

Thermal Treated Hardwood Floor Testing  
NRRRI Technical Note TN-2010/45  
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**Objective:** To conduct testing of thermal treated ash flooring materials provided by Attica Millwork Company to determine the dimensional stability performance as part of their internal research activities and compare the results to that of ash that was not heat treated. Specific testing includes a measurement of flooring cup/crown, bow/ski, twist, thickness, width and weight as assessed as received and after equilibration at high relative humidity (RH) and low RH conditions.

**Samples:** Twenty-four heat treated flooring samples were provided to the Natural Resources Research Institute for evaluation of dimensional stability in August 2010. An additional set of untreated ash was provided as a control group with the first set of measurements occurring on October 27, 2010.

8 samples - Trial #2010-1; 5 inch wide flooring "Salsa treatment"  
8 samples - Trial #2010-2; 7.5 inch wide flooring "Salsa treatment"  
8 samples - Trial #2010-3; 6 inch wide flooring "Tango treatment"  
  
3 samples – Trial #2010-4; 5 inch wide flooring “untreated”  
3 samples – Trial #2010-5; 6 inch wide flooring “untreated”  
3 samples – Trial #2010-6; 7.5 inch wide flooring “untreated”

**Testing:** Each group of thermal treated samples was measured as received to determine cup/crown, bow/ski, twist, thickness, width and weight. Two subgroups of three samples were created, HUMID and DRY. Each subgroup was placed in an environmental chamber with different settings- humid or dry on 8/06/10. The remaining two samples from each group were used to track moisture content of the subgroups humid and dry.

One third of each moisture tracking sample was cut off and oven dried to determine theoretical starting moisture content (MC) for the group. The remainder was placed with the subgroup in the conditioning room. The humid room was adjusted to 80% RH. The dry room was adjusted to 15%. On 9/3/10, the dry samples were re-measured and were then switched to the opposite room conditions. On 9/23/10, the humid room samples were re-measured and were

then switched to the opposite room conditions.

The control, non-heat treated samples were shipped to NRRI in late September. They were allowed to equilibrate at approximately 7-8% MC until late October. On October 27, the first set of measurements were taken. There were three pieces of each untreated ash and they were all placed into the low humidity room for equilibration. The untreated samples reached 4.5-5.5% MC on January 1, 2011. The samples were measured for weight, width, thickness, cup/crown, bow/ski, and twist.

**Results:** A summary of the testing results are shown in the following tables.

Table 1.--Moisture content of samples during the testing process as determined through oven drying.

Specimen Group	Moisture Content as Received (7/28/09)	Moisture Content at switch	Moisture Content (- End)
Trial #2010-1 <sup>a</sup>	4.42	8.10 humid room 2.05 dry room	
Trial #2010-2 <sup>a</sup>	3.78	8.04 humid room 2.63 dry room	
Trial #2010-3 <sup>a</sup>	4.26	6.42 humid room 2.99 dry room	
Trial #2010-4	7.65 <sup>b</sup>	4.93 dry room	
Trial #2010-5	8.79 <sup>b</sup>	5.96 dry room	
Trial #2010-6	7.22 <sup>b</sup>	4.43 dry room	

Note: Based on oven-dry testing according to ASTM D4442 – 07 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

Values are based on the weights of initial oven dried samples.

<sup>a</sup>Dry room samples switched 9/03/10, humid room samples switched 9/23/10.

<sup>b</sup>Moisture content at start of testing.

Table 2.--Weight change during testing.

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Weight (grams)</b>				
		8/6/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 15% RH)	Change from previous
Trial #2010-1	3	1,627.78	1,694.49	69.71	1630.01	-64.48
Trial #2010-2	3	2,366.07	2,447.74	81.67	2355.45	-92.27
Trial #2010-3	3	1,578.88	1606.70	27.82	1561.87	-44.83
		8/6/2010 (as received)	9/3/10 (after 28 days at 70°F and 15% RH)	Change from start	10/27/2010 (after 34 days at 70°F and 80% RH)	Change from previous
Trial #2010-1	3	1,506.73	1,484.60	-22.13	1566.81	82.21
Trial #2010-2	3	2,273.46	2,237.25	-36.21	2362.10	124.85
Trial #2010-3	3	1,741.44	1,708.65	-32.79	1771.87	63.22

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Weight (grams)</b>				
		10/27/10 (at start)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-4	3	1,502.58	1468.21	-34.37		
Trial #2010-5	3	1,933.47	1888.13	-45.34		
Trial #2010-6	3	2,223.54	2167.46	-56.08		

Table 3.--Width change during testing.

