INTERNATIONAL STANDARD 4492

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

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 des changements dimensionnels liés à la compression et au frittage

First edition — 1978-07-01

UDC 621.762.4/.5 : 531.71 **Ref. No. ISO 4492-1978 (E)**

Descriptors : metallic powder, compacting, sintering, tests, dimensional stability tests, dimensional measurement.

Price based on 5 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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.

International Standard ISO 4492 was developed by Technical Committee ISO/TC 119, *Powder metallurgical materials and products*, and was circulated to the member bodies in June 1977.

It has been approved by the member bodies of the following countries :

Australia	Germany	South Africa, Rep. of
Austria	Ireland	Spain
Bulgaria	Italy	Sweden
Canada	Korea, Rep. of	United Kingdom
Chile	Mexico	U.S.A.
Czechoslovakia	Poland	U.S.S.R.
Egypt, Arab Rep. of	Portugal	Yugoslavia
France	Romania	

No member body expressed disapproval of the document.

Printed in Switzerland

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

1 SCOPE AND FIELD OF APPLICATION

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 REFERENCES

ISO 2740, *Sintered metal materials (excluding hard-metal) — Tensile test pieces.*

ISO 3927, *Metallic powders, excluding powders for hard-metals — Determination of compactibility (compressibility) in uniaxial compression.*

3 PRINCIPLE

Compacting a metallic powder or powder mix with admixed lubricant to produce a test piece and then sintering it under controlled conditions. Depending upon the particular dimensional change required, measurement of the dimensions of the unloaded die cavity, the green compact and/or the sintered test piece. Calculation of the algebraic difference between these various measurements 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 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 change 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 DESIGNATIONS

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
Δd_{DG}	Spring back	% (+)
Δd_{GS}	Sintered dimensional change	% (+ or −)
Δd_{DS}	Total dimensional change	% (+ or −)

6 APPARATUS

6.1 Tool 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.

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 be not 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 at least three compacts from both 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) 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;

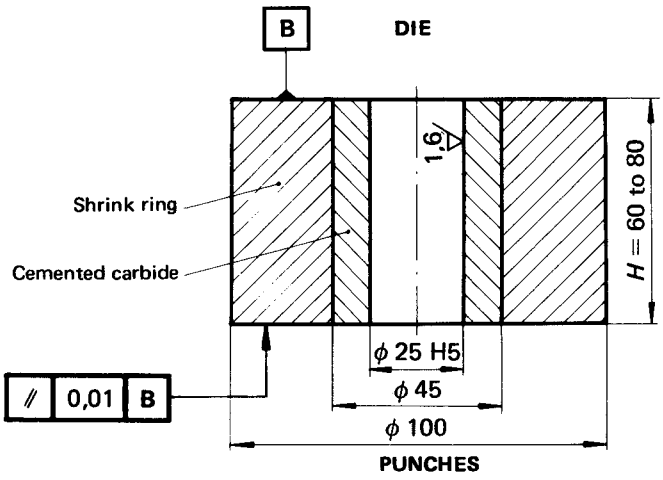
f) sintering details;

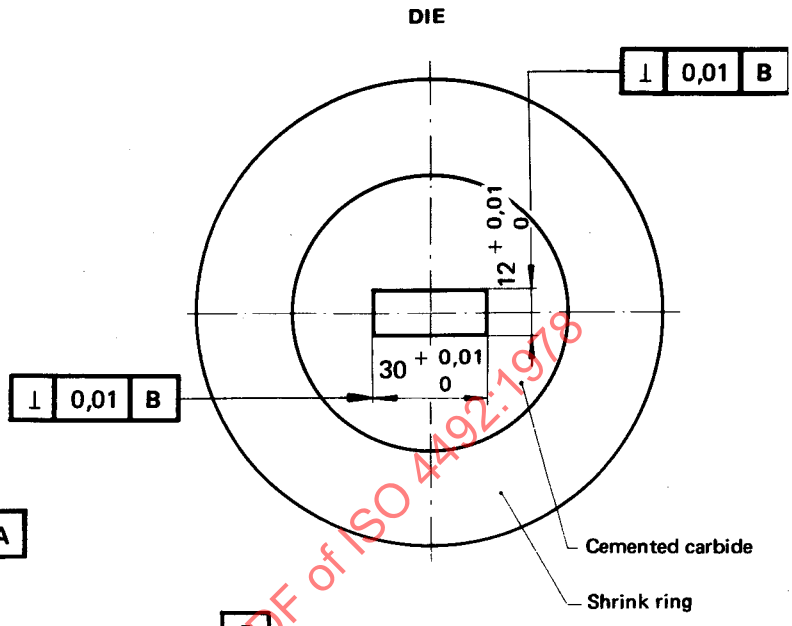
g) the result obtained;

