National Roof Deck Contractors Association
March 27, 2015
Hilton Head Island, SC

Update on roofing industry technical issues

presented by

Mark S. Graham
Associate Executive Director, Technical Services
National Roofing Contractors Association (NRCA)

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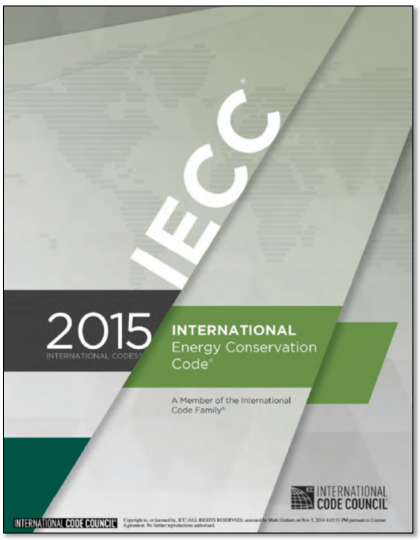
International Energy Conservation Code, 2015 Edition



- Applicable to all buildings, including existing buildings (reroofing)
- Format:
  - Commercial provisions (C) vs. Residential provisions (R)
  - Ch. 1-Scope and Admin.
  - Ch. 2-Definitions
  - Ch. 3-General requirements
  - Ch. 4-Energy efficiency
  - Ch. 5-Existing buildings
  - Ch. 6-Reference standards

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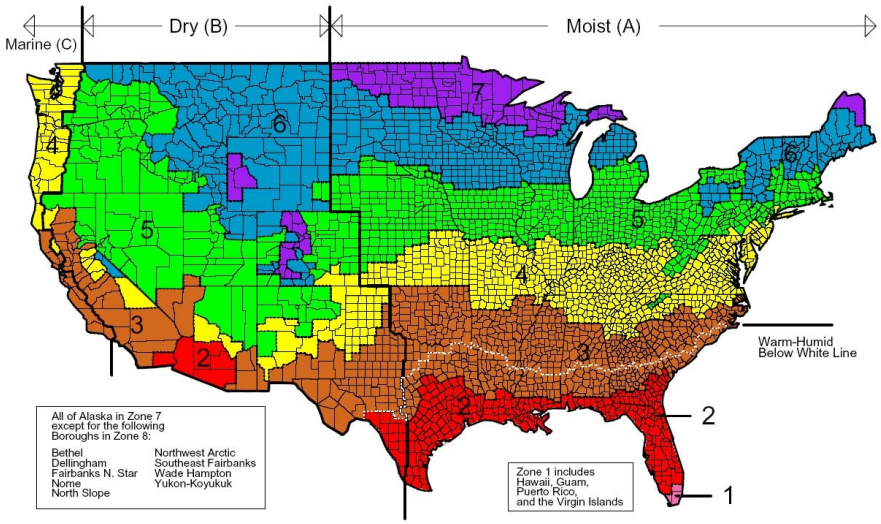
IECC 2015, Fig. C301.1-Climate zones



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Ch 4[CE]-Commercial energy efficiency

Sec. C401.2-Application

- Reference to ASHRAE 90.1 changed from 2010 edition to 2013 edition

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Ch 4[CE]-Commercial energy efficiency

Sec. C402-Building envelope requirements

- Section reformatted
- Low-energy buildings exempted:
  - Less than 3.4 Btu/h · ft^2 or 1.0 watt/ ft^2 of floor area
  - No *conditioned space*
  - Greenhouses
- Equipment buildings exempted (Sec. C402.1.2)

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Ch 4[CE]-Commercial energy efficiency

Sec. C402.1.3-Insulation component R-value-based method

- Use Table C402.1.3

Sec. C402.1.4-Assembly U-factor, C-factor or F-factor-based method

- Use Table C402.1.4

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Roofing-specific adaptation of Table C402.1.3

Commercial Buildings (Insulation component R-value-based method)

Climate zone	Assembly description		
	Insulation entirely above deck	Metal buildings	Attic and other
1	R-20ci (all other) R-25ci (Group R)	R-19 + R-11 LS	R-38
2	R-25ci		
3			
4	R-30ci		R-38 (except Marine 4
5			R-38 (all other) R-49 (Group R, Marine 4)
6		R-25 + R-11 LS	R-49
7	R-35ci	R-30 + R-11 LS	
8			

ci = Continuous insulation; LS = Liner system

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Roofing-specific adaptation of Table C402.1.3

Commercial Buildings (Insulation component R-value-based method)

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	R-25ci (Group R)		
2	R-25ci		
3			
4	R-30ci		R-38 (except Marine 4
5			R-38 (all other) R-49 (Group R, Marine 4)
6		R-25 + R-11 LS	R-49
7	R-35ci	R-30 + R-11 LS	
8			

ci = Continuous insulation; LS = Liner system

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Ch 4[CE]-Commercial energy efficiency

Sec. C402.3-Roof solar reflectance and thermal emittance

- Climate zones 1, 2 and 3, low-slope roofs over cooled, conditioned spaces (some exceptions)
- Three-year aged solar reflectance 0.55 and three-year thermal emittance of 0.75, or three-year aged solar reflectance index of 64
- Aged calculation method based upon CRRC-1-12 (Sec. C402.3.1)

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Ch 4[CE]-Commercial energy efficiency

Sec. C402.5-Air leakage-thermal envelope (Mandatory)

- All Climate zones, except 2B (IECC 2012 exempted Climate zones 1, 2, and 3)
- Whole building testing (ASTM E779); allowable maximum air leakage rate of 0.40 cfm/ft^2
- Materials (Sec. C402.5.1.2.1) and Assemblies (C402.5.1.2.2) options
- Deemed-to-comply Materials options:
  - Closed cell SPF, minimum 1.5 pcf density,
  - Built-up roofing membrane
  - Modified bituminous roof membrane
  - Fully-adhered single-ply roof membrane

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Ch. 4[CE]-Commercial energy efficiency

Sec. C503-Alterations

- New exception to Sec. 503.1-General:

  "4. *Air barriers* shall not be required for *roof recover* and roof membrane replacement where the *alterations* or renovations to the building do not include *alterations,* renovations or *repairs* to the remainder of the building envelope."

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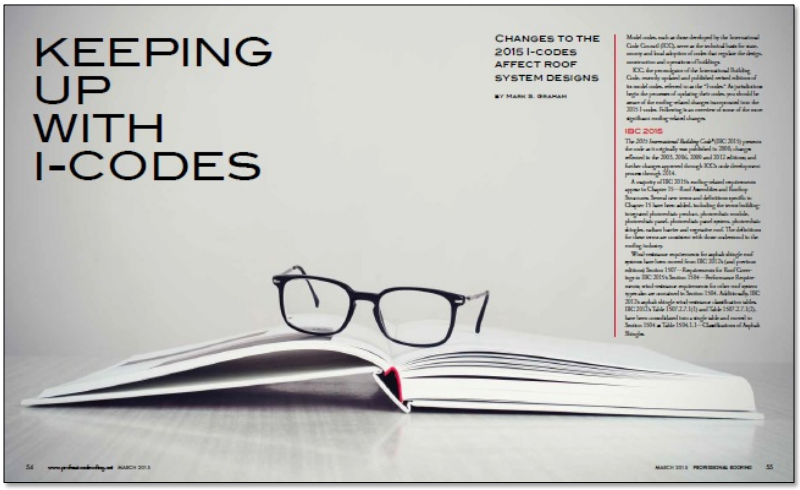
Professional Roofing, March 2015

Pages 54-60



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Polyiso. R-value testing

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NRCA's 2014 polyiso. R-value testing

