



AEROSPACE STANDARD

MA2241Issued 1993-11
Reaffirmed 2015-08Coupling Assembly, Threadless,
Flexible, Fixed Cavity, Self-Bonding, Metric

RATIONALE

MA2241 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

This document defines the requirements for a threadless, flexible, self-bonding coupling assembly, which, when installed on machined fixed cavity ferrules, provides a flexible connection for joining tubing and components in aircraft fuel, vent, or other systems. This assembled coupling, hereafter referred to as the assembly, is designed for use from -54 to 204 °C and at 862 kPa operating pressure. AS coupling components referenced herein have been qualified to AS1650. Ferrules referenced herein are inch ferrules adapted to metric tubing.

1.1 Product Classification:

The coupling assemblies shall be of the integral electrical bonding type.

2. REFERENCES:

2.1 Applicable Documents:

The following publications of the issue in effect on date of invitation for bids or request for proposals, form a part of this document to the extent specified herein unless otherwise specified.

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

AS568	Aerospace Size Standard for O-Rings
AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings and Similar System Components
AS1652	Coupling Assembly, Threadless, Fixed Cavity Ferrule Type, Self-Bonding
AS1654	Sleeve, Threadless Coupling - Fixed Cavity Ferrule Type
AS1655	Coupling, Threadless - Fixed Cavity Ferrule Type, Self-Bonding
MA2242	Assembled Coupling, Threadless, Flexible, Fixed Cavity, Self-Bonding, Envelope Dimensions, Metric
MA2243	Ferrule, Threadless Coupling, Flexible, Fixed Cavity, Self-Bonding, Swaged, Metric

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Documents

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2.1.1 (Continued):

MA2244	Ferrule End, Threadless Coupling, Flexible, Fixed Cavity, Self-Bonding, Design Standard, Metric
MA2245	Ferrule, Threadless Coupling, Flexible, Fixed Cavity, Self-Bonding, Butt Welded, Metric
MA2246	Sleeve End, Threadless Coupling, Flexible, Fixed Cavity, Self-Bonding, Design Standard, Metric
MA2262	Ferrule, Sleeve, Butt Weld, Threadless Coupling, Flexible Fixed Cavity, Self-Bonding, Metric
MA2263	Ferrule, Sleeve, Swaged, Threadless Coupling, Flexible, Fixed Cavity, Self-Bonding, Metric

2.1.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

PPP-T-60	Tape, Packaging, Waterproof
PPP-B-566	Boxes, Folding Paperboard
PPP-B-576	Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-585	Boxes, Wood Wirebound
PPP-B-591	Boxes, Shipping Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Boxes, Shipping Fiberboard
PPP-B-665	Boxes, Paperboard, Metal-Edged and Components
PPP-B-676	Boxes, Set-Up
VV-P-236	Petrolatum, Technical
WW-T-700/6	Tube, Aluminum Alloy, Drawn, Seamless, 6061
TT-S-735	Standard Test Fluids; Hydrocarbon
MIL-P-116	Preservation - Packaging, Methods of
MIL-B-5087	Bonding, Electrical and Lightning Protection for Aerospace Systems
MIL-C-7024	Calibrating Fluid, Aircraft Fuel System Components
MIL-L-10547	Liners, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
MIL-R-25988	Rubber, Fluorosilicone Elastomer, Oil & Fuel Resistant, Sheets, Strips, Molded Parts, & Extruded Shapes
MIL-STD-105	Sampling Procedure and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-831	Test Reports, Preparation of
MIL-STD-889	Dissimilar Metals

2.1.3 National Aerospace Standards: Available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005.

NAS1787	Clamp, Tube Mounting
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- 2.1.4 Uniform Classification Committee Publications: Available from The Uniform Classification Committee, 202 Chicago Union Station, Chicago, IL 60606.

Uniform Classification Committee
Uniform Freight Classification Rules

2.2 Other Publications:

The following documents form a part of this document to the extent specified herein. The issues of the documents where are indicated as DOD adopted shall be the issue listed in the current DODISS and supplement thereto, if applicable.

- 2.2.1 ANSI Publications: Available from ANSI, 11 West 42nd Street, New York, NY 10036.

ANSI/ASME B46.1 Surface Texture

- 2.2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 3951 Packaging, Commercial

2.3 Definitions:

ASSEMBLED COUPLING: The completed coupled connection utilizing a coupling assembly to connect two ferrules, which are attached to tube ends.

COUPLING ASSEMBLY: The connecting device, which constrains the ferrules and provides a pressure seal and electrical continuity across the ferrules.

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

Assemblies furnished under this document shall be products which are qualified by meeting all of the requirements covered by this document. Manufacturers choosing to produce only a part or parts of the assembled coupling shall qualify the part or parts by complying with the requirements and performing all tests of this document. The test specimens for qualification of a part or parts shall be tested with a qualified part or parts made by other qualified manufacturers whenever possible.

3.2 Materials and Finishes:

Materials and finishes for the components shall be those designated on the applicable MA and AS standard drawing. The assembly materials and finish shall be uniform in quality, free from defects, suitable for service, and in conformance with the applicable specifications and requirements stated herein.

- 3.2.1 Dissimilar Materials: Materials shall possess adequate corrosion-resistance characteristics or shall be suitably protected by the use of finishes to resist corrosion, which may result from such conditions as dissimilar metal combinations, moisture, salt spray, and high-temperature deterioration. Dissimilar materials are defined by MIL-STD-889.

3.3 Design and Fabrication:

The assembly shall be a lightweight flexible connection for fuel, vent, and other system lines using the basic principles of O-ring sealing. It shall be capable of operating at 862 kPa operating pressure at temperatures from 54 to +93 °C in aluminum and -54 to +204 °C in CRES. The assembly shall function at a maximum misalignment of 4° or maximum gap of 6 mm or, in combination, a minimum gap of 1.6 mm at 3° misalignment. If a component uses a sleeve end (MA2246-SIZE), the maximum misalignment is 2° or a maximum gap of 6 mm.

- 3.3.1 Assembled Coupling Components: The assembled coupling MA2242 shall consist of ferrules, O-ring seals and a coupling assembly AS1652, as follows:

- a. Two ferrules: MA2243 or MA2245 or a mix of one O-ring ferrule (MA2243, MA2245) and one sleeve ferrule (MA2262, MA2263)
- b. Two O-ring seals: User defined
- c. One coupling assembly: AS1652

- 3.3.2 Ferrule: Ferrules (MA2243 and MA2244) shall contain the fixed O-ring cavity. The design of the O-ring groove shall be for standard size O-rings as specified in Table 1. Attachment of the ferrule to the tubing shall be by mechanical roller swaging or welding. Ferrule material noted on the part standard drawing shall be compatible with the tubing to which it is attached and shall comply with MIL-STD-889.

- 3.3.3 Coupling Assembly: Coupling assemblies envelope drawings MA2242 and AS1652 are provided to aid in drawing callouts. Ferrules are not considered integral to the inch coupling assembly AS1652 because they are usually installed on tubing fabrication drawing and vary according to the attachment method.

- 3.3.3.1 Sleeve: The sleeve shall conform to AS1654 which is designed to carry only hoop stresses and to affect sealing. A portion of the sleeve outside surfaces shall be circumferentially grooved or knurled to facilitate installation and removal.

- 3.3.3.2 Coupling: The coupling, conforming to AS1655, shall lock when manually closed and shall be structurally capable of withstanding both the axial and bending moment loads transmitted by the system tubing when the tubing wall thickness is as specified in Table 2. The closure shall have clear indication of a locked condition both visually and by feel. Quick connect or disconnect action of the latch shall be utilized to allow assembly and removal with one hand. The coupling assembly shall provide a bonding means which meets the Class "S" electrical bonding requirements of MIL-B-5087.

