Code Compliance Research Report
CCRR-1025

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DIVISION: 07 00 00 – THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 – Thermal Insulation
Section: 07 21 19 – Foamed-In-Place Insulation

REPORT HOLDER:
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REPORT SUBJECT:
FOAM-LOK™ FL2000-4G Spray-applied Polyurethane Insulation

1.0 SCOPE OF EVALUATION

1.1 This Research Report addresses compliance with the following Codes:

- 2018, 2015, and 2012 *International Building Code®* (IBC)
- 2018, 2015, and 2012 *International Residential Code®* (IRC)
- 2018, 2015, and 2012 *International Energy Conservation Code®* (IECC)

NOTE: This report references 2018 Code sections. Section numbers for earlier Code editions may differ.

1.2 FOAM-LOK™ FL2000-4G insulation has been evaluated for the following properties (see Table 1):

- Surface-burning characteristics
- Physical properties
- Thermal resistance
- Air permeability
- Water vapor permeability

1.3 FOAM-LOK™ FL2000-4G insulation has been evaluated for the following uses (see Table 1):

- Use as nonstructural thermal insulation on or in interior and exterior walls, floors, and underside of roofs; and on the exterior side of vertical foundations and the underside of on-grade slabs
- Alternatives to Code-prescribed thermal Barriers
- Alternatives to Code-prescribed ignition Barriers
- Use as a Class II moisture vapor retarder
- Use as air-impermeable insulation
- Fire-resistance-rated construction
- Exterior walls of Types I through IV construction
- Use in Type V construction
- Use as water-resistive barrier

2.0 STATEMENT OF COMPLIANCE

FOAM-LOK™ FL2000-4G complies with the Codes listed in Section 1.1, for the properties stated in Section 1.2 and uses stated in Section 1.3, when installed as described in this report, including the Conditions of Use stated in Section 6.

3.0 DESCRIPTION

3.1 Materials:

3.1.1 FOAM-LOK™ FL2000-4G: FOAM-LOK FL2000-4G insulation is a semi-rigid, closed cell, polyurethane foam plastic. The insulation is a two-component spray foam plastic with a nominal in-place density of 2 pounds per cubic foot. The insulation is produced in the field by combining a polymeric isocyanate (A component) with a resin (B component). The insulation liquid components are supplied in 55-gallon drums and/or 250-gallon totes, and must be stored at temperatures between 50°F and 100°F. The resin (B component) must be protected from freezing temperatures and has a shelf life of 6 months.

3.2 Intumescent Coatings:

3.2.1 DC315 Intumescent Coating: DC315 intumescent coating is a water-based coating manufactured by IFTI, Paint to Protect, and is supplied in 5-gallon pails and 55-gallon drums. The coating material has a shelf life of 24 months when stored in factory-sealed containers at temperatures between 41°F and 95°F. DC315 complies with ICC-ES AC456 as recognized in ICC-ES ESR-3702.

3.2.2 TPR² Fireshell Coatings: TPR² Fireshell F10E and TB coatings, manufactured by ICP Construction, are water-based intumescent coatings supplied in 5-gallon pails and 55-gallon drums. The coatings have a shelf life of 1 year when stored unopened at temperatures between 45°F and 95°F. FIRESHELL F10E and TB comply with ICC-ES AC456 as recognized in ICC-ES ESR-3997.

3.2.3 No-Burn® Plus ThB: No-Burn® Plus ThB is a one-part water-based intumescent coating manufactured by No-Burn Inc. The coating is supplied in 5-gallon pails and 55-gallon drums, and has a shelf life of 18 months when stored in unopened containers between 40°F and 90°F. No-Burn® Plus ThB complies with ICC-ES AC456 as recognized in IAPMO UES ER-0305.

4.0 Performance Characteristics:

4.1 Surface-burning Characteristics: FOAM-LOK™ FL2000-4G insulation, at a maximum thickness of 4 inches and a nominal density of 2 pounds per cubic foot, has a flame-spread index of 25 or less and a smoke developed index of 450 or less, when tested in accordance with ASTM E84. Based on large scale tests in accordance with NFPA 286, the insulation can be installed at greater thicknesses as described in Sections 5.3 and 5.4. When the insulation is separated from the interior living space of the building with minimum 1/2-inch-thick gypsum board, the maximum insulation thickness is not limited. Under the 2018 and 2015 IRC, a thermal barrier of minimum 25/32-inch-thick wood structural panel is also permitted, and the maximum insulation thickness is not limited.

