

INCH-POUND
MIL-T-22214C(SH)
30 July 1993
SUPERSEDING
MIL-T-22214B(SH)
16 March 1987
(See 6.6)

MILITARY SPECIFICATION

TUBE, CONDENSER AND HEAT EXCHANGER WITH INTEGRAL FINS (UNS ALLOY NOS. C71500, C70600, C12200)

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers integral finned tubes with plain ends of copper nickel alloy and copper for use in heat exchangers and condensers.

1.2 Classification. Tubes shall be furnished in the following alloys and tempers, as specified (see 6.2).

Alloy:

C71500
C70600
C12200

Temper:

1. As-finned
2. Annealed

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-C-3993 - Copper Base Alloy Mill Products; Packaging of.
MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, ATTN: 03Q42, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 by using the Standardization Document Improvement Proposal (DD Form 1426 appearing at the end of this document or by letter.

AMSC N/A

FSC 4710

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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STANDARDS

MILITARY

- MIL-STD-271 - Nondestructive Testing Requirements for Metals.
- MIL-STD-2035 - Nondestructive Testing Acceptance Criteria.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- B 359 - Standard Specification for Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes with Integral Fins.
(DOD adopted)
- D 4727- Standard Specification for Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.
(DOD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1137.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. Copper alloy finned condenser and heat exchanger tubes shall be in accordance with ASTM B 359 and the additional requirements specified herein.

3.2 Recovered materials. Material covered by this specification shall be 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.

3.3 Soundness. Tubes shall be free of defects which would render them unusable as determined by visual or nondestructive inspection of completed, finned tubes in accordance with 4.3.1 and 4.3.3.

3.4 Number of fins. Unless otherwise specified (see 6.2), the tube shall have 19 fins with a tolerance of plus one, minus zero, fins per inch as averaged over any 12 inch length.

3.5 Fin height. Unless otherwise specified (see 6.2), the fin height shall be 0.050 inch, minimum.

3.6 Dimensions. Dimensions shall be as specified (see 6.2). Table I lists standard tube dimensions.

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TABLE I. Dimensions of integral finned tube (minimum wall).

Nominal		Unenhanced ends		Enhanced section	
Outside diameter, inches	Wall thickness, inch	Outside diameter, inch	Specified minimum wall, inch	Root diameter, inch	Specified minimum wall, inch
1/2	0.032	0.500	0.049	0.375	0.032
1/2	.042	.500	.058	.375	.042
1/2	.049	.500	.065	.375	.049
5/8	.028	.625	.042	.500	.028
5/8	.035	.625	.049	.500	.035
5/8	.049	.625	.065	.500	.049
5/8	.058	.625	.072	.500	.058
5/8	.065	.625	.083	.500	.065
3/4	.028	.750	.049	.625	.028
3/4	.035	.750	.052	.625	.035
3/4	.042	.750	.058	.625	.042
3/4	.049	.750	.065	.625	.049
3/4	.058	.750	.075	.625	.058
3/4	.065	.750	.083	.625	.065
3/4	.072	.750	.086	.625	.072
3/4	.083	.750	.095	.625	.083
3/4	.095	.750	.109	.625	.095
7/8	.035	.875	.052	.750	.035
7/8	.042	.875	.058	.750	.042
7/8	.049	.875	.065	.750	.049
7/8	.058	.875	.075	.750	.058
7/8	.065	.875	.083	.750	.065
7/8	.072	.875	.086	.750	.072
7/8	.083	.875	.095	.750	.083
1	.042	1.000	.058	.875	.042
1	.049	1.000	.065	.875	.049
1	.058	1.000	.075	.875	.058
1	.065	1.000	.083	.875	.065
1	.072	1.000	.086	.875	.072
1	.083	1.000	.095	.875	.083

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3.7 Tolerances. Tube tolerances shall be as specified in 3.7.1 through 3.7.3.

3.7.1 Root diameter. A tolerance of plus 0.007 inch and minus 0.003 inch on the root diameter shall be permitted.

3.7.2 Straightness. The straightness tolerances of table II shall apply to as-finned tube only.

TABLE II. Permissible variations in straightness of tube.

Length (feet)	Maximum curvature (depth of arc) (inch)
Over 3 to 6 inclusive	3/16
Over 6 to 8 inclusive	5/16
Over 8 to 10 inclusive	1/2
Over 10	1/2 inch in any 10 foot portion of the total length

3.7.3 Outside diameter of plain sections. The tolerances for outside diameter of the plain sections as shown in ASTM B 359 shall be all negative; that is, a plus tolerance of 0.000 inches.

