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DuPont Performance Building Solutions
1501 Larkin Center Drive
Midland, MI 48642

RE: NFPA 285 Compliant Exterior Wall Constructions Incorporating DuPont™ Thermax™ and Spray Polyurethane Foam (SPF) with Combustible Claddings
JENSEN HUGHES Project No. 1JJB05306.011

To Whom It May Concern:

Jensen Hughes has completed our engineering analysis of exterior wall assemblies compliant with NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, constructed using the Thermax™ Brand Rigid Insulation and a nominal 2.0 lb/ft^3 density closed cell (CC) spray polyurethane foam (SPF) insulation material.

Use of these combustible materials in an exterior wall assembly requires compliance with NFPA 285 by the applicable building code requirements to ensure excessive vertical and lateral exterior flame spread will not occur during a fire event. Specifically, Section 2603.5.5 of the International Building Code (2000 through 2021 Editions) require exterior wall systems incorporating foam plastic insulation materials to meet the requirements of NFPA 285. Similarly, Section 1403.5 of the IBC (2000 through 2015 Editions) and Section 1402.5 of the IBC (2018 and 2021 Editions) requires exterior wall assemblies on buildings of Types I, II, III, or IV construction that are greater than 40-feet above grade plane to comply with NFPA 285 if they incorporate a combustible water-resistive barrier (WRB) material.

DuPont has conducted numerous NFPA 285 fire tests of exterior wall assemblies that have incorporated the Thermax™ Brand Rigid insulation and various CC SPF insulation materials. The NFPA 285 test reports used as the bases for developing the NFPA 285 compliance tables within this letter are listed in the “references” section at the end of this letter.

Based on the results of these NFPA 285 tests, additional testing of water-resistive barriers (WRB) materials per ASTM E1354, and our experience with the NFPA 285 fire test, it is our opinion that the various configurations of exterior walls described in Tables 1 through 3 will meet the performance requirements of NFPA 285. Additionally, special opening header details shown in Figures 1 through 3 are to be used when the CC SPF products are included in the wall stud cavities. Figures 1 and 2 depict wall assemblies where the wall framing continues past each floor line (infill or curtain wall installation). Figure 3 depicts infill wall construction where the walls are supported on the floor slab and the end of the concrete floor slab extends into the wall construction. Figures 4, 5, and 6 depict the use of one of the DuPont™ Tyvek® WRB materials in conjunction with the Thermax™ foam plastic insulation material.

Table 1 – NFPA 285 Complying Wall Construction with Max 3-inch Thick Thermax™ Sheathing and Combustible Claddings

Wall Component	***Materials***
Base Wall System - Use either 1, 2, 3, 4, or 5	1) Concrete wall 2) Concrete Masonry Unit (CMU) wall 3) Standard clay brick wall (nominal 3⅝-inch thick brick) 4) Wood studs: nominal 2-inch × 4-inch or greater FRTW wood studs spaced at a maximum of 24-inch OC. One layer of ⅝-inch thick Type X gypsum wallboard installed on interior face of wood studs. One layer of ⅝-inch thick Type X exterior gypsum sheathing installed on exterior face of wood studs. Minimum two top plates at floorlines. As an option, any thickness of plywood or OSB may be installed on exterior face of wood studs under exterior gypsum sheathing. 5) Steel studs: minimum 3⅝-inch depth, minimum 20-gauge at a maximum spacing of 24-inch OC with lateral bracing every 4 ft. vertically. One layer of ⅝-inch thick Type X gypsum wallboard on interior face of studs. Gypsum wallboard joints shall receive at a minimum a Level 2 finish with all fasteners covered with joint compound.
Floor Line Firestopping Required in curtain-wall construction	4 lb./cu ft. mineral wool (e.g., Thermafiber) in each stud cavity and at each floor line
Interior Vapor/Moisture barrier	1) None 2) Any 6-mil thick polyethylene film
Cavity Insulation – Use either 1, 2, or 3 Or combination of 2 and 4 Or combination of 3 and 4	1) None – Screw end of fasteners that protrude into the stud cavity can be covered with a maximum of 1½-inch diameter plug of DuPont™ Froth-Pak Class A rated per ASTM E84 2) Minimum 1¾-inch thickness of BASF Walltite Plus (covered in Intertek CCRR-0374) applied using sheathing or insulation as substrate and covering the width of the cavity and inside the stud flange. Window header protection as shown in Figures 1, 2, and 3. 3) Minimum 1¾-inch thickness of Huntsman Building Solutions Heatlok HFO Pro (covered in IAPMO UES Evaluation Report No. ER-565) applied using sheathing or insulation as substrate and covering the width of the cavity and inside the stud flange. Window header protection as shown in Figure 1, 2, and 3. 4) Fiberglass blown-in or batt insulation (faced or unfaced) or mineral wool blown-in or batt insulation (faced or unfaced)
Exterior Sheathing – Use either 1, 2, or 3 OR	1) None 2) ½-inch thick, exterior gypsum sheathing 3) ⅝-inch thick, Type X exterior gypsum sheathing **Note:** Exterior sheathing is not required for ***Base Wall Systems 1 through 3***.
Multi-Function Sheathing & WRB Products	1) USG Securock® ExoAir® 430 System **Note:** This item replaces the exterior sheathings above. When this item is used the exterior sheathings are not required and WRBs below shall not be used.
WRB Materials Applied to ***Exterior Sheathing Items 2 or 3***	1) None 2) Any shown in Table 2 **Note:** Any WRB material shown in Table 2 can be applied over ***Base Wall Systems 1 through 4*** above, where able.

Wall Component	***Materials***
Exterior Insulation – Use either 1 or 2	1) None - If no exterior insulation is used, Exterior Sheathing Items 2 or 3 must be used for ***Base Wall Systems 4 or 5***. 2) DuPont™ Thermax™ Brand Rigid Insulation – Total thickness to be a minimum of ⅝-inch to maximum of 3-inches. **Note:** If no exterior insulation is used, only WRB materials which have been successfully tested by the MCM panel manufacturer via testing in accordance with NFPA 285 are permitted.
Exterior Insulation Joint Flashing – Use either 1 or 2	1) None – Only when a water-resistive barrier is applied to ***Exterior Sheathing Items 2 or 3*** or when a water-resistive barrier is applied to ***Exterior Insulation Item 2***. 2) Flash all exterior insulation joints and veneer tie penetrations with one of the following: a. DuPont™ LiquidArmor™ - CM Flashing and Sealant – max. 50-mil wet thickness, max. 4-inch width b. DuPont™ LiquidArmor™ - LT Flashing and Sealant – max. 35-mil wet thickness, max. 4-inch width. c. DuPont™ LiquidArmor™ - QS Flashing and Sealant – max. 50-mil wet thickness, max. 4-inch width d. DuPont™ Tyvek® Fluid Applied Flashing & Joint Compound+ – max. 25-mil wet thickness, max. 3-inch width e. DuPont™ Great Stuff Pro™ - Use on joints that are ≤ ¼-inch, vertical joints must be staggered & remove significant excess from the face of the Thermax™ **Note:** With either e) or f), a small amount of spray primer may be used to aid in adhesion; maximum 4-inch width.
WRB Materials Applied Over ***Exterior Insulation Item 2*** – Use either 1 or 2	1) None 2) Any shown in Table 3
Exterior Veneer	MCM System - Use any Metal Composite Material (MCM) system that has been successfully tested by the panel manufacturer via the NFPA 285 test method. Acceptable NFPA 285 testing shall consist of successful NFPA 285 test results on a wall assembly incorporating a comparable thickness of combustible foam insulation (e.g., polyiso) behind the MCM. These ACM panel systems include but is not limited to: a. Reynobond® FR ACM b. Alpolic®/fr ACM c. Alucobond® PLUS ACM

