



**BRITISH STANDARD**

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**BS 1449 :  
Section 1.4 :  
1991**

# **Steel plate, sheet and strip**

**Part 1. Carbon and carbon-manganese plate, sheet and  
strip**

**Section 1.4 Specification for hot rolled  
wide material based on specified  
minimum strength**

Tôles, bandes et feuillards en acier  
Partie 1. Tôles, bandes et feuillards en acier au  
carbone et au carbone-manganèse  
Section 1.4 Produits larges laminés à chaud à  
valeur minimale spécifiée de résistance —  
Spécifications

Bleche und Bänder  
Teil 1. Bleche und Bänder aus unlegiertem  
Stahl und Manganstahl  
Abschnitt 1.4 Warmgewalztes Breitband mit  
bestimmter Mindestfestigkeit

## 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

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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 : Part 1 : 1983 covering hot rolled wide strip with specified minimum strength. This Section of BS 1449, together with BS 1449 : Sections 1.1 to 1.3 and 1.5 to 1.15 and BS EN 10130, supersedes BS 1449 : Part 1 : 1983 which is withdrawn.

The requirements specified are technically identical to those applicable to hot rolled wide strip in section three of BS 1449 : Part 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 This Section of BS 1449 will be withdrawn when EU 149 'Flat products in high yield strength steels for cold forming.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 : Section 1.1 : 1991.

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

# Specification

## 1 Scope

This Section of BS 1449 specifies hot rolled plate, sheet and wide 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 5.1

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 : Section 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 : Section 1.4;
- (b) the form of product required, i.e. plate, sheet or strip (see clause 2 of BS 1449 : Section 1.1 : 1991);
- (c) the nominal dimensions (see BS 1449 : Section 1.6) and quantity of the product required;
- (d) the type of steel (see footnote 1 to table 1), the condition, grade and surface finish of the material (see 6.1);
- (e) the edge condition required (see clause 18 of BS 1449 : Section 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 : Section 1.1 : 1991);
- (j) whether oiling or other protective coating is required (see clause 7 of BS 1449 : Section 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 : Section 1.1 : 1991).

## 4 Carbon-manganese steels

### 4.1 Chemical composition

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

**Table 1. Chemical composition of carbon-manganese steels**

Rolled condition and grade	C max.	Mn max.	S max.	P max.
	%	%	%	%
HR34/20 <sup>1)</sup>	0.15	1.20	0.050	0.050
HR37/23 <sup>1)</sup>	0.20	1.20	0.050	0.050
HR43/25 <sup>1)</sup>	0.25	1.20	0.050	0.050
HR50/35 <sup>2)</sup>	0.20	1.50	0.050	0.050

<sup>1)</sup>Grades 34/20, 37/23 and 43/25 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).

<sup>2)</sup>Grade 50/35 is supplied as a balanced or killed steel and may also contain micro-alloying additions.

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

### 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 : Section 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 specified in table 4. (See also clauses 9 and 10 of BS 1449 : Section 1.1 : 1991.)

## 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).

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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. <sup>1)</sup>			Bend mandrel diameter <sup>1) 2)</sup>
			Original gauge length $L_0$			
			50 mm	80 mm <sup>3)</sup>	200 mm	
HR34/20	N/mm <sup>2</sup> 200	N/mm <sup>2</sup> 340	% 29	% (27)	% 21	2a
HR37/23	230	370	28	(26)	20	2a
HR43/25	250	430	25	(23)	16	3a
HR50/35	350	500	20	(18)	12	3a

<sup>1)</sup>In the case of grades 34/20 and 37/23, for steel 3 mm thick and over, the bend test requirement is for a mandrel diameter of 3a. For special applications, these grades together with grades 43/25 and 50/35 may be ordered with a bend test requirement of mandrel diameter of 2a.

<sup>2)</sup>The bend test requirements quoted in this table are for specially prepared test pieces (see B.2.2 of BS 1449 : Section 1.1 : 1991); conditions during fabrication may be more severe and may not be simulated by conditions during laboratory testing (see appendix A and table 5).

<sup>3)</sup>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.

NOTE.  $a$  is the thickness of the bend test piece.

