

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European

**BMW: 1975-79 3.0 Si,
528i, 530i, 630CSi, 633CSi, 733i**
Jaguar: 1979 XJ6L
Opel: 1975 1900
Renault: 1975-77 R-17 G, Gordini
Volkswagen: 1975-79 Type 1 & 2

NOTE: Also see Bosch AFC/MPC FUEL INJECTION article in this section.

DESCRIPTION

The Bosch Air Flow Controlled (AFC) electronic fuel injection system uses sensors to detect engine conditions. System consists of airflow meter, sensors, switches, air cleaner assembly, Electronic Control Unit (ECU), throttle chamber, air/fuel pressure regulators, injectors, and connecting wiring and hoses. See Fig. 1. The ECU receives sensor signals to determine amount of fuel and length of time that fuel is to be injected into engine.

An airflow meter, mounted between the throttle chamber and air cleaner, measures amount of intake air. Fuel injector on time is based on amount of intake air required for one rotation of engine. System maintains a constant fuel pressure and accurately balances air/fuel mixture under all operating conditions.

Beginning with 1977 model year, BMW models have a high altitude compensator. Altitude compensator should be hooked up if vehicle is to be operated above 4,000 feet. The altitude compensator is automatic on all other models. The intake air sensor transmits air flow information to the ECU while the distributor supplies engine RPM data. See Fig. 2.

The 1979 BMW 528i, Jaguar XJ6L, and Volkswagen Type 2 (California) models incorporate an oxygen sensor into the Bosch AFC

fuel injection system. The system consists of an oxygen sensor mounted in the exhaust manifold, a modulating or frequency valve, a 3-way catalytic converter and a modified electronic control unit.

OPERATION

Fuel under pressure from electric fuel pump, flows through a pulsation damper (some models) and fuel filter and is injected into intake manifold branch to mix with incoming air. Surplus fuel returns through a fuel pressure regulator to the fuel tank.

A pressure regulator controls fuel pressure so that a constant difference of 35 psi (2.55 kg/cm²) exists between fuel pressure and intake manifold vacuum. To aid in cold engine starting, a cold start valve is activated by a thermo-time switch to increase quantity of fuel to be injected.

Each engine cylinder is supplied fuel by an injector. Ignition signal from ignition coil determines frequency of injections while the ECU determines length of each injection.

Air is drawn in through air cleaner and is measured by the airflow meter. Air then travels through throttle chamber and into intake manifold. A throttle valve in the chamber controls air flow while driving. At idle, throttle valve is almost closed and air is drawn through a by-pass port in throttle chamber. Idle speed adjusting screw controls quantity of air intake at idle. During warm-up operation, extra air is by-passed through air regulator to increase engine RPM.

The oxygen sensor, if equipped, detects the amount of oxygen in the exhaust gases. If sensor senses too much or too little oxygen in the exhaust gases, a change in voltage is produced in the sensor and is transmitted to the ECU. The ECU then changes the amount of fuel injected by using the modulating valve to vary the length of time injectors are on. This varying injection time leans or richens the air/fuel ratio, keeping the air/fuel ratio very close to the stoichiometric value of 14.5 to 1.

