

INCH-POUND

MIL-R-5674F
29 MARCH 1994
 SUPERSEDING
 MIL-R-5674E
 12 July 1989

MILITARY SPECIFICATION

RIVETS, STRUCTURAL, ALUMINUM ALLOY, TITANIUM COLUMBIUM ALLOY
 GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers aluminum alloy and titanium columbium alloy rivets.

1.2 Classification.

1.2.1 Composition and condition. The rivets shall be furnished in the following compositions and conditions:

<u>Composition</u>	<u>Temper</u>	<u>Condition</u>
1100 (UNSA91100)	-F	As fabricated;
2017 (UNSA92017)	-T4	Solution heat treated and naturally aged (inactive for new design);
* 2024 (UNSA92024)	-T4	Solution heat treated and naturally aged (inactive for new design);
2117 (UNSA92117)	-T4	Solution heat treated and naturally aged;
2219 (UNSA92219)	-T81	Solution heat treated and naturally aged; and artificially aged (inactive for new design);
2219 (UNSA92219)	-T62	Solution heat treated and artificially aged;
5056 (UNSA95056)	-H32	Strain hardened and then stabilized;
7050 (UNSA97050)	-T73	Solution heat treated and artificially aged;
45Cb (UNSR58450)		Per AMS 4982;

Beneficial comments (recommendations, additions, deletions) any pertinent data which may be of use in improving this document should be addressed to: Defense Industrial Supply Center, DISC-EPP, 700 Robbins Avenue, Philadelphia, PA 19111-5096 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

FSC 5320

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification, standards and handbooks. The following specifications, standards and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be 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).

SPECIFICATIONS

FEDERAL

QQ-A-430 Aluminum Alloy Rod and Wire; for Rivets and Cold Heading

MILITARY

MIL-C-5541 Chemical Conversion Coatings on Aluminum Alloys
 MIL-H-6088 Heat Treatment of Aluminum Alloys
 MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys

STANDARDS

MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes.
 MIL-STD-129 Marking for Shipment and Storage
 MIL-STD-1312 Fastener Test Methods

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Defense Printing Service Detachment Office, 700 Robbins Avenue, Bldg. 4-D, Philadelphia, PA 19111-5096.)

2.2 Nongovernment 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 the documents are listed in the DODISS are issues of the documents cited in the solicitation (see 6.2).

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SOCIETY OF AUTOMOTIVE ENGINEERS

AMS 4982 Titanium Alloy Wire - 45Cb

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

B 565	Shear Testing of Aluminum and Aluminum Alloy Rivets and Cold-Heading Wire Rods
* D 3951	Standard Practice for Commercial Packaging
E 8	Tension Testing of Metallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

(Nongovernment 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 (except for related associated detail specifications, specification sheets, or MS standards), 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 Military standards. The individual item requirements shall be as specified herein and in accordance with the applicable standard. In the event of any conflict between the requirements of this specification and the standard, the latter shall govern.

3.2 Material. The rivets shall be made from material conforming to QQ-A-430 or AMS 4982, as applicable.

3.2.1 Grain size. Five (5) or finer except for AMS 4982 and aluminum alloys 1100 and 5056.

3.3 Design. Rivet design shall be as specified on the applicable standard.

3.4 Shear strength. The undriven shear strength of rivets greater than 0.0937 inch in diameter shall be as specified in Table I when tested as specified in 4.5.2.2. Shear strength tests on 2017, 2024, 2117, 2219 and 7050 rivets shall be made with the rivets in the heat-treated condition (see 4.4.1 and 4.4.3).

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* 3.4.1 Tensile strength. In lieu of a shear test, a tensile test shall be performed on rivets smaller than 0.0937 inch diameter, on rivet lengths less than 1.5D, and on nonstandard diameter rivets for which a shear test fixture is not available (see 4.5.2.2). The wire or rod samples shall be taken from the same material lot that the rivets are made from and heat-treated with the rivets it represents. Tensile properties shall be as specified in QQ-A-430, Table III or AMS 4982. A tensile test is not required for 1100-F and 5056-H32 aluminum alloy rivets.

TABLE I. Undriven shear strength.

