

NOTICE OF
CHANGE

INCH-POUND

MIL-STD-777E(SH)
NOTICE 4
31 January 2002

MILITARY STANDARD

SCHEDULE OF PIPING, VALVES, FITTINGS, AND ASSOCIATED
PIPING COMPONENTS FOR NAVAL SURFACE SHIPS

TO ALL HOLDERS OF MIL-STD-777E(SH) :

1. THE FOLLOWING PAGES OF MIL-STD-777E(SH) HAVE BEEN REVISED AND SUPERSEDE THE
PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
5	31 January 2002	5	17 January 1990
NONE	Delete	5a	17 January 1990
6	31 January 2002	6	13 November 1991
7	31 January 2002	7	7 February 1986
11	31 January 2002	11	7 February 1986
12	31 January 2002	12	1 June 1995
NONE	Delete	12a	1 June 1995
13	31 January 2002	13	7 February 1986
14	31 January 2002	14	7 February 1986
C-1.1	31 January 2002	C-1.1	13 November 1991
C-1.2	31 January 2002	C-1.2	13 November 1991
C-1.3	31 January 2002	C-1.3	7 February 1986
C-1.4	31 January 2002	NEW PAGE	
L-1.1	31 January 2002	L-1.1	13 November 1991
L-1.2	31 January 2002	NEW PAGE	

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-777E(SH) will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

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4.13 Threaded joints. Straight threaded connections with seals are permitted in all systems where unions are listed, subject to any notes pertaining to unions. Open-ended piping with threaded or union connections must be secured or foundationed to prevent accidental rotation of the threaded joints. Tapered pipe threads may be used only as follows:

- (a) Connections to commercial equipment such as washing machines and drinking water coolers which are not essential to the ship under combat conditions and where failure would not create a hazard to personnel, the surrounding area or affect the operation of other vital equipment.
- (b) Pipe plugs, of a material compatible with the parent equipment material in sizes 3/4 inch and below used for applications where gauge pressures do not exceed 50 psi.
- (c) Instrumentation, controls, vents and filling and drain connections for applications where gauge pressures are 50 psi and below where fluids handled are neither toxic or dangerous nor could cause atmospheric contamination and which would not cause, in the event of failure, a major breakdown of the equipment nor create a hazard to the surrounding area nor affect the operation of other vital equipment.
- (d) For equipment where taper pipe threads are specified in RR-C-901, MIL- DTL-2/15, MIL-V-17360, ASTM F1347, MIL-H-17902, and A-A-59227.
- (e) In unpressurized connections.

4.14 Fire-hardened fittings. Fire hardened fittings are defined as fittings which are welded, or which comply with ASTM F1387, including satisfactory accomplishment of fire testing, and are approved by NAVSEA for the intended application.

4.14.1 Fire-hardened fitting requirements. Fire hardened fittings are required in the systems listed below, where piping is located within compartments which are served by CO₂ fixed flooding or Halon 1301 fire extinguishing systems. Services not listed do not require fire-hardened fittings, such as "Cleaning Fluid", Category and Group H-2.

Category
and GroupService

G-3 through G-7	Hydraulic Oil (Cu and Cu-Ni piping)
H-2	Contaminated Aviation Lube Oil
J-2, J-3, J-4, J-7, J-8	Air (Cu and Cu-Ni piping)
K-3, K-5, K-7	Gaseous Oxygen, Liquid Oxygen, Propane (Cu and Cu-Ni piping)

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Fire-hardened fittings required throughout the ship in the systems listed below.

<u>Category and Group</u>	<u>Service</u>
E-1 through E-4	Fuel
F-1	Lubricating Oil
G-1 through G-7	Hydraulic Oil (steel and CRES piping)
H-1	Gasoline
I-1	JP-5
J-1	Air
J-2 through J-7, J-9	Air (steel and CRES piping)
K-2	Gaseous Oxygen
K-4, K-5, K-6	Liquid Oxygen, Mixed Gas (CRES piping)
N-1	Sprinkling System (dry)
N-2	Magazine Sprinkling System (Wet)
S-1	AFFF and AFFF/Seawater
T-2 and T-3	Halon and Halon Actuation
U-1	Fuel Stripping

Miscellaneous seawater sprinkling systems (sprinkling other than AFFF, magazine, and countermeasure washdown) shall comply with Category and Group N-2. However, miscellaneous sprinkling system piping within spaces which are wet-sprinkled does not require fire-hardened fittings, and may be silverbrazed.

