



Designation: D388 – 23

Standard Classification of Coals by Rank¹

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1. Scope

1.1 This standard covers the classification of coals by rank, that is, according to their degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite.

1.2 This classification is applicable to coals that are composed mainly of vitrinite.

NOTE 1—Coals rich in inertinite or liptinite (exinite), or both, cannot be properly classified because, in those macerals, the properties that determine rank (calorific value, volatile matter, and agglomerating character) differ greatly from those of vitrinite in the same coal. Often, such coals can be recognized by megascopic examination. In North America, these coals are mostly nonbanded varieties that contain only a small proportion of vitrain and consist mainly of attrital materials. The degree of metamorphism of nonbanded and other vitrinite-poor coals can be estimated by determining the classification properties of isolated or concentrated vitrinite fractions, or by determining the reflectance of the vitrinite (see Test Method D2798 and Appendix X1 of this classification). However, in the use of these vitrinite-poor coals, some properties normally associated with rank, such as rheology, combustibility, hardness, and grindability (as well as the rank determining properties) may differ substantially from those of vitrinite-rich coals of the same degree of metamorphism.

1.3 The accuracy of the classification of impure coal may be impaired by the effect of large amounts of mineral matter on the determination of volatile matter and calorific value, and on their calculation to the mineral-matter-free basis.

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

1.4.1 *Exception*—The values stated in British thermal units per pound (Btu/lb) are to be regarded as the standard. The SI equivalents of Btu/lb are provided for information only and are not considered standard.

1.5 *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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization 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

- D121 Terminology of Coal and Coke
- D720/D720M Test Method for Free-Swelling Index of Coal
- D1412/D1412M Test Method for Equilibrium Moisture of Coal at 96 to 97 Percent Relative Humidity and 30 °C
- D2013/D2013M Practice for Preparing Coal Samples for Analysis
- D2234/D2234M Practice for Collection of a Gross Sample of Coal
- D2798 Test Method for Microscopical Determination of the Vitrinite Reflectance of Coal
- D3172 Practice for Proximate Analysis of Coal and Coke
- D3173/D3173M 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
- D3302/D3302M Test Method for Total Moisture in Coal
- D4239 Test Method for Sulfur in the Analysis Sample of Coal and Coke Using High-Temperature Tube Furnace Combustion
- D4596 Practice for Collection of Channel Samples of Coal in a Mine
- D5016 Test Method for Total Sulfur in Coal and Coke Combustion Residues Using a High-Temperature Tube Furnace Combustion Method with Infrared Absorption
- D5192 Practice for Collection of Coal Samples from Core
- D5865 Test Method for Gross Calorific Value of Coal and Coke

3. Terminology

3.1 Definitions:

¹ This classification is under the jurisdiction of ASTM Committee D05 on Coal and Coke and is the direct responsibility of Subcommittee D05.23 on Sampling.

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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.

3.1.1 For additional definitions of terms used in this classification, refer to Terminology **D121**.

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

3.1.3 *apparent rank, n*—of a coal seam, the estimated rank designation obtained using samples other than face channel samples or core samples with 100 % recovery of the seam, but otherwise conforming to procedures of Classification D388.

3.1.4 *class, n*—a designation of coal rank indicating the degree of metamorphism, or progressive alteration.

3.1.4.1 *Discussion*—In order of increasing metamorphism, these classes range from lignitic through subbituminous and bituminous to anthracitic coals. Refer to **Table 1** of Classification D388.

3.1.5 *coal seam, n*—the stratum, layer, or bed of coal (containing less than a 50 % mass fraction of ash on the dry basis) that lies between two other rock layers whose compositions differ significantly from that of coal.

3.1.6 *group, n*—a subdivision within a coal rank class indicating a coal's designated rank; for example, subbituminous A rank coal is a group within the subbituminous class.

3.1.7 *high rank coal, n*—denotes a range of coal classes with a greater degree of metamorphism or alteration, including bituminous and anthracitic coals.

3.1.7.1 *Discussion*—These coals are generally characterized by lower inherent moisture and higher calorific value. Rank alone is not a sufficient indicator of whether a coal is suitable for a specific end use.

3.1.8 *low rank coal, n*—denotes a range of coal classes with a lesser degree of metamorphism or alteration, including lignitic and subbituminous coals.

3.1.8.1 *Discussion*—These coals are generally characterized by higher inherent moisture and lower calorific value. Rank alone is not a sufficient indicator of whether a coal is suitable for a specific end use.

3.2 Abbreviations:

TABLE 1 Classification of Coals by Rank^A

Class/Group	$FC_{d,MMF}$ Limits, %		$VM_{d,MMF}$ Limits, %		$GCV_{im,MMF}$ Limits ^B				Agglomerating Character
	Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Btu/lb		MJ/kg ^C		
					Equal or Greater Than	Less Than	Equal or Greater Than	Less Than	
Anthracitic:									} non-agglomerating
Meta-anthracite	98	...	...	2	...	...	...	...	
Anthracite	92	98	2	8	...	...	...	...	
Semianthracite ^D	86	92	8	14	...	...	...	...	
Bituminous:									} commonly agglomerating ^E
Low volatile bituminous coal	78	86	14	22	...	...	...	...	
Medium volatile bituminous coal	69	78	22	31	...	...	...	...	
High volatile A bituminous coal	...	69	31	...	14 000	...	32.557	...	
High volatile B bituminous coal	...	...	...	...	13 000	14 000	30.232	32.557	
High volatile C bituminous coal	...	...	...	...	{ 11 500	13 000	26.743	30.232	} agglomerating
						10 500	11 500	24.418	
Subbituminous:									} non-agglomerating
Subbituminous A coal	...	...	...	...	10 500	11 500	24.418	26.743	
Subbituminous B coal	...	...	...	...	9 500	10 500	22.09	24.418	
Subbituminous C coal	...	...	...	...	8 300	9 500	19.30	22.09	
Lignitic:									
Lignite A	...	...	...	...	6 300	8 300	14.65	19.30	} non-agglomerating
Lignite B	...	...	...	...	...	6 300	...	14.65	

^A This classification does not apply to certain coals, as discussed in Section 1.

^B Refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

^C Megajoules per kilogram. To convert British thermal units per pound to megajoules per kilogram, multiply by 0.0023255.

^D If agglomerating, classify in low volatile group of the bituminous class.

^E It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and that there are notable exceptions in the high volatile C bituminous group.