Designation: D5959 – 12 (Reapproved 2017)

Standard Test Method for Bulk Density of Level Paintbrush Filaments[1]

This standard is issued under the fixed designation D5959; 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 test method covers a procedure for measuring the weight of filaments per unit volume.

1.2 This test method is applicable only to monofilament with consistent longitudinal (level) profiles.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Summary of Test Method

2.1 The weight and volume of a bundle of filaments is measured, and the bundle density is calculated.

3. Significance and Use

3.1 Filaments are available in a variety of cross sections and materials. A measure of bulk density permits the brushmaker to estimate the weight of filament required to prepare a given number of brushes.

4. Apparatus

4.1 The apparatus requires some machining, and is assembled as shown in Fig. 1 from the following equipment:

4.1.1 *Air Valve*[2]

4.1.2 *Miniature Air Cylinder,*[3] dual acting, heavy duty.

4.1.3 Assorted parts shown in Fig. 1 are machined from 304 stainless steel and assembled as shown along with the air valve and cylinder just described. The scale must be fixed in place so that it reads accurately the diameters of metal standards that are 1.82 in. (46.2 mm) and 2.06 in. (52.3 mm) diameter.

4.2 *Weighing Device,* accurate to 0.1 g to weigh the bundle.

4.3 *Scale,* accurate to 0.02 in. (0.5 mm) to measure the bundle length.

4.4 *Air Supply,* with pressure regulator set for 50 psig.

4.5 *Calibration Standards,* 1.82 (46.2 mm) and 2.06 in. (52.3 mm) in diameter.[4]

5. Sampling, Test Specimens and Test Units

5.1 The test result will depend on the cross-sectional shape, the polymer, and the length of the bundle selected for the test. To a lesser extent it will also depend on the filament diameter since thin filaments pack more efficiently than large ones.

5.2 The device, as pictured in Fig. 1, is designed to measure diameters ranging from 1.82 to 2.06 in. (46.2 to 52.3 mm). Make sure that both ends are measured and the results are averaged.

6. Procedure

6.1 Select a sample of approximately 2-in. (50-mm) diameter. Filament may be removed from a sample so the bundle diameter falls within the scale range (1.82 to 2.06 in.) (46.2 to 52.3 mm). One convenient method to adjust the sample diameter to the desired range is to fill a 2-in. (50-mm) inside diameter tube. If the sample is too small, like samples may be combined to adjust the bundle diameter to the desired range.

6.2 Weigh the sample bundle to the nearest 0.1 g (W). Make sure that the weight excludes the wrap or rubber bands used to hold the filament together.

---

[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 D01.61 on Paint Application Tools.

Current edition approved June 1, 2017. Published June 2017. Originally approved in 1996. Last previous addition approved in 2012 as D5959 – 12. DOI: 10.1520/D5959-12R17.

[2] Air valve such as Model 6676 available from Hunt Valve Co., 1913 E. State Street, Salem, Ohio 44460, or equivalent, has been found suitable for this purpose.

[3] Miniature air cylinder such as Model H95-5D, 9/16-in. (14.3-mm) bore, 5-in. (127-mm) stoke, dual acting, heavy duty, available from Clippard Instrument Laboratory, 7390 Colerain Road, Cincinnati, OH 45239, or equivalent, has been found suitable for this purpose.

[4] Steel cylinders machined to diameters of 1.82 in. with a tolerance of 0.001 in. (46.2 mm with a tolerance of 0.02 mm) and 2.060 in. with a tolerance of 0.001 in. (52.3 mm with a tolerance of 0.02 mm).

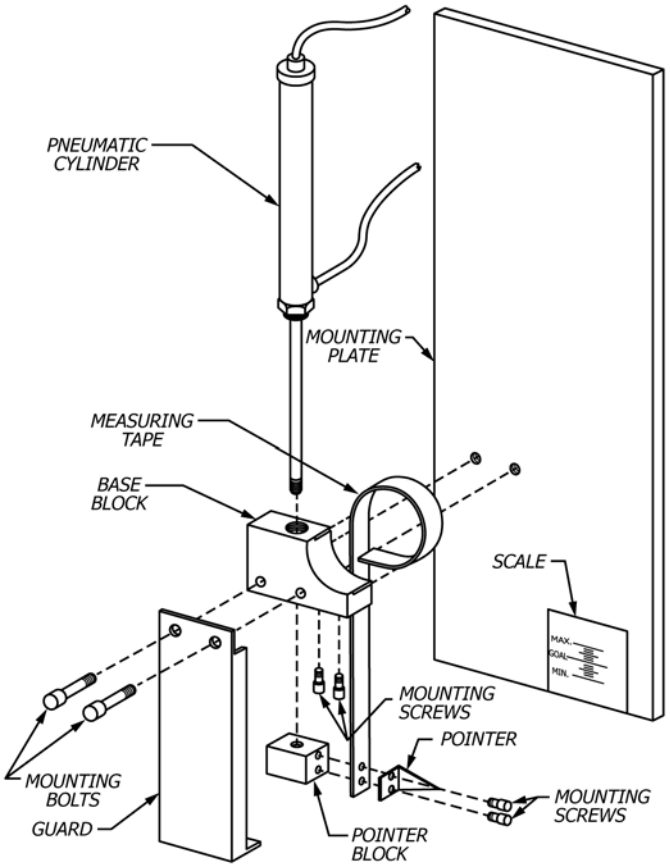

FIG. 1 Apparatus to Measure Bundle Diameter

6.3 Measure the lengths of five individual filaments to the nearest 0.02 in. (0.5 mm) with a ruler and average the lengths to determine bundle length (*L*).

6.4 With rubber bands holding the bundle together, roll it between the palms of the hands four times and then place the end of the bundle inside the loop of measuring tape in the device shown in Fig. 1. Operate the air valve lever 10 times to stabilize. Actuate the air valve to tighten the steel tape. Read the bundle diameter, estimating to the nearest 0.005 in. (0.1 mm) from where the pointer indicates on the scale.

6.5 Release the bundle. Reverse the bundle end for end and repeat 6.4 to measure the diameter of the opposite end.

6.6 Average the results (*D*) and proceed to calculate the bulk density as described in 7.1. Bulk density is expressed in g/in.^{3}, an accepted industry standard.

7. Calculation or Interpretation of Results

7.1 Calculate bulk density as follows:

$$\text{Bulk Density} = 4 \times W/(L \times \pi \times D^{2}) \quad (1)$$

where:

W = bundle weight, g,
L = bundle length, in. (cm), and
D = mean bundle diameter, in. (cm).

8. Precision and Bias

8.1 *Precision*—Measurements of bulk density of solid, level filament at five laboratories agreed within ±0.2 g/in.^{3} or ±1 %. Repeatability within the laboratory for four bundles was ±0.1 g/in.^{3} for solid and ±0.2 g/in.^{3} for hollow.

8.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test method, no statement on bias can be made.

9. Keywords

9.1 bulk density; density; filaments; paint brush