

MIL-T-16286E(SH)  
AMENDMENT-1  
25 June 1980

MILITARY SPECIFICATION  
TUBE, STEEL, SEAMLESS, MARINE  
BOILER APPLICATION

This amendment forms a part of Military Specification MIL-T-16286E(SH), dated 19 September 1977.

PAGE 1

2.1, under "SPECIFICATIONS, MILITARY" Add:

"MIL-I-45208 - Inspection System Requirements."

PAGE 2

2.2: Delete "ASTM E8" and "ASTM E18" and substitute:

"A370 - Mechanical Testing of Steel Products.  
"A450 - General Requirements for Carbon, Ferritic Alloy,  
and Austenitic Alloy Steel Tubes."

3.1: Delete last sentence.

Table I: Column 3 entitled "Manganese", last item: Delete "193 max" and substitute "0.93 max".

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Add new paragraph 3.1.1:

"3.1.1 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials."

3.4: Delete and substitute:

"3.4 Surface finish.

"3.4.1 All classes of carbon and alloy steel tube shall be free from scale by pickling or shot blasting. When controlled atmosphere heat treatment is used, pickling or shot blasting is not necessary.

"3.4.2 Austenitic steel tube shall be pickled free from scale. When bright annealing is used, pickling is not necessary."

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## 3.5.1: Delete and substitute:

"3.5.1 Hardness. Finished tubes shall have a hardness not exceeding the maximum values shown in table III. Class c, d, e, and g tube samples having hardness values below the minimum of table III shall also be tensile tested."

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## TABLE III: Delete and substitute:

TABLE III. Hardness requirements.

Class	Rockwell Hardness Number (min) <sup>1/</sup>	Rockwell hardness Number (max)	Brinell Hardness Number (max)
a	No requirements	B 77	137
c	B 70	B 90	192
d	B 65	B 80	146
e	B 68	B 85	163
g	B 68	B 79	143

<sup>1/</sup> Minimum requirements for Rockwell hardness (or for equivalent Brinell values) are not the basis for acceptance or rejection.

Table IV, line 4: Delete vertical lines immediately adjacent to both ends of the item entitled "Variation in wall thickness, percent".

Table IV, footnote <sup>1/</sup>: Delete last sentence.

Table V: Delete first three items and substitute:

Under 1	<sup>1/</sup> 0.004	<sup>1/</sup> 0.004
1 to 1-1/2 inclusive	<sup>1/</sup> .006	<sup>1/</sup> .006
Over 1-1/2 to 2 exclusive	<sup>1/</sup> .008	<sup>1/</sup> .008

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Add "<sup>1/</sup>" at end of table V.

"<sup>1/</sup> For cold-drawn class c tubes under 2 inch outside diameter, the maximum outside diameter variation may be plus or minus 0.010 inch. This increased variation is necessitated by ovality and is not to be added to the values in table V."

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3.7.1: Delete and substitute:

"3.7.1 Flaring. When subjected to the flaring test specified in 4.4.4, the test specimen after flaring shall show no tears or ruptures in the test area which exceed a depth of 10 percent of the actual wall thickness. Actual wall thickness shall be measured adjacent to the crack."

3.7.2: Delete and substitute:

"3.7.2 Flattening.

"3.7.2.1 Step one. When subjected to the flattening test specified in 4.4.5, the specimen after the first flattening step shall show no tears or ruptures on the inside, outside or end surfaces which exceed a crack depth of 10 percent of the actual wall thickness. Actual wall thickness shall be measured adjacent to the crack.

"3.7.2.2 Step two. When subjected to the flattening test specified in 4.4.5, the specimen after the second flattening step shall show no evidence of laminated or unsound material that is revealed during the entire flattening test."

3.8.1: Delete the second sentence.

3.8.2: Delete first sentence and substitute:

"Each length of tube with specified minimum wall thickness of 0.120 inch and below shall be subjected to either an eddy current or ultrasonic test as specified in 4.4.7."

3.10.2: Last sentence, after "for", insert "Class c".

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3.11: Delete and substitute:

"3.11 Workmanship. Finished tubes shall be of proper dimension with ends cut square, free from burrs, and shall not deviate from straightness by more than 0.060 inch in 3 feet of length. Tube surfaces shall conform to 3.4 and shall not contain defects such as laminations, laps, seams, tears, cracks, scratches, indentations, abrasions, or pits with depths greater than 10 percent of the specified minimum wall thickness, and which would reduce the wall thickness below the specified minimum wall thickness. Defects of lesser depth may be removed by grinding, provided the wall thickness is not decreased to less than that permitted in table IV, and the ground areas are well faired into the remaining portion of the tube. Workmanship quality shall be determined at the place of manufacture prior to shipment."

4.1.1: Delete and substitute:

"4.1.1 Inspection system. The contractor shall provide and maintain an inspection system in accordance with MIL-I-45208."

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## 4.2.1: Delete and substitute:

"4.2.1 Sample unit. The sample unit shall be a length of finished tube of the ordered wall thickness and outside diameter, prior to cutting it to the final ordered length, and after all required heat treatment and straightening has been performed."

## 4.2.4: Delete and substitute:

"4.2.4 Sampling for product (check) analysis. One sample for chemical analysis shall be taken by the tube manufacturer from a billet or tube hollow from each heat of steel."

