International Standard 8490

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Metallic materials — Sheet and strip — Modified Erichsen cupping test

Matériaux métalliques — Tôles et bandes — Essai d'emboutissage Erichsen modifié

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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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8490 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals.*

It cancels and replaces ISO Recommendation R 149-1960, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Metallic materials — Sheet and strip — Modified Erichsen cupping test

1 Scope and field of application

This International Standard specifies a method for determining the ability of metallic sheets and strips having a thickness from 0,2 up to 2 mm and a width of 90 mm or more to undergo plastic deformation in stretch drawing.

NOTE — The test is referred to as the modified Erichsen cupping test as, in the test as originally introduced, no blank holder pressure was used but, in the interests of obtaining greater consistency of results, this was changed.

2 Principle

Forming a cup shape by pressing a punch with a spherical end against a clamped test piece between a blank holder and a die until a through crack appears. The measured depth of the cup is the result of the test based on the movement of the punch.

3 Symbols, designation and units

Symbols, designations and units used in the Erichsen cupping test are given in table 1 and the figure.

Table 1 — Symbols, designations and units

Symbol	Designation	Value (mm)
a	Thickness of the test piece	*
b	Width or diameter of the test piece	
d_1	Diameter of the spherical end of the punch	20 ± 0,05
d_2	Bore diameter of the die	27 ± 0,05
d_3	Bore diameter of the blank holder	33 ± 0,1
d_4	Outside diameter of the die	55 ± 0,1
d_5	Outside diameter of the blank holder	55 ± 0,1
R_1	Outside corner radius of the die, outside corner radius of the blank holder	0,75 ± 0,1
R_2	Inside corner radius of the die	0,75 ± 0,05
h_1	Height of the inside rounded part of the die	3 ± 0,1
h	Depth of the cup during the test	*
IE	Erichsen cupping index	*

* See the figure.

4 Testing equipment

4.1 The Erichsen cupping test shall be carried out on a machine equipped with a die, punch and blank holder with dimensions and tolerances as shown in the figure.

4.2 The construction of the machine shall be such that it is possible to observe the outside of the test piece during the test to be able to determine the instant when a through crack appears.

4.3 A through crack is a crack which goes through the full thickness of the test piece and is just sufficiently wide to allow light to pass through part of its length.

4.4 The machine shall be equipped with a gauge for measuring the movement of the punch with a scale division of 0,1 mm.

4.5 The die, the blank holder and the punch shall be sufficiently rigid not to deform appreciably during the test. The Vickers hardness of working surfaces of the die, the blank holder and the punch shall be at least 750 HV 30.

4.5.1 The punch shall not turn during the test.

4.5.2 The working surface of the punch shall be spherical and polished. This spherical portion shall be in contact with the test piece during the test.

4.6 The distance from the axis of the die to the centre of the spherical part of the punch shall be less than 0,1 mm throughout its range of movement in use.

4.7 The surfaces of the blank holder and of the die in contact with the test piece shall be plane and perpendicular to the axis of movement of the punch. These surfaces shall be parallel within 0,01 mm.

4.8 The machine shall ensure holding the test piece with a constant holding force of approximately 10 kN.

4.9 Measurement of the movement of the punch takes place from the point where it initially touches the surface of the test piece.

5 Test piece

5.1 The test piece shall be flat and of such dimensions that the centre of any cup is not less than 45 mm from any edge of the test piece, and not less than 90 mm from the centre of the nearest cup.

5.2 The preparation of the test piece shall not produce on the edges any burr or distortion which would prevent it being placed in the machine and which could interfere with the performance of the test.

