

October 23, 2020

Mr. John Woestman
Extruded Polystyrene Foam Association (XPSA)
529 14th Street, N.W. Suite 1280
Washington, D.C. 20045

RE: Brick Industry Association NFPA 285 and ASTM E119 Insulation Equivalent Thicknesses –
Extruded Polystyrene Foam Plastic Insulation
Jensen Hughes Project No. 1JJB00060.001

Dear Mr. Woestman:

Jensen Hughes, Inc. has completed our analysis regarding the maximum allowable thicknesses of extruded polystyrene (XPS) foam plastic insulation used within an exterior wall assembly incorporating a thin brick veneer system evaluated to ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, for fire-resistance and to NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*, for vertical and lateral flame propagation. The Brick Industry Association (BIA) has previously tested 1-hour and 2-hour non-loadbearing fire-resistance rated wall assemblies to ASTM E119 and an exterior wall assembly for NFPA 285 compliance incorporating a ½-inch thick Glen-Gery Thin Brick veneer system. All tested assemblies utilized nominal 2.21 pcf density, Kingspan GreenGuard, Type IV, 25 psi, XPS foam plastic insulation board complying with ASTM C578 between the exterior gypsum sheathing and thin brick system. XPSA has requested that Jensen Hughes conduct an evaluation to provide the technical justification for substituting alternate XPS foam plastic insulation products for the tested Kingspan GreenGuard XPS insulation board. The following analysis outlines the maximum allowable thicknesses of alternate XPS products in lieu of the tested XPS in these wall assemblies. This analysis letter serves as an extension to the results found in the Jensen Hughes letter entitled “Alternate Exterior Wall Constructions Incorporating Thin Brick Veneer Systems Complying with NFPA 285 and ASTM E119 (Revised)”, dated August 17, 2020, Jensen Hughes Project number 1AJP00240.000.

1.0 Maximum Equivalent Thickness Summary Tables

Tables 1 and 2 depict the equivalent thicknesses of alternate XPS foam plastic insulation products that maintain NFPA 285 compliance and ASTM E119 fire-resistance ratings, respectively, when installed under the Glen-Gary Thin Brick veneer system or equivalent system. Should the wall assembly being designed require both ASTM E119 and NFPA 285 compliance, the compliant thickness of XPS foam plastic insulation shall be governed by the more restrictive thickness (lesser of the two) found in either Table 1 or Table 2 for the specific product.

1.1. NFPA 285 COMPLIANT XPS THICKNESSES

Manufacturer/Material	Max Equivalent Thickness
DuPont ASTM C578 Compliant Type IV and Type X XPS	4 inches
Kingspan ASTM C578 Compliant Type IV and Type X XPS	4 inches
Owens Corning ASTM C578 Compliant Type IV and Type X XPS	4 inches

Notes: manufacturer listed in alphabetical order

1.2. ASTM E119 COMPLIANT XPS THICKNESSES

Manufacturer/Material	Max Equivalent Thickness
DuPont ASTM C578 Compliant Type IV and Type X XPS	4 inches
*Styrofoam™ Square Edge R3 – Type IV	3.33 inches
*Styrofoam™ Ultra SL – Type IV	3.45 inches
Kingspan ASTM C578 Compliant Type IV and Type X XPS	4 inches
Owens Corning ASTM C578 Compliant Type IV and Type X XPS	4 inches

* Unless individual product specification is listed, maximum thickness is dictated by “DuPont ASTM C578 Compliant Type IV and Type X XPS”. Type IV Styrofoam™ Square Edge R3 and Styrofoam™ Ultra SL R-value per inch have a higher R-value than the rest of the Styrofoam™ brand products.

2.0 Analysis

2.1. NFPA 285 THICKNESS ANALYSIS

Section 2603.5.3 of the International Building Code (IBC) (2000, 2003, 2006, 2009, 2012, 2015, and 2018 Editions) addresses the potential heat of foam plastic insulation used in exterior walls of Types I, II, III or IV construction. This section requires that the potential heat of the foam plastic insulation installed in a wall assembly, expressed in Btu/ft², shall not be greater than the potential heat of the foam plastic insulation used in the NFPA 285 tested wall system. This code section allows the thicknesses or densities of the foam plastic to deviate from the tested plastic contingent that the heat content (Btu/ft²) does not exceed that of the NFPA 285 test that is the design basis for the wall system.

The potential heat value (Btu/ft²) is determined by the following:

$$\text{NFPA 259 potential heat value (Btu/lb)} \times \text{foam density (lb/ft}^3\text{)} \times \text{foam thickness (ft)}$$

BIA has conducted fire testing according to NFPA 285 with the ½-inch thick Glen-Gery Thin Brick veneer system. Compliant results of testing are documented in Intertek Test Report I8508.01-121-24-R2 revision date November 18, 2019. This tested assembly incorporated 4-inch thick Kingspan GreenGuard Type IV 25 psi XPS and was reported to have a density of 2.21 lb/ft³.

