



## Standard Specification for Aluminum Transmission Tower Bolts and Nuts<sup>1</sup>

This standard is issued under the fixed designation F 901; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This specification covers aluminum structural bolts and nuts for use in the construction of aluminum transmission towers, substations, and similar aluminum structures.

1.2 Diameters of bolts and nuts furnished to this specification are  $\frac{5}{8}$ ,  $\frac{3}{4}$ , and  $\frac{7}{8}$  in.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

B 565 Test Method for Shear Testing of Aluminum and Aluminum-Alloy Rivets and Cold-Heading Wire and Rods<sup>2</sup>

D 3951 Practice for Commercial Packaging<sup>3</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>4</sup>

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum Base Alloys<sup>5</sup>

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition<sup>5</sup>

E 101 Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique<sup>6</sup>

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique<sup>6</sup>

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets<sup>7</sup>

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection<sup>7</sup>

#### 2.2 ANSI Standards:<sup>8</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F-16 on Fasteners and is the direct responsibility of Subcommittee F16.04 on Nonferrous Fasteners.

Current edition approved July 10, 1997. Published September 1997. Originally published as F 901 – 84. Last previous edition F 901 – 90a.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 03.06.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 01.08.

<sup>8</sup> Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

B18.2.1 Square and Hex Bolts and Screws, Including Hex Cap Screws and Lag Screws

B18.2.2 Square and Hex Nuts

2.3 *Military Standard:*

MIL-STD-A-8625 Anodic Coatings for Aluminum and Aluminum Alloys<sup>9</sup>

### 3. Ordering Information

3.1 Orders for bolts and nuts under this specification shall include the following:

3.1.1 Quantity (number of pieces of each item and size),

3.1.2 Name of item,

3.1.3 Size (diameter, threads per inch, length),

3.1.4 Alloy number,

3.1.5 Shipment lot testing, as required (see Supplementary Requirements S1),

3.1.6 Source inspection, if required (see Section 14),

3.1.7 Certificate of compliance or test report, if required (see Section 16),

3.1.8 Additional requirements, if any, to be specified on the purchase order (see 4.2.1, 4.2.3, 8.2.1, 8.2.2, 9.2, 12.1, and 13.1),

3.1.9 Supplementary requirements, if any, and

3.1.10 ASTM specification and year of issue.

NOTE 1—*Example:* 10 000 pieces Aluminum Transmission Tower Bolt, 0.750-10 by 2.00 in., Alloy 2024-T4, Furnish Certificate of Compliance, Supplementary Requirement S2, ASTM F 901–XX.

### 4. Materials and Manufacture

4.1 *Materials*—Bolts shall be manufactured from Alloy 2024 and nuts from Alloy 6061 or 6262. The materials chemical composition shall be capable of developing the mechanical properties required by Table 1, when in the finished condition.

#### 4.2 *Manufacture:*

4.2.1 *Forming*—Unless otherwise specified, the bolts and nuts shall be cold formed, hot formed, or machined from suitable material at the option of the manufacturer.

4.2.2 *Condition*—The fasteners shall be furnished in the following conditions:

<sup>9</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094 Attn: NPODS.

**TABLE 1 Tensile Strength of 2024-T4 Bolts and Proof Loads for 6061-T6 and 6262-T9 Nuts<sup>A</sup>**

Bolt Size, in.	Tensile Strength, min, lbf (kN)
5/8	12 400 (55)
3/4	18 400 (82)
7/8	25 400 (113)

<sup>A</sup> Based on a tensile unit stress of 55 000 psi (380 MPa) and the thread stress area calculated as follows:

$$A_s = 0.7854 [D - (0.9743/n)]^2$$

where:

- A<sub>s</sub> = stress area,
- D = nominal diameter, and
- n = threads/in.

Alloy	Fastener	Condition
2024-T4	bolts	solution treated and naturally aged
6061-T6	nuts	solution treated and artificially aged
6262-T9	nuts	solution treated, artificially aged, and cold worked

4.2.3 *Threads*—Unless otherwise specified, the threads shall be rolled or cut at the option of the manufacturer.

**5. Chemical Composition**

5.1 *Chemical Composition Limits*—The bolts and nuts shall conform to the requirements as to chemical composition prescribed in Table 2.

