PRIEST & ASSOCIATES
CONSULTING, LLC

ENGINEERING EVALUATION

Siga WRB's and Rmax Thermasheath/Durasheath Series Polyiso Foam

Insulation in NFPA 285 Assemblies

Project No. 10561E

Prepared for:

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Abstract

Rmax has granted use of their NFPA 285 Engineering Evaluation (and related data) to determine Engineering Extensions of alternate WRB products manufactured by Siga. This evaluation, along with NFPA 285 and cone calorimeter (ASTM E1354) data from Rmax and Siga were used to create a matrix of constructions using various combinations of Rmax/Siga products which could meet 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

The purpose of this evaluation is to allow use of various Siga WRB products in previously evaluated Rmax NFPA 285 assemblies that can meet the requirements of NFPA 285 (Ref. 1). Cone Calorimeter (Ref. 3) and NFPA 285 data were submitted to evaluate various Siga WRB products to various Rmax constructions in EEV 10220 (Ref. 4).

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) *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*
3) *Cone Calorimeter and NFPA 285 Data for Siga and Rmax – Data Confidential btw Siga, Rmax and Priest & Associates*
4) *Priest and Associates EEV 10322 – Rmax NFPA 285 Evaluation*
5) *DRJ Engineering 1309-03 Rmax Approved NFPA 285 Assemblies*
6) *Lindholm et al. Cone Calorimeter – a Tool for Measuring Heat Release* *http://www.ffrc.fi/FlameDays_2009/4B/LindholmPaper.pdf*
7) *Babrauskas et al., 10 Years of Heat Release Research NIST Publication* *http://fire.nist.gov/bfrlpubs/fire93/PDF/f93048.pdf*

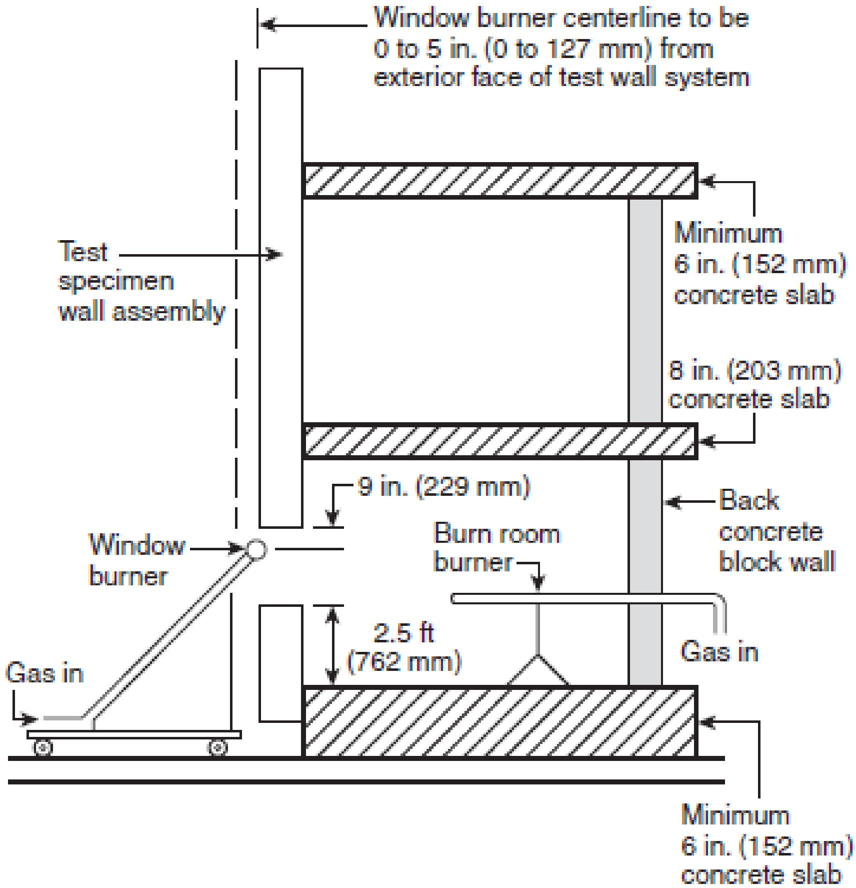
EVALUATION METHOD

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):

