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FOREST PRODUCTS LABORATORY

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METHODS OF DETERMINING THE SPECIFIC GRAVITY OF WOOD

Next to actual strength tests, the specific gravity of wood affords the best indication of its strength properties. The specific gravity of any piece of wood may easily be determined by the methods described in this note, and, with the aid of an equation table published by the U. S. Forest Products Laboratory, the strength of the piece as a beam or as a column, its shock-resisting ability, its ability to withstand wear, its toughness, its shearing strength, and its value in several other respects may be closely estimated.

The specific gravity of a substance is its weight divided by the weight of an equal volume of water. As both the weight and volume of wood vary with the amount of moisture in it, specific gravity as applied to wood is an indefinite quantity unless the circumstances under which it is determined are specified. The specific gravity of wood is based on the weight when oven dry, but the volume may be that in the oven-dry, air-dry, or green condition. The true specific gravity of wood is, of course, that based on volume when oven dry, but for greater convenience in making determinations, the Forest Products Laboratory bases specific gravity on the volume of the specimen when tested, either green or air dry, and has determined the relation of strength to specific gravity separately for green and air-dry wood.

In using the Laboratory table for estimating the properties of particular timber, therefore, it is necessary to determine specific gravity on the volume of the sample in a green condition, or at a moisture content of about 12 percent (air-dry condition), or the volume when oven dry may be obtained and converted into the volume when green by means of shrinkage figures.

Specific gravity determinations may be made upon solid specimens that should not contain more than 25 cubic inches. Larger pieces require considerably more time for drying.

After selecting a representative specimen proceed as follows:

To find specific gravity of wood based upon volume in a green or air-dry condition

1. Find volume of specimen by measurements or by immersion method.
2. Put specimen in oven at 103° C. (plus or minus 2° C.) and dry until constant weight is attained.
3. Weigh specimen.

To find specific gravity of wood based upon volume when oven dry

1. Put specimen in oven at 103° C. (plus or minus 2° C.) and dry until constant weight is attained.
2. Weigh specimen.
3. Find volume of specimen by measurements or by immersion method.

4. Compute specific gravity, using formula

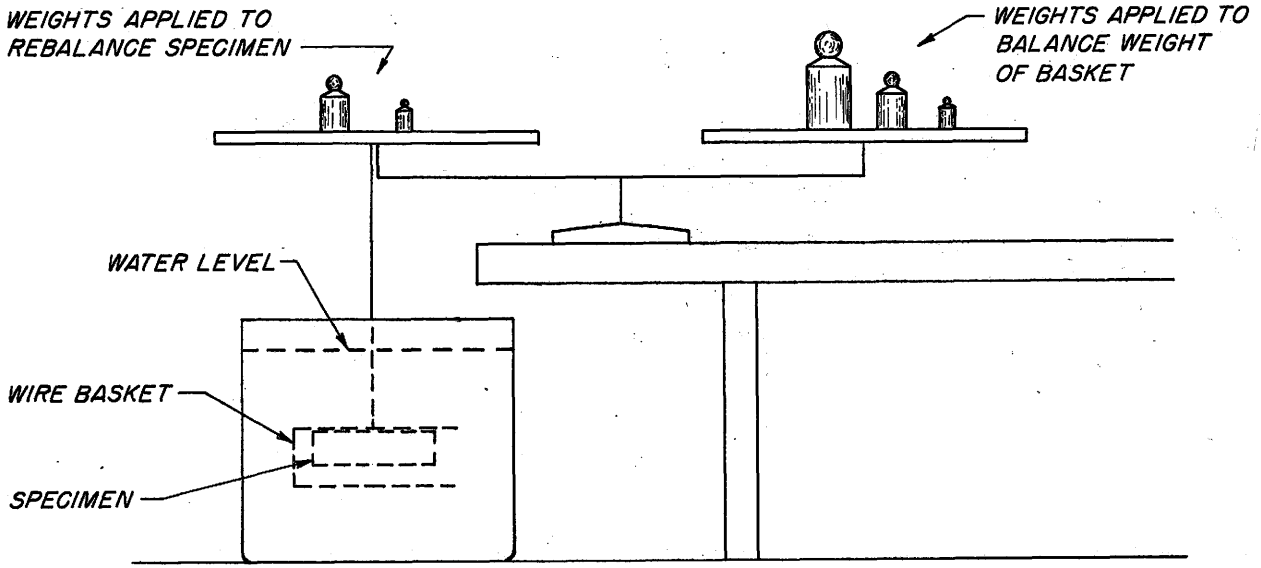
$$\text{Specific gravity} = \frac{D}{V},$$

where D = weight in grams and V = volume in cubic centimeters.

