North/East Roofing Contractors Association
January 15, 2025
Webinar

Understanding and Complying with the ES-1 Requirements

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

1

Topics

Edge metal testing

- Code requirements
- ANSI/SPRI/FM 4435/ES-1
- ANSI/SPRI GT-1
- FM 4435
- NRCA's edge metal testing and certification
- Certification directory listings

2

2

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

1504.5 Ballasted low-slope single-ply roof systems. Ballasted *low-slope* single-ply roof system coverings installed in accordance with Section 1507.12 shall be designed in accordance with ANSI/SPRI RP-4.

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 on a *low-slope* roof 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 wind speed, V*, shall be determined from Figures 1609.3(1)through 1609.3(4), 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* 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.

Note: ANSI/SPRI GT-1's Test Method G-3 is not included in the code requirement

Exception: Ballasted single-ply roof coverings shall be designed and installed in accordance with Section 1504.5.

TABLE 1504.8—MINIMUM REQUIRED PARAPET HEIGHT (INCHES) FOR AGGREGATE SURFACED ROOFS[a, b, c, d, e]

AGGREGATE SIZE	MEAN ROOF HEIGHT (ft)	WIND EXPOSURE AND BASIC WIND SPEED, *V* (MPH)																	
		Exposure B								Exposure C[f]									
		≤ 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. Parapet height is measured vertically from the top surface of the coping down to the surface of the roof covering in the field of the roof adjacent to the parapet and outbound of any cant strip.

b. Interpolation shall be permitted for wind speed, mean roof height and parapet height. Extrapolation is not permitted.

c. Basic wind speed, *V*, and wind exposure shall be determined in accordance with Section 1609.

d. 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.

e. The tabulated values apply only to conditions where the topographic factor (K_{zt}) determined in accordance with Chapter 26 of ASCE 7 is 1.0 or where K_{zt} is incorporated in the basic wind speed in Section 1609.

f. 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).

SECTION 1505—FIRE CLASSIFICATION

[BF] 1505.1 General. Fire classification of roof assemblies shall be in accordance with Section 1505. The minimum fire classification of roof assemblies installed on buildings shall comply with Table 1505.1 based on type of construction of the building. Class A, B and C *roof assemblies* and *roof coverings* required to be *listed* by this section shall be tested in accordance with ASTM E108 or UL 790. In addition, *fire-retardant-treated wood*roof *coverings* shall be tested in accordance with ASTM D2898.

Exception: *Skylights and sloped glazing* that comply with Chapter 24 or Section 2610.

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3

3

ANSI/SPRI/FM 4435/ES-1 2017

Test Standard for Edge Systems Used with Low Slope Roofing Systems

Approved January 24, 2017

Table of Contents

Disclaimer
This standard is for use by architects, engineers, roofing contractors, manufacturers, testing agencies, and owners of low slope roofing systems. SPRI, its members and employees do not warrant that this standards is proper and applicable under all conditions.

ANSI/SPRI/FM 4435/ES-1, "Test Standard for Edge Systems Used with Low Slope Roofing Systems"

Link

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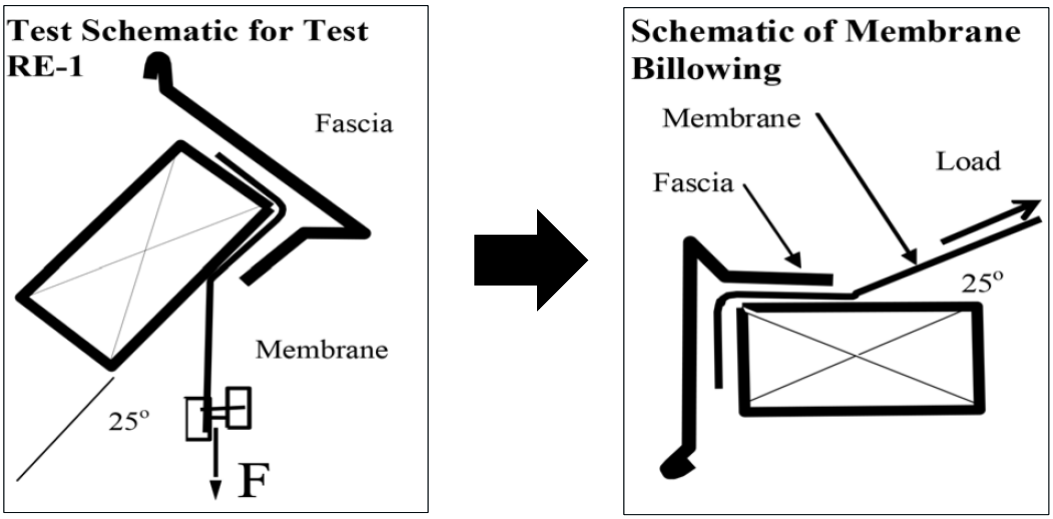
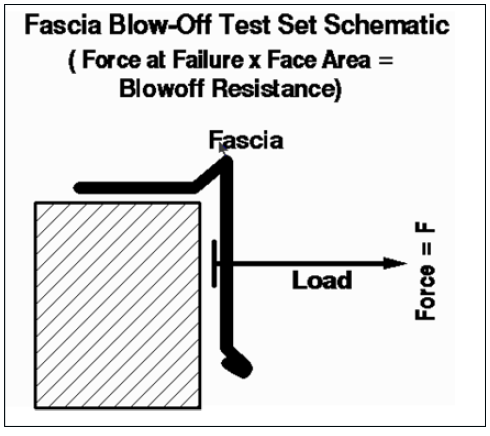


