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Standard Test Method for Block Resistance of Organic Coatings on Wood Panel Substrates[1]

This standard is issued under the fixed designation D 2793; 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.

1. Scope

1.1 This test method covers the determination of the block resistance of organic coatings on wood and wood-based panel substrates. Block resistance is the ability of a coating to resist sticking to another surface and to resist any change in appearance when it is pressed against that surface for a prolonged period of time.

1.2 General methods for determining block resistance are outlined in Sections 6 and 7. Variations inherent in user materials and procedures, however, may dictate adjustments to the general method to improve accuracy. Paragraphs 7.3 and 7.4 provide guidelines for tailoring the general procedure to a user's specific application. Paragraph 7.5 offers a rating methodology.

1.3 Test Method D 2091 should be used for the determination of print resistance or pressure mottling of organic coatings, particularly lacquers, applied to wood-based case goods such as furniture.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 2091 Test Method for Print Resistance of Lacquers[2]

3. Summary of Test Method

3.1 The coatings are prepared for testing in a manner duplicating production application and curing conditions as nearly as possible on the specified wood substrate. Then a stack of these painted substrates is formed and subjected to a specified pressure and temperature for a sufficient time to develop any sticking tendencies that exist. The pressure is released and the painted surfaces are examined for any signs of sticking or pressure mottling. If blocking (forming a block by panels sticking together) occurs, the material is unsatisfactory. If no sticking or damage to the film surface occurs, the material is satisfactory.

3.2 When the conditions of production finishing are established and known, the method of application, the substrate, film thickness, and cure of the film should duplicate these conditions as closely as possible. However, some acceleration of the test may be possible with more severe conditions.

4. Significance and Use

4.1 Coated wood panel products must be stacked face to face or face to back during warehousing, packaging, and transportation without the coated finish sticking (blocking) and becoming damaged. This test method describes a laboratory means of evaluating conditions of blocking using factors of pressure, heat, time and moisture.

4.2 Degrees of hardness or degrees of cure of organic coatings, or both, can be evaluated using a blocking test.

4.3 The rate of volatile loss (drying speed) of organic coatings can be evaluated using a blocking test.

4.4 The effectiveness of protective packaging materials (slip sheets) for organic coatings on wood substrates can be evaluated using a blocking test.

5. Apparatus

5.1 *Hydraulic Press* (preferably constant pressure), capable of maintaining the agreed upon stacking pressure.

5.2 *Rigid Platens*, at least 4 in. (100 mm) square, capable of being maintained at the desired test temperature.

6. Test Specimens

6.1 For those cases where the intended use conditions are not established or known, the following specifications or some set of specifications agreed upon between the purchaser and seller apply:

6.1.1 The test coating shall be applied by spray to a panel.

6.1.2 The panel shall be a piece of ¼ in. (6.4 mm) smooth two side (S2S) standard hardboard or other thickness and type of wood substrate.

6.1.3 The dry film thickness of pigmented coatings shall be 1.5 ± 0.2 mils (38 ± 5 µm), and of clear coatings, shall be 1.2 ± 0.2 mils (30 ± 5 µm) or other agreed upon film thickness.

[1] This test method is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.52 on Factory-Coated Wood Products.

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[2] *Annual Book of ASTM Standards*, Vol 06.02.

Cure of the coating shall be as agreed and should be standardized for each coating.

NOTE 1—Film thickness can be measured by weight differences before and after painting, but this requires careful conditioning of the substrate under standard temperature and humidity conditions prior to each weighing. Film thickness can also be determined by using an aluminum tab alongside the test panel and measuring the film thickness with a standard eddy-current gage or using a steel panel with a magnetic film thickness gage. Alternatively, on smooth surface boards, a draw down bar applicator with known film thickness delivery may be used.

7. Procedure

7.1 After an agreed upon time (after sample preparation) under ambient conditions, prepare a stack of six samples as follows (from bottom to top):

(1) one face up,
(2) two face down,
(3) one face up,
(4) two face down.

This provides two face-to-face and face-to-back contacts. If slipsheeting materials are utilized or are under consideration, include them between the appropriate interfaces.

7.2 Preheat the press platens to 120 ± 2°F (49 ± 1°C) or other agreed upon temperature. Insert the sample stack into the press and apply the load for a minimum of 24 h, through rigid pressure platens using one of the following conditions:

Class A80 psi± 4 psi (560 kPa ± 28 kPa)
Class B40 psi ± 2 psi (280 kPa ± 14 kPa)
Class C20 psi± 1 psi (140 kPa ± 7 kPa)
Class D5 psi ± 0.25 psi (35 kPa ± 1.7 kPa)

These classes are arbitrary and merely represent tests of greater to lesser severity depending upon materials and procedures of the end user. Other pressures, types of pressure plates or times, or combination thereof, may be used as agreed upon between purchaser and seller.

