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Standard Terminology of Coal and Coke[1]

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1. Scope

1.1 This terminology defines the technical terms used in standards that are the responsibility of Committee D05 on Coal and Coke. The terms are used in:

1.1.1 The sampling of coal and coke under conditions required for most commercial and technical purposes related to coal and coke.

1.1.2 Bias and related statistical testing,

1.1.3 The description of coal, both visually in the field and microscopically in the laboratory,

1.1.4 Chemical and physical analyses of coal and coke,

1.1.5 Classification of coal, and

1.1.6 Certain other related practices and guides applicable to the coal and coke industries.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D388 Classification of Coals by Rank
D720 Test Method for Free-Swelling Index of Coal
D1412 Test Method for Equilibrium Moisture of Coal at 96 to 97 Percent Relative Humidity and 30°C
D1857 Test Method for Fusibility of Coal and Coke Ash
D2013 Practice for Preparing Coal Samples for Analysis
D2234/D2234M Practice for Collection of a Gross Sample of Coal
D2361 Test Method for Chlorine in Coal[3]
D2795 Test Methods for Analysis of Coal and Coke Ash[3]
D2798 Test Method for Microscopical Determination of the Vitrinite Reflectance of Coal
D2961 Test Method for Single-Stage Total Moisture Less than 15 % in Coal Reduced to 2.36-mm (No. 8 Sieve) Topsize
D3172 Practice for Proximate Analysis of Coal and Coke
D3173 Test Method for Moisture in the Analysis Sample of Coal and Coke
D3174 Test Method for Ash in the Analysis Sample of Coal and Coke from Coal
D3175 Test Method for Volatile Matter in the Analysis Sample of Coal and Coke
D3176 Practice for Ultimate Analysis of Coal and Coke
D3180 Practice for Calculating Coal and Coke Analyses from As-Determined to Different Bases
D3302 Test Method for Total Moisture in Coal
D4371 Test Method for Determining the Washability Characteristics of Coal
D4596 Practice for Collection of Channel Samples of Coal in a Mine
D4749 Test Method for Performing the Sieve Analysis of Coal and Designating Coal Size
D4916 Practice for Mechanical Auger Sampling[3]
D5061 Test Method for Microscopical Determination of the Textural Components of Metallurgical Coke
D5114 Test Method for Laboratory Froth Flotation of Coal in a Mechanical Cell
D5192 Practice for Collection of Coal Samples from Core
D5263 Test Method for Determining the Relative Degree of Oxidation in Bituminous Coal by Alkali Extraction
D5515 Test Method for Determination of the Swelling Properties of Bituminous Coal Using a Dilatometer
D5865 Test Method for Gross Calorific Value of Coal and Coke
D6316 Test Method for Determination of Total, Combustible and Carbonate Carbon in Solid Residues from Coal and Coke

3. Terminology

air-dried moisture—this term has been used inappropriately to refer to both residual moisture and air-dry loss. Because of the potential for confusion, this term shall not be used.

air drying, *n*—a process of partial drying of coal to bring its moisture near to equilibrium with the atmosphere in the

[1] This terminology is under the jurisdiction of ASTM Committee D05 on Coal and Coke and is the direct responsibility of Subcommittee D05.30 on Quality Assurance.

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

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room in which further reduction and division of the sample will take place. D 2013D2013; D 2234/D 2234MD2234/D2234M

air-dry loss, *n—in coal*, the loss in mass, expressed as a percentage, resulting from each air-drying stage or the sum of all sequential air-drying stages in which the results from each stage are adjusted to the as-received basis.

DISCUSSION—Air-dry loss is neither a standard state nor a characterisetic property of a coal. Air drying only removes water that can evaporate at or near ambient laboratory conditions, leaving in the coal some fraction of the inherent moisture that is more tightly bound in the pores (residual moisture). Different laboratory environments or different drying temperatures or both will result in significant differences in air-dry loss and residual moisture. D 3302D3302

agglomerating, *adj—as applied to coal*, the property of softening when it is heated to above about 400°C in a nonoxidizing atmosphere, and then appearing as a coherent mass after cooling to room temperature.

alginite—See *alginite* under **maceral**.

analysis sample—See *analysis sample* under **sample**.

