British Standard

BRITISH STANDARD

BS 1449 : Section 1.3 : 1991

Steel plate, sheet and strip

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

Section 1.3 Specification for cold rolled steel plate, sheet and wide strip for vitreous enamelling based on formability

Tôles, bandes et feuillards en acier
Partie 1. Tôles, bandes et feuillards en acier au carbone et au carbone-manganèse
Section 1.3 Larges bandes laminées à froid, à caractéristiques spécifiées d'aptitude au formage, pour émaillage vitrifié — Spécifications

Bleche und Bänder
Teil 1. Bleche und Bänder aus unlegiertem Stahl und Manganstahl
Abschnitt 1.3 Emaillierbares kaltgewalztes Breitband mit besonderer Verformbarkeit

BSI STANDARDS

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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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 : Part 1 : 1983 dealing with cold rolled wide strip for vitreous enamelling based on formability. This Section of BS 1449, together with BS 1449 : Sections 1.1 and 1.2 and 1.4 to 1.15 and BS EN 10130, supersedes BS 1449 : Part 1 : 1983 which is withdrawn.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 cold rolled wide strip in section two of BS 1449 : Part 1: 1983. This Section of BS 1449 will be withdrawn when prEN 10209 'Cold rolled low carbon steel flat products for vitreous enamelling: technical delivery conditions' becomes a European Standard and is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 low carbon (0.12 % maximum) cold rolled steel plate, sheet and wide strip, intended for vitreous enamelling.

NOTE 1. Information on the manipulation of steels complying with this Section of BS 1449 is given in appendix A.

NOTE 2. 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

3.1 General

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 1.3;

(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 1.7) and quantity of the product required;

(d) the condition, grade and surface finish of the material (see **3.4**, **6.1** and **6.2**);

(e) if the material is to be supplied as 'SUITABLE FOR MAKING THE PART' (see **3.2** and **3.3**);

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

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

(h) whether proof of freedom from strain-age-embrittlement for grades 2, 3 or 4 (see **6.3**) is required;

(i) if the material is to be welded, the welding method to be used (see **6.2**);

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

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

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

(m) any limitations on masses and dimensions of individual coils or bundles if applicable;

(n) details of any special requirements, e.g. agreed tests for drawability (see clause **13** of BS 1449 : Section 1.1 : 1991);

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

3.2 Suitability for making the part

NOTE. Formability requirements vary widely and it is advisable with the steels in this Section of BS 1449 to seek the advice of the supplier and, if possible, to purchase material on the understanding that it will be suitable for a particular application and/or purpose.

Item (e) of **3.1** is included to cover such a case.

When, following an enquiry, the supplier undertakes to supply steel which is suitable for forming into a particular part, the purchaser, when ordering the steel, shall add the words 'SUITABLE FOR MAKING THE PART' after the grade selected.

In such cases, the steel supplied shall not be subject to rejection if there are minor variations from the chemical composition and/or mechanical properties specified for that steel.

3.3 Grade specified by the purchaser

Where a purchaser specifies a particular grade and **3.2** is not invoked, then it shall be the purchaser's responsibility to ensure that the grade is satisfactory for his requirements.

3.4 Grade and condition by consultation

Where a purchaser is unqualified to select a particular material in terms of grade and condition, it shall be sufficient for him to specify the requirements in items (a), (b) and (c) of **3.1**. It shall then be the responsibility of the supplier, in consultation with the purchaser, to select and supply a grade and condition of material which is satisfactory for the purchaser's requirements.

4 Chemical composition

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

Grade CR1 shall be an aluminium-killed steel. Unless otherwise agreed at the time of ordering, the deoxidation condition of all other grades shall be at the discretion of the manufacturer.

5 Mechanical properties

The mechanical properties of the materials at the time of despatch shall be as given in table 2; the Erichsen cupping test values (see clause **13** of BS 1449 : Section 1.1 : 1991) shall be as shown in figure 1.

NOTE. All the steels included in tables 1 and 2, other than CR1, may strain-age harden (see note to clause **6**) and the ductility will therefore deteriorate.

6 Condition of material on delivery

NOTE. **Strain-ageing.** Rimmed steel, as normally produced, strain-ages when supplied in the skin passed condition and this may lead to:

(a) increase in hardness;

(b) stretcher strain markings (Lüder's lines) when the material is formed;

(c) deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to the minimum.

Rotation of stock by using the oldest material first is important. Stocking of these skin passed steels for extended periods of time should be avoided and, for optimum performance, should not exceed 6 weeks.

Reasonable freedom from stretcher strain can be achieved in skin passed material by effective roller levelling immediately prior to pressing at the customer's plant.

Complete freedom from stretcher strain and also freedom from deterioration in ductility, due to strain-age-hardening, is achieved by the supply of skin passed, stabilized steels as established by the test in clause **12** of BS 1449 : Section 1.1 : 1991.

6.1 Designation

The condition and finish of the material shall be in accordance with the symbols included with the material grade, and shall be given on the enquiry and order in the following order:

(a) the symbol CR signifying the method of rolling;

(b) the number denoting the grade followed by the symbol VE denoting vitreous enamelling.

NOTE. The material is supplied only in the skin passed condition.

