

AMERICAN NATIONAL STANDARD

Standard for Performance-Rated Structural Insulated Panels in Wall Applications



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American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036
www.ansi.org

Published by
APA – The Engineered Wood Association
7011 South 19th Street
Tacoma, WA 98466

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ANSI/APA PRS 610.1-2018

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Standard for Performance-Rated Structural Insulated Panels in Wall Applications

APA – The Engineered Wood Association

Approved April 16th, 2018
American National Standards Institute

FOREWORD (This Foreword is not a part of American National Standard ANSI/APA 610.1-2018)

This standard provides requirements and test methods for qualification and quality assurance for performance-rated structural insulated panels (SIPs), which are manufactured with a foam plastic insulation core bonded between two wood structural panel facings intended for use in wall applications. Product performance requirements are specified.

The development of this consensus American National Standard was achieved by following the *Operating Procedures for Development of Consensus Standards* of APA – The Engineered Wood Association, approved by the American National Standards Institute (ANSI).

Inquiries or suggestions for improvement of this standard are welcome and should be directed to APA – The Engineered Wood Association at 7011 South 19th Street, Tacoma, WA 98466, www.apawood.org.

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1. SCOPE

- 1.1** The PRS-610.1 performance-rated structural insulated panels (referred to as SIPs hereinafter) are sandwich panels consisting of a foam plastic insulation core bonded between two wood structural panel facings. Performance rated refers to SIPs that meet the performance requirements as specified in this standard.
- 1.2** SIPs are intended for use as wall panels and lintels in above-grade wall applications. Wall panels shall resist axial, transverse, and racking loads. Lintels shall resist vertical loads. The values provided in this standard are obtained from testing under laboratory conditions and do not address end use considerations, such as basic wind speed, connections, creep, load duration, durability, seismic design categories, and combined racking and vertical load conditions. Derivation of design values is beyond the scope of this standard.
- 1.3** SIPs shall be qualified by Method A (prescriptive components method) or Method B (empirical full-scale test method). The facings used for the SIP walls shall have the strength axis oriented in the vertical direction of the wall with vertical loads applied uniformly to both facings at the top of the SIPs. The facings used for the SIP lintels shall have the strength axis oriented in the horizontal direction of the wall and gravity loads applied equally and uniformly to both facings at the top of the SIPs. For this standard, the facing materials on both exterior layers of the SIP shall be of the same type and thickness. Wall penetrations of SIPs other than the precut holes for electrical boxes described in this standard are beyond the scope of this standard.
- 1.4** SIPs shall be marked with the rated direction in accordance with the requirements of this standard. Manufacturer's specific installation requirements for SIPs marked as conforming to this standard shall be in agreement with the requirements of this standard.
- 1.5** SIPs are intended for use in dry service conditions where the average equilibrium moisture content of sawn lumber is less than 16%. SIPs used as bearing walls or shear walls shall be installed with both panel facings continuously supported at the bottom of the SIPs and shall be attached to the top and bottom plates. The panels shall be protected from the elements with an appropriate weather-resistive exterior wall covering and flashing, a water-resistive barrier, and a positive means of drainage, in accordance with building code requirements.
- 1.6** This standard provides minimum properties for the performance-rated SIPs. To qualify for marking as a PRS-610.1 performance-rated SIP, the SIP product shall demonstrate conformance to the qualification and quality assurance requirements set forth in this standard.
- 1.7** Annexes A and B contained in this standard are mandatory, and Appendix X1 and notes are non-mandatory. This standard incorporates the U.S. customary units as well as the International System of Units (SI). The values given in the U.S. customary units are the standard and the SI values given in parentheses are for information only.

2. REFERENCED DOCUMENTS

This standard incorporates dated references. These normative references are cited at the appropriate places in the text. Subsequent amendments or revisions to these references apply to this standard only when incorporated into this standard by amendments or revisions.

2.1 ASTM Standards:

C203-05a (2012) Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation

C272/C272M-16 Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions

C273/C273M-16 Standard Test Method for Shear Properties of Sandwich Core Materials

C297/C297M-16 Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions

C393/C393M-16 Standard Test Method for Core Shear Properties of Sandwich Constructions by Beam Flexure

C578-17a Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

D1621-16 Standard Test Method for Compressive Properties of Rigid Cellular Plastics

D1622-14 Standard Test Method for Apparent Density of Rigid Cellular Plastics

D1623-17 Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

D2126-15 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging

D2915-17 Standard Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products

D4761-13 Standard Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material

D7446-09 (2017) Standard Specification for Structural Insulated Panel (SIP) Adhesive for Laminating Oriented Strand Board (OSB) to Rigid Cellular Polystyrene Thermal Insulation Core Materials

E72-15 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

E84-17 Standard Test Method for Surface Burning Characteristics of Building Materials

E96/E96M-16 Standard Test Methods for Water Vapor Transmission of Materials

E1803-14 Standard Test Methods for Determining Structural Capacities of Insulated Panels

E2126-11 Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings

F1667-17 Specification for Driven Fasteners: Nails, Spikes, and Staples

2.2 Other Standards and Referenced Documents:

CAN/ULC-S102-10 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

CAN/ULC-S102.2-10 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

CAN/ULC S701.1: 2017 Standard for Thermal Insulation, Polystyrene Boards

CSA O121-17 Canadian Douglas Fir Plywood

CSA O151-17 Canadian Softwood Plywood

CSA O325-16 Construction Sheathing

FM 4880 (R2007) American National Standard for Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies, Plastic Interior Finish Materials, Plastic Exterior Building Panels, Wall/Ceiling Coating Systems, Interior and Exterior Finish Systems

NFPA 286-15 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

PS 1-09 Structural Plywood

PS 2-10 Performance Standard for Wood-Based Structural-Use Panels

PS 20-15 American Softwood Lumber Standard

UL 723-08 Test for Surface Burning Characteristics of Building Materials

UL 1040-96 Fire Test of Insulated Wall Construction—with Revisions through September 2007

UL 1715-97 Fire Test of Interior Finish Material—with Revisions through April 2008

2.3 International Standards:

ISO/IEC 17011-2004 Conformity Assessment—General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies

ISO/IEC 17020-2012 Conformity Assessment—Requirements for the Operation of Various Types of Bodies Performing Inspection

ISO/IEC 17025-2005 General Requirements for the Competence of Testing and Calibration Laboratories

ISO/IEC 17065-2012 Conformity Assessment—Requirements for Bodies Certifying Products, Processes and Services

3. TERMINOLOGY

3.1 Definitions

See the referenced documents for definitions of terms used in this standard.

3.2 Description of Terms Specific to This Standard:

Approved Agency (U.S.)—an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by regulatory bodies (see Qualified Inspection Agency and Qualified Testing Agency)

Approved Agency (Canada)—an established and recognized agency regularly engaged in conducting certification services, when such agency has been approved by regulatory bodies (see Qualified Certification Agency)

Characteristic Value—the structural property estimate, typically a population mean for stiffness properties or a tolerance limit (5th percentile with 75% confidence) for strength properties, as estimated from the test data that is representative of the population being sampled

Core—the light-weight middle section of the SIP composed of foam plastic insulation, which provides the link between the two structural panel facings and provides the required thermal insulation for the wall, supplies buckling resistance to the two panel facings under axial loads, and contributes to the shear and bending resistance of the panel under transverse and lateral loads:

- a. **EPS**—the letter designation for the molded expanded polystyrene thermal insulation classified by this standard and is defined as cellular plastic product manufactured from pre-expanded polystyrene beads subsequently molded into blocks resulting in a product which is rigid with closed cellular structure, and
- b. **XPS**—the letter designation for the extruded expanded polystyrene thermal insulation classified by this standard and is defined as cellular plastic product manufactured in a one-stage process by extrusion and expansion of the base polymer in the presence of blowing agent(s) into boards resulting in a product which is rigid with closed cellular structure
- c. **Foamed-in-place polyurethane insulation**—a rigid cellular plastic material that is formed in place by the catalyzed reaction of polyisocyanates and polyhydroxyl compounds, expanded with blowing agents between facers, resulting in a product that is a predominantly closed cell product

Facing—the wood structural panel material that forms both exterior layers of the SIP

Flame Spread Index—a comparative measure, expressed as a dimensionless number, derived from visual measurements of the spread of flame versus time for a material tested in accordance with ASTM E84, UL 723, CAN/ULC-S102 or CAN/ULC-S102.2

Laminating Adhesive—the adhesive used to bond the facings to the core

Lintel—a structural element acting as a header supporting gravity loads above an opening

Qualified Certification Agency (Canada)—an agency meeting the following requirements:

- a. has trained personnel to perform product certification in compliance with all applicable requirements specified in this standard,
- b. has procedures to be followed by its personnel in performance of the certification,
- c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being certified,

- d. is not owned, operated, or controlled by any such company, and
- e. is accredited by a recognized accreditation body under ISO/IEC 17065

Qualified Inspection Agency (U.S.)—an agency meeting the following requirements:

- a. has trained personnel to verify that the grading, measuring, species, construction, bonding, workmanship, and other characteristics of the products as determined by inspection in compliance with all applicable requirements specified in this standard,
- b. has procedures to be followed by its personnel in performance of the inspection,
- c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being inspected,
- d. is not owned, operated, or controlled by any such company, and
- e. is accredited by a recognized accreditation body under ISO/IEC 17020

Qualified Testing Agency—an agency meeting the following requirements:

- a. has access to the facilities and trained technical personnel to conduct testing on the characteristics of the products by sampling and testing in compliance with all applicable requirements specified in this standard,
- b. has procedures to be followed by its personnel in performance of the testing,
- c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being tested,
- d. is not owned, operated, or controlled by any such company, and
- e. is accredited by a recognized accreditation body under ISO/IEC 17025

