

# Highland Township adopted State Codes as of 2006

## Michigan Residential Code 2015

### **Section 7-26. Adoption of state construction code. as follows:**

Pursuant to the authority granted by the Charter Township Act, being Act 359 of the Public Acts of 1947 (M.C.L. 42.1-43.4) as amended, and the Stille-Derossett-Hale Single State Construction Code Act, being Act 230 of the Public Acts of 1972 (M.C.L. 125.1501-125.1531), as amended, along with the state construction code composed of the Michigan Residential Code, the Michigan Mechanical Code, the Michigan Plumbing Code, the Michigan Fire Code, the Michigan Rehabilitation Code for Existing Buildings, the Michigan Uniform Energy Code, and the Michigan Building Code, and its appendices, specifically including appendix G, the Township assumes responsibility for the administration and enforcement of the state construction code, as amended, throughout its corporate limits.

### **Section 7-27. Enforcing agency. as follows:**

Pursuant to the authority granted by the Charter Township Act, being Act 359 of the Public Acts of 1947 (M.C.L. 42.1-43.4) as amended, and the Stille-Derossett-Hale Single State Construction Code Act, being Act 230 of the Public Acts of 1972 (M.C.L. 125.1501-125.1531), as amended, along with the state construction code composed of the Michigan Residential Code, the Michigan Mechanical Code, the Michigan Plumbing Code, the Michigan Fire Code, the Michigan Rehabilitation Code for Existing Buildings, the Michigan Uniform Energy Code, and the Michigan Building Code, and its appendices, specifically including appendix G, the Township hereby designates the building official, and such building inspectors, plumbing inspectors, heating and refrigeration inspectors, electrical inspectors, and other officers and employees as shall be designated by the building official as the enforcing agency to discharge the responsibilities of the township thereunder.

## CHAPTER 9

# ROOF ASSEMBLIES

### SECTION R901 GENERAL

**R901.1 Scope.** The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies.

### SECTION R902 FIRE CLASSIFICATION

**R902.1 Roof covering materials.** Roofs shall be covered with materials as set forth in Sections R904 and R905. Class A, B, or C roofing shall be installed in jurisdictions designated by law as requiring their use or where the edge of the roof is less than 3 feet (914 mm) from a lot line. Classes A, B, and C roofing required by this section to be listed shall be tested in accordance with UL 790 or ASTM E108.

#### Exceptions:

1. Class A roof assemblies include those with coverings of brick, masonry, and exposed concrete roof deck.
2. Class A roof assemblies also include ferrous or copper shingles or sheets, metal sheets and shingles, clay or concrete roof tile, or slate installed on non-combustible decks.
3. Class A roof assemblies include minimum 16 ounces per square foot copper sheets installed over combustible decks.
4. Class A roof assemblies include slate installed over underlayment over combustible decks.

R408.30510a

**R902.2 Fire-retardant-treated shingles and shakes.** Fire-retardant-treated wood shakes and shingles shall be treated by impregnation with chemicals by the full-cell vacuum-pressure process, in accordance with AWWA C1. Each bundle shall be marked to identify the manufactured unit and the manufacturer, and shall be *labeled* to identify the classification of the material in accordance with the testing required in Section R902.1, the treating company and the quality control agency.

**R902.3 Building-integrated photovoltaic product.** Building-integrated photovoltaic products installed as the roof covering shall be tested, listed and labeled for fire classification in accordance with Section R902.1.

**R902.4 Rooftop-mounted photovoltaic panels and modules.** Rooftop-mounted photovoltaic panels and modules installed on or above the roof covering shall be tested, listed and identified with a fire classification in accordance with UL 1703. Class A, B or C photovoltaic panels and modules shall be installed in jurisdictions designated by law as requiring their use or where the edge of the roof is less than 3 feet (914 mm) from a lot line.

### SECTION R903 WEATHER PROTECTION

**R903.1 General.** Roof decks shall be covered with *approved* roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof assemblies shall be designed and installed in accordance with this code and the *approved* manufacturer's instructions such that the roof assembly shall serve to protect the building or structure.

**R903.2 Flashing.** Flashings shall be installed in a manner that prevents moisture from entering the wall and roof through joints in copings, through moisture permeable materials and at intersections with parapet walls and other penetrations through the roof plane.

**R903.2.1 Locations.** Flashings shall be installed at wall and roof intersections, wherever there is a change in roof slope or direction and around roof openings. A flashing shall be installed to divert the water away from where the eave of a sloped roof intersects a vertical sidewall. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than 0.019 inch (0.5 mm) (No. 26 galvanized sheet).

**R903.2.2 Crickets and saddles.** A cricket or saddle shall be installed on the ridge side of any chimney or penetration more than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

**Exception:** Unit skylights installed in accordance with Section R308.6 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

**R903.3 Coping.** Parapet walls shall be properly coped with noncombustible, weatherproof materials of a width not less than the thickness of the parapet wall.

**R903.4 Roof drainage.** Unless roofs are sloped to drain over roof edges, roof drains shall be installed at each low point of the roof.

**R903.4.1 Secondary (emergency overflow) drains or scuppers.** Where roof drains are required, secondary emergency overflow roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. Overflow drains having the same size as the roof drains shall be installed with the inlet flow line located 2 inches (51 mm) above the low point of the roof, or overflow scuppers having three times the size of the roof drains and having a minimum opening height of 4 inches (102 mm) shall be installed in the adjacent parapet walls with the inlet flow located 2 inches (51 mm) above the low point of the roof served. The installation and sizing of overflow drains, leaders and conductors shall comply with Sections 1106 and 1108 of the *International Plumbing Code*, as applicable.

Overflow drains shall discharge to an *approved* location and shall not be connected to roof drain lines.

**SECTION R904  
MATERIALS**

**R904.1 Scope.** The requirements set forth in this section shall apply to the application of roof covering materials specified herein. Roof assemblies shall be applied in accordance with this chapter and the manufacturer’s installation instructions. Installation of roof assemblies shall comply with the applicable provisions of Section R905.

**R904.2 Compatibility of materials.** Roof assemblies shall be of materials that are compatible with each other and with the building or structure to which the materials are applied.

**R904.3 Material specifications and physical characteristics.** Roof covering materials shall conform to the applicable standards listed in this chapter.

**R904.4 Product identification.** Roof covering materials shall be delivered in packages bearing the manufacturer’s identifying marks and *approved* testing agency labels required. Bulk shipments of materials shall be accompanied by the same information issued in the form of a certificate or on a bill of lading by the manufacturer.

**SECTION R905  
REQUIREMENTS FOR ROOF COVERINGS**

**R905.1 Roof covering application.** Roof coverings shall be applied in accordance with the applicable provisions of this section and the manufacturer’s installation instructions. Unless otherwise specified in this section, roof coverings shall be installed to resist the component and cladding loads

specified in Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3).

**R905.1.1 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 and metal roof panels 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 to the standard designation and, if applicable, type classification indicated in Table R905.1.1(1). Underlayment shall be applied in accordance with Table R905.1.1(2). Underlayment shall be attached in accordance with Table R905.1.1(3).

**Exceptions:**

1. As an alternative, self-adhering polymer-modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer’s and roof covering manufacturer’s instructions for the deck material, roof ventilation configuration and climate exposure for the roof covering to be installed, shall be permitted.
2. As an alternative, a minimum 4-inch-wide (102 mm) strip of self-adhering polymer-modified bitumen membrane complying with ASTM D1970, installed in accordance with the manufacturer’s instructions for the deck material, shall be applied over all joints in the roof decking. An approved underlayment for the applicable roof covering for maximum ultimate design wind speeds,  $V_{ult}$ , less than 140 miles per hour shall be applied over the entire roof over the 4-inch-wide (102 mm) membrane strips.

**TABLE R905.1.1(1)  
UNDERLAYMENT TYPES**

ROOF COVERING	SECTION	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} < 140$ MPH	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} \geq 140$ MPH
Asphalt shingles	R905.2	ASTM D226 Type I ASTM D4869 Type I, II, III or IV ASTM D6757	ASTM D226 Type II ASTM D4869 Type IV ASTM D6757
Clay and concrete tile	R905.3	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 shingles	R905.4	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	R905.5	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Slate and slate-type shingles	R905.6	ASTM D226 Type I ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shingles	R905.7	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Wood shakes	R905.8	ASTM D226 Type I or II ASTM D4869 Type I, II, III or IV	ASTM D226 Type II ASTM D4869 Type IV
Metal panels	R905.10	Manufacturer’s instructions	ASTM D226 Type II ASTM D4869 Type IV

