



International Roofing Expo

August 10-12, 2021

Las Vegas, NV

The new 2021 I-codes: Roofing-related changes



Mark S. Graham

Vice President, Technical Services

National Roofing Contractors Association

Rosemont, Illinois

1

Prerequisites

- Intermediate- to advanced-level
- Some knowledge of code requirements
- General knowledge of 2018 I-codes
- Understand...I am the messenger
– “...don't shoot the messenger...”

2

Review of roofing-related changes in the 2018 I-codes



International Roofing Expo

February 6-8, 2018
New Orleans, LA

The 2018 I-codes: Roofing-related changes



Mark S. Graham

Vice President, Technical Services
National Roofing Contractors Association
Rosemont, Illinois

3

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

4

Code development process

The 2021 I-codes are the 8th edition

The 2021 I-codes present the code as originally published in 2000, with changes reflected in the 2003 through 2018 editions and further changes approved by the ICC Code Development Process through 2020. A new edition is promulgated every three years.

2018 Group A: IBC Building Fire, Building General and Plumbing Committees

2019 Group B: IBC Structural, IECC-Commercial, IECC-Residential Committees

5

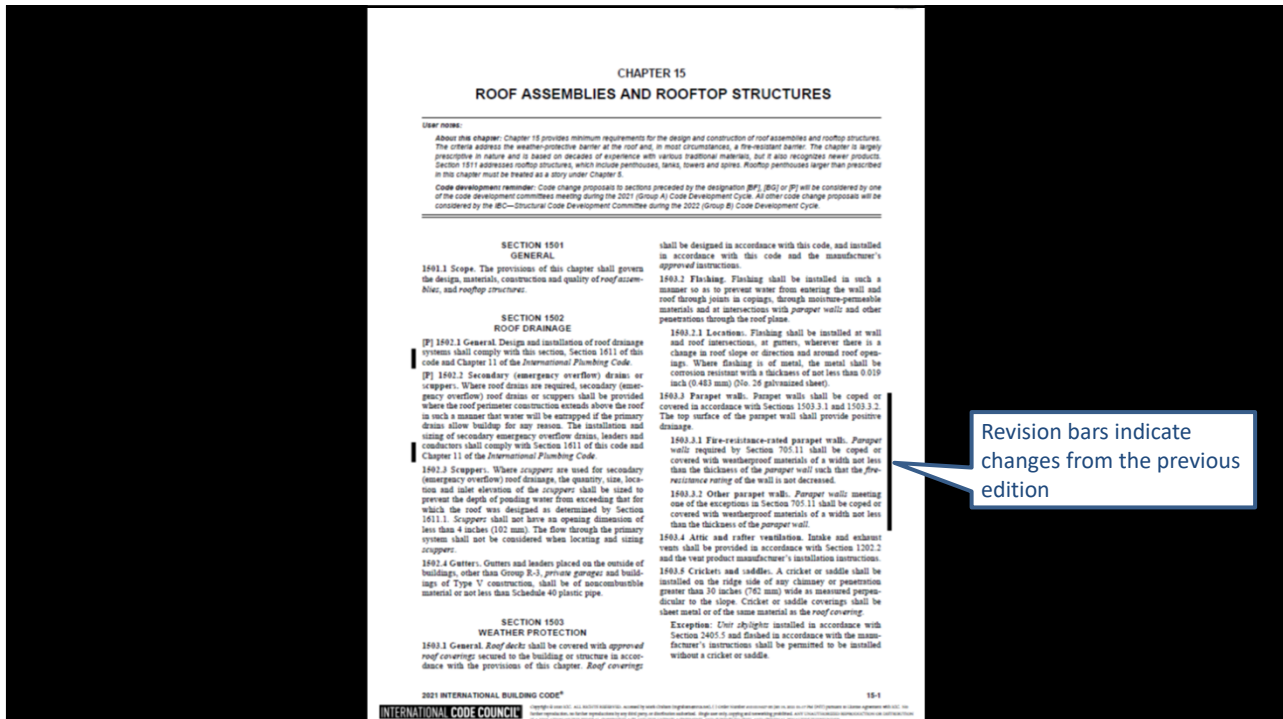
2021 I-codes



6



7



8

Edge metal testing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.6 Edge systems for low-slope roofs. Metal edge systems, except gutters and counterflashing, installed on built-up, modified bitumen and single-ply roof systems having a slope less than 2 units vertical in 12 units horizontal (2:12) shall be designed and installed for wind *loads* in accordance with Chapter 16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except basic design *wind speed*, *V*, shall be determined from Figures 1609.3(1) through 1609.3(12) as applicable.

9

Gutter testing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.6 Edge systems for low-slope roofs. Metal edge systems, except gutters and counterflashing, installed on built-up, modified bitumen and single-ply roof systems having a slope less than 2 units vertical in 12 units horizontal (2:12) shall be designed and installed for wind *loads* in accordance with Chapter 16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except basic design *wind speed*, *V*, shall be determined from Figures 1609.3(1) through 1609.3(12) as applicable.

1504.6.1 Gutter securement for low-slope roofs. Gutters that are used to secure the perimeter edge of the roof membrane on low-slope (less than 2:12 slope) built-up, modified bitumen, and single-ply roofs, shall be designed, constructed and installed to resist wind loads in accordance with Section 1609 and shall be tested in accordance with Test Methods G-1 and G-2 of SPRI GT-1.

10

ANSI/SPRI GT-1

ANSI/SPRI GT-1
Test Standard for Gutter Systems
Approved May 28, 2016

Table of Contents

1.0 Purpose 2

1.1 Scope 2

1.2 Intentions 2

1.3 Test Requirements 2

1.4 (PFI) Test Method 2

1.5 (PFI) Test Method 2

1.6 Test Reporting 2

1.7 Safety 2

Figure 2. Test Set-up for SPRI Test G-1

Figure 3. Test Set-up for SPRI Test G-2

Copyright © 2016
All Rights Reserved
ANSI
SPRI
www.spri.org

Disclaimer:
This standard is for use by architects, engineers, roofing contractors and building owners when designing, installing or evaluating a building's gutter system. SPRI, its members and employees do not warrant that this standard is proper and/or applicable under all conditions.

11

Aggregate surfacing

Changes in IBC 2021, Section 1504-Performance Requirements

1504.9 Wind resistance of aggregate-surfaced roofs. Parapets shall be provided for aggregate surfaced roofs and shall comply with Table 1504.9.

TABLE 1504.9
MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS^{a, b, c}

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC DESIGN WIND SPEED (MPH)																	
		Exposure B								Exposure C ^d									
		≤ 95	100	105	110	115	120	130	140	≤ 95	100	105	110	115	120	130	140	150	
ASTM D1863 (No. 7 or No. 67)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53
ASTM D1863 (No. 6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.
 a. Interpolation shall be permitted for mean roof height and parapet height.
 b. Basic design wind speed, *V*, and wind exposure shall be determined in accordance with Section 1609.
 c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.
 d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

12

Rooftop PV – Fire resistance

Changes in IBC 2021, Section 1505-Fire Classification

[BF] 1505.8 Building-integrated photovoltaic (BIPV) products. *BIPV products* installed as the roof covering shall be tested, *listed* and *labeled* for fire classification in accordance with Section 1505.1.

[BF] 1505.9 Rooftop mounted photovoltaic (PV) panel systems. Rooftop mounted *photovoltaic (PV) panel systems* shall be tested, *listed* and identified with a fire classification in accordance with UL 2703. Listed systems shall be installed in accordance with the manufacturer’s installation instructions and their listing. The fire classification shall comply with Table 1505.1 based on the type of construction of the building.

1507.16.6 Material standards. *Photovoltaic shingles* shall be *listed* and labeled in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

13

Single-ply membrane roof systems

1507.12 Single-ply roofing. The installation of single-ply roofing shall comply with the provisions of this section.

1507.12.1 Slope. Single-ply membrane roofs shall have a design slope of not less than $\frac{1}{4}$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.12.2 Material standards. Single-ply roof coverings shall comply with the material standards in Table 1507.12.2.

**TABLE 1507.12.2
SINGLE-PLY ROOFING MATERIAL STANDARDS**

MATERIAL	MATERIAL STANDARD
Chlorosulfonated polyethylene (CSPE) or polyisobutylene (PIB)	ASTM D5019
Ethylene propylene diene monomer (EPDM)	ASTM D4637
Ketone Ethylene Ester (KEE)	ASTM D6754
Polyvinyl Chloride (PVC) or (PVC/KEE)	ASTM D4434
Thermoplastic polyolefin (TPO)	ASTM D6878

1507.12.3 Ballasted low-slope roofs. Ballasted low-slope roofs (roof slope < 2:12) shall be installed in accordance with this section and Section 1504.5. Stone used as *ballast* shall comply with ASTM D448 or ASTM D7655.

14

SPF roof systems

1507.13 Sprayed polyurethane foam roofing. The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

1507.13.1 Slope. Sprayed polyurethane foam roofs shall have a design slope of not less than 1/4 unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.13.2 Material standards. Spray-applied polyurethane foam insulation shall comply with ASTM C1029 Type III or IV or ASTM D7425.

1507.13.3 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 1507.13.3 shall be applied not less than 2 hours nor more than 72 hours following the application of the foam.

**TABLE 1507.13.3
PROTECTIVE COATING MATERIAL STANDARDS**

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

1507.13.4 Foam plastics. Foam plastic materials and installation shall comply with Chapter 26.

15

Liquid-applied membrane roof systems

Changes in IBC 2021, Section 1507.14-Liquid-applied Roofing

1507.14 Liquid-applied roofing. The installation of liquid-applied roofing shall comply with the provisions of this section.

1507.14.1 Slope. Liquid-applied roofing shall have a design slope of not less than 1/4 unit vertical in 12 units horizontal (2-percent slope).

1507.14.2 Material standards. Liquid-applied roofing shall comply with ASTM C836, ASTM C957 or ASTM D3468. ■

16

Roof coatings

Changes in IBC 2021, Section 1509-Roof Coatings (new)

SECTION 1509 ROOF COATINGS

1509.1 General. The installation of a *roof coating* on a *roof covering* shall comply with the requirements of Section 1505 and this section.

1509.2 Material standards. Roof coating materials shall comply with the standards in Table 1509.2.

TABLE 1509.2
ROOF COATING MATERIAL STANDARDS

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Asphaltic emulsion coating	ASTM D1227
Asphalt coating	ASTM D2823
Asphalt roof coating	ASTM D4479
Aluminum-pigmented asphalt coating	ASTM D2824
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

17

Reroofing

Changes in IBC 2021, Section 1512-Reroofing

1512.2 Roof replacement. *Roof replacement* shall include the removal of all existing layers of *roof assembly* materials down to the *roof deck*.

18

Reroofing

Changes to IBC 2021, Section 1512-Reroofing

1512.4 Reinstallation of materials. Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashing, metal edgings, drain outlets, collars and metal counterflashings shall not be reinstalled where rusted, damaged or deteriorated. Existing *ballast* that is damaged, cracked or broken shall not be reinstalled. Existing aggregate surfacing materials from built-up roofs shall not be reinstalled.

19

Roof zones

Changes in IBC 2021, Section 1603-Construction Documents

CHAPTER 16
STRUCTURAL DESIGN

1603.1.4 Wind design data. The following information related to wind *loads* shall be shown, regardless of whether wind *loads* govern the design of the lateral force-resisting system of the structure:

1. Basic design *wind speed*, V , miles per hour and *allowable stress design wind speed*, V_{asd} , as determined in accordance with Section 1609.3.1.
2. *Risk category*.
3. Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
4. Applicable internal pressure coefficient.
5. Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials not specifically designed by the *registered design professional* responsible for the design of the structure, pounds per square foot (kN/m^2).

2021 INTERNATIONAL BUILDING CODE®
INTERNATIONAL CODE COUNCIL

20

Attic ventilation

Changes in IBC 2021, Section 1203-Unvented Attics and Unvented Enclosed Rafter Spaces

5.2.7. The roof slope shall be greater than or equal to 3 units vertical in 12 units horizontal (3:12).

5.2.8. Where only air-permeable insulation is used, it shall be installed directly below the structural roof sheathing, on top the attic floor, or on top of the ceiling.

5.2.9. Where only air-permeable insulation is used and is installed directly below the structural roof sheathing, air shall be supplied at a flow rate greater than or equal to 50 cubic feet per minute (23.6 L/s) per 1,000 square feet (93 m²) of ceiling.

5.3. The air shall be supplied from ductwork providing supply air to the occupiable space when the conditioning system is operating. Alternatively, the air shall be supplied by a supply fan when the conditioning system is operating. Where preformed insulation board is used as the air-impermeable insulation layer, it shall be sealed at the perimeter of each individual sheet interior surface to form a continuous layer.

Exceptions:

1. Section 1202.3 does not apply to special use structures or enclosures such as swimming pool enclosures, data processing centers, hospitals or art galleries.
2. Section 1202.3 does not apply to enclosures in Climate Zones 5 through 8 that are humidified beyond 35 percent during the three coldest months.

