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Coal — Guidance on the sampling of coal seams

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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~~document 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-](http://www.iso.org/directives-)).

~~Attention is drawn~~ISO draws attention to the possibility that ~~some of the elements~~implementation of this document may ~~be involve~~ the ~~subject~~use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. 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.~~

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 ~~the following URL~~.

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

This third edition cancels and replaces the second edition (ISO 14180:2017), of which it constitutes a minor revision. The changes are as follows:

- 3.7 revised, with note to entry added;
- notes in 4.1 and 4.4.2 changed to body text;
- new subclause 4.4.4 added;
- editorial changes in accordance with the latest version of the ISO/IEC Directives Part 2.

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.

Introduction

Coal is one of the most challenging materials to sample due to its characteristic heterogeneity. A coal seam can consist of a single stratum of one lithotype of relatively uniform maceral constitution, or, more commonly, ~~consist of~~ a number of layers of different coal lithotypes varying in thickness and lateral extent. The seam can also contain discrete layers of inorganic sediments or carbonaceous shales of varying thickness. Veins of concordant or discordant secondary mineral rock ~~could~~ also be present. The lithotype layers can vary considerably in hardness, texture and structure according to the nature of the coal and inorganic sediments. The inorganic layers can also thicken laterally, splitting the seam into two or more separate units, which ~~could~~ require multiple samples.

It is strongly recommended that a collaborative team, including geologists, mining engineers, safety, land and laboratory professionals ~~review, reviews~~ each proposed sampling ~~program~~ ~~programme~~ to help ensure optimal effectiveness and efficiency are obtained.

The purpose of sampling coal for any resource evaluation is to predict the expected quality of the produced coal from a given locale. Therefore, the fundamental goal of each sampling effort is the collection of representative samples of the seam(s) at each sampling location. A properly executed sampling ~~program~~ ~~programme~~ needs to accurately define both the lateral variation in coal quality and the average quality for a specified area.

After inspection of any seam, the sampler ~~designes~~ ~~designs~~ a sampling ~~program~~ ~~programme~~ with sufficient representative samples to define the range of expected coal quality. In variable seams it is necessary to take a number of samples to improve the representativity of sampling.

In operating mines, the manager needs to be consulted and approval needs to be obtained before sampling sites are selected and sampling proceeds. Where there is no operating mine, the area or tenement owner and/or operator is consulted.

In all sampling situations, experienced and qualified personnel will be required for supervision and to ensure that accurate records are made of location, thickness and lithotype descriptions and that all safety precautions have been addressed.

Methods of sampling for physical, chemical, petrographic or utilization properties are described for the following:

- a) ~~a)~~ sampling from small and large diameter drill cores;
- b) ~~b)~~ sampling from exposed seam faces;
- c) ~~c)~~ sampling from trial open-cut excavations;
- d) ~~d)~~ sampling from underground workings.

Coal — Guidance on the sampling of coal seams

SAFETY PRECAUTIONS — It is strongly recommended that a risk analysis of the sampling exercise be undertaken by an experienced safety officer before work begins.

1 Scope

This document provides guidance on methods for taking samples from coal seams in the ground, whether from exploration areas or tenements, or from operating underground or open-cut mines. The following methods are described:

- a) ~~a)~~ sampling of small- or large-diameter holes;
- b) ~~b)~~ drill cuttings sampling;
- c) ~~c)~~ open-cut slot sampling;
- d) ~~d)~~ adit, drift or shaft sampling;
- e) ~~e)~~ pillar sampling;
- f) ~~f)~~ channel sampling;
- g) ~~g)~~ strip sampling.

This document does not apply to sampling from moving streams in production or any other source of coal that is not in situ.

Recommendations are made for selection and preparation of the sampling site, and methods are described for taking both small and bulk samples, and for preparing the samples for transport.

NOTE ~~Annex A~~ gives an example of a channel sample record form that can be used to record sampling and other relevant data, and ISO 13909 ~~or~~ and ISO 18283 ~~describes~~ describe how to determine the mass of a representative sample at various nominal top sizes.

