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Hard coal and coke — Mechanical sampling —

Part 1: General introduction

Houille et coke — Échantillonnage mécanique —

Partie 1: Introduction générale

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 27, *Solid mineral fuels*, Subcommittee SC 4, *Sampling*.

This second edition cancels and replaces the first edition (ISO 13909-1:2001), which has been technically revised.

ISO 13909 consists of the following parts, under the general title *Hard coal and coke — Mechanical sampling*:

— *Part 1: General introduction*

— *Part 2: Coal — Sampling from moving streams*

— *Part 3: Coal — Sampling from stationary lots*

— *Part 4: Coal — Preparation of test samples*

— *Part 5: Coke — Sampling from moving streams*

— *Part 6: Coke — Preparation of test samples*

— *Part 7: Methods for determining the precision of sampling, sample preparation and testing*

— *Part 8: Methods of testing for bias*

Hard coal and coke — Mechanical sampling —

Part 1: General introduction

1 Scope

This part of ISO 13909 defines the basic terms used in the sampling of solid mineral fuels, describes the general principles of sampling and details the information to be provided in the documentation and the sampling report. It also lists the other parts and gives guidance on the selection of the appropriate part.

ISO 13909 does not include sampling of brown coals and lignites, or sampling from coal seams, for which guidance is given in ISO 14180. Manual sampling of coal and coke is covered in ISO 18283.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
air-drying
process of bringing the moisture content of the *sample* (3.31) near to equilibrium with the atmosphere in the area in which further reduction and division of the sample are to take place

Note 1 to entry: Air-drying to equilibrium with the atmosphere applies to coal. Drying of coke is generally to facilitate *sample preparation* (3.34).

3.2
bias
systematic *error* (3.10) which leads to the average value of a series of results being persistently higher or persistently lower than those which are obtained using a reference sampling method

3.3
coefficient of variation
standard deviation (3.37) expressed as a percentage of the absolute value of the arithmetic mean

3.4
common sample
sample (3.31) collected for more than one intended use

3.5
continuous sampling
taking of a *sample* (3.31) from each consecutive *sub-lot* (3.39) so that increments are taken at uniform intervals whenever the fuel is handled at the point of sampling

3.6
cut
see *increment* (3.15)

3.7
cutter
mechanical sampling device which extracts increment(s)

3.8
divided increment
part obtained from the division of the increment in order to decrease its mass

Note 1 to entry: Such division may be done with or without prior size reduction.

3.9
duplicate sampling
particular case of *replicate sampling* (3.30) with only two replicate *samples* (3.31)

3.10
error
difference between the observation and the accepted reference value as defined in ISO 5725-1:1994, 3.5

Note 1 to entry: This can be designated as systematic error [*bias* (3.2)] or *random error* (3.29).

3.11
fixed mass division
method of *sample division* (3.33) in which the mass retained is predetermined and independent of the mass of the feed

3.12
fixed ratio division
method of *sample division* (3.33) in which the division ratio is predetermined

Note 1 to entry: In fixed ratio division, the mass of *sample* (3.31) retained is a fixed proportion of the mass of the feed.

3.13
fuel
hard coal or coke

3.14
general-analysis test sample
sample (3.31), prepared to pass a sieve of nominal size of openings 212 µm complying with ISO 3310-1, used for the determination of most chemical and some physical characteristics

3.15
increment
portion of *fuel* (3.13) extracted in a single operation of the sampling device

3.16
lot
defined quantity of *fuel* (3.13) for which the quality is to be determined

Note 1 to entry: A lot may be divided into *sub-lots* (3.39).

3.17
manual sampling
collection of *increments* (3.15) by human effort

3.18
mass-basis sampling
taking of *increments* (3.15) whereby the position of each increment to be collected from the stream of *fuel* (3.13) is measured by a mass interval of stream flow and the increment mass is fixed

3.19
mechanical sampling
collection of *increments* (3.15) by mechanical means

3.20
mechanical sampling system
combination of sampling and *sample preparation* (3.34) performed mechanically

3.21
moisture sample
sample (3.31) taken specifically for the purpose of determining total moisture

Note 1 to entry: For coke, this sample may also be used for general analysis.