When weights or measures are not taken in metric units, use the following reduction factors:

Inches x 2.54 = centimeters	Ounces x 28.4 = grams
Cubic inches x 16.4 = cubic centimeters	Pounds x 454 = grams

Both the oven-dry weight and the volume should be correct to within at least 1/2 of 1 percent.


WEIGHTS APPLIED TO REBALANCE SPECIMEN
WEIGHTS APPLIED TO BALANCE WEIGHT OF BASKET
WATER LEVEL
WIRE BASKET
SPECIMEN

Determining Volume of Specimens

1. Lineal measurement method. -- The specimen must be regular in shape with right-angle corners for determination of its volume by lineal measurement. It should be measured carefully to determine its length and cross sectional area. Its volume is equal to the product of its length and cross sectional area.

2. Immersion method. --The volume of a specimen whether regular or irregular in shape, may be found by determining the weight of the specimen in air and the weight of the specimen when submerged under water. A container holding enough water to completely submerge the specimen is placed below one pan of a balance scale from which a wire basket is suspended of sufficient weight to hold the specimen submerged. (See sketch.) The weight of the basket is balanced with weights added to the other scale pan. The specimen is first weighed in air and then placed in the basket and held completely submerged without touching the container while the scales are again balanced. If the specimen has a tendency to float, the weight that is added to restore balance is added to the weight of the specimen in air to give the weight of an equal volume of water. The weight of the water in grams is numerically equal to the volume of the specimen in cubic centimeters. Conversely, if the specimen has a tendency to sink, the weight that is added to restore balance is subtracted from the weight of the specimen in air in order to determine the volume. (In this case the weights added to restore balance are added to the same pan as the weight applied to balance the weight of the wire basket.)

Green specimens may usually be immersed for volume determinations in the condition in which they are selected. The determination of volume should be made as quickly as possible after immersion of the specimen, because any absorption of water by the specimens directly affects the accuracy of the result. To prevent oven-dry specimens from taking-up water when they are immersed, they may be dipped in hot paraffin wax, preferably while still warm. Any surplus paraffin adhering to the specimen should be scraped off. The gain in weight of the specimen as a result of the treatment should be deducted from the volume determination, especially in the case of small-sized specimens.

A quicker method of treating specimens to prevent water absorption, but one that is only suitable for softwoods and for hardwoods with small pores, is to dip them in a solution of paraffin wax in carbon tetrachloride (1 gram of paraffin in 150 cubic centimeters of carbon tetrachloride). Allow a few minutes for the carbon tetrachloride to evaporate and then

determine the volume by the immersion method. The gain in weight due to the thin film of wax is negligible and may be ignored. This method of treating the specimen also has an advantage in that it may be used satisfactorily to determine the volume of air-dried specimens, since the thin film of wax in no way appears to affect the subsequent shrinkage of the specimen when it is oven dried.

Rapid Method for Determining Specific Gravity

The flotation method is a rapid method of determining specific gravity directly, but is less accurate than the other methods described. An elongated piece, of regular cross section, is floated on end in a narrow vessel of water. The percentage, expressed as a decimal, of the total length that is below the water line is numerically equal to the specific gravity of the specimen.

Determination of Moisture Content

If the specimen is weighed immediately when obtained as well as after oven drying, the moisture content may be computed, thus affording both moisture and specific gravity determinations on the same piece.

$$\text{Moisture content (percent)} = \frac{\text{green weight - oven-dry weight}}{\text{oven-dry weight}} \times 100$$

Weight per Cubic Foot

The weight per cubic foot of a specimen may be determined quite easily from the specific gravity, based on oven-dry weight and volume at test, by the following relationship:

$$\text{Weight per cubic foot} = \text{Specific gravity} \times 62.4 \times (100 + \text{moisture content at test})$$