

# I - SYSTEM/COMPONENT TESTS - GASOLINE

## Article Text

1991 Volkswagen Passat  
For Volkswagen Technical Site  
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Wednesday, August 25, 1999 08:46PM

### ARTICLE BEGINNING

#### 1990-91 ENGINE PERFORMANCE

#### Volkswagen Gasoline System & Component Testing

#### 1990-91 Passat

1991 Cabriolet, Corrado, Fox, Golf GL, GTI, Jetta,  
Jetta GLI, Vanagon

### INTRODUCTION

Before testing separate components or systems, perform procedures in F - BASIC TESTING and H - TESTS W/O CODES articles in the ENGINE PERFORMANCE Section.

**NOTE:** Testing individual components does not isolate shorts or opens. Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

### AIR INDUCTION SYSTEMS

#### SUPERCHARGER

##### Boost Pressure

1) Before checking supercharger boost pressure, ensure engine idle speed is correct. See D - ADJUSTMENTS article in the ENGINE PERFORMANCE Section. Ensure engine oil temperature is 176°F (80°C). Check knock sensor operation. See KNOCK SENSOR under IGNITION SYSTEM

2) Connect Pressure Gauge (VW 1397) to pressure regulator hose using "T" adapter. Open pressure gauge check valve to position "A" and start engine.

3) Remove harness connector from CO potentiometer and Blue connector from temperature sensor (in front flange on cylinder head). Accelerate to full throttle. Engine speed must increase periodically then drop (surge). Watch pressure gauge. Boost pressure must reach 8.7 psi (0.6 kg/cm<sup>2</sup>). If boost does not reach specification, check for leaks in air system and correct by-pass valve setting. Check supercharger.

### COMPUTERIZED ENGINE CONTROLS

**NOTE:** To identify fuel system used on model being tested, see FUEL SYSTEM APPLICATION table.

#### FUEL SYSTEM APPLICATION TABLE

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Application	Fuel System
-------------	-------------

Cabriolet 1.8L 8-Valve .....	(1) AFC-Digital
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Corrado 1.8L 8-Valve ..... (2) Digifant  
Fox 1.8L 8-Valve ..... (1) AFC-Digifant  
Golf GL 1.8L 8-Valve ..... (1) AFC-Digifant  
GTI  
    1.8L 8-Valve Engine ..... AFC-Digifant  
    2.0L 16-Valve Engine ..... CIS-E Motronic  
Jetta 1.8L 8-Valve ..... (1) AFC-Digifant  
Jetta GLI 2.0L 16-Valve ..... CIS-E Motronic  
Passat 2.0L 16-Valve ..... CIS-E Motronic  
Vanagon 2.1L ..... AFC-Digifant

(1) - California vehicles are equipped with Digifant.

(2) - Supercharged engine.

AA

### ELECTRONIC CONTROL UNIT (AFC-DIGIFANT)

**NOTE:** Before checking ECU terminal voltages, check all terminals and connections for looseness or corrosion. Repair as needed, before continuing.

#### Ground Circuits

Using Multimeter (US 1119), check resistance of ground connections for ECU. Remove ECU connector. Check continuity to ground on terminals No. 13 and 19. See Fig. 3. Resistance should be zero ohms. If resistance is not zero ohms, repair open or short in wiring.

#### Power Circuits

1) Turn ignition off. Disconnect ECU connector. Turn ignition on and, using a voltmeter, check for battery voltage between ECU connector terminals No. 13 (negative) and No. 14 (positive). See Fig. 3. If battery voltage is not present, repair wiring as required.

2) Check terminals No. 13 (negative) and No. 1 (positive) for battery voltage. If battery voltage is not present, check fuse No. 18 on fuse block. If fuse is okay, check wiring from ECU connector to fuse box for open.

### ELECTRONIC CONTROL UNIT (CIS-E MOTRONIC)

#### Ground Circuits

Using Multimeter (US 1119), check resistance of ground circuits for ECU. Remove ECU connector. Check continuity to ground on terminals No. 2 and No. 9. See Fig. 3. Resistance should be zero ohms. If resistance is not zero ohms, repair open or short in wiring.

