

## **ANSI/ABTG FS 100-20xx**

# **Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies**

PROPOSED REVISIONS FOR COMMITTEE BALLOT & PUBLIC REVIEW  
(revisions shown in underline/strike-out)

PENDING CONSENSUS PROCESS COMPLETION & APPROVAL BY ANSI

## Acknowledgements

This *American National Standard* establishes wind pressure resistance requirements for foam plastic insulating sheathing (FPIS) products used as exterior wall sheathing, including use as continuous insulation in exterior wall covering assemblies for the purpose of demonstrating wind pressure performance. This includes performance testing, analysis and quality control procedures.

In this endeavor, ABTG worked in concert with the Foam Sheathing Committee (FSC) of the American Chemistry Council whose mission is to develop solutions to building code issues and promote the proper technical use of foam sheathing to the construction industry. Thanks are extended to the members of FSC and the FS Project Committee for their hard work and commitment to achieving this consensus standard.

## Revision History

The first edition of ANSI/ABTG FS100 was completed in 2012 and re-affirmed in 2018. The standard is referenced in the International Building Code and the International Residential Code as a basis for evaluating and establishing the wind pressure resistance of FPIS products. This updated version of the standard contains the following revisions:

- Various editorial clarifications and improvements,
- Added reference to the ANSI/ABTG FS200.1 standard in Section 1.3,
- Updated reference standards listed in Section 2.0,
- Added a definition for *continuous insulation* and updated the *EIFS* definition in Section 3.0,
- Replaced Table 1 in Section 4.1 to align with newer ASCE 7 wind loads,
- Updated installation requirements in Section 5.0 to align with requirements in newer model building codes,
- Revised Section 6.1 and replaced Table 2 with a new Figure 1 to clarify wind pressure testing requirements based on user feedback,
- Clarified test specimen size requirements in Section A.1.1, and
- Clarified preload requirements and loading requirements in Section A.2.3.

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**ANSI/ABTG FS 100-20xx12 (R2018)****Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies***{formerly ANSI/SBCA FS 100-2012 (R2018)}*

*Note: User notes are not mandatory parts of this standard, but are provided to give the user some guidance on the intent of the mandatory language.*

**1.0 General**

**1.1 Scope.** This standard establishes wind pressure resistance requirements for *Foam Plastic Insulating Sheathing (FPIS)* products used as *exterior wall sheathing*, including use as continuous insulation ~~continuous insulation~~, in exterior wall covering assemblies.

1.1.1 *FPIS* products shall resist design transverse wind loads acting on exterior wall assemblies as provided in Section 4.0, except as limited in Section 1.2.

1.1.2 Section 6.0 provides requirements for establishment and use of wind pressure resistance values for *FPIS* products in *blocked* and *unblocked* installations.

1.1.3 Quality assurance shall be provided by an *approved agency* in accordance with Section 7.0.

*User Note: For information on the definition of continuous insulation, see ASHRAE 90.1.*

**1.2 Limitations.** The scope of this standard is limited to exterior applications where the *FPIS* product is used as an *exterior wall sheathing* that is required to resist transverse wind loading only. The following applications are excluded from the scope of this standard:

1. Applications of *FPIS* products that are intended to provide structural functions in addition to transverse wind load resistance of a wall assembly, such as in-plane racking shear resistance (wall bracing), in-plane uplift resistance, and buckling restraint of studs or columns.
2. Applications of *FPIS* products used in contact with and over sheathing and its fastening capable of independently resisting wind loads (see *over-sheathing*), used in contact with and under sheathing and its fastening capable of independently resisting wind loads, used on interior building walls, or used on the interior side of exterior walls behind an interior finish material.
3. Applications where *FPIS* is used as part of an *Exterior Insulating Finish System*.

**1.3 Additional Considerations.** Wall assemblies including *FPIS* products shall comply with the applicable building code and, where adopted, the requirements of ANSI/ABTG FS200.1.

*User Note: Refer to Commentary C1.3 for guidance on end use and code compliance considerations related to use of *FPIS* products on exterior wall assemblies, including cladding attachment, fire safety, thermal resistance, water resistive barrier performance, and wind-borne debris resistance.*

**1.4 Material Requirements.** *FPIS* products used in accordance with this standard shall comply with the following material standards, as applicable, and the additional quality assurance requirements of Section 7.0:

- *Expanded polystyrene (EPS)* – ASTM C578
- *Extruded polystyrene (XPS)* – ASTM C578
- *Polyisocyanurate (Polyiso)* – ASTM C1289

**1.5 Alternative Methods of Compliance.** The provisions of this standard are not intended to prevent use of alternative methods of compliance as permitted by the applicable building code. Alternate methods shall comply with the intent of this standard and shall be at least the equivalent of that prescribed in this standard for wind pressure resistance qualification and quality assurance.

## 2.0 Reference Standards

ASCE 7-22~~05~~ – *Minimum Design Loads for Buildings and Other Structures*

ASCE 37-14(R2019)~~02~~ – *Design Loads on Structures during Construction*

ASTM C203-05a(2017)~~5a~~ – *Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation*

ASTM C578-23~~11~~ – *Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*

ASTM C1289-22~~11~~ – *Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board*

ASTM C1396/C1396M-17-11 – *Standard Specification for Gypsum Board*~~Wallboard~~

ASTM E330-14(2021)~~09~~ – *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

ASTM E1233/E1233M-14(2021)-~~06~~ – *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential*

DOC PS2-18~~10~~ – *Performance Standard for Wood-Based Structural-Use Panels*

ANSI/ABTG FS200.1-22 - *Standard for Use of Foam Plastic Insulating Sheathing (FPIS) in Building Envelopes: Above-grade Walls*

## 3.0 Definitions

**Approved Agency:** An established independent, qualified and recognized agency regularly engaged in conducting tests or furnishing independent (third-party) inspection services.

**Blocked:** Refers to *FPIS* installation practice whereby all edges are supported on a framing member or blocking. See also “unblocked”.

**Continuous Insulation (c.i.):** Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. For the purposes of this standard, it is installed on the exterior side of an exterior wall assembly.



**Exterior Insulating Finish System (EIFS):** A nonstructural, nonload-bearing exterior wall cladding system that consists of an insulation board attached either adhesively or mechanically, or both, to the substrate; an integrally reinforced base coat; and a textured protective finish coat. A lightweight synthetic wall cladding that includes foam plastic insulation and thin synthetic coatings.

**Exterior Wall Covering:** A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, veneers, siding, exterior insulation and finish systems, architectural trim and embellishments such as cornices, soffits, fascia, gutters and leaders.

**Exterior Wall Sheathing:** A material in board or panel form attached directly to wall framing on the exterior side of an exterior wall assembly.

**Extruded Expanded Polystyrene (XPS) Thermal Insulation:** A cellular plastic product, with or without facings, manufactured in a one-stage process by extrusion and expansion of the base polymer in the presence of blowing agent(s) resulting in a product that is rigid with a closed cellular structure. Refer to ASTM C578 for additional information.

**Faced Rigid Cellular Polyisocyanurate (Polyiso) Thermal Insulation:** A cellular plastic product formed using polyurethane-modified polyisocyanurate encapsulated between *facer* materials. Refer to ASTM C1289 for additional information.

**Facer:** An integral material permanently applied to the face of one or both surfaces of the *FPIS* product evaluated in accordance with this standard.

**Foam Plastic Insulating Sheathing (FPIS):** For the purpose of this standard, Foam Plastic Insulating Sheathing is a wall sheathing material in board or panel form consisting of foam plastic material complying with ASTM C578 or ASTM C1289, including *facers* as applicable, with a minimum thermal resistance of  $R_2$  ( $\text{ft}^2 \text{ } ^\circ\text{F h/Btu}$ ) [ $\text{RSI } 0.35 \text{ m}^2\text{-K/W}$ ] at  $75^\circ\text{F}$  ( $24^\circ\text{C}$ ) mean temperature.

**Mean Roof Height:** The average of the height of the roof at the eave and the height at the highest point on the roof surface, except that, for roof angles less than or equal to  $10^\circ$ , the mean roof height is permitted to be taken as the roof eave height. Height is measured relative to the grade plane.

**Molded Expanded Polystyrene (EPS) Thermal Insulation:** A cellular plastic product, with or without facings, manufactured from pre-expanded polystyrene beads subsequently molded into desired shapes and sizes resulting in a product that is rigid with closed cellular structure. Refer to ASTM C578 for additional information.

**Over-sheathing:** Application of *FPIS* over and directly on the surface of wall sheathing material or solid wall construction, such as masonry or concrete, whereby the substrate is capable of resisting the full design transverse wind load required by the applicable building code or latest edition of the ASCE 7 standard.

**Sample:** A set of *specimens* analyzed together.

**Specimen:** The individual test piece or assembly.

**Transverse Wind Pressure Resistance:** Resistance to wind pressure acting perpendicular (transverse) to the plane of a wall as differentiated from other wind load effects, such as in-plane (racking) shear force acting horizontally in the length direction of a wall, or wind uplift force acting vertically on a wall.

**Unblocked:** Refers to an *FPIS* installation whereby an edge is not supported by blocking or framing members.

## 4.0 Design Wind Load Requirements

**4.1 Prescribed Design Wind Loads.** *FPIS* shall resist the component and cladding positive and negative design wind loads shown in Table 1 as applicable to the design wind speed and wind exposure of the intended end-use.

