DrJ™ 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:

October 16, 2020

Subject to Renewal:

October 1, 2021

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 EVALUATED[1]

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® 3D

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 1403.2[4].

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.

3.1.10 Performance with regard to ignition in accordance with *IBC* Section 2603.5.7.

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[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

3.1.11 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 1403.2[5] and Section 1402.5[6].

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.

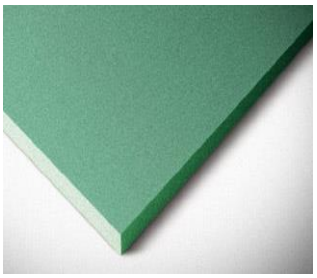
3.3 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.

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.


**GreenGuard® XPS Label**



**GreenGuard® XPS CM**

**GreenGuard® XPS SB**

**GreenGuard® XPS SL**

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/yd²) | 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® 3D | | | 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 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

5.1.1 Kingspan® GreenGuard® Insulation Board is FPIS complying with *IBC* Section 2603.

5.1.1.1 Kingspan® GreenGuard® Insulation Board is used in buildings of Type I through IV construction in accordance with *IBC* Section 2603.5.

5.1.2 The Kingspan® GreenGuard® Building Wrap products used as WRBs in buildings of Type I through IV construction are in accordance with the *IBC* Section 1402.5[7] and Section 1403.2[8].

5.1.3 Kingspan® GreenGuard® MAX™, RainDrop® 3D, 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 1403.2[8] 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]

[7] 2015 *IBC* Section 1403.5

[8] 2015 *IBC* Section 1404.2

5.2.3 Kingspan® GreenGuard® MAX™, RainDrop® 3D, C2000, VW, HPW™, and RainArmor™ building wraps have been tested in accordance with *ASTM E1354* and *ASTM E84* and meet the requirements of *IBC* Section 1402.5[7], 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.

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 ft² 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 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 INSULATION[1]

| Wall Component | Materials |
|---|---|
| **Base Wall System**<br>Use any of these options | 1. Concrete Wall<br>2. Concrete Masonry Wall<br>3. 20-gauge (min.) 3⅝″ depth (min.) steel studs spaced at a maximum of 16″ o.c. with lateral bracing every 4' vertically.<br>a. 1 layer – ⅝″-thick Type X or ½″-thick Type X gypsum wallboard on interior |
| **Floorline Firestopping** | 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**<br>Use any of these options | 1. None<br>2. Any noncombustible insulation per *ASTM E136*<br>3. Fiberglass (Batt type Class A *ASTM E84* faced or unfaced) |
| **Exterior Sheathing**<br>Use any of these options | 1. None<br>2. Minimum ½″-thick, exterior type gypsum sheathing<br>3. Minimum ⅝″-thick, Type X, exterior type gypsum sheathing |
| **Air Barrier or Weather-Resistive Barrier Applied to Exterior Sheathing**<br>Use any of these options | 1. None<br>2. BASF Enershield® HP<br>3. BASF Enershield® 1<br>4. Carlisle CCW-705FR w/Primers<br>5. Carlisle Barritech™ VP<br>6. Carlisle Barritech™ NP<br>7. Carlisle Barrithane VP<br>8. Carlisle 705 VP<br>9. Cosella-Dörken Delta®-Foxx<br>10. Cosella-Dörken Delta®-Foxx Plus<br>11. Cosella-Dörken Delta®-Fassade S<br>12. Cosella-Dörken Delta®-Vent S/Plus<br>13. Cosella-Dörken Delta®-Maxx Plus<br>14. Dow Weathermate™<br>15. Dow Weathermate™ Plus<br>16. Dryvit Backstop® NT<br>17. Dupont™ Tyvek® CommercialWrap®<br>18. Dupont™ Tyvek® CommercialWrap® D<br>19. Dupont™ Tyvek® ThermaWrap™<br>20. Dupont™ Tyvek® Fluid Applied Weather Barrier-nominal 25 mill (wet) thickness<br>21. Henry Air-Bloc® 32MR<br>22. Henry Air-Bloc® 31MR<br>23. Henry Air-Bloc® 33MR<br>24. Henry BlueskinVP ™ 160<br>25. Henry Air-Bloc® 21 FR<br>26. Henry Metal Clad ™<br>27. Henry Foilskin®<br>28. Hohmann & Barnard Enviro-Barrier™<br>29. Hohmann & Barnard Enviro-Barrier™ VP<br>30. Momentive Performance Materials GE SEC2500 SilShield AWB<br>31. Momentive Performance Materials GE SEC2600 SilShield AWB<br>32. Momentive Performance Materials GE SEC2600-R SilShield AWB<br>33. Kingspan® GreenGuard® Max™ Building Wrap<br>34. Kingspan® GreenGuard® VW<br>35. Kingspan® GreenGuard® Classic Wrap<br>36. Kingspan® GreenGuard® RainDrop® 3D<br>37. Kingspan® GreenGuard® C2000<br>38. Polyguard Airlok Flex® at 40 mils (wet)<br>39. Polyguard Airlok Flex® WG at 20 mils (wet) |

| Wall Component | Materials |
|---|---|
| | 40. Polyguard Airlok Flex® VP at 32 mils (wet)<br>41. Sto Corp Sto Gold Coat® with StoGuard Fabric<br>42. Sto Corp Sto Emerald Coat® with StoGuard Fabric<br>43. Sto Corp Sto ExtraSeal™ w/StoGuard Mesh<br>44. STS, Inc. Wall Guardian™ FW 100A<br>45. VaproShield WallShield®<br>46. VaproShield WrapShield®<br>47. VaproShield RevealShield™<br>48. VaproShield RevealShield SA™<br>49. W.R. Grace Perm-A-Barrier® Aluminum Wall Membrane<br>50. W.R. Grace Perm-A-Barrier® VPL<br>51. W.R. Grace Perm-A-Barrier® VPS<br>52. W.R. Grace Perm-A-Barrier® NPL<br>53. WR Meadows Air-Shield™ LMP (Gray)<br>54. WR Meadows Air-Shield™ LMP (Black)<br>55. WR Meadows Air-Shield™ TMP<br>56. WR Meadows Air-Shield™ LSR<br>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<br>Seal all insulation joints with maximum 4″-wide asphalt or Butyl based flashing tape. |
| **WRB Over Exterior Insulation**<br>Use any option 1-13 | 1. None<br>2. Dow Weathermate™<br>3. Dow Weathermate™ Plus<br>4. Dupont™ Tyvek® CommercialWrap®<br>5. Dupont™ Tyvek® CommercialWrap® D<br>6. Dupont™ Tyvek® ThermaWrap™<br>7. Kingspan® GreenGuard® Max™ Building Wrap<br>8. Kingspan® GreenGuard® VW<br>9. Kingspan® GreenGuard® Classic Wrap<br>10. Kingspan® GreenGuard® RainDrop® 3D<br>11. Kingspan® GreenGuard® C2000<br>12. VaproShield RevealShield™<br>13. VaproShield RevealShield SA™ |
| **Exterior Veneer**<br>Use any of these options | 1. Brick<br>a. Standard nominal 4"-thick, clay brick<br>b. Brick veneer anchors – standard types – installed maximum 24" o.c. vertically on each stud<br>c. Maximum 2" air gap between exterior insulation and brick<br>2. Concrete<br>a. Minimum 2" thick<br>b. Maximum 2" air gap between exterior insulation and concrete<br>3. CMU-Concrete Masonry Units<br>a. Minimum 4" thick<br>b. Maximum 2" air gap between exterior insulation and CMU<br>4. Stone Veneer<br>a. Minimum 2"-thick limestone or natural stone veneer<br>b. Minimum 1½"-thick cast artificial stone veneer<br>c. Any standard non-open joint technique may be used (e.g., shiplap, etc.)<br>5. Terracotta cladding<br>a. Minimum 1-¼" thick<br>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 INSULATION[1]

| Wall Component | Materials |
|---|---|
| **Base Wall System** | 1. 18-gauge 3-5/8" depth (min.) galvanized steel studs spaced at a maximum 24" o.c.<br>a. One (1) layer 5/8" thick gypsum wallboard on interior |
| **Cavity Insulation** | 1. Unfaced fiberglass batt insulation |
| **Exterior Sheathing** | 1. One (1) layer ½" thick exterior type gypsum |
| **Air Barrier and Weather Resistive Barrier applied to exterior sheathing**<br>Use any of these options. | 1. Tremco® ExoAir® 230 fluid applied, synthetic air & vapor permeable membrane<br>2. 3M™ Self-Adhered Air and Vapor Barrier 3015<br>3. BASF Senershield-R<br>4. BASF Senershield-VB<br>5. Carlisle CCW-705FR w/ Primers<br>6. Carlisle Barritech™ VP<br>7. Carlisle Barritech™ NP<br>8. Carlisle Barrithane VP<br>9. Carlisle 705 VP<br>10. Dörken Systems Delta®-Foxx<br>11. Dörken Systems Delta®-Foxx Plus<br>12. Dörken Systems Delta®-Fassade S<br>13. Dörken Systems Delta®-Vent S/Plus<br>14. Dörken Systems Delta®-Maxx Plus<br>15. Dow Chemical WeatherMate™<br>16. Dow Chemical WeatherMate™Plus<br>17. Dow Corning® Defend Air 200<br>18. Dryvit Backstop® NT<br>19. DuPont™ Tyvek® CommercialWrap®<br>20. DuPont™ Tyvek® CommerialWrap® D<br>21. DuPont™ Tyvek® ThermaWrap™<br>22. DuPont® Tyvek® Fluid Applied WB+ (nominal 25 wet mil thickness)<br>23. Henry Company Air-Bloc® 21 FR<br>24. Henry Company Air-Bloc® 31MR<br>25. Henry Company Air-Block® 33MR<br>26. Henry Company Blueskin VP™ 160<br>27. Henry Company Blueskin® Metal Clad®<br>28. Henry Company Foilskin®<br>29. Hohmann & Barnard Enviro-Barrier™ VP<br>30. Grace Construction Products Perm-A-Barrier® Aluminum Wall Membrane<br>31. Grace Construction Products Perm-A-Barrier® VPL<br>32. Grace Construction Products Perm-A-Barrier® VPL LT<br>33. Grace Construction Products Perm-A-Barrier® VPS<br>34. JX Nippon ANCI, Inc. JX ALTA™ Commercial Wrap<br>35. JX Nippon ANCI, Inc. JX ALTA™ HP Wrap<br>36. JX Nippon ANCI, Inc. JX ALTA™ LP Wrap<br>37. Kingspan® GreenGuard® Max™ Building Wrap<br>38. Kingspan® GreenGuard® Classic Building Wrap<br>39. Kingspan® GreenGuard® C2000 Building Wrap<br>40. Kingspan® GreenGuard® Raindrop® 3D Building Wrap<br>41. Kingspan® GreenGuard® HPW™ Building Wrap<br>42. Kingspan® GreenGuard® RainArmor™ Building Wrap<br>43. Everbilt™ Premium Non-woven Housewrap<br>44. Momentive Performance Materials GE SEC2500 SilShield* AWB<br>45. Momentive Performance Materials GE SEC2600 SilShield* AWB<br>46. Momentive Performance Materials GE SEC2600-r SilShield* AWB<br>47. Polyguard Products Airlok Flex® (applied at a maximum 50 mils WFT)<br>48. Polyguard Products Airlok Flex® WG (applied at a maximum 20 mils WFT)<br>49. Polyguard Products Airlok Flex® VP (applied at a maximum 32 mils WFT) |

| Wall Component | Materials |
|---|---|
| | 50. Prosoco CAT 5<br>51. Prosoco CAT 5 Rainscreen<br>52. Soprema Sopraseal Stick VP<br>53. Sto Corp Sto Gold Coat® with StoGuard Fabric<br>54. Sto Corp Sto Emerald Coat® with StoGuard Fabric<br>55. Sto Corp Sto ExtraSeal™ with StoGuard Mesh<br>56. Sto Corp StoGuard® VaproShield™<br>57. STS, Inc. Wall Guardian™ FW-100A<br>58. Tremco, Inc. ExoAir 430<br>59. VaproShield Wallshield®<br>60. VaproShield WrapShield®<br>61. VaproShield WrapShield® SA™<br>62. VaproShield RevealShield™<br>63. VaproShield RevealShield SA™<br>64. W.R. Meadows Air-Shield™ LMP (Gray)<br>65. W.R. Meadows Air-Shield™ LMP (Black)<br>66. W.R. Meadows Air-Shield™ TMP<br>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<br>a. First a layer of ½" thick PermaBase® cement board<br>b. Laticrete MVIS Thin Brick Mortar applied to full surface of PermaBase®<br>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. | |