3.22
nominal top size
aperture size of the smallest sieve in the range included in the R 20 Series (as defined in ISO 565, square hole) on which not more than 5 % of the *sample* (3.31) is retained

3.23
off-line sample preparation
sample preparation (3.34) performed manually or mechanically on the *samples* (3.31) produced by the *mechanical sampling system* (3.20), using equipment not integral to the mechanical sampling system itself

3.24
on-line sample processing
processing of the primary *sample* (3.31) material using equipment integral with the sampling system

3.25
outlier
result which meets statistical criteria identifying an outlier, esp. exceeding Cochran's maximum variance test, and for which there is direct physical evidence of causation by gross deviation from the prescribed experimental procedure

3.26
physical sample
sample (3.31) taken specifically for the determination of physical characteristics, such as physical strength indices or size distribution

3.27
precision
closeness of agreement between independent test results obtained under stipulated conditions

Note 1 to entry: This is often defined using an index of precision, such as two *standard deviations* (3.37).

3.28
primary increment
increment (3.15) taken at the first stage of sampling, prior to any *sample division* (3.33) and/or *sample reduction* (3.35)

3.29
random error
error (3.10) that is statistically independent of previous errors

Note 1 to entry: This implies that any two errors in a series of random errors are uncorrelated and that individual errors are unpredictable. In consequence of the partitioning of error into systematic [*bias* (3.2)] and random components, the theoretical mean of the random errors is zero. Whereas individual errors are unpredictable, the mean of the random errors in a series of observations tends towards zero as the number of observations increases.

3.30
replicate sampling
taking at intervals of *increments* (3.15) which are combined in rotation into different containers to give two or more *samples* (3.31) of approximately equal mass

3.31
sample
quantity of *fuel* (3.13), representative of a larger mass for which the quality is to be determined

3.32
sampler
device physically collecting a sample *increment* (3.15)

Note 1 to entry: Not to be confused with personnel physically collecting an increment or operating a sampling system.

3.33
sample division
process in *sample* (3.31) preparation whereby the sample is divided into representative, separate portions

3.34
sample preparation
process of bringing *samples* (3.31) to the condition required for analysis or testing

Note 1 to entry: Sample preparation covers mixing, particle size reduction, *sample division* (3.33) and sometimes *air-drying* (3.1) of the sample and may be performed in several stages.

3.35
sample reduction
process in *sample preparation* (3.34) whereby the particle size of the *sample* (3.31) is reduced by crushing or grinding

3.36
size analysis sample
sample (3.31) taken specifically for particle size analysis

3.37
standard deviation
square root of the *variance* (3.43)

3.38
stratified random sampling
taking of an *increment* (3.15) at random within the mass interval or time interval determined for *mass-basis sampling* (3.18) or *time-basis sampling* (3.42), respectively

3.39
sub-lot
part of a *lot* (3.16) for which a test result is required

3.40
systematic sampling
taking of *increments* (3.15) at uniform mass or time intervals according to a predetermined plan

3.41
test sample
sample (3.31) which is prepared to meet the requirements of a specific test

3.42
time-basis sampling
taking of *increments* (3.15) whereby the position of each increment to be collected from the stream of *fuel* (3.13) is measured by a time interval and the increment mass is proportional to the flow rate at the time the increment is taken

3.43
variance
measure of dispersion, which is the sum of the squared deviations of observations from their average divided by one less than the number of observations

4 Structure

ISO 13909 is divided into eight parts. ISO 13909–2, ISO 13909–3 and ISO 13909–4 relate to coal only; ISO 13909–5 and ISO 13909–6 to coke only.

Basic statistical procedures and formulae which apply equally to the sampling of hard coal or coke and which underlie the decisions concerning numbers of sub-lots, increments and masses taken and information concerning the precision and bias of the sampling operation are, for the most part, found in ISO 13909–7 and ISO 13909–8.

The parts are as follows:

ISO 13909, *Hard coal and coke — Mechanical sampling*

Part 1: General introduction

Part 2: Coal — Mechanical sampling from moving streams

Part 3: Coal — Mechanical sampling from stationary lots

Part 4: Coal — Preparation of test samples

Part 5: Coke — Mechanical sampling from moving streams

Part 6: Coke — Preparation of test samples

Part 7: Methods for determining the precision of sampling, sample preparation and testing

Part 8: Methods of testing for bias

5 General principles of sampling

The purpose of taking and preparing a sample of fuel is to provide a test sample which, when analyzed, will provide test results representative of the lot sampled.

The first stage of sampling, known as primary sampling, is the taking of an adequate number of fuel portions known as primary increments from positions distributed over the entire lot. The primary increments are then combined into a sample, either as taken or after having been divided in order to reduce the mass of the sample to a manageable size. From this sample, the required number and types of test samples are prepared by a series of processes jointly known as sample preparation.