[DELETE TABLE 1 AND REPLACE AS FOLLOWS WITH REVISED FOOTNOTES:]

**TABLE 1: Components and Cladding Design Wind Pressure Loads (PSF)<sup>1,2,3,4</sup>**

Design Wind Speed (mph, gust) and Exposure	85/B	90/B	100/B	110/B	120/B	130/B	140/B	150/B
	-	-	85/C	90/C	100/C	110/C	120/C	130/C
	-	-	-	85/D	90/D	100/D	110/D	120/D
Negative Pressure (Suction) Design Wind Load	-17.4	-19.5	-24.4	-29.1	-34.7	-40.7	-48.6	-57.6
Positive Pressure Design Wind Load	13.0	14.6	18.2	21.8	25.9	30.5	36.3	43.0

**TABLE 1: Components and Cladding Wind Loads<sup>1,2</sup>**

Wind Exposure Category <sup>3</sup>	Pressure Direction	Allowable Sress Design Wind Pressure (psf) by Basic Wind Speed (mph)												
		Basic Wind Speed (mph)												
		90	95	100	105	110	115	120	130	140	150	160	170	180
B	negative (outward)	-11.7	-13.0	-14.5	-15.9	-17.5	-19.1	-20.8	-24.4	-28.3	-32.5	-37.0	-41.8	-46.8
	positive (inward)	10.0	10.0	10.8	11.9	13.1	14.3	15.5	18.2	21.1	24.3	27.6	31.2	35.0
C	negative (outward)	-16.4	-18.2	-20.3	-22.3	-24.5	-26.7	-29.1	-34.2	-39.6	-45.5	-51.8	-58.5	-65.5
	positive (inward)	12.2	13.6	15.1	16.7	18.3	20.0	21.7	25.5	29.5	34.0	38.6	43.7	49.0
D	negative (outward)	-19.4	-21.6	-24.1	-26.4	-29.1	-31.7	-34.5	-40.5	-47.0	-54.0	-61.4	-69.4	-77.7
	positive (inward)	14.4	16.1	17.9	19.8	21.7	23.7	25.7	30.2	35.0	40.3	45.8	51.8	58.1

For SI: 1 psf = 0.048 kPa; 1 mph = 0.447 m/s

**TABLE NOTES:**

1. Tabulated wind pressures include a 0.6 load factor for allowable stress design (ASD) and are for mean roof height not exceeding 30 feet (9.1 m) (measured vertically from grade plane to middle of roof slope), enclosed buildings, effective wind tributary area of 10 ft<sup>2</sup> (0.93 m<sup>2</sup>) for wall corner zone, and basic wind speed determined in accordance with mapped ultimate wind speeds in ASCE 7 for the risk category of the building importance factor equal to 1.0. For other conditions of use, calculate wind load in accordance with Section 4.2.
2. Where topographic effects occur (e.g., wind speed up due to hill-top exposure), wind load shall be calculated in accordance with Section 4.2.
3. Refer to the applicable building code or the ASCE 7 standard for wind exposure descriptions (B = suburban/wooded terrain; C = open flat terrain; D = ocean/lake exposure).
4. ~~Tabulated wind pressures are for wall corner zones using an effective wind tributary area of 10 square feet. For lesser design wind pressures away from wall corner zones, refer to the applicable building code or the ASCE 7 standard.~~

*User Note: Table 1 wind speed and wind pressures are based on ASCE 7-05. Wind speed conversions are required for use with codes based on wind speed map in the ASCE 7-10 standard. An appropriate conversion can be achieved by multiplying the wind speed values in the heading of Table 1 by 1.26. Refer to commentary Section C4.0 for additional guidance.*

**4.2 Calculated Design Wind Loads.** As an alternative to prescribed wind loads provided in Section 4.1, the applicable components and cladding wind load shall be permitted to be calculated in accordance with the applicable building code or the ASCE 7 standard using an effective wind tributary area of 10 square feet (0.93 square meters).

## 5.0 Installation Conditions

Installation conditions shall comply with the following:

1. Light-frame wall construction shall have a minimum framing member thickness of 1-1/2 inches (38 mm) for wood framing or flange width of 1-1/2 inches (38 mm) for cold-formed steel framing.
2. Wall stud spacing shall not exceed 24 inches (610 mm) on center.
3. All *FPIS* sheathing edges shall be supported by wall framing or blocking unless *unblocked* construction is specifically addressed by *FPIS* manufacturer's installation instructions.
4. For applications of *FPIS* where its fastening is intended to resist full transverse negative design wind load independent of the cladding material and cladding fastening, *FPIS* shall be attached to wall framing in accordance with the *FPIS* manufacturer's installation instructions for this application, and in accordance with Sections 6.6.2 and 7.4.2.
5. For applications where the *FPIS* attachment is not capable of independently resisting negative design wind pressures in accordance with Section 4, exterior cladding shall be provided to secure the *FPIS* to the wall framing. Where cladding is used to secure *FPIS* to the wall framing, the cladding and cladding attachment shall be structurally adequate to resist the negative design wind pressure in accordance with Section 4. Installation of the cladding and its attachment over *FPIS* shall be in accordance with ~~one of the following:~~
  - a) the cladding manufacturer's installation instructions for installation over *FPIS*; ~~and~~
  - b) the applicable building code requirements for installation of cladding over *FPIS*, including the specification of an enhanced wind load design pressure rating for vinyl siding where it is installed over *FPIS* serving as the sole exterior sheathing material. where vinyl siding manufacturer's installation instruction for vinyl siding certified and labeled as conforming to ASTM D3679 does not address application over *FPIS*, the vinyl siding manufacturer's installation instructions for vinyl siding installed over structural sheathing capable of independently resisting negative design wind pressures shall be permitted when the following conditions are met:
    - i) ~~the wind pressure rating of the vinyl siding is reduced to account for the wind load acting on the vinyl siding layer and fasteners securing the vinyl siding and foam sheathing,~~
    - ii) ~~a minimum safety factor of 2 is used in determination of the reduced wind pressure rating, and~~
    - iii) ~~cladding fastener length is adequate to maintain required penetration into the framing; or~~
  - c) engineered design.

6. For applications where furring is installed over *FPIS*, furring shall be attached to wall framing to resist transverse wind load applied to furring from cladding and *FPIS*, and to support cladding weight in accordance with the applicable building code.

*User Note: Refer to Commentary C1.3 for guidance on installation of cladding and furring over FPIS on light frame wood or steel walls. This standard and typical practice relies primarily on cladding or furring attachments to provide securement for permanent wind load resistance of exterior wall covering assemblies which include FPIS products as a component. Designing FPIS attachments for the full design wind load has some advantages such as improved temporary wind resistance during construction and less reliance on quality of siding installation for wind resistance of the FPIS component and wall covering assembly as a whole.*

## 6.0 Wind Pressure Resistance Requirements

**6.1 General.** Tests shall be conducted in accordance with Test Method A.2 or A.3 (see Annex A), ~~and Table 2.~~ Wind pressure tests shall be conducted to address installation conditions including stud spacing, panel orientation relative to framing members, and blocked or unblocked panel edges as illustrated in Figure 1. For each installation condition, an allowable design wind pressure resistance to the applied uniform pressure bending load shall be determined in accordance with Sections 6.2 through 6.5.

### **Exceptions:**

1. Where the FPIS manufacturer's installation instructions limit installation to specific installation conditions shown in Figure 1, only those conditions are required to be tested.
2. Allowable design wind pressure resistance values determined by testing at a specified on-center stud spacing are permitted to be applied to installation conditions with a lesser stud spacing.
3. The test results for weaker axis panel bending strength and less restrained panel edge conditions are permitted for the design purpose of wind pressure resistance requirements in alternate directions and more restrained panel edge conditions. The opposite shall not be permitted.

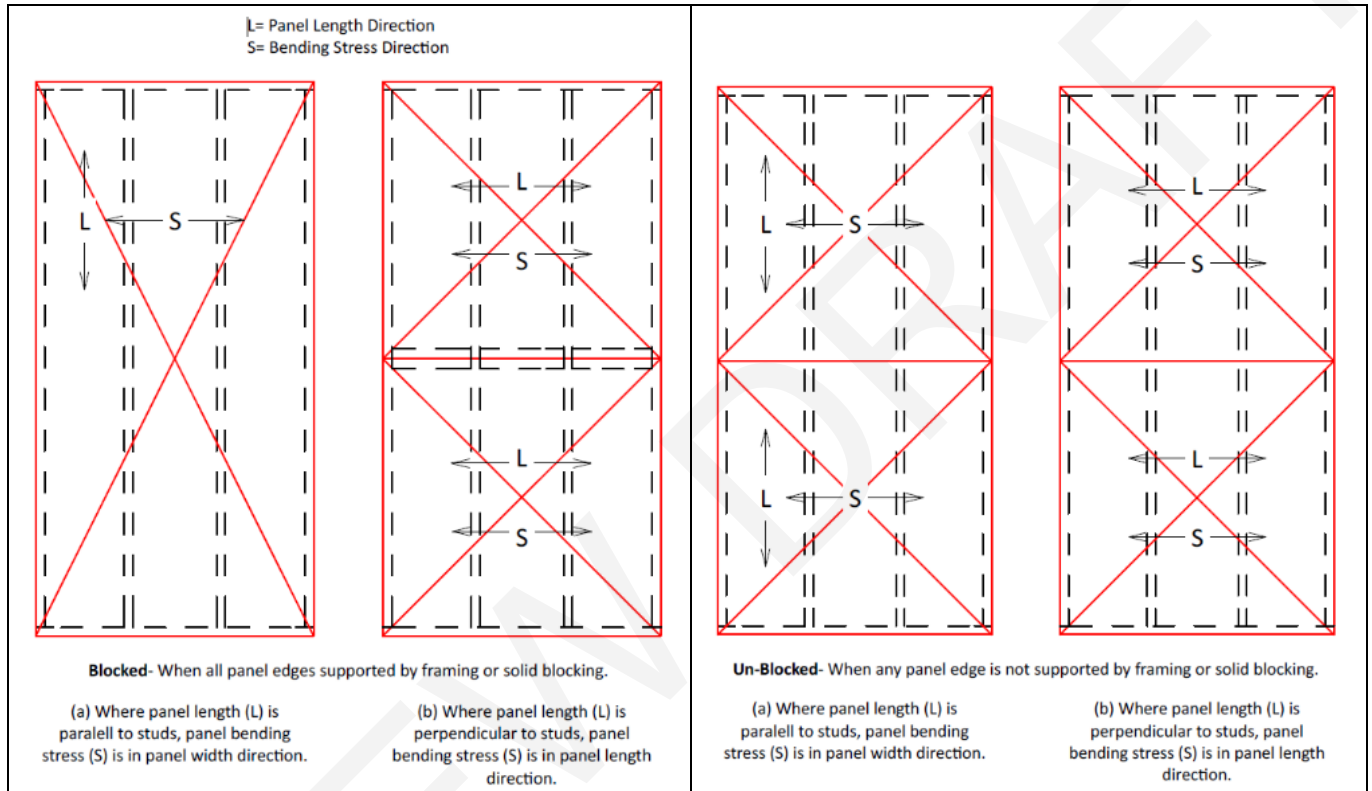
**6.1.1 Span Condition.** The minimum number of stud cavities spanned continuously by a single FPIS panel in the required wind pressure qualification test specimens shall be consistent with the manufacturer's installation instructions. Where installation instructions do not restrict the size of FPIS panels (or minimum number of stud cavities that must be spanned), then qualification testing shall be conducted with at least one stud cavity in the test specimen spanned by an individual FPIS panel cut to match the center-to-center width of the stud cavities.

