



# Standard Test Methods for Determining Strength Capacities of Structural Insulated Panels<sup>1</sup>

This standard is issued under the fixed designation E1803; 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 These test methods cover procedures for determining strength properties under specified loads for rigid-faced structural insulated panels. These test methods are appropriate for structural insulated panels with rigid facings having a minimum thickness of 0.16 in. (4 mm) and an insulating core with a minimum thickness of 1.5 in. (38 mm). These specified loads include:

- 1.1.1 Transverse loads,
- 1.1.2 Axial loads,
- 1.1.3 Shear loads,
- 1.1.4 Diaphragm loads,
- 1.1.5 Uplift loads,
- 1.1.6 Long Term loads
- 1.1.7 Impact loads, and
- 1.1.8 Concentrated loads.

1.2 Structural insulated panels are intended to resist structural loads 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 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.

1.7 *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*:<sup>2</sup>

**D1037** Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

**E72** Test Methods of Conducting Strength Tests of Panels for Building Construction

**E455** Test Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings

**E575** Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies

**E631** Terminology of Building Constructions

**E695** Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading

## 3. Terminology

3.1 *Definitions*—For definitions of general terms related to building construction used in this test method, refer to Terminology **E631**.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *structural insulated panel (SIP), n*—a prefabricated assembly consisting of an insulating core laminated between two rigid facings suitable to resist structural loads in permanent building structures.

## 4. Summary of Test Methods

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

## 5. Significance and Use

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

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee **E06** on Performance of Buildings and are the direct responsibility of Subcommittee **E06.11** on Horizontal and Vertical Structures/Structural Performance of Completed Structures.

Current edition approved March 1, 2014. Published March 2014. Originally approved in 1996. Last previous edition approved in 2006 as E1803 – 06. DOI: 10.1520/E1803-14.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## TEST METHODS

### 6. Transverse Loads for Walls, Roofs, and Floors

6.1 SIPs shall be tested in accordance with Test Methods E72, 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.

6.5 Increase the load continuously until the maximum load is determined.

### 7. Axial Loads for Walls

7.1 SIPs shall be tested in accordance with Test Methods E72, Section 9, with the following modifications:

7.2 Bearing conditions at the bottom of the SIP 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. Shear Loads for Walls

8.1 SIPs shall be tested in accordance with Test Methods E72, Section 14, with the following modifications:

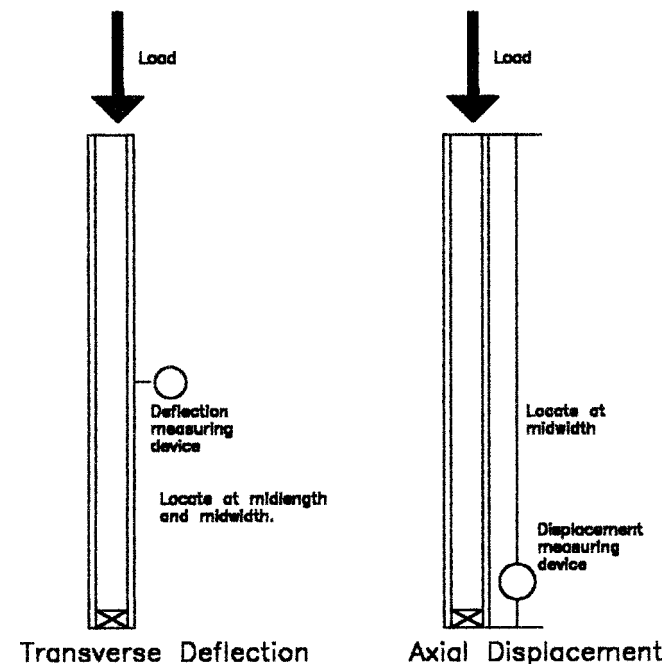


FIG. 1 Transverse Deflection and Axial Displacement

8.2 The SIP manufacturer's method for attaching the SIPs together and for attaching the SIPs to the top and bottom plates shall be followed. The SIPs shall not be 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 8 by 8 ft (2.4 by 2.4 m) consisting of a minimum of two 4 by 8 ft (1.2 by 2.4 m) SIPs.

8.3.2 Fasteners or adhesives, or both, as required by the manufacturer, shall be of the type and spacing intended for actual construction. Boundary members shall be installed per the manufacturer's requirements at the ends of SIP assembly. See Fig. 2.

