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Carbonaceous materials for use in the production of aluminium — Calcined coke — Determination of grain stability using a laboratory vibration mill

*Produits carbonés utilisés pour la production de l'aluminium —
Coke calciné — Détermination de la stabilité du grain par broyeur
à billes oscillant*



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Reference number
ISO 10142:1996(E)

Foreword

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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.

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Carbonaceous materials for use in the production of aluminium — Calcined coke — Determination of grain stability using a laboratory vibration mill

1 Scope

Calcined coke with poor mechanical strength may become degraded during mixing. Poor grain stability will affect the grain size and may result in poor quality of baked blocks.

This International Standard describes a laboratory vibration mill method for the determination of the grain stability of calcined coke for the manufacture of carbon products used in the manufacture of aluminium.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3310-1:1990, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*.

ISO 6375:1980, *Carbonaceous materials for the production of aluminium — Coke for electrodes — Sampling*.

3 Principle

The 4 mm to 8 mm fraction of a sample of calcined coke is subjected to the grinding action of a laboratory vibration mill and the percentage residue retained on a specified sieve screen is measured.

4 Apparatus

4.1 Laboratory vibration mill, having two grinding vessels, each filled with 1 kg of clean, hard steel balls, diameter $10\text{ mm} \pm 0,4\text{ mm}$. The main features of the mill are shown in figures 1 to 5.

The mill (1) and drive motor (9) are mounted on a common base plate (2). The grinding vessels (7, 8) are installed in the body of the mill, which is supported by four soft, flat springs (4). The spring suspension system is designed to allow the machine to be operated without any fastenings or anchorage. The grinding vessels are secured by adjustable straps (5) which have a quick-release catch (13). The oscillator is supported on a bearing (6), fitted to the body of the mill, and is driven by the motor (9) via a special clutch (3) and a hollow flexible shaft (12).

The peak-to-peak amplitude of the vibration shall be $4\text{ mm} \pm 0,5\text{ mm}$. A reference disc is fitted to the front of the machine to measure the amplitude of vibration.

The motor shall be capable of 1 450 rpm to 1 470 rpm. The bearing housing (11) is rigidly connected to the bearings (6). The shaft (12) rotates inside the bearings with two steel imbalance discs (10) attached and is connected to the motor via the clutch (3). The imbalance discs are shown in figure 4.

The imbalance discs rotate eccentrically and the entire oscillating mass follows with a phase lag of 180° , supported by the springs.

Each grinding vessel (see figure 5) has a total volume of 1 litre and an effective volume of 0,3 litres. It is closed by a lid (15) with a rubber sealing ring (16). The lid is held in place by a clamp (17) fitted with a wing nut (18).

The electric motor is linked to a timer switch having a precision of $\pm 2\text{ s}$.

