

**NOT MEASUREMENT
SENSITIVE**

MIL-STD-777F(SH)

w/CHANGE 2

13 February 2018

SUPERSEDING

MIL-STD-777F(SH)

w/CHANGE 1

21 February 2017

DEPARTMENT OF DEFENSE STANDARD PRACTICE

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



MIL-STD-777F(SH)
W/CHANGE 2

FOREWORD

1. This standard is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

2. This standard establishes the requirement for piping system components on surface ships, in order to preclude the necessity for including a piping schedule in each Navy Ship Specification. This standard represents and includes the latest material requirements previously covered in the Ship Specifications. It is the intent to refer to this standard in section 505 in the Ship Specifications for all new Navy surface ships and the General Specifications for Overhaul of Surface Ships (GSO) for existing ships.

3. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

MIL-STD-777F(SH)
W/CHANGE 2

SUMMARY OF CHANGE 2 MODIFICATIONS

1. Various document IDs and document titles throughout section 2 were updated in accordance with their respective repository's most recently published information. All cross-references to updated documents changed throughout the text of this document.
2. AIA NAS1613 added as a reference in 2.3 to support O-ring gasket requirements.
3. ASTM F3226/F3226M added as a reference in 2.3 to support press-connect fittings requirements.
4. Changed "cognizant SUPSHIP, Naval Shipyard, or NAVSEA" in paragraphs 4.24.2 and 4.42 to "Government" as the contract will define the approval authority.
5. Reworded paragraph 4.46; inserted new verbiage and updated existing verbiage.
6. Inserted new paragraph (4.47). Subsequent paragraphs in section 4 re-numbered to account for insertion of new paragraph, and all cross-references to re-numbered paragraphs corrected throughout document to reflect new numbering.
7. Updated ASTM A269 reference to ASTM A269/A268M in table XIII.
8. Added row for gaskets in the types, material, and applicable documents columns of table XIV.
9. Inserted "or copper nickel" in material columns for gate, ¼ to 2 NPS; swing-check, ¼ NPS and above; relief; butterfly; control; pressure-reducing; and ball, 3 to 6 NPS valves in table XVI.
10. Changed table title to "Chlorinated seawater piping for fouling prevention of heat exchangers," changed D-4 services cell to read "Chlorinated seawater piping for fouling prevention of heat exchangers," and changed flange bolting bolts, screws, and studs "Material" cell to read "Nickel alloy" in table XXIII.
11. Inserted "220" in the maximum system temperature °F cell for tables XXIV and XXV.
12. Added "or equal" to Garlock Bluegard 3000 in note I-1-4 of table XXXII in accordance with MIL-STD-962D(2), paragraph 4.7.5.
13. Inserted note J-1-4 and "See J-1-4" to the remarks cell for butt-welding fittings in table XXXIII.
14. Inserted "N/A" in the maximum system pressure psig cell in table LIII.
15. Inserted a row for press-connect fittings in tables LIX, LXI, and LXII.
16. Inserted a row for "Material" and "Applicable documents" columns for sheet gaskets in table LXI.
17. The following modifications to MIL-STD-777F(SH) w/Change 1 have been made:

<u>Paragraph</u>	<u>Modification</u>	<u>Paragraph</u>	<u>Modification</u>
2.2.1	Changed	Table XXXV	Changed
2.2.2	Changed	Table XXXVIII	Changed
2.3	Changed	Table XXXIX	Changed
4.46	Changed	Table XL	Changed
4.47	Added	Table XLIV	Changed
Table XIII	Changed	Table XLVI	Changed
Table XIV	Changed	Table XLVIII	Changed
Table XVI	Changed	Table XLIX	Changed
Table XXIII	Changed	Table L	Changed

MIL-STD-777F(SH)
W/CHANGE 2

Table XXIV	Changed	Table LI	Changed
Table XXV	Changed	Table LII	Changed
Table XXVI	Changed	Table LIII	Changed
Table XXVII	Changed	Table LIX	Changed
Table XXVIII	Changed	Table LX	Changed
Table XXIX	Changed	Table LXI	Changed
Table XXX	Changed	Table LXII	Changed
Table XXXI	Changed	Table LXIII	Changed
Table XXXII	Changed	Table LXIV	Changed
Table XXXIII	Changed	Table LXV	Changed
Table XXXIV	Changed	Table LXVI	Changed

MIL-STD-777F(SH)
W/CHANGE 2

CONTENTS

<u>PARAGRAPH</u>	<u>PAGE</u>
1. SCOPE.....	1
1.1 Scope.....	1
1.2 Category and group designation	1
1.3 Superseded pages	1
2. APPLICABLE DOCUMENTS	1
2.1 General.....	1
2.2 Government documents	1
2.2.1 Specifications, standards, and handbooks	1
2.2.2 Other Government documents, drawings, and publications	5
2.3 Non-Government publications	7
2.4 Order of precedence	11
3. DEFINITIONS	11
4. GENERAL REQUIREMENTS	12
4.1 Recycled, recovered, environmentally preferable, or biobased materials	12
4.2 Nuclear plant piping.....	12
4.3 Gauge piping.....	12
4.3.1 Root valves.....	12
4.4 Thermometer wells	12
4.5 Maximum material temperature.....	12
4.6 Fire protection.....	12
4.7 Seawater valves.....	12
4.8 Valve approvals	12
4.9 Pressure temperature ratings	13
4.10 Butt-weld requirements.....	13
4.11 Long-radius elbows.....	13
4.12 Steel valve seat and disc materials	13
4.13 Threaded joints.....	13
4.14 Fire-hardened fittings.....	13
4.14.1 Fire-hardened fitting requirements	13
4.15 Silver-brazed fitting requirements.....	15
4.16 Fasteners	15
4.17 Brass fastener restriction.....	16
4.18 Flange finishes	17
4.19 Weld joint requirements.....	17
4.19.1 Titanium weld restrictions.....	17
4.20 Flange facings	17
4.21 Welded branch outlets.....	17
4.22 Branch connections	17
4.23 Packing requirements.....	18
4.24 Bulkhead penetrations.....	18
4.24.1 Titanium piping penetrations.....	18
4.24.2 Sleeve requirements	18
4.25 Union joints.....	18

MIL-STD-777F(SH)
W/CHANGE 2

<u>PARAGRAPH</u>	<u>PAGE</u>
4.26 Gaskets.....	19
4.27 Missile systems	20
4.28 Slip-on joints.....	20
4.29 Steam generators.....	20
4.30 Butterfly valves.....	20
4.31 Fuel piping run rules	20
4.32 Butt-welded fittings	21
4.33 Bessemer steel restriction.....	21
4.34 Flexible hose fittings.....	21
4.35 Valve handwheel requirements	21
4.36 Cast valve material.....	21
4.36.1 Weld repair of copper-nickel castings	21
4.37 Flange and fitting construction	21
4.38 Hydrostatic testing of forgings.....	21
4.39 Casting inspections	21
4.40 Large ball valves	21
4.41 Flaring test	21
4.42 Approval of commercial items.....	21
4.43 GRP applications	22
4.44 Titanium applications.....	22
4.44.1 Flange face inserts	22
4.44.2 Insulating gasket kits	22
4.44.3 Insulating sleeves and washers	22
4.44.4 Isolation testing	22
4.44.5 Material requirements	22
4.44.6 Non destructive testing of grade 2 titanium material for class P-2 piping.....	24
4.45 Marking.....	24
4.46 Mechanically attached fittings (MAFs)	24
4.47 Press-connect fittings	25
4.48 Belled-end fittings and slip-on couplings	25
4.49 Commercial item requirements	25
4.49.1 Commercial plumbing material.....	25
4.50 Relief valves	25
4.50.1 MIL-DTL-20065 relief valves.....	25
4.50.2 MIL-V-24332 relief valves	25
4.51 Stainless steel piping.....	25
4.52 Valve actuators	25
5. DETAILED REQUIREMENTS.....	25
5.1 Service categories and groups.....	25
5.2 Using the tables.....	25
5.3 Category and group listing.....	26
6. NOTES	146
6.1 Intended use	146
6.2 Acquisition requirements	146
6.3 Subject term (key word) listing.....	146
6.4 Change notations.....	146

MIL-STD-777F(SH)
W/CHANGE 2

LIST OF TABLES

<u>TITLE</u>	<u>PAGE</u>
I. Fire-hardened fitting requirements (for systems in high fire hazard spaces).....	14
II. Fire-hardened fitting requirements.....	15
III. Gasket materials and ratings.....	19
IV. Gasket dimensions.....	19
V. Category A-1, Steam and steam drains, 1500 psig/1000 °F.....	29
VI. Category A-2, Steam and steam drains, 1500 psig/775 °F.....	30
VII. Category A-3, Propulsion plant saturated steam and steam drains, 600 to 1500 psig/775 °F.....	31
VIII. Category A-4 and A-7, Steam and steam drains, 600 psig/875 °F.....	33
IX. Category A-5, Steam and steam drains, 600 psig/775 °F.....	35
X. Category A-6, Steam and steam drains, 150 psig/775 °F.....	37
XI. Category A-8, Steam and steam drains for auxiliary boiler, reboiler, and waste heat boiler installation only, 150 psig/366 °F (sat).....	39
XII. Category A-9, Steam system overboard discharge, steam generator blowdown, 1500/600 psig/650 °F.....	41
XIII. Category A-10, High pressure steam drains between low point trap, drain strainer orifice/orifice plate assembly discharge stop-check valve and DFT or gland exhaust piping from turbines, discharge main, 100 psig/425 °F.....	43
XIV. Category B-1, Feed systems, 600 psig, 400 °F; 1200 psig, 475 °F.....	45
XV. Category B-2, Propulsion plant saturated feed system, 600 to 2050 psig/300 °F.....	47
XVI. Category C-1 and C-2, Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown, 200 psig/250 °F.....	49
XVII. Category C-2, Freshwater, feed water and condensate, including potable, gas turbine washdown, 100 psig/250 °F.....	52
XVIII. Category C-3, Glass-reinforced plastic (GRP), 200 psig/150 °F.....	55
XIX. Category C-4, Water mist fire fighting, 1500 psig/140 °F.....	56
XX. Category C-5, High purity water, 150 psig/140 °F.....	58
XXI. Category D-1 and D-3, Seawater, including firemain, main and secondary drainage, ballast, 250 psig/150 °F.....	59
XXII. Category D-2, Seawater missile injection system between freshwater accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer, 400 psig/150 °F.....	62
XXIII. Category D-4, Chlorinated seawater piping for fouling prevention of heat exchangers.....	64
XXIV. Category E-2, E-3 and U-1, Fuel service, transfer, and stripping, 600 psig.....	68
XXV. Category E-4 and U-1, Fuel service, transfer, and stripping, 200 psig.....	70
XXVI. Category F-1, Lubricating oil, 150 psig/250 °F.....	72
XXVII. Category G-1, G-3, G-4, and G-5, Hydraulic service, 3000 psig, 180 °F.....	75
XXVIII. Category G-2, G-6, and G-7, Low pressure hydraulic (including lines), 400 psig/180 °F.....	79
XXIX. Category G-8, Hydraulic service, 6000 psig/200 °F.....	82
XXX. Category H-1, Gasoline, 150 psig/150 °F.....	83
XXXI. Category H-2, Cleaning fluid and contaminated aviation lubricating system, 100 psig/150 °F.....	85
XXXII. Category I-1, JP-5 fuel service, filling transfer, tank stripping, and auxiliary JP-5, 200 psig/100 °F.....	87
XXXIII. Category J-1 and J-2, Air, nitrogen and helium, 6000 psig/150 °F.....	89
XXXIV. Category J-3, Air and nitrogen, 600 psig/150 °F.....	91
XXXV. Category J-4, Air and nitrogen, 200 psig/150 °F.....	93
XXXVI. Category J-5, Air, and bleed-off, 150 psig/550 °F.....	96
XXXVII. Category J-6, Air, gas turbine starting and prairie masker, 150 psig/450 °F.....	97
XXXVIII. Category J-7, Air, prairie-masker, gas turbine starting, 100 psig/600 °F.....	98

MIL-STD-777F(SH)
W/CHANGE 2

<u>TITLE</u>	<u>PAGE</u>
XXXIX. Category J-8, Air deballast, 50 psig/400 °F	100
XL. Category J-9, Air, gas turbine bleed, anti-icing, 300 psig/950 °F	102
XLI. Category K-1, Gaseous oxygen, outside hull, 4500 psig/150 °F.....	103
XLII. Category K-2, Gaseous oxygen, inside hull, 4500 psig/ambient	104
XLIII. Category K-3, Gaseous oxygen, 100 psig/ambient	105
XLIV. Category K-4, Liquid oxygen and nitrogen, 6000 psig	107
XLV. Category K-5, Liquid oxygen and nitrogen, 250 psig	108
XLVI. Category K-6, Mixed gas, 4500 psig/150 °F.....	109
XLVII. Category K-7, Propane, 200 psig	110
XLVIII. Category L-1, Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution, 150 psig/200 °F	111
XLIX. Category M-1, Seawater-washdown countermeasure system, 200 psig/100 °F.....	114
L. Category N-1, Sprinkling system (dry) other than AFFF and magazine, 175 psig/100 °F	116
LI. Category N-2, Magazine sprinkling system (wet and dry), 175 psig.....	117
LII. Category N-3, Miscellaneous seawater sprinkling systems (sprinkling other than AFFF, magazine, and countermeasure washdown), 175 psig	118
LIII. Category O-1, Diesel, incinerator, and gas turbine exhaust, and sewage treatment, 1200 °F	119
LIV. Category O-2, Diesel exhaust, subject to salt water spray for IR suppression, 850 °F	121
LV. Category P-1, Boiler safety valve and super-heater outlet safety valve escape, 150 psig/850 °F	122
LVI. Category P-2, Nuclear steam generator escape piping to transition joint, 150 psig/350 °F	123
LVII. Category P-3, Nuclear steam generator escape piping - transition to overboard, 150 psig/350 °F.....	124
LVIII. Category Q-1, Refrigerant piping, 30 inches vacuum to 300 psig/minus 85 °F to plus 250 °F.....	125
LIX. Category R-1, Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains, 50 psig/150 °F.....	127
LX. Category R-2, Chemical drains, 30 psig/150 °F.....	130
LXI. Category R-3, Plumbing drains and vents, interior space deck drains and AC condensate drains, 50 psig/150 °F	131
LXII. Category R-4, Sewage collection, holding, and transfer (CHT) and vacuum collection, holding, and transfer (VCHT), 100 psig/150 °F.....	133
LXIII. Category S-1, Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 psig.....	135
LXIV. Category T-2, HFP and Halon 1301 fire extinguishing systems, 1170 psig/140 °F.....	138
LXV. Category T-3, CO2 actuation for HFP and Halon fire extinguishing systems, 2080 psig/200 °F	140
LXVI. Category Y-1 and Y-2, Overflows, sounding tubes, vents and air escapes for JP-5, fuel, lubricating oil, oily tanks, 100 psig/150 °F.....	141
LXVII. Category Y-3, Overflows, sounding tubes, vents, and air escapes for other than fuel tanks [freshwater (except potable) clean ballast, voids, etc.], 50 psig/150 °F.....	143
LXVIII. Category Y-4, Vents, reduction gear, 5 psig/ambient.....	145

Refer to the index for system materials/components materials.

MIL-STD-777F(SH)
W/CHANGE 2

1. SCOPE

1.1 Scope. This standard covers requirements for basic piping system components on Navy surface ships. It is not the intention herein to include every conceivable component, valve, or fitting that might be used in the piping system of a surface ship. The requirements invoked herein are not desirable goals but are minimum acceptable standards.

1.2 Category and group designation. This standard is broken down into basic service categories and groups. The notes contained in each individual category and group are prefaced with the category and group designation, and apply only to that specific category and group. General requirements are also included to supplement the specific category and group notes. General requirements apply to all service categories and groups where the content of the requirement is applicable.

1.3 Superseded pages. This standard will be maintained with all superseded categories and groups and list of categories and groups intact to ensure that when users are applying the standard to requirements that may predate current category and group issues, the applicable issues will be available.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATIONS

HH-P-151	-	Packing, Rubber-Sheet, Cloth-Insert
QQ-N-281	-	Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections
QQ-N-286	-	Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)
RR-C-901	-	Cylinders, Compressed Gas: Seamless Shatterproof, High Pressure Dot 3AA Steel, and 3AL Aluminum
TT-P-28	-	Paint, Aluminum, Heat Resisting

COMMERCIAL ITEM DESCRIPTIONS

A-A-59860	-	Valves, Cylinder, Gas (for Compressed or Liquefied Gases)
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DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-PRF-1149	-	Gasket Materials, Synthetic Rubber, 50 and 65 Durometer Hardness
MIL-DTL-1183	-	Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for
MIL-V-1189	-	Valve, Gate, Bronze
MIL-DTL-1222	-	Studs, Bolts, Screws and Nuts for Applications Where a High Degree of Reliability is Required; General Specification for

MIL-STD-777F(SH)
W/CHANGE 2

MIL-T-1368	-	Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded
MIL-V-2961	-	Valves, Globe, Pressure Reducing, Gas Service
MIL-C-15726	-	Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod, and Wire
MIL-T-16420	-	Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706)
MIL-R-16743	-	Refrigerating Plants and Systems, Mechanical; and Refrigerating System Components - Dichlorodifluoromethane (R-12) - Naval Shipboard NOTE: MIL-R-16743 is inactive for new design and intended only for guidance. It will eventually be replaced.
MIL-R-17131	-	Rods and Powders, Welding, Surfacing
MIL-V-17360	-	Valves, Cylinder, Gas, Carbon Dioxide Fire Extinguisher
MIL-V-17501	-	Valves, Control Type, Magazine, and Hangar Deck Sprinkler
MIL-V-17547	-	Valves, Check, Bronze
MIL-V-17848	-	Valves, Pressure-Reducing, Steam Service NOTE: MIL-V-17848 is inactive for new design and intended only for guidance. It will eventually be replaced.
MIL-DTL-17902	-	Hose, End Fittings and Hose Assemblies, Synthetic Rubber, Aircraft Fuels
MIL-V-18030	-	Valves, Control, Air-Diaphragm-Operated (Complete with Instrumentation)
MIL-V-18110	-	Valves, Gate Type, Steel (Sizes 2-1/2 Inches to 16 Inches)
MIL-B-18381	-	Boilers, Steam, High Pressure, Naval Ship Propulsion
MIL-DTL-18436	-	Valves, Check - Bronze - and Steel Body
MIL-DTL-19772	-	Valves, Temperature Regulating, Automatic, Naval Shipboard
MIL-PRF-20042	-	Flanges, Pipe, Bronze (Silver Brazing)
MIL-DTL-20064	-	Valve, Nonferrous, for Use with Halogenated Refrigerants
MIL-DTL-20065	-	Valves, Angle, Pressure Relief, Naval Shipboard, for Steam Service
MIL-R-21252	-	Rubber Sheet, Solid, Synthetic, Shipboard Water Evaporator Gasketing
MIL-DTL-22050	-	Gasket and Packing Material, Rubber, for Use with Polar Fluids, Steam, and Air at Moderately High Temperatures
MIL-V-22052	-	Valves, Stop and Stop Check, Globe, Angle, and Y Pattern, Cast or Forged Carbon or Alloy Steel, Outside Screw and Yoke (Sizes 2-1/2 Inches and Larger)
MIL-V-22549	-	Valves, Angle, Relief, for Gas and Oxygen Service (Sizes 2-Inches IPS and Below); Naval Shipboard
MIL-V-22687	-	Valves, Ball, Naval Shipboard, for Air, Nitrogen, Helium or Hydraulic Service (Sizes 2-1/2 Inches NPS and Below)

MIL-STD-777F(SH)
W/CHANGE 2

MIL-S-22698	-	Steel Plate, Shapes and Bars, Weldable Ordinary Strength and Higher Strength: Structural
MIL-PRF-23236	-	Coating Systems for Ship Structures
MIL-R-24085	-	Refrigerant Unit, Centrifugal for Air Conditioning NOTE: MIL-R-24085 is inactive for new design and intended only for guidance. It will eventually be replaced.
MIL-T-24107	-	Tube, Copper (Seamless) (Copper Alloy Numbers C10100, C10200, C10300, C10800, C12000, C12200, and C14200)
MIL-V-24109	-	Valves, Globe, Angle, Quick Change Cartridge Trim, High Pressure (H.P.) Hydraulic and Pneumatic (Sizes 1/8 – 1-1/4 Inches)
MIL-F-24202	-	Fittings, Butt Welding, Seamless or Welded, 70-30 Copper-Nickel Alloy, 700 PSI, 200 °F
MIL-F-24227	-	Fittings and Flanges, Cast Bronze, Silver-Brazing Suitable for Ultrasonic Inspection
MIL-T-24270	-	Thermowells for Thermometers and Electrical Temperature Sensors General Specification for
MIL-V-24272	-	Valve Manifolds, High Pressure Gas Reducing
MIL-V-24332	-	Valves, Angle Relief, for Liquid Service (Naval Shipboard)
MIL-V-24336	-	Valves, Pressure Reducing, for Oxygen Service
MIL-V-24384	-	Valves, Pressure Regulating, for Low Pressure Air or Nitrogen Systems
MIL-P-24396	-	Packing Material, Braided PTFE (Polytetrafluoroethylene)
MIL-V-24439	-	Valves, Oxygen, Helium and Helium Oxygen Mixture, High Pressure for Gas Services
MIL-V-24509	-	Valves, Flanged, Ball and Plug for Sewage and Sea Water Service
MIL-E-24572	-	Extinguisher, Fire, Bromotrifluoromethane (Halon 1301) System Components (Fixed Pipe, Pneumatically Actuated, Naval Shipboard Use)
MIL-DTL-24578	-	Valves, Globe, Pressure Instrument, Stem Test Connection, Union End
MIL-V-24586	-	Valve, Needle, Size 1/4-Inch and 1/2-Inch, Union Bonnet Construction NOTE: MIL-V-24586 is inactive for new design and intended only for guidance. It will eventually be replaced.
MIL-P-24608	-	Pipe, Fittings, and Adhesive Kits, Glass-Reinforced Thermosetting Epoxy Resin for Shipboard Piping Systems
MIL-V-24624	-	Valves, Butterfly, Wafer and Lug Style, Shipboard Service
MIL-DTL-24630/1	-	Valves, Check, In-Line, Non-Reversible Installation for Hydraulic Fluid and Lubricating Oil Fluid
DOD-V-24657	-	Valve Actuator, Direct Coupled, Gear Driven Electrically Powered for Naval Shipboard Propulsion and Auxiliary Systems (Metric)
DOD-V-24675	-	Valves, Boiler Blow Service, Monel, Shipboard Use NOTE: DOD-V-24675 is inactive for new design and intended only for guidance. It will eventually be replaced.

MIL-STD-777F(SH)
W/CHANGE 2

MIL-P-24691	-	Pipe and Tube, Carbon, Alloy and Stainless Steel, Seamless and Welded, General Specification for
MIL-P-24691/1	-	Pipe and Tube, Carbon Steel, Seamless
MIL-P-24691/2	-	Pipe and Tube, Chromium-Molybdenum Steel, Seamless
MIL-P-24691/3	-	Pipe and Tube, Corrosion-Resistant, Stainless Steel, Seamless or Welded
MIL-V-24694/1	-	Valve, Hydraulic Relief, 1.5 - 35 Bar, 150 LPM Cartridge Type
MIL-V-24694/2	-	Valve, Hydraulic Relief, 1.5 - 35 Bar, 10 LPM Cartridge Type
MIL-DTL-24695	-	Valve, Hose Assembly, and Adapter, Vent and Test Hydraulic Service, General Specification for
MIL-DTL-24696	-	Gasket, Sheet, Non-Asbestos
MIL-DTL-24704	-	Flanges, Four Bolt Square, Hydraulic General Specification for
MIL-G-24716	-	Gaskets, Metallic-Flexible Graphite, Spiral Wound
MIL-DTL-24788	-	Coupling Assembly, Semi-Dry-Break, Quick-Disconnect Fuel, With or Without Continuity Switch
MIL-PRF-32187	-	Gasket, Hybrid, Flat and Raised Face Flange, Fire Resistant, Shipboard Use
MIL-DTL-32258	-	Nut, Self-Locking (Ring Type Non-Metallic Insert), Heavy Hex, Controlled Root Radius, Nickel-Copper Alloy
MIL-PRF-32307	-	Valve, Quarter Turn, Triple-Offset, Torque Seated, Shipboard Use
MIL-DTL-81940/4	-	Valve, Sampling and Bleed, Hydraulic, 3000 PSI Non-Aircraft Applications
MIL-V-85245/1	-	Valve, Relief, Hydraulic, High Response Inline
MIL-V-85245/2	-	Valve, Relief, Hydraulic, High Response Cartridge Type

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-22	-	Welded Joint Design
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-769	-	Insulation Requirements for U.S. Naval Vessels
MIL-STD-792	-	Identification Marking Requirements for Special Purpose Components
MIL-STD-1330	-	Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen, and Hydrogen Systems
MIL-STD-2035	-	Nondestructive Testing Acceptance Criteria

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-267	-	Guide for Selection of Lubricants and Hydraulic Fluids for Use in Shipboard Equipment
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(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

MIL-STD-777F(SH)
W/CHANGE 2

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

MILITARY STANDARD DRAWINGS

- | | | |
|---------|---|---|
| MS18307 | - | Laterals (Y-Branch), Forged Steel Socket Welding, 3000 PSI at 1000 °F (Max.) Steam Service |
| MS18308 | - | Alloy Steel Socket Welding Flanges and Flanged Nipples, 1/4 Inch and 3/8 Inch, 600 Pounds Per Square Inch at 850 °F (Maximum) |

(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) DRAWINGS

- | | | |
|-------------|---|--|
| 505-8289963 | - | Titanium Seawater Piping, Electrical Isolation to Prevent Galvanic Corrosion |
| 803-1385541 | - | Valves, Bronze, Flanged, In-Line & Angle Stop & Stop Check 2-1/2 - 12 |
| 803-1385623 | - | Valves, Bronze, Flanged Globe Y Pattern 250 PSI WOG |
| 803-1385637 | - | Valves, Bronze, Flanged, Check 250 PSI WOG |
| 803-1385707 | - | Valves, Scupper, Gag Type |
| 803-1385711 | - | Valve, Hose Globe, In-Line & Angle 1-1/2 In 250 PSI |
| 803-1385712 | - | Valve, Hose Globe, In-Line and Angle 2-1/2 In. - 250 PSI |
| 803-1385714 | - | Valve, Bronze 1/4 - 2, Union End, Gate |
| 803-1385721 | - | Valves, Bronze 1/4 - 2, Union End, Swing Check |
| 803-1385789 | - | Fittings, Deck Drain |
| 803-1385850 | - | Piping, Instrument, Pressure for All Services |
| 803-1385866 | - | Penetration, Bulkhead and Deck |
| 803-1385884 | - | Unions, Fittings and Adapters, Butt and Socket Welding, 6000 PSI WOG NPS |
| 803-1385892 | - | Flanges, Bronze, Special for Use with Butterfly Valves |
| 803-1385948 | - | Unions, Sil Brzg, OD, 3000 PSI, WOG for UT Insp |
| 803-1385950 | - | Bosses, Non-Ferrous Piping, for UT Insp |
| 803-1385965 | - | 3-Way By-Pass Valve, 1/2 - 1, BW & SW 900 LB ASME |
| 803-2177140 | - | Valves, 2-1/2 Inch Globe-Stop, Stop Check, Lift Check, and Throttle, Butt Weld – ASME Class 1500 |
| 803-2177141 | - | 3" & 4" Globe Stop, Stop Check, Lift Check, ASME Class 900 Valves - BW |
| 803-2177142 | - | 5" & 6" BW - ASME Class 900 Valves |
| 803-2177518 | - | ASME Class 900 Gate Valve, 5, 6, 8, 10, 12, 14, & 16 Sizes Welding Ends |

MIL-STD-777F(SH)
W/CHANGE 2

803-2177525	-	¼ - 2 BW & SW 900 LB ASME Valve
803-2177917	-	Valves, Bronze Flanged, Gate 250 PSI WOG
803-4384536	-	Valves; Bronze; ¼" – 2" Union End Globe; In-Line & Angle; Stop, Stop Check & Needle
803-5001003	-	Valve, Ball, ¼ Thru 2-1/2 Inch Straight and 3-Way Line 700 PSI
803-5001004	-	Valve, Ball, 3 Thru 6 Inch Straight Line 400 PSI
803-5184193	-	Steel Globe Valves, 1/4 to 2 NPS, 1500 Class
803-5959276	-	Valve, Tank Sounding Tube, Floating Ball Check
803-6397247	-	Valve, Globe – 1/8 Thru 1-1/2, Ni-Al-Brz, 6000 PSI
803-6397304	-	Valve, Globe, Instrument Isolation,, CRES and NICU Alloy, .25 Inch, 6000 PSI
803-6397404	-	Halon System Actuation Check Valve
803-6397408	-	Sprinkler Valve, 1-1/2-In Thru 8-In Size, Assembly & Details
803-6397430	-	Fittings, Socket Welded, Copper Nickel, 400 PSI Max
803-6983468	-	Diaph Oper Check Valve, 3/8 In. Thru 8 In. Size, Assembly & Details
803-6983491	-	Marine Composite Ball Valve (250 PSI Max)
803-6983512	-	Flanges, Standard, CU-NI Socket-Weld, Slip-on, and Welding Neck
803-7063850	-	Tailpiece Assemblies, Union End (BW, SW, SB), 1/4 - 2 inch, 400 PSI WOG
803-7106793	-	Butterfly Valve, Low Pressure, High Performance
804-4444650	-	Connections, Surface Ship Sewage Discharge
804-5284201	-	Reinforced Rubber Gasket Material for Pipeline Joints
810-1385791	-	Fittings, Air Test, Sounding, Flooding, & Draining
810-1385848	-	Deck Plates for Sounding & Filling Connections
810-1385880	-	Fittings, Copper-Nickel Alloy, Slip-on Sleeve for Brazing, Arc, or Gas Welded 200 PSI at 150°
810-1385888	-	Unions, Butt, & Socket Welding for OD Tubing, 6000 PSI, WOG
810-1385889	-	Unions, Silver Brazing for OD Tubing, 3000 PSI WOG
810-1385899	-	Std Fittings – Insulated Dk & Blk – Refrigerant Piping and Capillary Tube Application
810-1385915	-	Fittings, Pipe, Composition, Flanged, 100 PSI Max at 425degF Max, for all Services
810-1385917	-	Temperature Indicator and Thermowell Selection
810-1385992	-	Flanges, CUNI, 250 PSI, WOG, Welding Neck

MIL-STD-777F(SH)
W/CHANGE 2

(Copies of these documents are available from the applicable repositories listed in S0005-AE-PRO-010/EDM, which can be obtained online via Technical Data Management Information System (TDMIS) at <https://mercury.tdmis.navy.mil/>. Copies of these documents may also be obtained from the Naval Ships Engineering Drawing Repository (NSED) online at <https://199.208.213.105/webjedmics/index.jsp>. To request an NSED account for drawing access, send an email to NNSY_JEDMICS_NSED_HELP_DESK@navy.mil.)