4.2 Thermal Resistance, R-values: FOAM-LOK™ FL2000-4G insulation has thermal resistance (R-value) at a mean temperature of 75°F as shown in Table 2.

4.3 Air Permeability: FOAM-LOK™ FL2000-4G insulation, at a minimum thickness of 1 inch is considered air-impermeable insulation in accordance with IBC and IRC Sections 202 and R202, respectively, based on testing in accordance with ASTM E283. Air permeability was not defined in the 2012 IBC.

4.4 Water Vapor Permeability: FOAM-LOK™ FL2000-4G, at a minimum thickness of 1.5 inches, is a Class II vapor retarder in accordance with IBC Section 202 and IRC Section R202, based on testing in accordance with ASTM E96 (desiccant method). The insulation may be used where a Class II vapor retarder is required under IBC Section 1404.3 or IRC R702.7 when installed at a minimum of 1.5 inches.

4.5 Water-resistive Barrier: FOAM-LOK™ FL2000-4G may be used as an alternative to the water-resistive barrier prescribed in IBC Section 1403.2 and IRC Section R703.2 when spray-applied to the exterior side of exterior sheathing, masonry, or other suitable exterior wall substrates to form a continuous layer of 1-inch minimum thickness. All construction joints and penetrations must be sealed with FOAM-LOK™ FL2000-4G. The insulation must be covered with an exterior wall covering within the time specified in the Huntsman Building Solutions installation instructions.

5.0 INSTALLATION

5.1 General:

FOAM-LOK™ FL2000-4G insulation must be installed in accordance with the manufacturer's published installation instructions, the applicable Code, and this Research Report. The installation requirements in Sections 5.1 through 5.4 apply to all Types of construction. A copy of the manufacturer's instructions must be available on the jobsite during installation.

5.2 Application:

FOAM-LOK™ FL2000-4G insulation is spray-applied on the jobsite using a volumetric positive displacement pump as identified in the manufacturer's application instructions. The insulation must be applied when the ambient temperature is greater than 14°F. The insulation must not be used in areas that have a maximum in-service temperature greater than 180°F. The foam plastic must not be used in electrical outlet or junction boxes or in contact with water, rain, or soil. The foam plastic must not be sprayed onto a substrate that is wet, or covered with frost or ice, loose scales, rust, oil, or grease. The insulation must be protected from the weather during and after application. The insulation may be applied to a maximum thickness of 3-1/2 inches followed immediately by another 3-1/2 inches before waiting to cool and applying another pass. A minimum of 20 minutes must be allowed between the second and third passes and every additional pass. Where the insulation is used as an air-impermeable insulation, such as in unvented attic assemblies under IBC Section 1202.3 or

IRC Section R806.5, the insulation must be installed at a minimum thickness of 1 inch.

5.3 Thermal Barrier:

5.3.1 Application with a Prescriptive Thermal Barrier: FOAM-LOK™ FL2000-4G insulation must be separated from the interior living space of the building by an approved thermal barrier of 1/2-inch-thick gypsum board or an equivalent 15 minute thermal barrier complying with, and installed in accordance with, IBC Section 2603.4 or IRC Section R316.4, as applicable. Exceptions are provided in Sections 5.3.2 and 5.4.

When the insulation is separated from the interior living space of the building with minimum 1/2-inch-thick gypsum board, the maximum thickness is not limited. Under the 2018 and 2015 IRC, a thermal barrier of 25/32-inch-thick wood structural panel is also permitted, and the maximum insulation thickness is unlimited.

5.3.2 Application without a Prescriptive Thermal Barrier: FOAM-LOK™ FL2000-4G insulation may be installed without the 15-minute thermal barrier prescribed in IBC Section IBC Section 2603.4 and IRC Section R316.4, when installed as described in this section. The insulation must be covered on all exposed surfaces with intumescent coating as described in Table 3:

The coating must be applied over the insulation in accordance with the coating manufacturer's instructions and this report. Surfaces to be coated must be dry, clean, and free of dirt, loose debris and other substances that could interfere with adhesion of the coating. The coating is applied with low-pressure airless spray equipment.

5.4 Attics and Crawl Spaces:

FOAM-LOK™ FL2000-4G insulation may be applied in attics and crawl spaces as described in either 5.4.1 or 5.4.2. When the insulation is installed in an attic or crawlspace in accordance with this section, a thermal barrier is not required between the insulation and the attic or crawl space but is required between the insulation and the interior living space.

