UL U356 Summary

One-Hour Fire-Resistance Rated, Limited Load Bearing Wall Assemblies for STYROFOAM SIS™ & SIS™ Plus Using IBC Section 722 Calculation Method (Exposed to Fire on Interior Face Only)

Ox Engineered Products, LLC

Manufacturing Locations:
228 Broadway, Suite 2  164 Eyster Rd.  1255 N. 5th St.
Hanover PA, 17331  Halftown, WV 25423  Charleston, IL 61920
269-435-2425  269-435-2425  269-435-2425

DIVISION: 06 00 00 – WOOD, PLASTICS AND COMPOSITES
Section: 06 02 00 – Design Information
Section: 06 11 00 – Wood Framing
Section: 06 12 00 – Structural Panels
Section: 06 12 19 – Shear Wall Panels

DIVISION: 07 00 00 – THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 – Thermal Insulation
Section: 07 25 00 – Water-Resistive Barriers/Weather Barriers
Section: 07 27 00 – Air Barriers

1. Products Evaluated:
   1.1. STYROFOAM SIS™ Structural Insulated Sheathing (SIS)
   1.2. STYROFOAM SIS™ Plus
   1.3. This report summarizes TER No. 1109-01 calculations performed in accordance with the 2006-2012 IBC Chapter 7 calculated fire resistance substitutions for exterior sheathing based upon tested finish ratings.
   1.4. For the most recent version of this report, visit drjengineering.org.

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Scope of Responsibility / Work, Operations Policies, and Legal Responsibilities
- Mission and Scope of Responsibility
- Product Evaluation Operations Concepts and Policies
- Legal Aspects of Product Approval
2. Applicable Codes and Standards:¹
   2.2. 2006, 2009 and 2012 International Residential Code (IRC)

3. Performance Evaluation:
   3.1. Performance as a component element of one-hour rated wall assemblies.
   3.2. For other sheathing performance characteristics that may be required in an exterior wall assembly, see TER No. 0804-01: STYROFOAM SIS™ & SIS™ Plus.

4. Product Description and Materials:

5. Applications:
   5.1. Fire Endurance Assemblies
      5.1.1. Two full-scale ASTM E119 fire endurance tests and fire and hose stream tests of a limited load bearing unsymmetrical exterior wall assembly were conducted by the Building Research Laboratory at Ohio State University by Dr. Richard Bletzacker of Bletzacker and Associates.²
         5.1.1.1. OSU Test project number 7187 had a fire endurance performance of 65 minutes and had a finish rating for the 5/8” Type X GWB membrane of 19.9 minutes.
         5.1.1.2. OSU Test project number 3518 had a fire endurance performance of 60 minutes and had a finish rating for the 5/8” Type X GWB membrane of 20.4 minutes.
         5.1.1.3. OSU also tested 10 small scale assemblies that were fully thermocoupled, which also provided knowledge of the thermal transfer with respect to fire resistance layers with fire from one side of the assembly.
      5.1.2. The key structural sheathing component of STYROFOAM SIS™ and STYROFOAM SIS™ Plus was the assembly’s exterior sheathing.
      5.1.3. The finish rating for the 5/8” Type X gypsum wallboard (GWB) membrane of this assembly was 20.4 minutes.
         5.1.3.1. This is the GWB membrane finish rating used for the 2006 and 2009 IBC Section 721 and 2012 IBC Section 722 calculations.
         5.1.3.2. GWB membrane comparisons will be made for the application of this tested finish rating to other fire rated assemblies having GWB membrane finish ratings of 20.4 minutes or greater.
      5.1.4. The following table provides an IBC Section 703.3 “Alternative methods for determining fire resistance” based fire endurance assembly.
         5.1.4.1. This section allows for substitutions of STYROFOAM SIS™ and STYROFOAM SIS™ Plus as the exterior sheathing in the above mentioned one-hour rated fire tests conducted by the Building Research Laboratory at Ohio State University using code complying calculation procedures that incorporate specific thermal protection performance data taken directly from the fire testing performed.
         5.1.4.2. This assembly is solely for fire endurance performance where the assembly is exposed to fire on the interior face only and where interior GWB is the protective membrane.
         5.1.4.3. This is defined as an unsymmetrical fire endurance assembly where performance is from the interior side only.

