
International Standard



3953

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Metallic powders — Determination of tap density

Poudres métalliques — Détermination de la masse volumique après tassement

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Foreword

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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 3953 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*.

ISO 3953 was first published in 1977. This second edition cancels and replaces the first edition, of which it constitutes a minor revision.

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.

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Metallic powders – Determination of tap density

1 Scope and field of application

This International Standard specifies a method for the determination of tap density, i.e. the density of a powder that has been tapped in a container under specified conditions.

2 Principle

Tapping a specified amount of powder in a container by means of a tapping apparatus, until no further decrease of the volume of the powder takes place. The mass of the powder divided by its volume after the test gives its tap density.

By agreement, the tapping may be carried out by hand.

3 Symbols and designations

Table 1

| Symbol | Designation | Unit |
|----------|-----------------------------|------------------------|
| ρ_t | Tap density | g/cm^3 |
| m | Mass of the powder | g |
| V | Volume of the tapped powder | cm^3 |

4 Apparatus

4.1 Balance, of appropriate capacity and accuracy to satisfy the requirements shown in table 2.

4.2 Graduated glass cylinder, calibrated to contain 100 cm^3 , the height of the graduated portion being approximately 175 mm. The graduations shall be at 1 cm^3 intervals, thus allowing a measuring accuracy of $\pm 0,5 \text{ cm}^3$.

Alternatively :

Graduated glass cylinder, calibrated to contain 25 cm^3 , the height of the graduated portion being approximately 135 mm. The graduations shall be at $0,2 \text{ cm}^3$ intervals.

A 25 cm^3 cylinder shall be used for powders of apparent density higher than $4 \text{ g}/\text{cm}^3$, in particular for refractory metal powders, but may also be used for powder of lower apparent density.

4.3 Tapping apparatus, which permits the tapping of the graduated cylinder against a firm base. The tapping shall be

such that a densification of the powder can take place without any loosening of its surface layers. The stroke shall be 3 mm and the tapping frequency shall be between 100 and 300 taps per minute. An example of a tapping apparatus is shown in the figure.

Alternatively, by agreement only :

Hard rubber slab (about $100 \text{ mm} \times 100 \text{ mm} \times 5 \text{ mm}$).

5 Sampling

5.1 For the quantities of powder required for each test, see table 2.

Table 2

| Cylinder capacity | Apparent density | Mass of test portion |
|-------------------|------------------------|----------------------|
| cm^3 | g/cm^3 | g |
| 100 | > 1 | $100 \pm 0,5$ |
| 100 | < 1 | $50 \pm 0,2$ |
| 25 | > 7 | $100 \pm 0,5$ |
| 25 | 2 to 7 | $50 \pm 0,2$ |
| 25 | < 2 | $20 \pm 0,1$ |

5.2 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 vacuum or in inert gas. If the powder contains volatile substances, it shall not be dried.

5.3 The test shall be carried out on three test portions.

6 Procedure

6.1 Clean the inside wall of the graduated cylinder (4.2) with a suitable clean brush or, if necessary, by rinsing with a solvent, such as acetone. If a solvent is used, thoroughly dry the cylinder before re-use.

6.2 Weigh, to the nearest 0,1 g, the mass of the test portion as indicated in table 2, using the balance (4.1).

6.3 Pour the test portion into the graduated cylinder. Take care that a level surface of the powder is formed. Place the

cylinder in the tapping apparatus (4.3). Tap the cylinder until no further decrease in the volume of the powder takes place (see note 1).

By agreement, the tapping may be carried out as follows.

Tap the cylinder by hand against a hard rubber slab (see 4.3) until no further decrease in the volume takes place. Towards the end of the procedure, tap gently in order to avoid loosening the surface layers of the powder (see note 2).

NOTES

1 In practice, the minimum number of taps N such that no further change in volume takes place would be determined. For all further tests on the same type of powder, the cylinder would be subjected to $2N$ taps, except where general experience and acceptance had established a specific number of taps (no less than N taps) as being satisfactory. For fine refractory metal powders, 3 000 taps has been found to be satisfactory for all sizes.

2 In general, the mechanical and manual methods will give comparable results. However, for powders of very low apparent density, or for very fine powders, the results obtained by the two methods may be significantly different.

6.4 If the tapped surface is level, read the volume directly. If the tapped surface is not level, determine the tap volume by calculating the mean value between the highest and the lowest reading of the tapped surface. Read the final volume to the nearest 0,5 cm³ when using a 100 cm³ cylinder and to the nearest 0,2 cm³ when using a 25 cm³ cylinder.

