QQ-A-430C
14 December 1984
SUPERSEDING
QQ-A-430B
May 21, 1970

FEDERAL SPECIFICATION

ALUMINUM ALLOY ROD AND WIRE; FOR RIVETS AND COLD HEADING

This specification was approved by the Commissioner, Federal Supply Service General Service Administration for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. Aluminum alloy wire and rod covered by this specification are suitable for the manufacturer of rivets and other utility items by cold die-heading operations.

1.2 Classification.

1.2.1 Alloys and tempers. Wire and rod shall be furnished in one of the following alloys and tempers, as specified (see 6.1). The definitions of tempers shall be as specified in ANSI H35.1:

1100-0, H14, H24	2219-0, H13, H23	6053-0, H13, H23
2017-0, H13, H23	3003-0, H14, H24	6061-0, H13, H23
2024-0, H13, H23	5005-0, H22, H32	7050-0, H13
2117-0, H13, H23	5052-0, H22, H32	7075-0, H13, H23
2117-0, H15, H25	5056-0, H22, H32	7178-0, H13, H23

2. APPLICABLE DOCUMENTS

2.1 Government publications. The issues of the following documents, in effect on date of invitation for bids or solicitations for offers, form a part of this specification to the extent specified herein.

Federal Standards:

FED-STD-123 - Marking for Domestic Shipment (Civil Agencies).

FED-STD-151 - Metals; Test Methods.

FED-STD-184 - Identification Marking of Aluminum, Magnesium, and Titanium.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions, as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specification:

MIL-H-6088 - Heat Treatment of Aluminum Alloys.

Military Standards:

MIL-STD-129 - Marking for Shipment and Storage.

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage.

MIL-STD-1312 - Fasteners, Test Methods.

(Copies of Military Specifications and Standards 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 date of invitation for bid or solicitation for offers shall apply.

American Society for Testing and Materials (ASTM) Standard:

B 557 - Tension Testing Wrought and Cast Aluminum and Magnesium Alloy Products

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

American National Standards Institute (ANSI) Standards:

H35.1 - Alloy and Temper Designation Systems for Aluminum

H35.2 - Dimensional Tolerances for Aluminum Mill Products

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

National Motor Freight Traffic Association, Inc., Agent

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

3. REQUIREMENTS

3.1 Suitability for cold heading. The wire shall be such that cold-headed shapes may be produced therefrom in accordance with the requirements of the applicable product specification.

3.2 Chemical composition.

3.2.1 The chemical composition of the wire and rod shall conform to the requirements specified in table I.

3.3 Mechanical properties.

3.3.1 Tensile properties of materials as supplied. The tensile properties in the direction of rolling or drawing shall conform to the requirements of table II.

3.3.2 Tensile properties after heat treatment. In addition to the requirements of 3.3.1, the mechanical properties in the direction of rolling or drawing of heat-treatable material ordered in the annealed or strain-hardened tempers and subsequently solution heat-treated (T4 temper), or solution heat-treated and artificially aged (T6 temper), or solution heat-treated and overaged (T7 temper), or solution treated, cold worked, then artificially aged (T8 temper) shall conform to the requirements of table III for either tensile requirements or shear strength requirements. The measurement of elongation and yield strength is not required for wire less than 0.125 inch diameter.

TABLE I. Chemical Composition. 1/
(Percent maximum unless shown as a range)

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Others Each	Others Total 2/	Aluminum, min.
1100	0.95 Si+Fe		0.05 to 0.20	0.05	---	---	0.10	---	0.05	0.15	99.00
2017	0.20-0.8	0.7	3.5 to 4.5	0.40 to 1.0	0.40 to 0.8	0.10	0.25	0.15	0.05	0.15	Remainder
2024	0.50	0.50	3.8 to 4.9	0.30 to 0.9	1.2 to 1.8	0.10	0.25	0.15	0.05	0.15	Remainder
2117	0.8	0.7	2.2 to 3.0	0.20	0.20 to 0.50	0.10	0.25	---	0.05	0.15	Remainder
2219	0.20	0.30	5.8 to 6.8	0.20 to 0.40	0.02	---	0.10	0.02 to 0.10	0.05 3/	0.15	Remainder
3003	0.6	0.7	0.05 to 0.20	1.0 to 1.5	---	---	0.10	---	0.05	0.15	Remainder
5005	0.30	0.7	0.20	0.20	0.50 to 1.1	0.10	0.25	---	0.05	0.15	Remainder
5052	0.25	0.40	0.10	0.10	2.2 to 2.8	0.15 to 0.35	0.10	---	0.05	0.15	Remainder
5056	0.30	0.40	0.10	0.05 to 0.20	4.5 to 5.6	0.05 to 0.20	0.10	---	0.05	0.15	Remainder
6053	4/	0.35	0.10	---	1.1 to 1.4	0.15 to 0.35	0.10	---	0.05	0.15	Remainder
6061	0.40-0.8	0.7	0.15 to 0.40	0.15	0.8 to 1.2	0.04 to 0.35	0.25	0.15	0.05	0.15	Remainder
7050	0.12	0.15	2.0 to 2.6	0.10	1.9 to 2.6	0.04	5.7 to 6.7	0.06	0.05 5/	0.15	Remainder
7075	0.40	0.50	1.2 to 2.0	0.30	2.1 to 2.9	0.18 to 0.28	5.1 to 6.1	0.20	0.05	0.15	Remainder
7178	0.40	0.50	1.6 to 2.4	0.30	2.4 to 3.1	0.18 to 0.28	6.3 to 7.3	0.20	0.05	0.15	Remainder

1/ Analysis shall be made routinely only for the elements specifically mentioned in the table. If, however, the presence of other elements is indicated or suspected in amounts greater than the specified limits, additional analysis shall be made to determine that each of these elements is not present in excess of 0.05 percent, to determine conformance to the limits specified for other elements.

2/ The sum of those "Others" metallic elements of 0.010 percent or more each, expressed to the second decimal before determining the sum

3/ Vanadium 0.05-0.15, Zirconium 0.10-0.25

4/ Silicon 45 to 65 percent of actual magnesium content

5/ Zirconium 0.08-0.15

TABLE II. Tensile properties

Alloy and Temper	Diameter, Inches	Tensile strength, ksi	
		Minimum	Maximum
1100-0	Up thru 1.000	---	15.5
1100-H14, H24	Up thru 1.000	16.0	21.0
2017-0	Up thru 1.000	---	35.0
2017-H13, H23	Up thru 1.000	30.0	40.0
2024-0	Up thru 1.000	---	35.0
2024-H13, H23	Up thru 1.000	32.0	42.0
2117-0	Up thru 1.000	---	25.0
2117-H15, H25	Up thru 0.615	28.0	35.0
2117-H13, H23	0.616 - 1.000	25.0	32.0
2219-0	Up thru 1.000	---	32.0
2219-H13, H23	Up thru 1.000	28.0	38.0
3003-0	Up thru 1.000	---	19.0
3003-H14, H24	Up thru 1.000	20.0	26.0
5005-0	Up thru 1.000	---	20.0
5005-H22, H32	Up thru 1.000	17.0	23.0
5052-0	Up thru 1.000	---	32.0
5052-H22, H32	Up thru 1.000	31.0	37.0
5056-0	Up thru 1.000	---	46.0
5056-H22, H32	Up thru 1.000	44.0	52.0
6053-0	Up thru 1.000	---	19.0
6053-H13, H23	Up thru 1.000	19.0	26.0
6061-0	Up thru 1.000	---	22.0
6061-H13, H23	Up thru 1.000	22.0	30.0
7050-0	Up thru 1.000	---	40.0
7050-H13	Up thru 1.000	34.0	44.0
7075-0	Up thru 1.000	---	40.0
7075-H13, H23	Up thru 1.000	36.0	46.0
7178-0	Up thru 1.000	---	40.0
7178-H13, H23	Up thru 1.000	36.0	46.0

