QQ-C-390B
December 12, 1983
SUPERSEDING
Fed. Spec. QQ-C-390A
April 9, 1973

FEDERAL SPECIFICATION

COPPER ALLOY CASTINGS (INCLUDING CAST BAR)

This specification was approved by the Assistant Administrator, Office of Federal Supply and Services, General Service Administration, for the use of all Federal Agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers copper alloy castings produced by static mold, centrifugal mold or continuous processes (see 6.8.1, 6.8.2 and 6.8.3).

1.2 Classification.

1.2.1 Alloys. Copper alloy castings shall be furnished in the following alloys, as specified (see 6.2):

Copper alloy Nos.	Commercial composition grouping
C82000, C82500, C82700, C82900	Copper beryllium alloys
C83600, C83800, C84200, C84400	Leaded and nonleaded red and semi-red brass
C85200, C85400, C85500, C85700	Leaded and nonleaded yellow brass
C86100, C86200, C86300, C86400, C86500, C86800	Leaded and nonleaded high-strength yellow brass (manganese bronze)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, Army Materials and Mechanics Research Center, ATTN: DRXMR-SMS, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Copper alloy Nos.	Commercial composition grouping
C87200, C87400	Silicon bronze
C90300, C90500, C90700, C91000, C91300, C91500, C92200, C92300, C92500, C92700	Leaded and nonleaded tin bronze
C93200, C93400, C93500, C93700, C93800, C93900, C94000, C94100, C94300	High leaded tin bronze
C91600, C94700, C94800	Nickel tin bronze
C95200, C95300, C95400, C95500, C95700, C95800	Aluminum bronze
C96200, C96400	Copper-nickel alloy

1.2.2 Types. Copper alloy castings shall be of the following types, as specified (see 6.2):

Type I - Static castings.
Type II - Centrifugal castings.
Type III - Continuous castings.

1.2.3 Condition. Copper alloy castings shall be furnished in the following conditions, as specified (see 6.2):

As cast: Copper alloy castings are normally furnished in the as cast condition except for the following which may also be supplied in the listed conditions.

Heat treated: Copper alloy Nos. C94700, C95300, C95400, and C95500.

Solution heat treated: Copper alloy Nos. C82000, C82400, C82500, C82600, C82700, and C82800.

Solution heat treated and age hardened: Copper alloy Nos. C82000, C82400, C82500, C82600, C82700, and C82800.

Chill cast: Copper alloy Nos. C91600, C94000, and C95500.

Annealed: Copper alloy No. C95800.

1.2.4 It should be noted that specific alloys are available only in specific types (see 6.5) and conditions.

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

PPP-B-601 - Boxes, Wood, Cleated-Plywood
PPP-B-636 - Box Shipping, Fiberboard

Federal Standards:

Fed. Std. No. 123 - Marking for Shipment (Civil Agencies)
Fed. Test Method Std. No. 151 - Metals; Test Methods

Commercial Item Description:

A-A-880 - Strapping, Steel Flat and Seals

(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, US Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Office Centers in Boston; New York; Philadelphia; Washington, DC; Atlanta; Chicago; Kansas City, MO; Ft. Worth; Houston; Denver; San Francisco; Los Angeles; and Seattle, WA.

(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 Specifications:

MIL-P-116 - Preservation, Methods of

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129 - Marking for Shipment and Storage
MIL-STD-271 - Nondestructive Testing Requirements for Metals
MIL-STD-276 - Impregnation of Porous Nonferrous Metal Castings
MIL-STD-278 - Welding and Inspection of Machinery, Piping and Pressure Vessels for Ships of the United States Navy
MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of Military Specifications and Standards 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 a specific issue is identified, 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 208 - Tension Test Specimens for Copper-Base Alloys for Sand Castings
E 8 - Tension Testing of Metallic Materials
E 10 - Test for Brinell Hardness of Metallic Materials
E 18 - Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

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

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Association, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Chemical composition. The castings shall meet the chemical requirements shown in tables I through X.

3.1.1 When specified (see 6.2), an analysis of each lot shall be furnished by the contractor, showing the percentage of the elements designated.

3.2 Mechanical properties. When specified (see 6.2), results of mechanical property tests required by section 4 shall be furnished by the contractor. All mechanical property tests shall be taken on separately cast or attached test coupons. When test coupons are taken from sample castings, the mechanical properties shall be as agreed upon between the producer and the procuring agency.

3.2.1 Tensile properties. Castings shall meet the tensile property requirements shown in tables XI through XX. Unless otherwise indicated, all values are minimum.

3.2.2 Hardness. When specified (see 6.2), castings shall meet the hardness requirements shown in table XXI. Unless otherwise indicated, all values are minimum.

3.3 Soundness. When specified (see 6.2), the soundness of castings shall meet standards furnished by the procuring agency. The areas of the castings subject to soundness requirements shall be as specified, and the number and extent of blowholes, sponginess, and other defects in such areas shall not be greater than indicated by the standard (see 6.2).

3.3.1 Naval shipboard applications. The soundness of castings, when radiographically inspected, shall meet the requirements of MIL-STD-278.

3.4 Foundry control (static and centrifugal castings). When specified (see 6.2), castings shall be produced under foundry control approved by the procuring agency. Foundry control shall consist of examination of castings by radiography or other approved methods for determining internal defects until the gating, pouring, and other foundry practices have been established to produce castings meeting the quality standards furnished by the procuring agency or agreed upon by the procuring agency and the contractor. When foundry practices have been so established, the production method shall not be changed without demonstrating to the satisfaction of the procuring agency that the change does not adversely affect the quality of the castings.

3.5 Pressure and fracture requirements. When required, copper alloy castings shall conform to such requirements as to pressure and fracture tests as may be agreed upon by the manufacturer and the purchaser and as specified in the contract or order (see 6.2).

3.6 Liquid penetrant test. When liquid penetrant test is required, areas to be tested shall be as specified (see 6.2). Standards for acceptance shall be as furnished or approved by the procuring agency.

3.7 Heat treatment. Heat treatment, when required, shall be such as to produce castings meeting the mechanical requirements of the alloy and condition ordered (see 6.2).

3.7.1 Alloy C95800. For seawater contact, alloy C95800 shall be given a postweld temper anneal if weld repair is required on the seawater side of the casting, or if the heat-affected zone extends within 1/4 inch (6.4 mm) of this surface when weld repair is made from the non-seawater side of the casting. The temper anneal shall consist of heat treatment at 1300 $\pm$ 50°F (704 $\pm$ 28°C) for three hours at temperature, followed by either a furnace cool or air cool. Annealing requirements, if any, for weld repaired castings from other alloys should be as agreed upon by the manufacturer and the purchaser and as specified in the contract or order (see 6.2).

3.8 Repair of castings. Repairable defects shall be defined in the ordering data (see 6.2), and permission for such repairs, shall be authorized by the procuring agency. Defects not so covered shall not be repaired, plugged, welded, or "burned in" without permission from the procuring agency. Such permission shall be given only when the defects are small and do not adversely affect the strength, use, or machineability of the castings. Each repair shall be circled with a ring of white paint prior to submission for inspection or shipment. Castings shall not be impregnated without approval of the procuring agency. When impregnation is approved, it shall be performed in accordance with MIL-STD-276.

3.8.1 Naval shipboard applications. For the type of casting specified (see 6.2), repair welding of castings used in Naval shipboard pressure vessels, piping systems, and machinery shall be performed in accordance with requirements for repair of castings specified in MIL-STD-278.

3.9 Surface finish (cast bar only).

3.9.1 Type I (static) and type II (centrifugal) cast bar. Unless otherwise specified (see 6.2), solid and cored bars shall be machined to remove surface scale and defects from the outside of solid bars and inside and outside of cored bars.

3.9.2 Type III (continuous) cast bar. The outside surfaces of continuous cast solid bars and the inside and outside surfaces of continuous cast cored bars shall be smooth and free from surface defects except for high lead alloys which may have a slight surface roughness in the bores of cored bars.

3.10 Dimensions and dimensional tolerances (see 6.2).

3.10.1 Type I (static) and type II (centrifugal). Dimensions of types I and II castings shall be such that the furnished castings can be laid out and machined to the finished dimensions within the tolerances specified in the contract or order. Sufficient stock shall be allowed for shrinkage and, where required, for finishing. Castings of excessive size and weight shall not be furnished.

3.10.2 Type III (continuous).

3.10.2.1 Dimensions and permissible variations for continuous castings.

3.10.2.1.1 Cross-sectional dimensions (rod and bar). The average outside dimensions of continuous cast straightened rod and bar shall not vary from the ordered dimensions by more than the amounts shown in table XXII.

3.10.2.1.2 Cross-sectional dimensions (round tube only). The average outside and inside dimensions of continuous-cast straightened round tube shall not vary from the ordered dimensions by more than the amounts shown in table XXIII.

