INTERNATIONAL STANDARD

ISO 4492

Third edition
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Metallic powders, excluding powders for hardmetals — Determination of dimensional changes associated with compacting and sintering

Poudres métalliques à l'exclusion des poudres pour métaux-durs — Détermination de changements dimensionnels liés à la compression et au frittage

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4492 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 4492:1985), of which it constitutes a minor revision.

Metallic powders, excluding powders for hardmetals — Determination of dimensional changes associated with compacting and sintering

1 Scope

This International Standard specifies a method by which the dimensional changes associated with compacting and sintering of metallic powders are compared with those of a reference powder when processed under similar conditions. (See Clause 4.)

The method applies to the determination of three types of dimensional changes involved with the processing of metallic powders, excluding powders for hardmetals.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2740, *Sintered metal materials, excluding hardmetals — Tensile test pieces*

ISO 3927, *Metallic powders, excluding powders for hardmetals — Determination of compressibility in uniaxial compression*

3 Principle

Compaction of a metallic powder or powder mix with admixed lubricant was used to produce a test piece that was sintered under controlled conditions. Depending upon the particular dimensional change required, measurement of the dimension of the uploaded die cavity, the green compact, and/or the sintered test piece is calculated. The algebraic difference between these various measurements is calculated as a percentage of the dimension of the die cavity or the green compact. (See Clause 9.)

Standard test pieces made from a reference lot of powder are processed together with the sample under test and the dimensional changes of the two powders are reported.

4 Test parameters

The reference powder shall be chosen by agreement between the supplier and user and shall have a composition and properties as close as possible to those of the powder to be tested.

The following three types of dimensional changes are dealt with in this International Standard:

4.1 From die size to green size (spring back): The increase in dimensions of a compact, measured at right angles to the direction of pressing, after being ejected from the die.

4.2 From green size to sintered size (sintered dimensional change): The change in dimensions of an object that occurs as a result of sintering.

4.3 From die size to sintered size (total dimensional change).

5 Symbols and désignations

Table 1 — Symbols

Symbol	Designation	Unit
d_D	Test dimension of unloaded die	mm
d_G	Test dimension of green compact	mm
d_S	Test dimension of sintered compact	mm
$\Delta\ d_{DG}$	Spring back	% (+)
$\Delta\ d_{GS}$	Sintered dimensional change	% (+ or −)
$\Delta\ d_{DS}$	Total dimensional change	% (+ or −)

6 Apparatus

6.1 Tools set, that will produce cylindrical (see Figure 1), rectangular (see Figure 2) or tensile test pieces (in accordance with ISO 2740), or test pieces similar to the actual components for which the powder is required.

6.2 Press, capable of applying the pressures necessary to achieve the required density or required compacting pressure. See Figure 3.

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

6.4 Micrometer, or other suitable measuring device for measuring the dimensions of the compacts and the die to an accuracy of ± 0,005 mm.

6.5 Sintering furnace, capable of producing sintering conditions (time-temperature curve and atmosphere) as close as possible to those used in industry for the type of material to be tested.

7 Sampling

Representative quantities of both the test and the reference powders sufficient to give at least three compacts shall be taken.

8 Procedure

8.1 The test powder and the reference powder shall be mixed under the same conditions with the same mass of additives, including lubricant, each taken from the same batch, to produce the composition of the sintered components for which the powder is required.

A test powder supplied ready for pressing shall be tested in the as-received condition.

To avoid the possibility of distortion during sintering, it is recommended that the test pieces should not be less than 5 mm thick.

8.2 Measure, to the nearest 0,005 mm, the test dimension (diameter or length) of the die in the unloaded condition and record the value d_D obtained.

8.3 Press, at the agreed density or agreed compacting pressure, at least three compacts from the test and reference powders prepared as in 8.1.