### 9. Diaphragm Loads for Floors or Roofs

9.1 SIPs shall be tested in accordance with Test Method E455 with the following modifications:

#### 9.2 Cantilever Diaphragm and Simple Beam Diaphragm:

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

9.2.1 Add to 6.1 of Test Method E455: the diaphragm shall contain not less than four individual elements.

9.2.2 Modify paragraph 9.2 of Test Method E455 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 SIPs 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 Panels

10.1 The SIPs and the manufacturer's recommended fastening system shall be tested in accordance with Test Methods D1037 for fastener head pull through. Section 15 of Test Methods D1037 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. Long-Term Loads for Roofs and Floors

11.1 *Introduction*—This test method covers a procedure for determining flexural creep resistance of SIPs.

11.2 *Significance*—The determination of the deflection under constant loads, or creep, provides information on the behavior of SIP construction over long time periods.

#### 11.3 Size:

11.3.1 The SIP 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 SIP shall be chosen to conform to the length or height of the SIP 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

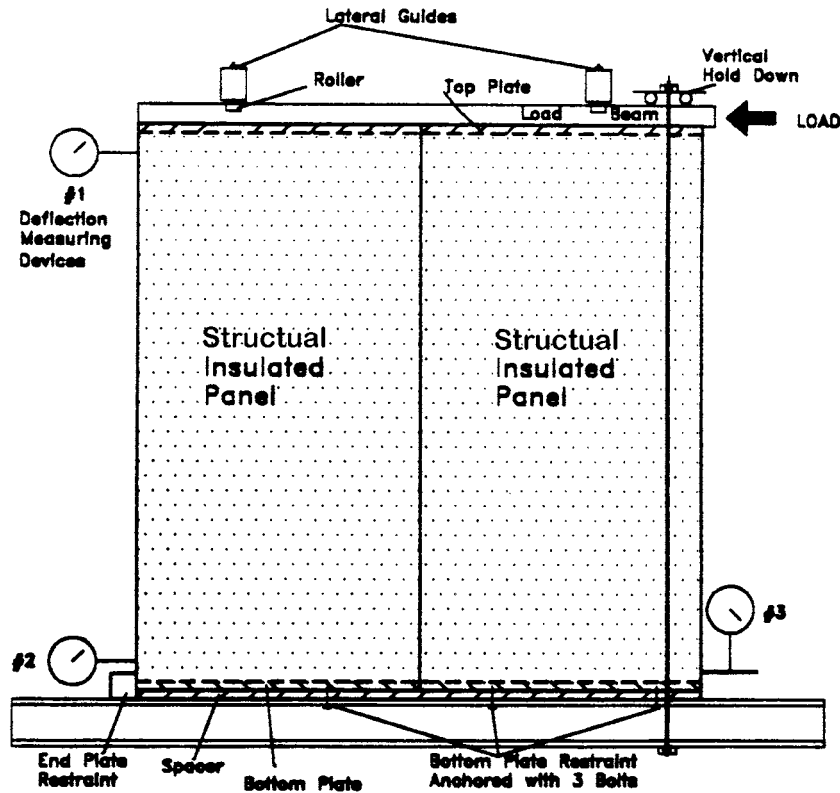


FIG. 2 Racking Load Test Assembly

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 4 ft (1.2 m) 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.

#### 11.4 Loading:

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 SIP 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 0.01 in. (0.25 mm). The deflection measuring apparatus shall be capable of measuring deflection to the nearest 0.01 in. (0.25 mm). 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 E575.

## 12. Impact Loads for Walls Roofs, or Floors

12.1 Impact loads for SIPs shall be applied in accordance with Test Method E695.

12.2 The SIPs 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 SIPs by roof and floor method.

12.4 The mass of the bag shall be 60 lb (27 kg)  $\pm$  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 Floors

13.1 *Introduction*—To determine the resistance to rigid concentrated loads, consideration of load application shall be addressed for simply supported SIPs. 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 SIPs 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 30 in. (0.76 m) square. The plate shall be designed to resist failure or deformation exceeding  $\frac{1}{4}$  in. (6 mm) in 30 in. (0.76 m) 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 0.01 in. (0.25 mm) 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 0.1 in. (2.5 mm) per minute up to a maximum 6000-lb (2727-kg). Deflections readings shall be taken at 500-lb (227-kg) intervals.

13.6 *Report*—A load versus deflection plot shall be recorded. 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; shear; structural insulated panel; uplift

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