Annual Education Conference
National Roof Deck Contractors Association

April 11, 2013

NRCA technical update

presented by

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Topics

- Revision of FM 4470
- Polyisocyanurate insulation
- IECC 2012
- Questions (other topics)

FM Approvals' revision of FM 4470

- FM 4470 provides the basis for FM's classification of roof assemblies (e.g., 1-60, 1-90)
- Previous edition dated 1992 (April 1986)
- New edition published in June 2012 with an effective date of January 1, 2013

NRCA

Code requirements

IBC 2006 and previous editions

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single ply, through fastened metal panels and other types of membrane roof coverings shall also be tested in accordance with FM 4450, FM 4470, UL 580 or UL 1897

NRCA

Code requirements

IBC 2009 and IBC 2012

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single ply, through fastened metal panels and other types of membrane roof coverings shall also be tested in accordance with FM 4474, UL 580 or UL 1897

NRCA

Revisions to FM 4470

June 2012

- Adds NFPA 276
- Changes conditions of acceptance for wind uplift and hail damage resistance testing
- Adds alternative test methods for fastener corrosion resistance
- Changes to methods on how steel roof decks are evaluated
- Adds optional tests for dynamic puncture resistance, noncombustible core insulation and solar reflectance

Revisions to FM 4470

Evaluation of steel roof decks

- Allowable stresses per AISI S100
- Deflection based upon 200 lb. point load
- Deck design based upon 0.7-mm-thick (< 22 ga.)
- Fasteners tested for “pull over” of the deck material
- Stress calcs. on decks and fastener heads; lower value controls

Effective date

FM 4470, Section 1.6

- Effective date is December 31, 2012
- "…Products FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval…"

So, what does all this mean?

- FM has re-evaluated pre-12/31/12 classifications:
  - Reduce deck span, increase deck thickness and/or grade (33 ksi to 80 ksi) to maintain wind rating and existing RoofNav number
  - Re-evaluate assemblies, lower wind rating and create a new RoofNav number
- FM classifications likely have changed

Deck span limitations

22 ga. wide rib deck, spanning 6 ft. with fully-adhered roof membranes:

- 33 ksi deck limited to Class 1-165
- 80 ksi deck limited to Class 1-300

Mechanically-attached roof membranes have varying ratings based upon row spacing

An example

Sika Sarnafil Roofing Technical Bulletin #08-12, dated December 19, 2012

System description:

S327 membrane, 9'6" row spacing, attached with XP/XPN fasteners at 6" o.c. to 22 ga. steel roof deck

Pre-12/31/12 wind rating:

120 psf

New wind ratings:

- 90 psf using 80 ksi steel deck
- 90 psf using 22 ga., 33 ksi steel deck and 6' membrane row spacing

Suggestions

- Be careful!
- Work closely with manufacturers
- For current projects, notify and seek clarification from A/E/C, GC/CMs and/or building owners.

Professional Roofing, Jan. 2013

TECH TODAY

Changes reduce some FM classifications

FM 4470 has been revised, resulting in different uplift resistance criteria

by Mark S. Graham

FM Approvals has revised its criteria for determining the uplift resistances of membrane and liquid-applied roof assemblies. Because many roofing professionals rely on FM Approvals' classifications when designing and specifying low-slope roof assemblies, you should be aware of the changes made and their effects on specific roof assembly classifications.

FM 4470

FM 4470, "Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction," is the basis for FM Approvals' determination of 1-60, 1-90, 1-120, etc., classifications used for low-slope membrane and liquid-applied roof assemblies.

In June 2012, FM Approvals revised FM 4470; the effective date of the new standard was Dec. 31, 2012. The revisions include adding NFPA 276, "Standard Method for Fire Tests for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components," to determine combustibility below the roof deck; changes to the conditions of acceptance for wind uplift and hail damage resistance testing and adding an alternative test method for determining fasteners' corrosion resistances.

One of the more significant changes to FM 4470 is how steel roof decks are evaluated. With the revised standard, steel roof decks cannot exceed the allowable stresses provided for in AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members." The maximum allowable deflection for steel roof decks is based on a 200-pound point load; previously, a 300-pound point load was used. Also, minimum designs of steel roof decks now are based on a minimum 0.7-mm-thick (slightly less than 22-gauge), 33-ksi yield strength steel. Previously, minimum 0.75-mm-thick (22-gauge) steel complying with the ASTM International specification was used for evaluation.

The method of analyzing attachment of steel decks also has been revised. Deck fasteners now are tested for fastener "pull over" (pull through) of the deck material. Also, stress calculations are performed on both steel decks and fastener heads, and the lower of the two values is used as the basis for classification.

FM 4470 also now includes additional provisions allowing for optional ratings for dynamic puncture resistance of roof coverings, noncombustible core for roof insulation and solar reflectance of roof surfaces.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements. Products FM Approvals already approved under previous editions of FM 4470 also need to comply with the current edition by the effective date or forfeit classification.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements

What this means

If a specific classified assembly results in an overstressed steel roof deck, FM Approvals has, upon consultation with the manufacturer, either changed the assembly's parameters to compensate for the deck overstress or reduced the assembly's wind rating to a level where the deck no longer is overstressed. Assembly parameters likely changed include reducing the deck span and/or increasing the deck's steel thickness and/or yield strength (from 33 ksi to 80 ksi).

For assemblies where the wind rating has been reduced, the assemblies' previous RoofNav numbers have been withdrawn and new RoofNav numbers issued to avoid confusion.

If you use the new version of FM 4470 for an adhered roof assembly applied to a 1½-inch-thick, 22-gauge steel deck at a 6-foot maximum span, FM Approvals has indicated maximum classifications are limited to 1-165 when using a 33-ksi steel deck and 1-300 when using an 80-ksi steel deck. For seam-fastened mechanically attached single-ply membrane assemblies, classifications will vary based on assembly parameters and seam fastener row spacing, but generally classifications will be noticeably lower than with FM 4470's previous version.

Proceed cautiously

Roof system designers and specifiers need to be aware of FM 4470's revision and its effect on assembly parameters, uplift ratings and RoofNav numbers for membrane and liquid-applied roof assemblies using steel roof decks.

For roofing projects designed before the implementation date but that will be installed after the implementation date, clarification needs to be sought regarding which version of FM 4470 applies. If the current version applies, changes to the roof assembly specification may be necessary and affect a project's cost.

I encourage roof system designers and specifiers and roofing contractors to work closely with manufacturers when determining changes to specific assembly parameters, uplift ratings and RoofNav numbers.

MARK S. GRAHAM is NRCA's associate executive director of technical services.

