International Standard 3327

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

Hardmetals — Determination of transverse rupture strength

Métaux-durs — Détermination de la résistance à la flexion

Second edition — 1982-08-15

UDC 669.018.25 : 620.174.24 **Ref. No. ISO 3327-1982 (E)**

Descriptors : powder metallurgy, sintered products, hardmetals, tests, mechanical tests, bend tests, determination, mechanical strength.

ISO 3327-1982 (E)

Foreword

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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 3327 was developed by Technical Committee ISO/TC 119, *Powder metallurgy,* and was circulated to the member bodies in August 1981.

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

Bulgaria	India	South Africa, Rep. of
China	Ireland	Spain
Czechoslovakia	Italy	Sweden
Egypt, Arab Rep. of	Korea, Rep. of	Switzerland
France	Poland	United Kingdom
Germany, F.R.	Romania	USSR

The member body of the following country expressed disapproval of the document on technical grounds:

USA

This second edition cancels and replaces the first edition (i.e. ISO 3327-1975).

Printed in Switzerland

Hardmetals — Determination of transverse rupture strength

1 Scope

This International Standard specifies a method for the determination of the transverse rupture strength of hardmetals.

2 Field of application

The method is applicable to hardmetals of negligible ductility. If it is used for hardmetals showing significant plastic deformation before breaking, incorrect results may be obtained. In such instances, the method may be used for comparison purposes only.

3 Symbols and designations

See table 1.

Table 1 — Symbols and designations

Symbol	Designation	Unit
F	Force required to fracture the test piece	N
l	Distance between supports	mm
b	Width of test piece perpendicular to its height	mm
h	Height of test piece parallel to the direction of application of the test force	mm
k	Correction factor to compensate for the chamfer	
R_{bm}	Transverse rupture strength	N / mm²

4 Principle

Breaking a test piece lying freely on two supports by application of a force at the midpoint of the span under conditions of short-term static application of the force.

5 Apparatus

5.1 The test equipment shall comprise any device capable of applying a uniformly increasing force with an accuracy of 1 % or better.

5.2 The fixture for testing shall have two freely lying support cylinders (rollers) with a fixed distance between them and a freely lying force cylinder (roller). The three cylinders shall be of equal diameter between 3,2 and 6 mm.

Alternatively, the force may be applied by a ball having a diameter of 10 mm.

The support cylinders and the force cylinder or ball shall be made of tungsten carbide hardmetal which will not be visibly deformed by the applied force. The surface roughness R_a of the cylinders and of the ball shall not be greater than 0,63 µm.

5.3 The support cylinders shall be mounted parallel, with a span between them of 30 ± 0,5 mm for type A test pieces and 14,5 ± 0,5 mm for type B test pieces. The measurement of the span used for the calculation shall be made to an accuracy of 0,1 mm for type B test pieces and to an accuracy of 0,2 mm for type A test pieces.

5.4 The mounting of the cylinders shall be such as to minimize deviations from parallelism of the support cylinders.

5.5 For safety, the fixture shall be surrounded by a suitable protective guard.

6 Test pieces

6.1 The test pieces shall be of rectangular cross-section and shall have the dimensions shown in table 2.

Table 2 — Dimensions of test pieces

Dimensions in millimetres

Type	Length	Width	Height
A	35 ± 1	5 ± 0,25	5 ± 0,25
B	20 ± 1	6,5 ± 0,25	5,25 ± 0,25

NOTE — In general, type B test pieces give strength values which are about 10 % higher than those obtained using type A test pieces, provided that they have the same surface conditions. The repeatability is similar for both types of test piece.

6.2 The test pieces shall be ground on the four faces which are parallel to the length with a free cutting diamond wheel, preferably resin bonded, using copious quantities of coolant. No pass shall exceed 0,01 mm and all grinding marks shall be parallel to the length. The amount taken off each face shall be not less than 0,1 mm and the surface roughness shall be $R_a \leqslant 0{,}4$ µm. The four long edges shall be chamfered to 0,15 to 0,20 mm at an angle of 45° and all grinding marks shall be parallel to the length.

It is also permitted to use test pieces in the as-sintered condition. Such test pieces shall have a chamfer of 0,4 to 0,5 mm at an angle of 45°, made before sintering to avoid flash.

6.3 The deviation from parallelism of opposite longitudinal sides, in both the longitudinal and transverse directions, shall not exceed 0,05 mm for each 10 mm length for as-sintered test pieces and 0,01 mm for each 10 mm length for ground test pieces.

6.4 Width and height measurements used for calculation of the results shall be carried out at the middle of the test pieces to the nearest 0,01 mm.

6.5 The test pieces shall be free from visual surface cracks and structural defects.

7 Procedure

7.1 Place a test piece flat and centrally on the support cylinders so that its length is perpendicular to the lengths of the support cylinders. In the case of a type B test piece, place its width on the support cylinders.

7.2 Bring the force cylinder or ball gradually into contact with the test piece.

The deviation of the line or the point of application of the force from the middle of the span shall not exceed 0,5 mm for type A test pieces and 0,2 mm for type B test pieces.

7.3 Increase the stress in the test piece at a uniform rate not exceeding 200 N / mm² per second.

NOTE — This corresponds to a force increasing at a maximum rate of 1 600 N per second for type B test pieces and 600 N per second for type A test pieces.

8 Expression of results

8.1 The transverse rupture strength R_{bm}, expressed in newtons per square millimetre, is given by the formula

$$R_{bm} = \frac{3 \times k \times F \times l}{2 \times b \times h^2}$$

Values of k are given in table 3.

Table 3 — Values of chamfer correction factor, k

Test piece type	Chamfer mm	Correction factor, k
A	0,4 to 0,5	1,03
A	0,15 to 0,2	1,00
B	0,4 to 0,5	1,02
B	0,15 to 0,2	1,00

NOTE — The formula for calculating the transverse rupture strength does not take into account the effect of any plastic deformation that may occur.

8.2 Report the arithmetical mean of at least five transverse rupture strength determinations, rounded to the nearest 10 N / mm².

9 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 type of test piece and the method of preparation of its surface;

d) the method of applying the force;

e) the result obtained. The following additional subscripts shall be added to the symbol indicating transverse rupture strength:

—for type A test pieces: 30,

—for type B test pieces: 15,

Example: R_{bm30};

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

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