



Determination of Fuel Permeability of Hoses at High Temperature

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. The object of this test procedure is to determine the fuel permeability of hoses.

1.2 Applicability. Hoses for use with fuel.

2 References

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

2.1 External Standards/Specifications.

DIN 50011-11

IEC 60079-0

SAE J30

SAE J1527

DIN 50011-12

2.2 GM Standards/Specifications.

GMW14914

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.

3.2 Equipment.

3.2.1 Test Equipment.

3.2.1.1 Test Equipment for Test Method A, Method B, and Method C.

3.2.1.1.1 Heating oven capable of maintaining the required temperatures within the specified tolerances, e.g., to DIN 50011-11 and DIN 50011-12; with explosion proof interior structure to IEC 60079-0. The heating oven shall have an air ventilation rate of twice per minute minimum.

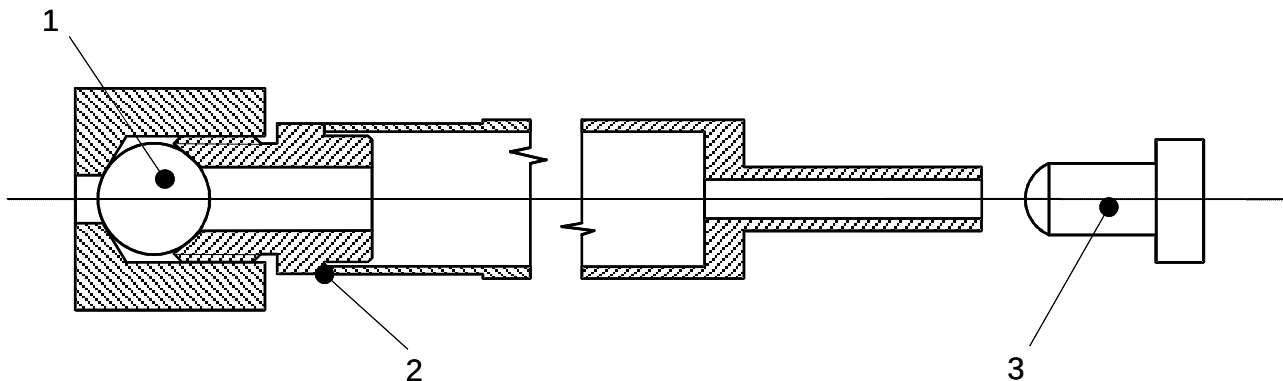
3.2.1.1.2 Capable Analytical Balance.

3.2.1.1.3 Test Vessel. The volume of the test vessel shall be about four (4) to five (5) times higher than the volume of the test hose. See Figure 1.

3.2.1.1.4 Test fuel to be used for all preconditioning of materials, and all permeation measurements, is to be gasoline test fuel per GMW14914; Table 1, "Conventional Gasoline", unless otherwise specified.

3.2.1.1.5 Preparation of Test Assembly. The test piece (section of hose) shall be connected to one end of the test vessel and the other end shall be sealed with a blanking plug, see 3.2.1.1.3.

Figure 1: Test Vessel

**Key:**

1 = Ball Lock Valve

2 = Brazed

3 = Blanking Plug

3.2.1.2 Test Equipment for Test Method D and Method E. The apparatus used to conduct the test shall be as indicated in SAE J1527; see 16.2, Rate of Fuel Permeation, with modifications for the dimensions of hose, reservoir, and fuel volume as listed in Table 1. Selection of dimensions for hose length, fuel volume, and reservoir volume is dependent on the Inner Diameter (ID) of the hose being measured. For hoses that do not have an ID listed in Table 1, the closest smaller hose ID shall be selected from the table for the determination of these test samples and apparatus dimensions. Fuel to be used for all preconditioning of materials, and all permeation measurements, is to be GMW14914, Table 1, "Conventional Gasoline", unless otherwise specified. Fuel temperature is to be maintained at $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ during the equilibrium pre-conditioning of the hose and during the permeation testing of the hose. Permeation test sample and fixture must be sealed before temperature of fuel is increased to avoid significant loss of volatiles prior to permeation measurements. Proper hot fuel handling safety procedures must be utilized.

