British Standard

BRITISH STANDARD

BS 1449-1.11: 1991

Steel plate, sheet and strip —

Part 1: Carbon and carbon-manganese plate, sheet and strip —

Section 1.11 Specification for cold rolled narrow strip based on specified minimum strength

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) to Technical Committee ISM/10, upon which the following bodies were represented:

British Railways Board
British Steel Industry
Cold Rolled Sections Association
Society of Motor Manufacturers and Traders Limited

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Welded Steel Tube Association
Institution of Mechanical Engineers
National Association of Steel Stockholders

This British Standard, having been prepared under the direction of the Iron and Steel Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 October 1991

The following BSI references relate to the work on this standard:
Committee references ISM/10
Draft announced in *BSI News*, August 1991

ISBN 0 580 19880 4

Amendments issued since publication

Amd. No.	Date	Comments

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Foreword

This Section of BS 1449 has been prepared under the direction of the Iron and Steel Standards Policy Committee. It is a new edition of the element of BS 1449-1:1983 covering cold rolled narrow strip based on specified minimum strength. This Section of BS 1449, together with BS 1449-1.1 to BS 1449-1.10 and BS 1449-1.12 to BS 1449-1.15 and BS EN 10130, supersedes BS 1449-1:1983 which is withdrawn.

The requirements specified are identical to those applicable to cold rolled narrow strip in section three of BS 1449-1:1983. This Section of BS 1449 will be withdrawn when EU 149 "Flat products in high yield strength steels for cold forming. Wide flats, sheet/plate, wide and narrow strip" becomes a European Standard and is published as a British Standard.

For further explanation of this change in presentation see the foreword to BS 1449-1.1:1991.

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Summary of pages

This document comprises a front cover, an inside front cover, pages 1 to 6, 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.

1 Scope

This Section of BS 1449 specifies carbon steel cold rolled narrow strip, intended for use where the essential requirement is a specified minimum strength.

NOTE 1 The combination of conditions and surface finishes for this type of material are given in note 2 to **6.1**.

NOTE 2 Information on the manipulation of steels complying with this Section of BS 1449 is given in appendix A.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Section of BS 1449, the definitions given in BS 1449-1.1 apply.

3 Information to be supplied by the purchaser

The following information shall be given on the enquiry and order.

NOTE Purchasers should pay particular attention to the various options available in this standard and included in the list below.

Where no specific choice is made by the purchaser, the supplier shall select what is appropriate, except that for items a), b), c) and d) reference back to the purchaser shall be made:

a) the number of this British Standard, i.e. BS 1449-1.11;

b) the form of product required, i.e. narrow strip;

c) the nominal dimensions and quantity of the product required;

d) the type of steel (see footnote a to Table 1), the condition, the grade and surface finish of the material (see **6.1**);

e) the edge condition required (see clause **18** of BS 1449-1.1:1991);

f) the application for which the material is intended, including the submission of a drawing;

g) whether proof of freedom from strain-age-embrittlement is required and if so, the method of test to be used (see **6.3**);

h) whether test certificates are required for cast analysis and/or mechanical properties;

i) whether the purchaser wishes to carry out inspection at the manufacturer's works (see clause **19** of BS 1449-1.1:1991);

j) whether oiling or other protective coating is *not* required (see clause **7** of BS 1449-1.1:1991);

k) any limitations on masses and dimensions of individual coils or bundles, if applicable;

l) details of any special requirements;

m) whether special requirements are necessary for packaging or marking (see clause **21** of BS 1449-1.1:1991).

4 Carbon-manganese steels

4.1 Chemical composition

The chemical composition of the materials shall be as given in Table 1.

4.2 Mechanical properties

The mechanical properties of the carbon-manganese steels in the as-rolled condition shall be as given in Table 2. (See also clauses **9** and **10** of BS 1449-1.1:1991).

5 Micro-alloyed steels

5.1 Chemical composition

The chemical composition of micro-alloyed steels shall be as given in Table 3.

