January 10, 2018 – Aventura, FL

Roof coatings

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

About NRCA

- Not-for-profit trade association founded in 1886
- Rosemont, IL and Washington , DC
- More than 3,500 members:
  - Roofing contractors and affiliate members
  - All 50 states and 53 counties
  - 97 local, state and regional affiliates organizations
  - Less than $1 M to large companies
  - Both residential and commercial work
  - One-third in business for more than 50 years
- Information, education, technology and advocacy

About me

- Grew up in a three-generation family construction business
- Degree in Architectural Engineering
- Roof contracting business
- Consulting engineer
- NRCA…for the last 25 years

Pay attention to ol' guys….

sometimes they know something.

--Joe Lstiburek
Building Science Corp.
www.BuildingScience.com

Topics

- Building codes (IBC 2018)
- ASTM
- Coatings vs. membranes
- Reflectivity basics
- Roof coating substrates
- Moisture in concrete roof decks
- Additional resources
- Questions (ask anytime)

Building codes

Roofing specific

Some background

- The I-Codes are “model codes” developed by the International Code Council (ICC)
- Model codes serve as the technical basis for state or local code adoption
- The code provides the minimum legal requirements for building construction…and operation
- The code is enforced by the “authority having jurisdiction” (AHJ)
- The code can also provide a basis for construction claims-related litigation

Who is responsible?

- The building owner
- And, everyone else involved

Legal considerations

"In most states, a building code violation is considered to be evidence of negligence. In some situations, a building code violation may be considered *negligence per se…*"

--Stephen M. Phillips
Hendrick, Phillips, Salzman & Flatt

Code enforcement

- Code official
- Construction litigation

International Code Council (ICC)

ICC INTERNATIONAL CODE COUNCIL®
People Helping People Build a Safer World™

THE I-CODES

ICC Performance Code (ICCPC)
International Building Code (IBC)
International Energy Conservation Code (IECC)
International Existing Building Code (IEBC)
International Fire Code (IFC)
International Fuel Gas Code (IFGC)
International Green Construction Code (IgCC)
International Mechanical Code (IMC)
International Plumbing Code (IPC)
International Private Sewage Disposal Code (IPSDC)
International Property Maintenance Code (IPMC)
International Residential Code (IRC)
International Swimming Pool and Spa Code (ISPSC)
International Wildland-Urban Interface Code (IWUIC)
International Zoning Code (IZC)

Publication cycle

- 2000 edition
- 2003 edition
- 2006 edition
- 2009 edition
- 2012 edition
- 2015 edition
- 2018 edition (just published)

Three-year code development and publication cycle

International Building Code, 2012 Edition (IBC 2012)

CHAPTER 1

SCOPE AND ADMINISTRATION

[A] 101.2 Scope. The provisions of this code shall apply to the construction, *alteration*, relocation, enlargement, replacement, *repair*, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.

Exception: Detached one- and two-family *dwellings* and *townhouses* not more than three *stories above grade plane* in height with a separate *means of egress*, and their accessory structures not more than three *stories above grade plane* in height, shall comply with this code or the *International Residential Code*.

[A] 101.3 Intent. The purpose of this code is to establish the minimum requirements to provide a reasonable level of safety, public health and general welfare through structural strength, *means of egress* facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire, explosion and other hazards, and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations.

CHAPTER 15

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

User notes:

About this chapter: Chapter 15 provides minimum requirements for the design and construction of roof assemblies and rooftop structures. The criteria address the weather-protective barrier at the roof and, in most circumstances, a fire-resistant barrier. The chapter is largely prescriptive in nature and is based on decades of experience with various traditional materials, but it also recognizes newer products such as photovoltaic shingles. Section 1510 addresses rooftop structures, which include penthouses, tanks, towers and spires. Rooftop penthouses larger than prescribed in this chapter must be treated as a story under Chapter 5.

Code development reminder: Code change proposals to sections preceded by the designation [BF], [BG] or [P] will be considered by one of the code development committees meeting during the 2018 (Group A) Code Development Cycle. All other code change proposals will be considered by the IBC—Structural Code Development Committee during the 2019 (Group B) Code Development Cycle. See explanation on page iv.

SECTION 1501
GENERAL

1501.1 Scope. The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies, and rooftop structures.

SECTION 1503
WEATHER PROTECTION

1503.1 General. Roof decks shall be covered with *approved* roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof coverings shall be designed in accordance with this code, and installed in accordance with this code and the manufacturer's

SECTION 1501
GENERAL

1501.1 Scope. The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies, and rooftop structures.

1502.3 Scuppers. Where scuppers are used for secondary (emergency overflow) roof drainage, the quantity, size, location and inlet elevation of the scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1611.1. Scuppers shall not have an opening dimension of less than 4 inches (102 mm). The flow through the primary system shall not be considered when locating and sizing scuppers.