5.4.1 Application with a Prescriptive Ignition Barrier: When FOAM-LOK™ FL2000-4G insulation is installed within attics and crawl spaces where entry is made only for service of utilities, the ignition barrier must be installed in accordance with IBC Section 2603.4.1.6, or IRC Section R316.5.3 or R316.5.4, as applicable. The ignition barrier must be consistent with the requirements for the type of construction required by the applicable Code and must be installed in a manner, so the foam plastic insulation is not exposed. The insulation as described in this section may be installed in unvented attics in accordance with IBC Section 1202.3 [2012 – not applicable] or IRC Section R806.5 at a minimum thickness of 1 inch.

5.4.2 Application without a Prescriptive Ignition Barrier:

5.4.2.1 General: FOAM-LOK™ FL2000-4G insulation may be installed in attics and crawl spaces, without the ignition barrier prescribed in IBC Section 2603.4.1.6 and IRC Sections R316.5.3 and R316.5.4, subject to the following conditions:

a. Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
b. There are no interconnected attic or crawl space areas.
c. Air in the attic or crawl space is not circulated to other parts of the building.
d. Under-floor (crawl space) ventilation is provided when required by IBC Section 1202.4 or IRC Section R408.1, as applicable.
e. Attic ventilation is provided when required by IBC Section 1202.2.1 or IRC Section R806, except when air-impermeable insulation is permitted in unvented attics in accordance with IBC Section 1202.3 [2012 – not applicable] or IRC Section R806.5.
f. Combustion air is provided in accordance with IMC (International Mechanical Code) Section 701.

The insulation may be installed in unvented attics as described in this section in accordance with IBC Section 1202.3 [2012 – not applicable] or IRC Section R806.5, when applied at a minimum thickness of 1 inch.

5.4.2.2 Application of Insulation without an Intumescent Coating: In attics and crawlspaces, FOAM-LOK™ FL2000-4G insulation may be applied to the underside of roof sheathing and rafters in attics and to the underside of wood floors and floor joists in crawl spaces, and to walls in both attics and crawl spaces. The thickness of the foam plastic must not exceed 8 inches on walls and 12 inches on the underside of roofs and wood floors. The insulation may be installed without the prescriptive ignition barrier required by IBC

Section 2603.4.1.6 or IRC Sections R316.5.3 and R316.5.4, or a protective coating.

5.4.2.3 Use on Attic Floors: FOAM-LOK™ FL2000-4G insulation may be installed exposed (no coating) at a maximum thickness of 8 inches between and over the joists in attic floors. The insulation must be separated from the interior of the building by 1/2-inch gypsum or an approved thermal barrier. The insulation may be installed without the prescriptive ignition barrier required by IBC Section 2603.4.1.6 or IRC Section R316.5.3 and R316.5.4 or a protective coating.

5.5 Fire Resistance Ratings:

Assemblies containing FOAM-LOK FL2000-4G have been tested for fire resistance. Refer to details in Design Listings LII/FIP 60-01, LII/FIP 60-02, and LII/FIP 120-01.

5.6 Exterior Walls in Types I, II, III, and IV Construction:

The insulation may be used in exterior walls of Types I, II, III, or IV construction complying with IBC Section 2603.5 when the assembly is as described in Design Listings LII/FIP 30-01 and LII/FIP 30-02. The potential heat of FOAM-LOK FL2000-4G insulation is 1885 Btu/ft^2 (21.4 MJ/m^2) per inch of thickness.

6.0 CONDITIONS OF USE

The FOAM-LOK™ FL2000-4G spray-applied foam plastic insulation described in this Research Report complies with, or is a suitable alternative to, what is specified in those Codes listed in Section 1.0 of this report, subject to the following conditions:

6.1 Installation must comply with this Research Report, the manufacturer's published installation instructions, and the applicable Code. In the event of a conflict between the manufacturer's instructions and this report, this report governs.

6.2 The insulation must be separated from the interior living space of the building by a thermal barrier as described in Section 5.3.

6.3 The insulation must not exceed the thicknesses noted in Sections 4.1, 5.3, 5.4, 5.5, and 5.6, as applicable.

6.4 The insulation must be applied by contractors approved by Huntsman Building Solutions (USA) LLC.

6.5 The insulation must be installed with a vapor retarder when required by the applicable Code.

6.6 Use of the insulation in areas where the probability of termite infestation is "very heavy" must be in accordance with IRC Section R318.4 or IBC Section 2603.8, as applicable.

6.7 Jobsite certification and labeling of the insulation must comply with IRC Section N1101.10, N1101.14 and IECC Section C303.1 or R303.1 and R401.3, as applicable.

