



Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings¹

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This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification establishes the performance characteristics required for mechanically attached fittings (MAFs) for use in piping and tubing systems. These fittings directly attach to pipe or tube by mechanical deformation of the pipe or tube or fitting, or a combination thereof, creating a seal and a restrained joint. The seal may be created via the mechanical deformation or created independently. Successful completion of the tests described constitutes completion of the technical portion of the qualification process.

1.2 Supplementary requirements are provided for use when additional testing or inspection is desired. These shall apply only when specified in part or whole by the purchaser in the order. Unless otherwise specified, U.S. Navy contracts shall invoke the supplementary requirements in whole.

1.3 Unless specific MAF types are specified, the term “MAF” shall apply to all types described herein.

1.4 The tests specified in Section 13 and described in Annex A1 and the Supplementary Requirements Section are applicable only to ascertain the performance characteristics of MAFs. These tests are not intended for use in the evaluation of non-MAF products.

1.5 A fire performance test is specified in Supplementary Requirement S7. This test provides general guidelines to determine the responsiveness of MAFs when subjected to fire. This test should not be considered for use to evaluate non-MAF products.

1.6 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.7 The following safety hazards caveat applies only to the tests listed in Section 13 and the tests described in the Supplementary Requirements Section and the annexes of this

specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A109/A109M Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (Withdrawn 2014)³

A182/A182M Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

A213/A213M Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes

A234/A234M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

¹ This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.11 on Machinery and Piping Systems.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

- A240/A240M** Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- A249/A249M** Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
- A262** Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- A269/A269M** Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A276/A276M** Specification for Stainless Steel Bars and Shapes
- A312/A312M** Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A335/A335M** Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
- A370** Test Methods and Definitions for Mechanical Testing of Steel Products
- A380/A380M** Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- A403/A403M** Specification for Wrought Austenitic Stainless Steel Piping Fittings
- A450/A450M** Specification for General Requirements for Carbon and Low Alloy Steel Tubes
- A479/A479M** Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
- A530/A530M** Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
- A564/A564M** Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
- A576** Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
- A967** Specification for Chemical Passivation Treatments for Stainless Steel Parts
- A999/A999M** Specification for General Requirements for Alloy and Stainless Steel Pipe
- A1016/A1016M** Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
- B16/B16M** Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B21/B21M** Specification for Naval Brass Rod, Bar, and Shapes
- B36/B36M** Specification for Brass Plate, Sheet, Strip, and Rolled Bar
- B75/B75M** Specification for Seamless Copper Tube
- B88** Specification for Seamless Copper Water Tube
- B111/B111M** Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
- B117** Practice for Operating Salt Spray (Fog) Apparatus
- B121/B121M** Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar
- B122/B122M** Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar
- B124/B124M** Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes
- B154** Test Method for Mercurous Nitrate Test for Copper Alloys
- B164** Specification for Nickel-Copper Alloy Rod, Bar, and Wire
- B251/B251M** Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
- B369/B369M** Specification for Copper-Nickel Alloy Castings
- B371/B371M** Specification for Copper-Zinc-Silicon Alloy Rod
- B564** Specification for Nickel Alloy Forgings
- B633** Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- B696** Specification for Coatings of Cadmium Mechanically Deposited
- B766** Specification for Electrodeposited Coatings of Cadmium
- E8/E8M** Test Methods for Tension Testing of Metallic Materials
- E511** Test Method for Measuring Heat Flux Using a Copper-Constantan Circular Foil, Heat-Flux Transducer
- E1529** Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies

2.2 Federal Specifications:⁴

- QQ-N-281** Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings and Structural and Special Shaped Sections
- QQ-N-286** Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)

2.3 Military Specifications:⁴

- MIL-DTL-901** Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
- MIL-T-1368** Tube and Pipe, Nickel Copper Alloy Seamless and Welded
- MIL-PRF-7808** Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-148
- MIL-T-8606** Tubing, Steel Corrosion-Resistant (18-8 Stabilized and Extra Low Carbon)
- MIL-C-15726** Copper-Nickel Alloy, Rod, Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate) and Forgings
- MIL-DTL-16232** Phosphate Coatings, Heavy, Manganese or Zinc Base (for Ferrous Metals)
- MIL-T-16420** Tube, Copper Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706)
- MIL-PRF-17331** Lubricating Oil, Steam Turbine and Gear, Moderate Service
- MIL-DTL-18866** Fittings Hydraulic Tube, Flared, 37° and Flareless Steel
- MIL-T-24107** Tube, Copper, (Seamless) (Copper Numbers 102, 103, 108, 120, 122, and 142)
- MIL-P-24691/1** Pipe and Tube, Carbon Steel, Seamless
- MIL-P-24691/2** Pipe and Tube, Chromium-Molybdenum Steel, Seamless

