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**Metallic powders — Determination of  
apparent density —**

Part 1:  
**Funnel method**

*Poudres métalliques — Détermination de la masse volumique  
apparente —*

*Partie 1: Méthode de l'entonnoir*



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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3923-1 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*.

This third edition cancels and replaces the second edition (ISO 3923-1:1979), which has been technically revised.

ISO 3923 consists of the following parts, under the general title *Metallic powders — Determination of apparent density*:

- *Part 1: Funnel method*
- *Part 2: Scott volumeter method*

# Metallic powders — Determination of apparent density —

## Part 1: Funnel method

### 1 Scope

This part of ISO 3923 specifies the funnel method for the determination of the apparent density of metallic powders under standardized conditions.

The method is intended for metallic powders that flow freely through a 2,5 mm diameter orifice. It may, however, be used for powders that flow with difficulty through a 2,5 mm diameter orifice but flow through a 5 mm diameter orifice.

Methods for the determination of the apparent density of powders that will not flow through a 5 mm diameter orifice are specified in ISO 3923-2.

### 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 3923-2, *Metallic powders — Determination of apparent density — Part 2: Scott volumeter method*

### 3 Principle

Measurement of the mass of a certain quantity of powder, which in a loose condition exactly fills a cup of known volume.

The loose condition is obtained by using, when filling the cup, a funnel placed at a determined distance above the cup.

The ratio between the mass and the volume represents the apparent density.

### 4 Symbols and designation

The symbols and designations used in this International Standard are defined in Table 1.

Table 1

Symbol	Designation	Unit
$\rho_a$	Apparent density of metallic powders (General term)	g/cm <sup>3</sup>
$\rho_{ac}$	Apparent density obtained by the funnel method	g/cm <sup>3</sup>
$m$	Mass of the powder	g
$V$	Volume of the cup	cm <sup>3</sup>

## 5 Apparatus

**5.1 Funnels**, one having an orifice of diameter 2,5 mm and the other an orifice of diameter 5 mm; see Figures 1 and 2, respectively.

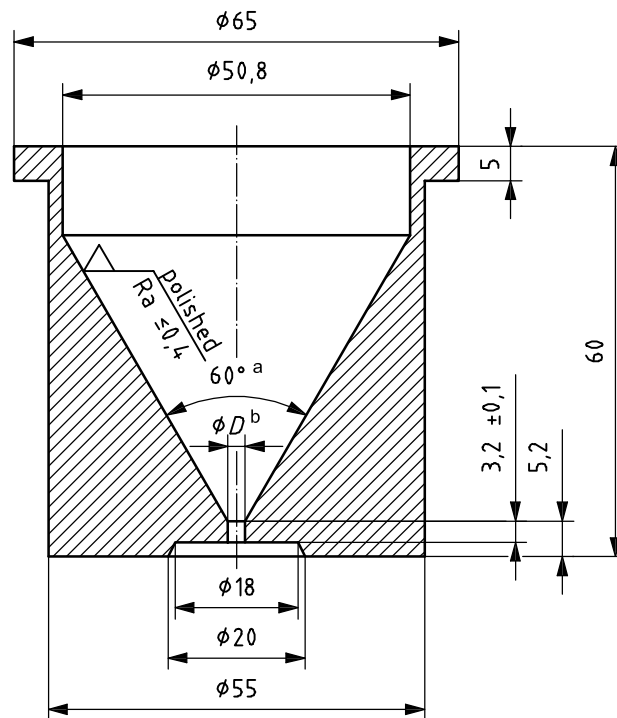
**5.2 Cylindrical cup**, having a capacity of  $25 \text{ cm}^3 \pm 0,03 \text{ cm}^3$  and an internal diameter of  $28 \text{ mm} \pm 0,5 \text{ mm}$ . A cup with the same capacity and with an internal diameter of  $30 \text{ mm} \pm 1 \text{ mm}$  is also acceptable.  $28 \text{ mm} \pm 0,5 \text{ mm}$  is however the first option when new equipment is manufactured.

The cup and funnels should be made of a non-magnetic, corrosion-resistant, metallic material having sufficient wall thickness and hardness to avoid distortion and excessive wear. The inner surfaces of the cup and funnels should be polished.

**5.3 Balance**, of sufficient capacity, capable of weighing the test sample to an accuracy of  $\pm 0,01 \text{ g}$ .

**5.4 Stand and horizontal vibration-free base**, to support the cup and funnel, the stand holding the orifice of the funnel 25 mm above the top surface of the cup and coaxially with it; see Figure 3.

