DrJ™ CERTIFICATION

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Technical Evaluation Report

TER 1105-01

Requirements for Attaching
THERMAX™ XARMOR (ci)
Exterior Insulation & Three-Coat Stucco
Cladding to Steel Stud Walls

DuPont Performance Building Solutions

Product:

THERMAX™ XARMOR (ci) Exterior Insulation

Issue Date:
September 9, 2011
Revision Date:
December 17, 2019
Subject to Renewal:
December 17, 2019

LEGACY

COMPANY
INFORMATION:

DuPont Performance Building Solutions

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

SECTION: 06 16 00 - Sheathing

DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION

SECTION: 07 21 00 - Thermal Insulation

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1 PRODUCT EVALUATED[1]

1.1 THERMAX™ XARMOR (ci) Exterior Insulation

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 *ASTM C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board*

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 E2357: Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies*

2.2.4 *ASTM E283: Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*

2.2.5 *ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

2.2.6 *ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*

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[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 ANSI-Accredited Product Certification Body – Accreditation #1131.

Through ANSI 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] 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.

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2.2.7 *SBCA ANSI/FS 100: Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies*

2.2.8 *NFPA 285: Standard Fire Test Method for the Evaluation of Fire Propagation Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components*

3 PERFORMANCE EVALUATION

3.1 This TER provides guidance for the code compliant application of three-coat stucco over a layer of THERMAX™ XARMOR (ci) Exterior Insulation applied to cold-formed steel wall framing. The wall assembly and components are illustrated in Figure 1.

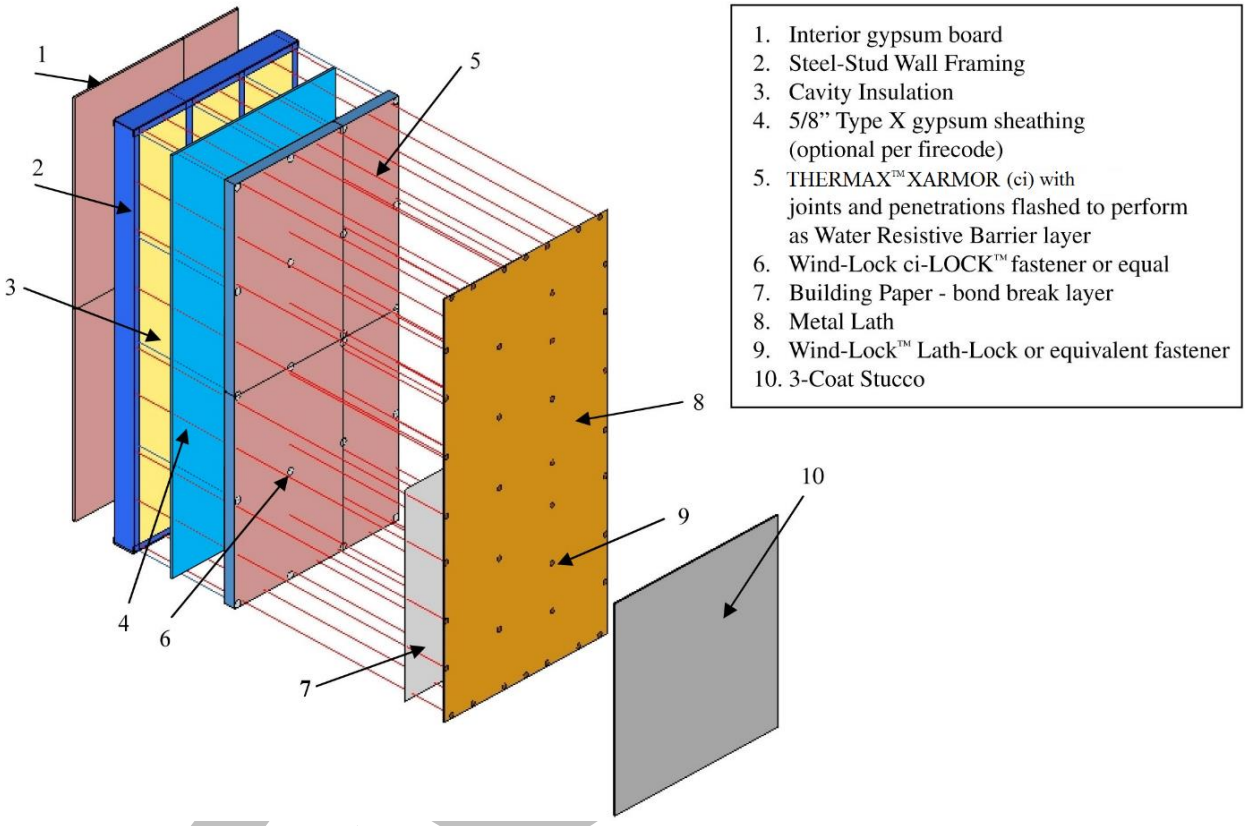

FIGURE 1. THERMAX™ XARMOR (CI) EXTERIOR INSULATION WALL SYSTEM WITH THREE-COAT STUCCO CLADDING

3.2 For guidance on wall assembly and code compliance considerations beyond the scope of this TER, refer to Appendix A. Wall assembly considerations addressed in Appendix A include energy code compliance, fire code compliance, temporary construction wind pressure resistance, THERMAX™ XARMOR (ci) Exterior Insulation wind pressure resistance under permanent design wind loads, and water-resistive barrier (WRB) compliance.

