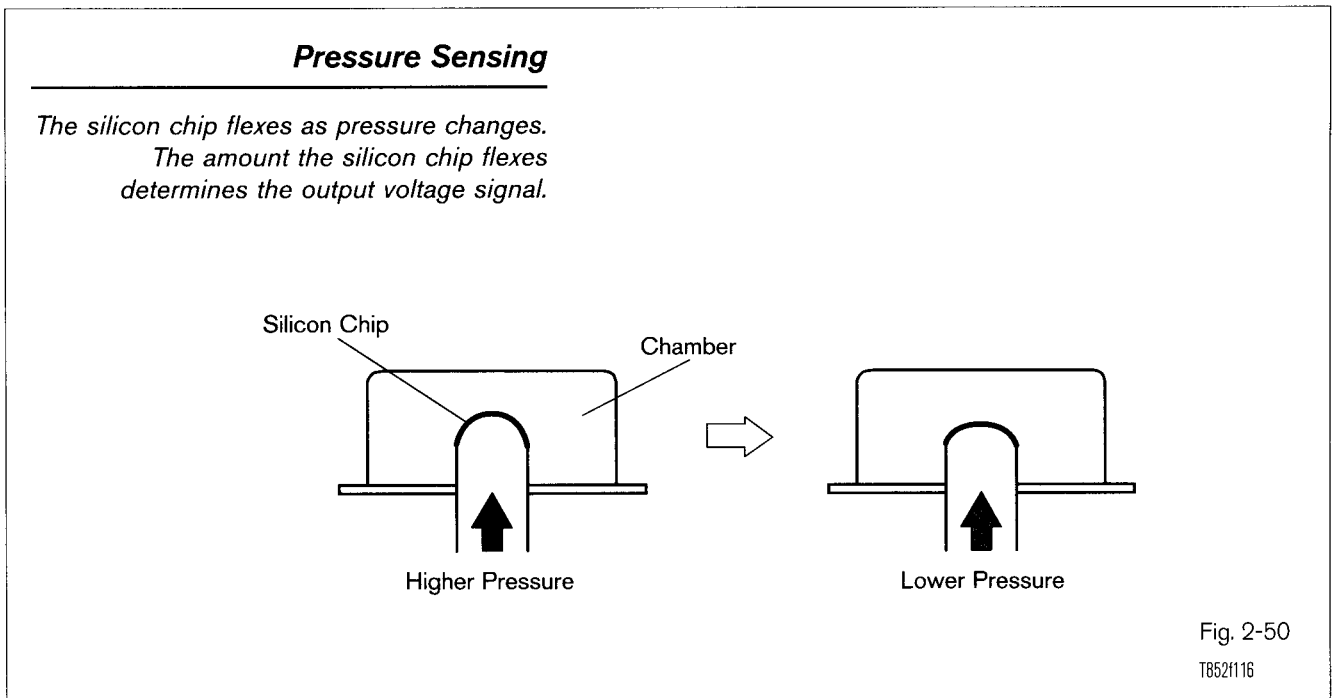
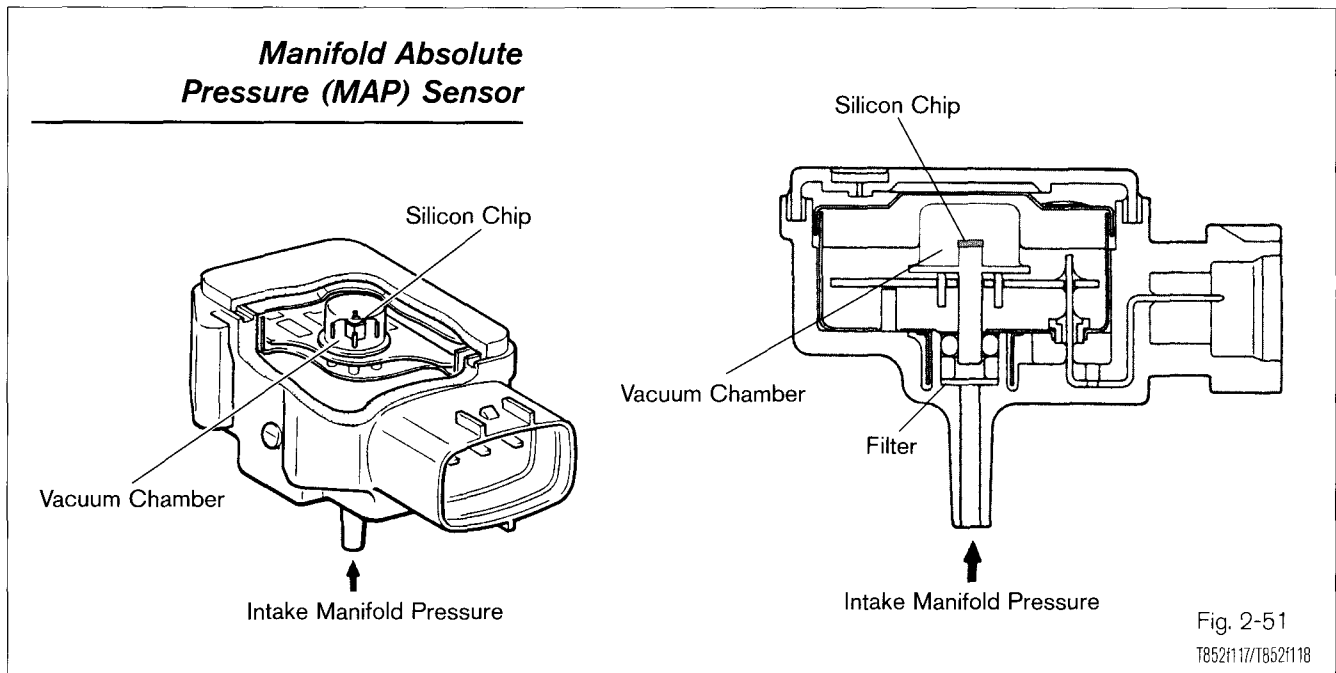


