Designation: C1569 – 03 (Reapproved 2016)

Standard Test Method for Wind Resistance of Concrete and Clay Roof Tiles (Wind Tunnel Method)[1]

This standard is issued under the fixed designation C1569; 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 a procedure to determine the resistance of concrete and clay roof tiles to simulated wind effects in a wind-tunnel apparatus. Simulated wind velocities of 70 mph (31 m/s) to 130 mph (58 m/s) are employed.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C43 Terminology of Structural Clay Products (Withdrawn 2009)[3]

C67 Test Methods for Sampling and Testing Brick and Structural Clay Tile

C140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C1167 Specification for Clay Roof Tiles

C1492 Specification for Concrete Roof Tile

C1568 Test Method for Wind Resistance of Concrete and Clay Roof Tiles (Mechanical Uplift Resistance Method)

C1570 Test Method for Wind Resistance of Concrete and Clay Roof Tiles (Air Permeability Method)

2.2 *SBCCI Standards:*

SBCCI SSDT 11 SBCCI Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles

NOTE 1—This standard is based on the International Code Council's ICC/SBCCI SSTD 11 Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles, and work derived from the tile industry's testing programs completed in the Redland Wind Tunnel in the UK.

2.3 *ASCE Standards:*

ASCE 7 Minimum Design Loads for Buildings and Other Structures

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method refer to Terminology C43, and Specifications C1167 and C1492.

4. Significance and Use

4.1 It is known that the observed effects of wind simulated in a wind-tunnel apparatus are related to the effects observed from natural wind. The resistance of tiles to simulated wind in this test relates to the resistance of the tiles to the effects of natural wind when they are applied to a roof. One factor in the resistance of the tiles to the effects of both natural and simulated wind is the method of attachment specified in the manufacturer's instructions. This test method determines the uplift forces acting as a result of the simulated wind when tile are attached to a section of roof deck in accordance with the manufacturer's instructions. Natural wind conditions differ with respect to intensity, duration, and turbulence; these conditions are beyond the means of this test method to simulate.

5. Apparatus

5.1 The test assembly of tiles attached to a section of roof deck is identical to that used in Test Method C1568 (Mechanical Uplift Method) except that tile are not fitted with a load-transfer device.

5.2 The test assembly of tiles attached to the roof deck section is positioned on the floor of the wind tunnel apparatus as shown in Fig. 1.

[1] This test method is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.06 on Roofing Tile.

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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] The last approved version of this historical standard is referenced on www.astm.org.

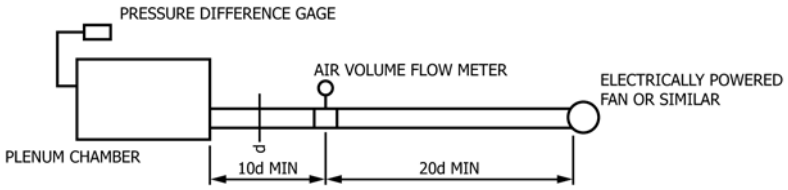

FIG. 1 Test Assembly Location in the Wind Tunnel Apparatus

6. Conditioning

6.1 See the conditioning specified in Test Method C1568 (Mechanical Uplift Method) for each specific installation system being investigated.

7. Procedure

7.1 Install the tile in the same manner as on a roof, in accordance with the manufacturer's instructions, on a small section of roof deck constructed to fit within the wind tunnel apparatus. The rafters shall be capable of being securely anchored to the floor of the wind tunnel apparatus, and the sheathing firmly nailed to the rafters. Roofing underlayment is installed on top of the sheathing and, if required, battens are nailed to the sheathing. The tile, underlayment system, and roof deck section constitute the test assembly.

7.2 The test assembly for the tile installation system being investigated shall be installed in the floor of the wind tunnel apparatus to cover area B in Fig. 1. Area A shall be used to provide the boundary conditions for the flow over Area B. The tiles in Area A shall be firmly fixed to the floor of the wind tunnel apparatus. The tiles along the side of the test assembly shall be sealed with adhesive tape to prevent air flow between the underside of the tiles and the slow moving layer of air on the floor of the wind tunnel. Roof sheathing shall have at least one transverse joint in the test assembly to simulate air leakage from within the building.