4.2.6, second sentence: Delete "shall" and substitute "may".

4.2.7, line 3: Delete "level III" and substitute "level II".

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## 4.3: Delete and substitute:

"4.3 Visual and dimensional examination. Each sample tube selected in accordance with 4.2.3 shall be visually examined and dimensions, as specified herein, measured to verify conformance with this specification. Any sample tube that deviates from a specific tolerance shall not be offered for delivery. If the number of nonconforming sample tubes exceeds the acceptance number specified, the entire lot shall be rejected or 100 percent examined to remove all nonconforming tubes. Any deviation from a specific tolerance shall constitute a defect. Types of defects is contained in table VI."

## TABLE VI: Delete and substitute:

"TABLE VI. Types of defects.

Characteristics	Defects
Design and construction (see 3.6.1, 3.6.2, and 3.6.3)	Tubes not the proper class as specified in contract or order.  Wall thickness, length, and outside diameter not as specified; variation exceeds the allowable limits.
Surface finish (see 3.4) and Workmanship (see 3.11)	Not free from mill scale as specified. Contains unallowable surface imperfections. Out of straightness tolerance. Ends not cut square and free of burrs.
Marking identification (see 3.10 through 3.10.3)	Missing, incomplete, not legible, or not continuous as specified. Marking fluid smears in normal handling.
Packaging (see 5.2)	Not as required.

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4.4.2, second sentence: Delete and substitute: "The specimen and test procedure shall be in accordance with ASTM A370."

4.4.3: Delete and substitute:

"4.4.3 Hardness test. Hardness testing shall be performed in accordance with ASTM A370 on test specimens selected as specified in 4.2.6. The position on the tube and wall thickness requirements at the test location shall be in accordance with ASTM A450. Five randomly distributed hardness determinations shall be made and the highest and lowest values discarded. The remaining values shall be averaged to obtain the hardness number for compliance with table III. If any specimen exceeds the maximum hardness value of table III, the entire lot shall be rejected."

PAGES 7 and 8

4.4.4: Delete and substitute:

"4.4.4 Flaring test. A specimen between 2 and 4 inches in length shall be cut from one end of each sample selected as specified in 4.2.7. Test specimen ends shall be smooth, but no special conditioning of the specimen surface is permitted. Each specimen shall withstand flaring with a flaring tool having a 60 degree included angle until the specimen at the mouth of the flare has been expanded uniformly to the requirements of table VII. The rate of flaring shall be slow and uniform. After-flared specimens shall meet the requirements of 3.7.1. Should tears or ruptures occur on the flared end, which appear to be near to or in excess of 10 percent of the actual wall thickness, the specimen shall be sectioned and polished with 320 grit or finer to determine maximum crack depth. Defect measurement shall be from the original tube surface measured radially to the depth of maximum penetration of the defect. Defect depth shall be measured to the nearest one-thousandth of an inch using a 10X lens and reticle. If the flaring test specimen results do not meet the acceptance/rejection criteria of MIL-STD-105, the entire lot shall be rejected subject to the resubmittal provision of 4.5.2."

PAGE 8

TABLE VII, 1/, line 2. Delete "actual specimen dimensions" and substitute "as specified (see 6.2.1)."

4.4.5: Delete and substitute:

"4.4.5 Flattening test. A specimen not less than 2-1/2 inches in length shall be cut from each sample selected as specified in 4.2.7. No special conditioning of the specimen surface is permitted. The sample shall be flattened cold between parallel plates at a slow and uniform rate in two steps. During the first step, which is a test for ductility, flattening shall continue until the distance between the plates correspond to the value of H calculated as follows:

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

Where: H = Distance between flattening plates in inches.  
t = Specified minimum wall thickness of tube in inches.

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- d = Specified outside diameter of tube in inches.  
e = Deformation per unit length:  
For classes a, c and d: e = 0.09  
For class e: e = 0.08  
For class g: e = 0.07.

Should tears or ruptures occur which appear to be near to or in excess of 10 percent of the actual wall thickness, the specimen shall be sectioned and polished with 320 grit or finer to determine maximum crack depth. Defect measurement shall be from the original tube surface measured radially to the depth of maximum penetration of the defect. Defect depth shall be measured to the nearest one-thousandth of an inch using a 10X lens and reticle. During the second step, which is a test for soundness, the flattening shall be continued until the specimen breaks or the opposite walls of the tube meet. Flattened specimens shall conform to the requirements of 3.7.2. If the flattening test results do not meet the acceptance/rejection criteria of MIL-STD-105, the entire lot shall be rejected subject to the resubmittal provision of 4.5.2."

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4.4.7.2: Delete last sentence and substitute: "Ultrasonic inspection shall be in accordance with section entitled "Pipes and tubes - seamless" of MIL-STD-271 with the exception of the following:

- (a) Location and dimensions of the calibration reference notches shall comply with the requirements herein in lieu of those specified in table entitled "Calibration reference notch dimensions of square and "U" bottom notch" of MIL-STD-271.
- (b) Reference to the 3 percent notch sensitivity shall be deleted.

The tubes or the probes may be rotated to achieve the requirements of this test."

4.5.2: End of line 2, add "be".

PAGE 11

6.2.2: Delete.

PAGE 12

6.2.2.1: Delete.

Preparing activity:  
Navy - SH  
(Project 4710-N476)