**6.1.2 Test Repetitions.** A minimum of three test specimens shall be constructed for each installation condition and for each of the two wind pressure directions (inward/positive and outward/negative) for a total of six test specimens. Where Test Method A.2 is used, the FPIS shall be located on the side of the test wall frame opposite of the suction chamber to assess inward/positive wind pressure bending resistance. The side of the FPIS facing the suction chamber shall be reversed to simulate the outward/negative wind pressure bending resistance.

**Exception:** FPIS with foam core materials that are homogenous through thickness and, if facers are included, have identical facers on both sides of FPIS, shall not be required to test in both orientations with respect to test chamber.

*User Note: Wind pressure resistance values obtained from this testing apply only to the FPIS product's ability to resist bending load from wind pressure for the installation conditions addressed in accordance with Section 6.1 with orientation and blocking specified in Table 2 and with other support conditions specified in Test Methods A.2 or A.3, as applicable. Other wall system components such as siding and framing or connections are excluded from the scope of this standard and may limit the allowable design wind pressure resistance of the exterior wall or exterior wall covering assembly as a whole.*

[NEW FIGURE:]



**FIGURE 1.** Illustration of typical installation conditions for FPIS panel orientation and edge support on minimum 4-ft x 8-ft (1.2 m x 2.4 m) frame wall test specimens.

[DELETE TABLE 2 IN ITS ENTIRETY:]

**TABLE 2: Product Orientation on Test Frame to Address Intended End-Use Installation Conditions<sup>1,2,3</sup>**

FPIS Face Orientation on Test Frame	FPIS Length Axis Relative to Wall Framing (Studs)			
	Unblocked		Blocked	
	Parallel	Perpendicular	Parallel	Perpendicular
Three tests with each face of FPIS oriented toward suction chamber for each FPIS length axis orientation option(s) at right. Regardless of face orientation, FPIS is always to be located on opposite side of test frame from suction chamber per Test Method A-2.  <b>Exception:</b> FPIS with foam core materials that are homogenous through thickness and, if facers are included, have identical facers on both sides of FPIS, shall not be required to test in both orientations with respect to test chamber.	The test result for this condition shall be permitted to be used for the following conditions: (1) <i>Unblocked</i> parallel, (2) <i>Blocked</i> parallel, (3) Perpendicular ( <i>blocked</i> ) and Perpendicular ( <i>unblocked</i> ) provided the FPIS has bending properties in length direction that are at least equivalent to the width direction.	The test result for this condition shall be permitted to be used for the following conditions: (1) Perpendicular ( <i>unblocked</i> ), (2) Perpendicular ( <i>blocked</i> ), (3) Parallel ( <i>blocked</i> ) and Parallel ( <i>unblocked</i> ) provided the FPIS has bending properties in width direction that are at least equivalent to the length direction.	The test result for this condition shall be permitted to be used for the following conditions: (1) Parallel ( <i>blocked</i> ) and (2) Perpendicular ( <i>blocked</i> ) provided the FPIS has bending properties in length direction that are at least equivalent to the width direction.	The test result for this condition shall be permitted to be used for the following conditions: (1) Perpendicular ( <i>blocked</i> ) and (2) Parallel ( <i>blocked</i> ) provided the FPIS has bending properties in width direction that are at least equivalent to the length direction.

**TABLE NOTES:**

1. Parallel and perpendicular (*unblocked*) conditions correspond to conditions where the horizontal edges are not continuously supported and vertical edges are continuously supported. Parallel and perpendicular (*blocked*) conditions correspond to conditions where all edges are continuously supported.
2. Each stud spacing condition intended for end use shall be tested or alternatively the allowable wind pressure resistance value established from testing the maximum stud spacing intended for end use shall be permitted to be used for smaller stud spacing.
3. The minimum number of stud bays spanned continuously by a single FPIS in the required wind pressure qualification test specimens shall be consistent with the manufacturer's installation instructions. For example, if installation instructions do not restrict the size of FPIS (or minimum number of stud bays that must be spanned), then qualification testing shall be conducted with at least one stud bay in the test specimen spanned by an individual FPIS cut to match the center to center width of the stud bays.

**6.2 Nominal Wind Pressure Resistance ( $P_{nom}$ ).** A product's nominal wind pressure resistance value for each condition tested in accordance with ~~Section 6.1~~ ~~Table 2~~ shall be taken as the lowest value of the maximum test pressures recorded from the required test repetitions.

**6.3 Yield Wind Pressure Resistance ( $P_y$ ).** A product's yield wind pressure resistance value for each condition tested in accordance with ~~Section 6.1~~ ~~Table 2~~ shall be taken as the ~~lowest~~ ~~smallest~~ yield test pressure recorded from the required test repetitions. The value of  $P_y$  shall be determined in accordance with the following methodology criteria:

1. Determine initial slope of load-deflection plot by determining the slope of a line defined by points on the load deflection plot at 10% and 30% of the nominal load.
2. Offset the ~~above~~ line determined in step 1 above such that the X-axis intercept equals the deflection recorded at 10% of nominal load.
3.  $P_y$  is the pressure associated with the point where the offset line intersects the load-deflection plot.

**6.4 Pressure Equalization Factor (PEF).** A PEF of 1.0 shall be required for *exterior wall sheathing* applications.

**Exceptions:**

1. For conditions where the design negative wind pressure load determined in accordance with Section 4.0 does not exceed 30 psf (1.44 kPa), a PEF of 0.9 shall be permitted to determine negative wind pressure resistance only for *exterior wall sheathing* on wall assemblies having an interior finish of at least 0.5-inch-thick gypsum wall board (ASTM C1396) or any material of at least equivalent bending strength, rigidity and air permeability.

**6.5 Allowable Design Wind Pressure Resistance ( $P_{all}$ ).** For each nominal wind pressure resistance value determined in accordance with Section 6.2 addressing end-use installation conditions in accordance with Section 6.1 and each PEF factor condition addressed in accordance with Section 6.4, a design wind pressure resistance value shall be determined in accordance with the following equation:

$$P_{all} = P_{nom} / [(SF)(PEF)] \leq P_y \quad [\text{Eq. 1}]$$

where:

$P_{all}$  = allowable design wind pressure resistance for the *FPIS* product and appropriate wall assembly condition corresponding with the PEF factor and nominal wind pressure resistance value

$P_{nom}$  = nominal wind pressure resistance value determined in accordance with Section 6.2

$P_y$  = pressure at which yielding behavior is considered to initiate due to a relatively rapid decrease in *FPIS* product stiffness during uniform pressure testing (see Section 6.3)

*User Note: An approved agency shall determine  $P_y$  based on test results using Test Method A.2; refer to commentary Section C6.3 for additional guidance.*

SF (safety factor) = 1.5

PEF = pressure equalization factor determined in accordance with Section 6.4

**Exception:**  $P_{nom}$  shall not be required to be limited to  $P_y$  provided that  $P_{nom}$  is taken as the least maximum test pressure from tests in accordance with Test Method A.3 (see Annex A).

## 6.6 Conditions of Use

6.6.1 The allowable design wind pressure for the *FPIS* product determined in accordance with Section 6.5 shall meet or exceed the positive and negative design wind pressure determined in accordance with Section 4.0.

**Exception:** *FPIS* is permitted to be selected using positive pressure only when the *FPIS* product is restrained from outward movement by cladding which is installed directly in contact with the surface of the *FPIS* product, is capable of resisting the full design wind load without reduction for pressure equalization, and has bending stiffness under uniform pressure loading that is greater than that of the *FPIS* product.

6.6.2 For applications where the foam sheathing is attached to the wall with fasteners capable of resisting the design negative wind pressure load independent from and without reliance on the cladding material and its attachment, the *approved agency* and manufacturer shall incorporate qualification testing and quality assurance procedures for fastener head or washer pull-through resistance of the *FPIS* product.

*User Note: ASTM E330 and ASTM E1233 are examples of suitable methods to evaluate capacity and determine design values for FPIS connections in accordance with Section 6.6.2. While qualification testing in accordance with specific requirements of Test Method A.2 and A.3 are intended to evaluate bending failure of foam sheathing under fully supported conditions (bearing on test frame members), modification of these methods is the recommended approach for evaluation of failure modes associated with fastener head or washer pull-through resistance of the FPIS product. For quality assurance purposes, individual fastener head or washer pull-through tests may be conducted in accordance with an appropriate test method, such as ASTM D1037, Section 15 coupled with periodic follow-up testing in accordance with modified Test Method A.2 or A.3 as applicable.*

## 7.0 Quality Assurance and Product Labeling

**7.1 Quality Control.** *FPIS* products complying with this standard shall be produced under a quality assurance program administered by an *approved agency*. An approved quality assurance manual shall be developed in collaboration with the *approved agency*. The quality assurance manual shall specify quality assurance testing and process control requirements in accordance with Sections 7.2 and 7.3.

