

QQ-C-450A  
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SUPERSEDING  
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September 11, 1964

## FEDERAL SPECIFICATION

### COPPER-ALUMINUM ALLOY (ALUMINUM BRONZE) PLATE, SHEET, STRIP, AND BAR (COPPER ALLOY NUMBERS 606, 610, 613, 614, AND 630)

This specification was approved by the Commissioner,  
Federal Supply Service, General Services Administra-  
tion, for the use of all Federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers five compositions of copper-aluminum alloy (aluminum bronze) flat products with slit, slit and edge rolled, sheared, sawed, or machined edges (plate, sheet, strip, and bar), but does not include flat products with finished edges.

#### 1.2 Classification.

1.2.1 Alloys. The copper-aluminum compositions covered by this specification shall be furnished in the following alloys: 606, 610, 613, 614, and 630. (see 6.2)

1.2.2 Forms and tempers. The alloys covered by this specification shall be furnished in the following tempers and forms, as specified (see 6.2):

##### Forms:

Plate  
Sheet  
Strip  
Bar

##### Tempers:

Soft  
Hard

#### 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.

FSC 9530, 9535

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Federal Standards:

- Fed. Std. No. 123 - Marking for Domestic Shipment, (Civil Agencies)
- Fed. Std. No. 146 - Tolerances for Copper and Copper Base Alloy Mill Products
- Fed. Std. No. 185 - Identification Marking of Copper and Copper Base Alloy Mill Products
- Fed. Test Method Std. No. 151 - Metals; Test Methods

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

(Single copies of this specification and other Federal specification required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Auburn, Washington.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks, and the Index of Federal Specifications and Standards, from established distribution points in their agencies.)

Military Specification:

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

Military Standards:

- MIL-STD-105 - Sampling Procedures and Tables 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) Standards:

- B 154 - Mercurous Nitrate Test for Copper and Copper Alloys
- E 8 - Tension Testing of Metallic Materials

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

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

### 3. REQUIREMENTS

3.1 Manufacture. Material furnished under this specification shall be manufactured by hot rolling, or cold rolling and annealing, as required to meet the requirements of this specification.

3.2 Unless material in rolls or on reels or bucks is specified in the contract or order, the plate, sheet, strip, and bar shall be furnished in flat, straight lengths (see 6.2).

3.3 Chemical composition. The material shall conform to the chemical requirements shown in table I.

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TABLE I. Chemical composition - percent maximum unless shown as a range or minimum

Copper Alloy No.	Copper & elements with specific limits, Min.	Aluminum	Iron	Manganese	Nickel	Tin	Lead	Zinc	Silicon	Phosphorus
606	99.5	4.0-7.0	.50	-	-	-	-	-	-	-
610	99.5	6.0-8.5	.50	-	-	-	.02	.20	.10	-
613	99.5	6.0-8.0	3.5	.50	.50	.20	-	-	-	-
614	99.5	6.0-8.0	1.5-3.5	1.0	-	-	.01	.20	-	.015
630	99.5	9.0-11.0	2.0-4.0	1.5	4.0-5.5	.20	-	.30	.25	-

