Designation: D7541 – 11

StandardPractice for Estimating Critical Surface Tensions[1]

This standard is issued under the fixed designation D7541; 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 procedures for estimating values of the critical surface tension of surfaces by observing the wetting and dewetting of a series of liquids (usually organic solvents) applied to the surface in question.

1.2 Another technique, measurement of the contact angles, θ, of a series of test liquids and plotting cos θ versus surface tension (Zisman plots), provides data that allow the determination of more exact values for critical surface tension.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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:*[2]

D2578 Test Method for Wetting Tension of Polyethylene and Polypropylene Films

2.2 *Nordtest Standards:*[3]

NT poly 176 Spreading Surface Tension by the Applied Droplet Method.

3. Terminology

3.1 *Definitions:*

3.1.1 *critical surface tension, n*—the surface tension of a hypothetical liquid that would just spontaneously spread if applied as a drop to the surface in question; any liquid with a surface tension lower than the critical surface tension will spread spontaneously.

4. Summary of Practice

4.1 In this practice, a series of liquids of gradually increasing surface tension are applied to a surface in the form of drops, narrow strips, or spots. Drops may be applied using a dropper, syringe or other device capable of producing individual drops. Liquid strips or spots are applied to the surface by swabbing with saturated cotton swabs or by another type of applicator, such as one that is similar to a marker pen. In the case of the drop, the observer determines whether the drop stays in place or spreads. In the case of the liquid strip or spot, the question is whether the liquid stays in place or dewets and crawls. In each case, the break point between wetting and dewetting provides the critical surface tension.

5. Significance and Use

5.1 Knowledge of the critical surface tension of substrates, primers and other coatings is useful for explaining or predicting wettability by paints and other coatings applied to those surrfaces. Surfaces with low critical surface tensions usually are prone to suffer defects such as crawling, picture framing, cratering and loss of adhesion when painted. Low or irregular values, or both, often are indicative of contamination that could reduce adhesion. Surfaces with high critical surface tensions are easy to wet and usually provide an excellent platform for painting.

5.2 The swab, marking pen and draw-down tests all simulate the application of a film

5.3 The swab and marking pen techniques are simple and rapid and are particularly useful for testing in the field or on curved, irregular or porous surfaces where contact angles cannot be measured. The drop test does not work well on such surfaces and the draw-down method requires a flat specimen that is relatively large.

5.4 The estimation of critical surface tension has been useful in characterizing surfaces before and after cleaning processes such as power washes and solvent wipes in order to evaluate the efficiency of the cleaning.

5.5 One or more of these techniques could be the basis of a go/no-go quality control test where if a certain liquid wets, the

[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 D01.23 on Physical Properties of Applied Paint Films.

Current edition approved Feb. 1, 2011. Published February 2011. Originally approved in 2009. Last previous edition approved in 2009 as D7541 – 09. DOI: 10.1520/D7541-11.

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

[3] For Nordtest standards, see www.nordicinnovation.net/nordtest.cfm or contact Nordtest, Tekniikantie 12, FIN-02150 Espoo, Finland.