TABLE R905.1.1(2)  
UNDERLAYMENT APPLICATION

ROOF COVERING	SECTION	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} < 140$ MPH	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} \geq 140$ MPH
Asphalt shingles	R905.2	<p>For roof slopes from two units vertical in 12 units horizontal (2:12), up to four units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied in the following manner: 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. Distortions in the underlayment shall not interfere with the ability of the shingles to seal.</p> <p>For roof slopes of four units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied in the following manner: 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.</p>	Same as Maximum Ultimate Design Wind Speed, $V_{ult} < 140$ mph except all laps shall be not less than 4 inches.
Clay and concrete tile	R905.3	<p>For roof slopes from two and one-half units vertical in 12 units horizontal (2½:12), up to four units vertical in 12 units horizontal (4:12), underlayment shall be a minimum of two layers applied as follows: starting at the eave, apply a 19-inch strip of underlayment parallel with the eave. Starting at the eave, apply 36-inch-wide strips of underlayment felt, overlapping successive sheets 19 inches.</p> <p>For roof slopes of four units vertical in 12 units horizontal (4:12) or greater, underlayment shall be a minimum of one layer of underlayment felt applied shingle fashion, parallel to and starting from the eaves and lapped 2 inches. End laps shall be 4 inches and shall be offset by 6 feet.</p>	Same as Maximum Ultimate Design Wind Speed, $V_{ult} < 140$ mph except all laps shall be not less than 4 inches.
Metal roof shingles	R905.4	Apply in accordance with the manufacturer's installation instructions.	<p>For roof slopes from two units vertical in 12 units horizontal (2:12), up to four units vertical in 12 units horizontal (4:12), underlayment shall be two layers applied in the following manner: 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, and fastened sufficiently to hold in place.</p> <p>For roof slopes of four units vertical in 12 units horizontal (4:12) or greater, underlayment shall be one layer applied in the following manner: 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.</p>
Mineral-surfaced roll roofing	R905.5		
Slate and slate-type shingles	R905.6		
Wood shingles	R905.7		
Wood shakes	R905.8		
Metal panels	R905.10		

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

TABLE R905.1.1(3)  
UNDERLAYMENT ATTACHMENT

ROOF COVERING	SECTION	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} < 140$ MPH	MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult} \geq 140$ MPH
Asphalt shingles	R905.2	Fastened sufficiently to hold in place	<p>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 the side laps.</p> <p>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. Cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than <math>\frac{3}{4}</math> inch into the roof sheathing.</p>
Clay and concrete tile	R905.3		
Metal roof shingles	R905.4	Manufacturer's installation instructions.	<p>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 the side laps.</p> <p>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 at least 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. Cap nail shank and cap staple legs shall have a length sufficient to penetrate through the roof sheathing or not less than <math>\frac{3}{4}</math> inch into the roof sheathing.</p>
Mineral-surfaced roll roofing	R905.5		
Slate and slate-type shingles	R905.6		
Wood shingles	R905.7		
Wood shakes	R905.8		
Metal panels	R905.10		

For SI: 1 inch = 25.4 mm.

**R905.1.2 Ice barriers.** In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(1), 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 fewer 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. On roofs with slope equal to or greater than 8 units vertical in 12 units horizontal, the ice barrier shall also be applied not less than 36 inches (914 mm) measured along the roof slope from the eave edge of the building.

**Exception:** Detached accessory structures not containing conditioned floor area.

**R905.2 Asphalt shingles.** The installation of asphalt shingles shall comply with the provisions of this section.

**R905.2.1 Sheathing requirements.** Asphalt shingles shall be fastened to solidly sheathed decks.

**R905.2.2 Slope.** Asphalt shingles shall be used only on roof slopes of two units vertical in 12 units horizontal (2:12) or greater. For roof slopes from two units vertical in 12 units horizontal (2:12) up to four units vertical in 12 units horizontal (4:12), double underlayment application is required in accordance with Section R905.1.1.

**R905.2.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.2.4 Asphalt shingles.** Asphalt shingles shall comply with ASTM D3462.

**R905.2.4.1 Wind resistance of asphalt shingles.** Asphalt shingles shall be tested in accordance with ASTM D7158. Asphalt shingles shall meet the classification requirements of Table R905.2.4.1 for the appropriate ultimate design wind speed.

Asphalt shingle packaging shall bear a label to indicate compliance with ASTM D7158 and the required classification in Table R905.2.4.1.

**Exception:** Asphalt shingles not included in the scope of ASTM D7158 shall be tested and labeled to indicate compliance with ASTM D3161 and the required classification in Table R905.2.4.1.

**R905.2.5 Fasteners.** Fasteners for asphalt shingles shall be galvanized steel, stainless steel, aluminum or copper roofing nails, minimum 12-gage [0.105 inch (3 mm)] shank with a minimum 3/8-inch-diameter (9.5 mm) head, complying with ASTM F1667, 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 fasteners shall penetrate through the sheathing.

**R905.2.6 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, 175-percent slope), shingles shall be installed as required by the manufacturer.

**R905.2.7 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.2.8 Flashing.** Flashing for asphalt shingles shall comply with this section.

**R905.2.8.1 Base and cap flashing.** Base and cap flashing shall be installed in accordance with manufacturer's instructions. Base flashing shall be of either corrosion-resistant metal of minimum nominal 0.019-inch (0.5 mm) thickness or mineral-surfaced roll roofing weighing not less than 77 pounds per 100 square feet (4 kg/m<sup>2</sup>). Cap flashing shall be corrosion-resistant metal of minimum nominal 0.019-inch (0.5 mm) thickness.

TABLE R905.2.4.1  
CLASSIFICATION OF ASPHALT ROOF SHINGLES

MAXIMUM ULTIMATE DESIGN WIND SPEED, $V_{ult}$ FROM FIGURE R301.2(4)A (mph)	MAXIMUM BASIC WIND SPEED, $V_{ASD}$ FROM TABLE R301.2.1.3 (mph)	ASTM D7158 <sup>a</sup> SHINGLE CLASSIFICATION	ASTM D3161 SHINGLE CLASSIFICATION
110	85	D, G or H	A, D or F
116	90	D, G or H	A, D or F
129	100	G or H	A, D or F
142	110	G or H	F
155	120	G or H	F
168	130	H	F
181	140	H	F
194	150	H	F

For SI: 1 foot = 304.8 mm; 1 mph = 0.447 m/s.

a. The standard calculations contained in ASTM D7158 assume Exposure Category B or C and building height of 60 feet or less. Additional calculations are required for conditions outside of these assumptions.

**R905.2.8.2 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 R905.2.8.2.
2. For open valleys, valley lining of two plies of mineral-surfaced roll roofing, complying with ASTM D3909 or ASTM D6380 Class M, 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 (valley covered with shingles), valley lining of one ply of smooth roll roofing complying with ASTM D6380 and not less than 36 inches wide (914 mm) or valley lining as described in Item 1 or 2 shall be permitted. Self-adhering polymer modified bitumen underlayment complying with ASTM D1970 shall be permitted in lieu of the lining material.

**R905.2.8.3 Sidewall flashing.** Base flashing against a vertical sidewall shall be continuous or step flashing and shall be not less than 4 inches (102 mm) in height and 4 inches (102 mm) in width and shall direct water away from the vertical sidewall onto the roof or into the gutter. Where siding is provided on the vertical sidewall, the vertical leg of the flashing shall be continuous under the siding. Where anchored masonry veneer is provided on the vertical sidewall, the base flashing shall be provided in accordance with this section and counterflashing shall be provided in accordance with Section R703.7.2.2. Where exterior plaster or adhered masonry veneer is provided on the vertical sidewall, the base flashing shall be provided in accordance with this section and Section R703.6.3.

**R905.2.8.4 Other flashing.** Flashing against a vertical front wall, as well as soil stack, vent pipe and chimney

flashing, shall be applied in accordance with the asphalt shingle manufacturer's printed instructions.

**R905.2.8.5 Drip edge.** A drip edge shall be provided at eaves and rake edges of shingle roofs. Adjacent segments of drip edge shall be overlapped not less than 2 inches (51 mm). Drip edges shall extend not less than 1/4 inch (6.4 mm) below the roof sheathing and extend up back onto the roof deck not less than 2 inches (51 mm). Drip edges shall be mechanically fastened to the roof deck at not more than 12 inches (305 mm) o.c. with fasteners as specified in Section R905.2.5. Underlayment shall be installed over the drip edge along eaves and under the underlayment along rake edges.

**R905.3 Clay and concrete tile.** The installation of clay and concrete tile shall comply with the provisions of this section.

**R905.3.1 Deck requirements.** Concrete and clay tile shall be installed only over solid sheathing or spaced structural sheathing boards.

**R905.3.2 Deck slope.** Clay and concrete roof tile shall be installed on roof slopes of two and one-half units vertical in 12 units horizontal (2 1/2:12) or greater. For roof slopes from two and one-half units vertical in 12 units horizontal (2 1/2:12) to four units vertical in 12 units horizontal (4:12), double underlayment application is required in accordance with Section R905.3.3.

**R905.3.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.3.4 Clay tile.** Clay roof tile shall comply with ASTM C1167.

**R905.3.5 Concrete tile.** Concrete roof tile shall comply with ASTM C1492.

**R905.3.6 Fasteners.** Nails shall be corrosion resistant and not less than 11 gage, 5/16-inch (11 mm) head, and of sufficient length to penetrate the deck not less than 3/4 inch (19 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 mm). Perimeter fastening areas include three tile courses but not less than 36 inches (914

TABLE R905.2.8.2  
VALLEY LINING MATERIAL

MATERIAL	MINIMUM THICKNESS (inches)	GAGE	WEIGHT (pounds)
Cold-rolled copper	0.0216 nominal	—	ASTM B370, 16 oz. per square foot
Lead-coated copper	0.0216 nominal	—	ASTM B101, 16 oz. per square foot
High-yield copper	0.0162 nominal	—	ASTM B370, 12 oz. per square foot
Lead-coated high-yield copper	0.0162 nominal	—	ASTM B101, 12 oz. per square foot
Aluminum	0.024	—	—
Stainless steel	—	28	—
Galvanized steel	0.0179	26 (zinc coated G90)	—
Zinc alloy	0.027	—	—
Lead	—	—	2 1/2
Painted terne	—	—	20

For SI: 1 inch = 25.4 mm, 1 pound = 0.454 kg.

mm) from either side of hips or ridges and edges of eaves and gable rakes.