4.14.2 Silver-brazed fittings. Silver-brazed fittings shall be of the pre-inserted ring type, except as follows:

- (a) In sizes 1/2 nominal pipe size (NPS) and below.
- (b) Fittings without preinserted brazing rings may be used in the refrigeration system (see category Q-1).
- (c) Expanded copper sleeves without preinserted brazing rings may be used in the inner wall of a double-walled gasoline piping system.
- (d) Joints for voice tube and pneumatic tube systems.
- (e) Joints for bellmouth to pipe for tailpipes within tanks.

4.15 Threaded fasteners. This standard identifies only generic material to be used in flange bolting. All other requirements are in NSTM 075.

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4.16 Flange finishes. The machine surface finish of gasket mating surfaces on flanges in piping systems and connected components shall be in accordance with ASME B46.1 and as follows:

- a. Non-ferrous and ferrous flanges for use with sheet gaskets:
 - (1) For flanges of nominal size of 12 inches or less, a finish with circular lay (concentric) of 500 to 1000 or (spiral) 125 to 250 roughness average (R_a) produced by machining 30 to 80 serrations of uniform depth per inch of face width.
 - (2) For flanges over a nominal size of 12 inches, the requirements shall be the same except that 21 to 80 serrations per inch of flange face width may be used.
 - (3) For flanges where the flange face cannot be turned and tool marks run across the flange face, the surface finish shall have a roughness average (R_a) of 500 μ -inches.
- b. Flanges for O-ring seals shall be finished in accordance with the Naval Ship Technical Manual (NSTM) Chapter 078 (NAVSEA document S9086-CM-STM-000/CH-078).
- c. Ferrous flanges for use with spiral wound (metallic) gaskets:
 - (1) A finish with a circular lay (concentric or spiral) of 125 to 250 R_a produced by machining of 45 through 55 serrations of uniform depth per inch of flange face width.
 - (2) For flanges where the flange face cannot be turned and tool marks run across the flange face, the surface finish shall be 63 to 125 R_a .

4.17 Weld joint requirements. Weld joint and backing ring design shall comply with MIL-STD-22 and the applicable NAVSEA fabrication document (e.g. NAVSEA S9074-AR-GIB-010/278).

4.18 Flange facings. Flat face non-ferrous flanges shall not be mated with raised face steel flanges. Steel flanges shall be of the flat face or raised face type.

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4.38 Flange and fitting construction. Flanges shall not be fabricated from bar stock material. Additionally fittings other than couplings and concentric reducers shall not be fabricated from bar stock material unless a specific document or drawing permits such construction.

4.39 Hydro testing of forgings. Hydrostatic testing of forged outlets and fittings prior to installation is not required.

4.40 Casting inspections. For the radiographic inspection requirements of cast piping system components refer to applicable ship's specifications.

4.41 Large ball valves. Where an 8 or 10-inch ball valve is required, it shall meet the design, material and test requirements of Drawing 803-5001004, extrapolated for the larger size. Modification for power operation shall be made when required.

4.42 Spiral wound gaskets. Where asbestos spiral wound gaskets made to MIL-G-21032 are specified, graphite spiral wound gaskets made to MIL-G-24716 shall be used. Gaskets provided in accordance with MIL-G-24716 shall be class B except that where the gasket is normally exposed to sea water the gasket shall be class C.

4.43 Sheet gaskets. Where sheet gasket material of synthetic rubber in accordance with MIL-PRF-1149 is specified, cloth insert rubber in accordance with HH-P-151 may be used. However, in using cloth inset rubber gaskets, precautions shall be taken to avoid pickling the joint containing the gasket to remove rust and scale using compounds or solutions containing hydrochloric acid, sulfuric acid or sodium bisulphate.

4.44 Expanding test. The expanding test for piping in accordance with MIL-P-24691/1 (MIL-T-20157 successor) is not required since flaring is not permitted for shipboard applications.

4.45 Approval of commercial items. Use of special or commercial items not covered by this standard and for items where the material or applicable document contains the word "commercial" or has not been designated shall be subject to approval by the cognizant Supervisor of Shipbuilding, Naval Shipyard or NAVSEA.

