Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

1.0 INTRODUCTION *(See Commentary: 1)*

The following standard is a reference for those who design, specify or install edge materials used with low slope roofing systems. This Standard focuses primarily on design for wind resistance. Nevertheless, it does address corrosion as well as fascia thicknesses that lead to satisfactory flatness. It is intended for use with the specifications and requirements of the manufacturers of the specific roofing materials and the edge systems used in the roofing assembly, excluding gutters. The membrane manufacturer shall be consulted for specific recommendations for making the roof watertight at the edge.

This design standard addresses copings and horizontal roof edges, and the following factors shall be considered in designing a roof edge.

- Structural integrity of the substrate that anchors the edge (e.g. nailers)
- Wind resistance of the edge detail
- Materials specifications

This guide has been revised in accordance with the ASCE 7-02[1] document titled "Minimum Design Loads for Buildings and Other Structures" to provide a relatively simple calculation method for the determination of the wind uplift pressures on components and cladding for any building. The complete ASCE 7-02 document has not been duplicated here, however key information from that document appears here so that most conditions will not require direct reference to that document.

2.0 GENERAL DESIGN CONSIDERATIONS AND DEFINITIONS *(See Commentary: 2)*

All materials for roof edge construction shall have sufficient strength to withstand the design wind load. The following factors apply when designing a roof edge system: Wind speed, building height, Exposure Factor, topography, Importance Factor, corner and perimeter regions, edge condition, galvanic compatibility and flatness of fascias.

2.1. ROOF SLOPE

Roof Slope is accounted for in the pressure coefficient factors used in this document. Only roof slopes ≤10° are addressed by this document.

2.2. WIND SPEED *(See Commentary: 2.2)*

Basic wind speed values used in the design calculations are 3-second maximum peak gust speeds in miles per hour (0.45 m/s) measured at 33 ft (10 m) above ground for Exposure Factor C associated with an annual probability of 0.02 (50 year return). These values are taken from the ANSI/ASCE 7-02[1] document (See Attachment I) or the authority having jurisdiction. ***(See Commentary: 2.2)*** The authority having jurisdiction shall be contacted for verification of wind data. The basic wind speed, V used in the determination of the design wind loads on buildings shall be as given in Attachment I except as follows:

Special Wind Regions: The basic wind speed shall be increased where records or experience indicate that the wind speeds are higher than those reflected in Attachment I. Mountainous terrain, gorges and special regions shown in Attachment

DISCLAIMER

This standard is for use by architects, engineers, roofing contractors and owners of low slope roofing systems. SPRI, ITS MEMBERS AND EMPLOYEES DO NOT WARRANT THAT THIS STANDARD IS PROPER AND APPLICABLE UNDER ALL CONDITIONS.

I shall be examined for unusual wind conditions. The authority having jurisdiction, if necessary, shall adjust the values given in Attachment I to account for higher local wind speeds. Such adjustments shall be based on meteorological information and an estimate of the basic wind speed obtained in accordance with the provisions of C.2 as follows.

Estimation of Basic Wind Speeds from Regional Climatic Data:
Regional climatic data shall only be used in lieu of the basic wind speeds given in Attachment I when: (a) Approved extreme-value statistical-analysis procedures have been employed in reducing the data; (b) and the length of record, sampling error, averaging time, anemometer height, data quality and terrain exposure have been taken into account. Section 6.5.7 of ASCE 7-02[1] shall be used to adjust design wind speed for the intensifying effects of valleys and other unique topographic features such as hills or escarpments.

Limitation: Wind conditions above basic wind speeds (e.g. tornadoes) have not been considered in developing the basic wind speed distributions.

2.3. BUILDING HEIGHT
The building height shall be measured from the ground to the eave of the roof section. Specific topographic features, such as hills, shall be considered when calculating building height.

2.4. ROOF EDGE REGIONS
Wind forces near building corner regions are of greater intensity than in the perimeter regions between corners. These regions are defined as follows:

2.4.1. CORNER REGION
For buildings with mean roof height of 60 feet (18 m) or less: The corner region is a distance from the building corner that is 10% of the minimum building width or 40% of the building height at the eaves, whichever is smaller, but not less than 4% of the minimum building width and not less than 3 feet (0.9 m).

For buildings with mean roof height greater than 60 feet (18 m): The corner region is a distance from the building corner that is 10% of the minimum building width but not less than 3 feet (0.9 m).

2.4.2. PERIMETER
The perimeter is the section of roof edge between building corner regions as defined in Section 2.4.1 (above). The edge condition includes the roof edge device (edge flashing or coping) and the nailer or other substrate to which the edge device is attached.

2.4.3. COVERAGE
Coverage is the location of the lowest vertical point of the roof edge device or any extension of it, exclusive of any drip bend or other protrusion. The coverage shall extend a minimum of 1 inch (25 mm) below the bottom of the nailer. The roof membrane shall not extend below the coverage.

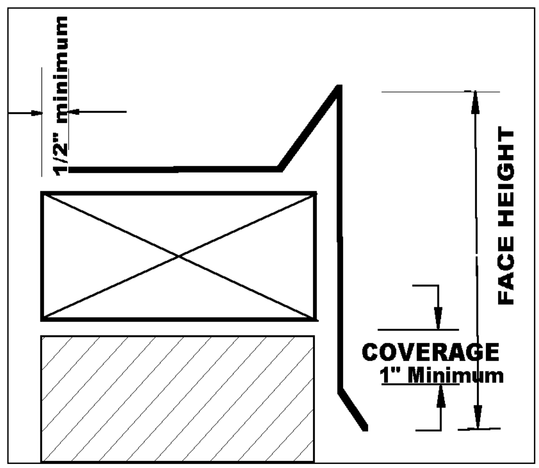


Figure 1: Coverage and Face Height

3.0 EXPOSURE *(See Commentary: 2.5)*

The building shall be classified into one of the following Exposures based on surrounding terrain:.

	Exposure Categories
B:	Exposure B shall apply where the ground surface roughness condition, as defined by Surface Roughness B, prevails in the upwind direction for a distance of at least 2630 ft (800 m) or 10 times the height of the building, whichever is greater. Exception**:** For buildings whose mean roof height is less than or equal to 30 ft (9.1 m), the upwind distance may be reduced to 1500 ft (457 m)
C:	Exposure C shall apply for all cases where exposures B or D do not apply.
D:	Exposure D shall apply where the ground surface roughness, as defined by surface roughness D, prevails in the upwind direction for a distance at least 5000 ft (1524 m) or 10 times the building height, whichever is greater. Exposure D shall extend inland from the shoreline for a distance of 660 ft (200 m) or 10 times the height of the building, whichever is greater. For a site located in the transition zone between exposure categories, the category resulting in the largest wind forces shall be used. Exception: An intermediate exposure between the above categories is permitted in a transition zone provided that it is determined by a rational analysis method defined in the recognized literature.

4.0 IMPORTANCE FACTOR *(See Commentary: 2.6)*

Buildings fitting one of the following criteria shall have an "Importance Factor" included in the wind design calculations. Table 1 explains these building classifications. Refer to Section 7.1 for use of Importance Factor.

Table 1

Nature of Occupancy	Category	Importance Factor	
		Non-Hurricane Prone Regions & Alaska. V=85-100 mph.	Hurricane Prone Regions V>100 mph.
Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: • Agricultural facilities • Certain temporary facilities • Minor storage facilities	I	**0.87**	**0.77**
All buildings and other structures except those listed in Categories I, III, and IV	II	**1.00**	**1.00**
• Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to: • Buildings and other structures where more than 300 people congregate in one area • Buildings and other structures with day care facilities with capacity greater than 150 • Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250 • Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities • Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities	III	**1.15**	**1.15**

Table 1 continued

Nature of Occupancy	Category	Importance Factor	
• Jails and detention facilities • Power generating stations and other public utility facilities not included in Category IV • Buildings and other structures not included in Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing sufficient quantities of hazardous materials to be dangerous to the public if released. • Buildings and other structures containing hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2 that a release of the hazardous material does not pose a threat to the public.			
• Buildings and other structures designated as essential facilities including, but not limited to: • Hospitals and other health care facilities having surgery or emergency treatment facilities • Fire, rescue, ambulance, and police stations and emergency vehicle garages • Designated earthquake, hurricane, or other emergency shelters • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response • Power generating stations and other public utility facilities required in an emergency • Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency • Aviation control towers, air traffic control centers, and emergency aircraft hangars • Water storage facilities and pump structures required to maintain water pressure for fire suppression • Buildings and other structures having critical national defense functions • Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction. • Buildings and other structures containing extremely hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2 that a release of the extremely hazardous material does not pose a threat to the public. This reduced classification shall not be permitted if the buildings or other structures also function as essential facilities.	IV	**1.15**	**1.15**

From ASCE 7/02[1]

5.0 SYSTEM REQUIREMENTS
(See Commentary: 5)

5.1. NAILER SECURED SYSTEMS
The attachment of the nailer to the structure shall be sufficient to resist the design wind uplift load and the load determined under Section 7.1. At outside building corners regions[a], nailer securement shall be designed to resist a load 1.5 times the load determined under Section 7.1. Wood nailers shall have minimum thickness of 1.5 inch (38 mm). For edge flashings used to secure the roofing (e.g., gravel stops), the substrate (e.g. nailer) shall extend at least 1/2 inch (13 mm) beyond the back edge of the horizontal flange of the roof edge device. The following fastener safety factors shall be applied to design loading.

Table 2

Substrate	Wind Load Safety Factor
Wood[2]	4.5
Masonry[3]	3.0
Steel[4]	1.9

6.0 DESIGN OPTIONS ***(See Commentary: 4)***

The following minimum securement criteria apply for edging systems. When building codes require higher wind resistance, the designer shall calculate and design for the required loads according to local building codes.

6.1. MEMBRANE ATTACHMENT
(See Commentary: 6.1)
Except for built-up or fully-adhered roofing, the design of the edge flashing, when used for terminating the roofing system, shall provide a minimum holding power specified in SPRI Test RE-1 (Page 14).

6.2. WIND RESISTANCE OF EDGE FLASHING (Gravelstop)
(See Commentary: 6.2 & 6.3)
The vertical face of edge flashing shall be tested according to SPRI Test RE-2 (Page 15). Test results shall meet or exceed design wind pressures as calculated according to RE-2.

6.3. WIND RESISTANCE OF COPING
(See Commentary: 6.2 & 6.3)
Copings shall be tested according to SPRI Test Method RE-3 (Page 17). Test results shall meet or exceed horizontal and vertical design wind pressures as calculated according to RE-3.

6.4. FASTENER SPACING
Fastener densities providing satisfactory results in SPRI Tests RE-2 and RE-3 for attaching the edge device to the substrate shall be increased by a factor of two at building corner regions (as defined in Section 2.4.1) to allow for increased velocity pressure in these regions.

7.0 DESIGN PROVISIONS

7.1. WIND DESIGN ***(See Commentary: 7.1)***
The roof edge design pressure (P) shall be calculated using the formula

$$P=(GC_p)*(q_z)*I$$

in which:

P = Design Pressure (psf),

GC_p = External Pressure Coefficient from Table 3

q_z = Velocity Pressure at roof height, z and

I = Importance Factor from Table 1.

To determine the Velocity Pressure (q_z) determine:

- Roof Height (z) from project plans and specifications,
- Basic Wind Speed (V) from Attachment I or the authority having jurisdiction, and
- Exposure Category through reference to Section 3.0 and project plans and specifications.
- Use these parameters to obtain Velocity Pressure (q_z) from Table 4.

Note: Where topological features (hill, ridge or escarpment) are present, Topologic Factor, K_{zt} shall be calculated according to Figure 6-4 of ASCE 7-02[1] and applied to the Roof Edge Design Pressure, P as calculated in this standard.

a See Section 2.4.1 for definition of building corner regions.

Table 3: External Pressure Coefficient (GC_p)

	Roof Height 60 feet or less (**z**≤60 ft)	Roof Height over 60 feet (**z**>60 ft)
Horizontal GCp (acting outward from the building face)	**-1.1**	**-0.9**
Vertical GCp (acting upward at the building edge)	**-1.8**	**-2.3**
Note: The negative signs (–) in the External Pressure Coefficients represent vector directionality of the force acting away from the building, tending to pull materials upward or outward from the building.		

Table 4

Velocity Pressure, q_Z (psf) Exposure B										
Height z (ft)	**Wind Speed, mph, 3-Second Gust**									
	85	**90**	**100**	**110**	**120**	**130**	**140**	**150**	**160**	**170**
0-60	16	18	22	26	31	37	43	49	56	63
>60-70	17	19	23	28	33	39	45	51	58	66
>70-80	17	19	24	29	34	40	47	53	61	69
>80-90	18	20	25	30	35	41	48	55	63	71
>90-100	18	20	25	31	36	43	50	57	65	73
>100-120	19	22	27	32	38	45	52	60	68	77
>120-140	20	23	28	34	40	47	55	63	71	80
>140-160	21	23	29	35	42	49	57	65	74	84
>160-180	22	24	30	36	43	51	59	67	77	86
>180-200	22	25	31	37	44	52	60	69	79	89
>200-250	24	27	33	40	47	56	64	74	84	95
>250-300	25	28	35	42	50	59	68	78	89	100
>300-350	26	29	36	44	52	61	71	81	93	105
>350-400	27	30	38	45	54	64	74	85	96	109
>400-450	28	31	39	47	56	66	76	87	100	112
>450-500	29	32	40	48	58	68	79	90	103	116

Velocity Pressure, q_Z (psf)
Exposure C

Height	Wind Speed, mph, 3-Second Gust									
z (ft)	85	90	100	110	120	130	140	150	160	170
0-60	21	24	29	35	42	49	57	65	74	84
>60-70	22	24	30	36	43	51	59	68	77	87
>70-80	22	25	31	37	45	52	61	70	79	89
>80-90	23	26	32	38	46	54	62	71	81	92
>90-100	23	26	32	39	47	55	64	73	83	94
>100-120	24	27	34	41	48	57	66	76	86	97
>120-140	25	28	35	42	50	59	68	78	89	101
>140-160	26	29	36	43	52	60	70	80	92	103
>160-180	26	30	37	44	53	62	72	83	94	106
>180-200	27	30	37	45	54	63	73	84	96	108
>200-250	28	32	39	48	57	66	77	88	101	114
>250-300	30	33	41	49	59	69	80	92	105	118
>300-350	30	34	42	51	61	71	83	95	108	122
>350-400	31	35	43	52	62	73	85	98	111	125
>400-450	32	36	44	54	64	75	87	100	114	129
>450-500	33	37	45	55	65	77	89	102	116	131

Velocity Pressure, q_Z (psf)
Exposure D

Height	Wind Speed, mph, 3-Second Gust									
z (ft)	85	90	100	110	120	130	140	150	160	170
0-15	19	21	26	32	38	45	52	59	68	76
>15-20	20	22	28	34	40	47	54	62	71	80
>20-30	21	24	30	36	43	50	58	67	76	86
>30-40	23	25	31	38	45	53	61	70	80	90
>40-50	23	26	33	39	47	55	64	73	83	94
>50-60	24	27	34	41	48	57	66	76	86	97
>60-70	25	28	34	42	50	58	68	78	88	100
>70-80	25	29	35	43	51	60	69	79	90	102
>80-90	26	29	36	44	52	61	71	81	92	104
>90-100	27	30	37	44	53	62	72	83	94	106
>100-120	27	31	38	46	55	64	74	85	97	109
>120-140	28	32	39	47	56	66	76	88	100	112
>140-160	29	32	40	48	57	67	78	90	102	115
>160-180	29	33	41	49	59	69	80	91	104	117
>180-200	30	34	41	50	60	70	81	93	106	120
>200-250	31	35	43	52	62	73	84	97	110	124
>250-300	32	36	44	54	64	75	87	100	114	128
>300-350	33	37	46	55	66	77	89	103	117	132
>350-400	34	38	47	56	67	79	92	105	120	135
>400-450	34	39	48	58	69	81	93	107	122	138
>450-500	35	39	49	59	70	82	95	109	124	140

Roof edge designs shall pass tests RE-1, RE-2 and RE-3 as appropriate for the application:

- Edge devices designed to act as membrane terminations shall pass SPRI Test RE-1.
- Edge flashings and other edge devices for which the exposed horizontal component is 4 inches (100 mm) or less the exposed horizontal component area (edge flashings, etc.) shall pass SPRI Test RE-2.
- Copings and other devices for which the exposed horizontal flange exceeds 4 inches (100 mm) shall pass SPRI Test RE-3. To allow for higher wind loads at corners, double the fastening in the corner region instead of testing corner assemblies when the tested assembly passes RE-3.

Exposed areas in the above requirements shall be those elements upon which the wind forces act directly.

7.2. METAL THICKNESS ***(See Commentary: 7.2)***

Minimum gauges for exposed faces[5] shall be determined for flatness from Table 5.

7.3. GALVANIC COMPATIBILITY AND RESISTANCE ***(See Commentary: 7.3)***

Metal edge devices (face, clip and fastener) shall be of the same kind of metal, or shall be galvanically compatible metal pairs. Compatible metal pairs shall be selected from the following list:

- Aluminum-Galvanized Steel
- Aluminum-Stainless Steel
- Copper-Stainless Steel
- Other pairs that can be shown to provide satisfactory galvanic compatibility.

Fasteners shall be galvanically compatible with the other roof edge system components. When used with aluminum, steel fasteners shall have a dielectric resistive coating.

Copper shall not be used in combination with steel, zinc or aluminum. Only copper fasteners shall be used with copper.

8.0 APPLIANCES

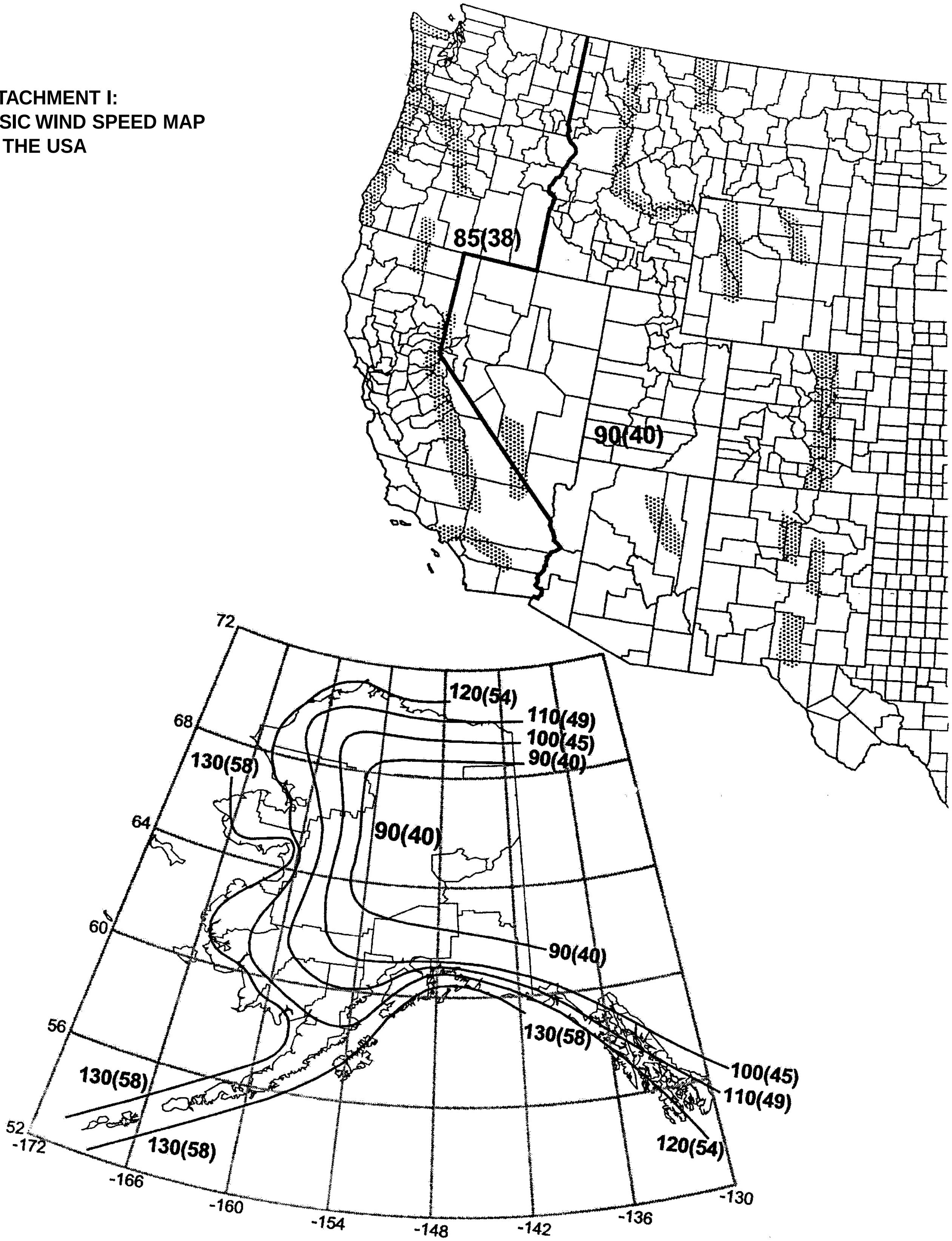
Appliance attachments, such as lightning rods, signs or antennae that penetrate the water seal, induce a galvanic reaction or otherwise compromise the effectiveness of the roof edge system, shall be eliminated or isolated to prevent problems.

Table 5

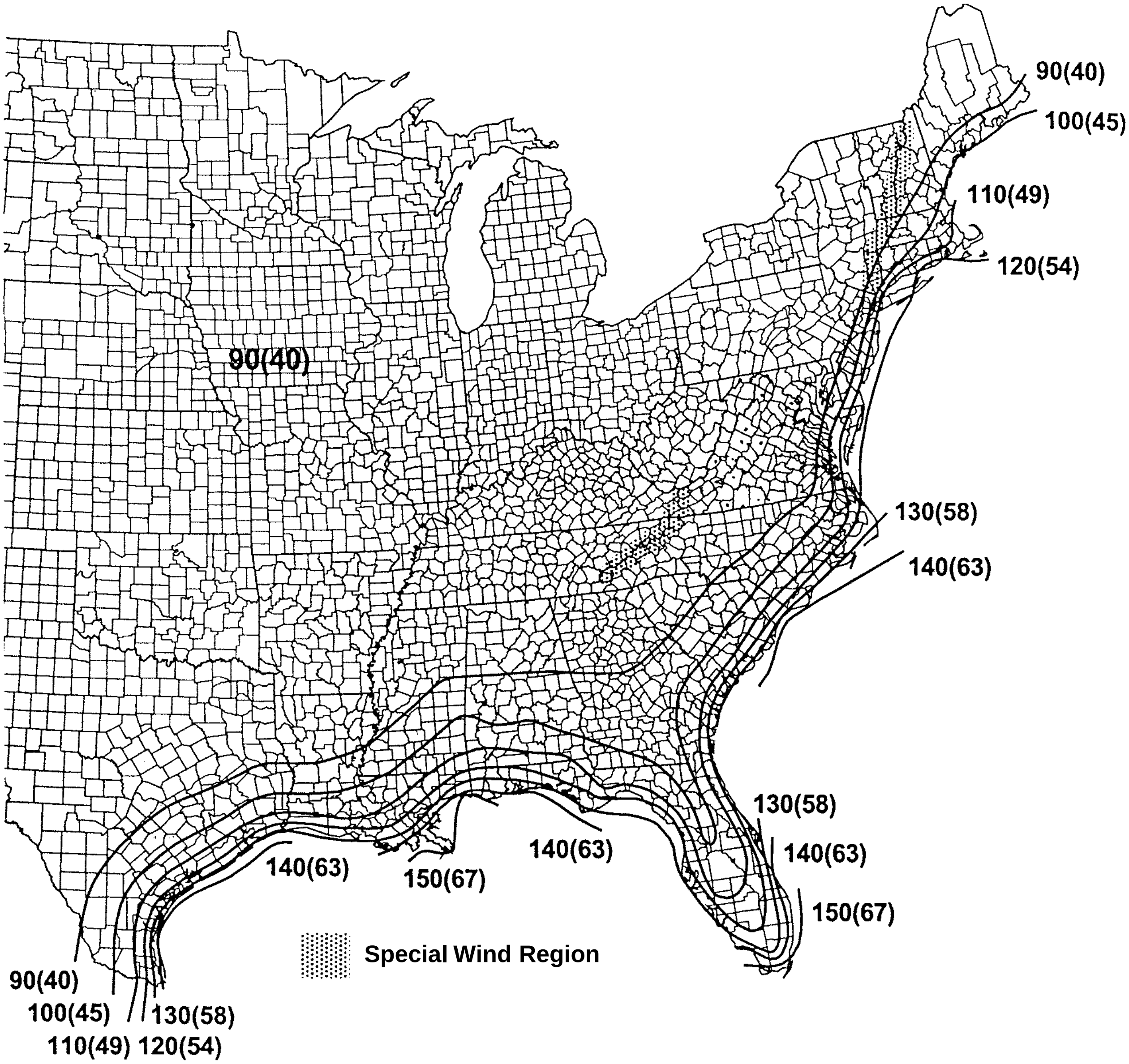
Minimum Metal Thickness for Flatness

Exposed Face	Galvanized Steel	Cold Rolled Copper	Formed Aluminum	Stainless Steel
Up to 4” (to 100 mm)	24 ga (0.028” 0.7 mm)	16 oz (0.022” 0.6 mm)	0.040” (1.0 mm)	26ga (0.016” 0.4 mm)
>4” - 8” (>100 - 200 mm)	24 ga (0.028” 0.7 mm)	16 oz (0.022” 0.6 mm)	0.050” (1.3 mm)	26ga (0.016” 0.4 mm)
>8” - 10” (>200 - 250 mm)	22 ga (0.034” 0.9 mm)	20 oz (0.027” 0.7 mm)	0.063” (1.6 mm)	24ga (0.023” 0.6 mm
>10” - 16” (>250 - 400 mm)	20 ga (0.040” 1.0 mm)	20oz w/stiffening ribs.	0.080” (2.0 mm)	22ga (0.029” 0.7 mm)

ATTACHMENT I:
BASIC WIND SPEED MAP
OF THE USA



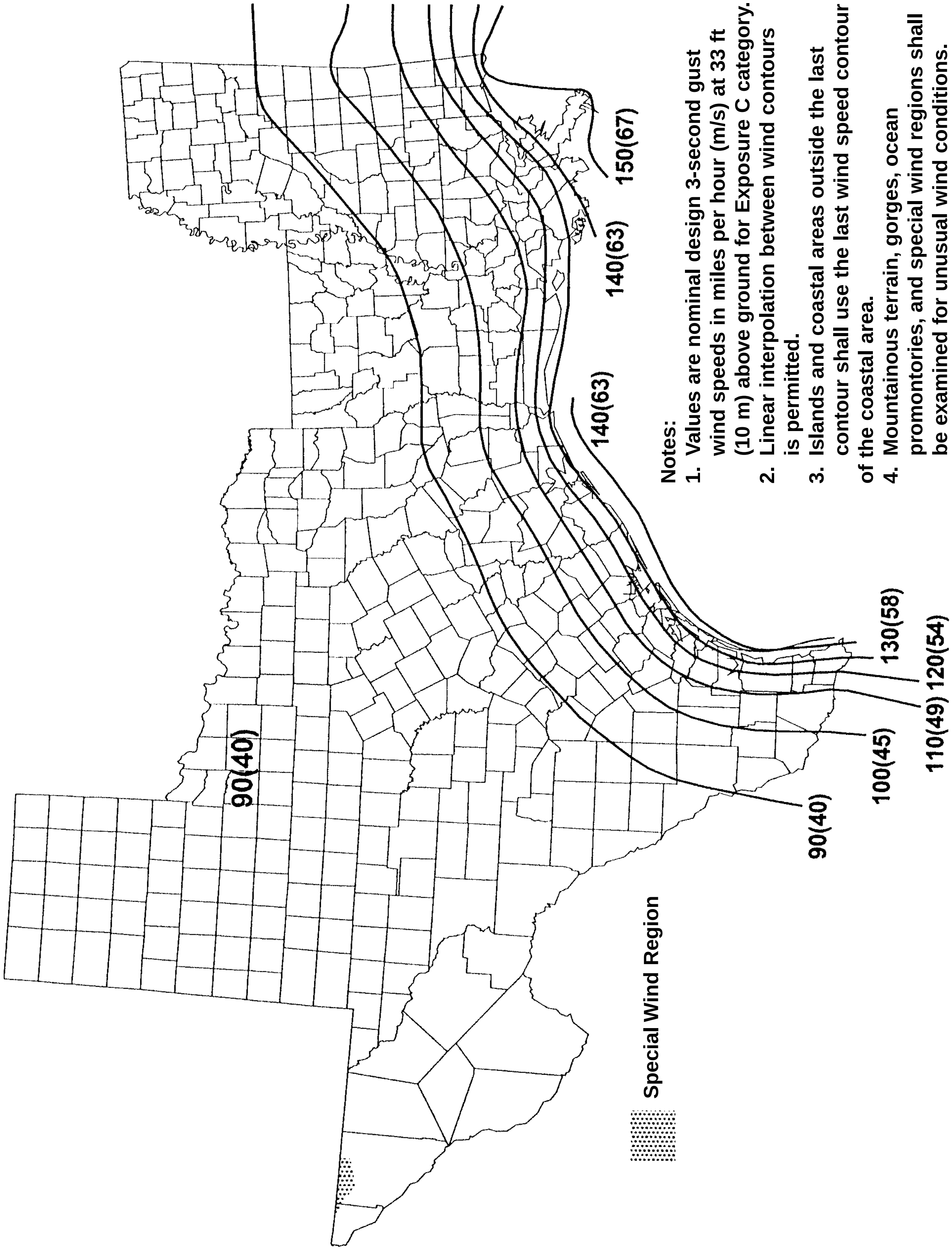
The wind speed map shown as Attachment I is an element of the ANSI/ASCE 7-02 document, "Minimum Design Loads for Buildings and Other Structures", an American National Standards Institute Standard, copyrighted in 2002 by the American Society of Civil Engineers. Copies of this standard may be purchased from the American Society of Civil Engineers at 1801 Alexander Bell Drive, Reston, VA 02019.



Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:

1. **Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.**
2. **Linear interpolation between wind contours is permitted.**
3. **Islands and coastal areas outside the last contour shall use the last wind speedcontour of the coastal area.**
4. **Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.**



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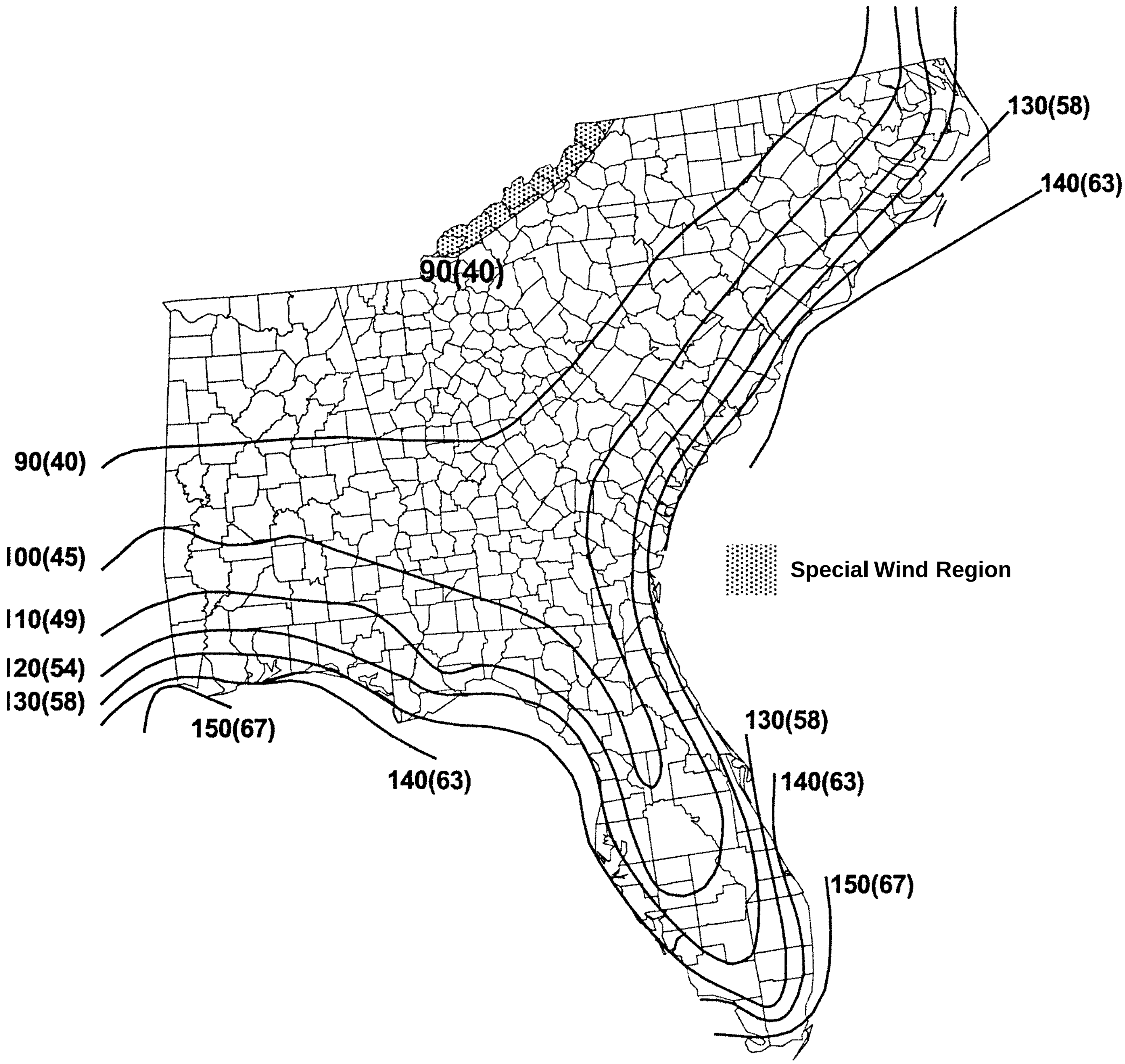
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.



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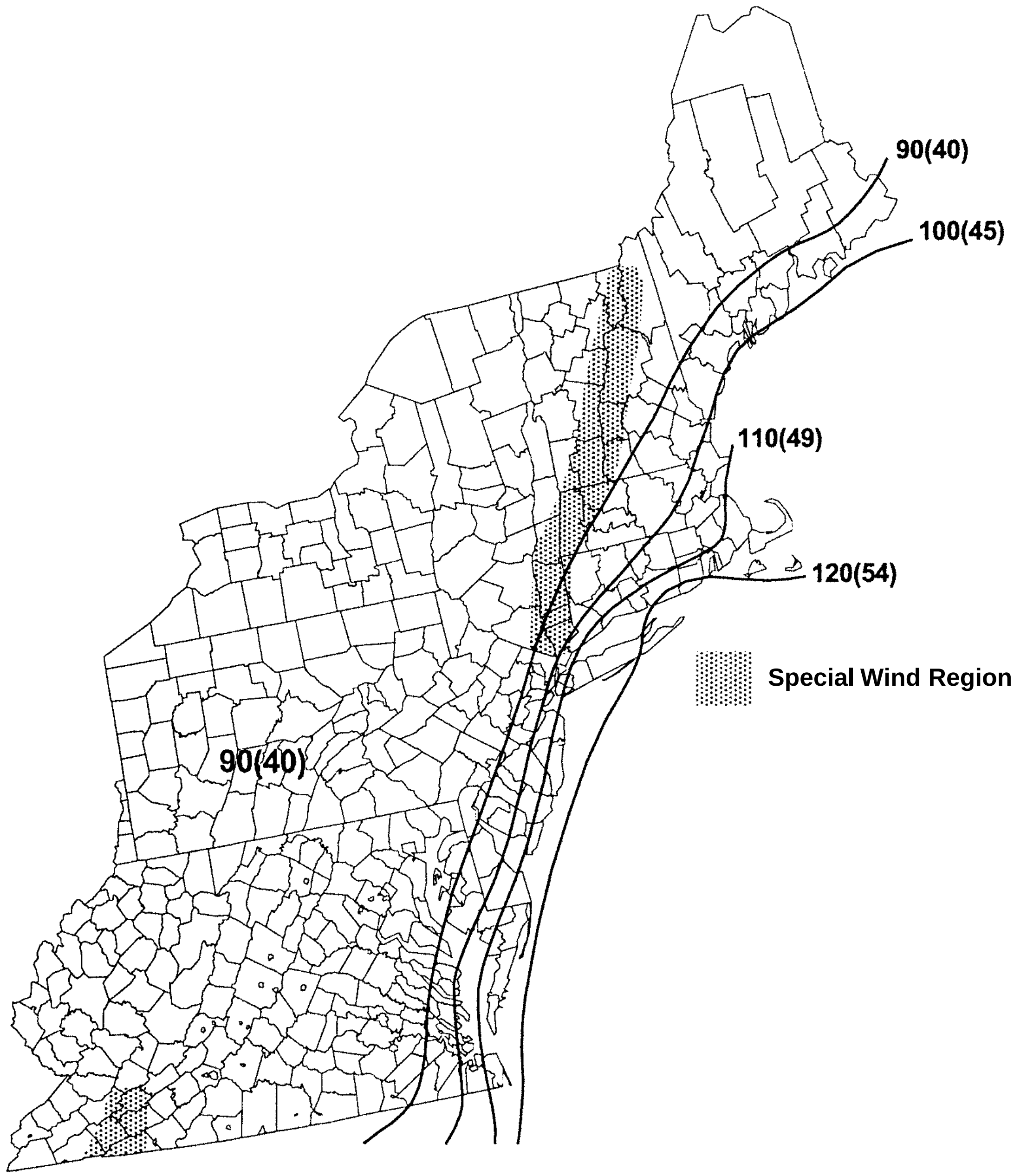

