SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS

1507.1 Scope.

Roof coverings shall be applied in accordance with the applicable provisions of this section and the manufacturer's installation instructions.

1507.1.1 Underlayment.

Underlayment for asphalt shingles, clay and concrete tile, metal roof shingles, mineral-surfaced roll roofing, slate and slate-type shingles, wood shingles, wood shakes, metal roof panels and *photovoltaic shingles* shall conform to the applicable standards listed in this chapter. Underlayment materials required to comply with ASTM D226, D1970, D4869 and D6757 shall bear a label indicating compliance with the standard designation and, if applicable, type classification indicated in Table 1507.1.1(1). Underlayment shall be applied in accordance with Table 1507.1.1(2). Underlayment shall be attached in accordance with Table 1507.1.1(3).

Exceptions:

1. As an alternative, a minimum 4-inch-wide (102 mm) strip of self-adhering polymer modified bitumen membrane complying with ASTM D1970 and installed in accordance with the manufacturer's installation instructions for the deck material shall be applied over all joints in the roof decking. An approved underlayment for the applicable roof covering for design wind speeds less than 120 mph (54 m/s) shall be applied over the 4-inch-wide (102 mm) membrane strips.
2. As an alternative, two layers of underlayment complying with ASTM D226 Type II or ASTM D4869 Type IV shall be permitted to be installed as follows: Apply a 19-inch (483 mm) strip of underlayment parallel with the eave. Starting at the eave, apply 36-inch-wide (914 mm) strips of underlayment felt, overlapping successive sheets 19 inches (483 mm). The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at side and end laps. End laps shall be 4 inches (102 mm) and shall be offset by 6 feet (1829 mm). Underlayment shall be attached using metal or plastic cap nails with a nominal cap diameter of not less than 1 inch (25.4 mm). Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a thickness of not less than 0.010 inch (0.254 mm). Thickness of the outside edge of plastic caps shall be not less than 0.035 inch (0.89 mm). The cap nail shank shall be not less than 0.083 inch (2.1 mm) for ring shank cap nails and 0.091 inch (2.3 mm) for smooth shank cap nails. The cap nail shank shall have a length sufficient to penetrate through the roof sheathing or not less than $^3/_4$ inch (19.1 mm) into the roof sheathing.
3. Structural metal panels that do not require a substrate or underlayment.

TABLE 1507.1.1(1)
UNDERLAYMENT TYPES

ROOF COVERING	SECTION	MAXIMUM BASIC DESIGN WIND SPEED, V < 140 MPH	MAXIMUM BASIC DESIGN WIND SPEED, V ≥ 140 MPH
Asphalt shingles	1507.2	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757
Clay and concrete tiles	1507.3	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral surfaced roll roofing	ASTM D226 Type II ASTM D2626 Type I ASTM D6380 Class M mineral surfaced roll roofing
Metal roof panels	1507.4	Manufacturer's instructions	ASTM D226 Type II ASTM D4869 Type IV
Metal roof shingles	1507.5	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Mineral-surfaced roll roofing	1507.6	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Slate shingles	1507.7	ASTM D226 Type II ASTM D4869 Type III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shingles	1507.8	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shakes	1507.9	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Photovoltaic shingles	1507.16	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757

TABLE 1507.1.1(2)
UNDERLAYMENT APPLICATION

ROOF COVERING	SECTION	MAXIMUM BASIC DESIGN WIND SPEED, *V* < 140 MPH	MAXIMUM BASIC DESIGN WIND SPEED, *V* ≥ 140 MPH

Asphalt shingles	1507.2	For roof slopes from 2 units vertical in 12 units horizontal (2:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches, Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, V < 140 mph except all laps shall be not less than 4 inches
Clay and concrete tile	1507.3	For roof slopes from $2^1/_2$ units vertical in 12 units horizontal ($2^1/_2$:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be not fewer than two layers applied as follows: Starting at the eave, a 19-inch strip of underlayment shall be applied parallel with the eave. Starting at the eave, a 36-inch-wide strip of underlayment felt shall be applied, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, V < 140 mph except all laps shall be not less than 4 inches
Metal roof panels	1507.4	Apply in accordance with the manufacturer's installation instructions	For roof slopes from 2 units vertical in 12 units horizontal (2:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 4 inches. End laps shall be 4 inches and shall be offset by 6 feet.
Metal roof shingles	1507.5		
Mineral-surfaced roll roofing	1507.6		
Slate shingles	1507.7		
Wood shingles	1507.8		
Wood shakes	1507.9		
Photovoltaic shingles	1507.16	For roof slopes from 3 units vertical in 12 units horizontal (3:12), up to 4 units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied as follows: Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches. End laps shall be 4 inches and shall be offset by 6 feet. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of 4 units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied as follows: Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be 4 inches and shall be offset by 6 feet.	Same as Maximum Basic Design Wind Speed, V < 140 mph except all laps shall be not less than 4 inches

