



## RAS 150/Mechanical Attachment Fastener Requirement

### Roof Type System: Cold Process; Hot Mop; Torch Down Roofs

**TABLE 1<sup>(3)</sup>**

<b>FOR MINIMUM BASE SHEET<sup>(5)</sup></b>		
<b>1 LAYER, TYPE #30, ASTM D 226 - TYPE II</b>		
Mean Roof Height (Ft.)	Fastening Pattern <sup>(1)</sup>	
	Perimeter Edge <sup>(2)</sup>	Field <sup>(4)</sup>
	0-30	6 in. @ laps, 2 rows @ 6 in. midsheet
40	6 in. @ laps, 2 rows @ 6 in. midsheet	6 in. @ laps, 2 rows @ 9 in. midsheet
<b>FOR MINIMUM BASE SHEET<sup>(6)</sup></b>		
<b>1 LAYER, TYPE #43, ASTM D 2626 - TYPE 1</b>		
Mean Roof Height (Ft.)	Fastening Pattern <sup>(1)</sup>	
	Perimeter Edge <sup>(2)</sup>	Field <sup>(4)</sup>
	0-30	12 in. @ laps, 2 rows @ 15 in. midsheet
40	12 in. @ laps, 2 rows @ 12 in. midsheet	12 in. @ laps, 2 rows @ 18 in. midsheet

**FOOTNOTES:**

- (1) See section 4 for fasteners.
- (2) Perimeter edge is measured from all roof edges and each side of ridge as follows:  
The smaller of 0.10 x minimum building width or 0.40 x mean roof height, but not less than 0.04 x minimum building width or 3 feet.
- (3) This table applies to roof slopes up to three inches (3 in.) per twelve inches (12 in.) (Maximum)
- (4) Rows of fasteners, midsheet, shall be evenly spaced across width of sheet and staggered along length of sheet.
- (5) Patterns shown require a minimum withdrawal capacity of 34 lb per fastener (unfactored.)
- (6) Patterns shown require a minimum withdrawal capacity of 67 lb per fastener (unfactored.)

**TABLE 2**  
**MECHANICALLY FASTENED INSULATION**  
**FOR BUILDINGS 40 FEET OR LESS IN HEIGHT**  
**FASTENERS PER BOARD<sup>1,5,6</sup>**

BOARD SIZE	FIELD	PERIMETER <sup>2</sup>	CORNERS <sup>3</sup>
<b>WOOD FIBERBOARD</b>			
2 x 4 1 inch minimum	2	3	4 <sup>(4)</sup>
2 x 4 1 inch minimum	4	6	8 <sup>(4)</sup>
4 x 8 1 inch minimum	8	12	16 <sup>(4)</sup>
<b>FIBERGLASS</b>			
4 x 4 <sup>3/4</sup> inch minimum	5	8	11
4 x 4 1.5 inch minimum	4	6	8
<b>PERLITE</b>			
2 x 4 1 inch minimum	4	6	8 <sup>(4)</sup>
<b>ISOCYANURATE</b>			
4 x 4 1.3 inch minimum	5	8	11
4 x 4 1.5 inch minimum	4	6	8

**FOOTNOTES**

- (1) Minimum 3-inch plates must be used
- (2) Perimeter: Defined as the first board or a minimum of 4 feet from the roof edge.
- (3) Corners: Defined as 8 feet in from each side.
- (4) If the building has parapet walls 36 inches or higher around the entire roof perimeter, use the number of fasteners for the perimeter.
- (5) Wood and Steel decks use a minimum #12 screw and penetrate through the deck a minimum of 1/2 inch.
- (6) The installation of Polymer Modified Bitumen as a single-ply directly applied over mechanically fastened insulation requires DOUBLE the amount of fasteners in the field, perimeter and corners.

## Uplift Pressure Requirements

**TABLE R301.2(2)**  
**COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN**  
**ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (psf)**

