



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

**AMS 6550F**  
Superseding AMS 6550E

Issued 4-1-43  
Revised 6-1-74

## STEEL TUBING, WELDED

0.50Cr - 0.55Ni - 0.20Mo (0.28 - 0.33C) (SAE 8630)

### 1. SCOPE:

1.1 Form: This specification covers an aircraft-quality low-alloy steel in the form of welded tubing.

1.2 Application: Primarily for general use in light wall-thickness sections where minimum tensile strength up to 160,000 psi (1103 MPa) is required and parts may be welded during fabrication.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

#### 2.1.1 Aerospace Material Specifications:

AMS 2253 - Tolerances, Carbon and Alloy Steel Tubing

AMS 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steel

AMS 2301 - Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure

AMS 2350 - Standards and Test Methods

AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock

AMS 2640 - Magnetic Particle Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM A370 - Mechanical Testing of Steel Products

ASTM E112 - Estimating the Average Grain Size of Metals

ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

#### 2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

### 3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

|            | min  | max   |
|------------|------|-------|
| Carbon     | 0.28 | 0.33  |
| Manganese  | 0.70 | 0.90  |
| Silicon    | 0.20 | 0.35  |
| Phosphorus | --   | 0.025 |
| Sulfur     | --   | 0.025 |
| Chromium   | 0.40 | 0.60  |
| Nickel     | 0.40 | 0.70  |
| Molybdenum | 0.15 | 0.25  |
| Copper     | --   | 0.35  |

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2259, paragraph titled "Low Alloy Steels."

3.2 Condition: Cold finished and either normalized and tempered, stress-relieved, or otherwise heat treated.

3.3 Fabrication: Tubing shall be produced by a welded and drawn process. The external and internal surface finishes may be produced by any method which will provide the required surface condition and not affect the limits of wall thickness, with the exception that centerless ground finish is not acceptable. A light polish to improve surface appearance may be employed.

3.3.1 Tubing shall be processed to remove completely the weld bead and any dimensional indication of the presence of welds.

3.4 Properties: The product shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.4.1 Tensile Properties: Shall be as specified in Table I.

TABLE I

| Nominal OD<br>Inches | Nominal Wall<br>Thickness<br>Inch | Tensile<br>Strength<br>psi, min | Yield Strength<br>at 0.2% Offset<br>psi, min | Elongation in<br>2 in., %, min |       |
|----------------------|-----------------------------------|---------------------------------|----------------------------------------------|--------------------------------|-------|
|                      |                                   |                                 |                                              | Full Tube                      | Strip |
| Up to 0.500, excl    | Up to 0.188, incl                 | 95,000                          | 75,000                                       | 10                             | --    |
| Up to 0.500, excl    | Over 0.188, incl                  | 90,000                          | 70,000                                       | 10                             | --    |
| 0.500 and over       | Up to 0.188, incl                 | 95,000                          | 75,000                                       | 12                             | 7     |
| 0.500 and over       | Over 0.188                        | 90,000                          | 70,000                                       | 15                             | 10    |

TABLE I (SI)

| Nominal OD<br>Millimetres | Nominal Wall<br>Thickness<br>Millimetres | Tensile<br>Strength<br>MPa, min | Yield Strength<br>at 0.2% Offset<br>MPa, min | Elongation in<br>50.8 mm, %, min |       |
|---------------------------|------------------------------------------|---------------------------------|----------------------------------------------|----------------------------------|-------|
|                           |                                          |                                 |                                              | Full Tube                        | Strip |
| Up to 12.70, excl         | Up to 4.78, incl                         | 655                             | 517                                          | 10                               | --    |
| Up to 12.70, excl         | Over 4.78                                | 621                             | 483                                          | 10                               | --    |
| 12.70 and over            | Up to 4.78, incl                         | 655                             | 517                                          | 12                               | 7     |
| 12.70 and over            | Over 4.78                                | 621                             | 483                                          | 15                               | 10    |

3.4.2 Crushing: Specimens shall withstand, without failure of the weld, crushing under a gradually applied axial load until the cross-sectional dimension is increased in one zone by 20%, or until one complete fold is formed, or until the specimen is reduced in length to 2/3 of the original length.

3.4.3 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, ASTM E112, McQuaid-Ehn test.

3.4.4 Decarburization:

- 3.4.4.1 Tubing ordered ground, turned, or polished, shall be free from decarburization on the ground, turned, or polished surfaces. Decarburization on tubing ID shall not exceed the maximum depth specified in Table II.
- 3.4.4.2 Allowable decarburization of tubing ordered for redrawing or to specified microstructural requirements shall be as agreed upon by purchaser and vendor.
- 3.4.4.3 Tubing to which 3.4.4.1 or 3.4.4.2 is not applicable shall be free from complete decarburization. Partial decarburization shall not exceed the limits specified in Table II.