3.10.2.1.3 Allowance for finishing over maximum outside dimension and under inside dimension of part to be machined shall be as shown in table XXIV.

3.10.2.2 Roundness tolerances. The maximum deviation from roundness shall not exceed the values shown in table XXV.

3.10.2.3 Straightness. The maximum depth of arc for rod, tube, bar, and shapes shall not exceed the values shown in table XXVI.

3.10.2.3.1 Twist. The degree of twist on non-round rod, tube and shapes shall conform to such requirements as may be agreed upon by the casting producer and the purchaser and as specified in the contract or order (see 6.2).

3.10.3 Cast bar (all types).

3.10.3.1 Concentricity. The outside periphery of cored bar, of all alloys except as noted below, shall be concentric with the bore within 2 percent of the nominal wall thickness over 1/4 in. (6.4 mm). With wall thickness 1/4 in. (6.4 mm) and less, permissible variations in concentricity shall be subject to agreement between the procuring agency and the contractor. The outside periphery of cored bar of copper alloy nos. C86200, C86300, C86400, C95200, C95300, C95400, C95500, C95800 and C96400 shall be concentric with the bore within 4 percent of the nominal wall thickness.

3.10.3.2 Length. Unless otherwise specified (see 6.2), cored and solid bar statically or centrifugally cast shall be furnished in 13 inch (330 mm) lengths and the ends shall be disc-ground or machined. Length tolerance shall be plus 1/32 inch (0.79 mm) minus 0. Continuously cast cored and solid bar shall be furnished in lengths of 105 inches (2,667 mm) unless otherwise indicated in the contract or purchase order.

3.10.4 Cast bar, machined (all types). The inside and outside dimensions of cored bar and the outside dimensions of solid bar shall not vary from the ordered dimensions by more than the amounts shown in table XXVII.

3.11 Straightening requirement, type III (continuous) only. Unless otherwise specified (see 6.2), all continuous cast round rod and tube shall be straightened to within the required straightness of 3.10.2.3.

3.12 Cleaning. Before examination, types I and II castings shall be smooth and well cleaned by sandblasting, tumbling, chipping, or other method approved by the procuring agency. Castings shall have heads and gates removed in addition to mechanical cleaning.

3.13 Identification marking.

3.13.1 Small castings. When practicable, castings weighing less than 250 pounds (114 kg) shall be marked with manufacturer's name or trademark and pattern or piece number. Castings too small to permit legible markings on the casting surface shall be so marked by use of tags or similar devices in order to be readily identifiable at the point of delivery.

3.13.2 Large castings. When practicable, castings weighing 250 pounds (110 kg) or more shall be integrally marked with the manufacturer's name or trademark and pattern or piece mark, number, and melt or lot number in a position on the casting where they will not be removed in subsequent machining to finished dimensions. When such marking is not practicable, castings shall be marked as specified in 3.13.1.

3.13.3 Impression stamping. When impression stamping is used for identification marking, the marking shall be located in areas of low stress as shown on casting drawings.

3.14 Workmanship. Castings shall be of uniform quality and condition, free from blowholes, sand inclusions, porosity, hard spots, surface depressions, cracks, and other injurious defects.

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 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.

4.2 Lot.

4.2.1 Type I (static) castings. A lot shall consist of all the castings from one melt defined as:

(a) The entire melt from a single furnace charge weighing not more than 10,000 lbs. (4,500 kg) used to pour one or more castings or

(b) The combination of two or more furnace charges or crucible melts weighing not more than 10,000 lbs. (4,500 kg) into a single ladle used to pour one or more castings.

4.2.2 Type II (centrifugal) castings. A lot shall consist of all castings produced from one melt except that when similar castings from several melts weighing less than 500 pounds (225 kg) each in the rough are involved, a lot shall consist of not more than 5,000 pounds (2,250 kg) of rough castings of the same alloy, kind, and size submitted for inspection at the same time. When two or more furnaces or crucible melts are used to charge a ladle for a pouring, the castings produced therefrom shall be considered as coming from a single melt.

4.2.3 Type III (continuous) castings. When castings are produced from alloy ingots or melts of known composition, a lot shall consist of not more than 4,000 pounds (1,800 kg) of material of the same nominal composition and same size and shape produced during the continuous operation of one casting machine and submitted for inspection at one time. When other raw materials are used, the lot shall consist of not more than 2,000 pounds (900 kg).

4.3 Sampling.

4.3.1 For chemical analysis. A sample for chemical analysis shall be taken from each lot. The sample may be taken from test coupons or from representative castings.

4.3.1.1 Wet chemical analysis. The sample shall consist of not less than two ounces of drillings taken from sound metal below the surface (from the cross-section in the case of type III castings) and shall be fine and clean, free from oil, grit, and other foreign material.

4.3.1.2 Spectrochemical analysis. Samples shall be obtained as specified in method 112 of Fed. Test Method Std. No. 151.

4.3.1.3 Other methods of analysis. Samples for other methods of analysis shall be as agreed upon by the contractor and the procuring agency.

4.3.2 Sampling for mechanical tests.

4.3.2.1 Separately cast coupons.

4.3.2.1.1 Type I (static) castings. Except as specified in 4.3.2.2 and 4.3.2.3, at least two separately cast test coupons shall be poured from each lot. Except for length, gating, and risering detail, the test coupons shall be poured to the form and dimensions of the keel block or of the double horizontal full web test bar of ASTM B 208. One coupon shall represent metal cast at the beginning of the lot, and the second metal cast at the end of the lot.

4.3.2.1.2 Type II (centrifugal) castings. Separately cast test bars may be provided under the following conditions:

(a) When extra length on centrifugal castings from which specimens can be prepared is impracticable, and
(b) When there are less than 10 castings or 500 pounds (225 kg) of rough castings in the lot, or
(c) When specimens of the required dimensions cannot be machined from castings.

The responsibility for furnishing sufficient test bars shall rest with the contractor. Where statically cast bars are used to represent castings produced in sand-lined molds, the bars shall be cast as standard keel block coupons. Where castings are produced in chill molds of metal or graphite, test coupons may be cast in open keel block molds of the same material as the molds used for the castings. One coupon shall represent metal cast at the beginning of the lot, and the second coupon metal cast at the end of the lot. Test coupons shall be positively identified with the castings they represent. Where castings are heat treated, test coupons shall be heat treated with the castings they represent. The conditions for centrifugally casting coupons shall be satisfactory to the procuring agency concerned.

4.3.2.2 Attached coupons, type I (static) castings. When specified (see 6.2), or if the contractor so desires and the procedure is satisfactory to the procuring agency, test coupons cast to the form and dimensions specified in 4.3.2.1 shall be attached to the castings as follows and serve in lieu of separately cast test bars:

(a) Each casting weighing 250 pounds (110 kg) or more shall have at least one test coupon attached thereto. Location of the test coupon shall be as agreed upon by the procuring agency and the contractor.

(b) For individual castings weighing less than 250 pounds (110 kg), at least one coupon shall be attached to two or more castings in each lot. One such casting shall be cast at the beginning of the lot and the other at the end of the lot.

4.3.2.3 Sample castings.

4.3.2.3.1 Type I (static) and type II (centrifugal) castings. When the contractor so desires, a casting in the lot may be submitted as a test coupon in lieu of separately cast test coupons or attached coupons.

4.3.2.3.2 Type III (continuous) castings. At least two test coupons shall be taken longitudinally from the cross-section. On rod or tube having dimensions two inches (51 mm) or over in diameter or wall thickness, the coupons shall be removed from the mid-radius or the mid-wall. One coupon shall represent metal cast at the beginning of the lot, and the second coupon metal cast at the end of the lot. When the lot consists of not more than 1,000 pounds (450 kg), only one test coupon shall be taken near the beginning of the lot.

4.3.2.4 Identification of test coupons. All test coupons shall be suitably identified with the proper melt or lot number and identification stamp. When it is not practicable to identify the test coupons, the manufacturer shall be required to establish and maintain procedures and records that will assure that test coupons are poured from and processed with the lot they represent.

4.3.2.5 Chilling of test coupons (types I and II castings). The chilling of test coupons shall be cause for rejection of the material represented except when casting of the complete melt in chills is authorized.

4.3.3 Sampling for visual and dimensional examination. From each lot of material, samples shall be selected for visual and dimensional examination in accordance with MIL-STD-105 at inspection level I. The acceptable quality level (AQL) shall be 1.5 percent defective. If an AQL of other than 1.5 percent defective is required, the required AQL shall be as specified in the contract or order. The samples selected for dimensional examination may be the same as those selected for visual examination, but the determination of acceptance or rejection shall not be based on the cumulative sample for both characteristics.

4.3.4 Soundness. When soundness is required in accordance with 3.3, the number of castings to be radiographed and the number and location of areas to be radiographed shall be as specified by the procuring agency.

