METRIC
MIL-C-24723
7 June 1989

MILITARY SPECIFICATION

CASTINGS, NICKEL-COPPER ALLOY

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

1. SCOPE

1.1 Scope. This specification covers three nickel-copper alloys for static or centrifugal casting for corrosion resistant service.

1.2 Classification. Nickel-copper alloy castings shall be of the following compositions, as specified (see 6.2):

Composition
M-30C (see 6.1.1)
M-30H (see 6.1.2)
M-25S (see 6.1.3)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
AREA MECA

STANDARDS

FEDERAL

FED-STD-102 - Preservation, Packaging, and Packing Levels.
FED-STD-123 - Marking for Shipment (Civil Agencies).
FED-STD-182 - Continuous Identification Marking of Nickel and Nickel Base Alloys.

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.
MIL-STD-271 - Requirements for Nondestructive Testing Methods.
MIL-STD-278 - Welding and Casting Standard.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 494/A 494M - Standard Specification for Castings, Nickel and Nickel Alloy.
A 802/A 802M - Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination.

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

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.1.1 No change shall be made to the casting method used for first article sample without specific approval of the Command or agency concerned (see 6.4.1).

3.2 Materials. In addition to the requirements specified in ASTM A 494, nickel-copper castings shall be in accordance with 3.3 through 3.9. Unless otherwise specified (see 6.2), either centrifugal or static castings may be supplied at the option of the foundry.

3.3 Chemical composition. The chemical composition shall be in accordance with ASTM A 494 (see 4.4.3) except iron content shall be 2.5 percent maximum.

3.4 Mechanical properties. The mechanical properties shall be in accordance with ASTM A 494 (see 4.4.3) except for composition M-25S which shall meet the requirements of 3.4.1.

3.4.1 Composition M-25S. Unless otherwise specified (see 6.2), the hardness of M-25S shall be the only mechanical property required. The hardness shall be 300 Brinell minimum. As-cast material may be aged to achieve this hardness. When tensile properties are specified, they shall meet the requirements of table I.

TABLE I. Mechanical properties for composition M-25S.

Tensile strength, minimum lb/in^2	Yield strength, at 0.2 percent offset or 0.5 percent extension under load, lb/in^2	Elongation in 2 inches, minimum lb/in^2	Hardness, Brinell, 3000Kg load
120,000	80,000	10	250 - 300

3.5 Weldability. Composition M-30C shall conform to the weldability requirement specified in ASTM A 494.

3.6 Soundness. Castings shall be free of cracks, hot tears, non-metallic inclusions, shrinkage, laps, fins and gas porosity, that may be detected by visual examination or are revealed by manufacturing operations performed subsequent to acceptance or by nondestructive inspections as specified (see 4.4.2). Perfects are as defined in ASTM A 802/A 802M.

3.7 Repair of castings. In addition to the requirements specified in ASTM A 494, weld repair of M-30C alloy shall be performed in accordance with MIL-STD-278 or an equivalent welding control standard, as specified (see 6.2). Welding procedure and welders shall be qualified in accordance with MIL-STD-248 or the standard specified (see 6.2) prior to production. M-30H and M-25S alloys shall not be weld repaired.

3.8 Identification marking. Individual castings shall be marked in accordance with FED-STD-182. In addition, the following marking shall also be applied:

(a) Pattern or drawing number.
(b) Lot or heat number.
(c) Foundry's name or trademark.

Where castings cannot be marked, the required information shall be recorded on a metal or oil proof tag which shall be affixed to the individual casting.

3.9 Recovered materials. Unless otherwise specified herein, all material incorporated in the castings covered by this specification shall be produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from scrap, from manufacturing operations or secondary metal sources and reprocessed to become a source of raw materials, as opposed to virgin raw materials.

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 (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material (see 6.3).

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examinations and tests as specified in 4.3.2 and 4.3.3 (see 6.3).

4.3.1 Sampling for first article inspection. The first casting of a given design submitted for inspection shall be the first article sample.

4.3.2 Radiographic inspection. The first article casting shall be radiographically inspected in accordance with MIL-STD-271 to the acceptable criteria specified in MIL-STD-278 or other applicable standard to the criticality level as specified (see 6.2).

