



**Advanced Topics and Current Issues in Low-slope Roofing**  
**The University of Wisconsin Madison**  
Madison, Wisconsin – March 19-20, 2024

**UL and FM**

presented by

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

# Code-approved testing agency

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- March 20-21, 2024  
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- March 25-26, 2024  
Uncertainty of Measurement for Labs (Arabian Time Zone)
- April 3-5, 2024  
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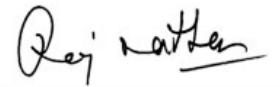
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Effective Date February 9, 2024



  
\_\_\_\_\_  
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## SCOPE OF ACCREDITATION

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ASTM E1677	Standard specification for air barrier (AB) material or system for low-rise framed building walls
ASTM E1745	Standard specification for plastic water vapor retarders used in contact with soil or granular fill under concrete slabs
ASTM E1886	Standard test method for performance of exterior windows, curtain walls, doors, and impact protective systems impacted by missile(s) and exposed to cyclic pressure differentials
ASTM E1996	Standard specification for performance of exterior windows, curtain walls, doors, and impact protective systems impacted by windborne debris in hurricanes
ASTM E2068	Standard test method for determination of operating force of sliding windows and doors
ASTM F476	Standard test methods for security of swinging door assemblies
ASTM F588	Standard test methods for measuring the forced entry resistance of window assemblies, excluding glazing impact
ASTM F842	Standard test methods for measuring the forced entry resistance of sliding door assemblies, excluding glazing impact
CAN/ULC S742	Standard for air barrier assemblies – specification
CSA A440 S1	Specification for windows, doors, and skylights
DASMA 108	Standard method for testing sectional garage doors and rolling doors: determination of structural performance under uniform static air pressure difference
FM 4450	Standard for class 1 insulated steel deck roofs
FM 4470	Single-ply, polymer-modified bitumen sheet, built-up roof (BUR) and liquid applied roof assemblies for use in class 1 and noncombustible roof deck construction
FM 4471	Class 1 panel roofs (excluding sections 4.1 and 4.2)
ICC-ES AC65	Concrete and clay roof tile fasteners (test methods referenced in section 3.0)
ICC-ES AC166	Metal roof coverings (test methods referenced in sections 3.0 and 4.0, excluding section 3.1.11 fire classification)
ICC-ES AC257	Corrosion-resistant fasteners and evaluation of corrosion effects of wood treatment chemicals (test methods referenced in sections 3.0 and 4.0)
ICC-ES AC318	Structural cementitious floor and roof sheathing panels (test methods referenced in section 3.0)
CPSC CFR 16 1201	Safety Standard for Architectural Glazing Materials
CAN/CGSB-12.1	Safety glazing

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## UL Solutions

- Standards development organization
  - Also active in other standards organizations
- Code-approved testing agency
- Certification provider:
  - Third-party certification
  - Follow-up Service (FUS)
  - UL mark
- Product iQ directory of certifications and listings

## What the UL Mark means

Earning UL certification is an achievement and shows that representative sampling of your products, processes, personnel, systems or facilities have demonstrated compliance with standards. This achievement also means that you are building confidence with users, retailers, regulators and other stakeholders.

UL Marks are the most prominent demonstration of your certification status and can be used in a variety of ways, such as on labels affixed, die-stamped, molded or silkscreened onto products or on packaging and promotions.

What are the differences between enhanced, smart and legacy Marks?



### Enhanced and smart Marks

UL Solutions developed the enhanced and smart UL Mark system to help our customers provide additional information to the marketplace.

- Enhanced clarity and acceptance
- Greater transparency into compliance
- Bundling of current and future certifications
- Faster deployment
- QR code links to user-friendly product certification pages



### Legacy UL Mark

These assets include the UL Listed, Classified and Recognized Marks and marks from other organizations.

- Highly recognizable
- Communicates certification status
- Fulfills certification requirements



## Testing services

Our testing services assess compliance to the following UL Solutions and industry standards:

- Dynamic wind uplift resistance of membrane -roofing systems (CSA A123.21)
- Edge systems used with low-slope roofing systems (ANSI/SPRI ES-1)
- Fire Tests of Roof Coverings - spread of flame, intermittent flaming, burning brand (UL 790/ASTM E108)
- Fire Tests of Building Construction and Materials - fire resistance of roofing systems (UL 263/ASTM E119)
- Impact test (UL 2218)
- Solar reflectance/thermal emittance (ASTM C1549 and C1371)
- Wind resistance (ASTM D3161 and ASTM D7158)
- Wind uplift (UL 1897 - 10x10ft, 5x8ft and 12x24ft deck)
- Wind uplift (UL 580)

The UL Evaluation Report, an additional differentiator, provides code authorities with added confirmation that roofing products and assemblies have been evaluated to the diverse code requirements to which they must comply.





