

Procedure for inspection, testing and acceptance of seamless steel tubes and tubestock

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- Aluminium Federation
- British Forging Industry Association
- British Investment Casting Trade Association
- British Iron and Steel Producers' Association
- Copper Development Association
- Light Metal Founders' Association
- Ministry of Defence
- Seamless Steel Tube Association
- Society of British Aerospace Companies

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¹⁾ Formerly appendix C of BS 3T 100:1978 (implemented by amendment).

Foreword

This British Standard prepared under the direction of Technical Committee ACE/61 is a revision of BS 3T 100:1978 which is withdrawn. It covers the general inspection and testing requirements for tube stock and seamless steel tubes to be used for aerospace purposes. The procedure set out is primarily for use in conjunction with related material specifications in the “T” series of British Standards and in the Ministry of Defence (Procurement Executive) DTD series. It may also be used with other material specifications by agreement between the manufacturer and the purchaser.

The first edition of this standard was published in June 1948 and a revised edition, which incorporated changes agreed between the manufacturers and users of the materials in the light of working to the provisions of the first edition, was published in April 1972.

In the February 1978 revision, new requirements for release documentation and an appendix (appendix B) relating to standards of cleanness were added, and the requirements for the bend test (as an alternative to the flattening test), the proof bend test and the impact test deleted. Except in the tables of dimensional tolerances, all reference to values in imperial units were deleted.

In this revision the text has been extensively revised to bring it into line with modern steel-making practices and current testing procedures required by the aerospace industry. Individual clauses have been renumbered by section to facilitate future amendments. In section 1, aspects of steel manufacture and testing which are common with BS 5S 100:1993 have been referred to that standard. New sections 6 and 7 have been added to identify the manufacture and inspection and testing requirements for tubestock which are separate from the basic requirements for steel manufacture dealt with in section 1. Additionally a new section 4 has been included for tube delivered in the softened condition for use in the hardened and tempered condition. Appendix A of BS 3T 100:1978, which covered modified requirements for the acceptance of small quantities of tube stock and tubes, has been embodied in a new section 5 of this standard. Appendix B of BS 3T 100:1978 which covered standards of cleanness of steels has been deleted because this subject is covered by BS 5S 100. The former appendix C of BS 3T 100 is reidentified as annex A. Finally, Tables 4, 5 and 6 have been deleted from this standard and in future the use of imperial dimensions will be subject to agreement between the manufacturer and the purchaser.

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 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.

Section 1. General

1.1 Scope

This British Standard specifies procedures for the inspection, testing and acceptance of seamless steel tube and tubestock for aerospace use. The standard is applicable to material specifications in the British Standard Aerospace T series, and the Ministry of Defence (Procurement Executive) DTD series and Defence Standards.

1.2 General

This British Standard details the basic requirements for the inspection and testing of British Standard Aerospace series and DTD series for tube stock and seamless steel tube.

In addition to the definitive requirements, this standard also requires the items detailed in 1.7 to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

If the purchaser wishes to specify an inspection, testing or acceptance procedure for any property of any product, which differs from that specified in this standard, this shall be agreed between the purchaser and the manufacturer and shall be fully documented on the order, drawing or inspection schedule, provided that the purchaser is also the quality assurance authority. If the purchaser is not the quality assurance authority, deviations from the requirements of this standard shall only be agreed and documented after written approval has been obtained from the quality assurance authority.

1.3 References

1.3.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover.

For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies together with any amendments.

1.3.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.4 Definitions

For the purposes of this British Standard and associated material specifications, the definitions given in BS 5S 100:1993 apply, together with the following.

1.4.1

extreme thickness

the greatest (or least) thickness at any point

1.4.2

mean thickness

the sum of the thicknesses measured at the ends of any two diameters at right angles, divided by four

1.4.3

tolerance on mean diameter

the amount by which the sum of any two diameters at right angles, divided by two, may depart from the nominal diameter

1.4.4

tolerance on out-of-round

the amount by which the largest (or smallest) diameter, measured at any point in the tube, may depart from the nominal diameter

1.4.5

total mean tolerance

the algebraic sum of the tolerances on the mean diameter

1.4.6

total out of round

the maximum permissible difference between the largest and smallest diameters at any point in the tube

1.4.7

tube

a hollow product of uniform wall thickness and continuous periphery having a length greater than the outside diameter

1.4.8

tubestock

a cast or wrought product which may be solid or pierced and which is designated for tube making

1.5 Tubestock manufacture, inspection and testing

1.5.1 Chemical composition

The chemical composition of the steel shall conform to the requirements of the relevant material specification and section 1 of BS 5S 100:1993.

1.5.2 Manufacture

The steel shall be manufactured in accordance with section 1 of the BS 5S 100:1993.

1.5.3 Temporary identity up to cast approval stage

Temporary identification shall be maintained in accordance with section 1 of BS 5S 100:1993.

1.5.4 Surface dressing

Where surface dressing is required by the material specification or order, it shall be effected in accordance with section 1 of BS 5S 100:1993.

1.5.5 Freedom from defects

1.5.5.1 All material shall be free from any defect detrimental to the end use.

1.5.5.2 Notwithstanding the prior acceptance of a material as conforming to this standard, any defect in the material found at a later stage, and which is likely to be detrimental to the subsequent use, shall be cause for rejection.

1.5.6 Sulfur printing and deep etching tests

Sulfur printing and deep etching tests shall be carried out in accordance with section 1 of BS 5S 100:1993. This test shall not be applied to corrosion resisting steels.

1.5.7 Cleanness

Unless otherwise specified in the material specification or order, the material shall conform to cleanness requirements specified in BS 5S 100:1993. These requirements shall not be applied to corrosion-resisting steels.

