INTERNATIONAL STANDARD

ISO 3927

Third edition
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Metallic powders, excluding powders for hardmetals — Determination of compressibility in uniaxial compression

Poudres métalliques, à l'exclusion des poudres pour métaux-durs — Détermination de la compressibilité sous compression uniaxiale

Reference number
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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 3927 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 3927:1985), which has been technically revised.

Metallic powders, excluding powders for hardmetals — Determination of compressibility in uniaxial compression

1 Scope

This International Standard specifies methods for measuring the extent to which a metallic powder is compacted when subjected to uniaxial compressive loading in a confining die under specified conditions.

The method is not applicable to powders for hardmetals.

2 Symbols

For the purposes of this International Standard, the symbols given in Table 1 apply.

Table 1 — Symbols

Symbol	Meaning	Unit
ρ_p	Compressibility[a]	g/cm^3
m	Mass of the compact	g
V	Volume of the compact	cm^3

[a] If the compressibility is measured at one pressure only, e.g. 400 N/mm^2, the symbol becomes $\rho_{p(400)}$.

3 Principle

Uniaxal compaction of a powder in a confining die by double action pressing. Samples of the powder may be pressed either at a single specified pressure or at a series of specified pressures. After ejection from the die, the density of the compacts is determined.

The density obtained in the former case represents the compressibility of the powder at the specified pressure. The densities obtained in the latter case can be utilized for drawing the compressibility curve of the powder, i.e. a plot of the density as a function of the compacting pressure.

4 Apparatus

4.1 Die, preferably of cemented carbide, or alternatively of tool steel, and **two punches** for producing either cylindrical or rectangular compacts.

The cylindrical die should be capable of making compacts of diameter 20 mm to 26 mm and a height to diameter ratio between 0,8 and 1. An example of a design for tooling is shown in Figure 1.

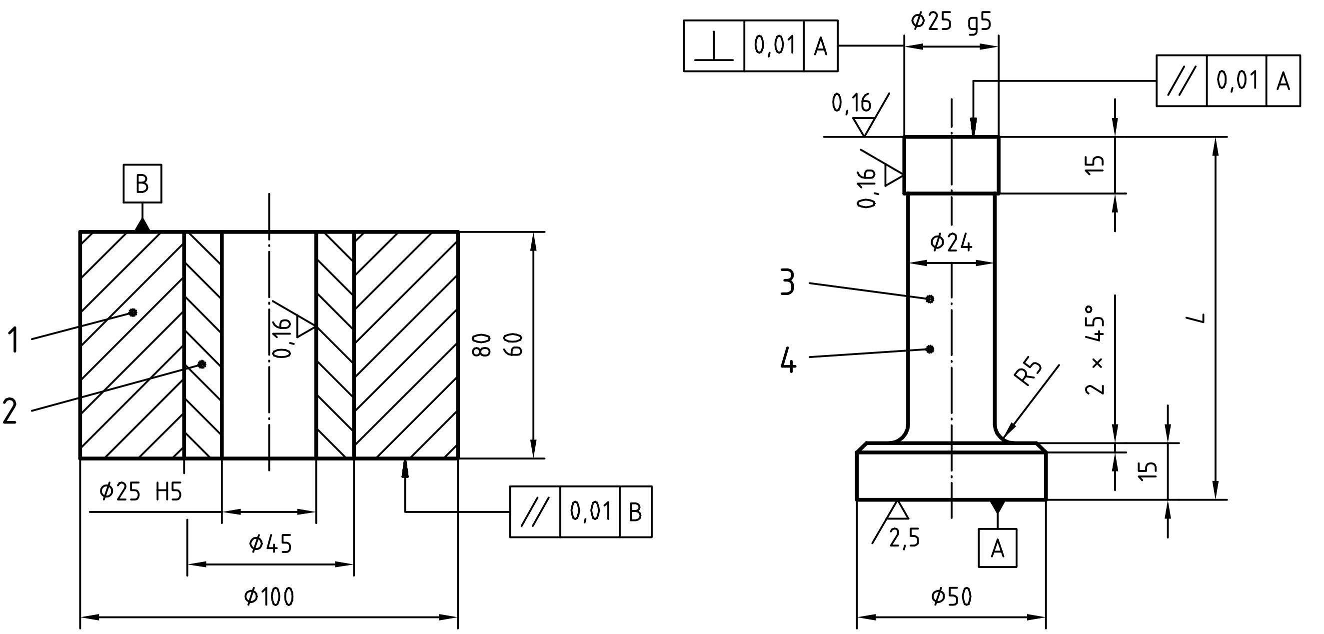
The rectangular die should be capable of making compacts 30 mm × 12 mm and of thickness 5 mm to 7 mm. An example for a design for tooling is shown in Figure 2.

