

MIL-C-19311B (OS)
16 March 1973

SUPERSEDING
MIL-C-19311A (WEP)
7 December 1962

MILITARY SPECIFICATION

COPPER-CHROMIUM-ALLOY FORGINGS, WROUGHT ROD, BAR, AND STRIP (COPPER ALLOY NUMBERS 182, 184, AND 185)

*This specification has been approved by the Naval Ordnance Systems Command,
Department of the Navy.*

1. SCOPE

*1.1 Scope. This specification covers copper-chromium-alloy forgings and also wrought material in rod, bar, and strip form which have been solution heat treated, quenched, cold worked, as applicable, and precipitation heat treated. (See 6.1.)

*1.2 Classification. The copper-chromium alloy shall be of the compositions designated in table I, as specified (see 6.2).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Military

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

Federal

FED-STD-146	Tolerances for Copper and Copper Base Alloy Mill Products
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FSC 9530

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FED-STD-151	Metals; Test Methods
FED-STD-185	Continuous Identification Marking of Copper and Copper Base Alloy Mill Products

Military

MIL-STD-105	Sampling Procedures and Table for Inspection by Attributes
MIL-STD-129	Marking 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.

American Society for Testing and Materials (ASTM)

B 193	Standard Method of Test for Resistivity of Electrical Conductor Materials
B 249	Standard Specification for General Requirement for Wrought Copper and Copper Alloy Rod, Bar and Shapes
B 342	Tests for Electrical Conductivity by Use of Eddy Currents
E 8	Tension Tests
E 18	Rockwell Hardness Tests

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

Consolidated Classification Committee**Consolidated Freight Classification Rules**

(Applications for copies should be addressed to the Consolidated Classification Committee, 202 Chicago Union Station, Chicago, Ill. 60606.)

3. REQUIREMENTS

3.1 Material. Raw materials used shall be of a quality suitable to produce material which complies with all the requirements of this specification.

3.2 Chemical composition. Chemical composition shall conform to one of the compositions shown in table I.

*Table I

CHEMICAL COMPOSITION
(Percent maximum unless shown as a range or minimum)

	Copper alloy No. 182	Copper alloy No. 184	Copper alloy No. 185
Copper (incl. silver) + elements with specific limits	99.5	99.8	99.8
Iron	0.10	0.15	-
Chromium	0.6-1.2	0.40-1.2	0.40-1.0
Silicon	0.10	0.10	-
Lead	0.05	-	0.015
Arsenic	-	0.005	-
Calcium	-	0.005	-
Lithium	-	0.05	-
Phosphorus	-	0.05	0.04
Zinc	-	0.7	-
Silver	-	-	0.08-0.12

3.3 Heat treatment. The alloy shall be solution heat treated and artificially aged in such a manner as to produce material which will conform to all requirements of this specification. The solution heat treatment shall be performed in a neutral or slightly reducing atmosphere to minimize the surface layer of chromium oxide subscale.

3.4 Mechanical properties. After heat treatment and working to final form (for rod, bar, and strip), the mechanical properties shall conform to the requirements given in table II when tested in accordance with 4.3.3.

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*Table II

MECHANICAL PROPERTIES

Dimensions (inches)	Tensile strength, min. (psi)	Yield strength, ¹ min. (psi)	Elonga- tion in 2 inches, min. (%)	Rockwell B Hardness, min.
Rounds--diameter				
1.50 or less	63,000	56,000	13	72
Over 1.50 to 2.00 incl.	59,000	52,000	13	70
Over 2.00 to 2.50 incl.	57,000	49,000	13	68
Over 2.50 to 3.75 incl.	53,000	40,000	13	62
Hexagons or octagons-- across flats				
0.500 to 1.25 incl.	63,000	56,000	13	68
Over 1.25 to 3.00 incl.	55,000	45,000	13	65
Rectangles--				
<u>Thickness</u>	<u>Width</u>			
Up to 1.00 incl.	All	60,000	50,000	70
Forging		53,000	40,000	62

¹0.5 percent extension under load**3.5 Electrical conductivity.**

*3.5.1 Electrical conductivity after heat treatment and working to final configuration shall not be less than 75 percent.

3.5.2 One hundred percent is defined as the conductivity of copper having a resistance of 0.15328 ohm per meter, gram at 20° centigrade (68° Fahrenheit).

