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## **Refractory materials — Determination of bulk density of granular materials (grain density)**

*Matériaux réfractaires — Détermination de la masse volumique apparente des matériaux en  
grains (masse volumique des grains)*

Reference number  
ISO 8840: 1987 (E)

## 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 8840 was prepared by Technical Committee ISO/TC 33, *Refractories*.

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.

# Refractory materials — Determination of bulk density of granular materials (grain density)

## 1 Scope and field of application

This International Standard specifies two methods for the determination of the bulk density of granular refractory materials (grain density) having a grain size larger than 2 mm :

- Method 1 : the mercury method with vacuum
- Method 2 : the arrested water absorption method.

Method 1 is intended as the referee method.

Depending on the nature of the material tested, the two methods may give different results. Any statement of the value of a bulk density shall therefore be accompanied by an indication of the method used or to be used in case of dispute.

The same method shall be used for the determination of the volume of the sample, for selecting and preparing the sample, for calculating the bulk density and for presenting the test report.

## 2 References

ISO 383, *Laboratory glassware — Interchangeable conical ground joints*.

ISO 385-1, *Laboratory glassware — Burettes — Part 1 : General requirements*.

ISO 5018, *Refractory materials — Determination of true density*.

ISO 8656, *Refractory products — Raw materials and unshaped products — Sampling*.<sup>1)</sup>

## 3 Definitions

For the purpose of this International Standard, the following definitions apply.

**3.1 bulk density of a granular material (grain density) :**  
The ratio of the mass of a quantity of the material to the total volume of its grains, including the volume of any closed pores within the grains.

**3.2 closed pores :** Pores that are not penetrated by a liquid in which the grains are immersed.

## 4 Principle

Measurement of the volume of a given mass of a granular material by displacement of a liquid.

## 5 Sampling

Sampling shall be carried out in accordance with ISO 8656 or with another standard sampling scheme agreed between the interested parties.

## 6 Preparation, number and size of test samples

### 6.1 Preparation of samples

The material to be tested shall consist of fractions or groups of fractions with grain sizes above 2 mm. Laboratory samples shall be produced by sieving, after any preliminary comminution of the material above 5,6 mm grain size. Test results can be affected by the comminution technique and the equipment used.

Any dust or loose particles adhering to the grains shall be removed before testing by washing or, with materials sensitive to moisture or humidity, by air blowing.

### 6.2 Number of samples

Take at least three test samples from the laboratory sample and carry out one determination of bulk density on each test sample.

### 6.3 Size of samples

The size of test samples to be taken depends on the grain size and the homogeneity of the material being tested. Recommended sizes are shown in table 1.

Table 1 — Size of test samples

Grain fraction (mm)	Method	Size of test samples (g)	
		Good homogeneity	Poor homogeneity
2,0 to 5,6	1	100	200
	2	50	50

1) At present at the stage of draft.