NRCA University Webinar
July 18, 2017

Roofing industry technical update

presented by

Mark S. Graham
Vice President, Technical Services
National Roofing Contractors Association

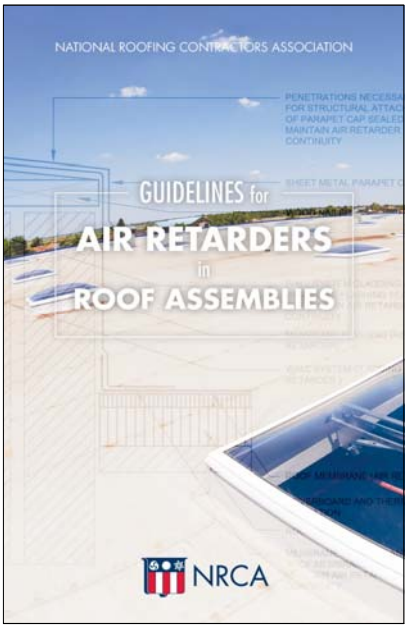
Recent technical webinars

www.nrca.net/Store/Webinars

Moisture in new concrete roof decks: Research and results
- Matt Dupuis, SRI Consultants
- March 2017

The situation with steel roof decks
- Mark Graham
- April 2017

Air barriers: What roofing contractors need to know
- Jason Wilen and Maciek Rupar
- June 2017



Guidelines for Air Retarders in Roof Assemblies

- Ch. 1: IECC and ASHRAE
- Ch. 2: Industry research
- Ch. 3: Recommendations

Some key points…

Air barriers

- Building and roof system designers are responsible for proper design….
- Construction Documents should clearly denote locations, materials, application methods and details
- NRCA considers a continuous, air-impermeable roof membrane to function as an air retarder
  - Built-up roof system
  - Polymer-modified bitumen roof system
  - Single-ply membrane roof system

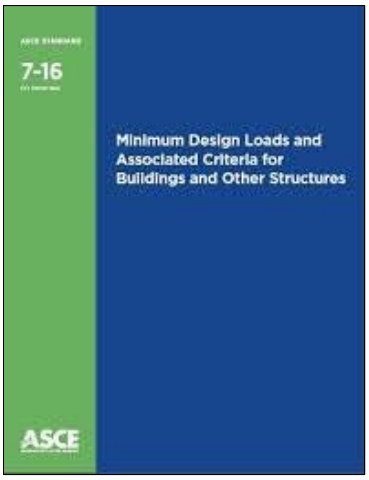
New model building code

2018 I-codes

New I-codes will be available in Aug./Sept.

