



Tire Puncture Sealing Efficiency

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 determine sealant tire puncture sealing efficiency in a laboratory environment.

1.2 Applicability. The test applies to passenger car tires and to punctures for which sealant technology is deemed appropriate.

2 References

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

2.1 External Standards/Specifications.

ASTM F551

2.2 GM Standards/Specifications.

GMW16590

2.3 Additional References.

- Component Technical Specification (CTS)
- European Tyre and Rim Technical Organisation (ETRTO) Year Book or equivalent
- The Tire & Rim Association, Incorporated (T&RA) Year Book or equivalent

3 Resources

3.1 Facilities. Tire testing laboratory with a 1.7 m, or greater, diameter road wheel dynamometer.

3.2 Equipment.

3.2.1 Wheels appropriate for testing the tire per the appropriate published tire standards (e.g., The Tire & Rim Association, Incorporated (T&RA) Year Book or European Tyre and Rim Technical Organisation (ETRTO) Year Book).

3.2.2 Standard tire testing 1.7 m road wheel dynamometer or equivalent conforming to ASTM F551.

3.2.3 Inflation pressure monitoring equipment (one (1) limit switch controlled by the tire loaded radius); a pressure transducer is optional.

3.2.4 Puncture Objects. See Table 1.

Table 1: Size of Puncture Objects

Size	Diameter	Length
Equivalent to a Number 8 Box Nail	2.9 mm	60 mm
Equivalent to a Number 12 Box Nail	3.7 mm	60 mm
Equivalent to a Number 20 Common Nail	4.6 mm	60 mm

Note: Puncture object points to be cone shaped with a 60 degree included angle.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

August 2016

Page 1 of 9

3.2.5 Tire Mounting Equipment.**3.3 Test Vehicle/Test Piece.**

3.3.1 Tires with sealant applied using production equipment.

3.3.2 Minimum of two (2) sealant tires must be tested.

3.4 Test Time.

Calendar time: 8 days

Test hours: 184 hours

Coordination hours: 1 hour

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills.

3.6.1 Dynamometer operators must be trained in the proper set up and operation of the equipment and this test procedure.

3.6.2 End of test inspection to be completed by an individual trained in the analysis of structurally degraded tires.

4 Procedure**4.1 Preparation.**

4.1.1 Mount sealant tires on test wheels following acceptable mounting procedures.

4.1.2 Inflate sealant tire to the test inflation pressure shown in Table 2 and place in the ambient test environment to thermally equilibrate prior to beginning the dynamic test.

4.2 Conditions.

4.2.1 Environmental Conditions. Ambient temperature shall be controlled to $38^{\circ}\text{C} \pm 3^{\circ}\text{C}$. The location of ambient temperature measurement is defined as a point on the rotational axis of the tire, $0.31\text{ m} \pm 0.01\text{ m}$ from the plane touching the nearest tire sidewall or at a point where an equivalent temperature exists.

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.

4.2.3 Test load shall be 90% of maximum load capacity for the tire. The maximum load capacity is typically molded into the sidewall of the tire and should be in agreement with the applicable published tire standards, (e.g., T&RA Year Book or ETRTO Year Book).

4.2.4 The capped test inflation pressure is specified in Table 2 for various tire types and load ranges. These pressures result from a consideration of both the maximum sidewall markings and expected usage pressures.

Table 2: Test Inflation Pressure

Tire Type and Load Range	Cold Inflation Pressure (kPa)
Passenger Car	
Standard Load and Light Load	250
Extra Load or Reinforced	290

4.2.5 Test speed shall be 90 km/h.

4.2.6 Punctures shall be created in each test tire as described in 4.3.2.

4.3 Instructions.

4.3.1 Break in the tire by running it on the roadwheel for a minimum of 160 km at the specified test conditions for load, speed, and inflation pressure.

4.3.2 Puncture tire immediately after the break-in while the tire is still near the operating temperature.

4.3.2.1 Each test tire will have a total of 24 punctures created with the puncture objects as described.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

August 2016

Page 2 of 9

- 4.3.2.2** All punctures will be made perpendicular to the tread surface.
- 4.3.2.3** For the nail removed punctures, the puncturing object is to be removed immediately from the tire.
- 4.3.2.4** For the nail retained punctures, the nail head is to be even with the surrounding tread surface and is to be allowed to remain in the tire.
- 4.3.2.5** Punctures shall be made in major grooves with one half ($\frac{1}{2}$) in the groove nearest the shoulder rib and one half ($\frac{1}{2}$) in grooves nearest the center of the tread.
- 4.3.2.6** Punctures should be evenly distributed around the tire circumferentially.
- 4.3.2.7** Create twelve (12) punctures of the nail removed type, four (4) punctures with each of the three (3) puncturing objects.
- 4.3.2.8** Create twelve (12) punctures of the nail retained type, four (4) punctures with each of the three (3) puncturing objects.
- 4.3.3** Allow the tire to cool to ambient temperature.
- 4.3.4** Set the test inflation pressure to the value stated in Table 2 immediately after puncturing the test tire.
- 4.3.5** Continue running the tire on the roadwheel at the specified load and speed conditions, monitoring the inflation pressure and structural condition of the tire. Each time the tires are inspected, record the as-found inflation pressure and total accumulated distance on the Data Sheet A1 in Appendix A.
- 4.3.6** If the inflation pressure decreases 60 kPa (hot) below the initial test inflation pressure (cold), temporarily suspend testing, plug the leaking hole(s), and then resume distance accumulation. Record the description of the puncture repaired and the adjusted inflation pressure prior to restarting the distance accumulation on the Data Sheet A1 in Appendix A.
- 4.3.7** Suspend testing when the tire accumulates 16 000 km of test distance after being punctured, or if the tire exhibits structural degradation.
- 4.3.8** Visually inspect the structural condition of the tire and describe on Data Sheet A1 in Appendix A.

5 Data

5.1 Calculations.

- 5.1.1** Each puncture location is considered a data point for the purposes of this test.
- 5.1.2** A sealant test success occurs at each punctured location not requiring a repair to stop an air leak and the tire has accumulated 16 000 km after being punctured.
- 5.1.3** Calculate the sealant efficiencies for each tire individually, including both nail retained and nail removed data, recording in the designated areas of the Data Sheet A1 in Appendix A.

Note: For equations in 5.1.3.1 through 5.1.5:

- E = Sealing Efficiency.
- NS = Number of Successes.
- NT = Number of Tests.

5.1.3.1 Sealing efficiency with the 2.9 mm object.

$$E_{2.9} = NS_{2.9}/NT_{2.9}$$

NS_{2.9} = Number of 2.9 mm test successes
 NT_{2.9} = Total number of 2.9 mm tests

5.1.3.2 Sealing efficiency with the 3.7 mm object.

$$E_{3.7} = NS_{3.7}/NT_{3.7}$$

NS_{3.7} = Number of 3.7 mm test successes
 NT_{3.7} = Total number of 3.7 mm tests

5.1.3.3 Sealing efficiency with the 4.6 mm object.

$$E_{4.6} = NS_{4.6}/NT_{4.6}$$

NS_{4.6} = Number of 4.6 mm test successes
 NT_{4.6} = Total number of 4.6 mm tests

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved