

# TECHNICAL BULLETIN

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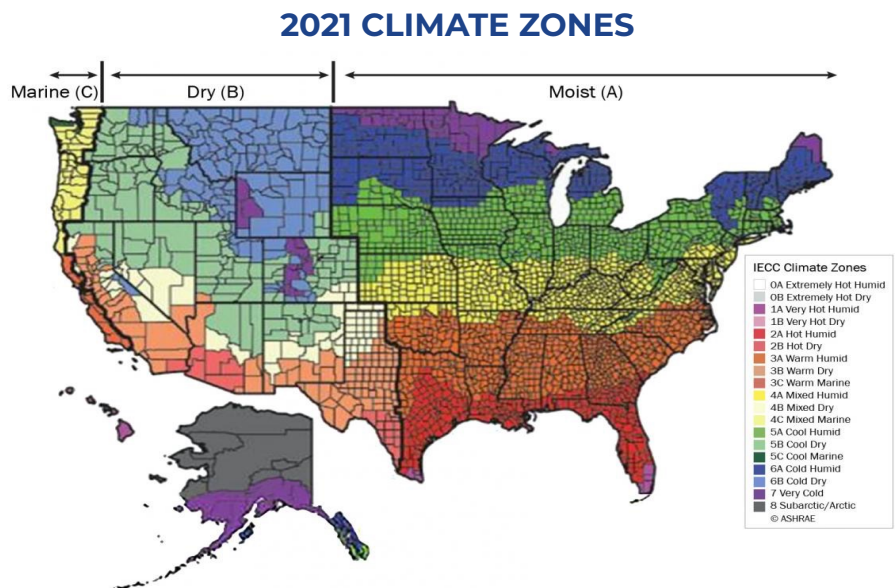
## SUBJECT: IECC INSULATION U-FACTOR REQUIREMENTS

Extreme SIPs are a versatile construction material used as walls, ceilings/roofs, and floors of buildings. Extreme SIPs provide both structural capacity and insulation for building envelopes and are available in a wide range of thicknesses to ensure that building owners can meet the most advanced energy code requirements – such as those published by the International Code Council (ICC). This technical bulletin provides a summary of the prescriptive U-factor requirements of the 2021 edition of the International Energy Conservation Code (IECC) published by the ICC. Please refer to the 2021 IECC for further detailed information.

The IECC is a leading energy code that is applicable to both commercial and residential buildings and is often adopted as a code requirement at the state level. State adoption of IECC may also be to the prior versions of the IECC issued in 2015 and 2018.

The tables within this bulletin provide the U-factor requirements of the 2021 IECC Table R402.1.2 (residential) and Table C402.1.4 (commercial) detailed by climate zone (map below) and demonstrate which Extreme SIPs thickness meets or exceeds the requirements for each climate zone. The U-factor is the rate of heat transfer per unit area and per unit temperature difference, and the units are BTU/hr•ft<sup>2</sup>•F. The lower the U-factor, the greater resistance to heat flow. U-factors equal to or less than those specified in the tables are permitted as an alternative to the R-value requirements of the 2021 IECC Table R402.1.2 or Table C402.1.4.

Alternative paths for conformance through comparison to 2021 IECC “R-value Tables” and detailed analysis are also available within the standard. Extreme recommends that the U-factor path be followed since this most appropriately accounts for insulation performance of SIPs in comparison to lumber framing with traditional insulations.



| <b>2021 IECC TABLE R402.1.2 EQUIVALENT U-FACTORS <sup>1</sup></b> |                              |              |         |       |         |       |         |
|---|------------------------------|--------------|---------|-------|---------|-------|---------|
| <b>Residential Walls</b>  |                              |              |         |       |         |       |         |
| Zone  | Wood-Framed Wall Requirement | Extreme SIPs |         |       |         |       |         |
|   |                              | 4 ½"         | Comply? | 6 ½"  | Comply? | 8 ¼"  | Comply? |
| 0 - 1   | 0.084                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 2   | 0.084                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 3   | 0.060                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 4   | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 4 Marine  | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 5   | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 6   | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 7   | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 8   | 0.045                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |

<sup>1</sup>Extreme SIPs U-Factors include inside air film, ½" gypsum wallboard, Extreme SIPs & outside air film. Values are calculated at 75 degrees.

| <b>2021 IECC TABLE R402.1.2 EQUIVALENT U-FACTORS <sup>1</sup></b> |                          |              |         |       |         |       |         |
|---|--------------------------|--------------|---------|-------|---------|-------|---------|
| <b>Residential Roof/Ceilings</b>                                  |                          |              |         |       |         |       |         |
| Zone  | Roof/Ceiling Requirement | Extreme SIPs |         |       |         |       |         |
|   |                          | 8 ¼"         | Comply? | 10 ¼" | Comply? | 12 ¼" | Comply? |
| 1   | 0.035                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 2   | 0.026                    | 0.032        | No      | 0.026 | Yes     | 0.022 | Yes     |
| 3   | 0.026                    | 0.032        | No      | 0.026 | Yes     | 0.022 | Yes     |
| 4   | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |
| 4 Marine  | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |
| 5   | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |
| 6   | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |
| 7   | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |
| 8   | 0.024                    | 0.032        | No      | 0.026 | No      | 0.022 | Yes     |

<sup>1</sup>Extreme SIPs U-Factors include inside air film, ½" gypsum wallboard, Extreme SIPs, asphalt singles & outside air film. Values are calculated at 75 degrees.

| 2021 IECC TABLE C402.1.4 EQUIVALENT U-FACTORS <sup>1</sup> |                              |              |         |       |         |       |         |
|--|------------------------------|--------------|---------|-------|---------|-------|---------|
| Commercial Walls   |                              |              |         |       |         |       |         |
| Zone   | Wood-Framed Wall Requirement | Extreme SIPs |         |       |         |       |         |
|  |                              | 4 ½"         | Comply? | 6 ½"  | Comply? | 8 ¼"  | Comply? |
| 0 - 1  | 0.064                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 2  | 0.064                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 3  | 0.064                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 4  | 0.064                        | 0.060        | Yes     | 0.041 | Yes     | 0.033 | Yes     |
| 4 Marine   | 0.051                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 5  | 0.051                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 6  | 0.051                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 7  | 0.051                        | 0.060        | No      | 0.041 | Yes     | 0.033 | Yes     |
| 8  | 0.051                        | 0.060        | No      | 0.041 | No      | 0.033 | Yes     |

<sup>1</sup>Extreme SIPs U-Factors include inside air film, ½" gypsum wallboard, Extreme SIP & outside air film. Values are calculated at 75 degrees.

| 2021 IECC TABLE C402.1.4 EQUIVALENT U-FACTORS <sup>1</sup> |                          |              |         |       |         |       |         |
|--|--------------------------|--------------|---------|-------|---------|-------|---------|
| Commercial Roof/Ceilings                                   |                          |              |         |       |         |       |         |
| Zone   | Roof/Ceiling Requirement | Extreme SIPs |         |       |         |       |         |
|  |                          | 8 ¼"         | Comply? | 10 ¼" | Comply? | 12 ¼" | Comply? |
| 0 - 1  | 0.039                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 2  | 0.029                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 3  | 0.035                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 4  | 0.032                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 4 Marine   | 0.032                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 5  | 0.032                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 6  | 0.032                    | 0.032        | Yes     | 0.026 | Yes     | 0.022 | Yes     |
| 7  | 0.028                    | 0.032        | No      | 0.026 | Yes     | 0.022 | Yes     |
| 8  | 0.028                    | 0.032        | No      | 0.026 | Yes     | 0.022 | Yes     |

<sup>1</sup>Extreme SIPs U-Factors include inside air film, ½" gypsum wallboard, Extreme SIP, asphalt shingles & outside air film. Values are calculated at 75 degrees.

### SUBJECT: EXTREME SIPS TESTING SUMMARY

Extreme SIPS are Building Code Recognized as complying with national and local building codes that follow the International Code Council's (ICC) series of I Codes, including the International Residential Code (IRC), International Building Code (IBC), and the International Energy Conservation Code (IECC).

To provide the testing and quality control data required by the ICC for I Codes recognition and compliance, Extreme SIPS has conducted numerous tests on Structural Capacity, Fire Duration Performance, Energy/Sound values and ratings, as well as the qualification and quality control of the components and processes used in SIP manufacturing.

This Technical Bulletin provides a summary of Extreme SIPS' testing data and technical information.

| STRUCTURAL     |  |   |   |  |  |   |
|----------------|--|---|---|--|--|---|
| STANDARD       | ASTM E72   | ICC-ES AC04   | ASTM E455   | ASTM E695  | ASTM E2322   | ASTM E2126  |
| TEST TITLE:    | STRENGTH TESTS OF PANELS FOR BUILDING CONSTRUCTION   | ICC-ES SANDWICH PANEL ACCEPTANCE CRITERIA   | ROOF DIAPHRAGM  | RESISTANCE TO IMPACT LOADING   | CONCENTRATED FLOOR LOAD  | CYCLIC (REVERSED) LOAD TEST FOR SHEAR RESISTANCE OF WALLS                             |
| ALSO KNOWN AS: | ASTM E1803   |   |   |  | IBS SECTION 1607.1   |   |
| RESULTS:       | - Axial Load<br>- Transverse Load<br>- Racking Shear<br><br><sup>1</sup> See Extreme SIPS Load Charts for structural capabilities. | Extreme SIPS meet AC04 requirements<br><br><sup>4</sup> See Extreme SIPS ICC-ESR Evaluation Report. | Diaphragm design capacity up to 1,130 plf<br><br><sup>1</sup> See Extreme SIPS Load Charts for structural capabilities. | Panel supported on short ends withstood repetitive impacts to the center of 90 ft. lbs., 240 ft. lbs., and 600 ft. lbs. with no deleterious effects. | Meets 2,000 lb. concentrated floor load requirement. Floor panels successfully supported 6,000 lbs. placed on 30"x30" area at various locations on the panel and panel joints. | Shear resistance capacity up to 1,000 plf designs for seismic categories A through F. |

<sup>1,2,3,4,5,6</sup> SEE LAST PAGE FOR FOOTNOTES.

| FIRE           |  |  |  |  |   |
|----------------|--|--|--|--|---|
| STANDARD       | ASTM E84   | UL 1715  | ASTM E119  | ASTM E119  | ASTM E119   |
| TEST TITLE:    | SURFACE BURNING CHARACTERISTICS  | CORNER ROOM BURN   | FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS | FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS   | FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS            |
| ALSO KNOWN AS: | UL 723 NFPA 255  | FM 4880 NFPA 286   | UL 263 NFPA 251                                  | UL 263 NFPA 251  | UL 263 NFPA 251   |
| RESULTS:       | <sup>3</sup> EPS Core Flame Spread: 20<br>Smoke Developed: 150-300<br><br>- Interior of panel covered with ½" gypsum board<br><br>- Flame Spread: 10<br>Smoke Development: 0 | PASS<br>Using ½" gypsum board on the interior of the Extreme SIP | 20 Min. Fire Resistant wall assembly             | <sup>2</sup> 60 Min. Fire Resistant wall assemblies  | <sup>2,4</sup> 60 Min. Fire Resistant Roof/Ceiling Assembly |
|                |  |  | ½" gypsum board as interior finish               | 2 layers 5/8" Type X gypsum board as fire side finish. Passed 30 PSI hose stream<br><br>Double 2X connection and 1 layer 5/8" Type C gypsum board as fire side finish. Passed 30 PSI hose stream | 2 layers 5/8" Type X gypsum board as interior finish        |

| COMPONENTS  |  |   |   |  |  |
|-------------|--|---|---|--|--|
| COMPONENT   | OSB  | ADHESIVE  | ADHESIVE  | EPS CORE   | EPS CORE   |
| TEST TITLE: | WOOD-BASED STRUCTURAL PANELS   | ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS                  | SANDWICH PANEL ADHESIVES  | SPECIFICATION FOR POLYSTYRENE INSULATION   | TERMITE EXPOSURE   |
| STANDARD:   | DOC PS2-92 APA PR-N610   | ASTM D 2559   | ICC-ES AC05   | ASTM C578<br>ICC-ES AC10   | ICC-ES AC239   |
| RESULTS:    | OSB meets Exposure I - 24/16 span rating qualified as facing of structural insulated panels. | Adhesive meets strength requirements of Class 2 Type II adhesive. | Adhesive used in Extreme SIPS manufacture meets ICC-ES Acceptance Criteria for sandwich panel adhesive. | Extreme SIPS EPS core (termite treated) exceeds the minimum values in ASTM C578. | <sup>2,5</sup> Extreme SIPS EPS core with termite treatment recognized by UL to be in compliance with ICC acceptance criteria 239. |

<sup>1,2,3,4,5,6</sup> SEE LAST PAGE FOR FOOTNOTES.

| ENERGY/SOUND   |  |  |  |   |  |
|----------------|--|--|--|---|--|
| STANDARD       | ORNL   | ASTM C236  | ORNL   | ASTM E90  | ASTM C423  |
| TEST TITLE:    | STEADY STATE THERMAL PERFORMANCE OF BUILDING ASSEMBLIES  | STEADY STATE THERMAL PERFORMANCE OF BUILDING PANELS BY GUARDED HOT BOX   | BLOWER DOOR  | SOUND TRANSMISSION CLASS (STC)  | SOUND ABSORPTION   |
| ALSO KNOWN AS: | WHOLE WALL R-VALUE   | R-VALUE  | AIR INFILTRATION   |   |  |
| RESULTS:       | <ul style="list-style-type: none"> <li>- 4 ½" Extreme SIP with ½" gypsum board and plywood siding R = 14.1</li> <li>- 2x4 and batt insulation with ½" gypsum board and plywood siding R = 9.6</li> <li>- 2x6 and batt insulation with ½" gypsum board and plywood siding R = 13.7</li> </ul> | <ul style="list-style-type: none"> <li>- 6 ½" Extreme SIP with ½" gypsum board mechanically fastened to the interior of the panel R = 21.2</li> <li>- Typical 2x6 construction using fiberglass batts tested under same standard R = 17.2</li> </ul> | <ul style="list-style-type: none"> <li>- Controlled room built with 4 ½" Extreme SIP = 9 cfm air leakage</li> <li>- Typical 2x6 construction using fiberglass batts tested under same configuration = 126 cfm air leakage</li> </ul> | <ul style="list-style-type: none"> <li><sup>8</sup>Achieved STC ratings from STC 28 to STC 59 using various facing assemblies of gypsum, air spaces, fiberglass and isolation cups</li> </ul> | <ul style="list-style-type: none"> <li>- 6½"Extreme SIP Noise Reduction Coefficient = 0.15</li> <li>- Sound Absorption average = 0.17</li> </ul> |

**FOOTNOTES:**

- <sup>1</sup>See Extreme SIPS Load Charts for complete details.
- <sup>2</sup>See ICC-ES report; contact your Extreme SIPS supplier for a current copy.
- <sup>3</sup>See UL certificate for complete details.
- <sup>4</sup>For specific Fire Resistance, see ICC-ESR 4524.
- <sup>5</sup>See rigid insulation literature for complete details.
- <sup>6</sup>See Extreme Technical Bulletins for assembly details.

**ABBREVIATIONS:**

- ASTM = American Society for Testing and Materials
- IBS = International Building Code
- ICC-ES = International Code Council Evaluation Service
- NFPA = National Fire Protection Agency
- UL = Underwriters Laboratories Inc.
- FM = Factory Mutual

**QUALITY ASSURANCE**

Extreme SIPs are made to the standards of an industry-leading quality control program monitored by ICC-NTA and recognized by national code agencies.

## SUBJECT: OSB FORMALDEHYDE LEVELS

The Oriented Strand Board (OSB) used as the facings for Extreme SIPS includes very low levels of phenol formaldehyde. Formaldehyde is present in very small amounts in the phenol formaldehyde adhesives used to create the structural bond between the OSB wood strands.

Data collected by HUD (HUD CFR 3280.308) indicated that emission levels from moisture-resistant phenol formaldehyde adhesives used for structural plywood - OSB were very low; therefore, HUD regulations explicitly excluded plywood/OSB made with phenol formaldehyde adhesives.

The APA, representing the Engineered Wood Association, has thoroughly researched formaldehyde emissions from APA trademarked products and has conducted tests using a large-scale test chamber method for measuring formaldehyde emissions. In this test, OSB is placed within a heated chamber and monitored for formaldehyde emission. Both newly produced OSB and OSB several months after production were tested. The amount of OSB placed within the heated test chamber was significantly greater than the amount of OSB that would normally be used to construct a typical structure.

Testing by the APA, as well as other laboratories, showed that OSB emits less than 0.1 parts per million (ppm) of formaldehyde within the large-scale heated test chamber. This is true for both new and aged OSB. Formaldehyde emitted by OSB is below HUD standards for allowable emissions.

Attached on the following pages, please find a bulletin authored by the APA and the Engineered Wood Association concerning formaldehyde and engineered wood products.

The APA Bulletin can also be found at [www.apawood.org](http://www.apawood.org) (form J330 “Structural Plywood, OSB exempt from new formaldehyde ruling”).





**TECHNICAL NOTE**

# Formaldehyde and Engineered Wood Products

**Number J330E**

**January 2022**

Formaldehyde is a naturally occurring organic airborne chemical that can be synthesized for certain industrial uses, such as adhesives used for wood products, and in the manufacture of many other household goods, such as medical products, carpets and cosmetics. Because elevated levels of formaldehyde may lead to health concerns, regulations exist to limit exposure. These include limits on formaldehyde emissions from some types of wood products. In addition, some green building specifications create a preference for low emitting products. This Technical Note provides facts on formaldehyde and regulations applicable to engineered wood products.

## Formaldehyde

At room temperature, formaldehyde is a colorless gas that has a pungent smell at higher concentrations. Small amounts of formaldehyde are naturally produced by humans, animals and plants and may be emitted by fruits, vegetables, trees and raw wood. Formaldehyde is naturally present in outdoor air. Compared to rural air, urban outdoor air concentrations of formaldehyde are typically higher due to human activities, such as traffic and other combustion sources. Indoor air may contain formaldehyde from products that emit formaldehyde, as well as from combustion sources, such as cigarette smoking, cooking or heating fuels. Table 1 shows levels of formaldehyde exposure measured from some typical household activities.

When formaldehyde is emitted into air, it is broken down into carbon dioxide, usually within hours. Formaldehyde is naturally attracted to water, where it is readily absorbed and breaks down. Formaldehyde does not build up in humans or plants. Further information on formaldehyde is cited in the reference section of this publication.

### WHAT IS FORMALDEHYDE?

Formaldehyde is a simple chemical made of hydrogen, oxygen and carbon. It occurs naturally and is the product of many natural processes. It is made by human bodies and is in the air. Plants and animals also produce formaldehyde. It is in many fruits and vegetables and is a byproduct of cooking certain vegetables, such as brussels sprouts and cabbage. This chemical breaks down quickly and is metabolized to simple carbon dioxide. Our bodies readily break down the low levels to which people are exposed every day. Formaldehyde is also a product from combustion associated with the burning of kerosene and natural gas, automobile emissions and cigarettes. It is an important industrial chemical used in the manufacture of numerous consumer products, including permanent press fabrics and even toothpaste.

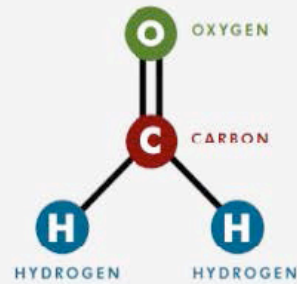


TABLE 1

VARIOUS FORMALDEHYDE EXPOSURE LEVELS

| Source/Description                       | Expected Exposure, parts per billion (ppb) | Footnote (see below) |
|--|--|----------------------|
| Painting a 12 ft x 12 ft x 9 ft room     | 968  | (a)                  |
| Wallpapering a 12 ft x 12 ft x 9 ft room | 2051                                       | (a)                  |
| Broil fish using a gas or electric range | 105  | (b)                  |
| Gas range in self-clean mode             | 337  | (b)                  |
| Electric range in self-clean mode        | 183  | (b)                  |
| One cigarette in small room              | 49   | (c)                  |
| Human breath                             | Around 2                                   | (d)                  |
| Typical indoor air                       | 10-30                                      | (e)                  |
| Urban air                                | 5-100                                      | —                    |
| Rural air                                | 0.8-5                                      | —                    |
| Raw wood (emission chamber)              | 20   | —                    |

- Calculated from data taken from the Batelle report for the California Air Resources Board, *Determination of Formaldehyde & Diisocyanate Emission from Residential Indoor Sources*, Contract No. 93-9315, Final Report 1996.
- Indoor Air Quality Residential Cooking Exposures Final Report*, prepared for the California Air Resources Board, CARB Contract Number 97-330, prepared by Roy Fortmann, Peter Kanher, and Russ Clayton, ARCADIS, Garaghty & Miller, Inc, November 30, 2001.
- Reference taken from the *International Programme on Chemical Safety, Environmental Health Criteria 89* published under the joint sponsorship of The United Nations Environment Programme, The International Labour Organization, The World Health Organization, Geneva, 1989.
- Mass Spectrometric Profile of Exhaled Breath* – field study by PTR-MS, Berthold Moser, Florian Bodrogi, Guenther Eibl, Matthias Lechner, Josef Rieder, Philipp Lirk, 2004.
- Interim Findings on Formaldehyde Levels in FEMA-Supplied Travel Trailers, Park Models and Mobile Homes* from the Centers for Disease Control and Prevention, February 29, 2008.

### Formaldehyde Standards and Regulations of Wood Products

Because some adhesives used to produce composite wood products contain formaldehyde, limits on emissions from pressed wood products have been developed in product standards and state and national regulations. In the U.S., formaldehyde regulations of composite wood products began in the early 1980s for particleboard and decorative plywood panels used in manufactured homes (HUD CFR 3280.308). Data indicated that emission levels from moisture-resistant phenol formaldehyde adhesives used for structural plywood were very low; therefore the HUD regulations explicitly excluded plywood made with phenol formaldehyde adhesives.

This Technical Note provides information on formaldehyde regulations that apply to U.S. and Canadian structural engineered wood products. For purposes of this Technical Note, “engineered wood products” are defined as wood products recognized in the U.S. and Canadian building codes for structural applications. Because the vast majority of North American construction involves site-built conditions where exposure to weather is expected, the standards for engineered wood products require moisture-resistant adhesive systems. The inherent structural and moisture durability of these adhesive systems naturally results in very low formaldehyde emissions.





Formaldehyde and Engineered Wood Products

Table 2 provides definitions of the standards, adhesive systems and applications for engineered wood products.

TABLE 2  
**DESCRIPTION OF U.S. AND CANADIAN ENGINEERED WOOD PRODUCTS**

| Product   | Applicable Standard(s) <sup>a</sup>   | Adhesives   | Uses  |
|---|---|---|---|
| Structural Plywood  | <i>U.S. Voluntary Product Standard PS 1 Structural Plywood, U.S. Voluntary Product Standard PS 2 Performance Standard for Wood Structural Panels, CSA O121 Canadian Douglas-fir Plywood and CSA O151 Canadian Softwood Plywood</i>                  | Phenol formaldehyde   | Sheathing for walls, floors, roofs and other industrial and construction uses |
| Oriented Strand Board (OSB)   | <i>U.S. Voluntary Product Standard PS 2 Performance Standard for Wood Structural Panels and CSA O325, Construction Sheathing</i>  | Phenol formaldehyde, pMDI <sup>b</sup>  | Sheathing for walls, floors, roofs and industrial uses                        |
| Structural Glued Laminated Timber (Glulam)  | <i>ANSI A190.1 Structural Glued Laminated Timber, CSA O122 Structural Glued-Laminated Timber and CSA O177 Qualification Code for Manufacturers of Structural Glued Laminated Timber</i>   | Phenol resorcinol formaldehyde (PRF), melamine, polymer isocyanate, polyurethane <sup>c</sup> | Beams, headers, columns, trusses  |
| Prefabricated Wood I-joists   | <i>ASTM D5055 Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists</i>   | Phenol formaldehyde, melamine, polymer isocyanate <sup>d</sup>                                | Floor joists, roof rafters  |
| Structural Composite Lumber (SCL) <sup>e</sup>  | <i>ASTM D5456 Standard Specification for Evaluation of Structural Composite Lumber Products</i>   | Phenol formaldehyde, pMDI <sup>f</sup>  | Beams, headers, studs, flanges of I-joists                                    |
| Specialty Products – Cross Laminated Timber (CLT), <sup>g</sup> Rim Board <sup>g</sup> , Engineered Wood Siding | <i>ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber, ANSI/APA PRR 410 Standard for Performance Rated Engineered Wood Rim Boards, ANSI/APA PRP 210 Standard for Performance Rated Engineered Wood Siding and ICC ES AC 321</i> | Phenol formaldehyde, pMDI, melamine, polymer isocyanate, polyurethane <sup>g</sup>            | Specialty construction uses   |

a. Complete citation of standards is provided in the reference section at the end of this publication.  
 b. pMDI = Polymeric Methylene Diphenyl Diisocyanate.  
 c. Adhesives must also meet ANSI 405 and ASTM D2559.  
 d. Adhesives used to adhere components must meet ASTM D2559 and D7247 in the U.S., and CSA O112.7, O112.9 or O112.10 in Canada.  
 e. SCL includes laminated strand lumber (LSL), laminated veneer lumber (LVL), parallel strand lumber (PSL) and oriented strand lumber (OSL).  
 f. Adhesives must meet ASTM D2559, D5456 and D7247 in the U.S. and CSA O112.6, O112.9 or C112.10 in Canada.  
 g. Adhesives must meet ANSI/APA PRG 320.

Formaldehyde and Engineered Wood Products

Table 3 provides formaldehyde emission results from a limited APA test program, where engineered wood products were tested using the ASTM E1333 large chamber test method.

**TABLE 3  
TEST RESULTS OF FORMALDEHYDE EMISSIONS FROM ENGINEERED WOOD PRODUCTS.<sup>a</sup>**

| Product            | Test Chamber Loading Ratio<br>(ft <sup>2</sup> /ft <sup>3</sup> ) <sup>b</sup> | Range of Test Results (ppm) |
|--------------------|--|-----------------------------|
| Structural Plywood | 0.130  | 0.01-0.04                   |
| OSB                | 0.130  | 0.02-0.03                   |
| LVL                | 0.016  | 0.00-0.01                   |
| I-joists           | 0.210  | 0.01-0.08                   |

a. APA Report T2018L-18, Benchmarking Formaldehyde Emissions From Structural Plywood, OSB, LVL and I-joists.

b. Test chamber loading ratio in ASTM E1333 is defined as the surface divided by the chamber volume. The test method specifies loading ratios for some wood products, but does not specify loading ratios for structural engineered wood products. Loading ratios for structural engineered wood products were based on technical analysis of the surface area to air volume ratio of the products used in construction applications.

### U.S. and Canadian Formaldehyde Regulations Applicable to Engineered Wood Products

**1. U.S. HUD Manufactured Home Construction and Safety Standard (CFR 3280.308)**

This standard specifies a 0.20 ppm emission limit for plywood and a 0.30 ppm limit for particleboard when tested with the ASTM E1333 Large Chamber Method. The intent was to regulate the specific nonstructural panel types. Testing during development of the regulations confirmed PS 1 structural plywood readily meets the plywood emission limit; therefore the regulations explicitly exempt phenolic-bonded plywood from ongoing testing and certification. Therefore, the engineered wood products in Table 2 are either not covered by, or are explicitly exempt from, the HUD regulations.

**2. California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM) for Composite Wood Products (also known as Title 17, California Code of Regulation 93120)**

These regulations were developed by a division of the California EPA and took effect in 2009. The scope of the standard covers particleboard, MDF and hardwood plywood. The demonstrated low emission levels of the engineered wood products listed in Table 2 led the CARB regulations to explicitly exempt structural plywood specified to PS 1, structural panels specified to PS 2, OSB specified to PS 2, structural composite lumber specified to ASTM D5456, structural glued laminated timber specified to ANSI A190.1 and prefabricated wood I-joists specified to ASTM D5055. These exemptions apply to the product trademarked or audited by APA under the APA quality assurance program, regardless of whether the product is used in a construction application or in an industrial (manufacturing) application. Note that although CLT is not listed as an exempted product, CLT certified to ANSI/APA PRG 320 is made with moisture-resistant adhesives and has a low formaldehyde emission.

### Formaldehyde and Engineered Wood Products

#### 3. U.S. Formaldehyde Standards for Composite Wood Products Act (also known as EPA TSCA Title VI)

This Federal Act was signed into law in July 2010. The EPA published draft implementation rules in July 2016 for implementation of the law in 2018. The emission standard mirrors the standard established by the California Air Resources Board and it explicitly exempts structural plywood specified to PS 1, structural panels specified to PS 2, OSB specified to PS 2, structural composite lumber specified to ASTM D5456, structural glued-laminated timber specified to ANSI A190.1 and prefabricated wood I-joists specified to ASTM D5055, as trademarked or audited by APA under the APA quality assurance program. Note that although CLT is not listed as an exempted product, CLT certified to ANSI/APA PRG 320 is made with moisture-resistant adhesives and has a low formaldehyde emission.