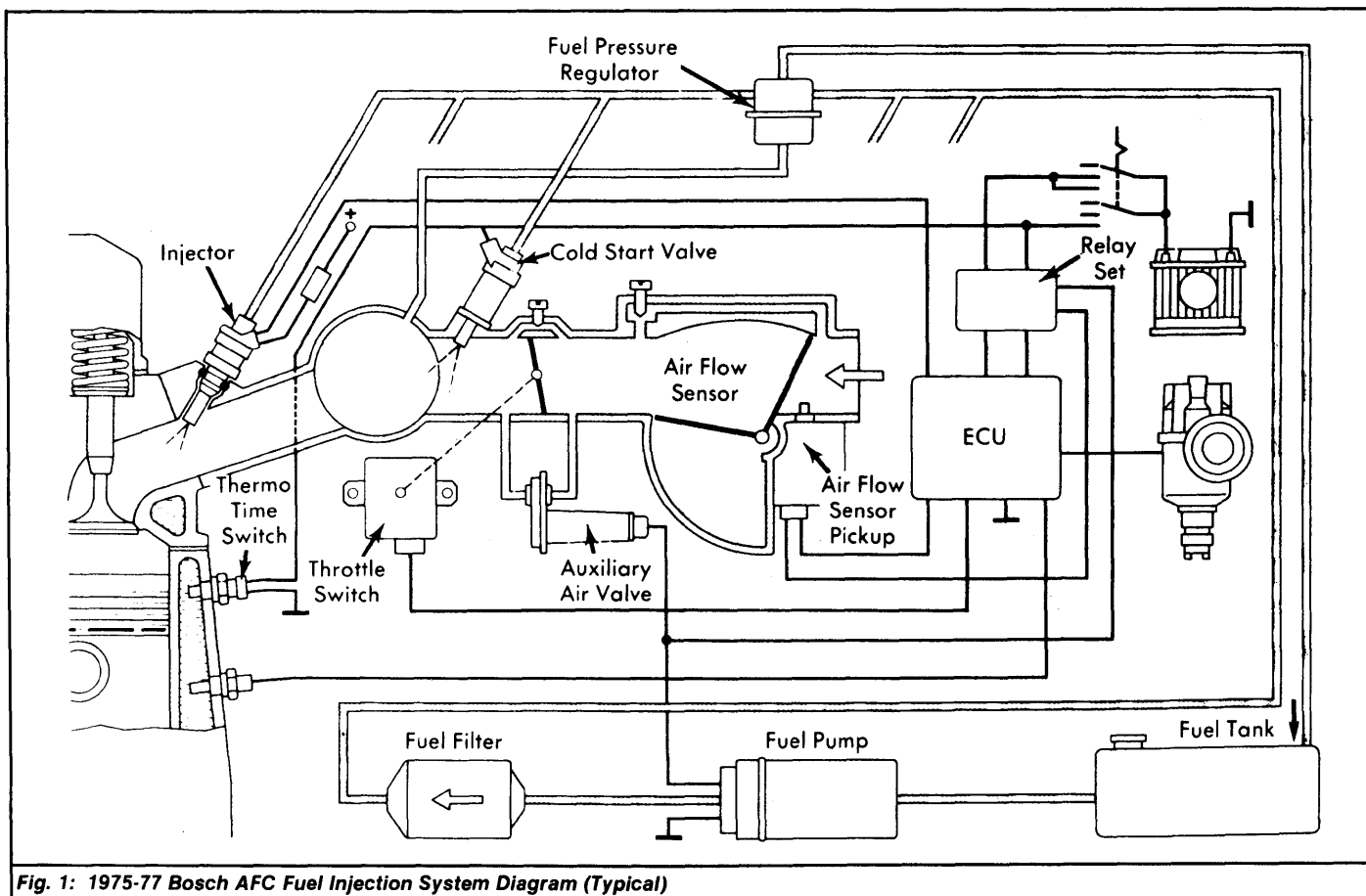


Fig. 1: 1975-77 Bosch AFC Fuel Injection System Diagram (Typical)

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

AIRFLOW METER & POTENTIOMETER

The throttle valve housing provides a method for air to enter engine under controlled conditions. The throttle valve sliding switch is a potentiometer which functions as a sensor for informing ECU of throttle valve position. Volkswagen models also have a fuel pump relay contact in the potentiometer section of airflow meter.

During starting, fuel pump receives power from starter solenoid through fuel pump relay. Once engine starts, fuel pump relay receives power contact in potentiometer section of airflow meter. Fuel pump contacts turn on only after flap in airflow meter opens. Contacts turn off when airflow meter returns to closed position. See Fig. 5

INTAKE AIR SENSOR

The intake air sensor (temperature sensor I) provides the ECU with voltage signals. The intensity of these signals, depends upon intake air volume and air temperature. The incoming air moves the stator flap against the force of the return spring. See Fig. 5.

As more air is drawn in, stator flap opens even more. This rotary motion of the stator flap actuates a special potentiometer (both are physically connected together) and thus varies the strength of the signal sent to the electronic control unit.

Connected to the stator flap is a dampening flap which prevents rapid oscillations of the stator flap. One of the contacts on the potentiometer operates the fuel pump as the stator flap is opened by air flow. This sensor is an integral part of the potentiometer and its operation modifies signal sent to the ECU.

ENGINE COOLANT SENSOR

The engine coolant sensor (temperature sensor II) provides the ECU with engine temperature information relating to cold starting and

warm-up enrichment operation. The temperature sensing unit uses a thermister which is sensitive in the lower temperature ranges. Electrical resistance of thermister decreases as coolant temperature rises.

THROTTLE VALVE SWITCH

Throttle valve switch, if equipped, is attached to throttle chamber. Accelerator pedal movement activates the switch which has 2 sets of contact points. One set of contacts monitor idle position, while the other monitors full throttle position. Idle contacts close when throttle valve is positioned at idle and open when it is at any other position.

Full throttle contacts close only when throttle valve is positioned at full throttle (at more than 34 degree opening of valve). Throttle valve switch compensates for enrichment at idle and after idle, and at full throttle positions. Idle circuit of switch also is responsible for sending out the fuel cut-off signal.

ELECTRONIC CONTROL UNIT

The Electronic Control Unit (ECU) is a pre-programmed computer. Its function is to process the incoming signal from each sensor to determine air volume (by airflow sensor), engine speed, engine temperature, air temperature and throttle position. From this information, ECU determines correct injection time and quantity. See Fig. 3.

FUEL PRESSURE REGULATOR

The non-adjustable pressure regulator controls fuel pressure, maintaining a constant 35 psi (2.55 kg/cm²) difference between fuel pressure and intake manifold vacuum. Fuel exerts pressure against spring-loaded diaphragm, which deflects uncovering return line to fuel tank. Engine vacuum also works with fuel pressure against diaphragm when high vacuum is present. Diaphragm then deflects at about 28 psi (2.0 kg/cm²) instead of 35 psi (2.55 kg/cm²).

