Designation: ~~D1921 – 12~~ D1921 – 18

Standard Test Methods for Particle Size (Sieve Analysis) of Plastic Materials[1]

This standard is issued under the fixed designation D1921; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 These test methods cover the measurement of the particle size of plastic materials in the powdered, granular, or pelleted forms in which they are commonly supplied. As these test methods utilize dry sieving, the lower limit of measurement is considered to be about 38 µm (No. 400 sieve). For smaller particle sizes, sedimentation test methods are recommended.

1.2 Two test methods are described:

1.2.1 *Test Method A*—This test method uses multiple sieves selected to span the particle size of the material. This method is used to determine the mean particle diameter and particle size distribution.

1.2.2 *Test Method B*—This test method is an abbreviated version of Test Method A conducted with a few specific sieves. This test method determines "percent passing" or "percent retained" on a given sieve. Test Method B is applicable to materials which do not have a normal particle size distribution such as pellets and cubes.

1.3 The values stated in SI units ~~shall be considered~~ are to be regarded as standard for dimensions of the wire cloth openings and the diameter of the wires used in the wire cloth. ~~The values stated in inch-pound units shall be considered standard with regard to the sieve frames.~~

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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent for this test method.

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. Referenced Documents

2.1 *ASTM Standards:*[2]

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Summary of Test Methods

3.1 A dry mass of plastic material is placed on a series of sieves arranged in order of increasing fineness and the mass is divided into fractions corresponding to the sieve opening.

4. Significance and Use

4.1 These test methods are used to determine particle size distribution and therefore are useful for determining lot-to-lot uniformity.

4.2 The particle sizes of plastic materials affect the handling characteristics and sometimes will affect the processing characteristics of some polymers.

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[1] These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and are the direct responsibility of Subcommittee D20.70 on Analytical Methods (Section D20.70.01).

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[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.

***A Summary of Changes section appears at the end of this standard**

5. Interferences

5.1 Some materials develop a static charge during sieving. This charge interferes with the sieving process and results in a coarse bias. Use of an antistat is necessary to obtain meaningful results.

5.2 The choice of antistat (or slip agent) has been known to affect the coarse bias. Some materials are more effective in aiding the fines to separate from the mass.

5.3 Too much material on a sieve causes mass blinding and results in a coarse bias. The sieve selection and charge weight must be chosen to avoid overloading any sieve.

5.4 Wavy, improperly stretched wire-cloth potentially allows wires to separate without being visually damaged. Sieves with wavy or torn wires shall not be used, as they no longer conform to Specification E11.

6. Apparatus

6.1 *Balance,* 500-g minimum capacity with the capability of reading to the nearest 0.1 g.

6.2 *Mechanical Sieving Device and Time Switch*—A mechanical sieve-shaking device equipped with an automatic time switch. This device shall be capable of imparting uniform rotary motion and a tapping action at a rate of 150 ± 10 taps/min.

6.3 *Wire Cloth Sieves,* woven wire cloth conforming to Specification E11, ~~as shown in Table 1,~~ mounted in 8-in. ~~[203-mm]~~(203-mm) frames. The number of sieves and the choice of sizes shall be selected for the material being tested. A cover and a bottom pan are also required.

6.4 *Accessories for Cleaning the Screens:*
6.4.1 *Brush*[3],
6.4.2 *Vacuum Cleaner,* and
6.4.3 *Air Hose.*

7. Reagents and Materials

7.1 Antistat (or slip) agent suitable to the material being tested.

8. Hazards

8.1 The sieving operation and cleaning of the sieves sometimes introduce fine plastic particles and antistat agent into the atmosphere. Take precautions to avoid breathing these particles.

9. Sampling

9.1 Homogenize the lot where possible before removing the test sample to avoid segregation of particles during handling.

10. Preparation of Apparatus

10.1 Thorough cleaning and inspection of the sieve are required prior to initiating a test. Carefully clean the sieves with a brush and vacuum cleaner or compressed air, or both. Periodic washing with soap and water or suitable solvent is recommended with some materials.

10.2 Tare each sieve and the pan. Record tare weights to the nearest 0.1 g.

10.3 Assemble sieves so that the sieve openings decrease in size in sequence from the top of the stack. Place the pan at the bottom.

