

MIL-T-8887(ASG)

1 JUNE 1961

MILITARY SPECIFICATION

TUBING, STEEL, CORROSION-RESISTANT, HEAT-RESISTANT,
STABILIZED, WELDED, THIN WALLThis specification has been approved by the Department
of the Air Force and by the Bureau of Naval Weapons.

1. SCOPE

1.1 Scope.- This specification covers welded thin wall tubing of stabilized corrosion- and heat-resistant steel in which the wall thickness is approximately 2 percent of the outside diameter (OD), or less.

1.2 Classification.- Tubing material shall conform to one of the following alloy compositions as indicated by table I. Unless otherwise specified (see 6.2), either composition may be supplied, except that all material supplied to an individual order shall be of the same nominal composition.

Composition 347.

Composition 321.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

STANDARDSFederal

FED. TEST METHOD
STD. NO. 151
FEDERAL STANDARD
NO. 183

Metals; Test Methods

Continuous Identification Marking of
Iron and Steel Products

Military

MIL-STD-129
MIL-STD-163

Marking for Shipment and Storage
Steel and Mill Products

Preparation for Shipment and Storage

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

FSC 4710

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2.2 Other publications.- The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

American Society for Testing Materials Method of Test Designations

E89-52 Estimating the Average Ferrite Grain Size of
 Low-Carbon Steels
A380-57 Descaling and Cleaning Stainless Steel Surfaces

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania.)

3. REQUIREMENTS

3.1 Chemical composition.- The chemical composition shall conform to the table I limits.

TABLE I

Alloy composition limits

Composition designation	347	321	Check analysis
Element	Composition (percent)	Composition (percent)	Tolerance (percent)
Carbon	0.08 max.	0.08 max.	+0.01
Manganese	2.00 max.	2.00 max.	+0.04
Phosphorus	0.04 max.	0.04 max.	+0.005
Sulfur	0.03 max.	0.03 max.	+0.005
Chromium	17.0/19.0	17.0/19.0	±0.20
Nickel	9.0/12.0	8.0/11.0	±0.15
Silicon	0.50/1.00	0.40/1.00	+0.05
Copper	0.50 max.	0.50 max.	+0.03
Columbium plus tantalum ^{1/}	1.10 max.	---	+0.05
Molybdenum	10 x C min. ^{2/} 0.50 max.	---	+0.03
Titanium	---	0.70 max. 6 x C min. ^{3/}	+0.05

^{1/} Columbium or columbium plus tantalum. The determination of tantalum is not required; however, when determined, the ratio of tantalum to the total of tantalum plus columbium should not exceed 0.4.

^{2/} The sum of the columbium content plus the tantalum content shall be not less than 10 times the carbon content.

^{3/} The ratio titanium-to-carbon shall be not less than 6 to 1.

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3.2 Surface treatment.- Tubing shall be passivated.

3.2.1 Finish.- The surface finish and appearance shall approximate commercial No. 2D sheet finish except for the weld bead.

3.3 Fabrication.- Tubing shall be machine-fusion welded by shielded arc processes, shall contain no more than one longitudinal weld, and shall contain no circumferential welds. Tube ends shall be cut square and deburred.

3.4 Mechanical properties.- The mechanical properties of the tubing shall conform to the requirements of table II.

TABLE II

Mechanical properties

Yield strength at 0.2 percent offset pounds per square inch (psi)	Tensile strength (psi)	Elongation (percent in 2 inches)	
		Full tube specimen	Strip specimen
35,000 min.	75,000 to 95,000	35 min.	32 min.

3.4.1 Grain size.- The grain size of tubing in the "as received" condition shall average 5.5 or higher, as determined by the method in 4.9.

3.5 Weld crack susceptibility.-

3.5.1 Bending.- Specimens including the weld area shall withstand bending as specified in 4.7.1 without developing cracks or other evidence of imperfection when inspected at 10 diameters magnification.

3.5.2 Tension.- Weld areas shall not develop cracks when tested in tension parallel to the weld axis at the conditions specified in 4.6.2.

3.6 Hydrostatic pressure test.-

3.6.1 Proof test.- After all fabricating and sizing operations, each length of tubing shall be capable of withstanding a gradually applied internal hydrostatic pressure (P) calculated according to the following formula, for 5 seconds, without developing leaks or bulges, permanent set, or other imperfections which exceed the allowable tolerances for the respective nominal size.

$$P = \frac{2st}{D}$$

where:

P = test pressure in psi

s = 30,000 psi

t = wall thickness, (min) inches

D = outside diameter, nominal, in inches

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3.6.2 Sampling test.- Tubing shall withstand an internal hydrostatic pressure sufficient to cause a hoop tensile stress of 75,000 psi in the walls, without rupture, when tested as specified in 4.8.2.

