Designation: D823 – 18 (Reapproved 2022)

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

This standard is issued under the fixed designation D823; 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 U.S. 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—Automated 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 use of wire-wound drawdown bars as described in Practice D4147 may also be an appropriate method for producing films of uniform coating thickness.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:*[2]

D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
D1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings
D3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
D4147 Practice for Applying Coil Coatings Using Wire-Wound Drawdown Bars
D4285 Test Method for Indicating Oil or Water in Compressed Air
D4414 Practice for Measurement of Wet Film Thickness by Notch Gages
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

PRACTICE A—AUTOMATED SPRAY MACHINE APPLICATION

3. Summary of Practices

3.1 A liquid material is applied to a test panel by means of an automated 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(s) 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 spray gun tip size, the viscosity of the material, and the amount of nonvolatile matter in the material.

4. Significance and Use

4.1 This practice should be used for those coatings that are designed for spray applications of objects in the factory or in

[1] These practices are under the jurisdiction of ASTM Committee D01 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] 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.

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 clean, planar rigid substrate with a uniform surface of a size that can be accommodated by the panel holder of the automated spray machine.

5.1.1 When steel panels are used, they should be prepared in accordance with the appropriate method in Practice D609.

5.2 *Automated Spray Machine,* 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 uniform speed past the fixed panel holder. The panel holder or the gun mount traverse speed shall be adjustable from 7.5 to 30 m (25 to 100 ft)/min. Examples of automated spray machines are shown in Fig. 1.

NOTE 1—Some automated 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 spray pattern at least 150 mm (6 in.) in width is satisfactory. The gun may be triggered manually or automatically.

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

5.5 *Air Pressure Regulator.*

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

6. Preparation of Apparatus

6.1 Mount the spray gun on the automated 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 200 to 300 mm (8 to 12 in.).

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 275 to 520 kPa (40 to 75 psi).

6.4 Set the automated 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 automotive coatings usually range from 17.5 to 22.5 m/min (700 to 900 in./min).

7. Procedure

7.1 If compressed air is used to atomize the coating, verify that the air is clean and dry according to Test Method D4285.

7.2 If recommended by the coating manufacturer, 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 using the coating manufacturer's recommended thinner.

7.3 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, and the type and amount of thinner.

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.

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

7.5 Measure the wet film thickness in accordance with Test Methods D1212 or Practice D4414. Additional passes may be made until the desired wet film thickness has been achieved.

7.6 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 (if required), as described in Specification D3924.

7.7 Measure the dry film thickness of the coating in accordance with Test Methods D1005 or Practice D7091, whichever is appropriate.

8. Report

8.1 Report the following information:

8.1.1 Type of coating material,

8.1.2 Type and amount of thinner added as a percentage by weight or volume of the total mixed coating, if applicable,

8.1.3 Temperature of coating material,

8.1.4 Wet film thickness,

8.1.5 Distance of test panel from gun tip,

8.1.6 Type of spray gun and spray tip size,

8.1.7 Air pressure,

8.1.8 Number of spray passes,

8.1.9 Traverse speed,

8.1.10 Air temperature, relative humidity and temperature of test panel at time of application, and

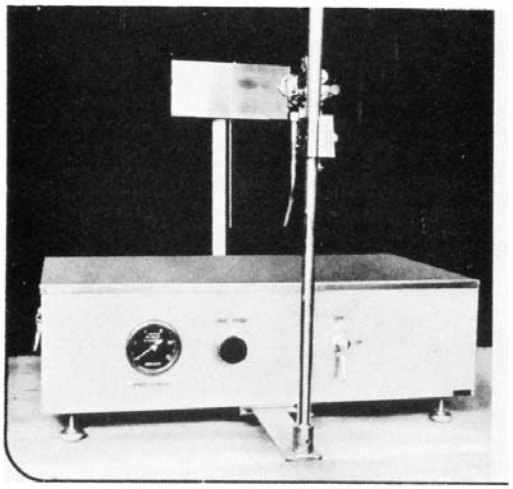
8.1.11 Mean and range of dry film thickness values obtained.

PRACTICE B—MOTOR-DRIVEN DIP COATER APPLICATION

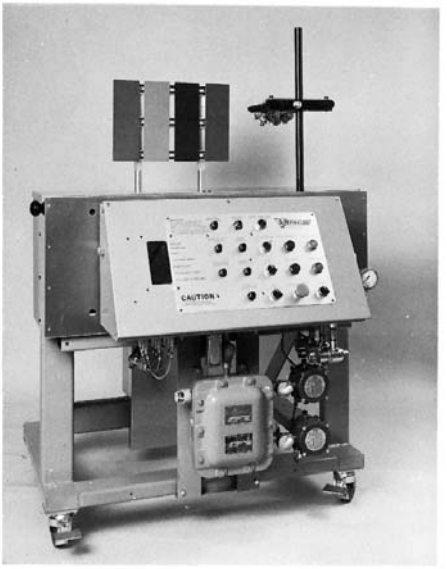
9. Summary of Practice

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.