5.2 *Manufacturer’s Analysis*—When test reports are required on the inquiry or purchase order (see 3.1.7), the manufacturer shall furnish a certificate of conformance certifying compliance with the chemical limits specified in Table 2.

5.3 *Product Analysis:*

5.3.1 Product analyses may be made by the purchaser from finished products representing each lot. The chemical composition thus determined shall conform to the requirements in Table 2.

5.3.2 In the event of disagreement, a referee chemical analysis shall be performed if agreed upon by both parties. A sample as required by Table 3 shall be selected for each lot. Chemical analysis shall be performed to the requirements of 13.1 and the result shall conform to Table 2.

**6. Mechanical Properties**

6.1 *Bolts*—Bolts having a length three times the diameter or longer shall be tested full size as specified in 13.2.2. At the manufacturer’s option, bolts of less than 3 diameters in length may be tested in full size as specified in 13.2.2. Bolts subjected

**TABLE 3 Sample Size and Acceptance for Mechanical Property Tests**

Number of Pieces in Lot	Acceptance Criteria		
	Number of Tests	Acceptance Number	Rejection Number
50 and under	2	0	1
51 to 500	3	0	1
501 to 35 000	5	0	1
35 001 to 100 000	8	0	1

to tension tests shall meet the tensile strength requirements specified in Table 1. Bolts of less than 3 diameters in length or for other reasons cannot be tested full size in tension, shall be subject to a shear test to be performed in accordance with 12.2.1. The test results shall conform to the following minimum shear-strength requirements: 37 ksi (255 MPa) for 2024-T4.

6.2 *Nuts*—Nuts shall be tested in accordance with the mechanical requirements for the applicable type and shall meet the minimum proof-load requirements in Table 1.

**7. Significance of Numerical Limits**

7.1 For purposes of determining compliance with the specified limits for requirements of the properties listed in this specification, an observed value or calculated value shall be rounded in accordance with Practice E 29.

**8. Dimensions**

8.1 *Bolts and Nuts:*

8.1.1 *Bolts*—Bolts shall be full-size body in accordance with the requirements of ANSI B18.2.1, except the full-body length listed in Table 4 shall be the basis of manufacture and inspection. Unless otherwise specified, hex bolts shall be furnished. The ends of the bolts need not be chamfered or pointed.

8.1.2 *Nuts*—The dimensions of the nuts shall be in accordance with the requirements of ANSI B 18.2.2. Unless otherwise specified, nuts are to be either the regular hex series or a recessed hex series that allows penetration of the bolt threads into the nut recess area.

8.2 *Threads:*

8.2.1 *Bolts*—Unless otherwise specified, the bolts shall be Class 2A threads in accordance with ANSI B1.1.

8.2.2 *Nuts*—Unless otherwise specified, the nuts shall be Class 2B threads in accordance with ANSI B1.1.

**9. Workmanship, Finish, and Appearance**

9.1 *Workmanship*—Bolts and nuts shall have a workmanlike

**TABLE 2 Chemical Requirements<sup>A,B</sup>**

UNS Designation Number	Alloy	General Name	Aluminum <sup>C</sup>	Chromium	Copper	Iron	Manganese	Silicon	Titanium	Zinc	Magnesium	Other Elements	
												Each	Total
A92024	2024	Aluminum 2024	Balance	0.10	3.8–4.9	0.50	0.30–0.9	0.50	0.15	0.25	1.2–1.8	0.05	0.15
A96061	6061	Aluminum 6061	Balance	0.04–0.35	0.15–0.40	0.7	0.15	0.40–0.8	0.15	0.25	0.8–1.2	0.05	0.15
A96262	6262	Aluminum 6262	Balance	0.04–0.14	0.15–0.40	0.7	0.15	0.40–0.8	0.15	0.25	0.8–1.2	0.05 <sup>D</sup>	0.15

<sup>A</sup> Limits are in percent, maximum, unless shown as a range or stated otherwise.

<sup>B</sup> Analysis shall regularly be made only for the elements specified in this table. If, however, the presence of other elements is suspected or indicated in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of the specified limits.

<sup>C</sup> Balance shall be arithmetically computed by deducting the sum of the other named elements from 100.

<sup>D</sup> Lead 0.4–0.7 %; bismuth 0.4–0.7 %.