Mating parts shall be fitted and lapped.

4.2 Press, capable of applying forces up to aproximately 500 kN with a minimum accuracy of ± 1 % and adjustable to permit an even increase of the force at a rate not higher than 50 kN/s.

4.3 Balance, capable of weighing at least 100 g to an accuracy of ± 0,01 g.

Dimensions in millimetres



a) Die b) Punches

Key

1 Shrink ring

2 Cemented carbide

3 Upper punch, $L = H - 10$

4 Lower punch, $L = H + 35$

Figure 1 — Example of tooling to produce a cylindrical test piece

4.4 Micrometer or other suitable measuring device for measuring the dimensions of the compacts to an accuracy of $\pm$ 0,01 mm.

5 Sampling

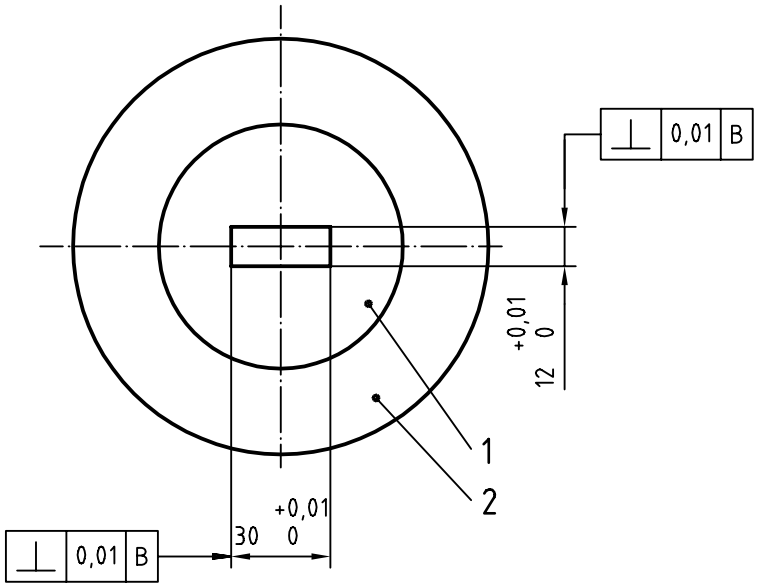
The quantity of the test sample shall be chosen to give the required number of test pieces (see clause 7) with the dimensions specified in 4.1. If necessary, preliminary tests should be made in order to establish the quantity of powder needed for fulfilling this requirement.

