

**Addendum to the 3<sup>rd</sup> Edition  
of the  
Concrete and Clay Roof Tile Installation Manual**

**Florida Roofing, Sheet Metal and  
Air Conditioning Contractors Association Inc.**

**Roof Tile Institute**

**March 1, 2003**

**The 3<sup>rd</sup> Edition was printed on June 6, 2001. Since that date the committee has made revisions to the manual and to the tables.**

**This addendum contains a new appendix section and replaces pages 80 thru 101 in the 3<sup>rd</sup> Edition.**

## **Addendum to the 3<sup>rd</sup> Edition of Concrete and Clay Roof Tile Installation Manual**

1. **On cover of the Concrete and Clay Roof Tile Installation Manual the subtitle ~~Minimum Standards~~ is changed to read Guide Specifications.**
2. **On page 1, 18, 35, and 53 the titles and subtitles of each system and the disclaimers are changed to read:**

**System One, Two, Three & Four:** FRSA & NTRMA RTI Model Tile Specifications Guidelines Mechanically Fastened Tile Specifications Guidelines (subtitle & disclaimer)

3. **The National Tile Roofing Manufacturers Association (NTRMA) has changed its name to the Roof Tile Institute (RTI). This name change is changed in the Title and Disclaimer sections on pages 1, 18, 35, 53.**  
This change is referenced in item 2.
4. **In System #1, Part II Products, 2.00, page 4           Add Disclaimer**  
**In System #2, Part II Products, 2.00, page 21       Add Disclaimer**  
**In System #3, Part II Products, 2.00, page 38       Add Disclaimer**  
**In System #4, Part II Products, 2.00, page 55       Add Disclaimer**

**DISCLAIMER NOTICE:** The FRSA and RTI rely on component industry data to establish minimum physical properties standards for their products. The standards listed in the Products section of this manual reflect that process.

5. **In System #1, #2, #3, & #4, Part I General, 1.02, A 1 on pages 3, 20, 37 and 54 is changed to read:**
  1. Concrete Roof Tile – In compliance with ASTM C 1492
6. **In System #1, 3.21, A, 2 on page 17 is changed to read:**  
**In System #2, 3.19, A, 2 on page 34 is changed to read:**  
**In System #4, 4.13, A, 2 on page 78 is changed to read:**

Apply adhesive per adhesive manufacturer's recommendations or mechanically fasten.

7. **In System #1, 3.21, B, 1, page 17**  
**In System # 2, 3.19, B, 1, page 34**  
**In System # 3, 3.18, B, 1, page 51**  
**In System # 4, 4.13, B, 1, page 78**

**Change to read:**

1. Elevate nose end of tile in course above small cut tile. Apply adhesive per adhesive manufacturers recommendations or mechanically fasten.

**8. Replace entire Appendix with new information**

**9. ABSTRACT – Will be changed to PREFACE and read:**

These guidelines were developed to summarize for the designer, applicator or developer good roofing practices for the installation of the mechanically-set and mortar/adhesive-set tiles, which have been developed over a period of time from actual trade practices and the requirements of various building code agencies. These guidelines may not be applicable in all geographical areas. It is the responsibility of those individuals who are referring to these guidelines to independently research and determine which, if any, of the guidelines set forth herein are best for their particular project. Accordingly, the Florida Roofing, Sheet Metal and Air-Conditioning Contractors Association and the Roof Tile Institute and their members expressly disclaim any express or implied warranties or any liability for any damages or loss that might be incurred as a result of the use of these guidelines.

**10. FORWARD -- Will be changed to read:**

In January 1987, the Roof Tile Committee of the FRSA/NTRMA was commissioned to develop and write consensus guidelines for the installation of concrete and clay roof tiles. Recently, the National Tile Roofing Manufacturers Association (NTRMA) changed its name to Roof Tile Institute (RTI). This consensus document was developed by a joint task force made up of roofing contractors, manufacturers, suppliers, academia, roofing consultants, and engineers, over a period of twelve (12) years.

- 11. In System 1, Product Section, 2.04, B, 1, a, Page 4**  
**In System 2, Product Section, 2.04, B, 1, a, Page 21**  
**In System 3, Product Section, 2.04, B, 1, a, Page 38**  
**In System 4, Product Section, 2.04, B, 1, a, Page 55**

Should read: Minimum  $\pm$  11gauge.

Note: ASTM A 641 Class 1 is a nail specification that can be converted to screw fasteners through performance testing (ASTM B 117). Each fastener manufacturer is responsible for supplying this support data.

- 12. In System 1, Part II Products 2.04, A 2, page 4 – Add text**  
**In System 2, Part II Products 2.04, A 2, page 21 – Add text**  
**In System 3, Part II Products 2.04, A 2, page 38 – Add text**  
**In System 4, Part II Products 2.04, A2, page 55 – Add text**

The text addition should read:

ASTM A 641 Class 1 is a nail specification that can be converted to screw fasteners through performance testing (ASTM B 117). Each fastener manufacturer is responsible for supplying this support data.

**13. In System 1, Execution, 3.16, B, Page 15**

Add Note after B:

Apply pre-manufactured apex or soaker flashing at hip or ridge junction.

**14. In System 1, Execution, 3.18, B, Page 17**

Eliminate existing note:

~~Rake tile application at finishing end may need special consideration to provide proper drainage, i.e. flashing or sealant may be needed.~~

**Insert new note:**

Apply pre-manufactured apex or soaker flashing at rake/ridge junction.