TABLE II

| Nominal Wall Thickness (T)<br>Inch | Depth of Partial Decarburization, Inch |       |         |
|------------------------------------|----------------------------------------|-------|---------|
|                                    | ID                                     | OD    | ID & OD |
| Up to 0.040, incl                  | 0.25T                                  | 0.25T | 0.30T   |
| Over 0.040 to 0.050, incl          | 0.009                                  | 0.009 | 0.012   |
| Over 0.050 to 0.070, incl          | 0.010                                  | 0.010 | 0.014   |
| Over 0.070 to 0.080, incl          | 0.012                                  | 0.012 | 0.016   |
| Over 0.080 to 0.090, incl          | 0.014                                  | 0.014 | 0.018   |
| Over 0.090 to 0.100, incl          | 0.015                                  | 0.015 | 0.020   |
| Over 0.100 to 0.150, incl          | 0.017                                  | 0.017 | 0.022   |
| Over 0.150 to 0.200, incl          | 0.020                                  | 0.020 | 0.026   |

TABLE II (SI)

| Nominal Wall Thickness (T)<br>Millimetres | Depth of Partial Decarburization, Millimetres |       |         |
|-------------------------------------------|-----------------------------------------------|-------|---------|
|                                           | ID                                            | OD    | ID & OD |
| Up to 1.02, incl                          | 0.25T                                         | 0.25T | 0.30T   |
| Over 1.02 to 1.27, incl                   | 0.23                                          | 0.23  | 0.30    |
| Over 1.27 to 1.78, incl                   | 0.25                                          | 0.25  | 0.36    |
| Over 1.78 to 2.03, incl                   | 0.30                                          | 0.30  | 0.41    |
| Over 2.03 to 2.29, incl                   | 0.36                                          | 0.36  | 0.46    |
| Over 2.29 to 2.54, incl                   | 0.38                                          | 0.38  | 0.51    |
| Over 2.54 to 3.81, incl                   | 0.43                                          | 0.43  | 0.56    |
| Over 3.81 to 5.08, incl                   | 0.51                                          | 0.51  | 0.66    |

- 3.4.4.4 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N scale or equivalent hardness testing method on hardened but untempered specimens protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the depth under that surface below which there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization or lack of decarburization thereon.
- 3.4.4.4.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the above limits by more than 0.005 in. (0.13 mm) and the width is 0.065 in. (1.65 mm) or less.

### 3.5 Quality:

3.5.1 Steel shall be aircraft quality conforming to AMS 2301.

3.5.2 Tubing shall be uniform in quality and condition and shall have a workmanlike finish conforming to the best practice for high quality tubing. It shall be smooth, clean, and free from heavy scale or oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other injurious conditions. Surface imperfections such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale pattern will not be considered injurious if the imperfections are removable within the tolerances specified for wall thickness. The removal of surface imperfections is not required.

3.5.2.1 When specified, the tubing, either with or without machining of the surface, shall be capable of passing magnetic particle inspection in accordance with AMS 2640. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, tubing will be acceptable in mill lengths of 6 - 20 ft (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.7 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2253.

### 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the tubing shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that the tubing conforms to the requirements of this specification.

#### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), tensile properties (3.4.1), crushing (3.4.2), grain size (3.4.3), decarburization (3.4.4), AMS 2301 frequency-severity rating (3.5.1), and tolerance (3.7) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to magnetic particle inspection (3.5.2.1) requirements when specified are classified as qualification or periodic control tests.

#### 4.3 Sampling:

4.3.1 Acceptance Tests: Sampling shall be in accordance with AMS 2370 and the following:

4.3.1.1 At least one sample for the crushing test of 3.4.2 shall be selected from each 1000 ft (305 m) or less from each lot of tubing. Specimens shall have length equal to 1.5 times the nominal OD of the tube. A lot shall be all tubing of the same size from a single heat, heat treated as a batch or sequentially heat treated in a continuous furnace.

4.3.2 Qualification Tests: Sampling shall be as agreed upon by purchaser and vendor.

#### 4.4 Reports:

4.4.1 The vendor of tubing shall furnish with each shipment three copies of a report of the results of tests for chemical composition, grain size, and AMS 2301 frequency-severity rating of each heat in the shipment and for tensile properties of each size from each heat. This report shall include the purchase order number, heat number, material specification number and its revision letter, size, and quantity from each heat.