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SUPERSEDING
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FEDERAL SPECIFICATION

COPPER FLAT PRODUCTS WITH SLIT, SLIT AND EDGE-ROLLED, SHEARED, SAWED, OR MACHINED EDGES, (PLATE, BAR, SHEET, AND STRIP)

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers copper flat products (bar, plate, sheet, and strip) with slit, slit and edge-rolled, sheared, sawed, or machined edges (see 6.6).

1.2 Classification.

1.2.1 Forms and tempers. Copper shall be furnished in the following forms and tempers, as specified (see 6.2):

Forms:

- Plate.
- Bar.
- Sheet.
- Strip.

Tempers:

- Cold-rolled, light.
- Cold-rolled, half-hard.
- Cold-rolled, hard.
- Cold-rolled, spring.
- Cold-rolled, extra-spring.
- Cold-rolled, soft-annealed.
- Cold-rolled, deep-drawing annealed.
- Hot-rolled.
- Hot-rolled and annealed.

1.2.2 Tinned sheet and strip. When specified (see 6.2), sheet and strip shall be furnished on one or on both sides (see 3.5.8).

2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS

2.1 Specifications and standards. The following specification and standards, of the issues in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

Federal Standards:

- Fed. Std. No. 102--Preservation, Packaging and Packing Levels.
- Fed. Std. No. 123--Marking for Domestic Shipment (Civilian Agencies).
- 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, Standards, and Handbooks 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 25, D. C.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available

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without charge at the General Services Administration Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.

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

Military Specifications:

MIL-P-3993--Preparation for Shipment and Storage of Copper and Copper Alloy Mill Products.

Military Standards:

MIL-STD-105--Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-185--Continuous Identification Marking of Copper and Copper Base Alloys.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring agency 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 shall apply.

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd St., New York 16, N.Y.)

3. REQUIREMENTS

3.1 Manufacture. Copper plate, bar, sheet, and strip shall be manufactured by such hot-working, cold-rolling, or annealing as is necessary to obtain the temper specified herein.

3.2 Chemical composition. Unless otherwise specified (see 3.4 and 6.2), the material shall contain not less than 99.88 percent copper, small amounts of silver being counted as copper.

3.3 Mechanical properties.

3.3.1 Tensile properties. Copper plate, bar, sheet, and strip shall meet the tensile requirements shown in table I.

TABLE I.--Tensile strength requirements

Temper	Tensile strength	
	Minimum	Maximum
	p.s.i.	p.s.i.
Cold-rolled tempers:		
Light_____	32,000	40,000
Half-hard[1]_____	37,000	46,000
Hard[1]_____	43,000	52,000

Spring[1]_____	50,000	58,000
Extra-spring[1]_____	52,000	----
Hot-rolled_____	30,000	38,000
Hot-rolled and annealed____	30,000	38,000

[1] This temper is normally available in strip only, that is, material up to 20 inches wide, inclusive, and 0.188 inch thick, inclusive (see 6.4).

3.3.2 Grain size. When cold-rolled-and-annealed material is required, the average grain size shall be as specified in table II.

TABLE II.--Grain-size requirements for cold-rolled-and-annealed tempers

Cold-rolled-and-annealed temper	Grain size	
	Minimum	Maximum
Soft annealed_____	Mm. [1]	Mm. ----
Deep-drawing annealed (nominal 0.025-mm. grain size)_____	[1]	0.050

[1] Although no minimum grain size is required, the material shall be fully recrystallized.

3.4 Oxygen-free copper.

3.4.1 When oxygen-free copper is specified (see 6.2), the material shall contain 99.92 percent copper (small amounts of silver being counted as copper) and shall be produced without the use of metallic or metalloidal deoxidizers.

3.4.2 Resistivity. For annealed oxygen-free copper the electric resistivity, at a temperature of 28 deg. C. (68 deg. F.), shall not exceed 0.15328 ohm-gram/meter[2]. The density of copper shall be taken as 8.89 grams per cubic centimeter at 20 deg. C. (see 4.10.2).