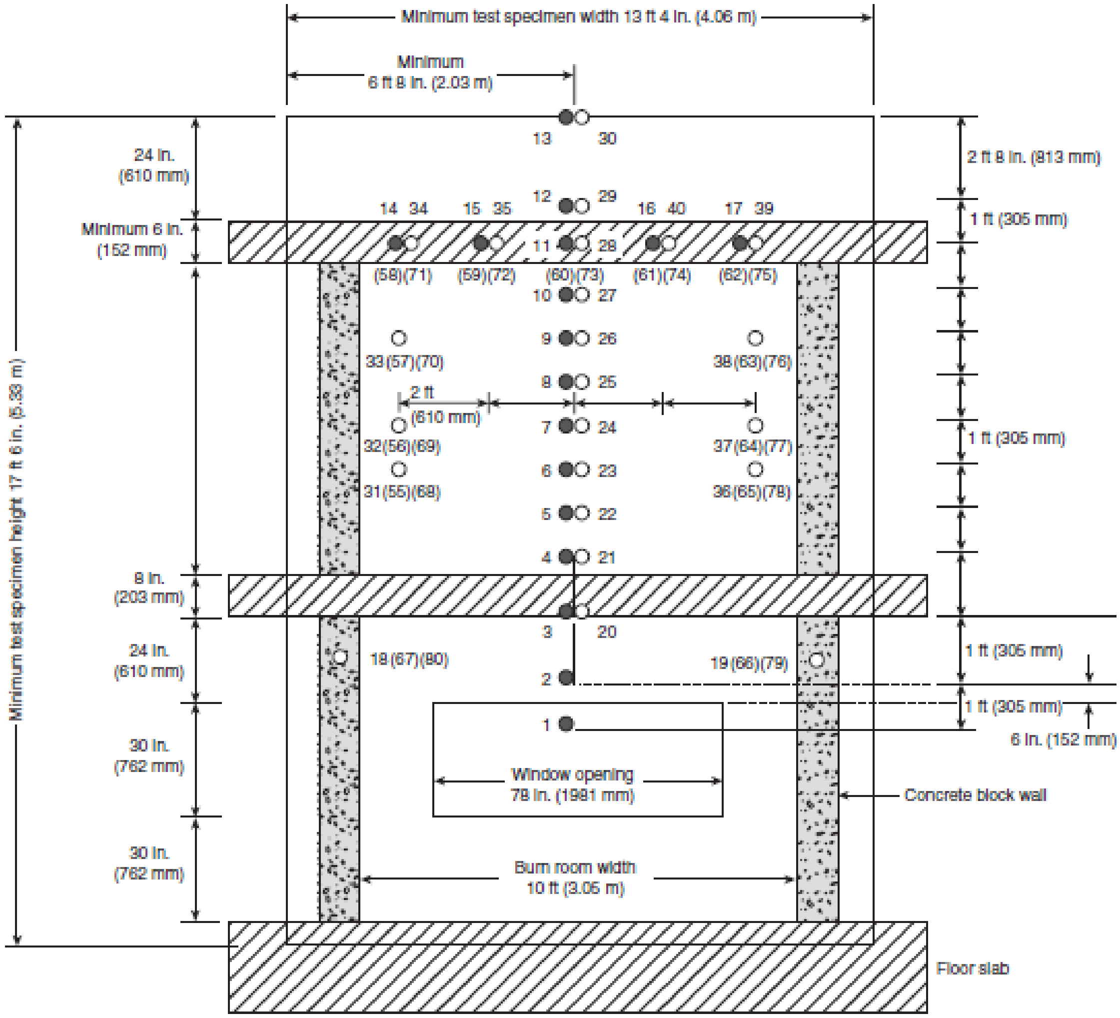
1) Flames shall not spread vertically 10 ft above the window opening as determined visually or by thermocouples located at the 10 ft level. Failure occurs when thermocouples 11 or 14 - 17 exceed 1000°F.
2) Flames shall not spread (visually) horizontally 5 ft on either side of the centerline of the window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

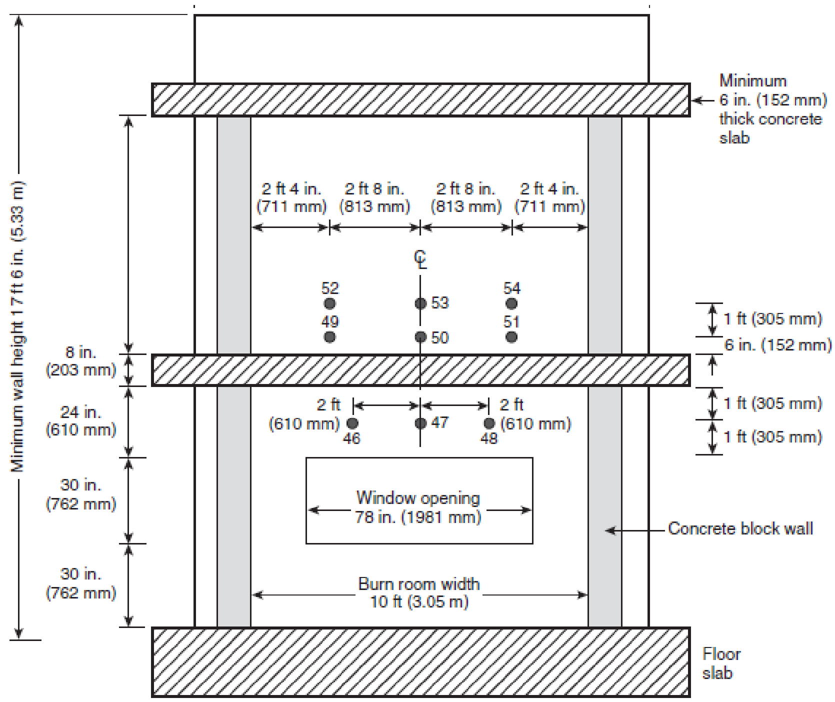
In the depictions below, thermocouples 1 - 10, and 20 - 27 are not used for compliance purposes. The remainders are used to monitor flame spread.



