MIL-T-16343C
3 July 1968
SUPERSEDING
MIL-T-16343B (NAVY)
12 August 1954

MILITARY SPECIFICATION

TUBING, STEEL, CARBON, STRUCTURAL

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope - This specification covers seamless and welded, black and zinc-coated (galvanized) carbon steel tubing (round cross section) suitable for structural purposes.

* 1.2 Classification - Tubing shall be furnished in the following types as specified (see 6.2):

Type I - Seamless
Type II - Electric-resistance welded
Type III - Butt welded

1.2.1 Finishes - Unless otherwise specified, tubing shall be furnished in the following finishes (see 3.4 and 6.2):

Zinc - coated (galvanized).
Black

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

QQ-Z-351	Zinc, Slab (Spelter)

FSC 4710

STANDARDS

Federal

FED-STD-66	Steel: Chemical Composition and Hardenability
Fed. Test Method Std. No. 151	Metals; Test Methods
FED-STD-183	Continuous Identification Marking of Iron and Steel Products

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-163	Steel Mill Products, Preparation for Shipment and Storage

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

* 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 or request for proposal shall apply.

Uniform Classification Committee
Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Blvd., Chicago, Illinois 60606.)

American Trucking Associations Inc.
National Motor Freight Classification Rules

(Applications for copies should be addressed to the American Trucking Associations, Inc., 1616 P Street N.W., Washington, D.C. 20036.)

American Society for Testing and Materials (ASTM)

A 90	Methods of test for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
E 8	Methods of Tension Testing of Metallic Materials.

(Applications for copies shall be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

* 3.1 Steel process - Unless a particular process is specified (see 6.2) the carbon steel for both seamless and welded tubing shall be made by one or more of the following processes: open-hearth, basic-oxygen, or electric-furnace.

3.2 Tubing, process - Tubing shall be formed by the process applicable to the type specified (see 1.2). Unless otherwise specified, tubing may be hot-finished or cold drawn (see 6.2).

* 3.3 Heat treatment -

3.3.1 Hot-finished tubing - Unless otherwise specified (see 6.2), hot finished tubing shall be annealed or normalized and tempered.

3.3.2 Cold drawn tubing - Cold drawn tubing shall be given a suitable thermal treatment after the last cold-draw pass to relieve injurious residual stresses. When specified by the procuring agency (see 6.2), cold drawn tubing shall be furnished as cold-drawn with no thermal treatment following the last cold-draw pass provided the surface hardness does not exceed Rockwell C-25 (or equal).

* 3.4 Finish -

3.4.1 Black finish - Unless otherwise specified by the procuring agency (see 6.2), black tubing furnished under the requirements of this specification shall be the normal black mill finish obtained by the manufacturing process.

3.4.2 Zinc-coated finish -

3.4.2.1 Application - Where a zinc-coated finish is required, galvanizing by the hot-dip process shall be used. Unless otherwise specified (see 6.2), a zinc-coated finish shall be applied to the inside and outside of the tubing. Any grade of zinc, conforming to QQ-Z-351, shall be used for the galvanizing. The zinc coating shall be adherent, smooth, continuous and of a uniform appearance. It shall be free from lumps, blisters, gritty areas, dross, warts, acid spots, flux, and other injurious defects.

3.4.2.2 Weight of zinc-coating - The weight of zinc-coating shall not be less than 2.0 ounces per square foot of total coated surface (inside surface plus outside surface) when tested as specified in 4.5.3.

3.4.2.3 Purity of zinc-coating - The molten zinc bath shall not contain more than 2 percent of elements other than zinc.

* 3.5 Chemical composition - The chemical composition of tubing shall be as specified in Table I.

TABLE I

CHEMICAL COMPOSITION

ELEMENT	PERCENT BY WEIGHT
Carbon, max.	0.30
Manganese, max.	0.90
Phosphorous, max.	0.045
Sulphur, max.	0.060
Silicon, max.	0.30
Copper, max.	0.35
Nickel, max.	0.50
Total, chromium and molybdenum, max.	0.30

3.5.1 Individual determinations may vary from the values specified in Table I to the extent shown in FED-STD-66 for check analysis tolerances except that elements shall not vary both above and below the values specified in Table I.

3.6 Mechanical properties - The mechanical properties of the tubing shall be as specified in Table II. When tubing is zinc-coated the mechanical properties of the base material shall be determined prior to galvanizing.