TABLE III.—Permissible variations in thickness of cold-rolled plate, bar, sheet, and strip

Ordered thickness	Thickness tolerances, plus and minus							
	Strip				Sheet			
	Ordered width up to 8 inches, incl.	Ordered width over 8 to 12 inches, incl.	Ordered width over 12 to 14 inches, incl.	Ordered width over 14 to 20 inches, incl.	Ordered width over 20 to 28 inches, incl.	Ordered width over 28 to 36 inches, incl.	Ordered width over 36 to 48 inches, incl.	Ordered width over 48 to 60 inches, incl.
Inches	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch
Up to 0.004, incl.	0.0003	0.0006	0.0006	-----	-----	-----	-----	-----
Over .004 to 0.006, incl.	.0004	.0008	.0008	0.0013	-----	-----	-----	-----
Over .006 to .009, incl.	.0006	.0010	.0010	.0015	-----	-----	-----	-----
Over .009 to .013, incl.	.0008	.0013	.0013	.0018	0.0025	0.003	0.0035	0.004
Over .013 to .017, incl.	.0010	.0015	.0015	.002	.0025	.003	.0035	.0045
Over .017 to .021, incl.	.0013	.0018	.0018	.002	.003	.0035	.004	.005
Over .021 to .026, incl.	.0015	.002	.002	.0025	.003	.0035	.004	.005
Over .026 to .037, incl.	.002	.002	.002	.0025	.0035	.004	.005	.006
Over .037 to .050, incl.	.002	.0025	.0025	.003	.004	.005	.006	.007
Over .050 to .073, incl.	.0025	.003	.003	.0035	.005	.006	.007	.008
Over .073 to .130, incl.	.003	.0035	.0035	.004	.006	.007	.008	.010
Over .130 to .188, incl.	.0035	.004	.004	.0045	.007	.008	.010	.012
	Bar				Plate			
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Over .188 to .205, incl.	0.0035	0.004	0.004	0.0045	0.007	0.008	0.010	0.012
Over .205 to .300, incl.	.004	.0045	.0045	.005	.009	.010	.012	.014
Over .300 to .500, incl.	.0045	.005	.005	.006	.012	.013	.015	.018
Over .500 to .750, incl.	.0055	.007	.007	.009	.015	.017	.019	.023
Over .750 to 1.00, incl.	.007	.009	.009	.011	.018	.021	.024	.029
Over 1.00 to 1.50, incl.	.022	.022	.022	.022	.022	.025	.029	.036
Over 1.50 to 2.00, incl.	.026	.026	.026	.026	.026	.030	.036	.044

sheet, and strip]

TABLE IV.—Maximum permissible variations in width

Finish of edges	Ordered dimensions			Permissible variations in width (plus and minus)
	Length	Width	Thickness	
	Inches	Inches	Inches	Inch
Slit metal and slit metal with rolled edges	All	Up to 2, incl.	0.004 to 0.032, incl.	0.005
		Up to 2, incl.	Over 0.032 to 0.125, incl.	.010
		Up to 2, incl.	Over 0.125 to 0.188, incl.	.012
		Up to 2, incl.	Over 0.188 to 0.500, incl.	.015
		Over 2 to 8, incl.	0.004 to 0.032, incl.	.008
		Over 2 to 8, incl.	Over 0.032 to 0.125, incl.	.013
		Over 2 to 8, incl.	Over 0.125 to 0.500, incl.	.015
		Over 8 to 20, incl.	0.004 to 0.188, incl.	1/64
		Over 8 to 20, incl.	Over 0.188 to 0.500, incl.	1/32
Square sheared edges	All	Up to 120	Up to 20, incl.	1/32
		Up to 120	Up to 20, incl.	3/64
		Up to 120	Up to 20, incl.	1/16
		Up to 120	Over 20 to 36, incl.	3/64
		Up to 120	Over 20 to 36, incl.	1/16
		Up to 120	Over 36 to 120, incl.	1/16

Sawed metal -	Up to 120	Up to 12, incl.	Up to 1-1/2, incl.	1/32
	Up to 120	Up to 12, incl.	Over 1-1/2	1/16
	Over 120	Up to 12, incl.	All	1/16
	All	Over 12 to 120, incl.	All	1/16
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3.4.3 Freedom from cuprous oxide. The oxygen-free copper shall be free from cuprous oxide, as determined by the test specified in 4.10.3.