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2. Linear interpolation between wind contours is permitted.
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4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

SPRI Test RE-1
Test for Roof Edge Termination of BALLASTED OR MECHANICALLY ATTACHED ROOFING MEMBRANE SYSTEMS

(See Commentary: SPRI Test Method RE-1)

- Fully adhered systems or systems using an alternative method of terminating the roof at the edge shall not require this test.
- For ballasted roofs, the edge device assembly shall provide a minimum load resistance (**F**) of 100 lbs/Ft (134 kg/m).
  F = 100 for ballasted roofs
- For mechanically attached systems the distance (**D**) of the first row of fasteners parallel to the edge away from corner regions, and distance ($\mathbf{D_{corner}}$) of the first row of fasteners parallel to the edge in the building corner regions shall be used in the following equations to determine the load resistance which shall be the greater of:

  $\mathbf{F} = (\mathbf{D})(\mathbf{P}) \div 2$ and

  $\mathbf{F_{corner}} = 1.5(\mathbf{D_{corner}})(\mathbf{P}) \div 2$

  The edge device assembly shall provide a minimum load resistance which is the maximum of **F** or $\mathbf{F_{corner}}$.

Testing: Load resistance shall be tested using the following method.

Method: A minimum 12 inch (300 mm) wide mock-up of the edge device system shall be constructed and mounted on the base of a tensile testing device so the membrane is pulled at a 45° angle to the roof deck to simulate a billowing membrane (see Figure 2). For devices in which fasteners are part of the membrane securement, at least two such fasteners shall be included in a balanced sample. However, no more fasteners shall be installed than would be typically installed in field conditions.

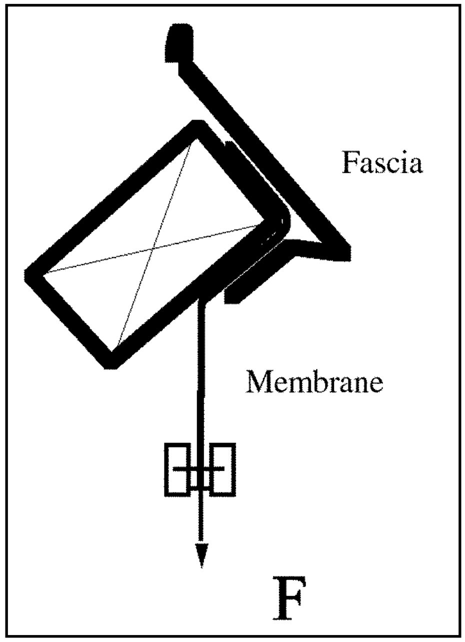

Figure 2: Test RE1

The jaws of the tester shall be connected to two bars that clamp the membrane securely between them so that the load is distributed uniformly along the width of the membrane (see **Commentary for Test RE-1**). The tester is loaded until failure occurs. Failure is defined as any event that allows the membrane to come free of the edge termination or the termination to come free of its mount. The roof edge termination strength is deemed satisfactory if the test force at failure on a 12 inch (300 mm) wide sample meets or exceeds the force, **F**, as specified above.

SPRI Test RE-2
Pull-Off Test for Edge flashings
Exposed horizontal component is 4 inches (100 mm) or less

(See Commentary: SPRI Test Method RE-2)

1. Apparatus

The description of the apparatus is general in nature. Any equipment capable of performing the test procedure within the allowed tolerances shall be permitted. A schematic drawing of this apparatus is shown in Figure 3. The test apparatus shall be constructed so that the performance of individual components are unaffected by edge or end constraints on the test sample.

2. Safety Precautions

Proper precautions shall be taken to protect the operating personnel and observers in case of any failure.

3. Test Specimens

All parts of the test specimen shall be full size in width and all other dimensions, using the same materials, details and methods of construction and anchoring devices (such as clips or cleats) as used on the actual building. Sample length shall be the average length designed for field use on the project with a minimum of 8 feet (2.4 m). When the longest length designed for the project is less than 8 feet (2.4 m) the longest design length shall be used. When the anchoring means at the ends of the edge flashing are normally used to restrain other additional lengths of edge flashing, then the anchoring means shall be modified so that only that percentage that might restrain rotational movement in the test specimen is used.

4. Procedure

4.1 Gravity
Any undue influence from gravity that does not occur during actual installation shall be omitted from the test specimen. If the test specimen is inverted, a gravity correction shall be made in the determination of the allowable superimposed loading. Tests run in an inverted position shall include data from pressure reversal or an upright specimen to show that unlatching at the drip edges will not occur in the normal orientation.

4.2 Stabilization
A dial gauge shall be attached to the centerline of each loaded surface to detect movement. Stabilization of the test shall be when the gauge ceases to show movement.

4.3 Loading
Loading shall be applied uniformly on centers no greater than 12 inches (300 mm) to the center-line of the vertical face of the edge flashing. Loading shall be applied on the horizontal centerline of the face. Loads shall be applied incrementally and held for not less than 60 seconds after stabilization has been achieved at each incremental load. Between incremental loads, the loading shall be reduced to zero until the specimen stabilizes, or for five minutes, whichever happens first. After a recovery period of not more than five minutes at zero load, initiate the next higher incremental load. Loading to the face of the edge flashing shall be applied in increments not to exceed 25-lb/SqFt. (120 kg/m^2) until approximately 150-lb/SqFt. (730-kg/m^2) is obtained. Thereafter, increments of load shall not exceed 10-lb/SqFt. (50-kg/m^2). Loading speed shall be such that each incremental load up to and including 150-lb/SqFt. (730-kg/m^2) shall be achieved in 60 seconds or less. Above 150-lb/SqFt. (730-kg/m^2), incremental loading shall be achieved in 120 seconds or less.

Loading shall proceed as indicated until the test specimen either fails or exceeds the required design pressure. The increments of load application shall be chosen so that a sufficient number of observations are made to determine the exact load at failure. The last sustained 60-second load without failure is the maximum load recorded as the design value.

4.4 Failure

Failure shall be loss of securement of any component of the roof edge system or deformation that would result in loss of weather protection of the edge.

4.5 Test Results

The force at the conditions described in 4.3 above shall be recorded. This force shall be converted to pressure by dividing the force by the area of the face: Force is measured in Pounds

$$\text{Pressure} = \frac{\text{Outward Force}}{\text{Face Height} * \text{Face Length}}$$

- Pressure is measured in pounds per square foot,
- Force is measured in Pounds Force,
- Face Length is the test sample length in feet,
- Face Height is in Feet (inches÷12).

If the test results exceed the design outward wind pressures, the edge flashing has acceptable wind blow-off resistance.

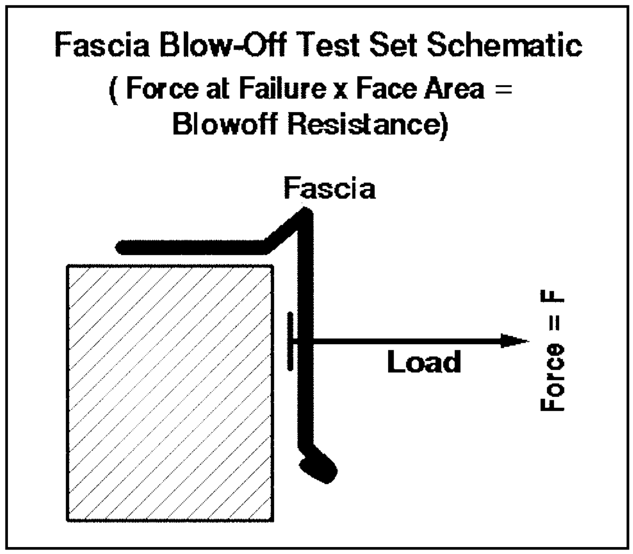

Figure 3: Test RE2

SPRI Test RE-3
Pull-Off Test for Copings
Exposed horizontal flange depth exceeds 4 inches (100 mm)

(See Commentary: SPRI Test Method RE-3)

1. Apparatus

This description of the apparatus is general in nature. Any equipment capable of performing the test procedure within the allowed tolerances shall be permitted. A schematic drawing of this apparatus is shown in Figures 4 and 5. The test apparatus shall be constructed so that the performance of individual components are unaffected by edge or end constraints on the test sample.

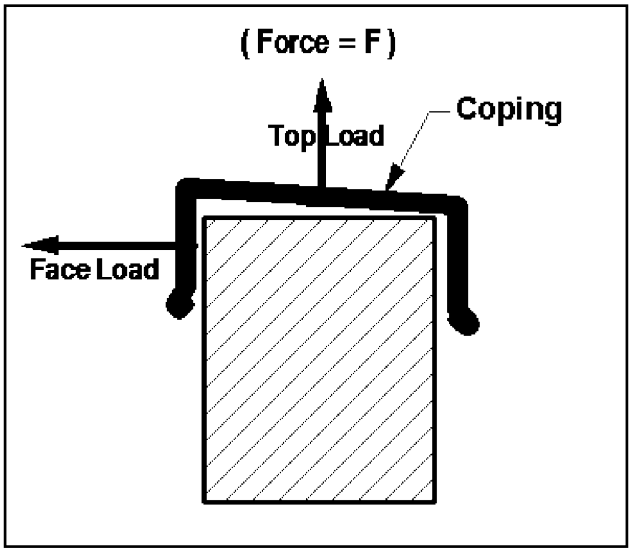

Figure 4: Test RE-3 on Face

2. Safety Precautions

Proper precautions shall be taken to protect the operating personnel and observers in case of any failure.

