



CERTIFICATION



Approved. Sealed. Code Compliant.

Technical Evaluation Report

TER 1407-05

NFPA 285 Tested Wall Assemblies
Using Kingspan® GreenGuard®
Insulation Boards & Kingspan®
GreenGuard® Building Wraps in
Exterior Walls of Buildings of Type I-IV
Construction

Kingspan® Insulation LLC

Product:

**Kingspan® GreenGuard®
Insulation Board Products &
Kingspan® GreenGuard®
Building Wrap products**

Issue Date:

August 14, 2014

Revision Date:

July 20, 2020

Subject to Renewal:

October 1, 2020

For the most recent version or a sealed copy of this Technical Evaluation Report (TER), visit drjcertification.org.





COMPANY
INFORMATION:

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DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION

SECTION: 07 21 00 - Thermal Insulation

SECTION: 07 24 00 - Exterior Insulation and Finish Systems

SECTION: 07 25 00 - Water-Resistive Barriers/Weather Barriers

SECTION: 07 27 00 - Air Barriers

1 PRODUCTS EVALUATED¹

1.1 Kingspan® GreenGuard® Insulation Board Products & Kingspan® GreenGuard® Building Wrap products

1.1.1 Kingspan® GreenGuard® Insulation Board products identified as:

1.1.1.1 Kingspan® GreenGuard® CM

1.1.1.2 Kingspan® GreenGuard® SL

1.1.1.3 Kingspan® GreenGuard® SB

1.1.2 Products referred to as Kingspan® GreenGuard® Insulation Board in this TER apply to any of the products listed in Section 1.1.1.

1.1.3 Kingspan® GreenGuard® Building Wrap products identified as:

1.1.3.1 Kingspan® GreenGuard® MAX

1.1.3.2 Kingspan® GreenGuard® RainDrop®

1.1.3.3 Kingspan® GreenGuard® C2000

1.1.3.4 Kingspan® GreenGuard® VW

1.1.3.5 Kingspan® GreenGuard® HPW™ (High Performance Wrap)

1.1.3.6 Kingspan® GreenGuard® RainArmor™ Building Wrap

1.1.3.7 Everbilt™ Premium Non-Woven Housewrap

1.1.4 Products referred to as Kingspan® GreenGuard® Building Wrap in this TER apply to any of the products listed in Section 1.1.3.

¹ Building codes require data from valid [research reports](#) be obtained from [approved sources](#). Agencies who are accredited through ISO/IEC 17065 have met the [code requirements](#) for approval by the [building official](#). DrJ is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131.

Through ANAB accreditation and the [IAF MLA](#), DrJ certification can be used to obtain product approval in any [jurisdiction](#) or country that has [IAF MLA Members & Signatories](#) to meet the [Purpose of the MLA](#) – “certified once, accepted everywhere.”

Building official approval of a licensed [registered design professional](#) (RDP) is performed by verifying the RDP and/or their business entity complies with all professional engineering laws of the relevant [jurisdiction](#). Therefore, the work of licensed RDPs is accepted by [building officials](#), except when plan (i.e., peer) review finds an error with respect to a specific section of the code. Where this TER is not approved, the [building official](#) responds in writing stating the reasons for [disapproval](#).

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, visit drjcertification.org or call us at 608-310-6748.



2 APPLICABLE CODES AND STANDARDS^{2,3}

2.1 Codes

- 2.1.1 *IBC—12, 15, 18: International Building Code®*
- 2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

- 2.2.1 *ANSI/AWC NDS: National Design Specification (NDS®) for Wood Construction*
- 2.2.2 *ASTM C518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus*
- 2.2.3 *ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*
- 2.2.4 *ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials*
- 2.2.5 *ASTM E1354: Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*
- 2.2.6 *ASTM E136: Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*
- 2.2.7 *ASTM E2178: Standard Test Method for Air Permeance of Building Materials*
- 2.2.8 *ASTM E2357: Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies*
- 2.2.9 *ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*
- 2.2.10 *ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials*
- 2.2.11 *NFPA 285: Standard Fire Test Method for the Evaluation of Fire Propagation Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components*
- 2.2.12 *NFPA 286: Standard Methods of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*

3 PERFORMANCE EVALUATION

3.1 Kingspan® GreenGuard® Insulation Board products were evaluated to determine:

- 3.1.1 Material properties in accordance with *ASTM C578*.
- 3.1.2 Thermal resistance properties in accordance with *IECC Section C402*.
- 3.1.3 Use as a water-resistant barrier (WRB) in accordance with *IBC Section 1403.2⁴*.
- 3.1.4 Use as an air barrier material in accordance with *IECC Section C402.5.1.1*.
- 3.1.5 Performance for use in buildings of Type I-IV construction in accordance with *IBC Section 2603.5*.
- 3.1.6 Performance in accordance with *ASTM E84* for flame spread and smoke development ratings in accordance with *IBC Section 2603.3* and *2603.5.4*.
- 3.1.7 Performance for use without a thermal barrier in accordance with *IBC Section 2603.4* and *2603.5.2*.
- 3.1.8 Performance with regard to the potential heat generated by the foam plastic insulated sheathing (FPIS) in accordance with *IBC Section 2603.5.3*.
- 3.1.9 Performance with regard to vertical and lateral fire propagation in accordance with *IBC Section 2603.5.5*.

² Unless otherwise noted, all references in this TER are from the 2018 version of the codes and the standards referenced therein (e.g., *ASCE 7, NDS, ASTM*). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein.