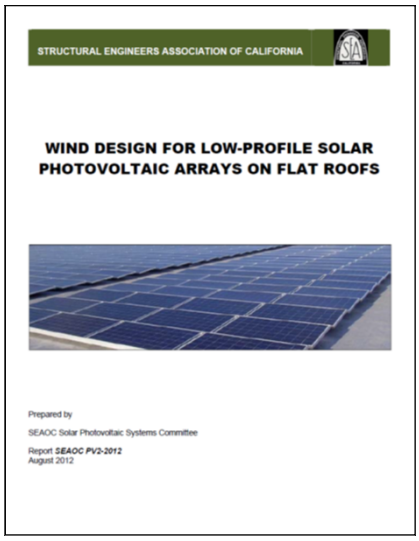
New wind design method

ASCE 7-16



- Published in June
- Referenced in IBC 2018

Design method for PV racking systems


STRUCTURAL ENGINEERS ASSOCIATION OF CALIFORNIA

WIND DESIGN FOR LOW-PROFILE SOLAR PHOTOVOLTAIC ARRAYS ON FLAT ROOFS

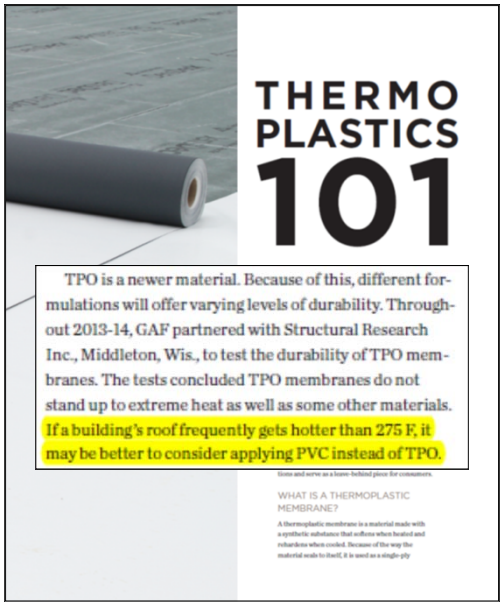
Prepared by

SEAOC Solar Photovoltaic Systems Committee

Report ***SEAOC PV2-2012***
August 2012

Concepts incorporated into IBC 2018, Ch. 16- Structural Design

Professional Roofing, June 2017


THERMO PLASTICS 101

TPO is a newer material. Because of this, different formulations will offer varying levels of durability. Throughout 2013-14, GAF partnered with Structural Research Inc., Middleton, Wis., to test the durability of TPO membranes. The tests concluded TPO membranes do not stand up to extreme heat as well as some other materials. If a building's roof frequently gets hotter than 275 F, it may be better to consider applying PVC instead of TPO.

WHAT IS A THERMOPLASTIC MEMBRANE?

A thermoplastic membrane is a material made with a synthetic substance that softens when heated and rehardens when cooled. Because of the way the material seals to itself, it is used as a single-ply

Heat aging

Laboratory conditioning to test specimens

ASTM D6878 (TPO) heat aging:

- Originally: 28 days at 240 F
- Now: 224 days at 240 F (32 weeks)
- Proposed alternative: 56 days at 275 F

Actual rooftop temperatures for white membranes will seldom exceed 120 F to 160 F

NRCA Board of Directors survey

July 2017

- LVOC adhesive failure on vertical flashings
- Foam spacer crushing in vented nail base
- Liquid-applied membrane appearance issues
- TPO seam failure/exposed reinforcement
- TPO welding issues
- MB cap sheet cracking (6 months old)
- SBS sheet wrinkling
- APP wrinkling/cracking mid-sheet

--Continued

NRCA Board of Directors survey – cont.

July 2017

- PVC cracking (one specific manufacturer)
- Self-adhering EPDM wrinkling
- Asphalt shingle blow-offs/seal strips not sealing
- Perlite board moisture
- Polyiso thickness variations
- Fiber-reinforced gypsum board dimensional stability
- Condensation issues

Thickness variations in polyio. insulation


RESEARCH+TECH

Not quite measuring up

Polyisocyanurate insulation thicknesses seem to vary

by Mark S. Graham

Professional Roofing,
July 2017

Thickness variations

Polyisocyanurate insulation

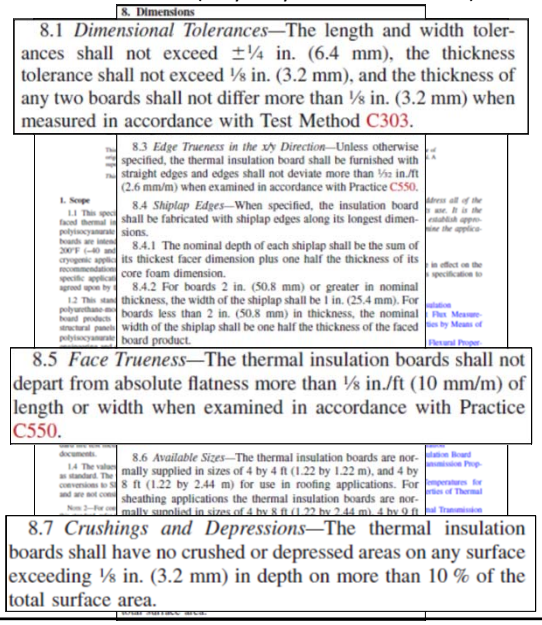
- Measured thicknesses notably less than nominal
- Reports from throughout the U.S.
- More common with thicker product
  - For example, 3.5 inch (nominal) measures less than 3¼-inch thick
- Most reports specific to one manufacturer
  - Multiple plants from the one manufacturer
  - Limited reports from most other manufacturers

3.5 inch (nominal)

2.0 inch (nominal)

Allowable tolerances

ASTM C1289 (Polyisocyanurate insulation)



8. Dimensions

8.1 *Dimensional Tolerances*—The length and width tolerances shall not exceed ±¼ in. (6.4 mm), the thickness tolerance shall not exceed ⅛ in. (3.2 mm), and the thickness of any two boards shall not differ more than ⅛ in. (3.2 mm) when measured in accordance with Test Method C303.

