

SIMPLIFIED PROCEDURE FOR DETERMINING OVEN-DRY SPECIFIC GRAVITY OF FLITCHES AND BOLTS

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SIMPLIFIED PROCEDURE FOR DETERMINING OVEN-DRY

SPECIFIC GRAVITY OF FLITCHES AND BOLTS

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Military specifications for aircraft structural plywood require that the specific gravity of the veneer "shall not be less than the minimum" values listed for particular species.² The Forest Products Laboratory has developed a practical method by which veneer for such plywood can be produced with reasonable assurance that it will meet the minimum of specific gravity requirement. By this method specific gravity of flitches and bolts is determined before veneer is cut, and wasteful cutting of low-density material is thereby avoided. In most cases, this material would not prove usable as commercial veneer because it has been cut to special thicknesses for aircraft plywood particularly designed for certain strength properties.

Variations in Specific Gravity

Specific gravity of the wood of all species varies with growth conditions of the trees. For example, the outer wood of some old-growth hardwood trees frequently has lower specific gravity than the inner wood of the same trees, or the wood of second-growth trees. For this reason, veneer cut from outer parts of bolts may be below the minimum requirements for a particular hardwood species. On the other hand, the inner wood of some tropical species, such as mahogany and khaya, is frequently of low specific gravity. Some variations in specific gravity also may be due to site conditions that affect total vigor of trees growing on certain sites.

Within each species, the strength of wood is closely related to its specific gravity and the design data for wood structures in aircraft are based on specific minimum strength values established for each acceptable species. It is important, therefore, that wood going into structural elements of aircraft be equal to or above the required minimum specific gravity, since this is an index to the strength of the wood.

¹Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

²Military Specification Plywood and Veneer: Aircraft Flat Panel MIL-P-6070, 29 March 1950.

Cross sections from ends of flitches and bolts are suitable for use in determining the inherent density of their wood. Usually those determinations can be done between the time when flitches or bolts are prepared and when they are ready to go on the slicer or the lathe. Thus, veneer production will not be seriously delayed and material that has a lower specific gravity than is permissible can be cut into commercial veneer, in which strength is not a primary requirement.

A Simple Determination of Specific Gravity

The specific gravity of wood is determined by relating its weight to the weight of an equal volume of water. Since oven-dry wood nearly always weighs less than water, its specific gravity is less.

The specific gravity of a standard-sized specimen can be determined directly by its weight. For example, if a specimen has a volume of 100 cubic centimeters, its weight in grams divided by 100 is equal to its specific gravity, since 1 cubic centimeter of water weighs 1 gram.

The method herein described is dependent on the weight of an oven-dry specimen with a volume of 100 cubic centimeters or multiples of this volume. Blocks of wood 1.00 by 2.00 by 3.05 inches or 1.00 by 2.00 by 6.10 inches in size, the volumes of which are, respectively, 100 and 200 cubic centimeters, are recommended as standard sizes of specimens for determination of specific gravity by this method. Their weight in grams divided by 100 or 200, therefore, is their specific gravity.

Procedure for Determination

The general procedure in this method of determining the oven-dry specific gravity of wood is (1) to cut specimens to rough dimensions about one-half inch larger than the final size, (2) oven dry the specimens, (3) accurately saw them to a standard size, and (4) weigh them. Certain details of procedure must be adhered to if suitably accurate determinations are to be obtained by this method.

Sampling and Rough Cutting

Complete cross sections about 1-1/2 inches thick along the grain are sawed from both ends of flitches and bolts for aircraft veneer. In order to get adequate sampling of specific gravity, specimens should be taken along at least two radii of flitches and four radii of round bolts from which aircraft veneer is to be prepared.

Specimens 2-1/2 inches wide and 6-1/2 inches long should be marked out on the end grain so that their length extends along a radius of the cross section. On some relatively short radii of flitches, it is possible to get only one

specimen 6-1/2 inches long, but an additional specimen 3-1/2 inches long can sometimes be cut. Figure 1 shows positions of specific gravity specimens that were cut from a cross section of a mahogany flitch. With larger flitches, two specimens 6-1/2 inches long can usually be obtained to give good sampling of specific gravity in a particular flitch.

Specimens cut from bolts for rotary-cut aircraft veneer should represent all parts of the bolt from which aircraft veneer is to be cut. That is, the specimens should extend from near the bark, where rounding up of the bolt is completed, to near the core, where cutting of this quality of veneer stops.

Specimens are most easily rough cut from cross sections of flitches and bolts on a band saw. Then they are trimmed to rough size of about 1-1/2 inches along the grain and 2-1/2 by 6-1/2 inches or 2-1/2 by 3-1/2 inches so as to remove excess wood in order to facilitate drying.

