Designation: F 1155 – 98

An American National Standard

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

This standard is issued under the fixed designation F 1155; 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:*

A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless[2]

A 105/A105M Specification for Carbon Steel Forgings for Piping Applications[2]

A 106 Specification for Seamless Carbon Steel Pipe for High-Temperature Service[2]

A 134 Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)[2]

A 139/A 139M Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)[2]

A 178/A 178M Specification for Electric-ResistanceWelded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes[2]

A 179/A 179M Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes[2]

A 181/A 181M Specification for Carbon Steel Forgings, for General-Purpose Piping[2]

A 182/A 182M Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service[2]

A 192/A 192M Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service[2]

A 193/A 193M Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service[2]

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service[2]

A 213/A 213M Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and HeatExchanger Tubes[2]

A 214/A 214M Specification for Electric-ResistanceWelded Carbon Steel Heat-Exchanger and Condenser Tubes[2]

A 216/A 216M Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service[3]

A 234/A 234M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service[2]

A 242/A 242M Specification for High-Strength Low-Alloy Structural Steel[4]

A 249/A 249M Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes[2]

A 283/A 283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates[4]

A 307 Specification for Carbon Steel Bolts and Studs, 60 000 Psi Tensile Strength[5]

A 320/A 320M Specification for Alloy Steel Bolting Materials for Low-Temperature Service[2]

A 335/A 335M Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service[2]

A 351/A 351M Specification for Castings, Austenitic, Austenitic–Ferritic (Duplex), for Pressure–Containing Parts[3]

A 387/A 387M Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum[4]

A 395 Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures[3]

A 515/A 515M Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service[4]

A 536 Specification for Ductile Iron Castings[3]

A 563 Specification for Carbon and Alloy Steel Nuts[5]

[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.

Current edition approved April 10, 1998. Published August 1998. Originally published as F 1155–88. Last previous edition F 1155–88 (1993)$^{\epsilon 1}$.

[2] *Annual Book of ASTM Standards*, Vol 01.01.

[3] *Annual Book of ASTM Standards*, Vol 01.02.

[4] *Annual Book of ASTM Standards*, Vol 01.04.

[5] *Annual Book of ASTM Standards*, Vol 15.08.

B 61 Specification for Steam or Valve Bronze Castings[6]
B 62 Specification for Composition Bronze or Ounce Metal Castings[6]
B 88 Specification for Seamless Copper Water Tube[6]
B 466 Specification for Seamless Copper-Nickel Pipe and Tube[6]
B 467 Specification for Welded Copper-Nickel Pipe[6]
D 2996 Specification for Filament-Wound "Fiberglass'' (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe[7]
D 2997 Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe[7]
D 4024 Specification for Machine Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges[7]
F 682 Specification for Wrought Carbon Steel Sleeve-Type Pipe Couplings[8]
F 683 Practice for Selection and Application of Thermal Insulation for Piping and Machinery[8]
F 704 Practice for Selecting Bolting Lengths for Piping System Flanged Joints[8]
F 722 Specification for Welded Joints for Shipboard Piping Systems[8]
F 1476 Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications[8]
F 1548 Specification for the Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications[8]

2.2 *ANSI Standards:*[9]
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:*[10]
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[11]
ABS' Rules for Building and Classing Steel Vessels[12]
Title 46, Code of Federal Regulations, Parts 41 to 69[13]
NVIC 11-86; Guidelines Governing the Use of Fiberglass Pipe (FGP) on Coast Guard Inspected Vessels[13]
MIL-F-1183 Fittings, Pipe, Cast Bronze, Silver-Brazing[13]

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 F 704 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).

[6] *Annual Book of ASTM Standards*, Vol 02.01.
[7] *Annual Book of ASTM Standards*, Vol 08.04.
[8] *Annual Book of ASTM Standards*, Vol 01.07.
[9] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.
[10] Available from Manufacturer's Standardization Society of the Valve and Fittings Industry, 127 Park St., N.E. Vienna, VA 22180.
[11] Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.
[12] Available from American Bureau of Shipping, Book Order, 45 Eisenhower Dr., Paramus, NJ 07652.
[13] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

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 F 722.

