MIL-C-22229A (OS)
8 November 1973
SUPERSEDING
MIL-C-22229 (NOrd)
9 November 1959

MILITARY SPECIFICATION

COPPER BASE ALLOY CASTINGS (FOR PRESSURE TIGHT APPLICATIONS)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

*1.1 Scope. This specification covers 12 compositions of copper base alloy castings for pressure-tight ordnance applications (see 6.1).

1.2 Classification. Copper base alloy castings shall be of the compositions and conditions shown in table I, as specified (see 6.2).

*Table I

COMPOSITIONS AND CONDITIONS OF CASTINGS

Composition			Condition
Copper alloy No.	Former composition No.	Description	
836	2	Hydraulic bronze	As cast
861	10	Aluminum manganese bronze	As cast
862	9	Aluminum manganese bronze	As cast
863	8	Aluminum manganese bronze	As cast
865	7	Manganese bronze	As cast
872	4	Silicon bronze	As cast
903	1	Tin bronze	As cast
934	3	High-leaded tin bronze	As cast
952	5	Aluminum bronze	As cast
955	6a	Aluminum nickel bronze	As cast
955	6b	Aluminum nickel bronze	Heat treated
958	-	Aluminum nickel bronze	As cast

FSC MECA

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.

SPECIFICATIONS

Federal

PPP-B-585	Boxes, Wood, Wirebound
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-650	Box, Fiberboard, Special Purpose (Record Retiring)

STANDARDS

Federal

FED-STD-151	Metals; Test Methods

Military

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

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

*2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

*ASTM E 8	Tension Testing of Metallic Materials
ASTM E 272	Reference Radiograph for High-Strength Copper-Base and Nickel-Copper Alloy Coatings

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

Consolidated Classification Committee

Consolidated Freight Classification Rules

(Application for copies shall be addressed to the Consolidated Classification Committee, 202 Chicago Union Station, Chicago, Ill. 60606.)

3. REQUIREMENTS

3.1 Preproduction sample. When specified in the contract or purchase order (see 6.2), a preproduction sample of castings is required for each composition of castings being purchased. Samples shall be manufactured using the methods and procedures proposed for the production lot. Samples shall be tested as specified herein and are for the purpose of determining that the manufacturer's production process will produce castings that will conform to the requirements of this specification. When preproduction castings have been accepted, production castings shall be produced without any change in manufacturing process.

*3.2 Chemical composition. The chemical composition shall conform to table II (see 6.4).

3.2.1 Analysis of each melt. An analysis of each melt of castings shall be furnished by the contractor, showing the percentage of the elements designated.

3.3 Condition. Castings shall be furnished in the condition specified in the contract or purchase order (see 6.2). The type of heat treatment, when required, shall be at the option of the contractor unless otherwise specified by the procuring activity.

*Table II

CHEMICAL REQUIREMENTS[1]
(Composition, percent maximum except as indicated)

Copper alloy No.	Former composition No.	Copper[2]	Tin	Lead	Zinc[2]	Iron	Antimony	Nickel	Sulfur	Phosphorus	Aluminum	Manganese	Silicon
836	2	84.0-86.0[3]	4.0-6.0	4.0-6.0	4.0-6.0	.30	-	1.0[4]	-	.05[5]	-	-	-
861	10	66.0-68.0	.20	.20	Remainder	2.0-4.0	-	-	-	-	4.5-5.5	2.5-5.0	-
862	9	60.0-66.0	.20	.20	Remainder	2.0-4.0	-	-	-	-	3.0-4.9	2.5-5.0	-
863	8	60.0-66.0	.20	.20	Remainder	2.0-4.0	-	-	-	-	5.0-7.5	2.5-5.0	-
865	7	55.0-60.0	1.0	.40	Remainder	.40-2.0	-	.50	-	-	.50-1.5	1.5	-
872	4	99.5 min[6]	1.0	.50	5.0	2.5	-	-	-	-	1.5	1.5	1.0-5.0
903	1	86.0-89.0	7.5-9.0	.30	3.0-5.0	.15	-	1.0	-	.50[5]	-	-	-
934	3	82.0-85.0	7.0-9.0	7.0-9.0	.7	.15	.50	1.0	-	.50[5]	-	-	-
952	5	86.0 min[5]	-	-	-	2.5-4.0	-	-	-	-	8.5-9.5	-	-
955	6	78.0 min[4]	-	-	-	3.0-5.0	-	3.0-5.5	-	-	10.0-11.5	3.5	-
958	-	78.0 min[4]	-	.02	-	3.0-5.0[7]	-	4.0-5.5[7]	-	-	8.5-9.5	3.5	.10

