

ACCEPTANCE CRITERIA FOR CLAY AND CONCRETE ROOF TILES

AC180

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PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

This acceptance criteria has been issued to provide all interested parties with guidelines for demonstrating compliance with performance features of the applicable code(s) referenced in the acceptance criteria. The criteria was developed and adopted following public hearings conducted by the ICC-ES Evaluation Committee, and is effective on the date shown above. All reports issued or reissued on or after the effective date must comply with this criteria, while reports issued prior to this date may be in compliance with this criteria or with the previous edition. If the criteria is an updated version from the previous edition, a solid vertical line (|) in the margin within the criteria indicates a technical change, addition, or deletion from the previous edition. A deletion indicator (→) is provided in the margin where a paragraph has been deleted if the deletion involved a technical change. This criteria may be further revised as the need dictates.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria set forth in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise demonstrate compliance with the performance features of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

Acceptance criteria are developed for use solely by ICC-ES for purposes of issuing ICC-ES evaluation reports.

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1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for recognition of clay and concrete roof tiles in ICC Evaluation Service, Inc. (ICC-ES), evaluation reports under the 2009 *International Building Code*® (IBC), the 2009 *International Residential Code*® (IRC) and the 1997 *Uniform Building Code*™ (UBC). Bases of recognition are IBC Sections 104.11, 1507.3.4 and 1507.3.5; IRC Sections R104.11, R905.3.4 and R905.3.5; and UBC Sections 104.2.8 and 1507.7.

1.2 Scope: This criteria applies to clay and concrete roof tiles that are flat or curved pieces manufactured entirely from noncombustible materials, and that have maximum widths and lengths of 16 and 22 inches (406 and 559 mm), respectively.

1.3 Codes and Reference Standards:

1.3.1 2009 International Building Code® (IBC), International Code Council.

1.3.2 2009 International Residential Code® (IRC), International Code Council.

1.3.3 1997 Uniform Building Code™ (UBC).

1.3.4 ASTM C 67-07, Sampling and Testing Brick and Structural Clay Tile, ASTM International.

1.3.5 ASTM C 1167-03, Standard Specification for Clay Roof Tiles, ASTM International.

1.3.6 ASTM C-1492-03, Specification for Concrete Roof Tile, ASTM International.

1.3.7 ASTM E 108-07a, Test Methods for Fire Tests of Roof Coverings, ASTM International.

1.3.8 ASTM F 1667-05, Standard Specification for Driven Fasteners: Nails, Spikes and Staples, ASTM International.

1.3.9 SBCCI SSTD 11-99 Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles.

1.3.10 UL 790-04, Standard Test Methods for Fire Tests of Roof Coverings.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted:

2.1.1 Product Description: Complete information concerning material specifications, thickness, size and the manufacturing process.

2.1.2 Installation Instructions: Dimensioned scale drawings and installation details as follows:

2.1.2.1. Roof Deck: The roof covering shall be installed only over code-complying solid sheathing or spaced structural sheathing boards.

2.1.2.2. Deck Slope: Installation shall be on deck slopes complying with IBC Section 1507.3.2, IRC Section R905.3.2 or UBC Section 1505.7, as applicable.

2.1.2.3. Underlayment: Underlayment shall comply with IBC Section 1507.3.3, IRC Section R905.3.3 or UBC Section 1507.7, as applicable. The underlayment shall be installed over the sheathing.

2.1.2.4. Flashing: Flashing shall be in accordance with IBC Section 1507.3.9, IRC Section R905.3.8 or UBC Sections 1508 and 1509, as applicable.

2.1.2.5. Attachment: Fasteners, complying with IBC Section 1507.3.6, IRC Section R905.3.6 or UBC Section 1507.7, as applicable, shall be used to attach tile in accordance with IBC Table 1507.3.7, IRC Section R905.3.7 or UBC 1507.7, as applicable. Fasteners shall comply with the tolerance requirements of ASTM F 1667.

2.1.2.6. Replacing Broken Tiles: Instructions for replacing damaged or defective tiles.

2.1.3 Other Installation Conditions: For tiles installed with a less than 3-inch (76 mm) headlap, see Section 3.7 and Figure 1.

2.1.4 Packaging and Identification: The method of packaging and identifying components shall be specified. Identification shall include the evaluation report number and notice of any product installation limitations.