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

TABLE 1507.1.1(3)
UNDERLAYMENT ATTACHMENT

ROOF COVERING	SECTION	MAXIMUM BASIC DESIGN WIND SPEED, *V* < 140 MPH	MAXIMUM BASIC DESIGN WIND SPEED, *V* ≥ 140 MPH
Asphalt shingles	1507.2	Fastened sufficiently to hold in place	The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches between side laps with a 6-inch spacing at side and end laps. Underlayment shall be attached using metal or plastic cap nails or cap staples with a nominal cap diameter of not less than 1 inch. Metal caps shall have a thickness of not less than 32-gage (0.0134 inch) sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Staples shall be not less than 21 gage (0.032 inch). The cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than $^{3}/_{4}$ inch into the roof sheathing.
Clay and concrete tile	1507.3		
Photovoltaic shingles	1507.16		
Metal roof panels	1507.4	Manufacturer's installation instructions	The underlayment shall be attached with corrosion-resistant fasteners in a grid pattern of 12 inches between side laps with a 6-inch spacing at side and end laps. Underlayment shall be attached using metal or plastic cap nails or cap staples with a nominal cap diameter of not less than 1 inch. Metal caps shall have a thickness of not less than 32-gage sheet metal. Power-driven metal caps shall have a minimum thickness of 0.010 inch. Minimum thickness of the outside edge of plastic caps shall be 0.035 inch. The cap nail shank shall be not less than 0.083 inch for ring shank cap nails and 0.091 inch for smooth shank cap nails. Staples shall be not less than 21 gage . The cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than $^{3}/_{4}$ inch into the roof sheathing.
Metal roof shingles	1507.5		
Mineral-surfaced roll roofing	1507.6		
Slate shingles	1507.7		
Wood shingles	1507.8		
Wood shakes	1507.9		

For SI: 1 inch = 25.4 mm; 1 mile per hour = 0.447 m/s.

1507.1.2 Ice barriers.

In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier shall be installed for asphalt shingles, *metal roof shingles*, mineral-surfaced roll roofing, slate and slate-type shingles, wood shingles, and wood shakes. The ice barrier shall consist of not less than two layers of *underlayment* cemented together, or a self-adhering polymer modified bitumen sheet shall be used in place of normal *underlayment* and extend from the lowest edges of all roof surfaces to a point not less than 24 inches (610 mm) inside the *exterior wall* line of the building.

Exception: Detached accessory structures that do not contain conditioned floor area.

1507.2 Asphalt shingles.

The installation of asphalt shingles shall comply with the provisions of this section.

1507.2.1 Deck requirements.

Asphalt shingles shall be fastened to solidly sheathed decks.

1507.2.2 Slope.

Asphalt shingles shall only be used on roof slopes of 2 units vertical in 12 units horizontal (17-percent slope) or greater. For roof slopes from 2 units vertical in 12 units horizontal (17-percent slope) up to 4 units vertical in 12 units horizontal (33-percent slope), double *underlayment* application is required in accordance with Section 1507.1.1.

1507.2.3 Underlayment.

Underlayment shall comply with Section 1507.1.1.

1507.2.4 Asphalt shingles.

Asphalt shingles shall comply with ASTM D3462.

1507.2.5 Fasteners.

Fasteners for asphalt shingles shall be galvanized, stainless steel, aluminum or copper roofing nails, minimum 12-gage [0.105 inch (2.67 mm)] shank with a minimum $^{3}/_{8}$-inch-diameter (9.5 mm) head, of a length to penetrate through the roofing materials and not less than $^{3}/_{4}$ inch (19.1 mm) into the roof sheathing. Where the roof sheathing is less than $^{3}/_{4}$ inch (19.1 mm) thick, the nails shall penetrate through the sheathing. Fasteners shall comply with ASTM F1667.

1507.2.6 Attachment.

Asphalt shingles shall have the minimum number of fasteners required by the manufacturer, but not less than four fasteners per strip shingle or two fasteners per individual shingle. Where the roof slope exceeds 21 units vertical in 12 units horizontal (21:12), shingles shall be installed as required by the manufacturer.

1507.2.7 Ice barrier.

Where required, ice barriers shall comply with Section 1507.1.2.

1507.2.8 Flashings.

Flashing for asphalt shingles shall comply with this section. Flashing shall be applied in accordance with this section and the asphalt shingle manufacturer's printed instructions.

1507.2.8.1 Base and cap flashing.

Base and cap flashing shall be installed in accordance with the manufacturer's instructions. Base flashing shall be of either corrosion-resistant metal of minimum nominal 0.019-inch (0.483 mm) thickness or mineral-surfaced roll roofing weighing not less than 77 pounds per 100 square feet (3.76 kg/m^2). Cap flashing shall be corrosion-resistant metal of minimum nominal 0.019-inch (0.483 mm) thickness.

1507.2.8.2 Valleys.

Valley linings shall be installed in accordance with the manufacturer's instructions before applying shingles. Valley linings of the following types shall be permitted:

1. For open valleys (valley lining exposed) lined with metal, the valley lining shall be not less than 24 inches (610 mm) wide and of any of the

corrosion-resistant metals in Table 1507.2.8.2.

2. For open valleys, valley lining of two plies of mineral-surfaced roll roofing complying with ASTM D3909 or ASTM D6380 shall be permitted. The bottom layer shall be 18 inches (457 mm) and the top layer not less than 36 inches (914 mm) wide.

3. For closed valleys (valleys covered with shingles), valley lining of one ply of smooth roll roofing complying with ASTM D6380, and not less than 36 inches (914 mm) wide or types as described in Item 1 or 2 above shall be permitted. Self-adhering polymer modified bitumen *underlayment* bearing a label indicating compliance with ASTM D1970 shall be permitted in lieu of the lining material.

TABLE 1507.2.8.2
VALLEY LINING MATERIAL

MATERIAL	MINIMUM THICKNESS	GAGE	WEIGHT
Aluminum	0.024 in.	—	—
Cold-rolled copper	0.0216 in.	—	ASTM B370, 16 oz. per square ft.
Copper	—	—	16 oz
Galvanized steel	0.0179 in.	26 (zinc-coated G90)	—
High-yield copper	0.0162 in.	—	ASTM B370, 12 oz. per square ft.
Lead	—	—	2.5 pounds
Lead-coated copper	0.0216 in.	—	ASTM B101, 16 oz. per square ft.
Lead-coated high-yield copper	0.0162 in.	—	ASTM B101, 12 oz. per square ft.
Painted terne	—	—	20 pounds
Stainless steel	—	28	—
Zinc alloy	0.027 in.	—	—

For SI: 1 inch = 25.4 mm, 1 pound = 0.454 kg, 1 ounce = 28.35 g, 1 square foot = 0.0929 m^2.

