



AEROSPACE STANDARD

AS4444™**REV. A**

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Superseding AS4444

Fittings, 24° Cone Flareless, Fluid Connection, 5000 psi

RATIONALE

This technical report is being stabilized because it covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. SCOPE:

1.1 Scope:

This SAE Aerospace Standard (AS) establishes the requirements for 24° cone flareless fluid connection fittings and nuts and bite type flareless sleeves (see Section 6) for use in aircraft fluid systems at an operating pressure of 5000 psi for the fittings and nuts and 3000 psi for the bite type sleeves.

1.2 Classification:

Fittings shall be furnished in the types and styles designated by the applicable AS, MS, NAS, or other engineering part standard drawings. This specification includes the same requirements for flareless fittings used with bite type sleeves that appear in MIL-F-18280 except for updated materials and process specifications and industry coordinated general improvements. It also includes requirements for machined acorn fitting ends. It is intended to serve as a procurement specification for the fittings described herein, and in Section 6. The requirements for bite type sleeves are given in AS4444/1.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and 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.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2486	Conversion Coating of Titanium Alloys, Fluoride Phosphate Type
AMS 2488	Anodic Treatment, Titanium and Titanium Alloys
AMS 2759	Heat Treatment, Steel Parts, General Requirements
AMS 2770	Heat Treatment of Wrought Aluminum Alloy Parts
AMS 4112	Aluminum Alloy Bars, Rods, and Wire, Rolled, Drawn, or Cold Finished 4.4Cu - 1.5Mg - 0.60Mn (2024-T6)
AMS 4124	Bars, Rods, and Wire, Rolled, Drawn or Cold Finished, 5.62N 2.5Mg 1.6Cu 0.23Cr
AMS 4134	Aluminum Alloy Die Forgings 4.4Cu - 0.85Si - 0.80Mn - 0.50Mg (2014-T4) Solution Heat Treated
AMS 4141	Forgings, Die, 5.6Zn - 2.6Mg - 7.6Cu - 0.23Cr, Solution and Precipitation Heat Treated
AMS 4928	Titanium Alloy Bars and Forgings, 6Al-4V, Annealed, 120,000 PSI (827 MPa) Yield
AMS 5639	Bars, Wire, Forgings, Tubing and Rings, 19Cr 10Ni Solution Heat Treated
AMS 5645	Bars, Forging, Tubing and Rings, 18Cr 10Ni 0.40Ti Solution Heat Treated
AMS 5648	Bars, Forgings, Tubing and Rings, 17Cr 12Ni 2.5Mo, Solution Heat Treated
AMS 5659	Bars, Wire, Forgings, Rings and Extrusions, 15Cr 4.5Ni 0.30 (Cb + Ta) 3.5Cu, Consumable Electrode Melted, Solution Heat Treated, Precipitation Hardenable
AMS 6370	Steel Bars, Forgings and Rings, 0.95Cr 0.20Mo (0.28-0.30C)
ARP603	Impulse Testing of Hydraulic Hose Tubing and Fittings Assemblies
ARP891	Determination of Aluminum Alloy Tempers Through Electrical Conductivity Measurements
ARP1185	Flexure Testing of Hydraulic Tubing Joints and Fittings
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AS1376	Alternate Dimensions, Center Body Section, Shape Fluid Fitting, Design Standard
AS4375	Fitting End, External Thread, Flareless Design Standard
AS4377	Fitting End, Bulkhead, Flareless, Design Standard
AS4444/1	Sleeve, Bite Type, 24° Cone Flareless Fitting
AS4458	Fitting End, Flareless, Blunt Nose, Design Standard
AS4658	Fitting End, External Thread, Short Flareless, Design Standard
AS4659	Fitting End, Bulkhead, External Thread, Short Flareless, Design Standard
AS4703	Fitting End, Acorn, Short Flareless, Design Standard
ARP4784	Performance and Evaluation Criteria, Surface Defects, Requirements for SAE Dictionary of Aerospace Engineering