[1] By agreement between consumer and producer, analysis may be required and limits established for elements not specified in the table of chemical requirements.
[2] In reporting chemical analyses obtained by the use of instruments, such as spectrograph, X-ray, and atomic absorption, copper may be indicated as "remainder." In reporting chemical analyses obtained by wet methods, zinc may be indicated as "remainder" on those alloys with over 2%.
[3] In determining copper minimum, copper may be calculated as copper plus nickel.
[4] Nickel is a residual element and shall not be intentionally added to the melt.
[5] For continuous castings, the maximum phosphorus shall be 1.5%.
[6] Copper plus sum of named elements.
[7] Iron content shall not exceed nickel content.

3.4 Mechanical properties. The mechanical properties shall conform to table III. Mechanical properties of castings required for conditions other than shown in table III shall be as specified in the contract or order (see 6.2).

*Table III

MECHANICAL PROPERTIES
(As cast condition except where noted)

Copper alloy No.	Former composition No.	Tensile strength (ksi-min)	Yield[1] strength (ksi-min)	Elongation (4 × dia) (% min)
836	2	30.0	14.0	20
861	10	90.0	45.0	18
862	9	90.0	45.0	18
863	8	110.0	60.0	12
865	7	65.0	25.0	20
872	4	45.0	18.0	20
903	1	40.0	18.0	20
934	3	25.0	12.0	8
952	5	65.0	25.0	20
955	6a	90.0	40.0	6
955 (heat treated)	6b	110.0	60.0	5
958	-	85.0	35.0	18

[1] Yield strength taken at 0.5% extension underload.

3.5 Soundness. The soundness of the castings shall conform to the following.

3.5.1 Surface. Castings shall be free from cold shuts, fins, laps, pits, or other defects detrimental to fabrication or performance of parts.

*3.5.2 Internal. Casting sections of 3/4-inch thickness or less shall conform to ASTM E 272 for all discontinuity types. Casting sections greater than 3/4 inch in thickness shall comply with suitable standards furnished by the agency concerned.

*3.6 Dimensions. The responsibility for furnishing castings to the specified dimensions and tolerances that will conform to such gages as may be specified shall rest with the contractor.

3.7 Pressure tightness. Each casting in the finish-machined condition shall conform to pressure test requirements specified on the drawing without leakage. All castings that have passed the specified pressure test shall be individually marked with the letter "P" to indicate they conform to the test conditions.

3.8 Identification marking. Castings shall be identified by melt or inspection lot number and drawing or part number. Markings will be made in a position on the casting where they will not be removed when machining to finished dimensions. Any method of marking which has no deleterious effect on serviceability may be used.

*3.9 Repairing of defects. Defective areas of castings shall not be repaired to any manner without written permission from the procuring activity. Permission on repair defects, when granted, shall not relieve the contractor from his responsibility to meet all the requirements of the drawings and the specification (see 6.5).

*3.9.1 Impregnation of leaking castings. Castings that leak under pressure test shall not be impregnated without written permission of the procuring activity. When permitted, impregnation shall be done in accordance with MIL-STD-276.

*3.10 Workmanship. Castings shall be uniform in quality and condition, free from foreign materials, well cleaned and free of any other injurious defects that could prevent their use for the purpose intended.

4. QUALITY ASSURANCE PROVISIONS

*4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or 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 this specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot. A lot shall consist of all castings of the same drawing, in the same condition, made by the same manufacturing process, poured from the same melt, and submitted for inspection at one time.

4.3 Sampling.

*4.3.1 Sampling for preproduction inspection. When specified, as soon as possible after the award of contract, the contractor shall submit three preproduction samples of the castings up to 100 pounds cleaned weight and one casting over 100 pounds cleaned weight of the type being purchased. Unless otherwise specified (see 6.2), one casting shall be inspected for soundness by radiographic inspection. All containers of preproduction castings shall be plainly marked with the following information:

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

(b) Composition (alloy No.), description, and condition (see 1.2 and table II)

(c) Sample for preproduction inspection and tests

(d) Manufacturer's designation or brand name

(e) Name of manufacturer

(f) Plant address

(g) Reference the procurement contract.