Wall Component	*Materials*
Flashing of Windows, Doors, and Other Exterior Wall Penetrations.	As an option, flash window, door and other exterior penetrations with either: 1) DuPont™ LiquidArmor™ – CM Flashing and Sealant – max. 50-mil wet thickness, max. 12-inch width. 2) DuPont™ LiquidArmor™ – LT Flashing and Sealant – max. 35-mil wet thickness, max. 12-inch width. 3) DuPont™ LiquidArmor™ – QS Flashing and Sealant – max. 50-mil wet thickness, max. 12-inch width. 4) DuPont™ Tyvek® Fluid Applied Flashing & Joint Compound+ – max. 25-mil wet thickness, max. 3-inch width 5) Limited amounts of acrylic, asphalt or butyl-based flashing tape – max. 12-inch width. 6) DuPont™ DuraGard™ CM Transition Flashing – max. 12-inch width **Note:** Flashing tape used in wall openings may extend the wall width plus extend up to a maximum of 4-inches onto the exterior face of the sheathing. Flashing tape may be used on sheathing exterior corners where the flashing tape may extend a maximum of 4-inches onto the sheathing face on either side of the corner.

Table 2 – Allowed Water-Resistive Barrier Applied Over Exterior Sheathing and Under Exterior Insulation

Weather Resistive Barrier Manufacturer/Product
3M™
• 3M™ Self-Adhered Air and Vapor Barrier 3015
Carlisle
• CCW-705FR w/ Primers
• Barritech™ VP
Dörken Systems
• Delta®-Foxx
• Delta®-Foxx Plus
• Delta®-Fassade S
• Delta®-Vent S/Plus
• Delta®-Maxx Plus
DOWSIL™
• DefendAir 200
• DefendAir 200C
Dryvit
• Backstop® NT
DuPont (See Figures 4, 5, and 6)
• DuPont™ Tyvek® CommercialWrap®
• DuPont™ Tyvek® CommercialWrap® D
• DuPont™ Tyvek® ThermaWrap™
• DuPont™ Tyvek® Fluid Applied WB+ – nominal 25 wet mil thickness
• WeatherMate™
• WeatherMate™ Plus
GCP Applied Technologies
• Perm-A-Barrier® Aluminum Wall Membrane
• Perm-A-Barrier® VPL
• Perm-A-Barrier® VPL LT
• Perm-A-Barrier® VPS
Henry Company
• Air-Bloc® 17MR
• Air-Bloc® 31MR
• Air-Bloc® 33MR
• Air-Bloc® 21 FR
• Air-Block® All Weather STPE

Weather Resistive Barrier Manufacturer/Product
• BlueskinVP™ 160 • Metal Clad™ • Foilskin®
Hohmann & Barnard • Enviro-Barrier™ VP
JX Nippon ANCI, Inc. • JX ALTA™ Commercial Wrap • JX ALTA™ HP Wrap • JX ALTA™ LP Wrap
Kingspan • Kingspan® GreenGuard® Max™ Building Wrap • Kingspan® GreenGuard® Classic Building Wrap • Kingspan® GreenGuard® C2000 Building Wrap • Kingspan® GreenGuard® Raindrop® 3D Building Wrap • Kingspan® GreenGuard® HPW™ Building Wrap
Momentive Performance Materials • GE SEC2500 SilShield* AWB • GE SEC2600 SilShield* AWB • GE SEC2600-R SilShield* AWB
Sto Corp • Sto Gold Coat® with StoGuard Fabric • Sto Emerald Coat® with StoGuard Fabric • Sto ExtraSeal™ w StoGuard Mesh
STS, Inc. • Wall Guardian™ FW-100A
Tremco • ExoAir 230 • ExoAir 430
VaproShield • WallShield® • WrapShield® • RevealShield™ • RevealShield SA™ • PanelShield SA™
W.R. Meadows • Air-Shield™ LMP (Gray) • Air-Shield™ LMP (Black) • Air-Shield™ TMP

Weather Resistive Barrier Manufacturer/Product
• Air-Shield™ LSR • Air-Shield Aluminum

Table 3 – Allowed Water-Resistive Barrier Applied Over Exterior Insulation

Weather Resistive Barrier Manufacturer/Product
DuPont (See Figures 4, 5, and 6) • DuPont™ Tyvek® CommercialWrap® • DuPont™ Tyvek® CommercialWrap® D • DuPont™ Tyvek® ThermaWrap™ • WeatherMate™ • WeatherMate™ Plus
Kingspan • Kingspan® GreenGuard® Max™ Building Wrap • Kingspan® GreenGuard® C500 Building Wrap • Kingspan® GreenGuard® Raindrop® 3D Building Wrap
VaproShield • RevealShield™ • RevealShield SA™ • PanelShield SA™

Engineering Analysis

DuPont has performed a number of successful NFPA 285 fire tests on exterior wall assemblies which form the technical basis for this engineering analysis letter. The first successful NFPA 285 test was constructed as follows (interior to exterior):

1. One layer of ⅝-inch thick Type X gypsum wallboard installed continuously over the interior surface of the wall assembly.
2. 3⅝-inch deep, 18 gauge steel studs spaced 24-inches on center
3. Stud cavities filled with minimum 1½-inch depth of BASF SPRAYTITE 81206 SPF applied to the Thermax™ sheathing as the substrate.
4. 3-inch thickness of the Thermax™ polyisocyanurate foam plastic insulation board. All board joints covered with a 3-inch thickness of the DuPont™ LiquidArmor™ CM Flashing and Sealant applied at 50 mils wet.
5. DuPont™ Tyvek® CommercialWrap® WRB
6. 4-mm thick Mitsubishi Alpolic®/FR ACM panels installed sing Carter Architectural Panels Fusion DRILLFREE mounting system.
7. Wall opening framed with two layers of ⅝-inch thick Type X exterior gypsum sheathing on header, jambs, and sill. Header, jambs, and sill were then finished with 18-gauge “L” shaped steel flashing

A complete description of the tested wall construction, the test observations, and the test results are provided in Intertek Building & Construction Test Report No. J0651.01-121-24-R0, dates April 24, 2019 [1].