3.3.3.3 Fitting and Ferrule Ends: Components and equipment requiring machined fitting end shall utilize ends conforming to MA2244 and MA2246.

3.3.4 Seals: O-rings are not considered a part of this document except for coupling qualification test requirements. O-ring sizes, AS568, for the couplings are given in Table 1.

TABLE 1 - Pressure Limits and O-ring Sizes

DN Size Code	Tube Size mm	(Tube Size in)	Operating Pressure Min Neg (-) in kPa	Operating Pressure Min Pos (+) kPa	Proof Pressure Min Neg (-) kPa	Proof Pressure Min Pos (+) kPa	Burst Pressure Min kPa	AS568 O-ring Dash No. (Ref)
12	12	.500	81	862	95	1724	2586	-015
16	16	.625	81	862	95	1724	2586	-017
18	18	.750	81	862	95	1724	2586	-117
25	25	1.000	81	862	95	1724	2586	-214
32	32	1.250	81	862	95	1724	2586	-218
38	38	1.500	81	862	95	1724	2586	-222
45	45	1.750	81	862	95	1724	2586	-224
50	50	2.000	81	862	95	1724	2586	-226
56	56	2.250	34	862	40	1724	2586	-228
63	63	2.500	34	862	40	1724	2586	-230
/1/ 76	76	3.000	34	862	40	1724	2586	-234
/1/ 88	88	3.500	34	862	40	1724	2586	-238
100	100	4.000	34	862	40	1724	2586	-242

/1/ These coupling assemblies use nonstandard tube diameters.

3.3.5 Dimensions: The assembly envelope dimensions shall be as specified in MA2242. Part dimensions shall be as specified in applicable MA and AS part standards.

3.3.6 Weights: The individual components of the coupling shall not exceed the maximum weights listed on the applicable MA and AS part standards.

3.4 Performance:

The assembled coupling shall meet the following performance requirements.

3.4.1 Proof Pressure: The assembled coupling shall meet the negative and positive proof pressures listed in Table 1 without leakage as specified or evidence of other malfunction. Testing is specified in 4.6.2.

3.4.1.1 Positive Pneumatic Leakage: The assembled coupling shall withstand pneumatic pressure equal to the proof pressure for 3 min at room temperature without any visible bubbles starting after 1 min at pressure or other malfunction that would affect assembly or disassembly.

3.4.1.2 Negative Pneumatic Leakage: The assembled coupling shall not exhibit a decrease in negative pressure exceeding .001 kPa within a period of 5 min, when subjected to the negative proof pressure.

