

Aircraft Material Specification

40-TON MOLYBDENUM-BORON STEEL TUBES (Suitable for welding)

NOTE.—This specification is one of a series issued by the Ministry of Supply, either to meet a limited requirement not covered by any existing British Standard or to serve as a basis for inspection of materials the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.

Straight circular tubes

Bent circular tubes

Non-circular tubes

1. Chemical composition

| | | | | | | |
|-----------------|----|----|----|----|----|---|
| Carbon | .. | .. | .. | .. | .. | not less than 0.10 nor more than 0.16 per cent. |
| Silicon | .. | .. | .. | .. | .. | not more than 0.40 per cent. |
| Manganese | .. | .. | .. | .. | .. | not less than 0.4 nor more than 0.7 per cent. |
| Molybdenum | .. | .. | .. | .. | .. | not less than 0.4 nor more than 0.6 per cent. |
| Boron (soluble) | .. | .. | .. | .. | .. | not less than 0.0015 nor more than 0.0050 per cent. |
| Sulphur | .. | .. | .. | .. | .. | not more than 0.045 per cent. |
| Phosphorus | .. | .. | .. | .. | .. | not more than 0.045 per cent. |

NOTE :—Soluble boron is defined as that portion of the boron which is dissolved when a sample of the material is decomposed by 8N sulphuric acid at 80°C.

2. Process of manufacture

- 2.1. Acid or basic open hearth, or electric.
- 2.2. The tubes shall be straightened before heat treatment. Any subsequent re-straightening which may be necessary on tubes subject to proof bend testing shall not be carried out until the tubes have been subjected to the proof bend test.

3. Inspection procedure

- 3.1. Straight circular tubes $\frac{1}{2}$ inch outside diameter and over.
Bent circular tubes $\frac{1}{2}$ inch outside diameter and over for which the manufacturer's proof bend testing machine is suitable.
 - 3.2. Straight circular tubes less than $\frac{1}{2}$ inch outside diameter.
Bent circular tubes not suitable for proof bend testing.
Non-circular tubes.
Tubes too short or too heavy for proof bend testing.
- } Sections 1 and 2 of
British Standard T.100.

} Sections 1 and 3 of
British Standard T.100.

4. Margins of manufacture

- 4.1. Circular tubes shall comply with the limits specified in Table 2 of British Standard T.100.
- 4.2. Non-circular tubes shall comply with the limits specified in the appropriate Table 4 to 7 of British Standard T.100.

5. Heat treatment

- 5.1. Tubes shall be supplied in the normalised and tempered condition.
- 5.2. Tubes shall be heated uniformly at a temperature within the range 930–980°C. and cooled freely in air. They shall then be tempered to give the specified mechanical properties.
- 5.3. No tube shall be re-normalised more than three times.

6. Mechanical tests

6.1. Tensile test

Before and after welding :—

- 0.2 per cent. proof stress not less than 30 tons per sq. in.
(Applicable to tubes not subject to proof bend testing).
- Ultimate tensile stress not less than 40 tons per sq. in.

6.2. Flattening test

Circular tubes :—

Distance between inner sides of test piece, in direction of flattening :— $5T$ or $\frac{3}{4}$ bore, whichever is the smaller.

Square and streamline tubes :—

Diagonal or major axis C , to be reduced by $\frac{0.5C}{T}$ per cent.

(e.g. if $\frac{C}{T} = 80$, then the required reduction is 40 per cent of major axis.)

6.3. Bend test (alternative test).

Radius of former $3T$.

6.4. Proof bend test

Deflection and proof bending moment shall be based on a bending stress of 30 tons per sq. in. (See Table 8 of British Standard T.100).

6.5. Hardness test

(Applicable to all tubes over $\frac{1}{4}$ inch diameter not subject to proof bend testing.)

Brinell hardness number not less than 183.

Approved for issue.

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Director of Materials Research and Development (Air).

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