³ All terms defined in the applicable building codes are italicized.

⁴ *2015 IBC Section 1404.2*



- 3.1.10 Performance with regard to ignition in accordance with IBC Section 2603.5.7.
- 3.1.11 Use as part of an *NFPA 285* wall assembly in accordance with IBC Section 2603.5.5.
- 3.1.12 Fire resistance rating as part of an *ASTM E119* wall assembly in accordance with IBC Section 703.
- 3.2 Kingspan® GreenGuard® Building Wrap products were evaluated for:
 - 3.2.1 Use as a WRB in accordance with IBC Section 1403.2⁵ and Section 1402.5⁶.
 - 3.2.2 Use as an air barrier material in accordance with IECC Section C402.5.1.1.
 - 3.2.3 Use as part of an approved *NFPA 285* wall assembly in accordance with IBC Section 2603.5.5.
- 3.3 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.
- 3.4 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and are within DrJ's professional scope of work.

4 PRODUCT DESCRIPTION AND MATERIALS

4.1 The products evaluated in this TER are shown in Figure 1.

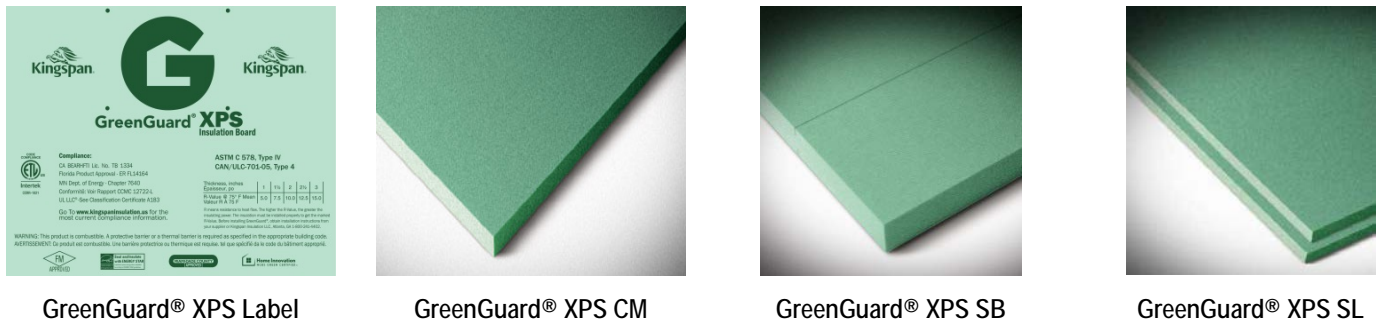


FIGURE 1. GREENGUARD® XPS - CM, SB, SL

- 4.2 Kingspan® GreenGuard® Insulation Board is:
 - 4.2.1 A proprietary Foam Plastic Insulating Sheathing (FPIS) made from extruded polystyrene in accordance with ASTM C578, Type IV.
 - 4.2.2 Available with various edge treatments and facers as follows:
 - 4.2.2.1 Kingspan® GreenGuard® CM – square edges
 - 4.2.2.2 Kingspan® GreenGuard® SB – scoreboard
 - 4.2.2.3 Kingspan® GreenGuard® SL – shiplap edges
 - 4.2.3 *Material Availability*
 - 4.2.3.1 Thickness: ½" (13 mm) through 4" (76 mm)
 - 4.2.3.2 Standard product width: 48" (1,219 mm)
- 4.3 Kingspan® GreenGuard® Building Wrap products are polyolefin materials of varying thicknesses, weights and coatings as shown in Table 1 and are produced in various sized rolls.

⁵ 2015 IBC Section 1404.2

⁶ 2015 IBC Section 1403.5



TABLE 1. KINGSPAN® GREENGUARD® BUILDING WRAP PRODUCTS

Product Name	Material Type	Coating Type	Thickness (in)	Weight (oz/lyd ²)	Water-Resistive Barrier	Air Barrier
Kingspan® GreenGuard® MAX	Cross woven, non-perforated polyolefin	Vapor permeable polyolefin	0.018	2.2	X	X
Kingspan® GreenGuard® RainDrop®			0.018	2.4	X	X
Kingspan® GreenGuard® C2000	Spun-bonded vapor permeable polyolefin	N/A	0.024	3.6	X	X
Kingspan® GreenGuard® VW	Cross-woven, micro perforated polyolefin	Polyolefin	0.004	1.9	X	
Kingspan® GreenGuard® HPW™ (High Performance Wrap)	Spun-bonded polypropylene non-woven material	N/A	0.012	3.0	X	X
Everbilt™ Premium Non-Woven Housewrap		N/A	0.012	3.0	X	X
Kingspan® GreenGuard® RainArmor™ Building Wrap	Spun-bond polypropylene building wrap with a non-perforated barrier layer	N/A	0.033	3.2	X	

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 lb/ft = 0.0146 kN/m
 N/A = Not Applicable





5 APPLICATIONS

5.1 General

- 5.1.1 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.
- 5.1.2 Kingspan® GreenGuard® Insulation Board is FPIS complying with IBC Section 2603.
 - 5.1.2.1 Kingspan® GreenGuard® Insulation Board is used in buildings of Type I through IV construction in accordance with IBC Section 2603.5.
- 5.1.3 The Kingspan® GreenGuard® Building Wrap products used as WRBs in buildings of Type I through IV construction are in accordance with the IBC Section 1402.5⁷ and Section 1403.2⁸.
- 5.1.4 Kingspan® GreenGuard® MAX, RainDrop® and C2000 are air barrier materials used as a component of air barrier assemblies in buildings of Type I through IV construction in accordance with the IECC Section C402.5.1.

