Designation: E 1803 – 99

Standard Test Methods for Determining Structural Capacities of Insulated Panels[1]

This standard is issued under the fixed designation E 1803; 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 These test methods cover procedures for determining strength and stiffness properties under specified loads of prefabricated insulated panels. These specified loads include:

1.1.1 Transverse loads,
1.1.2 Axial loads,
1.1.3 Shear loads,
1.1.4 Uplift loads,
1.1.5 Cold creep,
1.1.6 Impact loads, and
1.1.7 Concentrated loads.

1.2 Structural insulated panels are intended for use in permanent building structures.

1.3 These test methods are not intended for quality control purposes and do not evaluate the individual components of the structural insulated panels.

1.4 These test methods are not intended to measure dimensional stability.

1.5 The text of this standard references notes and footnotes, excluding tables and figures, which provide explanatory information. These notes and footnotes shall not be considered requirements of the standard.

1.6 *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:*

D 1037 Methods for Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials[2]
E 72 Methods of Conducting Strength Tests of Panels for Building Constructions[3]
E 455 Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings[3]
E 575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connectors, and Assemblies[3]
E 631 Terminology of Building Constructions[3]
E 695 Method for Measuring Relative Resistance of Wall, Floor, and Roof Constructions to Impact Loading[3]

3. Terminology

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

3.2 *Definition of Term Specific to This Standard:*

3.2.1 *insulated panel, n*—a prefabricated assembly consisting of an insulating core with a minimum thickness of 38 mm (1.5 in.) laminated between two facings.

4. Summary of Test Methods

4.1 Insulated panels are tested using various structural loading methods to determine their strength and stiffness properties for use as elements in permanent structures.

5. Significance and Use

5.1 Insulated panels are used as roof, wall, and floor components in building structures. The structural performance properties need to be determined for design purposes.

TEST METHODS

6. Transverse Loads for Wall, Roof, and Floor Panels

6.1 Insulated panels shall be tested in accordance with Methods E 72, Section 11, with the following modifications:

6.2 Support conditions shall closely represent actual construction and the bearing area shall be the minimum area required by the manufacturer.

6.3 Incremental loads shall be applied.

6.3.1 The deflection shall be recorded at initial load and after each increase in load increment.

6.4 After 0.75, 1.50, and 2.0 times the anticipated design load is achieved, decrease the load to the initial load and record the set. Continue incremental loads and record the deflections at each load until further loading risks damage to the deflection measuring devices.

[1] These test methods are under the jurisdiction of ASTM Committee E-6 on Performance of Buildings and are the direct responsibility of Subcommittee E06.11 on Horizontal and Vertical Structures/Structural Performance of Completed Structures.

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[2] *Annual Book of ASTM Standards*, Vol 04.10.

[3] *Annual Book of ASTM Standards*, Vol 04.07.

6.5 Increase the load continuously until the maximum load that can be applied to the panel is determined.

7. Axial Loads for Load Bearing Wall Panels

7.1 Insulated panels shall be tested in accordance with Methods E 72, Section 9, with the following modifications:

7.2 Bearing conditions at the bottom of the panel shall be according to manufacturers' requirements.

7.3 A minimum of one gage at midwidth is required to measure axial displacement and a minimum of one gage located at midspan is required to measure transverse displacement. See Fig. 1.

8. Racking Load for Wall Systems

8.1 Insulated panels shall be tested in accordance with Methods E 72, Section 14, with the following modifications:

8.2 This test is conducted using the structural insulated panel manufacturer's method for attaching the panels together and for attaching the panels to the top and bottom plates. The panels are not attached to an external prefabricated framework. Apply the load through the load beam to the top plate.

8.3 *Test Specimens*:

8.3.1 The test specimen shall be a minimum of 2.4 by 2.4 m (8 by 8 ft) consisting of a minimum of two 1.2 by 2.4 m (4 by 8 ft) panels. It is the intent of this test procedure to evaluate the panels and the attachment system.

8.3.2 The method of installation shall be according to the manufacturer's requirements. Fasteners or adhesives, or both, shall be of the type and spacing intended for actual construction. Vertical boundary members shall be installed per the manufacturer's requirements at the ends of shear walls. See Fig. 2.

