



**PRIEST & ASSOCIATES
CONSULTING, LLC**

ENGINEERING EVALUATION

Engineering Extensions based on 15 NFPA 285 Tests

Project No. 10123, Revision 46

Prepared for:

Carlisle Coatings & Waterproofing Incorporated
900 Hensley Lane
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September 14, 2021

Abstract

Fifteen NFPA 285 test reports on various wall designs have been submitted to determine Engineering Extensions on several aspects of wall designs. These include cavity insulation, exterior sheathing, water-resistive barrier (WRB), exterior insulation, exterior WRB, air gaps, claddings, window details, and base wall framing. We have determined that engineering extensions on various components of the tested wall designs can meet the criteria of NFPA 285 with specific limitations.

The conclusions reached by this evaluation are true and correct, within the bounds of sound engineering practice. All reasoning for our decisions is contained within this document.

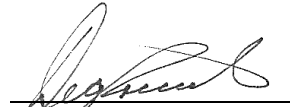
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INTRODUCTION

Fifteen NFPA 285 tests were conducted on various configurations of exterior wall system designs. The designs incorporated many variables, including cavity insulation, exterior sheathing, water-resistive barrier (WRB), exterior insulation, exterior WRB, air gaps, claddings, and window details. The purpose of this evaluation is to determine engineering extensions for the components that can meet the requirements of NFPA 285. An analysis is conducted on the components tested from the wall systems tested, which forms a base wall system from which replacement components can be added. Additionally, several ESR-approved competing wall systems incorporate similar features to the submitted wall systems. Some of the engineering extensions of those systems will also be examined in this evaluation.

SUBSTITUTION TABLES

The analysis results are presented in the following tables that list the allowable substitutions based on the tests submitted and Engineering Extensions as detailed in this report's appendix.

Table 1: R2+ SHEATHE Exterior Insulation (See Notes 1, 2, 3, 4, 5, 6, 7 & 8)

Wall Component	Table 1: R2+ SHEATHE Exterior Insulation Substitution Options
Base Wall Use Item 1, 2, 3 or 4	1) Cast Concrete Walls 2) CMU Concrete Walls 3) 25 GA. min. 3 $\frac{5}{8}$ " (min.) steel studs spaced 24" OC (max.) a. $\frac{5}{8}$ " type X Gypsum Wallboard Interior b. Lateral Bracing every 4 ft 4) FRTW (Fire-retardant-treated wood) studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.) a. $\frac{5}{8}$ in. type X Gypsum Wallboard Interior b. Bracing as required by code
Fire-Stopping at Floor Lines	1) Any approved mineral fiber-based safing insulation in each stud cavity at the floor line Safing thickness must match stud cavity depth. 2) Solid FRTW fire blocking at floor line per building code requirements for Type III construction
Cavity Insulation Use any Item 1 - 13 Items 8, 9, 10, 11, or 12 or 13 may only be used with Exterior Sheathing 2 with specific board thickness as noted to the right where applicable	1) None 2) 1 $\frac{1}{2}$ " (min.) of Carlisle SPI Sealtite Pro (up to full cavity thickness), SealTite PRO Closed Cell, or SealTite PRO One Zero (up to full cavity thickness for each) 3) 1 $\frac{1}{2}$ " (min.) of BASF Walltite SPF (up to full cavity thickness) 4) Any noncombustible insulation per ASTM E136 5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced) 6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced) 7) Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m ² heat flux) and shown by analysis to be less flammable (improved T _{ign} , Pk. HRR) than Carlisle SPI Sealtite Pro or BASF Walltite. 8) NCFI InsulBloc SPF (up to full cavity thickness) 9) Icynene Proseal (MD-C-200v3) up to 5 $\frac{1}{2}$ inches (only with $\frac{1}{2}$ in. (min.) exterior gypsum sheathing) 10) SWD Urethane Quick-Shield 112 up to 6 inches in 6 inch (max.) stud cavities with an air gap not exceeding 2 $\frac{1}{2}$ inches. 11) 1 $\frac{1}{2}$ " (min.) ThermoSeal 2000 (up to full cavity thickness) 12) Demilec HeatLok HFO – Max. 3 $\frac{5}{8}$ " thickness with $\frac{5}{8}$ " exterior gypsum sheathing per ESR 4073 13) Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, or SealTite PRO OCX, – up to full cavity thickness with $\frac{1}{2}$ " (min.) exterior gypsum sheathing
Exterior Sheathing Use Item 1, 2 or 3	1) None (only with Cavity Insulation 1, 2, 3, 4, 5, or 6) 2) $\frac{1}{2}$ " or thicker exterior gypsum sheathing 3) $\frac{1}{2}$ " (min.) FRTW structural panels in Type III construction



Wall Component	Table 1: R2+ SHEATHE Exterior Insulation Substitution Options
WRB Over Base Wall Surface Use Item 1, 2, 3 or 4	<ol style="list-style-type: none"> 1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP, Fire Resist 705 FR-A, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP. Fire Resist 705 VP may be used with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives. Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives 2) CCW-705 with 702 LV, 702 WB, Cav-Grip, Low VOC Travel-Tack, or 702 adhesives may be used with R2+ SHEATHE or unfaced noncombustible insulation and cladding Options 1 - 6. Note – Use any CCW WRB on the base wall surface with any cladding listed below if the insulation covering the WRB is 2" (min.) 4 pcf (min.) noncombustible mineral wool. 3) Other WRBs - See Table 5 4) CCW Barriseal - may be used on the base wall surface only under mineral wool meeting ASTM E136 and at least 2" thick, 4 pcf density minimum
Exterior Insulation Use Item 1, 2, 3, or 4 depending on the cladding	<ol style="list-style-type: none"> 1) 3½" thick (max.) R2+ SHEATHE for all claddings listed 2) 4" thick R2+ SHEATHE for Claddings 1 - 6 3) Any noncombustible insulation (faced or unfaced) 4) Any exterior insulation tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than those listed above.
WRB Over Exterior Insulation Use 1 or 2	<ol style="list-style-type: none"> 1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives), Fire Resist 705 FR-A (with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives), Fire Resist Barritech VP, Fire Resist Barritech NP (or NP LT) 2) Other WRBs – See Table 5
Exterior Cladding Use Item 1 - 17 Item 7 may use any tested/approved installation technique. Items 8, 9, and 12 may use any standard installation technique.	<ol style="list-style-type: none"> 1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath For systems that require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/external insulation and the lath. 3) Limestone – minimum 2" thick using any standard non-open joint installation technique such as shiplap 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as grouted/mortared stone 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap 7) Any MCM that has successfully passed NFPA 285 8) Uninsulated sheet metal building panels including steel, copper, aluminum, or zinc 9) ¼ inch (min.) uninsulated fiber-cement siding or porcelain or ceramic tile mechanically attached 10) Stone, porcelain, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria 11) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 criteria 12) Terra Cotta Cladding – Any Rain-screen Terra Cotta (min. ½" thick) with ventilated shiplap 13) ½ inch Stucco – Any one coat stucco (½ inch min.) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes



Wall Component	Table 1: R2+ SHEATHE Exterior Insulation Substitution Options
	<p>14) Thin brick/cultured stone set in thin-set adhesive and metal lath that has been tested to ASTM E119 (brick exposed to furnace) and remains in place for a minimum of 30 minutes or has passed an NFPA 285 test (Minimum $\frac{3}{4}$") For these systems, which require a more durable WRB system, any building wrap or 15# felt that meets Requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/AVP and the lath.</p> <p>15) Glen Gery Thin Tech Elite Series Masonry Veneer, TABS II Panel System with $\frac{1}{2}$" thick bricks using TABS Wall Adhesive or Brick It MCS & CI Panel Systems</p> <p>16) Natural Stone Veneer – minimum $\frac{1}{4}$" thick using any standard installation technique</p> <p>17) FunderMax M.Look Grey Core – minimum $\frac{1}{4}$ inch thick using any standard installation technique</p>

Table 2: R2+ MATTE or R2+ MATTE (Class A) Exterior Insulation (See Notes 1, 2, 3, 4, 5, 6, 7 & 8)

Wall Component	Table 2: R2+ MATTE or R2+ MATTE (Class A) Exterior Insulation Substitution Options
Base Wall Use Item 1, 2, 3 or 4	<ol style="list-style-type: none"> 1) Cast Concrete Walls 2) CMU Concrete Walls 3) 25 GA. min. $3\frac{5}{8}$" (min.) steel studs spaced 24" OC (max.) <ol style="list-style-type: none"> a. $\frac{5}{8}$" type X Gypsum Wallboard Interior b. Lateral Bracing every 4 ft 4) FRTW studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.) <ol style="list-style-type: none"> a. $\frac{5}{8}$ in. type X Gypsum Wallboard Interior b. Bracing as required by building code
Fire-Stopping at Floor Lines	<ol style="list-style-type: none"> 1) Any approved mineral fiber-based safing insulation in each stud cavity at the floor line Safing thickness must match stud cavity depth. 2) Solid FRTW fire blocking at floor line per building code requirements for Type III construction
Cavity Insulation Use Item 1 - 13 Items 8, 9, 10, 11, or 12 or 13 may only be used with Exterior Sheathing #2 with specific board thickness as noted to the right where applicable	<ol style="list-style-type: none"> 1) None 2) $1\frac{1}{2}$" (min.) of Carlisle SPI Sealtite Pro (up to full cavity thickness), SealTite PRO Closed Cell, or SealTite PRO One Zero (up to full cavity thickness for each) 3) $1\frac{1}{2}$" (min.) of BASF Walltite SPF (up to full cavity thickness) 4) Any noncombustible insulation per ASTM E136 5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced) 6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced) 7) Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than Carlisle SPI Sealtite Pro or BASF Walltite. 8) NCFI InsulBloc SPF (up to full cavity thickness) 9) Icynene Proseal (MD-C-200v3) up to 5½ inches (only with $\frac{1}{2}$ in. (min.) exterior gypsum sheathing) 10) SWD Urethane Quick-Shield 112 up to 6 inches in 6 inch (max.) stud cavities with an air gap not exceeding 2½ inches 11) $1\frac{1}{2}$" (min.) ThermoSeal 2000 (up to full cavity thickness) 12) Demilec HeatLok HFO – Max. $3\frac{5}{8}$" thickness with $\frac{5}{8}$" exterior gypsum sheathing per ESR 4073 13) Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, or SealTite PRO OCX – up to full cavity thickness with $\frac{1}{2}$" (min.) exterior gypsum sheathing
Exterior Sheathing Use Item 1, 2 or 3	<ol style="list-style-type: none"> 1) None (only with Claddings 1 – 6, and cavity insulation 1, 2, 3, 4, 5, 6) – also see note for Cavity Insulation) 2) $\frac{1}{2}$" or thicker exterior gypsum sheathing



Wall Component	Table 2: R2+ MATTE or R2+ MATTE (Class A) Exterior Insulation Substitution Options
WRB Over Base Wall Surface Use Item 1, 2 or 3	3) ½" (min.) FRTW structural panels in Type III construction 1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP, Fire Resist 705 FR-A, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP. Fire Resist 705 VP may be used with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives. Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives 2) Other WRBs - See Table 5 3) CCW Barriseal - may be used on the base wall surface only under mineral wool meeting ASTM E136 and at least 2" thick, 4 pcf density minimum
Exterior Insulation Use Item 1, 2, 3 or 4	1) 3½" thick (max.) R2+ MATTE or R2+ MATTE (Class A) for all claddings listed 2) 4" thick (max) R2+ MATTE or R2+ MATTE (Class A) for claddings 1-6 3) Any noncombustible insulation (faced or unfaced). 4) Any exterior insulation tested per ASTM E1354 (at a minimum of 20 kW/m ² heat flux) and shown by analysis to be less flammable (improved T _{ign} , Pk. HRR) than those listed above.
WRB Over Exterior Insulation Use Item 1 or 2	1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives), Fire Resist 705 FR-A (with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives), Fire Resist Barritech VP, Fire Resist Barritech NP (or NP LT) 2) Other WRBs – See Table 5
Exterior Cladding Use any Item 1 - 17 Item 7 may use any tested/approved installation technique. Items 8, 9, and 12 may use any standard installation technique.	1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath. For systems that require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/exterior insulation and the lath 3) Limestone – minimum 2" thick using any standard non-open joint installation technique such as shiplap 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as grouted/mortared stone 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap 7) Any MCM that has successfully passed NFPA 285 8) Uninsulated sheet metal building panels including steel, copper, aluminum 9) ¼ inch (min.) uninsulated fiber-cement siding or porcelain or ceramic tile mechanically attached 10) Stone, porcelain, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria 11) Autoclaved-Aerated-Concrete (AAC) panels that have successfully passed NFPA 285 criteria 12) Terra Cotta Cladding – Any Rain-screen Terra Cotta (min. ½" thick) with ventilated shiplap 13) ½ inch Stucco – Any one coat stucco (½ inch min.) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes 14) Thin brick/cultured stone set in thin-set adhesive and metal lath that has been tested to ASTM E119 (brick exposed to furnace) and remains in place for a minimum of 30 minutes or has passed an NFPA 285 test (Minimum ¾") For these systems, which require a more durable WRB system, any building wrap or 15# felt that meets Requirement #11 in



Wall Component	Table 2: R2+ MATTE or R2+ MATTE (Class A) Exterior Insulation Substitution Options
	<p>"WRB over Exterior Insulation" can be used as a slip sheet between the WRB/AVP and the lath.</p> <p>15) Glen Gery Thin Tech Elite Series Masonry Veneer or TABS II Panel System with ½" thick bricks using TABS Wall Adhesive or Brick It MCS & CI Panel Systems</p> <p>16) Natural Stone Veneer – minimum 1¼ in. thick using any standard installation technique</p> <p>17) FunderMax M.Look Grey Core – minimum ¼ inch thick using any standard installation technique</p>

Table 3: R2+ SILVER Exterior Insulation (See Notes 1, 2, 3, 4, 5, 6, 7 & 8)

Wall Component	Table 3: R2+ SILVER Exterior Insulation Substitution Options
Base Wall – Use either 1, 2, 3 or 4	<p>1) Concrete Walls</p> <p>2) CMU Concrete Walls</p> <p>3) 25 GA. min. 3⅝" (min.) steel studs spaced 24" OC (max.)</p> <p>a. ⅝" type X Gypsum Wallboard Interior</p> <p>b. Lateral Bracing every 4 ft</p> <p>4) FRTW studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.)</p> <p>a. ⅝" type X Gypsum Wallboard Interior</p> <p>b. Bracing as required by code</p>
Fire-Stopping at Floor Lines	<p>1) Any approved mineral fiber-based safing insulation in each stud cavity at the floor line</p> <p>Safing thickness must match stud cavity depth.</p> <p>2) Solid FRTW fire blocking at floor line per building code requirements for Type III construction</p>
Cavity Insulation Use any Item 1 - 13 Items 2, 3, 8, 9, 10, 11, or 12 or 13 may only be used with Exterior Sheathing 2 with specific board thickness as noted to the right where applicable	<p>1) None</p> <p>2) 1½" (min.) of Carlisle SPI SealTite Pro (up to full cavity thickness), SealTite PRO Closed Cell, or SealTite PRO One Zero (up to full cavity thickness for each)</p> <p>3) 1½" (min.) of BASF Walltite SPF (up to full cavity thickness)</p> <p>4) Any noncombustible insulation per ASTM E136</p> <p>5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced)</p> <p>6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced)</p> <p>7) Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than Carlisle SPI SealTite Pro or BASF Walltite.</p> <p>8) NCFI InsulBloc SPF (up to full cavity thickness)</p> <p>9) Icynene Proseal (MD-C-200v3) up to 5½ inches (only with ½ in. (min.) exterior gypsum sheathing)</p> <p>10) SWD Urethane Quick-Shield 112 up to 6 inches in 6 inch (max.) stud cavities with an air gap not exceeding 2½ inches.</p> <p>11) 1½" (min.) ThermoSeal 2000 (up to full cavity thickness)</p> <p>12) Demilec HeatLok HFO – Max. 3⅝" thickness with ⅝" exterior gypsum sheathing per ESR 4073</p> <p>13) Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, or SealTite PRO OCX – up to full cavity thickness with ½" (min.) exterior gypsum sheathing</p>
Exterior Sheathing Use Item 1, 2 or 3	<p>1) None (only with cavity insulation 1, 4, 5, or 6)</p> <p>2) ½" or thicker exterior gypsum sheathing</p> <p>3) ½" (min.) FRTW structural panels in Type III construction are allowed in place of gypsum sheathing when combustible cavity insulation is not used.</p>
WRB Over Base Wall Surface Use Item 1, 2 or 3	<p>1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP, Fire Resist 705 FR-A, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP. Fire Resist 705 VP may be used with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives. Fire Resist 705 FR-A may be used with</p>



Wall Component	Table 3: R2+ SILVER Exterior Insulation Substitution Options
	CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives 2) Other WRBs - See Table 5 3) CCW Barriseal - may be used on the base wall surface only under mineral wool meeting ASTM E136 and at least 2" thick, 4 pcf density minimum
Exterior Insulation Use Item 1, 2 or 3	1) 4" thick (max.) R2+ SILVER 2) Any noncombustible insulation (faced or unfaced) 3) Any exterior insulation which has been tested per ASTM E1354 (at a minimum of 20 kW/m ² heat flux) and shown by analysis to be less flammable (improved T _{ign} , Pk. HRR) than those listed above R2+Silver may be used with or without CavClear drainage mat (CavClear insulation system)
WRB Over Exterior Insulation Use Item 1 or 2	1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives), Fire Resist 705 FR-A (with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives), Fire Resist Barritech VP, Fire Resist Barritech NP (or NP LT) 2) Other WRBs – See Table 5
Exterior Cladding Use any Item 1 - 6	1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath For systems that require a more durable WRB system, any building wrap or 15# felt that meets Requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/external insulation and the lath. 3) Limestone – minimum 2" thick using any standard non-open joint installation technique such as shiplap 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as grouted/mortared stone 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap

Table 4: R2+ BASE (or R2+ Base (Class A) Exterior Insulation (See Notes 1, 2, 3, 4, 5, 6, 7 & 8)

Wall Component	Table 4: R2+ BASE (or R2+ Base (Class A) Exterior Insulation Substitution Options
Base Wall Use Item 1, 2, 3 or 4	1) Cast Concrete Walls 2) CMU Concrete Walls 3) 25 GA. min. 3⅝" (min.) steel studs spaced 24" OC (max.) a. ⅝" type X Gypsum Wallboard Interior b. Lateral Bracing every 4 ft 4) FRTW studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.) a. ⅝" type X Gypsum Wallboard Interior b. Bracing as required by code
Fire-Stopping at Floor Lines	1) Any approved mineral fiber-based safing insulation in each stud cavity at the floor line Safing thickness must match stud cavity depth. 2) Solid FRTW fire blocking at floor line per building code requirements for Type III construction
Cavity Insulation Use any Item 1 - 13 Items 3, 8, 9, 10 & 11 or 12 or 13 may only be used with Exterior Sheathing #2 with	1) None 2) 1½" (min.) of Carlisle SPI Sealtite Pro (up to full cavity thickness), SealTite PRO Closed Cell, or SealTite PRO One Zero (up to full cavity thickness for each) 3) 1½" (min.) of BASF Walltite SPF (up to full cavity thickness) 4) Any noncombustible insulation per ASTM E136 5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced)



Wall Component	Table 4: R2+ BASE (or R2+ Base (Class A) Exterior Insulation Substitution Options
specific board thickness as noted to the right where applicable	6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced) 7) Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m ² heat flux) and shown by analysis to be less flammable (improved T _{ign} , Pk. HRR) than Carlisle SPI Sealtite Pro or BASF Walltite. 8) NCFI InsulBloc SPF (up to full cavity thickness) 9) Icynene Proseal (MD-C-200v3) up to 5½ inches (only with ½ in. (min.) exterior gypsum sheathing) 10) SWD Urethane Quick-Shield 112 up to 6 inches in 6 inch (max.) stud cavities with an air gap not exceeding 2½ inches. 11) 1½" (min.) ThermoSeal 2000 (up to full cavity thickness) 12) Demilec HeatLok HFO – Max. 3⅝" thickness with ⅝" exterior gypsum sheathing per ESR 4073 13) Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, or SealTite PRO OCX – up to full cavity thickness with ½" (min.) exterior gypsum sheathing
Exterior Sheathing Use Item 1, 2 or 3	1) None (only with cavity insulation 1, 2, 4, 5, or 6) – Also see note for cavity insulation 2) ½" or thicker exterior gypsum sheathing 3) ½" (min.) FRTW structural panels in Type III construction.
WRB Over Base Wall Surface Use Item 1, 2 or 3	1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP, Fire Resist 705 FR-A, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP. Fire Resist 705 VP may be used with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives. Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives 2) Other WRBs - See Table 5 3) CCW Barriseal - may be used on the base wall surface only under mineral wool meeting ASTM E136 and at least 2" thick, 4 pcf density minimum
Exterior Insulation Use Item 1, 2, 3, or 4. Items 1 and 2 depend on the cladding used.	1) 4.25" (max.) R2+ BASE (R2+ Base (Class A))(3.5-inch foam max., ¾ inch FR Plywood max.) with all claddings listed 2) 4¾ inch (max.) R2+ BASE (R2+ Base (Class A) (4" foam max, ¾" FR Plywood max) may be used with claddings 1-6 3) Any noncombustible insulation (faced or unfaced) 4) Any exterior insulation which has been tested per ASTM E1354 (at a minimum of 20 kW/m ² heat flux) and shown by analysis to be less flammable (improved T _{ign} , Pk. HRR) than those listed above
WRB Over Exterior Insulation Use Item 1 or 2	1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives), Fire Resist 705 FR-A (with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives), Fire Resist Barritech VP, Fire Resist Barritech NP (or NP LT) 2) Other WRBs – See Table 5
Exterior Cladding Use any Item 1 - 17 Item 9 may use any tested/approved installation technique. Items 10, 11 & 14 may use any standard installation technique.	1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath For systems that require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/external insulation and the lath 3) Limestone – minimum 2" thick using any standard non-open joint installation technique such as shiplap 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as grouted/mortared stone 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap



Wall Component	Table 4: R2+ BASE (or R2+ Base (Class A) Exterior Insulation Substitution Options
	<p>6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap</p> <p>7) Thin brick/cultured stone set in thin-set adhesive and metal lath that has been tested to ASTM E119 (brick exposed to furnace) and remains in place for a minimum of 30 minutes, or has passed an NFPA 285 test (Minimum ¾")</p> <p>For these systems, which require a more durable WRB system, any building wrap or 15# felt that meets Requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/AVP and the lath.</p> <p>8) Glen Gery Thin Tech Elite Series Masonry Veneer or TABS II Panel System with ½" thick bricks using TABS Wall Adhesive or Brick It MCS & CI Panel Systems</p> <p>9) Any MCM that has successfully passed NFPA 285</p> <p>10) Uninsulated sheet metal building panels including steel, copper, aluminum</p> <p>11) ¼ inch (min.) Uninsulated Fiber-cement siding or porcelain or ceramic tile mechanically attached</p> <p>12) Stone, porcelain, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria</p> <p>13) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 criteria</p> <p>14) Terra Cotta Cladding – Any Rain-screen Terra Cotta (min. ½ " thick) with ventilated shiplap</p> <p>15) ½ inch Stucco – Any one coat stucco (½ inch min) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes</p> <p>16) Natural stone veneer – minimum 1¼" thick using any standard installation technique.</p> <p>17) FunderMax M.Look Grey Core – minimum ¼ inch thick using any standard installation technique</p>

Table 5: Allowable Alternate WRBs for Tables 1 - 4

Wall Component	Table 5: Allowable Alternate WRBs
Multi-Function Sheathing & WRB Products Use Item 1 or 2	<p>1) USG Securock® Exoair® 430 System</p> <p>2) ⅝ inch Georgia Pacific DensElement flashed with Prosoco R-Guard FastFlash on sheathing joints</p> <p>Note: Items 1 or 2 replace the exterior sheathings in Tables 1 - 4. When either of these items is used, do not use exterior sheathings or WRBs on the base wall surface in Tables 1 - 4 or the WRBs listed below (WRB Over Base Wall Surface).</p>
WRB Over Base Wall Surface Use any Item 1 - 21 Note – Some WRBs are only allowed with specific systems	<p>1) None</p> <p>2) GE Momentive SEC 2500 SiShield, Elemax 2600</p> <p>4) VaproShield WrapShield SA, RevealShield SA</p> <p>5) WR Grace Permabarrier VPS, Perm-A-Barrier NPL (AKA: PAB NP20), Perm-A-Barrier® VPL, Perm-A-Barrier® Aluminum Wall Membrane (AWM), Perm-A-Barrier VPL LT</p> <p>The following may only be used with Claddings 1 – 6: Perm-A-Barrier NPL 10, Perm-A-Barrier VPL 50</p> <p>6) StoGuard Vaporseal</p> <p>7) 3M 3015 (with Hold Fast 70 adhesive @ 6 mils)</p> <p>8) Henry Air-Bloc 21S, AB 33MR, AB 31MR, AB 17MR, AB 16MR, AB 32MR (only with R2+ BASE), Blueskin SA (only with R2+ SHEATHE and Claddings 1 - 6)</p> <p>9) Tyvek CommercialWrap or CommercialWrap D, Fluid Applied WB (only with R2+ BASE)</p>



Wall Component	Table 5: Allowable Alternate WRBs
	<ol style="list-style-type: none"> 10) PolyGuard Air Lok Flex VP, FlexGuard, Air Lok Flex (Only with Claddings 1 - 6) 11) Prosoco R-Guard Cat 5, R-Guard Cat 5 Rainscreen, R-Guard VB, or R-Guard Spray Wrap MVP 12) Dryvit Backstop NT 13) WR Meadows Air Shield LMP (Gray), Air Shield LMP (Black), Air Shield TMP, Air Shield LSR 14) Any WRB which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than those listed above 15) Dörken Systems Inc., Delta-Vent SA, Delta-Vent S, Delta-Fassade S, Delta Maxx or Delta Stratus SA 16) Enershield HP or Enershield I 17) Siga Majvest or Majvest 500 SA 18) Soprema Sopraseal Stick VP, Soprasolin HD, LM 204 VP, Soprema Stick 1100T with Mammoth Elastocol 600c Primer (1100T only for use with R2+MATTE, R2+Silver, R2+Base) 19) Pecora XL-Perm^{ULTRA} VP, XL-Perm^{ULTRA} NP, ProPerm VP 20) Sto Gold Coat or Emerald Coat 21) Tremco ExoAir 230 or ExoAir 130 22) Dow DefendAir 200C
<p>WRB Over Exterior Insulation Use any Item 1 - 18</p> <p>Note – Some WRBs are only allowed with specific systems</p>	<ol style="list-style-type: none"> 1) None 2) GE Momentive SEC 2500 SilShield, Elemax 2600 3) VaproShield WrapShield SA, RevealShield SA 4) Grace Perm-A-Barrier NPL (AKA: PAB NP20), Perm-A-Barrier® VPL, Perm-A-Barrier® Aluminum Wall Membrane (AWM), Perm-A-Barrier VPL LT, Perm-A-Barrier VPS 5) Henry Air-Bloc 21S, AB 33MR, AB 31MR, AB 17MR, AB 16MR, VP 160 (only with R2+ BASE) 6) Tyvek CommercialWrap 7) PolyGuard Air Lok Flex VP, FlexGuard, Air Lok Flex (only with claddings 1-6) 8) Prosoco R-Guard Cat 5, R-Guard Cat 5 Rainscreen, R-Guard VB, or R-Guard Spray Wrap MVP 9) Sto Gold coat or Emerald Coat (only with R2+ BASE) 10) Dryvit Backstop NT 11) Any WRB which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than those listed above 12) WR Meadows Air Shield LMP (Gray), Air Shield LMP (Black), Air Shield TMP, Air Shield LSR 13) 3" AlumaGRIP 701 or 4" FG-1402 joint tape may be interchanged. (Hardcast AFT is a rebrand of AlumaGRIP 701) 14) Cosella-Dörken Products Inc., Delta-Vent SA, Delta-Vent S, Delta-Fassade S, Delta Maxx 15) Siga Majvest (for all claddings) or Majvest 500 SA (for claddings 1-6) 16) Soprema Sopraseal Stick VP (with Claddings 1 - 6 – not with R2+Silver), Soprasolin HD 17) Pecora XL-Perm^{ULTRA} VP, XL-Perm^{ULTRA} NP, ProPerm VP 18) Dow DefendAir 200C

Note 1: The following adhesives may be used for attachment of R2+ SHEATHE, R2+ MATTE, R2+ MATTE (CLASS A), or R2+ SILVER

- 1) Adhesive applied discontinuously at a rate of ¾" X 3" dabs, 16" OC: LM 800 XL or **BarriBond** or **BarriBond XL**
- 2) Aerosol adhesive at application rate as per mfg. instructions: CAV-GRIP™ or Low VOC Travel-Tack



Note 2: The following may be used as a gap-filler between insulation panels

- a. FOMO HandiFoam Fireblock
- b. TVM Fireblock
- c. DuPont Great Stuff PRO Gaps & Cracks Insulating Foam

Note 3: These CCW detailing materials may be used over the base wall assembly. The detailing materials can be used alone or with any approved WRB for the assembly.

- 1) Board Joint Treatments:
 - a. 2" x 40 mil ribbon of **BarriBond** or **BarriBond XL**
 - b. 4" DCH Reinforcing Fabric embedded in Fire-Resist Barritech VP/NP/NP LT or embedded in Fire Resist Barrithane VP
 - c. 4" Foil-GRIP 1402*
 - d. 4" AlumaGRIP 701*
- 2) Termination Mastic for Flashing/Membrane: 1" X 40 mil ribbon or tooled 3/8" bead of SURE-SEAL Lap Sealant, CCW-704, LM 800 XL, **BarriBond**, or **BarriBond XL**
- 3) Detail Flashing, 3" on each side, at Openings, Terminations, Penetrations, Transitions and Angle Changes
 - a. CCW-705/XLT*, CCW-705 TWF/XLT* or Fire Resist 705 FR-A/XLT*
 - b. SURE-SEAL P/S Elastoform* or SURE-SEAL P/S Cover Strip*
 - c. LiquiFiber or DCH Reinforcing Fabric embedded in Barritech VP/NP/NP LT
 - d. 40 mil application of **BarriBond**, **BarriBond XL**, or Barrithane VP

*Prepare the surface as recommended by CCW using CCW-702, CCW-702 LV, CCW-702 WB, CCW-715, Low VOC Travel-Tack, CAV-GRIP, HP 250 Primer, or Low VOC EPDM Primer per instructions on Product Data Sheet

Note 4: These CCW detailing materials may be used over the CCW polyiso insulation; R2+ SHEATHE, R2+ MATTE, R2+ MATTE (CLASS A), R2+ SILVER, R2+ BASE, or R2+ BASE (Class A). The detailing materials can be used alone or with any approved WRB for the assembly.

- 1) Board Joint Treatments:
 - a. 2" x 40 mil ribbon of **BarriBond** or **BarriBond XL**
 - b. 4" DCH Reinforcing Fabric embedded in Fire-Resist Barritech VP/NP/NP LT or embedded in Fire Resist Barrithane VP
 - c. 4" Foil-GRIP 1402*
 - d. 4" AlumaGRIP 701*
- 2) Termination Mastic for Flashing/Membrane: 1" X 40 mil ribbon or tooled 3/8" bead of SURE-SEAL Lap Sealant, LM 800 XL, **BarriBond**, or **BarriBond XL**
- 3) Detail Flashing, 3" on each side at Openings, Terminations, Penetrations, Transitions and Angle Changes
 - a. Fire Resist 705 FR-A/XLT*
 - b. SURE-SEAL P/S Elastoform* or SURE-SEAL P/S Cover Strip*
 - c. LiquiFiber or DCH Reinforcing Fabric embedded in Barritech VP/NP/NP LT
 - d. 40 mil application of **BarriBond**, **BarriBond XL**, or Barrithane VP

*Prepare the surface as recommended by CCW using CCW-702, CCW-702 LV, CCW-702 WB, CCW-715, Low VOC Travel-Tack, CAV-GRIP, HP 250 Primer or Low VOC EPDM Primer per instructions on Product Data Sheet"

Note 5: In the NFPA 285 test, flashings for fenestration, including through-wall flashing "TWF" are not considered part of the WRB (REF 2015 IBC 1403.5 and 2018 IBC 1402.5). Therefore, suitable combustible or non-combustible *flashings* are permitted for wall assemblies as required in Building Code (Ref 2015 IBC 1405.4 and 2018 IBC 1404.4).

Note 6: BRT-801 tape may be used over Fire-Resist 705 RS at membrane splices, terminations, and penetrations. Fire-Resist 705 RS and the substrate may be treated with CCW-702, CCW-702 LV, CCW-702 WB, or Low VOC Travel-Tack to promote adhesion of BRT-801.

Note 7: Fire-Resist 705 RS may be used in the following applications:

- 1) Over the exterior insulation, while another approved WRB is used over the base wall assembly.
- 2) Over a WRB on the base wall assembly while no exterior insulation is used. Use only WRBs listed below:
 - a. CC Fire Resist 705 FR-A



b. Other WRBs that produce no ignition when tested per ASTM E1354 at a heat flux of 50 kW/m².

Note 8: Insulating coating applied over noncombustible substrate can mitigate thermal bridging at wall assembly terminations and penetrations. Coating applied in these conditions covers a small percentage of the total wall surface area. The following products are allowed:

- 1) Aerolon 945 tape with primer by Tnemec
- 2) Aerolon 971 coating with primer, by Tnemec

Table 6: R2+ Interior Insulation (See Notes 9, 10 & 11)

Wall Component	Table 6: R2+ Interior Insulation Substitution Options
Base Wall Use Item 1 or 2	<ol style="list-style-type: none"> 1) Cast concrete walls (min. 8" thick) 2) CMU concrete walls (min. 8" thick)
Exterior Coating Use Item 1, 2, 3 or 4	<ol style="list-style-type: none"> 1) Portland cement or Lime Stucco 2) Any ASTM E84 Class A Paint or Elastomeric Coating 3) Any ASTM E84 Class A Clear Sealer 4) None
Air/Vapor Barrier Membrane Position 1 Over Base Wall Interior Use any Item 1 - 12	<ol style="list-style-type: none"> 1) Fire-Resist 705 VP, Surface Prepared With 702 WB, Cav-Grip or Travel-Tack 2) Fire Resist 705 FR-A surface prepped with CCW 702, 702LV, 702 WB, CAV-Grip, or Low VOC Travel Tack adhesives. 3) Fire-Resist Barritech VP (or VP LT) 4) Fire-Resist Barritech NP (or NP LT) 5) Fire Resist 705 RS 6) Fire Resist Barrithane VP 7) Grace Perm-A-Barrier NPL (AKA: PAB NP20) 8) Grace Perm-A-Barrier® VPL 9) Grace Perm-A-Barrier® Aluminum Wall Membrane 10) CCW-705, Surface Prepared with Cav-Grip, 702, 702 LV or 702 WB 11) Henry Air-Bloc 21S, AB 33MR, AB 31MR, or AB 17MR 12) None
Continuous Insulation Use Item 1, 2, 3 or 4	<ol style="list-style-type: none"> 1) 3½" Thick (max.) R2+ SHEATHE 2) 3½" thick (max.) R2+ MATTE 3) 3½" thick (max.) R2+ MATTE (Class A) 4) 3½" thick (max.) R2+ SILVER
Air/Vapor Barrier Membrane Position 2 Over Insulation Use any Item 1 - 12	<ol style="list-style-type: none"> 1) None 2) Fire-Resist 705 VP, Surface Prepared With 702 WB, Cav-Grip Or Travel-Tack 3) Fire Resist 705 FR-A, Surface Prepared With CCW 702, 702LV, 702 WB, CAV-Grip, or Low VOC Travel Tack adhesives 4) Fire-Resist Barritech VP (or VP LT) 5) Fire-Resist Barritech NP (or NP LT) 6) Fire Resist 705 RS 7) Fire Resist Barrithane VP 8) Grace Perm-A-Barrier NPL (AKA: PAB NP20) 9) Grace Perm-A-Barrier® VPL 10) Grace Perm-A-Barrier® Aluminum Wall Membrane 11) Joints Taped With Foil-Grip 1402, 4" Width (max.) 12) Henry Air-Bloc 21S, AB 33MR, AB 31MR, or AB 17MR
Interior Cladding	5/8" type X Interior Gypsum Sheathing installed directly over R2+ insulation or installed over Metal Hat or Z Furring, 2" depth air gap (max.)

