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Standard Guide for Inspecting Crosscut, Sweep-Arm, and Auger Mechanical Coal-Sampling Systems for Conformance with Current ASTM Standards[1]

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1. Scope

1.1 This guide is applicable to cross-belt, falling stream, and auger sampling systems.

1.2 Spacing of increments pertains to the kind of interval between increments. Intervals can be defined in quantitative terms, such as units of time or mass, or in terms of position over the lot.

1.2.1 *Spacing of Increments for Cross-Belt and Falling Stream Samplers*—Cross-belt and falling stream type mechanical sampling systems take increments based on time, either at fixed time intervals or at random times during a fixed time strata. Some crosscut samplers can take increments based on equal mass of coal sampled as determined by scales. The sections of this guide that pertain to cross-belt and falling stream samplers describe procedures for only time-based sampling systems. This time-based inspection guideline will satisfy most criteria for mass-based or combination mass-based and time-based sampling systems. If there are items that are not covered, the inspector should refer to the manufacturer's literature.

1.2.2 *Spacing of Increments for Auger Sampling*—The spacing of increments collected by auger sampling systems is defined in terms of position over the lot.

1.3 It is essential that the inspector have the documentation listed in Section 2 of this guide when conducting an inspection.

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

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 and health practices and determine the applicability of regulatory limitations prior to use.* For a specific hazard statement, see Section 5.

2. Referenced Documents

2.1 *ASTM Standards:*

D 121 Terminology of Coal and Coke[2]

D 2013 Practice of Preparing Coal Samples for Analysis[2]

D 2234 Practice for Collection of a Gross Sample of Coal[2]

D 4749 Test Method for Performing the Sieve Analysis of Coal and Designating Coal Size[2]

D 4916 Practice for Mechanical Auger Sampling[2]

3. Terminology

3.1 *Definitions*—Definitions applicable to this guide are listed in Terminology D 121, Practices D 2234 and D 4916, and Practice D 2013.

4. Significance and Use

4.1 This guide addresses quality assurance criteria for operation of a mechanical coal-sampling system in accordance with Practice D 2234, Practice D 2013, and Practice 4916. This guide serves as a reference for inspecting mechanical coal-sampling systems for conformance with applicable ASTM standards. It describes step-by-step procedures for such inspections, with specific ASTM references for each step.

5. Hazards

5.1 *Precautions*—In addition to other precautions, personnel visiting facilities for observation of mechanical sampling system performance should immediately upon arrival report to the facility management to inform them of their presence and the purpose of their visit. The inspector should ask for drawings, specifications, and instructions on the applicable safety practices and regulations to be followed on the site.

6. Assessing the Organization and Planning of Sampling Operations

6.1 It is recommended that inspection personnel meet with the appropriate personnel responsible for the mechanical sampling system, on all visits, to discuss the organization and

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

planning of sampling operations. ASTM standards provide for the use of various options. Examples and references are given in 6.1.1 and 6.1.2 as follows:

6.1.1 *Cross-Belt and Falling Stream Samplers*—The number of primary increments for the gross sample collected by cross-belt and falling stream systems can be determined from sections 8.1.1.4 and 8.1.1.5 of Practice D 2234.

6.1.2 *Auger Sampling*—Considerations for the number of auger increments per lot and per vehicle are discussed in the Consideration for Number of Auger Increments section (6.3) of Practice D 4916.

6.2 Inspection personnel should refer to the sections of Practice D 2234 and Practice D 4916 referenced in 6.2.1 and 6.2.2 of this guide when assessing the conformance of the organization and planning of cross-belt, falling stream, and auger sampling operations as follows:

6.2.1 *Planning of Cross-Belt or Falling Stream Sampling Operations*—When assessing the conformance of the organization and planning of sampling operations for a specific cross-belt or falling stream mechanical sampling system, the inspector should use Section 7, Organization and Planning of Sampling Operations, of Practice D 2234 which covers the items that would be used in evaluating the sampling plan. Items covered are: Precautions, Selection of Appropriate Sampling Procedure, Number and Weight of Increments, Increment Collection Method to be Used, Distribution of Increments, Dimensions of Sampling Device, Movement of Sampling Device, Preservation of Moisture, Contamination, Mechanical System Features, Personnel, Criteria of Satisfactory Performance, and Relative Location of Sampling and Weighing.

6.2.2 *Planning of Auger Sampling Operations*—When assessing the conformance of the organization and planning of sampling operations for a specific auger sampling system, the inspector should use Section 6, Organization and Planning of Sampling Operations, of Practice D 4916, which covers the following items: Precautions, Consideration of Top Size, Consideration for Number of Auger Increments, Considerations for Auger Placement Patterns and Increment Collections, Preservation of Moisture, Contamination, Mechanical System Features, Personnel, Relative Location of Sampling and Weighing, and Reduction and Mechanical Division of the Auger Increments.

7. General Observations of Coal Stream Variability as Related to Primary Increment Collection by Crosscut and Sweep-Arm Samplers

7.1 The entire coal-handling system up to the cross-belt or falling stream mechanical sampler should be examined to determine if any unloading, storage, or reclaiming procedures produce a cyclical pattern which could cause the increment collection to get *in phase* with the sequence of coal variability. Variations in the physical characteristics, such as particle-size distribution, surface moisture, extraneous matter, and oversized material, can become cyclical and even could be in phase with the time-based increment collection. When such cyclical variations occur in the coal stream, the source of the variations should be investigated to determine the practicability of eliminating the variations. If there is no practical way to eliminate the variations, then either the number of primary increments or the primary cutter velocity or both shall be varied.

NOTE 1—The number of primary increments should be varied by adjusting the time interval between primary cuts so that the period of cyclic variation is not evenly divisible by the number of primary cuts per period or by using a method of random collection of primary increments.

8. General Observations of Auger Placement

8.1 At a minimum, the inspector should examine the following two aspects of the placement of the auger over the surface of the coal being sampled: (*1*) human discretion in placement of the auger over the surface of the coal in the vehicle(s) and (*2*) the pattern of auger placement from vehicle to vehicle for lots comprised of more than one vehicle load of coal.

8.1.1 *Human Discretion*—To the extent possible, human discretion should be minimized with respect to auger placement over the surface of the coal in the vehicle(s). The inspector should examine the placement of the auger over the surface of the coal in at least one vehicle to determine that human discretion is minimized in positioning the auger.

8.1.2 *Auger Placement Patterns*—The inspector should refer to the Considerations for Auger Placement Patterns and Increment Collections section (6.4) of Practice D 4916 in regard to considerations for auger placement patterns and increment collections.

9. Inspection of the Primary Sampler in Time-Based Cross-Belt or Falling Stream Sampling Systems

9.1 It is suggested that the inspector start at the primary cross-belt or falling stream sampler and follow through the system to the final *online* sample collection point. The inspection should be made with and without coal running through the system.

9.2 The following items should be checked for the primary sampler:

9.2.1 Check the cross-belt or falling stream cutter opening to determine that it complies with the Dimensions of Sampling Device section (7.4) of Practice D 2234.

9.2.2 Sufficient inspection doors shall be available to observe that the primary cross-belt or falling stream cutter cuts the full stream of coal.

9.2.3 Observe, or if necessary, measure, the movement of the primary cross-belt or falling stream cutter to verify uniform speed while in the coal stream.

9.2.4 Determine the velocity of the cross-belt or falling stream cutter by dividing the distance the cutter travels while in the coal stream by the time required for traveling that distance. Make the velocity check for both directions if applicable. See the Characteristics and Movement of Sampling Device section (7.5) of Practice D 2234 for recommendations.

