

VOL. \_\_\_\_\_

VOL. \_\_\_\_\_

JANBO

# E.F.I. SERVICE TIPS

FOR ALL CARS USING THE BOSCH ELECTRONIC FUEL INJECTION SYSTEM

## PRESSURE SENSOR

### INTRODUCTION

The pressure sensor is a key element in the EFI system. Its purpose is to control the air/gas mixture ratio under the varying conditions of engine loading. It does this by monitoring the engine vacuum level (0" to approx. 15" Hg) and converting this information into electrical signals which are fed to the control unit (Brain). It is the principle sensor for determining acceleration characteristics.

### HOW THE PRESSURE SENSOR WORKS

Fig. #1 shows a cut-away view of the Pressure Sensor. Basically it is sealed case except for its connection to the engine vacuum line/at (A). Within the housing are: (B) an aneroid (bellows); (C) a moveable, spring loaded transformer core slug (Metal rod); two transformer windings at (D); a tension spring at (E); two Spider springs that support the core slug at each end (F); and a factory calibration screw at (G).

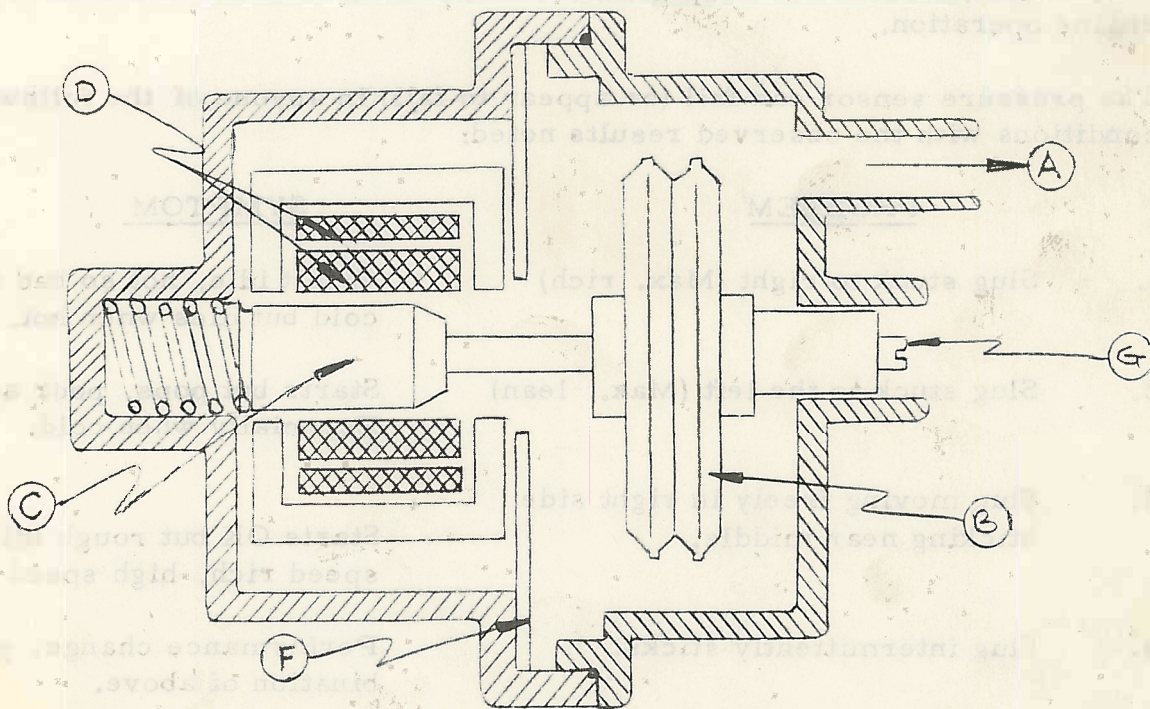


Fig. #1

At 0" of vacuum the transformer slug is forced to the extreme right side of the housing by the spring. This compresses the aneroid. This position is equivalent to what we will call the "Maximum Rich" position, and occurs when the engine is not running (ready to start) or close to what it is when running wide open (Butterfly valve in the air distributor fully open). In this position, as the engine is started, the brain will keep the injectors open for their maximum allowable period of time.