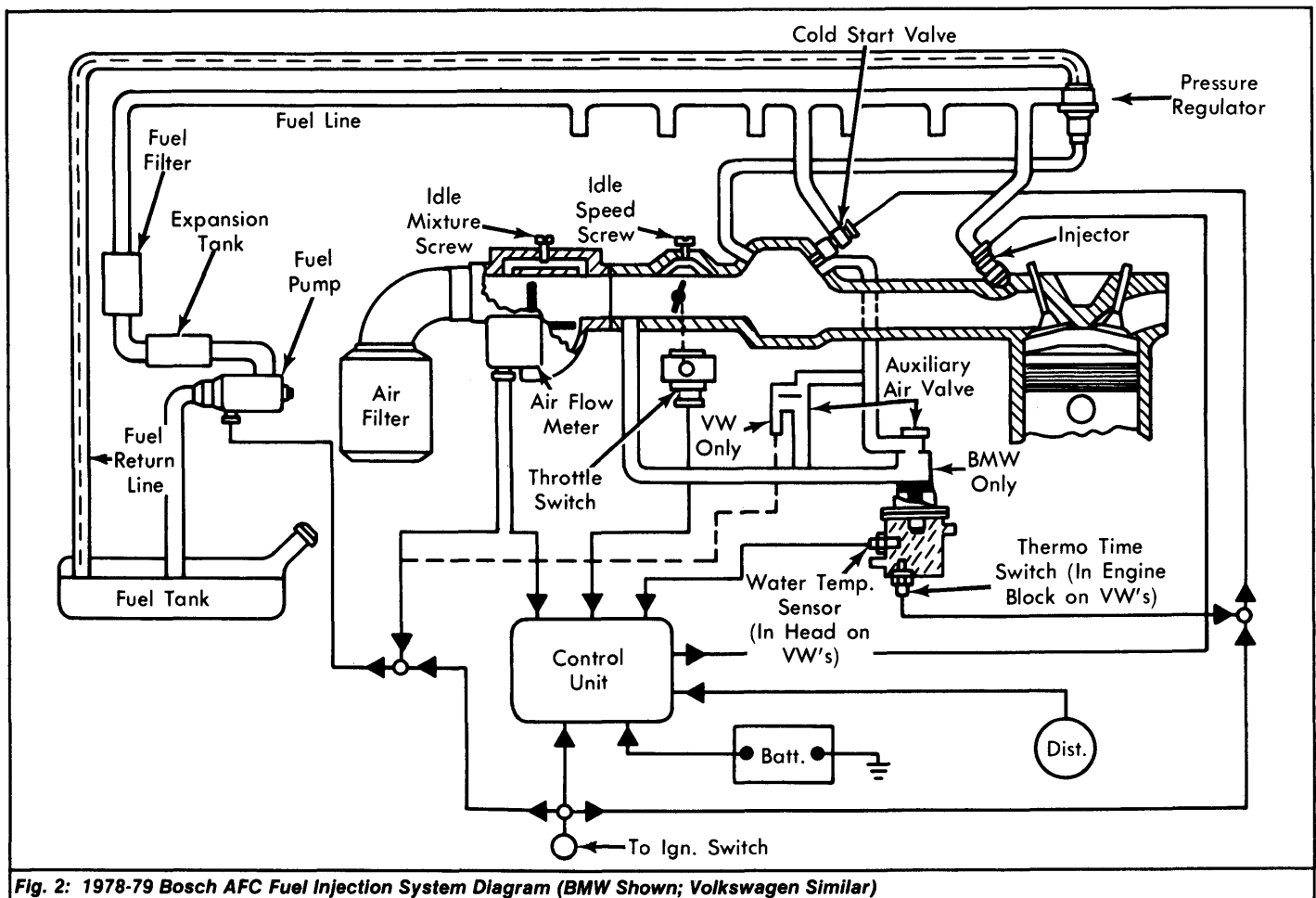


Fig. 2: 1978-79 Bosch AFC Fuel Injection System Diagram (BMW Shown; Volkswagen Similar)

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

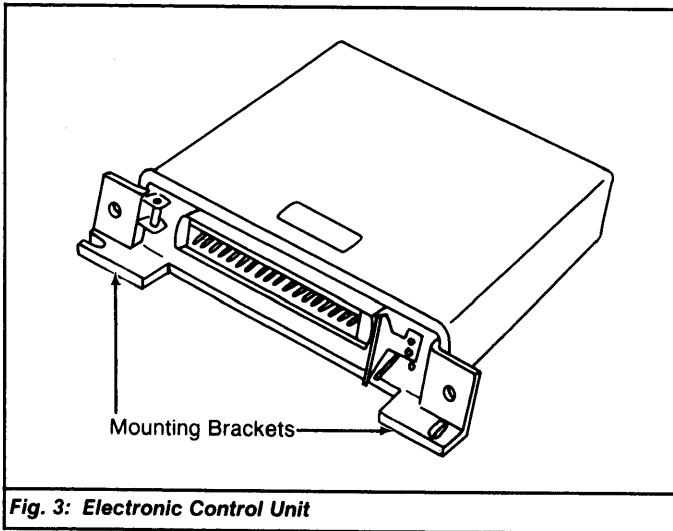


Fig. 3: Electronic Control Unit

AUXILIARY AIR REGULATOR

More air and fuel are required during cold starting and engine warm up. The auxiliary air regulator is fully open when engine is cold and provides the additional air required. The additional fuel is provided by the cold start valve.

As engine warms up, the auxiliary air regulator slowly closes, cutting off additional air. Valve closes by an electrically heated bimetallic spring on Volkswagen, or by coolant temperature on BMW and Jaguar.

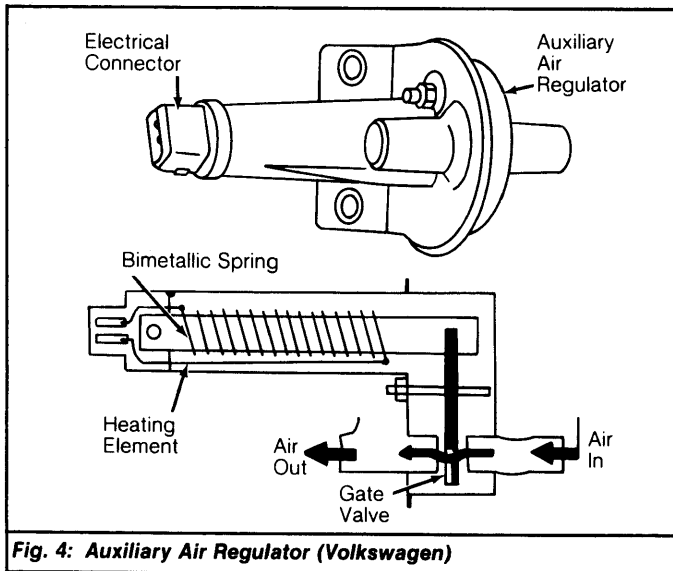


Fig. 4: Auxiliary Air Regulator (Volkswagen)

THERMO-TIME SWITCH

The thermo-time switch controls the time the cold start valve is switched on. This time limit is usually between 5-20 seconds depending upon engine. The time switch has a bimetallic contact, surrounded by a heating coil. The heating coil receives current during cranking. The bimetallic contact breaks the ground circuit of the cold start valve whenever the heating coil is about 95°F (35°C) or when the delay time is up. Delay time is shortened as temperature raises.

