Tire Pressure Monitoring Systems Test

1 Scope

Note: Nothing in this standard supersedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To define the tests that will determine if a vehicle meets the performance requirements of Federal Motor Vehicle Safety Standard 138 (FMVSS 138), Final Rule.

1.2 Foreword. This standard covers the test requirements and all design requirements of FMVSS 138 for Tire Pressure Monitoring Systems (TPMS) except:

S4.3.1 (a) and (b) and S4.4 (b) (1) and (2) which will be covered as part of GMW15924 (FMVSS 101 test procedure).

S4.5 which will be covered as part of the normal Owner's Manual review process.

All components involved must have the latest production intent released level software and production intent calibrations.

1.3 Applicability. This procedure applies to US passenger cars, multipurpose passenger vehicles, trucks, and busses that have a gross vehicle weight rating (GVWR) of 4536 kg (10 000 lb) or less, except those vehicles with dual wheels on an axle.

1.3.1 Legal Requirements. The FMVSS 138 requirements are found in the GM Global Legal Database, maintained by the GM North America Product Development (NAPD) Safety Regulations and Consumer Information department. The GM Global Legal Database contains the most recent statement of FMVSS requirements and supersedes those listed in any test procedure. Guidance for interpreting FMVSS requirements may be obtained from Safety Regulations and Consumer Information.

1.3.2 Uniform Parts Code (UPC). UPCs comprehended in this procedure include 10B, 12F, 12J.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

FMVSS 101 FMVSS 138
FMVSS 110

2.2 GM Standards/Specifications.

GMW15924

2.3 Additional References.

- GM Global Legal Database. Guidance for interpreting FMVSS requirements should be obtained from the GMNA Safety Integration, Safety Regulations and Consumer Information department.
- TPMS Reset procedure
- TPMS Sensor learn procedure
- Tire pressure placard
- Vehicle Owner's Manual

3 Resources

3.1 Facilities. A test track capable of running constant speeds for extended periods of time with several curves and safe stopping areas for changing tire pressures (i.e., Milford Proving Ground (MPG) Oval Test Track). The National Highway Traffic and Safety Administration (NHTSA) will use the "Southern Loop" of the Treadwear Test Course in San Angelo, Texas. This course is also used for uniform tire quality grading (UTQG) testing.

3.2 Equipment. Complete the Instrument Calibration Data Sheet in Appendix B.

3.2.1 Stopwatch with graduated increments of 1 s and an accuracy of at least 0.5 s.

3.2.2 Tire pressure gauge with an operating pressure of 0 to 700 kPa and graduated increments of 1 kPa and an accuracy of ± 0.5% of applied pressure.

3.2.3 Temperature gauge to measure ambient temperatures of 0 to 55 °C (32 to 131 °F) with an

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accuracy of ± 0.1% + 0.7 °C (1.3 °F) and a scale graduation of 1° (Fluke 50 Series II or equivalent).

3.2.4 TPMS sensor reprogramming tool (J 46079 Kent-Moore or equivalent).

3.2.5 Portable air supply (air bottle or compressor).

3.2.6 Portable tire shade (Recreational Vehicle (RV) vinyl tire guards or equivalent).

3.2.7 Ballast to simulate passenger, cargo, etc.

3.2.8 Platform scales to measure individual wheel, axle, and vehicle loads. Scale shall have a maximum graduation of 0.5 kg (1 lb) and have an accuracy of ± 1% of the measured reading.

3.3 Test Vehicle/Test Piece. Test vehicle equipped with the TPMS to be tested. The test vehicle should be selected as being representative of the group of vehicles whose compliance to FMVSS 138 is being demonstrated and should have at least 100 km (62 mi) of accumulated mileage.

Representative set(s) of wheels and tires (excluding spare) provided by the test engineer and equipped with the appropriate hardware for testing.

3.4 Test Time. Depends on number of scenarios tested. Up to 30 possible per tire/wheel set.

Calendar time:	Up to 15 days
Test hours:	3 hours per scenario for each tire/wheel set
Coordination hours:	8 hours

3.5 Test Required Information.

3.5.1 TPMS Reset Procedure, if applicable. This can be found in the vehicle Owner's Manual.

3.5.2 TPMS Sensor Learn Procedure, if applicable. This can be found in the vehicle Owner's Manual.

3.5.3 Tire placard pressure. This information must be approved by the Tire-Wheel Design Release Engineer (DRE). All test data should be exclusively in metric units – kilopascal (kPa).

3.5.4 Ballast conditions to be tested from the requesting engineer (see Appendix A). NHTSA tests vehicles at both lightly loaded vehicle weight (LLVW) and GVWR without exceeding any of its gross axle weight ratings.

3.5.5 Tire type(s). See Table 1 in 4.2.2.4.

3.5.6 Low tire pressure scenarios to be tested from the requesting engineer (see Appendix A). NHTSA tests two scenarios with one tire low, one scenario with two tires low, one scenario with three tires low and one scenario with all four tires low.

3.5.7 Simulated TPMS malfunctions to be tested. Some examples are listed in Appendix A. Describe on Test Information data sheet in Appendix B.