3.18 Thermal insulation for piping systems shall be in accordance with Practice F 683.

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 A 194/A 194M GR[B] 8, 8C, 8T	1200
	ASTM A 194/A 194M GR 8F	800
	ASME SA312 TP[C] 316L	850
	ASME SA312 TP 304L	800
	ASTM A 351/A 351M GR CF3M	850
Chrome-molybdenum steel	ASTM A 182/A 182M GR F6a, F11	1100
	ASTM A 193/A 193M GR B16	1100
	ASTM A 193/A 193M GF B7	1000
	ASTM A 194/A 194 GR 4	900
	ASME SA217 GR WC6	1100
	ASTM A 234/A 234M GR WP11	1100
	ASTM A 335/A 335M GR P11	1100
	ASTM A 387/A 387M	1000
Carbon steel	ASTM A 53 TY[D] S	800[E]
	ASTM A 53 TY E	650
	ASTM A 105/A 105M	800[E]
	ASTM A 106	800[E]
	ASTM A 134 GR 285C (straight seam)	300
	ASTM A 134 GR 285C (spiral seam)	200
	ASTM A 139/A 139M GR B (straight seam)	300
	ASTM A 139/A 139M GR B (spiral seam)	200
	ASTM A 181/A 181M	800[E]
	ASTM A 194/A 194M GR 2H	800
	ASTM A 216/A 216M GR WCB	1000
	ASTM A 234/A 234M GR WPB	800
	ASTM A 307	400
	ASTM A 515/A 515M GR 70	800
Ductile iron	ASTM A 395	650
	A 536	450
Bronze	ASME SB61	550
	ASME SB62	406
Copper nickel alloy	ASME SB466 C70600	600
	ASME SB467 C70600	600
Copper	ASTM B 88 TY K or L	400
	ASME SB75	400
Glass reinforced plastic	ASTM D 2996 GR 1	225
	ASTM D 2997 GR 1	225
	ASTM D 4024 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 A 536 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 A 335/A 335M GR[C] P11	ANSI B36.10	. . .
Takedown joints	Flanges: weld neck or socket weld	CrMo steel	ASTM A 182/A 182M GR F11	ANSI B16.5	. . .
Bolting	Bolts/bolt studs	CrMoV[D] steel	ASTM A 193/A 193M GR B16	ANSI B18.2.1	. . .
	Nuts	CMo[E] steel	ASTM A 194/A 194M GR 4	ANSI B18.2.2	. . .
Fittings	Flanged	CrMo steel	ASME SA217 GR WC6 or ASTM A 182/A 182M GR F11	ANSI B16.5	. . .
	Buttweld	CrMo steel	ASTM A 234/A 234M GR WP11	ANSI B16.9 or B16.28	. . .
	Socket weld	CrMo steel	ASTM A 182/A 182M GR F11	ANSI B16.11	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	CrMo steel	ASME SA217 GR WC6 or ASTM A 182/A 182M GR F11	ANSI B16.34	Trim group 1[F]
	Socket weld	CrMo steel	ASTM A 182/A 182M 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 A 106 GR[B] B or A 53 GR B TY S or E	ANSI B36.10	A 53 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 A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
Bolting	Bolts/bolt studs	CrMo[D] steel	ASTM A 193/A 193M GR B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 194/A 194M GR 2H	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.5	. . .
	Butt weld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	Carbon steel Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 2[E]
	Socket weld		ASTM A 234/A 234M GR WPB or A 105/A 105M	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 A 106 GR[C] B or A 53 GR B TY S or E	ANSI B36.10	A 53 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 A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Unions: threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 3 and 4[E]
	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	. . .
			ASTM A 105/A 105M	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 A 335/A 335M GR[C] P11	ANSI B36.10	. . .
	Plate formed	CrMo steel	ASTM A 387/A 387M	Commercial[D]	. . .
Takedown joints	Flanges: weld neck or socket weld	CrMo steel	ASTM A 182/A 182M GR F11	ANSI B16.5	. . .
	Flanges: plate	CrMo steel	ASTM A 387/A 387M	Commercial[D]	. . .
Bolting	Bolts/bolt studs	CrMoV[E] steel	ASTM A 193/A 193M GR B16	ANSI B18.2.1	. . .
	Nuts	CMo[F] steel	ASTM A 194/A 194M 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 A 106 GR[B] B or A 53 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 A 105/A 105M	ANSI B16.5	. . .
	Flanges: plate	Carbon steel	ASTM A 515/A 515M GR 70	Commercial[C]	. . .
Bolting	Bolts/bolt studs	CrMo[D] steel	ASTM A 193/A 193M GR B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 194/A 194M GR 2H	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A 234/A 234M 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 A 106 GR[C] B or A 53 GR B TY[D] S or E	ANSI B36.10	. . .
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D 2997 GR1	Commercial[F]	
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Unions: threaded or brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.9 or B16.28	. . .
	Sleeve couplings	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	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	A 536	F 1548	. . .
Valves	Butterfly wafer or lug type	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 4[I]
	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[I]
	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 3 and 4[I]
	Socket weld	Carbon steel	ASTM A 105/A 105M	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 A 536	. . .	Trim group 3 and 4[I]
Valves: ball	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M or A 181/A 181M	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 B 88 TY[C] K or L	ASTM B 88	Hard drawn. Must be annealed for pressures greater than 225 psig.
	Filament wound	FGP[D]	ASTM D 2996 GR[E] 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[D]	ASTM D 2997 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 D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron[I]	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 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 B 61 or B 62	ASTM F 1476	. . .
Valves	Butterfly wafer or lug	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 4[J]
	Butterfly grooved end	Bronze	ASTM B 61 or B 62	. . .	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 D 2996 GR[E] 1	Commercial[F]	See NVIC 11-86[G]
	Centrifugally cast	FGP[D]	ASTM D 2997 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 D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron[I]	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 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	ASTM B 61 or B 62	ASTM F 1548	. . .
		CNA	ASTM B 466 or ASTM B 467	ASTM F 1548	. . .
Valves	Butterfly water or lug	Ductile iron[J]	ASTM A 395	MSS-SP-67	Trim group 6[K]
		Carbon steel[J]	ASTM A 216/A 216M GR WCB or A 105/A 105M		
	Butterfly grooved end	Bronze	ASTM B 61 or B 62	. . .	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 A 106 GR[C] B or A 53 GR B TY[D] S or E	ANSI B36.10	. . .
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve coupling	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Threaded	Bronze	ASME SB61 or SB62	ANSI B16.15	. . .
	Used with Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly wafer or lug type	Ductile iron	ASTM A 395	MSS-SP-67	. . .
	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[E]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[E]
	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[E]
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	. . .
	Flanged or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[F]	. . .
	Grooved end	Ductile iron	ASTM A 536	. . .	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.