1502.4 Gutters. Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or not less than Schedule 40 plastic pipe.

1503.4 Attic and rafter ventilation. Intake and exhaust vents shall be provided in accordance with Section 1202.2 and the vent product manufacturer's installation instructions.

1503.5 Crickets and saddles. A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

Exception: Unit skylights installed in accordance with Section 2405.5 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

RE-2 and RE-3 of ANSI/SPRI ES-1, except basic design wind speed, *V*, shall be determined from Figures 1609.3(1)

SECTION 1505
FIRE CLASSIFICATION

[BF] 1505.1 General. Roof assemblies shall be divided into the classes defined in this section. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E108 or UL 790. In addition, *fire-retardant-treated wood* roof coverings shall be tested in accordance with ASTM D2898. The minimum roof coverings installed on buildings shall comply with Table 1505.1 based on the type of construction of the building.

ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

NOMINAL DESIGN WIND SPEED, V_{asd} (mph)[a, c]	MAXIMUM MEAN ROOF HEIGHT (ft)[b, c] Exposure category	

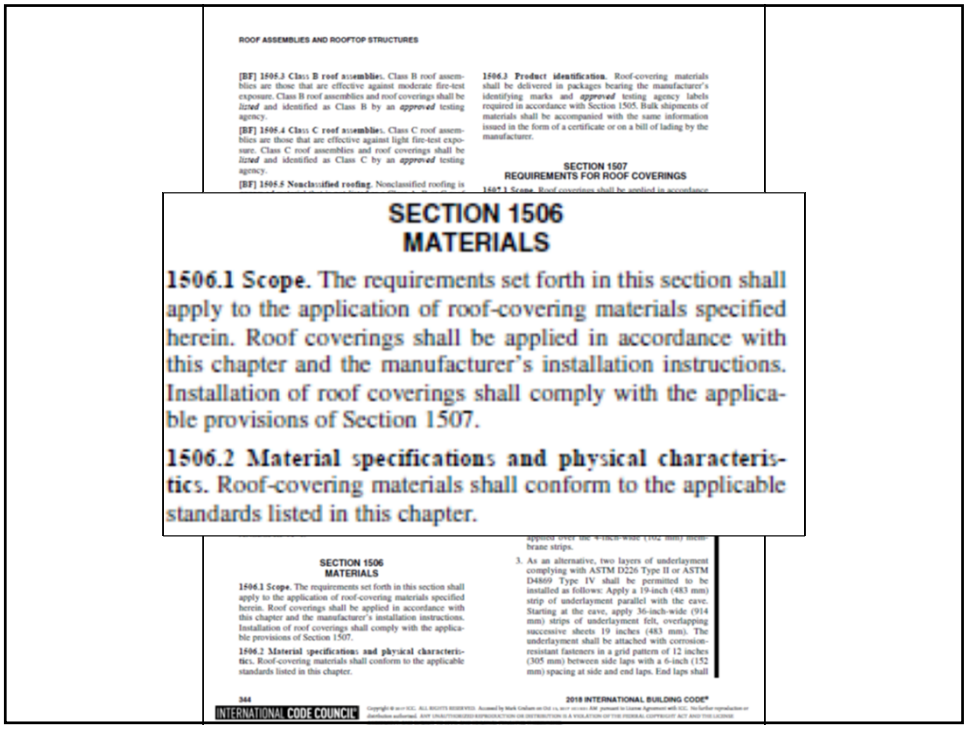
per square foot (0.0478 kg/m²) copper sheets installed over combustible decks.

4. Class A roof assemblies include slate installed over ASTM D226, Type II underlayment over combusti-

TABLE 1505.1[a, b]
MINIMUM ROOF COVERING CLASSIFICATION FOR TYPES OF CONSTRUCTION

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
B	B	B	C[c]	B	C[c]	B	B	C[c]

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².



ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

[BF] 1505.3 Class B roof assemblies. Class B roof assemblies are those that are effective against moderate fire-test exposure. Class B roof assemblies and roof coverings shall be *listed* and identified as Class B by an *approved* testing agency.

[BF] 1505.4 Class C roof assemblies. Class C roof assemblies are those that are effective against light fire-test exposure. Class C roof assemblies and roof coverings shall be *listed* and identified as Class C by an *approved* testing agency.

[BF] 1505.5 Nonclassified roofing. Nonclassified roofing is

1506.3 Product identification. Roof-covering materials shall be delivered in packages bearing the manufacturer's identifying marks and *approved* testing agency labels required in accordance with Section 1505. Bulk shipments of materials shall be accompanied with the same information issued in the form of a certificate or on a bill of lading by the manufacturer.

SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS

1507.1 Scope. Roof coverings shall be applied in accordance

SECTION 1506
MATERIALS

1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. Roof coverings shall be applied in accordance with this chapter and the manufacturer's installation instructions. Installation of roof coverings shall comply with the applicable provisions of Section 1507.

1506.2 Material specifications and physical characteristics. Roof-covering materials shall conform to the applicable standards listed in this chapter.

applied over the 4-inch-wide (102 mm) mem-
brane strips.

