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Standard Practice for Collection of a Gross Sample of Coal[1]

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INTRODUCTION

Data obtained from coal samples are used in establishing price, controlling mine and cleaning plant operations, allocating production costs, and determining plant or component efficiency. The task of obtaining a sample of reasonable mass to represent an entire lot presents a number of problems and emphasizes the necessity for using standard sampling procedures.

Coal is one of the most difficult of materials to sample, varying in composition from noncombustible particles to those which can be burned completely, with all gradations in between. The task is further complicated by the use of the analytical results, the sampling equipment available, the quantity to be represented by the sample, and the degree of precision required.

This practice gives the overall requirements for the collection of coal samples. The wide varieties of coal-handling facilities preclude the publication of detailed procedures for every sampling situation. The proper collection of the sample involves an understanding and consideration of the physical character of the coal, the number and mass of increments, and the overall precision required.

1. Scope

1.1 This practice covers procedures for the collection of a sample under various conditions of sampling and directs the user to the appropriate ASTM standard for that sampling condition. The sample is to be crushed and further prepared for analysis in accordance with Practice D2013/D2013M. However, the procedures for dividing large samples before any crushing are given in this practice.

1.2 This practice describes general and special purpose sampling procedures for coals *(1)* by size and condition of preparation (for example, mechanically cleaned coal or raw coal) and *(2)* by sampling characteristics.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4 *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.*

1.5 *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]

D121 Terminology of Coal and Coke
D2013/D2013M Practice for Preparing Coal Samples for Analysis
D4749 Test Method for Performing the Sieve Analysis of Coal and Designating Coal Size
D6609 Guide for Part-Stream Sampling of Coal
D6883 Practice for Manual Sampling of Stationary Coal from Railroad Cars, Barges, Trucks, or Stockpiles
D7430 Practice for Mechanical Sampling of Coal
E456 Terminology Relating to Quality and Statistics

3. Terminology

3.1 *Definitions*—Definitions applicable to this practice are listed in Terminology D121.

[1] This practice 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.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *accuracy, n—*

3.2.1.1 *generally*—a term used to indicate the reliability of a sample, a measurement, or an observation.

3.2.1.2 *specifically*—a measure of closeness of agreement between an experimental result and the true value. Example: the observed and true sulfur content of a coal consignment. This measure is affected by chance errors as well as by bias.

3.2.2 *cross-belt sampler, n*—a single sampling machine or component of a mechanical sampling system designed to extract an increment directly from a conveyor belt surface by sweeping a sampling device (cutter) through the material on the conveyor.

3.2.3 *falling-stream sampler, n*—a single sampling machine or component of a mechanical sampling system designed to extract an increment from a falling stream of coal at the discharge end of a conveyor or chute by moving a sampling device (cutter) through the falling stream of material.

3.2.4 *gross sample, n*—a sample representing one lot of coal and composed of a number of increments on which neither reduction nor division has been performed.

3.2.5 *increment, n*—a small portion of the lot collected by one operation of a sampling device and normally combined with other increments from the lot to make a gross sample.

3.2.6 *judgment sampling, n*—a procedure whereby enumerators select a few items of the population, based on visual, positional, or other cues that are believed to be related to the variable of interest, so that the selected items appear to match the population.

3.2.6.1 *Discussion*—In the case of sampling coal, this statistical terminology from Terminology E456 is stating that the enumerator (human sampler) selects items from the population (collects sample increments) based on various cues (time/tonnage, at transfer point, etc.) so that the items (sample increments) appear to match the population (representative sample). The key dynamic here is that the sampler is attempting to collect a representative sample using their best judgment as to when and how to collect increments when, *(a)* so many particles in the consignment have a zero chance of being selected; and *(b)* there is no sure way to overcome particle size segregation in the material.

3.2.7 *mechanical sampling system, n*—a single machine or series of interconnected machines whose purpose is to extract mechanically, or process (divide and reduce), or a combination thereof, a system sample of coal.

3.2.8 *nonprobability sample, n*—a sample of which the sampling units have not been selected in a manner that satisfies the minimum requirements of probability sampling.

3.2.8.1 *Discussion*—No meaningful statistical inference can be made with data obtained by a nonprobability sample. No meaningful statement can be made concerning the precision, standard error, or bias of the sample.

3.2.9 *probability sample, n*—a sample collected using a sampling process such that at each stage of the process, a specified non-zero probability of being selected for the sample can be attached to every sampling unit in the lot to be sampled.

3.2.9.1 *Discussion*—Given adequate information about the sample results obtained using probability sampling, the probability distribution of sampling errors can be estimated.

3.2.10 *sample, n*—a quantity of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity.

3.2.11 *size consist, n*—the particle size distribution of a coal.

3.2.12 *system sample, n*—a sample collected from a test batch or lot of coal by the final stage of a mechanical sampling system.

3.2.12.1 *Discussion*—A system sample that includes reduction and division within the sampling system is no longer a gross sample.

4. Summary of Practice

4.1 The general-purpose sampling procedures are intended to provide, in 19 of 20 cases, dry ash results that are within an interval of ±1/10 of the average dry ash results that would be obtained in hypothetical repeated sampling.

4.2 Special-purpose sampling procedures apply to the sampling of coal when other precision limits are required, or when other constituents are used to specify precision, or for performance tests.

4.3 For coals of known size and condition of preparation, tables are given for the determination of the number and mass of increments required for a gross sample for both general and special-purpose sampling.

