Designation: D 5286 – 01

Standard Test Methods for Determination of Transfer Efficiency Under General Production Conditions for Spray Application of Paints[1]

This standard is issued under the fixed designation D 5286; 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 These test methods cover the determination of the transfer efficiency of spray-applied coatings under general plant conditions. Transfer efficiency is the ratio of paint solids deposited to the total paint solids used during the application process, expressed as a percent.

1.2 The transfer efficiency is calculated from the weight or volume of the paint solids sprayed and that of the paint solids deposited on the painted part.

1.3 Limitations include the ability to accurately determine the amount of paint solids deposited on the part and the capability of accurate measurement of the amount of paint sprayed.

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

NOTE 1—These test methods apply to general plant production equipment and procedures. A method specific to automotive plants is defined in Test Method D 5066.

NOTE 2—The relationship between volatile organic compound emission rates and transfer efficiency in automobile and light duty truck topcoat operations, EPA 450/3-88-018, referenced in Test Method D 5066 does not apply to general production facilities.

NOTE 3—A single-point transfer efficiency measurement may not represent the entire process.

NOTE 4—The operator and the spray-application equipment-operating conditions during the transfer efficiency measurement should be representative of normal operating conditions.

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, and 10.3.1.

NOTE 5—These test methods have not been adopted by federal regulatory agencies for demonstration of compliance with air pollution regulations such as VOC, HAPS, etc.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings using Micrometers[2]

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

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

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

D 1475 Test Method for Density of Paint, Varnish, Lacquer and Related Products[2]

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

D 2697 Test Method for Volume Nonvolatile Content in Clear or Pigmented Coatings[2]

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

D 5066 Test Method for Determination of the Transfer Efficiency Under Production Conditions for Spray Application of Automotive Paints—Weight Basis[3]

2.2 *U.S. Government Standards:*

EPA 450/3-88-018, U.S. Environmental Protection Agency Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light Duty Truck Topcoat Operations[4]

EPA Federal Reference Method 24—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings. 40 Code of Federal Regulations, Part 60, Appendix A.[4]

2.3 *National Fire Protection Documents:*

NFPA 33 Spray Application Using Flammable and Combustible Materials[5]

NFPA 86 Standard for Ovens and Furnaces[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

[1] These test methods are 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 Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[5] Available from National Fire Protection Assn., Battery March, Quincy, MA 02269.

3.1.1 *paint*—the liquid material applied to coat or cover the surface of the part.

3.1.2 *transfer efficiency (volume)*—the ratio of the volume of paint solids deposited to the volume of the paint solids sprayed, expressed as a percent.

3.1.3 *transfer efficiency (weight)*—the ratio of the weight of paint solids deposited to the weight of the paint solids sprayed, expressed as a percent.

3.1.4 *volume of paint solids*—the difference in the volume of the paint solids on the part before painting and the volume of the paint solids on the part after painting.

3.1.5 *volume percent solids*—the solids content as percent of the total volume of a sample of paint used.

3.1.6 *weight of paint solids*—the difference in the weight of the part before painting and the weight of the part after painting and baking.

4. Summary of Test Methods

4.1 The weight of liquid paint used per part is determined (Procedure A). The weight solids content of the paint material is determined and used to calculate the paint solids sprayed. The transfer efficiency is calculated by dividing the weight of the paint solids deposited by the weight of the paint solids sprayed.

4.2 The volume of paint solids used per part is determined (Procedure B). The volume solids of the paint material is determined and used to calculate the paint solids sprayed. The transfer efficiency is calculated by dividing the volume of the paint solids deposited by the volume of the paint solids sprayed.

5. Significance and Use

5.1 Subject to the limitations listed in 1.3, these test methods can be used to optimize paint application processes.

6. Apparatus

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

6.2 *Tension Load Cells or Comparable Platform Scales*, accurate to ± 0.02 mg (0.05 lb).

6.3 *Film Thickness Gage*, see Test Methods D 1005, D 1186, and D 1400 for type of film thickness measurement of device.

6.4 *Targets*, consisting of the parts to be coated. A minimum of two targets is required. The larger the number of targets, the greater the accuracy of the test.

6.5 *Rule and Calipers*, for measuring the diameter of the paint supply tank or pot, tank agitator shaft, etc.

6.6 *Sample Containers*, clean, dry, for sampling the paint material.

7. Hazards

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

8. Paint Usage Measurement Procedures

8.1 Transfer efficiency measurement requires that accurate measurement be made of the quantity of paint material used in the application process during the time period associated with the coating of the parts. Two general methods are applicable for accurately measuring paint usage.

8.1.1 The preferred method is to determine the weight of paint used during the application period studied.

8.1.2 Where direct paint usage measurement by weight is not practical, an alternative approach for determining paint usage by volume is given. The latter approach involves measuring the drop in paint level in the paint supply tank (pot) during the application period studied.

8.1.3 Where paint meter/mix equipment is used to directly feed paint application equipment, paint-component meter readings shall be deemed reliable when the meter is properly calibrated in accordance with the equipment manufacturer's calibration instructions or local calibration procedures.

9. Paint Usage Determination by Weight Procedure—Procedure A

9.1 Level and calibrate the weighing device for weighing the paint supply tank (pot).

9.2 If an electronic weighing device is used, it must be turned on long enough to achieve stability, following the manufacturer's directions. All weighing devices must be situated to minimize disturbance from vibration or air movement.

9.3 Introduce the material reduced to spray viscosity, into the supply tank (pot) to be weighed. Before the test is conducted, be certain that fluid flows are properly set, that all supply and return lines are filled with the paint, and that no leaks are present in the piping system.

9.4 Shut off the paint supply tank (pot) agitator to minimize vibration during the weighing process.

9.5 Weigh the paint supply tank (pot) before the test parts are run. Weigh the tank until two consecutive measurements are obtained within the measurement accuracy of the weighing device. Average the two readings and record, P_i.

9.6 After painting the test parts, reweigh the paint supply tank (pot) as in 9.5 and record, P_f.

Paint Deposited Determination by Weight Measurement Method, Procedure A

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

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

9.9 Prior to running the test, agitate the test paint in a paint supply tank (pot) at least 30 min before paint samples are taken.

9.10 Using an airtight container, take a paint grab sample from the paint supply tank (pot) in accordance with Practice D 3925.

9.11 Determine and record the following from the paint sample:

9.11.1 Paint viscosity in accordance with Test Method D 1200,

9.11.2 Weight percent solids in accordance with Test Method D 2369. If the baking temperature in Test Method D 2369 is inadequate, use the manufacturer's recommended cure schedule, and