**R905.3.7 Application.** Tile shall be applied in accordance with this chapter and the manufacturer’s installation instructions, based on the following:

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

Clay and concrete roof tiles shall be fastened in accordance with this section and the manufacturer’s installation instructions. Perimeter tiles shall be fastened with not less than one fastener per tile. Tiles with installed weight less than 9 pounds per square foot (0.4 kg/m<sup>2</sup>) require not less than one fastener per tile regardless of roof slope. Clay and concrete roof tile attachment shall be in accordance with the manufacturer’s installation instructions where applied in areas where the ultimate design wind speed exceeds 130 miles per hour (58 m/s) and on buildings where the roof is located more than 40 feet (12 192 mm) above grade. In areas subject to snow, not less than two fasteners per tile are required. In other areas, clay and concrete roof tiles shall be attached in accordance with Table R905.3.7.

**TABLE R905.3.7  
CLAY AND CONCRETE TILE ATTACHMENT**

SHEATHING	ROOF SLOPE	NUMBER OF FASTENERS
Solid without battens	All	One per tile
Spaced or solid with battens and slope < 5:12	Fasteners not required	—
Spaced sheathing without battens	5:12 ≤ slope < 12:12	One per tile/every other row
	12:12 ≤ slope < 24:12	One per tile

**R905.3.8 Flashing.** At the juncture of roof vertical surfaces, flashing and counterflashing shall be provided in accordance with this chapter and the manufacturer’s installation instructions and, where of metal, shall be not less than 0.019 inch (0.5 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) in height 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 greater, valley flashing shall have a 36-inch-wide (914 mm) underlayment of one layer of Type I underlayment running the full length of the valley, in addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less, metal valley flashing underlayment shall be solid-cemented to the roofing underlayment for slopes less than seven units vertical in 12 units horizontal (58-percent slope) or be of self-adhering polymer modified bitumen sheet.

**R905.4 Metal roof shingles.** The installation of metal roof shingles shall comply with the provisions of this section.

**R905.4.1 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.

**R905.4.2 Deck slope.** Metal roof shingles shall not be installed on roof slopes below three units vertical in 12 units horizontal (25-percent slope).

**R905.4.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.4.3.1 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.4.4 Material standards.** Metal roof shingle roof coverings shall comply with Table R905.10.3(1). The materials used for metal roof shingle roof coverings shall be naturally corrosion resistant or be made corrosion resistant in accordance with the standards and minimum thicknesses listed in Table R905.10.3(2).

**R905.4.5 Application.** Metal roof shingles shall be secured to the roof in accordance with this chapter and the approved manufacturer’s installation instructions.

**R905.4.6 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 R905.10.3(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 mm) in height 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). The metal valley flashing shall have a 36-inch-wide (914 mm) underlayment directly under it consisting of one layer of underlayment running the full length of the valley, in addition to underlayment required for metal roof shingles. In areas where the average daily temperature in January is 25°F (-4°C) or less, the metal valley flashing underlayment shall be solid 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.

**R905.5 Mineral-surfaced roll roofing.** The installation of mineral-surfaced roll roofing shall comply with this section.

**R905.5.1 Deck requirements.** Mineral-surfaced roll roofing shall be fastened to solidly sheathed roofs.

**R905.5.2 Deck slope.** Mineral-surfaced roll roofing shall not be applied on roof slopes below one unit vertical in 12 units horizontal (8-percent slope).

**R905.5.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.5.3.1 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.5.4 Material standards.** Mineral-surfaced roll roofing shall conform to ASTM D3909 or ASTM D6380, Class M.



**R905.5.5 Application.** Mineral-surfaced roll roofing shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.6 Slate shingles.** The installation of slate shingles shall comply with the provisions of this section.

**R905.6.1 Deck requirements.** Slate shingles shall be fastened to solidly sheathed roofs.

**R905.6.2 Deck slope.** Slate shingles shall be used only on slopes of four units vertical in 12 units horizontal (33-percent slope) or greater.

**R905.6.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.6.3.1 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.6.4 Material standards.** Slate shingles shall comply with ASTM C406.

**R905.6.5 Application.** Minimum headlap for slate shingles shall be in accordance with Table R905.6.5. Slate shingles shall be secured to the roof with two fasteners per slate. Slate shingles shall be installed in accordance with this chapter and the manufacturer's instructions.

**TABLE R905.6.5  
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.

**R905.6.6 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 (0.5 mm) zinc coated G90. Chimneys, stucco or brick walls shall have not less 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).

**R905.7 Wood shingles.** The installation of wood shingles shall comply with the provisions of this section.

**R905.7.1 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.

**R905.7.1.1 Solid sheathing required.** In areas where the average daily temperature in January is 25°F (-4°C)

or less, solid sheathing is required on that portion of the roof requiring the application of an ice barrier.

**R905.7.2 Deck slope.** Wood shingles shall be installed on slopes of three units vertical in 12 units horizontal (25-percent slope) or greater.

**R905.7.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.7.3.1 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.7.4 Material standards.** Wood shingles shall be of naturally durable wood and comply with the requirements of Table R905.7.4.

**TABLE R905.7.4  
WOOD SHINGLE MATERIAL REQUIREMENTS**

MATERIAL	MINIMUM GRADES	APPLICABLE GRADING RULES
Wood shingles of naturally durable wood	1, 2 or 3	Cedar Shake and Shingle Bureau

**R905.7.5 Application.** Wood shingles shall be installed in accordance with this chapter and the manufacturer's instructions. Wood shingles shall be laid with a side lap not less than 1½ inches (38 mm) between joints in courses, and two joints shall not be in direct alignment in any three adjacent courses. Spacing between shingles shall be not less than ¼ inch to ⅜ inch (6.4 mm to 9.5 mm). Weather exposure for wood shingles shall not exceed those set in Table R905.7.5(1). Fasteners for untreated (naturally durable) wood shingles shall be box nails in accordance with Table R905.7.5(2). Nails shall be stainless steel Type 304 or 316 or hot-dipped galvanized with a coating weight of ASTM A153 Class D (1.0 oz/ft²). Alternatively, two 16-gage stainless steel Type 304 or 316 staples with crown widths 7/16 inch (11.1 mm) minimum, ¾ inch (19.1 mm) maximum, shall be used. Fasteners installed within 15 miles (24 km) of salt water coastal areas shall be stainless steel Type 316. Fasteners for fire-retardant-treated shingles in accordance with Section R902 or pressure-impregnated-preservative-treated shingles of naturally durable wood in accordance with AWPA U1 shall be stainless steel Type 316. All fasteners shall have a minimum penetration into the sheathing of ¾ inch (19.1 mm). For sheathing less than ¾ inch in (19.1 mm) thickness, each fastener shall penetrate through the sheathing. Wood shingles shall be attached to the roof with two fasteners per shingle, positioned in accordance with the manufacturer's installation instructions. Fastener packaging shall bear a label indicating the appropriate grade material or coating weight.

**TABLE R905.7.5(1)**  
**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	3 <sup>3</sup> / <sub>4</sub>	5
		No. 2	3 <sup>1</sup> / <sub>2</sub>	4
		No. 3	3	3 <sup>1</sup> / <sub>2</sub>
	18	No. 1	4 <sup>1</sup> / <sub>4</sub>	5 <sup>1</sup> / <sub>2</sub>
		No. 2	4	4 <sup>1</sup> / <sub>2</sub>
		No. 3	3 <sup>1</sup> / <sub>2</sub>	4
	24	No. 1	5 <sup>3</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>2</sub>
		No. 2	5 <sup>1</sup> / <sub>2</sub>	6 <sup>1</sup> / <sub>2</sub>
		No. 3	5	5 <sup>1</sup> / <sub>2</sub>

For SI: 1 inch = 25.4 mm.

**TABLE R905.7.5(2)**  
**NAIL REQUIREMENTS FOR WOOD SHAKES AND WOOD SHINGLES**

SHAKES	NAIL TYPE AND MINIMUM LENGTH	MINIMUM HEAD SIZE	MINIMUM SHANK DIAMETER
18" straight-split	5d box 1 <sup>3</sup> / <sub>4</sub> "	0.19"	.080"
18" and 24" handsplit and resawn	6d box 2"	0.19"	.0915"
24" taper-split	5d box 1 <sup>3</sup> / <sub>4</sub> "	0.19"	.080"
18" and 24" tapersawn	6d box 2"	0.19"	.0915"
SHINGLES	NAIL TYPE AND MINIMUM LENGTH		
16" and 18"	3d box 1 <sup>1</sup> / <sub>4</sub> "	0.19"	.080"
24"	4d box 1 <sup>1</sup> / <sub>2</sub> "	0.19"	.080"

**R905.7.6 Valley flashing.** Roof flashing shall be not less than No. 26 gage [0.019 inches (0.5 mm)] corrosion-resistant sheet metal and shall extend 10 inches (254 mm) from the centerline each way for roofs having slopes less than 12 units vertical in 12 units horizontal (100-percent slope), and 7 inches (178 mm) from the centerline each way for slopes of 12 units vertical in 12 units horizontal and greater. Sections of flashing shall have an end lap of not less than 4 inches (102 mm).

