



Designation: D3003 – 01 (Reapproved 2012)

## Standard Test Method for Pressure Mottling and Blocking Resistance of Organic Coatings on Metal Substrates<sup>1</sup>

This standard is issued under the fixed designation D3003; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers determination of the pressure mottling and sticking, or blocking resistance of organic coatings applied to coil-coated or factory-coated metal prior to fabrication.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *blocking or sticking, n*—the condition wherein coated surfaces adhere to each other.

2.1.2 *pressure mottling, n*—film distortion or uneven pattern giving a change of gloss and nonuniform appearance. It is usually caused by pressures within a painted coil or stacked painted sheets or other painted products.

### 3. Summary of Test Method

3.1 The coated metal is cut into suitably sized panels. A stack of these panels is then subjected to a specified pressure and temperature for a specified time to permit any pressure mottling and sticking or blocking to develop. The applied heat of the test apparatus is turned off and, after cooling, the specimens are examined for any signs of sticking (or blocking), and mottling. The results are rated on the 0 to 10 scale and may be used in accepting or rejecting the coating in accordance with standards established between the purchaser and the seller.

### 4. Apparatus<sup>2</sup>

4.1 *Suitable Hydraulic or Mechanical Press or Vise* may be used. The equipment shall be capable of producing the required test pressure in kilopascals (or pounds-force per square inch) and be equipped with a suitable device for measuring the force applied.

### 5. Test Specimens and Conditions

5.1 At least four, and preferably six, flat panels shall be cut from the coated stock, the age of which shall be within the limits agreed upon between the purchaser and the seller.

5.2 Panels should be at least 100 by 70 mm (4 by 2.5 in.) to provide an adequate area for assessing the results. Where the equipment does not provide adequate pressure, smaller panels may be used. The minimum recommended size is 50 by 50 mm (2 by 2 in.).

5.3 Use only flat panels. If necessary, file the edges smooth to ensure maximum contact between the surfaces. When the equipment permits, panels larger than the pressure plates may be used, thus eliminating any effect from uneven edges. With this method, the kilopascals (or pounds of force per square inch) is calculated using only the panel area within the pressure plates.

5.4 The film thickness of the coating under test shall be as specified or agreed upon between the purchaser and the seller.

5.5 The coated stock shall be tested under the conditions of pressure, temperature, and time mutually agreed upon between the purchaser and the seller. Pressures ranging from 750 to 2400 kPa (110 to 350 psi), temperatures from 43 to 60°C (110 to 140°F), and times of 2 to 16 h have been used.

5.6 In the absence of agreed or specified test conditions, a pressure of  $750 \pm 35$  kPa ( $110 \pm 5$  psi), a temperature of  $43 \pm 1.5^\circ\text{C}$  ( $110 \pm 3^\circ\text{F}$ ), and a time of 16 h shall be used.

5.7 The total force applied is measured by a suitable gage and the pounds of force per kilopascals (or square inch) is

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.53 on Coil Coated Metal.

Current edition approved June 1, 2012. Published August 2012. Originally approved in 1971. Last previous edition approved in 2006 as D3003 – 01 (2006). DOI: 10.1520/D3003-01R126.

<sup>2</sup> Suitable equipment includes presses and drill press vises modified for use with a torque wrench if agreed upon between purchaser and seller (Hensley, W. L., "Pressure Mottling Test," *Journal of Paint Technology*, Vol 40, No. 517, February 1968, p. 54A).



calculated by dividing the force by the area in square inches of one side of one panel.

## 6. Procedure

6.1 Stack the panels face to back as used in production with both face and back coatings applied. Limit the number of panels in the test to the quantity that can be heated rapidly to and maintained at the correct panel temperature throughout the test.

6.2 For presses having heating units, place the test panels in the press and bring the heating platens in contact but with light pressure. Turn on the heating unit, and heat the panels to the required test temperature. When this temperature is reached, apply the required pressure and maintain it for the specified time (6.4).

