British Standard

BS 1449-1.15: 1991

Steel plate, sheet and strip —

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

Section 1.15 Specification for cold rolled narrow strip supplied in a range of conditions for heat treatment and general engineering purposes

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 reference ISM/10
Draft announced in *BSI News* August 1991

ISBN 0 580 19884 7

Amendments issued since publication

Amd. No.	Date	Comments

Contents

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 for heat treatment and general engineering purposes. This Section of BS 1449, together with BS 1449-1.1 to BS 1449-1.14 and BS EN 10130, supersedes BS 1449-1:1983 which is withdrawn.

The requirements specified are technically identical to those applicable to cold rolled narrow strip in section 4 of BS 1449-1:1983. This Section of BS 1449 will be withdrawn when the requirements specified become a European Standard and are published as a British Standard.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 i and ii, 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 cold rolled low, medium and high carbon steels, rolled in widths of less than 600 mm, available in a variety of tempers and other conditions.

NOTE The title of the publication referred to in this standard is 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 1449-1.15;

b) the form of product required, strip or cut lengths (see **2.5** of BS 1449-1.1:1991);

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

d) the type of steel (see note 1 to Table 1), grade condition and surface finish of material required (see clause **6**);

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

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

g) whether tensile and bend, or hardness and bend, requirements are to be met (see clause **5**);

h) whether details of cast analysis are required;

i) whether the material is to be free from strain-age-embrittlement (normally applicable to grades 4, 12, 17 and 22 only);

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

k) if grades 60, 70, 80 or 95 are being ordered, the hardness range required (see note 2 to Table 2);

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

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

n) details of special requirements such as decarburization limits (see **6.2**) or grain size control;

o) limitations on masses and dimensions of individual coils or bundles if applicable;

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

q) if a special heat treatment is to be used, specific information on the process should be given.

4 Chemical composition

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

NOTE The cast identity of grade 4 is not normally maintained.

5 Mechanical properties

The mechanical properties of the materials shall be as given in Table 2. The material shall be supplied to comply with either the hardness and bend tests, or the tensile and bend tests, but in no case with both the hardness and tensile tests.

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/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 symbols R (rimmed), B (balanced) or K (killed) signifying the type of steel: applicable only to material grades 4, 12, 17 and 22;

b) the symbol CS (cold rolled narrow) signifying the method of rolling;

c) a symbol identifying any other material condition.

Symbols denoting surface finish shall appear after the grade number of the steel; thus, CSHT70 PF signifies cold rolled, hardened and tempered, grade 70 strip, supplied with a polished finish and CSH3 4 BR signifies cold rolled, half hard, grade 4 strip supplied with a bright finish.

NOTE 1 **Conditions of material**. The following material conditions are available; more complete descriptions are given in Table 1 of BS 1449-1.1:1991.

CS Cold rolled on narrow strip mills

SP Skin passed
N Normalized
A Annealed
H1 Eighth hard
H2 Quarter hard
H3 Half hard
H4 Three-quarters hard
H5 Hard
H6 Extra hard

HT Hardened and tempered

NOTE 2 **Surface finishes**. The following surface finishes are available; more complete desciptions are given in Table 2 of BS 1449-1.1:1991.

M Matt finish

BR Bright finish
PL Plating finish
MF Mirror finish
SF Special finish
UP Unpolished finish
PF Polished
PY Polished and coloured yellow

PB Polished and coloured blue

NOTE 3 **Conditions/finish combinations**. The combinations of material conditions and surface finishes that are available, in addition to the as-rolled condition, are indicated in Table 3. There may be some limitations on the nominal thicknesses and the widths available.

6.2 Decarburization

NOTE Decarburization is not applicable to grades 4, 10, 12, 17, 20 and 22.

6.2.1 *Grades 30 and 40*

When requested, the extent and nature of the normal slight decarburization shall be agreed between the manufacturer and purchaser.