The other successful NFPA 285 tests were constructed as follows (interior to exterior):

1. One layer of ⅝-inch thick Type X gypsum wallboard installed continuously over the interior surface of the wall assembly.
2. 3⅝-inch deep, 18 gauge steel studs spaced 16-inches on center
3. Stud cavities filled with minimum 1¾-inch depth of SPF applied to the Thermax™ sheathing as the substrate. SPF may be either the BASF WALLTITE Plus or the Huntsman Heatlok HFO PRO closed cell (CC) SPF products
4. 3-inch thickness of the Thermax™ polyisocyanurate foam plastic insulation board. All board joints covered with a 3-inch thickness of the DuPont™ LiquidArmor™ CM Flashing and Sealant applied at 50 mils wet.
5. DuPont™ Tyvek® CommercialWrap® WRB
6. 8¼-inch wide, 5/16-inch thick James Hardie Hardie® Plank Lap Siding installed horizontally over ⅞-inch deep, 18-gauge steel hat channels installed vertically, 24-inches on center.
7. Wall opening framed with one layer of ⅝-inch thick Type X exterior gypsum sheathing on header and jambs. Header, jambs, and sill finished with 18-gauge “L” shaped steel flashing and the header was additionally covered with aluminum drip cap. 5/4-inch × 4-inch Hardie window trim was fastened around the window perimeter

A complete description of the tested wall constructions, the test observations, and the test results are provided in Intertek Building & Construction Test Report No. N4815.01-121-24, dated June 9, 2022 [2] and ICC-NTA Test Report No. DDPS082422-45, dated August 24, 2022 [3].

The analysis which follows provides the technical substantiation for modifications to the tested wall assemblies for the following wall construction features:

1. Alternate base wall assembly construction
2. Stud cavity insulation materials
3. Exterior sheathing materials
4. Alternate WRB materials
5. Alternate exterior cladding materials
6. Alternate miscellaneous wall materials

ALTERNATE BASE WALL ASSEMBLY CONSTRUCTION

Concrete and CMU Block Walls

Additional base wall assemblies listed in Table 1 include a concrete wall and a concrete masonry wall. In an NFPA 285 test, a concrete or concrete masonry base wall will provide improved protection to the wall assembly from the burn room fire exposure based on its increased rigidity, significantly higher thermal mass, and increased level of fire performance. Table 1 of the National Concrete Masonry Association (NCMA) TEK Guide 7-1C, *Fire Resistance Rating of Concrete Masonry Assemblies* [4], provides minimum concrete thicknesses for various hourly fire-resistance ratings. A normal calcareous or siliceous gravel concrete wall with a minimum thickness of 2-inches will provide a 30-minute fire-resistance rating; a rating equal to the duration of the NFPA 285 test. Any exterior wall assembly will typically require a concrete wall thickness greater than 2-inches for structural reasons, and concrete block is typically much thicker than 2-inches, again for structural reasons. Based on the documented fire performance of concrete construction, a concrete or concrete block base wall assembly will provide the same or better fire performance than the tested steel stud and gypsum base wall assembly.

Standard Clay Brick Wall

Standard clay bricks have overall nominal dimensions of 3⅝ × 2¼ × 8-inch (D×H×L), and typically have hollow cores within them. Table 3 of the NCMA TEK 7-1C document [4], the equivalent thickness of hollow brick or tile or clay tile needed to achieve a 1-hour fire-resistance rating is 2.3 inches. The equivalent thickness of typical hollow core commercial masonry brick that has an overall thickness of 3⅝ inches is approximately this thickness. Therefore, a standard clay brick wall will provide approximately a 1-hour fire resistance rating. This is very close to the amount of fire protection a steel stud wall assembly with interior/exterior ⅝-inch thick Type X gypsum wallboard will provide. Therefore, a standard clay brick wall is an acceptable substitute for a steel stud and gypsum wallboard base wall assembly. This performance comparison does not take into account the improved structural performance of the wall assembly. This structural performance must be considered when performing a material installation over an existing clay brick wall assembly.

Wood Stud-Framed Walls

Table 1 allows for the use of minimum 2×4-inch dimensional fire-retardant treated wood (FRTW) lumber studs, spaced at maximum 24-inches on center. Through Jensen Hughes' experience from conducting and witnessing NFPA 285 tests, we have observed that when wood studs are used within a base wall assembly that has ⅝-inch thick, Type X interior and exterior gypsum coverings, minimal char damage is sustained by the wood studs throughout an NFPA 285 test. Since the wood studs only experience minimal char damage during an NFPA 285 test, vertical and lateral flame propagation does not occur from the compartment of fire origin such that failure criteria are observed. Based on this observed test assembly performance, it is Jensen Hughes' opinion that FRTW wood studs can be used as the framing for the base wall assembly as long as one layer of ⅝-inch thick, Type X gypsum is used on both the interior and exterior faces of the assembly.

All NFPA 285 compliant assemblies in Table 1 (Except for the concrete and masonry Base Wall Systems 1, 2, and 3) require one layer of ⅝-inch thick, Type X gypsum installed continuously over the entire interior face of the exterior wall assembly. However, when FRTW wood studs are used to frame an exterior wall, the exterior gypsum wallboard is also required to be ⅝-inch thick Type X gypsum wallboard, as reflected in Table 1. This will ensure sufficient protection is afforded to the FRTW wood stud framing from both the interior and the exterior face.

Base Wall System 4 also allows for plywood or OSB to be installed on the exterior face of the wood studs and under the exterior gypsum sheathing. When located behind the exterior gypsum sheathing, and in the wall stud cavity, the additional layer of plywood or OSB will not adversely impact the compliance of the wall assembly with NFPA 285 as it will be protected by the interior and exterior layers of gypsum wallboard. The optional use of plywood in fire-resistance rated wall assemblies is includes in a number of UL fire resistance design listings (e.g., UL Designs U302, V419, and V423). Wall assemblies tested to the more severe ASTM E119 fire resistance test standard has determined that this added combustible layer does not adversely impact the overall wall fire performance. In an NFPA 285 wall assembly incorporating wood studs, the plywood is protected in a manner similar to the wood studs with gypsum wallboard on the interior and exterior sides of the base wall assembly, shielding the plywood or OSB from direct flame impingement during the 30 minute NFPA 285 test.

Steel Stud Wall Assemblies

The successfully tested NFPA 285 wall assembly which formed the basis for this engineering evaluation letter utilized 3⅝-inch deep, 18-gauge steel stud spaced at 24-inches on center [1]. The interior surface of the stud framing was covered with a single layer of ⅝-inch thick Type X gypsum wallboard. Several of the referenced test assemblies [5, 6, 7, and 8] had a base wall consisting of a 3⅝-inch deep, 20-gauge steel stud spaced at 24-inches on center. Through Jensen Hughes' experience from conducting and witnessing NFPA 285 tests, we

have observed that wall assemblies framed with 3⅝-inch deep, 20-gauge steel stud spaced at 24-inches on center do not adversely impact the overall wall fire performance.

A steel stud/gypsum wallboard base wall assembly incorporating heavier gauge studs, decreased stud spacing, and/or deeper studs will provide improved fire performance of the wall assembly. Commentary in the front of the UL Fire Resistance Directory as well as Section 12.5 of ASTM E2032, *Standard Guide for Extension of Data from Fire Endurance Tests*, supports this conclusion. Therefore, Table 1 allows for minimum 3⅝-inch studs, of minimum 20-gauge, and at a maximum spacing of 24-inches on center.