1507.2.8.3 Drip edge.

A drip edge shall be provided at eaves and rake edges of shingle roofs. Adjacent segments of the drip edge shall be lapped not less than 2 inches (51 mm). The vertical leg of drip edges shall be not less than $1^1/_2$ inches (38 mm) in width and shall extend not less than $^1/_4$ inch (6.4 mm) below sheathing. The drip edge shall extend back on the roof not less than 2 inches (51 mm). *Underlayment* shall be installed over drip edges along eaves. Drip edges shall be installed over *underlayment* along rake edges. Drip edges shall be mechanically fastened at intervals not greater than 12 inches (305 mm) on center.

1507.3 Clay and concrete tile.

The installation of clay and concrete tile shall comply with the provisions of this section.

1507.3.1 Deck requirements.

Concrete and clay tile shall be installed only over solid sheathing.

Exception: Spaced lumber sheathing shall be permitted in *Seismic Design Categories* A, B and C.

1507.3.2 Deck slope.

Clay and concrete roof tile shall be installed on roof slopes of $2^1/_2$ units vertical in 12 units horizontal (21-percent slope) or greater. For roof slopes from $2^1/_2$ units vertical in 12 units horizontal (21-percent slope) to 4 units vertical in 12 units horizontal (33-percent slope), double *underlayment* application is required in accordance with Section 1507.1.1.

1507.3.3 Underlayment.

Unless otherwise noted, required *underlayment* shall conform to: ASTM D226, Type II; ASTM D2626 or ASTM D6380, Class M mineral-surfaced roll roofing.

1507.3.4 Clay tile.

Clay roof tile shall comply with ASTM C1167.

1507.3.5 Concrete tile.

Concrete roof tile shall comply with ASTM C1492.

1507.3.6 Fasteners.

Tile fasteners shall be corrosion resistant and not less than 11-gage [0.120 inch (3 mm)], $^5/_{16}$-inch (8.0 mm) head, and of sufficient length to penetrate the deck not less than $^3/_4$ inch (19.1 mm) or through the thickness of the deck, whichever is less. Attaching wire for clay or concrete tile shall not be smaller than 0.083 inch (2.1 mm). Perimeter fastening areas include three tile courses but not less than 36 inches (914 mm) from either side of hips or ridges and edges of eaves and *gable* rakes.

1507.3.7 Attachment.

Clay and concrete roof tiles shall be fastened in accordance with Table 1507.3.7.

TABLE 1507.3.7
CLAY AND CONCRETE TILE ATTACHMENT[a, b, c]

GENERAL—CLAY OR CONCRETE ROOF TILE			
Maximum Allowable Stress Design Wind Speed, V_{asd} [f] (mph)	**Mean roof height (feet)**	**Roof slope < 3:12**	**Roof slope 3:12 and over**
85	0-60	One fastener per tile. Flat tile without vertical laps, two fasteners per tile.	Two fasteners per tile. Only one fastener on slopes of 7:12 and less for tiles with installed weight exceeding 7.5 lbs./sq. ft. having a width not more than 16 inches.
100	0-40		
100	> 40-60	The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. Rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer's mastic.	
110	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.	
120	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.	

130	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
All	> 60	The fastening system shall resist the wind forces in Section 1609.5.3.		
INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS [d, e] (Installations on spaced/solid sheathing with battens or spaced sheathing)				
Maximum Allowable Stress Design Wind Speed, V_{asd} [f] (mph)	**Mean roof height (feet)**	**Roof slope < 5:12**	**Roof slope 5:12 < 12:12**	**Roof slope 12:12 and over**
85	0-60	Fasteners are not required. Tiles with installed weight less than 9 lbs./sq. ft. require not fewer than one fastener per tile.	One fastener per tile every other row. Perimeter tiles require one fastener. Tiles with installed weight less than 9 lbs./sq. ft. require not fewer than one fastener per tile.	One fastener required for every tile. Tiles with installed weight less than 9 lbs./sq. ft. require not fewer than one fastener per tile.
100	0-40			
100	> 40-60	The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. Rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer's mastic.		
110	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
120	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
130	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
All	> 60	The fastening system shall resist the wind forces in Section 1609.5.3.		
INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS (Installations on solid sheathing without battens)				
Maximum Allowable Stress Wind Speed, V_{asd} [f] (mph)	**Mean roof height (feet)**	**All roof slopes**		
85	0-60	One fastener per tile.		
100	0-40	One fastener per tile.		
100	> 40-60	The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. Rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer's mastic.		
110	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
120	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
130	0-60	The fastening system shall resist the wind forces in Section 1609.5.3.		
All	> 60	The fastening system shall resist the wind forces in Section 1609.5.3.		

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 4.882 kg/m^2.

a. Minimum fastener size. Corrosion-resistant nails not less than No. 11 gage with $^5/_{16}$-inch head. Fasteners shall be long enough to penetrate into the sheathing $^3/_4$ inch or through the thickness of the sheathing, whichever is less. Attaching wire for clay and concrete tile shall not be smaller than 0.083 inch.

b. Snow areas. Not fewer than two fasteners per tile are required or battens and one fastener.

c. Roof slopes greater than 24:12. The nose of all tiles shall be securely fastened.

d. Horizontal battens. Battens shall be not less than 1 inch by 2 inches nominal. Provisions shall be made for drainage by a riser of not less than $^1/_8$ inch at each nail or by 4-foot-long battens with not less than a $^1/_2$-inch separation between battens. Horizontal battens are required for slopes over 7:12.

e. Perimeter fastening areas include three tile courses but not less than 36 inches from either side of hips or ridges and edges of eaves and gable rakes.

f. V_{asd} shall be determined in accordance with Section 1609.3.1.

