

Methods for

Bend testing of metals

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	National Physical Laboratory (D.S.I.R.)*
	Radio Industry Council
	War Office*

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this standard:

Aluminium Federation	Institute of Iron and Steel Wire Manufacturers
British Cast Iron Research Association	Institute of Welding
British Non-ferrous Metals Federation	Institution of Engineering Inspection
British Non-ferrous Metals Research Association	Ministry of Aviation
D.S.I.R. — Building Research Station	Individual firms
D.S.I.R. — Forest Products Laboratory	

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Foreword

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 5000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook.

This British Standard is a revision of BS 1639 which was first published in 1950 to provide guidance in specifying simple, now referred to as "single", bend tests. During the revision the drafting Committee has taken into consideration current general practice in carrying out bend tests on ferrous and non-ferrous materials and also the corresponding recommendations of the International Organization for Standardization (ISO).

In consequence, it has been decided in the interests of unifying testing procedures that the standard should establish suitable methods of bend testing to which appropriate reference can be made in materials standards when this form of test is specified. In addition to covering single bend tests on materials of all thicknesses, the scope of the standard has been widened to include reverse bend tests and tests on thin metal sheet and strip which were formerly described in Section B of BS 485:1934.

It is acknowledged that certain requirements for the particular method to be employed will, of necessity, have to be stated in materials standards, but, in addition to describing the various methods, guidance is given regarding their application.

The standard does not apply to the bend testing of wire or tubes, nor to tests on composite or welded metals. For such tests reference should be made to the relevant standard for the material or methods of test for welded joints.

NOTE Where metric equivalents are stated the figures in British units are to be regarded as the standard. The metric conversions are approximate and more accurate conversions should be based on the tables in BS 350, "Conversion factors and tables".

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This British Standard describes the essential features of the principal methods for single and reverse bend testing, and indicates the usual fields of application of the several forms of test. Attention is drawn to the details in each method of test, some of which may need to be specified more exactly in individual materials standards.

2 Purpose and value of the test

Bend tests serve to indicate the capacity of a material for deformation. As a comparative empirical method bend testing has the advantage that either a machined or unmachined test piece may be prepared from wrought or cast material.

3 Symbols and definitions

a) *Symbols*. In this British Standard the following symbols apply:

Symbol	Designation
a	Thickness or diameter of test piece
b	Width of test piece
l	Length of test piece
	NOTE For cone bend test pieces the lengths at the broad and narrow end are designated respectively by the symbols l_1 and l_2 . (See Figure 9a).
α	Angle of bend
θ	Angle of taper of cone bend test piece
R	Radius of supports
$D/2$	Radius of mandrel or radius of curvature of blocks
r	Internal radius of the bent portion of the test piece after bending
h	Distance from top of blocks to bottom face of guide
Nb	Number of bends

b) *Single bend test*. A test in which a straight solid test piece, generally of round or rectangular cross-section, is submitted to appreciable plastic deformation by bending without reversing the direction of flexure.

c) *Reverse bend test*. A test in which a test piece, held firmly in a vice or machine, is alternately bent and straightened over a mandrel of specified radius.

d) *Thickness grading*. For the application of the various methods of test, the thickness of materials is graded as follows:

"Thin" Material up to $\frac{1}{8}$ in (3 mm) thick.

"Medium" Material from $\frac{1}{10}$ in to $\frac{1}{2}$ in (2.5 mm to 12.5 mm) thick.

"Thick" Material over $\frac{3}{8}$ in (9 mm) thick.

NOTE These grades are included for convenience and the overlap on the thickness ranges is intended to cover the nomenclature used in different industries.

4 Influence of geometrical proportions of test piece

For a given final internal radius of bend in relation to thickness, increasing the ratio of width to thickness of the test piece increases the severity of the test.

The results of experiments indicate that the test is less severe for a round section test piece than for one of square section having the same value of a .

For strict comparison of tests of different thicknesses the length and widths of the test piece and the radii to which they are bent should preferably all be in proportion to their thicknesses.

For sheet and plate material up to a thickness of $\frac{3}{8}$ in (10 mm) the effect of variation in width is not important provided that the width is at least four times the thickness.

5 Form and preparation of test piece

a) *Form*

i) *Wrought bar and cast materials*. Test pieces may be unmachined.

ii) *"Thin" material*. Test pieces shall be of rectangular cross-section and of the full thickness of the material under test. The width shall be not less than $\frac{3}{4}$ in (20 mm) or the full width of the strip it represents if less than $\frac{3}{4}$ in (20 mm).

iii) *"Medium" material*. For thickness up to and including $\frac{3}{8}$ in (10 mm), test pieces shall be of rectangular cross-section and of the full thickness of the material under test. The width shall be not less than $1\frac{1}{2}$ in (40 mm) or the full width of the material it represents if less than $1\frac{1}{2}$ in (40 mm).

iv) *"Thick" material*. For thicknesses exceeding $\frac{3}{8}$ in (10 mm), the width of the test piece should be specified in the standard for the material.