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INTERNATIONAL
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# AEROSPACE STANDARD

SAE AS81021

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## Copper-Beryllium Alloy
## (Copper Alloy Numbers C17500 and C17510), Strip

NOTICE

This document has been taken directly from U.S. Military Specification MIL-C-81021A, Notice 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-C-81021A, Notice 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.





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

1. SCOPE:

1.1 Scope:

This specification covers the requirements for the acquisition of two alloys of Copper-Beryllium alloy strip, having higher electrical conductivity than Copper-Beryllium alloy strip normally used (see 6.1). All sizes of strip are covered by this specification.

1.2 Tempers:

Copper alloy numbers C17500 and C17510 strip shall be furnished flat or coiled in the following tempers, as specified in 6.2:

| | |
|---|---|
| A | -Cold rolled and solution heat treated. |
| 1/2H | -Hot or cold rolled, solution heat treated, and cold rolled half-hard. |
| H | -Hot or cold rolled, solution heat treated, and cold rolled full-hard. |
| AT | -Temper A followed by precipitation hardening. |
| 1/2HT | -Temper 1/2H followed by precipitation hardening. |
| HT | -Temper H followed by precipitation hardening. |

2. APPLICABLE DOCUMENTS:

2.1 Government documents:

2.1.1 Specifications and Standards: Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

| | |
|---|---|
| MIL-C-3993 | Copper and Copper Base Alloy Mill Products, Packaging of. |
| MIL-H-7199 | Heat Treatment of Wrought Copper-Beryllium Alloys, Process For (Copper Alloy: Numbers C1700, C17200, and C17300, C17500, and C17510). |

STANDARDS

FEDERAL

| | |
|---|---|
| FED-STD-151 | Metals; Test Methods. |
| FED-STD-146 | Tolerances for Copper and Copper Base Alloy Mill Products. |
| FED-STD-185 | Identification Marking of Copper and Copper Base Alloy Mill Products. |

2.1.1 (Continued):

MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129 Marking for Shipment and Storage

(Copies of specifications and standards required by manufacturer's in connection with specific acquisition functions should be obtained from the contracting activity as directed by the contracting officer.)

2.2 Other publications:

The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|---|---|
| ASTM D 3951 | Packaging, Commercial |
| ASTM E 8 | Tension Testing of Metallic Materials |
| ASTM E 18 | Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials |
| ASTM B 193 | Test Methods for Resistivity of Electrical Conductor Materials |

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

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)



2.3 Order of precedence:

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

3. REQUIREMENTS:

3.1 Chemical composition:

The chemical composition of the alloys shall conform to the requirements shown in Table I. These specification limits do not preclude the presence of other elements. Limits may be established by agreement between material manufacturer or supplier and purchaser for these unnamed elements. Copper is customarily given as remainder, but may be taken as the difference between the sum of all elements analyzed and 100%. When all the elements in the table are analyzed, their sum shall be 99.5% minimum.

3.1.1 An analysis of each lot of strip shall be furnished by the material supplier. The analysis shall be certified by the supplier when a check analysis is not specified in the procurement document (see 6.2).

3.2 Mechanical properties:

The mechanical properties of the strip, as supplied, shall conform to the requirements of 3.2.1 and 3.2.2. Tensile requirements, unless otherwise specified in the contract or order (see 6.2), shall be waived for thickness greater than 0.015 inch provided the strip meets the hardness requirements; for strip 0.015 inch or less in thickness, the tensile requirements are mandatory. In cases of dispute, tension tests shall be the basis of acceptance.

3.2.1 Heat treatable strip: Heat treatable strip supplied in A, 1/2H, and H tempers shall conform to the mechanical properties listed in Table II. Such strip, when precipitation hardened in accordance with the prescribed minimum heat treating requirements of MIL-H-7199, shall be capable of developing mechanical properties conforming to tempers AT, 1/2HT, and HT listed in Table II.

3.2.2 Heat treated-mill supplied strip: Heat-treated-mill supplied strip shall conform to the specified mechanical properties of tempers AT, 1/2HT, and HT listed in Table II.

3.3 Electrical resistivity:

The electrical resistivity of the strip for all sizes and tempers shall conform to the requirements of Table III.

3.4 Dimensional tolerances:

Unless otherwise specified, dimensional characteristics of the strip shall meet the criteria of the following paragraphs of Federal Standard No. 146 (see 6.2).

| Dimensions | Paragraph |
|---|---|
| Thickness | 1b(1) |
| Width | 1b(2) |
| Length | 1b(3), 1b(4) |
| Straightness | 1b(5) |

3.4.1 Coiled lengths: When coiled strip is specified (see 6.2), coils shall consist of not more than three pieces, each of which shall be over 10 feet in length.

3.4.2 Flatness: Cut lengths and coiled strip shall be commercially flat so as not to interfere with normal stamping and forming operations.

3.5 Identification marking:

When specified in the procurement document, identification marking shall be in accordance with Fed. Std. 185 (see 6.2).

3.6 Workmanship:

The strip shall be uniform in quality and condition. The surfaces shall be free from scale, cracks, scratches, seams, laps or folds, slivers, burrs, and imbedded foreign matter so as to impair neither the usability nor affect the electrical conductivity of the strip for the intended applications.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the material supplier is responsible for the performance of all inspection requirements 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 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 strip of the same size, temper, and melt, submitted for inspection and acceptance at one time.

4.3 Sampling:

4.3.1 Chemical test: From each lot, four individual lengths or units shall be selected at random to provide a composite sample of a minimum of 50 grams, in accordance with the procedure described in Fed. Test Method Std. No. 151. If the lot consists of less than four lengths or units, a composite sample shall be prepared from a piece taken from each length or unit. (see 4.5.1).