Test RE-1

5



Test RE-2

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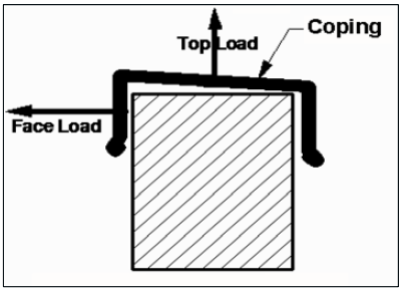
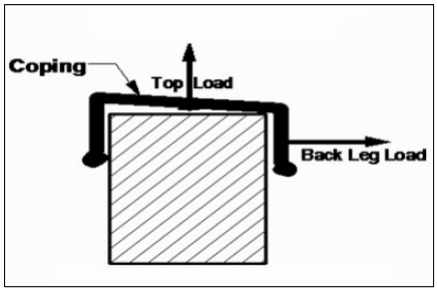
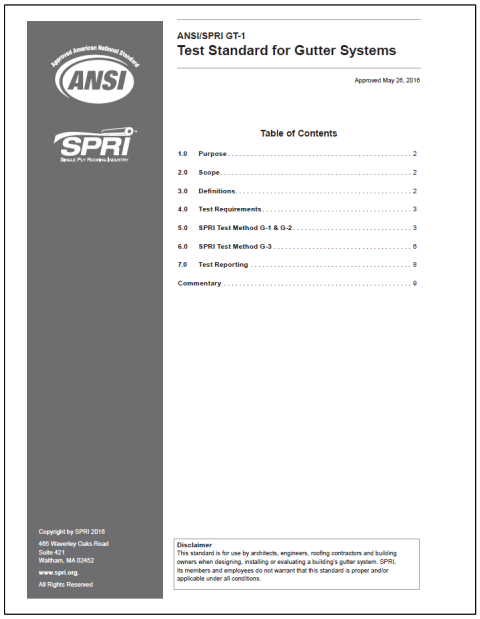




Test RE-3

7


ANSI/SPRI GT-1
Test Standard for Gutter Systems
Approved May 26, 2016
Table of Contents
1.0 Purpose . . . 2
2.0 Scope . . . 2
3.0 Definitions . . . 2
4.0 Test Requirements . . . 3
5.0 SPRI Test Method G-1 & G-2 . . . 3
6.0 SPRI Test Method G-3 . . . 6
7.0 Test Reporting . . . 8
Commentary . . . 9
Disclaimer
This standard is for use by architects, engineers, roofing contractors and building owners when designing, installing or evaluating a building's gutter system. SPRI, its members and employees do not warrant that this standard is proper and/or applicable under all conditions.
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Suite 421
Waltham, MA 02452
www.spri.org
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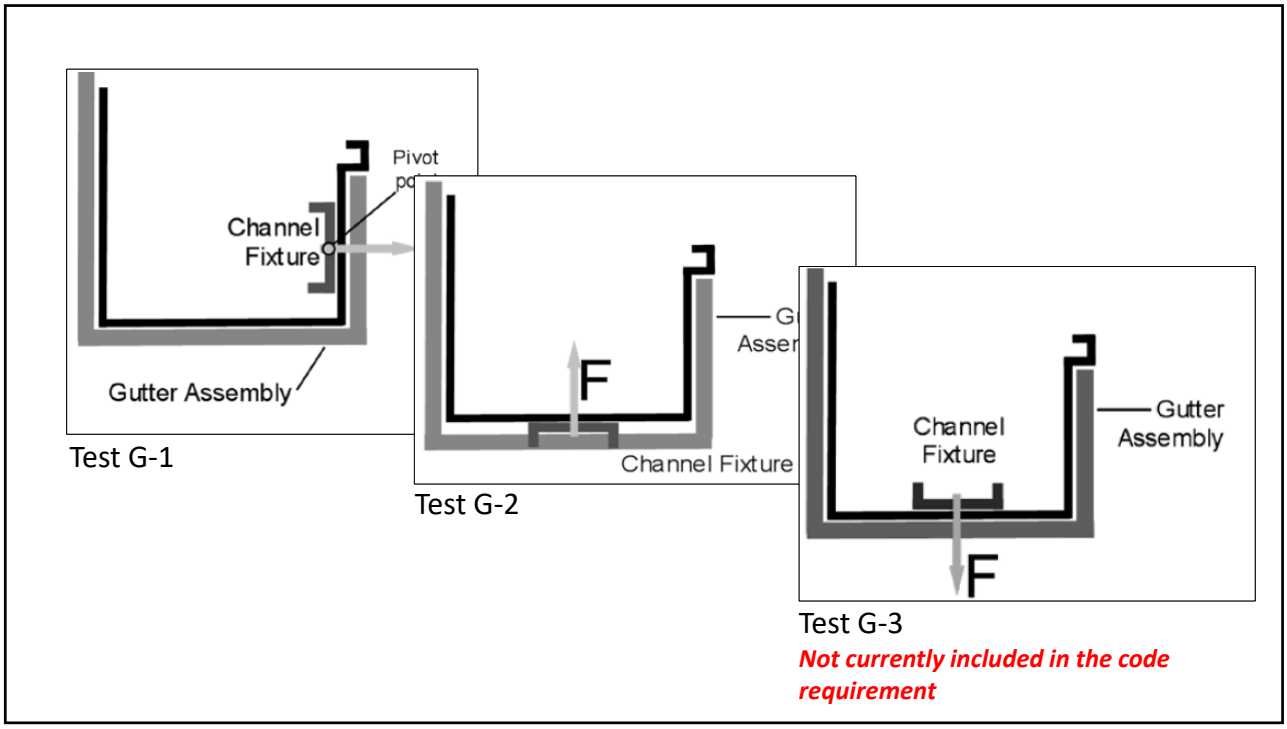
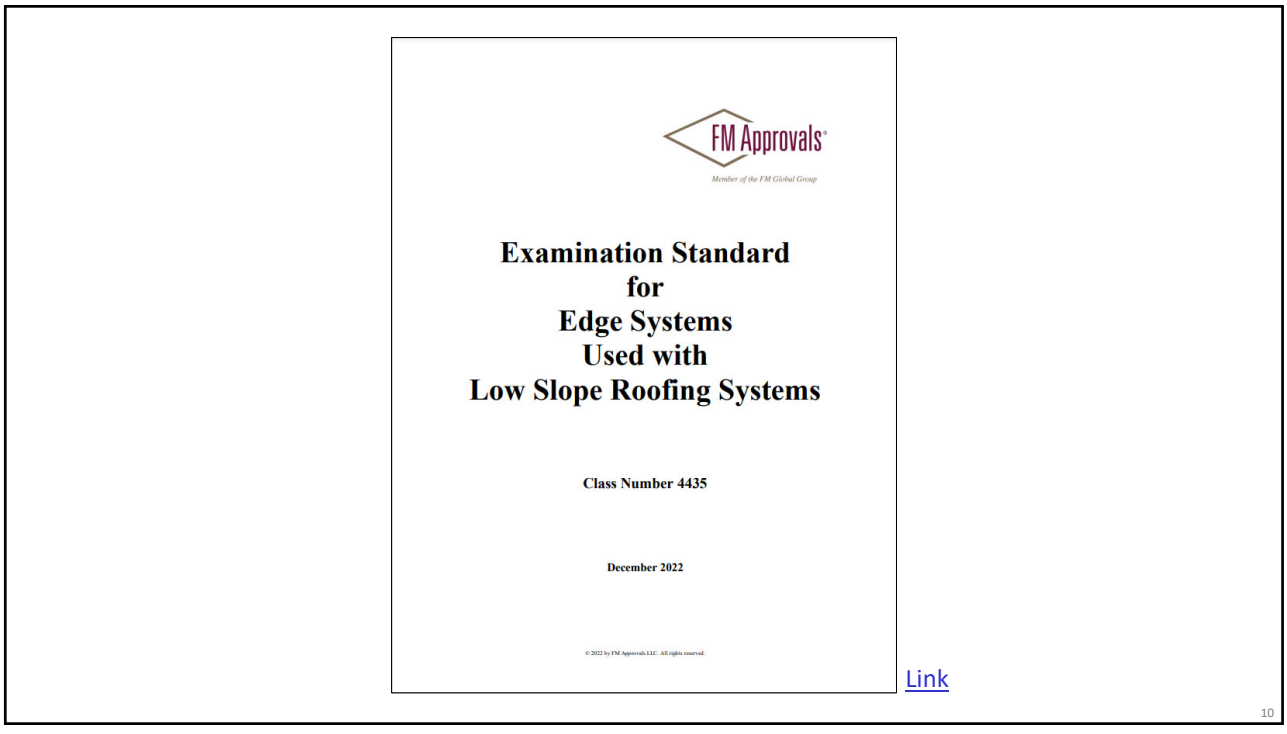
ANSI/SPRI GT-1, "Test Standard for Gutter Systems

