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STANDARD

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**Carbonaceous materials used in the
production of aluminium — Baked anodes
and cathode blocks —**

**Part 1:
Determination of apparent density using
a dimensions method**

Produits carbonés utilisés pour la production de l'aluminium — Anodes cuites et blocs cathodiques —

Partie 1: Détermination de la masse volumique apparente par une méthode de mesure dimensionnel

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 12985 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12985-1 was prepared by Technical Committee ISO/TC 47, *Chemistry*, Subcommittee SC 7, *Aluminium oxide, cryolite, aluminium fluoride, sodium fluoride, carbonaceous products for the aluminium industry*.

ISO 12985 consists of the following parts, under the general title *Carbonaceous materials used in the production of aluminium — Baked anodes and cathode blocks*:

- *Part 1: Determination of apparent density using a dimensions method*
- *Part 2: Determination of apparent density and of open porosity using a hydrostatic method*

Carbonaceous materials used in the production of aluminium — Baked anodes and cathode blocks —

Part 1: Determination of apparent density using a dimensions method

1 Scope

This part of ISO 12985 specifies a dimensions method for the determination of the apparent density of carbonaceous products used in the production of aluminium.

This method is applicable to samples with a simple or well-defined geometry (cylindrical, rectangular parallelepipedal, cubic, etc.) and having a smooth surface profile. The accuracy of measurement is strongly influenced by the equipment used for sampling, i.e. the drilling and sawing machines.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 12985. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 12985 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8007-1, *Carbonaceous materials used in the production of aluminium — Sampling plans and sampling from individual units — Part 1: Cathode blocks*.

ISO 8007-2, *Carbonaceous materials used in the production of aluminium — Sampling plans and sampling from individual units — Part 2: Prebaked anodes*.

3 Principle

The geometry of the test specimen and its mass are measured and the apparent density is calculated.

4 Apparatus

4.1 Balance, capable of weighing to the nearest 0,1 g for test specimens with a mass of 100 g or more and capable of weighing to the nearest 0,01 g for test specimens of a mass of less than 100 g.

4.2 Callipers, for measuring the sample dimensions, capable of measuring to the nearest 0,05 mm for dimensions of 30 mm or more and capable of measuring to the nearest 0,01 mm for dimensions of less than 30 mm.

5 Sampling

Sample the cathode blocks and baked anodes in accordance with ISO 8007-1 and ISO 8007-2, respectively.

NOTE To ensure that the precision given in clause 8 is achieved, a sample volume of approximately 100 cm³ is necessary.

6 Procedure

6.1 Measurement of dimensions

Measure each dimension four times as follows:

- for a cylindrical test specimen: measure along the test specimen's length at positions on the circumference which are 90° apart and determine the diameter from measurements taken at each end and at 1/3 and 2/3 of the way along the test specimen's length;
- for a rectangular parallelepipedical test specimen: measure the length in a similar manner to that described for a cylinder and measure the major and minor axes in a similar manner to that described for the measurement of the diameter of a cylinder.

Calculate the mean of each dimension, i.e. a₁, a₂ ... a_n, and if one dimension has to be taken to a power greater than 1 in the calculation of the volume, calculate the mean of the individual measurement to the given power.

EXAMPLE Cylinders: the area is calculated from the mean of the square diameters.

6.2 Determination of dry mass

Dry the test specimen until it maintains a constant mass by heating at (110 ± 5) °C for a minimum of 2 h or until consecutive weighings at 5 min intervals differ by less than 0,1 %. Cool the test specimen in a desiccator until it reaches room temperature and weigh the mass m₁.

7 Calculation

Calculate the volume V of the test specimen according to its geometrical formula and by using the mean values of each dimension; round off to 0,1 cm³ for volumes larger than 100 cm³ and to 0,01 cm³ for smaller volumes.

Calculate the apparent density ρ_a, expressed in grams per cubic centimetre, of the test specimen using the formula:

$$\rho_a = \frac{m_1}{V}$$

where

m₁ is the dry mass, expressed in grams;

V is the calculated volume, expressed in cubic centimetres.

Report the results to the second decimal place.

8 Precision

8.1 Repeatability

The difference between the values of duplicate determinations, carried out in rapid succession by the same operator using the same apparatus on the same test sample, shall not exceed the repeatability limit, r , as follows:

$$r = 0,004 \text{ g/cm}^3$$

8.2 Reproducibility

The difference between the values of the average of duplicate determinations obtained by two laboratories using this method for the analysis of the same laboratory sample is not expected to exceed the reproducibility limit, R , as follows:

$$R = 0,008 \text{ g/cm}^3$$

9 Test report

The test report shall include the following information:

- a) an identification of the sample;
- b) the method used by reference to this part of ISO 12985, i.e. ISO 12985-1:2000;
- c) the date of the test, the results and the method of expression used;
- d) any unusual features noted during the determination;
- e) any operation not included in this part of ISO 12985 or in the International Standards to which reference is made, or regarded as optional.

Bibliography

- [1] ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions.*
- [2] ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method.*
- [3] ISO 5725-3, *Accuracy (trueness and precision) of measurement methods and results — Part 3: Intermediate measures of the precision of a standard measurement method.*
- [4] ISO 5725-4, *Accuracy (trueness and precision) of measurement methods and results — Part 4: Basic methods for the determination of the trueness of a standard measurement method.*
- [5] ISO 5725-5, *Accuracy (trueness and precision) of measurement methods and results — Part 5: Alternative methods for the determination of the precision of a standard measurement method.*
- [6] ISO 5725-6, *Accuracy (trueness and precision) of measurement methods and results — Part 6: Use in practice of accuracy values.*

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