
International Standard



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Manganese and chromium ores — Experimental methods for evaluation of quality variation and methods for checking the precision of sampling

Minerais de manganèse et de chrome — Méthodes expérimentales d'évaluation de la variation de qualité et méthodes de contrôle de la fidélité de l'échantillonnage

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8542 was prepared by Technical Committee ISO/TC 65, *Manganese and chromium ores*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Manganese and chromium ores — Experimental methods for evaluation of quality variation and methods for checking the precision of sampling

1 Scope and field of application

This International Standard specifies experimental methods for the evaluation of quality variation of manganese and chromium ores, whether natural or processed, for the purpose of defining sampling procedure by the mass-basis systematic method and the two-stage method as specified in the relevant International Standards. It also specifies methods for checking the precision of sampling by the mass-basis systematic method and two-stage method.

NOTE — The evaluation of quality variation for the sampling procedure by the time-basis systematic method shall be derived on the basis of the mass-basis systematic method.

2 References

ISO 4296/1, *Manganese ores — Sampling — Part 1: Increment sampling*.

ISO 4296/2, *Manganese ores — Sampling — Part 2: Preparation of samples*.

3 Experimental methods for evaluation of quality variation — General conditions

3.1 Quality variation

The quality variation is a measure of the heterogeneity of the ore and is expressed in terms of standard deviation, denoted by σ . It shall be standard deviation within strata or intervals between taking increments, denoted by σ_w , in case of mass-basis systematic sampling; and shall be standard deviation between wagons, lorries, containers (hereinafter — wagons), denoted by σ_b , or standard deviation within wagons, denoted by σ_w , in case of two-stage sampling.

3.2 Quality characteristic

The quality characteristic chosen for determining the quality variation shall be manganese content for manganese ores and chromium oxide content for chromium ores.

NOTE — It should be recognized that other quality characteristics, such as moisture content, particle size distribution, etc., may have to be taken into account.

3.3 Determination of quality variation

The quality variation shall be determined for each type of an ore specified between the parties concerned.

3.4 Consignment for experiment

It is recommended that consignments to be selected for the experimental purposes be 3 000 t or over in mass and 50 or more increments constitute a gross sample.

3.5 Methods for sampling and testing

The sampling, sample preparation, chemical analysis and related testing for experimental purposes shall be carried out in accordance with the relevant International Standards.

3.6 Scale of experiment

The experiment shall be conducted on a consignment basis and shall be repeated five times. For systematic sampling, an experiment shall cover either a whole consignment or part of the consignment. For two-stage sampling, it shall cover 10 wagons out of M wagons of a consignment.

3.7 Frequency of experiment

It is recommended that the experiment for the evaluation of quality variation of each type of an ore of regular delivery be conducted at regular intervals, for example biennially, or as necessary.

4 Experimental methods

4.1 Method for systematic sampling

4.1.1 This method is applicable for the estimation of standard deviation within strata, σ_w , in the case of the mass-basis systematic method of sampling being applied to a consignment constituted at ports of loading or transferred at ports of discharge.

4.1.2 For the purpose of experiment, a whole consignment or part of the consignment shall be divided into five parts ($k = 5$) of equal mass.

4.1.3 Ten increments shall be collected from each part, an experimental sample being constituted from 50 increments. Each increment shall be taken at equal mass intervals after a random start within the first interval.

4.1.4 The five consecutive odd-number increments from the start shall constitute an odd-number subsample which is designated subsample A; and the five consecutive even-number increments from the start shall constitute an even-number subsample which is designated subsample B. See figure 1.

4.1.5 The samples for chemical analysis shall be prepared from subsamples A and B; a single final sample is prepared by discarding one of the binary divided portions for subsample A; and paired final samples are prepared from the binary divided portions for subsample B. See figure 2.

4.1.6 A single chemical determination shall be carried out on all of the final samples. The sequence of the 15 chemical determinations of the experimental samples shall be randomized, or otherwise both experimental and routine determinations shall be combined and the determinations shall be in a random order. The individual measurements shall be identified by the designations as shown in figure 2.

4.1.7 It is recommended that the experimental data be recorded on a data sheet such as that given in table 1.

4.2 Method for two-stage sampling

4.2.1 This method is applicable to the estimation of standard deviation between wagons, σ_b , and standard deviation within wagons, σ_w , in the case of the two-stage method of sampling being applied to a consignment loaded on to or discharged from wagons.

4.2.2 In the first stage of two-stage sampling, when sampling from a wagon-borne consignment, a total of 10 ($m = 10$) wagons shall be selected at equal mass intervals with a random start.

4.2.3 In the second stage of two-stage sampling, each of four ($\bar{n} = 4$) increments shall be taken at random from the ore within the selected wagons to obtain a total of 40 increments.

4.2.4 The two different paired subsamples, denoted (C_1, C_2), (D_1, D_2), each composed of 10 increments, shall be constituted as follows: C_1 and C_2 each comprise one increment of the 10 selected wagons; D_1 comprises two increments of the five even-number wagons; D_2 comprises two increments of the five odd-number wagons. (See figure 3.)

4.2.5 The samples for chemical analysis shall be prepared from subsamples $C_1, C_2; D_1, D_2$: a single final sample from each of the two different pairs of subsamples.

4.2.6 Duplicate chemical determinations shall be made on all the final samples. The sequence of chemical determinations of the experimental samples shall be randomized, or otherwise both experimental and routine samples are combined and the determinations shall be in random order. The individual measurements shall be identified by designations as shown in figure 3.

4.2.7 It is recommended that the experimental data be recorded on a data sheet such as that given in table 2.

5 Methods for analysis of experimental data

5.1 Method for systematic sampling

This method is applicable to the experimental data obtained in accordance with the method specified in 4.1. The procedure to evaluate the quality variation shall be as given in 5.1.1 to 5.1.3.

5.1.1 Calculate the estimated value of combined precision of division and measurement, in terms of variance, of the subsample

$$\bar{R}_1 = \frac{1}{5} (|b_{11} - b_{12}| + |b_{21} - b_{22}| + \dots + |b_{51} - b_{52}|) \quad \dots (1)^{1)}$$

$$\hat{\sigma}_{DM}^2 = (\bar{R}_1/d_2)^2 \quad \dots (2)^{1)}$$

where

b_{i1}, b_{i2} are the i th measurements of each of the paired samples;

$\bar{R}_1$ is the mean of ranges of the five paired samples;

$\hat{\sigma}_{DM}^2$ is the estimated value of combined precision of division and measurement, in terms of variance;

d_2 is a factor for obtaining the standard deviation from range ($d_2 = 1,128$ for paired measurements).

When the estimated value of precision of measurement ($\hat{\sigma}_M^2$) is available, the estimated precision of division ($\hat{\sigma}_D^2$) can be calculated by the equation

$$\hat{\sigma}_D^2 = \hat{\sigma}_{DM}^2 - \hat{\sigma}_M^2 \quad \dots (3)$$

5.1.2 Calculate the estimated value of quality variation within strata in which precision of division and measurement is included

$$\bar{R}_2 = \frac{1}{5} (|a_1 - b_{11}| + |a_2 - b_{21}| + \dots + |a_5 - b_{51}|) \quad \dots (4)$$

1) Source: ASTM. *ASTM Manual on Quality Control of Materials*. Philadelphia, PA, American Society for Testing and Materials, 1951.