INTERNATIONAL STANDARD

**ISO 18283**

Second edition
2022-03

# Coal and coke — Manual sampling

*Houille et coke — Échantillonnage manuel*

Reference number
ISO 18283:2022(E)

© ISO 2022



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland



© ISO 2022 – All rights reserved

# Contents

Page

**Foreword** ..... **v**
**Introduction** ..... **vii**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms and definitions** ..... **1**
**4 Establishing a sampling scheme** ..... **4**
4.1 General ..... 4
4.1.1 Sampling ..... 4
4.1.2 Sampling scheme ..... 5
4.1.3 Parameters ..... 5
4.1.4 Sampling methods ..... 5
4.2 Design of the sampling scheme ..... 6
4.2.1 General ..... 6
4.2.2 Coal or coke to be sampled and considerations for sampling ..... 6
4.2.3 Division of lots ..... 6
4.2.4 Precision of results ..... 7
4.2.5 Bias of results ..... 7
4.2.6 Requirements for test samples ..... 7
4.3 Precision of sampling ..... 8
4.3.1 General ..... 8
4.3.2 Precision and total variance ..... 8
4.3.3 Primary increment variance ..... 9
4.3.4 Sub-lot variance ..... 10
4.3.5 Preparation and testing variance ..... 10
4.3.6 Number of sub-lots and number of increments per sub-lot ..... 11
4.3.7 Minimum mass of samples for general analysis and determination of total moisture content ..... 12
4.4 Checking the overall precision for the lot by calculation and selection of sampling scheme ..... 15
4.5 Determination of acquired precision by replicate sampling ..... 15
4.5.1 General ..... 15
4.5.2 Method and calculation ..... 15
4.5.3 Precision obtained using normal sampling scheme ..... 16
4.6 Size analysis ..... 16
**5 Methods of sampling** ..... **17**
5.1 General ..... 17
5.2 Sampling by time interval (time-basis sampling) ..... 17
5.3 Sampling by mass interval (mass-basis sampling) ..... 18
5.4 Stratified random sampling ..... 18
5.4.1 General ..... 18
5.4.2 Stratified random sampling by time interval ..... 18
5.4.3 Stratified random sampling by mass interval ..... 18
5.5 Extracting the increment ..... 18
5.6 Coal or coke in motion ..... 19
5.6.1 General ..... 19
5.6.2 Stopped belt ..... 19
5.6.3 Falling stream ..... 20
5.6.4 Moving belt ..... 20
5.6.5 Stockpiles (building/reclaiming) ..... 21
5.6.6 Grabs/front-end loaders ..... 21
5.6.7 Barges/trucks/railcars/wagons (loading/unloading) ..... 22
5.7 Moisture/common sample ..... 22

© ISO 2022 – All rights reserved

5.8 Different coals or cokes ... 23
5.9 Random selection of increments ... 23

**6 Sampling equipment ... 24**
6.1 General ... 24
6.2 Examples ... 25
6.2.1 Ladles ... 25
6.2.2 Shovels ... 25
6.2.3 Scoops ... 25
6.2.4 Probes ... 25
6.2.5 Manual cutter ... 26
6.2.6 Stopped-belt sampling frame ... 26

**7 Handling and storage of samples ... 28**
7.1 Sample size ... 28
7.2 Time ... 28
7.3 Divided sample ... 29
7.4 Containers ... 29
7.5 Moisture loss/breakage or degradation ... 30
7.6 Identification/labelling ... 31

**8 Sample preparation ... 31**
8.1 General ... 31
8.2 Constitution of a sample ... 31
8.3 Division ... 32
8.3.1 General ... 32
8.3.2 Mechanical methods ... 33
8.3.3 Manual methods ... 36
8.4 Reduction ... 40
8.4.1 General ... 40
8.4.2 Reduction mills ... 40
8.5 Mixing ... 41
8.6 Air-drying of coal ... 41
8.7 Coal — Preparation of test samples ... 42
8.7.1 Types of test samples ... 42
8.7.2 Preparation of samples for determination of total moisture content ... 42
8.7.3 Preparation of samples for general analysis ... 43
8.7.4 Common samples ... 45
8.7.5 Preparation of size-analysis sample ... 47
8.7.6 Preparation of samples for other tests ... 48
8.7.7 Reserve sample ... 49
8.8 Coke — Preparation of test samples ... 49
8.8.1 Types of test samples ... 49
8.8.2 Preparation of coke samples for determination of total moisture content ... 50
8.8.3 Preparation of samples for general analysis ... 52
8.8.4 Storage ... 53
8.8.5 Physical test sample ... 53
8.8.6 Samples for special properties ... 53
8.8.7 Reserve sample ... 53