- Repeating similar NRCA testing from 2009
- Newly-manufactured (uninstalled) samples
  - 2.0-inch-thick
  - Permeable-facer-sheet faced
  - Obtained through distribution
- ASTM C518 tested "as received"
- Tested at 75 F, and 25 F, 40 F and 110 F

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NRCA's 2014 polyiso. R-value testing

Sample	R-value, per inch thickness (2-inch specimens) 75 F
1	5.774
2	5.444
3	5.371
4	5.828
5	5.522
6	5.889
7	5.058

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NRCA's 2014 polyiso. R-value testing

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	75 F
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2	5.444
3	5.371
4	5.828
5	5.522
6	5.889
7	5.058
Ave. (mean)	5.555
Std. dev.	0.297

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NRCA's 2014 polyiso. R-value testing

Sample	R-value, per inch thickness (2-inch specimens)			
	25 F	40 F	75 F	110 F
1	3.765	4.757	5.774	5.118
2	3.909	4.719	5.444	4.958
3	4.737	5.350	5.371	4.810
4	3.506	4.509	5.828	5.227
5	4.221	5.269	5.522	4.929
6	3.775	4.854	5.889	5.247
7	4.431	4.878	5.058	4.581

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NRCA's 2014 polyiso. R-value testing

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7	4.431	4.878	5.058	4.581
Ave. (mean)	4.049	4.905	5.555	4.981
Std. dev.	0.432	0.302	0.297	0.239

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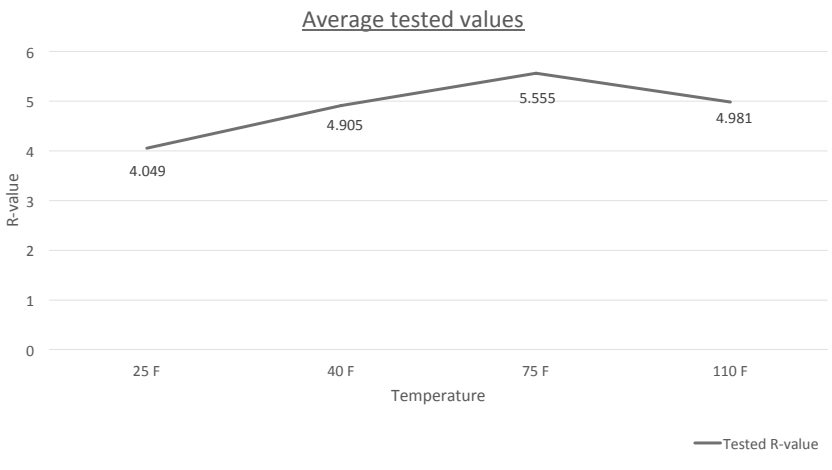
NRCA's 2014 polyiso. R-value testing



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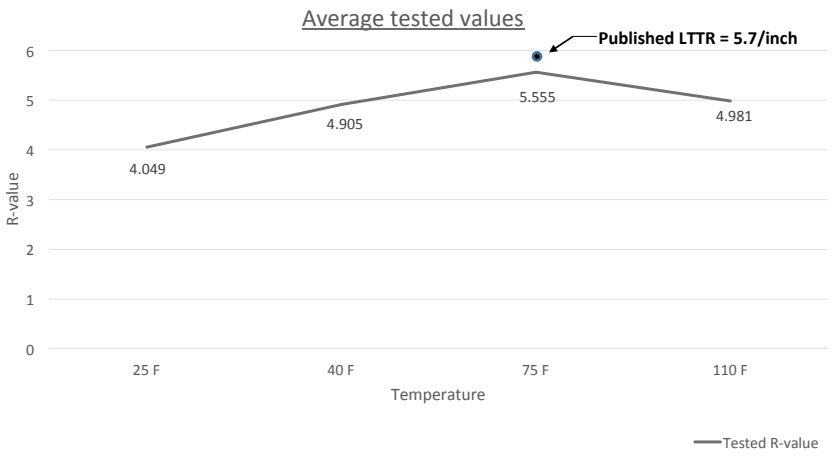
NRCA's 2014 polyiso. R-value testing



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NRCA's recommendations

Polyisocyanurate insulation

Designers should use in-service R-values:

- Heating conditions: R=5.0 per inch thickness
- Cooling conditions: R=5.6 per inch thickness

Specify insulation by its thickness,
not its R-value or LTTR value

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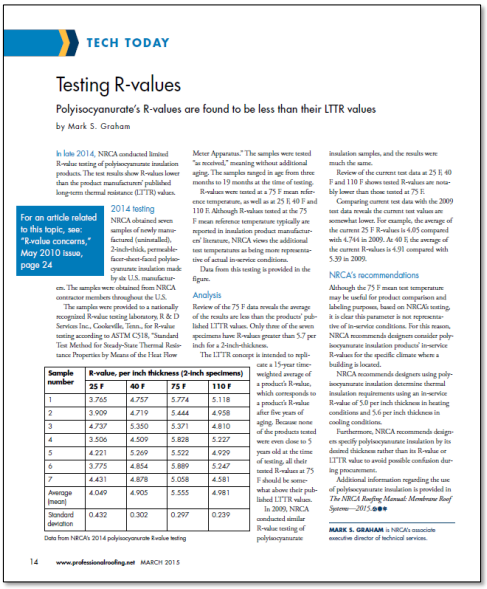
Professional Roofing, March 2015



TECH TODAY

Testing R-values

Polyisocyanurate's R-values are found to be less than their LTTR values

by Mark S. Graham

In late 2014, NRCA conducted limited R-value testing of polyisocyanurate insulation products. The test results show R-values lower than the product manufacturers' published long-term thermal resistance (LTTR) values.

For an article related to this topic, see: "R-value concerns," May 2010 issue, page 24

2014 testing

NRCA obtained seven samples of newly manufactured (uninstalled), 2-inch-thick, permeable-facer-sheet-faced polyisocyanurate insulation made by six U.S. manufacturers. The samples were obtained from NRCA contractor members throughout the U.S.

The samples were provided to a nationally recognized R-value testing laboratory, R & D Services Inc., Cookeville, Tenn., for R-value testing according to ASTM C518, "Standard Test Method for Steady-State Thermal Resistance Properties by Means of the Heat Flow Meter Apparatus." The samples were tested "as received," meaning without additional aging. The samples ranged in age from three months to 19 months at the time of testing.

R-values were tested at a 75 F mean reference temperature, as well as at 25 F, 40 F and 110 F. Although R-values tested at the 75 F mean reference temperature typically are reported in insulation product manufacturers' literature, NRCA views the additional test temperatures as being more representative of actual in-service conditions.

Data from this testing is provided in the figure.

Analysis

Review of the 75 F data reveals the average of the results are less than the products' published LTTR values. Only three of the seven specimens have R-values greater than 5.7 per inch for a 2-inch-thickness.

The LTTR concept is intended to replicate a 15-year time-weighted average of a product's R-value, which corresponds to a product's R-value after five years of aging. Because none of the products tested were even close to 5 years old at the time of testing, all their tested R-values at 75 F should be somewhat above their published LTTR values.

In 2009, NRCA conducted similar R-value testing of polyisocyanurate insulation samples, and the results were much the same.

Review of the current test data at 25 F, 40 F and 110 F shows tested R-values are notably lower than those tested at 75 F.

Comparing current test data with the 2009 test data reveals the current test values are somewhat lower. For example, the average of the current 25 F R-values is 4.05 compared with 4.744 in 2009. At 40 F, the average of the current R-values is 4.31 compared with 5.39 in 2009.

NRCA's recommendations

Although the 75 F mean test temperature may be useful for product comparison and labeling purposes, based on NRCA's testing, it is clear this parameter is not representative of in-service conditions. For this reason, NRCA recommends designers consider polyisocyanurate insulation products' in-service R-values for the specific climate where a building is located.

