

INCH-POUND

MIL-C-15726F

25 October 1988

SUPERSEDING

MIL-C-15726E(SHIPS)

(IN PART)

20 August 1965

(See 6.9)

MILITARY SPECIFICATION

COPPER-NICKEL ALLOY, SHEET, PLATE, STRIP, BAR, ROD AND WIRE

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

1. SCOPE

1.1 Scope. This specification covers copper-nickel alloy sheet, plate, strip, bar, and rod for use in applications in seawater.

1.2 Classification. Copper-nickel alloy shall be furnished in the following compositions, forms, and tempers, as specified (see 6.2).

Compositions:

Alloy C70600 (formerly 90-10)

Alloy C71500 (formerly 70-30)

Forms:

Rod

Bar

Plate

Sheet

Strip

Wire (nonelectrical)

Tempers:

O60 (formerly soft)

H01 (formerly hard)

M20-Soft

M20-Hard

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards 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).

SPECIFICATION

MILITARY

MIL-C-3993 - Copper and Copper-Base Alloy Mill Products;
Packaging of.

STANDARDS

FEDERAL

FED-STD-146 - Tolerances for Copper and Copper Base Alloy Mill
Products.

FED-STD-185 - Identification Marking of Copper and Copper Base
Alloy Mill Products.

MILITARY

MIL-STD-271 - Nondestructive Testing Methods, Requirements for.

(Unless otherwise indicated, copies of federal and Military specifications and standards are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government publication. The following other Government publication forms a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATION

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-LP-003-8000 - Metals, Surface Inspection Acceptance
Standards.

(Application for copies should be addressed to the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following documents form 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).

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- E 8 - Standard Methods of Tension Testing of Metallic Materials. (DoD adopted)
- E 75 - Standard Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys.
- E 478 - Standard Methods for Chemical Analysis of Copper Alloys.

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

(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, 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 Material. The material shall be of such quality and purity that the finished product shall have the properties and characteristics specified in this specification. The material shall be produced by either hot or cold working operations. Unless otherwise specified (see 6.2), material shall be finished by such hot working, cold working, or heat treatment as may be necessary to meet the properties specified.

3.2 Chemical composition. The material shall conform to the requirements of table I.

TABLE I. Chemical requirements.

Copper alloy number	C71500	C70600
Composition	70-30	90-10
Copper plus sum of named elements (minimum)	99.50	99.50
Copper (minimum)	65.0	86.5
Nickel	29.0-33.0	9.0-11.0
Zinc (maximum)	0.50	0.50
Iron	0.40-1.0	1.00-1.8
Lead (maximum)	0.02	0.02
Manganese (maximum)	1.0	1.0
Phosphorous (maximum)	0.02	0.02
Sulfur (maximum)	0.02	0.02
Carbon (maximum)	0.05	0.05

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3.2.1 Recovered materials. Unless otherwise specified herein, all material used in the products covered by this specification shall be new and may be processed using recovered materials to the maximum extent practicable without jeopardizing the specified requirements. 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 Mechanical properties. Sheet, strip and plate shall conform to the mechanical property requirements shown in table II. Bar and rod shall conform to the requirements of table III.

TABLE II. Mechanical properties, bar, plate, sheet and strip.

Size, diameter or distance between parallel faces, inches	Temper		Tensile strength, minimum, ksi	Yield strength, 0.5 percent extension under load, minimum, ksi	Elongation in 2 inches, or 4 times diameter, percent, minimum $\frac{1}{2}$
	Wire sheet and strip	Bar and plate			
			Alloy C71500		
Up to 2-1/2	060	M20-soft	50	20	30
Over 2-1/2	---	M20-soft	45	18	35
Up to 3/16 thick Up to 24 wide, incl.	H01	-----	60	30	10
Up to 3/16 Over 24 wide	H01	-----	55	25	10
Over 3/16 to 3/8 and 24 wide, incl.	---	M20-hard	60	30	10
Over 3/8 to 1/2 thick, incl and up to 24 wide	---	M20-hard	55	25	15
Up to 1/2 thick, incl and over 24 wide	---	M20-hard	50	22	15
Over 1/2 thick, all widths	---	M20-hard	45	18	20
			Alloy C70600		
Up to 0.021 thick	060	-----	38	15	20
Over 0.021 to 3/16 thick, incl.	060	-----	38	15	25
Over 3/16 thick	---	M20-soft	38	15	30
Up to 3/16, up to 24 wide, incl.	H01	-----	55	30	10

See footnote at end of table.