- 2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

QQ-A-225/6	Aluminum Alloy Bar, Rod, and Wire; Rolled, Drawn, or Cold Finished, 2024
QQ-A-225/9	Aluminum Alloy Bar, Rod, Wire and Special Shapes; Rolled, Drawn, or Cold Finished, 7075
QQ-A-367	Aluminum Alloy Forgings
QQ-P-35	Passivation Treatments for Corrosion Resisting Steel
QQ-P-416	Plating, Cadmium (Electro-deposited)
QQ-S-763	Steel Bars, Wire, Shapes and Forgings, Corrosion-Resisting
MIL-STD-12	Abbreviations for Use on Drawings, and in Specifications, Standards and Technical Documents
MIL-STD-1655	Fittings, Flareless, Classification of Defects of
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Missile Ordnance Reviewer
MIL-H-6083	Hydraulic Fluid, Petroleum Base, For Preservation and Operation
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-S-6758	Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)
MIL-T-6845	Tubing, Steel, Corrosion-Resistant (S30400), Aerospace Vehicle Hydraulic System 1/8 Hard Condition
MIL-H-6875	Heat Treatment of Steels (Aerospace Practice, Process For)
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter: General Specification For
MIL-F-18280	Fittings, Flareless Tube, Fluid Connection
MIL-L-46010	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-H-46170	Hydraulic Fluid, Rust Inhibited, Fire Resistant Synthetic Hydrocarbon Base
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric
FED-STD-595	Colors Used in Government Procurement
MS21932	Fitting End, Bolt Cluster Fitting, Single Port
MS21934	Fitting End, Bolt Cluster Fitting, Double Port
MS21935	Fitting End, Bolt Cluster Fitting, Double Port, Through, Flareless
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33515	Fitting End, Standard Dimension for Bulkhead Flareless Tube Connection

- 2.1.3 National Aerospace Standards Publications: Available from Aerospace Association of America, 1725 DeSales Street, N.W., Washington, DC 20036.

NAS1760	Fitting End, Flareless Acorn, Standard Dimensions for
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2.1.4 ANSI Publications: Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI/ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

ANSI Z540-1 Calibration Laboratories in Measuring Test Equipment General Requirements

2.1.5 ISO Publications: Available from International Organization for Standardization, Case Postale 56, CH-1211 Genève 20, Switzerland.

ISO 10012-1 Quality Assurance Requirements for Measuring Equipment

2.1.6 ASTM Publications: Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 370 Steel Products, Mechanical Testing of

2.2 Abbreviations and Acronyms:

Standard abbreviations used in this document and frequently used in aerospace technical documents may be found in MIL-STD-12.

2.3 Definitions:

Definitions of terms used in this document and frequently used in aerospace technical documents may be found in the SAE Dictionary of Aerospace Engineering.

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Fittings shall be fabricated of materials listed in Table 1 and in compliance with requirements in this specification or as specified on the applicable part standard drawing.

3.1.1 Heat Treatment:

3.1.1.1 Aluminum Alloy: Aluminum alloy fittings and nuts shall be supplied in the final temper as shown in Table 1. When fitting material is purchased in other than the final temper, the heat treatment of the raw material shall be in accordance with MIL-H-6088. Heat treating of semi-finished or finished parts shall be in accordance with AMS 2770.

3.1.1.1.1 Electrical Conductivity and Hardness: Aluminum alloy fittings and nuts shall meet the electrical conductivity and hardness requirements of ARP891. The material may have to be heat treated before or after fabrication of parts in order to meet the requirement.

3.1.1.2 Steel: When additional processing is required to comply with hardness requirements of 3.1.2, the heat treatment shall be in accordance with MIL-H-6875 or AMS 2759.

