



# AEROSPACE MATERIAL SPECIFICATION

AMS6361™

REV. G

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Superseding AMS6361F

Steel Tubing, Seamless  
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)  
125 ksi (862 MPa) Tensile Strength  
(Composition similar to UNS G41300)

## RATIONALE

AMS6361G results from a Five-Year Review and update of this specification that revises composition analytical methods (3.1) and decarburization (3.4.3), prohibits unauthorized exceptions (3.7), and revises reporting (4.4) and identification (5.2).

### 1. SCOPE

#### 1.1 Form

This specification covers an aircraft-quality, low-alloy steel in the form of round, seamless tubing having a wall thickness not greater than 0.188 inch (4.78 mm).

#### 1.2 Application

This tubing has been typically used in thin-walled sections where a minimum tensile strength of 125 ksi (862 MPa) is required, 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.

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## 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (outside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2253	Tolerances, Carbon and Alloy Steel Tubing
AMS2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS2301	Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure
AMS2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock
AMS2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications

## 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 A370	Mechanical Testing of Steel Products
ASTM A751	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM E112	Determining Average Grain Size
ASTM E384	Microindentation Hardness of Materials
ASTM E1077	Standard Test Methods for Estimating the Depth of Decarburization of Steel Specimens
ASTM E1444	Magnetic Particle Testing

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to purchaser.

**Table 1 - Composition**

Element	Min	Max
Carbon	0.28	0.33
Manganese	0.40	0.60
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

#### 3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

### 3.2 Condition

Hardened by quenching from a temperature within the range 1500 to 1600 °F (816 to 871 °C) and tempered to meet the requirements of 3.4.1.

### 3.3 Fabrication

Tubing shall be produced by a seamless process. Any surface finishing operation applied to remove objectionable pits and surface blemishes shall be performed prior to final heat treatment. A light polish to improve surface appearance may be employed after final heat treatment.

### 3.4 Properties

Tubing shall conform to the following requirements; tensile testing shall be performed in accordance with ASTM A370:

#### 3.4.1 Tensile Properties

Shall be as shown in Table 2.

**Table 2 - Minimum tensile properties**

Property	Value
Tensile Strength	125.0 ksi (862 MPa)
Yield Strength at 0.2% Offset	100.0 ksi (689 MPa)
Elongation in 2 Inches (50.8 mm)	12%
Full Elongation in 2 Inches (50.8 mm)	7%
Tube Strip	

3.4.1.1 Mechanical property requirements for product outside the size range covered 1.1 shall be agreed upon between purchaser and producer.

#### 3.4.2 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

#### 3.4.3 Decarburization

3.4.3.1 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 3.

3.4.3.2 Allowable decarburization of pierced billets, of tubing for redrawing, or of tubing ordered to specified microstructural requirements shall be as agreed upon by purchaser and producer.

3.4.3.3 Tubing where 3.4.3.1 or 3.4.3.2 are not applicable shall be free from complete decarburization. Partial decarburization shall be not greater than shown in Table 3.

**Table 3****Table 3A - Maximum decarburization, inch/pound units**

Nominal Wall Thickness (T) Inch	Depth of Partial Decarburization Inch ID	Depth of Partial Decarburization Inch OD	Depth of Partial Decarburization Inch ID+OD
Up to 0.040, incl	0.18T	0.18T	0.25T
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 0.188, incl	0.020	0.020	0.026

**Table 3B - Maximum decarburization, SI units**

Nominal Wall Thickness Millimeters	Depth of Partial Decarburization Millimeter ID	Depth of Partial Decarburization Millimeter OD	Depth of Partial Decarburization Millimeter ID+OD
Up to 1.02, incl	0.18T	0.18T	0.25T
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 4.78, incl	0.51	0.51	0.66

3.4.3.4 Decarburization shall be evaluated by one of the two methods of 3.4.3.4.1 or 3.4.3.4.2.

3.4.3.4.1 A cross section of the surface shall be prepared in accordance with ASTM E1077 and examined metallographically at a magnification not to exceed 100X. Optical indications of decarburization shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.4.3.4.2 The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E384 conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization is defined as the perpendicular distance from the surface to the depth under that surface where there is not further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. Acceptance shall be as listed in Table 3.

3.4.3.4.3 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 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.4.3.4.4 In case of dispute, the total depth of decarburization determined using the microindentation hardness traverse method shall govern.

### 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 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 Steel shall be aircraft quality conforming to AMS2301.

3.5.2 When specified, the tubing, either with or without machining of the surfaces, shall be subjected to magnetic particle inspection in accordance with ASTM E1444. Standards for acceptance shall be as agreed upon by purchaser and producer.

### 3.6 Tolerances

Shall conform to all applicable requirements of AMS2253.

### 3.7 Exceptions

Any exceptions shall be authorized by purchaser and reported as in 4.4.2.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The producer of tubing shall supply all samples for producer'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.

### 4.2 Classification of Tests

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

### 4.3 Sampling and Testing

Shall be in accordance with AMS2370.

### 4.4 Reports

4.4.1 The producer of the tubing shall furnish with each shipment a report showing the producer identity, country where the metal was melted (i.e., final melt in the case of metal processed by multiple melting operations), results of tests for composition and frequency-severity cleanliness rating of each heat, for tensile properties and average grain size of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS6361G, size, and quantity.

4.4.2 When material produced to this specification is beyond the sizes allowed in the scope or tables, or exceptions authorized by purchaser taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS6361G(EXC) because of the following exceptions:" and the specific exceptions shall be listed (also see 5.2).

### 4.5 Resampling and Retesting

Shall be in accordance with AMS2370.