

NOTE: MIL-STD-777 has been redesignated as a Design Criteria Standard. The cover page has been changed for Administrative reasons. There are no other changes to this Document.

MIL-STD-777E(SH)
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DEPARTMENT OF DEFENSE
DESIGN CRITERIA STANDARD

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



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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

Washington, DC 20362-5101

Schedule of Piping, Valves, Fittings and Associated Piping Components for
Surface Ships

1. This standard is approved for use by the Naval Sea Systems Command and the standard is published to establish the requirements 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 Ships Specifications for all new Navy surface ships.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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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 This standard is broken down into basic service categories and groups. The notes contained in each individual category and group and prefaced with the category and group designation, 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 This standard is bound so that any category and group can be removed and replaced with revised issues of that category and group. It is intended that changes, when required, will be made to individual categories and groups only, rather than issue a complete revision of the standard. Changes will be issued as notices and will be numbered consecutively.

1.4 This standard includes a list of categories and groups with the latest date of issue for each category and group. When a category and group is revised the list of categories and groups will also be revised and will be forwarded for insertion in the users copy of the standard.

1.5 This standard shall be maintained with all superseded categories and groups and list of categories and groups intact to assure that when users are applying the standard to requirements which may predate current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

2. REFERENCED DOCUMENTS

2.1 Government documents. Specifications, standards, drawings, and publications referenced in each category and group of this standard shall form a part of the standard to the extent specified herein and, unless otherwise specified, shall be the issue in effect on date of invitation for bids or request for proposal. Copies of specifications, standards, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. The issues of documents which have not been adopted shall be those in effect on the date of the cited DoDISS.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Nongovernment standards are generally available for reference from libraries. They are also distributed among nongovernment standards bodies and using Federal agencies.)

3. DEFINITIONS

Not applicable.

4. GENERAL REQUIREMENTS

4.1 For piping directly associated with a nuclear plant, the requirements of section 210 of the applicable ship specifications apply in lieu of the requirements specified herein.

4.2 Gauge piping requirements are specified on Drawing 804-1385850 except that gauge isolation and test valves shall be in accordance with MIL-V-24578 as modified below:

- (a) The material for all parts (except packing or O-ring) may also be nickel-copper to ASTM B 164 or B 564.
- (b) The lanyard shall be wire rope coated with flexible, translucent plastic of commercial design with suitable crimped fittings.
- (c) The valve design shall provide for a union type connection between the body and the bonnet. The design shall also provide for a positive method for preventing the stem from backing out of the bonnet. This shall be accomplished without the addition of separate pieces or additional operations (such as swaging). The intention is to have the stem assemble from the bottom of the bonnet.
- (d) The valve handwheel shall not exceed the dimensions shown on the valve envelope figure as specified in MIL-V-24578 and shall be round with a non-slip feature or "T" shaped and shall attach to the stem so as to preclude relative motion between the stem and handwheel. The preferred method of attachment is by flats or spline. If a friction device is used to attach the handwheel to the stem, a locking method to preclude unintentional loosening of the friction device shall be included. Handwheel material shall be metal or plastic or a combination of metal and plastic.
- (e) The stem back out test is not required.

The use of siphons and flexible connections as a means for providing flexibility is not mandatory provided configuration of gauge piping is such that the flexibility requirements of Drawing 804-1385850 are met and objectional vibrations are not transmitted to the gauges on the gauge board. Thermometer wells shall conform to the requirements of Drawing 810-1385917 and MIL-W-24270 using materials selected therefrom compatible with the materials specified for the intended service. If discrepancies exist with other specification requirements, clarification should be obtained from Naval Sea Systems Command (NAVSEA).

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Materials other than those specified are acceptable provided that they are entirely satisfactory in all respects and are approved by the command or agency concerned. The listing herein does not represent any order of preference.

