Designation: D 4916 – 97

Standard Practice for Mechanical Auger Sampling[1]

This standard is issued under the fixed designation D 4916; 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 practice describes procedures for the collection of an increment, partial sample, or gross sample of material using mechanical augers. Reduction and division of the material by mechanical equipment at the auger is also covered. Further manual or mechanical reduction or division of the material elsewhere shall be performed in accordance with Method D 2013.

1.2 The values stated in SI units are to be regarded as the standard. The values given 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 431 Method for Designating the Size of Coal from Its Sieve Analysis[2]

D 2013 Method of Preparing Coal Samples for Analysis[3]

D 2234 Practice for Collection of a Gross Sample of Coal[3]

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *accuracy*:

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

3.1.1.2 *specifically*, a measure of closeness of agreement between an experimental result and the true value. An example is the observed and true sulfur content of a coal consignment. This measurement is affected by chance errors as well as by bias.

3.1.2 *auger increment*—the retained portion of one extraction operation of the auger.

3.1.3 *bias (systematic error)*—an error that is consistently negative or consistently positive. The mean of errors resulting from a series of observations that does not tend towards zero.

3.1.4 *chance error*—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.

3.1.5 *consignment*—a discrete amount of coal, such as a shipment, a car load, a unit train, or a day's production. A consignment may include more than one lot of coal and may correspond to a specific period of time, such as a sampling period or a billing period.

3.1.6 *error*—difference of an observation or a group of observations from the best obtainable estimate of the true value.

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

3.1.8 *increment*—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.

3.1.9 *lot*—a quantity of coal to be represented by the gross sample.

3.1.10 *precision*—a term used to indicate the capability of a person, an instrument, or a method to obtain reproducible results; specifically, a measure of the chance error as expressed by the variance, standard error, or a multiple of the standard error (see Practice E 177).

3.1.11 *representative sample*—a sample collected in such a manner that every particle in the lot to be sampled is equally represented in the gross or divided sample.

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

3.1.13 *sample division*—a process whereby a sample is reduced in weight without change in particle size.

[1] This practice is under the jurisdiction of ASTM Committee D-5 on Coal and Coke and is the direct responsibility of Subcommittee D05.23 on Coal Sampling.

Current edition approved Nov. 10, 1997. Published May 1998. Originally published as D 4916 – 89. Last previous edition D 4916 – 91.

[2] Discontinued; see *1988 Annual Book of ASTM Standards*, Vol 05.05.

[3] *Annual Book of ASTM Standards*, Vol 05.05.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

3.1.14 *significant loss*—any loss that introduces a bias in final results that is of appreciable economic importance to the concerned parties.

3.1.15 *size consist*—the particle size distribution of a coal.

3.1.16 *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.

3.1.16.1 *systematic spacing 1*—in which the movements of individual increment collection are spaced evenly in time or in position over the lot.

3.1.16.2 *random spacing 2*—in which the increments are spaced at random in time or in position over the lot.

3.1.17 *subsample*—a sample taken from another sample.

3.1.18 *top size*—the opening of the smallest screen in the series upon which is retained less than 5 % of the sample (see Method D 431).

3.1.19 *unbiased sample (representative sample)*—a sample free of bias.

4. Summary of Practice

4.1 A sample of coal is extracted from a stationary load contained within a railcar(s), truck(s), or barge(s) by inserting an auger into the vehicle in a vertical manner to extract a columnar sample of coal from the vehicle. The coal collected by the auger is then placed into sealed containers for storage or is processed by additional sampling equipment, for example, a secondary sampler or crusher. The processed auger increments produced by these on-line components should be placed into sealed containers for future laboratory analysis.

5. Significance and Use

5.1 Auger sampling systems can be used to extract samples from trucks, railcars, barges, or static compacted stockpiles where the use of a full-stream mechanical sampling system may be impractical. The samples obtained from these systems can be used to establish the materials' commercial value or constituents for quality control purposes at the shipping or receiving location of the interested parties in the transaction. The utilization of an auger system and procedures for collecting coal samples for subsequent analysis should be agreed upon by all parties concerned. Compacted stockpiles should be no higher than the length of the auger sampler. Otherwise, the deeper areas of the stockpile cannot be sampled.

6. Organization and Planning of Sampling Operations

6.1 *General Considerations*—Mechanical auger sampling is designated as Condition D, Stationary Coal Sampling. When using augers to sample, the material taken may only be representative to the depth sampled. In addition, the parameters such as top size, degree of preparation, degree of material segregation, and pattern of auger placement should also be considered.

6.2 *Consideration of Top Size*—Designs of mechanical sampling augers vary from high-powered augers with cutter bits drilling through the coal to be sampled, to low-powered augers designed to sample loosely compacted coal. The clearance in the auger assembly and flights should be sufficient to allow passage of the largest top size in the lot of coal to be sampled. If the top size of coal makes the auger size impractical, the auger should be designed to cut through or break up the lumps of coal.

6.3 *Consideration for Number of Auger Increments*—The number of increments required should be based on the lot size and degree of material preparation. For purposes of this practice, the degree of preparation is divided into two categories, that is, raw and mechanically cleaned. The lot size may be determined by factors such as prior contractual agreements, operational restrictions, coal storage capabilities, and coal transportation methods such as rail car, truck, or barge. Determine the number of increments required to represent the lot by the following formula:

$$N_2 = N_1\sqrt{(a/908 \text{ Mg or } 1000 \text{ tons})}$$

where:

N_1 = 15 for clean coal and 35 for raw coal,
N_2 = number of increments required, and
a = lot size, Mg (tons).

6.3.1 Determine recommendations for the number of auger increments per vehicle by the following formula:

$$N_3 = N_2 \times b/a$$

where:

N_2 = number of increments required,
N_3 = number of increments per vehicle,
a = lot size, Mg (tons), and
b = amount of material per vehicle, Mg (tons).

If N_3 is greater than one, round it off to the nearest whole number. If N_3 is less than one, it is recommended that one increment be taken from each vehicle.

6.3.2 However, if operational considerations make the application of these procedures impractical, the following suggestions may be considered:

6.3.2.1 *Example 1*—When more than one increment per vehicle is recommended but deemed impractical, then take as many increments as possible, but never less than one increment per vehicle. It should be realized that any reduction in the number of increments could reduce the precision of the final sample. In any case, obtain the same number of increments from each vehicle within the lot.

6.3.2.2 *Example 2*—When N_3 is less than one and one increment per vehicle has not been selected as practical, then use the following procedure: take the reciprocal of N_3(that is, calculate $1/N_3$) and round off this value to the nearest whole number. This is now the number of vehicles per increment. Next, space the increments over the number of vehicles either systematically or randomly while noting these precautions; although systematic spacing (for example, one increment every second vehicle for 100 vehicles) may be preferred in other sampling practices, practical consideration must be given to the phenomena of cyclical variability which is common in this type of sampling operation. If systematic spacing is not chosen, random spacing (for example, distributing the 50 increments randomly over the next 100 vehicles) must ensure the elimination of human discretion. This may be done by preplanning and the use of various random-number generator schemes.