8.4 Measure, to the nearest 0,005 mm, the test dimension of the green compact and record the value d_G obtained.

8.5 Sinter the test and reference compacts adjacent to each other under the conditions of time, temperature, and atmosphere, which simulate production conditions to be used for the sintered components for which the test powder is required.

NOTE The support used for the test pieces to prevent distortion (i.e. ceramic plate or furnace belt), the rate of heat-up, the atmosphere, and the cooling rate may affect the dimensional change being measured and should be consistent.

8.6 After cooling to room temperature, measure, to the nearest 0,005 mm, the test dimension of the sintered test and reference compacts and record the value d_S obtained, ensuring that the dimensions before and after sintering are taken from the same position on the compacts.

9 Expression of results

9.1 The dimensional changes, expressed as percentages, are given by the following formulae:

9.1.1 Green dimensional change (spring back)

$$\Delta d_{DG} = \frac{d_G - d_D}{d_D} \times 100$$

9.1.2 Sintered dimensional change (positive or negative)

$$\Delta d_{GS} = \frac{d_S - d_G}{d_G} \times 100$$

9.1.3 Total dimensional change (positive or negative)

$$\Delta d_{DS} = \frac{d_S - d_D}{d_D} \times 100$$

9.2 Report the dimensional changes for both the test and reference powders as the average of at least three determinations, rounded to the nearest 0,01 %.

10 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) all details necessary for identification of the reference powder;

d) the type of test piece, and its dimensions before sintering;

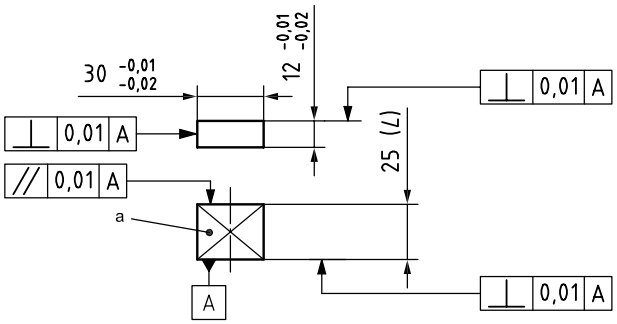
e) the density of the green compact or if the compacts were pressed to a required compacting pressure;

f) sintering details;

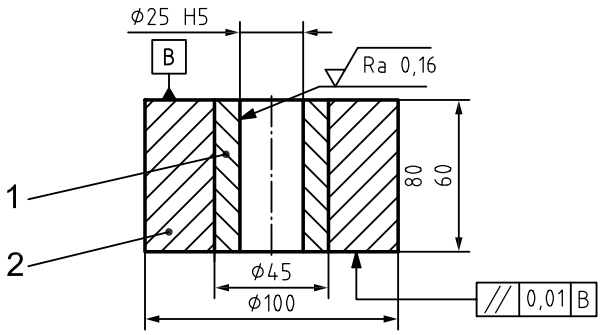
g) the result obtained;

h) all operations not specified by this International Standard, or regarded as optional;

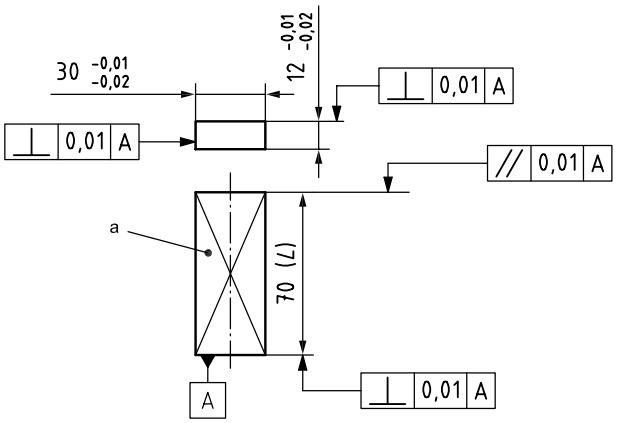
i) details of any occurrence which may have affected the result.