#### Power Circuits

Turn ignition off. Disconnect ECU connector. Turn ignition on and, using a voltmeter, check for battery voltage between ECU connector terminals No. 2 (negative) and No. 1 (positive). See Fig. 3. If battery voltage is not present, check fuse No. 23 on fuse block. If fuse is okay, check CIS-E ECU connector to fuse box wiring for open.

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### ENGINE SENSORS & SWITCHES

Airflow Sensor (CIS-E - Jetta GLI, GTI 2.0L & Passat)

1) Start engine to pressurize fuel system. Turn engine off and remove intake boot from top of airflow sensor. Disconnect coil secondary wire at coil, and jumper secondary wire to ground.

2) Check sensor play by slowly moving sensor plate through travel range with a magnet. See Fig. 1 Resistance should be felt. Move plate back to rest position. There should be no resistance. If binding is felt, loosen sensor plate hold-down bolt and adjust plate to center of venturi.

3) If resistance is uneven, remove airflow sensor from housing and clean and lubricate lever assembly. If resistance is caused by control plunger, remove and clean control plunger assembly. If binding continues, replace fuel distributor.

4) Check position of airflow sensor plate. Airflow sensor plate edge must be within .075" (1.9 mm) below narrowest section of venturi. If not, bend sensor spring until correct specification is obtained. Ensure a small gap exists between sensor lever and control plunger.

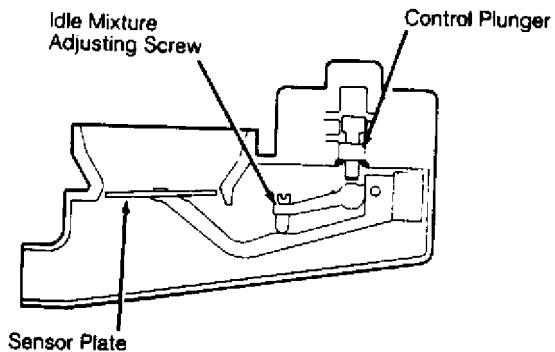


Fig. 1: Identifying Airflow Sensor Components  
Courtesy of Volkswagen United States, Inc.

Airflow Sensor (Digifant - Corrado, Fox, Golf GL, GTI 1.8L & Jetta)

1) Start engine to pressurize fuel system. Turn engine off and remove intake boot from top of airflow sensor. Check sensor plate by lifting plate through travel cycle with magnet or pliers.

2) Continuous resistance should be felt. Move plate back to rest position. There should be no resistance. If resistance is felt, replace airflow sensor. If sensor plate lever is difficult to move upward but moves freely downward, check sensor plate for correct centering.

3) Sensor plate should be evenly centered in housing with plate edge at narrowest section of venturi while at rest position. If sensor plate adjustment is correct, check control plunger for sticking. If control plunger is sticking, replace fuel distributor assembly.

Airflow Sensor (Vanagon)

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1) Turn ignition off. Remove Electronic Control Unit (ECU) connector. Attach ohmmeter to ECU connector. See Fig. 3. Resistance should correspond to ECU PIN CHECK in AFC-DIGIFANT AIRFLOW SENSOR RESISTANCE table.

2) With ignition off, unplug connector from airflow sensor. Attach ohmmeter to airflow sensor terminal. See Fig. 2. Resistance should correspond to AIRFLOW SENSOR PIN CHECK in AFC-DIGIFANT AIRFLOW SENSOR RESISTANCE table.

### AFC-DIGIFANT AIRFLOW SENSOR RESISTANCE TABLE

Terminal Ohms

#### ECU Pin Check

No. 6 & No. 17 ..... 500- 1000  
No. 17 & No. 21 ..... (1)

#### Airflow Sensor Pin Check

No. 3 & No. 4 ..... 500- 1000  
No. 2 & No. 3 ..... (1)

(1) - Resistance should fluctuate as sensor door is moved.