3.2.1 The wind pressure resistance performance of foam plastic insulating sheathing (FPIS) products was evaluated for use as part of an exterior wall covering assembly in accordance with *IBC* Section 104.11 and Section 1404.8.

3.2.2 Performance for use as a water-resistive barrier (WRB) in accordance with *IBC* Section 1404.2 and *IRC* Section R703.2.

3.2.3 Performance for use in an air barrier assembly in accordance with *IRC* Section N1102.4.1.1 and *IECC* Section R402.4.1.1 and Section C402.5.1.1.[4]

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

[4] 2012 *IECC* Section C402.4.1.1

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3.4 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ's professional scope of work.

4 Product Description and Materials

4.1 THERMAX™ XARMOR (ci) Exterior Insulation is:

4.1.1 Made from polyisocyanurate (ISO) conforming to *ASTM C1289* for Type I material

4.1.2 Available in various lengths and widths

4.1.2.1 Typically supplied in widths up to 48" and lengths of 96", 108", and 120"

4.1.3 Available in various thicknesses up to 4"

4.1.4 90-day aged R-value as measured in accordance with *ASTM C518*

4.1.4.1 6.5 per inch of thickness up to 2 inches

4.1.4.2 5.0 per inch of thickness every inch above 2 inches

5 Applications

5.1 *Requirements for THERMAX™ XARMOR (ci) Exterior Insulation*

5.1.1 Maximum Sheathing Thickness – the thickness of THERMAX™ XARMOR (ci) Exterior Insulation used in accordance with this TER shall not exceed 4".

5.1.2 Wall Sheathing Wind Pressure Resistance – when not installed as over-sheathing[5], THERMAX™ XARMOR (ci) Exterior Insulation shall be sized in accordance with *IRC* Section R703.15 and Section R703.16 as applicable. For conditions that exceed the scope of the *IRC*, furring and/or cladding connections shall be designed using *NDS* yield limit equations and *AWC TR12*, except the reduction factor shall be a minimum of 3. Wind pressures shall be determined in accordance with *IBC* Section 1609.

5.1.3 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

5.1.3.1 Refer to Appendix A for additional guidance.

5.1.4 Wall Sheathing Fastening – THERMAX™ XARMOR (ci) Exterior Insulation shall be attached to steel framing to resist wind load experienced during construction.

5.1.4.1 The installer shall be responsible for providing adequate attachment for temporary wind load resistance during construction, prior to installation of lath and three-coat stucco for permanent wind load resistance.

5.1.4.2 Refer to Appendix A and the manufacturer's installation instructions for guidance on fastening THERMAX™ XARMOR (ci) Exterior Insulation to provide temporary wind load resistance during construction.

5.1.5 Water-Resistive Barrier Sheathing Detailing Requirements – where a separate code compliant WRB is not applied to the wall assembly, THERMAX™ XARMOR (ci) Exterior Insulation shall be installed in accordance with the manufacturer's installation instructions to perform as a WRB in accordance with *IBC* Section 1404.2.

5.1.5.1 All joints and penetrations shall be sealed using LIQUIDARMOR™–CM Flashing and Sealant and/or WEATHERMATE™ flashing tape, code compliant mechanical flashings, or equivalent.

5.1.5.2 Refer to Appendix A for additional guidance.

5.1.6 Blocking – when not installed as over-sheathing, THERMAX™ XARMOR (ci) Exterior Insulation shall be installed directly to steel framing in a fully-blocked condition (i.e., all sheathing edges supported on framing or blocking) with a minimum ¾" bearing support at panel edges.

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[5] Over-sheathing occurs when THERMAX™ XARMOR (ci) Exterior Insulation is installed directly to the surface of a solid wall, such as concrete or masonry, or directly to the surface of a sheathing material (such as OSB or gypsum sheathing) that is separately attached to wall framing and capable of resisting the code-required design wind load. Where THERMAX™ XARMOR (ci) Exterior Insulation is installed directly to open cavity wall framing, the application is not over-sheathing.