TABLE 1 - Materials

Material	Type of Part	Form /1/	Specification	Alloy & Temper	Material Code
Aluminum alloy /2/	Straight fittings and nuts	Bars, rods	QQ-A-225/6 /2/	2024-T6 or T851	D
			AMS 4112 /2/	2024-T6	D
			QQ-A-225/9 /2/	7075-T73	W
			AMS 4124 /2/	7075-T7351	W
	Shape fittings and nuts	Forgings /3/	QQ-A-367 /2/	2014-T6	D
			AMS 4134 /2/	2014-T6	D
			QQ-A-367 /2/	7075-T73	W
			AMS 4141 /2/	7075-T73	W
	Shape fittings	Bars /1/	QQ-A-225/6 /2/	2024-T6 or T851	D
			AMS 4112 /2/	2024-T6	D
			QQ-A-225/9 /2/	7075-T73	W
			AMS 4124 /2/	7075-T7351	W
Carbon steel /4/	Straight and shape fittings and nuts	Bars, rods	MIL-S-6758 /4/	4130	None
			AMS 6370 /4/	4130	None
	Shape fittings	Forgings	MIL-S-6758 /4/ /6/	4130	None
Corrosion resistant steel /5/	Straight and shape fittings, nuts, and nonbite type sleeves	Bars	QQ-S-763 /5/	Class 304, Cond A	J
			AMS 5639 /5/	Class 304, Cond A	J
			QQ-S-763 /5/	Class 316, Cond A	K
			AMS 5648 /5/	Class 316, Cond A	K
			QQ-S-763 /5/	Class 321, Cond A	R
			AMS 5645 /5/	Class 321, Cond A	R
			AMS 5659	Type 15-5ph	V
	Shape fittings	Forgings	QQ-S-763 /5/	Class 304, Cond A	J
			AMS 5639 /5/	Class 304, Cond A	J
			QQ-S-763 /5/	Class 316, Cond A	K
			AMS 5648 /5/	Class 316, Cond A	K
			QQ-S-763 /5/	Class 321, Cond A	R
			AMS 5645 /5/	Class 321, Cond A	R
Titanium alloy	Straight and shape fittings, nuts, and nonbite type sleeves	Bars	AMS 4928	6Al-4V annealed	T
	Shape fittings	Forgings	AMS 4928	6Al-4V annealed	T

NOTES:

- /1/ The center body section of shape fittings machined from bar or oversized forgings shall conform to AS1376.
- /2/ The electrical conductivity and hardness of aluminum alloys shall meet ARP891. This requirement must be added as a supplement to the specification when materials are procured or the material may have to be heat treated before or after fabrication in order to meet the requirement.
- /3/ The parting lines in aluminum forgings shall meet the requirements of 3.1.3. This requirement may be added as a supplement to the specification when forgings are procured.
- /4/ The hardness of finished carbon steel parts shall be 92 HRB to 31 HRC per 3.1.2.1. If the materials are procured with this requirement as a supplement to the specification, the purchase order shall specify that any heat treatment applied shall be per MIL-H-6875 or AMS 2759 (see 3.1.1.2).
- /5/ The hardness of finished class 300 series corrosion resistant steel parts shall be 80 HRB minimum per 3.1.2.2. This requirement must be added as a supplement to the specification when materials are procured.
- /6/ This specification is for bar from which forgings shall be made and only the chemical composition applies.

3.1.2 Additional Physical Properties of Steel:

- 3.1.2.1 Carbon Steel: Unless otherwise specified on the applicable drawings, the hardness of the finished carbon steel fittings and nuts with plating removed shall be 92 HRB to 31 HRC. For carbon steel fittings and nuts below a hardness of 20 HRC, hardness tests shall be made using the B scale, in which case the hardness shall be within the range of 92 to 99 HRB (see 4.6.2).
- 3.1.2.2 Class 300 Series Corrosion Resistant Steel: Unless otherwise specified on the applicable drawings, the hardness of the finished class 300 series corrosion resistant steel parts shall be 80 HRB minimum (see 4.6.2).
- 3.1.2.3 Type 15-5ph Corrosion Resistant Steel: Unless otherwise specified on the applicable drawings, the type 15-5ph corrosion resistant steel material shall be heat treated to condition H-1075, before or after machining.
- 3.1.3 Parting Lines in Aluminum Forgings: Parting lines, which are formed by a pattern division during forming, shall be free of tears and crack-like indications. Surface defects may be explored as specified under 3.6.