**9 Packing and marking of samples ... 53**

**10 Sampling report ... 54**

**Annex A** (informative) **Example of calculation of precision, mass of increments,number of sub-lots and number of increments per sub-lot ... 55**

**Annex B** (informative) **Methods of sampling coal and coke from stationary lots ... 58**

**Bibliography ... 60**


© ISO 2022 – All rights reserved

# 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 27, *Coal and Coke*, Subcommittee SC 4, *Sampling*.

This second edition cancels and replaces the first edition (ISO 18283:2006), which has been technically revised. It also incorporates the Technical Corrigendum ISO 18283:2006/Cor.1:2006.

The main changes are as follows:

— Removal of any reference to intermittent sampling. Only continuous sampling is permitted.

— Discussion of the need to eliminate bias prior to discussing precision.

— Deletion of the separate tables on calculated numbers of increments.

— Deletion of the table on reference increment mass.

— Separation of tables for minimum sample masses for coal and coke.

— Removal of the table for reduced minimum sample mass for large sizes of coal and coke.

— Inclusion of manual sampling from a moving conveyor, provided a risk assessment is conducted at the outset and that this type of sampling is only permitted on a slow-moving belt or at low flow rates. Furthermore, at higher flow rates, mechanical assistance is necessary to ensure that primary increments can be collected safely.

— Restriction of the type of probes that can be used.

— Deletion of augers for manual sampling.

— Inclusion of a photograph of a gated riffle.

— Exclusion of sampling of large fuels in excess of the nominal top sizes in Tables 1, 2 and 4, because it is not practical.

© ISO 2022 – All rights reserved

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.


© ISO 2022 – All rights reserved

# Introduction

Mechanical sampling from moving streams is the preferred method for sampling coal and coke. However, often mechanical facilities are not available. Moreover, for sized coal or coke, mechanical sampling may be a problem because of (size) degradation by the sampling system.

The fundamental requirements of sampling are that all particles of the coal or coke in the lot are accessible to the sampling instrument and thus have a non-zero chance of being selected, and that each individual particle of equal mass has an equal probability of being selected and included in the sample.

When sampling manually, conditions are often far from ideal. The methods described in this document are intended to obtain the most representative sample that can be safely achieved. Manual sampling should only be applied if no possibility for mechanical sampling exists.

The purpose of taking and preparing a sample of coal or coke is to provide a test sample that, when analysed, provides test results representative of the lot or sub-lot sampled.

The first stage of sampling, known as primary sampling, is the taking from positions distributed over the entire lot of an adequate number of coal or coke portions known as primary increments. The primary increments are then combined into a sample. From this sample, the required number and types of test samples are prepared by a series of processes jointly known as sample preparation.

In devising a sampling procedure, it is also essential to guard against bias in the taking of increments. Bias can arise from:

a) incorrect location/timing of increments,

b) incorrect delimitation and extraction of increments,

c) particle size segregation at the point of sampling,

d) loss of integrity of increments after extraction.

Methods for measuring bias are described in ISO 13909-8.

© ISO 2022 – All rights reserved

# Coal and coke — Manual sampling

**WARNING — This document can involve hazardous materials, operations and equipment, and does not purport to address all the safety issues associated with its use. It is the responsibility of the user of this document to establish appropriate health and safety practices.**

## 1 Scope

This document provides the basic terms used in manual sampling of coal and coke and describes the general principles of sampling. It provides procedures and requirements for establishing a manual sampling scheme, methods of manual sampling, sampling equipment, handling and storage of samples, sample preparation and a sampling report, and applies to manual sampling during the transfer of coal or coke. Guidelines for manual sampling in stationary situations are given in Annex B, but this method of sampling does not provide a representative test sample and the sampling report shall state this.

This document covers sampling of brown coals and lignites, but does not include sampling from coal seams, for which guidance is given in ISO 14180. Mechanical sampling of coal and coke is covered in ISO 13909.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 579, *Coke — Determination of total moisture*

ISO 589, *Hard coal — Determination of total moisture*

ISO 687, *Solid mineral fuels — Coke — Determination of moisture in the general analysis test sample*

ISO 13909-8, *Hard coal and coke — Mechanical sampling — Part 8: Methods of testing for bias*

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**air-drying**
process of bringing the moisture content of the sample 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.

