British Standard

BS 1449-1.2: 1991

Steel plate, sheet and strip —

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

Section 1.2 Specification for hot rolled steel plate, sheet and wide strip based on formability

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
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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 hot rolled wide strip based on formability. This Section of BS 1449, together with BS 1449-1.1 and BS 1449-1.3 to BS 1449-1.15 and BS EN 10130, supersedes BS 1449-1:1983 which is withdrawn.

The requirements specified are technically identical to those applicable to hot rolled wide strip in section two of BS 1449-1:1983. This Section of BS 1449 will be withdrawn when EU 111 "Continuously hot rolled non-coated mild unalloyed steel sheet and strip for cold forming. Quality standard" 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.

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 4, 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 low carbon (0.20 % maximum) hot rolled steel plate, sheet and wide strip, intended for applications where formability is a major requirement.

NOTE 1 The combination of conditions and surface finishes, related to wide mill products, for this type of material are given in note 2 to **6.1** and Table 3.

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

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 1449-1.2;

b) the form of product required, i.e. hot rolled wide strip, sheet or plate (see clause **2** of BS 1449-1.1:1991);

c) the nominal dimensions (see BS 1449-1.6) and quantity of the product required;

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

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 1449-1.1:1991);

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 1449-1.1:1991);

l) whether oiling or other protective coating is required (see clause **7** of BS 1449-1.1:1991);

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 1449-1.1:1991);

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

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. The purchaser shall select a particular surface finish of material in accordance with note 1 to **6.1** if so required.

4 Chemical composition

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

HR1 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.

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

Table 1 — Chemical composition

Rolled condition and grade[a]	Quality	C max.	Mn max.	S max.	P max.
		%	%	%	%
HR1	Extra deep drawing aluminium-killed	0.08	0.45	0.030	0.025
HR2	Extra deep drawing	0.08	0.45	0.035	0.030
HR3	Deep drawing	0.10	0.50	0.040	0.040
HR4	Drawing or forming	0.12	0.60	0.050	0.050
HR14	Flanging	0.15	0.60	0.050	0.050
HR15	Commercial	0.20	0.90	0.050	0.060

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

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

Table 2 — Mechanical properties[a]

Rolled condition and grade	Yield strength R_e, min.	Tensile strength R_m, min.	Elongation A, min.[b] Original gauge length L_o			Bend mandrel diameter (180° bend)		
			50 mm	80 mm[c]	200 mm	a < 3 mm	3 mm ≥ a < 10 mm	a ≥ 10 mm
	N/mm^2	N/mm^2	%	%	%			
HR1								
HR2	170	290	34	(32)	25	0a	0a	—
HR3	(170)	(290)	(28)	(26)	(21)	0a	0a	—
HR4								
HR14	(170)	(280)	(25)	(23)	(18)	1a	2a	3a
HR15	(170)	(280)	—	—	—	2a	3a	4a

NOTE a is the thickness of the bend test piece.

[a] The mechanical properties shown correspond to material in the despatched condition only. The strength will increase with cold forming. 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, 4, 14 and 15.

[b] For material of less than 2.5 mm thickness, the percentage elongation is reduced by 1 for each 0.25 mm reduction in thickness.

[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

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.

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 (see 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 symbols HR signifying the method of rolling;

c) the symbol SP if the material is required in the skin passed condition.

The grade number of the steel shall be followed by symbols denoting surface finish (see Table 2 of BS 1449-1.1:1991).

Example. HR3VE signifies hot rolled grade 3 wide strip, supplied with a finish suitable for vitreous enamelling.

NOTE 1 **Surface finishes.** The following are available for material rolled on wide mills (HR).

P Pickled

VE Vitreous enamel

NOTE 2 **Condition and surface 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 limitation on the thicknesses and widths available.

NOTE 3 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 material.

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.

NOTE Extra precautions should be exercised in the spot welding of grades 14 and 15.

6.3 Strain-age-embrittlement

Grade 1 shall be free from strain-age-embrittlement. 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 3 — Conditions and surface finishes

Material condition	Surface finish of material									
	P	**D**	**GP**	**FF**	**M**	**BR**	**PL**	**MF**	**VE**	**SF**
HR	X	—	—	—	—	—	—	—	X	—
HRSP	X	—	—	—	—	—	—	—	—	—

NOTE X indicates availability of finish.

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 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.*

BS 1449-1.1, *General specification.*

BS 1449-1.6, *Specification for tolerances on dimensions and shape for hot rolled wide material.*

EU 111, *Continuously hot rolled non-coated mild unalloyed steel sheet and strip for cold forming. Quality standard*[1)].

[1)] Referred to in the foreword only.

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