a) Upper punch, $L = H - 10$



b) Die, $H = 60$ to 80

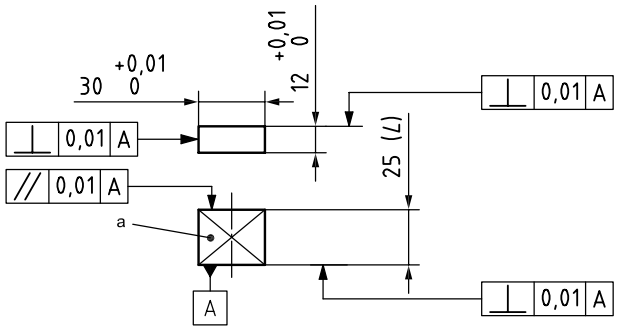


c) Lower punch, $L = H + 35$

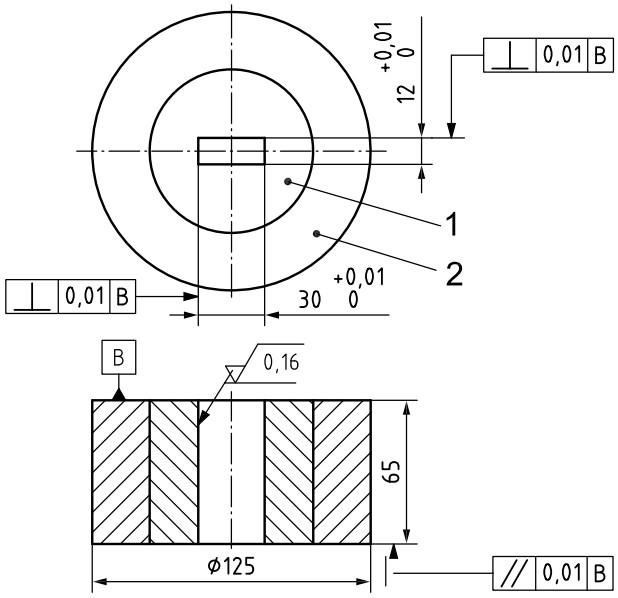
Key

1 cemented carbide
2 shrink ring
H height of tool die

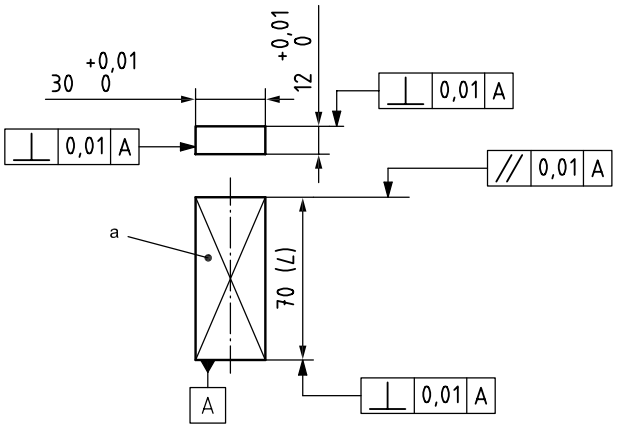
Figure 1 — Example of tooling to produce a cylindrical test piece