6 Procedure

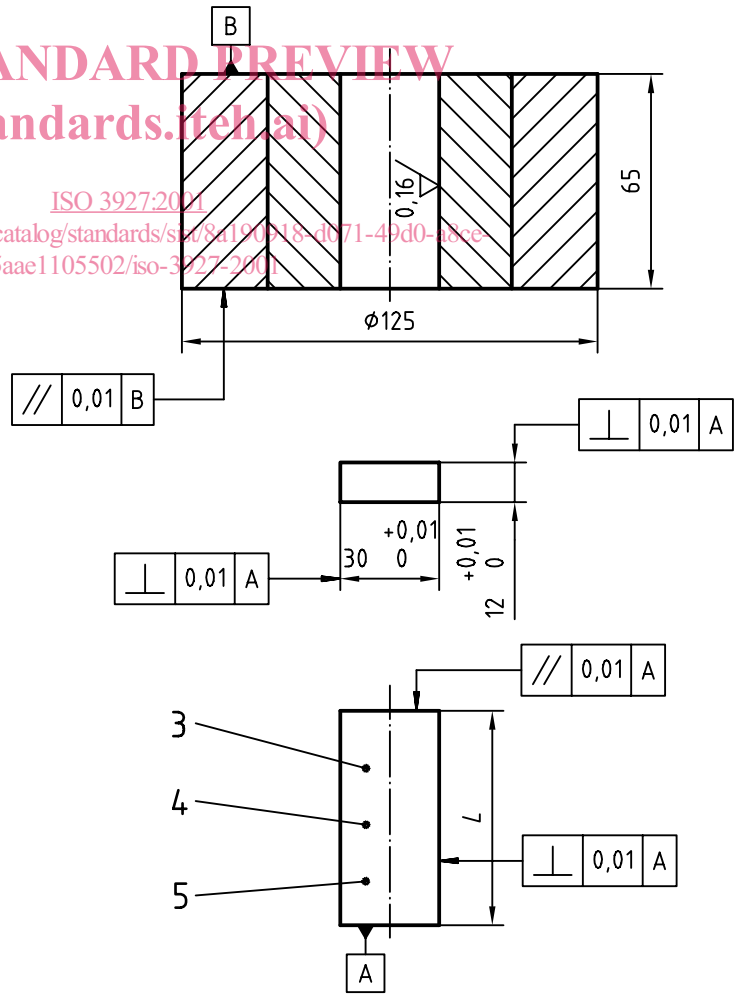
6.1 Cleaning of the die and punches

Wipe the die cavity and the punches with soft and clean paper towelling soaked with an appropriate solvent such as acetone. Allow the solvent to evaporate.

Dimensions in millimetres



a) Die



Key

1	Cemented carbide
2	Shrink ring
3	Steel, HRC 60 to 62
4	Upper punch, $L = 25$
5	Lower punch, $L = 70$

b) Punches

Figure 2 — Example of tooling to produce a rectangular test piece

6.2 Powder testing conditions

6.2.1 Powders which do not contain a lubricant can be tested

a) in a dry die,

WARNING — Seizure and excessive die wear may occur, particularly at high compacting pressures

b) in a die with lubricated walls (see 6.3.1), and

c) after admixing a lubricant (see 6.3.2) and in a dry die.

6.2.2 Powders which contain a lubricant can be tested

a) in a dry die, and

b) after admixing additional lubricant (see 6.3.2) and in a dry die.

6.3 Lubrication

6.3.1 General

Use one of the two following methods of lubrication.

6.3.2 Die wall lubrication

Apply to the die walls a mixture or a solution of a lubricant in a volatile organic liquid, e.g., 100 g of zinc stearate in 1 000 cm^3 of acetone. After any excess liquid has drained away, allow the solution adhering to the walls to evaporate leaving a thin layer of lubricant.

6.3.3 Lubrication of powder

Lubricate the powder to be tested by thoroughly mixing into it a quantity (e.g. 0,5 % to 1,5 %) of a suitable solid lubricant (e.g. zinc stearate or synthetic wax).

