



**PRIEST & ASSOCIATES
CONSULTING, LLC**

ENGINEERING EVALUATION

Dörken Systems, Inc. WRBs and
Mineral Wool Insulation in NFPA 285 Assemblies

Project No. 10750F, Revision 2

Prepared for:

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May 9, 2019

Abstract

Comparative Cone Calorimeter (ASTM E1354) data from Dörken Systems, Inc. were analyzed to justify allowing specific Dörken Systems, Inc. WRBs on the base wall surface (under mineral wool insulation) in the previously evaluated NFPA 285 tables for NFPA 285 compliance referencing Dörken EEVs 10750A, B, C, D and E. These were used to compile allowances for use with unfaced, noncombustible mineral wool.

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.

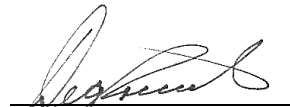
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INTRODUCTION

The purpose of this evaluation is to allow use of specific Dörken Systems, Inc. WRBs on the base wall surface under or over mineral wool insulation, based on previously evaluated polyisocyanurate NFPA 285 assemblies (Ref. 3) that can meet the requirements of NFPA 285 (Ref. 1). Comparative Cone Calorimeter data (Ref. 2) was submitted to compare the flammability of various Dörken Systems, Inc. WRB products to at least one WRB listed in the referenced EEVs. The peak Heat Release Rate of the Dörken Systems, Inc. WRBs were shown to be less than the listed product (depending on location under or over the insulation) – thus the proposed use is justified. Additionally, it is not possible to ignite a WRB under NFPA 285 conditions when the unfaced ASTM E136 compliant mineral wool is 2 inch (min.), 4 pcf density (min.).

REFERENCED DOCUMENTS

- 1) *NFPA 285-12 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-loadbearing Wall Assemblies Containing Combustible Components*
- 2) *Cone Calorimeter Data for Dörken Systems, Inc. - Data Confidential btw the client and Priest & Associates*
- 3) *Dörken EEVs 10750A, B, C, D & E - NFPA 285 Assemblies*
- 4) *Babrauskas et al., 10 Years of Heat Release Research NIST Publication*
https://www.researchgate.net/publication/280309156_Ten_Years_of_Heat_Release_Research_with_the_Cone_Calorimeter
- 5) *Hughes Associates Letter 1JJB 00116.000 – Mineral Wool with WRB's in NFPA 285 Assemblies*

EVALUATION METHOD

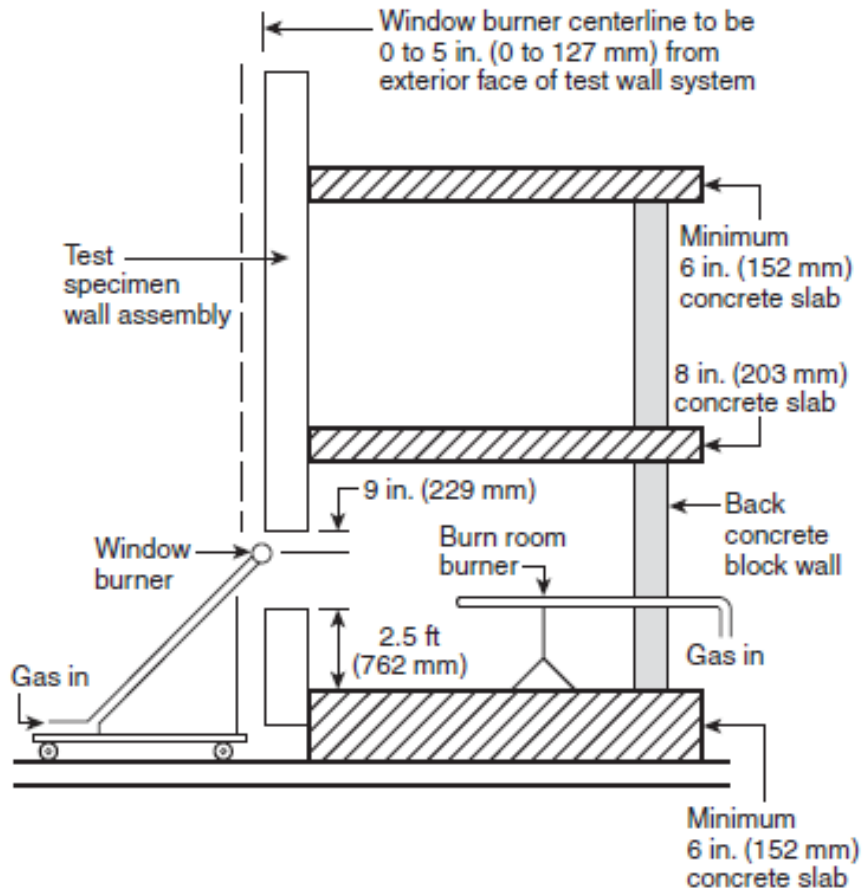
NFPA 285 Criteria

The NFPA 285 fire test (Ref. 1) 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 exterior face of the rooms. A typical test wall measures 14 ft x 18 ft with a 30 in. x 78 in. window opening placed on the bottom floor.