### 7.2 Quality Assurance Testing

7.2.1 Test equipment shall be properly maintained, calibrated, and evaluated for precision, accuracy and adequacy at a frequency satisfactory to the *approved agency* and consistent with the applicable standards.

7.2.2 The frequency of tests as required by Section 7.1 shall be chosen to yield quality assurance performance that supports design capacities assigned to the product.



### 7.3 Process Control

7.3.1 Data from tests outlined in 7.1 shall be evaluated prior to shipment of the material represented by the *sample*. Analytical procedures shall determine if product capacities are in statistical control. The control levels selected shall support current design capacities.

7.3.2 When the analysis described in 7.3.1 indicates that the product is below the control level, the associated portion of production shall be subject to re-examination in accordance with the acceptance procedures provided in the approved quality assurance manual.

7.3.3 All pertinent records shall be maintained and be available for review by both in-house and *approved agency* personnel. At a minimum, such records shall include:

7.3.3.1 All inspection reports and records of test equipment calibration, whether accomplished by in-house or by *approved agency* personnel.

7.3.3.2 All test data, including retests and data associated with rejected production.

7.3.3.3 Details of any corrective actions taken and the disposition of any rejected production resulting from tests or inspection.

### 7.4 Specific Requirements for *FPIS* Products

7.4.1 Reference values for quality and process control purposes shall be established using Test Method A.1 (Annex A) and *FPIS* material sampled from the same lot of material used for qualification testing in accordance with Section 6.2. In addition, the correlation between reference values per 7.4.1 and qualification testing in accordance with Section 6.2 shall be monitored for quality and process control purposes.

7.4.2 For applications where the intent of the manufacturer's installation instructions for the *FPIS* product and its attachment is to resist the design wind load independent of the cladding material and its fastening, quality assurance for *FPIS* attachment to resist wind load shall be provided in accordance with Section 6.6.2.

7.4.3 In addition to quality control testing based on correlated reference values, the quality assurance program shall include periodic follow-up testing in accordance with Test Method A.2 (Annex A).

### 7.5 Labeling

7.5.1 *FPIS* products shall be labeled with the name and identification of an *approved agency* responsible for verifying conformance to the requirements of this standard.

7.5.2 Product shall be labeled to indicate conformity with this standard and a notation referencing manufacturer's literature for finding wind pressure rating, pressure equalization factor and attachment method for wind pressure resistance.

7.5.3 Product label shall also include a coding to trace the product back to manufacturing plant and date of manufacture.

7.5.4 An example of a label meeting the requirement of Section 7.5.2: “Complies with ANSI/FS 100; refer to manufacturer for wind pressure rating.”

## ANNEX A – Test Methods

(Mandatory ANNEX)

### A.1 Bending Strength Behavior and Quality Control Test Method (“Test Method A.1”)

A.1.1 Bending tests shall be conducted in accordance with Section 10.5 of ASTM C203 using Test Method 1 (refer to Sections 1.1.1, 4.1.1 and 5.2 of ASTM C203) and Procedure D (refer to Sections 1.2.4 and 4.3.4 of ASTM C203) with the following modifications:

**SPECIMEN ORIENTATION:** *Specimens* shall be cut from *FPIS samples* with test *specimen* span dimension oriented in the cross-machine or width direction of the board. *Specimen* shall be placed in test apparatus such that the crosshead applies downward force and deflection to the exterior side (if applicable) of the *FPIS*.

**SPECIMEN SIZE:** The test *specimen* shall be full thickness with facings (if any) intact. In lieu of the range of permissible test specimen dimensions in Section 8 of ASTM C203, the test *specimen* span-to-thickness ratio (L/d) shall be 10 ~~(except 16 shall be used for ½" thick specimens)~~ and the *specimen* shall be not more than 2 inches (51 mm) greater in length than the required span. The span length, L, used for any specimen thickness, d, shall not be less than 8 inches (203 mm) and the Specimen width-to-thickness ratio (b/d) shall be at least 4, except that the minimum specimen width, b, used for any specimen thickness, d, shall not be less than 3 inches (76 mm).

**SPECIMEN CONDITIONING:** In lieu of conditioning requirements of ASTM C203 Section 9, *specimens* shall be equilibrated to and tested with an ambient air temperature of 75°F +/- 4°F (24°C +/- 2.2°C).

**DEFLECTION:** In lieu of deflection requirements in ASTM C203 Sections 4.2 and 10.1 or 10.2 and the crosshead speed requirement in Section 10.5.2 of ASTM C203, the *specimen* shall be deflected at a constant crosshead rate of 0.625 inches/min (16 mm/min) up to a maximum mid-span deflection of 1.6 inches (41 mm) or to a mid-span deflection at which the applied load drops by 50% from the peak applied load, with or without the occurrence of rupture. Deflection shall not be limited by 5% strain in accordance with ASTM C203 Sections 4.2 (Note 1) and Sections 10.1.6 and 10.2.6 of ASTM C203 shall not apply. Deflection measurement shall be based on cross-head movement without accounting for *specimen* compression at support and loading points as discussed in Sections 10.1.5 and 10.2.5 of ASTM C203.

**REFERENCE VALUE:** The reference value for the *sample* shall be the calculated value from Equation (6) of ASTM C203 Section 11.1 using the lowest value of maximum cross-head force (applied load) recorded for all required test *specimens* for the bending stress direction associated with each qualification test value.

A.1.2 Test method modifications shall be permissible provided an at least equivalent correlation to wind pressure qualification tests (Section A.2) is achieved subject to the review and approval of the *Approved Agency*.

A.1.2.1 The span dimension of the *specimen* shall be indicated as corresponding with the length or width direction of the *FPIS* as appropriate for the intended use of the test results. The side of

the product or *facer* subjected to tension due to bending load application shall be as appropriate for the intended use of the test data.

## A.2 Wind Pressure Qualification Test Method ("Test Method A.2")

A.2.1 Wind pressure resistance tests shall be conducted in accordance with ASTM E 330 and Sections A.2.2 through A.2.4. Alternatively, uniform pressure tests conducted in accordance with the uniform load test method described in Section 7.2 of DOC/PS 2-10 shall be permitted, except deflection measurements shall be read at mid-span of the sheathing at mid-height of the wall in the two outer stud cavities and averaged for construction of a load-deflection plot for each *specimen*.

*User Note: If the DOC/PS 2-10 test method is used, horizontal sheathing joints are unblocked and thus the qualification test results are applicable to installation conditions where horizontal sheathing joints are not supported on framing or blocking.*

A.2.2 Construct a minimum 4-ft x 8-ft (1.2 m x 2.4 m) test frame in accordance with ASTM E330 with stud framing members fully supported. The *FPIS* product shall be of the desired thickness for testing and shall be placed on the side of the test frame opposite the suction pressure chamber. Assembly conditions (framing spacing, product orientation on framing and test frame size) as addressed in Section 6.1 shall be representative of the intended conditions of use including presence of *FPIS* joints, single span and multiple span conditions as applicable per manufacturers' installation instructions. Width of bearing on studs at *FPIS* edges shall not be greater than  $\frac{3}{4}$  inches (19 mm). Faces of the *FPIS* shall be oriented relative to the test apparatus suction chamber such that results correspond with positive or negative wind pressure loading directions for products that have non-identical *facer* material on opposite faces of the *FPIS* and which are labeled to identify which *facer* material faces outward from the wall. Separate testing is required to address *FPIS* installation parallel or perpendicular to studs, unless the weaker condition is used for the purpose of wind pressure qualification.

*User Note: Testing in accordance with specific requirements of A.2.2 is intended to evaluate bending failure of foam sheathing where foam sheathing bears on stud framing. Where it is intended to evaluate the *FPIS* product and its attachment for wind pressure resistance independent of cladding and cladding fasteners, the *FPIS* product shall be placed on the side of the frame facing the suction chamber. Support of studs shall be provided in a manner to limit stud deflection without restraining movement of the *FPIS* product or reducing load resisted by the attachment of the *FPIS* product to the frame. Assembly conditions (framing spacing and product orientation on framing) shall be representative of the intended conditions of use including presence of panel joints, single span and multiple span conditions as applicable per manufacturers' installation instructions. Where both single span and multiple span conditions are included in each individual test specimen the test results can be considered to address both conditions.*

A.2.3 A uniform suction pressure load shall be applied in accordance with ASTM E330, Method B, except:

- (1) deflection measurements shall be read at mid-span of the sheathing at mid-height of the wall in the two outer stud cavities and averaged for construction of a load-deflection plot for each *specimen*, and
- (2) the preload required by ASTM E330 Section 11.3.2 shall not be not less than one-third of the expected yield load.

The test shall be permitted to be run to failure in a single ramp with a constant rate of pressure load increase that results in a load application duration of not less than 3 minutes.

The maximum test pressure shall be recorded for each specimen.

User Note: For the purposes of this Annex, the specified maximum test load in accordance with ASTM E330, Method B, is intended to represent the expected yield load of the specimen, not the peak load at failure. In the absence of definitive data from prior test results, the yield load can be assumed to be 50% of the expected peak load. Alternatively, preliminary tests may be used to better approximate the expected yield load.

A.2.4 Studs of the test frame shall be fully supported in accordance with A.2.2 to prevent failure of framing members or frame connections prior to bending failure of foam sheathing. Frame supports shall not interfere with response of foam sheathing to the applied uniform pressure load.

A.2.5 FPIS test specimens shall be equilibrated to and tested in an ambient temperature condition of 75°F +/- 4°F (24°C +/- 2.2°C).