Further production of castings by the contractor prior to the approval of the procuring activity or completion of inspection and tests on the preproduction samples shall be at the contractor's risk. Accepted preproduction samples will become the property of the procuring activity and will not be included in the quantity of castings called for in the contract or order.

4.3.2 Sampling for quality conformance inspection.

4.3.2.1 Sampling for visual and dimensional examination. Sampling of castings for dimensional, identification marking, and workmanship inspection shall be in accordance with the provisions of MIL-STD-105, inspection level II, and acceptable quality level (AQL) 1.5 percent defective.

*4.3.2.2 Sampling for soundness. Unless otherwise specified in the contract or purchase order (see 6.2), sampling of castings for soundness shall be in accordance with the provisions of MIL-STD-105, inspection level II, and AQL level 0.65 percent defective. (The number of castings in a lot cannot always be predicted and therefore sampling for soundness in accordance with MIL-STD-105 may not apply.)

4.3.2.3 Sampling for packaging, packing, and marking. A random sample of shipping containers for the inspection herein shall be selected in accordance with the provisions of MIL-STD-105, inspection level II, and AQL level 4.0 percent defective.

4.3.2.4 Sampling for chemical compositions. Three samples shall be taken from each heat in accordance with FED-STD-151 for chemical analysis.

*4.3.2.5 Sampling for mechanical properties. Sampling for mechanical property tests shall be in accordance with the following:

(a) Separately cast test bars: Unless otherwise specified in the contract or purchase order (see 6.2), at least two separately cast test coupons shall be poured for each lot. Test coupons shall conform to figure 1 of this specification. Test coupons shall be poured in molds of the same material as used for the castings they represent and shall not be chilled.

*(b) Attached coupons: When specified in the contract or order (see 6.2) or if the manufacturer so desires and the procedure is satisfactory to the Government inspector, test coupons shall be attached to castings of copper alloy No. 861, 862, 863, 865, 952, and 955 under the following conditions:

(1) Each casting weighing 250 pounds or more shall have at least one test coupon attached thereto.

(2) In case of castings weighing less than 250 pounds each, at least one test coupon shall be attached to one or more of the castings from each lot.

(c) Sample castings: When the manufacturer so desires, a casting in the lot may be submitted as the test coupon in lieu of attached or separately cast coupons.