5.2 Water-Resistive Barrier

- 5.2.1 Kingspan® GreenGuard® Insulation Board may be used as a WRB as prescribed in IBC Section 1403.2⁸ and 1402.5.7
- 5.2.2 Kingspan® GreenGuard® Building Wrap may be used as a WRB as prescribed in IBC Section 1403.2.8
- 5.2.3 Kingspan® GreenGuard® RainDrop® 3D, MAX™, VW, C2000, RainArmor™, and HPW building wraps have been tested in accordance with ASTM E1354 and ASTM E84 and meet the requirements of IBC Section 1402.5⁷, Exception 2, for use in Type I, II, III or IV construction that are greater than 40 feet (12,192 mm) in height above grade plane when the water-resistive barrier is the only combustible component without the need for NFPA 285 testing.

5.3 Air Barrier

- 5.3.1 Kingspan® GreenGuard® Insulation Board may be used as an air barrier material as prescribed in IECC Section R402.4.1.1 and Section C402.5.1.
- 5.3.2 Kingspan® GreenGuard® MAX™, RainDrop® 3D, C2000, and HPW™ and Everbilt™ Premium Non-Woven Housewrap may be used as an air barrier material as prescribed in IECC Section R402.4.1.1 and Section C402.5.1.

⁷ 2015 IBC Section 1403.5

⁸ 2015 IBC Section 1404.2



5.4 Thermal Resistance

5.4.1 Kingspan® GreenGuard® Insulation Board has the thermal resistance as shown in Table 2.

TABLE 2. THERMAL RESISTANCE OF INSULATION BOARDS

Product Name	Thickness (in)	R-Value (°F•ft.2•h/Btu)
Kingspan® GreenGuard® XPS ¹	½	3
	¾	3.8
	1	5
	1½	7.5
	2	10
	3	15
	4	20
SI: 1 in = 25.4 mm 1. Tested in accordance with ASTM C518 @ 75° mean temperature.		

5.5 Thermal Barrier

- 5.5.1 Industry testing on extruded polystyrene (XPS) insulation boards was evaluated in accordance with NFPA 286 for equivalence to the prescriptive ignition barriers in accordance with IBC Section 2603.4.1.6. This testing met the acceptance criteria for use in attics and crawlspaces without a thermal barrier or ignition barrier.
- 5.5.2 In addition, engineering analysis was performed to compare Kingspan® GreenGuard® Insulation Board to the tested assembly with respect to its flammability characteristics.
- 5.5.3 Testing in accordance with the following test methods was compared to determine the similarities between the products.
 - 5.5.3.1 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
 - 5.5.3.2 ASTM E1354: Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter
- 5.5.4 Based on the similar performance of GreenGuard® Insulation Boards and the tested XPS, Kingspan® GreenGuard® Insulation Board is approved for use without a thermal barrier or ignition barrier in attics and crawlspaces where entry is made only for the service of utilities in accordance with IBC Section 2603.4.1.6.

5.6 Potential Heat

5.6.1 Kingspan® GreenGuard® Insulation Board was tested to assess the potential heat generated by the FPIS in accordance with IBC Section 2603.5.3 and are shown in Table 3.

TABLE 3. POTENTIAL HEAT OF INSULATION BOARDS

Product Name	Potential Heat (Btu/lb) ¹
Kingspan® GreenGuard® XPS ¹	17,495
1. Tested in accordance with NFPA 259.	





5.7 Surface Burn Characteristics

5.7.1 Flame spread and smoke developed indexes for Kingspan® GreenGuard® XPS are shown in Table 4.

TABLE 4. FIRE PERFORMANCE OF INSULATION BOARDS & BUILDING WRAPS

Product Name	Flame Spread	Smoke Developed
Kingspan® GreenGuard® XPS ¹	< 25	< 450
1. Foam core tested in accordance with ASTM E84.		

5.8 Vertical and Lateral Fire Propagation

5.8.1 Kingspan® GreenGuard® Insulation Boards and Kingspan® GreenGuard® Building Wraps were tested to assess their performance with regard to vertical and lateral fire propagation in accordance with NFPA 285 and IBC Section 2603.5.5.

- 5.8.1.1 Engineering analysis also was conducted to assess substitution of other products within the approved wall assemblies.
- 5.8.1.2 The wall assemblies listed in Table 5 and Table 6 are approved for use in buildings of Type I-IV construction.

TABLE 5. APPROVED NFPA 285 WALL ASSEMBLIES WITH UP TO 3" KINGSPAN® GREENGUARD® XPS INSULATION¹

Wall Component	Materials
Base Wall System Use any of these options	<ol style="list-style-type: none"> 1. Concrete Wall 2. Concrete Masonry Wall 3. 20-gauge (min.) 3⁵/₈" depth (min.) steel studs spaced at a maximum of 16" o.c. with lateral bracing every 4' vertically. <ol style="list-style-type: none"> a. 1 layer – 5/8"-thick Type X or 1/2"-thick Type X gypsum wallboard on interior
Floorline Firestopping	<ol style="list-style-type: none"> 1. 4 lb/cu ft mineral wool (e.g., Thermafiber) in each stud cavity at each floor line – attached with Z-clips or equivalent
Cavity Insulation Use any of these options	<ol style="list-style-type: none"> 1. None 2. Any noncombustible insulation per ASTM E136 3. Fiberglass (Batt type Class A ASTM E84 faced or unfaced)
Exterior Sheathing Use any of these options	<ol style="list-style-type: none"> 1. None 2. Minimum 1/2"-thick, exterior type gypsum sheathing 3. Minimum 5/8"-thick, Type X, exterior type gypsum sheathing
Air Barrier or Weather-Resistive Barrier Applied to Exterior Sheathing Use any of these options	<ol style="list-style-type: none"> 1. None 2. BASF Enershield® HP 3. BASF Enershield® 1 4. Carlisle CCW-705FR w/Primers 5. Carlisle Barritech™ VP 6. Carlisle Barritech™ NP 7. Carlisle Barrithane VP 8. Carlisle 705 VP 9. Cosella-Dörken Delta®-Foxy 10. Cosella-Dörken Delta®-Foxy Plus 11. Cosella-Dörken Delta®-Fassade S 12. Cosella-Dörken Delta®-Vent S/Plus 13. Cosella-Dörken Delta®-Maxx Plus 14. Dow Weathermate™ 15. Dow Weathermate™ Plus 16. Dryvit Backstop® NT 17. Dupont™ Tyvek® CommercialWrap®





Wall Component	Materials
	18. Dupont™ Tyvek® CommercialWrap® D 19. Dupont™ Tyvek® ThermaWrap™ 20. Dupont™ Tyvek® Fluid Applied Weather Barrier-nominal 25 mill (wet) thickness 21. Henry Air-Bloc® 32MR 22. Henry Air-Bloc® 31MR 23. Henry Air-Bloc® 33MR 24. Henry BlueskinVP™ 160 25. Henry Air-Bloc® 21 FR 26. Henry Metal Clad™ 27. Henry Foilskin® 28. Hohmann & Barnard Enviro-Barrier™ 29. Hohmann & Barnard Enviro-Barrier™ VP 30. Momentive Performance Materials GE SEC2500 SilShield AWB 31. Momentive Performance Materials GE SEC2600 SilShield AWB 32. Momentive Performance Materials GE SEC2600-R SilShield AWB 33. Kingspan® GreenGuard® Max Building Wrap 34. Kingspan® GreenGuard® VW 35. Kingspan® GreenGuard® Classic Wrap 36. Kingspan® GreenGuard® RainDrop Drainage Wrap 37. Kingspan® GreenGuard® C2000 38. Polyguard Airlok Flex® at 40 mils (wet) 39. Polyguard Airlok Flex® WG at 20 mils (wet) 40. Polyguard Airlok Flex® VP at 32 mils (wet) 41. Sto Corp Sto Gold Coat® with StoGuard Fabric 42. Sto Corp Sto Emerald Coat® with StoGuard Fabric 43. Sto Corp Sto ExtraSeal™ w/StoGuard Mesh 44. STS, Inc. Wall Guardian™ FW 100A 45. VaproShield WallShield® 46. VaproShield WrapShield® 47. VaproShield RevealShield™ 48. VaproShield RevealShield SA™ 49. W.R. Grace Perm-A-Barrier® Aluminum Wall Membrane 50. W.R. Grace Perm-A-Barrier® VPL 51. W.R. Grace Perm-A-Barrier® VPS 52. W.R. Grace Perm-A-Barrier® NPL 53. WR Meadows Air-Shield™ LMP (Gray) 54. WR Meadows Air-Shield™ LMP (Black) 55. WR Meadows Air-Shield™ TMP 56. WR Meadows Air-Shield™ LSR Note: All WRBs to be installed at the indicated or recommended application rates and per the manufacturer's installation instructions.
Exterior Insulation	1. Kingspan® GreenGuard® XPS – ½" minimum and 3" maximum Seal all insulation joints with maximum 4"-wide asphalt or Butyl based flashing tape.
WRB Over Exterior Insulation Use any option 1-13	1. None 2. Dow Weathermate™ 3. Dow Weathermate™ Plus 4. Dupont™ Tyvek® CommercialWrap® 5. Dupont™ Tyvek® CommercialWrap® D 6. Dupont™ Tyvek® ThermaWrap™ 7. Kingspan® GreenGuard® Max Building Wrap 8. Kingspan® GreenGuard® VW 9. Kingspan® GreenGuard® Classic Wrap





Wall Component	Materials
	10. Kingspan® GreenGuard® RainDrop Drainage Wrap 11. Kingspan® GreenGuard® C2000 12. VaproShield RevealShield™ 13. VaproShield RevealShield SA™
Exterior Veneer Use any of these options	1. Brick <ul style="list-style-type: none"> a. Standard nominal 4"-thick, clay brick b. Brick veneer anchors – standard types – installed maximum 24" o.c. vertically on each stud c. Maximum 2" air gap between exterior insulation and brick 2. Concrete <ul style="list-style-type: none"> a. Minimum 2" thick b. Maximum 2" air gap between exterior insulation and concrete 3. CMU-Concrete Masonry Units <ul style="list-style-type: none"> a. Minimum 4" thick b. Maximum 2" air gap between exterior insulation and CMU 4. Stone Veneer <ul style="list-style-type: none"> a. Minimum 2"-thick limestone or natural stone veneer b. Minimum 1½"-thick cast artificial stone veneer c. Any standard non-open joint technique may be used (e.g., shiplap, etc.) 5. Terracotta cladding <ul style="list-style-type: none"> a. Minimum 1-¼" thick b. Any standard non-open joint technique may be used (e.g., shiplap, etc.)
SI: 1 in = 25.4 mm 1. See Header detail (Figure 2) for instructions on required treatment of window and door openings.	