3.8 Cleanliness. The inner and outer surface of the tubes shall be delivered clean, free of dirt, oils, grease, acid, chips, carbonaceous material, free carbon sulfur bearing compounds and any other foreign matter that render the tube unfit for their intended use. Contaminants such as sulfur or sulfur bearing compounds or carbon or carbon compounds from lubricants used in forming, machining, or other processing, and marking materials used for in-process identification shall be removed from the material prior to any heat treatment. Tubing shall be acid or abrasive cleaned. Traces of acid or abrasive shall be removed following cleaning.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Sampling. Inspection samples shall be selected by the contractor in accordance with ASTM B 359 as modified by 4.2.1 through 4.2.5. If one or more defects are found in any sample, the entire lot represented by that sample shall be rejected. If a lot is rejected, the contractor has the option of screening 100 percent of the lot for the defective characteristics or providing a new lot which shall be examined in accordance with the sampling plan contained herein.

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4.2.1 Lot. For sampling purposes, a lot shall consist of lengths of tubes of the same composition, temper, size, heat treated at the same time in the same furnace, offered for delivery at the same time and identifiable by mill records as originating from one or more heats (melts), as necessary, which conform to the chemical requirements. The total weight of the lot shall not be greater than 10,000 pounds.

4.2.2 Chemical analysis. Samples shall be taken at the time the metal is cast. One sample shall be taken for each group of castings poured simultaneously from the same source of molten metal. Analysis of all metal comprising the lot shall be performed (see 6.3).

4.2.3 Visual and dimensional examination. From each lot, a representative sample of completed tubes shall be selected in accordance with table III for inspection specified in 4.3.1.

TABLE III. Sampling for visual and dimensional examinations.

Lot size	Sample size
2 - 8	All
9 - 150	13
150 - 280	20
280 - 500	29
501 - 1200	34
1200 - 3200	42

4.2.4 Destructive tests. Samples for tensile tests shall be selected in accordance with ASTM B 359. From each lot a representative sample of completed tubes shall be selected in accordance with table IV for flattening, flaring and grain size tests specified in ASTM B 359.

TABLE IV. Sampling for destructive tests.

Lot size	Sample size
2 - 26	2
26 - 50	3
51 - 90	4
91 - 150	5
151 - 280	6
281 - 500	7
501 - 1200	8
1201 - 3200	9

4.2.5 Nondestructive tests. Each tube shall be subjected to the eddy current, liquid penetrant and hydrostatic/pneumatic tests in accordance with 4.3.3.

4.3 Examinations and tests. Tubes shall be subjected to the examination specified in 4.3.1 and the tests specified in 4.3.2 through 4.4.

4.3.1 Visual and dimensional examination (except wall thickness at fins). Each sample tube selected in accordance with table III shall be dimensionally inspected for conformance with 3.4 through 3.7 and visually inspected for compliance with 3.3 and 3.8. Tubes containing one or more defects shall be cause for rejection.

4.3.2 Destructive tests. The sample tubes selected in accordance with 4.2.4 shall be subjected to the tensile, flattening, flaring, and grain size tests in accordance with ASTM B 359 (see 6.3).

4.3.3 Nondestructive inspection. Each tube in the finished form shall be nondestructively inspected in accordance with ASTM B 359 with the following modifications (see 6.3).

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4.3.3.1 Eddy current and pressure tests. Both eddy current and pressure (hydrostatic or pneumatic) tests are required.

4.3.3.2 Eddy current procedure. The eddy current test shall be performed in accordance with the requirements of ASTM B 359 and MIL-STD-271. The procedure shall be qualified and approved as required by MIL-STD-271. Inspection personnel shall be qualified and certified in accordance with MIL-STD-271.

4.3.3.3 Liquid penetrant inspection. Liquid penetrant inspection in accordance with MIL-STD-271 shall be performed on the outside surface and the end surfaces of the smooth ends of the tubes to inspect the area of the tubes missed by the eddy current test due to "end affect". Alternatively, the area of the tube ends missed due to end effect may be cropped off and discarded. Liquid penetrant acceptance criteria shall be in accordance with MIL-STD-2035.

4.4 Inspection of packaging. Sample packages and packs, and the inspection of the (preservation, packing, and marking) for shipment, stowage, and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging, packing, and marking. Material shall be packaged level A or C, packed level A, B, or C, and marked in accordance with MIL-C-3993 (see 6.2).

