



Designation: E 2099 – 00

Standard Practice for the Specification and Evaluation of Pre-Construction Laboratory Mockups of Exterior Wall Systems¹

This standard is issued under the fixed designation E 2099; 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 standard practice describes procedures and documentation to assist in the specification and evaluation of pre-construction laboratory mockups of exterior wall systems.

1.2 This standard practice addresses design and construction of the mockup; observation during mockup construction and testing; evaluation of the mockup test results; and documentation of the mockup and testing process. Coordination is required between the parties involved in the design, construction and testing of the mockup to facilitate this process. Documentation should convey the results of pre-construction mockups from one party to others at appropriate stages in the process.

1.3 This standard practice recommends the selection and order of individual tests performed on the mockup in the absence of a specific test order.

1.4 This standard practice recommends a protocol for exchange of information between participants in the pre-construction mockup process.

1.5 Responsibility for specific activities is recommended by this standard. This practice is intended to provide a default structure in the absence of the assignment of specific responsibilities by the specifying authority.

2. Referenced Documents

2.1 ASTM Standards:

E 283 Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen²

E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference²

E 331 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference²

E 547 Test Method for Water Penetration of Exterior Win-

dows, Curtain Walls and Doors by Cyclic Static Air Pressure Difference²

E 631 Terminology of Building Constructions²

E 1233 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential²

2.2 AAMA Standards:

AAMA 501, Methods of Test for Exterior Walls³

AAMA 501.1, Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration using Dynamic Pressure³

AAMA 501.4, Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts³

AAMA 501.5, Test Method for Thermal Cycling of Exterior Walls³

AAMA CW-DG-1, Testing of Aluminum Curtain Walls, *Curtain Wall Design Guide Manual*³

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology E 631, unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard: 00

3.2.1 *pre-construction mockup*—a full-size representation of the proposed exterior wall system built before the exterior wall design is completed in order to study proposed construction details, test for performance and possibly judge appearance of the exterior wall system.

3.2.2 *specifier*—the architect or professional design party responsible for the design of the exterior wall system.

3.2.3 *builder*—the builder of the mockup and the exterior wall system.

3.2.4 *test agency*—the selected agency to conduct the required tests.

4. Significance and Use

4.1 Exterior wall systems require time to design, fabricate, construct and test. Mockups are a fullsize representative portion of the proposed exterior wall system built to study proposed construction details, test for performance and may be

¹ This test method is under the jurisdiction of ASTM Committee E-06 on Building Constructions and is the direct responsibility of Subcommittee E06.55 on Exterior Building Wall Systems.

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² *Annual Book of ASTM Standards*, Vol 04.11.

³ Available from American Architectural Manufacturers Association, Schaumburg, IL.

used to judge appearance of the exterior wall system. The project schedule shall allow time to design, construct and test the pre-construction mockup and to implement any design changes, fabrication changes, or modifications of planned construction procedures, before construction of the exterior wall system commences.

4.2 Performance testing of pre-construction mockups verifies compliance with specified standards and design criteria. Performance tests in separate ASTM or other industry standards, are intended to represent the effects of environmental conditions, such as wind, rain, and temperature extremes. The tests provide a measure of the performance of the proposed exterior wall system under specific and controlled conditions. The specified design and specification of the pre-construction mockup must be appropriate for the performance test requirements. Separate tests may be required for individual mockup materials or components.

4.3 Pre-construction mockup specimens require input from Specifier, Builder and Test Agency. Coordination of their efforts facilitates this process. Documentation should convey the results of preconstruction mockups from one party to others at appropriate stages in the process.

4.4 The referenced standards provided in this practice identify the historical standards typically utilized in pre-construction performance testing. This practice allows for the development and use of other project specific test procedures for various components that encompass exterior wall systems.

5. Design

5.1 The Specifier is responsible for the requirements of this section, unless stated otherwise.

5.2 Provide sufficient information on the design documents to describe the materials, details and performance testing requirements of the mockup.

5.3 Mockup Materials

5.3.1 All framing and cladding elements of the exterior wall system in accurate full size, orientation and configuration.

5.3.2 Color and finish of materials, if the appearance of the mockup is to be judged.

5.3.3 Joints between components.

5.3.4 Thermal insulation, if thermal testing is specified.

5.3.5 Structural support and attachment of the exterior wall system to the building frame.

NOTE 1—Tolerances between elements of the exterior wall system and the building support should be considered and tested in a “worst-case” condition in the mockup.

5.4 *Mockup Systems*—Elements of the exterior wall system that are designed to control:

5.4.1 Air infiltration.

5.4.2 Water penetration.

5.4.3 Wind pressure.

5.4.4 Movements of wall system due to thermal effects, volumetric changes or building frame movements.

5.4.5 Seismic movements, if the building is in a seismically active region.

5.5 *Mockup Size*—The mockup shall be of sufficient size to represent the following typical elements of the exterior wall system including interior and exterior comers where appropri-

ate. Refer to Section 8 of E 283, E 330 and E 331 for requirements of the test specimens.

NOTE 2—Confirm the maximum size mockup that the Test Agency can accommodate. In some projects, multiple mockups may be necessary to test all desired conditions of the project.

5.5.1 *Height*—Minimum one typical floor height plus an additional height so that typical horizontal conditions are represented. For exterior wall systems that have multi-floor structural elements or water control systems that occur on alternate floors, the mockup shall include the height of the minimum number of floors to represent one repetition of the exterior wall design.

NOTE 3—Typical details that occur adjacent to floor level, such as horizontal gutters and anchorage to the building, should not be located immediately adjacent to the mockup edge, since this creates a “non-job” condition that can lead to misinterpretation of mockup test results.

5.5.2 *Width*—Minimum two repetitive widths of the exterior wall system plus an additional width so that typical vertical conditions are represented. Other conditions, such as corners, end conditions and projecting bays shall be included, if practical.

5.6 *Mockup Details*—Provide the following details in mockup design drawings:

5.6.1 Illustrate the elevation view of the mockup in one of the two following ways:

5.6.1.1 Designate an area of the elevation drawings which represents the materials, height and width of the mockup.

5.6.1.2 Provide a separate mockup elevation drawing that represents the materials, height and width of the mockup. The mockup need not be an actual representation of one area of the exterior wall system, but instead can combine the parts of the exterior wall system in a manner that represents typical conditions.

5.6.2 Illustrate the mockup in section and detail views sufficient to describe the details of the mockup construction.

5.7 *Mockup Testing Requirements*—Specify the following testing requirements:

5.7.1 *Test Load*—Designate test loads for the mockup based on design wind pressures that are consistent with the corresponding area of the actual building.

NOTE 4—Mockup design wind pressures are the typical highest wind pressures for the building although not necessarily the highest “hot spot” wind pressures.

5.7.2 *Tests*—List the ASTM standard, other standard tests, or custom test that are to be performed on the mockup. For each test listed, identify the test procedure, test parameters, and pass/fail criteria, by reference to published standards or by providing detailed descriptions. Provide the following information for each of the following test standards:

5.7.2.1 *ASTM E 330*:

5.7.2.1.1 The positive and negative test loads, the duration of maximum load and the number and location of deflection measurements, as required in Section 10 of ASTM E 330. If the number and location of deflection measurements is not specified, the Test Agency shall recommend the number and location of deflection measurements.