TABLE 6. APPROVED NFPA 285 WALL ASSEMBLY WITH UP TO 4 INCHES OF GREENGUARD® XPS INSULATION¹

Wall Component	Materials
Base Wall System	1. 18-gauge 3-5/8" depth (min.) galvanized steel studs spaced at a maximum 24" o.c. a. One (1) layer 5/8" thick gypsum wallboard on interior
Cavity Insulation	1. Unfaced fiberglass batt insulation
Exterior Sheathing	1. One (1) layer 1/2" thick exterior type gypsum
Air Barrier and Weather Resistive Barrier applied to exterior sheathing Use any of these options.	<ol style="list-style-type: none"> 1. Tremco® ExoAir® 230 fluid applied, synthetic air & vapor permeable membrane 2. 3M™ Self-Adhered Air and Vapor Barrier 3015 3. BASF Senershield-R 4. BASF Senershield-VB 5. Carlisle CCW-705FR w/ Primers 6. Carlisle Barritech™ VP 7. Carlisle Barritech™ NP 8. Carlisle Barrithane VP 9. Carlisle 705 VP 10. Dörken Systems Delta®-Foxy 11. Dörken Systems Delta®-Foxy Plus 12. Dörken Systems Delta®-Fassade S 13. Dörken Systems Delta®-Vent S/Plus 14. Dörken Systems Delta®-Maxx Plus 15. Dow Chemical WeatherMate™ 16. Dow Chemical WeatherMate™ Plus 17. Dow Corning® Defend Air 200 18. Dryvit Backstop® NT 19. DuPont™ Tyvek® CommercialWrap® 20. DuPont™ Tyvek® CommercialWrap® D 21. DuPont™ Tyvek® ThermaWrap™ 22. DuPont® Tyvek® Fluid Applied WB+ (nominal 25 wet mil thickness) 23. Henry Company Air-Bloc® 21 FR 24. Henry Company Air-Bloc® 31MR 25. Henry Company Air-Block® 33MR 26. Henry Company Blueskin VP™ 160 27. Henry Company Blueskin® Metal Clad® 28. Henry Company Foilskin® 29. Hohmann & Barnard Enviro-Barrier™ VP 30. Grace Construction Products Perm-A-Barrier® Aluminum Wall Membrane 31. Grace Construction Products Perm-A-Barrier® VPL 32. Grace Construction Products Perm-A-Barrier® VPL LT 33. Grace Construction Products Perm-A-Barrier® VPS 34. JX Nippon ANCI, Inc. JX ALTA™ Commercial Wrap 35. JX Nippon ANCI, Inc. JX ALTA™ HP Wrap 36. JX Nippon ANCI, Inc. JX ALTA™ LP Wrap 37. Kingspan® GreenGuard® Max™ Building Wrap 38. Kingspan® GreenGuard® Classic Building Wrap 39. Kingspan® GreenGuard® C2000 Building Wrap 40. Kingspan® GreenGuard® Raindrop® 3D Building Wrap 41. Kingspan® GreenGuard® HPW™ Building Wrap 42. Kingspan® GreenGuard® RainArmor™ Building Wrap 43. Everbilt™ Premium Non-woven Housewrap 44. Momentive Performance Materials GE SEC2500 SiShield* AWB 45. Momentive Performance Materials GE SEC2600 SiShield* AWB 46. Momentive Performance Materials GE SEC2600-r SiShield* AWB 47. Polyguard Products Airluk Flex® (applied at a maximum 50 mils WFT)





Wall Component	Materials
	48. Polyguard Products Airlok Flex® WG (applied at a maximum 20 mils WFT) 49. Polyguard Products Airlok Flex® VP (applied at a maximum 32 mils WFT) 50. Prosoco CAT 5 51. Prosoco CAT 5 Rainscreen 52. Soprema Sopraseal Stick VP 53. Sto Corp Sto Gold Coat® with StoGuard Fabric 54. Sto Corp Sto Emerald Coat® with StoGuard Fabric 55. Sto Corp Sto ExtraSeal™ with StoGuard Mesh 56. Sto Corp StoGuard® VaproShield™ 57. STS, Inc. Wall Guardian™ FW-100A 58. Tremco, Inc. ExoAir 430 59. VaproShield Wallshield® 60. VaproShield WrapShield® 61. VaproShield WrapShield® SA™ 62. VaproShield RevealShield™ 63. VaproShield RevealShield SA™ 64. W.R. Meadows Air-Shield™ LMP (Gray) 65. W.R. Meadows Air-Shield™ LMP (Black) 66. W.R. Meadows Air-Shield™ TMP 67. W.R. Meadows Air-Shield™ LSR
Exterior Insulation	1. Kingspan® GreenGuard® XPS Insulation Board – 4" thickness
WRB Over Exterior Insulation	1. 10mm Keene Building Products Driwall™ Rainscreen drainage mat
Exterior Veneer	1. Glen-Gery Thin Veneer Brick <ul style="list-style-type: none"> a. First a layer of ½" thick PermaBase® cement board b. Laticrete MVIS Thin Brick Mortar applied to full surface of PermaBase® c. Thin Veneer Brick applied with Glen-Gery Mortar Blend Portland cement-line mortar as grout
1. See Header detail (Figure 2) for instructions on required treatment of window and door openings.	



