx. 25°C (77°F)



Oxygen Sensor — Checking

— Coolant temperature sensor must be at least 60°C (140°F).

— Connect CO tester to test receptacle on exhaust pipe (left side).

— With ignition turned OFF, disconnect connection **1** between oxygen sensor and the E.C.U.

— Pull off the vacuum hose **2** from the pressure regulator and plug hose.

— Start engine.
CO must increase to above 1.5%

— After about 2 minutes reconnect connection **1**.

CO must drop to 0.7 ± 0.4%

If **not**, the following components may be defective:

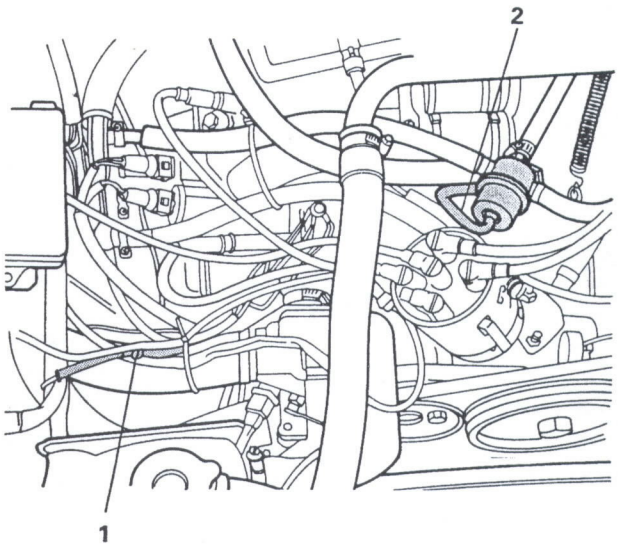
Wire between oxygen sensor and the E.C.U.

— Check wiring by disconnecting connection **1** and ground wire from control unit.

- CO must increase.

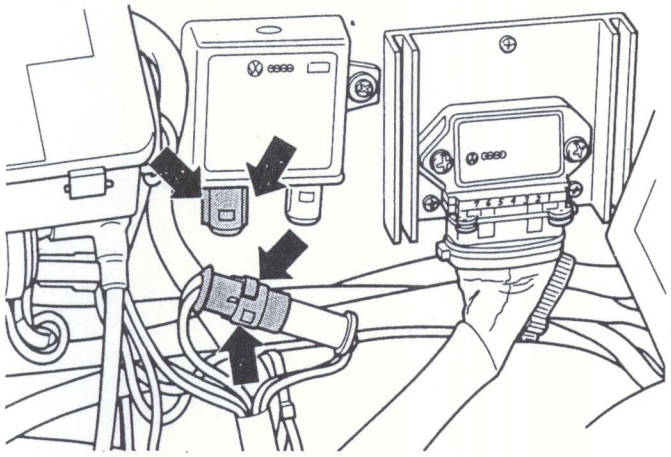
If **okay**, oxygen sensor must be defective or there is a leak in the exhaust system between the catalytic converter and the cylinder head.

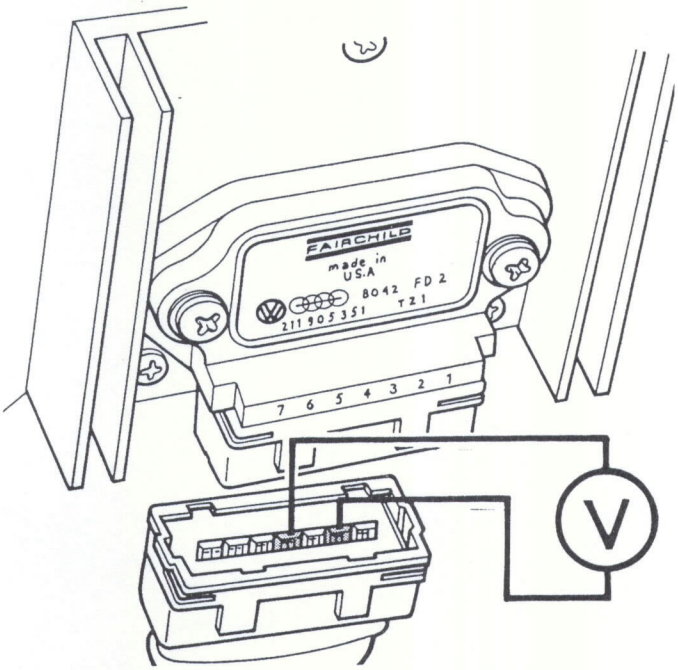
If not okay, replace E.C.U. and retest.