TABLE II

MECHANICAL PROPERTIES

PROPERTY	TYPE I	TYPE II	TYPE III
Ultimate Tensile strength, psi, min.	60,000	50,000	50,000
Yield point, psi, min.	33,000	33,000	33,000
Elongation, percent in 2 inches, min			
Full tube specimen	25	25	25
Strip or standard bar specimen	20	20	20

3.7 Flattening - Tubing of all types, including those with a zinc-coated finish, shall not crack or show any breaks in any section of the tubing or weld when subject to the flattening test specified in 4.5.5.

3.8 Dimensions and weights -

3.8.1 Dimensions - The tubing shall conform to the dimensions specified in the contract or purchase order (see 6.2). Unless otherwise specified, the tolerances shown in Table III shall apply.

TABLE III

TOLERANCES, DIMENSIONS AND WEIGHT

IDENTIFYING CHARACTERISTIC	TOLERANCE	
	Plus	Minus
Outside diameter (percent) 1/	1	1
Wall thickness (percent)	12-1/2	12-1/2
Weight (percent) for Type I	6-1/2	3-1/2
Weight (percent) for Types II and III	5	5
Length for tubing under 6 inches O.D. (inch) 2/	1/8	—
Length for tubing 6 inches O.D. and larger (inch) 2/	1/4	—

1/ Tubing in sizes smaller than 1-5/8 inch O.D. (not cold-drawn) shall have a tolerance of plus 0.015 inch and minus 0.030 inch.

2/ See 6.5.

3.8.2 Weight - The calculated weight of tubing shall be completed on the basis of cross sectional dimensions specified in the contract or purchase order, the furnished length, and the assumption that one cubic inch of steel weighs 0.2833 pound.

3.8.3 Straightness - Unless otherwise specified, the straightness tolerances shown in Table IV shall apply.

TABLE IV

STRAIGHTNESS TOLERANCE

SIZE LIMITS	MAXIMUM CURVATURE IN ANY 3 FEET, INCHES	MAXIMUM CURVATURE IN TOTAL LENGTHS	MAXIMUM CURVATURE FOR LENGTHS UNDER 3 FEET
O.D. 5 inches and smaller. Wall thickness over 3 percent of O.D. but not over 0.5 inch.	0.030	$0.030 \text{ in.} \times \frac{\text{No. of feet of length}}{3}$	Ratio of 0.010 inch per foot

TABLE IV (Continued)

STRAIGHTNESS TOLERANCE

SIZE LIMITS	MAXIMUM CURVATURE IN ANY 3 FEET, INCHES	MAXIMUM CURVATURE IN TOTAL LENGTHS	MAXIMUM CURVATURE FOR LENGTHS UNDER 3 FEET
O.D. over 5 inches to 8 inches incl. Wall thickness over 4 percent of O.D. but not over 0.75 inch.	0.045	$0.045 \text{ in.} \times \frac{\text{No. of feet of length}}{3}$	Ratio of 0.015 inch per foot
O.D. over 8 inches to 10-3/4 inches incl. Wall thickness, over 4 percent of O.D. but not over 1 inch.	0.060	$0.060 \text{ in.} \times \frac{\text{No. of feet of length}}{3}$	Ratio of 0.020 inch per foot

* 3.9 Identification marking - Unless otherwise specified in the contract or order (see 6.2), shall be marked as specified in 3.9.1 through 3.9.4.

3.9.1 Each length of Type I, seamless and Type II, electric resistance welded tubing 1/2-inch outside diameter and over, shall be printed in ink with constantly recurring symbols, which shall include coding of the name or trademark of the manufacturer and an identifying designation as specified hereinafter. The symbols shall be repeated at intervals of not greater than 3 feet.

Specification classification	Marking designation (Continuous marking required)
Type I	MIL-T-16343 Type I
Type II	MIL-T-16343 Type II

3.9.2 Continuous identification marking shall be in accordance with FED-STD-183.

3.9.3 Each length of Type III, butt welded tubing 2 inches outside diameter and over, shall be legibly marked by printing or paint stencilling or marked with raised symbols by mill rolling. The marking shall include coding of the name or trademark of the manufacturer and the following identification designation:

Marking designation (Continuous marking not required)

MIL-T-16343 Type III

3.9.4 For Types I and II tubing under 1/2-inch in outside diameter and Type III tubing under 2-inches in outside diameter, the identification specified in 3.9.1 and 3.9.3 shall be printed on substantial tags securely affixed to each end of the bundle.