The fundamental requirements of sampling are that all parts of the fuel in the lot shall be accessible to the sampling instrument and parts of equal mass shall have an equal probability of being selected and included in the sample.

In order to ensure that the result obtained is to the required precision, the following issues are considered:

— variability of the fuel;

— number of sub-lots;

— number of increments comprising each sample;

— mass of sample relative to nominal top size.

The means of determining these variables to achieve a required precision of sampling are developed in ISO 13909-7 and in the other parts of ISO 13909, where relevant.

In devising a sampling procedure, it is also important to guard against bias in the taking of samples. Bias may arise from

a) incorrect location/timing of increments,

b) incorrect delimitation and extraction of increments, or

c) loss of integrity of the sample after extraction.

Methods for measuring bias are described in ISO 13909-8. Procedures to minimize bias are also described in the other parts of ISO 13909, where relevant.

In order to minimize the bias associated with a), b), and c) above, the preferred method of sampling is mechanical sampling from moving streams. Where this method cannot be used, other methods, for example, mechanical sampling from stationary lots, are described in ISO 13909.

6 Choice of sampling procedure

In consequence of the fundamental requirements of sampling (see Clause 5), the preferred method of mechanical sampling is from a moving stream of fuel. The alternative method, sampling from a stationary lot by mechanical auger, is also acceptable provided that it is full-depth sampling. All methods shall be shown to be unbiased. Caution should be taken with all mechanical sampling, especially augers, when size grading is required. All drop heights should be minimized for the same reason.

Manual sampling is not covered in ISO 13909. For instances where mechanical sampling cannot be achieved either from moving streams or from stationary lots by use of a mechanical auger, manual sampling is covered in ISO 18283.

Sampling of fuel may be executed using one of the following methods:

a) increments are taken from a stream of fuel falling from the discharge end (belt head) of a conveyor (i.e. falling-stream sampler);

b) increments are taken from a stream of fuel on a moving belt (i.e. cross-belt sampler);

c) increments are taken by full-depth sampling of stationary lots (i.e. mechanical auger).

The stopped-belt sampling procedure described in ISO 13909-8 is the reference method. This is because collecting increments in accordance with this method ensures that increment extraction bias is minimized. Therefore, this reference method shall be used whenever the sampling system is being tested for bias as described in ISO 13909-8. However, since stopped-belt sampling will inevitably interfere with the operation of the fuel-handling plant concerned, it is not always a practical method for routine sampling.

Methods a) and b) are the preferred routine methods of mechanical sampling.

Method b) may offer advantages, for example, where there are space restrictions in the region of the belt head or in order to limit the mass of the primary increment when sampling from high-capacity conveyor belts.

Methods a) and b) are described in ISO 13909-2 for coal and in ISO 13909-5 for coke. A method of sampling from stationary lots of coal using a mechanical auger is described in ISO 13909-3.

7 Integrated sampling systems

A mechanical sampling system consists of a combination of the primary sampler and all the integrated components of on-line processing of the primary increments. However, for convenience, ISO 13909 is divided into separate parts. ISO 13909-2 covers the collection of the primary increments. ISO 13909-4 (for coal) and ISO 13909-6 (for coke) cover both the on-line processing of the primary increments and the off-line preparation of the sample produced by the mechanical sampling system.

8 Packing and marking of samples

Samples shall be packed in non-absorbent, airtight containers and tightly sealed. All samples shall be labelled in such a way as to identify them uniquely.

It is recommended that the following information, at a minimum, be shown on the label or accompanying documents:

a) the type, grade and nominal top size of the fuel and name of the lot (identity of the ship or train etc.);

b) the method of sampling, with reference to the appropriate parts of ISO 13909 and their publication date (e.g. sampled in accordance with ISO 13909-2);

c) the approximate mass of the lot and the number of sub-lots;

d) the approximate mass of fuel represented by the sample;

e) the sample, lot and sub-lot number(s);

f) the place, date and time of sampling;

g) the place, date and time of any off-line sample preparation;

h) the name(s) of the sampling personnel;

i) final mass of sample and its nominal top size, as collected by the on-line sampling systems before any off-line sample preparation;

j) description of test sample (e.g. test sample for general-analysis, test sample for moisture, etc.);

k) weather or other conditions which might affect the result;

l) any other relevant information, (e.g. percentage loss by air-drying of the moisture sample).

9 Sampling report

A complete and final report or certificate, duly signed, stating all relevant information on the sampling, sample preparation and sample distribution, shall be issued.

Any deviation from specified methods and the reason for the deviation shall be stated in the report and so shall any anomalies observed during sampling.