**15. In System 1 (only), Tile Installation, 3.12, C, 2, c is changed to read:**

- e. Raised Fascia/Wood Starter Strip – (when using a  $\frac{3}{4}$  “ raised fascia, a nominal 2” x 2” wood starter strip must be installed behind fascia). ~~The use of eave closure is required in a raised fascia system when using a medium or high profile tile.~~
  - i. Install fascia board approximately 1 ½” above roof deck or a nominal 2” X 2” wood starter strip at roof edge (See drawing 17).  
Choose one of the following:
    - ii. Install 8” tapered cant strip at eave behind fascia and /or starter strip to support metal flashing when using drip edge. Tapered cant strip is optional when using anti-ponding metal or
    - iii. Install a minimum 8” wide anti-ponding metal flashing to ensure positive drainage over fascia/starter strip. Nail tope edge of flange onto roof.
    - iv. Apply underlayment as per Section 3.02.

## ACKNOWLEDGMENTS

The FRSA/RTI acknowledges the devoted efforts of the joint Task Force of the FRSA/RTI. This group is comprised of roofing contractors, manufacturers, suppliers, academia, roofing consultants, and engineers. This Manual was prepared through the consensus standard process.

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## Anchor Sheet Fastening Table Instructions

The mean roof height limitations for attaching an anchor sheet to a wood surface substrate are based on many variables. The nail spacing, type of nail, thickness of the sheathing, type of anchor sheet, and the pitch of the roof are the variables we took into account to determine the mean roof height limitations in Tables 1 through 5.

### **Tables 1, 2 & 3**

Table 1 is to be used when using a single-ply underlayment system and applying tiles direct to the deck without battens. Table 2 is to be used when using a single-ply underlayment system and applying tiles with battens. Table 3 is to be used when using a two-ply hot or cold process underlayment system. These tables show the fastening pattern in the field, at the laps and if applicable, any back nailing requirements for both smooth or deformed shank nails.

### **Tables 4, 4A, 4B, 4C, 5, 5A, 5B, & 5C**

Tables 4 and 4A are the required underlayment design pressures based on Exposure B, with buildings having an importance factor of 1.00. Tables 4B and 4C are the required underlayment design pressures based on Exposure C, with buildings having an importance factor of 1.00. Tables 5 and 5A are the required underlayment design pressures based on Exposure B, with buildings having an importance factor of 1.15. Tables 5B and 5C are the required underlayment design pressures based on Exposure C, with buildings having an importance factor of 1.15. (See the Classification of Buildings and Other Structures for Flood, Wind, Snow and Earthquake Load on page 82 and Exposure Categories on page 83.)

### **Instructions**

- 1) Determine the required underlayment design pressure from Tables 4 through 5C based on the following parameters:
  - a) Importance Factor: Determine from the Classification of buildings and other structures and exposure categories listed on page 82 and 83.
  - b) Pitch of Roof: Acquire from job site.
  - c) Mean Roof Height: Acquire from job site.
  - d) Basic Wind Speed: Determine from Basic Wind Speed Map on page 84 and be sure to check with the local building official, especially for areas where the boundary lines intersect a county.

### **Example**

- a) Exposure Category: B
- b) Importance Factor: 1.00
- c) Pitch of Roof: 5:12
- d) Mean Roof Height: 40 feet
- e) Basic Wind Speed: 140 mph

**The Required Underlayment design pressure for the example above = 68.1 psf**

- 2) The fastening pattern needs to meet or exceed the underlayment design pressures as determined in section 1 above. The allowable uplift resistance values are determined by the following parameters:
  - a) Determine appropriate reference table from Tables 1 through 3 by the underlayment system to be used at the job site..
    - i) Table 1 is for Single-Ply Underlayment System Without the Use of Battens (Direct Deck).
    - ii) Table 2 is for Single-Ply Underlayment System With Battens.
    - iii) Table 3 is for Two-Ply Hot Mopped or Cold Applied Cap Sheet.
  - b) Determine the thickness of the sheathing from the job site.
  - c) Determine the type of nail to be used on the job site.
  - d) Find the allowable uplift pressure from the appropriate table that meets or exceeds the required design pressure as determined from section 1 above.
  - e) Underlayment must be attached to the substrate according to the required fastening pattern that corresponds with section 2d above.

**Example:**

30 / 90 hot mop system - Use Table 3

19/32" plywood (5/8") - Use 19/32" columns

Ring Shank nails - use "Deformed" column under the 19/32" column

Using the example in section 1 above, use a fastening pattern that meets or exceeds 68.1 Psf. The minimum options are as follows:

- 1) Two rows 8" on center in the field 6" at the laps and back nail the cap sheet 12" on center.  
**This fastening pattern achieves a 71.5 psf.**
- 2) Three rows 12" on center in the field 6" at the laps and back nail the cap sheet 12" on center.  
**This fastening pattern also happens to achieve a 71.5 psf.**

Either one of these fastening patterns is an acceptable anchor sheet fastening pattern.