Dimensions in millimetres

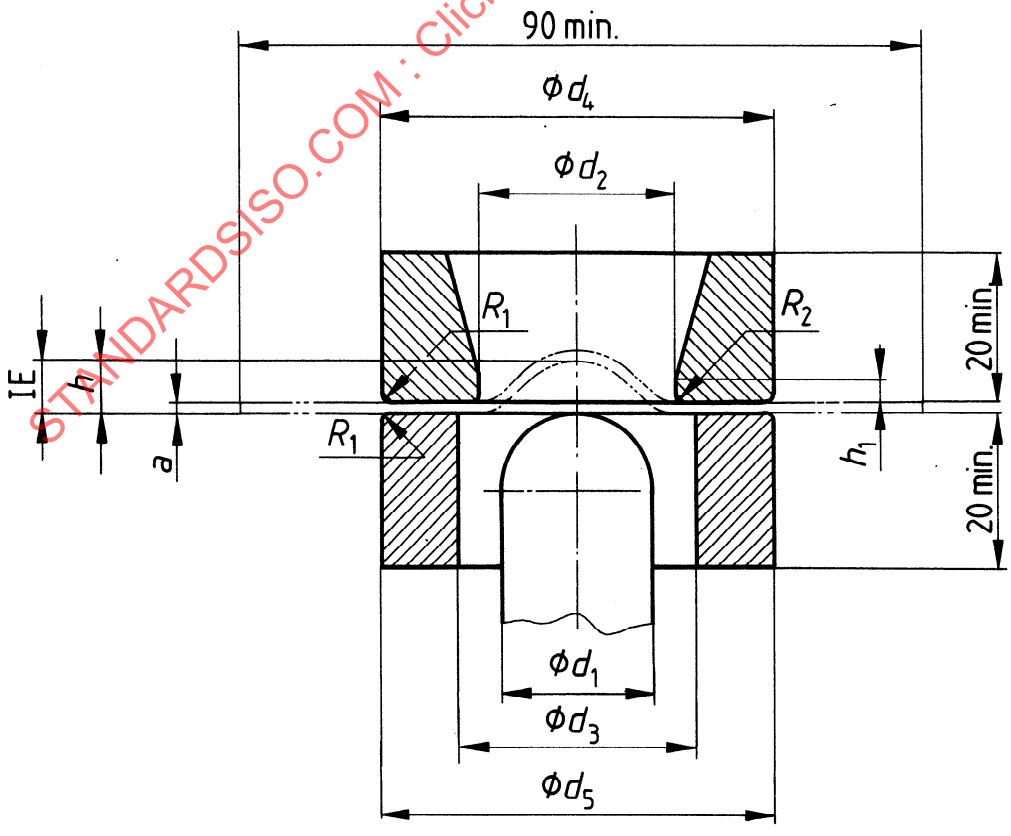

Figure — Dimensions of testing equipment

5.3 Before testing, the test piece shall not be submitted to any hammering or hot or cold working.

6 Procedure

6.1 In general, the test shall be carried out at ambient temperature within the limits of 10 to 35 °C. The test carried out under controlled conditions shall be made at a temperature of 23 ± 5 °C.

6.2 Determine the thickness of the test piece to the nearest 0,01 mm.

6.3 Before operating the machine, lightly grease the two faces of the test piece and the punch with graphite grease. For the recommended composition of the graphite grease, see the annex.

By agreement, another type of lubricant may be used.

6.4 Clamp the test piece between the blank holder and the die. The blank holder force shall be approximately 10 kN.

6.5 Bring the punch without shock into contact with the test piece. Make the measurement of penetration from this point.

6.6 Proceed with forming the cup smoothly at a rate between 5 and 20 mm/min. Towards the end of the operation, reduce the speed to the vicinity of the lower limit in order to determine accurately the moment when a through crack appears.

6.7 Terminate the movement of the punch at the instant when a crack appears through the full thickness of the test piece.

6.8 Measure the depth of penetration to the nearest 0,1 mm. This depth expressed in millimetres is the value of the Erichsen cupping index IE.

7 Test report

The test report shall include at least the following information:

a) reference to this International Standard;

b) identification of the test piece;

c) thickness of the test piece;

d) type of lubricant used;

e) value of the Erichsen cupping index.

Annex

Recommended composition of the graphite grease (see 6.3)

(This annex is given for information only.)

It is known that the results of tests depend on the type of grease used. One representative grease which is known to be suitable has the following characteristics, as determined by the relevant material specifications.

The grease consists of calcium soap, refined mineral oil and flake graphite.

It should be free from corrosive matter, grit resin, wax and fillers.

The grease and its components should conform to the requirements shown in table 2.

Table 2 — Recommended characteristics of the graphite grease

	Characteristic	Requirement
Grease	Worked penetration of cone of 150 g at a temperature of 25 °C	250 to 280
	Free acidity	0,2 % (*m*/*m*) max. oleic acid
	Free alkalinity	0,3 % (*m*/*m*) max. $Ca(OH)_2$
	Water content	0,5 to 1,2 % (*m*/*m*)
	Graphite content	23 to 28 % (*m*/*m*)
Flake graphite	Average particle size	0,3 mm
	Maximum particle size	0,5 mm
	Ash	4,5 % (*m*/*m*) max.
Mineral oil	Viscosity at 37,8 °C	100 to 120 cS
	Closed flash point	177 °C min.
	Ash	0,01 % (*m*/*m*) max.
	Neutralization value	0,1 mg of KOH/g max.