¹ Unless otherwise noted, all references in this TER are from the 2012 version of the codes and the standards referenced therein, including, but not limited to, ASCE 7, SDPWS and WFCM. This product is also approved for use with the 2000-2009 versions of the IBC and IRC and the standards referenced therein.
² Testing conducted by the Engineering Experiment Station at Ohio State University in Columbus, Ohio, 43212. The test is Standard ASTM Fire Endurance Test and a Fire and Hose Stream Test on Duplicate Limited Load Bearing Unsymmetrical Exterior Wall Assemblies, which was conducted by the Building Research Laboratory, Larry L. Whitaker, Supervisor, Test Operations.
5.1.5. Loading Requirements

5.1.5.1. The original wall assembly was loaded to 55% of the allowable load.

5.1.5.2. A superimposed load of 1,800 lbs. per stud was applied to the assembly at the start of the test and was maintained throughout the test. This superimposed load imposed a stress of 342.9 psi, compression parallel to grain.

5.1.5.3. This results in a wall assembly permitted to be built as follows:

5.1.5.3.1. 8' wall heights can be loaded to a maximum of 1,800 lbs. per stud (1,350 plf).

5.1.5.3.2. 9' wall heights can be loaded to a maximum of 1,180 lbs. per stud (885 plf).

<table>
<thead>
<tr>
<th>Fire Endurance Assembly Type or Designation</th>
<th>Hourly Rating Per UL Directory &amp; IBC Section 721.6 or 722.6</th>
<th>Gypsum Wall Board Manufacturer</th>
<th>Gypsum Wall Board Fastener &amp; Fastener Spacing</th>
<th>Exterior Side of Assembly Only SIS™ &amp; SIS™ Plus Fasteners &amp; Spacing Item #5 Substitute</th>
<th>Wood Studs</th>
<th>Maximum Applied Compression Load (plf)</th>
<th>Finish Rating Must be Greater than 20.4 Minutes</th>
<th>Wall Performance after Finish Rating is Achieved, in Minutes</th>
<th>Total Fire Endurance Performance of UL U356 Assembly as Defined, in Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL U356</td>
<td>One-Hour Rated Assembly Fire Endurance from Interior Side Only</td>
<td>See UL U356 for a listing of manufacturers of ⅝&quot; Fire Rated GWB that can be Applied to Achieve a Finish Rating of 21 minutes or greater as designated</td>
<td>Per UL U356 or max of 2&quot;- long GWB nails spaced 6&quot; o.c. around the perimeter and 12&quot; o.c. on intermediate studs</td>
<td>Attached Directly to Studs Staples 16 gauge min, ⅛&quot; crown penetrating a min of 1&quot; into the stud or 0.113&quot; nail min penetrating a min of 1&quot; into stud. Spacing: 3&quot; o.c. perimeter, 6&quot; o.c. field</td>
<td>Min SPF studs spaced at a maximum of 16&quot; o.c.</td>
<td>1,350 plf @ a maximum 8' wall height</td>
<td>885 plf @ a maximum 9' wall height</td>
<td>Base Finish Rating for UL U356 Assembly ranges from 23 to 25 minutes</td>
<td>39.6</td>
</tr>
</tbody>
</table>

Table 1: UL U356 with STYROFOAM SIS™ & SIS™ Plus Applied as Exterior Structural Sheathing in One-Hour Rated Fire Endurance Wall Assemblies (Exposed to Fire on Interior Face Only) for GWB Manufacturers with Finish Ratings over 21 Minutes
1. **Wood Studs** — Nom 2 by 4 in. spaced 16 in. OC with two 2 by 4 in. top and one 2 by 4 in. bottom plates. Studs laterally-braced by wood structural panel sheathing (Item 5).

