Designation: D 5327 – 97 (Reapproved 2002)

Standard Practice for Evaluating and Comparing Transfer Efficiency of Spray Applied Coatings Under General Laboratory Conditions[1]

This standard is issued under the fixed designation D 5327; 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 practice covers the evaluation and comparison of the transfer efficiency of spray-applied coatings under general laboratory conditions. Transfer efficiency is the ratio of paint solids deposited to the total paint solids used during the application process, expressed as a percent. This practice can be used to study the effect on transfer efficiency of changing operating variables and paint formulations. Key variables that need to be controlled are listed in 8.13.

NOTE 1—It is important that all process or formulation parameters, except that which is intentionally being changed, be kept consistent from test to test. If not done, the results of the study are to be questioned.

1.2 The reproducibility of this practice is highly dependent on the degree of control of the parameters listed in Section 8 of the practice.

1.3 *Limitations*—This laboratory practice indicates only the direction of the effect of operating variables and liquid paint formulations on transfer efficiency under conditions of the laboratory test: the magnitude of the effect can be determined only with specific plant experience. In fact, the nature of the critical parameters that affect transfer efficiency makes clear that it is not possible to extrapolate laboratory results.

NOTE 2—The laboratory practice outlined involves general laboratory spray equipment and procedures and is derived from Test Method D 5009. This practice and Test Method D 5009 are both derived from a study and report of transfer efficiency measurements conducted for the U.S. Environmental Protection Agency. For laboratories that have access to a conveyor and mass flow measurement equipment, a suitable, potentially more reproducible, tested method is defined in Test Method D 5009.

1.4 The values stated in SI 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.* For specific hazard statements see Section 7, Note 8 and Note 9.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1200 Test Method for Viscosity by Ford Viscosity Cup[2]

D 2369 Test Method for Volatile Content of Coatings[2]

D 3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings[2]

D 5009 Test Method for Evaluating and Comparing Transfer Efficiency of Spray Applied Coatings Under Laboratory Conditions[3]

2.2 *Other Standards:*

NFPA 33 Spray Application Using Flammable and Combustible Materials[4]

NFPA 86 Standard for Ovens and Furnaces[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Practice*:

3.1.1 *fluid mass flow rate*—the mass flow rate of paint in grams per minute during the test.

3.1.2 *mass of foil*—the weight of each target foil in grams before being painted.

3.1.3 *mass of foil plus paint solids*—the weight of each target foil in grams after being painted and baked.

3.1.4 *mass of paint solids*—the difference in the mass of the foil before painting and the mass of the foil after painting and baking. The sum of the mass of the foil plus paint solids less the sum of the mass of the foil.

3.1.5 *transfer efficiency*—the ratio of the mass of the paint solids deposited on the foil to the mass of the paint solids sprayed during the test, expressed as a percent.

3.1.6 *weight percent solids*—the solids content as percent of the total weight of a sample of the paint used during the test.

3.1.6.1 *Discussion*—Weight percent solids are determined as specified in 8.4.2.

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.55 on Factory Applied Coatings on Preformed Products.

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

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

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

4. Summary of Practice

4.1 Metal panels covered with preweighed aluminum foil are coated in a spray booth. The coated foils are baked to remove volatile matter. The transfer efficiency is calculated on a weight percent basis using the solids content, quantity of paint sprayed, and the amount of solids on the coated aluminum foil.

5. Significance and Use

5.1 Subject to the limitations listed in 1.3, this practice can be used as a research tool to optimize spray equipment and paint formulations, as well as to study the relative effect on transfer efficiency of changing operating variables, spray application equipment, type of coatings, etc.

6. Apparatus

6.1 *Laboratory Scale*, accurate to ±0.001 g.

6.2 *Platform Scale*, accurate to ±0.01 g.

6.3 *Targets*, should consist of a minimum of three steel panels, two scavengers and a target panel. If more than one target panel is used, a scavenger panel is to be used at the start and end of the test panel set. The steel panels are 15.2 by 0.15875 cm wide (6 by 0.0625 in.) with 0.635 cm (0.25 in.) radius corners. The length of the panel should be sufficient that a minimum of 30.4 cm (12 in.) above and below the spray pattern is achieved.