2.1.5 Field Preparation: Method of field-cutting, trimming or forming, and treatment of cut edges, shall be submitted.

2.2 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85), and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.3 Test Reports: Test reports shall comply with AC85. The test report shall be in sufficient detail to identify specimen properties that might affect performance as a roof covering. The testing laboratory shall verify and report dimensions, weight, density, chemical formulation, treatment, pressure, duration, treatment retention levels, moisture content and other relevant physical properties of the major components and the manner of installation, including a description of fastening elements. Photographs shall be included in the report.

2.4 Product Sampling: Test specimens shall be sampled in accordance with the product sampling requirements of AC85. Section 3.1 of AC85 applies to tests conducted in accordance with Section 3.6.1.1 of this criteria. Section 3.2 of AC85 applies to all other tests.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General: Prior to commencement of other tests, clay and concrete tiles shall be checked for shape, squareness of lugs, dimensional discrepancies and consistency in weight. A frame similar to the one shown in Figure 3 can be used to check for dimensional discrepancies. A minimum of eight tile specimens shall be individually weighed.

3.1.1 Condition of Acceptance: Tiles shall fit as intended to ensure proper installation and water runoff. Noninterlocking tiles are permitted a 1/2-inch (12.7 mm) tolerance before being considered off-size. For all other tiles, the individual tile weights and dimensions shall be within 5 percent of the manufacturer's stated specifications.

3.2 Materials:

3.2.1 Clay Roof Tiles: Clay roof tiles shall comply with ASTM C 1167.

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Note: Flat clay roof tiles installed with a maximum of 45 percent exposure shall comply with ASTM C 1167, except that the flexural strength test may be conducted in accordance with Section 3.3.10 of AC07, at the manufacturer's option.

3.2.2 Concrete Roof Tiles: Concrete roof tiles shall comply with ASTM C 1492.

3.3 Installed Weight: Twelve tiles, at a minimum, are to be initially weighed. The weighed tiles are then placed on a flat level surface in accordance with Figure 1, with tight side laps and head laps as specified in the manufacturer's installation instructions. The length (L) and width (W) of the area covered by the specific number of tiles is to be measured. The effective length is the measured length minus the head lap. The effective width is the measured width minus the side lap. The effective area is the effective length multiplied by the effective width. The tiles are put into a well-ventilated oven maintained at 221°F ± 4°F (105°C ± 2.2°C) for 24 hours. The tiles are removed from the oven and re-weighed. The unit dry weight is determined by adding the weights of each oven dry tile and dividing the total weight by the calculated effective area. The result is reported in pounds per square foot (kg/m²).

3.4 Uplift-bend Test: This test is required for installation on roof slopes exceeding 60 degrees from the horizontal.

Exception: Not required when the bottom edge of each tile is secured with an approved clip or nail.

3.4.1 The test specimen is a simulated roof, four courses high and a minimum of four tiles wide. Spaced or solid sheathing over typical roof framing, using minimum-size components, shall be used to typify field conditions. Fastener loads cannot exceed approved allowable values. Where allowable values are not available, load shall be based on a minimum factor of safety of 4, unless some other factor of safety is allowed. The test roof shall be erected and secured in a vertical position for testing, with the required loads applied horizontally. The horizontal load is applied at the center of the butt edge of an inner tile in the second course from the bottom of the test specimen. The loads required to lift the tile butt a distance of 1/8 inch (3.2 mm) and a distance of 2 inches (51 mm) shall be recorded. The latter is considered to be ultimate load. If failure occurs before the 2-inch (51 mm) movement, the method of failure shall be recorded. The same procedure is repeated for the butt edge of an inner tile in the top course of the test structure, recording the same loads. The test is continued with a load equal to three times the tile weight applied horizontally outward and vertically downward at the center of the butt edge of an inner tile in the second course from the bottom of the test deck.

3.4.2 Conditions of Acceptance: The load required to lift the tile butt 1/8 inch (3.2 mm) shall be a minimum of twice the tile weight. When subjected to a load equivalent to three times the tile weight, the tile shall not crack, break or fall off the specimen deck.

3.5 Wind Resistance:

3.5.1 IBC: On buildings having a maximum mean roof height of 60 feet (18.3 m), exposed to a maximum basic wind speed (3-second gust) not exceeding 100 mph (161 km/h), installation shall comply with IBC Table 1507.3.7.

3.5.1.1. For higher basic wind speeds or mean roof heights, the tile fastening system shall be designed in accordance with IBC Section 1609.5.2, as follows: The overturning moment determined in accordance with SBCCI SSTD 11, or the aerodynamic overturning moment, determined in accordance with either Section 800 or Section 900 of SBCCI SSTD 11, shall be equal to or greater than the aerodynamic uplift moment calculated in accordance with IBC Section 1609.5.3.

