INTERNATIONAL STANDARD

ISO 21398

Second edition
2019-10

Hard coal and coke — Guidance to the inspection of mechanical sampling systems

Houille et coke — Lignes directrices pour l'inspection des systèmes d'échantillonnage mécanique

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Reference number
ISO 21398:2019(E)

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Published in Switzerland

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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).

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This document was prepared by Technical Committee ISO/TC 27, *Solid mineral fuels*, Subcommittee SC 4, *Sampling*.

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This second edition cancels and replaces the first edition (ISO 21398:2007), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— the normative references have been updated and the dates removed;

— the references in Clause 5 have been updated;

— Bibliographic references have been updated.

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.

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Introduction

The objective of this document is to provide users of new and existing mechanical sampling systems for minerals with guidance on their operation and inspection.

An 'informative' annex is for information and guidance only.

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Hard coal and coke — Guidance to the inspection of mechanical sampling systems

1 Scope

This document sets out recommended practices for the inspection of mechanical sampling systems. It serves as a guide for conformance with applicable ISO/TC 27 standards.

This document covers general considerations including precision, mineral variability and bias, establishment of inspection systems and inspection procedure.

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 13909 (all parts), *Hard coal and coke — Mechanical sampling*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13909-1 and the following apply.

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

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

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

3.1
audit
<external> critical review of a mechanical sampling system, which measures its conformance with stipulated operating specifications, undertaken by a suitably qualified independent person who is not directly involved in the management of that system

3.2
audit
<internal> critical inspection and review of a mechanical sampling system, which measures its conformance with stipulated operation specifications, undertaken by a suitably qualified person who is not a day-to-day operator of that particular system

3.3
operational inspection
observations and inspections of operation conditions undertaken by the operator during sampling of a lot

Note 1 to entry: The operator is the person responsible for monitoring the sampling system on a shift-to-shift basis.

4 Safety

This document does not purport to address safety issues that can be associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices in line with site safety regulations and relevant Occupational Health and Safety Acts. It is highly recommended that the auditor or inspector start by conducting a careful review of all safety rules and procedures regarding the sampling system to be inspected.

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5 General considerations

5.1 Precision

Precision tests are recommended for each coal or coke type used in the system. If there is a significant change in a coal or coke type or a new coal or coke type introduced, then a precision test should be carried out. These tests should be in accordance with ISO 13909-7. The Manager or Supervisor should maintain a record of the precision of sampling, preparation and analysis of each type of coal and coke sampled with the system.

5.2 Bias

It is recommended that, after commissioning and auditing of a new system or any major engineering modifications of an existing system, a bias test be carried out to confirm the system. It is recommended that the system be verified in accordance with ISO 13909 (all parts) procedures. Reference is made to ISO 13909-2, and ISO 13909-5, where bias tests may be mandatory under certain conditions. When choosing a coal or coke type for bias testing, refer to ISO 13909-8. It is recommended that further bias sample pairs be taken on a regular basis to confirm that the initial bias result is still relevant. If a significant change is made to the sampling system, or a new mineral having more difficult sampling characteristics is introduced, a new bias test should be considered.

5.3 Operation of sampling system

The mechanical plant system should be started some time in advance of the start of conveying the coal or coke so that any foreign substances (including water) are purged. Where hydraulic drives are used, sufficient time should be allowed for the hydraulic oil and the associated system to attain temperature equilibrium. It is recommended, particularly in multi-coal or coke sampling systems, that one primary cut be allowed to pass through the mechanical system as a conditioner before actual sampling commences.

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It is recommended that the operator review any sampling records for the plant maintained by the previous operator. These records should include quantities of coal or coke handled and sampled, and notations as to system malfunctions, stoppages, blockages or other deficiencies. The operator should use a suitable checklist, such as the example given in Annex A. It is recommended that the operator complete all items on a suitable checklist designed for the system. For large, multi-user systems, an operators' inspection report, such as the example in given Annex B, should be developed.

Sufficient suitably designed inspection points should be available to observe that the falling-stream and cross-belt cutters cut the full stream of coal or coke and that cutter apertures can be inspected for blockages and blinding.

