
**Carbonaceous materials used in the
production of aluminium — Cold and
tepid ramming pastes — Preparation of
unbaked test specimens and
determination of apparent density after
compaction**

*Produits carbonés utilisés pour la production de l'aluminium — Pâtes de
brasquage froides et tièdes — Préparation d'éprouvettes non cuites et
détermination de la densité apparente après compactage*



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Carbonaceous materials used in the production of aluminium — Cold and tepid ramming pastes — Preparation of unbaked test specimens and determination of apparent density after compaction

1 Scope

This International Standard describes the preparation of unbaked test specimens made by compacting carbonaceous ramming pastes. It also includes a method for the determination of the apparent density after compaction.

Unbaked test specimens of ramming paste need to be prepared not only for the determination of the apparent density of the paste after compaction, but also for the determination of the dimensional change during baking and for the subsequent determination of properties of baked test specimens.

2 Normative references

The following referenced documents are indispensable for the application 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 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*

ISO 14422, *Carbonaceous materials used in the production of aluminium — Cold-ramming pastes — Methods of sampling*

3 Principle

The carbonaceous ramming paste is compacted in a cylindrical mould by a defined number of impacts at a specified force in a ramming apparatus. The bulk density is calculated from the mass and the dimensions of the resulting compacted test specimen. The test specimen may subsequently be baked, if desired, for further testing.

4 Apparatus and materials

An example of a rammer mould is shown in Figure 1.

4.1 Rammer cylinder, made of steel, with an inner diameter of 50 mm.

4.2 Ram base, made of steel. The ram base shall fit into the rammer cylinder and act as the bottom of the cylinder.

4.3 Rammer, consisting of a steel piston, a falling weight mounted so that it can be dropped onto the top of the piston, and a height-measuring device accurate to 0,1 mm. The mass of the falling weight shall be 6,35 kg and the weight shall travel a constant distance to impact of $(50 \pm 0,1)$ mm.

4.4 Box (with lid), capable of containing the amount of ramming paste needed to produce one test specimen. The free space over the paste shall not be more than 50 % of the volume of the paste.

4.5 Heating/cooling cabinet, capable of being maintained at a constant temperature $\pm 0,5$ °C in the range 5 °C to 100 °C.

4.6 Insulation layer (for example, 1-cm-thick polystyrene), for insulation of the rammer cylinder, or **thermostatically controlled surround** (see Figure 1).

4.7 Balance, accurate to 0,1 g.

5 Sampling

Sample the paste in accordance with ISO 14422.

NOTE Experience has shown that 150 g to 200 g of ramming paste is necessary for each test specimen.

6 Procedure

Ensure the cylinder, the ram base and the piston are clean.

Weigh the necessary amount of ramming paste (to the nearest 0,1 g) into a suitable box (4.4). If the amount of ramming paste to be used is not known, determine the required mass by preliminary tests [the height of the test specimen after compaction has to be (50 ± 5) mm (see below)]. Seal the box. Heat or cool the box together with the rammer cylinder (4.1), the ram base (4.2) and the insulation/surround (4.6) to the test temperature (agreed between the interested parties) in the heating/cooling cabinet (4.5) for 2 h to 3 h.

Transfer the paste to the cylinder. Protect the cylinder with the insulation or surround (4.6). Place the cylinder in the rammer (4.3) and lower the piston until it is resting on the paste. Compact the ramming paste with 100 impacts at a rate of about 1 impact per second.

Read the height h of the test specimen (to the nearest 0,1 mm) from the scale on the ramming apparatus, with the piston head resting on the specimen. If the height of the compacted test specimen is not equal to (50 ± 5) mm, discard the result and repeat the test with another sample mass.

Remove the test specimen. Clean the cylinder, the ram base and the piston carefully after each test.

7 Expression of results

7.1 Apparent density of unbaked paste

Calculate the apparent density ρ , in $\text{g}\cdot\text{cm}^{-3}$, of the unbaked test specimen from Equation (1):

$$\rho = \frac{m}{\pi r^2 h} \quad (1)$$

where

m is the mass, in g, of the ramming paste placed in the cylinder, accurate to 0,1 g;

r is the inner radius of the ramming cylinder, in cm, accurate to 0,01 cm;

h is the height of the unbaked test specimen as read from the rammer scale, in cm, accurate to 0,01 cm.