21

2021 IRC

22

IRC's applicability

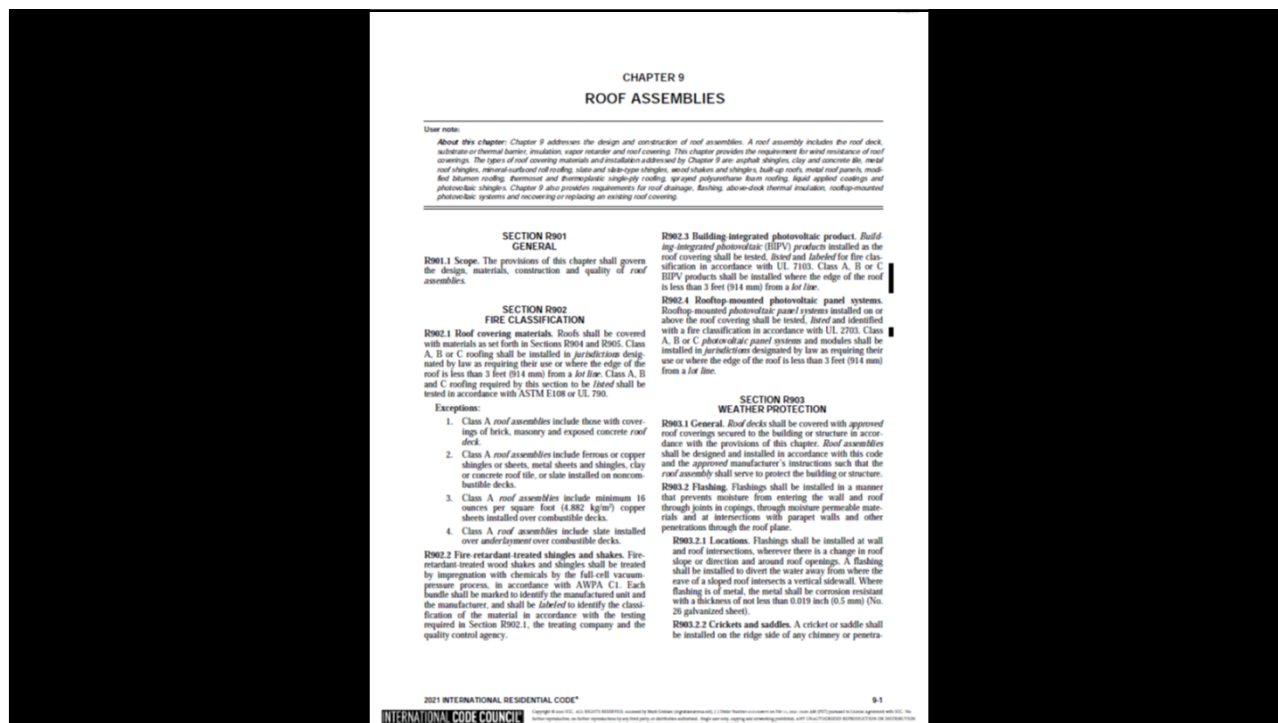
When does IRC apply vs. IBC?

R101.2 Scope. The provisions of this code shall apply to the construction, *alteration*, movement, enlargement, replacement, *repair*, equipment, use and occupancy, location, removal and demolition of 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.

Exception: The following shall be permitted to be constructed in accordance with this code where provided with an automatic sprinkler system complying with Section P2904:

1. Live/work units located in townhouses and complying with the requirements of Section 508.5 of the *International Building Code*.
2. Owner-occupied *lodging houses* with five or fewer guestrooms.
3. A care facility with five or fewer persons receiving custodial care within a *dwelling unit*.
4. A care facility with five or fewer persons receiving medical care within a *dwelling unit*.
5. A care facility for five or fewer persons receiving care that are within a single-family dwelling.

23



24

Rooftop PV – Fire resistance

Changes in IRC 2021, Section R902-Fire Classification

R902.3 Building-integrated photovoltaic product. *Building-integrated photovoltaic (BIPV) products* installed as the roof covering shall be tested, *listed* and *labeled* for fire classification in accordance with UL 7103. Class A, B or C BIPV products shall be installed where the edge of the roof is less than 3 feet (914 mm) from a *lot line*.

R902.4 Rooftop-mounted photovoltaic panel systems. Rooftop-mounted *photovoltaic panel systems* installed on or above the roof covering shall be tested, *listed* and identified with a fire classification in accordance with UL 2703. Class A, B or C *photovoltaic panel systems* and modules shall be installed in *jurisdictions* designated by law as requiring their use or where the edge of the roof is less than 3 feet (914 mm) from a *lot line*.

R905.16.4 Material standards. *Photovoltaic shingles* shall be *listed* and *labeled* in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

25

Steep-slope underlayment

Change in IRC 2021, Section R905-Requirements for Roof Coverings

R905.1.1 Underlayment. *Underlayment* for asphalt shingles, clay and concrete tile, *metal roof shingles*, mineral-surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes, *metal roof panels* and *photovoltaic shingles* shall conform to the applicable standards listed in this chapter. *Underlayment* materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a *label* indicating compliance to the standard designation and, if applicable, type classification indicated in Table R905.1.1(1). *Underlayment* shall be applied in accordance with Table R905.1.1(2). *Underlayment* shall be attached in accordance with Table R905.1.1(3).

Exceptions:

1. As an alternative, self-adhering polymer-modified bitumen underlayment bearing a label indicating compliance with ASTM D1970
2. As an alternative, a minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane bearing a *label* indicating compliance with ASTM D1970, installed in accordance with the *manufacturer's installation instructions* for the deck material, shall be applied over all joints in the roof decking. An *approved underlayment* complying with Table R905.1.1(1) for the applicable roof covering for areas where wind design is not required in accordance with Figure R301.2.1.1 shall be applied over the entire roof over the 4-inch-wide (102 mm) membrane strips. Underlayment shall be applied in accordance with Table R905.1.1(2) using the application requirements for areas where wind design is not required in accordance with Figure R301.2.1.1. Underlayment shall be attached in accordance with Table R905.1.1(3).

Continued...

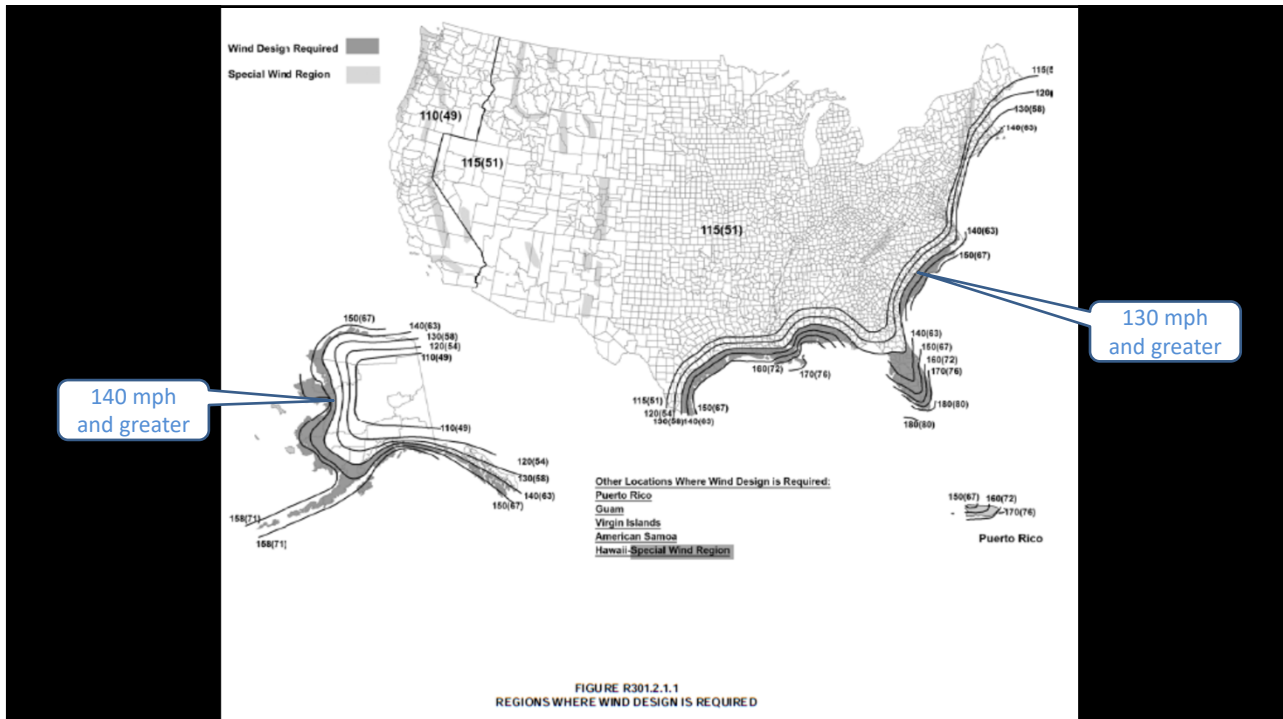
26

**TABLE R905.1.1(1)
UNDERLAYMENT TYPES**

ROOF COVERING	SECTION	AREAS WHERE WIND DESIGN IS NOT REQUIRED IN ACCORDANCE WITH FIGURE R301.2.1.1	AREAS WHERE WIND DESIGN IS REQUIRED IN ACCORDANCE WITH FIGURE R301.2.1.1
Asphalt shingles	R905.2	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type III or Type IV
Clay and concrete tile	R905.3	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral-surfaced roll roofing	ASTM D226 Type II
Metal roof shingles	R905.4	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Mineral-surfaced roll roofing	R905.5	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Slate and slate-type shingles	R905.6	ASTM D226 Type I ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Wood shingles	R905.7	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Wood shakes	R905.8	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type III or Type IV
Metal panels	R905.10	Manufacturer's instructions	ASTM D226 Type II ASTM D4869 Type III or Type IV
Photovoltaic shingles	R905.16	ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D4869 Type III or Type IV

Continued...

27



28

Clay and concrete tile

Changes in IRC 2021, Section R905.3-Clay and Concrete Tile

R905.3 Clay and concrete tile. The installation of clay and concrete tile shall comply with the provisions of this section.

R905.3.1 Deck requirements. Concrete and clay tile shall be installed only over solid sheathing.

Exception: Spaced lumber sheathing in accordance with Section R803.1 shall be permitted in *Seismic Design Categories A, B and C.*

29

Metal shingles

Changes in IRC 2021, Section R905.4-Metal Roof Shingles

R905.4.4.1 Wind resistance of metal roof shingles. *Metal roof shingles* applied to a solid or closely fitted deck shall be tested in accordance with ASTM D3161, FM 4474, UL 580 or UL 1897. *Metal roof shingles* tested in accordance with ASTM D3161 shall meet the classification requirements of Table R905.4.4.1 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a *label* to indicate compliance with ASTM D3161 and the required classification in Table R905.2.4.1.

30

TABLE R905.4.4.1
CLASSIFICATION OF STEEP SLOPE METAL ROOF SHINGLES TESTED IN ACCORDANCE WITH ASTM D3161

MAXIMUM ULTIMATE DESIGN WIND SPEED, V_{ult} FROM FIGURE R301.2(2) (mph)	MAXIMUM BASIC WIND SPEED, V_{ASD} FROM TABLE R301.2.1.3 (mph)	ASTM D3161 SHINGLE CLASSIFICATION
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

31

Wood shingles and shakes

Changes in IRC 2021, Section R905.7-Wood Shingles and Section R905.8-Wood Shakes

TABLE R905.7.5(2)
NAIL REQUIREMENTS FOR
WOOD SHAKES AND WOOD SHINGLES

PRODUCT TYPE	NAIL TYPE, MINIMUM LENGTH AND SHANK DIAMETER (inches)
Shakes	
18" straight-split	5d box $1\frac{3}{4}" \times 0.080$
18" and 24" handsplit and resawn	6d box $2" \times 0.099$
24" taper-split	5d box $1\frac{3}{4}" \times 0.080$
18" and 24" tapersawn	6d box $2" \times 0.099$
Shingles	
16" and 18"	3d box $1\frac{1}{4}" \times 0.076$
24"	4d box $1\frac{1}{2}" \times 0.076$

32

PV shingles – Wind resistance

Changes in IRC 2021, Section R905.16-Photovoltaic Shingles

R905.16.6 Wind resistance. *Photovoltaic shingles* shall comply with the classification requirements of Table R905.16.6 for the appropriate maximum basic wind speed.

**TABLE R905.16.6
CLASSIFICATION OF PHOTOVOLTAIC SHINGLES**

MAXIMUM ULTIMATE DESIGN WIND SPEED, V_{ult} , FROM FIGURE R301.2(2) (mph)	MAXIMUM BASIC WIND SPEED, V_{ASD} , FROM TABLE R301.2.1.3 (mph)	UL 7103 SHINGLE CLASSIFICATION
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

33

Unvented attics

Changes in IRC 2021, Section R806.5-Unvented Attics and Enclosed Rafter Spaces

ROOF-CEILING CONSTRUCTION

**SECTION R806
CEILING FINISHES**

R806.1 Ceiling installation. Ceilings shall be installed in accordance with the requirements for interior wall finishes as provided in Sections R702.1 through R702.6.

**SECTION R806
ROOF VENTILATION**

R806.1 Ventilation required. Unvented attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilating openings shall have a least dimension of $\frac{1}{8}$ inch (3.2 mm) minimum and $\frac{1}{4}$ inch (6.4 mm) maximum. Ventilating openings having a least dimension larger than $\frac{1}{8}$ inch (3.2 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth, perforated rigid or flexible material with openings having a least dimension of $\frac{1}{8}$ inch (3.2 mm) minimum and $\frac{1}{4}$ inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of Section R802.2. Required ventilating openings shall open directly to the outside air and shall be protected to prevent the entry of birds, rodents, snakes and other similar creatures.

R806.2 Minimum vent area. The minimum net free ventilating area shall be $\frac{1}{150}$ of the area of the vented space.