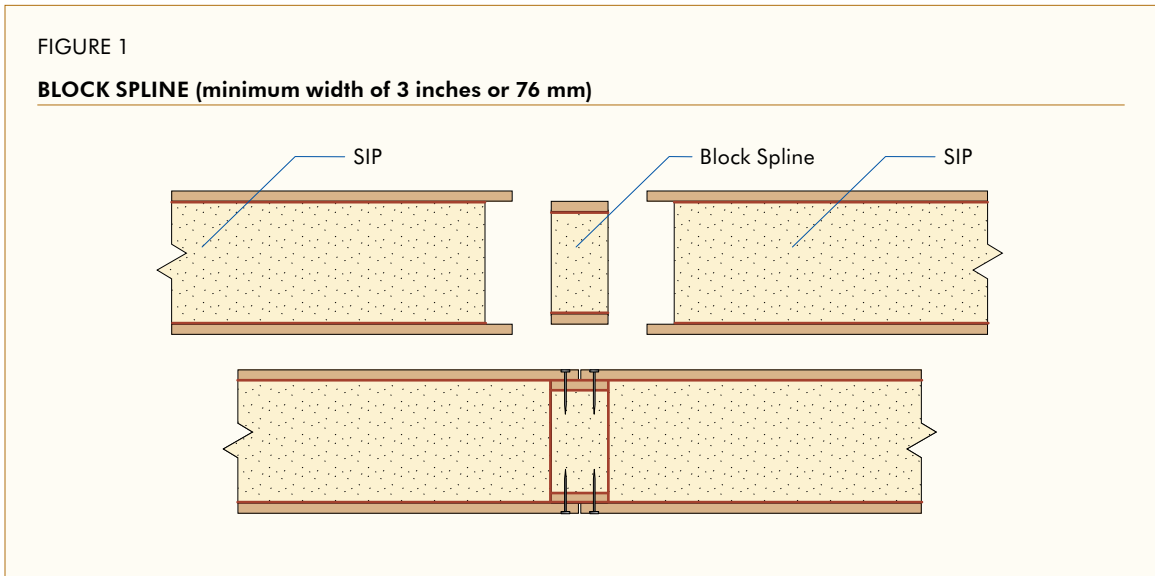
Recognized Accreditation Body—an organization complying with ISO/IEC 17011 and recognized by the regulatory body having jurisdiction as qualified to evaluate and accredit certification agencies, inspection agencies and/or testing agencies

Sealant—material used for sealing SIPs at spline, plate, and other connections to reduce air infiltration

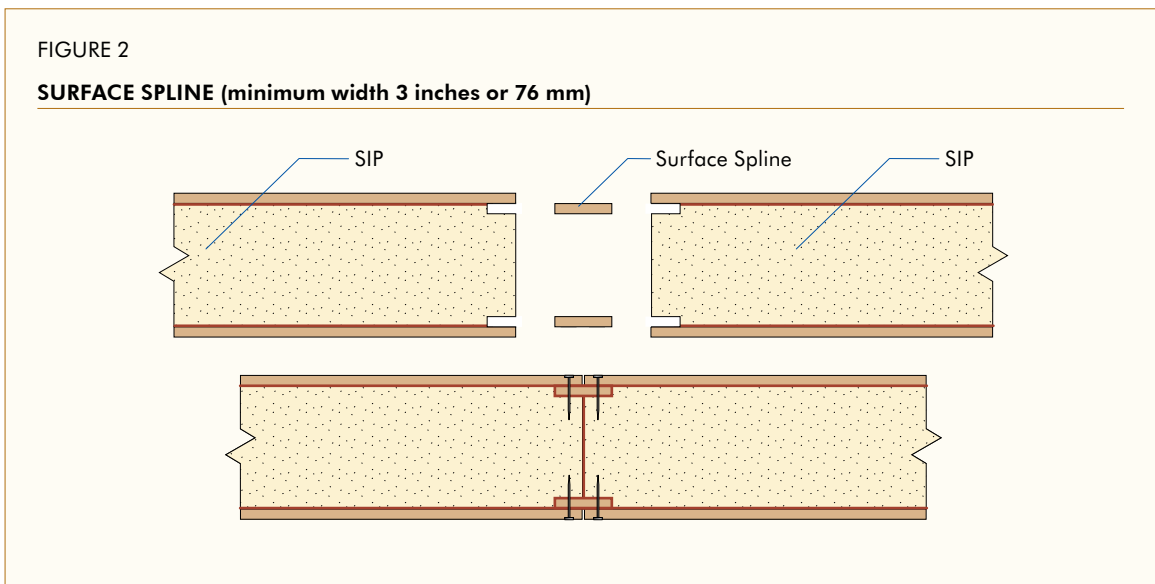
Smoke-Developed Index—a comparative measure, expressed as a dimensionless number, derived from measurements of smoke obscuration versus time for a material tested in accordance with ASTM E84, UL 723, CAN/ULC-S102 or CAN/ULC-S102.2

Spline—a full-height vertical connector installed between two adjacent wall panels

Spline, Block—a spline consisting of wood structural panels of the same material as the structural insulated panel facings bonded with the same foam core to form a block with overall thickness equal to the core thickness of the two structural insulated panels to be connected that fit into a recess at the vertical edges of the two structural insulated panels to be connected (see Figure 1); the width of the block spline shall be 3 inches (76 mm) minimum



Spline, Surface—A pair of wood structural panels of the same material as the structural insulated panel facings that fit into grooves cut into the foam core at the vertical edges of the two structural insulated panels to be connected (see Figure 2); the width of the surface spline must be 3 inches (76 mm) minimum



Strength Axis, Wood Structural Panels—the axis parallel to the face and back orientation of the flakes (oriented strand board) or the grain of the face veneers (plywood), which is generally the long panel direction, unless otherwise marked

Structural Insulated Panel (SIP)—a structural sandwich panel which consists of a foam plastic insulation core bonded directly between two structural facings made of wood structural panels (see Figure 3)

FIGURE 3

EXAMPLE OF A SIP WALL PANEL (for foamed-in-place foam cores, the foam is the adhesive)



Wood Structural Panel—a panel product composed of oriented strand board (OSB) or plywood in conformance with the performance requirements of DOC PS1 or DOC PS2 in the U.S. or CSA O121, CSA O151, or CSA O325 in Canada, and the additional requirements specified in this standard

4. SIP WALLS

SIPs for above grade wall construction shall comply with the cross section shown in Figure 3 and shall have a thickness as specified in Section 4.1.

4.1 SIP Thicknesses

SIPs shall have an overall panel thickness of 4-1/2 or 6-1/2 inches (114 or 165 mm) subject to the tolerances specified in Section 4.2.

4.2 SIP Tolerances

The tolerances for SIPs at the time of manufacture shall not exceed the following:

SIP Thickness—Plus 1/8 inch (3.2 mm) or minus 0

SIP Width—Plus or minus 1/8 inch (3.2 mm)

SIP Height—Plus or minus 1/4 inch (6.4 mm)

SIP Squareness—1/64 inch per lineal foot (1.3 mm per lineal meter) measured along the diagonals

SIP Straightness—1/16 inch (1.6 mm) of panel edge measured by a straight line drawn from one corner to the adjacent corner

SIP Facing to Facing Alignment—Plus or minus 1/16 inch (1.6 mm) measured from one facing to the other

5. PERFORMANCE CRITERIA AND REQUIREMENTS

SIPs shall be qualified in accordance with Method A or Method B as prescribed in this standard. Method A, as prescribed in Section 5.1 is based on prescriptive requirements for components of SIPs and further confirmed by limited full-scale SIP tests. Method B, specified in Section 5.2, is based on full-scale empirical SIP tests. For both Methods A and B the test materials shall be representative of production and substitutions of components or changes in manufacturing processes after qualification shall only be made with the approval of the approved agency.

5.1 Method A (Prescriptive Component Method)

5.1.1 Component Requirements

Requirements contained in this section shall be applicable to SIPs that are qualified based on prescriptive component requirements specified in Sections 5.1.2 through 5.1.4. For SIPs manufactured with materials that are not in compliance with the requirements specified in Sections 5.1.2 through 5.1.4, the SIP shall be qualified in accordance with the Method B specified in Section 5.2.

5.1.2 Core Materials

SIPs shall be produced using a foam plastic insulation core material meeting the requirements specified in this section.

5.1.2.1 The core material shall meet one of the following requirements:

- a. EPS insulation complying with ASTM C578 Type I in the U.S. or CAN/ULC-S701 Type 1 in Canada.
- b. XPS insulation complying with ASTM C578 Type X in the U.S. or CAN/ULC-S701 Type 2 in Canada.
- c. Foamed-in-place polyurethane insulation meeting the physical properties shown in Table 1.

Physical Property	Requirement
Minimum apparent overall core density (ASTM D1622)	2.2 lb/ft ³
Minimum apparent core density ^b (ASTM D1622)	1.8 lb/ft ³
Compressive resistance at yield or 10% deformation, whichever occurs first, (ASTM D1621)	19 psi (perpendicular to rise)
Minimum flexural strength (ASTM C203, Method B)	30 psi
Minimum tensile strength (ASTM D1623)	35 psi
Minimum shear strength (ASTM C273) ^c	25 psi
Maximum water vapor permeance of 1.00-in. thickness (ASTM E96)	2.3 perm
Maximum water absorption by total immersion (ASTM C272)	4.3% (volume)
Maximum change in dimensions (ASTM D2126, 7 days at 158°F/100% humidity and 7 days at -20°F)	2%

For SI: 1 inch = 25.4 mm, 1 lbf/ft³ = 16.0 kg/m³, 1 psi = 6.9 kPa

- a. Specimens for all tests shall be from samples from the SIP manufacturer
- b. As measured on the center 1-inch (25.4 mm) of the core thickness
- c. Based on the full thickness SIP

5.1.2.2 Core materials shall have a thickness of 3-5/8 or 5-5/8 inches (92 or 143 mm)

- a. In the U.S., the core material shall have a flame spread index of not more than 75 and a smoke-developed index of not more than 450 when tested in accordance with ASTM E84 or UL 723 at 4 inches in thickness. In addition, SIPs with a 5-5/8-inch (143-mm) core shall be tested in accordance with NFPA 286, FM 4880, UL 1040 or UL 1715.
- b. In Canada, the core material shall have a flame-spread rating less than 500 when tested in accordance with CAN/ULC-S102 for foamed-in-place polyurethane insulation or CAN/ULC-S102.2 for polystyrene insulation.

