



Tire Pressure Monitoring Systems Test Procedure (UN R 64.02)

1 Introduction

Note: Nothing in this standard supercedes 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 the United Nations (UN) UN R 64.02, Suppl. 2, Final Rule, Section 5.3 and Annex 5.

1.2 Applicability. This Test Procedure applies to any EU vehicle of categories M1 and N1, in both cases with all axles equipped with single tires and fitted with a tire pressure monitoring system.

1.3 Remarks. This standard covers the test requirements and all design requirements of UN R 64.02 (E/ECE/TRANS/505/Rev.1/Add.63/Rev.1/Amend.2) for Tire Pressure Monitoring Systems (TPMS) except Annex 4, which covers Run-Flat Warning Systems (RFWS) (required for vehicles equipped exclusively with run-flat tires). All components involved must have the latest production intent released level software and production intent calibrations.

2 References

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

2.1 External Standards/Specifications.

UN R 64.02 UN R121.01

2.2 GM Standards/Specifications.

GMW15924 (ID)

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

- Tire Pressure Monitoring System (TPMS) learn procedure or Deflation Detection System+ (DDS+) learn procedure
- Vehicle Placard Pressure or Tire Inflation Pressure Label
- Vehicle Owner's Manual

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 A test track capable of running constant speeds for extended periods with several curves and safe stopping areas for changing tire pressures, i.e., Dudenhofen Test Center.

3.2 Equipment.

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

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3.2.2 Tire Pressure Gauge. Tire pressure gauge with an operating pressure of (0 to 500) kPa and graduated increments of 1 kPa and an accuracy of at least ± 3 kPa.

3.2.3 Temperature Gauge. Temperature gauge to measure ambient temperatures of (0 to +50) °C ((32 to 131) °F) with an accuracy of $\pm 0.1\% + 0.7$ °C (1.3 °F) and a scale graduation of 1° (Fluke 50 Series II or equivalent).

3.2.4 Activation Tool. Only for manual learning of direct tire pressure monitoring system: TPMS sensor reprogramming tool (J 46079 Kent-Moore or equivalent).

3.2.5 Portable Air Supply. Portable air supply (air bottle or compressor).

3.3 Test Vehicle/Test Piece. Test vehicle equipped with the TPMS/DDS to be tested. The test vehicle should be selected as being representative of the group of vehicles whose compliance to UN R 64.02 is being demonstrated and should have ≥ 100 km (62 miles) of accumulated mileage.

3.4 Test Time.

Calendar time: 5 days

Test time: 1 h per scenario for each tire/wheel set

Coordination time: 8 h

3.5 Test Required Information.

3.5.1 TPMS Sensor Learn Procedure. TPMS sensor learn procedure if applicable. This can be found in the vehicle Owner's Manual.

3.5.2 Placard Pressure. The Tire-Wheel Design Release Engineer (DRE) shall approve this information. All test data should be exclusively in metric units (kPa).

3.5.3 Ballast Conditions. Ballast condition to be tested from the requesting engineer (see Appendix A). In compliance to UN R 64.02 the vehicle may be tested at any condition of load, the distribution of the mass among the axles being that stated by the vehicle manufacturer without exceeding any of the maximum permissible mass for each axle.

However, in the case where there is no possibility to set or reset the system shall be unladen. There may be, in addition to the driver, a second person on the front seat who is responsible for noting the results of the tests. The load condition shall not be modified during the test.

3.5.4 Low Tire Pressure Scenarios. Low tire pressure scenarios to test from the requesting engineer (see Appendix A). UN R 64.02 specifies to test one scenario with one tire low and one scenario with all four tires low.

3.5.5 Simulated TPM Malfunctions to be tested. Some examples are listed in Appendix A. Describe on Test Information data sheet in Appendix B.

3.5.6 Procedures to Restore the TPMS to Normal Operation. 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 to restore the TPMS to normal operation.

3.6 Personnel/Skills. The test engineer shall have a good understanding of how the TPMS/DDS+ 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 required.

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:

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4.1.1 Vehicle Software Update. 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.

4.2 Conditions.

4.2.1 Environmental Conditions. Dry roadway at an ambient air temperature in a range from (0 to +40) °C ((32 to 104) °F).

4.2.1.1 Road Test Surface. The road shall have a surface affording good adhesion. The road surface shall be dry during testing.

4.2.1.2 Radio Interferences. The tests shall be conducted in an environment free of interferences from radio wave.

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 Vehicle Conditions.

4.2.2.1.1 Test Weight. Ballast the vehicle to the desired test weight condition, i.e., LLVW. The vehicle shall be tested at any condition of load, the distribution of the mass among the axles being that stated by the vehicle manufacturer without exceeding any of the maximum permissible mass for each axle.

However, in the case where there is no possibility to set or reset the system, the vehicle shall be unladen. There may be, in addition to the driver, a second person on the front seat who is responsible for noting the results of the tests. The load condition shall not be modified during the test.

4.2.2.1.2 Vehicle Speed. The TPMS/DDS shall be calibrated and tested:

- In a speed range of (40 to 120) km/h ((25 to 75) mph) or the vehicle's maximum designed speed if < 120 km/h for the puncture test.
- In a speed range of (40 to 100) km/h ((25 to 62) mph) for the diffusion test.