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Width (in.)</b>				
		8/06/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 15% RH)	Change from previous
Trial #2010-1	3	5.1291	5.1931	0.0640	5.1386	-0.0545
Trial #2010-2	3	7.5117	7.5940	0.0823	7.5149	-0.0791
Trial #2010-3	3	5.9114	5.9480	0.0366	5.9053	-0.0427
		8/06/2010 (as received)	9/3/2010 (after 28 days at 70°F and 15% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 80% RH)	Change from previous
Trial #2010-1	3	5.1279	5.1068	-0.0211	5.1937	0.0869
Trial #2010-2	3	7.5097	7.4736	-0.0361	7.5965	0.0868
Trial #2010-3	3	5.9113	5.8812	-0.0301	5.9432	0.0620

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Width (in.)</b>				
		10/27/10 (at start)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-4 (untreated)	3	4.9319	4.8919	-0.0400		
Trial #2010-5 (untreated)	3	5.9103	5.8551	-0.0552		
Trial #2010-6 (untreated)	3	7.3876	7.3082	-0.0794		

Table 4.--Thickness change during testing.

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Thickness (in.)</b>				
		8/06/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 15% RH)	Change from previous
Trial #2010-1	3	0.7196	0.7271	0.0075	0.7186	-0.0085
Trial #2010-2	3	0.7250	0.7278	0.0028	0.7305	-0.0027
Trial #2010-3	3	0.7223	0.7247	0.0024	0.7206	-0.0041
		8/06/2010 (as received)	9/3/2010 (after 28 days at 70°F and 15% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 80% RH)	Change from previous
Trial #2010-1	3	0.7175	0.7137	-0.0038	0.7285	0.0148
Trial #2010-2	3	0.7226	0.7168	-0.0058	0.7318	0.0150
Trial #2010-3	3	0.7194	0.7162	-0.0032	0.7222	0.0028

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Thickness (in.)</b>				
		10/27/10 (at start)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-4 (untreated)	3	0.7127	0.7107	-0.0020		
Trial #2010-5 (untreated)	3	0.7092	0.7063	-0.0029		
Trial #2010-6 (untreated)	3	0.7124	0.7072	-0.0052		

Table 5.--Cup/crown change during testing.

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Cup/Crown (in.) cup = positive, crown = negative</b>				
		8/06/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 15% RH)	Change from previous
Trial #2010-1	3	0.0044	0.0031	0.0013	0.0033	0.0002
Trial #2010-2	3	0.0051	0.0099	0.0048	0.0152	0.0051
Trial #2010-3	3	0.0018	0.0026	0.0008	0.0029	0.0003
		8/06/2010 (as received)	9/3/2010 (after 31 days at 70°F and 15% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 80% RH)	Change from previous
Trial #2010-1	3	0.0023	0.0021	0.0002	0.0083	0.0062
Trial #2010-2	3	0.0009	-0.0044	0.0055	0.0068	0.0112
Trial #2010-3	3	-0.0018	-0.0029	0.0011	0.0002	.0031

Group (Trial #)	Number of Samples	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Cup/Crown (in.) cup = positive, crown = negative</b>				
		10/27/10 (at start)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-4 (untreated)	3	0.0031	0.0090	0.0059		
Trial #2010-5 (untreated)	3	-0.0272	-0.0340	-0.0068		
Trial #2010-6 (untreated)	3	0.0005	-0.0015	-0.0020		

Table 6.--Bow/ski change during testing.