3. As an alternative, two layers of underlayment complying with ASTM D226 Type II or ASTM D4869 Type IV shall be permitted to be installed as follows: Apply a 19-inch (483 mm) strip of underlayment parallel with the eave. Starting at the eave, apply 36-inch-wide (914 mm) strips of underlayment felt, overlapping successive sheets 19 inches (483 mm). The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at side and end laps. End laps shall

SECTION 1506
MATERIALS

1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. Roof coverings shall be applied in accordance with this chapter and the manufacturer's installation instructions. Installation of roof coverings shall comply with the applicable provisions of Section 1507.

1506.2 Material specifications and physical characteristics. Roof-covering materials shall conform to the applicable standards listed in this chapter.

TABLE 1507.10.2
BUILT-UP ROOFING MATERIAL STANDARDS

MATERIAL STANDARD	STANDARD
Acrylic coatings used in roofing	ASTM D6083
Aggregate surfacing	ASTM D1863
Asphalt adhesive used in roofing	ASTM D3747
Asphalt cements used in roofing	ASTM D2822; D3019; D4586
Asphalt-coated glass fiber base sheet	ASTM D4601
Asphalt coatings used in roofing	ASTM D1227; D2823; D2824; D4479
Asphalt glass felt	ASTM D2178
Asphalt primer used in roofing	ASTM D41
Asphalt-saturated and asphalt-coated organic felt base sheet	ASTM D2626
Asphalt-saturated organic felt (perforated)	ASTM D226
Asphalt used in roofing	ASTM D312
Coal-tar cements used in roofing	ASTM D4022; D5643
Coal-tar saturated organic felt	ASTM D227
Coal-tar pitch used in roofing	ASTM D450; Type I or II
Coal-tar primer used in roofing, dampproofing and waterproofing	ASTM D43
Glass mat, coal tar	ASTM D4990
Glass mat, venting type	ASTM D4897
Mineral-surfaced inorganic cap sheet	ASTM D3909
Thermoplastic fabrics used in roofing	ASTM D5665, D5726

1507.14 Sprayed polyurethane foam roofing. The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

1507.14.1 Slope. Sprayed polyurethane foam roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.14.2 Material standards. Spray-applied polyurethane foam insulation shall comply with ASTM C1029 Type III or IV or ASTM D7425.

1507.14.3 Application. Foamed-in-place roof insulation shall be installed in accordance with the manufacturer's instructions. A liquid-applied protective coating that complies with Table 1507.14.3 shall be applied not less than 2 hours nor more than 72 hours following the application of the foam.

TABLE 1507.14.3
PROTECTIVE COATING MATERIAL STANDARDS

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

1507.14.4 Foam plastics. Foam plastic materials and installation shall comply with Chapter 26.

1507.15 Liquid-applied roofing. The installation of liquid-applied roofing shall comply with the provisions of this section.

1507.15.1 Slope. Liquid-applied roofing shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope).

1507.15.2 Material standards. Liquid-applied roofing shall comply with ASTM C836, ASTM C957, ASTM D1227 or ASTM D3468, ASTM D6083, ASTM D6694 or ASTM D6947.