Rivet		Shear strength (lb/in ²)	
Composition	Temper	Minimum	Maximum
1100	F	N/A	N/A
5056	H32	24,000	N/A
2117	T4	26,000	N/A
2219	T81	32,000	N/A
2219	T62	32,000	N/A
2017	T4	35,000	42,000 1/
2024	T4	37,000	N/A
7050	T73	41,000	46,000
45Cb		50,000	59,000

1/ See applicable military standards for additional requirement.

3.5 Heat treatment. Heat treatment of aluminum alloy 2017-T4, 2024-T4, 2117-T4, 2219-T62, 2219-T81 and 7050-T73 rivets shall be in accordance with MIL-H-6088. Heat treatment for 45Cb rivets shall be in accordance with AMS 4982.

3.6 Finishes. Finishes shall be as specified on the applicable standards.

3.7 Roundness and runout. Rivet heads shall not deviate from true roundness and runout with the shank by an amount which will produce a full indicator movement greater than the value specified in Table II for the corresponding rivet diameter. The reading shall be taken with the indicator touching the periphery of the head as the rivet is rotated with the shank as an axis.

TABLE II. Tolerances on roundness and runout.

Nominal diameter of rivet shank (inch)	Total Variation in indicator reading on rivet head	
	Flush head (inch)	Protruding head (inch)
0.062, 0.094, 0.125	0.010	0.010
0.156, 0.187, 0.219	0.010	0.015
0.250	0.010	0.020
0.312, 0.375	0.015	0.020

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3.8 Discontinuities. Rivets shall be cold formed or forged to conform to the requirements of Table III. The rivets shall be free from surface discontinuities except that:

a. Indented circles or arc lines concentric to the shank diameter, not greater than 0.004 inch in depth, are acceptable.

b. Smooth irregularities at the periphery of the head that do not extend inside the minimum head diameter, as defined on the applicable standard, are acceptable. No material separation is permitted.

TABLE III. Discontinuities.

Location	Permissible condition	Maximum depth normal to surface 1/
Top of head and end of shank	Laps, seams, die marks, etch pits and minor isolated inclusions	For shank dia up to .250 .004 For shank dia .2812 & .3125 .006 For shank dia .3437 & .3750 .007
Shank and bearing area of head	Isolated nicks, abrasions, etch pits, minor isolated inclusions, intergranular corrosion laps, seams, die marks, fins, etc.	0.004
	Continuous longitudinal defects	0.002

1/ Measured perpendicular to a line tangent to the curved surface at the point of intersection with the discontinuity. Flat or end surfaces are not curved.

* 3.9 Driveability. When upset in a fixture in accordance with Figure 1 aluminum alloy 7050 rivets shall have a bucked head not less than 1.6 times the rivet diameter. Rivets of all other alloys shall have a bucked head diameter of not less than 1.5 times the rivet diameter. The bucked head height shall not exceed 0.3 times the rivet diameter (see Figure 1 and 4.5.2.4).

* 3.9.1 Cracks. The bucked head of driven rivets (all alloys) shall show no cracks when visually inspected without magnification.

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 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 ensure supplies and services conform to prescribed requirements.

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PROCEDURES FOR TEST SLUG

Remove manufactured head from rivet by machining or other suitable means to obtain test slug which must include terminal end of rivet. Be sure that ends are parallel. The terminal end is opposite of the manufactured head, and will be used to form the bucked head. Using a suitable driver, the rivet test slug shall be upset as illustrated in figure 1. The following is recommended for determining the initial test slug length, when bucked head height and driven head diameter are known:

$0.676D \pm .010$ for obtaining 1.5D driven diameter

$0.768D \pm .010$ for obtaining 1.6D driven diameter

NOTES: When preparing test slug length to be used with test fixture "A", an additional length of 0.5D which is height of the recess hole (see (a)) must be added to the initial length as determined above.

- Height of recess hole (a) of test fixture "A", $0.5D (+.005/-0.000)$.
- Diameter of recess hole (b) of test fixture "A", $1.0D (+.010/-0.003)$.
- D is the nominal diameter of the rivet.
- Test fixture "B" is intended for use on rivets with shank lengths not long enough to provide a sufficient test slug length for use with test fixture "A". Use test fixture "A" whenever possible.
- Material for test fixtures may be 2024 or 7050 aluminum or alloy steel. Outer edge geometry of the test fixture may be circular or square.