3.4.4 Embrittlement. When specified (see 6.2), samples of oxygen-free copper shall not show gassing or open-grain structure characteristic of embrittlement when tested as specified in 4.10.4.

3.5 Dimensional tolerances.

3.5.1 Thickness. Cold-rolled plate, bar, sheet, and strip with slit, slit and edge rolled, sheared, sawed, or machined edges shall not vary from the ordered thickness by more than the amounts shown in table III, except tinned sheets and strips (see 3.5.8).

3.5.2 Width. The width of finished products with slit, slit and edge rolled, square sheared or sawed edges, shall not exceed the values shown in table IV. Unless otherwise specified (see 6.2), tolerances for square sheared edges shall apply.

3.5.3 Length

3.5.3.1 Metal with slit, slit and edge rolled, sheared, or sawed edges.

3.5.3.1.1 Copper flat products with slit, slit and edge rolled, sheared, or sawed edges shall not vary from the ordered length by more than the amounts shown in table V.

TABLE V.--Permissible variations in length for flat products with slit, slit and edge rolled, sheared, or sawed edges

Ordered length	Permissible variation in length, plus only
	Inch
Specific lengths up to 10 feet, incl.	1/4
Specific lengths over 10 to 20 feet, incl.	1/2
Specific lengths with ends (short lengths)	1
Stock lengths with or without ends	1

3.5.3.1.2 Specific and stock lengths with ends (short pieces) included. When flat products with slit, slit and edge rolled, sheared, or sawed edges are ordered to specific or stock lengths with ends (short pieces) included, the minimum length of ends (short pieces) and the maximum permissible weight of ends (short pieces) in percent of lot weight shall be as shown in table VI.

TABLE VI.--Schedule of lengths (specific and stock) with ends

Ordered thickness	Ordered specific or stock length	Shortest length of ends	Maximum permissible weight of ends in percent of lot weight
Inch	Feet	Feet	Percent
Up to 0.050, incl.	Incl. 6 to 8, excl.	4	20
	Incl. 8 to 10, excl.	6	25

Over 0.050 to 0.125, incl.	Incl. 10 to 14, excl.	7	30
	Incl. 6 to 8, excl.	4	25
	Incl. 8 to 10, excl.	5	30
Over 0.125 to 0.250, incl.	Incl. 10 to 14, excl.	6	35
	Incl. 6 to 8, excl.	3	30
	Incl. 8 to 10, excl.	4	35
	Incl. 10 to 14, excl.	5	40

3.5.3.2 Metal with edges and ends sheared or sawed.

3.5.3.2.1 Flat products with edges and ends sheared shall not vary from the ordered length by more than the amounts shown in table IV for square sheared metal. The length tolerances are the same as the width tolerances for this material.

3.5.3.2.2 Flat products with edges and ends sawed shall not vary from the ordered length by more than plus 1/4 inch, minus 0.

3.5.4 Foil size (Air Force only). When copper "foil" is specified (see 6.2), the material shall be 0.0015 inch in thickness by 1.000 inch in width by 6 feet long, within the tolerances specified in tables III, IV, and V as applicable.

3.5.5 Weight

3.5.5.1 When hot-rolled copper products are ordered by thickness, the weight of any lot (see 4.2) or five or more pieces shall not vary from the theoretical weight by more than the amount shown in table VII.

TABLE VII.--Permissible variation in weight of hot-rolled, plate, bar, or sheet ordered by thickness

Ordered thickness	Weight tolerance[1] plus and minus				
	Ordered width to 48 inches, incl.	Ordered width over 48 to 60 inches, incl.	Ordered width over 60 to 72 inches, incl.	Ordered width over 72 to 90 inches, incl.	Ordered width over 90 to 110 inches, incl.
Inches	Percent	Percent	Percent	Percent	Percent
Up to 1/8, incl.	8	9.5	11	12.5	14
Over 1/8 to 3/16, incl.	6.5	8	9.5	11	12.5
Over 3/16 to 1/4, incl.	6	7.5	8.5	9	10
Over 1/4 to 5/16, incl.	5.5	7	8	8.5	9
Over 5/16 to 3/8, incl.	5	6	7	7.5	8
Over 3/8 to 7/16, incl.	4.5	5	6	7	7.5
Over 7/16 to 1/2, incl.	4	4.5	5.5	6	6.5
Over 1/2 to 5/8, incl.	3.5	4.5	5	5.5	6
Over 5/8 to 3/4, incl.	3	4	4.5	5	5.5
Over 3/4 to 1, incl.	2.75	3.5	4	4.5	5
Over 1 to 1-1/2, incl.	2.5	3	3.5	4	4.5
Over 1-1/2 to 2, incl.	2.25	2.75	3.25	3.75	4.25

[1] Based on theoretical weight, calculated on a density of 0.323 pound per cubic inch.

3.5.6 Straightness. The depth of arc of any longitudinal surface or edge for finished products with slit, slit and straightened or edge rolled, sheared or sawed edges, shall not exceed the values shown in table VIII and shall be determined in accordance with 4.8.3.

3.5.7 Corners and edges. Unless a particular type of corner or edge is specified (see 6.2), the material shall be furnished with such edges as would result directly from sawing, slitting, slitting an edge rolling, shearing, or machining.

3.5.8 Sheet and strip tinned on one and on both sides. For tinned

copper sheet and strip ordered in weights in ounces per square foot as listed in table IX, the permissible variation in thickness for thicknesses from 0.0162 to 0.0270 inch, inclusive, shall be as shown in table IX. For thicknesses less than 0.0162 inch or greater than 0.0270 inch, the permissible variations in thickness, unless otherwise specified (see 6.2), shall be as shown in table III.

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TABLE VIII.--Maximum permissible variations in depth of arc in any 72-inch portion of the total length

Finish of edges	Ordered dimensions			Maximum edgewise curvature
	Length	Thickness	Width	
	Inches	Inch	Inches	Inches
As slit (shipped in rolls)	All	All	Over 1/4 to 3/8, incl.	3
			Over 3/8 to 1/2, incl.	2
			Over 1/2 to 1, incl.	1-1/4
			Over 1 to 2, incl.	3/4
			Over 2 to 4, incl.	5/8
			Over 4	1/2
As slit (shipped flat)	All	All	Over 1/4 to 3/8, incl.	1-1/2
			Over 3/8 to 1/2, incl.	1
			Over 1/2 to 1, incl.	3/4
			Over 1 to 2, incl.	5/8
			Over 2 to 4, incl.	1/2
			Over 4	1/2
As slit and either straightened or edge rolled (shipped flat in rolls or on bucks)	All	All	All	1/2
Square sheared edges (flat straight lengths)	Up to 120, incl.	Up to 1/8, incl.	Up to 10, incl.	1/16
		Up to 1/8, incl.	Over 10	1/32
		Over 1/8 to 3/16, incl.	Up to 10, incl.	1/8
		Over 1/8 to 3/16, incl.	Over 10	3/64
		Over 3/16	Up to 10, incl.	1/8
		Over 3/16	Over 10	1/16
Sawed edges (flat straight lengths)	Up to 144, incl.	All	Up to 3, incl.	1/16
			Over 3	3/64

3.6 Identification marking. Identification marking for the Air Force and Navy, Bureau of Aeronautics, shall be in accordance with Military Standard MIL-STD-185. For other Military agencies, such marking shall be required when specified (see 6.2).