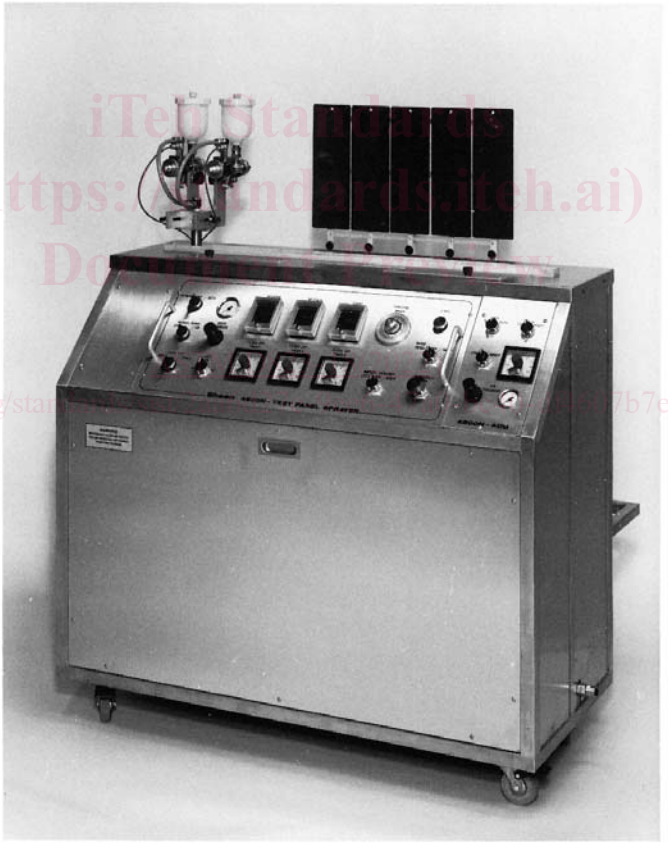
9.2 The wet film thickness of the applied coating is influenced by many variables including, but not limited to the speed



(*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

of withdrawal, rheological characteristics of the coating at the test temperature and the temperature of the test panel.

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,* 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 50, 75, and 100-mm (2, 3, and 4-in.)/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 65 to 510 mm (2.5 to 20 in.)/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, rigid substrate with a uniform surface 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 Practice D609.

NOTE 6—The test panels should not exceed 300 mm (12 in.) in length, but the width may be varied up to 300 mm (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.

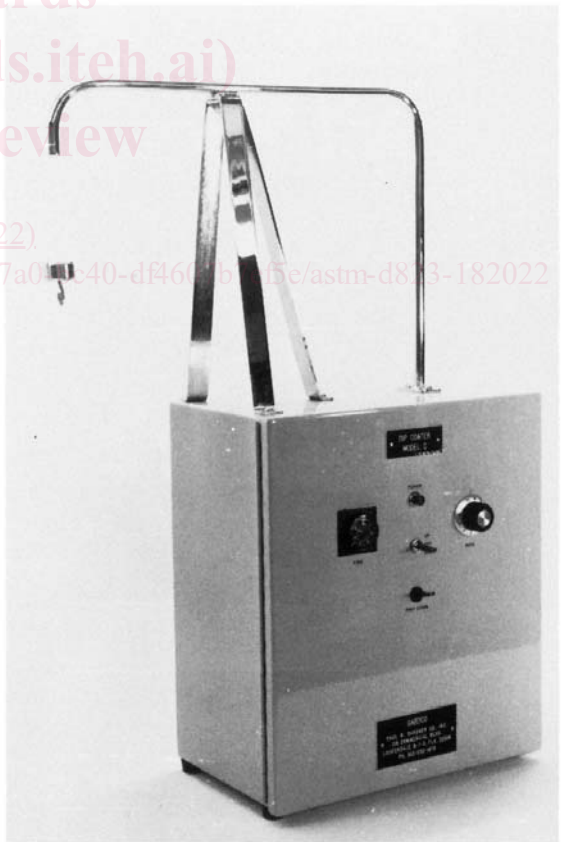
12. Procedure

12.1 Adjust the coating material to the desired viscosity using thinner as necessary. Measure the temperature of the material in the container at the time of application.

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 yield a similar film thickness.

12.2 Place the prepared test panel on the hook attached to the cord and lower it into the container holding the coating

(*a*) Dip-Coater With Motor-Driven Step-Cone Pulley



(*b*) Dip-Coater With Continuously Variable Speed Drive

FIG. 2 Dip-Coater, Practice B

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.

12.4 Measure the wet film thickness in accordance with Test Methods D1212 or Practice D4414.

12.5 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 D3924. Measure the dry film thickness of the coating in accordance with Test Method D1005 or Practice D7091.

12.6 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 withdrawal.

12.7 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 Type and amount of thinner added as a percentage by weight or volume of the total mixed coating, if applicable,

13.1.3 Temperature of coating material,

13.1.4 Rate of withdrawal,

13.1.5 Air temperature, relative humidity and temperature of test panel surface at time of application, and

13.1.6 Mean and range of dry film thickness values obtained.

PRACTICE C—MOTOR-DRIVEN BLADE FILM APPLICATION

14. Summary of Practice

14.1 A uniform film is produced by an applicator blade that is pushed or pulled across the test panel at a uniform speed by a motor-driven device.

14.2 The wet film thickness of the coating applied may be affected by the speed at which the applicator blade is moved, the clearance of the applicator blade, the design of the applicator blade, and the viscosity of the coating.

15. Significance and Use

15.1 This test method is applicable to substrates consisting of uniform rigid materials, such as metal or glass, and of non-rigid materials, such as paper charts. The motor-driven film applicator may offer advantages over the use of hand-held film applicator blade, due to the constant speed of application.

16. Apparatus

16.1 *Motor-Driven Blade Film Applicator,* consisting of a base plate, a bar for holding an applicator blade, and a driving mechanism. The base plate shall hold non-rigid substrates flat. A vacuum system is preferred except for very thin charts that can "pucker" if too much vacuum is applied. The blade holder shall be designed to accommodate common types of applicator blades and designed to accept weights for loading the applicator blade, if necessary, to prevent lifting of the blade when applying viscous materials. A mechanism shall be provided to stop the blade movement automatically at the end of the drawdown. A typical device is shown in Fig. 3.

16.2 *Vacuum Source,* a vacuum pump or a water aspirator.

FIG. 3 Blade Film Applicator, Motor-Driven, Practice C