3. Test Specimens

All parts of the test specimen shall be full size in width and all other dimensions, using the same materials, details and methods of construction and anchoring devices (such as clips or cleats) as used on the actual building. Sample length shall be the average length designed for field use on the project with a minimum of 8 feet (2.4 m). When the longest length designed for the project is less than 8 feet (2.4 m) the longest design length shall be used. When the anchoring means at the ends of the edge flashing are normally used to restrain other additional lengths of edge flashing, then the anchoring means shall be modified so that only that percentage that might restrain rotational movement in the test specimen is used.

4. Procedure

4.1 Gravity:
Any undue influence from gravity that does not occur during actual installation shall be omitted from the test specimen. If the test specimen is inverted, a gravity correction shall be made in the determination of the allowable superimposed loading. Tests run in an inverted position shall include data from pressure reversal or an upright specimen to show that unlatching of the drip edges at the cleats will not occur in the normal orientation.

4.2 Stabilization
A dial gauge shall be attached to the centerline of each loaded surface to detect movement. Stabilization of the test shall be when the gauge ceases to show movement.

4.3 Loading
Face and top loadings shall be applied simultaneously in the ratio of (Face Height x Horizontal GC_p) to (Top Width x Vertical GC_p) in which the Face Height is the height of the face (front or back leg) being tested. Loading shall be applied uniformly on centers no greater than 12 inches (300 mm) to the top of the coping and to one of the faces of the coping at the same time. Loads shall be applied on parallel horizontal centerlines of the surfaces tested. Loads shall be applied incrementally and held for not less than 60 seconds after stabilization has been achieved at each incremental load.

Between incremental loads, the loading shall be reduced to zero until the specimen stabilizes, or for five minutes, whichever happens first. After a recovery period of not more than five minutes at zero load, initiate the next higher incremental load. Loading to the top of the coping shall be applied in increments not to exceed 25-lb/SqFt (120 kg/m^2) until approximately 150-lb/SqFt (730 kg/m^2) is obtained. Thereafter, increments of load shall not exceed 10-lb/SqFt (5 kg/m^2). Loading speed shall be such that each incremental load up to and including 150 lb/SqFt (730 kg/m^2) shall be achieved in 60 seconds or less. Above 150-lb/SqFt (730 kg/m^2), incremental loading shall be achieved in 120 seconds or less.

Loading shall proceed as indicated until the test specimen either fails or exceeds the required design pressure. The increments of load application shall be chosen so that a sufficient number of observations are made to determine the exact load at failure. The last sustained 60-second load without failure is the maximum load recorded as the design value.

Both face and back legs shall be tested in this manner. Separate test samples shall be used for testing the face and back legs: One sample to test the face while loading the top (See Figure 4), and the other to test the back leg while loading the top (See Figure 5).

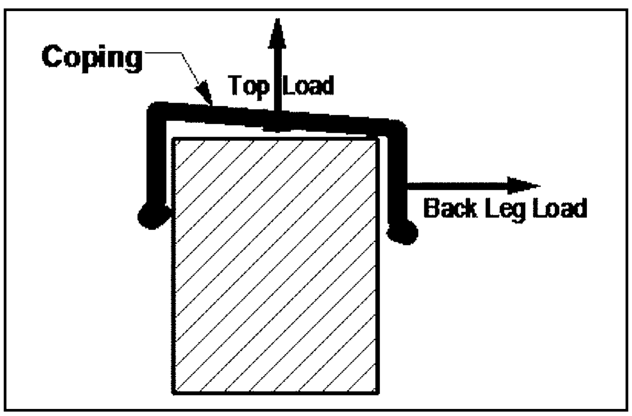

Figure 5: Test RE-3 on Back Leg

4.4 Failure

Failure shall be loss of securement of any component of the coping system or deformation that would result in loss of weather protection of the edge.

4.5 Test Results

The total of upward and outward forces at the conditions described in 4.3 above shall be recorded. Each total force shall be converted to pressure by dividing the force by the area of the surface upon which it acts:

$$\text{Outward Pressure} = \frac{\text{Outward Force}}{\text{Face Height * Face Length}}$$

$$\text{Upward Pressure} = \frac{\text{Upward Force}}{\text{Coping Width * Coping Length}}$$

- Pressure is measured in pounds per square foot,
- Force is measured in Pounds Force,
- Face Length is the test sample length in feet,
- Face Height is in Feet (inches÷12).
- “Face” refers to back leg or front leg of the coping specimen.

If the test results meet or exceed the design upward and outward wind pressures on both front and back leg tests, the coping has acceptable wind blow-off resistance.

COMMENTARY to WIND DESIGN STANDARD for EDGE SYSTEMS USED with LOW SLOPE ROOFING

This Commentary consists of explanatory and supplementary material designed to help designers, roofing contractors and local building authorities in applying the requirements of the preceding Standard.

This Commentary is intended to create an understanding of the requirements through brief explanations of the reasoning employed in arriving at these requirements.

The sections of this Commentary are numbered to correspond to sections of the Standard to which they refer. Since having supplementary material for every section of the Standard is not necessary, not all sections are referenced in this Commentary.

1. INTRODUCTION

This Design Standard was developed for use with Built-Up (BUR), Single-Ply and Modified Bitumen roofing systems. While the Standard is intended as a reference for designers and roofing contractors, the design responsibility rests with the "designer of record."

Roof edge systems serve aesthetic as well as performance functions for a building. Aesthetically, they provide an attractive finish and sometimes even a key feature to the exterior of a building. Of course, no matter how aesthetically pleasing, a roof edge system must act primarily as an effective mechanical termination and transition between the roof and other building components such as parapet walls, vertical walls, corners, soffits, edge flashing boards, etc.

A high performance roof edge system provides many benefits. It acts as a water seal at the edge. When it is also the means by which the membrane is attached to the building at the edge, it must also exhibit sufficient holding power to prevent the membrane from pulling out at the edge under design wind conditions. Furthermore, the edge device assembly itself must not come loose in a design wind. A loose edge assembly not only endangers surrounding property or persons, but it also exposes the roofing to blow-off, starting at the edge.

Perimeter systems considered for this Standard are differentiated into two general types:

COPINGS/CAPS: These are designs that cover the tops of parapet walls, usually with the roofing membrane terminated under them.

EDGE FLASHINGS: These products or designs complete the horizontal deck or membrane plane at its transition to a vertical wall drop, typically at a 90˚ angle. Normally the roofing membrane is restrained at the edge by means of a mechanical gripping of the roofing between metal members or by a bond between the roofing and edging.

Termination devices against vertical walls inboard of the roof edge are not considered by this Guideline.

An edge flashing may also function as an air seal, when combined with an air-retarder throughout the field of the roof, by preventing air infiltration under the roofing membrane. To resist air infiltration, nailers should be sealed to the building with appropriate sealant material[b]. Where multiple courses of nailers are used, these nailer courses should also be sealed to each other. Butt joints should also be sealed.

GUTTERS: Gutters and other rain-carrying devices are beyond the scope of this Standard. However, the designer should be aware that their securement is important to the proper functioning of the building.

Two general classes of materials cover nearly all perimeter systems. They are:

EXTRUSIONS: Shapes or designs made by forcing heated metal or polymeric material through pre-cut custom dies. These designs are usually of a heavier gauge than formed products, but many extrusions must have their finish applied after manufacturing.

FORMED METAL: Sheets of metal, usually steel, aluminum or copper, bent on press brakes or roll-forming equipment to match a desired design or configuration. These Configurations are available in many thicknesses and frequently with a variety of finishes.

MAINTENANCE
The design engineer should consider maintenance of the roof edge. See the ARMA/NRCA/SPRI Repair Manual for Low-Slope Roof Membrane Systems.[6]

SUMMARY
This document addresses factors that should be considered in the specification and design of roof edge systems for low slope (≤ 10 degree slope) roofing systems. Good design practice requires consideration of nailer, roof edge and membrane securement, and selection of materials and finishes to minimize corrosion, and metal gauges to assure strength and flatness.

2.0 GENERAL DESIGN CONSIDERATIONS AND DEFINITIONS

Determination of the appropriate wind load used in the design is based on wind speed, Exposure, building height, topography and the edge detail location on the building. Location of the edge detail on the building is also important, since blow-off forces increase near the corners.

2.2 WIND SPEED

Special wind regions (mountains or valleys): Refer to Section 6.5.5 of the ANSI/ASCE 7-02[1] Commentary.

The intensifying effects of topography (hills or escarpments) are to be accounted for. Speedup over hills and escarpments is accounted for in ASCE 7-02[1] by means of a topographic factor, K_{zt} that depends on the height of the building, the height and slope of the hill or escarpment, the distance of the crest upwind of the building, and whether the terrain is a hill or an escarpment.

2.4.1 Corner Region

The angle at which the walls meet to constitute a corner is undefined here and in ASCE 7-02[1]. It has been suggested that an airflow separation effect begins to take effect when walls meet at 150°. Since most walls meet at angles more acute than this, the meeting angle is not a practical consideration for this Standard[7]. Because it is difficult to test corner systems, the increased wind forces on the component have been accounted for by recommending doubled fastening at the building corner regions rather than testing corner components directly as such.

