TPMS – Service Repair Tips and approaching a vehicle with the light on

AMRA MAP - May 2014
Current status of TPMS

- VIO with TPMS – 113K plus
- # of vehicles per shop/day – over half are TPMS equipped
  - Average age of passenger vehicles 11.4 yrs. USA - Polk
- Overview of changes in sensor design/growth of rubber stems/reasons
- Increase of providers – concerns of fit/form/function
- Continued growth of current TPMS market ensures early adopters strong positioning with customers and DIY
- Technology improves, creating more SKU’s – steady growth of a physical sensor in wheel and tire assemblies
- 15 mil VIO/year for next six years-F&S
- Winter Tire conversions
  - 4.6 million winters in Canada 2013 = 30%
  - 4.7 million winters in USA 2013 = 3%
## TPMS Vehicles Produced

<table>
<thead>
<tr>
<th>Year</th>
<th>Light Vehicles Sold</th>
<th>Light Vehicles w/ Direct TPMS</th>
<th>Vehicles w/ Sensors installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>16,390,000*</td>
<td>96%</td>
<td>15,734,400*</td>
</tr>
<tr>
<td>2013</td>
<td>15,582,136</td>
<td>99%</td>
<td>15,426,314</td>
</tr>
<tr>
<td>2012</td>
<td>14,492,398</td>
<td>100%</td>
<td>14,492,398</td>
</tr>
<tr>
<td>2011</td>
<td>12,779,007</td>
<td>100%</td>
<td>12,779,007</td>
</tr>
<tr>
<td>2010</td>
<td>11,589,844</td>
<td>100%</td>
<td>11,589,844</td>
</tr>
<tr>
<td>2009</td>
<td>10,430,969</td>
<td>100%</td>
<td>10,430,969</td>
</tr>
<tr>
<td>2008</td>
<td>13,245,687</td>
<td>100%</td>
<td>13,245,687</td>
</tr>
<tr>
<td>2007</td>
<td>16,154,010</td>
<td>70%</td>
<td>10,607,807</td>
</tr>
<tr>
<td>2006</td>
<td>16,561,482</td>
<td>20%</td>
<td>3,399,437</td>
</tr>
<tr>
<td>2005</td>
<td>16,997,182</td>
<td>20%</td>
<td>3,398,931</td>
</tr>
<tr>
<td>2004</td>
<td>16,913,361</td>
<td>10%</td>
<td>1,691,336</td>
</tr>
<tr>
<td></td>
<td><strong>Estimated No. of vehicles with TPMS</strong></td>
<td></td>
<td><strong>113,607,552</strong>*</td>
</tr>
<tr>
<td></td>
<td><strong>Estimated No. of TPMS sensors in service</strong></td>
<td></td>
<td><strong>454,430,208</strong>*</td>
</tr>
</tbody>
</table>
Based on cumulative vehicles sales with a 5% average scrap rate each year. By year’s end there will be more than 78,000,000 cars on the road with TPMS or 315,000,00 TPMS sensors!

Source – Automotive News
## Current TPMS Types for MY 2014

<table>
<thead>
<tr>
<th>TPMS Type</th>
<th>Description</th>
<th>Qty Of Y/M/Y</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>Three Relearn Types</td>
<td>1133</td>
<td>96%</td>
</tr>
<tr>
<td>Indirect</td>
<td>Indirect systems – typically auto calibrate</td>
<td>42</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td><strong>Total MMY</strong></td>
<td><strong>1175</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**Direct TPMS**

**Indirect TPMS System**
The Three Buckets

• Direct Sensors – year/make/model specific per OEM
• Multi-application Sensors – aftermarket sensors that provide multiple vehicle coverage per sensor
• Programmed Sensors – aftermarket sensors that are programmed as needed to a specific year/make/model
  • Two different types (ID specific and fully programmable)
# UICS Condition - TPMS