As the engine begins to turn over a large amount of fuel (compared to the volume of air bleeding thru the idle bypass) enters each cylinder (rich mixture). As the engine fires a high vacuum is created which draws the air out of the Pressure sensor housing. This causes the aneroid bellows to expand against the spring and force the transformer slug toward the extreme left side of the housing (Maximum Lean). (This is about 12-15"Hg).

The brain then reduces the amount of time that the injectors stay open. The mixture ratio becomes optimum at this point.

As the throttle is depressed (butterfly valve opened at the air intake to the air distributor) the vacuum falls compressing the aneroid. The spring then pushes the transformer slug back toward the right causing the injectors to stay open longer which permits more gas to enter the cylinder, which permits a larger amount of the mixture to be present causing the engine speed to increase until balance is reached.

As you can see, the pressure sensor must track the "Correct" vacuum level very closely in order to keep the mixture ratio correct at all levels of engine operation.

The pressure sensor can fail (or appear to fail) in anyone of the following conditions with the observed results noted:

<u>PROBLEM</u>	<u>SYMPTOM</u>
1. Slug stuck to right (Max. rich)	Won't idle, not so bad when cold but dies when hot.
2. Slug stuck to the left (Max. lean)	Starts but pops, poor accel, etc. Especially when cold.
3. Slug moving freely in right side sticking near middle.	Starts OK but rough idle. Low speed rich, high speed OK.
4. Slug intermittently sticks.	Performance change, pops, combination of above.
5. Full of oil (VW's)	Poor response, hard to start on cold mornings, floods.

6. Leaking aneroid or housing (rare) but will happen occasionally in the older cars. Shift in RPM, changing response, seems to loose power under load.
7. A. Leaky, split or loose vacuum hose (If sensor checks OK on 110 or 112 Analyzer). Runs rich at all times.  
B. Check engine vacuum level S/B 12-15" Hg.
8. Check for leaks around inj. seals. Car runs lean at high speed but OK at low speeds or when cold.
9. Vacuum hose disconnected. Touchy or jumpy throttle near idle.

If the sensor is found to be bad, it is easily rebuilt. Merely disassemble, clean and dry. Push slug to see if it moves freely for 1/4" or so. (See Model 110 or 112 instruction manuals for more specific details).

Be sure the sealed factory calibration adjustment screw has not been tampered with. This should never be adjusted in the field.

#### DIFFERENCES BETWEEN SENSORS

There are two different, basic design differences in pressure sensors.

1. Those used in 1968-69 VW's are of the original design and must be used with the "A" and "B" VW brains.
2. All other units from 1970-on are of a newer design and are interchangeable for the purpose of testing. Even the earlier design will work in a pinch, but with reduced performance. As with the control units, it is a good policy to keep a good pressure sensor on the shelf for test and loan purposes.

#### ADDITIONAL SERVICE HINTS

If a car is hard to start during cold weather but all else checks out OK, check the floor mat. Sometimes it will slide forward and depress the accelerator pedal enough to activate the throttle switch which effects the starting mixture. For a quick check on engine vacuum level;

1. First connect and run the car, at idle, on the original car's control unit.
2. Remove the vacuum hose from the pressure sensor. Connect the vacuum pump hose to the sensor.

3. Increase the vacuum slowly from 0" up to about 15" Hg. The engine RPM's will increase and PEAK at the vacuum level of the engine. This should be about 12-15" for all cars except high performance engines (such as the M.B. 3.5 Litre. which should read 15"). Above this point the engine will lean out and starve. If the engine peaks at levels below 12" it is a good indication of low vacuum condition in the engine or a large leak in the manifold areas, so check further.

Make sure the rubber boots over the electrical connectors to the various sensors are pulled down tight. If not the plug can work loose and cause intermittent operation or moisture can leak in. Although the pressure sensor controls mixture at all levels of engine operation the key to its operation can often be observed best at or near idle.

VOL. 1NO. 1

JANBO

# E.F.I. SERVICE TIPS

FOR ALL CARS USING THE BOSCH ELECTRONIC FUEL INJECTION SYSTEM

## THE CONTROL UNIT

### INTRODUCTION

This issue of the JANBO E.F.I. "SERVICE TIPS" highlights the Control Unit or "Brain". Although we will review some material contained in your Janbo manuals, the objective of these Service Tips is to make you aware of new information and to acquaint you with some of the unusual service problems that are being encountered in the field. Our goal, of course, is to reduce your service and training costs. . . . Troubleshooting charts, failure symptoms and possible cures will be included whenever possible.

