PRIEST & ASSOCIATES CONSULTING, LLC

ENGINEERING EVALUATION

Dörken Systems, Inc. WRBs and

Rmax (TSX and EcoMax Series) Polyiso Foam Insulation in NFPA 285 Assemblies

Project No. 10750B, Revision 2

Prepared for:

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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 Rmax (TSX and EcoMax Series) polyisocyanurate foam) in the previously evaluated NFPA 285 tables for NFPA 285 compliance referencing Rmax EEV 10220.*

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.

Submitted by,

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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 the Rmax polyiso) in previously evaluated Rmax 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 EEV. The peak Heat Release Rate of the Dörken Systems, Inc. WRBs were shown to be less than the listed product – thus the proposed use is justified.

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 between the client and Priest & Associates*
3) *Rmax EEV 10220 - 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*

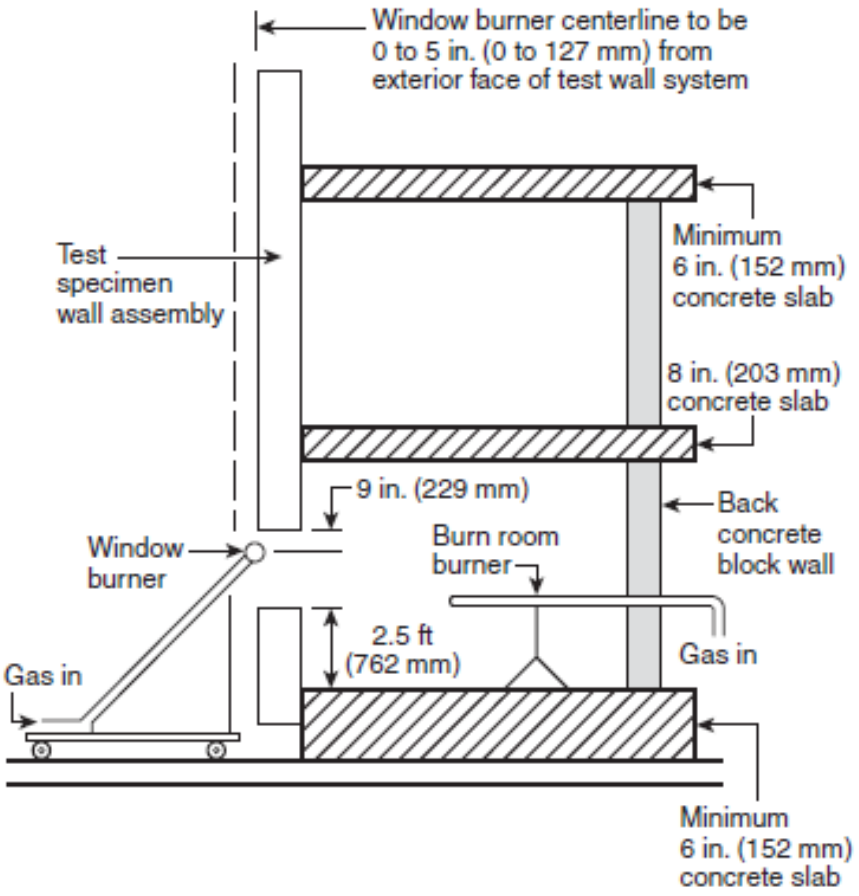
EVALUATION METHOD

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):

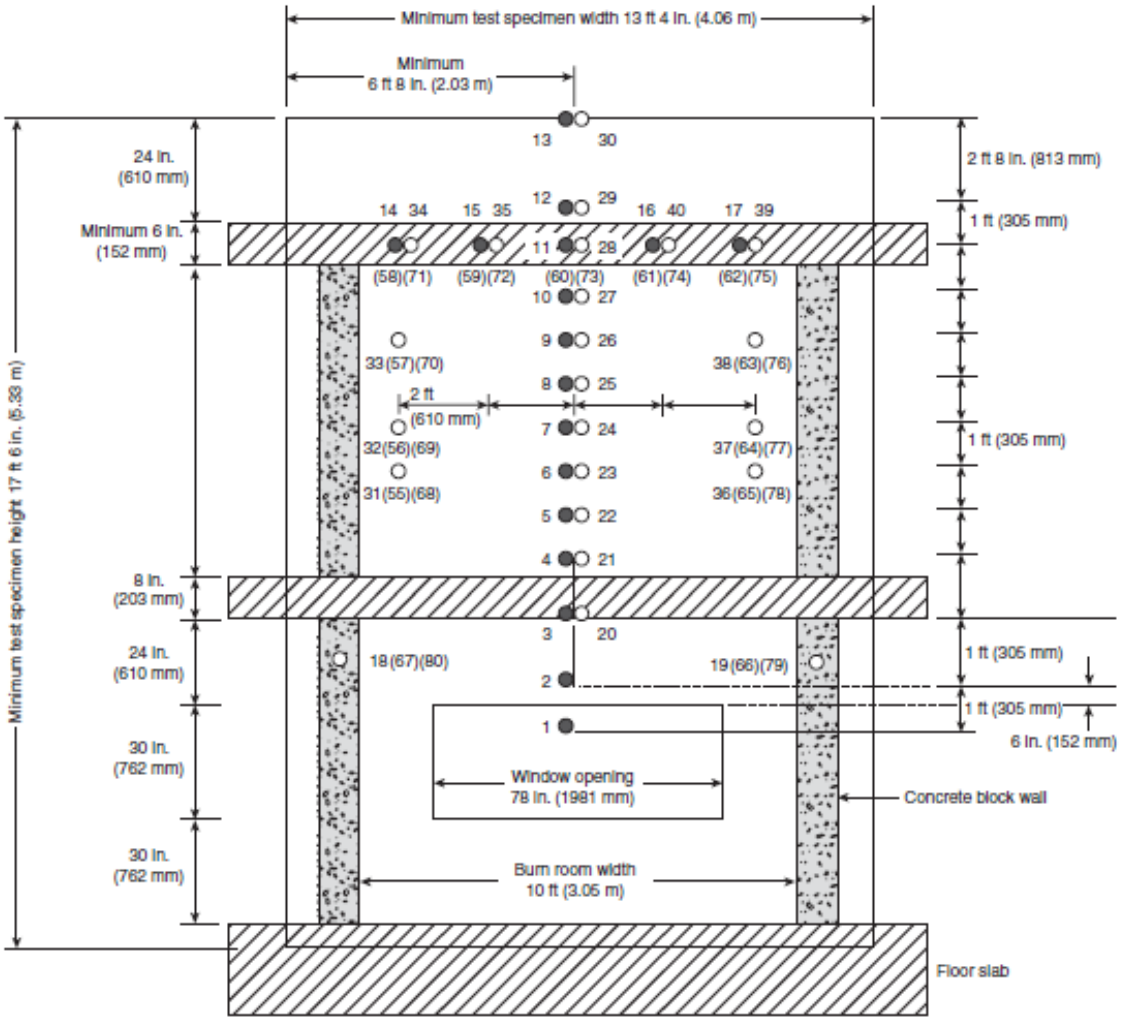
1) Flames shall not spread vertically 10 ft above the window opening as determined visually or by thermocouples located at the 10 ft level. Failure occurs when Thermocouples 11 or 14 - 17 exceed 1000 °F.
2) Flames shall not spread (visually) horizontally 5 ft on either side of the centerline of the window 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.

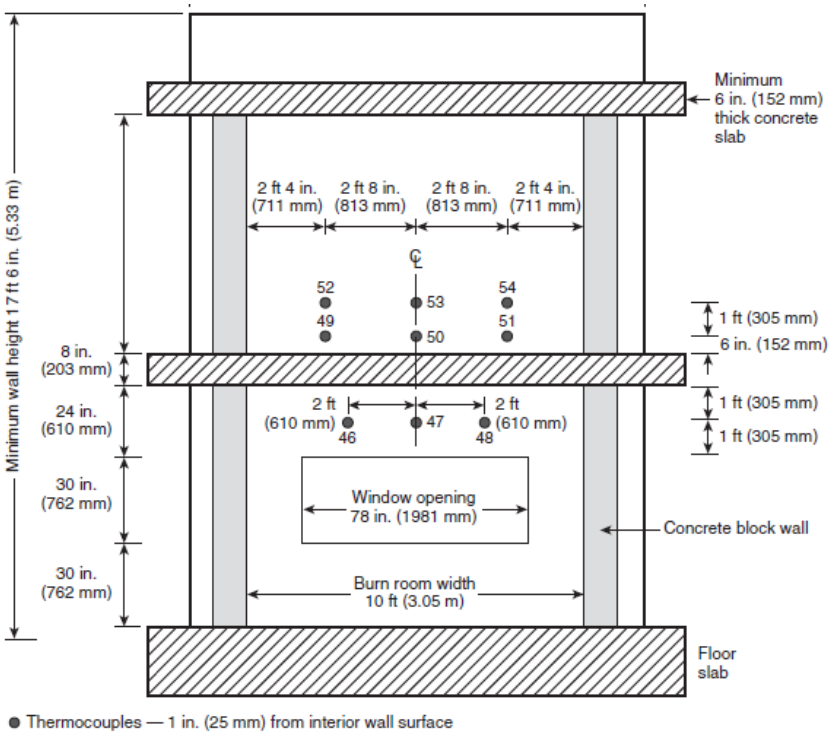
In the depictions below, Thermocouples 1 - 10, and 20 - 27 are not used for compliance purposes. The remainders are used to monitor flame spread.



