

## Strength and Warp Testing of Hard Maple Gymnasium Floor Systems

Nearly 70% of sports floors in the United States are manufactured from wood because wood floors provide good durability and performance. Most of these floors are manufactured from hardwood materials in a tongue and groove strip flooring orientation. A variety of floor configurations are available in the marketplace, each having their unique subflooring, flooring board profile, and fastener connection type and configuration. To assist in the development of performance-based design specifications for sports floors, we need a better understanding of how these different systems perform under various service conditions.

### Background

Typical problems reported by floor owners are excessive cupping deformations and localized failures. Expansion from cumulative moisture swelling of individual boards is routinely handled by proving edge gaps along the perimeter of the room. The swelling is most pronounced in the direction transverse to the flooring board orientation. This approach works well for floor systems in most environments. However, when floor systems are installed in high-humidity environments, unacceptable warping and cupping problems have been reported.



**This 53,000 square-foot maple floor system is located in the Boo Williams Sports complex in Hampton, Virginia.**

In addition, localized failures in the floor system have been reported in service, especially with the thinner (1/2-inch thick) board profiles. It is suspected that certain loads on the floor are surpassing the strength of the tongue and groove joints. Because several size flooring configurations are usually an option, quantifying the comparative strength of the thinner (1/2-inch thick) board profiles as compared with thicker board profiles is needed to develop in-service performance guidelines.

To gain a better understanding of the comparative performance of various floor systems that they manufacture, Action Floor

Systems, LLC, (Mercer, WI) contacted the Forest Products Laboratory for technical assistance. Subsequently, a cooperative research agreement was initiated and a project study plan was drafted for a laboratory investigation.

### Objective

The objective of this laboratory study is to investigate the comparative warping and strength characteristics of three different sizes of hardwood flooring. Warping investigations will monitor swelling and cupping of assembled floor test panels as they transition to high humidity conditions (75 °F and 75 RH). Strength investigations will involve static-bending failure tests of individual boards and assembled test panel sections.



**Test Specimens**

	Tongue and groove flooring dimension (in.)	Finger-joints?
Panel 1	2-1/4 by 1/2	Yes
Panel 2	2-1/4 by 25/32	No
Panel 3	1-1/2 by 25/32	No

**Approach**

- Monitor warping and cupping in the panel assemblies as they transition to high-humidity conditions.
- Conduct static tests on panel assemblies to determine stiffness and strengths.
- Conduct static tests on the flooring boards to determine tongue and groove joint strengths.

**Expected Outcomes**

The final report will document the comparative warping and strength characteristics of three different sizes of hardwood flooring.

**Timeline**

Design and preparations for testing were in February 2009. Testing was completed March through June 2009. A final report will be completed by the end of 2010.

**Cooperators**

U.S. Forest Service, Forest Products Laboratory  
Action Floor Systems, LLC

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