NRCA

Polyisocyanurate insulation

- R-value issues
- ASTM C1289 shortcomings
- Physical property issues
- LTTR concerns

Revision of PIMA QualityMark

- LTTR certification
- Based upon CAN/ULC-S770-03
- Being revised to:
  - CAN/ULC-S770-09
  - ASTM C1303 (-11a, -12, -12$^{\varepsilon 1}$)
  - Implementation Jan. 2014

NRCA

Still not known

- What are the new LTTR values?
- Will polyiso. manufacturers agree?
- Will there be physical property changes?

Professional Roofing, March 2013

TECH TODAY

Too many options

Improvements to ASTM C1289 for polyisocyanurate insulation are needed

by Mark S. Graham

Faced rigid board polyisocyanurate insulation is the most popular type of insulation used in low-slope roof systems in the U.S. However, the product's ASTM International standard is confusing and cumbersome, which often results in inadequate or improper specifications. If you are involved with specifying or installing polyisocyanurate insulation, you should be aware of these concerns.

ASTM C1289

The U.S. product standard for faced rigid board polyisocyanurate insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board."

ASTM C1289 addresses 18 types of faced rigid board polyisocyanurate

ASTM C1289 is divided into seven types identified as Types I through VII. Type I products are faced with aluminum foil and typically are used in wall sheathing applications. Type II products are faced with mat facers and typically are used in low-slope roof systems. Types III through VII products include composite-type polyisocyanurate boards laminated with perlite board, wood fiberboard, oriented strand board, wafer board or glass mat-faced gypsum board and often are used in roof systems.

ASTM C1289, Type II products are further differentiated by four classes—Classes 1 through 4—and three grades—Grades 1 through 3. Class 1 products are faced with fiberglass-reinforced cellulosic felt or uncoated or coated polymer-bonded fiberglass mat; this is the most popular facer class used in the U.S. Class 2 products are faced with coated polymer-bonded fiberglass mats. Class 3 products are faced with uncoated polymer-bonded fiberglass mats. Class 4 products are faced with coated or uncoated polymer-bonded fiberglass mats.

ASTM C1289's grade classifications differ among classes. For Classes 1 through 3, Grades 1 through 3 designate products with 16-, 20- and 25-pounds-per-square-inch (psi) minimum compressive strengths, respectively. For Class 4 products, Grades 1 through 3 designate products with 80-, 110- and 140-psi minimum compressive strengths, respectively.

When specifying faced rigid board polyisocyanurate insulation, it is best to use the ASTM C1289 designation followed by the applicable type, class and grade designations. For example, polyisocyanurate insulation with a cellulose/glass facer having a 20-psi minimum compressive strength is designated as ASTM C1289, Type II, Class 1, Grade 2.

Clarity is needed

ASTM C1289 addresses 18 types of faced rigid board polyisocyanurate insulation products. This large number of products being defined by a single product standard appears to present challenges; many specifiers simply specify "ASTM C1289" instead of the standard's designation followed by the specific type, class and grade classifications necessary to identify the specific product intended. Also, few polyisocyanurate insulation manufacturers include type, class and grade designations in their product literature to adequately differentiate their products.

Also, some of ASTM C1289's facer sheet descriptions seem redundant or lack clarity to adequately differentiate products. For example, ASTM C1289, Type II, Classes 1 and 2 have facers identified as coated polymer-bonded fiberglass mats. ASTM C1289, Type II, Classes 1 and 3 have facers identified as uncoated polymer-bonded fiberglass mats. Although it appears the difference between the two is whether the facers' glass mats are coated or uncoated, it is unclear how polyisocyanurate products identified by these classifications differ from those described by ASTM C1289, Type II, Class 1.

For ASTM C1289 Types III through VII, the standard identifies specific product standards and physical properties applicable to these facers. Product standards and physical properties applicable to the facers on ASTM C1289, Types I and II products are not provided. Such information would help roofing professionals differentiate faced rigid board polyisocyanurate insulation products for specific project conditions.

NRCA has raised these concerns to the ASTM International task force responsible for maintaining ASTM C1289; however, to date, the task force has not addressed these concerns.

Specify carefully

When specifying faced rigid board polyisocyanurate insulation, NRCA recommends specifiers use the ASTM C1289 designation followed by the specific type classification and, if applicable, class and grade classifications necessary to identify the intended products' compressive strength and facers.

Additional information regarding polyisocyanurate insulation and other insulation types used in low-slope roof systems is provided in *The NRCA Roofing Manual: Membrane Roof Systems—2011.*

MARK S. GRAHAM is NRCA's associate executive director of technical services.

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Professional Roofing, April 2013

TECH TODAY

Revising LTTR

Test method changes could affect polyisocyanurate's LTTR values

by Mark S. Graham

Faced rigid board polyisocyanurate insulation is the most popular type of insulation used in low-slope roof systems in the U.S. However, after years of debate, there still is no industry-wide consensus of an appropriate R-value for design purposes.

PIMA QualityMark℠

Since 2004, polyisocyanurate insulation manufacturers in the U.S. have reported R-values using the Polyisocyanurate Insulation Manufacturers Association's (PIMA's) QualityMark certified R-value program. Within this program, R-values are determined and reported using the long-term thermal resistance (LTTR) method. Currently, LTTR values are determined using CAN/ULC-S770-03, "Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams."

NRCA does not consider LTTR to be appropriate for roof system design

The U.S. product standard for polyisocyanurate insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board." Up until the 2011 edition of ASTM C1289, CAN/ULC-S770-03 also was the method used for LTTR determination in ASTM C1289.

Beginning with ASTM C1289-11a (the "-11a" designates the second revision published in 2011), either CAN/ULC-S770-09 (the standard's 2009 version) or ASTM C1303, "Standard Test Method for Predicting Long Term Thermal Resistance of Closed Cell Foam Insulation," may be used for LTTR determination. This revision was made in recognition of continuing development of LTTR test methods.

In early 2012, PIMA indicated it would update the QualityMark program to include the new LTTR determination methods by the end of 2012.

But on Oct. 5, 2012, PIMA issued a press release indicating the QualityMark program would continue to follow current LTTR determination procedures (CAN/ULC-S770-03) throughout 2013 followed by implementation of the new multiple procedures Jan. 1, 2014. PIMA indicated this delay is necessary to allow adequate time to harmonize with existing methods and allow additional time for the industry to transition to the new methods.

What does this mean?

U.S. polyisocyanurate insulation manufacturers' continued reliance on the LTTR method and PIMA's QualityMark program presents challenges and complications for polyisocyanurate insulation users, including roofing contractors, designers, specifiers, and building owners and operators.