NAVAL AIR WARFARE CENTER

A404734 - Fitting Assembly Data, Sil-Braze & Socket Weld "O"-Ring Seal

(Copies of this document are available online via Joint Engineering Data Management Information and Control System (JEDMICS) at <https://webjedmics.navair.navy.mil/webjedmics/index.jsp>. Refer questions, inquiries, or problems to nani_customerservice@navy.mil.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S6430-AE-TED-010 - Technical Directive for Piping Devices, Flexible Hose Assemblies; Volume 1

S6430-AE-TED-020 - Piping Devices, Flexible; Vol 2

S9AA0-AB-GOS-010, Section 505 - General Specifications for Overhaul (GSO) of Surface Ships, Section 505, General Requirements for Piping Systems

S9AA0-AB-GOS-010, Section 542 - General Specifications for Overhaul (GSO) of Surface Ships, Section 542, Gasoline and JP-5 Systems

S9074-AR-GIB-010/278 - Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels

S9086-CJ-STM-010 - NSTM Chapter 075, Fasteners

S9086-CM-STM-010 - NSTM Chapter 078, Volume 1 – Seals; Naval Ships Technical Manual

S9086-RK-STM-010 - NSTM Chapter 505, Piping Systems

S9086-VH-STM-010 - NSTM Chapter 635, Thermal, Fire, and Acoustic Insulation

S9505-A1-DDT-010 - NAVSEA Design Practices and Criteria Manual for Titanium Piping Systems

T9500-AA-PRO-110 - NAVSEA Design Practices and Criteria Manual for Glass Reinforced Plastic (GRP) Piping Systems, Chapter 505

(Copies of these documents are available online via Technical Data Management Information System (TDMIS) at <https://mercury.tdmis.navy.mil/> by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. These documents are available for ordering (hard copy) via the Naval Logistics Library at <https://nll.navsup.navy.mil>. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy.mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

AIA NAS1613 - Packing, Preformed, Ethylene Propylene Rubber

(Copies of this document are available online at www.aia-aerospace.org.)

MIL-STD-777F(SH)
W/CHANGE 2

ASME INTERNATIONAL

- ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - ASME B16.9 - Factory-Made Wrought Buttwelding Fittings
 - ASME B16.11 - Forged Fittings, Socket-Welding and Threaded
 - ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500
 - ASME B16.34 - Valves – Flanged, Threaded, and Welding End
 - ASME B31.1 - Power Piping
 - ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay)
- ASME Boiler and Pressure Vessel Code

(Copies of these documents are available online at www.asme.org.)

ASTM INTERNATIONAL

- ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications
- ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
- ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- ASTM A213/A213M - Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
- ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- ASTM A217/A217M - Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

MIL-STD-777F(SH)
W/CHANGE 2

ASTM A240/A240M	-	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269/A269M	-	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276/A276M	-	Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	-	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A335/A335M	-	Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASTM A351/A351M	-	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A376/A376M	-	Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Service
ASTM A403/A403M	-	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A449	-	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A479/A479M	-	Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A530/A530M	-	Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A743/A743M	-	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B61	-	Standard Specification for Steam or Valve Bronze Castings
ASTM B88	-	Standard Specification for Seamless Copper Water Tube
ASTM B210	-	Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B280	-	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B363	-	Standard Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings
ASTM B367	-	Standard Specification for Titanium and Titanium Alloy Castings
ASTM B369	-	Standard Specification for Copper-Nickel Alloy Castings
ASTM B381	-	Standard Specification for Titanium and Titanium Alloy Forgings
ASTM B443	-	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip
ASTM B444	-	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625 and UNS N06852) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Pipe and Tube

MIL-STD-777F(SH)
W/CHANGE 2

- ASTM B600 - Standard Guide for Descaling and Cleaning Titanium and Titanium Alloy Surfaces
- ASTM B705 - Standard Specification for Nickel-Alloy (UNS N06625, N06219 and N08825) Welded Pipe
- ASTM B861 - Standard Specification for Titanium and Titanium Alloy Seamless Pipe
- ASTM B862 - Standard Specification for Titanium and Titanium Alloy Welded Pipe
- ASTM D5363 - Standard Specification for Anaerobic Single-Component Adhesives (AN)
- ASTM F467 - Standard Specification for Nonferrous Nuts for General Use
- ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use
- ASTM F1347 - Standard Specification for Manually Operated Fueling Hose Reels
- ASTM F1370 - Standard Specification for Pressure-Reducing Valves for Water Systems, Shipboard
- ASTM F1387 - Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings
- ASTM F1508 - Standard Specification for Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services
- ASTM F1793 - Standard Specification for Automatic Shut-Off Valves (Also Known as Excess Flow Valves, EFV) for Air or Nitrogen Service
- ASTM F3226/F3226M - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems

(Copies of these documents are available online at www.astm.org.)

MANUFACTURERS STANDARDIZATION SOCIETY (MSS) OF THE VALVE AND FITTINGS INDUSTRY

- MSS SP-55 - Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
- MSS SP-97 - Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded, and Buttwelding Ends
- MSS SP-119 - Factory-Made Wrought Belled End Pipe Fittings for Socket-Welding

(Copies of these documents are available online at www.mss-hq.org.)

NACE INTERNATIONAL

- SP0286 - Electrical Isolation of Cathodically Protected Pipelines

(Copies of this document are available online at www.nace.org.)

NATIONAL AEROSPACE STANDARDS COMMITTEE (NA/NAS)

- NASM 17828 - Nut, Self-Locking, Hexagon Regular-Height, (Non-Metallic Insert) 250 °F or 450 °F, Nickel-Copper Alloy

MIL-STD-777F(SH)
W/CHANGE 2

NASM 25027 - Nut, Self-Locking, 250 °F, 450 °F, and 800 °F

(Copies of these documents are available online at www.aia-aerospace.org.)

SAE INTERNATIONAL

SAE-AMS3216 - Elastomer: Fluorocarbon (FKM) Rubber High-Temperature - Fluid Resistant Low Compression Set 70 to 80

SAE-AMS3218 - Elastomer: Fluorocarbon (FKM) Rubber High-Temperature-Fluid Resistant Low Compression Set 85 to 95

SAE-AMS5561 - Steel, Corrosion and Heat-Resistant, Welded and Drawn or Seamless and Drawn Tubing, 9.0Mn - 20Cr - 6.5Ni - 0.28N, High-Pressure Hydraulic

SAE-AMS7259 - Rubber: Fluorocarbon (FKM), High Temperature/Fluid Resistant, Low Compression Set/ 85 to 95 Hardness, for Seals in Fuel Systems and Specific Engine Oil Systems

SAE-AMS7276 - Rubber: Fluorocarbon (FKM) High-Temperature-Fluid Resistant Low Compression Set for Seals in Fuel Systems and Specific Engine Oil Systems

SAE-AMS-C-6183 - Cork and Rubber Composition Sheet; for Aromatic Fuel and Oil Resistant Gaskets

SAE-AMS-H-81200 - Heat Treatment of Titanium and Titanium Alloys

SAE-J20 - Coolant System Hoses

SAE-J514 - Hydraulic Tube Fittings

SAE-J518-1 - Hydraulic Flanged Tube, Pipe, and Hose Connections, 4-Screw Flange Connection Part 1: 3.5 MPa to 35 MPa (Code 61)

SAE-J518-2 - Hydraulic Flanged Tube, Pipe, and Hose Connections, 4-Screw Flange Connection Part 2: 42 MPa (Code 62)

SAE-J995 - Mechanical and Material Requirements for Steel Nuts

SAE-J2270 - Ship Systems and Equipment - Threaded Fasteners - Inspection, Test, and Installation Guidance

SAE-J24714 - Fluid Systems - Connector Tubes - General Specification and Part Standard

(Copies of these documents are available online at www.sae.org.)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SP 10/NACE No. 2 - Near-White Blast Cleaning

(Copies of this document are available online at www.sspc.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

This section is not applicable to this standard.

MIL-STD-777F(SH)
W/CHANGE 2

4. GENERAL REQUIREMENTS

4.1 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

4.2 Nuclear plant piping. For piping directly associated with a nuclear plant, the requirements of sections 210 and 9890-1 of the applicable ship specifications apply in lieu of the requirements specified herein.

4.3 Gauge piping. Pressure gauge piping requirements are specified in 803-1385850, except the root valve may be eliminated when the gauge is located on a gauge board that is mounted on a component and is not more than 3 feet from the root connection of the gauge. The use of siphons and flexible connections as a means for providing flexibility is not mandatory, provided the configuration of gauge piping is such that the flexibility requirements of 803-1385850 are met and objectionable vibrations are not transmitted to the gauges on the gauge board. When the gauge/isolation test valve is not mounted on the gauge board, the jam nut and washer shall be removed. Gauge/isolation valves to 803-6397304 may be used as alternatives to the MIL-DTL-24578 valves required by 803-1385850.

4.3.1 Root valves. Root connections for instrumentation piping shall be in accordance with the following:

- a. Where possible, root connections shall be made into the side of pipe or pressure vessels to minimize problems due to air binding or accumulation of foreign materials in the gauge lines.
- b. Root connections between the outlet and root valve shall be at least ¼ inch nominal pipe size (NPS).
- c. Root valves shall be of the same design, material, and rating as valves in the system to which they are connected, except stellite-faced seats are not required for root valves in steam and drain lines. However, the hardness for these seats shall be Brinell (BHN) 225 minimum.
- d. The overall size and weight of the root valves shall be kept to a minimum.

4.4 Thermometer wells. Thermometer wells shall conform to the requirements of 810-1385917 and MIL-T-24270 using materials selected which are compatible with the materials specified for the intended service. Materials other than those specified are acceptable, provided that they are entirely satisfactory in all respects and are approved by NAVSEA.

4.5 Maximum material temperature. The pressure listed for the service categories contained in this schedule, in general (although not in all cases), are system operating pressures. Temperatures indicated, with the exception of Category A – steam systems, are the maximum expected operating temperature. In the case of most cold systems, ambient temperatures of 150 °F have been used. For maximum allowable stresses for piping materials at various temperatures, see section 505 of the applicable ship specifications.

4.6 Fire protection. The piping systems, including support structures in high fire hazard spaces, shall be designed to remain operational for a specified temperature, time, and heat flux. The design specification shall specify the time, temperature, and heat flux for which various piping systems are to remain operational for each particular region within the ship. High fire hazard spaces are those compartments protected by high-pressure water mist, heptafluoropropane (HFP), Halon 1301, or CO₂ flooding systems.

4.7 Seawater valves. Valves intended for seawater service shall have nickel-copper alloy stems, seats, discs, disc nuts, hinge pins, and side plugs, as applicable. For valves in sizes 2½ inches and above, discs with a nickel-copper alloy facing of ⅛-inch minimum thickness are acceptable in lieu of solid nickel-copper alloy. Nickel-copper-aluminum or nickel-copper-silicon alloy may be used as an alternative to nickel-copper. Bronze valves for other than seawater service may have bronze stems, seats, discs, disc nuts, hinge pins, and side plugs, as applicable.

4.8 Valve approvals. For valves (except valves on many mechanical standard drawings), fittings, and flanges, contractor's designs previously approved for comparable installations may be substituted for those specified, subject to justification to and approval by NAVSEA. Extensions of the applicability of previously granted waivers or approvals for reasons of shipbuilding expediency are not valid.

MIL-STD-777F(SH)
W/CHANGE 2

4.9 Pressure temperature ratings. For ferrous and special alloy components, selection of the pressure series shall be made in accordance with the pressure temperature ratings of ASME B16.5 or ASME B16.34, as applicable, unless the series is specifically designated in the applicable category. Butt-welded or socket-welded fittings shall be of a schedule or thickness compatible with the service conditions.

4.10 Butt-weld requirements. Butt-welded ends for valves, fittings, and flanges shall not be used for sizes smaller than 1¼ inches, except where previously approved by NAVSEA, or where inert gas consumable insert type butt-welds are used in sizes down to and including ½ inch, subject to qualification of the procedure by the activity doing the welding. Socket-welded end valves, fittings, and flanges for P-1 piping may only be used in sizes up to and including 2 inches. For welded-end steel valves, fittings, and flanges, the carbon content shall not exceed 0.35 percent.

4.11 Long-radius elbows. The use of long-radius elbows are required to minimize flow turbulence. The use of short-radius elbows is acceptable where space conditions do not permit long-radius elbows.

4.12 Steel valve seat and disc materials. Steel valves, not covered by military specifications or standard drawings in steam and feed systems normally operating at gauge pressures of 150 psi and above, shall have seat and disc seating surfaces hard faced using material in accordance with type MIL-RCoCr-A of MIL-R-17131, or the equivalent. Steel valves in steam and feed systems below 150 psi at saturation temperatures shall have either hard-faced operating seat and disc seating surfaces as specified above, or seats and discs hardened by heat treatment. Special normally open valves not used for throttling, such as solenoid trips, shall have seating surfaces suitable for the service application.

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

- 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 or 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 ¾ 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, 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, A-A-59860, MIL-V-17360, ASTM F1347, MIL-DTL-17902, and MIL-DTL-24788.
- e. In unpressurized connections.
- f. Quick disconnect couplings for air hose connections and spray heads for washdown countermeasure systems, magazine sprinkling, and wet sprinkling systems.
- g. Male NPT to 37-degree flare adapter fittings in accordance with SAE-J514 (3-piece assembly including nut, sleeve, and tube) used for pneumatic (air) connection of control components to signal lines (125 psi maximum), where materials and fittings are specifically approved.

4.14 Fire-hardened fittings. Fire-hardened fittings are defined as fittings which are welded, or which comply with ASTM F1387, including satisfactory accomplishments of fire testing, and are approved by NAVSEA for the intended application. Where categories and groups have been combined from previous revisions of this standard as reflected in 5.3, only one designation from those combined categories/groups will be identified in [table I](#) and [table II](#).

4.14.1 Fire-hardened fitting requirements. Fire-hardened fittings are required in the systems listed in [table I](#) below, where piping is located within compartments which are served by CO₂ fixed flooding or Halon 1301 fire extinguishing systems.

MIL-STD-777F(SH)
W/CHANGE 2

TABLE I. Fire-hardened fitting requirements (for systems in high fire hazard spaces).

Category and group	Service
H-2	Contaminated aviation lube oil
J-4, J-8	Air and nitrogen, deballast (Copper and copper-nickel piping)
J-7	Prairie masker, gas turbine start (Copper and copper-nickel)
K-7	Propane (Copper and copper-nickel piping)

MIL-STD-777F(SH)
W/CHANGE 2

Fire-hardened fittings are required throughout the ship in the systems listed in [table II](#) below.

TABLE II. Fire-hardened fitting requirements.

Category and group	Service
C-4	Water mist
C-1, D-1	Firemain (see notes C-1-14, D-1-11)
E-2, E-4	Fuel
F-1	Lubricating oil
G-1, G-2, G-8	Hydraulic oil
H-1	Gasoline
I-1	JP-5
J-1, J-3, J-5, J-6, J-9	Air and nitrogen
J-4, J-7	Air [steel and corrosion-resistant steel (CRES) piping]
K-1, K-2, K-3	Gaseous oxygen
K-4, K-5, K-6	Liquid oxygen, mixed gas
N-1	Sprinkling system (dry)
N-2	Magazine sprinkling system (wet and dry)
R-1	Oily waste drains
S-1	Aqueous film forming foam (AFFF) and AFFF/seawater
T-2	HFP and Halon 1301 fire extinguishing systems
T-3	HFP and Halon, actuation

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

- a. In sizes ½-inch NPS and below.
- b. Fittings without pre-inserted brazing rings may be used in the refrigeration system (see Category Q-1).
- c. Expanded copper sleeves without pre-inserted brazing rings may be used in the inner wall of a double-walled gasoline piping system.
- d. Joints for bellmouth to pipe for tailpipes within tanks.
- e. Bronze fittings without pre-inserted brazing rings may be used in the air conditioning chilled water condensate drain system.

4.16 Fasteners. This standard identifies material to be used in flange bolting. Additional guidance for generic fastener application is provided in S9086-CJ-STM-010/075.

- a. Flanged joint fastener external threads shall be UNC-2A for fasteners up to 1-inch diameter. Flanged joint fastener external threads shall be UNC-2A or 8-UN-2A for fasteners larger than 1-inch diameter. Flanged joint internal threads shall be UNC-2B for fasteners up to 1-inch diameter. Flanged joint fastener internal threads shall be UNC-2B or 8-UN-2B for fasteners larger than 1-inch diameter.
- b. All Level I fasteners shall meet the requirements of MIL-DTL-1222.
- c. When applicable, each category/group lists if any commercial fastener specifications are allowed to be used for fasteners in that group/category. For all categories/groups in this standard, if the fastener requirements are identical to a fastener in a National Aerospace Standards-Military (NASM) sheet, the NASM Part Identification Number shall be used. Alternative material may be substituted, subject to approval by the cognizant technical authority.

MIL-STD-777F(SH)
W/CHANGE 2

d. Nuts on flanged joints in all tanks, non-accessible bilge regions, or locations that are otherwise inaccessible for examination or routine replacement in-service where temperatures do not exceed 450 °F shall be self-locking with at least one thread length extending beyond the insert when the nut is drawn up tight. The self-locking nuts shall be rated for the temperature of the service.

e. For studs that will be set in a hole with thread-locking compound, stud nut ends shall be Class 2A fit with Class 2B nuts, or Class 3A fit with Class 3B nuts. The setting end of the studs shall be Class 3A in Class 3B holes locked in place with a thread-locking compound in accordance with ASTM D5363. The procedure for installing studs with a thread-locking compound shall meet the requirements of SAE-J2270. The use of National Class 5 interference fit threads in accordance with ASME B1.12 shall be limited to the setting end of studs where the design temperature exceeds that allowed for thread-locking compounds.

f. Nickel-copper (Ni-Cu, UNS N04400) fasteners shall be used where the joints are not readily accessible for examination or maintenance in-service due to location of the fasteners below floor plates and in tanks or in other hidden areas where carbon steel, brass, or bronze fasteners are specified or where subject to seawater spray or submergence. Where nickel-copper fasteners do not meet the strength requirements of the joint, nickel-copper-aluminum (Ni-Cu-Al, UNS N05500) in accordance with MIL-DTL-1222, Grade 500 shall be used. If nickel-copper-aluminum fasteners are used and there are tapped holes as part of the bolted joint, the installing document shall provide torque limits for the fasteners used in the tapped holes to prevent damaging the internal threads of the tapped holes.

g. Nickel-copper-aluminum fasteners shall be in accordance with MIL-DTL-1222.

h. Flanged joint threaded fasteners in pump rooms and at all AFFF Pumping, Reserve and Transfer, and Distribution Stations shall use either nickel-copper or nickel-copper-aluminum material as appropriate to provide the required fastener strength. This does not apply to CRES piping systems, or component piping.

i. Hull integrity piping connections are defined as all flanged joints from the hull up to and including the inboard flange of the hull valve. Included in this category are the bonnet joints of the hull valves and both line flanges and the bonnet joint of the first valve (such as a blowout valve) in branch lines connected to piping between the hull valve and the hull connections. Such connections shall be as follows:

(1) All bolted hull integrity piping connections, as defined above, shall be fitted with nickel-copper-aluminum alloy fasteners in accordance with MIL-DTL-1222 and with self-locking nuts in accordance with MIL-DTL-32258.

(2) For services involving integrity of the hull against the sea, as defined in item i above, energy absorption shall be provided by making the mounting fasteners essentially constant strength throughout their length. Uniform strength in bolt-studs can be achieved by:

(i) Using continuously threaded bolt-studs (the preferred method with those having roll-formed threads being stronger than those with cut threads).

(ii) Using bolt-studs with roll-formed threads whose unthreaded shank diameter is equal to the pitch diameter.

(iii) Reducing the unthreaded shank diameter of bolt studs to the minor diameter when cut threads are used.

(3) Bonnet joints for the hull valves are not required to be designed for energy absorption, unless the valve bonnet joints receive essentially the same loading from hydraulic shock as the outboard flanged joint or use the same size fasteners as the flanged joint.

j. Where individual categories specify both non-ferrous and ferrous fasteners, the ferrous fasteners may be used on steel and stainless steel bolted joints unless non-ferrous fasteners are required for considerations discussed above.

4.17 Brass fastener restriction. Brass fasteners shall not be used in stressed applications, or in applications operating above 250 °F, for any piping system or component. Additional restrictions and warnings for “black oxide” coated brass fasteners are as specified in S9086-CJ-STM-010/075.

MIL-STD-777F(SH)
W/CHANGE 2

4.18 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 (Unless otherwise specified in the flange specification referenced on the propulsion plant fluid system diagram, the requirements of this section shall be used for gasket mating surfaces on flanges in piping systems and connected components.):

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 circular lay (spiral) of 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 of nominal size over 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 maximum roughness average (R_a) of 500 μ -inches.

b. Flanges for O-ring seals shall be finished in accordance with S9086-CM-STM-010/078.

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 .

(3) For special installations involving radioactive service or hazardous fluids (toxic or explosive) where a finer finish is required, the requirements shall be the same as above, except that the finish shall be 125 R_a or better.

4.19 Weld joint requirements. Weld joint and backing ring design shall comply with MIL-STD-22 and the applicable NAVSEA fabrication document (e.g., S9074-AR-GIB-010/278). Fillet welds on titanium piping, including belled-end fittings, socket joints and couplings, require NAVSEA approval.

4.19.1 Titanium weld restrictions. Fillet welds on titanium piping, including belled-end fittings, socket joints and couplings require NAVSEA approval following demonstration of adequacy in shock loading. Welds shall conform to fabrication document and 4.48 as applicable.

4.20 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.

4.21 Welded branch outlets. Welded branch connections can be effected by the following techniques:

- a. Extruded
- b. Saddle
- c. Boss
- d. Integrally reinforced branch outlet or integrally reinforced insert butt-welding pipe fitting
- e. Weld miter for non-pressure services
- f. Branch connections in accordance with MIL-STD-22, or as approved

For seawater piping, the following limitation applies to (b) and (c). Welded outlets may be used where the velocity is normally below 10 feet per second, provided the bore of the outlet is chamfered and the corner at the inside diameter of the pipe is rounded so turbulence is minimized.

Extruded and saddle-type branch connections shall be designed to meet the requirements of ASME B31.1.

4.22 Branch connections. Unreinforced branch connections (a connection where the branch pipe is attached directly to the pipe run by welding and joint fabrication does not include the techniques specified in 4.21.c and d) shall not be used in any system where the design gauge pressure is over 150 psi or the design temperature is over 450 °F. The required reinforcement shall not be obtained via weld build-up, and any branch connection fabricated by the use of welding only will be considered as un-reinforced.

MIL-STD-777F(SH)
W/CHANGE 2

4.23 Packing requirements. Only oil-free packing and gaskets shall be used in valves and components on nuclear-powered ships in secondary plant systems.

4.24 Bulkhead penetrations. Standard bulkhead penetration fittings are shown in 803-1385866 and 810-1385899.

4.24.1 Titanium piping penetrations. 803-1385866 shall be modified as follows for systems using titanium piping:

a. Titanium pipe penetrations through decks may be accomplished with contractor-selected designs that do not require welding. These penetrations are subject to the following restrictions:

(1) Penetrations not directly welded or swaged to the pipe shall not be used in tanks, at tank boundaries, or in applications subject to sea pressure.

(2) The penetration shall meet Grade A shock requirements.

(3) New penetration designs shall be approved by NAVSEA. Approval shall consider all aspects of design including shock and fire test procedures and results.

(5) The penetration sleeve interior shall be coated with one coat, 1.0 mil dry film thickness, inorganic zinc silicate or similar.

b. Titanium penetrations through tank boundaries and through bulkheads, other than non-tight, shall be accomplished using flanged sleeves as approved by NAVSEA. Prior to use, the penetration design shall be fire-tested in accordance with NAVSEA-approved procedures.

Where titanium pipe is insulated, flanged joints and watertight boundary penetrations shall be fitted with removable covers in accordance with MIL-STD-769 and S9086-VH-STM-010/635, as applicable. Where metal lagging is required, the lagging shall also be removable and reusable.

4.24.2 Sleeve requirements. Non-insulated type sleeves may be used for temperatures between 50 to 400 °F inclusive. Alternative construction may be used, subject to Government approval.

4.25 Union joints. Ground joint union bonnets shall not be used in vacuum service unless the bonnet design utilizes an O-ring or gasket seal which is totally captured. Ground joint unions, in accordance with MIL-DTL-1183, shall not be used for shipboard piping applications unless an O-ring gasket and a retainer ring are used as a secondary seal. In lieu of O-ring gaskets and retaining rings, flat washers may be used as an alternative secondary seal in accordance with tables [III](#) and [IV](#) below.

4.25.1 Union nuts. Material selected for union nuts shall prevent or minimize galling of threadpiece or nut threads. Union nuts shall not be made from silicon-aluminum-bronze (UNS C64200) due to stress-corrosion cracking.

MIL-STD-777F(SH)
W/CHANGE 2TABLE III. Gasket materials and ratings.

Service temperature (°F)	ASTM D2000 material ratings	Commercial product	Polymer	Restrictions
-30 to 200	BF 614 or BF 618	Garlock® Style 361 or equal	Acrylo-Nitrile	Not for use in Phosphate Ester based hydraulic fluid
-30 to 275	3BA610 B13 C12 Z1* or DA610 *Z1 – Polymer EP	Garlock® Style 563 or equal	Ethylene Propylene	Not for use when petroleum products may be present
-30 to 425	3HK710 A2 – 10 B37 EO78 Z1 Z2* *Z1 – 70-80 Durometer Z2 – Peroxide cured FKM	Vitron® GF Thermodyn™ TH-7070-FGC or equal	Peroxide cured FKM	Recommended for services exceeding 275 °F or exceeding 200 °F in cases where Ethylene Propylene is inappropriate (see above)

TABLE IV. Gasket dimensions.

Union size NPS	Thickness	Outside diameter	Inside diameter
¼	0.094	0.922	0.609
⅜	0.094	1.094	0.775
½	0.094	1.313	0.984
¾	0.094	1.609	1.203
1	0.125	1.922	1.484
1¼	0.125	2.359	1.828
1½	0.125	2.656	2.109
2	0.125	3.266	2.625
NOTE: All dimensions are in inches with a tolerance of $\pm\frac{1}{64}$ inch.			

4.26 Gaskets. Gaskets noted in this standard are for line joints only. (Asbestos gaskets are prohibited for line joints and components.)

a. Hybrid gaskets for hydrocarbon applications shall be qualified to MIL-PRF-32187. Where MIL-PRF-32187 gaskets are used, flange surface shall meet the finish requirements of ASME B16.5. Where hybrid gaskets are used in non-ferrous applications, carrier ring shall extend to flange outside diameter. Where tables offer a choice of materials, hybrids shall be used when all of the following apply:

- (1) System design is within the pressure-temperature rating of the gasket.
- (2) System is required to be fire-hardened in accordance with 4.14.
- (3) Flange or component design specifications require a gasket seating surface finish equal to ASME B16.5 requirements.

b. Monofilament nylon reinforced gaskets shall be constructed to 804-5284201, Types 1, 2, 3, and 4. Approved materials to this standard are:

MIL-STD-777F(SH)
W/CHANGE 2

- (1) 804-5284201, Type 1-UNAFLEX® SBR CI-Type #96
- (2) 804-5284201, Type 2-UNAFLEX® Neoprene CI Sheet-Type #87
- (3) 804-5284201, Type 3
- (4) 804-5284201, Type 4-UNAFLEX® Buna-N CI

Where monofilament reinforced material is used in gasoline and JP-5 service, thickness shall be 1/8 inch and not subject to compression limits specified in S9AA0-AB-GOS-010, Section 542.

- c. Pikotek gaskets for galvanic isolation in titanium systems are required in accordance with 4.44.
- d. Spiral wound gaskets shall be in accordance with MIL-G-24716. Where normally exposed to seawater, Class C shall be specified.
- e. Where rubber sheet gaskets are specified, precautions shall be taken to avoid pickling the joint containing the gasket using compounds or solutions containing hydrochloric acid, sulfuric acid, or sodium bisulphate.

4.27 Missile systems. Only metallic piping components shall be used in missile blast areas.

4.28 Slip-on joints. Slip-on flanges shall not be used, except as noted herein.

4.29 Steam generators. The term "steam generator", as used in this standard, is applicable to both nuclear and non-nuclear ship installations.

