MIL-C-11866C(MR)
14 January 1980
SUPERSEDING
MIL-C-11866B(ORD)
13 November 1961

MILITARY SPECIFICATION

CASTINGS, PRECISION, NONFERROUS

This specification is approved for use by the Army Materials and Mechanics Research Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers nonferrous castings cast to close dimensional tolerances in nonmetallic molds.

1.2 Classification. Precision castings covered by this specification shall be furnished in the alloys and tempers shown in table 1.

Table 1 - Alloy and temper

Commercial Alloy Designation & Applicable Specification	Temper	
B443.0 (ASTM B26)	F	As cast
356.0 (ASTM B26)	T6	Solution heat treated and artificially aged
355.0 (ASTM B26)	T6	Solution heat treated and artificially aged
	T71	Solution heat treated and further artificially aged
514.0 (ASTM B26)	F	As cast
535.0 (ASTM B26)	F	As cast
295.0 (ASTM B26)	T4	Solution heat treated
	T6	Solution heat treated and artificially aged
	T62	Solution heat treated and further artificially aged

Area MECA

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Army Materials and Mechanics Research Center, 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.

Table 1 - Alloy and temper (Cont'd)

Commercial Alloy Designation & Applicable Specification	Temper	
712.0 (ASTM B26)	F	As cast
	T5	Artificially aged (no prior solution heat treatment)
771.0 (ASTM B26)	T6	Solution heat treated and artificially aged
AZ63A (ASTM B80)	F	As cast
	T4	Solution heat treated
	T5	Artificially aged (no prior solution heat treatment)
	T6	Solution heat treated and artificially aged
AZ91C (ASTM B80)	F	As cast
	T4	Solution heat treated
	T5	Artificially aged (no prior solution heat treatment)
	T6	Solution heat treated and artificially aged
AZ92A (ASTM B80)	F	As cast
	T4	Solution heat treated
	T5	Artificially aged (no prior solution heat treatment)
	T6	Solution heat treated and artificially aged
QZ33A (ASTM B80)	T5	Artificially aged (no prior solution heat treatment)
HK31A (ASTM B80)	T6	Solution heat treated and artificially aged
HK32A (ASTM B80)	T5	Artificially aged (no prior solution heat treatment)
ZK51A (ASTM B80)	T5	Artificially aged (no prior solution heat treatment)
ZH62X (ASTM B80)	T5	Artificially aged (no prior solution heat treatment)
C82500 (MIL-C-22087)	M06	As Cast
	TF00	Solution and precipitation heat treated
C87400 (ASTM B584)	M06	As cast
C87200 (ASTM B584)	M06	As cast
C86200 (ASTM B584)	M06	As cast
C86300 (ASTM B584)	M06	As cast
C95300 (ASTM B148)	M06	As cast
	TF00	Solution and precipitation heat treated
C95400 (ASTM B148)	M06	As cast
	TF00	Solution and precipitation heat treated
C95500 (ASTM B148)	M06	As cast
	TF00	Solution and precipitation heat treated
C83600 (ASTM B584)	M06	As cast
C90300 (ASTM B584)	M06	As cast
C85700 (ASTM B584)	M06	As cast
C85200 (ASTM B584)	M06	As cast

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents form a part of this specification to the extent specified herein.

SPECIFICATION

FEDERAL

PPP-B-585	Box, Wood, Wirebound

MILITARY

MIL-C-22087	Copper Alloy Investment Castings

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedure and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-1188	Commercial Packaging of Supplies and Equipment

(Copies of specifications, standards, drawings, and publications required by contractors, 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 the date of invitation for bids or request for proposals shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

ASTM B26 - Aluminum-Alloy Sand Castings
ASTM B80 - Magnesium Alloy Sand Castings
ASTM B148 - Aluminum Bronze Sand Castings
ASTM B584 - Copper Alloy Sand Castings for General Applications

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

3. REQUIREMENTS

3.1 Chemical composition and mechanical properties. The chemical composition and mechanical properties for the alloy required shall conform to the applicable commercial alloy and ASTM standard listed in table 1 for the temper specified (see 6.2).

3.1.1 Certification. The contractor shall certify to the analysis of each master heat showing the percentages of the elements designated. A master heat shall be defined as previously refined metal or a single furnace charge or blend thereof.

3.2 Grain size. When specified (see 6.2), grain size shall conform to standards furnished or approved by the procuring agency.

3.3 Dimensions and tolerances. Castings shall conform to the drawings specified in the contract or order with respect to dimensions and tolerances. Unless otherwise specified (see 6.2), the tolerance on as-cast dimensions shall be ± 0.005 in. per in. (0.127mm per 25.4mm).

3.4 Surface finish. The surface finish of the completed castings shall conform to such standards as may be furnished or approved by the procuring agency, or shall be equal to or better than the surface finish of a sample casting furnished or aproved by the procuring agency. When surface finish measurements are specified (see 6.2) as a basis for acceptance, the method of measuring surface finish shall be as specified by the contracting officer.