## Pressure Sensors

Pressure sensors are used to measure intake manifold pressure, atmospheric pressure, vapor pressure in the fuel tank, etc. Though the location is different, and the pressures being measured vary, the operating principles are similar.





## Manifold Absolute Pressure (MAP) Sensor

In the Manifold Absolute Pressure (MAP) sensor there is a silicon chip mounted inside a reference chamber. On one side of the chip is a reference pressure. This reference pressure is either a perfect vacuum or a calibrated pressure, depending on the application. On the other side is the pressure to be measured. The silicon chip changes its resistance with the changes in pressure. When the silicon chip flexes with the change in pressure, the electrical resistance of the chip changes. This change in resistance alters the voltage signal. The ECM interprets the voltage signal as pressure and any change in the voltage signal means there was a change in pressure.

Intake manifold pressure is directly related to engine load. The ECM needs to know intake manifold pressure to calculate how much fuel to inject, when to ignite the cylinder, and other functions. The MAP sensor is located either directly on the intake manifold or it is mounted high in the engine compartment and connected to the intake manifold with vacuum hose. It is critical the vacuum hose not have any kinks for proper operation.

**MAP Sensor Operation**

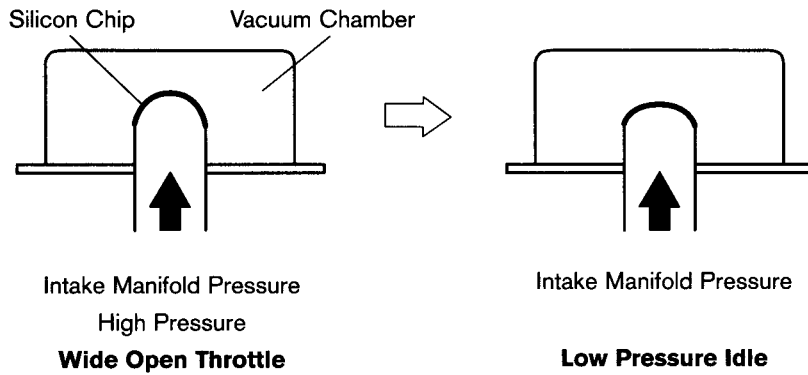


Fig. 2-52  
T852f116

The MAP sensor uses a perfect vacuum as a reference pressure. The difference in pressure between the vacuum pressure and intake manifold pressure changes the voltage signal. The MAP sensor converts the intake manifold pressure into a voltage signal (Pim).