7.3 When testing Hip and Ridge tiles, they shall be assembled on the test deck in the same manner that they would be applied to a roof in accordance with the manufacturer's instructions.

7.4 Specimens shall be tested at a surface temperature of 750°F (210°C) plus or minus 50°F (30°C) measured with a surface mounted thermocouple and recorded on a chart to confirm that the surface temperature meets the required test temperature.

7.5 The pressure distribution on tile top of the tile shall he measured by placing 20 pressure taps in a single tile in Area B. The pressure distribution shall be taken above the tile by a suitable pressure measuring device that permits the rapid sampling of the pressure on all pressure taps. The pressure on the bottom surface of the tile shall be measured by pressure taps open to the underside of the tile.

7.6 A plenum chamber shall be installed below the tiles in Area B. The chamber shall be connected via a swing valve to a fan. The test shall be conducted with a pressure in the plenum chamber set to simulate an internal building pressure of +0.2.

7.7 The wind speed over the test assembly shall be measured using a pitot-static tube as shown in Fig. 2. The Pitot-static tube shall be positioned 4 in. (102 mm) above the tiles in the free stream. Pressure tube connections shall be made to the pitot-static tube so that the total pressure head (pitot + static) and the static pressure alone can be measured. The velocity (dynamic) pressure shall be determined by subtracting the static pressure from the total head.

7.8 The wind tunnel shall be taken up to a wind speed of 70 mph (31 m/s) measured at the pitot-static tube position. This speed will he held steady for 60 s and then readings shall be taken. The wind speed will then increase to 80 mph (36 m/s) and be held at this speed for 60 s before the readings are taken. This procedure will be repeated in 10 mph (4 m/s) increments until a wind speed of 130 mph (58 m/s) is reached, the maximum wind speed of the wind tunnel is reached, or the test assembly has failed. If the test assembly fails, the wind speed when the roof covering is removed shall be recorded. If the roof covering is not removed, then the maximum wind speed obtained in the test shall be recorded.

7.9 The net pressures on the tile shall be used to determine the aerodynamic uplift force (overturning moment) on the tile as a function of the velocity pressures of the various wind speeds in the free stream. The wind velocity of the free stream shall be correlated to the fastest mile wind velocity used in the code.

8. Failure

8.1 The failure criteria are described for each specific installation system and tile in Test Method C1568 (Mechanical Uplift Method).

9. Report

9.1 The report shall include the following:

9.1.1 A statement that the test or tests were conducted in accordance with these test procedures. Deviations from these test procedures shall be described in the report and the effect of any deviations on the test results shall be explained in the report.

9.1.2 Descriptions of the framing system, concrete or clay roof tiles, with sketches. The description of the concrete or clay roof tiles shall include as a minimum the following: tile profile; location of nail holes; location of clips; headlap; side laps; thickness; weight.