4.3.4.1 Naval shipboard applications. The castings shall be tested for soundness in accordance with MIL-STD-271 to meet requirements of 3.3.1.

4.3.5 Foundry control (types I and II) castings. When specified in accordance with 3.4, radiographic and other methods of examination to establish gating, pouring, and other foundry practices shall be determined by the procuring agency.

4.4 Visual and dimensional examination. Each sample selected in accordance with 4.3.3 shall be subjected to surface examination for workmanship and dimensional requirements.

4.4.1 Examination of preparation for delivery. An examination shall be made to determine compliance with the requirements of Section 5. The sample unit shall be one shipping container fully prepared for delivery. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with an AQL of 4.0 expressed in terms of percent defective.

4.5 Test methods.

4.5.1 Chemical analysis. The samples selected in accordance with 4.3.1 shall be analyzed in accordance with method 111 or 112 of Fed. Test Method Std. No. 151. A single analysis of a composite sample may be made. In case of dispute, referee analysis shall be by method 111. If another method of analysis is desired, it shall be as agreed upon by the contractor and the procuring agency.

4.5.2 Tension tests. All tension tests shall be conducted in accordance with ASTM E8. Two tests shall be made for each lot except when test coupons are attached to castings weighing 250 pounds (110 kg) or more, in which case one test shall be made from a coupon attached to each casting. Yield strength, when required, shall be by the method specified in the appropriate table herein for the alloy ordered.

4.5.3 Hardness tests. When required, hardness tests shall be conducted in accordance with ASTM E10 or E18.

4.5.4 Pressure and fracture tests. When pressure and fracture requirements are required in accordance with 3.5, copper alloy castings shall be given the tests specified (see 6.2).

4.5.5 Other tests. When required, other tests shall be conducted as specified in the contract or order (see 6.2).

4.6 Naval shipboard applications. Castings which are procured to this specification for use in Naval shipboard pressure vessels, piping systems and machinery shall be inspected in accordance with MIL-STD-278, for the category of castings specified.

4.6.1 Liquid penetrant. The castings shall be tested in accordance with MIL-STD-271.

4.7 Rejection.

4.7.1 Examination. Any sample unit containing one or more visual or dimensional defects shall be rejected. If the number of defective units in any sample exceeds the acceptance number specified in 4.3.3 for that sample size, the entire lot represented by the sample shall be rejected.

4.7.2 Tests. A lot shall be rejected for failure to meet any of the test requirements, when tested in accordance with 4.5.

4.8 Retests. Retests shall be permitted in accordance with Fed. Test Method Std. No. 151.

5. PREPARATION FOR DELIVERY

5.1 General.

5.1.1 Unless otherwise specified (see 6.2), all castings shall be separated by size, shape, or pattern when packed for shipment.

5.1.2 Where practicable, shipping containers shall be of uniform size, and shall contain the identical number of castings of the same pattern. Containers shall be designed to fit the contents in a compact manner. Castings shall be adequately blocked, braced, or otherwise secured to prevent their movement within the shipping containers.

5.2 Packaging. Packaging shall be levels A, B, or Commercial as specified (see 6.2).

5.2.1 Level A. Unless otherwise specified (see 6.2), castings having a finished or polished surface shall be packaged in accordance with MIL-P-116, method III.

5.2.1.1 Rough castings not subjected to damage do not require packaging.

5.2.2 Commercial. The castings shall be packaged in accordance with normal commercial practice. The complete package shall be designed to protect the castings against damage during shipment, handling, and storage.

5.2.2.1 Army use. For Army users, castings shall be packaged in accordance with MIL-STD-1188.

5.3 Packing. Packing shall be level A, B, or Commercial, as specified (see 6.2).

5.3.1 Level A. Castings packaged as specified in 5.2 shall be packed in overseas type containers conforming to PPP-B-601 or to PPP-B-636 (class weather-resistant). Insofar as practical, containers shall be of uniform shape and size, be of minimum cube and tare consistent with the protection required, and contain identical quantities. Castings having a finished or polished surface, subjected to damage shall be afforded adequate blocking or bracing within the shipping container. Wood containers shall be provided with a waterproof, heat-sealable case liner. The case liner will not be required when the unit container or the exterior container conforms to PPP-B-636, class weather-resistant, and is waterproof and sealed in accordance with the container specification requirements. Containers shall be closed and strapped in accordance with applicable container specifications or appendix thereto. The gross weight and size shall not exceed the limitation of the applicable container specification.

5.3.1.1 Unless otherwise specified (see 6.2), large rough castings shall be shipped loose or in bundles or palletized loads. Bundles not exceeding 500 pounds (227 kg) maximum shall be securely strapped with a minimum of 1-1/4 inch (3.2 cm) wide strapping conforming to A-A-880. Palletized loads shall be in accordance with MIL-STD-147.

5.3.2 Level B. Castings packaged as specified in 5.2.1 shall be packed in domestic type containers conforming to PPP-B-601, or PPP-B-636. Insofar as practicable, containers shall be of uniform shape and size, be of minimum cube and tare consistent with the protection required, and contain identical quantities. Castings having a finished or polished surface subjected to damage, shall be afforded blocking or bracing within the shipping containers. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. The gross weight and size shall not exceed the limitation of the applicable container specification.

5.3.2.1 Unless otherwise specified (see 6.2), large rough castings shall be packed as specified in 5.3.1.1.

5.3.3 Commercial. The castings, packaged as specified in 5.2, shall be packed to insure delivery at destination, provide for redistribution by the unit receiving activity, and be acceptable by common carrier under National Motor Freight Classification and Uniform Freight Classification.

5.3.3.1 Army use. For Army users, castings shall be packed in accordance with MIL-STD-1188.

5.4 Marking.

5.4.1 Civil agencies. Marking shall be as specified in Fed. Std. No. 123.

5.4.2 Military agencies. Marking shall be as specified in MIL-STD-129 or, when specified, MIL-STD-1188.

6. NOTES

6.1 Intended use. The intended uses of copper alloy castings are as follows:

6.1.1 Copper alloy No. C82000. For switches and switch gear, circuit breakers, current-carrying devices, and other uses requiring moderate strength and hardness with good electrical conductivity.

6.1.2 Copper alloy No. C82400. For high strength pressure tight corrosion resistant applications. Good weldability.

6.1.3 Copper alloy No. C82500. For bushings, cams, bearings, gears, safety tools and other uses requiring good resistance to wear and corrosion coupled with high strength.

6.1.4 Copper alloy No. C82600. For high strength, high hardness applications.

6.1.5 Copper alloy No. C82700. General purpose applications requiring high hardness and maximum strength.

6.1.6 Copper alloy No. C82800. Applications requiring high tensile and yield strength plus maximum hardness.

6.1.7 Copper alloy No. C83600. For general castings requiring fair strength, soundness, and machining properties, such as: pipe fittings, gasoline-line and oil-line fittings, small gears, fire equipment fittings, and ornamental fixtures. Requires less critical materials than valve bronze (see copper alloy No. C92200).

6.1.8 Copper alloy No. C83800. A general purpose free machining bronze for use in low pressure valves, plumbing supplies, and general hardware. It is not recommended for castings intended for use in artillery fire control instruments and magnetic compass equipment which cannot tolerate any disturbances of a magentic field.

6.1.9 Copper alloy Nos. C84400 and C84800. For general service similar to ounce metal or hydraulic bronze (copper alloy No. C83600). Used for threaded pipe, ornamental, or electrical fittings. Should be used wherever practicable because tin content is lower than some similar compositions. Not recommended for castings used in fire control instruments and magnetic compass equipment which cannot tolerate any disturbance of the magnetic field. Ordinarily may be purchased without mechanical property tests.

6.1.10 Copper alloy No. C85200. A general purpose alloy with good machining properties.

6.1.11 Copper alloy No. C85400. For castings not exposed to water or air pressure and as substitute for ferrous castings that corrode easily. Used for name and number plates, instrument cases, oil cups, distribution boxes, trimmings, and similar small castings. Machines easier than naval brass (copper alloy No. C85700) but has lower mechanical properties. Maximum iron content (0.10 percent) should be specified for casting intended for use in artillery fire control instruments and magnetic compass equipment which cannot tolerate any disturbance of the magnetic field.

6.1.12 Copper alloy No. C85500. For torpedo tubes and similar applications requiring moderate seawater corrosion resistance and medium strength.

6.1.13 Copper alloy No. C85700. For corrosion-resisting castings where strength or bearing requirements are unimportant, such as: brass hatch and door fitting and frames, fittings for mess tables and benches, skylight and chest hinges and fittings, joiner-work fittings (except hardware), fittings in general not subjected to pressure, brackets and clips, brass valves and fittings for ventilation systems (except working parts), ship trim, and brass pipe flanges.

6.1.14 Copper alloy No. C86100. For use where superior strength, toughness, or resistance to corrosion by seawater is required. Typical applications: slides, brackets, worm wheels, and gears.

