



I-code update for roofing contractors

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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

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

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

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.

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.

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

Proceed cautiously

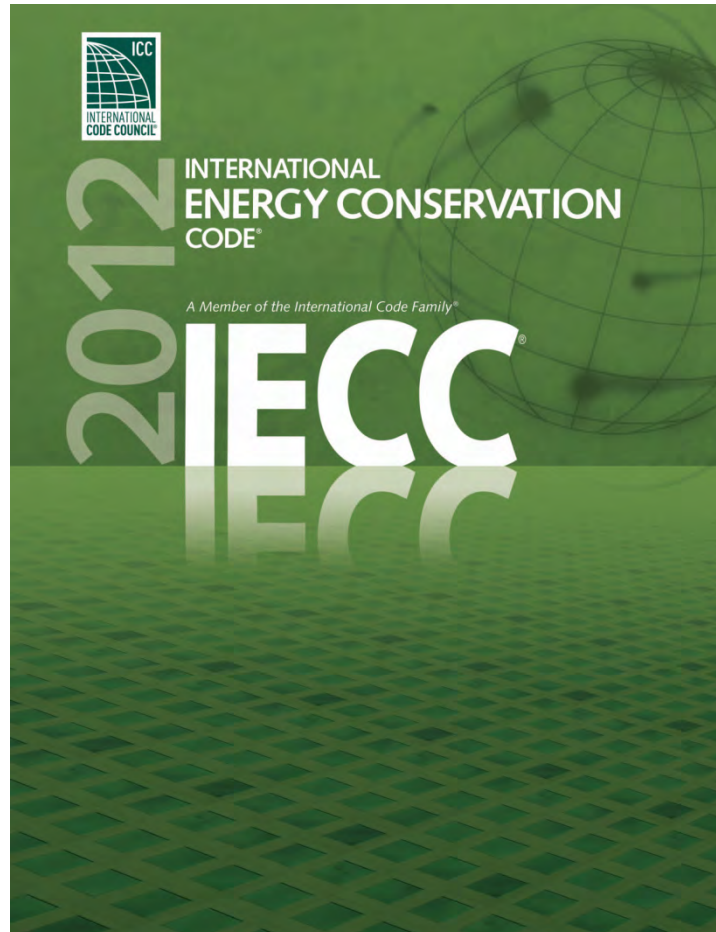
Roof system designers and specifiers need to be aware of FM 4470's revision and its effect on assembly parameters, uplift ratings and RoofNav numbers for membrane and liquid-applied roof assemblies using steel roof decks.

