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Standard Guide for Manual Sampling of Coal from Tops of Railroad Cars¹

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INTRODUCTION

Obtaining a sample of a single lot of coal from railcars that is acceptably representative of the lot from which it was taken may present some unique problems. Factors such as variations in railcar loading equipment and procedures, lack of access to predictable portions of coal in railcars, time, weather, and the heterogeneous nature of the product can all interact, inducing unacceptable bias and variance in the sample. Therefore, considering the aforementioned and considering the sample only represents the top layer of coal in the railroad car, this sampling guide should not be considered as a substitute for a more reliable sampling method, for example, full stream mechanical sampling. Nonetheless, some laboratory measurement of a lot of coal is often required, so sampling procedures for coal in railcars must be designed which reduces variance to an acceptable level while remaining physically and economically feasible.

The procedures described herein are designed to provide guidelines for meeting this criteria. As a caution, however, it is highly recommended that any modification in sampling procedure be accompanied by an understanding of both the product and potential effects of sample interactions with those modifications.

1. Scope

1.1 This guide describes manual sampling procedures for coal contained in railroad cars. These procedures are used to provide samples for general analysis and for the determination of total moisture. The gross sample is to be crushed and further prepared for analysis in accordance with Method D 2013 and Test Methods D 2234.

1.2 This guide provides instructions for sampling only the top 18 to 24 in. of a railcar. The user is cautioned that samples so obtained do not represent material below the point of penetration.

1.3 The user is cautioned that, during the removal of increments, spillage of coal from the sampling device is to be avoided. Spillage can result in a size biasing of the various sizes in the coal.

1.4 The samples obtained by this practice under Condition D (from stationary sources, see Test Methods D 2234), shall be considered less representative than samples taken from the same lot under Conditions A, B, or C (Test Methods D 2234).

1.5 The quantities stated in either acceptable SI units or in inch-pound units shall be regarded separately as standard. The quantities stated in each system may not be exact equivalents; therefore, each system must be used independently of the other,

without combining quantities in any way.

1.6 *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 Test Method for Designating the Size of Coal from its Sieve Analysis²

D 2013 Method of Preparing Coal Samples for Analysis³

D 2234 Test Methods for Collection of a Gross Sample of Coal³

E 105 Practice for Probability Sampling of Materials⁴

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods⁴

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

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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.



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

3.2 *analysis sample*—final subsample prepared from the original gross sample but reduced to 100 % through a No. 60 (250- μ m) sieve and divided to not less than 50 g.

3.3 *angle of repose*—the greatest angle, measured from horizontal, attained by a coal so that material on the sides or 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.

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

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

3.6 *free impurity*—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.

3.7 *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.

3.8 *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.

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

3.10 *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, the standard error, or a multiple of the standard error (see Practice E 177).

3.11 *representative sample*—a sample collected from a lot of coal in such a manner that all properties to be analyzed are proportionately represented in the sample, to within agreed upon limits of accuracy.

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

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

3.14 *sample preparation*—any procedure that may include air drying, crushing, division, and mixing of a gross sample, implemented for the purpose of obtaining an unbiased analysis sample.

3.15 *significant loss*—any loss that introduces a change in an analysis that is of appreciable economic importance to the concerned parties.

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

3.17 *subsample*—sample taken or prepared from another sample.

3.18 *top size*—the opening of the smallest screen in the

series upon which is retained less than 5 % of the sample (see Test Method D 431).

4. Summary of Guide

4.1 Manual car top sampling is accomplished by collecting increments from the tops of railroad cars for the purpose of acquiring a gross sample.

5. Significance and Use

5.1 Coal in any condition of preparation, from raw run-of-mine to a washed and sized product can be transported in railroad cars. The guidelines, cautions, and suggested procedures presented here are intended to aid in the proper planning of car top sampling operations, taking into account the wide variety of conditions that may be encountered.

5.2 When agreed upon by all interested parties, these guidelines provide procedures for collecting gross samples from tops of railroad cars; these samples then being further processed to provide subsamples for required laboratory determinations.

5.2.1 Use of this guide results in human discretion often being exercised in the selection of increments, therefore, samples collected in accordance with this guide are not considered probability samples (see Practice E 105). Thus, statistical inferences cannot be drawn from these samples. No general statement concerning the reliability of these samples may be made.

5.3 This sampling method is used only when sampling by the preferred methods, (Conditions A, B, or C in Test Methods D 2234) is not feasible. Condition D, of which car top sampling is a type, is described as the least desirable method for collection of gross samples from a lot of coal.

6. Organization and Planning

6.1 *Lot Size*—All interested parties shall agree before sampling begins to the size of the lot to be represented by one gross sample. Section 7 of Test Methods D 2234 is the proper guideline.

6.2 *Top Size*—The top size of the coal to be sampled should be ascertained to determine the size of the increment collection device (a minimum of two and one half times the top size of the coal), as well as the weight and number of increments to be taken. (Use of Table 1 is recommended to establish minimum weight and number of increments).

6.3 *Sampling Pattern*—The configuration of increment collection over the surface of the coal in a railcar should be agreed upon by all interested parties prior to commencement of sampling. Fig. 1 illustrates examples of typical car top sampling patterns, however, these are examples only and the user may be guided but not bound by these patterns. It is recommended that the user develop, by test, the pattern(s) that work best for the type of coal the user samples.

6.4 *Storage of Increments*—It is recommended that sample increments be adequately protected from moisture variation by the use of moisture-tight containers. Care must be taken to ensure that the integrity of the container, including any moisture seal, is not compromised during handling.

6.5 *Stratification*—Stratification can occur both vertically and horizontally within a railcar. Vertical stratification may