With the delay in implementing CAN/ULC-S770-09 or ASTM C1303, it can be interpreted polyisocyanurate insulation does not comply with ASTM C1289's current edition (ASTM C1289-12[e1]) or its two previous editions (-12 and -11a). This especially is a concern if project specifications and contract documents require compliance with ASTM C1289's most recent editions.

Also, once implemented, it remains to be seen whether LTTR values will change from current LTTR values (meaning they will be lower). Another possibility is the new LTTR values could vary among manufacturers. Polyisocyanurate insulation manufacturers also may reformulate their products to offset lower-tested LTTR values, resulting in possible changes in products' physical properties and Underwriters Laboratories Inc. and FM Global classifications.

This lack of information coming from PIMA and polyisocyanurate insulation manufacturers is of particular concern especially when considering some new construction and reroofing projects to be undertaken in 2014 already are in the preliminary design, specification, bidding or contract phases.

Finally, though the LTTR method of R-value determination and reporting may be considered appropriate for laboratory analysis and research comparisons, NRCA does not consider LTTR to be appropriate for roof system design where actual in-service R-values can be an important aspect of roof system performance.

NRCA's recommendations

NRCA maintains its recommendation that designers specifying polyisocyanurate insulation determine thermal insulation requirements using an in-service R-value of 5.0 per inch thickness for heating conditions and 5.6 per inch thickness for cooling conditions. Designers should use the recommended in-service R-value for heating or cooling conditions based on the predominant condition for building use and climate where the specific building being considered is located.

Futhermore, NRCA recommends designers specify polyisocyanurate insulation by its desired thickness—not R-value—to avoid possible confusion during procurement.

More information about polyisocyanurate insulation is contained in *The NRCA Roofing Manual: Membrane Roof Systems—2012.*

MARK S. GRAHAM is NRCA's associate executive director of technical services.

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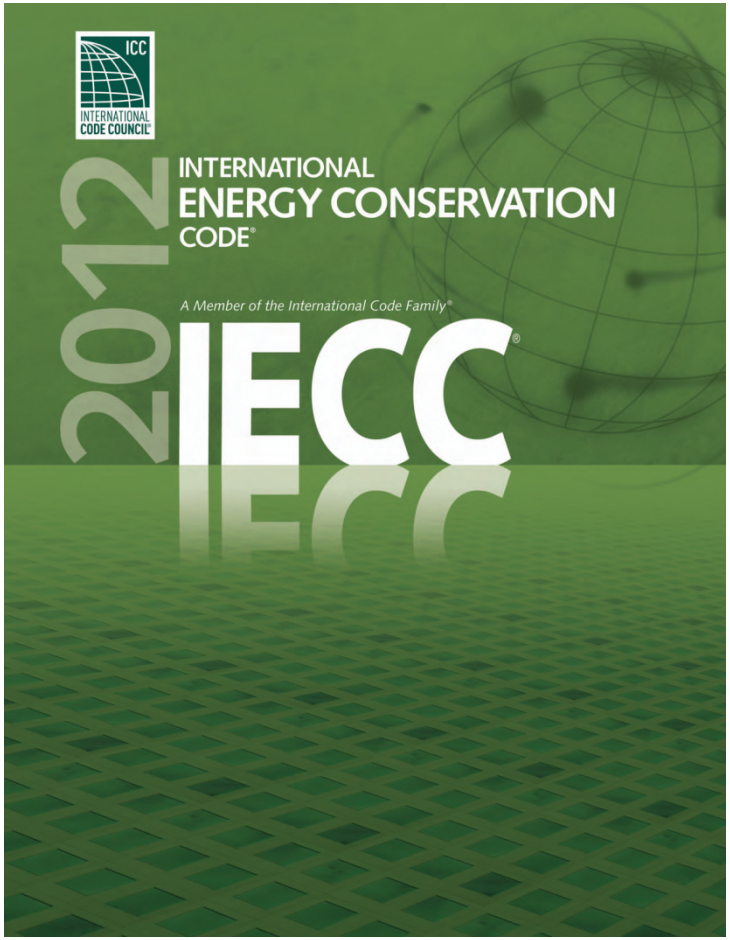
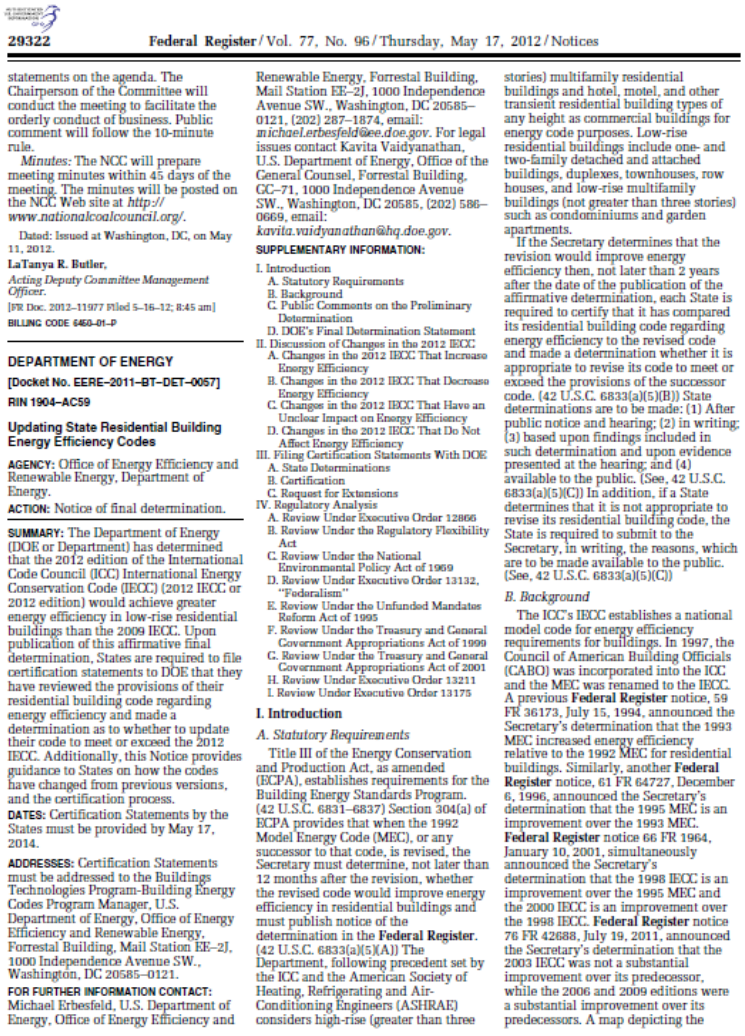
International Energy Conservation Code, 2012 Edition (IECC 2012)



NRCA

Federal Register, May 17, 2012



statements on the agenda. The Chairperson of the Committee will conduct the meeting to facilitate the orderly conduct of business. Public comment will follow the 10-minute rule.