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TABLE II. Mechanical properties, bar, plate, sheet and strip. - Continued

Size, diameter or distance between parallel faces, inches	Temper		Tensile strength, minimum, ksi	Yield strength, 0.5 percent extension under load, minimum, ksi	Elongation in 2 inches, or 4 times diameter, percent, minimum <u>1/</u>
	Wire sheet and strip	Bar and plate			
Up to 3/16 thick, over 24 wide	H01	-----	47	25	10
Over 3/16 to 3/8 and up to 24 wide, incl.	---	M20-hard	55	30	10
Over 3/8 to 1/2 and up to 24 wide, incl.	---	M20-hard	50	28	12
Up to 1/2 thick and over 24 wide	---	M20-hard	47	25	15
Over 1/2 to 3, incl all widths	---	M20-hard	40	17	20
Over 3 to 5, incl.	---	M20-hard	38	15	20

1/ Elongation requirements do not apply to material under 0.010 inch thick.

TABLE III. Mechanical properties, rod.

Size, distance between parallel faces, inches	Temper	Tensile strength, minimum, ksi	Yield strength, 0.5 percent extension under load, minimum, ksi	Elongation in 2 inches, or 4 times diameter, minimum, percent
All sizes Up to 1/2 Over 1/2 to 1 Over 1 to 3	060 H01 H01 H01	Alloy C71500	18 50 45 35	30 10 15 20
		45		
		65		
		60		
	All sizes Up to 3/8 Over 3/8 to 1 Over 1 to 3	060 H04 H04 H04	Alloy C70600	15 38 30 15
38				
60				
50				
		40		

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3.4 Soundness. Material shall be of uniform quality and condition and free of defects harmful to its intended use such as, seams, pipe, cracks, laminations, laps, excessive scale, fins, porosity, and segregation as determined by visual and the specified nondestructive tests such as, ultrasonic, or dye penetrant inspections. Surface imperfections such as handling marks, straightening marks, light mandrel and die roll marks will not be considered injurious defects, provided the imperfections do not detract from the product's end use.

3.5 Cleanliness. Contaminants, such as sulfur or sulfur containing compounds from lubricants used in forming, machining or other processing, or from marking materials used for in-process identification shall be removed prior to any heat treatment of the material.

3.5.1 During the manufacturing processes, examinations and tests, the material shall not come into direct contact with mercury or any of its compounds nor with any mercury containing device employing a single boundary of containment.

3.6 Dimensions. The dimensions of the material shall be as specified in the contract or order (see 6.2).

3.7 Tolerances. Unless otherwise specified (see 6.2), tolerances shall be as specified in FED-STD-146.

3.7.1 When specified (see 6.2), tolerances shall be all plus or all minus.

3.8 Removal and repair of defects. Soundness defects may be removed by machining or grinding, provided such removal does not reduce the dimensions below the minimum specified. Spot ground areas shall be faired smoothly into the surrounding material. The removal of a defect shall be verified by the method originally used to detect the defect.

3.9 Identification. Identification for marking shall be as specified in 3.9.1 and 3.9.2.

3.9.1 Marking. Material shall be marked in accordance with FED-STD-185. In addition to the marking required in accordance with FED-STD-185, the following marking shall be applied.

- (a) Lot number.
- (b) Contract number.

3.9.2 Alloy identity. When specified (see 6.2), each random mill length, prior to cutting to ordered length, and each forging shall be shown to be of the correct generic metallurgical group after final marking.

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

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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 inspection 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.

4.2.1 Lot. Lot shall be as specified in 4.2.1 through 4.2.1.2.

4.2.1.1 Batch melted material. For batch melted material, an inspection lot shall consist of up to 10,000 pounds or less of the same mill form, alloy, temper, and nominal dimensions submitted for inspection at the same time.

4.2.1.2 Continuously cast material. For continuously cast material, an inspection lot shall be the product of one cast billet or from a single melt charge, whose weight shall not exceed 15,000 pounds that has been continuously processed and subject to inspection at one time.

4.2.2 Sampling for chemical analysis. Sampling for chemical analysis shall be as specified in 4.2.2.1 through 4.2.2.2.

4.2.2.1 For batch melted material, one sample shall be taken from each melt preferably at the time of pouring.

4.2.2.2 For continuously cast material, samples shall be taken at the beginning of the pour and at the end of the pour. If the cast lasts more than 1 hour, an additional sample will be taken for each hour or portion thereof of pour. The results of analyses for all melts included in an inspection lot shall be reported when certification is specified (see 6.3).

4.2.3 Sampling for mechanical properties. A sample containing four individual lengths of the finished product shall be selected from the lot. If the lot consists of less than four lengths, the sample shall be taken from each individual length. Specimens shall be taken from two different pieces in the sample selected for testing. Mechanical tests shall be made on each of the specimens so selected. When the lot consists of only one piece, only one test shall be required.

4.2.4 Sampling for visual and dimensional examination. Sampling shall be as specified (see 6.2 and 6.7).

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4.2.5 Sampling for nondestructive inspection. When specified (see 6.2), each piece shall be inspected.

4.3 Test procedures. The sample shall be tested as specified in 4.3.1 through 4.3.3.1.

4.3.1 Chemical analysis. The sample selected as specified in 4.2.2 shall be analyzed by the wet chemical or spectrographic method to determine compliance with table I. In the case of dispute, chemical analysis shall be performed in accordance with ASTM E 75 with copper analysis in accordance with ASTM E 478.