9.2.5 For cross-belt or falling stream systems, it should be determined that the proper number of primary increments are taken to satisfy the requirements of the Sampling of Coals Based on Size and Condition of Preparation or the Sampling of Coals Based on Known Sampling Characteristics of Practice D 2234. It should be determined that the time interval between primary cuts is correct to assure that the minimum number of

increments are collected for the lot of coal being sampled during the inspection based on maximum attainable feed rates.

9.2.6 The inspector shall determine that the crosscut sample cutter is parked out of the stream of coal in the *at rest* position and that no coal is entering the cutter opening. There shall be no holes in the baffle plate, dust doors, or seals that may cause leaking of the sample into the primary sample hopper.

9.2.7 For cross-belt and falling stream systems, the minimum weight of the primary sample increment shall be as specified in Table 2 of Practice D 2234.

10. Inspection of Augers

10.1 The following items should be checked for the auger:

10.1.1 Check the auger assembly to determine that it complies with the Consideration of Top Size section (6.2) of Practice D 4916.

10.1.2 Check the auger to determine that it extracts a vertical increment of coal extending from the surface to as close as practicable to the bottom of the transport vehicle.

10.1.3 For auger sampling systems, it should be determined that the proper number of primary (auger) increments are taken to satisfy the requirements of the Consideration for the Number of Auger Increments section (6.3) of Practice D 4916.

11. Criteria for Secondary Sampler Operation

11.1 The items discussed in 11.2-11.6 of this guide apply regardless of whether the primary increments are collected by cross-belt, falling stream, or auger sampling devices. References are provided to applicable sections of Practice D 2234 and Practice D 4916.

11.2 The following items should be checked for the primary sample hopper:

11.2.1 The primary sample hopper shall be enclosed to minimize moisture change and shall be of adequate size to hold the amount of primary increments collected.

11.3 The feeder from the primary sample hopper to a secondary sampler or to a sample crusher should distribute the coal flow over a long enough time interval so the required number of secondary increments are collected or to minimize pluggage of the sample crusher.

11.3.1 The feeder shall be enclosed to minimize moisture change and designed to prevent spillage.

11.3.2 A primary belt feeder or conveyor or both shall be provided with an effective wiper designed to discharge the wipings into the next unit of the mechanical sampling system, thus avoiding loss of sample.

11.4 If the primary feeder discharges the primary increment directly into a secondary sampler without intermediate crushing, the inspector should check the following items:

11.4.1 A minimum of six secondary increments shall be collected from each uncrushed primary increment as specified in section 8.2.1.2 of Practice D 2234 and section 6.10.1.1 of Practice D 4916. The six or more secondary increments should be equally spaced throughout the entire flow of the primary increment.

11.4.2 Each secondary increment must conform to the minimum increment weight specified in Table 2 of Practice D 2234 for nominal top size.

11.4.3 Secondary cutter velocity must be uniform across the entire coal stream and conform to the recommendations of the Increment Collection Method to be Used and the Characteristics and Movement of Sampling Device sections (7.2.2 and 7.5) of Practice D 2234, and the Speed of Sampling Device section (6.10.1.3) of Practice D 4916.

NOTE 2—The use of a stopwatch may not provide sufficient accuracy for short travel.

11.4.4 Cutter opening shall conform to the recommendations of the Dimensions of Sampling Device section (7.4) of Practice D 2234, and the Opening of Sampling Device section (6.10.1.2) of Practice D 4916.

11.4.5 The secondary cutter is out of the coal stream when in the *at rest* position. See 9.2.6 of this guide for precautions against leakage.

11.5 The sample crusher is fed from either the primary or secondary sampler by a feeder. The requirements and criteria for the secondary feeder are the same as for the primary feeder as described in 11.3 of this guide.

11.6 The sampling system can be designed to crush to an intermediate coal size, which in turn would be resampled before it would be fed to a secondary sampler crusher or, as is done in many sampling systems, to crush to the final sample size.

11.6.1 The sample crusher shall produce a product as required by design and shall be ample in size so as to be essentially free of plugging.