3.7 Workmanship. The copper plate, bar, sheet, and strip shall be uniform in quality and temper and shall be sound, clean, and smooth, and shall be free from injurious defects, including foreign material, pipes, slivers, laps, cracks, seams, scales, burrs, buckles, damaged ends, damaged corners, and damaged edges.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be

kept complete and available to the Government as specified in the contract or order. 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.

TABLE IX.--Permissible variations in thickness of tinned sheet and strip

Weight per square foot	Thickness	Permissible variations at any point in thickness, [1]plus and minus, for widths given in inches						
		Up to 8, incl.	Over 8 to 14, incl.	Over 14 to 20, incl.	Over 20 to 28, incl.	Over 28 to 36, incl.	Over 36 to 48, incl.	Over 48 to 60, incl.
Ounces	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch
12	0.0162	0.0010	0.0015	0.002	-----	-----	-----	-----
14	.0189	.0013	.0018	.002	-----	-----	-----	-----
16	.0216	.0015	.002	.0025	0.003	0.0035	0.004	0.005
18	.0243	.0015	.002	.0025	.003	.0035	.004	.005
20	.0270	.002	.002	.0025	.0035	.004	.005	.006

[1] All plus tolerances for tinned copper sheet and strip shall be double those shown in table IX.

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 form, temper, and size submitted for inspection at one time.

4.3 Samples for chemical analysis. The inspector shall select from different representative pieces in each lot, the number of samples for chemical analysis as specified in table X. From each sample, not less than 2 ounces of clean millings, drillings, or clippings shall be obtained, placed in separate containers, and forwarded to a laboratory designated by the bureau or agency concerned for analysis.

TABLE X.--Sampling for chemical analysis

Pounds of material in lot	Number of samples[1]
Up to 5,000	2
5,001 to 10,000	4

[1] If the number of original bars, billets, or ingots from which the material is processed is less than the number of samples specified, not more than one sample need be taken from each piece.

4.4 Samples for tension test. Unless otherwise specified in the contract or order, two tension specimens shall be taken from each lot and shall be selected from different pieces.

4.5 For grain-size determination (cold-rolled-and-annealed tempers). For grain-size determination, two samples from different pieces shall be selected from each lot of cold-rolled-and-annealed temper copper. The ends of tension-test specimens before pulling may be used for grain-size-determination samples.

4.6 Samples for other tests (oxygen free copper). Unless otherwise specified in the contract or order, for oxygen-free copper, one resistivity

test specimen and one microscope test specimen shall be taken from each lot, but each need not be selected from different pieces. When specified (see 6.2), one embrittlement test specimen shall be taken from each lot.

4.7 Sampling for visual and dimensional examination. If the weight of each piece is more than 150 pounds, each piece shall be examined. If the weight of each piece is 150 pounds and under, sample pieces shall be selected as specified in 4.7.1 and 4.7.2.

4.7.1 Visual examination. From each lot of material containing pieces weighing 150 pounds and under, a representative sample of material shall be selected in accordance

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with table XI and shall be visually examined as specified in 4.8.1.

4.7.2 Dimensional examination. From each lot of material containing pieces weighing 150 pounds and under, a representative sample of material shall be selected in accordance with table XI and shall be dimensionally (tolerance) examined as specified in 4.8.2. The samples selected for dimensional examination may be the same as those selected for visual examination.

TABLE XI.--Sampling for visual and dimensional examination AQL (approx.) = 1.5 percent defective

Number of pieces in lot	Number of pieces required for sampling of 4.7.1 and 4.7.2
Up to 180	Inspection Level III MIL-STD-105
181 to 500	Inspection Level II MIL-STD-105
501 and over	Inspection Level I MIL-STD-105

4.7.3 Sheet and strip in rolls or on reels or bucks. For sheet and strip in rolls or on reels or bucks, the sample for examination shall be taken from within 10 feet of the outer end. (See 4.8.4.)