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5.1.6.1 Exception: Where sheathing is installed with length axis (machine direction) perpendicular to studs, blocking at horizontal sheathing joints shall not be required.

5.1.7 Air Barrier – THERMAX™ XARMOR (ci) Exterior Insulation may be used as an air barrier material as prescribed in *IRC* Section N1102.4.1.1 and *IECC* Section R402.4.1.1 and Section C402.5.1 in accordance with *ASTM E2357*.

TABLE 1. THERMAX™ XARMOR (CI) EXTERIOR INSULATION AIR BARRIER PROPERTIES

Test Standard	Result
ASTM E2357	THERMAX™ XARMOR (ci) < 0.02 (L/s-m^2)[1]

1. Liter per second per square meter
2. Temperature during testing averaged 65°F

5.2 *Requirements for Three-Coat Stucco Cladding*

5.2.1 General – metal plaster base (lath) and three-coat stucco installation shall comply with *IBC* Section 2510 and *IBC* Section 2512, the lath manufacturer's installation instructions, and the additional requirements in Section 5.2.

5.2.2 Fastening Schedule – the minimum screw fastener size and maximum spacing shall comply with Table 2 or Section 5.2.1, whichever results in the more stringent fastening requirement. Refer to Appendix A for alternative lath fastener spacing subject to an approved design.

5.2.2.1 Screw fasteners and washers for woven wire metal lath shall comply with Section 5.3.3, and the length of screw shall provide for a minimum of three (3) threads penetrating through and beyond the steel framing member thickness.

TABLE 2. MAXIMUM PERMISSIBLE THICKNESS OF THERMAX™ XARMOR (CI) EXTERIOR INSULATION BASED ON LATH SCREW FASTENER SIZE & SPACING

Lath Fastener Size & Steel Framing Thickness	Lath Fastener Vertical Spacing Along Studs (in)	Maximum Permissible Thickness of THERMAX™ XARMOR (ci) Exterior Insulation (in)	
		16" o.c. Stud Spacing	24" o.c. Stud Spacing
#8 screw into 33 mil steel or thicker	6	3	2
	7	2	2
#10 screw into 33 mil steel	6	3	3
	7	3	2
#10 screw into 43 mil steel or thicker	6	4	4
	7	4	4

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 lb/ft = 0.0146 kN/m, 1 psf = 0.0479 kN/m^2, 1 psi = 0.00689 MPa, 1 mph = 1.61 km/h

1. Lath fastener shall include a washer in accordance with Section 5.3.3.
2. Lath manufacturer's installation instructions shall be used, if more stringent.
3. The contents of this table were created from information taken from the references listed in Section 7.6 and 7.7.

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5.3 *Material Specifications*

5.3.1 Cold-Formed Steel Framing – cold-formed steel framing materials and fasteners shall comply with *IBC* Section 2210[6] and Section 2211.

5.3.2 Wall Sheathing and Fasteners – THERMAX™ XARMOR (ci) Exterior Insulation wall sheathing shall comply with *ASTM C1289*, Type I and the additional requirements of this TER. THERMAX™ XARMOR (ci) Exterior Insulation shall be fastened to steel framing using Wind-Lock® ci-LOCK US series screws with a ULP-302 plastic washer (Figure 2) or equivalent.



FIGURE 2. WIND-LOCK® CI-LOCK US SERIES ULP-302 PLASTIC WASHER



FIGURE 3. WIND-LOCK® PLATE-LOCK & LATH-LOCK WASHERS

5.3.3 Three-Coat Stucco, Metal Plaster Base and Fasteners – Three-coat stucco materials shall comply with *IBC* Section 2510 and Section 2512.

5.3.3.1 Where woven wire lath is used as a plaster base, screw fasteners attaching metal plaster base shall be Wind-Lock® ST series with Wind-Lock® Lath-Lock washers or Plate-Lock washers (Figure 3), or equivalent.

5.3.3.2 Technical information on the Wind-Lock® screws and washers can be found at wind-lock.com.

5.3.3.3 For other types of metal plaster base, screw fastener and washer or screw head style and size shall comply with the metal plaster base manufacturer's installation instructions and *IBC* Section 2510 and *IBC* Section 2512.

5.3.3.4 In all cases, screw fastener size shall not be less than, and spacing shall not be greater than, that required in Section 5.2.

6 INSTALLATION

6.1 THERMAX™ XARMOR (ci) Exterior Insulation shall be installed as indicated in Section 5 of this TER and per the manufacturer's installation instructions. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.

7 TEST ENGINEERING SUBSTANTIATING DATA

7.1 Wind Pressure Testing of Wall Assemblies with Foam Sheathing and Vinyl Siding Products, Report # 4107003013108, NAHBRC.

