

# Demonstration of the Bending Properties of the Wood of Western Juniper (*Juniperus occidentalis* Hook.)

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## Introduction

Wood of western juniper, *Juniperus occidentalis* Hook., that had been water-saturated, and either heated or unheated, displayed great flexibility during vertical veneer slicing trials conducted in 1993 at Rogue Valley Sash and Door, Grants Pass, Oregon. According to the guillotine-slicer operator, it was the most “noodly” species he had ever seen (Swan, 1993<sup>1</sup>).

Based on this information, a simple demonstration of the bending properties of the wood of western juniper was performed and is documented in the following report. Results are considered important to manufacturers interested in bending properties of alternative species and new product lines.

## Methods and Materials

Thin strips (0.100” to 0.250”) were sawn from clear, straight-grained 4/4 lumber cut from trees harvested near Klamath Falls, Oregon. Two methods of preparation were used: Resaturation in boiling water followed by steeping in live steam (soak/steam bending), and resaturation only (soak bending). Saturation was judged complete when air bubbles no longer escaped from the wood’s surface, and the strip sank to the bottom of the container. For water soak/steam bending, strips were first placed in boiling water for 3-5 minutes, then lifted from the water and allowed to steep in live steam generated at ambient pressure for another 2-3 minutes.

After preparation by both methods, sample pieces were bent into several shapes including helices, overhand knots, spirals, circles and several combinations of all these. Minimum radii of curvature were approximately 0.750” for 0.125” thick pieces.

Results of the demonstration show that average springback (straightening) after cooling only was approximately 5°/360° of springback, while 3 minutes in boiling water resulted in nearly 120°/360° of springback. Other shapes were also subjected to springback tests and behaved in a similar fashion.

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<sup>1</sup> Swan, L. 1993. Non-commercial wood species slicing and drying project. Unpublished manuscript. On file USDA Forest Service, Winema National Forest, Klamath Falls, OR.

Dry, unheated wood strips were also fashioned into bent shapes through adhesive laminating. Polyvinyl acetate crosslinking adhesive was used to laminate strips into semicircular shapes and tested for thicknesses by laminating over wooden forms. Minimum radius of curvature was 3.5" for a 4-ply specimen. Springback after boiling for 10 minutes was approximately 10°/180° semicircle. Springback after 10 minutes of immersion in cold water was not measurable.

A separate experiment was conducted to determine if saturation could be hastened or increased by immersion in cold water after cessation of air escape (emission of bubbles) from the wood strips. Very little additional moisture was taken into the strips with this method and no differences in bending results were observed. The additional time required to reheat the cooled strips for bending would be detrimental to veneer slicing or strip-bending operations requiring heated wood.

## **Conclusions**

1. Western juniper is a very flexible wood, conducive to bending after saturation and heating.
2. Minimum attainable radius of curvature for western juniper bentwood products decreases with decreasing stock thickness, with 0.75" the minimum practical radius for 1"-wide x 0.125"-thick strips.
3. Cold water soaking after saturation in boiling water does not result in increased moisture content of the bending strips.

## **Implications for Industry**

1. Thin, bent-wood western juniper products produced by steam or hot-water heating should not be exposed to a combination of heat and high-humidity (steam rooms and saunas). Other species, such as beech, ash hickory and oak also show relaxation of bends upon exposure to these extreme conditions, however not to the extent that western juniper does.
2. Cold-water storage following saturation in hot or boiling water will increase the length of reheating time for veneer blocks and bending stock prior to bending. Blocks and stock should be kept warm prior to bending to facilitate the manufacturing process.
3. Based on industry experience with other commonly bent species such as oak, beech and willow, a combination of pre-bending by steam/saturation and drying, followed by further bending and glue-lamination would allow smaller radii or curvature, increased strength, and improved resistance to springback. This technique is often used for furniture requiring extensive bending in intricate shapes such as Scandinavian-design beechwood and sling chair. Use in high strength and durability products such as furniture and engineered products will most likely require this technique for western juniper.

4. As with bentwood products of other species, western juniper plasticizes and springs back slightly toward its original, straight shape in humid environments. For example, if western juniper bentwood was to be used in outdoor furniture, water repellent finishes would have to be properly applied and maintained to prevent plasticization and the subsequent deformation that might occur.
5. Nearly straight-grain strips are required to fully-utilize western juniper's bending potential. This is also true of the other species, previously mentioned, commonly utilized for bending. Western juniper trees, however, generally have a highly-tapered stem with many limbs and bark pockets, which greatly decreases the length and total volume of pieces suitable for bending. Realistically, a relatively small amount of wood suitable for bending is available. Not every tree contains it, while some trees may contain a relatively high percentage. Certainly, sorting in the woods and most especially, prior to sawing will increase the yield. Correct sawing at the headrig will provide the greatest amount of material possible.