### **A.3 Wind Pressure Qualification Test Method ("Test Method A.3")**

A.3.1 Wind pressure resistance tests for determining structural performance under cyclic air pressure differential shall be conducted in accordance with requirements of ASTM E1233 and the requirements of this Annex.

A.3.2 The test frame shall be permitted to be in accordance with Section A.2.2 except ± 3/4-in x 2-1.5in (19 mm x 38 mm) battens shall be applied to the outside face of the FPIS product at each stud location on the test frame. Battens shall be fastened to studs to provide a 1.5 inch (38 mm) bearing width for withdrawal restraint under negative pressure loading cycles. Any modifications to allow cyclic air pressure testing shall be reported. FPIS test specimens shall be conditioned in accordance with A.2.5.

*User Note: Testing in accordance with specific requirements of A.3.2 is intended to evaluate bending failure of foam sheathing where bearing of foam is on stud framing and battens. Where it is intended to evaluate the FPIS product and its attachment for wind pressure resistance independent of cladding and cladding fasteners, the FPIS product shall be fastened to the frame in accordance with the intended end use application in lieu of use of battens. Support of studs shall be provided in a manner to limit stud deflection without restraining movement of the FPIS product or reducing load resisted by the attachment of the FPIS product to the frame. Assembly conditions (framing spacing and product orientation on framing) shall be representative of the intended conditions of use including presence of panel joints, single span and multiple span conditions as applicable per manufacturers' installation instructions.*

A.3.3 The general loading sequence shall be in accordance with Section X1.2.1 or X1.2.2 of ASTM E1233. Prior to application of the maximum test load, the observed condition of test specimens including visible damage and permanent set in sheathing deformation shall be recorded.

A.3.4 The maximum test pressure in accordance with ASTM E1233 shall be reported. For purposes of establishing the nominal wind pressure resistance value per Section 6.2.4, the maximum test pressure shall not exceed 1.5 times values of  $P_{pos}$  and  $P_{neg}$  as applicable.

Commentary for  
ANSI/ABTG FS 100-20~~xx12~~ (R2018)

Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

~~[formerly ANSI/SBCA FS 100-2012 (R2018)]~~

(Non-Mandatory)

C1.0 General.

**C1.1 Scope.** No commentary.

**C1.2 Limitations.** The standard applies to applications of *foam plastic insulating sheathing (FPIS)* only where wind pressure resistance is required or is not already addressed by other industry standards. For example, wind pressure resistance is not required where *FPIS* is placed over a solid sheathing material that is able to resist the required wind load, and is also covered by a siding material that is able to resist the required wind load. In this manner the *FPIS* is used as insulation and, in some cases, a water resistive barrier. Structural wind pressure loads are resisted by other materials that constrain the *FPIS*. *Exterior insulating finish systems* are excluded from the scope of this standard because wind pressure resistance of this *exterior wall covering* assembly (which uses *FPIS*) is addressed in other standards. This standard also does not apply to structural sheathing composites including *FPIS*. Such products must be appropriately qualified for wind pressure resistance and other structural functions (e.g., wall bracing) using requirements that may differ from those indicated in this standard for *FPIS*. For example, refer to the discussion on safety factors in Section C6.5.

**C1.3 Additional Considerations.** Wall assemblies are systems and, therefore, require consideration and integration of various code requirements. For example, *FPIS* products can address wind pressure, water resistance, and insulation requirements. Other products must be used to address other code requirements for wall assemblies, such as wall bracing and framing to support structural loads and finishes. This section is intended to help ensure that wall assemblies using *FPIS* meeting the requirements of this standard also address other code requirements for exterior walls and foam plastics.

*Cladding Attachments Over Foam Sheathing* — ~~Two approaches for attaching cladding over FPIS are shown in Figures C1 and C2 below.~~ For guidance on appropriate cladding and furring connections ~~through over~~ *FPIS*, refer to (<https://www.continuousinsulation.org/resources/quick-guides>):

- [Cladding Connections to Wood Frame Walls with Foam Plastic Insulating Sheathing \(FPIS\) Continuous Insulation \(ci\)](#)
- [Cladding Connections to Steel Frame Walls with Foam Plastic Insulating Sheathing \(FPIS\) Continuous Insulation \(ci\)](#)

[The guides listed above reference provisions for the same purpose in 2012 and later editions of the International Building Code \(IBC\)\[Chapters 14 and 26\] and International Residential Code \(IRC\)\[Section 703\]. the “Guide to Attaching Exterior Wall Coverings through Foam Sheathing to Wood or Steel Wall Framing” \(fsc.americanchemistry.com\).](#) Also, consult the cladding manufacturer and cladding fastener

manufacturer for available data and installation instructions. In no case should the fastener type, size and penetration requirement be less stringent than required by the locally applicable building code or the siding manufacturer's installation instructions.

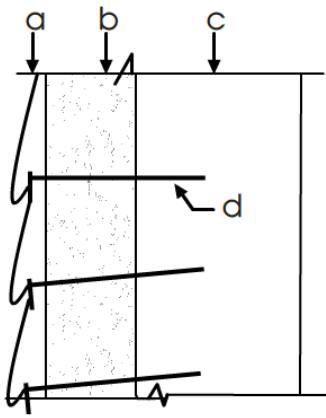
~~FPIS fasteners are not shown in Figures C1 and C2. FPIS shall be fastened to framing in accordance with the FPIS manufacturer's installation instructions. The cladding or furring fasteners are typically intended to provide attachments of the wall covering assembly, including FPIS, to resist negative (suction) wind pressure. Unless otherwise evaluated in accordance with Section 6.6.2 and addressed in the FPIS manufacturer's installation instructions, FPIS fastening is intended for temporary installation conditions only and cladding or furring is intended to provide for permanent fastening.~~

Use of FPIS as the sole exterior sheathing material on exterior walls clad with vinyl siding must comply with requirements in Section R703.11.2 of the 2009, 2012, 2015, 2018, 2021, or 2024 ~~or 2012~~ editions of the ~~International Residential Code (IRC)~~ requiring an adjusted (increased) ~~for adjustment (reduction) of~~ vinyl siding wind pressure ratings unless the FPIS product is attached in accordance with Section 6.6.2 in a manner capable of resisting the full design wind load. ~~The IRC reduction factors are applied as multipliers to vinyl siding wind pressure ratings to increase the pressure equalization factor from 0.36 (ASTM D3679, Annex A) to 0.7 (for walls with minimum 1/2" gypsum board interior finish) or 1.0 (for walls without an interior surface to share the net wind load). The principle of pressure equalization or load-sharing in multi-layered building envelope assemblies is discussed in ASCE 7-10 commentary, Section C30.1.5 (also see discussion in Section C6.4 in relation to the PEF used for foam sheathing qualification per this standard). In addition, the reduction factors in the IRC increase the safety factor of 1.5 for vinyl siding to a safety factor of 2.0 for the vinyl siding and foam sheathing exterior wall covering assembly. Thus, the net adjustment factors (multipliers) for vinyl siding wind pressure ratings in the IRC are  $(0.36/0.7)(1.5/2.0) = 0.39$  for walls with minimum 1/2" gypsum board interior finish and  $(0.36/1.0)(1.5/2.0) = 0.27$  for use on walls without interior finish. With these adjustments, the vinyl siding wind pressure rating is effectively de-rated by a factor of about 2.5 and 3.7, respectively. As mentioned, these~~ This adjustments of vinyl siding wind pressure ratings does not apply where ~~to~~ foam sheathing is when installed over a sheathing or solid wall system capable of separately resisting the full wind load. Furthermore, these adjustments may be subject to change based on future research and building code and standards development related to vinyl siding wind pressure ratings. Also, use of aluminum siding over FPIS products as the sole sheathing material on exterior walls should be avoided unless wind pressure resistance of the assembly is evaluated for code compliance or the FPIS product is attached in accordance with Section 6.6.2 in a manner capable of resisting the full design wind load. Aluminum sidings utilize the same pressure equalization principles to determine wind pressure resistance for the siding, yet appropriate adjustments for use over foam sheathing as an exterior wall covering assembly have not been determined or codified as of this writing.

**FIGURE C1: Exterior Wall Covering Assembly with Cladding Installed Directly Over FPIS Product**

**FIGURE C2: Exterior Wall Covering Assembly with Cladding and Furring Installed Over FPIS Product**





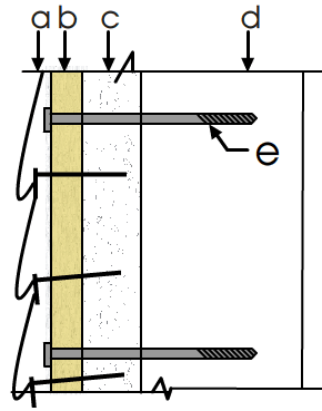
Cladding material

a.— Cladding

b.— FPIS product

c.— Wall framing per code (i.e., wood or steel studs)

d.— Cladding fastener



Cladding material and fasteners

a.— Cladding

b.— Wood or steel furring

c.— FPIS Product

d.— Wall framing per code (i.e., wood or steel studs)

e.— Furring fastener

**Foam Plastics and Fire Safety Requirements** – Fire-safety-related requirements for foam plastics are addressed in Chapter 26 of the International Building Code (IBC) and Section R316 of the IRC (changed to Section R303 of the 2024 IRC). Any use of FPIS products in accordance with this standard must also comply with fire-related requirements for foam plastics in the locally applicable building code, including requirements for thermal barriers, ignition barriers, flame spread resistance, limited smoke development, and other factors as relevant to the particular application. For additional information, see the FPIS manufacturer's literature and code compliance resources found at <https://www.continuousinsulation.org/fire-performance>. the following supplemental information as applicable:

**TER No. 1202-03:** Foam Plastic Insulating Sheathing Products in Type V Construction

**TER No. 1202-04:** Foam Plastic Insulating Sheathing Products in Type I, II, III or IV Construction

**Energy Efficiency and Thermal Resistance Requirements** – Requirements for use of FPIS as thermal insulation are addressed in locally adopted energy codes. In particular, use of FPIS products for building energy efficiency design isare addressed in the International Energy Conservation Code (IECC) and in ASHRAE standards 90.1 and 90.2. The typical application of FPIS is as continuous insulation (ci) to minimize the impact of structural thermal bridging on the performance of building thermal envelopes. In addition, minimum material requirements, including thermal resistance properties, are addressed in ASTM C578 and ASTM C1289 for the types of FPIS addressed in this standard. Furthermore, for home insulation products, the Federal Trade Commission's R-value Rule regulates the measurement and labeling of insulation R-values.

