



Designation: D 4016 – 93

Standard Test Method for Viscosity of Chemical Grouts by Brookfield Viscometer (Laboratory Method)¹

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1. Scope

1.1 This test method covers the determination of viscosity of catalysed chemical grouts with the Brookfield viscometer (laboratory method), over the range from 1.0 to 1000 cP (0.001 to 1 Pa·s).

1.2 *This standard does not purport to address all of the safety problems, 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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *coefficient of viscosity*—the ratio between the applied shear stress and the rate of shear. This coefficient is a measure of the resistance to flow of the liquid. It is commonly called the viscosity of the liquid. The cgs unit of viscosity is 1 g/cm·s (1 dyn/s cm²) and is called a poise (P). Viscosities of thin liquids are normally given in hundredths of a poise or centipoises (cP). The SI unit of viscosity is 1 Pa·s (1 N·s/m²) and is equal to 10 P, or 1000 cP.

2.1.2 *Newtonian liquid*—a liquid in which the shear stress is proportional to the rate of shearing strain. This constant ratio is the viscosity. Non-Newtonian behavior can be determined with the Brookfield instrument by taking measurements at different spindle speeds.

3. Summary of Test Method

3.1 A rotating spindle is immersed in a container of catalysed chemical grout. An index to the viscosity is read directly on the instrument scale.

4. Significance and Use

4.1 This test is intended for materials that will penetrate soil voids and rock fissures. Viscosity alone is not necessarily an exact index of grout penetrability.

5. Apparatus

5.1 *Brookfield Viscometer*—Any model whose lower limit of effective measurement is less than the value of the sample. Models LVF and LVT should be used for measurements above 20 cP (20 mPa·s), and for measurements from 1 to 20 cP (1 to 20 mPa·s) with the addition of a Model UL adapter. Models RV, RT, HA, and HB may be used for measurements above 100 cP (100 mPa·s).

NOTE 1—The UL adapter may be used for better accuracy in the 20 to 100-cP (20 to 100-mPa·s) range also.

5.2 *Griffin Beaker*, 600-cm³, low-form used as the container for the sample. Beaker material must not react with the grout. Glass beakers are not acceptable for silicates. Stainless steel beakers are acceptable for all materials.

5.3 *Calibrated Liquid-in-Glass Thermometers*, accurate to $\pm 1.0^\circ\text{F}$ (0.5°C), or any other thermometric device of equal accuracy.

NOTE 2—Glass thermometers should not be used with silicates.

5.4 *Temperature-Control Bath*, for work at other than ambient temperature, and large enough to hold the sample container. Any bath that will maintain its temperature within $\pm 1.0^\circ\text{F}$ (0.5°C) during the test period is adequate.

NOTE 3—Grout temperature must equal bath temperature at the start of the test. Temperature rise due to chemical reaction does not invalidate the test data.

6. Sample Preparation

6.1 The temperature of the grout components at time of testing shall be $68 \pm 1^\circ\text{F}$ ($20 \pm 0.5^\circ\text{C}$).

NOTE 4—Alternatively, three or more tests at various temperatures may be taken to define a viscosity versus temperature relationship. It is desirable to have such tests span the anticipated ground temperature.

6.2 Viscosity data should be taken on catalysed grout solution that contains all of the components normally used for field application.

7. Procedure

7.1 Prepare the grout components separately and bring them to the required temperature.

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization With Admixtures.

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