STUD CAVITY INSULATION MATERIALS

CC SPF Insulations

The successfully tested NFPA 285 wall assembly which formed the basis for this engineering evaluation letter [1] incorporated the BASF SPRAYTITE 81206 SPF applied in all stud cavities to the interior side of the DuPont™ Thermax™ Rigid Brand insulation at a nominal thickness of 1½-inches. This combination was tested under a 4-mm thick ACM panel system and passed the test. Therefore, this tested condition justifies the use of the BASF SPRAYTITE 81206 foam insulation, within the stud cavity, applied directly to the inside face of the Thermax at maximum 3 inches, and installed under an ACM panel system. As is discussed in the exterior sheathing section of this technical justification, it is the opinion of Jensen Hughes that the installation of gypsum sheathing direct to the studs to act as the application substrate for the BASF Spraytite® foam insulation is a more conservative installation condition than the tested condition in referenced test [1]. Exterior gypsum sheathing will provide thermal separation between the spray foam and the Thermax™ sheathing and will delay the combustion of the spray foam insulation due to an exterior flame source.

Other successfully tested NFPA 285 wall assemblies which supplemented the technical basis for this engineering evaluation letter incorporated the BASF Walltite Plus [2] and the Huntsman Building Solutions Heatlok HFO PRO SPF [3] applied in all stud cavities, applied to the interior side of the DuPont™ Thermax™ Rigid Brand insulation at a nominal thickness of 1¾-inches. These successful NFPA 285 tests support the use of the BASF Walltite Plus and Huntsman Heatlok HFO PRO SPF in an exterior wall assembly with the Thermax™ insulation material and non-combustible exterior cladding materials.

Based on these three successful NFPA 285 tests, the use of either the BASF Walltite Plus SPF or the Huntsman Heatlok HFO PRO SPF in an exterior wall assembly with the Thermax™ insulation material and non-combustible exterior cladding materials will maintain compliance with NFPA 285.

Fiberglass, Mineral Wool, or other Non-Combustible Batt Insulation Materials

The successful NFPA 285 wall assemblies tested by DuPont contained no stud cavity insulation or they contained combustible CC SPF spray applied into all wall stud cavities [1, 2, and 3]. Based on the fire performance of the tested assemblies and the experience of Jensen Hughes personnel in conducting and witnessing NFPA 285 tests, the inclusion of any fiberglass, mineral wool, or other noncombustible insulation, will not adversely impact compliance of the wall assembly with NFPA 285. Rather, the inclusion of fiberglass, mineral wool, or other non-combustible insulation in the stud cavity of a wall assembly typically improves the overall wall fire performance. When compared to an empty stud cavity, the inclusion of fiberglass or mineral wool insulation will increase the amount of insulation and thermal protection that the stud wall provides to the exterior combustible components; especially when the Thermax™ Rigid Brand sheathing is installed directly to studs and does not have exterior sheathing separating it from the stud cavity. When compared to foam plastic insulation, fiberglass and mineral wool do not have the heat content that foam plastic insulation does and therefore will reduce the overall combustible load within the wall assembly and will not contribute to a fire that reaches the stud cavity.

This is further supported by many fire-resistance rated wall designs from the UL Online Fire Resistance Directory. Many wall design listings describe wall assemblies, tested to the more severe ASTM E119 fire exposure conditions, where the inclusion of fiberglass or mineral wool insulation is an optional item in the assembly. The optional inclusion of the stud cavity insulations indicates that their inclusion will not adversely impact the fire-resistance rating of the assembly. An increase in the fire resistance performance of a wall assembly will result in the base wall assembly providing a greater degree of thermal protection to the exterior combustible components from an interior fire exposure.

The fiberglass or mineral wool insulation can be faced or unfaced. The minimal amount of fuel loading added to the assembly by these facer materials is very low and the facers are protected on both sides by the interior gypsum wallboard or the exterior gypsum sheathing.

EXTERIOR SHEATHING MATERIALS

Exterior Grade Gypsum Sheathing

The referenced test assembly had no exterior gypsum sheathing and Thermax™ Rigid Brand sheathing was installed directly to the studs. When a wall assembly is compared to the tested assembly that had the Thermax™ Rigid Brand sheathing direct to the studs, it is the opinion of Jensen Hughes that the installation of gypsum sheathing underneath the Thermax™ is a more conservative installation scenario. Exterior gypsum sheathing will provide thermal separation between the Thermax™ Rigid Brand sheathing and the potential spray foam insulation installed in the stud cavity and will also provide greater protection to the Thermax™ Rigid Brand sheathing from an interior fire source. It is acknowledged that the use of exterior gypsum sheathing may warrant the use of a combustible WRB material, but any WRB materials used over the exterior sheathing are approved based (per Table 2 above) on comparative flammability evaluations based on WRB materials included in NFPA 285 tests. Based on this rationale, it is the opinion of Jensen Hughes that the wall assemblies approved under Table 1 may use Thermax™ Rigid Brand sheathing direct to the studs, or the Thermax™ Rigid Brand sheathing installed over ½- or ⅝-inch thick exterior gypsum sheathing.

Securock ExoAir 430 Panel

The Securock ExoAir 430 panel is an exterior grade gypsum sheathing product with a factory applied fluid applied weather barrier to it. Specifically, Tremco's ExoAir 430 WRB is applied to United States Gypsum's Securock sheathing. Based on the fluid applied WRB material used in referenced tests [7,8] and WRB materials installed behind Thermax™ Rigid Brand sheathing in other tests Jensen Hughes has witnessed, it is the opinion of Jensen Hughes that the flammability of the ExoAir 430 compares favorably and is an acceptable material to be installed under the Thermax™ Rigid Brand sheathing.

ALTERNATE WRB MATERIALS

WRB Materials Installed Over Exterior Gypsum Sheathing and Under Exterior Insulation

In the referenced tests [7,8], the DuPont™ Tyvek® Fluid Applied WRB was installed over the exterior gypsum sheathing and under the Thermax™ Rigid Brand sheathing. Alternate sheet good WRB products having similar or better flammability properties as the tested WRB are approved in Table 2 for installation over exterior sheathing and under the Thermax™ sheathing. Comparative fire performance properties were either developed by testing conducted by Jensen Hughes on these materials in accordance with ASTM E1354 (Cone Calorimeter apparatus) or by ASTM E1354 test reports provided to Jensen Hughes from various WRB manufacturers who performed testing at accredited third-party laboratories. Given that these alternate materials would be expected to perform similarly based on comparative fire performance properties, it is our engineering opinion that the

materials listed in Table 2 will not adversely impact the overall wall fire performance and will maintain compliance with NFPA 285.

WRB Materials Installed Over Exterior Insulation

Referenced test [8] incorporated DuPont™ Tyvek® CommercialWrap® over the continuous Thermax™ sheathing exterior insulation. Therefore, alternate sheet good WRB products having similar flammability properties as the tested WRB are included in Table 3 for use over Thermax™ sheathing in NFPA 285 compliant exterior wall assemblies. Comparative fire performance properties were developed by testing conducted by Jensen Hughes on these materials in accordance with ASTM E1354 (Cone Calorimeter apparatus). Given that these alternate materials would be expected to perform similarly based on comparative fire performance properties, it is our engineering opinion that the materials listed in Table 3 will not adversely impact the overall wall fire performance and will maintain compliance with NFPA 285.

EXTERIOR CLADDING MATERIALS

ACM Panel Systems

Aluminum Composite Material (ACM) panel systems are approved for general use overall 3-inches of Thermax™ sheathing based on passed results of referenced test [1] which had 3-inches of Thermax™ sheathing installed under an ACM panels system. Additionally, Thermax™ sheathing has been tested with successful results with several ACM manufacturers panel materials. Referenced test [1] used Mitsubishi Alpolic/fr panels and referenced test [8] used Arconic's Reynobond panels. Jensen Hughes has participated/witnessed other NFPA 285 tests not sponsored by DuPont where Thermax™ sheathing was installed behind ACM panels of other manufacturers as well.