3.5.8 Procedure to restore the TPMS to normal operation (from the malfunctions in 3.5.7). The test engineer must use the procedure found in the vehicle Owner's Manual or obtain the procedure intended for the Owner's Manual from the requesting engineer.

3.6 Personnel/Skills. The test engineer shall have a good understanding of how the TPMS works as well as what modules are involved in the functioning of the system.

The test technician shall have access to a test track as defined in paragraph 3.1. No other special training is necessary.

4 Procedure

4.1 Preparation. Following vehicle procurement, assemble a Test Readiness Team (TRT) with the following members; Validation Engineer (VE), Vehicle System Engineer (VSE), Design Release Engineers (DRE) of each test component (including Tire Pressure Monitoring (TPM) sensors, TPM receiver, cluster/displays, tires/wheels), Vehicle Software Integration Engineer (VSIE) and Assembly Verification Software Engineer/Dynamic Vehicle Testing (AVSE/DVT). This team will determine the proper component hardware, software and calibration configurations required for test, and verify that the test components are production intent per the appropriate tracking system (i.e., Calibration Development System (Cal-DS), GM Electronic Controller (GMEC), Global Data File Release System (GDFRS)). The test engineer/test technician shall perform the following:

4.1.1 Obtain TRT approval on vehicle configuration levels and complete the Test Information Data Sheet. Explain any additional readiness steps taken to complete vehicle update. Approvals can be signed documentation or hard copy of email approvals from each TRT design release engineer (DRE) for their component (including the placard pressure to be used) attached to the Engineering Test Report.

4.1.2 Mount the set of wheels and tires to be tested.

4.1.3 For a direct TPMS, perform the sensor learn procedure.

4.1.4 Ballast the vehicle to the desired test weight condition (i.e., LLVW). The vehicle may be tested

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at any weight between LLVW +50/-0 kg, (+110/-0 lb) and GVWR +0/-50 kg, (+0/-110 lb) without exceeding any of its gross axle weight ratings (GAWR).

4.1.5 Inflate the vehicle's tires to the placard pressure. If needed, the portable air supply used must also be at the ambient temperature.

4.2 Conditions.

4.2.1 Environmental Conditions. This procedure can be performed on any road condition and temperature. It is recommended to be performed on a dry roadway from 0 °C (32 °F) to 40 °C (104 °F) ambient air temperature.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 The following will be conducted at speeds between 50 km/h (31 mph) and 100 km/h (62 mph). Do not engage cruise control during testing. Start timing when the vehicle speed exceeds 50 km/h (31 mph). Test time does not accumulate during service brake application or when vehicle speeds are outside the specified range.

4.2.2.2 When parked, the vehicle's tires are to be shaded from direct sunlight. Use tire shades if necessary.

4.2.2.3 The test tire pressure is defined as the highest of 25% below the placard pressure OR the Minimum Activation Pressure (MAP) from Table 1, and adding 7 kPa. In equation form:

Test Pressure = (placard × 0.75) + 7 kPa

OR

Test Pressure = MAP + 7 kPa

4.2.2.4 If necessary, round the test pressure up to the next whole number, in kilopascal (kPa), and record on the Test Information Data Sheet.

Table 1: Minimum Activation Pressure (MAP)

Tire Type	MAP
P Metric Standard	140 kPa
P Metric Extra Load	160 kPa
Load Range C	200 kPa
Load Range D	240 kPa
Load Range E	240 kPa

4.3 Instructions. Perform the following for each low tire pressure scenario (see Appendix A), tire/wheel combination and ballast condition specified by the test engineer. At least one scenario must be performed at the GVWR ballast condition. Record the test weight on the Detection Data Sheet in Appendix B.

4.3.1 Test Procedure Telltale Test.

4.3.1.1 Determine whether the vehicle is equipped with a dedicated TPMS Malfunction indicator or a combination Low Tire Pressure Warning (LTPW)/Malfunction telltale. Record on the Test Information Data Sheet (data sheets in Appendix B). The symbol, color and visibility requirements shall be tested as part of GMW15924 (FMVSS 101).

4.3.1.2 With the vehicle stationary, and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "On" or "Run" position, disengaging any starter interlock.

4.3.1.3 Verify that the LTPW telltale and the TPMS Malfunction telltale (if not combination) illuminate for a bulb check and then extinguish. Record this and the time the telltales remain illuminated on the Telltale Test Data Sheet.

4.3.2 Test Procedure Detection Test. Perform steps without delay, except as specified.

4.3.2.1 Measure and record the vehicle weight for the condition being tested. Record this on the Detection Test Data Sheet.

4.3.2.2 Drive the vehicle to the test track and if necessary, soak at the ambient temperature for at least 1 hour with the engine off.

4.3.2.3 Inflate each tire to the placard pressure.

4.3.2.4 For a direct TPMS, verify that the sensor learn has been completed. For an indirect TPMS, reset the system in accordance with the instructions specified in the vehicle Owner's Manual or from the test engineer.