7.2 Engineering analysis (Excel Spreadsheet) of data from Section 7.1 prepared for the Foam Sheathing Coalition by Jay H. Crandell, P.E, ARES Consulting; West River, MD.

7.3 *Performance Test Report*, Report No. 83831.03-109-44, Architectural Testing, Inc.; York, PA.

7.4 *Uniform Pressure Test on Mock-Up Wall Panels*, Report No. L-10-1741, Smith – Emery Laboratories, Inc.; Los Angeles, CA.

7.5 *Stucco Wall Performance Testing*, Report No. L-10-1481, Smith – Emery Laboratories, Inc.; Los Angeles, CA.

7.6 *Fastening Systems for Continuous Insulation*, Final Report 10-11, New York State Energy Research and Development Authority (NYSERDA); Albany, NY.

[6] Adds 2210.1.1.3 Composite slabs on steel decks

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7.7 *DRR No.1303-04: Attachment of Exterior Wall Coverings through Foam Plastic Insulating Sheathing (FPIS) to Wood or Steel Wall Framing*

7.8 *The Modeled and Measured Performance of Thick Continuous Insulation Under Heavy Cladding Systems*; Parsons, G. and Hansbro, J.

7.9 Additional technical information and related manufacturer's instructions can be found at each of the manufacturer's websites:

7.9.1 DuPont Performance Building Solutions – dupont.com

7.9.2 Wind-Lock® Corporation – wind-lock.com

7.10 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.

7.11 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 THERMAX™ XARMOR (ci) Exterior Insulation installed under three-coat stucco applied to cold-formed steel wall framing as described in this TER is compliant with 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 evaluation, they are listed here.

8.3.1 No known variations

9 CONDITIONS OF USE

9.1 The exterior wall covering assembly addressed in this TER shall comply with applicable sections of the *IBC*.

9.2 The user of this TER shall be responsible for providing the building official, building owner, and design professional of record with evidence of code compliance for matters beyond the scope of this report.

9.3 Refer to Appendix A for additional information.

9.4 THERMAX™ XARMOR (ci) Exterior Insulation shall comply with the quality control requirements of *ASTM C1289* Section 10 and *ANSI/SBCA FS100* Section 7.

9.5 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.

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

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9.7 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*).

9.8 At a minimum, this product shall be installed per Section 5.2 of this TER.

9.9 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.

9.10 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.

9.11 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 THERMAX™ XARMOR (ci) Exterior Insulation described in this TER is identified by a label on the board or packaging material bearing the manufacturer's name, product name, label of the third-party inspection agency, and other information to confirm code compliance.

10.2 Additional technical information can be found at dupont.com.

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.

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12 APPENDIX A: SUPPLEMENTAL DESIGN & CODE COMPLIANCE INFORMATION

12.1 *Use of THERMAX™ XARMOR (ci) Exterior Insulation for Energy Code Compliance*

12.1.1 THERMAX™ XARMOR (ci) Exterior Insulation provides a 6.5 R-value per inch up to 2" and 5.0 R-value for each inch greater than 2" as measured in accordance with *ASTM C518*.

12.1.1.1 This R-value permits use of less insulation thickness than would be required by many other insulation materials that have a lower R-value per inch.

12.1.2 Energy code requirements vary by wall framing type and climate zone. In general, steel framing requires a greater use of continuous insulation than other framing materials because the high thermal conductivity of steel framing reduces the effectiveness of or short-circuits cavity insulation.

12.1.3 While not necessarily required by locally applicable energy conservation codes, a minimum of 1" (R6.5) of THERMAX™ XARMOR (ci) Exterior Insulation is recommended in any hot to mild climate as an effective means to avoid heat loss or heat gain through steel framing. In moderately cold climates, a minimum of 1.5" (~R10) THERMAX™ XARMOR (ci) Exterior Insulation is recommended. In cold climates in the northern U.S. and Alaska, a minimum of 2" (~R13) or more of THERMAX™ XARMOR (ci) Exterior Insulation is recommended. In all cases, the user should verify that the wall assembly thermal resistance meets or exceeds the locally applicable energy conservation requirements.

12.1.4 Where code compliant thermal and sound attenuation performance can be achieved with the use of THERMAX™ XARMOR (ci) Exterior Insulation only, wall cavity insulation is not required.

12.1.5 Where used with THERMAX™ XARMOR (ci) Exterior Insulation, wall cavity insulation may be any code compliant insulation material including STYROFOAM™ Spray Polyurethane Foam (SPF).

12.1.6 Finally, code minimum energy efficiency requirements may be exceeded for added energy conservation benefits and recognition in voluntary energy efficiency programs. Refer to your local building and energy codes for requirements specific to your situation.