4.3 Maximum system pressure and temperature ratings of the piping systems specified herein are based on the service category and group. If conflict occurs with applicable ship detail specifications or other applicable shipbuilding documents, the operating conditions specified in the latter shall apply. The normal maximum sustained temperature for each of the steels and non-ferrous alloys used in the piping system shall be limited as follows, except that the overall piping system temperature limitation shall not be exceeded:

<u>Piping material</u>	<u>Maximum service temperature °F</u>	
	<u>(T₁)</u>	<u>(T₂)</u>
Carbon steel	650	775
1 1/4 percent chrome - 1/2 percent molybdenum steel	700	1000
2-1/4 percent chrome - 1 percent molybdenum steel	700	1050
Corrosion-resisting steel 304, 316	—	1000
347, 321	—	1125
304L	—	600
316L	—	750
Copper	1/	400
Tin-bronze	350	550
Aluminum-bronze	250	600
Naval brass	300	400
90-10 copper-nickel	350	600
70-30 copper-nickel	450	700
70-30 nickel-copper	650	900
70-30 nickel-copper aluminum	600	—
Nickel-chromium-molybdenum-columbium-alloy	900	—

1/ For light drawn temper, 250 degrees Fahrenheit (°F)

4.4 The materials listed in 4.3 may be used up to temperature T₁ assuming physical (not mechanical) properties are equal to those at room temperature. At temperatures above T₁ and less than T₂, an adequate safety factor based upon the stress for rupture or the stress corresponding to 1 percent creep (both in 100,000 hours), whichever is lower shall be used in the design stress. The materials shall not be used at temperatures exceeding T₂ unless specifically approved by NAVSEA, except that for steels specified in 4.3, fluctuations of not more than 25°F in excess of T₂ are permissible for short duration.

4.5 The piping systems including support structures in machinery and similar fire prone 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.

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4.6 Any valve intended for sea water service not in accordance with a Navy standard drawing shall have nickel copper alloy stems, seats, discs, disc nuts, hinge pins and side plugs as applicable. For valves in sizes 2-1/2 inches and above, discs with a nickel-copper alloy facing of 1/8 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 sea water service may have bronze stems, seats, discs, disc nuts, hinge pins and side plugs, as applicable.

4.7 For valves (except valves on many mechanical standard drawings) fittings and flanges, contractors designs previously approved for comparable installations may be substituted for those specified, subject to justification to and approval of the command or agency concerned. Extensions of the applicability of previously granted waivers or approvals for reasons of shipbuilding expediency are not valid.

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

4.9 Butt welding end valves, fittings, and flanges shall not be used for sizes smaller than 1-1/4 inches except that inert gas consumable insert type butt welds may be used in sizes down to and including 1/2 inch subject to qualification of procedure by the activity doing the welding. Socket welding end valves, fittings, and flanges for P-1 piping may only be used in sizes up to and including 2 inches. For welding end steel valves, fittings and flanges, the carbon content shall not exceed 0.35 percent.

4.10 The use of long-radius elbows is desired to minimize flow turbulence. The use of short-radius elbows is acceptable where space conditions do not permit long-radius elbows.

4.11 Butt welding elbows and return bends shall have 1/2 inch minimum tangents. For commercial fittings, the 1/2 inch minimum tangents shall be outside the ANSI radius dimension. Tangents on fitting may be omitted where consumable inserts are used or where welding without backing rings is permitted. Where consumable insert welding has been previously approved for the shipbuilder by the command or agency concerned, butt welding will be permitted down to and including 1/2 inch.

4.12 Steel valves not covered by military specifications or standard drawings in steam and feed systems normally operating at gauge pressures of 150 pounds per square inch (1b/in^2) and above, shall have seat and disc seating surfaces hard faced using material in accordance with type MIL-Co-Cr-A of MIL-R-17131, or the equivalent. Steel valves in steam and feed systems below 150 lb/in^2 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.