1.5.8 Inspection of tubestock

1.5.8.1 Surface inspection

Tubestock shall be visually examined. The outer surface and additionally, in the case of hollow tubestock, the inner surface shall be free from surface defects, detrimental to further processing of the material.

1.5.8.2 Non-destructive tests

If non-destructive tests for the detection of flaws in the tubestock are required, they shall be agreed between the manufacturer and purchaser and stated on the order. The stage at which the tests are to be applied, the method of test and the standards of acceptance shall also be stated on the order. For corrosion resisting steel tubestock, an ultrasonic test shall be carried out to ensure that the presence of any primary pipe has been removed by cropping. This test shall be carried out during manufacture after casting and prior to final finishing and shall be reported on the release documentation.

1.5.9 Condition of supply

Tubestock shall be supplied in the condition required by the order. If no condition is stated, then the tubestock shall be supplied in the fully softened condition.

1.6 Tube manufacture, inspection and testing

1.6.1 Manufacture

Tubes shall be manufactured from tubestock conforming to 1.5.

1.6.2 Dimensions and tolerances

1.6.2.1 Tube dimensions shall be measured at a frequency sufficient to show compliance with the tolerances given in Table A.1, Table A.2 and Table A.3. The tolerances shall meet the requirements of the tables unless otherwise stated in the material specification.

NOTE Tolerances other than those specified in Table A.1, Table A.2, and Table A.3 may be specified by agreement between the purchaser and manufacturer but these are outside the scope of this standard.

1.6.2.2 The tube sizes and tolerances shall be selected from those in Table A.1, Table A.2 and Table A.3 together with the note given in annex A.

NOTE Imperial dimensions may be used subject to agreement between the manufacturer and the purchaser.

1.6.2.3 Straightness

Tubes shall be free from kinks and shall not depart from straightness in any selected length of 500 mm or more by an amount exceeding 1/600 of the length measured. Unless otherwise stated in the material specification or order, machine straightening shall be used.

1.6.3 Heat treatment

1.6.3.1 Tubes shall be heat treated in accordance with the material specification.

1.6.3.2 Heat treatment shall be carried out in such a manner as to minimize harmful defects, such as carburization and decarburization.

1.6.3.3 If a temperature with limits is stated in the material specification, order or drawing, that temperature shall be used. If a temperature range is stated, a temperature from within that range shall be selected to give the required properties.

1.6.3.4 Temperature control shall conform to BS 2M 54:1991.

1.6.3.5 No tube shall be subjected to the specified final heat treatment more than three times.

1.6.3.6 Any heat treatment applied after cold drawing or other bright finishing shall not form a scale of measurable thickness.

NOTE The surface of the tubes which have been reheated after cold working may be slightly dulled or discoloured.

1.6.4 Testing (general)

1.6.4.1 Test samples shall be selected, prepared and tested in accordance with the relevant requirements of this standard and the material specification.

1.6.4.2 If any test sample or test piece fails to satisfy the requirements of a test as a result of incorrect test procedure or faulty equipment, the test results shall be disregarded and an additional test sample shall be selected and tested in accordance with the relevant requirements of **1.6.5** to **1.6.8**.

1.6.5 Tensile test

1.6.5.1 Selection and preparation of test samples

1.6.5.1.1 One test sample shall be selected from each batch.

1.6.5.1.2 Test samples representing tube which is not supplied in the finally heat treated condition shall be finally heat treated in accordance with the material specification.

1.6.5.1.3 Test samples representing tube which has been finally heat treated as required by the material specification shall not be subjected to additional heat treatment.

1.6.5.1.4 Test samples shall not be mechanically worked after they have been separated from the material that they represent.

1.6.5.2 Preparation and testing of test pieces

1.6.5.2.1 The test pieces shall be prepared from the test samples to the dimensions of one of the test pieces given in BS 4A 4:1:1:1966 or BS 4A 4:1:2:1967 as appropriate, and shall be tested in accordance with that standard.

1.6.5.2.2 The tensile properties obtained from the test pieces shall conform to the material specification.

1.6.5.2.3 The results of each test shall be recorded in accordance with BS 4A 4:1:2:1967.

1.6.5.3 Retests

If any test piece fails to conform to **1.6.5.2.2** one or both of the following procedures shall be adopted.

a) Select, for test, from the same batch, two additional samples, one of which shall be from the tube from which the original test sample was taken. The mechanical properties obtained from the test pieces prepared from both additional test samples shall conform to the material specification.

b) Reheat the batch in accordance with **1.6.3** and re-subject to all the tests required by the material specification.

1.6.6 Flattening test

1.6.6.1 Selection and preparation of test samples

1.6.6.1.1 One test sample shall be selected from every 30 m, or part thereof, of tube in each batch for the flattening test.

1.6.6.1.2 The test samples shall be tested in the condition specified in the material specification.

1.6.6.2 Preparation and testing of test pieces

A test piece, not less than 50 mm in length, shall be cut from each sample tube and shall withstand, without cracking, being flattened over its whole length as follows.

Flattening shall be effected by placing the test piece between parallel flat faces and applying a compressive load. The test piece shall be flattened until the greatest distance between the outer surfaces of the test piece in the direction of flattening has attained the value required by the material specification (see Figure 1) plus twice the nominal thickness (T) of the tube.

1.6.6.3 Retests

If any test piece fails to conform to **1.6.6.2** one or both of the following procedures shall be adopted.

a) Select, for test, from the same batch, twice the number of samples originally selected, half of which shall be from the tubes from which the original samples were taken. The test pieces prepared from all these additional samples shall conform to **1.6.6.2**.

b) Re-heat the batch in accordance with **1.6.3** and re-subject to all the tests required by the material specification.