Group (Trial #)	Sample Number	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Bow/ski (in.) B = Bow; S = Ski</b>				
		8/06/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 15% RH)	Change from previous
Trial #2010-1	4	0.0085 B	0.0275 B	0.0190	0.0060 B	0.0215
	5	0.0000	0.0080 S	0.0080	0.0070 B	0.0150
	6	0.0125 B	0.0070 B	0.0055	0.0070 B	0.0000
Trial #2010-2	4	0.0580 B	0.0045 B	0.0535	0.1505 B	0.1460
	5	0.0415 S	0.0555 S	0.0140	0.0875 B	0.1430
	6	0.0000	0.0695 B	0.0695	0.0065 B	0.0630
Trial #2010-3	4	0.0215 S	0.0425 B	0.0640	0.0160 S	0.0585
	5	0.0465 B	0.0455 B	0.0010	0.0630 B	0.0175
	6	0.0400 B	0.0315 S	0.0715	0.0610 B	0.0925
		8/06/2010 (as received)	9/3/2010 (after 28 days at 70°F and 15% RH)	Change from start	10/26/2010 (after 33 days at 70°F and 80% RH)	Change from previous
Trial #2010-1	1	0.0085 B	0.0085 B	0.0000	0.0090 B	0.0005
	2	0.0035 S	0.0050 S	0.0015	0.0045 S	0.0005
	3	0.0070 B	0.0060 B	0.0010	0.0190 B	0.0130
Trial #2010-2	1	0.0090 S	0.0065 S	0.0025	0.0240 S	0.0175
	2	0.0000	0.0070 B	0.0070	0.0095 S	0.0165
	3	0.0290 S	0.0490 S	0.0200	0.0505 S	0.0015
Trial #2010-3	1	0.0025 B	0.0045 B	0.0020	0.0035 B	0.0010
	2	0.0000	0.0085 B	0.0085	0.0020 B	0.0065
	3	0.0030 B	0.0320 S	0.0350	0.0220 S	0.0100

Group (Trial #)	Sample Number	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Bow/ski (in.) B = Bow; S = Ski</b>				
		10/27/10 (as received)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-4 (untreated)	1	0.1055 B	0.1285 B	0.0230		
	2	0.0035 B	0.0035 B	0.0000		
	3	0.0660 B	0.0850 B	0.0190		
Trial #2010-5 (untreated)	1	0.0310 B	0.0485 B	0.0175		
	2	0.0415 B	0.0100 B	0.0315		
	3	0.0300 S	0.0650 B	0.0350		
Trial #2010-6 (untreated)	1	0.0505 S	0.0195 B	0.0310		
	2	0.0295 S	0.0145 B	0.0150		
	3	0.0700 S	0.0780 S	0.0080		



Table 7.--Twist change during testing.

Group (Trial #)	Sample Number	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Twist (measured in 1/64 in.)</b>				
		8/06/2010 (as received)	9/23/2010 (after 48 days at 70°F and 80% RH)	Change from start	10/26/2010 (after 33 days at 70°F/15% RH)	Change from previous
Trial #2010-1	4	0	0	0	0	0
	5	0	0	0	0	0
	6	0	0	0	0	0
Trial #2010-2	4	0	0	0	9/64	9/64
	5	0	2/64	2/64	6/64	4/64
	6	0	8/64	8/64	0	8/64
Trial #2010-3	4	0	6/64	6/64	2/64	4/64
	5	0	3/64	3/64	3/64	0
	6	3/64	2/64	2/64	7/64	5/64
		8/06/2010 (as received)	9/3/2010 (after 28 days at 70°F and 15% RH)	Change from start	10/26/2010 (after 33 days at 70°F/80% RH)	Change from previous
Trial #2010-1	1	0	0	0	0	0
	2	0	0	0	1/64	1/64
	3	0	0	0	2/64	2/64
Trial #2010-2	1	1/64	1/64	0	2/64	1/64
	2	0	0	0	2/64	2/64
	3	1/64	5/64	4/64	5/64	0
Trial #2010-3	1	0	0	0	0	0
	2	0	1/64	1/64	1/64	0
	3	2/64	3/64	1/64	3/64	0

Group (Trial #)	Sample Number	Thermal Treated Wood Flooring Dimensions and Response to Environmental Conditions				
		<b>Twist (measured in 1/64 in.)</b>				
		10/27/10 (as received)	01/05/11 (after 70 days at 71°F and 15% RH)	Change from start		Change from previous
Trial #2010-1 (untreated)	4	2/64	3/64	1/64		
	5	0	1/64	1/64		
	6	1/64	1/64	0		
Trial #2010-2 (untreated)	4	5/64	7/64	2/64		
	5	4/64	4/64	0		
	6	4/64	3/64	1/64		
Trial #2010-3 (untreated)	4	5/64	5/64	0		
	5	5/64	5/64	0		
	6	4/64	5/64	1/64		



1.--Cup/crown measuring device.



2.--Thickness measuring device and bow/ski measuring device.



3.--Twist measurement device.