11.6.2 Performance of the sample crusher in achieving the designed particle-size distribution can be determined from the procedures and equipment prescribed in Test Method D 4749.

11.6.3 As specified in the Preservation of Moisture section of Practice D 2234, the flow of air through the sampling system shall be minimized. (Also see the Preservation of Moisture section (6.5) of Practice D 4916.) There are numerous devices for minimizing air windage in a sampling system, such as a pressure equalizing pipe connecting inlet to outlet of the crusher, air curtains, or baffles, and so forth.

12. Criteria for Tertiary or Final Sampler Operation

12.1 The criteria for tertiary or final sampler operation discussed in Section 11 of this guide apply regardless of whether the primary increments are collected by cross-belt, falling stream, or auger sampling devices. References are provided to applicable sections of Practice D 2234 and Practice D 4916.

12.2 The operation of the tertiary sampler cutter should be observed to determine that the cutter cuts the full coal stream and that it does so in the manner described in the Characteristics and Movement of Sampling Device section (7.5) of Practice D 2234.

12.3 Tertiary cutter velocity must be uniform across the entire coal stream and conform to the recommendations of the Increment Collection Method to be Used and Characteristics and Movement of Sampling Device sections (7.2.2 and 7.5) of Practice D 2234, and the Speed of Sampling Device and Speed of Sampling Device (After Crushing) sections (6.10.1.3 or 6.10.2.3) of Practice D 4916.

12.4 The cutter opening shall conform to the Dimensions of Sampling Device section (7.4) of Practice D 2234, and 6.10.1.2 or 6.10.2.2 of Practice D 4916, which include the recommendation that the opening shall not be less than 30.0 mm (1¼ in.).

12.5 Minimum increment weight before sample crushing shall conform to Table 2 of Practice D 2234. At present, there are no minimum increment weights after crushing given in Practice D 2013.

12.6 The tertiary or final cutter will be out of the coal stream in the *at rest* position.

12.7 The sampler shall be enclosed to minimize moisture change as specified in the Preservation of Moisture section of Practice D 2234. (Also see the Preservation of Moisture section (6.5) of Practice D 4916.)

12.8 When there is a crushing stage, the paragraph on the number of increments under Procedure B of Practice D 2013 specifies for mechanical division of the sample that at least 60 increments be taken at each stage of division. Therefore, this criteria can be used for determining the minimum number of increments to be collected by the tertiary or final sampler. Although not required by the standard, it is good practice to have at least one increment at every stage of reduction for every primary increment.

13. Cautions for Collecting Final Sample

13.1 The cautions for collecting the final sample discussed in Section 12 of this guide apply regardless of whether the primary increments are collected by cross-belt, falling stream, or auger sampling devices. References are provided to applicable sections of Practice D 2234 and Practice D 4916.

13.2 The container receiving the final sample increments shall be enclosed to minimize moisture change, as specified in the Preservation of Moisture section (7.7) of Practice D 2234. (Also see the Preservation of Moisture section (6.5) of Practice D 4916.)

13.3 The transfer pipe or chute from the final sampler to the final sample container should be as short as possible. There is a potential for significant moisture change if the relatively small amount of final sample falls through a long transfer pipe or chute.

14. General Considerations to be Observed by the Inspector

14.1 ASTM standards allow for flexibility in designing mechanical systems so that at any point in the division and reduction of the primary sample, such reduction and division can be done *online* in the mechanical sampling system or *offline* by a number of options and equipment specified in Practice D 2013. Practice D 2013 also specifies in Table 1 the minimum sample weight for four top sizes.

14.2 The conveyor belts shall be started and run for a period of time before the coal to be sampled is placed on the belt so that foreign substances (including water) are purged.

14.3 The mechanical sampling system should be started at some time in advance of the start of conveying coal. Where hydraulic drives are used, sufficient time should be allowed for the hydraulic oil and the associated system to reach temperature equilibrium. After reaching temperature equilibrium, cutter velocities should not change during sampling.