#### 4. Canadian Formaldehyde Emissions from Composite Wood Products Regulations

The Canadian government published the *Formaldehyde Emissions from Composite Wood Products Regulations* on June 17, 2021. The regulation comes into force 18 months afterward, and the requirements for laminated products will apply five years after the regulations come into force.

The regulations were developed following CARB and EPA TSCA Title VI to allow for uniform requirements for both the U.S. and Canada. Therefore, the Canadian regulations also do not apply to structural plywood specified to PS 1, CSA O121 or CSA O151; OSB specified to CSA O325 or PS 2; structural glued laminated timber specified to CAN/CSA O122 or ANSI A190.1; prefabricated wood I-joists specified to ASTM D5055; structural composite lumber, including laminated strand lumber (LSL), laminated veneer lumber (LVL), parallel strand lumber (PSL) and oriented strand lumber (OSL) specified to ASTM D5456; and cross-laminated timber (CLT) specified to ANSI/APA PRG 320. CSA O160, *Formaldehyde Emission Standard for Composite Wood Products*, is a voluntary standard providing the requirements for product sampling, emissions testing, marking and labeling for composite wood products in compliance with formaldehyde regulations in Canada.



### International Regulations for Engineered Wood Products

Wood product standards in other countries often group structural and nonstructural panel types into a common standard, whereby the moisture resistance and formaldehyde emission characteristics are evaluated to specific criteria. Some North American engineered wood products have been evaluated to these international formaldehyde emission standards. Following are summary conclusions:

1. The Japanese Agricultural Standards (JAS) use the JIS A1460 test method that measures the emissions for wood products when enclosed in a desiccator. The most stringent formaldehyde limit is the F\*\*\*\* designation whereby the product must have average emission level below 0.30 mg/l. U.S. and Canadian structural plywood (PS 1, PS 2, CSA O121 or CSA O151), OSB (PS 2 or CSA O325), structural glued laminated timber (ANSI A190.1, CSA O177 or CSA O122) and structural composite lumber (ASTM D5456) easily and consistently meet the F\*\*\*\* requirements when evaluated to the respective JAS standard. This formaldehyde level is considered one of the most stringent limits in the world.
2. U.S. and Canadian OSB and plywood panels sold in Europe for construction uses must meet the specific product standard for the panel type (such as EN 300 for OSB and EN 636 for plywood) and the general panel standard EN 13986 used for construction applications throughout the European Union. The European standard for formaldehyde emissions is EN 717-1, which uses a one cubic meter chamber to measure emission levels. U.S. and Canadian structural plywood (PS 1, PS 2, CSA O121 or CSA O151) and OSB (PS 2 or CSA O325) easily meet the 0.124 mg/m<sup>3</sup> limit of the E1 class, the most stringent formaldehyde class based on EN 717-1.
3. Laminated veneer lumber (LVL) is regulated in Australia by evaluation of formaldehyde emissions using the AS/NZS 4357.4 test method. This method is very similar to the JIS A1460 test method used in the JAS standards. U.S. and Canadian LVL made to ASTM D5456 has easily and consistently met the 0.5 mg/l limit, which qualifies it for the E0 rating, the most stringent rating in AS/NZS LVL standards.
4. The Korean Standard KS M 1998:2009 for determination of formaldehyde in building interior products is a method very similar to the JIS A1460 desiccator method. The most stringent formaldehyde limit for timber building products in Korea is the SE<sub>0</sub>, with an average below 0.3 mg/l. U.S. and Canadian structural plywood (PS 1, PS 2, CSA O121 or CSA O151), OSB (PS 2 or CSA O325), structural glued laminated timber (ANSI A190.1, CSA O177 or CSA O122) and structural composite lumber (ASTM D5456) easily and consistently meet the SE<sub>0</sub> requirements when evaluated to methods similar to the Korean standard.

**In summary, when tested to international formaldehyde emission limits, North American engineered wood products have consistently met the most stringent emission regulations.**

### Green Building Specifications

Green building rating systems often include criteria to address indoor air quality goals, including mitigation of formaldehyde concentrations or formaldehyde-emitting products. Some of these specifications are relevant to engineered wood products as follows:

#### 1. U.S. Green Building Council (USGBC) LEED v4

This popular rating system uses a point rating system for green buildings. The indoor Environmental Quality Credit includes “Low-Emitting Materials—Composite Wood.” The criteria specifies products that meet the California Air Resources Board (CARB) Airborne Toxic Control Measure for Formaldehyde Requirements for Ultra Low-Emitting Formaldehyde (ULEF) Resins or “no added formaldehyde resin” (NAF). LEED Interpretation (LI) 10466 was issued to clarify the applicability of structural engineered wood products in the LEED v4 low-emitting materials credit. It also clarifies that the scope of California Department of Public Health (CDPH) Standard v1.1 does not apply to structural products. **Products specifically considered compliant as LEED low emitting materials include the referenced standards in Table 2 for structural plywood, oriented strand board, structural glued laminated timber, prefabricated wood I-joists, structural composite lumber and cross-laminated timber.**

#### 2. National Green Building Standard ICC 700-2020

This national green rating program was developed as a consensus standard and adopted by the International Code Council as a reference standard for adoption by member code groups for residential construction. The criteria for formaldehyde emissions from composite wood products are similar to CARB. The engineered wood products listed in Table 2 are eligible for the points in Section 901.4(5) which require that a minimum of 85 percent of material within the product group is manufactured from composite wood products that contain no added urea-formaldehyde or are in accordance with the CARB regulations.

#### 3. CALGreen

This standard has been adopted into California state building law as a method to verify structures meet state environmental goals for buildings. The 2019 edition of CALGreen requires all new buildings (residential and nonresidential) as well as all remodels and additions to existing nonresidential buildings exceeding 1,000 square feet or \$200,000 (Section 301.3 of CALGreen) must meet the mandatory requirements of CALGreen. CALGreen specifies that composite wood products used in the interior or the exterior of a building meet the CARB regulations. Similar to the CARB regulations, all structural engineered wood products are explicitly exempt from the requirement. **The engineered wood products in Table 2 are not within the scope of the CALGreen formaldehyde limits and are therefore permitted.**



#### 4. The EPA Indoor airPLUS Program

The EPA Indoor airPLUS program is a voluntary partnership and labeling system that helps new home builders improve the quality of indoor air by requiring construction practices and product specifications that minimize exposure to airborne pollutants and contaminants. EPA created the Indoor airPLUS program to help builders meet the growing consumer preference for homes with improved indoor air quality. Indoor airPLUS builds on the foundation of EPA's ENERGY STAR® requirements for new homes and provides additional construction specifications to provide comprehensive indoor air quality protections in new homes. Section 6.1 of the Indoor airPLUS program provides information for composite wood. For structural plywood and OSB, the program prescriptively recognizes that PS 1 and PS 2 panels meet the requirements of the program.

#### References

##### Engineered Wood Product Standards

*U.S. Voluntary Product Standard PS 1 Structural Plywood*

*U.S. Voluntary Product Standard PS 2 Performance Standard for Wood Structural Panels*

*ANSI A190.1 Structural Glued Laminated Timber*

*ANSI/APA PRP 210, Standard for Performance-Rated Engineered Wood Siding*

*ANSI 405 Standard for Adhesives for Use in Structural Glued Laminated Timbers*

*ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber*

*ANSI/APA PRR 410 Standard for Performance-Rated Engineered Wood Rim Boards*

*ASTM D2559 Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions*

*ASTM D5055 Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists*

*ASTM D5456 Standard Specification for Evaluation of Structural Composite Lumber Products*

*ASTM D7247 Standard Test Method for Evaluating the Shear Strength of Adhesive Bonds in Laminated Wood Products at Elevated Temperatures*

*ASTM E1333 Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber*

*CSA O112 Standards for Wood Adhesives*

*CSA O121 Canadian Douglas-fir Plywood*

*CSA O122 Structural Glued-Laminated Timber*

### Formaldehyde and Engineered Wood Products

CSA O151 *Canadian Softwood Plywood*

CSA O177 *Qualification Code for Manufacturers of Structural Glued Laminated Timber*

CSA O325 *Construction Sheathing*

#### **Formaldehyde Emission Standards (for Wood Products)**

AS/NZS 4357.4 *Structural Laminated Veneer Lumber, Part 4: Determination of Formaldehyde Emissions*

CSA O160 *Formaldehyde Emission Standards for Composite Wood Products*

EN 717-1 *Wood-Based Panels, Determination of Formaldehyde Release, Formaldehyde Emission by the Chamber Method*

JAS/JIS A 1460 *Building Boards, Determination of Formaldehyde Emission—Desiccator Method*

KS M 1998:2009 *Determination of the Emission Rate of Formaldehyde and Volatile Organic Compounds in Building Interior Products*

#### **U.S. Formaldehyde Regulations**

CALGreen: <https://www.dgs.ca.gov/BSC/CALGreen>

CARB: <https://ww2.arb.ca.gov/our-work/programs/composite-wood-products-program>

EPA Federal Act: <https://www.regulations.gov/document/EPA-HQ-OPPT-2016-0461-0001>

HUD: standard is available at [www.gpo.gov/fdsys/pkg/CFR-2010-title24-voll/content-detail.html](http://www.gpo.gov/fdsys/pkg/CFR-2010-title24-voll/content-detail.html)  
(search for cfr 3280, Manufactured Housing Construction Safety Standard)

#### **Canadian Formaldehyde Regulations**

Health Canada: <https://canadagazette.gc.ca/rp-pr/p2/2021/2021-07-07/html/sor-dors148-eng.html>

#### **Formaldehyde Guidance**

ACC website: [www.formaldehydefacts.org](http://www.formaldehydefacts.org)

U.S. Consumer Product Safety Commission: <https://www.cpsc.gov/Regulations-Laws--Standards>

U.S. EPA: [www.epa.gov/iaq/formaldehyde.html](http://www.epa.gov/iaq/formaldehyde.html)

U.S. EPA Integrated Risk Information System: <https://www.epa.gov/iris>

U.S. Green Building Council LEED Interpretation website: <https://www.usgbc.org/leed-interpretations>

U.S. Green Building Council website: <https://www.usgbc.org/>

## **SUBJECT: SIP SCREWS USED IN ACQ TREATED LUMBER**

In 2004, the treated wood industry halted production of lumber pressure treated with Chromated Copper Arsenate (CCA) for residential applications in response to EPA concerns about arsenic (a known carcinogen). The primary product replacing CCA is Alkaline Copper Quaternary or ACQ. While ACQ is considered safer due to its non-arsenic content, studies have shown it may be more corrosive to metal fasteners than CCA. The corrosive nature of ACQ and its impact on metal fasteners has created concern in the construction industry. Initial efforts by the manufacturers of ACQ-treated lumber to identify acceptable metal fasteners resulted in the recommendation that stainless steel fasteners or hot-dipped galvanized fasteners be used with ACQ-treated wood products.

Extreme Panel Technologies also recommends that 8d nails used with Extreme SIPs be stainless steel or hot-dipped galvanized fasteners when ACQ lumber is used. Considering the ACQ issue, Extreme's SIP Screws have been evaluated by an independent third party to perform accelerated corrosion resistance tests in ACQ-treated lumber. These independent test results indicate that SIP Screws barrier coatings perform well in ACQ-treated lumber and even outperform hot-dipped galvanized fasteners. As a result of these performance tests, Extreme SIPs can recommend that SIP Screws are "compatible for ACQ" treated wood applications.

As with any fastener in an ACQ-treated lumber application, estimates of its service life cannot be provided due to the many variables that the fastener is exposed to, including (but not limited to) the chemical retention level in the wood, species of wood, and environment.

Note: SIP Screws are intended for use with Extreme SIPs as described in the Extreme SIPs details and are not intended for other applications.

Current Extreme Panel Details and additional Technical Bulletins with different Screw and Nail Properties can be found at [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: EXTREME SIPs ENGINEERING PROPERTIES

Extreme SIPs are recognized as a structural component for use as wall, roof, or floor panels that resist structural loads. The structural capacity of Extreme SIPs has been determined through extensive testing with leading independent third-party accredited testing laboratories. The results of these tests have been published in Extreme SIPs Load Charts and recognized in ICC ES ESR-4524.

The complete package of structural information that supports Extreme Panel Load Charts #3A and #6A has been analyzed and reviewed to provide basic SIP Engineering Properties for Extreme SIPs. These Extreme SIPs Engineering Properties (See Tables 1 and 2 on this Technical Bulletin) are suitable for use with NTA IM 14 TIP 01, "Engineered Design of SIP Panels using NTA Listing Report Data." A copy of NTA IM 14 TIP 01, as well as all current Extreme Panel Load Charts, can be accessed at [www.extremepanel.com](http://www.extremepanel.com).

| TABLE 1: EXTREME PANEL ENGINEERING <sup>1,2</sup> |                    |
|---|--------------------|
| PROPERTY  | VALUE <sup>3</sup> |
| Facing Tensile Strength, Ft (psi)                 | 495                |
| Facing Compressive Strength, Fc (psi)             | 550                |
| Elastic Modulus (Bending), Eb (psi)               | 1,677,107          |
| Shear Modulus, G (psi)                            | 284                |
| Core Shear Strength, Fs (psi)                     | 4.7                |
| Core Compressive Modulus, Ec (psi)                | 400                |
| Shear Reference Depth, h <sub>o</sub> (in)        | 4.5                |
| Shear Depth Factor Exponent, m                    | 0.59               |
| Face-peeling Factor, Cp                           | 0.975              |
| Apparent Foam Compression Strength (psi)          | 21                 |

Footnotes:

<sup>1</sup>All properties are based on a minimum panel width of 24-in.

<sup>2</sup>Refer to NTA IM14 TIP 01 SIP Design Guide for details on engineered design using basic properties.

<sup>3</sup>Values apply to panels constructed with the OSB strength axis oriented either parallel or perpendicular to supports.

**TABLE 2: EXTREME SIPs SECTION PROPERTIES**

| Panel Thickness, $h$ (in.) | Core Thickness, $c$ (in.) | Dead Weight, $W_d$ (psf) | Facing Area, $A$ (in. <sup>2</sup> /ft.) | Shear Area, $A_v$ (in. <sup>2</sup> /ft.) | Moment of Inertia, $I$ (in. <sup>4</sup> /ft.) | Section Modulus, $S$ (in. <sup>3</sup> /ft.) | Radius of Gyration, $r$ (in.) | Centroid-to-Facing Dist., $y_c$ (in.) |
|----------------------------|---------------------------|--------------------------|--|---|--|--|-------------------------------|---------------------------------------|
| 4.5                        | 3.63                      | 3.2                      | 10.5                                     | 48.8                                      | 43.3   | 19.3   | 2.03                          | 2.25                                  |
| 6.5                        | 5.63                      | 3.4                      | 10.5                                     | 72.8                                      | 96.5   | 29.7   | 3.03                          | 2.25                                  |
| 8.25                       | 7.38                      | 3.5                      | 10.5                                     | 93.8                                      | 160.2  | 38.8   | 3.91                          | 4.13                                  |
| 10.25                      | 9.38                      | 3.7                      | 10.5                                     | 117.8                                     | 252.7  | 49.8   | 4.91                          | 5.13                                  |
| 12.25                      | 11.38                     | 3.9                      | 10.5                                     | 141.8                                     | 366.3  | 59.8   | 5.91                          | 6.13                                  |

## SUBJECT: HVAC DESIGN AND ENERGY CALCULATIONS

HVAC professionals require substantiated design information to properly select the mechanical systems installed in Extreme Panel residential projects. HVAC professionals rely on ACCA (Air Conditioning Contractors of America) Manual J as the design guide to calculate the requirements for the heating and cooling systems in residential structures. These Manual J calculations are computer software-based and have defaults for R-value and air changes per hour (ACH). However, if a proper evaluation of a home built with SIPs is to be accurate, the HVAC professional needs to manually input the following two factors to arrive at a meaningful result: Extreme SIPs' higher R-value and air tightness.

**Extreme SIPs energy savings can be attributed to two main factors:**

1. Increased stable R-value due to the high-performance rigid insulation core
2. Lowered air infiltration due to fewer and tighter joints on the envelope.

Manual J-based calculations require the R-value of the insulation material and the air infiltration rate, or air leakage rate. The R-value of Extreme SIPs needs to be manually inputted into Manual J calculations based on their Whole Wall R-value. Additionally, the air infiltration rate for Extreme SIPs must be accounted for properly. Design guidelines for Manual J calculations suggest a reasonable air leakage assumption between 0.35 to 0.50 natural air-changes per hour at 50 pascals. This recommendation is for stick-built homes.

Extreme Panels has blower door test data generated from homes using SIPs for the exterior walls and roof that tested between 0.04 to 0.06 ACH. These SIP homes ACH values are approximately 10 times better than what the Manual J design guidelines suggest for natural air changes per hour. Therefore, based on Extreme SIPs achieving verified ACH test values between 0.04 to 0.06, Extreme Panel recommends that a value of 0.05 natural air changes per hour be used when performing Manual J heat loss calculations on homes using Extreme SIPs for the exterior walls and roof. If the software being used does not allow for numerical input, select the tightest option possible.

Applying Manual J calculations provides for the increased R-value and the reduced air infiltration of buildings constructed with SIPs. These two factors will allow for downsizing/right-sizing of the heating and cooling equipment. This will provide initial cost savings at the time of construction. In addition, right-sizing of the HVAC system will provide a more comfortable environment for the occupants.

Architects, engineers, builders, building owners, and other building professionals have learned from experience that energy savings for a well-built Extreme SIPs structure can be 30 to 50%, or more.

### FRESH AIR VENTILATION OF SIP STRUCTURES

Reducing air leaks in a structure is central to achieving maximum energy and clean air performance. Many building strategies, such as house wraps, vapor retarders, rigid insulation sheathing, tapes, and sealants, are designed to reduce air leakage. Extreme SIPs are one of the best building systems available to provide low air leakage and overall building energy efficiency. Moisture, fumes from adhesives, smoking, and other gases and particulates can become trapped within the structure. When these pollutants accumulate to high levels, they could potentially contribute to an unhealthy living environment.

Heat Recovery Ventilators (HRVs) and Energy Recovery Ventilators (ERVs) allow a structure to remain efficient while also providing fresh air at a low operating cost. Indoor air pollutants are continuously being removed and replaced with fresh air. This provides a healthier living environment while retaining energy savings.

A brief synopsis of how HRVs and ERVs work to effectively improve indoor air quality follows:

HRVs and ERVs are mechanical units that can continually exchange stale inside air for fresh outside air, while also using the heat (or cold) from the exhaust air to raise or lower the temperature of the incoming air. A large percentage of the heat in the exhausted air can be recaptured. This efficiency allows a constant flow of fresh air without needing a separate heating unit to heat the incoming fresh air. ERVs work in a similar manner regarding heat recovery but also allow the building owner to control inside humidity.

### WHAT INSTALLATION IS REQUIRED?

HRVs and ERVs require some planning before construction. The main unit should be placed in a temperature-controlled area, such as a basement or mechanical room. Ductwork is typically run from rooms such as bathrooms, laundries, and kitchens to the HRV or ERV unit. These areas are chosen for their typically high levels of odor and humidity. Insulated ductwork is then run from the HRV or ERV to the exterior of the building. A separate system of fresh air ductwork is run from the exterior of the building to the unit and continued to the fresh air drop, often the return air duct of a furnace.

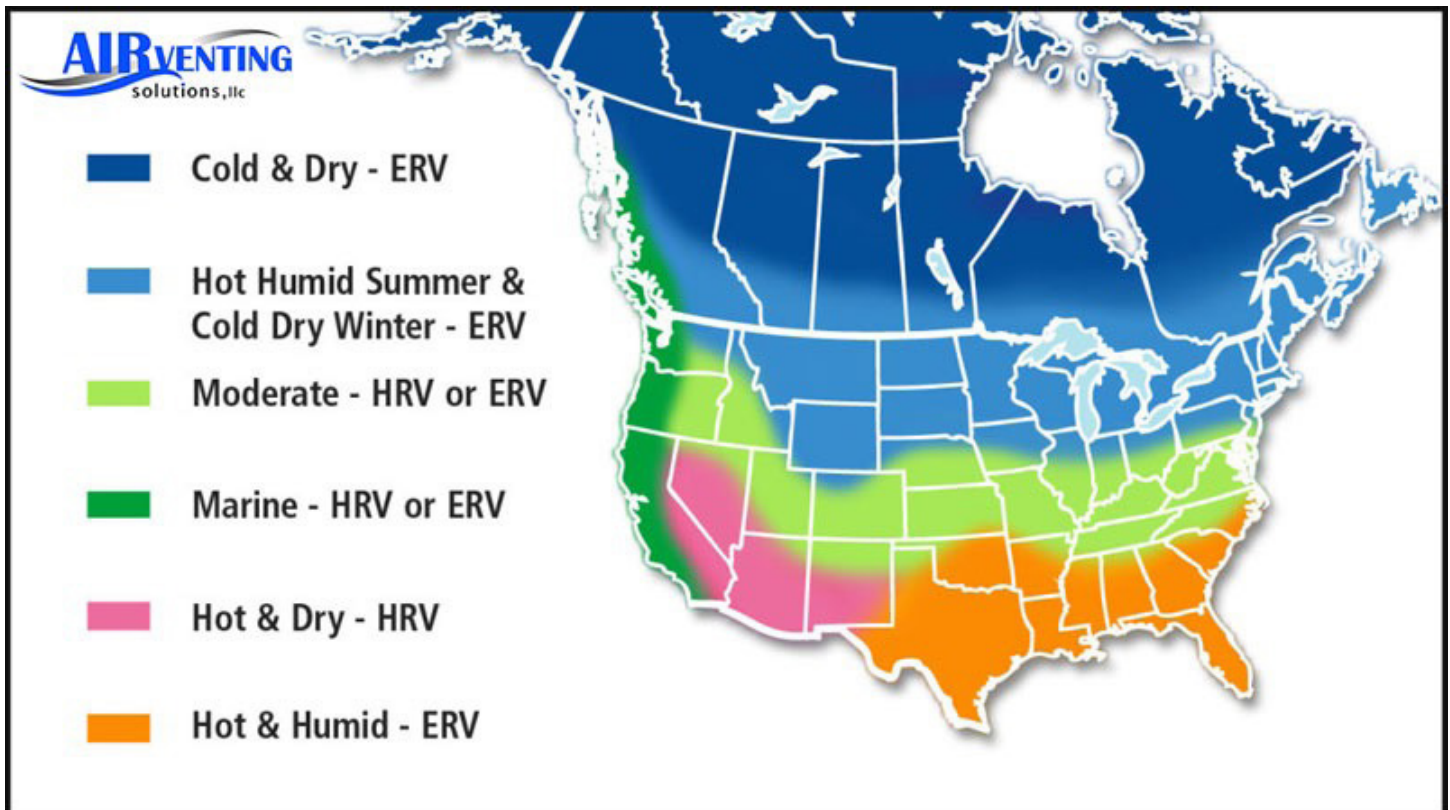


### HOW DO HRVS AND ERVS WORK?

Stale air is drawn from the bath, laundry, and kitchen to the HRV or ERV, and is ducted through the HRV or ERV to the outdoors. Meanwhile, fresh outside air is drawn into the HRV or ERV, then ducted to the inside fresh air drop point. As the two separate streams of air pass each other within the HRV or ERV, they are separated by a medium that conducts heat from the hot air to the cold air. The incoming fresh air is warmed by the transfer of heat from the inside air and is then ducted into the living area or furnace air supply.

Excessive summertime moisture can be controlled with an ERV. As the air streams pass the medium, condensation will appear on the exhaust side of the medium. This condensation forms because the warm, moisture-laden exhaust air cannot hold as much moisture after its heat has been drawn through the medium. The condensed moisture is removed and drained away. Conversely, the ERV can be set to retain interior moisture during winter months of operation.

### WHERE SHOULD I USE AN HRV OR AN ERV?



NOTE: Map prepared by Air Venting Solutions, LLC at [www.airventingsolutions.com](http://www.airventingsolutions.com).



It is recommended that the humidity level in a SIP structure be controlled to less than 40% in winter and less than 60% in summer. Higher levels of moisture could lead to condensation problems. Please consult a local HVAC engineer and contractor, or reference ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) standards for the design and installation of HRVs and ERVs as part of a complete HVAC design.

### ADDITIONAL RESOURCES:

National Center for Appropriate Technology

P.O. Box 2525

Butte, Montana

Ph: 800-428-2525

Energy Efficiency and Renewable Energy Clearinghouse

P.O. Box 3048

Merrifield, VA

Ph: 800-DOE-EREC

### SUBJECT: POINT LOADING WALLS

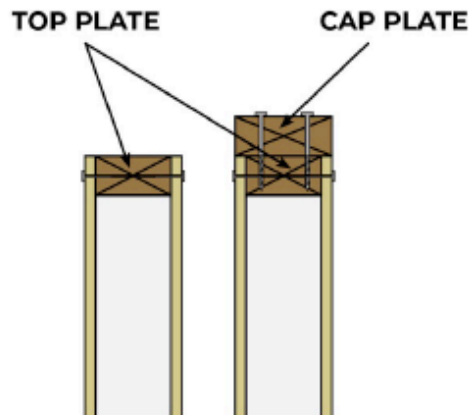
Extreme SIP walls are used in combination with various types of roof and floor designs. For roof systems, these include rafter and ridge beams to carry the roof SIPs, roof trusses, girder trusses, and girder truss beams. For floor systems, collection beams and girder trusses are often used in larger open rooms. Roof and floor systems using the load collection methods described above often result in the need to transfer a point load from the roof or floor system uniformly onto the wall.

Extreme Panel has evaluated the point load capacity of SIPs as shown in the Extreme Panel Load Chart #2A (See below). The total load should never exceed the lesser of the point load capacity or the SIPs axial and transverse capacity shown on the Extreme Panel Wall-Point Load Chart. If the design load exceeds these point loads, Extreme SIPs can be fabricated to accept a variety of posting methods, as determined by the engineer of record (EOR).

| <b>LOAD CHART #2A</b><br><b>Axial Point Loads - LBS <sup>1-2</sup></b><br><b>Type S Spline</b>          |                      |                  |
|---|----------------------|------------------|
| Top Plate Configuration   | 1-1/2" BEARING WIDTH | 3" BEARING WIDTH |
| Single 2x No. 2 or better Hem-Fir Plate   | 2040                 | 2450             |
| Single 2x No. 2 or better Hem-Fir Plate with 2x No. 2 or Better Cap Plate Ripped to Total Width of SIP. | 4030                 | 4678             |

<sup>1</sup> Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load.

<sup>2</sup> Tabulated values are based on the strong-axis of the facing material oriented parallel to the span direction.



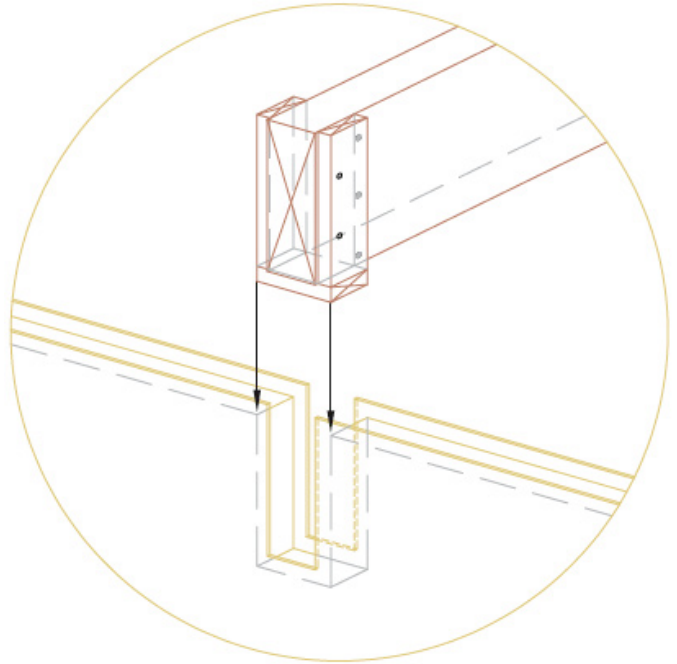
Beams may also be pocketed into the SIP wall assembly per detail EPT-415. This detail provides an aesthetically pleasing interface between the wall and the support mechanism for roofs and floors.

When this detail is used with Extreme SIPs, the following recommendations should be followed:

1. Loads for detail EPT-415 shown above are limited to the point loads established above Load Chart #2A. This generally calls for a maximum design load of 2450 pounds for a standard 2x plate used in the SIP under the beam. The use of an abbreviated cap plate placed above the base of the beam pocket and extending over the OSB facings does not allow for increased loads in this application. When loads exceed 2450 pounds, posting is required under the beam per detail EPT-414.