4.30 Butterfly valves. Butterfly valve applications shall be in accordance with the following:

- a. Butterfly valves are permitted only when specified in the service categories within this standard.
- b. Synthetic seated butterfly valves shall not be used in severe throttling applications where the gauge pressure drop exceeds 50 psi or the valve opening is less than 20 degrees; only metal-to-metal seated butterfly valves may be used in these applications.
- c. Synthetic seated or metal-to-metal seated butterfly valves shall not be used in the following applications:
 - (1) As seawater system hull valves.
 - (2) For seawater application in locations where a non-metallic flexible fitting is installed, the isolation of which is dependent upon closure of a single valve.
 - (3) Bulkhead damage control cutout valves in main and secondary drainage, gasoline, and oil systems.
 - (4) Firemain and AFFF segregation valves, except for triple offset high performance butterfly valves. (That is, those required to set material conditions Yoke and Zebra).
 - (5) Oil and gasoline tank cutout valves, except where the valve is installed inside a tank or where the valve is outside of the tank above the tank top.

4.31 Fuel piping run rules. JP-5 and fuel pipe material special applications (cargo JP-5 and cargo oil tanks refers to those convertible cargo tanks intended for selective stowage of JP-5 or fuel) shall be in accordance with the following:

- a. Piping passing through JP-5 or cargo JP-5 and cargo oil tanks shall be 70-30 copper-nickel or shall be completely externally coated with the same coating material used on the interior of the tank.
- b. Piping terminating within a JP-5 or cargo JP-5 and cargo oil tanks shall be 70-30 copper-nickel up to the first stop valve (for sounding tubes, overflows, and air escapes up to the first connector beyond tank boundary). If the first stop valve is within the tank in which the piping terminates, that section of the piping beyond the stop valve, but still within the tank, shall be 70-30 copper-nickel or shall be completely externally coated with the same coating material used on the interior of the tank.
- c. Piping passing through ships' fuel tanks which stows fuel for use in diesel or gas turbine engines shall be 70-30 copper-nickel or shall be completely externally coated with the same coating material used on the interior of the tank.
- d. Fuel piping passing through clean seawater ballast tanks shall be 70-30 copper-nickel. There shall be no flanged joints in the fuel piping within the ballast tanks.
- e. Valves located within JP-5 or cargo JP-5 and cargo oil tanks shall be of non-ferrous material.

MIL-STD-777F(SH)
W/CHANGE 2

4.32 Butt-welded fittings. All butt-welding elbows and return bends shall have ½-inch minimum tangents. For commercial fittings, the ½-inch minimum tangents shall be outside the ASME radius dimension. Tangents on fittings may be omitted where consumable inserts are used or where welding without backing rings is permitted. In copper-nickel systems where butt-welded construction is used, fittings specified to be in accordance with 810-1385880 may be designed to the dimensions of ASME B16.9 with a minimum of ½-inch tangent on elbows outside the ASME dimension.

4.33 Bessemer steel restriction. Pipe or tube made from Bessemer steel shall not be used in any piping system.

4.34 Flexible hose fittings. Where not specified in the tables herein, hose, hose couplings, and other flexible devices used in piping configuration for noise attenuation, or piping connections to resiliently mounted equipment, shall be compatible in all respects with the other components in the system concerned. Flexible piping devices shall be in accordance with the following:

a. Flexible hose assemblies: S6430-AE-TED-010, except hose assemblies in potable water systems which are not protected by an air gap backflow preventer, anti-siphon, or other approved device shall be AEROQUIP 2807 or Preece P1-301, or equal.

b. Rubber Inserted Sound Isolation Couplings (RISIC): S6430-AE-TED-020.

c. Hoses for connecting non-pressurized condensate gravity drains from cooling units to drain piping may be in accordance with SAE-J20 R1 and attached using clamps.

4.35 Valve handwheel requirements. Where commercial valves are used, handwheels 10 inches and less may be of commercial design and materials, except that cast iron shall not be used. Handwheels shall be cast or forged. Aluminum or other non-ferrous material for handwheels shall not be used in remotely operated damage control valves.

4.36 Cast valve material. For seawater and JP-5 systems, wherever cast valve bronze (in accordance with ASTM B61) is specified, cast 70-30 copper-nickel (in accordance with ASTM B369) may be used. ASME requirements identified in ASTM B369 for C96200 material should be extended to the 70-30 C96400 material and applied to cast parts used for this application. In addition, supplemental requirements of ASTM B369, as well as weldability testing for cast valves, should be specified in the purchase order.

4.36.1 Weld repair of copper-nickel castings. Weld repair of 70-30 copper-nickel castings is allowed, subject to the requirements of S9074-AR-GIB-010/278.

4.37 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.

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

4.39 Casting inspections. For the radiographic and non-destructive inspection requirements of cast piping system components, refer to the applicable ship specifications and requirements for cast piping components based on fluid service and pressure defined in S9074-AR-GIB-010/278.

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

4.41 Flaring test. The flaring test for piping in accordance with MIL-P-24691/1 is not required.

4.42 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 Government. Included shall be valves qualified to ASTM specifications.

MIL-STD-777F(SH)
W/CHANGE 2

4.43 GRP applications. Specific categories and groups contained in this document allow the use of glass-reinforced plastic (GRP) pipe and fittings. The maximum system operating temperature, which includes casualty conditions, shall not exceed 150 °F. GRP piping shall be in accordance with T9500-AA-PRO-110. The total amount of GRP piping in a space shall not exceed 25 pounds per 1000 cubic feet of volume for empty pipe situations, and 50 pounds per 1000 cubic feet of volume for flowing or stagnant pipe situation. When authorized, GRP installations shall be in accordance with applicable system material requirements as well as material identified in Category C-3.

4.44 Titanium applications. Material and installations contained herein have been developed for P-2 systems as categorized in S9074-AR-GIB-010/278. Titanium piping shall be installed in accordance with S9505-A1-DDT-010 and tested in accordance with 505-8289963. Titanium piping and fittings shall be galvanically isolated from titanium and non-titanium materials wherever applicable, including, but not limited to, flanged joints, pipe hangers, control and instrumentation connection, and electrically isolated from ship's ground. The interaction of grounded titanium bulkhead and deck penetrations with the closest grounded non-titanium component shall be evaluated for possible galvanic interaction. Analyses to predict the magnitude of any potential galvanic corrosion, and proposed measures to reduce its effects, shall be approved. NACE International Standard SP0286 may be used for guidance. If any conflicts between the application of the NACE Standard and the requirements of these specifications arise, the requirements of these specifications shall take precedence. If isolation in accordance with the NACE Standard is not practical for any of the above interfaces, alternative galvanic corrosion countermeasures shall be submitted for approval. Isolation materials selected shall be compatible with the intended pressure and service and shall not present fire, safety, or other hazards.

4.44.1 Flange face inserts. Flange inserts may corrode or otherwise deteriorate in seawater, such as those with exposed stainless steel reinforcement, and shall not be used. Insert and O-ring materials, such as fluorocarbon rubbers, shall be resistant to seawater with a low concentration (0.5 ppm) of chlorine solution. Flange face inserts shall be flush with the outside diameter of the metal joints, and grooved on both sides to accept and retain O-rings. The inserts shall have a thickness of not less than 0.125 inch.

4.44.2 Insulating gasket kits. Insulating gasket kits, Pikotek PGE-10 or equal, shall be used; series C36510XXXX-N for ASME B16.5, Class 150 flanges, series C3751XXXX-N for Navy flanges.

4.44.3 Insulating sleeves and washers. Insulating sleeves shall be used on all flanged joint fasteners. Insulating washers, in addition to all standard required washers, shall be used under all bolt heads and nuts. The insulating washer shall be installed between the standard washer and the flange. A combined insulating sleeve/insulating washer may be used.

4.44.4 Isolation testing. Isolation testing shall be performed before and after the joint is wetted (piping system in operation) in accordance with 505-8289963. Measurements shall be incorporated into and discussed in the appropriate chapter(s) of the Ship Information Book (SIB) and the Ship's Preventive Maintenance System (PMS) Documents, including the recommended periodicity of the measurements.

4.44.5 Material requirements. Grade 2 titanium for piping, valve components, flanges, and fittings shall be procured in accordance with listed specifications and the following additional requirements unless otherwise approved by NAVSEA:

- a. Maximum iron content is not to exceed 0.20 weight percent.
- b. Maximum oxygen content is not to exceed 0.20 weight percent.
- c. Except for castings, maximum yield strength shall be 60,000 psi unless otherwise approved by the purchaser. Maximum yield strength for castings and other materials shall not exceed 65,000 psi in any case.
- d. Fittings fabricated by welding and fittings formed from pipe shall be supplied in the stress relieved condition. Welded seam pipe may be supplied in the as welded condition, except that if forming is also employed during manufacture, stress relieving is required unless exempted by ASTM B862.
- e. Forgings, seamless pipe, and fittings other than those of d above, shall be supplied in the annealed condition. For castings, ASTM B367 supplemental requirement S5 Hot Isostatic Pressing shall apply, and times and temperatures shall be proposed by the foundry for acceptance by the purchaser.

MIL-STD-777F(SH)
W/CHANGE 2

- f. Heat treatment shall be performed in accordance with SAE-AMS-H-81200 in a vacuum or inert gas atmosphere except as further specified herein.
- (1) Stress relief holding temperature shall be 1000 to 1100 °F. Holding time for stress relief shall be 0.5 hr/in of wall thickness but no less than 20 minutes.
 - (2) Annealing temperature and holding time shall be in accordance with SAE-AMS-H-81200.
 - (3) Cooling rate equivalent to air cooling is required for all heat treatments.
 - (4) Cooling to 800 °F shall be in a vacuum or inert gas atmosphere except as further specified here. Air cooling below 800 °F is acceptable.
 - (5) Where approved by the purchaser, cooling to 800 °F and heating may be performed in other atmospheres allowed by SAE-AMS-H-81200 provided that:
 - (a) All contamination is removed as required therein, and
 - (b) At least 0.015" of material is removed from all surfaces unless otherwise approved by the purchaser, and
 - (c) The cleaning requirements of SAE-AMS-H-81200 and ASTM B600 shall be met as a minimum
- g. Final analysis for hydrogen shall be performed in accordance with SAE-AMS-H-81200 after completion of all heat treatment and chemical processing involving hydrogen evolution.
- h. Except for castings, metallographic examination for surface contamination shall be performed in accordance with SAE-AMS-H-81200 after all heat treatments and chemical removal processing, and shall assure absence of any oxygen rich layer such as alpha case. Castings shall be free of oxygen rich layers on all surfaces unless it will be removed by subsequent machining and is specifically allowed by the purchaser. Metallographic testing of castings is not required.
- i. Fittings fabricated by welding shall be as follows: There shall be no more than two longitudinal welds. Miter joints and tees fabricated by intersecting pipes are not permitted. Intersecting welds are not permitted. Welds shall be full penetration; and permanent backing strips are not permitted. Weld reinforcement shall not exceed $\frac{1}{16}$ inch on the inside or outside surfaces.
- j. Welding procedures and welders for seam welded pipe and fabricated fittings shall be in accordance with ASME Boiler and Pressure Vessel Code Section IX or S9074-AQ-GIB-010/248.
- k. Prior to welding, the Government will have accepted the welding procedure qualification data, the welding procedure, and the color acceptance criteria for welds along with the manufacturer's requirements for (1) assuring acceptable inert gas dew point at the welding torch, (2) tooling and cleaning used for ID and OD weld joint surfaces, (3) color discrimination testing for welders and visual inspectors, and (4) filler material cleaning.
- l. Pipe welded by United States titanium mills is exempt from the requirement of 4.44.5.k.
 - m. Materials are intended for, and shall be suitable for, welded applications and also bending for piping.
 - n. For castings the following shall apply:
 - (1) The following Supplemental Requirements of ASTM B367 shall apply: S-3 Examination of Weld Preparation (except visual inspection at 5X magnification shall be used in lieu of dye penetrant), S6 Tension Test, and S8 Hardness Test. If tensile specimens are removed from a separately cast test block, then test block dimensions shall be large enough to accurately represent the actual casting in accordance with good industry practice.
 - (2) Repair welding shall be performed with welding procedures and welding personnel conforming to 4.44.5.j and k.
 - (3) If multiple castings and limited foundry experience exists, the sample casting requirement of S9074-AR-GIB-010/278 Section 12 shall apply.

MIL-STD-777F(SH)
W/CHANGE 2

o. Titanium materials shall be supplied with a copy of the dated manufacturer's certificate verifying the lot of material has been produced, inspected, and tested in accordance with the requirements of the cited industry specifications and the requirements of this document, and shall include the actual results of the chemical analysis, mechanical property tests, hardness tests, metallographic examination, and non-destructive test inspections performed, as well as any rejectable results and re-test results. For castings, repair weld liquid penetrant inspection results, and the location and size of any repair weld exceeding 20 percent of the casting wall thickness shall be provided.

4.44.6 Non destructive testing of grade 2 titanium material for class P-2 piping. The following requirements shall be met in addition to the requirements of the governing material specification.

a. Six inches of one random fabrication weld in each welded fitting shall be radiographically inspected according to UW-52 of ASME Boiler and Pressure Vessel Code Section VIII Division 1, or to S9074-AR-GIB-010/278 and Class 2 criteria. Any reject shall require this same radiographic inspection of the entire length of both welds in the fitting, and any repair welds.

b. Seam welded titanium pipe shall be radiographically inspected in accordance with supplemental requirement S1.2.2 of ASTM B862.

c. All welds (each pass and the final weld OD and ID surface), including casting repair welds, shall be of a shiny, silvery color in the as-deposited condition. Other conditions shall cause rejection of the entire weld except that welds inspected in accordance with and conforming to the color requirements of S9074-AR-GIB-010/278 are also acceptable.

d. Completed welds shall also meet the visual inspection acceptance criteria of MIL-STD-2035, Class 2, or ASME B31.1, or equivalent standard.

e. For castings, surfaces shall be free of defects exceeding MSS SP-55. In addition ASTM B367 Supplemental Requirement S2 Liquid Penetrant Examination shall apply to accessible casting surfaces and any repair welds. Acceptance criteria shall be as follows:

(1) Repair welds shall be free of linear dye penetrant indications greater than $\frac{1}{16}$ inch.

(2) Casting surfaces shall meet the acceptance criteria of MIL-STD-2035 for casting linear indications as follows: Class 1 for wall thicknesses less than 1 inch; Class 2 for wall thicknesses 1 inch to 3 inches; Class 3 for thicknesses over 3 inches.

4.45 Marking. Marking of piping components shall be in accordance with MIL-STD-792.

4.46 Mechanically attached fittings (MAFs). Limited approvals for specific MAF types and compositions have been granted, but only for use in certain ship compartments and piping systems, as identified in the tables of this document and further constrained by usage restrictions identified in S9086-RK-STM-010, Chapter 505. MAFs are not permitted in applications where socket-welds are not allowed due to crevice corrosion. MAFs shall not be used to replace a pipe bend. MAFs shall not be installed closer than one pipe diameter or $\frac{3}{4}$ inch, whichever is larger, to an adjacent fitting (such as an elbow, tee, reducer, or other MAF) due to the adverse effects on piping stress and flexibility. MAFs for consideration shall be compliant with ASTM F1387, including the supplementary requirements in whole. MAFs previously subjected to testing are identified in S9086-RK-STM-010, Chapter 505. Only approved MAFs that have passed fire test requirements of ASTM F1387 shall be used where fire-hardened fittings are required (see 4.14.1) or in systems that do not allow silver-brazed fittings. Except for training purposes, there are no joint record requirements for currently approved MAFs.

MIL-STD-777F(SH)
W/CHANGE 2

4.47 Press-connect fittings. A press-connect fitting is a fitting that utilizes mechanical deformation of the pipe, tube, fitting, or a combination thereof around an O-ring, which creates a seal. Press-connect fittings are limited to a maximum allowable working pressure of 300 psi. Material, quality control, and performance requirements for press-connect fittings suitable for use on U.S. Navy Combatants shall be in accordance with commercial specification ASTM F3226/F3226M. The usage of press-connect fittings is limited to that identified in the tables of this document. Press-connect fittings are not allowed in fire-hardened, shock-hardened, or critical systems. The pipe system designer shall consider the effects a press-connect fitting will have on the stress, flexibility, and fatigue life of a piping system and shall incorporate supports and space constraint requirements that suit the arrangement and negate the effects of differential motions and vibrations. Further, press-connect fittings are susceptible to piping misalignment and activities that employ press-connect fittings shall ensure their installation is accomplished by a trained mechanic using an approved installation procedure.

4.48 Belled-end fittings and slip-on couplings. Belled-end fittings in accordance with Manufacturer's Standardization Society (MSS) SP-119, with the exception of couplings, are approved for systems defined by S9074-AR-GIB-010/278 as P-2 piping. Requirements and limitations for the fabrication, installation, welding, and system analysis are defined in S9AA0-AB-GOS-010, Section 505. Use of couplings to MSS SP-119 is approved based on mandatory supplemental and installation requirements defined in S9AA0-AB-GOS-010, Section 505.

4.49 Commercial item requirements. Use of special or commercial items not covered by this schedule 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 Government.

4.49.1 Commercial plumbing material. For piping designed and routed in accordance with applicable ship specifications, commercial plumbing fittings, excluding PVC, are permitted downstream of a piping cutout valve in washrooms and in plumbing applications in spaces serviced by deck drains. Fittings shall be in accordance with ASME A112.18, or as approved.

4.50 Relief valves.

4.50.1 MIL-DTL-20065 relief valves. MIL-DTL-20065 relief valves shall be modified as follows:

a. In table I for discs and seat rings in columns for compositions A, B, and D, change "ASTM A276" to read "ASTM A276 or ASTM A479/A479M."

4.50.2 MIL-V-24332 relief valves. MIL-V-24332 relief valves shall be modified as follows:

a. In table I for discs, seat rings, and stems in columns for Grades A and B, change "ASTM A276" to read "ASTM A276 or ASTM A479/A479M."

b. Gaskets to be in accordance with system categories specified herein.

4.51 Stainless steel piping. Where ASTM A312/A312M is identified as an alternative to MIL-P-24691, the intergranular corrosion and flattening tests of MIL-P-24691/3 are invoked. Where stainless piping is specified, minimum thickness shall be Sch 10S.

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

5. DETAILED REQUIREMENTS

5.1 Service categories and groups. Detailed requirements for piping systems are provided herein in tables arranged by service category and piping system groups. 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, 180 °F, hydraulic service) of Category G (hydraulics).

5.2 Using the tables. For each service category and group, the reference to maximum systems 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.

MIL-STD-777F(SH)
W/CHANGE 2

5.3 Category and group listing. The list below identifies the category and group combinations whose requirements are tabulated in this standard. Where requirements are specified for a single category and group, they shall apply to all of the category/groups within that combined group.

Category and group	Service
A-1	Steam and steam drains, 1500 psig/1000 °F
A-2	Steam and steam drains, 1500 psig/775 °F
A-3	Propulsion plant saturated steam and steam drains, 600 to 1500 psig/775 °F
A-4 and A-7	Steam and steam drains, 600 psig/875 °F
A-5	Steam and steam drains, 600 psig/775 °F
A-6	Steam and steam drains, 150 psig/775 °F
A-8	Steam and steam drains for auxiliary boiler, reboiler, and waste heat boiler installation only, 150 psig/366 °F (sat)
A-9	Steam system overboard discharge, steam generator blowdown, 1500/600 psig/650 °F
A-10	High pressure steam drains between low point trap, drain strainer orifice/orifice plate assembly discharge stop-check valve and DFT or gland exhaust piping from turbines, discharge main, 100 psig/425 °F
B-1	Feed systems, 600 psig, 400 °F; 1200 psig, 475 °F
B-2	Propulsion plant saturated feed system, 600 to 2050 psig/300 °F
C-1 and C-2	Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown, 200 psig/250 °F
C-2	Freshwater, feed water and condensate, including potable, gas turbine washdown, 100 psig/250 °F
C-3	Glass-reinforced plastic (GRP), 200 psig/150 °F
C-4	Water mist fire fighting, 1500 psig/140 °F
C-5	High purity water, 150 psig/140 °F
D-1 and D-3	Seawater, including firemain, main and secondary drainage, ballast, 250 psig/150 °F
D-2	Seawater missile injection system between freshwater accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer, 400 psig/150 °F
D-4	Chlorinated seawater piping for fouling prevention of heat exchangers
E-2, E-3 and U-1	Fuel service, transfer, and stripping, 600 psig
E-4 and U-1	Fuel service, transfer, and stripping, 200 psig
F-1	Lubricating oil, 150 psig/250 °F
G-1, G-3, G-4, and G-5	Hydraulic service, 3000 psig, 180 °F
G-2, G-6, and G-7	Low pressure hydraulic (including lines), 400 psig/180 °F
G-8	Hydraulic service, 6000 psig/200 °F
H-1	Gasoline, 150 psig/150 °F
H-2	Cleaning fluid and contaminated aviation lubricating system, 100 psig/150 °F
I-1	JP-5 fuel service, filling transfer, tank stripping, and auxiliary JP-5, 200 psig/100 °F
J-1 and J-2	Air, nitrogen and helium, 6000 psig/150 °F

MIL-STD-777F(SH)
W/CHANGE 2

Category and group	Service
J-3	Air and nitrogen, 600 psig/150 °F
J-4	Air and nitrogen, 200 psig/150 °F
J-5	Air, and bleed-off, 150 psig/550 °F
J-6	Air, gas turbine starting and prairie masker, 150 psig/450 °F
J-7	Air, prairie-masker, gas turbine starting, 100 psig/600 °F
J-8	Air deballast, 50 psig/400 °F
J-9	Air, gas turbine bleed, anti-icing, 300 psig/950 °F
K-1	Gaseous oxygen, outside hull, 4500 psig/150 °F
K-2	Gaseous oxygen, inside hull, 4500 psig/ambient
K-3	Gaseous oxygen, 100 psig/ambient
K-4	Liquid oxygen and nitrogen, 6000 psig
K-5	Liquid oxygen and nitrogen, 250 psig
K-6	Mixed gas, 4500 psig/150 °F
K-7	Propane, 200 psig
L-1	Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution, 150 psig/200 °F
M-1	Seawater-washdown countermeasure system, 200 psig/100 °F
N-1	Sprinkling system (dry) other than AFFF and magazine, 175 psig/100 °F
N-2	Magazine sprinkling system (wet and dry), 175 psig
N-3	Miscellaneous seawater sprinkling systems (sprinkling other than AFFF, magazine, and countermeasure washdown), 175 psig
O-1	Diesel, incinerator, and gas turbine exhaust, and sewage treatment, 1200 °F
O-2	Diesel exhaust, subject to salt water spray for IR suppression, 850 °F
P-1	Boiler safety valve and super-heater outlet safety valve escape, 150 psig/850 °F
P-2	Nuclear steam generator escape piping to transition joint, 150 psig/350 °F
P-3	Nuclear steam generator escape piping - transition to overboard, 150 psig/350 °F
Q-1	Refrigerant piping, 30 inches vacuum to 300 psig/minus 85 °F to plus 250 °F
R-1	Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains, 50 psig/150 °F
R-2	Chemical drains, 30 psig/150 °F
R-3	Plumbing drains and vents, interior space deck drains and AC condensate drains, 50 psig/150 °F
R-4	Sewage collection, holding, and transfer (CHT) and vacuum collection, holding, and transfer (VCHT), 100 psig/150 °F
S-1	Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 psig
T-2	HFP and Halon 1301 fire extinguishing systems, 1170 psig/140 °F
T-3	CO2 actuation for HFP and Halon fire extinguishing systems, 2080 psig/200 °F
U-1	See Categories E-2, E-3, or E-4
Y-1 and Y-2	Overflows, sounding tubes, vents and air escapes for JP-5, fuel, lubricating oil, oily tanks, 100 psig/150 °F
Y-3	Overflows, sounding tubes, vents, and air escapes for other than fuel tanks [freshwater (except

MIL-STD-777F(SH)
W/CHANGE 2

Category and group	Service
	potable) clean ballast, voids, etc.], 50 psig/150 °F
Y-4	Vents, reduction gear, 5 psig/ambient

TABLE V. Category A-1, Steam and steam drains, 1500 psig/1000 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-1	Steam and steam drains	1500	1000	See 4.39 See note A-1-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Chrome molybdenum alloy steel	ASTM A335/A335M, Grade P11 MIL-P-24691/2, Grade P11	See 4.41
Valves	Globe/angle stop and stop-check, ¼ to 2 NPS	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11, or ASTM A217/A217M, Grade WC-6	803-5184193	Socket-weld ends
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	Butt-weld ends
	Swing/lift-check		Commercial	See note A-1-2
	Gate, 2½ NPS and above		MIL-V-18110	See note A-1-1
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
Fittings	Butt-welding	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11, or ASTM A234/A234M, Grade WP-11	ASME B16.9	
	Socket-welding		ASME B16.11	
	Socket-welding laterals		MS18307	
Take-down joints	Flanges, butt- and socket-welding	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength studs	Alloy steel	MIL-DTL-1222, Grade B16	See 4.16
	Nuts	Alloy steel	MIL-DTL-1222, Grade 7H, heavy hex	

NOTES:

A-1-1 Flexible wedge and parallel disc gate valves, with stems located below the horizontal, in steam systems, shall have a drain connected to the lowest practical point of the body neck cavity, except that, where a valve is to be used with flow in one direction, a ¼-inch hole may be drilled in the upstream side of the disc in lieu of a drain.

A-1-2 Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.

TABLE VI. Category A-2, Steam and steam drains, 1500 psig/775 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-2	Steam and steam drains	1500	775	See 4.39 See note A-2-1
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B MIL-P-24691/1, Grade B	See 4.41
Valves	Globe/angle stop, stop-check, lift-check and throttle, ¼ to 2 NPS	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M	803-2177525	Butt- or socket-weld ends ASME B16.34, Class 900
			Commercial	ASME B16.34, Class 1500 See note A-2-3
	MIL-V-22052		Butt-weld ends	
	Commercial		See note A-2-3	
	MIL-V-18110		See note A-2-2	
	MIL-DTL-20065		Flanged ends only	
	MIL-V-17848			
	MIL-V-18030			
Fittings	Butt-welding	Carbon steel, ASTM A105/A105M, ASTM A234/A234M, Class WPB	ASME B16.9	
	Socket-welding		ASME B16.11	
	Socket-welding laterals		MS18307	See note A-2-4
Take-down joints	Flanges, butt- and socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength stud	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nuts		ASTM A194/A194M, Grade 4 or 7	
NOTES:				
A-2-1 Drain nipples shall be schedule 80 pipe thickness.				
A-2-2 Flexible wedge and parallel disc gate valves, with stems located below the horizontal in steam systems, shall have a drain connected to the lowest practical point of the body neck cavity, except that, where a valve is to be used with the flow in one direction, a ¼-inch hole may be drilled in the upstream side of the disc in lieu of a drain.				
A-2-3 Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.				
A-2-4 Fabricated from carbon steel material.				

TABLE VII. Category A-3, Propulsion plant saturated steam and steam drains, 600 to 1500 psig/775 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-3	Propulsion plant saturated steam and steam drains	600 to 1500	775	See 4.39 See note A-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B MIL-P-24691/1, Grade B	See 4.41
Valves	Gate, 2½ NPS and above	Carbon steel, ASTM A105/A105M, or ASTM A216/A216M, Grade WCB	MIL-V-18110	Butt-weld ends See note A-3-2
	5 to 16 NPS		803-2177518	
	Globe/angle stop, stop-check, lift-check and throttle, ¼ to 2 NPS		803-2177525	Socket- or butt-weld ends ASME B16.34, Class 900
	2½ NPS globe		803-2177140	Butt-weld ends
	3 and 4 NPS globe		803-2177141	Butt-weld ends ASME B16.34, Class 900
	5 and 6 NPS globe		803-2177142	
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	Butt-weld ends
	3-way bypass, ½ to 1 NPS		803-1385965	Socket- or butt-weld ends
	Swing-check		Commercial	See note A-3-5
	Control		MIL-V-18030	Flanged
	Relief		MIL-DTL-20065	
	Pressure-reducing		MIL-V-17848	
				See note A-3-4

TABLE VII. Category A-3, Propulsion plant saturated steam and steam drains, 600 to 1500 psig/775 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Flanged	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M	ASME B16.5	
	Butt-welding	Carbon steel, ASTM A234/A234M, Class WPB	ASME B16.9	
	Socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.11	
	Socket-welding laterals		MS18307	
Take-down joints	Flanges, butt- and socket-welding		ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength stud	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nut		ASTM A194/A194M, Grade 4 or 7	
NOTES:				
A-3-1	This category excludes high pressure steam drain main between each low point trap or drain strainer orifice/orifice plate assembly stop-check valve and the deaerator feed tank (DFT), which shall be in accordance with Category A-10 herein.			
A-3-2	Flexible wedge and parallel disc gate valves, in steam systems, shall have a drain connected to the lowest practical point of the body neck cavity, except that, where a valve is to be used with the flow in one direction, a ¼-inch hole may be drilled in the upstream side of the disc in lieu of a drain.			
A-3-3	Fabricated from carbon steel material.			
A-3-4	Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.			