**Pressure vs. MAP Voltage Signal**

*As intake manifold pressure rises, the voltage signal increases.*

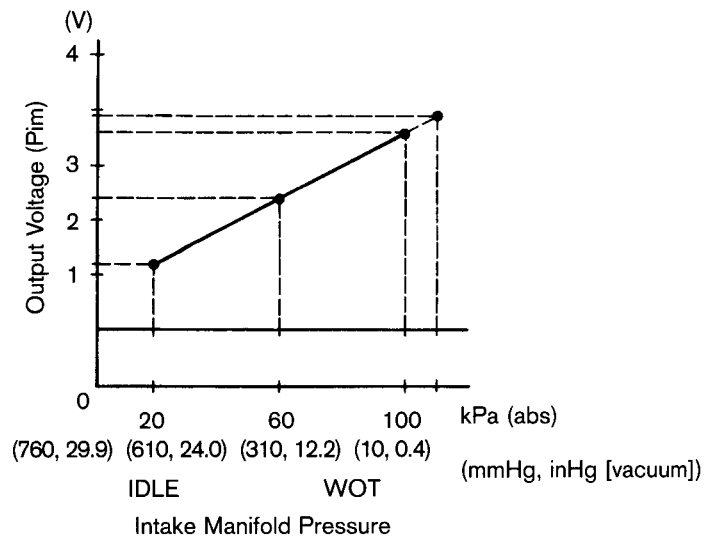


Fig. 2-53  
T852f119

## MAP Sensor Circuit

The ECM measures this voltage signal at the PIM terminal. This sensor receives 5 Volts from the ECM on the VC (or VCC) line. The ground for the sensor is through a ground wire to the ECM (usually terminal E2).

The PIM signal will be 5 Volts if the PIM wire is disconnected.

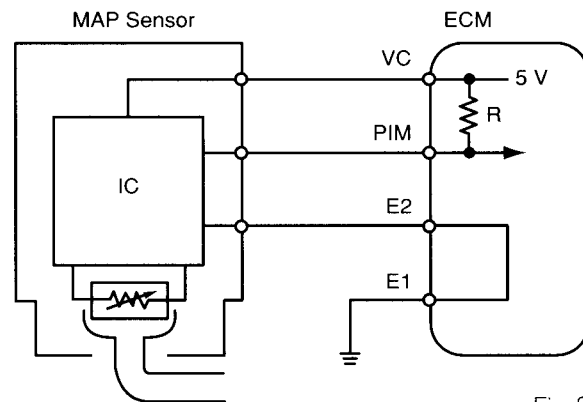


Fig. 2-54  
T8521120

The MAP sensor voltage signal is highest when intake manifold pressure is highest (ignition key ON, engine off or when the throttle is suddenly opened). The MAP sensor voltage signal is lowest when intake manifold pressure is lowest on deceleration with throttle closed.

## MAP Sensor Diagnosis

The MAP sensor can cause a variety of driveability problems since it is an important sensor for fuel injection and ignition timing.

Visually check the sensor, connections, and vacuum hose. The vacuum hose should be free of kinks, leaks, obstructions and connected to the proper port.

The VC (VCQ wire) needs to supply approximately 5 volts to the MAP sensor. The E2 ground wire should not have any resistance.

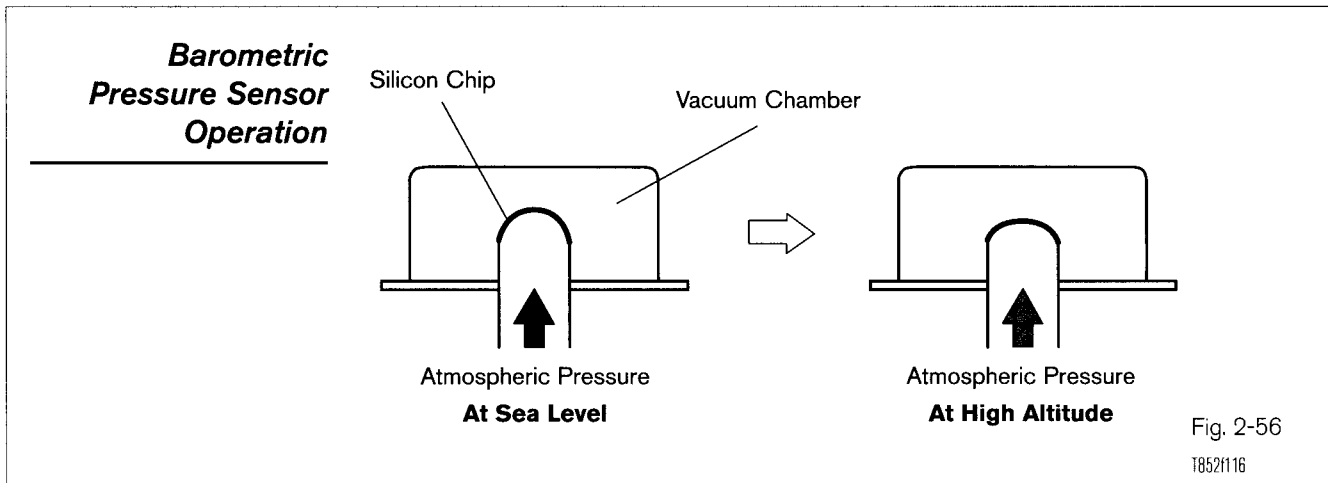
Sensor calibration and performance is checked by applying different pressures and comparing to the voltage drop specification. The voltage drop is calculated by subtracting the PIM voltage from the VC voltage.