PRE-RESISTORS

The purpose of the pre-resistor, if equipped, is mainly to reduce the response time of the injectors. The pre-resistors are connected in series between the injectors and the dual relay.

DUAL RELAY

The dual relay is composed of 2 relays which control current supply for entire electronic fuel injection system and which disengages system (electrically) from battery when ignition is turned to off position.

When ignition switch is on, the main relay points close, providing voltage to the ECU and pre-resistors (if used) of the electronic fuel injection system. The other relay within the dual relay, controls current to the electric fuel pump. These points close during cranking and when points of airflow valve are closed. This design is to cut-off current to fuel pump in the event that engine stops (airflow meter closed).

ADJUSTMENTS

OXYGEN SENSOR WARNING LIGHT

1979 BMW 528i, Jaguar & Volkswagen Type 2 – After oxygen sensor replacement, reset the oxygen sensor warning light switch. On BMW and Jaguar models, switch is located on left side of engine compartment (in line with speedometer cable). On Volkswagen, reset button is on control box located on speedometer cable. Service interval times are 25,000 for BMW models, 12,500 miles for Jaguar models and 30,000 miles for Volkswagen.

FUEL PRESSURE REGULATOR

1976-77 Renault – Connect pressure gauge to fuel line. Start and run engine at idle. Loosen lock nut on pressure regulator and turn hex screw to obtain 29-32 psi (2.0-2.2 kg/cm²). Turning screw clockwise increases pressure, counterclockwise decreases pressure.

THROTTLE VALVE SWITCH

1976-78 BMW & Renault – 1) Throttle valve switch should start to operate when throttle valve is opened 2 degrees from its normally closed position.

2) To adjust throttle valve switch use Tester (0684100202) on BMW, Tester (EFAW 228S 10) on Renault. Use manufacturer's instructions on tester for correct switch positions.

3) Readings on tester should indicate zero resistance at idle, infinity at part throttle, and zero resistance at full throttle. If not, loosen throttle switch screws.

4) Rotate throttle switch clockwise until needle on tester moves from an infinity reading to a zero reading, then rotate throttle switch counterclockwise one graduation (2 degrees). Tighten throttle valve switch and check for proper operation.

NOTE: On 1978 BMW 733i, the angle between idle cut-in position and idle stop on switch should be 4.5 degrees. Full throttle angle, between idle stop and full throttle cut-in, should be 62 degrees.

1979 BMW – 1) Disconnect throttle valve switch connector and connect one ohmmeter lead to throttle valve switch center terminal No. 18. Connect other ohmmeter lead to throttle valve switch terminal No. 2.

2) With throttle valve in idle position, ohmmeter should indicate zero ohms. Rotate throttle valve to mid throttle position. Ohmmeter should indicate infinity reading.

3) Rotate throttle valve to full throttle and hold. Disconnect ohmmeter lead from terminal No. 2 and touch terminal No. 3 with lead. Ohmmeter should indicate zero ohms.

4) If throttle valve switch does not perform as specified, return throttle valve to idle position and reconnect ohmmeter lead to throttle valve switch terminal No. 2.

5) Loosen screws and adjust switch so that ohmmeter changes from zero ohms to infinity when a .118-.157" (3-4 mm) feeler gauge is inserted between throttle valve shaft and stop. Tighten screws.

1978-79 Volkswagen – 1) Disconnect throttle valve switch connector and connect an ohmmeter to throttle valve switch terminals. With switch in idle position, ohmmeter reading should be infinity.

2) Raise switch roller to full throttle position. Ohmmeter should indicate zero ohms. If correct readings were not obtained, move throttle valve to full throttle position and hold.

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

3) Loosen hold-down screws and move switch until ohmmeter changes from infinity to zero ohms. Switch roller should contact center of throttle valve lever. Tighten screws.

TESTING

NOTE: Fuel injection system maintains constant fuel pressure in fuel lines and components parts at all times. Be sure to relieve fuel pressure before attempting to open system.

OXYGEN SENSOR MIXTURE CONTROL

1979 BMW & Volkswagen – 1) With ignition system in good condition, set idle speed to specifications. Check CO% level with oxygen sensor connected. If CO% level readings are not to specifications and cannot be adjusted, check for air leaks in exhaust system (ahead of oxygen sensor).

2) If no leaks are found, check sensor wiring for damage. If no damage is found, replace oxygen sensor. If readings still cannot be adjusted, reinstall original oxygen sensor and replace ECU. Recheck CO% level readings.

FUEL PRESSURE

1974-77 BMW & Renault – 1) Relieve fuel pressure. Connect fuel pressure gauge in cold start valve line on BMW, or in line to pressure regulator on Renault. Start engine and check fuel pressure.

2) If fuel pressure is incorrect, replace pressure regulator (adjust pressure regulator on Renault). If fuel pressure is still incorrect, check for leaking fuel lines and/or replace fuel pump.

1978-79 BMW – 1) Disconnect ground cable from battery and release pressure in fuel system. Connect fuel pressure gauge between fuel tube and hose to fuel filter. Disconnect lead wire from "S" terminal of starter.

2) Connect ground cable to battery. Turn ignition switch to "START" position to operate fuel pump. If pressure is not as specified, replace fuel pressure regulator and repeat test. If pressures are still below specifications, fuel pump is defective.

NOTE: On BMW 733i, detach plugs at air sensor. Connect terminals No. 36 and 39 with jumper wire. Turn ignition on. A click indicates pump relay is good; a humming sound means fuel pump is running. If no fuel is delivered, the pressure relief valve or check valve in fuel pump is defective. Fuel pump pressure should be 32-38 psi (2.4-2.7 kg/cm²).

1979 Jaguar – 1) Release fuel pressure from main fuel line at cold start valve and connect pressure gauge to hose. Disconnect negative lead from ignition coil and turn ignition on.