4.3.2.5 Start and drive the vehicle for 20 minutes. Observe the conditions in 4.2.2.1.

4.3.2.6 Bring vehicle to a complete stop at an appropriate stop location and shut vehicle off.

4.3.2.7 Deflate the tire (or combination of tires) to be tested to the test pressure. Recheck the pressure after 1 minute and adjust as necessary.

4.3.2.8 Within 5 minutes of reducing the tire pressure, restart vehicle and verify whether the LTPW telltale has illuminated. If so, record this on the Detection Test Data Sheet and continue with 4.3.2.10. If not, continue with 4.3.2.9.

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4.3.2.9 Drive the vehicle until the LTPW telltale illuminates or 20 minutes has expired. Observe the conditions in 4.2.2.1. Record this on the Detection Test Data Sheet.

4.3.2.10 With the LTPW telltale illuminated, stop the vehicle and deactivate the ignition locking system to the “Off” or “Lock” position.

4.3.2.11 After 5 minutes, activate the ignition locking system to the “On” or “Run” position. Verify the LTPW telltale illuminates and stays illuminated. Record this on the Detection Test Data Sheet.

4.3.2.12 Deactivate the ignition locking system, reactivate the ignition locking system and start the vehicle engine. Verify that the LTPW telltale illuminates and stays illuminated. Record this on the Detection Test Data Sheet.

4.3.2.13 Deactivate the ignition locking system and keep the vehicle stationary with the engine off for up to 1 hour or until the tire pressures return to within 7 kPa of their original set pressure, whichever occurs first. Observe the conditions in 4.2.2.2.

4.3.2.14 Activate the ignition locking system and start the vehicle engine. Verify the LTPW telltale illuminates and stays illuminated. Record this on the Detection Test Data Sheet.

4.3.2.15 Inflate all the tires to the placard pressure using the portable supply (if needed) at ambient temperature. Recheck pressures after 1 minute and adjust as necessary.

4.3.2.16 If applicable, reset the TPMS system.

4.3.2.17 Verify that the LTPW telltale extinguishes. If necessary, drive the vehicle until the telltale extinguishes. Observe the conditions in 4.2.2.1. Record this on the Detection Test Data Sheet.

4.3.2.18 If continuing to a new scenario, continue with 4.3.2.5.

4.3.3 Test Procedure Malfunction Test.

4.3.3.1 With the vehicle off, deflate the left front tire as described in 4.3.2.7.

4.3.3.2 Simulate a TPMS sensor failure as described on the Test Information data sheet in Appendix B.

4.3.3.3 Start the vehicle and verify whether the TPMS Malfunction telltale illuminates (or the Combination telltale flashes for 60 to 90 s) and remains illuminated. If so, record this on the Telltale Test - Malfunction Data Sheet and continue with 4.3.3.5. Also record whether the Low Tire Pressure Warning illuminated first and if so, whether the TPMS Malfunction Warning took precedence over the Low Tire Pressure Warning. If not, continue with 4.3.3.4.

4.3.3.4 Drive the vehicle until the TPMS Malfunction telltale illuminates (or Combination telltale flashes for 60 to 90 s and remains illuminated) or 20 minutes has expired. Observe the conditions in 4.2.2.1. Record this on the Telltale Test - Malfunction Data Sheet. Also record whether the Low Tire Pressure Warning illuminated first and if so, whether the TPMS Malfunction Warning took precedence over the Low Tire Pressure Warning.

4.3.3.5 With the TPMS Malfunction (or Combination) telltale illuminated, stop the vehicle and deactivate the ignition locking system to the “Off” or “Lock” position.

4.3.3.6 After 5 minutes, activate the ignition locking system to the “On” or “Run” position. Verify the TPMS Malfunction telltale illuminates (or Combination telltale flashes for 60 to 90 s) and remains illuminated. Verify for at least 60 s that the combination telltale remains illuminated. Record this on the Telltale Test - Malfunction Data Sheet.

4.3.3.7 Deactivate the ignition locking system, reactivate the ignition locking system and start the vehicle engine. Verify that the TPMS Malfunction telltale illuminates (or Combination telltale flashes for 60 to 90 s) and remains illuminated. Record this on the Telltale Test – Malfunction Data Sheet.

4.3.3.8 Deactivate the ignition locking system and restore the TPMS to normal operation as described on the Test Information data sheet in Appendix B.

4.3.3.9 Start the vehicle and verify that the TPMS Malfunction (or Combination) telltale extinguishes. If necessary, drive the vehicle until the telltale extinguishes. Observe the conditions in 4.2.2.1. Record this on the Telltale Test - Malfunction Data Sheet. Record the time necessary for the telltale to extinguish.

4.3.3.10 Deactivate the vehicle ignition locking system to the “Lock” or “Off” position.

4.3.3.11 Simulate a TPMS control module failure as described on the Test Information data sheet in Appendix B.

4.3.3.12 Repeat 4.3.3.3 through 4.3.3.10 for this new simulated malfunction.

4.3.3.13 Repeat 4.3.3.3 through 4.3.3.10 for any other simulated malfunction(s) requested by the test engineer. Describe on the Test Information data sheet in Appendix B.

4.3.3.14 Inflate the left front tire to the placard pressure.

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