The whole speed range shall be covered during the test.

Do not engage cruise control during testing.

Start timing when the vehicle speed exceeds 40 km/h (25 mph). Test time does not accumulate during service brake application or when vehicle speeds are outside the specified range.

4.2.2.1.3 Stationary Location. During the vehicle is parked, the vehicle tires shall be shaded from direct sunlight. The location shall be shielded from any wind that may affect the results.

4.2.2.1.4 Rim Position. The vehicle rims may be positioned at any wheel position, consistent with any related instructions or limitations from the vehicle's manufacturer.

4.2.2.1.5 Tires. The vehicle shall be tested with the tires installed on the vehicle according to the vehicle manufacturer's recommendation. However, the spare tire may be utilized for testing TPMS malfunction.

4.2.2.1.5.1 Test Tire Pressure Thresholds. The test tire pressure for the puncture test is defined as the highest of 20% below the test pressure, P_{warm} , OR the minimum pressure of 150 kPa, whichever is higher.

The test tire pressure for the diffusion test is defined as the highest of 20% below the test pressure P_{warm} plus a further deflation of 7 kPa.

Following a stabilization period of (2 to 5) minutes, the test pressure shall be rechecked and adjusted if necessary.

4.2.2.1.5.2 Round of the Test Tire Pressure. If necessary, round the test pressure up to the next whole number, in kPa, and record on the Test Information Data Sheet.

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 shall be performed at the Gross Vehicle Weight Rating (GVWR) ballast condition. Record the test weight on the Detection Data Sheet in Appendix B.

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4.3.1 Telltale Test Procedure.

4.3.1.1 Record of TPMS Telltale Hardware. 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 (Table 1 of UN R121.01 (E/ECE/TRANS/505/Rev.2/Add.120/Rev.2)).

4.3.1.2 Bulb Check. With the vehicle stationary, and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "Ignition On" position, disengaging any starter interlock. 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 Preparation. Drive the vehicle to the test track and if necessary, soak at the ambient temperature for at least 1 h with the engine off to let the tires cool down to ambient temperature. The vehicle's tires shall be shaded from direct sun when the vehicle is parked.

4.3.2.3 Preparation. Inflate each tire to the placard pressure.

4.3.2.4 Preparation. Verify that the sensor learn has been completed for direct tire pressure monitoring systems. Reset the indirect systems (DDS+) to start learning new pressure (see Owner Manual).

4.3.2.5 Learning Phase. Start and drive the vehicle for 20 minutes with an average speed of (80 ± 10) km/h. It is allowed to be outside the speed range for a maximum cumulative time of 2 minutes during the learning phase. Observe the conditions in paragraph 4.2.2.1.2.

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

4.3.2.7 Within the 5 minutes of completing the learning phase, measure the warm pressure of the tire(s) to be deflated. The warm pressure shall be taken as the value P_{warm} . This value will be used for subsequent operations.

4.3.2.8 Deflation Phase. Deflate the tire (or combination of tires) to be tested within 5 minutes to the test pressure of $P_{\text{warm}} - 20\%$, or a minimum pressure of 150 kPa, whichever is higher. Recheck the pressure after 1 minute and adjust as necessary.

4.3.2.9 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 paragraph 4.3.2.10. If not, continue with paragraph 4.3.2.10.

4.3.2.10 Low Tire Pressure Detection Phase. Drive the vehicle until the LTPW telltale illuminates or 10 minutes for a puncture test, 60 minutes for a diffusion test have expired. Observe the conditions in paragraph 4.2.2.1.2. Record this on the Detection Test Data Sheet.

4.3.2.11 With the LTPW telltale illuminated, stop the vehicle and deactivate the ignition locking system to the "Off" or "Lock" position.

4.3.2.12 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.

4.3.2.13 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.

4.3.2.14 Deactivate the ignition locking system and keep the vehicle stationary with the engine off for 1 h. Observe the conditions in paragraph 4.2.2.1.3.

4.3.2.15 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.

4.3.2.16 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.

4.3.2.17 If applicable reset the TPMS system.

4.3.2.18 Verify that the LTPW telltale extinguishes. If necessary, drive the vehicle until the telltale extinguishes. Observe the conditions in paragraph 4.2.2.1.2. Record this on the Detection Test Data Sheet.

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4.3.2.19 If continuing to a new scenario, continue with paragraph 4.3.2.1.

4.3.3 Test Procedure Malfunction Test.

4.3.3.1 Drive the vehicle to the test track.

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 paragraph 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 paragraph 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 10 minutes have expired. Observe the conditions in paragraph 4.2.2.1.2. 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 paragraph 4.2.2.1.2. 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 paragraphs 4.3.3.3 thru 4.3.3.10 for this new simulated malfunction.

4.3.3.13 Repeat paragraphs 4.3.3.3 thru 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.

5 Data

5.1 Calculations. To convert from psi (pounds per square inch) to kPa (kilopascal), multiply by 6.89476. To convert from bar to kPa (kilopascal), multiply by 100. To convert from km/h to miles per hour (mph), multiply by 0.62137.

5.2 Interpretation of Results. This compliance test is considered passed if all the applicable sections on the data sheets are marked "YES" and meet the detection criteria.

5.3 Test Documentation. Data sheets, see Appendix B.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

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