4.8 Visual and dimensional examination.

4.8.1 Pieces weighing over 150 pounds. For pieces weighing over 150 pounds, each piece shall be visually and dimensionally examined and the straightness of each piece shall be determined as specified in 4.8.3.

4.8.2 Pieces weighing 150 pounds, and under.

4.8.2.1 Visual. Each of the sample pieces selected in accordance with 4.7.1 shall be visually examined to determine compliance with this specification.

4.8.2.2 Dimensional. Each of the sample pieces selected in accordance with 4.7.2 shall be examined to determine compliance with this specification.

4.8.3 Straightness. Straightness shall be determined by placing the piece on a level surface so that the arc or departure from straightness is horizontal. The maximum depth of arc shall be measured to the nearest 1/32 inch by means of a straight edge and a steel scale.

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

4.9 Test procedures.

4.9.1 Chemical analysis. The sample selected and forwarded in accordance with 4.3 shall be analyzed by the wet chemical or spectrographic method in accordance with method 111 or 112 of Federal Test Method Standard No. 151 to determine conformance to 3.2 or 3.4, as applicable. A single analysis of a composite sample may be made. In case of dispute, the analysis by the wet method shall be the basis for acceptance.

4.9.2 Tension tests.

4.9.2.1 Tension-test specimens. Tension-test specimens for sheet and

strip, and for plates up to 3/8 inch, inclusive, in thickness shall be machined to the form and dimensions of type F2 of method 211 of Federal Test Method Standard No. 151. Tension-test specimens for plate over 3/8 inch in thickness shall be machined to the form and dimensions of type F1 of method 211 of Federal Test Method Standard No. 151 or shall be tested in full section. The longitudinal axis of the specimens shall be parallel to the direction of rolling or drawing.

4.9.2.2 Test methods. All tension tests shall be conducted in accordance with method 211 of Federal Test Method Standard No. 151.

4.9.3 Grain-size determination (cold-rolled and annealed tempers).

4.9.3.1 Grain-size shall be determined in accordance with method 312 of Federal Test Method Standard No. 151.

4.10 Resistivity, microscope, and embrittlement tests for oxygen-free copper.

4.10.1 Test samples. Samples selected in accordance with 4.6 shall be used in the resistivity, microscope, and embrittlement tests.

4.10.2 Resistivity test. The test specimen for the resistivity test may be in the form of plate, bar, sheet, or strip. It shall be of uniform cross section throughout its length within plus and minus 0.75 percent of the cross-sectional area. Wherever possible, it shall be the full cross section of the material it represents, if the full cross section is such that the uniformity of the cross-sectional area can be accurately determined. The specimens shall be annealed at approximately 500 deg. C. (932 deg. F.) for 30 minutes. Resistivity shall be determined by a method approved by the bureau or agency concerned.

4.10.3 Microscope test. The sample shall be examined under a microscope at 75 diameters magnification to determine conformance with 3.4.3.

4.10.4 Embrittlement test. The sample shall be heated to a temperature of 800 deg. to 875 deg. C. (1,472 deg. to 1,607 deg. F.) for a period of 20 minutes in a furnace containing an atmosphere of hydrogen. After removal from the furnace, the sample shall be polished, etched if desired, and examined under a microscope at magnification of not less than 75 diameters to determine conformance with 3.4.4.

4.11 If a test specimen fails to meet any of the requirements of this specification, the lot represented by the specimen shall be rejected.

5. PREPARATION FOR DELIVERY

(For civil agencies only, Federal Standard No. 102 should be referred to for definitions and applications of the various levels of packaging protection for supplies and equipment.)

5.1 Packaging.

5.1.1 Level A. Packaging shall be in accordance with Specification MIL-P-3993.

5.1.2 Level C. Packaging shall be in accordance with the supplier's commercial practice.

5.2 Packing.

5.2.1 Levels A and B. Packing shall be in accordance with Military Specification MIL-P-3993.

5.2.2 Level C. Packing shall be in containers which will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or other regulations as applicable to the mode of transportation.