4.3.2.6 Sampling for pressure tightness. All castings from each lot shall be subjected to pressure tightness tests.

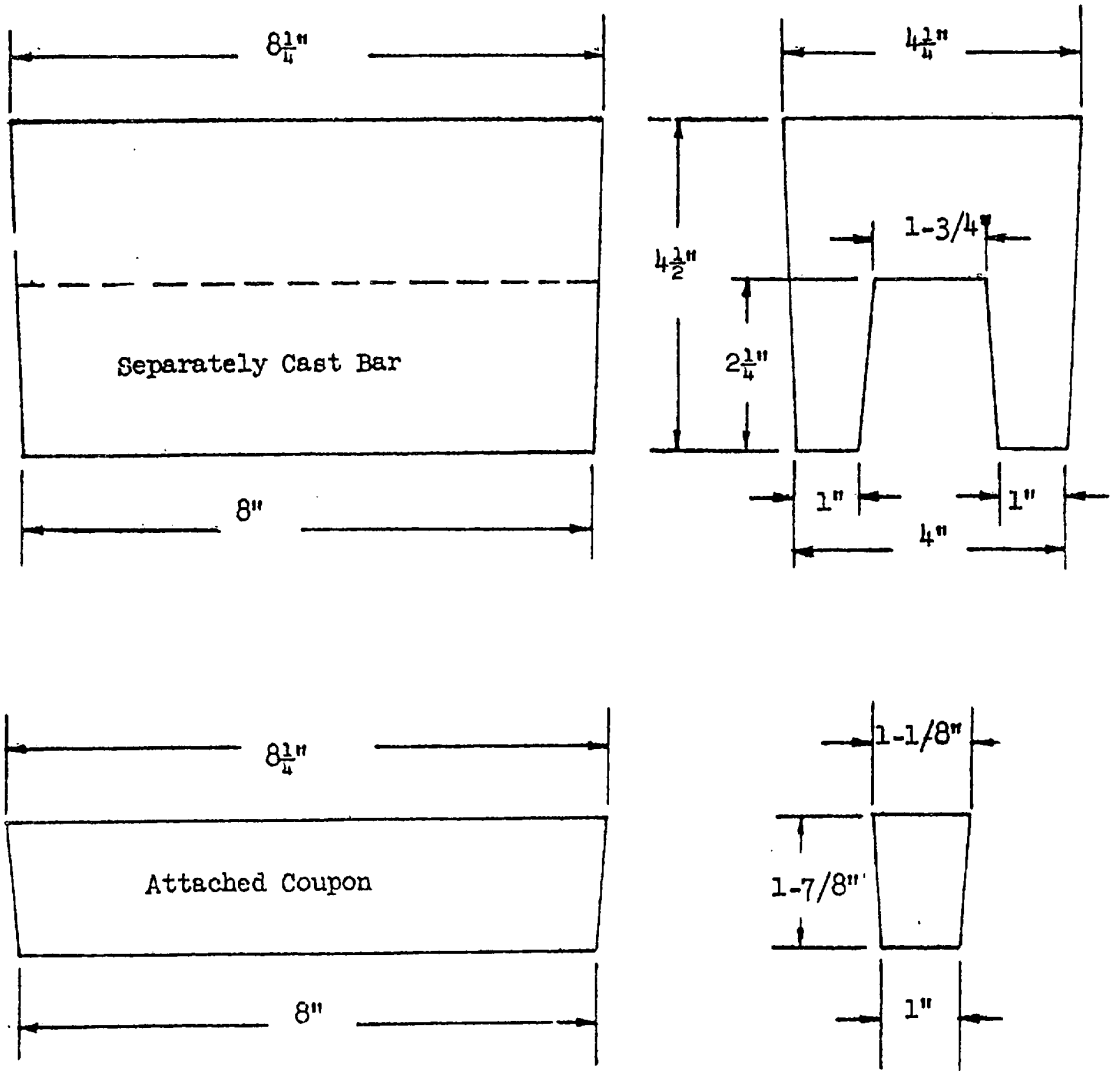

FIGURE 1. SEPARATELY CAST MECHANICAL PROPERTY TEST SAMPLE

*4.4 Classification of examinations and tests. The classification of examinations and tests shall be in accordance with the following:

(a) Preproduction inspection (see 4.5)
(b) Quality conformance inspection (see 4.6).

*4.5 Preproduction inspection. Preproduction inspection shall consist of all the quality conformance inspections herein on the samples submitted (see 4.3.1) and conformance with the provisions herein prior to starting production of castings.

4.6 Quality conformance inspection. The quality conformance examinations and tests shall consist of the following:

4.6.1 Visual and dimensional examination. Sample castings selected in accordance with 4.3.2.1 shall be inspected to determine conformance to the dimensional requirements of 3.6, the identification marking of 3.8, and the workmanship requirements of 3.9, 3.9.1, and 3.10.

4.6.2 Soundness. Sample castings selected in accordance with 4.3.2.2 shall be radiographically inspected in accordance with MIL-STD-271.

*4.6.3 Preservation, packaging, packing, and marking. Sample shipping containers shall be inspected to determine that preservation, packaging, packing, and marking of containers selected in accordance with 4.3.2.3 is in accordance with the requirements of this specification and the contract or order.

*4.6.4 Chemical composition. Chemical composition shall be determined in accordance with method III of FED-STD-151 under the following conditions.

(a) Unless otherwise specified, the tests shall be performed on the metal sample selected in accordance with 4.3.2.4.

(b) Specimens shall be tested by the wet chemical, spectrographic, or other analytical methods. In case of dispute, analysis by wet chemical methods shall govern.

(c) If any sample fails to conform to these chemical requirements, the lot represented by the sample shall be rejected.

*(d) In reporting chemical analyses obtained by the use of instruments, such as a spectrograph, X-ray, and atomic absorption, copper may be indicated as "remainder." In reporting chemical analyses obtained by wet methods, zinc may be indicated as "remainder" on those alloys with over 2 percent.