Example. CR3VE signifies cold rolled skin passed grade 3 wide strip, supplied with a finish suitable for vitreous enamelling.

6.2 Weldability

All grades shall be weldable by suitable resistance welding techniques (see also item (i) of **3.1**).

If fusion welding techniques are to be used, this shall be stated on the order.

6.3 Strain-age-embrittlement

Grade 1 shall be free from strain-age-embrittlement (see clause **11** of BS 1449 : Section 1.1 : 1991). Freedom from strain-age-embrittlement for other grades shall be by agreement between the manufacturer and the purchaser (see item (h) of **3.1**).

Table 1. Chemical composition

Rolled condition and grade[1)]	Quality	C max.	Mn max.	S max.	P max.
		%	%	%	%
CR1	Extra deep drawing aluminium-killed stabilized	0.08	0.45	0.030	0.025
CR2	Extra deep drawing	0.08	0.45	0.035	0.030
CR3	Deep drawing	0.10	0.50	0.040	0.040
CR4	Drawing or forming	0.12	0.60	0.050	0.050

[1)]Steels that have received a decarburizing treatment are not supplied against these grades unless previously agreed between the manufacturer and purchaser.

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

Table 2. Mechanical properties

Rolled condition and grade	Yield strength R_e, min.	Tensile strength R_m, min.	Elongation A, min.[1)] Original gauge length L_o			Bend mandrel diameter (180° bend)	Modified Erichsen cupping test
			50 mm	80 mm[2)]	200 mm		
	N/mm^2	N/mm^2	%	%	%		See figure 1 for minimum values
CR1	140	280	38	(36)	29	0a	
CR2	140	280	36	(34)	27	0a	
CR3	(140)	(280)	(34)	(32)	(25)	0a	
CR4	(140)	(280)	—	—	—	0a	

[1)]For material of less than 1.00 mm thickness, the percentage elongation is reduced by 1 for each 0.25 mm reduction in thickness.

[2)]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 1. a is the thickness of the bend test piece.

NOTE 2. Tensile properties given in brackets are for guidance only and are not mandatory unless specially agreed at the time of ordering. Tensile test results are not normally requested for grades 3 and 4.

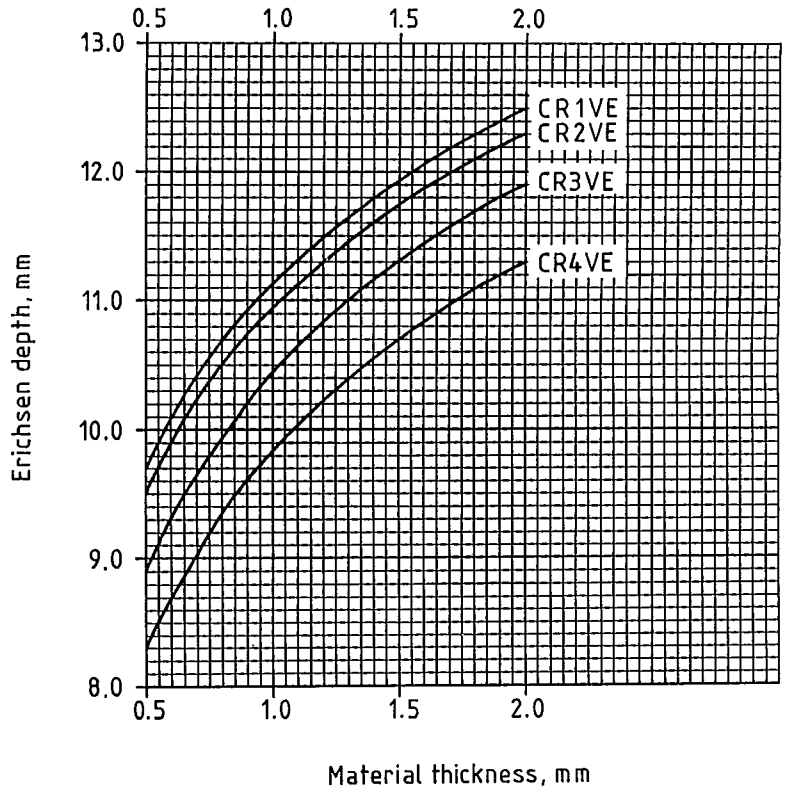

Figure 1. Minimum Erichsen cupping test values (using polyethylene sheet as lubricant) for materials based on formability

Appendix

Appendix A. Manipulation

Steels complying with this Section of BS 1449 can be formed to 90° without heating, providing that the following simple precautions are taken.

(a) The diameter of bending should be as generous as possible and always larger than those specified in table 2. Care should be taken to ensure that the steel accurately follows the shape of the tool. Knife edges should be avoided.

The bend diameters specified in table 2 are for specially prepared test pieces (see **B.1.2** of BS 1449 : Section 1.1 : 1991) and conditions during fabrication may be more severe and may not be simulated by conditions during laboratory testing.

(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 direction of rolling of the steel.

Publication(s) referred to

BS 1449	Steel plate, sheet and strip Section 1.1 General specification Section 1.7 Specification for tolerances on dimensions and shape for cold rolled wide material
prEN 10209[1)]	Cold rolled low carbon steel flat products for vitreous enamelling: technical delivery conditions

[1)]Referred to in the foreword only.

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