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An American National Standard

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

This standard is issued under the fixed designation F1155; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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 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.

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 Materials 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 Materials 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

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

[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.

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
B466/B466M Specification for Seamless Copper-Nickel Pipe and Tube
B467 Specification for Welded Copper-Nickel Pipe
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
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)
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-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 Carbon Steel Pipe Unions, Socket-Welding and Threaded

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.

3.2 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] 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.

3.16 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
	ASTM A335/A335M GR P11	1100
	ASTM A387/A387M	1000
Carbon steel	ASTM A53/A53M TY[D] S	800[E]
	ASTM A53/A53M TY E	650
	ASTM A105/A105M	800[E]
	ASTM A106/A106M	800[E]
	ASTM A134 GR 285C (straight seam)	300
	ASTM A134 GR 285C (spiral seam)	200
	ASTM A139/A139M GR B (straight seam)	300
	ASTM A139/A139M GR B (spiral seam)	200
	ASTM A181/A181M	800[E]
	ASTM A194/A194M GR 2H	800
	ASTM A216/A216M GR WCB	1000
	ASTM A234/A234M GR WPB	800
	ASTM A307	400
	ASTM A515/A515M GR 70	800
Ductile iron	ASTM A395/A395M	650
	A536	450
Bronze	ASME SB61	550
	ASME SB62	406
Copper nickel alloy	ASME SB466 C70600	600
	ASME SB467 C70600	600
Copper	ASTM B88 TY K or L	400
	ASME SB75	400
Glass reinforced plastic	ASTM D2996 GR 1	225
	ASTM D2997 GR 1	225
	ASTM D4024 GR 1	225

[A] Maximum temperature limits per ANSI B31.1 for all material, except glass reinforced plastic, which is per NVIC 11-86 and Specification A536 which is per 46 CFR 56.
[B] GR—grade.
[C] TP—tubular product.
[D] TY—type.
[E] Upon prolonged exposure to temperatures above 775°F, the carbide phase or carbon steel may be converted to graphite.

TABLE 2 Steam, Steam Drains, Boiler Blow, Superheater Safety Valve Escape Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 1100°F[A] Remarks/Limitations
Pipe	Seamless	CrMo[B] steel	ASTM A335/A335M GR[C] P11	ANSI B36.10	. . .
Takedown joints	Flanges: weld neck or socket weld	CrMo steel	ASTM A182/A182M GR F11	ANSI B16.5	. . .
Bolting	Bolts/bolt studs	CrMoV[D] steel	ASTM A193/A193M GR B16	ANSI B18.2.1	. . .
	Nuts	CMo[E] steel	ASTM A194/A194M GR 4	ANSI B18.2.2	. . .
Fittings	Flanged	CrMo steel	ASME SA217 GR WC6 or ASTM A182/A182M GR F11	ANSI B16.5	. . .
	Buttweld	CrMo steel	ASTM A234/A234M GR WP11	ANSI B16.9 or B16.28	. . .
	Socket weld	CrMo steel	ASTM A182/A182M GR F11	ANSI B16.11	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	CrMo steel	ASME SA217 GR WC6 or ASTM A182/A182M GR F11	ANSI B16.34	Trim group 1[F]
	Socket weld	CrMo steel	ASTM A182/A182M GR F6a or GR F11	ANSI B16.34	. . .

[A] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B] CrMo—chromium-molybdenum.
[C] GR—grade.
[D] CrMoV—chromium-molybdenum-vanadium.
[E] CMo—carbon-molybdenum.
[F] For trim group definition, refer to Table 28.