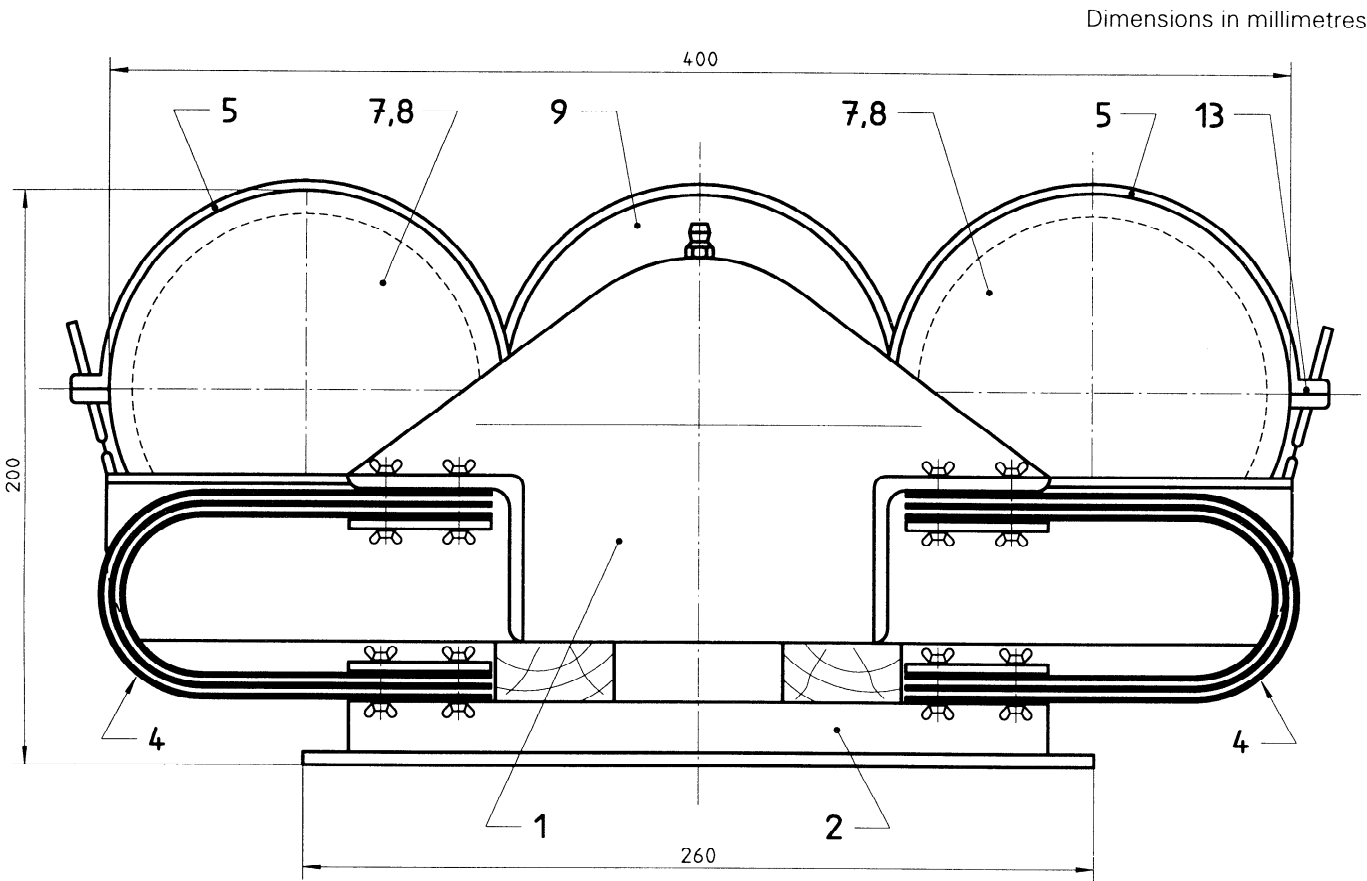


Figure 1 — Laboratory vibration mill — Front view

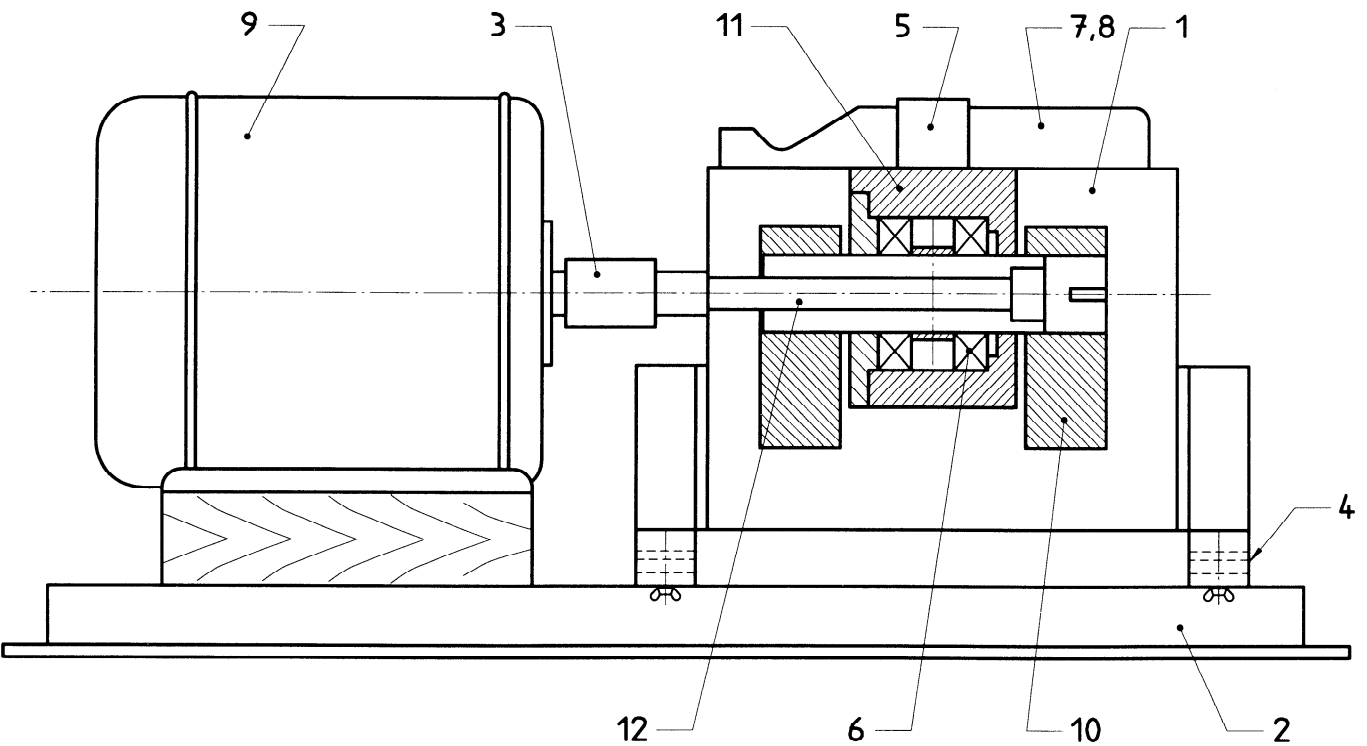