6.4 Compacting and ejection

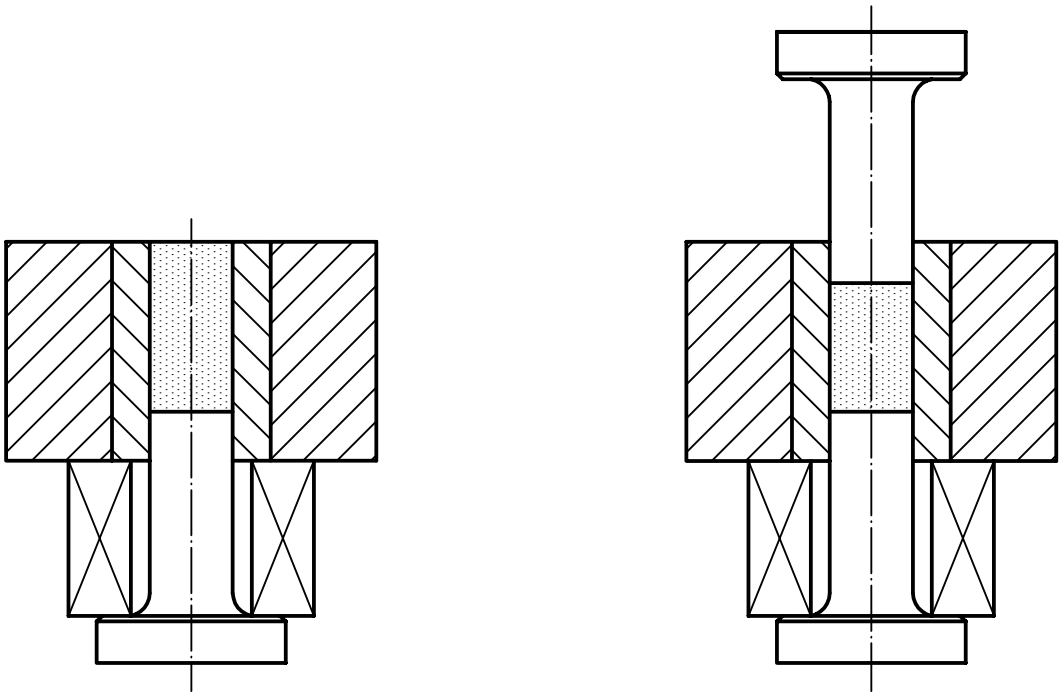
Insert the lower punch into the die cavity. Position the die to the desired filling height by using supporting spacers between the die and the foot of the lower punch. Pour the sample into the die cavity, taking the usual precautions to ensure that the powder is uniformly distributed in the die cavity. Position the upper punch and place the die with the punches between the platens of the press. Apply and release a preliminary force of approximately 20 kN. Remove the spacers supporting the die. If the die is supported by springs, or in some similar way, it is not necessary to apply the preliminary force.

Apply the final force at a constant rate that shall not exceed 50 kN/s. Release the force as soon as the predetermined pressure is reached.

Eject the compact from the die by means of the lower punch.

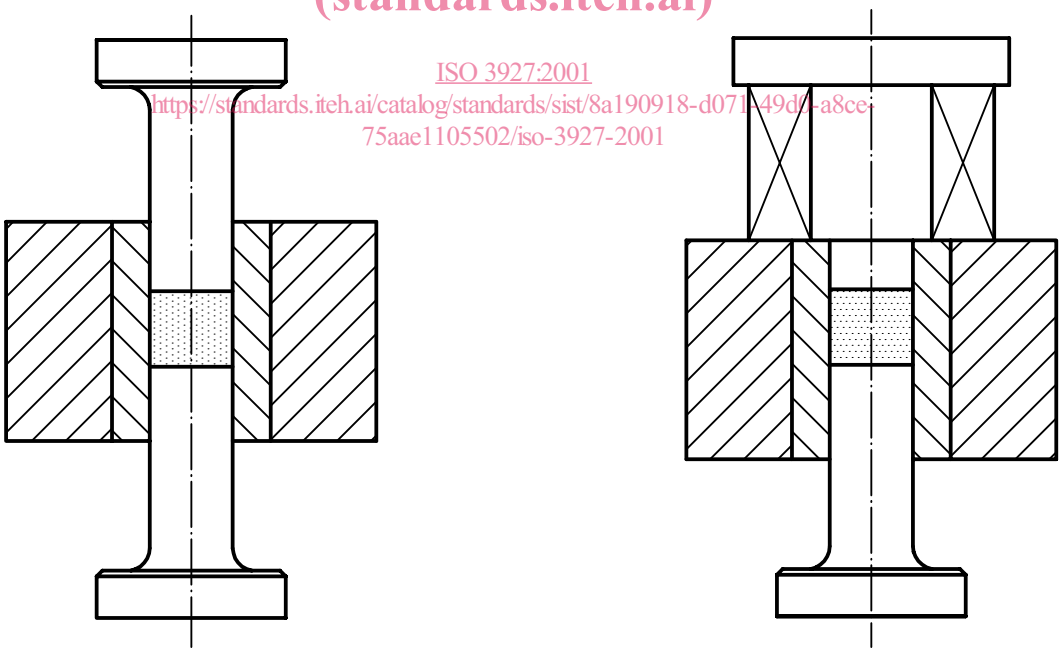
The procedure of compacting and ejection is exemplified in Figure 3.

After ejection and, if necessary, deburring, weigh the compact to the nearest 0,01 g. Measure its dimensions to the nearest 0,01 mm.



a) Filling

b) Pre-compacting



c) Compacting

d) Ejection

Figure 3 — Procedure of compacting and ejection