12.2 *THERMAX™ XARMOR (ci) Exterior Insulation Application as a Water-Resistive Barrier*

12.2.1 Refer to Thermax™ Wall System and also Tech Solutions 513.0 “THERMAX™ Wall System” for information on water-resistive barrier applications of THERMAX™ XARMOR (ci) Exterior Insulation.

12.2.2 Water-resistive barrier performance is based on testing in accordance with *ASTM E331* by an approved agency.[7]

12.3 *Fire Code Compliance with THERMAX™ XARMOR (ci) Exterior Insulation and Three-Coat Stucco Exterior Wall Covering*

12.3.1 THERMAX™ XARMOR (ci) Exterior Insulation with three-coat stucco constructed in accordance with this TER satisfies requirements for control of exterior flame spread as evaluated in accordance with the *NFPA 285* test method. The following engineering letter presents the fire test data, engineering analysis, and code compliant construction recommendations.

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[7] *Performance Test Report / ASTM E331-00 Test Report*, Report No. 01-46081.01, prepared by Architectural Testing, Inc. for The Dow Chemical Company; February 12, 2004.

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HUGHES ASSOCIATES, INC.
FIRE SCIENCE & ENGINEERING

July 20, 2011

Dow Building Solutions
The Dow Chemical Company
2859 Central Street
Evanston, IL 60201

Re: Various NFPA 285 Complying Exterior Wall Constructions
HAI Project No.: 1JJB05306.008

To Whom It May Concern:

This analysis provides a summary of various exterior wall constructions that incorporate one or more of the following Dow Chemical products and that will meet the requirements of NFPA 285:

- Thermax™ Brand Rigid Insulation;
- STYROFOAM™ Brand Spray Polyurethane Foam CM 2030, STYROFOAM™ Brand Spray Polyurethane Foam CM 2045 or STYROFOAM™ Brand Spray Polyurethane Foam CM 2060. These products are closed cell, nominal 2.0 lb/ft^3 density, spray polyurethane foam plastic insulation.

Section 2603.5.5 of the 2006 Edition of the International Building Code (IBC) requires that exterior walls systems that incorporate foam plastic insulation shall meet the requirements of NFPA 285 "Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components."

Dow Chemical has performed several NFPA 285 fire tests on various exterior wall systems that have incorporated Dow Thermax™ Brand Rigid Insulation. These tests include:

1. Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.05805.01.001, dated November, 2002.
2. Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001c, dated September 5, 2008.
3. Metal Composite Panel exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001d, dated September 5, 2008.

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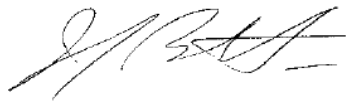
4. Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.15210.01.607a [1], dated May 24, 2010.

5. Brick exterior wall construction - Reported in Southwest Research Institute Final Report No. 01.15822.01.001, dated September 9, 2010

Based on the results of these tests and my experience with the NFPA 285 fire test, it is my judgment that the various configurations of exterior walls described in the attached Tables will meet the performance requirements of NFPA 285.

I hope that this information is of assistance and if you have any questions, please feel free to contact me.

Sincerely,



Jesse J. Beitel
Senior Scientist/Principal

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Table I. Base Wall Assemblies – See Tables II and III For Additional Wall Components

Wall Component	Materials
Base wall system – Use either 1, 2, 3, 4 or 5	1 – Concrete wall 2 – Concrete Masonry wall 3 – Standard clay brick wall 4 – Adobe block wall 5 – Steel studs: minimum 3⅝-inch depth, minimum 20-gauge at a maximum of 24-inch OC with lateral bracing every 4 ft. vertically with: a) 1 layer – ⅝-inch thick Type X or ½-inch thick Type X Gypsum wallboard on interior face of studs, or b) W.R. Grace's Monokote Z-3306 installed at a minimum of 3/8 inch thickness over cavity insulation (Item 2) or Thermax™, or c) Isolatek International's CAFCO – TB 415 installed at a minimum of 3/8 inch thickness over cavity insulation (Item 2) or Thermax™, or d) International Cellulose Corporation's Ure-K Thermal Barrier System installed at a minimum of 1.25 inch thickness over cavity insulation (Item 2) or Thermax™. e) Specialty Products, Inc. Flame Seal-TB coating applied at a wet mil thickness of 25 mils (18 mils dry, 65 ft^2/gal) over cavity insulation (Item 2) f) International Fireproof Technology, Inc. DC 315 applied at an application rate of 18 wet mils applied over 4 mils of primer which is applied over cavity insulation (Item 2)
Floorline Firestopping	4 lb/cu ft. mineral wool (e.g. Thermafiber) in each stud cavity and at each floorline – attached with Z-clips or equivalent
Cavity Insulation – Use either 1, 2, or 3 or combination of 2 & 3	1 – None 2 – Full stud depth or less thickness of DOW STYROFOAM™ Brand Spray Polyurethane CM 2060 or CM 2045 or CM 2030 applied using sheathing or insulation as substrate and covering the width of the cavity and inside the stud flange 3 – Fiberglass batt insulation (faced or unfaced)
Exterior sheathing – Use either 1, 2 or 3	1 – None 2 – ½-inch thick, exterior type gypsum sheathing 3 – ⅝-inch thick, exterior type gypsum sheathing
Weather-resistive barrier applied to exterior sheathing – Use either 1 or 2	1 – None 2 – Any shown in Table IV
Remainder of wall assembly	See Table II or Table III