3.5 Identification marking. When specified (see 6.2), castings shall be identified with the melt or inspection lot number, and in addition, when specified on the drawing, shall be marked with the drawing or part number by any method which has no deleterious effect on serviceability.

3.6 Repair of castings. Castings shall not be peened, plugged, welded, or impregnated unless approval is granted by the contracting officer.

3.7 Nondestructive inspection. When specified (see 6.2), the castings shall meet the radiographic, magnetic particle, or liquid penetrant standards approved by the contracting officer.

3.8 Special requirements. Castings shall meet any additional requirements specified on the drawing or as specified in the contract (see 6.2).

3.9 Workmanship. Castings shall be of uniform quality and condition and free from cracks, harmful shrinkage, porosity, gas holes, foreign matter, hard spots, and other injurious defects. Unless otherwise specified (see 6.2), the surface of the castings shall be free from pits, parting lines, porous areas, fins, ridges, nodules, raised metal and scale. All castings shall be completely cleaned prior to presentation for inspection.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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. A lot shall consist of all castings submitted for inspection at one time which are of the same design, same melt or master melt, and heat treated in the same furnace charge when heat treatment is involved.

4.3 Sampling

4.3.1 Chemical analysis and mechanical properties. Unless otherwise specified (see 6.2), sampling for chemical analysis and for tension testing, hardness shall be in accordance with the ASTM standards B26, B80, B148, and B584 as applicable for the alloy specified. Alloy C82500 shall be sampled in accordance with MIL-C-22087.

4.3.2 Nondestructive inspection. When specified (see 6.2), sampling for nondestructive inspection shall be a plan approved by the contracting officer.

4.3.3 Grain size. When specified (see 6.2), a minimum of three castings from each lot shall be examined for grain size standards approved by the contracting officer.

4.3.4 Visual and dimensional examination. Sampling of castings for dimensionsal, identification marking, surface finish, 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. The samples selected for any one examination may be used for all examinations.

4.4 Tests.

4.4.1 Chemical analysis. Unless otherwise specified (see 6.2, samples selected for chemical analysis shall be analyzed in accordance with the method specified in the applicable ASTM standard for the alloy required. Alloy C82500 shall be analyzed in accordance with MIL-C-22087.

4.4.2 Tension and hardness test. Unless otherwise specified (see 6.2), tension test specimens and hardness tests specimens shall be tested in accordance with the methods specified in the applicable ASTM standard for the alloy required.

4.4.3 Grain size. Unless otherwise specified (see 6.2), grain size sall be determined on the ends of the tension test specimens, before pulling.

4.5 Surface finish examination. Samples selected in accordance with 4.3.4 shall be inspected to detemine compliance with 3.4 and 3.9.

4.6 Rejection.

4.6.1 Examination of defects. Any sample unit having one or more defects shall be rejected. If the number of nonconforming sample units in the sample exceeds the acceptance number specified in Section 4.3, the entire lot shall be rejected.

4.7 Inspection for preparation for delivery. An examination shall be made to determine that preservation, packing, and marking comply with Section 5 of this specification.

5. PACKAGING.

(The preparation for delivery requirements specified herein apply only for direct Government procurement.)

5.1 Preservation and packaging. Designated machined surfaces of castings shall be preserved and packaged in accordance with the contract or order (see 6.2.1).

5.1.1 Levels A and commercial. Packaging shall be sufficient to afford adequate protection against damage during shipment from the supply source to the using activity.

5.2 Packing. Shipping containers shall be of similar constructions, uniform size, and shall contain the same number of castings of one size, melt, or lot number. Containers shall be designed to fit the contents in a compact manner. The number of packages per pack shall be as specified in 6.2.

5.2.1 Levels A and B. Unless otherwise specified (see 6.2), casting having projections which may be damaged in handling or shipment, shall be packed individually, or in multiple units with adequate blocking, bracing, and cushioning in boxes conforming to PPP-B-585, type 3. The gross shipping weight shall not exceed 150 pounds.

5.2.2 Commercial. Castings shall be packed in accordance with MIL-STD-1188.

5.3 Marking. In addition to any special marking reuired by the contract (see 6.2), shipment shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The precision castings purchased under this specification are intended primarily for use in manufacture and assembly of ordnance equipment. The data in table 2 are approximate, and are for general information.

6.2 Ordering Data. Purchasers should exercise the desired options offered herein and procurement documnts should specify the following:

6.2.1 Procurement requirements.

a. Title, number and date of this specification.
b. Alloy and temper of castings required (see 1.2 and 3.1).
c. Grain szie, if required and method of determination (see 3.2).
d. Applicable drawings of castings or tolerances if other than specified herein (see 3.3).
e. Surface finishing and method, when required (see 3.4).
f. Identification marking, when required (see 3.5).
g. Method of nondestructive inspection, when required (see 3.7).
h. If special requirements are needed (see 3.8).
i. Degree of surface conditions that can be tolerated (see 3.9).
j. If different sampling plan is required (see 4.3.1).
k. If different tests are required (see 4.4.1, 4.4.2 and 4.4.3).
l. The levels of preservation and packing required (see 5.1).
m. If additional marking is required (see 5.3).