### THE CONTROL UNIT (BRAIN) AND HOW IT WORKS

The control unit "Brain" is the heart of the Electronic Fuel Injection system. It receives information from each sensor and converts it into the proper commands to open and close the fuel injectors. The amount of time the injectors stay open determines the amount of fuel that reaches a cylinder. The brain will vary this time according to the information it receives from the various sensors. The most important of these are: 1) Engine Temperature ( the cylinderhead or coolant temperature sensor); 2) The vacuum level (Pressure Sensor); 3) the engine speed (trigger Points)

It is the job of the brain, then, to match the amount of fuel to the volume of air reaching the cylinder so as to obtain an optimum mixture-ratio under all conditions of engine operation. The brain also controls operation of the Fuel Pump thru the Fuel Pump Relay.

Problems associated with the brain will generally be of the "All or Nothing" type. That is, the injectors will either not open or will be on all the time. So for our purposes we can think of the brain as divided into just three sections: The Fuel Pump section, and 2 separate injector circuits. These are identified as groups I and II in the 4 and 6 cylinder cars. The only exception is the 8 cyl. Mercedes-Benz cars which have 4 injectors circuits ( Groups I, II, III and IV). Otherwise all the circuits are the same.

## PROBLEMS ASSOCIATED WITH THE BRAIN

Unless otherwise stated in the following discussion, it is assumed that all the basic system tests have been performed and are operating properly. These tests, as included in all Janbo EFI analyzers are as follows:

1. Car battery voltage and brain power relay OK
2. All injectors are connected properly and are operational.
3. The triggerpoints are opening and closing, fully.
4. Fuel pump and relay are operating and that the fuel pressure is holding correctly at about 28.7 PSI.
5. Starter voltage is reaching the brain.
6. The throttle, fuel enrichment and pressure ('68-69 VW only) switches are working.
7. The Ignition system is working and that the timing and valve settings are correct.

All the above tests can be performed on any Janbo analyzer, however, the model 111C and 112 have additional circuitry built in to dynamically test the Pressure Sensor and a manually controlled "Brain" for operating the car. When tests using these features are required, they will be called out and may be duplicated by owners of older analyzers by use of a Janbo Model 110 Pressure Sensor Tester and a new, or rebuilt, control unit from any model car.

## INTERMITTENT OPERATION

Undoubtedly the most encountered problem with the brain is intermittent operation. After about 2 years connections within the brain begin to break down or the contact pins, on the cable connector, become weak and dirty.

## THE CONNECTOR

When a car will not start, especially on a cold morning, but has otherwise been running well, suspect the cable connections to the brain first. Poor connections between the pins and the circuit board in the brain are often the cause. Hot and cold cycling tends to make the contact pins take a set which reduces the contact pressure and permits oxidation of the pins and contact strips on the circuit board to occur.

To correct this problem, remove the cable connector from the brain. With an awl or pointed tool ( even a nail will do ), push the pins together about .010--.020" ( see Fig #1 ).