1507.3.8 Application.

Tile shall be applied according to the manufacturer's installation instructions, based on the following:

1. Climatic conditions.
2. Roof slope.
3. *Underlayment* system.
4. Type of tile being installed.

1507.3.9 Flashing.

At the juncture of the roof vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer's installation instructions, and where of metal, shall be not less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend not less than 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) *underlayment* of either one layer of Type I *underlayment* running the full length of the valley, or a self-adhering polymer-modified bitumen sheet bearing a label indicating compliance with ASTM D1970, in addition to other required *underlayment*. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing *underlayment* shall be solid cemented to the roofing *underlayment* for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.4 Metal roof panels.

The installation of *metal roof panels* shall comply with the provisions of this section.

1507.4.1 Deck requirements.

Metal roof panel roof coverings shall be applied to a solid or closely fitted deck, except where the *roof covering* is specifically designed to be applied to spaced supports.

1507.4.2 Deck slope.

Minimum slopes for *metal roof panels* shall comply with the following:

1. The minimum slope for lapped, nonsoldered seam *metal roof panels* without applied lap sealant shall be three units vertical in 12 units horizontal (25-percent slope).
2. The minimum slope for lapped, nonsoldered seam *metal roof panels* with applied lap sealant shall be one-half unit vertical in 12 units horizontal (4-percent slope). Lap sealants shall be applied in accordance with the *approved* manufacturer's installation instructions.
3. The minimum slope for standing-seam *metal roof panel* systems shall be one-quarter unit vertical in 12 units horizontal (2-percent slope).

1507.4.3 Material standards.

Metal-sheet *roof covering* systems that incorporate supporting structural members shall be designed in accordance with Chapter 22. Metal-sheet *roof coverings* installed over structural decking shall comply with Table 1507.4.3(1). The materials used for metal-sheet roof coverings shall be naturally corrosion resistant or provided with *corrosion resistance* in accordance with the standards and minimum thicknesses shown in Table 1507.4.3(2).

TABLE 1507.4.3(1)
METAL ROOF COVERINGS

ROOF COVERING TYPE	STANDARD APPLICATION RATE/THICKNESS
Aluminum	ASTM B209, 0.024 inch minimum thickness for roll-formed panels and 0.019 inch minimum thickness for press-formed shingles.
Aluminum-zinc alloy coated steel	ASTM A792 AZ 50
Cold-rolled copper	ASTM B370 minimum 16 oz./sq. ft. and 12 oz./sq. ft. high yield copper for metal-sheet roof covering systems: 12 oz./sq. ft. for preformed metal shingle systems.
Copper	16 oz./sq. ft. for metal-sheet roof-covering systems; 12 oz./sq. ft. for preformed metal shingle systems.
Galvanized steel	ASTM A653 G-90 zinc-coated.[a]
Hard lead	2 lbs./sq. ft.
Lead-coated copper	ASTM B101
Prepainted steel	ASTM A755
Soft lead	3 lbs./sq. ft.
Stainless steel	ASTM A240, 300 Series Alloys
Steel	ASTM A924
Terne and terne-coated stainless	Terne coating of 40 lbs. per double base box, field painted where applicable in accordance with manufacturer's installation instructions.
Zinc	0.027 inch minimum thickness; 99.995% electrolytic high-grade zinc with alloy additives of copper (0.08% - 0.20%), titanium (0.07% - 0.12%) and aluminum (0.015%).

For SI: 1 ounce per square foot = 0.305 kg/m^2, 1 pound per square foot = 4.882 kg/m^2, 1 inch = 25.4 mm, 1 pound = 0.454 kg.

a. For Group U buildings, the minimum coating thickness for ASTM A653 galvanized steel roofing shall be G60.

TABLE 1507.4.3(2)
MINIMUM CORROSION RESISTANCE

55% Aluminum-zinc alloy coated steel	ASTM A792 AZ 50
5% Aluminum alloy-coated steel	ASTM A875 GF60
Aluminum-coated steel	ASTM A463 T2 65
Galvanized steel	ASTM A653 G90
Prepainted steel	ASTM A755[a]

a. Paint systems in accordance with ASTM A755 shall be applied over steel products with corrosion-resistant coatings complying with ASTM A463, ASTM A653, ASTM A792 or ASTM A875.

1507.4.4 Attachment.

Metal roof panels shall be secured to the supports in accordance with the *approved* manufacturer's fasteners. In the absence of manufacturer recommendations, the following fasteners shall be used:

1. Galvanized fasteners shall be used for steel roofs.
2. Copper, brass, bronze, copper alloy or 300 series stainless-steel fasteners shall be used for copper roofs.

3. Stainless-steel fasteners are acceptable for all types of metal roofs.
4. Aluminum fasteners are acceptable for aluminum roofs attached to aluminum supports.

1507.4.5 Underlayment and high wind.
Underlayment shall comply with Section 1507.1.1.

1507.5 Metal roof shingles.
The installation of *metal roof shingles* shall comply with the provisions of this section.

1507.5.1 Deck requirements.
Metal roof shingles shall be applied to a solid or closely fitted deck, except where the *roof covering* is specifically designed to be applied to spaced sheathing.

1507.5.2 Deck slope.
Metal roof shingles shall not be installed on roof slopes below three units vertical in 12 units horizontal (25-percent slope).