UL 580

**STANDARD FOR SAFETY**

Tests for Uplift Resistance of Roof Assemblies

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## **UL 580:**

- 5<sup>th</sup> edition, revised March 29, 2019
- 10' x 10' chamber
- Oscillating negative and positive pressures applied (80-minute cycles per load classification)
- Class 15, 30, 60 and 90
- Classified assemblies appear in UL Product iQ

*This is a very stringent test*

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## UL 580 test apparatus

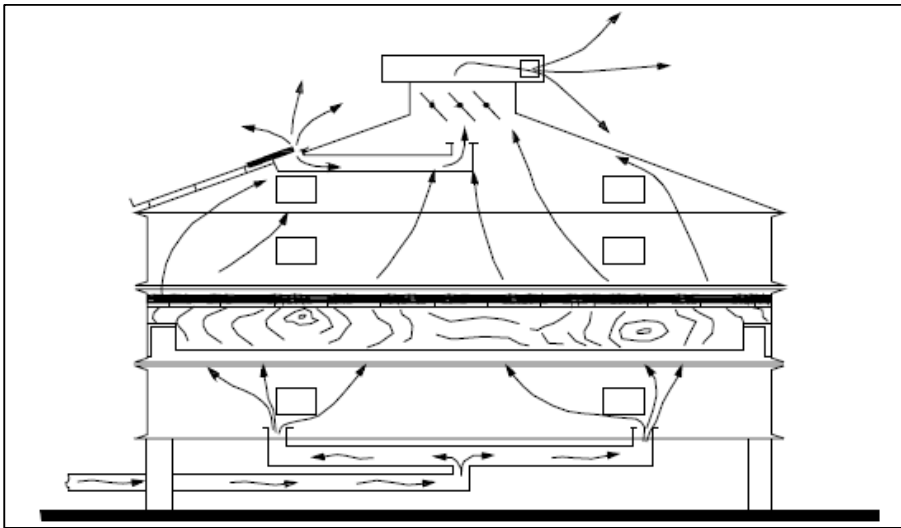


Photo courtesy of Atas International, Inc.



UL 1897

**STANDARD FOR SAFETY**

Uplift Tests for Roof Covering Systems

## **UL 1897:**

- 7<sup>th</sup> edition, revised July 13, 2023
- Part 1: 10' x 10' or 5' x 9' specimens
  - 15 psf load increments held of 60 seconds each (uniform static pressure)
- Part 2: 2' x 2' pull test (adhered systems)
- Class 15, 30, 60 and 90
- Classified assemblies appear in UL Product iQ

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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: E108 – 20a

An American National Standard

## Standard Test Methods for Fire Tests of Roof Coverings<sup>1</sup>

This standard is issued under the fixed designation E108; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

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

### 1. Scope<sup>8</sup>

1.1 This fire-test-response standard covers the measurement of the relative fire characteristics of roof coverings exposed to simulated fire sources originating outside the building. It is applicable to roof coverings intended for installation on either combustible or noncombustible roof decks when applied as intended for use. The following test methods are included:

- 1.1.1 Intermittent flame exposure test.
- 1.1.2 Spread of flame test.
- 1.1.3 Burning brand test.
- 1.1.4 Flying brand test.
- 1.1.5 Rain test.

1.2 Three classes of fire test exposure are described:

1.2.1 *Class A Tests* are applicable to roof coverings that are expected to be effective against severe fire exposure, afford a high degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

1.2.2 *Class B Tests* are applicable to roof coverings that are expected to be effective against moderate fire exposure, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

1.2.3 *Class C Tests* are applicable to roof coverings that are effective against light fire exposure, afford a light degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled laboratory conditions, but does not by itself incorporate all factors required for fire hazard or fire risk

assessment of the materials, products or assemblies under actual fire conditions.

1.5 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.

1.6 Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

1.7 The text of this standard references notes and footnotes that provide explanatory information. These notes and footnotes, excluding those in tables and figures, shall not be considered as requirements of this standard.

1.8 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:*<sup>2</sup>

- D225 Specification for Asphalt Shingles (Organic Felt Surfaced With Mineral Granules (Withdrawn 2012))<sup>3</sup>
- D226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
- D227 Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
- D312 Specification for Asphalt Used in Roofing
- D450 Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
- D1227 Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
- D2178 Specification for Asphalt Glass Felt Used in Roofing and Waterproofing

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee E05 on Fire Standards and are the direct responsibility of Subcommittee E05.14 on External Fire Exposures.

Current edition approved April 1, 2020. Published April 2020. Originally approved in 1955. Last previous edition approved in 2020 as E108 – 20. DOI: 10.1520/E108-20A.

<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

<sup>8</sup>A Summary of Changes section appears at the end of this standard

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1

## ASTM E108:

- UL 790, “Standard Test Methods for Fire Tests of Roof Coverings”
- Edition 9, February 18, 2022
- Spread of flame, burning brand, intermittent flame exposure, flying brand\* and rain\* tests
- Class A, B or C
- Assemblies classified by UL will appear in UL Product iQ

[Link to ASTM E108](#)

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## UL 790

### Standard Test Methods for Fire Tests of Roof Coverings

UL Standard

Edition 9

Published Date: February 18, 2022

ANSI Approved: February 18, 2022

DOD Approved: March 21, 1984

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ANSI/UL 790-2022

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1

UL 790

**Standard for Standard Test Methods for Fire Tests of Roof Coverings**

The first through seventh editions were titled Tests for Fire Resistance of Roof Covering Materials.

- First Edition – September, 1958
- Second Edition – April, 1969
- Third Edition – May, 1973
- Fourth Edition – December, 1978
- Fifth Edition – October, 1983
- Sixth Edition – October, 1995
- Seventh Edition – September, 1997
- Eighth Edition – April, 2004

**Ninth Edition**

**February 18, 2022**

This ANSI/UL Standard for Safety consists of the Ninth Edition.

The most recent designation of ANSI/UL 790 as an American National Standard (ANSI) occurred on February 18, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 790 on March 21, 1984. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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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: E108 – 20a

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

### 1.2 Three classes of fire test exposure are described:

1.2.1 *Class A Tests* are applicable to roof coverings that are expected to be effective against severe fire exposure, afford a high degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

1.2.2 *Class B Tests* are applicable to roof coverings that are expected to be effective against moderate fire exposure, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

1.2.3 *Class C Tests* are applicable to roof coverings that are effective against light fire exposure, afford a light degree of fire protection to the roof deck, do not slip from position, and are not expected to present a flying brand hazard.

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee E05 on Fire Standards and are the direct responsibility of Subcommittee E05.14 on External Fire Exposures.

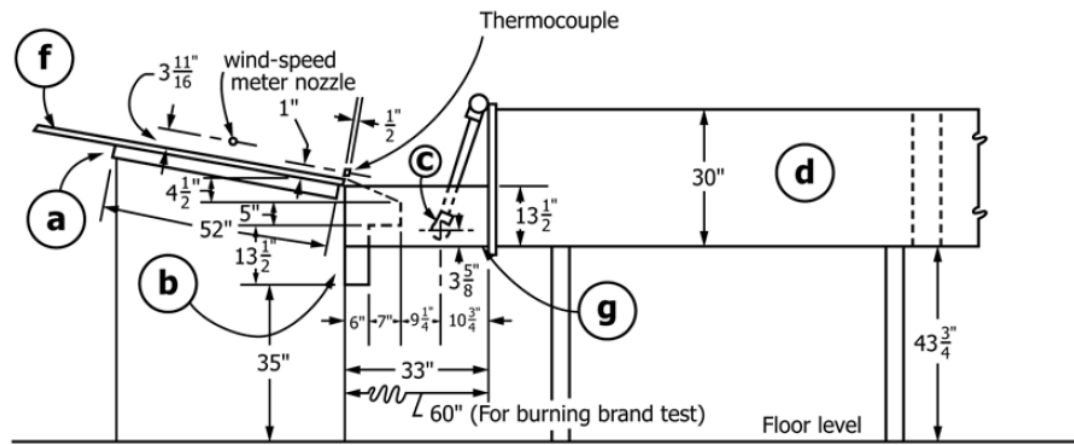
Current edition approved April 1, 2020. Published April 2020. Originally approved in 1955. Last previous edition approved in 2020 as E108 – 20. DOI: 10.1520/E108-20A.

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

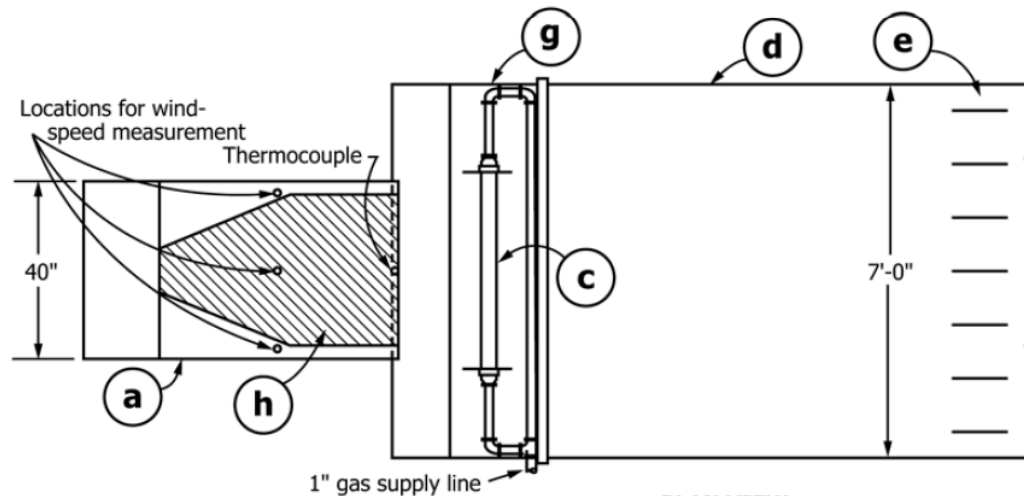
<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