5.3 Marking.

5.3.1 Civil agencies. Marking shall be in accordance with Federal Standard No. 123.

5.3.2 Military agencies. In addition to any special marking required by the contract or order, shipments shall be marked in accordance with Military Specification MIL-P-3993.

6. NOTES

6.1 Intended use. This specification covers copper plate, bar, sheet, and strip intended for general fabrication purposes. For special uses, the compositions shown in table XII are commercially available. If required, these particular compositions may be purchased under this specification by specifying chemical

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composition and other special requirements in the contract or order.

TABLE XII.--Compositions of copper plate, bar, sheet, and strip

Type of copper	Copper[1]	Phosphorus	Arsenic	Silver
	Percent	Percent	Percent	Percent
Electrolytic tough pitch	99.90	-----	-----	----
Fire refined tough pitch[2]	99.88	-----	0.012, max.	----
Phosphorized, with high residual P	99.90	0.015 - 0.04	-----	----
Oxygen-free, no residual deoxidants	99.92	-----	-----	----
Silver bearing, tough pitch	99.90	-----	-----	([3])
Silver bearing, phosphorized	99.90	0.04, max.	-----	([3])
Silver bearing, oxygen-free	99.90	-----	-----	([3])

[1] Minimum, including silver.

[2] Antimony, 0.003 percent, max.; selenium plus tellurium, 0.025 percent, max.; nickel, 0.05 percent, max.; bismuth 0.003 percent, max.; lead, 0.004 percent, max.

[3] Desired minimum must be specified (normally between 6 and 10 ounces per ton).

6.1.1 Sheets and strips in "light cold-rolled temper" are intended for the manufacture of gutters, conductor pipe, cornices and for metal work in connection with building construction.

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) Forms and tempers required (see 1.2.1).
- (c) When sheet and strip should be furnished tinned and whether on one side or both sides (see 1.2.2 and 3.5.8).
- (d) Whether oxygen-free copper is required (see 3.4.1).
- (e) When samples of oxygen-free copper shall not show gassing or open-grain structure characteristic of embrittlement (see 3.4.4).
- (f) Dimensional tolerances if other than as specified in 3.5.2.
- (g) When copper foil is required for Air Force (see 3.5.4).
- (h) Corners and edges required (see 3.5.7).
- (i) Whether continuous identification marking is required (see 3.6).
- (j) Variation in thickness for tinned sheet and strip if other than as specified in 3.5.8.
- (k) When one embrittlement test specimen shall be taken (see 4.6).
- (l) Applicable levels of packaging and packing required (see 5.1 and 5.2).
- (m) Maximum gross weight of container (see 5.2).
- (n) Particular composition and other special requirements, if other than

as specified (see 6.1).

6.3 Since Rockwell hardness tests offer a quick and convenient method of checking copper of any temper for general conformity to the requirements for tensile strength or grain size, the approximate Rockwell hardness values for each temper are shown in table XIII for general information and assistance in testing.

6.4 Cold-rolled copper in half-hard, spring, and extra-spring tempers is normally supplied only as strip. The manufacturer should be consulted concerning sheet, bar, and plate in these tempers.

6.5 Dimensional tolerance tables used in this specification are standard for all of the material covered by this specification. Procuring activities desiring plates, bar, sheet,

and strip, with dimensional tolerances other than those listed in 3.5, should consult the manufacturer.

TABLE XIII.--Approximate Rockwell hardnesses for each temper

Temper	Approximate Rockwell hardness[1]					
	B scale[2]		F scale		Superficial 30-T	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Cold-rolled tempers:						
Light cold-rolled	--	39	40	82	--	49
Half hard	30	50	77	89	43	57
Hard	45	57	86	93	54	62
Spring	54	64	91	97	60	66
Extra spring	56	--	92	--	61	--
Soft annealed	--	--	--	65	--	--
Deep-drawing annealed	--	--	30	75	--	--
Hot-rolled tempers:						
As rolled	--	--	--	75	--	41
As rolled and annealed	--	--	--	65	--	31

[1] Rockwell hardness values apply as follows: The B and F scales apply to metal 0.020 inch and over in thickness. The Superficial 30-T scale applies to metal 0.012 inch and over in thickness.

