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

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

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## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4490 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*.

This second edition cancels and replaces the first edition (ISO 4490:1978), which has been technically revised.

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

## 1 Scope

This International Standard specifies a method for determining the flow time of metallic powders, including powders for hardmetals, 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.<sup>1)</sup>

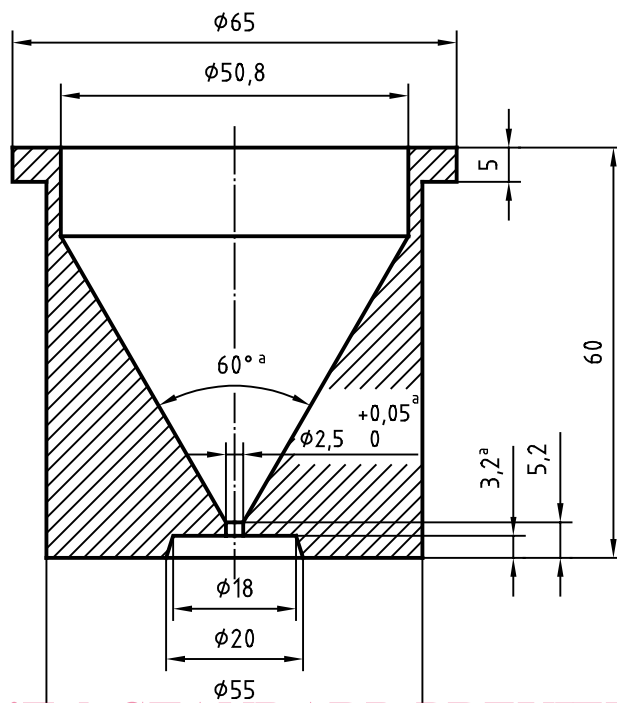
**3.2 Stand and horizontal vibration-free base**, to support the funnel rigidly, e.g. as indicated in Figure 2.<sup>1)</sup>

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

**3.4 Stopwatch**, capable of measuring elapsed time to an accuracy of  $\pm 0,1$  s.

**3.5 Chinese emery grit**, a reference powder used for calibration of the funnel.<sup>1)</sup>

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.



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<sup>a</sup> These dimensions are mandatory.

Figure 1 — Calibrated funnel (Hall flowmeter)

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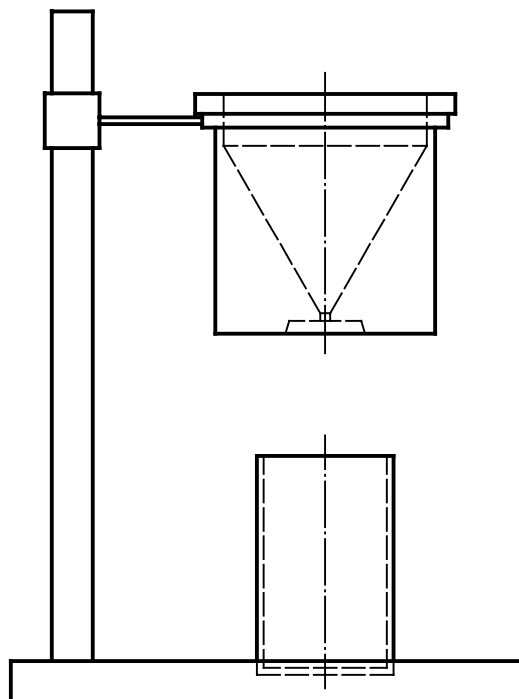


Figure 2 — Arrangement of calibrated funnel and stand

## 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  $40,0 \pm 0,5$  s.

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

NOTE 1 It is recommended that the users periodically verify whether a correction is needed or not.

NOTE 2 It is recommended that before a correction factor is adopted the cause of the change be investigated. If the flow time has decreased it is probable that repeated use has burnished the orifice and a (new) correction factor is justified. An increase in flow time may indicate a coating of soft powder on the orifice. This coating should be carefully removed and the calibration test repeated.

NOTE 3 It is recommended that the use of a funnel be discontinued after the flow time 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 supplier and user, the powder may be dried. However, if the powder is susceptible to oxidation, the drying shall take place in 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  $(50 \pm 0,1)$  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 stopwatch (3.4) when the orifice is opened and stop it at the instant 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 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

### 8.1 Repeatability

From spherical powders with shorter flow times than 20 s for 50 g, duplicated tests using the same equipment by the same operator on one homogenized batch of powder should be considered suspect, if they differ by more than 0,1 s at a 95 % confidence level.

### 8.2 Reproducibility

Adequate values are not available for this edition of ISO 4490.

## 9 Test report

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The test report shall include the following information:

- 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 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.



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