

# Automotive Technology 6<sup>th</sup> Edition

## Chapter 114 Tire Pressure Monitoring Systems

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
<b>Motivate Learners</b>	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
<b>State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.</b>	<p>Explain learning objectives to students as listed below:</p> <ol style="list-style-type: none"> <li>1. Explain why a tire-pressure monitoring system (TPMS) is used.</li> <li>2. Discuss the TREAD Act.</li> <li>3. Explain indirect and direct TPMS.</li> <li>4. List the two types of TPMS pressure sensors.</li> <li>5. Discuss TPMS sensor operation and the TPMS receiver.</li> <li>6. Explain direct TPMS diagnosis and TPMS diagnostic tools.</li> <li>7. List replacement options for TPMS sensors.</li> <li>8. Describe how to relearn TPMS sensors and the tools needed to service a TPMS.</li> <li>9. This chapter will help prepare for ASE Suspension and Steering (A4) certification content area "E" (Wheel and Tire Diagnosis and Repair).</li> </ol>
<b>Establish the Mood or Climate</b>	Provide a <b>WELCOME</b> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

**NOTE: Lesson plan is based on 6<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**DOWNLOAD Chapter 114 Chapter Images: From [http://www.jameshalderman.com/automotive\\_principles.html](http://www.jameshalderman.com/automotive_principles.html)**

**NOTE: You can use Chapter Images or possibly Power Point files:**

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### 1. SLIDE 1 CH114 TIRE PRESSURE MONITORING SYSTEMS

Check for **ADDITIONAL VIDEOS & ANIMATIONS**  
@ <http://www.jameshalderman.com/>  
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**Word Search Puzzle (Microsoft Word) (PDF)**

### Videos

2. **SLIDE 2 EXPLAIN** Figure 114-1 tire pressure placard (sticker) on driver's side door or door jamb indicates the specified tire pressure.

### DISCUSSION: discuss possible effects if tires are consistently underinflated

**EXPLAIN TECH TIP: Add 2 to 4 PSI. When servicing tires, it is often not practical to allow time needed for tires to cool after vehicle has been driven. To help compensate for the higher pressures due to higher temperature, add 2 to 4 PSI to cold inflation pressures. • SEE FIGURE 114-2.**

3. **SLIDE 3 EXPLAIN FIGURE 114-2** Inflation pressure increases as the temperature increases. When checking or correcting inflation pressure when the tires are hot, add 2 to 4 PSI to placard cold inflation pressure. Most experts recommend the use of an electronic tire pressure gauge that is accurate to 0.1 PSI so that all tires can be equally matched and inflated to the specified pressure.
4. **SLIDE 4 EXPLAIN FIGURE 114-3** A tire with low inflation will have a shorter distance (radius) between the center of the wheel and the road and will therefore rotate faster than a tire that is properly inflated.
5. **SLIDE 5 EXPLAIN FIGURE 114-4** speeds of diagonally opposed wheels are added together and then

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compared to the other two wheels to check if one tire is rotating faster.

**DISCUSSION:** Have the students discuss why **Indirect TPMS** is appealing to OEMS

**DEMONSTRATION:** Demonstrate wheel speed sensor signals using a scan tool.

**HANDS-ON TASK:** check wheel speed sensor signals with scan tool. Have students spin the tires by hand to see sensor values change.

**DEMONSTRATION:** Show how to determine proper tire pressure by using the information on door placards.

**DISCUSSION:** Ask the students why a pressure drop of less than 25% should be corrected.

**HANDS-ON TASK:** Have the students inflate tires on a vehicle to 75% of recommended pressure

**HANDS-ON TASK:** Have the students compare tire pressure recommendations of several automobiles by using information on door placards.

**DISCUSSION:** Ask the students to discuss why it is important to know how to identify a vehicle with TPMS.

6. SLIDE 6 **EXPLAIN** FIGURE 114-5 indirect tire-pressure monitoring system has a reset switch that should be depressed after rotating or replacing tires.
7. SLIDE 7 **EXPLAIN** FIGURE 114-6 A clear plastic valve-stem tire-pressure monitoring sensor, showing the round battery on the right and the electronic sensor and transistor circuits on the left.

**DISCUSS FREQUENTLY ASKED QUESTION:**  
***How Can an Indirect System Meet the TREAD Act Requirements?*** Some newer vehicles such as 2009 and newer Audis, plus many models of

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**Honda after 2013 and some Mazda models, use active wheel speed sensors to measure slight change in vehicle speed compared to speed in the internal memory of TPMS module. Always check service information for exact procedure to follow when a newer vehicle appears to not be equipped with a tire-pressure monitoring system because of no visible signs of a tire pressure sensor**

**DEMO**



**DEMONSTRATION: Show conventional rubber valve stems and rubber TPMS valve stems.**

8. **SLIDE 8 EXPLAIN FIGURE 114-7** A conventional valve stem is on the right compared with a rubber TPMS sensor stem on the left. Notice tapered and larger brass stem. The rubber TPMS sensor also uses a longer cap that makes it easy for a technician to spot that this is not a conventional rubber valve stem.
9. **SLIDE 9 EXPLAIN FIGURE 114-8** parts of a typical clamp-in TPMS sensor. Notice the small hole used to monitor the inflation pressure. The use of stop leak can easily clog this small hole.
10. **SLIDE 10 EXPLAIN FIGURE 114-9** The three types of TPMS sensors most commonly found include the two stem-mounted rubber (snap-in) and aluminum (clamp-in), left and top, and the banded sensors (right).