Oven Drying

The rough specimens should be placed in a thermostatically controlled oven (fig. 2) in such a way that air can circulate around them during drying. Drying at about 105° C. or 220° F. for 48 hours usually will remove all moisture from green wood 1-1/2 inches along the grain. Drying of a few specimens to a weight that is constant for 4 to 5 hours of drying is sufficient to determine whether an oven load of specimens is thoroughly dried. Although green specimens sometimes have drying checks on end-grain surfaces, such checks usually are closed by the time specimens are oven dried, so that there is no appreciable effect on specific gravity calculations.

Final Cutting

When the rough specimens are dried to zero moisture content, they should be trimmed to final size with a smooth-cutting circular saw. The final size is 1.00 inch along the grain and 2.00 by 6.10 inches across the grain, or 1.00 by 2.00 by 3.05 inches. In order to insure that specimens are cut to sufficiently accurate final size, measurements should be made with a steel rule to the nearest 0.01 inch. A standard hook-type steel rule having 0.01-inch graduations made by many tool manufacturers is suitable for this purpose.

Weighing and Determination of Specific Gravity

The trimmed specimens must be put back in the oven at 105° C. or 220° F. for 1 to 2 hours to remove any moisture picked up during their exposure to the room air while being cut. The specimens are weighed to the nearest 0.1 gram as soon as they are taken from the oven. This weight, divided by 100, represents the specific gravity of the specimens 3.05 inches long; the weight of those 6.10 inches long must be divided by 2, since their volume is 200 cubic centimeters.

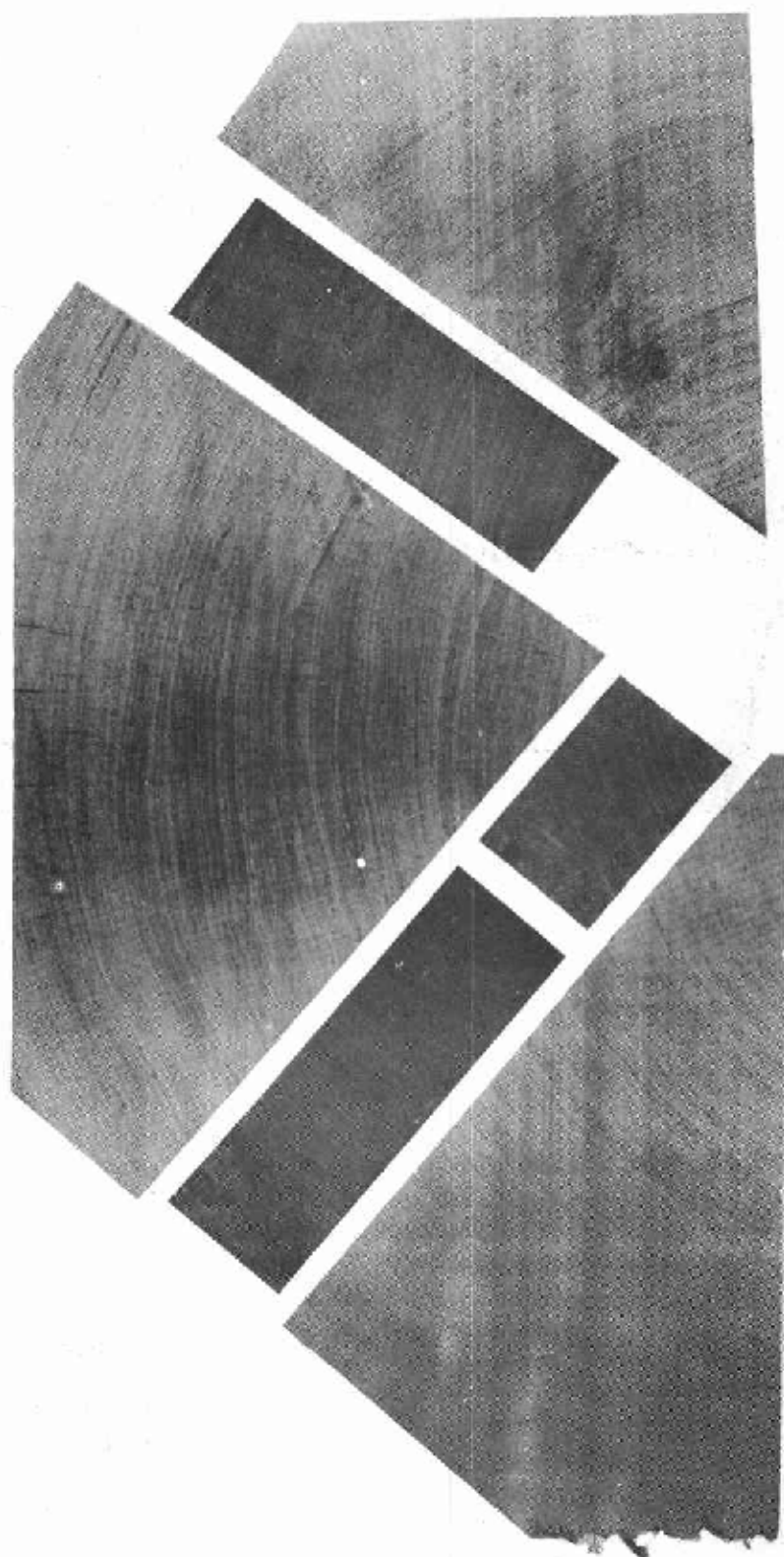
Equipment

Balances suitable for determination of the weights of the specimens can be obtained from companies that handle laboratory equipment. Ordinary balances with a capacity of 200 grams that will weigh accurately to 0.1 gram are suitable for this method of determining specific gravity of solid wood.