Although ACM panels are similar in composition with respect to their combustible cores, ACM panels by different manufacturers do not have identical core compositions. Consequently, the flammability of the cores differs from manufacturer to manufacturer. Table 1 allows the use of Thermax™ sheathing only with ACM manufacturers which successful test results have been obtained. However, in acknowledging the variation of panel flammability between manufacturers, Table 1 requires that an ACM panel system have achieved passing results of an NFPA 285 test with combustible insulation of a comparable type and thickness to be acceptable for use with Thermax™ sheathing.

Claddings with Knight Wall System

Knight Wall provides various attachment systems which have been successfully used in numerous NFPA 285 tests. The Knight Wall HCI and the Knight Wall CI systems are cladding attachment systems designed and tested to support the MCM cladding system. Based on the testing conducted by Knight Wall, it is our engineering opinion that the use of this attachment system will maintain compliance with NFPA 285.

MISCELLANEOUS MATERIALS

Exterior Insulation Joint Flashing

Referenced test [1] used the DuPont™ LiquidAmor™ flashing over the board joints at a 50 mil thickness and 4-inch wide strip. Based on ASTM E1354 test data, various LiquidArmor flashing products are approved for use over the board joints at maximum installed thicknesses and widths that are equal to or less than the tested condition.

DuPont utilizes the LiquidArmor flashing products to seal the board joints on a Thermax wall system. Cone calorimeter testing has been conducted on the LiquidArmor flashing products and the Dow Corning DefendAir 200 WRB product. The testing indicated that the LiquidArmor flashing products have higher flammability properties than the DefendAir 200 WRB (proprietary testing conducted for Dow Corning), which is normally applied full wall coverage. Given this comparative analysis, it is Jensen Hughes opinion that the use of the Dowsil DefendAir 200 or Dowsil DefendAir 200C products used as flashing materials will not adversely impact compliance with NFPA 285.

Additionally, the IBC specifically states that flashing materials are not to be considered part of the water-resistive barrier product when assessing compliance of products in an exterior wall assembly. Through our extensive testing experience, we have never seen flashing product applied in small quantities over the face of the exterior wall assembly contribute to excessive vertical and/or lateral flame spread. Flashing materials are simply not applied in sufficient quantities and do not contain excessively high amounts of heat energy when applied over the board joints to contribute significantly to increasing the overall wall combustibility; especially when applied over foam plastic materials which, due to their nature, contain high amounts of heat energy. Knowing that flashing products do not contribute to excessive burning and do not support flame spread in a wall assembly, it is our opinion that the wall flashing materials, in the limits specified in the report, will not adversely impact the compliance with NFPA 285.

CONCLUSION

DuPont has conducted successful NFPA 285 tests on exterior wall assemblies incorporating SPF products installed in the wall cavities and sprayed against the back of the Thermax™ sheathing material. One successful NFPA 285 test was conducted on a wall assembly incorporating the Thermax™ Rigid Board insulation covered by an ACM panel systems. Based on this successful testing, alternative wall constructions were developed as detailed in Table 1 of this letter. The additional wall construction features will result in wall assemblies which will still meet NFPA 285 and provide a comparable level of fire performance as the tested wall assemblies. The technical justification for the use of additional wall system components is provided above to support their use in an exterior wall assembly which will continue to meet the conditions of acceptance of NFPA 285.

REFERENCES

The NFPA 285 compliance table was generated based on the following test reports:

1. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Intertek Testing Final Report No. J0651.01-121-24-R0, dated April 24, 2019.
2. Fiber Cement Board exterior wall construction – Reported in Intertek Testing Final Report No. N4815.01-121-24, dated June 9, 2022.
3. Fiber Cement Board exterior wall construction – Reported in ICC-NTA Testing Final Report No, DDPS082422-4, dated August 24, 2022.
4. National Concrete Masonry Association (NCMA) TEK 7-1C, “Fire Resistance Rating of Concrete Masonry Assemblies,” Herndon, VA, 2009.
5. Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001c, dated September 5, 2008.
6. Metal Composite Material Panel exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001d, dated September 5, 2008.

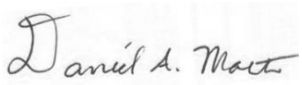
7. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Intertek Testing Final Report No. G101240263SAT-001, dated August 29, 2013
8. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Southwest Research Institute Final Report No. 16046.01.610b, dated November 30, 2012

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.

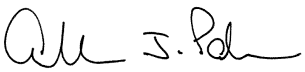
This analysis does not address performance characteristics such as weatherability, durability, or structural issues.

We trust this engineering analysis will be of use to DuPont. Should you have any questions regarding our analysis, please contact us at 443-313-9891 or at **aparker@jensenhughes.com**.