**R905.7.7 Label required.** Each bundle of shingles shall be identified by a label of an approved grading or inspection bureau or agency.

**R905.8 Wood shakes.** The installation of wood shakes shall comply with the provisions of this section.

**R905.8.1 Deck requirements.** Wood shakes shall be used only 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.

**R905.8.1.1 Solid sheathing required.** In areas where the average daily temperature in January is 25°F (-4°C) or less, solid sheathing is required on that portion of the roof requiring an ice barrier.

**R905.8.2 Deck slope.** Wood shakes shall only be used on slopes of three units vertical in 12 units horizontal (25-percent slope) or greater.

**R905.8.3 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.8.3.1 Ice barrier.** Where required, ice barriers shall comply with Section R905.1.2.

**R905.8.4 Interlayment.** Interlayment shall comply with ASTM D226, Type I.

**R905.8.5 Material standards.** Wood shakes shall comply with the requirements of Table R905.8.5.

**TABLE R905.8.5**  
**WOOD SHAKE MATERIAL REQUIREMENTS**

MATERIAL	MINIMUM GRADES	APPLICABLE GRADING RULES
Wood shakes of naturally durable wood	1	Cedar Shake and Shingle Bureau
Tapersawn shakes of naturally durable wood	1 or 2	Cedar Shake and Shingle Bureau
Preservative-treated shakes and shingles of naturally durable wood	1	Cedar Shake and Shingle Bureau
Fire-retardant-treated shakes and shingles of naturally durable wood	1	Cedar Shake and Shingle Bureau
Preservative-treated tapersawn shakes of Southern pine treated in accordance with AWPA Standard U1 (Commodity Specification A, Use Category 3B and Section 5.6)	1 or 2	Forest Products Laboratory of the Texas Forest Services

**R905.8.6 Application.** Wood shakes shall be installed in accordance with this chapter and the manufacturer's installation instructions. Wood shakes shall be laid with a side lap not less than 1<sup>1</sup>/<sub>2</sub> inches (38 mm) between joints in adjacent courses. Spacing between shakes in the same course shall be <sup>3</sup>/<sub>8</sub> inch to <sup>5</sup>/<sub>8</sub> inch (9.5 mm to 15.9 mm) including tapersawn shakes. Weather exposures for wood shakes shall not exceed those set in Table R905.8.6. Fasteners for untreated (naturally durable) wood shakes shall be box nails in accordance with Table R905.7.5(2). Nails shall be stainless steel Type 304, or Type 316 or hot-dipped with a coating weight of ASTM A153 Class D (1.0 oz/ft<sup>2</sup>). Alternatively, two 16-gage Type 304 or Type 316 stainless steel staples, with crown widths <sup>7</sup>/<sub>16</sub> inch (11.1 mm) minimum, <sup>3</sup>/<sub>4</sub> inch (19.1 mm) maximum, shall be used. Fasteners installed within 15 miles (24 km) of salt water coastal areas shall be stainless steel Type 316. Wood shakes shall be attached to the roof with two fasteners per shake positioned in accordance with the manufacturer's installation instructions. Fasteners for fire-retardant-treated (as defined in Section R902) shakes or pressure-impregnated-preservative-treated shakes of naturally durable wood in accordance with AWPA U1 shall be stainless steel Type 316. All fasteners shall have a minimum penetration into the sheathing of <sup>3</sup>/<sub>4</sub> inch (19.1 mm). Where the sheathing is less than <sup>3</sup>/<sub>4</sub> inch (19.1 mm) thick, each fas-

TABLE R905.8.6  
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	No. 1	7½
	24	No. 1	10 <sup>a</sup>
Preservative-treated tapered shakes of Southern Yellow Pine	18	No. 1	7½
	24	No. 1	10
	18	No. 2	5½
	24	No. 2	7½
Taper-sawn shakes of naturally durable wood	18	No. 1	7½
	24	No. 1	10
	18	No. 2	5½
	24	No. 2	7½

For SI: 1 inch = 25.4 mm.

a. For 24-inch by ¾-inch handsplit shakes, the maximum exposure is 7½ inches.

tener shall penetrate through the sheathing. Fastener packaging shall bear a label indicating the appropriate grade material or coating weight.

**R905.8.7 Shake placement.** The starter course at the eaves shall be doubled and the bottom layer shall be either 15-inch (381 mm), 18-inch (457 mm) or 24-inch (610 mm) wood shakes or wood shingles. Fifteen-inch (381 mm) or 18-inch (457 mm) wood shakes shall be permitted to be used for the final course at the ridge. Shakes shall be interlaid with 18-inch-wide (457 mm) strips of not less than No. 30 felt shingled between each course in such a manner that no felt is exposed to the weather by positioning the lower edge of each felt strip above the butt end of the shake it covers a distance equal to twice the weather exposure.

**R905.8.8 Valley flashing.** Roof valley flashing shall be not less than No. 26 gage [0.019 inch (0.5 mm)] corrosion-resistant sheet metal and shall extend not less than 11 inches (279 mm) from the centerline each way. Sections of flashing shall have an end lap of not less than 4 inches (102 mm).

**R905.8.9 Label required.** Each bundle of shakes shall be identified by a label of an approved grading or inspection bureau or agency.

**R905.9 Built-up roofs.** The installation of built-up roofs shall comply with the provisions of this section.

**R905.9.1 Slope.** Built-up roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs, which shall have a design slope of a minimum one-eighth unit vertical in 12 units horizontal (1-percent slope).

**R905.9.2 Material standards.** Built-up roof covering materials shall comply with the standards in Table R905.9.2 or UL 55A.

**R905.9.3 Application.** Built-up roofs shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.10 Metal roof panels.** The installation of metal roof panels shall comply with the provisions of this section.

**R905.10.1 Deck requirements.** Metal roof panel roof coverings shall be applied to solid or spaced sheathing, except where the roof covering is specifically designed to be applied to spaced supports.

**R905.10.2 Slope.** Minimum slopes for metal roof panels shall comply with the following:

1. The minimum slope for lapped, nonsoldered-seam metal roofs 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 roofs 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 roof systems shall be one-quarter unit vertical in 12 units horizontal (2-percent slope).

**R905.10.3 Material standards.** Metal-sheet roof covering systems that incorporate supporting structural members shall be designed in accordance with the *International Building Code*. Metal-sheet roof coverings installed over structural decking shall comply with Table R905.10.3(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 R905.10.3(2).

**R905.10.4 Attachment.** Metal roof panels shall be secured to the supports in accordance with this chapter and the manufacturer's installation instructions. In the absence of manufacturer's installation instructions, the following fasteners shall be used:

1. Galvanized fasteners shall be used for steel roofs.
2. Copper, brass, bronze, copper alloy and 300-series stainless steel fasteners shall be used for copper roofs.
3. Stainless steel fasteners are acceptable for metal roofs.

**TABLE R905.9.2  
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 primer used in roofing, dampproofing and waterproofing	ASTM D43
Coal-tar saturated organic felt	ASTM D227
Coal-tar used in roofing	ASTM D450, Type I or II
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

**TABLE R905.10.3(1)  
METAL ROOF COVERING STANDARDS**

ROOF COVERING TYPE	STANDARD APPLICATION RATE/THICKNESS
Galvanized steel	ASTM A653 G90 Zinc coated
Stainless steel	ASTM A240, 300 Series alloys
Steel	ASTM A924
Lead-coated copper	ASTM B101
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.
Hard lead	2 lb/sq ft
Soft lead	3 lb/sq ft
Aluminum	ASTM B209, 0.024 minimum thickness for roll-formed panels and 0.019-inch minimum thickness for pressformed shingles.
Terne (tin) and terne-coated stainless	Terne coating of 40 lb 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<sup>2</sup>, 1 pound per square foot = 4.214 kg/m<sup>2</sup>, 1 inch = 25.4 mm, 1 pound = 0.454 kg.

**TABLE R905.10.3(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 G-90
Prepainted steel	ASTM A755 <sup>a</sup>

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

**R905.10.5 Underlayment.** Underlayment shall comply with Section R905.1.1.

**R905.11 Modified bitumen roofing.** The installation of modified bitumen roofing shall comply with the provisions of this section.

**R905.11.1 Slope.** Modified bitumen membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

**R905.11.2 Material standards.** Modified bitumen roof coverings shall comply with the standards in Table R905.11.2.

**TABLE R905.11.2  
MODIFIED BITUMEN ROOFING MATERIAL STANDARDS**

MATERIAL	STANDARD
Acrylic coating	ASTM D6083
Asphalt adhesive	ASTM D3747
Asphalt cement	ASTM D3019
Asphalt coating	ASTM D1227; D2824
Asphalt primer	ASTM D41
Modified bitumen roof membrane	ASTM D6162; D6163; D6164; D6222; D6223; D6298; CGSB 37-GP-56M

**R905.11.3 Application.** Modified bitumen roofs shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.12 Thermoset single-ply roofing.** The installation of thermoset single-ply roofing shall comply with the provisions of this section.

