Aurora, Colorado -- December 14, 2022

Roofing Technical Update

presented by

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

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Topics

- Market conditions
- Imported plywood and OSB concerns
- Imported lumber concerns
- Synthetic underlayment
  - Water vapor transmission testing
- CERTA revisions
- Ignition temperature research
- Code developments/2021 I-codes
- Contractor-reported problems
- Questions and other topics

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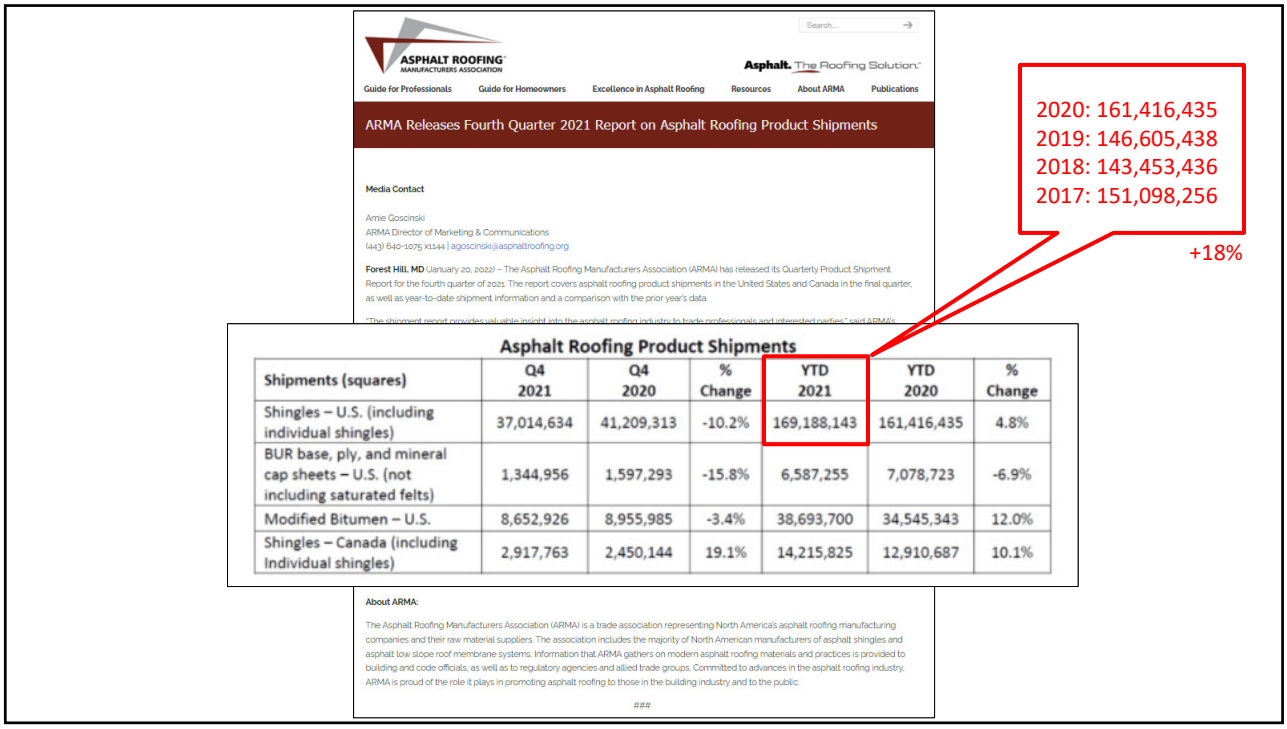
ASPHALT ROOFING MANUFACTURERS ASSOCIATION
Asphalt. The Roofing Solution.
Guide for Professionals
Guide for Homeowners
Excellence in Asphalt Roofing
Resources
About ARMA
Publications
ARMA Releases Fourth Quarter 2021 Report on Asphalt Roofing Product Shipments
Media Contact
Amie Goscinski
ARMA Director of Marketing & Communications
(443) 640-1075 x1144 | agoscinski@asphaltroofing.org
Forest Hill, MD (January 20, 2022) – The Asphalt Roofing Manufacturers Association (ARMA) has released its Quarterly Product Shipment Report for the fourth quarter of 2021. The report covers asphalt roofing product shipments in the United States and Canada in the final quarter, as well as year-to-date shipment information and a comparison with the prior year's data.
2020: 161,416,435
2019: 146,605,438
2018: 143,453,436
2017: 151,098,256
+18%
Asphalt Roofing Product Shipments
Shipments (squares) | Q4 2021 | Q4 2020 | % Change | YTD 2021 | YTD 2020 | % Change
Shingles – U.S. (including individual shingles) | 37,014,634 | 41,209,313 | -10.2% | 169,188,143 | 161,416,435 | 4.8%
BUR base, ply, and mineral cap sheets – U.S. (not including saturated felts) | 1,344,956 | 1,597,293 | -15.8% | 6,587,255 | 7,078,723 | -6.9%
Modified Bitumen – U.S. | 8,652,926 | 8,955,985 | -3.4% | 38,693,700 | 34,545,343 | 12.0%
Shingles – Canada (including Individual shingles) | 2,917,763 | 2,450,144 | 19.1% | 14,215,825 | 12,910,687 | 10.1%
About ARMA:
The Asphalt Roofing Manufacturers Association (ARMA) is a trade association representing North America's asphalt roofing manufacturing companies and their raw material suppliers. The association includes the majority of North American manufacturers of asphalt shingles and asphalt low slope roof membrane systems. Information that ARMA gathers on modern asphalt roofing materials and practices is provided to building and code officials, as well as to regulatory agencies and allied trade groups. Committed to advances in the asphalt roofing industry, ARMA is proud of the role it plays in promoting asphalt roofing to those in the building industry and to the public.
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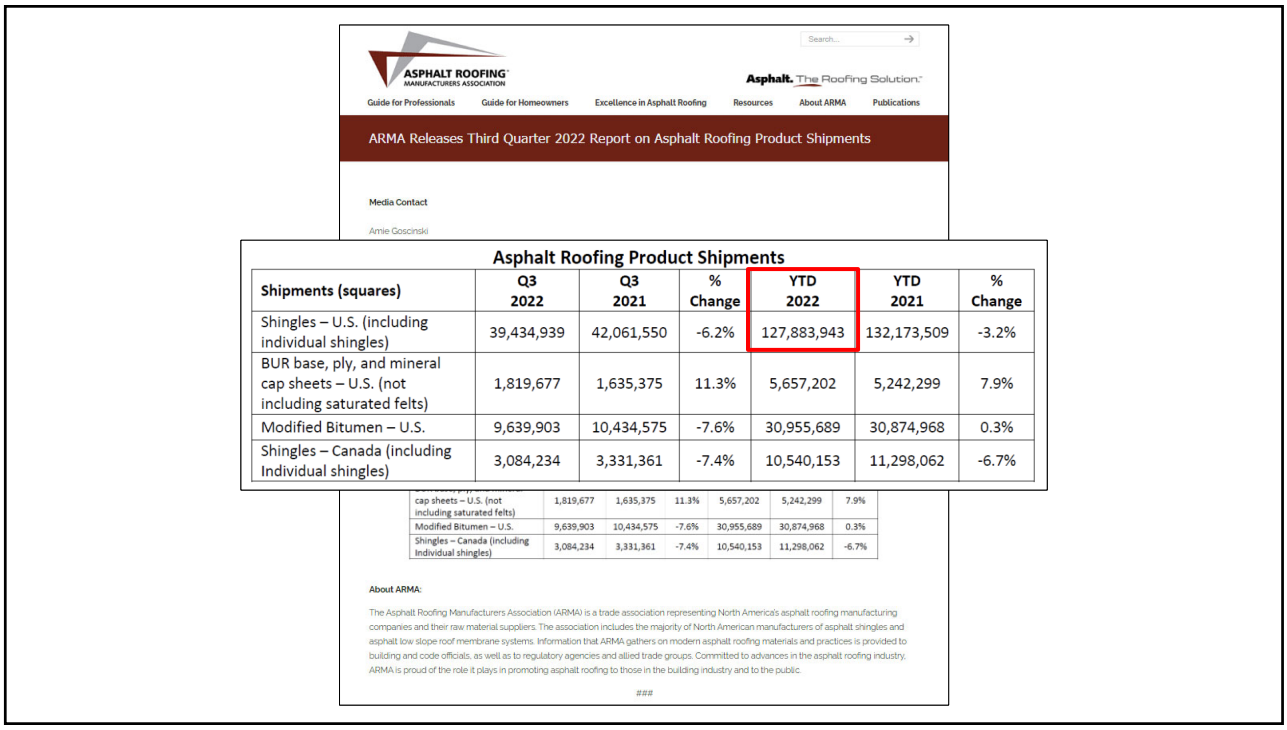
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Shipments (squares) | Q3 2022 | Q3 2021 | % Change | YTD 2022 | YTD 2021 | % Change
Shingles – U.S. (including individual shingles) | 39,434,939 | 42,061,550 | -6.2% | 127,883,943 | 132,173,509 | -3.2%
BUR base, ply, and mineral cap sheets – U.S. (not including saturated felts) | 1,819,677 | 1,635,375 | 11.3% | 5,657,202 | 5,242,299 | 7.9%
Modified Bitumen – U.S. | 9,639,903 | 10,434,575 | -7.6% | 30,955,689 | 30,874,968 | 0.3%
Shingles – Canada (including Individual shingles) | 3,084,234 | 3,331,361 | -7.4% | 10,540,153 | 11,298,062 | -6.7%
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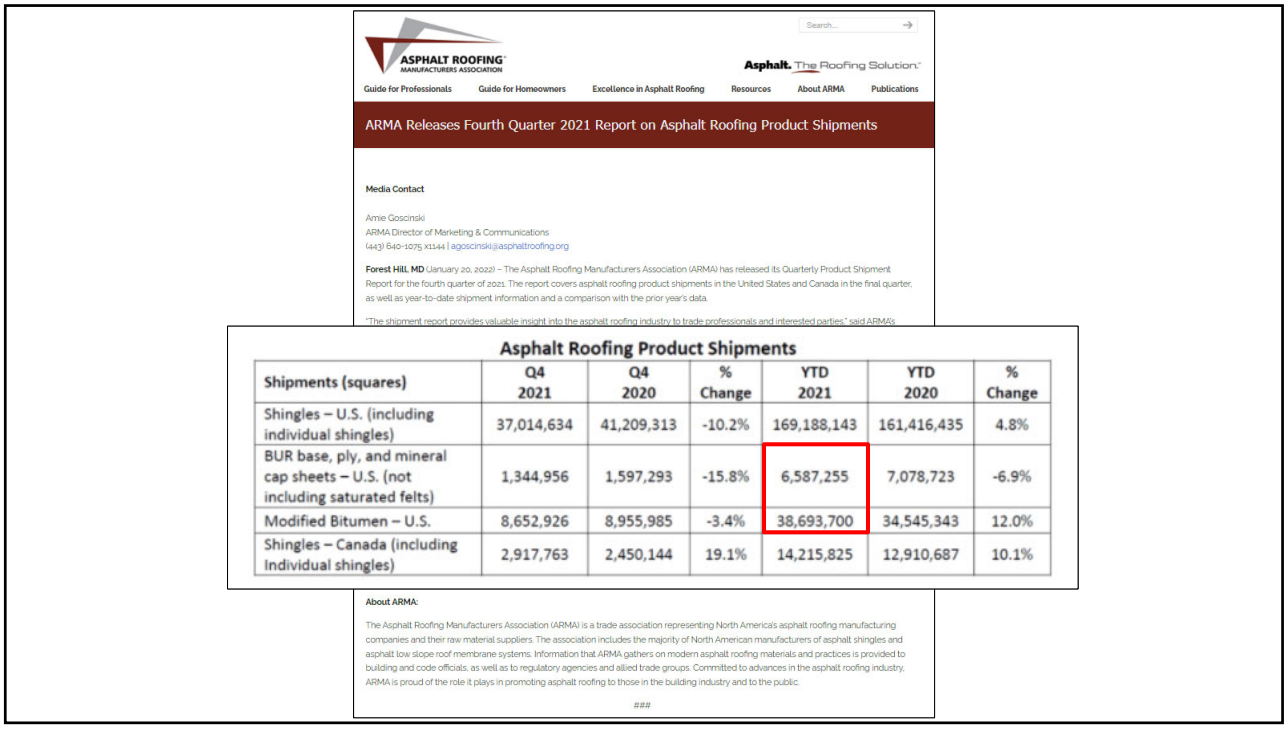

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"The shipment report provides valuable insight into the asphalt roofing industry to trade professionals and interested parties," said ARMA's

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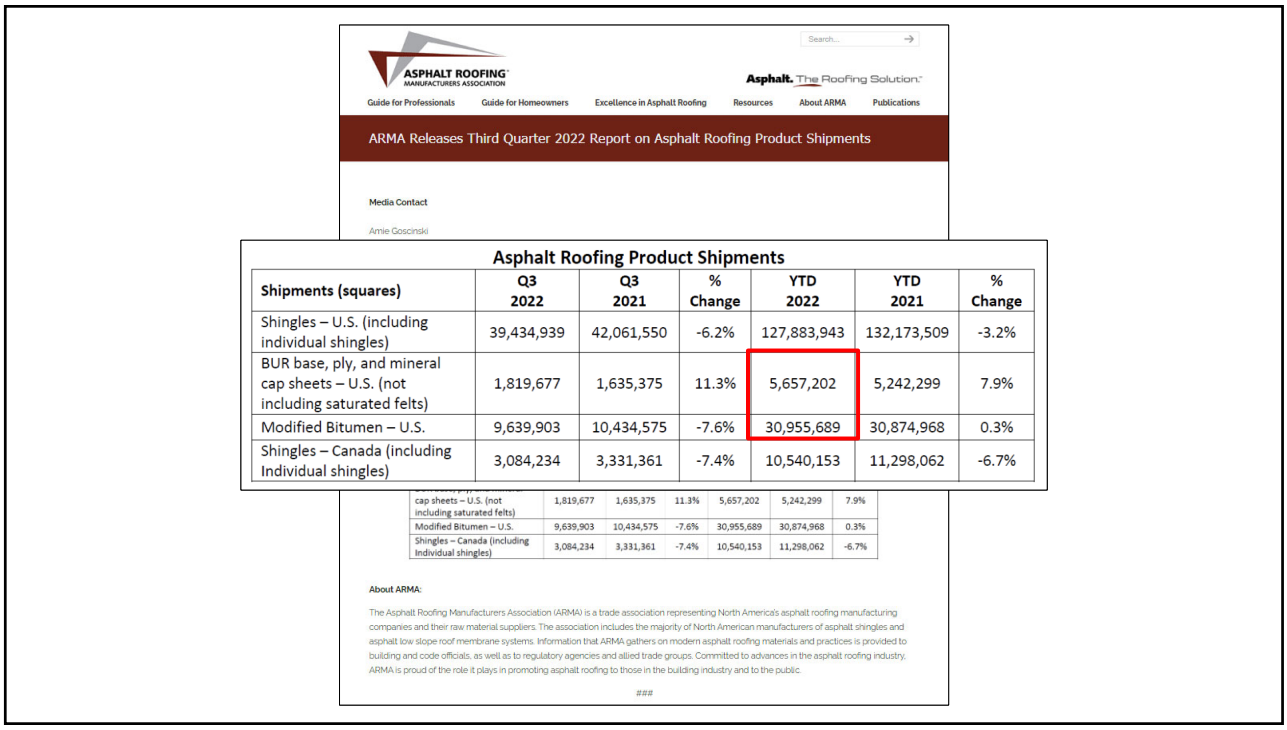

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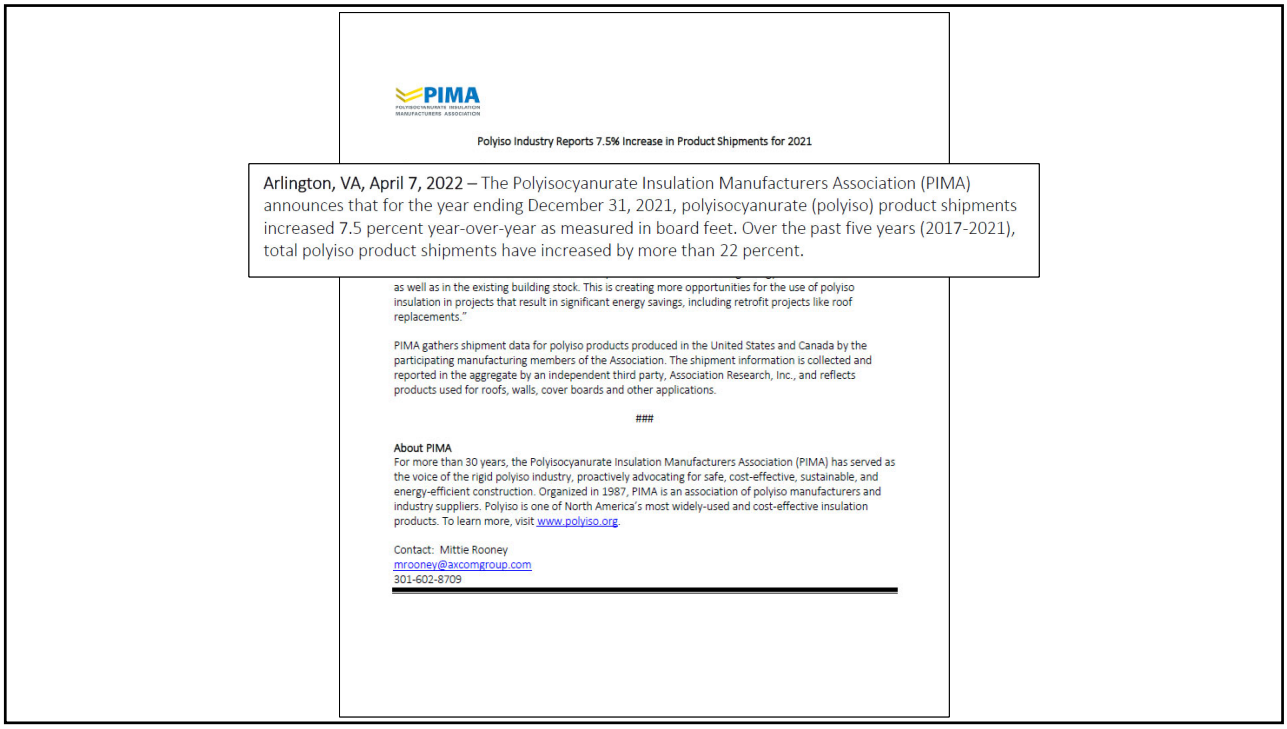

PIMA

Polyiso Industry Reports 7.5% Increase in Product Shipments for 2021

Arlington, VA, April 7, 2022 – The Polyisocyanurate Insulation Manufacturers Association (PIMA) announces that for the year ending December 31, 2021, polyisocyanurate (polyiso) product shipments increased 7.5 percent year-over-year as measured in board feet. Over the past five years (2017-2021), total polyiso product shipments have increased by more than 22 percent.

as well as in the existing building stock. This is creating more opportunities for the use of polyiso insulation in projects that result in significant energy savings, including retrofit projects like roof replacements."

