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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 149

MODIFIED ERICHSEN CUPPING TEST FOR STEEL SHEET AND STRIP

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ISO 8490

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BRIEF HISTORY

The ISO Recommendation R 149, *Modified Erichsen Cupping Test for Steel Sheet and Strip*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (B.S.I.).

Cupping tests were first considered during a meeting of Working Group ISO/TC 17/WG 1, *Methods of mechanical testing for steel*, held in London in November 1954. This discussion led to a proposal covering both the Erichsen and the Olsen cupping tests, which the Working Group submitted to the Technical Committee during its fourth plenary meeting, held in Stockholm in June 1955. The Technical Committee decided to refer the question back to the Working Group for study, requesting it to continue its efforts with a view to setting up a proposal dealing with a single cupping test.

During the fifth plenary meeting of ISO/TC 17, held in London in March 1957, the Working Group submitted a draft proposal for a single cupping test, and this was adopted, subject to a few minor amendments. Following the decisions reached at that meeting, the Secretariat drew up a new draft proposal, which was submitted to all the Members of the Technical Committee for vote by letter ballot. This new draft proposal was accepted, subject to a few amendments, and in its revised form was adopted as a Draft ISO Recommendation.

On 11 July 1958, the Draft ISO Recommendation (No. 209) was distributed to all the ISO Member Bodies and was approved, subject to small editorial modifications, by the following 24 Member Bodies:

Australia	Finland	New Zealand
Austria	France	Norway
Belgium	Germany	Poland
Bulgaria	Hungary	Romania
Burma	India	Spain
Chile	Israel	Sweden
Czechoslovakia	Italy	Switzerland
Denmark	Japan	Yugoslavia

Two Member Bodies opposed the approval of the Draft:

United Kingdom U.S.S.R.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1960, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 149 February 1960

MODIFIED ERICHSEN CUPPING TEST FOR STEEL SHEET AND STRIP

1. PRINCIPLE

The test consists in:

pressing the clamped test piece into a die by means of a ball or a tool (penetrator) with a spherical end until rupture commences;

measuring the depth of the cup.

2. SCOPE

The test as defined below is normally applicable to products having a thickness of not less than 0.5 mm and not more than 2 mm. It may however be extended to products having a thickness less than 0.5 mm by agreement between the parties concerned.

3. SYMBOLS AND DESIGNATIONS

Number	Symbol	Designation
1	*a*	Thickness of test piece
2		Side, width or diameter of test piece
3		Bore diameter of die
4		Bore diameter of retaining ring
5		External diameter of die
6		External diameter of retaining ring
7		Corner radius of interior of die
8		Corner radius of exterior of die
9		Corner radius of exterior of retaining ring
10		Depth of bore of die
11		Thickness of die
12		Thickness of retaining ring
13	*d*	Diameter of spherical end of penetrator
14		Depth of cup
—	IE	Cupping number