Sincerely,



Daniel A. Martin, P.E., CFEI, CVFI
Fire Protection Engineer



Arthur J. Parker, P.E.
Sr. Fire Protection Engineer

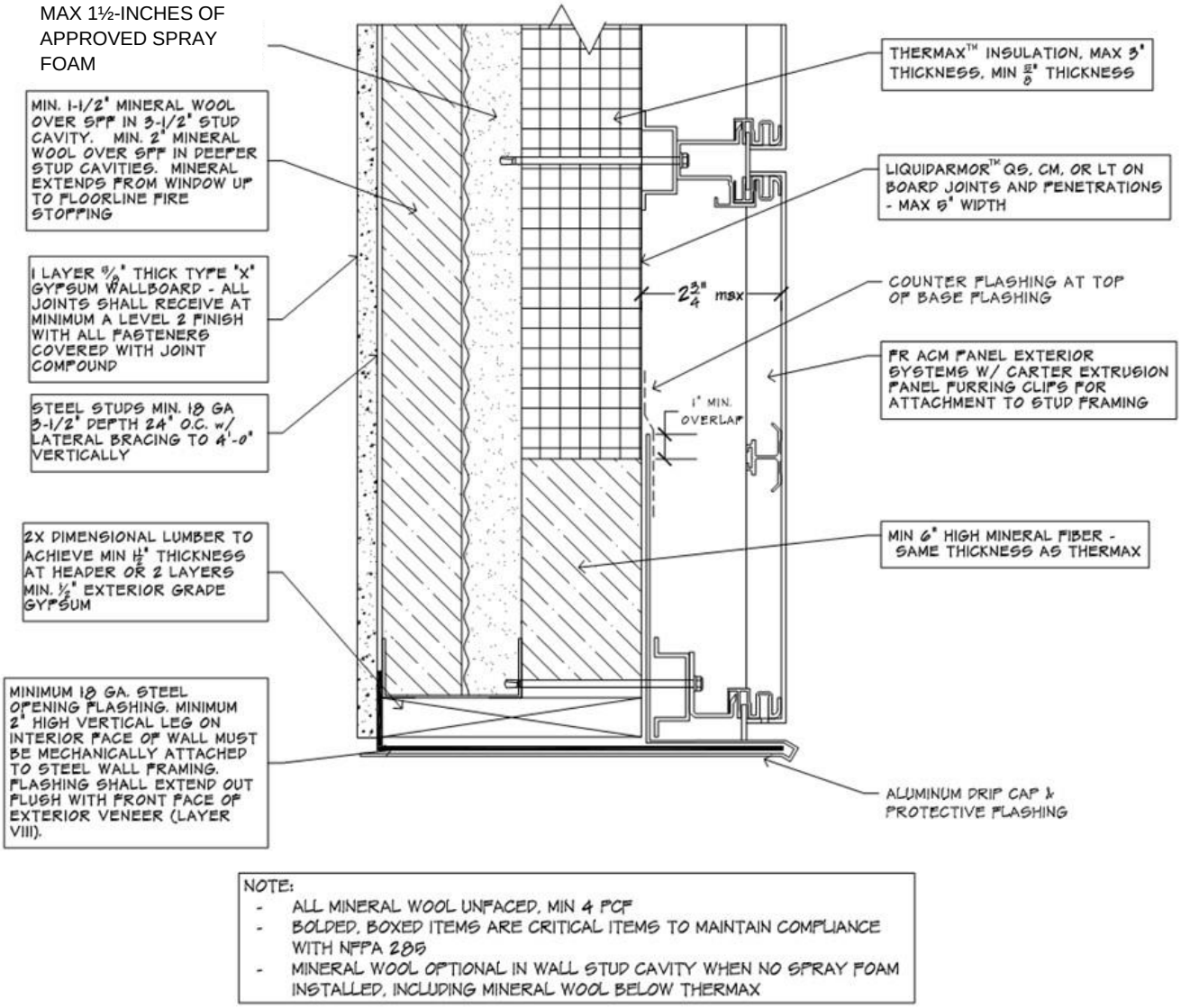


Figure 1. Required Opening Head Protection When Spray Foam Is Used in the Cavity – Option 1

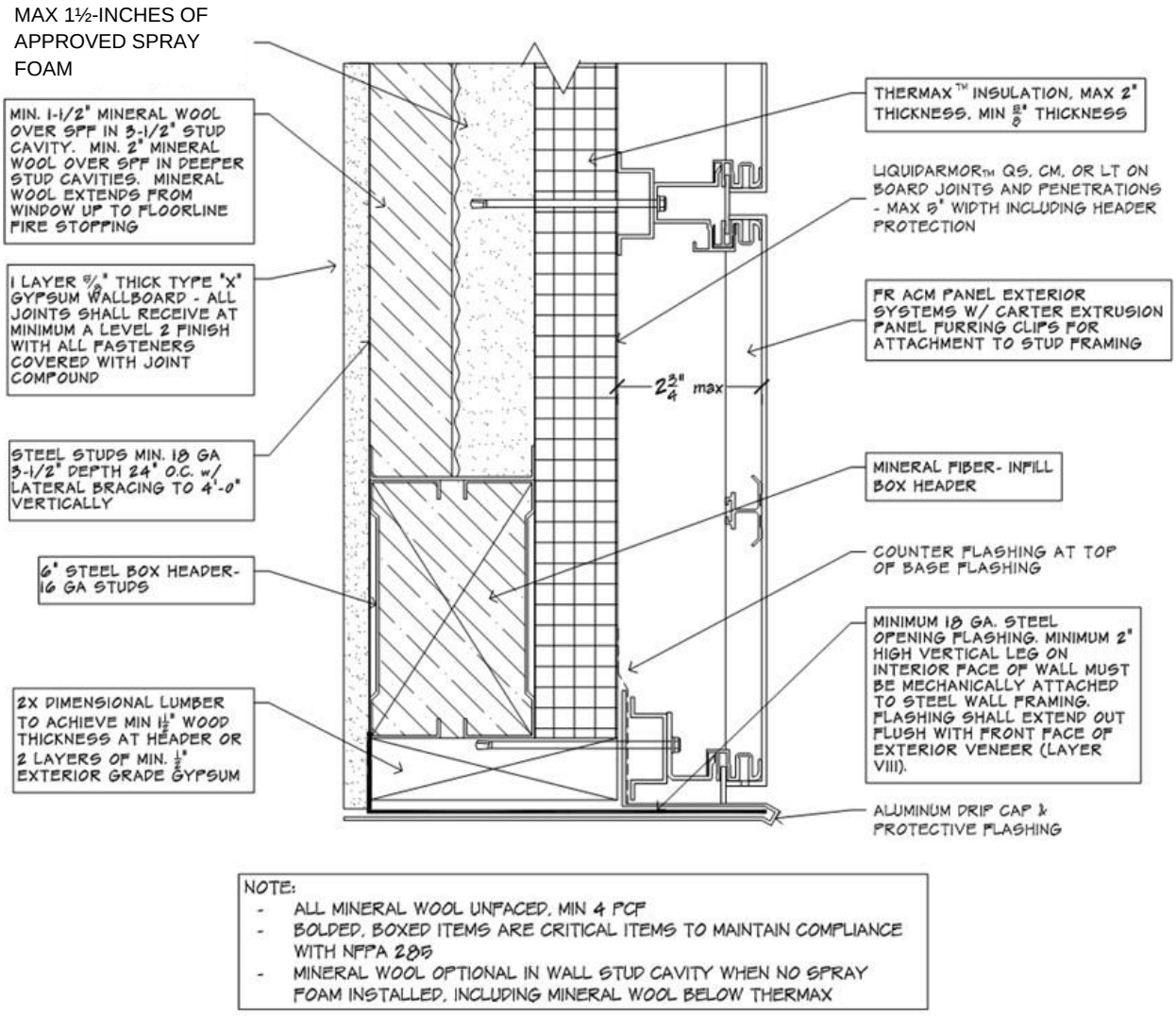


Figure 2. Required Opening Head Protection When Spray Foam Is Used in the Cavity – Option 2