3.3 Test Vehicle/Test Piece.**3.3.1 Test Material.**

3.3.1.1 Test Material for Method A, Method B, and Method C. Test piece is a section of the hose with a free hose length of approximately 100 mm at the test. Free hose lengths of <50 mm are not suitable for tests. The free hose length is the inner length of the hose between test vessel adapter and plug which is in contact with fuel.

3.3.1.1.1 For determination of properties, for initial samples approval and arbitration purposes, at least three (3) test pieces taken from at least three (3) components shall be tested. For routine quality control purposes, at least three (3) test pieces shall be tested.

3.3.1.2 Test Material for Test Method D, and Method E. Test specimens shall be prepared as indicated in SAE J1527, with the dimensions indicated in Table 1.

3.4 Test Time. Reference the lab test procedures in Section 4 for timing details.

3.5 Test Required Information. See 5.3.

3.6 Personnel/Skills. Conform to company and/or laboratory requirements. Technician training records must be available upon request.

4 Procedure**4.1 Preparation.**

4.1.1 Test Sample Preparation. For initial sample approval and arbitration purposes, the minimum time period between manufacturing and testing of elastomers shall be 72 h minimum. The test pieces shall remain at a temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for at least 8 h before testing, and shall be free from strain during this period.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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.

4.3 Instructions.

4.3.1 Test Procedure. All weight measurements shall be as accurate as possible but at least with an accuracy of 0.05 g.

4.3.1.1 Method A: Liquid Phase Permeation. The test assembly shall be filled to 75% with the respective test fuel and sealed. The test assembly shall be stored vertical with the test vessel at the top of the system. The test assembly shall be conditioned 48 h -2 h at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. After this time, the used fuel shall be removed and the system shall be once again filled up to 75% with fresh test fuel, sealed and weighed. Then the system shall be stored 2 h -0.5 h at $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. After storage, the entire system shall be cooled down for 30 minutes ± 5 minutes at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, and afterwards once again be weighed.

4.3.1.2 Method B: Liquid Phase Permeation. The test assembly shall be filled to 75% with the respective test fuel, sealed and weighed. The test assembly shall be stored vertical with the test vessel at the top of the system. Then the system shall be stored 24 h -0.5 h at $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. After storage, the entire system shall be cooled down in 30 minutes ± 5 minutes at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. Then the system shall be weighed. The old fuel shall be removed and the system shall be refilled with new test fuel. This test sequence shall be repeated for four (4) times with the same test piece.

4.3.1.3 Method C: Vapor Phase Permeation. The test vessel shall be filled to 90% with the respective test fuel, sealed and weighed. The test assembly shall be stored vertical with the test vessel at the bottom of the system. Then the system shall be stored 24 h -0.5 h at $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. During the storage, there should only be fuel vapor in the test piece. After storage, the entire system shall be cooled down in 30 minutes ± 5 minutes at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. Then the system shall be weighed. The old fuel shall be removed and the system shall be refilled with new test fuel. This test sequence shall be repeated for four (4) times with the same test piece.

4.3.1.4 Method D: Liquid Phase Permeation.

4.3.1.4.1 Conduct permeation test per SAE J1527, continuing the test until an equilibrium value of permeation is reached. Per SAE J1527, the test sample and apparatus are to be rotated 90 degrees every 24 h. During this rotation of the hose sample and apparatus, the fuel is to be gently mixed, per SAE J30. If a permeation measurement is to be made during this 24 h period, the manipulation of the hose test sample and apparatus is to be performed immediately after the permeation weight loss value has been measured. Data supporting the establishment of an equilibrium rate of permeation must be generated per the protocol contained in 4.3.2, of this standard and must be supplied to the GM Materials Engineer issuing the hose approval to the permeation requirements for review. The equilibrium rate of permeation will be deemed to have been obtained when the Coefficient of Variation (COV) for the last three (3) measurements is <0.05 .

4.3.1.4.2 If three (3) consecutive permeability determinations have a COV of <0.05 , equilibrium will be considered to have been obtained. The last permeability value measured will then be the value reported for the liquid fuel permeation rate of the hose. Units are to be in grams per meter squared (g/m^2) per 24 h, per SAE J1527.

4.3.1.4.3 At conclusion of the liquid fuel permeation rate determination for the hose, the fuel is changed again, and the vapor phase permeation determination is conducted per 4.3.1.5.