3.5.3 Conductivity shall be determined as specified in 4.3.4 on samples taken from heat-treated forgings (or bars or strips) from each melt.

3.6 Forging dimensions.

3.6.1 The manufacturer shall be responsible for furnishing forgings that can be laid out and machined to the finished dimensions within the permissible variations shown on the applicable drawings and that will conform to such gauges as may be specified. Forgings of excessive size and weight shall not be furnished.

3.6.2 Forged-to-size portions of forgings shall conform to such dimensions and permissible variations as may be shown on the applicable drawings and shall not be warped or distorted in such a manner as to adversely affect their appearance or serviceability.

3.7 Dimensional tolerances. The dimensions of the copper chromium alloy offered for delivery shall not vary from ordered dimensions by amounts greater than as follows:

<u>Dimensions</u>	<u>Paragraph</u>
Diameter of round rods or diameter across flats of hexagons and octagons	11b (1) FED-STD-146
Width of rectangular sections	2b (2) FED-STD-146
Thickness of rectangular sections	Table III of this specification

*3.7.1 Length. Permissible variation in lengths that are specific shall be -0, +0.375 inch. Stock length permissible variation shall be -0, +1.0 inch (ASTM B 249).

3.8 Camber. Round, hexagonal, and octagonal rods shall be commercially straight and shall be suitable for use in automatic screw machines.

3.9 Rounding of corners of strip.

3.9.1 Strip stock, whose thickness is between 0.051 and 0.102 inch, inclusive and whose width does not exceed 0.102 inch with a width-to-thickness ratio of less than two-to-one, shall have corners rounded to a maximum radius of 0.016 inch.

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Table III

THICKNESS TOLERANCES (\pm) FOR RECTANGULAR SECTIONS

Thickness (inches)	Width (inches)					
	Up to 0.050	Over 0.050 to 1.25	Over 1.25 to 2.00	Over 2.00 to 4.00	Over 4.00 to 8.00	Over 8.00
Up to 0.017	0.001	0.001	0.001	0.001	0.001	-
Over 0.017 to 0.026	0.0015	0.0015	0.0015	0.0015	0.0015	-
Over 0.026 to 0.050	0.002	0.002	0.002	0.002	0.002	0.002
Over 0.050 to 0.090	-	0.003	0.003	0.0035	0.0035	0.004
Over 0.090 to 0.130	-	0.003	0.0035	0.004	0.005	0.005
Over 0.130 to 0.188	-	0.0045	0.005	0.006	0.008	0.011
Over 0.188 to 0.500	-	0.005	0.006	0.007	0.009	0.012
Over 0.500 to 1.000	-	0.006	0.007	0.008	0.010	0.013
Over 1.000 to 2.000	-	0.007	0.007	0.009	0.011	0.014
Over 2.000 to 4.000	-	-	-	0.50% ¹	0.50% ¹	0.50% ¹

¹Expressed to the nearest 0.001 inch

3.9.2 Strip stock, whose thickness is less than 0.051 inch and which has a width-to-thickness ratio of less than two-to-one, shall have corners rounded to a maximum radius of 0.008 inch.

*3.10 Identification marking. When specified, product identification marking shall be in accordance with FED-STD-185.

3.11 Workmanship.

3.11.1 Rod, bar, and strip stock shall be clean and bright, with a good commercial finish and shall be free from injurious imperfections that would render the material unfit for its intended application. Rod, bar, and strip stock shall be cold worked to final form.

3.11.2 Forgings shall be of uniform quality and conditions, free from blisters, fins, folds, seams, laps, cracks, segregations, spongy areas, and other defects which would affect their suitability for the purpose intended.

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 forth in this specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

*4.2 Lot. A lot shall consist of material of the same form, composition, and condition from a single furnace charge or crucible melt.

4.3 Sampling and tests. Unless otherwise specified and when applicable, the sampling plans and procedures shall be in accordance with the provisions of MIL-STD-105.

4.3.1 Sampling for visual and dimensional examination. Samples of forgings, rods, bars, and strip for visual and dimensional examination for acceptance shall be taken from each lot in accordance with the provisions of MIL-STD-105, inspection level II and acceptance quality level (AQL) 1.5 percent defective.

*4.3.2 Chemical analysis. The samples shall be selected, prepared, and analyzed in accordance with method 111 or 112 of FED-STD-151. If another method of analysis is desired, it shall be as agreed upon by the contractor and procuring activity.

*4.3.3 Mechanical properties. A minimum of one sample shall be randomly selected from each lot and each sample shall be subjected to a tensile and hardness test. Failure of one sample to meet any of the requirements of table II shall result in the rejection of the lot represented. Mechanical properties shall be determined as specified in ASTM E 8 and ASTM E 18.

*4.3.4 Electrical conductivity tests. A minimum of two samples shall be randomly selected from each lot and subjected to the conductivity test. Conductivity shall be determined by any method approved by the procuring activity (preferably ASTM B 342, see 4.3.4.2). Failure of any of the samples to meet the requirements given in 3.5 shall be cause for rejection of the lot represented. Samples from each melt, as specified in

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3.5.3, shall be prepared for test by the methods specified in 4.3.4.1 or by any other method approved by the procuring activity.

*4.3.4.1 Electrical conductivity of forgings, rod, bar, or strip shall be determined by resistance measurements made on a sample of finished item cut to such width and length as will afford satisfactory measurements (ASTM B 193).

*4.3.4.2 Electrical conductivity measurements may be determined using an instrument employing eddy currents (ASTM B 342).

4.3.5 Marking. Samples selected in accordance with 4.3.1 shall be examined for compliance with 3.10.

4.3.6 Workmanship. Samples selected in accordance with 4.3.1 shall be inspected as specified for compliance with 3.11.

5. PREPARATION FOR DELIVERY

*5.1 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

*5.1.1 Levels A and B. The material shall be packed in accordance with MIL-C-3993.

*5.1.2 Level C. The products shall be separated by size, composition, and temper and packed in accordance with the manufacturer's standard practice into containers of a type and size commonly used for the purpose, in such a manner as to insure acceptance by carrier for transportation at the lowest rate applicable and to afford maximum protection from normal hazards of transportation.

*5.2 Marking. Unless otherwise specified in the contract or order each bundle, shipping container, and unpacked forging shall be marked with the name of the material, part number as specified on the drawings, alloy and condition of the forgings, this specification number, the gross weight and quantity, the name of the contractor, and the number of the contract or order.

*5.2.1 In addition to the marking specified in 5.2 and any special markings required in the contract or order, marking of the shipping containers shall be in accordance with MIL-STD-129.

6. NOTES

*6.1 Intended use. Copper-chromium-alloy is intended for applications requiring high electrical conductivity and higher mechanical strength than is attainable with copper. Major usage is primarily for resistance welding electrodes, structural members in spot welding units, and for forming the crucibles for electroslog melting.

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

- (a) Title, number, and date of this specification
- (b) Size, shape, and quantity
- (c) Drawing number for forgings
- (d) Composition (see table I)
- (e) Level of packing (see 5.1)
- (f) Special marking, if required (see 5.2.1)
- (g) Inspection for workmanship, if required (see 3.11)
- (h) Where quantity is large, it may be desirable to require that the material be melt identified
- (i) Where application requirements mandate material properties that approach the attainable limits, melt identification becomes necessary.

*6.3 Preparation for delivery criteria. Criteria for use of the proper level of packaging and packing shall be as follows:

Level A. This level shall be used for those items which are to be shipped to indeterminate destinations or stored under indeterminate conditions for redistribution anywhere.

Level B. This level shall be used for protection against damage during multiple domestic shipments, handling, and covered storage.

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Level C. This level shall be used only when it is definitely known that the packaged item is to be shipped to domestic installations for immediate use at the first receiving activity.

*6.4 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodian:
Navy - OS

Preparing activity:
Navy - OS
(Project No. 9550-N014)

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No 22-R255
INSTRUCTIONS This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.		
SPECIFICATION MIL-C-19311B (OS), Copper-Chromium-Alloy Forgings, Wrought Rod, Bar, and Strip (Copper Alloy Numbers 182, 184, and 185)		
ORGANIZATION		
CITY AND STATE	CONTRACT NUMBER	
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1 HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A GIVE PARAGRAPH NUMBER AND WORDING.		
B RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2 COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3 IS THE SPECIFICATION RESTRICTIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)		
4 REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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