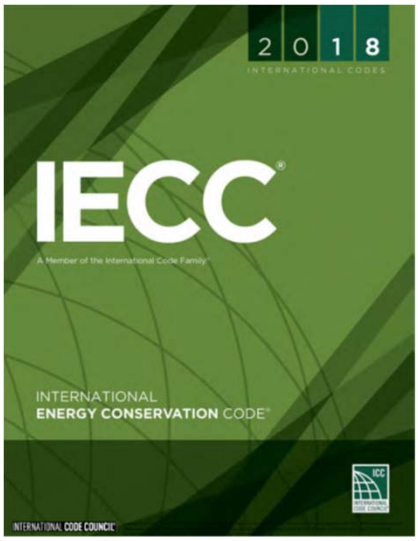
SECTION 1511
REROOFING

1511.1 General. Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter 15.

1511.3.1.1 Exceptions. A ***roof recover*** shall not be permitted where any of the following conditions occur:

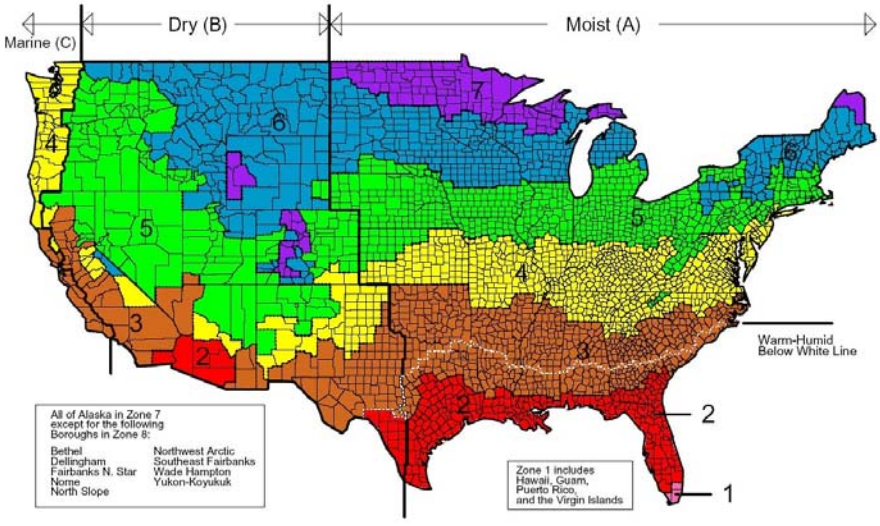
1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.
4. The application of a new protective roof coating over an existing protective roof coating, metal roof panel, built-up roof, spray polyurethane foam roofing system, metal roof shingles, mineral-surfaced roll roofing, modified bitumen roofing or thermoset and thermoplastic single-ply roofing shall be permitted without tear off of existing roof coverings.

International Energy Conservation Code, 2018 Edition (IECC 2018)



IECC 2018, Fig. C301.1-Climate zones

Fig. R301.1 (residential climate zones) is similar



Roofing-specific adaptation of Table C402.1.3

International Energy Conservation Code, 2018 Edition

Opaque Thermal Envelope Assembly Requirements			
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	R-25ci		
3			
4	R-30ci		
5			
6		R-25 + 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)

Comparison of IECC's various editions

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

Climate Zone	IECC 2006	IECC 2009	IECC 2012*	IECC 2015*
1	R-15 ci	R-15 ci	R-20 ci	R-20 ci
2		R-20ci		R-25 ci
3				
4			R-25 ci	R-30 ci
5	R-20 ci			
6				
7	R-25 ci	R-25 ci	R-30 ci	R-35 ci
8				

* Applies to roof replacement projects
ci = continuous insulation

Reflectivity

International Energy Conservation Code, 2018 Edition (Commercial)

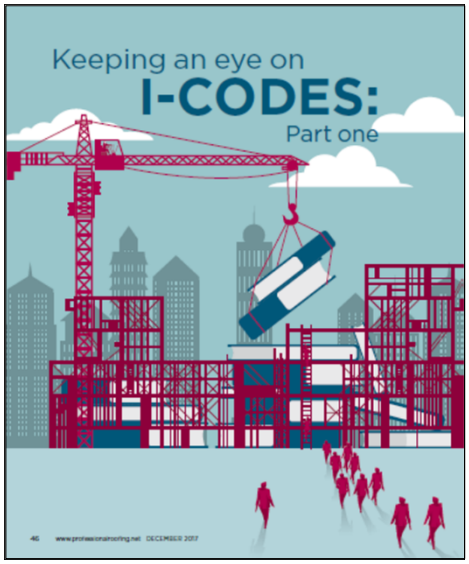
C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: [Refer to earlier "Cool and Green Roofs" presentation]

TABLE C402.3
MINIMUM ROOF REFLECTANCE AND EMITTNCE OPTIONS

Three-year solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75
Three-year-aged solar reflectance index of 64

[Footnotes omitted for clarity]