**Classification of Buildings and Other Structures for Flood, Wind, Snow and Earthquake Loads**

<b><u>Nature of Occupancy</u></b>	<b>Category</b>
Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: <ul style="list-style-type: none"> <li>x Agricultural facilities</li> <li>x Certain temporary facilities</li> <li>x Minor storage facilities</li> </ul>	<b>I</b>
All buildings and other structures except those listed in Categories I, III and IV	<b>II</b>
Buildings and other structures that represent a substantial hazard to human life in the event of failure including but not limited to: <ul style="list-style-type: none"> <li>x Buildings and other structures where more that 300 people congregate in one area.</li> <li>x Buildings and other structures with day-care facilities with capacity greater than 150.</li> <li>x Buildings and other structures with elementary or secondary school facilities with capacity greater than 150.</li> <li>x Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities.</li> <li>x Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities.</li> <li>x Jails and dentition facilities.</li> <li>x Power generating stations and other public utility facilities not included in Category IV.</li> </ul> Buildings and other structures containing sufficient quantities of toxic, explosive or other hazardous substances to be dangerous to the public if released including, but not limited to: <ul style="list-style-type: none"> <li>x Petrochemical facilities</li> <li>x Fuel storage facilities</li> <li>x Manufacturing or storage facilities for hazardous chemicals</li> <li>x Manufacturing or storage facilities for explosives</li> </ul> Buildings and other structures that are equipped with secondary containment of toxic, explosive or other hazardous substances (including, but not limited to double wall tank, dike of sufficient size to contain a spill or other means to contain a spill, a blast within the property boundary of the facility and prevent release of harmful quantities of contaminants to the air, soil, ground water, or surface water) or atmosphere (where appropriate) shall be eligible for classification as a Category II structure. <p>In hurricane prone regions, buildings and other structures that contain toxic, explosive, or other hazardous substances and do not qualify as Category IV structures shall be eligible for classification as Category II structures for wind loads if these structures are operated in accordance with mandatory procedures that are acceptable to the authority having jurisdiction and which effectively diminish the effects of wind on critical structural elements of which alternatively protect against harmful releases during and after hurricanes.</p>	<b>III</b>
Buildings and other structures designated as essential facilities including, but not limited to: <ul style="list-style-type: none"> <li>x Hospitals and other health care facilities having surgery or emergency treatment facilities.</li> <li>x Fire, rescue and police stations and emergency vehicle garages.</li> <li>x Designated earthquake, hurricane, or other emergency shelters.</li> <li>x Communication centers and other facilities required for emergency response.</li> <li>x Power generating stations and other public utility facilities required in an emergency.</li> <li>x 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.</li> <li>x Aviation control towers, air traffic control centers, and emergency aircraft hangars.</li> <li>x Water storage facilities and pump structures required to maintain water pressure for fire suppression.</li> <li>x Buildings and other structures having critical national defense functions.</li> </ul>	<b>IV</b>

\* Reprinted from ASCE 7-98



## Exposure Categories

### General

For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. For a site located in the transition zone between categories, the category resulting in the largest wind forces shall apply. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features. For any given wind direction, the exposure in which a specific building or other structure is sited shall be assessed as being one of the following categories:

**1. Exposure A.** Large city centers with at least 50% of the buildings having a height in excess of 70 feet. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least 1/2 mile or ten times the height of the building or other structure, whichever is greater. Possible channeling effects or increased velocity pressures due to the building or structure being located in the wake of adjacent buildings shall be taken into account.

**2. Exposure B.** Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure B prevails in the upwind direction for a distance of at least 1,500 feet or 10 times the height of the building or other structure, whichever is greater.

**3. Exposure C.** Open terrain with scattered obstructions having heights generally less than 30 feet. This category includes flat open country, grasslands and shorelines in hurricane prone regions.

**4. Exposure D.** Flat, unobstructed areas exposed to wind flowing over open waters (excluding shorelines in hurricane prone regions) for a distance of at least 1 mile. Shorelines in Exposure D include inland waterways, the Great Lakes, and the coastal areas of California, Oregon, Washington and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming over the water. Exposure D extends inland 1,500 feet or 10 times the height of the building or structure, whichever is greater.

### Importance Factors

Building Category	Non-Hurricane Prone Regions and Hurricane Prone Regions with V = 85-100 mph and Alaska	Hurricane Prone Regions with V >100 mph
I	0.87	0.77
II	1.00	1.00
III	1.15	1.15
IV	1.15	1.15

**Note1:** It is the responsibility of the contractor to contact the building department to determine the exposure category and basic wind speed.

**TABLE 1 - Underlayment Table for System 4 only.**

ALLOWABLE UPLIFT RESISTANCE FOR THE SINGLE-PLY UNDERLAYMENT SYSTEM

Single-Ply Underlayment Fastening Systems - (One Row in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
One row in the field, one row at the lap.  (Direct Deck)	12	6	N/A	23.8	27.1	30.2	34.3
	11	6	N/A	24.6	27.9	31.1	35.4
	10	6	N/A	25.4	28.9	32.2	36.6
	9	6	N/A	26.5	30.1	33.5	38.1
	8	6	N/A	27.8	31.6	35.2	40.0
	7	6	N/A	29.5	33.6	37.4	42.5
	6	6	N/A	31.8	36.1	40.2	45.7
	5	6	N/A	34.9	39.8	44.3	50.3
	4	6	N/A	39.7	45.2	50.3	57.2
	3	6	N/A	47.6	54.2	60.4	68.6

Single-Ply Underlayment Fastening Systems - (Two Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Two rows staggered in the field, one row at the lap.  (Direct Deck)	12	6	N/A	33.8	38.4	42.8	48.6
	11	6	N/A	35.2	40.0	44.6	50.7
	10	6	N/A	36.9	42.0	46.8	53.2
	9	6	N/A	39.0	44.4	49.5	56.2
	8	6	N/A	41.7	47.4	52.8	60.0
	7	6	N/A	45.1	51.3	57.1	64.9
	6	6	N/A	49.6	56.5	62.9	71.5
	5	6	N/A	56.0	63.7	70.8	80.6
	4	6	N/A	65.5	74.5	83.0	94.3
	3	6	N/A	81.4	92.6	103.1	117.2

Single-Ply Underlayment Fastening Systems - (Three Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Three rows staggered in the field, one row at the lap.  (Direct Deck)	12	6	N/A	41.7	47.4	52.8	60.0
	11	6	N/A	43.9	49.9	55.6	63.2
	10	6	N/A	46.5	52.9	58.8	66.9
	9	6	N/A	49.6	56.5	62.9	71.5
	8	6	N/A	53.6	61.0	67.9	77.2
	7	6	N/A	58.7	66.8	74.4	84.5
	6	6	N/A	65.5	74.5	83.0	94.3
	5	6	N/A	75.0	85.4	95.1	108.1
	4	6	N/A	89.3	101.6	113.2	128.6
	3	6	N/A	113.2	128.8	143.3	163.0

Note<sup>1</sup>: Deformed shank is inclusive of either a ring or screw shank nail.