During a test, a calibrated fire starts in the bottom room. After 5 minutes, the exterior burner is ignited to produce a specific heat flux/temperature pattern on the exterior of the wall. Both burners remain ignited during the 30 minute test. Personnel monitor flame spread visually during the course of the test. A computer data acquisition system monitors and records the thermocouples temperatures. The criteria for passing (Ref. 1) are as follows (reworded in simple terms for this analysis):

- 1) Flames shall not spread vertically 10 ft 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 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 or 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, or 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.



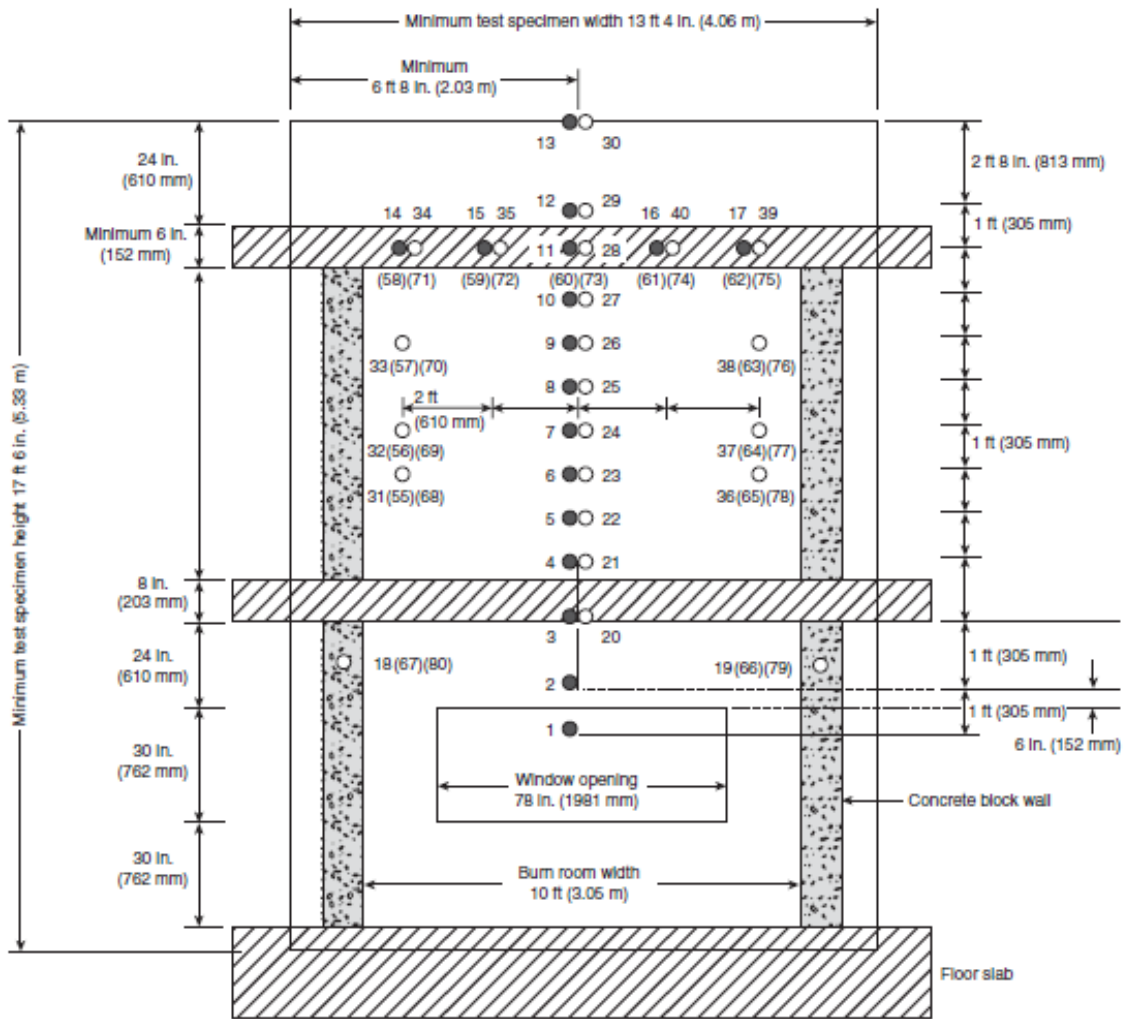


Two burners are ignited to produce a specific time-temperature profile in the room and on the exterior face of the wall.