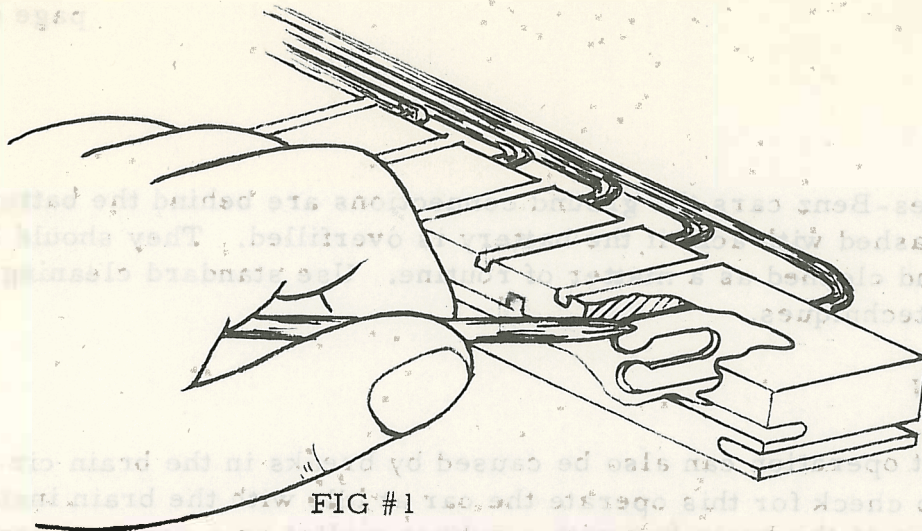


FIG #1

Also take a pencil eraser ( not an ink eraser) and buff the tarnish off the gold contact strips on the edge of the circuit board where it mates with the connector pins. Rub them just enough to remove the dull finish or surface film. This should only take one or two rubs per strip. (See Fig.#2 below).

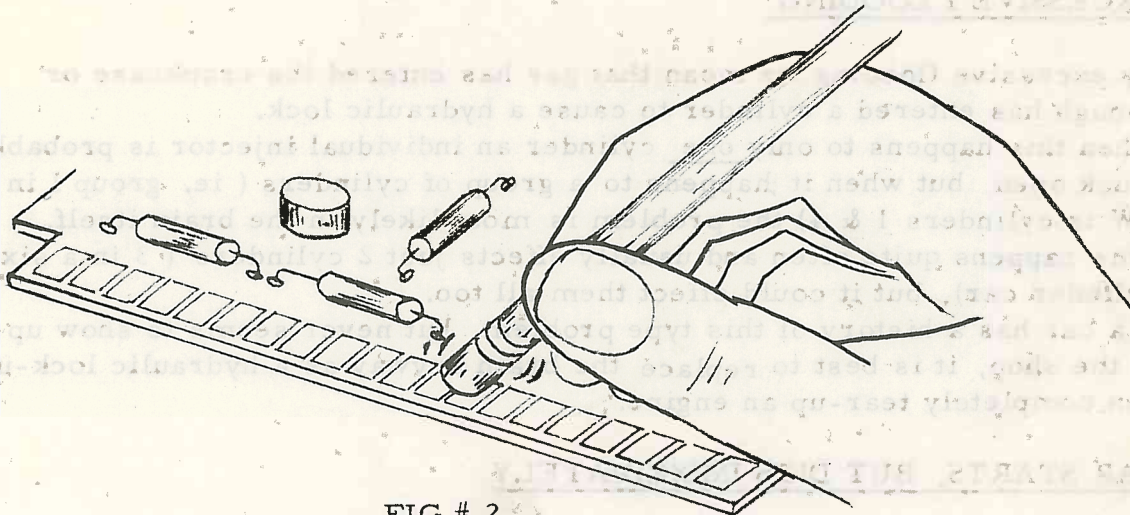


FIG # 2

It is always a good idea to do this any time you have the brain out of the car as it may eliminate a call-back.

Incidentally, this condition has caused a needless amount of good brains to be replaced, because as you remove the connector (to place it on the tester) you rub off some of the tarnish from the connector pins and they are flexed and somewhat cleaned up. Then when all checks show good and the car runs on the analyzer, or a new brain, the original brain is thought to be at fault. So always put the old brain back into the car to see if it will now run the car. All that may have been wrong is dirty contacts. Often the problem is that simple.

Always check ground connections on the block, at the injectors and at the battery. Clean them and make sure that they fit tight.

On Mercedes-Benz cars the ground connections are behind the battery and get splashed with acid if the battery is overfilled. They should be removed and cleaned as a matter of routine. Use standard cleaning and protection techniques.

### THE BRAIN

Intermittent operation can also be caused by breaks in the brain circuitry. To check for this operate the car at idle with the brain installed. Hit the sides of the brain box with a rubber mallet or a screwdriver handle. Hit it hard to see if the engine will stop or hesitate. Rap the case hard. You will not hurt it as long as you don't put big dents in it as it is quite rugged. Do this to all sides but be sure that the connector is securely held in place so you won't shake it loose.

