



CONSTRUCTION MATERIALS

TECHNOLOGIES

LABORATORY TEST REPORT

Report for: M. C. Harry Associates
2780 SW Douglas Road
Suite 302
Miami, FL 33133

Attention: Jim Piersol

Product Name: Alhambra®	Manufacturer: Zion Tile Corp.
Date Received: February 26, 2015	Sampling: M. C. Harry Associates
PRI Project No.: MCHA-001-02-01	Test Dates: Feb. 27 – Mar. 17, 2015

Purpose: Client has requested an evaluation of the aforementioned clay roof for compliance with **ASTM C 1167-03: STANDARD SPECIFICATION FOR CLAY ROOF TILES**. Freeze/Thaw testing was omitted from the evaluation.

Test Methods: Testing was conducted in compliance with ASTM C 1167-03: *STANDARD SPECIFICATION FOR CLAY ROOF TILES*. Test methods referenced in these specifications area the following: ASTM C 67: *STANDARD TEST METHODS FOR SAMPLING AND TESTING BRICK AND STRUCTURAL CLAY TILE*, ASTM C 297/C 297M: *STANDARD TEST METHODS FOR TENSILE STRENGTH OF FLAT SANDWICH CONSTRUCTIONS IN FLATWISE PLANE*, and ASTM C 554: *STANDARD TEST METHODS FOR CRAZING RESISTANCE OF FIRED BLAZED CERAMIC WHITEWARES BY A THERMAL SHOCK METHOD*.

Sampling: Zion Tile Corp.'s Alhambra® barrel roof tiles were provided by M.C. Harry Associates.

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Evaluation: Upon receipt of the test articles, samples were prepared, photographed and measured for overall dimensions and mass. Photographs of the test articles prior to testing are shown in Figures 1 and 2 below. Dimensions and Masses are shown in Table 1 below.



Figure 1. Alhambra® barrel tile prior to testing



Figure 2. Stamped manufacturer and origin of test article

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Table 1. Dimensions and Mass of Alhambra® barrel tile

Property	Test Method	Results		Requirement
		Measured	Specified ¹	
Dimensions				
Length, in	ASTM C 1167	18.15	18	± 5% from specified
Width (Head End), in	ASTM C 1167	6.5	6.25	± 5% from specified
Width (Butt End), in		7.8	8.25	± 5% from specified
Weight, lb	ASTM C 1167	6.21	5.5	± 10 % from specified
Rise, in.	ASTM C 1167	3	NS ²	Report.
Rise-to-Width	ASTM C 1167	0.46	NS ²	>0.2 for Type I

Notes: 1) Specifications obtained from Manufacturer's published information
 2) NS = "Not specified"

Test articles were further evaluated for *Wet Transverse Strength* for conformance with Type I tile requirements. Type I tiles must have a minimum average *Wet Transverse Strength* of 300 lbf, where N=5, with no individual tile having a strength of less than 260 lbf. The results of the aforementioned testing are contained in Table 2 below.

Table 2. Dry Transverse Strength of Alhambra® barrel tile

Property	Test Method	Results						Requirement	
		1	2	3	4	5	Average	Average	Individual
Wet Transverse Strength (lbf) Submerged 24h at 75±10°F								Type I	
Strength – lbf	ASTM C 67 / ASTM C 1167	82	162	124	156	181	141	≥ 300	≥ 260

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Cold Water Absorption and *Saturation Coefficient* compliance of the test article was also evaluated. The Weathering Index per Annex A1 of ASTM C 1167 requires tile for south Florida to meet a minimum Grade 3. Grade 3 tiles must have a maximum average *Cold Water Absorption* of 13%, where N=5, with no individual tile having an absorption greater than 15%. *Saturation Coefficient* must meet a maximum average of 0.84, and 0.86, individually. The results of the aforementioned testing are contained in Table 3 below.

Table 3. Cold Water Absorption and Saturation Coefficient of Alhambra® barrel tile

Property	Test Method	Results						Requirement	
		1	2	3	4	5	Average	Average	Individual
Cold Water Absorption; Cond. 235°F for 24h Immersed in 75°F water for 24h								Type I	
Absorption – %	ASTM C 67 / ASTM C 1167	19	15	22	19	27	21	≤13	≤15
Saturation coefficient, [dimensionless]	ASTM C 67	0.89	0.94	0.99	0.91	0.93	0.93	≤ 0.84	≤ 0.86

Lastly, all tile types and grades are required to meet the following properties.

Table 4. Efflorescence, Reactive Particles, and Permeability for Alhambra® barrel tile

Property	Test Method	Results	Requirement
Efflorescence, [visual inspection]	ASTM C 67 / ASTM C 1167	Not effloresced	Not effloresced
Reactive particulates, [visual inspection]	ASTM C 1167	Fail	None
Permeability, [Pass/Fail]	TAS 112 ¹	Fail	Pass

Notes: 1) Note enough tiles were provided to conduct the Permeability test in accordance with ASTM C 1167. Permeability per TAS 112 was conducted as a surrogate.

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Concluding Remarks:

The Alhambra® barrel clay roof tile provided from M. C. Harry Associates did not comply with ASTM C 1167-03 as required by the 2010 Florida Building Code.

Signed:



Zachary Priest, P.E.
Director

Report Issue History:

Issue #	Date	Pages	Revision Description (if applicable)
Original	03/17/2015	5	NA

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