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An American National Standard

Standard Practice for Selection and Application of Piping System Materials[1]

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1. Scope

1.1 This practice is intended as a guide to shipbuilders, shipowners, and design agents for use in the preparation of piping system material schedules for commercial ship design and construction.

1.2 The materials and limitations listed in Tables 1-28 meet the minimum requirements of the U.S. Coast Guard and the American Bureau of Shipping and, except for titanium, should be considered to be the minimum acceptable materials in regard to material, design, and testing. This document is not intended to limit the selection of material strictly to those listed. Other equal or superior materials may be used provided that they are acceptable to the regulatory bodies and classification societies.

NOTE 1—Titanium has been added as its use in fresh and sea water systems is becoming more common.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

A105/A105M Specification for Carbon Steel Forgings for Piping Applications

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

A134 Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)

A139/A139M Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

A178/A178M Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes

A179/A179M Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes

A181/A181M Specification for Carbon Steel Forgings, for General-Purpose Piping

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

A192/A192M Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service

A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A194/A194M Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

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

A214/A214M Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes

A216/A216M Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

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

A242/A242M Specification for High-Strength Low-Alloy Structural Steel

A249/A249M Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes

A283/A283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

A307 Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

A320/A320M Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

A335/A335M Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service

A351/A351M Specification for Castings, Austenitic, for Pressure-Containing Parts

A387/A387M Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum

[1] This practice 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.

A395/A395M Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A515/A515M Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
A536 Specification for Ductile Iron Castings
A563 Specification for Carbon and Alloy Steel Nuts
B61 Specification for Steam or Valve Bronze Castings
B62 Specification for Composition Bronze or Ounce Metal Castings
B88 Specification for Seamless Copper Water Tube
B265 Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate
B338 Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers
B348 Specification for Titanium and Titanium Alloy Bars and Billets
B363 Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings
B367 Specification for Titanium and Titanium Alloy Castings
B381 Specification for Titanium and Titanium Alloy Forgings
B466/B466M Specification for Seamless Copper-Nickel Pipe and Tube
B467 Specification for Welded Copper-Nickel Pipe
B861 Specification for Titanium and Titanium Alloy Seamless Pipe
B862 Specification for Titanium and Titanium Alloy Welded Pipe
B863 Specification for Titanium and Titanium Alloy Wire
B898 Specification for Reactive and Refractory Metal Clad Plate
D2996 Specification for Filament-Wound "Fiberglass'' (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
D2997 Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
D4024 Specification for Machine Made "Fiberglass'' (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
F467 Specification for Nonferrous Nuts for General Use
F468 Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
F682 Specification for Wrought Carbon Steel Sleeve-Type Pipe Couplings
F683 Practice for Selection and Application of Thermal Insulation for Piping and Machinery
F704 Practice for Selecting Bolting Lengths for Piping System Flanged Joints
F722 Specification for Welded Joints for Shipboard Piping Systems
F1476 Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications
F1548 Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications

2.2 *ANSI Standards:*[3]
B16.5 Steel Pipe Flanges and Flanged Fittings
B16.9 Factor Made Wrought Steel Buttwelding Fittings
B16.10 Face to Face and End to End Dimensions of Valves
B16.11 Forged Steel Fittings, Socket Welding and Threaded
B16.15 Cast Bronze Threaded Fittings Class 125 and 250
B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.24 Bronze Flanges and Flanged
B16.28 Wrought Steel Buttwelding Short Radius Elbows and Returns
B16.34 Valves Flanged, Threaded and Welding End
B16.42 Ductile Iron Pipe Flanges and Flanged Fittings
B18.2.1 Square and Hex Bolts and Screws Inch Series
B18.2.2 Square and Hex Nuts (Inch Series)
B18.21.1 Lock Washers (Inch Series)
B18.22.1 Plain Washers
B16.48 Steel Line Blanks
B31.1 Power Piping
B36.10 Welded and Seamless Wrought Steel Pipe
B36.19 Stainless Steel Pipe

2.3 *Manufacturer's Standardization Society of the Valve and Fitting Industry Standards:*[4]
SP-43 Wrought Stainless Steel Buttwelding Fittings
SP-44 Steel Pipeline Flanges
SP-67 Butterfly Valves
SP-72 Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-80 Bronze Gate, Globe, Angle and Check Valves
SP-83 Class 300 Steel Pipe Unions Socket Welding and Threaded
SP-97 Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded, and Buttwelding Ends
SP-119 Factory Made Belled End Socket-Welding Fittings