PIMA gathers shipment data for polyiso products produced in the United States and Canada by the participating manufacturing members of the Association. The shipment information is collected and reported in the aggregate by an independent third party, Association Research, Inc., and reflects products used for roofs, walls, cover boards and other applications.

###

About PIMA
For more than 30 years, the Polyisocyanurate Insulation Manufacturers Association (PIMA) has served as the voice of the rigid polyiso industry, proactively advocating for safe, cost-effective, sustainable, and energy-efficient construction. Organized in 1987, PIMA is an association of polyiso manufacturers and industry suppliers. Polyiso is one of North America's most widely-used and cost-effective insulation products. To learn more, visit www.polyiso.org.

Contact: Mittie Rooney
mrooney@axcomgroup.com
301-602-8709

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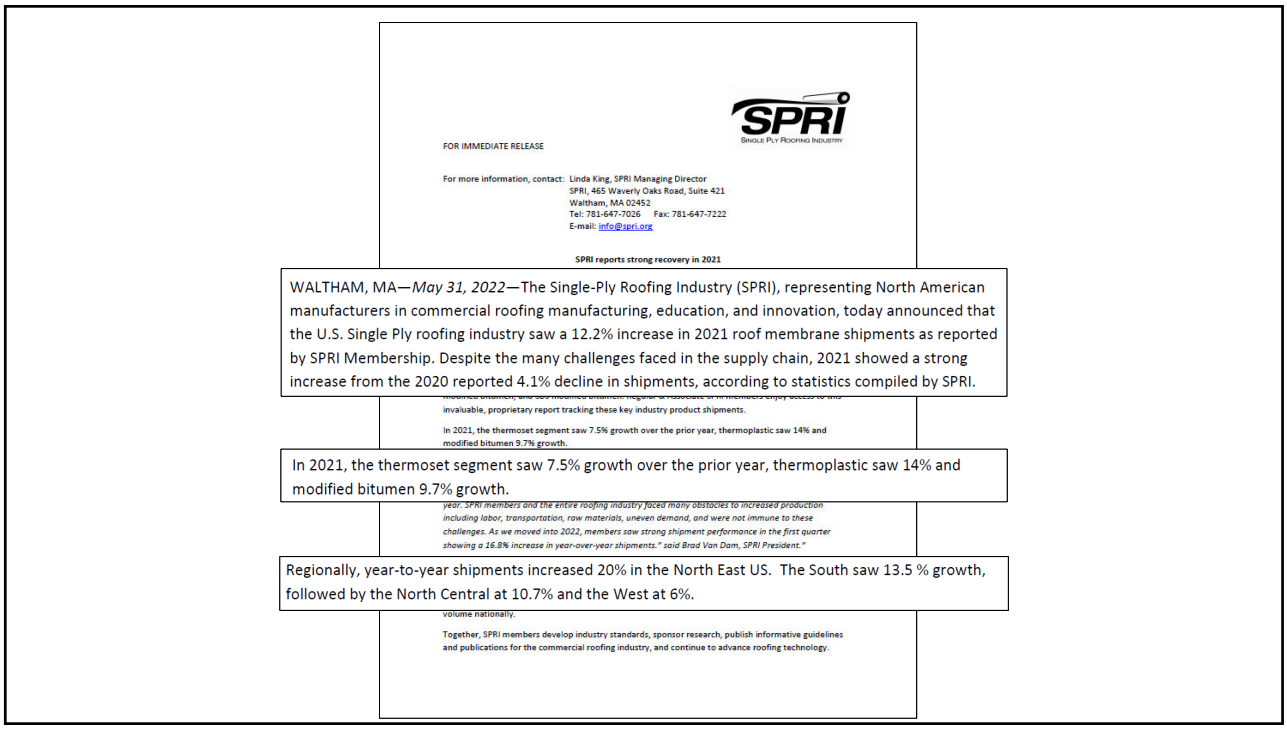

SPRI
Single Ply Roofing Industry

FOR IMMEDIATE RELEASE

For more information, contact: Linda King, SPRI Managing Director
SPRI, 465 Waverly Oaks Road, Suite 421
Waltham, MA 02452
Tel: 781-647-7026 Fax: 781-647-7222
E-mail: info@spri.org

SPRI reports strong recovery in 2021

WALTHAM, MA—*May 31, 2022*—The Single-Ply Roofing Industry (SPRI), representing North American manufacturers in commercial roofing manufacturing, education, and innovation, today announced that the U.S. Single Ply roofing industry saw a 12.2% increase in 2021 roof membrane shipments as reported by SPRI Membership. Despite the many challenges faced in the supply chain, 2021 showed a strong increase from the 2020 reported 4.1% decline in shipments, according to statistics compiled by SPRI.

invaluable, proprietary report tracking these key industry product shipments.

In 2021, the thermoset segment saw 7.5% growth over the prior year, thermoplastic saw 14% and modified bitumen 9.7% growth.

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year. SPRI members and the entire roofing industry faced many obstacles to increased production including labor, transportation, raw materials, uneven demand, and were not immune to these challenges. As we moved into 2022, members saw strong shipment performance in the first quarter showing a 16.8% increase in year-over-year shipments." said Brad Van Dam, SPRI President."

Regionally, year-to-year shipments increased 20% in the North East US. The South saw 13.5 % growth, followed by the North Central at 10.7% and the West at 6%.

volume nationally.

Together, SPRI members develop industry standards, sponsor research, publish informative guidelines and publications for the commercial roofing industry, and continue to advance roofing technology.

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INDUSTRY ISSUE UPDATE

NRCA Member Benefit

Roofing material shortages and price volatility

September 2021

The U.S. roofing industry is experiencing unprecedented shortages of roofing materials and products and significant price volatility. NRCA is providing this Industry Issue Update to help its members with building owners, facility managers, general contractors and construction managers involved in roof purchasing decisions.

Although this information is intended to apply specifically to the U.S. roofing market, based on NRCA's communications with its affiliates and partners in Canada, Mexico and elsewhere worldwide, shortages of roofing materials and products and price volatility appear to be global issues.

BACKGROUND

Compared with other industries, the U.S. roofing industry is domestic in nature. With few exceptions, a vast majority of roofing products and materials used are manufactured in the U.S. from U.S.-sourced raw materials, delivered by U.S. suppliers and distributors, and installed by U.S. roofing contractor companies. Although the global economy has some effect on many purchasing decisions, the U.S. roofing industry is largely driven by the U.S. economy, interest rates and consumer sentiment.

During the past decade, the U.S. roofing industry has experienced a period of consistent, moderate growth. The roofing materials and products supply chain has expanded in capacity and roofing contractors have added field personnel and capability to fill this growing need. In many regions of the U.S., additional roofing industry growth has been limited by a lack of adequately trained field personnel.

At the same time, energy code requirements and sustainability incentive programs have resulted in a demand for more energy-efficient roof systems. For example, when reroofing a building, it is not unusual to replace an existing, aged roof system having an R-10 insulation value with a new roof system with an energy code mandated minimum R-20, R-25, R-30 or R-35 insulation value. Such increases in insulation value necessitate using greater amounts of and thicker insulation, usually in multiple layers, longer fasteners, more layers of insulation adhesive and additional material handling and installation labor.

The level of roofing material and product in inventory shrunk considerably

THE CURRENT SITUATION

The U.S. roofing industry responded and adapted to the onset of the COVID-19 pandemic remarkably well. The U.S. roofing industry quickly was considered "essential," and at the start of the pandemic, the roofing materials and products supply chain functioned with only minimal interruptions. Roofing contractors adapted to additional safe work practices necessary to perform work on occupied buildings during the pandemic.

By many measures, 2020 was a productive year for the U.S. roofing industry. For example, 2020 was a near historic record level year for asphalt shingle installations. Homeowners invested in reroofing and maintaining their homes during the pandemic, spurred in part by low interest rates and the availability of stimulus funding, and the roofing industry responded to several weather events involving high winds and hail. The institutional and industrial segments of the U.S. roofing industry also experienced similar levels of activity.

However, one noticeable change in the level of roofing material and product in inventory shrunk considerably. Roofing material suppliers and distributors reduced their material and product inventories. Since the start of the pandemic, far more roofing materials and products are being shipped on a job-specific basis. This especially is the case with roof insulation and roof covering products and certain specialty products, such as fasteners and adhesives. A few years ago, many roofing jobs often could be carried out with roofing materials and products held in inventory, but manufacturers now are shipping roofing materials and products on a job-specific basis with fewer roofing materials and products being stocked in inventory.

NRCA Industry Issue Update: Roofing Material Shortages and Price Volatility

Link

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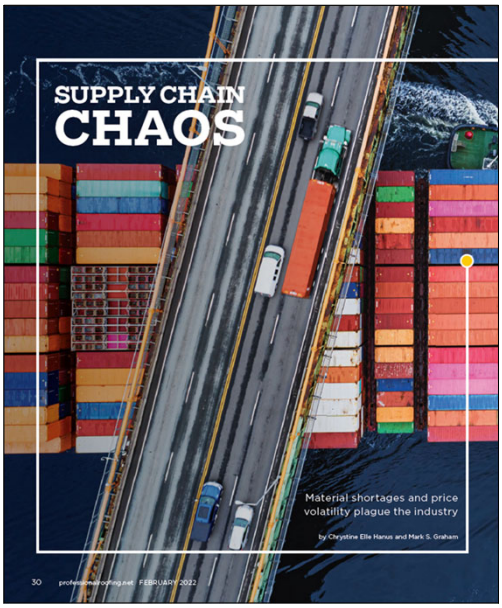

Professional Roofing
February 2022

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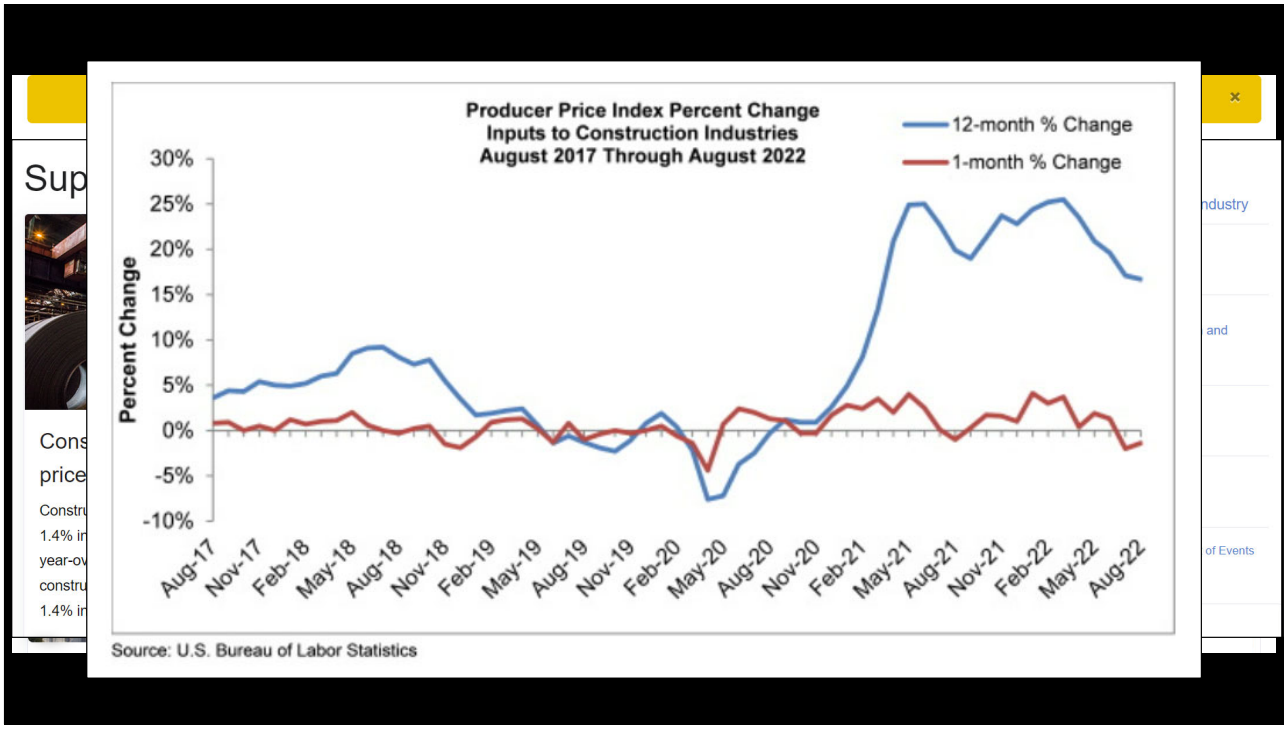

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Imported lumber concerns

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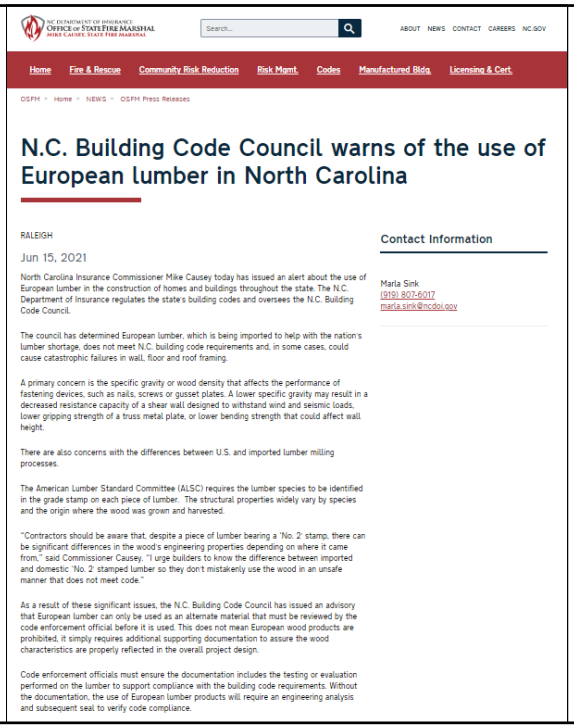

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OSFM > Home > NEWS > OSFM Press Releases

N.C. Building Code Council warns of the use of European lumber in North Carolina

RALEIGH

Jun 15, 2021

North Carolina Insurance Commissioner Mike Causey today has issued an alert about the use of European lumber in the construction of homes and buildings throughout the state. The N.C. Department of Insurance regulates the state's building codes and oversees the N.C. Building Code Council.

The council has determined European lumber, which is being imported to help with the nation's lumber shortage, does not meet N.C. building code requirements and, in some cases, could cause catastrophic failures in wall, floor and roof framing.

A primary concern is the specific gravity or wood density that affects the performance of fastening devices, such as nails, screws or gusset plates. A lower specific gravity may result in a decreased resistance capacity of a shear wall designed to withstand wind and seismic loads, lower gripping strength of a truss metal plate, or lower bending strength that could affect wall height.

There are also concerns with the differences between U.S. and imported lumber milling processes.

The American Lumber Standard Committee (ALSC) requires the lumber species to be identified in the grade stamp on each piece of lumber. The structural properties widely vary by species and the origin where the wood was grown and harvested.

"Contractors should be aware that, despite a piece of lumber bearing a 'No. 2' stamp, there can be significant differences in the wood's engineering properties depending on where it came from," said Commissioner Causey. "I urge builders to know the difference between imported and domestic 'No. 2' stamped lumber so they don't mistakenly use the wood in an unsafe manner that does not meet code."

As a result of these significant issues, the N.C. Building Code Council has issued an advisory that European lumber can only be used as an alternate material that must be reviewed by the code enforcement official before it is used. This does not mean European wood products are prohibited, it simply requires additional supporting documentation to assure the wood characteristics are properly reflected in the overall project design.

Code enforcement officials must ensure the documentation includes the testing or evaluation performed on the lumber to support compliance with the building code requirements. Without the documentation, the use of European lumber products will require an engineering analysis and subsequent seal to verify code compliance.

