

ICC-ES Evaluation Report

ESR-1826*

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**DIVISION: 07 00 00—THERMAL AND MOISTURE
PROTECTION**
Section: 07 21 00—Thermal Insulation
REPORT HOLDER:

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EVALUATION SUBJECT:
**ICYNENE LD-C-50™ (formerly known as The Icynene
Insulation System®)**
1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2012 and 2009 *International Building Code*® (2009 IBC)
- 2012 and 2009 *International Residential Code*® (2009 IRC)
- 2012 and 2009 *International Energy Conservation Code*® (2009 IECC)
- Other Codes (see Section 8.0)

Properties evaluated:

- Surface burning characteristics
- Physical properties
- Thermal performance (R-values)
- Attic and crawl space installation
- Fire resistance
- Air permeability
- Noncombustible construction

2.0 USES

Icynene LD-C-50™ is used to provide thermal insulation in buildings and to seal areas such as plumbing and wiring penetrations against air infiltration, in Types I, II, III, IV and Type V construction (IBC) and dwellings under the IRC. The Icynene Insulation System may be used in fire-resistance-rated construction when installed in accordance with Section 4.5 and in Types I through IV construction when installed in accordance with Section 4.6.

3.0 DESCRIPTION
3.1 General:

Icynene LD-C-50™ is a low-density, open-cell, polyurethane foam plastic insulation and air barrier system that is 100 percent water-blown with an installed nominal density of 0.5 pcf (8 kg/m³). Icynene LD-C-50 is a two-component, spray-applied product. The two components of the insulation are polymeric isocyanate (A-Component, also known as Base Seal®) and proprietary resin (B-Component, LD-C-50 Resin, also known as, Gold Seal®). The A-Component must be stored at a temperature of 50°F (10°C) or greater, and has a shelf life of six months. The B-Component must be stored at temperatures below 100°F (37.8°C), and has a shelf life of six months.

3.2 Surface Burning Characteristics:

When tested in accordance with ASTM E84/UL 723, at a thickness of 6 inches (152 mm) and a nominal density of 0.5 pcf (8 kg/m³), Icynene LD-C-50 has a flame spread index of 25 or less and a smoke-developed index of 450 or less. Thicknesses of up to 7¹/₂ inches (190.5 mm) for wall cavities and 11¹/₂ inches (292 mm) for ceiling cavities are recognized based on room corner fire testing in accordance with NFPA 286, when covered with minimum 1/2-inch-thick (13 mm) gypsum board or an equivalent thermal barrier complying with the applicable code.

3.3 Thermal Resistance:

Icynene LD-C-50 has thermal resistance (R-values) at a mean temperature of 75°F (24°C) as shown in Table 1.

3.4 Air Permeability:

Icynene LD-C-50™ spray-applied foam plastic insulation, at a minimum thickness of 3¹/₂ inches (89 mm), is considered air-impermeable insulation in accordance with IRC Section R202, based on testing in accordance with ASTM E283.

3.5 Intumescent Coatings:

3.5.1 No Burn Plus XD: No Burn Plus XD intumescent coating is a latex-based coating supplied in 1-gallon (4L) and 5-gallon (19L) pails and 55-gallon (208 L) drums. The coating material has a shelf life of 12 months when stored in factory-sealed containers at temperatures between 40°F (4.4°C) and 90°F (32.2°C).

3.5.2 DC 315: DC 315 intumescent coating is a water-based coating supplied in 5-gallon (19L) pails and 55-gallon (208L) drums. The coating material has a shelf life of 24 months when stored in factory-sealed containers at temperatures between 41°F (5°C) and 95°F (35°C).

*Revised March 2012

4.0 INSTALLATION

4.1 General:

The manufacturer's published installation instructions and this report must be strictly adhered to and a copy of these instructions and this evaluation report must be available on the jobsite at all times during installation.

4.2 Application:

Icynene LD-C-50™ foam plastic insulation must be applied using spray equipment specified by Icynene, Inc. The insulation must not be used in areas which have a maximum service temperature greater than 180°F (82°C). The foam plastic insulation must not be used in electrical outlet or junction boxes or in contact with rain or water, and must be protected from the weather during and after application. Where the insulation is used as air-impermeable insulation, such as in unventilated attic spaces regulated by IRC Section R806, the insulation must be installed at a minimum thickness of 3.5 inches (89 mm). The insulation can be installed in one pass to the maximum thickness. Where multiple passes are required, the cure time between passes is negligible.