6.2.2 Data requirements. When this specification is used in the contract which invokes the provision of the "Requirements for Data of the Defense Acquisition Regulation (DAR)," the data identifed below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the DAR are not invoked in a contract, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

Paragraph	Data Requirements	Applicable DID
3.1.1	Certification Data	UDI-A-23264

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.3 Cross-reference. The cross-reference between the classification of materials in MIL-C-11866B and MIL-C-11866C are shown in table 2.

Custodian:

Army - MR

Review interest:

Army - AR, MI

User interest:

Army - AL, ME, AT

Preparing activity

Army - MR

Project No. MECA-A070

Table 2 - Cross-reference and general information

Cross-reference Designation 3/		UNS 1/	Castability 2/	Remarks
MIL-C-11866B Composition	MIL-C-11866C Alloy			
1.	B443.0 (ASTM B26)	A04430	A	Excellent corrosion resistance. No great advantage over composition 2 in as-cast condition.
2.	356.0 (ASTM B26)	A03560	A	Combines best foundry characteristics with best overall mechanical properties.
3.	355.0 (ASTM B26)	A03550	B	Stronger but less ductile than comp. 2.
4.	514.0 (ASTM B26)	A05140	C	Good corrosion resistance (less than comp. 1 alloy, but w/greater strength)
5.	535.0 (ASTM B26)	A05350	C	Good mechanical properties.
6.	295.0 (ASTM B26)	A02950	C	Tendency for copper segregation
7.	712.0 (ASTM B26)	-	B	Use where subsequent brazing is to be done.
None	771.0 (ASTM B26)	A0771	B	Use where subsequent brazing is to be done
8.	A263A (ASTM B80)	M11630	D	General use. Good combination of strength ductility, and toughness.

Table 2 - Cross-reference and general information (Cont'd)

Cross-reference Designation 3/		UNS 1/	Castability 2/	Remarks
MIL-C-11866B Composition	MIL-C-11866C Alloy			
9.	AZ91C (ASTM B80)	M11914	B	Better foundry characteristics than comp. 8, but slightly less corrosion resistant. Good pressure tightness
10.	AZ92C (ASTM B80)	M11920	B	Similar to comp. 9, but not as weldable as comp. 9
11.	Discontinued			No longer available.
12.	EZ33A (ASTM B80)	M12330	B	No solution heat treatment needed.
13.	HK31XA (ASTM B80)	M13310	C	Useful range extended to 650 F
14.	HZ32XA (ASTM B80)	M13320	C	Similar to comp. 13. No solution heat treatment needed.
15.	ZK51A (ASTM B80)	M16510	C	Good Mechanical properties.
16.	ZH62A (ASTM B80)	M16620	C	High strength magnesium base alloy.
17.	825 (MIL-C-22087)	C832500	A	Can be brought to spring temper but then is poor for impact.
18.	874 (ASTM B584)	C87400	A	Used for stressed parts which need good corrosion resistance.
19.	872 (ASTM B584)	C87200	A	Similar to comp. 18 but lower strength.
20.	862 (ASTM B584)	C86200	C	High strength and toughness. Good elevated temperature properties. Susceptible to stress corrosion.

Table 2 - Cross-reference and general information (Cont'd)

Cross-reference Designation[3]				
MIL-C-11866B Composition	MIL-C-11866C Alloy	UNS[1]	Castability[2]	Remarks
21.	863 (ASTM B584)	C86300	C	Similar to comp. 20. Stronger and less ductile.
22.	953 (ASTM B148)	C95300	C	Excellent resistance to abrasion corrosion and fatigue. Good elevated temperature properties (to 600 F).
23.	954 (ASTM B148)	C95400	C	Similar to comp. 22.
24.	955 (ASTM B148)	C95500	C	Similar to comp. 22.
25.	836 (ASTM B584)	C83600	B	Good bearing properties and machinability, standard for general service.
26.	903 (ASTM B584)	C90300	C	Excellent steam metal and structural bronze. Relatively good electrical conductivity (80%).
27.	857 (ASTM B584)	C85700	D	Ornaments where strength is not important, but want corrosion resistance.
28.	852 (ASTM B584)	C85200	D	General purpose. Good machinability.

[1]Unified Number System

[2]A = Excellent B = Good C = Fair D = Poor

[3]Cross-reference for temper designations of copper alloys are as follows: OLD - F and HT NEW - 406 and TF00, respectively.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

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

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

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

DD FORM 82 MAR 1426

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