Contact Information

Maria Sink
(919) 807-6017
maria.sink@ncdoi.gov

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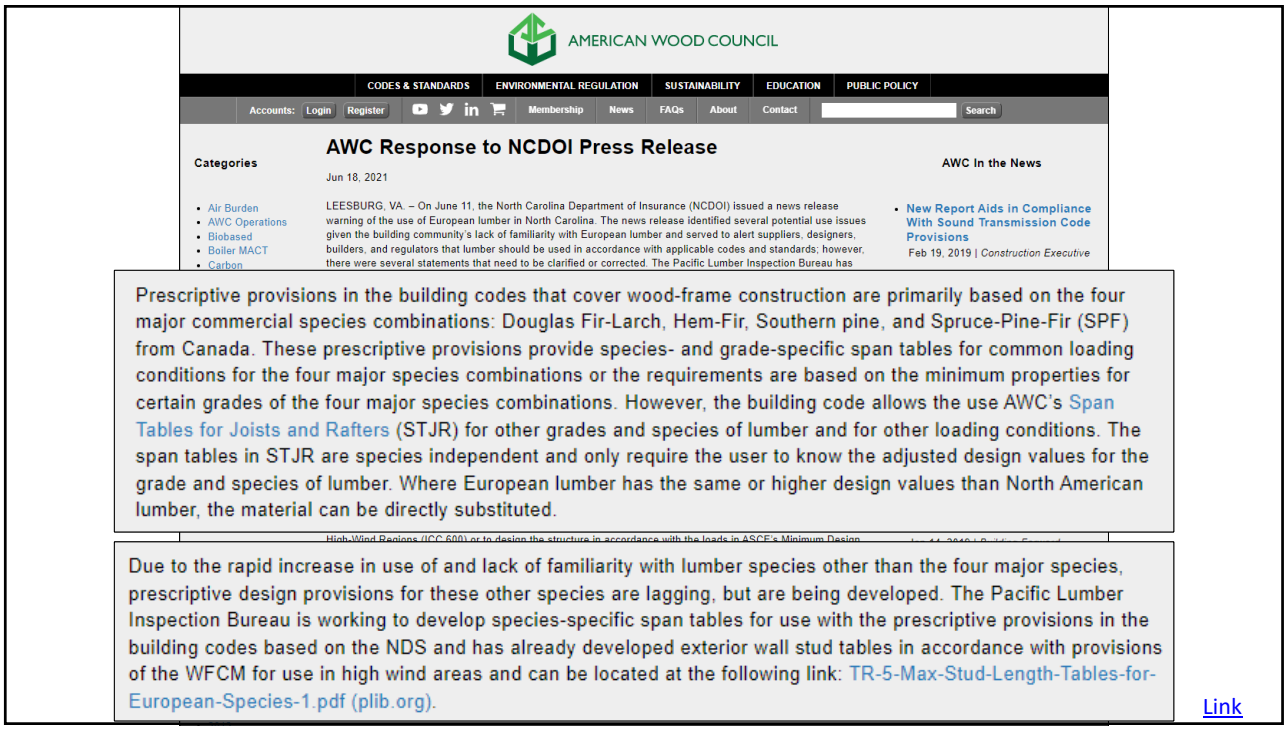

AMERICAN WOOD COUNCIL

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Categories

- Air Burden
- AWC Operations
- Biobased
- Boiler MACT
- Carbon

AWC Response to NCDOI Press Release

Jun 18, 2021

LEESBURG, VA. – On June 11, the North Carolina Department of Insurance (NCDOI) issued a news release warning of the use of European lumber in North Carolina. The news release identified several potential use issues given the building community's lack of familiarity with European lumber and served to alert suppliers, designers, builders, and regulators that lumber should be used in accordance with applicable codes and standards; however, there were several statements that need to be clarified or corrected. The Pacific Lumber Inspection Bureau has

AWC In the News

- **New Report Aids in Compliance With Sound Transmission Code Provisions**
  Feb 19, 2019 | *Construction Executive*

Prescriptive provisions in the building codes that cover wood-frame construction are primarily based on the four major commercial species combinations: Douglas Fir-Larch, Hem-Fir, Southern pine, and Spruce-Pine-Fir (SPF) from Canada. These prescriptive provisions provide species- and grade-specific span tables for common loading conditions for the four major species combinations or the requirements are based on the minimum properties for certain grades of the four major species combinations. However, the building code allows the use AWC's Span Tables for Joists and Rafters (STJR) for other grades and species of lumber and for other loading conditions. The span tables in STJR are species independent and only require the user to know the adjusted design values for the grade and species of lumber. Where European lumber has the same or higher design values than North American lumber, the material can be directly substituted.

Due to the rapid increase in use of and lack of familiarity with lumber species other than the four major species, prescriptive design provisions for these other species are lagging, but are being developed. The Pacific Lumber Inspection Bureau is working to develop species-specific span tables for use with the prescriptive provisions in the building codes based on the NDS and has already developed exterior wall stud tables in accordance with provisions of the WFCM for use in high wind areas and can be located at the following link: TR-5-Max-Stud-Length-Tables-for-European-Species-1.pdf (plib.org).

Link

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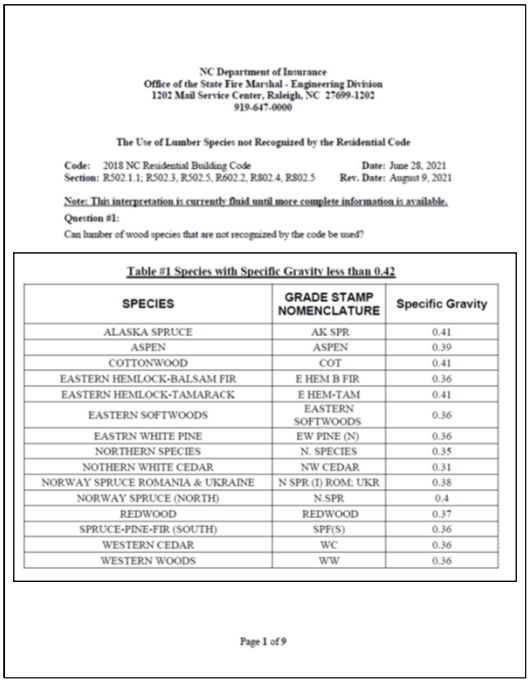

NC Department of Insurance
Office of the State Fire Marshal - Engineering Division
1202 Mail Service Center, Raleigh, NC 27699-1202
919-647-0000

The Use of Lumber Species not Recognized by the Residential Code

Code: 2018 NC Residential Building Code **Date:** June 28, 2021
Section: R502.1.1; R502.3, R502.5, R602.2, R802.4, R802.5 **Rev. Date:** August 9, 2021

Note: This interpretation is currently fluid until more complete information is available.

Question #1:
Can lumber of wood species that are not recognized by the code be used?

Table #1 Species with Specific Gravity less than 0.42

SPECIES	GRADE STAMP NOMENCLATURE	Specific Gravity
ALASKA SPRUCE	AK SPR	0.41
ASPEN	ASPEN	0.39
COTTONWOOD	COT	0.41
EASTERN HEMLOCK-BALSAM FIR	E HEM B FIR	0.36
EASTERN HEMLOCK-TAMARACK	E HEM-TAM	0.41
EASTERN SOFTWOODS	EASTERN SOFTWOODS	0.36
EASTRN WHITE PINE	EW PINE (N)	0.36
NORTHERN SPECIES	N. SPECIES	0.35
NOTHERN WHITE CEDAR	NW CEDAR	0.31
NORWAY SPRUCE ROMANIA & UKRAINE	N SPR (I) ROM; UKR	0.38
NORWAY SPRUCE (NORTH)	N.SPR	0.4
REDWOOD	REDWOOD	0.37
SPRUCE-PINE-FIR (SOUTH)	SPF(S)	0.36
WESTERN CEDAR	WC	0.36
WESTERN WOODS	WW	0.36

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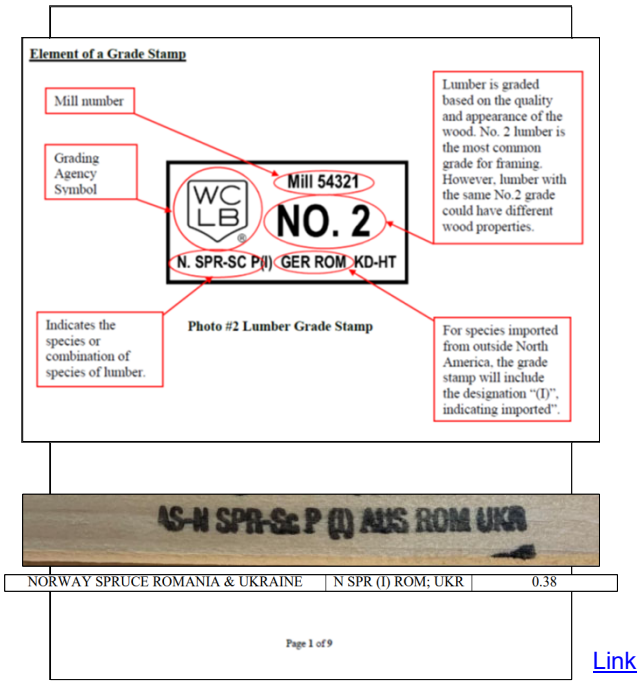

Element of a Grade Stamp

Mill number

Grading Agency Symbol

Lumber is graded based on the quality and appearance of the wood. No. 2 lumber is the most common grade for framing. However, lumber with the same No.2 grade could have different wood properties.

Mill 54321
WC LB
NO. 2
N. SPR-SC P(I) GER ROM KD-HT

Indicates the species or combination of species of lumber.

Photo #2 Lumber Grade Stamp

For species imported from outside North America, the grade stamp will include the designation "(I)", indicating imported".

AS-N SPR-Sc P (I) AUS ROM UKR

NORWAY SPRUCE ROMANIA & UKRAINE	N SPR (I) ROM; UKR	0.38

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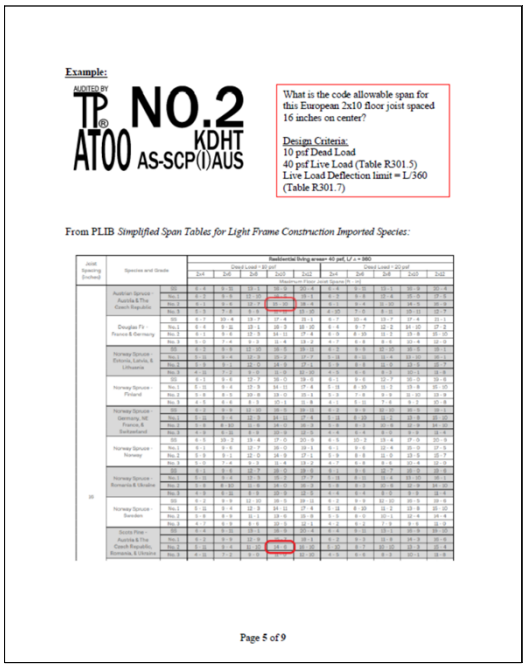

Example:

AUDITED BY TP® NO.2 ATOO AS-SCP(I)AUS KDHT

What is the code allowable span for this European 2x10 floor joist spaced 16 inches on center?

Design Criteria:
10 psf Dead Load
40 psf Live Load (Table R301.5)
Live Load Deflection limit = L/360 (Table R301.7)

From PLIB *Simplified Span Tables for Light Frame Construction Imported Species:*

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RESEARCH+TECH

Considering substitutions

Be aware of potential consequences with product substitution

by Mark S. Graham

With ongoing shortages of building materials and products, substitutions have become more commonplace—but they can have unintended consequences. One issue that has arisen involves substituting European lumber for North American lumber, a decision that could result in unintended consequences.

The situation

At the start of the COVID-19 pandemic, wood product producers were operating under the same uncertainty as the rest of the world. Many mills curtailed production in anticipation of worker shortages and reduced demand. At the same time, many wholesale and retail lumber customers significantly reduced inventory levels. Also, because of the Great Recession, several mills had closed permanently. The American Wood Council reports between 2007 and 2017, mill closures in the South resulted in a lumber capacity loss between 1.7 to 2 billion board feet. Mill closures in the Pacific Northwest represented 10% of the area's mills.

Although the demand for wood products had dipped, it quickly rebounded during the pandemic because of increased remodeling projects and new housing starts spurred, in part, by low interest

20 professionalroofing.net SEPTEMBER 2021

Professional Roofing
September 2021

Link

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Imported plywood and OBS concerns

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Standards for wood structural panels

International Residential Code, 2018 Edition

Plywood:

- U.S. Department of Commerce PS-1, “Structural Plywood”
- CSA Group O325, “Construction Sheathing”

Oriented-strand board (OSB):

- U.S. Department of Commerce PS-2, “Performance Standard for Wood-based Structural-use Panels”
- CSA Group O437, “Standards for OSB and Waferboard”

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Concerns with Brazilian plywood

NRCA ProfessionalRoofing
the source for the roofing industry

NRCA DECKS to DOCKETS LEGAL CONFERENCE OCT. 27-29 Austin, Texas

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HOME > NEWS >

Lawsuit highlights inferior Brazilian plywood and false certification

A recent lawsuit has shined a light on the use of inferior Brazilian plywood and its false certification by long-time certifier PFS-TECO, according to NRCA General Counsel Trent Cotney.

What the lawsuit claimed

The suit was filed by U.S. Structural Plywood Integrity Coalition, which includes nine family-owned plywood manufacturers. The group alleged that PFS-TECO designated PS 1 certification for the plywood despite failing to meet U.S. standards. The lawsuit claimed negligence, false advertising and loss of revenue.

PS 1 certification indicates structural integrity for plywood panels used in floors, roofs and walls of commercial and residential buildings. After its production, PFS-TECO inspected the plywood and stamped it PS 1 before it was made available in the U.S.; however, the plywood had substantial failure rates during American Plywood Association testing and evaluation from other laboratories. Unfortunately, the plywood in question has been used throughout the U.S. for new construction projects, as well as for reconstruction in Florida, Puerto Rico and other areas affected by hurricanes.

The suit alleges that dating to Jan. 1, 2016, the inspection services "made false statements of fact through certifications that authorized 35 Brazilian plywood producers to export plywood into Florida" they either knew or

JUL./AUG. 2022
VOL. 52 ISSUE 6

Link

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PFS-TECO

PFS Corporation d/b/a PFS TECO
An Employee-Owned Company

NEWS RELEASE

For Immediate Release

For more information, contact:

Scott Drake
Office: (608) 839-1013
scott.drake@pfsteco.com

Court-Issued Permanent Injunction related to Brazilian Plywood

Cottage Grove, WI (May 31, 2022) — In September 2019, a group of US plywood manufacturers filed a complaint in the Southern District of Florida concerning PFS TECO's work as an accredited third-party agency in Southern Brazil. The complaint alleged that the PFS TECO certification mark should be considered false advertising because their group believes it is not possible for plywood made from pine grown in Southern Brazil to meet the requirements of US DOC Product Standard 1 (PS 1).

PFS TECO has tested and certified plywood in Brazil for over 20 years. PFS TECO has been accredited and reaccredited by International Accreditation Services, Inc. as an inspection and testing agency and Standards Council of Canada as a certification agency. The third-party certification system for building products involves the manufacturer taking responsibility for their product while the third-party agency's role is to be the impartial link between the manufacturer and the local building official's review of the application of the product. The certification mark is intended to inform the building official that the manufacturer has demonstrated they have the capability to comply with the product standard and they had third-party oversight at the time the product was manufactured. The referenced product type and grade in the mark are then used during the building official's inspection.

On May 23, 2022, PFS TECO and the U.S. Structural Plywood Integrity Coalition agreed on the terms of a permanent injunction to settle the ongoing dispute between them. On the following day, according to the terms agreed by the parties, the Judge issued a permanent injunction under which PFS TECO exits the certification market for PS 1 rated plywood in Southern Brazil. The case was settled before the jury trial took place and/or the Court has made any determination on the case's merits. Therefore, the federal district court has not made any determination concerning the accuracy of the plaintiffs' allegations concerning the "strength" of the Brazilian plywood bearing the PFS TECO stamps or what "wholesalers and retailers" must or should do regarding existing stocks of the labeled product.

Indeed, the injunction does not prohibit, limit, or restrain the sale and/or use of the products labeled with PFS TECO mark on or before May 31, 2022. The injunction entered by the Court addresses only the future actions of PFS TECO. The injunction was made without any findings of fact about the products that have been labeled. The injunction specifically does not order the removal or obliteration of any label applied to the product on or before May 31, 2022. The relevant injunction language states:

> "IT IS ORDERED AND ADJUDGED that, within seven (7) days of the entry of this Judgment, PFS TECO is ordered to revoke all of the PS 1 certificates and grade stamps that PFS TECO has issued to plywood mills located in southern Brazil by emailing a notice of PS 1 certificate revocation to each Brazilian licensee and to remove all revoked PS 1 certificates from the PFS TECO website."

608.839.1013 · 1507 Matt Pass · Cottage Grove, WI 53527
WWW.PFSTECO.COM

PFS TECO TESTED MARKS YOU CAN BUILD ON

PFS-TECO New Release

May 31, 2022

Link

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Conclusions and recommendations

Concerns with imported lumber and plywood and OSB sheathing

- Be cautious of newly-installed lumber and plywood and OSB
- You may want to check grade stamps
- Roof deck acceptance should be limited
- Prepare yourself for more roof deck replacement

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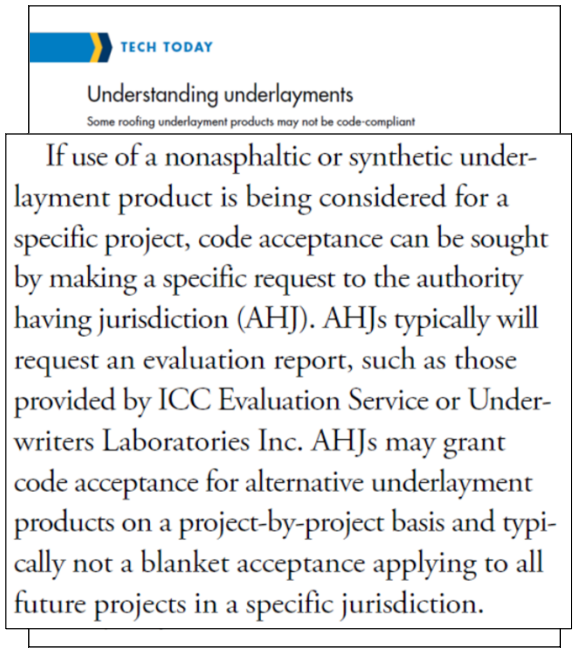
Synthetic underlayment

24



TECH TODAY

Understanding underlayments

Some roofing underlayment products may not be code-compliant

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

Professional Roofing
December 2016

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RESEARCH+TECH

A new standard

Guidelines for synthetic underlayments

by Mark S. Graham

After more than eight years in development, in December 2020 ASTM International published the first U.S. product standard applicable to synthetic, sloop-slope underlayment products. If you are involved with the design or installation of sloop-slope roof systems, I encourage you to become familiar with this standard and begin to use it when specifying and procuring sloop-slope underlayment products.

ASTM D8257

ASTM D8257, "Standard Specification for Mechanically Attached Polymeric Roof Underlayment Used in Sloop-Slope Roofing," addresses mechanically attached synthetic underlayment used in sloop-slope roof systems.