3.5.2 IRC: On buildings having a maximum mean roof height of 40 feet (12.2 m), exposed to a maximum basic wind speed (3-second gust) not exceeding 100 mph (161 km/h), tile application shall comply with IRC Section R905.3.7. For higher basic wind speeds or mean roof heights, installation shall be in accordance with Section 3.5.1.1 of this criteria.

3.5.3 UBC: Installation shall be justified as equivalent to that specified in UBC Tables 15-D-1 and 15-D-2.

3.6 Fire Classification:

3.6.1 IBC and IRC:

3.6.1.1. New Construction: Roofing assemblies shall be tested in accordance with either ASTM E 108 or UL 790.

Exceptions:

1. Clay or concrete roof tile are Class A roof coverings when installed on noncombustible decks in accordance with the exception to Section 1505.2 of the IBC and Section R902.1 of the IRC.

2. Under the IBC, nonclassified roofing in accordance with IBC Section 1505.5 and as permitted in IBC Table 1505.1.

3.6.1.2. Reroofing: Clay and concrete tiles are permitted to be installed over existing roofs, provided the requirements of IBC Section 1510 or IRC Section R907, as applicable, are met. The roof classification will be as determined in Section 3.6.1.1 of this criteria.

3.6.2 UBC:

3.6.2.1. New Construction: Clay and concrete tiles are noncombustible roof coverings in accordance with UBC Section 1504.2. Roof underlayment necessary for obtaining the classification in the tests will be identified in detail in the evaluation report and shall bear identification showing compliance with a nationally recognized standard. Successful fire-retardant roof tests described in UBC Standard 15-2 (ASTM E 108) and in this criteria are necessary for recognition as Class A, B or C roof assemblies on new construction, if such recognition is to be considered.

3.6.2.2. Reroofing: Fire-retardant roof tests conducted in accordance with UBC Standard 15-2 (ASTM E 108) and this criteria are necessary for recognition of all reroofing over existing roof covering materials.

Exception: Reroofing classified as nonrated.

3.7 Other Installation Conditions: The following conditions apply to tiles designed specifically for use with less than a 3-inch (76 mm) head lap:

3.7.1 IBC and IRC:

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1. Installation is over solid sheathing complying with the IBC or IRC, as applicable.
2. Tiles are fastened with a minimum of one fastener per tile. Fasteners shall comply with IBC Table 1507.3.7 or IRC Section R905.3.7, as applicable.
3. Tiles are of the interlocking type.
4. Minimum roof slope is in accordance with Table 1.
5. Minimum installed weight of tiles is 7.5 psf (36.6 kg/m²).

Exception: For tiles with an installed weight less than 7.5 psf (36.6 kg/m²), the tile fastening system, for each combination of tile type, tile size, substrate, mean roof height, roof pitch and wind speed for which recognition is sought, shall be designed in accordance with IBC Section 1609.5.2, as outlined in Section 3.5.1.1 of this criteria.

3.7.2 UBC:

1. Installation is over solid sheathing complying with the UBC.
2. Tiles are fastened with a minimum of one fastener per tile. Fasteners shall comply with UBC Table 15-D-1 or 15-D-2.
3. Tiles are of the interlocking type.
4. Minimum roof slope is in accordance with Table 1.
5. Minimum installed weight of tiles is 7.5 psf (36.6 kg/m²).

EXCEPTION: For tiles with an installed weight less than 7.5 psf (36.6 kg/m²), the tile fastening system shall be designed as follows:

For each combination of tile type, tile size, substrate, mean roof height, roof slope and wind speed for which recognition is sought, the overturning moment determined in accordance with SSTD 11-99, or the aerodynamic overturning moment determined in accordance with either Section 800 or Section 900 of SSTD 11-99, must be equal to or greater than the aerodynamic uplift moment calculated in accordance with the following formula:

$$M_a = L_a \cdot A \cdot C_e \cdot r \cdot C_q \cdot q_s \cdot I_w$$

where:

- A = Exposed area, feet² (mm²).
- C_e = Combined height, exposure and gust factor coefficient from UBC Table 16-G.
- C_q = Pressure coefficient from UBC Table 16-H.
- I_w = Importance factor = 1.0.
- L = Length of tile, feet (mm).
- L_a = Moment arm, in feet (mm), from the axis of rotation to the point of uplift on the roof tile. The point of uplift must be taken at 0.76L from the head of the tile and the middle of the exposed width.
- M_a = Aerodynamic uplift moment, ft.-lbf. (N-mm).

q_s = Wind stagnation pressure at standard height of 33 feet, from UBC Table 16-F, psf (kN/mm²).

r = Aerodynamic moment ratio = 0.25.