6.2.2 *Grades 50, 60, 70, 80 and 95*

When specially requested, complete plus partial decarburization, as indicated by the proportion of ferrite, shall not extend to a depth below the surface greater than 3 % of the nominal thickness of the material, at a distance of not less than 20 mm from the edge.

NOTE In certain CS conditions, material free from total decarburization may be available by arrangement between purchaser and supplier.

Total depth of decarburization = depth of complete carburization (where present) + depth of partial decarburization.

Table 1 — Chemical composition

Rolled condition	Type of steel	C		Si		Mn		S	P
		min.	max.	min.	max.	min.	max.	max.	max.
		%	%	%	%	%	%	%	%
CS4	Mild steel	—	0.12	—	—	—	0.60	0.050	0.050
CS10	Case hardening	0.08	0.15	0.10	0.35	0.60	0.90	0.045	0.045
CS12	“12” carbon	0.10	0.15	—	—	0.40	0.60	0.050	0.050
CS17	“17” carbon	0.15	0.20	—	—	0.40	0.60	0.050	0.050
CS20	“20” carbon	0.15	0.25	0.05	0.35	1.30	1.70	0.045	0.045
CS22	“22” carbon	0.20	0.25	—	—	0.40	0.60	0.050	0.050
CS30	“30” carbon	0.25	0.35	0.05	0.35	0.50	0.90	0.045	0.045
CS40	“40” carbon	0.35	0.45	0.05	0.35	0.50	0.90	0.045	0.045
CS50	“50” carbon	0.45	0.55	0.05	0.35	0.50	0.90	0.045	0.045
CS60	“60” carbon	0.55	0.65	0.05	0.35	0.50	0.90	0.045	0.045
CS70	“70” carbon	0.65	0.75	0.05	0.35	0.50	0.90	0.045	0.045
CS80	“80” carbon	0.75	0.85	0.05	0.35	0.50	0.90	0.045	0.045
CS95	“95” carbon	0.90	1.00	0.05	0.35	0.30	0.60	0.040	0.040

NOTE 1 Unless otherwise agreed at the time of ordering, the deoxidation condition for grade 4 is at the discretion of the manufacturer. Grades 12, 17 and 22 are available as rimming, balanced or killed steels and any preference should be indicated by employing the appropriate prefix to the grade (see **6.1**). Grades 10, 20, 30, 40, 50, 60, 70, 80 and 95 are all killed steels.
NOTE 2 For grades 30 to 95 inclusive the purchaser may order to restricted ranges of carbon and manganese within the ranges specified in the table. For steels containing up to and including 0.85 % C, the minimum carbon range is 0.05 % (e.g. 0.40/0.45 % C). Above 0.85 % carbon, the minimum carbon range is 0.07 % (e.g. 0.93/1.00 % C). These steel types may also be ordered with a restricted manganese range of 0.20 % (e.g. 0.60/0.80 % Mn) when this is required for special applications.
NOTE 3 The purchaser may order to specified lower maxima for sulphur and phosphorus by arrangement with the supplier.
NOTE 4 The analysis of the product may vary from the chemical composition, specified in the table for the appropriate grade, by the variations given in appendix A of BS 1449-1.1:1991. This does not apply to rimmed (R) or balanced (B) steels, which may show wider variations than those given in appendix A of BS 1449-1.1:1991.
NOTE 5 Where case hardening is to be carried out, a silicon-killed, aluminium-free steel is more suitable.

