

FEBRUARY, 1947.

EMERGENCY STANDARD

No. (E) 2D.709—1947

Being British Standards Institution
Specification for Aircraft Material

B.S. No. 3T. 51*

endorsed without amendment

STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :

Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL

(Emergency Series)

HIGH PRESSURE SEAMLESS COPPER TUBES

This standard forms one of a series prepared by the Standards Association of Australia at the request of Departments of the Commonwealth Government for use in relation to the supply of materials required for defence purposes. In appropriate cases these specifications will be reviewed for inclusion in the normal series of Australian standards.

1. Chemical Composition.

(a) The chemical composition of the tubes shall be :

Copper Not less than 99.20%.
Arsenic (if present) Not more than 0.50%.

Impurities :

Antimony Not more than 0.05%.
Bismuth Not more than 0.01%.

(b) The analysis of not less than 5% of the casts of alloy shall be submitted to the inspector. The minimum number of analyses required may be increased by the inspector if he is not satisfied with the conditions of manufacture.

(c) A cast shall be defined as :

- (i) The product of one furnace melt.
- (ii) The product of one crucible melt.
- (iii) The product of a number of crucible or furnace melts where such are aggregated and mixed prior to casting.
- (iv) Where a continuous melting process is employed, a cast shall be taken as the amount of metal tapped from the furnace without any further additions of metal having been made to the charge, or
- (v) As may be otherwise defined from time to time.

2. Manufacture.

- (a) The tubes shall be solid drawn and free from defects.
- (b) The tubes shall not be re-drawn from tubes that have been used previously.
- (c) Any tube may be rejected for faults in manufacture notwithstanding that it has been passed previously on chemical composition and mechanical tests.

3. **Condition.** The condition in which the tubes are supplied shall be at the discretion of the manufacturer. The condition shall however be such as will ensure compliance with the tests specified in Clause 5. When tubes are annealed they should be annealed at a temperature not exceeding 700° C.

* In order to avoid confusion it is recommended that this specification be referred to by its British classification No. 3T. 51, by which it is already well known.

4. Dimensions.

- (a) The maximum length of the tubes shall not exceed 17 ft. 6 in.
- (b) The outside diameter and thickness of the tubes shall be as specified in the following table :

| Nominal Thickness. | | OUTSIDE DIAMETER. | | | | | | | |
|--------------------|-------|-------------------|----------------|---------------|----------------|---------------|----------------|---------------|---------------|
| S.W.G. | In. | In. | | | | | | | |
| 16 | 0.064 | — | $\frac{3}{16}$ | $\frac{1}{4}$ | — | $\frac{3}{8}$ | — | $\frac{1}{2}$ | — |
| 18 | 0.048 | $\frac{1}{8}$ | $\frac{3}{16}$ | $\frac{1}{4}$ | — | $\frac{3}{8}$ | $\frac{7}{16}$ | — | — |
| 20 | 0.036 | — | $\frac{3}{16}$ | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ | — | $\frac{5}{8}$ |
| 21 | 0.032 | $\frac{1}{8}$ | — | — | — | — | — | — | — |
| 22 | 0.028 | — | $\frac{3}{16}$ | — | — | — | — | — | — |

(c) The outside diameter and mean thickness of all tubes shall not vary from the nominal dimensions by more than the following tolerances :

- (i) The outside diameter shall not vary from the nominal thickness by more than ± 0.003 in.
- (ii) The thickness of all tubes shall not vary from the nominal thickness more than the following :

| Nominal Thickness. | | Tolerance on Mean Thickness. In. | Maximum Thickness at any Point. In. | Minimum Thickness at any Point. In. |
|--------------------|-----------------|-------------------------------------|--|--|
| S.W.G. | In. | | | |
| 16 and 18 | 0.064 and 0.048 | ± 0.004 | Nominal plus 0.006 | Nominal minus 0.006 |
| 20 to 22 | 0.036 to 0.028 | ± 0.003 | Nominal plus 0.004 | Nominal minus 0.004 |

5. Mechanical Tests.

- (a) All tests shall be carried out to the satisfaction of the inspector.
- (b) A piece of tube selected as specified in Clause 6, flattened or plugged sufficiently for gripping, and having an effective unflattened or unplugged length of not less than 4 in., shall when tested in tension give the following result :

| |
|---|
| Ultimate Tensile Stress. |
| Not less than 14 or more than 20 tons per sq. in. |

(c) *Flattening Test.* A test piece, not less than 2 in. long, cut from each selected tube shall withstand without showing signs of cracking being flattened down until the interior surfaces of the tube meet as shown in Fig. 1.