5.1.2.3 Prior to SIP manufacturing, core materials shall bear a label containing manufacturer identification, flame spread index, smoke-developed index, and name, logo or identification of an approved agency certifying the foam materials.

5.1.2.4 Core joints shall not be allowed unless specifically qualified with core joints in each assembly tested in accordance with 5.1.5. Cores shall be in full contact with the facings and shall not contain surface channels.

5.1.3 Facing Materials

Facing materials shall be 7/16 Performance Category wood structural panels composed of oriented strand board (OSB) or plywood in conformance with DOC PS1 or DOC PS2 in the U.S., or CSA O121, CSA O151, or CSA O325 in Canada, and the properties specified in Table 2. Wood structural panels shall be identified by a grade mark or letter of conformance issued by a qualified inspection agency, signifying conformance with Table 2 of this standard.

TABLE 2

MINIMUM PROPERTIES FOR WOOD STRUCTURAL PANEL FACING MATERIALS^a

Flatwise Bending Stiffness ^b (lbf-in. ² /ft)		Flatwise Bending Strength ^c (lbf-in./ft)		Tension ^c (lbf/ft)		Density ^{b,d} (pcf)
Along	Across	Along	Across	Along	Across	
55,600	16,500	1,040	460	7,450	5,800	34

For SI: 1 lbf-in.²/ft = 9.4 N-mm²/mm, 1 lbf-in./ft = 0.37 N-mm/mm, 1 lbf/ft = 0.015 N/mm, 1 lbf/ft³ = 16.0 kg/m³

a. Tested in accordance with Annex A of this standard

b. Mean test value

c. Characteristic test value (5th percentile with 75% confidence)

d. Based on oven-dry weight and oven-dry volume

5.1.4 Adhesives

5.1.4.1 Laminating adhesives shall be used to bond the core to facings of a SIP during manufacture unless the SIPs are manufactured with a foam-in-place component. SIPs shall be produced with a laminating adhesive distributed on the full surface of the core in contact with the facings. The laminating adhesives shall conform to the requirements of ASTM D7446 and the qualification requirements specified in this standard. Bead application of laminating adhesives shall be verified to ensure distribution of the adhesive on the full surface of the core during lamination.

5.1.4.2 The facing surface (rough or smooth surface where applicable) used to qualify the adhesive under ASTM D7446 shall be the same facing surface that the SIP manufacturer is using as the laminating surface. The foam plastic used in the adhesive qualification tests under ASTM D7446 shall be the same core materials complying with Section 5.1.2.1(a) through (c) as that used in the manufacturing of the SIP.

5.1.4.3 Material parameters including core material, facings, adhesives and manufacturing parameters such as adhesive mix ratios, mixing procedure, application pressure and duration used during the adhesive qualification shall be representative of SIP manufacturing and shall be identified as part of the qualification procedures. Changes in these parameters shall require evaluation by the approved agency to determine if a new qualification is required.

5.1.4.4 Each container of adhesive qualified under this standard shall bear a label with the adhesive manufacturer identification (such as name or logo), adhesive name and type, date of manufacturing, and the name or logo of the approved agency certifying the adhesive.

5.1.4.5 Foam-in-place materials used to simultaneously manufacture the core and provide the bond of the foam core to the facing materials shall be evaluated in accordance with Section 6.8 for compliance with the durability requirements specified in Table 4.

5.1.5 Full-Scale SIP Confirmation Test Requirements

A limited number of full-scale SIP confirmation tests, as listed in Table 3, are required to verify that the performance of the component materials specified in this standard conform with the expected SIP performance evaluated by full-scale testing in accordance with Section 6. Confirmation test results for each test type shall meet the applicable requirements specified in Tables 4 and 5 for the specific SIP configurations listed in the footnotes to Table 3. Annex B provides additional testing details such as provisions for electrical chases and electrical boxes.

TABLE 3

SIP CONFIRMATION TEST REQUIREMENTS

Requirements	Minimum Number of Tests	Test Method Section
Axial Load	3 ^{a,b}	6.2
Transverse Load	3 ^{a,b}	6.3
Racking Resistance	3 ^{a,c}	6.4
Lintel Load	3 ^{a,d}	6.5
Bond Strength – Tension	5	6.7
Bond Strength – Shear	5	6.7

- a. A minimum of three (3) tests are required with none of the peak load values varying more than 15 percent from the average peak load of the three, unless the lowest peak load value is used; the average peak load based on a minimum of five (5) tests shall be permitted for use regardless of the variation
- b. 4-1/2 in. x 4 ft x 10 ft (114 x 1219 x 3048 mm) panels are required to be tested
- c. 4-1/2 in. x 8 ft x 8 ft (114 x 2438 x 2438 mm) assemblies are required to be tested
- d. 4-1/2 in. x 12 in. x 4 ft (114 x 305 x 1219 mm) lintels are required to be tested

5.1.6 Small-Scale SIP Test Requirements

The characteristic (5th percentile with 75% confidence) flatwise bending strength and average bending stiffness of SIPs in the rated direction shall be established during qualification in accordance with ASTM C393 using SIPs representative of the transverse load qualification testing in Table 3. A minimum of 20 or more specimens, as determined in accordance with ASTM D2915, of 4-1/2 inches (114 mm) in thickness, 4 inches (102 mm) in width, and 4 feet (1219 mm) in length shall be tested at a 46.5-inch (1181-mm) span from center to center of supports using four-point loading with an end bearing of 1-1/2 inches (38 mm).

5.2 Method B (Empirical Full-Scale Test Method)

SIPs shall be permitted to be qualified based on empirical full-scale SIP tests specified in this section. When using this qualification method, core materials, facings, and adhesives shall meet the following requirements.

- a. Core materials shall meet the requirements specified in Sections 5.1.2.1 and 5.1.2.2 and shall be characterized in accordance with the test methods of ASTM C578 in the U.S., CAN/ULC-S701 in Canada, or Table 1.
- b. Adhesives shall meet the requirements specified in Sections 5.1.4.
- c. Facing materials shall be a minimum of 7/16 Performance Category wood structural panels composed of oriented strand board (OSB) or plywood in conformance with DOC PS1 or DOC PS2 in the U.S., or CSA O121, CSA O151, or CSA O325 in Canada, and shall be characterized in accordance with Annex A.
- d. Lumber and fasteners used for qualification under this method as described in Annex B shall be documented and specified for end-use applications. Annex B also provides details regarding provisions for electrical chases and boxes.

Note 1: The core and facing material characterization tests are intended for the development of the on-going quality control values and there are no minimum property qualification requirements for the core and wood structural panel facing materials when SIPs are qualified using Method B.

5.2.1 SIP Performance Requirements

SIPs shall meet or exceed the minimum test values for all properties listed in Table 4 when tested in accordance with the methods provided in Section 6.

TABLE 4

PERFORMANCE REQUIREMENTS FOR SIPs

Properties	SIP Configuration (Thickness x Length x Height)	Minimum Number of Tests	Test Method Section	Minimum Test Value ^a		
				Peak Load	Load at Deformation Limit	
					Def. Limit (in.)	Test Load
Axial Load Capacity	4-1/2 in. x 4 ft x 8 ft	3 ^b	6.2	9,600 lbf/ft	0.125	3,200 lbf/ft
	4-1/2 in. x 4 ft x 10 ft	3 ^b		9,300 lbf/ft	0.125	3,100 lbf/ft
	6-1/2 in. x 4 ft x 8 ft	3 ^b		9,600 lbf/ft	0.125	3,200 lbf/ft
	6-1/2 in. x 4 ft x 10 ft	3 ^b		9,300 lbf/ft	0.125	3,100 lbf/ft
Transverse Load Capacity	4-1/2 in. x 4 ft x 8 ft	3 ^b	6.3	85 lbf/ft ²	0.400 ^d	28 lbf/ft ²
	4-1/2 in. x 4 ft x 10 ft	3 ^b		60 lbf/ft ²	0.500 ^d	20 lbf/ft ²
	6-1/2 in. x 4 ft x 8 ft	3 ^b		85 lbf/ft ²	0.400 ^d	28 lbf/ft ²
	6-1/2 in. x 4 ft x 10 ft	3 ^b		60 lbf/ft ²	0.500 ^d	20 lbf/ft ²
Racking Resistance ^c	4-1/2 in. x 8 ft x 8 ft	3 ^b	6.4	945 lbf/ft	0.20	315 lbf/ft
	6-1/2 in. x 8 ft x 8 ft	3 ^b			0.25	
	4-1/2 in. x 8 ft x 10 ft	3 ^b				
	6-1/2 in. x 8 ft x 10 ft	3 ^b				
Construction Moisture Effect	4-1/2 in. x 4 ft x 8 ft	3 ^b	6.2 & 6.6	Axial: 8,160 ^e lbf/ft	0.125	2,720 lbf/ft
		3 ^b	6.3 & 6.6	Transverse: 72 ^e lbf/ft ²	0.400 ^d	24 lbf/ft ²
		3 ^b	6.4 & 6.6	Racking: 803 ^e lbf/ft	0.20	268 lbf/ft
Bond Strength ^f	Polystyrene Cores -Tension -Shear	5	6.7	20 psi	NA	NA
		5		12 psi	NA	NA
	Foamed-In-Place Cores -Tension -Shear	5	6.7	22 psi	NA	NA
		5		25 psi	NA	NA
Durability of Foamed-In- Place Core Materials ^f	-Tension -Shear	5	6.8	19 ^e psi	NA	NA
		5		21 ^e psi	NA	NA

For SI: 1 in. = 25.4 mm, 1 ft = 304.8 mm, 1 lbf/ft = 0.015 N/mm, 1 lbf/ft² = 47.9 Pa

- The tabulated values are average test values and not intended for design use. The average test value shall meet the minimum requirements for both peak load and the test load at the specified deformation limit
- minimum of three (3) tests are required with none of the peak load values varying more than 15 percent from the average peak load of the three, unless the lowest peak load value is used; the average peak load based on a minimum of five (5) tests shall be permitted for use regardless of the variation
- Based on 8d common (0.131 x 2-1/2 in. or 3.33 x 63.5 mm) nails at 6 in. (152 mm) o.c.
- Based on H/240 where H is the wall height in inches (mm)
- The tabulated peak load and test load are 85% of that of corresponding dry (as-received) assemblies
- Each specimen shall show no more than 10% bond line failure

5.2.1.2 SIPs having a depth of 12 inches (305 mm) shall meet the minimum test values for lintels specified in Table 5 when tested in accordance with the test methods provided in Section 6.