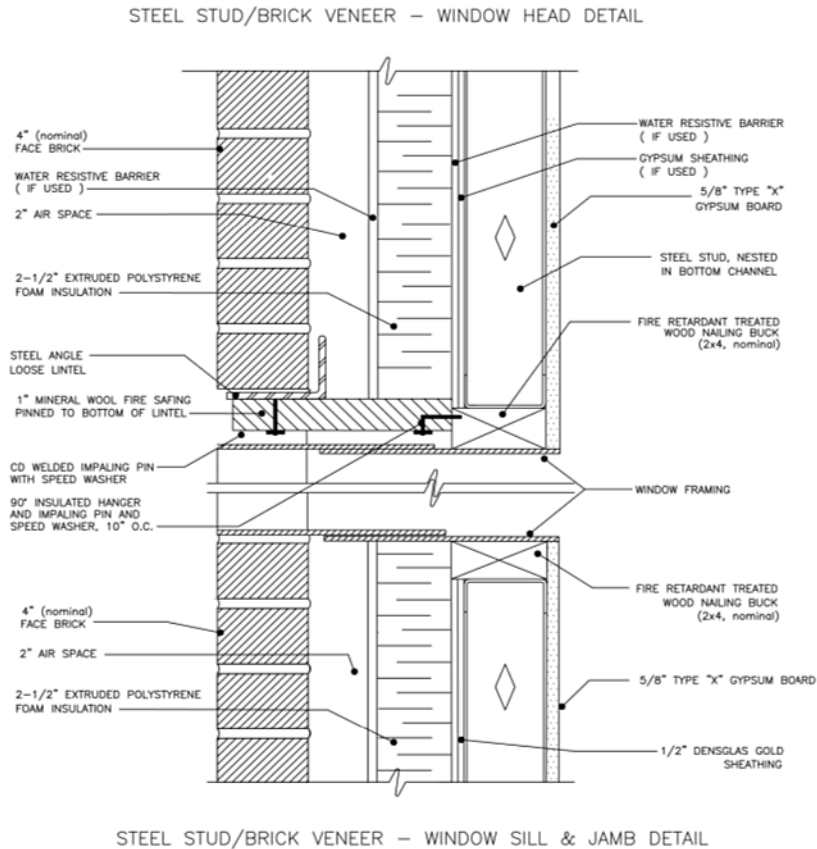


FIGURE 2. HEADER DETAIL FOR *NFPA 285* WALL ASSEMBLIES (BRICK SHOWN, OTHER CLADDINGS SIMILAR)

5.9 Ignition

- 5.9.1 Kingspan® GreenGuard® Insulation Boards were evaluated to assess performance with regard to ignition in accordance with IBC Section 2603.5.7.
 - 5.9.1.1 Kingspan® GreenGuard® Insulation Boards comply with this section when the exterior side of the sheathing is protected with one of the following materials:
 - 5.9.1.1.1 A thermal barrier complying with IBC Section 2603.4.
 - 5.9.1.1.2 A minimum 1" (25 mm) thickness of concrete or masonry.
 - 5.9.1.1.3 Glass-fiber-reinforced concrete panels of a minimum thickness of 3/8" (9.5 mm).
 - 5.9.1.1.4 Metal-faced panels having a minimum 0.019"-thick (0.48 mm) aluminum or 0.016"-thick (0.41 mm) corrosion-resistant steel outer facings.
 - 5.9.1.1.5 A minimum 7/8" (22.2 mm) thickness of stucco complying with IBC Section 2510.
 - 5.9.1.1.6 A minimum 1/4" (6.4 mm) thickness fiber-cement lap, panel or shingle siding complying with IBC Section 1404.16.⁹

⁹ 2015 IBC Section 1405.16



5.10 Fire Resistance

5.10.1 The exterior non-loading wall assembly described in Table 7 was tested and evaluated in accordance with ASTM E119 and was found to have a one-hour fire-resistance rating from either side.

TABLE 7. ONE-HOUR FIRE RESISTANCE RATED WALL ASSEMBLY¹

Wall Component	Material
Interior Cladding	One (1) layer of 5/8" thick gypsum wallboard
Framing	18-gauge 3-5/8" depth galvanized steel studs spaced at a maximum 24" o.c.
Cavity Insulation	Unfaced fiberglass batt insulation, Type I
Exterior Sheathing	One (1) layer of 1/2" thick exterior type gypsum
Water-Resistive Barrier	Tremco® ExoAir® 230 fluid applied, synthetic air & vapor permeable membrane
Exterior Insulation	Kingspan® GreenGuard® XPS insulation board – 4" thickness
WRB Over Insulation	10mm Keene Building Products Driwall™ Rainscreen drainage mat
Exterior Cladding	Glen-Gery Thin Veneer Brick 1. First a layer of 1/2" thick PermaBase® cement board 2. Laticrete MVIS Thin Brick Mortar applied to full surface of PermaBase® 3. Thin Veneer Brick applied with Glen-Gery Mortar Blend Portland cement-line mortar as grout

SI: 1 in = 25.4 mm

1. Tested in accordance with ASTM E119. One hour rating is achieved with the fire exposure from either side.
2. Wall components listed from interior to exterior.