**UICS Component Name:** Tire [PRESSURE](#) Monitoring System [SENSOR](#)

<table>
<thead>
<tr>
<th>Condition:</th>
<th>Code</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inoperative&lt;br&gt;<code>Includes intermittent operation</code></td>
<td>A</td>
<td>Require repair or replacement</td>
</tr>
<tr>
<td>Loose</td>
<td>B</td>
<td>Require repair or replacement</td>
</tr>
<tr>
<td>Missing (Non-OE Wheel and/or Tire Applications)</td>
<td>2</td>
<td>Suggest replacement if appropriate <a href="#">SENSOR</a> is available</td>
</tr>
<tr>
<td>Missing (OE Wheel and Tire Applications)</td>
<td>C</td>
<td>Require replacement</td>
</tr>
<tr>
<td>Not Responding&lt;br&gt;<code>If [SENSOR](#) does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause</code></td>
<td></td>
<td>Further inspection required</td>
</tr>
<tr>
<td>TPMS <a href="#">SENSOR</a> NOT removed during tire/wheel service&lt;br&gt;<code>Tire/wheel service is defined as when tire is removed from the wheel</code></td>
<td>1</td>
<td>Suggest replacement of Service Kit</td>
</tr>
<tr>
<td>TPMS <a href="#">SENSOR</a> removed during tire/wheel service&lt;br&gt;<code>Tire/wheel service is defined as when tire is removed from the wheel</code></td>
<td>A</td>
<td>Require replacement of Service Kit</td>
</tr>
</tbody>
</table>
The Service Process

• First step – Inspection and Testing [TBYT]
• Second step – Replace, and Repair
• Third step – Relearn the vehicle
Test Before You Touch

- Check for sensor function
- Check for low battery condition
- Confirm proper sensor installed
- Confirm sensor is in proper mode
- Check physical condition and for damage
- Check for TPMS Trouble Codes [DTC’s]
## The Risk if You Skip TBYT

<table>
<thead>
<tr>
<th>Skip The Test</th>
<th>The Result</th>
<th>The Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check sensor function</td>
<td>Miss that one or more sensors have a flat battery</td>
<td>Flashing light after customer leaves</td>
</tr>
<tr>
<td>Check for low battery condition</td>
<td>Miss that a low battery condition is present in one or more sensors</td>
<td>Flashing light after customer leaves</td>
</tr>
<tr>
<td>Confirm proper sensor application</td>
<td>Miss that an incorrect sensor was installed</td>
<td>Flashing light after customer leaves</td>
</tr>
<tr>
<td>Confirm proper mode</td>
<td>Miss that a sensor is in the wrong mode</td>
<td>Flashing light after customer leaves</td>
</tr>
</tbody>
</table>

*By not performing this, you are possibly inheriting someone else's mistakes or non-functioning systems.*
What does Relearn really mean?
The Direct TPMS Relearn:

• The process of registering or writing a sensor ID [or ID’s] into the proper Body Control Module [BCM].
• Three distinct methods
• TPMS tools are typically required
• Always required when a NEW sensor ID is installed onto a wheel
• Most cases, the relearn clears active DTC’s
• Establishes a baseline for future service
TPMS Relearn Breakdown
[based on 2013 sales]

Stationary - 35%
Or “On-Board.” Use a activation tool with the car in “re-learn” mode. New ID’s can be programmed without driving the vehicle.

OBD - 27%
An activation tool in conjunction with a scan tool is required to program new sensor ID’s into the vehicle. New ID’s can be programmed without driving the vehicle.

Auto, 38%
Vehicle can learn a single new ID and in some cases multiple new ID’s without the use of a tool. Requires driving the car in order to turn off the light.

Auto learn 38%
TPMS Relearns by model 
[based on 2013 unit sales]

<table>
<thead>
<tr>
<th>TPMS Relearn Methods by Model</th>
<th>Ford F-150</th>
<th>Chevrolet Silverado</th>
<th>Toyota Camry</th>
<th>Honda Accord</th>
<th>Ram Pickup</th>
<th>Honda Civic</th>
<th>Nissan Altima</th>
<th>Honda CR-V</th>
<th>Toyota Corolla</th>
<th>Ford Escape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBDII</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

| Top 20 Cars & Trucks         |            |                     |              |              |            |            |               |            |                 |            |

- Ford Fusion
- Chevrolet Cruze
- Hyundai Elantra
- Chevrolet Equinox
- Ford Focus
- Toyota Prius
- Toyota Rav4
- Hyundai Sonata
- Chevrolet Malibu
- GMC Sierra
Print the Report

Tool/Vehicle Info
Always helpful when reaching out for tech support!

DTC’s
Know the respective fault codes and make the right call on what to repair.

Sensor & Vehicle Data
Know sensor state, position while validating function.