angle of repose, *n*—the greatest angle, measured from horizontal, attained by a coal so that material on the sides of top of the inverted cone or trench created in car top sampling remains stable, that is, will not shift or slide. Coal size and moisture content are contributing factors to this angle. In all cases, the coal shall be dug so that the physical angle is less than the angle of repose.

anisotropic, *adj—as used in Test Method D 5061D5061*, exhibiting optical properties of different values when viewed with an optical microscope having mutually exclusive polarized light, for example, crossed nicols. D 5061D5061

anthracite—See *anthracite* under **rank**.

anthracitic class—See *anthracitic class* under **rank**.

apparent rank, *n—of coal*, the rank designation obtained on samples other than channel samples, but otherwise conforming to procedures of Classification D 388D388.

as-analyzed moisture—synonym for *as-determined moisture.*

as-determined basis—See *as-determined basis* under **reporting bases**.

ash, *n*—inorganic residue remaining after ignition of combustible substances, determined by definite prescribed methods.

DISCUSSION—Ash need not be identical, in composition or quantity, with the inorganic substances present in the material before ignition.

In the case of coal and coke, the methods used shall be those prescribed in Test Method D 3174D3174.

as-mined coal—*for the purpose of Test Method D 4749D4749*, same as **run-of-mine (ROM) coal**. D 4749D4749

as-received basis—See *as-received basis* under **reporting bases**. D 3180D3180

as-shipped or produced coal—*for the purpose of Test Method D 4749D4749*, raw or prepared coal in any state or condition at which it leaves the mine property or loading facility. D 4749D4749

attrital coal—See *attrital coal* under **coal**.

auger increment, *n*—the retained portion of one extraction operation of the auger. D 4916D4916

banded coal—See *banded coal* under **coal**.

basis—See **reporting bases**.

bed moisture—synonym for *inherent moisture.*

beehive coke—See *beehive coke* under **coke**.

binder phase, *n—as used in Test Method D 5061D5061*, a continuous solid carbon matrix formed during the thermoplastic deformation of those coal macerals that become plastic during carbonization.

DISCUSSION—The binder phase material is formed from the thermoplastic deformation of reactive (vitrinite and liptinite) and semi-inert (semifusinite) coal macerals of metallurgical bituminous coals. During thermoplasticity, the inert coal maceral and mineral are partly or wholly incorporated into the binder phase. Also, most of the coke pores are located in the binder phase. D 5061D5061

bituminous class—See *bituminous class* under **rank**.

boghead coal—See *boghead coal* under **coal**.

bone coal—See *bone coal* under **coal**.

borehole, *n*—the circular hole through soil and rock strata made by boring.

bottomsize, nominal—*for the purpose of Test Method D 4749D4749*, the sieve designating the lower limit or bottomsize shall be that sieve of the series given in the Standard Series of Sieves section with the largest openings through which passes a total of less than 15 % of the sample. This defined bottomsize is not to be confused with the size of the smallest particles in the lot.

DISCUSSION—(**Warning**—In the case of a commercial, double-screened product, for example, 37.5 by 9.5 mm (1½ by ⅜ in.), this designation may *not* be valid. In such commercial or contractual situations, the amount of allowable material smaller than the bottomsize (for example, 9.5 mm) must be specified by the contract under which the coal is bought and solid.) D 4749D4749

briquette, *n*—a cylindrical block composed of granulated coal or coke particles compressed and embedded with an epoxy binder.

by-product coke—See *by-product coke* under **coke**.

C test, *n*—a standard statistical test for homogeneity of variance.

calorific value, *n*—the heat of combustion of a unit quantity of a substance.

DISCUSSION—It is expressed in ASTM test methods in British thermal units per pound (Btu/lb). Calorific value can also be expressed in calories per gram (cal/g) or in the International System of Units, joules per gram (J/g), when required. D 5865D5865

calorimeter, *n—as used in Test Method D 5865D5865*, the bomb and its contents, the calorimeter vessel with stirrer, the water in which the bomb is immersed, and the portions of the thermometer and the ignition leads within the calorimeter vessel. D 5865D5865

calorimeter jacket, *n*—the insulating medium surrounding the calorimeter.

cannel coal—See *cannel coal* under **coal**.

carbonate carbon, *n*—the carbon content present in the solid products derived from the combustion or reaction of coal, coal by-products, or coke as carbonates and which is noncombustible in standard industry practice. D 6316D6316

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carbon form, *n—as used in Test Method D 5061D5061*, microscopically distinguishable carbonaceous textural components of coke, but excluding mineral carbonates.