2. This detail provides for a thermal short circuit in the wall panel system. Great care should be taken to seal this joint. After sealants are placed in the pocket, all interior interfaces must be further sealed with SIP Tape.

3. Maximum design loads can be compromised if the beam pocket is overcut at the corner of the pocket. Good craftsmanship is required to ensure that the pocket is not overcut in the corners.



## **SUBJECT: EXTREME SIPS WALL LOADS (COMBINED AXIAL & TRANSVERSE LOADING)**

Building materials that are utilized to create structural components, such as walls, are subject to a combination of loads. Wall assemblies must be able to withstand axial forces while also resisting a bending load. Most building materials, including concrete, steel, lumber, and other engineered wood products, determine their suitability for application in an assembly using a well-known engineering formula known as the Unity Equation.

The Unity Equation considers the ultimate load capacity for a product in both the axial and transverse directions. These ultimate loads are divided by a factor of safety, which yields design values. To determine if a wall assembly meets the required combined axial and transverse loads, the wall assembly must satisfy the following formula:

$$\left( \frac{f_a \text{ (Design Axial Load)}}{F_a \text{ (Allowable Axial Load)}} \right) + \left( \frac{f_b \text{ (Design Bending Load)}}{F_b \text{ (Allowable Bending Load)}} < 1 \right)$$

Refer to Load Chart #1A / #1B for uniform axial load values for type S / type L splines and Load Chart #3A for uniform transverse loads for the data necessary to complete the Unity Equation.

All current Load Charts are available at [www.extremepanel.com](http://www.extremepanel.com).

| <b>LOAD CHART #1A</b><br>Uniform Axial Loads - PLF <sup>1-4</sup><br>Type S Spline |                  |      |      |      |      |      |
|--|------------------|------|------|------|------|------|
| SIP Thickness  | SIP Height (ft.) |      |      |      |      |      |
|  | 8'               | 10'  | 12'  | 16   | 20'  | 24'  |
| 4-1/2"   | 3500             | 2553 | 2453 | 2117 | NA   | NA   |
| 6-1/2"   | 4250             | 4043 | 3373 | 3923 | 2817 | 2183 |
| 8-1/4"   | 4917             | 4327 | 4473 | 4197 | 3497 | 3067 |
| 10-1/4"  | 4600             | 4414 | 4228 | 4417 | 3389 | 3248 |
| 12-1/4"  | 3889             | 3959 | 4028 | 4408 | 3837 | 3333 |

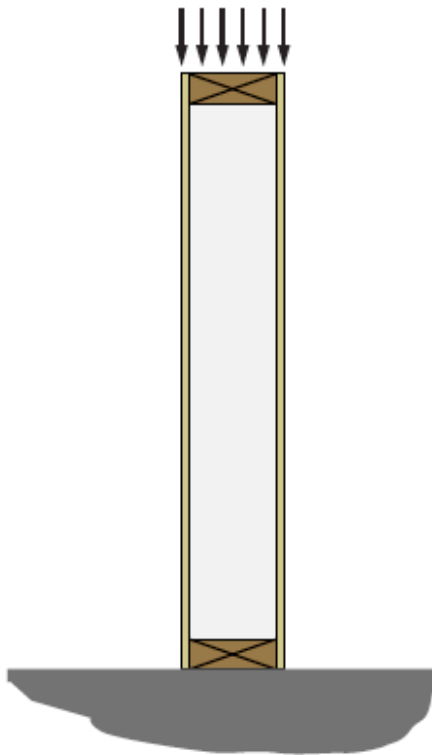
<sup>1</sup> Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load.

<sup>2</sup> Uniform axial loads.

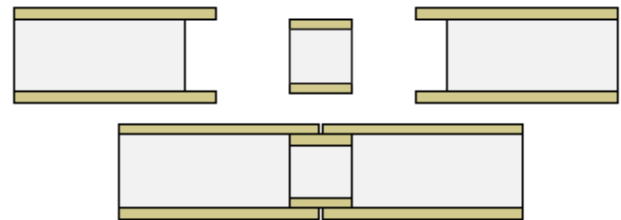
<sup>3</sup> Both facings must bear on the supporting foundation or structure.

<sup>4</sup> Tabulated values for 8-foot (2.44 m) walls apply to SIPs constructed with OSB strength axis oriented either parallel or perpendicular to supports.

**AXIAL LOAD**



**TYPE S SPLINE**



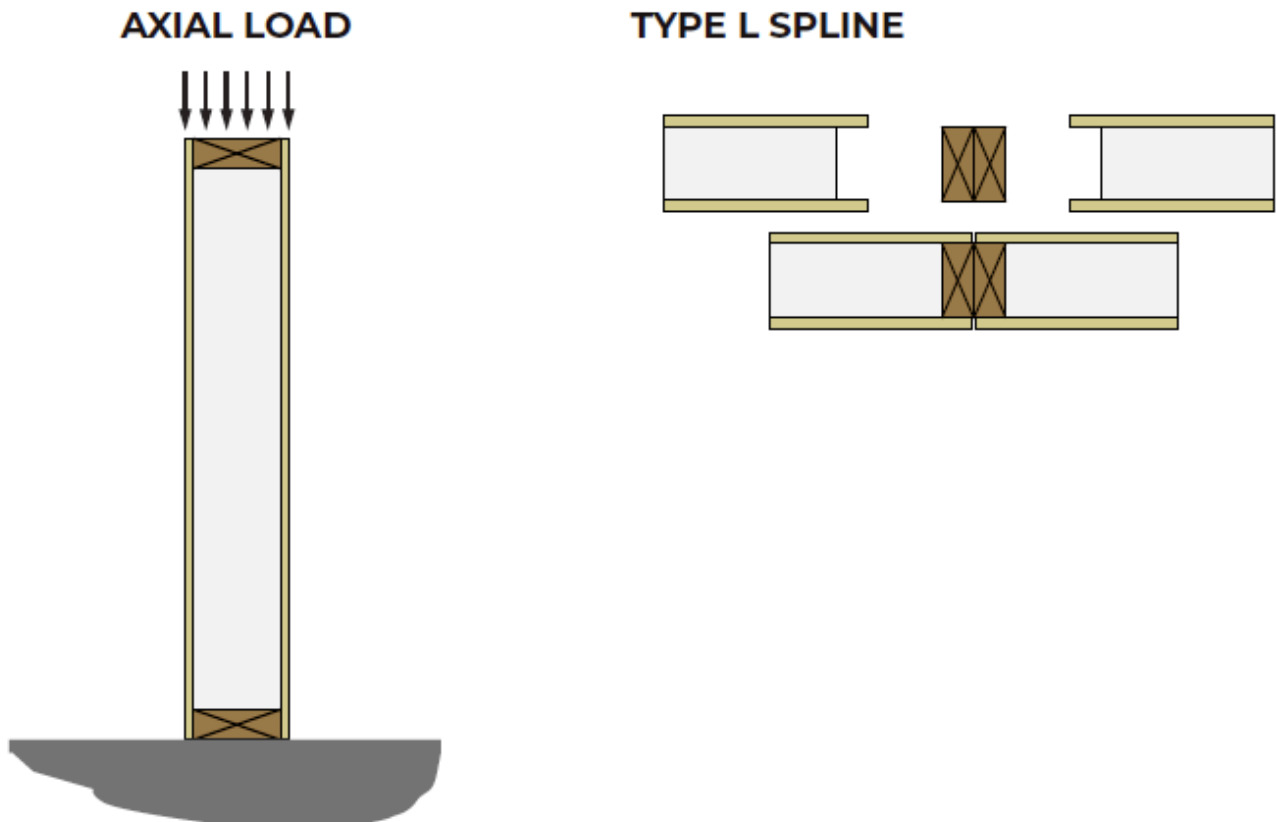
| <b>LOAD CHART #1B</b><br>Uniform Axial Loads - PLF <sup>1-4</sup><br>Type L Spline |                  |      |      |      |      |      |
|--|------------------|------|------|------|------|------|
| SIP Thickness  | SIP Height (ft.) |      |      |      |      |      |
|  | 8'               | 10'  | 12'  | 16'  | 20'  | 24'  |
| 4-1/2"   | 4723             | 3903 | 3273 | 2623 | NA   | NA   |
| 6-1/2"   | 5850             | 5890 | 4277 | 4310 | 2933 | 2837 |
| 8-1/4"   | 6807             | 6110 | 5557 | 5180 | 4837 | 4083 |
| 10-1/4"  | 5473             | 5709 | 5946 | 5948 | 4729 | 4250 |
| 12-1/4"  | 5667             | 5474 | 5281 | 5775 | 4729 | 4223 |

<sup>1</sup> Splines consist of No. 2 or better, Hem-Fir, 1-1/2 inch (38.1 mm) wide with depth equal to the core thickness, spaced to provide no less than two members for every 48 inches (1219.2 mm) of SIPs width. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load.

<sup>2</sup> Uniform axial loads.

<sup>3</sup> Both facings must bear on the supporting foundation or structure.

<sup>4</sup> Tabulated values for 8-foot (2.44 m) walls apply to SIPs constructed with OSB strength axis oriented either parallel or perpendicular to supports.



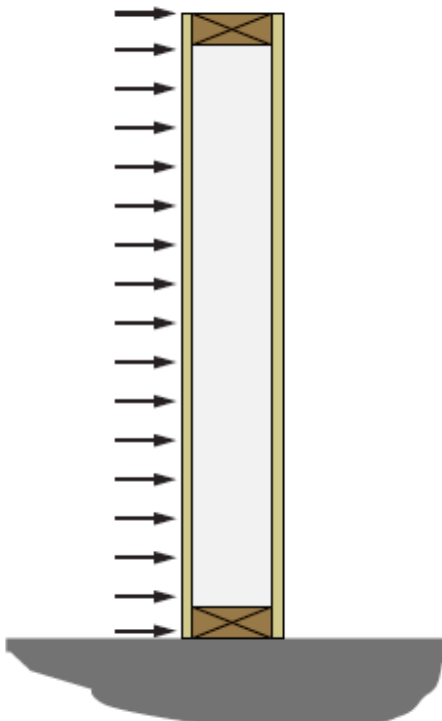
| <b>LOAD CHART #3A</b>                                     |                  |                  |     |     |     |     |     |     |     |     |
|---|------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Wall Uniform Transverse Loads - PSF <sup>1-3</sup></b> |                  |                  |     |     |     |     |     |     |     |     |
| <b>Type S Spline</b>                                      |                  |                  |     |     |     |     |     |     |     |     |
| SIP Thickness   | Deflection Limit | SIP Height (ft.) |     |     |     |     |     |     |     |     |
|   |                  | 8'               | 10' | 12' | 14' | 16' | 18' | 20' | 22' | 24' |
| 4-1/2"  | L/360            | 32               | 23  | 18  | 14  | 11  | NA  | NA  | NA  | NA  |
|   | L/240            | 48               | 35  | 27  | 21  | 16  | NA  | NA  | NA  | NA  |
|   | L/180            | 55               | 44  | 36  | 28  | 22  | NA  | NA  | NA  | NA  |
| 6-1/2"  | L/360            | 51               | 38  | 29  | 23  | 19  | 15  | 12  | NA  | NA  |
|   | L/240            | 67               | 53  | 44  | 35  | 28  | 23  | 19  | NA  | NA  |
|   | L/180            | 67               | 53  | 44  | 38  | 33  | 29  | 24  | NA  | NA  |
| 8-1/4"  | L/360            | 67               | 51  | 40  | 32  | 26  | 22  | 18  | 15  | 13  |
|   | L/240            | 75               | 60  | 50  | 42  | 37  | 33  | 27  | 23  | 19  |
|   | L/180            | 75               | 60  | 50  | 42  | 37  | 33  | 30  | 26  | 22  |
| 10-1/4"   | L/360            | 83               | 66  | 52  | 43  | 35  | 29  | 25  | 21  | 18  |
|   | L/240            | 83               | 66  | 55  | 47  | 41  | 36  | 33  | 30  | 27  |
|   | L/180            | 83               | 66  | 55  | 47  | 41  | 36  | 33  | 30  | 27  |
| 12-1/4"   | L/360            | 89               | 72  | 60  | 51  | 44  | 37  | 32  | 27  | 23  |
|   | L/240            | 89               | 72  | 60  | 51  | 45  | 40  | 36  | 32  | 30  |
|   | L/180            | 89               | 72  | 60  | 51  | 45  | 40  | 36  | 32  | 30  |

<sup>1</sup> Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load.

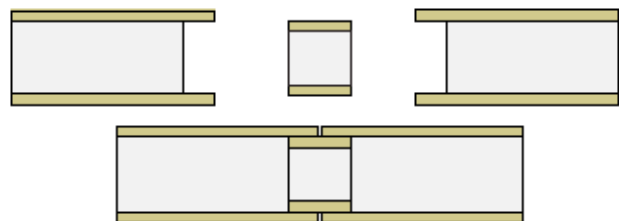
<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code. Values are based on loads of short duration only.

<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction..

### TRANSVERSE LOAD



### TYPE S SPLINE



## **SUBJECT: SHEAR WALL & DIAPHRAGM CAPACITY OF EXTREME SIPS**

Extreme SIPS have been evaluated for use as shear walls and diaphragms in structures. Shear wall and diaphragm applications include both wall and roof assemblies that are subjected to seismic or wind loads. Through large and small-scale testing conducted at the APA laboratories, overseen by an independent structural consultant, it was determined that Extreme SIPS can develop design diaphragm capacities of up to 850 lbs./ft. Please refer to the Extreme Panel Load Chart #7A for SIPS Screw and nail spacing required to obtain this capacity.

These tests have allowed for the determination of design capacities for SIPS Screws and nails when used in diaphragms. The following lateral load capacities are recommended:

- SIP Screws: 250 lbs.
- 8d nails @ surface splines: 62.5 lbs.

### **DESIGN VALUES INCLUDE A SAFETY FACTOR OF THREE ON THE ULTIMATE LOAD.**

In all shear wall and diaphragm applications, the design of the lateral load-resisting system must be engineered to provide a load path for the forces that the structure experiences. This is provided by the engineer of record on the specific project.

Current Extreme Panel Load Charts can be found at [www.extremepanel.com](http://www.extremepanel.com).



| LOAD CHART #7A   |  |  |   |                            |                                      |                      |
|--|--|--|---|----------------------------|--------------------------------------|----------------------|
| Roof/Floor Diaphragms Loads - PLF <sup>1,5</sup> • Type S Spline |  |  |   |                            |                                      |                      |
| Minimum Connections <sup>2</sup>                                 |  |  |   | Allowable Shear Load (PLF) | G' Apparent Shear Stiffness (lbf/in) | Maximum Aspect Ratio |
| Interior Supports <sup>2</sup>                                   | Spline <sup>3</sup>  | Boundary <sup>4</sup>                                  |   |                            |                                      |                      |
|  |  | Support  | Spline                                  |                            |                                      |                      |
| SIP Screw with 1" penetration 12" on center                      | 0.113"x 2-1/2" nails, 3" on center 7/16" x 3" OSB Box/Block Spline                     | PBS No. 14 SIP Screw with 1" penetration 12" on center | 0.113" x 2-1/2" nails, 6" on center     | 430                        | 24000                                | 4:1                  |
| SIP Screw with 1" penetration 12" on center                      | 0.113"x 2-1/2" nails, 3" on center, 2 rows, staggered 7/16" x 3" OSB Box/Block Spline  | PBS No. 14 SIP Screw with 1" penetration 3" on center  | 0.113" x 2-1/2" nails, 4" on center     | 460                        | 30300                                | 4:1                  |
| SIP Screw with 1" penetration 2" on center                       | 0.113"x 2-1/2" nails, 3" on center, 2 rows, staggered 7/16" x 3" OSB Box/Block Spline  | PBS No. 14 SIP Screw with 1" penetration 2" on center  | 0.113" x 2-1/2" nails, 1-1/2" on center | 655                        | 41300                                | 4:1                  |
| SIP Screw with 1" penetration 4" on center                       | 0.113"x 2-1/2" nails, 3" on center, 2 rows, staggered 7/16" x 3" OSB Box/Block Spline  | PBS No. 14 SIP Screw with 1" penetration 4" on center  | 0.113" x 2-1/2" nails, 3" on center     | 795                        | 93700                                | 3:1                  |
| SIP Screw with 1" penetration 4" on center                       | 0.113"x 2-1/2" nails, 6" on center, 2 rows, staggered 23/32" x 4" OSB Box/Block Spline | PBS No. 14 SIP Screw with 1" penetration 4" on center  | 0.113" x 2-1/2" nails, 6" on center     | 1130                       | 110600                               | 3:1                  |

<sup>1</sup> The maximum diaphragm length-to-width ratio shall not exceed 4:1. Load may be applied parallel to continuous panel joints.

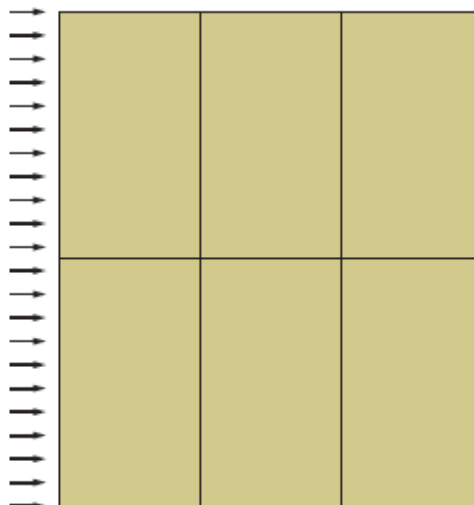
<sup>2</sup> Interior supports shall be spaced not to exceed 12 feet (3.66 m) on center and have a minimum width of 3-1/2 inches (88.9 mm) and a specific gravity of 0.42 or greater. Specified fasteners are required on both sides of panel joint where panels are joined over a support. See Figure 4A.

<sup>3</sup> Box/Block Spline fastened at top only, at interior panel-to-panel joints. Specified fasteners are required on both sides of panel joint. See Figure 4B.

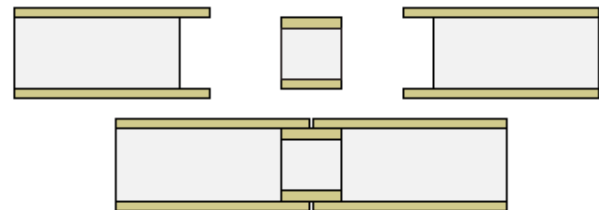
<sup>4</sup> Boundary spline shall be solid 1-1/2 inches (38.1 mm) wide, minimum, and have a specific gravity of 0.42 or greater. Boundary supports shall have a minimum width of 3-1/2 inches (88.9 mm) and a specific gravity of 0.42 or greater. Specified spline fasteners are required through both facings. See Figure 4C.

<sup>5</sup> Diaphragms shall be designed by a registered design professional in accordance with accepted engineering practice.

### DIAPHRAGM LOAD



### TYPE S SPLINE



| <b>LOAD CHART #4A</b>  |  |  |  |                     |
|--|--|--|--|---------------------|
| <b>Shear Loads - PLF<sup>1-7</sup> Seismic Design Categories A-C</b> |  |  |  |                     |
| <b>Type S or Type L Spline</b>                                       |  |  |  |                     |
| Framing<br>Minimum SG  | Minimum Facing Connections <sup>4</sup>                    |  |  | Shear Load<br>(PLF) |
|  | Chord <sup>4,5</sup>                                       | Plate  | Spline   |                     |
| 0.50   | 0.113"x 2-1/2" nails<br>6" on center                       | 0.113"x 2-1/2" nails<br>6" on center                       | (7/16" OSB Faced x 3" wide Box/Block Spline)<br>0.113"x 2-1/2" nails, 6" on center                                   | 410                 |
| 0.50   | 0.113"x 2-3/8" nails<br>6" on center<br>Staggered (2 rows) | 0.113"x 2-3/8" nails<br>6" on center                       | (7/16" OSB Faced x 3" wide Box/Block Spline)<br>0.113"x 2-3/8" nails, 6" on center <sup>6</sup>                      | 460                 |
| 0.42   | 0.113"x 2-3/8" nails<br>6" on center<br>Staggered (2 rows) | 0.113"x 2-3/8" nails<br>4" on center<br>Staggered (2 rows) | (7/16" OSB Faced x 3" wide Box/Block Spline)<br>0.113"x 2-3/8" nails, 4" on center <sup>6</sup>                      | 700                 |
| 0.42   | 0.148"x 2-3/8" nails<br>6" on center<br>Staggered (2 rows) | 0.148"x 2-3/8" nails<br>3" on center                       | (23/32" OSB Faced x 3" wide Box/Block Spline)<br>0.148"x 2-3/8" nails, 3" on center stagger<br>(2 rows) <sup>7</sup> | 1000                |

<sup>1</sup> Wind and seismic loads in seismic design categories A, B, C.

<sup>2</sup> Aspect ratio (height:width) does not exceed 2:1.

<sup>3</sup> Shear wall height-width ratios greater than 2:1, but not exceeding 3.5:1, are permitted for assemblies using lumber splines provided the allowable shear strength values in the table are multiplied by 2w/h.

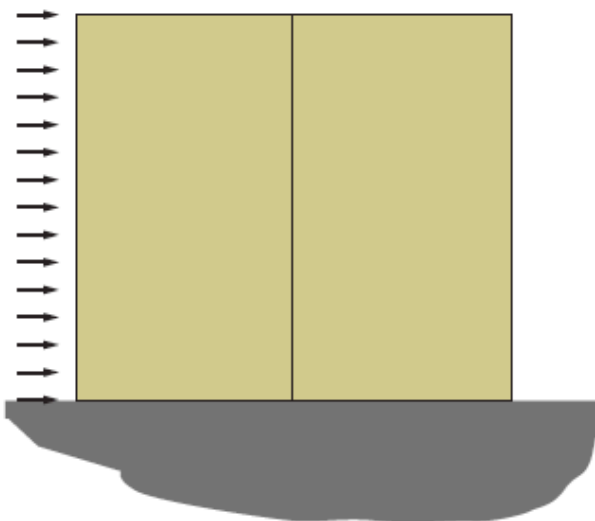
<sup>4</sup> Required connections must be made on each side of the SIPs. Dimensional or engineered lumber shall have an equivalent specific gravity not less than specified.

<sup>5</sup> Chords, hold-downs and connections to other structural elements must be designed by a registered designer professional in accordance with accepted engineering practice.

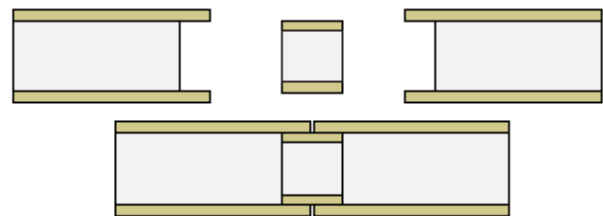
<sup>6</sup> 4 inch (101.6 mm) wide spline.

<sup>7</sup> 4 inch (101.6 mm), 23/32 inch (18.25 mm) thick facing.

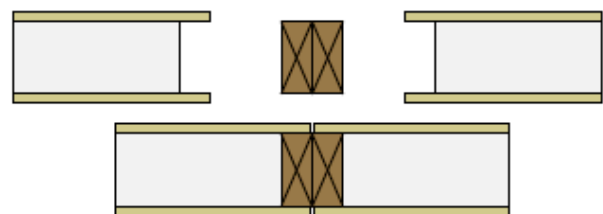
### SHEAR LOAD



### TYPE S SPLINE



### TYPE L SPLINE



## SUBJECT: EXTREME SIPS USED IN FLOOR APPLICATIONS

Extreme SIPs are often used in floor applications when an insulated floor system is required. Examples of this situation include over a non-conditioned crawl space, the floor of a sunroom addition, or a bedroom floor over an unheated garage.

When using Extreme SIPs in floor applications, there are a few design considerations to keep in mind. Extreme recommends that the floor panel be overlaid with an additional layer of 7/16" sheathing to minimize any potential for puncturing of the SIP's structural skins and to provide a divorcement layer to protect the structural integrity of the SIP should flooring need to be replaced. The application of these divorcement materials will prevent any damage to the top OSB structural facing of the SIP if the floor finishing were to need replacing. The OSB facings of a SIP are part of the SIP's structural component assembly; therefore, the OSB facings must remain intact to provide long-term structural capacity.

Floor SIPs, without added spline structure (e.g., Type I and Type L Splines), are not able to support load-bearing walls and cannot be cantilevered over a lower wall to support an upper wall and roof systems. Please consult the Extreme Panel Load Charts for Type I Splines and Type L Splines. The load limitations of SIPs used in floor systems are covered by Extreme Panel Load Charts #6a, #6b, #6c, and other technical bulletins.

Building codes have specific requirements for materials used to create floor assemblies. In residential applications, the floor system must be able to carry a uniform load of 40 psf. Commercial floor assemblies, such as those found in churches, schools, banks, hotels, etc., have more stringent requirements. These include the capacity to support uniform loads greater than 40 psf and the ability to support concentrated loads. The concentrated load requirement for most commercial structures is 1000 or 2000 pounds over a 30" x 30" (6.25 sq. ft.) area.

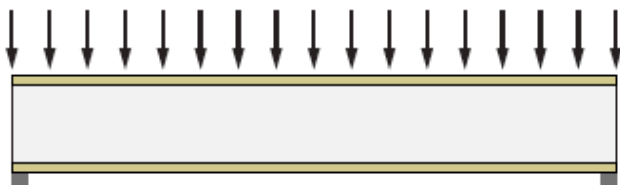
Two typical Extreme SIPs floor assemblies have been subjected to concentrated floor load testing. The results from this testing demonstrate that Extreme SIPs floor assemblies meet the code requirement for commercial floors of 2000-pound concentrated loads, while providing a safety factor of three.

Load Charts #6A, #6B & #6C (Pages 2-4) demonstrate the load capacities for floor design applications. View on the following pages or at [www.extremepanel.com](http://www.extremepanel.com).

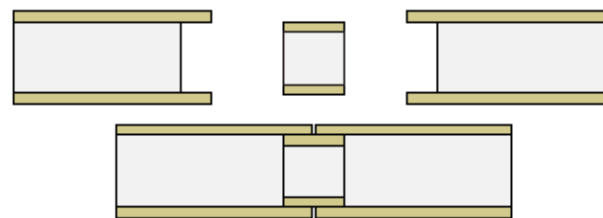
| <b>LOAD CHART #6A</b>   |                  |                |    |     |     |     |     |     |     |     |     |
|---|------------------|----------------|----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                |    |     |     |     |     |     |     |     |     |
| <b>Type S Spline</b>  |                  |                |    |     |     |     |     |     |     |     |     |
| SIP Thickness   | Deflection Limit | SIP Span (ft.) |    |     |     |     |     |     |     |     |     |
|   |                  | 4' 4           | 8' | 10' | 12' | 14' | 16' | 18' | 20' | 22' | 24' |
| 4-1/2"  | L/360            | 100            | 32 | 23  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 143            | 48 | 35  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 143            | 63 | 47  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
| 6-1/2"  | L/360            | 105            | 51 | 38  | 29  | 23  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 162            | 76 | 57  | 44  | 35  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 191            | 80 | 61  | 50  | 42  | NA  | NA  | NA  | NA  | NA  |
| 8-1/4"  | L/360            | 120            | 67 | 51  | 40  | 32  | 26  | 22  | NA  | NA  | NA  |
|   | L/240            | 179            | 94 | 71  | 57  | 48  | 40  | 33  | NA  | NA  | NA  |
|   | L/180            | 179            | 94 | 71  | 57  | 48  | 41  | 36  | NA  | NA  | NA  |
| 10-1/4"   | L/360            | 131            | 86 | 66  | 52  | 43  | 35  | 29  | 25  | 21  | NA  |
|   | L/240            | 168            | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 32  | NA  |
|   | L/180            | 168            | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 33  | NA  |
| 12-1/4"   | L/360            | 132            | 94 | 75  | 63  | 53  | 44  | 37  | 32  | 27  | 23  |
|   | L/240            | 163            | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |
|   | L/180            | 163            | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |

- <sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Values do not include the dead weight of the SIP.
- <sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code. Values are based on loads of short duration only and do not consider the effects of creep.
- <sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.
- <sup>4</sup> SIPs shall be a minimum of 8-foot (2.44 m) long spanning two 4-foot (1.22 m) spans.