4.3.3 Mechanical property test. Mechanical properties for first article inspections shall be determined on highly stressed regions of the casting as specified (see 6.2) and shall meet requirements as agreed upon between the Command or agency concerned and the contractor and be compared to values obtained from test bars of 4.4.1.

4.4 Quality conformance inspection.

4.4.1 Sampling.

4.4.1.1 Lot definition. A lot shall consist of all castings from the same heat (see 6.7.1).

4.4.1.2 Sampling for chemical analysis. One sample shall be taken from each lot.

4.4.1.3 Sampling for mechanical property tests. Two tensile specimens shall be taken from each lot. When hardness is required it shall be taken on at least two castings in the lot.

4.4.1.3.1 Static castings. Separately cast test blocks of the shape and dimensions shown on figure 1 shall be cast with each heat. Separate castings may be used at the foundry's option. Unless attached test coupons are specified (see 6.2), use of chills or chill molds is prohibited.

4.4.1.3.2 Centrifugal castings. Centrifugal castings shall have extra length provided, as necessary, for test specimens. When extra length or an additional production casting cannot be provided, separately cast test specimens may be provided. The size of separately produced castings shall be as follows:

(a) The casting's cross section shall be within plus or minus 1 inch thickness of the production casting.
(b) The casting shall be of sufficient thickness to remove test specimens.
(c) The length of the casting shall be at least twice the size of the cross section.

4.4.1.4 Sampling for weldability test. Sampling for weldability test shall be in accordance with ASTM A 494 for static castings. For centrifugal castings, material produced from separately centrifugally cast test material can be used for the weldability test. At least one test bar shall be provided for the weldability test.

4.4.1.5 Sampling for nondestructive tests. Unless otherwise specified (see 6.2), nondestructive tests are required. Unless otherwise specified (see 6.2), each casting shall be inspected.

4.4.1.6 Sampling for visual and dimensional examination. Samples shall be selected from each lot for visual and dimensional examination in accordance with table II. If the number of defective items found in the lot equals or exceeds the rejection number specified in table II, the lot shall be rejected.

TABLE II. Sampling for visual and dimensional examination.

Lot size	Sample size	Accept number	Reject number
2 - 15	2	0	1
16 - 25	3	0	1
26 - 90	5	0	1
91 - 150	8	1	2
151 - 280	13	1	2
281 - 500	20	2	3
501 - 1200	32	3	4

4.4.2 Examination.

4.4.2.1 Visual and dimensional examination. Each of the castings selected in accordance with 4.4.1.6 shall be visually examined for conformance to 3.7 and 3.8 and with the workmanship, finish, and appearance requirements of ASTM A 494. They shall be dimensionally examined for conformance to the drawing or pattern. Any castings in the lot containing one or more visual or dimensional defects shall be considered a defective item and shall be rejected.

4.4.2.2 Soundness. Unless otherwise specified (see 6.2), castings shall be inspected for soundness in accordance with MIL-STD-278 or other standards as specified (see 6.2).

4.4.3 Chemical analysis, tensile tests, hardness test, and weldability test. The chemical analysis and tensile test for quality conformance inspections shall be performed in accordance with ASTM A 494. The hardness and weldability test shall be performed in accordance with the supplemental requirements specified in ASTM A 494.

4.5 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging. The castings shall be separated by size, composition, grade, or class and shall be packaged level A, B, or C as specified (see 6.2). The requirements of FED-STD-102 shall be referenced for definitions of the various levels of packaging protection.

5.2 Marking. In addition to any special marking required (see 6.2), marking for shipment shall be in accordance with MIL-STD-129 for Military activities and FED-STD-123 for civil agencies.

6. NOTES

(This section contain information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use.

6.1.1 Nickel-copper alloy composition M-30C is a weldable alloy intended for use in parts requiring moderate strength, high ductility and high resistance to corrosion.

6.1.2 Nickel-copper-silicon alloy, composition M-30H is intended for applications involving nongalling and antiseizing characteristics coupled with moderately high hardness, high strength and relative ease of machinability. Weldability is poor.

6.1.3 Nickel-copper-silicon alloy, composition M-25S is intended for use where nongalling and antiseizing characteristics combined with high hardness, and good corrosion and abrasion resistance are desired. Weldability is poor.

