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Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[1]

This standard is issued under the fixed designation D 823; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 Five practices are given for preparing films of uniform thickness of coatings on test panels. These practices are:
Practice A—Automatic Spray Machine Application
Practice B—Motor-Driven Dip Coater Application
Practice C—Motor-Driven Blade Film Application
Practice D—Hand-Held Spray Gun Application
Practice E—Hand-Held Blade Film Application

1.2 The values stated in inch-pound 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. Referenced Documents

2.1 *ASTM Standards:*

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products[2]

D 1005 Test Methods for Measurement of Dry Film Thickness of Organic Coatings Using Micrometers[2]

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[2]

D 1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings[2]

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base[2]

D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer and Related Materials[2]

PRACTICE A—AUTOMATIC SPRAY MACHINE APPLICATION

3. Summary of Practices

3.1 A liquid material is applied to a test panel by means of an automatic spray machine consisting of a mounted spray gun and a panel holder. This machine can (*1*) move the panel holder, with test panel, at a uniform speed through the atomized spray produced by a fixed spray gun, or (*2*) it can move the gun, with atomized spray, at a uniform speed past the test panel mounted on a fixed panel holder. A machine equipped with a programmable system can index the spray gun vertically for multiple passes and for multiple coats with selective time delay.

3.2 The thickness of coating applied is controlled by the traverse speed of the panel or gun, the fluid delivery rate of the gun, the viscosity of the material, and the amount of nonvolatile matter in the material.

4. Significance and Use

4.1 These practices should be used for those coatings that are designed for spray applications of objects in the factory or in the field. It is particularly important that it be used in the evaluation of metallic coatings for appearance properties, such as gloss and color.

4.2 Coatings applied by this test method may exhibit a slight orange-peel or spray wave.

5. Apparatus

5.1 *Test Panels*, of any smooth, planar material of a size that can be accommodated by the panel holder of the automatic spray machine.

5.1.1 When steel panels are used, they should be prepared in accordance with the appropriate method in Practice D 609.

5.2 *Automatic Spray Machine*,[3] equipped with a panel holder and a mounting for a spray gun. The machine shall be designed to move the panel holder at a uniform speed past the fixed gun mount, or designed to move the gun mount at a

[1] These practices are under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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[2] *Annual Book of ASTM Standards*, Vol 06.01.

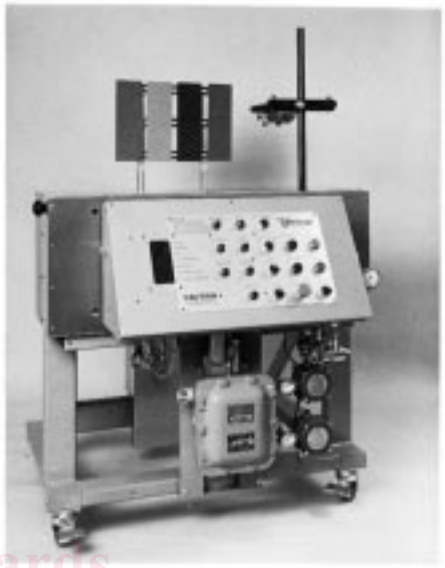
[3] Machines suitable for this purpose are manufactured by Eclipse Systems, Inc., 12 Cork Hill Rd., Franklin, NJ 07416; Spraymation, Inc., 5320 N.W. 35th Ave., Ft. Lauderdale, FL 33309-6314; and Sheen Instruments Ltd., 8 Waldegrave Road, Teddington, Middlesex, TW118LD, England.

uniform speed past the fixed panel holder. The panel holder or the gun mount traverse speed shall be adjustable from 25 to 100 ft (7.5 to 30 m)/min. Typical machines are shown in Fig. 1.

NOTE 1—Some automatic spray machines provide additional features that can improve the uniformity of film preparation. Some examples are: a z-bar panel holder; indexing of the panel holder at right angles to the gun to provide uniform lapping; and automatic control of number of passes, time between passes, and lapping distance.