6 INSTALLATION

6.1 Installation shall comply with the manufacturer's installation instructions and this TER. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.

6.2 Installation Procedure

6.2.1 For Kingspan® GreenGuard® Insulation Board [installation instructions](#), see DrJ Installation Instructions, [TER 1410-09](#).

6.2.2 For commercial building wrap applications, see the [Commercial Installation Guide for Kingspan® GreenGuard® Building Wraps](#).

6.3 See Table 5 for NFPA 285-compliant wall assemblies using Kingspan® GreenGuard® Insulation Board and Kingspan® GreenGuard® Building Wraps with non-combustible veneers. See Figure 2 for the "Window/Door Opening Detail" required for these assemblies.

6.4 For applications outside the scope of this TER, an engineered design is required.

7 TEST ENGINEERING SUBSTANTIATING DATA

7.1 Test reports and data supporting the following material properties and wall assembly performance:

7.1.1 Flame spread and smoke developed ratings in accordance with ASTM E84/UL 273 by Underwriters Laboratories, Inc.

7.1.2 Flame spread and smoke developed ratings for GreenGuard® HPW™ and GreenGuard® RainArmor™ Building Wraps, and Everbilt™ Premium Non-Woven Housewrap in accordance with ASTM E84 by Intertek.

7.1.3 Air barrier performance of GreenGuard® Max Building Wrap in accordance with ASTM E331 by Architectural Testing.

7.1.4 Air permeance of GreenGuard® Insulation Boards in accordance with ASTM E2178 by RADCO.





- 7.1.5 Water-resistance barrier performance of GreenGuard® VW, GreenGuard® RainDrop® 3D, GreenGuard® MAX™, GreenGuard® C2000, GreenGuard® HPW™ and GreenGuard® RainArmor™ Building Wraps, and Everbilt™ Premium Non-Woven Housewrap as equivalent to Grade D paper and air barrier performance of GreenGuard® RainDrop® 3D, GreenGuard® MAX™, GreenGuard® C2000, and GreenGuard® HPW™ Building Wraps, and Everbilt™ Premium Non-Woven Housewrap in accordance with *ASTM E2178* by Intertek.
- 7.1.6 Water-resistance barrier performance of GreenGuard® Insulation Boards in accordance with *ASTM E331* by ATI.
- 7.1.7 Water resistance properties of GreenGuard® HPW™ and GreenGuard® RainArmor™ Building Wraps, and Everbilt™ Premium Non-Woven Housewrap in accordance with *AATCC 127* by Intertek.
- 7.1.8 Material properties in accordance with *ASTM C578* by RADCO.
- 7.1.9 Vertical and lateral flame spread in accordance with *NFPA 285*; by Southwest Research Institute, UL, and Intertek.
- 7.1.10 Exclusion of thermal and ignition barriers in attics and crawlspaces in accordance with *NFPA 286* by Southwest Research Institute.
- 7.1.11 Fire Resistance characteristics evaluated in accordance with *ASTM E119* by Intertek.
- 7.1.12 Southwest Research Institute, Final Report No. 01.06440.01.001.
- 7.1.13 Underwriters Laboratories, Inc., Final Report No. 05CA2541, NC2650.
- 7.1.14 Southwest Research Institute, Final Report No. 01.13537.01.106.
- 7.1.15 Cone calorimeter testing in accordance with *ASTM E1354* by Jensen Hughes, Inc.
- 7.1.16 Cone calorimeter testing in accordance with *ASTM E1354* by University of Dayton Research Institute.
- 7.1.17 Surface burning characteristics testing in accordance with *ASTM E84* by Intertek.
- 7.1.18 Hughes Associates, Engineering Evaluation for Comparative Fire Properties Relating to *NFPA 285*, HAI Project No. 5242-005.
- 7.1.19 Hughes Associates, Engineering Evaluation for Comparative Fire Properties Relating to *NFPA 286*, HAI Project No. 1JJB05192.001.
- 7.1.20 Hughes Associates, Engineering Evaluation for Comparative Fire Properties Relating to *NFPA 285*, HAI Project No. 1JJB00060.001.
- 7.1.21 Jensen Hughes, Inc., Alternate Weather Resistive Barrier Materials for use with Kingspan® GreenGuard® Insulation and Thin Brick Exterior Wall Assembly Complying with *NFPA 285* and *ASTM E119*, Project No.: 1JJB00153.013.000.
- 7.2 Engineering analysis supporting the following material properties:
 - 7.2.1 Engineering analysis comparing the fire resistance properties of GreenGuard® Insulation Boards and GreenGuard® Building Wraps by Hughes Associates for contribution of materials to room fire growth in accordance with *NFPA 286*.
 - 7.2.2 Engineering analysis assessing the substitution of products within the approved *NFPA 285* tested wall assemblies by Hughes Associates for vertical and lateral flame spread.
 - 7.2.3 Jensen Hughes, Analysis of Kingspan® Building Wraps and Section 1403.5 of the *IBC* (2015 edition), Project No. 1JJB05192.001.
- 7.3 Manufacturer technical data sheets and installation instructions.
- 7.4 Test reports and data for determining comparative equivalency for use as an alternative material in accordance with *IBC Section 104.11*.