6.3 Where the apparatus does not have built-in heating units, preheat the mechanical press or vise. Place the panels in the press at room temperature with very light contact and heat the unit (press and panels) in an oven to the required temperature. Then apply the proper pressure and return the unit to the oven for the specified time.

6.4 Record the time only after the specified temperature and pressure are reached. Check the temperature and pressure at intervals during the test.

6.5 At the end of the specified time, turn off the heat and allow the panels to cool to room temperature under pressure before removal and separation.

6.6 After removal from the press, grade the panels separately for both sticking (or blocking) and mottling in accordance with Table 1. In assessing the results, ignore effects due to sharp or uneven edges.

6.7 Maintain panels that are to be reassessed for a mottling grade in accordance with Table 1 after a 24-h recovery period at  $24 \pm 3^\circ\text{C}$  ( $75 \pm 5^\circ\text{F}$ ).

6.8 For both properties assign each coating a grade that is the arithmetic mean of all panels tested.

## 7. Report

7.1 Report the following information for each coating:

7.1.1 Equipment used,

7.1.2 Number of panels tested,

7.1.3 Pressure (or force applied and surface area of test coupons),

7.1.4 Temperature and heating process (built-in or oven),

7.1.5 Time,

7.1.6 Grade for sticking or blocking,

7.1.7 Grade for mottling,

7.1.8 Age of specimen,

7.1.9 Size of panels tested,

7.1.10 Dry film thickness of coupon, and

7.1.11 Evaluation time (for example, immediate, 24 h, etc).

## 8. Precision and Bias

8.1 *Precision*—In an interlaboratory test of this test method, two operators in each of seven laboratories tested two different coatings, subjected to two treatments (pressure, temperature, and duration) and rated them for sticking (*S*), and pressure mottling (*PM*). The within-laboratory and between laboratory pooled standard deviations were found to be as follows:

Rating Parameter	Pooled Standard Deviations	
	Within- Laboratory	Between Laboratory
<i>S</i>	0.42	1.10
<i>PM</i>	0.38	1.06
Average	0.40	1.08

Based on these results the following criteria should be used in judging the acceptability of results at the 95 % confidence level.

8.1.1 *Repeatability*—Two results, each the mean of the two sets of panels, obtained by the same operator should be considered suspect if they differ by more than 1.2 units.

8.1.2 *Reproducibility*—Two results, each the mean of two sets of panels, obtained by operators in different laboratories should be considered suspect if they differ by more than 3.7 units.

TABLE 1 Classification

NOTE 1—Intermediate grades are permissible to distinguish small differences.

NOTE 2—Reasonable force is defined as that which can be exerted by the fingers only, using the fingernails as the only prying instrument.

NOTE 3—The transfer of components of one coating onto or into another coating is also known as offsetting or pickoff.

Sticking or Blocking		Mottling	
Grade		Grade	
10	Panels fall apart—no sticking.	10	no mottling immediately after separation.
8	Slight tackiness or panels pull apart easily.	8	no mottling after 24-h separation.
6	Panels pull apart with effort. No flexing or prying is required to aid separation.	6	light permanent mottling after 24-h separation.
4	Panels pull apart using reasonable force. Flexing may be required (Note 2).	4	heavy permanent mottling after 24-h separation.
2	Panels require prying apart with a spatula or similar instrument.	2	light pickoff or transfer of one or both coatings (Note 3).
0	Panels block together so they cannot be separated with a spatula or similar instrument, without using extreme force.	0	one or both coatings show heavy pickoff down to the metal or basecoat; or block together (Note 3).



## D3003 – 01 (2012)

8.2 *Bias*—The procedure in this test method has no bias because only the value of pressure mottling is defined in this test method.

## 9. Keywords

9.1 blocking resistance; pressure mottling

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the ASTM website (www.astm.org/COPYRIGHT/).*