Professional Roofing
December 2017

ASTM International

- Test methods (ASTM E108)
- Product standards (ASTM D6083)
- Practices
- Guides

ASTM product standards

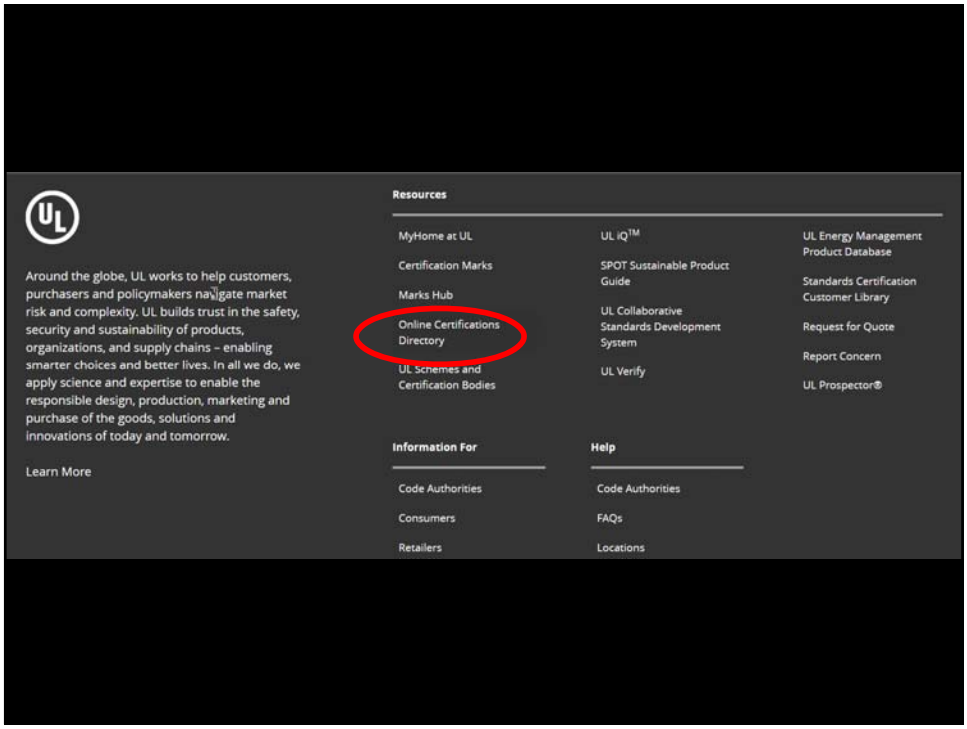
Roof coatings

- ASTM D6083: acrylic
- ASTM D1227: emulsified asphalt
- ASTM D2823: asphalt
- ASTM D2824: aluminum
- ASTM D4479: asphalt
- ASTM D6694: silicone
- ASTM D6947: polyurethane

Roof coatings
vs.
Liquid-applied membranes

The differences

- Roof coatings are classified as surfacing products
- Liquid-applied membranes are classified as roof membranes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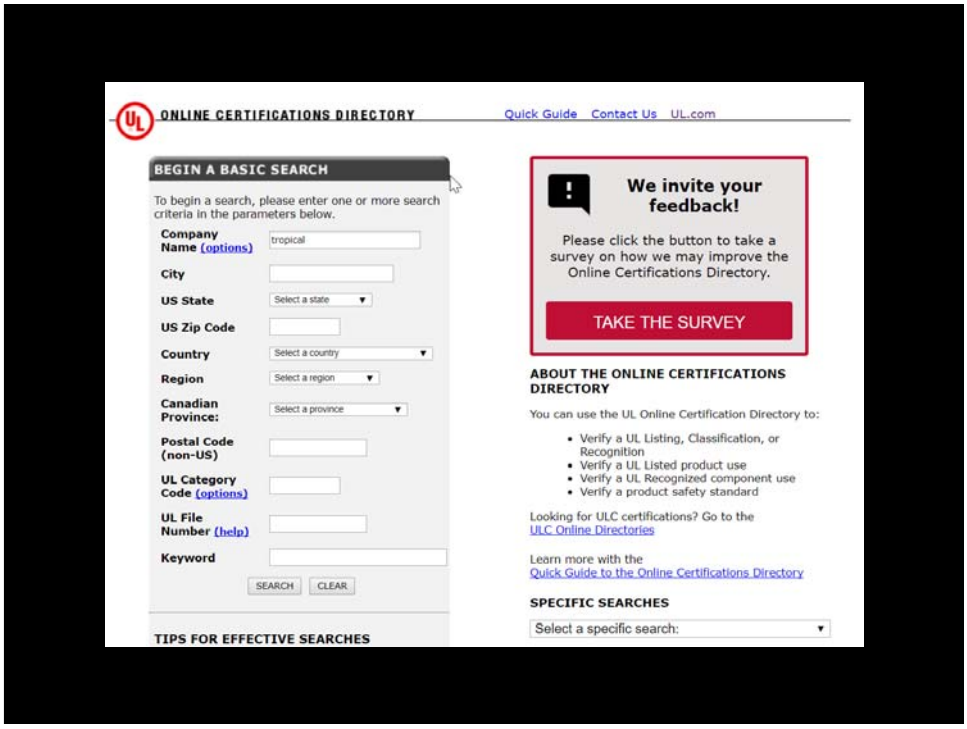
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TGFU.R37974
Roofing Systems

Page Bottom

Roofing Systems

See General Information for Roofing Systems

TROPICAL ROOFING PRODUCTS R37974
1818 SW 31st Ave
Hallandale, FL 33009 USA

FLUID APPLIED COATING SYSTEMS

Where the coating is applied directly to the deck, sealing compound ("Silicone Construction Sealant") must be used to reinforce the membrane at all joints of stress, to bridge joints or large cracks and at all finishing locations.

Class A

1. **Deck:** NC **Incline:** 1/2

Surfacing: — "#904P Eterna-Sil Premium Original Formula Silicone Roof Coating" applied at 11/2-gal/100-ft^2.
Surfacing (Optional): — No. 11 ceramic coated roof granules applied at 30-lb/100-ft^2 into wet top coat.

2. **Deck:** NC (metal, concrete) **Incline:** Unlimited

Surfacing: — "#914P Eterna-Sil Premium 100% Silicone Roof Coating" applied at 11/2-gal/100-ft^2.
Surfacing: — "#904P Eterna-Sil Premium Original Formula Silicone Roof Coating" applied at 11/2-gal/100-ft.^{2}.
Surfacing (Optional): — No. 11 ceramic coated roof granules applied at 30-lb/100-ft^2 into wet top coat.