Jensen Hughes has been provided proprietary NFPA 259 data by various manufacturers to perform the above analysis (DuPont, Kingspan, Owens Corning). Each alternate product included in Tables 1 and/or 2 was evaluated against the Kingspan GreenGuard, Type IV, 25 psi, XPS insulation board. The equivalent thickness results can be found above in Table 1. When the calculated equivalent thickness exceeds the tested 4-inch thickness, the maximum allowable thickness is limited to the tested 4-inches. It is our engineering opinion that the use of the alternate XPS products found in Table 1 in an identically constructed test assembly will have the same or similar fire performance than the Kingspan GreenGuard XPS insulation board when evaluated to the NFPA 285 performance criteria and will also meet the Code requirements of the IBC.

2.2. ASTM E119 THICKNESS ANALYSIS

Within the 2000, 2003, 2006, 2009, 2012, 2015, and 2018 editions of the IBC, modifications to previously tested assemblies for fire-resistance compliance are allowed via Section 703.3. This engineering analysis compared the proposed building elements and their impact on the fire performance of the tested assemblies. Per ASTM C578, there are several parameters that are used to quantifiably categorize the foam plastic insulation Types. In particular, with respect to ASTM E119 fire-resistance comparison, the R-value per inch (thermal resistance of the material) will dictate the insulative value of the foam plastic insulation within the assembly and its influence on the assembly's fire performance. Alternate XPS insulation boards can be substituted for the tested Kingspan GreenGuard, Type IV, 25 psi, XPS insulation board, but based on different insulating values of XPS foam product the overall R-value must be evaluated to determine the maximum allowable thickness of an alternate XPS product. By maintaining the same R-value, the insulative value of the foam plastic insulation within the wall assembly will be the same and not change the fire performance.

BIA has conducted fire testing according to ASTM E119 with the ½-inch thick Glen-Gery Thin Brick veneer system. This testing was successful and is reported in Intertek Test Reports I8509.01-121-24-R3 revision date November 18, 2019 and I8509.02-121-24-R3 revision date November 11, 2019. These tests incorporated 4-inch thick Kingspan GreenGuard, Type IV, 25 psi, XPS, which was reported to have a density of 2.21 lb/ft³.

Per ASTM C578 data, the tested Type IV XPS foam has an R-value of 5 °F-ft²-hr/BTU per inch. Therefore, 4-inches of this XPS foam has an R-value of 20 °F-ft²-hr/BTU. The equivalent thickness calculations performed are limited to the XPS foam Types IV and X. The representative R-value for each manufacturer's product was found via technical data sheets and/or proprietary test data. In order to maintain the same R-value as the tested Kingspan GreenGuard Type IV XPS foam, alternate XPS foams are allowed to have a maximum thickness per Table 2. It is our engineering opinion that the use of the alternate XPS products found in Table 2 will have the same or similar fire performance when evaluated for ASTM E119 compliance and will meet the Code requirements of the IBC.

3.0 Conclusion

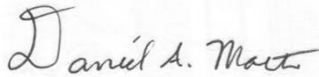
Jensen Hughes has completed our analysis of equivalent thicknesses for alternate XPS products that may be used in the above referenced NFPA 285 and ASTM E119 tested assemblies. The equivalent thicknesses were calculated based on the potential heat of combustion values obtained through NFPA 259 testing and the insulative R-value of the XPS foam plastic insulations. It is our engineering opinion that the substitution of the alternate XPS foam plastic insulations listed above in Tables 1 and 2 for the tested Kingspan GreenGuard, Type IV, 25 psi, XPS insulation will maintain compliance of the wall assemblies when evaluated for NFPA 285 and the hourly ratings of the wall assembly per ASTM E119. This letter is an extension of results found in the Jensen Hughes letter addressed to the Brick Industry Association entitled "Alternate Exterior Wall Constructions Incorporating Thin Brick Veneer Systems Complying with NFPA 285 and ASTM E119 (Revised)".

This analysis is based on the specific construction materials installed in the manner described in the referenced test report(s). Changes or modifications to the construction and/or materials used in the tested assembly may result in a different fire performance and may change this analysis. This analysis also does not address performance characteristics such as weatherability, durability or structural issues.

Jensen Hughes appreciates the opportunity to assist XPSA. We trust that the above analysis will be acceptable. If you have any questions regarding this analysis, please feel free to reach out to us at (410) 737-8677.

Submitted by,

Jensen Hughes



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