NOTE 3—It is essential to effectively capture the entire height of the spray pattern.

NOTE 4—Other panel sizes similar to those in the end use can be used. Differences in the part shape will influence the transfer efficiency.

NOTE 5—Results of this test may not be extrapolated to different spray booths, part geometries, etc.

6.4 *Aluminum Foil*, medium temper or equivalent, 0.0037-cm (1.5-mil) thick. The aluminum foil should be preheated at the conditions specified in the cure schedule recommended by the paint manufacturer.

6.5 *Back-Draw Water-Wash Spray Booth*, or equivalent. The booth should be capable of developing and maintaining up to 36.58 m/min (120 ft/min) air velocity in the middle at the plane of the target. If a filter booth is used, filters should be changed as frequently as necessary to maintain uniform air velocity.

6.6 *Forced Draft Curing Oven*, if required, of sufficient size for curing targets, capable of achieving and maintaining the cure temperature specified by the paint supplier. All ovens should conform to NFPA 86.

6.7 *Curing Rack*.

6.8 *Stopwatch*.

6.9 *Air Velocity Measurement Equipment*.

6.10 *Humidity and Temperature Measurement Equipment*.

6.11 *Compressed Air Supply*.

6.12 *Spray Gun*.

NOTE 6—The spray gun can be attached to a spray machine or hand held. Needless to say, operator variation with a hand held spray gun can mask the effect of changes in the variable being studied.

7. Hazards

7.1 For specific hazard information and guidance, consult the supplier's Material Safety Data Sheet (MSDS) for the materials used.

8. Procedure

8.1 Set up the paint supply equipment to the spray apparatus in accordance with the manufacturer's instructions.

8.1.1 Ground all electrically conductive objects in the spray area, except those objects required by the process to be at high voltage in accordance with Chapter 9.11 of NFPA 33.

8.2 Agitate the test paint in a closed container at least 30 min before paint samples are taken.

8.3 Using an airtight container, take a paint grab sample from the paint pot in accordance with Practice D 3925.

8.4 Determine and record the following from the paint sample:

8.4.1 Paint viscosity in accordance with Test Method D 1200,

8.4.2 *Weight Percent Solids*—The preferred method is Test Method D 2369. If the baking temperature in Test Method D 2369 is considered inadequate for complete cure, use the manufacturer's recommended cure schedule. Make sure that the cure schedule used is agreed upon and recorded, and

8.4.3 Electrical resistivity for samples being applied electrostatically.

8.5 Cut the aluminum foil to dimensions of 58 by 5 cm (15 by approximately 2 in.) longer than the length of the target panel.

8.6 Number each precut foil strip, before weighing, using a permanent marking pen.

8.7 Weigh each test foil strip and record the uncoated weight and the foil number.

8.8 Attach the preweighed, labeled test foil to the targets using the technique shown in Fig. 1.

8.9 Mount the foil covered targets on a panel or target holder, with the foil seam on each target facing away from the spray gun. Set panel spacing as desired.

8.9.1 If electrostatic equipment is being used, the resistance shall be less than 1 by 10^6 Ω between the target and earth ground, in accordance with Chapter 9.8 of NFPA 33.

8.10 Adjust the following equipment operating parameters, as appropriate, to the values desired for testing:

8.10.1 Paint fluid pressure at spray gun, kPa (psi),

8.10.2 Atomizing air pressure at spray gun, kPa (psi),

8.10.3 Rotating atomizer head speed (revolutions per minute) with and without paint fluid flow,

8.10.4 Operating voltage if electrostatic equipment is used, kV,

8.10.5 Ambient air temperature (°C),

8.10.6 Paint fluid temperature (°C),

8.10.7 Booth air velocity, feet per minute (meters per minute),

8.10.8 Relative humidity (percent),

8.10.9 Spray machine variables or spray gun procedures when using a hand held spray gun,

NOTE 7—The spray gun can be attached to a spray machine or hand held. If hand held, variations in technique can effect reproducibility of the transfer efficiency study and may override comparisons made.

8.10.10 Set the following variables where applicable (see Note 8):

8.10.10.1 Spray gun to target distance, cm (in.),