### TRANSVERSE LOAD



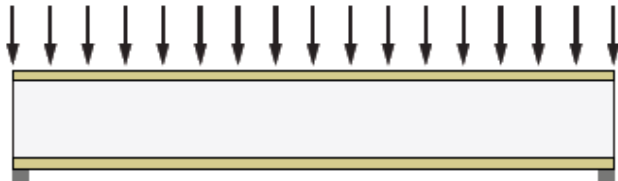
### TYPE S SPLINE



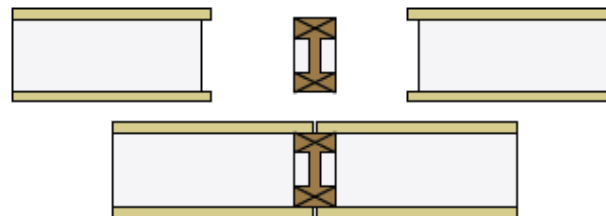
| <b>LOAD CHART #6B</b>  |                  |                 |     |     |     |    |    |    |    |    |    |
|--|------------------|-----------------|-----|-----|-----|----|----|----|----|----|----|
| <b>Roof/Floor Uniform Transverse Loads - PSF<sup>1-4</sup></b> |                  |                 |     |     |     |    |    |    |    |    |    |
| <b>Type I Spline</b>   |                  |                 |     |     |     |    |    |    |    |    |    |
| SIP Thickness  | Deflection Limit | SIP Span (feet) |     |     |     |    |    |    |    |    |    |
|  |                  | 4 <sup>4</sup>  | 8   | 10  | 12  | 14 | 16 | 18 | 20 | 22 | 24 |
| 10-1/4"  | L/360            | 197             | 164 | 124 | 72  | 67 | 61 | 48 | 34 | 29 | 24 |
|  | L/240            | 336             | 164 | 124 | 107 | 96 | 84 | 70 | 49 | 43 | 36 |
|  | L/180            | 336             | 164 | 124 | 107 | 96 | 84 | 76 | 65 | 56 | 47 |
| 12-1/4"  | L/360            | 258             | 143 | 103 | 86  | 83 | 77 | 61 | 42 | 37 | 32 |
|  | L/240            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 46 |
|  | L/180            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 49 |

- <sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Splines consist of I-beam, 2-1/4 inch (57.2 mm) wide flange (minimum) with a depth equal to the core thickness, spaced not to exceed 48 inches (1219.2 mm) on center.
- <sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code.
- <sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.
- <sup>4</sup> SIP shall be a minimum of 8 foot (2.44 m) long spanning a minimum of two 4-foot (1.22 m) spans.

### TRANSVERSE LOAD



### TYPE I SPLINE



## SUBJECT: EXTREME SIPS USED IN FLOOR APPLICATIONS

Extreme SIPs are often used in floor applications when an insulated floor system is required. Examples of this situation include over a non-conditioned crawl space, the floor of a sunroom addition, or a bedroom floor over an unheated garage.

When using Extreme SIPs in floor applications, there are a few design considerations to keep in mind. Extreme recommends that the floor panel be overlaid with an additional layer of 7/16" sheathing to minimize any potential for puncturing the SIP's structural skins and to provide a divorcement layer to protect the structural integrity of the SIP should flooring need to be replaced. The application of these divorcement materials will prevent any damage to the top OSB structural facing of the SIP if the floor finishing needs replacing. The OSB facings of a SIP are part of the SIP's structural component assembly; therefore, the OSB facings must remain intact to provide long-term structural capacity.

Floor SIPs, without added spline structure (e.g., Type I and Type L Splines), are not able to support load-bearing walls and cannot be cantilevered over a lower wall to support an upper wall and roof systems. Please consult the Extreme Panel Load Charts for Type I Splines and Type L Splines. The load limitations of SIPs used in floor systems are covered by Extreme Panel Load Charts #6a, #6b, #6c, and other technical bulletins.

Building codes have specific requirements for materials used to create floor assemblies. In residential applications, the floor system must be able to carry a uniform load of 40 psf. Commercial floor assemblies, such as those found in churches, schools, banks, hotels, etc., have more stringent requirements. These include the capacity to support uniform loads greater than 40 psf and the ability to support concentrated loads. The concentrated load requirement for most commercial structures is 1000 or 2000 pounds over a 30" x 30" (6.25 sq. ft.) area.

Two typical Extreme SIPs floor assemblies have been subjected to concentrated floor load testing. The results from this testing demonstrate that Extreme SIPs floor assemblies meet the code requirement for commercial floors of 2000-pound concentrated loads, while providing a safety factor of three.

Load Charts #6A, #6B & #6C (Pages 2-4) demonstrate the load capacities for floor design applications. View on the following pages or at [www.extremepanel.com](http://www.extremepanel.com).



| <b>LOAD CHART #6A</b>   |                  |                 |    |     |     |     |     |     |     |     |     |
|---|------------------|-----------------|----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |    |     |     |     |     |     |     |     |     |
| <b>Type S Spline</b>  |                  |                 |    |     |     |     |     |     |     |     |     |
| SIP Thickness   | Deflection Limit | SIP Span (ft.)  |    |     |     |     |     |     |     |     |     |
|   |                  | 4' <sup>4</sup> | 8' | 10' | 12' | 14' | 16' | 18' | 20' | 22' | 24' |
| 4-1/2"  | L/360            | 100             | 32 | 23  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 143             | 48 | 35  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 143             | 63 | 47  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
| 6-1/2"  | L/360            | 105             | 51 | 38  | 29  | 23  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 162             | 76 | 57  | 44  | 35  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 191             | 80 | 61  | 50  | 42  | NA  | NA  | NA  | NA  | NA  |
| 8-1/4"  | L/360            | 120             | 67 | 51  | 40  | 32  | 26  | 22  | NA  | NA  | NA  |
|   | L/240            | 179             | 94 | 71  | 57  | 48  | 40  | 33  | NA  | NA  | NA  |
|   | L/180            | 179             | 94 | 71  | 57  | 48  | 41  | 36  | NA  | NA  | NA  |
| 10-1/4"   | L/360            | 131             | 86 | 66  | 52  | 43  | 35  | 29  | 25  | 21  | NA  |
|   | L/240            | 168             | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 32  | NA  |
|   | L/180            | 168             | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 33  | NA  |
| 12-1/4"   | L/360            | 132             | 94 | 75  | 63  | 53  | 44  | 37  | 32  | 27  | 23  |
|   | L/240            | 163             | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |
|   | L/180            | 163             | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |

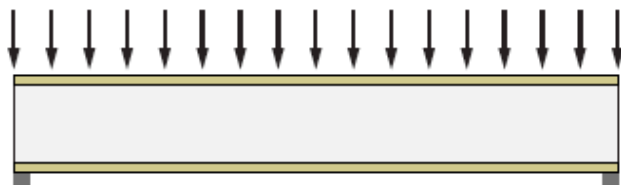
<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Values do not include the dead weight of the SIP.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code. Values are based on loads of short duration only and do not consider the effects of creep.

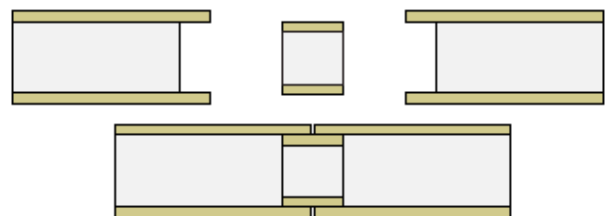
<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIPs shall be a minimum of 8-foot (2.44 m) long spanning two 4-foot (1.22 m) spans.

### TRANSVERSE LOAD



### TYPE S SPLINE



| <b>LOAD CHART #6B</b>   |                  |                 |     |     |     |    |    |    |    |    |    |
|---|------------------|-----------------|-----|-----|-----|----|----|----|----|----|----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |     |     |     |    |    |    |    |    |    |
| <b>Type I Spline</b>  |                  |                 |     |     |     |    |    |    |    |    |    |
| SIP Thickness   | Deflection Limit | SIP Span (feet) |     |     |     |    |    |    |    |    |    |
|   |                  | 4 <sup>4</sup>  | 8   | 10  | 12  | 14 | 16 | 18 | 20 | 22 | 24 |
| 10-1/4"   | L/360            | 197             | 164 | 124 | 72  | 67 | 61 | 48 | 34 | 29 | 24 |
|   | L/240            | 336             | 164 | 124 | 107 | 96 | 84 | 70 | 49 | 43 | 36 |
|   | L/180            | 336             | 164 | 124 | 107 | 96 | 84 | 76 | 65 | 56 | 47 |
| 12-1/4"   | L/360            | 258             | 143 | 103 | 86  | 83 | 77 | 61 | 42 | 37 | 32 |
|   | L/240            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 46 |
|   | L/180            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 49 |

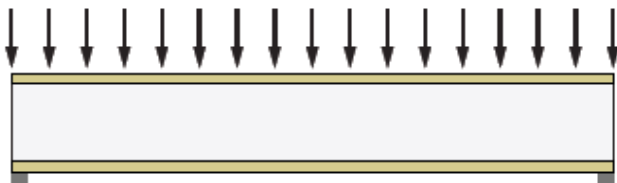
<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Splines consist of Premier I-beam, 2-1/4 inch (57.2 mm) wide flange (minimum) with a depth equal to the core thickness, spaced not to exceed 48 inches (1219.2 mm) on center.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code.

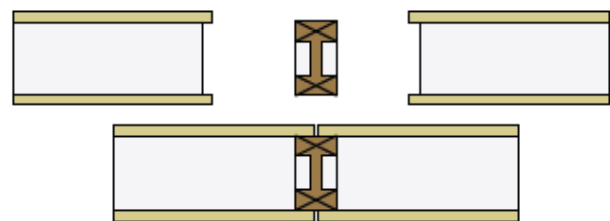
<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIP shall be a minimum of 8 foot (2.44 m) long spanning a minimum of two 4-foot (1.22 m) spans.

### TRANSVERSE LOAD



### TYPE I SPLINE





| <b>LOAD CHART #6C</b>   |                  |                 |     |     |     |     |     |    |    |    |    |
|---|------------------|-----------------|-----|-----|-----|-----|-----|----|----|----|----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |     |     |     |     |     |    |    |    |    |
| <b>Type L Spline</b>  |                  |                 |     |     |     |     |     |    |    |    |    |
| SIP Thickness   | Deflection Limit | SIP Span (feet) |     |     |     |     |     |    |    |    |    |
|   |                  | 4 <sup>4</sup>  | 8   | 10  | 12  | 14  | 16  | 18 | 20 | 22 | 24 |
| 4-1/2"  | L/360            | 103             | 45  | 33  | 24  | NA  | NA  | NA | NA | NA | NA |
|   | L/240            | 225             | 68  | 47  | 34  | NA  | NA  | NA | NA | NA | NA |
|   | L/180            | 297             | 91  | 61  | 45  | NA  | NA  | NA | NA | NA | NA |
| 6-1/2"  | L/360            | 307             | 129 | 57  | 42  | 34  | 25  | 20 | NA | NA | NA |
|   | L/240            | 307             | 182 | 87  | 61  | 49  | 37  | 30 | NA | NA | NA |
|   | L/180            | 307             | 182 | 112 | 80  | 65  | 49  | 39 | NA | NA | NA |
| 8-1/4"  | L/360            | 253             | 171 | 82  | 66  | 54  | 41  | 32 | 23 | NA | NA |
|   | L/240            | 288             | 188 | 128 | 100 | 81  | 61  | 48 | 35 | NA | NA |
|   | L/180            | 288             | 188 | 133 | 117 | 105 | 80  | 63 | 45 | NA | NA |
| 10-1/4"   | L/360            | 286             | 188 | 117 | 101 | 80  | 58  | 47 | 36 | 32 | 27 |
|   | L/240            | 326             | 188 | 147 | 134 | 120 | 90  | 71 | 52 | 47 | 41 |
|   | L/180            | 326             | 188 | 147 | 134 | 121 | 106 | 93 | 68 | 61 | 53 |
| 12-1/4"   | L/360            | 327             | 188 | 167 | 141 | 116 | 91  | 75 | 58 | 47 | 36 |
|   | L/240            | 327             | 188 | 167 | 153 | 132 | 110 | 97 | 83 | 69 | 53 |
|   | L/180            | 327             | 188 | 167 | 153 | 132 | 110 | 97 | 83 | 83 | 70 |

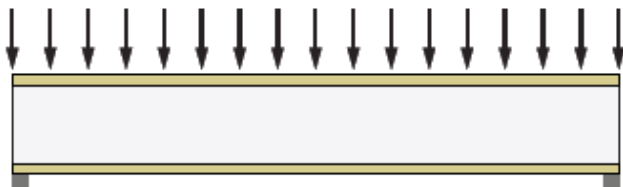
<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Splines consist of No. 2 or better Hem-Fir, 1-1/2 inches (38.1 mm) wide with a depth equal to the core thickness, spaced to provide not less than two members for every 48 inches (1219.2 mm) of SIP width.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code.

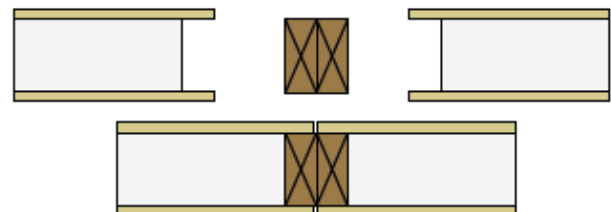
<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIP shall be a minimum of 8 foot (2.44 m) long spanning two 4-foot (1.22 m) spans. No single span condition is allowed.

### TRANSVERSE LOAD



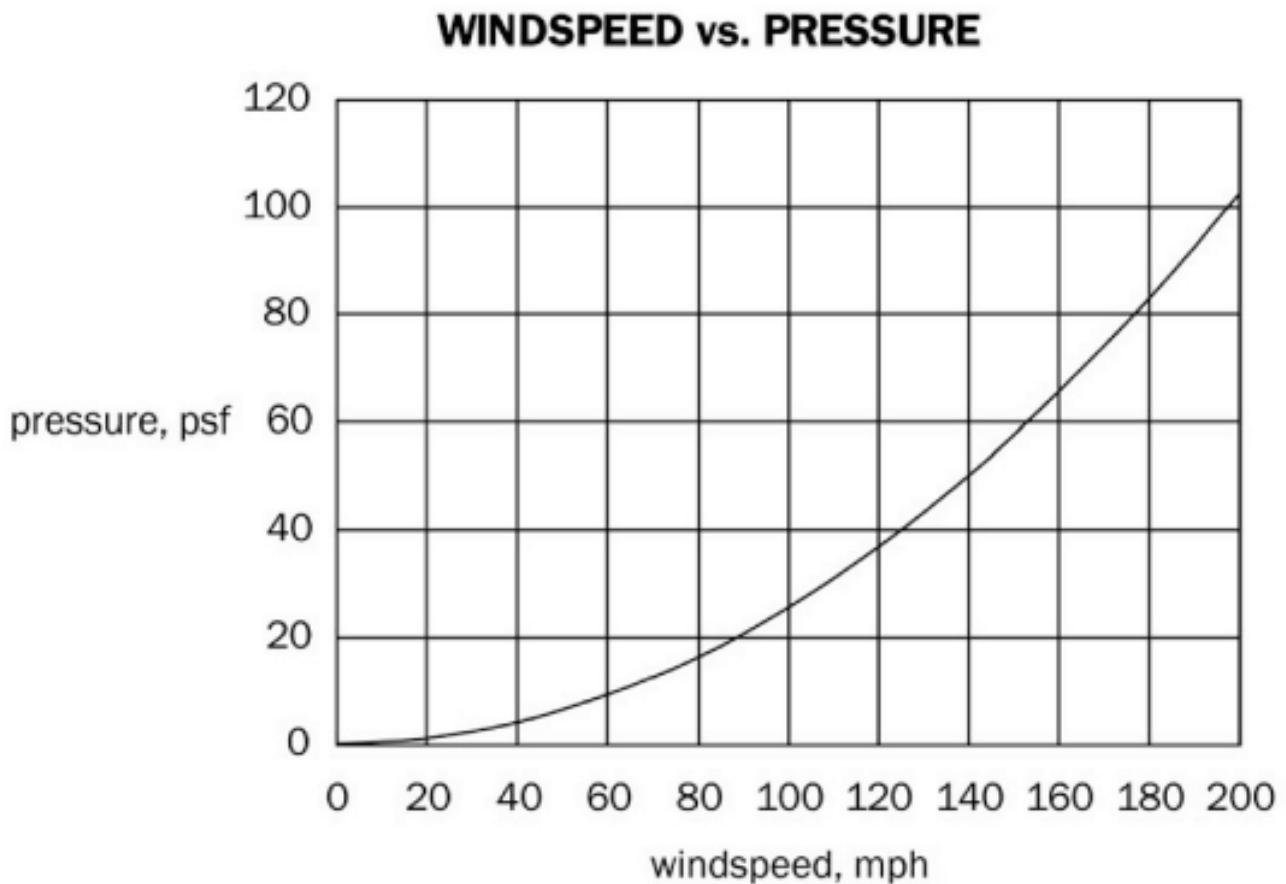
### TYPE L SPLINE



### SUBJECT: WIND SPEED VS. PRESSURE

Building codes have established minimum design criteria that must be met in the structural design of a building, covering both gravity and lateral loading. The purpose of this technical bulletin is to address the requirements for designing structures to resist wind loads.

Both the IRC and the IBC reference ASCE 7 to determine design wind pressures for a structure. ASCE 7 provides three methods for determining wind loads on structures. This technical bulletin uses the simplified procedure to create the following chart as an aid in estimating a structure's design wind load requirement. This chart is not intended for the final structural design of the structure. Your design professional will need to determine the final design for your specific project.

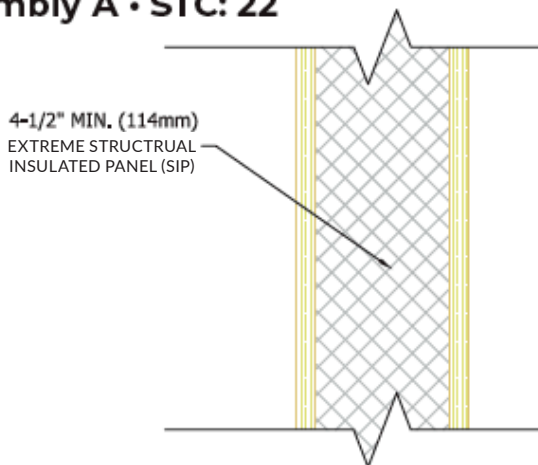


### SUBJECT: SOUND TRANSMISSION OF EXTREME SIPS

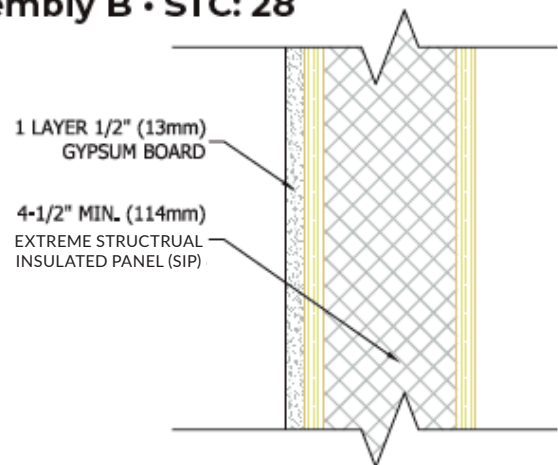
Extreme SIPs have been erected in numerous residential and commercial applications where occupants have expressed great satisfaction with the reduced noise level within their structure due to the SIP construction. While these stories are anecdotal, they indicate that structures built with Extreme SIPs do provide a measure of sound attenuation.

Within the building industry, specific tests are used to determine the Sound Transmission Class (STC) of an assembly or component. ASTM E90, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements," subjects a wall assembly to random noises in a frequency range of 125 to 4000 Hz. The following are STC values for several Extreme SIPS assemblies with a minimum 4 1/2" thickness, used in standard construction, which were determined through testing at an accredited independent laboratory. These assemblies are for typical residential applications:

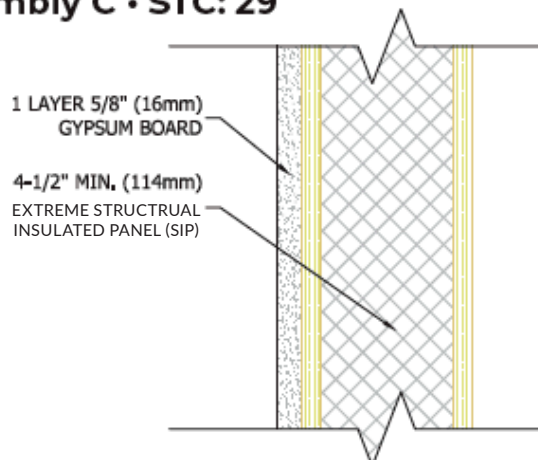
**Assembly A • STC: 22**



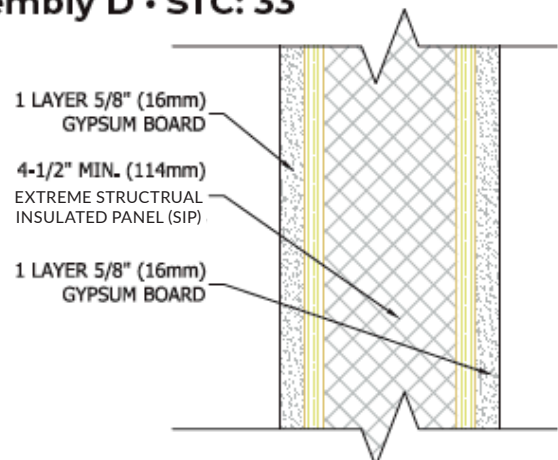
**Assembly B • STC: 28**



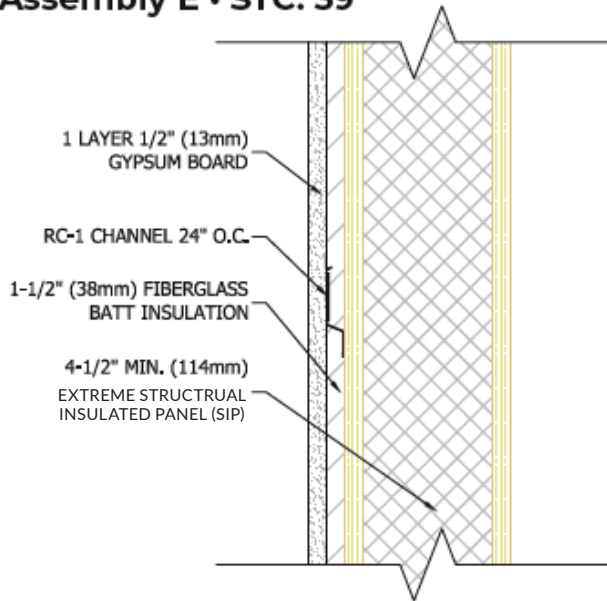
**Assembly C • STC: 29**



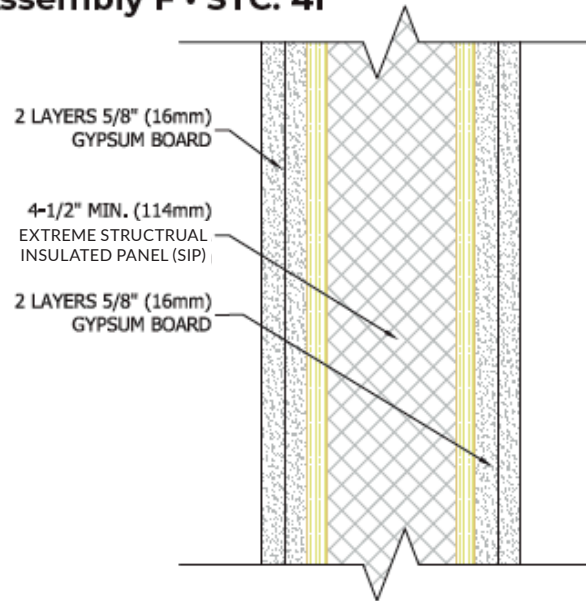
**Assembly D • STC: 33**



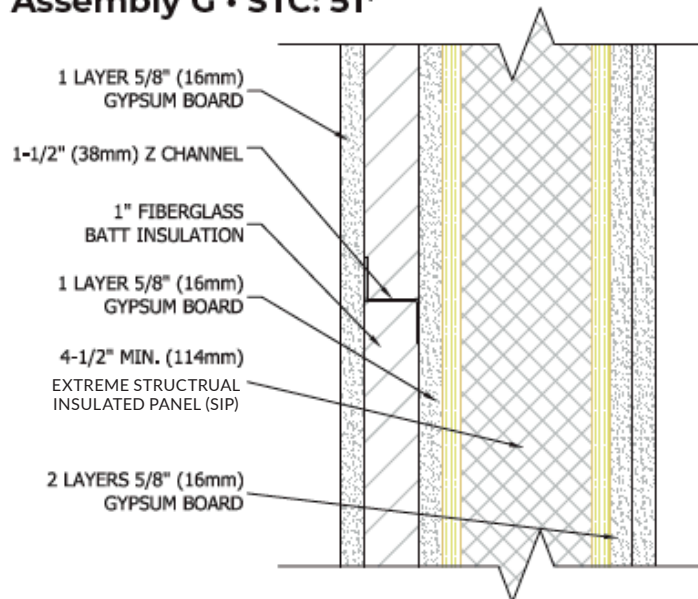
### Assembly E • STC: 39



### Assembly F • STC: 41\*



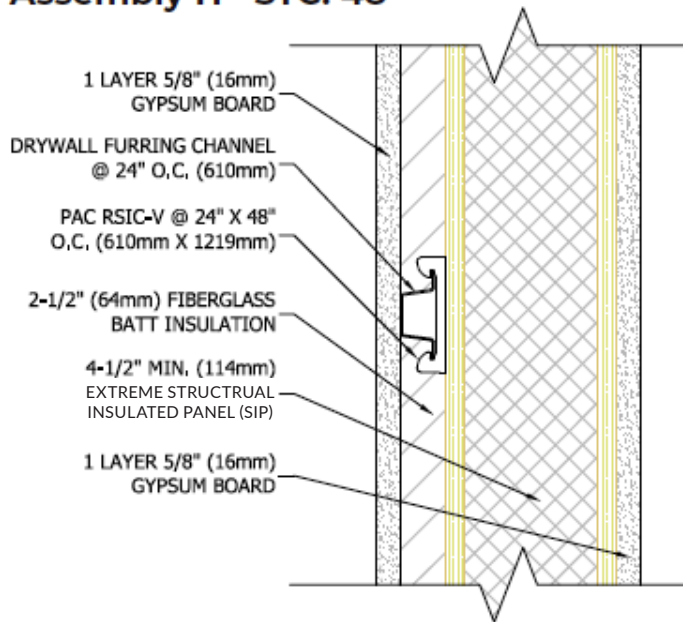
### Assembly G • STC: 51\*



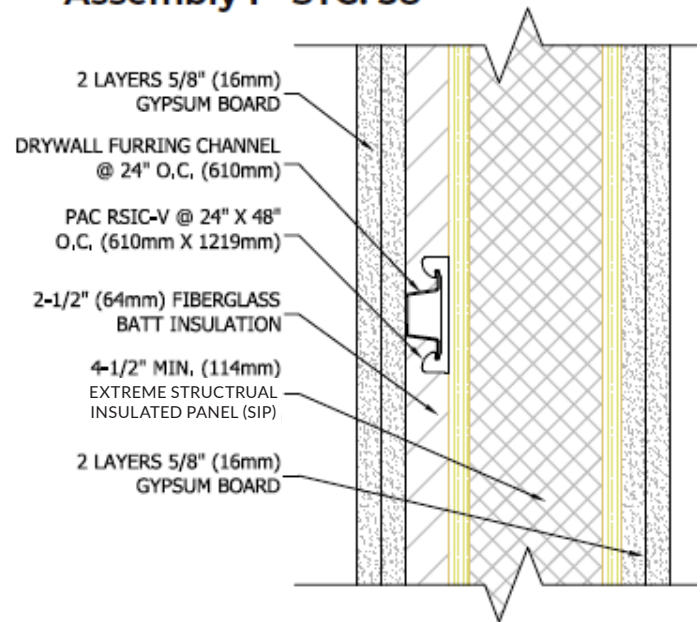
In all of the previously described assemblies, gypsum wallboard was attached using standard screws directly into the face of the SIP or metal channels. In multiple layer assemblies, the joints were offset a minimum of six inches from the joints of the previous layer.