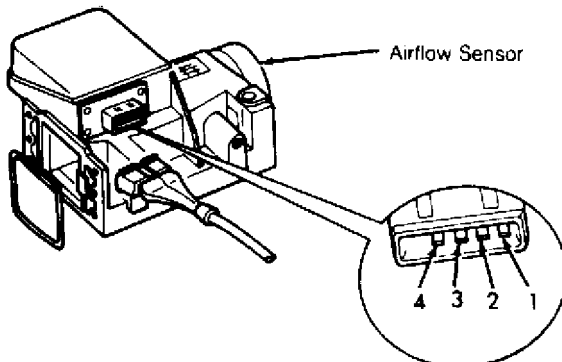


Fig. 2: AFC-Digifant Airflow Sensor & Terminal ID  
Courtesy of Volkswagen United States, Inc.

#### Coolant Temperature Sensor

Turn ignition off. Use a thermometer to measure coolant temperature. Unplug connector from Electronic Control Unit (ECU). Attach an ohmmeter between terminals No. 6 and No. 10 of ECU connector. See Fig. 3. Resistance should decrease as coolant temperature increases. See COOLANT TEMPERATURE SENSOR RESISTANCE table. Replace sensor if resistance is NOT within specification.

### COOLANT TEMPERATURE SENSOR RESISTANCE TABLE

Temperature Ohms

68°F (20°C) ..... 2200- 2700  
158°F (70°C) ..... 400- 480

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194°F (90°C) ..... 210-280  
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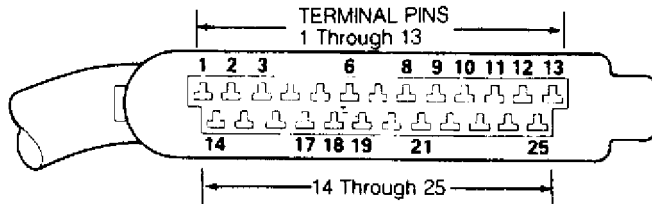


Fig. 3: ECU Connector Terminal ID  
Courtesy of Volkswagen United States, Inc.

### Hall Effect Sender

For Hall Effect sender testing, see F - BASIC TESTING article in the ENGINE PERFORMANCE Section.

### Oxygen Sensor (Except Vanagon)

1) Ensure exhaust system is not leaking. Warm engine to normal operating temperature with all accessories off. Remove differential pressure regulator connector. Connect Wiring Harness Adapter (VW 1315 A/1) in series. See Fig. 4.

2) Attach Multimeter (US 1119) to adapter and set meter on DCA 200m scale. Remove PCV hose and vent to atmosphere. Remove 90 degree "T" connector and insert port with small vent hole into intake air boot. See Fig. 5.

3) Start engine and allow to run for 2 minutes. Meter reading should start fluctuating. If reading does not fluctuate, raise engine speed to 3000 RPM. If meter reading fluctuates, oxygen sensor is okay. If reading still does not fluctuate, check control unit and wiring harness for short or open circuit.

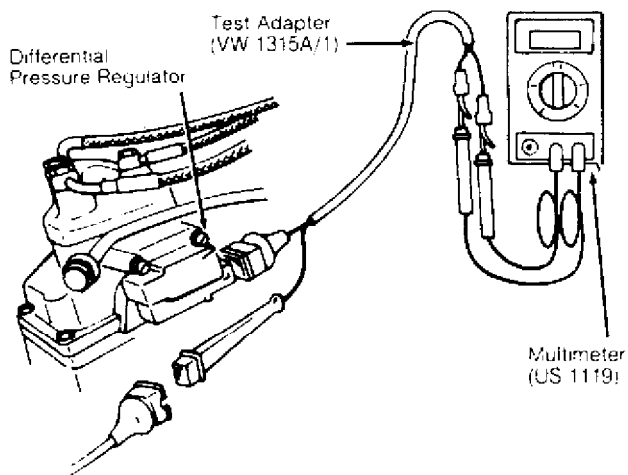


Fig. 4: Testing Oxygen (O2) Sensor (Except Vanagon)  
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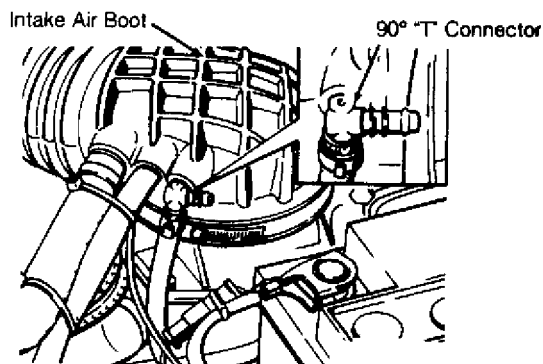


Fig. 5: Positioning Canister Hose For O<sub>2</sub> Sensor Test  
Courtesy of Volkswagen United States, Inc.