TABLE 11 Bilge, Clean Ballast, and Pump Priming Piping

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 100°F[B] Remarks/Limitations
Pipe	Seamless or electric resistance weld	Carbon steel	ASTM A 106 GR[C] B or A 53 GR B TY[D] S or E	ANSI B36.10	. . .
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D 2997 GR 1	Commercial[F]	See NVIC 11-86[G]
Takedown joints	Flanges: slip-on or socket weld	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Flanges: plate	Steel with NCA[H] facing	ASTM A 283/A 283M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Flanges: adhesive bonded	GRP[I]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve coupling	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Adhesive bonded	GRP[I]	Commercial	Commercial[F]	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly wafer or lug type	Ductile iron	ASTM A 395	MSS-SP-67	. . .
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		
	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[J]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 3 and 4[J]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 3 and 4[J]
	Threaded or brazed	Bronze	ASME SB61 or SB62	MSS-SP-80[K]	Trim group 3 and 4[J]
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 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] 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] NCA—nickel copper alloy.
[I] GRP—glass-reinforced plastic.
[J] For trim group definition, refer to Table 28.
[K] MSS-SP-80 valves limited to 75 % of valve design pressure.

TABLE 12 Diesel and Lube Oil System Piping Fuel Oil Filling, Transfer, and Service Suction Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 200°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S or E	ANSI B36.10	. . .
	Filament wound	FGP[D]	ASTM D 2996 GR 1	Commercial[E]	See NVIC 11-86[F]
	Centrifugally cast	FGP[D]	ASTM D 2997 GR 1	Commercial[E]	See NVIC 11-86[F]
Takedown joints	Flanges: weldneck, socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Flanges: adhesive bonded	GRP[G]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Adhesive bonded	GRP[D]	Commercial	Commercial[E]	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly wafer or lug	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 4 and 5[H]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		
	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[H]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4 and 5[H]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		
	Socket weld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	Trim group 3[H]
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[H]

[A] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B] GR—grade.
[C] TY—type.
[D] FGP—fiberglass pipe.
[E] Specific Coast Guard and ABS approval required.
[F] For U.S. flag vessel in addition to classification society requirements.
[G] GRP—glass reinforced plastic.
[H] For trim group definition, refer to Table 28.