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

© ISO 2022 – All rights reserved

**3.3**
**common sample**
sample collected for more than one intended use

**3.4**
**continuous sampling**
taking of a sample from every consecutive *sub-lot* (3.30) so that *increments* (3.10) are taken at uniform intervals over the entire *lot* (3.11) being handled

**3.5**
**cut**
see *increment* (3.10)

**3.6**
**divided increment**
part obtained from the division of the *increment* (3.10) in order to decrease its mass

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

**3.7**
**fixed-mass division**
method of sample division in which the mass retained is predetermined and independent of the mass of the feed

**3.8**
**fixed-ratio division**
method of sample division in which the division ratio is predetermined, i.e. the mass of sample retained is a fixed proportion of the mass of the feed

**3.9**
**general analysis test sample**
sample prepared to pass a sieve of nominal size of openings of 212 µm used for the determination of most chemical and some physical characteristics

**3.10**
**increment**
portion of coal or coke extracted in a single operation of the sampling device

Note 1 to entry: Cut is an equivalent term.

**3.11**
**lot**
defined quantity of coal or coke for which the quality is to be determined

Note 1 to entry: A lot can be divided into sub-lots.

**3.12**
**manual sampling**
extraction of *increments* (3.10) by human effort

**3.13**
**mass-basis sampling**
taking of *increments* (3.10) whereby the position of each *increment* (3.10) to be extracted from the stream of coal or coke is measured by a mass interval of stream flow and the *increment* (3.10) mass is fixed

**3.14**
**mechanical sampling**
extraction of *increments* (3.10) by mechanical means


© ISO 2022 – All rights reserved

**3.15**
**moisture sample**
sample taken specifically for the purpose of determining total moisture

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

**3.16**
**nominal top size**
aperture size of the smallest sieve in the range included in the R 20 Series on which not more than 5 % of the mass of the sample is retained

Note 1 to entry: See ISO 565, square hole.

**3.17**
**physical sample**
sample taken specifically for the determination of physical characteristics, e.g. physical strength indices or size distribution

**3.18**
**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 2 standard deviations.

Note 2 to entry: A determination might be made with great precision and the standard deviation of a number of determinations on the same sub-lot might, therefore, be low; but such results are accurate only if they are free from bias.

**3.19**
**primary increment**
*increment* (3.10) extracted at the first stage of sampling, prior to any sample division and/or sample reduction

**3.20**
**random sampling**
extracting of *increments* (3.10) at random mass or time intervals

**3.21**
**replicate sampling**
extracting, at intervals, of *increments* (3.10) that are combined in rotation into different containers to give two or more samples of approximately equal mass

**3.22**
**representative sample**
sample collected in such a manner that the analyses, size distribution and moisture content represent that of the *lot* (3.11)

**3.23**
**sample**
quantity of coal or coke, representative of a larger mass for which the quality is to be determined

**3.24**
**sample division**
process in sample preparation whereby the sample is divided into representative, separate portions

**3.25**
**sample preparation**
process of bringing samples to the condition required for analysis or testing

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

© ISO 2022 – All rights reserved

**3.26**
**sample reduction**
process in sample preparation whereby the particle size of the sample is reduced by crushing or grinding

**3.27**
**size analysis sample**
sample taken specifically for particle size analysis

**3.28**
**standard deviation**
square root of the variance

**3.29**
**stratified random sampling**
extracting of an increment at random within the mass interval or time interval determined for mass-basis sampling or time-basis sampling respectively

**3.30**
**sub-lot**
part of a *lot* (3.11) for which a test result is required

**3.31**
**systematic sampling**
extracting of *increments* (3.11) at uniform time intervals according to a predetermined plan

**3.32**
**test sample**
sample which is prepared to meet the requirements of a specific test

**3.33**
**time-basis sampling**
extracting of increments whereby the position of each increment to be collected from the stream of coal or coke is measured by a time interval and the increment mass is proportional to the flow rate at the time the increment is taken

**3.34**
**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 Establishing a sampling scheme

## 4.1 General

### 4.1.1 Sampling

Mechanical sampling of coal and coke in accordance with ISO 13909-2, ISO 13909-3 and ISO 13909-5 is the preferred method. However, where this is not possible, manual sampling may be conducted. The recommended method for manual sampling of coal and coke is while it is being transferred, e.g. loading or unloading of ships, barges, wagons, rail cars and trucks, transferring coal or coke using fixed/moveable conveyors and/or stackers, or during the formation of or reclaiming from stockpiles. For safety and practical reasons, manual sampling of coal or coke being transferred is sometimes not possible.

NOTE Manual sampling in stationary situations (see Annex B) refers to static lots, where no formation of or reclaiming from piles/heaps takes place.


© ISO 2022 – All rights reserved