

The logo for I-CAR ADVANTAGE Online. It features the text "I-CAR" in a stylized font on the left, followed by "ADVANTAGE" in large, bold, blue letters with a black outline. Below "ADVANTAGE" is the word "Online" in a smaller, white font with a black outline, followed by a trademark symbol (TM). The entire logo is set against a blue background with a white horizontal line above it.

I-CAR[®] ADVANTAGE[™] Online[™]

Technical Information For The Collision Industry

TIRE PRESSURE MONITORING SYSTEMS

The tire pressure monitoring system (TPMS) is a safety feature that is currently being installed in several new model vehicles. These systems will be required to be installed in all U.S. passenger vehicles and small trucks less than 4,500 kg (10,000 lb) built after November 2006 and Canada may adopt a similar regulation in the future. The main purpose of a TPMS is to monitor tire air pressure and warn the driver if pressure in one or more of the tires has fallen below a specific level. This gives the driver enough warning to slow down to a safe driving speed until the tire or tires can be inflated.

REGULATION

Until recently, monitoring tire pressure has been the responsibility of vehicle owners and service technicians. After a number of fatalities involving defective tires, the U.S. Congress passed a new auto safety bill called the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act. Responsibility was delegated to the National Highway Transportation Safety Administration (NHTSA) for developing safety standards, and to adopt a regulation requiring vehicles to be equipped with TPMS. Vehicle makers were given a three year time period, beginning late 2003 through late 2006, to gradually incorporate TPMS into new vehicles.

The regulation is designed to reduce the number of accidents caused by under-inflated tires. Tire pressure in today's vehicles is so important that as little as three psi below the recommended rating may affect braking distance and handling. This is due to the fact that the vehicle weight is not spread out evenly across the full width of the tires and the sidewalls flex, creating a "mushy" steering response. Basically, a tire loses its required rigidity if significantly under-inflated. Blowouts may also occur due to the heat generated by under-inflation. This is especially true if a tire is originally defective.

Although safety is the primary reason for the regulation, there are economic reasons as well. Under-inflated tires reduce fuel mileage, which can account for significant

quantities of wasted fuel each year. Money may also be needlessly spent on tire replacement, due to excessive wear caused by under-inflated tires.

The average tire will lose about one psi of pressure per month, and in some situations even more. Many vehicle owners tend to neglect regularly monitoring tire pressure. NHTSA considered a similar regulation back in the early 70s, but the idea was dismissed because those TPMS were not reliable and considered too costly.

There are disagreements concerning the regulation's minimum activation pressure requirement. As the regulation currently stands, a TPMS warning does not require triggering until a loss of 25 percent below the recommended cold inflation pressure or 20 psi, whichever is higher, is reached. For example, a tire with a recommended cold inflation pressure of 32 psi is allowed to drop 8 psi before warning the driver. The minimum activation pressure issue is currently in debate and may or may not change in the near future. Many believe that in order to keep drivers safe, a warning should engage before the tires become significantly under-inflated.

TPMS DESIGN

A variety of aftermarket TPMS have been available for a number of years. One type is a monitor in the form of a stem cap that changes color according to the tire pressure. This allows the owner to merely look at the wheel stem to be assured of proper tire pressure. Another type, that may also be factory installed, uses transmitting sensors located in each tire. Every few minutes, a signal is sent to a receiver, located near the driver, to assure that the tire pressure is at a safe level or give warning if it is not.

An OEM-designed TPMS may use a transmitter/receiver concept or use the anti-lock brake system (ABS) computer to monitor tire pressure. The type of system that uses the ABS computer is considered the indirect method of monitoring tire pressure. Rather than directly monitoring tire pressure, the ABS measures the rotational speed of each

tire. If one tire starts to spin faster than the others, the ABS determines that a tire has become smaller and has likely lost air pressure (see Figure 1). This is done by measuring tire rotations within a given distance. A tire that has a reduced rotation that meets a predetermined percentage is considered to be low on air pressure.

Some engineers question the effectiveness of indirect monitoring systems. If all tires lose air at the same rate, the computer may not be able to detect a drop in tire pressure because there is no difference in rotational speed. Also, there are several situations that will cause a tire to spin faster, and the TPMS may give frequent false alarms which could eventually lead a driver to ignore the warnings altogether.

The direct type of TPMS can detect actual pressure levels and transmit the information to the driver more quickly. Tires are monitored individually by sensors clamped to a special tire valve (see Figure 2), or strapped to the drop center of each wheel. Each sensor monitors and transmits tire pressure and temperature every few minutes (see Figure 3). Temperature is monitored to compensate for cold and warm pressure variations. To reduce battery consumption, the sensors revert to a "sleep" mode when the vehicle is parked or not moving. During this "sleep mode," sensors may only activate and transmit signals about every 45 minutes.

Both factory-installed direct and indirect monitoring systems are often integrated with other vehicle computer modules, such as the remote keyless entry (for the direct type), or the ABS (for the indirect type). Trouble codes may be diagnosed with the use of a scan tool and service manual flowchart.

AVOIDING DAMAGE AND SERVICE

It is important to know if a vehicle is equipped with a TPMS so as not to damage it while servicing the vehicle. The sensors used with direct monitoring systems

are sensitive electronic parts and caution should be used when demounting and mounting the tires.

To avoid damaging sensors when mounting and demounting tires, it is beneficial to know where the sensors are located. Sensor assemblies are commonly attached to the valve stem, with the valve stem acting as an antenna to assist with transmitting RF signals. They may also be strapped to the drop center of the wheel. If this is the case, the sensor assembly should be located in-line with the valve stem. To avoid damaging sensors when demounting tires, do not break the bead within 45° of either side of sensor assembly locations (see Figure 4). Be careful not to damage sensors when mounting tires as well. Sensors are not repairable and require replacement if damaged or when their battery is completely drained.

It may be necessary to reprogram the TPMS when the tires are rotated, when a new sensor is installed, or after the vehicle loses power. This usually requires a scan tool and may involve the use of a special magnet. Refer to the vehicle service manual to properly reprogram the TPMS.

CONCLUSION

Both aftermarket and factory-installed TPMS are currently being used in many vehicles. The TREAD Act requires that these systems be installed in all passenger vehicles and light trucks built after November of 2006. Technicians must be aware of these systems and know how to properly diagnose, program, and repair damaged systems. To learn about TPMS, and other electronically controlled steering and suspension systems, consider taking the I-CAR training program Electronically Controlled Steering and Suspension Systems (STE05).

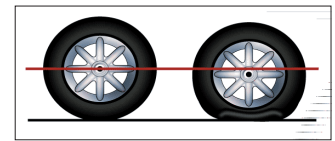


Figure 1—The ABS system may determine that a tire is under-inflated due to a difference in rotational speed.



Figure 2—TPMS sensors may be attached to a special tire valve.

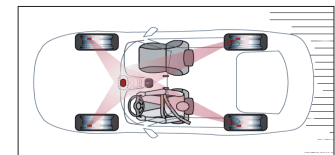


Figure 3—Each sensor transmits information via radio frequency to a receiving module.

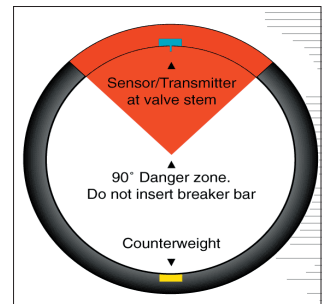


Figure 4—To avoid damaging TPMS sensors when demounting tires, the breaker bar should never be inserted within the 90° danger zone.