● 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.

Based on the analysis above, the following is allowed.

WRB	Allowed Location
Dörken Systems Inc. Delta Stratus SA	Under Rmax polyiso insulation (on base wall surface) in EEV 10220
Dörken Systems Inc. DELTA-VENT SA	Under Rmax polyiso insulation (on base wall surface) in EEV 10220
Dörken Systems Inc. DELTA-VENT S	Under Rmax polyiso insulation (on base wall surface) in EEV 10220

Approved Assemblies

This evaluation is based on the Rmax EEV 10220 (Ref. 3) as the basis document.

NFPA 285 Table of Allowed Constructions

The following table shows the relevant content for specific WRBs for use with Rmax insulation based on the referenced EEV. 4 pcf (min.), 1 inch thick (min.) mineral wool may replace the polyiso since mineral wool is non-combustible.

Wall Component	
Base Wall – Use either 1, 2 or 3 Note: May use 4 optionally when FRTW framing is allowed by code.	1) Cast Concrete Walls 2) CMU Concrete Walls 3) 20 GA. (min.) 3⅝ in. (min.) steel studs spaced 24 in. OC (max.) a. ⅝ 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.) a. ⅝ in. type X Gypsum Wallboard Interior b. Bracing as required by code
Fire-Stopping in Stud Cavity at floor lines – As an option, use 2 with FRTW framing	1) 4 pcf mineral wool installed with z-clips 2) FRTW fire blocking at floor line in accordance with applicable code requirements
Cavity Insulation – Use either 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 Note. Items 5 - 15 are SPF Foam Type EZ FLO may be used inside the box headers and jamb studs for NFPA 285 assemblies requiring SPF in stud cavities.	1) None 2) Any noncombustible insulation per ASTM E136 3) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced) 4) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced) 5) 5½ inch (max.) Icynene LD-C-50 spray foam in 6 inch deep studs (max.). Use with ⅝ inch exterior sheathing. 6) 5½ inch (max.) Icynene MD-C-200 2 pcf spray foam in 6 inch deep studs (max.) full fill without an air gap. Use with ⅝ inch exterior sheathing. 7) 5½ inch (max.) Icynene MD-R-210 2 pcf spray foam in 6 inch deep studs (max.) full fill without an air gap. Use with ⅝ inch exterior sheathing. 8) SWD Urethane QS 112 2 pcf spray foam in 6 inch deep studs (max.) partial fill with a maximum 2½ inch air gap or full fill. Use with ⅝ inch exterior sheathing. 9) Gaco Western 183M (3½ inch max.). Use with ⅝ inch exterior sheathing. 10) Gaco Western F1850 (3½ inch max.). Use with ⅝ inch exterior sheathing. 11) Demilec Sealection 500 (3⅝ inch max). Use with ⅝ inch exterior sheathing. 12) Demilec HeatLok Soy 200 Plus (3.4 inch max). Use with ⅝ inch exterior sheathing. 13) Bayer Bayseal (3 inch max). Use with ⅝ inch exterior sheathing. 14) Lapolla FoamLok FL 2000 (3 inch max). Use with ⅝ inch exterior sheathing. 15) BASF SprayTite 81206 or WallTite (US & US-N) (3⅝ inch max). Use with ⅝ inch exterior sheathing.

