QQ-B-750
JULY 5, 1961

SUPERSEDING
Fed. Spec. QQ-P-330
October 20, 1955

FEDERAL SPECIFICATION

BRONZE, PHOSPHOR; BAR, PLATE, ROD, SHEET, STRIP, FLAT WIRE, AND STRUCTURAL AND SPECIAL SHAPED SECTIONS

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers wrought phosphor bronze for bolt material, pump rods, springs, valve stems, valves, objects exposed to the action of salt water, valve disks, and electric contacts or similar applications.

1.2 Classification. Phosphor bronze shall be of the following compositions, forms, and tempers, as specified (see 6.1):

Composition A:

Bar and rod—soft, hard, and spring.
Shapes—(see 3.2.1.1 and 3.7).
Plate, sheet, strip, and flat wire—soft, half-hard, hard, extra-hard, spring, and extra spring.

Composition B:

Bar and rod—hard.

Composition D:

Bar and rod—soft and hard.
Shapes—(see 3.2.1.1 and 3.7).
Plate, sheet, strip, and flat wire—soft, half-hard, hard, extra-hard, spring, and extra spring.

1.2.1 When temper is not specified, bar, rod, shapes, plate, sheet, and strip shall be furnished in the hard temper. Round rods over ½ inch in diameter may be furnished as standard shafting, with or without piston finish.

2. APPLICABLE SPECIFICATIONS AND STANDARDS

2.1 The following specifications 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. Std. No. 146—Tolerances for Copper and Copper Base Alloy Mill Products.
Fed. Test Method Std. No. 151—Metals; Test Methods.
Fed. Std. No. 185—Identification Marking of Copper and Copper Base Alloy Mill Products.

(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 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–C–3993—Copper and Copper Alloy Mill Products, Preparation for Shipment and Storage of.

Military Standards:

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

MIL–STD–129—Marking for Shipment and Storage.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

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

TABLE I.—*Chemical composition*

Element	Composition A[1]	Composition B	Composition D[1]
	Percent	*Percent*	*Percent*
Copper	Remainder	Remainder	Remainder
Tin	3.5–5.8	3.5–4.5	9.0–11.0
Phosphorus	0.03–0.35	0.01–0.50	0.03–0.35
Zinc	[2].30	1.5–4.5	[2].20
Lead	[2].05	3.5–4.5	[2].05
Iron, maximum	.10	0.10	.10
Copper plus tin plus phosphorus, minimum	[3]99.5	99.5	99.5

[1] In the case of rods 1.25 inches and over in diameter, a manganese content of 1.25 percent, maximum, will be permitted and the maximum iron content may be increased to 1.25 percent, in which case the minimum total shall apply to copper plus tin plus phosphorus plus manganese plus iron.

[2] Maximum.

[3] For composition B, the minimum percentages of 99.5 includes lead and zinc as well as copper plus tin plus phosphorous.

3.2 Mechanical properties.

3.2.1 The material shall conform to the mechanical properties shown in tables II and III.

TABLE III.—*Mechanical properties of phosphor bronze plate[1], sheet, strip, and flat wire; compositions A and D; all thicknesses*

Composition and temper	Tensile strength
	P.s.i.
Composition A:	
Soft	40,000–55,000
Half-hard	55,000–70,000
Hard	72,000–87,000
Extra-hard	84,000–99,000
Spring	91,000–105,000
Extra-spring	96,000–109,000
Composition D:	
Soft	58,000–73,000
Half-hard	76,000–91,000
Hard	94,000–109,000
Extra-hard	107,000–122,000
Spring	115,000–129,000
Extra-spring	120,000–133,000

[1] Plate is generally available in only the soft and half-hard temper. Required properties for other tempers shall be as specified (see 6.1).

3.2.1.1 The mechanical properties of shapes shall be as specified (see 6.1).

3.2.2 Where material is required in special forms and tempers other than those specified in tables II and III, the material shall be as specified (see 6.1).

3.3 Standard shafting. When specified (see 6.1), round rods ½ inch and over in diameter shall be furnished as standard shafting having standard shafting straightness and special roundness tolerances.