7.3 Determination of valid pressures for use in the blocking procedure is not easy. In practice, pressures of 20 to 100 psi (140 to 200 kPa) have proven suitable for hardboard substrates: 2 to 5 psi (14–35 kPa) for solid wood substrates. Where no procedure exists, approximations may be made using a calculation of production stacking pressure, as follows:

$$(DHA_1/A_2) \times F \quad (1)$$

where:
D = board density,
H = stack height,
A_1 = stack area,
A_2 = support area, and
F = safety factor.

Support area is difficult to establish precisely. In practice, stacking may be directly on the floor, or support stringers may be used. As stringers increase stacking pressures substantially, this should be compensated for by use of higher platen pressures or by the inclusion of stringer rods in the sample stack.

7.4 If the presence of water between substrate surfaces can be logically anticipated as a result of the manufacturing process or storage conditions, include it in the procedure, as blocking tendencies may be altered. Systematic coated surface wetting prior to test such as contact with saturated toweling, or conditioning at elevated relative humidity conditions, can be useful in improving test efficacy.

7.5 At test conclusion, open the press and pick up the stack in such a fashion that first the bottom panel, then the next to bottom panel, and eventually all the panels are allowed to free fall of their own weight. Sample pairs that do not separate via free fall will be set aside to be separated by hand. If desired, a rating of blocking tendency can be established to differentiate between categories. The following designations may be useful:

Degree of Blocking	Surface Damage
A = free fall separation	0 = none
B = slight tap to separate	1 = <1 % damage
C = slight pressure to separate	2 = 1–5 % damage
D = moderate pressure to separate	3 = 5–20 % damage
E = extreme pressure to separate	4 = 20–50 % damage
F = tool required to separate	5 = >50 % damage

Although "degree of blocking" is a subjective determination, its usefulness in differentiating between variables in a single evaluation is obvious. Results of experiments conducted over long time periods are of greatest utility if the same rater does the evaluation or if control panels are included for reference. Ratings of surface damage could be based upon visual standards to assist the rater and reduce variation between raters. Passing rating generally would be "A-0" or as mutually agreed upon.

7.6 Whichever method is chosen or developed, it is strongly recommended to incorporate pass-fail controls of known blocking tendency as a means to establish test validity. If the blocking test under study proves less severe than actual production/storage conditions, increases in test temperature, platen pressure, or water contact, or a combination thereof, will increase the severity and vice versa.

7.7 *Accelerated Procedure to Reduce the Time Period for Simulation of Blocking Conditions Observed in the Field* :

7.7.1 After an agreed upon period of cooling, the cured, coated boards are placed in a stack of two or more panels oriented to provide face to face or face to back contact, or both, depending upon the stacking configuration in use.

7.7.2 As in the *Standard Procedure*, the panel stack is loaded in a hydraulic press under some experimentally determined temperature, pressure and time period that has been found to correlate with actual experience in use.

7.7.2.1 A typical starting point set of conditions is:

(1) Temperature—That of the actual stack in use under worst case (highest temperature) condition, that is, up to 212°F (100°C),

(2) Pressure—Increased several fold above that encountered in use, that is, 50 to 200 psi (350 to 1400 kPa), and

(3) Time—As short a time under test as possible with reasonable correlation, that is, 15 to 60 minutes.

7.7.3 Conversely, a set of temperature, pressure, and time period can be experimentally determined that produces no blocking. This can then be used to establish field stacking procedures and conditions.

7.7.4 Pass or fail criteria at the end of the test is similar to 7.3 and 7.4.

8. Report

8.1 This is a go/no-go test for both face-to-face and face-to-back conditions. In addition to the separate statement of

satisfactory or not satisfactory under both of these conditions, the nature of the failure should be reported. The report should also include the particulars of the test as follows:

8.1.1 Type of substrate,

8.1.2 Method of application,

8.1.3 Curing cycle,

8.1.4 Film thickness, and test method used,

8.1.5 Temperature, humidity, and pressure of the wet or dry blocking test,

8.1.6 Type of stacking including identification and type of packaging material (slip sheets) if any, and

8.1.7 Duration of test.

9. Precision and Bias

9.1 *Precision*—Because this test method is used for a variety of coating chemistries, substrate stacking orientation and storage conditions, precision and bias must be determined for each specific set of test conditions as determined by producer and user.

9.2 *Bias*-As no accepted reference material exists, bias cannot be determined.

10. Keywords

10.1 blocking test; lacquer; organic coating; paint; pressure test; varnish; wood substrates