3. **Deck:** C-15/32 **Incline:** Unlimited

SINGLE PLY MEMBRANE SYSTEMS

Class A

1. **Deck:** NC **Incline:** 3

Insulation: — Dyplast Products LLC "Pyrox White Line," glass fiber, perlite or wood fiber, any thickness.
Membrane: — Any UL Certified PVC, mechanically fastened.
Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" applied 11/2-gal/100-ft^2.

2. **Deck:** NC **Incline:** 1/2

Insulation: — Dyplast Products LLC "Pyrox White Line," glass fiber, perlite or wood fiber, any thickness.
Membrane: — Any UL Certified hypalon, mechanically fastened.
Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 11/2-gal/100-ft^2.

SPRAY APPLIED FOAM AND COATING SYSTEMS

"Tropical #914 High Solids Silicone Roof Coating" may be used in lieu of "Tropical #904 Silicone Roof Coating Solvent Base" series silicone roof coating in any applicable system.

Unless otherwise indicated, the deck surface may be primed with UL Certified asphalt emulsion.

Class A

1. **Deck:** NC **Incline:** 3

   Foam: — BASF Polyurethane Foam Enterprises LLC "FE 303" any thickness.
   Base Coat: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 11/2-gal/100-ft^2.
   Top Coat: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 11/2-gal/100-ft^2.

2. **Deck:** NC **Incline:** 1

   Foam: — "RT-2716," 2.5 to 3.0-lb/ft^3, 11/2- to 2-in. thick.
   Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 21/4-gal/100-ft^2.

3. **Deck:** NC **Incline:** 3/4

   Foam: — "RT-2717," 2.5 to 3.0-lb/ft^3, 11/2- to 2-in. thick.
   Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 21/4-gal/100-ft^2.

4. **Deck:** NC **Incline:** 1

   Foam: — "RT-2718" any thickness.
   Base Coat: — "Tropical #904 Silicone Roof Coating Solvent Base" applied at 11/2-gal/100-ft^2.
   Top Coat: — "Tropical #904 Silicone Roof Coating Solvent Base" applied at 11/2-gal/100-ft^2.

MAINTENANCE AND REPAIR SYSTEMS

Class A, B or C

1. **Deck:** C-15/32 **Incline:** See Note 1

   Existing Roof System: — Any UL Certified existing single-ply membrane system, to retain existing Certification, covered with:
   Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 11/2-gal/100-ft^2.

   Note 1: Certification (A, B or C) and maximum incline will be the same as that of the Certified Roofing System (TGFU).

2. **Deck:** C-15/32 **Incline:** 1/2

   Existing Roof System: — Any UL Certified existing single-ply membrane system, to retain existing Certification, covered with:
   Surfacing: — "Tropical #904 Silicone Roof Coating Solvent Base" or "Tropical #914 High Solids Silicone Roof Coating" applied at 11/2-gal/100-ft^2.

3. **Deck:** C-15/32 **Incline:** See Note 1

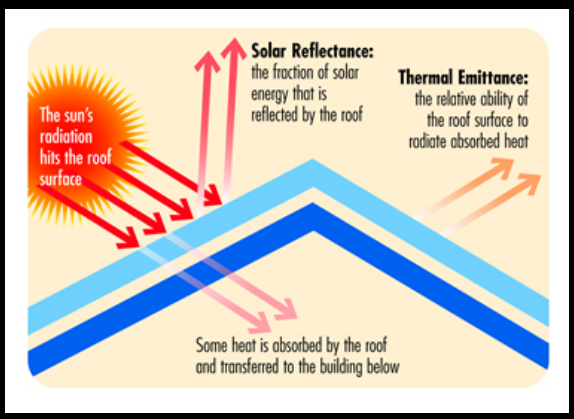
   Existing Roof System: — Any Class A, B or C UL Certified EPDM, TPO, Hypalon, PVC, TPA, or CPE single ply membrane system, mechanically fastened or fully adhered, non-insulated or insulated, to retain existing Certification.
   Surfacing: — "#914P Eterna-Sil Premium 100% Silicone Roof Coating", applied at 11/2-gal/100-ft^2.
   Surfacing (Optional): — No. 11 ceramic coated roof granules applied at 30-lb/100-ft^2 into wet top coat.

   Note 1: Certification (A, B or C) and maximum incline will be the same as that of the Certified Roofing System (TGFU).

4. **Deck:** NC **Incline:** See Note 1

   Existing Roof System: — Any Class A, B or C UL Certified EPDM, TPO, Hypalon, PVC, TPA, or CPE single ply membrane system, mechanically fastened or fully adhered, non-insulated or insulated, to retain existing Certification.
   Surfacing: — "#914P Eterna-Sil Premium 100% Silicone Roof Coating", applied at 11/2-gal/100-ft^2.
   Surfacing (Optional): — No. 11 ceramic coated roof granules applied at 30-lb/100-ft^2 into wet top coat.

Roof surface reflectivity



Courtesy of the Cool Roofs Rating Council

Definitions

Solar reflectance: The fraction of solar flux reflected by a surface expressed within the range of 0.00 and 1.00.

