Designation: D7158/D7158M – 24a

Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)[1]

This standard is issued under the fixed designation D7158/D7158M; 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 covers the procedure for calculating the wind resistance of asphalt shingles when applied in accordance with the manufacturer's instructions and sealed under defined conditions. Shingle designs that depend on interlocking or product rigidity to resist the wind cannot be evaluated using this test method. The method calculates the uplift force exerted on the shingle by the action of wind at specified conditions, and compares that to the mechanical uplift resistance of the shingle. A shingle is determined to be wind resistant at a specified basic wind speed for standard conditions (see 6.3) when the measured uplift resistance exceeds the calculated uplift force for that velocity (3 s gust, ASCE 7).

1.2 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 nonconformance with the standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D228/D228M Test Methods for Sampling, Testing, and Analysis of Asphalt Roll Roofing, Cap Sheets, and Shingles Used in Roofing and Waterproofing

D1079 Terminology Relating to Roofing and Waterproofing

D3161/D3161M Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method)

D3462/D3462M Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules

D6381/D6381M Test Method for Measurement of Asphalt Shingle Mechanical Uplift Resistance

2.2 *ASCE Standards:*[3]

ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASCE 49-21 Wind Tunnel Testing for Buildings and Other Structures

2.3 *ANSI/UL Standard:*[4]

ANSI/UL 2390-04 Test Method for Wind Resistant Asphalt Shingles with Sealed Tabs

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this test method, refer to Terminology D1079.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *seal—as it relates to steep roofing shingles*, is the bonding that results from the activation of the sealant under the action of time and temperature.

3.2.2 *sealant—as it relates to steep roofing shingles*, is defined as factory-applied or field-applied typically asphaltic

[1] This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.02 on Steep Roofing Products and Assemblies.

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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.

[3] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

material designed to seal the shingles to each other under the action of time and temperature after the shingles are applied to a roof.

3.2.3 *sealed*—the condition of the shingles after they are subjected to the conditioning procedure described in 10.3.

4. Types and Classes of Shingles

4.1 Shingles are classified based on their resistance to wind velocities determined from measured data (Section 11), calculations of uplift force (Section 12), and interpretation of results (Section 13), as follows:

4.1.1 *Class D*—Passed at basic wind speeds up to and including 187 km/h [116 mph].

4.1.2 *Class G*—Passed at basic wind speeds up to and including 249 km/h [155 mph].

4.1.3 *Class H*—Passed at basic wind speeds up to and including 312 km/h [194 mph].

NOTE 1—This standard associates basic wind speeds with the classes shown in this section. Some earlier versions of this standard associated the classes with allowable stress design (ASD) wind speeds. For convenience of any parties interested in correlating this standard with ASD wind speeds, the equivalent ASD wind speeds for Classes D, G, and H are 90 mph, 120 mph, and 150 mph, respectively.

NOTE 2—The symbol for basic wind speed, V, in this standard is equivalent to the use of the symbol, V, in ASCE 7-22 and the 2024 International Building Code (IBC), and to the symbol, V_{ult} in the 2024 International Residential Code (IRC). In prior editions of the IBC and the IRC, the term "ultimate wind speed" or V_{ult} may be used, and it is consistent with the use of "basic wind speed" or V in this standard.

5. Summary of Test Method

5.1 The uplift force induced by wind passing over the surface of asphalt shingles is determined by calculation involving the uplift coefficients obtained from pressures measured above and below the shingle at the windward and leeward sides of the sealant, taking into account the desired basic wind speed classification and the uplift rigidity of the shingle. The calculated uplift force (F_T) for each of the possible classifications is compared to the measured uplift resistance (R_T) of the sealed shingle to establish the wind resistance classification of the shingle.

5.2 The method involves three steps:

5.2.1 Uplift coefficients are determined by measuring pressure differences above and below the shingle as air moves over the surface of a deck of sealed shingles under controlled conditions.

5.2.2 The uplift forces acting on the shingle are calculated using the wind uplift coefficients, shingle sealant configuration, and a specific basic wind speed.

5.2.3 Shingle uplift resistance to that specific basic wind speed is determined by comparing the calculated uplift forces acting on the sealant to the uplift resistances measured with Test Method D6381/D6381M. Uplift resistances from Procedure A and Procedure B are applied against the uplift forces in a manner detailed in the calculation section.

5.3 This test method is applicable to any asphalt shingle surfaced with mineral granules where the shingle above is affixed to the surface of the shingle below with a sealant (factory or field applied) applied in a pattern aligned parallel to the windward edge of the shingle.

NOTE 3—It is not prohibited to use this test method for research purposes using variations in the number and placement of fasteners. If this is done, the report shall include details of the number and placement of fasteners.

6. Significance and Use

6.1 The wind resistance of sealed asphalt shingles is directly related to the ability of the sealed shingle to resist the force of the wind acting to lift the shingle from the shingle below. This test method employs the measured resistance of the shingle to mechanical uplift after sealing under defined conditions, in a calculation which determines whether this resistance exceeds the calculated force induced by wind passing over the surface of the shingle. Natural wind conditions differ with respect to intensity, duration, and turbulence; while these conditions were considered, and assumptions that specify higher than actual loads are used, extreme natural variations are beyond the means of this test method to simulate.

6.2 Many factors influence the sealing characteristics of shingles in the field; for example, temperature, time, roof slope, contamination by dirt and debris, and fasteners that are misaligned or under driven and interfere with sealing. It is beyond the scope of this test method to address all of these influences. The classification determined in this test method is based on the mechanical uplift resistance determined when representative samples of shingles are sealed under defined conditions before testing.

6.3 The calculations that support the classes in 4.1 apply to buildings of any risk category and any roof slope where all of the following conditions are applicable:

(1) The ASCE 7-22 mapped basic wind speed (3 s gust) for a given building risk category does not exceed the wind speed associated with the applicable shingle class in Section 4,

(2) The wind exposure category is B or C,

(3) The mean roof height does not exceed 60 ft, and

(4) There are no topographic wind speed-up effects.

NOTE 4—The assumptions used in the calculations for the classes in 4.1 cover the requirements for the majority of the asphalt shingle roofs installed. If environmental factors are outside those listed above as used in the calculations for these classes, other calculations are required to determine the required shingle class based on project-specific conditions; refer to Appendix X1 for additional information and calculation examples. Consult the shingle manufacturer for the specific shingle's DC_p, EI, L, L_1, and L_2 values needed to complete these calculations.

NOTE 5—Additional engineering consideration is necessary to verify acceptability of asphalt shingles classified in accordance with this standard for use on Category III and IV buildings for either of the following conditions: (*1*) geographic areas in which the ASCE 7-22 basic wind speed exceeds 312 km/h [194 mph], or (*2*) project sites within the "tornado prone region" and determined to require design for tornado loads in accordance with Chapter 32 of ASCE 7-22.

6.4 The test to determine uplift coefficients is conducted with a wind velocity of 15.6 ± 1.3 m/s [35 ± 3 mph]. Research data obtained during the development of this test procedure, as well as standard wind modeling practices, provides for data extrapolation to other wind speeds. In order to simulate the raised shingle edge that is inherent behavior under high wind exposure, shims are inserted under the windward edge of the