TABLE 5
LINTEL LOAD CAPACITIES FOR SIPs^a

Property	Span (ft)	Minimum Number of Tests	Test Method Section	Minimum Test Value ^b		
				Peak Load (lbf/ft)	Def. Limit (in.)	Test Load (lbf/ft)
Lintel Load Capacity	2	3 ^c	6.5	3,180	0.067	1,060
	4	3 ^c		1,620	0.133	540
Construction Moisture Effect ^d	2	3 ^c	6.6	2,705	0.067	900

For SI: 1 in. = 25.4 mm, 1 ft = 304.8 mm, 1 lbf/ft = 0.015 N/mm

a. The tabulated values are average test values and not intended for design use. The average test value shall meet the minimum requirements for both peak load and the test load at the specified deformation limit

b. For SIP thickness of 4-1/2 inches (114 mm) or thicker, and depth of 12 inches (305 mm) or deeper in accordance with the configuration shown in Figure 4

c. A minimum of three (3) tests are required with none of the peak load values varying more than 15 percent from the average peak load of the three, unless the lowest peak load value is used; the average peak load based on a minimum of five (5) tests shall be permitted for use regardless of the variation

d. The tabulated peak load and test load are 85% of that of corresponding dry (as-received) lintel

5.2.2 Small-Scale SIP Test Requirements

The characteristic (5th percentile with 75% confidence) flatwise bending strength and average bending stiffness of SIPs in the rated direction shall be established during qualification in accordance with ASTM C393 using SIPs representative of the transverse load qualification testing in Table 4. A minimum of 20 or more specimens, as determined in accordance with ASTM D2915, of 4-1/2 inches (114 mm) in thickness, 4 inches (102 mm) in width, and 4 feet (1219 mm) in length, and tested at a 46.5-inch (1181-mm) center span using four-point loading with a end bearing of 1-1/2 inches (38 mm).

6. TEST METHODS FOR SIPS

6.1 General

Sampling procedures, number of samples, test methods, and data analyses for the SIP qualification shall conform to the principles set forth in the referenced standard of each qualification test method unless specifically noted in this section.

Specimens shall be sampled from representative production by the qualified inspection or test agency. The specimens shall include electrical chases of 1-1/2 inches (38 mm) in diameter centered in the foam core and 4-inch by 4-inch (102 mm by 102 mm) electrical boxes as shown in Annex B. The vertical edges of the SIP shall be recessed to accommodate the spline as required for testing in accordance with Annex B.

Parameters, such as core, facing, adhesive, adhesive application method, fasteners, lumber, splines, SIP configuration, and processing details, shall be identified as part of the qualification procedures. Changes in these parameters shall require evaluation by the approved agency.

For the qualification testing, sealants shall not be used in spline, panel-to-top-plate, panel-to-bottom-plate, or panel-to-end-post connections of the test specimen. Additional details used in the test setup are shown in Annex B. The SIP assemblies shall be tested at the as-received moisture conditions. The moisture content and specific gravity of the representative facing materials and lumber shall be reported.

6.2 Axial Load Capacity

Axial load capacity of SIPS shall be qualified in accordance with ASTM E1803 with the additional requirement that the wall panel shall be loaded with an eccentricity of 1/6 the panel thickness to the interior panel. The test setup shall accommodate rotation of the test specimen at the top of the wall. The electrical chases in the core and the pre-cut holes for electrical boxes on the facing materials shall be included in the test assembly. Splines shall not be used. Additional details of the test setup are shown in Annex B.

The test assembly dimension and minimum number of tests shall be in accordance with Table 3 or 4. Both the peak test load and the load at the deflection limit specified in Table 4 shall be reported.

6.3 Transverse Load Capacity

Transverse load capacity of SIPS shall be qualified in accordance with ASTM E1803 using uniform loading. The bearing of the SIP specimen at the support shall simulate the end-use conditions. The electrical chases in the core and the pre-cut holes for electrical boxes on the facing materials shall be included in the test assembly and placed on the tension side of the test setup. Splines shall not be used along the test span of the SIP specimen. Additional details of the test setup are shown in Annex B.

The test assembly dimension and minimum number of tests shall be in accordance with Table 3 or 4. Both the peak test load and the load at the deflection limit specified in Table 4 shall be reported.

6.4 Racking Resistance

Racking resistance of SIPS shall be qualified in accordance with ASTM E1803 with the load beam as described in Annex B. Splines meeting the requirements shown in Figure 1 or 2 shall be used in the SIP assembly. End posts consisting of No. 2 spruce-pine-fir (SPF) lumber shall be installed. The bearing of the SIP specimen at the top and bottom plates shall be as shown in Annex B. The electrical chases in the core and the pre-cut holes for electric boxes on the facing materials shall be included in the test assembly. Additional details of the test setup are shown in Annex B.

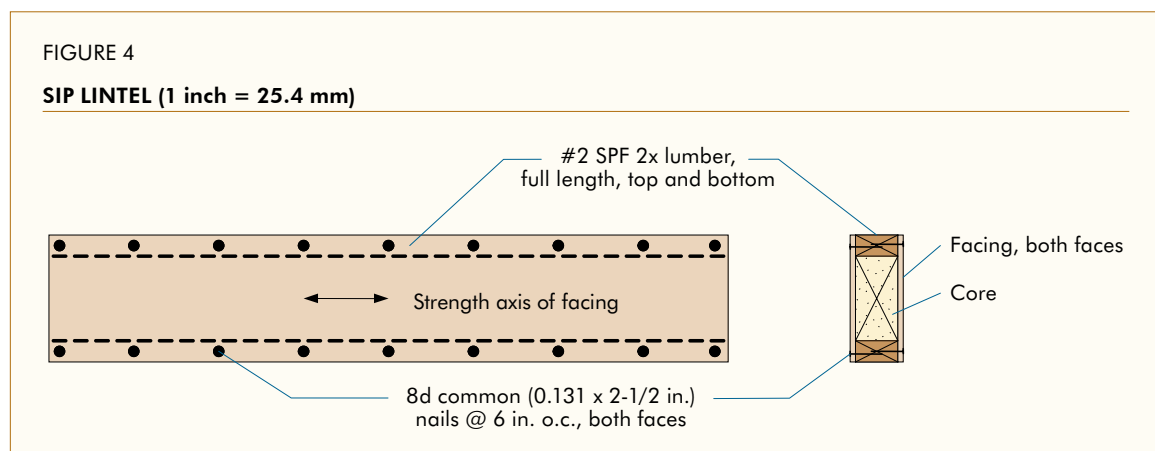
The test assembly dimension and minimum number of tests shall be in accordance with Table 3 or 4. Both the peak test load and the load at the deflection limit specified in Table 4 shall be reported. The failure mode and measurements of all displacement measuring devices shall be reported.

6.5 Lintel Load Capacity

Lintel load capacity of SIPs shall be qualified in accordance with this section. Additional details of the testing procedures are shown in Annex B. The lintel depth of 12 inches (305 mm) is considered as the standard depth and the results obtained from the qualification are applicable to lintel depths of 12 inches (305 mm) or deeper.

The test assembly dimension and minimum number of tests shall be in accordance with Table 3 or 5. Each specimen shall be taken from a separate SIP to permit the assessment of the variability of the test results.

The SIP lintels shall be cut from larger SIPs and fabricated with No. 2 SPF 2x lumber attached to the top and bottom of the lintel with nails (see Figure 4). The long edges (lintel length) of the core material in each specimen shall be recessed to a depth of 1-1/2 inches (38 mm) to accommodate the 2x lumber. The short edge of the specimens shall not include the 2x lumber and the core material shall be kept flush with the ends of the specimen. The 2x lumber shall run the full length of the specimen. The SIP facing shall be continuous without joints.



Edgewise bending tests shall be conducted in accordance with the third-point load method of ASTM D4761 with the additional requirement that the facings of the SIP specimens shall not bear on the supports of the test setup and the bearing length shall be 1-1/2 inches (38 mm). Load and deflection data shall be continuously recorded until failure.

Test results from each specimen shall be reported to include the peak load and the load at the deflection limit of $L/360$, where L is the lintel span in inches (mm).

6.6 Construction Moisture Effects

The effects of anticipated changes in moisture content on the SIP performance shall be qualified by comparing the performance of SIPs between as-received and wet-and-redry conditions in accordance with Section 15.3 of ASTM E72 with the additional requirement that the specimen shall be re-dried at the final (3rd) cycle and tested when the assembly is re-dried. The test assembly dimension and minimum number of tests shall be in accordance with Table 4.