6.1.15 Copper alloy No. C86200. For use where superior strength or toughness is required. Its resistance to corrosion by seawater is unsatisfactory. Typical applications: gears and worm wheels.

6.1.16 Copper alloy No. C86300. Has the highest mechanical properties of the manganese bronzes, but its resistance to salt water corrosion is unsatisfactory.

6.1.17 Copper alloy No. C86400. Can be produced from secondary materials, and is easier to machine than other classes of this alloy. For uses where strength or toughness plus resistance to seawater corrosion is required, as in shock loaded slides, bearings, worm wheels, framing, propeller blades and hubs, lever arms, gears, and liners. Do not use where stress corrosion may be a factor.

6.1.18 Copper alloy No. C86500. Can be produced from secondary materials. It is similar to copper alloy No. C86400 in corrosion resistance except that it is recommended where stress corrosion may be a factor. It has higher strength than copper alloy No. C86400 and has similar applications.

6.1.19 Copper alloy No. C86800. As an alternative to manganese bronze where higher strength and improved resistance to erosion-corrosion are required.

6.1.20 Copper alloy Nos. C87200 and C87400. For sound, homogeneous castings of high strength, toughness and corrosion resistance.

6.1.21 Copper alloy No. C90300. Excellent steam metal and high-tensile structural bronze used for expansion joints, special pipe fittings, gears, bolts and nuts, valves, pump pistons and casings, bushings, bearings, and similar applications with weight limitations requiring strength plus the corrosion resistance of tin bronze. This alloy is recommended for pipe fittings and similar parts which are to be silver brazed.

6.1.22 Copper alloy No. C90500. A nonleaded hard bronze with excellent wearing properties; can be silver brazed; preferred for guides, bushings operating at very high loads at low speeds, gears, and worms.

6.1.23 Copper alloy No. C90700.

6.1.24 Copper alloy No. C91000. A hard bearing bronze, also known as a hard gear bronze.

6.1.25 Copper alloy No. C91300. An extra-hard bearing bronze intended only for special applications.

6.1.26 Copper alloy No. C91500.

6.1.27 Copper alloy No. C91600. Used as gear material; generally chill cast with mechanical property requirements based on method of casting. Can also be centrifugally and continuous cast.

6.1.28 Copper alloy No. C92200. A general purpose free-machining bronze for parts requiring medium strength and resistance to salt water corrosion. Used for low and medium pressure valves, castings for stern tube and propeller shaft sleeves, hose couplings and fittings, and cocks. Good brazing qualities make it suitable for general bearing use if the bushings are to be silver brazed to other components.

6.1.29 Copper alloy No. C92300. A leaded gun metal used instead of copper alloy No. C90300 where better machining properties and sounder castings are required.

6.1.30 Copper alloy No. C92500.

6.1.31 Copper alloy No. C92700.

6.1.32 Copper alloy No. C93200. Used for strength, hardness, or shock resistance and for general utility bearings, ordnance bushings, and fittings similar to copper alloy No. C93400. Suitable for heavily loaded true-running, finely polished bearings which are lubricated, and for members where the bearings are integral with the supporting or enclosing structure.

6.1.33 Copper alloy No. C93400. Similar to copper alloy Nos. C93200 and C94300.

6.1.34 Copper alloy No. C93500. A good general purpose bronze for applications involving high speeds at low loads.

6.1.35 Copper alloy No. C93700. Used for general bearing service similar to copper alloy Nos. C93200 and C93400.

6.1.36 Copper alloy No. C93800. High-leaded bronze for bearings or bushings under light loads and high speeds. Suitable for bearing liners where the bearing metal must deform slightly to conform to irregular motion or imperfect fit; also effective where lubrication is difficult and for uses as bearings on railway rolling stock, traveling cranes, rock crushers, winches, and conveyors.

6.1.37 Copper alloy No. C93900.

6.1.38 Copper alloy No. C94000. Used for torpedo engine and tail bushings.

6.1.39 Copper alloy No. C94100. Same as copper alloy No. C93800.

6.1.40 Copper alloy No. C94300. Same as copper alloy No. C93800.

6.1.41 Copper alloy No. C94700. For expansion joints, pipe fittings, gears, bolts, nuts, valves, pump pistons, casings, bushings, and bearings requiring good strength and resistance to salt water corrosion.

6.1.42 Copper alloy No. C94800. Similar to copper alloy No. C94700, but with lesser strength and better machinability.

6.1.43 Copper alloy Nos. C95200, C95300, C95400, and C95800. Similar to copper alloy No. C95500 only insofar as application is concerned. Suitable for propellers and is not subject to dealuminization with proper chemical control or temper annealing.

6.1.44 Copper alloy No. C95500. A heavy duty, dense, high-strength alloy with hardness equal to that of manganese bronze, and excellent resistance to corrosion and fatigue. Has good wearing qualities for elevated temperature uses. For gun slides and mountings, for worm wheels and gears, valve seats, bearings and bushings, propeller blades and hubs, liners, and bearing plates subjected to heavy loads, and shaft sleeves in highly stressed shafting. Proper precautions and controls are necessary to obtain satisfactory welds.

6.1.45 Copper alloy No. C95700. Occasionally used for propellers. Favorable ratio of elongation to yield strength.

6.1.46 Copper alloy No. C96200.

6.1.47 Copper alloy No. C96400. Pipe and tube fittings and similar uses requiring a high-grade alloy resistant to seawater corrosion.

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) Alloy, type, and condition required (see 1.2, 3.1, and 3.2).
(c) Chemical analysis of each lot, when required (see 3.1.1).
(d) Results of mechanical tests, when required (see 3.2).
(e) Hardness requirements of table XXI, when required (see 3.2.2).
(f) Condition of casting for alloys C94000 and C95500 (see table XXI).
(g) Soundness standards, when required (see 3.3).
(h) Foundry control, when required (see 3.4).
(i) Pressure or fracture tests, when required (see 3.5 and 4.5.4).
(j) Liquid penetrant tests areas (see 3.6).
(k) Heat treatment, when required (see 3.7).
(l) Repair of castings (see 3.8 and 3.8.1).
(m) When solid and cored bars are not to be machined (see 3.9.1).
(n) Dimensions and dimensional tolerances (see 3.10).
(o) Twist tolerances on non-round rod, tube, and shapes (see 3.10.2.3.1).
(p) When statically or centrifugally cast cored or solid bar are required in other than 13 inch (33.0 cm) lengths (see 3.10.3.2).
(q) When type III castings are not required to be straightened (see 3.11).
(r) Pattern or drawing number.
(s) Whether pattern is to be furnished.
(t) When more than one melt makes up a lot.
(u) Attached test coupons, when required (see 4.3.2.2).
(v) Other tests, when required (see 4.5.5).
(w) Selection of applicable levels of packaging and packing required (see 5.2 and 5.3).
(x) Whether civil or military marking is required (see 5.4).
(y) Quantity of castings required.

6.3 In the case of critical loaded castings it may be desirable to determine compliance with the soundness requirements of 3.3 by radiographic examination, penetrant tests, or both. In such cases, provision for inspection by radiographic or penetrant means should be included in the inquiry or invitation for bids and in the contract or purchase order.

6.4 Each cast copper alloy is furnished in the type indicated in table XXVIII.

6.5 Superseded Government specifications and similar industry specifications are as shown in table XXIX.

6.5.1 In addition, the following specifications, not listed in table XXIX, have also been superseded.

QQ-C-00395
QQ-C-00400
QQ-C-00420
QQ-C-00430
Fed. Std. No. 00153, April 21, 1961

6.6 Designations. Copper alloy numbers are the same as the UNS numbers developed by the Society of Automotive Engineers (SAE) and the American Society for Testing and Materials (ASTM). For copper alloys, these numbers represent a simple expansion of the former three-digit designation system (as used in QQ-C-390A) accomplished by the addition of the prefix "C" and suffix "00". The suffix can be used to accommodate composition variations of the base alloy.

6.7 The attention of manufacturers is specifically invited to the fact that the mechanical requirements of this specification can be met only by a careful proportioning of the ingredients of the melt within the limits of a chemical composition specified and by careful heat treating after casting when applicable.

6.8 Definitions.

6.8.1 Static castings. Static castings are those made in molds in which gravity is used to force molten metal into the mold.

6.8.2 Centrifugal castings. Centrifugal castings are those which are cast in molds and rotated during pouring and solidification.

6.8.3 Continuous castings. Continuous castings are made by the use of a mold open at both ends which is equipped with provisions for water cooling. Molten metal is continuously supplied to one end of the mold, continuously solidified within the mold at a high rate of chill, and continuously withdrawn from the mold by suitable mechanical means.

