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AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428

Standard Practice for Measurement of Wet Film Thickness by Notch Gages[1]

This standard is issued under the fixed designation D 4414; 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 describes the use of thin rigid metal notched gages, also called step or comb gages, in the measurement of wet film thickness of organic coatings, such as paint, varnish, and lacquer.

1.2 Notched gage measurements are neither accurate nor sensitive, but they are useful in determining approximate wet film thickness of coatings on articles where size(s) and shape(s) prohibit the use of the more precise methods given in Methods D 1212.

1.3 This practice is divided into the following two procedures:

1.3.1 *Procedure A*—A square or rectangular rigid metal gage with notched sides is used to measure wet film thicknesses ranging from 0.5 to 80 mils (13 to 2000 µm). Such a gage is applicable to coatings on flat substrates and to coatings on articles of various sizes and complex shapes where it is possible to get the end tabs of the gage to rest in the same plane on the substrate.

1.3.2 *Procedure B*—A circular thin rigid metal notched gage is used to measure wet film thicknesses ranging from 1 to 100 mils (25 to 2500 µm). Such a gage is applicable to coatings on flat substrates and to coatings on objects of various sizes and complex shapes.

1.4 The values stated in inch-pound 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

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

3. Summary of Practice

3.1 The material is applied to the articles to be coated and the wet film thickness measured with a notched gage.

3.2 *Procedure A*—A square or rectangular thin rigid metal gage with notched sides, having tabs of varying lengths, is pushed perpendicularly into the film. After removal from the film, the gage is examined and the film thickness is determined to lie between the clearance of the shortest tab wet by the film and the clearance of the next shorter tab not wetted by the film.

3.3 *Procedure B*—A circular thin rigid metal gage having spaced notches of varying depths around its periphery is rolled perpendicularly across the film. After removal from the film, the gage is examined and the film thickness is determined as being between the clearance of the deepest face wetted and the clearance of the next deepest notch face not wetted by the film.

4. Significance and Use

4.1 Wet film thickness measurements of coatings applied on articles can be very helpful in controlling the thickness of the final dry coating, although in some specifications the wet film thickness is specified. Most protective and high performance coatings are applied to meet a requirement or specification for dry film thickness for each coat or for the completed coating system, or for both.

4.2 There is a direct relationship between dry film thickness and wet film thickness. The wet film/dry film ratio is determined by the volume of volatiles in the coating as applied, including permitted thinning. With some flat coatings the dry film thickness is higher than that calculated from the wet film thickness. Consequently, the results from the notch gage are not to be used to verify the nonvolatile content of a coating.

4.3 Measurement of wet film thickness at the time of application is most appropriate as it permits correction and adjustment of the film by the applicator at the time of application. Correction of the film after it has dried or chemically cured requires costly extra labor time, may lead to contamination of the film, and may introduce problems of adhesion and integrity of the coating system.

4.4 The procedures using notched gages do not provide as accurate or sensitive measurements of wet film thickness as do the Interchemical and Pfund gages described in Methods D 1212. Notch gages may, however, be used on nonuniform surfaces, like concrete block, that are too rough to use the

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[1] This practice is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is 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.

Interchemical and Pfund gages. Also notched gages can be very useful in the shop and field for determining the approximate thickness of wet films over commercial articles where size(s) and shape(s) are not suitable for measurements by other types of gages. Examples of such items are ellipses, thin edges, and corners.

4.5 An operator experienced in the use of a notched gage can monitor the coating application well enough to ensure the minimum required film thickness will be obtained.

4.6 Application losses, such as overspray, loss on transfer, and coating residue in application equipment, are a significant unmeasurable part of the coating used on a job and are not accounted for by measurement of wet film thickness.

5. Report

5.1 Report the following information:

5.1.1 The mean and range of the readings taken and the number of readings.

5.1.2 The smallest graduation of the gage used.

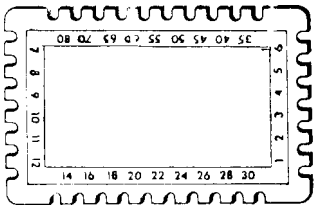

FIG. 1 Rectangular Notched Gage

6. Precision and Bias

6.1 The precision and bias of Procedure A or B for measuring wet film thickness with notch gages are very dependent on methods of film application, time that the measurement is taken after film application, mechanical condition of the notch gages, and the step range of the gages.

6.2 Generally, the agreement between notch gages is good because they are insensitive to small differences in film thickness, that is the step intervals of the gages are relatively large.

PROCEDURE A

7. Apparatus

7.1 *Notched Gage*, square or rectangular, thin rigid metal plate, with notched sides (see Fig. 1), made from steel or aluminum[3] (Note 1). Nonmetallic gages shall not be used.

NOTE 1—Aluminum or aluminum alloy gages are more easily distorted and may exhibit greater wear than steel gages. Gages made of plastic or deformable metal are not suitable.