Exception: The minimum net free ventilation area shall be $\frac{1}{100}$ of the vented space provided both of the following conditions are met:

1. In Climate Zones 6, 7 and 8, a Class I or II vapor retarder is installed on the warm or winter side of the ceiling.
2. Not less than 40 percent and not more than 50 percent of the required ventilating area is provided by ventilators located in the upper portion of the attic or rafter space. Upper ventilators shall be located not more than 3 feet (914 mm) below the ridge or highest point of the space, measured vertically. The balance of the required ventilation provided shall be located in the bottom one-third of the attic space. Where the location of wall or roof framing members conflicts with the installation of upper ventilators, ventilation more than 12 feet (3658 mm) below the ridge or highest point of the space shall be provided.

R806.3 Vast and insulation clearance. Where rafter or ceiling voids are finished, blocking, bridging and insulation shall not block the free flow of air. Not less than a 3 inch (76 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.

R806.4 Installation and weather protection. Ventilators shall be installed in accordance with manufacturer's instructions. Installation of ventilators in roof systems shall be in accordance with the requirements of Section R905.16a.

size of ventilators in wall systems shall be in accordance with the requirements of Section R702.1.

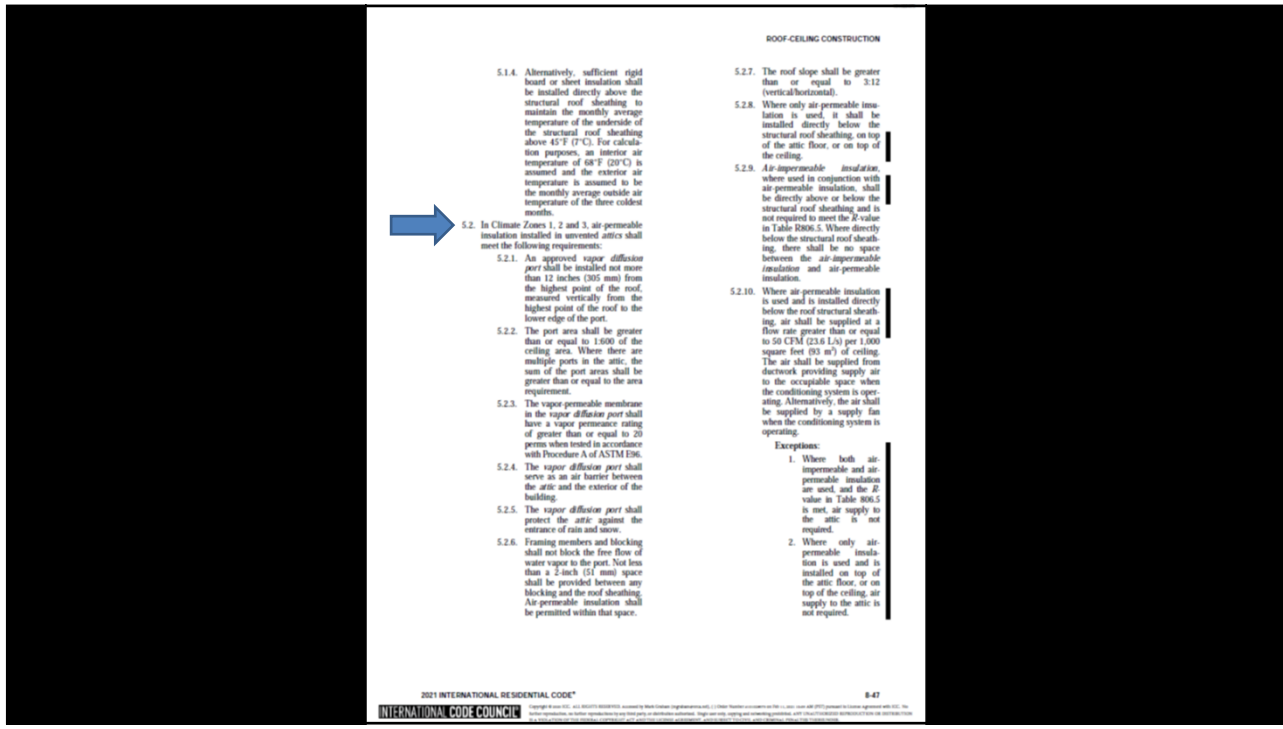
R806.5 Unvented attic and unvented enclosed rafter assemblies. Unvented attic and unvented enclosed rafter assemblies created by ceilings that are applied directly to the underside of the roof framing members and structural roof sheathing applied directly to the top of the roof framing members, shall be permitted where all the following conditions are met:

1. The unvented attic space is completely within the building thermal envelope.
2. Interior Class I vapor retarders are not installed on the ceiling and (one floor) or the unvented attic assembly or on the ceiling side of the unvented enclosed rafter assembly.
3. Where wood shingles or shakes are used, a minimum $\frac{1}{8}$ inch (3.2 mm) vented airspace separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. In Climate Zones 5, 6, 7 and 8, any air-impermeable insulation shall be a Class II vapor retarder or shall have a Class II vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Insulation shall comply with Item 5.1 and other Item 5.1 or 5.2:

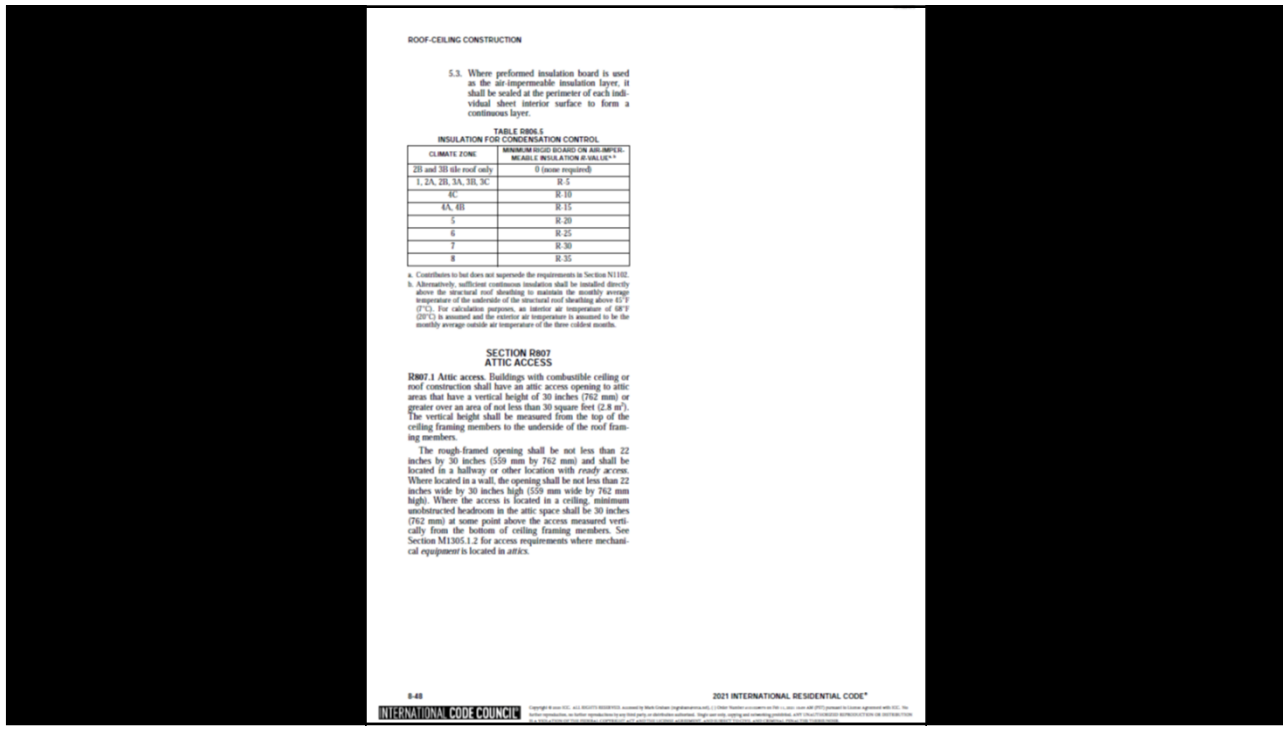
- 5.1. Item 5.1.1, 5.1.2, 5.1.3 or 5.1.4 shall be met, depending on the air permeability of the insulation directly above the structural roof sheathing.
 - 5.1.1. Where only air-impermeable insulation is provided, it shall be applied in direct contact with the underside of the structural roof sheathing.
 - 5.1.2. Where air-permeable insulation is installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing in accordance with the R-values in Table R806.5 for condensation control.
 - 5.1.3. Where both air-impermeable and air-permeable insulation are provided, the air-impermeable insulation shall be applied in direct contact with the underside of the structural roof sheathing in accordance with Item 5.1.1 and shall be in accordance with the R-values in Table R806.5 for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation.

8-48 2021 INTERNATIONAL RESIDENTIAL CODE®

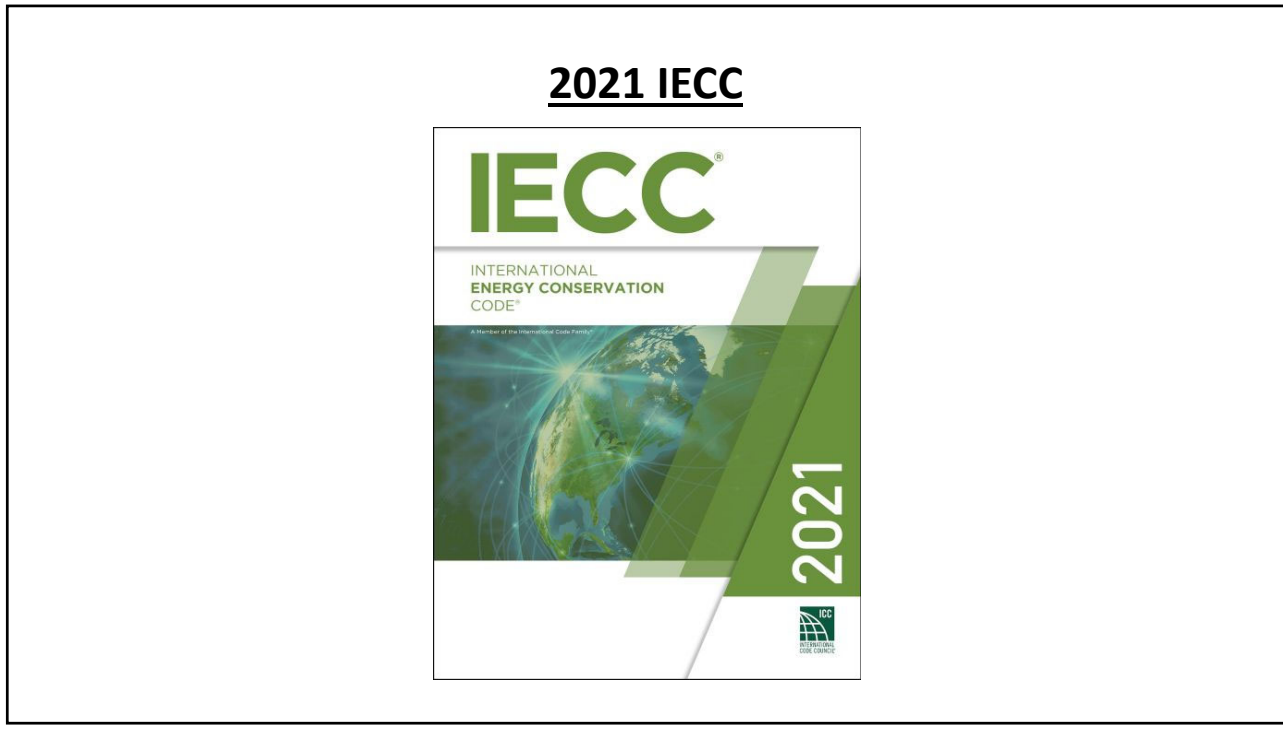
34



35



36



37

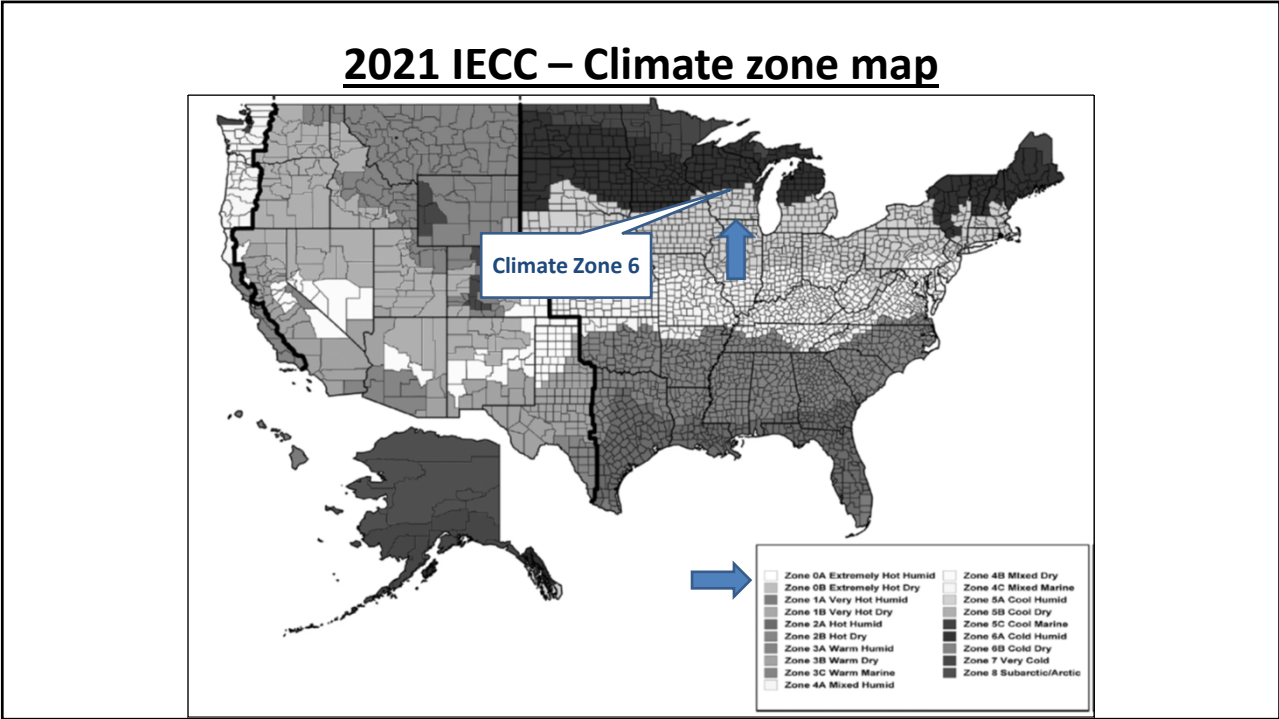
TABLE OF CONTENTS

<p><i>IECC—COMMERCIAL PROVISIONS</i> C-4</p> <p>CHAPTER 1 SCOPE AND ADMINISTRATION.....C1-1</p> <p>CHAPTER 2 DEFINITIONS.....C2-1</p> <p>CHAPTER 3 GENERAL REQUIREMENTS ... C3-1</p> <p>CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY C4-1</p> <p>CHAPTER 5 EXISTING BUILDINGS C5-1</p> <p>CHAPTER 6 REFERENCED STANDARDS ... C6-1</p> <p>APPENDIX CA BOARD OF APPEALS—COMMERCIAL .. APPENDIX CA-1</p> <p>APPENDIX CB SOLAR-READY ZONE—COMMERCIAL .. APPENDIX CB-1</p> <p>APPENDIX CC ZERO ENERGY COMMERCIAL BUILDING PROVISIONS..... APPENDIX CC-1</p> <p>INDEX.....INDEX C-1</p>	<p><i>IECC—RESIDENTIAL PROVISIONS</i> R-4</p> <p>CHAPTER 1 SCOPE AND ADMINISTRATION R1-1</p> <p>CHAPTER 2 DEFINITIONS R2-1</p> <p>CHAPTER 3 GENERAL REQUIREMENTS... R3-1</p> <p>CHAPTER 4 RESIDENTIAL ENERGY EFFICIENCY R4-1</p> <p>CHAPTER 5 EXISTING BUILDINGS R5-1</p> <p>CHAPTER 6 REFERENCED STANDARDS... R6-1</p> <p>APPENDIX RA BOARD OF APPEALS—RESIDENTIAL.....APPENDIX RA-1</p> <p>APPENDIX RB SOLAR-READY PROVISIONS—DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES ...APPENDIX RB-1</p> <p>APPENDIX RC ZERO ENERGY RESIDENTIAL BUILDING PROVISIONSAPPENDIX RC-1</p> <p>INDEXINDEX R-1</p>
---	--

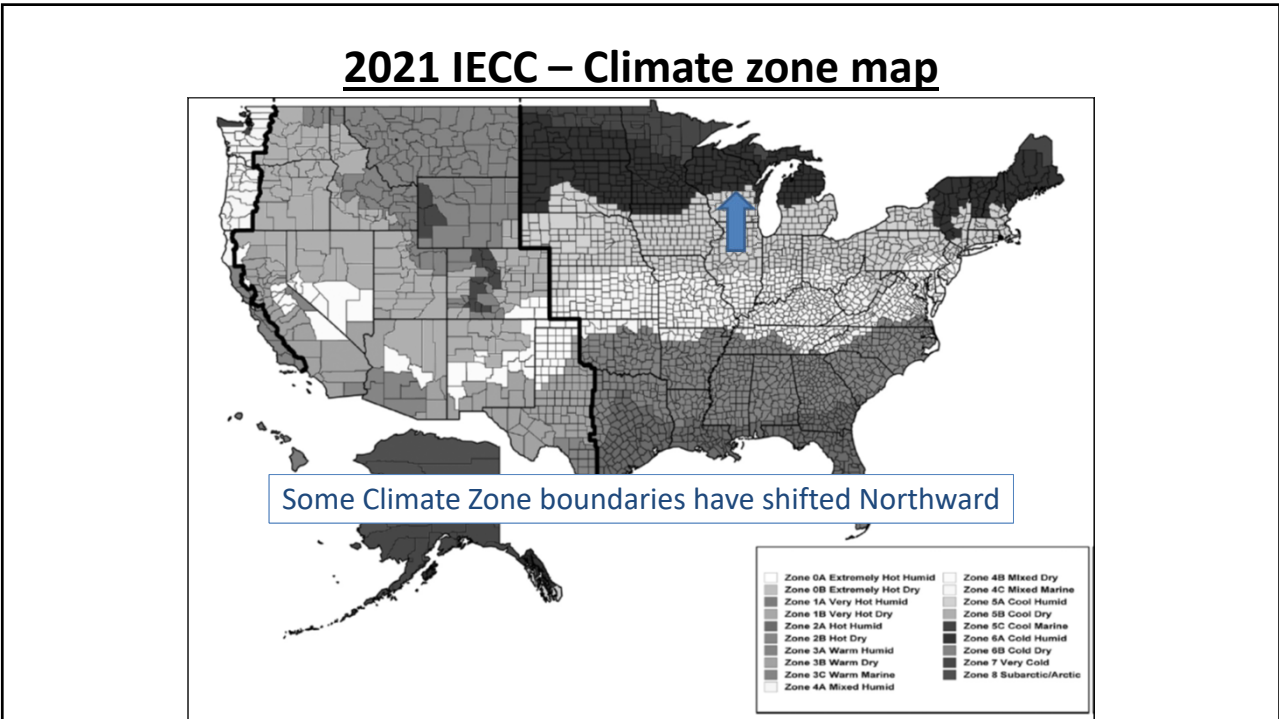
2021 INTERNATIONAL ENERGY CONSERVATION CODE®

INTERNATIONAL CODE COUNCIL

38



39



40

GENERAL REQUIREMENTS

TABLE C301.1—continued
CLIMATE ZONES, MOISTURE REGIMES, AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY*

WEST VIRGINIA—continued		GENERAL REQUIREMENTS	
4A Jefferson	6A Boone	6A Boone	
4A Kanawha	6A Cabnet	6A Cabnet	
4A Lewis	6A Chippewa	6A Chippewa	
4A Lincoln	6A Clark	6A Clark	
4A Logan	6A Columbia	6A Columbia	
4A Mingo	6A Crawford	6A Crawford	
4A Boone	6A Dine	6A Dine	
4A Hancock	6A Dodge	6A Dodge	
4A Mason	6A Door	6A Door	
4A McDowell	6A Douglas	6A Douglas	
4A Mercer	6A Drum	6A Drum	
4A Mineral	6A Eau Claire	6A Eau Claire	
4A Mingo	6A Florence	6A Florence	
4A Monongalia	6A Fond du Lac	6A Fond du Lac	
4A Monroe	6A Forest	6A Forest	
4A Morgan	6A Grant	6A Grant	
4A Nicholas	6A Green	6A Green	
4A Ohio	6A Green Lake	6A Green Lake	
4A Pendleton	6A Iowa	6A Iowa	
4A Pleasants	6A Ina	6A Ina	
4A Putnam	6A Jackson	6A Jackson	
4A Raleigh	6A Jefferson	6A Jefferson	
4A Randolph	6A Jones	6A Jones	
4A Richwood	6A Kanawha	6A Kanawha	
4A Boone	6A Kenosha	6A Kenosha	
4A Summers	6A Kewaunee	6A Kewaunee	
4A Taylor	6A La Crosse	6A La Crosse	
4A Tucker	6A Lafayette	6A Lafayette	
4A Tyler	6A Langlade	6A Langlade	
4A Upshur	6A Lincoln	6A Lincoln	
4A Wayne	6A Manitowish	6A Manitowish	
4A Webster	6A Manitowoc	6A Manitowoc	
4A West	6A Marquette	6A Marquette	
4A Wood	6A Marquette	6A Marquette	
4A Wyoming	6A Menominee	6A Menominee	
4A Adams	6A Milwaukee	6A Milwaukee	
4A Ashland	6A Monroe	6A Monroe	
4A Boone	6A Oconto	6A Oconto	
4A Boyfield	6A Oconto	6A Oconto	
4A Boone	6A Oshkosh	6A Oshkosh	
	6A Peoria	6A Peoria	
	6A Polk	6A Polk	
	6A Putnam	6A Putnam	

(continued)

2021 INTERNATIONAL ENERGY CONSERVATION CODE®

INTERNATIONAL CODE COUNCIL

IECC 2021
Climate Zone 5A

41

GENERAL REQUIREMENTS

TABLE C301.1—continued
CLIMATE ZONES, MOISTURE REGIMES, AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY*

3A San Saba*	3A Young	4C Clark	4A Gilmer	6A Adams
3B Schreiner	3B Columbia	5B Columbia	5A Grant	7 Ashland
3B Sevier	2B Zavala	4C Cowles	5A Greenlee	6A Boone
3B Shackelford	UTAH	5B Douglas	5A Hampshire	7 Boyfield
3A Shelby*	5B Beaver	6B Ferry	5A Hancock	6A Boone
4B Sherman	6B Ben Elder	5B Franklin	5A Hardy	6A Boone
3A Smith*	6B Boone	5B Garfield	5A Harrison	6A Boone
3A Somervell*	6B Carls	5B Grant	4A Jackson	7 Burnett
2A Stan*	6B Duggett	4C Gray Harbor	4A Jefferson	6A Cabnet
3A Stephens	5B Davis	4C Island	4A Kanawha	6A Chippewa
3B Stepling	5B DeWitt	4C Jefferson	5A Lewis	6A Clark
3B Stone	5B Emery	4C King	4A Lincoln	6A Columbia
3B Sutton	5B Garfield	4C Knap	4A Logan	6A Crawford
4B Swisher	5B Grand	5B Knott	5A Marion	6A Dine
3A Tarrant*	5B Grant	5B Klickitat	5A Marshall	6A Dodge
3B Taylor	5B Ina	4C Lewis	4A Mason	6A Door
3B Terry	5B Kane	5B Lincoln	4A McDowell	7 Douglas
3B Throckmorton	5B Millard	4C Mason	4A Mercer	6A Drum
3A Tins*	6B Morgan	6B Okanogan	5A Mineral	6A Eau Claire
3B Tom Green	5B Paine	4C Pacific	4A Mingo	7 Florence
2A Travis*	6B Rich	6B Paud O'Neill	5A Monongalia	6A Fond du Lac
2A Trinity*	5B Salt Lake	4C Pierce	4A Monroe	7 Forest
2A Tyler*	5B San Juan	4C San Juan	4A Morgan	6A Grant
3A Upton*	5B Saupeta	4C Skagit	5A Nicholas	6A Green Lake
3B Upton	5B Sevier	5B Skamania	5A Ohio	6A Ina
2B Uvalde	6B Summit	5B Spokane	4A Piasa	7 Ina
2B Val Verde	5B Toole	6B Stevens	5A Pocahontas	6A Jackson
3A Van Zandt*	6B Umatilla	4C Thurston	5A Preston	6A Jones
2A Victoria*	5B Utah	4C Wallowa	4A Putnam	6A Kewaunee
2A Walker*	6B Wasatch	5B Walla Walla	5A Raleigh	6A Lafayette
3B Walker	5B Washington	4C Whitson	5A Randolph	6A Langlade
3A Wise	5B Wayne	5B Whitman	4A Richland	7 Lincoln
2A Washington*	5B Weber	5B Yakima	5A Rowan	6A Manitowish
2B Webb	VERMONT	WEST VIRGINIA	5A Summers	6A Manitowoc
2B Wharton*	6A (all)	5A Barbour	5A Taylor	6A Marquette
3B Wheeler	VIRGINIA	4A Berkeley	5A Tucker	6A Marquette
3A Wichita	4A (all)	4A Boone	4A Tyler	6A Marquette
3B Wilber	WASHINGTON	4A Braxton	5A Upshur	6A Marinette
2A Wilkes*	5B Adams	5A Brooke	4A Wayne	6A Manitowish
3A Williams*	5B Adams	4A Cabell	5A Wayne	6A Milwaukee
2A Wilson*	5B Boone	4A Carter	4A Wetzel	6A Monroe
3B Winkler	5B Boone	4A Clay	4A West	6A Monroe
3A Wise	5B Chelan	5A Doddridge	4A Wood	7 Oconto
3A Wood*	4C Clallam	5A Fayette	4A Wyoming	6A Oconto
4B Yorkum				7 Oconto
				6A Outagamie

(continued)

2018 INTERNATIONAL ENERGY CONSERVATION CODE®

INTERNATIONAL CODE COUNCIL

WISCONSIN

IECC 2018
Climate Zone 6A

IECC 2018

42

2021 IECC Commercial – Tapered insulation

C402.2 Specific building thermal envelope insulation requirements. Insulation in *building thermal envelope* opaque assemblies shall comply with Sections C402.2.1 through C402.2.7 and Table C402.1.3.

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly.

COMMERCIAL ENERGY EFFICIENCY

C402.1.4.2 Thermal resistance of cold-formed steel walls. *C*-factor of walls with cold-formed steel shall be determined in accordance with Equation 4.1:

$$U = 1/R_s + [ZR] \quad \text{(Equation 4.1)}$$

where:

- R_s = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs.
- ZR = The effective *R*-value of the cavity insulation with steel studs as specified in Table C402.1.4.2.