NOTE: Parting lines or flash lines of fittings having such defect indications shall be ground flush to blend with the forging body, without reduction of the forging body thickness below drawing minimum. The finish in the ground parting line or flash line area shall not exceed 125 μ in roughness average (Ra) as defined in ANSI/ASME B46.1 after grinding. Machined and unmachined surfaces shall not exceed the discontinuity criteria of ARP4784, Grade A. Following anodizing, the part shall not exhibit cracks or crack-like defects exceeding ARP4784, Grade A.

3.2 Design and Fabrication:

The design and fabrication of the fittings shall be in accordance with the applicable drawings. The fitting ends shall be in accordance with AS4375, AS4377, AS4458, AS4658, AS4659, AS4703, MS21932, MS21934, MS21935, MS33514, MS33515, or NAS1760 as applicable. Dimensional requirements are applicable after heat treatment and protective finishing. The center body section of shape fittings machined from bar or oversized forgings shall conform to AS1376.

- 3.2.1 Shape and Form Restrictions: Abrupt reductions of section shall be avoided. Small external sections adjoining relatively heavy body sections shall transition into the heavier sections by means of ample fillets.

3.2.2 Passages:

- 3.2.2.1 Machining Offset: For straight fittings where the fluid passage is machined from each end, the offset between the machined holes at the meeting point of the holes shall not exceed .015 in. It shall be possible to pass through the fluid passage a ball whose diameter is .020 less than the minimum diameter specified for the passage. This does not mean that the fluid passage may be smaller than that required by the detail standard part drawings.

- 3.2.2.2 Cross Section at Fluid Path Junction: For shape fittings, the cross-sectional area at the junction of fluid passages shall be such that it shall be possible to pass through the fitting from end to end, a ball whose diameter is not less than .7 times the minimum diameter specified for the smaller passage.
- 3.2.3 Threads: Threads shall be per MIL-S-8879 except that the root radius is not required on incomplete threads. External threads on steel, corrosion resistant steel, and titanium alloy may be produced by a single point method, ground, or rolled. External threads on aluminum alloy may be cut, ground, or rolled (see 3.2.3.1). Internal threads may be produced by a single point method, cut, ground, or rolled.
- 3.2.3.1 Rolled External Threads: Laps and seams, whose depths are within the limits of Table 2, are acceptable on the crest, and the nonpressure thread flank above the pitch diameter. Laps and seams are not acceptable on any part of the pressure thread flank, in the thread root, or on the nonpressure thread flank in the area between the thread root and the pitch diameter (see Figure 1). Stress cracks are unacceptable.

TABLE 2 - Depth of Laps, Seams, Surface Irregularities, and Discontinuities in Rolled Threads

Size Code in .062 Increments	Depth, Max
02	.006
03	.006
04	.007
05	.007
06	.008
08	.009
10 thru 32	.010

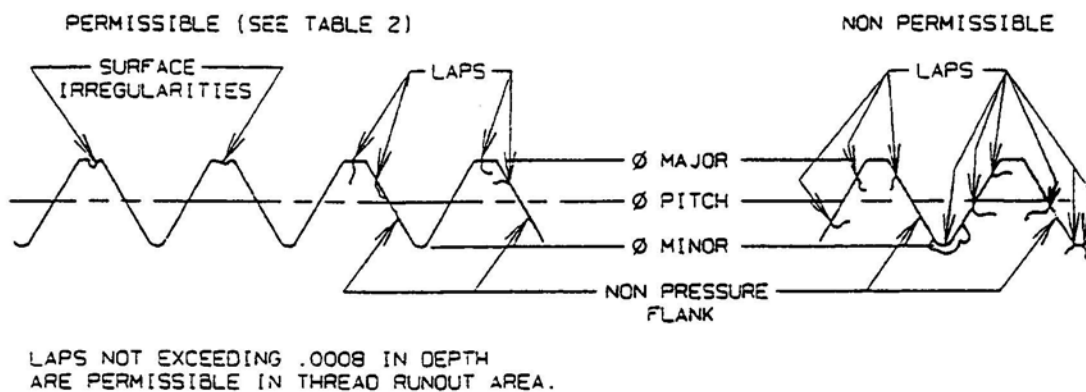


FIGURE 1 - Laps and Surface Irregularities in Threads

3.3 Finish:

3.3.1 Aluminum Alloy: Aluminum alloy fittings and nuts shall be anodized in accordance with MIL-A-8625, Type II, Class 2, dyed green similar to No. 14187 of FED-STD-595 or brown similar to No. 10080 of FED-STD-595 as applicable (see 3.4.4) and shall be duplex sealed.

3.3.2 Carbon Steel:

3.3.2.1 Carbon Steel Fittings: Carbon steel fittings and nuts shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2. The color will be iridescent bronze to brown including olive drab and yellow due to the post plate chromate treatment (see 3.4.4). All such carbon steel fittings and nuts shall be dipped in oil conforming to MIL-H-6083 or MIL-H-46170. Fluid passage holes, other openings, and internal threads shall not be subject to a plating thickness requirement and may exhibit bare areas provided that they are protected with a light film of oil.

3.3.3 Corrosion Resistant Steel:

3.3.3.1 Class 300 Series Corrosion Resistant Steel Fittings: Class 300 series corrosion resistant steel fittings, nuts, and sleeves shall be passivated per QQ-P-35, Type VI or VII. The inside only of sizes 16 through 32 slip-on nuts or retained nuts shall be coated with solid film lubricant per MIL-L-46010, Type I. Minor overspray of the lubricant on the outside of the nut is permitted.

3.3.3.2 Type 15-5ph Corrosion Resistant Steel: Type 15-5ph corrosion resistant steel fittings, nuts, and sleeves shall be passivated per QQ-P-35, Type II or VIII. The inside only of sizes 16 through 32 slip-on nuts or retained nuts shall be coated with solid film lubricant per MIL-L-46010, Type I. Minor overspray of the lubricant on the outside of the nut is permitted.

When cadmium plating is specified, passivation and solid film lubricant shall be omitted and the parts shall be cadmium plated per QQ-P-416, Type II, Class 2 except that following cadmium plating in all hardnesses, post plate baking shall be performed for a minimum of 3 h at 375 °F $\pm$ 25 °F. Fluid passages, other openings, and internal threads shall not be subjected to plating thickness requirements and may exhibit bare areas. The color will be iridescent bronze to brown including olive drab and yellow due to the post plate chromate treatment (see 3.4.4).

3.3.4 Titanium Alloy Fittings: Titanium alloy fittings and nuts shall be anodized per AMS 2488 or fluoride phosphate coated per AMS 2486, except that a pretreatment, a modification of the fluoride treatment, or a post treatment shall be applied so that the final color of the fittings shall be gray similar to color numbers 36076 through 36176 per FED-STD-595 (see 3.4.4).

3.4 Identification of Product:

All fittings, nuts, and sleeves shall be marked as specified on the applicable drawing in a location not detrimental to the performance of the fitting and not detrimental to the corrosion protection of the fitting. When items cannot be physically marked because of lack of space or because marking would have a deleterious effect, the package shall provide the identification per 5.4.