#### Oxygen Sensor (Vanagon)

1) Ensure pressure regulator is functional and engine is at normal operating temperature. Start engine and allow to run for 2 minutes. Install exhaust gas analyzer at vehicle tailpipe. Observe CO reading while disconnecting and plugging vacuum hose from fuel pressure regulator.

2) If CO increases and drops to 0.3-1.0%, system is okay. If CO does change as indicated, stop engine and disconnect O<sub>2</sub> sensor wire. Connect jumper wire between O<sub>2</sub> sensor wire and jumper to ground. If CO reading rises, replace O<sub>2</sub> sensor.

3) If CO reading does not rise, check for continuity between O<sub>2</sub> sensor wire and terminal No. 2 of ECU. See Fig. 3. If continuity exists, replace ECU. For more information, see J - PIN VOLTAGE CHARTS and K - SENSOR RANGE CHARTS articles in the ENGINE PERFORMANCE Section.

#### Throttle Valve Switch (Vanagon)

1) Disconnect throttle valve switch connector. With ohmmeter set on 200-ohm scale, attach probes to male terminals. Ensure throttle valve switch is completely closed. With throttle valve closed, meter reading should be zero.

2) Position throttle valve to half open position. Ohmmeter reading should be infinite. Position throttle to fully open position. Ohmmeter reading should be zero. If any reading is incorrect, perform throttle valve switch adjustment. See D - ADJUSTMENTS article in the ENGINE PERFORMANCE Section.

3) If correct specifications cannot be obtained, check throttle shaft play, accelerator cable adjustment and throttle switch actuating cam. If okay, replace throttle valve switch.

## RELAYS

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**Fuel Pump Relay (Cabriolet, Golf GL, GTI, Jetta, Jetta GLI & Passat)**

1) Ensure fuel pump fuse (No. 5) is okay. Remove fuel pump relay (No. 2) from fuse/relay panel. See Fig. 6. With ignition on, check for battery voltage between the following locations:

- \* Terminal No. 2 and ground
- \* Terminals No. 2 and No. 1
- \* Terminal No. 4 and No. 1

If voltage is not present, repair wiring and recheck fuel pump operation.

2) With battery voltage present between terminal No. 1 and terminal No. 5, lightly touch middle wire of ignition distributor harness connector to ground. If voltage drops, replace fuel pump relay and check Hall Effect sender.

3) If voltage does not drop, check Hall Effect sender. See HALL EFFECT SENDER in F - BASIC TESTING article in the ENGINE PERFORMANCE Section. For fuel pump and fuse number/location, see FUEL PUMP RELAY & FUSE NUMBER table.

**Fuel Pump Relay (Corrado)**

1) Ensure fuel pump fuse No. 18 is okay. Remove fuel pump relay No. 12 from fuse/relay panel. See Fig. 6. With ignition on, check for battery voltage between the following locations:

- \* Terminal No. 6 and ground.
- \* Terminal No. 2 and ground.
- \* Terminals No. 6 and No. 4.

2) If battery voltage is not present, check wiring and repair as needed. Check fuel pump operation. With ignition off, connect voltmeter between terminals No. 2 and No. 3. Turn ignition on. Voltage should be present for one second. If voltage is not present for one second, check wiring to ECU or replace ECU. Check fuel pump relay operation. For fuel pump and fuse number/location, see FUEL PUMP RELAY & FUSE NUMBER table.