Extreme SIPs are also used in attached multifamily applications such as condominiums and townhomes. Hence, Extreme SIPs has also conducted ASTM E90 tests on wall assemblies that produce higher sound attenuation while meeting fire and clearance requirements for these types of structures. These include the following four assemblies using Extreme SIPs in conjunction with two types of PAC International Isolation clips to yield higher STC values. The assemblies are as follows:

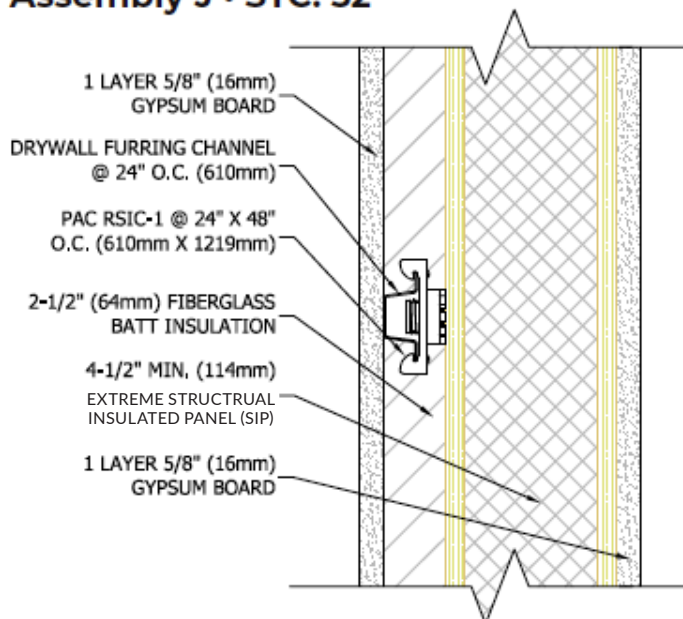
### Assembly H • STC: 48



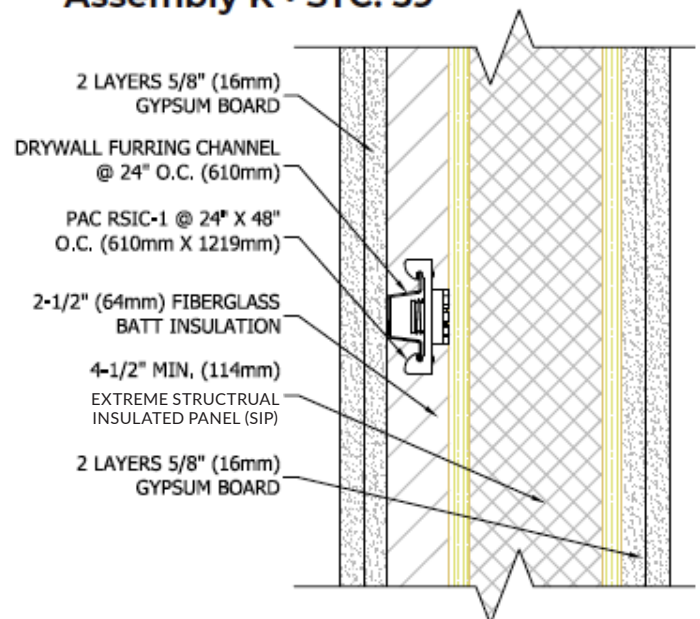
### Assembly I • STC: 58\*



### Assembly J • STC: 52



### Assembly K • STC: 59\*



Assemblies 1 through 4 used standard drywall screws to fasten the gypsum to drywall furring channels attached to the RSIC-V or RSIC-1 Isolation clip assembly. In the multi-layered assemblies, the gypsum wallboard joints were staggered between layers.

The above results will be affected by the use of additional or different finish materials and are provided as reference values. It should also be noted that sound attenuation depends on installation practices. Penetrations through the wall assembly for electrical, plumbing, and other fenestrations (such as windows and doors) can affect the sound transmission performance of a wall. Design consideration should be given to any penetrations through a wall requiring an STC value.

For more construction details on PAC International isolation clips, visit <https://pacinternationalllc.com/pac-products/rsic-1-product/>.

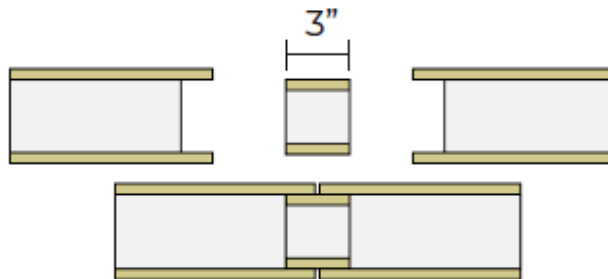
These assemblies meet the requirements of UL U524 Bearing Wall Rating - 1 HR.



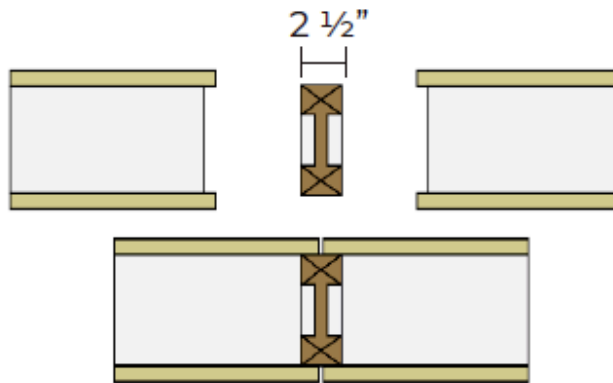
## SUBJECT: SPLINES (MINIMUM WIDTH)

Extreme Panels use three types of splines for connecting its SIPs. The three types of splines are:

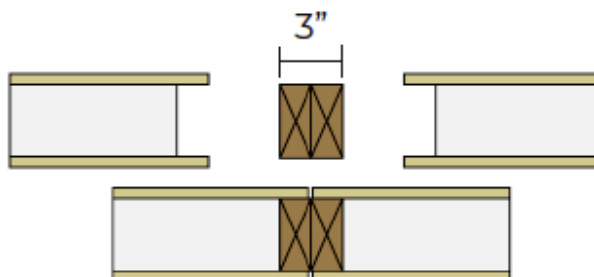
**TYPE S SPLINE:** Block spline, having a width of 3".



**TYPE I SPLINE:** I-Joist spline, having a width of 2 1/2".



**TYPE L SPLINE:** Double 2x dimensional lumber spline, having a width of 3".



When following OSB manufacturers' recommendation of a 1/2" edge distance of spline to fastener and a 3/8" edge distance of fastener to OSB on both sides of the 1/8" Sheathing Gap, you end up with a minimum spline width of 1-7/8". However, that minimum width does not allow any room for the fasteners to deviate from the recommended edge nailing distances.

Pneumatic nailing guns are used to install the fasteners, and the accuracy with which an installer can hit the theoretical nailing line is impractical. Therefore, to ensure a proper nailing base for joining Extreme SIPs together, only splines that are 2.5" minimum width or greater are recommended by Extreme Panels. Furthermore, Extreme SIPs does not recommend the use of a single 2x, or any member that is less than 2-1/2" wide, as an acceptable spline member.

These spline widths and the corresponding minimum width for fastening have been recommended by OSB manufacturers for edge fastening distances and what is practical for actual site conditions.

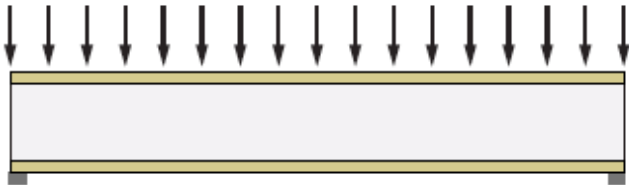
That said, the minimum width of 1-7/8" for a spline does not allow any room for fasteners to deviate from the recommended edge nailing distances. Pneumatic nailing guns are used to install the fasteners, and the accuracy with which an installer can hit the theoretical nailing line is impractical. Therefore, to ensure a proper nailing base for joining SIPs together, only splines that exceed a 2.5" minimum width are recommended by Extreme Panels. Furthermore, Extreme Panel does not recommend the use of a single 2x, or any member that is less than 2-1/2" wide, as an acceptable spline member.

## SUBJECT: EXTREME SIPS WITH TYPE S (BLOCK) SPLINES

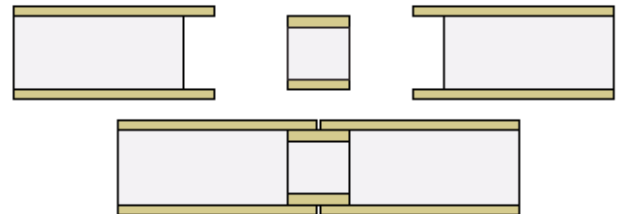
To offer our customers optimal energy efficiency, Extreme SIPS utilize Block Splines (Extreme Detail #EPT-200) as an interconnecting spline within our SIPs. Using Block Splines virtually eliminates the thermal bridging that may occur with other types of spline options. Extreme Panels commissioned an independent, code-recognized testing agency to conduct full-scale destructive transverse load testing to determine the design capacity loads of our Extreme SIPs with Type S Splines for various span conditions. Extreme Panels can be accessed at [www.extremepanel.com](http://www.extremepanel.com).

The Extreme Panel Type S Load Chart summarizes the panel capacities obtained from full-scale destructive testing of Extreme SIPs with Type S Splines. The minimum bearing required to support the SIP end is 1-½". Loads shown on the Type S Spline, Extreme Panel Load Chart #6A (Page 2) for spans that exceed the limitations imposed on floors and roofs, are used for wall design.

### TRANSVERSE LOAD



### TYPE S SPLINE



| <b>LOAD CHART #6A</b>   |                  |                 |    |     |     |     |     |     |     |     |     |
|---|------------------|-----------------|----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |    |     |     |     |     |     |     |     |     |
| <b>Type S Spline</b>  |                  |                 |    |     |     |     |     |     |     |     |     |
| SIP Thickness   | Deflection Limit | SIP Span (ft.)  |    |     |     |     |     |     |     |     |     |
|   |                  | 4' <sup>4</sup> | 8' | 10' | 12' | 14' | 16' | 18' | 20' | 22' | 24' |
| 4-1/2"  | L/360            | 100             | 32 | 23  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 143             | 48 | 35  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 143             | 63 | 47  | NA  | NA  | NA  | NA  | NA  | NA  | NA  |
| 6-1/2"  | L/360            | 105             | 51 | 38  | 29  | 23  | NA  | NA  | NA  | NA  | NA  |
|   | L/240            | 162             | 76 | 57  | 44  | 35  | NA  | NA  | NA  | NA  | NA  |
|   | L/180            | 191             | 80 | 61  | 50  | 42  | NA  | NA  | NA  | NA  | NA  |
| 8-1/4"  | L/360            | 120             | 67 | 51  | 40  | 32  | 26  | 22  | NA  | NA  | NA  |
|   | L/240            | 179             | 94 | 71  | 57  | 48  | 40  | 33  | NA  | NA  | NA  |
|   | L/180            | 179             | 94 | 71  | 57  | 48  | 41  | 36  | NA  | NA  | NA  |
| 10-1/4"   | L/360            | 131             | 86 | 66  | 52  | 43  | 35  | 29  | 25  | 21  | NA  |
|   | L/240            | 168             | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 32  | NA  |
|   | L/180            | 168             | 94 | 75  | 63  | 54  | 47  | 41  | 36  | 33  | NA  |
| 12-1/4"   | L/360            | 132             | 94 | 75  | 63  | 53  | 44  | 37  | 32  | 27  | 23  |
|   | L/240            | 163             | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |
|   | L/180            | 163             | 94 | 75  | 63  | 54  | 47  | 42  | 37  | 34  | 31  |

<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Values do not include the dead weight of the SIP.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code. Values are based on loads of short duration only and do not consider the effects of creep.

<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIPs shall be a minimum of 8-foot (2.44 m) long spanning two 4-foot (1.22 m) spans.

Extreme Detail Load Charts can be accessed at: [www.extremepanel.com](http://www.extremepanel.com).

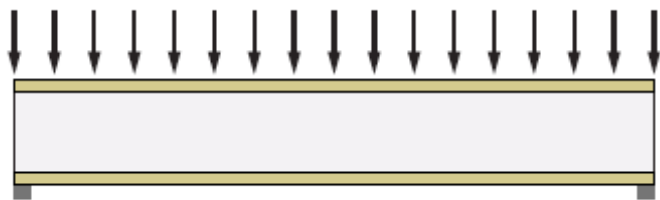
## SUBJECT: EXTREME SIPS WITH TYPE I (I-JOIST) SPLINES

To offer our customers optimal energy efficiency, Extreme Panels utilize APA Performance Rated I-Joists, reflected in Extreme Panel Detail #EPT-201 through 203, as an interconnecting spline within our SIPs. Using the I-Joist spline minimizes the thermal bridging that may occur with other types of spline options. Extreme Panels commissioned an independent, code-recognized testing agency to conduct full-scale destructive transverse load testing to determine the design capacity loads of our Extreme SIPs with a Type I Spline for various span conditions.

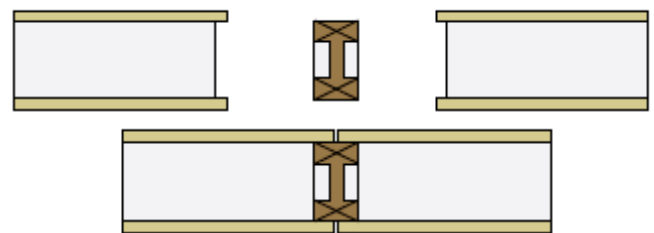
The Type I Spline, Extreme Panel Load Chart #6B (Page 2), summarizes the SIP capacities obtained from full-scale destructive testing of Extreme SIPs with Type I Splines. It should be noted that when an I-Joist is used as a spline member, it is spaced at a maximum of 4' on center and must extend the full length of the SIP span as a single piece. Please refer to Extreme Panel Detail #EPT-203 contained in the Extreme Construction Detail Manual.

Please note that the minimum bearing required to support the panel ends is 1-½". In the case of a single-span roof SIP, spanning from the ridge to the eave, the 2x blocking at the top and bottom of the SIP will not be continuous because the I-Joist extends to both SIP bearing edges. Loads shown on the Type I Spline, Extreme Panel Load Chart #6B for spans that exceed the limitations imposed on floors and roofs, are used for wall design.

### TRANSVERSE LOAD



### TYPE I SPLINE



| <b>LOAD CHART #6B</b>   |                  |                 |     |     |     |    |    |    |    |    |    |
|---|------------------|-----------------|-----|-----|-----|----|----|----|----|----|----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |     |     |     |    |    |    |    |    |    |
| <b>Type I Spline</b>  |                  |                 |     |     |     |    |    |    |    |    |    |
| SIP Thickness   | Deflection Limit | SIP Span (feet) |     |     |     |    |    |    |    |    |    |
|   |                  | 4 <sup>4</sup>  | 8   | 10  | 12  | 14 | 16 | 18 | 20 | 22 | 24 |
| 10-1/4"   | L/360            | 197             | 164 | 124 | 72  | 67 | 61 | 48 | 34 | 29 | 24 |
|   | L/240            | 336             | 164 | 124 | 107 | 96 | 84 | 70 | 49 | 43 | 36 |
|   | L/180            | 336             | 164 | 124 | 107 | 96 | 84 | 76 | 65 | 56 | 47 |
| 12-1/4"   | L/360            | 258             | 143 | 103 | 86  | 83 | 77 | 61 | 42 | 37 | 32 |
|   | L/240            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 46 |
|   | L/180            | 318             | 143 | 103 | 93  | 85 | 77 | 68 | 59 | 54 | 49 |

<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Splines consist of Extreme I-beam, 2-1/4 inch (57.2 mm) wide flange (minimum) with a depth equal to the core thickness, spaced not to exceed 48 inches (1219.2 mm) on center.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code.

<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIP shall be a minimum of 8 foot (2.44 m) long spanning a minimum of two 4-foot (1.22 m) spans.

Extreme Detail Load Charts can be accessed at: [www.extremepanel.com](http://www.extremepanel.com).



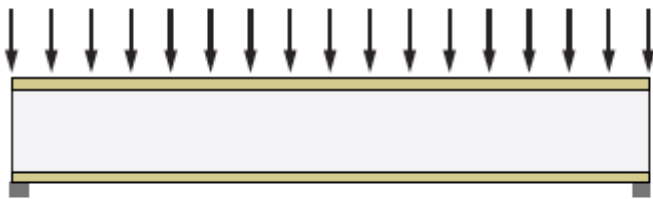
## SUBJECT: EXTREME SIPS WITH TYPE L (LUMBER) SPLINES

Extreme Panels utilize Type L Splines when the structural design loads exceed the capacities of our standard Type S or Type I Splines. Extreme Panel Details #EPT-204 and #EPT-205, contained in the Extreme Construction Detail Manual, illustrate the Type L Spline connections. The double 2x's shown in the Extreme SIP Type L Spline details must be both continuous pieces and extend for the full length of the SIP span.

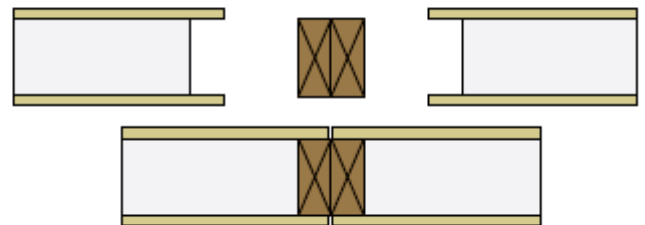
Extreme Panels commissioned an independent, code-recognized testing agency to conduct full-scale destructive transverse load testing to determine the design capacity loads of our Extreme SIPs with Type L Splines for various span conditions.

The Extreme Panels Type L Load Chart summarizes the panel capacities obtained from full-scale destructive testing of Extreme SIPs with Type L Splines. When Type L Splines are utilized, the maximum spacing of the lumber spline is 4' on center. The minimum bearing required to support the panel end is 1-½". Loads shown on the Type L Spline, Extreme Panel's #6 Load Chart (Page 2) for spans that exceed the limitations imposed on floors and roofs, are used for wall design.

### TRANSVERSE LOAD



### TYPE L SPLINE



| <b>LOAD CHART #6C</b>   |                  |                 |     |     |     |     |     |    |    |    |    |
|---|------------------|-----------------|-----|-----|-----|-----|-----|----|----|----|----|
| <b>Roof/Floor Uniform Transverse Loads - PSF <sup>1-4</sup></b> |                  |                 |     |     |     |     |     |    |    |    |    |
| <b>Type L Spline</b>  |                  |                 |     |     |     |     |     |    |    |    |    |
| SIP Thickness   | Deflection Limit | SIP Span (feet) |     |     |     |     |     |    |    |    |    |
|   |                  | 4 <sup>4</sup>  | 8   | 10  | 12  | 14  | 16  | 18 | 20 | 22 | 24 |
| 4-1/2"  | L/360            | 103             | 45  | 33  | 24  | NA  | NA  | NA | NA | NA | NA |
|   | L/240            | 225             | 68  | 47  | 34  | NA  | NA  | NA | NA | NA | NA |
|   | L/180            | 297             | 91  | 61  | 45  | NA  | NA  | NA | NA | NA | NA |
| 6-1/2"  | L/360            | 307             | 129 | 57  | 42  | 34  | 25  | 20 | NA | NA | NA |
|   | L/240            | 307             | 182 | 87  | 61  | 49  | 37  | 30 | NA | NA | NA |
|   | L/180            | 307             | 182 | 112 | 80  | 65  | 49  | 39 | NA | NA | NA |
| 8-1/4"  | L/360            | 253             | 171 | 82  | 66  | 54  | 41  | 32 | 23 | NA | NA |
|   | L/240            | 288             | 188 | 128 | 100 | 81  | 61  | 48 | 35 | NA | NA |
|   | L/180            | 288             | 188 | 133 | 117 | 105 | 80  | 63 | 45 | NA | NA |
| 10-1/4"   | L/360            | 286             | 188 | 117 | 101 | 80  | 58  | 47 | 36 | 32 | 27 |
|   | L/240            | 326             | 188 | 147 | 134 | 120 | 90  | 71 | 52 | 47 | 41 |
|   | L/180            | 326             | 188 | 147 | 134 | 121 | 106 | 93 | 68 | 61 | 53 |
| 12-1/4"   | L/360            | 327             | 188 | 167 | 141 | 116 | 91  | 75 | 58 | 47 | 36 |
|   | L/240            | 327             | 188 | 167 | 153 | 132 | 110 | 97 | 83 | 69 | 53 |
|   | L/180            | 327             | 188 | 167 | 153 | 132 | 110 | 97 | 83 | 83 | 70 |

<sup>1</sup> Table values assume a simply supported SIP with 1-1/2 inches (38.1 mm) of continuous bearing. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load. Splines consist of No. 2 or better Hem-Fir, 1-1/2 inches (38.1 mm) wide with a depth equal to the core thickness, spaced to provide not less than two members for every 48 inches (1219.2 mm) of SIP width.

<sup>2</sup> Deflection limit shall be selected by building designer based on the serviceability requirements of the structure and the requirements of applicable building code.

<sup>3</sup> Table values for 8-foot (2.44 m) spans apply to SIPs constructed with the OSB strength axis oriented either parallel or perpendicular to span direction. Table values for other spans are based on the OSB strength axis parallel to the span direction.

<sup>4</sup> SIP shall be a minimum of 8 foot (2.44 m) long spanning two 4-foot (1.22 m) spans. No single span condition is allowed.

Extreme Detail Load Charts can be accessed at: [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: EXTREME SIPS JOINT DETAILING

Extreme SIPs are a high-performance building envelope system. To provide maximum comfort, energy savings, and durability, Extreme SIPs must be installed in compliance with Extreme Panel Details. A key component of an Extreme SIPs building envelope is the proper use and application of SIPs Sealant, SIP Tape, and expanding foam sealants.

### SIP SEALANT

Extreme's SIPs Sealant was specifically formulated for application in SIP installations and is the only recommended sealant product for all Extreme's SIP Sealant applications, including core, splines, wood plating, and internal wood members. Other adhesives or sealants have been shown to cause damage to the rigid insulation core or become brittle over time. Extreme's SIPs Sealant is compatible with EPS rigid insulation and will retain its flexibility. In addition, some products cannot be applied under damp or cold conditions. Extreme's SIP Sealant can be applied to damp surfaces, is water washout resistant, and can be applied at low temperatures. Importantly, Extreme's SIP Sealant prevents the passage of water vapor due to its low water vapor permeability.

Extreme's SIP Sealant must always be installed in a continuous unbroken line pattern and applied in the recommended bead size (3/8" diameter) and location to ensure contact is maintained with the core, splines, wood plating, and internal wood members. Please refer to the Extreme's SIP Sealant Details and the installation video demonstrating the proper application of Extreme's SIP Sealant, which can be viewed at [www.extremepanel.com](http://www.extremepanel.com).

Failure to apply the sealant in a continuous pattern or maintain contact with adjacent materials will create paths for moisture vapor to pass through panel joints, causing potential moisture issues.

### SIP TAPE

Extreme's SIP Tape was specifically formulated for application to Extreme SIPs. Extreme's SIP Tape is the only recommended tape product for installation on the surface of Extreme SIPs. Other tapes are often manufactured with asphalt adhesives, which are not suitable for use in interior environments.

Please refer to the Extreme's SIP Tape Details and Installation Video demonstrating the proper application of Extreme's SIP Tape, which can be viewed at [www.extremepanel.com](http://www.extremepanel.com).

### EXPANDING FOAM SEALANTS

Extreme Building Systems does not recommend the use of expanding foam sealants as a vapor retarder in the critical area of joint detailing between the SIP core, splines, wood plating, and internal wood members. Expanding foams become brittle as they age and can crack in tight margin areas such as SIP joints where expansion and contraction can occur.

Additionally, the field installation of expanding foam sealants can be challenging under typical construction site conditions such as cold or damp weather. The long-term volume stability and flexibility of foam sealants cannot be guaranteed. Field inspections of past foam sealant panel applications have shown that issues with expanding foam sealant performance can occur.

However, the use of low-expanding foam sealants is recommended for filling voids around electrical boxes and window and door openings. These applications take place in the controlled environment on the inside of a standing SIPs structure.

## SUBJECT: EXTREME SIPS HEADER OPTIONS

When erecting structures that utilize Extreme SIPs for the wall assemblies, several header design options are available when a load needs to be carried over a window, door, or other opening. Extreme Panels provide several options, including SIPs where the SIP itself is the header, or an Insulated Header that is a factory composite of engineered lumber plus rigid insulation. Extreme SIP Headers and Insulated Headers are best suited for Extreme SIPs structures since both options provide insulation and reduce thermal bridging in the header area.

When a header is required, its load-carrying capacity must be established and determined by the designer to ensure it is suitable for its intended application. In cases where a concentrated load is placed over an opening, or the design loads exceed the capacity of an Extreme Panel SIP Header, an Extreme Panel Insulated Header should be used. If neither of the two Extreme Panel header options works for the opening condition, other engineered header assemblies will need to be considered by the designer.

Please refer to Extreme Panel Load Charts #5A, #5B & #5C to obtain the necessary design information required. Also, refer to Extreme Panel Details #EPT-407 through #EPT-411.

Extreme Details & Load Charts can be accessed at: [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: EXTREME'S SIP SCREWS

Extreme's SIP screws are available from Extreme Panels for the attachment of Extreme SIPs to wood or metal substrates. These screws were developed to provide an engineered fastener that meets the requirements of Extreme Panels building code recognized assemblies.

Please find attached engineering properties (pages 2-4) for the Extreme's SIP Wood Screws, Light-Duty Metal Screws, and Heavy-Duty Metal Screws. The properties include withdrawal, shear, pull-through, and tensile strength.

The values provided for Extreme's SIP Screws are maximum values. Appropriate safety factors should be applied for the design as determined by the project architect and/or engineer.

### WOOD SCREWS:

Extreme's SIP Wood Screws are used to attach SIPs to wood structural members and substrates.

### LIGHT-DUTY METAL SCREWS:

Extreme's SIPs Light-Duty Fasteners are used to attach SIPs to light gauge steel members up to 16-gauge thickness metal.

### HEAVY-DUTY METAL SCREWS:

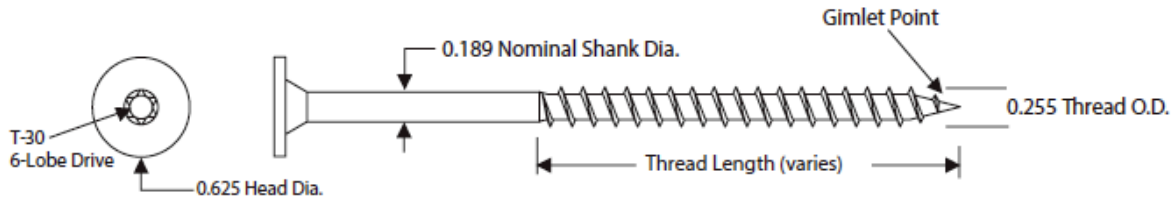
Extreme's SIP Heavy-Duty Metal Screws are used to attach SIPs to metal structural members and substrates. Extreme's SIP Heavy-Duty Metal Screws can self-drill into 3/16" steel without pilot hole predrilling. Installation is direct and fast; no wood nailers are required.

The Heavy-Duty Metal Screw should be driven with a low rpm (<1500 rpm) high-torque drill. Firm, but not excessive, pressure should be applied. This allows the drill point to engage the surface of the metal to cut and clear away metal kerf, letting the threads of the screw pull through the metal substrate. Excessive pressure and/or rpm will dull the drill point and render the screw ineffective.



### EXTREME'S SIP WOOD SCREW PROPERTIES

Extreme's SIP Wood Metal Screw property values provided are average ultimate values. As determined by the project architect/engineer, appropriate safety factors must be used in design.



| WOOD SCREW PROPERTIES      |                          |  |  |
|----------------------------|--------------------------|--|--|
| Tensile (lbs)<br>AISI S904 | Shear (lbs)<br>AISI S904 | Bending Yield Strength - Fyb (psi)<br>ASTM F1575 | Corrosive Resistance<br>ASTM D6294, ETAG 006 |
| 3555                       | 2580                     | 185,000  | <15% Red Rust<br>after 30 cycles             |

| WITHDRAWAL: LUMBER & ENGINEERED WOOD - LBS./IN. <sup>1,2</sup> |               |                 |               |               |               |               |                |
|--|---------------|-----------------|---------------|---------------|---------------|---------------|----------------|
| SPF/HF<br>(0.42)   |               | DF/SP<br>(0.50) |               | LVL<br>(0.50) |               | LSL<br>(0.50) | OSB<br>(7/16") |
| Face<br>Grain  | Edge<br>Grain | Face<br>Grain   | Edge<br>Grain | Face<br>Grain | Edge<br>Grain | Face<br>Grain | Face           |
| 799  | 615           | 899             | 702           | 556           | 495           | 711           | 265            |

<sup>1</sup> Load values include fastener tip.

<sup>2</sup> 1" fastener embedment into face / edge grain.

| WITHDRAWAL: CONCRETE & CMU - LBS. <sup>1</sup> |                      |                  |
|--|----------------------|------------------|
| 2500 psi<br>Concrete                           | 5000 psi<br>Concrete | CMU <sup>2</sup> |
| 682  | 869                  | 713              |

<sup>1</sup> Fastener penetrates 1" into concrete or CMU block, including the tip.