NRCA recommends designers using polyisocyanurate insulation determine thermal insulation requirements using an in-service R-value of 5.0 per inch thickness in heating conditions and 5.6 per inch thickness in cooling conditions.

Furthermore, NRCA recommends designers specify polyisocyanurate insulation by its desired thickness rather than its R-value or LTTR value to avoid possible confusion during procurement.

Additional information regarding the use of polyisocyanurate insulation is provided in *The NRCA Roofing Manual: Membrane Roof Systems—2015*.

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

Sample number	R-value, per inch thickness (2-inch specimens)			
	25 F	40 F	75 F	110 F
1	3.765	4.757	5.774	5.118
2	3.909	4.719	5.444	4.958
3	4.737	5.350	5.371	4.810
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7	4.431	4.878	5.058	4.581
Average (mean)	4.049	4.905	5.555	4.981
Standard deviation	0.432	0.302	0.297	0.239

Data from NRCA's 2014 polyisocyanurate R-value testing

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Concrete roof deck issues

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Reported roofing-related problems

Concrete roof decks

- Moisture within the roof system
- Loss of adhesion
- Insulation facer delamination
- Adhesive curing issues
- Mold growth
- Fastener/metal corrosion
- R-value loss

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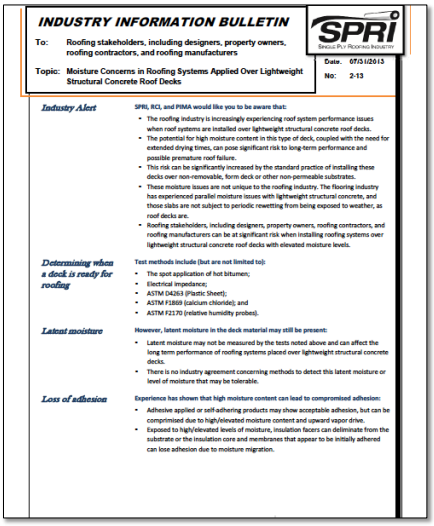
SPRI/PIMA/RCI Industry Information Bulletin

No. 2-13, July 31, 2013



INDUSTRY INFORMATION BULLETIN

SPRI Single Ply Roofing Industry

To: Roofing stakeholders, including designers, property owners, roofing contractors, and roofing manufacturers

Topic: Moisture Concerns in Roofing Systems Applied Over Lightweight Structural Concrete Roof Decks

Date: 07/31/2013

No: 2-13

Industry Alert

SPRI, RCI, and PIMA would like you to be aware that:

- The roofing industry is increasingly experiencing roof system performance issues when roof systems are installed over lightweight structural concrete roof decks.
- The potential for high moisture content in this type of deck, coupled with the need for extended drying times, can pose significant risk to long-term performance and possible premature roof failure.
- This risk can be significantly increased by the standard practice of installing these decks over non-removable, form deck or other non-permeable substrates.
- These moisture issues are not unique to the roofing industry. The flooring industry has experienced parallel moisture issues with lightweight structural concrete, and those slabs are not subject to periodic rewetting from being exposed to weather, as roof decks are.
- Roofing stakeholders, including designers, property owners, roofing contractors, and roofing manufacturers can be at significant risk when installing roofing systems over lightweight structural concrete roof decks with elevated moisture levels.

Determining when a deck is ready for roofing

Test methods include (but are not limited to):

- The spot application of hot bitumen;
- Electrical impedance;
- ASTM D4263 (Plastic Sheet);
- ASTM F1869 (calcium chloride); and
- ASTM F2170 (relative humidity probes).

Latent moisture

However, latent moisture in the deck material may still be present:

- Latent moisture may not be measured by the tests noted above and can affect the long term performance of roofing systems placed over lightweight structural concrete decks.
- There is no industry agreement concerning methods to detect this latent moisture or level of moisture that may be tolerable.

Loss of adhesion

Experience has shown that high moisture content can lead to compromised adhesion:

- Adhesive applied or self-adhering products may show acceptable adhesion, but can be compromised due to high/elevated moisture content and upward vapor drive.
- Exposed to high/elevated levels of moisture, insulation facers can delaminate from the substrate or the insulation core and membranes that appear to be initially adhered can lose adhesion due to moisture migration.

"… Because of these performance issues and the potential risk for roof system failure, SPRI, RCI, and PIMA urge building designers to select roofing components and system with great care…."

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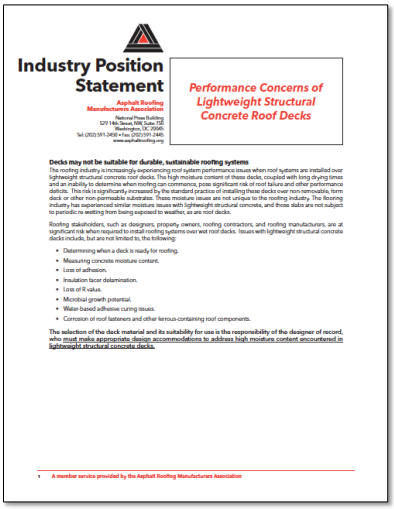
ARMA Industry Position Statement



Industry Position Statement

Asphalt Roofing Manufacturers Association

Performance Concerns of Lightweight Structural Concrete Roof Decks

Decks may not be suitable for durable, sustainable roofing systems

The roofing industry is increasingly experiencing roof system performance issues when roof systems are installed over lightweight structural concrete roof decks. The high moisture content of these decks, coupled with long drying times and an inability to determine when roofing can commence, pose significant risk of roof failure and other performance deficits. This risk is significantly increased by the standard practice of installing these decks over non-removable, form deck or other non-permeable substrates. These moisture issues are not unique to the roofing industry. The flooring industry has experienced similar moisture issues with lightweight structural concrete, and those slabs are not subject to periodic re-wetting from being exposed to weather, as are roof decks.

Roofing stakeholders, such as designers, property owners, roofing contractors, and roofing manufacturers, are at significant risk when required to install roofing systems over wet roof decks. Issues with lightweight structural concrete decks include, but are not limited to, the following:

- Determining when a deck is ready for roofing.
- Measuring concrete moisture content.
- Loss of adhesion.
- Insulation facer delamination.
- Loss of R-value.
- Microbial growth potential.
- Water-based adhesive curing issues.
- Corrosion of roof fasteners and other ferrous-containing roof components.

The selection of the deck material and its suitability for use is the responsibility of the designer of record, who must make appropriate design accommodations to address high moisture content encountered in lightweight structural concrete decks.

1 A member service provided by the Asphalt Roofing Manufacturers Association

"…The selection of the deck material and its suitability for use is the responsibility of the designer of record, who must make appropriate design accommodations to address high moisture content encountered in lightweight structural concrete decks."