6.8.4 Ksi. The term "ksi" is defined as 1,000 pounds per square inch.

6.8.5 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N=kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6,894,757 Pa, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

6.9 Availability, type III castings. Continuous cast shapes are available in symmetrical forms such as squares, rectangles, hexagons, octagons, and also relatively simple nonsymmetrical shapes. Either sharp or rounded corners are obtainable. External and internal bosses running the full length of the shapes can be provided.

6.10 Size limitations, type III castings. The attention of purchasers is invited to the following information regarding size limitations:

Cross-sectional dimensions

Rod:

Diameter - 11/32 (8.7 mm) to 9-1/8 inches (232 mm)

Tube:

Outside diameter - 15/16 (24 mm) to 9-1/8 inches (232 mm)
Inside diameter - 15/16 inch (24 mm), minimum
Wall thickness:

For O.D. to 3 inches (76 mm) - 5/32 inch (4 mm), minimum
For O.D. over 3 inches (76 mm) - 8 percent of O.D., minimum

Shapes:

Greatest cross-sectional dimension - 9-1/8 inches (232 mm), maximum

Length, all forms

12 feet (3.7 m) is standard length
1 to 12 feet (0.3 to 3.7 m) on request
12 to 20 feet (3.7 to 6.1 m) on special arrangement

6.11 This specification covers the technical requirements for castings, and is not intended for the purchase of ingots.

6.12 The packaging, packing, and marking requirements specified herein apply to direct shipment to the Government, and are not intended to apply to contracts or orders between the manufacturer and the prime contractor.

6.13 For civil agency procurement. When level B packaging is required for civil agency, the level A requirements in 5.2.1.1 shall apply, except the fiberboard box shall be class domestic.

MILITARY CUSTODIANS:
Army - MR
Navy - SH
Air Force - 99

Review activities:
Army - MI, EA, AR
Navy - OS,
DLA - IS

User activities:
Army - ME

Preparing activity:
Army - MR

Civil Agency Coordinating Activities:
COMMERCE-NBS
GSA-FSS

Project No. MECA-0078

(WP# Disc 0041A/ID #2599A FOR AMMRC USE ONLY)

TABLE I. Chemical composition, copper-beryllium alloys (percent maximum, unless otherwise indicated)

Copper Alloy No.	Copper	Tin	Zinc	Lead	Nickel	Iron	Silicon	Aluminum	Beryllium	Cobalt	Chromium
C82000	95.0 min.	0.10	0.10	0.02	0.20	0.10	0.15	0.10	0.45-0.8	2.4 -2.7[a]	0.10
C82400	96.4 min.	0.10	0.10	0.02	0.10	0.20	-	0.15	1.65-1.75	0.20-0.40	0.10
C82500	95.5 min.	0.10	0.10	0.02	0.20	0.25	0.20-.35	0.15	1.90-2.15	.35- .7[a]	0.10
C82600	95.2 min.	0.10	0.10	0.02	0.20	0.25	.20-.35	0.15	2.25-2.45	.35- .7	0.10
C82700	94.6 min.	0.10	0.10	0.02	1.0-1.5	0.25	.15	0.15	2.35-2.55	-	0.10
C82800	94.8 min.	0.10	0.10	0.02	0.20	0.25	.20-.35	0.15	2.50-2.75	0.35-0.7[a]	0.10

[a]Nickel plus cobalt.

TABLE II. Chemical composition, leaded and nonleaded, red and semi-red brass (percent maximum unless range is indicated)

Copper Alloy No.	Nominal Composition	Copper (b)	Tin	Lead	Zinc	Nickel incl. Cobalt	Aluminum	Iron	Antimony	Phosphorus[a]	Silicon	Sulphur
C83600	85-5-5-5	84.0-86.0[b]	4.0-6.0	4.0-6.0	4.0-6.0	1.0	0.005	0.30	0.25	0.05	0.005	0.08
C83800	83-4-6-7	82.0-83.8[b]	3.3-4.2	5.0-7.0	5.0-8.0	1.0	.005	.30	.25	.03	.005	.08
C84200	80-5-2-13	78.0-82.0	4.0-6.0	2.0-3.0	10.0-16.0	0.8	.005	.40	.25	.05	.005	.08
C84400	81-3-7-9	78.0-82.0[b]	2.3-3.5	6.0-8.0	7.0-10.0	1.0	.005	.40	.25	.02	.005	.08
C84800	76-3-6-15	75.0-77.0[b]	2.0-3.0	5.5-7.0	13.0-17.0	1.0	.005	.40	.25	.02	.005	.08

[a] For continuous castings, the maximum phosphorus shall be 1.5 percent.
[b] In determining copper minimum, copper may be calculated as copper plus nickel.

TABLE III. Chemical composition, leaded and nonleaded, yellow brass (percent maximum unless range is indicated)

Copper Alloy No.	Nominal Composition	Copper	Tin	Lead	Zinc	Iron	Antimony	Nickel incl. Cobalt	Sulphur	Phosphorus	Aluminum	Silicon
C85200	72-1-3-24	70.0-74.0	0.7 - 2.0	1.5-3.8	20.0-27.0	0.60	0.20	1.0	0.05	0.02	0.005	0.05
C85400	67-1-3-29	65.0-70.0	0.50-1.5	1.5-3.8	24.0-32.0	.7	-	1.0	-	-	.35	.05
C85500[a]	60-40 +AL	59.0-63.0	- 0.20	- 0.20	Rem.	- 0.20	-	- 0.20	-	-	.50-1.0	.05
C85700	63-1-1-35	58.0-64.0	0.5 - 1.5	0.8-1.5	32.0-40.0	.7	-	1.0	-	-	0.50	.05

[a] 0.20 percent maximum manganese.

TABLE IV. Chemical composition, leaded and nonleaded, high strength yellow brass (manganese bronze) (percent maximum unless a range is indicated)

Copper Alloy No.	Designation	Copper	Tin	Lead	Zinc	Iron	Nickel incl. Cobalt	Aluminum	Manganese
C86100	90000-MnBr	66.0-68.0	0.20	0.20	Rem.	2.0-4.0	-	4.5-5.5	2.5-5.0
C86200	90000-MnBr	60.0-66.0	.20	.20	22.0-28.0	2.0-4.0	1.0	3.0-4.9	2.5-5.0
C86300	110000-MnBr	60.0-66.0	.20	.20	22.0-28.0	2.0-4.0	1.0	5.0-7.5	2.5-5.0
C86400	60000-MnBr	56.0-62.0	0.50-1.5	0.50-1.5	34.0-42.0	0.40-2.0	1.0	0.50-1.50	0.10-1.0
C86500	65000-MnBr	55.0-60.0	1.0	.40	36.0-42.0	0.40-2.0	1.0	0.50-1.5	0.10-1.5
C86800	Ni-Mn-Br	53.5-57.0	1.0	.20	Rem.[a]	1.0-2.5	2.5-4.0	2.0	2.5-4.0

[a] The chemical composition of the castings shall be so controlled that the "zinc equivalent" based on the following formula, does not exceed 45.0 percent:

$$\text{Percent zinc equivalent} = 100 - \frac{(100 \times \% \text{ Cu})}{(100 + A)}$$

Where A is the algebraic sum of the following zinc replacement factors:

Tin = +1.0 x percent Sn
Aluminum = +5.0 x percent Al
Manganese = -0.5 x percent Mn
Iron = -0.1 x percent Fe
Nickel = -2.3 x percent Ni
Lead = 0

TABLE V. Chemical composition, silicon bronze (percent maximum unless otherwise indicated)

Copper Alloy No.	Copper	Tin	Lead	Zinc	Iron	Aluminum	Manganese	Silicon
C87200	89.0 min.	1.0	0.50	5.0	2.5	1.5	1.5	1.0-5.0
C87400	79.0 min.	-	1.0	12.0-16.0	-	0.8	-	2.5-4.0

TABLE VI. Chemical composition, leaded and nonleaded tin bronze (percent maximum unless a range is indicated)

Copper Alloy No.	Nominal Composition	Copper	Tin	Lead	Zinc	Iron	Antimony	Nickel incl Cobalt	Sulphur	Phosphorus	Aluminum	Silicon
C90300	88-8-0-4	86.0-89.0[c]	7.5-9.0	0.30	3.0-5.0	0.20	0.20	1.0	0.05	0.05[a]	0.005	0.005
C90500	88-10-0-2	86.0-89.0[c]	9.0-11.0	.30	1.0-3.0	.20	.20	1.0	.05	.05[a]	.005	.005
C90700	89-11	88.0-90.0	10.0-12.0	.50[b]	0.50[b]	.15	.20	0.50	.05	.30[a]	.005	.005
C91000	85-14-0-1	84.0-86.0	14.0-16.0	.20	1.5	.10	.20	.8	.05	0.05[a]	.005	.005
C91300	80-20-0-0	79.0-82.0	18.0-20.0	.25	0.25	.25	.20	.50	.05	1.0 [a]	.005	.005
C92200	88-6-2-4	86.0-90.0	5.5-6.5	1.0 - 2.0	3.0 - 5.0	.25	.25	1.0	.05	.05[a]	.005	.005
C92300	87-8-1-4	85.0-89.0	7.5-9.0	0.30-1.0	2.5 - 5.0	.25	.25	1.0	.05	.05[a]	.005	.005
C92500	87-11-1-0-1	85.0-88.0	10.0-12.0	1.0 - 1.5	0.50	.30	.25	0.8 - 1.5	.05	.30[a]	.005	.005
C92700	88-10-2-0	86.0-89.0	9.0-11.0	1.0 - 2.5	.7	.20	.25	1.0	.05	.25[a]	.005	.005

[a] For continuous castings, the maximum phosphorus shall be 1.5 percent.
[b] Total lead, zinc, and nickel shall be 1.0 percent.
[c] In determining copper minimum, copper may be calculated as copper plus nickel.