Minutes: The NCC will prepare meeting minutes within 45 days of the meeting. The minutes will be posted on the NCC Web site at *http://www.nationalcoalcouncil.org/*.

Dated: Issued at Washington, DC, on May 11, 2012.

LaTanya R. Butler,

Acting Deputy Committee Management Officer.

[FR Doc. 2012–11977 Filed 5–16–12; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

[Docket No. EERE–2011–BT–DET–0057]

RIN 1904–AC59

Updating State Residential Building Energy Efficiency Codes

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Notice of final determination.

SUMMARY: The Department of Energy (DOE or Department) has determined that the 2012 edition of the International Code Council (ICC) International Energy Conservation Code (IECC) (2012 IECC or 2012 edition) would achieve greater energy efficiency in low-rise residential buildings than the 2009 IECC. Upon publication of this affirmative final determination, States are required to file certification statements to DOE that they have reviewed the provisions of their residential building code regarding energy efficiency and made a determination as to whether to update their code to meet or exceed the 2012 IECC. Additionally, this Notice provides guidance to States on how the codes have changed from previous versions, and the certification process.

DATES: Certification Statements by the States must be provided by May 17, 2014.

ADDRESSES: Certification Statements must be addressed to the Buildings Technologies Program-Building Energy Codes Program Manager, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, Mail Station EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121.

FOR FURTHER INFORMATION CONTACT: Michael Erbesfeld, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, Mail Station EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121, (202) 287–1874, email: *michael.erbesfeld@ee.doe.gov*. For legal issues contact Kavita Vaidyanathan, U.S. Department of Energy, Office of the General Counsel, Forrestal Building, GC–71, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586–0669, email: *kavita.vaidyanathan@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

I. Introduction

A. Statutory Requirements

Title III of the Energy Conservation and Production Act, as amended (ECPA), establishes requirements for the Building Energy Standards Program. (42 U.S.C. 6831–6837) Section 304(a) of ECPA provides that when the 1992 Model Energy Code (MEC), or any successor to that code, is revised, the Secretary must determine, not later than 12 months after the revision, whether the revised code would improve energy efficiency in residential buildings and must publish notice of the determination in the **Federal Register**. (42 U.S.C. 6833(a)(5)(A)) The Department, following precedent set by the ICC and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) considers high-rise (greater than three stories) multifamily residential buildings and hotel, motel, and other transient residential building types of any height as commercial buildings for energy code purposes. Low-rise residential buildings include one- and two-family detached and attached buildings, duplexes, townhouses, row houses, and low-rise multifamily buildings (not greater than three stories) such as condominiums and garden apartments.

If the Secretary determines that the revision would improve energy efficiency then, not later than 2 years after the date of the publication of the affirmative determination, each State is required to certify that it has compared its residential building code regarding energy efficiency to the revised code and made a determination whether it is appropriate to revise its code to meet or exceed the provisions of the successor code. (42 U.S.C. 6833(a)(5)(B)) State determinations are to be made: (1) After public notice and hearing; (2) in writing; (3) based upon findings included in such determination and upon evidence presented at the hearing; and (4) available to the public. (See, 42 U.S.C. 6833(a)(5)(C)) In addition, if a State determines that it is not appropriate to revise its residential building code, the State is required to submit to the Secretary, in writing, the reasons, which are to be made available to the public. (See, 42 U.S.C. 6833(a)(5)(C))

B. Background

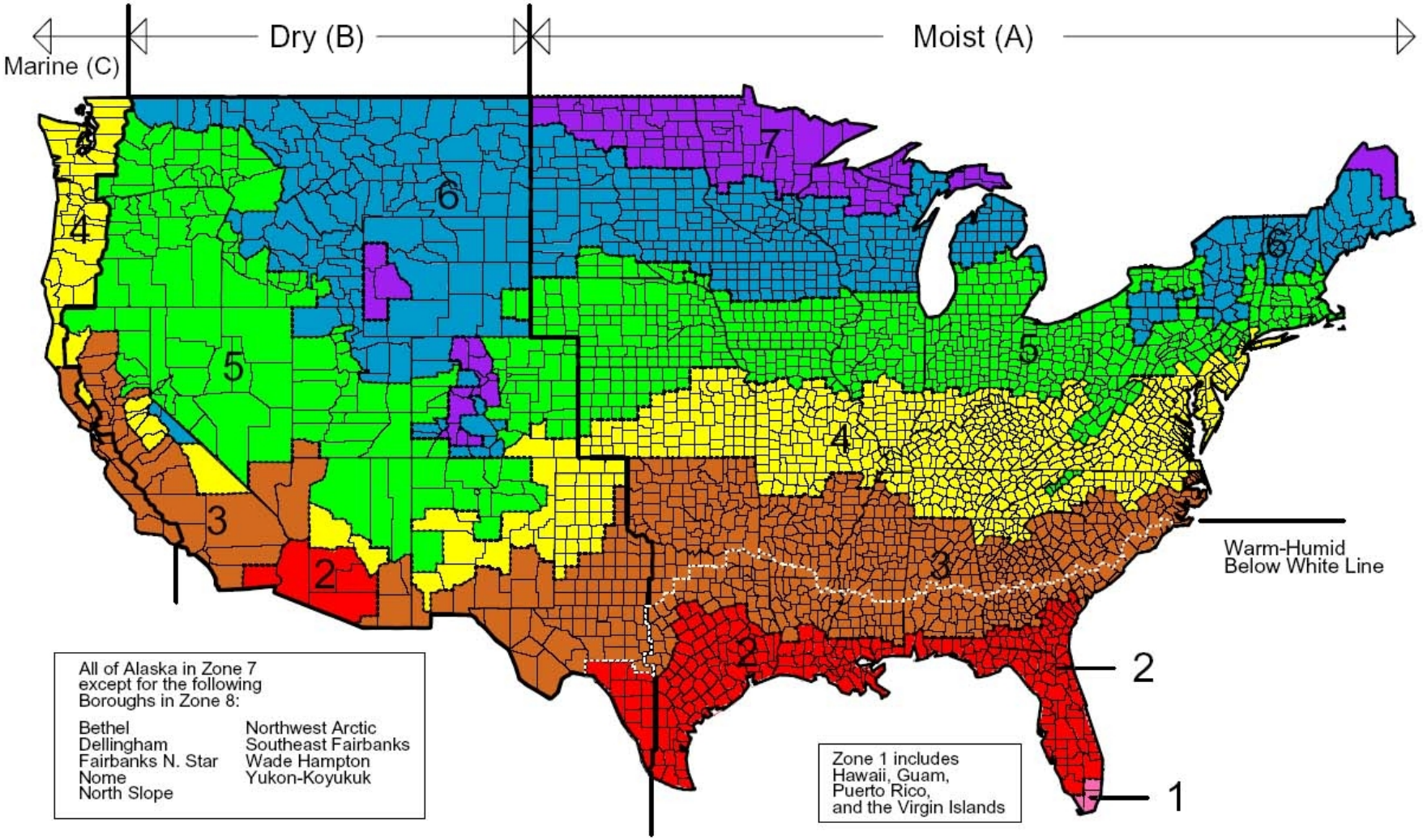
The ICC's IECC establishes a national model code for energy efficiency requirements for buildings. In 1997, the Council of American Building Officials (CABO) was incorporated into the ICC and the MEC was renamed to the IECC. A previous **Federal Register** notice, 59 FR 36173, July 15, 1994, announced the Secretary's determination that the 1993 MEC increased energy efficiency relative to the 1992 MEC for residential buildings. Similarly, another **Federal Register** notice, 61 FR 64727, December 6, 1996, announced the Secretary's determination that the 1995 MEC is an improvement over the 1993 MEC. **Federal Register** notice 66 FR 1964, January 10, 2001, simultaneously announced the Secretary's determination that the 1998 IECC is an improvement over the 1995 MEC and the 2000 IECC is an improvement over the 1998 IECC. **Federal Register** notice 76 FR 42688, July 19, 2011, announced the Secretary's determination that the 2003 IECC was not a substantial improvement over its predecessor, while the 2006 and 2009 editions were a substantial improvement over its predecessors. A map depicting the