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Concrete drying rates[1]

- Normal-weight structural concrete:
  - Less than 90 days
- Light-weight structural concrete:
  - Almost 6 months

[1] Howard Kanare, "Concrete Floors and Moisture, Second Edition," 75 percent internal RH, controlled laboratory conditions

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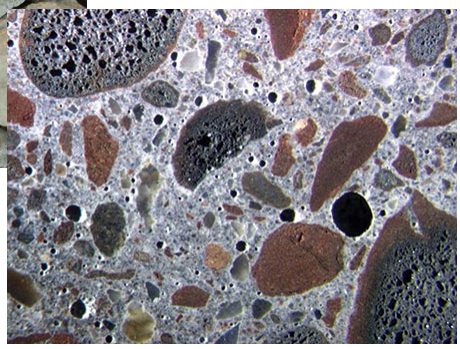
An up-close look



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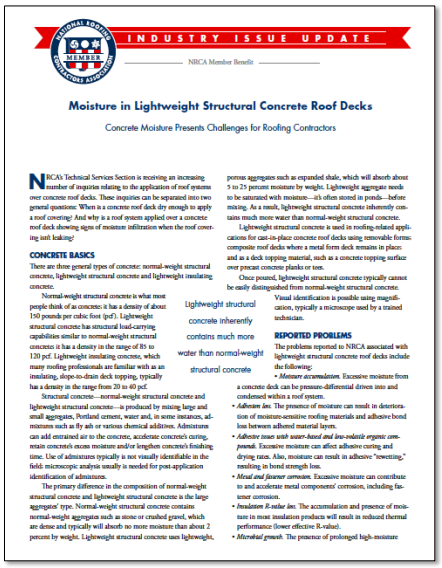
NRCA Industry Issue Update, August 2013



INDUSTRY ISSUE UPDATE

NRCA Member Benefit

Moisture in Lightweight Structural Concrete Roof Decks

Concrete Moisture Presents Challenges for Roofing Contractors

NRCA's Technical Services Section is receiving an increasing number of inquiries relating to the application of roof systems over concrete roof decks. These inquiries can be separated into two general questions: When is a concrete roof deck dry enough to apply a roof covering? And why is a roof system applied over a concrete roof deck showing signs of moisture infiltration when the roof covering isn't leaking?

CONCRETE BASICS

There are three general types of concrete: normal-weight structural concrete, lightweight structural concrete and lightweight insulating concrete.

Normal-weight structural concrete is what most people think of as concrete; it has a density of about 150 pounds per cubic foot (pcf). Lightweight structural concrete has structural load-carrying capabilities similar to normal-weight structural concrete; it has a density in the range of 85 to 120 pcf. Lightweight insulating concrete, which many roofing professionals are familiar with as an insulating, slope-to-drain deck topping, typically has a density in the range from 20 to 40 pcf.

Lightweight structural concrete inherently contains much more water than normal-weight structural concrete

Structural concrete—normal-weight structural concrete and lightweight structural concrete—is produced by mixing large and small aggregates, Portland cement, water and, in some instances, admixtures such as fly ash or various chemical additives. Admixtures can add entrained air to the concrete, accelerate concrete's curing, retain concrete's excess moisture and/or lengthen concrete's finishing time. Use of admixtures typically is not visually identifiable in the field; microscopic analysis usually is needed for post-application identification of admixtures.

The primary difference in the composition of normal-weight structural concrete and lightweight structural concrete is the large aggregate' type. Normal-weight structural concrete contains normal-weight aggregates such as stone or crushed gravel, which are dense and typically will absorb no more moisture than about 2 percent by weight. Lightweight structural concrete uses lightweight, porous aggregates such as expanded shale, which will absorb about 5 to 25 percent moisture by weight. Lightweight aggregate needs to be saturated with moisture—it's often stored in ponds—before mixing. As a result, lightweight structural concrete inherently contains much more water than normal-weight structural concrete.

Lightweight structural concrete is used in roofing-related applications for cast-in-place concrete roof decks using removable forms; composite roof decks where a metal form deck remains in place; and as a deck topping material, such as a concrete topping surface over precast concrete planks or tees.

Once poured, lightweight structural concrete typically cannot be easily distinguished from normal-weight structural concrete. Visual identification is possible using magnification, typically a microscope used by a trained technician.

REPORTED PROBLEMS

The problems reported to NRCA associated with lightweight structural concrete roof decks include the following:

- *Moisture accumulation.* Excessive moisture from a concrete deck can be pressure-differential driven into and condensed within a roof system.
- *Adhesion loss.* The presence of moisture can result in deterioration of moisture-sensitive roofing materials and adhesive bond loss between adhered material layers.
- *Adhesive issues with water-based and low-volatile organic compounds.* Excessive moisture can affect adhesive curing and drying rates. Also, moisture can result in adhesive "sweetening," resulting in bond strength loss.
- *Metal and fastener corrosion.* Excessive moisture can contribute to and accelerate metal components' corrosion, including fastener corrosion.
- *Insulation R-value loss.* The accumulation and presence of moisture in most insulation products will result in reduced thermal performance (lower effective R-value).
- *Microbial growth.* The presence of prolonged high-moisture

NRCA's recommendations:

- Designers should avoid using light-weight structural concrete for roof decks
- Remedial system configurations for retrofit applications

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Steel roof deck concerns

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Steel deck design

Prior to 2010:

- SDI's *Design Manual for Composite Decks, Form Decks and Roof Decks*
- ANSI/SDI RD1.0-2006, "Standard for Steel Roof Deck" (referenced in IBC 2009)

30-pound-per-square-foot (psf) uplift and 45-psf uplift at roof overhangs

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Steel deck design

Since 2010:

- ANSI/SDI RD1.0-2010, "Standard for Steel Roof Deck" (referenced in IBC 2012 and IBC 2015)

"… be anchored to resist the required net uplift forces, but not less than…"
30 psf and 45 psf for eave overhangs

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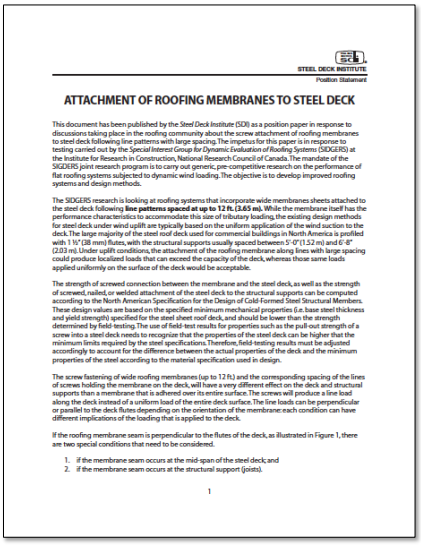
SDI bulletin



STEEL DECK INSTITUTE
Position Statement

ATTACHMENT OF ROOFING MEMBRANES TO STEEL DECK

This document has been published by the *Steel Deck Institute* (SDI) as a position paper in response to discussions taking place in the roofing community about the screw attachment of roofing membranes to steel deck following line patterns with large spacing. The impetus for this paper is in response to testing carried out by the *Special Interest Group for Dynamic Evaluation of Roofing Systems* (SIDGERS) at the Institute for Research in Construction, National Research Council of Canada. The mandate of the SIGDERS joint research program is to carry out generic, pre-competitive research on the performance of flat roofing systems subjected to dynamic wind loading. The objective is to develop improved roofing systems and design methods.

The SIDGERS research is looking at roofing systems that incorporate wide membranes sheets attached to the steel deck following **line patterns spaced at up to 12 Ft. (3.65 m).** While the membrane itself has the performance characteristics to accommodate this size of tributary loading, the existing design methods for steel deck under wind uplift are typically based on the uniform application of the wind suction to the deck. The large majority of the steel roof deck used for commercial buildings in North America is profiled with 1 ½" (38 mm) flutes, with the structural supports usually spaced between 5'-0" (1.52 m) and 6'-8" (2.03 m). Under uplift conditions, the attachment of the roofing membrane along lines with large spacing could produce localized loads that can exceed the capacity of the deck, whereas those same loads applied uniformly on the surface of the deck would be acceptable.

The strength of screwed connection between the membrane and the steel deck, as well as the strength of screwed, nailed, or welded attachment of the steel deck to the structural supports can be computed according to the North American Specification for the Design of Cold-Formed Steel Structural Members. These design values are based on the specified minimum mechanical properties (i.e. base steel thickness and yield strength) specified for the steel sheet roof deck, and should be lower than the strength determined by field-testing. The use of field-test results for properties such as the pull-out strength of a screw into a steel deck needs to recognize that the properties of the steel deck can be higher that the minimum limits required by the steel specifications. Therefore, field-testing results must be adjusted accordingly to account for the difference between the actual properties of the deck and the minimum properties of the steel according to the material specification used in design.