Fig. 1.

(d) *Bore Test.* (i) The bore of each tube shall be such as to permit of a metallic bob, a wire with metallic bob attached, or a wire, being passed through freely. The diameter of the bob or wire shall be 80% of the nominal bore diameter of the tube. The length of the bob shall be not less than twice its diameter.

(ii) All tubes which fail to comply with the bore test will be rejected.

(e) *Hydraulic Test.* (i) All tubes shall be subjected to and shall withstand without showing signs of failure the appropriate internal test pressure. The test pressures for the various sizes of tubes are given in the following table.

| Nominal Outside Diameter. | | Nominal Thickness. | | Test Pressure. |
|---------------------------|--------|--------------------|-------|-----------------|
| In. | | S.W.G. | In. | Lb. per Sq. In. |
| $\frac{1}{8}$ | 0.1250 | 18 | 0.048 | 6,000 |
| $\frac{1}{4}$ | 0.1250 | 21 | 0.032 | 6,000 |
| $\frac{3}{16}$ | 0.1875 | 16 | 0.064 | 6,000 |
| $\frac{1}{2}$ | 0.1875 | 20 | 0.036 | 4,000 |
| $\frac{5}{8}$ | 0.1875 | 22 | 0.028 | 4,000 |
| $1\frac{1}{4}$ | 0.2500 | 16 | 0.064 | 6,000 |
| $1\frac{1}{2}$ | 0.2500 | 20 | 0.036 | 2,500 |
| $1\frac{3}{4}$ | 0.3125 | 20 | 0.036 | 2,500 |
| 2 | 0.3750 | 16 | 0.064 | 4,000 |
| $2\frac{1}{4}$ | 0.3750 | 20 | 0.036 | 2,500 |
| $2\frac{1}{2}$ | 0.4375 | 18 | 0.048 | 2,500 |
| $2\frac{3}{4}$ | 0.4375 | 20 | 0.036 | 2,500 |
| 3 | 0.5000 | 16 | 0.064 | 4,000 |
| $3\frac{1}{2}$ | 0.6250 | 20 | 0.036 | 1,000 |

(ii) All tubes which fail to comply with the hydraulic test will be rejected.

6. Selection of Test Samples.

(a) Tubes of the same nominal diameter and gauge shall be grouped into parcels of not more than 5 cwt. No parcel shall contain more than 5,000 ft. When tubes are finally annealed, a parcel shall contain only tubes which have been annealed together.

(b) The inspector shall select test samples from each parcel as follows:

(i) *Tensile Test.* One test sample from each parcel for the tensile test specified in Clause 5 (b).

(ii) *Flattening Test.* Two and a half per cent. of the tubes in each parcel for the flattening test specified in Clause 5 (c).

(iii) The test samples shall be marked as directed by the inspector and shall not be further mechanically worked or heat-treated before they are tested.

7. Re-tests.

(a) *Tensile Test.* If any test piece fails to comply with the tensile test, two other samples from the same parcel as that which failed shall be selected by the inspector and tested in the same manner. One of the samples shall be from the tube from which the original sample was taken, unless that tube has been withdrawn by the manufacturer. All the test pieces prepared from these further samples shall comply with the tensile test specified in Clause 5 (b).

(b) *Flattening Test.* If any test piece fails to comply with the flattening test an additional five per cent. of the tubes in the same parcel as that which failed shall be selected by the inspector and tested in the same manner. This further selection shall include tubes from which the previous samples which failed were taken, unless those tubes have been withdrawn by the manufacturer. All the test pieces prepared from these further tubes shall comply with the flattening test specified in Clause 5 (c).

8. *Identification.* All tubes passed by the inspector shall be identified by the mark of the inspector and such other marking as shall ensure full identification of the material and of the internal proof pressure applied.

For the purposes of this specification as an Australian standard the term "Inspector" shall be interpreted in the manner directed by the Australian Airworthiness Authority concerned.

This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 31st December, 1946.

NOTE.

In order to keep abreast of progress in the industries concerned, Australian standards are subject to periodical review. Suggestions for improvement, addressed to the Headquarters of the Association, will be welcomed.