TABLE VIII. Category A-4 and A-7, Steam and steam drains, 600 psig/875 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-4 and A-7	Steam and steam drains	600	875	See 4.39
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Chrome molybdenum alloy steel	MIL-P-24691/2 ASTM A335/A335M, Grade P-11	See 4.41
Valves	Gate, 2½ NPS and above	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11, or ASTM A217/A217M, Grade WC-6	MIL-V-18110	See note A-4-1
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	Butt-weld ends
	Globe/angle stop-check, ¼ to 2 NPS		803-5184193	Socket-weld ends
	Lift/swing-check		MIL-DTL-18436	300 psig max. at 850 °F max.
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
	Relief		MIL-DTL-20065	
Fittings	Socket-welding	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11	ASME B16.11	
	Butt-welding	ASTM A234/A234M, Grade WP-11	ASME B16.9	
	Flanged	ASTM A182/A182M, Grade F-11, ASTM A217/A217M WC-6	ASME B16.5	
	Socket-welding laterals	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11	MS18307	
Take-down joints	Flanges, butt- and socket-welding	Chrome molybdenum alloy steel, ASTM A182/A182M, Grade F-11	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	

TABLE VIII. Category A-4 and A-7, Steam and steam drains, 600 psig/875 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flange bolting	Constant strength stud	Alloy steel	MIL-DTL-1222 Grade B16 ASTM A193/A193M, Grade B16	See 4.16 See note A-4-3
	Nuts		MIL-DTL-1222, Grade 7H, ASTM A194/A194M, Grade 7H heavy hex	
NOTES:				
A-4-1	Flexible wedge and parallel disc gate valves, with stems located below the horizontal in steam systems, shall have a drain connected to the lowest practical point of the body neck cavity, except that, where a valve is to be used with the flow in one direction, a ¼-inch hole may be drilled in the upstream side of the disc in lieu of a drain.			
A-4-2	Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.			
A-4-3	MIL-DTL-1222 used for Level I applications.			

TABLE IX. Category A-5, Steam and steam drains, 600 psig/775 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-5	Steam and steam drains	600	775	See 4.39 See note A-5-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Grade B ASTM A106/A106M, Grade B	See 4.41
Valves	Globe/angle, stop-check, lift-check and throttle, ¼ to 2 NPS	Carbon steel, ASTM A216/A216M, Grade WCB, ASTM A105/A105M	803-2177525	Socket-weld ends
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	Butt-weld ends
	Gate, 2½ NPS and above		MIL-V-18110	See note A-5-2
	Swing-check		MIL-DTL-18436	300 psig max. at 850 °F max.
	Pressure-reducing		Commercial	See note A-5-4
	Relief		MIL-V-17848	Flanged ends only
	Control		MIL-DTL-20065	
				MIL-V-18030
Fittings	Flanged	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M	ASME B16.5	
	Butt-welding	Carbon steel, ASTM A234/A234M, Class WPB, ASTM A105/A105M	ASME B16.9	
	Socket-welding lateral		ASME B16.11	
			MS18307	See note A-5-3
Take-down joints	Flanges, butt- and socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	

TABLE IX. Category A-5, Steam and steam drains, 600 psig/775 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flange bolting	Constant strength stud	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nut		ASTM A194/A194M, Grade 4 or 7	
NOTES:				
A-5-1 Drain nipples shall be schedule 80 pipe thickness.				
A-5-2 Flexible wedge and parallel disc gate valves, with stems located below the horizontal in steam systems, shall have a drain connected to the lowest practical point of the body neck cavity, except that, where a valve is to be used with the flow in one direction, ¼-inch hole may be drilled in the upstream side of the disc in lieu of a drain.				
A-5-3 Fabricated from carbon steel material ASTM A105/A105M.				
A-5-4 Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.				

TABLE X. Category A-6, Steam and steam drains, 150 psig/775 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-6	Steam and steam drains	150	775	See notes A-6-1 and A-6-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Grade B ASTM A106/A106M, Grade B	See 4.41
Valves	Gate, 2½ NPS and above	Carbon steel, ASTM A105/A105M, or ASTM A216/A216M, Grade WCB	MIL-V-18110	Butt-weld ends
	Globe/angle/Y-pattern stop-check, 2½ NPS and above		MIL-V-22052	
	Globe/angle stop-check, lift-check and throttle, ¼ to 2 NPS		803-2177525	
	Lift-check		MIL-DTL-18436	See note A-6-3
	Swing-check		MIL-DTL-18436	
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
	Relief		MIL-DTL-20065	
	Temperature regulating			MIL-DTL-19772, Type IV
Fittings	Flanged	Carbon steel, ASTM A105/A105M, or ASTM A216/A216M, Grade WCB	ASME B16.5	See note A-6-4
	Socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.11	
	Socket-welding lateral		MS18307	See note A-6-5
	Butt-welding	ASTM A234/A234M, Class WPB	ASME B16.9	

TABLE X. Category A-6, Steam and steam drains, 150 psig/775 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges, butt- and socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.5	See note A-6-4
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
	Sheet	Non-asbestos	MIL-DTL-24696, Type I	Grafoil GHR® or equal See note A-6-4
Flange bolting	Constant strength stud	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nuts		ASTM A194/A194M, Grade 4 or 7	
NOTES:				
A-6-1 The basic ANSI rating for 150 psig series components is 150 psig at 500 °F.				
A-6-2 Drain nipples shall be schedule 80 pipe thickness.				
A-6-3 Lift-check valves may be constructed similar to MIL-V-22052 modified for check design.				
A-6-4 Flat face flanges and sheet gaskets may be used for temperatures up to 425 °F.				
A-6-5 Fabricated from carbon steel material.				

TABLE XI. Category A-8, Steam and steam drains for auxiliary boiler, reboiler, and waste heat boiler installation only, 150 psig/366 °F (sat).

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-8	Steam and steam drains for auxiliary boiler, reboiler, and waste heat boiler installation only	150	366 (Sat. temp.)	See notes A-8-1, A-8-3, and A-8-5

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel (90-10)	MIL-T-16420	
Valves	Gate, 2½ NPS and above	Bronze	803-2177917	
	Gate, ¼ to 2 NPS		803-1385714	
	Globe/angle stop and stop-check, 2½ NPS and above		803-1385541	See note A-8-2
	Globe Y-pattern, stop and stop-check, 2½ NPS and above		803-1385623	
	Globe/angle stop, stop-check, and needle, ¼ to 2 NPS		803-4384536	
	Control		MIL-V-18030	
	Relief		MIL-DTL-20065	
	Pressure-reducing		MIL-V-17848	
	Check, -¼ NPS and above		MIL-V-17547	
	Check, 2½ NPS and above		803-1385637	
	Swing-check, ¼ to 2 NPS		803-1385721	
Fittings	Socket-welded	Copper-nickel (90-10)	803-6397430	
	Welding		810-1385880	150 °F max.
	Bulkhead/deck		803-1385866	
	MAFs	Various	ASTM F1387	See 4.46

TABLE XI. Category A-8, Steam and steam drains for auxiliary boiler, reboiler, and waste heat boiler installation only, 150 psig/366 °F (sat) - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges, welded	Copper-nickel	803-6983512	See note A-8-4
	Union end, socket-weld tailpiece assy		803-7063850	
	Unions, socket-welded		Commercial	
Gaskets	Sheet	Non-asbestos reinforced graphite sheet	MIL-DTL-24696, Type I	Grafoil GHR® or equal
Flange bolting	Bolts, screws, and studs	Nickel-copper-aluminum	MIL-DTL-1222, Grade 500	See 4.16 See note A-8-6, A-8-7
	Nuts	Nickel-copper	ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
<p>NOTES:</p> <p>A-8-1 For other boiler installations, use other applicable category.</p> <p>A-8-2 100 psig maximum.</p> <p>A-8-3 Use Category A-6 for superheated steam application.</p> <p>A-8-4 Commercial items not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.</p> <p>A-8-5 System pressure is gauge pressure.</p> <p>A-8-6 Evaluate torque limits where Grade 500 used on tapped bronze flanges and on bronze material.</p> <p>A-8-7 NASM 25027/NASM 17828 limited to 250 °F; MIL-DTL-32258 limited to 450 °F.</p>				

TABLE XII. Category A-9, Steam system overboard discharge, steam generator blowdown, 1500/600 psig/650 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-9	Steam system overboard discharge, steam generator blowdown	1500/600	650	See 4.39 See note A-9-2
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Nickel-copper	MIL-T-1368, Class A	Schedule 80 min.
Valves	Globe/angle stop, stop-check, lift-check and throttle, ¼ to 2 NPS	Nickel-copper	803-2177525	See note A-9-1
			Commercial	
			DOD-V-24675	1½ NPS
Fittings	Socket-welding	Nickel-copper, QQ-N-281, Class A, annealed	ASME B16.11, bored as required	See note A-9-3
	Butt-welding	Nickel-copper, MIL-T-1368, Class A	ASME B16.9	
	Socket-welding laterals	Nickel-copper, QQ-N-281	MS18307	
	Socket-welding outlets	Nickel-copper, QQ-N-281, Class A, annealed	Commercial	
	Butt-welding outlets			
Take-down joints	Flanges socket-welding, ¼ and ⅜ NPS	Nickel-copper, QQ-N-281, Class A, annealed	Commercial	¼", raised face
			MS18308	See note A-9-3 and A-9-4
	Flanges, butt- and socket-welding, ½ NPS and above		ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	Class C

TABLE XII. Category A-9, Steam system overboard discharge, steam generator blowdown, 1500/600 psig/650 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flange bolting	Bolts, screws, or bolt-stud	Nickel-copper aluminum	MIL-DTL-1222, Grade 500	See 4.16 See note A-9-5
	Nuts	Nickel-copper	ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
A-9-1	If higher pressure ratings are needed than specified on the valve drawing, commercial valves shall be used. Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.			
A-9-2	Does not include boiler pressure piping.			
A-9-3	Fabricated from nickel-copper alloy material.			
A-9-4	Where MS18308 is used to procure nickel-copper alloy flanges, the pressure ratings for these flanges must be suitably reduced to account for their lower strength compared to steel flanges. Conservatively, these flanges should not be used above 720 psig at room temperature or above 535 psig at 650 °F.			
A-9-5	NASM 25027/NASM 17828 limited to 250 °F; MIL-DTL-32258 limited to 450 °F.			

TABLE XIII. Category A-10, High pressure steam drains between low point trap, drain strainer orifice/orifice plate assembly discharge stop-check valve and DFT or gland exhaust piping from turbines, discharge main, 100 psig/425 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
A-10	High pressure steam drains between low point trap, drain strainer orifice/orifice plate assembly discharge stop-check valve and DFT or gland exhaust piping from turbines, discharge main	100	425	See note A-10-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	CRES, 304L or 316L	MIL-P-24691/3 ASTM A269/A269M ASTM A312/A312M	See 4.51
	Seamless	Nickel-copper	MIL-T-1368, Class A	
Valves	Gate, 2½ NPS and above	CRES, ASTM A182/A182M, Grade F304L, F316L, ASTM A351/A351M CF3 or CF3M	MIL-V-18110	
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above	CRES, ASTM A182/A182M, Grade F304L, F316L, ASTM A351/A351M CF3 or CF3M	MIL-V-22052	See note A-10-3, A-10-4
	Globe/angle stop, stop-check, life check and throttle, ¼ to 2 NPS	Corrosion resisting steel, ASTM A182/A182M, F316	803-2177525	
	Relief	Nickel-copper, QQ-N-281	MIL-DTL-20065	See note A-10-2

TABLE XIII. Category A-10, High pressure steam drains between low point trap, drain strainer orifice/orifice plate assembly discharge stop-check valve and DFT or gland exhaust piping from turbines, discharge main, 100 psig/425 °F - Continued.

Item	Types	Material	Applicable documents	Remarks	
Fittings	Socket-welding	CRES in accordance with ASTM A182/A182M, Grade F304L, F316L	ASME B16.11		
	Butt-welding	ASTM A403/A403M, Class WP304L-S, WP316L-S	ASME B16.9		
	Butt-welding	Nickel-copper, QQ-N-281	ASME B16.9		See note A-10-2
	Socket-welding		ASME B16.11		
	Socket-welding laterals		MS18307		
		MAFs	Various		ASTM F1387
Take-down joints	Flanges, butt- and socket-welding	CRES, ASTM A182/A182M, Grade F316L or F304L Nickel-copper, QQ-N-281	ASME B16.5		
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716		
Flange bolting	Bolts, screws, studs	Nickel-copper aluminum	MIL-DTL-1222, Grade 500	See 4.16 See note A-10-5	
	Nuts	Nickel-copper	ASTM F467, Alloy 400		
	Nuts, self-locking		NASM 25027/NASM 17828 MIL-DTL-32258		
<p>NOTES:</p> <p>A-10-1 This category applies to drains covered in Category A-3 only. For drains in systems other than Category A-3, see the applicable category.</p> <p>A-10-2 Fabricated from nickel-copper alloy material.</p> <p>A-10-3 Fabricated from stainless steel alloy material.</p> <p>A-10-4 Valve internal trim as approved.</p> <p>A-10-5 NASM 25027/NASM 17828 limited to 250 °F.</p>					

TABLE XIV. Category B-1, Feed systems, 600 psig, 400 °F; 1200 psig, 475 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
B-1	Feed systems	600 maximum boilers 1200 boilers	400 475	See 4.39 See notes B-1-1 thru B-1-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Gr B or ASTM A106/A106M, Grade B	
Valves (see note B-1-3)	Globe, angle stop, stop-check, throttle and lift-check, ¼ to 2 NPS	Carbon steel, ASTM A105/A105M, or ASTM A216/A216M, Grade WCB	Commercial	Socket-welded ends only See note B-1-4
			803-2177525	Socket- or butt-welded ends ASME B16.34, Class 900
	2½ NPS globe		803-2177140	
	3, 4 NPS globe		803-2177141	
	5, 6 NPS globe		803-2177142	
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	
	Gate, -2½ NPS and above		MIL-V-18110	
	Gate, 5" through 16"		803-2177518	See note B-1-5
	Relief		MIL-V-24332 or MIL-DTL-20065	Flanged ends only
	Control		MIL-V-18030	Flanged ends only
	Check	Commercial	See note B-1-4, B-1-6	
	3-way bypass	803-1385965		

TABLE XIV. Category B-1, Feed systems, 600 psig, 400 °F; 1200 psig, 475 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Butt-welding	Carbon steel, ASTM A105/A105M, or ASTM A234/A234M, Class WPB	ASME B16.9	
	Socket-welding		ASME B16.11	
	Socket-welding end branch outlets		Commercial	
	Butt-weld end branch outlets			
	MAFs	Various	ASTM F1387	See 4.46
Take down joints	Flanges, butt- and socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.5	See note B-1-3
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
	Sheet	Rubber	MIL-R-21252	
Flange bolting	Studs, screws, and bolts	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	

NOTES:

- B-1-1 In view of the exceptionally high relief valve setting in the boiler's feed system, which if used for selection of pressure series, might result in a heavier series than necessary, this category specifies the required series for both 600 and below and 1200 psig boiler.
- B-1-2 The 400/475 °F temperature applies only to that section of the feed system between the economizer and the steam drum. Refer to Category B-2 for feed system piping component requirements upstream of economizer.
- B-1-3 Valves and flanges of 600 psig and below boilers shall be ASME B16.34/B16.5, Class 600. Valves and flanges for 1200 psig boilers shall be ASME B16.34/B16.5, Class 900, except for valves 2 NPS and below which shall be ASME B16.34/B16.5, Class 1500.
- B-1-4 Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.
- B-1-5 Wedge disc gate valves in the catapult steam drain system may also be provided under the requirements of MIL-V-18110.
- B-1-6 Lift-check valves installed between the outlet of the economizer on a boiler and the steam drum must be modified in accordance with MIL-B-18381 by drilling a 1/8" hole in the valve bridge.

TABLE XV. Category B-2, Propulsion plant saturated feed system, 600 to 2050 psig/300 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
B-2	Propulsion plant saturated feed system	600 to 2050	300	See 4.39 See note B-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B MIL-P-24691/1, Grade B	
Valves	Gate, 2½ NPS and above	Carbon steel, ASTM A105/A105M, or ASTM A216/A216M, Grade WCB	MIL-V-18110	Butt-weld ends
	Gate, 5 to 16 NPS		803-2177518	Butt-weld ends ASME B16.34, Class 900 max.
	Globe/angle stop, stop-check, throttle and lift-check, ¼ to 2 NPS		803-2177525	Socket- or butt-weld ends ASME B16.34, Class 900 max.
	2½ NPS globe		803-2177140	Butt-weld ends ASME B16.34, Class 1500
	3 and 4 NPS globe		803-2177141	Butt-weld ends ASME B16.34, Class 900 See note B-2-2
	5 and 6 NPS globe		803-2177142	
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052	Flanged or butt-weld ends
	Relief		MIL-V-24332	Flanged ends
	Control		MIL-V-18030	
	Swing-check		Commercial	See note B-2-3
Fittings	Butt-welding	Carbon steel, ASTM A105/A105M, or ASTM A234/A234M, Class WPB	ASME B16.9	
	Socket-welding		ASME B16.11	
	Socket-welding end branch outlets		Commercial	
	Butt-welding end branch outlets			
	MAFs	Various	ASTM F1387	See 4.46

TABLE XV. Category B-2, Propulsion plant saturated feed system, 600 to 2050 psig/300 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges, socket or butt-welding	Carbon steel, ASTM A105/A105M	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength stud	Carbon steel	MIL-DTL-1222, Grade 5	See 4.16
	Nuts		MIL-DTL-1222, Grade 5	
NOTES:				
B-2-1	To be used in conjunction with Category A-3 steam system only. Feed systems for use with other Category A steam systems shall be in accordance with Category B-1.			
B-2-2	Valves and flanges for 600 psig and below boilers shall be ASME B16.34/B16.5, Class 600. Valves and flanges for 1200 psig boilers shall be ASME B16.34/B16.5, Class 900, except for valves 2 NPS and below, which may be ASME B16.34/B16.5, Class 900 or 1500, depending upon system operating pressure.			
B-2-3	Commercial valves not in accordance with DoD-adopted non-Government standards shall be approved by NAVSEA.			

TABLE XVI. Category C-1 and C-2, Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown, 200 psig/250 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-1 and C-2	Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown	200	250	See notes C-1-6 to C-1-14, 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch min. wall thickness (see note C-1-1)
		GRP	MIL-P-24608	See 4.43
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Gate, ¼ to 2 NPS	Bronze or copper-nickel	803-1385714	Union ends only
	Gate, 2½ to 12 NPS		803-2177917	Flanged ends only
	Globe/angle stop/stop-check, ¼ to 2 NPS		803-4384536	Union ends only See note C-1-2
	Globe Y-pattern, 2½ to 10 NPS		803-1385623	Flanged ends only
	Globe/angle check and stop-check, 2½ NPS and larger		803-1385541	100 psig max. Flanged ends only
	Swing-check, ¼ to 2 NPS		803-1385721	Union ends only
	Swing-check, 2½ to 12 NPS		803-1385637	Flanged ends only
	Swing-check, ¼ NPS and above	Bronze, Nickel-aluminum-bronze or copper-nickel	MIL-V-17547	
	Relief	Bronze or copper-nickel	MIL-V-24332	
	Butterfly	Nickel-aluminum-bronze or copper-nickel	MIL-V-24624	Special flanges required
	Control	Bronze (nickel-copper trim or 300-series CRES trim) or copper-nickel	MIL-V-18030	100 psig max. Flanged ends only
	Pressure-reducing	Bronze or copper-nickel	ASTM F1370 including supplements	See 4.42

TABLE XVI. Category C-1 and C-2, Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown, 200 psig/250 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Valves - continued	Ball, ¼ to 2½ NPS	Bronze	803-5001003	Bronze body with bronze, copper-nickel end piece
		Copper-nickel		Copper-nickel body with copper-nickel end piece
	Ball, 3 to 6 NPS	Bronze or copper-nickel	803-5001004	6-NPS valve is butt-welded only
Fittings	Silver brazing		MIL-DTL-1183	
	Butt-welding	Copper-nickel (90-10)	810-1385880	150 °F max.
	Welded base by silver brazing end outlet boss	Copper-nickel (90-10 or 70-30)	803-1385950 or commercial	Welded to copper-nickel pipe run
	Socket-welding	Copper-nickel	803-6397430	
	Belled end and couplings	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48
	Socket (bonded)	GRP	MIL-P-24608	
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Silver brazing unions	Bronze	MIL-DTL-1183	
	Socket-welding flanges	Copper-nickel	803-6983512	
	Silver-brazed flanges	Bronze	MIL-PRF-20042, Class plain, 150 and 250 pounds	See notes C-1-3, C-1-4
			803-1385892	Special flanges or butterfly valves, 180 °F max.
	Socket-bonded flanges	GRP	MIL-P-24608	See 4.43, notes C-1-5, C-1-6
Gaskets	Sheet	Non-asbestos	MIL-DTL-24696, Type II	Preferred gasket for butterfly valves
		Nylon inserted rubber	804-5284201, Types 1, 2, or 4	See 4.26 as approved
		EPDM	MIL-DTL-22050	See note C-1-12
	O-ring	Fluorocarbon	SAE-AMS7276	

TABLE XVI. Category C-1 and C-2, Freshwater, including feed, chilled water, condensate, electronic freshwater cooling, potable, freshwater firefighting, and gas turbine washdown, 200 psig/250 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
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 ½ 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	150-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	Restricted from heated potable water system. Applicable pressure/temperature rating points are 200 psig at 150 °F and 100 psig at 200 °F.			
C-1-6	Electronic freshwater 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-1-7	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-1-8	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-1-9	Expansion tank valves subject to air pressure shall be soft-seated.			
C-1-10	The sample connection between the DFT and the sample water cooler shall be CRES composition 304L in accordance with MIL-P-24691/3, Grade 304L or ASTM A312/A312M, TP304L. Connection to be as close to DFT as possible.			
C-1-11	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.			
C-1-12	Gaskets used in potable water shall be 804-5284201, Type 1 or EPDM. Materials selected for use in steam condensate systems shall be tested for leachable chlorides not to exceed 200 ppm.			
C-1-13	GRP piping shall not be used for freshwater fire fighting.			
C-1-14	Firemain piping and any source piping or fittings shall be welded for sizes 2 NPS and above. Sizes 1½ NPS and below may be welded or brazed.			

TABLE XVII. Category C-2, Freshwater, feed water and condensate, including potable, gas turbine washdown, 100 psig/250 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-2	Freshwater, feed water and condensate, including potable, gas turbine washdown	100	250	See notes C-2-1 to C-2-4, C-2-9

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch max. wall thickness
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
	Seamless	GRP	MIL-P-24608	150 °F max. (see note C-2-5)
Valves	Globe, angle, and globe stop-check, ¼ to 2 NPS	Bronze	803-4384536	See note C-2-3
	Swing-check		803-1385721 MIL-V-17547 803-1385637	
	Gate, ¼ to 2 NPS		803-1385714	Union ends
	Globe, angle, globe stop-check, and angle stop-check		803-1385541	Flanged ends only 100 psig max. 150 °F max.
	Butterfly		MIL-V-24624	
	Gate, 2½ to 12 NPS		803-2177917	Flanged ends
	Relief		MIL-V-24332	
	Control		MIL-V-18030	
	Ball, ½ to 2½"		803-5001003	
	Ball, 3 to 6"		803-5001004	

TABLE XVII. Category C-2, Freshwater, feed water and condensate, including potable, gas turbine washdown, 100 psig/250 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Flanged		810-1385915	
	Butt-welding	Copper-nickel (90-10)	810-1385880	
	Welded base by silver brazing end outlet boss	Copper-nickel (90-10 or 70-30)	803-1385950	Welded to copper-nickel pipe run
	Socket-welded		803-6397430	
	Belled end and couplings	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48
	Socket-bonded	GRP	MIL-P-24608	150 °F max. See note C-2-5
Flanges	Silver brazing	Bronze	MIL-PRF-20042, Class plain	
			803-1385892	Special flanges for butterfly valves
	Welded	Copper-nickel	803-6983512	
	Socket-bonded	GRP	MIL-P-24608	See note C-2-5
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Type 1, 2, or 4, as approved	See note C-2-6 See 4.26
		EPDM	MIL-DTL-22050	See note C-2-3
	O-ring	Fluorocarbon	SAE-AMS7276	
Flange bolting	Bolts, screws, and studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
C-2-1	The thickness of copper tubing in condensate piping shall be calculated using allowable stresses for the fully annealed condition.			
C-2-2	The sample connection between the DFT and the sample water cooler shall be CRES composition 304L in accordance with MIL-P-24691/3. Connection to be as close to DFT as possible.			
C-2-3	Gaskets used in potable water shall be 804-5284201, Type 1 or EPDM. Materials selected for use in steam condensate systems shall be tested for leachable chlorides not to exceed 200 ppm.			
C-2-4	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.			
C-2-5	Installation and joining of GRP shall be in accordance with Category C-3.			
C-2-6	Where temperature is expected to exceed 200 °F, 804-5284201, Type 4 shall be specified.			

TABLE XVII. Category C-2, Freshwater, feed water and condensate, including potable, gas turbine washdown, 100 psig/250 °F - Continued.

NOTES (continued):

- C-2-7 Electronic freshwater cooling system and 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" and 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-2-8 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-2-9 See Category C-1 notes and design requirements.

TABLE XVIII. Category C-3, Glass-reinforced plastic (GRP), 200 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-3	Glass-reinforced plastic (GRP)	200	150 See 4.43	GRP shall be utilized when system specifications require its use See note C-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Glass-reinforced thermosetting epoxy resin	MIL-P-24608	See 4.43
Valves	Ball	GRP	803-6983491	As approved See note C-3-2
Fittings	Socket-bonded	Glass-reinforced thermosetting epoxy resin	MIL-P-24608	See note C-3-3
Take-down joints	Flanged	Glass-reinforced thermosetting epoxy resin	MIL-P-24608	See note C-3-3
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Types 1, 2, or 4, as approved	See 4.26
Flange bolting	Bolts, studs, screws	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

NOTES:

- C-3-1 This category applies where GRP piping, fittings, and take-down joints may be used as an alternative to non-ferrous materials for the systems specified.
- C-3-2 Valves shall be flanged end in accordance with associated system categories.
- C-3-3 Adhesive in accordance with MIL-P-24608 shall be used for joining GRP fittings and flanges.

TABLE XIX. Category C-4, Water mist fire fighting, 1500 psig/140 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-4	Water mist fire fighting	1500	140	See 4.14, 4.39, notes C-4-4 thru C-4-6

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	As approved		See note C-4-2 and 4.51
Valves	Gate	As approved	MIL-V-18110 or as approved	Flanged ends See note C-4-1
	Globe, angle, 2½ NPS and above		MIL-V-22052 or as approved	
	Globe/angle check and stop-check, ¼ to 2 NPS	As approved	803-2177525	Flanged valves limited too ASME B16.34, Class 600 rating
	Swing-check	As approved	As approved	
	Relief	As approved	MIL-V-24332 ASTM F1508 including supplemental requirements and appendix as approved	
	Globe	As approved	Combination Pump Valve Co., Catalog 68 (series), or equal, or MIL-V-24109 or 803-6397247	
	Lift-check (soft seat design)		Commercial	Union end, socket-welding
	Butterfly	As approved	MIL-V-24624	Limited to ASME B16.34, Class 150 rating. See note C-4-3
	Ball, 2½" and below	As approved	MIL-V-22687	

TABLE XIX. Category C-4, Water mist fire fighting, 1500 psig/140 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Socket-welding	As approved	ANSI B16.11	
	Butt-welding	As approved	ANSI B16.9	
Take-down joints	Flanges, weldneck	As approved	ASME B16.5	
	Flanges, socket-welding			
	Unions	As approved	803-1385884	
Gaskets	Sheet	Composite	MIL-DTL-24696, Type II	
	O-ring	Fluorocarbon	SAE-AMS7259	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
NOTES:				
C-4-1 MIL-V-22052 used for design guidance but modified for approved material.				
C-4-2 Seam welded pipe shall not be used in P-1 class piping.				
C-4-3 Keystone Valve USA, Inc., K-LOK High Performance Butterfly Valve, ANSI Class 150, with manual worm gear type actuator and actuator handwheel as an alternative.				
C-4-4 Use of socket-welds limited to sections of systems not subject to crevice corrosion.				
C-4-5 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.				
C-4-6 Material for piping and components to be as specifically approved. Component specifications listed must be reviewed for modifications to approved material.				