Note 9: left blank per previous revisions

Note 10: CCW Membrane used in Position 1 or Position 2, not both

Note 11: R2+ insulation can be tacked in place with Cav-Grip or Travel-Tack during installation. Follow Instructions on Product Data Sheet



Table 7a - Construction for HPL Claddings

Item	Table 7a - Construction for HPL Claddings Component Substitution Options
Base Wall	Refer to the local building codes, Trespa or Fundermax or Prodema test reports, and other installation support documents, as applicable, for further guidance on base wall construction.
Exterior Sheathing	½ inch or ⅝ inch thick, exterior type gypsum sheathing per approved base wall for each manufacturer.
WRB over Sheathing or Exterior Wall Surface Use any Item 1 - 6 Note: Items 1, 2, 3, 5, or 6 must be used with Exterior Insulation 2 or 3 below. Item 4 may be used with Exterior Insulation Items 1, 2, or 3. Any CCW WRB may be used if the exterior insulation is unfaced 2 inches (min.) thick, 4 pcf (min.) density mineral fiber insulation that meets ASTM E136	<ol style="list-style-type: none"> 1) CCW Fire Resist Barritech NP (or NP LT) 2) CCW Fire Resist Barritech VP (or VP LT) 3) CCW Fire Resist 705 VP 4) CCW Fire Resist 705 FR-A 5) Fire Resist 705 RS 6) Fire Resist Barrithane VP <p>Note: Fire Resist 705 VP may be applied using CCW-702 WB, Travel Tack, or Cav-Grip contact adhesives because Fire Resist 705 VP acts as an ignition barrier for adhesives applied as thin films. Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives.</p> <p>When Exterior Insulation Item 4 is used, any CCW WRB may be used under the insulation (on base wall surface) to include at a minimum any of the following:</p> <p style="padding-left: 40px;">CCW Barritech NP CCW Barritech VP CCW 705 CCW 705 FR CCW 705 RS CCW 705 VP CCW Barrithane VP CCW Barritech NP 60 CCW 705 FR-A CCW Barriseal</p>
Exterior Insulation Use Item 1, 2 or 3	<ol style="list-style-type: none"> 1) None 2) Unfaced mineral fiber insulation that meets ASTM C612 (min. 1 inch thick) Note Item 2 only for Trespa 3) Unfaced mineral fiber insulation that meets ASTM C612 (min. 2 inches thick) Note: Item 3 only for Fundermax 4) Unfaced 2 inch (min.) thick, 4 pcf (min.) density mineral fiber insulation that meets ASTM E136 Note: Item 4 for Trespa, Fundermax, or Prodema.
Cladding Use Item 1 or 2	<ol style="list-style-type: none"> 1) Trespa - See Tables 7b and 7c below 2) Fundermax – See Table 7d Below 3) Prodema ProdEX IGN Panel (6 mm, 8 mm, 10 mm) – see note Note – Item 3 (Prodema) requires a special firestop (2.5x3.5x1.5 Z Girt) 27 inches above the window opening per Prodema Design Listing with Intertek Listing PSA/CWP 30-01. All details per the design listing must be followed for this application (except that CCW WRBs above may be used)



Table 7b – Trespa Panels

Thickness (mm)	décor	Fixing System To Be Used
8	UniColor (F32) / Metallic (F32) / NW/NA (F33+Tran 80)	1 or 2
10	UniColor (F32) / Metallic (F32)	1, 2, 3 or 4
10	NW/NA (F33+Tran 80)	1 or 2
13	UniColor (F32) / Metallic (F32)	1, 2, 3 or 4
13	NW/NA (F33+Tran 80)	1 or 2

Table 7c – Trespa Fixing Systems

Wall Panel Cladding System Components	Fixing System Installation Type
Fixing System – Use either 1, 2, 3 or 4 Note: The Fixing System specifies the necessary assembly geometry and the required free air cavity.	1 – TS 110 – 285 2 – TS 110DC - 285 3 – TS 210 - 285 4 – TS 210DC – 285
Exterior Wall Panels	See Table I

Table 7d. Fundermax Panel System

Panel ID	Attachment	Air Gap
10 mm Fundermax Max. Exterior F Quality Panels	Allface F2.10	1 inch

Table 8 - Construction for Noncombustible Cladding with no Insulation (See notes 3, 5, 6, 7 & 8)

Wall Component	Table 8 - Construction for Noncombustible Cladding with no Insulation Substitution Options
Base Wall Use Item 1, 2 or 3	<ol style="list-style-type: none"> 1) Cast Concrete Walls 2) CMU Concrete Walls 3) 25 GA. min. 3/8" (min.) steel studs spaced 24" OC (max.) <ol style="list-style-type: none"> a. 5/8" type X Gypsum Wallboard Interior b. Lateral Bracing every 4 ft c. 1/2" or thicker exterior gypsum sheathing
Cavity Insulation Use any Item 1 - 7	<ol style="list-style-type: none"> 1) None 2) 1 1/2" (min.) of Bayer (Covestro) EcoBay CC SPF (up to full cavity thickness) 3) 1 1/2" (min.) of BASF Walltite SPF (up to full cavity thickness) 4) Any noncombustible insulation per ASTM E136 5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced) 6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced) 7) Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than Bayer (Covestro) EcoBay CC or BASF Walltite
WRB Use Item 2 only with Claddings 2 and 7	<ol style="list-style-type: none"> 1) Carlisle Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist 705 VP, Fire Resist 705 FR-A, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP (or VP LT). Fire Resist 705 VP may be used with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives. Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives 2) CCW-705 with 702 LV, 702 WB, Cav-Grip, Low VOC Travel-Tack, or 702 adhesive <p>For systems that require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" in Table 5 can be used as a slip sheet between the WRB/external insulation and the lath.</p>
Exterior Insulation	None



Wall Component	Table 8 - Construction for Noncombustible Cladding with no Insulation Substitution Options
<p>Cladding Use any Item 1 - 16</p> <p>Use Cladding 2 or 7 with no air gap when WRB Item 2 is used</p>	<ol style="list-style-type: none"> 1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath For systems that require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/external insulation and the lath. 3) Limestone – minimum 2" thick using any standard non-open joint installation technique such as shiplap 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as grouted/mortared stone 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap 7) Thin brick/cultured stone set in thin-set adhesive and metal lath that has been tested to ASTM E119 (brick exposed to furnace) and remains in place for a minimum of 30 minutes, or has passed an NFPA 285 test (Minimum ¾") For these systems, which require a more durable WRB system, any building wrap or 15# felt that meets requirement #11 in "WRB over Exterior Insulation" can be used as a slip sheet between the WRB/AVP and the lath. 8) TABS II Panel System with ½" thick bricks using TABS Wall Adhesive or Brick It MCS & CI Panel Systems 9) Any MCM that has successfully passed NFPA 285 10) Uninsulated sheet metal building panels including steel, copper, aluminum 11) Uninsulated fiber-cement siding 12) Stone/Aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria 13) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 criteria 14) Terra cotta cladding – Any Rain-screen Terra Cotta (min. ½ " thick) with ventilated shiplap 15) ½ inch Stucco – Any one coat stucco (½ inch min) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes 16) Natural stone veneer – minimum 1¼" thick using any standard installation technique.

~~ End of Summary ~~



APPENDIX A

ANALYSIS OF TEST RESULTS FOR ENGINEERING EXTENSIONS

The branding relationship between Hunter Panels and Carlisle is as follows:

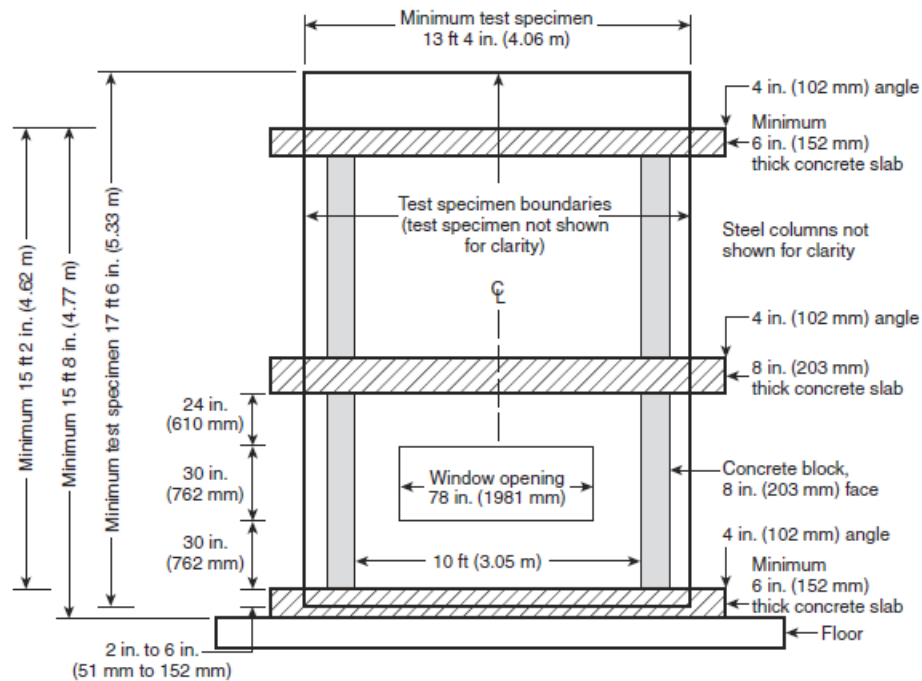
XCI Class A = R2+ SHEATHE,
XCI Foil = R2+ SILVER,
XCI CG = R2+ MATTE,
XCI CG (Class A) = R2+ MATTE (Class A),
XCI PLY = R2+ BASE.



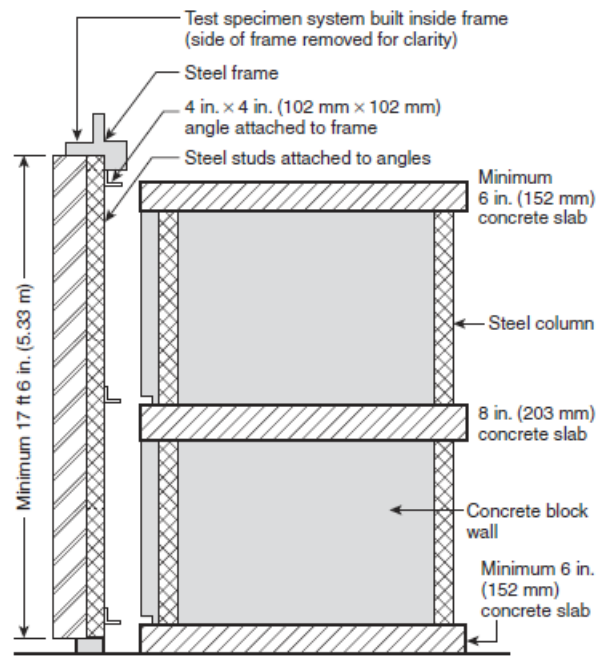
EVALUATION METHOD

NFPA 285 Criteria

The NFPA 285 fire test (see References section) is designed to test the flame spread properties of exterior walls containing combustible components. Two noncombustible rooms are stacked to simulate two stories of a multi-story building. The wall assembly is then attached to the outer face of the rooms.



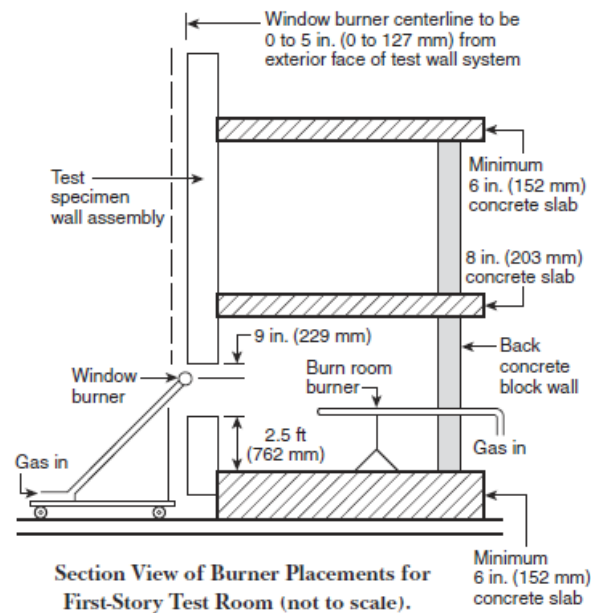
Front View of Test Specimen Superimposed over Test Apparatus (not to scale).



Side View of Test Apparatus with Test Specimen in Movable Test Frame (not to scale).



The two burners illustrated below are ignited to produce a specific time-temperature profile in the room and on the wall's exterior face.



A typical test wall measures 14 ft x 18 ft with a 30 in. tall x 78 in. wide window opening placed on the bottom floor. Thermocouples are placed at strategic locations to monitor temperature as an indicator of flame spread. In the depictions below, Thermocouples 1 - 10 and 20 - 27 are not used for compliance purposes. The remainders are used to monitor the spread of flame.



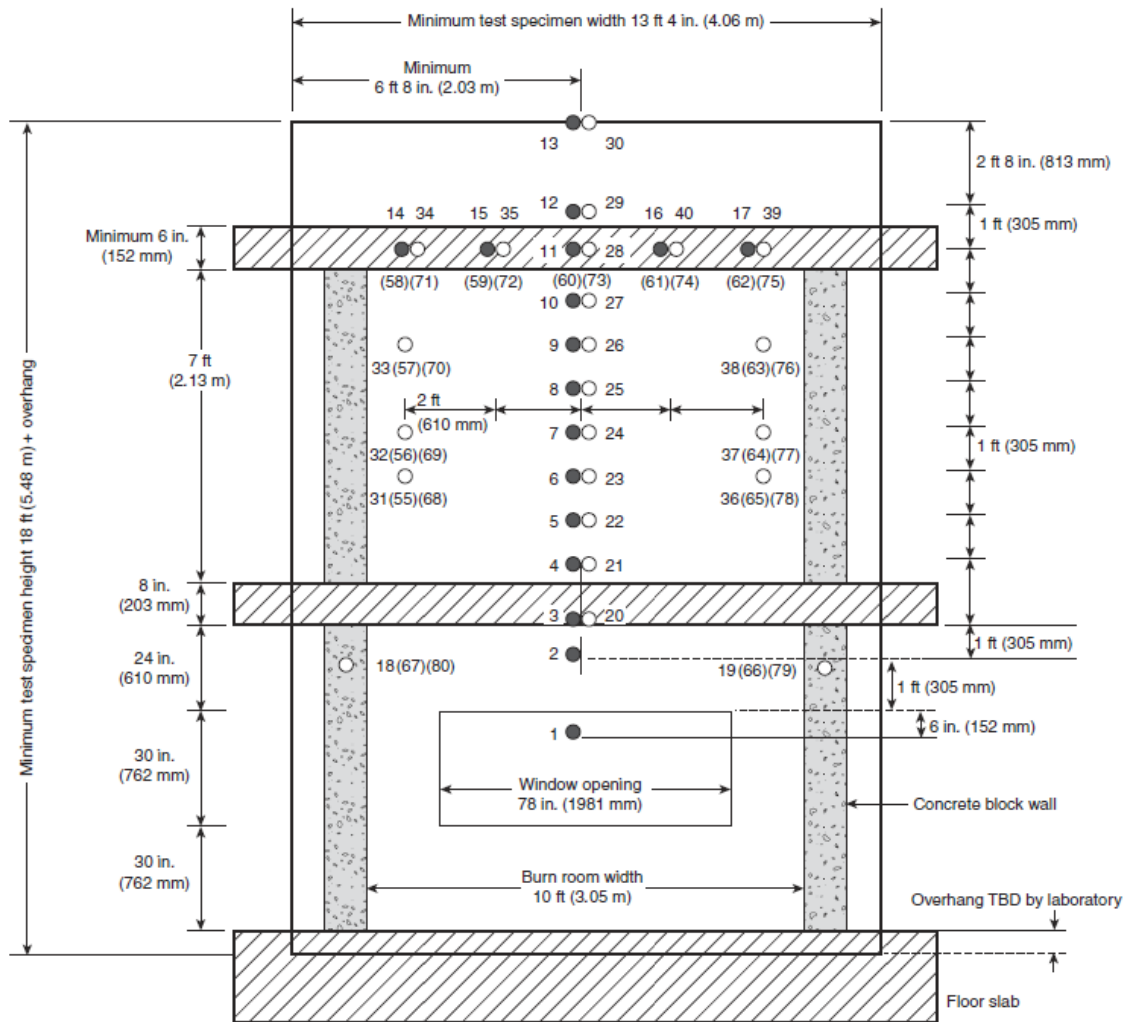
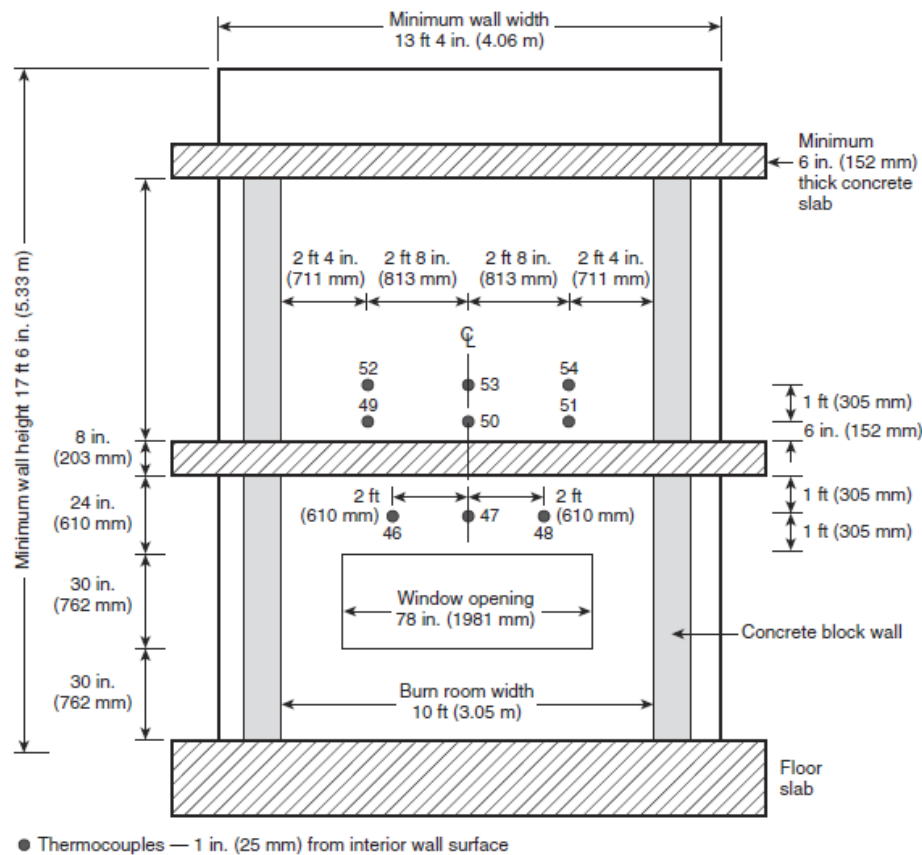


Figure not to scale





During a test, a calibrated fire starts in the bottom room. After 5 minutes, the exterior (window) burner is ignited to produce a specific heat flux/temperature pattern on the exterior of the wall. Both burners remain ignited during the remainder of the 30-minute test, with the gas flow to each increasing every five minutes. During calibration, the temperatures at various locations throughout the 30 minutes must reach those indicated below.