DISCUSSION—Carbon forms are recognized on the basis of their reflectance, anisotropy, and morphology. They are derived from the organic portion of coal and can be anisotropic or isotropic. **D 5061D5061**

caves or washouts, *n*—zones of increased hole diameter caused by rock fragments that fall from the walls of a borehole and can block the hole or contaminate the cuttings and which erode or abrade the sidewall of the borehole by the action of the drilling. These zones can affect the accuracy of certain geophysical logs (especially density). Corrections to other geophysical logs can be made if a caliper log is available. The most common causes of caves or washouts include soft or fractured lithologies, the presence of water-producing zones, and the downhole pressure of the drilling medium (fluid or air) that often causes differential erosion of various strata within the borehole.

chance error, *n*—error that has equal probability of being positive or negative. The mean of the chance errors resulting from a series of observations tends toward zero as the number of observations approaches infinity.

circular anisotropic phase, *n—as used in Test Method D 5061D5061*, a group of binder-phase anisotropic carbon textures that are distinguished by approximately circular domains (that is length equals width) and composed of fine circular (0.5- to 1.0-μm), medium circular (1.0- to 1.5-μm), and coarse circular (1.5- to 2.0-μm) size categories. **D 5061D5061**

cleat, *n*—the joint system of coal seams, usually oriented normal or nearly normal to the bedding.

DISCUSSION—Cleat is most commonly found in bituminous coal, being most prominently developed in vitrain bands and bright layers. Some cleat, especially the more widely separated joints, extend through all or a large part of the seam. Cleat surfaces are commonly coated with minerals such as calcite, kaolinite, and pyrite.

coal, *n*—a brown to black combustible sedimentary rock (in the geological sense) composed principally of consolidated and chemically altered plant remains.

DISCUSSION—Conditions required for formation of coal are believed to include accumulation of plant remains and their partial decomposition under moist conditions, followed by sedimentary burial and subjection to increased pressure and temperature according to the geological history of the seam. Coals exhibit a wide range of properties as a result of differences in the kinds and relative amounts of different plant materials and intermixed mineral matter, the amount of alteration of the plant remains achieved before burial, and especially the degree of physical and chemical alteration after burial. See Classification D 388D388 for classification of coal in accordance with its degree of alteration or rank. The moisture content and the kind, amount, and mode of occurrence of mineral matter also vary greatly.

lithotype, n— any of the constituents of banded coal: vitrain, fusain, clarain, durain, or attrital coal or a specific mixture of two or more of these.

banded coal, n—coal that is visibly heterogeneous in composition, being composed of layers of vitrain and attrital coal, and, commonly, fusain.

attrital coal, n—the ground mass or matrix of banded coal in which vitrain and, commonly, fusain layers as well, are embedded or enclosed.

DISCUSSION—Layers in banded coal, often referred to as bands, are commonly 1 to 30 mm thick. Attrital coal in banded coal is highly varied in composition and appearance, its luster varying from a brilliance nearly equal to that of the associated vitrain to nearly as dull as fusain; it exhibits striated, granulose, or rough texture. In a few cases, relatively thick layers of such attrital coal are found that contain no interbedded vitrain. Nonbanded coal also is attrital coal but is not usually referred to as such. In contrast to the coarser and more variable texture of attrital coal in banded coal, nonbanded coal is notably uniform and fine in texture, being derived from size-sorted plant debris.

The luster of attrital coal, which ranges from bright (but less than that of associated vitrain) to dull, is commonly used to describe and characterize attrital coal. As an alternative, some petrographers subdivide attrital coal into clarain and durain. Clarain has bright luster and silky texture, being finely striated parallel to the coal bedding. Durain has dull luster and sometimes is referred to as dull coal. Similarly, coal consisting of vitrain or clarain or a mixture of the two is sometimes referred to as bright coal.

fusain, n—coal layers composed of chips and other fragments in which the original form of plant tissue structure is preserved; commonly has fibrous texture with a very dull luster.