6.7 Bond Strength

The bond shear strength between facing and core, including foam-in-place core as applicable, shall be tested in accordance with Section 15.1 of ASTM D7446. The bond tensile strength between facing and core shall be tested in accordance with Section 15.2 of ASTM D7446.

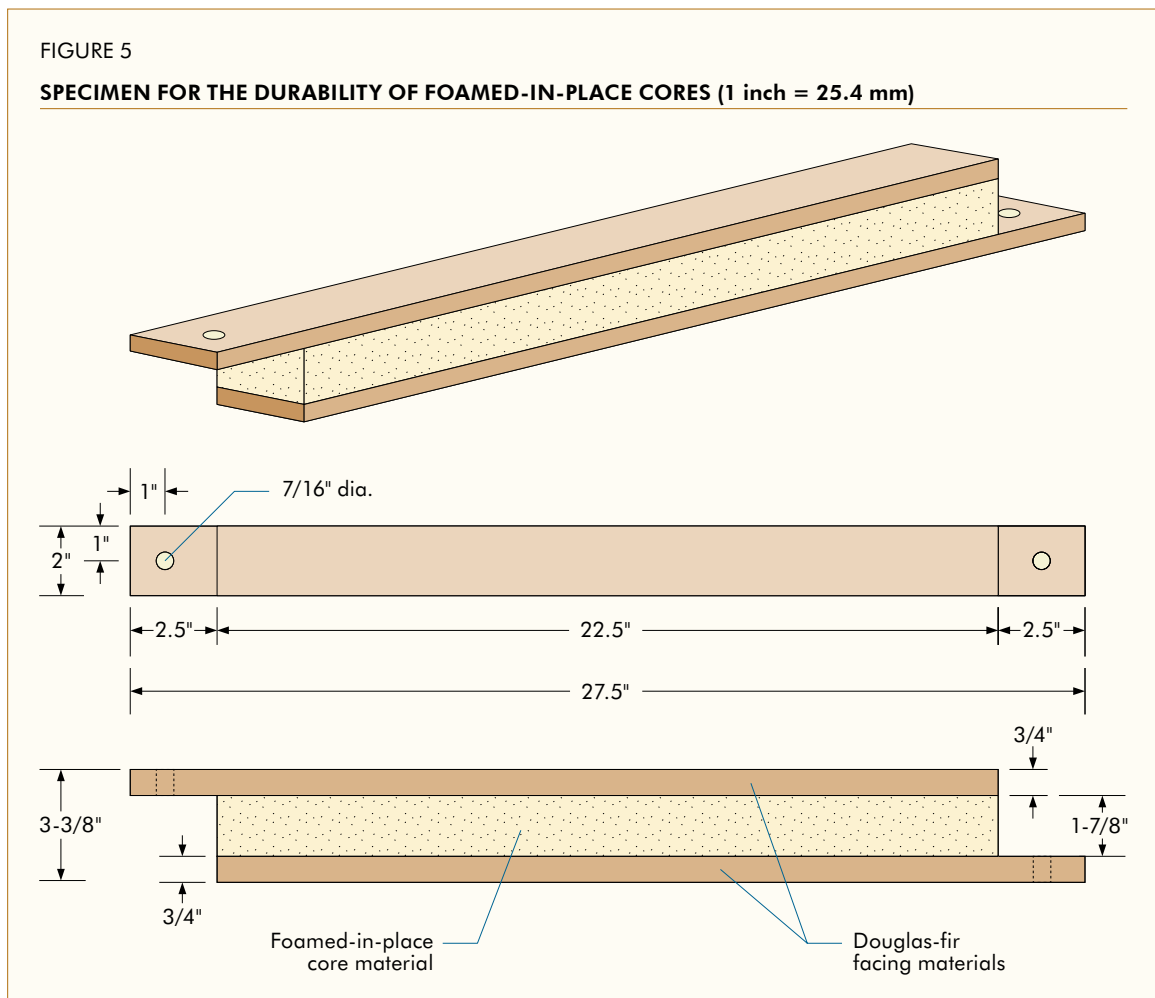
6.8 Durability of Foamed-In-Place Core Materials

6.8.1 Construction

Test assemblies shall be constructed using Douglas-fir panel facings having a specific gravity range of 0.45 and 0.55 with moisture content between 10 and 12 percent. The assemblies shall be sized so that the core material shall measure 1-7/8 inches (48 mm) in thickness. The custom specimens shall be prepared by the SIP manufacturer with foam-in-place core material following the same qualified material specification (i.e. density, etc.) and foaming process as used in the SIP panels in production.

6.8.2 Shear Specimens

Fifteen (15) shear test specimens shall be prepared in conformance with Figure 5.



6.8.3 Bond Specimens

Fifteen (15) 3 x 3 x 3-3/8-in. (76 x 76 x 86-mm) bond test specimens shall be prepared.

6.8.4 Conditioning

Five (5) of each of the shear and bond specimens shall be conditioned in accordance with Section 15.2.2 of ASTM D7446. Five (5) of each of the shear and bond specimens shall be subjected to the modified ASTM D1183 “C” cycle in accordance with Table 1 of ASTM D7446. Five (5) of each of the shear and bond specimens shall be subjected to the soak/dry cycle in accordance with Table 1 of ASTM D7446.

6.8.5 Testing

Shear testing shall be performed in accordance with ASTM C273. Load shall be applied through the holes shown in Figure 5 and the specimen shall be able to self-align between load points. Tensile adhesion testing shall be performed in accordance with ASTM C297.

7. REPORTING OF TEST RESULTS

All test results shall be documented by a qualified testing agency in a test report and evaluated by an approved agency. This applies to tests done for qualification using Method A (Section 5.1) or Method B (Section 5.2). Failure modes for the SIPs shall be recorded to identify possible changes in performance during subsequent re-evaluations.

8. TRADEMARKING AND CERTIFICATION

8.1 Certification

SIPs represented as conforming to this standard shall bear the stamp of an approved agency which inspects the manufacturer for conformance with this standard.

Quality assurance of the PRS-610.1 performance-rated SIPs shall follow the in-plant quality manual accepted by an approved agency. As a minimum, bond tension tests shall be conducted on a production shift basis in accordance with ASTM C297.

Periodic re-evaluation of the PRS-610.1 SIPs shall be conducted in accordance with the requirements of the qualified inspection agency. As a minimum, the characteristic (5th percentile with 75% confidence) flatwise bending strength and average bending stiffness in the rated direction shall be determined in accordance with ASTM C393. A minimum of 10 specimens of 4-1/2 inches (114 mm) in thickness, 4 inches (102 mm) in width, and 4 feet (1219 mm) in length shall be tested at a 46.5-inch (1181-mm) span from center to center of supports using four-point loading with an end bearing of 1-1/2 inches (38 mm). The characteristic (5th percentile with 75% confidence) bending strength and average stiffness of the SIP specimens shall be compared with the properties established during qualification in accordance with Section 5.1.6 or 5.2.2 and the requirements of the qualified inspection agency.

8.2 Product Marking

SIPs in conformance with this standard shall be identified with a mark or certificate issued by an approved agency. The product marking shall meet the following minimum requirements:

- a. Manufacturer Identification (such as name or logo),
- b. Manufacturing date or equivalent traceable marking,
- c. Approved Agency Identification (such as name or logo),
- d. Conformance with this standard as signifying by the designation of “ANSI/APA PRS-610.1”,
- e. Flame spread index and smoke-developed index of the core materials in accordance with Section 3.2 of this standard, and
- f. Designation as “Wall” or “W” with the rated direction identified.

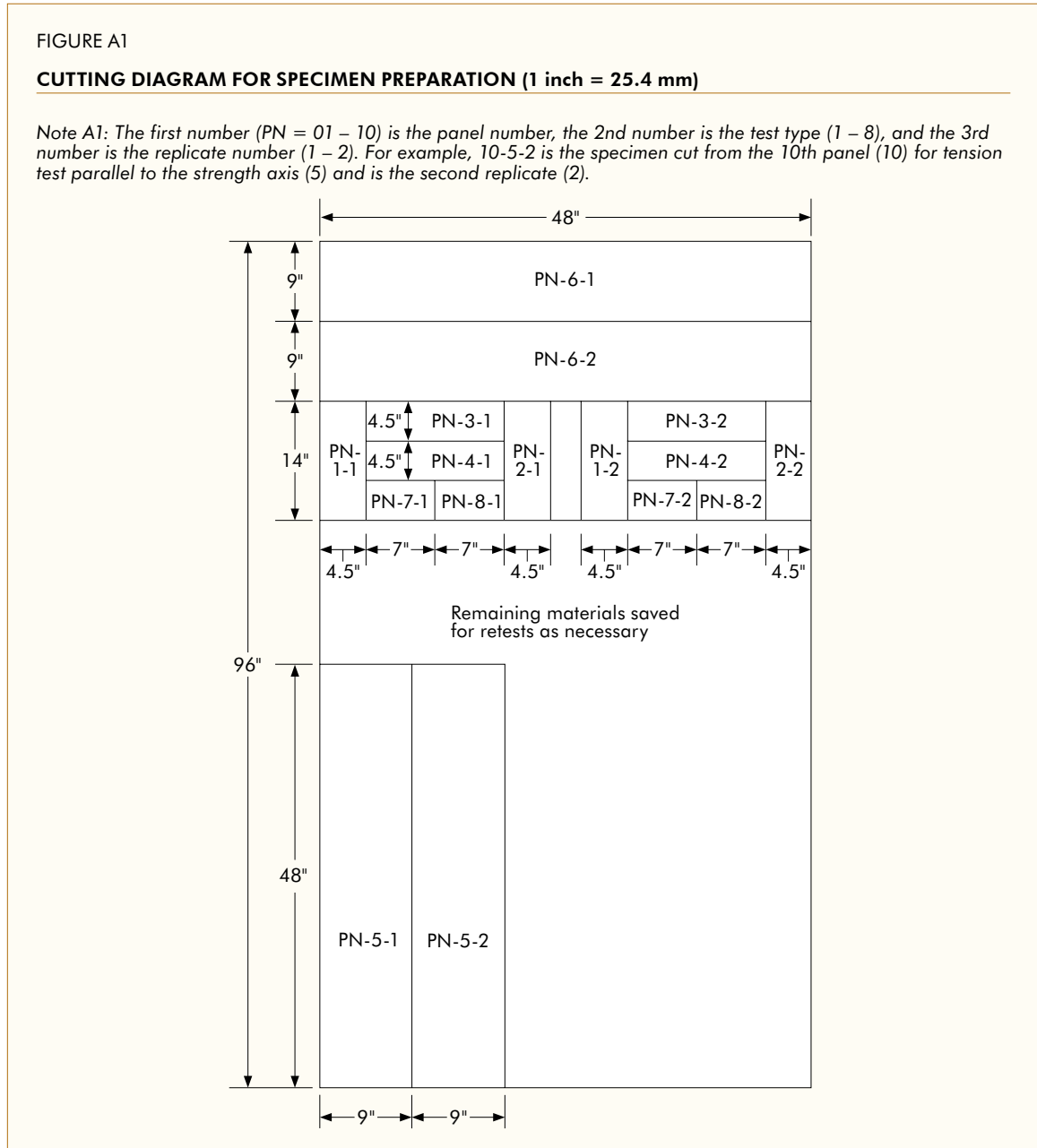
ANNEX A. TEST REQUIREMENTS FOR FACING MATERIALS (MANDATORY INFORMATION)

