Hardness of Wood Baseball Bats

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The significance of the relationship between surface hardness and wood bat durability is currently not well understood. In the current exploratory study, the Janka hardness of maple wood bats with and without a surface treatment was studied. The Janka hardness of each bat from a set of finished wood baseball bats from five different manufacturers was measured at three locations on the radial grain of the barrel region of each bat. Eight maple wood billets were hardness tested at four locations at 1.6-cm increments. All samples were conditioned at 22˚C and 50% R.H. for >2 weeks before testing. The nominal sizes of the billets were 6.4 cm in diameter and 33.7 cm in length. Billets were categorized based on the growth-ring density (wide or tight) and by the grain surface (radial or tangential). Each billet had one of two different proprietary surface treatments consisting of a cross-linked polymer heat treatment developed and applied by Dove Tail Bats. Four of the eight billets were cut down their length such that the testing was conducted on the tangential grain of the wood while the remaining four were tested on the radial grain of the wood. The Janka hardness of the wood was calculated as given in ASTM Standard D1037-12 [1]. Per the wood handbook, the expected Janka hardness values for maple wood are expected to be near 6450 N [2].

A tabulated comparison of the average measured hardness of the five baseball bats and average hardness of billets by surface finish are shared in Table 1. BM1 denotes Bat Manufacturer #1, etc. Note that the billet hardness values are the averages of the respective tested grain surfaces (16 hardness tests each).

Table 1: Janka Hardness Comparison

ID	Janka Hardness (N)	St. Dev (N)
BM1	6961	280
BM2	6877	258
BM3	5836	36
BM4	5120	102
BM5	5952	93
Billet - Radial Grain	8078	405
Billet - Tangential Grain	10080	712

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The results in Table 1 show that the billets with a surface treatment are considerably harder than the baseball bats that were tested. Additional analysis was conducted related to understanding Janka hardness with respect to growth ring density, test location, and each tested billet. Figure 1 compares the measured hardness values of the billets with a surface treatment. The labels used on the x-axis in Figure 1 outline the testing conditions, which include the billet category based on growth-ring density (1-tight, 2-wide), the testing surface grain (R-Radial, T-Tangential), and which side of the billet was tested after being cut down its length (A or B).

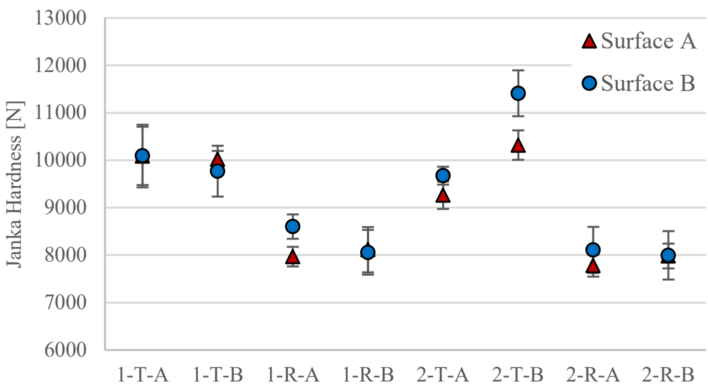

Fig. 1: Billet Janka Hardness Comparison

The results in Figure 1 show that Surface B is slightly harder in three of the eight testing conditions, while the remaining five conditions show no statistically significant difference between the surface treatments. More importantly, the results in Figure 1 show that the tangential grain of the maple wood with a surface treatment is harder than the radial grain with a surface treatment. All Janka hardness values were found to be significantly harder than the range of maple bats tested (5120 to 6961 N) and the average hardness of maple cited in the wood handbook (6450 N). Future work will be to conduct high-speed impact testing of bats with and without the surface treatment to examine effects on bat durability.

1. ASTM Standard 1037-12, 2020, “Evaluating Properties of Wood-Base Fiber and Particle Panel Materials,” ASTM International, West Conshohocken, PA, 2020, DOI: 10.1520/D1037-12R20, www.astm.org
2. United States Department of Agriculture, Forest Service, Forest Products Laboratory (2010) Wood Handbook: Wood as an Engineering Material. Forest Products Laboratory, Madison, Wisconsin.

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