4.3 Thermal Barrier:

4.3.1 Application with a Prescriptive Thermal Barrier:

Icynene LD-C-50™ foam plastic insulation must be separated from the interior of the building by an approved thermal barrier, such as 1/2-inch (12.7 mm) gypsum wallboard installed using mechanical fasteners in accordance with the applicable code, or an equivalent 15-minute thermal barrier complying with the applicable code. When installation is within an attic or crawl space as described in Section 4.4, a thermal barrier is not required between the foam plastic and the attic or crawl space, but is required between the foam and the interior of the building. Thicknesses of up to 7 1/2 inches (190.5 mm) for wall cavities and 11 1/2 inches (292 mm) for ceiling cavities are recognized based on room corner fire testing in accordance with NFPA 286, when covered with minimum 1/2-inch-thick (13 mm) gypsum board or equivalent thermal barrier complying with, the applicable code.

4.3.2 Application without a Prescriptive Thermal Barrier or Ignition Barrier:

The prescriptive 15-minute thermal barrier or ignition barrier may be omitted when installation is in accordance with this section. The insulation and coating may be spray-applied to the interior facing of walls, the underside or roof sheathing of roof rafters, and in crawl spaces, and may be left exposed as an interior finish without a prescribed 15-minute thermal barrier or ignition barrier. The thickness of the foam plastic applied to the underside of the roof sheathing must not exceed 14 inches (356 mm). The thickness of the spray foam insulation applied to vertical wall surfaces must not exceed 6 inches (152 mm). The foam plastic must be covered on all surfaces with DC 315 coating at a minimum thickness of 13 dry mils, 20 wet mils, 80 ft² per gallon. 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 in one coat with low-pressure airless spray equipment.

4.4 Attics and Crawl Spaces:

4.4.1 Application with a Prescriptive Ignition Barrier:

When Icynene LD-C-50™ foam plastic insulation installed within attics where entry is made only for service of utilities, an ignition barrier must be installed in accordance with IBC Section 2603.4.1.6 and IRC Sections R316.5.3 and 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 that the foam plastic insulation is not exposed. The insulation may be installed in unvented attics in accordance with the 2009 IRC Section R806.4 or 2012 IRC Section R806.5, as applicable.

4.4.2 Application without a Prescriptive Ignition Barrier:

Where Icynene LD-C-50 foam plastic insulation is installed in an attic or crawl space without a prescriptive ignition barrier, in accordance with Sections 4.4.2.1, 4.4.2.2 and 4.4.3, the following conditions apply:

1. Entry to the attic or crawl space is only for the service of utilities and no storage is permitted.
2. There are no interconnected attic, crawl space or basement areas.
3. Air in the attic or crawl space is not circulated to other parts of the building.
4. Combustion air is provided in accordance with IMC Section 701.
5. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, or as required, except when air-impermeable insulation is permitted in unvented attics in accordance with Section R806.4 of the 2009 IRC or Section R806.5 of the 2012 IRC.
6. Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.

4.4.2.1 Attics:

In attics Icynene LD-C-50™ foam plastic insulation may be spray-applied to the underside of the roof sheathing and/or rafters, as described in this section. The thickness of the foam plastic applied to the underside of the roof sheathing must not exceed 14 inches (356 mm). The thickness of the spray foam insulation applied to vertical wall surfaces must not exceed 5.5 inches (140 mm). The insulation must be covered on all surfaces with one of the coatings described in Section 3.5. 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 in one coat with low-pressure airless spray equipment. The coating must be applied to a thickness as follows:

- No Burn Plus XD at a minimum dry film thickness of 4 mils (6 wet mils) at 270 ft² per gallon.
- DC 315 at a minimum dry film thickness of 3 mils (4 wet mils) at 400 ft² per gallon.

The coatings must be applied when ambient and substrate temperature is at least 60°F (16°C) and no more than 95°F (35°C). All other surfaces (including glass) must be protected against damage from the coating. The insulation may be installed in unvented attics when the foam plastic is applied at a minimum thicknesses of 3.5 inches (89 mm) as described in this section in accordance with the 2009 IRC Section R806.4 or Section R806.5 of the 2012 IRC.

4.4.2.2 Crawl Spaces:

In crawl spaces, Icynene LD-C-50 insulation may be spray-applied to vertical walls and the underside of floors, as described in this section. The thickness of the foam plastic applied to the underside of the floors must not exceed 14 inches (356 mm). The thickness of the spray foam insulation applied to vertical wall surfaces must not exceed 3 1/2 inches (88.9 mm). The foam plastic does not require an ignition barrier or a coating.