14.4 It is recommended that the inspector review any records or logs maintained by the operator. These records or logs may include such things as amounts of coal handled, amounts of coal sampled, and notations as to system malfunctions, stoppages, pluggages, or other deficiencies. The inspector may also wish to use a checklist, such as the example in Appendix X1, when actually conducting an inspection. It is recommended that the inspector complete all items on the checklist pertinent to the inspection. Such a checklist is also recommended for inclusion in the operator's records.

15. Keywords

15.1 coal sampling; inspection; mechanical sampling; sampling systems

APPENDIX

(Nonmandatory Information)

X1. TYPICAL MECHANICAL COAL SAMPLER CHECKLIST

Company: _____ Date: _____
Sampler Location and Identification: _____ Inspector: _____

I. General Information
(a) Weather conditions _____
(b) Coal type (raw, clean, appearance, etc.) _____
(c) Coal top size _____
(d) Lot size _____
(e) Feed rate (maximum and normal) _____
(f) Purpose of sample _____
(g) Source of coal (rail car, barge, truck, stockpile) _____

			Operators Recommended Inspection Frequency
II. Type of Sampling System	Falling Stream	_____	A Daily
	Cross-Belt	_____	B Monthly
	Auger	_____	C Each system operation
III. Number of Stages		_____	
IV. Start-up of Falling Stream and Cross-Belt Systems			
(a) System Checked, started prior to sampling		_____	C
(b) Fluid level		_____	C
(c) Oil temperature equilibrium		_____	C
V. General Observations of Augers			
(a) Human discretion in auger placement		_____	C
b) Auger placement patterns		_____	C
VI. Primary Falling Stream and Cross-Belt Cutters			
(a) Size opening		_____	B
(b) Cutting full stream		_____	C
(c) Uniform speed		_____	B
(d) Velocity		_____	B
(e) Interval between cuts		_____	B
(f) Contamination or loss of sample by leakage		_____	B
(g) Parked out of coal stream		_____	B
(h) Sample hopper enclosed		_____	B
(i) Number of cuts per lot		_____	
VII. Augers			
(a) Consideration of top size		_____	C
(b) Depth of extraction		_____	C
(c) Number of increments		_____	A
VIII. Primary Sample Feeder			
(a) Type		_____	
(b) Enclosed		Yes _____ No _____	B
(c) Feedrate		_____	B
(d) Belt wiper		Yes _____ No _____	B
IX. Secondary Cutter			
(a) Size opening		_____	B
(b) Cutting full stream		_____	C
(c) Uniform speed		_____	B
(d) Velocity		_____	B
(e) Interval between cuts		_____	B
(f) Contamination or loss of sample by leakage		_____	B
(g) Parked out of coal stream		_____	A
(h) Sample hopper enclosed		_____	B
(i) Number of cuts		_____	B
X. Secondary Sample Feeder			
(a) Type		_____	
(b) Enclosed		Yes _____ No _____	B
(c) Feedrate		_____	C
(d) Belt wiper		Yes _____ No _____	A
XI. Sample Crusher			
(a) Coal product top size		_____	B
(b) Equalizing pipe		Yes _____ No _____	B
XII. Tertiary Cutter			
(a) Size opening		_____	B
(b) Cutting full stream		_____	C
(c) Uniform speed		_____	B
(d) Velocity		_____	B
(e) Interval between cuts		_____	B
(f) Contamination or loss of sample by leakage		_____	B
(g) Parked out of coal stream		_____	A
(h) Sample hopper enclosed		_____	A
(i) Number of cuts		_____	B
XIII. Final Sample			
(a) Enclosed container		Yes _____ No _____	C
(b) Length and size used for sample chute		_____	B
(c) Calculated weight of final sample from mechanical sampling system		_____	B
(d) Actual weight of sample		_____	B
(e) Ratio of actual sample weight (line XIII (d)) to lot size (line I (d))		_____	B