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<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1501</td>
<td>Tire #1 Sensor Transmission Failure</td>
<td>Current</td>
</tr>
<tr>
<td>C1502</td>
<td>Tire #2 Sensor Transmission Failure</td>
<td>Current</td>
</tr>
<tr>
<td>C1503</td>
<td>Tire #3 Sensor Transmission Failure</td>
<td>Current</td>
</tr>
<tr>
<td>C1504</td>
<td>Tire #4 Sensor Transmission Failure</td>
<td>Current</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Tool:</th>
<th>Tech400SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version:</td>
<td>51.0</td>
</tr>
<tr>
<td>SerialNumber:</td>
<td>732111</td>
</tr>
<tr>
<td>Make:</td>
<td>Chrysler</td>
</tr>
<tr>
<td>Model:</td>
<td>300</td>
</tr>
<tr>
<td>Year:</td>
<td>2010</td>
</tr>
<tr>
<td>VIN:</td>
<td>2C3CA5CVXAH112515</td>
</tr>
<tr>
<td>Qualifier:</td>
<td>000006C</td>
</tr>
<tr>
<td>State:</td>
<td>TBYT</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Wheel</th>
<th>OEM ID</th>
<th>Sensor</th>
<th>Type</th>
<th>Needs</th>
<th>ID (Hex)</th>
<th>ID (Dec)</th>
<th>Mode</th>
<th>Battery</th>
<th>PS</th>
<th>Temp. (°F)</th>
<th>OEM #</th>
<th>Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>617A05</td>
<td>Same</td>
<td>Schr</td>
<td>1</td>
<td>617A05</td>
<td>6306315</td>
<td>Learn</td>
<td>Pass</td>
<td>37.5</td>
<td>97</td>
<td>5002531658</td>
<td>No</td>
</tr>
<tr>
<td>RR</td>
<td>6161F</td>
<td>Same</td>
<td>Schr</td>
<td>1</td>
<td>6161F</td>
<td>6381965</td>
<td>Learn</td>
<td>Pass</td>
<td>31.4</td>
<td>97</td>
<td>5002531658</td>
<td>No</td>
</tr>
<tr>
<td>LR</td>
<td>613A5A</td>
<td>Same</td>
<td>Schr</td>
<td>1</td>
<td>617A6A</td>
<td>6388330</td>
<td>Learn</td>
<td>Pass</td>
<td>32.8</td>
<td>69</td>
<td>5002531658</td>
<td>No</td>
</tr>
</tbody>
</table>

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Test Performed By: Jimmy Cross
Owners Name: John McClane
License Plate Number: RYX 763
Mileage: 00000
Model and Year: 2010
Comments:
When to perform a relearn

- After a new sensor installation
- After a tire rotation
- After season wheel/tire changeover
Common Relearn Problems

Stationary Relearns –
• Missing Key Fob
• Difficulty getting into learn mode

OBD Relearns –
• Vehicle in a “loop condition”
• No vehicle coverage or comms has changed

Auto [Drive]Relearns –
• Long relearn period [drive long enough]
• Customer may leave with the light flashing
Common Solutions

Stationary Relearns –
• Use OBD Method whenever possible
• Have good information like a TIA Chart

OBD Relearns –
• Have proper tooling to reset loop condition
• Keep your TPMS Tool up to date

Auto [Drive]Relearns –
• Use OBD Method whenever possible
• Make sure sensors “drive in” before delivering to customer
Let’s review a few problem scenarios
1. Sensor valve stem does not fit in wheel hole
# 1. Sensor valve stem does not fit in wheel hole

## How it could occur

- Not properly qualifying customer’s application with your parts/service
- Not stocking basic TPMS parts
- Mixing data sets that are different brands
- Sourcing wheels from a non-reputable source
- Installing customer supplied wheels

## Prevention tips

- Pick one program and train to it — have an external go to plan to eliminate the guessing or “drive it, it will go out” attitude
- Basic stock plan as recommended by manufacturer/program provider
- Simplicity and consistency win
- Training module on banded applications and alternatives
- Consider placing note on work order so technician has a heads-up
- Scan tire with tool to locate location
Universal adapters and alternative approaches

- Mixing sensors/replacing kits next time around
- Plugs for aftermarket wheels
- Banded connectors
- Mitsubishi vehicles
- Know - before you go
2. Changing size/load/inflation
2. Changing size/load/inflation

**How it could occur**
- Installing a wheel package that the customer brought in (lack of source knowledge)
- Conversion to flotation/off-road designs
- Consumer is asking for a look – “I only trailer it to car shows”
- Typical SUV with load E’s and converting lower
- Older SUV with P-metric and converting to LT due to increase of load – not understanding tongue weight accurately

**Prevention tips**
- Using proper components; i.e. HP stems on performance vehicles
- How to measure this or who to call when in your bay
- Approach/process to changing air pressure
- Free online tools; i.e. load inflation tables (lean on tire manufacturers)
- Consumer awareness and clearly documented practices
3. Breaking stems/sensors/kits
Why inspection is so important