TABLE 3 Steam, Steam Drains, Feed, Condensate Boiler Blow Sampling and Compounding, Safety Valve Escape Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 775°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A106/A106M GR[B] B or A53/A53M GR B TY S or E	ANSI B36.10	A53/A53M GR B TY[C] E Limited to a design pressure of 350 psig. See also Table 1.
Takedown joints	Flanges: weld neck, socket weld or slip-on	Carbon steel	ASTM A105/A105M	ANSI B16.5	. . .
	Unions: socket weld	Carbon steel	ASTM A105/A105M	MSS-SP-83	. . .
Bolting	Bolts/bolt studs	CrMo[D] steel	ASTM A193/A193M GR B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A194/A194M GR 2H	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.5	. . .
	Butt weld	Carbon steel	ASTM A234/A234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.11	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	Carbon steel Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.34	Trim group 2[E]
	Socket weld		ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.34	. . .

[A] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B] GR—grade.
[C] TY—type.
[D] CrMo—chromium-molybdenum
[E] For trim group definition, refer to Table 28.

TABLE 4 Steam, Steam Drains, Feed, Condensate, Boiler Blow Sampling and Compounding, and Safety Valve Escape Piping

Item	Type	Style	Material Specification[A]	Design Specification	Maximum Temperature 406°F[B] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A106/A106M GR[C] B or A53/A53M GR B TY S or E	ANSI B36.10	A53/A53M GR B TY[D] E limited to a design pressure of 350 psig
Takedown joints	Flanges: weld neck, socket weld or slip-on	Carbon steel	ASTM A105/A105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A105/A105M	MSS-SP-83	. . .
	Unions: threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A216/A216M GR WCB or	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A234/A234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.11	. . .
	Sleeve couplings	Carbon steel	ASTM A234/A234M GR WPB	ASTM F682	. . .
	Threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A395/A395M	ANSI B16.34	Trim group 3 and 4[E]
	Flanged or buttweld	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.34	. . .
			ASTM A105/A105M	ANSI B16.34	
	Socket weld	Carbon steel	ASME SB61 or SB62	MSS-SP-80[F]	. . .
	Threaded or brazed	Bronze			. . .

[A] When combining dissimilar materials, galvanic corrosion can occur, especially in seawater systems, and should be considered.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] GR—grade.
[D] TY—type.
[E] For trim group definition, refer to Table 28.
[F] MSS-SP-80 valves limited to 75 % of valve design pressure.

TABLE 5 Gas Turbine and Diesel Exhaust Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 1100°F[A] Remarks/Limitations
Pipe	Seamless	CrMo steel[B]	ASTM A335/A335M GR[C] P11	ANSI B36.10	. . .
	Plate formed	CrMo steel	ASTM A387/A387M	Commercial[D]	. . .
Takedown joints	Flanges: weld neck or socket weld	CrMo steel	ASTM A182/A182M GR F11	ANSI B16.5	. . .
	Flanges: plate	CrMo steel	ASTM A387/A387M	Commercial[D]	. . .
Bolting	Bolts/bolt studs	CrMoV[E] steel	ASTM A193/A193M GR B16	ANSI B18.2.1	. . .
	Nuts	CMo[F] steel	ASTM A194/A194M GR 4	ANSI B18.2.2	. . .

[A] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B] CrMo—chromium-molybdenum.
[C] GR—grade.
[D] Specific Coast Guard and ABS approval for design required.
[E] CrMoV—chromium-molybdenum-vanadium.
[F] CMo—carbon-molybdenum.

TABLE 6 Gas Turbine and Diesel Exhaust Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 775°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A106/A106M GR[B] B or A53/A53M GR B TY S or E	ANSI B36.10	See Table 1
Takedown joints	Flanges: weld neck, socket weld or slip-on	Carbon steel	ASTM A105/A105M	ANSI B16.5	. . .
	Flanges: plate	Carbon steel	ASTM A515/A515M GR 70	Commercial[C]	. . .
Bolting	Bolts/bolt studs	CrMo[D] steel	ASTM A193/A193M GR B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A194/A194M GR 2H	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A234/A234M GR WPB	ANSI B16.9 or B16.28	. . .

[A] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B] GR—grade.
[C] Specific Coast Guard and ABS approval required.
[D] CrMo—chromium-molybdenum.

