
**Metallic powders — Determination
of flow rate by means of a calibrated
funnel (Hall flowmeter)**

*Poudres métalliques — Détermination du temps d'écoulement au
moyen d'un entonnoir calibre (appareil de Hall)*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 119, *Powder metallurgy*, Subcommittee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*.

This fourth edition cancels and replaces the third edition (ISO 4490:2008), of which it constitutes a minor revision with the following changes:

- a note has been added in [3.1](#);
- “stopwatch” replaced with “timing device” in [3.4](#).

Metallic powders — Determination of flow rate by means of a calibrated funnel (Hall flowmeter)

1 Scope

This International Standard specifies a method for determining the flow rate of metallic powders, including powders for hard metals, by means of a calibrated funnel (Hall flowmeter).

The method is applicable only to powders which flow freely through the specified test orifice.

2 Principle

Measurement of the time required for 50 g of a metallic powder to flow through the orifice of a calibrated funnel of standardized dimensions.

3 Apparatus

3.1 Calibrated funnel, having the dimensions shown in [Figure 1](#) (see [Clause 4](#)).

The funnel shall be made of a non-magnetic, corrosion-resistant metallic material having sufficient wall thickness and hardness to withstand distortion and excessive wear.¹⁾

NOTE The dimensions shown for the funnel, including the orifice, are not to be considered controlling factors. Calibration with emery, as specified in [Clause 4](#), determines the working flow rate of the funnel.

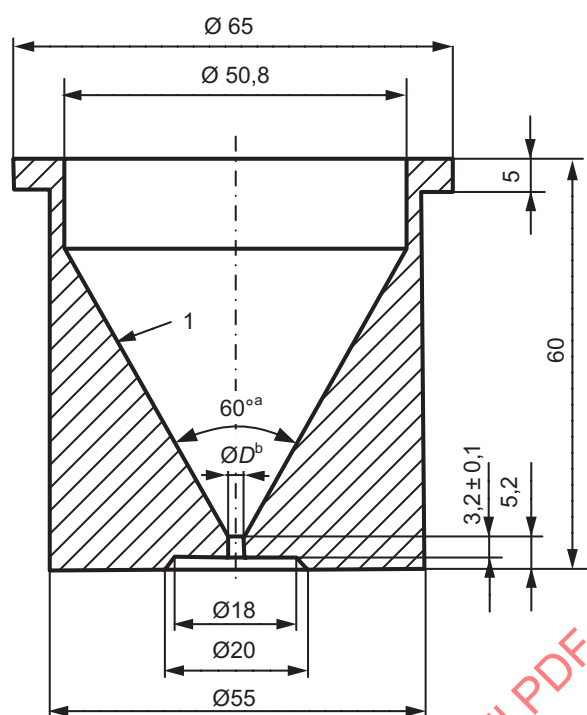
3.2 Stand and horizontal vibration-free base, to support the funnel rigidly, e.g. as indicated in [Figure 2](#).¹⁾

3.3 Balance, of sufficient capacity, capable of weighing the test portion to an accuracy of $\pm 0,05$ g.

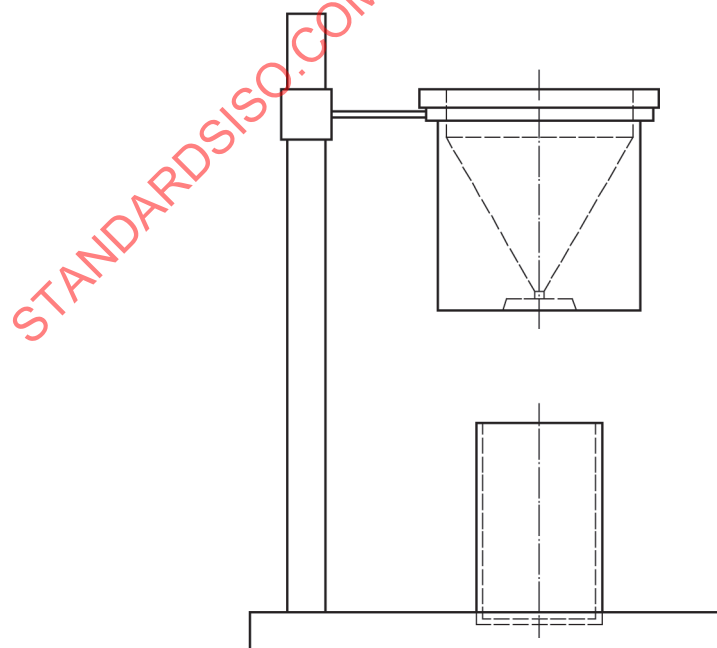
3.4 Timing device, capable of measuring the elapsed time to an accuracy of $\pm 0,1$ s.