4.4.3 Use on Attic Floors: When used on attic floors, Icynene LD-C-50™ foam plastic insulation may be installed at a maximum thickness of 11¹/₂ inches (292 mm) between joists in attic floors. The insulation must be separated from the interior of the building by an approved thermal barrier. The ignition barrier, coatings specified in in Section 4.4.2.1 and in accordance with IBC Section 2603.4.1.6 and IRC Section R316.5.3 may be omitted.

4.5 One-hour Fire-resistance-rated Assemblies:

4.5.1 Assembly 1 (Limited Load-bearing Wood Stud Wall): Minimum nominally 2-by-4 [1¹/₂ by 3¹/₂ inches (38 mm by 89 mm)] southern pine (G = 0.55), No. 2 grade studs spaced 16 inches (406 mm) on center with a base layer of 1/2-inch-thick (12.7 mm) wood fiber sound board installed horizontally on each face with vertical joints located over the studs, attached with 6d box nails, 2 inches (51 mm) long and spaced 24 inches (610 mm) on center along the studs, and a second layer of 5/8-inch-thick (15.9 mm) Type X gypsum wallboard installed vertically on each face, attached with 8d box nails, 2¹/₂ inches (64 mm) long and spaced 7 inches (178 mm) on center along the studs. The stud cavity contains Icynene insulation nominally 2 inches (51 mm) thick.

Axial loads applied to the wall assembly must be limited to the least of the following:

- 1,805 pounds (8029 N) per stud.
- Design stress of 0.78 *F*'c.
- Design stress of 0.78 *F*'c at a maximum *l*_e/*d* of 33.

4.5.2 Assembly 2 (Limited Load-bearing Wood Stud Wall): Minimum nominally 2-by-4 [1¹/₂ by 3¹/₂ inches (38 mm by 89 mm)] southern pine (G = 0.55), No. 2 grade studs spaced 16 inches (406 mm) on center with two layers of 1/2-inch-thick (12.7 mm) Type X gypsum wallboard installed vertically with joints staggered on each face, attached with 8d box nails, 2¹/₂ inches (64 mm) long and spaced 7 inches (178 mm) on center along the studs for the face layer and 6d cement coated box nails, 2 inches (51 mm) long and spaced 24 inches (610 mm) on center along the studs. The stud cavity contains Icynene insulation nominally 2 inches (51 mm) thick.

Axial loads applied to the wall assembly must be limited to the least of the following:

- 1,805 pounds (8029 N) per stud.
- Design stress of 0.78 *F*'c.
- Design stress of 0.78 *F*'c at a maximum *l*_e/*d* of 33.

4.5.3 Assembly 3 (Floor/Ceiling): Minimum nominally 2-by-10 [1¹/₂ by 9¹/₄ inches (38 mm by 235 mm)] Douglas fir, No. 2 grade wood joists spaced 24 inches (610 mm) on center, with minimum 1-by-3 [3/4 by 2¹/₂ inches (19.1 by 64 mm)] spruce bridging at mid-span. Floor decking must be minimum 1/2-inch-thick (12.7 mm) exterior grade plywood installed perpendicular to joists and fastened with 2-inch-long (51 mm) ring shank nails 6 inches (152 mm) on center at the joints and 12 inches (305 mm) on center at the intermediate joists. Plywood joints must occur over joists. Icynene insulation must be applied to the underside of the plywood deck between the joists to a depth of 5 inches (127 mm). Two layers of minimum 5/8-inch-thick (15.9 mm), Type X gypsum wallboard must be attached perpendicular to the joists on the ceiling side of the assembly. The first layer must be attached with 1¹/₄-inch-long (32 mm), Type W drywall screws, spaced 24 inches (610 mm) on center. The second layer must be applied perpendicular to the joists, offset 24 inches (610 mm) from the base layer. The second layer must be attached with 2-inch-long (51 mm), Type S drywall screws spaced 12 inches (305 mm) on

center. Additional fasteners must be installed along the butt joints of the second layer, securing the two layers together. These fasteners must be 1¹/₂-inch-long (38 mm), Type G drywall screws placed 2 inches (51 mm) back from each end of the butt joint and spaced 12 inches (305 mm) on center. The wallboard joints on the exposed side must be treated with paper tape embedded in joint compound and topped with an added coat of compound, and the fastener heads must be coated with joint compound in accordance with ASTM C840 or GA-216.

4.5.4 Assembly 4 (Non-loadbearing Steel Stud Wall): Nominally 6-inch-deep (152.4 mm), No. 18 gage, galvanized steel studs spaced 16 inches (406.4 mm) on center, are friction-fit into No. 18 gage galvanized steel floor and ceiling track with a layer of 5/8-inch-thick (15.9 mm), Type X gypsum board applied to the interior side with the long edge parallel to steel studs and secured using No. 6, 1¹/₄-inch-long (31.7 mm), self-drilling drywall screws spaced 8 inches (203 mm) on center around the perimeter and 12 inches (305 mm) on center in the field. The gypsum board joints must be treated with vinyl or casein, dry or premixed joint compound applied in two coats to cover all exposed screw heads and gypsum board butt joints, and a minimum 2-inch-wide (51 mm) paper, plastic, or fiberglass tape embedded in the first layer of compound over butt joints of the gypsum board. The stud cavity is filled with Icynene insulation up to 6 inches (152 mm) thick. DensGlass® Gold Exterior Sheathing, 1/2 inch (12.7 mm) thick, is installed parallel to steel studs with vertical joints offset a minimum of 16 inches (406 mm) from the vertical joints of the gypsum board and the horizontal joints offset a minimum of 24 inches (610 mm) from the horizontal joints of the gypsum board. The sheathing is attached using No. 6, 1¹/₄-inch-long (31.7 mm), self-drilling drywall screws spaced 8 inches (203 mm) on center around the perimeter and in the field. Hohmann & Barnard DW-10 brick ties, 6 inches (152 mm) long by 1¹/₂-inches (38 mm) wide, are spaced 16 inches (406.4 mm) on center vertically on each steel stud, and secured, using two 5/8-inch-long (41.3 mm) self-drilling screws, through 4-inch (102 mm) red clay brick [3¹/₂ inches (88.9 mm) by 2¹/₄ inches (57.1 mm) by 7³/₄ inches (197 mm)] laid in a running bond pattern with Type S mortar, leaving a nominally 1-inch (25.4 mm) air gap between the brick and the exterior sheathing.

Optional: It is permitted to add code-complying, expanded polystyrene (EPS), extruded polystyrene (XPS), foil-faced, rigid polyurethane board stock or polyurethane spray foam on the exterior of the wall (between the DensGlass® Gold sheathed wall and the brick), while maintaining the 1-inch (25.4 mm) air space. The length of the brick ties must be increased to account for the thickness of the insulation.

4.6 Exterior Walls in Type I, II, III and IV Construction:

4.6.1 General: When used on exterior walls of Types I, II, III or IV construction, the assembly must comply with IBC Section 2603.5 and this section, and the LD-C-50 insulation must be installed at a maximum thickness of 6 inches (152 mm). The potential heat of Icynene LD-C-50 insulation is 494 Btu/ft² (5.6 MJ/m²) per inch of thickness, when testing is in accordance with NFPA 259.

4.6.2 Exterior Face: Nominally 6-inch-deep (152 mm), No. 18 gage, galvanized steel studs spaced 16 inches (406 mm) on center, are fastened to No. 18 gage, galvanized steel floor and ceiling track using No. 8, 1/8-inch-long (22.2 mm), self-tapping pan head framing screws. GP DensGlass® Gold Exterior Sheathing, 1/2 inch (12.7 mm) thick, is installed over the exterior side of steel

studs with the long end perpendicular to the steel studs, using No. 6, Type S, 1¹/₄-inch (31.7 mm), self-tapping bugle head screws spaced 8 inches (203 mm) on center around the perimeter and in the field. The stud cavity is filled with Icynene insulation to a nominal thickness of 6 inches (152 mm).

4.6.3 Interior Face: Type X gypsum board, 5/8 inches (15.9 mm) thick, is installed with the long dimension perpendicular to steel studs with No. 6, Type S, 1¹/₄ inch-long (31.7 mm), self-tapping, bugle head screws spaced 8 inches (203 mm) on center around the perimeter and in the field. The gypsum board joints must be treated with vinyl or casein, dry or premixed joint compound applied in two coats to cover all exposed screw heads and gypsum board butt joints, and a minimum 2-inch-wide (51 mm) paper, plastic, or fiberglass tape embedded in the first layer of compound over butt joints of the gypsum board.

4.6.4 Exterior Wall Covering: Details of the exterior wall covering must be provided to the code official by the report holder, designer or specifier, with an engineering analysis demonstrating that (1) the exterior wall covering conforms to ASTM E136 and (2) the addition of the wall covering to the assembly described in this section does not negatively affect conformance of the assembly with the requirements of IBC Section 2603.5.