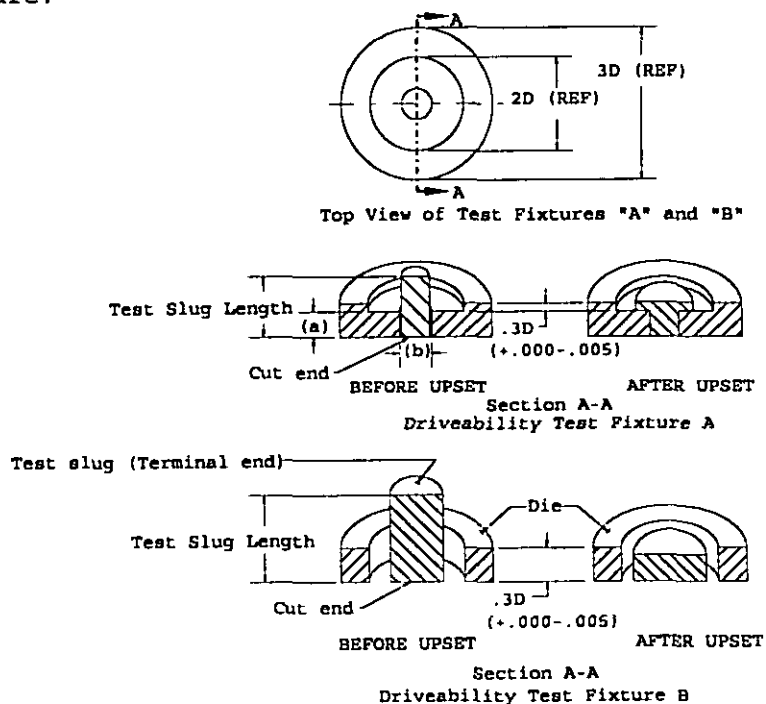


FIGURE 1. Driveability Test Fixture

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4.1.1 Responsibility for compliance. All items shall meet all requirements of Section 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 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.

4.2 Classification of inspections. All of the examinations and tests specified herein are classified as quality conformance inspections.

4.3 Sampling.

4.3.1 Sampling for material acceptance. Sampling, inspection and testing of the wire or rod from which the rivets are manufactured shall be in accordance with QQ-A-430 or AMS 4982.

4.3.2 Sampling for end item acceptance.

* 4.3.2.1 Inspection lot. An inspection lot shall consist of rivets of the same alloy, condition, temper, diameter and form. The rivets shall be manufactured and heat treated and aged when applicable as a batch and submitted for acceptance at the same time.

4.3.2.2 Sampling for visual examination. A random sample shall be selected from each lot in accordance with MIL-STD-105, inspection level II, acceptable quality level of 4.0 percent defective.

4.3.2.3 Sampling for tests. Lot size shall be defined in terms of pounds and sampling size shall be defined in terms of number of rivets. For lots of 1300 pounds or less, a random sample shall be selected in accordance with MIL-STD-105, inspection level S-2, acceptance quality level (AQL) of 4.0 percent defective. For lots over 1300 pounds, 10 rivets shall be selected from each lot. The AQL shall be 2.5 percent defective.

4.4 Preparation of specimens.

4.4.1 Shear strength specimens. Rivet samples with a shank length 2.5 times the nominal diameter (and greater) shall be double shear tested as specified in 4.5.2.2. Rivet samples with a shank length less than 2.5 times the nominal diameter shall be single shear tested.

4.4.2 Heat treatment of tension test specimens. Tension test specimens shall be not less than 18 inches long (or 3 specimens not less than 6 inches long). The specimens shall be taken from the wire used to make the rivets and heat treated with the lot of rivets it represents (see 4.5.2.3).

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4.4.3 Test after heat treatment. Specimens may be tested within 4 days after completion of the heat treatment. If, however, the specimens fail to conform to this specification, the test results may be discarded (except for 2219-T81 and 2219-T62) and the specimens retested after the expiration of 4 days without prejudice.

4.5 Inspection methods.

4.5.1 Examinations.

* 4.5.1.1 Visual inspection. The rivets shall be visually inspected to determine conformance to 3.8.