6.8 The insulation is produced under a quality control program with inspections by Intertek Testing Services NA, Inc.

7.0 SUPPORTING EVIDENCE

7.1 Reports of tests in accordance with ASTM C518, ASTM E84, ASTM E96, ASTM E119, ASTM E283, NFPA 259, NFPA 285, and NFPA 286.

7.2 Data in accordance with the ICC-ES Acceptance Criteria for Spray-applied Foam Plastic Insulation (AC 377), dated April 2016, including reports of tests in accordance with Appendix X.

7.3 Data in accordance with ICC-ES Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water-resistive Barriers (AC71), dated February 2003 (editorially revised September 2012).

7.4 Research Reports for evaluation of data in accordance with ICC-ES Acceptance Criteria for Fire-protective Coatings Applied to Spray-applied Foam Plastic Insulation Installed without a Code-prescribed Thermal Barrier (AC456), dated October 2015.

7.5 Intertek Listing Report "Huntsman Building Solutions (USA) LLC FOAM-LOK FL2000-4G Spray Foam Wall Insulation".

8.0 IDENTIFICATION

The A and B components of the insulation described in this Research Report are identified with the manufacturer's name (Huntsman Building Solutions (USA) LLC), address and telephone number; the product name (FOAM-LOK™ FL2000-4G); use instructions; the flame spread and smoke-development indices; the lot number; the Intertek Mark, and the Code Compliance Research Report number (CCRR-1025).

9.0 OTHER CODES

This section does not apply.

10.0 CODE COMPLIANCE RESEARCH REPORT USE

10.1 Approval of building products and/or materials can only be granted by a building official having legal authority in the specific jurisdiction where approval is sought.

10.2 Code Compliance Research Reports shall not be used in any manner that implies an endorsement of the product by Intertek Testing.

10.3 Reference to https://bpdirectory.intertek.com is recommended to ascertain the current version and status of this report.

TABLE 1 – PROPERTIES EVALUATED

PROPERTY	2018 IBC SECTION[1]	2018 IRC SECTION[1]	2018 IECC SECTION[1]
Physical properties	Not required	Not required	Not required
Surface-burning characteristics	2603.3	R316.3	Not applicable
Thermal barrier/ignition barrier	2603.4	R316.4	Not applicable
Air permeability	1202.3	R806.5	C402.5 R402.4
Vapor permeance	202, 1404.3	R202, R702.7.1	Not Applicable
Thermal resistance	1301	N1101.10 N1102	C303.1.1 C303.1.4 R303.1.1 R303.1.4
Water-resistive barrier	1403.2	R703.2	Not Applicable
Exterior walls of Type I-IV construction	2603.5	Not applicable	Not applicable

[1] Section numbers may be different for earlier versions of the International Codes.

TABLE 2 – THERMAL RESISTANCE (R Values) [1,2,3]

THICKNESS (inches)	R-VALUE (°F.ft^2.h/Btu)
1	6.2
2	13
3	20
3.5	24
4	27
5	34
5.5	38
6	41
7	48
8	55
9	62
10	68
11	75
11.5	79
12	82

[1] R-values are calculated based on tested K-values at 1 inch and 4 inch thicknesses.
[2] R-values greater than 10 are rounded to the nearest whole number.
[3] To determine R values for thickness not listed:
a. Between 1 inch and 4 inch can be determined through linear interpolation or
b. Greater than 4 inches can be calculated based on R= 6.84/inch

TABLE 3 – USE OF INSULATION WITHOUT A PRESCRIPTIVE THERMAL BARRIER

INSULATION TYPE	MAXIMUM THICKNESS (in.) (Wall Cavities and Attic Floor)	MAXIMUM THICKNESS (in.) (Underside of Roof Sheathing/Rafters and Floors)	INTUMESCENT COATING, MINIMUM THICKNESS & TYPE (Applied to all Exposed Foam Surfaces)	MINIMUM APPLICATION RATE OF INTUMESCENT COATING	TEST SUBMITTED (AC377)
Foam-Lok FL2000-4G	5-1/2	9-1/2	FIRESHELL® F10E 20 mil wet film thickness (13 mil dry film)	1.25 gal / 100 ft²	NFPA 286
	5-1/2	9-1/2	DC315 14 mil wet film thickness (9 mil dry film)	0.9 gal / 100 ft²	NFPA 286
	6	9	No-Burn Plus ThB 14 mil wet film thickness (9 mil dry film)	0.9 gal / 100 ft²	UL 1715