Dimensions in millimetres



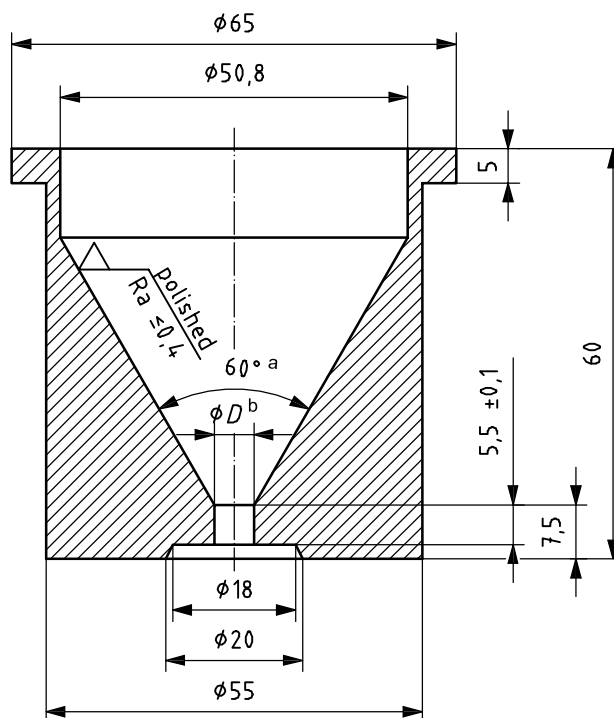
### Key

<sup>a</sup> This value is mandatory.

<sup>b</sup>  $D = 2,5^{+0,2}_0$

Figure 1 — Funnel with orifice diameter 2,5 mm

Dimensions in millimetres

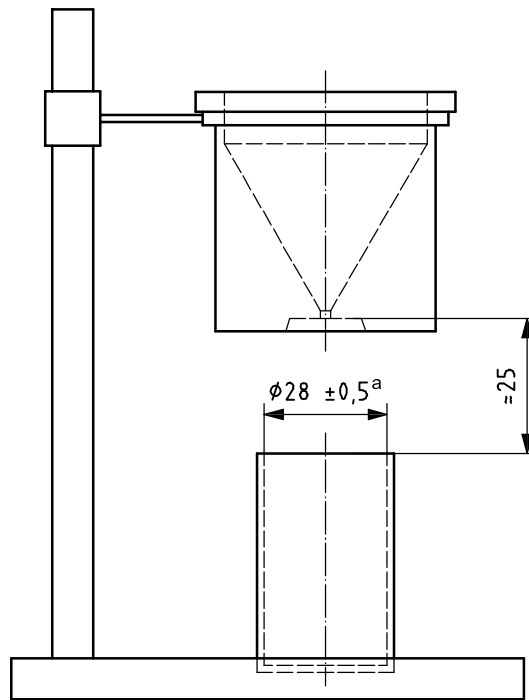
**Key**

<sup>a</sup> This value is mandatory.

<sup>b</sup>  $D = 5^{+0,2}_0$

**Figure 2 — Funnel with orifice diameter 5 mm**

Dimensions in millimetres



**Key**

<sup>a</sup> A cup with the same capacity and with an internal diameter of 30 mm ± 1 mm is also acceptable (see 5.2).

**Figure 3 — Arrangement of the stand with funnel and cup**

**6 Sample**

6.1 The test sample shall be of at least 100 cm<sup>3</sup> in volume to allow the determination to be carried out on three test portions.

6.2 In general, the powder should be tested in the as-received condition. In certain instances, the powder may be dried. However, if the powder is susceptible to oxidation, the drying shall take place in a vacuum or in an inert gas. If the powder contains volatile substances, it shall not be dried.

**7 Procedure**

7.1 Pour the test portion of powder into the funnel with the 2,5 mm orifice and, from that, directly into the cylindrical cup, until this is completely filled and the powder flows over. Level the powder in one operation with a non-magnetic straight-edge without compressing it, and take care not to jar or vibrate the cup.

7.2 If the powder does not flow through this funnel, use the funnel with the 5 mm orifice. If the powder still does not flow, it is allowable to initiate flow by poking once with a 1 mm wire from the top of the funnel. The wire shall not enter the cup.

7.3 After levelling the powder, tap the cup to settle the powder, in order to avoid spilling it during transport. Make sure that there are no adhering particles on the exterior of the cup.

7.4 Determine the mass of the powder to the nearest 0,01 g.

7.5 Carry out the determinations on three test portions.



## 8 Expression of results

The apparent density is given by the formula

$$\rho_{ac} = \frac{m}{V} = \frac{m}{25}$$

Report the arithmetical mean of the three determinations to the nearest 0,01 g/cm<sup>3</sup>, and also the highest and lowest results if the scatter between results exceeds 1 % of the mean.

## 9 Precision

### 9.1 Repeatability

Duplicated tests with the same equipment, by the same operator, on a homogenized batch of powder, should be considered suspect if they differ by more than 0,03 g/cm<sup>3</sup> at a 95 % confidence level.

### 9.2 Reproducibility

Results from two different laboratories, on the same homogenized batch of powder, should be considered suspect if they differ by more than 0,05 g/cm<sup>3</sup> at a 95 % confidence level.

## 10 Test report

The test report shall include the following information:

- a) a reference to this part of ISO 3923;
- b) all details necessary for the identification of the test sample;
- c) the drying procedure, if the powder has been dried;
- d) the nominal diameter of the orifice and the use of a wire, if applied;
- e) the result obtained;
- f) all operations not specified in this part of ISO 3923, or regarded as optional;
- g) details of any occurrence which may have affected the result.

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