Key points:

- US DOE has determined IECC 2012 will achieve greater energy efficiency in low-rise residential buildings than IECC 2009
- States must certify by May 17, 2014 their energy code meets or exceeds the levels of IECC 2012

This triggers most states to update their state energy code

Climate Zone Map



Format

International Energy Conservation Code, 2012 Edition

Ch. 1: Administration

- Part 1: Scope and Application
- Part 2: Administration and Enforcement

Ch. 2: Definitions

Ch. 3: General Requirements

Ch. 4: Commercial Energy Efficiency

Ch. 5: Reference Standards

International Energy Conservation Code, 2012 Edition

- Ch. 4[CE]-Commercial Energy Efficiency
- Ch. 4[RE]-Residential Energy Efficiency
- ASHRAE 90.1-2010 alternative

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Ch. 4—Commercial Energy Efficiency

International Energy conservation Code, 2012 Edition

- Sec. C402—Building Envelope Requirements
- Sec. C403—Building Mechanical Systems
- Sec. C404—Service Water Heating
- Sec. C405—Electrical Power and Lighting Systems
- Sec. C406—Additional Efficiency Package Options
- Sec. C407—Total Building Performance

Minimum thermal insulation requirements

IECC 2012, Section C402.2—Specific insulation Requirements (Prescriptive)

C402.2 Specific insulation requirements (Prescriptive). Opaque assemblies shall comply with Table C402.2. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Section C303.2. If the continuous insulation board manufacturer's installation instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.

Ch. 4[CE]-Commercial Energy Efficiency

International Energy Conservation Code, 2012 Edition

C402.2.1 Roof assembly. The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.2, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U-factor is* equivalent to the same assembly with the *R-value* specified in Table C402.2.
2. …

NRCA

Ch. 4[CE]-Commercial Energy Efficiency

International Energy Conservation Code, 2012 Edition

<table>
<tr><th colspan="4">Minimum thermal insulation requirements
for commercial buildings</th></tr>
<tr><th rowspan="2">Climate zone</th><th colspan="3">Roof assembly configuration</th></tr>
<tr><th>Insulation entirely above deck</th><th>Metal buildings (with R-5 thermal blocks)</th><th>Attic and other</th></tr>
<tr><td>1</td><td rowspan="3">R-20ci</td><td rowspan="5">R-19 + R-11 LS</td><td rowspan="5">R-38</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="2">R-25 ci</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td><td>R-30ci</td><td>R-25 + R-11 LS</td><td rowspan="3">R-49</td></tr>
<tr><td>7</td><td rowspan="2">R-35ci</td><td rowspan="2">R-30 + R-11 LS</td></tr>
<tr><td>8</td></tr>
<tr><td colspan="4">ci = Continuous insulation
LS = Liner system (a continuous membrane installed below the purlins and uninterrupted by framing members; uncompressed, faced insulation rests on top of the membrane between the purlins)</td></tr>
</table>

Ch. 4[CE]-Commercial Energy Efficiency

International Energy Conservation Code, 2012 Edition

C402.2.1 Roof assembly. The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.2, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U-factor is* equivalent to the same assembly with the *R-value* specified in Table C402.2.
2. …

IECC Commentary indicates Exception 1 applies to tapered insulation systems.

NRCA

2012 IECC Code and Commentary

"…The exception to this section permits a roof that is "continuously insulated" to have areas that do not meet the required *R*-values, provided that the area-weighted values are equivalent to the specified insulation values. This type of insulation referred to as tapered insulation is where the roof insulation varies to provide slope for drainage…."

[continued…]

2012 IECC Code and Commentary

"…This 1-inch (25 mm) limitation does not prevent the provisions from being applied to roofs that have a greater variation; it simply does not allow the additional thickness to be factored into the average insulation values. Where the variation exceeds 1 inch (25 mm), it would be permissible to go to the thinnest spot and measure the *R*-value at that point (for the example call this Point "a"). Then go to a point that is 1 inch (25 mm) thicker than Point "a" and measure the *R*-value there (for the example, call this Point "b"). The remaining portions of the roof that are thicker than the additional 1-inch (25 mm) portion (Point "b") would simply be assumed to have the same *R*-value that Point "b" had. All portions of the roof that meet or exceed the Point "b" *R*-value would simply use the Point "b" *R*-value when determining the area weighted *U*-factor for the roof."

