Designation: ~~D3053 – 17a~~ D3053 – 17a$^{\varepsilon 1}$

Standard Terminology Relating to Carbon Black[1]

This standard is issued under the fixed designation D3053; 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.

ε[1] NOTE—Editorially corrected definitions for OAN and COAN in March 2018.

1. Scope

1.1 This terminology covers a compilation of definitions of technical terms used in the carbon black and rubber industries. Terms that are generally understood or adequately defined in other readily available sources are not included.

1.2 *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]

D1508 Test Method for Carbon Black, Pelleted Fines and Attrition
D1509 Test Methods for Carbon Black—Heating Loss
D1510 Test Method for Carbon Black—Iodine Adsorption Number
D1511 Test Method for Carbon Black—Pellet Size Distribution
D1513 Test Method for Carbon Black, Pelleted—Pour Density
D1514 Test Method for Carbon Black—Sieve Residue
D1566 Terminology Relating to Rubber
D1618 Test Method for Carbon Black Extractables—Transmittance of Toluene Extract
D1765 Classification System for Carbon Blacks Used in Rubber Products
D1799 Practice for Carbon Black—Sampling Packaged Shipments
D1900 Practice for Carbon Black—Sampling Bulk Shipments
D1937 Test Method for Carbon Black, Pelleted—Mass Strength
D2414 Test Method for Carbon Black—Oil Absorption Number (OAN)
D2663 Test Methods for Carbon Black—Dispersion in Rubber
D3265 Test Method for Carbon Black—Tint Strength
D3313 Test Method for Carbon Black—Individual Pellet Hardness (Withdrawn 2017)[3]
D3493 Test Method for Carbon Black—Oil Absorption Number of Compressed Sample (COAN)
D3849 Test Method for Carbon Black—Morphological Characterization of Carbon Black Using Electron Microscopy
D5230 Test Method for Carbon Black—Automated Individual Pellet Hardness
D6556 Test Method for Carbon Black—Total and External Surface Area by Nitrogen Adsorption
D6602 Practice for Sampling and Testing of Possible Carbon Black Fugitive Emissions or Other Environmental Particulate, or Both
D7854 Test Method for Carbon Black-Void Volume at Mean Pressure

3. Terminology

3.1 *Definitions:*

aciniform, *adj*—shaped like a cluster of grapes.

[1] This terminology is under the jurisdiction of ASTM Committee D24 on Carbon Black and is the direct responsibility of Subcommittee D24.41 on Carbon Black Nomenclature and Terminology.

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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] The last approved version of this historical standard is referenced on www.astm.org.

DISCUSSION—

The spheroidal primary particles of carbon black are fused into aggregates of colloidal dimension forming an aciniform morphology.

carbon black, *n*—an engineered material, primarily composed of elemental carbon, obtained from the partial combustion or thermal decomposition of hydrocarbons, existing as aggregates of aciniform morphology which are composed of spheroidal primary particles which exhibit uniformity of primary particle sizes within a given aggregate[4] and turbostratic layering within the primary particles.

DISCUSSION—

Carbon black exhibits a hierarchy of morphological features: particles (that is, primary particles), aggregates, and agglomerates. While the fundamental building block of carbon black is the primary particle, they almost never exist in isolation, but are strongly fused by covalent bonds into aggregates.[4] The primary particles are conceptual in nature, in that once the aggregate is formed the primary particle no longer exists, they are no longer discrete and have no physical boundaries amongst them. Once produced, individual aggregates join together by van der Waals forces to form agglomerates. Agglomerates do not break down into smaller components unless adequate force is applied (for example, shear force). Primary particle and aggregate sizes are distributional properties and vary depending on the carbon black grade. Transmission electron micrographs shown in Annex A1 of Practice D6602 demonstrate that while primary particle and aggregate sizes vary greatly within a given grade of carbon black, the primary particle size is essentially uniform within an individual aggregate.[4]

carbon black, carcass grade, *n*—a type of furnace carbon black having an average nitrogen surface area in the range of 21 to 69 m^2/g.