2 Normative reference

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 1213-2, *Solid mineral fuels — Vocabulary — Part 2: Terms relating to sampling, testing and analysis*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1213-2 and the following apply.

ISO and IEC maintain ~~terminological~~ terminology 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

bulk sample

sample of large mass, taken in a particular operation for a specific reason, such as for pilot washing, coal preparation or combustion tests

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Note 1 to entry: It is not possible to define the minimum size of a bulk sample.

3.2

channel sample

sample of the coal and associated inorganic material taken by removing a vertical channel of even cross-section from the seam

Note 1 to entry: Where the full section of the seam is not accessible or not required, this term can refer to a sample taken either from a specifically defined portion of the seam, or from the floor to roof as mined or exposed.

3.3

coal seam

stratum or sequence of strata composed of coal as a significant component and significantly different in lithology to the strata above and below it

Note 1 to entry: It is laterally persistent over a significant area, and it will be of sufficient thickness and persistence to warrant mapping or description as an individual unit.

3.4

core sample

cylindrical sample of the whole or part of a coal seam obtained by drilling using a coring barrel

Note 1 to entry: The diameter of the core can vary from 50 mm to 2 000 mm depending on the reason for which the sample is required. However, 50 mm to 200 mm is the most common core diameter range.

3.5

cuttings sample

sample of coal chips produced from the rotary drilling of a coal seam using a non-coring bit, such as a blade bit or roller bit

3.6

pillar sample

section of a seam taken in the form of a block, or series of blocks, of coal with associated inorganic rock which, when arranged in correct vertical sequence, represent a true section of the seam

Note 1 to entry: Where the full section of the seam is not accessible or not required, this term can refer to a sample taken either from a specifically defined portion of the seam, or from the floor to roof as mined or exposed.

3.7

ply

layer of coal seam normally differing in properties from adjacent layers. ~~Any distinctive layer maybe regarded as a ply~~

Note 1 to entry: Any distinctive layer can be regarded as a ply.

3.8

ply sample

sample taken from an individual ply or leaf or from a series of plies or leaves of a coal seam

3.9

strip sample

sample like a channel sample but smaller in cross-section

Note 1 to entry: A single strip sample can often be regarded as being too small to guarantee that all horizons of the seam are adequately represented. However, several such samples can be taken to achieve better representativity in a variable seam.

4 Selection of sampling site

4.1 Initial considerations

Sampling sites, where possible, are chosen at random when no other information regarding the tenement or exploration site is available. The site for sampling apart from drill holes should be chosen, as far as possible, to avoid cracks and breaks, random lenses of rock or mineral matter, or other abnormalities or irregularities in the face to be sampled. However, on occasion, the purpose ~~may~~ can be to sample a particular mode of development of the seam section, in which case the sample should be taken at the best available site exhibiting this feature. The location of the sampling point should be recorded accurately (see ~~Clause 5~~ Clause 5).

Core sampling is usually employed for sampling coal seams that are not exposed in outcrop or by mining. It is especially useful in areas which are not readily accessible as drill rigs are small enough to be located by helicopter. Sometimes, however, this method is used even though exposed faces are available. This is because it is often faster, less labour-intensive, safer and more representative than pillar or strip sampling, especially if a suitable drilling rig is readily available. For example, many open-cut mines take cores of the seam to be uncovered in the next mining strip to obtain coal quality data for mine planning purposes. Coring of the uncovered coal seam by a drilling rig sitting directly on top of the coal is also common practice where detailed coal quality parameters need to be known for blending purposes or for specific cargoes where the customer ~~may be~~ is particularly sensitive to certain coal properties or inorganic impurities.

Cores can be obtained routinely in diameters ranging from 50 mm to 200 mm, depending on the amount of material required for testing. It is generally advisable that, for routine sampling operations, 100 mm cores be taken, as this size provides a good compromise between representativity and cost.

NOTE—There are risks in comparing data from different core sizes of the same coal. The determined yield values and analysis for washing coals can vary significantly. When this occurs, it is recommended that the results be confirmed by very large cores as described ~~above~~ previously.

4.2 Sampling procedures

No two projects are exactly the same and may have different requirements regarding sampling, such as when and what should be sampled, how the sampling should be done, and the details of how the samples should be numbered or identified, wrapped, recorded, stored and treated.