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. ●●●

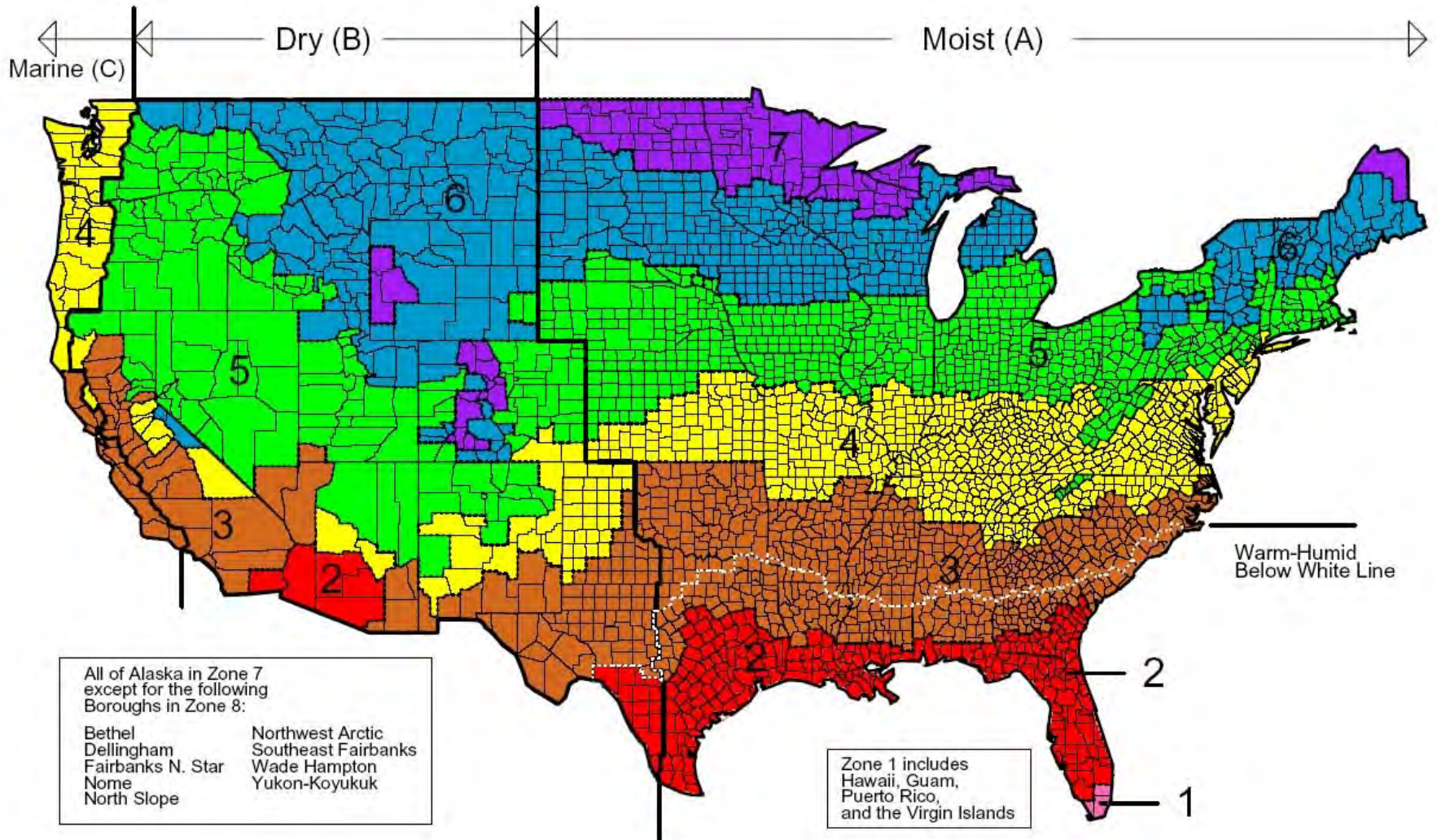
MARK S. GRAHAM is NRCA's associate executive director of technical services.

International Energy Conservation Code, 2012 Edition (IECC 2012)



Climate zones

IECC 2012, Section C301—Climate Zones



Minimum thermal insulation requirements

IECC 2009, 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.

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. Unit skylight curbs included as a component of an NFRC 100 rated assembly shall not be required to be insulated.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Ch. 4[CE]-Commercial Energy Efficiency

International Energy Conservation Code, 2012 Edition

| Minimum thermal insulation requirements for commercial buildings | | | |
|---|---|--|------------------------|
| Climate zone | Roof assembly configuration | | |
| | Insulation entirely above deck | Metal buildings (with R-5 thermal blocks) | Attic and other |
| 1 | R-20ci | R-19 + R-11 LS | R-38 |
| 2 | | | |
| 3 | | | |
| 4 | R-25 ci | R-25 + R-11 LS | R-49 |
| 5 | | | |
| 6 | R-30ci | R-30 + R-11 LS | R-49 |
| 7 | R-35ci | R-30 + R-11 LS | |
| 8 | | | |

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)