TABLE XX. Category C-5, High purity water, 150 psig/140 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
C-5	High purity water	150	140	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES 304L or 316L	MIL-P-24691/3, ASTM A312/A312M, Grade Type 304L	Schedule 10S, see 4.51
Valves	Gate, 2½" & below	CRES, ASTM A351/A351M, Grade CF-8/CF-8M	Commercial, Powell Fig. 2491 316 SST or equal	
	Globe, 2½" and below	CRES ASTM A351/A351M, Grade CF-8/CF-8M	Commercial, Powell Fig. 2475TD 3166 SST or equal	
	Swing-check	CRES ASTM A351/A351M, Grade CF-8/CF-8M	Commercial, Powell Fig. 2342(F.E.) 3166 SST or equal	
Fittings	Socket-welding	CRES, ASTM A182/A182M, F304L	ANSI B16.11	
Take-down joints	Flanges, socket-welding	CRES, ASTM A182/A182M, F304L	ASME B16.5	
Gaskets	Sheet	Rubber	As approved	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

TABLE XXI. Category D-1 and D-3, Seawater, including firemain, main and secondary drainage, ballast, 250 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
D-1 and D-3	Seawater, including firemain, main and secondary drainage, ballast	250	150	See 4.14 and D-1-11

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10 or 70-30)	MIL-T-16420	See notes D-1-3, D-1-4 and D-1-6
	Seamless	GRP	MIL-P-24608	200 psig max. See note D-1-2, D-1-9, D-1-10 See 4.43
Valves	Globe/angle stop/stop-check, 2½ NPS and above	Bronze	803-1385541	Flanged ends only 100 psig max.
	Globe Y-pattern, 2½ to 10 NPS		803-1385623	Flanged ends only
	Globe/angle check and stop-check, ¼ to 2 NPS		803-4384536	Union ends only
	Gate, 2½ NPS and above		MIL-V-1189 803-2177917	Flanged ends only
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Swing-check, 2½ to 12 NPS		803-1385637	Flanged ends only
	Swing-check, 2½ NPS and above	Bronze, Nickel-aluminum-bronze	MIL-V-17547, Type A, Class 2, 250	
	Swing-check, ¼ to 2 NPS	Bronze	803-1385721	Union ends only
	Relief	Bronze	MIL-V-24332	Flanged or union ends
	Remote control			140 deg max.
	Pressure-reducing		ASTM F1370 including supplements	Copper-nickel trim IAW UNS N05500 See 4.42
	Control check, diaphragm actuated		MIL-V-17501, Type I, Class 4	Flanged ends

TABLE XXI. Category D-1 and D-3, Seawater, including firemain, main and secondary drainage, ballast, 250 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks	
Valves - continued	Globe, hose end	Bronze	803-1385711		
			803-1385712		
	Ball, ¼ to 2½ NPS	Bronze	803-5001003		Bronze body with bronze, copper-nickel end piece
				Copper-nickel	
	Ball, 3 to 6 NPS	Bronze	803-5001004		6-NPS valve is butt-welded only
	Ball, 1¼ to 8 NPS		MIL-V-24509		150 psi max. See note D-1-7
	Butterfly	Nickel-aluminum-bronze	MIL-V-24624		Special flanges required 200 psig max. (see 4.7, 4.30)
MIL-PRF-32307				See 4.7, 4.30	
Fittings	Silver brazing	Bronze	MIL-DTL-1183		
	Butt-welding	Copper-nickel (90-10 or 70-30)	810-1385880	200 psig max.	
	Socket-welding		803-6397430		
	Welded base by silver brazing end outlet boss		803-1385950 or commercial	Welded to copper-nickel pipe run	
	Belled end	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48	
	Socket-bonded	GRP	MIL-P-24608	200 psig max. (see note D-1-2, D-1-9)	
	MAFs	Various	ASTM F1387	See 4.42	
Take-down joints	Silver brazing flanges	Bronze	MIL-PRF-20042		
			803-1385892	Special flanges for butterfly valves, 200 psig max.	
	Socket-bonded flanges	GRP	MIL-P-24608	200 psig max. (see note D-1-2, D-1-9)	
	Welding flanges	Copper-nickel	810-1385992		
803-6983512					

TABLE XXI. Category D-1 and D-3, Seawater, including firemain, main and secondary drainage, ballast, 250 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints - continued	Slip-on flanges, 12 NPS and above	Copper-nickel (90-10)	Commercial 803-6983512	50 psig max. See notes D-1-5 and D-1-6
	Silver brazing unions	Bronze	MIL-DTL-1183	
	Union end tailpiece assy	Bronze, Copper-nickel	803-7063850	For union end valves
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Types 1 or 2, as approved	See 4.26, note D-1-8
		Synthetic rubber	MIL-R-21252	See note D-1-1
		Non-asbestos	MIL-DTL-24696, Type II	Preferred gasket for butterfly valves
	O-ring	Fluorocarbon	SAE-AMS7276	
Flange bolting	Bolts, screws, and studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
D-1-1	For use in piping systems subject to acid flush paths.			
D-1-2	Adhesive in accordance with MIL-P-24608 shall be used for joining GRP pipe to GRP fittings and flanges.			
D-1-3	For sizes not covered by MIL-T-16420, pipe fabricated from copper-nickel sheet specified in MIL-C-15726 may be used for pressures up to 50 psig.			
D-1-4	70-30 copper-nickel alloy shall be used inside compensated fuel tanks, and 90-10 alloy shall be used elsewhere.			
D-1-5	Slip-on flanges shall be bored to suit outside diameter of the tube with flange thickness, drilling, and facing in accordance with 50 psig class of MIL-PRF-20042.			
D-1-6	Piping from discharge flange of fire pump to first flange of pump discharge check valve shall be 70-30 copper-nickel alloy.			
D-1-7	MIL-V-24509 ball valves designed, tested, and NAVSEA-approved for a maximum pressure rating above 150 psig may be used in systems having a design pressure not exceeding the valve's approved maximum pressure rating.			
D-1-8	For suction sea chest steam out connections 804-5284201, Types 3 or 4, AMS-G-6855, or MIL-DTL-22050 should be used.			
D-1-9	For GRP piping installation see Category C-3.			
D-1-10	GRP shall not be used in firemain piping or as any source piping or fittings to the firemain.			
D-1-11	Firemain piping and any source piping or fittings shall be welded for sizes 2 NPS and above. Sizes 1½ NPS and below may be welded or brazed.			

TABLE XXII. Category D-2, Seawater missile injection system between freshwater accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer, 400 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
D-2	Seawater missile injection system between freshwater accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer	400	150	See 4.39

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (70-30)	MIL-T-16420, Class 700	
Valves	Gate, 2½ NPS and above	Bronze	MIL-V-1189	Flanged ends Class 3 max.
			803-2177917	250 psig max.
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS		803-4384536	Union ends only
	Globe, Y-pattern, 2½ to 10 NPS		803-1385623	Flanged ends only See note D-2-1
	Globe/angle stop and stop-check, 2½ NPS and above		803-1385541	
	Relief		MIL-V-24332	
	Ball, ¼ to 2½ NPS		803-5001003	Bronze body with bronze, nickel-copper, or copper-nickel end piece
			Copper-nickel	Copper-nickel body with copper-nickel end piece
Control diaphragm check	Bronze	MIL-V-17501		
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Butt-welding	Copper-nickel (70-30)	MIL-F-24202	
	MAFs	Various	ASTM F1387	See 4.46

TABLE XXII. Category D-2, Seawater missile injection system between freshwater accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer, 400 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Silver brazing flanges	Bronze	MIL-PRF-20042	
	Butt and socket-welding flanges	Copper-nickel (70-30)	ASME B16.5, Class 400	Flat face See note D-2-2
			803-6983512	
	Silver brazing unions	Bronze	MIL-DTL-1183	
	Union end tailpiece	Bronze Copper-nickel	803-7063850	For union end valves
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Type 2	See 4.26 as approved
Flange bolting	Bolts, screws, and studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
<p>NOTES:</p> <p>D-2-1 100 psig maximum for 803-1385541; 250 psig maximum for 803-1385623. 2½ NPS and above globe and angle, stop, and stop-check valves for use in systems exceeding these limits shall be of commercial design as approved by NAVSEA.</p> <p>D-2-2 ASME B16.5 modified for copper-nickel material</p>				

TABLE XXIII. Category D-4, Chlorinated seawater piping for fouling prevention of heat exchangers.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
D-4	Chlorinated seawater piping for fouling prevention of heat exchangers	250 psi	150	This category of material shall be used when specifically required in system specifications. See 4.19.1, 4.44.

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Titanium	ASTM B861 or ASTM B862, Grade 2	Schedule 10 min. See notes D-4-1 and D-4-12
Valves	Gate	Bronze	803-2177917	Flanged See notes D-4-2 and D-4-12
			MIL-V-1189	Flanged See note D-4-2
	Gate, 2 NPS and below	Bronze or titanium	803-1385714	Union end See notes D-4-3 and D-4-5
	Globe, stop-check, 2½ NPS and above	Bronze	803-1385623 803-1385541	Flanged See notes D-4-2, D-4-4, and D-4-12
			803-4384536	Union end See notes D-4-3, D-4-5, and D-4-6
	Globe and angle stop and stop-check, 2 NPS and below			
Relief	Bronze or titanium	ASTM F1508, including supplementary requirements and the appendix	Flanged or union end See notes D-4-2, D-4-3, D-4-5, and D-4-6	

TABLE XXIII. Chlorinated seawater piping for fouling prevention of heat exchangers - Continued.

Item	Types	Material	Applicable documents	Remarks
Valves - continued	Ball	Bronze	MIL-V-24509	150 psi max. See notes D-4-2 and D-4-7
	Check, 2 NPS max.	Bronze or titanium	803-1385721	Union end. See notes D-4-3, D-4-5, and D-4-6
	Ball	Titanium	803-5001003 and 803-5001004	Socket-welding ends. See note D-4-9
	Ball, ½ NPS to 10 NPS	Reinforced thermosetting resin (RTR)	803-6983491	Installs between titanium ASME B16.5 flanges. See notes D-4-10 and D-4-11
	Swing-check, 2½ NPS and above	Bronze	803-1385637	NPS 2½ to 12 NPS See notes D-4-2 and D-4-12
			MIL-V-17547, Type A, Class 2	Over 12 NPS See note D-4-2
	Butterfly		Keystone Valve USA, Inc., K-LOK High Performance Butterfly Valve, ASME B16.5 Class 150, with manual worm gear type actuator and actuator handwheel or equal or MIL-V-24624	See note D-4-2
	Triple-offset torque seated butterfly		MIL-PRF-32307	
Fittings	Butt-welding	Titanium ASTM B363, Grade WPT2	ASME B16.9	
	Socket-welding	Titanium ASTM B381, Grade F-2	ASME B16.11	
	Socket-welding, belled-end, 12 NPS max.	Titanium, ASTM B861 or ASTM B862, Grade 2	MSS SP-119	See 4.48

TABLE XXIII. Chlorinated seawater piping for fouling prevention of heat exchangers - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flange, butt-welding	Titanium, ASTM B381, Grade F-2	ASME B16.5	See note D-4-2
	Flange, socket and butt-welding		810-1385992	See note D-4-2 Modified material to mate with valves
			803-6983512	
	Unions, welding end, 2 NPS max.	Titanium, ASTM B381, Grade F-2	Commercial	
Gaskets	Electrical isolation			See 4.44
	O-ring	Fluorocarbon	SAE-AMS7276	
	Sheet gasket	Nylon inserted rubber	804-5284201, Types 1 or 2	See 4.26, as approved
Flange bolting	Bolts, screws, and studs	Nickel alloy	MIL-DTL-1222, Grade 400 or 405	See 4.16
	Nuts		MIL-DTL-1222, Grade 400 or 405	
	Nuts, self-locking		NASM 25027/NASM 17828	
		MIL-DTL-32258		
	Bolts, screws, and studs	Titanium	ASTM F468, Alloy Ti 23	
	Nuts		ASTM F467, Alloy Ti 23	
	Electrical isolation washers and sleeves			See 4.44

TABLE XXIII. Chlorinated seawater piping for fouling prevention of heat exchangers - Continued.

NOTES:

- D-4-1 Firemain piping shall be at least Schedule 10 in high fire hazard compartments (see 4.14.1). Heavier schedule piping may be used as necessary.
- D-4-2 Flange and gasket bolt holes, for flanges used with titanium pipe, may be drilled to a hole diameter sufficient to accept the bolt isolators and still maintain required clearances.
- D-4-3 Union end valves and flanged valves shall be constructed of titanium, ASTM B367, Grade C2, or ASTM B381, Grade F-2. The valve design shall ensure that any non-titanium parts do not result in a galvanic interface.
- D-4-4 100 psi globe and angle valves shall be used in systems not exceeding 150 psi, provided the valves pass the seat tightness test to 150 psi and strength and porosity test to 200 psi.
- D-4-5 Valves in potable water disinfection (sodium hypochlorite) system shall be titanium
- D-4-6 Bronze union end valves shall be limited to applications where titanium union end valves are not available and a flanged or welding end ball valve cannot be used for the application. Bronze union end valves shall be installed with inlet and outlet spool pieces. Each spool piece shall be installed with inlet and outlet spool pieces. Each spool piece shall be a copper-nickel Flagg-Flow, or equal, dimensioned and drilled, in accordance with ASME B16.24, flange. 70-30 copper-nickel pipe length shall be limited to that necessary for attaching end connections.
- D-4-7 MIL-V-24509 ball valves designed, tested, and NAVSEA-approved for a maximum pressure rating above 150 psi may be used in systems having a design pressure not exceeding the valve's approved maximum pressure rating.
- D-4-8 Flanges shall be in accordance with ASME B16.5 for mating to ASME B16.5 flanges, equipment supplied with ANSI flanges, and to copper-nickel fittings dimensioned and drilled in accordance with ASME B16.24.
- D-4-9 Ball valves shall be constructed of titanium, ASTM B367, Grade C2, or ASTM B381, Grade F-2. The valve design shall ensure that any non-titanium parts do not result in a galvanic interface. Level 1 requirements shall not be applicable.
- D-4-10 Flange gaskets shall be nylon inserted rubber in accordance with 804-5284201, as approved. Isolation sleeves and washers are still required with these gaskets.
- D-4-11 Valves may be used only in non-throttling applications. Valves shall not be used as hull cutout valves.
- D-4-12 In all sizes 12 inches and less, schedule 10S pipe is an acceptable substitution for schedule 10 pipe.

TABLE XXIV. Category E-2, E-3 and U-1, Fuel service, transfer, and stripping, 600 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
E-2, E-3 and U-1	Fuel service, transfer, and stripping	600	220	See 4.14, 4.39, and notes E-2-1 and E-2-2
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B MIL-P-24691/1, Grade B	See 4.41
Valves	Gate	Carbon steel, ASTM A216/A216M, Grade WCB, ASTM A105/A105M	MIL-V-18110	
	Globe, angle		MIL-V-22052	2½" and larger
	Check		803-2177525	2" and smaller
	Control		Commercial	Flanged ends, ASME B16.5 See 4.49
	Relief		MIL-V-18030	Flanged ends only
	Needle, vent, drain and sampling		MIL-V-24332	Flanged ends only
	Ball, ¼" to 2½"		MIL-V-24586	200 °F max.
	Butterfly	Carbon steel, ASTM A181/A181M, Class 70	803-5001003	
Fittings	Flanged	CRES	MIL-V-24624	Type I, See note E-2-3
	Socket-welded	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M	ASME B16.5	
	Butt-welded	Carbon steel, ASTM A105/A105M	ASME B16.11	
Flanges	Socket-welding	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M	ASME B16.9	
	Butt-welding			ASME B16.5
Gaskets	Hybrid		MIL-PRF-32187	See 4.26, 4.42, note E-2-4
			Commercial	
	Spiral wound		Metallic-flexible graphite	MIL-G-24716
Flange bolting	Bolts, screws, and studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	

TABLE XXIV. Category E-2, E-3 and U-1, Fuel service, transfer, and stripping, 600 psig - Continued.

NOTES:

- E-2-1 This category does not include fuel overflows, sounding tubes, vents, or air escapes (see Category Y for these items).
- E-2-2 This category includes cargo fuel and cargo oil systems.
- E-2-3 Pressure limited to ASME B16.34 pressure/temperature rating.
- E-2-4 Use of approved fire-hardened hybrid gaskets outside pressure rating of MIL-PRF-32187.
- E-2-5 Spiral wound gaskets used where approved fire-hardened hybrids are not available.

TABLE XXV. Category E-4 and U-1, Fuel service, transfer, and stripping, 200 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
E-4 and U-1	Fuel service, transfer, and stripping	200	220	See 4.14 and note E-4-1

Item	Types	Material	Applicable documents	Remarks
Pipe (within tank containing seawater)	Seamless	Copper-nickel (70-30)	MIL-T-16420, Class 200	
Pipe	Seamless	CRES	MIL-P-24691/3 or ASTM A312/A312M, Ty 316L, 304L	See 4.51, note E-4-4
Valves	Gate	CRES, ASTM A351/A351M, Grade CF-3 or CF-3M; ASTM A182/A182M, 316L or 304L	MIL-V-18110	Stellite disc See E-4-2
	Globe, angle	CRES, ASTM A351/A351M, Grade CF-3 or CF-3M; ASTM A182/A182M, 316L or 304L	MIL-V-22052	2½" and larger See E-4-3
		ASTM A182/A182M, F316	803-2177525	2" and smaller
	Check		Commercial	Flanged ends, ASME B16.5 See 4.49
	Control	CRES, ASTM A351/A351M, Grade CF-8M	MIL-V-18030	Flanged ends only
	Relief		MIL-V-24332	
	Needle	ASTM A182/A182M (F316) or ASTM A743/A743M (CF-8M)	MIL-V-24586	200 °F max.
	Ball, ¼" to 2½"	CRES	803-5001003	
Butterfly	CRES	MIL-V-24624	Type I	

TABLE XXV. Category E-4 and U-1, Fuel service, transfer, and stripping, 200 psig - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Flanged	CRES, ASTM A182/A182M, 304L or 316L	ASME B16.5	
	Socket-welding		ASME B16.11	
	Belled end and couplings	ASTM A312/A312M, TP304L or 316L	MSS SP-119	See 4.48
	Butt-welding	CRES, ASTM A403/A403M, WP304L-S, WP316L-S	ASME B16.9	
Flanges	Butt-welding	CRES, ASTM A182/A182M, 304L or 316L	ASME B16.5	Flat faced if mating to non-ferrous flanges
	Socket-welding			
	Welding	Copper-nickel (70-30)	803-6983512	Modified See E-4-5
Gaskets	Hybrid		MIL-PRF-32187	See 4.26
Flange bolting	Bolts, screws, and studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
NOTES:				
E-4-1 This category does not include fuel overflows, sounding tubes, vents, or air escapes (see Category Y for these items).				
E-4-2 ASTM A182/A182M, F304L and 316L are preferred alloys for new valve qualification.				
E-4-3 Modified for CRES construction. Valve internal trim components as approved.				
E-4-4 Only Ty 316L is to be used in bilge region.				
E-4-5 For mating to ferrous flanges, copper-nickel flanges shall be flat-faced and meet ASME B16.5 bolt pattern and surface finish.				

TABLE XXVI. Category F-1, Lubricating oil, 150 psig/250 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
F-1	Lubricating oil	150	250	See 4.14, notes F-1-1 and F-1-3

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Grade B, ASTM A106/A106M, Grade A or B		
		CRES	MIL-P-24691/3, ASTM A312/A312M, 316L, or 304L	CRES to be used for new construction, see note F-1-3 and 4.51	
Valves	Globe/angle stop, stop-check, throttle and lift-check, ¼ to 2 NPS	Carbon steel, ASTM A216/A216M, Grade WCB, or ASTM A105/A105M CRES steel, ASTM A182/A182M, F304L or F316L ASTM A351/A351M, Grade CF-3/CF-3M	803-2177525	Socket-weld ends 2" max.; butt-weld ends 1¼" min. Flanged ASME B16.5, 600#	
	Globe/angle and Y-pattern stop and stop-check, 2½ NPS and above		MIL-V-22052		
	Gate, 2½ NPS and above		MIL-V-18110		
	Check		ASME B16.34, Class 150 MIL-DTL-18436	Flanged end	
	Relief		MIL-V-24332	Flanged ends only	
	Control		MIL-V-18030		
			Commercial	Electronically controlled; approved by NAVSEA	
	Pressure-reducing		Commercial	See note F-1-2	
	Butterfly		MIL-V-24624	Type I	
	Needle, ¼ to ½ NPS, vent, drain and sampling		MIL-V-24586	Socket-weld only 200 °F max.	
	Ball, ¼ to 2½ NPS		Carbon steel/stainless steel	803-5001003	

TABLE XXVI. Category F-1, Lubricating oil, 150 psig/250 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Flanged, ½ NPS and above	Carbon steel, ASTM A216/A216M, Grade WCB	ASME B16.5, series 150	
	Socket-weld	Carbon steel, ASTM A105/A105M or CRES, ASTM A182/A182M, F304L or 316L	ASME B16.11	
	Butt-weld	Carbon steel, ASTM A234/A234M, WCB, CRES ASTM A403/A403M WP304L-S or WP316L-S	ASME B16.9	
	Belled end and couplings	ASTM A312/A312M, TP304L or 316L	MSS SP-119	See 4.48
	Socket-welding end branch outlets	Carbon steel or CRES, ASTM A105/A105M or ASTM A234/A234M, WCB, ASTM A182/A182M, F304L or 316L	MSS SP-97 or as approved	
	Butt-welding end branch outlets			
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Socket-weld flanges, ¼ and ⅜ NPS	Carbon steel, ASTM A105/A105M, or ASTM A234/A234M, Class WPB CRES steel, ASTM A182/A182M, F304L, or F316L	As approved	⅛" raised face
	Butt- and socket-weld flanges, ½ NPS and above		ASME B16.5	

TABLE XXVI. Category F-1, Lubricating oil, 150 psig/250 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Gaskets	Hybrid		MIL-PRF-32187	See 4.26
	Sheet	Non-asbestos	MIL-DTL-24696, Type II	For butterfly valve flange joints
	O-ring	Fluorocarbon	SAE-AMS7276	
Flange bolting	Bolts, screws, and studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
<p>NOTES:</p> <p>F-1-1 New ship designs referring to this specification shall be CRES.</p> <p>F-1-2 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.</p> <p>F-1-3 Where the applicable valve specifications do not include stainless steel as a material choice, the specification design requirements shall be modified to fabricate the valve from stainless steel, subject to NAVSEA approval.</p>				

TABLE XXVII. Category G-1, G-3, G-4, and G-5. Hydraulic service, 3000 psig, 180 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
G-1, G-3, G-4, and G-5	Hydraulic service	3000	180	See 4.14, 4.39 See notes G-1-1 through G-1-4, G-1-9

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Grade B or ASTM A106/A106M, Grade B	
		Copper-nickel (70-30)	MIL-T-16420	
		CRES	MIL-P-24691/3 or ASTM A312/A312M, 316L or 304L	See 4.51
			ASTM A213/A213M, Ty 304L or 316L	See note G-1-8
	Welded and drawn	Corrosion and heat resistant steel, 21Cr-6Ni-9Mn	SAE-AMS5561	Use in weight critical areas only
Valves	Globe/ angle stop and stop-check, ¼ to 2 NPS	Alloy steel	803-5184193	1500# ASME B16.34 rating
		Carbon steel or CRES	803-2177525	Limited to ASME B16.34 600# rating for flanged, 900# socket or butt-welded
	Globe, angle	Nickel-aluminum bronze	803-6397247	
		Aluminum bronze	MIL-V-24109	
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above	Carbon steel or CRES	MIL-V-22052 (mod if CRES)	
	Gate, 2½ NPS and above	Steel or CRES	MIL-V-18110	
Control-special (includes directional flow control, pressure control)	Carbon steel, ASTM A216/A216M, Grade WCB, ASTM A105/A105M, Aluminum alloy 6061-T6, Nickel-aluminum-bronze, Corrosion resisting steel, Bronze	Commercial	See note G-1-7	

TABLE XXVII. Category G-1, G-3, G-4, and G-5, Hydraulic service, 3000 psig, 180 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Valves - continued	Ball	CRES, bronze or aluminum bronze	MIL-V-22687	
	Check	As qualified	MIL-DTL-24630/1 803-6397247	
	Vent and test	Nickel-copper	MIL-DTL-24695	
	Sample and bleed	Aluminum bronze, CRES	MIL-DTL-81940/4	
	Relief		Commercial MIL-DTL-20065 MIL-V-85245/1 MIL-V-85245/2	See note G-1-7 MS33649 end connections
Fittings	Butt-weld	Carbon steel/CRES, ASTM A234/A234M, Class WPB, ASTM A403/A403M WP304L-S, WP316L-S, Copper-nickel, MIL-C-15726	ASME B16.9	1¼ inch min.
	Socket-weld	Carbon steel, ASTM A105/A105M, CRES, ASTM A182/A182M, F316L or F304L, Copper-nickel, MIL-C-15726	ASME B16.11	2 inch max.
	O-ring connector	CRES	SAE-J24714	
	MAFs	Various	ASTM F1387	See 4.45
Take-down joints	Flanges, butt- or socket-weld Flanged welding neck	CRES, ASTM A182/A182M, F304L or F316L Copper-nickel, MIL-C-15726 Carbon steel, ASTM A105/A105M	ASME B16.5	1¼ inch min. (butt-weld) 2 inch max. (socket-weld)
	Unions, butt- or socket-weld	CRES, ASTM A182/A182M, F304L or F316L, MIL-C-15726	803-1385884 810-1385888	

TABLE XXVII. Category G-1, G-3, G-4, and G-5, Hydraulic service, 3000 psig, 180 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints - continued	Unions, adapter tailpiece for O-ring sealed unions	CRES, ASTM A182/A182M, F304L or F316L, copper-nickel, MIL-C-15726, carbon steel, ASTM A105/A105M	Commercial	See G-1-7
	Union welding	Carbon steel, ASTM A105/A105M	NAWC Drawing A404734	See note G-1-12
	Flanges, 4-bolt square	Corrosion resisting steel nickel-copper	MIL-DTL-24704	
	Flange, 4-bolt split	Carbon steel	SAE-J518-1 and SAE-J518-2	2 NPS max. See G-1-11
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	See note G-1-10, 4.26
	Hybrid	Fluorocarbon seal	MIL-PRF-32187	
	O-ring	Fluorocarbon	SAE-AMS7276	
Flange bolting	Bolt and studs	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nuts		ASTM A194/A194M, Grade 4 or 7	
	Bolt, screws, and studs	Nickel-copper-aluminum/ nickel-copper	MIL-DTL-1222, Grade 500, ASTM F468, Grade 400	
	Nuts		ASTM F467, Grade 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
	NOTES:			
G-1-1	Hydraulic piping and fittings which are located in water or on weather decks or other locations where they are or may be exposed to the weather shall be CRES or copper-nickel.			

TABLE XXVII. Category G-1, G-3, G-4, and G-5, Hydraulic service, 3000 psig, 180 °F - Continued.

NOTES (continued):

G-1-2 Unless otherwise permitted by applicable specifications, the design pressure for determining the wall thickness of the pipe and the selection of fittings shall be the sum of the operating pressure and the hydraulic surge pressure. The hydraulic surge pressure shall include such factors as rapid valve opening and closing, overhauling loads, suddenly applied loads, and relief valve response time. The hydraulic surge pressure requirement may be relaxed if it can be definitely ascertained that the maximum fluid velocity for a particular size pipe will be lower than 30 feet per second (ft/s), in such cases the maximum velocity determined to be present for the pipe size in question shall be used as a basis for determining the hydraulic surge pressure and maximum total pressure to be used in calculating pipe wall thickness. Hydraulic surge pressure is to be determined by the following formula:

$$s = 70V$$

Where:

Ps = Pressure increase due to shock psig

V = Velocity of liquid flow in the pipe before valve closure (feet per second) use V = 30 ft/s

G-1-3 Socket-welded construction shall be limited to service applications expected to see less than 100,000 cycles where the magnitude of the pressure variation exceeds 2000 psi.

G-1-4 For carbon steel piping, unions of carbon steel, ASTM A105/A105M may be used, provided the material for the union nut is nickel-copper alloy in accordance with QQ-N-286 or CRES in accordance with ASTM A276/A276M, Type 304 or 316.

G-1-5 Where ANSI flanges modified for O-rings are employed, they shall be flat face, grooved, and equipped with standard O-ring gaskets with back-up rings suitable for the service.

G-1-6 All joints shall be welded or MAFs, except where take-down joints are required.

G-1-7 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.

G-1-8 Tubing is permitted to facilitate use of NAVSEA-approved hydraulic fittings sized for tube vice pipe.

G-1-9 Valves and components limited by pressure-temperature rating of the design drawing or specification for the component.

G-1-10 Hybrid gaskets shall have specific approval for application and pressure rating.

G-1-11 This flange subject to NAVSEA approval

G-1-12 Where unions to NAWC Drawing A404734 are used, the material for the union nut shall be nickel-copper alloy in accordance with QQ-N-281

TABLE XXVIII. Category G-2, G-6, and G-7, Low pressure hydraulic (including lines), 400 psig/180 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
G-2, G-6, and G-7	Low pressure hydraulic (including lines)	400	180	See 4.14, 4.39 See notes G-2-1 through G-2-7

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B or MIL-P-24691/1, Grade B	
		CRES, TP 304L or 316L	MIL-P-24691/3 ASTM A312/A312M	See 4.51
		Copper-nickel	MIL-T-16420	
Valves	Gate, 2½ NPS and above	Steel	MIL-V-18110	
		Bronze	803-2177917	
	Gate, 2 NPS and below	Bronze	803-1385714	
		Globe/angle stop, stop-check, throttle and lift-check, ¼ to 2 NPS	Bronze	803-4384536
	Globe/angle/Y-pattern stop and stop-check, 2½ NPS and above	Steel	803-2177525	
		Bronze	803-1385623	
	Check	Bronze	MIL-V-17547 803-1385637 803-1385721	
		Bronze and steel	MIL-DTL-18436	
	Stop-check, 2½ NPS and larger	Steel	MIL-V-22052	
	Relief	CRES, Ni-Cu	MIL-V-24694/1 MIL-V-24694/2	
Ball, ¼ to 2½ NPS	Bronze, corrosion-resting steel, carbon steel	803-5001003		

TABLE XXVIII. Category G-2, G-6, and G-7, Low pressure hydraulic (including lines) 400 psig/180 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Butt-weld	Carbon steel, ASTM A105/A105M, ASTM A106/A106M, Grade B, ASTM A234/A234M, Grade WPB, CRES, ASTM A403/A403M WP304L-S or WP316L-S, Copper-nickel, MIL-C-15726	ASME B16.9	1/4" min. See 4.10
	Socket-weld	CRES, ASTM A182/A182M, F304L or F316L, Steel, ASTM A105/A105M	ASME B16.11	See G-2-8
		Copper-nickel	803-6397430	See note G-2-8
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Butt- or socket-welding flanges	Carbon steel, ASTM A105/A105M, or CRES, ASTM A182/A182M, 304L or 316L	ASME B16.5	1/4" min. for butt-welded flanges See note G-2-1, G-2-8
		Copper-nickel	803-6983512	See note G-2-8
	Union tailpieces	Copper-nickel	803-7063850	For bronze union-ended valves
	Union, welding	Carbon steel	NAEL Drawing A404734	See note G-2-3
		CRES, ASTM A182/A182M, F304L or F316L, copper-nickel, MIL-C-15726	803-1385884 810-1385888	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	If hybrid gasket not available
	O-ring	Fluorocarbon	SAE-AMS7276	
	Hybrid	Fluorocarbon seal	MIL-PRF-32187	See 4.26
Flange bolting	Bolts, screws, studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
	Bolts, studs	Nickel-copper	ASTM F468, Grade 400	
	Nuts		ASTM F467, Grade 400	
	Nuts, self-locking		NASM 25027/NASM 17828	

TABLE XXVIII. Category G-2, G-6, and G-7, Low pressure hydraulic (including lines) 400 psig/180 °F - Continued.