5.2 Navy fire retardant requirements. When specified (see 6.2), packaging materials shall be fire retardant treated.

5.2.1 Lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

- Level A and B - Type II - weather resistant.
Category 1 - general use.
- Level C - Type I - non-weather resistant.
Category 1 - general use.

5.2.2 Fiberboard. When specified (see 6.2), fiberboard used in the construction of class-domestic, non-weather resistant fiberboard, and cleated fiberboard boxes including interior packaging forms shall meet the flame spread index and specific optic density requirements of ASTM D 4727.

5.2.3 Cushioning and wrapping materials. The use of excelsior, newspaper, shredded paper (all types), and similar hydroscopic or nonneutral materials and all types of loose fill materials for packaging applications such as cushioning, fill, stuffing, and dunnage is prohibited. Materials selected shall have properties for resistance to fire. Cushioning or wrapping materials shall be provided to prevent damage and to prevent free movement of the container contents. Materials having properties for resistance to fire and acceptable for use within shipping containers for Navy use are listed in section 6.4 for information.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. These tubes are intended for high flux density heat transfer tubes in condensers and other types of heat exchangers.

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6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Alloy and temper (see 1.2).
- (c) Issue of DODISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- (d) Number of fins per inch when other than specified (see 3.4).
- (e) Height of fin required when other than specified (see 3.5).
- (f) Size required (outside diameter and wall thickness) (see 3.6).
- (g) Length of tube and length of plain ends required (see ASTM B 359).
- (h) Quantity of tubes required.
- (i) Level of packaging and packing required (see 5.1).
- (j) Whether Navy fire retardant packaging is required (see 5.2, 5.2.1, and 5.2.2).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference paragraph</u>	<u>DID number</u>	<u>DID title</u>	<u>Suggested tailoring</u>
3.3	DI-MISC-80678	Certification data/report	----
4.2.2, 4.3.2, 4.3.3	DI-MISC-81020	Certification data for Level I material	----

The above DIDs were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements List (AMSDL), must be searched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.4 Fire resistant cushioning and wrapping materials. Materials having properties for resistance to fire and acceptable for use within interior packs and shipping containers are:

<u>Materials</u>	<u>Specification</u>
Cushioning Material, Plastic, Open Cell	A-A-440
Paper, Kraft, Treated (Fire Resistant)	A-A-1894
Paper, Kraft, Wrapping	UU-P-268, Type II, Grade C or D
Fiberboard	PPP-F-320
Plastic Film, Flexible, Cellular	PPP-C-795, Class 3-Fire Retardant
Polystyrene Expanded, Resilient	PPP-C-850, Grade SE
Plastic, Open Cell, Cushioning	PPP-C-1842, Type I, Style B
Bound Fiber	PPP-C-1120, Class A, Grade 1, Type Optional
Barrier Materials	MIL-B-131, Type II
Rubber, Latex Foam	MIL-R-5001, Grade A
Rubber, Cellular	MIL-R-6130, Grade A
Fibrous Glass	MIL-C-17435
Polystyrene Foam	MIL-P-19644, Type II
Rubber, Cellular, Synthetic	MIL-R-20092, Class 5
Polyurethane Foam	MIL-P-26514
Cushioning Material, Resilient Type, General	MIL-C-26861
Polyurethane Foam, Flexible, Open Cell	MIL-F-81334
Foam-In-Place Packaging Materials:	
General Specification For	MIL-F-83671

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Foam, Combustion, Retardant, for Cushioning
Supply Items Aboard Navy Ships

MIL-F-87090(SA)

6.5 Subject term (key word) listing.

Annealed
Condenser tube
Copper alloy
Copper nickel alloy
Finned heat exchanger tube

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 4710-N026)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-T-22214C(SH)

2. DOCUMENT DATE (YYMMDD)
930730

3. DOCUMENT TITLE

TUBE, CONDENSER AND HEAT EXCHANGER WITH INTEGRAL FINS (UNS ALLOY NOS. C71500, C70600, C12200)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
(1) Commercial
(2) AUTOVON
(If applicable)

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. NAME TECHNICAL POINT OF CONTACT (TOPC):
John Allison (Sea 03M2)
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(703) 602-0143

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8-332-0143

c. ADDRESS (Include Zip Code)

Commander, SEA 03Q42
Naval SEA Systems Command
2531 Jefferson Davis Hwy., Arlington, VA

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
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