## MAP Sensor Performance Check

The chart is representative of testing the MAP sensor. Voltage drop is calculated. VC voltage - PIM voltage = Voltage drop

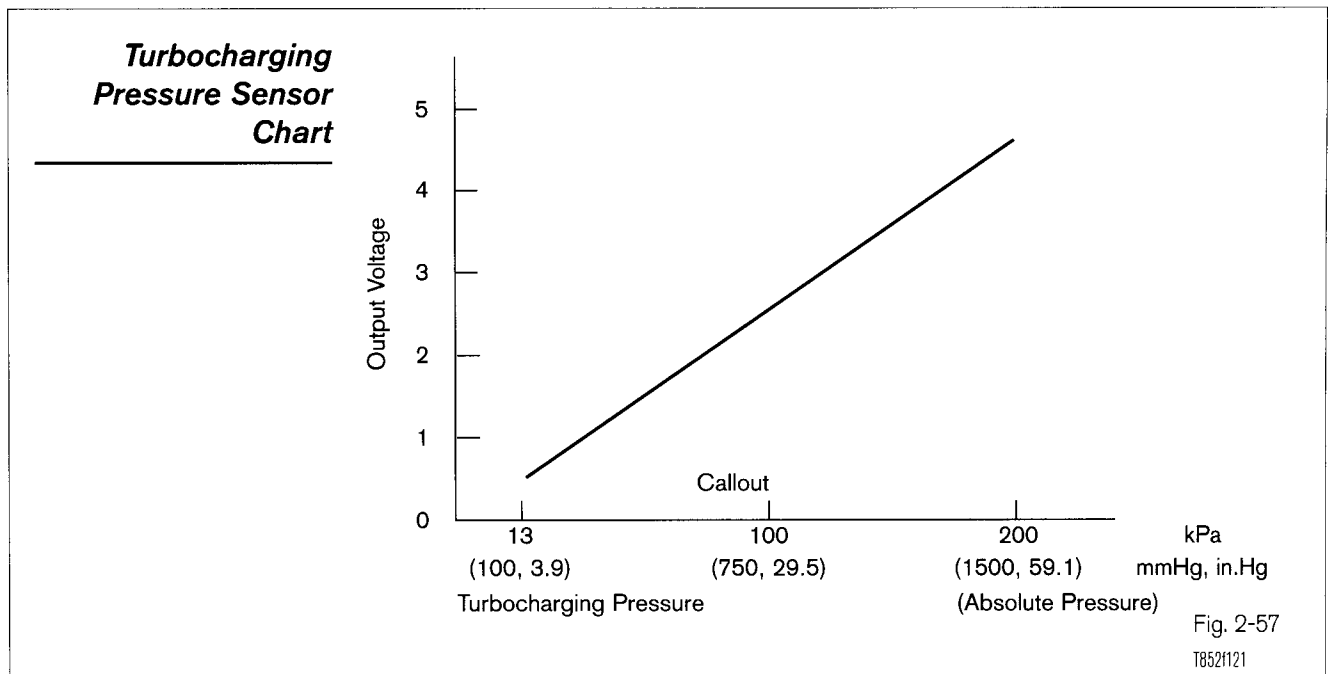
Applied Vacuum kPa	13.3	26.7	40.0	53.5	66.7
mmHg	100	200	300	400	500
in. Hg.	3.94	7.87	11.81	15.75	19.69
Voltage Drop V	0.3 — 0.5	0.7 — 0.9	1.1 — 1.3	1.5 — 1.7	1.9 — 2.1