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4.13 Where required, straight threaded union connections fitted with O-rings are permitted. Otherwise pipe threaded connections (tapered or straight) between piping, machinery and valves and in piping system joints not permitted except as follows:

- (a) Connections to commercial equipment such as washing machines and drinking water coolers which are not essential to the ship under combat conditions and where failure would not create a hazard to personnel, the surrounding area or affect the operation of other vital equipment.
- (b) Pipe plugs, of a material compatible with the parent equipment material in sizes 3/4 inch and below used for applications where gauge pressures do not exceed 50 lb/in².
- (c) Instrumentation, controls, vents and filling and drain connections for applications where gauge pressures are 50 lb/in² and below where fluids handled are neither toxic or dangerous nor could cause atmospheric contamination and which would not cause, in the event of failure, a major breakdown of the equipment nor create a hazard to the surrounding area nor affect the operation of other vital equipment.
- (d) For equipment where taper pipe threads are specified in RR-C-901, MIL-V-2/15, MIL-V-17360, MIL-R-15835, MIL-R-15917, MIL-H-17902, MIL-H-21291 and MIL-H-24606.
- (e) In unpressurized connections.

4.14 Silver brazing fittings shall be of the pre-inserted ring type, except as follows:

- (a) In sizes 1/2 inch nominal pipe size (nps) and below.
- (b) Fittings without preinserted brazing rings may be used in the refrigeration system (see category Q-1).
- (c) Expanded copper sleeves without preinserted brazing rings may be used in the inner wall of a double-walled gasoline piping system.
- (d) Water closet discharge fittings as shown on figures 6 and 7 of Drawing 810-1385706 may be used without preinserted rings.
- (e) Joints for voice tube and pneumatic tube systems.
- (f) Joints for bellmouth to pipe for tailpipes within tanks.

4.15 Threaded fasteners. In addition to the requirements contained in each category, the following also applies:

- (a) Piping system fasteners shall be of the UNC series with a class 2 or 3 fit.
- (b) Threaded fasteners shall be in accordance with MIL-S-1222 with dimensions in accordance with ANSI B18.2.1, washer faced or doubled chamfered.
- (c) Studs shall be in accordance with MIL-S-1222, type and style as applicable.
- (d) Nuts shall be in accordance with MIL-S-1222, with dimensions in accordance with ANSI B18.2.2, washer faced or double chamfered.

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- (e) Nuts located within tanks, in the bilge region or inaccessible for examination or routine replacement in service shall be of the self-locking type as specified in section 075 of the ship's specifications.
- (f) 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 blow-out valve) in branch lines connected to piping between the hull and the hull valve. Connections shall be as follows:
 - (1) Bolted hull integrity piping connections shall be fitted with nickel-copper-aluminum alloy fasteners in accordance with MS18116 except that lot identification is not required and with self-locking nuts, as specified in (e). Nuts may be nickel-copper alloy QQ-N-281 class A or B or nickel-copper-aluminum alloy in accordance with QQ-N-286.
 - (2) For services involving integrity of the hull against the sea, as defined in (f) above, energy absorption shall be provided by making the mounting fasteners essentially constant throughout their length. This may be achieved by threading over the entire length, reducing the non-threaded shank diameter to a dimension that falls between the pitch diameter and the root diameter (usually for cut threads), or maintaining the unthreaded shank diameter the same dimension as the unthreaded blank (usually for rolled threads). For resistance to shear forces, mating surfaces of the fasteners holes shall be beveled.
- (g) Nickel-copper alloy bolting in accordance with class A or B of QQ-N-281 shall be used in the following application:
 - (1) Where subject to sea water spray or submergence.
 - (2) Where not readily accessible for examination or maintenance in service due to their location and carbon steel, alloy steel, or bronze bolting is specified for the rest of the system. Some examples are: bilges, below floor plates, tanks, voids and other hidden areas. Where nickel-copper bolting does not meet the strength requirements of the joint, nickel-copper-aluminum alloy QQ-N-286 shall be used.
- (h) Threaded fasteners in non-ferrous joints where ferrous bolting is specified and located in high condensation areas, such as machinery spaces, scullery, galley, laundry and sanitary spaces shall be either nickel-copper in accordance with QQ-N-281 or silicon-bronze in accordance with QQ-C-591.
- (i) Wherever non-ferrous flanges mate up to ferrous flanges bolting material shall be either nickel-copper in accordance with QQ-N-281 or silicon-bronze in accordance with QQ-C-591.
- (j) Carbon and alloy steel fasteners shall be given protective coating as follows:

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- (1) For service temperatures to 1000°F coating in accordance with MIL-C-81751, type I, class 4.
- (2) For service temperatures to 650°F and for high humidity areas, coating in accordance with MIL-C-81751, type I, class 4; MIL-C-87115, class 3; or MIL-C-83488, type II, class 3.
- (3) For service temperatures to 300°F coating in accordance with MIL-C-81751, type I, class 4; MIL-C-87115, class 3; MIL-C-83488, type II, class 3; or ASTM B 633, type II, class 13.

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

(a) Non-ferrous and ferrous flanges for use with sheet gaskets:

- (1) For flanges of a nominal size of 12 inches or less, a finish with a circular lay (concentric) of 500 to 1000 or (spiral) 125 to 500 roughness height rating (RHR) produced by machining 30 to 80 serrations of uniform depth per inch of face width.
- (2) For flanges over a nominal size of 12 inches, the requirements shall be the same except that 21 to 80 serrations per inch of 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 be a maximum RHR of 500.

(b) Flanges for O-ring seals:

- (1) A finish of 63 or smoother RHR in O-ring grooves.
- (2) A finish of 63 or smoother RHR on the flange face opposite the groove.

(c) Ferrous flanges for spiral wound (metallic) gaskets:

- (1) A finish with a circular lay (concentric or spiral) of 125 to 500 RHR produced by machining not less than 40 serrations of uniform depth per inch of face width.
- (2) For special installations involving radioactive service or hazardous fluids (toxic or explosive) where a finer finish is required, the requirements shall be same as above except that the finish shall be 125 RHR maximum.
- (3) 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 RHR.

4.17 Weld joint and backing ring design shall comply with MIL-STD-22 and MIL-STD-278 as appropriate.

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

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4.19 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.

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

4.20 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 4.18 (c) and (d)) shall not be used in any system where the design gauge pressure is over 150 lb/in² 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 unreinforced.

4.21 Only oil free packing and gaskets shall be used in valves and components on nuclear-powered ships in secondary plant systems. Application shall include, although not necessarily be limited to, the following:

- (a) Condensate.
- (b) Feed.
- (c) Steam drains.
- (d) Main steam.
- (e) Auxiliary steam.
- (f) Air ejector piping.
- (g) Distilling (only steam, condensate and distillate portions).
- (h) Reserve feed.

4.22 Standard bulkhead penetration fittings, are shown on Drawings 803-1385866 and 810-1385899.

4.23 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-F-1183, shall not be used for ship-board piping applications unless an O-ring gasket and a retainer ring are used as a secondary seal.

4.24 Gaskets and threaded fasteners noted in this standard are for line joints only.

4.25 Only metallic piping components shall be used in missile blast areas.

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

4.27 The words steam generator, as used in this standard, are applicable to both nuclear and non-nuclear ships installations.

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4.28 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 throttling applications where the gauge pressure drop exceeds 50 lb/in² or the valve opening is less than 20 degrees.
- (c) Synthetic seated or metal-to-metal seated butterfly valves shall not be used in the following applications:
 - (1) As sea water system hull valves.
 - (2) For sea water 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 segregation valves. (That is, those required to set material conditions Yoke and Tebra).
 - (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.

4.29 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 an 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 sea water 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.

4.30 Naval brass shall not be used in fasteners for stressed applications in propulsion plant piping systems, or bolting in flange connections in non-propulsion plant piping system.