4.3.1.1 Check analysis: When specified (see 6.2), sampling preparation shall be performed in accordance with 4.3.1 so as to provide three composite samples of 50 grams each: one for the manufacturer or vendor, one for the procuring activity and one for a referee, if necessary.

4.3.2 Mechanical properties.

4.3.2.1 Tension test: For heat treated strip, a total of three tensile test samples, each 8 inches long by 3/4 inch wide, shall be taken either longitudinally or transversely to the direction of rolling from three individual lengths or units selected at random from the lot. If the lot consists of less than three lengths or units, a sample shall be taken from each length or unit. For heat treatable strip, six samples shall be taken (see 4.5.2.1).

4.3.2.2 Hardness test: For heat treated strip, a total of three specimens, each 2 to 3 inches long, shall be taken from three individual lengths or units selected at random from the lot. If the lot consists of less than three lengths or units, a sample shall be taken from each length or unit. For heat treatable strip, six samples shall be taken (See 4.5.2.2)

4.3.3 Electrical resistivity: A total of three samples, each 15 inches long by 1 inch in width, shall be taken either longitudinally or transversely to the direction of rolling from three individual lengths or units selected at random from the lot. If the lot consists of less than three lengths or units, a sample shall be taken from each length or unit (See 4.5.3).

4.3.4 Visual and dimensional examination: From each lot, seven cut lengths or coils shall be selected. Ten percent of each of these seven lengths or coils shall be used as the sample for visual and dimensional examination.

4.4 Examination:

4.4.1 Visual and dimensional examination: Strips selected in accordance with 4.3.4 shall be visually examined to determine compliance with 3.5 and dimensionally examined to determine conformance to dimensional requirements of 3.4.

4.4.2 Preparation for delivery: The entire lot shall be visually examined to assure compliance with the packaging requirements of Section 5 of this specification.

4.5 Tests:

4.5.1 Chemical analysis: The analysis furnished by the manufacturer or vendor from the sample taken in 4.3.1 for the lot can be accepted as defining the composition of the material. This analysis shall conform to the requirements of 3.1 when checked in accordance with the procedures of Methods 111 or 112 of Fed. Test Method STD. No. 151.

4.5.1.1 Check analysis: The chemical analysis, as determined from the sample obtained in 4.3.1.1 for the lot, shall conform to the requirements of 3.1 when checked in accordance with the procedures of Methods 111 or 112 of Fed. Test Method STD. No. 151.

4.5.2 Mechanical properties tests:

4.5.2.1 Tension test: Samples selected in accordance with 4.3.2.1 shall be tested in accordance with the requirements of ASTM E 8 using standard sheet type rectangular test specimens, to assure conformance of heat treated lots to the tensile requirements of 3.2.2 and of heat treatable lots to the tensile requirements and precipitation hardening response of 3.2.1.

4.5.2.2 Hardness test: Specimens selected in accordance with 4.3.2.2 shall be tested in accordance with the requirements of ASTM E 18 to assure conformance of heat treated lots to the hardness requirements of 3.2.2 and of heat treatable lots to the hardness requirements and precipitation hardening response of 3.2.1.

4.5.3 Electrical resistivity: Samples selected in accordance with 4.3.3 shall be tested for electrical resistivity in accordance with the requirements of ASTM B 193 to assure conformance of the lot to the requirements of 3.3.

4.6 Rejection:

4.6.1 Examination defects: Any lot containing one or more examination defects shall be rejected, subject to the provisions on “Disposition of Non-conforming Product” of MIL-STD-105.

4.6.2 Test failures: A lot shall be rejected for failure to meet any of the test requirements when tested in accordance with 4.5, subject to the retest provisions (Section 4 of the General Section) of Fed. Test Method STD, No. 151.

5. PACKAGING:

5.1 Preservation:

The levels of preservation shall be level A or Industrial as specified (see 6.2).

5.1.1 Level A: Level A preservation shall be in accordance with MIL-C-3993.

5.1.2 Industrial: Industrial preservation shall be in accordance with ASTM D 3951.

5.2 Packing:

The levels of packing shall be level A, B or Industrial as specified (see 6.2).

5.2.1 Levels A and B: Levels A and B shall be in accordance with MIL-C-3993.

5.2.2 Industrial: Industrial packing shall be in accordance with ASTM D 3951.

5.3 Marking:

IIn additiona to any special marking required (see 6.2), marking for shipment shall be in accordance with MIL-STD-129.

6. NOTES:

6.1 Intended use:

Strip material procured by this specification is intended primarily for usage as the contact elements of electrical switches where conductivity requirements are higher than can be met by standard grades of copper-beryllium strip. The material should be used only in the precipitation hardened tempers in the finished part in order to take advantage of the higher mechanical properties (see 6.3) and higher conductivity.

6.2 Ordering data:

Procurement documents should specify the following:

(a) Title and number of this specification.
(b) Size, form, and temper required (see 1.1 and 1.2).
(c) Dimensional tolerances if other than standard (see 3.4).
(d) Quantity of material required.
(e) If check analysis is required (see 3.1.1 and 4.3.1.1.).
(f) If tension requirements are not to be waived (see 3.2).
(g) Levels of packaging required (see 5.1 and 5.2).
(h) If identification marking is required (see 3.5).

6.3 Heat treatable strips:

Strip procured in tempers A, 1/2H, or H are heat treatable strip which can be precipitation hardened at 900° F, from 2 to 3 hours to obtain the mechanical properties respectively of the AT, 1/2HT, and HT tempers. For applications requiring severe deformation of the strip in the manufacture of the parts, the heat treatable tempers (A, H and 1/2H) should be specified followed by the prescribed precipitation hardening treatment.



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