TABLE II.—*Mechanical properties of phosphor bronze bars and rods; compositions A, B, and D*

Composition and temper	Diameter or distance between parallel surfaces	Tensile strength (minimum[1])	Elongation in 4 × diameter or thickness of specimen (minimum)
	Inches	*P.s.i.*	*Percent*
Composition A:			
Soft	Rounds under ¼	40,000– 58,000	..
Hard	Rounds under ¼	80,000–128,000	..
	Rounds and hexagons:		
	¼ to ½, incl.	70,000	13
	Over ½ to 1, incl.	60,000	15
	1 to 3, incl.	55,000	18
	Over 3	50,000	18
	Squares and rectangles:		
	Up to ⅜, incl.	60,000	10
	Over ⅜	55,000	15
Spring	Rounds:		
	Under 0.026	125,000	..
	0.026 to 1/16, incl.	115,000	..
	Over 1/16 to ⅛, incl.	110,000	..
	Over ⅛ to ¼, incl.	105,000	3.5
	Over ¼ to ⅜, incl.	100,000	5.0
	Over ⅜ to ½, incl.	90,000	9.0
Composition B:			
Hard	Rounds and hexagons:		
	¼ to ½, incl.	60,000	10
	Over ½ to 1, incl.	55,000	12
	Over 1	50,000	15
	Squares and rectangles:		
	¼ to ⅜, incl.	55,000	10
	Over ⅜	50,000	15
Composition D:			
Soft	Rounds under ¼	60,000– 75,000	..
Hard	Rounds under ¼	105,000–160,000	..
	Rounds and hexagons:		
	¼ to ½, incl.	95,000	10
	½ to 1, incl.	85,000	12
	Over 1	70,000	15
	Squares and rectangles:		
	Up to ⅜, incl.	76,000	10
	Over ⅜	70,000	15

[1] Unless a range is specified.

3.4 Finish.

3.4.1 *Piston finish for standard shafting.* When specified (see 6.1), standard shafting shall be furnished with piston finish, a special surface produced by grinding or within specified RMS limit.

3.5 Tolerance. Tolerance shall not exceed that specified in the following sections of Federal Standard No. 146.

Flat Products, with Finished Edges, Cold Drawn or Cold Rolled:

Length Tolerances (Nonrefractory Alloys).
Schedule of Lengths (Nonrefractory Alloys).
Straightness Tolerances (Nonrefractory Alloys).
Standard Edge Contours (Nonrefractory Alloys).
Thickness Tolerances (Refractory Alloys).
Width Tolerances (Refractory Alloys).

Flat Products, with Unfinished Edges, Cold Rolled:

Width Tolerances (Nonrefractory Alloys).
Length Tolerances (Nonrefractory Alloys).
Schedule of Lengths (Nonrefractory Alloys).
Straightness Tolerance (Nonrefractory Alloys).
Thickness Tolerance (Refractory Alloys).

Rod, Special Products:

Diameter Tolerance (Piston Finish Rod).
Straightness Tolerance (Shafting Rod).

Rod, Cold Drawn:

Diameter Tolerance (Nonrefractory Alloys).
Straightness Tolerance (Nonrefractory Alloys).

Bar, as Extruded:

Tolerance of Diameter or Distance Between Parallel Surfaces (Refractory Alloys).

3.6 Material may be furnished in rolls, flat plates, sheets, or strips, as required (see 6.1).

3.7 The permissible variations for extruded shapes shall be as specified (see 6.1).

3.8 If, for special purposes, tolerances are required all plus or all minus, it shall be so specified, and the tolerance permitted shall be doubled (see 6.1).

3.9 Identification marking. Product identification marking when specified shall be in accordance with Federal Standard No. 185 (see 6.1).

3.10 Workmanship. Phosphor bronze shall be uniform in quality and hardness; clean; sound; smooth; and free from pipes, slivers, laps, cracks, twists, seams, scale, damaged ends or edges, buckles, and any other injurious defects. Material shall be commercially straight or flat unless coils or rolls are specifically specified (see 6.1).