1507.5.3 Underlayment.
Underlayment shall comply with Section 1507.1.1.

1507.5.4 Ice barrier.
Where required, ice barriers shall comply with Section 1507.1.2.

1507.5.5 Material standards.
Metal roof shingle roof coverings shall comply with Table 1507.4.3(1). The materials used for metal-roof shingle *roof coverings* shall be naturally corrosion resistant or provided with *corrosion resistance* in accordance with the standards and minimum thicknesses specified in the standards listed in Table 1507.4.3(2).

1507.5.6 Attachment.
Metal roof shingles shall be secured to the roof in accordance with the *approved* manufacturer's installation instructions.

1507.5.7 Flashing.
Roof valley flashing shall be of corrosion-resistant metal of the same material as the *roof covering* or shall comply with the standards in Table 1507.4.3(1). The valley flashing shall extend not less than 8 inches (203 mm) from the centerline each way and shall have a splash diverter rib not less than $^{3}/_{4}$ inch (19.1 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing shall have a 36-inch-wide (914 mm) *underlayment* directly under it consisting of either one layer of *underlayment* running the full length of the valley or a self-adhering polymer-modified bitumen sheet bearing a label indicating compliance with ASTM D1970, in addition to *underlayment* required for *metal roof shingles*. The metal valley flashing *underlayment* shall be solidly cemented to the roofing *underlayment* for roof slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.6 Mineral-surfaced roll roofing.
The installation of mineral-surfaced roll roofing shall comply with this section.

1507.6.1 Deck requirements.
Mineral-surfaced roll roofing shall be fastened to solidly sheathed roofs.

1507.6.2 Deck slope.
Mineral-surfaced roll roofing shall not be applied on roof slopes below one unit vertical in 12 units horizontal (8-percent slope).

1507.6.3 Underlayment.
Underlayment shall comply with Section 1507.1.1.

1507.6.4 Ice barrier.
Where required, ice barriers shall comply with Section 1507.1.2.

1507.6.5 Material standards.
Mineral-surfaced roll roofing shall conform to ASTM D3909 or ASTM D6380.

1507.7 Slate shingles.
The installation of slate shingles shall comply with the provisions of this section.

1507.7.1 Deck requirements.
Slate shingles shall be fastened to solidly sheathed roofs.

1507.7.2 Deck slope.
Slate shingles shall only be used on slopes of four units vertical in 12 units horizontal (4:12) or greater.

1507.7.3 Underlayment.
Underlayment shall comply with Section 1507.1.1.

1507.7.4 Ice barrier.
Where required, ice barriers shall comply with Section 1507.1.2.

1507.7.5 Material standards.
Slate shingles shall comply with ASTM C406.

1507.7.6 Application.
Minimum headlap for slate shingles shall be in accordance with Table 1507.7.6. Slate shingles shall be secured to the roof with two fasteners per slate.

TABLE 1507.7.6
SLATE SHINGLE HEADLAP

SLOPE	HEADLAP (inches)
4:12 < slope < 8:12	4
8:12 < slope < 20:12	3
slope ≥ 20:12	2

For SI: 1 inch = 25.4 mm.

1507.7.7 Flashing.

Flashing and counterflashing shall be made with sheet metal. Valley flashing shall be not less than 15 inches (381 mm) wide. Valley and flashing metal shall be a minimum uncoated thickness of 0.0179-inch (0.455 mm) zinc-coated G90. Chimneys, stucco or brick walls shall have not fewer than two plies of felt for a cap flashing consisting of a 4-inch-wide (102 mm) strip of felt set in plastic cement and extending 1 inch (25 mm) above the first felt and a top coating of plastic cement. The felt shall extend over the base flashing 2 inches (51 mm).

1507.8 Wood shingles.

The installation of wood shingles shall comply with the provisions of this section and Table 1507.8.

TABLE 1507.8
WOOD SHINGLE AND SHAKE INSTALLATION

ROOF ITEM	WOOD SHINGLES	WOOD SHAKES
1. Roof slope	Wood shingles shall be installed on slopes of not less than 3 units vertical in 12 units horizontal (3:12).	Wood shakes shall be installed on slopes of not less than 4 units vertical in 12 units horizontal (4:12).
2. Deck requirement		
Temperate climate	Shingles shall be applied to roofs with solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1″ × 4″ nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners.	Shakes shall be applied to roofs with solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1″ × 4″ nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners. Where 1″ × 4″ spaced sheathing is installed at 10 inches, boards must be installed between the sheathing boards.
In areas where the average daily temperature in January is 25°F or less or where there is a possibility of ice forming along the eaves causing a backup of water.	Solid sheathing is required.	Solid sheathing is required.
3. Interlayment	No requirements.	Interlayment shall comply with ASTM D226, Type 1.
4. Underlayment		
Temperate climate	Underlayment shall comply with Section 1507.1.1.	Underlayment shall comply with Section 1507.1.1.
5. Application		
Attachment	Fasteners for wood shingles shall be hot-dipped galvanized or Type 304 (Type 316 for coastal areas) stainless steel with a minimum penetration of 0.75 inch into the sheathing. For sheathing less than 0.5 inch thick, the fasteners shall extend through the sheathing.	Fasteners for wood shakes shall be hot-dipped galvanized or Type 304 (Type 316 for coastal areas) with a minimum penetration of 0.75 inch into the sheathing. For sheathing less than 0.5 inch thick, the fasteners shall extend through the sheathing.
No. of fasteners	Two per shingle.	Two per shake.
Exposure	Weather exposures shall not exceed those set forth in Table 1507.8.7.	Weather exposures shall not exceed those set forth in Table 1507.9.8.
Method	Shingles shall be laid with a side lap of not less than 1.5 inches between joints in courses, and no two joints in any three adjacent courses shall be in direct alignment. Spacing between shingles shall be 0.25 to 0.375 inch.	Shakes shall be laid with a side lap of not less than 1.5 inches between joints in adjacent courses. Spacing between shakes shall not be less than 0.375 inch or more than 0.625 inch for shakes and taper sawn shakes of naturally durable wood and shall be 0.25 to 0.375 inch for preservative-treated taper sawn shakes.
Flashing	In accordance with Section 1507.8.8.	In accordance with Section 1507.9.9.