5.0 CONDITIONS OF USE

The Icynene LD-C-50™ spray-applied polyurethane foam plastic insulation described in this 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:

- 5.1 This evaluation report and the manufacturer's published installation instructions, when required by the code official, must be submitted at the time of permit application.
- 5.2 The insulation must be installed in accordance with the manufacturer's published installation instructions, this evaluation report and the applicable code. If there is a conflict between the installation instructions and this report, this report governs.
- 5.3 The insulation must be separated from the interior of the building by an approved 15-minute thermal barrier, except when installation is as described in Section 4.3.2 or in attics and crawl spaces as described in Section 4.4.2 and 4.4.3.
- 5.4 The insulation must not exceed the thickness and density noted in Sections 3.2, 4.3, 4.4, 4.5 and 4.6.
- 5.5 The insulation must be protected from the weather during and after application.
- 5.6 The insulation must be applied by licensed dealers and installers certified by Icynene, Inc.
- 5.7 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.
- 5.8 Jobsite certification and labeling of the insulation must comply with IRC Sections N1101.4 and N1101.4.1 and IECC Sections 303.1.1 and 303.1.2, as applicable.
- 5.9 A vapor retarder must be installed in accordance with the applicable code.
- 5.10 Icynene LD-C-50 foam plastic insulation is manufactured in Mississauga, Ontario, Canada, under a quality control program with inspections by Intertek Testing Services (AA-691).

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Spray-applied Foam Plastic Insulation (AC377), dated June 2011, including reports of tests in accordance with Appendix X (Section 4.4.2.1) and Appendix C (Section 4.4.2.2).
- 6.2 Test report on air leakage rate in accordance with ASTM E283.
- 6.3 Reports of room corner fire testing in accordance with NFPA 286.
- 6.4 Test reports in accordance with ASTM E119.
- 6.5 Test report in accordance with NFPA 285, and related engineering analysis.
- 6.6 Reports of tests in accordance with NFPA 259.
- 6.7 Reports of fire tests in accordance with ASTM E970.

7.0 IDENTIFICATION

All packages and containers of Icynene LD-C-50™ must be labeled with the Icynene, Inc., name and address; the product name; the flame spread index and the smoke-developed index; the shelf life expiration date; the label of the inspection agency (Intertek Testing Services); and the evaluation report number (ESR-1826).

Intumescent coatings are identified with the manufacturer's name and address, the product trade name and use instructions.

8.0 OTHER CODES

8.1 Scope:

In addition to the codes referenced in Section 1.0, the products recognized in this report were evaluated for compliance with the requirements of the following codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2006 *International Energy Conservation Code*® (2006 IECC)

8.2 Uses:

The products comply with the above-mentioned codes as described in Sections 2.0 to 7.0 of this report, with the revisions noted below.

- **Application with a Prescriptive Ignition Barrier:** See Section 4.4.1, except attics must be vented in accordance with 2006 IBC Section 1203.2, and crawl space ventilation must be in accordance with 2006 IBC Section 1203.3, as applicable. Additionally, an ignition barrier must be installed in accordance with 2006 IRC Section R314.5.3 or R314.5.4, as applicable.
- **Application without a Prescriptive Ignition Barrier:** See Section 4.4.2, except attics must be vented in accordance with Section 1203.2 of the 2006 IBC or Section R806 of the 2006 IRC, and crawl space ventilation must be in accordance with Section 1203.3 of the 2006 IBC or Section R408 of the 2006 IRC, as applicable.
- **Jobsite Certification and Labeling:** See Section 5.8, except jobsite certification and labeling must comply with Sections 102.1.1 and 102.1.11, as applicable, of the 2006 IECC.
- **Protection Against Termites:** See Section 5.7, except use of the insulation in areas where the probability of termite infestation is "very heavy" must be in accordance with Section R320.5 of the 2006 IRC.

TABLE 1—THERMAL RESISTANCE (R-VALUES)

THICKNESS (inches)	R-VALUE (°F·ft ² ·h/Btu)
1	3.7
2	7
3	11
3.5	13
4	14
5	18
5.5	20
6	22
7	25
7.5	27
8	29
9	32
9.5	34
10	36
11.5	41
14	50

For **SI**: 1 inch = 25.4 mm, 1°F·ft²·h/Btu = 0.176 110°K·m²/W.

¹R-values are calculated based on tested K values at 1- and 3.5-inch thicknesses.