There are several rules related to sampling that should be noted:

- a) ~~a)~~ **Prepare well.** Even if there is little expectation of finding anything of commercial significance, the sampler should always be prepared and in a position to take samples if the opportunity presents. Always have a selection of sample bags, bottles, or other containers on hand, in case they are needed.
- b) ~~b)~~ **Ask questions.** Before embarking on a new project, the sampler should discuss the sampling requirements with the ~~Exploration Geologist~~ exploration geologist and/or ~~Manager~~ manager, so it is clear exactly what is required.
- c) ~~c)~~ **If in doubt, take samples rather than not.** Samples that are excess or surplus to ~~requirement~~ requirements can always be disposed of later, but if samples are not taken when the opportunity is available, then the chance to do so may be lost completely. Take more samples than you may think are needed and divide if uncertain about coal ply boundaries. These can always be recombined in the laboratory following geophysical reconciliation.
- d) ~~d)~~ **Do not put off until tomorrow what you can do today.** For example, if it is late in the day but the project requires that ~~4 m~~ 1 m increment soil samples should be collected from the first 10 m of the cuttings of an exploration chip borehole, do not leave the cuttings overnight with the intention of

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collecting the samples the next morning. Do not take the risk that samples ~~could be~~ lost, contaminated, or have their integrity compromised.

- e) ~~e)~~ Care should also be taken to prevent contamination by out-of-seam materials, or other sources, such as drilling fluid. In all cases, but particularly for lower rank coals, it is imperative that the sample be promptly packed in its container to minimize loss of moisture and be transported to the laboratory as soon as practicable.
- f) ~~f)~~ Before sampling an exposed face, the section to be sampled should, as far as practicable, be uniformly dressed and squared up, and any loose, overhanging, or protruding pieces of coal or rock should be removed. Where a face is weathered, the immediate surface material should be removed to a depth sufficient to eliminate weathering effects. In the case of underground face sampling, contamination by stone dust is to be avoided, as this will influence the analysis.
- g) ~~g)~~ The coal sample after logging and identification should be kept in a sealed bag or container.
- h) ~~h)~~ If the laboratory cannot begin analysis immediately, arrangements should be made to keep the sample in cold or cool storage to prevent oxidation of the coal. Any coal not being analysed should be returned to cold or cool storage until it is required.
- i) ~~i)~~ It is critical that sample information is recorded carefully, thoroughly, and accurately. There is no value in having a sample that cannot be identified or being ~~able~~ unable to determine where ~~it a~~ sample came from, or why it was sampled.
- j) ~~j)~~ It is essential that all samples are analysed using rigid quality assurance and quality control procedures. Examples such as duplicate samples, round robins between laboratories, standard samples, and laboratory certification to ISO/IEC 17025 are recommended in this document.

4.3 Core sampling¹

4.3.1 Purpose of coal sampling

Core drilling is used to obtain representative samples for geotechnical, coal quality and gas content and other testing to provide as much information from a borehole as possible. A well-drilled and recovered core enables precise detail to be recorded on the thickness and brightness of coal bands and the presence of any inter-bedded rock types, such as mudstone, siltstone, or tuffaceous material, within a coal seam. It also enables the weathered state of the coal to be identified. The combination of detailed lithology logs with coal quality determinations and other test results, supports the determination of working sections and mining methods, coal handling procedures and products.

4.3.2 Core drilling and sampling procedures

The drilling and sampling of core is an expensive and time-consuming process. The information available from logging and testing of core contributes significantly to critical decisions about the quantity and quality of the resource and the potential mining conditions. Cores should be highly valued and treated with appropriate care. Tasks when coring include the following:

- a) ~~a) communicate~~ Communicate with the driller about the length of the core run, the depth of the borehole, and the condition of the core.
- b) ~~b) carefully~~ Carefully transfer core from driller's splits to PVC splits for logging.
- c) ~~c) clean~~ Clean drilling mud and cuttings from core surface with as little water and disturbance as possible.

¹ Much of 4.3 is taken from Reference [7], used with permission.