4.46 Valve actuators. Valve electric actuators shall be in accordance with DOD-V-24657.

4.46.1 Non-nuclear applications. For non-nuclear ships, remote manual valve actuating systems shall be designed and installed in accordance with the following technical manuals:

- (a) S9505-AG-MMM-010 Design Criteria and Installation Requirements; Rigid Rod Valve Remote Control Systems.
- (b) S6435-QJ-MMC-010 Design Criteria and Installation Requirements; Remote Mechanical Valve Actuator System - RMVA.
- (c) 0948-LP-022-7010 Valve Remote Control Systems. These systems shall be limited to a maximum length of eight (8) feet.

4.47 GRP applications. Specific categories and groups contained in this document allow the use of glass reinforced plastic (GRP) pipe and fittings. However, the use of GRP is limited to specific applications as identified in General Specifications for Ships of the United States Navy. GRP piping shall conform to NAVSEA T9500-AA-PRO-110, Design Practices and Criteria manual for GRP Piping Systems.

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4.48 Deleted.

4.49 Mechanically attached fittings (MAFs). Fittings utilizing mechanical means of attachment to piping (for example, crimping, ring locking, heat shrinking) are available from commercial suppliers. Approvals are presently limited to fittings 2 1/2 NPS and below in size. MAFs may be substituted for welded or silver-brazed fittings within the MAF application and performance requirements as specified in NSTM-505, unless additional approval/notification of the substitution is required by the appropriate contractual document. Only approved MAFs that have passed the fire test requirements of ASTM F 1387 shall be used in fire hazardous areas or in systems that do not allow silver-brazed fittings. Except for training purposes, there are no joint record requirements for currently approved MAFs.

5. DETAILED REQUIREMENTS

5.1 Service categories and groups. Detailed requirements for piping systems are provided here in tables arranged by service category and piping system group. In general, service categories refer to the types of fluids handled, while system groups are designated according to piping pressure and temperature requirements. For example, the table for category-group G-1 provides detailed requirements for all piping in the first system group (3000 psig, 150°F, steam catapult) of category G (hydraulics)

5.2 Using the tables. For each service category and group, the reference to maximum system for pressure and temperature is not meant to infer that only systems with these conditions are applicable to the category and group; only that the components and materials identified are suitable up to these maximum conditions, unless notes within a category and group identify other limitations. The contractor or installing activity shall be responsible for matching system requirements as closely as possible with the applicable category and group.

5.3 Category and group listing. The list below identifies the seventy category and group combinations whose requirements are tabulated in this standard. The "date" column shows the date of the most recent update or change for each table.

<u>Category and Group</u>	<u>Service</u>	<u>Date</u>
A-1	Steam and steam drains, 1500 psig, 1000°F	February 7, 1986
A-2	Steam and steam drains, 1500 psig, 775°F	February 7, 1986
A-3	Propulsion plant saturated steam and steam drains, 600 to 1500 psig, 775°F	February 7, 1986
A-4	Steam and steam drains, 600 psig, 875°F	February 7, 1986
A-5	Steam and steam drains, 600 psig, 775°F	February 7, 1986
A-6	Steam and steam drains, 150 psig, 775°F	February 7, 1986
A-7	Steam, 100 psig, 875°F	February 7, 1986
A-8	Steam and steam drains for auxiliary boiler, reboiler and waste heat boiler installation only, 150 psig, 366°F	February 7, 1986
A-9	Steam system overboard discharge, steam generator blowdown, 1500/600 psig, 650°F	February 7, 1986