8.3 *Edge Trueness in the x/y Direction*—Unless otherwise specified, the thermal insulation board shall be furnished with straight edges and edges shall not deviate more than ½₂ in./ft (2.6 mm/m) when examined in accordance with Practice C550.

8.4 *Shiplap Edges*—When specified, the insulation board shall be fabricated with shiplap edges along its longest dimensions.

8.4.1 The nominal depth of each shiplap shall be the sum of its thickest facer dimension plus one half the thickness of its core foam dimension.

8.4.2 For boards 2 in. (50.8 mm) or greater in nominal thickness, the width of the shiplap shall be 1 in. (25.4 mm). For boards less than 2 in. (50.8 mm) in thickness, the nominal width of the shiplap shall be one half the thickness of the faced board product.

8.5 *Face Trueness*—The thermal insulation boards shall not depart from absolute flatness more than ⅛ in./ft (10 mm/m) of length or width when examined in accordance with Practice C550.

8.6 *Available Sizes*—The thermal insulation boards are normally supplied in sizes of 4 by 4 ft (1.22 by 1.22 m), and 4 by 8 ft (1.22 by 2.44 m) for use in roofing applications. For sheathing applications the thermal insulation boards are normally supplied in sizes of 4 by 8 ft (1.22 by 2.44 m), 4 by 9 ft

8.7 *Crushings and Depressions*—The thermal insulation boards shall have no crushed or depressed areas on any surface exceeding ⅛ in. (3.2 mm) in depth on more than 10 % of the total surface area.

The issues…

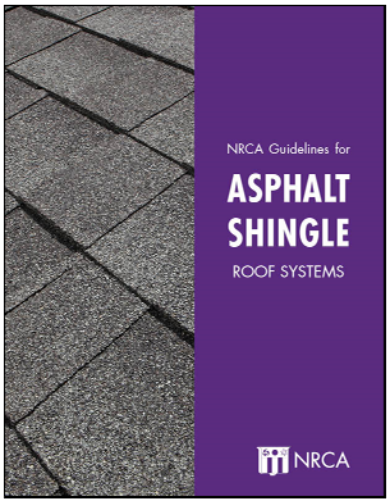
Thickness variations in polyiso. insulation

- Most physical properties are thickness related
- R-value loss:
  - R-value decreased about 0.7 per ⅛-inch thickness loss (assuming an LTTR of 5.6 per inch)
- Insulation thickness does not match established wood blocking heights

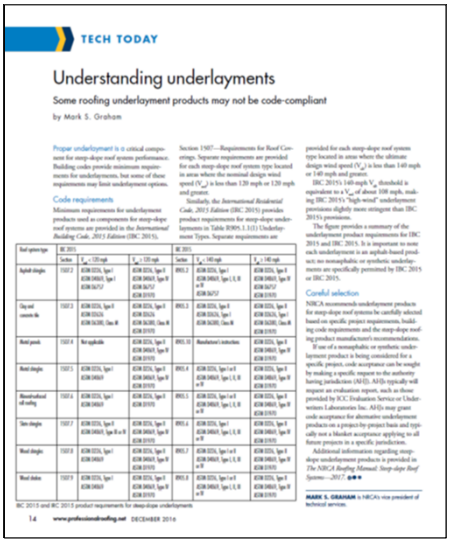
NRCA's recommendations

Thickness variations in polyio. insulation

- Distributors and contractors should measure board edge thicknesses upon delivery, preferably while the insulation still is on the truck
- Contact the manufacturer or distributor if thicknesses are less (or more) than specified
- Also contact NRCA Technical Services



NRCA Guidelines for Asphalt Shingle Roof Systems



TECH TODAY

Understanding underlayments

Some roofing underlayment products may not be code-compliant

by Mark S. Graham

Proper underlayment is a critical component for steep-slope roof system performance. Building codes provide minimum requirements for underlayments, but some of these requirements may limit underlayment options.

Code requirements

Minimum requirements for underlayment products used as components for steep-slope roof systems are provided in the *International Building Code, 2015 Edition* (IBC 2015).

Section 1507—Requirements for Roof Coverings. Separate requirements are provided for each steep-slope roof system type located in areas where the nominal design wind speed (V_{asd}) is less than 120 mph or 120 mph and greater.