TABLE 7 Fresh Water for Auxiliary Machinery and Engine Cooling

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 240°F[B] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A106/A106M GR[C] B or A53/A53M GR B TY[D] S or E	ANSI B36.10	. . .
	Filament wound	FGP[E]	ASTM D2996 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D2997 GR1	Commercial[F]	
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A105/A105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A105/A105M	MSS-SP-83	. . .
	Unions: threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D4024 GR 1	ASTM D4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A536	ASTM F1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A234/A234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded	Carbon steel	ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.9 or B16.28	. . .
	Sleeve couplings	Carbon steel	ASTM A234/A234M GR WPB	ASTM F682	. . .
	Threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
	Used with gasketed mechanical couplings	Ductile iron	A536	F1548	. . .
Valves	Butterfly wafer or lug type	Ductile iron	ASTM A395/A395M	MSS-SP-67	Trim group 4[I]
	Butterfly grooved end	Ductile iron	ASTM A536	. . .	Trim group 4[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A395/A395M	ANSI B16.34	Trim group 4[I]
	Flanged or buttweld	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M	ANSI B16.34	Trim group 3 and 4[I]
	Socket weld	Carbon steel	ASTM A105/A105M	ANSI B16.34	Trim group 3 and 4[I]
	Threaded or brazed	Bronze	ASME SB61 or SB62	MSS-SP-80[J]	Trim group 3 and 4[I]
	Grooved end	Ductile iron	ASTM A536	. . .	Trim group 3 and 4[I]
Valves: ball	Flanged or buttweld	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M or A181/A181M	MSS-SP-72	Trim group 3 and 4[I]

[A] When combining dissimilar materials, galvanic corrosion can occur especially in seawater systems, and should be considered.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] GR—grade.
[D] TY—type.
[E] FGP—fiberglass pipe.
[F] Specific Coast Guard and ABS approval required.
[G] For U.S. flag vessels in addition to classification society requirements.
[H] GRP—glass reinforced plastic.
[I] For trim group definition, refer to Table 28.
[J] MSS-SP-80 valves limited to 75 % of valve design pressure.

TABLE 8 Fresh Water, Hot and Cold Domestic, Air Conditioning, Sanitary

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 240°F[B] Remarks/Limitations
Pipe	Seamless	Copper	ASTM B88 TY[C] K or L	ASTM B88	Hard drawn. Must be annealed for pressures greater than 225 psig.
	Filament wound	FGP[D]	ASTM D2996 GR[E] 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[D]	ASTM D2997 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
Takedown joints	Flanges: silbraze	Bronze	ASME SB62	ANSI B16.24	. . .
	Unions: brazed or threaded	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D4024 GR 1	ASTM D4024	. . .
	Gasketed mechanical couplings	Ductile iron[I]	ASTM A536	ASTM F1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A563 GR A	ANSI B18.2.2	. . .
Fittings	Silbraze	Copper	ASME SB88 TY K or L	ANSI B16.22	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
	Used with gasketed mechanical couplings	Bronze	ASTM B61 or B62	ASTM F1476	. . .
Valves	Butterfly wafer or lug	Ductile iron	ASTM A395/A395M	MSS-SP-67	Trim group 4[J]
	Butterfly grooved end	Bronze	ASTM B61 or B62	. . .	Trim group 4[J]
Valves: gate, globe, angle, check	Flanged or brazed	Bronze	ASME SB61 or SB62	MSS-SP-80[K]	Trim group 4[J]
Valves: ball	Flanged	Bronze	ASME SB61 or SB62	MSS-SP-72	Trim group 4[J]

[A] When combining dissimilar materials galvanic corrosion can occur, especially in seawater systems, and should be considered.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] TY—type.
[D] FGP—fiberglass pipe.
[E] GR—grade.
[F] Specific Coast Guard and ABS approval required.
[G] For U.S. flag vessels in addition to classification society requirements.
[H] GRP—glass reinforced plastic.
[I] Acceptable when gasket isolates coupling housings from fluid.
[J] For trim group definition, refer to Table 28.
[K] MSS-SP-80 valves limited to 75 % of valve design pressure.