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Table II. Walls With A Maximum Of 4.25-inch Thick Thermax™

Wall Component	Materials
Exterior insulation – Use either 1, 2, 3 or 4	1 – None (Exterior sheathing must be Item 2 or 3 listed in Table I. 2 – Dow Thermax™ Brand Rigid Insulation – Total thickness to be a minimum of ⅝ inch to maximum of 4.25 inches. 3 – DOW STYROFOAM™ Brand Spray Polyurethane CM 2060 or CM 2045 or CM 2030 – to a maximum of 3.5 inches thick. 4 – Combination of Item 2 and Item 3 – Total thickness of combination not to exceed 4.25 inches and thickness of Item 3 not to exceed 3.5 inches.
Weather-resistive barrier applied to exterior insulation – Use either 1 or 2	1 – None 2 – WeatherMate™ or WeatherMate™Plus – Dow Chemical
Flashing	Flash all exterior insulation joints and veneer tie penetrations with one of the following: 1 – Dow WeatherMate™ Flashing – max. 4-inch width 2 – Asphalt or Butyl-based flashing tape – max. 4-inch width Note: With either 1 or 2, a small amount of spray primer may be used to aid in adhesion; maximum 5-inch width.
Exterior Veneer – Use either 1, 2, 3 or 4	1 – Brick – Brick veneer anchors – standard types – installed maximum 24 inches OC vertically on each stud – Maximum 2-inch air gap between exterior insulation and brick – Standard nominal 4-inch thick, clay brick 2 – Stucco – Minimum ¾-inch thick, exterior cement plaster and lath. A secondary water-resistive barrier can be installed between the exterior insulation and the lath. The secondary water-resistive barrier shall not be full-coverage asphalt or butyl-based self-adhered membranes. 3 – Minimum 2-inch thick, Limestone or natural stone veneer or minimum 1-1/2 inch thick cast artificial stone veneer. Any standard non-open-joint installation technique such as ship-lap, etc. can be used. 4 – Terracotta cladding – Use any terracotta cladding system in which terracotta is minimum 1-1/4 inch thick. Any non-open-joint installation technique such as ship-lap, etc. can be used.

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Table III. Walls With A Maximum Of 3-inch Thick Thermax™

Wall Component	Materials
Exterior insulation – Use either 1 or 2	1 – None (Exterior sheathing must be either 1 or 2 listed in Table I) 2 – Dow Thermax™ Brand Rigid Insulation – Total thickness to be a minimum of ⅝ inch to maximum of 3 inches.
Flashing	Flash all exterior insulation joints and veneer tie penetrations with one of the following: 1 – Dow WeatherMate™ Flashing – max. 4-inch width 2 – Asphalt or Butyl-based flashing tape – max. 4-inch width Note: With either 1 or 2, a small amount of spray primer may be used to aid in adhesion; maximum 5-inch width.
Exterior Veneer – Use either 1, 2, 3, 4 , 5, 6 or 7	1 - MCM System - Use any Metal Composite Material system that has been successfully tested by the panel manufacturer via the NFPA 285 test method. Any standard installation technique can be used. 2 - Terracotta cladding – Use any terracotta cladding system in which terracotta is minimum 1-1/4 inch thick. Any standard installation technique can be used. 3 - Metal exterior wall coverings such as steel, aluminum, copper, etc. Any standard installation technique can be used. 4 - Cement board siding – Any standard installation technique can be used. 5 – StoneLite natural stone wall panels by Stone Panels, Inc. 6 – Glen-Gery Thin Tech Elite Series – Masonry veneer 7 – Knight Wall Systems to include: • Knight™ Series Metal Panels (Aluminum or steel) • Thin Brick Panels • Stucco • Terracotta • Concrete panels

Table IV. Allowed Weather-resistive Barriers

Weather-resistive Barrier – Over Sheathing
WeatherMate™ or WeatherMate™Plus – Dow Chemical
Tyvek® CommercialWrap® - Dupont
Backstop® NT – Dryvit
Barritech™ VP – Carlisle
AIR-SHIELD™ LMP – (Black Only) W. R. Meadows
Green Guard®Max Building Wrap – Pactiv
Perm-A-Barrier® VPS - W.R. Grace

Note: all barriers to be installed at recommended application rates and per manufacturer's installation instructions.