**R905.12.1 Slope.** Thermoset single-ply membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

**R905.12.2 Material standards.** Thermoset single-ply roof coverings shall comply with ASTM D4637, ASTM D5019 or CGSB 37-GP-52M.

**R905.12.3 Application.** Thermoset single-ply roofs shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.13 Thermoplastic single-ply roofing.** The installation of thermoplastic single-ply roofing shall comply with the provisions of this section.

**R905.13.1 Slope.** Thermoplastic single-ply membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope).

**R905.13.2 Material standards.** Thermoplastic single-ply roof coverings shall comply with ASTM D4434, ASTM D6754, ASTM D6878 or CGSB CAN/CGSB 37.54.

**R905.13.3 Application.** Thermoplastic single-ply roofs shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.14 Sprayed polyurethane foam roofing.** The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

**R905.14.1 Slope.** Sprayed polyurethane foam roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

**R905.14.2 Material standards.** Spray-applied polyurethane foam insulation shall comply with ASTM C1029, Type III or IV or ASTM D7425.

**R905.14.3 Application.** Foamed-in-place roof insulation shall be installed in accordance with this chapter and the manufacturer's instructions. A liquid-applied protective coating that complies with Table R905.14.3 shall be applied not less than 2 hours nor more than 72 hours following the application of the foam.

**TABLE R905.14.3  
PROTECTIVE COATING MATERIAL STANDARDS**

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

**R905.14.4 Foam plastics.** Foam plastic materials and installation shall comply with Section R316.

**R905.15 Liquid-applied roofing.** The installation of liquid-applied roofing shall comply with the provisions of this section.

**R905.15.1 Slope.** Liquid-applied roofing shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope).

**R905.15.2 Material standards.** Liquid-applied roofing shall comply with ASTM C836, C957, D1227, D3468, D6083, D6694 or D6947.

**R905.15.3 Application.** Liquid-applied roofing shall be installed in accordance with this chapter and the manufacturer's instructions.

**R905.16 Photovoltaic shingles.** The installation of photovoltaic shingles shall comply with the provisions of this section, Section R324 and NFPA 70.

**R905.16.1 Deck requirements.** Photovoltaic shingles shall be applied to a solid or closely-fitted deck, except where the roof covering is specifically designed to be applied over spaced sheathing.

**R905.16.2 Deck slope.** Photovoltaic shingles shall be used only on roof slopes of two units vertical in 12 units horizontal (2:12) or greater.

**R905.16.3 Underlayment.** Unless otherwise noted, required underlayment shall conform to ASTM D4869 or ASTM D6757.

**R905.16.4 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.

**R905.16.4.1 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, as designated in Table R301.2(1), an ice barrier that consists of not less than two layers of underlayment cemented together or of a self-adhering polymer modified bitumen sheet shall be used in lieu 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 contain no conditioned floor area.

**R905.16.4.2 Underlayment and high winds.** Underlayment applied in areas subject to high winds [above 140 mph (63 m/s), in accordance with Figure R301.2(4)A] shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center.

Underlayment installed where the ultimate design wind speed equals or exceeds 150 mph (67 m/s) shall comply with 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. Underlayment shall be applied as required for asphalt shingles in accordance with Table R905.1.1(2). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of not less than 32-gage sheet metal. The cap-nail shank shall be not less than 12 gage (0.105 inches) with a length to penetrate through the roof sheathing or not less than 3/4 inch (19 mm) into the roof sheathing.

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

**R905.16.5 Material standards.** Photovoltaic shingles shall be listed and labeled in accordance with UL 1703.

**R905.16.6 Attachment.** Photovoltaic shingles shall be attached in accordance with the manufacturer's installation instructions.

**R905.16.7 Wind resistance.** Photovoltaic shingles shall be tested in accordance with procedures and acceptance criteria in ASTM D3161. Photovoltaic shingles shall com-

ply with the classification requirements of Table R905.2.4.1 for the appropriate maximum basic wind speed. Photovoltaic shingle packaging shall bear a label to indicate compliance with the procedures in ASTM D3161 and the required classification from Table R905.2.4.1.

## SECTION R906 ROOF INSULATION

**R906.1 General.** The use of above-deck thermal insulation shall be permitted provided such insulation is covered with an *approved* roof covering and complies with FM 4450 or UL 1256.

**R906.2 Material standards.** Above-deck thermal insulation board shall comply with the standards in Table R906.2.

TABLE R906.2  
MATERIAL STANDARDS FOR ROOF INSULATION

Cellular glass board	ASTM C552
Composite boards	ASTM C1289, Type III, IV, V or VI
Expanded polystyrene	ASTM C578
Extruded polystyrene board	ASTM C578
Perlite board	ASTM C728
Polyisocyanurate board	ASTM C1289, Type I or II
Wood fiberboard	ASTM C208
Fiber-reinforced gypsum board	ASTM C1278
Glass-faced gypsum board	ASTM C1177

## SECTION R907 ROOFTOP-MOUNTED PHOTOVOLTAIC SYSTEMS

**R907.1 Rooftop-mounted photovoltaic systems.** Rooftop-mounted photovoltaic panels or modules shall be installed in accordance with this section, Section R324 and NFPA 70.

**R907.2 Wind resistance.** Rooftop-mounted photovoltaic panel or modules systems shall be installed to resist the component and cladding loads specified in Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3).

**R907.3 Fire classification.** Rooftop-mounted photovoltaic panels or modules shall have the same fire classification as the roof assembly required in Section R902.

**R907.4 Installation.** Rooftop-mounted photovoltaic panels or modules shall be installed in accordance with the manufacturer's instructions.

**R907.5 Photovoltaic panels and modules.** Rooftop-mounted photovoltaic panels and modules shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacturer's printed instructions.

## SECTION R908 REROOFING

**R908.1 General.** Materials and methods of application used for re-covering or replacing an existing roof covering shall comply with the requirements of Chapter 9.

### Exceptions:

1. Reroofing shall not be required to meet the minimum design slope requirement of one-quarter unit vertical in 12 units horizontal (2-percent slope) in Section R905 for roofs that provide positive roof drainage.
2. For roofs that provide positive drainage, re-covering or replacing an existing roof covering shall not require the secondary (emergency overflow) drains or scuppers of Section R903.4.1 to be added to an existing roof.

**R908.2 Structural and construction loads.** The structural roof components shall be capable of supporting the roof covering system and the material and equipment loads that will be encountered during installation of the roof covering system.

**R908.3 Roof replacement.** Roof replacement shall include the removal of existing layers of roof coverings down to the roof deck.

**Exception:** Where the existing roof assembly includes an ice barrier membrane that is adhered to the roof deck, the existing ice barrier membrane shall be permitted to remain in place and covered with an additional layer of ice barrier membrane in accordance with Section R905.

**R908.3.1 Roof re-cover.** The installation of a new roof covering over an existing roof covering shall be permitted where any of the following conditions occur:

1. Where the new roof covering is installed in accordance with the roof covering manufacturer's approved instructions
2. Complete and separate roofing systems, such as standing-seam metal roof systems, that are designed to transmit the roof loads directly to the building's structural system and do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.
3. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs where applied in accordance with Section R908.4.
4. The application of a new protective coating over an existing spray polyurethane foam roofing system shall be permitted without tear-off of existing roof coverings.

**R908.3.1.1** A *roof re-cover* shall not be permitted where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the

existing roof or roof covering is not adequate as a base for additional roofing.

2. Where the existing roof covering is slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

**R908.4 Roof re-covering.** Where the application of a new roof covering over wood shingle or shake roofs creates a combustible concealed space, the entire existing surface shall be covered with gypsum board, mineral fiber, glass fiber or other *approved* materials securely fastened in place.

**R908.5 Reinstallation of materials.** Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Any existing flashings, edgings, outlets, vents or similar devices that are a part of the assembly shall be replaced where rusted, damaged or deteriorated. Aggregate surfacing materials shall not be reinstalled.

**R908.6 Flashings.** Flashings shall be reconstructed in accordance with *approved* manufacturer's installation instructions. Metal flashing to which bituminous materials are to be adhered shall be primed prior to installation.

## SECTION R909 ROOFTOP-MOUNTED PHOTOVOLTAIC PANEL SYSTEMS

**R909.1 General.** The installation of photovoltaic panel systems that are mounted on or above the roof covering shall comply with the provisions of this code, Section R324, and NFPA 70.

R 408.30521a

**R909.2 Structural requirements.** Rooftop mounted photovoltaic panel systems shall be designed to structurally support the system and withstand gravity loads in accordance with chapter 3. The roof upon which these systems are installed shall be designed and constructed to support the loads imposed by such systems in accordance with Chapter 8.

R 408.30521a

**R909.3 Installation.** Rooftop mounted photovoltaic systems shall be installed in accordance with the manufacturer's instructions. Roof penetrations shall be flashed and sealed in accordance with this chapter.

