QQ-B-650C
23 July 1987
SUPERSEDING
QQ-B-650B
25 August 1971

FEDERAL SPECIFICATION

BRAZING ALLOYS, COPPER, COPPER-ZINC, AND COPPER-PHOSPHORUS

1. SCOPE

1.1 Scope. This specification covers copper, copper-zinc, and copper-phosphorus alloys for use in brazing ferrous and nonferrous base metals. Copper-phosphorus brazing alloys shall not be used on ferrous alloys or on alloys containing more than 10 percent of nickel because of the adverse effects of the phosphorus content (see 6.1).

1.2 Classification.

1.2.1 Classes, forms, and sizes. Brazing alloys shall be of the following classes. The forms and sizes shall be as specified (see 3.3 and 6.2).

BCu-1
BCu-1a
BCu-2
BCuZn-A
BCuZn-D
BCuP-1
BCuP-2
BCuP-3
BCuP-4
BCuP-5
BCuP-6
BCuP-7

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, U.S. Army Laboratory Command, Materials Technology Laboratory, ATTN: SLCMT-MSE, Watertown, MA 02172-0001 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

/FSC 3439/

SPECIFICATIONS

FEDERAL

PPP-P-704 - Pails, Metal: (Shipping, Steel, 1 through 12 Gallon).

MILITARY

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

STANDARDS

FEDERAL

FED-STD-123 - Marking for Domestic Shipment (Civil Agencies)

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by attributes
MIL-STD-129 - Marking for Shipment and Storage

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

ASTM B214 - Test Method for Sieve Analysis of Granular Metal Powders.
ASTM B215 - Methods of Sampling Finished Lots of Metal Powders.
ASTM D3951 - Commercial Packaging, Practices For
ASTM E11 - Specification for Wire-Cloth Sieves for Testing Purposes.
ASTM E478 - Method for Chemical Analysis of Copper Alloys

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

AMERICAN WELDING STANDARDS

Z49.1 - Safety in Welding and Cutting

(Application for copies should be addressed to the American Welding Society, P.O. Box 351040, Miami, FL 33135

(Non-Government standards and other publications are normally available from the organizations which prepare or which 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 specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Manufacture. The brazing alloy may be made by any method that will yield a product conforming to this specification.

3.2 Chemical composition. The compositions listed in 1.2 shall conform to table I.

3.2.1 Analysis shall be routinely made only for the elements specifically mentioned in table I. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not in excess of the limits specified.

TABLE I. Chemical composition.

Classification	Copper	Nickel	Tin	Phosphorus	Lead, max.	Iron, max.	Silver	Aluminum, max.	Silicon	Manganese	Zinc	Other Elements, Total, max,
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Copper and Copper-Zinc												
BCu-1	99.90 min.	--	--	0.075 max.	0.02	--	--	0.01	--	--	--	0.10
BCu-1a	99.0 min.	--	--	--	--	--	--	--	--	--	--	0.30
BCu-2[1]	86.5 min.	--	--	--	--	--	--	--	--	--	--	0.50
BCuZn-A	57-61	--	0.25-1.00	--	0.05*	*	--	0.01*	*	*	Rem.	0.50[2]
BCuZn-D	46-50	9.0-11.0	--	0.25 max.	0.05*	--	--	0.01*	0.04-0.25	--	Rem.	0.50[2]
Copper-Phosphorus												
BCuP-1	Rem.	--	--	4.8-5.2	--	--	--	--	--	--	--	0.15
BCuP-2	Rem.	--	--	7.0-7.5	--	--	--	--	--	--	--	0.15
BCuP-3	Rem.	--	--	5.8-6.2	--	--	4.8-5.2	--	--	--	--	0.15
BCuP-4	Rem.	--	--	7.0-7.5	--	--	5.8-6.2	--	--	--	--	0.15
BCuP-5	Rem.	--	--	4.8-5.2	--	--	[1]4.5-15.5	--	--	--	--	0.15
BCuP-6	Rem.	--	--	6.8-7.2	--	--	1.8-2.2	--	--	--	--	0.15
BCuP-7	Rem.	--	--	6.5-7.0	--	--	4.8-5.2	--	--	--	--	0.15

[1]These chemical requirements pertain only to the copper oxide and do not include requirements for the organic vehicle in which the copper oxide is suspended.

[2]Total other elements, including the elements marked with an asterisk(*) shall not exceed the value specified.

3.3 Standard forms, sizes, and tolerances.

3.3.1 Powders and suspensions. Particle size distributions of powdered materials used in finished lots or in suspensions shall conform to table II.