DISCUSSION—Fusain is very friable and resembles charcoal. Commonly, it is concentrated in bedding layers or lenses that form planes of weakness in coal and thus is often exposed on bedding surfaces of broken coal. The many pores (cell cavities and cracks) of fusain are sometimes filled with mineral matter.

vitrain, n—shiny black bands, thicker than 0.5 mm, of subbituminous and higher rank banded coal.

DISCUSSION—Vitrain, attributed to the coalification of relatively large fragments of wood and bark, may range up to about 30 mm (approximately 1 in.) thick in eastern North American coals, but may be much thicker in the younger western deposits. Vitrain is commonly traversed by many fine cracks oriented normal to the banding.

In lignite, the remains of woody material lack the shiny luster of vitrain in the higher rank coals and may instead be called previtrain. It is differentiated from attrital bands of lignite by its smoother texture, often showing the grain of wood. Previtrain may be several inches thick.

nonbanded coal, n—consistently fine-granular coal essentially devoid of megascopic layers.

DISCUSSION—Nonbanded coal may be interbedded with common banded coal, or form a discrete layer at the top or at the bottom of the seam, or may compose the entire seam. It is formed from natural accumulations of finely comminuted plant detritus and commonly includes a significant amount and variety of remains of pollen grains, spores, planktonic algae, wax and resin granules, as well as other fragments of plants. These materials, containing markedly higher amounts of volatile matter than vitrain and some other attrital components, are more abundant in this variety of coal than they are in common types of banded coal. Also, nonbanded coal may contain more disseminated detrital mineral matter, chiefly clay, than associated

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banded coals, and in the field it may be difficult to distinguish from bone coal. Nonbanded coal is much less common than banded coal in North America.

cannel coal, n—nonbanded coal in which the liptinite is predominantly sporinite.

DISCUSSION—Transitions between cannel and boghead, that is, coals containing both types of liptinite, are also known. Microscopic examination is essential for differentiation of the two kinds of nonbanded coal and their transitions.

boghead coal, n—nonbanded coal in which the liptinite (the waxy component) is predominantly alginite.

impure coal, n—coal having 25 weight % or more, but less than 50 weight %, of ash on the dry basis.

DISCUSSION—Bone coal with more than 50 weight % ash is properly called coaly or carbonaceous shale or siltstone. Types of impure coal other than bone coal and mineralized coal sometimes occur, for example, sandy coal.

bone coal, n—impure coal that contains much clay or other fine-grained detrital mineral matter.

mineralized coal, n—impure coal that is heavily impregnated with mineral matter, either dispersed or discretely localized along cleat joints or other fissures. Pyritic or calcareous mineralized coal is most common.

coal seam, *n*—the stratum, layer, or bed of coal that lies between two other rock layers whose compositions differ significantly from that of coal.

coal washability, *n*—the determination of the theoretical limits for the removal of mineral impurities from coal by beneficiation processes that rely on specific gravity separations. **D 4371D4371**

coarse coal, n—that portion of a coal sample being subjected to a washability study that is larger than a specific predetermined particle size, generally between 2.36 mm (No. 8 USA Standard Sieve Series) and 9.5 mm (3⁄8 in.) round in diameter.

DISCUSSION—This same particle size breakpoint should then be used in subsequent washability studies of the same material sampled from the same location for the same application. This breakpoint is determined by the analyst or the person designing the test procedure as the point that best suits the application. This coarse-coal fraction may be further sieved (generally by dry sieving) to produce additional size fractions, each of which may be processed through the desired specific gravity solutions. **D 4371D4371**

coke—a carbonaceous solid produced from coal, petroleum, or other materials by thermal decomposition with passage through a plastic state.

beehive coke, n—coke manufactured in beehive, rectangular, or similar forms of ovens in a horizontal bed, where heat for the coking process is secured by combustion within the oven chamber.

by-product coke, n—coke manufactured with attendant recovery of by-products, in ovens that are heated externally.

coke breeze, n—the fine screenings from crushed coke or from coke as taken from the ovens, of a size varied in local practice but usually passing a 12.7-mm (1⁄2-in.) or 19.0-mm (3⁄4-in.) screen opening.

dry coke, n—a laboratory term applied to coke that has been dried to constant weight in accordance with definite prescribed methods.