NOTE The specified mechanical properties (see **5.2**) are a function of thickness and processing as well as chemical composition.

5.2 Mechanical properties

The mechanical properties of the micro-alloyed steels in the as-rolled condition shall be as given in Table 4. (See also clauses **9** and **10** of BS 1449-1.1:1991.)

Table 1 — Chemical composition of carbon-manganese steels[a]

Rolled condition and grade	C max.	Mn max.	S max.	P max.
	%	%	%	%
CS34/20	0.15	1.20	0.050	0.050
CS37/23	0.20	1.20	0.050	0.050

NOTE For improved atmospheric corrosion resistance, these grades may be supplied with a specified minimum copper content, by agreement between the manufacturer and purchaser.

[a] These grades are supplied as either rimmed (R), balanced (B), or killed (K). Should a particular deoxidation condition be required, it has to be specified on the enquiry and order (see item d) of clause **3**) by using the appropriate prefix (see **6.1**).

Table 2 — Mechanical properties of carbon-manganese steels

Rolled condition and grade	Yield strength R_e, min.	Tensile strength R_m, min.	Elongation A min.			Bend madrel diameter[ab]
			Original gauge length L_O			
			50 mm	80 mm[c]	200 mm	
	N/mm^2	N/mm^2	%	%	%	
CS34/20	200	340	29	(27)	21	2a
CS37/23	230	370	28	(26)	20	2a

NOTE a is the thickness of the bend test piece.

[a]For steel 3 mm thick and over, the bend test requirement is for a mandrel diameter of 3a. For special applications, these grades may be ordered with a bend test requirement of a mandrel diameter of 2a.

[b] The bend test requirements quoted in this table are for specially prepared test pieces; conditions during fabrication may be more severe and may not be simulated by conditions during laboratory testing (see appendix A and Table 5).

[c] The 80 mm gauge length is currently not used in the UK but, as a step towards conforming with European practice, tentative values have been included.

6 Condition of material on delivery

6.1 Designation

The condition and finish of the material shall be in accordance with the symbols included with the material grade and given on the enquiry and order (see item d) of clause **3**).

The symbols denoting material condition, if required, shall be given before the grade number of the steel, in the following order:

a) the symbol R, B or K signifying the type of steel;

b) the symbol CS signifying the method of rolling.

NOTE 1 Attention is drawn to the fact that it is not obligatory for the purchaser of a fabricated component to specify the manufacturing method for the flat rolled product.

In this Section of BS 1449, the grade number shall indicate, respectively, minimum tensile strength/minimum yield strength in newtons per square millimetre (N/mm^2) (see the example below).

A letter F in place of the oblique line, e.g. 40 F 30, shall denote steels which offer superior formability for the same strength levels as the corresponding steels in the upper part of Table 4.

Symbols denoting surface finish shall appear after the grade number of the steel.

Example. CS37/23BR signifies a cold rolled narrow strip having a specified minimum tensile strength and yield strength of 370 N/mm^2 and 230 N/mm^2 respectively, supplied with a bright finish.

NOTE 2 **Conditions and surface finish.** The following material condition is available:

CS Cold rolled on narrow mills. These steels are normally supplied with a bright finish (BR).

Table 3 — Chemical composition of micro-alloyed steels[a]

Rolled condition and grade	C max.	Mn max.	S max.	P max.
	%	%	%	%
CS40/30	0.15	1.20	0.040	0.040
CS43/35	0.15	1.20	0.040	0.040
CS46/40	0.15	1.20	0.040	0.040
CS50/45	0.20	1.50	0.040	0.040
CS60/55	0.20	1.50	0.040	0.040
CS40F30	0.12	1.20	0.030	0.030
CS43F35	0.12	1.20	0.030	0.030
CS46F40	0.12	1.20	0.030	0.030
CS50F45	0.12	1.20	0.030	0.030
CS60F55	0.12	1.20	0.030	0.030

NOTE 1 The steels including F in their designation offer superior formability for the same strength levels compared with the corresponding steel in the upper part of the table.