	ZONE	EFFECTIVE WIND AREA (feet <sup>2</sup> )	Basic Wind Speed (mph—3 second gust)					
			120		125		130	
Roof > 0 to 10 degrees	1	10	10.5	-25.9	11.4	-28.1	12.4	-30.4
	1	20	10.0	-25.2	10.7	-27.4	11.6	-29.6
	1	50	10.0	-24.4	10.0	-26.4	10.6	-28.6
	1	100	10.0	-23.7	10.0	-25.7	10.0	-27.8
	2	10	10.5	-43.5	11.4	-47.2	12.4	-51.0
	2	20	10.0	-38.8	10.7	-42.1	11.6	-45.6
	2	50	10.0	-32.7	10.0	-35.5	10.6	-38.4
	2	100	10.0	-28.1	10.0	-30.5	10.0	-33.0
	3	10	10.5	-65.4	11.4	-71.0	12.4	-76.8
	3	20	10.0	-54.2	10.7	-58.8	11.6	-63.6
	3	50	10.0	-39.3	10.0	-42.7	10.6	-46.2
	3	100	10.0	-28.1	10.0	-30.5	10.0	-33.0
Roof > 10 to 30 degrees	1	10	14.9	-23.7	16.2	-25.7	17.5	-27.8
	1	20	13.6	-23.0	14.8	-25.0	16.0	-27.0
	1	50	11.9	-22.2	12.9	-24.1	13.9	-26.0
	1	100	10.5	-21.5	11.4	-23.3	12.4	-25.2
	2	10	14.9	-50.1	16.2	-54.3	17.5	-58.7
	2	20	13.6	-45.4	14.8	-49.3	16.0	-53.3
	2	50	11.9	-39.3	12.9	-42.7	13.9	-46.1
	2	100	10.5	-34.7	11.4	-37.6	12.4	-40.7
	3	10	14.9	-50.1	16.2	-54.3	17.5	-58.7
	3	20	13.6	-45.4	14.8	-49.3	16.0	-53.3
	3	50	11.9	-39.3	12.9	-42.7	13.9	-46.1
	3	100	10.5	-34.7	11.4	-37.6	12.4	-40.7
Roof > 30 to 45 degrees	1	10	23.7	-25.9	25.7	-28.1	27.8	-30.4
	1	20	23.0	-24.6	25.0	-26.7	27.0	-28.9
	1	50	22.2	-22.8	24.1	-24.8	26.0	-25.8
	1	100	21.5	-21.5	23.3	-23.3	25.2	-25.2
	2	10	23.7	-30.3	25.7	-32.9	27.8	-35.6
	2	20	23.0	-29.0	25.0	-31.4	27.0	-34.0
	2	50	22.2	-27.2	24.1	-29.5	26.0	-32.0
	2	100	21.5	-25.9	23.3	-28.1	25.2	-30.4
	3	10	23.7	-30.3	25.7	-32.9	27.8	-35.6
	3	20	23.0	-29.0	25.0	-31.4	27.0	-34.0
	3	50	22.2	-27.2	24.1	-29.5	26.0	-32.0
	3	100	21.5	-25.9	23.3	-28.1	25.2	-30.4
Wall	4	10	25.9	-28.1	28.1	-30.5	30.4	-33.0
	4	20	24.7	-26.9	26.8	-29.2	29.0	-31.6
	4	50	23.2	-25.4	25.2	-27.5	27.2	-29.8
	4	100	22.0	-24.2	23.9	-26.3	25.9	-28.4
	5	10	25.9	-34.7	28.1	-37.6	30.4	-40.7
	5	20	24.7	-32.4	26.8	-35.1	29.0	-38.0
	5	50	23.2	-29.3	25.2	-31.8	27.2	-34.3
	5	100	22.0	-26.9	23.9	-29.2	25.9	-31.6

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>, 1 mile per hour = 0.447 m/s.

**NOTES:** For effective areas between those given above the load may be interpolated, otherwise use the load associated with the lower effective area. Table values shall be adjusted for height and exposure by multiplying by the adjustment coefficient in Table R301.2(3).

See Figure R301.2(7) for location of zones.  
 Plus and minus signs signify pressures acting toward and away from the building surfaces.

**TABLE R301.2(3)**

**HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR TABLE R301.2(2)**

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

**ROOFING APPLICATION STANDARD (RAS) NO. 127**

**PROCEDURE FOR DETERMINING THE MOMENT OF RESISTANCE AND MINIMUM CHARACTERISTIC RESISTANCE LOAD TO INSTALL A TILE SYSTEM ON A BUILDING OF A SPECIFIED ROOF SLOPE AND HEIGHT**

**1. Scope**

This standard covers the procedure for determining the Moment of Resistance ( $M_r$ ) and Minimum Characteristic Resistance Load ( $F'$ ) to install a tile system on buildings of a specified roof slope and height. Compliance with the requirements and procedures herein specified, where the pressures ( $P$ ) have been determined based on Table 1 of this standard, do not require additional signed and sealed engineering design calculation. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect.