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.

4.1.1 *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.

4.2 Samples for chemical analysis. The inspector shall select from different randomly selected pieces in each lot the number of samples for chemical analysis specified in table IV. 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. A single analysis of a composite sample may be made.

TABLE IV.—*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.

4.3 Samples for tension tests. Unless otherwise specified in the contract or order (see 6.1), two tension test specimens shall be taken from each lot and each shall be selected from different pieces.

4.4 Sampling for visual and dimensional examination. If the weight of each piece is more than 150 pounds, every piece shall be examined. If the weight of each piece is not over

150 pounds, the inspector shall select sample pieces as specified in 4.4.1 and 4.4.2.

4.4.1 *Visual examination.* From each lot of material with pieces weighing 150 pounds and under, a randomly selected sample of material shall be selected by the inspector in accordance with table V, and shall be visually examined as specified in 4.5.2.1.

TABLE V.—*Sampling for visual and dimensional examination AQL (approx.) = 1.5 percent defective. (Single sampling plan)*

Number of pieces in lot	Number of pieces required for sampling of 4.4.1 and 4.4.2
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

4.4.2 *Dimensional examination.* From each lot of material with pieces weighing 150 pounds and under, a randomly selected sample of material shall be selected by the inspector in accordance with table V and shall be measured as specified in 4.5.2.2. The samples selected for dimensional examination may be the same as those selected for visual examination.

4.4.3 When material is furnished in coils, reels, or bucks, the portion for examination shall be an area representing the outer wrap of the coil up to 10 feet (see 4.5.4).

4.5 Examination.

4.5.1 *Pieces weighing over 150 pounds.* For pieces weighing over 150 pounds, each piece shall be examined and the straightness of each piece shall be determined as specified in 4.5.3.

4.5.2 *Pieces weighing 150 pounds, and under.*

4.5.2.1 *Visual.* Each of the sample pieces selected in accordance with 4.4.1 shall be visually examined to determine compliance with this specification.

4.5.2.2 *Dimensional.* Each of the sample pieces selected in accordance with 4.4.2 shall be dimensionally (tolerance) examined to determine compliance with this specification.

4.5.2.3 Any nonconforming piece in each sample shall be rejected, and if the number of nonconforming pieces in the sample exceeds the acceptance number specified in table V for that sample, the entire lot shall be rejected.

4.5.3 *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 $\frac{1}{32}$ inch by means of a straightedge and a steel scale.

4.5.4 If the sample coil, reel, or buck specified in 4.4.3 is rejected due to handling marks, an additional 20 feet shall be used for re-examination.

4.6 Test procedures.

4.6.1 *Chemical analysis.* The sample selected and forwarded in accordance with 4.2 shall be analyzed by the wet chemical or spectrographic method to determine conformance with 3.1. 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. Samples for chemical analysis shall conform to the requirements of Federal Test Method Standard No. 151, methods 111 and 112.

4.6.2 *Tension tests.* Each of the specimens selected in accordance with 4.3 shall be subjected, in the presence of the inspector, to the tension test as follows:

4.6.2.1 *Bar, rod, flat wire, and shapes.*

4.6.2.1.1 All bar, rod, flat wire, and shapes shall be tested in full size when practicable, and the elongation measured in a gage length of four times the diameter of round specimens and of four times the minimum distance across flats of specimens other than round except that the gage length shall be not less than 2 inches. When a machined specimen becomes necessary, enough metal may be removed from the gage section to

meet the limitations of the testing machine, or the specimen may be machined to form and dimensions in accordance with type R1 of method 211 of Federal Test Method Standard No. 151. When a type R1 specimen is used, the elongation shall be measured in a gage length of 2 inches.

4.6.2.1.2 For bar, rod, and shapes up to 1½ inches in diameter or minimum thickness, the axis of the test specimen shall coincide with the central axis of the piece. For bar, rod, and shapes 1½ inches and over in diameter or minimum thickness, when a machined specimen is used, the axis shall be located midway between the center and the rolled or drawn surface of the piece.