TABLE 13 Fuel Oil Service Discharge Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 300°F[A] Remarks/Limitations
Pipe	Seamless	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S	ANSI B36.10	. . .
Takedown joints	Flanges: weldneck, socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[D]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4 and 5[D]
		Carbon steel	ASTM A 216/A 216M GR WCB		Trim group 3[D]
	Buttweld or socket weld	Carbon steel	or A 105/A 105M ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	. . .
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[D]

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

TABLE 14 Cargo Oil and Vent Piping and Crude Oil Wash Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 200°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S or E	ANSI B36.10	. . .
	Filament wound	FGP[D]	ASTM D 2996 GR 1	Commercial[E]	See NVIC 11-86[F]
	Centrifugally cast	FGP[D]	ASTM D 2997 GR 1	Commercial[E]	See NVIC 11-86[F]
Takedown joints	Flanges: weld neck, socket weld, or threaded	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Flexible couplings	Steel with resilient gasket	Commercial	Commercial[E]	. . .
	Flanges: adhesive bonded	GRP[G]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Ductile iron	ASTM A 395	ANSI B16.42	. . .
		Carbon steel	ASTM A 216/A 216M GR WCB	ANSI B16.5	. . .
	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve coupling	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Adhesive bonded	GRP[G]	Commercial	Commercial[E]	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly wafer or lug	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 4[H]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[H]
	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[H]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[H]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[H]
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[H]

[A]Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B]GR—grade.
[C]TY—type.
[D]FGP—fiberglass pipe.
[E]Specific Coast Guard and ABS approval required.
[F]For U.S. flag vessel in addition to classification society requirements.
[G]GRP—glass reinforced plastic.
[H]For trim group definition, refer to Table 28.

TABLE 15 Steering Gear Fill and Drain Piping, and Telemotor Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 406°F[A] Remarks/Limitations
Pipe	Seamless	Copper	ASTM B 88 TY[B] K	ASTM B 88	Must be annealed for pressures over 225 psig
Takedown joints	Unions: brazed or threaded	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
Bolting	None required				
Fittings	Brazed or threaded	Bronze	ASME SB61 or SB62	ANSI B16.18	. . .
	Brazed	Copper	ASME SB75	ANSI B16.22	. . .
Valves: gate, globe, angle, check	Brazed or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[C]	Trim group[D]
Valves: ball	Flanged	Bronze	ASME SB61 or SB62	MSS-SP-72, Table 2	Trim group[D]

[A]Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B]TY—type.
[C]MSS-SP-80 valves limited to 75 % of valve design pressure.
[D]For trim group definition, refer to Table 28.

TABLE 16 Hydraulic Piping[A,B]

Item	Type/Style	Material	Material Specification[C]	Design Specification	Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106, A 178/A 178M, A 179/A 179M, A 192/A 192M or A 214/A 214M	ANSI B36.10	. . .
		CRES[D]	ASTM A 213/A 213M or A 249/A 249M		
Takedown joints	Flanges: weldneck or socket weld	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: flared, flareless, compression	Carbon steel	Commercial	Commercial[E]	. . .
Bolting	Bolts/bolt studs	CrMo[F] steel	ASTM A 193/A 193M GR[G] B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 194/A 194M GR 2H	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Flared, flareless, compression	Carbon steel	Commercial	Commercial[E]	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 2[H]
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	. . .
	Flared, flareless, compression	Carbon steel	Commercial	Commercial[E]	. . .
Valves: ball	Flanged	Bronze	ASME SB61 or SB62	MSS-SP-72	Trim group 3 and 4[H]

[A] This table does not apply to packaged hydraulic systems and equipment. For such applications, specific Coast Guard and ABS approval should be obtained.
[B] Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[C] When combining dissimilar materials, galvanic corrosion can occur, especially in seawater systems, and should be considered.
[D] CRES—corrosion resistant steel.
[E] Specific Coast Guard and ABS approval required.
[F] CrMo—chromium-molybdenum.
[G] GR—grade.
[H] For trim group definition, refer to Table 28.