Link

8


Pivot
Channel
Fixture
Gutter Assembly
Test G-1
F
Channel Fixture
Test G-2
Channel
Fixture
Gutter
Assembly
F
Test G-3
Not currently included in the code requirement

9


FM Approvals
Member of the FM Global Group
Examination Standard
for
Edge Systems
Used with
Low Slope Roofing Systems
Class Number 4435
December 2022
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10

10

FM 4435

- Testing based on ANSI/SPRI/FM 4435/ES-1 and ANSI/SPRI GT-1
- Results reported:
  - -FM Approvals' classifications (Class 60, 90, etc.)
  - -Resistance pressures (psf)
- FM Approvals' surveillance audits

11

11

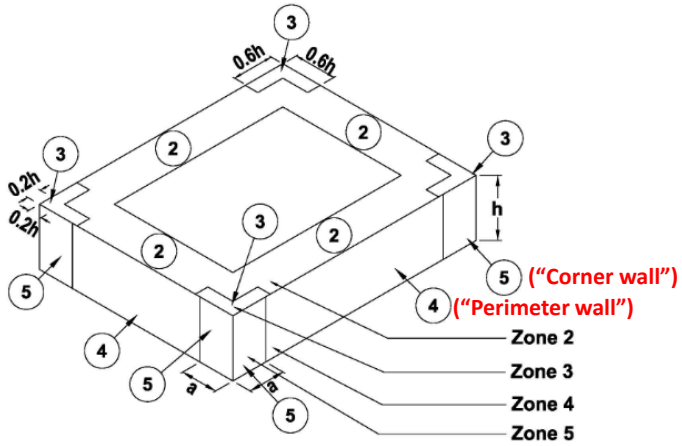
ES-1 and GT-1 (and FM 4435) provide tested resistance

12

Design wind loads come from ASCE 7… the same calculation applies, except some additional pressure coefficients are used for Zone 4 and Zone 5 (vertical surfaces).

13

13



Zones for buildings h ≤ 60 ft.

14

14

Roof Wind Designer

www.roofwinddesigner.com

Roof Wind Designer provides design wind loads for ES-1 and GT-1

15

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Remember, tested resistance needs to be greater than the design wind loads

16

16

ES-1 and GT-1 testing

17

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22

NRCA's ES-1 and GT-1 testing and certifications

- NRCA has tested various fascia, gravel stop, coping and gutters
  - Accredited testing laboratory
- NRCA has obtained third-party certifications for compliance
  - UL Solutions
  - Intertek Testing Services, N.A.

