Designation: F577 – 03 (Reapproved 2009)

Standard Test Method for Particle Size Measurement of Dry Toners[1]

This standard is issued under the fixed designation F577; 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 aperture particle size analysis using an electronic sensing zone apparatus provided with a digital pulse processor. Dry inks, toners, and so forth, are covered. Particles as small as 1 µm and as large as 120 µm can be analyzed.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *channel*—a size subgroup that has been obtained by dividing the range of the analysis into a certain number of size categories. The resolution of the analysis is increased when the number of channels is increased.

2.1.2 *dynamic range*—the ratio between the upper and lower limit of an analysis.

2.1.3 *number size distribution*—the number size distribution is measured and may be represented in a number percent curve as differential, cumulative larger than or cumulative smaller than. (Figs. 1-3).

2.1.4 *pulse (man height average) by sequence*—the max pulse height average is calculated from the pulses generated during the anaylsis (Fig. 4).

2.1.5 *median particle size*—the median size (50 % oversize or undersize) is a convenient value for the central tendency of a size distribution curve. For a distribution derived by number of particles, it is called the number median size.

2.1.6 *volume size distribution*—the volume size distribution is calculated by the instrument's software and may be represented in a volume percent curve as differential, cumulative larger than or, cumulative smaller than. (Figs. 5-7).

3. Summary of Test Method

3.1 This technique (**1**) [2] determines the number and size of particles suspended in an electrolyte by causing them to flow through a small orifice on both sides of which are immersed electrodes. Voltage pulses, whose amplitudes are proportional to the particle volumes, are generated by changes in resistance as the particles pass through the orifice. The signal generated is scanned, digitized and integrated in pulses. These pulses are processed yielding size and pulse distributions. The pulse data is saved and may be reprocessed at a later time for a different analysis range or resolution.

3.2 This test method covers the size range from 2 % to 60 % of the aperture diameter chosen as being appropriate to the expected particle size range.

Aperture Diameter, µm	Particle Size Range, µm
50	1 to 30
70	1.4 to 42
100	2.0 to 60
140	2.8 to 84
200	4 to 200

For broader size ranges two aperture tubes may be used and both results are combined by the instrument's software into a single size distribution.

4. Significance and Use

4.1 This test is useful in determining particle size characteristics of dry toners used in electrostatic imaging devices such as copiers and laser printers. It is a practiced method for use in quality control of toner particle size.

5. Apparatus

5.1 *Electrical Sensing Zone Instrumentation* **(2),** equipped with a minimum capability of 256 size channels, a digital pulse processor and 50, 70, 100, 140, or 200-µm aperture tubes.

5.2 *Software,* capable of processing the pulse data to yield size distribution graphs and statistics.

5.3 *Ultrasonic Dispersing Probe ,* or alternative equipment suitable for dispersing the dry toner in an aqueous electrolyte.

[1] This test method is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.04 on Electrostatic Imaging Products.

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[2] The boldface numbers in parentheses refer to the list of references at the end of the test method.

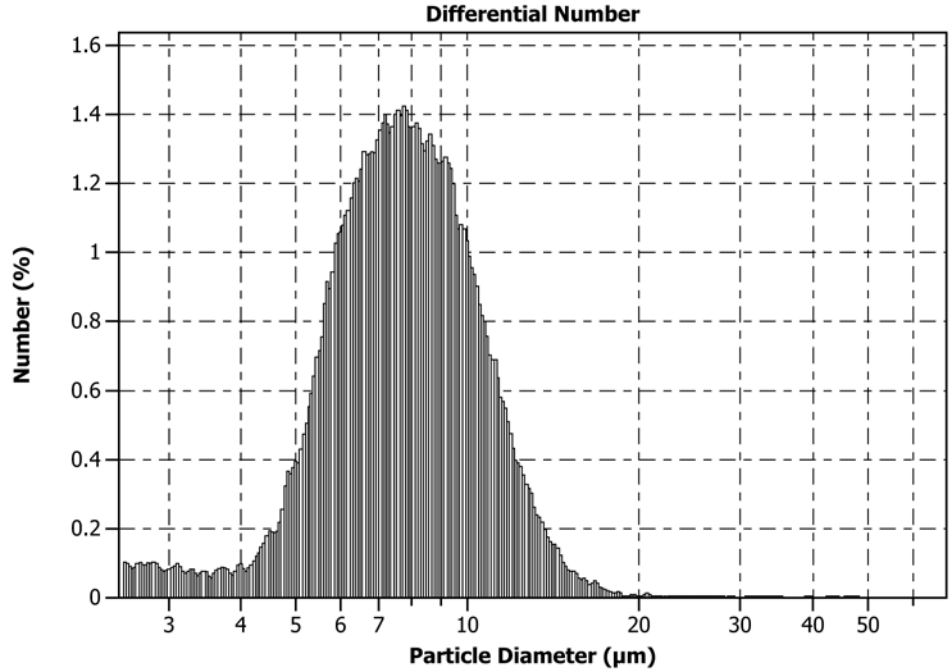

FIG. 1 Differential Number Size Distribution

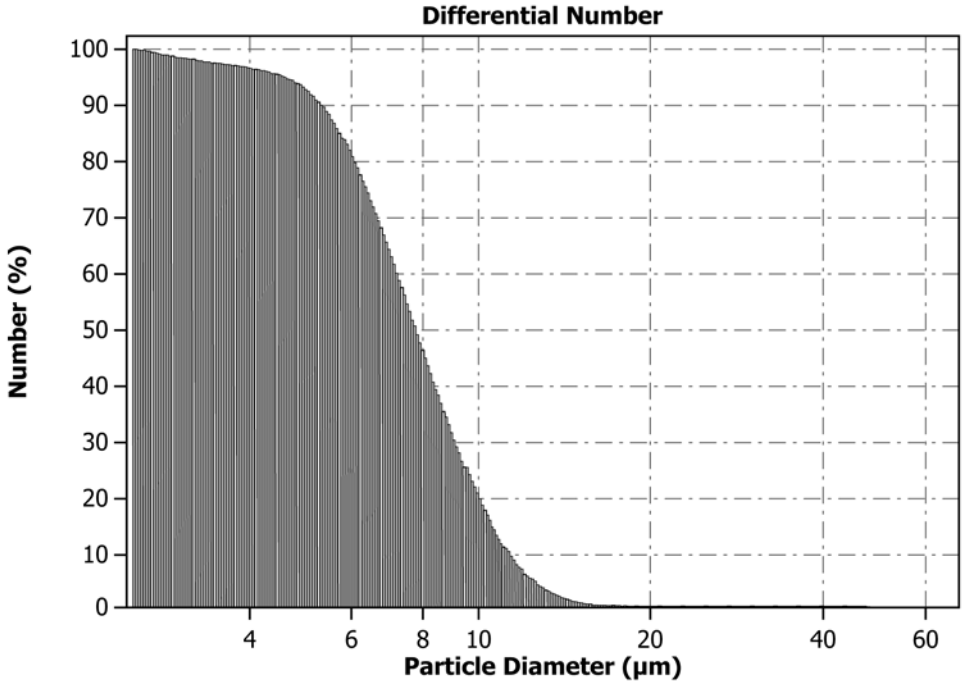

FIG. 2 Cumulative Number Size Distribution Larger Than

6. Reagents and Materials

6.1 *Electrolyte*—4 weight % aqueous sodium pyrophosphate or 1 weight % sodium chloride. The electrolyte shall be adequately filtered to remove almost all particle contaminants greater than 1 µm. Some aqueous electrolytes are commercially available.

6.2 *Surfactant*—a nonionic surface active agent suitable for keeping toner particles separated while in suspension.

6.3 Near monosized spherical particles standardized for the number % modal size as calibration standards.[3]

7. Sampling

7.1 Sample the powder when flowing (**1**).

[3] The standardized particles are usually available from the equipment manufacturer.