The standard defines polymeric underlayment as a sheet material primarily composed of polymers for use as a secondary water-shedding layer on sloop-slope roofs when installed below a primary roof covering.

The standard's objective is to provide a finished product that will be used as a water-shedding underlayment layer before and after the installation of a primary sloop-slope roof covering.

26 professionalroofing.net JULY/AUGUST 2021

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July/August 2021

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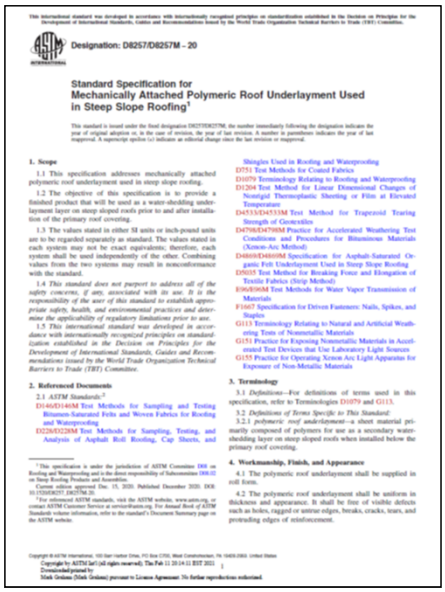

Designation: D8257/D8257M – 20

Standard Specification for
Mechanically Attached Polymeric Roof Underlayment Used in Steep Slope Roofing[1]

ASTM D8257, "Standard Specification for Mechanically Attached Polymeric Roof Underlayment Used in Steep Slope Roofing"

Published in December 2020

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Designation: D8257/D8257M – 20

Standard Specification for
Mechanically Attached Polymeric Roof Underlayment Used in Steep Slope Roofing[1]

1. Scope

1.1 This specification addresses mechanically attached polymeric roof underlayment used in steep slope roofing.

1.2 The objective of this specification is to provide a finished product that will be used as a water-shedding underlayment layer on steep sloped roofs prior to and after installation of the primary roof covering.

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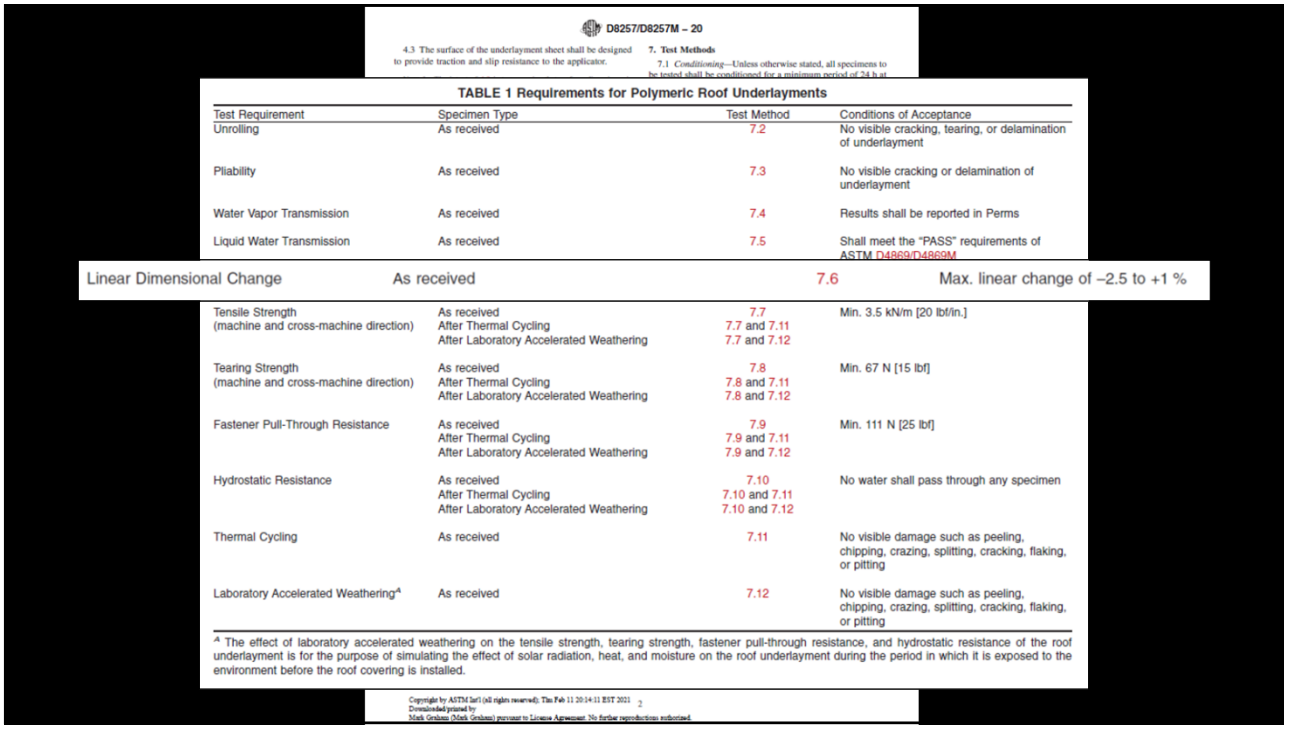

D8257/D8257M – 20

4.3 The surface of the underlayment sheet shall be designed to provide traction and slip resistance to the applicator.

7. Test Methods

7.1 *Conditioning*—Unless otherwise stated, all specimens to be tested shall be conditioned for a minimum period of 24 h at

TABLE 1 Requirements for Polymeric Roof Underlayments

Test Requirement	Specimen Type	Test Method	Conditions of Acceptance
Unrolling	As received	7.2	No visible cracking, tearing, or delamination of underlayment
Pliability	As received	7.3	No visible cracking or delamination of underlayment
Water Vapor Transmission	As received	7.4	Results shall be reported in Perms
Liquid Water Transmission	As received	7.5	Shall meet the "PASS" requirements of ASTM D4869/D4869M
Linear Dimensional Change	As received	7.6	Max. linear change of –2.5 to +1 %
Tensile Strength (machine and cross-machine direction)	As received After Thermal Cycling After Laboratory Accelerated Weathering	7.7 7.7 and 7.11 7.7 and 7.12	Min. 3.5 kN/m [20 lbf/in.]
Tearing Strength (machine and cross-machine direction)	As received After Thermal Cycling After Laboratory Accelerated Weathering	7.8 7.8 and 7.11 7.8 and 7.12	Min. 67 N [15 lbf]
Fastener Pull-Through Resistance	As received After Thermal Cycling After Laboratory Accelerated Weathering	7.9 7.9 and 7.11 7.9 and 7.12	Min. 111 N [25 lbf]
Hydrostatic Resistance	As received After Thermal Cycling After Laboratory Accelerated Weathering	7.10 7.10 and 7.11 7.10 and 7.12	No water shall pass through any specimen
Thermal Cycling	As received	7.11	No visible damage such as peeling, chipping, crazing, splitting, cracking, flaking, or pitting
Laboratory Accelerated Weathering[A]	As received	7.12	No visible damage such as peeling, chipping, crazing, splitting, cracking, flaking, or pitting

[A] The effect of laboratory accelerated weathering on the tensile strength, tearing strength, fastener pull-through resistance, and hydrostatic resistance of the roof underlayment is for the purpose of simulating the effect of solar radiation, heat, and moisture on the roof underlayment during the period in which it is exposed to the environment before the roof covering is installed.

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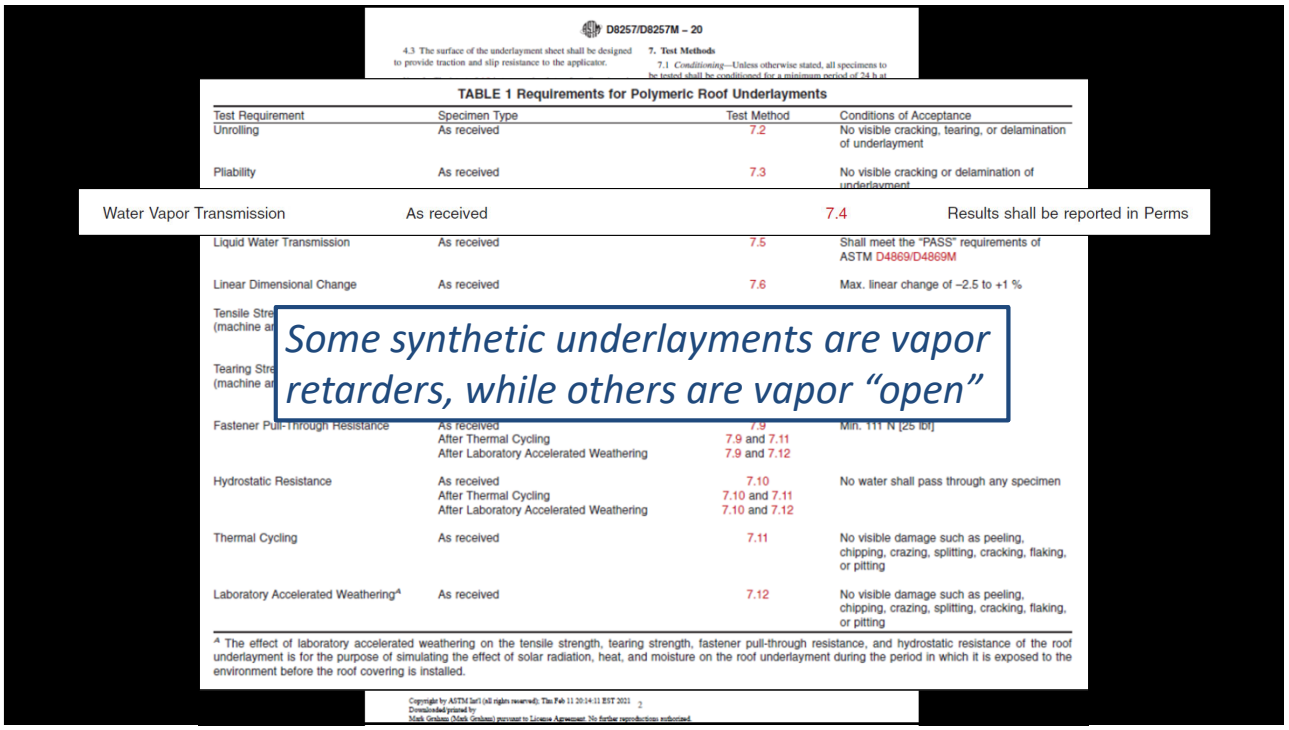

D8257/D8257M – 20

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Some synthetic underlayments are vapor retarders, while others are vapor "open"

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NRCA permeance testing of asphalt shingle roof assemblies

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Measurement of a vapor retarder's effectiveness

Classification	Permeance[1]
Class I vapor retarder	0.1 perm or less
Class II vapor retarder	1.0 perm or less and greater than 0.1 perm
Class III vapor retarder	10 perm or less and greater than 1.0 perm

[1] Permeance determined according to ASTM E-96 Test Method A (the desiccant method or dry cup method)

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VAPOR PERMEABILITY PROVIDES

TEST MATERIAL	PERMEANCE RATING
Asphalt shingles – individual	0.9
#15 felt	7.0
Breathable synthetic	9.5
Nonbreathable synthetic	0.1
7/16-in. OSB decking	1.0

TEST MATERIAL	PERMEANCE RATING
OSB, #15 felt, Classic® shingles	0.31
OSB, Fiberglas™-reinforced felt, Classic® shingles	0.32
OSB, nonbreathable, Classic® shingles	0.27

IIBEC (formerly RCI) *Interface*

December 2011

Link

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This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: E96/E96M – 22

Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials[1]

This standard is issued under the fixed designation E96/E96M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These test methods cover the determination of water vapor transmission rate (WVTR) of materials, such as, but not limited to, paper, plastic films, other sheet materials, coatings, foams, fiberboards, gypsum and plaster products, wood products, and plastics. Two basic methods, the Desiccant Method and the Water Method, are provided for the measurement of WVTR. In these tests, the desired temperature and side-to-side humidity conditions, with resultant vapor drive through the specimen, are used. Agreement is not to be expected between results obtained by different methods. The test conditions employed are at the discretion of the user, but in all cases, are reported with the results.

1.2 The values stated in either Inch-Pound or SI units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, each system shall be used independently of the other. Derived results are converted from one system to the other using appropriate conversion factors (see Table 1).

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

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C1809 Practice for Preparation of Specimens and Reporting of Results for Permeance Testing of Pressure Sensitive Adhesive Sealed Joints in Insulation Vapor Retarders

D449/D449M Specification for Asphalt Used in Dampproofing and Waterproofing

D2301 Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 Definitions of terms used in this standard will be found in Terminology C168, from which the following is quoted:

water vapor permeability—the time rate of water vapor transmission through unit area of flat material of unit thickness induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

Discussion—Permeability is a property of a material, but the permeability of a body that performs like a material may be used. Permeability is the arithmetic product of permeance and thickness.

water vapor permeance—the time rate of water vapor transmission through unit area of flat material or construction induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

Discussion—Permeance is a performance evaluation and not a property of a material.

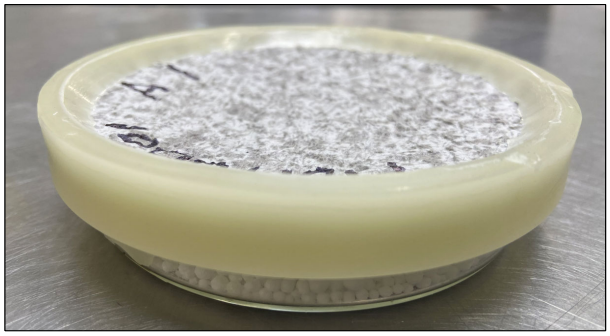
[1] These test methods are under the jurisdiction of ASTM Committee C16 on Thermal Insulation and are the direct responsibility of Subcommittee C16.33 on Insulation Finishes and Moisture.

Current edition approved March 1, 2022. Published April 2022. Originally approved in 1953. Last previous edition approved in 2021 as E96/E96M – 21. DOI: 10.1520/E0096_E0096M-22.

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

1

ASTM E96, "Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials"



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ASTM E96 Procedure A results

NRCA permeance testing of asphalt shingle roof assemblies

Sample	Water vapor permeance (Perms)
7/16” OSB sheathing	1.4
15/32” CDX plywood sheathing	0.9

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ASTM E96 Procedure A results -- continued

NRCA permeance testing of asphalt shingle roof assemblies

Sample	Water vapor permeance (Perms)
Non-breathable synthetic underlayment	0.02
Breathable synthetic underlayment	0.5

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ASTM E96 Procedure A results -- continued

NRCA permeance testing of asphalt shingle roof assemblies

Sample	Water vapor permeance (Perms)
Non-breathable synthetic underlayment over 7/16” OSB sheathing	0.03
Non-breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.05
Breathable synthetic underlayment over 7/16” OSB sheathing	0.50
Breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.22

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ASTM E96 Procedure A results -- continued

NRCA permeance testing of asphalt shingle roof assemblies

Sample	Water vapor permeance (Perms)
Laminated asphalt shingle over non-breathable synthetic underlayment over 7/16” OSB sheathing	0.05
Laminated asphalt shingle over non-breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.04
Laminated asphalt shingle over breathable synthetic underlayment over 7/16” OSB sheathing	0.40
Laminated asphalt shingle over breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.09

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ASTM E96 Procedure A results -- continued

NRCA permeance testing of asphalt shingle roof assemblies

Sample	Water vapor permeance (Perms)
Laminated asphalt shingle over non-breathable synthetic underlayment over 7/16” OSB sheathing	0.05 0.10 with nail
Laminated asphalt shingle over non-breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.04 0.10 with nail
Laminated asphalt shingle over breathable synthetic underlayment over 7/16” OSB sheathing	0.40 0.50 with nail
Laminated asphalt shingle over breathable synthetic underlayment over 15/32” CDX plywood sheathing	0.09 0.18 with nail

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“Preliminary” conclusions

NRCA permeance testing of asphalt shingle roof assemblies

- There is a potential for condensation development at the roof deck level when using synthetic underlayment
- Functional below-deck ventilation is (even more) important for mitigating condensation development at the roof deck level when using synthetic underlayment

40

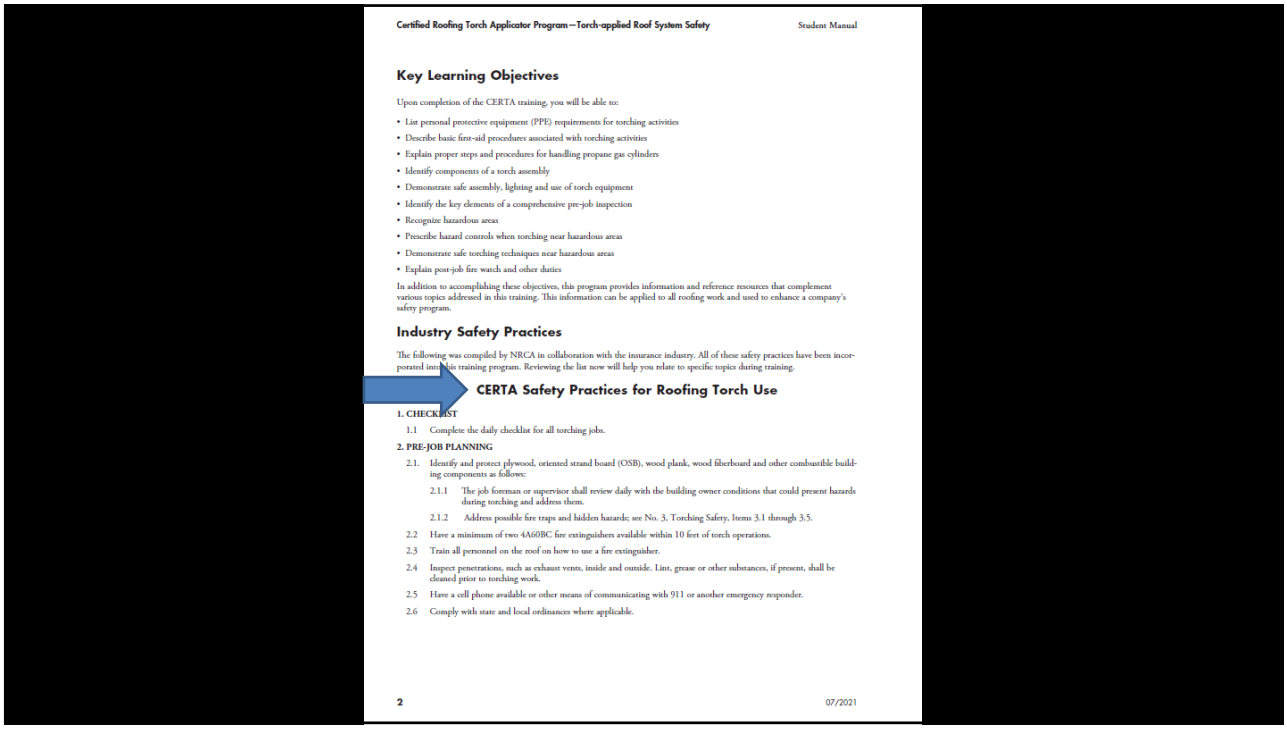
CERTA program updates

41

2,650 Trainers

41,500 Applicators

42



Certified Roofing Torch Applicator Program—Torch-applied Roof System Safety Student Manual

Key Learning Objectives

Upon completion of the CERTA training, you will be able to:

- List personal protective equipment (PPE) requirements for torching activities
- Describe basic first-aid procedures associated with torching activities
- Explain proper steps and procedures for handling propane gas cylinders
- Identify components of a torch assembly
- Demonstrate safe assembly, lighting and use of torch equipment
- Identify the key elements of a comprehensive pre-job inspection
- Recognize hazardous areas
- Prescribe hazard controls when torching near hazardous areas
- Demonstrate safe torching techniques near hazardous areas
- Explain post-job fire watch and other duties

In addition to accomplishing these objectives, this program provides information and reference resources that complement various topics addressed in this training. This information can be applied to all roofing work and used to enhance a company's safety program.