3.7 Tolerances.- The variation between the actual and the nominal dimensions of tubing shall not exceed the following tolerances.

3.7.1 Diameter.-

<u>Nominal OD</u>	<u>Tolerance, inch</u> 1/ 2/
1.000 to 2.500	-0.005 +0.000
2.501 to 3.500	-0.007 +0.000
3.501 to 4.500	-0.009 +0.000
Over 4.501	-0.012 +0.000

1/ One of 2 increments of 90 degrees at the same station.

2/ Tolerance on maximum variation between individual measurements shall be 5 percent of nominal diameter.

3.7.2 Weld bead heights.- The weld bead shall follow the general contour of the tube wall and shall not extend in height beyond the contour of the adjacent tube wall more than 0.0025 inch on either the outside or inside of the tubing, with the sum of both outside weld bead heights not to exceed 0.004 inch.

3.7.3 Wall thickness.- Wall thickness tolerances are applicable to all areas, including weld areas.

<u>Nominal thickness, inch</u>	<u>Tolerance, inch</u>
0.010 to 0.016	±0.002
0.017 to 0.026	±0.003
0.027 to 0.040	±0.004
0.041 to 0.058	±0.005
0.059 to 0.072	±0.006

3.7.4 Ovality.- Ovality shall not exceed 6 percent of nominal OD. Ovality is obtained by dividing the difference between the maximum and the minimum diameters of any one station along the tube by the nominal OD, and multiplying by 100.

3.7.5 Length.- Tubing cut to ordered lengths shall not vary from the specified length more than +1/8 -0 inch.

3.7.6 Straightness.- When measured, using a 3-foot straightedge touching the outer tube surface at any two points, the perpendicular distance from the straight-edge of the tube shall not exceed 0.010 x L/1 foot at any location between the points of contact; provided the straightedge is not less than 3 feet in length where L is the distance between the points of contact.

3.8 Identification of product.- Each tube shall be marked in accordance with Standard MIL-STD-183, except that the following items shall be included in the legend:

MIL-T-8887
Welded tubing
Composition designation (347 or 321, as appropriate)

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3.9 Workmanship.- Tubing shall be of uniform contour, quality, and condition, and free from detectable voids and harmful inclusions. Surfaces shall be clean, sound, and free from burrs, cracks, tears, grooves, seams, laminations, sharp dents, crimps, foreign matter, and other imperfections detrimental to the fabrication or performance of parts, provided the wall thickness at any point is not less than the minimum specified in 3.7.3.

3.9.1 Specified surface imperfections, such as light tool marks and handling marks which do not reduce the wall thickness more than 5 percent of the nominal thickness, are acceptable, provided the thickness at any point is not less than the thickness specified in 3.7.3.

3.9.2 Weld quality.- The welds shall be sound and free from porosity, pinholes, entrapped slag, cracks, mismatches, lack of fusion, or undercutting. Thinning of the metal wall in or adjacent to the weld is permissible, provided the remaining wall thickness is not less than 90 percent of the parent material thickness at any point; provided also that there are no abrupt changes in thickness in any area.

3.9.3 Dents.- Smooth dents, free from cuts, are permissible, provided the depth does not exceed the limits specified in 3.7.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection responsibility.- The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests.- All the tests required for the testing of steel tubing are classified as acceptance tests, for which sampling techniques and methods of testing are specified in this section.

4.3 Examination of product.- All tubing shall be carefully examined to determine compliance with workmanship, surface imperfections, and marking requirements. Spot checks shall be made as necessary to assure compliance with applicable dimensions and tolerances.

4.4 Chemical analysis.-

4.4.1 Sampling.- Samples for chemical analysis shall be selected by the Government inspector, as described in Method III of Federal Test Method Standard No. 151, to represent each heat in the shipment. The sample shall consist of not less than 2 ounces of material.

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4.4.1.1 Samples for chemical analysis may be waived at the discretion of the Government inspector, provided that all of the material under inspection can be identified as being made from a heat previously analyzed and found to be in accordance with the chemical composition specified herein.