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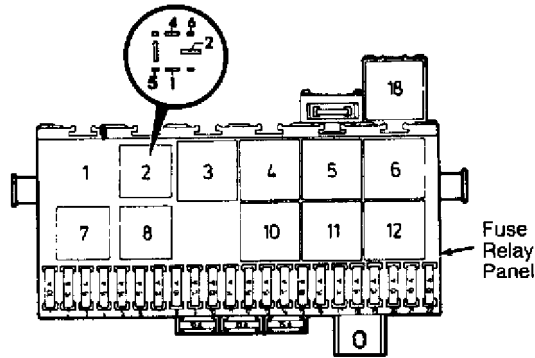


Fig. 6: Identifying Fuse/Relay Panel (Except Vanagon)  
Courtesy of Volkswagen United States, Inc.

### Fuel Pump Relay (Fox)

1) Ensure fuel pump fuse (No. 13) is okay. Remove fuel pump relay. Note terminals numbers molded on fuse/relay panel. With ignition on, check for battery voltage between the following locations:

- \* Terminal No. 46 and ground
- \* Terminal No. 48 and ground

See Fig. 6.

2) If voltage is not present, current is not reaching relay. Repair wiring. Check fuel pump operation. If voltage is present, check for battery voltage between the following locations:

- \* Terminals No. 48 and No. 50
- \* Terminals No. 46 and No. 50

If voltage is not present, terminal No. 50 (ground circuit) is open. Repair wiring. Check fuel pump operation.

3) If voltage is present, check for battery voltage between terminals No. 50 and No. 51. If voltage is not present, ignition signal is not reaching fuel pump relay. Repair wiring. Check fuel pump operation.

4) If no faults can be found and fuel pump operates when relay is by-passed, replace fuel pump relay. For fuel pump relay and fuse number, see FUEL PUMP RELAY & FUSE NUMBER table.

### Fuel Pump Relay (Vanagon)

1) Check terminal No. 30 and terminal No. 86 of fuel pump relay for battery voltage. See Fig. 7. If battery voltage is not present, check circuit for short or open circuit.

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3) If continuity is not present, check for continuity between terminal No. 85 of fuel pump relay and terminal No. 3 of ECU connector. If continuity is present, circuit is okay but ECU is not switching to ground. Replace ECU and install fuel pump relay.

**Fig. 7: Fuel Pump Relay Circuit Schematic (Vanagon)**  
 Courtesy of Volkswagen United States, Inc.

[illegible]

Application	Relay No.	Fuse No.
Cabriolet .....	2 .....	5
Corrado, Golf GL, GTI, Jetta, Jetta GLI & Passat .....	12 .....	18
Fox .....	10 .....	13
Vanagon .....	(1) .....	(2)

- (1) - Relay located in relay box left side of engine compartment, fused through AFC-Digifant ECU control relay.
- (2) - Fuse and terminal number molded into plastic fuse box housing.

[illegible]

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### FUEL SYSTEM

#### FUEL DELIVERY

**NOTE:** For FUEL SYSTEM PRESSURE TESTING, see F - BASIC TESTING article in the ENGINE PERFORMANCE Section.

#### FUEL CONTROL

**NOTE:** On AFC-Digifant System, cold start valve is NOT used. Cold starts are controlled by ECU.

##### Cold Start Valve (Except Vanagon)

1) Engine temperature must be below 85°F (30°C). Disconnect cold start valve attaching screws and remove valve with harness connector and fuel line attached.

2) Remove ignition coil secondary wire and jumper to ground. Attach metal housing of cold start valve to ground. Direct cold start valve injector into a clean container. See Fig. 8. Have assistant turn ignition switch to START position, while observing cold start valve spray pattern.

3) The valve should deliver a consistent cone-shaped pattern until thermo time switch interrupts fuel flow. Ensure valve does not leak after fuel flow stops. If spray pattern is uneven or inconsistent, check for plugged or defective cold start valve. If valve does not function, proceed to THERMO TIME SWITCH.

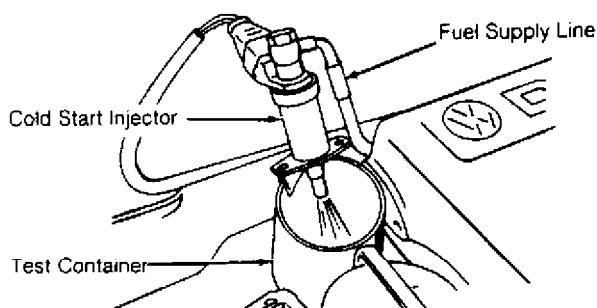


Fig. 8: Testing Typical Cold Start Valve  
Courtesy of Volkswagen United States, Inc.