TABLE III. Tensile properties after heat treatment

Alloy and Temper	Diameter, inches	Tensile strength, ksi minimum	Yield strength at 0.2 percent offset, ksi minimum	Elongation in 2 inches or 4D, 1/ percent minimum	Shear strength 2/ ksi minimum
2017-T4	0.063 to 1.000 incl.	55.0	32.0	12	33.0
2024-T4	0.063 to 1.000 incl.	62.0	40.0	10	37.0
2117-T4	0.063 to 1.000 incl.	38.0	18.0	18	26.0
2219-T6	0.063 to 1.000 incl.	55.0	35.0	6	30.0
2219-T81	0.063 to 1.000 incl.	58.0	40.0	6	32.0
6053-T61	0.063 to 1.000 incl.	30.0	20.0	14	20.0
6061-T6	0.063 to 1.000 incl.	42.0	35.0	10	25.0
7050-T73	0.063 to 1.000 incl.	70.0	58.0	10	41.0 3/
7075-T6	0.063 to 1.000 incl.	77.0	66.0	7	42.0
7075-T73	0.063 to 1.000 incl.	68.0	56.0	10	41.0
7178-T6	0.063 to 1.000 incl.	84.0	73.0	5	46.0

1/ "D" represents specimen diameter.

2/ Shear strength applicable for finished rivets in lieu of tensile tests.

3/ Maximum shear strength is 46.0 ksi.

3.4 Tolerances. The tolerances shall not exceed those specified in ANSI H35.2 for straightness, specified length, and diameter of rod and wire.

3.5 Marking for identification. Unless otherwise specified (see 6.2), wire and rod shall be marked in accordance with FED-STD-184.

3.6 Material in sizes not covered in this specification. Mechanical properties and tolerances of material falling outside the diameter limits (see tables II and III) covered in this specification shall be as specified in the procurement documents (see 6.2).

3.7 Heat treatment. Heat treatment shall be in accordance with the requirements of MIL-H-6088.

3.8 Workmanship. Rod and wire shall be uniform in quality and condition, clean, sound, smooth, and free from hard spots, internal voids, kinks, damaged ends, longitudinal surface defects appearing as cracks, folds, or crevices, and other defects detrimental to processing and service applications. Normal oxidation occurring during heat treatment shall not be cause for rejection.

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 as specified herein. Except as otherwise specified in the contract or order, the contractor may use his own or any other facilities suitable for 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 that supplies and services conform to prescribed requirements.

4.2 Sampling.

4.2.1 Lot. A lot shall consist of an identified quantity of rod and wire of the same alloy, temper and size traceable to a heat-treated lot or lots and subjected to inspection at one time.

4.2.2 Sampling for chemical analysis.

4.2.2.1 Ingot sampling. At least one sample shall be taken for each group of ingots of the same alloy poured simultaneously from the same source of molten metal by the producer and analyzed to determine conformance to 3.2 (see 4.4.1). Ingots not conforming to the requirements of this specification shall be rejected. Complete ingot analysis records shall be available to the Government.

4.2.2.2 Finish product analysis. When compliance with 3.2 has not been established in accordance with 4.2.2.1, samples shall be selected as follows: From material having a nominal weight of less than one pound per linear foot, one sample shall be selected from each lot weighing 1,000 pounds or less; from lots weighing more than 1,000 pounds, one additional sample shall be taken for each 1,000 pounds or fraction thereof in excess of the first 1,000 pounds. From material having a nominal weight of one pound or more per linear foot, one sample shall be taken from each lot consisting of 1,000 feet or less; from lots consisting of more than 1,000 feet, one additional sample shall be taken for each 1,000 feet or fraction thereof in excess of the first 1,000 feet. Only one sample shall be taken from any one piece when more than one piece is available. Not more than one analysis shall be required per piece.

4.2.3 Samples for mechanical property data.

4.2.3.1 Number of test samples in temper supplied. From material having a nominal weight of less than one pound per linear foot, one tension test sample shall be selected from each lot weighing 1,000 pounds or less; from lots weighing more than 1,000 pounds, one additional sample shall be taken for each 1,000 pounds or fraction thereof in excess of the first 1,000 pounds. From material having a weight of one pound or more per linear foot, one tension test sample shall be taken from each lot consisting of 1,000 feet or less; from lots consisting of more than 1,000 feet, one additional sample shall be taken for each 1,000 feet or fraction thereof in excess of the first 1,000 feet. Only one tension test shall be taken from any one piece when more than one piece is available.