Calibration Average Values for Time Periods Indicated

Thermocouple Location and Numbers	Temperature											
	0–5 min		5–10 min		10–15 min		15–20 min		20–25 min		25–30 min	
	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
Test room ceiling: Nos. 18–22	1151	622	1346	730	1482	806	1600	871	1597	869	1648	898
Interior wall surface of test room: Nos. 15–17	1065	574	1298	703	1433	778	1578	859	1576	858	1655	902
1 ft (305 mm) above top of window opening: No. 2	602	317	870	466	952	511	992	533	1046	563	1078	581
2 ft (610 mm) above top of window opening: No. 3	679	359	1015	546	1121	605	1183	639	1245	674	1296	702
3 ft (914 mm) above top of window opening: No. 4	646	341	971	521	1096	591	1174	634	1245	674	1314	712
4 ft (1219 mm) above top of window opening: No. 5	577	302	858	459	982	528	1063	573	1135	613	1224	662
5 ft (1524 mm) above top of window opening: No. 6	521	272	765	407	875	469	949	509	1007	542	1106	597
6 ft (1829 mm) above top of window opening: No. 7	472	244	690	366	787	419	856	458	913	489	1010	543

Also, during the calibration procedure, the radiant flux at the identified locations and times must reach those indicated in the table below.



Calorimeter Locations and Numbers	Heat Flux (W/cm ²)					
	0–5 min	5–10 min	10–15 min	15–20 min	20–25 min	25–30 min
2 ft (610 mm) above top of window opening; Letter C–2ft	0.9 ± 0.2	1.9 ± 0.4	2.5 ± 0.5	2.9 ± 0.6	3.4 ± 0.7	3.8 ± 0.8
3 ft (914 mm) above top of window opening; Letter C–3ft	1.0 ± 0.2	2.0 ± 0.4	2.6 ± 0.5	3.2 ± 0.6	3.7 ± 0.7	4.0 ± 0.8
4 ft (1219 mm) above top of window opening; Letter C–4ft	0.8 ± 0.2	1.5 ± 0.3	2.0 ± 0.4	2.5 ± 0.5	3.0 ± 0.6	3.4 ± 0.7

Both the room and window burners are under programmed PID control, so once they are calibrated to meet the above requirements, they repeat the same exposure for each test wall.

Personnel monitor flame spread visually during the test; a computer data acquisition system monitors and records the thermocouple temperatures. The criteria for passing are as follows (reworded in more straightforward terms for this analysis):

- 1) Flames shall not spread vertically 10 ft or more above the window opening as determined visually or by thermocouples located at the 10 ft level. Failure occurs when Thermocouples 11 or 14 - 17 exceed 1000 °F.
- 2) Flames shall not spread (visually) horizontally 5 ft or more on either side of the centerline of the window opening.
- 3) Flames shall not spread inside the wall cavity as determined by thermocouples placed within the wall cavity insulation and air gaps if present. Failure occurs when Thermocouples 28, 31 - 40, or 55 - 65 and 68 - 79 exceed 750 °F above ambient.
- 4) Flames shall not spread horizontally within the wall cavity past the interior room dimension as determined by wall cavity thermocouples. Failure occurs when Thermocouples 18 - 19, 66 - 67, or 79 - 80 exceed 750 °F above ambient.
- 5) Flames shall not spread to the second-story room as determined by interior wall surface thermocouples. Failure occurs when Thermocouples 49 - 54 exceed 500 °F above ambient.
- 6) Flames shall not occur in the second story (visually).
- 7) Flames shall not escape (visually) from the interior to the exterior at the wall/wall intersection of the bottom story room.

Constructions Tested

The table below outlines the reports submitted for analysis (Refs. 1 - 12, 24, 26 & 32). For each tested system, critical components are listed. These include cavity insulation, exterior sheathing, water-resistive barrier (WRB), exterior insulation, exterior WRB, air gaps, claddings, and window details. Some details, such as stud spacing, joint tapes, attachment, and faster patterns, application rates, etc., are not included. For those details, the descriptions in the referenced reports should be used.

Reports Submitted

The following represents the identification of components used, as stated in the reports. (Note: H Shield F is the same as Xci Class A due to rebranding. H Shield NB is the same as Xci Ply due to rebranding.)

Ref.	Interior sheath	Stud	Cavity Insulation	Exterior Sheath	WRB	Exterior Insulation	Exterior WRB	Gap	Exterior Clad
1. Note 1	5/8" type X	20 GA. 3 5/8"	None	1/2" Dens-glass	CCW 702 LV adhered with CCW 705	3 1/2" Hunter Xci Class A Foil Facing in. w/ Cav-Grip adh. on ext.	None Used flashing 705 and 705FR	Not reported – photo approx. 1/2"	3 5/8" Brick
2. Note 2	5/8" type X	20 GA. 3 5/8"	1 1/2" Bayer (Covestro) CC EcoBay	None	None	3 1/2" Hunter Xci Class A	None. Alumagrip tape over joints only.	Not Reported. Assumed 1"	4 mm Reynobond



3 Note 3	5/8" type X	22 GA. 35/8"	None	1/2" Dens- glass	CCW Barritech VP	3 1/2" Hunter H Shield NB – Plywood out.	VaproShiel d WrapShield SA	0	5/16" Hardie Lap Siding (8") w/ 2" overlap
4. Note 4	5/8" type X	20 GA. 35/8"	None	None	None	3 1/2" Hunter Vertical H Shield F	CCW Barritech VP	2"	35/8" Brick
5. Note 5	5/8" type X	25 GA. 35/8"	None	1/2" Dens- glass	None	3 1/2" Xci CG Glass facing Densglass	VaproShiel d WrapShield SA	2"	35/8" Brick
6. Note 6	5/8" type X	25 GA. 35/8"	None	1/2" Dens- glass	VaproShiel d WrapShield SA	3 1/2" Xci CG	None	2.25"	4 mm Reynobond (FR)
7. Note 7	5/8" type X	22 GA. 35/8"	1 1/2" BASF Walltite 2 pcf	None	None	3 1/2" Xci Class A Foil facing in	None. Hardcast AFT over joints	None Reported .	3/4" Stucco
8. Note 8	5/8" type X	22 GA. 35/8"	1 1/2" Bayer (Covestro) Ecobay CC	None	None	3 1/2" Xci Class A Foil facing in	None. Hardcast AFT over joints	2"	35/8" Brick
9. Note 9	5/8" type X	22 GA. 35/8"	None	None	None	3 1/2" Xci – Foil w/ Embossed facer	VaproShiel d WrapShield SA	2"	35/8" Brick
10. Note 10	5/8" type X	22 GA. 35/8"	None	1/2" Dens- glass	WR Grace Permabarri er VPS	3 1/2" Xci – Foil w/ foil out	None	2"	35/8" Brick
11. Note 11	5/8" type X	20 GA. 35/8"	1 1/2" Bayer (Covestro) Ecobay CC w/ Roxul Fire Barrier at floor line	None	None	3.6" Xci Plywood facing out	CCW Barritech VP	None Reported 1" assumed	AMS 5000 MCM
12. Note 12	5/8" type X	22 GA. 35/8"	None	1/2" Densglas s	StoGuard Vaporseal	3.6" Xci Plywood facing out	VaproShiel d WrapShield SA	None Reported . 1" assumed	4 mm ReynoBond (FR)
24 Note 13	5/8" type X	20 GA. 35/8"	None w/ lateral bracing every 4 ft	5/8" Densglas s	3M 3015 Self Adhered	2" Xci CG adhered w/ 3M Scotch- Weld Hold Fast 70 @ six mils	None	1 5/8"	4 mm Alpollic FR
26 Note 14	5/8" type X	20 GA. 35/8"	None w/ lateral bracing every 4 ft	5/8" Densglas s	CCW 705 FR-A w/ 702 LV adhesive	3.5" Xci-CG	None	None reported. Appears to be 1.5" (min) in photogra phs	1/2" Terra Cotta (Zephyr Evolution) w/ R.A.M. EXO Extrusions
32 Note 15	5/8" type X	20 GA. 35/8"	None w/ lateral bracing every 4 ft	5/8" Densglas s	CCW 705 FR-A w/ 702 LV adhesive	3.5" Xci-CG	None	3/4 inch	3 mm AL13 ACM
41 Note 16	5/8" type X	18 GA. 6" 16 in. OC	None w/ lateral bracing every 4 ft	5/8" Nat'l Gyp Gold Bond	Grace PAB PL-10	CavClear Insulation System (uses 4- inch Xci- Foil)	CavClear was attached on exterior side of the foam	1 inch (btw foam & CavClear)	35/8" Brick

Note 1: Window Header 2x8 lumber

Note 2: Window Header 0.040 in Aluminum with 5/8" type X.

Note 3: Window Header 25 GA. Aluminum Angle

Note 4: Window Header 1/4" Steel Lintel with 25 GA. Aluminum Angle Flashing

Note 5: Window Header 1/4" Steel Lintel with 25 GA. Aluminum Angle Flashing



Note 6: Window Header 0.040" Aluminum Flashing

Note 7: Window header not reported. Assumed stucco based on photographs.

Note 8: Window Header ¼" Steel Lintel with 25 GA. Aluminum Angle Flashing

Note 9: Window Header ¼" Steel Lintel with 25 GA. Aluminum Angle Flashing

Note 10: Window Header ¼" Steel Lintel with 25 GA. Aluminum Angle Flashing

Note 11: Window Header 0.040" Aluminum Flashing

Note 12: Window Header 18 GA. Galv. Aluminum Flashing

Note 13: Window Header 0.082 Aluminum Flashing

Note 14 Window Header 23 GA. sheet steel flashing

Note 15: Window Header 16 GA. sheet steel flashing

Note 16: Window Header 0.080 aluminum flashing

Note – The gap between the brick and exterior insulation was only protected with the aluminum flashing for all brick walls.

Analysis of Components

When making flammability comparisons of NFPA 285 wall systems, the elements which could potentially cause increased flame spread should be considered. The wall systems depicted above all have similar design elements – differing only in brand/type/model of components for each element. Each wall contained a base wall consisting of steel studs, stud sheathings (interior and/or exterior), WRB over exterior sheathing, exterior insulation, WRB over exterior insulation, air gap, and exterior cladding. Since each system is unique, the analysis below outlines the various brands/types/models of components used for each element, and criteria are established for interchanging/removing/adding brands/types/models of components for each element.

- 1) **Interior Gypsum Wallboard** – All tests incorporated 5/8" type X Special Fire Resistant gypsum wallboard. Experience has shown that using 1/2" regular gypsum wallboard causes failures of thermocouples 18 and 19 (Foam Core Thermocouples). Therefore, the use of 1/2" regular gypsum board is not permitted as the interior sheathing.
- 2) **Steel Studs** – All tests incorporated 35/8" steel studs. The thinnest gauge used was 25 GA. (Refs. 5 & 6). These were spaced 24" OC with 16 GA. CRC horizontal bracing every 4 ft above the window. Field applications typically use 16" or 24" OC spacing. Wider spacing is the worst case since the wall is potentially more flexible and prone to warping. Care must be taken to choose the gauge needed to support items such as z-clips or ties used to support panels or claddings. Since the test in Reference 5 incorporated brick ties and bricks (the heaviest cladding), 25 GA. may be used in all the referenced designs (Refs. 1-12.)
- 3) **Cavity Insulation** – The tests listed above used various cavity insulations, including 1½" Bayer (Covestro) CC EcoBay, and 1½" BASF Walltite 2 pcf, and no insulation. It is assumed that fire-stopping at each floor line is present in stud cavities, typically accomplished with a safing insulation made of compressed mineral fiber insulation. Since flammability data is not available for these spray foams, it is impossible to list the worst case. However, the only way for the cavity insulation to ignite is if the interior gypsum board fails, if the window header fails, or if flames from the exterior fire penetrate the system. Flames from the exterior burner must penetrate cladding, insulation, exterior stud sheathing, and the window header to ignite the cavity insulation. The worst case would be to attach the cavity insulation to the exterior insulation's interior surface (i.e., no stud exterior sheathing). This was implemented in test References 2, 7, 8, and 11, in which exterior stud sheathing was not used, and both foam types were represented. The exterior insulation consisted of 3½" Xci Class A for Tests 2, 7, and 8, and Xci Ply in Test 11. The exterior cladding represented MCM panels, Stucco and Brick. Test 2 incorporating MCM panels was the worst case (Ref. 2) since the exterior burner flames can easily melt through this cladding. This did not result in the ignition of the cavity insulation. The tests incorporating exterior stud sheathing (Refs. 1, 3, 5, 6, 10, and 12) used ½" Densglass Gold encapsulating the stud cavity. Flames would have to penetrate the sheathing to ignite the cavity insulation, and the heat flux is not sufficient for this to occur. The test incorporating H Shield F (Ref. 4) and Xci Foil (Ref. 9) included brick claddings with steel window headers. Flames cannot penetrate this system to ignite the cavity foam. Therefore, since all tests incorporate some kind of fire protection for the stud cavity insulations, either of the cavity foams listed may be added or interchanged within any wall system listed above (Refs. 1-12), only if exterior sheathing is used (see note below). Additionally, since the tests which utilized spray foam cavity



insulation were only filled to 1½" (of the 3⅝" in the cavity), adding additional foam to fill the cavity is allowed since the air cavity is reduced. This reduces the available oxygen in the cavity making ignition of the insulation more difficult.

Note: Any construction which does not incorporate exterior sheathing and uses foil-faced exterior insulation may only use cavity insulations that are not spray foams. However, wall systems that incorporate FRT wood-faced exterior insulations or FRTW structural panel sheathing may use either of the two spray foams referenced above in the absence of exterior gypsum sheathing.

- 4) **Exterior Sheathing** – The tests listed above incorporate two scenarios for exterior sheathing. Some tests used no sheathing (i.e., the exterior insulation acted as the sheathing), or ½" Densglass Gold. In all cases where no sheathing was utilized (Refs. 2, 4, 7, 8, 9 and 11), any ½" gypsum-based sheathing (or thicker) may be used. In those tests which utilized ½" Densglass Gold sheathing (Refs. 1, 3, 5, 6, 10, and 12), the Densglass may be omitted in some cases but not others. In Reference 2, that construction utilized MCM exterior cladding (considered worst case), Xci Class A exterior insulation with no exterior sheathing, and cavity insulation. These features make this a worse case system than the construction in Reference 1, which incorporates a brick cladding, Xci Class A, ½" Densglass exterior sheathing, and no cavity insulation. Therefore, the exterior sheathing in Reference 1 may be omitted. In the test incorporating Xci Ply (Ref. 11), the test observations indicated that the plywood was not penetrated during the test. In the test containing Xci Ply (Ref. 12), the test observations indicated that the plywood was penetrated during the test. But, since cavity insulation was not present, further ignition was not possible. Therefore, the exterior sheathing in that test (Ref. 12) may be omitted. The plywood was not penetrated in the test incorporating H Shield NB - Plywood out (Ref. 3) because the Hardie siding remained intact. Also, cavity insulation was not present, so further ignition was not possible. Therefore, the exterior sheathing for that test (Ref. 3) may be omitted. In this construction, cavity insulation may be added since the Hardie cladding and plywood were not penetrated. In all other constructions incorporating exterior sheathing with brick and steel window header (Refs. 5 & 10), those claddings were not penetrated, so the exterior sheathing may be omitted in those cases. The following tests did not use exterior sheathing (Refs. 2, 4, 7, 8 & 9). The only remaining test in question is Reference 6, which incorporated MCM cladding, Xci CG exterior insulation, ½" Densglass, and no cavity insulation. The existing data do not support removing the exterior sheathing is allowable since this would introduce a large air cavity (larger than the cavity between the MCM panel and the insulation, which was 1"). Therefore, the constructions for which it is allowed to remove the exterior sheathing are the constructions described in Refs. 1, 3, 5, 10, and 12. All other constructions (Refs. 2, 4, 7, 8, 9, and 11) were tested without exterior sheathing in place and adding any ½" or greater thickness of exterior gypsum-based sheathing is allowed.