Note<sup>2</sup>: Table conforms to ASCE 7-98.

**TABLE 2 - Underlayment Table for System 4 only.**

ALLOWABLE UPLIFT RESISTANCE FOR THE SINGLE-PLY UNDERLAYMENT SYSTEM WITH BATTENS

Single-Ply With Battens Underlayment Fastening Systems - (One Row in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
One row in field, one row at the lap, and battens <sup>2</sup> 14" o/c.	12	6	N/A	40.3	43.6	51.0	55.1
	11	6	N/A	41.0	44.4	51.9	56.2
	10	6	N/A	41.9	45.4	53.0	57.4
	9	6	N/A	42.9	46.6	54.4	59.0
	8	6	N/A	44.2	48.1	56.0	60.8
	7	6	N/A	46.0	50.0	58.2	63.3
	6	6	N/A	48.2	52.6	61.1	66.6
	5	6	N/A	51.4	56.2	65.1	71.1
	4	6	N/A	56.2	61.6	71.1	78.0
3	6	N/A	64.1	70.7	81.2	89.4	

Single-Ply With Battens Underlayment Fastening Systems - (Two Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Two rows staggered in the field, one row at the lap, and battens <sup>2</sup> 14" o/c.	12	6	N/A	50.2	54.9	63.6	69.4
	11	6	N/A	51.6	56.5	65.4	71.5
	10	6	N/A	53.4	58.5	67.6	74.0
	9	6	N/A	55.5	60.9	70.3	77.0
	8	6	N/A	58.2	63.9	73.6	80.9
	7	6	N/A	61.6	67.8	78.0	85.8
	6	6	N/A	66.1	72.9	83.7	92.3
	5	6	N/A	72.4	80.2	91.7	101.4
	4	6	N/A	82.0	91.0	103.8	115.2
3	6	N/A	97.8	109.7	123.9	138.0	

Single-Ply With Battens Underlayment Fastening Systems - (Three Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Three rows staggered in the field, one row at the lap, and battens <sup>2</sup> 14" o/c.	12	6	N/A	58.2	63.9	73.6	80.9
	11	6	N/A	60.3	66.4	76.4	84.0
	10	6	N/A	62.9	69.3	79.6	87.7
	9	6	N/A	66.1	72.9	83.7	92.3
	8	6	N/A	70.1	77.4	88.7	98.0
	7	6	N/A	75.2	83.2	95.2	105.4
	6	6	N/A	82.0	91.0	103.8	115.2
	5	6	N/A	91.5	101.8	115.9	128.9
	4	6	N/A	105.8	118.1	134.0	149.5
3	6	N/A	129.6	145.2	164.2	183.8	

Note<sup>1</sup>: Deformed shank is inclusive of either a ring or screw shank nail.

Note<sup>2</sup>: Battens density was based on 3 - 8d - .0120 diameter ring shank nail per 4' batten, spaced 14" o/c.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

**TABLE 3 - Underlayment Table for System 3 & 4 only.**

ALLOWABLE UPLIFT RESISTANCE FOR THE TWO-PLY UNDERLAYMENT SYSTEM

Two-Ply Underlayment Fastening Systems - (Two Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Two rows staggered in the field, one row at the lap, and one row at the top edge of the cap sheet.	12	6	12	41.6	47.4	52.7	60.0
	11	6	12	43.1	49.1	54.6	62.1
	10	6	12	44.9	51.0	56.8	64.6
	9	6	12	47.0	53.5	59.5	67.7
	8	6	12	49.6	56.5	62.9	71.5
	7	6	12	53.0	60.3	67.2	76.4
	6	6	12	57.6	65.5	72.9	82.9
	5	6	12	63.9	72.7	81.0	92.0
	4	6	12	73.5	83.6	93.0	105.8
3	6	12	89.3	101.6	113.2	128.6	

Two-Ply Underlayment Fastening Systems - (Three Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Three rows staggered in the field, one row at the lap, and one row at the top edge of the cap sheet.	12	6	12	49.6	56.5	62.9	71.5
	11	6	12	51.8	58.9	65.6	74.6
	10	6	12	54.4	61.9	68.9	78.3
	9	6	12	57.6	65.5	72.9	82.9
	8	6	12	61.5	70.0	78.0	88.6
	7	6	12	66.6	75.8	84.4	96.0
	6	6	12	73.5	83.6	93.0	105.8
	5	6	12	83.0	94.4	105.1	119.5
	4	6	12	97.3	110.7	123.2	140.1
3	6	12	121.1	137.8	153.4	174.4	

Two-Ply Underlayment Fastening Systems - (Four Rows in Field)							
Attachment	Field (inches o/c)	Lap (inches o/c)	Backnail Cap Sheet (inches o/c)	Allowable Uplift Resistance (psf)			
				15/32"		19/32"	
				Smooth	Deformed <sup>1</sup>	Smooth	Deformed <sup>1</sup>
Four rows staggered in the field, one row at the lap, and one row at the top edge of the cap sheet.	12	6	12	58.6	66.6	74.2	84.3
	11	6	12	61.4	69.9	77.8	88.5
	10	6	12	64.9	73.9	82.2	93.5
	9	6	12	69.2	78.7	87.6	99.6
	8	6	12	74.4	84.7	94.3	107.2
	7	6	12	81.3	92.4	102.9	117.0
	6	6	12	90.3	102.8	114.4	130.1
	5	6	12	103.0	117.2	130.5	148.4
	4	6	12	122.1	138.9	154.6	175.8
3	6	12	153.9	175.1	194.9	221.6	

Note<sup>1</sup>: Deformed shank is inclusive of either a ring or screw shank nail.