R-value determination

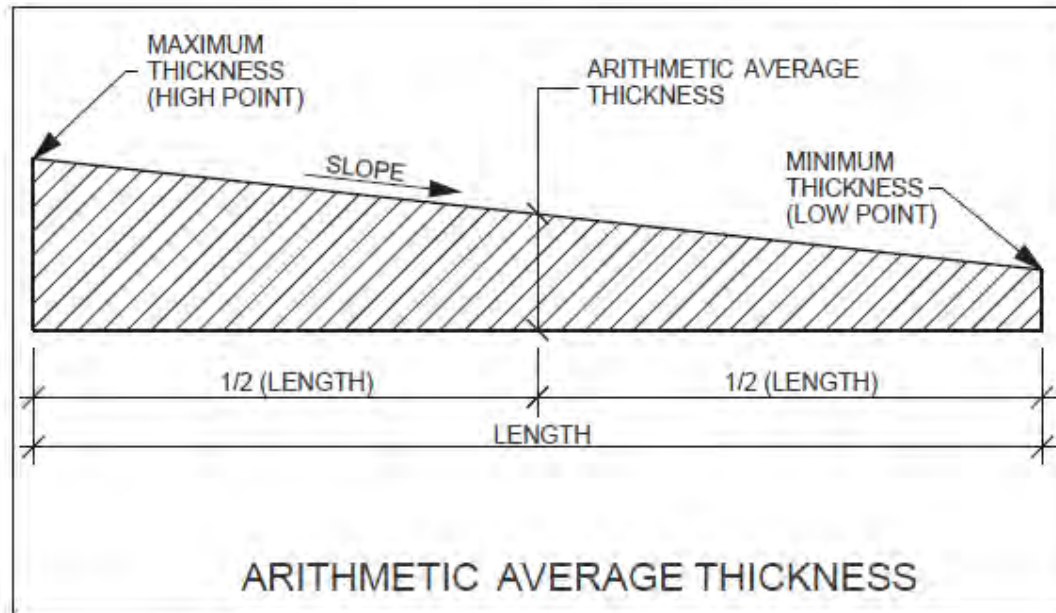
IECC 2012, Section C303.1.4-Insulation Product Rating

C303.14 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the U.S. Federal Trade commission R-value rule (CFR Title 16, Part 460) in units of $h \times ft^2 \times ^\circ F/Btu$ at a mean temperature of $75^\circ F$ ($24^\circ C$).

What about tapered insulation?

Average R-value

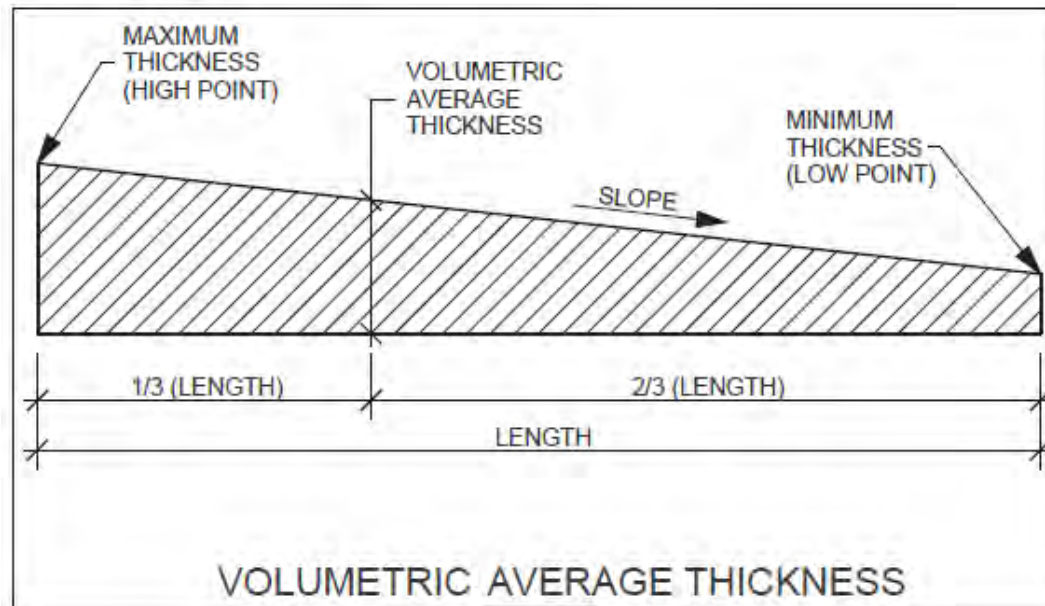
Arithmetic average thickness method



$$\text{Arithmetic average thickness} = LP + [1/2 (HP - LP)]$$

Average R-value

Volumetric average thickness method



$$\text{Volumetric average thickness} = \text{LP} + [2/3 (\text{HP} - \text{LP})]$$