DISCUSSION—The methods used shall be those for the determination of moisture prescribed in Test Method D 3302D3302. In the case of lump coke, the temperature shall be not less than 104°C nor more than 200°C; in the case of coke passing a 250-µm (No. 60) sieve, the temperature shall be not less than 104°C nor more than 110°C for a period of 1 h.

coke pore, *n—as used in Test Method D 5061D5061*, a microscopically distinguishable void that is a structural element of coke. **D 5061D5061**

DISCUSSION—Coke pores are considered to be nearly spherical-shaped voids created by the entrapment of gaseous volatiles during the solidification of thermoplastic coal. However, other types of voids can be distinguished in coke that include fractures or cracks, interconnected and elongated pores, and the open cell lumens of fusinite and semifusinite. The size and shape of the voids are coal rank and grade, and to some degree, process dependent. Pore sizes vary from tens of angstroms to tens of millimetres in any given coke. **D 5061D5061**

coke reactivity, *n—as used in Test Method D 5061D5061*, a measure of the mass loss when coke, held at a designated temperature, is contacted with gaseous carbon dioxide over a specific time interval. **D 5061D5061**

coke wall, *n—as used in Test Method D 5061D5061*, a predominantly carbonaceous layer that encloses a coke pore and which is a structural element and essence of coke. **D 5061D5061**

collector, *n*—a reagent used in froth flotation to promote contact and adhesion between particles and air bubbles. **D 5114D5114**

combustible carbon, *n*—carbon content remaining in the solid products derived from the combustion or reaction of coal, coal by-products, or coke, exclusive of carbonate in any form. **D 6316D6316**

combustibles, *n*—the value obtained by subtracting the dry weight (in percent) of the ash (as determined in Test Method D 3174D3174) from 100 % representing original weight of analyzed sample. **D 5114D5114**

concentrate, *n*—the froth product recovered in coal froth flotation. **D 5114D5114**

concretion, *n—in a geological sense*, a mass of mineral matter found in rock of a composition different from its own and produced by deposition from aqueous solution in the rock.

conditioning agents, *n*—all chemicals that enhance the performance of the collectors or frothers. Conditioning agents change the characteristics of the surface of the minerals or the environment. There are many subgroups according to their function: activators, depressants, emulsifiers, dispersants, flocculants, chelating reagents, froth depressants, pH modifiers, etc. **D 5114D5114**

core, *n—in drilling*, a cylindrical section of rock (coal) that is usually 5 to 10 cm in diameter, taken as part of the interval

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penetrated by a core bit and brought to the surface for geologic examination, representative sampling and laboratory analyses.

core barrels, *n*—two nested tubes above the bit of a core drill, the outer rotating with the bit, the inner receiving and preserving a continuous section or core of the material penetrated. The following two types of inner barrels are commonly used.

split-tube barrel, n—a type of inner barrel consisting of two longitudinal halves of pipe bound together by reinforced tape at intervals along the barrel length that allows easy access to a relatively intact core (by cutting the tape). (This is the preferred barrel type for coal exploration, where available.)

solid-tube barrel, n—a type of inner barrel consisting of a single solid-walled length of pipe in which removal of the core is accomplished by mechanical or hydraulic pressure at one end of the pipe thus extruding the core onto a core tray. (The core is likely to be less intact than when a split-tube barrel is used.)

core sample, *n*—that part of a core of rock or coal obtained so as to represent accurately a thickness of a unit penetrating by drilling. **D 5192D5192**

corrected temperature rise, *n*—the temperature of the calorimeter, caused by the process that occurs inside the bomb; that is, the observed temperature change corrected for various effects.

DISCUSSION—Temperature is measured in either degrees Celsius or degrees Fahrenheit. Thermometer corrections should be applied. Temperatures may be recorded in ohms or other arbitrary units instead of degrees. Consistent units must be used in standardization and the actual calorific value determination. If arbitrary units other than degrees Celsius or Fahrenheit are used, the temperature interval over which all tests are made must not vary so much that an error greater than 0.001°C would be caused. **D 5865D5865**

cutinite—See *cutinite* under **maceral**.