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<u>Category and Group</u>	<u>Service</u>	<u>Date</u>
A-10	High pressure steam drains between low point trap discharge stop check valve and DFT/gland exhaust piping from turbines and discharge main, 100 psig, 425°F	February 7, 1986
B-1	Feed systems, 600 psig, 400°F; 1200 psig, 475°F	February 7, 1986
B-2	Propulsion plant saturated feed system, 600 to 2050 psig, 300°F	February 7, 1986
C-1	Fresh water, including feed, chilled water, and condensate, electronic fresh water cooling,	Draft, 2001
C-2	potable, and gas turbine washdown, 200 psig, 250°F.	
D-1	Sea water, 250 psig, 150°F	February 7, 1986
D-2	Sea water missile injection system between fresh water accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer, 400 psig, 150°F	February 7, 1986
D-3	Sea water, 50 psig, 150°F	February 7, 1986
E-1	Fuel, 1200 psig	February 7, 1986
E-2	Fuel, 600 psig	February 7, 1986
E-3	Fuel, 200 psig	February 7, 1986
E-4	Fuel (gas turbine powered ships) 200 psig	February 7, 1986
F-1	Lubricating oil, 150 psig, 250°F	February 7, 1986
G-1	Steam catapult, hydraulic oil, 3000 psig, 150°F	February 7, 1986
G-2	Steam catapult, hydraulic oil, 200 psig, 150°F	February 7, 1986
G-3	Hydraulic oil - other than steam catapult, 3000 psig, 180°F	February 7, 1986
G-4	Hydraulic oil - other than steam catapult, 1500 psig, 180°F	February 7, 1986
G-5	Hydraulic oil - other than steam catapult, 900 psig, 180°F	February 7, 1986
G-6	Hydraulic oil - other than steam catapult, 300 psig, 180°F	February 7, 1986
G-7	Hydraulic oil - other than steam catapult, 150 psig, 150°F	February 7, 1986
H-1	Gasoline, 150 psig, 150°F	February 7, 1986

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<u>Category and Group</u>	<u>Service</u>	<u>Date</u>
H-2	Cleaning fluid and contaminated aviation lubricating system, 100 psig, 150°F	February 7, 1986
I-1	JP-5 200 psig, 100°F	February 7, 1986
J-1	Air, nitrogen and helium, 6000 psig, 150°F	February 7, 1986
J-1	Air, nitrogen and helium, 3300 psig, 150°F	February 7, 1986
J-3	Air and nitrogen, 600 psig, 150°F	February 7, 1986
J-4	Air and nitrogen, 200 psig, 150°F	February 7, 1986
J-5	Air, aircraft, starting and cooling, bleed-off and 20.2 psi absolute systems, 150 psig, 550°F	February 7, 1986
J-6	Air, aircraft, starting and cooling, main system, 150 psig, 450°F	February 7, 1986
J-7	Air, Prairie-Masker, gas turbine starting sewage aerating, 100 psig, 600°F	February 7, 1986
J-8	Air, deballast, 50 psig, 400°F	February 7, 1986
J-9	Gas turbine bleed air system, 250 psig, 950°F	February 7, 1986
K-1	Gaseous oxygen, outside hull, 4500 psig, 150°F	February 7, 1986
K-2	Gaseous oxygen, inside hull, 4500 psig, ambient	February 7, 1986
K-3	Gaseous oxygen, 100 psig, ambient	February 7, 1986
K-4	Liquid oxygen and nitrogen, 6000 psig	February 7, 1986
K-5	Liquid oxygen and nitrogen, 250 psig	February 7, 1986
K-6	Mixed gas, 4500 psig, 150°F	February 7, 1986
K-7	Propane, 200 psig	February 7, 1986
L-1	Cooling (electronic equipment, diesel engine, and so forth) ethylene glycol, fresh water solution, distilled water transfer, 150 psig, 150°F	Draft, 2001
M-1	Sea water-washdown countermeasure system, 200 psig, 100°F	February 7, 1986
N-1	Sprinkling system (dry) other than foam, 175 psig	February 7, 1986
N-2	Magazine sprinkling system (wet), 175 psig	February 7, 1986
O-1	Diesel, sewage treatment, incinerator and gas turbine exhaust, 1125°F	February 7, 1986
P-1	Boiler safety valve and super-heater outlet safety valve escape, 150 psig, 850°F	February 7, 1986
Q-1	Refrigerant piping, 30 inches vacuum to 300 psig, minus 85°F to plus 250°F	February 7, 1986