Note<sup>2</sup>: Table conforms to ASCE 7-98.

**Category II Buildings**  
Exposure B - Importance Factor = 1.00

**Table 4 - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf)										
Gable/Hip Roofs										
( For Pitches 2:12 ≤ 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 30	25.9	32.0	35.3	38.7	46.1	50.0	54.1	62.7	67.3	72.0
40	28.2	34.8	38.3	42.1	50.0	54.3	58.7	68.1	73.1	78.2
50	30.0	37.0	40.8	44.8	53.3	57.9	62.6	72.6	77.9	83.4
60	31.6	39.0	43.0	47.2	56.2	61.0	66.0	76.5	82.1	87.8

**Table 4A - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf)										
Gable/Hip Roofs										
( For Pitches > 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 30	14.8	18.3	20.2	22.1	26.3	28.6	30.9	35.9	38.5	41.2
40	16.1	19.9	21.9	24.0	28.6	31.0	33.6	38.9	41.8	44.7
50	17.1	21.2	23.3	25.6	30.5	33.1	35.8	41.5	44.5	47.6
60	18.1	22.3	24.6	27.0	32.1	34.8	37.7	43.7	46.9	50.2

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

**Category II Buildings**  
Exposure C - Importance Factor = 1.00

**Table 4B - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf)										
Gable/Hip Roofs										
( For Pitches 2:12 ≤ 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 15	31.4	38.8	42.8	46.9	55.9	60.6	65.6	76.0	81.6	87.3
20	33.4	41.2	45.4	49.9	59.3	64.4	69.6	80.8	86.6	92.7
25	35.0	43.2	47.6	52.3	62.2	67.5	73.0	84.7	90.8	97.2
30	36.4	44.9	49.5	54.3	64.6	70.1	75.9	88.0	94.4	101.0
40	38.6	47.7	52.6	57.7	68.7	74.5	80.6	93.5	100.3	107.3
50	40.5	50.0	55.1	60.5	72.0	78.1	84.5	98.0	105.1	112.5
60	42.1	51.9	57.3	62.8	74.8	81.2	87.8	101.8	109.2	116.9

**Table 4C - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf)										
Gable/Hip Roofs										
( For Pitches > 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 15	18.0	22.2	24.4	26.8	31.9	34.6	37.5	43.4	46.6	49.9
20	19.1	23.6	26.0	28.5	33.9	36.8	39.8	46.2	49.5	53.0
25	20.0	24.7	27.2	29.9	35.5	38.6	41.7	48.4	51.9	55.5
30	20.8	25.6	28.3	31.0	36.9	40.1	43.3	50.3	53.9	57.7
40	22.1	27.2	30.0	33.0	39.2	42.6	46.1	53.4	57.3	61.3
50	23.1	28.6	31.5	34.6	41.1	44.6	48.3	56.0	60.0	64.3
60	24.0	29.7	32.7	35.9	42.7	46.4	50.2	58.2	62.4	66.8

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

**Category III Buildings**  
Exposure B - Importance Factor = 1.15

**Table 5 - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf) Gable/Hip Roofs ( For Pitches 2:12 <= 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 30	29.8	36.8	40.6	44.5	53.0	57.5	62.2	72.2	77.4	82.8
40	32.4	40.0	44.1	48.4	57.6	62.5	67.5	78.3	84.0	89.9
50	34.5	42.6	47.0	51.5	61.3	66.6	72.0	83.5	89.6	95.9
60	36.4	44.9	49.5	54.3	64.6	70.1	75.8	88.0	94.4	101.0

**Table 5A - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf) Gable/Hip Roofs ( For Pitches > 7:12 )										
Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 30	17.0	21.0	23.2	25.5	30.3	32.9	35.6	41.2	44.2	47.3
40	18.5	22.8	25.2	27.6	32.9	35.7	38.6	44.8	48.0	51.4
50	19.7	24.3	26.8	29.5	35.1	38.0	41.1	47.7	51.2	54.8
60	20.8	25.6	28.3	31.0	36.9	40.1	43.3	50.3	53.9	57.7

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.



**Category III Buildings**  
Exposure C - Importance Factor = 1.15

**Table 5B - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf) Gable/Hip Roofs ( For Pitches 2:12 ≤ 7:12 ) Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 15	36.1	44.6	49.2	54.0	64.2	69.7	75.4	87.4	93.8	100.4
20	38.4	47.4	52.3	57.3	68.2	74.1	80.1	92.9	99.6	106.6
25	40.2	49.7	54.8	60.1	71.5	77.6	83.9	97.4	104.4	111.8
30	41.8	51.6	56.9	62.5	74.3	80.7	87.2	101.2	108.5	116.1
40	44.4	54.8	60.5	66.4	79.0	85.7	92.7	107.5	115.3	123.4
50	46.6	57.5	63.4	69.5	82.8	89.8	97.1	112.7	120.8	129.3
60	48.4	59.7	65.8	72.3	86.0	93.3	100.9	117.1	125.6	134.4