4.0 QUALITY CONTROL

4.1 General: Clay and concrete roof tiles are required to be manufactured under a quality control program documented in accordance with the ICC-ES Acceptance Criteria for Quality Documentation (AC10). Complete records shall be maintained of the quality control tests.

4.1.1 Clay Tile: As a minimum, tiles drawn from each production shift shall be subjected to the strength, durability and permeability tests specified in ASTM C 1167. For permeability tests, only one specimen is required. Additionally, tile dimensions shall be checked to ensure that when installed in the specified manner, a uniform and tight installation is achieved. To accomplish this, a test stand similar to that shown in Figure 3 may be used. Complete records shall be maintained of the quality control tests. Tiles shall comply with the strength values specified in ASTM C 1167 at the time of shipment from the manufacturing plant.

4.1.2 Concrete Tile: As a minimum, tiles drawn from each production shift shall be subjected to the strength, water absorption and permeability tests specified in ASTM C 1492. For permeability tests, only one specimen is required. Additionally, tile dimensions shall be checked to ensure that when installed in the specified manner, a uniform and tight installation is achieved. To accomplish this, a test stand similar to that shown in Figure 3 may be used. Complete records shall be maintained of the quality control tests. Tiles shall comply with the strength values specified in ASTM C 1492 at the time of shipment from the manufacturing plant.

4.1.2.1. Alternate Permeability Tests: As an option, permeability testing shall be conducted in accordance with Section 6.6 of ASTM C 1167.

4.2 Inspections: Roofing assemblies listed as Class A, B or C as determined by test shall be produced under an approved quality control program with inspections by an inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES. Quality control documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality control program shall ensure the ongoing compliance of the roof coverings with the requirements of ASTM E 108 or UL 790, as applicable.

4.3 EXCEPTIONS TO INSPECTIONS BY AN ACCREDITED AGENCY:

1. Under the IBC and the IRC, clay or concrete roof tiles that are Class A roof coverings in accordance with Exception 2 to Section 1505.2 of the IBC and Section R902.1 of the IRC.

2. Under the IBC, nonclassified roofing that is in accordance with Section 1505.5 of the IBC and as permitted in Table 1505.1 of the IBC.

3. Under the UBC, roof construction recognized as nonrated.

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4. Under the UBC, roof constructions complying with the exception for a noncombustible roof covering under Section 1504.2 of the UBC.

4.4 Except as noted in Section 4.2, third-party follow-up inspections are not required under this acceptance criteria.

5.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following:

5.1 Basic information required by Sections 2.1.1 through 2.1.5, including product description, installation procedures, installed weight, and packaging and identification.

5.2 Information concerning reroofing applications, if applicable.

TABLE 1—MINIMUM ROOF SLOPES

ITEM NO.	TILE INTERLOCKING MECHANISM(S)	HEAD LAP (inches) ²	MINIMUM ROOF SLOPE (inches/horizontal foot)
1	Interlocking up the slope and across the slope	2 ¹ / ₂ to less than 3	3:12
		2 to less than 2 ¹ / ₂	4:12 ³
		1 ³ / ₄ to less than 2	5:12
2	Interlocking only across the slope	2 ¹ / ₂ to less than 3	4:12
		2 to less than 2 ¹ / ₂	5:12
		1 ³ / ₄ to less than 2	6:12

For **SI**: 1 inch = 25.4 mm.

¹See Figure 2 for details on interlocking mechanism orientations.

²Minimum head lap required is 1³/₄ inches (44.5 mm).

³Tiles with a headlap of 2 to less than 2¹/₂ inches may be installed at roof slopes less than 4:12 but not less than 3:12 provided the tiles are installed over solid sheathing with two layers of underlayment.