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4.31 Where hose outlets or fill connections are required, a valve in accordance with the applicable category shall be used. An adaptor for attaching a hose shall be provided on the open end of installed valves. Hose for general service applications shall be in accordance with Drawing 810-1385506.

4.32 Fittings dimensionally in accordance with ANSI B16.9 may be substituted for fittings in accordance with Drawing 803-1385880, in copper-nickel piping systems where butt-weld joint fabrication is used, provided the fitting inside diameter is compatible with the pipe or tubing inside diameter.

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

4.34 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: NAVSEA S6430-AE-TED-010 Volume 1, "Technical Directive for Piping Devices, Flexible Hose Assemblies".
- (b) RISIC: NAVSEA S6430-AE-TED-020 Volume 2, "Technical Directive for Piping Devices Flexible, Rubber Insert Sound Isolation Coupling (RISIC)".

4.35 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 Where valve bronze in accordance with MIL-B-16541 or tin bronze in accordance with QQ-C-390 copper alloy UNS C92200 is specified, tin bronze in accordance with QQ-C-390 copper alloy UNS C90300 may be used interchangeably.

4.37 Root connections for instrumentation piping:

- (a) Where possible, root connections shall be made into the side of pipe or pressure vessel 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 1/4 inch 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 BHN 225 minimum.
- (d) The overall size and weight of the root valves shall be kept to a minimum.

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

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

4.40 For the radiographic inspection requirements of cast piping system components refer to applicable ships specifications.

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

4.42 Gaskets provided in accordance with MIL-G-21032 shall be class B except that where the gasket is normally exposed to sea water the grade shall be class C.

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

4.44 The expanding test for piping in accordance with MIL-T-20157 is not required since flaring is not permitted for shipboard applications.

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

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

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

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

4.47 Specific categories and groups contained in this document allow the use of glass reinforced plastic (GRP) pipe and fittings. However, the use of GRP is limited to the following specific applications:

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- (a) Deck drain systems, excluding those used for flight decks, hanger decks, and helicopter platforms, including VERTREP areas.
- (b) Distilled water systems.
- (c) Main and secondary drainage systems.
- (d) Those portions of the chilled water system providing non-vital services, that is, those services not classified "W, or not a machinery space demand, or not an electronic cooling water system".
- (e) Those portions of the low pressure compressed air system providing non-vital services, that is, those services whose continued operation is not essential for maintaining ship control, propulsion, communications, seaworthiness, combat capability or survivability.
- (f) Oily water and waste water drain collecting system.
- (g) Plumbing vents.
- (h) Potable water.
- (i) Seawater flushing systems.
- (j) Those portions of seawater cooling systems providing non-vital services, that is, those services whose continued operation is not essential for maintaining ship control, propulsion, communications, seaworthiness, combat capability or survivability.

4.48 Except for GRP or wood hull ships, the total amount of GRP in a space shall not exceed 25 pounds per 1000 cubic foot of volume for empty pipe situations, and 50 pounds per 1000 cubic foot of volume for flowing or stagnant pipe situations.

5. SERVICE CATEGORIES AND GROUPS

5.1 Service categories and groups shall be as specified hereinafter. When any category and group is modified, this record will be corrected and reissued to indicate the latest date of issue of that category and group.

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

<u>Category and group</u>	<u>Service</u>	<u>Date</u>
A-1	Steam and steam drains, 1500 lb/in ² , 1000°F	February 7, 1986
A-2	Steam and steam drains, 1500 lb/in ² , 775°F	February 7, 1986
A-3	Propulsion plant saturated steam and steam drains, 600 to 1500 lb/in ² , 775°F	February 7, 1986
A-4	Steam and steam drains, 600 lb/in ² , 875°F	February 7, 1986
A-5	Steam and steam drains, 600 lb/in ² , 775°F	February 7, 1986
A-6	Steam and steam drains, 150 lb/in ² , 775°F	February 7, 1986
A-7	Steam, 100 lb/in ² , 875°F	February 7, 1986