\*A Summary of Changes section appears at the end of this standard

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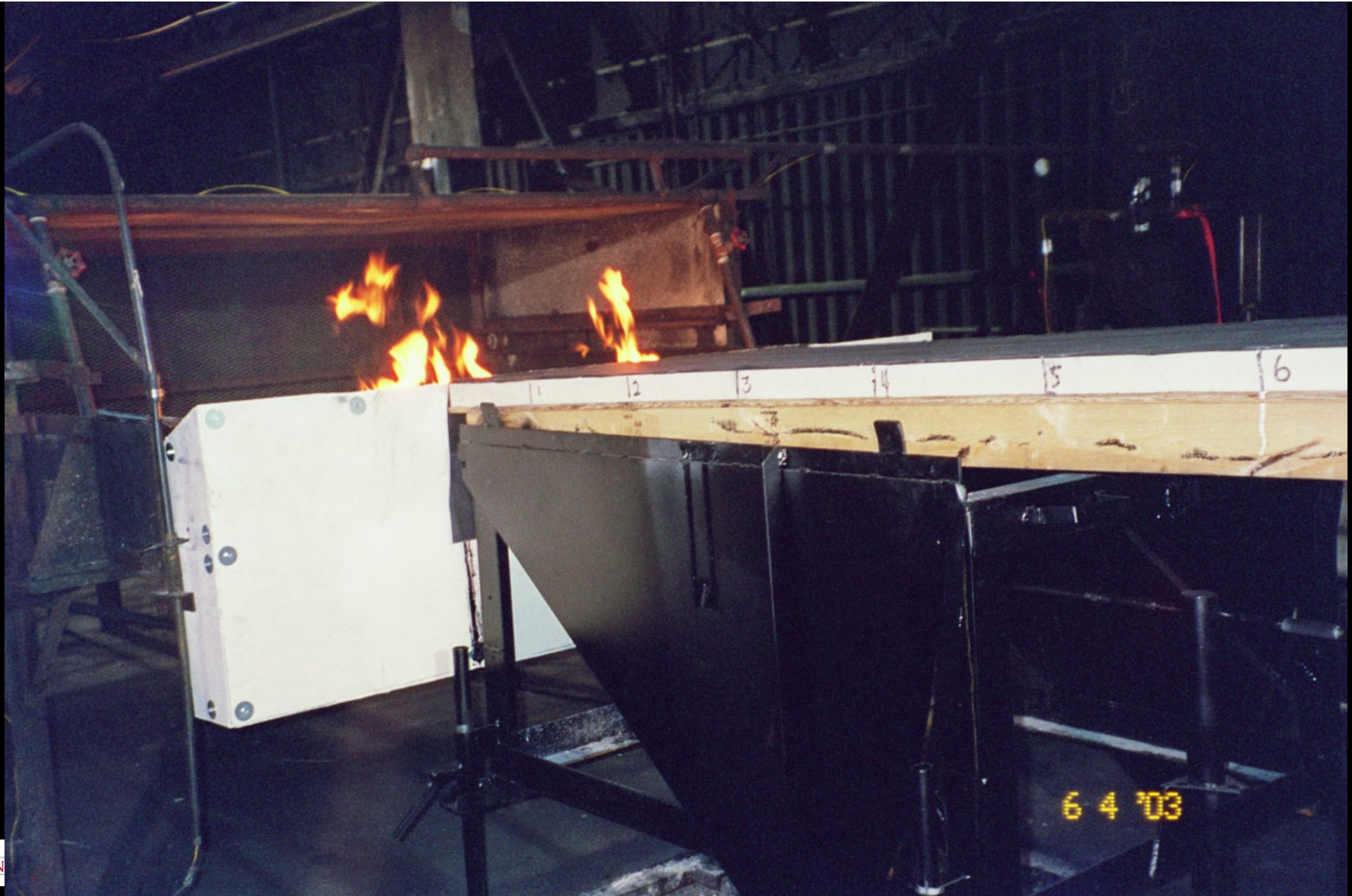
**SIDE VIEW**

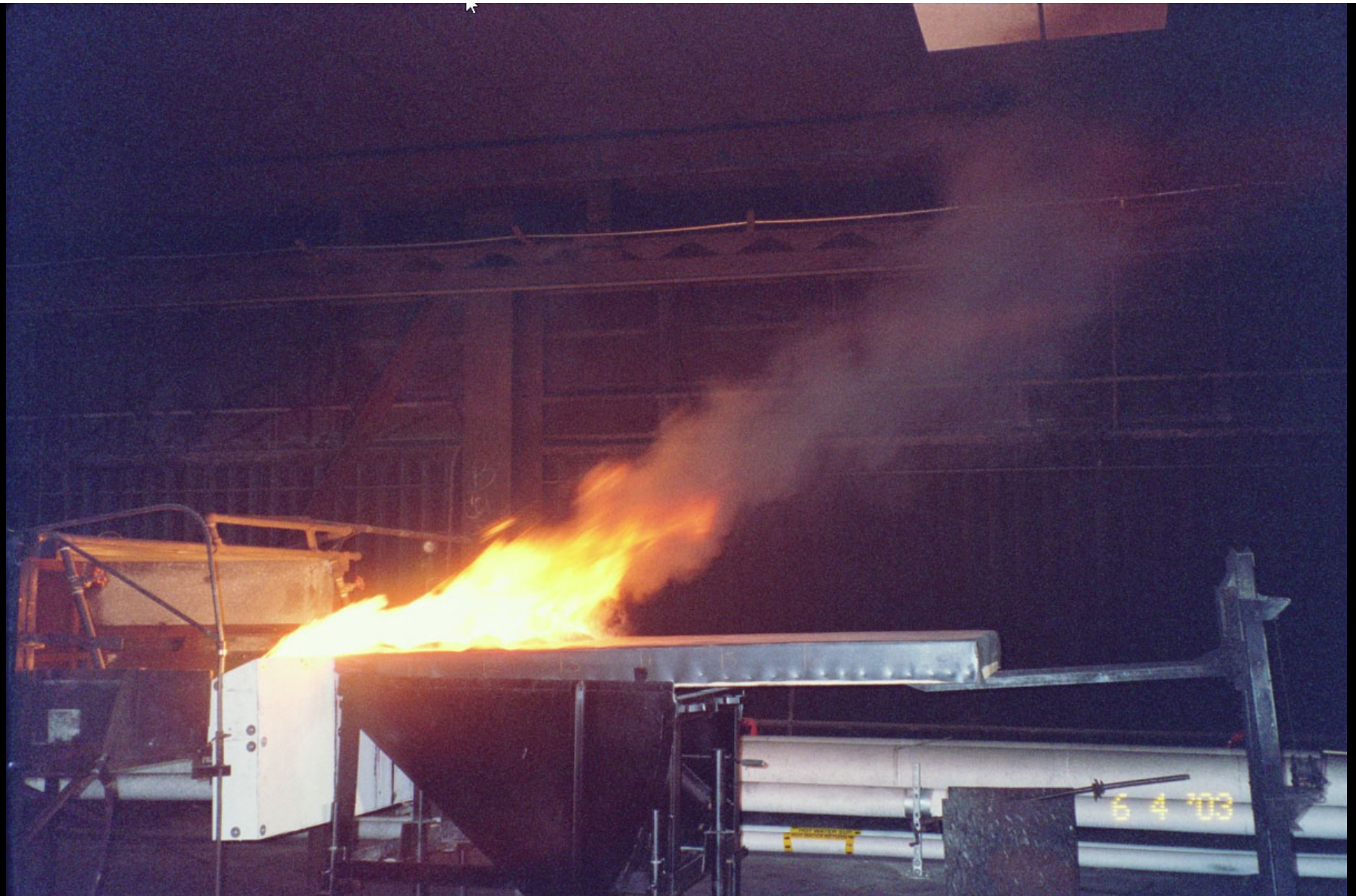


**PLAN VIEW**

(See Appendix X1 for metric equivalents.)