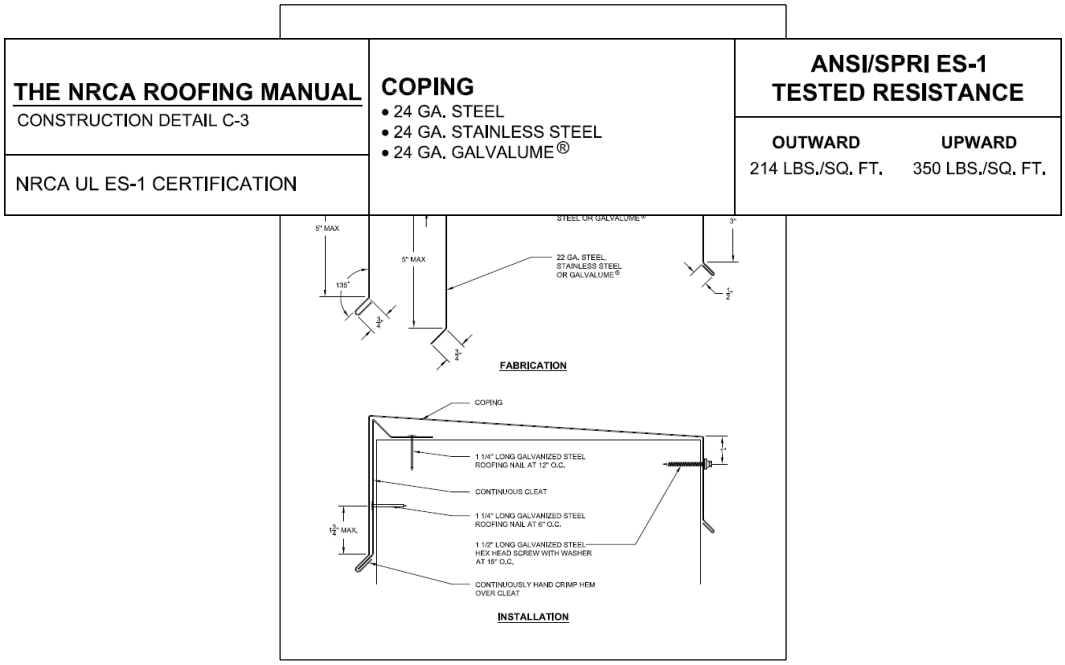
UL and Intertek are recognized, code-approved testing and certification agencies

23

Steps for a sheet metal shop to obtain certification

- Execute NRCA's Authorized Fabricator Agreement
- Initial "factory" inspection
  - Orientation
  - Verify capability
- Fabricate and install as tested (i.e., per NRCA's drawings

24



25

Steps for a sheet metal shop to obtain certification

- Execute NRCA's Authorized Fabricator Agreement
- Initial "factory" inspection
  - Orientation
  - Verify capability
- Fabricate and install as tested
- Product labeling (UL or Intertek mark labels)
- Periodic factory "audits"
  - Verify production documentation… document label usage
  - Material verification… verify mill certificates

26

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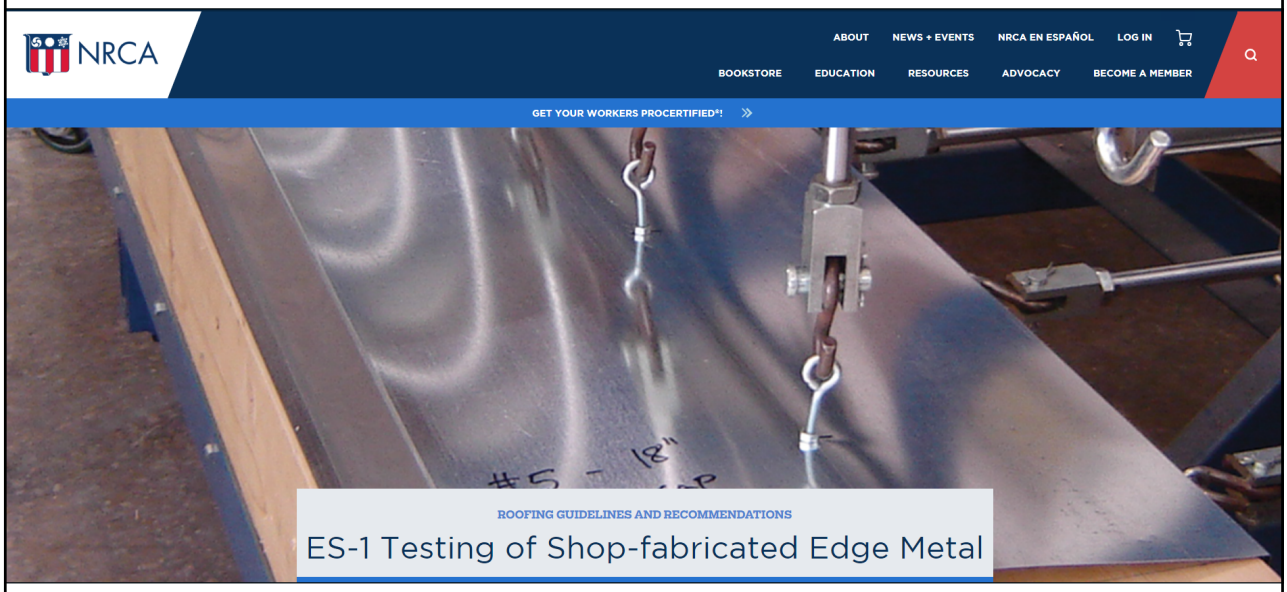