depositional carbon, *n—as used in Test Method D 5061D5061*, a group of carbon forms that are formed from cracking and nucleation of gas-phase hydrocarbon molecules during coal carbonization. **D 5061D5061**

pyrolytic carbon, n—as used in Test Method D 5061D5061, an anisotropic carbon form that is formed by the deposition of carbon parallel to an inert substrate causing the resulting texture to appear ribbon-like. **D 5061D5061**

sooty carbon, n—as used in Test Method D 5061D5061, an isotropic carbon form comprised of approximately spherical particles of less than 1-µm diameter sometimes referred to as combustion black. **D 5061D5061**

spherulitic carbon, n—as used in Test Method D 5061D5061, a spherical anisotropic carbon form sometimes referred to as thermal black that is formed by the deposition of carbon concentrically around a nucleus. **D 5061D5061**

divided sample—See *divided sample* under **sample**.

domain, *n—as used in Test Method D 5061D5061*, a region of anisotropy in a carbon form that is distinctively marked by its isochromatic boundary and cleavage. **D 5061D5061**

dry, ash-free basis—See *dry, ash-free basis* under **reporting bases**.

dry basis—See *dry basis* under **reporting bases**.

dry coke—See *dry coke* under **coke**.

dry sieving—*for the purpose of Test Method D 4749D4749*, the test method for the sieving of coal after the sample has been airdried under prescribed conditions; this is generally used when testing with coal particles larger than 600 µm (No. 30 U.S.A. Standard Sieve Series.) **D 4749D4749**

easily oxidized coals, *n*—low rank coals such as subbituminous or lignitic coals. **D 3302D3302**

energy equivalent, heat capacity, or water equivalent, *n*—the energy required to raise the temperature of the calorimeter an arbitrary unit. This is the quantity that, when multiplied by the corrected temperature rise, then adjusted for extraneous heat effects, and divided by the weight of the sample, gives the gross calorific value.

DISCUSSION—Energy units for quantities listed throughout this test method are such that the number of energy units per gram of sample corresponds exactly to the number of British thermal units per pound of sample. For brevity, these are referred to as British thermal units. The actual energies are smaller than those stated by the ratio of the number of pounds per gram (1/453.59). The energy equivalent of the calorimeter has the units (British thermal units per pound) times (grams per degree). Time is expressed in minutes. Mass is expressed in grams. **D 5865D5865**

equilibrium, *n*—condition reached in air drying in which change in weight of the sample, under conditions of ambient temperature and humidity, is no more than 0.1 %/h or 0.05 %/½ h. **D 3302D3302**

equilibrium moisture basis—See *equilibrium moisture basis* under **reporting bases**.

error—difference of an observation from the best obtainable estimate of the true value. **D 2234/D 2234MD2234/D2234M; D 4916D4916**

excess moisture—synonym for *surface moisture*.

exinite—See *exinite* under **maceral**.

extraneous moisture—synonym for *surface moisture.*

filler phase, *n—as used in Test Method D 5061D5061*, a discontinuous solid formed from coal macerals and minerals that do not deform thermoplastically during carbonization. **D 5061D5061**

DISCUSSION—The filler phase material is formed from coal macerals that are inert with respect to development of thermoplasticity (inertinite), the inorganic components of coal (minerals), as well as normally reactive coal entities that are noncoking or have been rendered inert by thermal oxidation, natural weathering, or brecciation. These inert materials possess their original morphologies, but their reflectance and chemical properties have been altered prior to or during carbonization. **D 5061D5061**

fine coal, n—that portion of a coal sample being subject to a washability study that is smaller than the predetermined particle size, generally between 2.36 mm (No. 8 USA Standard Sieve Series) and 9.5 mm (⅜ in.) round in diameter, which is specified in Test Method D 4371D4371.

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Discussion—This same particle size breakpoint should then be used in subsequent washability studies of the same material samples from the same location for the same application. This breakpoint is determined by the analyst or the person designing the test procedure as the point that best suits the application. This fine-coal fraction may be further sieved (generally by wet sieving) to produce additional size fractions, each of which is processed through the desired specific gravity solutions. **D 4371D4371**

fixed carbon, *n—in the case of coal, coke, and bituminous materials*, the solid residue other than ash, obtained by destructive distillation, determined by definite prescribed methods.

Discussion—It is made up principally of carbon but may contain appreciable amounts of sulfur, hydrogen, nitrogen, and oxygen.

In the case of coal and coke, the methods used shall be those prescribed in Test Method D 3172D3172.

float/sink, *n*—a reference to the physical action that particles undergo when immersed in a liquid of a predetermined specific gravity.