TABLE 17 Air Piping 150 psi and Below

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature Ambient[B] Remarks/Limitations
Pipe	Seamless	Carbon steel	ASTM A 106 GR[C] B	ANSI B36.10	. . .
	Seamless	Copper	ASTM B 88 TY[D] K	ASTM B 88	. . .
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D 2997 GR 1	Commercial[F]	See NVIC 11-86[G]
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Unions: brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	. . .
	Buttweld		ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socketweld		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Brazed	Bronze	ASME SB61 or SB62	MIL-F-1183	. . .
	Adhesive bonded	GRP[H]	Commercial[F]	Commercial[F]	. . .
	Sleeve coupling	Carbon steel	ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[I]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[I]
	Socket weld	Carbon steel	ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	Trim group 3[I]
	Brazed or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[J]	Trim group 4[I]
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[I]
Valves: ball	Flanged	Bronze	ASME SB61 or SB62	MSS-SP-72	Trim group 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 18 Air Piping Above 150 psi

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature Ambient[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY S or E	ANSI B36.10	A 53 GR B TY[C] E limited to a design pressure of 350 psig
Takedown joints	Flanges: weld neck, socket weld, or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.5	. . .
	Buttweld		ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve coupling		ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536		Trim group 4[D]
Valves: gate, globe, angle, check	Flanged	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 3[D]
	Socket weld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.34	. . .
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[D]
Valves: ball	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M or A 181/A 181M	MSS-SP-72	Trim group 3[D]

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

TABLE 19 Refrigeration Piping

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 406°F[A] Remarks/Limitations
Pipe	Seamless	Copper	ASTM B 88 TY[B] K or L or ASME SB75	ASTM B 88 or ASME SB75	Must be annealed for pressures over 225 psig
Takedown joints	None				
Bolting	None				
Fittings	Brazed	Copper	ASTM B 88 TY K or L or ASME SB75	ANSI B16.22	. . .

[A]Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B]TY—type.

TABLE 20 CO_2, Halon, and Smoke Detection

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 850°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S	ANSI B36.10	See Table 1. Must be internally and externally protected from corrosion. CO_2 piping requires 6000-psig burst rating.
Takedown joints	Flanges: buttweld or socketweld	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
Bolting	Bolts/bolt studs	CrMo[D] steel	ASTM A 193/A 193M GR B7	ANSI B18.2.1	. . .
	Nuts	Carbon steel	ASTM A 194/A 194M GR 2H	ANSI B18.2.2	. . .
Fittings	Buttweld, socketweld or threaded	Carbon steel	ASTM A 234/A 234M GR WPB A 105/A 105M	ANSI B16.9 or B16.28	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 2[E]
	Socket weld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	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 21 Sounding Tubes, Vents, and Overflows for Freshwater, Saltwater, and Oil

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 406°F[B] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[C] B or A 53 GR B TY[D] S or E	ANSI B16.10	. . .
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D 2997 GR 1	Commercial[F]	
Takedown joints	Flanges: socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings		ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536		Trim group 4[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395 A 105/A 105M	ANSI B16.34	Trim group 4[I]
	Socket weld		ASTM A 234/A 234M GR WPB or A 105/A 105M		Trim group 3[I]
	Brazed or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[J]	Trim group 4[I]
	Grooved end	Ductile iron	ASTM A 536		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 22 Waste, Soil, and Interior Deck Drains

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 A 106 GR[C] B or ASTM A 53 TY[D] S or E	ANSI B36.10	. . .
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G] FGP not permitted outboard of shell valve.
	Centrifugally cast	FGP[E]	ASTM D 2997 GR 1	Commercial[F]	
Takedown joints	Flanges: socket weld or threaded	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld or threaded			MSS-SP-83	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D 4024 GR 1	ASTM D 4024	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
	Sleeve coupling	Carbon steel	ASTM F 682	ASTM F 682	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[I]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[I]
	Brazed or threaded	Bronze	ASME SB61 or SB62	ANSI B16.24 MSS-SP-80[J]	Trim group 4[I]
	Grooved end	Ductile iron		ASTM A 536	Trim group 4[I]
Valves: ball	Flanged	Ductile iron	ASTM A 395	MSS-SP-72	Trim group 4[I]
		Bronze	ASME SB61 or SB62		