6 Establishment of inspection system

6.1 General

6.1.1 To ensure reliable operation, it is recommended that a sampling checklist (see Annex B) and operators' sampling record (see Annex C) be developed with input from the following sources:

a) original design criteria;

b) sampling equipment operating and maintenance manuals;

c) management responsible for the system;

d) personnel operating or maintaining the system;

e) for a new system, the designers and commissioning personnel;

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f) relevant International Standards where applicable;

6.1.2 The general method for establishing these procedures is as follows:

a) Reference should be made to ISO 13909-2 and ISO 13909-5 to ascertain the correct sampling scheme.

b) Reference should be made to the equipment supplier's operating and maintenance manual to ascertain correct procedures for operation and intervals for routine maintenance. The manuals can provide useful information based on the system design. Such information as conveyor rates, conveyor speeds, material parameters (particularly sizing and variability) are significant data and should always be kept in mind when any changes are contemplated.

c) Existing sampling and maintenance records for an extended period should be examined. This information provides guidance for operators to ensure that the required level of inspection and maintenance is carried out to ensure reliable operation and possibly to alert operators to any inappropriate maintenance or modifications that can have been made to the equipment.

d) Personal experience of maintenance, operational and sampling personnel should be sought with respect to the sampling system. This information, together with that obtained from items b) and c), enable appropriate operators' manual, operators' sampling record and system checklist to be prepared.

6.2 Audit — External

A scheme for regular audits of the sampling system should be established. Reference should be made to the original operating parameters and equipment supplier's design data establish conformance with the currently applicable International Standards.

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NOTE Annex B provides a typical reference list.

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It is recommended that correct operation of all new systems be confirmed by an audit following the commissioning stage before being accepted as operational. Also, the design and operation of the system should be confirmed by an audit prior to any bias test.

6.3 Audit — Internal

It is recommended that a scheme for routine inspections of the sampling system by operators should be established. The frequency and detail of inspections is determined by such factors as, but not limited to, reliability of the system, handling characteristics of the sampled material and frequency of use of the system and purpose of sampling (e.g. process control compared to large multi-user port facilities).

6.4 Operational inspections

It is recommended that operational procedures and inspections should be established and carried out immediately before, during and immediately after operation of the sampling system for a given lot or sub-lot. These procedures and inspections are less extensive than those undertaken as audits or mechanical inspections as given in 7.2 and 7.3. They should be designed to be simple inspections of the integrity of the sampling process. For large, multi-user facilities, it is recommended that a system of operational reports, as per the example in Annex B, be developed.

7 Procedures

7.1 Audit — External

When assessing the conformance of a mechanical sampling system, an auditor should refer to Annexes A and B, the relevant parts of ISO 13909-2 and ISO 13909-5, and the design flow chart of the system being evaluated. It is recommended that a person who is not directly involved in the operation and management of that sampling system carry out an audit at least once per year.

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It is recommended that reference be made to the original operational parameters upon which the sampling system was designed. Operational conditions such as conveyor capacity, belt speed or material top size may have been altered without due regard to the impact on the operation and conformity of the sampling system.

The following are common examples of such alterations and their potential consequences.

— An increase in the capacity of a conveyor may result in excessive primary increment mass that can no longer be entirely contained by the primary sample cutter.

— A change in conveyor speed may affect the trajectory of material at a transfer point, which may result in a part of the material stream being missed by the sample cutter.

— A change in nominal top size of the coal or coke may result in the original cutter aperture no longer being large enough (i.e. three times nominal top size of the mineral) to conform to the relevant parts of ISO 13909.

Items that should be covered as a minimum are as follows:

a) safety requirements of site;

b) original and current operating parameters;

c) selection of appropriate sampling procedure;

d) general condition of the equipment, including build-up of material or blockages in chutes, cutters and sample loss or sample contamination. Attention should be paid to wear items or corrosion that can lead to moisture loss from air flow through the sampling system;

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e) confirmation and comparison of design and actual increment masses for all cutters at several flow rates on the product belt, up to the maximum;

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f) condition of cutters, cutter apertures and cutter lips. Check for foreign material such as wood, rags, stones and material that can be blinding the cutter apertures;

g) conformity to the relevant parts of ISO 13909. The following information should be referenced:

  1) minimizing bias;

  2) correct design and operation of sample cutters;

  3) number of primary increments per lot or sub-lot required;

  4) methods of taking primary, secondary or tertiary increments and the division of increments and/or gross samples;

h) crusher inspection (inspect hammers or rolls and screens for wear and blinding);

i) determination of the top size of feed and crusher product;

j) staff training and procedures manual assessment;

k) check of previous mechanical inspections and operational inspections.

7.2 Audit — Internal

It is recommended that an experienced inspector should start at the primary cutter and follow through the system to the final on-line sample collection point. The mechanical inspection should be made both with and without coal or coke running through the system. Mechanical inspections should be carried out at more frequent intervals than audits. For systems in daily use, it is recommended that the management of the sampling system and not the direct operators of the system carry out mechanical inspections at least once per month.