2) Check reading on pressure gauge and compare with specification. Operate fuel change-over switch on dash and recheck reading. If gauge reading is incorrect, replace fuel pressure regulator. Turn ignition off, remove pressure gauge, and reconnect fuel hose and coil lead.

FUEL PRESSURE SPECIFICATIONS

Application	Pressure
BMW	33.4-39.0 psi (2.2-2.7 kg/cm ²)
Renault	29-32 psi (2.0-2.2 kg/cm ²)
Jaguar	36.3 psi (2.55 kg/cm ²)
Volkswagen	
1976-77	31-44 psi (2.17-3.09 kg/cm ²)
1978-79	33-38 psi (2.35-2.65 kg/cm ²)

1974-77 Volkswagen – 1) Remove air sensor and air cleaner. Connect Fuel Pressure Gauge (US 1076) to injector supply line. Detach vacuum hose which connects air distributor and pressure regulator. Connect plug to removed intake air sensor.

2) Turn ignition on. Slightly open stator flap by hand until pump contacts close. Fuel pressure should be 31-44 psi (2.17-3.09 kg/cm²). If not, replace fuel pump.

1978-79 Volkswagen – 1) Warm engine to normal operating temperature and turn it off. Disconnect negative battery cable. Release pressure from main fuel line at cold start valve and connect pressure gauge to hose.

2) Disconnect and plug vacuum hose from pressure regulator. Reconnect negative battery cable. Start engine. Gauge should read approximately 35 psi (2.5 kg/cm²) or at least 33-38 psi (2.35-2.65 kg/cm²).

3) If pressure is within specifications, repeat test with vacuum hose connected. Gauge should read approximately 28 psi (2.0 kg/cm²) or at least 26-30 psi (1.85-2.15 kg/cm²). If pressures are incorrect, replace pressure regulator.

4) Correct pressure is most important at idle. However, if engine lacks power, check for large pressure drop at full throttle. If so, look for a restricted fuel line, clogged filter, dirt in tank, or defective fuel pump.

INTAKE AIR SENSOR

1975-79 BMW – Connect ohmmeter leads to temperature sensor terminals. Readings should be as specified in appropriate BMW INTAKE AIR SENSOR SPECIFICATIONS table. If not, replace temperature sensor and airflow meter as an assembly.

1975-78 BMW INTAKE AIR SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
14 (-10)	8250-10,560
68 (20)	2280-2720
122 (50)	760-910

1979 BMW INTAKE AIR SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
68 (20)	7000-12,000
122 (50)	2000-3000
176 (80)	250-400

1979 Jaguar – Disconnect battery negative cable and airflow meter connector. Record outside air temperature. Connect ohmmeter leads to terminals No. 6 and 27 on potentiometer connector. Ohmmeter readings should be as specified in 1979 JAGUAR INTAKE AIR SENSOR SPECIFICATIONS table. If not, replace temperature sensor and airflow meter as an assembly.

1979 JAGUAR INTAKE AIR SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
14 (-10)	9200
32 (0)	5900
68 (20)	2500
104 (40)	1180
140 (60)	600

1975-77 Volkswagen – Disconnect plug from intake air sensor. Connect an ohmmeter to terminals No. 6 and 9 of intake air sensor. Resistance should be between 200-800 ohms. Now, connect ohmmeter between terminals No. 7 and 8. Reading should be between 120-200 ohms. If readings are not within specifications, replace intake air sensor.

1978-79 Volkswagen – 1) Disconnect plug from intake air sensor. Connect an ohmmeter between air sensor terminals No. 36 and 39. See Fig. 5. Operate air sensor flap by hand. With flap closed there should be no continuity. When flap is opened slightly, there should be continuity. If not, replace intake air sensor.

2) To check potentiometer, connect an ohmmeter to terminals No. 6 and 9 of intake air sensor. Resistance should be between 200-400 ohms (100-300 ohms on Type 2). Now, connect ohmmeter between terminals No. 7 and 8. Reading should be between 100-500 ohms (80-200 ohms on Type 2). If readings are not within specifications, replace intake air sensor.

ENGINE COOLANT SENSOR

1975-79 Models (All) – Disconnect plug and connect an ohmmeter between engine coolant sensor and ground. As sensor temperature increases, resistance will decrease. See ENGINE COOLANT SENSOR SPECIFICATIONS table.

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

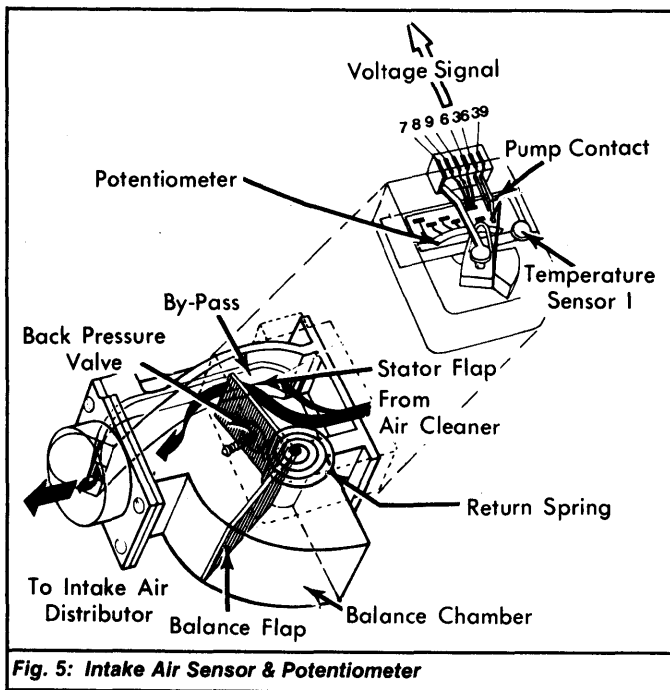


Fig. 5: Intake Air Sensor & Potentiometer

1976-79 ENGINE COOLANT SENSOR SPECIFICATIONS

Coolant Temperature °F (°C)	Resistance (Ohms)
-22 (-30)	20,300-33,000
14 (-10)	¹ 7600-10,800
50 (10)	3250-4150
68 (20)	² 2250-2750
122 (50)	740-940
176 (80)	³ 290-360

¹ – On BMW 733i, reading should be 7000-11,600 ohms.