TABLE VII. Chemical composition, high leaded tin bronze (percent maximum unless a range is indicated)

Copper Alloy No.	Nominal Composition	Copper	Tin	Lead	Zinc	Iron	Antimony	Nickel incl. Cobalt	Sulphur	Phosphorus	Aluminum	Silicon
C93200	83-7-7-3	81.0-85.0[a]	6.3-7.5	6.0-8.0	2.0-4.0	0.20	0.35	1.0	0.08	0.15[b]	0.005	0.005
C93400	84-8-8	82.0-85.0	7.0-9.0	7.0-9.0	0.8	.20	.50	1.0	.08	.50[b]	.005	.005
C93500	85-5-9-1	83.0-86.0	4.3-6.0	8.0-10.0	2.0	.20	.30	1.0	.08	.05[b]	.005	.005
C93700	80-10-10	78.0-82.0[a]	9.0-11.0	8.0-11.0	0.8	.15	.55	1.0	.08	.15[b]	.005	.005
C93800	78-7-15	75.0-79.0	6.3-7.5	13.0-16.0	.8	.15	.8	1.0	.08	.05[b]	.005	.005
C93900	78-6-16	76.5-79.5[a]	5.0-7.0	14.0-18.0	1.5	.40	.50	0.8	.08	1.5[b]	.005	.005
C94000	70-14-16-0	69.0-72.0[a]	12.0-14.0	14.0-16.0	0.50	.25	.50	0.50-1.0	.08	0.05[b]	.005	.005
C94100	75-5-20-0	65.0-75.0	4.5-6.5	15.0-22.0	3.0	.25	.8	0.8	.08	.05[b]	.005	.005
C94300	71-5-24-0	68.5-73.5[a]	4.5-6.0	22.0-25.0	0.8	.15	.8	1.0	.08	.05[b]	.005	.005

[a] In determining copper minimum, copper may be calculated as copper plus nickel.
[b] For continuous castings, the maximum phosphorus shall be 1.5 percent.

TABLE VIII. Chemical composition, nickel tin bronze (percent maximum unless a range is indicated)

Copper Alloy No.	Nominal Composition	Copper	Tin	Lead	Zinc	Iron	Antimony	Nickel incl. Cobalt	Sulphur	Phosphorus	Aluminum	Manganese	Silicon
C91600	88-10.5-0-1.5	86.0-89.0[a]	9.7-10.8	0.25	0.25	0.20	0.20	1.2-2.0	0.05	0.30	0.005	-	0.005
C94700	88-5-0-2-5	85.0-90.0	4.5-6.0	0.10[b]	1.0-2.5	.25	.15	4.5-6.0	.05	.050	.005	0.20	.005
C94800	87-5-1-2-5	84.0-89.0	4.5-6.0	0.30-1.0	1.0-2.5	.25	.15	4.5-6.0	.05	.050	.005	.20	.005

[a] Copper, tin, nickel, lead, and phosphorus shall be 99.5 percent minimum.
[b] The mechanical properties in the heat treated condition may not be attained if the lead content exceeds 0.01 percent.

TABLE IX. Chemical composition, aluminum bronze (percent maximum unless a range is indicated)

Copper Alloy No.	Nominal Composition	Copper min.	Lead	Nickel incl. Cobalt	Aluminum	Iron	Manganese	Silicon
C95200	88-3-9	86.0[c]	-	-	8.5-9.5	2.5-4.0	-	-
C95300	89-1-10	86.0[c]	-	-	9.0-11.0	0.8 1.5	-	-
C95400	85-0-4-11	83.0[b]	-	2.5	10.0-11.5	3.0-5.0	0.50	-
C95500	81-4-4-11	78.0[b]	-	3.0-5.5	10.0-11.5	3.0-5.0	3.5	-
C95700	75-3-8-2-12	71.0[b]	0.03	1.5-3.0	7.0-8.5	2.0-4.0	11.0-14.0	0.10
C95800	81-4-4-9-2	79.0[b]	.03	4.0-5.0[a]	8.5-9.5	3.5-4.5[a]	0.8-1.5	.10

[a] Iron content shall not exceed the nickel content.
[b] Sum of named elements 99.5 percent minimum.
[c] Sum of named elements 99.0 percent minimum.

TABLE X. Chemical composition, copper nickel (percent maximum unless a range is indicated)

Copper Alloy No.	Copper	Lead	Nickel incl. Cobalt	Iron	Manga-nese	Phos-phorus	Silicon	Sulphur	Columbium	Carbon
C96200	Rem.	0.03[a]	9.0-11.0	1.0 - 1.8	1.5	-	0.30	-	1.0	0.10
C96400	65.0-69.0	.03[a]	28.0-32.0	0.25-1.5	1.5	0.02	.50	0.02	1.5	.15

[a] For welding grades, lead may not exceed 0.01 percent.

TABLE XI. Tensile properties, copper-beryllium cast alloys (Solution heat treated and aged)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C82000	I	95 (655)	-	3
C82400	I and II	145 (1000)	130 (895)	0
C82500	I and II	155 (1070)	140 (965)	0
C82600	I	160 (1105)	145 (1000)	0
C82700	I	155 (1070)	140 (965)	0
C82800	I	160 (1105)	150 (1035)	0

[a] Yield strength determination by 0.2 percent offset method.

TABLE XII. Tensile properties, leaded and nonleaded, red and semi-red brass cast alloys (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C83600	I and II	30 (205)	14 (95)	20
	III	36 (250)[b]	19 (130)[b]	15
C83800	I and II	30 (205)	13 (90)	20
	III	30 (205)[b]	15 (105)[b]	16
C84200	III	32 (220)[b]	16 (110)[b]	13
C84400	I and II	29 (200)	13 (90)	18
	III	30 (205)[b]	15 (105)[b]	16
C84800	I and II	28 (195)	12 (85)	16
	III	30 (205)[b]	15 (105)[b]	16

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] Minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XIII. Tensile properties, leaded and nonleaded, yellow brass cast alloys (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C85200	I	35 (240)	12 (85)	25
C85400	I	30 (205)	11 (75)	20
C85500	I and II	55 (380)	-	25
C85700	I and II	40 (275)	14 (95)	15

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

TABLE XIV. Tensile properties, leaded and nonleaded high strength yellow brass (manganese bronze) cast alloys (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C86100	I and II	90 (620)	45 (310)	18
C86200	I and III	90 (620)[b]	45 (310)[b]	18
C86300	I and II	110 (760)	60 (415)	12
	III	110 (760)[b]	62 (425)	14
C86400	I	60 (415)	20 (140)	15
	III	70 (485)	25 (170)[b]	25
C86500	I and II	65 (450)	25 (170)	20
C86800	I	78 (540)	35 (240)	18

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] For type III, minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XV. Tensile properties, silicon bronze alloy castings (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C87200	I	45 (310)	18 (125)	20
C87400	I	50 (345)	21 (145)	18

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

TABLE XVI. Tensile properties, leaded and nonleaded, tin bronze, alloy castings (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C90300	I and II	40 (275)	18 (125)	20
	III	44 (305)[b]	22 (150)[b]	18
C90500	I and II	40 (275)	18 (125)	20
	III	44 (305)[b]	25 (170)[b]	10
C90700	III	40 (275)[b]	25 (170)[b]	10
C91000	I and II	30 (205)	-	1
	III	30 (205)[b]	-	0
C91500	III	45 (310)	25 (170)[b]	8
C92200	I and II	34 (235)	16 (110)	24
	III	38 (260)[b]	19 (130)[b]	18
C92300	I and II	36 (250)	16 (110)	18
	III	40 (275)[b]	19 (130)[b]	16
C92500	III	40 (275)[b]	24 (165)[b]	10
C92700	III	38 (266)[b]	20 (140)[b]	8