5) **Multi-Function Sheathing & WRB Products**

Cone calorimeter data was submitted (Ref. 47), which showed that USG Securock Exoair 430 System had flammability similar to the baseline WRB tested per NFPA 285 under foam insulation, which allows the product (sheathing with integrated WRB) to replace exterior sheathings with the WRBs allowed on those sheathings.

- 6) **WRB Over Exterior Sheathing** - The constructions which incorporated WRB over the exterior sheathing included various combinations as follows: CCW 702 LV adhered with CCW 705 over ½" Densglass (Ref. 1), Fire Resist Barritech VP over ½" Densglass (Ref. 3), VaproShield WrapShield SA over ½" Densglass (Ref. 6), WR Grace Permabarrier VPS over ½" Densglass (Ref. 10), StoGuard Vaporseal over ½" Densglass (Ref. 12), 3M 3015 with six mils Scotch-Weld Hold Fast 70 adhesive (Ref. 24). CCW 705 FR-A w/ 702 LV adhesive (Ref. 26) Any of the tested WRB products listed (CCW 702 LV Adhesive with CCW 705, Fire Resist Barritech VP, VaproShield WrapShield SA, WR Grace Permabarrier VPS, StoGuard Vaporseal, 3M 3015 with Hold Fast 70 adhesive, Grace Perm-A-Barrier NPL (AKA: PAB NP20), Grace Perm-A-Barrier® VPL, Grace Perm-A-Barrier® Aluminum Wall Membrane) may be substituted for each other over ½" Densglass exterior sheathing. The same argument holds for the constructions listed above, for which exterior sheathing may be added (Refs. 2, 4, 7, 8 & 9). For applications requiring discontinuous application (⅜" x 3" dabs, 16" OC) of adhesive on the WRB over exterior sheathing for attaching the exterior insulation, CCW LM 800 XL is allowed since it represents a minimal addition of fuel load to the system compared to the fuel load of the insulation panel and WRB combined. LM 800 XL is a solvent-based synthetic rubber adhesive/mastic with an auto-ignition temperature of 433 °F. (<http://www.carlisleccw.com/?page=view&mode=media&contentID=2440>)



Additionally, cone calorimeter data (Ref. 25) analysis suggests that Dryvit Backstop NT, Henry Air-Bloc 21S, AB 33, AB 31, AB 17, WR Meadows Air Shield LMP (Gray), WR Meadows Air Shield LMP (Black), WR Meadows Air Shield TMP, WR Meadows Air Shield LSR, Dörken Systems Inc., Delta-Vent SA, Delta-Vent S, Delta-Fassade S, Delta Maxx, Delta Stratus SA, GE Momentive SEC Silshield 2500, GE Elemax 2600 and Siga Majvest all perform the same or better than at least one of the tested WRB products and may be substituted for the tested products. Also, NFPA 285 testing and analysis of BASF WRB products (Ref. 40) allows both Enershield HP and Enershield I to be used under (over base wall surface) Hunter Xci series of products (Xci-Class A [or 286], Xci-CG, Xci-Foil, Xci-Ply). Test reference 41 used 4-inch Xci-Foil with a brick-clad wall, which allows Xci-Class A, Xci-286, Xci-CG, and Xci-Ply to be used with heavy masonry Claddings 1 - 6. Ref. 45 allows the use of Tremco ExoAir 230 on the base wall (with all claddings) and the use of ExoAir 130.

Notes:

CCW-705 with 702 LV, 702 WB, or 702 adhesives may only be used with Xci Class A and cladding options 1 - 8 (Brick, Stucco, etc.).

Fire Resist Barritech NP (or NP LT) may be substituted for Fire Resist Barritech VP (or VP LT) since it performs similarly to Fire Resist Barritech VP (Ref. 18). Barritech VP LT contains more volatiles for cold weather applications but evaporates, leaving the same material as Barritech VP. Fire Resist 705 VP was tested per ASTM E1354 at 50 kW/m² and the same as WrapShield SA (Ref 33). Therefore, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives) may also be used in constructions.

Fire Resist 705 FR-A (with 702 WB) was tested (Ref.22) per ASTM E1354 at 50 kW/m² and did not sustain ignition. The primer showed no sign of flame damage due to the effectiveness of the foil facer. The rubberized asphalt did not ignite. Therefore, Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives.

Grace NPL, VPL, VPL LT, NPL 10, VPS, VPL 50, and Aluminum (AWM) were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref. 25). Some only qualify with heavy claddings 1-6 (NPL 10 and VPL 50).

VaproShield RevealShield SA was analyzed via cone calorimeter data and shown to be less flammable than WrapShield SA (Ref. 27).

Since Sto Gold Coat and Emerald Coat are allowed over XCI ply under any cladding, they can be permitted under any hunter foam. The WRB has less chance of ignition when placed under the foam than directly under the cladding.

Tremco ExoAir 230 and ExoAir 130 were analyzed for use on the base wall surface (Ref. 45).

CCW Barriseal may be used on the base wall surface only under mineral wool meeting ASTM E136 and at least 2" thick, 4 pcf density minimum based on the following from Draft NFPA 285 Annex (March 2021):

B.11.1

Some successful NFPA 285 tested wall assemblies have incorporated a WRB product over the exterior sheathing. Testing with a specific WRB allows WRBs with lower or lesser fire characteristics to be used in place of the specific tested WRB.

B.11.3.2.4

When a minimum 2-inch thickness of mineral wool insulation (4 pcf or greater) is directly applied via mechanical attachment to a WRB that is applied directly to the gypsum sheathing, concrete or CMU base wall, the WRB is not required to meet B.11.1.

Special Notes

Note 1: The following adhesives may be used for attachment of R2+ SHEATHE, R2+ MATTE, R2+ MATTE (CLASS A), or R2+ SILVER

- 1) Adhesive applied discontinuously at a rate of ¾ X 3" dabs, 16" OC: LM 800 XL or **BarriBond** or **BarriBond XL**
- 2) Aerosol adhesive at application rate as per mfg. instructions: CAV-GRIP™ or Low VOC Travel-Tack



Note 2: Flame spread will be limited based on staggered panel joints and intermittent use of various joint fillers. The following may be used as a gap filler between insulation panels: FOMO Handifoam Fireblock or TVM Fireblock, or DuPont Great Stuff PRO Gaps & Cracks Insulating Foam.

Note 3: These CCW detailing materials may be used over the base wall assembly. The detailing materials can be used alone or with any approved WRB for the assembly.

- 3) Board Joint Treatments:
 - e. 2" x 40 mil ribbon of **BarriBond** or **BarriBond XL**
 - f. 4" DCH Reinforcing Fabric embedded in Fire-Resist Barritech VP/NP/NP LT or embedded in Fire Resist Barrithane VP
 - g. 4" Foil-GRIP 1402*
 - h. 4" AlumaGRIP 701*
- 4) Termination Mastic for Flashing/Membrane: 1" X 40 mil ribbon or tooled ⅜" bead of SURE-SEAL Lap Sealant, CCW-704, LM 800 XL, **BarriBond**, or **BarriBond XL**
- 5) Detail Flashing, 3" on each side, at Openings, Terminations, Penetrations, Transitions and Angle Changes.
 - a. CCW-705/XLT*, CCW-705 TWF/XLT* or Fire Resist 705 FR-A/XLT*
 - b. SURE-SEAL P/S Elastoform* or SURE-SEAL P/S Cover Strip*
 - c. LiquiFiber or DCH Reinforcing Fabric embedded in Barritech VP/NP/NP LT
 - d. 40 mil application of **BarriBond**, **BarriBond XL**, or Barrithane VP

*Prepare the surface as recommended by CCW using CCW-702, CCW-702 LV, CCW-702 WB, CCW-715, Low VOC Travel-Tack, CAV-GRIP, HP 250 Primer or Low VOC EPDM Primer per instructions on Product Data Sheet"

Note 4: These CCW detailing materials may be used over the CCW polyiso insulation; R2+ SHEATHE, R2+ MATTE, R2+ MATTE (CLASS A), R2+ SILVER, R2+ BASE, or R2+ BASE (Class A). The detailing materials can be used alone or with any approved WRB for the assembly.

- 6) Board Joint Treatments:
 - e. 2" x 40 mil ribbon of **BarriBond** or **BarriBond XL**
 - f. 4" DCH Reinforcing Fabric embedded in Fire-Resist Barritech VP/NP/NP LT or embedded in Fire Resist Barrithane VP
 - g. 4" Foil-GRIP 1402*
 - h. 4" AlumaGRIP 701*
- 7) Termination Mastic for Flashing/Membrane: 1" X 40 mil ribbon or tooled ⅜" bead of SURE-SEAL Lap Sealant, LM 800 XL, **BarriBond**, or **BarriBond XL**
- 8) Detail Flashing, 3" on each side at Openings, Terminations, Penetrations, Transitions and Angle Changes
 - i. Fire Resist 705 FR-A/XLT*
 - j. SURE-SEAL P/S Elastoform* or SURE-SEAL P/S Cover Strip*
 - k. LiquiFiber or DCH Reinforcing Fabric embedded in Barritech VP/NP/NP LT
 - l. 40 mil application of **BarriBond**, **BarriBond XL**, or Barrithane VP

*Prepare the surface as recommended by CCW using CCW-702, CCW-702 LV, CCW-702 WB, CCW-715, Low VOC Travel-Tack, CAV-GRIP, HP 250 Primer, or Low VOC EPDM Primer per instructions on Product Data Sheet

Note 5: In the NFPA 285 test, flashings for fenestration, including through-wall flashing "TWF" are not considered part of the WRB (REF 2015 IBC 1403.5 and 2018 IBC 1402.5). Therefore, suitable combustible or non-combustible *flashings* are permitted for wall assemblies as required in Building Code (Ref 2015 IBC 1405.4 and 2018 IBC 1404.4).

Note 6: BRT-801 tape may be used over Fire-Resist 705 RS at membrane splices, terminations, and penetrations. Fire-Resist 705 RS and the substrate may be treated with CCW-702, CCW-702 LV, CCW-702 WB, or Low VOC Travel-Tack to promote adhesion of BRT-801.

Note 7: Fire-Resist 705 RS may be used in the following applications:

- 9) Over the exterior insulation, while another approved WRB is used over the base wall assembly.



- 10) Over a WRB on the base wall assembly while no exterior insulation is used. Use only WRBs listed below:
- m. CC Fire Resist 705 FR-A
 - n. Other WRBs that produce no ignition when tested per ASTM E1354 at a heat flux of 50 kW/m².

Note 8: Insulating coating applied over noncombustible substrate can mitigate thermal bridging at wall assembly terminations and penetrations. Coating applied in these conditions covers a small percentage of the total wall surface area. The following products are allowed:

- 11) Aerolon 945 tape with primer by Tnemec
- 12) Aerolon 971 coating with primer, by Tnemec

The base wall joint and detailing treatments above are allowed based on the following justifications:

1. Discontinuity – no straight vertical path exists in sheathing joint details. With horizontally applied sheathing, horizontal joints are 8 ft maximum. Vertical joints are 4 ft maximum.
2. Application over a noncombustible base wall only
3. A small amount of joint detail material relative to the whole membrane (40 mils dry Fire Resist Barritech NP (or NP LT)/VP (or VP LT))
4. A Cone calorimeter test over the assembly (substrate, joint treatment, WRB, foam) would not show increased flammability.
5. Some products are Class A E84 rated.
6. Flashings around fenestrations are exempted from NFPA 285 compliance - see Note 5 above.
7. ESR 1659 allows 4" asphalt or butyl tape on polyiso insulation joints. These are quite flammable. Based on this reference, we can allow discontinuous (i.e., joints staggered) small quantity (4" width) of the products listed in note 4. Where flashings are used at fenestration openings, the 3" on either side allowance is based on item 6 above.
8. Note 7 allows WRB in two locations based on test reference three where WRBs were used in two locations (over foam, under foam). Test report with 2 WRBs listed below.

3 Note 3	5/8" type X	22 GA. 3 5/8"	None	1/2" Dens- glass	CCW Barritech VP	3 1/2" Hunter H Shield NB – Plywood out.	Vapro- Shield Wrap- Shield SA	0	5/16" Hardie Lap Siding (8") w/ 2" overlap
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- 7) **Exterior Insulation** – All constructions as referenced herein utilized exterior insulation. Various types were installed. These were: 3 1/2" Hunter Xci Class A (Refs. 1, 2, 7 & 8); 3.6" Hunter H Shield NB – Plywood out (Ref. 3; Note: H Shield NB is the same as Xci Ply due to rebranding); 3 1/2" Hunter Vertical H Shield F (Ref. 4; Note: H Shield F is the same as Xci Class A due to rebranding); 3 1/2" Xci CG (Refs. 5, 6, 24 & 26); and, 3 1/2" Xci –Foil (Refs. 9 & 10), Xci Ply (Refs. 11 & 12). The test in Ref. 2 uses no exterior sheathing (large air gap) and is clad with MCM building panels (weak cladding). Only Xci Class A may be used since it incorporates FR additives reducing flame spread compared to the other products listed. The tests in References 1, 4, 5, 7, 8, 9, and 10 encapsulate the exterior insulation between a brick cladding, and 1/2" Densglass exterior sheathing or 5/8" type X interior gypsum, thus reducing the likelihood for ignition. Therefore, in those constructions utilizing Xci CG, or Xci Class A, these insulations may be substituted for each other in those tests (Refs. 1, 4, 5, 7, 8, 9 & 10).

Note – Constructions in test References 7 and 8 each incorporate cavity insulation, but it is encapsulated along with the exterior insulation between brick and sheathing. 3 1/2" thick (max.) Xci Foil may only be used with cladding options 1-8 since it is more flammable due to the paper/foil facer material.

The tests in References 6, 24 & 26 incorporate Xci CG (a non-FR Polyiso foam sandwiched between coated glass facers) clad between MCM panels or Terra Cotta and 1/2" Densglass. Since it does not incorporate FR chemistry, it is presumed that H Shield F (non-FR Polyiso foam with foil facers), Xci Foil (non-FR Polyiso foam with foil facers) all have lesser flammability than Xci CG due to the foil facers. Additionally, Xci Class A incorporates an FR-treated Polyiso foam clad between embossed foil. This product also should have lesser flammability than Xci CG. Therefore, the



exterior insulation in test Reference 6 may be substituted with the foil-faced products listed immediately above. The constructions tested in References 3, 11, and 12 each utilize an FRT plywood-faced 3" Polyiso foam board. The FRT plywood is protected from the fire via the exterior cladding, which for these tests was Hardie siding and MCM building panels. In these tests, the FRT plywood acted as an ignition barrier for the underlying foam. Therefore, these tests' exterior insulations (Refs. 3, 11 & 12) may be substituted for each other.

Xci CG is allowed to be used with exterior sheathing with SPF cavity insulation (listed above) and all the claddings / WRBs in the list based on the following:

- 1) Xci CG may replace Xci Class A in any of the tests listed. However, only Xci Class A can be used in constructions with no exterior gypsum sheathing and no SPF cavity insulation.
- 2) Test Ref. 2 uses Xci Class A with no exterior gypsum sheathing but with SPF cavity insulation and ACM cladding (worst case).
- 3) In Test Ref. 2, adding exterior gypsum board makes the test less severe (SPF is protected).
- 4) Replacing Xci Class A with Xci CG is allowed based on item 1 above and Test Ref. 6 (Xci CG Test with ACM – worst case allows any cladding).

Overall, Xci CG can be used with exterior gypsum sheathing and SPF in stud cavities and any claddings and WRBs listed.

As of this revision (Rev. 41b), correspondence with the client previously did not allow (in the conclusion tables) the use of foil-faced insulation with no exterior gypsum board where spray foam is attached directly to the inside surface of the exterior insulation. Several tests were conducted in this manner, and those restrictions are now removed. Additionally, Xci CG with Class A foam core is designated Xci-CG (Class A) and may be used. Xci-Ply with Class A Xci CG (Class A) foam is designated Xci-Ply (Class A) and may be used.

Special Case – 2" (min.) 4 pcf (min.) noncombustible mineral wool for use with any weather barrier on the exterior sheathing.

When mineral wool is 2" (min.) and four pcf density (min.), it is not possible to ignite the WRB under the mineral wool in NFPA 285 fire conditions. Based on this, any NFPA 285 complying cladding may be used over the mineral wool, including the claddings listed for this report.

The basis for this judgment is that the mineral wool is a noncombustible material and it provides fire protection to the underlying air/vapor barrier. Mineral wool (4 pcf) is used to provide fire-resistance rated seals for penetrations and perimeter joints. Typically, 4-inches of 4 pcf mineral wool will provide 2-hour fire-resistance ratings for these types of systems. In this case, the 2-inch thick mineral wool will provide protection for the air/vapor barrier for the 30-minute NFPA 285 test duration. Additionally, JENSEN HUGHES personnel witnessed a proprietary NFPA 285 fire test where a combustible material was covered with 2-inches of 4 pcf mineral wool. This test was successful and in fact, there was no ignition or burning of the combustible material. Based on this performance and the fire-resistance performance of the mineral wool in fire-resistance rated tests, the mineral wool will provide protection to the underlying air/vapor membrane. Additionally, the gypsum sheathing will provide protection to the backside of the air/vapor barrier. Thus, the assembly described above would exhibit the fire performance that is required by NFPA 285.