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12.4 *Temporary Wind Pressure Resistance during Installation of THERMAX™ XARMOR (ci) Exterior Insulation*

12.4.1 Test data in Reference 7.3 and 7.4 of this TER indicate that the wind pressure resistance of THERMAX™ XARMOR (ci) Exterior Insulation is limited by fastener head or washer pull-through.

12.4.1.1 According to Reference 7.3 and 7.4, minimum #8 self-drilling tapping screws including ULP 302 Wind-Lock® ci-LOCK washers (wind-lock.com) were used to attach THERMAX™ XARMOR (ci) Exterior Insulation thicknesses ranging from $^{5}/_{8}$" to 3" to steel wall framing.

12.4.1.2 An example fastening pattern and use of washers at sheathing joints is shown in Figure 4.

12.4.1.3 The fastener/washer pull-through resistance was approximately 130 lbs. on average (with a coefficient of variation of about 22%).

12.4.1.4 Assuming normality, this data indicates a lower 5th percentile pull-through strength of about 82 lbs. per fastener/washer combination.

12.4.1.5 Using this value as a temporary installation resistance value, and also checking foam sheathing bending strength based on Reference 7.1 and 7.2 using a safety factor of 1.25, various fastening schedule options and associated wind pressure resistance values are shown in Table 3.

12.4.2 For temporary construction exposure to wind load not exceeding 6 weeks in duration, *SEI/ASCE 37-02* Section 6.2.1 recommends that the code required design wind speed (mph) be multiplied by 0.75, which corresponds to design wind load (pounds per square foot) multiplied by 0.56.

12.4.2.1 Thus, design wind loads determined in accordance with *IBC* Section 1609 for building safety can be multiplied by 0.56 for temporary construction installation purposes.

12.4.2.2 As a minimum recommended practice, a fastening schedule for THERMAX™ XARMOR (ci) Exterior Insulation should be selected from the table below, so that the wind pressure resistance value exceeds the temporary wind load value.

12.4.2.3 Since temporary wind load conditions during construction are not a building code regulated matter, the specifier or installer of THERMAX™ XARMOR (ci) Exterior Insulation should select and adjust minimum recommended connection requirements to provide a project-specific acceptable level of performance during construction.

12.4.3 Permanent wind load resistance of the exterior wall covering assembly (cladding and THERMAX™ XARMOR (ci) Exterior Insulation) is provided by a code compliant installation of three-coat stucco, as required in this TER.

12.4.3.1 Refer to the stucco or metal plaster base (lath) manufacturer for information on wind load resistance of code compliant installations of three-coat stucco.

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TABLE 3. MINIMUM RECOMMENDED FASTENING SCHEDULES & TEMPORARY CONSTRUCTION WIND PRESSURE RESISTANCE VALUES FOR THERMAX™ XARMOR (CI) EXTERIOR INSULATION[1]

THERMAX™ XARMOR (ci) Wall Sheathing Thickness (in)	Temporary Construction Wind Pressure Resistance Value (psf)							
	16" o.c. Wall Framing				24" o.c. Wall Framing			
	Screw & Washer Spacing[2] (edge:field) (in)							
	6:6	12:12	16:16	24:24	6:6	12:12	16:16	24:24
5/8"	28	28	28	28	12	12	12	12
¾"	36	36	36	31	21	21	21	20
1"	56	56	46	31	25	25	25	20
≥ 1½"	65	61	46	31	29	29	29	20

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 lb/ft = 0.0146 kN/m, 1 psf = 0.0479 kN/m², 1 psi = 0.00689 MPa, 1 mph = 1.61 km/h

1. Attached to minimum 33 mil steel framing with a minimum #8 self-drilling tapping screws and ULP 302 Wind-Lock® Washers
2. Screws and washers shall be spaced on center (o.c.) and located along panel edges and joints as shown in Figure 4.

