Designation: D7586/D7586M – 11

Standard Test Method for Quantification of Air Intrusion in Low-Sloped Mechanically Attached Membrane Roof Assemblies[1]

This standard is issued under the fixed designation D7586/D7586M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method provides a laboratory technique for determining the air intrusion in low-sloped mechanically attached membrane roof assemblies under specified negative air pressures differences.

1.2 This test method is intended to measure only air intrusion associated with the opaque roof assembly free from penetrations such as those associated with mechanical devices, roof junctions, and terminations.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1079 Terminology Relating to Roofing and Waterproofing

E283 Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

E631 Terminology of Building Constructions

E2357 Test Method for Determining Air Leakage of Air Barrier Assemblies

3. Terminology

3.1 For definitions of general terms relating to roofing and building construction used in this test method, refer to Terminologies D1079 and E631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *air intrusion*—the mechanism by which indoor air enters into a roof assembly but does not escape to the exterior environment.

3.2.2 *air leakage*—the movement/flow of air from one environmental condition to the other environmental condition through the building envelope assembly which is driven by either positive or negative pressure differences, or both across the envelope assembly.

3.2.3 *extraneous leakage,* L/s (ft^3/min)—the volume of air flowing per unit time into the bottom test chamber due to its leakiness, under a pressure difference.

3.2.4 *flow rate,* L/s—the volume of air flow per unit time.

3.2.5 *specimen air intrusion,* L (ft^3)—the volume of air intruding into the membrane assembly specimen under a test pressure difference.

3.2.6 *test pressure difference,* Pa (lbf/ft^2)—the specified difference in static air pressures across the membrane assembly specimen.

3.2.7 *standard conditions*—dry air at a pressure of 101 kPa (29 in. Hg), temperature of 21°C (69°F) and air density of 1.2 kg/m^3 (0.075 lb/ft^3).

4. Summary of Test Method

4.1 The test consists of installing a mechanically attached membrane assembly specimen between two chambers; specifically an airtight bottom chamber into which air flows and a top chamber that exhausts air at a rate required to maintain the specified negative pressure across the membrane assembly specimen. The resultant air intrusion into the membrane assembly specimen is measured from the airflow measurement system installed on the bottom chamber.

5. Significance and Use

5.1 This test method can be useful in understanding the response of low-sloped mechanically attached membrane roofing assemblies to air pressure differences induced across the assembly.

5.2 This test method can be useful in understanding the role of different roofing components in providing resistance to air intrusion into the membrane roofing assembly.

[1] This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.20 on Roofing Membrane Systems.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5.3 When applying the results of tests by this test method, note that the performance of a roof or its components, or both, may be a function of proper installation and adjustment.

5.4 This test method subjects the roof specimen to negative static pressures, as it is difficult to simulate the complex environmental conditions that can be encountered in service, including rapidly changing pressures due to wind gusting.

5.5 This test method does not purport to establish all criteria necessary for the consideration of air intrusion in the design of a roof assembly. The results are intended to be used for comparison purposes and may not represent the field installed performance of the roof assembly.

6. Test Apparatus

6.1 This description of the apparatus is general in nature, and any arrangement of the equipment capable of performing the test method within the allowable tolerances is permitted.

6.2 The major components of the test apparatus are (see Fig. 1):

6.2.1 *Pressure Box*—The pressure box shall consist of two test chambers designated as the top chamber and the bottom chamber.

6.2.1.1 *Top Chamber*—The interior length and width dimension of top chamber shall be 6.1 m (20 ft) long and 2.44 m (8 ft) wide, respectively. It shall have a minimum height of 0.9 m (3 ft) and should be movable. To measure the chamber pressure, it shall be fitted with at least one pressure tap. Provision shall be made for an opening on the top chamber through which the pipe network will be installed and connected to the blower. The pipe network shall have a control valve for creating different negative pressures on the membrane assembly specimen. The top chamber shall be provided with window openings to view the membrane assembly specimen response. To facilitate the control of test pressures that is applied over the membrane assembly specimen, the top chamber shall be well sealed by appropriate sealing products.

NOTE 1—Sealing products such as non-hardening mastic compounds or pressure-sensitive tape can be used to achieve the air tightness in the construction of the pressure chamber, to seal the membrane assembly specimen to the bottom chamber, to seal the access door to the chamber and at all other location where effective sealing is required.