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<u>Category and group</u>	<u>Service</u>	<u>Date</u>
A-8	Steam and steam drains for auxiliary boiler, reboiler and waste heat boiler installation only, 150 lb/in ² , 400°F	February 7, 1986
A-9	Steam system overboard discharge, steam generator blowdown, 1500/600 lb/in ² , 650°F	February 7, 1986
A-10	High pressure steam drains between low point trap discharge stop check valve and DFT/gland exhaust piping from turbines and discharge main, 100 lb/in ² , 425°F	February 7, 1986
B-1	Feed systems, 600 lb/in ² , 400°F; 1200 lb/in ² , 475°F	February 7, 1986
B-2	Propulsion plant saturated feed system, 600 to 2050 lb/in ² , 300°F	February 7, 1986
C-1	Fresh water, chilled water condensate and electronic fresh water cooling, 200 lb/in ² , 250°F	February 7, 1986
C-2	Fresh water, feed water and condensate, including potable 100 lb/in ² , 250°F	February 7, 1986
D-1	Sea water, 250 lb/in ² , 150°F	February 7, 1986
D-2	Sea water missile injection system between fresh water accumulating tank and nozzles, 400 lb/in ² , 150°F	February 7, 1986
D-3	Sea water, 50 lb/in ² , 150°F	February 7, 1986
E-1	Fuel, 1200 lb/in ²	February 7, 1986
E-2	Fuel, 600 lb/in ²	February 7, 1986
E-3	Fuel, 200 lb/in ²	February 7, 1986
E-4	Fuel (gas turbine powered ships) 200 lb/in ²	February 7, 1986
F-1	Lubricating oil, 150 lb/in ² , 250°F	February 7, 1986
G-1	Steam catapult, hydraulic oil, 3000 lb/in ² , 150°F	February 7, 1986
G-2	Steam catapult, hydraulic oil, 200 lb/in ² , 150°F	February 7, 1986
G-3	Hydraulic oil - other than steam catapult, 3000 lb/in ² , 180°F	February 7, 1986
G-4	Hydraulic oil - other than steam catapult, 1500 lb/in ² , 180°F	February 7, 1986
G-5	Hydraulic oil - other than steam catapult, 900 lb/in ² , 180°F	February 7, 1986
G-6	Hydraulic oil - other than steam catapult, 300 lb/in ² , 180°F	February 7, 1986
G-7	Hydraulic oil - other than steam catapult, 150 lb/in ² , 150°F	February 7, 1986

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

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<u>Category and group</u>	<u>Service</u>	<u>Date</u>
R-1	Waste water, oily waste bilge, stripping, weather deck and contaminated deck drains 50 lb/in ² , 150°F	February 7, 1986
R-2	Chemical drains, 30 lb/in ² , 150°F	February 7, 1986
R-3	Drains and vents, deck drains and plumbing, 50 lb/in ² , 150°F	February 7, 1986
R-4	Sewage collection, holding and transfer (CHT), 50 lb/in ² , 150°F	February 7, 1986
S-1	Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution, 250 lb/in ²	February 7, 1986
T-1	Fixed CO ₂ , cofferdam inerting systems, 1900 lb/in ²	February 7, 1986
T-2	HALON 1301 fire extinguishing systems distri- bution piping and discharge piping, 2800 lb/in ² , 200°F	February 7, 1986
T-3	HALON 1301 fire extinguishing systems actua- tion piping, 2800 lb/in ² , 200°F	February 7, 1986
U-1	Stripping, fuel, 150 lb/in ²	February 7, 1986
V-1	Voice tubes	February 7, 1986
W-1	Pneumatic tubes	February 7, 1986
Y-1	Overflows, sounding tubes, vents and air escapes for JP-5 tanks	February 7, 1986
Y-2	Overflows, sounding tubes, vents and air escapes for fuel tanks (except JP-5)	February 7, 1986
Y-3	Overflows sounding tubes, vents, and air escapes for other than fuel tanks (fresh water (except potable) clean ballast, voids, etc.)	February 7, 1986
Y-4	Vents, reduction gear, 5 lb/in ² ambient	February 7, 1986