Thermocouples are placed at strategic locations to monitor temperature as an indicator of flame spread.

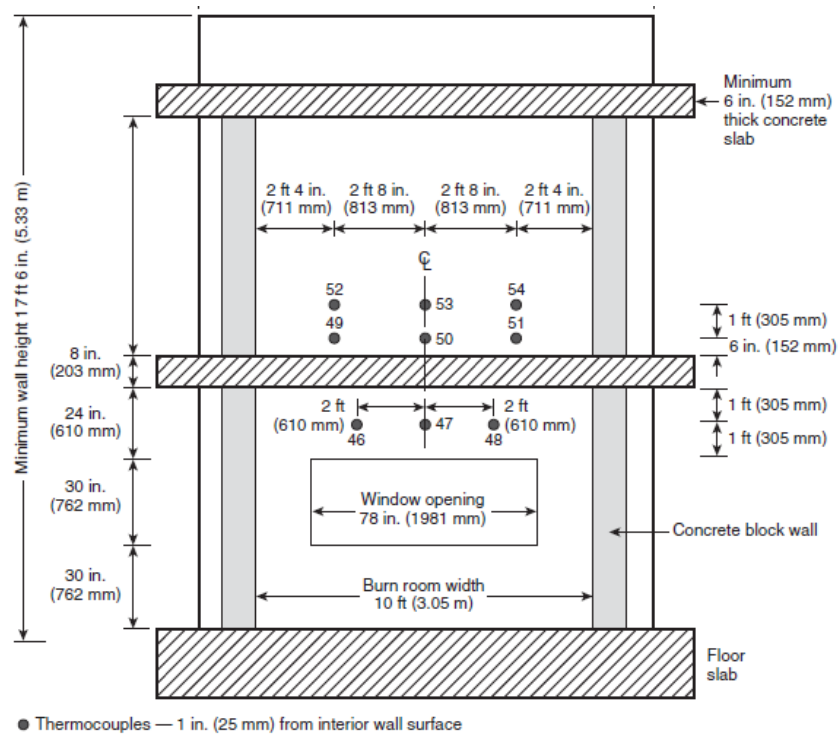
In the depictions below, thermocouples 1 - 10, and 20 - 27 are not used for compliance purposes. The remainders are used to monitor flame spread.





- Thermocouples — 1 in. (25 mm) from exterior wall surface
- Thermocouples — In the wall cavity air space or the insulation, or both, as shown in Figure 6.1(b) Details A through I.
- () Thermocouples — Additional thermocouples in the insulation or the stud cavity, or both, where required for the test specimen construction being tested, as shown in Figure 6.1(b) Details C through I.





WRB Analysis

If an alternate WRB is less flammable than the NFPA 285 approved WRB, it is allowed as an alternate component. Cone calorimeter data (Ref. 2) of Dörken Systems, Inc. was submitted for evaluation.

Flame spread rate is dictated by the peak Heat Release Rate (pk HRR). The pk HRR induces heat flux on unburned material which ignites the unburned material and the process repeats as flames spread along surfaces. An excerpt from Ref. 4 suggests the following:

“The earliest applications of Cone Calorimeter data have been in the polymers industry. Hitherto, in the US manufacturers typically have relied either on limiting oxygen index (LOI) [14] tests or on UL94 [15]. The latter is a simple Bunsen-burner type test which gives only pass/fail results; it is clear that quantitative information useful for polymer development does not come from such a test. The former, however, does give quantitative results and uses what would appear to be a suitable engineering variable. Again, however, a recent study has clearly demonstrated that the results, while quantitative, are not capable of even correctly rank-ordering according to actual fire behavior [16]. **By contrast, it has been shown quite clearly that heat release rate is the single most important variable describing the hazard of the actual fire [17].**”

Based on this, when comparing a tested material to an alternate material, the alternate material shall have a lower peak Heat Release Rate (pk HRR) than the tested material when tested per ASTM E1354.

