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Hardmetals — Determination of transverse rupture strength

Métaux-durs — Détermination de la résistance à la flexion

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Foreword

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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.

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ISO 3327 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 4, *Sampling and testing methods for hardmetals*.

This third edition cancels and replaces the second edition (ISO 3327:1982), which has been technically revised.

Hardmetals — Determination of transverse rupture strength

1 Scope

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

This 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 cases, the method may be used for comparison purposes only.

2 Symbols and designations

For the purposes of this document, the symbols, designations and units given in Table 1 apply.

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_a	Surface roughness	µm
R_{bm}	Transverse rupture strength	N/mm^2
d	Diameter of test piece (if a cylindrical test piece is used)	mm

3 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.

4 Apparatus

4.1 Device for applying a force, capable of applying a uniformly increasing force with an accuracy of 1 % or better.

4.2 Three cylinders (rollers), of which two are freely lying support cylinders with a fixed distance between them and one is a freely lying force cylinder. The three cylinders shall be of equal diameter between 3,2 mm and 6 mm.

Alternatively, the force may be applied by a ball having a diameter of 10 mm. Loading of the test piece can only be made via three cylinders if a cylindrical test piece is used. Consequently, a ball is only applicable for test pieces having plane surfaces.

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 the ball shall not be greater than 0,63 µm.

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

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

4.3 **A suitable protective guard**, surrounding the fixture for safety.

5 Test pieces

5.1 The test pieces shall be of rectangular (Type A or B) or cylindrical (Type C) cross-section and shall have the dimensions shown in Table 2.

Table 2 — Dimensions of test pieces

Dimensions in millimetres

Type	Length	Width/Diameter	Height
A	35 ± 1	5 ± 0,25	5 ± 0,25
B	20 ± 1	6,5 ± 0,25	5,25 ± 0,25
C	25 ± 5	3,3 ± 0,5	—

NOTE In general, Type B test pieces give strength values which are about 10 % to 20 % higher than those obtained using Type A test pieces, depending on the material tested and provided that they have the same surface conditions. The repeatability is similar for all types of test piece. Type C test pieces give strength values which are about 5 % – 10 % higher than Type B specimens whereas the increase of the strength values are material related.

5.2 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 mm to 0,2 mm at an angle of 45° and all grinding marks shall be parallel to the length. Type C test pieces shall be centreless ground to a surface roughness $R_a \leqslant$ 0,4 µm.

5.3 It is also permitted to use test pieces in the as-sintered condition. Such test pieces shall have a chamfer of 0,4 mm to 0,5 mm at an angle of 45°, made before sintering to avoid flash. Bend strength results from as-sintered test pieces are generally significantly lower than those for ground test pieces.

Surface preparation is an important variable and should be standardized to ensure that consistent results are obtained.

5.4 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. For round test pieces, opposite sides shall be parallel within 0,015 mm.

5.5 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.

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

6 Procedure

6.1 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.

6.2 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.

6.3 Increase the stress in the test piece at a uniform rate not exceeding 200 N/(mm^2·s).

NOTE This corresponds to a force increasing at a maximum rate of 1 600 N/s for Type B and Type C test pieces and 600 N/s for Type A test pieces.

7 Expression of results

7.1 The transverse rupture strength R_{bm}, expressed in newtons per square millimetre, is given by the equation:

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

for rectangular test pieces.

Values of the chamfer correction factor, 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

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

$$R_{bm} = \frac{8 \cdot F \cdot l}{\pi \cdot d^3}$$

for cylindrical test pieces.

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

7.2 Report the arithmetical mean of at least five transverse rupture strength determinations, round to the nearest 10 N/mm^2.

8 Test report

Since the test piece geometry and surface preparation can significantly affect the values of transverse rupture strength, it is important that 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, to indicate the surface condition, i.e. sintered (S) or ground (G):

   — for Type A test pieces: A30S or A30G,

   — for Type B test pieces: B15S or B15G,

   — for Type C test pieces: C15S or C15G

   EXAMPLES R_{bm30} (A30S), R_{bm30} (A30G);

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

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

Bibliography

[1] ROEBUCK, B. VAMAS Report No. 22, June 1996 (ISSN 1016-2186), B. *Bend Strength Measurements for Hardmetals, Part 1 Rationale and Results*

[2] ROEBUCK, B. *Effect of Test Piece Geometry on the Bend Strength of Hardmetals*, 14th Int. Plansee Seminar '97, Reutte, Austria, V2, pp. 352-365

[3] VAMAS Report, Part 2, *Analysis*, No. 24, 1997 (ISSN 1016-2186)

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