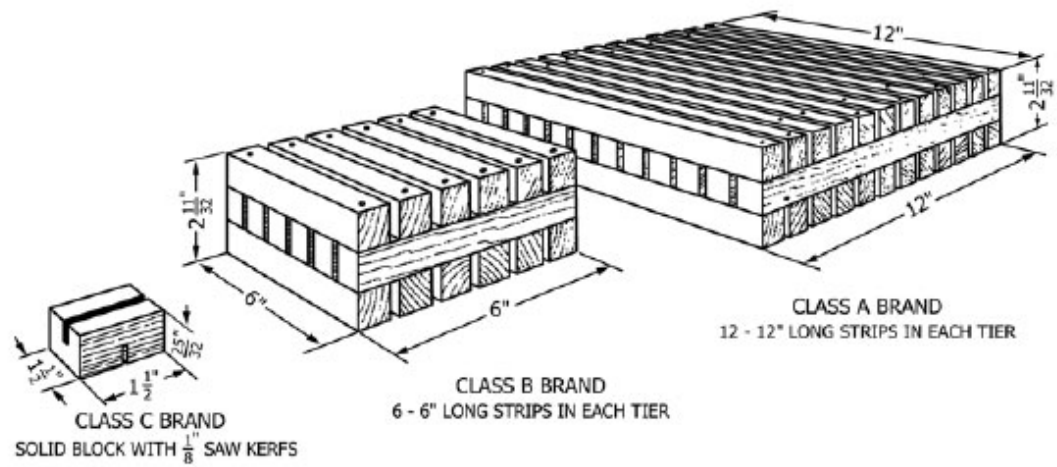
**FIG. 1 Schematic Drawing of Fire Test Apparatus**











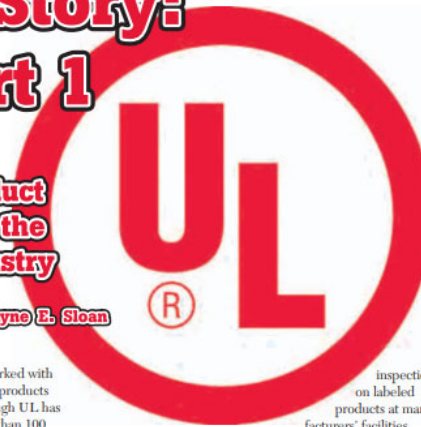
(See [Appendix X1](#) for metric equivalents.)

**FIG. 4 Brands for Classes A, B, and C Tests**

# The UL Story: part 1

Learn why UL's product testing influences the roofing industry

by Dwayne E. Sloan



Underwriters Laboratories (UL) Inc. has worked with the roofing industry for many years to test products for various performance characteristics. Although UL has been involved with roofing products for more than 100 years, there still is confusion within the roofing industry about UL's role and its various test methods. This article—the first of a two-part series—will concentrate on UL's history and various roofing activities, testing standards and requirements. Part two will concentrate on UL's *Roofing Materials and Systems Directory* and the UL Online Certifications Directory as it pertains to roofing materials and roof systems.

## The beginning

UL is a product-safety testing, certification and standards-development organization that dates to 1894 when its founder, William Henry Merrill, had two employees and \$350 worth of testing equipment in a small lab in Chicago. There, he opened Underwriters Electrical Bureau and conducted the first test on a noncombustible insulation material. By 1903, UL had conducted its first tests on roofing products.

Other significant UL events during the early 1900s included the following: Underwriters Electrical Bureau and Underwriters Bureau of Fire Protection incorporated as Underwriters Laboratories Inc.; Merrill and his chief engineer built the first fire test chamber to evaluate fire resistance of doors and windows; UL published its first standard, "Tin Clad Fire Doors"; UL issued its first product label (it was for a fire extinguisher); a label service was established for certain product categories that require more frequent inspections; and UL inspectors conducted their first factory

inspections on labeled products at manufacturers' facilities.

In addition, during the early 1900s, UL certifications first were applied to many products, such as waste cans, automatic fire sprinklers, fire extinguishers and hoses, electric control panels, safety goggles and wooden safety matches, among others.

Since its early days, UL has continued to test many products and every roofing product imaginable. Currently, there are more than 18,000 types of products UL evaluates. UL is recognized as a leader in product safety testing and certification within the United States and has expanded its activities throughout the world.

## Background

It is important to realize UL is an independent, not-for-profit organization; it is not part of the federal government. Manufacturers voluntarily submit products to UL for testing and safety certification.

