

BS ISO 13909-1:2016



BSI Standards Publication

Hard coal and coke — Mechanical sampling

Part 1: General introduction

National foreword

This British Standard is the UK implementation of ISO 13909-1:2016. It supersedes BS ISO 13909-1:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PTI/16, Solid mineral fuels.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 83174 4

ICS 73.040; 75.160.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2016.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

INTERNATIONAL
STANDARD

BS ISO 13909-1:2016

ISO
13909-1

Second edition
2016-07-01

**Hard coal and coke — Mechanical
sampling —**

**Part 1:
General introduction**

*Houille et coke — Échantillonnage mécanique —
Partie 1: Introduction générale*



Reference number
ISO 13909-1:2016(E)

© ISO 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Structure	5
5 General principles of sampling	5
6 Choice of sampling procedure	6
7 Integrated sampling systems	7
8 Packing and marking of samples	7
9 Sampling report	7
Bibliography	9

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

Relevant information from the sampling report shall be attached to the sample(s) or otherwise made available to the person(s) in charge of subsequent sample preparation.

It is recommended that all the information listed in [Clause 8](#) and the following information be shown in the sampling report or certificate:

- a) title (e.g. report of sampling, sample preparation and distribution of samples);
- b) name and address of the client;
- c) type of sample and its intended uses, (e.g. common sample, moisture sample, etc.);
- d) distribution of test samples and minimum period of storage of arbitration and reserve samples.

Bibliography

- [1] ISO 14180, *Solid mineral fuels — Guidance on the sampling of coal seams*
- [2] ISO 18283, *Hard coal and coke — Manual sampling*
- [3] ISO 11648-1, *Statistical aspects of sampling from bulk materials — Part 1: General principles*
- [4] ISO 21398, *Hard coal and coke — Guidance to the inspection of mechanical sampling systems*

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email (orders): orders@bsigroup.com

Email (enquiries): cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK