INTERNATIONAL STANDARD ISO 3927

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

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

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

First edition — 1977-01-15

UDC 621.762.4 : 539.58

Ref. No. ISO 3927-1977 (E)

Descriptors : powder metallurgy, metal powder, tests, compression tests, compressibility.

Price based on 4 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 3927 was drawn up by Technical Committee ISO/TC 119, *Powder metallurgical materials and products,* and was circulated to the member bodies in October 1975.

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

Austria	Italy	Sweden
Brazil	Japan	Turkey
Canada	Mexico	United Kingdom
Czechoslovakia	Poland	U.S.A.
Egypt, Arab Rep. of	Portugal	U.S.S.R.
France	Romania	Yugoslavia
Germany	Spain	

No member body expressed disapproval of the document.

Printed in Switzerland

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

1 SCOPE AND FIELD OF APPLICATION

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

This test method is not applicable to powders for hardmetals.

2 PRINCIPLE

The test consists in compacting a powder uniaxially 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 compactibility of the powder at the specified pressure. The densities obtained in the latter case can be utilized for drawing the compactibility (compressibility) curve of the powder, i.e. a plot of the density as a function of the compacting pressure.

3 SYMBOLS AND DESIGNATIONS

Symbol	Designation	Unit
ρ_p	Compactibility	g/cm^3
m	Mass of the compact	g
V	Volume of the compact	cm^3

If the compactibility is measured at one pressure only, for example 400 N/mm^2, the symbol becomes $\rho_{p(400)}$.

4 APPARATUS

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

4.1.1 The cylindrical die should be capable of making compacts of diameter 20 to 26 mm and a height to diameter ratio between 0,8 and 1. A recommended tool design is shown in figure 1.

4.1.2 The rectangular die should be capable of making compacts 30 mm × 12 mm and of thickness 5 to 7 mm. A recommended tool design is shown in figure 2.

4.2 Press, capable of applying forces up to about 500 kN with a minimum accuracy of ± 2 % 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.

4.4 Micrometer or other suitable measuring device for measuring the dimensions of the compacts to an accuracy of ± 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 which is 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.

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);

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;

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

6.3 Lubrication

Use one of the two following methods of lubrication.

6.3.1 *Die wall lubrication*

Apply to the die walls a mixture or a solution of a lubricant in a volatile organic liquid, for example 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.

6.3.2 *Lubrication of powder*

Lubricate the powder to be tested by thoroughly mixing into it a quantity (for example 0,5 to 1,5 %) of a suitable solid lubricant (for example zinc stearate or stearic acid).

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 which shall not exceed 50 kN/s.

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.

6.5 Compacting pressures

For determining the compactibility curve of a powder at a series of pressures, the applied pressures shall be 200, 400, 500, 600 and 800 N/mm^2. If compactibility is to be determined at a single pressure only, it shall be measured at one of the pressures given above.

7 EXPRESSION OF RESULTS

7.1 The density of the compact is given by the formula

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

Report the density to the nearest 0,01 g/cm^3.

7.2 Report the compactibility as the average of the three density figures, calculated to the nearest 0,01 g/cm^3, obtained at the specified compacting pressure.

7.3 The compactibility curve of a powder is drawn through points representing single determinations of ρ_p at the specified compacting pressures.

8 TEST REPORT

The test report shall include the following information :

a) reference to this International Standard;

b) all details necessary for the identification of the test sample;

c) the type of test piece;

d) the type, nature and amount of the lubricant, if it has been added to the powder; in certain cases it may be desirable to report how the lubricant was added;

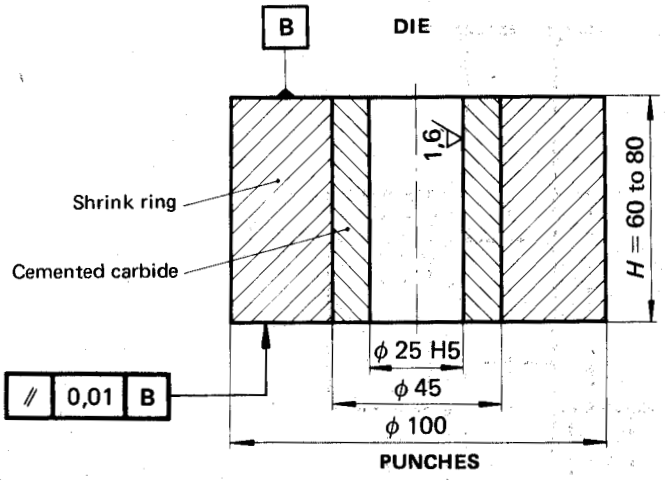
e) the compacting pressures;

f) the result obtained;

g) all operations not specified in this International Standard, or regarded as optional;

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

Dimensions in millimetres



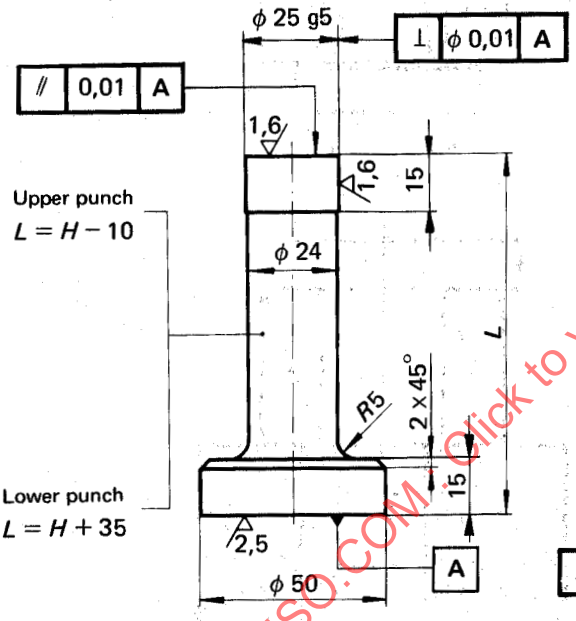
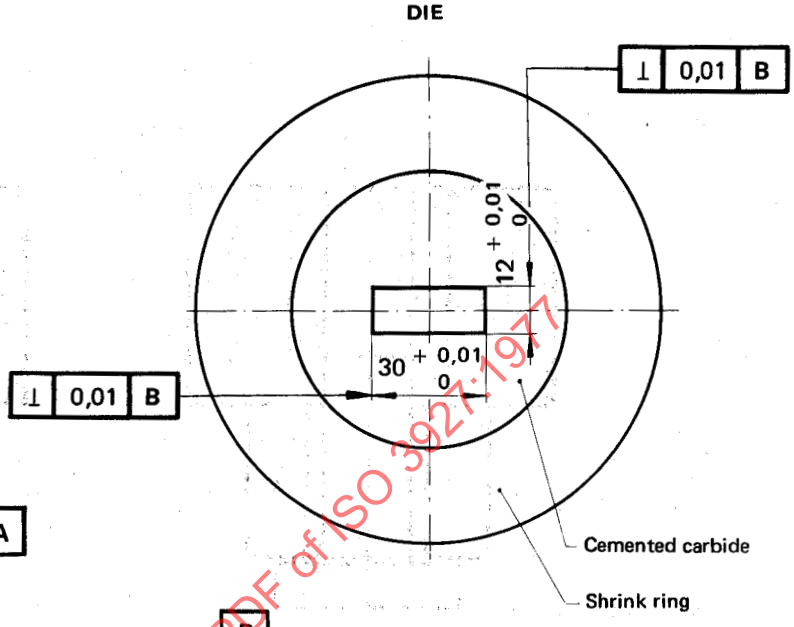
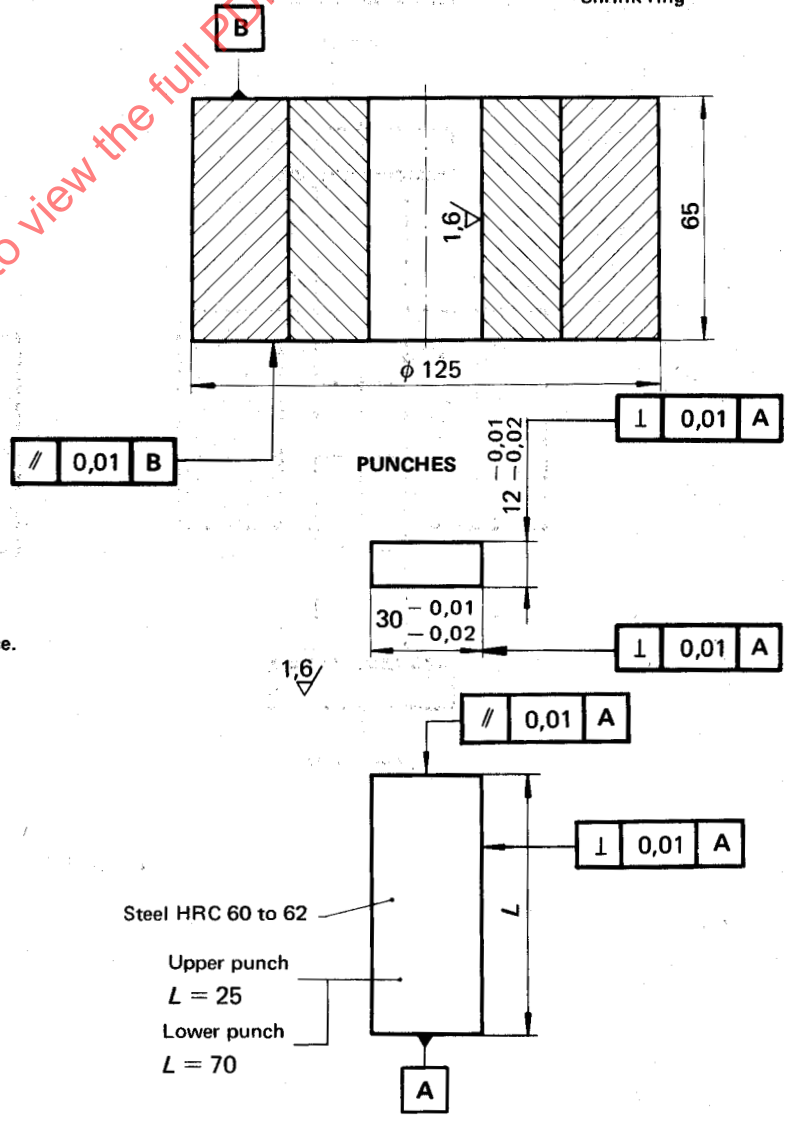


FIGURE 1 – **Example of tooling to produce a cylindrical test piece.**





NOTE – Mating parts shall be fitted and lapped.

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

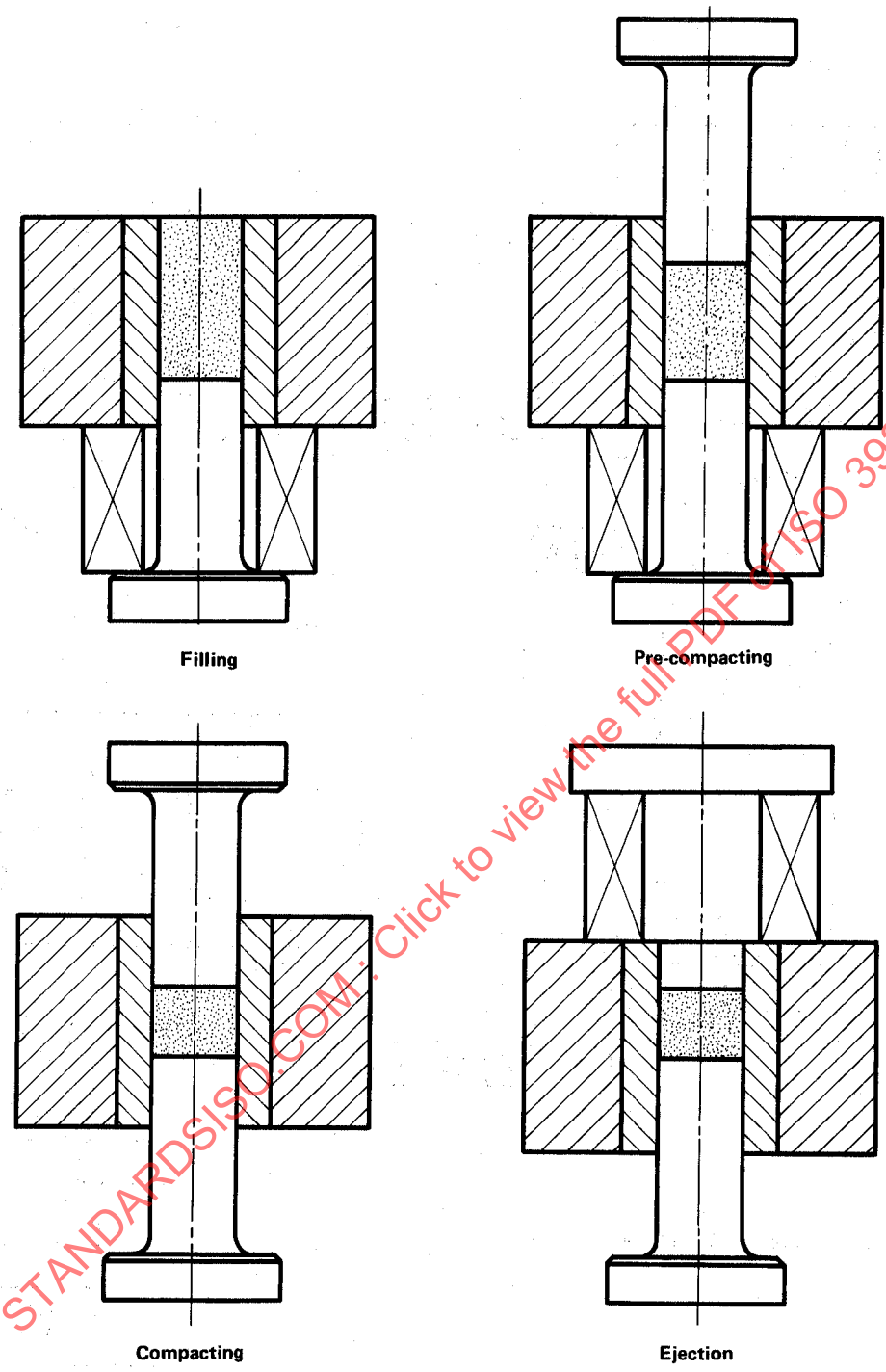


FIGURE 3