

**AEROSPACE  
MATERIAL  
SPECIFICATION**

**SAE** AMS5562

REV. E

|                      |         |
|----------------------|---------|
| Issued               | 1974-06 |
| Reaffirmed           | 2006-04 |
| Revised              | 2010-08 |
| Superseding AMS5562D |         |

Steel, Corrosion and Heat Resistant, Seamless Tubing  
9.0Mn - 20Cr - 6.5Ni - 0.28N  
Solution Heat Treated

UNS S21904

RATIONALE

AMS5562E revises sampling and testing (4.3.2) and results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat resistant steel in the form of seamless tubing.

1.2 Application

This tubing has been used typically for parts, such as fluid-conducting lines, requiring both corrosion and heat resistance, especially when such parts are welded or brazed during fabrication, and which require strength higher than that of the 18 8 type steels, or require oxidation resistance up to 1100 °F (593 °C), but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

- |         |   |
|---------|---|
| AMS2243 | Tolerances, Corrosion and Heat-Resistant Steel Tubing   |
| AMS2248 | Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys |
| AMS2371 | Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock                |

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|         |   |
|---------|---|
| AMS2634 | Ultrasonic Inspection, Thin Wall Metal Tubing   |
| AMS2807 | Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing |

## 2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

|                   |   |
|-------------------|---|
| ASTM A 262        | Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels   |
| ASTM A 370        | Mechanical Testing of Steel Products  |
| ASTM A 450/A 450M | General Requirements for Carbon, Ferritic Alloy and Austenitic Alloy Steel Tubes  |
| ASTM E 353        | Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys                           |
| ASTM E 426        | Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys |
| ASTM E 1417       | Liquid Penetrant Testing  |

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

| Element    | min   | max   |
|------------|-------|-------|
| Carbon     | --    | 0.04  |
| Manganese  | 8.00  | 10.00 |
| Silicon    | --    | 1.00  |
| Phosphorus | --    | 0.060 |
| Sulfur     | --    | 0.030 |
| Chromium   | 19.00 | 21.50 |
| Nickel     | 5.50  | 7.50  |
| Nitrogen   | 0.15  | 0.40  |
| Molybdenum | --    | 0.75  |
| Copper     | --    | 0.75  |

#### 3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

### 3.2 Condition

Solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, pickled as required or passivated.

### 3.3 Fabrication

Tubing shall be produced by a seamless process. Any surface finishing operation applied to remove objectional sets and surface blemishes shall be performed prior to final solution heat treatment. A light polish to improve external surface appearance may be employed after solution heat treatment and, if performed, the product shall be subsequently passivated.

### 3.4 Properties

Tubing shall conform to the following requirements:

#### 3.4.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM A 370.

| Property                               | Value              |
|--|--------------------|
| Tensile Strength                       | 90.0 ksi (621 MPa) |
| Yield Strength at 0.2% Offset          | 50.0 ksi (345 MPa) |
| Elongation in 2 Inches (50.8 mm)       | 40% 45%            |
| Strip Specimens    Full Tube Specimens |                    |

#### 3.4.2 Flarability

Specimens as in 4.3.1 shall withstand flaring at room temperature, without formation of cracks or other visible defects, by being forced axially with steady pressure over a hardened and polished tapered steel pin having a 74-degree included angle to produce a flare having a permanent expanded OD not less than shown in Table 3.

| Nominal OD<br>Inches | Expanded OD<br>Inches | Nominal OD<br>Inches | Expanded OD<br>Inches |
|----------------------|-----------------------|----------------------|-----------------------|
| 0.125                | 0.200                 | 0.750                | 0.937                 |
| 0.188                | 0.302                 | 1.000                | 1.187                 |
| 0.250                | 0.359                 | 1.250                | 1.500                 |
| 0.312                | 0.421                 | 1.500                | 1.721                 |
| 0.375                | 0.484                 | 1.750                | 2.106                 |
| 0.500                | 0.656                 | 2.000                | 2.356                 |
| 0.625                | 0.781                 |                      |                       |

| Nominal OD<br>Millimeters | Expanded OD<br>Millimeters | Nominal OD<br>Millimeters | Expanded OD<br>Millimeters |
|---------------------------|----------------------------|---------------------------|----------------------------|
| 3.18                      | 5.08                       | 19.05                     | 23.80                      |
| 4.78                      | 7.67                       | 25.40                     | 30.15                      |
| 6.35                      | 9.12                       | 31.75                     | 38.10                      |
| 7.92                      | 10.69                      | 38.10                     | 43.71                      |
| 9.52                      | 12.29                      | 44.45                     | 53.49                      |
| 12.70                     | 16.66                      | 50.80                     | 59.84                      |
| 15.88                     | 19.84                      |                           |                            |

3.4.2.1 Tubing with nominal OD between any two standard sizes shown in Table 3 shall take the same percentage flare as shown for the larger of the two sizes.

### 3.4.3 Pressure Test

The tubing shall show no bulges, leaks, pinholes, cracks, or other defects when subjected to an internal hydrostatic pressure (P), except that a diametric permanent set of 0.002 inch per inch (0.002 mm/mm) of diameter is acceptable. The hydrostatic pressure (P) shall be determined using Equation 1:

$$P = S \frac{D^2 - d^2}{D^2 + d^2} \quad (\text{Eq. 1})$$

where:

P = Test pressure in ksi (MPa)

S = Minimum yield strength from 3.4.1

D = Nominal OD

d = Nominal ID

### 3.4.4 Susceptibility to Intergranular Attack

Specimens from tubing, after sensitizing treatment, shall pass the intergranular corrosion test performed in accordance with ASTM A 262, Practice E. After exposure, tubing shall be tested in accordance with the flattening test requirements of ASTM A 450/A 450M. Samples shall be taken from tubing after final annealing but may be taken prior to cold working.

## 3.5 Quality

Tubing, as received by purchaser, shall be uniform in quality and condition and shall have a finish conforming to the best practice for high quality aircraft tubing. It shall be smooth and free from grease, oil and other foreign matter, heavy scale or oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other imperfections detrimental to usage of the tubing. 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, but removal of such imperfections is not required.

3.5.1 Tubing shall be free from grease or other foreign matter. Metallic flakes or particles shall not be collected by a clean, white cloth drawn through the length of the bore of a test sample. Discoloration of the cloth, without the presence of flakes or particles, is acceptable.

3.5.2 When specified, tubing shall be subjected to fluorescent penetrant testing in accordance with ASTM E 1417, to ultrasonic inspection in accordance with AMS2634, to electromagnetic (eddy-current) inspection in accordance with ASTM E 426, or to any combination thereof. Tubing shall meet the requirements of 3.5 and other acceptance criteria established by the cognizant engineering organization (See 8.4).

## 3.6 Tolerances

Shall conform to all applicable requirements of AMS2243.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The vendor of tubing shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to specified requirements.