TABLE II. Standard sieve analyses.1/

Designation of particle size distribution	Sieve analysis
Coarse	Thru No. 60 sieve - 100 percent. Thru No. 100 sieve - 95 percent min.
Medium-1	On No. 100 sieve - trace On No. 140 sieve - 10 percent max. Thru No. 325 sieve - 20 percent max.
Medium-2	On No. 100 sieve - trace On No. 140 sieve - 10 percent max. Thru No. 325 sieve - 55 percent max.
Fine	On No. 200 sieve - trace Thru No. 325 sieve - 90 percent min.

1/ Based on standard ASTM sieve sizes selected from table I of ASTM E11, Wire-Cloth Sieves for Testing Purposes.

3.3.2 Wrought products. Standard forms and sizes of wrought products shall conform to table III. Dimensional tolerances of wrought products shall conform to table IV.

3.4 Toxicity. Volatile liquids used as suspending media in suspensions (pastes) shall not be harmful to the health of personnel when the suspensions are used as directed for their intended purposes (see 4.5.3).

3.5 Workmanship. Brazing alloys in all forms, when examined visually, shall appear free from excessive oxide, dirt, or other foreign matter that would adversely affect the working qualities of the material.

TABLE III. Standard forms and sizes.

Classes	Standard forms	Wrought product sizes: inches or particle size distribution
BCu-1	Strip	1/
	Rod	Round, 1/32 (0.031), 1/16 (0.062), 3/32 (0.094) 1/8 (0.125), 5/32 (0.156), 3/16 (0.188) 5/16 (0.310), 3/8 (0.375) by 18 or 36 inches long
BCu-1a	Powder	Medium-1 and Medium-2
BCu-2	Suspension	Available in a volatile medium. Commonly called a paste.
BCuZn-A and BCuZn-D	Strip	1/
	Rod	Round, 1/32 (0.031), 1/16 (0.062), 3/32 (0.094), 1/8 (0.125), 5/32 (0.156), 3/16 (0.188), 1/4 (0.250), 5/16 (0.310), 3/8 (0.375) by 18 or 36 inches long
	Wire	1/
BCuP-1	Strip	0.005, 0.100, 0.015 by 0.5, 1.0, or 1.5 inches incl.
BCuP-2, BCuP-3, and BCuP-4	Wire	Round, square, or rectangular, 1/32 to 1/4 (0.047 to 0.125) incl.
	Rod	Round, square, or rectangular, 1/32 to 1/4 (0.047 to 0.125) incl. by 18 or 36 inches long
	Powder	Coarse, Medium-1, Medium-2, Fine
BCuP-5	Strip	0.003, 0.005, 0.010, 0.025 by multiples of 0.250 inch to 6 inches by 18 or 36 inches long
	Rod	Round, square, or rectangular, 1/32 to 1/4 (0.047 to 0.125) incl. by 18 or 36 inches long
	Powder	Coarse, Medium-1, Medium-2, Fine
BCuP-6	Wire Rod Powder	Same as BCuP-2, BCuP-3 and BCu P-4
BCuP-7	Wire Rod Powder	Same as BCuP-2, BCuP-3 and BCu P-4

1/ There are no standard sizes. Sizes will be furnished according to customer requirements subject to mill limitations.

TABLE IV. Permissible variations in dimensions for wire, rod, sheet, and strip.

Size, in.	Permissible variation, plus and minus, in.	
	Round	Square
Drawn wire:		
Diameter (round) or width (square		
0.010 to 0.020, incl.	0.0003	--
Over 0.020 to 0.030, incl.	0.0005	--
Over 0.030 to 0.040, incl.	0.0007	--
Over 0.040 to 0.050, incl.	0.0008	--
Over 0.050 to 0.060, incl.	0.0010	--
Over 0.060 to 0.080, incl.	0.0015	--
Over 0.080 to 0.250, incl.	0.0020	0.004
Drawn rod:		
Diameter (round):		
5/32 (0.156) and under	0.003	--
3/16 (0.188) and under	0.004	--
Rolled or extruded rod and wire:		
Diameter (round) or width (square):		
1/32 to 1/16 (0.031 to 0.062), incl.	0.005	--
Over 1/16 to 1/8 (Over 0.062 to 0.125), incl.	0.006	--
Over 1/8 to 3/16 (Over 0.125 to 0.188), incl.	0.007	0.009
Over 3/16 to 1/4 (Over 0.188 to 0.250), incl.	0.008	0.010

	8 in. and under in width	Over 8 in. in width
Strip or sheet:		
Thickness:		
0.006 and under	0.0006	Standard strip
Over 0.006 to 0.013, incl.	0.0010	and sheet
Over 0.013 to 0.021, incl.	0.0015	tolerances
Over 0.021 to 0.026, incl.	0.0020	apply

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 as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must 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 assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Lot.