3.0 EXPOSURE

The terrain surrounding a building will influence the exposure of that building to the wind.

4.0 IMPORTANCE FACTOR

The **Importance Factor, I**, accounts for the degree of hazard to human life and damage to property. The Importance Factor, I, is used to modify the wind speed and, in effect, assign different levels of risk based upon intended use of the structure. Category I Exposure gives a 25-year mean recurrence value while Categories III and IV give 100-year mean recurrence values. Other recurrence values can be found in the Commentary of ASCE 7-02[1].

5.0 SYSTEM REQUIREMENTS

Resistance to blow-off depends not only upon the attachment of the roof edge device to the edge of the building, but also upon the integrity of the nailer or other substrate to which the edge device is attached. It is important to consider the load path from the nailer to the foundation of the building to assure proper wind load protection.

Common fastener safety factors appear in Table 6. Note that when designing for wind, static load safety factors may be reduced by 25%.

5.1 Nailer Secured Systems

Wood Members: Nailers should be preservatively treated wood[11] secured to structural components of the building by corrosion

[b] An appropriate sealant is a single- or multi-component elastomeric material used to weatherproof construction joints.

resistant[12] means sufficient to resist a vertical load of 200 lbf/Ft (300 kg/m) or the design load, whichever is greater. For wood nailers wider than 6 inches (152 mm), bolts should be staggered to avoid splitting the wood. Each wood nailer member should have at least two fasteners. A fastener should be located approximately 4 inches (100 mm) but not less than 3 inches (75 mm) from each end of the wood. Additional wood members, such as cant strips and stacked nailers should be fastened with corrosion resistant fasteners having sufficient pullout resistance. Fasteners should be staggered, spaced at a maximum 12 inches (305 mm) on centers, and should penetrate the wood sufficiently to achieve design pullout resistance. Spacing should be on maximum 6 inch (152 mm) centers in corner regions of the building.

Table 6

Substrate	Safety Factor	
	Static Load	Wind Load
Wood[8]	6.0	4.5
Masonry[9]	4.0	3.0
Steel[10]	2.5	1.9

When Re-roofing, the existing nailer should be exposed and inspected. If it has deteriorated, is should be replaced.

Masonry: When embedded in masonry, anchor bolts as defined above should be bent 90 degrees at the base or have heads designed to prevent rotation and slipping out. When hollow block masonry is used at the roofline, cores and voids in the top row of blocks should be filled with concrete having a minimum density of 140-lbs/cu ft (10,900 g/m^3). When embedded in lightweight aggregate hollow block, bolts should be embedded minimum 12 inches (300 mm) into concrete fill. When heavy aggregate blocks are used, bolts should be embedded minimum 8 inches (200 mm).

Light Weight Concrete And Gypsum Decks: Nailers should not be fastened to light weight concrete or gypsum decks. Instead, anchor all roof perimeter nailers directly to building structural members using fasteners whose size and locations meet provisions in Section 5.1 of the Standard.

Steel Deck: The steel deck should be designed to withstand the design forces specified under Section 5.1 of the Standard. Nailer attachment should be strong enough to resist 200-bf/Ft (300 kg/m) vertical load.

Nailerless Systems: When the roof edge is attached directly to masonry or steel without the use of a nailer, its attachment configuration should be tested to resist wind loading, using tests specified in Section 6 of this Standard.

Reroofing: For nailer security when reroofing, the contractor should check to be sure the nailer or other substrate is in good condition and well secured to the building. Questionable members should be removed and replaced according to the above guidelines. Note that it is much more difficult to be sure that the load path (connection of roof members ultimately to the building foundation) is secure for an existing building than it is for new construction. The roofing contractor should notify the designer if unexpected conditions or deteriorated substrate materials are discovered during the reroofing process.

6.0 DESIGN OPTIONS

Load Resistance of the edge detail is divided into two considerations. The first is the resistance of the edge to outward and upward forces that tend to blow or peel the edge system off the substrate. The second is the ability of the edge to resist the pull of the roofing inwardly.

Edge details may be selected from manufacturers who certify certain minimum performance to meet design requirements, based upon testing. Other designs may be used, provided they are tested and certified by an independent testing laboratory to meet the wind and pullout resistance design standards suggested in this document.

6.1 MEMBRANE ATTACHMENT

The edge flashing may be the only restraint preventing a roof blow-off. In ballasted systems, ballast may be scoured away from the edge. Mechanically attached membranes may be attached only by the edge flashing at the building edge. The 100 lb/Ft (1.46 kN/m) may not be sufficient if there is excessive scour, exposing a wide span of roofing. Ballasted roofs should be designed to meet ANSI/SPRI RP-4 to prevent excessive scour.

Consideration should be given to sealing the edge against air infiltration. Air infiltration may affect the loads on the roofing and the perimeter edge detail[14] by adding a positive pressure under the roofing, thus compounding the effect of negative pressure above the roofing.

Modified Bitumen and BUR membranes should be fully adhered to roof deck or insulation.

6.2 & 6.3 WIND RESISTANCE OF EDGE FLASHINGS & COPINGS

Although all edge devices are to be tested according to the tests outlined in the Standard and its attachments, the following guidelines may be used to establish designs for testing. The guidelines may be modified to achieve desired test results.

Edge flashings, copings and the like should be secured with continuous cleats of minimum 24 ga steel, 0.050 inch (2 mm) aluminum or metal of equivalent tensile strength at the bottom of the face edge. Cleats should be secured with annular threaded or ring-shank nails long enough to penetrate the wood nailer at least 1-1/4 inch (3 cm). Nail heads should be at least 3/16 inch (5 mm) in diameter. Alternatively, cleats may be secured with minimum No. 8 (4 mm) screws long enough to penetrate the nailer 3/4 inch (20 mm) or penetrate metal 3/8 inch (10 mm). Where velocity pressures are less than 45 lbs/Ft^2 (220 kg/m^2), cleat fasteners should be placed no farther than 24” (600 mm) apart. Where velocity pressures are greater than 45 lbs/Ft^2 (220 kg/m^2) they should be spaced 16” (400 mm) or closer. Fastener frequency should be doubled in building corner regions.

Metal coping should be secured by a cleat at the wall exterior. Where velocity pressures exceed 45 psf (220 kg/m^2), the coping should be secured on the inside with No. 10 (5 mm) galvanized screw fasteners through neoprene washers on 30 inch (760 mm) or narrower centers. At higher velocity pressures, the centers should be 20 inch (500 mm) or narrower. Screws should be long enough to penetrate the wood nailer at least 1 inch (25 mm). The effects of thermal expansion should be considered. Screw holes in the coping should be pre-punched or drilled oversize to allow for thermal expansion. Edge flashing sections should be spaced to allow for expansion.

To ensure adequate holding, edge designs should also include a drip edge that securely engages the cleat. Inadequate securement may lead to a release of the edge, resulting in the ultimate failure of the roof edge device.

Fastener spacing is doubled in building corner regions to account for the increased wind forces in these regions.

7.0 DESIGN PROVISIONS

7.1 WIND RESISTANCE

TABLE 4 values have been calculated using Equation 6-15 from ASCE 7-02[1]

$\mathbf{q_z = 0.00256(K_z)(K_{zt})(V^2)(I)}$

in which:

$\mathbf{q_z}$ = Velocity Pressure (the Velocity Pressures shown in Table 4 of this Standard are actually “ $\mathbf{q_z}$ /I” as defined in ASCE 7-02 and therefore are to be multiplied by **I** to obtain $\mathbf{q_z}$**.**

$\mathbf{K_z}$ = Velocity Pressure Exposure Coefficient from Equation C6-3 in the Commentary Section of ASCE 7-02 (Also shown as Table 6-3 in ASCE 7-02),

$\mathbf{K_{zt}}$ = Topographical factor for buildings built on hills or escarpments (from Equation 6-3 of ASCE 7-02),

V = Basic Wind Speed, mph, from Attachment I of this Standard and

I = Importance factor defined in Table 1.

Velocity Pressure **“$\mathbf{q_z}$”** is the pressure imparted by the energy of the wind. In practice, aerodynamics will cause actual wind pressures to differ from theoretical values at certain locations on the building. A building with a flat, level (or slightly sloped) roof will experience greater forces at the corners and eaves than on interior roof surfaces because of eddy effects at the eaves. These effects are accounted for by using the External Pressure Coefficient obtained from Table 3, which is taken from ASCE 7-021 assuming an effective wind area of 10 square feet or less. The precise sources for these data are shown on Table 7:

The vertical component was taken from the values for Surface 2 on those Figures. ASCE 7-02[1] does not address the horizontal component of **GC_p** at the roof edge. Therefore, the horizontal value of **GC_p** was taken from the values for Surface 5, which is the vertical corner region. That surface was selected because it presents nearly the same geometry to the wind, as would the roof edge. ASCE 7-02[1] suggests different External Pressure Coefficients to be used in building corner regions. Instead of using ASCE 7-02[1] values for these corner regions in this Standard, the design method was simplified by requiring doubled fastening in these regions.