Table 2 — Mechanical properties

Rolled condition and grade[a]	Material condition	Tensile properties[b]					Hardness HV[b]		Bend mandrel diameter[c] (180° bend) for strip thicknesses up to and including 10 mm	Remarks
		Yield strength R_e, min.	Tensile strength, R_m		Elongation A, min.					
					Original gauge length, L_o					
			min.	max.	50 mm	80 mm[d]	min.	max.		
		N/mm^2	N/mm^2	N/mm^2	%	%				
CS4	Annealed[e]	(140)	280	350	30	(28)	—	105	0a	
CS4	Skin passed[f]	(140)	280	370	30	(28)	—	115	0a	
CS4	Temper rolled, H1[g]	—	290	390	20	(18)	95	120	0a	Thickness 3 mm max. For temper-rolled conditions H2 and H3, the bend angle is 90°
CS4	Temper rolled, H2[g]	—	350	420	—	—	110	135	2a	
CS4	Temper rolled, H3[g h]	—	420	540	—	—	135	165	2a	
CS4	Temper rolled, H4[g]	—	540	640	—	—	165	195	—	
CS4	Hard rolled, H5	—	540	—	—	—	165	—	—	
CS4	Extra hard rolled, H6	—	710	—	—	—	210	—	—	
CS10	Annealed[e]	—	—	—	—	—	—	120	1a	The bend mandrel diameter for strip > 3 mm thick is 1a
CS10	Hardened in water form 900 °C (core properties of case-hardened component)	—	—	—	—	—	200	300	—	
CS12	Skin passed[f]	170	310	410	28	(26)	—	—	1a	The bend mandrel diameter for strip ≤ 1.2 mm thick is 0a
CS17	Annealed[e]	190	340	—	26	(24)	—	—	1a	
CS20	Annealed[e]	230	420	—	20	(18)	—	—	3a	
CS22	Annealed[e]	200	370	—	25	(23)	—	—	1a	
CS30	Annealed[e]	230	380	—	20	(18)	—	—	1a	

Table 2 — Mechanical properties

Rolled condition and grade[a]	Material condition	Tensile properties[b]					Hardness HV[b]		Bend mandrel diameter[c] (180° bend) for strip thicknesses up to and including 10 mm	Remarks
		Yield strength R_e, min.	Tensile strength, R_m		Elongation A, min.					
					Original gauge length, L_o					
			min.	max.	50 mm	80 mm[d]	min.	max.		
CS40	Annealed[e]	250	420	—	18	(16)	—	155	1a	
CS40	Temper rolled, H3	—	—	—	—	—	220	260	—	
CS40	Induction or flame hardened	—	—	—	—	—	600		—	
CS50	Normalized	—	—	—	—	—	—	230	4a	
CS50	Annealed[e]	—	—	—	—	—	—	165	1a	
CS50	Temper rolled, H3	—	—	—	—	—	230	270	—	
CS50	Induction or flame hardened	—	—	—	—	—	700		—	
CS60	Annealed[e]	—	—	—	—	—	—	170	1a	Thickness < 1.0 mm
CS60	Annealed	—	—	—	—	—	—	175	2a	Thickness ≥ 1.0 mm
CS60	Temper rolled, H3	—	—	—	—	—	235	275	—	
CS60	Hardened and tempered	—	—	—	—	—	280	530	20a	
CS70	Normalized	—	—	—	—	—	250	300	—	
CS70	Annealed[e]	—	—	—	—	—	—	180	2a	Thickness < 1.00 mm
CS70	Annealed	—	—	—	—	—	—	185	3a	Thickness ≥ 1.00 mm
CS70	Temper rolled, H3	—	—	—	—	—	240	280	—	
CS70	Hardened and tempered	—	—	—	—	—	370	545	20a	
CS80	Normalized	—	—	—	—	—	270	320	—	
CS80	Annealed[e]	—	—	—	—	—	—	190	3a	Thickness < 1.0 mm
CS80	Annealed	—	—	—	—	—	—	195	4a	Thickness ≥ 1.0 mm
CS80	Temper rolled, H3	—	—	—	—	—	250	280	—	
CS80	Hardened and tempered	—	—	—	—	—	395	580	20a	