**2. How to determine the Moment Resistance ( $M_r$ ) (Moment Based Systems)**

2.1 Determine the minimum design wind pressures for the field, perimeter and corner areas ( $P_1$ ,  $P_2$  and  $P_3$ , respectively) using the values given in Table 1 or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on [ASCE 7](#).

2.2 Locate the aerodynamic multiplier ( $l$ ) in tile Product Approval.

2.3 Determine the restoring moment due to gravity ( $M_g$ ) per Product Approval.

2.4 Determine the attachment resistance ( $M_f$ ) per Product Approval.

2.5 Determine the Moment of Resistance ( $M_r$ ) per following formula:

$$M_r = (P \times l) - M_g$$

2.6 Compare the values for  $M_r$ , with the values for  $M_f$ , noted in the Product Approval. If the  $M_f$  values are greater than or equal to the  $M_r$  values, for each area of the roof [i.e., field

$P(1)$ , perimeter  $P(2)$  and corner  $P(3)$  areas], then the tile attachment method is acceptable.

**3. How to determine the Minimum Characteristic Resistance Load ( $F'$ ) (Uplift Based System)**

3.1 Determine the minimum design pressures for the field, perimeter and corner areas [ $P(1)$ ,  $P(2)$  and  $P(3)$ , respectively] using the values given in Table 1 or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on the criteria set forth in [ASCE 7](#).

3.2 Determine the angle ( $\theta$ ) of roof slope, from Table 1.

3.3 Determine the length ( $l$ ), width ( $w$ ) and average tile weight ( $W$ ) of tile, per Product Approval.

3.4 Determine the required uplift resistance ( $F_r$ ) per following formula:

$$F_r = [(P \times l \times w) - W] \times \cos \theta$$

3.5 Compare the values for  $F_r$  with the values for  $F'$  noted in the Product Approval. If the  $F'$  values are greater than or equal to the  $F_r$  values, for each area of roof [i.e., field  $P(1)$  perimeter ( $P(2)$  and corner  $P(3)$  areas], then the tile attachment method is acceptable.

<b>TABLE 1</b> <b>MINIMUM DESIGN WIND UPLIFT PRESSURES IN PSF FOR FIELD (P(1), PERIMETER (P(2) AND CORNER (P(3) AREAS OF ROOFS</b> <b>FOR EXPOSURE C BUILDINGS WITH A ROOF MEAN HEIGHT AS SPECIFIED<sup>1</sup></b>					
<b>ROOF SLOPE</b>	> 2:12 to ≤ 6:12			> 6:12 to ≤ 12:12	
	P(1)	P(2)	P(3) <sup>2</sup>	P(1)	P(2) & P(3)
Roof mean height					
≤ 20'	-45.1	-78.6	-116.2	-49.1	-57.5
> 20' to ≤ 25'	-47.3	-82.3	-121.8	-51.2	-60.4
> 25' to ≤ 30'	-49.2	-85.7	-126.8	-53.6	-62.9
> 30' to ≤ 35'	-50.9	-88.5	-130.9	-55.3	-65.0
> 35' to ≤ 40'	-52.3	-91.0	-134.6	-56.9	-66.8

<sup>1</sup> Calculated in accordance with [ASCE 7.05](#) (Wind Speed: 146 mph).

<sup>2</sup> For Hip Roofs with slope ≤ 5.5: 12, P(3) shall be treated as P(2). [Mod 2014r/2104r

<b>TABLE 2</b> <b>WHERE TO OBTAIN INFORMATION</b>		
<b>Description</b>	<b>Symbol</b>	<b>Where to find</b>
Design Pressure	P(1) or P(2) or P(3)	Table 1 or by an engineer analysis prepared, signed and sealed by a professional engineer based on <a href="#">ASCE 7</a>
Mean Roof Height	H	Job Site
Roof Slope	q	Job Site
Aerodynamic Multiplier	l	Product Approval
Restoring Moment due to Gravity	M <sub>g</sub>	Product Approval
Attachment Resistance	M <sub>f</sub>	Product Approval
Required Moment Resistance	M <sub>r</sub>	Calculated
Minimum Characteristic Resistance Load	F'	Product Approval
Required Uplift Resistance	F <sub>r</sub>	Calculated
Average Tile Weight	W	Product Approval
Tile Dimensions	l=length w=width	Product Approval

**All calculations must be submitted to the building official at the time of permitting.**