- 7.5 Some information contained herein is the result of testing and/or data analysis by other sources which conform to IBC Section 1703 and relevant professional engineering law. DrJ relies on accurate data from these sources to perform engineering analysis. DrJ has reviewed and found the data provided by other professional sources to be credible.
- 7.6 Where appropriate, DrJ's analysis is based on design values that have been codified into law through codes and standards (e.g., *IBC*, *IRC*, *NDS*®, and *SDPWS*). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g., lumber, steel, and concrete), DrJ relies upon the grade mark, stamp, and/or design values provided by raw material suppliers to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8 FINDINGS

- 8.1 When used and installed in accordance with this TER and the manufacturer's installation instructions, the product(s) listed in Section 1.1 are approved for the following:
 - 8.1.1 Kingspan® GreenGuard® Insulation Boards and Kingspan® GreenGuard® Building Wraps are approved for use in exterior walls without a thermal barrier in accordance with IBC Section 2603.4 and 2603.5.2.
 - 8.1.2 Kingspan® GreenGuard® Insulation Boards and Kingspan® GreenGuard® Building Wraps are approved for use in exterior walls of buildings of Type I-IV construction in accordance with IBC Section 2603.5.
 - 8.1.3 Kingspan® GreenGuard® Insulation Boards and Kingspan® GreenGuard® Building Wraps are approved for use in wall assemblies meeting the requirements of *NFPA 285* testing when constructed in accordance with Table 5.
 - 8.1.3.1 Kingspan® GreenGuard® RainDrop® 3D, MAX™, VW, and C2000 building wraps have been tested in accordance with *ASTM E1354* and *ASTM E84* and meet the requirements of IBC Section 1402.5¹⁰, Exception 2, for use in Type I, II, III or IV construction that are greater than 40 feet (12 192 mm). As such, where these Kingspan® building wraps are the only combustible products in the wall assembly, *NFPA 285* testing is not required.
 - 8.1.4 Wall assemblies containing Kingspan® GreenGuard® Insulation Boards up to 4" in thickness are fire resistance rated for one hour when used as described in Table 6.
 - 8.1.5 Kingspan® GreenGuard® Insulation Boards and Kingspan® GreenGuard® Building Wraps described in this TER comply with, or are a suitable alternative to, the applicable sections of the codes listed in Section 2.
- 8.2 IBC Section 104.11 (IRC Section R104.11 and IFC Section 104.9 are similar) states:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code ... Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.
- 8.3 This product has been evaluated in the context of the codes listed in Section 2 and is compliant with all known state and local building codes. Where there are known variations in state or local codes applicable to this TER, they are listed here.
 - 8.3.1 No known variations

¹⁰ 2015 IBC Section 1403.5





9 CONDITIONS OF USE

- 9.1 The products listed in this TER shall be installed in accordance with this TER and the manufacturer's installation instructions.
- 9.2 When the insulation boards or building wraps are used on exterior walls of buildings of Type I, II, III or IV, construction must be as described in Table 3.
- 9.3 In areas where the probability of termite infestation is very heavy and the building is wood-framed construction, the product must not be placed on exterior walls located within 6" (152 mm) of the ground and shall meet the requirements of IBC Section 2603.8.
- 9.4 Kingspan® GreenGuard® Insulation Boards shall be separated from the interior of the building by an approved thermal barrier except as provided for in Section 5.3.
- 9.5 This product shall not be used as a nailing base for claddings.
- 9.6 The insulation boards shall not be used to resist lateral loads. Walls shall be braced by other materials in accordance with the applicable code, and the exterior wall covering shall be capable of resisting the full design wind pressure.
- 9.7 The insulation boards are manufactured in Winchester, VA, under a quality control program with quality control inspections in accordance with IBC Section 110.3.9¹¹ and 110.3.10¹².
- 9.8 When used as part of a continuous air barrier, Kingspan® GreenGuard® Insulation Boards shall be a minimum 1" thickness and all sheathing panel edges at the top and bottom of the wall assemblies and all butted joints between sheathing panels shall be sealed with 1/8" GreenGuard® Seam Tape or equivalent.
- 9.9 Where required by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this TER and the installation instructions shall be submitted at the time of permit application.
- 9.10 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.
- 9.11 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the Building Designer (e.g., owner or registered design professional).
- 9.12 At a minimum, this product shall be installed per Section 6 of this TER.
- 9.13 This product is manufactured under a third-party quality control program in accordance with IBC Section 104.4 and 110.4 and IRC Section R104.4 and R109.2.
- 9.14 The actual design, suitability, and use of this TER for any particular building is the responsibility of the owner or the owner's authorized agent. Therefore, the TER shall be reviewed for code compliance by the building official for acceptance.
- 9.15 The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party quality assurance program and procedures, proper installation per the manufacturer's instructions, the building official's inspection, and any other code requirements that may apply to demonstrate and verify compliance with the applicable building code.

¹¹ 2015 IBC Section 110.3.8

¹² 2015 IBC Section 110.3.9



10 IDENTIFICATION

- 10.1 The product(s) listed in Section 1.1 are identified by a label on the board or packaging material bearing the manufacturer's name, product name, TER number, and other information to confirm code compliance.
- 10.2 Additional technical information can be found at www.kingspan.com/us/en-us.

11 REVIEW SCHEDULE

- 11.1 This TER is subject to periodic review and revision. For the most recent version of this TER, visit drjcertification.org.
- 11.2 For information on the current status of this TER, contact [DrJ Certification](#).