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

MIL-P-24691/3 Pipe and Tube, Corrosion-Resistant, Stainless Steel, Seamless or Welded

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537

2.4 Military Standards:⁴

MIL-STD-167-1 Mechanical Vibration of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)

MIL-STD-777 Schedule of Piping Valves, Fittings, and Associated Piping Components for Naval Surface Ships

MIL-STD-889 Dissimilar Metals

MIL-STD-1916 DoD Preferred Methods for Acceptance of Products

NAVSEA Technical Publication S9074-AR-GIB-010/278

2.5 ANSI Publications:⁵

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

ANSI/NCSL Z540 General Requirements for Laboratories and Measuring and Test Equipment

2.6 ASME Publications:⁶

ASME Boiler and Pressure Vessel Code, Section IX

B36.10M Welded and Seamless Wrought Steel Pipe

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

2.7 SAE Publications:⁷

AMS 2243 Tolerances, Corrosion Resistant Steel Tubing

AMS 5643 Bars, Forgings, Tubing and Rings — 16 Cr 4.0 Ni 0.30 (Cb + Ta) 4.0 Cu

AMS-QQ-P-416 Plating Cadmium (Electrodeposited)

AMS-QQ-S-763 Steel Bars, Wire, Shapes, and Forgings; Corrosion Resistant

AMS-STD-753 Corrosion Resistant Steel Parts: Sampling, Inspection and Testing for Surface Passivation

AS3208 Packing, Preformed – AMS 7276, Seal

AS3209 Packing, Preformed – AMS 7276, ‘O’ Ring

SAE J514 Hydraulic Tube Fittings

SAE J515 Hydraulic ‘O’ Ring

SAE 1010 Carbon Steel: Nonsulfurized Manganese 10 % Minimum

3.1.2 *failure, n*—any leakage or joint separation unless otherwise determined to be due to a tubing/pipe or fitting defect.

3.1.3 *fitting, n*—connecting device used to join multiple pipes or tubes or other MAFs together to create a working system.

3.1.3.1 *Discussion*—Shapes such as couplings, unions, elbows, tees, crosses, plugs, adapters, reducers, flanges, and special shapes are used as needed to fulfill MAF system design specifications.

3.1.4 *joint, n*—interface between pipe or tube and MAFs where the seal is maintained or mechanical holding strength is applied or maintained within the overall MAF design.

3.1.5 *leakage, n*—the escape of fluid or gas from any point of the MAF, including the MAF joint interface, sufficient to drop or flow from the point of formation or gas bubbles rising to the surface after the first minute of submersion.

3.1.6 *mechanically attached fitting (MAF), n*—a fitting that is directly attached to pipe or tube by mechanical deformation of the pipe/tube or fitting, or both, creating a seal and a restrained joint. The seal may be created via the mechanical deformation or created independently.

3.1.7 *penalty run, n*—a penalty run is performed with penalty run MAF specimens when the original MAF test specimen leaks or separates during testing as a result of any cause that is not related to the design of the MAF being qualified.

3.1.8 *penalty run MAF specimens, n*—additional specimen(s) that are tested in the place of the original specimen(s) (see 3.1.7).

3.1.8.1 *Discussion*—These additional MAF specimen(s) are assembled using the same methods along with additional MAFs of the same type, grade, class, and configuration and additional pipe or tube with the same wall thickness and material conditions as the original test specimen.

3.1.9 *permanent MAF, n*—a fitting whose joint(s) attach directly to the pipe or tube to join two or more pipes or tubes or other MAFs in a combination of pipes or tubes and components. In either case, the permanent MAFs cannot be disassembled and reused after initial assembly.

3.1.10 *pipe, n*—hollow round product conforming to the dimensional requirements for nominal pipe size (NPS) as tabulated in ASME B36.10M, Table 2.

3.1.11 *rated pressure, n*—the manufacturer’s recommended in-service pressure assigned to the MAF (see 3.1.15).

3.1.12 *separable MAF, n*—a fitting whose joint(s) attach directly to the pipe or tube to join two or more pipes or tubes or other MAFs in a combination of pipes or tubes and components. Once assembled, the separable MAFs can be disassembled and reassembled a multiple number of times.

3.1.12.1 *Discussion*—Some subcomponents of separable MAFs may become permanently attached to the pipe or tube without affecting the function of the joint.

3.1.13 *specimen, n*—a prepared assembly consisting of a MAF assembled onto a preselected pipe or tube. The specimen

3. Terminology

3.1 Definitions:

3.1.1 *class, n*—a group of MAFs of a particular design with the dimensions proportional to pipe or tube outside diameters, made from the same material grade (or combination of grades), for the same rated pressure, or for a rated pressure inversely proportional to the diameter.

3.1.1.1 *Discussion*—Class designation for MAF is assigned based upon the rated pressure used to test the MAF design.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁷ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.