10.4 Use full- or half-size screens to accommodate the holder in the shaker.

11. Conditioning

11.1 The plastic material must be in a free-flowing condition.

11.2 If possible, condition the material to the laboratory temperature and humidity.

TEST METHOD A

12. Procedure

12.1 Select sieves in sufficient number to cover the expected range of particle sizes, and nest them together in order of diminishing opening with the coarsest sieve on top and the pan on the bottom.

[3] The sole source of supply of the Type 8577 (W. S. Tyler) Brush known to the committee at this time is W. S. Tyler, Inc., 8750 Tyler Blvd., Mentor, OH 44060. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

12.2 Select sieves in sufficient number to have significant measurable quantities on four or more sieves. Weigh the sieves on a balance reading to the nearest 0.1 g. Record these sieve masses as their tare masses, respectively.

12.3 Weigh 50 g of sample to the nearest 0.1 g and transfer it to the top of the stack. Record the sample weight used. Large sample size causes screen blinding and will skew the results to the coarse particle size. A screen is considered blinded if it is holding 20 ~~or more g. For repeatable results,~~grams or more. If screen blinding occurs, use a smaller sample size.

NOTE 2—For some materials an antistat (or slip agent) is needed. Add 1 % of the antistat (or slip agent) to the sample and mix in with a spatula. With polyvinyl chloride resins, it has been found that the distribution will skew to either the fine or the coarse particle size depending on the antistat used. Record the antistat (or slip agent) used.

12.4 Cover the stack and place it in the mechanical sieve shaker. Start the shaker and run for 10 min. ~~Run the shaker for a longer time if it is required by the material and the efficiency of the shaker.~~

12.5 After shaking, carefully separate the stack of sieves, beginning at the top, and weigh each sieve with ~~powder~~material to the nearest 0.1 g. Determine the net weight of the ~~powder~~material remaining in each sieve by subtracting the sieve tare masses from the total weight of the sieve and the ~~powder~~material in that sieve.

12.6 If the cumulative total of actual weight is less than 98 %, carefully check the weights and operations and repeat the work if necessary.

13. Analysis of Particle Distribution

13.1 *Calculation of Particle Distribution:*

13.1.1 Obtain net weight of material retained on each sieve. Calculate percentage by dividing net weight by total sample weight × 100.

13.1.2 Repeat for each sieve.

13.2 *Calculation of Mean Particle Size:*

13.2.1 Obtain net weight of material retained on each sieve.

13.2.2 Determine an average particle size for each sieve. The average particle size is defined as the nominal opening size of that sieve plus the nominal opening size of the next larger sieve in the stack divided by two.

NOTE 3—Options are recommended to determine the average mesh size of the top sieve and the pan. On the coarse end, if the particles have already been through a coarser screen, the screen size of the "through screen" can be used as the upper limit of the top screen (first screen). A commonly used method is to place a set of sieves with openings greater than the desired top sieve. Select the lowest sieve where there is no particle on or the amount of particles on the sieve is insignificant. Use the opening size of this sieve for calculation. Similar analog can be used to the pan by using smaller opening sieves. A more practical way is to divide the opening size of the sieve above the pan by two and use it as the average particle size of the pan.

13.2.3 For materials that have a normal distribution, calculate the mean particle size as

$$D_m = \frac{\sum(P_i \times D_i)}{100}$$

where:

D_m = mean particle diameter, μm,
P_i = material retained on sieve (or pan), %, and
D_i = average particle size of material on sieve, μm.

14. Report

14.1 Report the following information:

14.1.1 Percentage of material retained on each sieve, with its corresponding sieve size,

14.1.2 Sample weight,

14.1.3 Antistat (or slip agent) used, and

14.1.4 Mean particle size and method used for calculation.

TEST METHOD B

15. Procedure

15.1 Choose the sieve(s) to be used and weigh each of them to the nearest 0.1 g. Record these sieve masses as their tare masses, respectively. If a single sieve is being used, stack it on the pan and transfer a sample weighing 100 ± 0.1 g to that sieve. If two sieves are to be used in the analysis of the sample, stack the coarse sieve over the fine sieve and transfer the weighed sample to the coarse sieve. For those finely divided powders which tend to clog the sieves, add 1.0 % of an antistat (see Note 2).

15.2 Cover the stack and place it in the mechanical sieve shaker. Start the shaker and run for 10 min ± 15 s.