The screw fastening of wide roofing membranes (up to 12 Ft.) and the corresponding spacing of the lines of screws holding the membrane on the deck, will have a very different effect on the deck and structural supports than a membrane that is adhered over its entire surface. The screws will produce a line load along the deck instead of a uniform load of the entire deck surface. The line loads can be perpendicular or parallel to the deck flutes depending on the orientation of the membrane: each condition can have different implications of the loading that is applied to the deck.

If the roofing membrane seam is perpendicular to the flutes of the deck, as illustrated in Figure 1, there are two special conditions that need to be considered.

1. if the membrane seam occurs at the mid-span of the steel deck; and
2. if the membrane seam occurs at the structural support (joists).

1

- Decks designed for joist spacing between 5' and 6' 8" o.c.
- Steel decks designed for uniform loading
- Seam-fastened single-ply membranes are a concern

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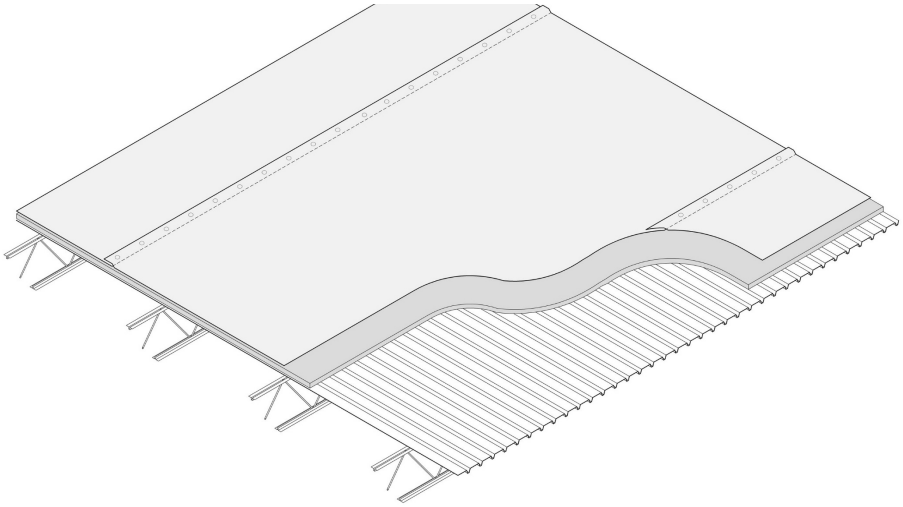
Membrane seams across deck flutes



SDI: 3.8 X moment (deck); 2 X load (joists)

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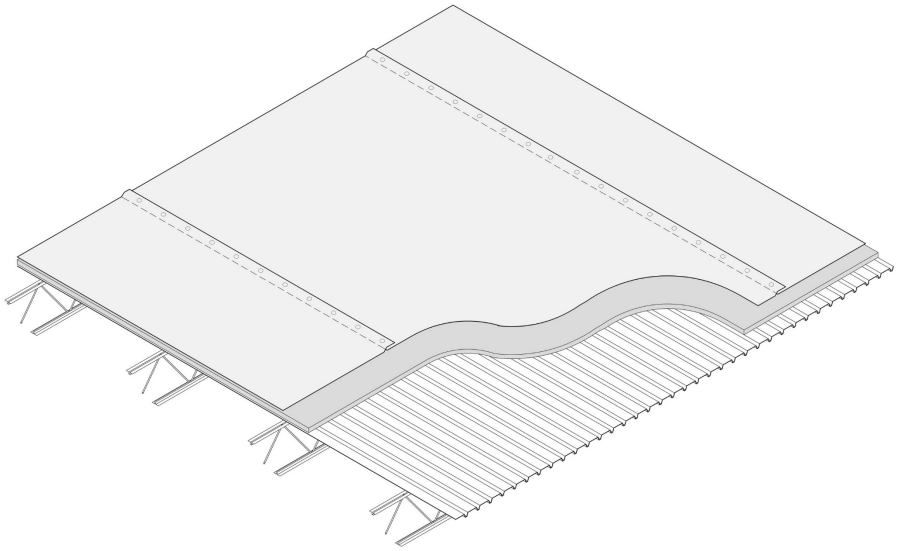
Membrane seams in deck flute direction



SDI: 12 X bending moment and shear (deck)

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SDI bulletin -- Conclusion

"…SDI does not recommend the use of roofing membranes attached to the steel deck using line patterns with large spacing unless a structural engineer has reviewed the adequacy of the steel deck and the structural supports to resist to wind uplift loads transmitted along the lines of attachment. Those lines of attachment shall only be perpendicular to the flutes of the deck."

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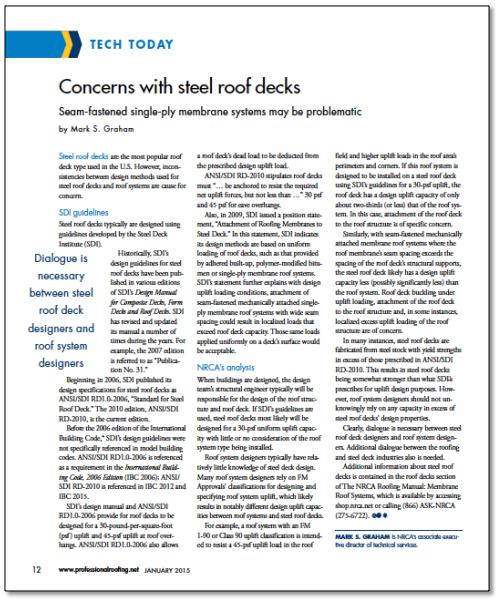
January 2015



TECH TODAY

Concerns with steel roof decks

Seam-fastened single-ply membrane systems may be problematic

by Mark S. Graham

Steel roof decks are the most popular roof deck type used in the U.S. However, inconsistencies between design methods used for steel roof decks and roof systems are cause for concern.

SDI guidelines

Steel roof decks typically are designed using guidelines developed by the Steel Deck Institute (SDI).

Historically, SDI's design guidelines for steel roof decks have been published in various editions of SDI's *Design Manual for Composite Decks, Form Decks and Roof Decks*. SDI has revised and updated its manual a number of times during the years. For example, the 2007 edition is referred to as "Publication No. 31."

Dialogue is necessary between steel roof deck designers and roof system designers

Beginning in 2006, SDI published its design specifications for steel roof decks as ANSI/SDI RDI.0-2006, "Standard for Steel Roof Deck." The 2010 edition, ANSI/SDI RD-2010, is the current edition.

Before the 2006 edition of the International Building Code," SDI's design guidelines were not specifically referenced in model building codes. ANSI/SDI RDI.0-2006 is referenced as a requirement in the *International Building Code, 2006 Edition* (IBC 2006); ANSI/SDI RD-2010 is referenced in IBC 2012 and IBC 2015.

SDI's design manual and ANSI/SDI RDI.0-2006 provide for roof decks to be designed for a 30-pound-per-square-foot (psf) uplift and 45-psf uplift at roof overhangs. ANSI/SDI RDI.0-2006 also allows a roof deck's dead load to be deducted from the prescribed design uplift load.

ANSI/SDI RD-2010 stipulates roof decks must "… be anchored to resist the required net uplift forces, but not less than …" 30 psf and 45 psf for eave overhangs.