TABLE 9 Sea Water Circulating, Wet Firemain, and Distilling Plant Piping

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 150°F[B] Remarks/Limitations
Pipe	Seamless or welded	CNA[C] 90:10	ASME SB466 or SB467	ASME SB466 or SB467	
	Filament wound	FGP[D]	ASTM D2996 GR[E] 1	Commercial[F]	See NVIC 11-86[G]
	Centrifugally cast	FGP[D]	ASTM D2997 GR 1	Commercial[F]	See NVIC 11-86[G]
Takedown joints	Flanges: brazed	Bronze	ASME SB62	ANSI B16.24	. . .
	Unions: brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D4024 GR 1	ASTM D4024	. . .
	Gasketed mechanical couplings	Ductile iron[I]	ASTM A536	ASTM F1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Bronze	ASME SB61 or SB62	ANSI B16.24	. . .
	Buttweld or welding sleeve	CNA 90:10	ASME SB466 or SB467	810-1385880	. . .
	Brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
	Used with gasketed mechanical couplings	Bronze CNA	ASTM B61 or B62 ASTM B466/B466M or ASTM B467	ASTM F1548 ASTM F1548	. . . . . .
Valves	Butterfly water or lug	Ductile iron[J] Carbon steel[J]	ASTM A395/A395M ASTM A216/A216M GR WCB or A105/A105M	MSS-SP-67	Trim group 6[K]
	Butterfly grooved end	Bronze	ASTM B61 or B62	. . .	Trim group 4[K]
Valves: gate, globe, angle, check	Flanged Brazed	Bronze	ASME SB61 or SB62	MSS-SP-80[L]	Trim group 6[K]

[A] When combining dissimilar materials, galvanic corrosion can occur, especially in seawater systems, and should be considered.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] CNA—copper nickel alloy.
[D] FGP—fiberglass pipe.
[E] GR—grade.
[F] Specific Coast Guard and ABS approval required.
[G] For U.S. flag vessels in addition to classification society requirements.
[H] GRP—glass reinforced plastic.
[I] Acceptable when gasket isolates coupling housings from fluid.
[J] Not permitted with CNA piping.
[K] For trim group definition, refer to Table 28.
[L] MSS-SP-80 valves limited to 75 % of valve design pressure.

TABLE 10 Dry Fire Main, Foam, Sprinkling, Deckwash, Tank Cleaning Piping

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 200°F[B] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A106/A106M GR[C] B or A53/A53M GR B TY[D] S or E	ANSI B36.10	. . .
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A105/A105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A105/A105M	MSS-SP-83	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A536	ASTM F1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A234/A234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.11	. . .
	Sleeve coupling	Carbon steel	ASTM A234/A234M GR WPB	ASTM F682	. . .
	Threaded	Bronze	ASME SB61 or SB62	ANSI B16.15	. . .
	Used with Gasketed mechanical couplings	Ductile iron	ASTM A536	ASTM F1548	. . .
Valves	Butterfly wafer or lug type	Ductile iron	ASTM A395/A395M	MSS-SP-67	. . .
	Butterfly grooved end	Ductile iron	ASTM A536	. . .	Trim group 4[E]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A395/A395M	ANSI B16.34	Trim group 4[E]
	Flanged or buttweld	Carbon steel	ASTM A216/A216M GR WCB or A105/A105M		Trim group 3[E]
	Socket weld	Carbon steel	ASTM A234/A234M GR WPB or A105/A105M	ANSI B16.34	. . .
	Flanged or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[F]	. . .
	Grooved end	Ductile iron	ASTM A536	. . .	Trim group 3 and 4[E]

[A] When combining dissimilar materials, galvanic corrosion can occur, especially in seawater systems, and should be considered.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] GR—grade.
[D] TY—type.
[E] For trim group definition, refer to Table 28.
[F] MSS-SP-80 valves limited to 75 % of valve design pressure.