



Designation: D3849 – 22

Standard Test Method for Carbon Black—Morphological Characterization of Carbon Black Using Electron Microscopy¹

This standard is issued under the fixed designation D3849; 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 (1) the morphological (for example, size and shape) characterization of carbon black from transmission electron microscope images which are used to derive the mean particle and aggregate size of carbon black in the dry (as manufactured) state, from CAB chip dispersion or removed from a rubber compound and (2) the certification of mean particle size using a correlation based on statistical thickness surface area measurements.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

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

1.4 *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

D3349 Test Method for Absorption Coefficient of Ethylene Polymer Material Pigmented with Carbon Black

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

D6556 Test Method for Carbon Black—Total and External Surface Area by Nitrogen Adsorption

¹ This test method is under the jurisdiction of ASTM Committee D24 on Carbon Black and is the direct responsibility of Subcommittee D24.81 on Carbon Black Microscopy and Morphology.

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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.

3. Terminology

3.1 Definitions:

3.1.1 General:

3.1.1.1 *carbon black particle*—a small spheroidally shaped, paracrystalline, non-discrete component of an aggregate; it can only be separated from the aggregate by fracturing; carbon black particle size is a distributional property; therefore, the term particle size implies the mean value from multiple measurements.

3.1.1.2 *carbon black aggregate*—a discrete, rigid colloidal entity that is the smallest dispersible unit; it is composed of extensively coalesced particles; carbon black aggregate size is a distributional property; therefore, the term aggregate size implies the mean value from multiple measurements.

3.1.1.3 *statistical thickness surface area (STSA)*—the external specific surface area of carbon black that is calculated from nitrogen adsorption data using the de Boer theory and a carbon black-specific model.

3.1.1.4 *glow discharge*—a plasma of ionized gas that is formed in a high-voltage field at pressures of about 3 to 20 Pa (25 to 150×10^{-3} torr); an alternating current (a-c) glow discharge using air is effective in cleaning and oxidizing the surface of carbon substrates to improve the wetting characteristics of polar vehicles containing pigment dispersions.

3.1.1.5 *substrate*—a thin film that is used to support electron microscope specimens; evaporated carbon films are commonly used because of relatively good mechanical strength, stability, and conductivity.

3.1.2 Aggregate Dimensional Properties from Image Analysis:

3.1.2.1 *area (A)*—the two-dimensional projected area of the carbon black aggregate image.

3.1.2.2 *perimeter (P)*—the total boundary length of an aggregate.

3.1.2.3 *volume (V)*—an estimate of the volume of the carbon black aggregate using stereological principles.

3.1.3 Image Analysis:

3.1.3.1 *dilation*—the converse of erosion; this process is accomplished by changing any OFF pixel to ON if it has greater than a preset minimum of ON neighbors, causing image