- 3.4.1.3 Liquid Leakage: The assembled coupling shall withstand liquid pressure equal to the proof pressure for 3 min at room temperature without allowing the escape of liquid or external wetting from any point of the assembly.
- 3.4.2 Fuel Resistance (Aging): The assembled coupling shall not show evidence of malfunction or leakage in excess of 3.4.1.3 when subjected to high temperature fuel aging, 93 °C, low temperature fuel aging, -54 °C, and air dry out, 93 °C. Testing is specified in 4.6.3.
- 3.4.3 Vibration: The assembled coupling shall show no evidence of malfunction or structural failure and no leakage in excess of 3.4.1.3 after exposure to vibration levels in accordance with 4.6.4. The resistance across the coupling shall not exceed 1 Ω .
- 3.4.4 Repeated Assembly: There shall be no evidence of deformation, damage, or degradation in latching ability to the assembled coupling and it shall not leak in excess of 3.4.1.3 when subjected to the burst pressure requirements of 3.4.9, after 100 repeated assembly operations. The resistance across the coupling shall not exceed 1 Ω . Testing is specified in 4.6.5.
- 3.4.5 Salt Fog: The assembled coupling shall show no evidence of leakage in excess of 3.4.1.3 when subjected to the Table 1 proof and burst pressures and shall show no evidence of excessive corrosion, peeling, chipping, or blistering of the finish nor exposure of base metal under plated surfaces after being subjected to salt fog. The resistance across the coupling shall not exceed 1 Ω . Testing is specified in 4.6.6.
- 3.4.6 Dust: The assembled coupling shall show no damage such as fouling of parts and no evidence of malfunction and shall be capable of withstanding Table 1 proof pressures without evidence of leakage in excess of 3.4.1.3 after being subjected to the dust test. The resistance across the coupling shall not exceed 1 Ω . Testing is specified in 4.6.7.
- 3.4.7 Flexure: The assembled coupling shall withstand Table 1 burst pressure without evidence of leakage in excess of 3.4.1.3 with no binding or galling of parts after being subjected to 28 800 flexure cycles with the coupling at an offset of 3°. Testing is specified in 4.6.8.
- 3.4.8 Pressure Impulse: The assembled coupling shall withstand 100 000 pressure impulse cycles as defined in Figure 5 without evidence of malfunction or leakage in excess of 3.4.1.3. Testing is specified in 4.6.9.
- 3.4.9 Burst: The assembled coupling shall not rupture nor show evidence of leakage in excess of 3.4.1.3 at any pressure up to the Table 1 burst pressures. Testing is specified in 4.6.10.
- 3.4.10 Electrical Bonding: The electrical resistance of the assembled coupling, when measured from tube to tube, shall not exceed 1 Ω at any time. Testing is specified in 4.6.11.
- 3.5 Identification of Product:

Coupling assembly parts and ferrules shall be marked for identification in accordance with MIL-STD-130 as specified on the applicable MA and AS standard drawing.

3.6 Workmanship:

Coupling components shall be manufactured and finished in accordance with commercially accepted practices and processes.

3.7 Cleaning:

The coupling components as supplied shall be free of oil, grease, dirt, or any other foreign material both internally and externally.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection and test requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the procuring activity for the performance of the inspection and test requirements. The procuring activity reserves the right to perform any of the inspections and tests set forth in the specification, where such inspections and tests are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of Inspections:

The examining and testing of assemblies shall be classified as:

- a. Qualification inspections (4.3)
- b. Quality conformance inspections (4.4)

4.3 Qualification Inspections:

- 4.3.1 Qualification Test Specimens: Aluminum alloy test specimens in accordance with Figure 1A or 1B and Table 3 shall be used for all tests specified herein. The number of specimens are specified in 4.3.2. Tubing for fabrication of test specimens shall be 6061-T6 in accordance with WW-T-700/6 with dimensions as shown in Table 2. Attachment of ferrules to tubing shall be in accordance with user specifications.

Qualification of cress and titanium couplings shall be by similarity, subject to approval by the user.

TABLE 2 - Tube Size and Wall Thickness

DN Size Code /1/	Tube Size in mm /1/	(Tube Size in Inches)	(Tube Wall Thickness in Inches) /2/	Tube Wall Thickness in mm (Inch Conversion)	Tube Wall Thickness in mm
12	12	.500	.035	0.889	0.8
16	16	.625	.035	0.889	0.8
18	18	.750	.035	0.889	0.8
25	25	1.000	.035	0.889	0.8
32	32	1.250	.035	0.889	0.8
38	38	1.500	.035	0.889	0.8
45	45	1.750	.045	0.889	0.8
50	50	2.000	.035	0.889	0.8
56	56	2.250	.042	1.067	1.0
/3/ 63	63	2.500	.042	1.067	1.0
76	76	3.000	.042	1.067	1.0
/3/ 88	88	3.500	.049	1.245	1.2
100	100	4.000	.049	1.245	1.2

/1/ All sizes listed are not required for qualification testing but are included in the event that the user specifies additional testing.

/2/ Aluminum drawn tubing, 6061-T6 in accordance with WW-T-700/6.