Similarly, the *International Residential Code, 2015 Edition* (IRC 2015) provides product requirements for steep-slope underlayments in Table R905.1.1(1) Underlayment Types. Separate requirements are provided for each steep-slope roof system type located in areas where the ultimate design wind speed (V_{ult}) is less than 140 mph or 140 mph and greater.

IBC 2015's 140-mph V_{ult} threshold is equivalent to a V_{asd} of about 108 mph, making IBC 2015's "high-wind" underlayment provisions slightly more stringent than IBC 2015's provisions.

The figure provides a summary of the underlayment product requirements for IBC 2015 and IRC 2015. It is important to note each underlayment is an asphalt-based product; no nonasphaltic or synthetic underlayments are specifically permitted by IBC 2015 or IRC 2015.

Careful selection

NRCA recommends underlayment products for steep-slope roof systems be carefully selected based on specific project requirements, building code requirements and the steep-slope roofing product manufacturer's recommendations.

If use of a nonasphaltic or synthetic underlayment product is being considered for a specific project, code acceptance can be sought by making a specific request to the authority having jurisdiction (AHJ). AHJs typically will request an evaluation report, such as those provided by ICC Evaluation Service or Underwriters Laboratories Inc. AHJs may grant code acceptance for alternative underlayment products on a project-by-project basis and typically not a blanket acceptance applying to all future projects in a specific jurisdiction.

Additional information regarding steep-slope underlayment products is provided in *The NRCA Roofing Manual: Steep-slope Roof Systems—2017*.

MARK S. GRAHAM is NRCA's vice president of technical services.

IBC 2015 and IRC 2015 product requirements for steep-slope underlayments

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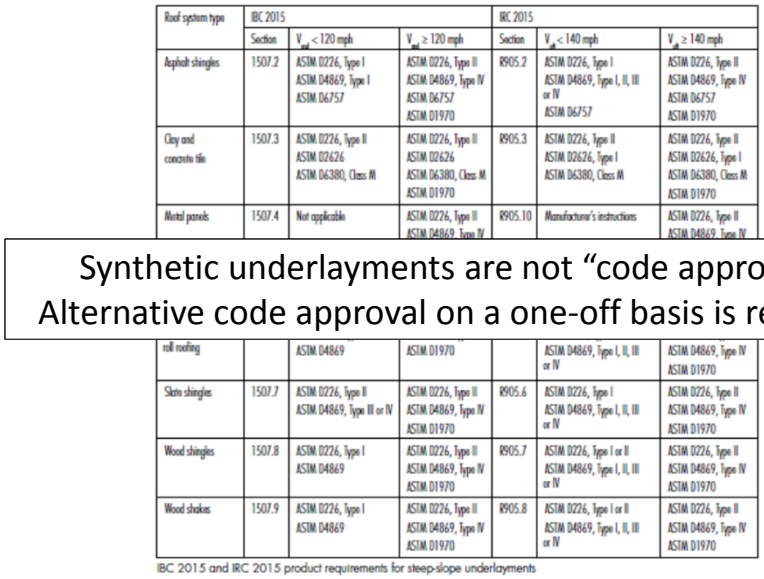
Professional Roofing,
December 2016



Roof system type	IBC 2015			IRC 2015		
	Section	V_{asd} < 120 mph	V_{asd} ≥ 120 mph	Section	V_{ult} < 140 mph	V_{ult} ≥ 140 mph
Asphalt shingles	1507.2	ASTM D226, Type I ASTM D4869, Type I ASTM D6757	ASTM D226, Type II ASTM D4869, Type IV ASTM D6757 ASTM D1970	R905.2	ASTM D226, Type I ASTM D4869, Type I, II, III or IV ASTM D6757	ASTM D226, Type II ASTM D4869, Type IV ASTM D6757 ASTM D1970
Clay and concrete tile	1507.3	ASTM D226, Type II ASTM D2626 ASTM D6380, Class M	ASTM D226, Type II ASTM D2626 ASTM D6380, Class M ASTM D1970	R905.3	ASTM D226, Type II ASTM D2626, Type I ASTM D6380, Class M	ASTM D226, Type II ASTM D2626, Type I ASTM D6380, Class M ASTM D1970
Metal panels	1507.4	Not applicable	ASTM D226, Type II ASTM D4869, Type IV	R905.10	Manufacturer's instructions	ASTM D226, Type II ASTM D4869, Type IV
roll roofing		ASTM D4869	ASTM D1970		ASTM D4869, Type I, II, III or IV	ASTM D4869, Type IV ASTM D1970
Slate shingles	1507.7	ASTM D226, Type II ASTM D4869, Type III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970	R905.6	ASTM D226, Type I ASTM D4869, Type I, II, III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970
Wood shingles	1507.8	ASTM D226, Type I ASTM D4869	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970	R905.7	ASTM D226, Type I or II ASTM D4869, Type I, II, III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970
Wood shakes	1507.9	ASTM D226, Type I ASTM D4869	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970	R905.8	ASTM D226, Type I or II ASTM D4869, Type I, II, III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970