Fig. 2-55



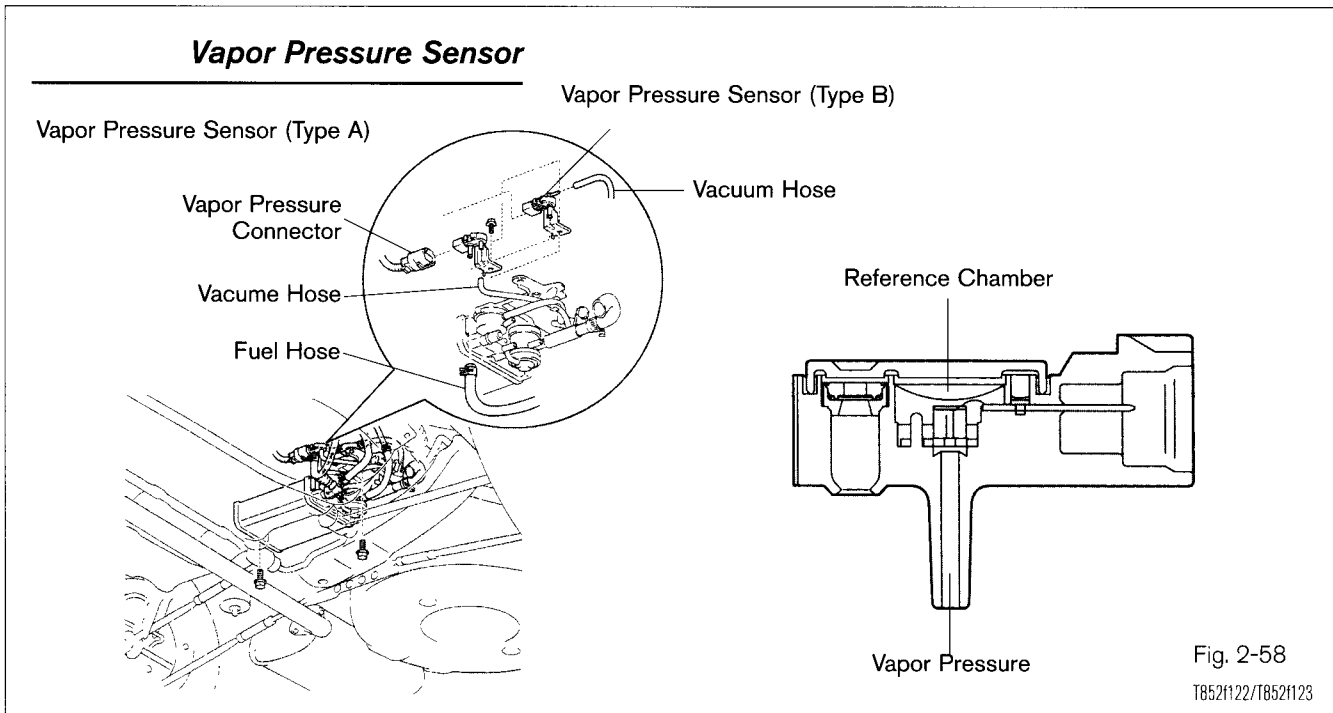
**Barometric Pressure Sensor**

The Barometric Pressure Sensor, sometimes called a High Altitude Compensator (HAC), measures the atmospheric pressure. Atmospheric pressure varies with weather and altitude. At higher elevations the air is less dense, therefore, it has less pressure. In addition, weather changes air pressure. This sensor operates the same as the MAP sensor except that it measures atmospheric pressure. It is located inside the ECM. If it is defective, the entire ECM must be replaced.



**Turbocharging Pressure Sensor**

The turbocharging pressure sensor operates identically to the MAP sensor and is used to measure intake manifold pressure. The only difference is that when there is boost pressure, the voltage signal goes higher than on a naturally aspirated engine.