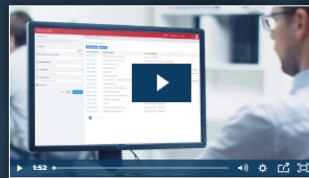
Although there may not be building codes or fire codes that specify UL marks must be on roofing products, many municipalities' laws, codes and regulations require roofing products and roof systems be tested, listed and/or labeled by a nationally recognized certification organization before the products can be installed in a jurisdiction. Many roofing product manufacturers make it company policy to obtain UL certification for their products to minimize the possibility of nonacceptance by various authorities having jurisdiction. Some companies choose to obtain UL certification

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# Factory Mutual (FM)

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- Insurance company
- Specializes in highly-protected risk
- Engineering-based approach to risk management
- Loss Prevention Data Sheets
- Field engineers assigned to specific FM Global-insured clients
- Project submission/approval (Form X2688)

# Factory Mutual (FM) - continued

## FM Approvals

- A subsidiary of FM Global
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  - Also active in other standards organizations
- Code-approved testing agency
- Certification provider:
  - Third-party certification
  - Factory surveillance/audits
  - FM diamond mark
  - RoofNav

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- 1-15: Roof-mounted Solar Photovoltaic Panels
- 1-28: Wind Design
- 1-29: Roof Deck Securement
- 1-33: Safeguarding Torch-applied Roof Installations
- 1-34: Hail Damage
- 1-35: Vegetative Roof Systems
- 1-49: Perimeter Flashing
- 1-52: Field Verification of Roof Wind Uplift Resistance
- 1-54: Roof Loads for New Construction

**FM Global  
Property Loss Prevention Data Sheets**

**1-29**

January 2016  
Interim Revision July 2022  
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**ROOF DECK SECUREMENT AND ABOVE-DECK ROOF COMPONENTS**

**Note to Insureds of Factory Mutual Insurance Company: Contact the local FM Global office before beginning any roofing work.**

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2.2.2.5 Prevent over-stressing of the roof deck due to possible high concentrated loads during construction. This includes rolls of membrane and gravel carts. When the weight of individual rolls of single-ply membrane exceeds 1100 lb (500 kg), use precautions such as plywood sheets over steel deck to reduce point loads.

2.2.2.6 Protect roof expansion joints by filling the space between nailers with noncombustible, compressible insulation, such as mineral wool. Cover the expansion joint with flashing made of galvanized steel, zinc-aluminum-coated steel, or stainless steel secured in accordance with Data Sheet 1-49. An example is shown in Figure 2. Similar details can be found in the *NRCA Roofing Manual: Membrane Roof Systems*.

2.2.2.7 Provide adequate separation and/or noncombustible insulation between hot exhaust stacks and combustible roof components. See DS 1-13, *Chimneys*, for details.

2.2.2.8 Ensure all above-deck components are dry and surfaces are free of debris or dirt prior to adhering roof covers to them. This will help ensure complete adhesion of the cover to its substrate.

2.2.2.9 In locations that are prone to tropical cyclones, plan roof installations that use cold-process adhesives to ensure adequate curing time prior to potential exposure from a tropical cyclone. Also, see Section 3.1.2.2.

2.2.2.10 Apply adhesives in accordance with the manufacturer's temperature limitations.

### 2.2.3 Steel Roof Deck

2.2.3.1 Select a RoofNav assembly after determining the needed wind, hail, and interior and exterior fire ratings. Use the center-to-center spacing of supports to determine the deck span.

2.2.3.2 When designing the steel deck, give consideration to the needed wind rating, and how the load is applied (concentrated vs. uniformly distributed) from the above-deck components to the deck. Where the distance between rows of roof cover fasteners is greater than half the deck span, treat as a concentrated load.

As an alternative to using Tables 1A or 1B for concentrated loads, a performance-based approach may be used if calculations are conducted by a licensed S.E. or P.E. in structural engineering. This applies to situations where the distance between rows of roof cover fasteners is greater than one-half the deck span. Make the following assumptions:

- A. Assume a 3-span structural condition.
- B. Assume the first row of roof cover fasteners is located at mid-point of the first deck span.
- C. Assume maximum allowable strength is determined using allowable strength design (ASD) in accordance with AISI S100-2016, or comparable standard outside the United States.

Due to the more brittle nature of higher grade steels, the maximum yield stress used in the analysis is 60,000 psi (414 MPa), even for 80,000 psi (552 MPa) yield stress steel. Use Tables 1A through 1E as follows to facilitate deck selection:

**Table 1A.** Use for roof covers or base plies that are mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is more than half the deck span and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with a minimum yield stress of 33,000 psi (228 MPa).

**Table 1B.** Use for roof covers or base plies that are mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is more than half the deck span and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with a minimum yield stress of 60,000 psi (414 MPa).

**Note:** Where the minimum specified yield stress is between 33,000 psi (228 MPa) and 60,000 psi (414 MPa), it is reasonably accurate to interpolate the maximum deck span linearly based on Tables 1A and 1B.

**Table 1C.** Use for roof covers or base plies that are adhered to insulation or cover board, or mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is one-half the deck span or less and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with minimum yield stresses of 33,000 psi (228 MPa) and ultimate wind ratings of from 60 to 225 psf (2.9 to 10.8 kPa).

**Table 1D.** Use for roof covers or base plies that are adhered to insulation or cover board, or mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is one-half the deck span or less and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with minimum yield stresses of 33,000 psi (228 MPa) and ultimate wind ratings of from 240 to 405 psf (11.5 to 19.4 kPa).

**Table 1E.** Use for roof covers or base plies that are adhered to insulation or cover board, or mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is one-half the deck span or less and the deck is 3 in. (75 mm) deep, with an 8 in. (200 mm) rib spacing (Type N) with minimum yield stresses of 33,000 psi (228 MPa) and ultimate wind ratings of from 60 to 225 psf (2.9 to 10.8 kPa).

**NOTE for Tables 1A through 1E:** Maximum spans may vary slightly depending on the exact section properties for the specific deck.

Table 1C. Maximum Steel Deck Span (ft) for 1½ in. (38 mm) Deep, Wide Rib (Type B) Steel Deck with an Adhered Roof Cover, for Wind Ratings from 60 to 225 psf (2.9 to 10.8 kPa)

(NOTE: Use this table when the distance between rows of roof cover fasteners is one-half the deck span or less. Green font indicates that deflection governs over bending stress.)