27

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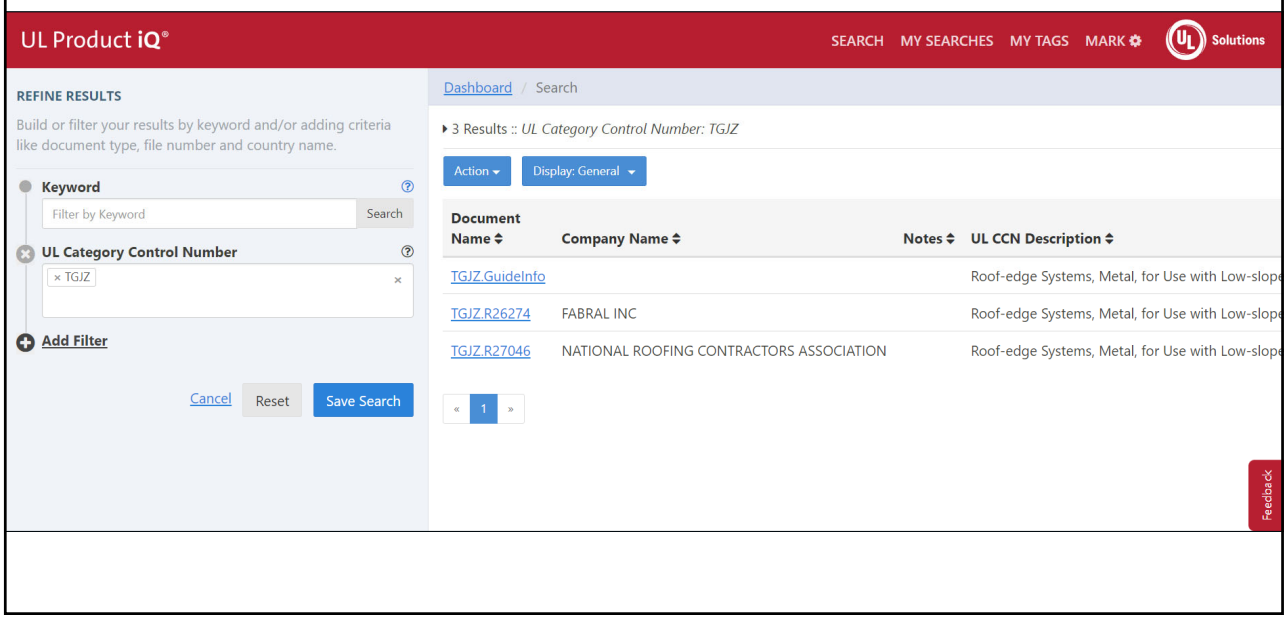

28

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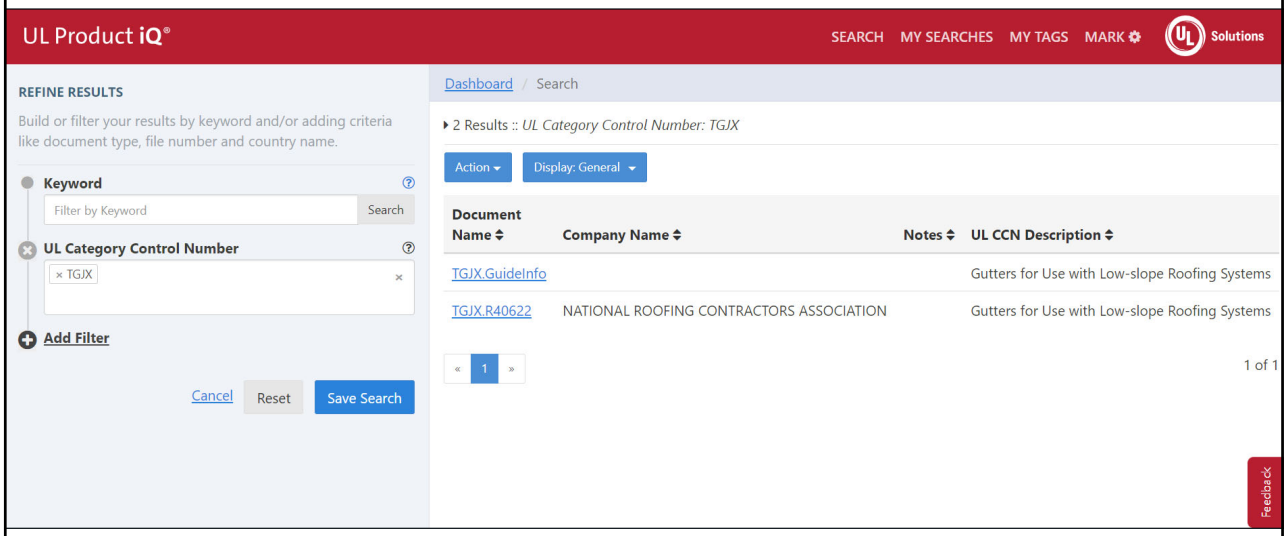
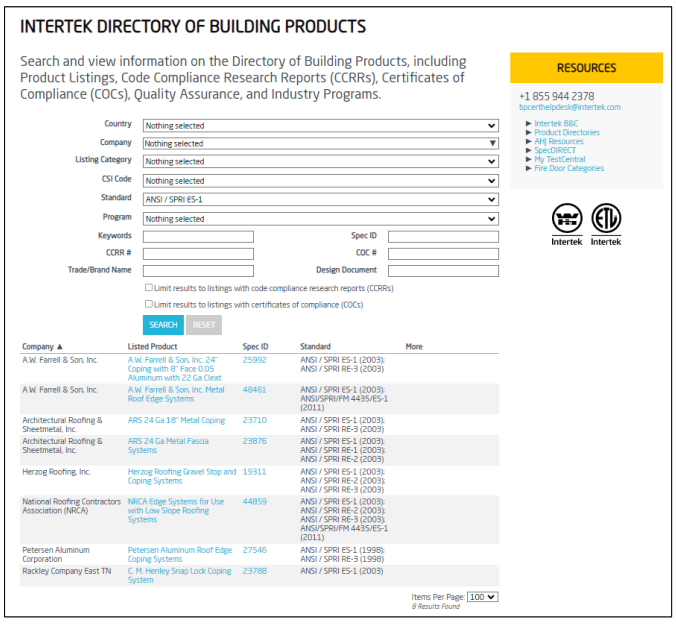


