

Specification for

Steels for fired and unfired pressure vessels: sections and bars

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This British Standard, having been prepared under the direction of the Iron and Steel Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 September 1982

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Foreword

This edition of BS 1502, prepared under the direction of the Iron and Steel Standards Committee, has been extensively technically revised and metricated. The previous edition published in 1968 has now been withdrawn.

Major technical changes now included are:

- the addition of low and medium alloy, and austenitic steels;
- the addition of elevated temperature properties;
- the inclusion of impact properties.

Requirements for bars used in the manufacture of rivets have now been excluded. Requirements are specified for carbon, carbon-manganese, low and medium alloy, and austenitic steels in the form of sections and bars for general structural purposes in the manufacture of boilers and pressure vessels. The requirements for bars for forging are included in BS 1503, and those for bars for the manufacture of bolts in BS 1506.

Characteristic minimum elevated temperature yield or proof stress values derived from data or considered appropriate by the responsible BSI committee are specified. However, it is expected that verification by testing will not normally be required although the option to request this is included.

The appropriate British Standards for the design and construction of boilers and pressure vessels should be consulted for requirements relating to the application and permissible design stresses for products made from steels complying with this standard.

In preparing this revision, particular account has been taken of the views expressed by the Technical Committees of the Pressure Vessel Standards Committee.

BS 1502 is one of a set of publications for different steel product forms used for pressure purposes. Others in the series are as follows.

BS 1501, *Steels for fired and unfired pressure vessels Plates*.

BS 1503, *Steel forgings (including semi-finished forged products) for pressure purposes*.

BS 1504, *Steel castings for pressure purposes*.

Not all section forms are necessarily available without restriction and the intending purchaser should make appropriate enquiries of the manufacturer.

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 to iv, pages 1 to 20, 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.

Section 1. General requirements

1 Scope

This British Standard specifies requirements for carbon, carbon-manganese, low and medium alloy, and austenitic steel sections and bars, for fired and unfired pressure vessels.

Section 1 covers the general requirements for these steels and section 2 specifies testing requirements.

Elevated temperature yield or proof stress and stress rupture values are given in Appendix A and Appendix B. For most steel types appropriate impact properties are also specified.

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

2 Designations

The steel shall be designated by the number of this standard [see note to 9.1 a)] and the steel type number/letters, followed when appropriate by the number (the grade) representing the minimum tensile strength, e.g. BS 1502-620-440.

In addition, except for steel type 509 for which impact tests at -196°C are mandatory, if impact tests are to be made at temperatures below 0°C , the suffix LT followed by a number representing the temperature below zero, in $^{\circ}\text{C}$, at which tests are to be made shall be added to indicate the required impact properties. If impact tests are to be made at 0°C the suffix LT0 shall be added. If impact tests are to be made at room temperature the suffix RT shall be added.

The property options for the various types and grades of steel provided by this specification are shown in Table 1.

Examples

- a) BS 1502-224-430 LT30 designates fully killed, aluminium treated, carbon-manganese steel of type 224 and grade 430, having the tensile properties at room temperature specified in Table 3 and the Charpy V-notch impact properties at -30°C specified in Table 6.
- b) BS 1502-620-540 designates 1 % chromium, 0.5 % molybdenum steel having the tensile properties at room temperature specified in Table 4.

3 Information to be supplied by the purchaser

3.1 General. The following information shall be stated on the enquiry and order:

- a) the full material designation (see clause 2);
- b) the dimensions of the bar or section;
- c) quantity required;
- d) optional requirements (see 3.2).

Table 1 — Property options

Steel	Specified room temperature tensile tests	Options (see note 1)		
		Elevated temperature tensile tests	Impact tests	Others
151	M	X	—	—
161	M	X	—	—
211	M	X	X	—
221	M	X	X	—
224 (grades 430, 490)	M	X	X	—
271	M	X	X	X (see note 2)
509 (grades 650, 690)	M	—	M	—
620 (grades 440, 470 and 540)	M	X	X	X (see note 2)
622	M	X	X	X (see note 2)
625 (grades 590, 640)	M	X	X	X (see note 2)
629	M	X	X	X (see note 2)
Austenitic steels	M	X	X	X (see note 3)

NOTE 1 indicates that the option is not available.

X indicates that an option is available.

M indicates that the test is always carried out.

NOTE 2 An option to specify hardness and associated tensile tests is available (see 15.3.3).

NOTE 3 An option to specify intercrystalline corrosion tests is available, for all austenitic steels except 304S51, 316S51 and 316S53.

3.2 Options. If the purchaser wishes to take up any of the optional requirements covered by this standard, he shall specify his requirements at the time of the enquiry and order. In the absence of such information, the manufacturer shall be permitted to assume the following:

a) *General*

- 1) The steel may be made by the open hearth, electric or one of the basic oxygen processes (see 4.1).
- 2) Product analysis is not required (see 5.2).
- 3) The purchaser or his representative does not wish to visually inspect the products, select test samples or witness tests (see clause 12).
- 4) The normal dimensional tolerances apply (see clause 13).

b) *Testing*

- 1) Brinell hardness tests and associated tensile tests are not required for low and medium alloy steels (see 15.3.3.2).
- 2) Intercrystalline corrosion tests on austenitic steels are not required (see 16.4).
- 3) Elevated temperature tensile tests are not required (see 17.2).

c) *Specific steels*

- 1) For steels 151 and 211, semi-killed steel is not specifically required (see Table 3 and its associated note 5).
- 2) For steels 271, 620–440, 620–470, 622 and 625–590, supply in either normalized and tempered or quenched and tempered conditions are permitted (see Table 4).