● 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.



Constructions Tested

This evaluation is based on Rmax EEV 10322 (Ref. 4) as the basis document. That EEV was based on several NFPA 285 tests deemed as worst case assemblies allowing various component options based on the testing. Each report describes a specific construction tested per NFPA 285. The specific constructions are confidential, but included various combinations of wall components. These include cavity insulation, exterior sheathing, water resistive barrier (WRB), exterior insulation, exterior WRB, air gap, claddings and window details.

Additionally, Cone Calorimeter tests conducted by Siga were used for this analysis.

WRB Analysis

If a new WRB is less flammable than the NFPA 285 tested WRB, it is allowed as an alternate component. Cone calorimeter data (Ref. 3) was submitted to evaluate substitutions of the WRB products.

When analyzing cone calorimeter data, two sets of numbers are typically used. These are: the time to ignition (T_{ign}) at a given heat flux; and, the peak heat release rate (Pk. HRR). Clearly, smaller Peak Heat Release Rate (Pk. HRR) values and longer time to ignition (T_{ign}) values are considered to be improvements (i.e., less flammable) when comparing materials using the Cone Calorimeter. However, some data for a given comparison are conflicting. To resolve these types of discrepancies, researchers (Ref. 7) have used a ranking system to organize cone calorimeter data for flammability comparison.

The expression $Rank = \frac{Pk.HRR}{T_{ign}}$ resolves inconsistencies in relative flammability data when using the Cone Calorimeter. Lower HRR and longer T_{ign} make the rank smaller. So, smaller rank materials are considered less flammable than higher rank materials.

With that understood, it should be noted that the accepted relative error [of the HRR] in cone calorimeters is “approximately 20 - 30% for 1 kW fires, 10% for 3 kW fires and less than 10% for 5 kW fires”. (Ref. 6).

WRB under Foam Insulation
The Siga WRB products listed below are less flammable (peak HRR or improved Rank) than at least one of the WRB's in the EEV (Ref. 4) or TER report (Ref. 5) for WRB's used under the exterior insulation (over the base wall surface).

Majvest 500 SA

WRBs over Exterior Insulation
Cone Calorimeter data has been analyzed (Ref. 3) for this condition. The WRB products listed above are less flammable than at least one if the WRB's listed for this location (with specific claddings) and may be used over the exterior insulation – only under specific masonry claddings.

WRB Conclusions
The data were analyzed with the following conclusions. Only the claddings in EEV 10322 are allowed as the claddings for this report.

WRB	Allowed Location
Majvest 500 SA	Ok under foam, with all claddings listed
	Ok over foam, Claddings 1 – 6 (heavy masonry)

CONCLUSIONS

Based on the discussion above, the following Table of NFPA 285 Assemblies (Ref. Rmax EEV 10322) shall apply to Siga. We allow Mineral Fiber (Mineral Wool) Insulation to replace the polyiso insulation since mineral wool is noncombustible

Wall Component	
Base Wall – Use either 1, 2 or 3 (Options)	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
Fire-Stopping in Stud Cavity at floor lines	4 pcf mineral fiber insulation installed with z-clips
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 Note –When SPF is used, ⅝ inch exterior gypsum sheathing must be used.	½ in. or thicker exterior gypsum sheathing
WRB Over Sheathing – Use any item 1 or 2	1) None 2) Majvest 500 SA
Exterior Insulation – Use either 1, 2, 3 or 4 Item 1 – "None" may only be used with specific claddings It is assumed mineral wool is 2 pcf (min.) 1 inch (min.) thickness	1) None (only with Claddings 1 - 6 when WRB #2 is used) 2) 4½ in. (max. consisting of a single panel or multiple thinner panels) Rmax Durasheath-3 3) 4½ in. (max. consisting of a single panel or multiple thinner panels) Rmax Thermasheath-3. 4) Mineral wool
WRB Over Exterior Insulation – Use any item 1 or 2 Item 2 may only be used with specific claddings	1) None 2) Majvest 500 SA (only with Claddings 1 - 6)
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 2½ ± ¼ 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 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).

Note: Window Headers for all constructions shall incorporate 0.08 in. (min.) aluminum flashing to cover air gaps between the exterior insulation and exterior façade. Also, flashing of sheathing joints, window, door, and other exterior wall penetrations may be done with asphalt, acrylic, butyl based flashing tape or liquid flashing – max. 12 in. width, or R-SEAL 6000 35 mil thick woven polyethylene tape – max. 12 in. width.

~ End of Report ~