Ref: Hughes Report 1JJB00029.005

- 8) **Exterior WRB** - Some constructions, as referenced herein, utilized WRBs over the exterior insulation. Various types were installed. These were Alumagrip tape over joints only on Xci Class A under MCM building panels (Ref. 2), VaproShield WrapShield SA over H-Shield NB plywood under Hardie Siding (Ref. 3), Fire Resist Barritech VP over H-Shield F under Brick (Ref. 4), VaproShield WrapShield SA over Xci CG under Brick (Ref. 5), None over Xci CG under MCM building panels (Ref. 6), None. Hardcast AFT over joints of Xci Class A under Stucco or Brick (Refs. 7 & 8), VaproShield WrapShield SA over Xci Foil under Brick (Ref. 9), None over Xci Foil under Brick (Ref. 10), Fire Resist Barritech VP over Xci Plywood under MCM building panels (Ref. 11), VaproShield WrapShield SA over Xci Ply under MCM building panels (Ref. 12). There are two classes of WRBs in the tests for this report (Refs. 1-12). The first type is for the plywood-faced



exterior insulations, which utilize either VaproShield WrapShield SA or Fire Resist Barritech VP. For these systems (Refs. 3, 11 & 12), the two WRB systems referenced may be interchanged. Additionally, flammability data suggests Fire Resist Barritech NP performs as well or better than WrapShield SA or Fire Resist Barritech VP (Ref 18). The other type of WRB is applied directly over the exterior insulation panel facer material. For these exterior insulations, the WRB materials tested were CCW 705, Fire Resist Barritech VP, VaproShield WrapShield SA. For these systems (Refs. 1, 4, 5 & 9), the three WRB systems referenced may be interchanged. Grace Perm-A-Barrier NPL (AKA: PAB NP20), Grace Perm-A-Barrier® VPL, Grace Perm-A-Barrier® Aluminum Wall Membrane were tested per ASTM E1354 (Ref. 25) and shown to be less flammable than some of the products listed above and may replace those products. Henry VP160 has flammability properties similar to Barritech NP (Ref. 18) and is therefore allowed to be used over Xci-Ply insulation. Additionally, cone calorimeter data (Ref. 25) analysis suggests that Dryvit Backstop NT, Henry Air-Bloc 21S, AB 33, AB 31, AB 17, WR Meadows Air Shield LMP (Gray), WR Meadows Air Shield LMP (Black), WR Meadows Air Shield TMP, WR Meadows Air Shield LSR, Cosella-Dörken Products Inc., Delta-Vent SA, Delta-Vent S, Delta-Fassade S, Delta Maxx, and Siga Majvest all perform the same or better than at least one of the tested WRB products and may be substituted for the tested products. For those systems which utilized foil tape (AlumaGrip 701 or Hardcast AFT) over insulation board joints (Refs. 2, 7 & 8), it is noted that FG 1402 tape is the same as AlumaGRIP 701 tape with a lighter fuel load. Also, AFT is a rebranded name for AlumaGrip 701. 4" FG 1402 is two mil aluminum with 15 mils of butyl while 3" AlumaGRIP 701 is two mil aluminum with 28 mils of butyl. FG 1402 represents a lighter fuel load and may be used in those tests referencing a joint tape. It is sometimes necessary to fill gaps between insulation boards with canister spray foams so that the WRB has a solid substrate without gaps. Since these gaps are intermittent, products with the same flame spread rating (tested as a fire caulk or sealant) as the foam core (ASTM E84 Class A or UL Class 1) may be used. These include FOMO HandiFoam FireBlock, and TVM FireBlock, and Sealant Foam. Also, NFPA 285 testing and analysis of BASF WRB products (Ref. 40) allows both Enershield HP and Enershield I to be used under (over base wall surface) Hunter Xci series of products (Xci-Class A [or 286], Xci-CG, Xci-Foil, Xci-Ply).

Notes:

Fire Resist Barritech NP may be substituted for Fire Resist Barritech VP since it performs similar to Fire Resist Barritech VP (Ref. 18). Barritech VP LT contains more volatiles for cold weather applications but evaporates, leaving the same material as Barritech VP.

Fire Resist 705 VP was tested per ASTM E1354 at 50 kW/m² and performed the same as WrapShield SA (Ref 33). Therefore, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives) may also be used in constructions.

Fire Resist 705 FR-A (with 702 WB) was tested (Ref. 23) per ASTM E1354 at 50 kW/m² and did not sustain ignition. The primer showed no sign of flame damage due to the effectiveness of the foil facer. The rubberized asphalt did not ignite. Therefore, Fire Resist 705 FR-A may be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives.

Grace NPL, VPL, VPL LT, VPS, Aluminum (AWM) were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref.25).

VaproShield RevealShield SA was analyzed via cone calorimeter data and shown to be less flammable than WrapShield SA (Ref. 27).

- 9) **Air Gap** - All constructions referenced herein (Refs. 1-12) utilized air gaps between the exterior cladding and the exterior insulation. Various gap sizes were installed, ranging from 0" (Stucco) to 1" (MCM building panels) to 2" (Brick). Typically, smaller air gaps spread flame less than larger air gaps (Ref. 17). Therefore, it would not be possible to increase the air gap size for any claddings in this report (Refs. 1-12). However, any air gap listed may be reduced.
- 10) **Exterior Cladding** - All constructions referenced herein (Refs. 1-12, 24, and 26) utilized exterior claddings. Various types were installed. These were MCM building panels, Stucco, Hardie Siding panels (8"), Brick, and terra cotta. In all cases, brick (with up to 2" air gap with steel lintel header) may be substituted for the cladding tested since it represents the heaviest (greatest heat sink), thickest material. Stucco may be substituted for MCM or Hardie Siding since it is thicker (higher R-value) and tougher (less prone to degradation under NFPA 285 heat flux conditions). Hardie siding may be substituted for MCM building panels since it remains intact during testing compared to MCM building panels, which tend to melt, warp, and degrade under NFPA 285 heat flux conditions. MCM building panels are considered the worst case since the product easily melts and degrades



under NFPA 285 heat flux conditions. Other claddings are allowed as well and are discussed in more detail below.

Engineering Extensions

Base Walls

Since all tests submitted (Refs. 1 - 12, 24 & 26) utilized steel stud (min. 25 GA. with lateral bracing every 4 ft above the window) base wall systems, other base wall types that tend to perform the same or better are allowed. These include:

- 1) Cast Concrete Walls
- 2) CMU Concrete Walls
- 3) 25 GA. min. 3 $\frac{5}{8}$ " (min.) steel studs spaced 24" OC (max.)
 - a. $\frac{5}{8}$ " type X Gypsum Wallboard Interior
 - b. $\frac{1}{2}$ " Exterior Gypsum Sheathing
 - c. Lateral Bracing Every 4 ft
 - d. Any approved mineral fiber-based safin insulation in each stud cavity at the floor line
Safin thickness must match stud cavity depth.
- 4) FRTW studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.)
 - a. $\frac{5}{8}$ " type X Gypsum Wallboard Interior
 - b. Braced as required by code
 - c. Fire blocking at floor line per code

The use of Fire-retardant-treated wood (FRTW) framing and sheathing covered under IBC Section 2303.2 is allowed in Type III construction within bearing and nonbearing exterior walls with required fire ratings of two hours or less. Type II construction also provides for FRT lumber and sheathing in non-bearing exterior walls where a fire rating is not required. The use of FRT framing and sheathing in the exterior walls with specific limitations as described in this EEV is not expected to detract from the NFPA 285 performance of the allowed Hunter wall systems for the following reasons:

- 1) In ASTM E1354 Cone calorimeter testing, the initial Peak Heat Release Rate (Pk. HRR) for FRT plywood is comparable to gypsum sheathing (Refs. 28 and 29).
- 2) From the literature (Ref. 30), it has been established that steel stud walls exhibit fire resistance behavior similar to wood stud walls.
- 3) The building code allowance for the use of FRT framing instead of noncombustible materials is predicated on its Class A flame spread rating. In essence, FRTW will not support combustion once the flame source is removed. It does not support progressive combustion during the ASTM E84 30 minute fire test.
- 4) Tests incorporating Xci Ply with FRT plywood (Refs. 3, 11, and 12) demonstrated that the FRT plywood component did not support vertical or lateral flame propagation and acted as an ignition barrier to the underlying foam insulation, even though in these tests, the plywood was covered with a combustible WRB.

Tables 1 through 4 have been amended to include FRTW framing/sheathing. In all cases, nominal 2x4 FRT stud framing at a spacing of 24 inches on center is specified in each case as a minimum. FRT structural sheathing allowances are established as follows:

- 1) Table 1. Xci Class A Exterior Insulation: Test Refs. 2, 7, and 8 were performed with spray foam cavity insulation and Xci Class A continuous insulation fastened directly to studs (without exterior sheathing). Exterior cladding used in these tests included brick, stucco, and ACM (considered the worst case). The use of minimum $\frac{1}{2}$ " FRT structural panels as the exterior sheathing is indicated as an option to either no sheathing or exterior gypsum sheathing due to its low flammability and its function as an ignition barrier to the foam wall cavity insulation.
- 2) Table 2. Xci CG Exterior Insulation: All testing with Xci CG included exterior gypsum sheathing, and the basis for substituting FRT sheathing is not established. Therefore, while FRT studs are allowed, exterior sheathing of the framing must include a minimum of $\frac{1}{2}$ " gypsum sheathing.
- 3) Table 3. Xci Foil Exterior Insulation: Testing was performed (Test Refs. 4, 9, and 10) without exterior sheathing or SPF cavity insulation and with 2 $\frac{1}{2}$ " brick cladding, providing the limitation to



noncombustible exterior claddings referenced by Items 1 – 6 in Table 3. Combustible spray foam insulation is allowed by engineering extension herein when min. ½" exterior gypsum sheathing is used. The use of min. ½" FRTW sheathing is allowable when combustible cavity insulation is not employed. It is considered to add integrity to the structure by serving as an additional layer of protection to the internal wall cavity.

- 4) Table 4. Xci Ply Exterior Insulation: The addition of FRTW sheathing to this construction allows the use of either BASF or Bayer (Covestro) spray foam cavity insulations, or those covered under Item 7 of the Table, which is consistent with the cavity insulation allowances given in Table 1 when FRTW panels are used.

Cavity Insulation

The tests submitted (Refs. 1-12) utilized two brands of spray polyurethane foam (Bayer EcoBay CC (aka Carlisle SPI), BASF Walltite) and, in some cases, none. Other less combustible cavity insulations may be utilized in the tests approved to contain cavity insulation. Data from NCFI allows the use of Insulfoam up to full cavity depth or less (Ref. 37) in constructions utilizing ½ inch (min.) exterior gypsum sheathing. Data from Icynene (Ref. 38) allows the use of Proseal up to 5½ inches when ½ inch (min.) exterior sheathing is used. Data from SWD Urethane (Ref. 39) allows the use of Quick-Shield 112 in 6 inches (max.) stud cavities up to 6 inches thick with a maximum air gap of 2½ inches. Based on our experience, the stud exterior sheathing may be ½ inch gypsum board sheathing since this is a thermal barrier. ThermoSeal 2000 showed similar flammability to at least one SPF listed below (Ref. 25). EcoBay CC was renamed Carlisle SPI SealTite Pro (Rev 41.) Demilec HeatLok HFO has been tested per NFPA 285 (Ref. ESR 4073, IAPMO ER 565, and Intertek report 102680245SAT-030), which allows 3⅝" (max.) thickness of HeatLok HFO to be used in the stud cavity when encapsulated by ⅝" gypsum board (type X on interior side, exterior sheathing on exterior side) on both sides of studs.

As of Revision 41b, correspondence with the client previously did not allow (in the conclusion tables) foil-faced insulation with no exterior gypsum board where spray foam is attached directly to the inside surface of the exterior insulation. Several tests were conducted in this manner, and those restrictions are now removed. In the list below, Insulations #2 (Carlisle SPI – tested per NFPA 285) and #3 BASF Walltite tested per NFPA 285) may be used in this manner. All other SPF insulations below are allowed as stud cavity insulations with gypsum board on both sides of the studs based on 3rd party approvals or testing of those products.

Additionally, the following items can be added per NFPA 285 testing and cone calorimeter analysis (Ref. 48).

- Full stud cavity depth or less of Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, SealTite PRO OCX, SealTite PRO Closed Cell, SealTite PRO One Zero

Note 1. SealTite PRO Closed Cell, SealTite PRO One Zero may be used directly behind R2+ SHEATHE and R2+ BASE (no exterior gyp).

Note 2. SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, SealTite PRO OCX for use with ½" (min.) exterior gypsum sheathing.

Per the commentary above, the following is allowed.

- 1) None
- 2) 1½" (min.) of Carlisle SPI SealTite Pro, SealTite PRO Closed Cell, or SealTite PRO One Zero (up to full cavity thickness for each)
- 3) 1½" (min.) of BASF Walltite SPF (up to full cavity thickness)
- 4) Any noncombustible insulation per ASTM E136
- 5) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced)
- 6) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced)
- 7) With exterior insulation options Xci Ply, Xci CG, Xci Class A, Mineral Wool, or None: Any foam plastic insulation (SPF or board type) which has been tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than Bayer (Covestro) EcoBay CC or BASF Walltite.



- 8) NCFI InsulBloc SPF (up to full cavity thickness [only with ½ in. min.] exterior gypsum sheathing)
- 9) Icynene LD-C-50, LD-C-50v2, MD-C-200, MD-R-210, and MD-C-200v3 (Proseal) up to 5½ inches (only with ½ in. (min.) exterior gypsum sheathing)
- 10) SWD Urethane Quick-Shield 112 up to 6 inches in 6 inch (max.) stud cavities with an air gap not exceeding 2½ inches
- 11) 1½" (min.) ThermoSeal 2000 (up to full cavity thickness)
- 12) Demilec HeatLok HFO - Max 3⅝" thickness with ⅝" exterior gypsum sheathing per ESR 4073
- 13) Carlisle SealTite PRO High Yield, SealTite PRO Open Cell, SealTite PRO No Mix, SealTite PRO No Trim 21, SealTite PRO OCX, SealTite PRO Closed Cell, or SealTite PRO One Zero – up to full cavity thickness

Exterior Sheathing

Since the tests submitted utilized ½" exterior gypsum-based sheathing (including "None" in test Refs. 2, 4, 7, 8, 9 & 11), other exterior sheathings with similar or better performance may be utilized. The list of approved sheathings is listed below:

- 1) None (only with Xci Class A exterior insulation without spray foam cavity insulation, or with Xci Ply with cavity insulations 1 - 7 and all claddings listed, or with Xci Foil without spray foam cavity insulation for claddings 1 - 6, or Xci-CG with claddings 1 - 6 with cavity insulations 1 - 7).
- 2) ½" or thicker exterior gypsum sheathing

Note – Per the SPF allowances above, Note 1. SPI Sealtite Pro, SealTite PRO Closed Cell, SealTite PRO One Zero may be used directly behind R2+ SHEATHE and R2+ BASE with no exterior gypsum sheathing.

Multi-Function Sheathing & WRB Products

Cone calorimeter data was submitted (Ref. 47), which showed that USG Securock Exoair 430 System had flammability similar to the baseline WRB tested per NFPA 285 under foam insulation, which justifies the product (sheathing with integrated WRB) to replace exterior sheathings with the WRBs allowed on those sheathings.

DensElement flashed with Prosoco R-Guard FastFlash, may replace the exterior sheathing/WRB listed above and is deemed a less combustible alternate for the following reasons:

- 1) ⅝ inch DensElement is defined as a noncombustible building sheathing meeting ASTM C1177 (Ref. Georgia Pacific ICC-ES ESR Report 3786 per Ref. 45) when tested per ASTM E136. That ESR prescribes using Prosoco R-Guard FastFlash liquid applied flashing to seal sheathing joints, screw heads, and penetrations.
- 2) Sheathing Joint Flashing is discontinuous in use and provides less fuel than full coverage WRBs installed over gypsum board sheathing. If the flashing ignites, the flame spread would be limited when the sheathing joints are staggered.
- 3) To ignite the flashing, the fire from the NFPA 285 burner must penetrate the cladding, ignite the combustible exterior insulation, consume the insulation, and ignite the flashing. Our professional judgment is that a test failure would have already occurred when the fire had consumed enough insulation to involve the flashing.
- 4) None of the assemblies listed in this EEV will burn enough insulation to cause a failure (based on worst-case scenario testing), so the flashing would be minimally involved in the fire.
- 5) Our interpretation of Section 1403.5 of the 2015 IBC is that fenestration flashings are exempt from NFPA 285 testing since they are not considered part of the WRB. This is because fenestration flashings do not contain enough material to cause an NFPA 285 failure. Our professional judgment is that sheathing joint flashings also do not have enough material, nor are they installed in such a way as to allow unlimited flame spread to cause an NFPA 285 failure when installed under (behind) NFPA 285 approved combustible or noncombustible insulations and cladding assemblies.



WRB over Base Wall Surface.

Since the tests submitted utilized various types/brands/models of WRB systems, these may be substituted for each other as follows:

- 1) None
- 2) Any of the NFPA 285 tested WRB products or those less flammable per ASTM E1354 data, to include:

Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist Barritech NP (or NP LT), Fire Resist Barritech VP (or VP LT), GE Momentive SEC 2500 SilShield, GE Elemax 2600, VaproShield WrapShield SA, RevealShield SA, WR Grace Permabarrier (PAB) VPS, StoGuard Vaporseal, 3M 3015 with Hold Fast 70 adhesive, Grace Perm-A-Barrier (PAB) NPL (AKA: PAB NP20), Grace Perm-A-Barrier® VPL, Grace Perm-A-Barrier® Aluminum Wall Membrane (AWM) PAB VPL LT, PAB NPL 10, PAB VPS, PAB VPL 50, WR Meadows Air Shield LMP (Gray), WR Meadows Air Shield LMP (Black), WR Meadows Air Shield TMP, WR Meadows Air Shield LSR, BASF Enershield HP & I, Dörken Systems (Delta-Vent SA, Delta-Vent S, Delta-Fassade S, Delta Maxx) (Ref. 25), Dryvit Backstop NT, Henry Air-Bloc 21S, AB 33, AB 31 and AB 17, Air-Bloc 16MR, Pecora XL-Perm^{ULTRA} VP, XL-Perm^{ULTRA} NP and ProPerm VP, Soprema Sopraseal Stick VP, Soprasolin HD, LM 204 VP, and Siga Majvest or Majvest 500 SA (Ref. 25), Tremco ExoAir 230, Tremco ExoAir 130. Soprema Stick 1100T with Mammoth Elastocol 600c Primer (for use with Xci-CG, Xci Class A, Xci-Ply), Dörken Systems Delta Stratus SA (Ref. 25) and Dow DefendAir 200C.