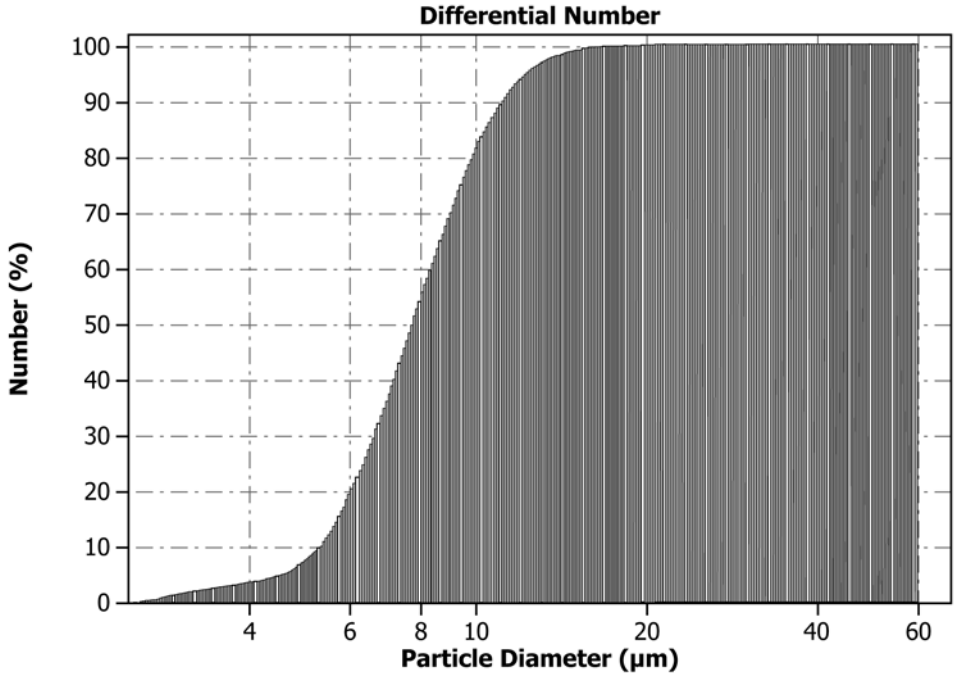

FIG. 3 Cumulative Number Size Distribution Small Than

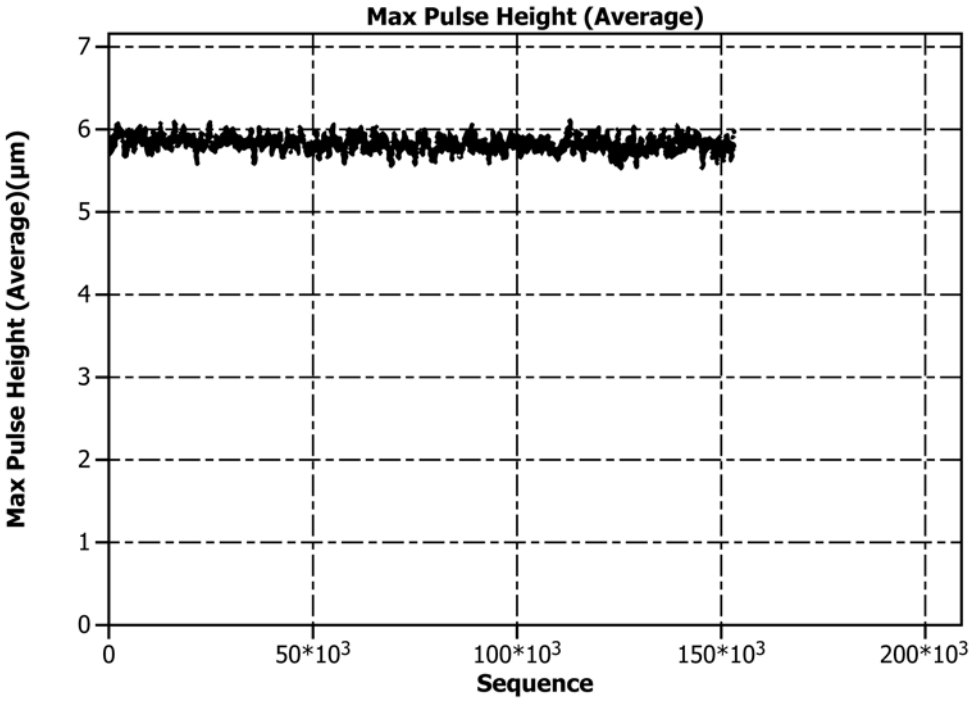

FIG. 4 Max Pulse Height Average by Sequence

7.2 Sample the entire powder flow over small intervals of time. This is preferable to a continuous withdrawal of a small fraction of the flow.

7.3 A further positive aspect is that electrostatic imaging requires material that produces uniform, stable, and acceptable image quality, one copy after the other. In general, the usage rate is in the range from 1 to 100 mg per copy, depending on the original document and the electrostatic conditions. Each copy, consequently, contains a small sampling of the bulk toner.

NOTE 1—Often the processes used to produce dry toner and the semicohesive, electrostatic nature of the fine material can make it prohibitively difficult to follow these important general rules for powder sampling.