Also, in 2009, SDI issued a position statement, "Attachment of Roofing Membranes to Steel Deck." In this statement, SDI indicates its design methods are based on uniform loading of roof decks, such as that provided by adhered built-up, polymer-modified bitumen or single-ply membrane roof systems. SDI's statement further explains with design uplift loading conditions, attachment of seam-fastened mechanically attached single-ply membrane roof systems with wide seam spacing could result in localized loads that exceed roof deck capacity. Those same loads applied uniformly on a deck's surface would be acceptable.

NRCA's analysis

When buildings are designed, the design team's structural engineer typically will be responsible for the design of the roof structure and roof deck. If SDI's guidelines are used, steel roof decks most likely will be designed for a 30-psf uniform uplift capacity with little or no consideration of the roof system type being installed.

Roof system designers typically have relatively little knowledge of steel deck design. Many roof system designers rely on FM Approvals' classifications for designing and specifying roof system uplift, which likely results in notably different design uplift capacities between roof systems and steel roof decks.

For example, a roof system with an FM 1-90 or Class 90 uplift classification is intended to resist a 45-psf uplift load in the roof field and higher uplift loads in the roof area's perimeters and corners. If this roof system is designed to be installed on a steel roof deck using SDI's guidelines for a 30-psf uplift, the roof deck has a design uplift capacity of only about two-thirds (or less) that of the roof system. In this case, attachment of the roof deck to the roof structure is of specific concern.

Similarly, with seam-fastened mechanically attached membrane roof systems where the roof membrane's seam spacing exceeds the spacing of the roof deck's structural supports, the steel roof deck likely has a design uplift capacity less (possibly significantly less) than the roof system. Roof deck buckling under uplift loading, attachment of the roof deck to the roof structure and, in some instances, localized excess uplift loading of the roof structure are of concern.

In many instances, steel roof decks are fabricated from steel stock with yield strengths in excess of those prescribed in ANSI/SDI RD-2010. This results in steel roof decks being somewhat stronger than what SDI's prescribes for uplift design purposes. However, roof system designers should not unknowingly rely on any capacity in excess of steel roof decks' design properties.

Clearly, dialogue is necessary between steel roof deck designers and roof system designers. Additional dialogue between the roofing and steel deck industries also is needed.

Additional information about steel roof decks is contained in the roof decks section of The NRCA Roofing Manual: Membrane Roof Systems, which is available by accessing shop.nrca.net or calling (866) ASK-NRCA (275-6722).

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

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Continuing concerns with water-based bonding adhesives

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Professional Roofing, Aug. 2012

THE SAME BUT DIFFERENT

Although low-VOC adhesives are marketed as direct replacements for VOC-solvent-based adhesives, there are significant differences

by Maciek Rupar

In markets subject to volatile organic compound (VOC) regulations, single-ply roof membrane manufacturers supply alternative materials for solvent-based adhesives and primers. Among the VOC regulation-compliant materials that have emerged, low-VOC solvent-based and water-based adhesives are marketed as direct replacements for VOC-solvent-based contact adhesives.

Although intended as direct replacements, these materials should be considered apart from traditional solvent-based contact adhesives. For one thing, work and handling practices for low-VOC materials differ somewhat from those for traditional solvent-based materials. And water-based materials present some challenges that set them apart from both types of solvent-based materials. Additionally, depending on specific products and manufacturers, different recommendations for handling and use may apply for products within the same general category.

Where are VOCs regulated?

The California Clean Air Act of 1988 established the framework for the state's air quality management efforts, including requirements for controlling ground-level ozone. To meet the requirements, in 1989, the South Coast Air Quality Management District, which is the air pollution control agency for Orange County and urban portions of Los Angeles, Riverside and San Bernardino counties, adopted Rule 1168. Rule 1168 limits VOC content of adhesives and sealants, including single-ply roof membrane adhesives and sealants. The VOC content limits introduced in Rule 1168 later were included in similar regulations adopted by a number of other California air districts.

The limits (in grams VOC content per liter [g/L] determined as the weight of volatile compounds, less water and exempt compounds) are: single-ply roof membrane adhesives—250 g/L; single-ply roof membrane sealants—450 g/L; and single-ply roof membrane adhesive primers—250 g/L.

More recently, the same VOC content limits have been used in regulations adopted by the states and districts that comprise the Ozone Transport Region (OTR) and are advised about air quality management strategies by the Ozone Transport Commission (OTC).

OTC is a regional advisory body of the Environmental Protection Agency (EPA) established in 1990 through amendments to the Clean Air Act (CAA). The amended CAA granted the EPA authority to establish air pollutant transport regions and corresponding transport commissions, specifically established OTR, which includes Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island,

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Professional Roofing, "Tech today," Dec. 2013

TECH TODAY

Cold weather application

Installing roofing products and roof systems in fall and winter can prove challenging

by Mark S. Graham

Roofing in cold weather, such as during late fall and winter in northern climates, presents roofing contractors with challenges. In addition to having to manage relatively cold rooftop temperatures and increased moisture, contractors face working with roofing products that are temperature- and moisture-sensitive.

This year, NRCA established a Cold Weather Application Task Force to review manufacturers' recommendations for roofing product and roof system application during cold weather.

Certain roofing products and roof system types are temperature-sensitive

Temperature limitations

Roofing contractors have long recognized certain roofing products and roof system types are temperature-sensitive. For example, with hot-applied bituminous roof systems, when ambient temperatures are less than 40 F, shortening the distance between bitumen heating equipment and the point of application and using insulated rooftop bitumen transport and dispensing equipment is recommended by NRCA and most manufacturers to make sure bitumen is at its equiviscous temperature at the point of application.

For self-sealing asphalt shingles, it is recognized shingles' sealing strips may not immediately activate if installed in cold weather. However, some manufacturers provide asphalt shingles with sealant strips that will activate at lower temperatures. Also, in some cold-weather application situations, manufacturers suggest hand-rubbing shingle tabs during installation to prevent shingle tab uplift until the shingles' self-seal strips activate.

The relatively recent introduction of water-based and low-volatile organic compound (VOC) adhesives, such as those used with fully adhered single-ply membrane roof systems and membrane flashings, presents contractors with unique challenges.

Manufacturers generally recommend such adhesives be transported and stored at temperatures between 40 F and 90 F. Also, most manufacturers' application instructions limit adhesives use when rooftop temperatures are 40 F and rising. This is in recognition that installed adhesives should not freeze during drying and initial curing after application. Adhesive cure times necessary to reach adequate initial "green" strength are based on temperature and humidity conditions and vary among adhesive products. It generally is recognized newly applied adhesives should not freeze until at least two days after application.

Dew-point considerations

For water-based adhesives, the humidity at the time of adhesive application also is an important consideration. Adhesive application can cause evaporative cooling of a substrate to which an adhesive is applied, resulting in the adhesive substrate's temperature being slightly lower than the surrounding surfaces' temperatures. If this lower temperature results in the substrate being at or below the surrounding air's dew-point temperature, condensation will occur within the applied adhesive. This condition is referred to as "adhesive bloaking" and can significantly affect an adhesive's drying and cure times and strength.

To minimize the potential for adhesive bloaking, based on input from manufacturers, NRCA's task force suggests water-based and low-VOC adhesive application be limited to when the dew-point temperature is at least five degrees Fahrenheit (preferably 10 degrees Fahrenheit or more) from the ambient temperature. This suggested differential is in recognition that rooftop temperatures vary, such as from the sun side to shade side of penthouses. Dew point and ambient temperatures typically are closest during early morning and sundown. Also, this condition is more common in northern climates during periods of cold temperatures.

For water-based and low-VOC adhesives, when the minimum-recommended ambient temperature or dew-point temperature cannot be met, adhesive application should be suspended.

Being aware

You need to be aware of the temperature- and moisture-related limitations of the products and systems you use and install. Product-specific limitations typically are provided in manufacturers' printed installation instructions.