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The following items should be inspected:

a) falling-stream and/or cross-belt cutter apertures, to determine that they comply with the requirements of the relevant parts of ISO 13909 and with the design flow chart of the system;

b) speed in both directions of all cutters. For time-based sampling check that the speed is constant; for mass-based sampling check that the speed is proportional to the flow rate to ensure that the mass of increment is constant;

c) movement of all cutters to verify uniform speed while in the material stream;

d) that all cutters take a complete cross-section of material flow;

e) for all cutters, that the proper number of increments is taken to satisfy the requirements of ISO 13909-2 and ISO 13909-5. It should also be verified that the time or mass interval between primary cuts is correct to assure that the minimum number of increments is collected for the lot of material being sampled during the inspection, based on maximum attainable feed rates;

f) that all cutters are parked out of the material stream in the at-rest position and that no coal or coke is entering the cutter opening. There should be no holes in the baffle plates, dust doors or seals that may cause leaking of material into the primary sample hopper. In the case of slotted-belt cutters, checks should be undertaken to confirm the aperture size, cutter lips and belt speed;

g) masses of the sample increments for falling-stream and/or cross-belt cutters should confirm that they conform to ISO 13909-2 and ISO 13909-5;

h) that the cycle time for all cutters, including dividers, should not be evenly divisible into the cycle time of the previous division stage;

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i) that belt feeders (sample conveyors) and vibrating feeders are in good condition. This is especially important for sample integrity. The correct tracking of belts, condition of belts, skirt rubbers and belt scrapers may have a significant impact on sample integrity. Check that the belt scrapers and skirts are adjusted properly to avoid spillages. Check the flow rate settings of vibrating belt feeders;

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j) the general condition of the crusher and the nominal top size of the crushed product. Variations in product size over time may indicate that maintenance is required to screens, hammers in hammer-mill crushers and rolls and gaps in roll crushers. Check that the crusher body and chutes are not spilling material from the system;

k) final sample collector to determine general condition. Checks should be undertaken to ensure that sample integrity is not being compromised through contamination, sample loss or total moisture loss;

l) records of previous operations and inspections.

7.3 Operational inspections

Operational inspections should be carried out immediately prior to, during and immediately after each sampling operation. This falls due at changes of shift or material type, or for each lot. The emphasis of operational inspections should be on ensuring that the sampling system is operated at correct settings and that reliable operation is achieved during the sampling period. It is recommended that the direct operators of the system carry out operational inspections. The following points should be checked and reported:

a) that operational settings are correct, considering lot size, sub-lot size, time- or mass-based sampling, number of primary, secondary and tertiary increments, division ratios and sample collection interval;

b) that all equipment and sample chutes are clear of coal and coke build-up or blockages. Evidence of chute damage due to damage to external walls or scraping should be recorded;

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c) that all equipment and sample chutes are clear of foreign material such as wood, paper, rags, stones or metal;

d) that all drives have been checked for correct operation, with attention paid to smooth operation of sample cutter drives. Any unusual noises or vibrations should be reported;

e) that all drives, including hydraulic systems, have been started well before sampling is required. Hydraulic systems may require a period of time to attain temperature equilibrium;

f) that the sampling system has been "conditioned" by passing one or more primary increments through the sampling system before commencing or recommencing sampling. Any sample collected during conditioning should be discarded;

g) that control charts have been maintained in accordance with Clause 8. This may provide evidence of restricted flow through the system, if this occurs. An example of this may be found in Annex C.

8 Quality control

8.1 General

In addition to the operators' sampling record, it is recommended that control charts also are maintained. Two types of control charts are recommended, viz. for sampling ratio and extraction ratio.

8.2 Sampling ratio

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The sampling ratio control chart is a plot of sampling ratio as a function of units sampled, where the sampling ratio, F_{SR}, is defined by Formula (1):

$$F_{SR} = \frac{m_1}{m_2} \times 1\,000 \qquad (1)$$

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where

m_1 is the mass of the sample, expressed in kilograms;

m_2 is the mass of the material that the sample represents, expressed in tonnes.

Sampling ratio comparisons should be made only for like system settings (same cutter apertures, timer settings, sub-lot size and mass flow rate through the system). Thus, a separate control chart is required for each set of system settings used.

Samples having a sampling ratio out of the control range are suspect and should be investigated for validity. When there is a significant variation in the sampling ratio, the reasons for this should be investigated.

A detailed description of how to use control charts to monitor sampling ratios is provided in Annex A. An example of sampling ratio charting is provided in Figure 1 and Table 1.

An example of an inspection summary and the associated sampling ratio control chart is shown in Table 1 and Figure 1, respectively.

8.3 Coefficient of variation

After the sampling ratio is shown to be under control, it is good practice to monitor the percent coefficient of variance (% CV) of the sampling ratio as an additional measure of whether the sampling process is under control. See Annex A, Clause A.5, for instructions on how to calculate the % CV. A value for the % CV of more than 15 % may indicate that system improvement is necessary.

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