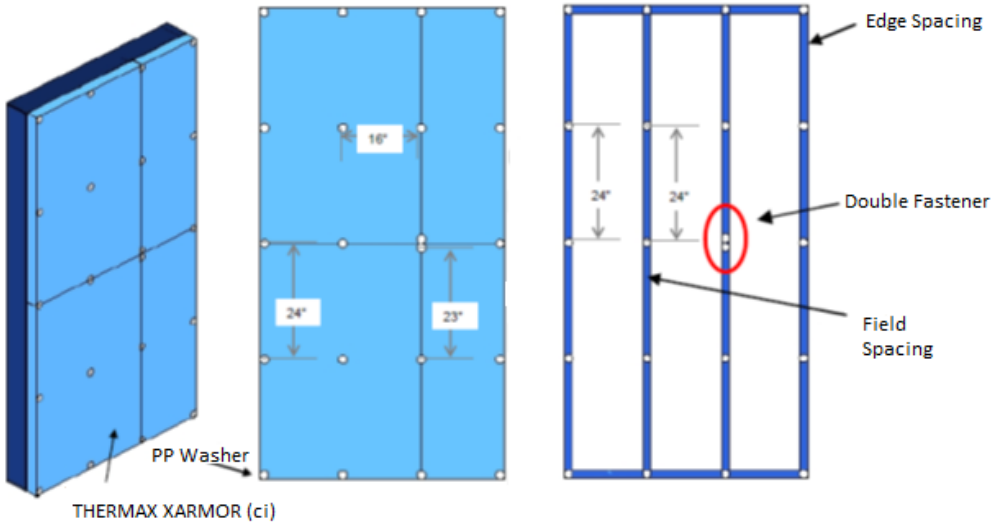

FIGURE 4. EXAMPLE CONNECTION SCHEDULE BASED ON TABLE 3 REQUIREMENTS (NOTE: TWO FASTENERS SHALL BE APPLIED AT PANEL CORNER JOINTS, AS SHOWN IN THE FIGURE.)

12.5 *THERMAX™ XARMOR (ci) Exterior Insulation Wind Pressure Resistance*

12.5.1 When THERMAX™ XARMOR (ci) Exterior Insulation is not used as over-sheathing (Footnote 5), specify a thickness of THERMAX™ in accordance with the table below that results in an allowable wind pressure resistance value equal to or greater than the design components and cladding wind pressure as determined in accordance with *IBC* Section 1609.

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TABLE 4. ALLOWABLE WIND PRESSURE RESISTANCE VALUE (PSF) FOR THERMAX™ XARMOR (CI) EXTERIOR INSULATION SHEATHING (TYPE I, *ASTM C1289*) USED IN EXTERIOR WALL COVERING ASSEMBLIES

THERMAX™ XARMOR (ci) Exterior Insulation Sheathing Thickness (in)	Allowable (ASD) Components & Cladding Design Wind Pressure (psf)[3]			
	Walls with Interior Finish		Walls without Interior Finish	
	16" o.c. Framing	24" o.c. Framing	16" o.c. Framing	24" o.c. Framing
½" & 5/8"	33.3	14.8	23.3	10.4
¾"	56.4	25.1	30.5	17.6
1"	67.5	30.0	47.2	21.0
≥ 1½"	77.4	34.4	54.1	24.1

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m²

1. Linear interpolation shall not be permitted.
2. Values include a 1.5 safety factor adjustment.
3. Table based Reference 7.8.

12.6 *Alternative Lath Fastener Spacing*

12.6.1 Three-coat stucco metal lath fastener spacings reported in Table 2 are limited to a maximum of 7" o.c., based on limitations found in reference standards for three-coat stucco installation as invoked by building code requirements included in Section 5.2.1. However, this limitation does not preclude the use of an alternative fastener spacing, provided all relevant code requirements are satisfied by an approved design (e.g., support of cladding weight, resistance to wind and seismic loads).

12.6.2 Refer to Table 5 for recommended alternative fastener spacing and thicknesses of THERMAX™ XARMOR (ci) Exterior Insulation that are consistent with the performance basis of Table 2, but which permit lath fastener spacing as much as 12" o.c. The recommendations in Table 5 address support of cladding (stucco) weight only and do not address other concerns such as wind and seismic pull-off resistance of the lath and stucco or pull-out resistance of the fastener from steel framing. The user shall verify appropriate use limitations by an approved design. Consultation with lath and fastener manufacturers is also recommended.

TABLE 5. MAXIMUM PERMISSIBLE THICKNESS OF THERMAX™ XARMOR (CI) EXTERIOR INSULATION BASED ON LATH SCREW FASTENER SIZE & ALTERNATIVE SPACING

Lath Fastener Size & Steel Framing Thickness	Lath Fastener Vertical Spacing Along Studs (in)	Maximum Permissible Thickness of THERMAX™ XARMOR (ci) Exterior Insulation (in)	
		16" o.c. Stud Spacing	24" o.c. Stud Spacing
#8 screw into 33 mil steel or thicker	8	2	1.5
	12	1.5	0.75
#10 screw into 33 mil steel	8	3	2
	12	2	1
#10 screw into 43 mil steel or thicker	8	4	3
	12	3	3

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 lb/ft = 0.0146 kN/m, 1 psf = 0.0479 kN/m², 1 psi = 0.00689 MPa, 1 mph = 1.61 km/h

1. Lath fastener shall include a washer in accordance with Section 5.3.3.
2. The contents of this table were created from information taken from Reference 7.6 and 7.8.

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