4.2.3.2 Number of tests after heat treatment. From heat-treatable material ordered in the O or one of the H tempers an additional number of specimens equal to those required by 4.2.3.1 shall be taken and tested for conformance to 3.3.2, as applicable, after having been processed to the T4, T6, T61, T73, or T81 tempers as specified (see 6.2). The contractor shall have the option of performing either the tension or shear test in lieu of performing both tests. However, the material tested must meet all the applicable requirements of table III.

4.2.4 Sampling for visual and dimensional examination. Each rod and wire shall be examined to determine conformance to this specification with respect to workmanship and identification marking. Examinations for dimensions shall be made at planned intervals to insure conformance to the tolerances specified. On approval of the procuring activity, a system of statistical quality control may be used for dimensional, marking, and workmanship examination.

4.2.5 Sampling for packaging examination. Sampling shall be in accordance with MIL-STD-105, inspection level S-1. A lot shall be as specified in MIL-STD-649.

4.3 Examination.

4.3.1 Visual and dimensional examination. Each sample rod and wire selected in accordance with 4.2.4 shall be visually examined and measured to verify conformance to the specification (see 3.8). A magnifier with capability to magnify to 10X may be used for visual examination.

4.3.2 Preservation, packaging, packing, and marking for shipment. The preservation, packaging, packing, and marking for shipment shall be examined to determine compliance with the requirements of section 5. The AQL shall be 1.5 percent defective.

4.4 Test methods.

4.4.1 Chemical analysis. Chemical analysis shall be made by the wet chemical method in accordance with method 111 of FED-STD-151, or by the spectrochemical method in accordance with method 112 of FED-STD-151.

4.4.2 Mechanical properties testing.

4.4.2.1 Types of specimen and test method. Specimens for determining tensile properties shall be prepared and tested in accordance with ASTM B 557. When practical, the material shall be tested in full section. For material which can not practically be tested in full section, the standard round type specimen in the largest size applicable shall be used.

4.4.2.2 Shear test. When performed, the shear test shall be made in a fixture substantially in accordance with figure 1 of this specification. Alternatively, a double-shear fixture conforming with the requirements of Test 13, MIL-STD-1312, may be used. Fixtures of other designs may be used upon the approval of the procuring activity. The shearing strength of the rod and wire shall be calculated using the actual measured diameter of the test sample.

4.5 Rejection and retest. Failure of a specimen to meet the test requirements shall be cause for rejection of the lot. At the discretion of the purchaser, retest may be permitted. A retest sample of three specimens shall be tested to replace each failed specimen of the original sample. If one of the retest specimens fail, the lot shall be rejected with no further retesting permitted.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. All rod and wire shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-649. Unless otherwise specified (see 6.2), material shall be preserved, packaged, and packed in accordance with best applicable commercial practice (see National Motor Freight and Uniform Classification Committee Classifications).

5.2 Marking for shipment.

5.2.1 Civil agencies. Marking for shipment shall be in accordance with FED-STD-123. Special marking shall be as specified (see 6.2).

5.2.2 Military agencies. Shipping containers shall be marked in accordance with MIL-STD-129. Special marking shall be as specified (see 6.2).

6. NOTES

6.1 Intended use. Aluminum and aluminum alloy rod and wire produced to this specification are intended for general and aerospace applications as rivets and other parts which are formed by cold-heading.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

(a) Title, number, and date of this specification
(b) Alloy and temper desired (see 1.2)
(c) Size required
(d) Identification marking, if not in accordance with FED-STD-184
(e) Level of preservation, packaging and packing if other than commercial
(f) Requirements for sizes not identified within this specification

MILITARY INTEREST:

Custodians
Army-ME
Navy-AS
Air Force-20

Review Activites
Army-MR, AR, AV, MI, EA
Air Force-99
DLA-IS

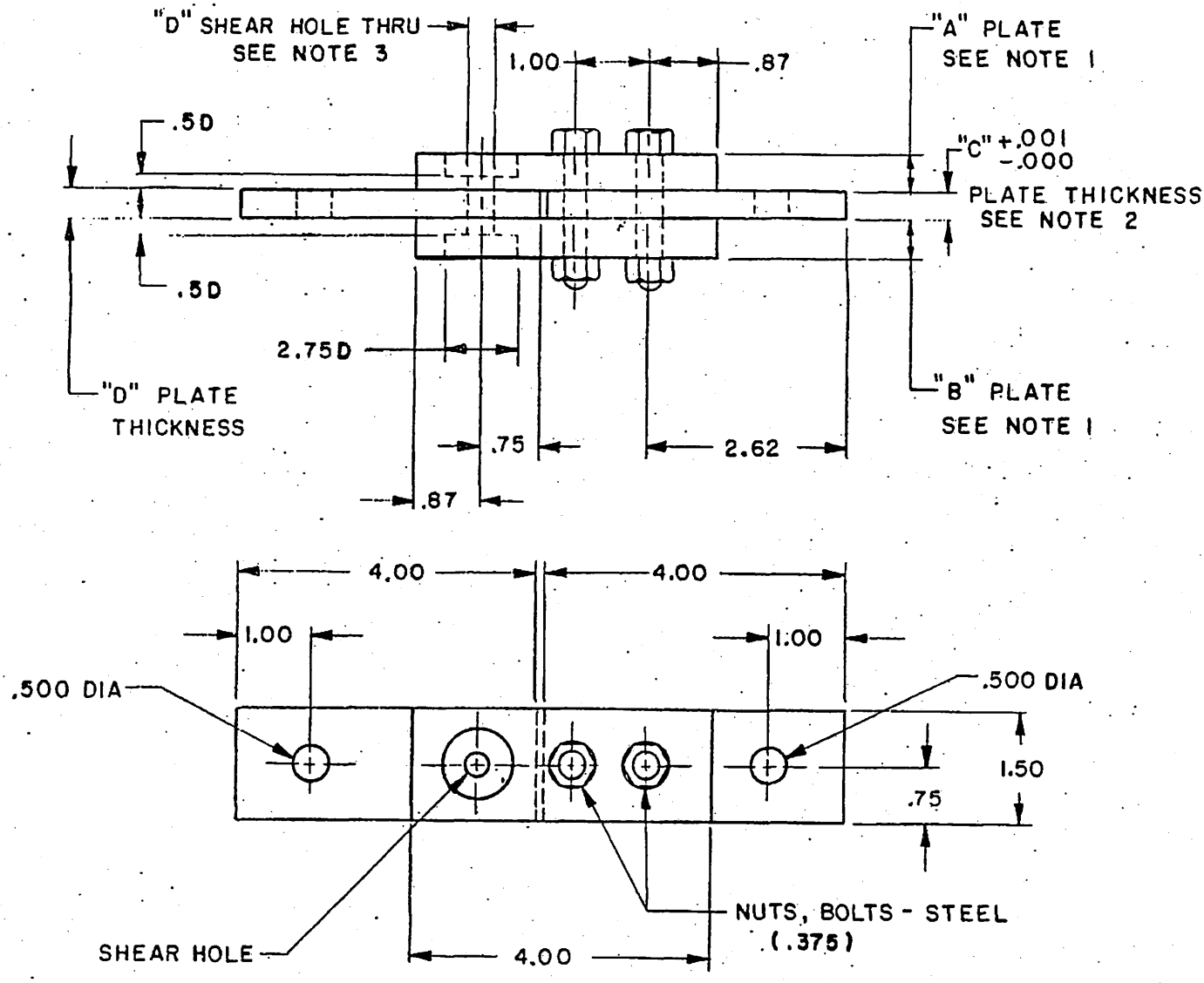
CIVIL AGENCY COORDINATING ACTIVITIES:

GSA-FSS, PCD

PREPARING ACTIVITY:

NAVY-AS

DoD Project 9525-0098



NOTES:

1. THICKNESS OF PLATES "A" AND "B" SHALL BE .50 FOR RIVETS OF .188 TO .375 INCH DIAMETER AND .25 FOR RIVETS LESS THAN .188 INCH DIAMETER.
2. "C" NOMINAL DIAMETER OF SPECIMEN
3. "D" REPRESENT SPECIMEN DIAMETER
4. DIMENSIONS IN INCHES.

Figure 1. Double shear test fixture.