AI. General

This annex provides test requirements for facing materials to a) demonstrate compliance with the properties specified in Table 2 when Method A is used for SIP qualification, or b) characterize the facing material properties when Method B is used for SIP qualification. Prior to testing, the facing material shall be pre-qualified in accordance with a recognized wood structural panel standard specified in Section 3.2. For each formulation of facing materials from each supplier, a separate test series in accordance with this annex is required.

A2. Sampling and Specimen Preparation

A minimum of 10 – 4-ft x 8-ft (1219 mm x 2438 mm) panels shall be randomly sampled from representative production by a qualified inspection agency. A report of the sampling shall be prepared by the qualified inspection agency. Each panel shall be prepared in accordance with the cutting diagram shown in Figure A1.



A3. Required Tests

Tests shall be conducted in accordance with Table A1 based on standard and as-received moisture conditions.

TABLE A1
DETAILED TEST REQUIREMENTS FOR EACH SUPPLIER (1 inch = 25.4 mm)

Property ID	Test Type	Orientation	Condition	No. of Tests	Specimen Dimension	Test Setup	Required Data	Note
(1)	S14 (ASTM D1037) flatwise bending	Parallel	Standard	20 (2 per panel)	4.5" (across) x 14" (along)	Center-point load with a span of 24 times panel thickness (10.5" for 7/16" panels)	MM, EI, and specimen thickness	Screened-side up
(2)	S14 (ASTM D1037) flatwise bending	Parallel	As-received	20 (2 per panel)	4.5" (across) x 14" (along)	Center-point load with a span of 24 times panel thickness (10.5" for 7/16" panels)	MM, EI, and specimen thickness	Screened-side up
(3)	S14 (ASTM D1037) flatwise bending	Perpendicular	Standard	20 (2 per panel)	4.5" (along) x 14" (across)	Center-point load with a span of 24 times panel thickness (10.5" for 7/16" panels)	MM, EI, and specimen thickness	Screened-side up
(4)	S14 (ASTM D1037) flatwise bending	Perpendicular	As-received	20 (2 per panel)	4.5" (along) x 14" (across)	Center-point load with a span of 24 times panel thickness (10.5" for 7/16" panels)	MM, EI, and specimen thickness	Screened-side up
(5)	ASTM D3500 tension	Parallel	Standard	20 (2 per panel)	9" (across) x 48" (along)	Axial tension with 24" gauge length	Tensile capacity and specimen thickness	—
(6)	ASTM D3500 tension	Perpendicular	Standard	20 (2 per panel)	9" (along) x 48" (across)	Axial tension with 24" gauge length	Tensile capacity and specimen thickness	—
(7)	Density and moisture content	—	Standard/OD	20 (2 per panel)	5" x 7"	—	Density (OD weight, OD volume) and MC	For comparison between suppliers
(8)	Density and moisture content	—	As-received/OD	20 (2 per panel)	5" x 7"	—	Density (OD weight, as-received volume) and MC	For control value

Required panels: 10 – 4 ft x 8 ft (1220 mm x 2440 mm) randomly selected by a third-party auditor from representative production
 Specimen preparation: per cutting diagram
 Moisture conditioning: Standard conditions are 65% RH and 68°F (20°C)

A4. Data Analysis

Test results shall be analyzed in accordance with ASTM D2915 and the results from the standard moisture conditions shall be used to compare with the properties specified in Table 2. Test results from the as-received moisture conditions shall be used to establish the control values for quality assurance purposes unless the quality assurance tests at the panel plant or the SIP manufacturer’s facility are conducted at the standard moisture conditions.

A5. Acceptance Criteria

When Method A is used for SIP qualification, the facing materials shall be considered as in conformance with this standard when the following criteria are all met:

- a. The mean test values from the standard moisture conditions for flatwise stiffness in both along and across directions are not less than the values tabulated in Table 2.
- b. The 5th percentile values with 75% confidence from the standard moisture conditions for flatwise strength and tensile strength in both along and across directions are not less than the values tabulated in Table 2.
- c. The mean panel density based on the oven-dry weight and oven-dry volume is not less than the value tabulated in Table 2.

When Method B is used for SIP qualification, test results are used to characterize the facing material properties and there are no minimum requirements.

A6. Quality Assurance

A quality assurance program shall be established by the panel or SIP manufacturer and a qualified inspection agency in accordance with a recognized wood structural panel standard specified in Section 3.2. The control values for small-specimen flatwise bending tests shall be established based on the test results at the as-received moisture conditions, as described in Section A4.

ANNEX B. TESTING REQUIREMENTS FOR SIP ASSEMBLIES (MANDATORY INFORMATION)

B1. Lumber

The top and bottom plates of SIP assemblies shall be lumber conforming to the requirements of PS 20 and bearing the trademark and grade of a lumber grading agency recognized by American Lumber Standards Committee (ALSC) or Canadian Lumber Standards Accreditation Board (CLSAB), provided that the wood species/grade is No. 2 Spruce-Pine-Fir (SPF).

B2. Fasteners

Nails used for SIPs assemblies shall be 8d common (0.131 x 2-1/2 inches or 3.33 x 63.5 mm) nails meeting the requirements of ASTM F1667. For power driven nails, the nail head shall not penetrate the facings by more than 1/8 inch (3 mm).

B3. Electrical chases and electrical boxes

Electrical chases and electrical boxes shall be incorporated into tests prescribed in Sections B4 through B6.

B4. Axial load tests

The specimen configuration and an example test setup for axial load tests are shown in Figures B1 and B2, respectively. 8d common (0.131 x 2-1/2 inches or 3.33 x 63.5 mm) nails shall be installed on the top and bottom plates at 6 inches (162 mm) o.c. and 3/8 inch (9.5 mm) from the edge of the facing.

B5. Transverse load tests

The specimen configuration and an example test setup for transverse load tests are shown in Figures B3 and B4, respectively. 8d common (0.131 x 2-1/2 inches or 3.33 x 63.5 mm) nails shall be installed on the end plates at 6 inches (162 mm) o.c. and 3/8 inch (9.5 mm) from the edge of the facing.

B6. Racking tests

The specimen configuration and an example test setup for racking tests are shown in Figures B5 and B6, respectively. 8d common (0.131 x 2-1/2 inches or 3.33 x 63.5 mm) nails shall be installed on the top plate, bottom plate, spline, and end posts at 6 inches (162 mm) o.c. and 3/8 inch (9.5 mm) from the edge of the facing.

B7. Lintel tests

An example test setup for lintel tests is shown in Figure B7. 8d common (0.131 x 2-1/2 inches or 3.33 x 63.5 mm) nails shall be installed in the top and bottom lumber at 6 inches (162 mm) o.c. and 3/8 inch (9.5 mm) from the edge of the facing.