R 408.30521a

**R702.6.1 Attachment.** Nails, staples or glue are permitted for attaching shakes or shingles to the wall, and attachment of the shakes or shingles directly to the surface shall be permitted provided the fasteners are appropriate for the type of wall surface material. Where nails or staples are used, two fasteners shall be provided and shall be placed so that they are covered by the course above.

**R702.6.2 Furring strips.** Where furring strips are used, they shall be 1 inch by 2 inches or 1 inch by 3 inches (25 mm by 51 mm or 25 mm by 76 mm), spaced a distance on center equal to the desired exposure, and shall be attached to the wall by nailing through other wall material into the studs.

**R702.7 Vapor retarders.** Class I or II vapor retarders are required on the interior side of frame walls in Climate Zones 5, 6, 7, 8 and Marine 4.

**Exceptions:**

1. Basement walls.
2. Below-grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

**R702.7.1 Class III vapor retarders.** Class III vapor retarders shall be permitted where any one of the conditions in Table R702.7.1 is met.

**TABLE R702.7.1  
CLASS III VAPOR RETARDERS**

CLIMATE ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR: <sup>a</sup>
Marine 4	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with <i>R</i> -value $\geq 2.5$ over 2 × 4 wall. Continuous insulation with <i>R</i> -value $\geq 3.75$ over 2 × 6 wall.
5	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with <i>R</i> -value $\geq 5$ over 2 × 4 wall. Continuous insulation with <i>R</i> -value $\geq 7.5$ over 2 × 6 wall.
6	Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with <i>R</i> -value $\geq 7.5$ over 2 × 4 wall. Continuous insulation with <i>R</i> -value $\geq 11.25$ over 2 × 6 wall.
7 and 8	Continuous insulation with <i>R</i> -value $\geq 10$ over 2 × 4 wall. Continuous insulation with <i>R</i> -value $\geq 15$ over 2 × 6 wall.

For SI: 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

a. Spray foam with a maximum permeance of 1.5 perms at the installed thickness, applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to meet the continuous insulation requirement where the spray foam *R*-value meets or exceeds the specified continuous insulation *R*-value.

**R702.7.2 Material vapor retarder class.** The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.

The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, unperforated aluminum foil.

Class II: Kraft-faced fiberglass batts.

Class III: Latex or enamel paint.

**R702.7.3 Minimum clear airspaces and vented openings for vented cladding.** For the purposes of this section, vented cladding shall include the following minimum clear airspaces. Other openings with the equivalent vent area shall be permitted.

1. Vinyl lap or horizontal aluminum siding applied over a weather-resistive barrier as specified in Table R703.3(1).
2. Brick veneer with a clear airspace as specified in Table R703.8.4.
3. Other approved vented claddings.

**SECTION R703  
EXTERIOR COVERING**

**R703.1 General.** Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.4.

**Exception:** Log walls designed and constructed in accordance with the provisions of ICC 400.

**R703.1.1 Water resistance.** The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R702.7 of this code.

**Exceptions:**

1. A weather-resistant exterior wall envelope shall not be required over concrete or masonry walls designed in accordance with Chapter 6 and flashed in accordance with Section R703.4 or R703.8.
2. Compliance with the requirements for a means of drainage, and the requirements of Sections R703.2 and R703.4, shall not be required for an exterior wall envelope that has been demonstrated to resist wind-driven rain through testing of the exterior wall envelope, including joints, penetrations and intersections with dissimilar materials, in accordance with ASTM E331 under the following conditions:

2.1. Exterior wall envelope test assemblies shall include at least one opening, one control joint, one wall/eave interface and one wall sill. All tested openings and penetrations shall be representative of the intended end-use configuration.



- 2.2. Exterior wall envelope test assemblies shall be at least 4 feet by 8 feet (1219 mm by 2438 mm) in size.
- 2.3. Exterior wall assemblies shall be tested at a minimum differential pressure of 6.24 pounds per square foot (299 Pa).
- 2.4. Exterior wall envelope assemblies shall be subjected to the minimum test exposure for a minimum of 2 hours.

The exterior wall envelope design shall be considered to resist wind-driven rain where the results of testing indicate that water did not penetrate control joints in the exterior wall envelope, joints at the perimeter of openings penetration or intersections of terminations with dissimilar materials.

**R703.1.2 Wind resistance.** Wall coverings, backing materials and their attachments shall be capable of resisting wind loads in accordance with Tables R301.2(2) and R301.2(3). Wind-pressure resistance of the siding and backing materials shall be determined by ASTM E330 or other applicable standard test methods. Where wind-pressure resistance is determined by design analysis, data from approved design standards and analysis conforming to generally accepted engineering practice shall be used to evaluate the siding and backing material and its fastening. All applicable failure modes including bending rupture of siding, fastener withdrawal and fastener head pull-through shall be considered in the testing or design analysis. Where the wall covering and the backing material resist wind load as an assembly, use of the design capacity of the assembly shall be permitted.

**R703.2 Water-resistive barrier.** One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm). The felt or other approved material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1. The water-resistive barrier is not required for detached accessory buildings.

**R703.3 Nominal thickness and attachments.** The nominal thickness and attachment of exterior wall coverings shall be in accordance with Table R703.3(1), the wall covering material requirements of this section, and the wall covering manufacturer's installation instructions. Cladding attachment over foam sheathing shall comply with the additional requirements and limitations of Sections R703.15 through R703.17. Nominal material thicknesses in Table R703.3(1) are based on a

maximum stud spacing of 16 inches (406 mm) on center. Where specified by the siding manufacturer's instructions and supported by a test report or other documentation, attachment to studs with greater spacing is permitted. Fasteners for exterior wall coverings attached to wood framing shall be in accordance with Section R703.3.2 and Table R703.3(1). Exterior wall coverings shall be attached to cold-formed steel light frame construction in accordance with the cladding manufacturer's installation instructions, the requirements of Table R703.3(1) using screw fasteners substituted for the nails specified in accordance with Table R703.3(2), or an approved design.

**TABLE R703.3(2)  
SCREW FASTENER SUBSTITUTION FOR SIDING  
ATTACHMENT TO COLD-FORMED STEEL LIGHT  
FRAME CONSTRUCTION<sup>a, b, c, d, e</sup>**

NAIL DIAMETER PER TABLE R703.3(1)	MINIMUM SCREW FASTENER SIZE
0.099"	No. 6
0.113"	No. 7
0.120"	No. 8

For SI: 1 inch = 25.4 mm

- a. Screws shall comply with ASTM C1513 and shall penetrate a minimum of three threads through minimum 33 mil (20 gage) cold-formed steel frame construction.
- b. Screw head diameter shall be not less than the nail head diameter required by Table R703.3(1).
- c. Number and spacing of screw fasteners shall comply with Table R703.3(1).
- d. Pan head, hex washer head, modified truss head or other screw head types with a flat attachment surface under the head shall be used for vinyl siding attachment.
- e. Aluminum siding shall not be fastened directly to cold-formed steel light frame construction.

**R703.3.1 Wind limitations.** Where the design wind pressure exceeds 30 psf or where the limits of Table R703.3.1 are exceeded, the attachment of wall coverings shall be designed to resist the component and cladding loads specified in Table R301.2(2), adjusted for height and exposure in accordance with Table R301.2(3). For the determination of wall covering attachment, component and cladding loads shall be determined using an effective wind area of 10 square feet (0.93 m<sup>2</sup>).

**TABLE R703.3.1  
LIMITS FOR ATTACHMENT PER TABLE R703.3(1)**

Ultimate Wind Speed (mph 3-second gust)	MAXIMUM MEAN ROOF HEIGHT		
	Exposure		
	B	C	D
115	NL	50'	20'
120	NL	30'	DR
130	60'	15'	DR
140	35'	DR	DR

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

NL = Not limited by Table R703.3.1, DR = Design required.