4.4 The procedures appear in the following order:

Test Method	Section
Sampling of Coals Based on Size and Condition of Preparation	8.1
General-Purpose Sampling Procedure	8.1.1
Number and Mass of Increments	8.1.1.2
Number of Gross Samples	8.1.1.4
Special-Purpose Sampling	8.1.2
Number and Mass of Increments	8.1.2.2
Number of Gross Samples	8.1.2.3
Division of the Gross Sample Before Crushing	8.2
Sampling of Coal for Total Moisture Determinations	8.3
Types of Moisture Samples	8.3.1
Entire Gross Sample	8.3.1.1
Special Moisture Subsample	8.3.1.2
Other Subsamples for Moisture Testing	8.3.1.3
Special Precautions	8.3.2
Mass of Increments	8.3.3
Number of Increments	8.3.4
Moisture Sampling Based Only on Size	8.3.4.1

5. Significance and Use

5.1 It is intended that this practice be used to provide a sample representative of the coal from which it is collected. Because of the variability of coal and the wide variety of sampling equipment, caution should be used in all stages of sampling from system specifications and equipment procurement to equipment acceptance testing and actually taking the final sample.

5.2 After further processing (Practice D2013/D2013M), the sample may be analyzed for a number of different parameters. These parameters may affect the lot's value, its ability to meet specifications, its environmental impact, as well as other properties.

6. Increment Collection Classification

6.1 The type of selection, the conditions under which individual increments are collected, and the method of spacing of increments from the coal consignment or lot are classified according to the following descriptions and Table 1. These designations are to be used for sampling specifications and for descriptions of sampling programs and sampling equipment.

6.2 *Types of Increments*—The types of selection of increments are based on whether or not there is human discretion in the selection of the pieces of coal or portions of the coal stream.

6.2.1 *Type I,* in which specific pieces or portions are not subject to selection on a discretionary basis. This includes that in which the increment is collected in precise accord with previously assigned rules on timing or location that are free of any bias. Type I selection increments generally yield more accurate results.

6.2.2 *Type II,* in which some measure of human discretion is exercised in the selection of specific pieces of coal or of specific portions of the stream, pile, or shipment.

6.3 *Conditions of Increment Collection*—The conditions under which individual increments are collected are the conditions of the main body of coal relative to the portion withdrawn. Four conditions are recognized:

6.3.1 *Condition A (Stopped-Belt Cut),* in which a loaded conveyor belt is stopped and a full cross-section cut with parallel sides is removed from the coal stream. The distance between the parallel faces shall not be less than three times the normal top size of the coal.

6.3.2 *Condition B (Full-Stream Cut),* in which a full cross-section cut is removed from a moving stream of coal.

6.3.3 *Condition C (Part-Stream Cut),* in which a portion, not a full cross section, is removed from a moving stream of coal.

6.3.4 *Condition D (Stationary Coal Sampling),* in which a portion of coal is collected from a pile, a rail car, a barge, or a ship hold. Mechanical sampling with an Auger is Condition D sampling.

6.3.5 The first two Conditions A and B, Stopped Belt Cut and Full Stream Cut, respectively, are considered probability samples because every particle in the lot has a non-zero chance of being selected and the sample collection method overcomes any particle size segregation in the material. The latter two Conditions C and D, Part-stream Cut and Stationary Sampling, respectively, are considered nonprobability samples primarily because there are large numbers of particles in the lot that have a zero chance of being selected for the sample and the sampling method cannot assure overcoming any particle size segregation in the consignment. In addition, Conditions C and D are often referred to as judgment samples because the increments are not collected according to probability but primarily based on the human judgment of the sampling personnel.

6.3.6 The highest possible condition according to Table 1, wherever feasible, should be used for sample collection, and probability sampling is strongly preferred over nonprobability or judgment sampling.

6.4 *Spacing of Increments*—The spacing of increments pertains to the kind of intervals between increments. Two spacing methods are recognized: systematic and random. Systematic spacing is usually preferable.

6.4.1 *Systematic Spacing 1,* in which the movements of individual increment collection are spaced evenly in time or in position over the lot.

6.4.2 *Random Spacing 2,* in which the increments are spaced at random in time or in position over the lot.

7. Organization and Planning of Sampling Operations

7.1 This practice provides definitive procedures for the collection of a gross sample. Parties claiming to use this practice must adhere to the procedures as set out in this standard. If the sampling is not done in accordance with the procedures set out in this practice, then that sample may not be suitable for comparison with a sample collected by the procedures described in this practice. Since it may be impracticable or impossible to take another sample of a given lot of coal, it is essential that parties agree on sampling procedures prior to undertaking sampling.

7.2 *Selection of Appropriate Sampling Procedure*—Variations in coal-handling facilities make it impossible to publish rigid rules covering every sampling situation in complete and exact details. Proper sampling involves an understanding and proper consideration of the minimum number and mass of increments, the size consist of the coal, the condition of preparation of the coal, the variability of the constituent sought, and the degree of precision required.

7.2.1 *Number and Mass of Increments*—The number and mass of increments required for a given degree of precision depends upon the variability of the coal. This variability increases with an increase in free impurity. A coal high in inherent impurity and with comparatively little free impurity may exhibit much less variability than a coal with a low inherent impurity and a relatively high proportion of free impurity. For most practical purposes, an increase in the ash content of a given coal usually indicates an increase in

TABLE 1 Increment Types, Conditions, and Spacing

Condition of Increment Collection from the Main Body of Coal	Types of Increment			
	Type I No Human Discretion Is Used		Type II Human Discretion Is Used	
	Spacing of Increments		Spacing of Increments	
	1. Systematic	2. Random	1. Systematic	2. Random
Condition A, stopped belt cut	I-A-1	I-A-2	II-A-1	II-A-2
Condition B, full-stream cut	I-B-1	I-B-2	II-B-1	II-B-2
Condition C, part-stream cut	I-C-1	I-C-2	II-C-1	II-C-2
Condition D, stationary sampling	I-D-1	I-D-2	II-D-1	II-D-2