29

Intertek SpecDirect



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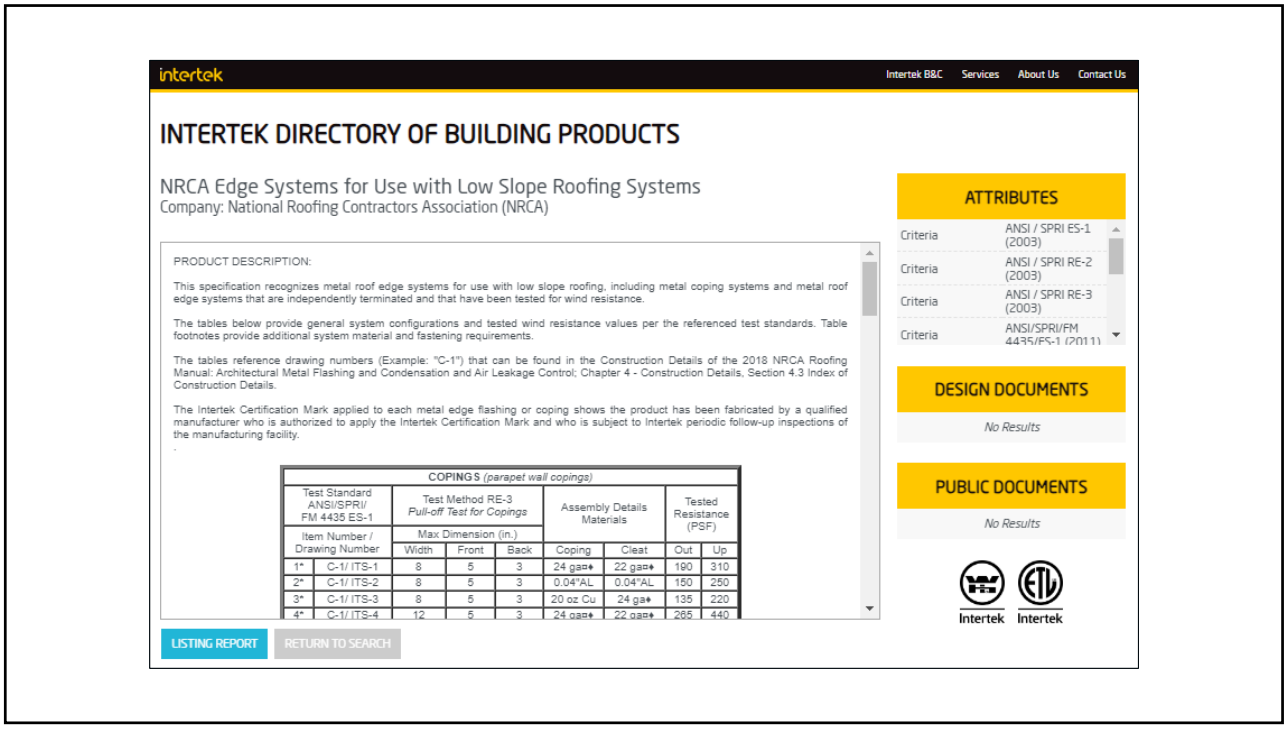
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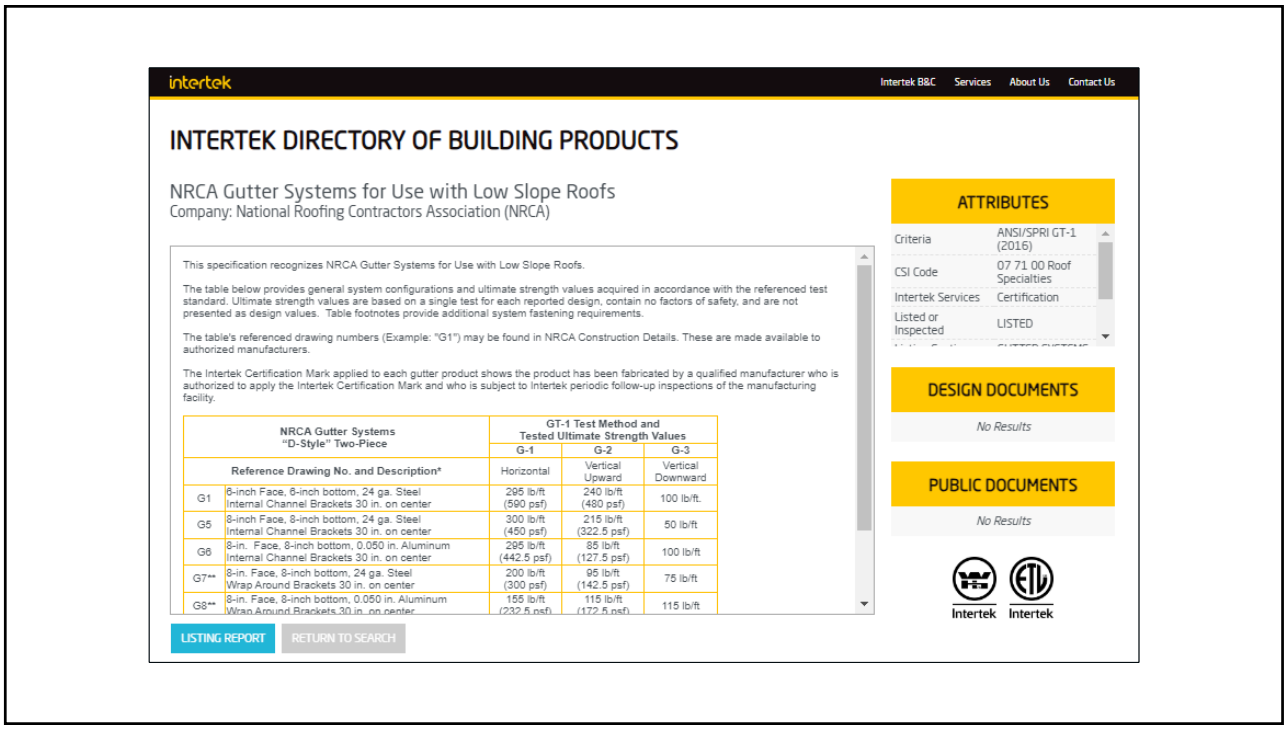
INTERTEK DIRECTORY OF BUILDING PRODUCTS
NRCA Edge Systems for Use with Low Slope Roofing Systems
Company: National Roofing Contractors Association (NRCA)
PRODUCT DESCRIPTION:
This specification recognizes metal roof edge systems for use with low slope roofing, including metal coping systems and metal roof edge systems that are independently terminated and that have been tested for wind resistance.
The tables below provide general system configurations and tested wind resistance values per the referenced test standards. Table footnotes provide additional system material and fastening requirements.
The tables reference drawing numbers (Example: "C-1") that can be found in the Construction Details of the 2018 NRCA Roofing Manual: Architectural Metal Flashing and Condensation and Air Leakage Control; Chapter 4 - Construction Details, Section 4.3 Index of Construction Details.
The Intertek Certification Mark applied to each metal edge flashing or coping shows the product has been fabricated by a qualified manufacturer who is authorized to apply the Intertek Certification Mark and who is subject to Intertek periodic follow-up inspections of the manufacturing facility.
COPINGS (parapet wall copings)
Test Standard ANSI/SPRI/FM 4435 ES-1
Test Method RE-3 Pull-off Test for Copings
Assembly Details Materials
Tested Resistance (PSF)
Item Number / Drawing Number
Max Dimension (in.)
Width
Front
Back
Coping
Cleat
Out
Up
1* C-1/ ITS-1 8 5 3 24 gage 22 gage 190 310
2* C-1/ ITS-2 8 5 3 0.04"AL 0.04"AL 150 250
3* C-1/ ITS-3 8 5 3 20 oz Cu 24 ga 135 220
4* C-1/ ITS-4 12 5 3 24 gage 22 gage 265 440
LISTING REPORT
RETURN TO SEARCH
ATTRIBUTES
Criteria ANSI / SPRI ES-1 (2003)
Criteria ANSI / SPRI RE-2 (2003)
Criteria ANSI / SPRI RE-3 (2003)
Criteria ANSI/SPRI/FM 4435/ES-1 (2011)
DESIGN DOCUMENTS
No Results
PUBLIC DOCUMENTS
No Results
Intertek
Intertek