Building owners, designers, general contractors, construction managers and rooftop construction observers also need to be aware of the limitations of roofing products and roof systems installed in colder temperatures. They also need to acknowledge in some weather conditions, roofing work will need to be suspended until more favorable conditions exist.

In situations where roofing work must take place during periods of unfavorable weather, such as when construction project sequencing requires roofing work be conducted in late fall and winter, building owners and designers should consider specifying roofing products and/or roof system types that are not as sensitive. Roofing product manufacturers and roofing contractors should be consulted for specific recommendations. ◆◆◆

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

12 www.professionalroofing.net DECEMBER 2012

Manufacturers:

- Store at 60F-90F
- Install at 40F and rising
- Longer green time

NRCA:

- Don't freeze
- Dew point differential of 5F or more

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MRCA/NRCA testing

Water-based bonding adhesives

- Products vary
- Pails variability
- Long times to develop strengths
- Peel strengths are relatively low, particularly with paper-faced polyisocyanurate insulation

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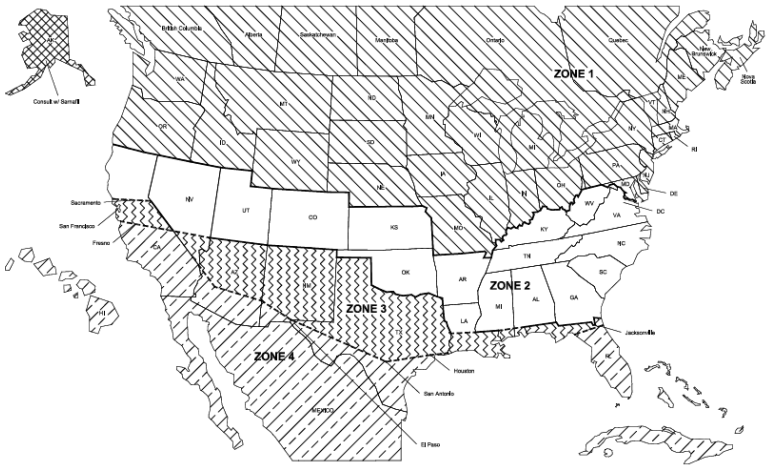
Sika/Sarnafil



BLACKOUT DATES FOR SIKACOAT & WATER BASED PRODUCTS
Zone 1: October 1st thru April 15th Zone 3: November 1st thru March 1st
Zone 2: October 15th thru April 1st Zone 4: No Blackout Dates

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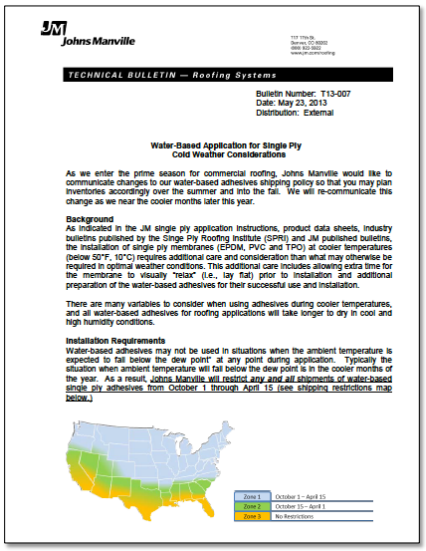
JM technical bulletin



Johns Manville

TECHNICAL BULLETIN — Roofing Systems

Bulletin Number: T13-007
Date: May 23, 2013
Distribution: External

Water-Based Application for Single Ply Cold Weather Considerations

As we enter the prime season for commercial roofing, Johns Manville would like to communicate changes to our water-based adhesives shipping policy so that you may plan inventories accordingly over the summer and into the fall. We will re-communicate this change as we near the cooler months later this year.

Background
As indicated in the JM single ply application instructions, product data sheets, industry bulletins published by the Singe Ply Roofing Institute (SPRI) and JM published bulletins, the installation of single ply membranes (EPDM, PVC and TPO) at cooler temperatures (below 50°F, 10°C) requires additional care and consideration than what may otherwise be required in optimal weather conditions. This additional care includes allowing extra time for the membrane to visually "relax" (i.e., lay flat) prior to installation and additional preparation of the water-based adhesives for their successful use and installation.

There are many variables to consider when using adhesives during cooler temperatures, and all water-based adhesives for roofing applications will take longer to dry in cool and high humidity conditions.

Installation Requirements
Water-based adhesives may not be used in situations when the ambient temperature is expected to fall below the dew point* at any point during application. Typically the situation when ambient temperature will fall below the dew point is in the cooler months of the year. As a result, Johns Manville will restrict any and all shipments of water-based single ply adhesives from October 1 through April 15 (see shipping restrictions map below.)

- Shipment restrictions from 10/1 to 4/15
- Storage 60F – 80F
- Should not be applied:
  - Below 40F
  - RH 90%+
  - DP separation < 5F
  - Temp. = DP within 6 hrs.
  - Temp. < 32F within 48 hrs.

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NRCA's interim recommendations

- Manufacturers need to take a more active role
- Designers need to consider/offer alternatives
- Designers should specify Class 2 (coated glass) facers when using water-based adhesives
- Make field crews aware of limitations
- Consider alternative products/systems

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Consultant concerns

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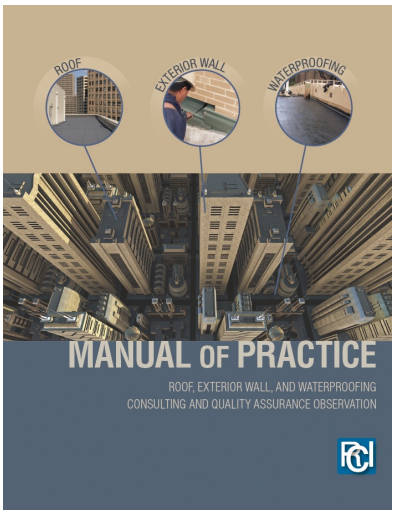
RCI



Manual of Practice:

- Sec. 1: Introduction
- Sec. 2: Recommended practices for consulting
- Sec. 3: Recommended practices for QAO
- Sec. 4: Specialized areas of practice
- Appendixes

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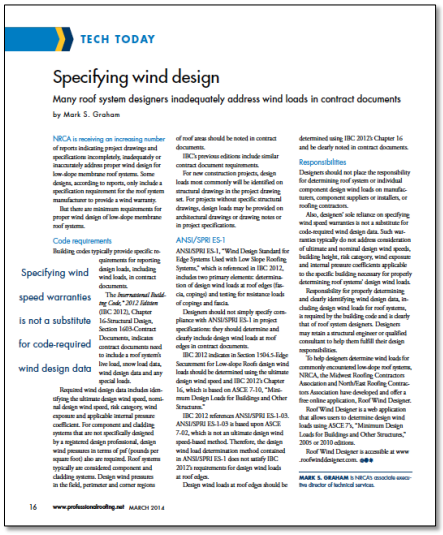
Inadequate wind design


TECH TODAY

Specifying wind design

Many roof system designers inadequately address wind loads in contract documents

by Mark S. Graham

Specifying wind speed warranties is not a substitute for code-required wind design data

16 www.professionalroofing.net MARCH 2014

Professional Roofing, March 2014

- A wind warrantee is not a substitute for proper wind design
- IBC, Ch. 16:
  - ASCE 7 wind loads
  - Loads are required in Contract Documents

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A QAO is not a "field superintendent"
and should never direct roofing work/operations

