Designation: D7836 – 13

Standard Test Methods for Measurement of Yield Stress of Paints, Inks and Related Liquid Materials[1]

This standard is issued under the fixed designation D7836; 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 three approaches for determining yield stress values of paints, inks and related liquid materials using rotational viscometers. The first method uses a rotational viscometer with coaxial cylinder, cone/plate, or plate/plate geometry. The second method uses a rheometer operating in controlled stress mode with similar geometries. The third method uses a viscometer with a vane spindle.

1.2 A non-rotational technique, the falling needle viscometer (FNV), also can be used to measure yield stress values in paints, inks and related materials. See Test Methods D5478, Test Method D, Yield Stress Determination for details.

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:*[2]

D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings

D5478 Test Methods for Viscosity of Materials by a Falling Needle Viscometer

3. Terminology

3.1 *vane spindle, n*—spindle in which several (4 to 6) rectangular vanes are attached to the shaft giving the appearance of a cross or star when viewed from the end.

3.1.1 *Discussion*—A vane spindle can be immersed in a specimen without destroying the shear-sensitive structure.

3.2 *yield stress, n*—the critical stress at which a material goes from being a deformable solid to showing fluid-like behavior.

3.2.1 *Discussion*—Examples of such fluids include many paints and pigment pastes and certain food materials such as ketchup.

4. Summary of Test Methods

4.1 *Test Method A* uses a viscometer with coaxial cylinder, cone/plate, or plate/plate geometry running a several different low rotational speeds. The materials is sheared at each speed and a shear stress value is measured. By plotting shear stress versus shear rate, a dynamic yield stress value is determined by extrapolating the data curve to zero shear rate. "Dynamic" indicates that the material has been allowed to flow and that the yield stress value is mathematically calculated by using a best-fit line through the measured data points.

4.2 *Test Method B* uses a controlled stress rheometer to determine a yield stress value. This can be done more readily with cone/plate or plate/plate geometry, but can also be accomplished with coaxial cylinder geometry. The rheometer applies a stress ramp to the material, starting at zero and increasing to a preset stress value above the yield stress of the material. As the torque applied to the spindle increases, the spindle will start to move when the yield stress in the material is exceeded. The stress reading at the onset of spindle rotation is the yield stress value for the material.

4.3 *Test Method C* uses a rotational viscometer or rheometer with a vane spindle immersed in the material. The vane spindle is rotated slowly at a fixed speed and the torque value is recorded continuously. The yield stress value is determined when the torque value reaches a maximum.

5. Significance and Use

5.1 The yield stress of a material is a measure of the amount of force required to initiate movement of that material in a pipe, through a pump, or from nozzle. The yield stress also characterizes the ability of the material to maintain particles in suspension. Along with viscosity measurements, yield stress measurements have been useful in establishing root causes of flow problems such as excessive orange peel and sagging and in explaining resistance to such problems. After a coating has

[1] These test methods are under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.24 on Physical Properties of Liquid Paints and Paint Materials.

Current edition approved June 1, 2013. Published July 2013. DOI: 10.1520/D7836-13.

[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.