These may be substituted for each other over ½" or thicker exterior sheathing.

Note: NPL 10 and VPL 50 may only be used with brick or heavy claddings 1-6.

- 3) CCW-705 (with 702 LV, 702 WB, or 702 adhesives) or Henry Blueskin SA may be used with Xci Class A or unfaced noncombustible insulation and Cladding Options 1 - 6.

Note: CCW LM 800 XL adhesive applied discontinuously at a rate of ¾" x 3" dabs 16" OC may be used to adhere exterior insulation to WRB over sheathing for those applications requiring this adhesive to be used.

Note: CAV-GRIP™ or Low VOC Travel-Tack may be used as an adhesive (application rate per manufacturer's instructions) to attach exterior insulation panels to the WRB surface when exterior cladding options 1-8 are used based on testing per Reference 1.

Note: Fire Resist 705 VP was tested per ASTM E1354 at 50 kW/m² and performed the same as WrapShield SA (Ref 33). Therefore, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives) may also be used in constructions. Fire Resist 705 FR-A (with 702 WB) was tested (Ref. 23) per ASTM E1354 at 50 kW/m² and did not sustain ignition. The primer showed no sign of flame damage due to the effectiveness of the foil facer. The rubberized asphalt did not ignite. Therefore, Fire Resist 705 FR-A may also be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives. Grace NPL, VPL, Aluminum were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref.25). VaproShield RevealShield SA was analyzed via cone calorimeter data and shown to be less flammable than WrapShield SA (Ref. 27). Fire Resist 705 RS and Fire Resist Barrithane VP were tested per ASTM E1354 at 50 kW/m² heat flux (ref. 25). The flammability data showed equivalence or improvement to WRBs tested per NFPA 285 in the list of tests referenced herein.

Note: Verified flammability data (Ref. 31) published by GE Momentive suggests that the peak heat release rate and total heat release (per ASTM E1354) of SEC 2500 Silshield GE Elemax 2600 is much lower than Fire Resist Barritech NP or VP, which allows substitution of Fire Resist Barritech NP or VP with GE Momentive SEC 2500 SilShield. Barritech VP LT contains more volatiles for cold weather applications but evaporates, leaving the same material as Barritech VP. Therefore, Barritech VP LT may replace Barritech VP. Tyvek CommercialWrap D passed NFPA 285 with a combustible HPL cladding. Commercialwrap has the same flame spread rating as Commercialwrap D (Ref. Dupont ESR 2375 and Priest & Assoc. Letter 10239D). These Tyvek products may be used under the exterior insulation based on the data submitted. PolyGuard Air Lok Flex VP, FlexGuard, Air Lok Flex and Prosoco R-Guard Cat 5, R-Guard Cat 5 Rainscreen, R-Guard VB and R-Guard



Spray Wrap MVP, Pecora XL Perm Ultra VP, Soprema Sopraseal Stick VP, Soprasolin HD, and the four WR Meadows products listed above were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref. 25). Cone Calorimeter, NFPA 285, and analysis data (Ref. 45) for Tremco, allow ExoAir 230 and ExoAir 130 on the base wall surface.

Note. Hughes Associates' Flammability analysis (Ref. 34) allows Henry 32MR and Tyvek Fluid Applied WB to be used over exterior sheathing (under Xci-Ply). Also, cone calorimeter data (Ref.25) indicates that Henry Blueskin SA is less flammable than the WRB tested in Ref. 1, so this WRB may be used in assemblies with Xci-Class A and brick or equivalent claddings (Claddings 1 - 6). Soprema Stick 1100T with Mammoth Elastocol 600c Primer was tested per NFPA 285 (Ref. 43) in an ACM wall under polyiso insulation similar to Hunter Xci-CG and is allowed to be used under Xci-CG, Xci-CG (Class A), Xci Foil (Class A), Xci-Ply, or Xci-Ply (Class A). Since Sto Goldcoat and Emeraldcoat are allowed over Xci-Ply, it is permitted under the foam for all Hunter foams and claddings.

Note: Various detail and joint treatments are allowed. See the list of notes in WRB over Exterior Sheathing and justifications for allowance of these treatments.

Note: Tables 1, 2, 3, 4, 5, and 6: In WRB options, "Fire Resist Barritech NP" and "Fire Resist Barritech NP (or NP LT)." The low-temp version of Barritech NP (Barritech NP LT) has different solvent content and species when wet. Otherwise, NP and NP LT are identical materials when dry. (Ref. NP LT datasheet and client description).

Exterior Insulation

Since the tests submitted utilized various types/brands/models of exterior insulation systems, these may be substituted for each other as follows:

Note - The test in Ref. 2 uses no exterior sheathing (large air gap) and is clad with MCM building panels (weak cladding). Only Xci Class A may be used since it incorporates FR additives reducing flame spread compared to the other products listed. A construction that utilizes no exterior sheathing and includes spray foam cavity insulation may not use foil-faced exterior insulation. 4¼-inch Xci-Ply is allowed based on tests with 3½-inch Xci-CG. Maximum foam thickness 3.56 inches. Maximum FR plywood thickness is ¾ inch. The FR plywood protects the foam from direct ignition, and Xci-CG passed with MCM cladding. Test Reference 41 allows 4-inch foam with Heavy Claddings 1 - 6. R2+ MATTE (Class A) is the same as R2+ MATTE (aka Xci-CG), except that the Class A version is a Class A foam while the MATTE version is a Class B foam. Xci-CG (Class A) is the same as R2+ MATTE (Class A). From this, and the fact that the MATTE version (Xci-CG) passed several NFPA 285 tests in the referenced test reports, it is expected that R2+ MATTE (Class A) performs better than R2+ MATTE in NFPA 285 tests.

- 1) Any noncombustible insulation which incorporates a WRB that has been tested or approved for exterior insulation when used behind MCM building panels
The insulation may then be used behind any cladding in Options 1 - 14, except Thin Brick/TABS II since these are only used with Xci-Ply.
- 2) Any noncombustible insulation (faced or unfaced) when either of cladding options 1-8 are used.
- 3) 3½" thick (max.) Xci CG (or Xci-CG (Class A) or R2+ MATTE (Class A) and Xci Class A may be used for light claddings.
Exception: A construction that utilizes no exterior sheathing can only use Xci Class A.
- 4) 4" thick (max.) Xci Foil, Xci-Class A, Xci-286, Xci-CG (or Xci-CG (Class A) or R2+ MATTE (Class A)) or Xci-Ply (4" foam thickness) may only be used with cladding options 1 – 6 (see below).
- 5) 4¼" (max.) Xci Ply (3½ inch foam max., ¾ inch FR Plywood max.) may be used with light claddings. 4¾ inch Xci-Ply (4" foam max, ¾" FR Plywood max) may be used with claddings 1-6.
- 6) Any exterior insulation tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than those listed above.
- 7) None – Only when the base wall incorporates exterior sheathing and the WRB products listed in 1 - 4 below. The base wall may have cavity insulation and may be clad with any of the cladding options except Thin Brick/TABS II since these are only used with Xci-Ply.



WRB over Exterior Insulation

Since the tests submitted utilized various types/brands/models of WRB systems, these may be substituted for each other as follows:

- 1) None
- 2) Fire Resist 705 RS, Fire Resist Barrithane VP, Fire Resist Barritech VP (or VP LT), Fire Resist Barritech NP (or NP LT), GE Momentive SEC 2500 SilShield, GE Elemax 2600, VaproShield WrapShield SA, RevealShield SA, or Henry VP160 are applied over exterior insulations which incorporate plywood facers facing the exterior (Xci Ply). For these systems, the four WRB systems referenced may be interchanged. Also, see notes below for additional allowances.
- 3) Fire Resist Barritech VP, Fire Resist Barritech NP (or NP LT), VaproShield WrapShield SA, Grace Perm-A-Barrier (PAB) NPL (AKA: PAB NP20), PAB VPL, PAB Aluminum Wall Membrane (AWM), PAB VPL LT, PAB VPS are applied over the foil or glass facers of exterior insulations. For these systems, the three WRB systems referenced may be interchanged.
- 4) Any WRB tested per ASTM E1354 (at a minimum of 20 kW/m² heat flux) and shown by analysis to be less flammable (improved T_{ign}, Pk. HRR) than those listed above. These include Dryvit Backstop NT, Henry Air-Bloc 21S, AB 33, AB 31, AB 17, Air-Bloc 16MR, WR Meadows Air Shield LMP (Gray), WR Meadows Air Shield LMP (Black), WR Meadows Air Shield TMP, WR Meadows Air Shield LSR, Dörken (various), Pecora XL-Perm^{ULTRA} VP, XL-Perm^{ULTRA} NP, and ProPerm VP, Soprema Sopraseal Stick VP, Soprasolin HD, and Siga Majvest or Majvest 500 SA (for Claddings 1 - 6), Dow DefendAir 200C (Ref. 25).
- 5) 3" AlumaGRIP 701 or 4" FG-1402 joint tape may be interchanged. (Hardcast AFT is a rebrand of AlumaGRIP 701).

Note: The following may be used as a gap filler between insulation panels: FOMO HandiFoam FireBlock, and TVM FireBlock.

Note: Fire Resist 705 VP was tested per ASTM E1354 at 50 kW/m² and performed the same as WrapShield SA (Ref 33). Therefore, Fire Resist 705 VP (with 702 WB, Cav-Grip, or Low VOC Travel-Tack adhesives) may also be used. Fire Resist 705 FR-A (with 702 WB) was tested (Ref. 23) per ASTM E1354 at 50 kW/m² and did not sustain ignition. The primer showed no sign of flame damage due to the effectiveness of the foil facer. The rubberized asphalt did not ignite. Therefore, Fire Resist 705 FR-A may also be used with CCW 702, 702LV, 702 WB, CAV-Grip, and Low VOC Travel Tack adhesives. Grace NPL, VPL, Aluminum were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref.25). VaproShield RevealShield SA was analyzed via cone calorimeter data and shown to be less flammable than WrapShield SA (Ref. 27). Barritech VP LT contains more volatiles for cold weather applications but evaporates, leaving the same material as Barritech VP. Therefore, Barritech VP LT may replace Barritech VP. Fire Resist 705 RS and Fire Resist Barrithane VP were tested per ASTM E1354 at 50 kW/m² heat flux (ref. 25). The flammability data showed equivalence or improvement to WRBs tested per NFPA 285 in the list of tests referenced herein.

Note: Verified flammability data (Ref 31) published by GE Momentive suggests that the peak heat release rate and total heat release (per ASTM E1354) of SEC 2500 Silshield and GE Elemax 2600 is much lower than Fire Resist Barritech NP or VP, which justifies substitution of Fire Resist Barritech NP or VP with GE Momentive SEC 2500 SilShield.

Note: Sto Gold Coat and Emerald Coat cone calorimeter data (ref. 25) indicates that these products have lower flammability than the tested WRB products when used on the surface Xci-Ply. These Sto products may be applied over the plywood surface of Xci-Ply. Tyvek CommercialWrap D passed NFPA 285 with a combustible HPL cladding. CommercialWrap has the same flame spread rating as Commercialwrap D (Ref. Dupont ESR 2375 and Priest & Assoc. Letter 10239D). These Tyvek products may be used over the exterior insulation based on the data submitted. However, at the request of Dupont, Commercialwrap D may not be used over the foam. PolyGuard Air Lok Flex VP, FlexGuard, Air Lok Flex, and Prosoco R-Guard Cat 5, R-Guard Cat 5 Rainscreen, R-Guard VB and R-Guard Spray Wrap MVP, Pecora XL Perm Ultra VP, Soprema Sopraseal Stick VP, Soprasolin HD were analyzed via cone calorimeter data and shown to be less flammable than products tested per NFPA 285 and ASTM E1354 (Ref.25).

Note: Tables 1, 2, 3, 4, 5, and 6: In WRB options, "Fire Resist Barritech NP" and "Fire Resist Barritech NP (or NP LT)." The low-temp version of Barritech NP (Barritech NP LT) has different



solvent content and species when wet. Otherwise, NP and NP LT are identical materials when dry. (Ref. NP LT datasheet and client description).

Claddings

Since the tests submitted utilized various types/brands/models of exterior cladding systems (Brick, Hardie Siding, Stucco, MCM Building Panels), they may be substituted for each other.

Substitutions based on tests submitted (Refs. 1 - 12):

- 1) In all cases, Brick (with up to 2" air gap with steel lintel header) may be substituted for the cladding tested since it represents the heaviest (largest heat sink), thickest material (highest R-value).
- 2) Stucco may be substituted for MCM or Hardie Siding since it is thicker (higher R-value) and tougher (less prone to degradation under NFPA 285 heat flux conditions).
- 3) Hardie siding may be substituted for MCM building panels since it remains intact during testing compared to MCM building panels, which tend to melt, warp, and degrade under NFPA 285 heat flux conditions.

Substitutions based on approvals of competing systems:

According to the three competing ESR reports for NFPA 285 approvals (Refs. 14, 15 & 16), the three competing systems are approved for various claddings. The list is as follows:

Exterior wall covering—Use either 1, 2, 3 or 4	<p>1—Brick</p> <p>—Standard type brick veneer anchors installed maximum 24 inches on center, vertically on each stud</p> <p>—Maximum 2-inch air gap between exterior insulation and brick</p> <p>—Standard nominal 4-inch thick, clay brick</p> <p>2—Stucco – Minimum $\frac{3}{4}$-inch thick, exterior cement plaster and lath. A secondary water-resistive barrier can be installed between the exterior insulation and the lath. The secondary water-resistive barrier shall not be full-coverage asphalt or butyl-based self-adhered membranes.</p> <p>3—Minimum 2-inch thick Limestone, natural stone or minimum 1 – $\frac{1}{2}$ inch thick cast artificial stone. Any standard non-open-jointed installation technique such as ship-lap, etc. can be used.</p> <p>4—Terracotta cladding – Use any terracotta cladding system in which the terracotta is minimum $\frac{1}{4}$ inch. Any standard non-open-jointed installation technique such as ship-lap, etc. can be used.</p>
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Table 1. From ESR 2642

Exterior Veneer – Use 1, 2, 3, 4, 5 or 6	<p>1 – Brick. Use standard nominal 4-inch thick, clay brick. Use standard brick veneer anchors installed vertically on each stud at a maximum of 24-inch o.c. creating a 2-inch maximum air gap between the exterior insulation and brick</p> <p>2 – Stucco¹. Minimum $\frac{3}{4}$-inch thick, exterior cement plaster and lath. An optional secondary water-resistive barrier can be installed between the exterior insulation and the lath. The secondary water-resistive barrier must not be full-coverage asphalt or butyl-based self-adhered membranes</p> <p>3 – Limestone – Minimum 2-inch thick installed using any standard non-open-joint installation technique such as ship-lap</p> <p>4 – Natural Stone Veneer – Minimum 2-inch thick installed using any standard non-open-joint installation technique such as ship-lap</p> <p>5 – Cast Artificial Stone complying with ICC-ES AC51 – Minimum 1 $\frac{1}{2}$-inch thick installed using any standard non-open-joint installation technique such as ship-lap</p> <p>6 – Terracotta² Cladding– Minimum 1 $\frac{1}{4}$-inch thick installed using any standard non-open-joint installation technique such as ship-lap</p>
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Table 2. From ESR 1659

Exterior Wall Covering – Use either 1, 2 or 3	<p>1 – Brick - standard nominally 4-inch-thick clay brick; brick veneer anchors – standard types installed a maximum of 24 inches OC vertically on each stud</p> <p>– Maximum 2-inch air gap between exterior insulation and brick</p> <p>2 – Stucco - minimum $\frac{3}{4}$-inch-thick, exterior cement plaster and lath. A secondary water-resistive barrier may be installed between the exterior insulation and the lath. The secondary water-resistive barrier must not be full-coverage asphalt or butyl- based self-adhered membranes</p> <p>3 – Minimum 2-inch-thick limestone. Any standard non-open-jointed installation technique such as ship-lap, etc., may be used</p>
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Table 3. From ESR 2072

Since these claddings can be applied to the base walls of the manufacturers holding these ESR reports, then they may be applied to the CCW or Hunter base walls (Refs. 1 - 12) because all of the CCW and Hunter systems submitted for analysis successfully met NFPA 285 criteria using various claddings including MCM, Brick, Stucco, Fiber-Cement Siding applied over a wide array of exterior insulations and base wall configurations. These ESR approved exterior claddings include:



- 1) Brick – Nominal 4" clay brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.)
- 2) Stucco – minimum ¾" thick exterior cement plaster and lath (with approved WRB over exterior insulation as listed above)
- 3) Limestone – minimum 2" thick, using any standard non-open joint installation technique such as shiplap
- 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as shiplap
- 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap
- 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap

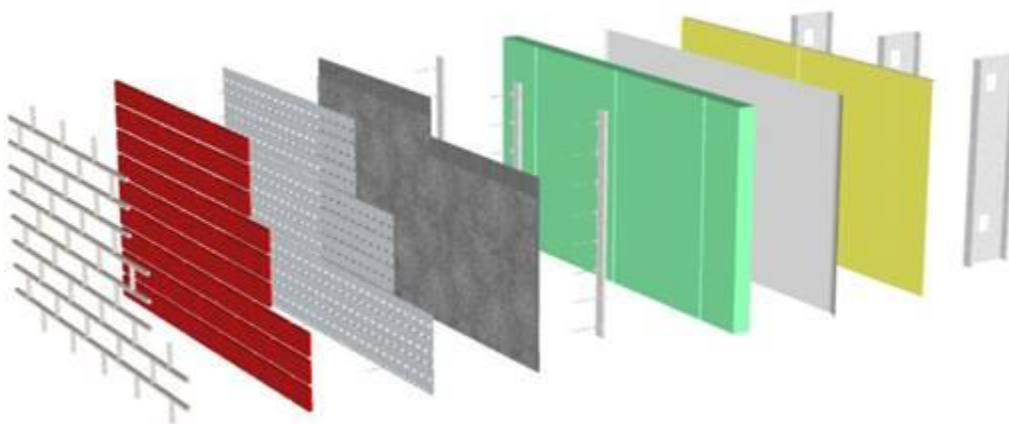
Substitutions based on worst-case scenario testing:

Since test results submitted include testing with aluminum-based MCM building panels (considered to be the worst-case since the panels readily melt and ignite due to the plastic cores), other claddings that tend to perform better may also be used. Item 11 is based on noncombustibility and flame spread tests per Ref. 44. These include:

- 1) Any MCM that has successfully passed NFPA 285 using any tested/approved installation technique
- 2) Uninsulated sheet metal building panels, including steel, copper, aluminum, or zinc (only for Xci-Class A) using any installation technique.
Zinc is allowed for the following reasons:
 - a. Testing with ACM or MCM allows the use of noncombustible sheet metals (incl. aluminum) since ACM/MCM can melt and ignite while sheet aluminum can only melt.
 - b. Zinc melts at a lower temperature than aluminum but is much denser, which results in zinc melting at nearly the same timeframe under identical heating conditions. Calculations under NFPA 285 conditions on typical thicknesses (approx. 0.1 inches) indicate that both materials melt within timeframes consistent with the time to melting of typical ACM/MCM tests. For conservative purposes, we allow zinc only with Carlisle R2+ SHEATHE.
- 3) ¼ inch (min.) Uninsulated Fiber-cement siding, porcelain, or ceramic tile mechanically attached.
- 4) Stone, porcelain, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria
- 5) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 criteria.
- 6) Thin brick/cultured stone set in thin-set adhesive and metal lath (for use with Xci Ply) has successfully remained in place for at least 30 minutes in an ASTM E119 test (bricks exposed to furnace) or passed NFPA 285 criteria. For these systems that require a more durable AVB/WRB system, any building wrap or 15# felt less flammable than the WRBs listed in this report (per ASTM E1354) can be used as a slip sheet between the WRB/exterior insulation and the lath.
- 7) Glen Gery Thin Tech Elite Series Masonry Veneer per Reference 42 allows this system based on ACM testing or TABS II Panel System with ½" thick bricks using TABS Wall Adhesive. For this system, a test has shown (OPL Report 16976-119158A) that this system remains intact for over 70 minutes in an ASTM E119 fire environment. Brick It MCS & CI Panel Systems are constructed similar to Tabs with an added metal layer as noted below. Brick It is completely noncombustible (ASTM E84 result 0/0), and Brick It is more robust than the ACM claddings tested as referenced in this report.