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

1507.8.1 Deck requirements.

Wood shingles shall be installed on solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1-inch by 4-inch (25 mm by 102 mm) nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners.

1507.8.1.1 Solid sheathing required.

Solid sheathing is required in areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water.

1507.8.2 Deck slope.

Wood shingles shall be installed on slopes of not less than three units vertical in 12 units horizontal (25-percent slope).

1507.8.3 Underlayment.

Underlayment shall comply with Section 1507.1.1.

1507.8.4 Ice barrier.

Where required, ice barriers shall comply with Section 1507.1.2.

1507.8.5 Material standards.

Wood shingles shall be of *naturally durable wood* and comply with the requirements of Table 1507.8.5.

TABLE 1507.8.5
WOOD SHINGLE MATERIAL REQUIREMENTS

MATERIAL	APPLICABLE MINIMUM GRADES	GRADING RULES
Wood shingles of naturally durable wood	1, 2 or 3	CSSB

CSSB = Cedar Shake and Shingle Bureau.

1507.8.6 Attachment.

Fasteners for wood shingles shall be corrosion resistant with a minimum penetration of $^{3}/_{4}$ inch (19.1 mm) into the sheathing. For sheathing less than $^{1}/_{2}$ inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shingle shall be attached with not fewer than two fasteners.

1507.8.7 Application.

Wood shingles shall be laid with a side lap not less than $1^{1}/_{2}$ inches (38 mm) between joints in adjacent courses, and not be in direct alignment in alternate courses. Spacing between shingles shall be $^{1}/_{4}$ to $^{3}/_{8}$ inch (6.4 to 9.5 mm). Weather exposure for wood shingles shall not exceed that set in Table 1507.8.7.

TABLE 1507.8.7
WOOD SHINGLE WEATHER EXPOSURE AND ROOF SLOPE

ROOFING MATERIAL	LENGTH (inches)	GRADE	EXPOSURE (inches)	
			3:12 pitch to < 4:12	4:12 pitch or steeper
Shingles of naturally durable wood	16	No. 1 No. 2 No. 3	3.75 3.5 3	5 4 3.5
	18	No. 1 No. 2 No. 3	4.25 4 3.5	5.5 4.5 4
	24	No. 1 No. 2 No. 3	5.75 5.5 5	7.5 6.5 5.5

For SI: 1 inch = 25.4 mm.

1507.8.8 Flashing.

At the juncture of the roof and vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer's installation instructions, and where of metal, shall be not less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend not less than 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) *underlayment* of either one layer of Type I *underlayment* running the full length of the valley or a self-adhering polymer-modified bitumen sheet bearing a label indicating compliance with ASTM D1970, in addition to other required *underlayment*. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing *underlayment* shall be solidly cemented to the roofing *underlayment* for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.8.9 Label required.

Each bundle of shingles shall be identified by a label of an approved grading or inspection bureau or agency.

1507.9 Wood shakes.

The installation of wood shakes shall comply with the provisions of this section and Table 1507.8.

1507.9.1 Deck requirements.

Wood shakes shall only be used on solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1-inch by 4-inch (25 mm by 102 mm) nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners. Where 1-inch by 4-inch (25 mm by 102 mm) spaced sheathing is installed at 10 inches (254 mm) on center, additional 1-inch by 4-inch (25 mm by 102 mm) boards shall be installed between the sheathing boards.

1507.9.1.1 Solid sheathing required.

Solid sheathing is required in areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water.

1507.9.2 Deck slope.

Wood shakes shall only be used on slopes of not less than 4 units vertical in 12 units horizontal (33-percent slope).

1507.9.3 Underlayment.

Underlayment shall comply with Section 1507.1.1.

1507.9.4 Ice barrier.

Where required, ice barriers shall comply with Section 1507.1.2.

1507.9.5 Interlayment.

Interlayment shall comply with ASTM D226, Type I.

1507.9.6 Material standards.

Wood shakes shall comply with the requirements of Table 1507.9.6.

TABLE 1507.9.6
WOOD SHAKE MATERIAL REQUIREMENTS

MATERIAL	MINIMUM GRADES	APPLICABLE GRADING RULES
Wood shakes of naturally durable wood	1	CSSB
Taper sawn shakes of naturally durable wood	1 or 2	CSSB
Preservative-treated shakes and shingles of naturally durable wood	1	CSSB
Fire-retardant-treated shakes and shingles of naturally durable wood	1	CSSB
Preservative-treated taper sawn shakes of Southern pine treated in accordance with AWPA U1 (Commodity Specification A, Special Requirement 4.6)	1 or 2	TFS

CSSB = Cedar Shake and Shingle Bureau.

TFS = Forest Products Laboratory of the Texas Forest Services.

1507.9.7 Attachment.

Fasteners for wood shakes shall be corrosion resistant with a minimum penetration of $^{3}/_{4}$ inch (19.1 mm) into the sheathing. For sheathing less than $^{1}/_{2}$ inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shake shall be attached with not fewer than two fasteners.