NOMINAL STUD SPACING (inches)	SPACING OF STUDS (inches)	CAVITY ASSEMBLY (prescription)	CORRECTION FACTOR (Z)	EFFECTIVE R-VALUE (R _s + ZR)
P ₁	16	11	0.48	3.98
P ₁	24	11	0.52	3.80
6	16	11	0.37	3.61
6	24	11	0.41	3.53
6	16	22	0.32	3.70

C402.2 Specific building thermal envelope insulation requirements. Insulation in *building thermal envelope* opaque assemblies shall comply with Sections C402.2.1 through C402.2.7 and Table C402.1.3.

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly.

Prescriptive approach

45

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + R-11 LS	R-25 + R-11 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
Walls, below grade																
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
Floors																
Mass ^c	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below	R-25 for 48" below
Heated slabs ^d	R-7.5 for 12" below+ R-5 fall slab	R-7.5 for 12" below+ R-5 fall slab	R-7.5 for 12" below+ R-5 fall slab	R-7.5 for 12" below+ R-5 fall slab	R-10 for 24" below+ R-5 fall slab	R-10 for 24" below+ R-5 fall slab	R-15 for 24" below+ R-5 fall slab	R-15 for 24" below+ R-5 fall slab	R-15 for 36" below+ R-5 fall slab	R-15 for 36" below+ R-5 fall slab	R-15 for 36" below+ R-5 fall slab	R-15 for 36" below+ R-5 fall slab	R-20 for 48" below+ R-5 fall slab	R-20 for 48" below+ R-5 fall slab	R-20 for 48" below+ R-5 fall slab	R-20 for 48" below+ R-5 fall slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

a. Continuous Insulation, NR = No Requirement, LS = Linear System.

b. Assembly descriptions can be found in ANSI/ASHRAE/IESNA 90.1 Appendix A.

c. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.

d. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with augmented cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.

e. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

f. "Mass floors" shall be in accordance with Section C402.2.3.

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

46

2021 IECC Commercial – Tapered insulation

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly R-value calculation, the sloped roof insulation R-value contribution to that calculation shall use the average thickness in inches (mm) along with the material R-value-per-inch (per-mm) solely for R-value compliance as prescribed in Section 402.1.3.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R-value) of roof insulation in roof/ceiling construction.

C402.2.1.4 Joints staggered. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

C402.2.3 Floors. E-value as shown elsewhere over or shall be as follows:

“Main floor” where used as a component of the thermal envelope of a building shall provide one of the following weights:

1. 15 pounds per square foot (71 kg/m²) of floor surface area.
2. 27 pounds per square foot (122 kg/m²) of floor surface area where the nominal weight is not more than 120 pounds per square foot (54 kg/m²).

Exemptions:

1. The floor finish shall be:

“Slab on grade” shall mean an exterior floor slab that meets or exceeds the minimum E-value in Table C402.1.3 for “Slab on Grade” or “Ground-Framed and Other” values for “Walls, above grade” and extends from the bottom to the top of all perimeter floor framing or floor assembly members.

Insulation applied to the underside of concrete floor slabs shall be permitted on a surface of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the building thermal envelope.

C402.2.4 Slabs on grade. The minimum thermal resistance (R-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the E-value method of Section C402.1.3 shall be as specified in Table C402.1.3.

C402.2.4.1 Insulation installation. Where installed, the perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downwards from the top of the slab for the minimum distance shown in the table to the top of the footing, which, over its length, is downward to not less than the bottom of the slab nor horizontally to the exterior or interior face of the wall. Insulation extending over from the footing shall be permitted by pavement or by not less than 10 inches (254 mm) of soil. Where installed, full thickness insulation shall be continuous under the entire area of the slab-on-grade floor, except for certain, limited locations and service penetrations. Insulation required at the heated slab

C402.2.4.2 Insulation installation. Where installed, the perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downwards from the top of the slab for the minimum distance shown in the table to the top of the footing, which, over its length, is downward to not less than the bottom of the slab nor horizontally to the exterior or interior face of the wall. Insulation extending over from the footing shall be permitted by pavement or by not less than 10 inches (254 mm) of soil. Where installed, full thickness insulation shall be continuous under the entire area of the slab-on-grade floor, except for certain, limited locations and service penetrations. Insulation required at the heated slab

...average thickness...
 ...not less than 1 inch...
 ...more than 120 pcf (1901 kg/m³)
 2021 INTERNATIONAL ENERGY CONSERVATION CODE®

47

ICC 2021 Commercial – Roof Reflectivity

C402.2.5 Below-grade walls. The C-factor for the below-grade exterior walls shall be in accordance with Table C402.1.4. The E-value of the unheated exterior wall shall be determined in accordance with Section C402.1.3. The C-factor or E-value required shall extend to a depth of not less than 10 feet (3048 mm) below the finished ground level, or to the level of the lowest floor of the conditioned space indicated by the below-grade wall, whichever is less.

C402.2.6 Foundation of radiant heating systems. Radiant heating system panels, and their associated components that are installed as interior or exterior assemblies, shall be insulated to an E-value of not less than 2.5.5 on all surfaces not facing the space being heated. Radiant heating system panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than 2 inches of insulation installed in the space assembly in which they are installed or the assembly shall comply with Section C402.1.4.

Exemption: Heated slabs on grade installed in accordance with Section C402.2.4.

C402.2.7 Airspaces. Where the E-value of an airspace is used for compliance in accordance with Section C402.1, the airspace shall be enclosed in an unventilated cavity constructed in accordance with Section C402.1.3 and the enclosed airspace shall be deemed unconditioned where the enclosed airspace is located on the exterior side of the continuous air barrier and is bounded on all sides by building components.

Exemption: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to, and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace or as an unventilated cavity of not less than 75 mm nominal.

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs shall have uncoated conditioned spaces in Climate Zones 3 through 7 shall comply with one or more of the options in Table C402.3.

Exemption: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that are not covered by the following:
 - 1.1. Photovoltaic systems or components.
 - 1.2. Solar air or water-heating systems or components.
 - 1.3. Vegetation such as landscaped roofs.
 - 1.4. Above-roof decks or walkways.
 - 1.5. Skylights.
 - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Portions of roofs that are ballasted with a minimum mass ballast of 17 pounds per square foot (74 kg/m²) or 23 pcf (117 kg/m³) pavers.
4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions in this section.

TABLE C402.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS

Three-year aged solar reflectance index^a of 77 and 3-year aged thermal emittance^b of 75

Three-year aged solar reflectance index^a of 64

^a The use of area-weighted averages to comply with these requirements shall be permitted. Minimum lighting equipment heat gain from solar reflectance or thermal emittance shall be exempt with a 3-year aged solar reflectance in accordance with Section C402.1.1 and 3-year aged thermal emittance of 64.

^b Aged solar reflectance index is in accordance with ASTM C1363, ASTM D5101 or ASTM E1918 or CRIE-1010.

^c Aged thermal emittance index is in accordance with ASTM C1371 or ASTM E1918 or CRIE-1010.

^d Solar reflectance index (SRI) shall be determined in accordance with ASTM E1918 with a conversion coefficient of 1.1. $SRI = \frac{1}{0.09} (11 W/m^2 \cdot K) \cdot C$. Calculations of aged SRI that do not use aged test data shall be permitted.

C402.3.1 Aged roof solar reflectance. Where an aged solar reflectance is required by Section C402.3, if not available, it shall be determined in accordance with Equation 4-3:

$$R_{s,aged} = [0.2 + 0.7(R_{s,new}) - 0.2] \quad \text{(Equation 4-3)}$$

where:

- $R_{s,aged}$ = The aged solar reflectance
- $R_{s,new}$ = The initial solar reflectance determined in accordance with CRIE-5100.

C402.3.2 Emittance. Emittance shall comply with Sections C402.1.1 through C402.2.4 and Table C402.3. Daylight responsive controls shall comply with this section and Section C402.2.4.

COMMERCIAL ENERGY EFFICIENCY

2021 INTERNATIONAL ENERGY CONSERVATION CODE®

48

IECC 2021 Commercial – Air Retarders

COMMERCIAL ENDS

Daylight areas skylight shall be manufactured in accordance with Section C402.4.3.1.1. Compliance with Table C402.4.3.1.1 shall be considered as part of the assembly. Compliance with Section C402.4.3.1.1 shall be considered as part of the assembly.

C402.4.3.1.1 Skylight areas shall comply with Section C402.4.3.1.1.1. Compliance with Section C402.4.3.1.1.1 shall be considered as part of the assembly.

C402.4.3.1.1.1 Skylight areas shall comply with Section C402.4.3.1.1.1.1. Compliance with Section C402.4.3.1.1.1.1 shall be considered as part of the assembly.

C402.4.3.1.1.1.1 Skylight areas shall comply with Section C402.4.3.1.1.1.1.1. Compliance with Section C402.4.3.1.1.1.1.1 shall be considered as part of the assembly.

COMMERCIAL ENERGY EFFICIENCY

code official. The measured air leakage shall not exceed 0.40 cfm/ft² (2.0 L/s • m²) of the building thermal envelope area at pressure differential of 0.3 inch water gauge (7.5 Pa). Alternatively, portions of the building shall be tested and the measured air leakage shall be area weighted by the surface area of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

- The entire envelope area of all stories that have any space directly under a roof.
- The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or an below grade.
- Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft² (2.0 L/s • m²), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized using a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

C402.4 Air Leakage of Penetration. The air leakage of building penetrations shall meet the provisions of Table C402.5.4. Testing shall be in accordance with the applicable reference test detailed in Table C402.5.4 by an accredited, independent testing laboratory and labeled by the manufacturer.

Exception:

- Field fabricated penetrations assemblies that are tested in accordance with Section C402.5.1.
- Penetrations in buildings that comply with the testing alternative of Section C402.1.3 are not required to meet the air leakage requirements in Table C402.5.4.

C402.5.5 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

- The room or space containing the appliance shall be located outside of the building thermal envelope.
- The room or space containing the appliance shall be enclosed and isolated from conditioned space inside the building thermal envelope. Such rooms shall comply with all of the following:
 - The walls, floors and ceiling that separate the enclosed rooms or spaces from conditioned spaces shall be sealed to be not less than equivalent to the construction requirement of below-grade walls as specified in Table C402.1.3 or Table C402.1.4.
 - The walls, floors and ceiling that separate the enclosed rooms or spaces from conditioned spaces shall be sealed in accordance with Section C402.3.1.1.

TABLE C402.5.4
MAXIMUM AIR LEAKAGE RATE FOR PENETRATION ASSEMBLIES

PENETRATION ASSEMBLY	MAXIMUM RATE (CFM/FT ²)	TEST PROCEDURE
Windows	0.20	
Sliding doors	0.20 ^a	
Swinging doors	0.20 ^a	ASTM D2584, ASTM E1106, or NFRC 400
Skylights—non-condensation wrap-up springs	0.20	
Skylights—oil-rub	0.20 ^a	
Climate walls	0.05	
Clustering glazing	0.05	
Commercial glass window entrance doors	1.00	NFRC 400 or ASTM E330 at 1.57 psf (71 Pa)
Power-operated rolling doors and power-operated sliding doors	1.00	
Louvering doors	1.00	
Ceiling doors	1.00	
Rolling doors	1.00	ASTM D2584, NFRC 400, or ASTM E330 at 1.57 psf (71 Pa)
High-speed doors	1.00	

Note: 1. ^a Only for air masses < 0.47 L/s • m² (1.00 cfm/ft²).

2. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with ASTM D2584, ASTM E1106, or ASTM E330.

49

IECC 2021 Commercial-- Reroofing

EXISTING BUILDINGS

C402.4.1.1. The addition shall comply with Section C402.1.3, C402.4.3 or C407.

2. Where an addition has vertical fenestration that results in a total building fenestration area greater than Section C402.4.1.1 or an addition that exceeds the fenestration area greater than that permitted by Section C402.4.1.1, the fenestration shall comply with Section C402.4.1.1 for the addition only.

3. Where an addition has vertical fenestration that results in a total building vertical fenestration area exceeding that permitted by Section C402.4.1.1, the addition shall comply with Section C402.1.3 or C407.

C402.3.2 Skylight area. Skylights shall comply with the following:

- Where an addition has any skylight area that results in a total building fenestration area less than or equal to that permitted by Section C402.4.1.1, the addition shall comply with Section C402.1.3 or C407.
- Where an addition has any skylight area that results in a total building fenestration area greater than permitted by Section C402.4.1.1 or where additions have skylight area greater than that permitted by Section C402.4.1.1, the skylight area shall comply with Section C402.1.3 for the addition only.
- Where an addition has skylight area that results in a total building skylight area exceeding that permitted by Section C402.4.1.1, the addition shall comply with Section C402.1.3 or C407.

C402.3.3 Building mechanical systems. New mechanical systems and equipment that are part of the addition and serve the building heating, cooling and ventilation needs shall comply with Sections C403 and C406.

C402.3.4 Service water heating systems. New service water heating equipment, controls, and service water heating piping shall comply with Section C404.

C402.3.5 Pools and spas. Pools and spas shall comply with Section C405.9.

C402.3.6 Lighting power and systems. New lighting systems that are installed as part of the addition shall comply with Sections C403 and C406.

C402.3.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Section C403.2 for the addition alone, or the existing building and the addition shall comply in a single building.

C402.3.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Section C403.2 for the addition alone, or the existing building and the addition shall comply in a single building.

SECTION C503 ALTERATIONS

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503.1.1. The alterations shall be such that the existing building or structure is not less conditioning to the provisions of this code than the existing building or structure was prior to the alteration. Alternatively, an existing building, building system, or portion thereof shall conform to the provisions of this code if those provisions relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alternatively, shall not occur as a result of hazardous conditions or overlaid existing building system.