**HANDS-ON TASK: Have students locate a TPMS receiver on a vehicle equipped with direct TPMS.**

11. **SLIDE 11 EXPLAIN FIGURE 114-10** Some vehicles display the actual measured tire pressure for each tire on a driver information display.

**DISCUSSION: Ask the students why an overinflated tire is a safety hazard?**

**HANDS-ON TASK: Have the students install a pressure sensor.**



**QUESTION**



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### DISCUSS FREQUENTLY ASKED QUESTION:

***Does a TPMS Sensor Work Before Being Installed? No.*** New tire-pressure warning sensors (transmitters) are shipped in storage mode. This mode prevents the battery from becoming discharged while in storage. When transmitter is installed in a wheel/tire assembly and tire is inflated to more than 14 PSI (97 kPa), transmitter automatically cancels storage mode. Once a transmitter has canceled storage mode, it cannot enter this mode again. Therefore, once a sensor has been installed and the tire inflated above 14 PSI, the clock is ticking on battery life.

### DISCUSS CASE STUDY: TPMS *Warning Lamp*

The owner of a six-year-old Honda Civic was concerned that the tire-pressure warning lamp was on even though all of tires had the proper inflation pressure. The technician noted that TPMS warning lamp was not the one that indicates a low tire, but it was the one that indicates that a fault with system has been detected. • SEE FIGURE 114-11. Technician used a factory-level aftermarket scan tool and retrieved several diagnostic trouble codes for “pressure sensor signal failures.” • SEE FIGURE 114-12. The technician also noted that the tires were relatively new and recommended to the owner that all four TPMS sensors be replaced. The major reason why technician recommended that all of them be replaced is that battery life is normally 7 to 10 years so the life of sensors is near the end of their useful life. Also, technician thought that one or more of the sensors may have been damaged when the new tires were replaced. The vehicle owner approved the replacement

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of sensors and system was restored to normal operation.

### Summary

- **Complaint**—TPMS warning lamp was on.
- **Cause**—Most of tire-pressure warning system sensors had a stored diagnostic trouble code.
- **Correction**—four tire-pressure sensors were replaced and system relearned to new sensors. The codes were cleared and the system was restored to normal operation.

12. **SLIDE 12 EXPLAIN FIGURE 114–11** TPMS warning lamp on this vehicle is a separate light from the tire icon light that warns of low tire pressure. In this case, both warning lights were on all of the time.

13. **SLIDE 13 EXPLAIN FIGURE 114–12** codes set were for low pressure and sensor signal failure.

**EXPLAIN TECH TIP: Check TPMS Sensors Before and After Service.** It is wise to check that all of tire-pressure monitoring system sensors are working before beginning work. This is commonly called “test before you touch.” For example, if tires need to be rotated, sensors will have to be reprogrammed for their new location. If a tire-pressure monitoring sensor is defective, procedure cannot be performed. Use aftermarket or original equipment tire-pressure monitoring sensor tester to check sensors • **SEE FIGURE 114–13.** Then tire-pressure sensors should be checked again after service to make sure that they are working correctly before returning the vehicle to customer.

14. **SLIDE 14 EXPLAIN FIGURE 114–13** A typical tire-pressure monitoring system tester. The unit should be held near the tire and opposite the valve stem if equipped with a wheel-mounted sensor, and near the valve stem if equipped with a valve-stem-type sensor.

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DEMO



DEMO



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**DEMONSTRATION:** Show the students how to use the TPMS scan tool to view the transmitter ID, perform initialization, and monitor sensor values.

**HANDS-ON TASK:** Have the students use the TPMS scan tool to view the transmitter ID, perform initialization, & monitor sensor values.

**DISCUSSION:** Ask the students to discuss why the **delta pressure method** may not be practical for a service technician to use.

**DEMONSTRATION:** Show how to do a **TPMS Relearn** using magnetic tool.

**HANDS-ON TASK:** Have the students perform the relearn procedures on an indirect TPMS.

**HANDS-ON TASK:** Have students how to do a **TPMS Relearn** using magnetic tool

**ON-VEHICLE ASE EDUCATION TASK F10:** Identify indirect and direct tire pressure monitoring system (TPMS); calibrate system; verify operation of instrument panel lamps.

**ON-VEHICLE ASE EDUCATION TASK F11:** Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system (TPMS) including relearn procedure

If the horn does not "chirp," try honking horn using the horn button. It would be a waste of time trying to troubleshoot a TPMS problem only to find a bad horn.