Industry Safety Practices

The following was compiled by NRCA in collaboration with the insurance industry. All of these safety practices have been incorporated into this training program. Reviewing the list now will help you relate to specific topics during training.

CERTA Safety Practices for Roofing Torch Use

1. CHECKLIST

1.1 Complete the daily checklist for all torching jobs.

2. PRE-JOB PLANNING

2.1. Identify and protect plywood, oriented strand board (OSB), wood plank, wood fiberboard and other combustible building components as follows:

2.1.1 The job foreman or supervisor shall review daily with the building owner conditions that could present hazards during torching and address them.

2.1.2 Address possible fire traps and hidden hazards; see No. 3, Torching Safety, Items 3.1 through 3.5.

2.2 Have a minimum of two 4A60BC fire extinguishers available within 10 feet of torch operations.

2.3 Train all personnel on the roof on how to use a fire extinguisher.

2.4 Inspect penetrations, such as exhaust vents, inside and outside. Lint, grease or other substances, if present, shall be cleaned prior to torching work.

2.5 Have a cell phone available or other means of communicating with 911 or another emergency responder.

2.6 Comply with state and local ordinances where applicable.

2 07/2021

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Revisions to the CERTA practices

- Implementation of a job hazard analysis specific to torching operations
- Update to the current edition of The NRCA Roofing Manual
  - Torching over wood roof decks is no longer recommended
  - Guidance for torching over wood decks is provided for when necessary
- Clarification to incidental torching guidance

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The revisions will be provided to all CERTA Trainers
and will be implemented via CERTA's re-authorization process

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MRCA/NRCA ignition temperature research

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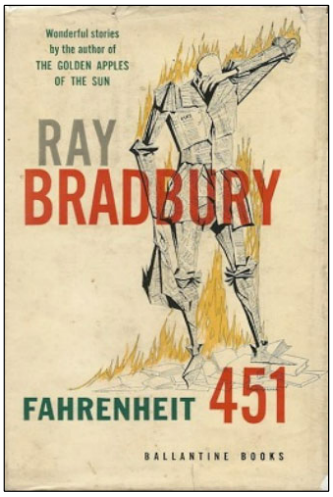

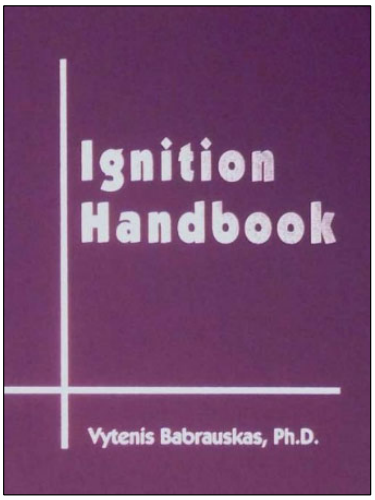

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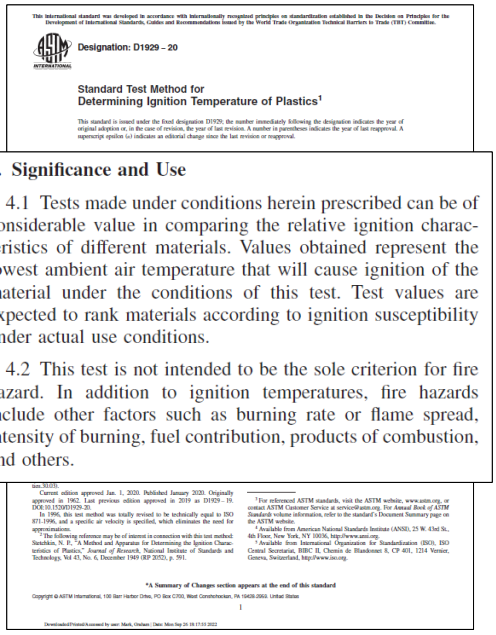

Designation: D1929 – 20

Standard Test Method for
Determining Ignition Temperature of Plastics[1]

4. Significance and Use

4.1 Tests made under conditions herein prescribed can be of considerable value in comparing the relative ignition characteristics of different materials. Values obtained represent the lowest ambient air temperature that will cause ignition of the material under the conditions of this test. Test values are expected to rank materials according to ignition susceptibility under actual use conditions.

4.2 This test is not intended to be the sole criterion for fire hazard. In addition to ignition temperatures, fire hazards include other factors such as burning rate or flame spread, intensity of burning, fuel contribution, products of combustion, and others.

ASTM D1929, "Standard Test Method for Determining Ignition Temperature of Plastics"

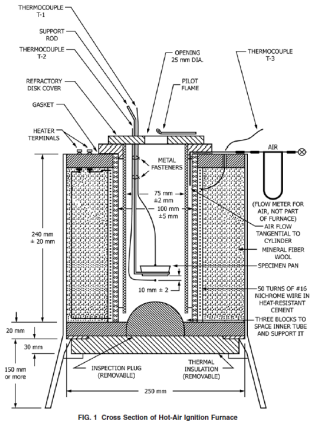

FIG. 1 Cross Section of Hot-Air Ignition Furnace

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ASTM D1929 results

Sample	Test result
Extruded polystyrene	865 F
HD polyiso with glass facer	865 F
Wood fiberboard	875 F
Polyiso with coated glass facer	895 F
Perlite board	905 F
Expanded polystyrene	910 F
Polyiso with cellulose/glass facer	920 F
Cellular glass with facer	965 F
Mineral fiber board	1,040 F
Gypsum-fiber board	Greater than 1,740 F
Gypsum board with coated fiberglass facer	Greater than 1,740 F
Cellular glass (no facer)	Greater than 1,740 F

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Some known roof application temperatures

Mopping bitumen:

- EVT: 375 F to 455 F (typ.)
- Flash point: 525 F (min.)

Hot-air welding:

- Equipment settings up to 600 C (1,112 F)

Torch application:

- Blue flame: 3,596 F
- Yellow/orange flame: 1,800 F

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“Preliminary” recommendations

- When hot-air welding or torching roofing products, realize the relative differences in ignition temperatures of various insulation substrates
- Share this information/concept with field workers

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Code developments/2021 I-codes

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2021 I-codes

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2021 IBC

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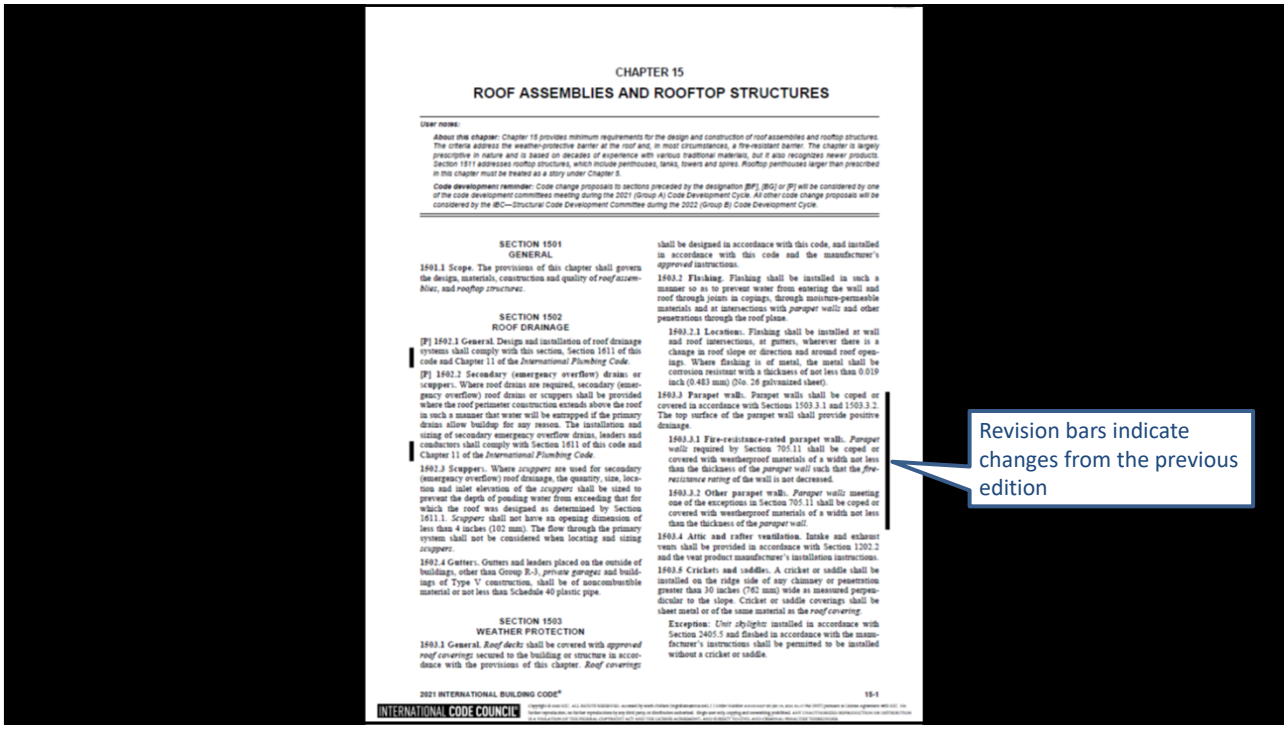

CHAPTER 15

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

User notes:

About this chapter: Chapter 15 provides minimum requirements for the design and construction of roof assemblies and rooftop structures. The criteria address the weather-protective barrier at the roof and, in most circumstances, a fire-resistant barrier. The chapter is largely prescriptive in nature and is based on decades of experience with various traditional materials, but it also recognizes newer products. Section 1511 addresses rooftop structures, which include penthouses, tanks, towers and spires. Rooftop penthouses larger than prescribed in this chapter must be treated as a story under Chapter 5.

Code development reminder: Code change proposals to sections preceded by the designation [BF], [BG] or [P] will be considered by one of the code development committees meeting during the 2021 (Group A) Code Development Cycle. All other code change proposals will be considered by the IBC—Structural Code Development Committee during the 2022 (Group B) Code Development Cycle.

SECTION 1501
GENERAL

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

SECTION 1502
ROOF DRAINAGE

[P] 1502.1 General. Design and installation of roof drainage systems shall comply with this section, Section 1611 of this code and Chapter 11 of the *International Plumbing Code*.

[P] 1502.2 Secondary (emergency overflow) drains or scuppers. Where roof drains are required, secondary (emergency overflow) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. The installation and sizing of secondary emergency overflow drains, leaders and conductors shall comply with Section 1611 of this code and Chapter 11 of the *International Plumbing Code*.

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

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

SECTION 1503
WEATHER PROTECTION

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

1503.2 Flashing. Flashing shall be installed in such a manner so as to prevent water from entering the wall and roof through joints in copings, through moisture-permeable materials and at intersections with *parapet walls* and other penetrations through the roof plane.

1503.2.1 Locations. Flashing shall be installed at wall and roof intersections, at gutters, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than 0.019 inch (0.483 mm) (No. 26 galvanized sheet).

1503.3 Parapet walls. Parapet walls shall be coped or covered in accordance with Sections 1503.3.1 and 1503.3.2. The top surface of the parapet wall shall provide positive drainage.

1503.3.1 Fire-resistance-rated parapet walls. *Parapet walls* required by Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the *parapet wall* such that the *fire-resistance rating* of the wall is not decreased.

1503.3.2 Other parapet walls. *Parapet walls* meeting one of the exceptions in Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the *parapet wall*.

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

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

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

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Revision bars indicate changes from the previous edition

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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.

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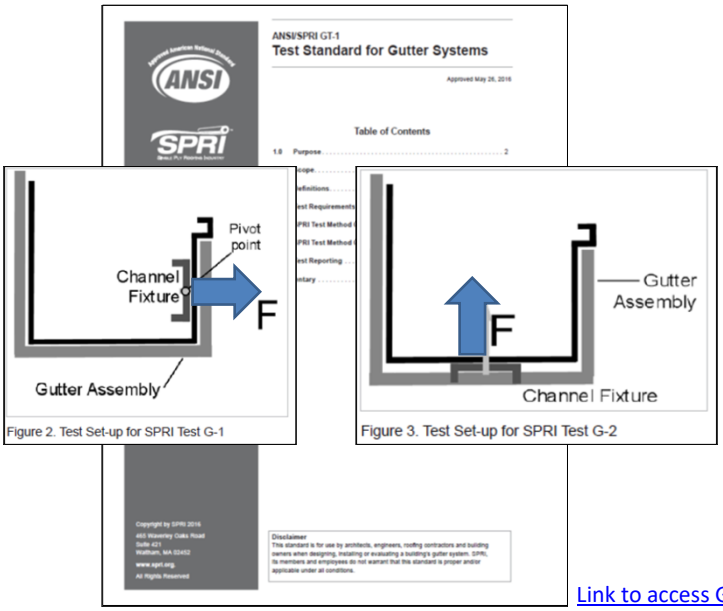
ANSI/SPRI GT-1



Link to access GT-1

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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	150	≤ 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
	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
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).

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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.

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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 $^1/_4$ 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.

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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.

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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.

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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

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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*.

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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.

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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).

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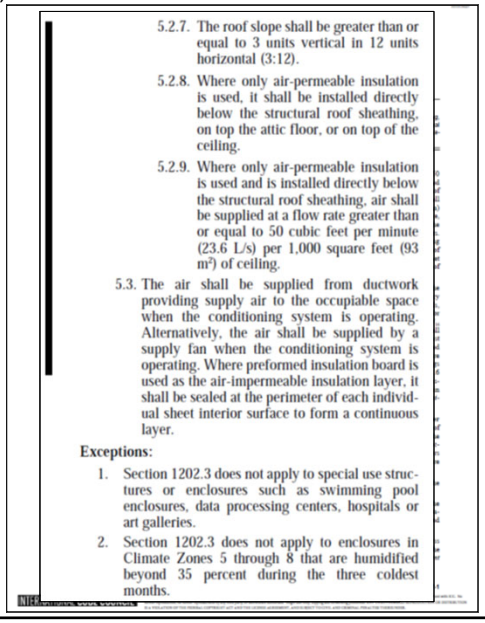
Attic ventilation

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.

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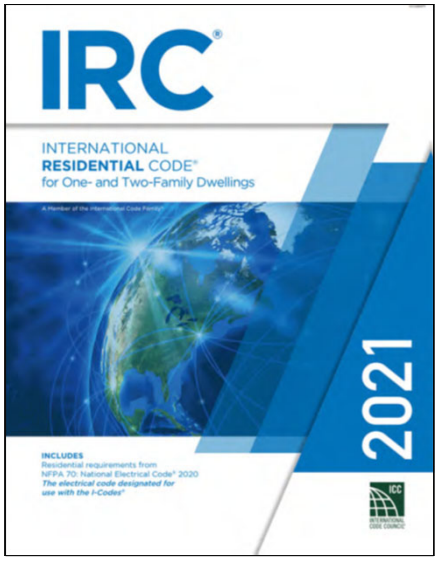
2021 IRC



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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 spinkler 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.

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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.