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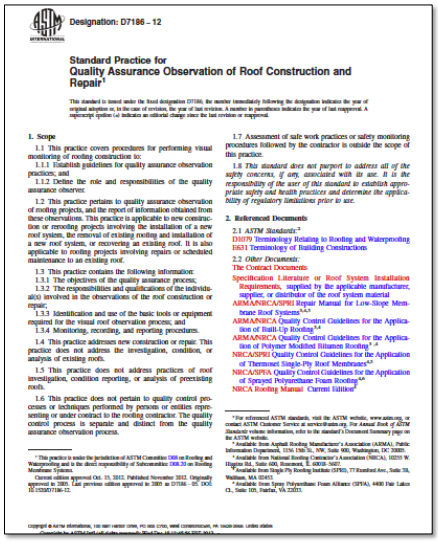
ASTM D7186-12



Designation: D7186 – 12

Standard Practice for
Quality Assurance Observation of Roof Construction and Repair[1]

This standard is issued under the fixed designation D7186; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers procedures for performing visual monitoring of roofing construction to:

1.1.1 Establish guidelines for quality assurance observation practices; and

1.1.2 Define the role and responsibilities of the quality assurance observer.

1.2 This practice pertains to quality assurance observation of roofing projects, and the report of information obtained from these observations. This practice is applicable to new construction or reroofing projects involving the installation of a new roof system, the removal of existing roofing and installation of a new roof system, or recovering an existing roof. It is also applicable to roofing projects involving repairs or scheduled maintenance to an existing roof.

1.3 This practice contains the following information:

1.3.1 The objectives of the quality assurance process;

1.3.2 The responsibilities and qualifications of the individual(s) involved in the observations of the roof construction or repair;

1.3.3 Identification and use of the basic tools or equipment required for the visual roof observation process; and

1.3.4 Monitoring, recording, and reporting procedures.

1.4 This practice addresses new construction or repair. This practice does not address the investigation, condition, or analysis of existing roofs.

1.5 This practice does not address practices of roof investigation, condition reporting, or analysis of preexisting roofs.

1.6 This practice does not pertain to quality control processes or techniques performed by persons or entities representing or under contract to the roofing contractor. The quality control process is separate and distinct from the quality assurance observation process.

1.7 Assessment of safe work practices or safety monitoring procedures followed by the contractor is outside the scope of this practice.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1079 Terminology Relating to Roofing and Waterproofing

E631 Terminology of Building Constructions

2.2 *Other Documents:*

The Contract Documents

Specification Literature or Roof System Installation Requirements, supplied by the applicable manufacturer, supplier, or distributor of the roof system material

ARMA/NRCA/SPRI Repair Manual for Low-Slope Membrane Roof Systems[3,4,5]

ARMA/NRCA Quality Control Guidelines for the Application of Built-Up Roofing[3,4]

ARMA/NRCA Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing[3, 4]

NRCA/SPRI Quality Control Guidelines for the Application of Thermoset Single-Ply Roof Membranes[4,5]

NRCA/SPFA Quality Control Guidelines for the Application of Sprayed Polyurethane Foam Roofing[4,6]

NRCA Roofing Manual: Current Edition[5]

[1] This practice is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.10 on Roofing Membrane Systems.

Current edition approved Oct. 15, 2012. Published November 2012. Originally approved in 2005. Last previous edition approved in 2005 as D7186 – 05. DOI: 10.1520/D7186-12.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Asphalt Roofing Manufacturer's Association (ARMA), Public Information Department, 1156 15th St., NW, Suite 900, Washington, DC 20005.

[4] Available from National Roofing Contractor's Association (NRCA), 10255 W. Higgins Rd., Suite 600, Rosemont, IL 60018-5607.

[5] Available from Single-Ply Roofing Institute (SPRI), 77 Rumford Ave., Suite 3B, Waltham, MA 02453.

[6] Available from Spray Polyurethane Foam Alliance (SPFA), 4400 Fair Lakes Ct., Suite 105, Fairfax, VA 22033.

"Standard Practice for Quality Assurance Observation of Roof Construction and Repair"

- Observe and report
- Reporting procedures
- QAO shall have insurance
- QAO shall provide and maintain PPE and fall protection equipment, if required by regulating authorities

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"Tech today" column, February 2014

TECH TODAY

Quality-assurance guidelines

Quality-assurance observers have specific project roles and responsibilities

by Mark S. Graham

Proper quality assurance during roof system installation can be an important element for long-term performance.

Quality assurance—unlike quality control, which is performed by roofing contractors—is the responsibility of a building owner or his or her designated representative, such as a licensed design professional, roof consultant or general contractor. The purpose of quality assurance is to verify the scope and intent of a project's contract documents are being met and roof system materials are being installed in accordance with contract documents, manufacturers' installation instructions and accepted industry practices.

The most effective means of providing quality assurance is visually observing materials and procedures

NRCA asserts the most effective means of providing quality assurance is by visually observing materials and procedures used at the time of roof system installation. The person performing visual observation often is referred to as a quality-assurance observer (QAO).

ASTM D7186

ASTM D7186, "Standard Practice for Quality Assurance Observation of Roof Construction and Repair," establishes the role and responsibilities of those performing quality-assurance observation, as well as procedures for observation and reporting.

A QAO's function is to provide on-site observation and reporting of a roof system's construction process in a clear, accurate and objective manner; a QAO should not direct or order any work. A QAO should:

- Observe and record the general condition of the job site and roof areas under construction and materials used and stored
- Note pre-existing property damage or damage that can occur and the substrate condition and repair or replacement procedures
- Observe and record the installation of roofing materials and any other components specified in the contract documents, and flashing installation and detailing
- Record weather conditions, roofing crew size, foreman's name and all job-site visitors

A QAO should prepare a daily written report with photographs; this report should be made available to all parties involved in the roofing project. A copy of the report should be provided to the roofing contractor no later than the commencement of work the following day. ASTM D7186 includes sample pre-construction damage, material delivery, daily construction and progress summary, and unit cost tracking report forms for use by QAOs when completing the documentation necessary to provide proper quality assurance.

A QAO also should keep on-site copies of contract documents, including project specifications, the roof plan, construction detail drawings and any addenda, as well as stamped material submittals and minutes from the pre-bid, pre-construction and project meeting minutes.

A QAO is responsible for providing and maintaining the tools and equipment required to perform his or her work, including any necessary safety equipment, such as personal protective equipment and fall protection. A QAO should follow all applicable safe work practices.

A QAO or the firm providing the quality-assurance observations must provide insurance and submit a certificate of insurance showing coverage for workers' compensation, comprehensive general liability, automobile insurance and, if applicable, professional liability insurance. Insurance limits shall be the statutory amounts or higher amounts if required in the contract.

NRCA guidelines

ASTM D7186 references the following NRCA documents that provide industry-accepted guidelines for evaluating roof system application:

- *Quality Control Guidelines for the Application of Built-up Roofing*
- *Quality Control Guidelines for the Application of Polymer-modified Bitumen Roofing*
- *Quality Control Guidelines for the Application of Thermoset Single-ply Roof Membranes*
- *Quality Control Guidelines for the Application of Spray Polyurethane Foam-based Roofing*
- *Quality Control Guidelines for the Application of Asphalt Shingle Roof Systems*

NRCA recommends these documents be used with ASTM D7186 to provide effective quality assurance.

When a QAO will be present on a job site, NRCA recommends his or her role be clearly defined and understood by all parties, including the building owner, licensed design professional, general contractor or construction manager, and roof consultant. NRCA encourages referencing ASTM D7186 for this purpose.

All NRCA documents referenced can be purchased by accessing the NRCA Bookstore at shop.nrca.net.

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

12 www.professionalroofing.net FEBRUARY 2014

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NRCA's recommendations

- Confirm/clarify QAO's role and responsibilities
- Use "Tech today" column and/or ASTM D7186
- Get QAO's daily reports
- Document any situation where a QAO directs your work/operations

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Questions… and other topics

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NRCA

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