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**Metallic powders — Determination of tap
density**

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*Poudres métalliques — Détermination de la masse volumique après
tassement*

ISO 3953:1993

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INTERNATIONAL

ISO



Reference number
ISO 3953:1993(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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

International Standard ISO 3953 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Sub-Committee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*.

This third edition cancels and replaces the second edition (ISO 3953:1985), in which table 2 has been modified.

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Metallic powders — Determination of tap density

1 Scope

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

A specified amount of powder in a container is tapped by means of a tapping apparatus until no further decrease in 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

Table 1

Symbol	Meaning	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 ap-

proximately 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 g/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 figure 1.

Alternatively, by agreement only:

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

5 Sampling

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

Table 2

Apparent density	Cylinder capacity	Mass of test portion
g/cm^3	cm^3	g
≥ 1	100	$100 \pm 0,5$
< 1	100	$50 \pm 0,2$
> 7	25	$100 \pm 0,5$
> 2 to 7	25	$50 \pm 0,2$
0,8 to 2	25	$20 \pm 0,1$
$< 0,8$	25	$10 \pm 0,1$

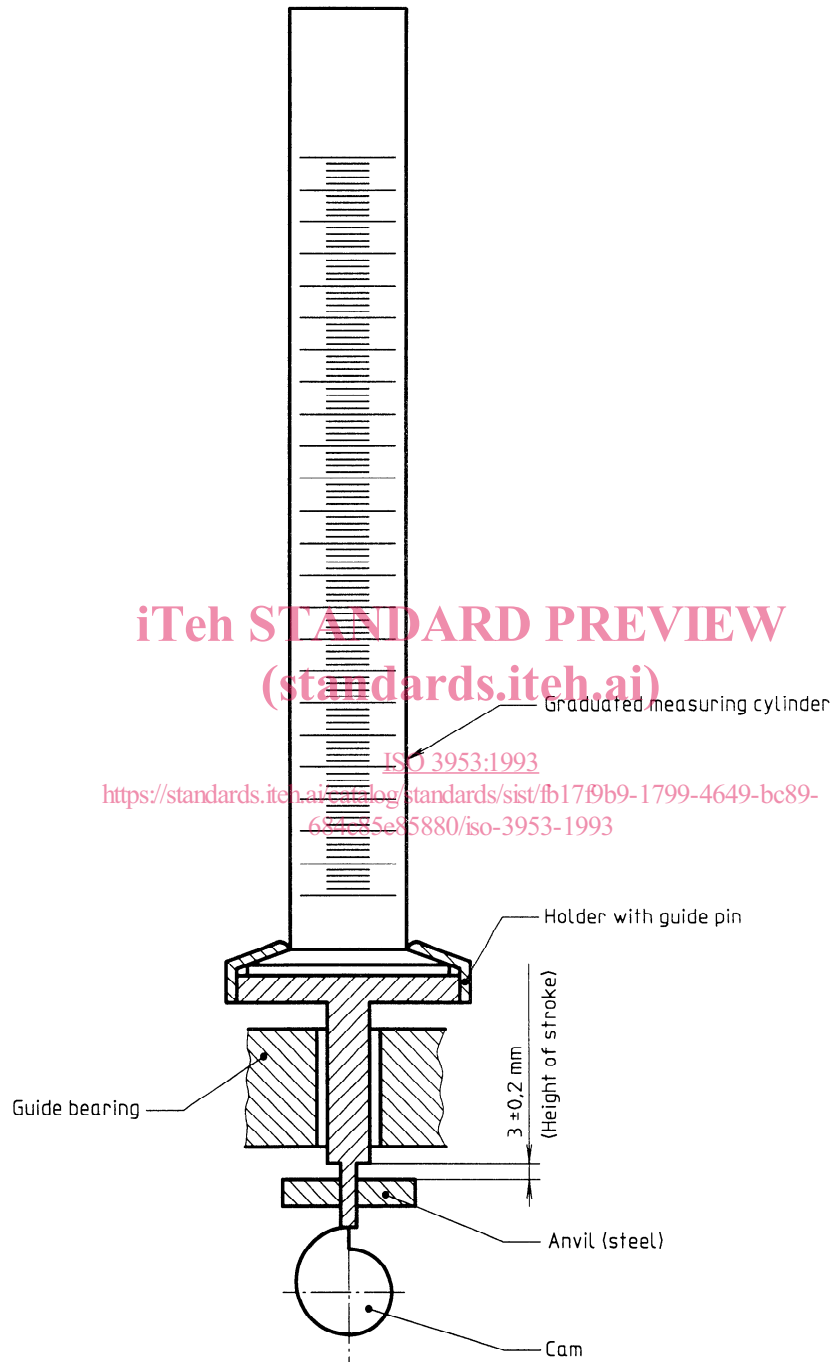


Figure 1 — Example of tapping apparatus

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 (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) 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) the cylinder capacity, mass of the 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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