3.4 Mechanical properties. The material shall conform to the properties shown in table II.

TABLE II. Mechanical properties

Copper alloy No.	Temper	Thickness	Width	Tensile strength, min.	Yield strength, min.	Elongation in 2 in., min.
		Inch	Inch	P.s.i.	P.s.i.	Percent
606	Hard	Less than 0.0625	30 and under	60,000	24,000	8
		0.0625 to 0.50 incl.	30 and under	60,000	24,000	25
		Less than 0.0625	Over 30	55,000	22,000	8
		0.0625 to 0.50 incl.	Over 30	55,000	22,000	25
	Soft	Over 0.50	All	50,000	20,000	30
		All	All	45,000	17,000	40
610	Hard	Less than 0.0625	30 and under	65,000	27,000	8
		0.0625 to 0.50 incl.	30 and under	65,000	27,000	20
		Less than 0.0625	Over 30	60,000	25,000	8
		0.0625 to 0.50 incl.	Over 30	60,000	25,000	20
	Soft	Over 0.50	All	55,000	22,000	25
		All	All	50,000	20,000	30
613	Hard	0.125 and less	All	85,000	55,000	30
		Over 0.125 to 0.3125 incl.	All	80,000	50,000	30
		Over 0.3125 to 0.50 incl.	All	75,000	45,000	35
		Over 0.50 to 1.0 incl.	All	70,000	40,000	35
		Over 1.0	All	70,000	40,000	30
	Soft	0.50 and less	All	72,000	32,000	30
		Over 0.50 to 2.0 incl.	All	70,000	30,000	35
		Over 2.0 to 5.0 incl.	All	65,000	28,000	35
614	Hard	0.50 and less	All	80,000	45,000	25
		Over 0.50 to 1 incl.	All	70,000	40,000	30
	Soft	0.50 and less	All	72,000	32,000	35
		Over 0.50 to 2 incl.	All	70,000	30,000	35
		Over 2 to 5 incl.	All	65,000	28,000	35
630	Soft	Up to 2.0 incl.	All	90,000	36,000	10
		Over 2.0 to 3.5 incl.	All	85,000	33,000	10
		Over 3.5 to 5.0 incl.	All	80,000	30,000	10

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3.5 Residual stress. When specified in the contract or order, material shall withstand without cracking the mercurous nitrate test when tested in accordance with 4.5.2.3.

3.6 Dimensional tolerances. The following references of Fed. Std. No. 146 shall apply.

<u>Dimension</u>	<u>Reference</u>
Thickness	1b(1)
Width	1b(2)
Length	1b(3)
Schedule of lengths	1a(4)
Straightness	1a(5)

3.7 Identification marking. When specified in the contract or order, item identification marking shall be in accordance with Fed. Std. No. 185 (see 6.2).

3.8 Workmanship. Material shall be uniform in quality and temper, clean, sound, smooth, and free from foreign material, pipes, slivers, laps, cracks, seams, scale, burrs, buckles, damaged ends or edges, and other defects which, due to their nature, degree or extent, detrimentally affect the serviceability of the intended parts.

#### 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 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 assure supplies and services conform to prescribed requirements.

4.2 Lot. Unless otherwise specified in the contract or order, a lot shall consist of 10,000 pounds or fraction thereof of material of the same composition, form, temper, and size submitted for inspection at one time.

#### 4.3 Sampling.

4.3.1 Sampling for chemical analysis. From each lot, the number of pieces specified in table III shall be sampled. Each sample shall consist of not less than 2 ounces of clean millings, drillings, or clippings.

TABLE III. Sampling for chemical analysis

Pounds of material in lot	Number of samples <sup>1/</sup>
Up to 5,000, incl.	2
5,001 to 10,000	4

<sup>1/</sup> If the number of original bars, billets, or cakes from which the material is processed is less than the number of pieces specified for sampling, only one sample need be taken from each piece.

4.3.2 Sampling for mechanical properties. Two tension test specimens shall be taken from each lot. Each specimen shall be taken from a different piece. If the lot consists of only one piece, only one sample need be taken.

4.3.3 Sampling for mercurous nitrate test. When this test is required, one sample shall be selected from each 5,000 pounds or fraction thereof in the lot. If the lot consists of only one piece, only one sample shall be taken.

4.3.4 Sampling for visual and dimensional examination.

4.3.4.1 Pieces weighing over 150 pounds. Each piece shall be examined.

4.3.4.2 Pieces weighing 150 pounds or less. From each lot of material with pieces weighing 150 pounds or less, a representative sample shall be selected in accordance with MIL-STD-105, inspection level II with an acceptable quality level (AQL) of 1.5 percent defective, and shall be examined as specified in 4.4.1. Pieces selected for dimensional examination may be the same as those selected for visual examination.

4.3.4.3 When material is furnished in rolls or on reels or bucks, the sample shall be taken from within 10 feet of the outer end.

4.4 Examination.

4.4.1 Visual and dimensional. Pieces selected in accordance with 4.3.4 shall be visually examined to determine compliance with the requirements for identification marking (see 3.7) and workmanship (see 3.8) and shall be measured for compliance with the dimensional requirements (see 3.6) of this specification.

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4.4.2 Preparation for shipment. Examination of the packing and marking for shipment shall be made for conformance to the requirements of section 5.