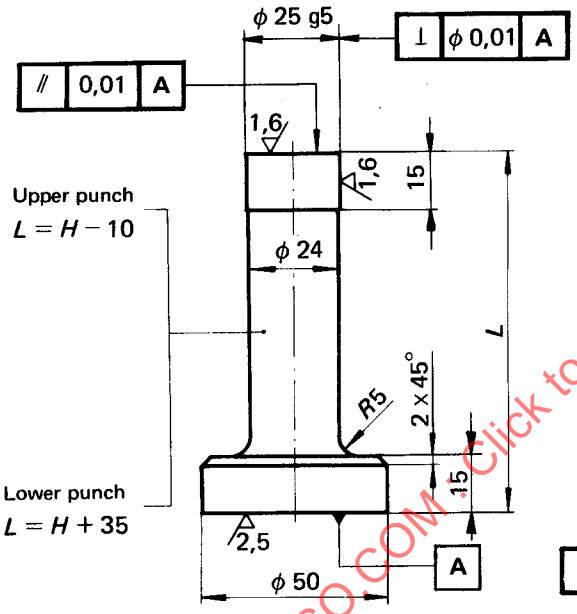
h) all operations not specified by this International Standard, or regarded as optional;

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

Dimensions in millimetres







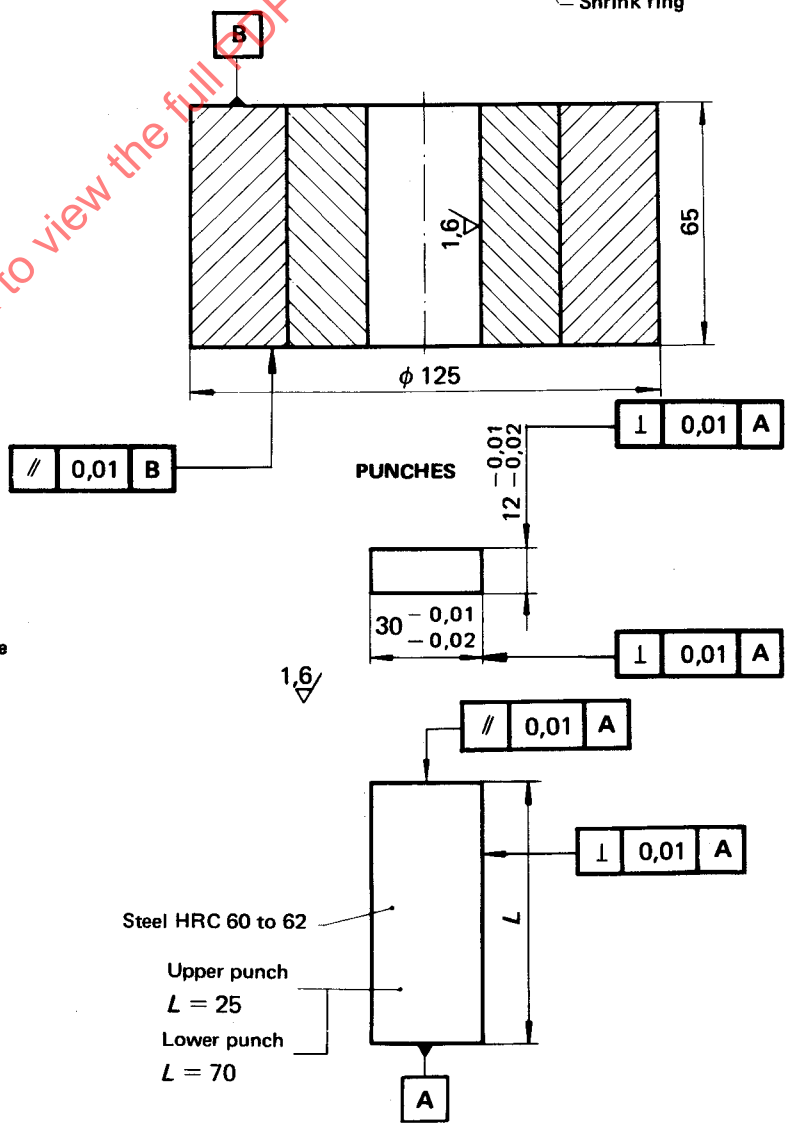


FIGURE 1 – **Example of tooling to produce a cylindrical test piece**

NOTE – Mating parts shall be fitted and lapped.

