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Standard Test Methods for Conducting Machining Tests of Wood and Wood-Base Panel Materials[1]

This standard is issued under the fixed designation D1666; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

One of the significant characteristics of wood and wood-base panels is the facility with which they can be machined and fabricated. Different species and products, however, vary greatly in their behavior under cutting tools, so that some systematic method is needed for determining their suitability for uses where the character of the machined surface is of prime importance. Such uses include cabinetwork, millwork, and other applications where favorable machining properties are essential to good finish. For such products as common boards, on the other hand, good machining properties are secondary, although still an asset.

The machining test procedures presented in these test methods cover such common operations as planing, routing/shaping, turning, boring, mortising, and sanding. They are the result of many years of extensive research and development and include practical methods for qualitatively evaluating and interpreting the results. Because of their satisfactory use with a wide range of materials, it is believed that the methods are equally applicable to species, hardwoods and softwoods, and to wood-base panel materials, such as plywood, particleboard, fiberboard, and hardboard.

1. Scope

1.1 These test methods cover procedures for planing, routing/shaping, turning, mortising, boring, and sanding, all of which are common wood-working operations used in the manufacture of wood products. These tests apply, in different degrees, to two general classes of materials:

1.1.1 Wood in the form of lumber, and

1.1.2 Wood-base panel materials such as plywood and wood-base fiber and particle panels.

1.2 Because of the importance of planing, some of the variables that affect the results of this operation are explored with a view to determining optimum conditions. In most of the other tests, however, it is necessary to limit the work to one set of fairly typical commercial conditions in which all the different woods are treated alike.

1.3 Several factors enter into any complete appraisal of the machining properties of a given wood or wood-base panel. Quality of finished surface is recommended as the basis for evaluation of machining properties. Rate of dulling of cutting tools and power consumed in cutting are also important considerations but are beyond the scope of these test methods.

1.4 Although the methods presented include the results of progressive developments in the evaluation of machining properties, further improvements may be anticipated. For example, by present procedures, quality of the finished surface is evaluated by visual inspection, but as new mechanical or physical techniques become available that will afford improved precision of evaluation, they should be employed.

1.5 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*

[1] These test methods are under the jurisdiction of ASTM Committee D07 on Wood and are the direct responsibility of Subcommittee D07.01 on Fundamental Test Methods and Properties.

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D9 Terminology Relating to Wood and Wood-Based Products
D1038 Terminology Relating to Veneer and Plywood
D1554 Terminology Relating to Wood-Base Fiber and Particle Panel Materials
D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials
D4933 Guide for Moisture Conditioning of Wood and Wood-Based Materials
D7438 Practice for Field Calibration and Application of Hand-Held Moisture Meters

3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology D9, D1038, and D1554.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *chip marks*—shallow dents in the surface caused by shavings that have clung to the knives instead of passing off in the exhaust as intended.

3.2.2 *planer knife clearance angle*—planer cutterhead knife angle *(c)* depicted for both knife alternatives in Fig. 1.

3.2.3 *planer knife cutting angle*—planer cutterhead knife angle *(a)* depicted for both knife alternatives in Fig. 1.

3.2.4 *planer knife cutting bevel*—planer cutterhead knife bevel angle *(b)* depicted for Knife Alternative 2 in Fig. 1.

3.2.5 *planer knife cutting circle*—the circumference *(d)* defined by the outer limits of the planer knives of a cutterhead and depicted in Fig. 1.

3.2.6 *computer numeric controller (CNC) machine*—a computer automated machine center often used to machine wood and wood-based panel materials that are typically integrated with drafting software and may have the capabilities to perform machining activities that include cutting, routing, drilling, shaping, and turning.

3.2.7 *feed rate*—the resultant rate of movement measured in feet (metres) per minute at which material moves through a machining tool that includes the combination of machining tool and material motion.

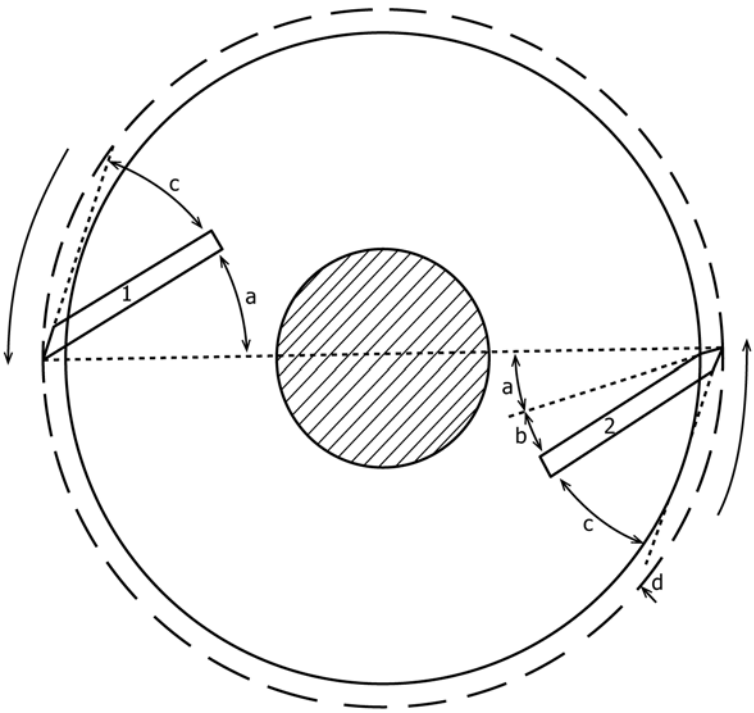
3.2.8 *fuzzy grain*—small particles or groups of fibers that did not sever clearly in machining but stand up above the general level of the surface.