Figure 2 — Laboratory vibration mill — Side view

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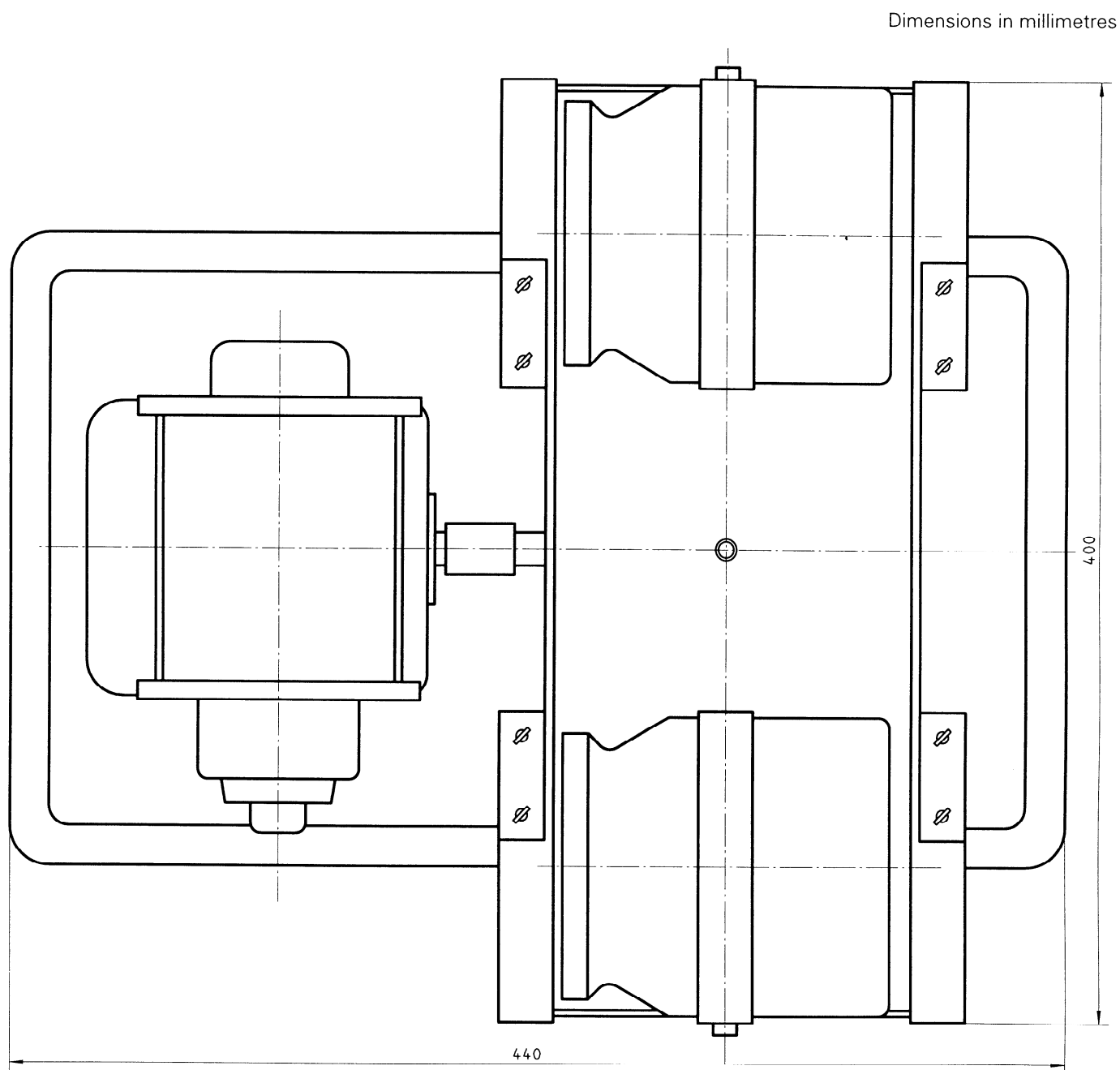