*4.6.5 Mechanical properties. Mechanical properties shall be determined in accordance with FED-STD-151 under the following conditions:

*(a) The test bars shall be those prepared in accordance with 4.3.2. Test specimens shall conform to the requirements of ASTM E 8.

(b) If a test bar fails to conform to these mechanical properties, the lot represented by the test bar shall be subject to rejection.

(c) Retests will be permitted in accordance with the provisions of FED-STD-151.

4.6.6 Pressure tightness. Specific requirements of the test such as minimum pressure, length of time under pressure, media for applying pressure, and test temperature shall be as specified on the applicable drawing.

*4.7 Disposition of nonconforming product. If a test specimen fails to conform to the requirements of this specification, the lot represented by the specimen shall be rejected. Nonconforming lots shall be disposed of in accordance with the provisions of MIL-STD-105. If the failure is due to improper heat-treatment, the lot may be reheat-treated and resubmitted. Only two such reheat-treatments shall be permitted. Retests shall be permitted in accordance with the procedures set forth in the applicable sections of FED-STD-151.

5. PREPARATION FOR DELIVERY

5.1 Preparation for shipment. Preparation for shipment shall be level A, B, or C as specified. (See 6.2 and 6.6.) Individual containers shall contain only material of the same lot. All casting shall be separated by alloy, condition, and pattern when prepared for shipment. Where practicable, each container shall be of the same uniform size and contain the identical number of items of one lot. 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.

5.1.1 Finished or polished castings. Finished or polished castings shall be so packed as to afford adequate protection to the finished surfaces. Where practicable, the castings shall be boxed. Large polished or finished castings, when boxing is not practicable, shall have finished or polished surfaces protected with batten strips.

5.1.2 Rough castings. Unless otherwise specified in the contract or order (see 6.2), rough castings not subject to damage in shipment may be shipped unpacked or bundled.

5.1.3 Castings having projections. Castings having projections that may be damaged in handling shall be boxed or crated or the projections adequately protected by wood batten strips.

5.2 Packing.

5.2.1 Level A.

5.2.1.1 Small castings. Castings weighing up to 250 pounds each shall be packed in wirebound wood boxes, cleated-plywood boxes, nailed wood boxes, or wood crates conforming to PPP-B-585 (class 3), PPP-B-601 (overseas type), PPP-B-621 (class 2), or PPP-B-650, as applicable. Finished castings shall be adequately protected from mechanical damage. The gross weight of shipping container shall not exceed approximately 600 pounds.

5.2.1.2 Other castings. Large rough castings weighing more than 250 pounds each require no packing, except that when specified for convenience in handling due to size and shape, the items shall be secured on skids or pallets. Large finished or polished castings having projections or surfaces that may be damaged shall be packed as specified in 5.1 through 5.1.3. Containers, when required, shall be as specified in 5.2.1.1.

5.2.2 Level B.

5.2.2.1 Small castings. Castings weighing up to 250 pounds each shall be packed in wirebound wood boxes, cleated-plywood boxes, nailed wood boxes, or wood crates conforming to PPP-B-585 (class 1 or 2), PPP-B-601 (domestic type), PPP-B-621 (class 1), or PPP-B-650, as applicable. Finished castings shall be adequately protected from mechanical damage. The gross weight of shipping containers shall not exceed approximately 600 pounds.

5.2.2.2 Other castings. Castings shall be packed as specified in 5.2.1.2 except, shipping containers, when required, shall be in accordance with 5.2.2.1.

5.2.3 Level C. Castings shall be so prepared and shipping containers so constructed as to ensure safe delivery by common or other carrier to the point of delivery at the lowest rate, and afford maximum protection from the normal hazards of transportation. Containers shall comply with the Consolidated Freight Classification Rules or other carrier regulations applicable to the mode of transporation.

5.3 Marking. Unless otherwise specified in the contract or purchase order (see 6.2) each bundle, shipping container, and unpacked casting shall be marked with the name of the material, part number as specified on the drawings, alloy and condition of the castings, this specification number, the gross weight and quantity, the name of the contractor, and the number of the contract or order.

5.3.1 Special marking. In addition to the marking specified in 5.3 and special markings required in the contract or purchase order (see 6.2), marking of the shipping containers shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Castings covered by this specification are intended primarily for pressure tight applications where leak free service under gas or hydrostatic pressure is required.