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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…

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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 D48696 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

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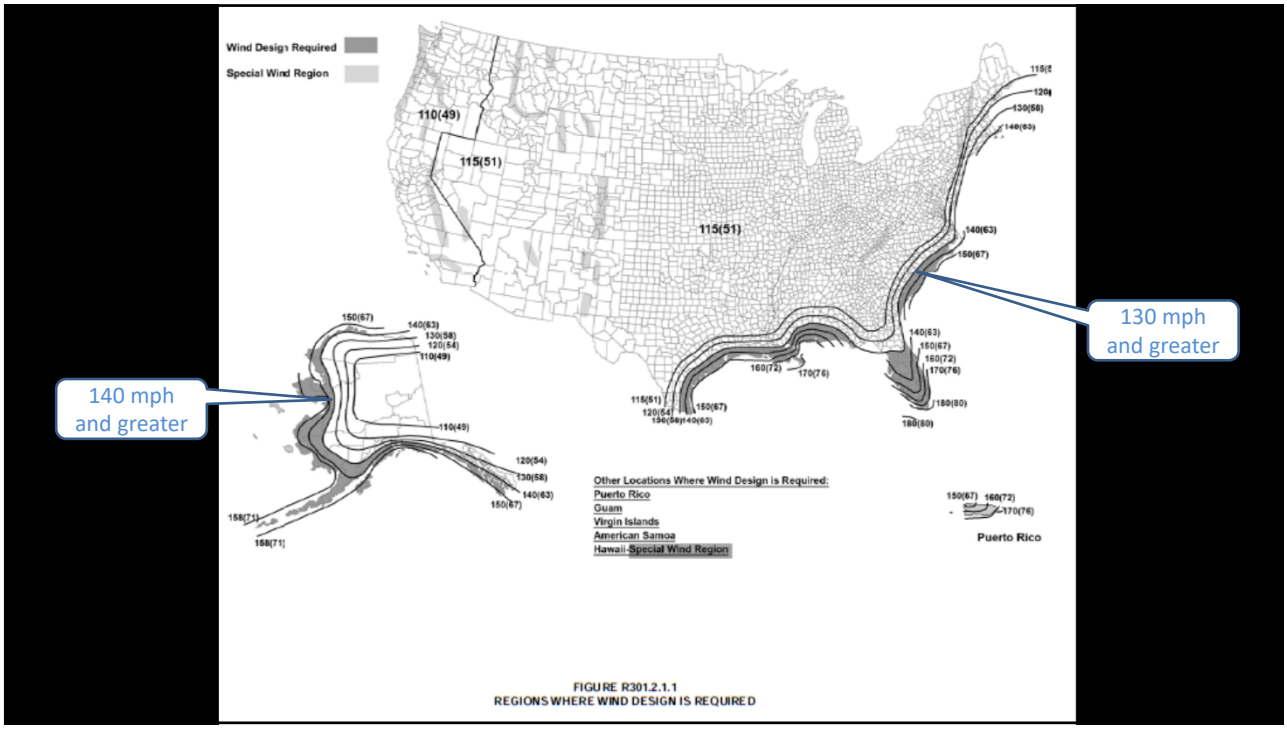

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Metal shingles

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.

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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

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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 $1^{3}/_{4}$″ × 0.080
18″ and 24″ handsplit and resawn	6d box 2″ × 0.099
24″ taper-split	5d box $1^{3}/_{4}$″ × 0.080
18″ and 24″ tapersawn	6d box 2″ × 0.099
Shingles	
16″ and 18″	3d box $1^{1}/_{4}$″ × 0.076
24″	4d box $1^{1}/_{2}$″ × 0.076

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PV shingles – Wind resistance

Changes in IRC 2021, Section R905.16-Photvolotais 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

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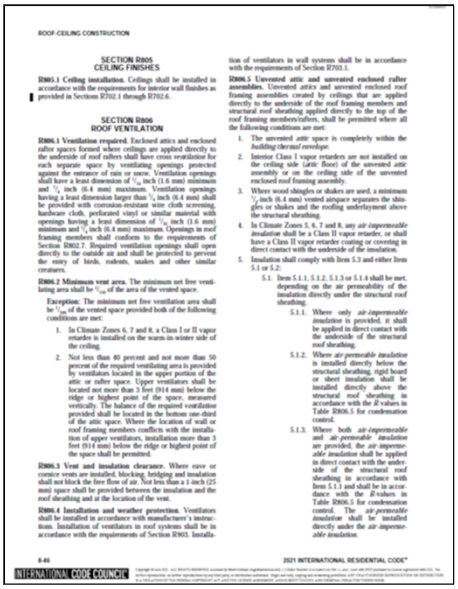
Unvented attics

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



ROOF-CEILING CONSTRUCTION

SECTION R805
CEILING FINISHES

R805.1 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. Enclosed 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. Ventilation openings shall have a least dimension of 1/16 inch (1.6 mm) minimum and 1/4 inch (6.4 mm) maximum. Ventilation openings having a least dimension larger than 1/4 inch (6.4 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth, perforated vinyl or similar material with openings having a least dimension of 1/16 inch (1.6 mm) minimum and 1/4 inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of Section R802.7. Required ventilation 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 1/150 of the area of the vented space.

Exception: The minimum net free ventilation area shall be 1/300 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-in-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, installation more than 3 feet (914 mm) below the ridge or highest point of the space shall be permitted.

R806.3 Vent and insulation clearance. Where eave or cornice vents are installed, blocking, bridging and insulation shall not block the free flow of air. Not less than a 1 inch (25 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 R903. Installation of ventilators in wall systems shall be in accordance with the requirements of Section R703.1.

R806.5 Unvented attic and unvented enclosed rafter assemblies. Unvented attics and unvented enclosed roof framing 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/rafters, 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 side (attic floor) of the unvented attic assembly or on the ceiling side of the unvented enclosed roof framing assembly.
3. Where wood shingles or shakes are used, a minimum 1/4 inch (6.4 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 5.3 and either 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 under 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*.

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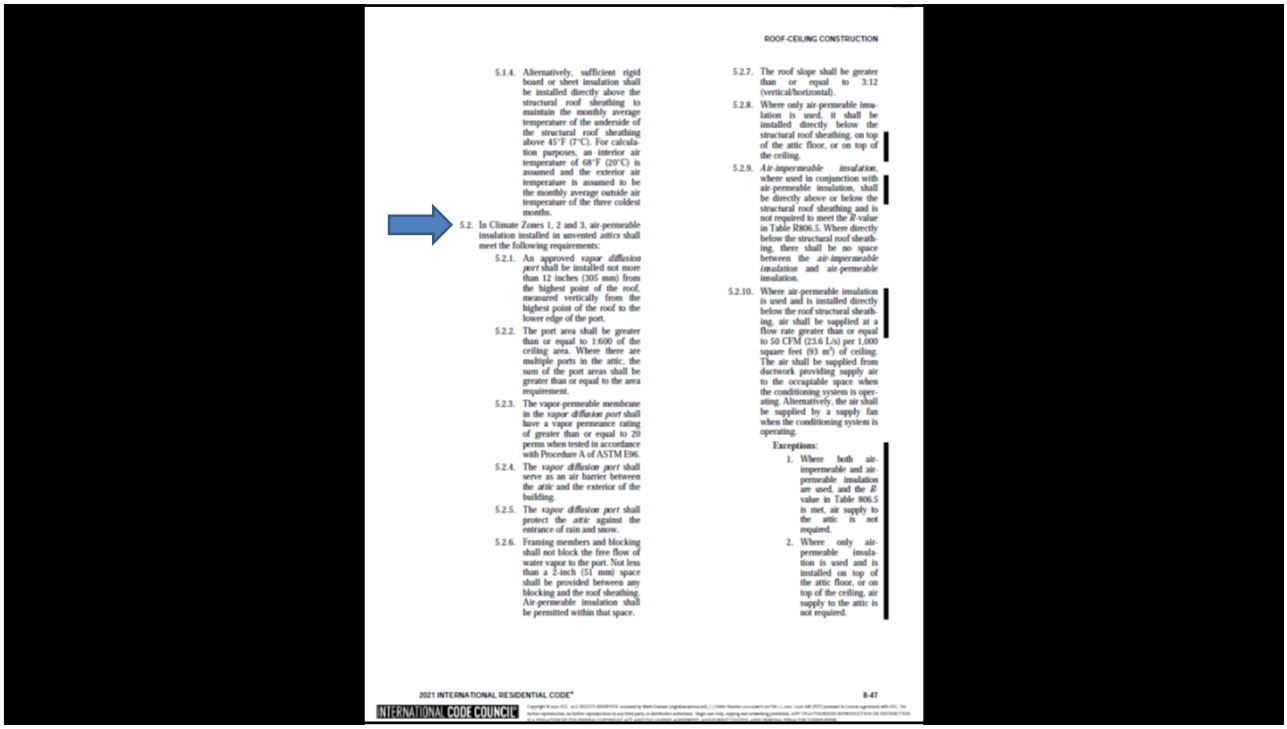

ROOF-CEILING CONSTRUCTION

5.1.4. Alternatively, sufficient rigid board or sheet insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.

5.2. In Climate Zones 1, 2 and 3, air-permeable insulation installed in unvented *attics* shall meet the following requirements:

5.2.1. An approved *vapor diffusion port* shall be installed not more than 12 inches (305 mm) from the highest point of the roof, measured vertically from the highest point of the roof to the lower edge of the port.

5.2.2. The port area shall be greater than or equal to 1:600 of the ceiling area. Where there are multiple ports in the attic, the sum of the port areas shall be greater than or equal to the area requirement.

5.2.3. The vapor-permeable membrane in the *vapor diffusion port* shall have a vapor permeance rating of greater than or equal to 20 perms when tested in accordance with Procedure A of ASTM E96.

5.2.4. The *vapor diffusion port* shall serve as an air barrier between the *attic* and the exterior of the building.

5.2.5. The *vapor diffusion port* shall protect the *attic* against the entrance of rain and snow.

5.2.6. Framing members and blocking shall not block the free flow of water vapor to the port. Not less than a 2-inch (51 mm) space shall be provided between any blocking and the roof sheathing. Air-permeable insulation shall be permitted within that space.

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

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

5.2.9. *Air-impermeable insulation*, where used in conjunction with air-permeable insulation, shall be directly above or below the structural roof sheathing and is not required to meet the *R*-value in Table R806.5. Where directly below the structural roof sheathing, there shall be no space between the *air-impermeable insulation* and air-permeable insulation.

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

Exceptions:

1. Where both air-impermeable and air-permeable insulation are used, and the *R*-value in Table 806.5 is met, air supply to the attic is not required.
2. Where only air-permeable insulation is used and is installed on top of the attic floor, or on top of the ceiling, air supply to the attic is not required.

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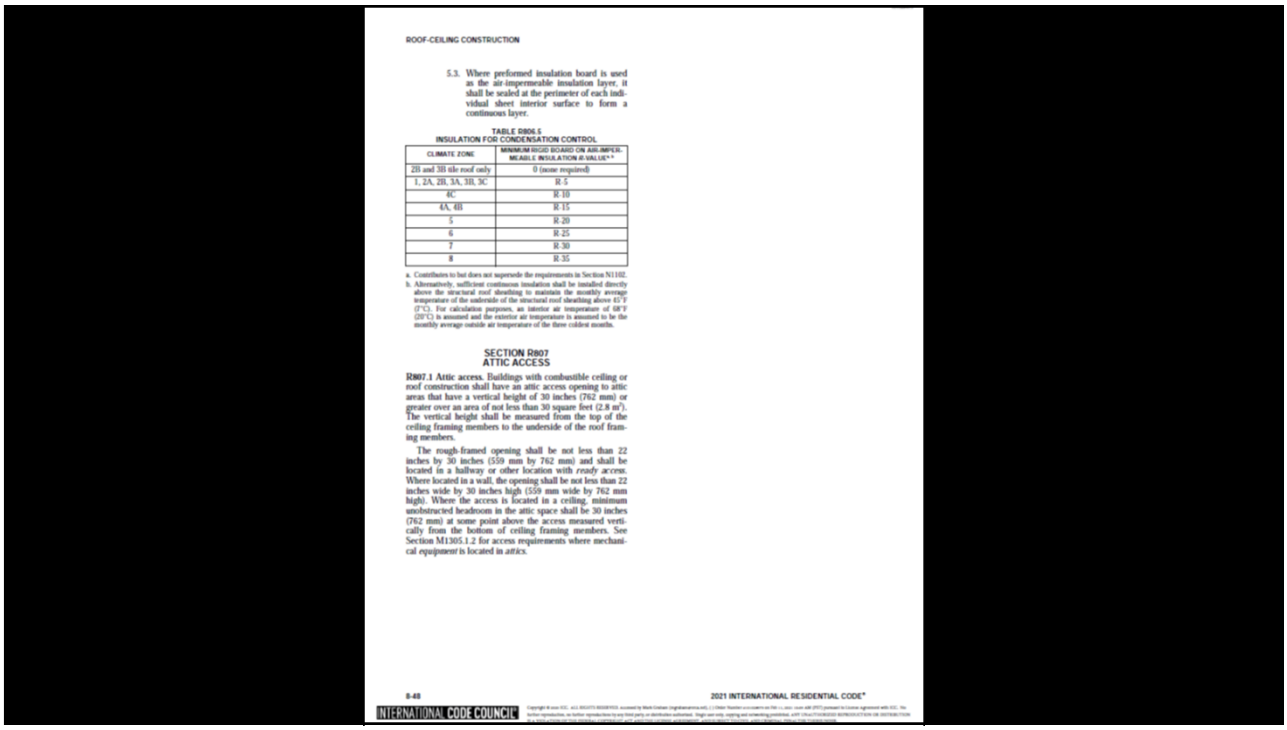

ROOF-CEILING CONSTRUCTION

5.3. 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.

TABLE R806.5
INSULATION FOR CONDENSATION CONTROL

CLIMATE ZONE	MINIMUM RIGID BOARD OR AIR-IMPERMEABLE INSULATION *R*-VALUE[a,b]
2B and 3B tile roof only	0 (none required)
1, 2A, 2B, 3A, 3B, 3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

a. Contributes to but does not supersede the requirements in Section N1102.
b. Alternatively, sufficient continuous insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.

SECTION R807
ATTIC ACCESS

R807.1 Attic access. Buildings with combustible ceiling or roof construction shall have an attic access opening to attic areas that have a vertical height of 30 inches (762 mm) or greater over an area of not less than 30 square feet (2.8 m²). The vertical height shall be measured from the top of the ceiling framing members to the underside of the roof framing members.

The rough-framed opening shall be not less than 22 inches by 30 inches (559 mm by 762 mm) and shall be located in a hallway or other location with *ready access*. Where located in a wall, the opening shall be not less than 22 inches wide by 30 inches high (559 mm wide by 762 mm high). Where the access is located in a ceiling, minimum unobstructed headroom in the attic space shall be 30 inches (762 mm) at some point above the access measured vertically from the bottom of ceiling framing members. See Section M1305.1.2 for access requirements where mechanical *equipment* is located in *attics*.

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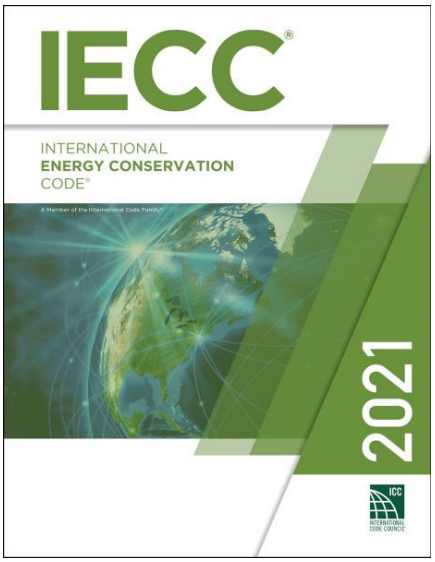

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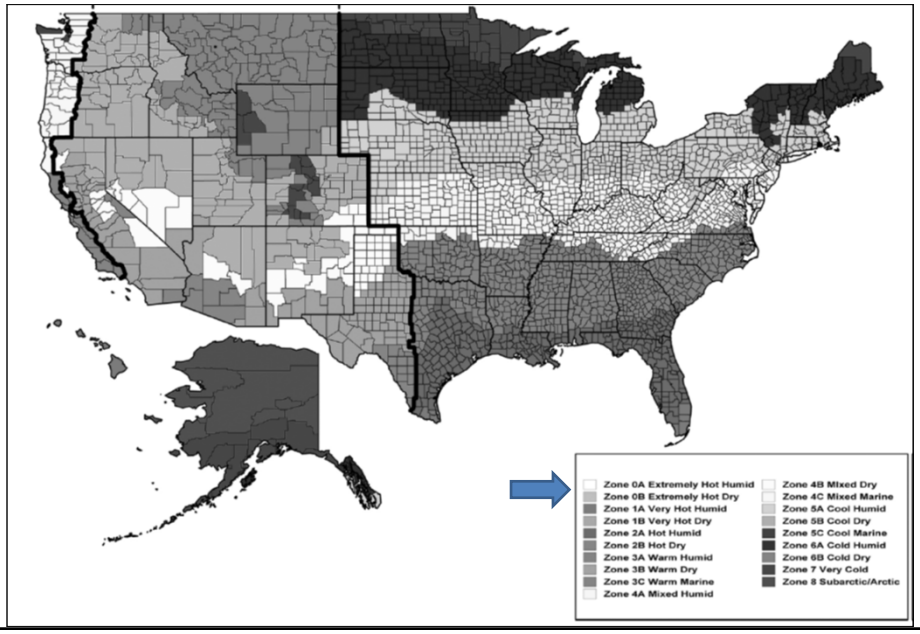
2021 IECC – Climate zone map



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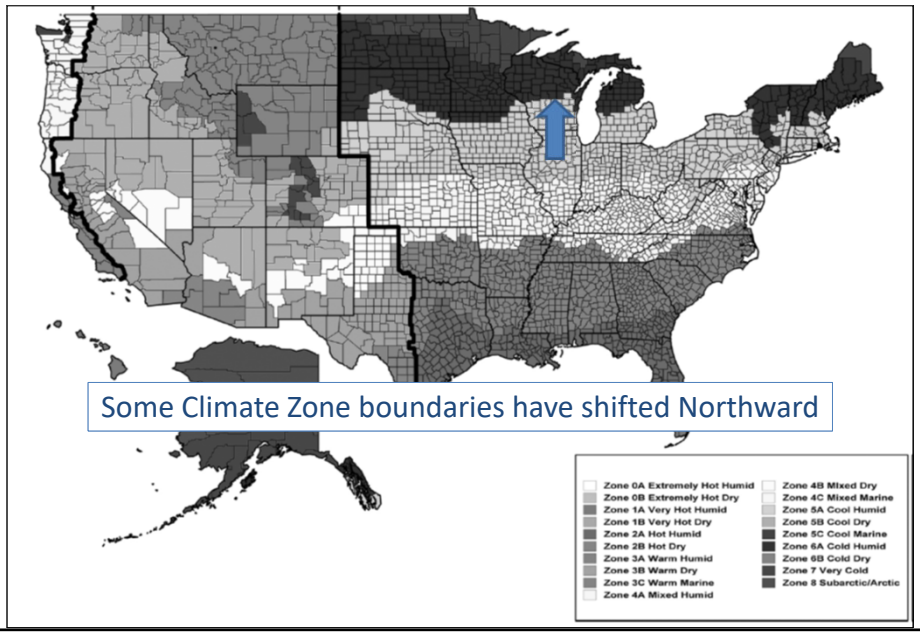
2021 IECC – Climate zone map