**Moisture Vapor Control** – As with any wall sheathing component, FPIS has moisture vapor permeability properties that should be considered in the strategy for controlling moisture vapor transmission through the wall assembly and limit the potential for condensation. Properties will vary by FPIS product type and composition. Because FPIS is an insulation material, it can be used to control wall temperatures such that risk of condensation is reduced. All walls act as a system in controlling moisture vapor transmission



and preventing condensation. Therefore, the amount of *FPIS* insulation, its location on the wall assembly, the climate conditions, and the moisture vapor transmission properties of other materials comprising a wall assembly should all be considered as part of a moisture vapor control strategy. Refer to the moisture vapor retarder requirements of the 2009 and ~~later 2012~~ editions of the IBC and IRC for more information. More complete and advanced requirements are included in 2021 and later editions of the IBC and IRC. For additional guidance moisture protection of walls using *FPIS* refer to <https://www.continuousinsulation.org/water-vapor-control> and also wall calculators available at <https://www.continuousinsulation.org/calculators>.

*Water Resistive Barrier Performance* — ~~Some~~Many *FPIS* products also serve as code-compliant water resistive barriers. In general, a code evaluation report by an *approved agency* and approval of the local building official are pre-requisites for this application. Consult the *FPIS* manufacturer for relevant data for code acceptance. Also, use of *FPIS* as a water resistive barrier generally entails strict adherence to installation details addressing flashing and sealing of joints and penetrations. For additional information on this application of *FPIS* WRB systems, refer to <https://www.continuousinsulation.org/WRB>.

*Wind-debris Resistance* — In all but southern Florida's high hurricane hazard areas, building exterior wall constructions are not required by Code to resist wind-borne debris impacts. In southern Florida or other areas where wind-borne debris resistance is desirable, it should be anticipated that *FPIS* products need to be combined with impact-resistant sheathing materials (e.g., *over-sheathing* application) or claddings to achieve required or desired wind-borne debris impact resistance levels.

**C1.4 Material Requirements.** No commentary.

**C1.5 Alternative Methods of Compliance.** The various provisions of the standard provide a minimum standard of care in conducting tests, evaluations, and assessments for wind pressure performance qualification and quality assurance to demonstrate and maintain code compliance for *FPIS* products. These provisions are not the only means by which code compliance can be successfully demonstrated and maintained. For example, test methods may be modified or other suitable test methods may be employed provided they result in an at least equivalent measure of performance qualification and quality assurance. In addition, any alternative to or modification of any part of this standard should be considered and approved as equivalent by an *approved agency*.

**C2.0 Reference Standards.** The provisions of this standard are dependent on the various listed reference standards addressing matters such as material quality, test methods, and design wind loads. Use of updated versions of these standards is not explicitly prohibited, but should be done only when verified as appropriate for use with this standard by an *approved agency*.

**C3.0 Definitions.** No commentary.

**C4.0 Design Wind Load Requirements.** Design wind loads provided in this standard are based on consensus standard, "Minimum Design Loads for Buildings and Other Structures," ASCE 7-05. Locally applicable building code requirements or the latest edition of the ASCE 7 standard are also permitted as a means to determine wind load. Pre-calculated design wind loads in this standard are based on common ~~worst-case~~ conditions (i.e., wall corner zone, effective wind area of 10 square feet (0.93 square meters), and 30-foot (9.1 m) maximum building height) for a range of wind speed and exposure conditions. For applications that address wall interior zones only, building heights greater than 30 feet

(9.1 m), or design wind speeds other than tabulated, design wind loads must be determined in accordance with Section 4.2 of the standard.

When using the 2012 IBC and ASCE 7-2010 which use a newer form of design wind speed map, wind speeds in the header of Table 1 must be converted to an “ultimate” wind speed basis from the “allowable” design wind speed basis of Table 1 as used in prior building codes and standards. To make this conversion, wind speeds in the header of Table 1 can be multiplied by 1.26. Alternatively, conversion tables or guidance provided in the ASCE 7-2010 standard or the 2012 IBC may be used. Care must be taken, however, to avoid confusion of wind speed basis. For example, the 2012 IRC also uses an updated wind speed map from ASCE 7-2010, but the IRC wind speed map was converted back to the former “allowable” design wind speed basis. Therefore, conversions of wind speeds reported in Table 1 of this standard do not need to be converted for use with the 2012 IRC. Also be aware of the wind speed basis when using other codes and standards as referenced in R301.2.1.1 of the 2012 IRC for use in high-wind regions.

**C5.0 Installation Conditions.** Section 5.0 of the standard lists specific installation conditions for the intended use of *FPIS* products in accordance with this standard. In accordance with the user note, this standard and typical practice relies primarily on cladding or furring attachments to provide securement for permanent wind load resistance of *exterior wall covering* assemblies which include *FPIS* products as a component. For example, Item 5 provides requirements for cladding use to secure *FPIS* to address this typical practice. Designing *FPIS* attachments for the full design wind load, without reliance on cladding for securement, has some advantages such as improved temporary wind resistance during construction and less reliance on quality of siding installation for wind resistance of the *FPIS* component and wall covering assembly as a whole. For additional information on cladding installation over *FPIS*, refer to Section C1.3.

## C6.0 Wind Pressure Resistance Requirements

**C6.1 General.** Wind pressure qualification tests are required to be conducted using Test Method A2 or A3 in Annex A. Test Method A2 is based on the ASTM E330 test method with modification as noted for the purpose of qualifying the wind pressure resistance of the *FPIS* product. Test Method A3 provides an alternate cyclic wind pressure qualification procedure based on ASTM E1233, and is also referenced in an exception statement in Section 6.5. The primary intent of Test Methods A2 and A3 is to primarily determine bending resistance to wind pressure on *FPIS* products, or in some cases (as in 6.6.2) to additionally determine fastener resistance to wind pressure for *FPIS* products independent of siding. It is not intended to evaluate, but not the wall framing assembly or *exterior wall covering* attachments which may vary according to code requirements and assembly conditions. Therefore, *FPIS* products qualified for wind pressure resistance in accordance with this standard are applicable for use on any code compliant wall assembly with exception that the spacing of the framing or supports is limited to the maximum spacing of framing used for purposes of qualifying the *FPIS* product’s wind pressure resistance.

Section 6.1 and Figure 1 provide guidance on testing various~~Table 2 provides a matrix of~~ end-use conditions for which wind pressure resistance qualification testing is required depending on the installation practice (e.g., vertical panels with length parallel to wall studs or horizontal panels with length perpendicular to wall studs) complexity of bending strength behavior of the *FPIS* product (e.g., equivalent or different stress and stiffness properties in panel width and length directions). Panels spanning only a single stud cavity vs. continuously across two or more stud cavities also affects the bending resistance to applied uniform wind pressure. Wind pressure resistance may be qualified for

each end-use installation conditions separately or more generally for all end-use conditions in Table 2 if the worst case installation condition is used for determining a single nominal wind pressure resistance value.

**C6.2 Nominal Wind Pressure Resistance ( $P_{nom}$ ).** For each tested end use installation condition (see Section 6.1 and Figure 1Table 2), the nominal wind pressure resistance (see Figure C1) is determined as the lowest peak or lowest maximum uniform pressure value achieved using Test Method A2 or A3, as applicable, and three test repetitions. This constitutes the basis for a strength-based performance criterion for wind pressure resistance. When using Test Method A2, an additional yield-based criterion is separately applied as explained in Section C6.3.

In general, deflection is not considered as a limiting serviceability criterion for wall sheathing applications. Furthermore, a sheathing material is not necessarily required behind cladding materials constructed in accordance with the applicable building code where wall bracing is provided by other means in accordance with the building code. For example, walls clad with Portland cement stucco, wood lap siding, and others do not require the use of sheathing in the 2009 IRC. Thus, strength of the siding and/or sheathing material, when present, is the primary consideration for wind pressure performance. This emphasis on strength is also echoed for other wall sheathing materials. For example, DOC PS2-~~10~~ Performance Standard for Wood-Based Structural-Use Panels does not require deflection limitations for wood structural panel wall sheathing.

Similarly, the ASTM C208 standard for regular and structural types of cellulosic fiber insulating board does not apply deflection criteria for out-of-plane wind pressure bending (flexural) resistance. Instead, the average maximum flexural strength is determined from 3-in x 15-in (76 mm x 381 mm)3"x15" strips of fiberboard sheathing in accordance with ASTM C209 Section 10. The average maximum flexural strength is then used to calculate wind pressure resistance without consideration of deflection.<sup>1</sup>

By precedent and accepted practice, deflection criteria have not been applied to code-compliant wall coverings including cladding and sheathing. However, the total wall framing assembly (with or without an exterior sheathing material as permitted by code) is required by code to meet deflection criteria (e.g., 2009 IRC Section R301.7 or 2009 IBC Section 1604.3.1). The code deflection requirements exclude any requirement for wall sheathing. Furthermore, *FPIS* products qualified in accordance with this standard are intended for application on code-compliant wall framing providing a code-compliant level of overall wall deflection and strength. Stiffness of code-compliant wall framing assemblies, with or without the presence of *FPIS*, is beyond the scope of this standard.