FIGURE B1

SPECIMEN CONFIGURATION FOR AXIAL LOAD TESTS (1 inch – 25.4 mm)

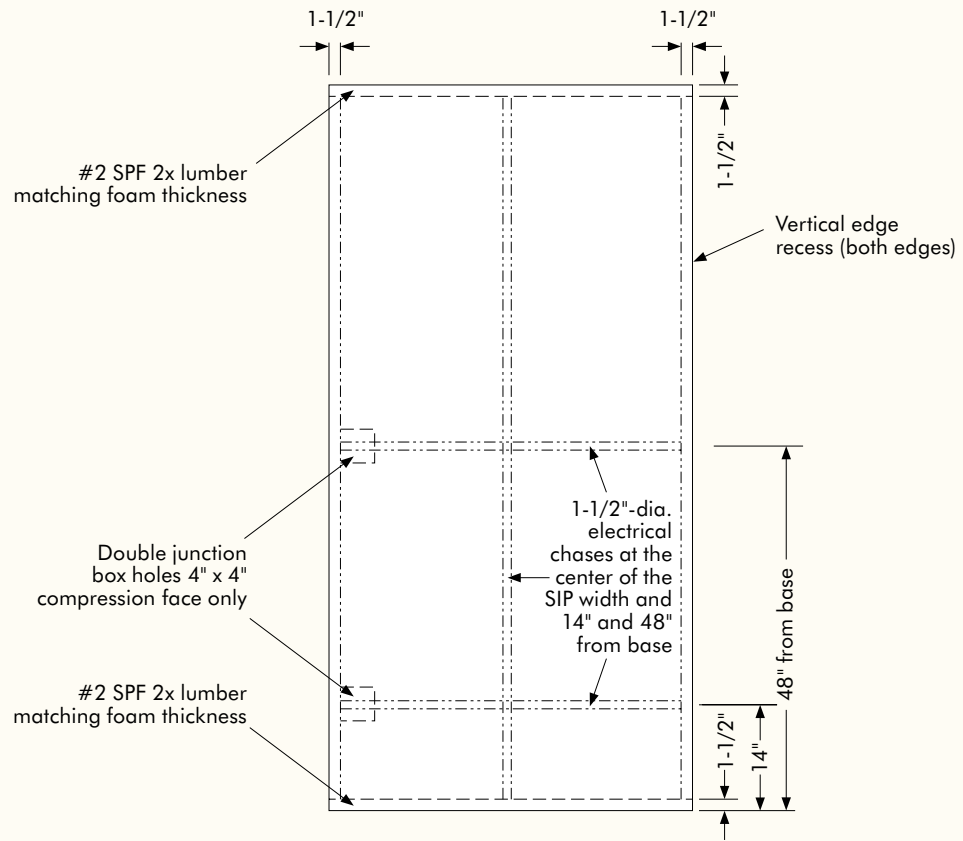


FIGURE B2

EXAMPLE TEST SETUP FOR AXIAL LOAD TESTS

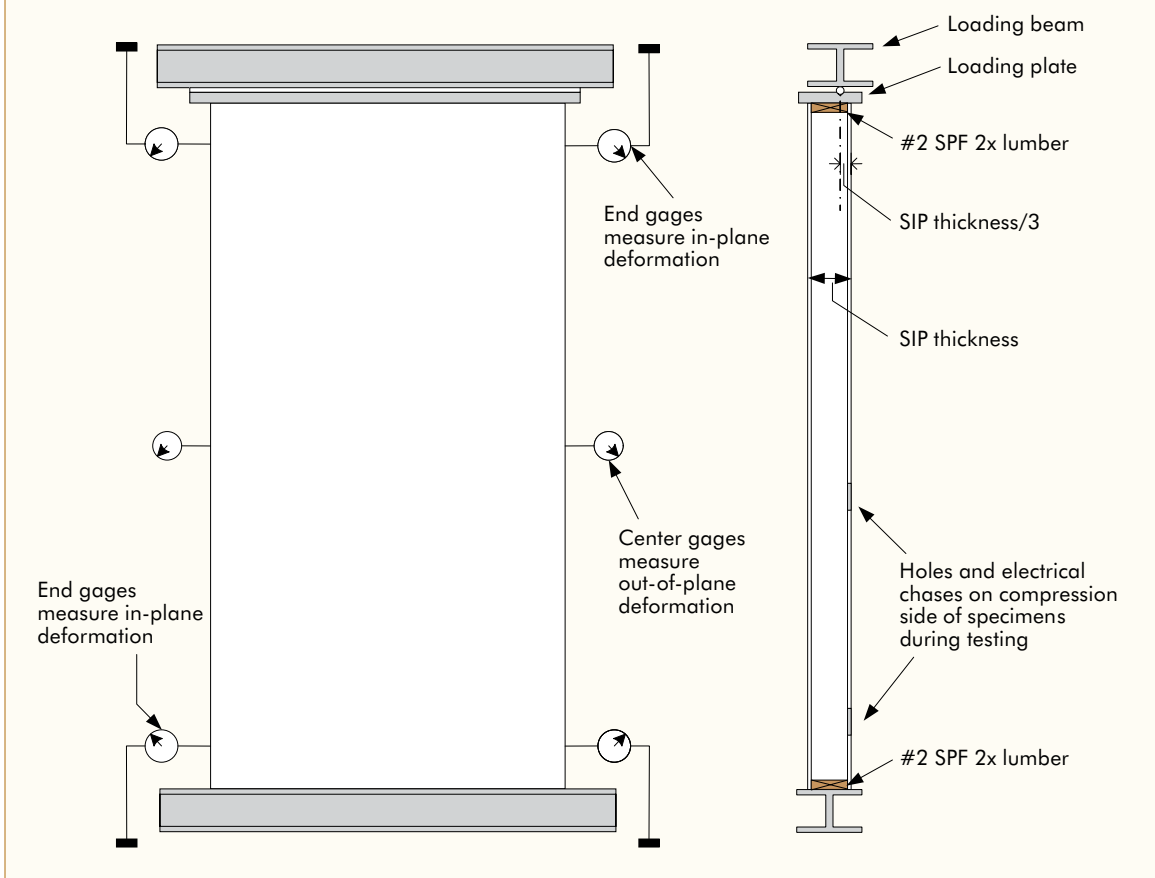


FIGURE B3

SPECIMEN CONFIGURATION FOR TRANSVERSE LOAD TESTS (1 inch = 25.4 mm)

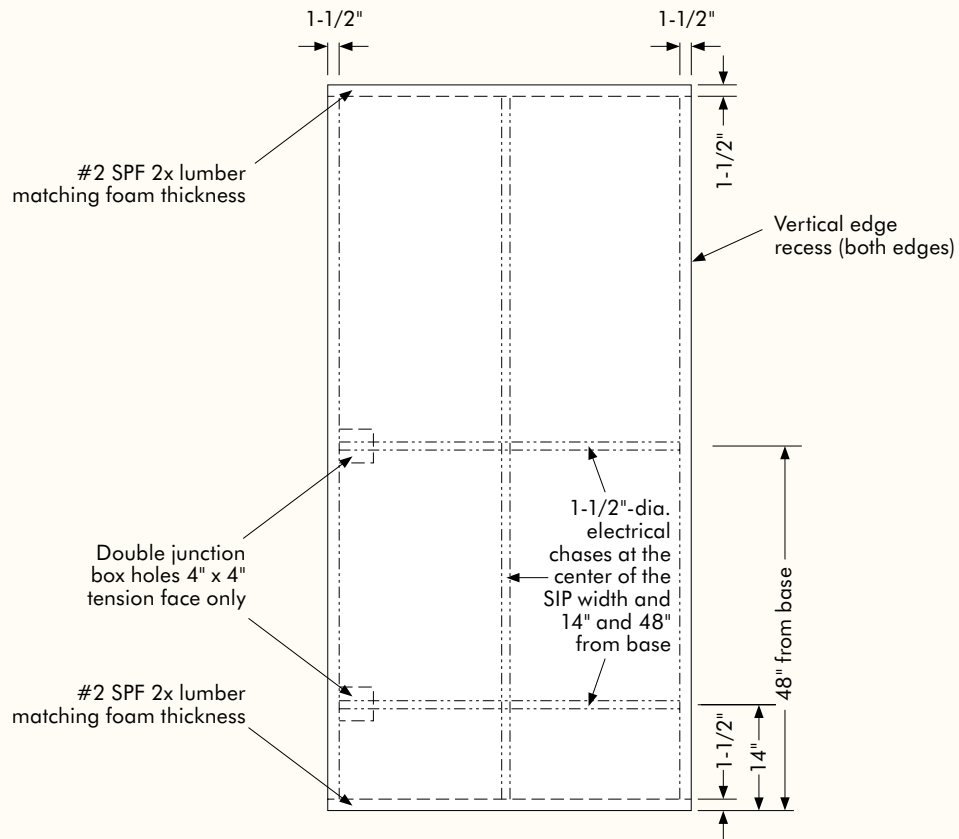


FIGURE B4

EXAMPLE TEST SETUP FOR TRANSVERSE LOAD TESTS

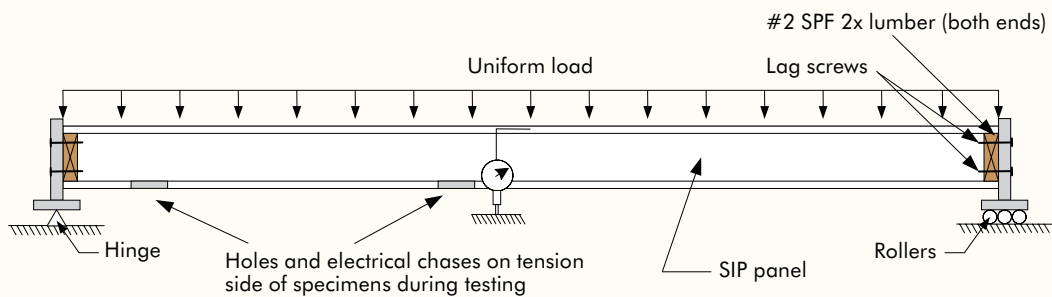


FIGURE B5

SPECIMEN CONFIGURATION FOR RACKING LOAD TESTS (1 inch = 25.4 mm)