**Table 5C - Underlayment Table for Systems 3 & 4 only.**

Required Underlayment Design Pressures, p (psf) Gable/Hip Roofs ( For Pitches > 7:12 ) Basic Wind Speed, V; (mph)										
ASCE 7-98 - V3s	90	100	105	110	120	125	130	140	145	150
Height (ft) above ground level, z										
0 - 15	20.6	25.5	28.1	30.8	36.7	39.8	43.1	50.0	53.6	57.4
20	21.9	27.1	29.9	32.8	39.0	42.3	45.8	53.1	56.9	60.9
25	23.0	28.4	31.3	34.3	40.9	44.4	48.0	55.6	59.7	63.9
30	23.9	29.5	32.5	35.7	42.5	46.1	49.8	57.8	62.0	66.4
40	25.4	31.3	34.5	37.9	45.1	49.0	53.0	61.4	65.9	70.5
50	26.6	32.8	36.2	39.7	47.3	51.3	55.5	64.4	69.1	73.9
60	27.6	34.1	37.6	41.3	49.1	53.3	57.7	66.9	71.8	76.8

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

## **Required Aerodynamic Moment Tables Instructions**

The required aerodynamic uplift moment values for determining the fastening pattern to attach clay and concrete tiles are based on many variables. The building category, importance factor, building exposure, basic wind speed, slope of roof, and a generic tile dimension (tile factor) of 1.407 are the variables we took into account to determine the required uplift moment in tables 6 through 7A. It is the responsibility of the roof contractor to contact the building official for status of project to determine if the job is located in coastal or non-coastal region.

### **Tables 6, 6A, 7 & 7A**

Tables 6 and 6A are to be used for non-coastal construction and category II buildings only.  
Tables 7 and 7A are to be used for coastal construction and category II buildings only.

1. Determine the building category from page 82, the exposure category and importance factor from page 84.
2. Determine the mean roof height and slope of the roof.
3. Select the appropriate table based on the information gathered from numbers 1 and 2 above.
4. Follow across the basic wind speed row to the appropriate basic wind speed for the project. Then follow down the column to the appropriate mean roof height to determine the required aerodynamic uplift moment.

### **Tables 8, 9, 10 & 11**

1. Select Tables 8, 10 or 11 based on the thickness of the decking and if tiles will be attached directly to the deck, or use Table 9 if the tiles will be attached over battens.
2. Select a fastening method where the uplift capacity from Tables 8 through 11 is equal to or greater to those values listed in the required uplift value in Tables 6 through 7A.

### **Tables 12 through 15A**

Lists the quick reference charts for roof tiles in a non-coastal exposure.

### **Tables 16 through 19A**

Lists the quick reference charts for roof tiles in a coastal exposure.

### **Table 20**

Attachment resistance limitation for adhesive and mortar based systems.

### **Table 21**

Hip and ridge board attachment instructions.

**Roof Tile only - Non-Coastal**  
**Category II Buildings - Exposure B - Importance Factor = 1.00**

**Table 6**

Required Aerodynamic Uplift Moment, $M_a$ (ft. lbs.)											
Gable/Hip Roofs											
( For Slopes 2:12 $\leq$ 7:12 )											
Basic Wind Speed <sup>2</sup> , $V$ ; (mph)											
ASCE 7-98 - $V_{3s}$	85	90	100	105	110	120	125	130	140	145	150
SBC - $V_{fm}$	70	75	80	85	90	100	105	110	120	125	130
Height (ft) above ground level, $z$											
0-30	9.6	10.8	13.3	14.7	16.1	19.2	20.8	22.5	26.1	28.0	29.9
40	10.4	11.7	14.4	15.9	17.5	20.8	22.6	24.4	28.3	30.4	32.5
50	11.1	12.5	15.4	17.0	18.6	22.2	24.0	26.0	30.2	32.4	34.6
60	11.7	13.1	16.2	17.9	19.6	23.3	25.3	27.4	31.8	34.1	36.5

**Table 6A**

Required Aerodynamic Uplift Moment, $M_a$ (ft. lbs.)											
Gable/Hip Roofs											
( For Slopes $>$ 7:12 )											
Basic Wind Speed <sup>2</sup> , $V$ ; (mph)											
ASCE 7-98 - $V_{3s}$	85	90	100	105	110	120	125	130	140	145	150
SBC - $V_{fm}$	70	75	80	85	90	100	105	110	120	125	130
Height (ft) above ground level, $z$											
0-30	6.8	7.6	9.4	10.4	11.4	13.6	14.7	15.9	18.5	19.8	21.2
40	7.4	8.3	10.2	11.3	12.4	14.8	16.0	17.3	20.1	21.5	23.1
50	7.9	8.8	10.9	12.0	13.2	15.7	17.1	18.5	21.4	23.0	24.6
60	8.3	9.3	11.5	12.7	13.9	16.6	18.0	19.4	22.5	24.2	25.9

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

Roof Tile only - Coastal  
 Category II Buildings - Exposure C - Importance Factor = 1.00

Table 7

Required Aerodynamic Uplift Moment, $M_a$ (ft. lbs.)											
Gable/Hip Roofs ( For Slopes 2:12 <= 7:12 )											
Basic Wind Speed <sup>2</sup> , $V$ ; (mph)											
ASCE 7-98 - $V_{3s}$	85	90	100	105	110	120	125	130	140	145	150
SBC - $V_{fm}$	70	75	80	85	90	100	105	110	120	125	130
Height (ft) above ground level, $z$											
0 - 15	11.6	13.1	16.1	17.8	19.5	23.2	25.2	27.2	31.6	33.9	36.3
20	12.4	13.9	17.1	18.9	20.7	24.7	26.7	28.9	33.6	36.0	38.5
25	13.0	14.5	17.9	19.8	21.7	25.8	28.0	30.3	35.2	37.7	40.4
30	13.5	15.1	18.6	20.6	22.6	26.8	29.1	31.5	36.5	39.2	42.0
40	14.3	16.0	19.8	21.8	24.0	28.5	31.0	33.5	38.8	41.6	44.6
50	15.0	16.8	20.8	22.9	25.1	29.9	32.4	35.1	40.7	43.7	46.7
60	15.6	17.5	21.6	23.8	26.1	31.1	33.7	36.5	42.3	45.4	48.5