4 Manufacture of the steel

4.1 Steelmaking process. The steelmaking process shall be at the option of the steelmaker unless a particular process is specified by the purchaser, agreed with the steelmaker and stated on the order. Air and air-oxygen bottom blown basic converter processes shall not be used.

4.2 Deoxidation. The deoxidation practice for carbon and carbon-manganese steels shall be as specified in Table 3, for the relevant steel type. All alloy and stainless steels shall be fully killed.

5 Chemical composition

5.1 Ladle analysis. The chemical composition of the steel shall be determined by ladle analysis and shall comply with the requirements for the relevant material specification given in Table 3, Table 4 or Table 5.

5.2 Product analysis. If specified by the purchaser in his enquiry and order, analysis of the finished material shall be carried out on either the test sample used for verification of the mechanical properties or, at the option of the manufacturer, on material taken from the same location as that used for samples for mechanical testing. The number of samples to be taken for analysis and the elements to be determined shall be as agreed at the time of the enquiry and order, and shall be detailed on the order.

The permitted deviations for product analysis specified in Table 7 to Table 9 shall be applicable to the specified chemical composition limits given for the relevant material in Table 3, Table 4 or Table 5.

5.3 Disputes. In cases of dispute the methods for chemical analysis shall be in accordance with British Standard Handbook No. 19.

6 Condition of supply

The material shall be supplied in the relevant condition given in Table 3, Table 4 or Table 5. Where alternative conditions are available, the choice shall be at the option of the manufacturer unless otherwise agreed.

Austenitic stainless steels shall be delivered in the solution treated and quenched condition.

7 Freedom from defects

7.1 Bars

The bars shall be reasonable straight, and shall be sound and free from such segregation, cracks, laminations, or surface flaws as might preclude their use for the purpose intended.

Removal of surface imperfections shall be by mechanical means. After such treatment the bars shall comply with the requirements of clause 13.

7.2 Sections

7.2.1 Surface condition. The surface condition of sections shall comply with the requirements of BS EN 10163-3.

7.2.2 Internal soundness. The sections shall be reasonably straight, and shall be sound and free from such internal defects as might preclude their use for the purpose intended.

8 Marking

8.1 Except as stated in 8.3, each section or bar shall be legibly marked with the following:

- a) manufacturer's name or trade mark;
- b) a reference number by which the section or bar and the manufacturer's certificate can be related;

c) the designation for the steel type (see Table 3 to Table 5) and the suffix designating impact tests (see clause 2), e.g. “224-430-LT50”.

8.2 Marking of items b) and c) shall be by stamping, painting or by the use of durable adhesive labels at the option of the manufacturer unless one of these is agreed at the time of the enquiry and order. If paint is used it shall be commercially free from lead, copper, zinc and tin. The manufacturer's name or trade mark shall be marked by one of the above methods or by rolling in relief on the surface of sections.

8.3 Unless otherwise agreed, for bars or sections that are bundled or boxed, the information given in 8.1 shall be marked on the box or on a tag securely attached to the bundle or box.

9 Manufacturer's certificate

9.1 Supply by manufacturer. The manufacturer of the sections or bars shall supply a certificate stating:

a) the number of this British Standard;

NOTE Marking BS 1502 on or in relation to a product is a claim by the manufacturer that the product has been manufactured and supplied in accordance with the requirements and provisions specified in the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility.

b) the material designation (see clause 2);

c) the ladle analysis in respect of all specified elements (see 5.1 and Table 3 to Table 5 as appropriate);

d) the product analysis if required (see 5.2);

e) the heat treatment, if any, given to the sections or bars (see clause 6);

f) the reference number of each batch of sections or bars and its cast number (see 8.1);

g) for sections or bars having specified impact properties, the temperature at which the impact tests were made and the results obtained (see 17.3);

h) the results of the room temperature mechanical tests (see 17.1);

i) if elevated temperature tests were made, the temperature of the test and the yield or proof stress value obtained (see 17.2);

j) the results of any special tests;

k) whether the product contains any thinned areas as indicated by surface markings (see 13.2).

The test certificate shall be signed by an appointed representative of the manufacturer.

9.2 Supply by merchant. If any steel is supplied from a merchant's stock, the merchant shall satisfy the purchaser by means of numbers and identification marks on the steel, combined with a manufacturer's certificate, that such steel has been tested and complies with all the tests and requirements of this standard applicable to the material specified.

10 Delivery

No material shall be despatched from the manufacturer's works until it has been tested and has complied with all the tests and requirements of this standard as applicable to the material ordered, and any additional requirements specified in the order.

11 Defects revealed after delivery

In the event of any material proving defective during subsequent fabrication such material shall be deemed not to comply with the requirements of this standard notwithstanding any previous certificates of satisfactory testing. The manufacturer shall not be responsible for any failure to comply with this standard caused by improper treatment after delivery.

12 Inspection

The purchaser or his representative shall have access at all reasonable times to those parts of the works engaged on the order, and shall be allowed to inspect the manufacturing process at any stage.

If stated on the enquiry and order, the purchaser shall be allowed to inspect visually the items produced for his order, to select the test samples in accordance with clause 15 and to witness the tests, or any of these.

13 Dimensional tolerances

13.1 The dimensional tolerances of all sections shall comply with the requirements of BS 4360.

The dimensional tolerances of bars shall comply with the requirements of BS 4360 in the case of carbon and carbon-manganese steels, and BS 970-2 and BS 970-4 in the case of alloy and austenitic steels respectively.

13.2 Should any product be reduced locally below the specified thickness during rolling or dressing, the position of the thinned areas shall be carefully marked and indicated to the purchaser, and the marks shall be referred to in the test certificate.