



Standard Test Method for Determining the Solvent Resistance of an Organic Coating using a Mechanical Rubbing Machine¹

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1. Scope

1.1 This test method covers a mechanical rub method for assessing the solvent resistance of an organic coating that chemically and/or physically changes during the curing process. This technique can be used in the laboratory, in the field, or in the fabricating shop.

1.2 This test method does not specify the solvent, number of double rubs, or expected test results.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *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:²

D740 Specification for Methyl Ethyl Ketone

D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means

D5402 Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs

D5796 Test Method for Measurement of Dry Film Thickness of Thin-Film Coil-Coated Systems by Destructive Means Using a Boring Device

D6132 Test Method for Nondestructive Measurement of Dry

Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage

D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

3. Terminology

3.1 Definitions:

3.1.1 *double rub, n*—one complete forward and backward motion over a coated surface under specific conditions, which are characterized by the force applied normal to the surface, the length of travel, and rate of speed.

4. Summary of Test Method

4.1 An automated machine is used to test the solvent resistance of a coating by rubbing a cloth saturated with the solvent across the coating and counting the number of strokes (double rubs) to coating break-through or failure.

5. Significance and Use

5.1 Many coatings used in the coil coating and other industries achieve a degree of solvent resistance after they have experienced a bake condition characterized by exposure to elevated temperatures in an oven over time. Insufficient bake, or occasionally over bake, may affect the intended chemical bonds or physical curing of the film and result in reduced solvent resistance.

5.2 The mechanical rubbing machine provides consistent stroke length, rate, pressure, and contact area that are not subject to variables such as human fatigue (see Practice D5402).

5.3 Factors other than bake can influence degree of solvent resistance of a coated surface. Paint film chemistry and composition, surface preparation, oven dwell time, oven air velocity, ambient oven temperature, oven profiling, film thickness, etc., all are influential. The test solvent used in the rub machine has a significant effect on the number of double rubs measured. Common solvents used for these tests include Methyl Ethyl Ketone (MEK), Methyl Isobutyl Ketone (MIBK), and Isopropyl Alcohol to name a few. The specific solvent to be used and the number of double rubs to be achieved should be

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

agreed upon between manufacturer and user for any given coating system, thickness, and application.

6. Apparatus

6.1 *Solvent Rub Machine*—with operator instructions.

6.1.1 The machine may be any suitable device that drives a mechanical finger through double rubs across the same path on a coated surface and has the following characteristics (see Fig. 1).

6.1.1.1 The mechanical finger must have a flat, smooth, circular surface 1.6 ± 0.2 cm [0.625 ± 0.08 in.] diameter.

6.1.1.2 A weighted block must apply 3000 ± 50 g of pressure to the mechanical finger.

6.1.1.3 Disposable cheesecloth, as specified below, is attached to the contact surface of the finger.

6.1.1.4 There must be some means of maintaining constant saturation of the cheesecloth, typically by a solvent reservoir.

6.1.1.5 The double rub (stroke) length must be 20 ± 2 cm [8 ± 0.8 in.] (one direction) at a minimum rate of 60 and maximum of 100 double rubs per minute.

6.1.1.6 The number of double strokes must be automatically counted (up or down) and displayed by the machine.

7. Reagents and Materials

7.1 *Methyl Ethyl Ketone (MEK)*, conforming to Specification D740.

7.2 *Other Solvents*, as specified by the coating manufacturer or user.

7.3 *100 % Cotton Cheesecloth*, mesh grade 28 by 24, or other mutually agreed upon cloth.

8. Sampling, Test Specimens, and Test Units

8.1 Obtain representative, coated, flat panels, and cut the panels to an appropriate size for the test machine. If possible,

use a panel of sufficient length to allow a 200 mm [8 in.] long test surface by 25 mm [1 in.] width. The long dimension must be parallel to the rolling (longitudinal) direction of the coil for coil coatings.

8.2 Measure the dry film thickness of the coating on the selected panel in accordance with standards D4138, D5796, D6132, or D7091 to ensure that the coating meets thickness requirements.

8.3 For items that may have varied coating thickness and cure across the item (for example, across a coil of coated metal), it is recommended that samples representing that variation be collected.

9. Preparation of Apparatus

9.1 Prepare in accordance with the manufacturer's instructions.

9.2 Adjust the machine rub or stroke rate to the desired value. For coil coatings, this would be as close as possible to 100 double rubs per minute, consistent with the machine capability, and no less than 60 double rubs per minute regardless of coating type.

10. Calibration and Standardization

10.1 Standardize and/or calibrate the rub machine in accordance with the machine manufacturer's instructions.

11. Procedure

11.1 Select the appropriate solvent for the test and be sure that the solvent reservoir is filled as recommended by the rub machine manufacturer.

11.2 Fold the cheesecloth into a pad of double thickness, cut to fit over the mechanical finger, and then secure into place in accordance with the manufacturer's recommendations.

11.3 Clamp the panel to be tested into position according to the surface to be tested with the long dimension parallel to the rubbing direction of the machine (and the rolling direction for coil coatings) and in accordance with the machine manufacturer's recommendations.

11.4 Set the machine counter to the desired number of rubs, and place the mechanical finger with cheesecloth in position on the test panel. Be sure the cheesecloth is saturated with solvent from the reservoir.

11.5 Start the machine.

11.6 The test may be run in two different ways as agreed upon between producer and user: (1) the machine is allowed to run for the set number of counts as agreed upon between producer and user, and the coating is inspected for visible substrate (coating break-through) or failure; (2) the machine is allowed to run until the operator observes visible substrate (coating break-through) and the number of double rubs on the machine counter is recorded (or subtracted from the original setting if counting down). In the first method, the result is pass or fail, and in the second, a numerical result is recorded. The second method may be more useful for research or cases where comparison of continuous data is desired.



FIG. 1 Example of a Mechanical Rubbing Machine



11.7 If it is desirable to disregard visible substrate (coating break-through) within 13 mm [0.5 in.] either end of the rub surface (sometimes referred to as heel-break), such a definition must be agreed upon between producer and user.

11.8 If it is desirable to change or expose fresh cheesecloth surface at a specified double rub interval (for example, every 25 double rubs) such a procedure must be agreed upon between producer and user.

12. Report

12.1 Report the following information as a minimum:

12.1.1 Identity of the machine used including model number.

12.1.2 Any machine parameters that deviate from those specified in Section 6.

12.1.3 Identity of the coated sample tested.

12.1.4 The solvent used.

12.1.5 The dry film thickness of the coating prior to testing.

12.1.6 The number of double rubs tested and agreed upon between producer and user and the respective pass or fail result, or

12.1.7 The number of double rubs at which coating failure as defined by producer and user occurred. If no failure occurred at some maximum test limit, report as >total double rubs tested (for example, >100 or 100+).

13. Precision and Bias

13.1 The precision for this test method has not been determined.

14. Keywords

14.1 coil coating; cure; solvent rubs

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