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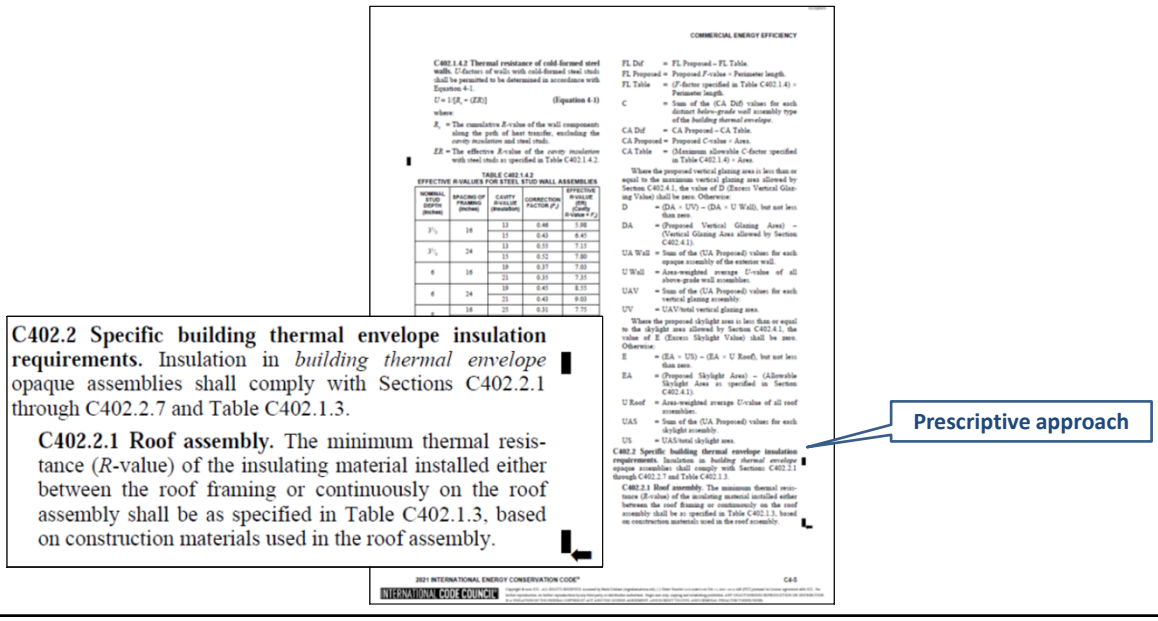

C402.2 Specific building thermal envelope insulation requirements. Insulation in *building thermal envelope* opaque assemblies shall comply with Sections C402.2.1 through C402.2.7 and Table C402.1.3.

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

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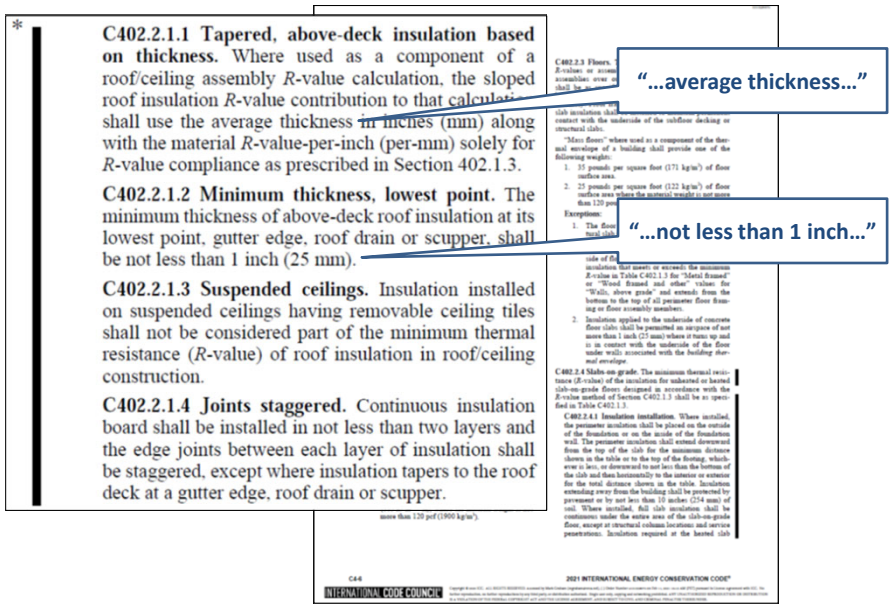
2021 IECC Commercial – Tapered insulation



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 calculati… 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.

"…average thickness…"

"…not less than 1 inch…"

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

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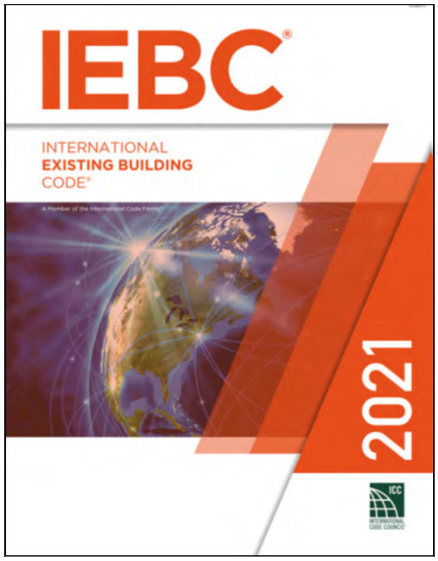

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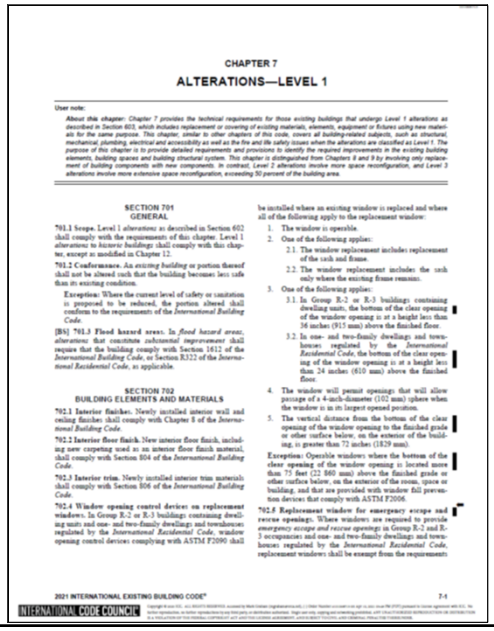
IEBC 2021 -- Reroofing



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 603, which includes replacement or covering of existing materials, elements, equipment or fixtures using new 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 elements, building spaces 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 Conformance. 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 sanitation is proposed to be reduced, the portion altered shall conform to the requirements of the *International Building Code*.

[BS] **701.3 Flood hazard areas.** In *flood hazard areas*, *alterations* that constitute *substantial improvement* shall require that the building comply with Section 1612 of the *International Building Code*, or Section R322 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 where an existing window is replaced and where 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 where 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 (22 860 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 F2006.

702.5 Replacement window for emergency escape and rescue openings. Where windows are 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

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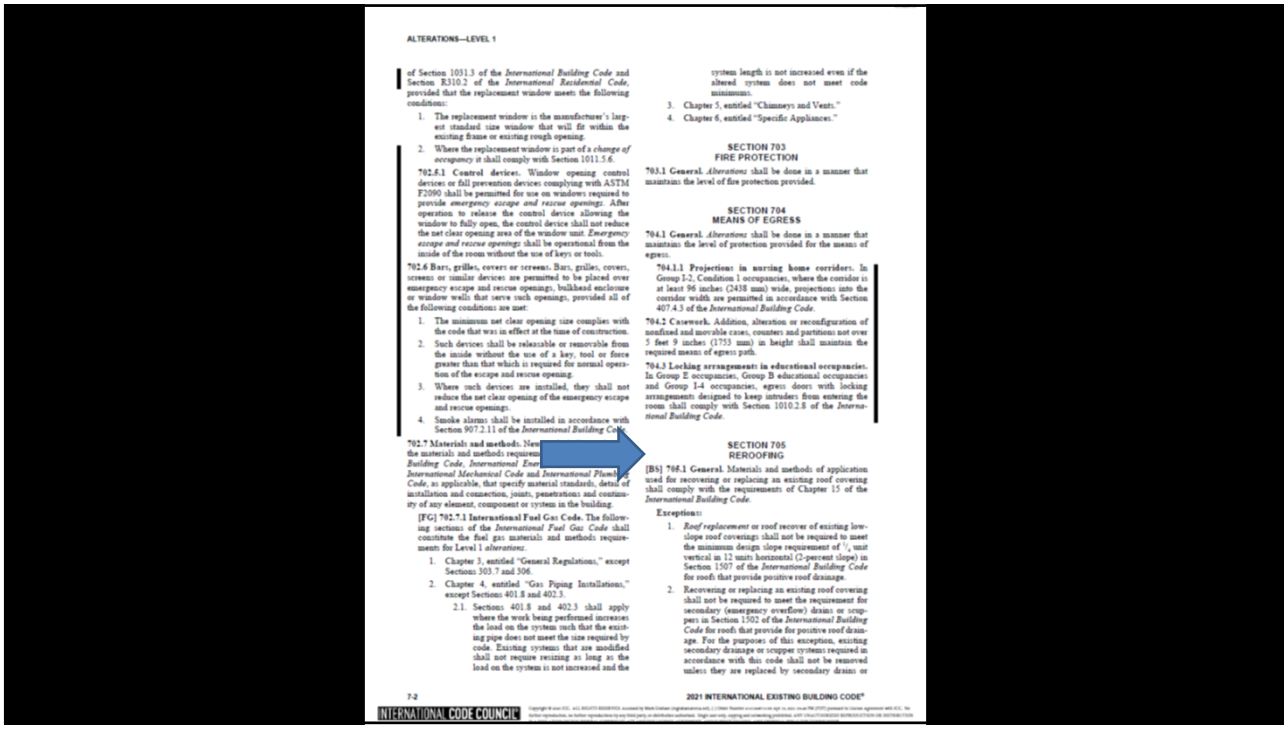

ALTERATIONS—LEVEL 1

of Section 1031.3 of the *International Building Code* and Section R310.2 of the *International Residential Code*, provided that the replacement window meets 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.

702.6.1 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, bulkhead enclosure 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 openings.
4. Smoke alarms shall be installed in accordance with Section 907.2.11 of the *International Building Code*.

702.7 Materials and methods. New

the materials and methods requirem

Building Code, *International Ener*

International Mechanical Code and *International Plumb*

Code, as applicable, that specify material standards, detail of installation and connection, 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 402.3.
   2.1. Sections 401.8 and 402.3 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 resizing 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 minimums.
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 Projection in nursing 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 nonfixed 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 arrangement in educational occupancies. In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8 of the *International Building Code*.

SECTION 705
REROOFING

[BS] 705.1 General. Materials and methods of application used for recovering 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 recover of existing low-slope roof coverings shall not be required to meet the minimum design slope requirement of $\frac{1}{4}$ unit vertical in 12 units horizontal (2-percent slope) in Section 1507 of the *International Building Code* for roofs that provide positive roof drainage.
2. Recovering or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or scuppers in Section 1502 of the *International Building Code* for roofs that provide for positive roof drainage. For the purposes of this exception, existing secondary drainage or scupper systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or

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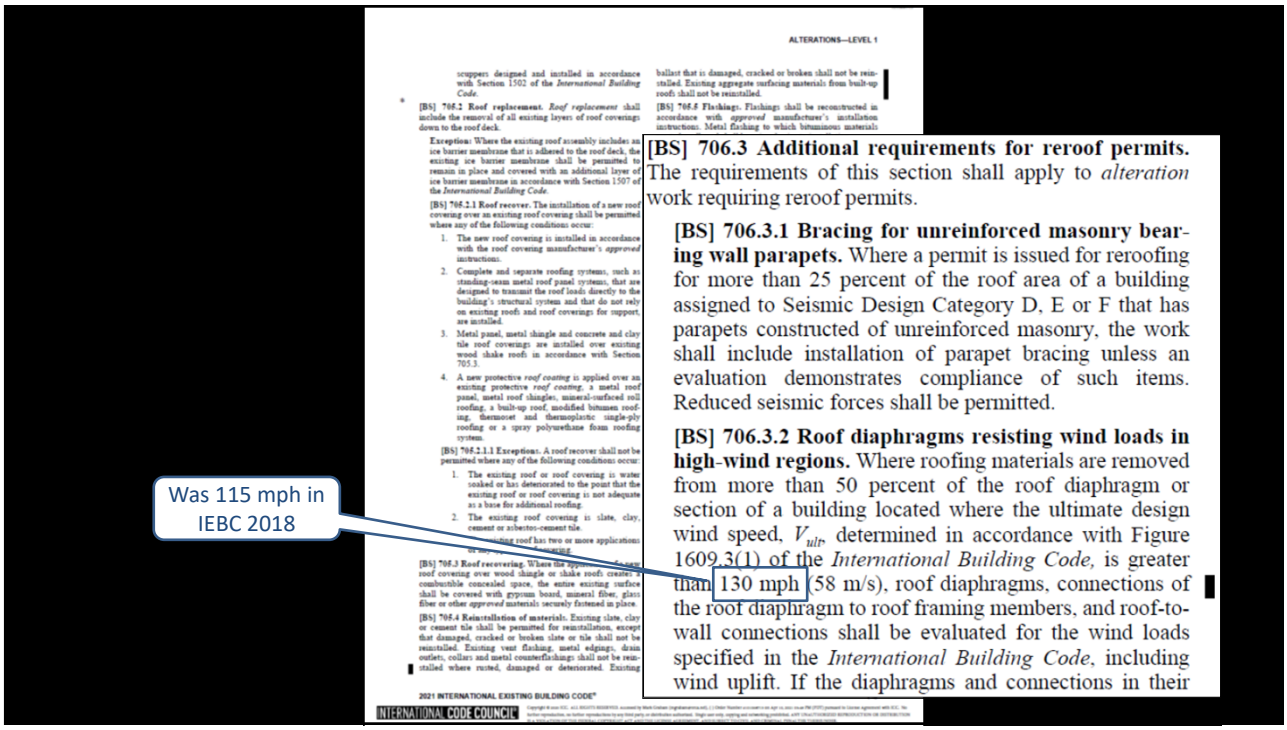

ALTERATIONS—LEVEL 1

scuppers designed and installed in accordance with Section 1502 of the *International Building Code*.

[BS] 705.2 Roof replacement. *Roof replacement* shall include the removal of all existing layers of roof coverings down to the roof deck.

Exception: Where the existing roof assembly includes an ice barrier membrane that is adhered to the roof deck, the existing ice barrier membrane shall be permitted to remain in place and covered with an additional layer of ice barrier membrane in accordance with Section 1507 of the *International Building Code*.

[BS] 705.2.1 Roof recover. The installation of a new roof covering over an existing roof covering shall be permitted where any of the following conditions occur:

1. The new roof covering is installed in accordance with the roof covering manufacturer's *approved* instructions.
2. Complete and separate roofing systems, such as standing-seam metal roof panel systems, that are designed to transmit the roof loads directly to the building's structural system and that do not rely on existing roofs and roof coverings for support, are installed.
3. Metal panel, metal shingle and concrete and clay tile roof coverings are installed over existing wood shake roofs in accordance with Section 705.3.
4. A new protective *roof coating* is applied over an existing protective *roof coating*, a metal roof panel, metal roof shingles, mineral-surfaced roll roofing, a built-up roof, modified bitumen roofing, thermoset and thermoplastic single-ply roofing or a spray polyurethane foam roofing system.

[BS] 705.2.1.1 Exceptions. A roof recover shall not be permitted where any of the following conditions occur:

1. The existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. The existing roof covering is slate, clay, cement or asbestos-cement tile.

[illegible] roof has two or more applications [illegible]

[BS] 705.3 Roof recovering. Where the application of a new roof covering over wood shingle or shake roofs creates a combustible concealed space, the entire existing surface shall be covered with gypsum board, mineral fiber, glass fiber or other *approved* materials securely fastened in place.

[BS] 705.4 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.

[BS] 705.5 Flashings. Flashings shall be reconstructed in accordance with *approved* manufacturer's installation instructions. Metal flashing to which bituminous materials

[BS] 706.3 Additional requirements for reroof permits. The requirements of this section shall apply to *alteration* work requiring reroof permits.

[BS] 706.3.1 Bracing for unreinforced masonry bearing wall parapets. Where a permit is issued for reroofing for more than 25 percent of the roof area of a building assigned to Seismic Design Category D, E or F that has parapets constructed of unreinforced masonry, the work shall include installation of parapet bracing unless an evaluation demonstrates compliance of such items. Reduced seismic forces shall be permitted.