TPMS must be part of the Mounting/balancing category

<table>
<thead>
<tr>
<th>Service</th>
<th>No. of jobs</th>
<th>Avg. ticket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioning</td>
<td>18</td>
<td>$353.55</td>
</tr>
<tr>
<td>Alignment</td>
<td>67</td>
<td>$80.45</td>
</tr>
<tr>
<td>Batteries/electrical</td>
<td>28</td>
<td>$134.28</td>
</tr>
<tr>
<td>Bearings/seals</td>
<td>12</td>
<td>$242.96</td>
</tr>
<tr>
<td>Brakes</td>
<td>45</td>
<td>$244.58</td>
</tr>
<tr>
<td>Chassis/suspension</td>
<td>23</td>
<td>$309.33</td>
</tr>
<tr>
<td>Cooling systems</td>
<td>19</td>
<td>$151.37</td>
</tr>
<tr>
<td>Engine diagnostics</td>
<td>23</td>
<td>$123.77</td>
</tr>
<tr>
<td>Exhaust systems</td>
<td>9</td>
<td>$246.30</td>
</tr>
<tr>
<td>Mounting/balancing</td>
<td>250</td>
<td>$53.79</td>
</tr>
<tr>
<td>Oil/lubrication</td>
<td>135</td>
<td>$37.51</td>
</tr>
<tr>
<td>Shocks/struts</td>
<td>11</td>
<td>$360.78</td>
</tr>
<tr>
<td>TPMS</td>
<td>21</td>
<td>$85.88</td>
</tr>
</tbody>
</table>

Source: MTD 2012 Tire Dealer Automotive Service Survey.
Once galvanic corrosion starts, functionality will never be the same until complete stem replacement is conducted where applicable.
3. Breaking stems and sensors

How it could occur
• Not identifying stem replacements where corrosion has started
• TPMS is not part of your inspection process
• Using knock-off parts that may look the same but lack in function
• Over tightening

Prevention tips
• Provide your technicians resources to review in backshop for easy access and reinforcement of inspection
• Ensure torque tools are accurate
• Incorporate TPMS interaction/updates when summarizing car status
• Using extra force in TPMS always loses
• When corrosion is identified on a two-piece Service Kit, replace stem too
Temporary fixes increase your Risk and Exposure

Do not alter valve stems that are critical in the safety and functionality of the customers wheels/tires and TPMS.

- Instead replace the component(s) with new OEM specified parts

Inflating tires with any form of liquid or gel will plug the TPM sensor port hole and create an inoperative system.

Be sure to warn customer before you start servicing the tire(s)
Valve stem conversion

• Mixing rubber stems with aluminum stems is acceptable however:
  – Know torque values for each
  – Service Kits need to be replaced at same time when replacing all four tires
  – Inform customer of appearance/aesthetics before

• Replacing metal stems on HP applications should be with a product that is certified to the high pressure values for the application
2014 Ram Dually

- Auto-learn Type System
- Three Unique sensor types
- Three vehicle configurations

OE# 68157568AA

OE# 68157575AA

OE# 68157572AA
2014 Ram Dually

Non-dually
Alloy or Steel Wheel
4- Snap-fit TRW sensor
OE# 68157568AA

Dually Alloy Wheels
Front and Rear Outer Clamp-in TRW sensor
OE# 68157572AA
Rear Inner
OE# 68157575AA

Dually Steel Wheels
Front and Rear Outer Clamp-in TRW sensor
OE# 68157568AA
Rear Inner
OE# 68157575AA
Service Kit replacement – industry support

“The grommet (and washer) can and should be replaced if the sensor is removed from the wheel. The rubber grommet provides the air seal inside the valve stem opening, and a new one should be used to ensure a fresh seal after every service.”
GM Service Information ID# 2257327, March 9, 2009 (updated 2010). #07-03-16-004B: TPM System Overview, Diagnosing TPMS Concerns, and TPM FAQ’s.


“Before reinstalling an existing TPM sensor, replace seal and metal washer at base of valve stem. The nut and valve core must also be replaced to ensure proper sealing.” Mopar Instruction Sheet K6855511 TPM Sensor Replacement, January 13, 2006. DaimlerChrysler Motors Company LLC.

“When new tires are installed, it is recommended to also replace all components included in the valve replacement kit.” Tire Information Service Bulletin, Volume 40, Number 2, Rubber Manufacturers Association, 2010.
Thank you for the opportunity

-your Tire and Wheel Team