NOTE 2 For improved atmospheric corrosion resistance, these grades may be supplied with a specified minimum copper content by agreement between manufacturer and purchaser.

[a]These grades are fine-grained, fully killed steels containing additions of micro-alloying elements such as Nb and Ti. The manufacturer, at his option, may also add certain elements, e.g. Ca, Ce and Zr, in order to modify the shape of the sulphide inclusions to achieve the high degree of formability offered by these steels particularly the F series (see note 1).

Table 4 — Mechanical properties of micro-alloyed steels

Rolled condition and grade[a]	Yield strength R_e, min.[b]	Tensile strength R_m, min.	Elongation, A, min.			Bend mandrel diameter, 180° bend[b]
			Original gauge length L_O			
			50 mm	80 mm[c]	200 mm	
	N/mm^2	N/mm^2	%	%	%	
CS40/30	300	400	26	(24)	18	2a
CS43/45	350	430	23	(21)	16	2a
CS46/40	400	460	20	(18)	12	3a
CS50/45	450	500	20	(18)	12	3a
CS60/55	550	600	17	(15)	10	3.5a
CS40F30	300	400	28	(26)	20	0a
CS43F35	350	430	25	(23)	18	0.5a
CS46F40	400	460	22	(20)	14	1a
CS50F45	450	500	22	(20)	14	1.5a
CS60F55	550	600	19	(17)	11	1.5a

NOTE a is the thickness of the bend test piece.

[a] A specific range for the yield strength of any particular grade and thickness may be agreed between manufacturer and purchaser at the time of ordering.

[b] The bend test requirements quoted in this table are for specially prepared test pieces; conditions during fabrication may be more severe and may not be simulated by conditions during laboratory testing (see appendix A and Table 5).

[c] The 80 mm gauge length is currently not used in the UK but, as a step towards conforming with European practice, tentative values have been included.

6.2 Weldability

All the grades specified in Table 1 and Table 3 shall be weldable provided that the welding techniques employed make allowance for composition and thickness. (See BS 1140, BS 2630, BS 5135 and BS 6265.)

6.3 Strain-age-embrittlement

Where proof of freedom from strain-age-embrittlement is required (see item g) of clause **3**), the method of test shall be agreed between the manufacturer and the purchaser, as the test given in **B.3** of BS 1449-1.1:1991 may not be appropriate to all steels in this Section of BS 1449.

Table 5 — Minimum internal forming radii

Grade	Minimum internal forming radii for material of thickness ≤ 4 mm
34/20	1a
37/23	1a
40/30	1.5a
43/35	1.5a
46/40	2a
50/45	2.5a
60/55	2.5a
40F30	0.5a
43F35	0.5a
46F40	1a
50F45	1a
60F55	1.5a

NOTE a is the thickness of the material.

Appendix A Manipulation

In general, steels complying with this Section of BS 1449 can be formed to 90° without heating, provided the following precautions are taken:

a) The radius of bending should be as generous as possible and care should be taken to ensure that the steel accurately follows the shape of the tool. Knife edges should be avoided.

b) Bending of heavily cold-worked or flame-cut edges should be avoided. In particular, heavy shearing burr should not be present. Burr produced by shearing or blanking should be on the inside of the bend.

c) Where possible the axis of the bend should be transverse to the rolling direction of the steel.

Publication(s) referred to

BS 1140, *Specification for resistance spot welding of uncoated and coated low carbon steel.*

BS 1449, *Steel plate, sheet and strip.*

BS 1449-*1.1 General specification.*

BS 2630, *Specification for resistance projection welding of uncoated low carbon steel sheet and strip using embossed projections.*

BS 5135, *Specification for arc welding of carbon and carbon manganese steels.*

BS 6265, *Specification for resistance seam welding of uncoated and coated low carbon steel.*

EU 149, *Flat products in yield strength steels for cold forming. Wide flats, sheet/plate, wide and narrow strip*[1)].

[1)] Referred to in the foreword only.

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