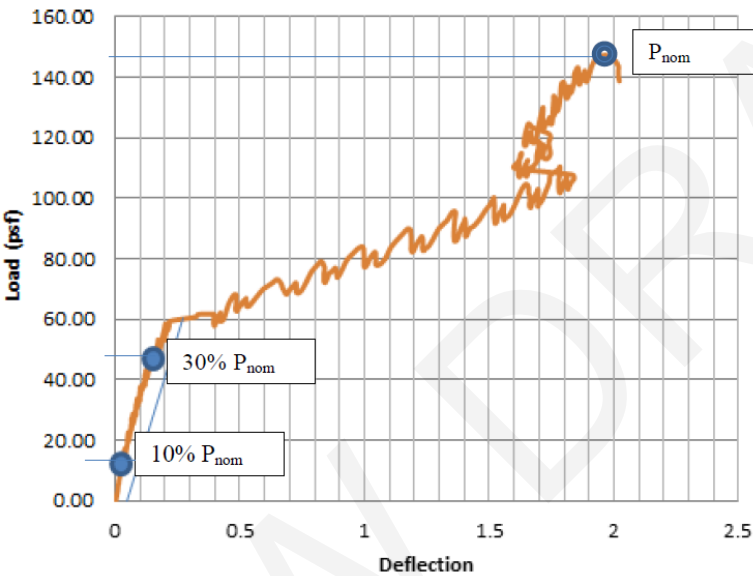
**C6.3 Yield Wind Pressure Resistance ( $P_y$ ).** Design wind pressure resistance values determined in accordance with Section 6.5 are limited or “capped” by a yield wind pressure resistance,  $P_y$ . Plastics and many other materials or composites are not linear in load-deflection behavior (i.e., yielding is a progressive process without a clear delineation between linear elastic and non-linear inelastic behavior). This creates some difficulty in defining a meaningful yield point or proportional limit. In some cases, yielding may be associated with a region where stiffness (slope of load-deflection plot) decreases abruptly in a relative sense. Other standards, such as ASTM D198, suggest that a proportional limit for wood members in flexure “can be determined using a threshold value of the slope deviation or other suitable criteria.” The yield wind pressure resistance,  $P_y$ , in Section 6.3 uses criteria based on the project

<sup>1</sup>Special Design Provisions for Wind and Seismic, American Forest & Paper Association, American Wood Council, Washington, D.C. 2005, pp 8-9.

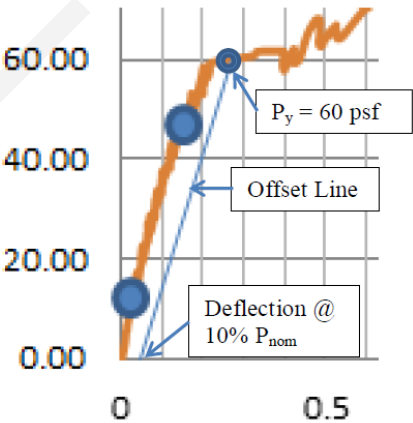
committee’s review of similar criteria for other materials and bending load-deflection behavior of *FPIS* products from industry-representative testing of a variety of *FPIS* products.<sup>2,3</sup> Determination of  $P_y$  is illustrated in Figure C-13 for an actual *FPIS* product. Other *FPIS* products may behave differently (see Figure C2), but the criteria are applied in the same manner.

Other methods of determining  $P_y$  are permissible, but the expectation is that  $P_y$  should not exceed that determined in accordance with Section 6.3.

**FIGURE C-13: Illustration of Recommended Criteria to Determine  $P_y$**   
[For SI: 1 psf = 0.048 kPa; 1 in = 25.4 mm]



	Load (psf)	Deflection (in)
Max Test Load (Pnom)	147.3	1.96
10% of Pnom	14.73	0.034
30% of Pnom	44.19	0.14

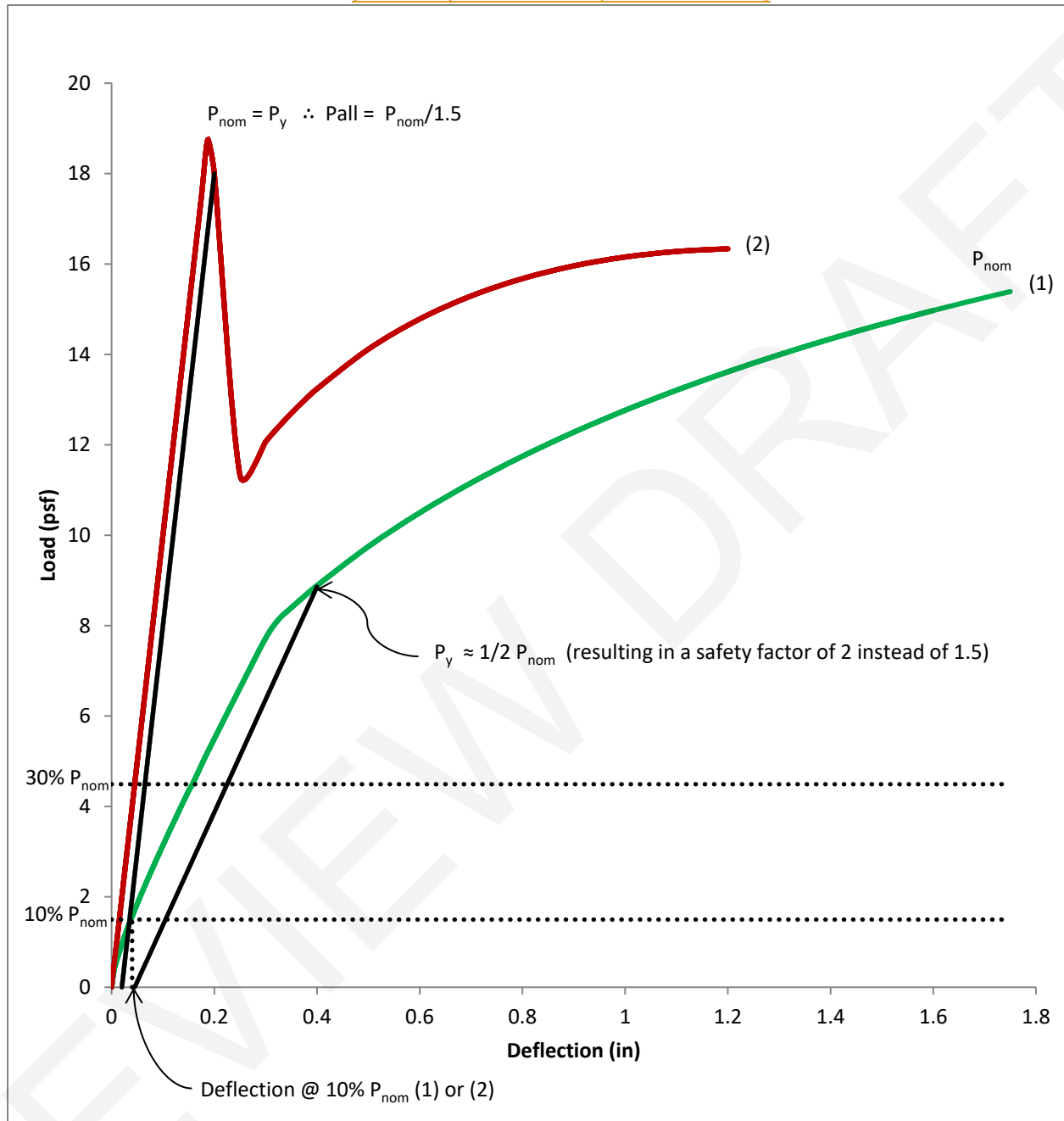


<sup>2</sup>Wind Pressure Testing of Wall Assemblies with Foam Sheathing and Vinyl Siding Products (Report #4107003013108), NAHB Research Center, Inc., Upper Marlboro, MD. January 31, 2008. (Available at [fsc.americanchemistry.com](http://fsc.americanchemistry.com).)

<sup>3</sup>Positive Wind Pressure Testing of Foam Sheathed Wall Assemblies (Report #4108007062508), NAHB Research Center, Inc., Upper Marlboro, MD. July 10, 2008. (Available at [fsc.americanchemistry.com](http://fsc.americanchemistry.com).)

**FIGURE C24: Examples from Extremes in FSC Test Data**  
**(Applications of Yield Criteria to Determine  $P_y$ )**

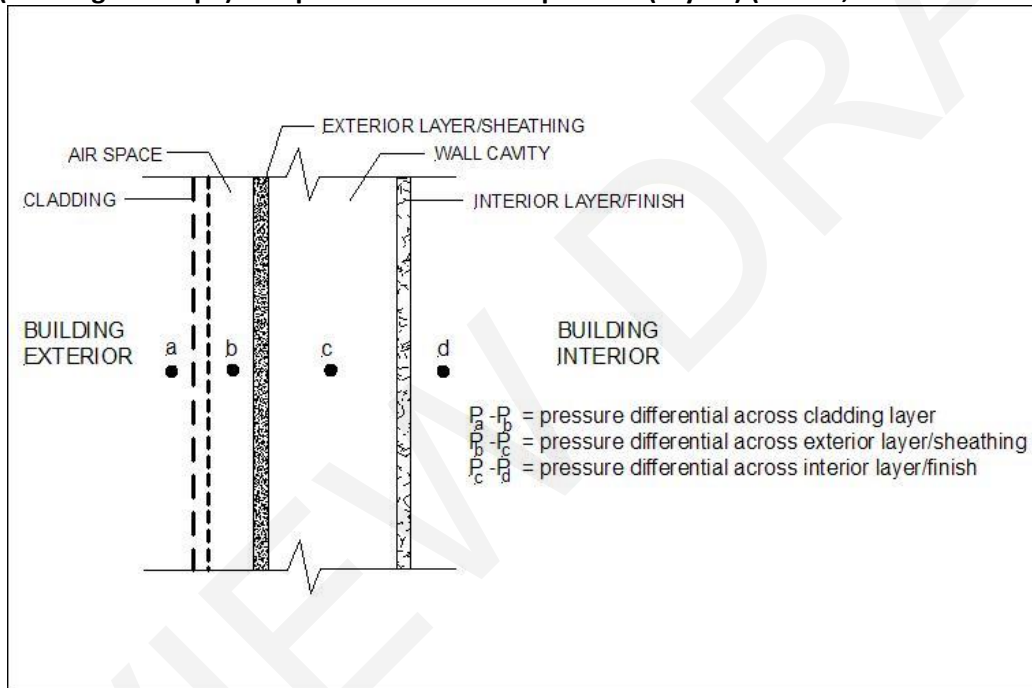
[For SI: 1 psf = 0.048 kPa; 1 in = 25.4 mm]