Thermal emittance: The ratio of radiant heat flux emitted by a surface to that emitted by a black body radiator at the same temperature expressed within a range of 0.00 to 1.00.

Definitions – cont.

Solar reflectance index (SRI): The relative steady-state surface temperature of a surface with respect to the standard white (SRI = 100) and standard black (SRI = 0) under standard solar and ambient conditions.

--ASTM E 1980

Reflectivity

International Energy Conservation Code, 2018 Edition (Commercial)

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: [Refer to earlier "Cool and Green Roofs" presentation]

TABLE C402.3
MINIMUM ROOF REFLECTANCE AND EMITTNCE OPTIONS

Three-year solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75
Three-year-aged solar reflectance index of 64

[Footnotes omitted for clarity]

Roof coating substrates

Roof coating substrates

NRCA Guidelines for Roof Coatings

- Metal roof panels and metal surfaces
  - Mill finish
  - Pre-finished or painted
- Built-up and modified bitumen membranes
- Single-ply membranes
- Spray polyurethane foam
- Existing roof coatings

Moisture in concrete roof decks


2

All of these are problems relating to moisture in concrete roof decks…

Concrete mix design

- Aggregate:
  - Large aggregate
  - Fine (small) aggregate
- Portland cement
- Water
- Admixtures:
  - Fly ash
  - Air entrainment
  - Curing compounds
  - Etc.

Concrete Aggregates

60-80% of Concrete Mix Design

- Normal-weight aggregates (stone):
  - Dense
  - Absorb about 2% by weight
- Light-weight aggregates (expanded shale):
  - Porous
  - Absorbs from 5 - 25% by weight

Lightweight structural concrete inherently contains more moisture

When is it OK to roof?

Historical guidelines

- After 28 days
- Application of hot bitumen
- Plastic film test
  - ASTM D4263, "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method"

These are not appropriate for current generations of concrete mixes

Concrete Floors and Moisture, 2nd Edition

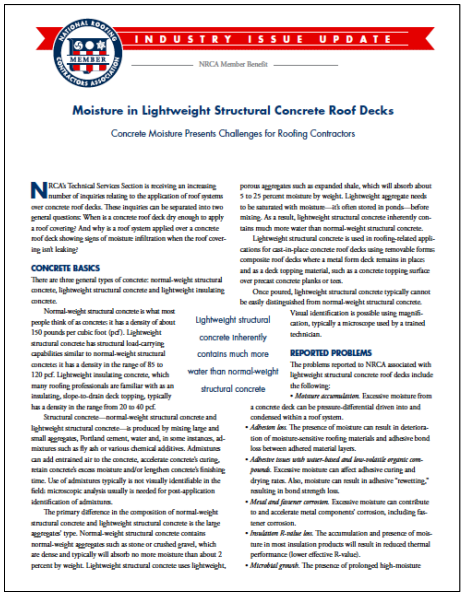
Howard M. Kanare, CTL Group

75% internal RH can be achieved:

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

These values are based upon "protected" concrete, without re-wetting

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 aggregates' 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 "rewetting," 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