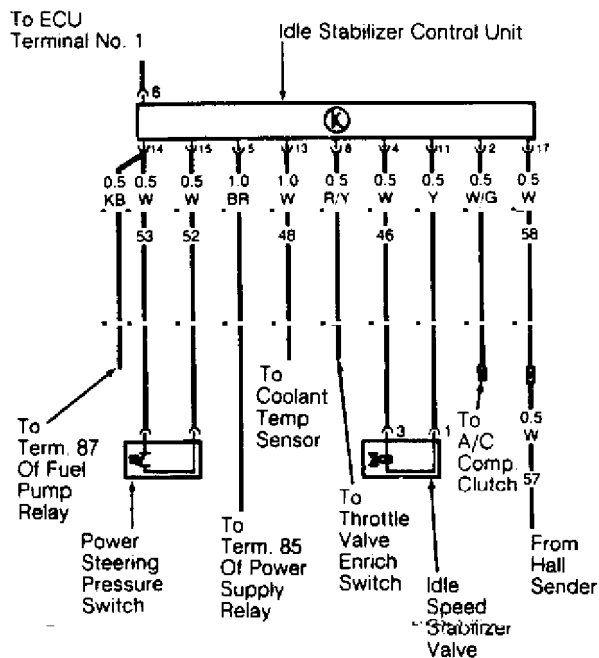
##### Thermo Time Switch

1) Engine temperature must be below 86°F (30°C). Disconnect cold start valve wiring harness connector and attach LED test light to terminals. Have assistant hold ignition switch in START position while

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2) Light should stay on for 3-8 seconds depending on coolant temperature. If light does not come on, check voltage supply to cold start valve and repair as necessary. If voltage to cold start valve is okay, check ground circuit through thermo time switch. Replace thermo time switch if contact to ground cannot be made.

3) Test light should be on when A/C switch is in on position. If light is on, replace idle stabilization valve. If light does not go on, repair wiring between idle stabilization control unit terminal No. 2 and A/C compressor clutch.



## IGNITION SYSTEM

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**NOTE:** For basic ignition checks, see F - BASIC TESTING article in the ENGINE PERFORMANCE Section.

### IGNITION CONTROL UNIT

#### Ignition Control Unit (Except Vanagon)

1) Perform SPARK TEST in F - BASIC TESTING article in the ENGINE PERFORMANCE Section. If secondary spark is present, ignition control unit is okay. If secondary spark is not present, turn ignition off. Disconnect ignition control unit wire harness connector. Turn ignition on. Using a voltmeter, measure voltage between terminals No. 2 (negative) and No. 4 (positive) of connector. See Fig. 10.

2) Voltage should be present. If voltage is not present, ensure continuity exists between control unit connector terminal No. 2 and ground. Continuity should also exist between terminal No. 4 and ignition coil positive terminal. Repair wiring if necessary. If wiring is okay, replace ignition control unit.

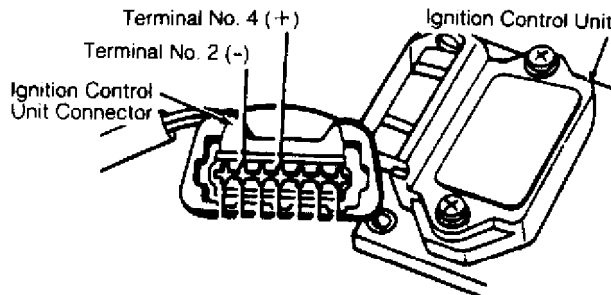


Fig. 10: Identifying Typical Ignition Control Unit Connector  
Courtesy of Volkswagen United States, Inc.

#### Ignition Control Unit (Vanagon)

1) Turn ignition off. Attach DVOM to ignition coil primary terminals. Disconnect Hall Effect sender wire harness connector from distributor. See Fig. 11. Turn ignition on.