4.5.1.2 Manufacturer's identification. The rivets shall be marked with the manufacturer's identification as indicated on the applicable standard.

4.5.2 Tests.

4.5.2.1 Grain size. The grain size test shall be in accordance with ASTM B 112, by comparison method, on the transverse section of the wire or rivet.

4.5.2.2 Shear strength. The double shear strength tests shall be in accordance with ASTM B 565. The single shear test method shall be in accordance with MIL-STD-1312-20.

* 4.5.2.3 Material tensile strength. The tensile strength test method shall be in accordance with ASTM E 8.

* 4.5.2.4 Driveability. Using the test fixture and procedures shown in figure 1, the bucked head of the driven rivet shall be inspected for conformance to 3.9 and 3.9.1. When testing 2024 alloy, the rivet shall be tested in the "W" condition and driven 15 minutes after quenching or removal from cold storage (-10°C maximum, not to exceed 7 days).

* 4.6 Inspection of packaging. The sampling and inspection of the preservation, packing and marking shall be examined and tested in accordance with ASTM D 3951 to determine conformance to Section 5.

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5. PACKAGING

- * 5.1 Packaging Requirements. The requirements for packaging shall be in accordance with ASTM D 3951.

5.2 Marking.

- * 5.2.1 Unit container labels. In addition to MIL-STD-129 marking, unit containers shall be marked with the special color-coded label identifying the alloy number, and the material finish shall be annotated on the container.

Alloy	Color
1100	White
2017	Yellow
2024	Red
2117	Orange
2219	Violet
5056	Blue
7050	Green
45Cb	Grey

6. NOTES

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

6.1 Intended use. Rivets covered by this specification are intended for joining riveted structures that develop the driven load allowables defined in MIL-HDBK-5, Chapter 8.

6.1.1 Aluminum alloy 1100-F rivets are intended for use in low strength applications.

6.1.2 Aluminum alloy 2017-T4 rivets are high shear strength rivets intended for use with aluminum alloy sheets. This temper shall not be used where optimum corrosion resistance is required. Aluminum alloy 2017-T4 is inactive for new design.

- * 6.1.3 Aluminum alloy 2024-T4 rivets are high strength, high temperature rivets intended for use with aluminum alloy sheets. The rivets should be kept in cold storage until used and be driven in the "W" condition. Aluminum alloy 2024-T4 is inactive for new design.

6.1.4 Aluminum alloy 2117-T4 rivets are medium strength rivets intended for riveting aluminum alloy sheets.

6.1.5 Aluminum alloy 2219-T81 and 2219-T62 rivets are intended for use where high strength at a high temperature is required. Aluminum alloy 2219-T81 is inactive for new design.

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6.1.6 Aluminum alloy 5056-H32 rivets are intended for use with magnesium alloy structures and structures with magnesium and other alloys to minimize galvanic corrosion and is not recommended for use at temperatures exceeding 150 degrees F.

6.1.7 Aluminum alloy 7050-T73 rivets are high shear strength, high temperature rivets intended for use with aluminum alloy sheets. This alloy is intended as a substitute for alloy 2024-T4.

6.1.8 Titanium-columbium (45Cb) rivets are intended for riveting structures of titanium and aluminum or a combination of both. These rivets are intended to be used where material compatibility and cold formability are desired. They are suitable for use in high temperature and high strength applications.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of the specification.
- * b. MS or applicable part number, (see 1.2).
- c. Level of packaging required (see 5.1).

- * 6.2.1 Acquisition of rivets manufactured prior to issuance of Revision F. Unless otherwise specified, Revision F is applicable to rivets manufactured after 29 March 1994.

6.3 Part or identifying number (PIN). The part number for rivets acquired to this specification is specified on the applicable military standard.

6.4 Subject term (keyword) listing.

Aluminum alloy rivet
Rivet
Structural rivet
Titanium columbium rivet

6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Review activities:
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
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3. DOCUMENT TITLE RIVETS, STRUCTURAL, ALUMINUM ALLOY, TITANIUM COLUMBIUM ALLOY GENERAL SPECIFICATION FOR			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach sheets if needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
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8. PREPARING ACTIVITY			
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