## Vapor Pressure Sensor

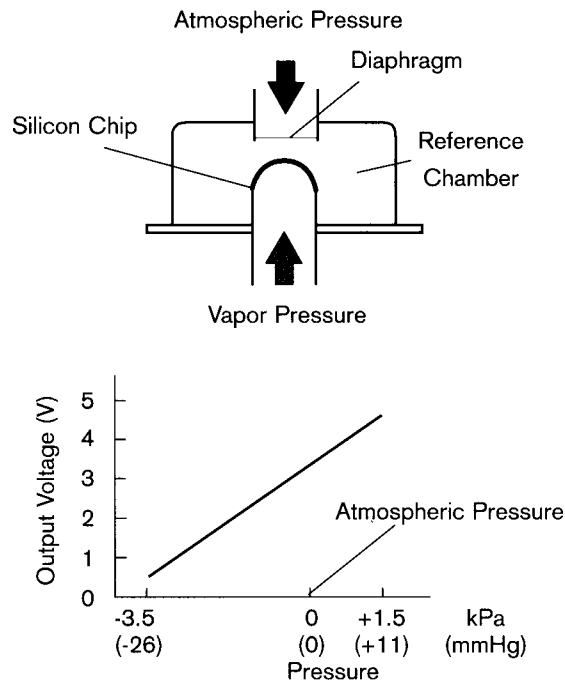
The Vapor Pressure Sensor (VPS) measures the vapor pressure in the evaporative emission control system. The Vapor Pressure Sensor may be located on the fuel tank, near the charcoal canister assembly, or in a remote location.

### Vapor Pressure Sensor Operation

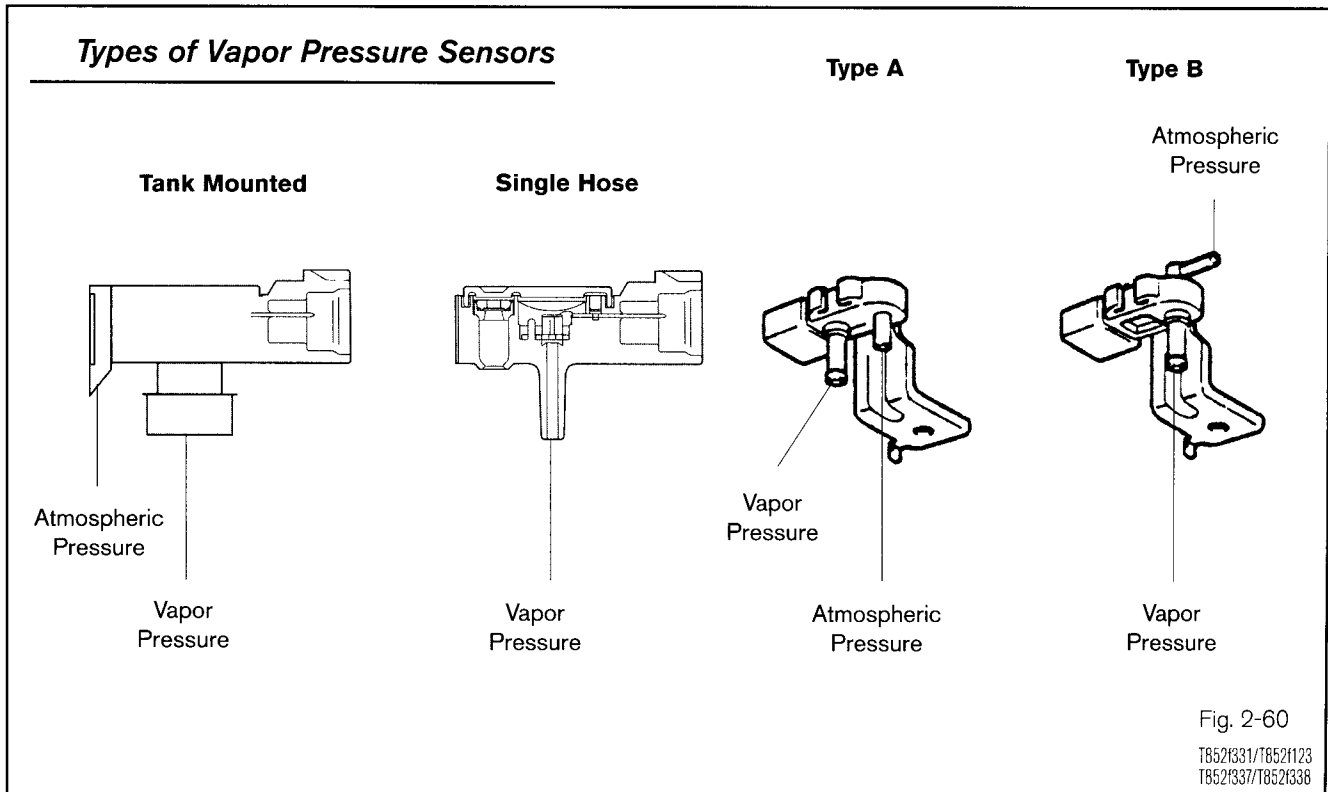
*The pressure inside the reference chamber changes with atmospheric pressure. The reference chamber pressure uses a small flexible diaphragm exposed to atmospheric pressure. This causes the reference pressure to increase with an increase in atmospheric pressure.*