Table 2 — Mechanical properties

Rolled condition and grade[a]	Material condition	Tensile properties[b]					Hardness HV[b]		Bend mandrel diameter[c] (180° bend) for strip thicknesses up to and including 10 mm	Remarks
		Yield strength R_e, min.	Tensile strength, R_m		Elongation A, min.					
					Original gauge length, L_o					
			min.	max.	50 mm	80 mm[d]	min.	max.		
CS95	Normalized	—	—	—	—	—	330	350	—	
CS95	Annealed[e]	—	—	—	—	—	—	205	3a	Thickness < 1.00 mm
CS95	Annealed	—	—	—	—	—	—	210	4a	Thickness ≥ 1.00 mm
CS95	Hardened and tempered	—	—	—	—	—	420	650	24a	

NOTE 1 a is the thickness of the bend test piece.

NOTE 2 Material grades 60, 70, 80 and 95 in the hardened and tempered (HT) condition are supplied with hardness in bands of 40 HV within the overall hardness ranges.

[a] Tempers and mechanical properties for CS4 grade, as listed, are applicable up to 3 mm thick; above 3 mm such properties are to be the subject of an agreement between the manufacturer and purchaser.

[b] Tensile and hardness property figures in brackets are for guidance only.

[c] The bend mandrel diameter for strip thickesses over 10 mm may be specified by agreement between manufacturer and purchaser.

[d] 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.

[e] Material supplied in the annealed (A) condition has to be capable of meeting the specified properties in the hardended and tempered (HT) condition, when heat treated by a process agreed between the manufacturer and purchaser.

[f] It is recommended that material in the skin passed (SP) condition should be used within a period of 6 weeks, in order to avoid the loss, during storage, of the beneficial effect of skin passing.

[g] Temper rolled rimmed steels are prone to age hardening which leads to an increase in hardness and a decrease in ductility. Because of this factor, the period between final processing at the mill and fabrication should be kept to a minimum.

Freedom from age-hardening may be achieved by the selection of an aluminium-stabilized steel.

[h] CS4 in the H3 conditions has to have the axis of the bend at the right angles to the direction of final rolling.

Table 3 — Availability of conditions and surface finishes

Grade	Condition	Surface finish of material[a]								
		M	BR	PL	MF	SF	UP	PF	PY	PB
4	CSA	X	X	—	—	—	—	—	—	—
	CSSP	X	X	X	X	X	—	—	—	—
	CSH1	X	X	X	X	X	—	—	—	—
	CSH2	X	X	X	X	X	—	—	—	—
	CSH3	—	X	X	—	—	—	—	—	—
	CSH4	—	X	X	—	—	—	—	—	—
	CSH5	—	X	—	—	—	—	—	—	—
	CSH6	—	X	—	—	—	—	—	—	—
10	CSA	—	X	—	—	—	—	—	—	—
	CSSP	—	X	—	—	—	—	—	—	—
	CSH3	—	X	—	—	—	—	—	—	—
12, 17, 20 and 22	CSA	—	X	—	—	—	—	—	—	—
	CSN	—	X	—	—	—	—	—	—	—
	CSSP	—	X	—	—	—	—	—	—	—
	CSH5	—	X	—	—	—	—	—	—	—
30	CSA	—	X	—	—	—	—	—	—	—
	CSN	—	X	—	—	—	—	—	—	—
	CSSP	—	X	—	—	—	—	—	—	—
	CSH5	—	X	—	—	—	—	—	—	—
40, 50	CSA	—	X	—	—	—	—	—	—	—
	CSSP	—	X	—	—	—	—	—	—	—
	CSN	—	X	—	—	—	—	—	—	—
	CSH3	—	X	—	—	—	—	—	—	—
60, 70, 80 and 95	CSA	—	X	—	—	—	—	—	—	—
	CSH3	—	X	—	—	—	—	—	—	—
	CSHT	—	—	—	—	—	X	X	X	X

NOTE X indicates availablility of surface finish.

[a] See note 3 to **6.1**.

Publication(s) referred to

BS 1449, *Steel plate, sheet and strip*.
BS 1449-1.1, *General specification*.

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