4.2.1 Powder. All material of the same classification and granulation offered for delivery at the same time.

4.2.2 Suspensions. All material in the same suspension offered for delivery at the same time.

4.2.3 Wrought products. All material of the same classification, form, size, and melt offered for delivery at the same time. If the material cannot be identified by melt, a lot shall consist of not more than 500 pounds of material of the same classification, form, and size offered for delivery at the same time.

4.3 Sampling.

4.3.1 For examination of the preparation for delivery: All material. Select a random sample of filled shipping containers from each lot in accordance with MIL-STD-105, at inspection level II and acceptable quality level (AQL) = 2.5 percent defective.

4.3.2 For measurement of dimensions: Wrought products only. Select at least five random samples from each lot of wrought products for verification of dimensional requirements.

4.3.3 For chemical analysis and sieve analysis.

4.3.3.1 Powder. Select samples of powder material for chemical and sieve analysis from each finished lot in accordance with ASTM method B 215.

4.3.3.2 Suspensions. Select samples of dry powder material for chemical and sieve analysis, prior to suspension in the volatile medium, from each finished lot in accordance with ASTM method B 215.

4.3.3.3 Wrought products. Select samples for chemical analysis from each lot of wrought products in accordance with table V.

TABLE V. Sampling for chemical analysis of wrought products.

Pounds of material in lot	No. of pieces to be sampled
Up to 5,000, incl.	2
5,001 to 10,000	4

4.4 Examination.

4.4.1 Examination of the preparation for delivery.

4.4.1.1 Powders and suspensions. Examine samples selected in accordance with 4.3.1 for conformity with section 5 with regard to fill, closure, sealing, leakage, packaging, packing, and marking requirements. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, reject the lot represented by the sample.

4.4.1.2 Wrought products. Examine samples selected in accordance with 4.3.1 for conformity with section 5 with regard to fill, packaging, packing, and marking requirements. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, reject the lot represented by the sample.

4.4.2 Visual and dimensional examination: Wrought products only. Examine samples selected in accordance with 4.3.2 for conformity to the specified dimensions and tolerances (3.3) for wrought products. Determine thickness measurements by means of a micrometer.

4.5 Tests.

4.5.1 Sieve analysis: Powders and suspensions. Test the samples selected in accordance with 4.3.3.1 and 4.3.3.2 in accordance with ASTM B214.

4.5.2 Chemical analysis. Analyze the samples in accordance with ASTM E478. For the alloys BCuP-1, BCuP-2, BCuP-3, BCuP-4 and BCuP-5 a chemical analysis should be determined by an approved equivalent method.

4.5.3 Toxicity. Suppliers of brazing alloys in the form of suspensions (pastes) shall furnish the procuring activity with information necessary to evaluate the physiological effects of the volatile suspending medium. The procuring activity shall decide whether or not submitted data is satisfactory. Ordinarily, however, a statement signed by a responsible officer of the supplying firm, giving the identities and percentages of composition of all substances used in formulating the volatile suspending medium, will be sufficient. Standard chemical nomenclature shall be used. Questions concerning toxicity shall be referred by the procuring activity to the appropriate departmental medical service which will act as advisor to the procuring activity.

4.6 Rejection and retest.

4.6.1 Rejection. Unless otherwise specified (see 6.2) where one or more test specimens fail to meet the requirements of the specification the lot represented by the specimen or specimens shall be subject to rejection.

4.6.2 Retest. When no sampling plan is provided or approved by the procuring agency (see 6.2) and where there is evidence that indicates that the specimen was not representative of the lot of material, and when the detail specification does not otherwise specify, at least two specimens shall be selected to replace each test specimen which failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be rejected.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or C as specified (see 6.2).

5.1.1 Level A. Unless otherwise specified in the contract or order, the brazing filler metal shall be packaged as follows:

5.1.1.1 Powders and suspensions. Powders and suspensions shall be packaged in containers conforming to type I of PPP-B-704. The capacity of the container shall be 50 pounds.

5.1.1.2 Wrought products. Packaging of wrought products shall conform to MIL-C-3993.

5.1.2 Level C. Materials shall be packaged in accordance with ASTM D3951.

5.1.3 Closure of containers. After filling containers with powders or suspensions, closures shall be applied to seal the containers against leakage of the contents. Closures shall prevent the escape of volatile liquids used in the suspensions. Closures shall not loosen during handling, shipment, or storage.

5.1.4 Fill capacity of containers. Unit containers shall be filled by volume or by weight with the product to the rated capacity of the container.

5.2 Packing. Packing shall be level C as specified (see 6.2).

5.2.1 Level C. Packing shall be in accordance with commercial practice adequate to ensure acceptance and delivery by the carrier for the mode of transportation employed. Powder and suspensions packaged in accordance with 5.1.1.1 will not require packing for shipment.

5.3 Marking.

5.3.1 Civil agencies. In addition to any marking required herein, and any special marking required by the contract or order, shipping containers shall be marked in accordance with FED-STD-123.

5.3.2 Military agencies. In addition to any marking required herein, and any special marking required by the contract or order, shipping containers shall be marked in accordance with MIL-STD-129.

5.3.3 Cautionary marking. The following cautionary note shall be permanently affixed to each unit container, in legible type on or near the manufacturer's label, and shall also be permanently affixed to any special instructions which may be enclosed in the container:

WARNING: PROTECT yourself and others. Read and understand this label.

FUMES AND GASES can be dangerous to your health. HEATRAYS (INFRARED RADIATION from flame or hot metal) can injure eyes.

o Before use read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs) and your employer's safety practices.

o Keep your head out of the fumes.

o Use enough ventilation, exhaust at the work, or both, to keep fumes and gases from your breathing zone, and the general area.

o Wear correct eye, ear, and body protection.

o See American National Standard Z49.1 "Safety in Welding and Cutting," published by the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33135; OSHA Safety and Health Standards, 29 CFR 1910, available from U. S. Government Printing Office, Washington, D.C. 20402

DO NOT REMOVE THIS LABEL

5.4 Packaging Inspection. Inspection of the preservation, packaging, and container marking of the items or commodities concerned shall be in accordance with 4.4.1.1.

6. NOTES

6.1 Intended use. Brazing alloys covered by this specification are nonferrous materials melting above 800°F (427°C) and are used to join two or more members of base metal(s), with closely fitted surfaces, at temperatures below the melting point(s) of the base metal(s) of either member. Distribution of brazing alloy throughout the joint is accomplished by capillary attraction of molten metal or by placement of brazing alloy before the brazing operation. Lap and butt joints are commonly used. Flux is sometimes necessary. Use of borax-boric acid flux is common. Copper-phosphorus brazing alloys shall not be used on ferrous alloys or on alloys containing more than 10 percent of nickel because of the adverse effects of the phosphorus content. Copper-zinc brazing alloys are not generally used in furnace brazing because excessive boiling-off of zinc during the relatively long periods at high temperatures can cause contamination of the furnace.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Classification and form required (see 1.2).
(c) Size of bar, wire, rod, sheet or strip for wrought products; particle size distribution of metal powders and suspensions (see 3.3).
(d) Amount of material required.
(e) Level of packaging and level of packing required (see section 5).
(f) When rejection and retest procedures other than as specified in 4.6 are required.

6.3 Relationships to other compositions. The relationships between compositions covered by this issue and previous issues of QQ-B-650 are as follows:

	QQ-B-650C	QQ-B-650B dated August 25, 1971	QQ-B-650A dated March 18, 1960	QQ-B-650 dated April 25, 1956
	BCu-1	BCu-1	FS-BCu	--
	BCu-1a	BCu-1a	--	--
	BCu-2	BCu-2	--	--
*	--	A	A	A
*	--	B	B	B
*	--	C	C	C
*	--	D	D	D
	BCuZn-A	BCuZn-A	--	--
	BCuZn-D	BCuZn-D	--	--
	BCuP-1	BCuP-1	FS-BCuP-1	--
	BCuP-2	BCuP-2	FS-BCuP-2	--
	BCuP-3	BCuP-3	FS-BCuP-3	--
	BCuP-4	BCuP-4	FS-BCuP-4	--
	BCuP-5	BCuP-5	FS-BCuP-5	--
	BCuP-6	--	--	--
	BCuP-7	--	--	--

*Item is no longer supplied by U.S. Producers.

6.4 Metric Units. When metric units are required, units for inch and pounds may be converted to the metric equivalent as follows:

English	Multiply by	Equals	Metric Unit
inch	2.54	=	Centimeter (cm)
pound	0.4539	=	Kilogram (Kg)

6.5 Key Words

Brazing Alloys
Copper
Copper-phosphorus
Copper-zinc
Rod
Sheet
Strip
Wire

6.6 Subject term (key word) listing. The margins of this specification are marked with vertical lines 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.

Military custodians:
Army - MR
Navy - SH
Air Force - 20

Review activities:
Army - MI, AT, MD, AR

User activities:
Army - ME

Preparing activity:
Army - MR

Project 3439-0649

(KBWP# ID-0255A/DISC-0142A. FOR MTL USE ONLY)

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
QQ-B-650C	BRAZING ALLOYS, COPPER, COPPER-ZINC, AND COPPER-PHOSPHORUS

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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(TO DETACH THIS FORM, CUT ALONG THIS LINE.)