NOTES:

- G-2-1 Where ANSI flanges modified for O-rings are employed, they shall be flat face, grooved, and equipped with standard O-ring gaskets with back-up rings suitable for the service.
- G-2-2 Hydraulic piping and fittings which are located in water or on weather decks or other locations where they are or may be exposed to the weather shall be CRES or copper-nickel.
- G-2-3 For carbon steel piping, unions of carbon steel, ASTM A105/A105M may be used, provided the material for the union nut is nickel-copper alloy in accordance with QQ-N-286 or CRES in accordance with ASTM A276/A276M, Type 304 or 316.
- G-2-4 Where bronze 150 psi line flanges bolt up to 250 psi valve flanges in sizes 2 to 4 inches, the diameter of the bolt holes in the line flanges shall be increased to match the 250 psi flange bolting.
- G-2-5 Unless otherwise permitted, the design pressure shall be the sum of the operating pressure and the hydraulic surge pressure. The hydraulic surge pressure shall include such factors as rapid valve opening and closing, overhauling loads, suddenly applied loads and relief valve response time.
- G-2-6 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.
- G-2-7 Valves and components limited to pressure-temperature rating on valve drawing.
- G-2-8 Socket-welds limited to 2 NPS maximum for pressures 300 psi or above.

TABLE XXIX. Category G-8, Hydraulic service, 6000 psig/200 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
G-8	Hydraulic service	6000	200	See 4.14, 4.39, note G-8-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES	MIL-P-24691/3 or ASTM A312/A312M, Grade TP321	See 4.51
			ASTM A213/A213M, Gr 321	See G-8-1
Valves	Globe w/ test connection	CRES, Grade 316 Body	MIL-DTL-24578 803-6397304	
	Globe		Commercial	CPV O-seal system or equal, see G-8-3
Fittings	Socket-welding	CRES	ASTM A182/A182M, Grade F321 ASME B16.11	
	Butt-welding	Seamless or radiographed CRES	ASME B16.9	
		ASTM A403/A403M WP321-S		
Take-down joints	Flange, 4 bolt	CRES	As approved	
	Union, O-ring face seal	CRES, Grade 321	Commercial	CPV O-seal system or equal, see G-8-3
			803-1385884 810-1385888	
Gaskets	O-ring	Fluorocarbon rubber	SAE-AMS7276	
Flange bolting	Screws, bolts, studs	Alloy steel	ASTM A193/A193M, Grade B16	See 4.16
	Nuts		ASTM A194/A194M, Grade 7H	

NOTES:

G-8-1 Tubing permitted in lieu of piping where use of NAVSEA-approved hydraulic fittings designed for tubing sizes is required.

G-8-2 Unless otherwise permitted, the design pressure shall be the sum of the operating pressure and the hydraulic surge pressure. The hydraulic surge pressure shall include such factors as rapid valve opening and closing, overhauling loads, suddenly applied loads, and relief valve response time.

G-8-3 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.

TABLE XXX. Category H-1, Gasoline, 150 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
H-1	Gasoline	150	150	Silver-braze restriction See 4.13, notes H-1-2, H-1-3

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420, Class 200		
Valves	Gate, 2½ NPS and above	Bronze	803-2177917	Flanged ends only	
			MIL-V-1189		
	Gate, ¼ to 2 NPS		803-1385714	Union ends only	
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS		803-4384536	Union ends only	
	Globe/Y-pattern, 2½ to 10 NPS		803-1385623	Flanged ends only	
	Globe/angle stop, stop-check and cross		Copper-nickel (90-10)	Commercial	See note H-1-1
	Swing-check		Bronze	MIL-V-17547	
	Swing-check, ¼ to 2 NPS			803-1385721	Union ends only
	Swing-check, 2½ NPS and above			803-1385637	Flanged ends only
	Butterfly		Aluminum bronze	MIL-V-24624	Type III, special flanges required
	Relief		Bronze	MIL-V-24332	
Regulating	Commercial	See note H-1-1			
Fittings	Socket-welding	Copper-nickel	803-6397430		
	Butt-welding		810-1385880		
	MAFs	Various	ASTM F1387	See 4.46	
	Belled end and couplings	Copper-nickel alloy	MSS SP-119	See 4.48	

TABLE XXX. Category H-1, Gasoline, 150 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks	
Take-down joints	Flanges (butt-weld)	Copper-nickel	810-1385992		
	Flanges (socket-weld)		803-6983512		
	Unions (welded)	Copper-nickel	Commercial 803-1385884		See note H-1-1
	Union end tailpiece assy	Copper-nickel	803-7063850		For union end valves
Gaskets	Flat	Buna-N and cork	SAE-AMS-C-6183, Class 1, Grade C-firm	See 4.26	
		Nylon reinforced rubber	804-5284201, Types 3 or 4		
	O-ring	Fluorocarbon rubber	SAE-AMS7276		
	Hybrid		MIL-PRF-32187		
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16	
	Nuts		ASTM F467, Grade 400		
	Nuts, self-locking		NASM 25027/NASM 17828 MIL-DTL-32258		
NOTES:					
H-1-1 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.					
H-1-2 Materials shown are for existing system repair and shall contain no ferrous material or other materials which can spark or store static electricity. New ships shall utilize portable bladders and containers which can be jettisoned overboard during emergencies.					
H-1-3 See 4.39 regarding casting radiographic/non-destructive test requirements.					

TABLE XXXI. Category H-2, Cleaning fluid and contaminated aviation lubricating system, 100 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
H-2	Cleaning fluid and contaminated aviation lubricating system	100	150	See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Gate, 2½ NPS and above	Bronze	803-2177917	Flanged ends only
			MIL-V-1189	
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Globe/angle stop and stop-check, 2½ NPS and above		803-1385541	Flanged ends only
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS		803-4384536	Union ends only
	Butterfly	Aluminum bronze	MIL-V-24624	Type III, special flanges required
	Swing-check	Bronze	MIL-V-17547	
	Swing-check, ¼ to 2 NPS		803-1385721	Union ends only
	Relief		MIL-V-24332	
	Regulating		Commercial	See note H-2-1
	Ball, ¼ inch to 2½ NPS		803-5001003	
	Ball, 3 to 6 NPS		803-5001004	

TABLE XXXI. Category H-2, Cleaning fluid and contaminated aviation lubricating system 100 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Socket-welding	Copper-nickel	803-6397430	
	Butt-welding		810-1385880	
	Silver brazing	Bronze	MIL-DTL-1183 MIL-F-24227	
	MAFs	Various	ASTM F1387	See 4.46
	Belled end and couplings	Copper-nickel	MSS SP-119	See 4.48
Take-down joints	Flanged, silver brazing	Bronze	MIL-PRF-20042 MIL-F-24227	
			803-1385892	
	Flange, welded	Copper-nickel	803-6983512	
	Union	Bronze	MIL-DTL-1183 MIL-F-24227	
	Union end tailpiece assy	Bronze, Copper-nickel	803-7063850	For union end valves
Gaskets	Flat	Buna-N and cork	SAE-AMS-C-6183, Class 1, Grade C-firm	See 4.26
		Nylon reinforced rubber	804-5284201, Types 3 or 4	
	O-ring	Fluorocarbon rubber	SAE-AMS7276	See 4.26
	Hybrid		MIL-PRF-32187	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16
	Nuts		ASTM F467, Grade 400	See 4.16
	Nuts, self-locking		NASM 25027/NASM 17828 MIL-DTL-32258	
NOTE:				
H-2-1 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.				

TABLE XXXII. Category I-1, JP-5 fuel service, filling transfer, tank stripping, and auxiliary JP-5, 200 psig/100 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
I-1	JP-5 fuel service, filling transfer, tank stripping and auxiliary JP-5	200	100	See 4.14, notes I-1-1, I-1-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	CRES 316L	MIL-P-24691/3 or ASTM A312/A312M, Ty 316L or 304L	See 4.51
Valves	Gate	Bronze	803-2177917	See note I-1-2
			803-1385714	
	Globe, angle and cross	Bronze	MIL-V-18110	100 psig max.
			803-1385541	See note I-1-2
			803-1385623	
		CRES 316L	803-4384536	See note I-1-2
			MIL-V-22052	
			CRES ASTM A182/A182M, F316	
	Butterfly	Bronze or CRES	MIL-V-24624	Type III
	Relief		MIL-V-24332	See note I-1-2
	Swing-check		803-1385637	
	Ball, ¼" to 2½"		803-5001003	
Ball, 3" to 6"	803-5001004			
Manifold	Copper-nickel		Soft seating, as approved	
Fittings	Butt-welding	CRES ASTM A403/A403M WP316L-S or WP304L-S	ASME B16.9 810-1385880 (mod)	See note I-1-2
	Belled end and couplings	ASTM A312/A312M, 304L or 316L	MSS SP-119	See 4.48
	Socket-welding	ASTM A182/A182M, F304L or F316L	ANSI/ASME B16.11	
	Tailpiece, socket or buttwelded	ASTM A182/A182M, F304L or 316L	803-7063850 (mod for CRES)	

TABLE XXXII. Category I-1, JP-5 fuel service, filling transfer, tank stripping and auxiliary JP-5, 200 psig/100 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges Socket and butt-weld	CRES, ASTM A182/A182M, F304L or F316L	ASME B16.5 (mod) 803-6983512 (mod)	Flat face See note I-1-2
Gaskets	Sheet	Buna-N and cork	SAE-AMS-C-6183, Class 1, Grade C-firm	See 4.26
		Nylon reinforced rubber	804-5284201, Types 3 or 4	
		Non asbestos	MIL-DTL-24696, Type II	For butterfly valves See 4.26 and I-1-4
	Hybrid		MIL-PRF-32187	See 4.26
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16
	Nuts		ASTM F467, Grade 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
Orifices	Flow orifice	CRES 316L		
<p>NOTES:</p> <p>I-1-1 This category includes cargo JP-5 systems. The cargo JP-5 piping within convertible cargo tanks (those intended for selective stowage of JP-5 fuel) shall be in accordance with this category.</p> <p>I-1-2 Modified for use of 316L material</p> <p>I-1-3 Valves shall be provided with Teflon stem packing and flat face flanges.</p> <p>I-1-4 Use of sheet gasket only when conditions noted in 4.26 do not allow use of hybrid. When hybrid cannot be used, an alternative sheet to the MIL-DTL-24696 is Garlock Bluegard 3000, or equal.</p>				

TABLE XXXIII. Category J-1 and J-2, Air, nitrogen and helium, 6000 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-1 and J-2	Air, nitrogen and helium	6000	150	See 4.39 Silver-brazed restriction see 4.14 and note J-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel (70-30)	MIL-T-16420	
		CRES	MIL-P-24691/3, 304L or 316L, ASTM A312/A312M, TP304L or TP316L	See 4.51
Valves	Globe and angle, 1/8 to 2 NPS	Aluminum-bronze, Nickel-aluminum bronze, and HT bronze (80,000 UTS min.)	803-6397247, MIL-V-24109	Union ends only
	Check, lift and in-line	Bronze, Aluminum-bronze, Copper-nickel, CRES, Nickel-aluminum bronze	Soft seating design (commercial) 803-6397247	Union end, socket-welding See note J-1-3
	Ball		MIL-V-22687	
	Relief		MIL-V-22549	
	Control-special		As approved	
	Pressure-reducing		MIL-V-2961	
	Manifolds pressure- reducing		MIL-V-24272	
	Automatic shut-off		ASTM F1793	

TABLE XXXIII. Category J-1 and J-2, Air, nitrogen and helium, 6000 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Socket-welding	Forged copper-nickel, MIL-C-15726 (70-30) or CRES, ASTM A182/A182M, 304L or 316L	ASME B16.11	See J-1-4
	Butt-welding	CRES, ASTM A403/A403M WP304L-S or WP316L-S Copper-nickel, MIL-C-15726	ASME B16.9	
	Socket or butt-welding outlets	CRES, ASTM A182/A182M, F304L or F316L or forged copper-nickel (70-30), MIL-C-15726	Commercial MSS SP-97	Welded to pipe run See note J-1-3
	Bosses	Copper-nickel (70-30)	803-1385950	3300 psi max. welded to pipe run
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Butt and socket-welded unions	Forged copper-nickel, MIL-C-15726 or CRES, ASTM A182/A182M, F304L or F316L	803-1385884	See note J-1-1
			810-1385888	For OD tubing, see note J-1-1
Gaskets	O-ring	Fluorocarbon	SAE-AMS7259	
<p>NOTES:</p> <p>J-1-1 To prevent or minimize galling, the union nut shall be of dissimilar metal than the thread piece.</p> <p>J-1-2 Air piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or CRES. Valves in these spaces shall be welded, flanged, or union-ended with copper-nickel or CRES tailpieces. Silver-brazed joints shall not be used in these spaces.</p> <p>J-1-3 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.</p> <p>J-1-4 For copper-nickel socket welded fittings manufactured to ASME B16.11 dimensional requirements, a pressure test equal to 2 times the working pressure of the fitting is required prior to placing in service. The test shall be applied for a minimum of 1 minute and the tested fitting shall exhibit no signs of permanent deformation after the test. New sources shall be qualified via a one-time burst test in accordance with ASME Boiler and Pressure Vessel Code VIII-I UG-101(b).</p>				

TABLE XXXIV. Category J-3, Air and nitrogen, 600 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-3	Air and nitrogen	600	150	See 4.39 Silver brazing restriction, see 4.14 and note J-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel (70-30)	MIL-T-16420	
		CRES	MIL-P-1 24691/3, 304L or 316L ASTM A312/A312M, TP304L, TP316L	See 4.51
Valves	Globe, angle and check, 1/8 to 1 1/2 NPS	Nickel-aluminum-bronze	803-6397247	Union ends only
		Bronze, aluminum-bronze, copper-nickel or CRES	MIL-V-24109, soft- seating design	
	Ball, 1/4" to 2 1/2 NPS		803-5001003	See note J-3-2
			MIL-V-22687	Union ends
	Control, special		As approved	
	Lift-check	Aluminum bronze	Commercial (soft seat design)	Union end, socket-welding
	Relief	Nickel-aluminum-bronze	MIL-V-22549	Union ends only
	Pressure-reducing	Bronze, aluminum-bronze, copper-nickel	MIL-V-2961	
	Manifolds, pressure-reducing	CRES	MIL-V-24272	Union ends only 40-120 °F temp. limits
Automatic shut-off		ASTM F1793	Union ends only See 4.42	

TABLE XXXIV. Category J-3, Air and nitrogen, 600 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Socket-weld	CRES, ASTM A182/A182M, 304L, or 316L	ASME B16.11	
		Copper-nickel, MIL-C-15726	ASME B16.11	
		Copper-nickel	803-6397430	400 psi max.
	Butt-weld, seamless	Copper-nickel, MIL-C-15726, CRES, ASTM A403/A403M WP304L-S or WP316L-S	ASME B16.9	
	Bosses	Copper-nickel (70-30)	803-1385950	Weld to pipe run
	Socket-welding and butt-welding end outlet	Copper-nickel (70-30), MIL-C-15726	Commercial	See note J-3-1
Take-down joints	Socket-welded unions	Forged copper-nickel, MIL-C-15726, or CRES, 304L or 316L	803-1385884	
Gaskets	O-ring	Fluorocarbon	SAE-AMS7276	
NOTES:				
J-3-1 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.				
J-3-2 600 psi at 135 °F maximum for 2½ NPS valve.				

TABLE XXXV. Category J-4, Air and nitrogen, 200 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-4	Air and nitrogen	200	150	Silver brazing restriction, see 4.14, note J-4-5

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel	MIL-T-16420	
	Seamless	CRES	MIL-P-24691/3, 304L or 316L ASTM A312/A312M, TP304L or TP316L	See 4.51
		Copper	MIL-T-24107	
		GRP	MIL-P-24608	See notes J-4-2, J-4-3
Valves	Gate, ¼ to 2 NPS	Bronze, Aluminum-bronze, Nickel-aluminum bronze	803-1385714	Union ends only
	Swing-check, ¼ to 2 NPS		803-1385721	
	Globe/ angle, needle, stop-check and check, ¼ to 2 NPS		803-4384536 803-6397247	Soft seat design, except needle valve Union ends only
	Pressure-regulating		MIL-V-24384	150 psi max. Union ends only
	Pressure-reducing		MIL-V-2961	Union ends only
	Lift-check		Commercial (soft seat design)	See note J-4-1
	Relief		MIL-V-22549	Union ends only
	Automatic shut-off		ASTM F1793	See 4.42
	Ball, ¼" to 2½ NPS		803-5001003 MIL-V-22687	

TABLE XXXV. Category J-4, Air and nitrogen, 200 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Socket-welded	CRES, ASTM A182/A182M, F304L, F316L	ASME B16.11	
		Copper-nickel, MIL-C-15726		
		Copper-nickel	803-6397430	
	Butt-welded, seamless	Copper-nickel, MIL-C-15726, MIL-T-16420	ASME B16.9 810-1385880	
	Socket-welded and butt-welded end outlet	Copper-nickel (70-30 or 90-10), MIL-C-15726	Commercial MSS SP-97	Weld to pipe run See note J-4-1
	Socket-bonded	GRP	MIL-P-24608	See note J-4-3
	Butt and socket-welded	CRES or copper-nickel (70-30)	803-1385884 and 810-1385888	
	Union end tailpiece assy	Bronze, Copper-nickel	803-7063850	For union end valves
	Silver-brazed flanges	Bronze	MIL-PRF-20042 ASME B16.24	
	Silver-brazed fittings and unions		MIL-DTL-1183	
	Socket-welded flanges	CRES, ASTM A182/A182M, F304L, F316L	ASME B16.5	
			Copper-nickel (70-30)	ASME B16.5, Class 150 803-6983512
	Socket-bonded	GRP	MIL-P-24608	See note J-4-3
Adapter	As approved	SAE J514	See note J-4-4, 4.13.g	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16
	Nuts		ASTM F467, Grade 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

TABLE XXXV. Category J-4, Air and nitrogen, 200 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Types 2 and 4	See 4.26
	O-ring	Fluorocarbon	SAE-AMS7259	
NOTES:				
J-4-1	The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.			
J-4-2	GRP may be used for L.P. non-vital air system outside of high fire hazard spaces.			
J-4-3	Category C-3 may be used for GRP components and fittings. See 4.43.			
J-4-4	Male NPT to three-piece 37-degree flare adapter fittings for control components to tubing (125 psi max.) where materials and fittings are specifically approved.			
J-4-5	Air piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or CRES. Valves in these spaces shall be welded, flanged, or union-ended with copper-nickel or CRES tailpieces. Silver-brazed joints shall not be used in these spaces.			

TABLE XXXVI. Category J-5, Air, and bleed-off, 150 psig/550 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-5	Air, and bleed-off	150	550	See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-P-24691/1, Grade A or B ASTM A106/A106M, Grade A or B	
Valves	Gate, 2½ NPS and above	Carbon steel ASTM A105/A105M	MIL-V-18110	Socket or butt-weld ends ASME B16.34, Class 900
	Globe/angle stop, stop-check, lift-check and throttle, ¼ to 2 NPS		803-2177525	
	Control		MIL-V-18030	Flanged ends only, ASME B16.5
	Relief		MIL-DTL-20065	
Fittings	Butt-welding	ASTM A234/A234M, Class WPB	ASME B16.9	
	Socket-welding	Carbon steel, ASTM A105/A105M	ASME B16.11	
Take-down joints	Flanges	Carbon steel, ASTM A105/A105M	ASME B16.5	Flat face
Gaskets	Sheet	Commercial	Commercial	¼" thick
Flange bolting	Bolts, studs, screws	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	

TABLE XXXVII. Category J-6, Air, gas turbine starting and prairie masker, 150 psig/450 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-6	Air, gas turbine starting and prairie masker	150	450	See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	CRES	MIL-P-24691/3, Grade 304L, 316L	
Valves	Gate, 2½ NPS and above	CRES, ASTM A351/A351M, Grade CF3-8 or CF3M, ASTM A182/A182M, Grade F316L or F304L	MIL-V-18110	
	Control		MIL-V-18030	Flanged ends only ASME B16.5 See note J-6-2
	Relief		MIL-DTL-20065	
Fittings	Butt-welding	CRES, ASTM A403/A403M WP304L-S or WP316L-S	ASME B16.9	
	Socket-welding	CRES, ASTM A182/A182M, F304L or F316L	ASME B16.11	
Take-down joints	Butt-welding and socket-welding flanges		ASME B16.5	Flat face
Gaskets	Sheet	Commercial	Commercial	See note J-6-1 ¼" thick
Flange bolting	Bolts, studs, screws	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
NOTES:				
J-6-1	The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.			
J-6-2	Modified to fabricate from CRES Type 304L/316L.			

TABLE XXXVIII. Category J-7, Air, prairie-masker, gas turbine starting, 100 psig/600 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-7	Air, prairie-masker, gas turbine starting	100	600	Silver brazing restriction see 4.14 See notes J-7-1 and J-7-6

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	See note J-7-2 and 4.51
	Seamless or welded	Copper-nickel	MIL-T-16420	
		CRES	MIL-P-24691/3 or ASTM A312/A312M, TP321 or TP347	
Valves	Gate, 2½ NPS and above	Bronze	803-2177917 MIL-V-1189	Flanged ends only 400 °F max.
	Globe/ angle stop and stop-check, 2½ NPS and above		803-1385541	
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS		803-4384536	Union ends only 400 °F max.
	Swing-check, 2½ inches and above		MIL-V-17547	Flanged ends only 425 °F max.
			803-1385637	400 °F max.
	Swing-check, ¼ to 2 NPS		803-1385721	Union ends only, 425 °F max.
	Butterfly		MIL-V-24624	See note J-7-3
	Automatic shut-off, ¼ to 2 NPS		ASTM F1793	Union ends only See 4.42

TABLE XXXVIII. Category J-7, Air, prairie-masker, gas turbine starting, 100 psig/600 °F - Continued.

Item	Types	Material	Applicable documents	Remarks	
Fittings	Silver-brazed	Bronze	MIL-DTL-1183	See notes J-7-4 and J-7-5	
	Socket-welded end outlet	Copper-nickel (70-30), MIL-C-15726, CRES, ASTM A182/A182M, Grade 316L, 321, or 347	Commercial		
	Socket-welded		ASME B16.11		
	Butt-welded		ASME B16.9		
		Copper-nickel (70-30)	810-1385880		
Flanges, take-down joints	Silver-brazed flanges	Bronze	MIL-PRF-20042 803-1385892		
	Butt- and socket-welded flanges	Copper-nickel (70-30) or CRES	ASME B16.5, Class 300 803-6983512		
	Silver-brazed unions	Bronze	MIL-DTL-1183		
	Butt- and socket-welded unions	Copper-nickel (70-30) or CRES	803-1385884 and 810-1385888		
	Union end tailpiece assy		Bronze, Copper-nickel	803-7063850	For union end valves See note J-7-4
			CRES, ASTM A182/A182M F304L/316L		Mod for CRES
Gaskets	Sheet	Non-asbestos	Commercial	1/16" thick. See note J-7-5	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16	
	Nuts		ASTM F467, Grade 400		
	Nuts, self-locking		NASM 25027/NASM 17828		
			MIL-DTL-32258		
	Bolts, screws, studs	Carbon steel	ASTM A449, Type I		
	Nuts		SAE-J995, Grade 5		
NOTES:					
J-7-1	Piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or CRES. Valves in these spaces shall be welded, flanged, or union-ended with copper-nickel or CRES tail pieces. Silver-brazed joints shall not be used in these spaces.				
J-7-2	Piping within the shaft bore shall be 70-30 copper-nickel.				
J-7-3	Butterfly valves may be used where the temperatures do not exceed 500 °F.				
J-7-4	Joints above 425 °F shall be welded.				
J-7-5	The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.				
J-7-6	Unless otherwise noted, bronze valves, fittings, and take-down joints in this table shall not be used above 425 °F.				

TABLE XXXIX. Category J-8, Air deballast, 50 psig/400 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-8	Air deballast	50	400	Silver brazing restrictions See 4.14, note J-8-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420, Class 200	
Valves	Gate, 2½ NPS and above	Bronze	803-2177917 MIL-V-1189	Flanged ends only
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Globe/ angle stop and stop-check, 2½ NPS and above		803-1385541	Flanged ends only
	Globe/angle stop, stop-check, and needle, ¼ to 2 NPS		803-4384536	Union ends only
	Check, swing, 2½ NPS and above		803-1385637 MIL-V-17547	Flanged ends only
	Check, swing, ¼ to 2 NPS		803-1385721	Union ends only
	Butterfly, 2 NPS and above		MIL-V-24624	See note J-8-2
	Relief		MIL-DTL-20065	Flanged ends only Modified for bronze
	Ball		MIL-V-22687	
	Control		MIL-V-18030	Flanged ends only
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Butt-welding	Copper-nickel (90-10), MIL-C-15726	810-1385880	150 °F max.
	Socket-welding		ASME B16.11	
	Belled end and couplings	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48

TABLE XXXIX. Category J-8, Air deballast, 50 psig/400 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings - continued	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Unions, silver brazing	Bronze	MIL-DTL-1183	
	Union end tailpiece assy	Bronze, Copper-nickel	803-7063850	For union end valves
	Silver brazing flanges	Bronze	MIL-PRF-20042	
			803-1385892	Special flanges for butterfly valves 180 °F max.
	Butt-weld flanges	Copper-nickel (90-10), MIL-C-15726	810-1385992	
Slip-on, socket-weld flanges	803-6983512		See note J-8-1	
Gasket	Sheet	Non-asbestos	Commercial	See note J-8-3 $\frac{1}{16}$ " thick
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.16
	Nuts	Nickel-copper	ASTM F467, Grade 400	See 4.16
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
<p>NOTES:</p> <p>J-8-1 Slip-on flanges shall be bored to suit the outside diameter of the tube with flange thickness, drilling, and facing in accordance with MIL-PRF-20042.</p> <p>J-8-2 Valve must be suitable for a temperature of 400 °F.</p> <p>J-8-3 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.</p> <p>J-8-4 Air piping and fittings in fire hazardous areas, such as machinery spaces, shall be welded. Valves in these spaces shall be welded, flanged, or union-ended with copper-nickel tailpieces. Silver-brazed joints shall not be used in these spaces.</p>				

TABLE XL. Category J-9, Air, gas turbine bleed, anti-icing, 300 psig/950 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
J-9	Air, gas turbine bleed, anti-icing	300	950	See 4.14, 4.39

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES	MIL-P-24691/3 or ASTM A312/A312M, TP321 or TP347	See 4.51
Valves	Gate, 2½ NPS and above	CRES, ASTM A182/A182M, F321, or F347	MIL-V-18110, modified	See note J-9-1
	Globe/angle stop, stop-check and lift-check, ¼ to 2 NPS		803-5184193, modified	
	Globe/angle/Y-pattern stop, stop- check and lift-check, 2½ NPS and above		MIL-V-22052, modified for CRES and lift-check	
	Swing-check		Commercial	See note J-9-2
	Ball		803-5001003 or commercial	See note J-9-3 See note J-9-2
Fittings	Socket-welded	CRES, ASTM A182/A182M, F321, or F347	ASME B16.11	
	Butt-welded	CRES, ASTM A403/A403M WP321-S or WP347-S	ASME B16.9	
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Flanges	CRES, ASTM A182/A182M, F321, or F347	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength studs	Alloy steel	ASTM A193/A193M, Grade B16	See 4.16
	Nuts (heavy hex)		ASTM A194/A194M, Grade 7H	
NOTES:				
J-9-1	Composition E: CRES F321 or F347 (valve backseat and guide to be HF). This requirement will be part of the classification of MIL-V-18110 and MIL-V-22052.			
J-9-2	The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.			
J-9-3	250 °F maximum temperature. This temperature may be further reduced depending on actual valve size and service pressure. Consult drawing for details.			

TABLE XLI. Category K-1, Gaseous oxygen, outside hull, 4500 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-1	Gaseous oxygen, outside hull	4500	150	See 4.39 and notes K-1-1, K-1-2, and K-1-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel	MIL-T-16420	
Valves	Globe and angle, ¼ to 1¼ NPS	Bronze, aluminum bronze, copper-nickel (as approved)	Soft seat design MIL-V-24109	Union end
	Check-lift	Nickel-copper	MIL-V-24439	
	Relief, ¼ to 2 NPS		MIL-V-22549	
	Pressure-reducing		MIL-V-24336	
Fittings	Socket-welding	Nickel-copper	ASME B16.11	
Take-down joint	Socket-welded unions	Nickel-copper	803-1385884	See note K-1-3
Gaskets	O-ring	Fluorocarbon	SAE-AMS7259	

NOTES:

- K-1-1 Oxygen system components shall be cleaned in accordance with requirements of MIL-STD-1330.
- K-1-2 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain information covered in the handbook from the cognizant SUPSHIP.)
- K-1-3 Union nut shall be of nickel-copper-aluminum.
- K-1-4 See 4.39 for casting requirements.

TABLE XLII. Category K-2. Gaseous oxygen, inside hull, 4500 psig/ambient.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-2	Gaseous oxygen, inside hull	4500	Ambient	See notes K-2-1, K-2-2, and K-2-4 See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Nickel-copper	MIL-T-1368, Class A	
Valves	Globe and angle, ¼ to 1¼ NPS	Nickel-copper	MIL-V-24439	With nickel-copper nipples welded to body
	Relief, ¼ to 2 NPS		MIL-V-22549	
	Pressure-reducing		MIL-V-24336	
	Packless		As approved by NAVSEA	
Fittings	Socket-welding	Nickel-copper, QQ-N-281, Class A, annealed	ASME B16.11	
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Unions, welded	Nickel-copper	803-1385884	See note K-2-3

NOTES:

K-2-1 Oxygen system components shall be cleaned in accordance with the requirements of MIL-STD-1330.