² – On BMW 733i, reading should be 2100-2900 ohms

³ – On BMW 733i, reading should be 270-390 ohms.

AUXILIARY AIR REGULATOR

1975-78 Models (All) – 1) Remove auxiliary air regulator and connect an ohmmeter to both terminals of regulator. Resistance reading should be 30-33 ohms. Apply compressed air to regulator. Passage must be open while engine is cold.

2) Connect battery voltage to both terminals. As temperature increases, opening in regulator should become smaller. If ohmmeter reading is incorrect or if regulator fails to close with voltage applied, replace auxiliary air regulator.

1978-79 BMW – 1) With engine cold, disconnect air hose to auxiliary air regulator (at throttle valve end). You should be able to blow air through auxiliary air regulator. If not, replace auxiliary air regulator.

2) Reconnect hose to throttle valve housing. Start engine. While engine is warming up, pinch either air hose going to auxiliary air regulator. Idle speed should decrease.

3) After engine is fully warmed up, idle speed should not change when hose is pinched. If auxiliary air regulator failed to perform as described, replace auxiliary air regulator.

1978-79 Volkswagen & 1979 Jaguar – 1) Remove auxiliary air regulator and connect an ohmmeter to both terminals of regulator. Resistance reading should be 30-33 ohms. Apply compressed air to regulator. Passage must be open while engine is cold.

NOTE: If regulator resistance is correct, use test light to check voltage at regulator plug while engine is running. If no voltage, check double relay. Also check that starter solenoid wires on terminals No. 30 and 50 are not reversed.

2) Connect battery voltage to both terminals. As temperature increases, opening in regulator should become smaller. If ohmmeter reading is incorrect or if regulator fails to close with voltage applied, replace auxiliary air regulator.

THERMO-TIME SWITCH

1975-77 Models (All) – Disconnect negative battery cable. Disconnect plug from cold start valve and connect ohmmeter between terminals. If engine temperature is above 72°F (22°C), ohmmeter should indicate infinity. Below 59°F (19°C), resistance reading should be zero. Measure resistance between thermo-time switch terminal No. 45 and switch body. Reading should be 70-86 ohms.

1978 BMW (Except 733i) – Pull plug from thermo-time switch. Connect ohmmeter to terminal No. 46 on thermo-time switch and ground. If engine temperature is above 72°F (22°C), ohmmeter should indicate infinity. Below 57°F (14°C), resistance reading should be zero. Measure resistance between thermo-time switch terminal No. 45 and switch body. Reading should be 51-62 ohms.

1978 733i, 1979 BMW & 1979 Jaguar – 1) Pull plug from thermo-time switch. Connect ohmmeter to terminal "G" on thermo-time switch and switch body. Reading should be 40-70 ohms.

2) Connect ohmmeter between terminal No. 85 or "W" on thermo-time switch and ground. Connect terminals No. 86 with 30 ("G" on thermo-time switch). For temperatures above 59°F (15°C), you should have an infinity reading. Below 59°F (15°C), you should have a zero reading for 0-8 seconds.

1978-79 Volkswagen – 1) Cool thermo-time switch with ice until below operating temperature marked on housing, usually 95°F (35°C).

2) Disconnect electrical plug from cold start valve. Disconnect ignition primary wire from terminal No. 1 of ignition coil to prevent engine from starting. Tape disconnected wire to prevent shorting.

3) Attach test light leads to terminals of plug. Operate starter for 12 seconds or more. Test light should glow brightly at first, and then dim or go out within time period marked on switch (usually 8-11 seconds). If light glows brightly but does not dim, replace switch.

4) If light does not glow, attach leads from one terminal to ground. Repeat test using other terminal and ground. If light does not glow, wire to double relay or double relay may be the problem.

5) Also check for bad connections and check wire from terminal 50 of starter solenoid to double relay terminal No. 86a. If current is reaching plug, but test light does not glow (and test light is good), replace thermo-time switch.

COLD START VALVE

1975-76 Models (All) – Connect pressure gauge to injector supply line. Operate starter to build-up fuel pressure. Disconnect cold start valve. Connect wires from negative coil terminal to cold start valve. Observe fuel pressure reading, it should slowly decrease. If pressure does not drop, replace cold start valve.

1977-78 BMW & Volkswagen – 1) On all models except BMW 733i, connect pressure gauge to injector supply line. Operate starter to build up fuel pressure. Unplug connector from cold start valve.

2) Disconnect wire from negative coil terminal. Observe fuel pressure reading. Fuel pressure reading should slowly decrease. If pressure does not drop, replace cold start valve.

3) On 1978 BMW 733i, remove cold start valve and pull plugs from air-flow sensor. Connect jumper wires between terminals No. 36 and 39. Pull plugs from cold start relay.

4) Connect relay terminal No. 87 with terminal No. 30. Turn ignition on. Cold start valve must discharge fuel. If not, remove cold start relay. pull off plugs.

5) Connect terminal No. 85 to ground. Connect terminal No. 30 and 86c to battery positive terminal. With test light connected between terminals No. 86 or 87 and ground, test light should come on. If not, replace cold start relay.

1979 BMW & Volkswagen – 1) With ignition off, disconnect electrical connector from cold start valve. Tape connector terminals to prevent them from accidental grounding.

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

2-167

2) Remove cold start valve from air distributor, leaving all fuel hoses connected. Disconnect ignition primary wire from negative coil terminal to prevent engine from starting.

3) Crank engine. Cold start valve should not discharge or leak any fuel. If it does, replace cold start valve. If valve does not leak, connect electrical plug to cold start valve. Disconnect plug from thermo-time switch. Ground terminal "W" of disconnected plug with a jumper wire.