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] Minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XVII. Tensile properties, high leaded tin bronze, alloy castings (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C93200	I and II	30 (205)	14 (95)	15
	III	35 (240)[b]	20 (140)[b]	10
C93400	I and II	25 (170)	12 (85)	8
	III	34 (235)[b]	20 (140)[b]	8
C93500	I and II	28 (195)	12 (85)	15
	III	30 (205)[b]	16 (110)[b]	12
C93700	I and II	30 (205)	12 (85)	15
	III	35 (240)[b]	20 (140)[b]	6
C93800	I and II	26 (180)	14 (95)	12
	III	25 (170)[b]	16 (110)[b]	5
C93900	III	25 (170)[b]	16 (110)[b]	5
C94100	I	25 (170)	-	10
	III	25 (170)[b]	17 (115)[b]	7
C94300	I and II	24 (165)	-	7
	III	21 (145)[b]	15 (105)[b]	7

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] Minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XVIII. Tensile properties, nickel tin bronze, cast alloys

Copper Alloy No.	Casting Type	Condition of Castings	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C91600	I	As cast	35 (240)	17 (115)	10
		Chill cast	45 (310)	25 (170)	14
	II	As cast	45 (310)	25 (170)	14
C94700	I	As cast	45 (310)	20 (140)	25
		Heat treated	75 (515)	50 (345)	5
	III	As cast	45 (310)[b]	20 (140)[b]	25
		Heat treated	75 (515)[b]	50 (345)[b]	5
C94800	I	As cast	40 (275)	20 (140)	20
	III	As cast	40 (275)[b]	20 (140)[b]	20

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] Minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XIX. Tensile properties, aluminum bronze, cast alloys

Copper Alloy No.	Casting Type	Condition of Castings	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C95200	I and II	As cast	65 (450)	25 (170)	20
	III	As cast	68 (470)[b]	26 (180)[b]	20
C95300	I and II	As cast	65 (450)	25 (170)	20
	III	As cast	70 (485)[b]	26 (180)[b]	25
	I, II, and III	Heat treated	80 (550)[b]	40 (275)[b]	12
C95400	I and II	As cast	75 (515)	30 (205)	12
	III	As cast	85 (585)[b]	32 (220)[b]	12
	I and II	Heat treated	90 (620)	45 (310)	6
	III	Heat treated	95 (655)[b]	45 (310)[b]	10
C95500	I and II	As cast	90 (620)	40 (275)	6
	III	As cast	95 (655)[b]	42 (290)[b]	10
	I and II	Heat treated	110 (760)	60 (415)	5
	III	Heat treated	110 (760)[b]	62 (425)[b]	8
C95700	I and II	As cast	90 (620)	40 (275)	20
C95800	I and II	As cast or annealed	85 (585)	35 (240)	15

[a] Yield strength determination by 0.5 percent extension under load or 0.2 percent offset method.

[b] For type III, minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XX. Tensile properties, copper nickel cast alloys (as cast)

Copper Alloy No.	Casting type	Tensile strength, ksi (MPa)	Yield strength, ksi (MPa)[a]	Elongation in 2 in. percent
C96200	I and II	45 (310)	25 (170)	20
C96400	I and II	60 (415)	32 (220)	20
	III	65 (450)[b]	35 (240)[b]	25

[a] Yield strength determination by 0.2 percent extension under load or 0.2 percent offset method.

[b] Minimum tensile strength and yield strength shall be reduced 10 percent for cast bars having a cross-section of 4 inches (102 mm) or more.

TABLE XXI. Hardness of copper cast alloys

Copper Alloy No.	Casting Type	Condition of Casting	Brinell hardness 500 kg load	Brinell hardness 3000 kg load	Rockwell hardness B scale	Rockwell hardness C scale
C82000	I	As cast[a]	-	-	92	-
C82400	I and II	As cast[a]	-	-	-	35
C82500	I and II	As cast[a]	-	-	-	38
C82600	I	As cast[a]	-	-	-	40
C82700	I	As cast[a]	-	-	-	39
C82800	I	As cast[a]	-	-	-	42
C91300	I, II, III	As cast	-	160	-	-
C91600	I	Chill cast	85	-	-	-
	II	As cast	80	-	-	-
C94000	I	Chill cast	80	-	-	-
	I	Sand cast	50	-	-	-
	II, III	As cast	80	-	-	-
C94300	I	As cast	38	-	-	-
C95500	I	Chill cast, sand cast	-	190	-	-
	I	Chill cast, heat treated	-	200	-	-
	II	As cast	-	190[b]	-	-
	II	Heat treated	-	200	-	-

[a] Solution heat treated and age hardened.
[b] Typical hardness for information only; not required.

TABLE XXII. Permissible variations in average outside cross-sectional dimensions of continuous-cast straightened rod and bar

Diameter or distance between parallel surfaces, in. (mm)	Tolerances, in. (mm) rounds, square, rectangles, hexagons, octagons plus[a]	minus[a]
All alloys except as noted below		
Up to 4 (102), excl.	0.005 (0.13)	0.016 (0.41)
Incl. 4 (102) to 5 (127) incl.	.008 (.20)	.016 (.41)
Over 5 (127)	.016 (.41)	.016 (.41)
Alloys C86200, C86300, C86400, C95200, C95300, C95400, C95500, and C96400		
Up to 3 (76.2), incl.	0.010 (0.25)	0.020 (0.51)
Over 3 (76.2) to 4 (102), incl.	.015 (.38)	.020 (.51)
Over 4 (102) to 5-1/2 (140), incl.	.020 (.51)	.020 (.51)
Over 5-1/2 (140)	.025 (.64)	.025 (.64)

[a] When tolerances are specified as all plus or all minus, double the values given.

TABLE XXIII. Permissible variations in average outside and inside diameters of continuous-cast straightened round tube

Average outside diameter, in (mm)	Tolerances, in. (mm)		
	Outside diameter	Inside diameter	
	plus or minus[a]	plus[b]	minus[b]
All alloys except as noted below			
Up to 4 (102), excl.	0.005 (0.13)	0.012 (0.30)	0.033 (0.84)
Incl. 4 (102) to 5 (127) incl.	.008 (.20)	.016 (.41)	.046 (1.2)
Over 5 (127)	.016 (.41)	.032 (.81)	.064 (1.6)
Alloys C86200, C86300, C86400, C95200, C95300, C95400, C95500, and C96400			
Up to 3 (76), incl.	0.010 (0.25)	0.012 (0.30)	0.033 (0.84)
Over 3 (76) to 4 (102), incl.	.015 (.38)	.015 (.38)	.050 (1.3)
Over 4 (102) to 5-1/2 (140), incl.	.020 (.51)	.025 (.64)	.070 (1.8)
Over 5-1/2 (140)	.025 (.64)	.035 (.89)	.090 (2.3)

[a] When tolerances are specified as all plus or all minus, double the values given.
[b] When tolerances are specified as all plus or all minus, total the values given.

TABLE XXIV. Cleanup or finish allowance

Finished outside diameter[a] in. (mm)	Finish allowances added to finish or print dimensions of the part, in. (mm)	
All alloys except as noted below	Inside diameter	Outside diameter
Up to 4 (102), excl.	-1/32 (0.79)	+1/32 (0.79)
Incl. 4 (102) to 5 (127), incl.	-1/16 (1.6)	+1/16 (1.6)
Over 5 (127)	-3/32 (2.4)	+3/32 (2.4)
Alloys C86200, C86300, C86400, C95200, C95300, C95400, C95500, and C96400		
Up to 3 (76.2), incl.	-1/8 (3.2)	+1/16 (1.6)
Over 3 (76.2) to 4 (102), incl.	-1/8 (3.2)	+3/32 (2.4)
Over 4 (102) to 5-1/2 (140), incl.	-3/16 (4.8)	+1/8 (3.2)
Over 5-1/2 (140)	-1/4 (6.4)	+3/16 (4.8)

[a] For rounds only. For other shapes, finish allowance shall be subject to agreement between purchaser and manufacturer.

TABLE XXV. Permissible variations in roundness of round rod and tube

Outside diameter, in. (mm)	Maximum out-of-roundness[a], in. (mm)
All alloys except as noted below	
Up to 4 (102), excl.	0.020 (0.51)
Incl. 4 (102) to 5 (127), incl.	.032 (.81)
Over 5 (127)	.064 (1.6)
Alloys C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, and C96400	
Up to 3 (76.2), incl.	0.025 (0.64)
Over 3 (76.2) to 4 (102), incl.	.040 (1.0)
Over 4 (102) to 5-1/2 (140), incl.	.060 (1.5)
Over 5-1/2 (140)	.075 (1.9)

[a] The deviation from roundness is measured as the difference between major and minor diameters as determined at any one cross section.

TABLE XXVI. Permissible variations in straightness of rod, tube, bar, and shapes

Product	Length[a], ft. (m)	Maximum curvature[b] (depth of arc), in. (mm)
Round rod or tube	Up to 10 (3.05)	1/4 (6.4) in any 5-ft (1.52 m) portion
	10 (3.05) and over	1/2 (13) in any 10-ft (3.05 m) portion
Bar and shapes	Any length	1/2 (13) in any 6-ft (1.83 m) portion

[a] Of total length.
[b] Applicable to any longitudinal surface or edge.

