



Designation: D 5946 – 99

Standard Test Method for Corona-Treated Polymer Films Using Water Contact Angle Measurements¹

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1. Scope *

1.1 This test method covers measurement of the contact angle of water droplets on corona-treated polymer film surfaces.

NOTE 1—There is no similar or equivalent ISO standard.

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

1.3 *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 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 724 Test Method for Surface Wettability of Paper (Angle-of-Contact Method)³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *static contact angle*, θ (degrees), n —the angle between the substrate surface and the tangent line drawn to the droplet surface at the three-phase point, when a liquid drop is resting on a plane solid surface.

3.1.1.1 *Discussion*—Contact angle values can be determined as follows: (1) by measuring the contact angle directly with a protractor by using tangential alignment of a cursor line; (2) by measuring the angle between the substrate surface and the line from the three-phase point to the apex of the droplet, and then multiplying the obtained number by 2 to calculate the

contact angle;⁵ or (3) from the dimensions of the droplet's image, as follows (Test Method D 724):

$$\theta = 2 \times \arctan (H/R) \quad (1)$$

where:

H = height of a droplet's image, and

R = half its width.

Method (1) is biased due to the subjective nature of finding a tangent to the droplet image at the three-phase point; if Method (1) is to be used, the bias of each operator's measurements must be determined; Methods (2) and (3) are generally free of bias.

4. Summary of Test Method

4.1 In this test method, drops of water are placed on the surface of a film sample, and the contact angle values are measured and then averaged.

5. Significance and Use

5.1 The ability of polymer films to retain inks, coatings, adhesives, etc. is primarily dependent on the character of their surfaces and can be improved by one of several surface-treating techniques. The electrical discharge treatment, such as corona treatment, has been found to increase the wetting tension of a polymer film. The stronger the treatment, the more actively the surface reacts with different polar interfaces. It is therefore possible to relate the contact angle of a polymer film surface to its ability to accept and retain inks, coatings, adhesives, etc., if the ink, coating, or adhesive contains the polar functionalities. Contact angle in itself is not a completely acceptable measure of ink, coating, or adhesive adhesion.

5.2 The wetting tension of a polymer film belongs to a group of physical parameters for which no standard of accuracy exists. The wetting tension of a polymer cannot be measured directly because solids do not change shape measurably in reaction to surface energy. Many indirect methods have been proposed.⁶ Different test methods tend to produce different results on identical samples. Practical determination of a solid's surface energy uses this interaction of the solid with test liquids.

5.3 Although the level of surface treatment of polymer films has been traditionally defined in the industry in terms of

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 15.09.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ U.S. Patent No. 5 268 733.

⁶ Wu, S., *Polymer Interface and Adhesion*, Marcel Dekker, Inc., New York, NY, 1982.

*A Summary of Changes section appears at the end of this standard.