<sup>2</sup> Concrete Masonary unit (CMU) conforming to ASTM C90.

| HEAD PULL-THRU - LBS. |     |
|-----------------------|-----|
| 7/16" OSB             | SIP |
| 490                   | 630 |

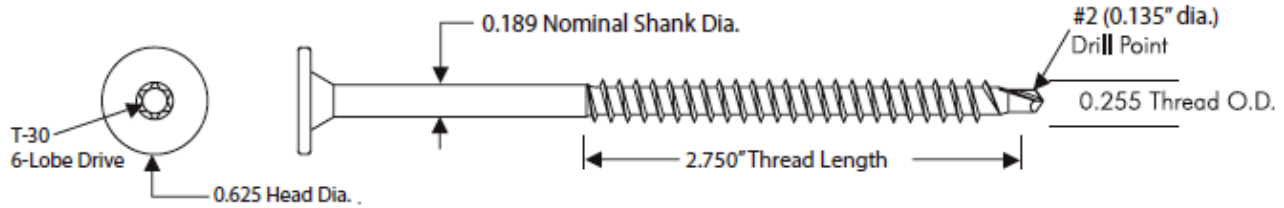
<sup>1</sup> 1-3/4" fastener embedment into edge grain, including tip.

<sup>2</sup> 1" fastener embedment into face grain, including tip.

| LATERAL LOAD RESISTANCE - LBS. |                          |      |
|--------------------------------|--------------------------|------|
| Main Member                    | Side Member              | Load |
| SPF <sup>1,2</sup>             | 4-1/2" to<br>12-1/4" SIP | 943  |

### EXTREME'S LIGHT DUTY METAL SCREW PROPERTIES

Extreme's Light Duty Metal Screw property values provided are average ultimate values. As determined by the project architect/engineer, appropriate safety factors must be used in design.



| LIGHT DUTY METAL SCREW PROPERTIES |                          |  |  |
|-----------------------------------|--------------------------|--|--|
| Tensile (lbs)<br>AISI S904        | Shear (lbs)<br>AISI S904 | Bending Yield Strength - Fyb (psi)<br>ASTM F1575 | Corrosive Resistance<br>ASTM D6294, ETAG 006 |
| 3390                              | 2490                     | 185,000  | <15% Red Rust<br>after 30 cycles             |

| WITHDRAWAL: CORRUGATED STEEL DECK - LBS. |                    |                    |                    |                    |                    |                     |
|--|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| 24 ga.<br>(36 ksi)                       | 22 ga.<br>(36 ksi) | 22 ga.<br>(85 ksi) | 20 ga.<br>(36 ksi) | 18 ga.<br>(36 ksi) | 16 ga.<br>(36 ksi) | 16 ga.<br>(100 ksi) |
| 250                                      | 381                | 435                | 449                | 694                | 896                | 1186                |

\* Minimum 3/4" penetration of fastener through deck from underside of deck.

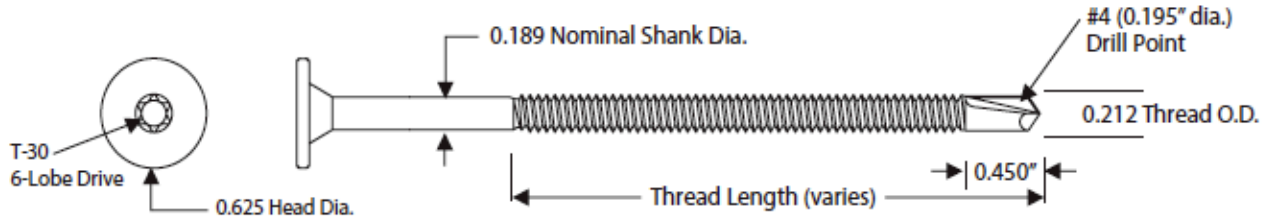
| WITHDRAWAL: LUMBER & ENGINEERED WOOD - LBS./IN. <sup>1</sup> |               |                 |               |               |               |               |                |
|--|---------------|-----------------|---------------|---------------|---------------|---------------|----------------|
| SPF/HF<br>(0.42)   |               | DF/SP<br>(0.50) |               | LVL<br>(0.50) |               | LSL<br>(0.50) | OSB<br>(7/16") |
| Face<br>Grain  | Edge<br>Grain | Face<br>Grain   | Edge<br>Grain | Face<br>Grain | Edge<br>Grain | Face<br>Grain | Face           |
| 662  | 497           | 732             | 720           | 540           | 469           | 646           | 284            |

<sup>1</sup> Load values include fastener tip.

| HEAD PULL-THRU - LBS |     |
|----------------------|-----|
| 7/16" OSB            | SIP |
| 490                  | 630 |

### EXTREME'S HEAVY DUTY METAL SCREW PROPERTIES

Extreme's Heavy Duty Metal Screw property values provided are average ultimate values. As determined by the project architect/engineer, appropriate safety factors must be used in design.



| HEAVY DUTY METAL SCREW PROPERTIES |                          |  |  |
|-----------------------------------|--------------------------|--|--|
| Tensile (lbs)<br>AISI S904        | Shear (lbs)<br>AISI S904 | Bending Yield Strength - Fyb (psi)<br>ASTM F1575 | Corrosive Resistance<br>ASTM D6294, ETAG 006 |
| 3855                              | 2625                     | 185,000  | <15% Red Rust<br>after 30 cycles             |

| WITHDRAWAL: CORRUGATED STEEL DECK - LBS. <sup>1</sup> |                     |                    |       |        |       |
|---|---------------------|--------------------|-------|--------|-------|
| 16 ga.<br>(36 ksi)                                    | 16 ga.<br>(100 ksi) | 12 ga.<br>(50 ksi) | 1/8\" | 3/16\" | 1/4\" |
| 491   | 794                 | 1255               | 1454  | 3098   | 3814  |

<sup>1</sup> Minimum (3) threads of penetration of fastener through deck as measured from underside of steel.

| HEAD PULL-THRU - LBS. |     |
|-----------------------|-----|
| 7/16\" OSB            | SIP |
| 490                   | 630 |

| LATERAL LOAD RESISTANCE - LBS.      |                         |      |
|-------------------------------------|-------------------------|------|
| Main Member                         | Side Member             | Load |
| 1/8\" Structural Steel <sup>1</sup> | 4-1/2\" to 12-1/4\" SIP | 929  |

<sup>1</sup> Minimum (3) threads of penetration of fastener through steel as measured from underside of steel.

### SUBJECT: SCREW WITHDRAWAL CAPACITIES OF OSB

To finish a project that utilizes Extreme SIPs for the walls and roof of a structure, many types of materials need to be fastened to SIPs. These materials can include siding, roofing materials, other structural elements, cabinets, and more.

In many of these applications, screws are the preferred method of fastening. To help quantify the performance of screw withdrawal from OSB, a major manufacturer of OSB generated test data on various screw types and sizes withdrawn from different thicknesses of OSB. Prior to the withdrawal testing, the OSB was exposed to three different environmental conditions—dry, wet, and wet/dry. Fifteen repetitions of both direct and lateral withdrawal from the environmentally conditioned OSB were conducted on the screw types and sizes shown in the charts below. The following tables summarize the lowest ultimate average value achieved for each screw type and size when withdrawn from three different thicknesses of environmentally conditioned OSB.

#### Average Direct Withdrawal (Pullout) - lbs.

| Screw Size        | 7/16" OSB | 5/8" OSB | 3/4" OSB |
|-------------------|-----------|----------|----------|
| #6 Deck Screw     | 177       | 272      | 324      |
| #8 Deck Screw     | 182       | 309      | 359      |
| #10 Deck Screw    | 198       | 355      | 363      |
| #12 Roofing Screw | 190       | 312      | 360      |
| #14 Roofing Screw | 177       | 340      | 393      |

These values are ultimate values. Appropriate safety factors should be applied to obtain design values.

#### Average Lateral Withdrawal (Shear) - lbs.

| Screw Size        | 7/16" OSB | 5/8" OSB | 3/4" OSB |
|-------------------|-----------|----------|----------|
| #6 Deck Screw     | 198       | 273      | 295      |
| #8 Deck Screw     | 118       | 197      | 224      |
| #10 Deck Screw    | 143       | 260      | 301      |
| #12 Roofing Screw | 436       | 581      | 561      |
| #14 Roofing Screw | 466       | 630      | 797      |

These values are ultimate values. Appropriate safety factors should be applied to obtain design values.

## SUBJECT: NAIL WITHDRAWAL CAPACITIES OF OSB

With the use of Extreme SIPs, the attachment of finishing materials such as roof shingles, siding, drywall, etc., is required. The application of these materials is typically accomplished with conventional nail products. An independent, code-recognized testing agency conducted withdrawal tests following ASTM D1037 procedures to provide data on the direct withdrawal resistance of nail fasteners when driven into the 7/16" OSB face of SIP. The following is a summary of the average ultimate values achieved for various nail fasteners.

### AVERAGE DIRECT WITHDRAWAL (PULLOUT) – LBS.

| Nail Size & Description           | Avg. Ultimate Pullout | Nominal Shank Diameter |
|-----------------------------------|-----------------------|------------------------|
| 4d ring shank-drywall nail        | 133                   | 0.109"                 |
| 6d smooth galvanized              | 59                    | 0.120"                 |
| Roofing Nail-smooth galvanized    | 51                    | 0.110"                 |
| 8d smooth coated sinker           | 150                   | 0.131"                 |
| 8d smooth galvanized spiral shank | 112                   | 0.120"                 |
| 8d galvanized ring shank          | 77                    | 0.113"                 |
| 8d smooth galvanized              | 65                    | 0.134"                 |
| 8d bright box                     | 107                   | 0.113"                 |
| 10d galvanized ring shank         | 164                   | 0.148"                 |
| 16d smooth galvanized             | 63                    | 0.165"                 |
| 16d bright box                    | 90                    | 0.135"                 |

These values are ultimate values. Appropriate safety factors should be applied to obtain design values.

This data has been compiled to provide manufacturers, designers and engineers with values for the assessment of fastener requirements.

## SUBJECT: WINDOW INSTALLATION DETAILS

Extreme SIPs are a high-performance building material. To provide maximum comfort, energy savings, and durability for the building envelope, the selection of high-performance windows is required to complement the performance of Extreme SIPs. Regardless of the window type selected, proper installation of window flashing materials is required. Window flashing consists of the following basic steps for installing integral flanged windows in new construction:

1. Install the weather-resistive barrier on the wall.
2. Properly cut the weather-resistive barrier to conform to window openings, holding up the weather-resistive barrier at the head temporarily.
3. Install sill flashing.
4. Apply caulk to the jambs and head of the window opening (not the sill) or directly to the window.
5. Fasten the window into the opening according to the manufacturer's instructions.
6. Install overhead flashing for the weather-resistive barrier.

These basic steps above provide a general outline of the process required to properly flash a window opening.

Many commercial products are available that are suitable for use as flashing products with Extreme SIPs.

Regardless of the product selected for flashing windows installed onto Extreme SIPs, the flashing manufacturer's and window manufacturer's installation guidelines must be followed completely.



## SUBJECT: WIRING EXTREME SIPS

Extreme SIPs can be manufactured with 1-½" diameter wiring chases in the panel cores for quick access by the electrical contractor. The chases are typically located at 44" and 17 1/2" from the bottom of the SIP, as well as vertically 4' on center. These locations, as well as any custom chases, should be verified during the SIP shop drawing phase.

Type NM-B cable, as Classified by Underwriters Laboratories, passes UL-719, which mandates a maximum conductor temperature of 90 degrees C (194 degrees F). The conductor temperatures under normal loads will not exceed 60 degrees C due to restrictions on amperage loading and breaker sensitivity.

The wiring used for most residential and light commercial structures, commonly referred to as "Romex," is widely available with the NM-B designation and is UL Classified and acceptable for use with Extreme SIPs.

It is strongly recommended that you review the electrical chase design for your project with your electrical contractor representative early in the design process and provide this information to Extreme's Project Coordinator assigned to your project to ensure a proper chase layout. It is recommended that your electrician work around obstacles such as doors, windows, and other openings.

Please refer to the Extreme Panel's electrical details (#EPT-106, 107, and 108) and view the Extreme Panel's Electrical Installation Video demonstrating the proper wiring of Extreme SIPs available at [www.extremepanel.com](http://www.extremepanel.com).

## **SUBJECT: RECESSED LIGHTING IN EXTREME SIPs**

The primary considerations for the installation of recessed lighting in Extreme SIPs include potential excessive cutting of the structural facing and excessive heat. (Refer to Extreme Panel's ICC ESR-4524, Section 4.2.9.2, Holes in Panels, paragraph 2, and to Extreme Panel Technical Bulletin I-1.)

The SIPs facing is a key structural component. Therefore, excessive cutting of the SIP OSB facers, along with the foam core, may lead to a reduction in the structural capacity of the SIPs. Heat buildup with recessed lights results from being installed in a fully insulated cavity. Although some recessed lights are designated for insulated cavities, these lights are not designed for the superior insulating performance of the rigid insulation solid core within the SIP.

However, if recessed lights are desired to be installed, a cavity or soffit can be created by installing framing material attached to the surface of the SIP before installing gypsum board. This creates a cavity or soffit in which lighting can be installed without cutting the face of the SIP. The use of recessed lighting is not recommended for application within a SIP.

Extreme Panels recommends the best choice for lighting are LED disk lights, whether 110V or low voltage due to their energy efficiency, slim profile, and compatibility with the high-performance insulation of SIP construction. Their ultra-thin design allows seamless integration into the SIPs without compromising the airtightness or structural integrity of the SIPs. LED disk lights generate minimal heat, ensuring they don't interfere with the SIP's insulating performance of the rigid insulation solid core, while their long lifespan reduces maintenance needs. Additionally, their energy-efficient operation compliments the sustainable goals of SIP construction, offering owners lower utility bills and a reduced environmental footprint. Whether using 110V for simplicity or low voltage for added safety, LED disk lights provide a sleek, durable, and efficient light solution tailored to SIP-built spaces.

Other applications can be utilized like surface-mount fixtures or track lighting utilizing a surfaced mount electrical box designed for the application.

Please consult with an Extreme Panel's representative with any questions.

## SUBJECT: FIRE-RESISTANCE-RATED ASSEMBLIES

### WALL: TWENTY MINUTE RATING

An Extreme SIPs wall section faced with 1/2" gypsum board, with an electrical outlet and wiring in place, was tested. Foam sealant was placed around the outlet opening following Extreme Panel Detail #EPT-108. The results from ASTM E119 testing showed that Extreme SIPs, complies as a twenty-minute fire rating per the criteria of ASTM E119 (UL 263). Reference: ULR12389 89NK14D67.

An Extreme SIPs wall section faced with a single layer of 5/8" gypsum board was tested. The results from ASTM E119 testing showed that Extreme SIPs exceeds the requirement of a twenty-minute fire rating per the criteria of ASTM E119 (UL 263). Reference: SWRI Pro. No. 01-8305-52b.

### WALL: 1-HOUR RATING

Extreme SIPs with two layers of 5/8" Type X gypsum board applied to the face, having an outlet and wiring in place and intumescent caulk placed around the electrical outlet opening, complies as an hourly wall assembly per the criteria of ASTM E119 (UL 263). Please refer to ICC ESR-4524, Section 4.2.11 Fire-resistance-rated Assemblies - View code reports at [www.extremepanel.com/code-reports](http://www.extremepanel.com/code-reports).

### WALL: 1-HOUR RATING

Extreme SIPs with one layer of 5/8" Type C gypsum board applied to the face and connected using (2) 2x dimensional lumber splines, 4' on center, and top plates, complies as an hourly wall assembly per the criteria of ASTM E119 (UL 263). Please refer to ICC ESR-4524, Section 4.2.1.1 Fire-resistance-rated Assemblies.

### ROOF/CEILING: 1-HOUR RATING

Extreme SIPs with two layers of 5/8" Type X gypsum board applied to the face complies as an hourly roof/ceiling assembly per the criteria of ASTM E119 (UL 263). Please refer to ICC ESR-4524, Roof Assembly, Section 4.2.1.1 Fire-resistance-rated Assemblies.

All current code reports are available at [www.extremepanel.com](http://www.extremepanel.com).

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## **SUBJECT: COMBUSTION TOXICITY OF EXTREME SIPS**

Extreme Panels have undergone numerous fire tests for fire and life safety and code recognition of our SIPs and their components, including ASTM E84 “Test Method for Surface Burning Characteristics of Building Materials,” ASTM E119 “Standard Fire Tests of Building Construction and Materials,” and UL 1715 “Safety Fire Test of Interior Finish Material.” As a result of this successful fire testing, Extreme SIPs are recognized by the International Code Council’s Evaluation Services to comply with the fire and life safety requirements of both the International Building Code and the International Residential Code. Please refer to the Extreme Panel’s ICC ESR-4524 for information regarding code-recognized Fire Rated Assemblies.

It is accepted that when a material is burned, combustion gases are released. In building fires, the materials that compose the interior of the structure, i.e., carpet, furniture, etc., are the primary threat when considering toxic combustion gases. In the case of Extreme SIPs, the primary gases released are carbon monoxide, carbon dioxide, and water vapor. These gases are common in fires containing organic materials. Extreme SIPs, when burned, emit by-products similar to those found when wood is burned. While these gases are typically harmless in low concentrations, in the high concentrations resulting from a fire, they can cause asphyxiation.

Extreme Panels believes strongly in fire and life safety first and foremost, and thus always recommends the use of non-combustible fire protection thermal barriers as required by building code. An example would be gypsum board applied to all interior surfaces of the SIPs structure, thereby providing excellent fire protection to the structure and its occupants.

## SUBJECT: EXPOSURE TO EXCESSIVE TEMPERATURES

Extreme SIPs are a structural engineered component, providing both insulation and structure. Extreme SIPs are manufactured with Exposure I rated Oriented Strand Board (OSB) facings and an Expanded Polystyrene (EPS) rigid insulation core. The rigid insulation core provides the structural connection between the OSB facings and must be protected for the life of the structure from exposure to excessive heat that may damage the rigid insulation.

### TEMPERATURE:

The maximum recommended use temperature for the rigid insulation core is 165°F (75°C). The temperature that the Extreme SIPs are exposed to depends on exterior temperature, building orientation relative to the sun, building elevation, and the type of roof covering material(s) used. In most locations across the United States and with standard roof covering material(s), the Extreme SIPs core will not be exposed to temperatures over 165°F. Peak temperatures typically occur under the following conditions: south-facing, low or medium slope, and dark-colored roofs. In these situations, roof surface temperatures have been documented to reach 200°F or higher on sunny days in the southern U.S. Roof designs with wall/roof intersections oriented toward the sun may also result in high roof temperatures.

If the roof temperature is anticipated to exceed 175°F, a ventilated roofing system is recommended over Extreme SIPs. Metal roof systems have inherent properties that transfer and build heat that could cause an Extreme SIPs roof deck to exceed a safe use temperature. When installing metal roof systems over Extreme SIPs, additional design considerations may be necessary to protect the roofing underlayment and the Extreme SIPs from excessive temperatures. These design strategies may include the use of a ventilated air space above the Extreme SIPs to minimize temperature exposure.

Another source of excessive temperature exposure to Extreme SIP roof and wall structures can be reflective surfaces, such as windows with reflective coatings and reflective water features. In these situations, the rays of the sun are reflected off these features, resulting in concentrated heat energy being projected onto wall and roof surfaces. If these temperatures exceed 165°F, damage to the rigid insulation core may occur.

To prevent potential damage from reflective features, light-colored, reflective cladding materials should be selected for walls and roofs on areas of the SIP structure where concentrated reflective light will hit. An additional method to protect SIP walls from concentrated reflective light is to install a ventilated rain-screen cladding system over the SIPs. (See Extreme Technical Bulletin #R-7 for information about “Ventilating Mats” that provide water management, ventilation, and heat reduction to SIP exterior surfaces.)

Consult an Extreme Panel representative for specific recommendations for your geographical location and building design. Additionally, temporary roof, wall, or floor coverings must be breathable to ensure that an Extreme SIPs structure is not subjected to excessive temperatures. For example, using clear poly (not breathable) as a temporary roof covering may create a greenhouse effect that could damage the SIP structure.



## SUBJECT: EXPOSURE TO SOLVENTS

Extreme SIPs are commonly used as a structural component because they provide both insulation and structure in a single component. Extreme SIPs are manufactured with Exposure I rated structural Oriented Strand Board (OSB) facings and a rigid insulation core (Expanded Polystyrene - EPS). The rigid insulation core provides the structural connection between the OSB facings and must be protected for the life of the structure from exposure to solvents that may damage the rigid insulation core.

### Solvents:

The rigid insulation core may be attacked and damaged by some solvents and/or their vapors. The installation of roof coverings, wall coverings, or other materials attached to Extreme SIPs must be done with water-based and/or low VOC materials, as materials containing solvents could lead to damage of the Extreme SIPs rigid insulation core. Additionally, temporary roof, wall, or floor coverings must be breathable to ensure that any damaging solvent vapors present in the construction of the Extreme SIPs structure can breathe quickly through the temporary covering materials. For example, using clear polyethylene (not breathable) applied over asphalt paper may trap solvents that could damage the SIP structure.

### Note:

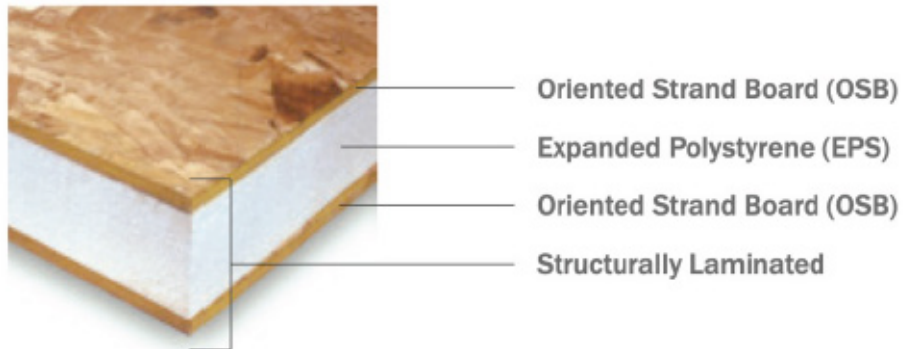
The use of water-based and/or low VOC adhesives, sealants, coatings, cleaning solutions, etc., helps meet the growing need to eliminate solvent-based VOC-emitting materials used in construction. The selection and use of water-based and/or low VOC materials also promote building practices that improve air quality performance in buildings. Extreme Panel supports these important initiatives by obtaining Clean Air Certification for its SIP assembly and SIP sealant.

## SUBJECT: RECOMMENDED EXPOSURE TO SIPS OSB FACERS

The Structural Grade Performance Rated OSB material used in the manufacturing of Extreme SIPs is recognized as a qualified Structural Insulated Panel facing material according to criteria outlined in the following:

- IRC Section R610 (2015-2021) [Section R613 (2012)]
- ANSI/APA PRS 610, Standard for Performance-Rated Structural Insulated Panels (APA 2-18)

The OSB used as the facing component in Extreme SIPs is also approved by the ICC in Extreme's Code Report #ESR-4524.



The APA (Engineered Wood Association) has also tested and made recommendations for appropriate weather exposure during construction (Doc X501). Review these recommendations on the following pages.

You can also find all current APA testing, recommendations and additional related documents at:

[www.apawood.org](http://www.apawood.org).



### FAQs

## Questions About Wood Structural Panel Exposure to Excessive Moisture

This document provides guidance about the serviceability of wood structural panels (plywood and oriented strand board [OSB]) after exposure to high levels of moisture, such as significant weather events during the construction process or when construction sites are delayed but moisture management steps aren't taken. Wood structural panels can also be exposed to high levels of moisture after the construction process is complete due to flooding. *Note: This document is not intended to address potential health and indoor air quality concerns that may arise from flooding.*

### APA Trademark Identification and Water-Resistant Adhesives

The APA panel trademark will typically be in black ink, printed in one or more places on one side of the panel. Since 1972, all APA-trademarked plywood and OSB has been manufactured using water-resistant adhesives. The presence of the words "Exposure 1" or "Exterior" in the APA trademark assures that panels are manufactured with water-resistant adhesive.

Some plywood panels that were manufactured prior to 1972 may contain adhesives which are not fully water-resistant. These panels can be identified by the term "Interior" in the trademark. Older panels may have APA trademarks or trademarks that include "DFPA," which corresponds to APA's original name, the Douglas Fir Plywood Association.

### Wood Construction and Water

Wood construction is durable and will normally be structurally sound after severe exposure to moisture. Structural plywood and OSB used in floors, walls and roofs are made with water-resistant adhesives and retain their strength following wetting events. Although the surface of the panels may be rougher from water exposure, they generally remain structurally sound. However, panels saturated with water will feel less stiff than those in a dry condition. Once the panels re-dry, strength typically returns, and only minor repairs may be necessary. Until the panels are dry, they should not be subjected to heavy loading, such as repeated heavy foot traffic or loaded drywall carts.





FAQs: Questions About Wood Structural Panel Exposure to Excessive Moisture

### What Will Plywood or OSB Panels Look Like After A Re-Dry?

They will not look as good as when they were new, but they should be serviceable. Because they are a wood (hygroscopic) product, both plywood and OSB can be expected to expand after wetting. This is commonly observed as swelling at panel edges and increased surface unevenness. Localized swelling or blistering over knotholes and core gaps may be evident, but this condition does not compromise the structural integrity of the panel. Some lifting or flaking of surface strands on OSB panels may also occur. Structural tests show that such surface degradation does not result in a loss of panel structural capacity after the panel dries to in-service moisture conditions.

### What About Buckling?

Buckling of wood structural panel sheathing occasionally results when increased moisture conditions cause the wood sheathing to expand. Such buckling may occur between supports or between nails along supports. Although structural properties are unaffected, the resulting waviness may affect the building's appearance and lead to complaints. Builders can significantly reduce the potential for buckling by ensuring a minimal increase in moisture content of the wood panels during construction and providing for its natural expansion by properly spacing and fastening the panels.

Once buckling has occurred, there are two primary remedies that can help minimize buckled panel areas:

1. First, run a circular saw (set to the panel thickness, and no deeper) along the panel joints. This is called "kerfing," and will help relieve the internal panel stresses that cause buckling. If the tongue-and-groove edges of floor panels are cut, they must be blocked from underneath, or a layer of APA plywood underlayment must be installed over the subfloor, with the underlayment joints offset from the subfloor joints. Keep in mind that kerfing and drying may not completely remedy buckling. See *APA Data File: Selection, Installation and Preparation of Plywood Underlayment*, Form L335.
2. The second step involves installing blocking under the buckled portions to flatten the panels.
  - a. Identify the buckled area and measure the distance between the structural members supporting the buckled panel area.
  - b. Cut a piece of lumber that is the same dimension as the supporting framing (e.g., for a 2x10 joist, cut the support blocking from another 2x10).
  - c. Depending on the direction of the buckling, the buckled panel will either need to be pushed up by the support block (which would then be nailed into the adjacent framing) or be pressed down tight to the previously installed blocking. In both cases, additional fasteners are used to connect the panel and the blocking.



FAQs: Questions About Wood Structural Panel Exposure to Excessive Moisture

### What About a Rough Floor Surface?

Panels exposed to extended moisture may exhibit a rough surface. Some finish floor coverings, such as carpet and pad, may mask any unevenness and not require remediation. If the finish is sensitive to the smoothness of the panel, it may be possible to professionally sand the panel face and edges with a commercial sander. Installing a layer of APA plywood underlayment over the subfloor usually will correct the problem. Offset all panel edges and nail to the existing subfloor with ring-shank nails that pass through the subfloor by about 1/4 inch. See *APA Data File: Selection, Installation and Preparation of Plywood Underlayment*, Form L335.

### How to Prevent Floor Squeaks?

Floor squeaks result when components within a floor system move as stepped on. Floor noise most commonly involves a subfloor that is not held tight to floor supports and is able to move against something metal, like a nail. In addition to misinstalled panels, subfloor movement can also result when panels are fastened into higher moisture content lumber framing, which will eventually dry to a lower moisture content and shrink, leaving a space between the joists and the floor panels. To combat floor squeaks, re-nail with ring-shank nails after the panels and floor framing are dry. Squeaks may also happen where cross-blocking or bridging occurs between floor joists and between walls and floors. Precautionary re-nailing at those points may be advisable if they will be inaccessible after the remediation. See *APA Technical Note: Floor Squeaks—Causes, Solutions and Prevention*, Form C468.

### How to Tell if Plywood is Delaminated?

Delamination is a separation of the individual “plies” or veneers in plywood. This condition is not common. Dry delaminated floor panels may feel soft or spongy when stepped on. The face ply may appear blistered or wrinkled. If you suspect delamination, walk over the areas of concern after the plywood is dry. Panels with extensive soft spots may need replacement. Localized swelling or blistering over knotholes and core gaps is not delamination and does not compromise the structural integrity of the panel. If necessary, blisters over knotholes may be repaired by injecting glue under the affected areas. It may be possible to repair delaminated plywood panels using the instructions in *APA Technical Note: Field Repairs of Plywood*, Form J805.

### Will Plywood Delaminate at Some Future Date?

It is not likely. Subsequent soakings seldom cause additional delamination.