IBC 2015 and IRC 2015 product requirements for steep-slope underlayments

Synthetic underlayments are not "code approved".
Alternative code approval on a one-off basis is required.

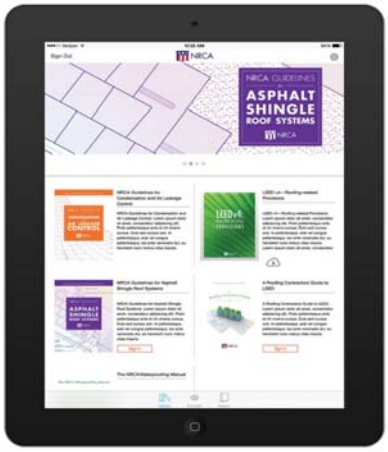
The NRCA Roofing Manual - 2017

Manual online

www.nrca.net

- Available to all NRCA member registered users (multiple users per member company)
- "Members only" section, click on "My account", the "Electronic file"
- View, download and print

NRCA App



- NRCA App available on the Apple Store and Google Play Store for tablets
- iPhone App also available
- Register within App as being an NRCA member
- The NRCA Roofing Manual is viewable to NRCA members
- Favorite and send pages features

Questions….

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Not quite measuring up

Polyisocyanurate insulation thicknesses seem to vary

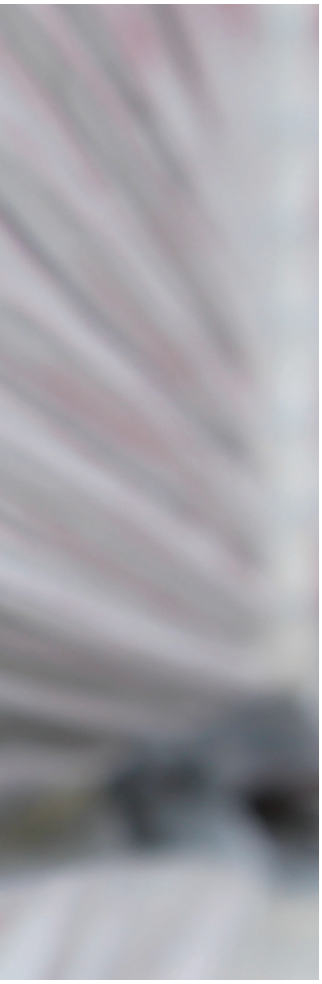
by Mark S. Graham

NRCA has received a limited number of reports of faced, rigid board polyisocyanurate insulation with thicknesses less than what was specified and indicated on the insulation's package labeling being delivered from manufacturers to distributors and job sites. Following is information about these reports, as well as information about recognized allowable thickness tolerances and NRCA's recommendations to roofing contractors for monitoring this situation.

Reports

NRCA has received reports of new, uninstalled polyisocyanurate insulation being received directly from polyisocyanurate insulation manufacturers with thicknesses notably less than nominal dimensions. Reports have been received from the East Coast to the Rocky Mountains and as far north as Wisconsin and south to Texas.

Reports have been received about various specified nominal thicknesses of polyisocyanurate insulation; however, the problems appear to be more common with thicker polyisocyanurate insulation products than thinner ones. For example, NRCA has received multiple reports of 3½-inch nominal thickness polyisocyanurate insulation measuring



less than 3¼ inches thick at board edges.

Although most reports relate specifically to one polyisocyanurate insulation manufacturer and have been traced to multiple manufacturing plants from that manufacturer, the problems are not unique to that manufacturer.

Allowable tolerances

When assessing nominal length, width and thickness dimensions of polyisocyanurate insulation, it is important to realize reasonable manufacturing tolerances apply.

The U.S. product standard for polyisocyanurate insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board." ASTM C1289, Types I and II are referenced in the *International Building Code®* as minimum requirements for polyisocyanurate insulation used in roof systems.

