

Steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties —

**Part 1: Specification for seamless and
electric resistance welded including
induction welded tubes**

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Committee (ISM/-) to Technical Committee ISM/73, upon which the following bodies were represented:

- Associated Offices Technical Committee
- BEAMA Ltd. (Power Generation Association)
- British Compressed Air Society
- British Gas plc
- British Steel Industry
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- High Pressure Pipework Consultative Committee
- Lloyds Register of Shipping
- Process Plant Association
- Seamless Steel Tube Association
- Water Tube Boilermakers' Association
- Welding Institute
- Coopted members

The following bodies were also represented in the drafting of the standard, through sub-committees and panels:

- British Fluid Power Association
- British Forging Industry Association
- British industrial Truck Association
- British Welded Steel Tube Association
- Confederation of British Industry
- Energy Industries Council
- Coopted member

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Foreword

BS 3602-1:1987 has been prepared under the direction of the Iron and Steel Standards Committee. It supersedes BS 3602-1:1978, which is withdrawn.

This standard is one of a series specifying requirements for steel pipes and tubes for pressure purposes. Other standards in the series are as follows.

BS 3601, *Specification for steel pipes and tubes for pressure purposes: carbon steel with specified room temperature properties.*

BS 3602, *Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties.*

BS 3603, *Specification for steel pipes and tubes for pressure purposes: carbon and alloy steel with specified low temperature properties.*

BS 3604, *Specification for steel pipes and tubes for pressure purposes: ferritic alloy steel with specified elevated temperature properties.*

BS 3605, *Specification for seamless and welded austenitic stainless steel pipes and tubes for pressure purposes.*

Part 1 takes account of current production procedures for seamless and welded tubes as well as grades of carbon and carbon manganese steel now in common industrial use. Requirements for tubes manufactured by the submerged arc welding process are given in BS 3602-2.

The steels covered by this standard are generally regarded as being weldable. However, care should be taken and welding should be in accordance with the appropriate British Standards for welding, e.g. BS 2633.

The main technical differences between this edition and the previous edition are that steel grade 460 is not included in this edition and changes have been made to the chemical analysis and the mechanical properties of the other grades at room temperature and elevated temperature to take into account current steelmaking practice. For example, the minimum specified tensile strength of grade 410, included in the previous edition, has been increased to 430 N/mm² and the grade designation has been changed accordingly in this edition to 430.

In a number of cases, changes have been made to the tolerances of tubes and tolerances for seamless tubes and cold finished electric resistance, including induction welded tubes specified by inside diameter and thickness, are included.

The designation of steel tubes in this standard and their nearest equivalent designations in ISO 2604-II and 2604-III are shown in appendix A for information purposes.

This Part of BS 3602 is aligned as far as possible with corresponding material requirements and test procedures now agreed for incorporation in documents by the International Organization for Standardization (ISO).

The specified elevated temperature yield or proof stress values are those derived from national data by the procedure described in BS 3920. Additionally, provision is made for the application of the related procedure for verifying that a product consistently meets specified levels of elevated temperature values.

Estimated average stress rupture values (taken from ISO/TR 7468) are shown in appendix C.

It is recommended that the results of elevated temperature tests should, together with information on the product thickness, the room temperature tensile properties and the chemical composition of the material, be sent to Secretariat of ISO/TC17/SC18, British Standards Institution, 3 York Street, Manchester M2 2AT, UK, so that, for future revisions of this standard, minimum elevated temperature proof stress values can be derived from a continuously updated data bank.

Impact test values are not specified in this standard but if the purchaser requires an impact test to be carried out then it is recommended that the Charpy impact test should be carried out in accordance with BS 131-2.

The appropriate British Standard for the design and construction of boilers, pressure vessels, pipework, etc. should be consulted for requirements relating to the application and permissible design stress for products made to this standard.

Purchasers ordering to this standard are advised to specify in their purchasing contract that the supplier operates a quality system in compliance with BS 5750-2 to assure themselves that products claimed to comply with BS 3602-1 consistently achieve the required level of quality.

It is outside the scope of this standard to specify formal qualifications for personnel engaged in testing but it is emphasized that the operation of all equipment should be supervised by competent, trained personnel.

For the purpose of this standard, no difference is intended in the meaning between “pipe” and “tube” though idiomatic use prefers sometimes the one and sometimes the other.

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 16, 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 British Standard specifies requirements for plain end, seamless and electric resistance welded, including induction welded, carbon and carbon manganese steel tubes suitable for pressure purposes.

Tubes manufactured in accordance with this standard have specified room temperature properties and specified proof stress values at elevated temperatures.

In addition to the definitive requirements this specification requires the items detailed in 2.1 to be documented. It also requires options selected by the purchaser from those detailed in 2.2 to be documented. For compliance with this standard both the definitive requirements and the documented items have to be satisfied.

This standard provides for two categories of room temperature test procedure, designated category 1 and category 2 (see clause 11).

NOTE 1 The range of diameters and thicknesses appropriate to this standard is given in appendix B. However, it may be convenient to select from the discrete sizes given in the following standards.

- a) BS 3600:1976, Table 1.
- b) BS 1600-2:1970 (completely interchangeable with ANSI B36.10M and ANSI B36.19M).
- c) BS 3600:1976, Table 4 (for use with compression couplings).

Tubes of diameters and thicknesses not covered by the above standards are also available.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Information to be supplied by the purchaser and options to be documented

2.1 Information to be supplied by the purchaser

The following information shall be supplied by the purchaser and shall be fully documented:

- a) the designation of the tubes, i.e. the number and part of this British Standard, the method of tube manufacture, the grade of steel and the category of test as specified in clause 3, e.g. BS 3602-1:HFS 430:Cat. 1;
- b) the tube outside diameter and thickness for electric resistance welded tubes or the outside or inside diameter and thickness for seamless tubes and cold finished electric resistance welded tubes (see 10.2);
- c) the tube length if exact (see 10.4);
- d) the quantity in metres or number of lengths.