Discussion—A series of float/sink tests is considered as being synonymous with a washability analysis. A float fraction or float material is the material or the specific gravity fraction that floats in a certain solution of specific gravity liquids. A sink fraction or sink material is the material or the specific gravity fraction that sinks in a certain solution of specific gravity liquids. **D 4371D4371**

floor, *n*—the rock material immediately underlying a coal bed.

flotation cell, *n*—the vessel or compartment in which the flotation test is performed. **D 5114D5114**

fluid temperature (FT), *n—in reference to the fusibility of coal and coke ash according to Test Method D 1857D1857*, the temperature at which the fused mass has spread out in a nearly flat layer with a maximum height of 1.6 mm (1⁄16 in.). **D 1857D1857**

free impurity, *n*—the impurities in a coal that exist as individual discrete particles that are not a structural part of the coal and that can be separated from it by coal preparation methods. **D 2234/D 2234D2234/D2234M**

free moisture—synonym for *surface moisture.*

froth, *n*—a collection of bubbles and particles on the surface of a pulp in a froth flotation cell. **D 5114D5114**

froth flotation, *n*—a process for cleaning fine coal in which hydrophobic particles, generally coal, attach to air bubbles in a water medium and rise to the surface to form a froth. The hydrophilic particles, generally the ash-forming matter, remain in the water phase. **D 5114D5114**

frother, *n*—a reagent used in froth flotation to control the size and stability of the air bubbles, principally by reducing the surface tension of water. **D 5114D5114**

fusain—See *fusain* under **coal**.

fusinite—see *fusinite* under **maceral**.

funginite, *n*—See *funginite* under **maceral**.

geophysical log, *n*—a graphic record of the measured or computed physical characteristics of the rock section encountered in a borehole, plotted as a continuous function of depth. Measurements are made by a sonde which contains the detectors, as it is withdrawn from the borehole by a wire line. Several measurements are usually made simultaneously, and the resulting curves are displayed side by side on the common depth scale. A common suite of logs used in coal exploration include caliper, density (gamma-gamma), natural gamma, and resistivity.

caliper log, n—a continuous mechanical measurement of the diameter and thus the rugosity of the borehole. The tool identifies zones where swelling or cavings (washouts) have occurred during drilling. The tool's value is in allowing qualitative or quantitative corrections to be made to other geophysical logs which are affected by borehole size (especially density).

density log (gamma-gamma log), n—measures electron density within lithologic units which is related to their bulk density. The wireline tool records the intensity of gamma radiation (in counts per second) from a nuclear source within the tool after it has been attenuated and backscattered by lithologies within the borehole. Due to the distinctly low density of coals, the density log is essential in coal exploration for identifying coal seams and coal-seam partings. The bias/resolution of density logs can be affected by source-detector spacing (closer spacing increases resolution), borehole size, and irregularities (see *caves* or *washouts*), and the presence of casing and logging speed.

natural gamma-ray log, n—a record of the natural radioactivity of the lithologies encountered in the borehole environment. During recording of geophysical logs, the amount of natural radiation is recorded and presented in either counts per second (CPS) or American Petroleum Institute (API) units. Unlike many other log types, a representative natural gamma log can be obtained where borehole or fluid conditions, or both, are not optimal or where casing is present. The natural gamma log is most often used in the coal environment for identifying clastic lithologies and differentiating coal seams and coal-seam partings.

resistivity log, n—a measure of the voltage differential of strata along the walls of a borehole when electrical current is passed through the strata. The resistivity log requires a fluid-filled hole to provide a conductive medium constantly between electrodes on the tool. The spacing between the electrodes determines the precision of the bed boundary relationships in much the same manner as with the density log. The resistivity log is useful primarily in conjunction with other log types. The logs are affected by casing, logging speed, electrode spacing, formation porosity, and resistivity changes in the borehole fluid. **D 5192D5192**

grade/recovery, *n*—the relationship between quality and quantity of the clean coal product. The quality can be defined in terms of ash, sulfur, or Btu content. The quantity can be designated as yield or heating value recovery (Btu or combustibles). **D 5114D5114**

green coke, *n—as used in Test Method D 5061D5061*, carbonaceous binder or filler phase material that has exceeded the temperature of thermoplasticity, but has not obtained the temperature of metallurgical coke.

Discussion—Green coke is recognized on the basis of relative reflectance in comparison to fully carbonized coke. Green coke exhibits

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