FIGURE 2 – **Example of tooling to produce a rectangular test piece**

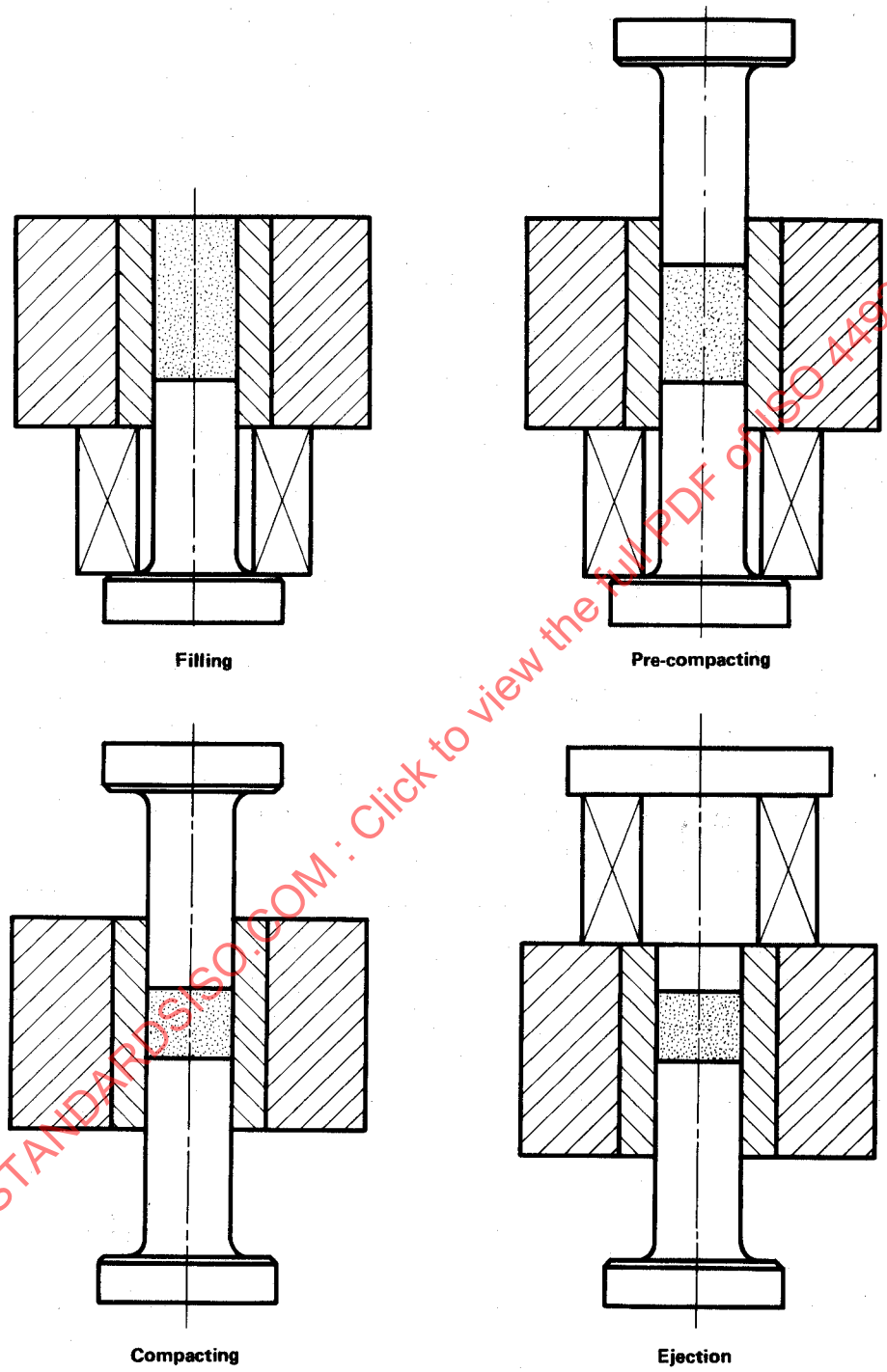


FIGURE 3 — **Production of a compact**