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-1 and C-2	Fresh water, including feed, chilled water, condensate, electronic fresh water cooling, potable, and gas turbine washdown	200	250	See notes C-1-7 to C-1-12
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch minimum wall thickness (see note C-1-1)
	Seamless or welded	Glass Reinforced Plastic	MIL-P-24608	See 4.47
Valves	Gate, 1/4 to 2 NPS	Copper-Nickel (90-10)	MIL-T-16420	
	Gate, 2-1/2 to 12 NPS	Bronze	Drawing 803-1385714	Union ends only
	Globe/angle stop/stop check, 1/4 to 2 NPS		Drawing 803-2177917	Flanged ends only
	Globe, Y-Pattern 2-1/2 to 10 NPS		Drawing 803-4384536	Union ends only. See note C-1-2
	Globe/angle check and stop check 2-1/2 NPS and larger		Drawing 803-1385623	Flanged ends only
	Swing check 1/4 to 2 NPS		Drawing 803-1385541	Flanged ends only 100 psig max, 150°F max
	Swing check 2-1/2 to 12 NPS		Drawing 803-1385721	Union ends only
Swing check 1/4 NPS and above		Drawing 803-1385637	Flanged ends only	
		Bronze Nickel-Aluminum-Bronze	MIL-V-17547	

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-1 and C-2 cont'd	Fresh water, including feed, chilled water, condensate, electronic fresh water cooling, potable, and gas turbine washdown	200	250	See notes C-1-7 to C-1-12

Item	Types	Material	Applicable documents	Remarks
Valves: cont'd	Relief	Bronze	MIL-V-24332	
	Butterfly	Nickel-Aluminum-Bronze	MIL-V-24624	Special flanges req'd
	Control	Bronze (Nickel-Copper alloy trim or 300 series corrosion-resisting steel trim)	MIL-V-18030	100 psig max Flanged ends only
	Pressure-reducing	Bronze	ASTM F1370 including supplements	165°F maximum
	Ball, 1/4 to 2-1/2 NPS	Bronze	Drawing 803-5001003	Bronze body with Bronze, Cu-Ni, or NiCu end piece
		Copper-Nickel		Copper-Nickel body with Cu-Ni end piece
Fittings	Ball, 3 to 6 NPS	Bronze	Drawing 803-5001004	6-NPS valve is butt welded only
	Silver-brazing		MIL-F-1183	
	Butt welding	Copper-Nickel (90-10)	Drawing 810-1385880	150°F maximum
	Welded base by silver brazing end outlet boss	90-10 or 70-30 Copper-Nickel	Drawing 803-1385950 or commercial	Welded to Copper-Nickel pipe run
	Socket welding	Copper-Nickel	Drawing 803-6397430	
	Socket (bonded)	Glass Reinforced Plastic	MIL-P-24608	See note C-1-6 and C-1-7
	Mechanically attached fittings (MAFs)	Various	ASTM F1387	See 4.49

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-1 and C-2 cont'd	Fresh water, including feed, chilled water, condensate, electronic fresh water cooling, potable, and gas turbine washdown	200	250	See notes C-1-7 to C-1-12

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Silver-brazing unions	Bronze	MIL-F-1183	
	Socket welding flanges	Copper-Nickel	Drawing 810-4715319	
	Silver-brazing flanges	Bronze	MIL-PRF-20042, class plain, 150 and 250 pounds Drawing 803-1385892	See notes C-1-3 and C-1-4 Special flanges for butterfly valves. 180°F max
Gaskets	Socket bonded flanges	Glass Reinforced Plastic	MIL-P-24608	See 4.47
	Sheet	Cloth inserted rubber	HH-P-151	See note C-1-5
		Non-asbestos	MIL-G-24696	Preferred gasket for butterfly valves
Flange bolting	O-ring	Synthetic rubber	MIL-PRF-1149	
		Fluorocarbon	MIL-R-83248, type I, class 1	See 4.15

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-1 and C-2 cont'd	Fresh water, including feed, chilled water, condensate, electronic fresh water cooling, potable, and gas turbine washdown	200	250	See notes C-1-7 to C-1-12

NOTES:

- C-1-1 The thickness of copper tubing in condensate piping shall be calculated using allowable stresses for the fully annealed condition.
- C-1-2 Globe valves for shower service shall meet the following: (1) Valves shall be of brass, nickel chrome plated, with 1/2 NPS silver brazing union ends. (2) Compression valves shall be of heavy pattern, suitable for 100 pounds working pressure, with raised metal seat and removable composition disk, suitable for hot and cold water. (3) Valve stems shall have suitable packing and cross type indexed handle. (4) Valves shall be sized to suit the installation.
- C-1-3 Where 150 psig line flanges bolt up to 250 psig valve flanges in sizes 2 to 4 NPS, the diameter of the bolt holes in the line flanges shall be increased to match the 250 psig flange bolting.
- C-1-4 One hundred fifty pound flanges may be used to 150 psig service, where temperatures do not exceed 150°F. For temperature of 151°F to 250°F, they shall be limited to 100 psig and below.
- C-1-5 Class 4 of HH-P-151 shall be used where service temperature is expected to exceed 200°F.
- C-1-6 Restricted from heated potable water system. Applicable P/T rating points are 200 psig @ 150°F and 100 psig @ 200°F.
- C-1-7 Electronic fresh water cooling system shall be fabricated of copper nickel pipe, with all components (including but not limited to pipe, valves, fittings, thermowells, and flanges) either flanged or welded.
- C-1-8 The chilled water mains and risers up to and including chilled water branch root cutout valves and branches to air conditioning cooling coils shall be classified "W".
- C-1-9 For electronic cooling water and gas turbine washdown systems valve gland packing and all other elastomers shall be compatible with the fluid. Natural rubber products are not permitted.
- C-1-10 Expansion tank valves subject to air pressure shall be soft seated.
- C-1-11 The sample connection between the DFT and the sample water cooler shall be CRES composition 304 in accordance with MIL-P-24691/3 or ASTM A312, TP304. Connection to be as close to DFT as possible.
- C-1-12 Where copper tubing is used in potable water systems that supply water to equipment containing carbonated water dispensers, the system shall have double check valves installed.

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
L-1	Cooling, (electronic equipment, diesel engine, and so forth) - ethylene glycol, fresh water solution, distilled water transfer	150	150	See note L-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Corrosion-resisting steel	MIL-P-24691/3, 304L or ASTM A312, TP304L	See note L-1-1
		Copper-Nickel, 90-10	MIL-T-16420	
Valves	Globe/angle stop and stop check, 1/4 to 2 NPS	Bronze	Drawing 803-4384536	Union ends only
	Gate, 1/4 to 2 NPS		Drawing 803-1385714	Union ends only
	Swing check, 1/4 to 2 NPS	Corrosion-resisting steel ASTM A743, grade CF-8, or bronze	Commercial	
	Relief Temperature regulating	Bronze	Drawing 803-1385721 MIL-V-24332 MIL-DTL-19772	Union ends only
Fittings	Ball, 1/4 to 2-1/2 NPS	Bronze	Drawing 803-5001003	Bronze body with Ni-Cu, Bronze, or Cu-Ni end piece
	Butterfly	Corrosion-resisting steel		CRES body with CRES end piece
	Socket welding	Corrosion-resisting steel, Nickel-Aluminum-Bronze	MIL-V-24624	Special flanges req'd
	Butt welding	Corrosion-resisting steel, ASTM A182, 304L	ASME B16.11 ASME B16.9	

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Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
L-1 cont'd	Cooling, (electronic equipment, diesel engine, and so forth) - ethylene glycol, fresh water solution, distilled water transfer	150	150	See note L-1-2

Item	Types	Material	Applicable documents	Remarks
Fittings cont'd	Socket welding	Copper-Nickel	Drawing 803-6397430	
	Silver-brazing	Bronze	MIL-F-1183	
	Mechanically attached (MAFs)	Various	ASTM F1387	See 4.49
Take-down joints	Welding flanges	Corrosion-resisting steel, ASTM A182, 304L	ASME B16.5	
	Silver-brazing flanges	Bronze	Drawing 810-1385892	Special for butterfly valves
	Silver-brazing Unions		MIL-F-20042 MIL-F-1183	
Gaskets	Sheet	Non-asbestos	MIL-G-24696	Preferred gasket for butterfly valves
	Flat	Synthetic rubber	MIL-PRF-1149	
Flange bolting	Bolts, studs and nuts	Nickel-Copper Corrosion-resisting steel		See 4.15

NOTES:

- L-1-1 Copper-Nickel shall be used for systems with a corrosion inhibitor added to the ethylene glycol/water solution.
- L-1-2 Electronic cooling water systems, which require demineralized water, shall use uninhibited ethylene glycol/water solutions and materials in accordance with category C-1 and C-2.