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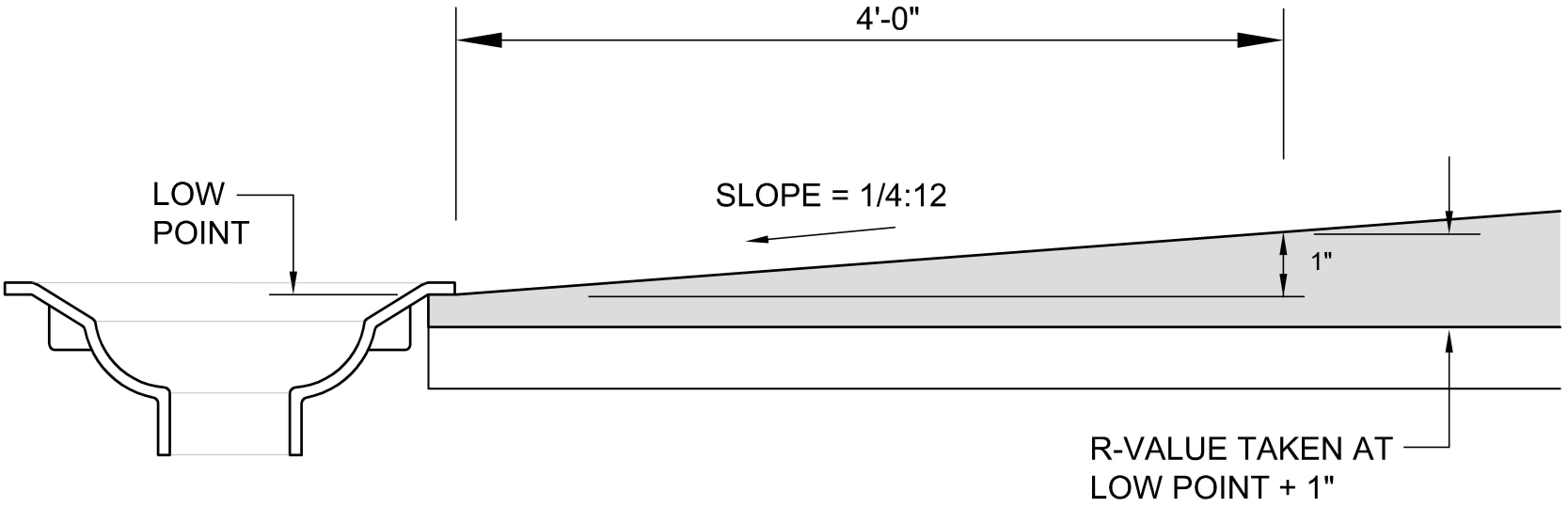
Graphically depicted…



Solar reflectance and thermal emittance

IECC 2012, Section C402.2.1.1

C402.2.1.1 Roof solar reflectance and thermal emittance. Low-sloped roofs, with a slope less than 2 units vertical in 12 horizontal, directly above cooled *conditioned spaces* in Climate Zones 1, 2, and 3 shall comply with one or more of the options in Table C402.2.1.1.

Exceptions: The following roofs and portions of roofs are exempt from the requirements in Table C402.2.1.1:

1. Portions of roofs that include or are covered by:
   - 1.1 Photovoltaic systems or components.
   - 1.2 Solar air or water heating systems or components.
   - 1.3 Roof gardens or landscaped roofs.
   - 1.4 Above-roof decks or walkways.
   - 1.5 Skylights.
   - 1.6 HVAC systems, components, and other opaque objects mounted above…

[Continued…]

TABLE C402.2.1.1

MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Three-year aged solar reflectance[b] of 0.55 and three-year aged thermal emittancec of 0.75
Initial solar reflectance[b] of 0.70 and initial thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64
Initial solar reflectance index[d] of 82

[Footnotes omitted for clarity]

Air retarders

IECC 2012, Section C402.4-Air Leakage (Mandatory)

C402.4 Air leakage (Mandatory). The thermal envelope of buildings shall comply with Sections C402.4.1 through C402.4.8.

C402.4.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.4.1.1 and C402.4.1.2.

Exception: Air barriers are not required in buildings located in Climate Zones 1, 2 and 3.

[Continued…]

C402.4.1.1 Air barrier construction. The *continuous air barrier* shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. Air barrier penetrations shall be sealed in accordance with Section C402.4.2. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Recessed lighting fixtures shall comply with Section C404.2.8. Where similar objects are installed which penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

Exception: Buildings that comply with Section C402.4.1.2.3 are not required to comply with Items 1 and 3.

[Continued…]

C402.4.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall comply with Section C402.4.1.2.1, C402.4.1.2.2, or C402.4.1.2.3.

C402.4.1.2.1 Materials. Materials with an air permeability no greater than 0.004 cfm/ft^2 (0.02 L/s · m^2) under a pressure differential of 0.3 inches water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 15 shall be deemed to comply with this section provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than 3/8 inch (10 mm).
2. Oriented strand board having a thickness of not less than 3/8 inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch (12 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch (12 mm).
5. Closed cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than 1-1/2 inches (36 mm).

[Continued….]

6. Open cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) and having a thickness of not less than 4.5 inches (113 mm).
7. Exterior or interior gypsum board having a thickness of not less than ½ inch (12 mm).
8. Cement board having a thickness of not less than 1/2 inch (12 mm).
9. Built up roofing membrane.
10. Modified bituminous roof membrane.
11. Fully adhered single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch (16 mm).
13. Cast-in-place and precast concrete.
14. Fully grouted concrete block masonry.
15. Sheet steel or aluminum.

[Continued…]

C402.4.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not to exceed 0.04 cfm/ft^2 (0.2 L/s · m^2) under a pressure differential of 0.3 inches of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 and 2 shall be deemed to comply provided joints are sealed and requirements of Section C402.4.1.1 are met.

1. Concrete masonry walls coated with one application either of block filler and two applications of a paint or sealer coating;

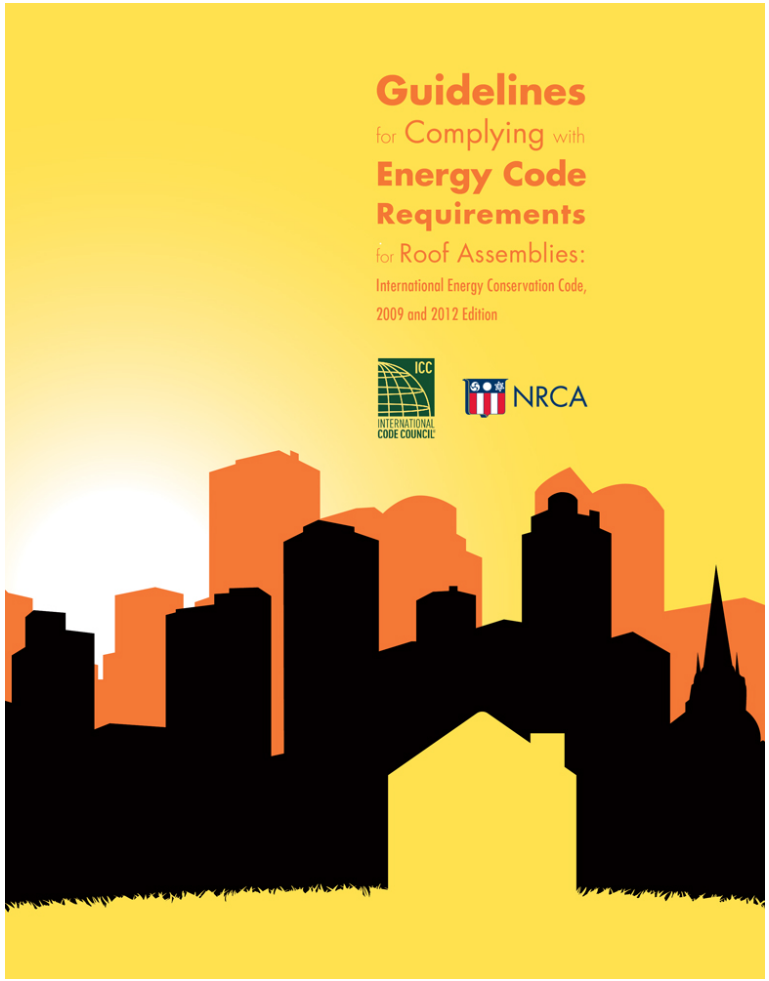
2. A Portland cement/sand parge, stucco or plaster minimum 1/2 inch (12 mm) in thickness.