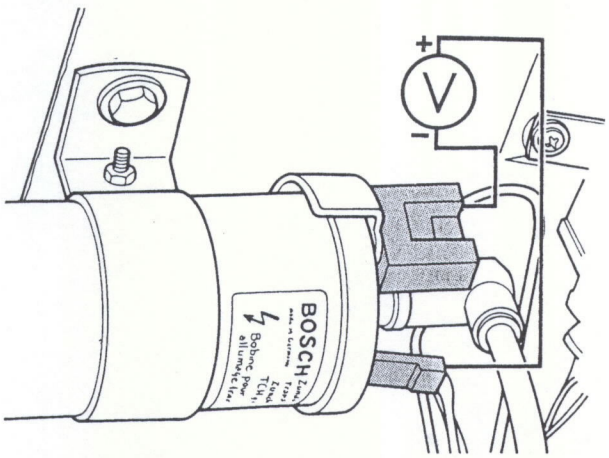


Note: Do not disconnect oxygen sensor with engine running.

Hall Generator — Checking







— Disconnect idle stabilizer plugs from control unit (squeeze plugs to release-upper arrows).

— Connect plugs together (lower arrows).

— Remove connector from Hall control unit.

— Connect voltmeter with + (plus) to terminal **4** and with – (minus) to terminal **2** in connector.

— Turn ignition ON.

Spec. = approx. battery voltage.

If not, check for wire breaks and repair.

— Turn ignition OFF.

— Reconnect connector to Hall control unit.

— Disconnect Hall generator connector from the ignition distributor.

— Connect voltmeter with + (plus) to terminal **15** and with – (minus) to terminal **1** of ignition coil.

— Turn ignition ON.

Specification = 2 volts minimum for 1-2 seconds and then drops to 0 volts. If not, replace Hall control unit and ignition coil.

— Touch center wire of connector on distributor briefly to ground. Voltage must increase briefly to 2 volts (minimum). If not, check for wire break in center wire and repair or replace Hall control unit if wire is **okay**.

Hall Generator — Checking

Two different types of Hall control units can be installed.

— Connect voltmeter as follows:

a. **FAIRCHILD** — HALL CONTROL UNIT
Connection **A** to terminal 15 of ignition coil and other connection to terminal **7.**

b. **AEG** — HALL CONTROL UNIT
Connection **A** to ground and other connection to terminal **7**.

- Voltmeter must show **approximate battery voltage.**

— Touch center wire of connector on distributor briefly to ground (see illustration).

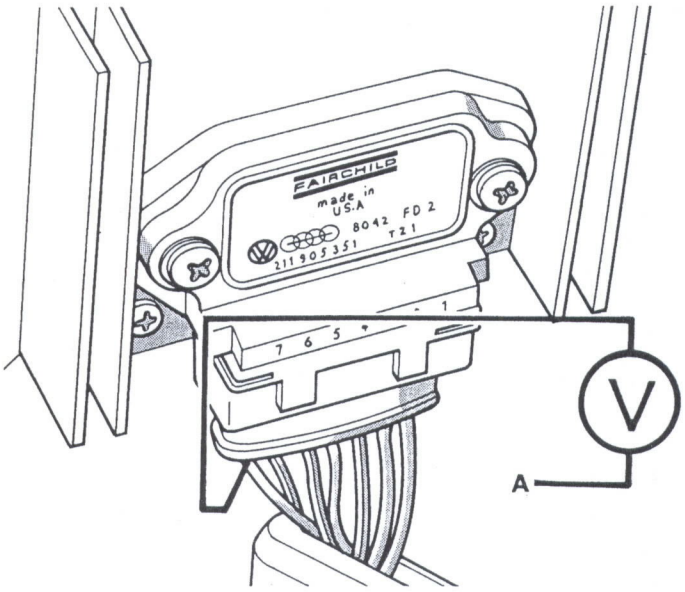
Voltage must drop briefly below 1.5V.

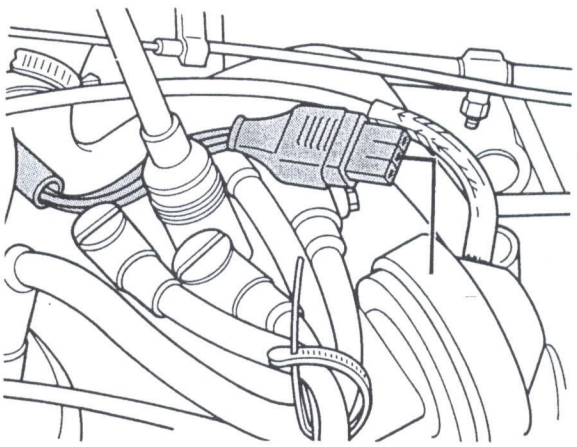
— Connect voltmeter to outer terminals of Hall generator connector.

— Turn ignition ON.