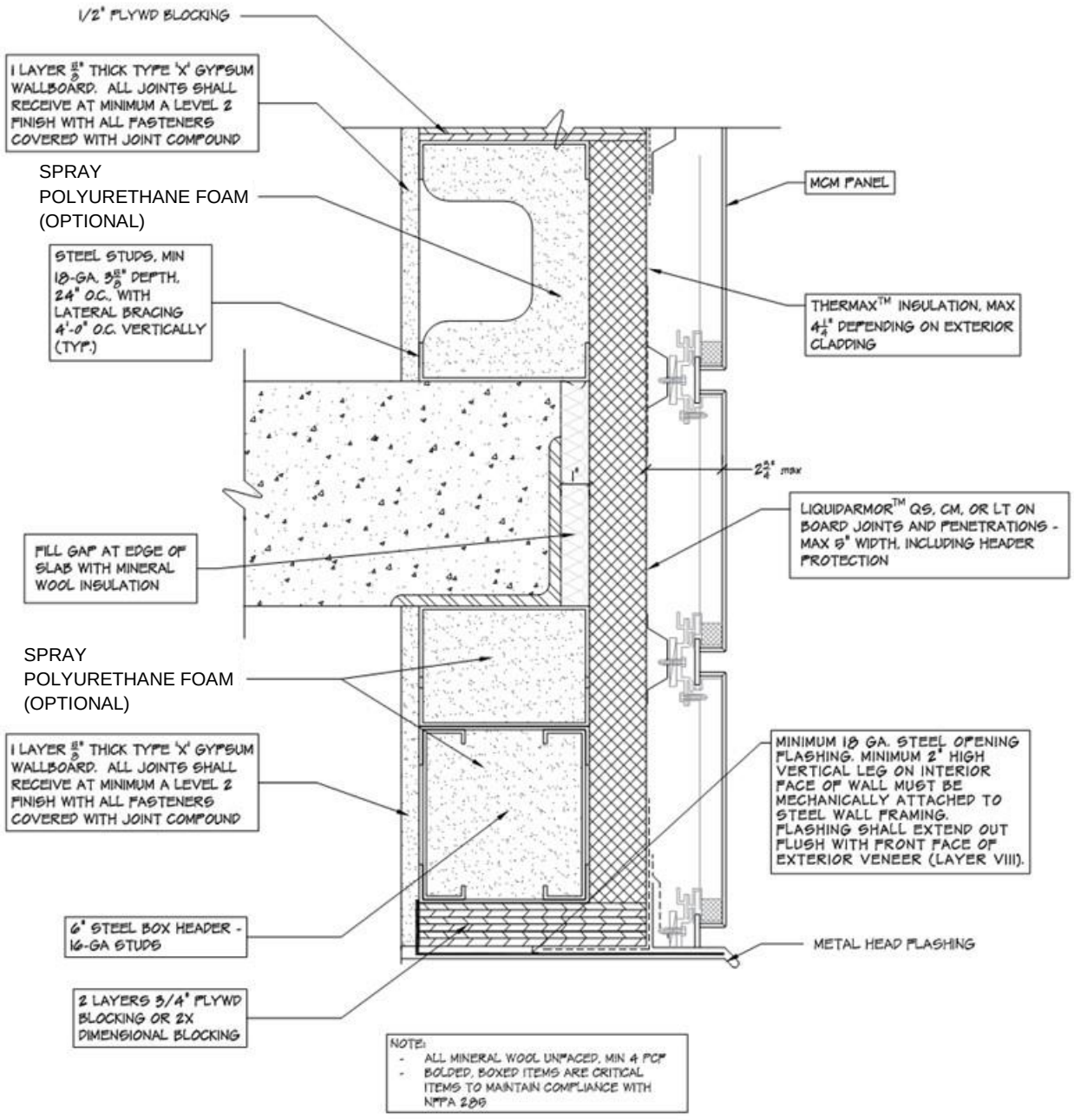


Figure 3. Required Opening Head Protection When Spray Foam Is Used in the Cavity (Infill Wall Construction with ACM Façade)

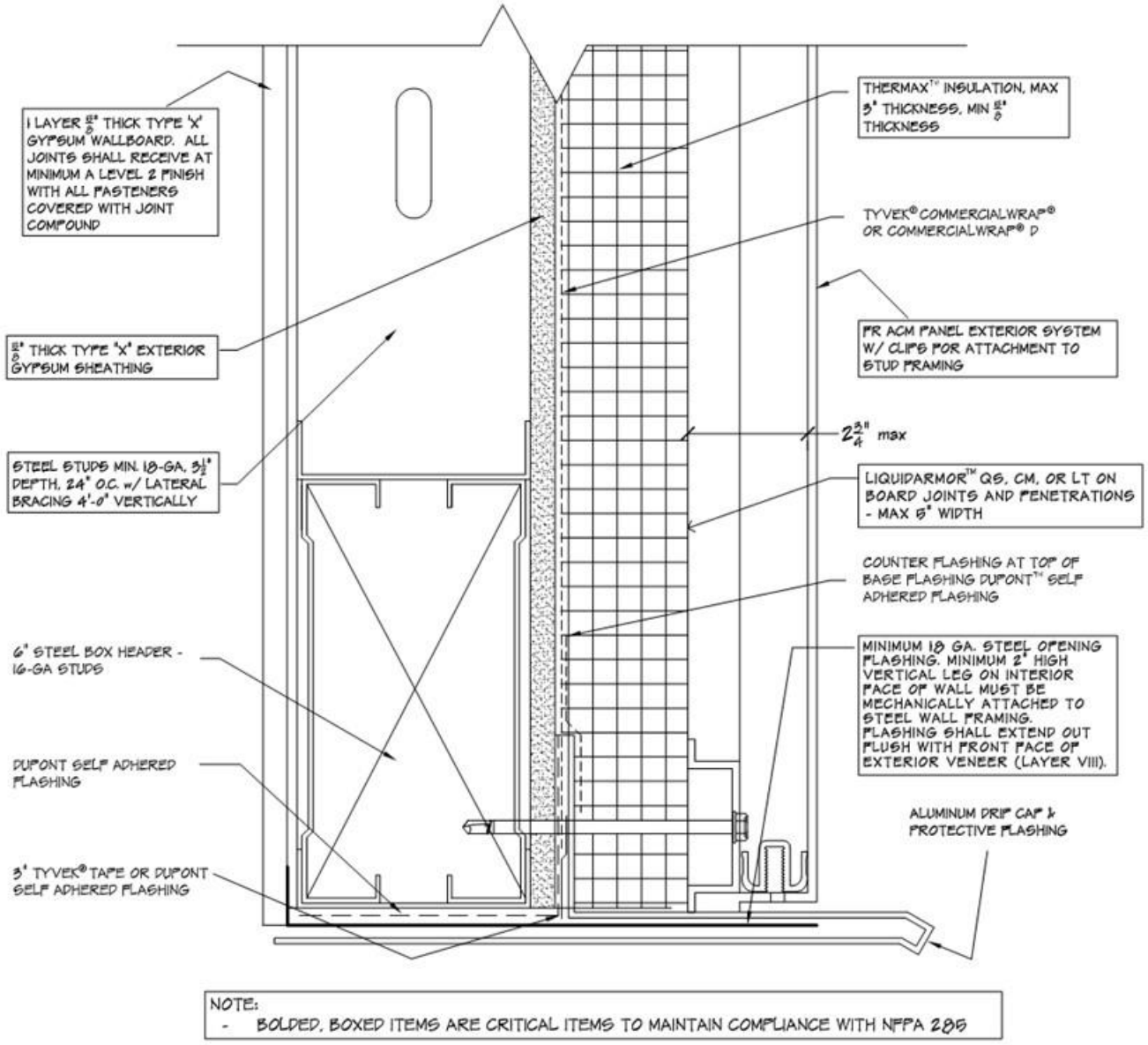


Figure 4. Use of Tyvek® CommercialWrap® or CommercialWrap® D WRB behind Thermax™ insulation