3D cutaway of Brick It system (Layers 1, 2, 3, 4 left to right) with all the same components of Tabs Wall Systems CI System with one added feature (G90 16 Gauge Batten Plate for reinforcement of the panel).





- 8) Terra cotta cladding – Any Rain-Screen Terra Cotta (min. ½" thick) with ventilated shiplap using any installation technique. For use with Xci-Ply.
- 9) ½ inch Stucco – Any one coat stucco (½ inch min.) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes
- 10) Natural stone veneer – minimum 1¼" thick using any standard installation technique.
- 11) FunderMax M.Look Grey Core – minimum ¼ inch thick using any standard installation technique

Based on the discussion above, the following claddings are allowed with specific limitations depending on other components used (exterior sheathing, WRB, Exterior Insulation, Exterior WRB):

- 1) Brick – Nominal 4" clay or concrete brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.)
- 2) Stucco – minimum ¾" thick exterior cement plaster and lath (with approved WRB over exterior insulation as listed above)
- 3) Limestone – minimum 2" thick, using any standard non-open joint installation technique such as shiplap
- 4) Natural Stone Veneer – minimum 2" thick using any standard non-open joint installation technique such as shiplap
- 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 using any standard non-open joint installation technique such as shiplap
- 6) Terra Cotta Cladding – minimum 1¼" thick (solid or equivalent by weight) using any standard non-open joint installation technique such as shiplap
- 7) Any MCM that has successfully passed NFPA 285 using any tested/approved installation technique
- 8) Uninsulated sheet metal building panels including steel, copper, aluminum, or zinc using any installation technique
- 9) ¼ inch (min.) uninsulated fiber-cement siding using any installation technique or porcelain or ceramic tile mechanically attached
- 10) Stone, porcelain, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria
- 11) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 criteria
- 12) Thin brick/cultured stone set in thin-set adhesive and metal lath that has successfully remained in place for at least 30 minutes in an ASTM E119 test (bricks exposed to furnace) or passed NFPA 285 criteria
For these systems, which require a more durable AVB/WRB system, any building wrap or 15# felt that is less flammable than the WRBs listed in this report (per ASTM E1354) or has passed NFPA 285 can be used as a slip sheet between the WRB/interior insulation and the lath.
- 13) Glen Gery Thin Tech Elite Series Masonry Veneer, TABS II Panel System with ½" thick bricks using TABS Wall Adhesive or Brick It MCS & CI Panel Systems
- 14) Terra cotta cladding – Any Rain-screen Terra Cotta (min. ½ " thick) with ventilated shiplap using any installation technique



- 15) ½ inch Stucco – Any one coat stucco (½ inch min.) which meets AC11 acceptance criteria or is approved for use in Type I-IV construction or has been tested per NFPA 285 or stays in place when tested per ASTM E119 (stucco exposed to fire) for at least 30 minutes
- 16) Natural stone veneer – minimum 1¼" thick using any standard installation technique
- 17) FunderMax M.Look Grey Core – minimum ¼ inch thick using any traditional installation technique

Continuous Insulation Constructions

The continuous insulation construction allowances in Table 5 are based on the fact that the cavity insulations in Table 1 are Class A spray foam. The insulation in Table 5 (Xci Class A is a Class A foam product protected with the same ⅝" type X interior Gypsum Wallboard on the interior and concrete or CMU on the exterior. This is a more robust system than the construction allowances in Table 1. The WRB allowances are generally the same as allowed in Table 1. The exterior surface is a massive concrete heat sink with a thin coat of Class A finish, limiting flame spread, and is generally a minimum amount of fuel. Additionally, test Ref 9 is a test with Xci-Foil with one layer of gypsum wallboard protecting the foam from the interior. Test Ref. 11 is a test with Xci-Ply (Xci-CG with plywood face) with one layer of gypsum wallboard protecting the foam from the interior. In a typical NFPA 285 test wall, two layers of gypsum wallboard protect the foam from the interior side. Since Xci-Foil and Xci-CG foam both passed the NFPA 285 test with one layer of gypsum wallboard (with an air gap, which is the worst-case on the interior, these qualify to be used in the mass wall designs in Table 5.

Special Constructions

High-Pressure Laminate (HPL) Claddings

Trespa claddings are High-Pressure Laminate (HPL) products for which extensive NFPA 285 testing has been conducted and evaluated (Ref. 35). The evaluation allowed various types, thicknesses, and attachment methods of Trespa products over wall systems incorporating mineral fiber insulation and several WRB products.

Cone calorimeter analysis (Refs. 25 & 35) indicates that various CCW WRB products show equivalent or lower flammability than the approved WRB and may be used in Trespa wall designs as depicted in the table for HPL claddings.

Additionally, Fundermax panels have been tested per NFPA 285 in two configurations (Ref. 36). When 2 inches (min.) mineral fiber exterior insulation is used (Ref: Fundermax Test Report SWRI 01.16046.01.615), the WRB cannot ignite under these test conditions, so the same WRB allowances for Trespa are used for Fundermax.

However, only CCW Fire Resist 705 FR-A may be used when no exterior insulation is used since it does not ignite when tested per ASTM E1354 at heat fluxes similar to the NFPA 285 test (Ref. 25). This limitation is conservative since the 10 mm Fundermax product was tested with a combustible WRB directly under the cladding (Ref: SWRI Report 01.15210.01.617).

In the original reference (Ref. 35), the use of ⅝ type X is listed as the exterior sheathing. However, there is no adverse effect in this construction when using ½ inch exterior sheathing, which is just a substrate for the WRB.

Prodema has a certified HPL system (Ref. 46) in Intertek Listing PSA/CWP 30-01. This approval is for Prodema ProdEX IGN Panel (6 mm, 8 mm, 10 mm) installed over mineral wool (3½ inch, four pcf) such that the mineral covers the tested WRB. The WRB is attached to the base wall exterior surface. This design incorporates a special firestop (2.5x3.5x1.5 Z Girt) 27 inches above the window opening. All details per the design listing must be followed for this application except for the following. According to a Hughes Assoc. report (Ref. HAI Report 1JJB00116.000), the following statement is made:



The basis for this judgment is that the mineral wool is a noncombustible material and it provides fire protection to the underlying water-resistive barrier. Mineral wool (4 pcf) is used to provide fire-resistance rated seals for penetrations and perimeter joints. Typically, 4-inches of 4 pcf mineral wool will provide 2-hour fire-resistance ratings for these types of systems. In this case, the 2-inch thick mineral wool will provide protection for the water-resistive barrier for the 30-minute NFPA 285 test duration. Additionally, HAI personnel witnessed a proprietary NFPA 285 fire test where a combustible WRB was covered with 2-inches of 4 pcf mineral wool. This test was successful and in fact, there was no ignition or burning of the combustible material. Based on this performance and the fire-resistance performance of the mineral wool in fire-resistance rated tests, the mineral wool will provide protection to the underlying WRB. Additionally, the gypsum sheathing will provide protection to the backside of the WRB. Thus, the assembly described above would exhibit the fire performance that is required by NFPA 285.

The implication being that any WRB placed under 2 inch, 4 pcf mineral wool that meets ASTM E136 (unfaced) will not ignite or contribute to the spread of flames in an NFPA 285 test. Based on this, any Carlisle (CCW) WRB may be used in this design (i.e., WRB under the mineral wool), which includes the use of:

CCW Barritech NP
CCW Barritech VP
CCW 705
CCW 705 FR
CCW 705 RS
CCW 705 VP
CCW Barrithane VP
CCW Barritech NP 60
CCW 705 FR-A

This applies to all HPL constructions.

Noncombustible Claddings with No Insulation

The 2015 IBC allows several exceptions for WRB products that require no testing.

1403.5 Vertical and lateral flame propagation.

Exterior walls on buildings of Type I, II, III or IV construction that are greater than 40 feet (12 192 mm) in height above grade plane and contain a combustible *water-resistive barrier* shall be tested in accordance with and comply with the acceptance criteria of NFPA 285. For the purposes of this section, fenestration products and flashing of fenestration products shall not be considered part of the *water-resistive barrier*.

Exceptions:

1. Walls in which the *water-resistive barrier* is the only combustible component and the *exterior wall* has a wall covering of brick, concrete, stone, terra cotta, stucco or steel with minimum thicknesses in accordance with Table 1405.2.
2. Walls in which the *water-resistive barrier* is the only combustible component and the *water-resistive barrier* has a peak heat release rate of less than 150 kW/m², a total heat release of less than 20 MJ/m² and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E 1354 and has a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E 84 or UL 723. The ASTM E 1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m².

CCW 705 was tested per NFPA 285 (Ref. 13) with R2+Sheathe (Ref. 1) insulation under a brick cladding. R2+MATTE and R2+ Sheathe were tested in several configurations using lightweight combustible claddings with and without combustible WRBs over the insulation. The table of allowances for R2+ Sheathe allows "none" for exterior insulation (reduced fuel load in the wall) with CCW 705 WRB behind heavy



masonry claddings from these tests. From this information and the 2015 IBC exceptions listed above, the following special constructions are allowed:

Base Wall – Steel studs with gypsum sheathing, CMU, or concrete. Limitations based on previous descriptions in the Engineering Extensions section apply.

WRB - CCW-705 with 702 LV, 702 WB, Cav-Grip, Low VOC Travel-Tack, or 702 adhesives. 15# paper or building wrap as slip sheet is allowed between CCW-705 and cladding provided it is less flammable than the CCW 705 membrane.

Air Gap - None

Cladding – ¾ inch stucco, adhered cultured stone or thin brick that remains in place for a minimum of 30 minutes under NFPA 285 or ASTM E119 conditions.

CONCLUSIONS

Fifteen NFPA 285 tests were conducted on various configurations of Carlisle/Hunter exterior wall system designs. The designs incorporated many variables, including cavity insulation, exterior sheathing, water-resistive barrier (WRB), exterior insulation, exterior WRB, air gaps, claddings, and window details. From the wall systems tested, an analysis was conducted on the components tested, which allowed the determination of a base wall system from which replacement components can be interchanged. The purpose of this evaluation was to determine engineering extensions for the components that can be expected to meet the requirements of NFPA 285.

Several ESR-approved competing wall systems incorporating similar features to the Carlisle/Hunter wall systems were examined. Some of the engineering extensions of those systems were also included in this report. In conclusion, we have determined that engineering extensions on various components of the tested wall designs can meet the criteria of NFPA 285 with specific limitations.



APPENDIX B

REFERENCES

REFERENCED DOCUMENTS

- 1) ATI Test Report C0964.03-121-24 NFPA 285
- 2) ATI Test Report C0964.01-121-24 NFPA 285
- 3) ITS Test Report 100153870-001 Rev1. NFPA 285
- 4) ITS Test Report 100153870-005 NFPA 285
- 5) ITS Test Report 100299250SAT-006 NFPA 285
- 6) ITS Test Report G100299250SAT-001 Rev2 NFPA 285
- 7) ITS Test Report G100561530SAT-004 NFPA 285
- 8) ITS Test Report G100561530SAT-001 NFPA 285
- 9) ITS Test Report G100445307SAT-005 Rev1 NFPA 285
- 10) ITS Test Report G100445307SAT-006 Rev1 NFPA 285
- 11) ATI Test Report B7324.01-121-24 NFPA 285
- 12) ITS Test Report G100445307SAT-001 Rev1 NFPA 285
- 13) NFPA 285-12 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-loadbearing Wall Assemblies Containing Combustible Components
- 14) ICC-ES ESR 1659 Dow Chemical Thermax Insulation
- 15) ICC-ES ESR 2642 BASF SprayTite Insulation
- 16) ICC-ES ESR 2072 Bayer (Covestro) Bayseal Insulation
- 17) Babrauskas, V., Lucas, D., Eisenberg, D., Singla, V., Dedeo, M., & Blum, A. (2012). Flame retardants in building insulation: a case for re-evaluating building codes. *Building Research & Information*. doi:10.1080/09613218.2012.744533
- 18) Hughes Associates Project No.: 1JJB00086.000 Letter Report
- 19) PAC Engineering Letter to Carlisle Dated 5/23/13 Allowing various adhesives
- 20) Dillon, Scott – Analysis of the ISO 9705 Room Corner Test, Simulations, Correlations and Heat Flux Measurements.
- 21) Intertek Report 101041624SAT-002A and 002B.
- 22) Intertek Test Report 10127497MID-001C, Rev 2 ASTM E1354 Test on Fire Resist 705 VP
- 23) Intertek Test Report 1014508732MID001-Rev 1 ASTM E1354 Test on Fire Resist 705 FR-A.
- 24) Intertek Test Report G101171298SAT-004A NFPA 285 (3M 3015 WRB under XCi-CG w/ Alpolic MCM)
- 25) Cone Calorimeter Data for Grace, 3M, Carlisle, Henry, Sto, PolyGuard, Prosoco, Dryvit, WR Meadows, Dörken, Pecora, Soprema, Siga, ThermoSeal – Held confidential by Priest & Associates. GCP VPL 50 new cone data in HAI Report 1JJB00029.006 dated 5/29/2016. Soprema NFPA 285 and Cone Calorimeter data. Siga Cone Calorimeter data, Dow DefendAir 200C cone calorimeter data
- 26) ATI Report D6274.01-121-24 NFPA 285 Xci-CG w/ ½" Terra Cotta
- 27) Priest & Assoc. EEV 10216 – Allowances for RevealShield SA in NFPA 285 constructions
- 28) White, R.H., and Dietenberger, M.A., Wood Handbook Chapter 18 "Fire Safety of Wood Construction".
- 29) Cone Calorimeter Data for BASF – Held confidential by Priest & Associates
- 30) Benichou, N., Sultan, M.A., Kodur, V.R., *Fire resistance performance of light weight framed wall assemblies: effects of various parameters, key design considerations and numerical modelling*. NRCC-45688, Institute of Research in Construction, National Research Council, Ottawa, Canada.
- 31) Momentive Cone Calorimeter Data published online
- 32) ATI Report D6274.02-121-24 NFPA 285 Xci-CG w/ AL13 ACM
- 33) UDRI Report Dated 1/8/15 ASTM E1354 WrapShield SA vs 705 VP
- 34) Hughes Letter 1J00069.000 for Tyvek fluid Applies and Draft Table for Henry 32MR
- 35) Priest & Associates Letter 10171F – Trespa/CCW WRB Analysis
- 36) Priest & Associates Letter 5/23/13 – Fundermax CCW Analysis
- 37) NCFI ICC-ES ESR 1615 and Hughes Letter 1JJB00035.000 for NCFI InsulBloc SPF for use in NFPA 285 assemblies.
- 38) Icynene EEV 10166W – Allowance of Hunter systems over Icynene Base Walls



- 39) Intertek SWD CCRR 1011 – Quick-Shield 112
- 40) BASF EEV 10211 – NFPA 285 Assemblies with Enershield HP & I
- 41) ATI/Intertek Test Report F9270.01-121-24 NFPA 285 Test on 4 inch Xci Foil w/ Brick
- 42) Jensen Hughes Report 1JJB05306.011 – Dow with Glen Gery Cladding
- 43) Intertek Report 102164147SAT-001 NFPA 285 Test Soprema 1100T with ACM and polyiso
- 44) FunderMax M.Look Grey Core ASTM E84 and E136 Reports (ATI G1014.01-121-24 and G3542.01.121-24)
- 45) Tremco EEV 10543, Tremco Cone and 285 data ExoAir 230, ExoAir 130
- 46) Intertek Listing PSA/CWP 30-01 Prodema HPL NFPA 285 Approval
- 47) Intertek Report 103643243MID-001 USG Cone Calorimeter Test on Securock Exoair 430
- 48) Carlisle EEV 10747H – NFPA 285/Cone Calorimeter Analysis of various stud cavity SPF insulations

- End of Report -