TABLE R703.3(1)  
SIDING MINIMUM ATTACHMENT AND MINIMUM THICKNESS

SIDING MATERIAL	NOMINAL THICKNESS (inches)	JOINT TREATMENT	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS						Number or spacing of fasteners
			Wood or wood structural panel sheathing into stud	Fiberboard sheathing into stud	Gypsum sheathing into stud	Foam plastic sheathing into stud <sup>f</sup>	Direct to studs		
Anchored veneer: brick, concrete, masonry or stone (see Section R703.8)	2	Section R703.8	Section R703.8						
Adhered veneer: concrete, stone or masonry (see Section R703.12)	—	Section R703.12	Section R703.12						
Fiber cement siding	Panel siding (see Section R703.10.1)	$\frac{5}{16}$	Section R703.10.1	6d common (2" x 0.113")	6d common (2" x 0.113")	6d common (2" x 0.113")	6d common (2" x 0.113")	4d common (1½" x 0.099")	6" panel edges 12" inter. sup.
	Lap siding (see Section R703.10.2)	$\frac{5}{16}$	Section R703.10.2	6d common (2" x 0.113")	6d common (2" x 0.113")	6d common (2" x 0.113")	6d common (2" x 0.113")	6d common (2" x 0.113") or 11 gage roofing nail	Note f
Hardboard panel siding (see Section R703.3)	$\frac{7}{16}$	—	0.120" nail (shank) with 0.225" head	0.120" nail (shank) with 0.225" head	0.120" nail (shank) with 0.225" head	0.120" nail (shank) with 0.225" head	0.120" nail (shank) with 0.225" head	0.120" nail (shank) with 0.225" head	6" panel edges 12" inter. sup. <sup>d</sup>
Hardboard lap siding (see Section R703.3)	$\frac{7}{16}$	Note e	0.099" nail (shank) with 0.240" head	0.099" nail (shank) with 0.240" head	0.099" nail (shank) with 0.240" head	0.099" nail (shank) with 0.240" head	0.099" nail (shank) with 0.240" head	0.099" nail (shank) with 0.240" head	Same as stud spacing 2 per bearing
Horizontal aluminum <sup>a</sup>	Without insulation	0.019 <sup>b</sup>	Lap	Siding nail 1½" x 0.120"	Siding nail 2" x 0.120"	Siding nail 2" x 0.120"	Siding nail <sup>h</sup> 1½" x 0.120"	Not allowed	Same as stud spacing
		0.024	Lap	Siding nail 1½" x 0.120"	Siding nail 2" x 0.120"	Siding nail 2" x 0.120"	Siding nail <sup>h</sup> 1½" x 0.120"	Not allowed	
	With insulation	0.019	Lap	Siding nail 1½" x 0.120"	Siding nail 2½" x 0.120"	Siding nail 2½" x 0.120"	Siding nail <sup>h</sup> 1½" x 0.120"	Siding nail 1½" x 0.120"	
Insulated vinyl siding <sup>j</sup>	0.035 (vinyl siding layer only)	Lap	0.120 nail (shank) with a 0.313 head or 16-gage crown <sup>h, i</sup>	0.120 nail (shank) with a 0.313 head or 16-gage crown <sup>h</sup>	0.120 nail (shank) with a 0.313 head or 16-gage crown <sup>h</sup>	0.120 nail (shank) with a 0.313 head or 16-gage crown <sup>h</sup>	0.120 nail (shank) with a 0.313 head or 16-gage crown <sup>h</sup>	Not allowed	16 inches on center or specified by manufacturer instructions, test report or other sections of this code
Particleboard panels	$\frac{3}{8}$	—	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	Not allowed	6" panel edges 12" inter. sup.
	$\frac{1}{2}$	—	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")		
	$\frac{5}{8}$	—	6d box nail (2" x 0.099")	8d box nail (2½" x 0.113")	8d box nail (2½" x 0.113")	6d box nail (2" x 0.099")	6d box nail (2" x 0.099")		
Polypropylene siding <sup>k</sup>	Not applicable	Lap	Section 703.14.1	Section 703.14.1	Section 703.14.1	Section 703.14.1	Section 703.14.1	Not allowed	As specified by the manufacturer instructions, test report or other sections of this code

(continued)

TABLE R703.3(1)—continued  
SIDING MINIMUM ATTACHMENT AND MINIMUM THICKNESS

SIDING MATERIAL	NOMINAL THICKNESS (inches)	JOINT TREATMENT	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS						
			Wood or wood structural panel sheathing into stud	Fiberboard sheathing into stud	Gypsum sheathing into stud	Foam plastic sheathing into stud <sup>d</sup>	Direct to studs	Number or spacing of fasteners	
Steel <sup>c</sup>	29 ga.	Lap	Siding nail (1 <sup>3</sup> / <sub>4</sub> " × 0.113") Staple—1 <sup>3</sup> / <sub>4</sub> "	Siding nail (2 <sup>3</sup> / <sub>4</sub> " × 0.113") Staple—2 <sup>1</sup> / <sub>2</sub> "	Siding nail (2 <sup>1</sup> / <sub>2</sub> " × 0.113") Staple—2 <sup>1</sup> / <sub>4</sub> "	Siding nail (1 <sup>3</sup> / <sub>4</sub> " × 0.113") Staple—1 <sup>3</sup> / <sub>4</sub> "	Not allowed	Same as stud spacing	
Vinyl siding (see Section R703.11)	0.035	Lap	0.120" nail (shank) with a 0.313" head or 16-gage staple with <sup>3</sup> / <sub>8</sub> - to <sup>1</sup> / <sub>2</sub> -inch crown <sup>h,i</sup>	0.120" nail (shank) with a 0.313" head or 16-gage staple with <sup>3</sup> / <sub>8</sub> - to <sup>1</sup> / <sub>2</sub> -inch crown <sup>h</sup>	0.120" nail (shank) with a 0.313" head or 16-gage staple with <sup>3</sup> / <sub>8</sub> - to <sup>1</sup> / <sub>2</sub> -inch crown <sup>h</sup>	0.120" nail (shank) with a 0.313 head Section R703.11.2	Not allowed	16 inches on center or as specified by the manufacturer instructions or test report	
Wood siding (see Section R703.3)	Wood rustic, drop	<sup>3</sup> / <sub>8</sub> min.	Lap	6d box or siding nail (2" × 0.099")	6d box or siding nail (2" × 0.099")	6d box or siding nail (2" × 0.099")	6d box or siding nail (2" × 0.099")	8d box or siding nail (2 <sup>1</sup> / <sub>2</sub> " × 0.113") Staple—2"	Face nailing up to 6" widths, 1 nail per bearing; 8" widths and over, 2 nails per bearing
	Shiplap	<sup>19</sup> / <sub>32</sub> average	Lap						
	Bevel	<sup>7</sup> / <sub>16</sub>							
	Butt tip	<sup>3</sup> / <sub>16</sub>	Lap						
Wood structural panel ANSI/APA PRP-210 siding (exterior grade) (see Section R703.3)	<sup>3</sup> / <sub>8</sub> - <sup>1</sup> / <sub>2</sub>	Note e		2" × 0.099" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2" × 0.099" siding nail	6" panel edges 12" inter. sup.
Wood structural panel lap siding (see Section R703.3)	<sup>3</sup> / <sub>8</sub> - <sup>1</sup> / <sub>2</sub>	Note e Note g		2" × 0.099" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2 <sup>1</sup> / <sub>2</sub> " × 0.113" siding nail	2" × 0.099" siding nail	8" along bottom edge

For SI: 1 inch = 25.4 mm.

- a. Aluminum nails shall be used to attach aluminum siding.
- b. Aluminum (0.019 inch) shall be unbacked only where the maximum panel width is 10 inches and the maximum flat area is 8 inches. The tolerance for aluminum siding shall be +0.002 inch of the nominal dimension.
- c. Shall be of approved type.
- d. Where used to resist shear forces, the spacing must be 4 inches at panel edges and 8 inches on interior supports.
- e. Vertical end joints shall occur at studs and shall be covered with a joint cover or shall be caulked.
- f. Face nailing: one 6d common nail through the overlapping planks at each stud. Concealed nailing: one 11-gage 1<sup>1</sup>/<sub>2</sub>-inch-long galv. roofing nail through the top edge of each plank at each stud in accordance with the manufacturer's installation instructions.
- g. Vertical joints, if staggered, shall be permitted to be away from studs if applied over wood structural panel sheathing.
- h. Minimum fastener length must be sufficient to penetrate sheathing other nailable substrate and framing a total of a minimum of 1<sup>1</sup>/<sub>4</sub> inches or in accordance with the manufacturer's installation instructions.
- i. Where specified by the manufacturer's instructions and supported by a test report, fasteners are permitted to penetrate into or fully through nailable sheathing or other nailable substrate of minimum thickness specified by the instructions or test report, without penetrating into framing.
- j. Insulated vinyl siding shall comply with ASTM D7793.
- k. Polypropylene siding shall comply with ASTM D7254.
- l. Cladding attachment over foam sheathing shall comply with the additional requirements and limitations of Sections R703.15, R703.16 and R703.17.

**R703.3.2 Fasteners.** Exterior wall coverings shall be securely fastened with aluminum, galvanized, stainless steel or rust-preventative coated nails or staples in accordance with Table R703.3(1) or with other approved corrosion-resistant fasteners in accordance with the wall covering manufacturer's installation instructions. Nails and staples shall comply with ASTM F1667. Nails shall be T-head, modified round head, or round head with smooth or deformed shanks. Staples shall have a minimum crown width of  $\frac{7}{16}$  inch (11.1 mm) outside diameter and be manufactured of minimum 16-gage wire. Where fiberboard, gypsum, or foam plastic sheathing backing is used, nails or staples shall be driven into the studs. Where wood or wood structural panel sheathing is used, fasteners shall be driven into studs unless otherwise permitted to be driven into sheathing in accordance with either the siding manufacturer's installation instructions or Table R703.3.2.