Moisture on concrete roof decks


RESEARCH+TECH

Moisture in concrete roof decks

Normal-weight and lightweight structural concrete cause some concern

by Mark S. Graham

20 www.professionalroofing.net SEPTEMBER 2017

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Sept. 2017

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Some useful resources

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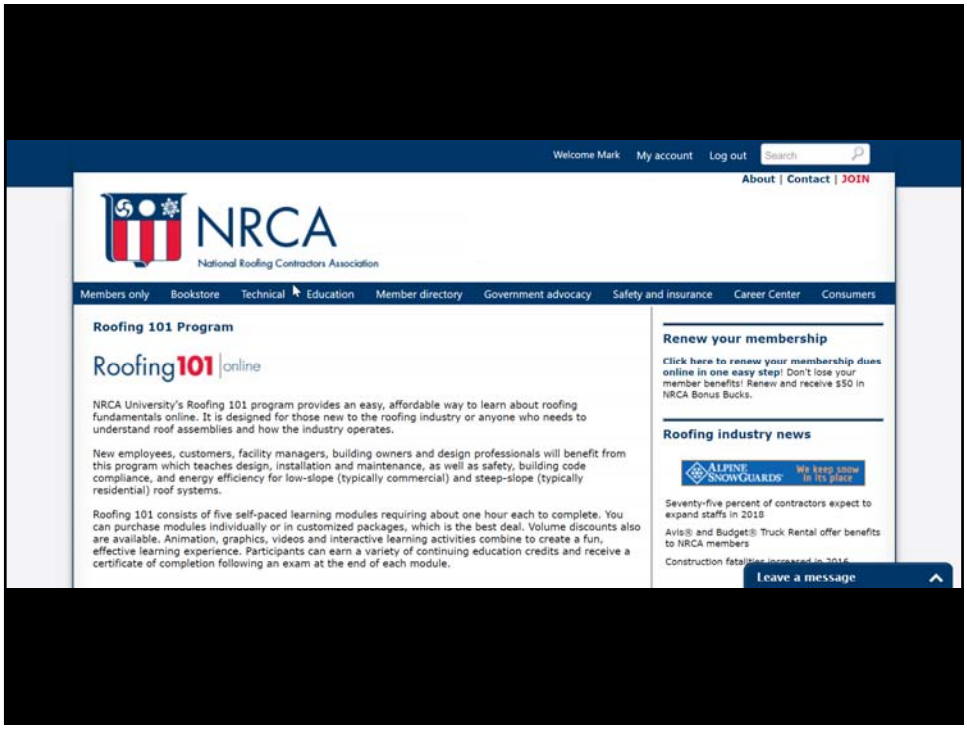
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NRCA University's Roofing 101 program provides an easy, affordable way to learn about roofing fundamentals online. It is designed for those new to the roofing industry or anyone who needs to understand roof assemblies and how the industry operates.
New employees, customers, facility managers, building owners and design professionals will benefit from this program which teaches design, installation and maintenance, as well as safety, building code compliance, and energy efficiency for low-slope (typically commercial) and steep-slope (typically residential) roof systems.
Roofing 101 consists of five self-paced learning modules requiring about one hour each to complete. You can purchase modules individually or in customized packages, which is the best deal. Volume discounts also are available. Animation, graphics, videos and interactive learning activities combine to create a fun, effective learning experience. Participants can earn a variety of continuing education credits and receive a certificate of completion following an exam at the end of each module.
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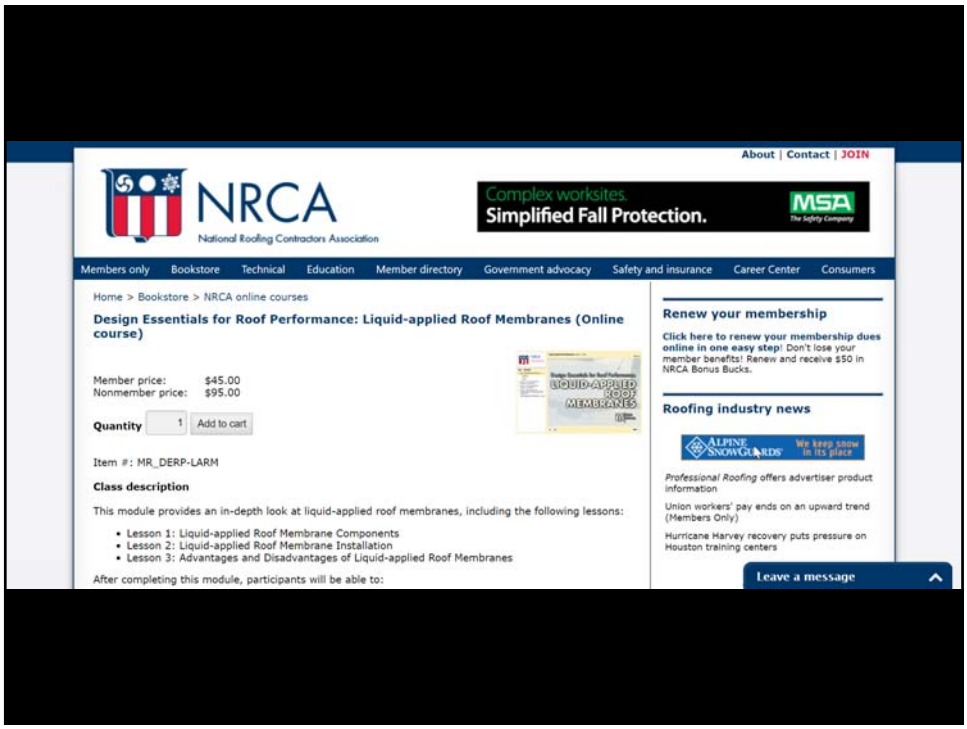
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Class description
This module provides an in-depth look at liquid-applied roof membranes, including the following lessons:
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• Lesson 3: Advantages and Disadvantages of Liquid-applied Roof Membranes
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NRCA Guidelines for Roof Coatings

The NRCA Roofing Manual - 2018

Manual online

www.nrca.net

- Available to all NRCA member registered users (multiple users per member company)
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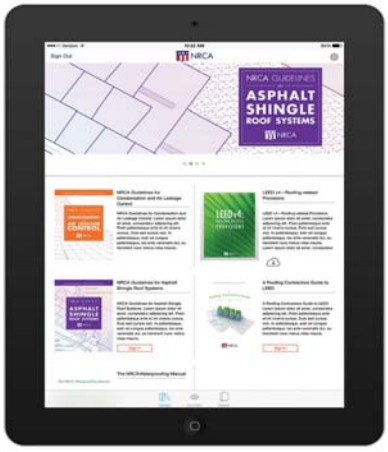

- NRCA App available on the Apple Store and Google Play Store for tablets
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