31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INTERTEK DIRECTORY OF BUILDING PRODUCTS
NRCA Gutter Systems for Use with Low Slope Roofs
Company: National Roofing Contractors Association (NRCA)
This specification recognizes NRCA Gutter Systems for Use with Low Slope Roofs.
The table below provides general system configurations and ultimate strength values acquired in accordance with the referenced test standard. Ultimate strength values are based on a single test for each reported design, contain no factors of safety, and are not presented as design values. Table footnotes provide additional system fastening requirements.
The table's referenced drawing numbers (Example: "G1") may be found in NRCA Construction Details. These are made available to authorized manufacturers.
The Intertek Certification Mark applied to each gutter product shows the product has been fabricated by a qualified manufacturer who is authorized to apply the Intertek Certification Mark and who is subject to Intertek periodic follow-up inspections of the manufacturing facility.
NRCA Gutter Systems "D-Style" Two-Piece
GT-1 Test Method and Tested Ultimate Strength Values
G-1
G-2
G-3
Reference Drawing No. and Description*
Horizontal
Vertical Upward
Vertical Downward
G1 6-inch Face, 6-inch bottom, 24 ga. Steel Internal Channel Brackets 30 in. on center 295 lb/ft (590 psf) 240 lb/ft (480 psf) 100 lb/ft.
G5 8-inch Face, 8-inch bottom, 24 ga. Steel Internal Channel Brackets 30 in. on center 300 lb/ft (450 psf) 215 lb/ft (322.5 psf) 50 lb/ft
G6 8-in. Face, 8-inch bottom, 0.050 in. Aluminum Internal Channel Brackets 30 in. on center 295 lb/ft (442.5 psf) 85 lb/ft (127.5 psf) 100 lb/ft
G7** 8-in. Face, 8-inch bottom, 24 ga. Steel Wrap Around Brackets 30 in. on center 200 lb/ft (300 psf) 95 lb/ft (142.5 psf) 75 lb/ft
G8** 8-in. Face, 8-inch bottom, 0.050 in. Aluminum Wrap Around Brackets 30 in. on center 155 lb/ft (232.5 psf) 115 lb/ft (172.5 psf) 115 lb/ft
LISTING REPORT
RETURN TO SEARCH
ATTRIBUTES
Criteria ANSI/SPRI GT-1 (2016)
CSI Code 07 71 00 Roof Specialties
Intertek Services Certification
Listed or Inspected LISTED
DESIGN DOCUMENTS
No Results
PUBLIC DOCUMENTS
No Results
Intertek
Intertek

32

FM's RoofNav

Approvals | RoofNav

Enter Assembly #

Back

Product Trade Name	Company Name	Approved Use	Country
AnchorGard Nailer-T	Amrize Building Envelope LLC	Coping	United States of America
Cantilever Coping (Tapered, Flat and Existing Slope) (Aluminum)	Mule-Hide Products Co Inc	Coping	United States of America
Cantilever Coping (Tapered, Flat and Existing Slope) (Steel)	Mule-Hide Products Co Inc	Coping	United States of America
CentiMark Basic Coping - Aluminum	Centimark Corp	Coping	United States of America
CentiMark Basic Coping - Steel	Centimark Corp	Coping	United States of America
CentiMark Basic Coping Plus - Aluminum	Centimark Corp	Coping	United States of America
CentiMark Basic Coping Plus - Steel	Centimark Corp	Coping	United States of America
CentiMark EdgeBox RI	Centimark Corp	Coping	United States of America
CentiMark Premier Enhanced Coping - Aluminum	Centimark Corp	Coping	United States of America
CentiMark Premier Enhanced Coping - Steel	Centimark Corp	Coping	United States of America
CentiMark Premier Prime Coping - Aluminum	Centimark Corp	Coping	United States of America
CentiMark Premier Prime Coping - Steel	Centimark Corp	Coping	United States of America
CJ Coping 2-A1 - aluminum	CJ Systems Inc	Coping	United States of America
CJ Coping 2-A1 - steel	CJ Systems Inc	Coping	United States of America
CJ Coping 2-A2 - aluminum	CJ Systems Inc	Coping	United States of America
CJ Coping 2-A2 - steel	CJ Systems Inc	Coping	United States of America
CJ Coping 4-A1 - aluminum	CJ Systems Inc	Coping	United States of America