6.2.1.2 *Bottom Chamber*—It is a closed chamber with the interior length and width dimension of 6.1 m (20 ft) long and 2.44 m (8 ft) wide, respectively. It shall have a minimum height of 0.9 m (3 ft) and shall be fixed to the ground. The membrane assembly specimen is installed horizontally at the top of the bottom chamber (see Fig. 3) supporting on a height adjustable lever, which can accommodate membrane roof assemblies with different thickness. At least one pressure tap shall be provided in the bottom chamber to measure the chamber pressures. It shall be fitted with a relief control valve to discharge the air after the application of each differential pressure on the test specimen in the top chamber. Provision shall be made for an opening on the bottom chamber through which the airflow measurement system shall be installed. To facilitate adjustment and observations after the membrane assembly specimen has been installed, it shall be provided with means of access into the chamber. Extraneous leakage into the chamber should be minimized by applying suitable sealing products (see Note 1) to ensure that the airflow due to extraneous leakage does not exceed the airflow measured through the airflow measurement system.

6.2.2 *Air System*—A controllable blower designed to provide the required airflow at the specified negative pressures. The blower shall be capable of creating suction pressures of 5 kPa (100 psf).

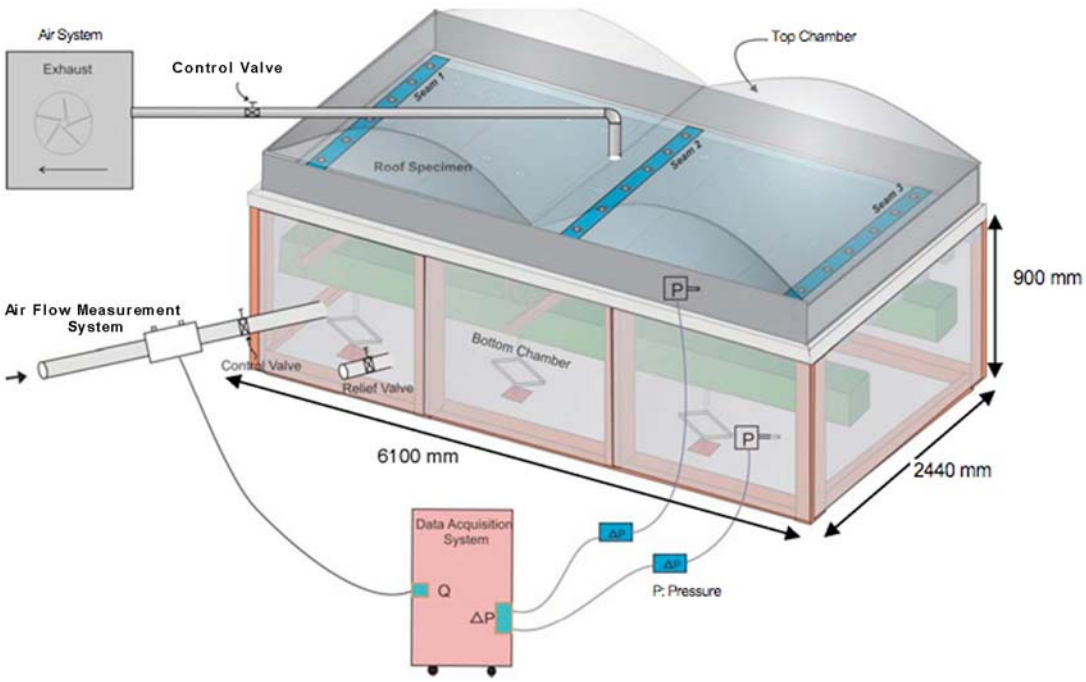

FIG. 1 Air Intrusion Test Apparatus

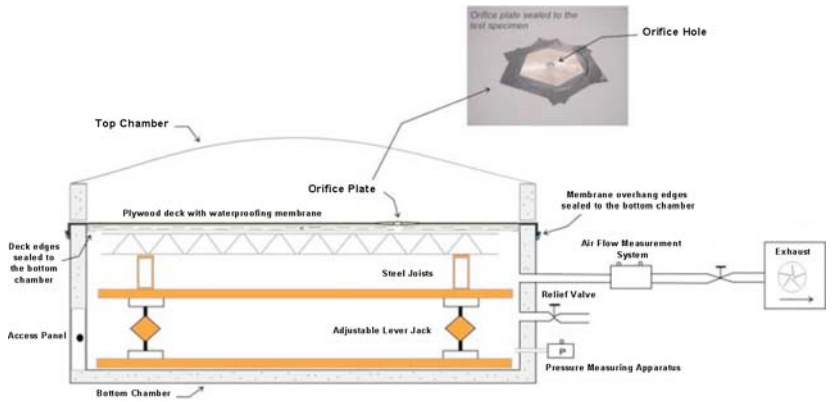

FIG. 2 Calibration Setup

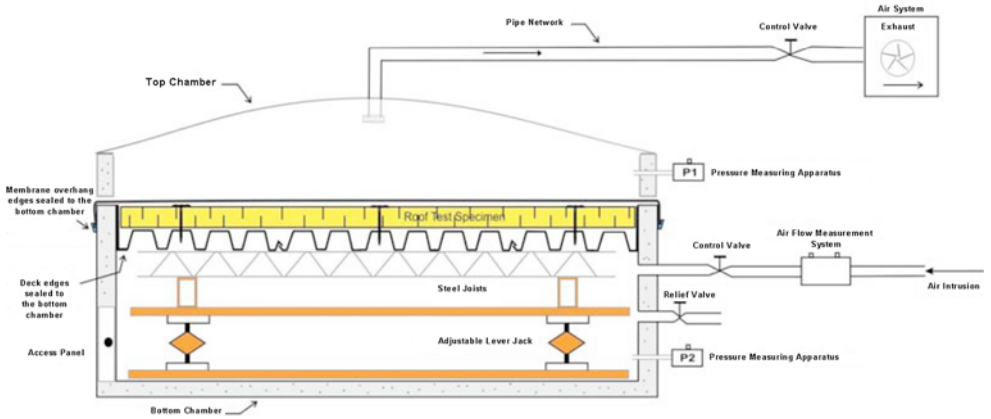

FIG. 3 Membrane Assembly Specimen Air Intrusion Setup

6.2.3 *Pressure Measuring Apparatus*—A device for measuring the test pressure difference within a tolerance of ±2 % of the reading or ±2.5 Pa (0.05 psf), whichever is greater.

6.2.4 *Airflow Measurement System*—A flow-measuring device with a 2 in. diameter opening and a flow capacity of 18.8 L/s (40 cfm). It should be capable of measuring the airflow with an accuracy of 0.8 % of the reading.

6.2.5 *Data Acquisition System*—A computer based system capable of reading and recording the pressure and airflow measurements with time scale.

