



# Standard Test Method for Field Testing Uplift Resistance of Adhered Membrane Roofing Systems<sup>1</sup>

This standard is issued under the fixed designation E 907; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the resistance of adhered membrane roofing systems to uplift pressure. It applies to roof systems with or without rigid board insulation or base ply, which are either adhered or mechanically fastened, and fully adhered membranes.

1.2 This test method is intended to be used as a measure of the uplift resistance of the roofing system. Systems containing cold adhesive shall be in place for the cure time specified by the adhesive manufacturer to obtain optimum adhesion before conducting the test. Hot-applied systems shall be permitted to cool to normal prevailing surface temperatures before conducting the test.

1.3 *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:

E 575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies<sup>2</sup>

## 3. Summary of Test Method

3.1 A controlled negative pressure is created on top of the roof surface by means of a chamber fitted with a pressure measuring device and vacuum equipment.

3.2 For roofs containing surfacing such as gravel, slag, or granules, the loose surfacing shall be removed by sweeping a 300 mm (12 in.) wide path around the perimeter of the test area. Care shall be taken not to damage the test area. A heavy pouring of hot asphalt is applied over the swept area and

allowed to cool. This provides a smooth surface and allows the edges of the chamber to be in complete contact with the roof surface so that a negative pressure is developed inside the chamber. Other methods are not to be used to prepare the test area unless the method used will produce a tight seal and is compatible so as not to damage the roof membrane. Examples are the use of wet sand, duct tape, water, or polythene film.

## 4. Significance and Use

4.1 This field test method is suitable for determining the uplift resistance of the roofing system as stated in applicable specifications, bid documents, or when required by other authorities having jurisdiction. This field test method is also intended to supplement measurement of the uplift resistance performance of roofing systems as determined under laboratory conditions.

## 5. Apparatus

5.1 *Square Chamber*, 1500  $\pm$  15 mm (60  $\pm$  1/2 in.) in size, sufficiently strong to withstand the necessary negative pressure without collapsing.

NOTE 1—A manufactured dome shaped chamber of rigid clear polycarbonate shown in Fig. 1 has been successfully used. The dome consists of four equal segments for ease of transporting the unit to and from the job site. Rubber gaskets are used to seal the joints along the flanges. One segment of the dome has a hole to accommodate vacuum equipment and another segment has a hole for a flexible hose leading to a manometer (Fig. 2). The bottom flanges of the chamber are equipped with a flexible poly(vinyl chloride) foam strip to seal the chamber to the roof surface.

5.2 *Pressure-Sensing Device*, for measuring the negative pressure inside the chamber. The manometer shall be calibrated to indicate negative pressures in increments of 360  $\pm$  20 Pa (7.5  $\pm$  0.5 lbf/ft<sup>2</sup>).

5.3 *Vacuum Equipment*, with sufficient capacity to create the negative pressures required in the test chamber (see 8.8). The chamber vacuum equipment shall also be equipped with controls to maintain the constant negative pressure at each test pressure increment as required in 8.8.

5.4 *Dial Indicator*, with a reset face graduated in at least 0.05 mm (0.002 in.) units and having at least a 50 mm (2 in.) range, mounted at the center of a 50 by 50 by 1500 mm (2 by 2 by 59 in.) long aluminum bar or member of equivalent

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<sup>2</sup> 1983 Annual Book of ASTM Standards, Vol 04.11.



FIG. 1 View of Chamber over Roof Test Area During Test

stiffness. Feet on each end of the bar provide support and give a clear distance of 50 mm (2 in.) above the roof surface. This allows measurement of roof surface deflections in the test area (see Fig. 3).

5.4.1 All persons not involved in the test shall be kept far enough away from the test area to ensure that the dial gage indicator is not affected by movement and influence the readings.

## 6. Hazards

6.1 The manometer shall be designed to serve as a safety device to prevent negative pressures that will cause the plastic dome to shatter. The design of the manometer or safety features of other pressure sensing devices shall not be changed to increase negative pressures above the design or allowable values of the chamber.

6.2 Safety goggles or face shield shall be worn by persons operating the equipment or observing its operation as a precaution against injury caused by a sudden failure of the test chamber or roofing system.