2.4 *Other Documents:*
ASME Boiler and Pressure Vessel Code, Sections I and VIII[5]
ABS' Rules for Building and Classing Steel Vessels[6]
Title 46, Code of Federal Regulations, Parts 41 to 69[7]
NVIC 11-86; Guidelines Governing the Use of Fiberglass Pipe (FGP) on Coast Guard Inspected Vessels[7]
MIL-F-1183 Fittings, Pipe, Cast Bronze, Silver-Brazing[7]

3. General Requirements

3.1 Shipboard piping systems shall be in accordance with ANSI B31.1 except as modified by 46 CFR Part 56 of the U.S. Coast Guard regulations and Sections 36 and 44 of the ABS' Rules.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.
[4] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602.
[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.
[6] Available from American Bureau of Shipping (ABS), ABS Plaza, 16855 Northchase Dr., Houston, TX 77060.
[7] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

3.2 Piping systems shall be classed in accordance with 46 CFR 56.04.

3.3 Valves shall be in accordance with 46 CFR 56.20.

3.4 Valves for Class I systems shall be in accordance with 46 CFR 56.20-9(b) and if larger than 2-in. NPS shall not have socket weld ends.

3.5 Resilient seated valves shall be in accordance with 46 CFR 56.20-15.

3.6 Dimensions of ductile iron gate, globe, angle, and check valves shall be in accordance with ANSI B16.34 and shall use the adjusted pressure temperature ratings of ANSI B31.1, Appendix E.

3.7 Flanges for flanged valves and fittings and their companion flanges shall be in accordance with 46 CFR 56.25 and 56.30-10.

3.8 Bolting shall be in accordance with 46 CFR 56.25-20. Practice F704 shall be used as a guide for determining flange bolting lengths.

3.9 Socket weld joints shall be in accordance with 46 CFR 56.30-5(c) and 56.30-10(b), Method 4, and shall not exceed 3-in. NPS for Class I and II-L service.

3.10 Threaded joints shall be in accordance with 46 CFR 56.30-20 and shall not exceed 2-in. NPS for Class I systems.

3.11 Flared, flareless, and compression tube fittings shall be limited to 2-in. OD or below and shall be in accordance with 46 CFR 56.30-25.3.12

3.12 Brazed socket type joints shall be in accordance with 46 CFR 56.30-30 and 56.75.

3.13 Gasketed mechanical couplings and fittings for use with gasketed mechanical couplings shall be in accordance with 46 CFR 56.30–35.

3.14 Flexible pipe couplings of the compression or slip-on types shall be in accordance with 46 CFR 56.30-40.

3.15 For restrictions on the use of welded tube and pipe, see 46 CFR 56.60-2(b).

3.16 Ferrous pipe used for saltwater service shall be protected against corrosion in accordance with 46 CFR 56.60-3(a).

3.17 All welding of Class I and II piping shall be in accordance with 46 CFR 56.70 and Specification F722.

3.18 Thermal insulation for piping systems shall be in accordance with Practice F683.

3.19 Fiberglass reinforced thermosetting epoxy resin pipe and fittings shall be in accordance with 46 CFR 56.60-25 and U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 11-86.

3.20 Fiberglass pipe shall not be used outboard of skin valves.

4. List of Tables

4.1 The tables are arranged in the following sequence:

5. Keywords

5.1 materials; piping systems; piping systems materials; ship construction; ship design

TABLE 1 Material Temperature Limitations[A]

Material	Material Specifications	Temperature Limit, °F, max
Corrosion resistant steel	ASTM A194/A194M GR[B] 8, 8C, 8T	1200
	ASTM A194/A194M GR 8F	800
	ASME SA312 TP[C] 316L	850
	ASME SA312 TP 304L	800
	ASTM A351/A351M GR CF3M	850
Chrome-molybdenum steel	ASTM A182/A182M GR F6a, F11	1100
	ASTM A193/A193M GR B16	1100
	ASTM A193/A193M GF B7	1000
	ASTM A194/A194M GR 4	900
	ASME SA217 GR WC6	1100
	ASTM A234/A234M GR WP11	1100