*Using this method allows the vapor pressure reading to be calibrated with atmospheric pressure.*

*The VPS is extremely sensitive to changes in pressure. 1.0 psi = 51.7 mmHg*



This sensor uses a silicon chip with a calibrated reference pressure on one side of the chip, the other side of the chip is exposed to vapor pressure. Changes in vapor pressure cause the chip to flex and vary the voltage signal to the ECM. The voltage signal out depends on the difference between atmospheric pressure and vapor pressure. As vapor pressure increases the voltage signal increases. This sensor is sensitive to very small pressure changes (1.0 psi = 51.7 mmHg).



Vapor pressure sensors come in variety of configurations. When the VPS is mounted directly on the fuel pump assembly, no hoses are required. For remote locations, there may be one or two hoses connected to the VPS. If the VPS uses one hose, the hose is connected to vapor pressure. In the two hose configuration, one hose is connected to vapor pressure, the other hose to atmospheric pressure. It is important that these hoses are connected to the proper port. If they are reversed, DTCs will set.

## VPS

### Electrical Circuit

The ECM receives this voltage signal at the PTNK terminal. This sensor receives 5 volts from the ECM on the VC line. The ground for the sensor is through a ground wire to the ECM (usually terminal E2).

The PTNK signal will be 5 volts if the PTNK wire is disconnected.

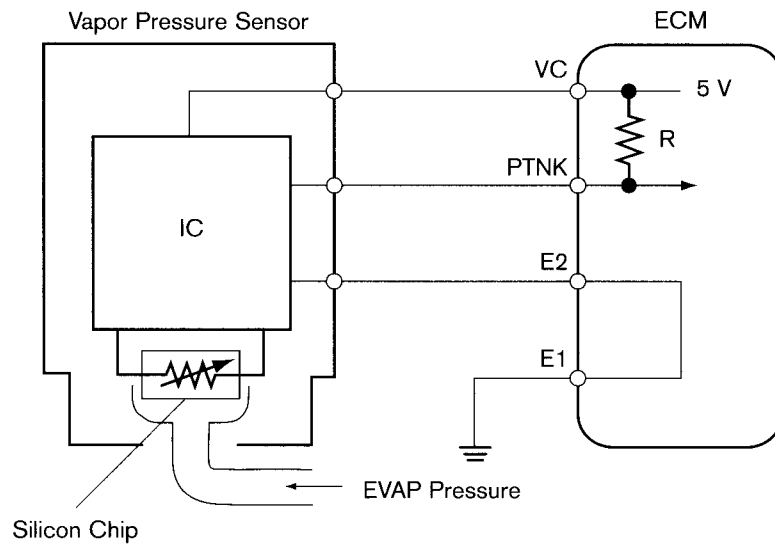


Fig. 2-61

T8524013

### VPS Diagnosis

Check all hoses for proper connection, restrictions, and leaks. Check the VC and E2 voltages. Apply the specified pressure and read sensor voltage output. The vapor pressure sensor is calibrated for the pressures found in the EVAP system, so apply only the specified amount to prevent damaging the sensor.



**ASSIGNMENT**      **NAME:** \_\_\_\_\_

1. List the different types of Pressure Sensors used on cars?
2. Explain in detail the constructions and how a MAP (Manifold Absolute Pressure) sensor works?
3. What type of voltage signal is produced by a MAP and what would you expect to change as the engine goes from idle to W.O.T.?
4. Explain in detail the testing procedure of a MAP sensor.
5. Explain the need for a Barometric Pressure Sensor?
6. Explain the need for a Turbocharging Pressure Sensor and how does this compare to a MAP sensor?
7. Explain the need for a EVAP Vapor Pressure Sensor and how does this compare to a MAP sensor?