[BS] 706.3.2 Roof diaphragms resisting wind loads in high-wind regions. Where roofing materials are removed from more than 50 percent of the roof diaphragm or section of a building located where the ultimate design wind speed, V_{ult}, determined in accordance with Figure 1609.3(1) of the *International Building Code*, is greater than 130 mph (58 m/s), roof diaphragms, connections of the roof diaphragm to roof framing members, and roof-to-wall connections shall be evaluated for the wind loads specified in the *International Building Code*, including wind uplift. If the diaphragms and connections in their

Was 115 mph in IEBC 2018

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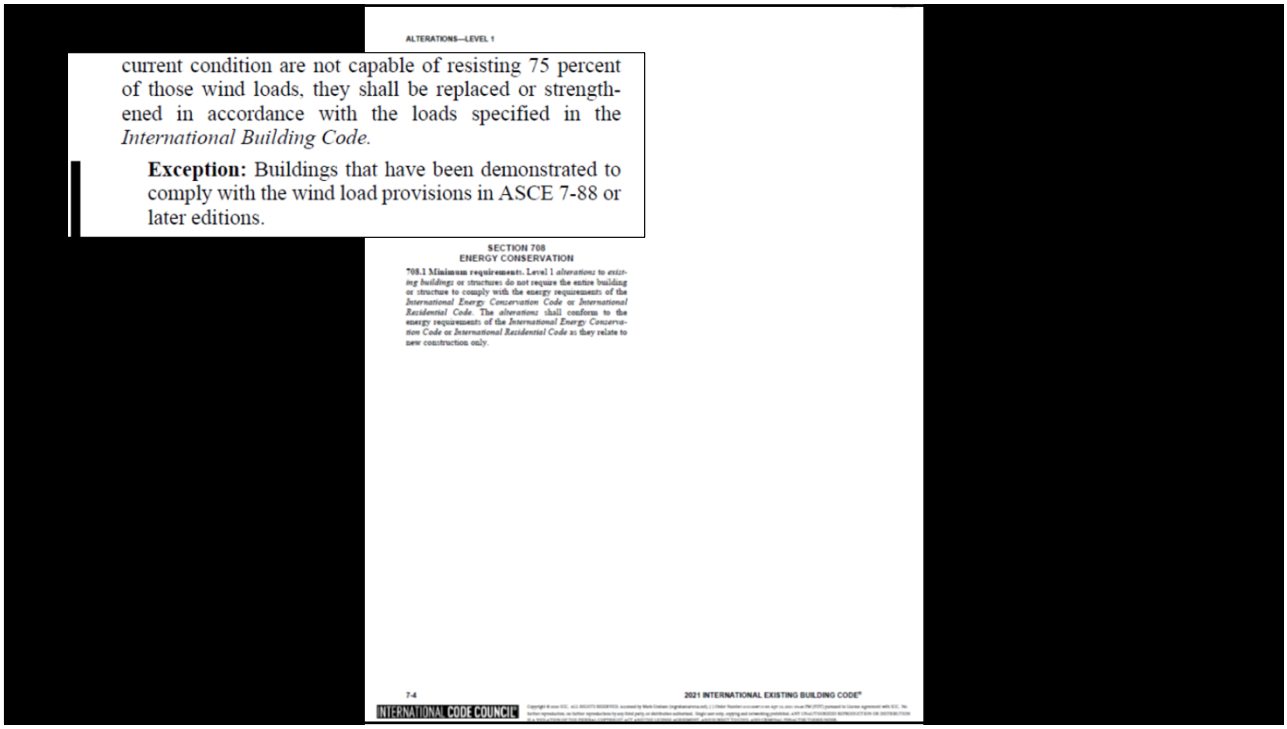

ALTERATIONS—LEVEL 1

current condition are not capable of resisting 75 percent of those wind loads, they shall be replaced or strengthened in accordance with the loads specified in the *International Building Code*.

Exception: Buildings that have been demonstrated to comply with the wind load provisions in ASCE 7-88 or later editions.

SECTION 708
ENERGY CONSERVATION

708.1 Minimum requirements. Level 1 *alterations* to *existing buildings* or structures do not require the entire building or structure to comply with the energy requirements of the *International Energy Conservation Code* or *International Residential Code*. The *alterations* shall conform to the energy requirements of the *International Energy Conservation Code* or *International Residential Code* as they relate to new construction only.

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International Plumbing Code, 2021 Edition

- Roof drainage: Ch. 11-Storm Drainage

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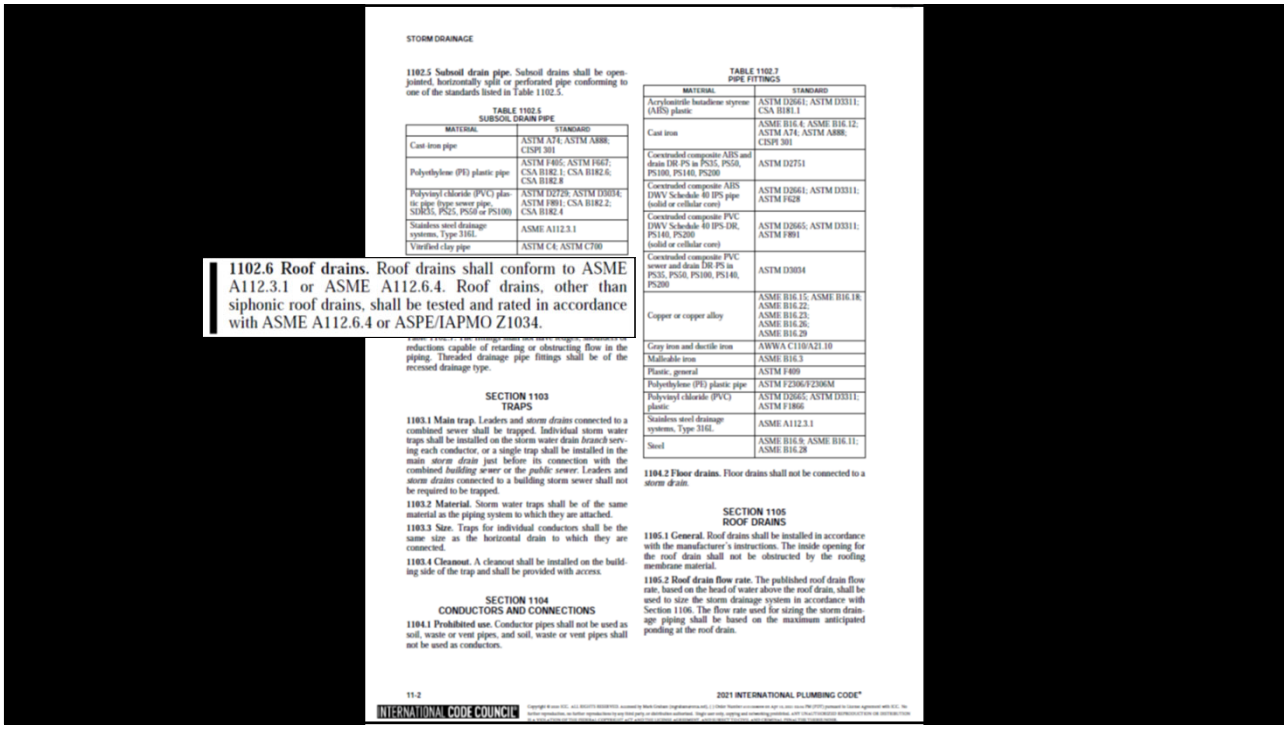

STORM DRAINAGE

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

TABLE 1102.5
SUBSOIL DRAIN PIPE

MATERIAL	STANDARD
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Polyethylene (PE) plastic pipe	ASTM F405; ASTM F667; CSA B182.1; CSA B182.6; CSA B182.8
Polyvinyl chloride (PVC) plastic pipe (type sewer pipe, SDR35, PS25, PS50 or PS100)	ASTM D2729; ASTM D3034; ASTM F891; CSA B182.2; CSA B182.4
Stainless steel drainage systems, Type 316L	ASME A112.3.1
Vitrified clay pipe	ASTM C4; ASTM C700

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.

reductions 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 connection 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.

TABLE 1102.7
PIPE FITTINGS

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; CISPI 301
Coextruded composite ABS and drain DR PS in PS35, PS50, PS100, PS140, PS200	ASTM D2751
Coextruded composite ABS DWV Schedule 40 IPS pipe (solid or cellular core)	ASTM D2661; ASTM D3311; ASTM F628
Coextruded composite PVC DWV Schedule 40 IPS-DR, PS140, PS200 (solid or cellular core)	ASTM D2665; ASTM D3311; ASTM F891
Coextruded composite PVC sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM D3034
Copper or copper alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; 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 F2306/F2306M
Polyvinyl chloride (PVC) plastic	ASTM D2665; 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.

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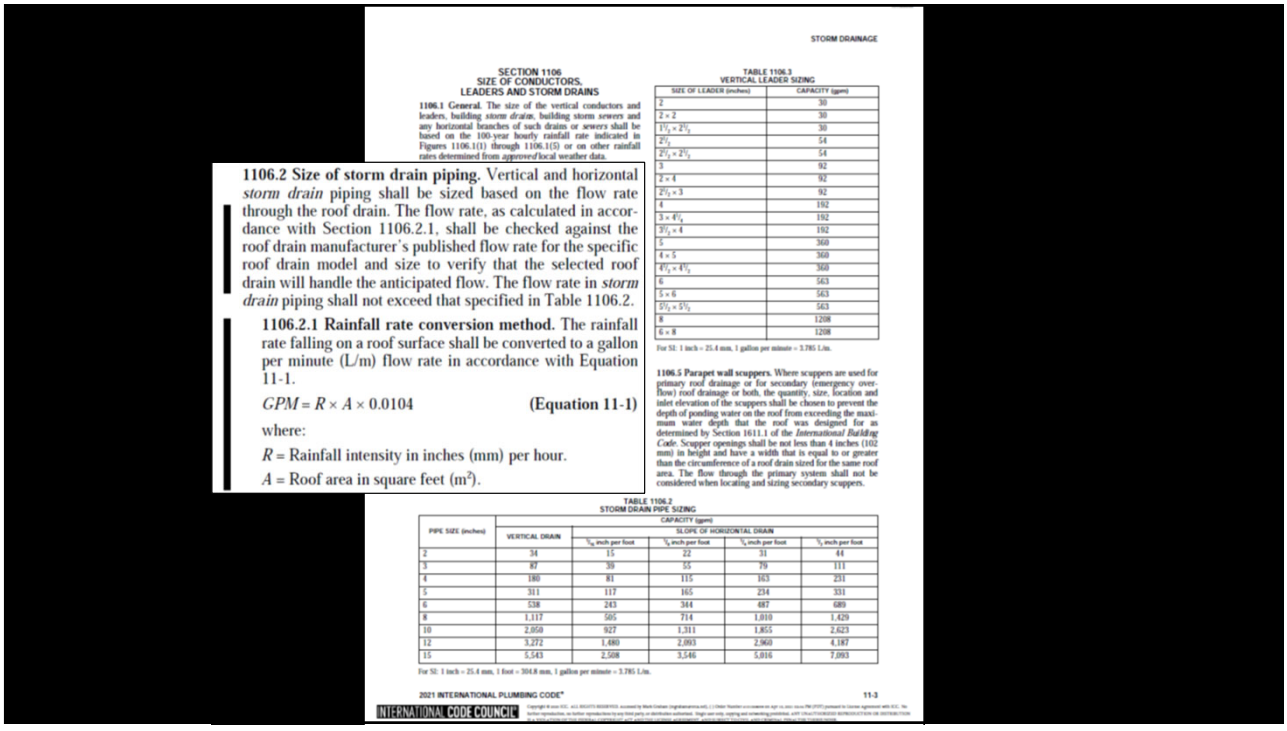

STORM DRAINAGE

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.

$$GPM = R \times A \times 0.0104 \quad \textbf{(Equation 11-1)}$$

where:

R = Rainfall intensity in inches (mm) per hour.

A = Roof area in square feet (m^2).

TABLE 1106.3
VERTICAL LEADER SIZING

SIZE OF LEADER (inches)	CAPACITY (gpm)
2	30
2 × 2	30
1½ × 2½	30
2½	54
2½ × 2½	54
3	92
2 × 4	92
2½ × 3	92
4	192
3 × 4½	192
3½ × 4	192
5	360
4 × 5	360
4½ × 4½	360
6	563
5 × 6	563
5½ × 5½	563
8	1208
6 × 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)	CAPACITY (gpm)				
	VERTICAL DRAIN	SLOPE OF HORIZONTAL DRAIN			
		⅛ inch per foot	¼ inch per foot	½ inch per foot	1 inch per foot
2	34	15	22	31	44
3	87	39	55	79	111
4	180	81	115	163	231
5	311	117	165	234	331
6	538	243	344	687	689
8	1,117	505	714	1,010	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.

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

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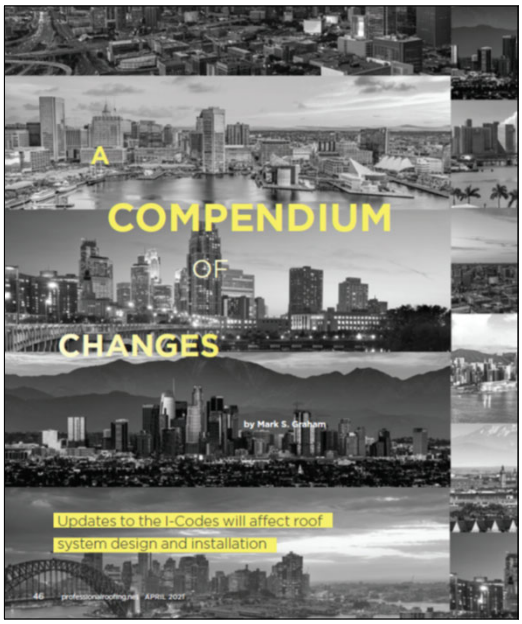

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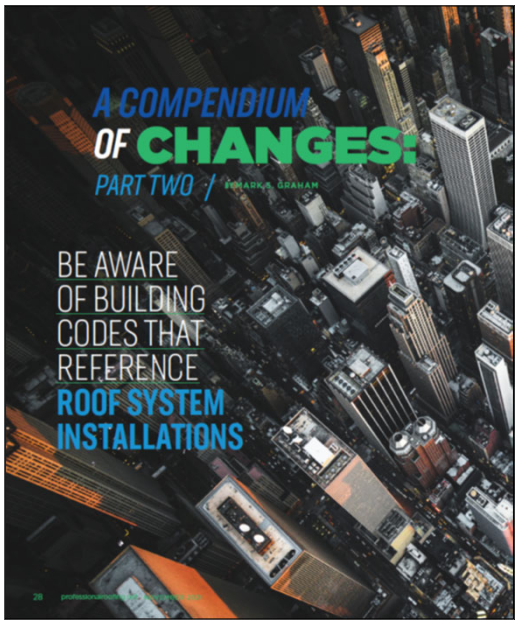

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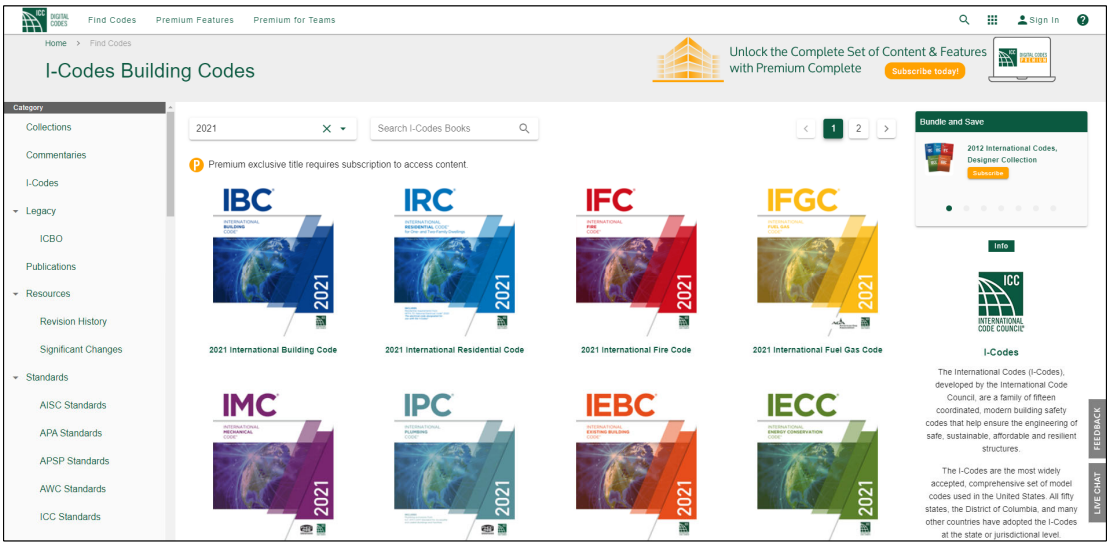
ICC codes accessible online

codes.iccsafe.org



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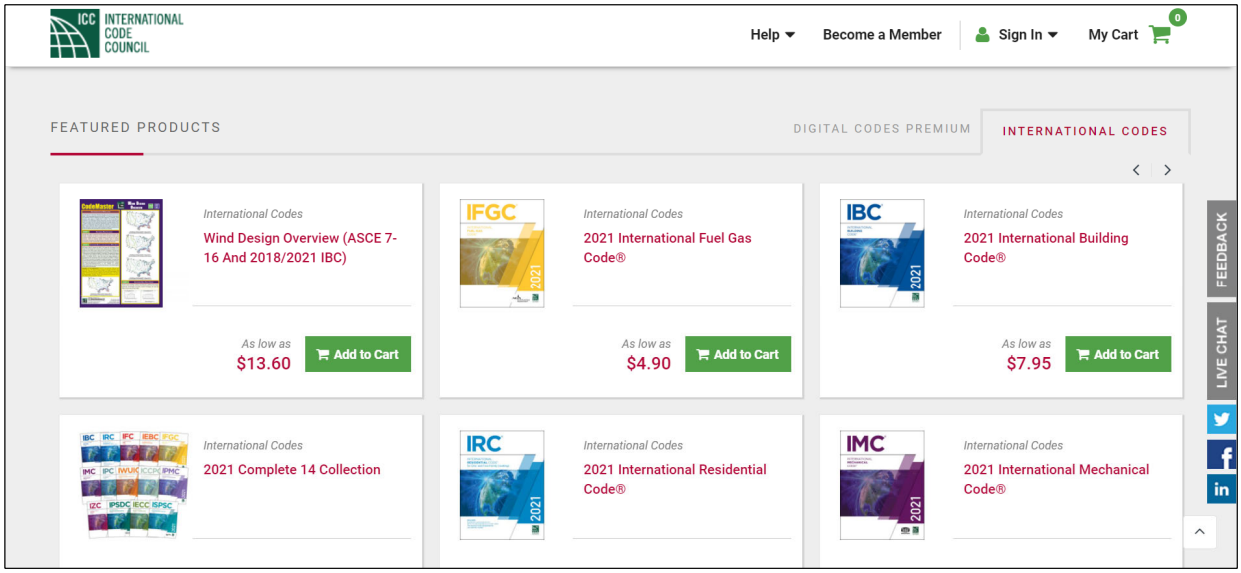

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Contractor-reported problems

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Questions… and other topics

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