[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 23 Weather Deck Drains, Main Deck, and Above

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature Ambient[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S or E	ANSI B36.10	. . .
Takedown joints	Flanges: socketweld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
	Unions: socket weld	Carbon steel	ASTM A 105/A 105M	MSS-SP-83	. . .
	Gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1476	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings		ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Used with gasketed mechanical couplings	Ductile iron	ASTM A 536	ASTM F 1548	. . .
Valves	Butterfly grooved end	Ductile iron	ASTM A 536	. . .	Trim group 4[D]
Valves: check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 4[D]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[D]
	Grooved end	Ductile iron	ASTM A 536	. . .	Trim group 3 and 4[D]

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

TABLE 24 Inert Gas-Generator or Uptakes to Scrubber

Item	Type/Style	Material	Material Specification	Design Specification	Maximum Temperature 840°F[A] Remarks/Limitations
Pipe	Fabricated duct	Alloy steel	ASTM A 242/A 242M TY[B] 1	Commercial[C]	. . .
Takedown joints	Flanges: welded	Alloy steel	ASTM A 242/A 242M TY 1	Commercial[C]	. . .
Bolting	Bolts	CrMoV[D] steel	ASTM A 193/A 193M GR[E] B 16	ANSI B18.2.1	. . .
	Nuts	CMo[F] steel	ASTM A 194/A 194M GR 4	ANSI B18.2.2	. . .
Fittings	Fabricated duct	Alloy steel	ASTM A 242/A 242M TY 1	Commercial[C]	. . .
Valves	Sliding gate	Carbon steel	Commercial[C]	Commercial[C]	Trim group 3[G]
Valves	Butterfly wafer or lug	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 3[G]

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

TABLE 25 Inert Gas, Scrubber to Tanks

Item	Type/Style	Material	Material Specification[A]	Design Specification	Maximum Temperature 406°F[B] Remarks/Limitations
Pipe	Electric resistance welded	Carbon steel	ASTM A 134 GR[C] 285C or ASTM A 139/A 139M GR B	ANSI B36.10	. . .
	Seamless or electric resistance welded		ASTM A 106 GR B or A 53 GR B TY[D] S or E		
	Filament wound	FGP[E]	ASTM D 2996 GR 1	Commercial[F]	See Table 1 and NVIC 11-86[G]
	Centrifugally cast	FGP[E]	ASTM D 2997 GR 1	Commercial[F]	
Takedown joints	Flanges: weldneck socket weld or slip-on	Carbon steel	ASTM A 105/A 105M or A 181/A 181M CL 60	ANSI B16.5	. . .
	Flexible couplings	Steel with resilient gaskets	Commercial	Commercial[F]	. . .
	Flanges: adhesive bonded	GRP[H]	ASTM D 4024 GR 1	ASTM D 4024	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socketweld or threaded		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve couplings		ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
	Adhesive bonded	GRP[H]	Commercial	Commercial[F]	. . .
Valves	Butterfly wafer or lug	Ductile iron	ASTM A 395	MSS-SP-67	Trim group 8[I]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[I]
Valves: gate, globe, angle, check	Flanged	Ductile iron	ASTM A 395	ANSI B16.34	Trim group 8[I]
		Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M		Trim group 3[I]
	Flanged, brazed, or threaded	Bronze	ASME SB61 or SB62	MSS-SP-80[J]	Trim group 8[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 26 Liquified Natural Gas Systems Including Vapor Fuel, Inert Gas, and Nitrogen Service

Item	Type/Style	Material	Material Specification	Design Specification	Minimum Temperature 0°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	Carbon steel	ASTM A 106 GR[B] B or A 53 GR B TY[C] S or E	ANSI B36.10	. . .
Takedown joints	Flanges: weld neck, socket weld or slip-on	Carbon steel	ASTM A 105/A 105M	ANSI B16.5	. . .
Bolting	Bolts/bolt studs	Carbon steel	ASTM A 307 GR B	ANSI B18.2.1	. . .
	Nuts		ASTM A 563 GR A	ANSI B18.2.2	. . .
Fittings	Buttweld	Carbon steel	ASTM A 234/A 234M GR WPB	ANSI B16.9 or B16.28	. . .
	Socket weld		ASTM A 234/A 234M GR WPB or A 105/A 105M	ANSI B16.11	. . .
	Sleeve coupling		ASTM A 234/A 234M GR WPB	ASTM F 682	. . .
Valves	Butterfly wafer or lug	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	MSS-SP-67	. . .
Valves: gate, globe, angle, check	Flanged or buttweld	Carbon steel	ASTM A 216/A 216M GR WCB or A 105/A 105M	ANSI B16.34	Trim group 3[D]
	Socket weld		ASTM A 234/A 234M GR WPB or A 105/A 105M	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]For trim group definition, refer to Table 28.

