



## Standard Test Method for Curl in Carbon Paper<sup>1</sup>

This standard is issued under the fixed designation F415; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of curl of carbon paper.

1.2 This test method may be used for specification acceptance, manufacturing control, development, and research.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product \(Withdrawn 2010\)](#)<sup>3</sup>

[D685 Practice for Conditioning Paper and Paper Products for Testing](#)

[E104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions](#)

[F221 Terminology Relating to Carbon Paper and Inked Ribbon Products and Images Made Therefrom](#)

### 3. Definitions

3.1 Refer to Terminology [F221](#).

### 4. Summary of Test Method

4.1 Sheets of carbon paper are placed on a flat surface under different conditions of humidity and with a controlled tempera-

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.02 on Inked Transfer Imaging Products.

Current edition approved Oct. 1, 2010. Published November 2010. Originally approved in 1975. Last previous edition approved in 2005 as F415 – 87 (2005). DOI: 10.1520/F0415-87R10.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

ture. The amount of curl is expressed as height above a flat surface attained by the edge of a carbon paper sheet.

### 5. Significance and Use

5.1 This test method is intended to measure the amount of curl of a carbon paper sheet relative to the flat surface supporting the sample. The test is useful as a quality control method and for predicting field performance.

### 6. Apparatus

6.1 *Template*, 3-in. (76-mm) square, metal.

6.2 *Rule*, 6-in. (or an equivalent metric rule 150 mm). The rule shall be graduated either in inches with 0.1-in. subdivisions or in centimetres with 1-mm subdivisions, and the zero mark must be at the edge of the rule. Also, the width of the rule should be a minimum of 1/2 in. (12.7 mm) to facilitate supporting the rule in an upright perpendicular position relative to the flat supporting surface.

6.3 *Conditioning Cabinets*—Three humidity cabinets, electric with positive uniform air circulation, capable of maintaining the relative humidity and temperature ranges specified. The cabinets should be free of any hygroscopic materials such as wood, fabric, paper, etc.; sealed from external moisture and either insulated from external temperature changes or used in a room maintained at constant temperature. The cabinets should be small. A useful configuration can be constructed as follows: transparent sides, 14 in. wide by 8 in. high by 26 in. long (metric units 356 by 203 by 660 mm). The front shall overlap the sides and be hinged to serve as the door. During the conditioning interval, the front door shall be sealed. An inverted 6-in. (152-mm) rule can be supported on each wall of the conditioning cabinet to facilitate testing. The zero mark of the rule shall coincide with the top of the shelving upon which the sample is placed. A glass tray holding a saturated salt solution shall be placed on the bottom of the conditioning cabinet and below the shelving which is perforated to assist circulation. Chambers that mechanically control humidity, rather than with salts, are also acceptable.

6.4 *Hygrometer*, accurate to  $\pm 1\%$  relative humidity over a range of 20 to 80% relative humidity.

6.5 *Shelving*—Flat wire screens or similar shelving sufficiently rigid to hold its flatness, to fit inside the conditioning

cabinets, approximately 3 in. (75 mm) above the bottom of the cabinets. They shall be so constructed as to allow uniform air circulation.

## 7. Reagents

7.1 Reagents for maintaining appropriate relative humidities are shown in **Table 1**. (See Practice **E104**.)

7.1.1 A saturated salt solution is one in which the dissolved salt is in equilibrium with undissolved material of the same composition. Therefore, in order to be certain that saturation exists, there should always be some solid visible in the same tray that contains the saturated solution. Distilled water should be used in making up the salt solution.

7.2 The temperature at which the salt solutions are maintained governs the humidity level. These salt solutions have been chosen because over the range from 73 to 100°F (23 to 38°C) the relative humidity variation is small. It is intended for this test to be performed at the 73°F (23°C) level.