4.6.2.2 *Sheets, strips, and plates.* Tension-test specimens for sheets and strips, and for plates up to ⅜ 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 ⅜ 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 in full section. The longitudinal axis of the specimens shall be parallel to the direction of rolling or drawing.

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

4.6.2.3.1 *Yield strength.* The yield strength shall be determined by the extension-under-load method of method 211 of Federal Test Method Standard No. 151. The limiting extension shall be 0.005 inch-per-inch for all specified strength values.

4.7 Rejection and retests.

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

4.7.2 *Retests.* Retests will be permitted in accordance with Federal Test Method Standard No. 151.

4.8 Inspection of preparation for delivery requirements. The preservation, packaging, packing, and marking of the equipment shall be subjected to examination to determine compliance with the requirements of section 5 of this specification. Inspection shall be made in accordance with Military Standard MIL–STD–105 with an AQL of 4.0 percent defective.

5. PREPARATION FOR DELIVERY

(For nonmilitary agencies, 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 The material shall be prepared for delivery for the level of preservation, packaging, and packing, as specified (see 6.1), in accordance with Military Specification MIL–C–3993.

5.2 Marking.

5.2.1 *Civilian agencies.* Marking for shipment shall be in accordance with Federal Test Method Standard No. 151.

5.2.2 *Military.* In addition to any special marking required in the contract or order, marking of the shipping containers shall be in accordance with Military Standard MIL–STD–129.

6. NOTES

6.1 Ordering data. Procurement documents should specify the following:

(*a*) Title, number, and date of this specification.

(*b*) Compositions, forms, and tempers (see 1.2).

(*c*) Mechanical properties of plate, if other than in the soft or half-hard temper (see table III).

(*d*) Mechanical properties of shapes (see 3.2.1.1).

(*e*) Special forms and tempers required (see 3.2.2).

(*f*) When standard shafting is required (see 3.3).

(*g*) When standard shafting should be furnished with piston finish (see 3.4.1) or within specified RMS limits.

(*h*) Whether material is to be furnished in rolls, flat plates, sheets, or strips (see 3.6.6).

(*i*) Permissible variations for extruded shapes (see 3.7).

(*j*) When tolerances are required all plus or all minus (see 3.8).

(*k*) When coils or rolls are required (see 3.10).

(*l*) Character of application of the material if practical; that is, cupping, deep drawing, spinning, edgewise winding, bending at sharp right angles.

(*m*) Level of preservation, packaging, and packing required (see 5.1).

(*n*) Samples for tension test if different from 4.3.

(*o*) Special marking required (see 5.2.2).

6.2 General information.

6.2.1 The thickness of plate, sheet, and strip should be stated in decimals of an inch.

6.2.2 Plate, sheet, and strip should be ordered in as narrow widths as can be used.

6.2.3 For purposes of weight calculations, the weight per cubic inch may be taken as 0.320 pound for compositions A and B and 0.317 pound for composition D.

6.2.4 When rounds, 1 inch in diameter and smaller, and all sizes of hexagons are ordered for definite purposes other than the manufacture of nuts and bolts, the permissible variations in diameter or thickness may be specified as plus and minus half the values given for the respective sizes in table VI.

6.2.5 Rods up to ¾ inch in coils are generally furnished at a lower price than in straight lengths.

6.2.6 Round, hexagonal, and octagonal sections are classed as "rod". Square and rectangular sections are classed as "bar". The term "shape" should be defined as a section produced by extruding, rolling, drawing, or forming, or a combination thereof, not specifically classified as "flat-rolled or drawn product and rod".

6.2.7 The size limitations as shown in table VI for flat material covered by this specification should apply.

TABLE VI.—*Size limitations for flat material*

Form	Thickness	Width
	Inch	*Inches*
Bar	Over 0.188	Up to 12, inclusive
Plate	Over .188	Over 12
Sheet	Up to .188, inclusive	Over 20
Strip	Up to .188, inclusive	Up to 20, inclusive
Flat wire ...	Up to .188, inclusive	Up to 1¼, inclusive

6.2.8 When material is ordered in the form of plate, sheet, and strip, it should be understood that these terms refer merely to the general form and dimensions of the material, and do not have any technical significance as to the methods of manufacture.