1507.9.8 Application.

Wood shakes shall be laid with a side lap not less than $1^{1}/_{2}$ inches (38 mm) between joints in adjacent courses. Spacing between shakes in the same course shall be $^{3}/_{8}$ to $^{5}/_{8}$ inch (9.5 to 15.9 mm) for shakes and taper sawn shakes of *naturally durable wood* and shall be $^{1}/_{4}$ to $^{3}/_{8}$ inch (6.4 to 9.5 mm) for preservative taper sawn shakes. Weather exposure for wood shakes shall not exceed those set in Table 1507.9.8.

TABLE 1507.9.8
WOOD SHAKE WEATHER EXPOSURE AND ROOF SLOPE

ROOFING MATERIAL	LENGTH (inches)	GRADE	EXPOSURE (inches) 4:12 PITCH OR STEEPER
Shakes of naturally durable wood	18 24	No. 1 No. 1	7.5 10[a]
Preservative-treated taper sawn shakes of Southern yellow pine	18 24	No. 1 No. 1	7.5 10
	18 24	No. 2 No. 2	5.5 7.5
Taper sawn shakes of naturally durable wood	18 24	No. 1 No. 1	7.5 10
	18 24	No. 2 No. 2	5.5 7.5

For SI: 1 inch = 25.4 mm.

a. For 24-inch by 0.375-inch handsplit shakes, the maximum exposure is 7.5

1507.9.9 Flashing.

At the juncture of the roof and vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer's installation instructions, and where of metal, shall be not less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend not less than 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) *underlayment* of either one layer of Type I *underlayment* running the full length of the valley or a self-adhering polymer-modified bitumen sheet bearing a label indicating compliance with ASTM D1970, in addition to other required *underlayment*. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing *underlayment* shall be solidly cemented to the roofing *underlayment* for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.9.10 Label required.

Each bundle of shakes shall be identified by a label of an approved grading or inspection bureau or agency.

1507.10 Built-up roofs.

The installation of built-up roofs shall comply with the provisions of this section.

1507.10.1 Slope.

Built-up roofs shall have a design slope of not less than $^{1}/_{4}$ unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs that shall have a design slope of not less than $^{1}/_{8}$ unit vertical in 12 units horizontal (1-percent slope).

1507.10.2 Material standards.

Built-up roof covering materials shall comply with the standards in Table 1507.10.2 or UL 55A.

TABLE 1507.10.2
BUILT-UP ROOFING MATERIAL STANDARDS

MATERIAL STANDARD	STANDARD
Acrylic coatings used in roofing	ASTM D6083
Aggregate surfacing	ASTM D1863
Asphalt adhesive used in roofing	ASTM D3747
Asphalt cements used in roofing	ASTM D2822; D3019; D4586
Asphalt-coated glass fiber base sheet	ASTM D4601
Asphalt coatings used in roofing	ASTM D1227; D2823; D2824; D4479
Asphalt glass felt	ASTM D2178
Asphalt primer used in roofing	ASTM D41
Asphalt-saturated and asphalt-coated organic felt base sheet	ASTM D2626
Asphalt-saturated organic felt (perforated)	ASTM D226
Asphalt used in roofing	ASTM D312
Coal-tar cements used in roofing	ASTM D4022; D5643
Coal-tar saturated organic felt	ASTM D227
Coal-tar pitch used in roofing	ASTM D450; Type I or II
Coal-tar primer used in roofing, dampproofing and waterproofing	ASTM D43
Glass mat, coal tar	ASTM D4990
Glass mat, venting type	ASTM D4897
Mineral-surfaced inorganic cap sheet	ASTM D3909
Thermoplastic fabrics used in roofing	ASTM D5665, D5726

1507.11 Modified bitumen roofing.

The installation of modified bitumen roofing shall comply with the provisions of this section.

1507.11.1 Slope.

Modified bitumen roofing shall have a design slope of not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.11.2 Material standards.

Modified bitumen roofing materials shall comply with ASTM D6162, ASTM D6163, ASTM D6164, ASTM D6222, ASTM D6223, ASTM D6298 or ASTM D6509.

1507.11.2.1 Base sheet.

A base sheet that complies with the requirements of Section 1507.11.2, ASTM D1970 or ASTM D4601 shall be permitted to be used with a modified bitumen cap sheet.

1507.12 Single-ply roofing.

The installation of single-ply roofing shall comply with the provisions of this section.

1507.12.1 Slope.

Single-ply membrane roofs shall have a design slope of not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.12.2 Material standards.

Single-ply roof coverings shall comply with the material standards in Table 1507.12.2.

TABLE 1507.12.2
SINGLE-PLY ROOFING MATERIAL STANDARDS

MATERIAL	MATERIAL STANDARD
Chlorosulfonated polyethylene (CSPE) or polyisobutylene (PIB)	ASTM D5019
Ethylene propylene diene monomer (EPDM)	ASTM D4637
Ketone Ethylene Ester (KEE)	ASTM D6754
Polyvinyl Chloride (PVC) or (PVC/KEE)	ASTM D4434
Thermoplastic polyolefin (TPO)	ASTM D6878

1507.12.3 Ballasted low-slope roofs.

Ballasted low-slope roofs (roof slope < 2:12) shall be installed in accordance with this section and Section 1504.5. Stone used as *ballast* shall comply with ASTM D448 or ASTM D7655.

1507.13 Sprayed polyurethane foam roofing.

The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

1507.13.1 Slope.

Sprayed polyurethane foam roofs shall have a design slope of not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.13.2 Material standards.

Spray-applied polyurethane foam insulation shall comply with ASTM C1029 Type III or IV or ASTM D7425.

1507.13.3 Application.

Foamed-in-place roof insulation shall be installed in accordance with the manufacturer's instructions. A liquid-applied protective coating that complies with Table 1507.13.3 shall be applied not less than 2 hours nor more than 72 hours following the application of the foam.

