Figure 75-1: A vane air flow (VAF) sensor.

Figure 75-2: A typical air vane sensor with the cover removed. The movable arm contacts a carbon resistance path as the vane opens. Most air vane sensors also have contacts that close to supply voltage to the electric fuel pump as the air vane starts to open when the engine is being cranked and air is being drawn into the engine.
FREQUENTLY ASKED QUESTION

What Is the Difference Between an Analog and a Digital MAF Sensor?

Some MAF sensors produce a digital DC voltage signal whose frequency changes with the amount of airflow through the sensor. The frequency range also varies with the make of sensor and can range from 0- to 300-Hz for older General Motors MAF sensors to 1,000- to 9,000-Hz for most newer designs.

Some MAF sensors, such as those used by Ford and others, produce a changing DC voltage, rather than frequency, and range from 0- to 5-volts DC.
Figure 75-5: A Karman Vortex air flow sensor uses a triangle-shaped rod to create vortices as the air flows through the sensor. The electronics in the sensor itself converts these vortices to a digital square wave signal.

Figure 75-6: Carefully check the hose between the MAF sensor and the throttle body assembly for cracks or splits that could cause extra (false) air into the engine that is not measured by the MAF sensor.

REAL WORLD FIX: The Dirty MAF Sensor Story

The owner of a Buick Park Avenue equipped with a 3.8-liter engine complained that the engine would hesitate during acceleration, showed lack of power, and seemed to surge or miss at times. A visual inspection found everything to be like new, including a new air filter. There were no stored diagnostic trouble codes (DTCs). A look at the scan data showed airflow to be within the recommended 3 to 7 grams per second. A check of the frequency output showed the problem.

Idle frequency = 2.177 kHz (2,177 Hz)

Normal frequency at idle speed should be 2.37 to 2.52 kHz.

Cleaning the hot wire of the MAF sensor restored proper operation. The sensor wire was covered with what looked like fine fibers, possibly from the replacement air filter.

NOTE: Older GM MAF sensors operated at a lower frequency of 32 to 150 Hz, with 32 Hz being the average reading at idle and 150 Hz for wide-open throttle.
FREQUENTLY ASKED QUESTION: What Is Meant By a "High-Authority Sensor"?

A high-authority sensor is a sensor that has a major influence over the amount of fuel being delivered to the engine. For example, at engine start-up, the engine coolant temperature (ECT) sensor is a high-authority sensor and the oxygen sensor (O2S) is a low-authority sensor. However, as the engine reaches operating temperature, the oxygen sensor becomes a high-authority sensor and can greatly affect the amount of fuel being injected into the engine.

### High-Authority Sensors
- ECT (especially when the engine is warming up)
- TPS (throttle position sensor)
- MAP
- PRNDL (shift position sensor)
- KSP
- TP
- EFT

### Low-Authority Sensors
- IAT (intake air temperature)
- O2S (after the engine reaches closed-loop operation)
- Transmission fluid temperature

FREQUENTLY ASKED QUESTION: What Is Meant By "False Air"?

Airflow sensors and mass airflow (MAF) sensors are designed to measure all of the air entering the engine. If an air hose between the MAF sensor and throttle body becomes loose or has a hole, extra air can enter the engine without being measured. This extra air is often called false air.

- SEE FIGURE 75–6. Because this extra air is unmeasured, the computer does not provide enough fuel delivery and the engine operates too lean, especially at idle. A small hole in the air hose can have a significant effect on fuel delivery.

To diagnose for false air, look at long-term fuel trim numbers at idle and at 3000 RPM. NOTE: If the engine runs well in reverse, yet runs terrible in any forward gear, carefully look at the inlet hose for air leaks that would open when the engine torque moves the engine slightly on its mounts.

TECH TIP: The Unplug It Test

If a sensor is defective yet still produces a signal to the computer, the computer will often accept the reading and make the required changes in fuel delivery and spark advance. However, if the sensor is not reading correctly, the computer will not use the information and use data from other sensors instead. For example, if a mass airflow (MAF) sensor is telling the computer that 12 grams of air per second is going into the engine, the computer will pulse the injector for 6.4 ms or whatever figure it is programmed to provide. However, if the air going into the engine is actually 14 grams per second, the computer will not provide enough fuel delivery. If the MAF sensor is unplugged, the computer knows that the sensor is not capable of supplying airflow information, so it defaults to a fixed amount of fuel based on the values of other sensors such as the TP and MAP sensors. If in doubt, take it out. If the engine operates better with a sensor unplugged, then suspect that the sensor is defective. A sensor that is not supplying the correct information is said to be skewed. The computer will not set a diagnostic trouble code for this condition because the computer can often not detect that the sensor is supplying wrong information.
REAL WORLD FIX

The Rich Running Toyota

A Toyota failed an enhanced emission test for excessive carbon monoxide, which is caused by a rich (too much fuel) air–fuel ratio problem. After checking all of the basics and not finding any fault in the fuel system, the technician checked the archives of the International Automotive Technicians Network (www.iatn.net) and discovered that a broken spring inside the air flow sensor was a possible cause. The sensor was checked and a broken vane return spring was discovered. Replacing the air flow sensor restored the engine to proper operating conditions and it passed the emission test.