5.3 *Spray Gun*, any that will provide a uniform fan-type

(*a*) Fixed Gun, Traveling Panel Machine



(*b*) Fixed Panel, Traveling Gun Machine

(*c*) Fixed Panel Programmable Indexing Traveling Gun Machine

FIG. 1 Automatic Spray Machines, Practice A

spray pattern at least 6 in. (150 mm) in width is satisfactory. The gun may be triggered manually or automatically.

5.4 *Pressure Gage*, covering the range of 0 to 100 psi (0 to 690 kPa).

5.5 *Air Pressure Regulator*.

5.6 *Air Supply*, oil-free, under pressure.

6. Preparation of Apparatus

6.1 Mount the spray gun on the automatic spray machine. Connect the air line hose from the regulator to the air pressure gage which in turn is connected to the air inlet of the spray gun.

6.2 Set the gun so that its tip is at the desired distance from the test panel surface, usually in the range from 8 to 12 in. (200 to 300 mm).

6.3 With the gun trigger fully open, adjust the air regulator to provide the desired reading on the air pressure gage.

NOTE 2—A suitable air pressure is usually from 40 to 75 psi (275 to 520 kPa).

6.4 Set the automatic spray machine controls to provide the desired traverse speed of the panel holder or the gun mount, whichever is pertinent to the type of machine being used.

NOTE 3—Suitable traverse speeds for automative coatings usually range from 700 to 900 in./min (17.5 to 22.5 m/min).

7. Procedure

7.1 Strain the material to be sprayed into the container to be used with the spray gun. Reduce the material to a viscosity suitable for spraying.

7.2 Connect the container to the gun and test the spray gun operation while stationary, for correct spray pattern and uniformity by allowing a momentary spray to be deposited on a piece of paper placed in the panel position. Adjust the air pressure material flow, and spray fan width controls until the desired pattern and uniformity are obtained. Further refinements may be made in the spray pattern by modifying the air pressure, the type of thinning agent, and the consistency of the material.

NOTE 4—The width of the spray pattern should be considerably wider than the width of the test panel to assure spray uniformity on the test panel.

7.3 Place a test panel on the panel holder and start the machine. Operate the spray gun so that it will begin spraying a few seconds before the test panel enters the spray pattern and continue spraying a few seconds after the test panel leaves the spray pattern.

7.4 Remove the coated panel and bake, force-dry, or air-dry it, in accordance with its type, in a vertical position in a dust-free atmosphere, as described in Specification D 3924.

7.5 Determine the thickness of the coating in accordance with Test Methods D 1005, D 1186, D 1212, or D 1400, whichever is appropriate.

8. Report

8.1 Report the following information:

8.1.1 Type of coating material,

8.1.2 Viscosity and percent of nonvolatile coating material,

8.1.3 Distance of test panel from gun tip,

8.1.4 Air pressure,

8.1.5 Number of spray passes,

8.1.6 Traverse speed,

8.1.7 Temperature and relative humidity at time of application, and

8.1.8 Film thickness values obtained for applied coating.

PRACTICE B—MOTOR-DRIVEN DIP COATER APPLICATION

9. Summary of Practice

9.1 A motor-driven device is employed to withdraw the test panel from a container of the coating material at a desired uniform rate.

9.2 The thickness of coating applied is controlled by the speed of panel withdrawal, the viscosity of the material, and the percent of solids in the material.

10. Significance and Use

10.1 This test method is limited to those materials that flow out to smooth films when test panels are dipped into the material and withdrawn.

11. Apparatus

11.1 *Dip Coater*,[4] consisting of a mechanism that will withdraw a panel from a container of the coating material at a predetermined rate. Suitable apparatus, is shown in Fig. 2(*a*) and 2(*b*):

11.1.1 The apparatus shown in Fig. 2(*a*) uses a cord wound around a step-cone pulley on the shaft of a motor to provide panel withdrawal rate of 2, 3, and 4-in. (50, 75, and 100-mm)/min. Prior to withdrawal, the panel, attached to the cord, is lowered by hand into the container holding the material.