2.2 Options to be documented

A number of options are permitted by this standard as listed below and the purchaser shall identify the options required. Both the definitive requirements specified throughout this standard and the following documented items shall be satisfied before a claim of compliance with this standard can be made and verified. In the event that the purchaser does not indicate his requirements at the time of enquiry or order the manufacturer shall select the options where appropriate.

- a) whether the steelmaking process used has to be reported [see 4.2 and 15.2 a)];
- b) whether a product analysis is required [see 6.2 and 15.2 b)];
- c) whether selected chemical elements additional to those specified are to be reported [see 6.3 and 15.2 c)];
- d) the final supply condition of the tubes (see clause 7);
- e) whether the upper limit for the dressing of surface imperfections will be less than the specification value (see 9.8);
- f) whether the tube tolerances are required to suit compression couplings (see 10.3);
- g) whether lengths other than random lengths are required (see 10.4);
- h) whether the method of leak tightness test to be carried out on test category 2 tubes up to and including 180 mm o.d. is the hydraulic test or the eddy current test [see 12.4 and 15.2 e)];
- i) whether the hydraulic test, if specified, is to be carried out at a pressure in excess of 140 bar¹⁾ and the pressure required [see 13.3 and 15.2 e)];
- j) whether additional non-destructive testing is required (see 13.6);
- k) whether verification of elevated temperature proof stress values is required (see 13.7);
- l) whether verification of elevated temperature proof stress values by testing is required and the temperature selected from Table 5 at which this is to be carried out (see 13.7.2);
- m) whether the tubes are to be supplied uncoated or with the manufacturer's normal mill coating (see 16);
- n) whether marking requirements in accordance with BS 5383 are required (see 17.1 and 17.4).

¹⁾ 1 bar = 10⁵ N/m² = 100 kPa.

3 Designation

The tubes shall be designated by the number, and Part of this British Standard, i.e. BS 3602-1 and from Table 1, by one of the references which indicates the method of manufacture (see clause 5) and the appropriate grade of steel (see Table 2), and the test category (see clause 11).

Table 1 — Method of manufacture of tube, reference and steel grades applicable

Method of manufacture	Reference	Steel grades applicable		
Hot finished seamless	HFS	360	430	500 Nb
Cold finished seamless	CFS	360	430	500 Nb
Electric resistance welded	ERW	360	430	—
Cold finished electric resistance welded	CEW	360	430	—
Tubes intended for compression couplings (see 10.2) shall have the letters CC added to the designation. Example. BS 3602-1:CFS 430:Cat. 1 designates cold finished seamless tube made from steel grade 430 tested to category 1. The designations for tubes in this standard and their nearest equivalent designations in ISO 2604-II and ISO 2604-III are listed in appendix A for information.				

4 Manufacture of the steel

4.1 General

The steelmaking process within the provisions of 4.2 and the deoxidation practice within the provisions of 4.3 shall be at the option of the steel manufacturer.

4.2 Steelmaking process

The steel shall be produced by an electric or one of the basic oxygen processes. If he so requires [see 2.2 a)] the purchaser shall be informed of the steelmaking process used.

4.3 Deoxidation

Steels for seamless tubes shall be fully killed. Steels for welded tubes shall be either semi-killed or fully killed.

5 Manufacture of the product

The tubes shall be manufactured by one of the following processes.

- Seamless.* The tubes shall be manufactured by a seamless process and shall be hot finished or cold finished (see note 1).

- Electric resistance welded.* The tubes shall be manufactured from hot or cold flat rolled strip, longitudinally welded continuously by the passage of an electric current across the abutting edges or along the edges prior to closure under welding pressure without the addition of filler metal. They shall be as-welded, hot finished or cold finished. The finished tubes shall not include welds used for joining lengths of the hot or cold, flat-rolled strip, prior to tube forming (see note 1).

For tubes of both test categories ultrasonic or other suitable non-destructive testing method shall be used for continuous examination of the weld area (see note 4).

NOTE 1 The terms “as-welded”, “hot finished” and “cold finished” apply to the condition of the tube before heat treatment, if required, in accordance with clause 7.

NOTE 2 Electric resistance welded tubes cover those produced by both high frequency and low frequency techniques using either direct contact or induction.

NOTE 3 The range of dimensions and tolerances in which tubes are available is dependent upon the method of manufacture. The thicknesses available are also dependent upon the diameter. The dimensional limits generally applicable to this standard are shown in appendix B and the tolerances in clause 10.

NOTE 4 Non-destructive testing of the weld area is made for the purpose of quality control during manufacture by a method and at a place chosen by the manufacturer.

6 Chemical analysis

6.1 Ladle analysis

The steel shall show on ladle analysis the composition given in Table 2 appropriate to the steel grade specified.

6.2 Product analysis

If a product analysis for acceptance purposes is required by the purchaser this shall be stated in the enquiry and order [see 2.2 b)].

When an analysis on the product is carried out, the permitted deviations given in Table 3 shall apply to the specified ladle analysis in Table 2.

The number of samples to be taken shall be one per cast. The samples shall be taken either from the test pieces used for the verification of the mechanical properties or from the whole thickness of the tube at the same location as for the mechanical test samples.

In cases of dispute the methods for chemical analysis shall be in accordance with British Standard Handbook 19 or BS 6200-3 as appropriate.