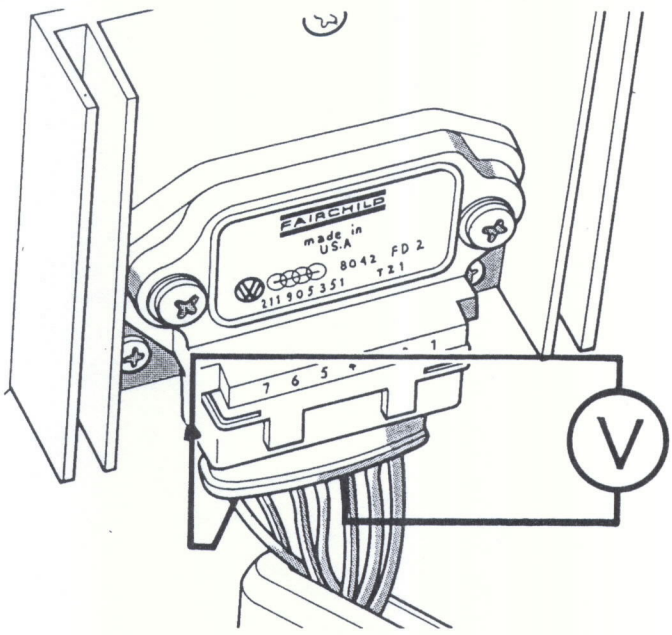
Spec. = 5 volts (min.).

Note: If readings are within specifications, but problem still exists, check for wire break between Hall generator connector and Hall control unit; and repair as necessary. If wire is okay, replace Hall control unit.





Hall Generator — Checking (Cont'd.)



Specified values given are valid for ambient temperatures from 0 to 40°C (32 to 104°F).

— Disconnect center coil wire from distributor and ground using jumper wire.

— Pull rubber boot from control unit connector (with connector connected) as shown.

— Connect + (plus) wire of voltmeter to terminal **6** and – (minus) wire to terminal **3**.

— Turn ignition ON.

— Turn engine over slowly by hand (in clockwise direction) and watch tester reading.

Spec. = voltage must fluctuate between 0 and minimum 2 volts.

If not, replace Hall generator.

Idle Stabilizer — Checking

Note: If engine is difficult to start, does not start, or misfires/stalls, proceed as follows:

Work Sequence:

— Disconnect both wire plugs from idle stabilizer.

— Check contact pins and sockets of both idle stabilizer connectors for correct position or damage.

— Connect both plugs together.

— Start engine:

If starting troubles are still experienced, idle stabilizer control unit is **not** defective.

If engine starting troubles are eliminated, but troubles start again after reconnecting plugs to idle stabilizer unit, idle stabilizer unit must be defective; replace unit.

— Connect VW 1367 tester or equivalent according to manufacturer's instructions.

— Apply parking brake.

Note: The following tests should be done with a partner performing the specified operations while you observe the readings. The drive wheels should be raised off the ground during operations which require that the vehicle be in gear.

— Apply brake.

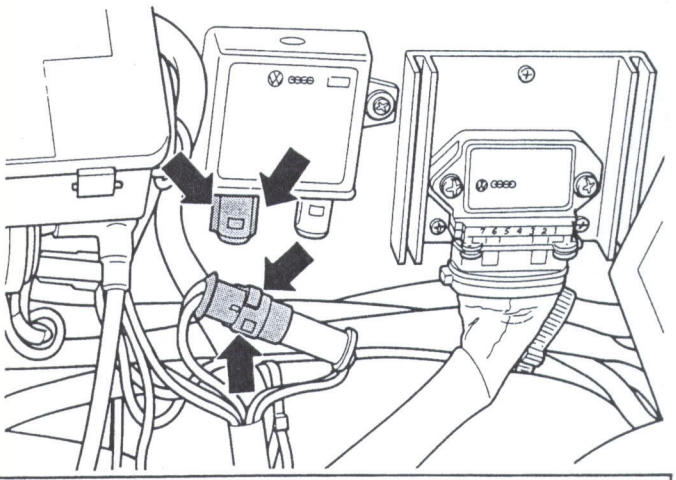
— Start and accelerate engine (i.e., to 2,500-3,000 RPM) briefly.

— Let engine idle and note ignition timing.

— Select fourth gear and slowly engage clutch (standard trans.) or place into drive (automatic trans.)