2) While observing DVOM reading, attach center terminal of connector to ground for 3 seconds. Voltage reading should briefly increase to 4.5 volts. If voltage reading did not increase, check

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wiring for short or open circuit. If wiring is okay, replace ignition control unit.

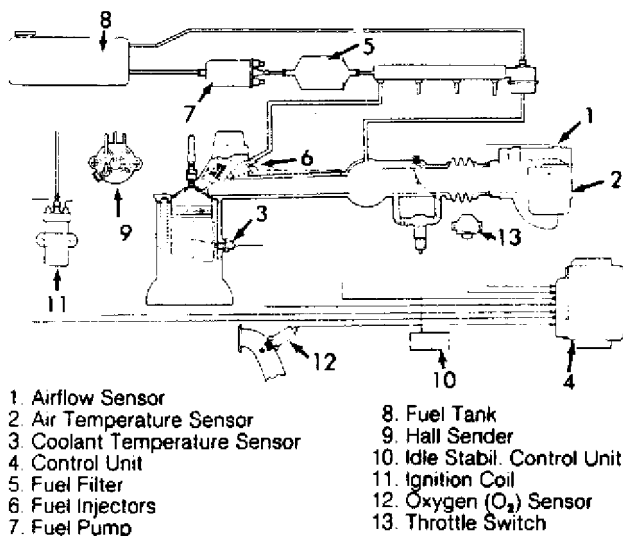


Fig. 11: Locating AFC-Digifant Components (Vanagon)  
Courtesy of Volkswagen United States, Inc.

NOTE: Knock control is integral in AFC-Digifant ECU.

#### Knock Sensor Control Unit (Except Vanagon)

1) Check ignition coil and Hall Effect sender before checking knock sensor control unit. Remove knock sensor control unit harness connector. Turn ignition on. Using a voltmeter, check for battery voltage between terminals No. 3 and No. 5, and terminals No. 6 and No. 3 of knock sensor control unit. See Fig. 12. Open throttle valve. Voltage should drop to zero volt.

2) If voltage does not drop to zero volt, check voltage between terminals No. 8 and No. 3 of knock sensor control unit while fully opening throttle valve. If battery voltage is not present when throttle opens fully, replace throttle valve switch.

3) Remove Hall Effect sender connector and connect voltmeter to outside terminals. Turn ignition on. There should be 5 volts present. Turn ignition off. Connect voltmeter between terminals No. 1 (negative) and No. 15 (positive) of ignition coil. Turn ignition on and touch center terminal of Hall Effect sender briefly to ground. Voltage should jump momentarily to approximately 2 volts. If voltage does not jump, replace knock sensor control unit.

#### Knock Sensor(s)

Before replacing knock sensor, check knock sensor torque and resistance. Remove knock sensor connector and check resistance between terminals No. 13 and No. 14. See Fig. 12. See KNOCK SENSOR RESISTANCE & TORQUE SPECIFICATION table. If resistance is incorrect, replace knock sensor.

NOTE: Knock sensor Type I has signal wire attached 90 degrees from side. Type II sensor has signal wire running straight into

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side. Knock sensor mounting bolt torque must be exact. DO NOT use washers when mounting knock sensor.

#### KNOCK SENSOR RESISTANCE & TORQUE SPECIFICATION TABLE

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Application	Ohms	Ft. Lbs (N.m)
-------------	------	---------------

Type I .....	300,000 .....	7-9 (10-12)
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Type II .....	Infinite .....	15-18 (20-25)
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AA