7.1.1 Each notched side shall consist of a series of tabs (between notches) varying in length and located in a line between two end tabs equal in length and longest in the row.

7.1.2 As an example, the tabs on one row of a gage may differ in length as follows:

By 0.5 mil (13 µm) between 0 and 6 mils (0 to 150 µm),
By 1 mil (25 µm) between 6 and 10 mils (150 to 250 µm),
By 2 mils (50 µm) between 10 and 30 mils (250 to 750 µm), and
By 5 mils (125 µm) over 30 mils (750 µm).

8. Procedure

8.1 Apply the coating material to a rigid substrate and test with the gage immediately. The gage must be used immediately following application of the coating. Some coatings lose solvents quickly and spray application increases the speed. The resulting rapid reduction in wet film thickness can cause misleading readings.

8.2 Locate an area sufficiently large to permit both end tabs of the gage to rest on the substrate in the same plane.

8.3 Push the gage perpendicularly into the wet film so that the two end tabs rest firmly on the substrate at the same time.

8.4 Or, set one end tab firmly on the substrate and lower the gage until the other end tab is firmly in contact with the substrate.

8.5 Remove the gage from the film and examine the tabs. The film thickness is determined as being between the clearance of the shortest tab wettedd and the clearance of the next shorter tab not wetted by the film.

8.6 Clean the gage immediately after each reading by wiping it on a dry or solvent-dampened cloth so that subsequent readings are not affected. Do not clean with metal scrapers.

8.7 Repeat the procedure in 8.2-8.5 for at least three locations on the film. The number of readings required to obtain a good estimate of the film thickness varies with the shape and size of the article being coated, with the operator's experience, and whether one or more of the following problems are encountered:

8.7.1 Some coatings may not wet (leave residue on) some metal gages. However, the film itself may show where contact was made. When reading the gage, look at both the gage and the film itself for verification of the reading.

8.7.2 The gage may slip on the surface. Ignore such readings.

8.7.3 The surface may be coarse and false readings produced. The spot where the gage is used must be as uniform as possible and questionable readings ignored.

8.8 Determine the mean and range of the readings.

9. Report

9.1 Report the mean and range of the readings.

PROCEDURE B

10. Apparatus

10.1 *Circular Notched Gage*,[4] thin metal disk, with calibrated notches of various depths spaced around its periphery

[3] These gages are commercially available from various coating equipment and instrument suppliers.

[4] The "Hotcake" Wet Film Thickness Gage is covered by a patent held by Paul N. Gardner, Sr., 316 N.E. First Street, Pompano Beach, FL 33060. Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented item to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive., West Conshohocken, PA 19428. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

(see Fig. 2). Each notch has a recessed flat face. A hole is in the center of the disk.

10.2 Examples of the scale increments and ranges provided by the notches are:

10.2.1 1.0-mil increments between 1 to 4 mils (25 µm to 100 µm),

10.2.2 2-mil increments between 6 and 60 mils (150 µm to 1500 µm), and

10.2.3 4-mil increments between 60 and 80 mils (1500 µm to 2000 µm).

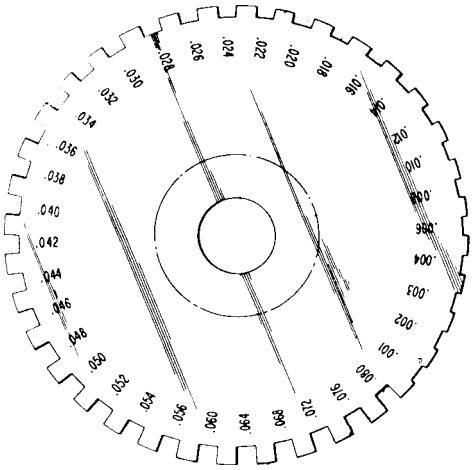

FIG. 2 Circular Notched Gage

11. Procedure

11.1 Select a gage that has a segment with a thickness scale appropriate for the expected range of wet-film thickness.

11.2 Locate areas on the rigid substrate sufficiently large to permit the gage to roll for at least 1½ in. (40 mm).

11.3 Apply the liquid coating to the substrate and immediately place the selected segment perpendicularly on the wet film and in firm contact with the substrate. Roll the gage across the film, holding the disk with a thumb and index finger in the center hole.

11.4 Remove the gage from the film and inspect the notch faces. The wet-film thickness is determined as being between the clearance of the deepest notch face wetted and the clearance of the next deeper notch face not wetted by the film.

11.5 Clean the gage immediately after each reading by wiping on a dry or solvent-dampened cloth so that subsequent readings are not affected. Do not clean with metal scrapers.

11.6 Repeat the procedure from 11.1-11.5 as described in 8.7.

11.7 Determine the mean and range of the readings.

12. Report

12.1 Report the mean and range of the readings.

13. Keywords

13.1 circular notched gage; rectangular notched gage