TABLE 27 Liquified Natural Gas Systems Including Cargo, Inert Gas, Nitrogen, and Cargo Tank Cooldown and Warm-Up Piping Below 0°F

Item	Type/Style	Material	Material Specification	Design Specification	Minimum Temperature −325°F[A] Remarks/Limitations
Pipe	Seamless or electric resistance welded	CRES[B]	ASME SA312 TP[C] 316L or 304L	ANSI B36.19	. . .
Takedown joints	Flanges: weld neck or socket weld	CRES	ASTM A 182/A 182M GR[D] 316L	ANSI B16.5	. . .
Bolting	Bolts/bolt studs	CRES	ASTM A 320/A 320M GR B8T, B8F, B8M, or B8C	ANSI B18.2.1	. . .
	Nuts		ASTM A 194/A 194M GR 8, 8C, 8F, or 8T	ANSI B18.2.2	. . .
Fittings	Buttweld	CRES	ASTM A 182/A 182M GR 316L or 304L; or A 351/A 351M GR CF3M	ANSI B16.9 or B16.28	. . .
	Socket weld		ASTM A 182/A 182M GR 316L or 304L; or A 351/A 351M GR CF3M	ANSI B16.11	. . .
Valves	Butterfly wafer or lug	CRES	ASTM A 182/A 182M GR 316L or 304L; or A 351/A 351M GR CF3M	MSS-SP-67	Trim group 7[E]
Valves: gate, globe, angle, check	Flanged, buttweld, or socket weld	CRES	ASTM A 182/A 182M GR 316L or 304L; or A 351/A 351M GR CF3M	ANSI B16.34	Trim group 7[E]

[A]Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B]CRES—corrosion resistant steel.
[C]TP—tubular product.
[D]GR—grade.
[E]For trim group definition, refer to Table 28.

TABLE 28 Valve Trim Groups[A]

Group	Trim	Material	Material Specification[B]	Remarks/Limitations
1	Stem	CRES[C]	ASTM A 182/A 182M GR[D]F6a	. . .
	Wedge/disk	CrMo[E]	ASTM A 182/A 182M GR F11	
	Seat ring	CrMo	ASTM A 182/A 182M GR F11 or ASME SA217 GR WC6	hard-faced seat
	Seat, integral	Same as valve body		
2	Stem, wedge/disk or seat ring	CRES	ASTM A 182/A 182M GR F6a	hard-faced seat
	Integral seats	Same as valve body		
3	Stem, wedge/disk or seat ring	CRES	ASTM A 182/A 182M GR F6a	hard-faced seat optional
	Seat integral	Same as valve body		
4	Stem, wedge/disc or seating	Bronze	ASME SB61 or SB62	. . .
	Seat integral	Same as valve body		
5	Stem, wedge/disk or seat ring	CRES	ASTM A 182/A 182M GR F6a	. . .
	Seat integral	Same as valve body		
6	Stem, wedge/disk or seat ring	NCA[F]	ASTM A 164[G]	. . .
7	Stem, wedge/disk or seat ring	CRES	ASTM A 182/A 182M GR F304L or F316L or ASTM A 351/A 351M GR CF3M	hard-faced seat optional
8	Stem	CRES	ASTM A 182/A 182M GR F6a	. . .
	Wedge/disk or seat ring	Bronze	ASME SB61 or SB62	. . .
	Integral seat	Same as valve body	. . .	. . .

[A]Consult applicable material and design specifications, and Table 1 where indicated, to establish pressure/temperature ratings.
[B]When combining dissimilar materials, galvanic corrosion can occur, especially in seawater systems, and should be considered.
[C]CRES—corrosion resistant steel.
[D]GR—grade.
[E]CrMo—chromium-molybdenum.
[F]NCA—nickel copper alloy.
[G]Discontinued.