3.2.9 *jointing*—an equalization of the projection of all the knives in the cutterhead performed by bringing a sharpening stone into contact with the knife edges while the cutterhead revolves.

3.2.10 *land (or heel)*—the part of the cutting edges of the knives that conforms to the cutting circle, has no clearance, and that comes into contact with the sharpening stone in the jointing operation.

3.2.11 *speed, cutterhead*—the rate measured in revolutions per minute at which a cutterhead is turning.

3.2.12 *speed, rim*—the rate measured in feet (metres) per minute at which the periphery of a cutting tool (usually a saw) is turning.



(*a*) Cutting angle.
(*b*) Cutting bevel.
(*c*) Clearance bevel.
(*d*) Cutting circle.

FIG. 1 Terms Used in Connection with Planer Knives

4. Significance and Use

4.1 Machining tests are made to determine the working qualities and characteristics of different species of wood and of different wood-based panel materials under a variety of machine operations such as are encountered in commercial manufacturing practice. The tests provide a systematic basis for comparing the behavior of different products with respect to woodworking machine operations and of evaluating their potential suitability for certain uses where these properties are of prime importance.

5. Apparatus

5.1 *Machines*—To yield data that can be duplicated for comparative purposes, all machines used in these tests shall be modern commercial size machines of good make, in good mechanical condition, and operated by fully qualified persons. Numerous machines meet these requirements, and no attempt is made to do more than describe the preferred type of machine for each test in very general terms (Note 1). Complete information on the machine used, the cutting tool, and the operating conditions of each test shall be made part of the record.

NOTE 1—Where machines with all of these qualifications are not available, machines that are inferior in some respects have limited uses, such as for comparing the machining properties of species for local use under local conditions.

5.2 *Feed Rates*—While either automated or manual feed machines may be used, preference shall be given to machines with automated feed systems. To the extent possible, the feed rates used for the tests shall be chosen to correspond with the desired cutting conditions that will be employed for production. The feed rates and cutting conditions shall be kept constant throughout each test type and reported.

5.3 *Knives and Cutters*—Insert tooling or one-piece cutters may be used for testing. Carbide-tipped knives and cutters shall be the preferred type because of the much longer sharpness life of that material. High-speed steel shall be second choice and carbon steel third. The cutting tool, material, manufacturer, and any relevant grade information shall be made part of the record. Every precaution shall be taken to keep the sharpness uniformly good in all tests by resharpening or replacing the knives and cutters when necessary.

NOTE 2—A practical measure of the deterioration of a machined lumber surface because of dulling of the cutting tool can be obtained by the use of two check samples. They should come from the same board of some species that machines exceptionally well, such as maple or any other closed-grain species. Both should be machined with a freshly sharpened cutting tool at the outset. One will be retained in that condition as a control, and the other, at intervals of 1 h or so as experience dictates, should be machined with the regular test specimens and compared with the control. When the machined surface deteriorates perceptibly, as indicated by this comparison, the cutting tool should be resharpened or replaced.

Similarly with wood-base panels, some well-known product that has good machining properties may be used as a control material for comparison.

NOTE 3—Whenever possible, preference should be given to carbide insert tooling (Fig. 2). Carbide insert tools are inexpensive and can be readily replaced in the tool holder. Replacing the tooling in place of resharpening will increase the repeatability of the method. Tooling manufactures have tables of recommended carbide tooling for the various wood-based products. Preference should be given to the grade and type of tooling recommended. Experience has shown that there can be a difference in performance between carbide tools produced by different manufacturers.

FIG. 2 Illustration of a Router Head With Insert Tooling

6. Shipment and Protection of Samples

6.1 All test material shall be properly protected in shipment to ensure its delivery in satisfactory condition for the required tests. On receipt, the material shall be carefully protected to prevent deterioration pending the preparation for the tests.

7. General Requirements of Samples

7.1 The tests shall primarily be made on seasoned material brought to an equilibrium moisture content in a conditioned environment of 68 ± 11°F (20 ± 6°C) and 65 % (±5 %) relative humidity. Methods for determination of completion of conditioning are given in Guide D4933. Alternative conditioning may be specified provided that it is recorded.

7.2 Lumber shall be clear (Note 4), sound, well-manufactured, and accurately identified as to species. It may be either rough or dressed.

NOTE 4—Clear means free from all defects, including knots, stain, incipient decay, surface checks, end splits, compression wood, and tension wood.

7.3 Wood-base panel samples may be typical commercial products or samples of new boards under development as the occasion requires. In either case, the kind or kinds of wood, the density, and the amount and kind of binder should be known and made part of the record. Wood-base panels shall be typical of the product under consideration as they are manufactured and marketed. For the sanding tests, the wood-base panel samples should be procured in the unsurfaced condition, whenever possible, so that these evaluations may be made on the same part of the material that will be removed from the board in the normal use conditions where sanding is done.

7.4 Test samples of lumber shall be so selected as to exclude extremely high or low ring counts per inch (average ring width per millimetre) that are not typical of the species under consideration.

NOTE 5—Number of rings per inch is determined by visual count along a line perpendicular to the growth rings. Different samples of a given species often differ widely in this respect, and often the samples at both extremes are not typical in their properties.

8. Dimensions, Weight, and Moisture Content of Samples

8.1 Samples must be large enough to yield the minimum acceptable size (0.75 by 5 in. by 4 ft) (19 by 127 mm by 1.2 m)