* 3.10 Workmanship - Tubing ends shall be cut square and all burrs removed. Tubing shall be free from lamination, tears, indentations, grooves, inperfect welds, rust, and other injurious defects. Type I tubing shall have no welds. Types II and III tubing shall have no welding other than one continuous longitudinal weld necessary in the manufacturing process. Types II and III tubing shall be free from protruding flash on the outside surface. The flash on the inside of Types II and III tubing shall not protrude more than 1/64 inch at any point along the line of welding. Surface imperfections, such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale pattern will not be considered as injurious defects and cause for rejection, provided the wall thickness is not reduced to a value less than the minimum wall thickness calculated in accordance with Table III.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set fort in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.2 Lot - A lot shall consist of all tubing of the same heat, type, finish, size and wall thickness processed together. When heat treatment is involved (see 3.3), the lot as defined above shall consist of all tubing processed in the same heat treatment continuous furnace or in any one batch which forms the change for a stationary furnace treatment.

* 4.3 Sampling - Unless otherwise specified herein, sampling shall be in accordance with the provisions set forth in MIL-STD-105.

4.3.1 Quality conformance samples -

* 4.3.1.1 For visual examination, dimensional tolerance and weight tolerances - Samples for visual examination, dimensional tolerances and weight tolerances shall be selected from each lot of carbon steel tubing in accordance with the provisions of MIL-STD-105. Acceptance criteria shall be in accordance with MIL-STD-105, Inspection Level II, Acceptable Quality Level 2.5 percent defective.

4.3.1.2 For chemical analysis -

* 4.3.1.2.1 Finished product sampling for chemical analysis - At least one sample, consisting of not less than 2 ounces, shall be selected for chemical analysis tests of 4.5.1 in accordance with Method 111.2 or Method 112.2 of Fed. Test Method Std. No. 151. At the option of the supplier, samples from broken tension test pieces (see 4.5.4) or from sections used in the flattening test (see 4.5.5) may be used.

4.3.1.2.2 Weight of zinc coating - A random sample of one length of zinc-coated tubing shall be selected from each lot for test purposes.

* 4.3.1.2.3 Zinc coating composition - At least one sample shall be taken from the upper half of the hot zinc bath used for galvanizing the tubing. The sample shall be taken at any time so that the sample represents the zinc coating being processed. When a sample of the bath used for galvanizing is not available, the coating purity shall be established from the samples selected in accordance with 4.3.1.2.2 for test of 4.5.2, in which case iron shall not be considered as an impurity.

* 4.3.1.2.4 Chemical analysis preparation - Samples for chemical analysis of steel composition and for zinc coating composition shall be prepared as described in Method 111.2 or 112.2 of Fed. Test Method Std. No. 151 to represent each lot. Samples for weight of zinc coating shall be prepared as described in ASTM Method A 90.

* 4.3.1.3 For mechanical tests - A random sample of one length of tubing shall be selected from each lot furnished with a black finish or from uncoated tubing to be furnished with the galvanized finish for tests of 4.5.4 and 4.5.5. If any sample fails to comply with the mechanical tests, the lot shall be rejected.

4.4 Examination - Tubing sampled in accordance with 4.3.1.1 shall be visually inspected to determine whether the tubing meets the requirements of 3.8, 3.10, and when applicable 3.4.2.1 and 3.9.

4.5 Tests -

* 4.5.1 Chemical analysis - The samples selected for test in accordance with 4.3.1.2.1 shall be analyzed to determine compliance with 3.5 in accordance with Test Method 111.2 or 112.2 of Fed. Test Method Std. No. 151. In case of dispute, the analysis of Test Method 111.2 shall be the basis for acceptance or rejection.

* 4.5.2 Zinc coating composition - Samples selected for test from the hot bath, 4.3.1.2.3 or tubing selected from each lot of finished material shall be analyzed to determine compliance with 3.4.2.3.

