RockBats
Technical Note
RB-TN-001



June, 2006

# Mechanical Properties of Various Hardwoods Suitable for Baseball Bats

When considering a wood species for manufacturing solid-wood baseball bats, there are several mechanical properties that can be compared for an initial evaluation of the species. Specific gravity, Modulus of Elasticity, Modulus of Rupture, and Hardness are commonly published mechanical properties that are good indicators of potential baseball bat performance.

**Specific gravity (S.G.)** is important because it is a measure of the density of the wood. If one plans to make a baseball bat similar in shape to that of a solid-wood White Ash bat, the specific gravity must be approximately that of White Ash to achieve the same weight drop. Specific gravity is usually a value less than 1.0; it is determined by dividing the density of the wood by the density of water (62.4 lbs/ft$^3$).

**Modulus of Elasticity (MOE)** is a measure of the stiffness of the wood. Slow-motion video has shown that baseball bats do deflect during impact with a baseball. Woods having higher modulus of elasticity will resist this type of deflection.

**Modulus of Rupture (MOR)** is the stress at which wood breaks when deflected by a "static" bending load. A "static" load is a slowly applied load that slowly bends the wood until it breaks. This property can be used to preliminarily evaluate the strength of different wood species for use in baseball bats, however, the reader should keep in mind that a baseball bat actually undergoes "dynamic" loading when it hits a baseball. Dynamic loads cause much higher stresses than static loads. When a bat hits a baseball, especially away from the sweet spot, the stresses in the handle usually far exceed the modulus of rupture of the wood. There are several other properties that more exactly measure the shock-absorbance and impact-resistance of wood when subjected to dynamic loads. Those are not covered here.

**Hardness** is a measure of the resistance to denting. This property is often used to compare different wood species for uses such as flooring. In a baseball bat, if the wood dents when it hits a baseball, there is energy lost during the bat-ball collision. Energy lost due to denting is not transferred to the ball. In baseball terms, wood species with higher hardness are often said to have "more pop".

The following table from the USDA Forest Products Laboratory's *Wood Handbook* (1999) lists the above mechanical properties of several species often used for baseball bats.

| Common name | Scientific name | S.G. | MOE (x10$^6$ lb/in$^2$) | MOR (lb/in$^2$) | Hardness (lbs.) |
|---|---|---|---|---|---|
| White Ash | *Fraxinus americana* | 0.60 | 1.74 | 16,000 | 1,320 |
| Sugar Maple | *Acer saccharum* | 0.63 | 1.83 | 15,800 | 1,450 |
| Red Maple | *Acer rubrum* | 0.54 | 1.64 | 13,400 | 950 |
| Hickory | *Carya ovata* | 0.72 | 2.16 | 20,200 | 1,820 |
| Yellow Birch | *Betula alleghaniensis* | 0.62 | 2.01 | 16,600 | 1,260 |
| Beech | *Fagus grandifolia* | 0.64 | 1.72 | 14,900 | 1,300 |
| Red Oak | *Quercus rubra* | 0.63 | 1.82 | 14,300 | 1,290 |
| White Oak | *Quercus alba* | 0.68 | 1.78 | 15,200 | 1,360 |

Wood Handbook. 1999. Wood As An Engineering Material. USDA-FS-FPL General Technical Report No. 113. Madison, WI.