Table 7A

Required Aerodynamic Uplift Moment, $M_a$ (ft. lbs.)											
Gable/Hip Roofs ( For Slopes > 7:12 )											
Basic Wind Speed <sup>2</sup> , $V$ ; (mph)											
ASCE 7-98 - $V_{3s}$	85	90	100	105	110	120	125	130	140	145	150
SBC - $V_{fm}$	70	75	80	85	90	100	105	110	120	125	130
Height (ft) above ground level, $z$											
0 - 15	8.3	9.3	11.4	12.6	13.8	16.5	17.9	19.3	22.4	24.0	25.7
20	8.8	9.8	12.1	13.4	14.7	17.5	19.0	20.5	23.8	25.5	27.3
25	9.2	10.3	12.7	14.0	15.4	18.3	19.9	21.5	25.0	26.8	28.7
30	9.6	10.7	13.2	14.6	16.0	19.1	20.7	22.4	25.9	27.8	29.8
40	10.2	11.4	14.1	15.5	17.0	20.2	22.0	23.8	27.6	29.6	31.6
50	10.6	11.9	14.7	16.2	17.8	21.2	23.0	24.9	28.9	31.0	33.2
60	11.1	12.4	15.3	16.9	18.5	22.0	23.9	25.9	30.0	32.2	34.4

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

### Roof Tile Attachment Resistance Values

Table 8 Attachment Resistance

Profile	15/32" Decking, Direct to Deck	Uplift Capacity (ft.lbs.)
Flat/Low	1 - 10d Smooth or Screw Shank, 1 Clip	25.2
Medium	1 - 10d Smooth or Screw Shank, 1 Clip	25.2
High	1 - 10d Smooth or Screw Shank, 1 Clip	35.5
Flat/Low	2 - 10d Smooth or Screw Shank, 1 Clip	38.1
Medium	2 - 10d Smooth or Screw Shank, 1 Clip	38.1
High	2 - 10d Smooth or Screw Shank, 1 Clip	44.3
Flat/Low	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	39.1
Medium	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	36.1
High	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	28.6
Flat/Low	1 - #8 Screw	39.1
Medium	1 - #8 Screw	33.2
High	1 - #8 Screw	28.7
Flat/Low	2 - #8 Screw	50.2
Medium	2 - #8 Screw	55.5
High	2 - #8 Screw	51.3

Table 9 Attachment Resistance

Profile	15/32" Decking, With Battens	Uplift Capacity (ft.lbs.)
Flat/Low	1 - 10d Smooth or Screw Shank, 1 Clip	27.5
Medium	1 - 10d Smooth or Screw Shank, 1 Clip	27.5
High	1 - 10d Smooth or Screw Shank, 1 Clip	29.4
Flat/Low	2 - 10d Smooth or Screw Shank, 1 Clip	37.6
Medium	2 - 10d Smooth or Screw Shank, 1 Clip	37.6
High	2 - 10d Smooth or Screw Shank, 1 Clip	47.2
Flat/Low	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	24.6
Medium	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	36.4
High	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	26.8
Flat/Low	1 - #8 Screw	25.6
Medium	1 - #8 Screw	30.1
High	1 - #8 Screw	25.5
Flat/Low	2 - #8 Screw	36.1
Medium	2 - #8 Screw	41.9
High	2 - #8 Screw	37.1

Table 10 Attachment Resistance

Profile	19/32" Decking, Direct to Deck	Uplift Capacity (ft.lbs.)
Flat/Low	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	46.4
Medium	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	45.5
High	2 - 10d Ringshank Nails, 1 (18-22 rings per inch)	41.2

Table 11 Attachment Resistance

Profile	15/32" Decking, Direct to Deck	Uplift Capacity (ft.lbs.)
Flat/Low	2 - 10d Ringshank Nails, With 2.5" Nail Hole	50.3
Medium	2 - 10d Ringshank Nails, With 2.5" Nail Hole	43.0
High	2 - 10d Ringshank Nails, With 2.5" Nail Hole	33.1

Note<sup>1</sup>: Conforms to ASCE 7-98

Roof Tile - Quick Reference Chart - Non-Coastal - Importance Factor 1.00

Attachment Resistance Limitations - Direct to Deck

Table 12

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		2:12 $\alpha$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	40 feet	N/A	N/A
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	40 feet	N/A	N/A
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	N/A
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	N/A
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 12A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		> 7:12 $\alpha$ 2:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

Roof Tile - Quick Reference Chart - Non-Coastal - Importance Factor 1.00

Attachment Resistance Limitations - With Battens

Table 13

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		2:12 $d$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	N/A
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	N/A
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	N/A
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	40 feet	N/A	N/A
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	50 feet	30 feet	N/A
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	40 feet	N/A	N/A
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	30 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	40 feet	N/A	N/A
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 13A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		> 7:12 $d$ 2:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

## Roof Tile - Quick Reference Chart - Non-Coastal - Importance Factor 1.00

### Attachment Resistance Limitations - Direct to Deck

Table 14

Profile	Minimum - 19/32" Decking	Mean Roof Height Limitations						
		2:12 $\mathbf{d}$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 14A

Profile	Minimum - 19/32" Decking	Mean Roof Height Limitations						
		> 7:12 $\mathbf{d}$ 2:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 15

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		2:12 $\mathbf{d}$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet

Table15A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		> 7:12 $\mathbf{d}$ 2:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.