TABLE 1507.13.3

PROTECTIVE COATING MATERIAL STANDARDS

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Silicone coating	ASTM D6694
Moisture-cured polyurethane coating	ASTM D6947

1507.13.4 Foam plastics.
Foam plastic materials and installation shall comply with Chapter 26.

1507.14 Liquid-applied roofing.
The installation of liquid-applied roofing shall comply with the provisions of this section.

1507.14.1 Slope.
Liquid-applied roofing shall have a design slope of not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope).

1507.14.2 Material standards.
Liquid-applied roofing shall comply with ASTM C836, ASTM C957 or ASTM D3468.

1507.15 Vegetative roofs and landscaped roofs.
Vegetative roofs and landscaped roofs shall comply with the requirements of this chapter, Section 1607.14.2.2 and the *International Fire Code*.

[BF] 1507.15.1 Structural fire resistance.
The structural frame and roof construction supporting the load imposed on the roof by the *vegetative roof* or landscaped roofs shall comply with the requirements of Table 601.

1507.16 Photovoltaic shingles.
The installation of *photovoltaic shingles* shall comply with the provisions of this section.

1507.16.1 Deck requirements.
Photovoltaic shingles shall be applied to a solid or closely fitted deck, except where the shingles are specifically designed to be applied over spaced sheathing.

1507.16.2 Deck slope.
Photovoltaic shingles shall be installed on roof slopes of not less than 2 units vertical in 12 units horizontal (2:12).

1507.16.3 Underlayment.
Underlayment shall comply with Section 1507.1.1.

1507.16.4 Ice barrier.
Where required, ice barriers shall comply with Section 1507.1.2.

1507.16.5 Fasteners.
Fasteners for *photovoltaic shingles* shall be galvanized, stainless steel, aluminum or copper roofing nails, minimum 12-gage [0.105 inch (2.67 mm)] shank with a minimum $^3/_8$-inch-diameter (9.5 mm) head, of a length to penetrate through the roofing materials and not less than $^3/_4$ inch (19.1 mm) into the roof sheathing. Where the roof sheathing is less than $^3/_4$ inch (19.1 mm) thick, the nails shall penetrate through the sheathing. Fasteners shall comply with ASTM F1667.

1507.16.6 Material standards.
Photovoltaic shingles shall be *listed* and labeled in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

1507.16.7 Attachment.
Photovoltaic shingles shall be attached in accordance with the manufacturer's installation instructions.

1507.16.8 Wind resistance.
Photovoltaic shingles shall comply with the classification requirements of Table 1504.2 for the appropriate maximum nominal design wind speed.

1507.17 Building-integrated photovoltaic roof panels.
The installation of building-integrated photovoltaic (*BIPV*) roof panels shall comply with the provisions of this section.

1507.17.1 Deck requirements.
BIPV roof panels shall be applied to a solid or closely fitted deck, except where the *roof covering* is specifically designed to be applied over spaced sheathing.

1507.17.2 Deck slope.
BIPV roof panels shall be used only on roof slopes of 2 units vertical in 12 units horizontal (2:12) or greater.

1507.17.3 Underlayment.
Underlayment shall comply with ASTM D226, ASTM D4869 or ASTM D6757.

1507.17.4 Underlayment application.
Underlayment shall be applied *shingle fashion*, parallel to and starting from the eave, lapped 2 inches (51 mm) and fastened sufficiently to hold in place.

1507.17.4.1 High-wind attachment.
Underlayment applied in areas subject to high winds [V_{asd} greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied in accordance with the manufacturer's instructions. Fasteners shall be applied along the overlap at not more than 36 inches (914 mm) on center. *Underlayment* installed where V_{asd} is not less than 120 mph (54 m/s) shall comply with ASTM D226, Type III, ASTM D4869, Type IV or ASTM D6757. The *underlayment* shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. The *underlayment* shall be applied in accordance with Section 1507.1.1 except all laps shall be not less than 4 inches (102 mm). *Underlayment* shall be attached using cap nails or cap staples. Caps shall be metal or plastic with a nominal head diameter of not less than 1 inch (25.4 mm). Metal caps shall have a thickness of not less than 0.010 inch (0.25 mm). Power-driven metal caps shall have a thickness of not less

than 0.010 inch (0.25 mm). Thickness of the outside edge of plastic caps shall be not less than 0.035 inch (0.89 mm). The cap nail shank shall be not less than 0.083 inch (2.11 mm) for ring shank cap nails and 0.091 inch (2.31 mm) for smooth shank cap nails. Staple gage shall be not less than 21 gage [0.0.2 inch (0.81 mm)]. Cap nail shank and cap staple legs shall have a length sufficient to penetrate through-the-roof sheathing or not less than $^{3}/_{4}$ inch (19.1 mm) into the roof sheathing.

Exception: As an alternative, adhered *underlayment* complying with ASTM D1970 shall be permitted.

1507.17.4.2 Ice barrier.

In areas where there has been a history of ice forming along the eaves causing a back-up of water, an ice barrier consisting of not fewer than two layers of *underlayment* cemented together or of a self-adhering polymer modified bitumen sheet shall be used instead of normal *underlayment* and extend from the lowest edges of all roof surfaces to a point not less than 24 inches (610 mm) inside the *exterior wall* line of the building.

Exception: Detached accessory structures that do not contain conditioned floor area.

1507.17.5 Material standards.

BIPV roof panels shall be listed and labeled in accordance with UL 7103 or with both UL 61730-1 and UL 61730-2.

1507.17.6 Attachment.

BIPV roof panels shall be attached in accordance with the manufacturer's installation instructions.