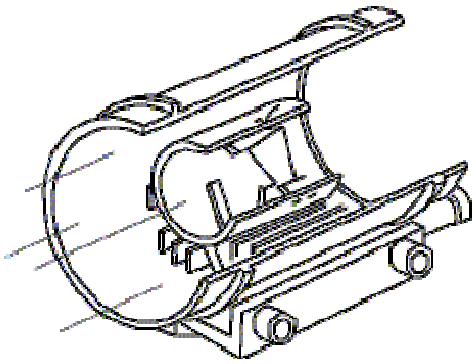
Mass Air Flow (MAF) Sensor

The Mass Air Flow Sensor is probably the best way to measure the amount of air an engine takes in (engine load). This sensor not only measures the volume of air but also compensates for its density as well. Ford, GM, and many imports are using engine control systems based around this sensor.

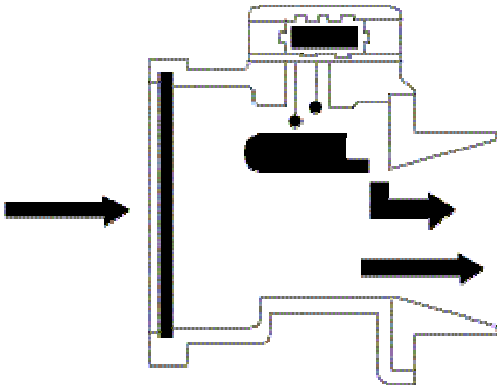
There are two common designs of MAF sensors used in today's vehicles. One produces a variable voltage output (analog) and the other produces a frequency output (digital). In either case their operation is similar. Both outputs can be measured by a scanner or a digital volt/ohm meter (dvom) that can measure frequency.

Both designs work on the "hot wire" principle. Here's how they work. A constant voltage is applied to the heated film or heated wire. This film or wire is positioned in the air stream or in an air flow sampling channel and is heated by the electrical current that the voltage produces. As air flows across it, it cools down. The heated wire or film is a positive temperature coefficient (ptc) resistor. This means that it's resistance drops when it's temperature drops. The drop in resistance allows more current to flow through it in order to maintain the programmed temperature. This current is changed to a frequency or a voltage which is sent to the computer and interpreted as air flow. Adjustments for air temperature and humidity are taken into consideration since they also affect the temperature of the heated wire or film.



GM (Bosch) Hot Wire MAF Sensor

Humidity always affects the density of air since humid air is denser than dry air. No other compensation is therefore needed for this factor. Air temperature affects density since colder air is more dense than warmer air. Many systems use an air temperature sensor to compensate for this factor since similar amounts of air can enter an engine at different temperatures. Some MAF sensors use an internal "cold" wire to send ambient temperature information to the computer. Some use an intake air temperature sensor in the manifold or the intake piping. This sensor is almost always ntc in design (negative temperature coefficient). That is, it's resistance goes up as air temperature goes down. This "thermistor" works just like a coolant temperature sensor and usually has identical resistance to temperature values. By the way, these values are very different from manufacturer to manufacturer and are available in most repair manuals. They are also programmed into scanner software.



Ford Hot Wire MAF Sensor

Now, as we discussed, the MAF sensor sends either a variable voltage or a changing frequency to the computer. The computer is programmed to accept this information when the car is running in any mode. For example, idle rpm will send a low voltage or low frequency and a high revving engine will send a high voltage

or high frequency to the computer along a specific wire (the MAF signal wire). If the signal is not present when it should be and within a programmed parameter, say high voltage at high throttle opening, the computer will set a code.

So, there are several things to consider whenever there is a code which points to the MAF sensor as the problem:

1. Derive the code(s) by the manufacturer's recommended method.

2. Look up the code(s) in a service manual.

3. Read the explanation(s) carefully!

4. A code that indicates an out of range signal is often an indication that another sensor, like the throttle position sensor or the rpm input signal is contradicting the MAF signal. The cause might be the other sensor or signal being out of adjustment or faulty.

5. A code that indicates a low MAF signal may be set by various problems. These include the following:

1. A bad MAF sensor (internal fault)

2. Any wire on the MAF sensor circuit including:

A. The 12 volt feed wire which connects the MAF to the battery through the ignition switch or through a relay as in many GM applications

B. The MAF ground wire

C. The output wire

D. The MAF or computer connectors

E. The computer

Note: The GM Bosch style system used on 5.0L/5.7L Firebirds, Camaros, and Corvettes have a hot wire "burn-off" feature that uses a relay to burn any impurities off of the hot wire. This system will set a code if the ecu controlled side of the relay fails.