

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

**Part 2: Specification for longitudinally
arc welded tubes**

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/73, upon which the following bodies were represented:

- Associated Offices Technical Committee
- BEAMA Ltd.
- British Compressed Air Society
- British Forging Industry Association
- British Gas plc
- British Steel Industry
- Electricity Supply Industry in United Kingdom
- Engineering Equipment and Materials Users' Association
- Lloyd's Register of Shipping
- Power Generation Contractors' Association (BEAMA Ltd.)
- Process Plant Association
- The Welding Institute
- Coopted members

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

- British Fluid Power Association
- British Welded Steel Tube Association
- Confederation of British Industry
- Energy Industries Council
- Stainless Steel Fabricators' Association of Great Britain

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Foreword

This Part of BS 3602 has been prepared under the direction of the Iron and Steel Standards Policy Committee. It supersedes BS 3602-2:1978, which is withdrawn.

This Part of BS 3602 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 carbon steel pipes and tubes with specified room temperature properties for pressure purposes.*

BS 3602, *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.*

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

BS 3604, *Steel pipes and tubes for pressure purposes: ferritic alloy steel with specified elevated temperature properties — Part 1 Specification for seamless and electric resistance welded tubes.*

BS 3605:1973, *Specification for seamless and welded austenitic stainless steel pipes and tubes for pressure purposes.*

BS 3605, *Austenitic stainless steel pipes and tubes for pressure purposes — Part 1 Specification for seamless tubes.*

This Part of BS 3602 takes account of current production procedures for longitudinally arc welded tubes, as well as pressure vessel quality grades of carbon and carbon manganese steel plate now in common industrial use.

The steels covered by this Part of BS 3602 are generally regarded as being weldable. However, care should be taken and welding should be carried out in accordance with the appropriate British Standards for welding.

The main technical differences between this edition and the previous edition are that, reflecting improvements in steelmaking practice, the steel types 430 and 490 show improvement in minimum specified room temperature tensile strength and 0.2 % proof stress at elevated temperatures. The chemical composition and mechanical properties at room temperature align with corresponding steels in BS 1501-1. Tubes to this Part of BS 3602 are available in a choice of supply conditions, depending on the class ordered, as detailed in clause 7. The two test categories in BS 3602-2:1978 have been merged into one set of test requirements which include mandatory non-destructive testing of the weld. Arc welding processes, in addition to submerged arc welding, are now permitted.

The appendix showing elevated temperature stress rupture values has been deleted. Available values refer to parent metal only with little data available on weld metal. Elevated temperature stress rupture values for corresponding steels are given in BS 1501-1 (see Table 1, notes 5 and 7 of this Part of BS 3602).

The designations of steel tubes in this Part of BS 3602 and their nearest equivalent designations in ISO 2604-VI are given in Appendix A for information.

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.

It is recommended that the results of elevated temperature tests, together with information on the product thickness, the room temperature tensile properties and the chemical composition of the material, should be sent to the committee so that, for future revisions of this Part of BS 3602, minimum elevated temperature proof stress values can be derived from a continuously updated data bank. The address is Secretariat of ISM/73/-/1, British Standards Institution, 3 York Street, Manchester, M2 2AT, UK.

Impact test values are not specified in this Part of BS 3602 but if the purchaser requires an impact test to be carried out the Charpy impact test should be carried out in accordance with BS EN 10 045-1.

The appropriate British Standards 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 in accordance with this Part of BS 3602.

Assessed capability. Users of this British Standard are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

It is outside the scope of this Part of BS 3602 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 purposes of this Part of BS 3602, no difference is intended in 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 Part of BS 3602 specifies requirements for plain end, longitudinally arc welded, carbon and carbon manganese steel tubes suitable for pressure purposes.

Tubes manufactured in accordance with this Part of BS 3602 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 Part of BS 3602 both the definitive requirements and the documented items have to be satisfied.

NOTE 1 The range of diameters and thicknesses appropriate to this Part of BS 3602 is given in Appendix B.

NOTE 2 The titles of the publications referred to in this standard are listed on page 16.

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 type of steel and the final supply condition (see clause 3), e.g. BS 3602-2:430: class 10;
- b) the tube outside diameter and thickness;
- c) the tube length, if exact (see 10.9);
- d) the quantity in metres or numbers of lengths.

2.2 Options to documented

A number of options are permitted by this Part of BS 3602 as listed below and the purchaser shall identify the options required. Both the definitive requirements specified throughout this Part of BS 3602 and the following documented items stated by the purchaser shall be satisfied by the manufacturer before a claim of compliance with this Part of BS 3602 can be made and verified. In the event that the purchaser does not indicate his requirements at the time of enquiry and order the manufacturer shall select the options where appropriate.

- a) The steelmaking process [see 4.1 and 15.2 a)].

b) Whether welding procedure details and welding procedure approval details are required (see 5.2).

c) Whether evidence of welder or welding machine operator approval is required (see 5.2).

d) Whether additional procedure approval is required (see 5.2).

e) Whether a product analysis is required [see 6.2 and 15.2 b)].

f) Whether the content of selected chemical elements additional to those specified are to be reported [see 6.3 and 15.2 c)].

g) Whether the maximum carbon equivalent value is to be reported (see 6.4).

h) Whether the upper limit above which the dressing of surface imperfections is required will be 1.5 mm (see 9.8).

i) Whether end sizing is required (see 10.8).

j) Whether lengths other than random lengths are required (see 10.9).

k) Whether the hydraulic test is to be carried out at a pressure in excess of 140 bar¹⁾ and the pressure required (see 13.3).

l) The method of non-destructive testing to be used (see 13.4).

m) Whether additional non-destructive testing of the weld is required (see 13.5.1).

n) The quality grade to which the plate shall be tested (see 13.5.2).

o) Whether verification of elevated temperature proof stress values is required (see 13.6.1).

p) Whether verification of elevated temperature proof stress values by testing is required (see 13.6.2) and the temperature selected from Table 4 at which this is to be carried out.

q) Whether the tubes are to be supplied uncoated or with the manufacturer's normal mill coating (see clause 16).

r) Whether the marking requirements to BS 5383 are required (see 17.1 and 17.4).

3 Designation

The tubes shall be designated by the number and Part of this British Standard, i.e. BS 3602-2, by a number which indicates the type of steel (see Table 1) and by the final supply condition (see clause 7).

Example. BS 3602-2:430: class 10, designates longitudinally arc welded tube made from steel type 430 supplied in the as welded condition.

¹⁾ 1 bar = 10⁵ N/m² = 10⁵ Pa.

NOTE The designations for tubes in this Part of BS 3602 and their nearest equivalent designations in ISO 2604-VI are listed in Appendix A for information.

4 Manufacture of the steel

4.1 Steelmaking process

The steel shall be produced by an electric process or by one of the basic oxygen processes, at the option of the manufacturer unless otherwise specified by the purchaser [see 2.2 a)].

4.2 Deoxidation

All steels shall be fully killed.

5 Manufacture of the product

5.1 The tubes shall be manufactured from steel plate welded longitudinally and continuously across the abutting edges by either:

- a) an automatic arc welding process; or
- b) the manual metal arc process.

At least one pass on the inside and at least one pass on the outside of the tube shall be made. The filler metal shall comply with BS 2901-1, BS 4165 or BS 639 as appropriate.

The tubes shall be hot formed or cold formed prior to longitudinal welding.

NOTE 1 At the option of the manufacturer a final hot finishing operation may be carried out.

NOTE 2 The dimensional limits generally applicable to this Part of BS 3602 are shown in Appendix B and the tolerances are given in clause 10.

NOTE 3 The terms "hot formed" and "cold formed" apply to the condition of the tube before final heat treatment, if required, in accordance with clause 7.

5.2 The welding procedure including the repair procedure shall be specified and qualified in accordance with BS 4870-1 or BS 4870-4. If required by the purchaser, the manufacturer shall supply details of welding procedure and evidence of welding procedure approval [see 2.2 b)].

The welder shall be qualified to BS 4871-1 and the welding machine operator shall be qualified to BS 4870-4. If required by the purchaser, the manufacturer shall provide evidence of the welder or welding machine operator approval [see 2.2 c)].

If the purchaser requires additional procedure approval for his particular order, this shall be specified in the enquiry and order [see 2.2 d)].

5.3 Repairs to the weld shall be permitted. Defects in the weld shall be completely removed by flame gouging, grinding or chipping and the cavity shall be finished by grinding. The cleaned cavity shall be examined by magnetic particle inspection in accordance with BS 6072 to ensure the removal of defects. Repair to welds shall be by an arc welding process in accordance with 5.1 a) or b) and a procedure in accordance with 5.2. Repair welds shall be subjected to hydraulic testing and the same type and level of non-destructive testing as used for examination of the full length of the weld.

6 Chemical analysis

6.1 Ladle analysis

The steel shall show on ladle analysis the composition given in Table 1 appropriate to the steel type 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 e)]. When an analysis on the product is carried out, the permitted deviations given in Table 2 shall apply to the specified ladle analysis in Table 1.

The number of samples to be taken shall be one per cast. The samples shall be taken either from the test piece used for the verification of the parent metal mechanical properties or from the parent 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.

6.3 Additional elements

If required by the purchaser [see 2.2 f)] the content of elements, selected by the purchaser, in addition to those specified in Table 1, shall be reported.

NOTE The purchaser may require, for example, to know the content of elements relating to weldability.