



AEROSPACE STANDARD	MA4510	
	Issued 1996-11 Reaffirmed 2015-08	
Fittings, Weld, Fluid Connection, 35 000 kPa, Metric		

RATIONALE

MA4510 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Scope:

This SAE Metric Aerospace Standard (AS) establishes the requirements for weld fluid connection fittings and rings to be orbital arc welded to tubing for use in metric aircraft fluid systems at a maximum operating pressure of 35,000 kPa.

1.2 Classification:

Fittings and rings shall be furnished in the types and styles designated by the applicable MA or other engineering part standard drawings. This specification is intended to serve as a procurement specification for the fittings described herein. The requirements for weld to separable fittings are given in slash specifications such as MA4510/1.

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.

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Documents

Document Sharing Hub

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

AMS 2759	Heat Treatment, Steel Parts, General Requirements
AMS 4928	Titanium Alloy Bars and Forgings, 6Al-4V, Annealed, 120,000 PSI (827 MPa) Yield
AMS 4945	Titanium Alloy Tubing, Seamless, Hydraulic, 3Al 2.5V, Texture Controlled, 105 ksi (724 MPa) Yield Strength, Cold Worked, Stress Relieved
AMS 5561	Tubing, Welded and Drawn, 9.0Mn 20Cr 0.28N High Pressure Hydraulic
AMS 5656	Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, and Rings 9.0 Mn 20Cr 6.5Ni 0.27N 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
AS478	Identification Marking Methods
ARP603	Impulse Testing of Hydraulic Hose Tubing and Fittings Assemblies
ARP1185	Flexure Testing of Hydraulic Tubing Joints and Fittings
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
MA2023	Wrench Pad, Fluid Fitting, Alternate Machined Shapes of, Design Standard for
MA2094	Test Methods for Tube-Fitting Assemblies, Metric (ISO 10583)
MA2307	Welded Girth, Design Standard, Metric
MA4510/1	Fittings, Weld to 24° Cone Flareless, Fluid Connection
ARP4784	Performance and Evaluation Criteria, Surface Defects, Requirements for

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

MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, For Preservation and Operation
MIL-H-46170	Hydraulic Fluid, Rust Inhibited, Fire Resistant Synthetic Hydrocarbon Base
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, Nato Code Number H-537

2.1.3 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

2.1.4 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
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3. TECHNICAL REQUIREMENTS:

3.1 Material:

Fittings and rings 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.

TABLE 1 - Materials

Material	Type of Part	Form	Specification	Alloy & Temper	Material Code
Corrosion resistant steel	Rings	Bars	AMS 5656	Type 21-6-9	Z
	Straight and Shape Fittings	Bars	AMS 5659	Type 15-5ph	V
	Shape fittings	Forgings	AMS 5659	Type 15-5ph	V
Titanium alloy	Straight and Shape Fittings and Rings	Bars	AMS 4928	6Al-4V annealed	T
	Shape fittings	Forgings	AMS 4928	6Al-4V annealed	T

3.1.1 Heat Treatment: Unless otherwise specified on the applicable drawings, the type 15-5ph corrosion resistant steel material shall be heat treated to condition H-1075 per AMS 2759/3, before or after machining.

3.2 Design and Fabrication:

The design and fabrication of the fittings and rings shall be in accordance with the applicable drawings. The fitting ends shall be in accordance with MA2307 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 MA2023.

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 0.4. It shall be possible to pass through the fluid passage a ball whose diameter is 0.5 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.

3.3 Finish:

3.3.1 Corrosion Resistant Steel: Corrosion resistant steel fittings and rings have no finish.

3.3.2 Titanium Alloy Rings and Fittings: Titanium alloy rings shall have no finish. Titanium alloy fittings shall have no finish on the weld end surfaces within a distance from the weld end of one half the nominal tube OD minimum.

3.4 Cleaning:

Parts that are to be cleaned only to standard industry practice for fittings shall have no code letter after the part number and shall be cleaned per 5.1. These parts may then have special cleaning as specified by the user prior to welding.

3.5 Identification of Product:

All fittings and rings shall be marked in accordance with the following instructions. The marking shall be applied per AS478 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 5.2.

3.5.1 Manufacturer's Identification: Unless otherwise specified, all fittings shall be marked with the manufacturer's name, CAGE code or trademark, and with the letters MA. Rings shall not be marked.

3.5.2 Material Identification: Fittings shall be marked with the material code letter as shown in Table 1. Forged shapes such as elbows or tees shall also be marked with the forging manufacturer's trademark or a code identification letter or number.

3.5.3 Marking for Part Number and Size: A numerical size code equivalent to the nominal tube size in 1 mm increments is optional. All fittings and sleeves larger than 10 fitting size code shall be marked with the basic part number, exclusive of size. Fitting assemblies with assembled nuts shall be marked as above on the fitting body, but assembled nuts that have their own part number identification are acceptable. Rings shall not be marked, but the package shall be identified per 5.2.

3.6 Performance:

The fittings and rings, when assembled to tubing specified in Tables 2 or 3 and tested in accordance with applicable procedures specified in Section 4, shall meet the following performance requirements. Weld fittings with separable fitting ends shall have had their separable fitting connection tested per the applicable performance specification for that type of connection at the applicable operating pressure but the separable fitting connection shall not fail the performance requirements of this specification when tested at the applicable operating pressure.

TABLE 2 - Tubing Wall Thickness, Operating Pressure, and Flexure Test Stress
For Weld Fittings with Type 21-6-9 Corrosion Resistant Steel Tubing

Nominal Tube Size DN /1/	Nominal Wall Thickness Type 21-6-9 Corrosion Resistant Steel Tubing Per AMS 5561	Maximum Operating Pressure kPa Corrosion Resistant Steel Fittings	Bending Stress Level in Tube for Flexure Test +0/-10% MPa Corrosion Resistant Steel Fittings 1 x 10 ⁷ cycles 6 samples /2/	Bending Stress Level in Tube for Flexure Test +0/-10% MPa Corrosion Resistant Steel Fittings 5 x 10 ⁵ cycles 2 samples	Bending Stress Level in Tube for Flexure Test +0/-10% MPa Corrosion Resistant Steel Fittings 5 x 10 ⁴ cycles 2 samples
4	0.5	21,000	130	172	240
5	0.4	21,000	130	172	240
5	0.5	21,000	130	172	240
6	0.4	21,000	130	172	240
6	0.5	21,000	130	172	240
8	0.5	21,000	130	172	240
8	0.6	21,000	130	172	240
10	0.6	21,000	130	172	240
10	0.7	21,000	130	172	240
10	0.8	21,000	130	172	240
12	0.8	21,000	130	172	240
14	1.0	21,000	130	172	240
16	1.0	21,000	130	172	240
20	1.5	21,000	130	172	240
25	1.6	21,000	130	172	240
32	2.2	21,000	130	172	240

/1/ DN = Nominal tube outside diameter.

/2/ Only 2 samples need be tested if Rotary Flexure Test Method is used. Six samples if Planar Test Method is used.