a) Upper punch, L = 25



b) Die



c) Lower punch, L = 70

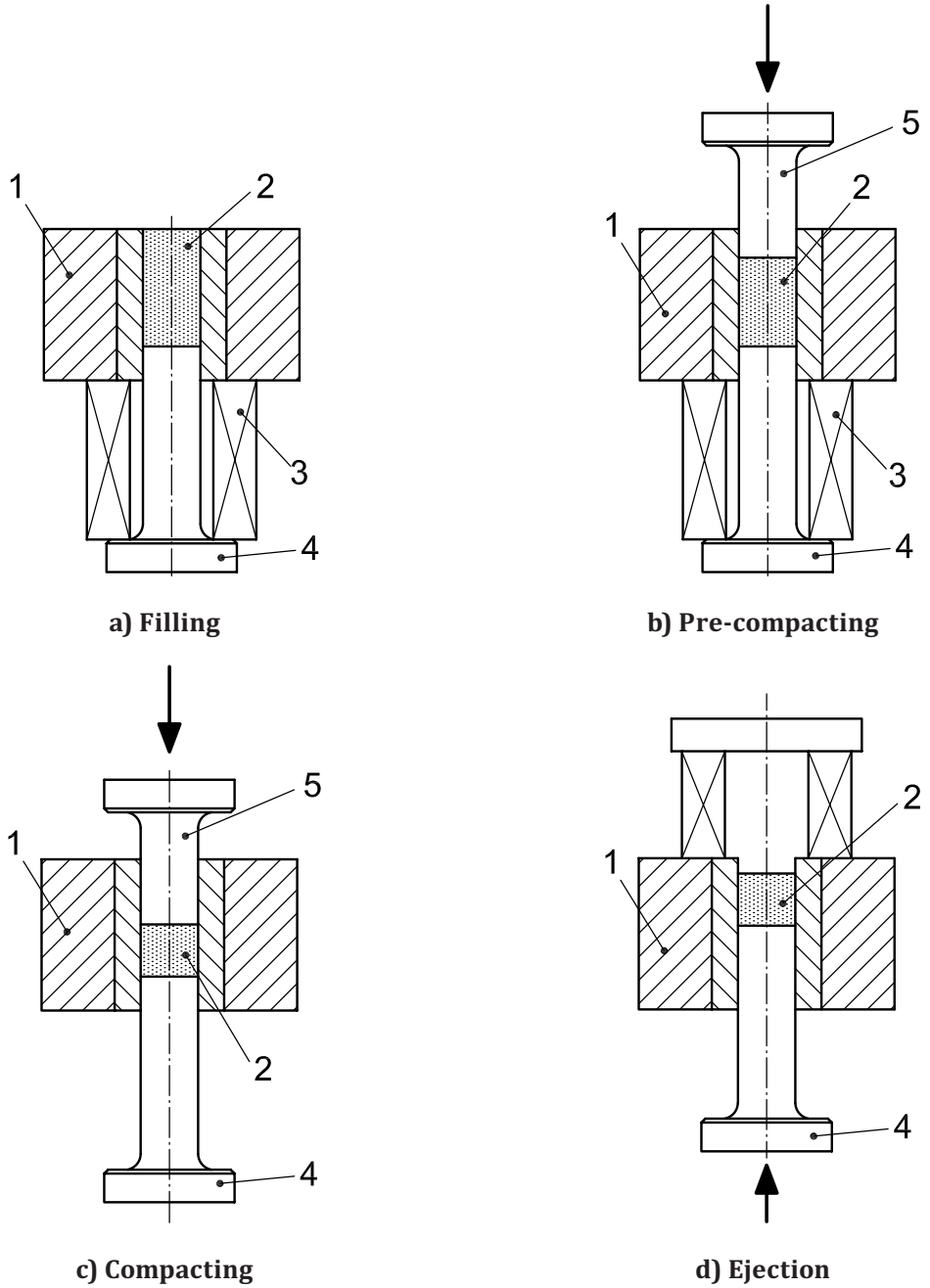
Key

1 cemented carbide

2 shrink ring

[a] steel HRC 60 to 62

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



a) Filling **b) Pre-compacting**

c) Compacting **d) Ejection**

Key

1 tool die
2 sample powder
3 spacer
4 lower punch
5 upper punch

Figure 3 — Procedure of compacting and ejection

Annex A
(informative)

Information on dimensional change behaviour

The inclusion of information on dimensional change behaviour in technical literature, which is supplied by powder producers regarding various properties of their products, is of great value to the powder-consuming industry. It is recommended that such data be given with reference to the dimensional change behaviour of well-established grades of powder after testing, in accordance with this International Standard.

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Price based on 8 pages