Figure 3 — Laboratory vibration mill — Ground plan

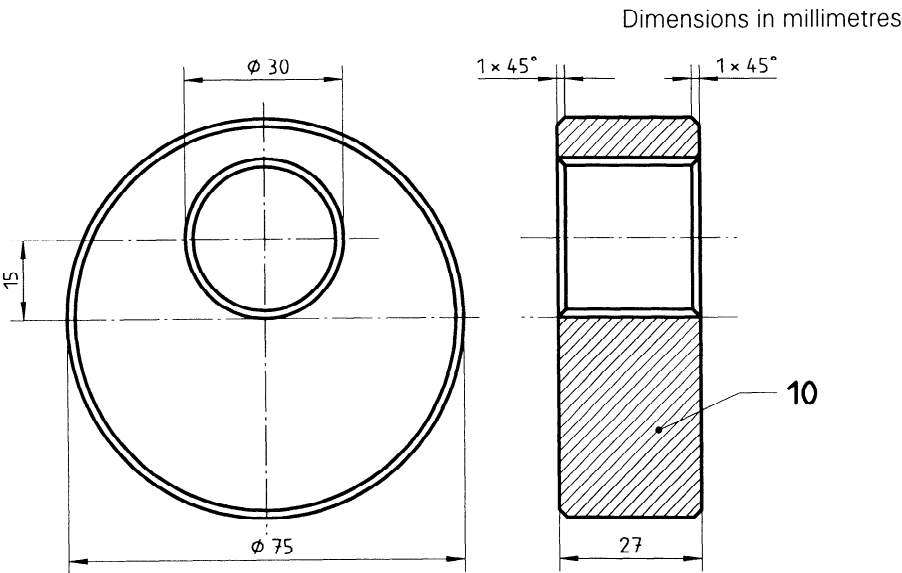


Figure 4 — Imbalance discs

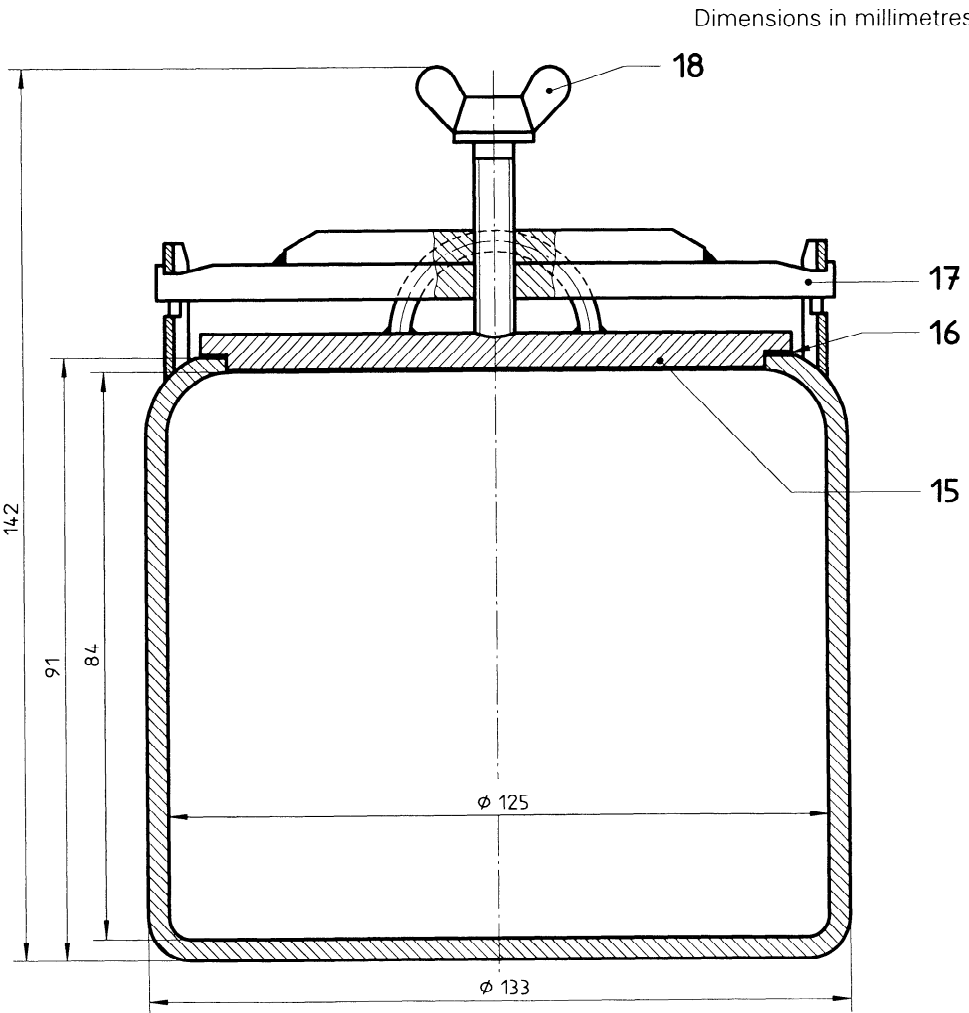


Figure 5 — Grinding vessel

4.2 Sieves, mesh size 4 mm and 8 mm, conforming to the requirements of ISO 3310-1.

5 Sampling and preparation of the test sample

Sample in accordance with ISO 6375. Do not precrush the sample. Sieve the sample to collect 200 g of coke of grain size between 4 mm and 8 mm.

6 Procedure

Carefully place 1 kg of the steel balls and 100 g \pm 0,01 g of the 4 mm to 8 mm fraction of the sieved test sample in each grinding vessel and close the lid. Attach the vessels to the vibration mill.

Turn the mill on and grind the sample for 3,5 min as measured by the timer switch.

Carefully empty the contents of one vessel on to an 8 mm sieve, placed on top of a 4 mm sieve. Screen by hand, using approximately 60 horizontal movements in about half a minute. The steel balls will remain on the 8 mm sieve, and part of the granular material will remain on the 4 mm sieve.

Weigh the portion of granular material which remains on the 4 mm sieve to the nearest 0,01 g.

Repeat with the contents of the other vessel.

7 Expression of results

The grain stability GS of the calcined coke, expressed in per cent, is given by the equation

$$GS = \frac{GS_1 + GS_2}{2} = \frac{1}{2} \left(\frac{m_3}{m_1} \times 100 + \frac{m_4}{m_2} \times 100 \right)$$

where

GS₁ is the grain stability for vessel 1;

GS₂ is the grain stability for vessel 2;

m₁ is the mass, in grams, of test sample placed in vessel 1;

m₂ is the mass, in grams, of test sample placed in vessel 2;

m₃ is the mass, in grams, of test sample from vessel 1 retained on the 4 mm sieve;

m₄ is the mass, in grams, of test sample from vessel 2 retained on the 4 mm sieve.