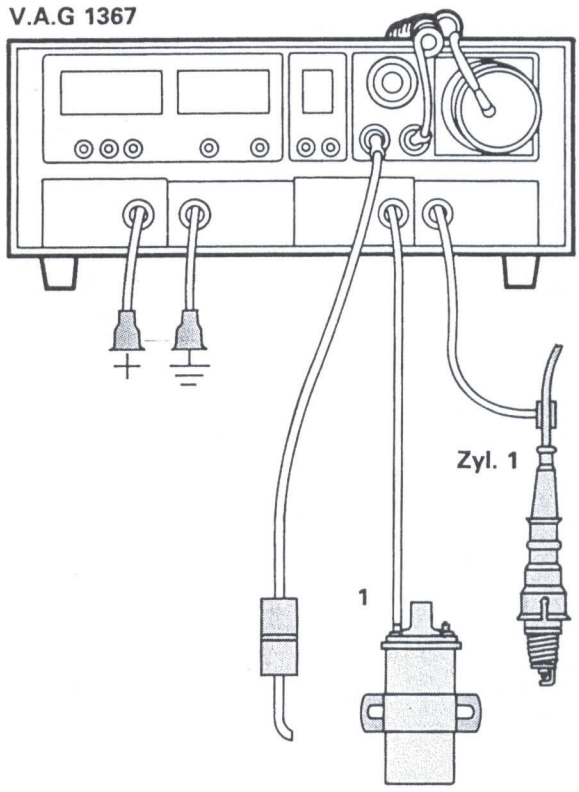
As engine speed drops **below 940 RPM** ignition timing must move in "advance" direction.

— If not, replace idle stabilizer control unit and retest.



CAUTION

Ignition must be switched OFF before connecting tester.

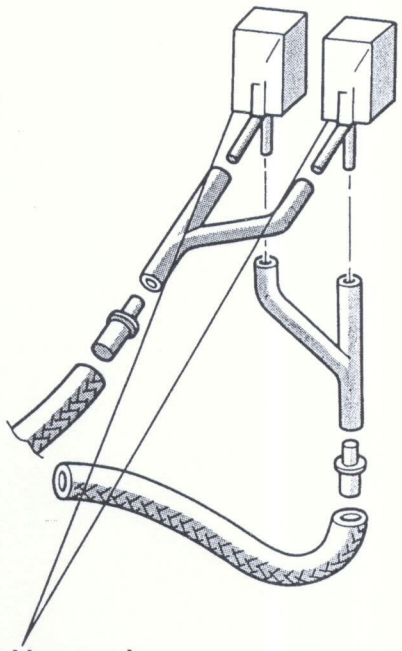


Note: Replacing digital idle stabilizer control unit can lower idle speed RPM. When replacing control unit, always recheck idle speed and adjust as necessary.

Power Steering Idle Boost Valve — Checking

— Run engine at idle.

— Turn steering wheel to lock (left or right).



Idle speed boost valves
- power steering boost valve: open when engine is running with steering turned to lock (pressure switch on P/S pump closed)
- A/C boost valve: open when engine is running with A/C on, and compressor clutch engaged

— Pinch off air supply hose to power steering idle boost valve with steering turned to lock; idle RPM must drop.
- If yes; P/S boost valve is okay.
- If no; continue.

— Ignition switched on.

— Pull back rubber boot on electrical plug and connect US 1115 L.E.D. tester to "+" side of boost valve (black wire) and ground; diode must light with steering turned to lock.

If not; check continuity of black wire from boost valve to terminal 15 of the ignition coil.

— If voltage supply was okay, connect jumper wire from "–" side of boost valve to ground; boost valve must audibly "click" open. If okay; proceed to next step.

— Disconnect wires from pressure switch on power steering pump and touch together momentarily; boost valve must "click" audibly. If okay; replace power steering pressure switch.

— If not; check continuity of wires from pressure switch to boost valve, and from pressure switch to ground point on alternator.

Air Conditioning Idle Boost Valve — Checking

— Run engine at idle.

— Turn on A/C, and pinch off air supply hose to A/C idle boost valve (compressor clutch must be engaged); idle RPM must drop.

— If yes; A/C boost valve is okay

If not;

— Shut engine OFF

— Turn ignition and A/C on.

— Peel back rubber boot on electrical plug and connect US 1115 L.E.D. tester to "+" side of boost valve (red wire) and ground; diode must light.

If not; check continuity of red wire from boost valve to A/C clutch.

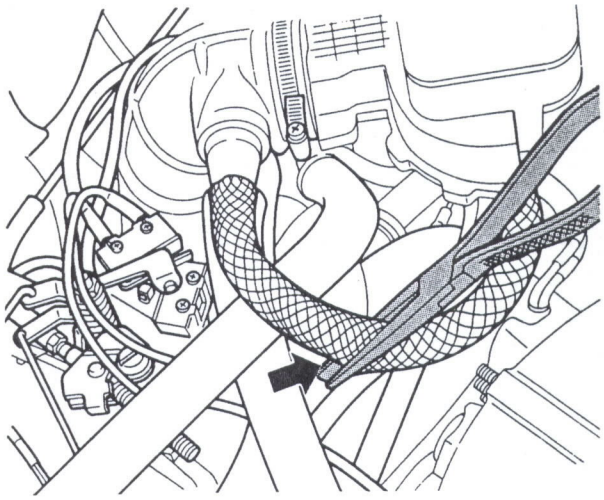
— If voltage supply was okay, connect jumper wire from "–" side of boost valve to ground; boost valve must audibly "click" open.

If yes; check continuity of brown wire from boost valve to ground cluster on side panel beneath ignition coil.

If not; replace boost valve.

Auxiliary Air Regulator — Checking

Note: When engine is cold, regulator is open fully, allowing additional air to engine.



Engine cold.

— Run engine at idle speed.

— Pinch hose (arrow).
RPM must drop. If not: check voltage supply.

— Run engine at idle speed for about 5 minutes more.

— Repeat above test.
RPM must not change.

If RPM **does** change: (voltage supply)

— Disconnect plug from auxiliary air regulator.

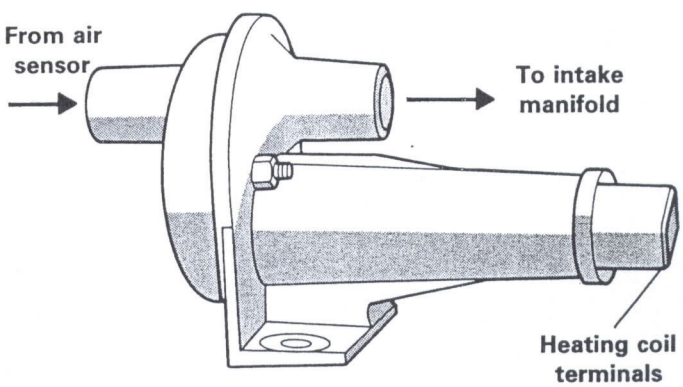
— Check voltage supply at connector plug with engine running: Min. 11.5 volts.

If voltage is okay: Replace auxiliary air regulator.

If voltage is not okay:

— Check continuity from auxiliary air regulator to terminal 87 of fuel pump relay.

— Check continuity from auxiliary air regulator to ground stud on left cylinder head.



Note: Current for the heating element is supplied by terminal No. 87 of fuel pump relay.

Evaporative Emission System — Checking For Leaks

Warning: Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

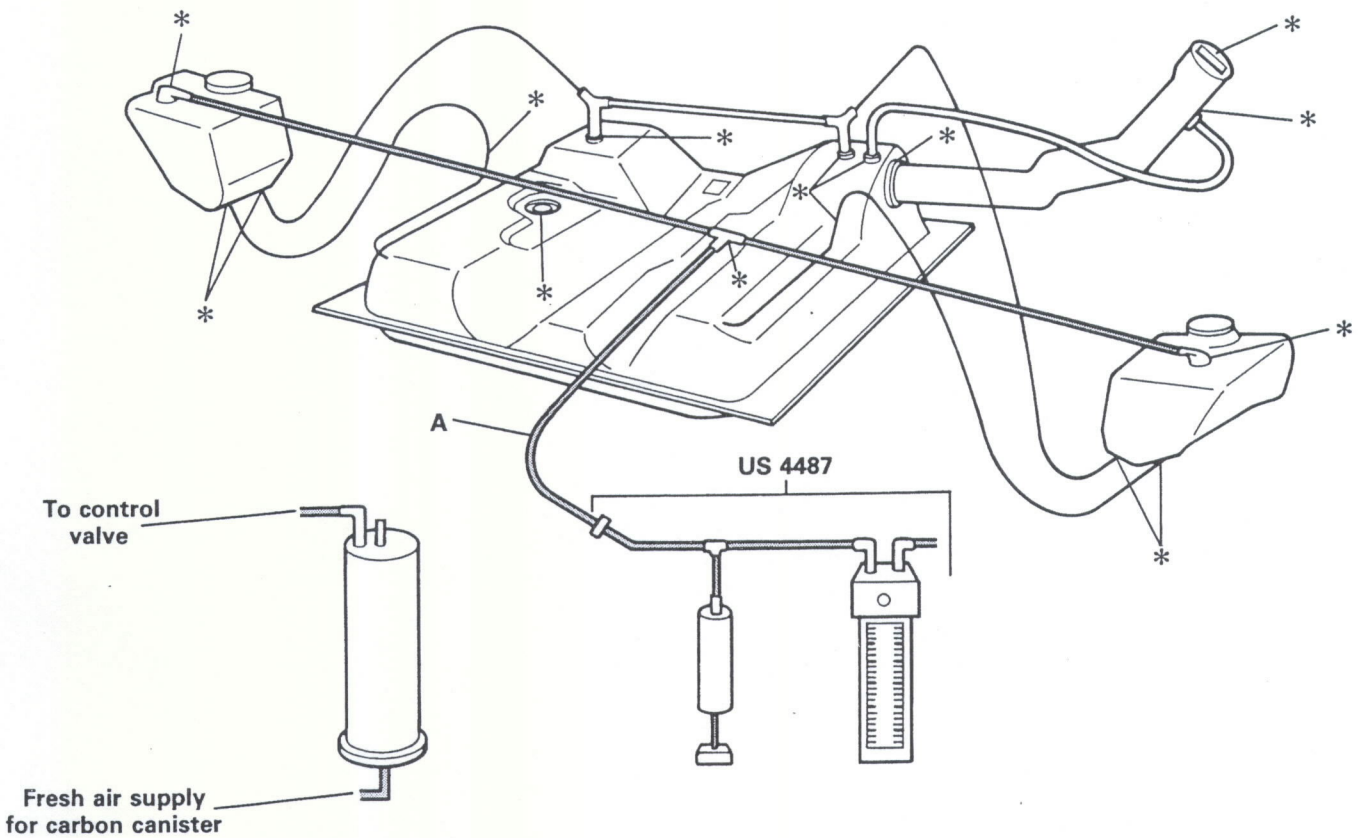
— Remove small hose "A" from top of charcoal filter connect to leak tester US 4487.