K-2-2 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain information covered in the handbook from the cognizant SUPSHIP.)

K-2-3 To be used only where take-down joints are absolutely necessary for shipboard piping installation and test. Union joints shall be seal-welded in accordance with S9074-AR-GIB-010/278. The O-ring shall be removed prior to seal welding each joint. Union nut shall be of nickel-copper-aluminum.

K-2-4 See 4.39 for casting RT requirements.

TABLE XLIII. Category K-3, Gaseous oxygen, 100 psig/ambient.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-3	Gaseous oxygen	100	Ambient	Silver braze restriction, see 4.14 See notes K-3-1, K-3-2, K-3-6, and K-3-7

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel	MIL-T-16420	0.065" min. wall thickness
Valves	Globe/angle stop, stop-check, and needle, ¼ to 2 NPS	Bronze	803-4384536	Soft seated globe valves See note K-3-4 Union ends only Teflon stem packing, Teflon or nylon disc washer
	Gate, ¼ to 2 NPS		803-1385714	See note K-3-4 Union ends only
	Swing-check, ¼ to 2 NPS		803-1385721	
	Pressure-reducing		MIL-V-24336 MIL-V-2961	
	Diaphragm, packless	Bronze, ASTM B61	Commercial	See note K-3-5, union ends, Teflon or nylon disc washer
	Relief, ¼ to 2 NPS	Bronze, ASTM B61	MIL-V-22549	See note K-3-3 Union ends only
Fittings	MAFs	Various	ASTM F1387	
	Socket or butt-welding outlets	Copper-nickel (70-30)	As approved MSS SP-97 803-1385950	See note K-3-5

TABLE XLIII. Category K-3, Gaseous oxygen, 100 psig/ambient - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Unions, weld	Copper-nickel, MIL-C-15726	Commercial	See note K-3-5
	Union end tailpiece assy	Copper-nickel	803-7063850	For union end valves
Gaskets	O-ring	Fluorocarbon	SAE-AMS7276	
<p>NOTES:</p> <p>K-3-1 Components shall be cleaned in accordance with the requirements of MIL-STD-1330.</p> <p>K-3-2 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain information covered in the handbook from the cognizant SUPSHIP.)</p> <p>K-3-3 Relief valves shall conform to the basic requirements of MIL-V-22549. Seat or disc material shall be suitable for oxygen service.</p> <p>K-3-4 Valve packing shall be in accordance with MIL-P-24396, Type C.</p> <p>K-3-5 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.</p> <p>K-3-6 For new construction, copper piping and brazing shall not be used.</p> <p>K-3-7 See 4.39 regarding RT of castings.</p>				

TABLE XLIV. Category K-4, Liquid oxygen and nitrogen, 6000 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-4	Liquid oxygen and nitrogen	6000		See 4.14 and notes K-4-1, K-4-2, and K-4-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES	MIL-P-24691/3, 316L ASTM A312/A312M, 316L	See 4.51
Valves	Globe and angle, ¼ to 1¼ NPS	CRES	MIL-V-24109	Union ends only
Fittings	Socket-welding	CRES, ASTM A182/A182M, F316L	ASME B16.11	
	Butt-welding, seamless	CRES, ASTM A403/A403M WP316L-S	ASME B16.9	
	MAFs	Various	ASTM F1387	See 4.46

NOTES:

K-4-1 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain Information covered in the handbook from the cognizant SUPSHIP.)

K-4-2 Components shall be cleaned in accordance with the requirements of MIL-STD-1330.

K-4-3 See 4.39 regarding RT of castings.

TABLE XLV. Category K-5, Liquid oxygen and nitrogen, 250 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-5	Liquid oxygen and nitrogen	250		Silver braze restriction See 4.14 and notes K-5-1, K-5-2, and K-5-5

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel	MIL-T-16420	0.065 inch min. wall thickness
		CRES, Grade TP 304L or TP 316L	MIL-P-24691/3	
Valves	Globe/angle stop, stop-check and needle, ¼ to 2 NPS	Bronze	803-4384536	See note K-5-3 Union ends only
	Gate ¼ to 2 NPS		803-1385714	
	Swing-check, ¼ to 2 NPS		803-1385721	
	Relief	CRES	Commercial	See note K-5-4
Fittings	Socket-welding	CRES, ASTM A182/A182M, F304L or F316L	ASME B16.11	
		Copper-nickel	803-6397430	
	MAFs	Various	ASTM F1387	See 4.46
	Unions, weld	Copper-nickel, ASTM B369 or MIL-C-15726	Commercial 803-6397430	See note K-5-4
			CRES 803-1385884	
	Union end tailpiece assy	Copper-nickel	803-7063850	For union end valves

NOTES:

K-5-1 Components shall be cleaned in accordance with the requirements of MIL-STD-1330.

K-5-2 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain information covered in the handbook from the cognizant SUPSHIP.)

K-5-3 Valve packing shall be in accordance with MIL-P-24396, Type C.

K-5-4 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.

K-5-5 See 4.39 regarding RT of castings.

TABLE XLVI. Category K-6, Mixed gas, 4500 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-6	Mixed gas	4500	150	See 4.14, 4.39, and notes K-6-1, K-6-2, and K-6-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES	MIL-P-24691/3 or ASTM A312/A312M, 304L, or 316L	See 4.51
Valves	Globe and angle, ¼ to 1¼ NPS	CRES	MIL-V-24109	Union ends to 803-1385884 See note K-6-3
	Relief, ¼ to 2 NPS		MIL-V-22549	
	Pressure-reducing		MIL-V-24336	
Fittings	Socket-welding	CRES, ASTM A182/A182M, F304L or F316L	ASME B16.11	
	Butt-welding	CRES, ASTM A403/A403M WP304L-S or WP316L-S	ASME B16.9	
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Butt- or socket-welded unions	CRES, ASTM A182/A182M, F304L or F316L	803-1385884	

NOTES:

- K-6-1 Oxygen system components shall be cleaned in accordance with the requirements of MIL-STD-1330.
- K-6-2 Lubricants shall be of an approved type as listed in MIL-HDBK-267. (Private shipbuilding activities may obtain information covered in the handbook from the cognizant SUPSHIP.)
- K-6-3 Valves intended for use where system operating gauge pressure exceeds 3000 psig shall be modified for the applicable pressure and approved by NAVSEA.
- K-6-4 For systems with oxygen content greater than 40 percent by volume, see Categories K-1 or K-2.

TABLE XLVII. Category K-7, Propane, 200 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
K-7	Propane	200		Silver braze restriction See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Globe/angle stop, stop-check and needle, ¼ to 2 NPS	Bronze	803-4384536 Commercial	Union ends only See note K-7-1
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Welded	Copper-nickel	803-6397430	
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Unions, silver brazing	Bronze	MIL-DTL-1183	See 4.14
	Unions, weld	Copper-nickel, MIL-C-15726	Commercial	See note K-7-1
	Union end tailpiece assy	Bronze Copper-nickel	803-7063850	For union end valves

NOTE:
K-7-1 The use of commercial items not conforming to DoD-adopted non-Government standards shall be subject to NAVSEA approval.

TABLE XLVIII. Category L-1, Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution, 150 psig/200 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
L-1	Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution	150	200	See notes L-1-2, L-1-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	CRES	MIL-P-24691/3, 304L or ASTM A312/A312M, TP304L	See 4.51
		Copper-nickel (90-10)	MIL-T-16420	See note L-1-1
Valves	Globe/angle stop/stop-check, ¼ to 2 NPS	Bronze	803-4384536	Union ends only
	Globe, 2½" and larger		803-1385541	Flanged, 100 psi max.
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Gate, 2 ½" and larger		MIL-V-1189, Type 1, Class 1 or 803-2177917	Flanged
	Gate/globe/swing-check	CRES, ASTM A743/A743M, Grade CF-8	Commercial	See note L-1-3
	Swing-check, ¼ to 2 NPS	Bronze, Nickel-aluminum-bronze	803-1385721	Union ends only
	Swing-check, 2 ½ NPS and larger		MIL-V-17547 or 803-1385637	Flanged ends

TABLE XLVIII. Category L-1, Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution, 150 psig/200 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Valves - continued	Reducing	Bronze	ASTM F1370 including supplements	Copper-nickel UNS N05500 trim See 4.42
	Temperature regulating		MIL-DTL-19772	
	Ball, ¼" to 2½ NPS	Bronze	803-5001003	Bronze body with nickel-copper, bronze, or copper-nickel end piece
		CRES		
	Ball 3 to 6 NPS	Bronze	803-5001004	6" butt-welded only
	Butterfly	CRES, nickel-aluminum-bronze	MIL-V-24624, MIL-PRF-32307 803-7106793	Special flanges required
	Relief	Bronze	MIL-V-24332	
Fittings	Socket-welding	Copper-nickel	803-6397430	
		CRES, ASTM A182/A182M, F304L or F316L	ASME B16.11	
	Butt-welding	CRES, ASTM A403/A403M WP304L-S or WP316L-S	ASME B16.9	
		Copper-nickel	810-1385880	
	Belled-end and couplings	Copper-nickel/CRES 304L or 316L	MSS SP-119	See 4.48
	MAFs	Various	ASTM F1387	See 4.46
	Silver brazing	Bronze	MIL-DTL-1183	

TABLE XLVIII. Category L-1, Cooling, (electronic equipment, diesel equipment, diesel engine, and so forth) – ethylene glycol, freshwater solution, distilled water solution, 150 psig/200 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Welding flanges	CRES, ASTM A182/A182M, 304L or 316L	ASME B16.5	
	Silver brazing flanges	Bronze	803-1385892	Special for butterfly valves
			MIL-PRF-20042	
	Socket-welded and weld neck	Copper-nickel (90-10 or 70-30)	803-6983512 or 810-1385992	
Gaskets	Sheet	Non-asbestos	MIL-DTL-24696, Type II	Preferred gasket for butterfly valves
	Flat	Nylon inserted rubber	804-5284201, Types 1 or 2 as approved	See 4.26
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Grade 400	See 4.15
	Nuts		ASTM F467, Grade 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
Flange fasteners	Bolts, screws, studs	Carbon steel	ASTM A449, Type I	
	Nuts		SAE-J995, Grade 5	
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.				
L-1-3 Commercial valves subject to NAVSEA approval.				
L-1-4 For electronic cooling water refer to Category C-1/C-2 for restrictions on brazing copper-nickel.				

TABLE XLIX. Category M-1, Seawater-washdown countermeasure system, 200 psig/100 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
M-1	Seawater-washdown countermeasure system	200	100	See notes M-1-1, M-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10 or 70-30)	MIL-T-16420	See notes M-1-2, M-1-3
Valves	Gate, 2½ to 12 NPS	Bronze	803-2177917	Flanged ends only
	Gate, 2 NPS and smaller		803-1385714	Union ends only
	Globe/angle stop, stop-check and needle, 2 NPS and smaller		803-4384536	Union ends only
	Swing-check, ¼ to 2 NPS		803-1385721	Union ends only Flanged ends only
	Diaphragm-check		803-6983468 MIL-V-17501, Type 4	
	Control		803-6397408	
	Ball, 2½ NPS and smaller	Bronze	803-5001003	Bronze Body with Bronze, nickel-copper, or copper-nickel end pieces Copper-nickel body with copper-nickel end piece
		Copper-nickel		
	Ball, 3 to 6 NPS	Bronze	803-5001004	6 NPS valve butt-welded only
	Butterfly		MIL-V-24624	See 4.30
	Butterfly, 3 to 10 inches	Nickel-aluminum-bronze	803-7106793	Not for use where firehardening is required
			MIL-PRF-32307	See 4.7, 4.30
Needle, ⅜" NPT	Bronze body, nickel-copper (N04400) trim	Commercial		

TABLE XLIX. Category M-1, Seawater-washdown countermeasure system, 200 psig/100 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Butt-welding	Copper-nickel	810-1385880	
			ASME B16.9	
	Socket-welding	Copper-nickel	803-6397430	
	Belled end and couplings, 12 NPS max.	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48
	Socket-welded end outlet	70-30 copper-nickel	MIL-C-15726	Commercial
	MAFs	Various	ASTM F1387	See 4.46
Take-down joints	Union end tailpiece assy	Bronze and copper-nickel	803-7063850	For union end valves
	Socket-welding flanges	Copper-nickel	803-6983512	
	Butt-welding flanges		810-1385992	
	Butt- and socket-welded, unions	Copper-nickel	Commercial	
	Flanges, silver brazing	Bronze	MIL-PRF-20042	
			803-1385892	Special for butterfly valves
Unions, silver brazing		MIL-DTL-1183		
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Types 1 or 2 as approved	See 4.26
		Non-asbestos	MIL-DTL-24696, Type II	Preferred gasket for butterfly valves
	O-ring	Fluorocarbon	SAE-AMS7276	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
M-1-1	For attachment of Type SB CRES spray heads, a nickel-copper transition piece in accordance with MIL-T-1368, Class A, shall be welded to the head and silver-brazed to a bronze fitting in the piping system. Weld joint design shall be Type P-14 of MIL-STD-22, except that the "T" dimension shall be the thickness of the welding socket wall.			
M-1-2	Portions of the WDCM system that are shared with AFFF sprinkling require fire hardening in accordance with 4.14.			
M-1-3	70-30 copper-nickel shall be used as specified in special applications and where required for maximum system pressure.			

TABLE L. Category N-1, Sprinkling system (dry) other than AFFF and magazine, 175 psig/100 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
N-1	Sprinkling system (dry) other than AFFF and magazine	175	100	See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Sprinkling control	Bronze	803-6397408	
	Globe/angle stop/stop-check, 2½ NPS and above		803-1385541	100 psi max.
	Globe Y-pattern, 2½ to 10 NPS		803-1385623	
Fittings	Welding	Copper-nickel (90-10)	810-1385880	
	Socket-welding		ASME B16.11	Modified for copper-nickel
	Belled end and couplings		803-6397430	
Flanges	Socket-welding	Copper-nickel (90-10)	MSS SP-119	See 4.48
	Butt-welding		803-6983512	
Unions	Welding	Copper-nickel (90-10)	810-1385992	
Gaskets	Sheet	Nylon inserted rubber	803-1385884	
Flange bolting	Bolts, screws, studs	Nickel-copper	804-5284201, Type 2, as approved	See 4.26
	Nuts		ASTM F468, Alloy 400	See 4.16
	Nuts, self-locking		ASTM F467, Alloy 400	
			NASM 25027/NASM 17828	
		MIL-DTL-32258		

TABLE LI. Category N-2, Magazine sprinkling system (wet and dry), 175 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
N-2	Magazine sprinkling system (wet and dry)	175		See 4.14

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	Seawater filled
Valves	Gate, 2 inches max.	Bronze	803-1385714	Union end
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS max.		803-4384536	
	Check, 2 inches max.		803-1385721	
	Gate, 2½ inches and above		803-2177917	Flanged end
	Globe, 2½ inches and above		803-1385623	
	Check, 2½ inches and above		803-1385637	
	Sprinkling control			803-6397408
	Butterfly	Bronze, nickel-aluminum-bronze	MIL-V-24624	
Fittings	Butt-welding	Copper-nickel (90-10)	810-1385880	
	Socket-welding	Copper-nickel	ASME B16.11 803-6397430	
	Belled end and couplings		MSS SP-119	See 4.48
Flanges	Socket-welding	Copper-nickel	803-6983512	
	Butt-welding		810-1385992	
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Type 2 as approved	See 4.26
Flange bolting	Bolts, studs, screws	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

TABLE LII. Category N-3, Miscellaneous seawater sprinkling systems (sprinkling other than AFFF, magazine, and countermeasure washdown), 175 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
N-3	Miscellaneous seawater sprinkling systems (sprinkling other than AFFF, magazine, and countermeasure washdown)	175		

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	Seawater filled
Valves	Gate, 2 inches max.	Bronze	803-1385714	Union end
	Globe, 2 inches max.		803-4384536	
	Check, 2 inches max.		803-1385721	
	Gate, 2½ inches and above		803-2177917	Flanged end
	Globe, 2½ inches and above		803-1385623	
	Check, 2½ inches and above		803-1385637	
	Sprinkling control			803-6397408
	Butterfly	Bronze, nickel-aluminum-bronze	MIL-V-24624	
Fittings	Butt-welding	Copper-nickel (90-10)	810-1385880	
	Socket-welding	Copper-nickel, Bronze	ASME B16.11 803-6397430	
	Belled end and couplings		MSS SP-119	See 4.48
	Silver-brazed		MIL-DTL-1183	
Flanges	Socket-welding	Copper-nickel	803-6983512	
	Butt-welding		810-1385992	
	Silver-brazed flanges	Bronze	803-1385892	Special flanges for butterfly valves 200 psig max.
			MIL-PRF-20042	
Gaskets	Sheet	Nylon inserted rubber	804-5284201, Type 2 as approved	See 4.26
Flange bolting	Bolts, studs, screws	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828 MIL-DTL-32258	

TABLE LIII. Category O-1, Diesel, incinerator, and gas turbine exhaust, and sewage treatment, 1200 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
O-1	Diesel, incinerator, and gas turbine exhaust, and sewage treatment	N/A	1200	See notes O-1-1 and O-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Carbon steel	MIL-S-22698, Type I	775 °F max.
			ASTM A106/A106M, Grade B	
Fittings	Special fabricated	CRES	ASTM A376/A376M MIL-P-24691/3 ASTM A240/A240M ASTM A312/A312M	See 4.51 See note O-1-1
			CRES 321, 316L, or 347	
	Forged	Carbon steel, ASTM A105/A105M, CRES, ASTM A182/A182M, F321, F316L, F347	MIL-P-24691/3 ASTM A376/A376M	775 °F max. for carbon steel
			ASTM A182/A182M, F321	
	Socket-welding	Carbon steel, ASTM A234/A234M WPB, ASTM A106/A106M, Grade B, or ASTM A403/A403M, WP316L-S, WP321-S	ASME B16.11	775 °F max.
Butt-welding	Carbon steel, ASTM A234/A234M WPB, ASTM A106/A106M, Grade B, or ASTM A403/A403M, WP316L-S, WP321-S	ASME B16.9		
Butt-weld, special fabricated	Carbon steel plate	MIL-S-22698	775 °F max.	
Take-down joints	Flanges	CRES, ASTM A182/A182M, 321, 316L or 347	ASME B16.5	775 °F max.
		Cast carbon steel, ASTM A216/A216M, Grade WCB	ASME B16.5 or specially fabricated MIL-S-22698, Ty 1	

TABLE LIII. Category O-1, Diesel, incinerator, and gas turbine exhaust, and, sewage treatment, 1200 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Graphite composite	MIL-DTL-24696, Type I	
			Commercial, as approved	
	Spiral wound	Metallic-flexible graphite	MIL-G-24716, C1 B	
Flange bolting	Constant strength stud	Alloy steel	MIL-DTL-1222, B16	See 4.16
	Nuts (heavy hex)		MIL-DTL-1222, Grade 7H	
NOTES: O-1-1 Grade 316L CRES shall not be used where the temperatures may exceed 750 °F. O-1-2 Gas turbine exhaust uptake surfaces in direct contact with hot exhaust gas shall be of nickel-chromium-molybdenum-columbium alloy (Ni-Cr-Mo-Cb) in accordance with ASTM B443 or ASTM B444.				

TABLE LIV. Category O-2, Diesel exhaust, subject to salt water spray for IR suppression, 850 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
O-2	Diesel exhaust, subject to salt water spray for IR suppression		850	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Inconel 625	ASTM B444, ASTM B705	
Valves	Globe		ASTM B443	See note O-2-1
			803-5959306	See note O-2-2, O-2-3
Fittings	Butt-weld		803-2177525	
			ASME B16.9	See note O-2-2
Flanges			ASME B16.5	See note O-2-2
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716, C1 B	
	Constant strength stud	Alloy steel	MIL-DTL-1222, B16	See 4.16
	Nuts (heavy hex)		MIL-DTL-1222, Grade 7H	

NOTES:

O-2-1 The 6, 8, and 10 NPS pipe shall be made from ASTM B443 plate. The dimensional and hydrostatic test requirements shall be in accordance with ASTM A530/A530M. Welding shall be in accordance with NAVSEA.

O-2-2 Modified for use of Inconel 625 as approved.

O-2-3 Butt-weld ends trim as approved.

TABLE LV. Category P-1, Boiler safety valve and super-heater outlet safety valve escape, 150 psig/850 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
P-1	Boiler safety valve, and super-heater outlet safety valve escape	150	850	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-24691/1, Grade B ASTM A106/A106M, Grade B	See note P-1-1
Fittings	Butt-welding	Carbon steel, ASTM A234/A234M, Grade WPB	ASME B16.9	
Take-down joints	Flanges, butt-welding	Carbon steel, ASTM A105/A105M	ASME B16.5, series 150	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716	
Flange bolting	Constant strength stud	Alloy steel	ASTM A193/A193M, Grade B7	See 4.16
	Nuts		ASTM A194/A194M, Grade 4 or 7	

NOTE:
P-1-1 Carbon steel pipe permitted based on 850 °F non-continuous and open-ended service.

TABLE LVI. Category P-2, Nuclear steam generator escape piping to transition joint, 150 psig/350 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
P-2	Nuclear steam generator escape piping to transition joint	150	350	See note P-2-1

Item	Types	Material	Applicable documents	Remarks
Piping and tubing	Seamless	Carbon steel	MIL-P-24691/1, Grade B	
Fittings	Butt-weld, 1/4" and above	Carbon steel, ASTM A234/A234M, Grade WPB	ASME B16.9	
	Butt-welding end branch outlets, 1/4" and larger		Commercial	
	Flanged, 1/2" and larger	Carbon steel, ASTM A216/A216M, Grade WCB ASME B16.5	ASME B16.5	
Flanges	Butt-weld (welding neck), 1/4" and larger	Carbon steel, ASTM A105/A105M	ASME B16.5	
Gaskets	Spiral wound	Metallic-flexible graphite	MIL-G-24716, Class B	
Flange bolting	Bolts, screws, studs	Alloy steel	MIL-DTL-1222, Grade B7	See 4.16
	Nuts		MIL-DTL-1222, Grade 4 or 7	
NOTE:				
P-2-1	If a cutout valve is installed downstream of the steam generator safety valves, main steam pressure and temperature design criteria shall be used for the escape piping. Where no cutout valve is installed downstream of the steam generator safety valve, the design pressure shall be equal to 110 percent of the calculated back pressure created under max. flow conditions at the discharge of the safety valves.			

TABLE LVII. Category P-3, Nuclear steam generator escape piping - transition to overboard, 150 psig/350 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
P-3	Nuclear steam generator escape piping - transition to overboard	150	350	See note P-3-1

Item	Types	Material	Applicable documents	Remarks
Piping and tubing	Seamless	Copper-nickel (90-10 or 70-30)	MIL-T-16420	Limited to 100 psig max.
Fittings	Butt-welding	Copper-nickel (70-30)	ASME B16.9	
Flanges	Welding neck	Copper-nickel (70-30)	ASME B16.5	
Valves	Horizontal lift-check	Nickel-copper (N04400)	As approved	Flanged
	Outside screw and yoke gate valve			
Gaskets	Sheet	As approved		
	Spiral wound	Metallic-flexible graphite	MIL-G-24716, Class B	
Bolting	Bolts, screws, studs	Nickel-copper-aluminum, QQ-N-286, Class A	MIL-DTL-1222, Alloy 500	See 4.16
	Nuts	Nickel-copper	MIL-DTL-1222, Alloy 400	
	Nuts, self-locking		MIL-DTL-32258	

NOTE:

P-3-1 If a cutout valve is installed downstream of the steam generator safety valves, main steam pressure and temperature design criteria shall be used for the escape piping. Where no cutout valve is installed downstream of the steam generator safety valve, the design pressure shall be equal to 110 percent of the calculated back pressure created under max. flow conditions at the discharge of the safety valves.

TABLE LVIII. Category Q-1, Refrigerant piping, 30 inches vacuum to 300 psig/minus 85 °F to plus 250 °F.

Category and group	Services	Maximum system pressure psig	System operating temperature °F	Remarks
Q-1	Refrigerant piping	30 inches vacuum to 300 psig	Minus 85 to plus 250	See notes Q-1-1 and Q-1-2
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	ASTM B88, hard drawn or ASTM B280	
		Copper-nickel	MIL-T-16420	
Valves	Manual	Bronze	MIL-DTL-20064	
		Forged brass	MIL-R-16743	
	Angle relief (line)	Brass	MIL-R-16743	
	Control		MIL-R-16743 or MIL-R-24085	
Fittings	Silver brazing	Wrought copper or forged brass	ASME B16.22	See note Q-1-3
	Socket and butt-weld	Copper-nickel	ASME B16.11 or B16.9	
Mechanical take-down joints	O-ring face seal unions, brazed or welded	Corrosion resisting steel, Copper-nickel	Commercial 810-1385889 803-1385948	See note Q-1-4
Flanges	Silver brazing, 4-bolt tongue and groove	Steel	ASTM A105/A105M	Flange
		Brass	Commercial	Adapter
Flange bolting	Bolts, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
Gaskets	Sheet	Composite	Garlock (CAGEC 73680) Blue Gard 3300 or equal	See note Q-1-6
		Nylon inserted rubber	804-5284201, Type 1	See note Q-1-5, 4.26

TABLE LVIII. Category Q-1, Refrigerant piping, 30 inches vacuum to 300 psig/minus 85 °F to plus 250 °F - Continued.

NOTES:

- Q-1-1 Copper-nickel piping with welded joints shall be used where practical for locations where joints would not otherwise be accessible for leak detection and repair.
- Q-1-2 The system design gauge pressure is dependent with refrigerant utilized R-11, 30 psig; R-12, 150 psig; R-22, 300 psig, R-114, 50 psig, R-134a, 165 psig, and R-236fa, 70 psig.
- Q-1-3 ASME B16.22 fittings shall be silver-brazed.
- Q-1-4 For tubing 1 $\frac{5}{8}$ inch outside diameter and smaller, take-down joints shall be silver-brazed or welded O-ring face seal unions. O-ring material shall be compatible with refrigerant in system.
- Q-1-5 For use with discharge rupture disk assembly.
- Q-1-6 Additional qualified materials to MIL-G-24717 include Klinger (CAGEC 9U500) C-4400, Parker Hannifin (CAGEC 48482) Clipper Style 976, and Claremont (CAGEC 52307) Rotex 10.

TABLE LIX. Category R-1, Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains, 50 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
R-1	Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains	50	150	See 4.14 and notes R-1-1 through R-1-5, R-1-8

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
	Seamless	Aluminum alloy, 5086	ASTM B210	
		Carbon steel, galvanized	ASTM A106/A106M, Grade B	
		GRP	MIL-P-24608	See note R-1-5, Category C-3
Valves	Gate, 2½ to 12 NPS	Bronze	803-2177917 or MIL-V-1189	Flanged ends only See note R-1-7
	Gate, ¼ to 2 NPS		803-1385714	Union ends only
	Globe/angle stop, stop-check, 2½ NPS and above		803-1385541	Flanged ends only
	Globe/angle stop, stop-check and needle, ¼ to 2 NPS		803-4384536	Union ends only
	Swing-check, 2½ to 12 NPS		803-1385637 or MIL-V-17547	Flanged ends only
	Swing-check, ¼ to 2 NPS		803-1385721	Union ends only
	Ball, ¼ to 2½ NPS	Bronze	803-5001003	Bronze body w/bronze, copper-nickel, or nickel-copper end piece
		Copper-nickel		Copper-nickel body w/copper-nickel end piece
	Ball, 3 to 6 NPS	Bronze	803-5001004	6 NPS valve is butt-welded only
Ball or plug, full port, 1¼ to 8 NPS		MIL-V-24509		

TABLE LIX. Category R-1, Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains, 50 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Deck drain	Copper-nickel	803-1385789	See note R-1-6
		Bronze, aluminum	803-1385789	Modified for alternate material
		Carbon steel, galvanized	Commercial	
	Butt-welding	Copper-nickel (90-10)	810-1385880	
		Aluminum alloy, 5086 or carbon steel, galvanized	ASME B16.9	
	Socket-bonded	GRP	MIL-P-24608	See notes R-1-4 and R-1-5 See 4.43, Category C-3
	Socket-welding	Carbon steel, galvanized, ASTM A105/A105M	ASME B16.11	
		Copper-nickel	803-6397430	
	MAFs	Various	ASTM F1387	See 4.46
Belled end and closure couplings	Copper-nickel, MIL-T-16420	MSS SP-119	See 4.48	
Take-down joints	Flanges, silver brazing	Bronze	MIL-PRF-20042	
	Flanges, socket-bonded	GRP	MIL-P-24608	See notes R-1-4 and R-1-5
	Flanges, socket-welding	Carbon-steel, galvanized, ASTM A105/A105M	ASME B16.5	
		Copper-nickel	803-6983512	
Gaskets	Sheet	Synthetic rubber	MIL-PRF-1149	See 4.26
		Synthetic rubber cloth inserted	HH-P-151	
		Nylon inserted rubber	804-5284201, Type 1 as approved	
	Hybrid	Elastomer seal	MIL-PRF-32187	Oily waste, see 4.26
	O-rings	Fluorocarbon	SAE-AMS7276 (75 durometer)	For oily water drainage and oily waste transfer
		Ethylene Propylene Rubber (EPR)	AIA NAS1613	For non-oily systems

TABLE LIX. Category R-1, Waste water, oily water drainage, oily waste transfer, weather deck drainage systems, and contaminated deck drains, 50 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flange bolting (not in bilge or on non-ferrous components)	Bolts, screws, and studs	Carbon steel, zinc-coated	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
Flange bolting (located in bilge or on non-ferrous components)	Bolts, screws, and studs	Nickel-copper	ASTM F468, Alloy 400	
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
R-1-1 Aluminum pipe, fittings, and drains are to be used in area of aluminum structures only.				
R-1-2 Steel pipe, fittings, and deck drains are to be used only in the weather deck drains above the main deck in the area of steel structure outside ship envelope.				
R-1-3 Copper-nickel pipe, bronze fittings, and valves to be used in weather deck drains within ship envelope, oily waste, waste water and oily waste transfer.				
R-1-4 GRP pipe or fittings may be used in oily waste transfer.				
R-1-5 Adhesive in accordance with MIL-P-24608 shall be used for joining GRP pipe to GRP fittings and flanges.				
R-1-6 Weather deck drains routed through the hull or superstructure shall be welded, 90-10 copper-nickel pipe.				
R-1-7 Bonnet gaskets for MIL-V-1189 valves shall be in accordance with SAE-AMS3216.				
R-1-8 Oily waste drains shall be fire-hardened. Silver-brazed joints and GRP shall not be used in that service.				