9.1.3 A detailed description, with sketches, of the test setup, auxiliary apparatus, and equipment.

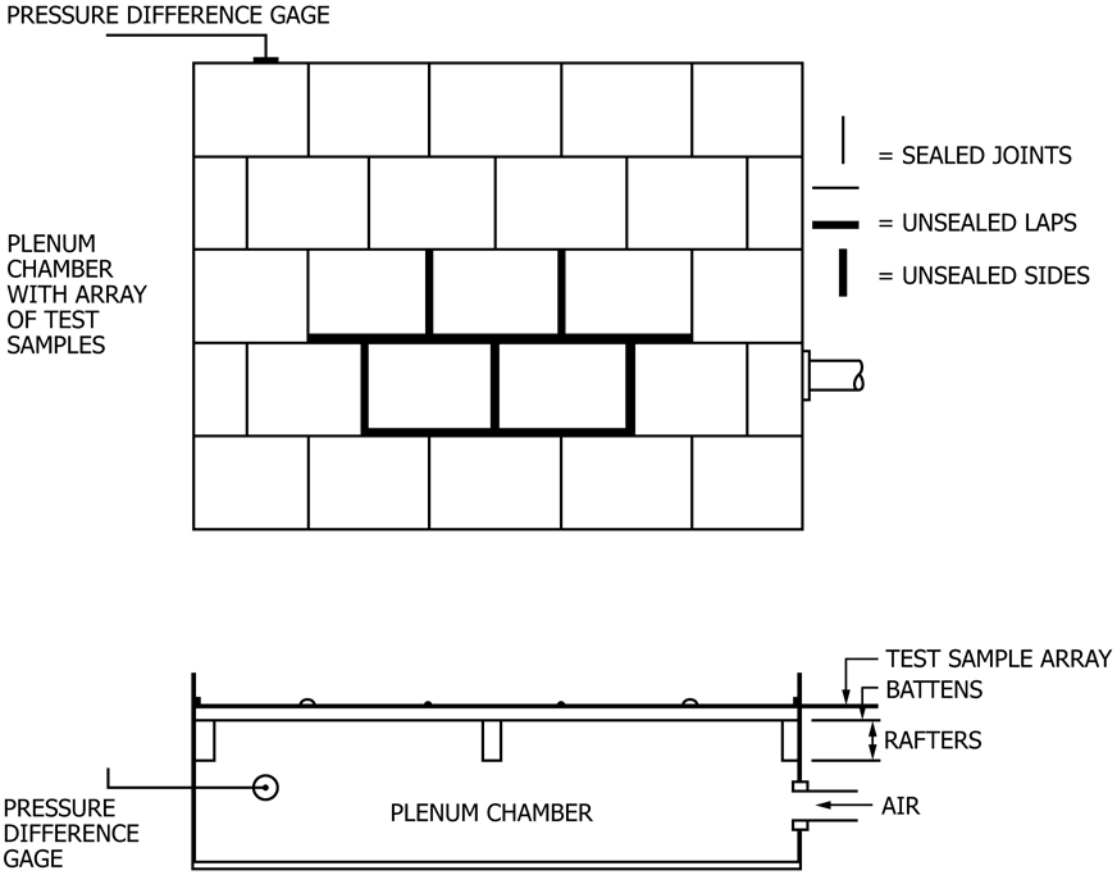

FIG. 2 Pitot-Static Tube

9.1.4 *All Data*—This should include pertinent observations on the behavior of the concrete or clay roof tiles during the test including as a minimum the following:

9.1.4.1 *Failure Mode*—Specify the criteria that determined failure (see Test Method C1568, Mechanical Uplift Method). When adhesive systems or mortar Systems are tested, specify the type of separation which occurred The separation of the system may be (*1*) between the adhesive or mortar patty and the roof tile, (*2*) within the adhesive or mortar patty, (*3*) between the adhesive or mortar patty and the underlayment, or (*4*) separation of the underlayment.

9.1.4.2 Adhesive and mortar system mixing, installation and curing details.

9.1.4.3 Conditioning details.

9.1.4.4 Quantity of adhesive or mortar.

9.1.4.5 The contact area between tile and adhesive or mortar system.

9.1.5 The maximum wind speed at failure, if the roof covering is removed.

9.1.6 The maximum wind speed recorded during the test, if no failure occurs.

9.1.7 The calculated aerodynamic overturning moment (uplift resistance) of the tile.

9.1.8 Analysis and calculations.

10. Precision and Bias

10.1 *Precision*—It is not possible to specify the precision of the procedure in Test Method C1570 (Wind Tunnel Method) because the wind tunnel is a unique structure used only to develop data and criteria for use in Test Method C1568 (Mechanical Uplift Method), and to facilitate correlation of tile uplift resistance to the speed of the simulated wind.

10.2 *Bias*—No information can be presented on the bias of the procedure in Test Method C1570 (Wind Tunnel Method) for measuring wind resistance of roof tiles because no material having an accepted reference value is available.

11. Keywords

11.1 clay roof tile; concrete roof tile; plenum chamber; simulated wind; uplift resistance; wind resistance; wind tunnel method