— Set leak tester scale to "0".

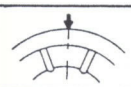
— Pressurize system with hand pump to 3.3 cm of mercury.

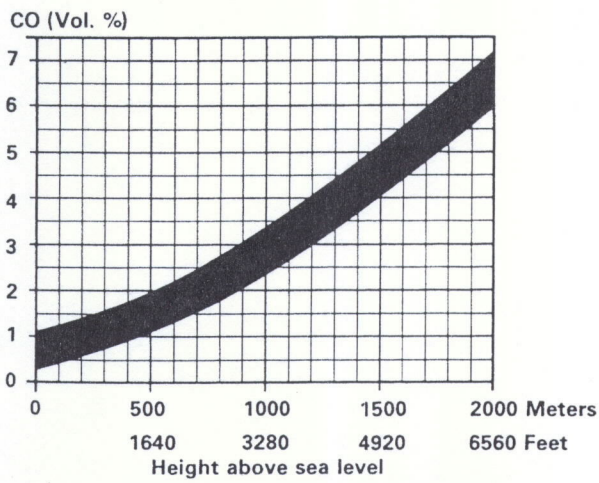
- system okay if pressure is 2.54 cm or greater after 5 minutes.
- system leaking if pressure drops below 2.54 cm after 5 minutes.

Note: Check system for leaks using soap solution at spots marked with *. Seal if necessary.



Specifications/Adjustments

Ignition timing (vacuum hoses connected)	5 ±1° ATDC (Idle Stabilizer Control Unit By-Passed)		
Timing mark location: crankshaft pulley			
Idle speed	**Application/ Model Year**	**Idle Stab. Control Unit Identification/Test Conditions**	**Idle Speed RPM**
	California & Canada 1983-85 49 States	Green 251 906 083 Control Unit by-passed	850 ± 50
	1983-84	Control Unit connected	900 ± 50
	49 States	Black 321 906 083 Control Unit by-passed	750 ± 80
	1985	Control Unit connected	800 ± 50
	Note: Replacing digital idle stabilization control unit can lower idle speed RPM. When replacing control unit, always recheck idle speed and adjust as necessary.		
CO-value *			
Checking spec.	0.3 - 1.1%	Oxygen sensor and idle stabilizer connected.	
Adjusting spec.	0.7 ± 0.4%	Oxygen sensor disconnected.	
Spark plug gap	0.7 + 0.1 mm (0.028 + 0.004 in.)		
Spark plug tightening torque	20 Nm (14 ft.-lb.)		
Firing order	1-4-3-2		



* **Note: CO:** Content is altitude dependent, refer to graph to the left for checking and adjusting.

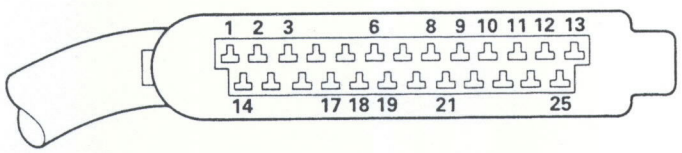
Example: At 1600 meters (approx. 1 mile) CO should be 5% ± .5%

System Check With Volt/Ohmmeter

Entire system can be checked electrically at disconnected multi-pin connector of fuel injection E.C.U.

TESTER TO TERMINAL:	COMPONENTS	CHECKS/TEST CONDITIONS	SPECIFICATIONS
1 and 7	Hall control unit type: AEG	Voltage with ignition ON	Battery voltage
1 and ignition coil terminal 15	Hall control unit type: FAIRCHILD	Touch center wire of harness connector at ignition distributor to ground	1.5 volt
2 and 7	Temp. Sensor II (Coolant Temp.)	Resistance	Corresponding to graph on next page
4* and 7	Deceleration/idle switch	Idle speed position	0 ohms
	Full throttle enrichment switch	Full throttle position	0 ohms
5 and 7	Oxygen sensor	Connector disconnected and grounded	0 ohms
		Connector connected	∞ ohms
6 and 19	Air flow sensor	Resistance/potentiometer	Approx. 500-1000 ohms
7 and 25	Ground connection/ control unit	Wiring	0 ohms
11 and 7	Fuel injector, cyl. 2	Injector and wiring	Approx. 14 - 18 ohms
12 and 7	Fuel injector, cyl. 1	Injector and wiring	Approx. 14 - 18 ohms
13 and 7	Relay, left; terminal 87	Ignition ON: function of relay	Battery voltage
14 and 16	Temp. sensor I (Intake air temp.)	Resistance	Corresponding to graph on next page
15 and 19	Air flow sensor	Resistance/potentiometer if sensor plate is moved	Ohms - changing

*DO NOT connect test light on this terminal if the E.C.U. is connected to multi-pin connector.