## 7. Sampling

7.1 Perform testing in selected locations representative of the perimeter and interior areas of the roof.

7.2 Select the number of tests in accordance with Table 1.

## 8. Procedure

8.1 Measure and record air temperature with a thermometer, and roof surface temperature with a surface thermometer.

8.2 Conduct tests when the temperature of the roof surface is in the range from 4 to 38°C (40 to 100°F). Temperatures outside this range will produce questionable results. For safety

considerations, tests shall not be conducted when the wind speed at the roof level is over 6.5 m/s (15 mph). When necessary to measure and record wind speed, a portable anemometer shall be used.

8.3 Place the bar with attached dial indicator so that the tip of the dial indicator is in contact with the roof membrane near the center of the test area.

8.4 Place the assembled chamber over the roof test area so that the deflection bar with attached dial indicator is centered within the chamber and is perpendicular to two sides of the chamber. The edges of the chamber shall be sealed to the roof surface. Orient the chamber on the roof so that the edges are parallel with the direction of the structural framing of the building.

8.5 Install the pressure measuring device. If a manometer is used, fill it with water to zero calibration level.

8.6 Connect the vacuum equipment to the hole provided for it in the chamber. Make sure that the bypass valve on the vacuum equipment is open before starting the equipment, or if a rheostat is used, that it is in the OFF position.

8.7 Continuously observe the deflection and pressure measuring device throughout the period that vacuum is created for sudden or variable rates of movement.

8.8 Regulate the negative pressure in the chamber to the specified level. Unless otherwise specified, conduct the test by raising the negative pressure in the chamber to  $720 \pm 20$  Pa (15 lbf/ft<sup>2</sup>) and holding this pressure for 1 min. Thereafter, raise the pressure in increments not greater than  $360 \pm 20$  Pa (7.5 lbf/ft<sup>2</sup>) until the agreed upon pressure is reached. Hold the pressure at each increment for 1 min. Terminate the test when