Additionally, it is not possible to ignite a WRB under NFPA 285 conditions when the WRB is on the base wall surface and under 2 inch (min.), 4 pcf density (min.) mineral wool that meets noncombustibility requirements when tested per ASTM E136 (Ref. 5) The following extract is from Ref. 5:



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 referenced (Ref. 5) analysis is based on NFPA 285 complying claddings and no foam in the base wall cavity. However, based on our experience, the exterior sheathing of the base wall acts as a thermal break between the exterior insulation/cladding (Wall Region 1) and the cavity insulation/interior sheathing (Wall Region 2). The fire response of the Region 1 has very little to do with the fire behavior of Region 2 when separated by 5/8" type X gypsum sheathing. The two wall regions behave independent of each other when separated by gypsum sheathing. This allows NFPA 285 tested or approved SPF products in stud cavities and NFPA 285 tested or approved items on the exterior as long as the two regions are separated by the 5/8" gypsum sheathing.

Based on the analysis above, the following is allowed.

WRB	Allowed Location
Dörken Systems Inc. DELTA-STRATUS SA DELTA-VENT SA DELTA-FASSADE S DELTA-VENT S DELTA-VENT S PLUS	Under Mineral Wool (on base wall surface)
DELTA-FASSADE S	Over Mineral Insulation (with specific claddings)

Approved Assemblies

This evaluation is based on Dörken EEVs 10750A, B, C, D & E (Ref. 3) as the basis documents. These are for polyiso insulation. It is permissible to replace the polyiso insulation with noncombustible, unfaced mineral wool as long as the mineral wool has the minimum thickness and density values stated herein and meets ASTM E136 noncombustibility.

NFPA 285 Table of Allowed Constructions

The following table shows the relevant content for specific WRBs for use with mineral wool insulation based on the referenced EEVs. As a special case, three claddings are added to the list since these have NFPA 285 approvals for use with mineral wool. These are High Pressure Laminate (HPL), Ceraclad, and Insulated Metal Panels (IMP). These are to be used with no WRB over the mineral wool. However, Trespa Meteoron FR HPL is allowed to be used with DELTA-FASSADE S over the mineral wool (Ref. EEV 10486).



TABLE OF SUBSTITUTIONS

Wall Component	
<p>Base Wall – Use either 1, 2, 3 or 4</p>	<ol style="list-style-type: none"> 1) 1" min. Cast Concrete Walls 2) 1" min. CMU Concrete Walls 3) 20 GA. (min.) 3⁵/₈ in. (min.) steel studs spaced 24 in. OC (max.) <ol style="list-style-type: none"> a. 5/8 in. type X Gypsum Wallboard Interior b. Bracing as required by code. 4) Where allowed in Types I, II, III or IV construction, FRTW (Fire-retardant-treated wood) studs complying with IBC Section 2303.2, min. nominal 2 x 4 dimension, spaced 24" OC (max.) <ol style="list-style-type: none"> a. 5/8 in. type X Gypsum Wallboard Interior b. Bracing as required by code
<p>Fire-Stopping in Stud Cavity at Floor Lines – Use 1 or 2 or 3</p>	<ol style="list-style-type: none"> 1) None 2) 4 lb/ft³ mineral wool (e.g., Thermafiber, etc.) in each stud cavity at each floor line – attached with Z-clips or equivalent 3) FRTW fire blocking at floor line in accordance with applicable code requirements
<p>Cavity Insulation - Use any item 1 - 16</p> <p>Note: Cavity Insulations 5 - 16 must use floor line fire-stopping compliant with Item 2 and 5/8" exterior gypsum sheathing.</p>	<ol style="list-style-type: none"> 1) None 2) Any noncombustible insulation per ASTM E136 3) Any mineral fiber (Board type Class A ASTM E84 faced or unfaced) 4) Fiberglass (Batt type Class A ASTM E84 faced or unfaced) 5) 5½" (max.) Icynene LD-C-50 spray foam in 6" deep studs (max.) full fill without an air gap 6) 5½" (max.) Icynene MD-C-200, 2 pcf spray foam in 6" deep studs (max.) full fill without an air gap 7) 5½" (max.) Icynene MD-R-210, 2 pcf spray foam in 6" deep studs (max.) full fill without an air gap 8) 6" (max.) SWD Urethane QS 112, 2 pcf spray foam in 6" deep studs (max.) or partial fill with a maximum 2½" air gap 9) 3½" (max.) Gaco Western 183M spray foam in 3½" deep studs (max.) 10) Gaco Western F1850 (3½" max.). Use with 5/8" exterior sheathing in 3½" deep studs (max.) 11) Demilec Sealection 500 (3½" max). Use with 5/8" exterior sheathing in 3½" deep studs (max.) 12) Demilec HeatLok Soy 200 Plus (3.4" max). Use with 5/8" exterior sheathing in 3½" deep studs (max.) 13) Bayer Bayseal (3" max). Use with 5/8" exterior sheathing. 14) Lapolla FoamLok FL 2000 (3" max). Use with 5/8" exterior sheathing in 3½" deep studs (max.) 15) BASF SprayTite 81206 or WallTite (US & US-N) (3½" max). Use with 5/8" exterior sheathing in 3½" deep studs (max.) 16) Accella (Premium Spray Products) Foamsulate 220 (3½ in. max.). Use with 5/8 inch exterior sheathing in 3½ in. deep studs (max.)
<p>Exterior Sheathing – Use either 1 or 2 or 3</p>	<ol style="list-style-type: none"> 1) ½" or thicker exterior gypsum sheathing 2) 2" precast concrete panels attached to structural elements of building 3) ½" (min.) FRTW structural panels complying with IBC Section 2303.2 and installed in accordance with code allowances for Types I, II, III or IV construction <p>Note – exterior FRTW sheathing or gypsum board is optional for Base Walls 1 and 2.</p> <p>When SPF is used, 5/8 inch exterior gypsum sheathing must be used.</p>
<p>WRB Use any Item 1 - 5</p>	<ol style="list-style-type: none"> 1) Dörken Systems Inc. DELTA-STRATUS SA 2) Dörken Systems Inc. DELTA-VENT SA 3) Dörken Systems Inc. DELTA-FASSADE S 4) Dörken Systems Inc. DELTA-VENT S 5) Dörken Systems Inc. DELTA-VENT S PLUS