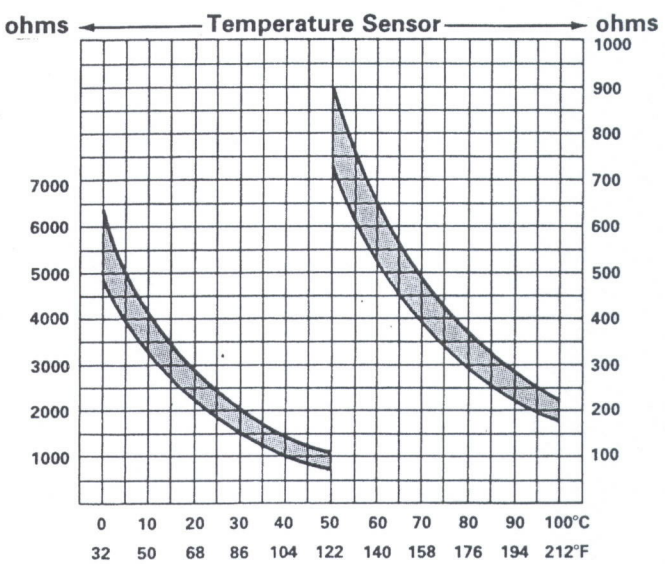


System Check With Volt/Ohmmeter

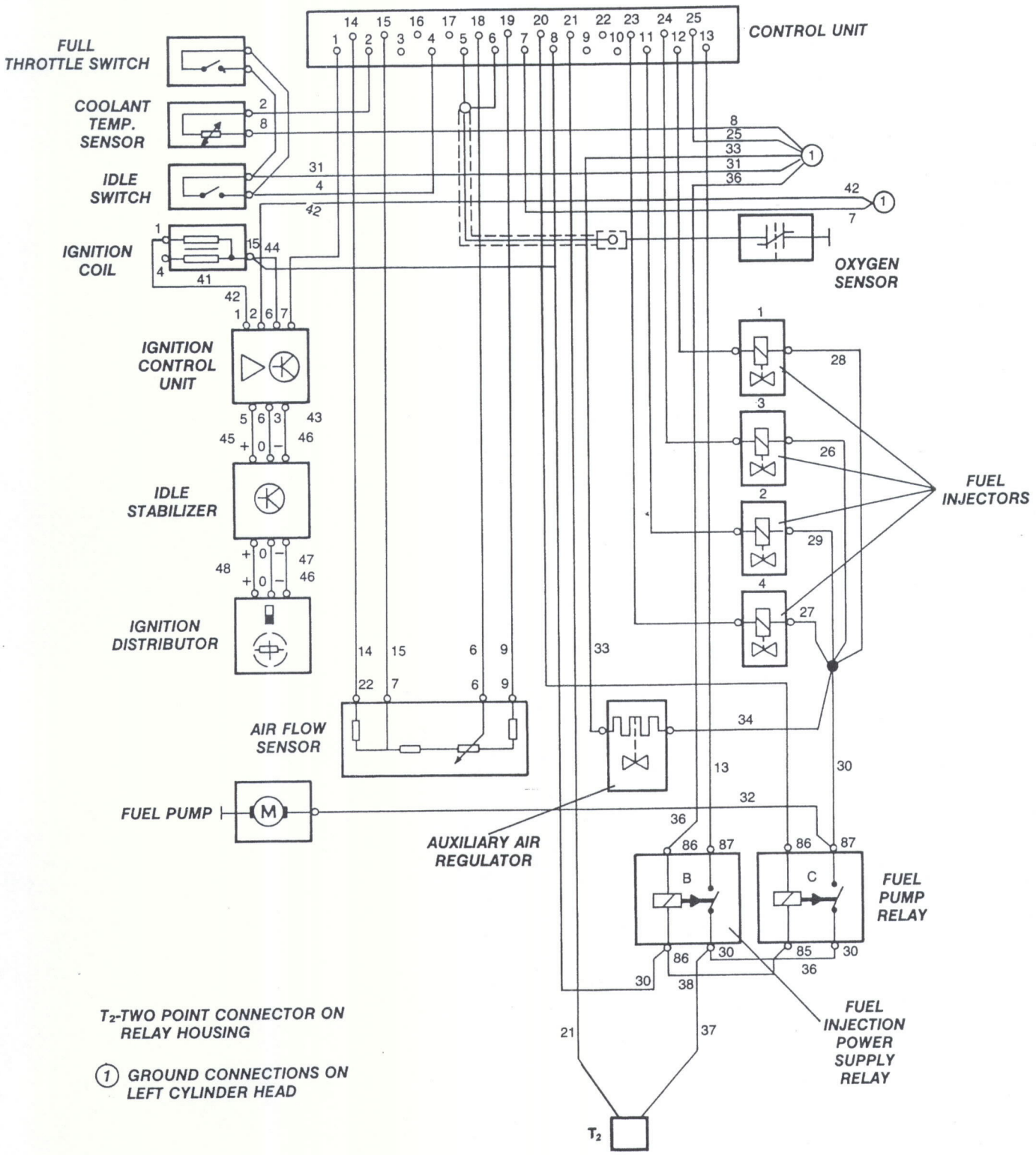
TESTER TO TERMINAL:	COMPONENTS	CHECKS/TEST CONDITIONS	SPECIFICATIONS
20* and 25 bridged	Relay, right; terminal 86*	Ignition ON; function of relay	Fuel pump must run
	Auxiliary air regulator	Ignition ON; function of auxiliary air regulator	Power must be supplied to auxiliary air regulator
21 and 7	Wiring from starter; starting enrichment	Voltage at terminal 50 during starting Crank engine (with injector plugs OFF)	Cranking voltage
23 and 7	Fuel injector, cyl. 4	Injector and wiring	Approx. 14 - 18 ohms
24 and 7	Fuel injector, cyl. 3	Injector and wiring	Approx. 14 - 18 ohms
25 and 7	Ground connection/ control unit	Wiring	0 ohms