**R703.3.3 Minimum fastener length and penetration.** Fasteners shall have the greater of the minimum length specified in Table R703.3(1) or as required to provide a minimum penetration into framing as follows:

1. Fasteners for horizontal aluminum siding, steel siding, particleboard panel siding, wood structural panel siding in accordance with ANSI/APA-PRP 210, fiber-cement panel siding and fiber-cement lap siding installed over foam plastic sheathing shall penetrate not less than  $1\frac{1}{2}$  inches (38 mm) into framing or shall be in accordance with the manufacturer's installation instructions.
2. Fasteners for hardboard panel and lap siding shall penetrate not less than  $1\frac{1}{2}$  inches (38 mm) into framing.
3. Fasteners for vinyl siding and insulated vinyl siding installed over wood or wood structural panel sheathing shall penetrate not less than  $1\frac{1}{4}$  inches (32 mm) into sheathing and framing combined. Vinyl siding and insulated vinyl siding shall be permitted to be installed with fasteners penetrating into or through wood or wood structural sheathing of minimum thickness as specified by the manufacturer's instructions or test report, with or without penetration into the framing. Where the fastener penetrates fully through the sheathing, the end of the fastener shall extend not less than  $\frac{1}{4}$  inch (6.4 mm) beyond the opposite face of the sheathing. Fasteners for vinyl siding and insulated vinyl siding installed over foam plastic sheathing shall be in accordance with Section

R703.11.2. Fasteners for vinyl siding and insulated vinyl siding installed over fiberboard or gypsum sheathing shall penetrate not less than  $1\frac{1}{4}$  inches (32 mm) into framing.

4. Fasteners for vertical or horizontal wood siding shall penetrate not less than  $1\frac{1}{2}$  inches (38 mm) into studs, studs and wood sheathing combined, or blocking.
5. Fasteners for siding material installed over foam plastic sheathing shall have sufficient length to accommodate foam plastic sheathing thickness and to penetrate framing or sheathing and framing combined, as specified in Items 1 through 4.

**R703.4 Flashing.** Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. Fluid-applied membranes used as flashing in exterior walls shall comply with AAMA 714. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at the following locations:

1. Exterior window and door openings. Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier complying with Section 703.2 for subsequent drainage. Mechanically attached flexible flashings shall comply with AAMA 712. Flashing at exterior window and door openings shall be installed in accordance with one or more of the following:
  - 1.1. The fenestration manufacturer's installation and flashing instructions, or for applications not addressed in the fenestration manufacturer's instructions, in accordance with the flashing manufacturer's instructions. Where flashing instructions or details are not provided, pan flashing shall be installed at the sill of exterior window and door openings. Pan flashing shall be sealed or sloped in such a manner as to direct water to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Openings using pan flashing shall incorporate flashing or protection at the head and sides.
  - 1.2. In accordance with the flashing design or method of a registered design professional.

**TABLE R703.3.2**  
**OPTIONAL SIDING ATTACHMENT SCHEDULE FOR FASTENERS WHERE NO STUD PENETRATION NECESSARY**

APPLICATION	NUMBER AND TYPE OF FASTENER	SPACING OF FASTENERS <sup>b</sup>
Exterior wall covering (weighing 3 psf or less) attachment to wood structural panel sheathing, either direct or over foam sheathing a maximum of 2 inches thick. <sup>a</sup> Note: Does not apply to vertical siding.	Ring shank roofing nail (0.120" min. dia.)	12" o.c.
	Ring shank nail (0.148" min. dia.)	15" o.c.
	No. 6 screw (0.138" min. dia.)	12" o.c.
	No. 8 screw (0.164" min. dia.)	16" o.c.

For SI: 1 inch = 25.4 mm.

- a. Fastener length shall be sufficient to penetrate back side of the wood structural panel sheathing by at least  $\frac{1}{4}$  inch. The wood structural panel sheathing shall be not less than  $\frac{7}{16}$  inch in thickness.
- b. Spacing of fasteners is per 12 inches of siding width. For other siding widths, multiply "Spacing of Fasteners" above by a factor of  $12/s$ , where "s" is the siding width in inches. Fastener spacing shall never be greater than the manufacturer's minimum recommendations.

- 1.3. In accordance with other approved methods.
2. At the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings.
3. Under and at the ends of masonry, wood or metal copings and sills.
4. Continuously above all projecting wood trim.
5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction.
6. At wall and roof intersections.
7. At built-in gutters.

**R703.5 Wood, hardboard and wood structural panel siding.** Wood, hardboard, and wood structural panel siding shall be installed in accordance with this section and Table R703.3. Hardboard siding shall comply with CPA/ANSI A135.6. Hardboard siding used as architectural trim shall comply with CPA/ANSI A 135.7.

**R703.5.1 Vertical wood siding.** Wood siding applied vertically shall be nailed to horizontal nailing strips or blocking set not more than 24 inches (610 mm) on center.

**R703.5.2 Panel siding.**  $\frac{3}{8}$ -inch (9.5 mm) wood structural panel siding shall not be applied directly to studs spaced more than 16 inches (406 mm) on center where long dimension is parallel to studs. Wood structural panel siding  $\frac{7}{16}$  inch (11.1 mm) or thinner shall not be applied directly to studs spaced more than 24 inches (610 mm) on center. The stud spacing shall not exceed the panel span rating provided by the manufacturer unless the panels are installed with the face grain perpendicular to the studs or over sheathing approved for that stud spacing.

Joints in wood, hardboard or wood structural panel siding shall be made as follows unless otherwise approved. Vertical joints in panel siding shall occur over framing members, unless wood or wood structural panel sheathing is used, and shall be shiplapped or covered with a batten. Horizontal joints in panel siding shall be lapped not less than 1 inch (25 mm) or shall be shiplapped or flashed with Z-flashing and occur over solid blocking, wood or wood structural panel sheathing.

**R703.5.3 Horizontal wood siding.** Horizontal lap siding shall be installed in accordance with the manufacturer's recommendations. Where there are no recommendations the siding shall be lapped not less than 1 inch (25 mm), or  $\frac{1}{2}$  inch (12.7 mm) if rabbeted, and shall have the ends caulked, covered with a batten or sealed and installed over a strip of flashing.

**R703.6 Wood shakes and shingles.** Wood shakes and shingles shall conform to CSSB *Grading Rules for Wood Shakes and Shingles*.

**R703.6.1 Application.** Wood shakes or shingles shall be applied either single course or double course over nominal  $\frac{1}{2}$ -inch (12.7 mm) wood-based sheathing or to furring strips over  $\frac{1}{2}$ -inch (12.7 mm) nominal nonwood sheathing. A water-resistive barrier shall be provided over all sheathing, with horizontal overlaps in the membrane of not less than 2 inches (51 mm) and vertical overlaps of not less than 6

inches (152 mm). Where horizontal furring strips are used, they shall be 1 inch by 3 inches or 1 inch by 4 inches (25 mm by 76 mm or 25 mm by 102 mm) and shall be fastened to the studs with minimum 7d or 8d box nails and shall be spaced a distance on center equal to the actual weather exposure of the shakes or shingles, not to exceed the maximum exposure specified in Table R703.6.1. When installing shakes or shingles over a nonpermeable water-resistive barrier, furring strips shall be placed first vertically over the barrier and in addition, horizontal furring strips shall be fastened to the vertical furring strips prior to attaching the shakes or shingles to the horizontal furring strips. The spacing between adjacent shingles to allow for expansion shall be  $\frac{1}{8}$  inch (3.2 mm) to  $\frac{1}{4}$  inch (6.4 mm) apart, and between adjacent shakes shall be  $\frac{3}{8}$  inch (9.5 mm) to  $\frac{1}{2}$  inch (12.7 mm) apart. The offset spacing between joints in adjacent courses shall be not less than  $1\frac{1}{2}$  inches (38 mm).

**TABLE R703.6.1**  
**MAXIMUM WEATHER EXPOSURE FOR WOOD SHAKES AND SHINGLES ON EXTERIOR WALLS<sup>a, b, c</sup>**  
 (Dimensions are in inches)

LENGTH	EXPOSURE FOR SINGLE COURSE	EXPOSURE FOR DOUBLE COURSE
Shingles <sup>a</sup>		
16	7	12 <sup>b</sup>
18	8	14 <sup>c</sup>
24	10 $\frac{1}{2}$	16 <sup>d</sup>
Shakes <sup>a</sup>		
18	8	14
24	10 $\frac{1}{2}$	18

For SI: 1 inch = 25.4 mm.

- a. Dimensions given are for No. 1 grade.
- b. A maximum 9-inch exposure is permitted for No. 2 grade.
- c. A maximum 10-inch exposure is permitted for No. 2 grade.
- d. A maximum 14-inch exposure is permitted for No. 2 grade.

**R703.6.2 Weather exposure.** The maximum weather exposure for shakes and shingles shall not exceed that specified in Table 703.6.1.

**R703.6.3 Attachment.** Wood shakes or shingles shall be installed according to this chapter and the manufacturer's instructions. Each shake or shingle shall be held in place by two stainless steel Type 304, Type 316 or hot-dipped zinc-coated galvanized corrosion-resistant box nails in accordance with Table R703.6.3(1) or R703.6.3(2). The hot-dipped zinc-coated galvanizing shall conform to minimum standard ASTM A153D, 1.0 ounce per square foot. Alternatively, 16-gage stainless steel Type 304 or Type 316 staples with crown widths  $\frac{7}{16}$  inch (11 mm) minimum,  $\frac{3}{4}$  inch (19 mm) maximum, shall be used and the crown of the staple shall be placed parallel with the butt of the shake or the shingle. In single-course application, the fasteners shall be concealed by the course above and shall be driven approximately 1 inch (25 mm) above the butt line of the succeeding course and  $\frac{3}{4}$  inch (19 mm) from the edge. In double-course applications, the exposed shake or shingle shall be face-nailed with two fasteners, driven approximately 2 inches (51 mm) above the butt line and  $\frac{3}{4}$