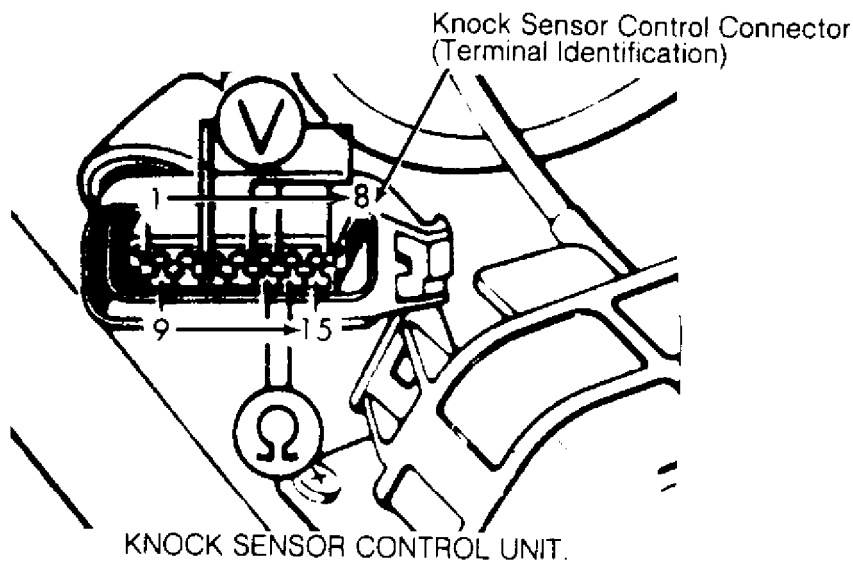


Fig. 12: Identifying Knock Sensor Control Unit Terminals  
Courtesy of Volkswagen United States, Inc.

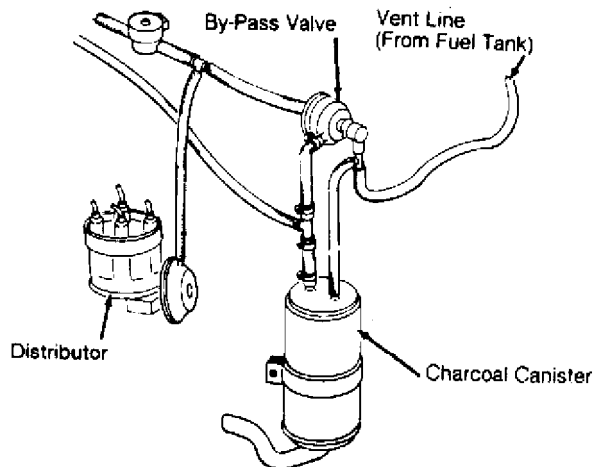


Fig. 13: Identifying Typical Fuel Evaporation System Components  
Courtesy of Volkswagen United States, Inc.

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### **EMISSION SYSTEMS & SUB-SYSTEMS**

#### **EXHAUST GAS RECIRCULATION (EGR)**

1) With engine idling, apply about 12 in. Hg to EGR valve with a hand-held vacuum pump. Engine should run rough or stall. If idle does not change, remove EGR valve and inspect for restricted port passage. Clean as required.

2) If port is clean, apply about 12 in. Hg to EGR valve with vacuum pump. If valve does not move, replace EGR valve. If valve moves, go to next step.

3) Install EGR valve and new gasket. Connect vacuum gauge to EGR vacuum line with a "T" fitting. Start engine and increase engine speed to about 3000 RPM. If vacuum gauge indicates vacuum, test is complete. If gauge does not indicate vacuum, vacuum source is plugged. Repair as necessary and repeat test.

#### **FUEL EVAPORATION**

##### **EVAP Canister By-Pass Valve (Except Vanagon)**

1) Remove both vent hoses and vacuum hose from canister by-pass valve. See Fig. 13. Apply very low air pressure to vent hoses individually. There should be no airflow. If air passes through, replace by-pass valve.

2) Attach vacuum pump to vacuum hose and apply 5-10 in. Hg. Apply low air pressure to vent hoses individually. Valve should be open and air should flow. If air does not flow, replace by-pass valve.

##### **EVAP Canister By-Pass Valve (Vanagon)**

1) Start and warm engine to normal operating temperature. Disconnect White nylon hose from rubber boot at rear of intake manifold. Attach vacuum pump and apply 5-10 in. Hg. If vacuum holds, control valve is okay.

2) If vacuum does not hold, disconnect Purple vacuum hose from throttle body. Attach vacuum gauge. If less than one in. Hg is present, replace control valve. If more than one in. Hg is present, adjust throttle valve stop screw and repeat test.

### **MISCELLANEOUS CONTROLS**

**NOTE:** Although some controlled devices are not technically engine performance components, they can affect driveability if they malfunction.

#### **A/C CLUTCH**

See IDLE CONTROL SYSTEM

**END OF ARTICLE**