* DO NOT connect test light on this terminal if the E.C.U. is connected to multi-pin connector.

Intake air temperature and coolant temperature sensors



Functional Wiring Diagram



AIR FLOW SENSOR

Measures the amount of air entering the intake manifold and sends a voltage signal to the electronic control unit. Location: attached to air filter housing.

AUXILIARY AIR REGULATOR

Increases idle speed during warm-up by allowing additional air to bypass the throttle plate. Location: bolted to right side of cylinder head, in front of #1 intake pipe and directly below air flow sensor.

BAR

Unit of measurement pressure — 1 bar is about 14.5 PSI.

COOLANT TEMPERATURE SENSOR

A sensor for measuring engine coolant temperature to determine cold running engine operation. Location: left, lower side of thermostat housing.

DIGITAL IDLE STABILIZER (DIS)

Maintains a steady idle speed by regulating ignition timing while at idle. Location: left side panel in engine compartment, directly in front of ignition coil.

ELECTRONIC CONTROL UNIT (E.C.U.)

Provides the proper actuation signal to the injectors and optimum ignition timing point based on inputs from other system components. Location: left side of engine compartment.

FUEL FILTER

A filter which removes foreign particles from the fuel system. Location: inboard side of right frame member, between fuel pump and fuel tank (49 state/Canada), or behind fuel pump (California).

FUEL STRAINER

A strainer which removes foreign particles from the fuel system. Location: inboard side of right frame member between fuel tank and fuel pump (California only).

FUEL PUMP

An electric pump which delivers fuel to the injectors. Location: inboard side of right frame member, directly behind fuel tank.

FUEL PUMP RELAY

When energized by the ignition switch and grounded by E.C.U., provides battery voltage to fuel pump, injectors, and auxiliary air regulator. Location: right side relay inside black plastic relay box, directly above ignition coil on left side of engine compartment.

INJECTOR

Electronically activated valve which directs a cone shaped mist of fuel into the intake manifold near each intake valve. Location: intake manifold at cylinder head.

OXYGEN SENSOR

Used to detect the amount of oxygen in the exhaust gases. Location: threads into the exhaust pipe ahead of the catalytic converter.

POWER SUPPLY RELAY

When energized by ignition switch, provides battery voltage to E.C.U. Location: left relay inside black plastic relay box, directly above ignition coil on left side of engine compartment.

PRESSURE REGULATOR

A diaphragm type regulator used to maintain system pressure. Location: bolted to rear of intake air distributor, directly adjacent to ignition distributor.

AIR FLAP POTENTIOMETER

A variable resistor connected to the air flow sensor that provides a signal for determining fuel system enrichment. Location: internal component of air flow sensor (not available separately).

RESIDUAL PRESSURE

Fuel pressure in the fuel injection lines after the engine has been turned off.

THROTTLE SWITCHES

Provide(s) closed throttle and full throttle signals to E.C.U. for idle stabilization, deceleration fuel shut-off, and full load enrichment. Location: mounted to throttle valve housing.