### EXCESSIVE FLOODING

By excessive flooding we mean that gas has entered the crankcase or enough has entered a cylinder to cause a hydraulic lock. When this happens to only one cylinder an individual injector is probably stuck open, but when it happens to a group of cylinders (ie. group I in a VW is cylinders 1 & 4) the problem is most likely in the brain itself. This happens quite often and usually effects just 2 cylinders (3 in a six cylinder car), but it could effect them all too. If a car has a history of this type problem, but never seems to show up in the shop, it is best to replace the brain anyway as a hydraulic lock-up can completely tear-up an engine.

### CAR STARTS, BUT DIES IMMEDIATELY

If the car will run on the Analyzer, the problem is usually caused by the fuel pump circuit in the brain. If the car will not run on either the analyzer or a brain, check the trigger points and the fuel pump fuses.

### FUEL PUMP RUNS CONTINUALLY

This is also caused by a failure in the fuel pump circuit in the brain. Even though the car will run when this condition exists, it is safer to replace the brain.

### SOME ADDITIONAL NOTES ON THE BRAIN

When replacing a brain always replace it with the same part number as the one removed. However, there are some points along this line



that are worth remembering:

1. Any brain will work in any car for purposes of tests or short time operation. The older VW brains (68-69) will exhibit a pronounced hesitation when operated in newer cars, but they will work in a pinch until you can get the proper one. For this reason we recommend that you keep either a new or rebuilt brain on your parts shelf for test or emergency purposes. Try and get one from a wrecked car or from a wrecking yard. Twenty five dollars is tops, unless you can get at least a years guarantee.
2. The 1968 and 69 VW brains are directly interchangeable with each other and can safely be sold as such. The same is true for the 1970-71 units. The letter after the VW part no. designates the year. "A" is 1968, "B" is 1969, etc. All brains from 1970 and on are similar and are of a newer design that improves performance and eliminates the flat spots that plagued the first models.
3. Always turn off the ignition switch when installing or removing a brain. It is a good habit to get into.
4. Always disconnect the brain (or the battery leads) when charging the battery. On high, or quick, charge, if the battery leads do not make good contact with the battery terminals, the voltage can rise to over 24 volts. This is probably the main cause of burn-outs in the fuel pump circuit. Also remove the brain when running the car thru a paint booth as the heat can exceed the ratings of the components on the circuit board.
5. We have received numerous reports of radio interference with EFI (Called RFI). . . . . This can happen both ways (ie. the radio can interfere with normal EFI operation or the EFI system can cause static in the car (shortwave) radio. Probably the only time you will have complaints along this line is when there is a high power mobile installed into the car. Radio Frequency energy can cause all sort of problems in a EFI system but usually it will either cut-off the engine completely or cause it to miss and run poorly. We will have more information on this problem later on but you might try the following:
  - A. Make sure all grounds in the EFI system are making good connection. Add a heavy, braided wire strap from the brain case to a good ground on the main frame or body.
  - B. It is best, if the antenna is not mounted near the brain as they will then share the same ground paths. Try and get the antenna moved to the opposite end of the car.
  - C. Install generator or alternator Hash Filters in series with leads 16 and 24 going to the brain. These are available at mobile radio stores, Radio Shack, etc.  
We understand that Bosch has a supression kit available in Europe but we have not seen one, as yet.

6. The 4.5 Litre Mercedes-Benz has a modified throttle switch which incorporates a high-speed acceleration switch segment which is activated only when the accelerator is pushed to the floor. To check this on a Janbo Analyzer, insert the test leads and switch to "EXT. OHMMETER". Remove the plug from the throttle switch (or the connector from the Brain). Touch one lead to pin #2 and the other to a good ground connection. Depress the accelerator pedal to the floor. The meter will swing from the OPEN (White) to the CLOSED (Black) position, if it is operating properly.
7. Occasionally pin 24 (12 volts) will not make contact. To check for this remove the connector from either the tester or the brain, and using the analyzer, connect the test leads and switch the analyzer to the "EXT. VOLTS" position. Touch one lead to a good ground (Black) and the other lead (Red) to pin 24 at the brain connector. A reading of 12 volts should occur.

Drop us a line if you have any information concerning an unusual EFI that you have encountered. We will pass it along. In this manner we can distribute troubleshooting information that will benefit everyone.

Subscriptions to these Service Tips are available for \$24.00/yr., additional copies at \$15.00/yr. Training and correspondence courses will be available in 1973.