7. Test Specimen

7.1 Different components of the membrane assembly specimen shall be installed and constructed on the top of the bottom chamber (see Fig. 3) according to the recommendations of the party commissioning the test.

7.2 The perimeter edges of the structural deck shall be flush to the interior of the bottom chamber and shall be sealed to the bottom chamber using suitable sealing products as shown in Figs. 2 and 3. This is crucial to ensure that the deck seams or joints are the flow paths and not the deck edges.

7.3 When insulated membrane assembly specimens are tested, the top surface of the insulation board shall be flush with the top edges of the bottom chamber.

7.4 To ensure that edges of the waterproofing component or the roofing membrane are not the flow paths during the air intrusion testing, the roofing membrane shall have a minimum overhang of 600 mm (24 in.) on all the four sides and shall be sealed to the outside of the bottom chamber as shown in Figs. 2 and 3 by suitable sealing products (see Note 1).

8. Calibration

8.1 Perform calibration by installing a 19 ± 3 mm (¾ ± ⅛ in.) thick tongue and groove plywood deck in the bottom test chamber. The edge treatment shall be the same as those used for the membrane assembly specimens (see 7.2). Install a continuous sheet of waterproofing membrane on the plywood deck. The membrane(s) being tested may be used for calibration or at least as determined by the party commission the test. It shall be loose laid with its overhang edges sealed to the bottom chamber as shown in Fig. 2 by using suitable sealing products (see Note 1).

8.2 Make a 150 mm (6 in.) diameter hole through the membrane sheet and plywood for mounting a National Institute of Standards and Technology (NIST) traceable orifice plate.

8.3 The NIST traceable orifice plate shall be constructed of 3 mm (⅛ in.) thick stainless steel having an outside diameter of 200 mm (8 in.) and containing an interior square edge diameter of 25.40 mm (1 in.).

NOTE 2—Calibrated orifice plates traceable to NIST may be obtained by using the method in Annex 2 of Test Method E283.