Round the result to the nearest $0,001 \text{ g}\cdot\text{cm}^{-3}$.

7.2 Precision (determined in accordance with ISO 5725-2)

Repeatability (r) = 0,023 (in $\text{g}\cdot\text{cm}^{-3}$)

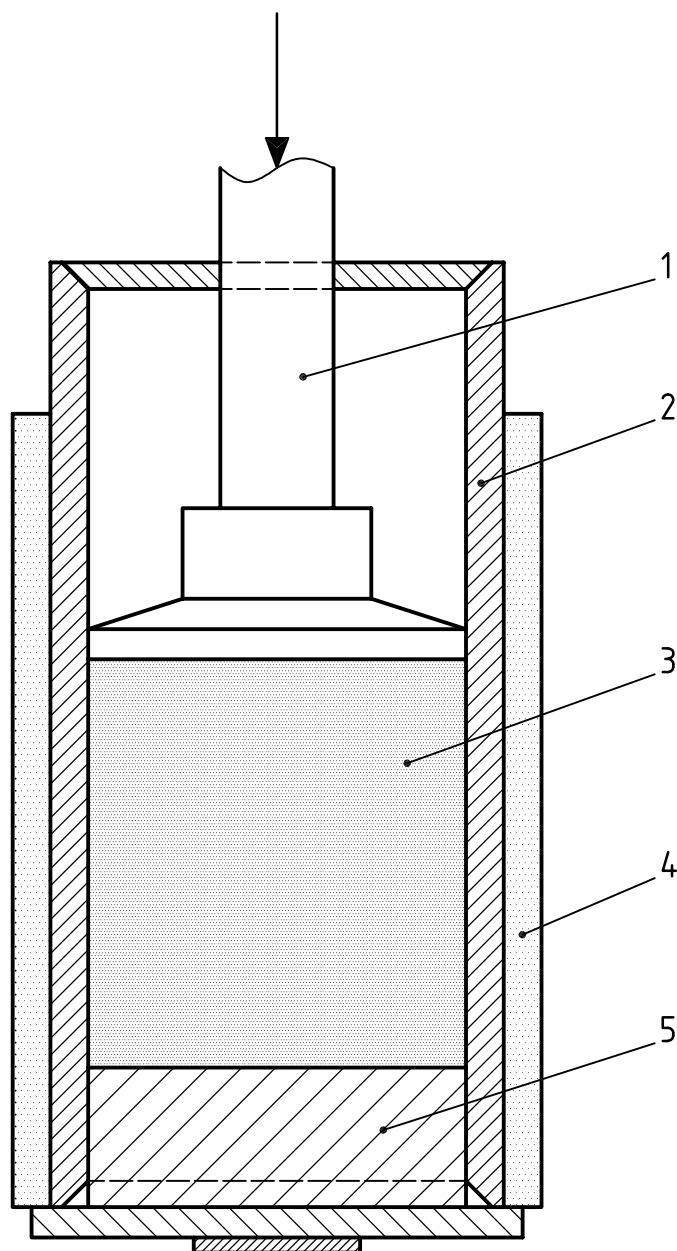
Reproducibility (R) = 0,042 (in $\text{g}\cdot\text{cm}^{-3}$)

The number of degrees of freedom, i.e. number of laboratories (6) \times number of samples (4), was 24.

8 Test report

The test report shall include the following information:

- a) a reference to this International Standard;
- b) all details necessary for identification of the sample tested;
- c) the temperature used for the test;
- d) the result of the test, i.e. the apparent density of the unbaked paste after compaction;
- e) the date of the test;
- f) details of any unusual features noted during the determination;
- g) details of any operation not included in this International Standard or regarded as optional.



Key

- 1 piston
- 2 steel cylinder
- 3 ramming paste
- 4 insulation or thermostatically controlled surround
- 5 ram base

Figure 1 — Rammer mould

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