## 8. Sampling

8.1 Sample the carbon copy paper in accordance with Practice **D585**.

## 9. Test Specimens

9.1 Using the template and a sharp knife, cut 3-in. (76-mm) square specimens and mark the grain direction of each with a soft pencil on the top side. From each test unit of the sample, 18 square specimens are required.

## 10. Conditioning

10.1 Condition the carbon paper sheets accordance with Practice **D685**.

10.2 The recommended test conditions are three levels of relative humidity ( $22.9 \pm 2.0\%$ ;  $53.5 \pm 2.0\%$ ; and  $75.5 \pm 2.0\%$ ) at a temperature of  $73 \pm 3.5^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and an exposure time of 2 h.

## 11. Procedure

11.1 Place three separate test specimens top or face side up and three separate test specimens top or face side down in each of the conditioning cabinets.

**TABLE 1 Saturated Solutions**

Reagent	Relative Humidity, %	Temperature, °F (°C)
Potassium acetate, $\text{KC}_2\text{H}_3\text{O}_2$	22.9	73 (23)
Potassium acetate, $\text{KC}_2\text{H}_3\text{O}_2$	20.4	100 (38)
Magnesium nitrate, $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	53.5	73 (23)
Magnesium nitrate, $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	49.0	100 (38)
Sodium chloride, NaCl	75.5	73 (23)

11.2 At the end of the exposure time, visually inspect the three pairs of samples. Record which samples have curled, for example, the sheets positioned face up or the sheets positioned face down, or both. Record the relative humidity, temperature, and time duration of conditioning.

11.3 Without removing the sheets from the cabinet, quickly measure and record the height of the curled-up edge of the curled sheets. Report the class of curl as 0,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , I, II, III, IV, or tube curl, described as follows:

11.3.1 *Class 0*—No curl by visual inspection. Paper will be flat.

11.3.2 *Class  $\frac{1}{4}$* —Curl greater than Class 0 where any edge or corner of the paper measures not more than  $\frac{1}{4}$  in. (6.3 mm) above a flat surface.

11.3.3 *Class  $\frac{1}{2}$* —Curl greater than Class  $\frac{1}{4}$  where any edge or corner of the paper measures more than  $\frac{1}{4}$  in. but not more than  $\frac{1}{2}$  in. (12.7 mm) above a flat surface.

11.3.4 *Class I*—Curl greater than Class  $\frac{1}{2}$  where any edge or corner of the paper measures more than  $\frac{1}{2}$  in. but not more than 1 in. (25.4 mm) above a flat surface.

11.3.5 *Class II*—Curl includes any edge or corner of the paper greater than Class I but equal to or less than the point of intersection of a vertical line tangent to the paper.

11.3.6 *Class III*—Curl includes any edge or corner of the paper greater than Class II but equal to or less than the point of intersection of a horizontal line tangent to the paper.

11.3.7 *Class IV*—Curl includes any edge or corner of the paper greater than Class III but less than a point of actual contact with any other point in the paper.

11.3.8 *Tube Curl*—Curl includes any edge or corner of the paper greater than Class IV.


11.4 Report the direction of curl as “reverse” if the paper curls toward the side of contact with the rack. Report the direction of curl as “against the grain” if the paper curls about an axis perpendicular to the machine direction, or “diagonal” if one corner or two opposite corners of the paper curl. The curl data of the three samples should be reported. In the event one of the samples is much higher than other tests, it may be advisable to repeat this test.

## 12. Precision and Bias

12.1 Repeatable ranking order is obtained that is reproducible within a laboratory and between laboratories. The test is a comparative test, is subjective, and no quantitative data are intended.

## 13. Keywords

13.1 carbon paper; curl

 **F415 – 87 (2010)**

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or [service@astm.org](mailto:service@astm.org) (e-mail); or through the ASTM website ([www.astm.org](http://www.astm.org)). Permission rights to photocopy the standard may also be secured from the ASTM website ([www.astm.org/COPYRIGHT/](http://www.astm.org/COPYRIGHT/)).*