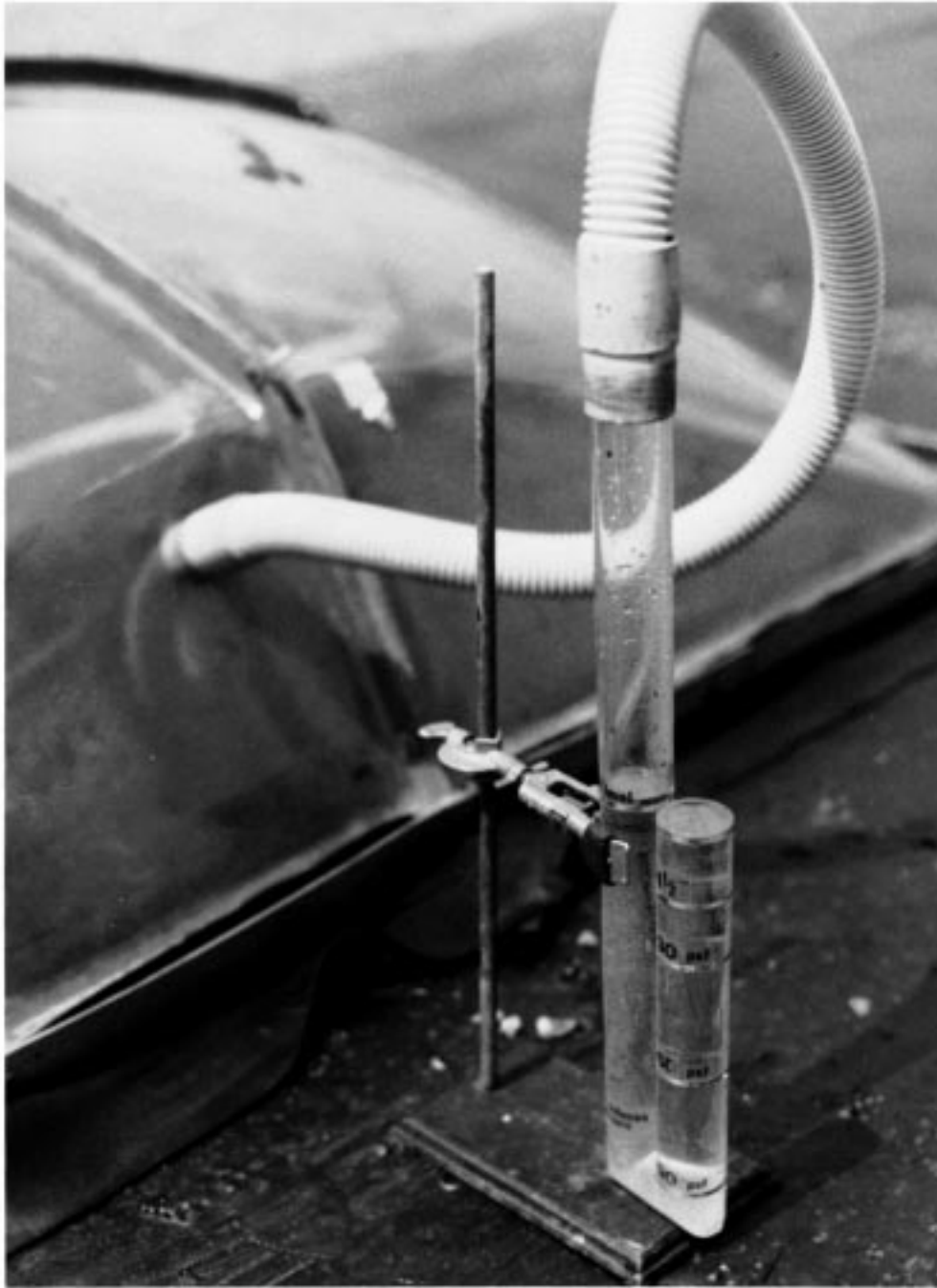


FIG. 2 View of Chamber Showing Manometer Used to Measure Negative Pressure

failure occurs or at the completion of 1 min at the agreed upon specified negative pressure. Roof assembly failure is described in Section 9.

### 9. Interpretation of Results

9.1 Most roof systems subjected to a negative pressure will exhibit an upward deflection that will increase as the negative pressure increases. Poorly adhered systems will exhibit relatively large increases in upward deflections with relatively small increases in applied pressure. For roof systems that are

well adhered, the increase in deflection will be gradual and at a relatively constant rate up to a point at or near failure. When failure occurs due to lack of adhesive or cohesive resistance of the roof system, there will be a sudden increase in the upward deflection.

9.2 Failure is taken as uplifting of the roof covering as indicated by a measured upward deflection of 25 mm (1 in.) or greater at the center unless a particular system exhibits greater limits of deflection without failure as determined by examination or past test experience, or both. A sudden increase in