Exception: The following alterations need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

- Structural alterations that are required to repair or replace damaged or deteriorated structural members.
- Surface-applied window films installed on existing single-pane fenestration assemblies, including solar heat gain control, provided that the code does not require the glazing or fenestration to be replaced.
- Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
- Construction where the existing roof, wall or floor cavity is not exposed.
- Roof repairs.
- Air barriers shall not be required for reroofing and roof replacement where the alterations or replacements to the building do not include alterations, renovations or repairs to the remainder of the building assembly.

TABLE C503.2.1
Roof replacement. Roof replacements shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck. In no case shall the R-value of the roof insulation be reduced or the U-factor of the roof assembly be increased as part of the roof replacement.

50

IECC 2021 Residential -- Application

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

USER NOTE
About this chapter: Chapter 4 presents the paths and options for compliance with the energy efficiency provisions. Chapter 4 contains energy efficiency provisions for the building envelope, mechanical and water heating systems, lighting and electrical efficiency requirements, a performance alternative, energy saving alternatives, and tropical climate alternatives and also provides a table for energy code compliance other than by the prescriptive method.

R401.2 Application. Residential buildings shall comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections R401 through R404.

R401.2.2 Total Building Performance Option. The Total Building Performance Option requires compliance with Section R405.

R401.2.3 Energy Rating Index Option. The Energy Rating Index (ERI) Option requires compliance with Section R406.

R401.2.4 Tropical Climate Region Option. The Tropical Climate Region Option requires compliance with Section R407.

3. For buildings complying with the Energy Rating Index alternative in Section R401.2.3, the Energy Rating Index value shall be at least 1 percent less than the Energy Rating Index value specified in Table R404.1.

The options selected for compliance shall be identified in the conditions required by Section R401.3.

R401.3 Certificate. A permanent certificate shall be completed by the holder or other approved party and posted on a wall in the space where the fixture is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the correct directory label, service disconnect label or other required labels. The certificate shall indicate the following:

1. The predominant R-value of insulation installed in or on ceilings, walls, walls, foundation components such as walls, basement walls, crawl space walls and floors and doors outside conditioned spaces.
2. U-factors of insulation and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value of fenestration.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The type, size and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or heat-pump electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "heat-pump electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric heat-pump heaters.
5. Where on-site photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, lock work and window

51

IECC 2021 Residential -- Attics

RESIDENTIAL ENERGY EFFICIENCY

R402.1 Ceilings with attic spaces. Where Section R402.1.3 requires R-49 insulation in the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation whenever the full length of uncompressed R-38 insulation extends over the wall top plane at the eave. Where Section R402.1.3 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation whenever the full length of uncompressed R-49 insulation extends over the wall top plane at the eave. This reduction shall not apply to the insulation and fenestration criteria in Section R402.1.2 and the Total UA alternative in Section R402.1.5.

R402.2 Ceilings without attics. Where Section R402.1.3 requires insulation R-value greater than R-30 in the unvented space above a ceiling and below the structural roof deck, and the design of the roof-ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation R-value for such roof-ceiling assemblies shall be R-30. Insulation shall extend over the top of the wall plane to the outer edge of each plane and shall not be compressed. The reduction of insulation from the requirements of Section R402.1.3 shall be limited to 100 square feet (9.3 m²) or 20 percent of the total unvented ceiling area, whichever is less. This reduction shall not apply to the Total UA alternative in Section R402.1.5.

R402.3 Eave baffles. For air-permeable insulation in unvented attics, a baffle shall be installed adjacent to rafters and eave vents. Baffles shall maintain a net free area opening equal to or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. The baffle shall be installed to the outer edge of the exterior wall top plane as to provide continuous space for attic insulation coverage over the top plane. Where eave venting is not continuous, baffles shall be installed continuously to prevent conditioned air in the eave vents from bypassing the baffles.

R402.4 Access hatches and doors. Access hatches and doors from conditioned to unconditioned spaces such as attics and crawl spaces shall be installed to the same R-value required by Table R402.1.3 for the wall or ceiling in which they are installed.

- Exceptions:**
1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the insulation requirements of Table R402.1.3 based on the applicable climate zone specified in Chapter 3.
 2. Horizontal pull-down, non-type access hatches in ceiling assemblies that provide access from

conditioned to unconditioned spaces in Climate Zones 0 through 4 shall not be required to comply with the insulation level of the surrounding surfaces provided the hatch meets all of the following:

1. The average U-factor of the hatch shall be less than or equal to U-0.10 or have an average insulation R-value of R-10 or greater.
2. The net free area of the hatch shall be less than or equal to 13.3 square feet (1.2 m²).
3. The net area of the closed opening shall be less than or equal to 13.3 square feet (1.2 m²).
4. The perimeter of the hatch edge shall be weatherstripped.

This reduction shall not apply to the Total UA alternative in Section R402.1.5.

R402.4.1 Access hatches and door insulation installation and retention. Vertical or horizontal access hatches and doors from conditioned space to unconditioned spaces such as attics and crawl spaces shall be weatherstripped. Access that prevents damage to or compression of the insulation shall be provided for all equipment. Where loose-fill insulation is installed, a wind-blown or expanded baffle or screen, or fans shall be installed to prevent the loose-fill insulation from spilling into the living space. Fans higher to lower sections of the attic and from attics covering conditioned spaces to unconditioned spaces. The baffle or screen shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

R402.5 Mass walls. Mass walls where used as a component of the building thermal envelope shall be one of the following:

1. Above-ground walls of concrete block, concrete, insulated concrete form, masonry cavity block but not brick veneer, adobe, compressed earth block, rammed earth, solid masonry, mass masonry or solid logs.
2. Any wall having a heat capacity greater than or equal to 8 Btu/ft² · °F (21 kJ/m² · °C).

R402.6 Steel frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall comply with the insulation requirements of Table R402.1.6 or the U-factor requirements of Table R402.1.2. The calculation of the U-factor for a steel-frame envelope assembly shall use a seven-pointed path calculation method.

52

ICC is changing its development process for future editions of the IECC to their standard development process.

53



54

IEBC 2021 -- Reroofing

CHAPTER 7 ALTERATIONS—LEVEL 1

User note:
 About this chapter: Chapter 7 provides the technical requirements for those existing buildings that undergo Level 1 alterations as described in Section 602 which includes replacement or covering of existing material, elements, equipment or fixtures using like materials for the same purpose. This chapter, similar to other chapters of this code, covers all building-related subjects, such as structural, mechanical, plumbing, electrical and accessibility as well as the fire and life safety issues when the alterations are classified as Level 1. The purpose of this chapter is to provide detailed requirements and provisions to identify the required improvements in the existing building element, building system and building structural system. This chapter is distinguished from Chapters 8 and 9 by involving only replacement of building components with new components. In contrast, Level 2 alterations involve more space reconfiguration, and Level 3 alterations involve more extensive space reconfiguration, exceeding 50 percent of the building area.

**SECTION 701
GENERAL**

701.1 Scope. Level 1 alterations as described in Section 602 shall comply with the requirements of this chapter. Level 1 alterations to historic buildings shall comply with this chapter, except as modified in Chapter 12.

701.2 Conference. An existing building or portion thereof shall not be altered such that the building becomes less safe than its existing condition.

Exception: Where the current level of safety or condition is proposed to be reduced, the portion altered shall conform to the requirements of the International Building Code.

(B) 701.3 Flood hazard areas. In flood hazard areas, alterations that require substantial improvement shall require that the building comply with Section 612 of the International Building Code or Section 522 of the International Residential Code, as applicable.

**SECTION 702
BUILDING ELEMENTS AND MATERIALS**

702.1 Interior finishes. Newly installed interior wall and ceiling finishes shall comply with Chapter 8 of the International Building Code.

702.2 Interior floor finish. New interior floor finish, including new carpeting used as an interior floor finish material, shall comply with Section 804 of the International Building Code.

702.3 Interior trim. Newly installed interior trim materials shall comply with Section 806 of the International Building Code.

702.4 Window opening control devices on replacement windows. In Group R-2 or R-3 buildings containing dwelling units and one- and two-family dwellings and townhouses regulated by the International Residential Code, window opening control devices complying with ASTM F2090 shall be installed when an existing window is replaced and when all of the following apply to the replacement window:

1. The window is operable.
2. One of the following applies:
 - 2.1 The window replacement includes replacement of the sash and frame.
 - 2.2 The window replacement includes the sash only when the existing frame remains.
3. One of the following applies:
 - 3.1 In Group R-2 or R-3 buildings containing dwelling units, the bottom of the clear opening of the window opening is at a height less than 36 inches (915 mm) above the finished floor.
 - 3.2 In one- and two-family dwellings and townhouses regulated by the International Residential Code, the bottom of the clear opening of the window opening is at a height less than 24 inches (610 mm) above the finished floor.
4. The window will permit openings that will allow passage of a 4-inch-diameter (102 mm) sphere when the window is in its largest opened position.
5. The vertical distance from the bottom of the clear opening of the window opening to the finished grade or other surface below, on the exterior of the building, is greater than 72 inches (1829 mm).

Exception: Operable windows where the bottom of the clear opening of the window opening is located more than 75 feet (22 800 mm) above the finished grade or other surface below, on the exterior of the room, space or building, and that are provided with window fall prevention devices that comply with ASTM F2096.

702.5 Replacement window for emergency escape and rescue openings. In new windows required to provide emergency escape and rescue openings in Group R-2 and R-3 occupancies and one- and two-family dwellings and townhouses regulated by the International Residential Code, replacement windows shall be exempt from the requirements of Section 702.4.

55

ALTERATIONS—LEVEL 1

of Section 1011.3 of the International Building Code and Section 2310.2 of the International Residential Code, provided that the replacement window meet the following conditions:

1. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening.
 2. Where the replacement window is part of a change of occupancy it shall comply with Section 1011.5.6.
- 702.5.1 Control devices.** Window opening control devices or fall prevention devices complying with ASTM F2090 shall be permitted for use on windows required to provide emergency escape and rescue openings. After operation to release the control device allowing the window to fully open, the control device shall not reduce the net clear opening area of the window unit. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools.
- 702.6 Bars, grilles, covers or screens.** Bars, grilles, covers, screens or similar devices are permitted to be placed over emergency escape and rescue openings, built-in enclosures or window wells that serve such openings, provided all of the following conditions are met:
1. The minimum net clear opening size complies with the code that was in effect at the time of construction.
 2. Such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the escape and rescue opening.
 3. Where such devices are installed, they shall not reduce the net clear opening of the emergency escape and rescue opening.
 4. Smoke alarms shall be installed in accordance with Section 907.1.1.1 of the International Building Code.

702.7 Materials and methods. New materials and methods required by the International Building Code, International Existing Building Code, International Fire Code and International Fuel Gas Code, as applicable, that specify material standards, details of installation and construction, joints, penetrations and continuity of any element, component or system in the building.

(FG) 702.7.1 International Fuel Gas Code. The following sections of the International Fuel Gas Code shall constitute the fuel gas materials and methods requirements for Level 1 alterations:

1. Chapter 3, entitled "General Regulations," except Sections 303.7 and 306.
2. Chapter 4, entitled "Gas Piping Installations," except Sections 401.8 and 402.2.
 - 2.1. Sections 401.8 and 402.2 shall apply where the work being performed increases the load on the system such that the existing pipe does not meet the size required by code. Existing systems that are modified shall not require reventing as long as the load on the system is not increased and the

system length is not increased even if the altered system does not meet code requirements.

3. Chapter 5, entitled "Chimneys and Vents."
4. Chapter 6, entitled "Specific Appliances."

SECTION 703 FIRE PROTECTION

703.1 General. Alterations shall be done in a manner that maintains the level of fire protection provided.

SECTION 704 MEANS OF EGRESS

704.1 General. Alterations shall be done in a manner that maintains the level of protection provided for the means of egress.

704.1.1 Projections in sleeping home corridors. In Group I-2, Condition 1 occupancies, where the corridor is at least 96 inches (2438 mm) wide, projections into the corridor width are permitted in accordance with Section 407.4.3 of the International Building Code.

704.2 Casework. Addition, alteration or reconfiguration of modified and movable cases, counters and partitions not over 5 feet 9 inches (1753 mm) in height shall maintain the required means of egress path.

