AEROSPACE MATERIAL SPECIFICATION

AMS4863™	REV. A

Issued 2015-02
Revised 2024-07

Superseding AMS4863

Copper-Nickel-Tin Alloy Castings
Cu - 15Ni - 8Sn
Hot Isostatically Pressed, Solution Annealed and Spinodal Heat Treated
(Composition similar to UNS C96900)

RATIONALE

AMS4863A results from a Five-Year Review and update of this specification with changes to clarify that casting approval and reapproval actions are to be carried out by the cognizant engineering organization (see 4.2.2 and 4.4); update wording to prohibit unauthorized exceptions (see 3.8, 4.5.1, and 8.4); relocate Definitions (see 2.3); update Applicable Documents (see Section 2), Composition (see 3.1), and Ordering Information (see 8.5), and allow use of the immediate prior revision of this specification (see 8.3).

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1. SCOPE

1.1 Form

This specification covers a copper-nickel-tin alloy in the form of castings, made using the investment process unless sand or centrifugal processes are agreed upon by the purchaser (see 8.5).

1.2 Application

These copper alloy castings are for use as nonmagnetic small parts of intricate design requiring good corrosion resistance and anti-friction and wear characteristics with high strength, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2175 Castings, Classification and Inspection of

AMS2360 Room Temperature Tensile Properties of Castings

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS4863A

AMS2750 Pyrometry

AMS2804 Identification, Castings

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E18 Rockwell Hardness of Metallic Materials

ASTM E29 Using Significant Digits in Test Data to Determine Conformance with Specifications

ASTM E272 Reference Radiographs for High-Strength Copper-Base and Nickel-Copper Alloy Castings

ASTM E478 Chemical Analysis of Copper Alloys

ASTM E1417 Liquid Penetrant Testing

ASTM E1742 Radiographic Examination

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM E478 or by other analytical methods acceptable to the purchaser (see 8.5).

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Table 1 - Composition

Element (see 3.1.1)	Min	Max
Nickel (+ Cobalt)	14.5	15.5
Tin	7.5	8.5
Iron	--	0.50
Zinc	--	0.50
Manganese	--	0.30
Columbium	--	0.10
Magnesium	--	0.15
Lead	--	0.02
Copper (see 3.1.2)	remainder	
Copper + sum of Named Elements (see 3.1.3)	99.5	

3.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and the purchaser.

3.1.2 Copper may be reported as “remainder,” or as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.

3.1.3 When all the elements in the table are analyzed, the sum shall be 99.5% minimum, but such determination is not required for routine acceptance of each lot.

3.1.4 Test results may be rounded in accordance with the “rounding off” method of ASTM E29.

3.2 Condition

Hot isostatically pressed, solution heat treated and spinodally hardened.

3.3 Casting

Castings shall be made by the investment casting process unless another process is agreed to by the purchaser. Castings shall be poured from a single furnace charge of not more than 2000 pounds (907 kg). The furnace charge may consist of virgin material, gates, sprues, risers, or other recycled material.

3.4 Heat Qualification

Each heat shall be qualified by chemical analysis and tensile specimens conforming to 3.4.1 and 3.4.2, respectively. Heat identity of all specimens and parts shall be maintained through all operations.

3.4.1 Chemical Analysis Specimens

Shall be cast from each heat after the last melt addition and shall be of any suitable size, shape, and form.

3.4.2 Tensile Specimens

Unless otherwise specified by the purchaser, specimens shall be cast separately as net shape tensile specimens, which are ready for testing after heat treatment (see 3.5). Specimens shall be of standard proportions in accordance with ASTM E8/E8M with 0.350-inch (8.89-mm) diameter at the reduced parallel gage section or shall be prepared as agreed upon with the purchaser.

3.5 Heat Treatment

All castings and representative tensile specimens shall be subjected to hot isostatic pressing (HIP) in the as-cast condition, followed by solution annealing and spinodal heat treatment. Pyrometry shall be in accordance with AMS2750. Hot isostatic pressing, solution heat treatment, and spinodal hardening heat-treatment practices are proprietary.