Exterior Sheathing – Use 1, 2 or 3	1) ½ in. or thicker exterior gypsum sheathing 2) 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 3) None (for 3 in. max. exterior insulation for all claddings or 4½ in. max. exterior insulation for Claddings 1 - 6) Note – exterior FRTW sheathing or gypsum board is optional for Base Walls 1 and 2. When SPF is used, ⅝ inch exterior gypsum sheathing must be used.
WRB Over Sheathing or Base Wall Surface – Use 1, 2 or 3	1) Dörken Systems Inc. Delta Stratus SA 2) Dörken Systems Inc. DELTA-VENT SA 3) Dörken Systems Inc. DELTA-VENT S
Exterior Insulation – Use any Item 1 - 8 Installation may use FRT plywood on exterior side (installed over exterior sheathing) or interior side (applied direct to studs). This option (plywood on interior) negates use of exterior sheathing since the FRT ply acts as the sheathing.	1) 4½ in. (max. consisting of a single panel or multiple thinner panels) Rmax TSX-8500 2) 4½ in. (max. consisting of a single panel or multiple thinner panels) Rmax ECOMAXci 3) 4½ in. (max. consisting of a single panel or multiple thinner panels) Rmax TSX-8510 4) 4½ in. (max. consisting of a single panel or multiple thinner panels) ECOMAXci FR 5) 4½ in. (max. consisting of a single panel or multiple thinner panels) ECOMAXci FR Air Barrier 6) 4½ in. (max. consisting of a single panel or multiple thinner panels) ECOMAXci FR White 7) ECOMAXci FR Ply - 4½ inch (max.) foam thickness, ⅝ in. (min.) FRT plywood thickness. 8) Unfaced mineral wool (minimum 1 inch thick, 4 pcf density) that meets ASTM E136 non-combustible testing. Note: FRT plywood may be applied in the field or factory applied. Adhesive must not be full coverage.
Exterior Cladding - Use either 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13	1) Brick – Nominal 4 in. clay brick or veneer with maximum 2 in. air gap behind the brick. Brick Ties/Anchors 24 in. OC (max.) 2) Stucco – minimum ¾ in. thick exterior cement plaster and lath with an optional secondary water resistive barrier between the exterior insulation and lath. The secondary barrier shall not be full coverage asphalt or self-adhered butyl membrane. 3) Limestone – minimum 2 in. thick using any standard installation technique 4) Natural Stone Veneer – minimum 2 in. thick using any standard installation technique 5) Cast Artificial Stone – minimum 1½ in. thick complying with ICC-ES AC 51 using any standard installation technique 6) Terra Cotta Cladding – minimum 1¼ in. thick using any standard installation technique 7) Any MCM or ACM (aluminum, steel, copper, zinc) (w/ 2½ in. max. air gap) that has successfully passed NFPA 285 using any standard installation technique such as Carter Companies EVO Architectural Panel Systems for use with FR ACM/MCM NFPA 285 material. 8) Uninsulated sheet metal building panels including aluminum, zinc, steel or copper using any standard installation technique 9) Uninsulated fiber-cement siding using any standard installation technique 10) Stone/Aluminum honeycomb composite building panels that have passed NFPA 285 or equivalent

	Stone Panels Inc. Stone Lite Panel system has been analyzed using mfr's standard installation technique. 11) Autoclaved-aerated-concrete (AAC) panels that have successfully passed NFPA 285 using any standard installation technique 12) Thin Set Brick - Glen Gery Thin Tech Elite has been analyzed using mfr's standard installation technique. 13) Natural Stone Veneer – minimum 1¼ inch (adhered with mortar or concrete/cement based adhesive). 14) FunderMax M.Look using the manufacturer's standard installation technique. The air gap between the cladding and insulation or WRB must not exceed 1½ inches.

Note: All WRBs must be installed at recommended application rates and per the manufacturers installation instructions.. Window Headers for all assemblies shall incorporate 0.08 in. (min.) aluminum flashing to cover air gaps between the exterior insulation and exterior veneer. All fenestrations and penetrations shall be flashed in accordance with the applicable code using asphalt, acrylic, or butyl based flashing tape, liquid flashing or R-SEAL 6000 polyethylene tape up to 12 in. maximum width.

End of Report