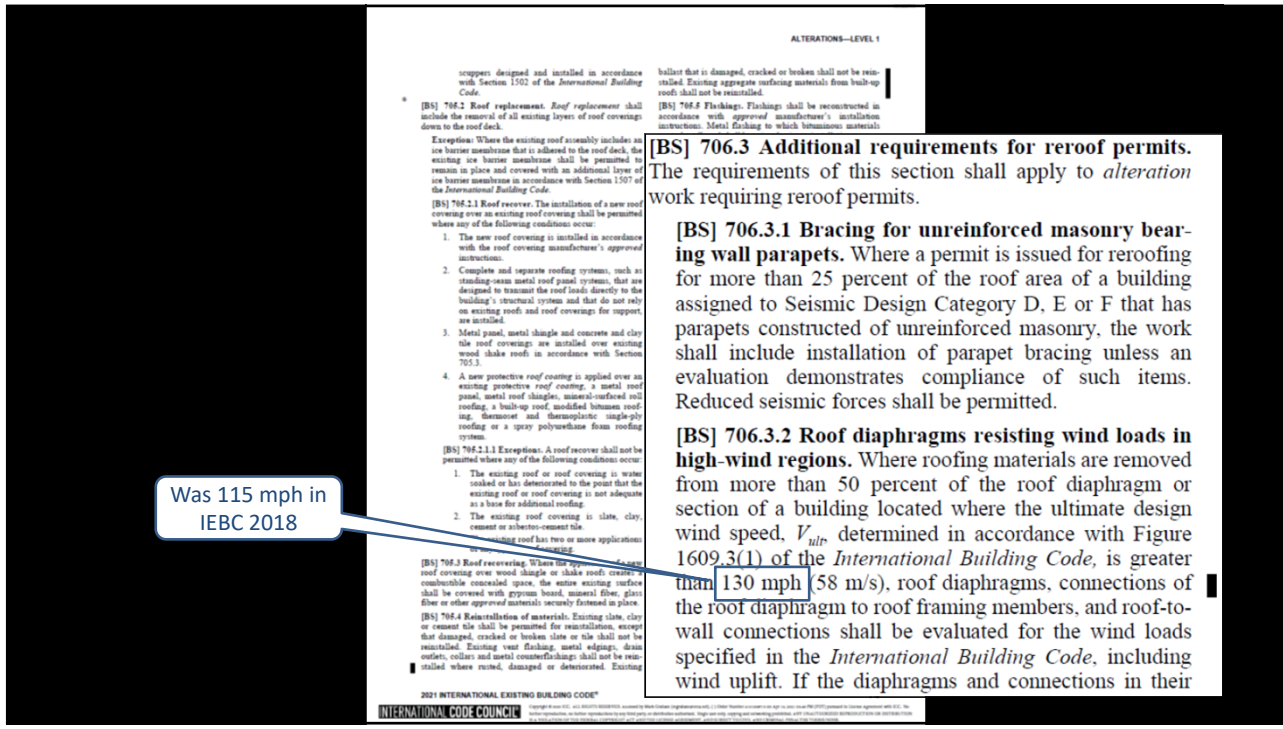
704.3 Locking arrangements in educational occupancies. In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep students from entering the room shall comply with Section 1010.2.8 of the International Building Code.

SECTION 705 REROOFING

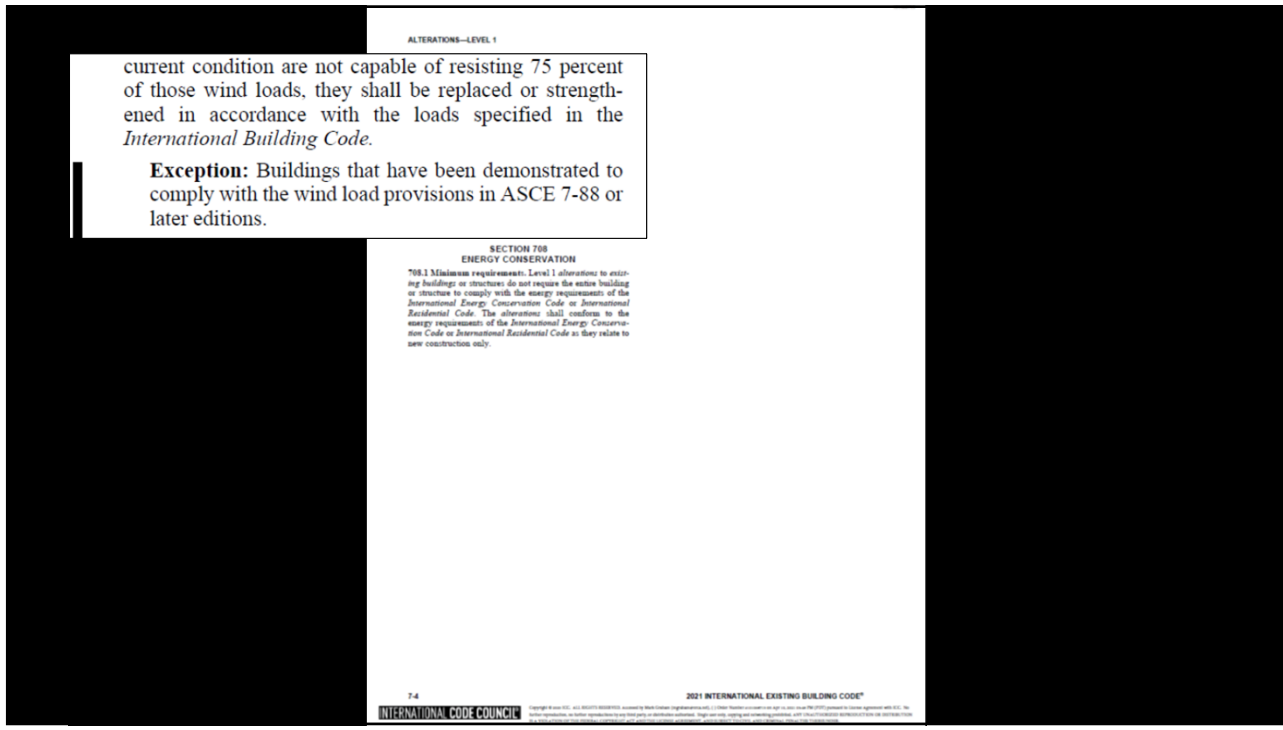
(B) 705.1 General. Materials and methods of application used for reroofing or replacing an existing roof covering shall comply with the requirements of Chapter 15 of the International Building Code.

- Exception:**
1. Roof replacement or roof remove of existing low-slope roof coverings shall not be required to meet the minimum design slope requirement of 1/4" vertical in 12" horizontal (2 percent slope) in Section 1507 of the International Building Code for roofs that provide positive roof drainage.
 2. Reroofing or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or straps in Section 1502 of the International Building Code for roofs that provide positive roof drainage. For the purpose of this exception, existing secondary drainage or strap systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or

56



57



58



International Fire Code, 2021 Edition

- Ch. 2-Definitions (torch-applied roof system)
- Sec. 303-Asphalt Kettle
- Sec. 317-Landscaped Roofs
- Sec. 905-Landscaped Roofs
- Sec. 3318-Safeguarding Roofing Operations

59

CHAPTER TOPICS

Parts and Chapters	Subjects
Part I—Chapters 1 and 2	Administrative and definitions
Part II—Chapters 3 and 4	General safety provisions
Part III—Chapters 5 through 12	Building and equipment design features
Part III—Chapters 13 through 19	Reserved for future use
Part IV—Chapters 20 through 40	Special occupancies and operations
Part IV—Chapters 41 through 49; 52	Reserved for future use
Part V—Chapters 50, 51 and 53 through 67	Hazardous materials
Part V—Chapters 68 through 79	Reserved for future use
Part VI—Chapter 80	Referenced standards
Part VII—Appendices A through N	Adoptable and informational appendices

60

raft shall not create an obstruction that is less than 7 feet (2133 mm) high above the surface of the roof.

Exceptions:

- Such obstruction shall be permitted where the wire, cable, rope, antenna or suspended obstruction is encased in a white, 2-inch (51 mm) minimum diameter plastic pipe or an approved equivalent.
- Such obstruction shall be permitted where there is a solid obstruction below such that accidentally walking into the wire, cable, rope, antenna or suspended obstruction is not possible.

316.5 Security device. Any security device or system that restricts any means that could obscure a means of egress in any building, structure or premises shall be prohibited.

316.6 Structures and outdoor storage underneath high-voltage transmission lines. Structures and outdoor storage underneath high-voltage transmission lines shall comply with Sections 316.6.1 and 316.6.2, respectively.

316.6.1 Structures. Structures shall not be constructed within the utility easement beneath high-voltage transmission lines.

Exception: Restrooms and unoccupied telecommunication structures of noncombustible construction less than 15 feet (4572 mm) in height.

316.6.2 Outdoor storage. Outdoor storage within the utility easement underneath high-voltage transmission lines shall be limited to noncombustible material. Storage of hazardous materials including, but not limited to, flammable and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports and building service equipment.

317.4 Vegetation. Vegetation shall be maintained in accordance with Sections 317.4.1 and 317.4.2.

317.4.1 Irrigation. Supplemental irrigation shall be provided to maintain levels of hydration necessary to keep green roof plants alive and to keep dry foliage to a minimum.

317.4.2 Dead foliage. Excess biomass, such as overgrown vegetation, leaves and other dead and decaying material, shall be removed at regular intervals not less than two times per year.

317.4.3 Maintenance plan. The fire code official is authorized to require a maintenance plan for vegetation placed on roofs due to the size of a landscaped roof, materials used or where a fire hazard exists to the building or exposures due to the lack of maintenance.

317.5 Maintenance equipment. Fueled equipment stored on roofs and used for the care and maintenance of vegetation on roofs shall be stored in accordance with Section 313.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports and building service equipment.

317.4 Vegetation. Vegetation shall be maintained in accordance with Sections 317.4.1 and 317.4.2.

317.4.1 Irrigation. Supplemental irrigation shall be provided to maintain levels of hydration necessary to keep green roof plants alive and to keep dry foliage to a minimum.

317.4.2 Dead foliage. Excess biomass, such as overgrown vegetation, leaves and other dead and decaying material, shall be removed at regular intervals not less than two times per year.

317.4.3 Maintenance plan. The fire code official is authorized to require a maintenance plan for vegetation placed on roofs due to the size of a landscaped roof, materials used or where a fire hazard exists to the building or exposures due to the lack of maintenance.

317.5 Maintenance equipment. Fueled equipment stored on roofs and used for the care and maintenance of vegetation on roofs shall be stored in accordance with Section 313.

SECTION 319 MOBILE FOOD PREPARATION VEHICLES

319.1 General. Mobile food preparation vehicles that are equipped with appliances that produce smoke or grease-laden vapors shall comply with this section.

319.2 Permit required. Permits shall be required as set forth in Section 105.5.

319.3 Exhaust hood. Cooking equipment that produces grease-laden vapors shall be provided with a kitchen exhaust hood in accordance with Section 606.

319.4 Fire protection. Fire protection shall be provided in accordance with Sections 210.4.1 and 210.4.2.

319.4.1 Fire protection for cooking equipment. Cooking equipment shall be protected by automatic fire-extinguishing systems in accordance with Section 904.13.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

SECTION 319 MOBILE FOOD PREPARATION VEHICLES

319.1 General. Mobile food preparation vehicles that are equipped with appliances that produce smoke or grease-laden vapors shall comply with this section.

319.2 Permit required. Permits shall be required as set forth in Section 105.5.

319.3 Exhaust hood. Cooking equipment that produces grease-laden vapors shall be provided with a kitchen exhaust hood in accordance with Section 606.

319.4 Fire protection. Fire protection shall be provided in accordance with Sections 210.4.1 and 210.4.2.

319.4.1 Fire protection for cooking equipment. Cooking equipment shall be protected by automatic fire-extinguishing systems in accordance with Section 904.13.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

Vegetative Roofs

IFC 2021, Section 317-Landscaped Roofs

61

FIRE PROTECTION AND LIFE SAFETY SYSTEMS

4. At public entrances at the perimeter line of an open mall building.

5. At other locations as necessary so that the distance to reach all portions of a tenant space does not exceed 200 feet (60 960 mm) from a hose connection.

905.3.4 Stages. Stages greater than 1,000 square feet (93 m²) in area shall be equipped with a Class III wet standpipe system with 1 1/2-inch and 2 1/2-inch (38 mm and 64 mm) hose connections on each side of the stage.

Exception: Where the building or area is equipped throughout with an automatic sprinkler system, a 1 1/2-inch (38 mm) hose connection shall be installed in accordance with NFPA 13 or in accordance with NFPA 14 for Class II or III standpipes.

905.3.4.1 Hose and cabinet. The 1 1/2-inch (38 mm) hose connections shall be equipped with sufficient lengths of 1 1/2-inch (38 mm) hose to provide fire protection for the stage area. Hose connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or on a rack.

905.3.5 Underground buildings. Underground buildings shall be equipped throughout with a Class I automatic wet or manual wet standpipe system.

905.3.6 Helistops and helipads. Buildings with a roof-top helistop or helipad shall be equipped with a Class I or III standpipe system extended to the roof level on which the helistop or helipad is located in accordance with Section 2007.5.

905.3.7 Marinas and boatyards. Standpipes in marinas shall be equipped throughout with a Class I automatic wet or manual wet standpipe system.

905.3.8 Landscaped roofs. Buildings or structures that have landscaped roofs and that are equipped with a standpipe system shall have the standpipe system extended to the roof level on which the landscaped roof is located.

Exception: In buildings equipped throughout with an approved automatic sprinkler system, laterals that are not located within an interior exit passageway are not required to be enclosed within fire-resistance-rated construction.

905.4.2 Interconnection. In buildings where more than one standpipe is provided, the standpipes shall be interconnected in accordance with NFPA 14.

905.5 Location of Class II standpipe hose connections. Class II standpipe hose connections shall be located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose. Class II standpipe hose connections shall be located where they have ready access.

905.5.1 Groups A-1 and A-2. In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

905.5.2 Protection. Fire-resistance-rated protection of risers and laterals of Class II standpipe system is not required.

905.4.1 Protection. Risers and laterals of Class I standpipe systems not located within an interior exit passageway shall be protected by a degree of fire resistance equal to that required for vertical enclosures in the building in which they are located.

Exception: In buildings equipped throughout with an approved automatic sprinkler system, laterals that are not located within an interior exit passageway are not required to be enclosed within fire-resistance-rated construction.

905.4.2 Interconnection. In buildings where more than one standpipe is provided, the standpipes shall be interconnected in accordance with NFPA 14.

905.5 Location of Class II standpipe hose connections. Class II standpipe hose connections shall be located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose. Class II standpipe hose connections shall be located where they have ready access.