TABLE LX. Category R-2, Chemical drains, 30 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
R-2	Chemical drains	30	150	See note R-2-1
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	CRES	MIL-P-24691/3, 316L or ASTM A312/A312M, 316L	See 4.51
		Carbon steel (lead lined)	ASTM A106/A106M, Grade B	
		Lead lining	As approved	
		GRP	MIL-P-24608	See Category C-3 See 4.43
Valves	Gate	Bronze, Corrosion-steel, ASTM A351/A351M, Grade CF-8M	MIL-V-1189	
	Check		MIL-V-17547	
	Ball, ¼" to 2½"		803-5001003	
	Ball, 3" to 6"		803-5001004	
Fittings	Flanged	CRES, ASTM A182/A182M, 316L	ASME B16.5	
		Carbon-steel (lead lined)		
	Butt-welding	CRES, ASTM A182/A182M, 316L	ASME B16.9	
Flanges	Butt-welding	CRES, ASTM A182/A182M, 316L	ASME B16.5	
		Carbon steel (lead lined)		
	Silver brazing	Bronze	MIL-PRF-20042	
Gaskets	Sheet	Lead		
	Spiral wound	Metallic	MIL-G-24716	
Flange bolting	Bolts, screws, studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts		SAE-J995, Grade 5	
NOTE: R-2-1 CRES material to be used for photo lab drainage piping system.				

TABLE LXI. Category R-3, Plumbing drains and vents, interior space deck drains and AC condensate drains, 50 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
R-3	Plumbing drains and vents, interior space deck drains and AC condensate drains	50	150	
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	See note R-3-1
		Carbon steel (galvanized)	ASTM A106/A106M	See note R-3-2
	Seamless	Copper	MIL-T-24107	See note R-3-8
		Aluminum alloy 5086	ASTM B210	See note R-3-4
		GRP	MIL-P-24608	See note R-3-6 See Category C-3
Valves	Flanged, 50 psig scupper	Bronze, Copper-nickel (90-10 or 70-30), bronze	803-1385707 2-6 NPS	
			NAVSEA approved (8 NPS)	
	3-way, 2-position valve		MIL-V-24509	See note R-3-3
	Ball or plug, full port, 1/4 to 8 NPS			
	Swing-check, 1/4 to 2 NPS		803-1385721	Union ends only
Swing-check, 2 1/2 to 12 NPS	803-1385637	Flanged ends only		
Fittings	Silver brazing	Bronze	MIL-DTL-1183	See note R-3-5
	Socket-welding	Carbon steel, galvanized, ASTM A105/A105M	ASME B16.11	
		Copper-nickel (90-10 or 70-30)	803-6397430	
	Belled-end and couplings	Copper-nickel	MSS SP-119	See 4.48
	Butt-welding	Carbon steel, galvanized, ASTM A234/A234M, Class WPB	ASME B16.9	
		Copper-nickel	810-1385880	

TABLE LXI. Category R-3, Plumbing drains and vents, interior space deck drains and AC condensate drains, 50 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings - continued	Deck drain	Aluminum alloy 5086, copper-nickel	803-1385789	See note R-3-4
	Tailpieces	Copper-nickel, bronze	803-7063850	
	MAFs	Various	ASTM F1387	See 4.46
	Press-connect	Various	ASTM F3226/F3226M	See 4.47
	Socket (bonded)	GRP	MIL-P-24608	See note R-3-6, R-3-7
Take-down joints	Flanges, welded	Copper-nickel	803-6983512	
		Carbon steel	ASTM A105/A105M	
	Flanges, silver-braze	Bronze	MIL-PRF-20042	
	Union, welded	Copper-nickel	Commercial	See note R-3-9
	Union, silver-braze	Bronze	MIL-DTL-1183	
	Flanges, socket (bonded)	GRP	MIL-P-24608	See note R-3-6, R-3-7
Gaskets	Sheet	Synthetic rubber	MIL-PRF-1149, Ty II, Cl 2	See 4.26
		Nylon inserted rubber	804-5284201, Types 1 or 2 as approved	
		Rubber	MIL-R-21252	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
R-3-1	Required for gravity water closet and urinal drains, seawater waste drains, vent piping subject to seawater emersion up to a height of fixture overflow, and sewage treatment plant effluent overboard discharge.			
R-3-2	Steel pipe and fittings are to be used only in vent piping above the height of fixture overflows.			
R-3-3	Impregnation of castings as an aid in meeting tightness test is permissible on flanged end valves which have no need for application of heat in either manufacture or installation. Impregnation requirements of S9074-AR-GIB-010/278 are applicable.			
R-3-4	Use aluminum alloy for freshwater drains in interior aluminum superstructure.			
R-3-5	Fittings used in gravity drainage systems shall promote smooth flow and facilitate cleaning. Pipe bends, long radius elbows, sweep ties, laterals, and reducing fittings shall be used to the maximum extent practicable. The use of short radius elbows, tees, and bushings shall be avoided.			
R-3-6	GRP pipe and fittings may be used only for interior space deck drains and plumbing vents, except for deck drains from spaces subject to fuel spills. The mass of GRP pipe installed shall be limited to 25 pounds per 1000 cubic feet of compartment volume, because of personnel fire-fume hazard.			
R-3-7	Adhesive in accordance with MIL-P-24608 shall be used for joining GRP pipe to GRP fittings and flanges.			
R-3-8	Use for freshwater drains and vents up to a height of fixture overflow.			
R-3-9	Commercial items subject to NAVSEA approval.			

TABLE LXII. Category R-4, Sewage collection, holding, and transfer (CHT) and vacuum collection, holding, and transfer (VCHT), 100 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
R-4	Sewage collection, holding, and transfer (CHT) and vacuum collection, holding, and transfer (VCHT)	100	150	See notes R-4-1, R-4-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	GRP	MIL-P-24608	See note R-4-5 See Category C-3
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Swing-check, ¼ to 2 NPS	Bronze	803-1385721	Union ends only
	Swing-check, 2½ to 12 NPS		803-1385637	Flanged ends only
	Swing-check, 14 NPS and above	Bronze, Nickel-aluminum-bronze	MIL-V-17547	
	Swing-check with manual jack-open device	Bronze		See note R-4-2
	Gate, 2½" and larger		MIL-V-1189, Type 1, Class 1 or 803-2177917	
	Ball or plug, full port	Bronze	MIL-V-24509	See note R-4-2
	Ball or plug, 3 port, two position			
Fittings	Butt-welding	Copper-nickel	810-1385880	
	Socket-welding		803-6397430	
	Silver brazing	Bronze	MIL-DTL-1183	
	Socket-bonded	GRP	MIL-P-24608	See note R-4-4 and R-4-5
	Mechanically attached (MAFs)	Various	ASTM F1387	See 4.46
	Press-connect	Various	ASTM F3226/F3226M	See 4.47
	Inside tanks	GRP	MIL-P-24608	See 4.43
	Belled-end and couplings	Copper-nickel	MSS SP-119	See 4.48

TABLE LXII. Category R-4, Sewage collection, holding, and transfer (CHT) and vacuum collection, holding, and transfer (VCHT), 100 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges, silver brazing	Bronze	MIL-PRF-20042	
	Unions, silver brazing		MIL-DTL-1183	
	Flanges, welded	Copper-nickel	803-6983512	
	Unions, welded		Commercial	See note R-4-6
Gaskets	Sheets	Synthetic rubber	MIL-PRF-1149, Ty II Cl 2	See 4.26
			HH-P-151	
		Nylon inserted rubber	804-5284201, Type 1 or 2, as approved	
Flange bolting	Bolts, studs, screws	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES:				
R-4-1	Deck discharge connections shall be in accordance with 804-4444650.			
R-4-2	Impregnation of castings as an aid in meeting tightness test is permissible on flanged end valves which have no need for application of heat in either manufacture or installation. Impregnation requirements of S9074-AR-GIB-010/278 are applicable.			
R-4-3	This category and group shall apply to VCHT system collection piping, waste drain pump and sewage pump suction and discharge piping, overflow and vent piping for CHT, VCHT, and waste drain tanks, and aeration and tank washdown piping located inside CHT, VCHT, and waste drain tanks.			
R-4-4	May be used only for CHT, VCHT, or waste drain tank overflow and vent piping, and for piping installed inside CHT, VCHT, or waste drain tanks, such as pump suction, aeration, or tank washdown piping. The mass of GRP pipe installed shall be limited to 25 pound per 1000 cubic feet of compartment volume, because of personnel fire-fume hazard.			
R-4-5	Adhesive in accordance with MIL-P-24608 shall be used for joining GRP pipe to GRP fittings and flanges.			
R-4-6	Commercial items subject to NAVSEA approval.			

TABLE LXIII. Category S-1, Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 psig.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
S-1	Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution	250		See 4.14 and note S-1-2

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless or welded	Copper-nickel (90-10 or 70-30)	MIL-T-16420	See note S-1-3	
Valves	Gate	Bronze	803-1385714 803-2177917		
			MIL-V-1189 or as approved		
	Globe and angle		803-1385623		
			803-4384536		
	Swing-check		803-1385541	100 psi max.	
			803-1385721 803-1385637 (or as approved)		
	Hose end		803-1385711		
			803-1385712		
	Control		803-6397408		
			803-6983468 MIL-V-17501	Type 4	
	Ball, ¼" to 2½"		Bronze or copper-nickel	Commercial	See note S-1-1
				803-5001003	
	803-5001004				
	Ball, 3" to 6"		Bronze	MIL-V-24332	
	Relief			ASTM F1370 including supplements	Copper-nickel trim UNS N05500 See 4.42
Pressure reducing					
Butterfly 2 inches and larger	Ni-Al-bronze	MIL-V-24624, Type I or III	See 4.7, 4.30		
		MIL-PRF-32307			

TABLE LXIII. Category S-1, Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 psig - Continued.

Item	Types	Material	Applicable documents	Remarks
Fittings	MAFs		ASTM F1387	See 4.46
	Butt-welding	Copper-nickel (90-10 or 70-30)	810-1385880 ASME B16.9	
	Socket-welding		ASME B16.11	
	Tailpieces		803-6397430	
	Belled end and couplings, 12 NPS max.		803-7063850	For union valves
		MSS SP-119	See 4.48	
Take-down joints	Flanges, butt-welding	Copper-nickel	810-1385992	
	Flanges, butt and socket-welding		803-6983512	
	Unions, weld	Copper-nickel, MIL-C-15726	Commercial 803-1385884	See note S-1-1
Gaskets	Sheet	Ethylene propylene terpolymer (EPT)	MIL-DTL-22050	For concentrate
		Nylon inserted rubber	804-5284201, Type 4, as approved	See 4.26 For mixture
	O-ring	Fluorocarbon	SAE-AMS7276	
	Hybrid	Elastomer seal	MIL-PRF-32187	Use with butterfly valves
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	
	Nuts		ASTM F467, Alloy 400	See 4.16
	Nuts, self-locking		NASM 25027/NASM 17828 MIL-DTL-32258	

TABLE LXIII. Category S-1, Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 psig - Continued.

NOTES:

S-1-1 The use of commercial items shall be subject to NAVSEA approval.

S-1-2 All piping joints shall be welded downstream of the service control valves. Silver-brazed joints shall not be used.

S-1-3 70-30 copper-nickel shall be used as specified in special applications and where required for maximum system pressure.

TABLE LXIV. Category T-2, HFP and Halon 1301 fire extinguishing systems, 1170 psig/140 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
T-2	HFP and Halon 1301 fire extinguishing systems	1170	140	See 4.14, 4.39 and note T-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A106/A106M, Grade B, schedule 80	See note T-2-2
		CRES	ASTM A312/A312M, Grade 304L or 316L, schedule 80	See 4.51
Valves	Ball, plug and check	CRES, ASTM A182/A182M, Grade F316	MIL-E-24572	Valves shall meet the requirements of MIL-STD-167-1 and MIL-DTL-901
	Check		803-6397404 (outlet mod ¼ NPS)	
Fittings	Butt-welding	Carbon steel, ASTM A234/A234M, Grade WPB, ASTM A105/A105M, ASTM A106/A106M, Grade B, CRES, ASTM A403/A403M, WP304L-S or WP316L-S	ASME B16.9	
	Socket-welding	Carbon steel, ASTM A105/A105M, CRES, ASTM A182/A182M, Grade F316L or F304L	ASME B16.11	

TABLE LXIV. Category T-2, HFP and Halon 1301 fire extinguishing systems, 1170 psig/140 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Flanges	Butt-welding	Carbon steel, ASTM A105/A105M, CRES, ASTM A182/A182M, F304L or F316L	ASME B16.5	
	Socket-welding			
Gasket	Spiral wound	Metallic	MIL-G-24716	
Flange bolting	Bolts, screws, studs	Carbon steel	ASTM A449, Type I	See 4.16
	Nuts	Carbon steel	SAE-J995, Grade 5	
Nozzle	Various orifice sizes with 360 pattern or 180 pattern	CRES, ASTM A182/A182M, Grade 316	MIL-E-24572	Orifice code to be in accordance with NFPA Standard 12A
NOTES:				
T-2-1	1170 psig design pressure is applicable to sections of discharge piping which are downstream of distribution valves and all other open-ended sections of piping in the discharge portion of the HFP/Halon system. For modular type HRP/Halon systems the 1170 psig design pressure applies to all of the discharge piping.			
T-2-2	Exposed carbon steel pipe in the bilge region shall require the following special coatings: When abrasive blasting equipment is available, abrasive blast the external surfaces to near white metal (steel structure, SSPC SP 10). Coat immediately with an inorganic zinc coating in accordance with Class 2 of MIL-PRF-23236 in accordance with manufacturers' instructions. Then apply 3 coats of heat resisting aluminum paint, TT-P-28. When abrasive blasting equipment is not available, use the pneumatic portable sealer over the metal surface and then apply 3 coats of heat resisting aluminum paint, TT-P-28.			

TABLE LXV. Category T-3, CO₂ actuation for HFP and Halon fire extinguishing systems, 2080 psig/200 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
T-3	CO ₂ actuation for HFP and Halon fire extinguishing systems	2050	200	See 4.14, 4.39

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless, Type I	CRES, GR TP 316L, SCH 80	MIL-P-24691/3	
Valves	Check	CRES, Grade 316 or 316L ASTM A182/A182M, F316L	803-6397404 (outlet mod ¼ NPS)	Valves shall meet the requirements of MIL-STD-167-1 and MIL-DTL-901
	Ball - SWUE		MIL-E-24572	
Fittings	Socket-weld	CRES, ASTM A182/A182M, Grade 316L	ASME B16.11	
Take-down joints	Unions, socket-weld	CRES 316L	803-1385884	See note T-3-1
NOTE:				
T-3-1 O-ring for unions to be in accordance with SAE-AMS7276.				

TABLE LXVI. Category Y-1 and Y-2. Overflows, sounding tubes, vents and air escapes for JP-5, fuel, lubricating oil, oily tanks, 100 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
Y-1 and Y-2	Overflows, sounding tubes, vents and air escapes for JP-5, fuel, lubricating oil, oily tanks	100	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	CRES 316L or copper-nickel (70-30 or 90-10)	MIL-P-24691/3 or ASTM A312/A312M, Ty 316L, MIL-T-16420	See 4.51
Valves	Wafer check	Bronze	Commercial, Proquip International Model Procheck, or equal 803-2177917 803-1385714 MIL-V-1189	
	Gate			
	Floating ball check valve	Carbon steel	803-5959276	
	Ball	Bronze or CRES 316L	803-5001003 (mod)	Flange x socket-weld
Fittings	Belled end socket-weld	Copper-nickel or CRES 316L	MSS SP-119	See 4.48
	Deck (sounding and filling)	Bronze	810-1385848	
	Butt-weld	Copper-nickel (70-30 or 90-10) or CRES 316L	ASME B16.9 810-1385880 ASTM A403/A403M WP316L	
	Socket-weld		ASME B16.11 (mod) 803-6397430	

TABLE LXVI. Category Y-1 and Y-2, Overflows, sounding tubes, vents and air escapes for JP-5, fuel, lubricating oil, oily tanks, 100 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanges, socket-welding	Copper-nickel (70-30 or 90-10) or CRES 316L	810-1385992, ASME B16.5 (mod) 803-6983512	
	Unions	Copper-nickel	As approved	
	Tailpieces for union valves		803-7063850	
Gaskets	Sheet	Buna-N and cork	SAE-AMS-C-6183, Class 1, Grade C-firm	See 4.26
		Nylon reinforced rubber	804-5284201, Type 3 or 4 as approved	
	Hybrid		MIL-PRF-32187	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

TABLE LXVII. Category Y-3, Overflows, sounding tubes, vents, and air escapes for other than fuel tanks [freshwater (except potable) clean ballast, voids, etc.], 50 psig/150 °F.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
Y-3	Overflows, sounding tubes, vents and air escapes for other than fuel tanks [freshwater (except potable) clean ballast, voids, etc.]	50	150	See note Y-3-1 Non-ferrous material for new construction

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel, galvanized or copper-nickel (90-10 or 70-30)	ASTM A53/A53M MIL-T-16420	
Valves	Gate	Bronze	803-2177917 803-1385714	
	Swing-check		803-1385637 803-1385721	
	Ball, ¼" - 2½"		803-5001003	
	Ball, 3" - 6"		803-5001004	
Fittings	Flanged	Carbon steel, galvanized, ASTM A105/A105M, Bronze	ASME B16.5 810-1385915	Flat face
	Butt	Carbon steel, ASTM A105/A105M, ASTM A106/A106M, Grade B, ASTM A234/A234M WPB, Copper-nickel (90-10 or 70-30)	ASME B16.9	
			810-1385880	
	Socket-weld	Carbon steel, ASTM A105/A105M, Copper-nickel (90-10 or 70-30)	ASME B16.11 803-6397430	
	Deck	Steel	810-1385848	
Carbon steel			810-1385791	

TABLE LXVII. Category Y-3, Overflows, sounding tubes, vents and air escapes for other than fuel tanks
[freshwater (except potable) clean ballast, voids, etc.], 50 psig/150 °F - Continued.

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Flanged	Carbon steel, galvanized, ASTM A105/A105M, Copper-nickel (90-10 or 70-30)	810-1385992 ASME B16.5 803-6983512	Flat face See note Y-3-2
	Unions		803-1385884	
	Tailpieces for union valves		Copper-nickel/bronze	Commercial 803-7063850
	Gaskets	Sheet	Nylon reinforced rubber	804-5284201, Type 1 or 2 as approved
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	See 4.16
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	
NOTES: Y-3-1 For potable water use Category C-2. Y-3-2 Ferrous flanges may be constructed from ASTM A105/A105M to 803-6983512 and 810-1385992 for mating to non-ferrous.				

TABLE LXVIII. Category Y-4, Vents, reduction gear, 5 psig/ambient.

Category and group	Services	Maximum system pressure psig	Maximum system temperature °F	Remarks
Y-4	Vents, reduction gear	5	Ambient	
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10 or 70-30)	MIL-T-16420	
Fittings	Silver brazing	Bronze	MIL-DTL-1183	
	Socket-welding	Copper-nickel	803-6397430	
Flanges	Silver brazing	Bronze	MIL-PRF-20042	
	Welding	Copper-nickel	803-6983512	
Gaskets	Sheet	Buna-N and cork	SAE-AMS-C-6183, Class 1, Grade C-firm	See 4.26
		Nylon reinforced rubber	804-5284201, Type 1 or 2 as approved	
Flange bolting	Bolts, screws, studs	Nickel-copper	ASTM F468, Alloy 400	See 4.16
	Nuts		ASTM F467, Alloy 400	
	Nuts, self-locking		NASM 25027/NASM 17828	
			MIL-DTL-32258	

MIL-STD-777F
W/CHANGE 2

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard identifies approved piping and component specifications for design of new shipboard piping systems on Navy Vessels and repair of piping systems on Navy Vessels when invoked by the applicable contract document.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this standard.

6.3 Subject term (key word) listing.

Fasteners

Flanges

Gaskets

Unions

6.4 Change notations. The margins of this standard are marked with vertical lines to indicate modifications generated by this change. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

MIL-STD-777F(SH)
W/CHANGE 2

INDEX

Since operating conditions may vary among different designs of ships, this index often refers to a category of materials only for each system. Within each category, selection should be made of that group which can accommodate the specific operating conditions of pressure and temperature for the system under consideration. (Example: Where the category only is specified such as "A", the proper group, that is A-1, A-2, and so forth, shall be selected according to the operating conditions.)

	<u>Applicable category and group</u>
<u>A</u>	
Actuation, CO ₂	T-2
AFFF	S-1
Air, aircraft, starting and prairie	J-6
Air and bleed-off	J-5
Air and nitrogen	J-3 and J-4
Air, bleed-off	J-5
Air deballast	J-8
Air escapes, overflows, sounding tubes and vents for JP-5 outside tank beyond first connection	Y-1 and Y-2
Air escapes, overflows, sounding tubes and vents for tanks other than fuel tanks (freshwater (except potable) clean ballast, voids, and so forth)	Y-3
Air, nitrogen and helium	J-1 and J-2
Air, prairie-masker ships gas turbine starting	J-6
Anti-icing, gas turbine bleed air system	J-9
Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution	S-1
Aviation lubricating system, cleaning fluid, contaminated	H-2
<u>B</u>	
Ballast, seawater including main and secondary drainage	D-1 and D-3
Bleed-off and air	J-5
Blowdown, steam generator, overboard discharge	A-9
Boiler feed	B-1
Boiler safety valve, and super-heater outlet safety valve escape	P-1
<u>C</u>	
Chemical drains	R-2
Clean ballast	D-1 and D-3
Cleaning fluids and contaminated aviation lubricating system	H-2
CO ₂ Actuation, HFP and Halon	T-2
Condensate, freshwater and electronic freshwater cooling	C-1 and C-2
Condensate, freshwater – feed water, including potable	H-2
Contaminated aviation lubricating system and gasoline cleaning fluid	H-2
Contaminated, deck waste, oily water and weather deck drains	R-1
Cooling, condensate and electronic freshwater	L-1
Cooling for electronic equipment diesel engine and so forth – ethylene glycol, freshwater solution	L-1
Cooling for electronic equipment – seawater	D-1 and D-3
Countermeasure – washdown	M-1

MIL-STD-777F(SH)
W/CHANGE 2

	<u>Applicable category and group</u>
<u>D</u>	
Deck waste drains and oily water and weather deck drains, contaminated	R-1
Deionized water	C-5
Diesel, sewage treatment, incinerator and gas turbine exhaust	O-1
Drainage, main and secondary	D-1 and D-3 and D-2
Drains, chemical	R-2
Drains, deck, waste contaminated, and oily water and weather deck	R-1
Drains and vents, plumbing	R-3
Drains, steam	A-1, A-2, A-3, A-4 and A-7, A-5, A-6, A-8, and A- 10
<u>E</u>	
Electronic equipment, cooling for ethylene glycol, freshwater solution	L-1
Electronic freshwater cooling and freshwater, condensate	C-1 and C-2
Escape, boiler safety valve and super-heater outlet safety valve	P-1
Exhaust, auxiliary	A-8
Exhaust, diesel, sewage treatment, incinerator and gas turbine	O-1
Exhaust, gland	A-6
<u>F</u>	
Feed systems	B-1
Feed systems propulsion plant saturated	B-2
Feed water – freshwater and condensate, including potable	C-2
Filling transfer and tank stripping, JP-5 fuel service	E-4 and U-1, I-1
Film-forming foam (AFFF) concentrate and AFFF/SW solution, aqueous	S
Firemain	D-1 and D-3, D-4
Freshwater, condensate and electronic freshwater cooling	C-1 and C-2
Freshwater, chilled water, feed water and condensate, including potable	C-2
Freshwater firemain	C-1
Fuel and tank stripping, JP-5	E-4 and U-1, I-1
Fuel	E-4 and U-1
<u>G</u>	
Gas, mixed	K-6
Gaseous oxygen	K-3
Gaseous oxygen, outside hull	K-1
Gasoline	H-1
Gas turbine bleed air system, anti-icing	J-9
Gas turbine and diesel, sewage treatment, incinerator, exhaust	O-1
Gauge piping	803-1385850
Gland, exhaust	A-6
<u>H</u>	
HALON 1301 and HFP (fire extinguishing systems)	T-2
Helium, air and nitrogen	J-1 and J-2 and J-3

MIL-STD-777F(SH)
W/CHANGE 2

	<u>Applicable category and group</u>
HFP, HALON 1301 (fire extinguishing systems)	T-2
HFP water spray	N-1
High purity water	C-5
Hull, gaseous inside; oxygen	K-2
Hull, gaseous outside; oxygen	K-1
Hydraulic service	G-1, G-3, G-4, and G-5, G-8
Hydraulic system (including lines)	G-2, G-6, and G-7
<u>I</u>	
Inside hull, gaseous oxygen	K-2
<u>J</u>	
JP-5 fuel service, filling transfer or tank stripping	E-4 and U-1, I-1
<u>L</u>	
Liquid oxygen and nitrogen	K-4 and K-5
Lubricating oil	F-1
<u>M</u>	
Main steam and steam drains	A-3
Magazine sprinkling (wet and dry)	N-2
Main system, starting and prairie	J-7
Miscellaneous sprinkling, wet	N-3
Mixed gas	K-6
<u>N</u>	
Nitrogen and air	J-1 and J-2, J-3, J-5, and J-6
Nitrogen, helium and air	J-1 and J-2, J-3
Nitrogen and oxygen, liquid	K-4 and K-5
Nuclear steam generator piping to transition joint	P-2
Nuclear steam generator escape piping, transition to overboard	P-3
<u>O</u>	
Oil, fuel	E
Oil, lubricating	F-1
Overflows, sounding tubes, vents and air escapes for JP-5 tanks	Y-1 and Y-2
Overflows, sounding tubes, vents and air escapes for tanks other than oil tanks (freshwater (except potable) clean ballast, voids, and so forth)	Y-3
Oxygen, gaseous	K-3
Oxygen, gaseous inside hull	K-2
Oxygen, gaseous outside hull	K-1
Oxygen and nitrogen, liquid	K-4 and K-5

MIL-STD-777F(SH)
W/CHANGE 2

	<u>Applicable category and group</u>
<u>P</u>	
Prairie maskers, air	J-7
Propane	K-7
<u>R</u>	
Reduction gear, vents	Y-4
Refrigerant piping	Q-1
<u>S</u>	
Safety valve, boiler, escape	P-1
Seawater, ballast	D-1 and D-3 and D-4
Seawater, firemain, potable water disinfection	D-4
Seawater missile injection system between freshwater accumulating tank and nozzles	D-2
Seawater, wash down, countermeasure system	M-1
Service, hydraulic	G-1, G-3, G-4, and G-5
Sewage collection, holding and transfer system (CHT)	R-4
Sounding tubes, overflows, vents and air escapes for JP-5 tanks	Y-1 and Y-2
Sounding tubes, overflows, vents and air escapes for tanks other than fuel tanks (freshwater (except potable) clean ballast, voids, and so forth)	Y-3
Sprinkling, AFFF	S-1
Sprinkling, (dry)	N-1
Sprinkling, HFP water spray	N-1
Sprinkling, magazine, (wet and dry)	N-2
Sprinkling, miscellaneous, (wet)	N-3
Sprinkling, washdown countermeasure	M-1
Starting and cooling, air	J-7
Steam and steam drains	A-1, A-2, A-3, A-4 and A-7, A-5, A-6, A-8, A-10
Steam system for auxiliary boiler, reboiler and waste heat boiler installation only	A-8
Steam system overboard discharge, steam generator blow down	A-9
Stripping, JP-5	E-4 and U-1, I-1
Super-heater outlet safety valve escape	P-1
<u>T</u>	
Tank stripping and JP-5 fuel service, filling transfer	E-4 and U-1, I-1
<u>V</u>	
Valve, boiler safety and super-heater outlet safety escape	P-1
Vents and drains, deck drains, plumbing, AC	R-3
Vents, reduction gear	Y-4
Vents, overflows, sounding tubes, and air escapes for JP-5 tanks	Y-1 and Y-2
Vents, overflows, sounding tubes, and air escapes for other than oil tanks (freshwater (except potable) clean ballast, voids, and so forth)	Y-3

MIL-STD-777F(SH)
W/CHANGE 2

Applicable category and group

W

Washdown countermeasure

Water, fresh condensate and electronic freshwater cooling (chilled)

Water, fresh, feed, condensate, including potable

Water mist

Water spray, HFP

M-1

C-1 and C-2

C-2

C-4

N-1

MIL-STD-777F(SH)
W/CHANGE 2

CONCLUDING MATERIAL

Custodian:
Navy – SH

Preparing activity:
Navy – SH
(Project 4730-2018-012)

Review activity:
DLA – CC

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.