Ovens that are suitable for drying wood to determine its specific gravity can be obtained from companies dealing in laboratory supplies. The ovens should have thermostatic control in order to maintain the required temperatures within a range of about 5° F.

Figure 1.--Position of specimens along two radii for determining
average specific gravity of a end-grain section of a
flitch of mahogany to be flat-sliced into veneer.

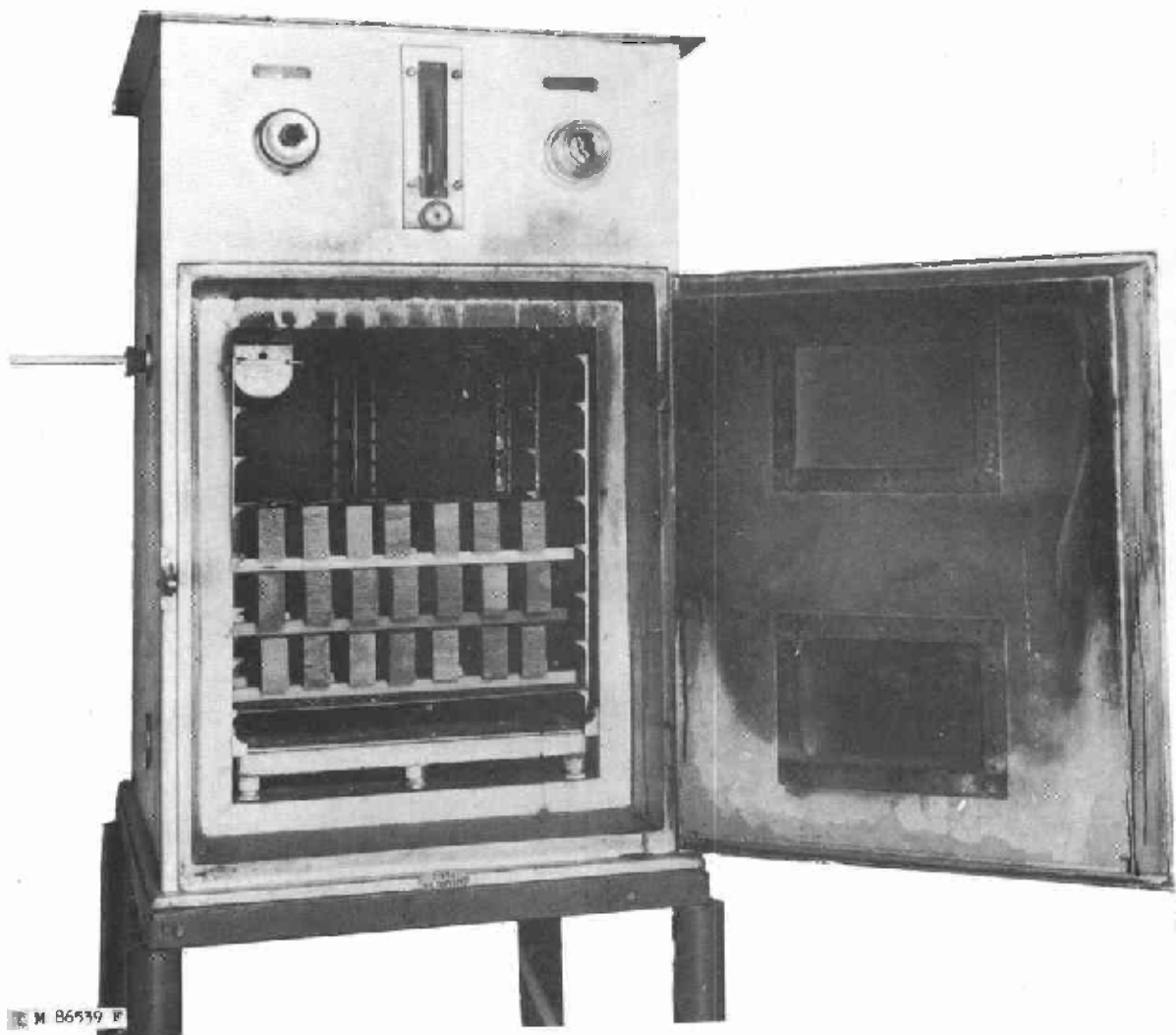
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Figure 2.--Thermostatically controlled oven showing position of specimens so as to permit natural circulation of air around specimens that will facilitate their drying.

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