6.1.3.1 Nickel-copper-silicon alloy, composition M-25S, while machinable in the as-cast condition, is capable of being solution treated for improved machinability and, subsequently, age hardened to a minimum Brinell hardness of 300 and finish machined or ground. However, caution should be exercised in the quenching procedure to avoid the possibility of thermal cracking; pilot heat treatment of parts is recommended before attempting heat treatment. If cooling is fast enough from the pouring temperature to keep all alloys in solution, the castings may be directly aged without solution treating. Heat treatment procedure is described in the supplements to ASTM A 494.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Quantity of castings required.
(c) Shape and dimensions of casting to be supplied as specified by drawing, pattern, or sample (see ASTM A 494).
(d) Composition required (see 1.2).
(e) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(f) When first article inspection is required (see 3.1).
(g) If centrifugal or static casting is required (see 3.2).
(h) If more than hardness is to be tested on M-25S (see 3.4.1).
(i) Applicable standards, if other than MIL-STD-248 and MIL-STD-278 (see 3.7, 4.3.2, and 4.4.2.2).
(j) Requirements for mechanical properties test for first article inspection (see 4.3.3).
(k) Whether attached test bars are required (see 4.4.1.3.1).
(l) Sampling plan when 100 percent inspection is not required (see 4.4.1.5).
(m) If castings are not to be inspected for soundness (see 4.4.2.2).
(n) Level of packaging required (see 5.1).
(o) Special marking required (see 5.2).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.1.1	UDI-T-23191	Certification data for level I material	----
4.3	DI-T-4902	First article inspection report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first ___ production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.4.1 Should the process the contractor plans to use vary from the first article process, he may be required to perform specific first article tests and examinations prior to approval to verify that the change will not degrade casting quality.

6.5 Supersession. When the alloys of QQ-N-288 or MIL-C-15345 are specified, the following equivalent alloys of this specification are to be used.

MIL-C-24723 Composition	QQ-N-288 Composition	MIL-C-15345 alloy
M-30C	A	18
M-30H	B	16
M-25S	C	17
M-25S	D	17
M-30C	E	19
No longer used	F	----

When composition M-25S is used as a replacement for QQ-N-288, composition C, tensile properties should be required.

6.6 Conditions for use of level B preservation. When level B preservation is specified (see 5.1), this level of protection should be reserved for the acquisition of nickel-copper casting for resupply worldwide under known favorable handling, transportation and storage conditions.

6.7 Definition.

6.7.1 Heat. Heat is defined as a single charge produced by the melting process ready to pour into castings. Several charges mixed in one ladle prior to pouring any castings is considered one heat.

6.8 Subject term (key word) listing.

Alloy, nickel-copper-silicon
Casting

Custodians:
Army - MR
Navy - SH
Air Force - 20

Review activities:
Army - AR
Air Force - 20, 99
DLA - IS

User activities:
Army - ER, ME, GL
Navy - MC

Preparing activity:
Navy - SH
(Project MECA-0371)

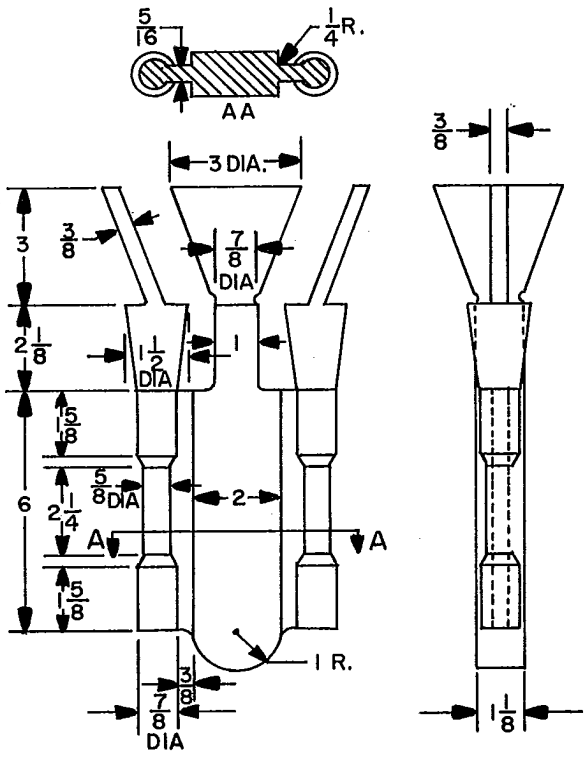

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FIGURE 1. Separately cast test bar.

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