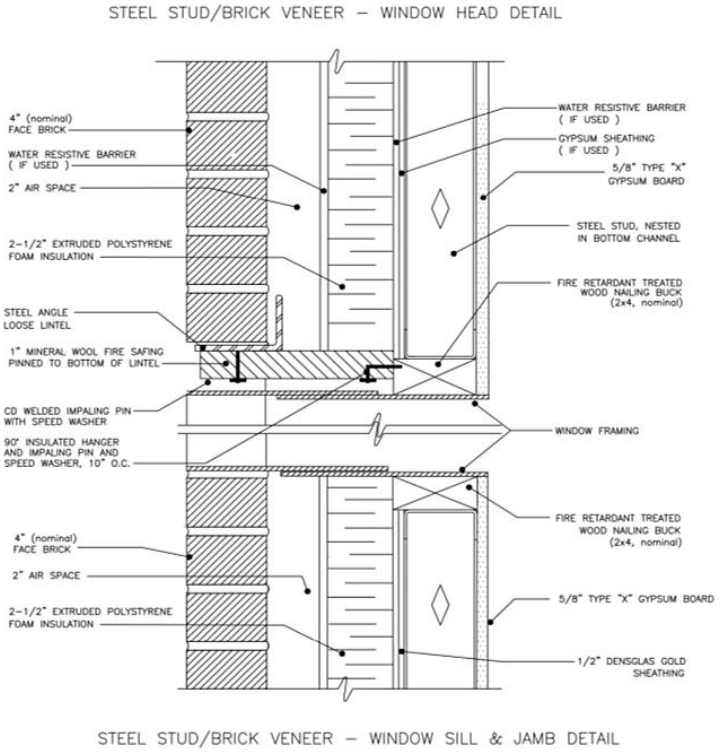



FIGURE 2. HEADER DETAIL FOR *NFPA 285* WALL ASSEMBLIES (BRICK SHOWN, OTHER CLADDINGS SIMILAR)

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 ⅜″ (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 ⅞″ (22.2 mm) thickness of stucco complying with *IBC* Section 2510.

*5.9.1.1.6* A minimum ¼″ (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 ASSEMBLY[1]

| 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 ½" 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<br>1. First a layer of ½" thick PermaBase® cement board<br>2. Laticrete MVIS Thin Brick Mortar applied to full surface of PermaBase®<br>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 form 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.

## 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® MAX™, GreenGuard® RainDrop® 3D, GreenGuard® C2000, GreenGuard® VW, GreenGuard® HPW™, GreenGuard® RainArmor™, and Everbilt™ Premium Non-Woven Housewrap building wraps as equivalent to Grade D paper and air barrier performance of GreenGuard® MAX™, GreenGuard® RainDrop® 3D, GreenGuard® C2000, and GreenGuard® HPW™, and Everbilt™ Premium Non-Woven Housewrap building wraps 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™, GreenGuard® RainArmor™, and Everbilt™ Premium Non-Woven Housewrap building wraps 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 Test reports and data for determining comparative equivalency for use as an alternative material in accordance with *IBC* Section 104.11.

7.4 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.

7.5 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® MAX™, GreenGuard® RainDrop® 3D, GreenGuard® C2000, GreenGuard® VW, GreenGuard® HPW™, GreenGuard® RainArmor™, and Everbilt™ Premium Non-Woven Housewrap building wraps have been tested in accordance with *ASTM E1354* and *ASTM E84* and meet the requirements of *IBC* Section 1402.5[10], 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 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.

9.2 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.

9.3 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.

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

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 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 1⅞″ GreenGuard® Seam Tape or equivalent.

9.8 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.

9.9 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.

9.10 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*).

9.11 At a minimum, this product shall be installed per Section 6 of this TER.

9.12 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.

9.13 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.

9.14 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.

## 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.