The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6373D

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Superseding AMS 6373C

Submitted for recognition as an American National Standard

STEEL, WELDED TUBING
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)

UNS G41300

1. SCOPE:

1.1 Form:

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

1.2 Application:

This tubing has been used typically for general use where welding and moderate tensile properties are required and especially when a minimum tensile strength of 160 ksi (1103 MPa) is required after proper heat treatment, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2253 Tolerances, Carbon and Alloy Steel Tubing
MAM 2253 Tolerances, Metric, Carbon and Alloy Steel Tubing
AMS 2259 Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2301 Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure

2.1 (Continued)

AMS 2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steels, Wrought Products and Forging Stock
AMS 2640 Magnetic Particle Inspection
AMS 2807 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, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 370 Mechanical Testing of Steel Products
ASTM E 112 Determining the Average Grain Size
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition:
(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, 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 requirements of AMS 2259.

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 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 completely remove the weld bead and any dimensional indication of the presence of welds.

3.4 Properties:

Tubing shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A 370:

3.4.1 Tensile Properties: Shall be as specified in Table 2.

TABLE 2 - Minimum Tensile Properties, Inch/Pound Units

Nominal OD Inches	Nominal Wall Thickness Inch	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches % Full Tube	Elongation in 2 Inches % Strip
Up to 0.500, excl	Up to 0.188, incl	95.0	75.0	10	--
Up to 0.500, excl	Over 0.188	90.0	70.0	12	--
0.500 and over	Up to 0.188, incl	95.0	75.0	12	7
0.500 and over	Over 0.188	90.0	70.0	15	10

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal OD Millimeters	Nominal Wall Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm % Full Tube	Elongation in 50.8 mm % Strip
Up to 12.70, excl	Up to 4.78, incl	655	517	10	--
Up to 12.70, excl	Over 4.78	621	483	12	--
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 as in 4.3.1.1 shall withstand, without failure of the weld, crushing under a gradually applied 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 two-thirds of the original length.

3.4.3 (R) Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112 (See 8.2).

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.

3.4.4.2 Tubing to which 3.4.4.1 is not applicable shall be free from complete decarburization. Partial decarburization shall not exceed the limits specified in 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	0.25T	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 3B - Maximum Decarburization, SI Units

Nominal Wall Thickness (T) Millimeters	Depth of Partial Decarburization Millimeters ID	Depth of Partial Decarburization Millimeters OD	Depth of Partial Decarburization Millimeters 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

3.4.4.3 Decarburization shall be measured by the microscopic method or by HR30N 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.

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

3.4.5 Flarability: Tubing 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 not less than the permanent percentage OD increase shown in Table 4. After flaring, the inside surface of the tubing shall be smooth and shall show no evidence of a bead that might prevent the assembly of pressure tight joints.

TABLE 4 - Minimum OD Increase

Nominal Wall Thickness % of OD	OD Increase %
Up to 7, incl	35
Over 7	45

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 AMS 2301.

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

3.6 Tolerances:

Shall conform to all applicable requirements of AMS 2253 or MAM 2253.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), tensile properties (3.4.1), crushing (3.4.2), grain size (3.4.3), decarburization (3.4.4), frequency-severity cleanliness rating (3.5.1), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests for flarability (3.4.5), and, when specified, magnetic particle inspection (3.5.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:
(R)

4.3.1 For Acceptance Tests: 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 feet (305 m) or less of tubing from each lot. Specimens shall have length equal to 1.5 times the nominal OD of the tube.

4.3.2 For Periodic Tests: As agreed upon by purchaser and vendor.

4.3.2.1 Specimens for flarability test shall be full tubes or sections cut from a tube. The end of the specimen to be flared shall be cut square, with the cut end smooth and free from burrs, but not rounded.

4.4 Reports:
(R)

The vendor of tubing shall furnish with each shipment a report showing the results of tests for chemical composition, grain size, and frequency-severity cleanliness rating of each heat and for tensile properties of each lot. This report shall include the purchase order number, lot number, AMS 6373D, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2370.