4.5.3 Weight of zinc coating - (Stripping test method for zinc-coated tubing) - The test solution shall be prepared by adding 100 milliliters of concentrated.

hydrochloric acid (specific gravity 1.20) to 5 milliliters of a solution of 20 grams of antimony trioxide in 1000 milliliters of concentrated hydrochloric acid. The temperature of the solution shall at no time exceed 100° F. Test specimens approximately 4 inches long shall be cut from each end of tubing selected in 4.3.1.2.2. For large diameter tubing, the specimens may be sectioned along the axis of the tubing provided such sectioned specimens include approximately 24 square inches of surface (inside plus outside). The weight of coating shall be determined on each specimen separately, and the average coating weight of the two specimens reported. The specimens shall be weighed to the nearest 0.01 gram per square foot of surface and then completely immersed in the test solution and allowed to remain 1 minute or longer until the coating is fully removed. The specimens shall then be washed and scrubbed in running water to remove the deposited antimony, finally dried by heating to about 212° F, cooled and reweighed to the nearest 0.01 gram per square foot of surface. The loss in weight represents the weight of zinc coating removed from the area of the specimen. The coating weight shall be reported in ounces per square foot and checked for conformance to 3.4.2.2.

* 4.5.4 Tension tests - All tension tests shall be made on black or uncoated tubing samples selected as specified in 4.3.1.3 to determine conformance with 3.6. Where practicable, specimens for the tension test shall be full-section tubing test specimens in accordance with ASTM Test Method E8. When testing welded tubing, the specimen shall be taken from a location 90 degrees from the weld.

4.5.4.1 Standard round test specimens - For heavy walled tubing with wall thickness over 3/4 inch, the standard 0.500 in. (12.5 mm) round tension test specimen with 2-in. (50-mm) gage length as specified in ASTM Method E8 shall be used. The axis of the specimen shall be parallel to the axis of the tube.

4.5.4.2 Longitudinal strip test specimens - When tension tests are made on longitudinal strip test specimens as specified in ASTM Method E8, the minimum dimension between shoulders (length of reduced section) shall be 8 inches. Reference points shall be marked one inch apart along the gage length. The value of elongation shall be computed using the distance between two reference points across the fracture, which were originally two inches apart.

4.5.5 Flattening tests - A section of tubing not less than four inches in length from each test sample selected in accordance with 4.3.1.3 shall be flattened cold (room temperature) between parallel plates. When testing Type II or III tubing, the test specimen shall be placed with the weld at 45 degrees from the line of direction of the applied force. For all types, no cracks or breaks of the tubing or weld shall occur until the distance between the plates is less than that calculated for the value of "h" in the following formula:

$$H = \frac{(1 + e)t}{e + t/D}$$

where:

H = distance between flattening plate in inches.
t = nominal wall thickness in inches.
D = actual outside diameter of the tube.
e = deformation per unit length (constant for a given grade of steel, 0.08 for under 0.25 carbon and 0.07 for over 0.25 carbon).

For coated tubing, flaking or cracking of the coating alone shall not be considered cause for rejection.

* 4.5.6 Rejection and retest - Failure of a specimen to comply with the requirements of this specification shall be cause for rejection of the lot represented. A retest sample of five specimens will be permitted to replace each failed specimen of the original sample. If one retest sample fails, the lot shall be rejected and no further retesting permitted.

* 4.6 Inspection of preparation for delivery - The preservation, packing and marking of the tubing shall be inspected to determine compliance with the requirements of Section 5 of this specification.

5. PREPARATION FOR DELIVERY

* 5.1 Preservation -

5.1.1 Level A - All black tubing shall be furnished with a protective coating in accordance with MIL-STD-163. Zinc-coated tubing (galvanized) will not require the application of a preservation coating.

5.1.2 Level C - Tubing shall be preserved in accordance with the manufacturer's commercial practice.

* 5.2 Packing -

5.2.1 Level A - Tubing shall be packed in accordance with MIL-STD-163.

5.2.2 Level C - The tubing shall be packed in a manner which will insure arrival at destination in satisfactory condition and acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification Rules, or National Motor Freight Classification Rules.

5.3 Marking - In addition to any special marking required by the contract or order, shipments shall be marked in accordance with MIL-STD-163.

6. NOTES

* 6.1 Intended use - The tubing covered by this specification is made of a weldable grade of steel intended for use in structural and mechanical applications.

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

(a) Title, number, and date of this specification.

(b) Type and finish required (see 1.2, 1.2.1 and 3.4).

(c) Particular steel process other than specified (see 3.1).

(d) Hot-finished or cold-drawn tubing as required (see 3.2).