When Mineral and Fiber Boards* (Item 5A) are considered as bracing for the studs, the load is restricted to 76% of allowable axial load. Walls effectively fire stopped at top and bottom of wall.

2. **Gypsum Board*** — Nom 5/8 in. thick, 4 ft. wide, applied vertically and nailed to studs and bearing plates 7 in. OC with 6d cement-coated nails, 1-7/8 in. long with 1/4 in. diam head. **Finish Rating is 23 minutes.**

Any UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305. See Gypsum Board (CKNX) Category for names of Classified companies.

2A. **Gypsum Board*** — (As an alternate to Item 2, not shown) - Any 5/8 in. thick 4 ft. wide gypsum panels that are eligible for use in Design Nos. L501, G512 or U305, supplied by the Classified Companies listed below shown in the Gypsum Board* (CKNX) category. Applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. **Finish Rating is 23 minutes.**

CGC INC
UNITED STATES GYPSUM CO
USG MEXICO S A DE C V

2B. **Gypsum Board*** — (As an alternate to Item 2, not shown) - 5/8 in. thick 4 ft. wide gypsum panels applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. **Finish Rating is 23 minutes.**

AMERICAN GYPSUM CO — Types AGX-1, M-Glass, AG-C
CERTAINTIED GYPSUM INC — ProRoc Type C or ProRoc Type X
CERTAINTIED GYPSUM CANADA INC — ProRoc Type C or ProRoc Type X
PABCO BUILDING PRODUCTS L L C, DBA
PABCO GYPSUM — Type PG-11

TEMPLE-INLAND — Types X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, Type X ComfortGuard Sound Deadening Gypsum Board.

2C. **Gypsum Board** — (As an alternate to Item 2, not shown) - For Use with Item 5A only - 5/8 in. thick 4 ft. wide gypsum panels applied horizontally and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screws 1 in. and 4 in. from edges of board. **Finish Rating is 25 min.**

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM

2D. **Gypsum Board*** — (As an alternate to Item 2 ) - Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. **Finish Rating is 23 minutes.**

NATIONAL GYPSUM CO — SoundBreak XP Type X Gypsum Board

2E. **Wall and Partition Facings and Accessories*** — (As an alternate to Items 2 through 2D) — Nominal 5/8 in. thick, 4 ft. wide panels, secured as described in Item 2. **Finish Rating is 23 minutes.**

SERIOUS ENERGY INC — Type QuietRock ES, Type QuietRock QR-527.

2F. **Gypsum Board*** — (As an alternate to Item 2) - Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. **Finish Rating is 23 minutes.**
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CERTAINTEED GYPSUM INC — Type SilentFX


4. Batts and Blankets* — Mineral fiber or glass fiber insulation, 3-1/2 in. thick, pressure fit to fill wall cavities between studs and plates. Mineral fiber insulation to be unfaced and to have a min density of 3 pcf. Glass fiber insulation to be faced with aluminum foil or kraft paper and to have a min density of 0.9 pcf (min R-13 thermal insulation rating).


4A. Fiber, Sprayed* — As an alternate to Batts and Blankets (Item 4) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 3.0 lb/ft³. Alternate application method: The fiber is applied with U.S. Greenfiber LLC Type AD100 hot melt adhesive at a nominal ratio of one part adhesive to 6.6 parts fiber to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 2.5 lb/ft³.

U S GREENFIBER L L C — Cocoon2 Stabilized or Cocoon-FRM (Fire Rated Material)

4B. Fiber, Sprayed* — As an alternate to Item 4 and 4A — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 4.58 lb/ft³.

NU-WOOL CO INC — Cellulose Insulation

4C. Fiber, Sprayed* — As an alternate to Batts and Blankets (Item 4) - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft³.