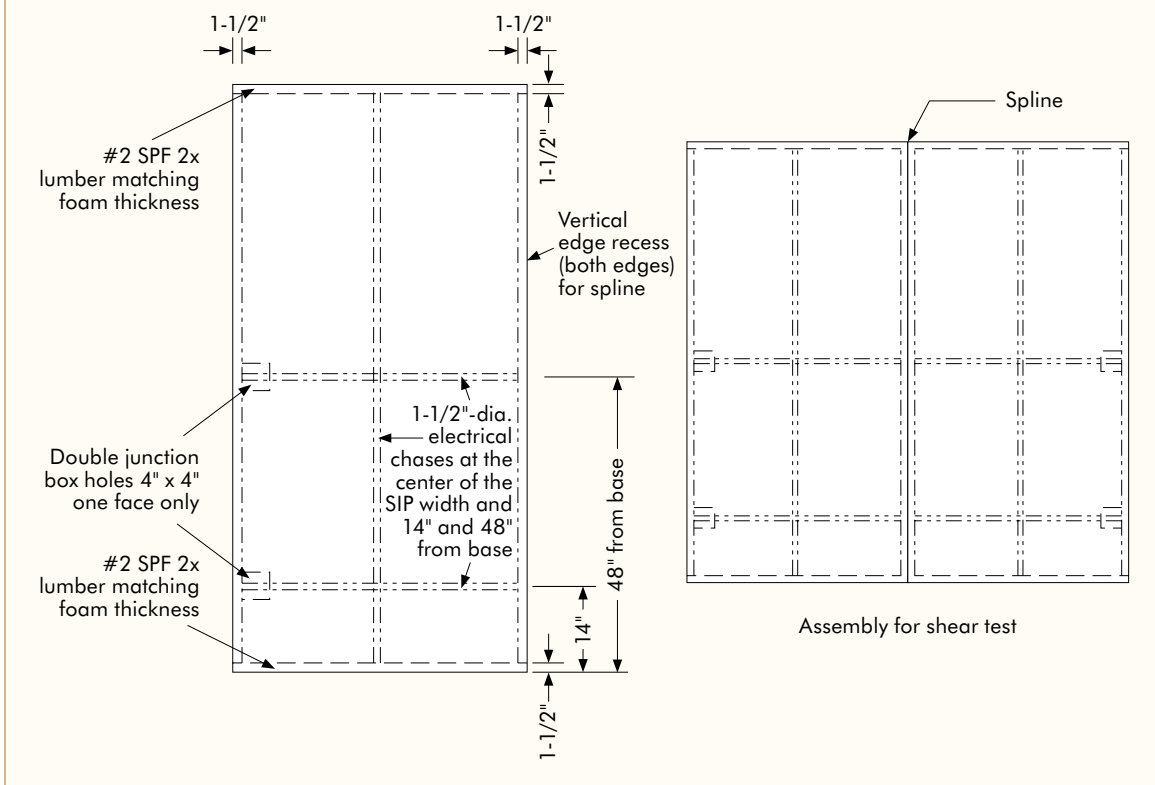


FIGURE B6

EXAMPLE TEST SETUP FOR RACKING LOAD TESTS

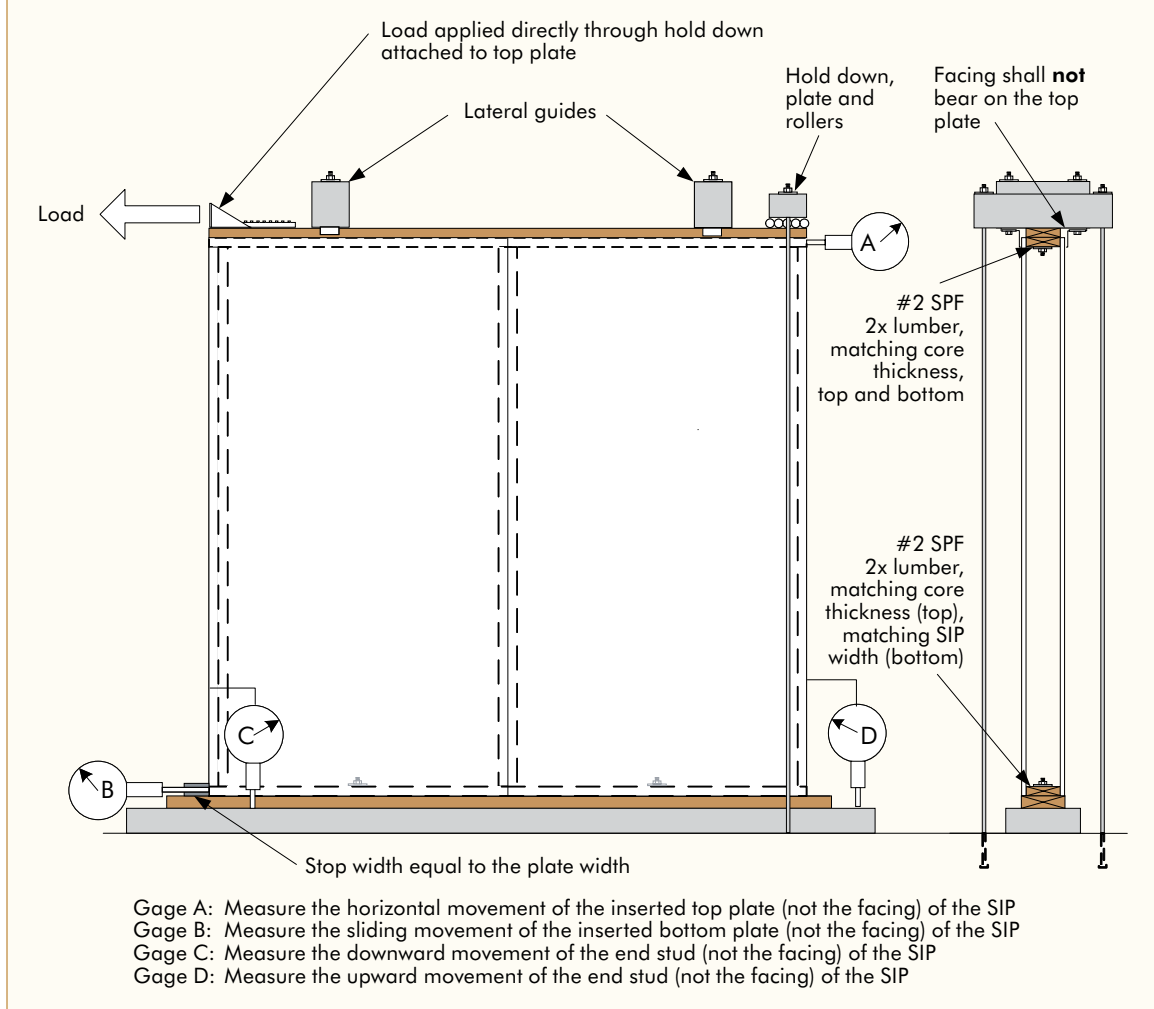
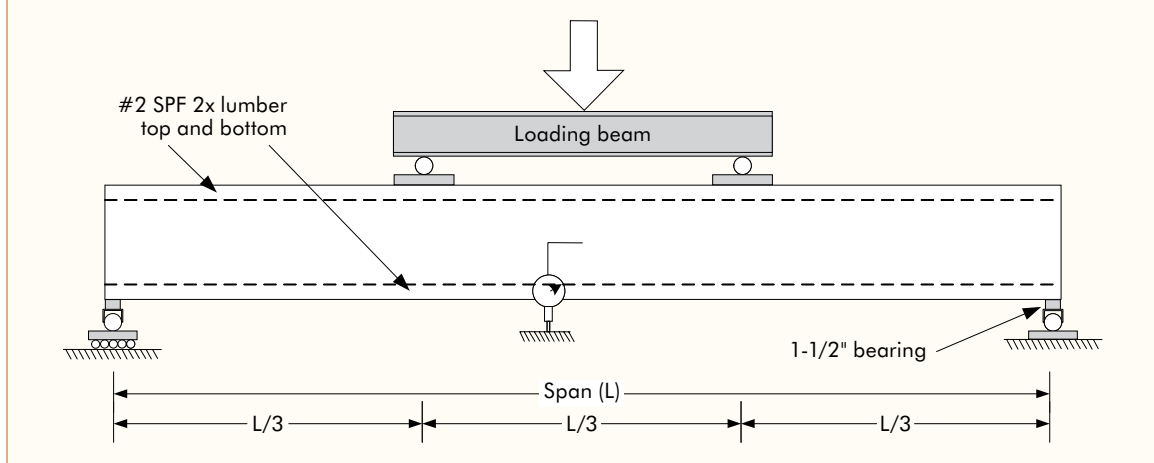


FIGURE B7

EXAMPLE TEST SETUP FOR LINTEL TESTS (SEE FIGURE 4 FOR THE END VIEW OF THE LINTEL)



**APPENDIX X1. HISTORY OF STANDARD
(NON-MANDATORY INFORMATION)**

In October 2007, the APA Standards Committee on Standard for Performance-Rated Structural Insulated Panels in Wall Applications was formed to develop a national standard under the consensus processes accredited by the American National Standards Institute (ANSI). This national consensus standard, designated as ANSI/APA PRS 610.1, was developed in collaboration with the Structural Insulated Panel Association (SIPA) based on broad input from around the world. The first version of this standard was approved by ANSI for publication on May 28, 2018. This standard supersedes ANSI/APA PRS 610.1-2013 with editorial changes.

The names of the ANSI/APA PRS 610.1 Committee members when this version of the standard was published are as shown below. The current list of the committee membership is available from the committee secretariat upon request.

Name	Affiliation	Notes
Todd Bergstrom	AFM Corporation	
Kevin Blau	Tolko Industries	
Bruno Di Lenardo	Canadian Construction Materials Centre	
Gary Ehrlich	National Association of Home Builders	ExSub Member
Bill Gareis	Ashland Chemical	
Kal Kooner	Intertek Testing Services NA Ltd.	
Russ Krivchuk	International Code Council Evaluation Service LLC	
Mike Krupa	BASF Corporation	ExSub Member
Jeff Linville	Weyerhaeuser Company	
Vince McClure	Nelson & McClure PLLC	
Corey Nigh	NTA Inc.	
Claude Ostiguy	Norbord Industries	
Ron Reindl	PFS TECO	
Tom Savoy	Insulfoam LLC	
Tom Williamson	T. Williamson—Timber Engineering LLC	Vice Chair
Jim Whalen	PFB Corporation	Chair
Chris Whelan	Henkel Corporation	
B.J. Yeh	APA – The Engineered Wood Association	Secretariat

Inquiries or suggestions for improvement of this standard should be directed to:

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ANSI/APA PRS 610.1-2018
Standard for Performance-Rated Structural
Insulated Panels in Wall Applications

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