DISCUSSION—

Carcass-grade carbon blacks are produced by the oil furnace process. The use of these grades in the rubber industry is not limited to the carcass portion of the tire. These grades are designated with an "N" first character and a second character of "4, 5, 6, or 7" in Table 1 of Classification D1765. See Terminology D1566 for the definition of carcass.

carbon black, furnace, *n*—a type of carbon black produced by the decomposition reaction of hydrocarbons when injected into a high-velocity stream of combustion gases under controlled conditions.

carbon black, hard, *n*—See **carbon black, tread grade**, the preferred term.

DISCUSSION—

All carbon blacks provide some level of reinforcement when mixed in rubber. The amount of reinforcement is a function of the carbon black grade and amount used. See Terminology D1566 for the definition of reinforcement.

carbon black, semi-reinforcing, *n*—See **carbon black, carcass grade**, the preferred term.

DISCUSSION—

All carbon blacks provide some level of reinforcement when mixed in rubber. The amount of reinforcement is a function of the carbon black grade and amount used. See Terminology D1566 for the definition of reinforcement.

carbon black, soft, *n*—See **carbon black, carcass grade**, the preferred term.

DISCUSSION—

All carbon blacks provide some level of reinforcement when mixed in rubber. The amount of reinforcement is a function of the carbon black grade and amount used. See Terminology D1566 for the definition of reinforcement.

carbon black, surface activity, *n*—the inherent ability of the carbon black surface to interact physically or chemically, or both, with rubber or other molecules.

carbon black, target value, *n*—a consensus value for selected primary properties on which producers center their manufacturing process and users center their specification.

DISCUSSION—

[4] The one exception to this general characteristic of manufactured carbon black is thermal black, in which primary particles may exist in isolation and the primary particle sizes within an aggregate are not necessarily uniform.

Target values for carbon black properties are shown in Classification D1765 for most rubber grade carbon blacks currently in commerce.

carbon black, thermal, *n*—a type of carbon black produced under controlled conditions by the thermal decomposition of hydrocarbons in the absence of air or flames.

DISCUSSION—

These grades are designated with an "N" first character and a second character of "8 or 9" in Table 1 of Classification D1765.

carbon black, thermal, acetylenic, *n*—a thermal black produced from acetylene gas.

carbon black, tread grade, *n*—a type of furnace carbon black having an average nitrogen surface area of 70 m^2/g or greater.

DISCUSSION—

Tread grade carbon blacks are produced by the oil furnace process. The use of these grades in the rubber industry is not limited to the tread portion of the tire. These grades are designated with an "N" first character and a second character of "0, 1, 2, or 3" in Table 1 of Classification D1765.

carbon black, typical value, *n*—a consensus value for those carbon black properties that are not specifically targeted for control in the manufacturing process and that are somewhat dependent upon the targeted properties.

DISCUSSION—

Typical values for carbon black properties are shown in Classification D1765 for most rubber grade carbon blacks currently in commerce. These are consensus values based upon the range in values supplied by the manufacturers. Typical values are useful in making comparisons between grades but they are not the set-point targets for the process and may be expected to differ significantly between producers.

carbon black agglomerate, *n*—a cluster of physically bound and entangled aggregates.

DISCUSSION—

See Test Method D3849.

carbon black aggregate, *n*—a discrete, rigid, colloidal mass of extensively coalesced particles; it is the smallest dispersible unit.

carbon black microstructure, *n*—arrangement of carbon atoms within a carbon black particle.

carbon black particle, *n*—a small spheroidally shaped (paracrystalline, non-discrete) component of a carbon black aggregate; it is separable from the aggregate only by fracturing.

carbon black particle diameter, *n*—arithmetic average of the diameters of particles within a carbon black aggregate as measured by electron microscopy.

DISCUSSION—

See Test Method D3849.

carbon black pellet, *n*—a relatively large agglomerate mass that has been densified in spheroidal form to facilitate handling and processing.

DISCUSSION—

See Test Method D1511.

carbon black reinforcing, *n*—See **carbon black, tread grade**, the preferred term.

DISCUSSION—

All carbon blacks provide some level of reinforcement when mixed in rubber. The amount of reinforcement is a function of the carbon black grade and amount used. See Terminology D1566 for the definition of reinforcement.

carbon black structure, *n*—the quality of irregularity and deviation from sphericity of the shape of a carbon black aggregate.

carbon black weight mean particle size, *n*—ratio equal to the sum of individual particle diameters, each raised to the fourth power, divided by the sum of the individual particle diameters, raised to the third power.