### Following Flood Events

As noted previously, this publication does not address potential health concerns or indoor air quality after flooding. More information on these topics is available from the Federal Emergency Management Agency (FEMA) and the American Red Cross, such as *Repairing Your Flooded Home*, FEMA P-234. *Note: Extensive flood damage may require professional services to assess and repair wood construction.*





### FAQs: Questions About Wood Structural Panel Exposure to Excessive Moisture

The main difference in water events during construction and after a building is finished, when it may be affected by a flood or other major water event such as a broken plumbing line, is the need to remove finish materials and insulation so that wet structural components can be exposed. Unless these finish materials are removed, the underlying structure is not able to properly dry out. If the structure does not dry out, it will not be able to retain structural integrity, and decay can set in.

#### **Fungal Decay Prevention**

Once flood water recedes, fungal decay organisms are presented with an ideal moisture condition. Therefore, it is important that wood products dry as soon as possible to ensure that the wood decay does not affect structural capacity. Note that mold and mildew are not decay organisms. These steps help to preserve a sound structure:

1. Clean out all mud and debris in contact with panels, studs, joists and beams. This will allow the wood to dry and permit inspection for structural damage.
2. Remove carpeting, pad and vinyl. This is vital to allow the panels to dry.
3. Remove wet interior finish (such as gypsum wallboard) from walls. Remove wet insulation and clean out any mud and debris. This will encourage free air circulation to speed the drying process.
4. Remove wet insulation from crawl spaces and the attic, if it is wet.
5. Remove standing water from crawl spaces. Standing water will prevent floors from drying.
6. Open up any other wet cavities to allow air to circulate freely.
7. Finally, make every effort possible to speed the drying process. Drying speed is relative to the thickness of the wood being dried, the humidity, the air temperature and the amount of air circulation. Heating the structure, if possible, will greatly speed drying. Do not use portable propane heaters to provide heat, as they add moisture to the air and increase drying time. Use fans and dehumidifiers to help move the air. If heat or dehumidifiers are not available, open doors and windows to encourage air circulation. Depending on conditions, the drying process can take from a week or two to several months.

#### **How to Tell if Panels are Dry?**

The use of a calibrated moisture meter is the easiest way to determine moisture content. Panels are dry when the moisture content is 15% or less, and usually safe from the threat of decay when 20% or less. Most general contractors and flooring installers have meters. Moisture meters can also be ordered from a contractor supply or hardware store.

#### **What About Odors?**

Mud may contain sewage or microorganisms. To minimize the possibility of odor problems, hose out all wall cavities and connection joints, such as between wall studs and bottom plates. Other common causes of odor are mold and mildew. To minimize this potential, thoroughly dry all concealed spaces and follow FEMA guidelines.



### FAQs: Questions About Wood Structural Panel Exposure to Excessive Moisture

#### Other APA References

1. *Build A Better Home: Controlling Mold and Mildew*, Form A525
2. *Research Report: Plywood in Hostile Environments*, Form Z820
3. *Technical Note: Buckling of Wood-Based Panel Siding*, Form F410
4. *Technical Note: Condensation—Causes and Control*, Form X485
5. *Technical Note: Controlling Decay in Wood Construction*, Form R495
6. *Technical Note: Field Repairs of Plywood*, Form J805
7. *Technical Note: Floor Squeaks—Causes, Solutions and Prevention*, Form C468
8. *Technical Note: Mildew Discoloration of Wood Siding*, Form L805
9. *Technical Note: Minimizing Buckling of Wood Structural Panels*, Form D481

## Questions About Wood Structural Panel Exposure to Excessive Moisture

We have field representatives in many major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying engineered wood products, contact us:

#### APA HEADQUARTERS

7011 So. 104th St. • Tacoma, Washington 98466  
(253) 565-6600 • Fax: (253) 565-7265

#### PRODUCT SUPPORT HELP DESK

(253) 620-7400 • [help@apa-wood.org](mailto:help@apa-wood.org)

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[www.apawood.org](http://www.apawood.org)

Form No. X301D/Revised May 2021

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## SUBJECT: SEALING EXTREME SIPs

Building science has taught us that a tight building envelope significantly contributes to the energy efficiency of the structure. Building science has also shown us that SIPs can significantly reduce air leakage through the building envelope. This reduction in air leakage significantly enhances the energy efficiency of an SIP structure.

If a structure using Extreme SIPs is to achieve reduced air leakage that contributes to the energy efficiency of the SIP system, the details relating to the sealing of SIP joints and connections must be followed. Designers and contractors are encouraged to become thoroughly familiar with the Extreme Panel technical bulletins and details that describe the proper use of Extreme's SIP Sealant and SIP tape.

Please refer to the Extreme Panel Construction Manual for illustrations of Extreme's SIP Sealant and SIP Tape installation. The Details and Instructional Videos demonstrating Extreme's SIP Sealant and SIP Tape installation can all be found at [www.extremepanel.com](http://www.extremepanel.com).

Low-expanding foam sealants compatible with the rigid insulation core (EPS) must be used to seal penetrations cut into Extreme SIPs during the construction process. This includes any penetrations from construction, as well as penetrations for the HVAC, plumbing, and electrical systems. These penetrations need to be thoroughly and completely sealed. Proper sealing of the electrical chases in Extreme SIPs, as well as the electrical boxes within the Extreme SIPs, is part of the Extreme Panels sealing process.

Giving proper attention to the sealing of penetrations, SIP joints, and connections in your Extreme SIPs structure will ensure that the structure has minimal air leakage through the exterior envelope, helping to maximize the energy efficiency of the Extreme SIPs high-performance envelope.

## **SUBJECT: SEALING REQUIREMENTS FOR SIPS USED IN COMMERCIAL APPLICATIONS**

The purpose of this technical bulletin is to provide guidelines for the use of vapor retarders, Extreme's SIP Sealant, and SIP Tape for SIPs used in commercial applications. Building Codes require that for commercial structures where a whole-building ventilation system is not installed, insulated framed walls, floors, and ceilings must have vapor retarders installed on either the interior or exterior based on code requirements and local climate conditions.

In commercial structures that do not meet the ventilation requirements of the building code, Extreme Panel recommends that the building code within the local jurisdiction be followed regarding the installation of a vapor retarder. If a vapor retarder is required in your commercial project, Extreme Panels recommends the use of Extreme's SIP Tape over the panel joints. Extreme's SIP Tape is formulated with a permeance of less than 1.

Buildings with intended uses involving pools, spas, or other high-humidity conditions need to be evaluated by the mechanical design professional to ensure that adequate ventilation is provided to the structure. In high-humidity environments, special attention to SIP joint sealing, tape, or the use of a vapor retarder must be considered. The use of a complete wall and/or roof surface coverage vapor retarder, such as polyethylene sheeting, may be warranted based on the structure's exposure to interior high humidity, local building code, or climatic conditions. It is up to the design professional to make this determination. If an additional vapor retarder is utilized, it must be installed in compliance with the appropriate local building code.

That said, most commercial applications address ventilation by installing mechanical air handling and heating/cooling equipment. A mechanical engineer or HVAC consultant is typically involved with the design of the ventilation system for commercial buildings. The mechanical engineer's design will determine the amount of ventilation the structure requires, based on the intended use of the building. In most applications, the ventilation system provides for numerous air changes, which may preclude the need for Extreme's SIP Tape or other vapor retarders. In addition, commercial structures intended to be used for storage or general warehouse purposes may not require additional vapor control methods.

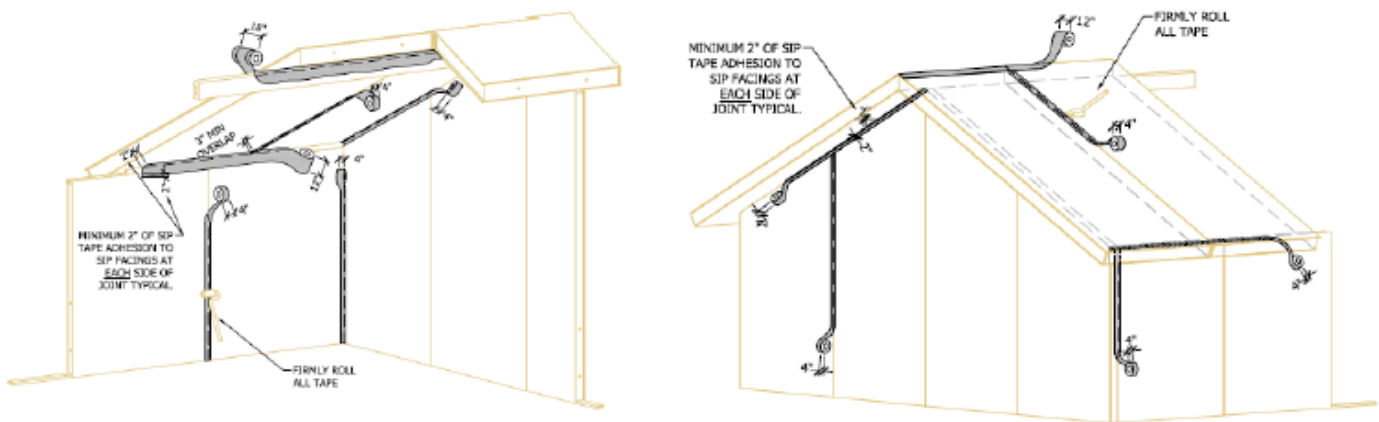
# TECHNICAL BULLETIN

## NO. M-2

REVISION DATE: 3/2025

Refer to the Extreme's Technical Bulletin M-3, Vapor Retarders with Extreme SIPs, for more information on Extreme's SIP Tape.

Extreme Panel's Detail #EPT-105, 105A, and 105B specify the use and application of SIP Tape at all joints. A minimum of 2" SIP Tape adhesion to SIP facings on each side of the joint is required.



Refer to the Extreme Panel's Resource Manual, and Instructional Videos demonstrating Extreme's SIP Sealant and SIP Tape installation. These can be found at [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: VAPOR RETARDERS WITH EXTREME SIPS

Questions about using vapor retarders in conjunction with Extreme SIPs are frequently asked. Extreme SIPs installation requires the proper application of Extreme's SIP Sealant and SIP Tape over SIP joints. The function of the SIP Sealant and SIP Tape is to provide a seal against water vapor transmission and air passing through the SIP joint.

The purpose of this technical bulletin is to provide guidelines for the use of vapor retarders with Extreme SIPs in residential applications.

### THE INTERNATIONAL RESIDENTIAL CODE (IRC) REQUIRES:

#### SECTION R318 - MOISTURE VAPOR RETARDERS

R318.1 Moisture control: In all framed walls, floors, and roof/ceilings comprising elements of the building thermal envelope, a vapor retarder shall be installed on the warm-in-winter side of the insulation.

#### Exceptions:

- a. In construction where moisture or freezing will not damage the materials.
- b. Where the framed cavity or space is ventilated to allow moisture to escape.
- c. In counties identified as climate zones 1 through 4 in Table N1101.2.

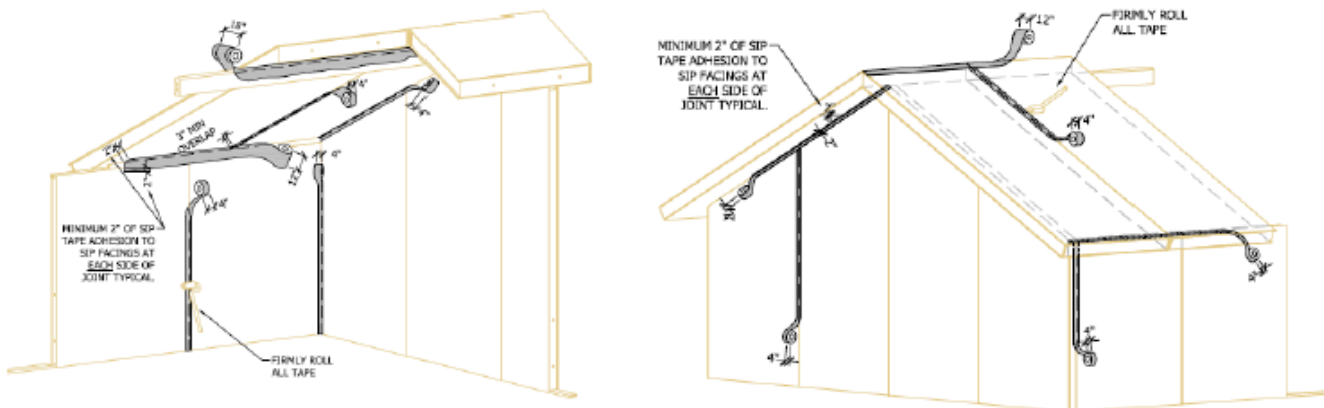
### THE IRC DEFINITION OF A VAPOR RETARDER IS:

VAPOR RETARDER: A vapor-resistant material, membrane, or covering such as foil, plastic sheeting, or insulation facing having a permeance rating of 1 perm or less, when tested in accordance with the desiccant method using Procedure A of ASTM E96. Vapor retarders limit the amount of moisture vapor that passes through a material or wall assembly.

The APA has determined that OSB has a perm rating of less than 1 when relative humidity is under 40%. With the OSB skins of SIPs having a water vapor permeance rating of less than 1, the panel joints and boundaries become the primary areas of concern for water vapor transfer.

As mentioned earlier, Extreme Panels requires that SIP Sealant be used in all SIP joints. After the SIP Sealant step is completed (see Extreme Panel Details #EPT-103 & EPT-104), Extreme recommends the use of Extreme's SIP Tape over SIP joints (see Extreme Panel Details #EPT-105, 105A, and 105B). Extreme's SIP Tape has a water vapor permeance of less than 1. Therefore, the combination of the field coverage of OSB skins that SIPs provide and the addition of Extreme's SIP Tape over the SIP joints meets the building code requirements for a vapor retarder.

SIP roofs with joints occurring on support beams require 18" wide SIP Tape draped over the support beam and tacked in place. A ridge beam is an example of this condition. See Extreme Panel Detail #EPT-105A.



The use of a complete wall and/or roof surface coverage vapor retarder, such as polyethylene sheeting, may be warranted based on the structure's exposure to interior high humidity, local building code, or climatic conditions. It is up to the design professional to make this determination. If an additional vapor retarder is utilized, it must be installed in compliance with the appropriate local building code.

Refer to the Extreme Panel's Construction Detail Manual, and Instructional Videos demonstrating Extreme's SIP Sealant and SIP Tape installation. These can be found at [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: WATER RESISTIVE BARRIERS OVER EXTREME SIPS

The purpose of this technical bulletin is to provide guidelines for the use of Water-Resistive Barriers applied to the exterior of SIPs walls.

### THE 2018 INTERNATIONAL RESIDENTIAL CODE (IRC) REQUIRES:

#### SECTION R703 – EXTERIOR COVERING

R703.1 General: Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.8. The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining water that enters the assembly to the exterior.

### THE 2018 INTERNATIONAL BUILDING CODE (IBC) REQUIRES:

#### SECTION 1403 – PERFORMANCE REQUIREMENTS

1403.2 Weather protection: Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing, as described in Section 1405.3. The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer, as described in Section 1404.2, and a means for draining water that enters the assembly to the exterior.

### EXTREME SIPS ICC ESR-4524 REPORT STATES:

“The exterior face of wall SIPs is required to be covered with a wall covering complying with the applicable code or recognized in a current ICC-ES evaluation report. A water-resistive barrier must be installed over the panels in accordance with IBC Section 1404.2, IRC Section R703.2, BNBC Section 1406.3.6, and UBC Section 1402, as applicable, prior to application of the wall covering. Where Portland cement plaster is used, compliance with IBC Sections 2510 and 2512, IRC Section R703.6.3 or UBC Section 2506.4, as applicable, is necessary. All exterior panel joints must be sealed with a compatible acrylic latex caulk.”



### THE IRC AND IBC DEFINITION OF A WATER-RESISTIVE BARRIER IS:

Water-Resistive Barrier: A material behind an exterior wall covering intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

Therefore, Extreme Panels recommends that a water-resistive barrier recognized by ICC-ES be installed over Extreme SIPs used as exterior walls.

Current ICC-ES report holders for water-resistive barriers can be obtained by visiting the ICC-ES website at [www.icc-es.org](http://www.icc-es.org) and navigating to Evaluation Reports, CSI List, Section 0728 – Water-Resistive Barriers.

## **SUBJECT: MOISTURE CONTENT OF LUMBER USED WITHIN EXTREME SIPS**

Integral to the construction of an Extreme SIPs structure is the lumber used as plating and splines within the SIPs. Extreme SIPs are designed to be used with kiln-dried lumber. Therefore, Extreme Panels recommends the use of kiln-dried lumber with a moisture content at or below 12%. This requirement helps to minimize any shrinkage of the lumber used within the SIPs, reducing the potential for unsealed gaps and cracks.

The Forest Products Laboratory's Wood Handbook, Chapter 12, reports that lumber with a moisture content greater than 19% may experience considerable shrinkage as it dries to an equilibrium moisture content below 19%. If this shrinkage occurs within a SIP plate pocket, gaps or cracks may open, providing a pathway for air movement. This air may contain moisture, and if it encounters a surface at or below its dew point temperature, condensation will occur. Using lumber with a moisture content of 12% or less provides a reasonable safety factor to reduce the potential for lumber shrinkage and minimize issues associated with lumber shrinkage.

## SUBJECT: FRAMEGUARD - MOLD RESISTANT SIPs

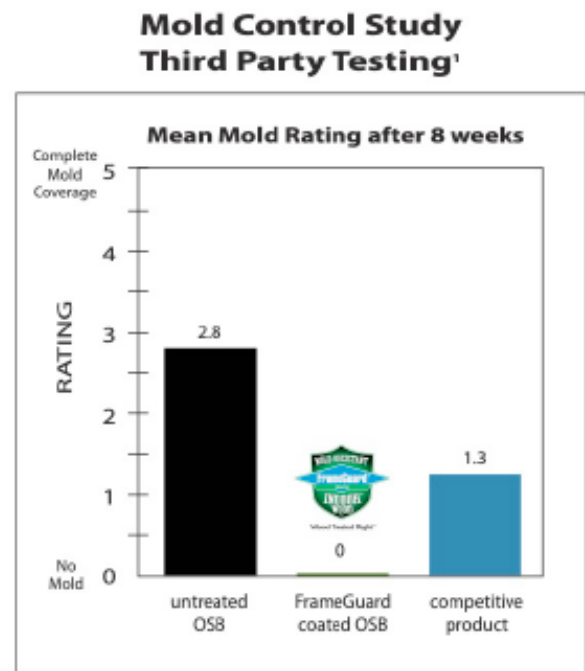
Extreme SIPs, when coated with FrameGuard®, provide protection against mold, fungal decay and termite damage to the oriented strand board (OSB) facings. An important aspect of choosing a mold, fungal decay and termite resistant coating for a SIP panel is to understand the regulatory, manufacturing, testing, air quality and warranty details of the system. EPA Registration is a critical regulatory issue in that all chemicals and components claiming to provide protection against mold, fungal decay and termites must be registered with the Environmental Protection Agency (EPA). The moldecide component of FrameGuard coating is covered by EPA registration # 72616-1-62190 and the termite resistant component is covered by EPA registration # 64405-1-62190. Other products may use an EPA registered component recognized for termites, but we recommend that you verify their registration with the EPA to ensure it includes recognition for mold resistance.

### QUALITY CONTROLLED MANUFACTURING

FrameGuard coating is a blend of components factory applied to SIPs with advanced manufacturing equipment and processes to provide thorough coverage to the surface of Extreme SIPs. Quality control records are maintained and ongoing tests are conducted to ensure proper treatment.

### INDEPENDENT TESTING - MOLD

The FrameGuard coating has been tested side by side with many other wood protection products claiming protection against mold. Testing was conducted by Forintek, an independent third-party agency recognized as a leader in wood protection testing. The testing followed ASTM D3273, "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber". This mold growth study examined coated and uncoated samples over eight weeks, at a temperature of 77°F, and a relative humidity of 100%. The product performance was rated on a scale from 0 (no mold) to 5 (complete mold coverage). The FrameGuard formulation was the clear leader in performance when compared against competitive products used to treat the wood facings of SIPs.



<sup>1</sup> Independent testing by Forintek Canada Corporation, using ASTM D-3273, Project 4528

### WARRANTY COVERAGE

Extreme SIPs sources the FrameGuard coating exclusively from Lonza/Arch Wood Protection, Inc. The FrameGuard limited warranty (see the warranty document for details) is backed by your Extreme SIPs supplier and Lonza/Arch Wood Protection, Inc. You can be assured the warranty protection is backed by companies with a long history of performance servicing the SIP and wood protection markets. Lonza, the parent company of Lonza/Arch Wood Protection, is an international leader in biocides with over \$3.5 billion in sales. There is no cost for your FrameGuard limited warranty nor are there any special registration requirements. Some other competitive products may charge a fee for their warranty and require registration. FrameGuard® is a registered trademark of Arch Wood Protection, Inc.

## **SUBJECT: VENTING OF EXTREME SIPS USED IN ROOFS**

Even though SIPs have been used in unvented roof applications since the 1960s, confusion still exists about the need to vent SIPs used as an insulated roof structure.

Building codes require ventilation of “enclosed attics and enclosed rafter spaces which are formed where ceilings are applied directly to the underside of roof rafters.” The building code defines an attic as the unfinished space between the ceiling joists of the top story and the roof rafters. When SIPs are used on a project where the SIPs are the exterior insulated roof envelope of the structure, a non-conditioned attic space does not exist. Like the rest of the structure, this is now considered a conditioned space. Therefore, roof ventilation is not required in an SIP roof structure.

IRC Section R806.4 furthers the discussion by addressing “unvented conditioned attic assemblies (spaces between the ceiling joists of the top story and the roof rafters ...)”. However, when SIPs are used as the insulated roof structure, a non-conditioned attic space is not present.

Based on the information above, roof venting of Extreme SIP roof structures is not required. Please refer to Extreme PanelsS Technical Bulletin #D-2 for HVAC Design and Energy Calculations.

Current Extreme Panel Technical Bulletins can be found at [www.extremepanel.com](http://www.extremepanel.com).

## SUBJECT: ROOF SIPS IN CANTILEVER CONDITIONS

Extreme SIPs are used in many applications where the SIPs create the eave and gable end overhangs of the roof. Using SIPs to create the overhangs for eaves and gables is advantageous because it speeds up the construction of the project and saves labor costs associated with hand framing.

Extreme SIPs have been evaluated through a series of full-scale destructive tests at an independent, code-recognized laboratory to determine the capabilities of SIPs in cantilever applications. These full-scale tests followed ASTM E-72 parameters for loading and monitoring deflection of the tested SIPs. The following addresses the capabilities of Extreme SIPs when installed in a cantilever application for roof overhangs.

When evaluating overhangs or cantilevers, consideration must be given to how the SIP cantilever is oriented in relation to the SIP span between supports. The two cantilever orientations that are possible include parallel and perpendicular to the SIP span. SIP cantilevers that are parallel to the SIP span can support greater overhangs with the use of structural I-Joist or Double 2x splines.

At SIP roof corner overhangs, SIPs simultaneously cantilever both parallel and perpendicular in relation to the SIP span. Where cantilevering perpendicular to the SIP span, utilize the Block Spline support loads indicated in the “Cantilevered Roof SIPs Type S Spline Capacity” table on the next page (TABLE 1).

SIPs spanning both parallel and perpendicular to the SIP span are subject to two conditions:

1. The overall SIP width must be a minimum of two times the perpendicular cantilever.
2. The back span of the parallel cantilever (‘Y’ dimension in FIGURE 1) must be a minimum of two times the cantilever (‘X’ dimension in FIGURE 1).
3. Unless engineered, the maximum cantilever oriented perpendicular to the SIP span is 4’.

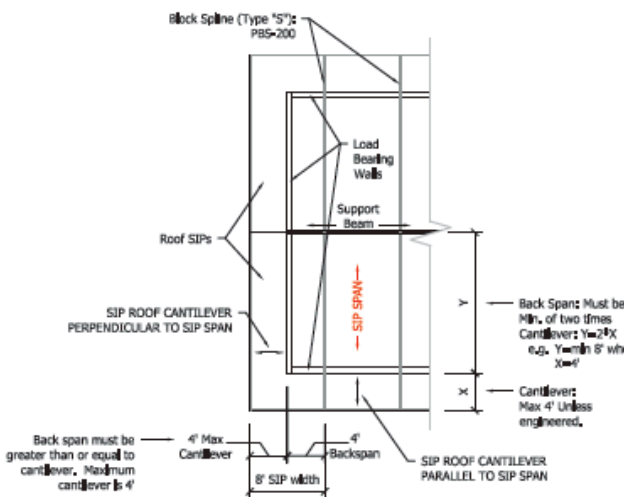
In situations where increased loads are required or where an overhang greater than 4’ is desired, I-Joists (See Detail #EPT-203) or double 2x (Detail #EPT-205) splines can be used in conjunction with the “Cantilevered Roof SIPs Type ‘L’ or Type ‘I’ Spline Capacity” table on the following pages (TABLE 2).

These I-Joist and double 2x spline cantilevers are subject to two conditions:

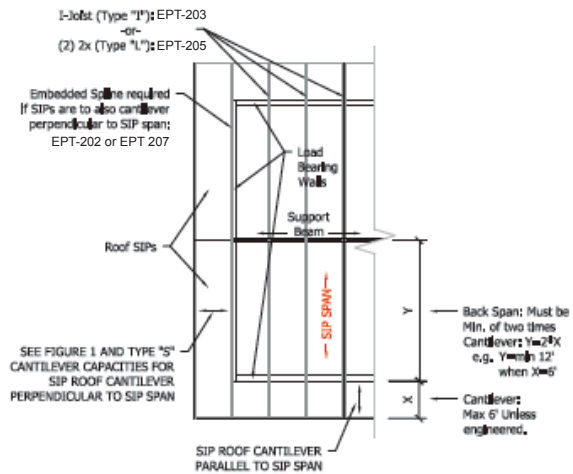
1. The cantilever must be parallel to the SIP span.
2. The back span of the cantilever ('Y' dimension in FIGURE 2) must be a minimum of two times the cantilever ('X' dimension in FIGURE 2).

When Extreme SIPs utilize I-Joist (Detail #EPT-203) or double 2x (Detail #EPT-205) splines at a frequency of 4' O.C., overhangs of up to 6' of horizontal projection are possible. Greater loads can be achieved if the spline frequency is increased to 2' O.C. Refer to the "Cantilevered Roof SIPs Type S Spline Capacity" table below (TABLE 1) for determining the cantilever capacities oriented perpendicular to the SIP span.

**FIGURE 1  
Type S (Block) Spline**



**FIGURE 2  
Type I (I-Joist) Spline OR  
Type L (2X Lumber) Spline**



**CANTILEVERED ROOF SIPs TYPE S  
SPLINE CAPACITY (PSF) - TABLE 1**

| SIP Thickness | Type S Spline         |                       |
|---------------|-----------------------|-----------------------|
|               | 2' Maximum Cantilever | 4' Maximum Cantilever |
| 4 1/2"        | 81*                   | 41*                   |
| 6 1/2"        | 114*                  | 57*                   |
| 8 1/4"        | 149*                  | 75*                   |
| 10 1/4"       | 161*                  | 81*                   |
| 12 1/4"       | 166*                  | 83*                   |



**CANTILEVERED ROOF SIPS TYPE L/TYPE I  
SPLINE CAPACITY (PSF) - TABLE 2**

| SIP Thickness | Type L or I Spline with splines 4' o.c. |  | Type L or I Spline with splines 2' o.c. |  |
|---------------|---|--|---|--|
|               | 4' cantilever with minimum 8' back span | 6' cantilever with minimum 12' back span | 4' cantilever with minimum 8' back span | 6' cantilever with minimum 12' back span |
| 4 ½"          | 53*                                     | 54*                                      | 81*                                     | 53*                                      |
| 6 ½"          | 87*                                     | 67*                                      | 114*                                    | 87*                                      |
| 8 ¾"          | 115*                                    | 84*                                      | 149*                                    | 115*                                     |
| 10 ¾"         | 125*                                    | 91*                                      | 161*                                    | 125*                                     |
| 12 ¾"         | 129*                                    | 93*                                      | 166*                                    | 129*                                     |

\* Value is less than the ultimate load divided by a safety factor of three.

## **SUBJECT: ROOFING UNDERLAYMENTS OVER NON-VENTILATED EXTREME PANEL SIPS**

One of the many benefits of building with Extreme SIPs is the speed of construction, especially for roof installations. Another advantage of using SIPs is the fact that you have now created additional conditioned space directly under the SIP deck. Unlike a ventilated roof system which can dry from the underside, SIPs must dry to the exterior side of the building's envelope – meaning underlayments with little or no permeance can trap moisture that needs to move away from the upper OSB layer of the SIP. It's essential to fully understand and mitigate the effects of precipitation during installation on a SIP roof assembly. Proper construction methodology and sequencing for roofing over non-ventilated SIP roofs should allow the OSB and SIP joint interiors to dry adequately before the installation of roofing underlayments, and cladding. SIP joints and termination joints on the underside of the SIP roof should not be taped until after the underlayment has been applied, and the joint is dry.