INTERNATIONAL CELLULOSE CORP — Celbar-RL

5. Wood Structural Panel Sheathing — Min 7/16 in. thick, 4 ft wide wood structural panels, min grade "C-D" or "Sheathing". Installed with long dimension of sheet (strength axis) or face grain of plywood parallel or perpendicular to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 6d cement coated box nails spaced 6 in. OC along interior studs.

5A. Mineral and Fiber Boards* — As an alternate to Item 5 - Min 1/2 in. thick, 4 ft wide sheathing, installed vertically to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 1-1/2 in. long galvanized roofing nails spaced 6 in. OC at perimeter of panels and 12 in. OC along interior studs. As an option a weather resistive barrier may be applied over the Mineral and Fiber Boards.

TEMPLE-INLAND FOREST PRODUCTS CORP — Types FiberBrace or QuietBrace

5B. STYROFOAM SIS™ and STYROFOAM SIS™ Plus — As an alternate to Item 5 per the IBC Section 703.3, gypsum wallboard finish rating from ASTM E119 testing and the IBC Chapter 721.6/722.6 calculations. (For more information, see TER No. 0804-01 and No. 1109-01.)

6. Exterior Facings — Installed in accordance with the manufacturer's installation instructions. One of the following exterior facings is to be applied over the sheathing:

A. Vinyl Siding — Molded Plastic* — Contoured rigid vinyl siding having a flame spread value of 20 or less.

B. Particle Board Siding — Hardboard exterior sidings including patterned panel or lap siding.

C. Wood Structural Panel or Lap Siding — APA Rated Siding, Exterior, plywood, OSB or composite panels with veneer faces and structural wood core, per PS 1 or APA Standard PRP-108, including textured, rough sawn, medium density overlay, brushed, grooved and lap siding.

D. Cementitious Stucco — Portland cement or synthetic stucco systems with self-furring metal lath or adhesive base coat. Thickness from 3/8 to 3/4 in., depending on system.

E. Brick Veneer — Any type on nom 4 in. wide brick veneer. When brick veneer is used, the rating is applicable with exposure on either face. Brick veneer fastened with corrugated metal wall ties attached over sheathing to wood studs with 8d nail per tie: ties spaced not more than each sixth course of brick and max 32 in. OC horizontally. One in. air space provided between brick veneer and sheathing.

F. Exterior Insulation and Finish System (EIFS) — Nom 1 in. Foamed Plastic* insulation bearing the UL Classification Marking, attached over sheathing and finished with coating system, or Portland cement or synthetic stucco systems, in accordance with manufacturer's instructions. See Foamed Plastic (BRYX and CCVW) categories for names of Classified companies.

G. Siding — Aluminum or steel siding attached over sheathing to studs.

H. Fiber-Cement Siding — Fiber-cement exterior sidings including smooth and patterned panel or lap siding.
6. Findings:

6.1. *IBC Section 104.11 and IRC Section R104.11 (IFC Section 104.9 is similar)* state:

> 104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. … Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons the alternative was not approved.3

6.2. The use of vinyl siding will not affect the one-hour fire resistance rating of the STYROFOAM SIS™ and STYROFOAM SIS™ Plus wall assembly.

6.3. The assembly as described in Table 1 is an accurate assessment of fire endurance performance for the STYROFOAM SIS™ and STYROFOAM SIS™ Plus wall assembly.

7. Identification:

7.1. Each STYROFOAM SIS™ and STYROFOAM SIS™ Plus board described in this TER is identified by a label on the board or packaging material bearing the manufacturer’s name, product name, label of the third-party inspection agency, and other information to confirm code compliance.

8. Review Schedule:

8.1. This TER is subject to periodic review and revision. For the most recent version of this report, visit drjengineering.org.

8.2. For information on the current status of this report, contact DrJ Engineering.

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3 The last sentence is adopted language in the 2015 codes.