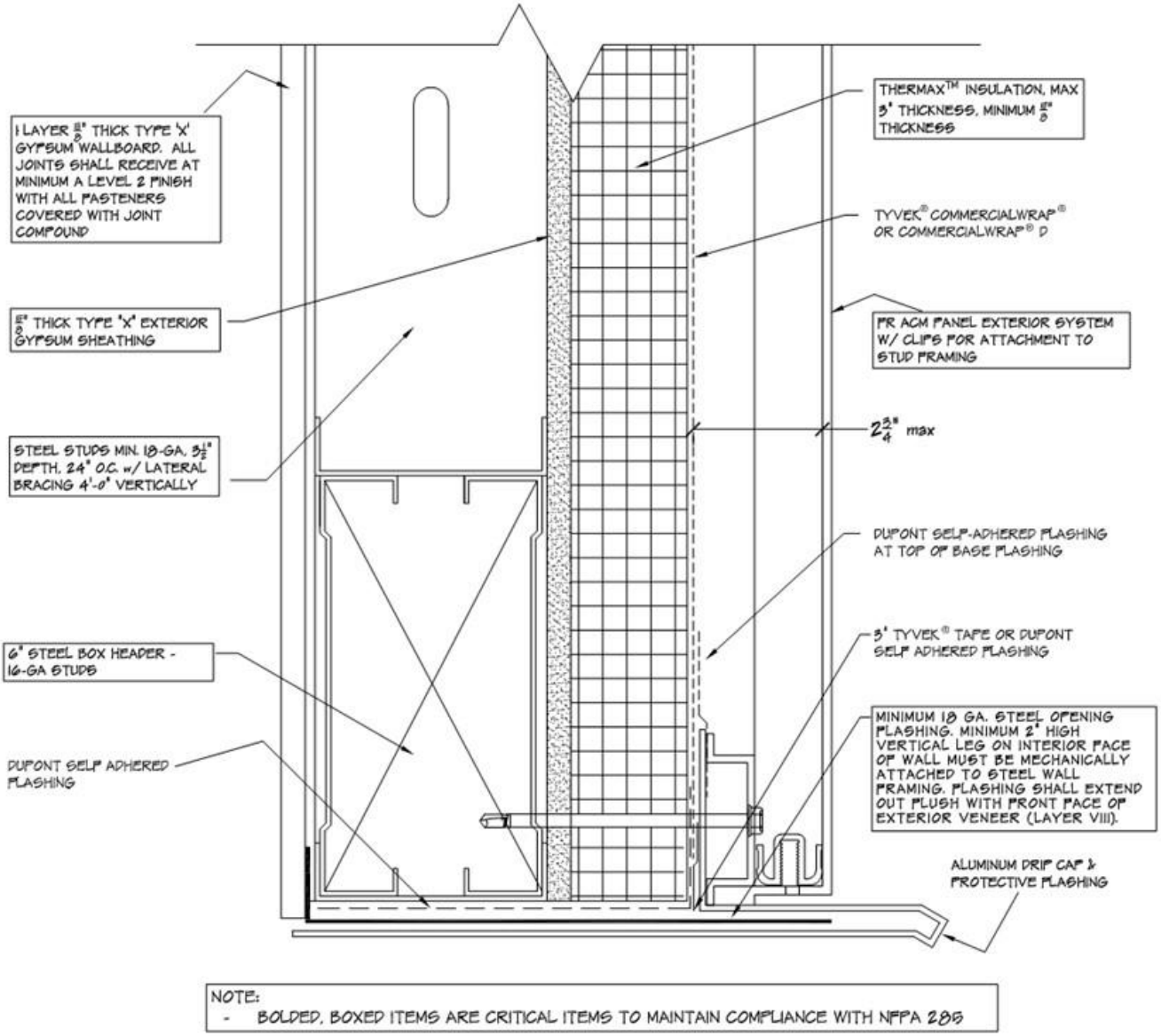


Figure 5. Use of Tyvek® CommercialWrap® or CommercialWrap® D WRB over Thermax™ insulation

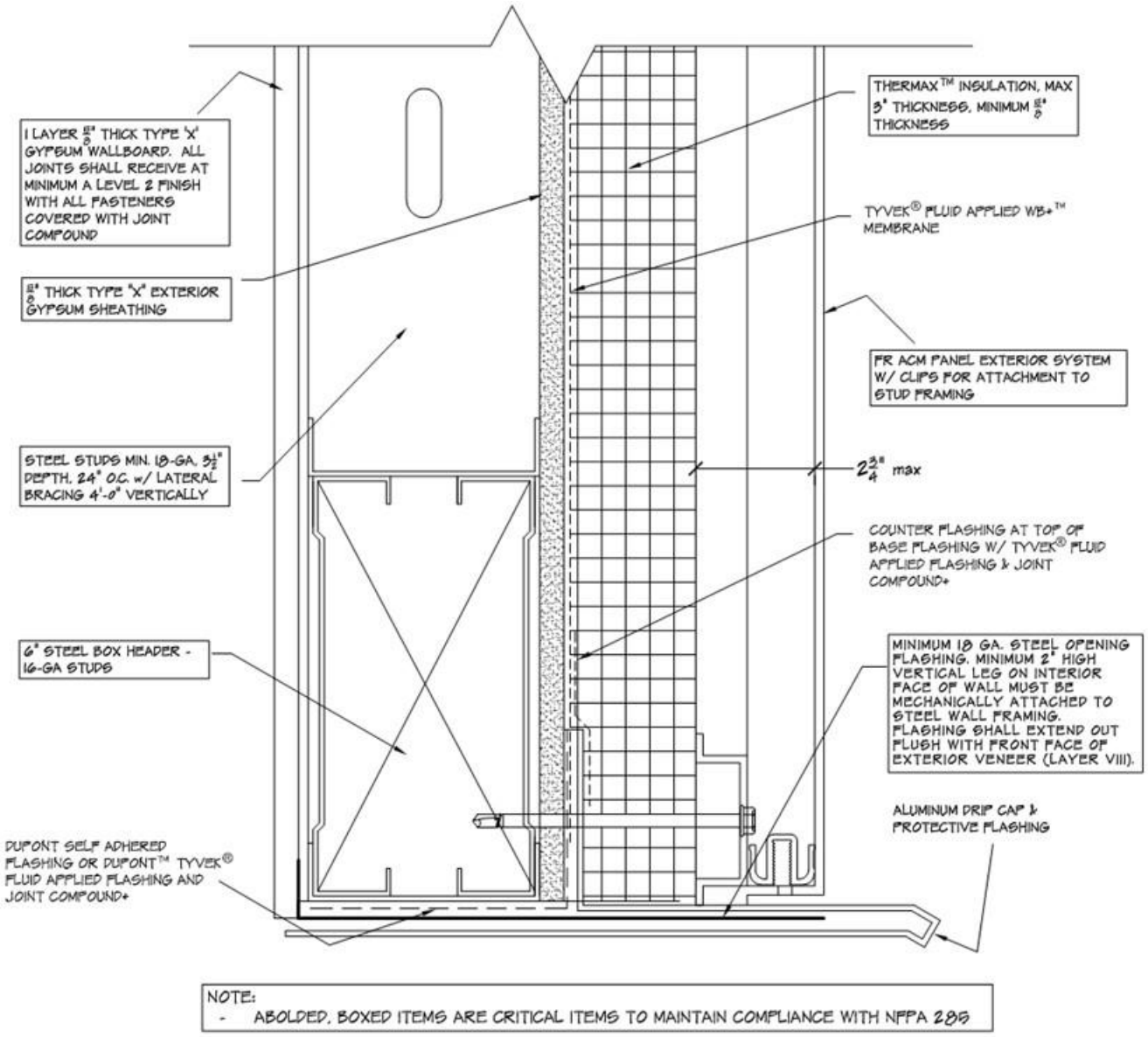


Figure 6. Use of Tyvek® Fluid Applied WB+® WRB behind Thermax™ insulation