<p>Exterior Insulation</p>	<p>Unfaced mineral wool (minimum 2 inch thick, 4 pcf density) that meets ASTM E136 noncombustible testing. a) Rockwool (verify product specs) b) Thermafiber (Owens Corning) (verify product specs)</p>
<p>WRB over Insulation</p>	<p>Dörken Systems Inc. DELTA-FASSADE S (Only with Exterior Claddings 1 - 18)</p>
<p>Exterior Cladding – Use any Item 1 - 21</p>	<ol style="list-style-type: none"> 1) Brick – Nominal 4 in. clay brick or veneer. Brick Ties/Anchors 24 in. OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and the lath. A secondary WRB can be installed between the exterior insulation and lath. The secondary WRB shall not be full coverage asphalt or butyl based self-adhering membranes. 3) Limestone – minimum 2" thick 4) Natural Stone Veneer – minimum 2" thick 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 6) Terra Cotta Cladding – Use any terracotta cladding system in which terracotta is minimum 1¼" thick. Any installation technique can be used. 7) Any ACM or MCM that has passed NFPA 285 (do not exceed air gap tested or approved). 8) Uninsulated sheet metal building panels including aluminum, steel, copper or zinc using any standard installation technique 9) Uninsulated fiber-cement cladding panels minimum ¼" thick using any standard installation technique 10) Stone/Aluminum porcelain/aluminum, ceramic/aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria. Stone Panels Inc. Stone Lite Panel system has been analyzed using mfr's standard installation technique. 11) Terra Cotta Cladding – Any Rain-screen Terra Cotta (min. ½" thick) with ventilated shiplap 12) ½" Stucco – Any one coat stucco (½" 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 13) Autoclaved-aerated-concrete (AAC) panels minimum 1½" thick 14) Thin Set Brick - Glen Gery Thin Tech Elite or TABS II Panel System with ½" thick bricks using TABS Wall Adhesive have been analyzed using mfr's standard installation technique 15) Terreal Zephir Evolution Rainscreen System (terra cotta), minimum 9/16" thick 16) Natural Stone Veneer – minimum 1¼ inch (adhered with mortar or concrete/cement based adhesive) 17) FunderMax M.Look using the manufacturer standard installation technique 18) Trespa Meteor FR (See Table Below for Trespa thicknesses and fixing systems) <p>The claddings below are for use with no WRB over the mineral wool.</p> <ol style="list-style-type: none"> 19) CERACLAD using the manufacturer's standard installation technique with an air gap not exceeding 15mm 20) Any NFPA 285 tested or NFPA 285 approved Insulated Building Panels (IMP) approved for use over mineral wool 21) Any High Pressure Laminate (HPL) other than Trespa Meteor FR approved for NFPA 285 for use over mineral wool (do not exceed air gap tested or approved).



Trespa Meteon FR Thicknesses Allowed and Fixing Systems:

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

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

~ End of Report ~