33

RESEARCH+TECH

Understanding FM Approvals' metal edge testing approval

The roofing industry needs more clarity for using FM 4435

by Mark S. Graham

Based on calls being received by NRCA's Technical Services Section, there appears to be confusion in the roofing industry regarding FM 4435, "Approval Standard for Edge Systems Used with Low Slope Roofing Systems." FM Approvals' criteria for metal edge testing. Perhaps the confusion lies with the FM 4435 designation also being included in the title of the U.S. national consensus standard for metal edge flashings. Also, there appears to be some lack of understanding by specifiers regarding how they should properly implement FM 4435. Following is a brief explanation to provide some clarity.

ANSI/SPRI/FM 4435/ES-1

The U.S. national consensus standard for testing the wind resistances of metal edge flashings (except gutters) is ANSI/SPRI/FM 4435/ES-1, "Test Standard for Edge Systems Used with Low Slope Roofing Systems." The most current edition of the standard was published in 2017 and is designated ANSI/SPRI/FM 4435/ES-1-2017.

The standard's previous edition, which was published in 2011 and is designated ANSI/SPRI/FM 4435/ES-1-2011, is referenced in the

26 www.professionalroofing.net NOVEMBER 2018

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November 2018

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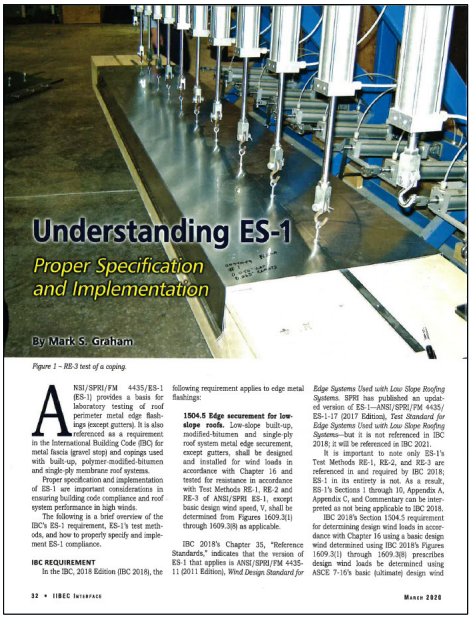
34



Understanding ES-1

Proper Specification and Implementation

By Mark S. Graham

Figure 1 – RS-3 test of a coping.

ANSI/SPRI/FM 4435/ES-1 (ES-1) provides a basis for laboratory testing of roof perimeter metal edge flashings (except gutters). It is also referenced as a requirement in the International Building Code (IBC) for metal fascia (gravel stop) and copings used with built-up, polymer-modified-bitumen and single-ply membrane roof systems.

Proper specification and implementation of ES-1 are important considerations in ensuring building code compliance and roof system performance in high winds.

The following is a brief overview of the IBC's ES-1 requirement, ES-1's test methods, and how to properly specify and implement ES-1 compliance.

IBC REQUIREMENT

In the IBC, 2018 Edition (IBC 2018), the following requirement applies to edge metal flashings:

1504.5 Edge securement for low-slope roofs. Low-slope built-up, modified-bitumen and single-ply roof system metal edge securement, except gutters, 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(8) as applicable.

IBC 2018's Chapter 35, "Reference Standards," indicates that the version of ES-1 that applies is ANSI/SPRI/FM 4435-11 (2011 Edition), *Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems*. SPRI has published an updated version of ES-1—ANSI/SPRI/FM 4435/ES-1-17 (2017 Edition), *Test Standard for Edge Systems Used with Low Slope Roofing Systems*—but it is not referenced in IBC 2018; it will be referenced in IBC 2021.

It is important to note only ES-1's Test Methods RE-1, RE-2, and RE-3 are referenced in and required by IBC 2018; ES-1 in its entirety is not. As a result, ES-1's Sections 1 through 10, Appendix A, Appendix C, and Commentary can be interpreted as not being applicable to IBC 2018.

IBC 2018's Section 1504.5 requirement for determining design wind loads in accordance with Chapter 16 using a basic design wind determined using IBC 2018's Figures 1609.3(1) through 1609.3(8) prescribes design wind loads be determined using ASCE 7-16's basic (ultimate) design wind

32 • IIBEC Interface March 2020

IIBEC *Interface*
March 2020

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35

RESEARCH+TECH

Getting closer to gutters

NRCA tests metal roof edge gutters and maintains certification programs

by Mark S. Graham

NRCA has conducted testing of metal roof edge gutters according to ANSI/SPRI GT-1-2016, "Test Standard for Gutter Systems." If you design, shop fabricate and/or install gutters for low-slope membrane roof systems, you should be aware of ANSI/SPRI GT-1, the building code requirement that requires gutter testing, and NRCA's gutter testing and certification programs.

ANSI/SPRI GT-1

ANSI/SPRI GT-1 provides a methodology for testing static load resistances of exterior hanging gutters used with low-slope roof systems. Gutter resistances are tested in three directions as shown in the figure.

Test G-1 tests a gutter's resistance to a horizontal outward load, such as an outward wind load. Test G-2 tests a gutter's resistance to a vertical upward load, such as an upward wind load. Test G-3 tests a gutter's resistance to a downward load, such as the weight of water, snow and ice.

The test method does not assess a gutter's water-carrying capacity or water removal.

ANSI/SPRI GT-1 was developed and is promulgated as a national

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April 2023

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36

Questions….

37

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38