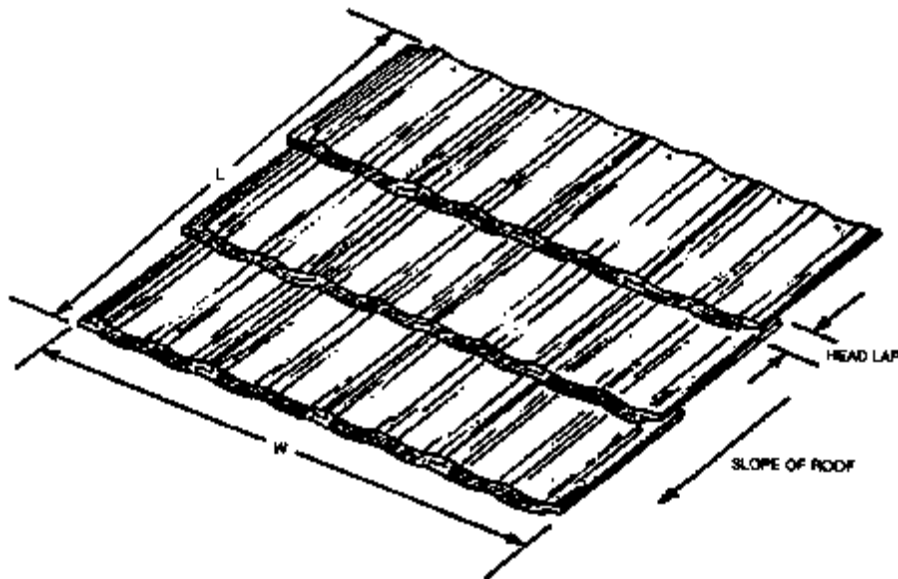


FIGURE 1

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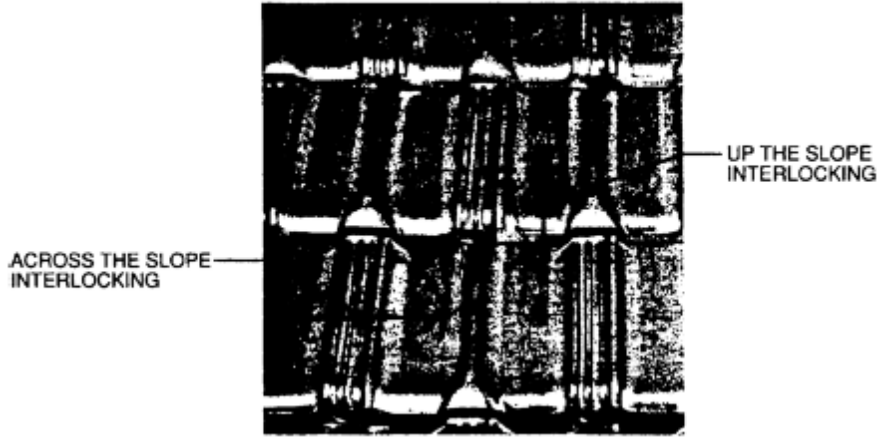
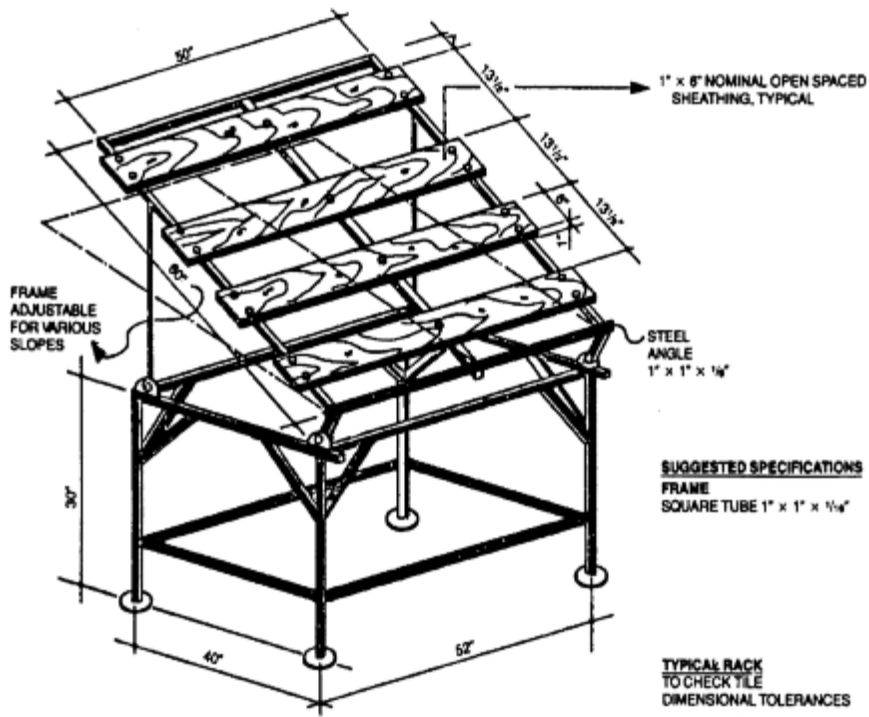


FIGURE 2



For SI: 1 inch = 25.4 mm.

FIGURE 3