Yield Stress psi	Deck Gauge	Ultimate Wind Rating per RoofNav (psf)											
		Maximum Span (ft)											
		60	75	90	105	120	135	150	165	180	195	210	225
33,000	22	7.10	7.10	7.10	7.10	7.07	6.67	6.33	6.03	5.78	5.55	5.35	5.17
	20	7.78	7.78	7.78	7.78	7.78	7.43	7.05	6.72	6.44	6.18	5.96	5.76
	18	9.08	9.08	9.08	9.08	9.08	8.66	8.22	7.84	7.50	7.21	6.95	6.71
	16	10.36	10.36	10.36	10.36	10.36	9.89	9.38	8.94	8.56	8.23	7.93	7.66
40,000	22	7.10	7.10	7.10	7.10	7.10	7.10	6.96	6.64	6.35	6.10	5.88	5.68
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.76	7.40	7.08	6.80	6.56	6.33
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.04	8.62	8.25	7.93	7.64	7.38
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.32	9.84	9.42	9.05	8.72	8.43
45,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.04	6.74	6.48	6.24	6.03
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.51	7.22	6.95	6.72
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	8.76	8.41	8.11	7.83
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	9.99	9.60	9.25	8.94
50,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	6.93	6.66	6.42	6.20
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.72	7.42	7.15	6.91
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.00	8.65	8.33	8.05
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.28	9.87	9.51
55,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	6.90	6.67
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.69	7.43
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	8.97	8.66
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.24
60,000 +	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	6.97
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.77
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.06
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.34

Green font indicates that deflection governs over bending stress.

Table 1B. Maximum Steel Deck Span (ft) for 1½ in. (38 mm) Deep, Yield Stress ≥ 60,000 psi (414 MPa) with a mechanically fastened Roof Cover (continued)  
 (Note: Use this table when the distance between rows of roof cover fasteners is more than one-half the deck span.)

		Max Deck Spans By Wind Rating/Fastener Spacing, Sheet Gauge for 80 ksi, 1½ in. Deep Wide Rib Deck																		
Roof Cover Fastener Row Spacing (ft)	Gauge	Wind Rating [psf]																		
		330	315	300	285	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60
8.5	18	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	4	4	4.5	5.5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6
9	18	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6
9.5	18	-	-	-	-	-	-	4	4	4	4.5	5	5.5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6
10	18	-	-	-	-	-	-	-	4	4	4.5	4.5	5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	4	4.5	4.5	5.5	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5.5	6	6	6
10.5	18	-	-	-	-	-	-	-	4	4	4.5	4.5	5	5.5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6
11	18	-	-	-	-	-	-	-	-	4	4	4.5	5	5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
11.5	18	-	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
12	18	-	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	5.5	6	6
Roof Cover Fastener Row Spacing	Gauge	330	315	300	285	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60
		Wind Rating [psf]																		

## CHECKLIST FOR ROOFING SYSTEM



FM Global Clients: submit completed form and completed RoofNav Contractor Package to local FM Global field office for review.

CONTACT INFORMATION:		FM GLOBAL INDEX NUMBER: _____
ROOFING CONTRACTOR (NAME, ADDRESS, PROJECT NO.)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:
CLIENT SITE (NAME & ADDRESS)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:

**OVERVIEW OF WORK:** (Submit 1 form per roof area)

Building Name & Number (provide building diagram as appropriate): \_\_\_\_\_

Type of Work:  New Construction  Recover (New roof over existing Roofing System)  
 Reroof (New cover/remove existing roofing system to deck)  Other (describe) \_\_\_\_\_

Building Dimensions: Length: \_\_\_\_\_ ft/m; Width: \_\_\_\_\_ ft/m; Height: \_\_\_\_\_ ft/m.

Roof Slope: \_\_\_\_\_ in. per ft. / degrees

Parapet Height, max (ft./m): \_\_\_\_\_ Parapet Height, min (in./m): \_\_\_\_\_ (enter "0" if not always present)

Roof Zone Width/Dimension:  
 Zone 1: \_\_\_\_\_ Zone 2: \_\_\_\_\_ Zone 3: \_\_\_\_\_

FM Approved RoofNav Assembly Numbers (provide Assembly Number for individual roof zones as appropriate): \_\_\_\_\_

\*Refer to FM Global Property Loss Prevention Data Sheet 1-28, Wind Design or RoofNav for determination of various zone dimensions.

**ROOF SURFACING:**

None

Coating \_\_\_\_\_ (Trade Name/Application Rate)

Granules \_\_\_\_\_ (Application Rate)

Gravel/Slag \_\_\_\_\_ (Application Rate)

Ballast:  Stone Size \_\_\_\_\_  Pavers \_\_\_\_\_ (Beveled, strapped or square edge);  Other: \_\_\_\_\_

Ballast Weight (psf): Zone 1: \_\_\_\_\_ Zone 2: \_\_\_\_\_ Zone 3: \_\_\_\_\_

Additional Detail: \_\_\_\_\_

**ROOF COVER / MEMBRANE:**  
 (Provide ALL applicable details including trade name, type, number of plies, thickness, reinforced, adhesive, etc.)