C402.4.1.2.3 Building test. The completed building shall be tested and the air leakage rate of the *building envelope* shall not exceed 0.40 cfm/ft^2 at a pressure differential of 0.3 inches water gauge (2.0 L/s · m^2 at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.

[Continued…]

C402.4.2 Air barrier penetrations. Penetrations of the air barrier and paths of air leakage shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.

Energy Codes Manual



- Based upon IECC 2012 with ASHRAE 90.1-07 option and IECC 2012 with ASHRAE 90.1-10 option
- Includes roofing-related code text and NRCA commentary on each section
- Appendix has county-specific prescriptive R-value tables
- Co-branded with ICC; NRCA promotes to industry and ICC promotes to code officials

NRCA

Questions?

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Changes reduce some FM classifications

FM 4470 has been revised, resulting in different uplift resistance criteria

by Mark S. Graham

FM Approvals has revised its criteria for determining the uplift resistances of membrane and liquid-applied roof assemblies. Because many roofing professionals rely on FM Approvals' classifications when designing and specifying low-slope roof assemblies, you should be aware of the changes made and their effects on specific roof assembly classifications.

FM 4470

FM 4470, "Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction," is the basis for FM Approvals' determination of 1-60, 1-90, 1-120, etc., classifications used for low-slope membrane and liquid-applied roof assemblies.

In June 2012, FM Approvals revised FM 4470; the effective date of the new standard was Dec. 31, 2012. The revisions include adding NFPA 276, "Standard Method for Fire Tests for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components," to determine combustibility below the roof deck; changes to the conditions of acceptance for wind uplift and hail damage resistance testing; and adding an alternative test method for determining fasteners' corrosion resistances.

One of the more significant changes to FM 4470 is how steel roof decks are evaluated. With the revised standard, steel roof decks cannot exceed the allowable stresses provided for in AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members." The maximum allowable deflection for steel roof decks is based on a 200-pound point load; previously, a 300-pound point load was used. Also, minimum designs of steel roof decks now are based on a minimum 0.7-mm-thick (slightly less than 22-gauge), 33-ksi yield strength steel. Previously, minimum 0.75-mm-thick (22-gauge) steel complying with the ASTM International specification was used for evaluation.

The method of analyzing attachment of steel decks also has been revised. Deck fasteners now are tested for fastener "pull over" (pull through) of the deck material. Also, stress calculations are performed on both steel decks and fastener heads, and the lower of the two values is used as the basis for classification.

FM 4470 also now includes additional provisions allowing for optional ratings for dynamic puncture resistance of roof coverings, noncombustible core for roof insulation and solar reflectance of roof surfaces.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements. Products FM Approvals already approved under previous editions of FM 4470 also need to comply with the current edition by the effective date or forfeit classification.

> All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements

What this means

If a specific classified assembly results in an overstressed steel roof deck, FM Approvals has, upon consultation with the manufacturer, either changed the assembly's parameters to compensate for the deck overstress or reduced the assembly's wind rating to a level where the deck no longer is overstressed. Assembly parameters likely changed include reducing the deck span and/or increasing the deck's steel thickness and/or yield strength (from 33 ksi to 80 ksi).

For assemblies where the wind rating has been reduced, the assemblies' previous RoofNav numbers have been withdrawn and new RoofNav numbers issued to avoid confusion.

If you use the new version of FM 4470 for an adhered roof assembly applied to a 1½-inch-thick, 22-gauge steel deck at a 6-foot maximum span, FM Approvals has indicated maximum classifications are limited to 1-165 when using a 33-ksi steel deck and 1-300 when using an 80-ksi steel deck. For seam-fastened mechanically attached single-ply membrane assemblies, classifications will vary based on assembly parameters and seam fastener row spacing, but generally classifications will be noticeably lower than with FM 4470's previous version.

Proceed cautiously

Roof system designers and specifiers need to be aware of FM 4470's revision and its effect on assembly parameters, uplift ratings and RoofNav numbers for membrane and liquid-applied roof assemblies using steel roof decks.

For roofing projects designed before the implementation date but that will be installed after the implementation date, clarification needs to be sought regarding which version of FM 4470 applies. If the current version applies, changes to the roof assembly specification may be necessary and affect a project's cost.

I encourage roof system designers and specifiers and roofing contractors to work closely with manufacturers when determining changes to specific assembly parameters, uplift ratings and RoofNav numbers.

MARK S. GRAHAM is NRCA's associate executive director of technical services.

Too many options

Improvements to ASTM C1289 for polyisocyanurate insulation are needed

by Mark S. Graham

Faced rigid board polyisocyanurate insulation is the most popular type of insulation used in low-slope roof systems in the U.S. However, the product's ASTM International standard is confusing and cumbersome, which often results in inadequate or improper specifications. If you are involved with specifying or installing polyisocyanurate insulation, you should be aware of these concerns.

ASTM C1289

The U.S. product standard for faced rigid board polyisocyanurate insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board."

ASTM C1289 addresses 18 types of faced rigid board polyisocyanurate

ASTM C1289 is divided into seven types identified as Types I through VII. Type I products are faced with aluminum foil and typically are used in wall sheathing applications. Type II products are faced with mat facers and typically are used in low-slope roof systems. Types III through VII products include composite-type polyisocyanurate boards laminated with perlite board, wood fiberboard, oriented strand board, wafer board or glass mat-faced gypsum board and often are used in roof systems.