4.5 Tests.4.5.1 Test specimens.

4.5.1.1 Tension test specimens. Tension test specimens for sheet and strip, and for bar and plate up to 3/8 inch, inclusive, in thickness shall be machined to the form and dimensions of sheet-type, 1/2 inch wide (figure 6) of ASTM E 8. Tension test specimens for plate and bar over 3/8 inch thick shall be machined to the form and dimensions of plate-type, 1-1/2 inches wide (figure 6) of ASTM E 8 or the largest possible size of 0.500 inch diameter or 0.350 inch diameter (figure 8) of ASTM E 8, or tested in full section. The longitudinal axis of the specimen shall be parallel to the direction of rolling. For material up to and including 1-1/2 inches in thickness, the central axis of the test specimen shall coincide with the central axis of the material. For material over 1-1/2 inches in thickness, the central axis of the specimen shall be located midway between the center and surface of the piece.

4.5.1.2 Mercurous nitrate test. Where practical, the test specimen shall be the full cross-section of the material and at least 6 inches in length. For large plate, sheet and strip, a specimen the full thickness of the material and at least 1 inch wide may be used. Sawed edges may be machined or filed, but no annealing, bending, springing, or polishing of the test specimen shall be permitted. Preparation of the test specimens shall be in accordance with ASTM B 154.

4.5.2 Test procedures.

4.5.2.1 Chemical analysis. The samples selected in accordance with 4.3.1 shall be analyzed by method 111 or method 112 of Fed. Test Method Std. No. 151 to determine conformance with 3.3. A single analysis of a composite sample may be made. In case of dispute, analysis by method 111 shall be the basis for acceptance.

4.5.2.2 Tension tests. Tension tests shall be conducted in accordance with ASTM E 8. The yield strength shall be determined by the extension under load method. The limiting extension shall be 0.005 inch per inch for all specified yield strength values.

4.5.2.3 Mercurous nitrate test. This test shall be conducted in accordance with ASTM B 154.



#### 4.6 Rejection.

4.6.1 Examination defects. Any sample unit having one or more defects shall be rejected. If the number of nonconforming sample units in the sample exceeds the acceptance number specified in 4.3.4.2 for that sample size, the entire lot shall be rejected subject to the "Disposition of Nonconforming Products" provisions of MIL-STD-105.

4.6.2 Test failures. A lot shall be rejected for failure to meet any of the test requirements when tested in accordance with 4.5.

4.7 Retests. Retests shall be permitted in accordance with the "Rejection and Retests" provisions of Fed. Test Method Std. No. 151.

4.7.1 Rolls, reels, or bucks. If the sample selected for examination in accordance with 4.3.4.3 is rejected because of handling marks, an additional 20 feet shall be selected for retesting.

#### 5. PREPARATION FOR DELIVERY

##### 5.1 Packing (see 6.3).

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 (see 6.3).

5.2.1 Civil agencies. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.2.2 Military activities. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with MIL-STD-129.

#### 6. NOTES

6.1 Intended use. With the exception of alloy number 630, these alloys are all alpha type (a uniform solid solution of aluminum in copper). All have good corrosion resistance and are suitable for hot working. With the exception of number 630, these alloys are also suitable for cold working.

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6.2 Ordering data. Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Composition, form, temper and size of the material required (see 1.2).
- c. When material is required in rolls or on reels or bucks (see 3.2).
- d. When the mercurous nitrate test is required (see 3.5).
- e. Length, whether specific, or stock lengths with or without ends.
- f. When item identification marking is required (see 3.7).
- g. Whether material is to be packed by level A, B, or C. (see 5.1).
- h. Special marking, if required (see 5.2).
- i. Maximum gross weight of containers.

6.3 The requirements for item identification marking (see 3.7), and for packing and marking for shipment (see 5.1 and 5.2), specified herein apply to direct shipment for Government activities and apply also, where specified, to contracts or orders between the manufacturer and the Government prime contractor.

**MILITARY CUSTODIANS:**

Army - MR  
Navy - SH  
Air Force - 11

Preparing activity:

Army - MR

Review activities:

Army - MU, MR, MI  
Navy - SH, AS  
Air Force - 84  
DSA - IS

User activities:

Army - GL

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