[2] The Rockwell F scale is preferred for testing material in these tempers.

6.6 This specification covers flat products having slit, slit and edge-rolled, sheared, sawed, or machined edges. Federal Specification QQ-C-502 covers flat products with drawn edges or with rolled (not previously slit) edges.

6.7 Definition of forms.

6.7.1 Plate. Plate is a flat rolled product over 0.188 inch in thickness and over 12 inches in width.

6.7.2 Bar. Bar as covered by this specification is a solid rectangular section, or one with two plane parallel surfaces and round or other simple regularly shaped edges, up to and including 12 inches in width and over 0.188 inch in thickness.

6.7.3 Sheet. Sheet is a flat rolled product up to and including 0.188 inch in thickness and over 20 inches in width.

6.7.4 Strip. Strip is a flat product, other than flat wire, up to and including 0.188 inch in thickness and up to and including 20 inches in width, furnished with slit, sheared, or sawed edges.

6.7.5 Foil. A term applied to a thin rolled section 0.005 inch or less in thickness.

6.8 Samples for chemical, tension, grain size, embrittlement, freedom from cuprous oxide, and resistivity tests may be taken from material that is too short for shipment. This will preclude needless destruction of finished material when samples representative of such material are available from other sources.

6.9 The chemical and mechanical property requirements of this specification are similar to those of ASTM B152-58.

Notice. -- When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other

QQ-C-576b

data, is not to be regarded, by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

MILITARY CUSTODIANS:

Army--Ordnance Corps
Navy--Bureau of Ships
Air Force.

Copies of this specification may be purchased for 10 cents each.

QQ-C-576b
AMENDMENT--1
November 6, 1961

FEDERAL SPECIFICATION

COPPER FLAT PRODUCTS WITH SLIT, SLIT AND
EDGE-ROLLED, SHEARED, SAWED, OR
MACHINED EDGES, (PLATE, BAR, SHEET,
AND STRIP)

This amendment, which forms a part of Federal Specification QQ-C-576b, dated July 12, 1961, was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

Page 1, paragraph 2.1, under Federal Standards add:

"Fed. Std. No. 185--Identification Marking of Copper and Copper Base Alloy Mill Products."

Page 2, paragraph 2.1, under Military Standards: Delete reference to "MIL-STD-185".

Page 6, paragraph 3.6: Delete and substitute:

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

Page 6, paragraph 4.1: Delete and substitute:

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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 that supplies and services conform to prescribed requirements.

Page 10, paragraph 6.2 sub-item (i). Delete and substitute:

"(i) Identification marking when required (see 3.6)."

Page 11. Delete notice in entirety.

Page 11. Add new paragraph 6.10 as follows:

6.10 Transportation description. The transportation descriptions and minimum weights applicable to this commodity are:

Rail:

Bars, drawn extruded or rolled, copper.
Carload minimum weight 30,000 pounds.

Motor:

Bars, drawn extruded or rolled, cooper:
Truckload minimum weight 36,000 pounds, subject to Rule 115,
National Motor Freight Classification.

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Rail:

Plate, sheet or strip, not otherwise indexed by name, copper, other than perforated or silver plated.
Carload minimum weight 30,000 pounds.

Motor:

Plate, sheet or strip, not otherwise indexed, copper, other than perforated or silver plated.
Truckload minimum weight 30,000 pounds, subject to Rule 115, National Motor Freight Classification."

MILITARY CUSTODIANS:

Army--MR
Navy--SH
Air Force--69

Review activities:

Army--MR, MI
Navy--SH, WP
Air Force--69

User Activities:

Army--WC
Navy--YD, MC

Preparing activity:

Navy--SH