ASTM C1289, Type II products are further differentiated by four classes—Classes 1 through 4—and three grades—Grades 1 through 3. Class 1 products are faced with fiberglass-reinforced cellulosic felt or uncoated or coated polymer-bonded fiberglass mat; this is the most popular facer class used in the U.S. Class 2 products are faced with coated polymer-bonded fiberglass mats. Class 3 products are faced with uncoated polymer-bonded fiberglass mats. Class 4 products are faced with coated or uncoated polymer-bonded fiberglass mats.

ASTM C1289's grade classifications differ among classes. For Classes 1 through 3, Grades 1 through 3 designate products with 16-, 20- and 25-pounds-per-square-inch (psi) minimum compressive strengths, respectively. For Class 4 products, Grades 1 through 3 designate products with 80-, 110- and 140-psi minimum compressive strengths, respectively.

When specifying faced rigid board polyisocyanurate insulation, it is best to use the ASTM C1289 designation followed by the applicable type, class and grade designations. For example, polyisocyanurate insulation with a cellulose/glass facer having a 20-psi minimum compressive strength is designated as ASTM C1289, Type II, Class 1, Grade 2.

Clarity is needed

ASTM C1289 addresses 18 types of faced rigid board polyisocyanurate insulation products. This large number of products being defined by a single product standard appears to present challenges; many specifiers simply specify "ASTM C1289" instead of the standard's designation followed by the specific type, class and grade classifications necessary to identify the specific product intended. Also, few polyisocyanurate insulation manufacturers include type, class and grade designations in their product literature to adequately differentiate their products.

Also, some of ASTM C1289's facer sheet descriptions seem redundant or lack clarity to adequately differentiate products. For example, ASTM C1289, Type II, Classes 1 and 2 have facers identified as coated polymer-bonded fiberglass mats. ASTM C1289, Type II, Classes 1 and 3 have facers identified as uncoated polymer-bonded fiberglass mats. Although it appears the difference between the two is whether the facers' glass mats are coated or uncoated, it is unclear how polyisocyanurate products identified by these classifications differ from those described by ASTM C1289, Type II, Class 1.

For ASTM C1289 Types III through VII, the standard identifies specific product standards and physical properties applicable to these facers. Product standards and physical properties applicable to the facers on ASTM C1289, Types I and II products are not provided. Such information would help roofing professionals differentiate faced rigid board polyisocyanurate insulation products for specific project conditions.

NRCA has raised these concerns to the ASTM International task force responsible for maintaining ASTM C1289; however, to date, the task force has not addressed these concerns.

Specify carefully

When specifying faced rigid board polyisocyanurate insulation, NRCA recommends specifiers use the ASTM C1289 designation followed by the specific type classification and, if applicable, class and grade classifications necessary to identify the intended products' compressive strength and facers.

Additional information regarding polyisocyanurate insulation and other insulation types used in low-slope roof systems is provided in *The NRCA Roofing Manual: Membrane Roof Systems—2011.*

MARK S. GRAHAM is NRCA's associate executive director of technical services.

Revising LTTR

Test method changes could affect polyisocyanurate's LTTR values

by Mark S. Graham

Faced rigid board polyisocyanurate insulation is the most popular type of insulation used in low-slope roof systems in the U.S. However, after years of debate, there still is no industry-wide consensus of an appropriate R-value for design purposes.

PIMA QualityMark℠

Since 2004, polyisocyanurate insulation manufacturers in the U.S. have reported R-values using the Polyisocyanurate Insulation Manufacturers Association's (PIMA's) QualityMark certified R-value program. Within this program, R-values are determined and reported using the long-term thermal resistance (LTTR) method. Currently, LTTR values are determined using CAN/ULC-S770-03, "Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams."

NRCA does not consider LTTR to be appropriate for roof system design

The U.S. product standard for polyisocyanurate insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board." Up until the 2011 edition of ASTM C1289, CAN/ULC-S770-03 also was the method used for LTTR determination in ASTM C1289.

Beginning with ASTM C1289-11a (the "-11a" designates the second revision published in 2011), either CAN/ULC-S770-09 (the standard's 2009 version) or ASTM C1303, "Standard Test Method for Predicting Long Term Thermal Resistance of Closed Cell Foam Insulation," may be used for LTTR determination. This revision was made in recognition of continuing development of LTTR test methods.

In early 2012, PIMA indicated it would update the QualityMark program to include the new LTTR determination methods by the end of 2012.

But on Oct. 5, 2012, PIMA issued a press release indicating the QualityMark program would continue to follow current LTTR determination procedures (CAN/ULC-S770-03) throughout 2013 followed by implementation of the new multiple procedures Jan. 1, 2014. PIMA indicated this delay is necessary to allow adequate time to harmonize with existing methods and allow additional time for the industry to transition to the new methods.

What does this mean?

U.S. polyisocyanurate insulation manufacturers' continued reliance on the LTTR method and PIMA's QualityMark program presents challenges and complications for polyisocyanurate insulation users, including roofing contractors, designers, specifiers, and building owners and operators.

With the delay in implementing CAN/ULC-S770-09 or ASTM C1303, it can be interpreted polyisocyanurate insulation does not comply with ASTM C1289's current edition (ASTM C1289-12^{e1}) or its two previous editions (-12 and -11a). This especially is a concern if project specifications and contract documents require compliance with ASTM C1289's most recent editions.

Also, once implemented, it remains to be seen whether LTTR values will change from current LTTR values (meaning they will be lower). Another possibility is the new LTTR values could vary among manufacturers. Polyisocyanurate insulation manufacturers also may reformulate their products to offset lower-tested LTTR values, resulting in possible changes in products' physical properties and Underwriters Laboratories Inc. and FM Global classifications.

This lack of information coming from PIMA and polyisocyanurate insulation manufacturers is of particular concern especially when considering some new construction and reroofing projects to be undertaken in 2014 already are in the preliminary design, specification, bidding or contract phases.

Finally, though the LTTR method of R-value determination and reporting may be considered appropriate for laboratory analysis and research comparisons, NRCA does not consider LTTR to be appropriate for roof system design where actual in-service R-values can be an important aspect of roof system performance.

NRCA's recommendations

NRCA maintains its recommendation that designers specifying polyisocyanurate insulation determine thermal insulation requirements using an in-service R-value of 5.0 per inch thickness for heating conditions and 5.6 per inch thickness for cooling conditions. Designers should use the recommended in-service R-value for heating or cooling conditions based on the predominant condition for building use and climate where the specific building being considered is located.

Futhermore, NRCA recommends designers specify polyisocyanurate insulation by its desired thickness—not R-value—to avoid possible confusion during procurement.

More information about polyisocyanurate insulation is contained in *The NRCA Roofing Manual: Membrane Roof Systems—2012.*

MARK S. GRAHAM is NRCA's associate executive director of technical services.