Average R-value

Volumetric average thickness method – Alternative method

$$\text{Volumetric average thickness} = \frac{\text{Total board footage} - \text{Anticipated waste}}{\text{Roof surface area}}$$

Average R-value

Volumetric average thickness method – Another alternative method

$$\text{Volumetric average thickness} = \frac{\text{Volume of insulation}}{\text{Roof surface area}}$$

These methods do not comply
with the Energy Code's intent.

Codes provide minimum requirements

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.

2012 IECC Code and Commentary

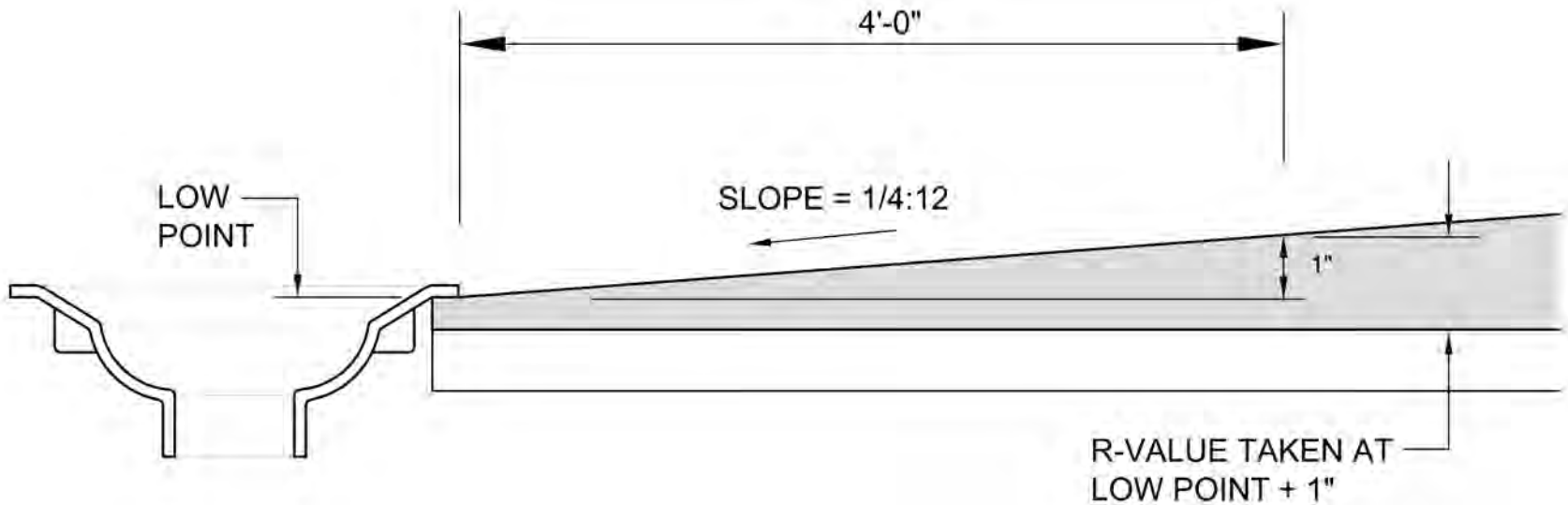
“...The exception to this section permits a roof that is “continuously insulated” to have areas that do not meet the required *R*-values, provided that the area-weighted values are equivalent to the specified insulation values. This type of insulation referred to as tapered insulation is where the roof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

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 emittance ^c 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/ft² (0.02 L/s · m²) 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/m³) 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/m³) 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/ft² (0.2 L/s · m²) 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/ft² at a pressure differential of 0.3 inches water gauge (2.0 L/s · m² at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.