4) Place cold start valve in a container. Crank engine briefly. Valve should discharge fuel. If not, check for voltage at cold start valve with test light. If all wires are good and voltage exists at valve connector, replace cold start valve.

DECELERATION VALVE

1976-78 Models (All) – 1) Check vacuum controlled valves by detaching hose from deceleration valve at sensor. Start and run engine at 3000 RPM and suddenly close throttle. If no vacuum is present at end of disconnected hose at instant of throttle closing, replace deceleration valve.

2) Check electrically controlled deceleration valves by first turning ignition on. Remove wires from deceleration valve. Remove wire from deceleration valve to ATF pressure switch, at switch.

3) Ground disconnected wire and listen for "click". If no "click" is heard, replace deceleration valve or pressure switch. After parts replacement, repeat deceleration valve test procedure.

4) If deceleration valve is defective, idle speed will be too fast. To check for a faulty valve, pinch closed the valve's large, fabric-covered hose. If idle speed drops, replace deceleration valve.

1979 Volkswagen – 1) On Type 2 models, disconnect large hose from deceleration valve at intake duct. Plug hole in intake duct. Start and run engine at 3000 RPM, then close throttle. Suction should be felt at disconnected hose. If not, replace decel valve.

2) On Type 1 models, with engine at idle, pinch large hose closed. If idle speed drops, deceleration valve is faulty.

REMOVAL & INSTALLATION

NOTE: Fuel injection system maintains constant fuel pressure in fuel lines and components parts at all times. Be sure to relieve fuel pressure before attempting to open system.

AIRFLOW METER & AIR CLEANER

1975-79 Removal & Installation (BMW) – Disconnect electrical plug and loosen clamps on both sides of airflow meter. Remove air cleaner and lift airflow meter out of holder. To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – Disconnect battery ground cable. Disconnect rubber hose from both sides of airflow meter. Disconnect airflow meter ground cable and remove three bolts securing airflow meter to bracket. Move airflow meter upward, disconnect electrical connector and remove airflow meter. To install, reverse removal procedure.

1975 Removal & Installation (Opel) – 1) Disconnect battery ground cable and airflow meter connector. Remove hose clamp, airflow meter retaining nut, and air cleaner top retaining clip. Remove air cleaner top and airflow meter.

2) Airflow meter and top of air cleaner should come off as an assembly. Remove 4 air cleaner-to-airflow meter bolts. Remove gasket and airflow meter. To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – 1) Remove air cleaner top and filter. Carefully remove electrical connector from sensor. Loosen hose clamp then disconnect elbow duct from sensor.

2) Remove nuts securing air cleaner body to vehicle chassis. Remove sensor and air cleaner body as a unit. Remove sensor from air cleaner. To install, reverse removal procedure. Make sure sensor is properly adjusted after installation.

THROTTLE VALVE HOUSING

1975-78 Removal & Installation (BMW) – 1) Remove throttle valve housing cover. Disconnect electrical plug at throttle valve sliding switch. Disconnect vacuum control hose and Red electrical cut-off valve hose, at collector.

2) Disconnect warm air hose. Disconnect accelerator linkage and engine vent hose. Disconnect ignition control unit vent hose. Remove cylinder head cover and lower left stud.

1979 Removal & Installation (BMW) – 1) Disconnect and remove air cleaner assembly. Remove engine valve cover. Remove throttle linkage and throttle cable (with automatic transmission).

2) Disconnect all vacuum hoses. Always mark or note where vacuum hose was removed from for correct replacement. Disconnect throttle valve switch connector.

3) Drain vehicle coolant below auxiliary air valve or pinch water hoses going to air valve with clamps. Remove hoses from auxiliary air valve. Remove throttle valve mounting bolts and throttle valve. To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – 1) Remove intake air sensor and air cleaner as a unit. Loosen clamp and remove elbow ducting from top of throttle valve housing.

2) Disconnect throttle return spring from bracket on EGR valve body. Detach operating rod from EGR valve. Disconnect throttle linkage from arm on throttle valve shaft. Detach upper end of ball link from arm.

3) Disconnect vacuum hoses from throttle valve housing, mark hoses for correct position when installing. Remove screws securing throttle valve housing to manifold and remove throttle valve housing. To install, reverse removal procedure.

ELECTRONIC CONTROL UNIT (ECU)

1975-79 Removal & Installation (BMW) – Press clip located on wire end of electrical connector and swing cable assembly to right side. Remove screws retaining electronic control unit. To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – Disconnect negative battery cable. At forward end of luggage compartment, remove cover, electronic control unit retainer band and cable clamp clip. Unclip end cover and lift out electronic control unit. Disconnect pin connector and remove electronic control unit from vehicle. To install, reverse removal procedure.

1975-77 Removal & Installation (Renault) – 1) Locate electronic control unit beneath passenger's side defroster nozzle, in passenger compartment. Disconnect air hose at passenger's side defroster nozzle. Disconnect rubber band holders.

2) Tilt electronic control unit forward and remove metal holder. Loosen clamp and slide holder out of electronic control unit. Unplug connector and remove electronic control unit from vehicle. To install, reverse removal procedure.

1975 Removal & Installation (Opel) – Disconnect battery ground cable. Loosen right door edge beading and remove right kick panel. Remove 3 screws and electronic control unit. Unplug electronic control unit and remove from vehicle. To install, reverse removal procedure.

1977-79 Removal & Installation (Volkswagen) – 1) Disconnect battery ground strap. Locate electronic control unit on right-hand side of luggage compartment, behind rear seat backrest (above battery on Type 2).

2) Remove composition board cover. Use a screwdriver to carefully remove electronic control unit plug. Position it where it cannot be damaged physically or electrically. Remove electronic control unit from body.

3) To install, reverse removal procedure. Make sure cable plug is carefully and completely engaged in ECU. Be sure new electronic control unit has same part number as one removed. Reattach battery ground strap.