**C6.4 Pressure Equalization Factor (PEF).** A pressure equalization factor (PEF) of 1.0 represents a baseline condition for evaluation of *FPIS* wind pressure resistance. It is a common design assumption whereby 100% of the wind load acting across an entire wall assembly is considered to act on the exterior sheathing layer. If there is only one layer on a wall assembly then that layer will indeed experience 100% of the wind load. However, if there are multiple layers in a wall assembly (cladding, exterior sheathing, interior sheathing), those layers share the wind load for reasons discussed in ASCE 7-10 Commentary, Section C30.1.5 as illustrated in the figure below. Consequently, the exception statement in Section 6.4

permits use of a 0.9 PEF for a limited condition where an additional layer (i.e., gypsum wall board interior finish) is present to share a portion of the total wind pressure acting across the entire wall assembly. The 0.9 PEF is based on the project committee's judgment from review of relevant full-scale wind tunnel test data with actual wind flow conditions creating temporally- and spatially-varying wind pressure.<sup>4,5</sup> This data suggests a maximum 0.6 PEF for the foam sheathing layer when used in combination with siding such as vinyl siding; however, a conservative 0.9 PEF was selected for the purpose of qualifying foam sheathing resistance to bending stress from wind pressure. The same data also confirmed use of a 0.7 PEF for vinyl siding and foam sheathing *exterior wall covering* assembly as discussed in Section C1.3. Such pressure equalization effects cannot be reliably determined under conventional static or cyclic wind pressure test methods that produce a spatially uniform pressure condition.

**FIGURE C5C3: Distribution of Net Components and Cladding Pressure Acting on a Building Surface (Building Envelope) Comprised of Three Components (Layers) (ASCE 7, FIGURE C30.1-1)**



**C6.5 Allowable Design Wind Pressure Resistance ( $P_{all}$ ).** Allowable wind pressure resistance is determined using the nominal wind pressure resistance (Section 6.2), the yield wind pressure resistance (Section 6.3), a PEF factor (Section 6.4), and a safety factor. Based on the intended application of *FPIS* as a wall insulation sheathing, a safety factor of 1.5 is used in the standard together with a minimum value of the peak tested wind pressure resistance (nominal wind pressure resistance). This safety factor may be compared with precedents for other wall components as follows:

<sup>4</sup>Cope, Anne D., et al., "Wind pressure performance evaluation and building code improvements for energy efficient exterior wall assemblies including continuous insulation – Phase 1," Advances in Hurricane Engineering Conference, Applied Technology Council and Structural Engineering Institute of ASCE, Miami, FL. October 24-26, 2012. (Accepted paper.)

<sup>5</sup>Kopp, Gregory A. and Eri Gavanski, "Effects of pressure equalization on the performance of residential wall systems under extreme wind loads," Journal of Structural Engineering. August 5, 2011.



**TABLE C1: Comparison of Safety Factors**

Product Type	Use	Safety Factor	Reference
Exterior Windows and Doors	Building Envelope Component	1.5 (applied to single proof test)	AAMA/WDMA/CSA 101/I.S.2/A440 and ASTM E330 (Section 5.3)
Garage Doors	Building Envelope Component	1.5 (applied to a single proof test)	ANSI/DASMA 108 and ASTM E330 (Section 5.3)
Vinyl Siding	Cladding Material	1.5 (applied to average of three pressure tests)	ASTM D3679 and ASTM D5206
Regular Cellulosic Insulating Fiber Board	Wall Insulation	1.6 (applied to average of three small-scale bending tests for each board direction)	ASTM C208, ASTM C209, and AWC/SDPWS
Structural Cellulosic Insulating Fiber Board	Wall Insulation and Bracing	1.6 (applied to average of three small-scale bending tests for each board direction)	ASTM C208, ASTM C209, and AWC/SDPWS
Backerboard Cellulosic Insulating Fiber Board	Wall Insulation/Backer for Siding	Undefined	ASTM C208
Wood Structural Panel	Wall Sheathing, Fastener Base and Bracing	1.6 (applied to lowest value 10 tests)	DOC PS 2-04 and AWC/SDPWS
		1.3 (applied to lower-bound statistic from 60 or more tests)	ASTM D7033 (with safety factor isolated from load duration adjustment)
Engineered Wood Panel Siding	Wall Cladding and Bracing	SF unspecified; Qualification to 150 psf capacity based on five tests; inspection reference values based on lowest of five bending tests in both panel directions	APA/PRP 210-2008

For structural design, safety margins as low as 1.5 are considered adequate for structures such as retaining walls (e.g., 2009 IBC Section 1807.2.3). For wall bracing against wind loads, a safety factor of 2 on minimum values is commonly used for in-plane racking shear resistance of sheathing and other bracing materials. For structural connections under withdrawal load in wood, a safety factor of 3.125 (applied to average withdrawal strength and assuming load duration factor of 1.6 does not apply to fasteners in withdrawal such that the safety factor is effectively  $5/1.6 = 3.125$ ) is used to account for the large variability in withdrawal capacity of nail fasteners in wood. For lumber structural materials, which

are highly variable in properties relative to other materials, a safety factor of 1.3 is applied to a lower bound statistical representation of bending strength (lower 5<sup>th</sup> percentile value). For steel structural members, the safety factor is 1.6 which is applied to a nominal (minimum) bending stress value and relatively low material variability.

Based on the above survey of precedents for safety margins applied to building envelop components and structural materials, a safety factor of 1.5 (applied to the lowest value of three full-scale wind pressure tests) was considered appropriate by the project committee for the intended function of *FPIS* as a building envelope component. A larger safety factor would provide little overall building envelope performance benefit relative to the performance of other key building envelope components (e.g., windows, doors, and sheathing such as fiber board). Conversely, a lesser safety factor would potentially create a weak link in the overall building envelop performance.

**C6.6 Conditions of Use.** No commentary.

**C7.0 Quality Assurance and Product Labeling.** The quality assurance provisions of Sections 7.1 through 7.3 are modeled after ASTM D7033 with modifications deemed appropriate by the project committee. For each *FPIS* product with wind pressure resistance qualified and determined in accordance with Section 6.0, a correlated ~~+~~bending strength value (reference bending strength) must also be determined for quality control purposes in accordance with Section 7.4. This procedure ensures that the stiffness and strength of the material is maintained above an acceptable minimum tolerance during production.

The product labeling requirements of Section 7.5 are in addition to those otherwise already required and provided to demonstrate building code compliance for requirements beyond the scope of this standard.

## ANNEX A – Test Methods

**CA.1 Bending Strength Behavior and Quality Control Test Method (“Test Method A.1”).** This test method is based on the ASTM C203 Method 1, Procedure D. Modifications to the *specimen* preparation and displacement rate were made to ensure applicability as a structural property test that correlates to full-scale wind pressure performance as determined by Test Method A.2 or A.3.

**CA.2 Wind Pressure Qualification Test Method (“Test Method A.2”).** The wind pressure test method is based on the ASTM E330 standard, which is typically used to assess the wind pressure resistance of entire wall assemblies. However, its use in ~~this the ANSI~~ standard is to assess the wind pressure resistance of a foam sheathing layer in bending. The amount of design wind load resistance is then determined as described in Section 6.0.

*FPIS* should be attached to framing according to *FPIS* manufacturer installation instructions or with adequate attachment to prevent movement of the *FPIS* material relative to the test frame. However, the intent of the test as required by [Section 6.1 and Figure 1Table-2](#) of the standard is not to test *FPIS* attachments. Thus, the tests are conducted with suction pressure only causing the *FPIS* to bear against framing. [Figure 1Table-2](#) addresses orientation of panel faces relative to suction pressure chamber to address *FPIS* products with asymmetric bending behavior (usually due to use of non-identical *facers* on opposite faces of a panel) resulting in differences in performance under a positive or negative wind loading direction experienced in end-use. The User Note in Section A.2.2 addresses the use of ASTM E330 for testing *FPIS* attachment, when qualification is desired for *FPIS* wind pressure resistance independent of cladding and cladding fasteners. In this case, *FPIS* will not bear against framing or



battens (unless the battens are the intended means of *FPIS* attachment to resist wind load independently), and will be placed adjacent to the suction chamber relative to the test frame.

**CA.3 Wind Pressure Qualification Test Method (“Test Method A3”).** This test method is based on ASTM E1233 and is provided as an alternative to the application of  $P_y$  in Section 6.3 as a cap to design pressure. Use of this test method is referenced in the exception statement of Section 6.5. User Notes in Section A.3.2 address use of ASTM E1233 for testing *FPIS* attachment, when qualification is desired for *FPIS* wind pressure resistance independent of cladding and cladding fasteners. In this case, *FPIS* will not bear against framing or battens (unless the battens are the intended means of *FPIS* attachment to resist wind load independently), and will be placed adjacent to the suction chamber relative to the test frame.