ASTM C1289's Section 8—Dimensions provides specific dimensional tolerance criteria, namely length and width tolerances shall not exceed ±¼ of an inch, thickness tolerance shall not exceed ⅛ of an inch and the thickness of any two boards shall not differ more than ⅛ of an inch.

ASTM C303, "Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation," provides the specific procedure for board measurement. For measuring a board's thickness, ASTM C303 prescribes measurements be made not along the board's edges but about 1 to 3 inches in from the board's corners. Two additional thickness measurements shall be taken near the center of the long dimension direction of the board between the corner measurement locations.

Also, boards shall not depart from absolute flatness by more than ⅛ of an inch per foot of length and width. Boards shall have no crushed or depressed areas on any surface exceeding ⅛ of an inch in depth on more than 10 percent of the board's total surface area.

Discussion

Similar to there being recognized, reasonable tolerances for the application of roofing products and roof systems, NRCA recognizes the necessity for reasonable tolerances, including minimal thickness tolerances, in the manufacture of roofing products, including polyisocyanurate insulation.

Some minimal thickness variability is inherent in polyisocyanurate insulation's manufacturing process. In the U.S., faced, rigid board polyisocyanurate insulation typically is manufactured using a restrained rise process where the board's top and bottom surfaces (facer sheets) are set at established distances (thicknesses) in a laminator within the manufacturing line. Once the board leaves the laminator and during its curing, the board may slightly grow (rise) in thickness as a result of the chemical reaction of the product's raw materials and heat generated during manufacturing. Manufacturers may account for this additional rise by setting the thickness in the laminator slightly less than the board's desired nominal thickness.

Also, it generally is recognized the center of a polyisocyanurate insulation board may be slightly thicker than its manufactured edges because of this rise. Some in the industry also theorize manufacturers' weatherproof packaging, which is applied at the end of the manufacturing line but before the product fully cures, may restrict additional rise during curing, resulting in board edges being slightly thinner than a board's center.

When considering polyisocyanurate insulation's allowable thickness tolerances and the reports of thicknesses being less than specified, it is important to realize thickness variations can affect overall roof system performance. For example, if insulation boards' thicknesses are not as nominally specified, insulation thickness likely will not match established thicknesses of perimeter wood blocking and nailers, resulting in uneven surfaces to which to adhere roof membranes. This particularly is a concern when using multiple insulation layers.

Also, some of polyisocyanurate insulation's physical properties are affected by board thickness. Polyisocyanurate insulation's R-value, for example, is thickness-sensitive. Assuming an R-value (or LTTR value) of 5.6 per inch thickness of polyisocyanurate insulation, a board's thickness being ⅛ of an inch less than nominal can result in a reduction in the board's R-value of about 0.7.

Moving forward

NRCA has met with polyisocyanurate insulation manufacturers identified in the reports. The meetings have been constructive, and the manufacturers have committed to making the changes necessary to properly address this situation.

In the meantime, NRCA suggests distributors and roofing contractors measure polyisocyanurate insulation board edge thicknesses upon delivery, preferably while the insulation still is on the truck. If the measured thicknesses are less (or more) than the specified and labeled thickness, taking into consideration applicable tolerances, you should contact the manufacturer or distributor immediately. You also can contact NRCA's Technical Services Section at (800) 323-9545 to report the situation and the manufacturer's or distributor's response.

MARK S. GRAHAM IS NRCA'S VICE PRESIDENT OF TECHNICAL SERVICES.

@MarkGrahamNRCA

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Code requirements

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Similarly, the *International Residential Code, 2015 Edition* (IRC 2015) provides product requirements for steep-slope underlayments in Table R905.1.1(1) Underlayment Types. Separate requirements are provided for each steep-slope roof system type located in areas where the ultimate design wind speed (V_{ult}) is less than 140 mph or 140 mph and greater.

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Metal shingles	1507.5	ASTM D226, Type I ASTM D4869	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970	R905.4	ASTM D226, Type I or II ASTM D4869, Type I, II, III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970
Mineral-surfaced roll roofing	1507.6	ASTM D226, Type I ASTM D4869	ASTM D226, Type II ASTM D1970	R905.5	ASTM D226, Type I or II ASTM D4869, Type I, II, III or IV	ASTM D226, Type II ASTM D4869, Type IV ASTM D1970
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