1974-79 FUEL SYSTEMS

Bosch AFC Fuel Injection – European (Cont.)

COLD START VALVE

1975-79 Removal & Installation (BMW) – Relieve fuel pressure. Remove electrical connector and retaining screws. Remove cold start valve. To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – Disconnect negative battery cable. Disconnect cold start valve connector and release fuel line pressure. Remove 2 screws securing cold start valve to intake manifold and remove cold start valve. To install, reverse removal procedure.

1975-77 Removal & Installation (Renault) – Relieve fuel pressure. Remove electrical connector and retaining screws. Remove cold start valve. With valve removed from manifold, carefully disconnect fuel hose. To install, reverse removal procedure.

1979 Removal & Installation (Opel) – Disconnect negative battery cable. Disconnect cold start valve connector and release fuel line pressure. Remove 2 screws securing cold start valve and cold start valve. To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – Relieve fuel pressure and disconnect battery. Disconnect electrical connector and fuel hoses at cold start valve. Remove screws securing cold start valve to air distributor and remove valve with gasket. To install, reverse removal procedure.

AUXILIARY AIR REGULATOR

1976-79 Removal & Installation (BMW, Renault & Jaguar) – 1) Disconnect air hoses attached to auxiliary air regulator. Auxiliary air regulator is installed in cooling system.

2) When removing auxiliary air regulator from cooling system, either have another regulator ready for immediate installation or drain cooling system below level of regulator. Remove screws securing regulator to engine and remove regulator.

1975 Removal & Installation (Opel) – Loosen both hose clamps. Remove throttle valve hose going to intake manifold adapter. Disconnect auxiliary air regulator electrical connector. Remove bolt and auxiliary air regulator from thermostat housing. To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – Disconnect air hoses and the electrical connector at auxiliary air regulator. Remove screws securing regulator to its mounting bracket. Remove auxiliary air regulator. To install, reverse removal procedure.

THERMO-TIME SWITCH

1975-79 Removal & Installation (BMW) – From beneath pressure regulator, remove electrical connector to thermo-time switch. Drain sufficient coolant to allow removal of switch. Use socket to remove switch. To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – Remove radiator cap and drain radiator coolant to level below cylinder head. Disconnect negative battery cable. Disconnect electrical connector to thermo-time switch. Loosen and remove thermo-time switch. To install, reverse removal procedure.

1975 Removal & Installation (Opel) – Remove radiator cap to release cooling system pressure. Disconnect electrical connector to thermo-time switch. Remove thermo-time switch. To install, reverse removal procedure.

1976-77 Removal & Installation (Renault) – Remove electrical connector to thermo-time switch. Drain sufficient coolant to allow removal of switch. To install, reverse removal procedure.

1976-79 Removal & Installation (Volkswagen) – Disconnect electrical connection then remove screws securing switch. Then remove thermo-time switch from bracket. To install, reverse removal procedure.

FUEL PRESSURE REGULATOR

1975-79 Removal & Installation (BMW) – Relieve pressure in fuel system and disconnect battery. Disconnect pressure regulator fuel lines. Disconnect vacuum hose at collector and remove pressure regulator. To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – Disconnect negative battery cable and relieve pressure in fuel system. Remove 2 screws securing pressure regulator bracket. Disconnect fuel and vacuum hoses. Remove nut and washer attaching regulator to bracket and remove regulator. To install, reverse removal procedure.

1975 Removal & Installation (Opel) – Remove rear injector hold-down bracket bolt from injector insulator. Remove vacuum hose from fuel pressure regulator "T" valve. Loosen hose clamps from fuel lines and remove pressure regulator. To install, reverse removal procedure.

1975-77 Removal & Installation (Renault) – Disconnect negative battery cable and relieve pressure in fuel system. Clamp both fuel hoses to prevent spillage. Disconnect fuel hoses from regulator. Remove screws and pressure regulator. To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – 1) Disconnect battery and relieve pressure in fuel system. Disconnect vacuum hose from regulator. Clamp or plug fuel hoses to prevent leakage. Disconnect fuel hoses from regulator.

2) From underneath vehicle, remove ring nut securing pressure regulator to engine front cover. Remove pressure regulator. To install, reverse removal procedure.

INJECTORS

1975-79 Removal & Installation (BMW) – Disconnect battery and relieve pressure in fuel system. Disconnect and plug fuel lines to injector(s) being removed. Disconnect electrical connections. Remove screws and injector(s). To install, reverse removal procedure.

1979 Removal & Installation (Jaguar) – 1) Disconnect negative battery cable and depressurize fuel system. Disconnect electrical connectors to all injectors. Remove 2 screws attaching fuel rail to intake manifold.

2) Release clips holding fuel supply and return rails. Remove manifold pressure pipe. Remove 6 nuts and washers from injector clamps and lift off fuel rail with injectors. Loosen injector clamps and remove injectors from fuel rail.

3) To install, reverse removal procedure. Make sure electrical connectors on injectors are in proper installed position before installing fuel rail to induction ram.

1975 Removal & Installation (Opel) – Disconnect electrical connectors at injectors. Remove injector center hold-down bolt. Loosen clamp and disconnect injector from fuel line. Remove injector from hold-down bracket. To install, reverse removal procedure.

1975-77 Removal & Installation (Renault) – Disconnect battery and relieve pressure in fuel system. Disconnect and plug fuel lines to injector(s) being removed. Disconnect electrical connections. Remove screws and injector(s). To install, reverse removal procedure.

1975-79 Removal & Installation (Volkswagen) – 1) Remove air duct between fan housing and heat exchangers on exhaust system. Disconnect battery and relieve pressure in fuel system.

2) Disconnect electrical connector and fuel lines from injectors to be removed. Remove screw securing injector to intake manifold. Remove injector with seals and retainer plate. To install, reverse removal procedure.