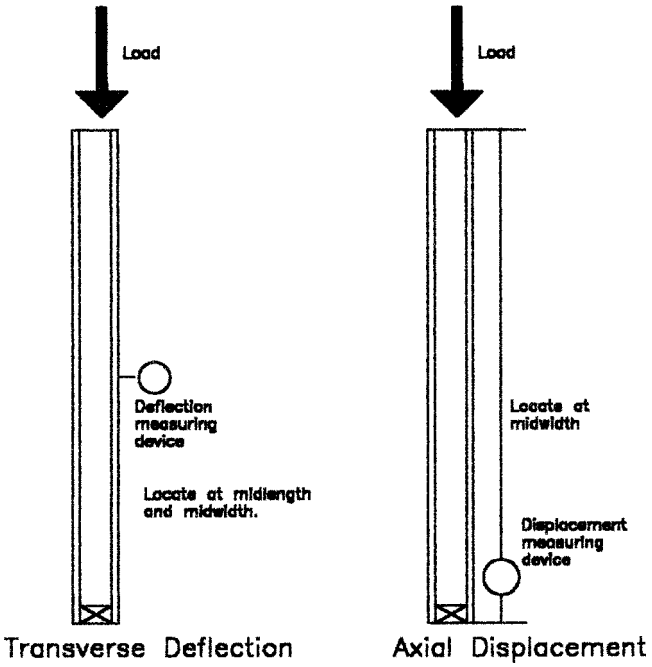

FIG. 1 Transverse Deflection and Axial Displacement

9. Diaphragm Testing for Floor or Roof Constructions

9.1 Insulated panels shall be tested in accordance with Method E 455 with the following modifications:

9.2 *Cantilever Diaphragm and Simple Beam Diaphragm*:

NOTE 1—The test assembly will be at least 2.4 by 4.8 m (8 by 16 ft) if the smallest element is 1.2 by 2.4 m (4 by 8 ft).

9.2.1 Add to 4.1.3.1 of Method E 455: the diaphragm shall contain not less than four individual elements.

9.2.2 Modify paragraph 7.2 to read at 0.75, 1.5, and 2 times the anticipated design load remove the load and measure the recovery after 5 min. Delete the 10 min requirement to reach full design load.

NOTE 2—Because framing inside of sandwich panels is not accessible for inserting and tightening nuts, washers, and bolts, small access openings through one or both faces may be required. These are acceptable provided qualification tests conducted with the holes in place.

10. Uplift Resistance for Roof Panel Attachment

10.1 Insulated panels and the fastening system shall be tested in accordance with Methods D 1037 for fastener head pull through. Sections 54 through 60 of Methods D 1037 shall be used with the following modifications:

10.1.1 Specimens shall be tested in the dry condition only.

10.1.2 Fasteners of the type intended for use in service shall be tested.

11. Cold Creep for Roof and Floor Insulated Panels

11.1 *Introduction*—This test method covers a procedure for determining creep resistance of insulated panels when loaded in flexure at ambient conditions.

11.2 *Significance*—The determination of the creep rate provides information on the behavior of insulated panel construction under constant load.

11.3 *Size*:

11.3.1 The panel shall be representative as to material and workmanship and shall be as large as practicable to minimize the effect of variations in the material and workmanship.

11.3.2 The length, width, and thickness of the panel shall be chosen to conform to the length or height of the panel in actual use.

11.3.3 The width of the specimen shall, insofar as possible, include several of the principal load carrying members such as stringers, ribs, etc., to ensure that the behavior under load will simulate that under service conditions. The nominal width for all specimens shall be the lesser of 1.2 m (4 ft) or full panel width.

11.3.4 Support conditions shall closely represent actual construction and the bearing area shall be the minimum area required by the manufacturer.

11.3.5 Panels constructed of materials, such as concrete and masonry (brick, structural clay tile, concrete block) for which the structural properties depend upon the age of the specimen, shall be tested not less than 25 days nor more than 31 days after fabrication. This age requirement also applies to plastered and stuccoed constructions. All other specimens shall age a minimum of 7 days prior to testing.

11.4 *Loading*:

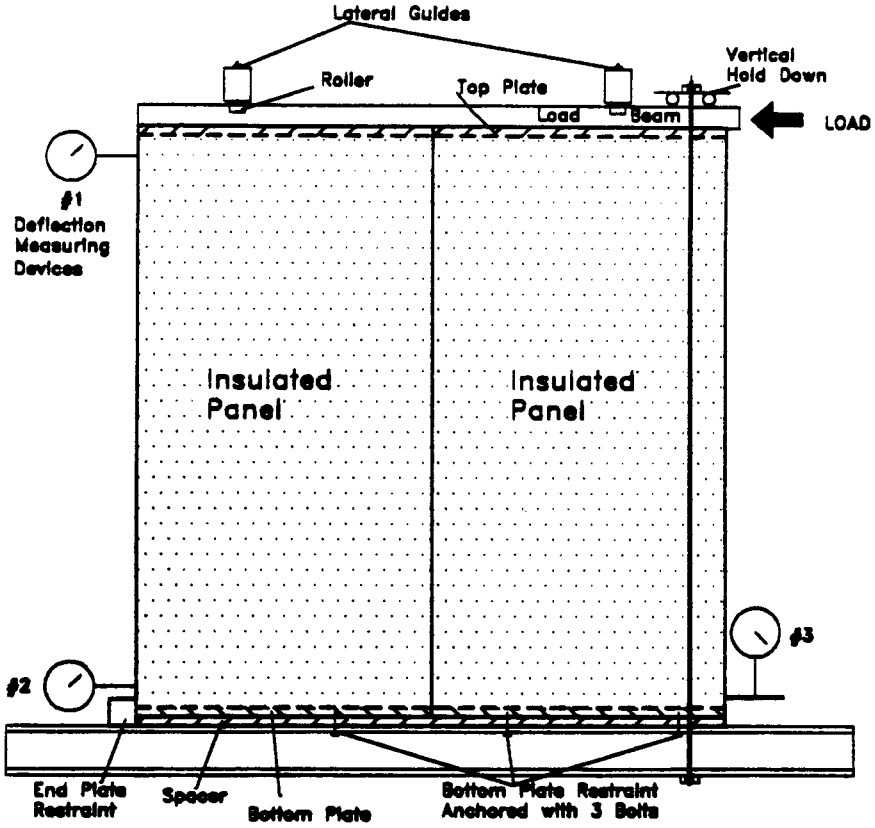

FIG. 2 Racking Load Test Assembly

11.4.1 Predetermined weights to allow for uniform distribution of loads shall be used. The maximum design load limited by either strength or deflection shall be used.

11.4.2 *Application of Load*—The design load shall be applied uniformly over the entire panel in a time period not to exceed 5 min.

11.4.3 *Duration of Load*—Design load shall be left in place for a minimum of 30 days.

11.5 *Deflection Measurements*—Measure the midspan deflection accurately to define the load versus deflection relationship, and report at least to the nearest 0.25 mm (0.01 in.). The deflection measuring apparatus shall be capable of measuring deflection to the nearest 0.25 mm (0.01 in.). Initial deflection reading at no load and the deflection immediately after design load has been applied shall be recorded. Deflection readings shall be taken hourly for the first 6 h and at 24-h intervals for the remainder of the 30 days. Complete deflection versus time recordings shall be maintained. A final deflection shall be recorded 24 h after the 30 day load has been removed.

11.6 *Report*:

11.6.1 Results of each test shall be shown graphically. Deflection shall be shown as ordinates and time as abscissas for each test on semi-log graph paper. A smooth curve is drawn among the average points to show the average behavior of the construction.

11.6.2 The test report is to be prepared in accordance with Practice E 575.

12. Impact Loads for Insulated Panels Wall, Roof, and Floor

12.1 Impact loads for insulated panels shall be applied in accordance with Method E 695.

12.2 The insulated panel(s) shall be attached to supporting members in a manner to closely represent field installation. The bearing shall be the minimum recommended by the manufacturer.

12.3 Test wall panels by roof and floor method.

12.4 The mass of the bag shall be 27 kg (60 lb) ± 1 %.

12.5 The bag shall be dropped at midspan and near the supports. The drops shall be continued until failure or a predetermined maximum height is achieved.

13. Concentrated Loads for Floor Panels

13.1 *Introduction*—To determine the resistance of panels to rigid concentrated loads, consideration of load application shall be addressed for simply supported panels. Load locations include near supports for maximum shear and at the center of the span for maximum moment and deflections. In addition, supplemental tests evaluating the concentrated load over unreinforced, unsupported edges is required.

13.2 The minimum number of insulated panels to be tested is three.

13.3 Position panels horizontally spanning the design span and supported at the ends with the bearing required by the manufacturer. The application of concentrated load requires a rigid plate of steel or other acceptable material 0.76 m (30 in.)

square. The plate shall be designed to resist failure or deformation exceeding 6 mm (¼ in.) in 0.76 m (30 in.) when subjected to the expected ultimate load. The load is applied through a self-aligning device to assure uniform application.

13.4 *Deflection Readings*—Two deflection gages with a minimum accuracy of 0.25 mm (0.01 in.) shall be placed at midspan along the longitudinal panel edges. For concentrated loads located near supports, place two additional deflection gages along the longitudinal edge in line with the concentrated load.

13.5 *Procedure*—The load is applied at a speed of 2.5 mm (0.1 in.) per minute up to a maximum 2727-kg (6000-lb). Deflections readings shall be taken at 227-kg (500-lb) intervals.

13.6 *Report*—A load versus deflection plot shall be developed for each insulated panel. Record the ultimate load along with the reason for terminating loading.

14. Precision and Bias

14.1 No statement is made either on the precision or on the bias of these test methods due to the variety of materials and combinations of materials involved.

15. Keywords

15.1 axial; creep; impact; insulated panels; shear; uplift