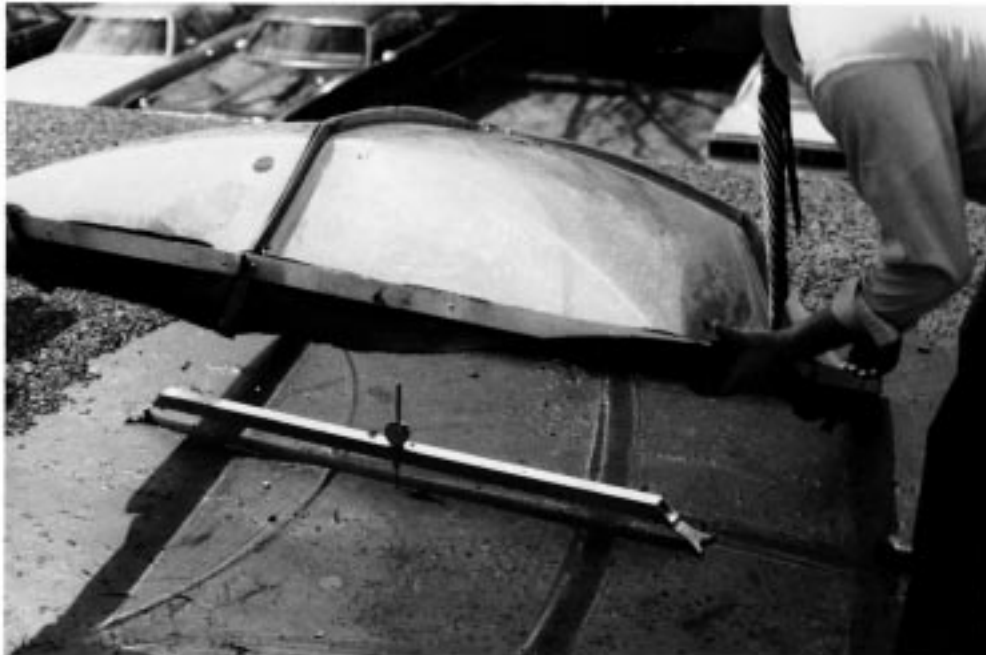


FIG. 3 Bar with Attached Dial Indicator Used to Measure Roof Surface Deflections

TABLE 1 Number of Tests per Roof Area

Roof Area	Number of Tests
100–450 m <sup>2</sup> or 10–50 squares <sup>A</sup>	2
450–1000 m <sup>2</sup> or 50–100 squares	4
Over 1000 m <sup>2</sup> or 100 squares	4 plus 1 additional test for each additional 1000 m <sup>2</sup> (100 squares) or portion thereof

<sup>A</sup> A square is equal to 100 ft<sup>2</sup>(9.3 m<sup>2</sup>) of roof area.

deflection indicates a problem that requires further investigation to determine if adhesion or attachment of roofing system components is adequate.

NOTE 2—Deflection due to negative pressure will potentially vary at different locations because of varying stiffness of the roof system assembly. Stiffness of a roof system assembly including deck is influenced by location of mechanical fasteners, the thickness of insulation, stiffness of decking, and by the type, proximity, and rigidity of connections between the decking and framing system.

## 10. Report

10.1 Refer to Practice E 575 for general use in reporting structural performance tests of building assemblies.

10.2 Report the following information:

10.2.1 Area, height, and plan view of the roof showing the location of the test areas.

10.2.2 Complete detailed description of the roof assembly construction being tested. Include the type of roof deck and method of attachment, deck support spacing, vapor retarder and adhesive, if any, types and thicknesses of insulation, if any, methods of attachment, and the type of adhered roofing including surfacing.

10.2.3 Dates of tests, air and roof surface temperatures, and wind speed (if measured). The internal pressure of the building shall be recorded before starting the uplift tests.

10.2.4 Description of the test procedure giving the negative pressure increments, length of time pressure maintained at each increment, and the maximum applied pressure.

10.2.5 Tabulation of results observed at each pressure increment including visual observations and deflection. The deflection shall be measured and recorded at the start and end of each pressure increment.

10.2.6 If failure occurs during the tests, the complete record shall include: (a) the negative pressure at which failure occurred, (b) observations obtained by thorough examination of the failed area including cuts through the membrane if necessary (cuts in built-up membranes shall be made as shown in Fig. 4 to preserve the integrity of the test cut area), (c) description of type of failure and its location within the roof assembly, and (d) other observations of the roof assembly conditions that are attributed to the failure. The cut area of roofing shall be repaired after examination of the failed area.

10.2.7 Names, signatures, and affiliations of the persons observing the tests.

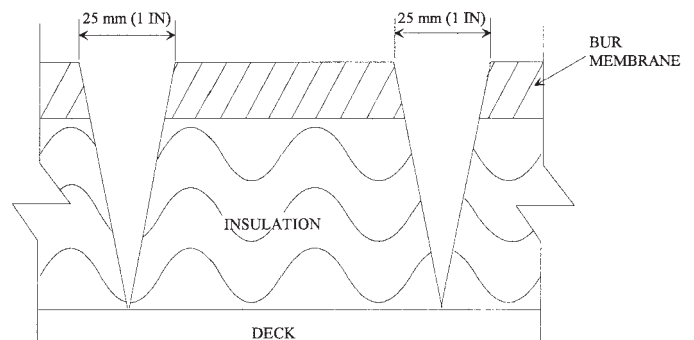


FIG. 4 Cuts for Examination of Failed Insulated Bur Sections

## 11. Precision and Bias

11.1 When sufficient testing has been completed using this test method, a precision and accuracy statement will be included.

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## 12. Keywords

12.1 bituminous roofing; built-up roofing; field testing; performance testing; roofing systems; steel deck insulation; wind uplift resistance