4.3.2 Tension tests. The sample selected as specified in 4.2.3 shall be tested in accordance with ASTM E 8 to determine compliance with table II.

4.3.2.1 Yield strength. Yield strength shall be determined by 0.5 percent extension under load.

4.3.3 Nondestructive test. Items selected as specified in 4.2.5 shall be inspected in accordance with MIL-STD-271.

4.3.3.1 Ultrasonic inspection. Ultrasonic inspection testing shall be by the longitudinal wave technique.

4.3.3.1.1 Reference notch removal. If reference holes are made in the material to be tested, they shall be so located that their subsequent removal will not impair the suitability of the material for its intended use.

4.3.3.2 Liquid penetrant inspection. Unless otherwise specified (see 6.2), acceptance criteria for liquid penetrant inspection shall be in accordance with NAVSEA 0900-LP-003-8000.

4.4 Retest, rejection, and resubmittal.

4.4.1 Retests. Retest shall be as specified in 4.4.1.1 through 4.4.1.3.

4.4.1.1 If any test specimen shows defective machining or develops flaws, it may be discarded and a replacement test specimen substituted.

4.4.1.2 If the percentage of elongation of any tension test specimen is less than that specified and any part of the fracture is outside of the middle two thirds of the gauge length or in a punched or scribed mark within the reduced section, a retest shall be allowed.

4.4.1.3 If the results of the test on one of the specimens fails to meet the specified requirements two additional specimens shall be taken from different sample pieces and tested. The results of the tests on both of these specimens shall meet the specified requirements.

4.4.2 Rejection. When any retest specimen does not conform to specification requirements for the characteristic being tested or more than one specimen of the original sample fails to meet the specified requirements for a particular property the lot represented by the specimen shall be rejected.

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4.4.3 Resubmittal. Resubmittal shall be as specified in 4.4.3.1 and 4.4.3.2.

4.4.3.1 Rejected lots. A rejected lot may be resubmitted for acceptance testing only after rework, as necessary, is performed to correct the nonconforming condition without adversely affecting the conforming properties. Removal and repair of lots rejected for failure to meet soundness requirements shall be in accordance with 3.8. If the rejected lot is re-heat treated to correct a nonconforming characteristic, all mechanical properties, including those which were initially conforming, shall be determined.

4.4.3.2 Individual pieces. When a rejected lot consists of more than one piece, each remaining piece in the lot may be resubmitted for testing for the nonconforming characteristic and each piece that conforms to all specification requirements may be offered for acceptance.

4.5 Alloy identity. Alloy identity shall be as specified in 4.5.1 and 4.5.2.

4.5.1 Procedure. Method of test for alloy identity shall be by an approved procedure (see 6.2).

4.5.2 Acceptance criteria. If the alloy test demonstrates that the material tested is not the alloy specified by the contracting activities, the material shall be rejected.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment 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. The material shall be packaged to level A or C; packed to level A, B, or C, as specified (see 6.2) and marked in accordance with MIL-C-3993.

6. NOTES

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

6.1 Intended use. This material is intended for use in seawater applications where corrosion resistance takes precedence over strength.

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6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) 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).
- (c) Composition, form, temper (see 1.2).
- (d) If a specific manufacturing technique is required (see 3.1).
- (e) Dimensions and whether tolerances are all plus or all minus (see 3.6, 3.7, and 3.7.1).
- (f) If alloy identity test is required (see 3.9.2).
- (g) If sampling for visual and dimensional inspections is other than specified (see 4.2.4).
- (h) If nondestructive inspection is required (see 4.2.5).
- (i) If liquid penetrant inspection is other than specified (see 4.3.3.2).
- (j) Method used for alloy identity test (see 4.5.1).
- (k) Level of packing and packaging (see 5.1).

6.3 Data requirements. The following Data Item Descriptions (DID) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this specification is applied on a contract, in order 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>
4.2.2.2	UDI-A-23264	Certification data/ report	-----

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

6.4 The thickness of all flat products should be specified in decimals of an inch.

6.5 Where no description of the edge of plate, sheet, or strip is specified, the edges furnished will be the finish (slitting, shearing, sawing) most available to the contractor and the greatest tolerances specified in 3.6 will be permitted.

6.6 Supersession data. MIL-C-15726F supersedes those portions of MIL-C-15726E which pertains to the acquisition of plates, sheet, strip, bar and rod. Forgings previously acquired to MIL-C-15726E are now acquired to MIL-C-24679.

6.7 Sampling for visual and dimensional examination. Unless otherwise specified (see 4.2.4), sampling should be in accordance with MIL-STD-105, general inspection level II, acceptable quality level 1.5.

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6.8 Subject term (key word) listing.

Continuously cast
Forging
Nondestructive inspection

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

Custodian:
Navy - SH

Preparing activity:
Navy - SH
(Project 9525-0137)

Review activities:
Army - MI
Navy - MC
DLA - IS

User activity:
Army - ME