4.4.1.2 The method of selecting samples specified above is based on the assumption that the material is produced from ingots from the same heat, and is essentially homogeneous in all respects. If the material is taken from stock and is not identifiable as to heat and method of manufacture, or if the identity of any portion of the shipment is obscure in any respect, the Government inspector shall select the necessary additional samples to determine conformance of all portions of the shipment to this specification.

4.4.2 Method.- Analysis shall be by wet chemical spectrochemical, or other analytic methods. In the event of dispute, analysis shall be by wet chemical methods.

4.5 Passivity.- Tubing shall show no plating or blush when subjected to the copper sulfate inspection test of ASTM Method A380-57.

4.6 Tensile test.-

4.6.1 Sampling.- Three samples shall be selected to represent each 5,000 feet or less of tubing of one diameter and wall thickness, produced under the same processing conditions, from the same heat of steel, essentially uniform in all respects, and presented for acceptance at one time.

4.6.2 Specimens.- Strip specimens shall be taken transverse to the welded seam, with the weld included in the test section and shall conform insofar as practicable, with type T1 or T2, Method 211 of Federal Test Method Standard No. 151.

4.6.3 Method.- Test shall conform to Method 211 of Federal Test Method Standard No. 151. The speed of testing shall be regulated to produce a strain rate of 0.005 to ± 0.002 inch per inch per minute.

4.7 Weld crack susceptibility.- Two specimens shall be selected to represent each 3,000 feet or less of tubing of one diameter and wall thickness presented for acceptance at one time. The specimens shall be approximately 2 inches square, depending on the tube dimensions, and shall include the weld.

4.7.1 Method.- Specimens shall be bent around a diameter equal to double the tube wall thickness, with the fold along the weld zone and with the inner surface of the tubing on either the inside or outside of the bend.

4.8 Hydrostatic internal pressure.-

4.8.1 Sampling tests.- Two samples shall be selected from each 3,000 feet or less of tubing of one size and wall thickness and presented for acceptance at one time.

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4.8.2 Method.- The specimen shall consist of a full section of tubing, the unsupported length of which is not less than 2 feet or 6 times the nominal diameter, whichever is greater. An internal hydrostatic pressure calculated in accordance with the formula of 3.6.1, except that it shall be sufficient to cause a tensile stress of 75,000 psi in the tube wall, shall be gradually applied in 1/2 to 1 minute, at a temperature in the range of 60° to 115° F. The specimen shall withstand the calculated pressure for not less than 1 minute without leakage or rupture.

4.9 Grain size determination.- One or more specimens shall be selected to represent tubing of one size and wall thickness, from the same heat of steel, annealed in the same charge, and submitted for inspection at one time. Specimens shall be electrolytically etched in 10-percent oxalic-acid solution and examined microscopically at 100 diameters magnification. The austenitic grain size may be determined by comparison with the austenitic grain size classification chart of Method 311, Federal Test Method Standard No. 151, except that, in case of dispute, the Heyn Intercept Method, section 7 of ASTM Method E89 shall be used. The average grain size shall be the average of 5 fields of view on each specimen.

4.10 Rejection.- Tubing failing to conform to any requirements of this specification shall be rejected.

4.11 Packaging, packing, and marking.- Preparation for delivery shall be examined for conformance with section 5.

5. PREPARATION FOR DELIVERY

5.1 Each length of tubing shall be individually encased in a cardboard container, fiberboard tube or otherwise separated by suitable packing materials to ensure maximum protection during shipment, handling, and storage.

5.1.1 All tubing shall be packed in wooden boxes or crates in accordance with Standard MIL-STD-163. Only tubing of the same OD and wall thickness shall be contained in any one box.

5.2 Marking of shipments.- Interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129. The nomenclature shall be as follows:

TUBING, STEEL, CORROSION-RESISTANT, HEAT-RESISTANT,
 STABILIZED, WELDED, THIN WALL
 Specification MIL-T-8887
 Composition designation
 Outside diameter
 Wall thickness
 Contract or Order No.
 Quantity (aggregate length)
 Manufacturer's name or trademark

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6. NOTES

6.1 Intended use.- Steel tubing procurable to this specification is intended for use in aircraft and missile ducting applications for the transfer of fluids under moderate pressures and at elevated temperatures.

6.2 Ordering data.- Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Alloy composition (see 1.2).
- (c) Diameter (see 3.7.1)
- (d) Wall thickness (see 3.7.3).
- (e) Length (when exact lengths are required) (see 3.7.5).
- (f) Amount of tubing desired.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:
Navy - Wep
Air Force - AFSC

Preparing activity:
Navy - Wep