6.2.9 Coiled flat wire, strip, or rolled sheet is generally more economical than material of the same cross section in straight or flat lengths.

6.3 Hardness. The Rockwell hardness values for the various tempers as shown in table VII are given for informatory purposes only.

TABLE VII.—*Rockwell hardness values*

Temper	Numbers hard	Thickness	Composition A						Composition D					
			B scale		G scale		Superficial 30-T		B scale		G scale		Superficial 30-T	
			Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
		Inches												
Soft	0	0.040 and over	7	50	..	12	..	..	35	75	..	40	..	..
		.030 and over	..	..	..	..	24	50	..	..	..	..	40	78
		.020 to 0.040	0	45	..	..	..	..	25	71	..	30	..	..
		.010 to .030	..	..	..	..	16	46	..	..	..	..	29	64
Half-hard	2	.040 and over	60	81	20	53	..	..	78	95	48	75	..	..
		.030 and over	..	..	..	..	57	73	..	..	..	..	67	80
		.020 to 0.040	53	78	15	51	..	..	74	93	38	71	..	..
		.010 to .030	..	..	..	..	52	71	..	..	..	..	63	77
Hard	4	.040 and over	82	90	55	66	..	..	94	101	72	83	..	..
		.030 and over	..	..	..	..	71	77	..	..	..	..	78	82
		.020 to 0.040	80	88	53	64	..	..	92	100	68	80	..	..
		.010 to .030	..	..	..	..	69	75	..	..	..	..	75	81
Extra-hard ...	6	.040 and over	88	94	64	73	..	..	98	103	79	86	..	..
		.030 and over	..	..	..	..	75	80	..	..	..	..	80	84
		.020 to 0.040	86	92	62	71	..	..	97	102	76	83	..	..
		.010 to .030	..	..	..	..	73	78	..	..	..	..	79	83
Spring	8	.040 and over	90	96	69	75	..	..	99	104	81	88	..	..
		.030 and over	..	..	..	..	77	81	..	..	..	..	81	85
		.020 to 0.040	88	94	67	73	..	..	98	103	78	85	..	..
		.010 to .030	..	..	..	..	75	79	..	..	..	..	80	84
Extra-spring ..	10	.040 and over	92	97	72	77	..	..	100	105	83	90	..	..
		.030 and over	..	..	..	..	78	82	..	..	..	..	82	86
		.020 to 0.040	89	94	70	75	..	..	99	104	80	87	..	..
		.010 to .030	..	..	..	..	76	80	..	..	..	..	81	85

6.4 The chemical and mechanical property requirements of this specification are similar to ASTM B139-58 and B103-55, Compositions A and D.

6.5 Transportation description. Transportation description applicable to this item is:

Bar:

Bar, bronze, drawn, extruded or rolled loose.

Carload minimum weight 30,000 pounds.

Motor volume minimum weight 36,000 pounds.

Rod:

Rod, bronze, drawn, extruded or rolled, loose.

Carload minimum weight 30,000 pounds.

Motor volume minimum weight 36,000 pounds.

Sheet, Strip and Plate:

Plate, sheet or strip, bronze not otherwise indexed by name, other than perforated or silver plated. (Specify gauge.)

Carload minimum weight 30,000 pounds.

Motor volume minimum weight 30,000 pounds.

Flat Wire:

Wire, bronze, covered, insulated or plain.

Carload minimum weight 30,000 pounds.

Motor volume minimum weight 30,000 pounds.

Structural and Special Shaped Sections:

Unfinished shapes, bronze, tinned or not tinned, not otherwise indexed by name, loose.

Carload minimum weight 30,000 pounds.

Motor volume minimum weight 30,000 pounds.

MILITARY INTEREST:

Army—ORD

Navy—Ships

Air Force—WADD