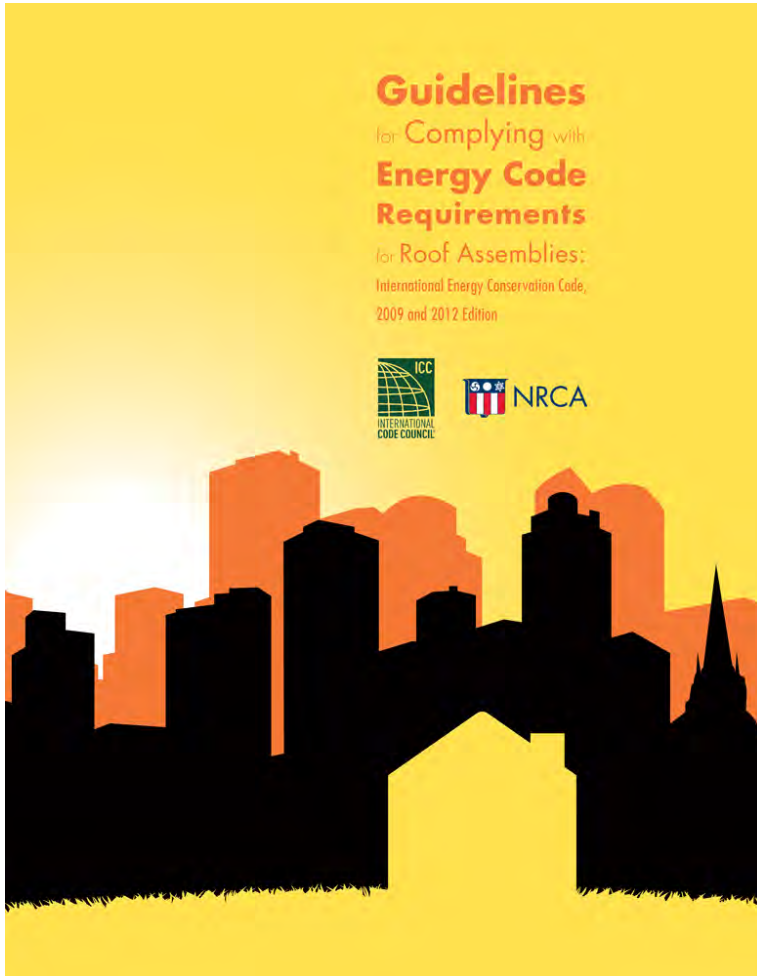
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C402.4.2 Air barrier penetrations. Penetrations of the air barrier and paths of air leakage shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals shall be sealed in the 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.

