

BS 5T 100:2010



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AEROSPACE SERIES

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 28, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 March 2010. It was prepared by Panel ACE/61/-/15, *Steels*, under the authority of Technical Committee ACE/61, *Metallic materials for aerospace purposes*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 4T 100:1997, which is withdrawn.

Information about this document

This is a full revision of BS T 100, and introduces the following principal changes.

Section 1

- a) Information and requirements to be agreed and documented amended.
- b) Heat treatment details amended to add temperature tolerances and permit the use of polymer quenchants.
- c) Tensile testing at ambient temperature to BS 4A4:1966, Part 1.1, replaced by BS EN 2002-1.
- d) Tensile testing at elevated temperature to BS 4A4:1966, Part 1.2, replaced by BS EN 2002-2.
- e) Hardness testing to BS 4A4:1966, Part 5, replaced by BS EN ISO 6506-1, BS EN ISO 6507-1 and BS EN ISO 6508-1.
- f) Flattening test details replaced by reference to BS EN ISO 8492.
- g) Drift-expanding test to BS 4A4:1966, Part 4, replaced by BS EN ISO 8493.
- h) For the decarburization test, reference added to the micrographic method detailed in BS EN ISO 3887.
- i) Reference to new Annex A (rules for application of values for mechanical properties given in material specifications) added.
- j) Requirements for non-destructive and ultrasonic examinations of tube deleted.

Section 3

- k) For the susceptibility to intercrystalline corrosion test, reference to BS EN ISO 3651-2 added.

Section 5

- l) Bend test to BS 1639 replaced by BS EN ISO 7438.

Annex A

- m) New Annex A (rules for application of values for mechanical properties given in material specifications) added.

Annex B

- n) Former Annex A (dimensions and tolerances) re-identified as Annex B.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Section 1. General requirements

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 also to other British Standard material specifications for seamless steel tubes and tubestock which are suitable for aerospace use.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1134-1, *Assessment of surface texture – Part 1: Methods and instrumentation*

BS 1134-2, *Assessment of surface texture – Part 2: Guidance and general information*

BS 7773, *Code of practice for cleaning and preparation of metal surfaces*

BS S 100, *Procedure for inspection, testing and acceptance of wrought steels (other than plate, sheet, strip and tube)*

BS EN 2002-1, *Metallic materials – Test methods – Part 1: Tensile testing at ambient temperature*

BS EN 2002-2, *Metallic materials – Test methods – Part 2: Tensile testing at elevated temperature*

BS EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels – Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels – Corrosion test in media containing sulfuric acid*

BS EN ISO 3887, *Steels – Determination of depth of decarburization*

BS EN ISO 6506-1, *Metallic materials – Brinell hardness test – Part 1: Test method*

BS EN ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1: Test method*

BS EN ISO 6508-1, *Metallic materials – Rockwell hardness test – Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

BS EN ISO 7438, *Metallic materials – Bend test*

BS EN ISO 8492, *Metallic materials – Tube – Flattening test.*

BS EN ISO 8493, *Metallic materials – Tube – Drift-expanding test*

EN 3718, *Test method for metallic materials – Ultrasonic inspection of tubes*¹⁾

AMS 2750, *Pyrometry*²⁾

¹⁾ Published as ASD Prestandard at the date of publication of this standard.

²⁾ Available from www.sae.org.

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS S 100 and the following apply.

- 3.1 extreme thickness**
greatest (or least) thickness at any point
- 3.2 mean thickness**
sum of the thicknesses measured at the ends of any two diameters at right angles, divided by four
- 3.3 tolerance on mean diameter**
amount by which the sum of any two diameters at right angles, divided by two, may depart from the nominal diameter
- 3.4 total mean tolerance**
algebraic sum of the tolerances on the mean diameter
- 3.5 tube**
hollow product of uniform wall thickness and continuous periphery having a length greater than the outside diameter
- 3.6 tubestock**
cast or wrought product which may be solid or pierced and which is designated for tube making

4 General

This standard details the basic requirements for the inspection and testing of British Standard Aerospace T series seamless steel tube and tubestock.

In addition to the definitive requirements, this standard also requires the items detailed in Clause 5 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 manufacturer and the purchaser 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 also 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.

5 Information and requirements to be agreed and to be documented

5.1 Information to be supplied by the purchaser

The following information to be supplied by the purchaser, which is specified in the clauses referred to, shall be fully documented on the order, drawing or inspection schedule, on which the number of this British Standard shall also be given.

Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard³⁾ can be made and verified.

a) General:

- 1) the identity of the material specification with which this standard is to be used;
- 2) if sulfur printing and/or deep etching tests are also required on samples corresponding to the bottom of ingots (see 6.6);
- 3) the required sampling frequency for sulfur printing and/or deep etching tests if different from the material specification and this standard (see 6.6);
- 4) the condition of supply of tubestock if other than fully softened (see 6.9);
- 5) if an alternative method of straightening tubes is required (see 7.3);
- 6) the heat treatment condition in which the tubes are to be supplied if different from the material specification (see 7.4.1);
- 7) the required heat treatment temperature (and tolerance) if different from the material specification (see 7.4.4);
- 8) if the use of polymer quenching is to be precluded where it is not precluded by the material specification (see 7.4.7);
- 9) if ultrasonic testing is required, in cases where this is not a requirement of the material specification (see 9.1);
- 10) if overall ink marking is required where not specified in the material specification (see 11.3);
- 11) if corrosion protection of tubes other than those made from corrosion-resisting steel is not required (see 12.1);

b) Tubes delivered in the softened condition for use in the hardened and tempered condition:

- 1) if tests in the softened condition are required when not specified in the material specification (see 27.1).

5.2 Items to be agreed between the contracting parties

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented.

Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard³⁾ can be made and verified:

- a) if non-destructive testing of tubestock is required, the nature of the tests, the stage at which the tests are to be applied, the method of testing and the acceptance standards (see 6.8.2);

³⁾ Marking a British Standard identifier (e.g. BS T 80:1997) on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

- b) the method of temperature control if other than AMS 2750 (see 7.4.3);
- c) if a particular limit for decarburization is required (see 8.9.4);
- d) if any tests other than those specified in the standard are required (see 8.10);
- e) methods for the examination of the bore of the tube where its diameter renders normal methods impractical (see 9.2);
- f) if non-destructive testing of tubes delivered in the final heat-treated condition is required, the nature of the tests, the stage at which the tests are to be applied, the method of testing and the acceptance standards (see Clause 18);
- g) if non-destructive testing of corrosion-resisting and heat-resisting austenitic steel tubes is required, the nature of the tests, the stage at which the tests are to be applied, the method of testing and the acceptance standards (see Clause 25);
- h) if non-destructive testing of tubes delivered in the softened condition for use in the hardened and tempered condition is required, the nature of the tests, the stage at which the tests are to be applied, the method of testing and the acceptance standards (see Clause 30).

6 Tubestock manufacture, inspection and testing

6.1 Chemical composition

The chemical composition of the steel shall conform to the requirements of the relevant material specification and Section 1 of BS S 100.

Values for chemical composition given in the material specification shall be applied in accordance with Annex A.

6.2 Manufacture

The steel shall be manufactured in accordance with Section 1 of BS S 100.

6.3 Temporary identity up to cast approval stage

Temporary identification shall be maintained in accordance with Section 1 of BS S 100.

6.4 Surface dressing

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

6.5 Freedom from defects

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

6.5.2 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.

6.6 Sulfur printing and deep etching tests

Sulfur printing and deep etching tests shall be carried out in accordance with Section 1 of BS S 100 [see 5.1a2) and 5.1a3)]. This test shall not be applied to corrosion-resisting steels.

6.7 Cleanness

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

6.8 Inspection of tubestock

6.8.1 Surface inspection

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

6.8.2 Non-destructive tests

If non-destructive tests, additional to visual examination for the detection of flaws in the tubestock, are required, they shall be agreed between the manufacturer and the purchaser and stated on the order. The manufacturer and the purchaser shall also agree the stage at which the tests are to be applied, the method of testing and the acceptance standards [see 5.2a)].

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.

6.9 Condition of supply

Tubestock shall be supplied in the condition required by the order [see 5.1a4)]. If no condition is stated, the tubestock shall be supplied in the fully softened condition.

7 Tube manufacture, inspection and testing

7.1 Manufacture

Tubes shall be manufactured from tubestock conforming to Clause 6.

7.2 Dimensions and tolerances

7.2.1 Tube dimensions shall be measured at a frequency sufficient to show conformance to the tolerances specified in Table B.1, Table B.2 and Table B.3. The tolerances shall meet the requirements of the tables unless otherwise stated in the material specification.