Roof Cover: Trade Name: \_\_\_\_\_

Hail Rating Provided: \_\_\_\_\_

Single Ply:  Reinforced  Unreinforced  Adhered  Fastened  Ballasted

Multi-Ply:  Built Up Roofing (BUR)  Modified Bitumen

Number of Piles: \_\_\_\_\_

Lap Width \_\_\_\_\_ in/mm  Lap Adhesion Type \_\_\_\_\_

Panel:  Through Fastened Metal  Standing Seam metal  Steel  Aluminum  Copper Thickness: \_\_\_\_\_

Rib Spacing: \_\_\_\_\_ Clip Model: \_\_\_\_\_  1-Piece  2-Piece

Insulated Metal Panel Roof: Bottom facer: Metal type: \_\_\_\_\_ Thickness: \_\_\_\_\_  
 Top facer: Material: \_\_\_\_\_ Thickness: \_\_\_\_\_

Fiber Reinforced Plastic (FRP) \_\_\_\_\_

Other: \_\_\_\_\_

Spray Applied  Other: \_\_\_\_\_

Additional Detail: \_\_\_\_\_

Asphalt Shingles  Metal Shingles: Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_  Ring Shank Nails  
 Smooth Shank Nails  Screws Size \_\_\_\_\_ Number per shingle: \_\_\_\_\_

Concrete Tile  Clay Tile: Manufacturer \_\_\_\_\_ Model: \_\_\_\_\_  Ring Shank Nails  
 Smooth Shank Nails  Screws Size \_\_\_\_\_ Number \_\_\_\_\_  Mortar or urethane at lower end of tile  
 Only mortar or urethane adhesive at top and bottom (No fasteners)

Slate tile: Width: \_\_\_\_\_ Thickness: \_\_\_\_\_ Length of reveal: \_\_\_\_\_  Ring Shanks Nails  Smooth Shank Nails  
 Number per tile: \_\_\_\_\_

Self-Adhering modified bitumen underlayment Trade Name: \_\_\_\_\_

X2688 ENGINEERING (Rev. October 2021)

# FM Global Form X2688

Accessible in RoofNav's Reference Materials tab

# FM Approvals

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4431	Approval Standard for Skylights
4435	Approval Standard for Edge Systems Used with Low Slope Roofing Systems
4450	Approval Standard for Class 1 Insulated Steel Deck Roofs
4451	Approval Standard for Profiled Steel Panels for Use as Decking in Class 1 Insulated Roof Construction
4454	Approval Standard for Lightweight Insulating Concrete for Use in Class 1 and Noncombustible Roof Constructions
4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction
4471	Approval Standard for Class I Panel Roofs
4472	Approval Standard for Cementitious Panel Roof Decks
4475	Approval Standard for Class 1 Steep Slope Roof Covers
4476	Approval Standard for Flexible Photovoltaic Modules
4477	Approval Standard for Vegetative Roof Systems
4478	Examination Standard for Roof-Mounted Rigid Photovoltaic Module Systems
4479	Steep Slope Building Integrated Photovoltaic Roof Covers
4481	Examination Standard for Anchors for Roof Mounted Equipment
4482	Examination Standard for Roof Maintenance Coatings



**Examination Standard for  
Single-Ply, Polymer-Modified  
Bitumen Sheet, Built-Up Roof  
(BUR) and Liquid Applied Roof  
Assemblies for Use in Class 1  
and Noncombustible Roof Deck  
Construction**

Class Number 4470

April 2022

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## **FM 4470**

- Multi-attribute evaluation:
  - Combustibility, wind uplift, hail damage, water leakage, foot traffic, corrosion, non-combustible core\*, dynamic puncture\* and solar reflectance\*
- Manufacturing QC program, surveillance audits and installation inspections
- FM Approvals' classification
- RoofNav listing



# FM Approvals classification designation

An example

***This is a tested uplift resistance.  
It is not a wind speed!!!***

FM 1-60 A (MH)

Hail resistance (MH, SH, VSH)

Class A fire resistance

Uplift resistance (60 psf tested load)

Class 1 combustibility

## Remaining topics

UL and FM

- Demonstrations:
  - UL's Product iQ ([link](#))
  - FM Approval's RoofNav ([link](#))
- Manufacturer's private-label arrangements

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#### [Continuity Head-of-Wall Joint Systems](#)

Covers continuity head-of-wall joint systems, consisting of a fire-resistance-rated wall, a non-fire-resistance-rated horizontal assembly, and materials to prevent the spread of fire through the linear opening between these assemblies.

#### [Dampers](#)

The category Dampers for Fire Barrier and Smoke Applications covers fire dampers, smoke dampers (leakage-rated dampers), combination fire and smoke dampers (fire and leakage-rated dampers), and corridor dampers.

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## Help us improve RoofNav!

[Take a Brief Survey](#)

### Welcome to RoofNav

FM Approvals welcomes you to RoofNav, your source for the latest information on FM Approved roofing assemblies and products.

To get the most from RoofNav, we recommend reviewing the training materials, documentation, and online help within the application. See the the links at the top of each page; and on the navigation bar, look under *Reference Materials*, and click the question mark (?) for context sensitive help.

### What's New

This section communicates new functionality, changes, and items of interest. In addition, Data Sheets and Approvals Standards are kept current in the Reference Materials section.

- 2/1/2024** There are now FM Approved Anchors for Roof Mounted Equipment. They can be found under products Category: Securement; Subcategory: Fastening; Approved Use: Anchors, Roof Mounted Equipment
- 12/21/2023** A BETA release of the new and improved RoofNav is now available. Go to <https://roofnav.app.fmglobal.com/> to check it out. NOTE: you will need to create a new account.

### Getting Started

Using the links below, you are just a click away from learning how to get the most out of RoofNav:

- [Downloadable RoofNav Quick Start Guide](#)
- [RoofNav Online Training](#)
- [Help Documentation](#)



# Questions

UL and FM



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