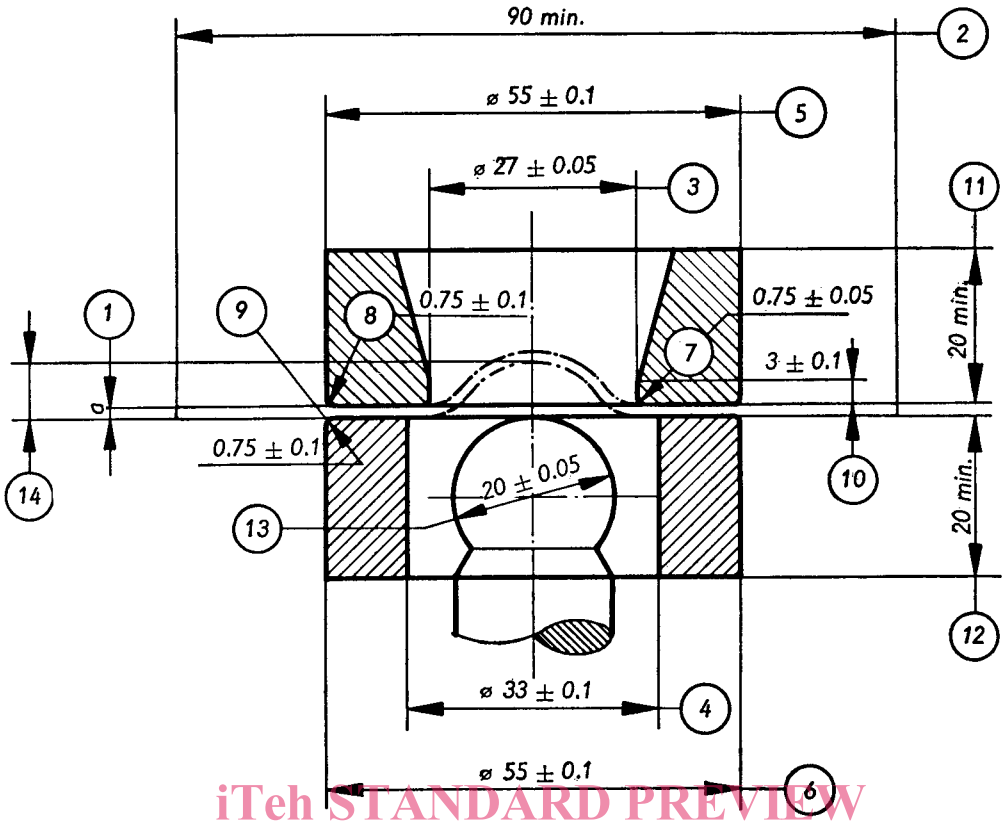

FIGURE. — Cupping test.

4. TESTING MACHINE

4.1 The die, the retaining ring and the penetrator should be sufficiently rigid not to deform appreciably during the test.

4.1.1 The penetrator should not turn during the test.

4.1.2 The construction of the machine should be such that it is possible to determine accurately the moment when rupture commences.

4.1.3 The surfaces of the retaining ring and of the die in contact with the test piece should be plane, polished and parallel to each other and perpendicular to the axis of movement of the penetrator.

4.2 The dimensions and tolerances should comply with those shown in the above figure. The distance from the axis of the die to the centre of the spherical part of the penetrator should be less than 0.1 mm throughout its range of travel in use.

4.2.1 The working surface of the penetrator should be spherical and only this spherical portion should be in contact with the test piece during the test.

4.3 The Vickers hardness of the working surfaces of the die, the retaining ring and the penetrator should be at least 750 HV.

4.3.1 The working surface of the penetrator should be polished.

5. TEST PIECE

5.1 The test piece should be flat and of such dimensions that the centre of any indentation 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 indentation, where the dimensions of the product permit.

5.1.1 If this is not possible, special agreement may be reached.

5.2 The cutting of the test piece should not produce on the edges any burr or distortion which would interfere with its being placed in the apparatus. The test piece before test should not be submitted to any hammering or hot or cold working.

6. PROCEDURE

6.1 Determine the thickness of the test piece to the nearest 0.01 mm.

6.2 Before operating the machine, lightly grease the two faces of the test piece and the penetrator with a graphite grease (see Appendix, page 7).

6.3 Press the test piece between the retaining ring and the die. It is preferable that the load be approximately 1 000 kgf.

6.3.1 Bring the penetrator without shock into contact with the test piece, thus determining the point from which to measure the depth of penetration.

6.4 Proceed with the cupping, which should take place without jerking and at a speed between 5 mm/min and 20 mm/min. Towards the end of the operation, reduce this speed to the vicinity of the lower limit, in order to determine accurately the moment when rupture commences.

7. TEST REQUIREMENTS

7.1 By convention, rupture commences when a crack appears through the full thickness of the test piece and sufficiently open to allow daylight to pass through all or part of its length.

7.1.1 In general, the commencement of rupture is accompanied by a drop in the force sustained by the test piece and sometimes by a perceptible noise.

7.2 Stop the test at this point and determine by direct reading on the apparatus, with an accuracy of 0.1 mm, the depth of penetration of the penetrator (reference 14 of figure, page 5). This depth, expressed in millimetres, gives a number which is the cupping number IE.

7.3 The drop in force may also be considered as the criterion of the end of the test, but in cases of dispute the appearance of the crack should be used.

7.4 In all cases, the ambient temperature at the time of the test should be reported.

NOTES:

1. This test may be made on a machine of the Erichsen type.
2. There is no general process for converting accurately the results obtained by the Erichsen method into those obtained by the test described in this ISO Recommendation. The results are very close, but the dispersion is much less in the latter case.

APPENDIX

(see Clause 6.2)

It is known that the results of tests depend on the type of grease used. One of the greases 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, waxes and fillers.

The grease and its components conform to the following requirements:

Grease

Worked penetration or cone of 150 g at temperature of 25 °C	250 to 280
Free acidity	0.2 per cent oleic acid max.
Free alkalinity	0.3 per cent $Ca(OH)_2$ max.
Water content	0.5 to 1.2 per cent weight
Graphite content	23 to 28 per cent weight

Flake graphite

Average particle size	0.3 mm max.
Maximum particle size	0.5 mm
Ash	4.5 per cent weight max.

Mineral oil

Viscosity at 100 °F (37.8 °C)	100 to 120 cS
Closed flash point	350 °F min. (or 177 °C) min.
Ash	0.01 per cent weight max.
Neutralization value	0.1 mg KOH/g max.

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