3.6 Properties

Separately cast net shape tensile samples shall conform to the following requirements:

3.6.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M on specimens in accordance with 3.4.2.

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	113 ksi (779 MPa)
Yield Strength at 0.2% Offset	96 ksi (662 MPa)
Elongation in 4D	2%

3.6.2 Hardness

Shall be not lower than HBW277, or equivalent, determined in accordance with ASTM E18.

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3.6.3 When properties other than those of 3.6.1 and 3.6.2 are required, the engineering drawing or purchase order shall specify tensile property and hardness limits. Property requirements may be designated in accordance with AMS2360.

3.6.4 Microstructure

When specified, microstructure and grain size shall conform to standards acceptable to the purchaser (see 8.5).

3.7 Quality

3.7.1 Castings, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the castings.

3.7.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with ASTM E1742 until proper foundry technique is established for each part number and of production castings as necessary to ensure satisfactory quality. ASTM E272 may be used to define radiographic acceptance standards acceptable to the purchaser (see 8.5).

3.7.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417. Standards for acceptance shall be as agreed upon between the purchaser and vendor (see 8.5).

3.7.4 Castings shall not be reworked by plugging, peening, welding, or other methods without written permission from the purchaser.

3.7.5 Methods of inspection and frequency of inspection shall be as agreed upon by the purchaser and vendor (see 8.5).

3.7.6 When acceptance standards are not specified, the following applies: Castings shall meet Grade C of AMS2175, and radiographic indications of gas holes, sand spots, and inclusions shall be cause for rejection when closer to the edge than twice their maximum dimension.

3.8 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.5.1

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of castings shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Except as specified in 4.2.1.1, composition (see 3.1), tensile properties (see 3.6.1), hardness (see 3.6.2), and, when specified, microstructure (see 3.6.4) and fluorescent penetrant inspection (see 3.7.3) are acceptance tests and shall be performed to represent each heat and lot of castings.

4.2.1.1 Tensile properties of specimens cut from castings shall be determined only when specified by the purchaser or when separately cast net shape tensile samples are not available (see 8.5).

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4.2.2 Preproduction Tests

All technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, when a change in material and/or processing requires reapproval by the cognizant engineering organization as in 4.4.2, and when the purchaser and/or the cognizant engineering organization deems confirmatory testing to be required.

4.3 Sampling and Testing

A lot shall be all castings of the same form and size from the same heat processed at the same time. Sampling and testing shall include the following:

4.3.1 One chemical analysis specimen from each heat for conformance to 3.1.

4.3.2 A minimum of two castings from each lot for hardness testing in accordance with 3.6.2.

4.3.3 Sufficient castings of each part number shall be supplied in accordance with 4.4.1 to ensure that all requirements of the drawing and this specification can be tested.

4.3.4 Unless otherwise specified, one separately cast net-shape tensile sample, representing each lot for testing as in 3.6.1.

4.4 Approval

4.4.1 Sample castings from new or reworked master patterns and the casting procedure shall be approved by the cognizant engineering organization before castings for production use are supplied, unless such approval is waived by the cognizant engineering organization.

4.4.2 The producer shall establish, for production of sample castings of each part number, parameters for the process control factors that will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in parameters for the process control factors, the producer shall submit for reapproval to the cognizant engineering organization a statement of the proposed changes in processing and, when requested, test specimens, sample castings, or both. Production castings incorporating the revised procedures shall not be shipped prior to receipt of reapproval by the cognizant engineering organization.

4.4.2.1 Control factors for producing castings include, but are not limited to, the following; additional or other control factors may be listed depending on the method of casting:

Type of furnace and its capacity
The casting method used
Type and size of furnace charge
Time molten metal is in furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Number of ladles, if required, used in pour
Mold refractory formulation
Mold backup material
Gating practices
Mold preheat and metal pouring temperatures; variations of ±25 °F (±14 °C) are permissible
Solidification and cooling procedures
Solution heat-treatment cycle
Cleaning operations
Methods of inspection

4.4.2.1.1 Any of the above process control factors for which parameters are considered proprietary by the producer may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

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