Summary – IECC 2012

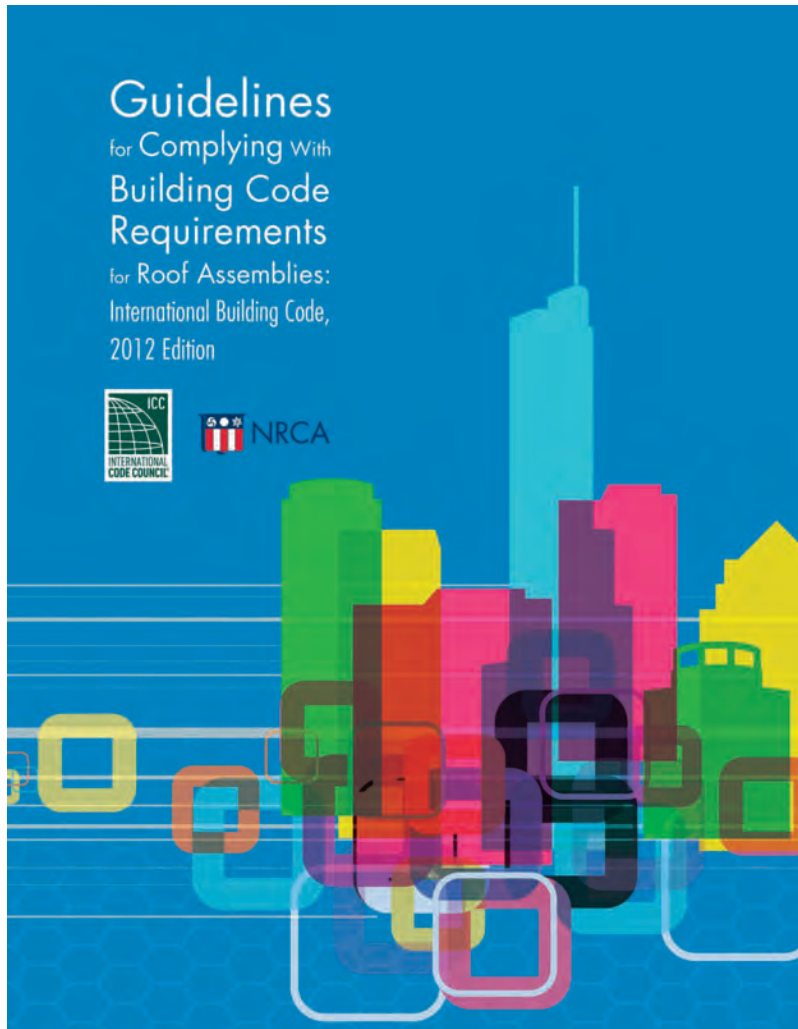
- R-value increases
- Mandatory reflectivity requirements in Climate Zones 1-3
- Air barriers in Climate Zone 4-8

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

Building Codes Manual (2012 Codes)



- Based on 2012 I-codes:
 - IBC 2012
 - IRC 2012
 - IECC 2012
 - IPC 2012
 - IFC 2012
- Includes roofing-related code text and NRCA commentary on each section
- Co-branded with ICC; NRCA promotes to industry and ICC promotes to code officials
- Available in March 2013

Summary

- FM 4470 revision has a major impact
 - Be careful!
- IECC 2012 mandates relatively high R-values
 - Handle tapered insulation appropriately
 - Air barrier requirements may dictate roof system selection



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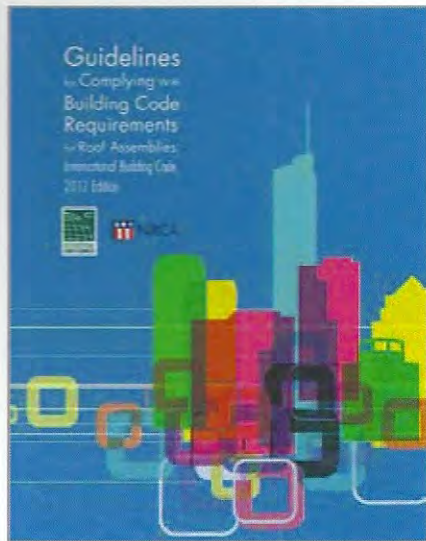
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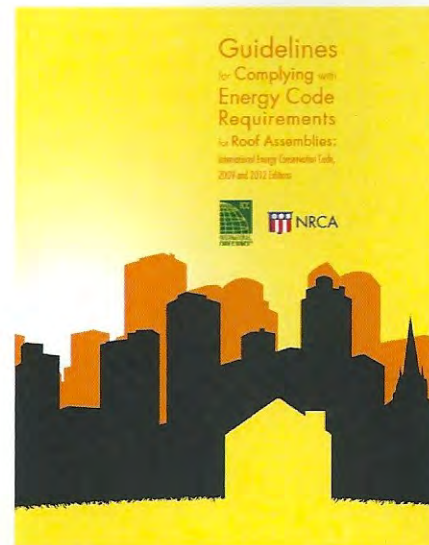
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Item # 3773

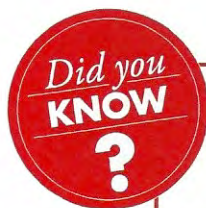
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