Table 7: Sources of External Pressure Coefficient (GC_p)

	Buildings 60 feet high or less	Buildings over 60 feet high
Horizontal **GC_p** (acting outward from the building face)	**-1.1** *Table 6-11A loc(4)*	**-0.9** *Table 6-17 loc(2)*
Vertical **GC_p** (acting upward at the building edge)	**-1.8** *Table 6-11B loc(2)*	**-2.3** *Table 6-17 loc(4)*

7.2 METAL THICKNESS

Increased metal thickness improves the flatness reduces the "oil-can" effect of the roof edge metal. The required minimums do not address other important design factors such as fastening pattern and frequency, continuous or intermittent cleating, stiffening ribs or breaks in the edges. Metal thickness may need to be increased for higher wind areas unless Test RE-2 or RE-3 has been performed. Table 5 was developed from NRCA and Factory Mutual and SMACNA[5] recommendations. The table has been constructed to simplify its use over the Factory Mutual table and to extend the range of fascia widths beyond that given by NRCA.

7.3 GALVANIC COMPATIBILITY AND RESISTANCE

Corrosion and strength should be considered in the choice of materials. This Standard focuses primarily on metal edge systems. When plastic materials are used, corrosion is not usually a factor (although environmental deterioration must be considered), however, strength of the materials must be considered. Corrosive potential can be roughly predicted by knowing the placement of the two metals in the Galvanic Series. The farther apart the metals are in the Galvanic Series, the greater is this potential for corrosion. Metals adjacent to each other in the Series have little potential for corrosion. In the Figure 6[14], the metals high on the list are potentially corroded while those low on this list are protected. Frequently, the corrosion rate of "sacrificed" metals will be low, even if there is a potential for corrosion. Thus there will generally be little corrosion between metals that are close to each other on the list, however, when they are in contact, the lower of a pair will be protected by the higher even if no perceptible corrosion is taking place. For this reason, steel, being lower on the list than zinc will be protected by the zinc, which is "sacrificed" to save the steel. Fortunately, though there is a potential for corrosion between zinc and steel, under most conditions, the rate of corrosion is

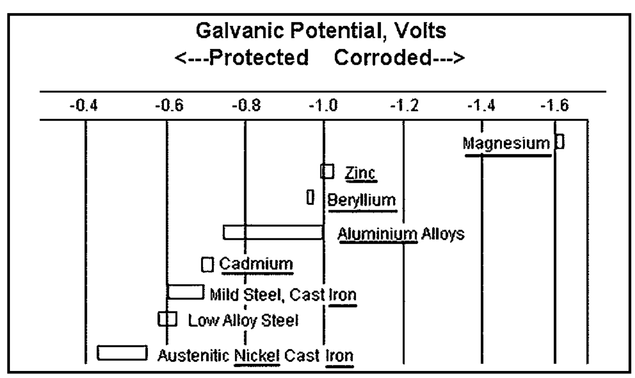

Figure 6

minuscule so that the zinc lasts many years while electrolytically protecting the steel.

Similarly, pairs of metals such as aluminum and zinc or aluminum and stainless steel will show no perceptible corrosion between them, because of their proximity to each other on the list. On the other hand, pairing copper with zinc or aluminum or even steel must be avoided because copper is far from them on the Galvanic Series and the potential for corrosion is great.

In extremely corrosive environments such as salt-water environments, chemical plants or paper mills, corrosion resistant materials such as stainless steel shall be used.

SPRI TEST RE-1

The method with which the edge of the roofing membrane is terminated (edge flashing, nailer, or other) is a key anchor point holding the membrane in place. During high-speed wind loading, the roof system can create extreme loads on the edge device assembly.

For a ballasted roof, the edge device assembly must withstand a minimum force of 100 lbs/Ft (134 kg/m) when tested using the method. This value has been adopted from the ANSI RP-4 Standard.

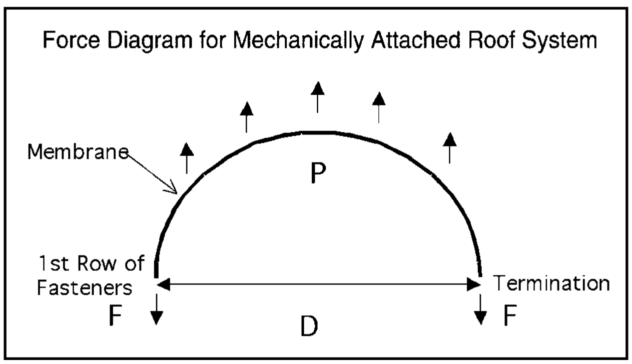

Figure 7

See Figure 7 for a mechanically attached system, the loading depends upon the distance, **D**, of the first row of fasteners to the edge. The total upward force indicated in the diagram is **P**, the design pressure times the distance to the first row of fasteners parallel to the edge. The fasteners and the termination share the total force, so the restraining force, F, at either the fastening row or the termination is one half the force exerted by the membrane:

$$\mathbf{F} = \boldsymbol{P*D} \div 2$$

Note that extra membrane fastening in building corner regions could reduce **D** enough to eliminate the need for extra reinforcement in the edge detail to comply with RE-1.

Fully adhered systems are assumed to apply no stress on the edge system under consideration.

TEST METHODS RE-2 and RE-3

4.2 Stabilization

Stabilization is necessary during loading to ensure that the specimen has reached equilibrium before considering a sustained load for a period of 60 seconds. As the specimen approaches its ultimate capacity, stabilization of the specimen will generally take longer to achieve.

4.3 Loading

These test methods consist of applying loads on surfaces of a test specimen and observing deformations and the nature of any failures of principal or critical elements of the coping or edge flashing system profiles or members of the anchor systems. Loads are applied to simulate the static wind loading of the members. Test RE-2, for edge flashings, requires horizontal loading on only the vertical face since the upward wind loading on an edge flashing member is considered to be negligible because of the small area exposed to uplift.

Since corners are difficult to test with these methods, corner areas are best handled by designing a device to pass RE-2 or RE-3 as appropriate and doubling the number of fasteners in building corner regions.

A recovery period between increases in incremental loading is allowed for the test specimen to attempt to assume its original shape prior to applying the next load level.

The rate of sustained loading can be a critical issue when specimens are subjected to continuously increasing load until failure is achieved. Loading rate has little meaning in RE-2 and RE-3 because these methods employ incrementally increased loads sustained for relatively long times followed by brief recovery periods. This incremental method is more stringent than continuous loading because of the requirement of holding a load for 60 seconds.

The Standard requires full-length specimens because end conditions of discreet sections of copings and edge flashings can play a profound role in the failure mode of the materials. Furthermore, those products having non-continuous cleating can exhibit different performance under testing than in the field if the cleats do not act upon the products as they would in the field. For example, if a product requiring two cleats in a 144 inch (5669 mm) length were tested as a 36 inch (914 mm) sample with one cleat, the cleat would act over a larger percent of the product than would be experienced in the field, rendering the results difficult to translate to the field.

These are new procedures. The precision and bias of these test measures have not been determined.

4.4 Failure

Some examples of component failure that will not enable the edge flashing to perform as designed would be:

- Full nail pull-out at some point
- Collapse of a cleat, fascia or cover
- Disengagement of a face or coping at the drip-edge

EXAMPLE

Consider a 95-foot (30 m) high suburban conference-type hotel building in Suburban Atlanta. Attachment I is a map showing basic wind speeds for most of the United States.

Basic Wind Speed from the Map is 90 mph.

The “Exposure” for such a building according to the definitions given on Page 3 of the Design Standard is Exposure “C.” Consulting Table 4 for Exposure “C,” at 90 mph, the velocity pressure, q_z, for a 95-foot structure at 90 mph is 26 pounds per square foot (psf).

Velocity Pressure = 26 psf

The Importance Factor (see Table 1) would be that of a Category III building (occupancy by more than 300 people in one room). The importance factor I, is 1.15 for this building.

Importance Factor Multiplier (I) = 1.15

Velocity Pressure is multiplied by the Importance Factor Multiplier to obtain an Adjusted Velocity Pressure:

Adjusted Velocity Pressure = 26 * 1.15 = 30 psf

Using External Pressure Coefficient **(GC_p)** from Table 3 of -2.3 for the vertical direction and -0.9 horizontally, the following design force is calculated:

Vertical Design Pressure: -2.3 * 30 lb/SqFt = -69 lb/SqFt
Horizontal Design Pressure: -0.9 * 30 lb/SqFt = -27 lb/SqFt

In this case, a coping must be tested to withstand 27 psf (lb/SqFt) outward force and 69 psf uplift force.

If the coping had 4 inches legs (.33 SqFt/Ft) and a cap width of 18 inches (1.5 SqFt/Ft), the cap would be required to withstand an upward force of:

1.5 sq. ft/ft * -69 lb/SqFt = -103 lb/ft

and outward forces of:

.33 sq. ft/ft * -27 lb/SqFt = 9 lb/ft

on each face.

The coping is to be tested according to SPRI Test RE-3 run on straight lengths. Doubling fasteners in the corner region will be sufficient instead of testing corner assemblies if the straight length assembly passes RE-3. Note that in testing the edge device, upward forces and outward forces on a face are to be applied simultaneously. Both face leg and back leg tests are to be run.

If the perimeter were an edge flashing instead of a coping, it would need to withstand an outward design force of 26 psf.

If the edge flashing had a 6 inches (0.5 sq. ft/ft) face, the design resistance would need to be

0.5 sq. ft./ft * -26 lb/SqFt. = 13 lb/ft.

The edge flashing is to be tested according to SPRI Test RE-2 run on straight lengths. Doubling fasteners in the corner region will be sufficient instead of testing corner assemblies if the straight length assembly passes RE-2. Furthermore, the edge flashing must be tested according to SPRI Test RE-1 to restrain a 45 degree pull to meet the requirements of Test RE-1.

A roof edge may be designed and tested to meet the above criteria, or one may be selected that has been previously certified to meet the minimum design requirements of this Standard.

REFERENCES

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