### **SLOPED ROOFING: Mechanically Attached**

Extreme SIPs must be covered by asphalt-saturated felt or synthetic, vapor-permeable roofing underlayment, mechanically fastened below the final roof covering material. Roofing underlayments with perm ratings of 10 or higher are recommended. Vapor-permeable underlayment allows water vapor to pass through it while preventing bulk water from moving back through to the OSB facer of the SIP roof deck.

The purpose of vapor-permeable underlayment is to allow any trapped water vapor at the OSB interface to pass through the synthetic roofing underlayment.

### **SLOPED ROOFING: Self-Adhered**

Self-adhered, vapor permeable underlayment, with a perm rating of 10 or greater, can be used on Extreme SIPs sloped roofs as code-recognized ice barriers for roof eaves, valleys, gables and full-field coverage. When adhered over Extreme SIPs roof deck, it should never be removed. During future re-roofing, an additional layer of vapor-permeable underlayment, with a perm rating of 10 or greater, must be applied over the existing layer.

Special Note: Non-permeable underlayments, made with modified bitumen technology, adhered with solvent-based primers and adhesives, and described as “vapor and air barriers” must never be applied over Extreme SIPs roof decks. The manufacturers of these products caution that non-permeable underlayments are intended solely for “ventilated” attics and “vented spaces” below the non-permeable underlayment layer.

Special Note: Solvent-based primers and adhesives can volatilize in hot weather, causing damage to the SIP insulation core; they must never be applied over an Extreme SIPs roof deck. FOR MORE ON EXPOSURE TO SOLVENTS SEE EXTREME PANEL'S TECHNICAL BULLETIN I-2

Fortunately, many manufacturers of vapor-permeable underlayments in North America offer products with a permeance rating greater than 10 that are compatible with SIP roof decks and the roofing materials used in SIP projects. Below is a partial list of vapor- permeable underlayment manufacturers you may contact to learn more about their products\*\*:

1. VaproShield – SlopeShield® Plus Self-Adhered: [www.vaproshield.com](http://www.vaproshield.com)
2. Benjamin Obdyke (VaporDry SH): <https://benjaminobdyke.com/product-systems/system-wood-roof/>
3. Malarkey Roofing – Secure Start® Permeable: [www.malarkeyroofing.com](http://www.malarkeyroofing.com)
4. GAF – Deck-Armor™: [www.gaf.com/en-us/products/deck-armor](http://www.gaf.com/en-us/products/deck-armor)
5. ACGI - Air Outshield Roof Underlayment: [allenconsultinggroup.net](http://allenconsultinggroup.net)
6. DELTA®-Trella Vapor Permeable Underlayment: [www.dorken.com](http://www.dorken.com)

### LOW-SLOPED ROOFING: Mechanically Attached

Before applying a low-sloped roofing membrane system over Extreme SIPs, a capping layer of vapor-permeable cover board—such as GP's DensDeck, GAF's DEXcell, USG's Securock, or a similar gypsum fiber or cement fiber roof cover board product—must be mechanically attached to the Extreme SIPs roof deck. A single-ply membrane can be mechanically fastened through the vapor-permeable cover board into the SIP roof deck.

FOR MORE INFORMATION ON LOW-SLOPED SIP ROOFING APPLICATIONS, SEE EXTREME PANEL'S TECHNICAL BULLETIN R-5. FOR MORE ON ROOF ASSEMBLIES IN EXCESSIVE HEAT SCENARIOS SEE TECHNICAL BULLETIN R-7.

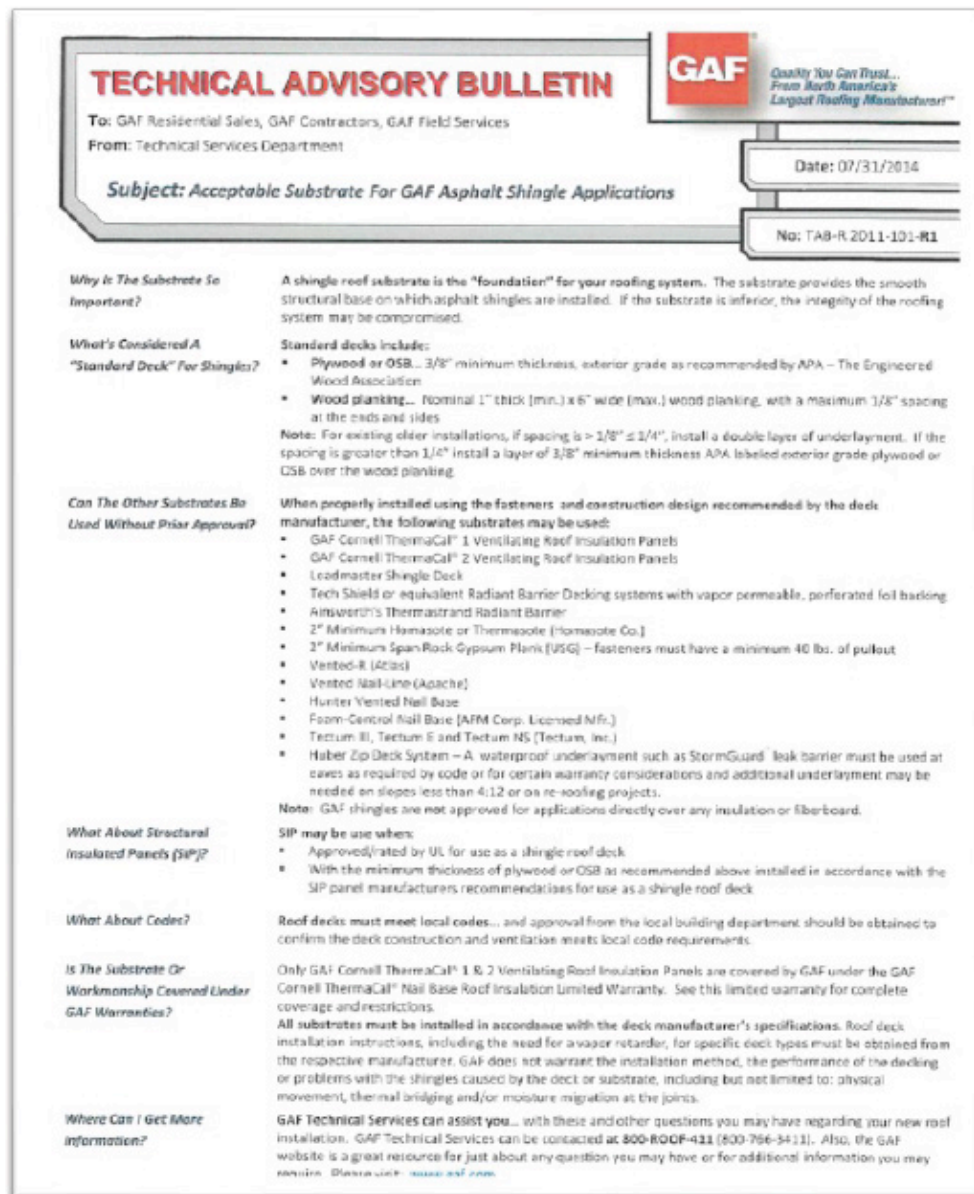
For more information, please contact your Extreme Panel representative.

\*\* Extreme Panels have no business relationship, financial interest, or involvement in the performance or warranty claims made by the companies listed above or discussed in this Technical Bulletin. It is the responsibility of each customer to research information from these companies and determine the suitability of the listed products when used with Extreme SIPs.

# SUBJECT: ASPHALT SHINGLES APPLIED TO SIP ROOF SUBSTRATES

GAF, a leader in the manufacture of asphalt shingles, examined the use of their shingles with SIPs and authored the attached Technical Advisory Bulletin. GAF has confirmed that their products, when applied directly over SIP substrates, are acceptable and that no restrictions will be placed on their warranty.

GAF shingles are recommended as the preferred asphalt shingle product for use with Extreme SIPs. When using shingles other than GAF, please contact your asphalt shingle manufacturer to clarify their warranty coverage when applied over SIP roof substrates.



**TECHNICAL ADVISORY BULLETIN**

**To:** GAF Residential Sales, GAF Contractors, GAF Field Services  
**From:** Technical Services Department

**Subject:** Acceptable Substrate For GAF Asphalt Shingle Applications

**Date:** 07/31/2014  
**No:** TAB-R 2011-101-R1

**Why is The Substrate So Important?**  
A shingle roof substrate is the "foundation" for your roofing system. The substrate provides the smooth structural base on which asphalt shingles are installed. If the substrate is inferior, the integrity of the roofing system may be compromised.

**What's Considered A "Standard Deck" For Shingles?**  
**Standard decks include:**

- Plywood or OSB... 3/8" minimum thickness, exterior grade as recommended by APA – The Engineered Wood Association
- Wood planking... nominal 1" thick (min.) x 6" wide (max.) wood planking, with a maximum 1/8" spacing at the ends and sides

**Note:** For existing older installations, if spacing is > 1/8" < 1/4", install a double layer of underlayment. If the spacing is greater than 1/4" install a layer of 3/8" minimum thickness APA labeled exterior grade plywood or OSB over the wood planking.

**Can The Other Substrates Be Used Without Prior Approval?**  
When properly installed using the fasteners and construction design recommended by the deck manufacturer, the following substrates may be used:

- GAF Cornell ThermaCal® 1 Ventilating Roof Insulation Panels
- GAF Cornell ThermaCal® 2 Ventilating Roof Insulation Panels
- Leadmaster Shingle Deck
- Tech Shield or equivalent Radiant Barrier Decking systems with vapor permeable, perforated foil backing
- AirSaver™'s Thermastrand Radiant Barrier
- 2" Minimum Homasote or Thermaote (Homasote Co.)
- 2" Minimum Span-Rock Gypsum Plank (USG) – fasteners must have a minimum 40 lbs. of pullout
- Vented-R (Atlas)
- Vented Nail-Line (Apache)
- Hunter Vented Nail Base
- Foam-Control Nail Base (AFM Corp. Licensed Mfr.)
- Tectum II, Tectum E and Tectum NS (Tectum, Inc.)
- Haber Zip Deck System – A waterproof underlayment such as StormGuard® leak barrier must be used at eaves as required by code or for certain warranty considerations and additional underlayment may be needed on slopes less than 4:12 or on re-roofing projects.

**Note:** GAF shingles are not approved for applications directly over any insulation or fiberboard.

**What About Structural Insulated Panels (SIP)?**  
SIP may be used when:

- Approved/rated by UL for use as a shingle roof deck
- With the minimum thickness of plywood or OSB as recommended above installed in accordance with the SIP panel manufacturer's recommendations for use as a shingle roof deck

**What About Codes?**  
Roof decks must meet local codes... and approval from the local building department should be obtained to confirm the deck construction and ventilation meets local code requirements.

**Is The Substrate Or Workmanship Covered Under GAF Warranties?**  
Only GAF Cornell ThermaCal® 1 & 2 Ventilating Roof Insulation Panels are covered by GAF under the GAF Cornell ThermaCal® Nail Base Roof Insulation Limited Warranty. See this limited warranty for complete coverage and restrictions.  
All substrates must be installed in accordance with the deck manufacturer's specifications. Roof deck installation instructions, including the need for a vapor retarder, for specific deck types must be obtained from the respective manufacturer. GAF does not warrant the installation method, the performance of the decking or problems with the shingles caused by the deck or substrate, including but not limited to: physical movement, thermal bridging and/or moisture migration at the joints.

**Where Can I Get More information?**  
GAF Technical Services can assist you... with these and other questions you may have regarding your new roof installation. GAF Technical Services can be contacted at 800-ROOF-411 (800-766-3411). Also, the GAF website is a great resource for just about any question you may have or for additional information you may require. Please visit: [www.gaf.com](http://www.gaf.com).

## **SUBJECT: LOW SLOPE ROOFING OVER EXTREME SIPS**

Low slope roofing systems are applied over Extreme SIPs for both residential and commercial building applications and require that the architect and contractor applicator fully understand the applicable code requirements and the performance of materials and systems.

Low slope roof applications typically utilize a single-ply roofing membrane, built-up roof (BUR), or modified bitumen as the roofing system. Within these systems, several techniques are used to secure the roof system to the roof deck, including ballasted, adhered, or mechanically attached methods. Ballasted systems rely on overlaid rock or cementitious pavers as a weight to hold the membrane in place. Adhered systems use asphalt or adhesives that are placed on the roof deck or carried on the membrane to adhere it to the underlying roof deck. Solvent-based adhesives are not approved by Extreme Panels, as they could cause deterioration of the Extreme SIPs rigid insulation core. Water-based adhesives are acceptable. In some attached systems, the adhesive layer is applied to a board or sheet known as a divorcement layer, which has been previously mechanically attached to the roof deck. Mechanical attachment is accomplished with long screws through the membrane and insulation layers.

When Extreme SIPs are used as the roof deck on a low slope roof system, Extreme Panels requires that a divorcement material be placed over the SIPs prior to the roof membrane installation. This divorcement layer can be a slip sheet for ballasted systems, a nail-applied base sheet for BUR systems, or a cover board such as gypsum, cement, or wood fiber for adhered systems. The application of these divorcement materials will protect the top OSB structural skin of the SIP if the roof membrane system were to fail and/or need replacing. The OSB skins of a SIP are part of the SIP's structural component assembly, so they must remain intact to ensure long-term structural capacity.

Further consideration should be given if the roof system needs to meet a Class A, B, or C designation based on ASTM E108 or UL 790 testing. Extreme SIPs are rated as a "combustible roof deck." Therefore, low slope roofing systems that can achieve a Class A, B, or C rating over a combustible deck should be specified by the architect and installed by the roofing contractor.

If a Class A rating over an SIPs combustible deck is specified, an acceptable and cost-effective method to achieve the Class A requirement is to apply a layer of gypsum or cementitious board over the SIPs. An example of a gypsum product is ¼" DensDeck®, which is mechanically attached to the SIPs. The attachment of the DensDeck needs to be sufficient to meet wind uplift requirements when used in conjunction with adhered membranes.

In addition to gypsum and cementitious board products, there are also fire-rated membranes that can achieve Class A fire ratings when applied over combustible roof decks. In all cases, whatever divorcement material is used, it should meet the requirements of the roofing membrane manufacturer.

Therefore, Extreme Panels requires that a DensDeck\* (1/4" thickness or greater), or equivalently rated divorcement product in the type and style approved by the Low Slope Roofing System Manufacturer, be attached on top of the Extreme SIPs roof deck prior to the installation of fully adhered systems. Mechanical attachment of the divorcement product shall be installed in accordance with the Low Slope Roofing Manufacturer's recommendation when applied to a 7/16" OSB faced SIP roof deck system.

\*DensDeck® is a registered trademark of Georgia Pacific.

## SUBJECT: METAL ROOFING ATTACHMENT

Extreme SIP roofs can be finished with a wide range of roof covering systems. Metal roofing is one type of roof covering that has been used successfully over Extreme SIPs for many years. Metal roofing provides a water-tight roof system and has a long life expectancy compared to many other roof claddings. One major advantage of metal roofing is that minimal maintenance is required over the life of the roof. As with all roof covering systems, the installation must comply with the metal roofing manufacturer’s recommended installation details.

The primary consideration when installing metal roofing over Extreme SIPs is to ensure the metal roofing manufacturer provides installation recommendations for proper attachment into the 7/16” OSB facing of the Extreme SIPs. Berridge Manufacturing Company, a leader in the metal roofing industry, provides installation recommendations for the attachment of their metal roof system directly into the 7/16” OSB facing of Extreme SIPs. Following their installation recommendations ensures that the metal roof system will provide the long-term durability expected.

Extreme Panels confirmed the strength of the Berridge attachment recommendations by testing the uplift resistance of Berridge 24-gauge Zee-Lock panel in accordance with UL 580, “Tests for Uplift Resistance of Roof Assemblies.” The tested assembly consisted of the Zee-Lock panel installed with a double lock, continuous Zee Rib, and #14 x 1-1/2 in. hex washer head Type A w/sealing washer from SFS Intec directly into the 7/16 in. OSB facing of the Extreme SIPs. Two different fastening frequencies were evaluated.

| Ultimate Pressure | Fastener Spacing |
|-------------------|------------------|
| 160 psf           | 14 in. o.c.      |
| 265 psf           | 8 in. o.c.       |

The test results clearly demonstrate that metal roofing can meet high wind uplift pressures when fastened directly into the 7/16 in. OSB of Extreme SIPs.

For further information regarding Berridge Manufacturing Company products, please visit [www.berridge.com](http://www.berridge.com).



In addition, MBCI, another leader in the metal roofing industry, can provide installation recommendations for the installation of their metal roofing products directly into the 7/16" OSB facing of Extreme SIPs. Following the MBCI installation recommendations ensures that their metal roofing materials will provide long-term durability when their metal roofing is selected. For further information regarding MBCI Metal Roofing, please visit [www.mbc.com](http://www.mbc.com).

Similar performing metal roofing systems may be available in the marketplace. It is the responsibility of the designer and installer to determine if the manufacturer of these metal roofing systems recommends the use of their products and to obtain installation instructions and details for application when applied over SIP roof deck assemblies.

## SUBJECT: VENTILATION OF METAL ROOFING

The ventilation of metal roofing when installed over Extreme SIPs provides many building science benefits. The primary benefit of venting above an Extreme SIPs roof deck is the removal of unintended moisture vapor that may emanate (known as “vapor drive”) from the interior of the building due to the misapplication of Extreme’s SIP sealant and SIP tape at spline joints and SIP-to-SIP intersections. The venting of moisture vapor between the metal roof covering and the top of the SIP roof deck reduces the risk of condensation and the potential for moisture damage to the SIPs’ upper facer. It should also be noted that vapor-permeable underlayments should also be used in metal roof assemblies when applied over SIP roof decks (See Extreme Panel Technical Bulletins R3 & R6).

In addition to venting moisture vapor, any rainwater or melting snow that bypasses the metal roofing materials is also removed by the ventilation space. Additional benefits of a ventilation cavity include:

- Reduction in the temperature of the SIPs’ upper facer from high heat generated by direct sunlight exposure in hot climate zones and the potential of concentrated heat from reflective surfaces, such as windows and reflective ponds.
- Protection of metal roofing systems, particularly Zinc and Copper, which can expose Extreme SIP roof decks to high temperatures, potentially damaging the rigid insulation core. Underlayments can also be damaged by excessive heat exposure.
- The vented cavity keeps temperatures at the Extreme SIP roof surface within safe operating limits for both the SIP and underlayment.
- In winter, the ventilated space creates a cold roof, reducing the potential for ice dams when snow depth on the roof is significant.
- Impact noise from rain and hail is also mitigated.

Extreme Panels have investigated a unique products that is compatible with Extreme SIPs for achieving a cost-effective above-the-roof deck ventilation cavity— Dorken Delta-Trela and Colbond’s Enkamat 7020. These products are commonly used in roofing applications to provide the ventilation, drainage, and thermal separation needed for the long service life of roof structures.



**Enkamat 7020 from Colbond**

These products are a three-dimensional mat made of continuous nylon filaments fused at their intersections. The 95% open structure of the entangled filaments facilitates drying of condensed water vapor from the building interior while providing full support to the metal roof. The nylon filaments withstand the load of the roof and the demands of the construction environment, including construction foot traffic. The space created between the Extreme SIPs roof deck and the roof covering allows moisture to flow away or evaporate.

Testing has been conducted on the temperature difference that an Extreme SIP surface experiences when ventilated with these products compared to no ventilation. A standing seam metal roof was applied over a small-scale Extreme SIPs roof structure for testing evaluation. Dark-colored standing seam metal roof panels were fixed to the SIPs roof over the ventilated material/roofing underlayment. An assembly of metal roof panels over roofing underlayment alone was also tested for comparison.

The top surface of both metal roofing assemblies was brought to a temperature of 194°F (90°C) using infrared heat lamps. This temperature was maintained for 6 hours to ensure stable temperature movement through the assembly.

The temperature recorded on the top surface of the Extreme SIPs was reduced by 18% with the use of a ventilated system. These results clearly demonstrate the effect of an air space in lowering the temperature of an Extreme SIPs roof deck when metal roofing is exposed to solar radiation, resulting in high surface temperatures.

| SIP Ventilation | Temperature Reduction from Metal Roof to Top Surface of Extreme SIP |
|-----------------|---|
| None            | 10°F  |
| Enkamat 7020    | 43°F  |

Extreme SIPs recommends Dorken Delta-Trela or Colbond's Enkamat 7020 as a product that provides the important benefit of easy, cost-effective installation over Extreme SIPs, thereby achieving the additional building science benefits of ventilation: cooling the top of roof deck air temperature, allowing above-roof deck evaporation of moisture, and mitigating the sounds of rain and/or hail striking the metal roof.

Similar performing ventilating mats may be available in the marketplace. It is the responsibility of the designer and installer to determine if the manufacturer of these ventilating mats recommends the use of their products and to provide installation instructions and details for application when applied over SIP roof deck assemblies.

## SUBJECT: EXTERIOR CLADDING TO EXTREME SIP WALLS

Extreme SIPs are used in both commercial and residential applications. Over the years, Extreme has seen nearly every type of exterior cladding applied to the face of its SIPs. This bulletin reviews common claddings that are available and their attachment to Extreme SIPs. Extreme SIPs do not incorporate framing members and, therefore, require cladding materials that are approved for installation over 7/16" Structural OSB Sheathing.

A review of the requirements for attachment of the siding material typically calls for the cladding to be attached with 8d nails 16" or 24" on center, depending on the framing spacing. Using these values, one can compare the pullout values for 8d nails into standard framing with the fastener pullout values listed in Extreme's Technical Bulletins D-16 and D-17 regarding Screw & Nail Withdrawal Capabilities of OSB. This comparison shows that all claddings with the requirements of fastening to framing members can be matched by applying 8d ring shank nails 12" o.c. into Extreme SIPs. This includes the attachment of standard sidings such as vinyl, Hardie® Board, cedar, redwood board, metal, composites, and fiber cement sidings.

This comparison is also valid for the application of lath for stucco as well as brick tie placement. Typically, these products are attached to SIPs by simply increasing the number of fasteners by 25%. When a manufacturer calls for fasteners 16" o.c., the fasteners would be placed in a SIP at a spacing of 12" o.c. This adjustment allows the application to meet or exceed the pull-out values required by the siding manufacturer. It should be noted that the fastener placement can be maintained at the siding manufacturer's recommendations if a nail/staple is replaced with a screw. In all cases, the fastener should be corrosion-resistant.

### FIBER CEMENT BOARD SIDING MANUFACTURERS & SIPS

James Hardie, Allura, and Nichiha are the leading manufacturers of fiber cement board siding supplied throughout the US and Canada. Each of these companies has examined the use of their products when applied over Extreme SIPs. All three companies have provided notice that their products, when applied directly over the 7/16" OSB facing of SIPs, are acceptable by following their recommended attachment patterns and approved fasteners.

James Hardie, Allura, and Nichiha Sidings are recommended as premium fiber cement board siding products compatible with Extreme SIPs. Information on the attachment requirements for each of these companies can be found at:

James Hardie

[www.jameshardie.com](http://www.jameshardie.com)

ICC-ES Evaluation Reports: ESR-2290 and ESR-1844

Allura

[www.allurausa.com](http://www.allurausa.com)

ICC-ES Evaluation Report: ESR-1668

Nichiha

[www.nichiha.com](http://www.nichiha.com)

Intertek CCRR-0258

### **SIPS & Engineered Wood Lap Siding from Louisiana-Pacific**

Louisiana-Pacific, a leader in the manufacture of Engineered Wood lap siding, has examined the use of their SmartSide Precision Treated Engineered Wood lap siding with SIPs. Louisiana-Pacific worked with APA, which authored the APA Product Report (PR-N124). Louisiana-Pacific has confirmed that their products, when applied directly over Extreme SIPs, are acceptable when following their recommended fastening patterns. Louisiana-Pacific siding is recommended as a premium Engineered-Wood lap siding product compatible with Extreme SIPs.

Information regarding the attachment requirements for Louisiana-Pacific's Engineered Wood lap siding can be found in the PR-N124 APA Product Report. Tables 4a and 4b list specific SIP attachment recommendations, and these tables are attached to this bulletin.

For further information on Louisiana-Pacific siding products, please visit [www.lpsmartside.com](http://www.lpsmartside.com), Engineered Wood Lap Siding from Louisiana-Pacific.

## SUBJECT: EIFS & EXTREME SIPS

Extreme SIPS structures can be finished with any code-approved weather covering. Exterior Insulation Finish Systems (EIFS) are one type of code-recognized weather covering. EIFS provide watertight protection and have been used successfully over Extreme SIPS structures for many years. It is recommended that EIFS intended for use over OSB substrates be used. EIFS system installers must follow the EIFS Manufacturer's installation guidelines to achieve a warranted outcome.

Various code jurisdictions require that the EIFS being installed include a water drainage system. Many EIFS Manufacturers have systems that meet this requirement.

### STO SYSTEM:

Sto Corp. has developed StoTherm® ci, a water-managed EIFS, utilizing an air/moisture barrier system that works exceptionally well over Extreme SIPS. The Sto system features benefits that enhance the long-term performance of Extreme SIPS:

1. Extreme SIPS OSB skins and penetrations are moisture protected.
2. StoTherm ci is adhesively applied, resulting in a perfectly air- and watertight surface coating over the SIP exterior skin.
3. Incidental water that may get behind the EIFS is drained outside the system.

This Technical Bulletin provides guidelines for applying StoTherm ci with StoGuard® Moisture Protection when applied over Extreme SIPS.

### GENERAL CAUTION:

StoGuard protects the Extreme SIPS OSB facings from moisture damage during the construction phase, as well as in-service protection in the event of a moisture breach in the EIFS wall cladding. Proper application by the installer is required. Application of the StoGuard over Extreme SIPS is not intended to correct faulty workmanship. It is essential that proper flashing and details be integrated into the design to direct water to the outside of the cladding system. Defective components of construction, such as leaky windows and doors, should not be used.

### APPLICATION RECOMMENDATIONS:

Sto Corp. publishes complete specifications for the installation of their StoGuard and StoTherm ci. The following recommendations are provided as they apply to installations over Extreme SIPs. Prior to starting any work, thoroughly read all specifications and installation guidelines.

#### STEP 1:

Clean Extreme SIPs OSB facing surfaces that are to receive the StoGuard Moisture Protection System. Extreme SIPs OSB surfaces must be in good condition, free of dirt and all bond-inhibiting contaminants. Surfaces must be dry, with the ambient air temperature at 40°F and rising before application can occur.

#### STEP 2:

Apply Sto Gold Coat® to the entire exterior Extreme SIPs OSB facing receiving the Sto EIFS. Using a 3/4" (19mm) nap roller, apply Sto Gold Coat in a uniform wet thickness coating of 10 mils. Protect from weather and temperature until dry.

#### STEP 3:

Extreme SIPs joints, rough openings, corners, and tops of wall parapets are filled and covered with Sto Gold Fill® and StoGuard Mesh, embedded into the Sto Gold Fill (additional Sto joint and rough-opening material options are listed at [www.stocorp.com](http://www.stocorp.com)). Fastener and surface defects must be spot-filled with Sto Gold Fill. Application is by trowel with a maximum thickness on the Extreme SIPs OSB surface of 1/16". Joints require a 4" minimum width mesh, while rough openings, corners, and parapets require a 9" minimum width mesh detail.

#### STEP 4:

Re-apply a second coat of Sto Gold Coat over the entire Extreme SIPs OSB facing receiving the Sto EIFS, including all surfaces previously covered with Sto Gold Fill. Using a 3/4" (19mm) nap roller, apply Sto Gold Coat in a uniform wet thickness coating of 10 mils. Protect from weather and temperature until dry.

#### STEP 5:

Coordinate the proper installation of flashing and other moisture protection components, such as windows, doors, fireplaces, chimneys, and other similar penetrations that impact the watertightness of the StoTherm ci applied over the Extreme SIPs.



### STEP 6:

Install the StoTherm ci System per the manufacturer's detailed specifications and installation guidelines, including all accessories such as, but not limited to: Starter Track, Window/Door Head Flashing, Side Wall Step Flashing, Backwrapping, adhesive and EPS Insulation Board, Trim and Reveals, Base Coat and Reinforcing Mesh, Primer, and Finish Coat. dry, with the ambient air temperature at 40°F and rising before application can occur.

### NOTE:

This Technical Bulletin presents applications using Sto Gold Fill, StoGuard Mesh and the StoTherm ci System. Information regarding other Sto products and systems options are available at [www.stocorp.com](http://www.stocorp.com).