/3/ These tube sizes are nonstandard.

4.3.2 Test Schedule and Sequence: Seven test specimens each for coupling DN sizes 12, 25, 38, 50, and 63 and six test specimens each for coupling DN sizes 76 and 100 shall be subjected to qualification tests in the order indicated in Table 3. MIL-R-25988/1 O-rings shall be used for all test specimens. Sizes other than those listed and smaller than DN size 100 are considered qualified by design similarity.

TABLE 3 - Test Schedule and Sequence

Specimen Numbers	1	2	3	4	5	6	/3/ 7
Applicable	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1
Tests	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2
	4.6.11	4.6.11	4.6.11	4.6.11	4.6.11	4.6.11	4.6.11
	4.6.3	4.6.3	4.6.7	4.6.7	4.6.5	4.6.5	4.6.4
	4.6.4 /1/	4.6.4 /1/	4.6.11	4.6.11	4.6.6	4.6.6	4.6.2
	4.6.2	4.6.2	4.6.8	4.6.8	4.6.9	4.6.9	4.6.11
	4.6.11	4.6.11	4.6.2	4.6.2	4.6.2	4.6.2	
	4.6.10		4.6.11	4.6.11	4.6.11	4.6.11	
			4.6.10		4.6.10		

/1/ Specimens 1 and 2 will not be subjected to the vibration tests of 4.6.4 in DN sizes 12, 25, 38, 50, and 63. All other tests are applicable. Specimen 7 will be used for vibration testing of these sizes. Specimens 1 and 2 in DN sizes 76 and 100 will be subjected to the vibration tests of 4.6.4.

4.3.3 Test Report, Test Samples, and Data for the Procuring Activity: When the tests are conducted at a location other than the laboratory of the procuring activity:

- a. Test Report: A minimum of three copies of a test report in accordance with MIL-STD-831, which shall include a report of all tests and an outline description of the tests and conditions.
- b. Test Sample: The sample which was tested, when requested by the procuring activity.
- c. Test Data: A minimum of three sets of engineering data in the form of assembly drawings. The assembly drawings shall have a cut-away section showing all details in their normal assembled position and shall carry part numbers of all details and subassemblies.

NOTE: Log sheets, containing required test data, shall remain on file at the suppliers test facility and shall be made available upon request.

4.3.4 Qualification Inspection Methods: Qualification inspection methods shall consist of all the examinations and tests specified in 4.6.

4.4 Quality Conformance Inspections:

Each coupling component shall be subjected to examination of product as specified in 4.6.1.

4.4.1 Quality Conformance Inspection Sampling: If sampling is used to determine compliance, the sample size shall be in accordance with MIL-STD-105. Recommended classes, AQLS, and defect characteristics referred to in MIL-STD-105 are presented in 6.2.

4.4.2 Rejection and Retest: Where one or more items selected from a lot fails to meet the specification, all items in the lot shall be inspected for the particular characteristic that failed.

4.4.2.1 Resubmitted Lots: Once a lot (or part of a lot) has been rejected by a procuring activity (Government or Industrial), before it can be resubmitted for tests, full particulars concerning the cause of previous rejection and the action taken to correct the defects in the lot shall be furnished, in writing, by the manufacturer to the procuring activity.

4.5 Test Conditions:

4.5.1 Assembly of Test Specimens: O-rings shall be lubricated with VV-P-236 Petrolatum, or equivalent.

4.5.2 Test Fluids: Test fluids shall be Type I or Type III, in accordance with TT-S-735 or as specified for each test.

4.5.3 Pressure Measurements: Unless otherwise specified, positive pressure measurements shall have a tolerance of ± 69 kPa. Negative pressures shall be equal to or greater than the specified value.

4.5.4 Temperature Measurements: Unless otherwise specified, the test specimens and fluid shall be maintained within 3 °C. Ambient temperature measurements shall be taken within 152 mm of the specimen.