TABLE XXVII. Permissible variations in outside and inside dimensions for machined cored and solid bars

Ordered diameter, in. (mm)	Permissible variation, in. (mm)			
	Inside diameter		Outside diameter	
	plus	minus	plus	minus
Up to 4 (102), incl.	0	1/32 (0.79)	1/32 (0.79)	0
Over 4 (102)	0	1/16 (1.6)	1/16 (1.6)	0

TABLE XXVIII. Cast copper alloys and types available

Commercial destination	Copper alloy No.	Type of casting		
		Type I (static)	Type II (centrifugal)	Type III (continuous)
Copper-beryllium alloys	C82000	x		
	C82400	x	x	
	C82500	x	x	
	C82600	x		
	C82700	x		
	C82800	x		
Leaded and nonleaded, red and semi-red brass	C83600	x	x	x
	C83800	x	x	x
	C84200			x
	C84400	x	x	x
	C84800	x	x	x
Leaded and nonleaded yellow brass	C85200	x		
	C85400	x		
	C85500	x	x	
	C85700	x	x	
Leaded and nonleaded, high strength yellow brass	C86100	x	x	
	C86200	x	x	x
	C86300	x	x	x
	C86400	x		x
	C86500	x	x	
	C86800	x		
Silicon bronze	C87200	x		
	C87400	x		
Leaded and nonleaded tin bronze	C90300	x	x	x
	C90500	x	x	x
	C90700			
	C91000	x	x	x
	C91300			
	C92200	x	x	x
	C92300	x	x	x
	C92500			x
	C92700			x
High leaded tin bronze	C93200	x	x	x
	C93400	x	x	x
	C93500	x	x	x
	C93700	x	x	x
	C93800	x	x	x
	C93900			
	C94000			
	C94100	x		x
	C94300	x	x	x
Nickel tin bronze	C91600	x	x	
	C94700	x		x
	C94800	x		x
Aluminum bronze	C95200	x	x	x
	C95300	x	x	x
	C95400	x	x	x
	C95500	x	x	x
	C95700	x	x	
	C95800	x	x	
Copper-nickel alloys	C96200	x	x	
	C96400	x	x	x

TABLE XXIX. Superseded Government specifications and similar industry specifications

Copper Alloy No.[a]	QQ-C-390 desig-nation	Superseded Government specification		Similar industry specification	
		Federal	Military	ASTM	SAE
C82000	X5	-	MIL-C-19464, class 1	-	-
C82500	X6	-	MIL-C-19464, class 2	-	-
C82700	X7	-	MIL-C-19464, class 3	-	-
C82900	X8	-	MIL-C-19464, class 4	-	-
C83600	B5	QQ-B-1005, comp. 2	MIL-B-11553, comp. 2; MIL-B-16444	B271, alloy 836; B505, alloy 836; B584, C83600	40
C83800	B4	QQ-B-1005, comp. 17	-	B271, alloy 838; B505, alloy 838; B584, C83800	-
C84200	B1	QQ-B-1005, comp. 3	MIL-B-11553, comp. 3; MIL-B-16542	B505, alloy 842	-
C84400	B2	QQ-B-1005, comp. 11	MIL-B-11553, comp. 11	B271, alloy 844; B505, alloy 844; B584, C84400	-
C85200	A4	QQ-B-621, class C	-	B271, alloy 852; B584, C85200	-
C85400	A3	QQ-B-621, class B	-	B271, alloy 854; B584, C85400	-
C85500	A5	-	MIL-B-17512	-	-
C85700	A1	QQ-B-621, class A	-	B271, alloy 857; B584, C85700	-
C86100	C5	-	-	-	-
C86200	C4	QQ-B-726, class B	-	B271, alloy 862; B584, C86200	430A
C86300	C7	-	-	B22, C86300; B271, alloy 863; B505, alloy 863	-
C86400	C2	QQ-B-726, class D	-	B271, alloy 864; B584, C86400	-

TABLE XXIX. Superseded Government specifications and similar industry specifications (cont'd)

Copper Alloy No.[a]	QQ-C-390 designation	Superseded Government specification		Similar industry specification	
		Federal	Military	ASTM	SAE
C86500	C3	QQ-B-726, class A	-	B271, alloy 865; B505, alloy 865; B584, C86500	-
C86800	C1	-	MIL-B-16522, classes 1 and 2	-	-
C87200	X2	QQ-C-593, class B	-	B271, alloy 872; B584, C87200	-
C87400	X1	QQ-C-593, class A	-	B271, alloy 874; B584, C87400	-
C90300	D5	QQ-B-1005, comp. 3	MIL-B-11553, comp. 5; MIL-M-16576	B271, alloy 903; B505, alloy 903; B584, C90300	620
C90500	D6	QQ-B-1005, comp. 16	MIL-B-11553, comp. 16	B22, C90500; B271, alloy 905; B505, alloy 905; B584, C90500	-
C91000	D2	QQ-B-1005, comp. 9	MIL-B-16262, grade III	B505, alloy 910	-
C91600	F1	-	-	-	-
C92200	D4	QQ-B-1005, comp. 1	MIL-B-11553, comp. 1	B61; B271, alloy 922; B505, alloy 922; B584, C92200	622
C92300	D3	QQ-B-1005, comp. 6	MIL-B-11553, comp. 6 MIL-B-16540, grades A and B	B271, alloy 923; B505, alloy 923; B584, C92300	621
C93200	E7	QQ-B-1005, comp. 12	MIL-B-11553, comp. 12 MIL-B-16261, grade VI	B271, alloy 932; B505, alloy 932; B584, C93200	660
C93400	E8	QQ-B-1005, comp. 8	MIL-B-11553, comp. 8 MIL-B-16261, grade II	B505, alloy 934	-
C93500	E9	QQ-B-1005, comp. 14	MIL-B-11553, comp. 14	B271, alloy 935; B505, alloy 935; B584, C93500	66
C93700	E10	-	MIL-B-11553, comp. 23	B22, C93700; B271, alloy 937; B505, alloy 937; B584, C93700	64

TABLE XXIX. Superseded Government specifications and similar industry specifications (cont'd)

Copper Alloy No.[a]	QQ-C-390 designation	Superseded Government specification		Similar industry specification	
		Federal	Military	ASTM	SAE
C93800	E6	QQ-B-1005, comp. 19	MIL-B-11553, comp. 19 MIL-B-16261, grade IV	B66, C93800; B271, alloy 938; B505, alloy 938; B584, C93800	-
C94000	E2	QQ-B-1005, comp. 13	MIL-B-11553, comp. 13 MIL-B-16261, grade VII	B505, alloy 940	-
C94100	E5	-	MIL-B-16261, grade X	B67;	-
C94300	E1	QQ-B-1005, comp. 18	MIL-B-16261, grade V	B505, alloy 941 B66, C94300; B271, alloy 943; B505, alloy 943; B584, C94300	-
C94700	F2	-	-	-	-
C94800	F3	-	-	-	-
C95200	G6	QQ-B-671, class 1	MIL-B-16033, class 1	B148, alloy 952; B271, alloy 952	68A
C95300	G7	QQ-B-671, class 2	MIL-B-16033, class 2	B148, alloy 953; B271, alloy 953	68B
C95400	G5	QQ-B-671, class 3	MIL-B-16033, class 3	B148, alloy 954; B271, alloy 954	-
C95500	G3	-	MIL-B-16033, class 4	B148, alloy 955; B271, alloy 955	-
C95800	G8	-	-	B148, alloy 958; B271, alloy 958	-
C96400	X9	-	-	B369, C96400; B505, alloy 964	-
-	A2	-	MIL-B-17511	-	-
-	B6	QQ-B-1005, comp. 4	MIL-B-11553, comp. 4	-	-
-	D1	QQ-B-1005, comp. 10	MIL-B-11553, comp. 10	-	-
-	E3	QQ-B-1005, comp. 15	MIL-B-11553, comp. 15	-	-
-	E4	QQ-B-1005, comp. 7	MIL-B-11553, comp. 7	-	-
-	G1	QQ-B-671, class 4	-	-	-
-	G2	-	-	-	-
-	G4	-	-	-	-
-	X3	-	MIL-B-16358	-	-

[a] See 6.6

U.S. GOVERNMENT PRINTING OFFICE : 1984 - 421-595/3713

Orders for this publication are to be placed with the General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (Cont'd)

TABLES

TABLES (cont'd)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
CC-C-390B	COPPER ALLOY CASTINGS (INCLUDING CAST BAR)

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

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)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE ARMY

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12062 WASHINGTON D C

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE ARMY

Director
US Army Materials & Mechanics Research Center
ATTN: DRXMR-SMS
Watertown, MA 02172