905.5.1 Groups A-1 and A-2. In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

905.5.2 Protection. Fire-resistance-rated protection of risers and laterals of Class II standpipe system is not required.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

SECTION 319 MOBILE FOOD PREPARATION VEHICLES

319.1 General. Mobile food preparation vehicles that are equipped with appliances that produce smoke or grease-laden vapors shall comply with this section.

319.2 Permit required. Permits shall be required as set forth in Section 105.5.

319.3 Exhaust hood. Cooking equipment that produces grease-laden vapors shall be provided with a kitchen exhaust hood in accordance with Section 606.

319.4 Fire protection. Fire protection shall be provided in accordance with Sections 210.4.1 and 210.4.2.

319.4.1 Fire protection for cooking equipment. Cooking equipment shall be protected by automatic fire-extinguishing systems in accordance with Section 904.13.

SECTION 317 LANDSCAPED ROOFS

317.1 General. Landscaped roofs shall be installed and maintained in accordance with Sections 317.2 through 317.5 and Sections 1505 and 1507.16 of the *International Building Code*.

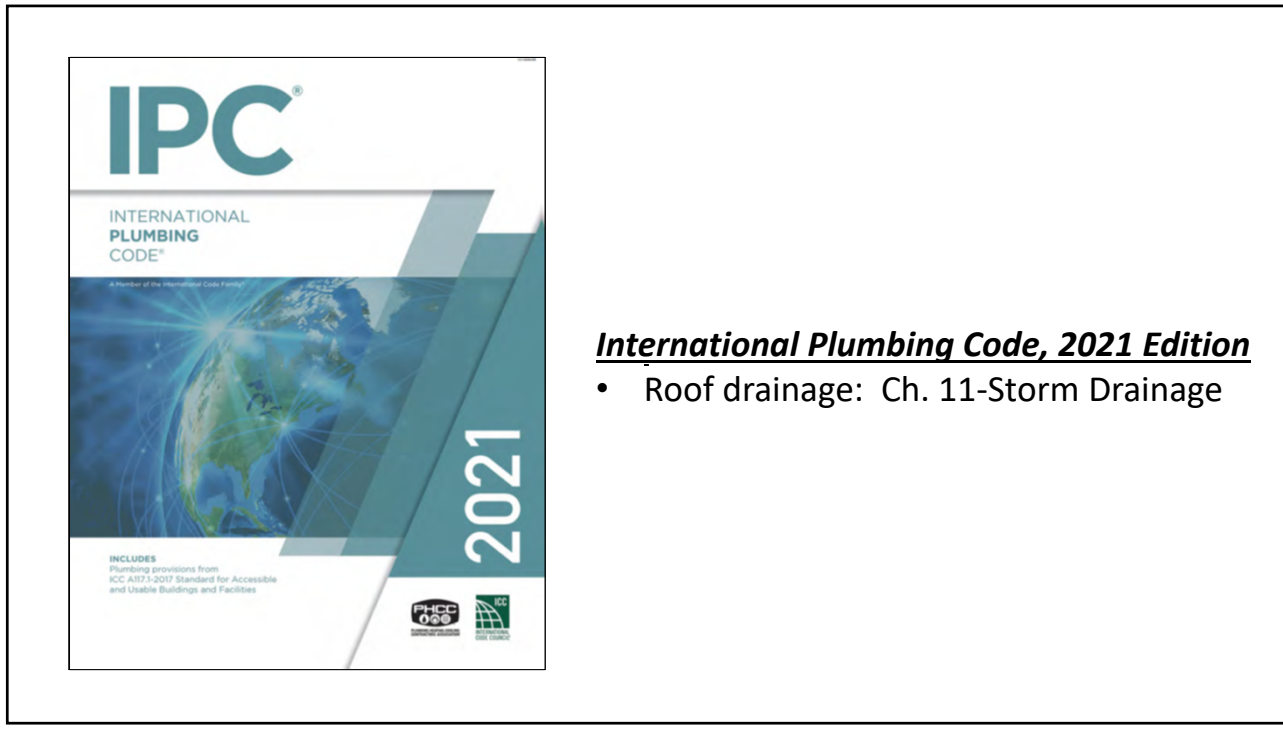
317.2 Landscaped roof size. Landscaped roof areas shall not exceed 15,625 square feet (1450 m²) in size for any single area with a maximum dimension of 125 feet (39 m) in length or width. A minimum 6-foot-wide (1.8 m) clearance consisting of a listed Class A roof assembly tested in accordance with ASTM E108 or UL 790 shall be provided between adjacent landscaped roof areas.

317.3 Rooftop structure and equipment clearance. For all vegetative roofs abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical

Vegetative Roofs

IFC 2021, Section 905.3.8-Landscaped Roofs

62



International Plumbing Code, 2021 Edition

- Roof drainage: Ch. 11-Storm Drainage

63

STORM DRAINAGE

1102.5 Subsoil drain pipe. Subsoil drains shall be open-jointed, horizontally rigid or perforated pipe conforming to one of the standards listed in Table 1102.5.

MATERIAL	STANDARD
Cast iron pipe	ASTM A174, ASTM A888, CNSP 301
Polyethylene (PE) plastic pipe	ASTM F406, ASTM F1042, CSA B182.1, CSA B182.6, CSA B182.8
Polyvinyl chloride (PVC) plastic pipe (type sewer pipe, SDR35, PS25, PS50 or PS100)	ASTM D2728, ASTM D2886, ASTM F801, CSA B182.2, CSA B182.4
"Standard vent drainage" systems, Type 316L	ASME A112.3.1
Verified clay pipe	ASTM C4, ASTM C70

1102.6 Roof drains. Roof drains shall conform to ASME A112.3.1 or ASME A112.6.4. Roof drains, other than siphonic roof drains, shall be tested and rated in accordance with ASME A112.6.4 or ASPE/IAPMO Z1034.

ducts capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

SECTION 1103 TRAPS

1103.1 Main trap. Leaders and storm drains connected to a combined sewer shall be trapped. Individual storm water traps shall be installed on the storm water drain branch serving each conductor, or a single trap shall be installed in the main storm drain just before its connecting with the combined building sewer or the public sewer. Leaders and storm drains connected to a building storm sewer shall not be required to be trapped.

1103.2 Material. Storm water traps shall be of the same material as the piping system to which they are attached.

1103.3 Size. Traps for individual conductors shall be the same size as the horizontal drain to which they are connected.

1103.4 Cleanout. A cleanout shall be installed on the building side of the trap and shall be provided with access.

SECTION 1104 CONDUCTORS AND CONNECTIONS

1104.1 Prohibited use. Conductor pipes shall not be used as soil, waste or vent pipes, and soil, waste or vent pipes shall not be used as conductors.

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D2661, ASTM D3311, CSA B181.1
Cast iron	ASME B16.4, ASME B16.12, ASTM A74, ASTM A888, CNSP 301
Controlled composite ABS and drain DR-PS in PS25, PS50, PS100, PS140, PS200	ASTM D2751
Controlled composite ABS DWV Schedule 40 IPS pipe (solid or cellular core)	ASTM D2661, ASTM D3311, ASTM F428
Controlled composite PVC DWV Schedule 40 IPS DR, PS140, PS200 (solid or cellular core)	ASTM D2886, ASTM D3311, ASTM F801
Controlled composite PVC sewer and drain DR-PS in PS25, PS50, PS100, PS140, PS200	ASTM D3034
Copper or copper alloy	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.25, ASME B16.26, ASME B16.29
Gray iron and ductile iron	AWWA C110/A21.10
Malleable iron	ASME B16.3
Plastic, general	ASTM F409
Polyethylene (PE) plastic pipe	ASTM F2369/F2369M
Polyvinyl chloride (PVC) plastic	ASTM D2661, ASTM D3311, ASTM F1866
Stainless steel drainage systems, Type 316L	ASME A112.3.1
Steel	ASME B16.9, ASME B16.11, ASME B16.28

1104.2 Floor drains. Floor drains shall not be connected to a storm drain.

SECTION 1105 ROOF DRAINS

1105.1 General. Roof drains shall be installed in accordance with the manufacturer's instructions. The inside opening for the roof drain shall not be obstructed by the roofing membrane material.

1105.2 Roof drain flow rate. The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106. The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain.

11-2
INTERNATIONAL CODE COUNCIL
2021 INTERNATIONAL PLUMBING CODE®

64

**SECTION 1106
SIZE OF CONDUCTORS,
LEADERS AND STORM DRAINS**

1106.1 General. The size of the vertical conductors and leaders, building storm drains, building storm sewers and any horizontal branches of such drains or sewers shall be based on the 100-year hourly rainfall rate indicated in Figures 1106.1(1) through 1106.1(5) or on other rainfall rates determined from approved local weather data.

1106.2 Size of storm drain piping. Vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain. The flow rate, as calculated in accordance with Section 1106.2.1, shall be checked against the roof drain manufacturer's published flow rate for the specific roof drain model and size to verify that the selected roof drain will handle the anticipated flow. The flow rate in storm drain piping shall not exceed that specified in Table 1106.2.

1106.2.1 Rainfall rate conversion method. The rainfall rate falling on a roof surface shall be converted to a gallon per minute (L/m) flow rate in accordance with Equation 11-1.

$GPM = R \times A \times 0.0104$ (Equation 11-1)

where:
 R = Rainfall intensity in inches (mm) per hour.
 A = Roof area in square feet (m²).

STORM DRAINAGE

**TABLE 1106.3
VERTICAL LEADER SIZING**

SIZE OF LEADER (inches)	CAPACITY (gpm)
2	30
2 x 2	30
1 1/2 x 2 1/2	30
2 1/2	54
2 1/2 x 2 1/2	54
3	92
2 x 4	92
2 1/2 x 3	92
4	192
3 x 4 1/2	192
2 1/2 x 4	192
5	360
4 x 5	360
4 1/2 x 4 1/2	360
6	563
5 x 6	563
5 1/2 x 5 1/2	563
8	1208
6 x 8	1208

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

1106.5 Parapet wall scuppers. Where scuppers are used for primary roof drainage or for secondary (emergency overflow) roof drainage or both, the quantity, size, location and inlet elevation of the scuppers shall be chosen to prevent the depth of ponding water on the roof from exceeding the maximum water depth that the roof was designed for as determined by Section 1611.1 of the International Building Code. Scupper openings shall be not less than 4 inches (102 mm) in height and have a width that is equal to or greater than the circumference of a roof drain sized for the same roof area. The flow through the primary system shall not be considered when locating and sizing secondary scuppers.

**TABLE 1106.2
STORM DRAIN PIPE SIZING**

PIPE SIZE (inches)	VERTICAL DRAIN CAPACITY (gpm)	SLOPE OF HORIZONTAL DRAIN CAPACITY (gpm)			
		1/8 inch per foot	1/4 inch per foot	1/2 inch per foot	3/4 inch per foot
2	30	15	22	31	44
3	92	39	58	79	111
4	180	81	115	163	231
5	311	117	165	234	331
6	538	243	344	487	689
8	1,117	505	714	1,019	1,429
10	2,050	927	1,311	1,855	2,623
12	3,272	1,480	2,093	2,960	4,187
15	5,543	2,508	3,546	5,016	7,093

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

2021 INTERNATIONAL PLUMBING CODE®
INTERNATIONAL CODE COUNCIL

65

Professional Roofing

April 2021

Link

66

Be aware whether and, if so, when your state and local jurisdictions will be adopting the 2021 I-codes

67

ICC codes accessible online
codes.iccsafe.org

The screenshot shows the ICC codes website interface. At the top, there is a navigation bar with 'Find Codes', 'Premium Features', and 'Premium for Teams'. A search bar is present with the text 'Search I-Codes Books'. Below the navigation, the main content area displays a grid of eight 2021 International Codes: IBC (International Building Code), IRC (International Residential Code), IFC (International Fire Code), IFGC (International Fuel Gas Code), IMC (International Mechanical Code), IPC (International Plumbing Code), IEBC (International Existing Building Code), and IECC (International Energy Conservation Code). Each code is represented by a colorful cover image with the year '2021' prominently displayed. A 'Premium exclusive title requires subscription to access content.' message is visible above the grid. On the right side, there is a 'Bundle and Save' section for the '2012 International Codes, Designer Collection' with a 'Subscribe today!' button. The bottom right corner features an 'Info' section about the ICC and I-Codes, and a 'LIVE CHAT' button.

68

www.iccsafe.org
shop.iccsafe.org

The screenshot shows the ICCSAFE website's product page. At the top, the ICC International Code Council logo is on the left, and navigation links for 'Help', 'Become a Member', 'Sign In', and 'My Cart' are on the right. Below the header, there are tabs for 'FEATURED PRODUCTS', 'DIGITAL CODES PREMIUM', and 'INTERNATIONAL CODES'. The main content area displays six product cards, each with a cover image, title, and price. The products include: 'Wind Design Overview (ASCE 7-16 And 2018/2021 IBC)' for \$13.60, '2021 International Fuel Gas Code®' for \$4.90, '2021 International Building Code®' for \$7.95, '2021 Complete 14 Collection', '2021 International Residential Code®', and '2021 International Mechanical Code®'. Each card has an 'Add to Cart' button. On the right side of the product grid, there is a vertical sidebar with 'FEEDBACK', 'LIVE CHAT', and social media icons for Twitter, Facebook, and LinkedIn.

69

Questions...

70



Mark S. Graham
Vice President, Technical Services
National Roofing Contractors Association
10255 West Higgins Road, 600
Rosemont, Illinois 60018-5607

(847) 299-9070
mgraham@nrca.net
www.nrca.net

Twitter: @MarkGrahamNRCA
Personal website: www.MarkGrahamNRCA.com

71