If GS₁ and GS₂ differ by less than $\sqrt{2}$ \times the repeatability of the method, report the result, GS, as the mean of the simultaneous duplicate determinations GS₁ and GS₂, to the nearest 0,01 %.

If GS₁ and GS₂ differ by more than $\sqrt{2}$ \times the repeatability of the method, repeat the procedure detailed in clause 6. If the difference between the mean result of each pair of simultaneous duplicate tests is less than the repeatability of the method, report the result as the mean of the means. Otherwise reject all the results and repeat the determination.

8 Precision

8.1 Repeatability

The results of duplicate determinations, carried out at different times in the same laboratory by the same operator with the same apparatus, on representative portions taken from the same test sample, should not differ by more than 2 % absolute.

8.2 Reproducibility

The means of the results of duplicate determinations, carried out in each of two different laboratories, on representative portions taken from the same sample after the last stage of sample preparation, should not differ by more than 3 % absolute.

9 Test report

The test report shall include the following particulars:

- a reference to this International Standard;
- all details necessary for identification of the sample;
- the result of the test;
- the date of the test;
- details of any unusual features noted during the determination;
- details of any operation not included in this International Standard or regarded as optional.

ICS 71.100.10

Descriptors: extractive metallurgy, aluminium, electrodes, carbonaceous materials, granular materials, coke, tests, determination, stability, sieve analysis.

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