Roof Tile - Quick Reference Chart - Coastal - Importance Factor 1.00

Attachment Resistance Limitations - Direct to Deck

Table 16

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		2:12 $\alpha$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	50 feet	20 feet	N/A	N/A	N/A
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	50 feet	20 feet	N/A	N/A	N/A
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	20 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	40 feet	15 feet	N/A	N/A
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	20 feet
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet	N/A
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	40 feet	15 feet	N/A	N/A
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 16A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations						
		> 7:12 $\alpha$ 12:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	20 feet
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet	25 feet
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

Roof Tile - Quick Reference Chart - Coastal - Importance Factor 1.00

Attachment Resistance Limitations - With Battens

Table 17

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations (in ft.)						
		2:12 $\nabla$ 7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	30 feet	15 feet	N/A	N/A
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	30 feet	15 feet	N/A	N/A
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	40 feet	20 feet	N/A	N/A
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	40 feet	15 feet	N/A	N/A	N/A
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	15 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	30 feet	N/A	N/A	N/A
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	50 feet	20 feet	N/A	N/A	N/A
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	50 feet	20 feet	N/A	N/A
High	1 - No. 8 Screw	60 feet	60 feet	50 feet	20 feet	N/A	N/A	N/A
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet

Table 17A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations (in ft.)						
		> 7:12 $\nabla$ 2:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
Medium	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
High	1 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet
Flat/Low	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Smooth or Screw Shank, 1 clip	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	40 feet	20 feet	N/A
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet
Flat/Low	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
Medium	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet
High	1 - No. 8 Screw	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet	N/A
Flat/Low	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - No. 8 Screws	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

Roof Tile - Quick Reference Chart - Coastal - Importance Factor 1.00

Attachment Resistance Limitations - Direct to Deck

Table 18

Profile	Minimum - 19/32" Decking	Mean Roof Height Limitations (in ft.)						
		2:12 d7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	50 feet	25 feet

Table 18A

Profile	Minimum - 19/32" Decking	Mean Roof Height Limitations (in ft.)						
		> 7:12 d12:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, (18-22 rings per inch)	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Table 19

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations (in ft.)						
		2:12 d7:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	30 feet
High	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	30 feet	15 feet	N/A

Table 19A

Profile	Minimum - 15/32" Decking	Mean Roof Height Limitations (in ft.)						
		> 7:12 d12:12 Slope						
		90	100	110	120	130	140	150
Flat/Low	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
Medium	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet
High	2 - 10d Ring Shank, with 2.5" Nail Hole	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet	40 feet

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

# 7 D E O H                      5 R R I 7 L O H 2 Q O \

## Attachment Resistance Limitations For Adhesive & Mortar Based Systems

Profile	15/32" or 19/32" Decking, Direct to Deck	Uplift Capacity
Flat/Low	Adhesive Based Systems	See Note 1
Medium	Adhesive Based Systems	See Note 1
High	Adhesive Based Systems	See Note 1
Flat/Low	Mortar Based Systems	See Note 2
Medium	Mortar Based Systems	See Note 2
High	Mortar Based Systems	See Note 2

Note<sup>1</sup>: Please contact adhesive manufacturer for approved uplift capacities.  
This system produces product specific results based on composition and placement of adhesive.

Note<sup>2</sup>: Please contact mortar manufacturer for approved uplift capacities.  
This system produces product specific results based on composition and placement of mortar.

## Hip and Ridge Board Attachment Instructions

### How to use Table 16:

1. Determine the Exposure Category (see page 83)
2. Determine the thickness of the roof sheathing.
3. Determine the basic wind speed.
4. Follow the rows to the right, based on the information gathered from Numbers 1, 2 & 3 above. Under the basic wind speed column, lists the center to center spacing based on either a 3/4" or a 1 - 1/2" wide gauge strap.

Roof Tile - Table 21

Hip and Ridge Board Attachment Recommendations

Category II Buildings

Roof Sheathing (inches)	Exposure	Number of Fasteners on each side of Ridge Board	Strap Width	Basic Wind Speeds, V (mph)					
				100	110	120	130	140	150
				Center to Center Spacing (inches)					
15/32"	B	1 - #8	3/4"	32	27	22	19	16	14
		2 - #8	1-1/2"	56	46	39	33	28	25
	C	1 - #8	3/4"	24	20	17	14	12	11
		2 - #8	1-1/2"	42	34	29	25	21	19
19/32"	B	1 - #8	3/4"	35	29	24	21	18	15
		2 - #8	1-1/2"	56	46	39	33	28	25
	C	1 - #8	3/4"	26	22	18	15	13	12
		2 - #8	1-1/2"	42	34	29	25	21	19

Note<sup>1</sup>: For Building Category Definition See Page 82.

Note<sup>2</sup>: For Exposure Categories See Page 84.

Note<sup>3</sup>: Table conforms to ASCE 7-98.

Notes:

1. These measurements were based on actual center-to-center spacing.
2. Minimum thickness of roof sheathing shall be 15/32".
3. Steel straps shall have a minimum tensile strength ( $F_u$ ) for cold-rolled steel of 42 ksi and a minimum Design yield strength ( $f_y$ ) for cold-rolled steel of 25 ksi conforming to one of the following ASTM A 606, ASTM A 607, ASTM A 611, ASTM A 653, ASTM A 715, and ASTM A 792.
4. Minimum thickness of steel straps shall be 26 gauge (0.0179") before application of corrosion Resistance protection.
5. #8 wood screws are to conform to ASME / ANSI B18.6.1.
6. #8 wood screws shall have a minimum end distance, an edge distance, and a minimum distance between screws of 1/2". The distance is to be measured to the center of the screw.
7. Table 21 is for Category II buildings with a mean roof height of 60' or less.
8. The building is not located on isolated hills, ridges, or escarpments, constituting Abrupt changes in general topography, which creates wind speed-up effects.