The symbols denoting material condition, if required (see table 1 of BS 1449 : Section 1.1 : 1991 and note 2), shall be given before the grade number of the steel, in the following order:

- the symbol R, B or K signifying the type of steel;
- the symbol HR 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<sup>2</sup>) (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.* HR37/23P signifies a hot rolled wide strip having a specified minimum tensile strength and yield strength of 370 N/mm<sup>2</sup> and 230 N/mm<sup>2</sup> respectively, supplied with a pickled finish.

NOTE 2. **Conditions and surface finish.** The following material conditions are available; more complete descriptions are given in tables 1 and 2 of BS 1449 : Section 1.1 : 1991.

HR Hot rolled on wide mills. Also available pickled (P).

Table 3. Chemical composition of micro-alloyed steels

Rolled condition and grade <sup>1)</sup>	C max.	Mn max.	S max.	P max.
	%	%	%	%
HR40/30	0.15	1.20	0.040	0.040
HR43/35	0.15	1.20	0.040	0.040
HR46/40	0.15	1.20	0.040	0.040
HR50/45	0.20	1.50	0.040	0.040
HR40 F 30	0.12	1.20	0.030	0.030
HR43 F 35	0.12	1.20	0.030	0.030
HR46 F 40	0.12	1.20	0.030	0.030
HR50 F 45	0.12	1.20	0.030	0.030

<sup>1)</sup>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).

NOTE 1. The steels including F in their designation offer superior formability for the same strength levels as 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.

Table 4. Mechanical properties of micro-alloyed steels

Rolled condition and grade	Yield strength $R_e$ , min. <sup>1)</sup>	Tensile strength $R_m$ , min.	Elongation $A$ , min.			Bend mandrel diameter (180° bend) <sup>2)</sup>
			Original gauge length $L_0$			
			50 mm	80 mm <sup>3)</sup>	200 mm	
	N/mm <sup>2</sup>	N/mm <sup>2</sup>	%	%	%	
HR40/30	300	400	26	(24)	18	2a
HR43/35	350	430	23	(21)	16	2a
HR46/40	400	460	20	(18)	12	3a
HR50/45	450	500	20	(18)	12	3a
HR40 F 30	300	400	28	(26)	20	0a
HR43 F 35	350	430	25	(23)	18	0.5a
HR46 F 40	400	460	22	(20)	14	1a
HR50 F 45	450	500	22	(20)	14	1.5a

<sup>1)</sup>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.

<sup>2)</sup>The bend test requirements quoted in this table are for specially prepared test pieces (see B.2.2 of BS 1449 : Section 1.1 : 1991); conditions during fabrication may be more severe and may not be simulated by conditions during laboratory testing (see appendix A and table 5).

<sup>3)</sup>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.

NOTE.  $a$  is the thickness of the bend test piece.

## 6.2 Weldability

All the grades specified in tables 1 and 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 : Section 1.1 : 1991 may not be appropriate to all steels in this Section of BS 1449.

Table 5. Minimum internal forming radii

Grade	Material thickness			
	≤ 4 mm	> 4 mm to ≤ 6 mm	> 6 mm to ≤ 9 mm	> 9 mm
	Minimum internal forming radii			
34/20	1.5a	1.5a	1.5a	2a
37/23	1.5a	1.5a	1.5a	2a
43/25	1.5a	1.5a	1.5a	2a
50/35	2a	2a	3a	4a
40/30	1.5a	1.5a	1.5a	2a
43/35	1.5a	1.5a	2a	3a
46/40	2a	2a	2.5a	3a
50/45	2.5a	2.5a	3a	3.5a
60/55	2.5a	3a	3.5a	3.5a
40 F 30	0.5a	1a	1a	1a
43 F 35	0.5a	1a	1a	1a
46 F 40	1a	1a	1.5a	1.5a
50 F 45	1a	1a	1.5a	2a

NOTE.  $a$  is the thickness of the material



## Appendix

### 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 during 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 Section 1.1 General specification Section 1.6 Specification for tolerances on dimensions and shape for hot rolled wide material
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 <sup>1)</sup>	Flat products in high yield strength steels for cold forming. Wide flats, sheet/plate, wide and narrow strip

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<sup>1)</sup>Referred to in the foreword only.

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