**EXPLAIN TECH TIP:** *Check the Spare.* Many vehicles equipped with a full-size spare tire also have TPMS sensor. If the inflation pressure decreases enough, system will trigger TPMS

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**warning light. This is confusing to many vehicle owners who have checked all 4 tires and found them to be properly inflated. This fault often occurs during cold weather when tire inflation pressure drops due to the temperature change. Most 2008 and newer vehicles with a full-size spare tire will come equipped with a TPMS sensor in spare.**

15. **SLIDE 15 EXPLAIN FIGURE 114–14** A tire-pressure warning light can vary depending on the vehicle, but includes a tire symbol.
16. **SLIDE 16 EXPLAIN FIGURE 114–15** A magnet is placed around the valve stem to reprogram some stem-mounted tire-pressure sensors.
17. **SLIDE 17 EXPLAIN FIGURE 114–16** When replacing a TPMS sensor, be sure to record the sensor ID because this needs to be entered into system through the use of a tester or scan tool

**DISCUSS CASE STUDY: *Acura Dash Display Problem.* Tires were rotated on an Acura equipped with a direct type TPMS. The published relearn procedure included driving vehicle above 15 MPH for at least 40 seconds. However, even after driving for over 10 miles, the pressures were not being displayed on instrument panel cluster (IPC). Technician thought that maybe there was fault with IPC. The owner decided to think it over what to do and drove vehicle home. The next day, when vehicle was driven, tire pressure display worked as designed. Apparently system needed to be powered down and allowed to go to sleep before it would start to transmit new locations to IPC.**

### **Summary**

- **Complaint—tire pressures for each wheel were not being displayed on the dash after the tires were rotated.**



- **Cause—tire-pressure monitoring system apparently needed to go to sleep and then awoken before tire pressure would be displayed on the dash.**
- **Correction—No action was required by the service technician because the system started to transmit after going to sleep, and the display operated as designed.**

**DISCUSS FREQUENTLY ASKED QUESTION:**

***How Does a Vehicle Learn Where the Sensor Is Located?*** Vehicles that are capable of automatically learning their new position after a tires rotation or after being replaced can detect their location by:

- **Some vehicles use an initiator located in each wheel well. TPMS sensor broadcasts the pressure information which is detected by each initiator and then transmitted over a bus network to the TPMS or body control module. The module then will know where sensor is located by its unique serial number.**
- **Include an accelerometer in sensor which allows the sensor to “know” which side of vehicle the sensor is located. When a tire revolves, it turns in an opposite direction than a wheel on the opposite side of the vehicle. By using the accelerometer, the TPMS controller can detect which side sensor is located.**
- **Then TPMS module checks for relative strength of signal being transmitted by sensor. If the receiver is located at the rear of the vehicle, and two sensors are showing stronger signal, then these two must be two rear wheels.**

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**DISCUSSION:** Ask the students to discuss why it is so important to tighten the valve core to the correct torque.

[Tire Pressure Monitor System, TPMS-Failed Sensor \(View\) \(Download\)](#)

[Tire Pressure Monitor System, TPMS \(Normal\) \(View\) \(Download\)](#)

[Tire Pressure Monitor System, TPMS \(With Tire Leak\) \(View\) \(Download\)](#)

### **EXPLAIN TECH TIP: All Sensors Will Fail**

All TPMS pressure sensors will fail because they contain a battery that has a service life of 7 to 10 years. What does this mean to technician? This means that if new tires are being installed on a five or six-year-old vehicle equipped with tire-pressure sensors, then the customer should be notified that the TPMS sensors could fail almost anytime.

18. SLIDE 18 **EXPLAIN** FIGURE 114–17 The sensor relearn procedure is performed in the following order after the system has been placed in learn mode: LF, RF, RR, and then LR..
19. SLIDE 19 **EXPLAIN** FIGURE 114–18 Always use an accurate, known-good tire-pressure gauge. Digital gauges are usually more accurate than mechanical gauges.
20. SLIDE 20 **EXPLAIN** FIGURE 114–19 A clicker-type valve core tool ensures that valve core is tightened to factory specifications
21. SLIDE 21 **EXPLAIN** FIGURE 114–20 An assortment of service parts that include all of the parts needed to service a stem-mounted TPMS sensor being installed after removal for a tire replacement or repair.

### **DISCUSS FREQUENTLY ASKED QUESTION:**

**Can TPMS Sensors Be Switched to New Wheels? Maybe. It depends on the style of new or replacement wheels as to whether sensors will fit or not. Some vehicles are designed to allow for a second set of sensors such as for winter tires. Many Lexus vehicles can be programmed to use set #1 or set #2. It is best to check before purchasing new wheels.**

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Another set of TPMS sensors could be a major added expense.

**HANDS-ON TASK:** Have the students remove and replace a valve core on a TPMS sensor.

**SEARCH INTERNET:** Have students search Internet for The TREAD Act is more than tire pressure monitoring. Have the students search the Internet to find other standards set by the TREAD Act. Have students share their findings in a class discussion.