(e) Treatment of hot-finished tubing if other than annealed or normalized and tempered (see 3.3.1).

(f) When cold-drawn tubing is required, specify if thermal treatment is required (see 3.3.2).

(g) When zinc-coating is only required on the inside or outside of the tubing (see 3.4.2.1).

(h) Length and total quantity in feet.

(i) Outside diameter and wall thickness (see Table III).

(j) Tolerances other than specified in Tables III and IV (see 3.8.1 and 3.8.3).

(k) The calculated weight of tubing (see 3.8.2).

(l) When special identification markings are permitted (see 3.9).

(m) Selection of applicable levels of preservation and packing (see 5.1 and 5.2).

6.3 Sizes - Tubing is manufactured in practically any combination of outside diameters and wall thicknesses. However, when practicable, tubing should be ordered in accordance with decimal wall thicknesses corresponding to Birmingham wire gages, and in the following fractions of an inch:

5/32 to 5/16 inch, in multiples of 1/32 inch.
3/8 to 5/8 inch, in multiples of 1/16 inch.
5/8 to 1 inch, in multiples of 1/8 inch.

6.3.1 Iron pipe sizes - If iron pipe sizes are required, sizes should be designated by actual outside diameter and wall thickness, never by nominal iron-pipe sizes. Table V lists standard weight, standard iron pipe sizes. Table VI lists some additional pipe sizes used for structural applications.

TABLE V

STANDARD WEIGHTS, STANDARD IRON PIPE SIZES

OUTSIDE DIAMETER	WALL THICKNESS	WEIGHT PER FOOT
Inches	Inch	Pounds
1.050	0.113	1.13
1.315	.133	1.68
1.660	.140	2.27
1.900	.145	2.72
2.375	.154	3.65
2.875	.203	5.79
3.500	.216	7.58
4.000	.226	9.11
4.500	.237	10.79
5.563	.258	14.62
6.625	.280	18.97

6.4 Metal-arc welding - Tubing to be metal-arc welded should be ordered with a wall thickness adequate to support the process without burning through.

6.5 Length tolerances - The tolerances on length given in Table III cover tubing in definite cut lengths. Where random lengths are permissible, requirements should be stated in the procurement document.

TABLE VI

ADDITIONAL PIPE SIZES USED FOR STRUCTURAL APPLICATIONS

OUTSIDE DIAMETER	WALL THICKNESS	WEIGHT PER FOOT
Inches	Inch	Pounds
3.500	.300	10.25
3.500	.600	18.58
4.000	.318	12.51
4.000	.636	22.85
4.500	.337	14.98
4.500	.674	27.54
5.563	.375	20.78

TABLE VI (Continued)

ADDITIONAL PIPE SIZES USED FOR STRUCTURAL APPLICATIONS

OUTSIDE DIAMETER	WALL THICKNESS	WEIGHT PER FOOT
Inches	Inch	Pounds
5.563	.750	38.55
6.625	.432	28.57
6.625	.864	53.16
8.625	.322	28.55
8.625	.500	43.39
8.625	.875	72.42
10.750	.365	40.48
10.750	.500	54.74
10.750	.593	64.33
10.750	.625	67.58
12.750	.375	49.56
12.750	.500	65.42
12.750	.625	80.93
14.000	.375	54.57
14.000	.500	72.09
14.000	.625	89.28
15.000	.375	58.57
15.000	.500	77.43
16.000	.375	62.58

* 6.6 Supersession data - This specification supersedes Military Specification MIL-T-16343B (NAVY), dated 12 August 1954 and its amendments. The material furnished under this specification is completely interchangeable with and substitutable for the material procured under the previous issue, MIL-T-16343B (NAVY) dated 12 August 1954.

* 6.7 Changes from previous issue - The outside margins of this specification have been marked "*" to indicate where changes (deletions, additions, etc) from the previous issue have been made. This has been done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in those notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - AV
Navy - OS
Air Force - 11

Preparing activity:
Navy - OS
Project No. 4720-0115

Review activities:
Army - AV, MR
Navy - OS, AS, YD
Air Force - 82

User activities:
Army - MI
Navy - SH, CG, MC
Air Force - 85

Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current Federal Supply Classification Listing of DOD Standardization Documents.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-T-16343C	TUBING, STEEL, CARBON, STRUCTURAL

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*:
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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