*6.1.1 Alloy No. 836. Hydraulic bronze is used for castings requiring fair strength, good machining properties, and good corrosion resistance. For pressure castings, it is considered better than alloy No. 903. However, it is also susceptible to gas porosity and interdendritic shrinkage and, therefore, should be limited to pressure castings which have as cast section thicknesses 1/2 inch or less and require little machining. For critical nonmagnetic applications, the iron content should be 0.10 percent maximum.

*6.1.2 Alloy No. 861, 862, and 863. Aluminum-manganese bronzes are heavy duty high strength bronzes used where strength, toughness, or resistance to sea water corrosion resistance is required. Where stress

corrosion is encountered alloy No. 861 is the best of these three alloys for service use. These alloys have the same limitations as alloy No. 865 for pressure casting applications.

*6.1.3 Alloy No. 865. Manganese bronze is used for parts requiring medium high strength and good resistance to salt water corrosion. This bronze is excellent for producing dense pressure castings because of its freedom from interdendritic shrinkage. Its limitations for pressure castings applications are the same as those of alloy No. 952 and 955.

*6.1.4 Alloy No. 872. Silicon bronze is a bronze used for parts requiring good corrosion resistance and moderate strength. It is used as a tin saving substitute for alloy No. 903 and has approximately the same limitations for pressure casting applications as alloy No. 903. Its castability is good but not as good as alloy No. 836, 903, and 934.

*6.1.5 Alloy No. 903. Tin bronze is a general purpose bronze used for parts requiring good corrosion resistance and moderate strength. For pressure castings its use should be limited to castings with as cast section thicknesses of 1/2 inch or less. Its susceptibility to gas porosity and interdendritic shrinkage limits its application for pressure casting to thin wall parts with very little machining.

*6.1.6 Alloy No. 952 and 955. Aluminum and aluminum-nickel bronzes have very good resistance to sea water corrosion, shock, and fatigue. They are excellent for producing heavy duty, dense high strength pressure castings because of their freedom from interdendritic shrinkage. These bronzes are readily welded. The use of this bronze for pressure castings is limited by its castability to less intricate casting shapes than can be cast by alloy No. 836, 872, 903, 934, and 952.

*6.1.7 Alloy No. 958. Bronze, nickel aluminum castings are heavy duty, high strength, pressure tight castings for sea water applications (other than propellers) and resistance to corrosion is imperative. (For castings for propellers, refer to MIL-B-21230.)

*6.2 Ordering data. Procuring documents should specify the following:

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

(b) The alloy No. and condition of the castings required (see 1.2, 3.2, and 3.3)

(c) Mechanical properties if other than specified herein (see 3.4)

(d) Applicable drawings or dimensions of castings (see 3.6)

*(e) Preproduction samples and location of test (when required) (see 3.1, 4.3, 4.3.1, and 4.5)

(f) Sampling plan for soundness when MIL-STD-105 may not apply due to lot size (see 4.3.2.2)

(g) Sampling for mechanical properties, if different from 4.3.2.5

(h) Place of inspection and test, if different from the suppliers (see 4.1)

(i) Whether level A, level B, or level C packaging and packing is required (see 5.1 and 6.6)

(j) Whether rough casting are to be shipped other than specified in 5.1.2

(k) Additional marking, if required, or other than specified (see 5.3 and 5.3.1).

*6.3 Supersession data. This specification includes the requirements of MIL-B-23921 as copper alloy No. 958.

6.4 Analysis for other elements. When desirable and by agreement between consumer and producer, analysis may be required and limits established for elements not specified in the table of chemical requirements.

6.5 Defective castings. The contractor may be required to replace castings in which injurious defects are revealed by manufacturing operations performed subsequent to acceptance, without expense to the Government.

6.6 Preparation for delivery criteria. Criteria for use of the proper level of packaging and packing specified in section 5, preparation for delivery, shall be as follows:

(a) Level A: This level shall be used for those items which are to be shipped to indeterminate destinations or stored under indeterminate conditions for redistribution anywhere.

(b) Level B: This level shall be used for protection against damage during multiple domestic shipments, handling, and covered storage.

(c) Level C: This level shall be used only when it is definitely known that the packaged item is to be shipped to domestic installations for immediate use at the first receiving activity.

*6.7 The margins of this specification are marked with an asterisk 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.

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(See Instructions -- Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
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	☐ MANUFACTURER
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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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