



Standard Test Method for Viscosity and Yield of Vehicles and Varnishes by the Duke Viscometer¹

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1. Scope

1.1 This test method covers the procedure for determining the viscosity of varnishes, ink vehicles, and similar liquids that are essentially nonvolatile and unreactive under ordinary room conditions using the Duke Automated high shear rod and collar viscometer.²

1.2 The instrument in this test method is similar in principle to the falling-rod viscometer described in Test Method D 4040 except that the collar is motor driven and the range of available shear stresses is considerably greater. This instrument is capable of measured and extrapolated viscosity and yield values provided the proper model is chosen for the given application. See Section 6 for the ranges of specified models.

1.3 *This standard does not purport to address all of the safety concerns, if any, that may be associated with its use. It is the responsibility of the user of this standard to establish any appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 4040 Test Method for Viscosity of Printing Inks and Vehicles by the Falling Rod Viscometer³

3. Terminology

3.1 **Definitions:** Terms relative to this test method are defined in Test Method D 4040 except for those found in 3.2.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 **yield value, n** —The Lehman's yield value that is defined as the stress at 2.5 s^{-1}

3.2.1.1 **Discussion**—This value can be either extrapolated or measured.

3.2.2 **shortness ratio, n** —a ratio to determine the shortness characteristic of the fluid where $SR = \text{yield value/apparent viscosity}$.

4. Summary of Test Method

4.1 This automated test method is based upon accurate measurement of the force that is transferred at a known temperature into a stationary vertical rod as a fluid such as printing ink/varnish moves through a precision measurement gap formed between the outside diameter of the rod and the inside diameter of collar of specific geometry as said collar moves upward along the length of the rod at specified velocities.

4.2 The operator of the instrument and the customer must agree on the preprogrammed test sequence, which is to be run for a given material and the desired test temperature. Supervisory personnel should know the specifics of each preprogrammed test sequence, how to change a given test sequence, and how to make a new test sequence.

4.3 This test method provides actual measured test data of fluids at specified shear rates, which can be programmed to relate. In addition to actual measured data, extrapolated data using the "power law mathematical model" is provided that correlates with manual testing methods as outlined in Test Method D 4040.

4.4 Specified test reference temperatures can range from 20–40°C. Allowable deviation from desired test reference temperature could be specified differently in each test sequence. Allowable programmable is within the range of 0.05 to 0.4°C.

5. Significance and Use

5.1 Actual direct measurements of apparent viscosity and stress at shear rates of interest can be useful in the practical control of ink viscosity during production and the specification acceptance between supplier and purchaser.

¹ This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.37 on Ink Vehicles.

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² The sole source of supply of an automated high shear rod and collar viscometer known to the committee at this time is Duke Custom Systems, Inc., Pleasant View, TN. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

³ *Annual Book of ASTM Standards*, Vol 06.02.