11.1.2 The apparatus shown in Fig. 2(*b*) uses a cord driven by a variable-speed device that can provide panel immersion and withdrawal rates that are continuously variable from 2.5 to 20 in. (65 to 510 mm)/min.

NOTE 5—Rectangular containers (F-style can with lid cut off) are useful because the smaller exposed surfaces of the liquid coating reduces volatile loss.

11.2 *Test Panels*, of any clean, smooth, rigid substrate of a size that can be accommodated by the dip coater and the container.

11.2.1 When steel panels are used they shall be prepared in accordance with the appropriate method in Methods D 609.

NOTE 6—The test panels should not exceed 12 in. (300 mm) in length, but the width may be varied up to 12 in. if a suitable counterweight is used and a dip tank of adequate size is provided. Use of a multiple hook will permit dipping several panels at one time.

12. Procedure

12.1 Adjust the coating material to the proper percentage of solids and viscosity. Measure the temperature of the material in the container at the time of application.

[4] Suitable dip coaters are the Gardco Dip Coater obtainable from Paul N. Gardner Co., Inc., 316 N.E. First St., P.O. Box 10688, Pompano Beach, FL 33061-6688 and the Dipcoater obtainable from Technical Equipment Co., P.O. Box 208, Willoughby, OH 44094.

(*a*) Dip-Coater With Motor-Driven Step-Cone Pulley (*b*) Dip-Coater With Continuously Variable Speed Drive

FIG. 2 Dip-Coater, Practice B

NOTE 7—The operating conditions (viscosity, percent of nonvolatile matter, and rate of withdrawal) are specific for a given coating material and film thickness and need to be determined by trial. Subsequent reproduction of the same operating conditions should give the same film thickness. Data are available[5] on a variety of materials and film thickness to indicate the range required. The viscosity range for normal film thickness of 0.5 to 2.0 mil (13 to 50 mm) has been shown to be 1 to 2.5 P.

12.2 Place the prepared test panel on the hook attached to the cord and lower it into the container holding the coating material. Wind the cord once completely around the pulley of the correct size to give the desired rate of withdrawal.

12.2.1 For the stepped-cone pulley apparatus, wind the cord once completely around the pulley of the correct size to give the desired weight of withdrawal.

12.2.2 For the continuously variable speed apparatus set the desired panel immersion and withdrawal rates on the control panel.

12.3 Start the motor and withdraw the panel at the desired rate, with a smooth movement entirely free of vibration. Bake, force-dry, or air-dry the coated panel, in accordance with its type, in a vertical position in a dust-free atmosphere in accordance with Specification D 3924.

12.4 Determine the thickness of the coating in accordance with Test Methods D 1005, D 1186, or D 1400, whichever is appropriate.

12.5 If the coating thickness is too low, coat another panel using a slower rate of panel withdrawal. If the coating thickness is too high, coat another panel using a faster rate of panel withdraw.

12.6 Continue in this manner until a test panel having the desired film thickness is produced. Measure thickness on at least three different areas of the test panel to determine coating uniformity.

NOTE 8—With the dip coater, non-uniform thickness on a panel is frequently obtained. Hence, if the film thickness is greater at the bottom than the top, the viscosity should be increased or the panel withdrawal speed should be reduced, or both.

13. Report

13.1 Report the following information:

13.1.1 Type of coating material,

13.1.2 Viscosity, temperature, and percent nonvolatile of coating material,

13.1.3 Rate of withdrawal,

13.1.4 Air temperature and relative humidity at time of application, and

[5] Information covering viscosity, percent of solids, rates of withdrawal and film thickness for a variety of finishing materials is given in the paper by Payne, H. F., "The Dip Coater, An Instrument For Making Uniform Films by the Dip Method," *Industrial and Engineering Chemistry*, Analytical Edition, Vol 15, 1943, p. 48.