7 Expression of results

The tap density is given by the formula

$$\rho_t = \frac{m}{V}$$

where ρ_t , m and V are as defined in table 1.

Report the arithmetical mean of the three determinations rounded to the nearest 0,1 g/cm³ for values up to and including 4 g/cm³ and to the nearest 0,2 g/cm³ for values greater than 4 g/cm³.

8 Test report

The test report shall include the following information :

- a) reference to this International Standard;
- b) all details necessary for identification of the test sample;
- c) the drying procedure, if the powder has been dried;
- d) cylinder capacity, mass of test portion and method used;
- e) the result obtained;
- f) all operations not specified in this International Standard or regarded as optional;
- g) details of any occurrence which may have affected the result.

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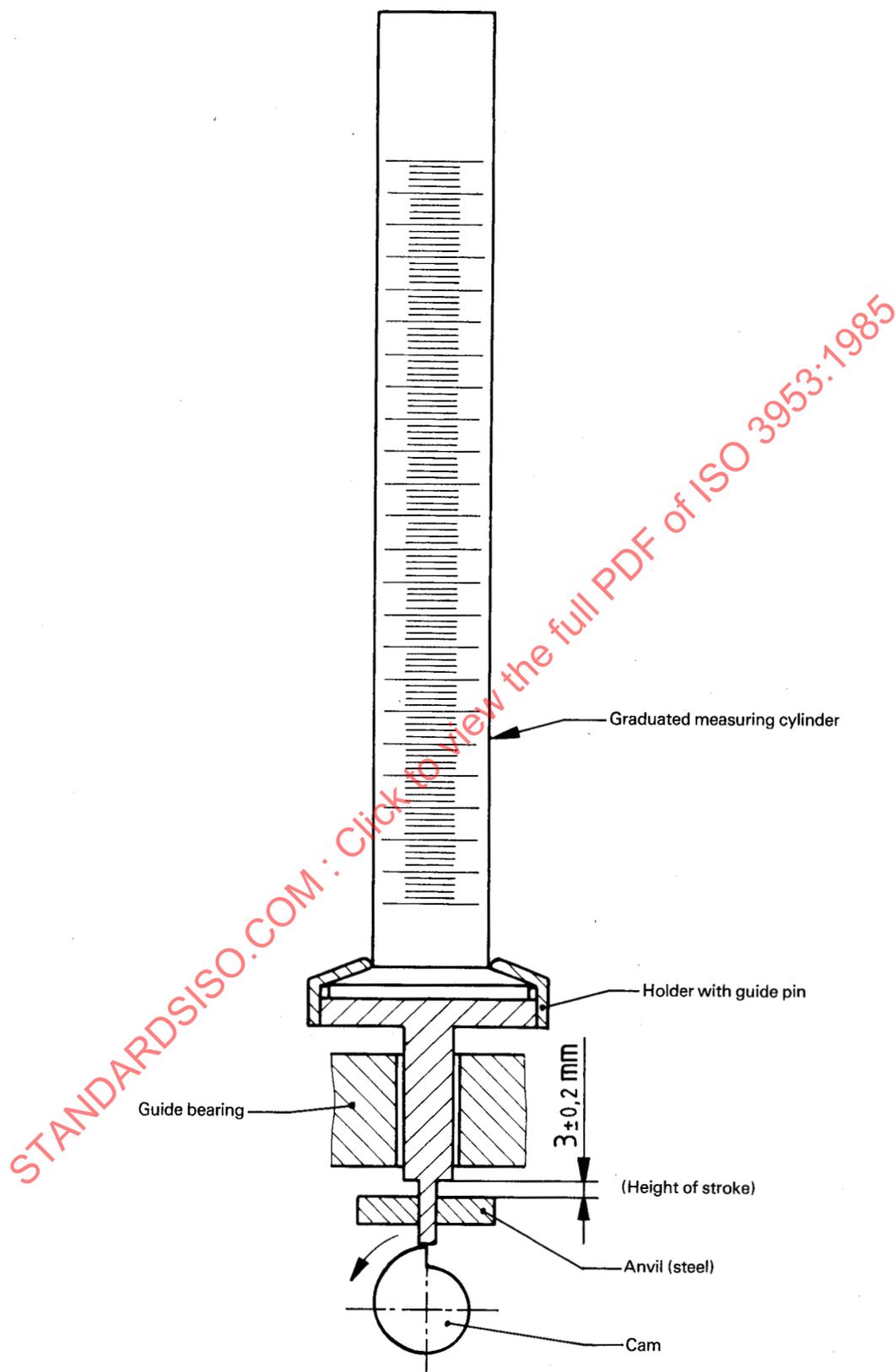


Figure — Example of tapping apparatus

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