3.5 Chinese emery grit, a reference powder used for calibration of the funnel.¹⁾

1) Apparatus complying with 3.1 and 3.2, and standard Chinese emery grit can be purchased from ACuPowder International, LLC, 901 Lehigh Avenue, Union, NJ 07083, USA. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the company named above. Equivalent products may be used if they can be shown to lead to the same results.

**Key**

- 1 polished to $R_a \leq 0,4 \mu\text{m}$
 a This value is mandatory.
 b $D = 2,5^{+0,2}_0$

Figure 1 — Calibrated funnel (Hall flowmeter)**Figure 2 — Arrangement of calibrated funnel and stand**

4 Calibration of the funnel

4.1 Calibration by the manufacturer of the funnel

The manufacturer shall supply the flowmeter calibrated as follows.

- a) Dry the Chinese emery grit (3.5) in an open and clean glass jar at 110 °C for 60 min in air.
- b) Cool the emery to room temperature in a desiccator.
- c) Weigh out 50 g of the emery grit.
- d) Follow the procedure outlined in Clause 6.
- e) Repeat the procedure with the same 50 g mass of emery, until there are five determinations within 0,4 s.
- f) The average of these five determinations is stamped on the bottom of the funnel and shall be within 40,0 s $\pm$ 0,5 s.

The Chinese emery grit used as the reference powder replaces the Turkish emery grit from the first edition of this International Standard, as the latter is no longer available. The Chinese emery has been found to be more sensitive and the instructions should therefore be followed carefully.

4.2 Calibration by the user of the funnel

The flow rate of the reference sample shall be determined by the above method. If the flow rate has changed to be outside 40,0 s $\pm$ 0,5 s, a correction factor shall be used when measuring different powders. This correction factor is obtained by dividing 40,0 by this new value for the Chinese emery grit.

It is recommended that the users periodically verify whether a correction is needed or not.

It is recommended that, before a correction factor is adopted, the cause of the change be investigated. If the flow rate has decreased, it is probable that repeated use has burnished the orifice and a (new) correction factor is justified. An increase in flow rate may indicate a coating of soft powder on the orifice. This coating should be carefully removed and the calibration test repeated.

It is recommended that the use of a funnel be discontinued after the duration of flow of the reference sample has decreased to less than 37 s.

5 Sampling

5.1 The mass of the test sample shall be at least 200 g.

5.2 In general, the powder shall be tested in the as-received condition. In certain cases, and after agreement between the supplier and user, the powder may be dried. However, if the powder is susceptible to oxidation, the drying shall take place in a vacuum or in inert gas. If the powder contains volatile substances, it shall not be dried.

5.3 Immediately before the test, weigh out a 50 g $\pm$ 0,1 g test portion.

5.4 The determination shall be carried out on three test portions.

6 Procedure

Transfer the test portion to the funnel, keeping the discharge orifice closed by a dry finger. Take care that the stem of the funnel is filled with powder. Start the timing device (3.4) when the orifice is opened and

stop it at the instant when the last of the powder leaves the orifice. Record the elapsed time measured to the nearest 0,1 s.

Alternatively, the orifice can be kept open, when the test portion is transferred to the funnel with the rest of the procedure being the same.

NOTE If the powder does not begin to flow when the orifice is opened, one slight tap on the funnel to start the flow is permitted. If this has no effect, or if the flow stops during the test, the powder is considered to possess no flowability according to the test method described in this International Standard.

7 Expression of results

Calculate the arithmetic mean of the results of the three determinations and report the value in seconds per 50 g, rounded to the nearest second. If a correction factor (see 4.2) should be used, the average shall be multiplied by this correction factor.

8 Precision

There are no relevant data available for this issue.

9 Test report

The test report shall include the following information:

- a) a reference to this International Standard (i.e. ISO 4490);
- b) all details for identification of the test sample;
- c) the result obtained;
- d) the use of an open orifice;
- e) all operations not specified by this International Standard, or regarded as optional (e.g. the drying procedure applied and whether flow has been induced by tapping the funnel);
- f) details of any occurrence which may have affected the result.