Preparing activity:
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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-1	Steam and steam drains	1500	1000	See note A-1-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Chrome molybdenum alloy steel	ASTM A 335, grade P11 MIL-T-18165, class 1	
Valves	Globe, angle	Chrome molybdenum alloy steel ASTM A 182, grade F-11 or ASTM A 217, grade WC-6	Drawing 803-5184193	Socket weld ends
	Stop check		MIL-V-22052	Butt weld ends
	Lift check			See note A-1-2
	Astern		MIL-V-22682	
	Gate		MIL-V-18110	See note A-1-1
	Swing check		MIL-V-18436	
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
Fittings	Butt welding	Chrome molybdenum alloy steel ASTM A 182, grade F-11 or ASTM A 217, grade WC-6 or ASTM A 234, grade WP-11	ANSI B16.9	
	Socket welding		ANSI B16.11	
	Socket welding laterals		MS18307	
Flanges	Butt welding	Chrome molybdenum alloy steel	ANSI B16.5	
	Socket welding		ASTM A 182, grade F-11	
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Through bolting (nuts at both ends)	Alloy steel	MIL-S-1222, grade B16	
	Nuts		MIL-S-1222, grade 4	

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 body neck, except that, where a valve is to be used with flow in one direction, a 1/4-inch hole may be drilled in the upstream side of the disc in lieu of a drain.

A-1-2 Lift check valves shall be constructed similar to MIL-V-22052 modified for check design.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-2	Steam and steam drains	1500	775	See note A-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A 106, grade B MIL-T-20157, type E	
Valves	Globe, angle	Carbon steel ASTM A 216, grade WCB or ASTM A 105	Drawing 803-5184193	Socket weld ends
	Stop check		MIL-V-22052	Butt weld ends
	Lift check			See note A-2-3
	Gate		MIL-V-18110	See note A-2-2
	Swing check		MIL-V-18436	
	Relief		MIL-V-20065	Flanged ends only
	Pressure-reducing Control		MIL-V-17843	
				MIL-V-18030
Fittings	Butt welding	Carbon steel ASTM A 105, ASTM A 234, class WPB ASTM A 181, class 70	ANSI B16.9	
	Socket welding	Carbon steel ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Socket welding laterals	ASTM A 234, class WPB	MS18307	See note A-2-4
Flanges	Butt welding	Carbon steel ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	
	Socket welding			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 5	

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 body neck, except that, where a valve is to be used with the flow in one direction, a 1/4-inch hole may be drilled in the upstream side of the disc in lieu of a drain.
- A-2-3 Lift check valves shall be constructed similar to MIL-V-22052, modified for check design.
- A-2-4 Modified for carbon steel material.

A-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-3	Propulsion plant saturated steam and steam drains	600 to 1500	775	See note A-3-1

Item	Types		Material	Applicable documents	Remarks
Pipe	Seamless		Carbon steel	ASTM A 106, grade B MIL-T-20157, type E	
Valves	Gate	4 inches and smaller	Carbon steel ASTM A 105 or ASTM A 216, grade WCB	MIL-V-18110	Butt weld ends
		5 through 16 inches		Drawing 803-2177518	See note A-3-2
	Globe, angle stop and lift check, 2 inches and smaller			Drawing 803-2177525	Socket or butt weld ends 900 lb/in ² maximum
	2-1/2 inches			Drawing 803-2177140	Butt weld ends
	3 and 4 inches			Drawing 803-2177141	
	5 and 6 inches			Drawing 803-2177142	
	8 inches and larger			MIL-V-22052	
	3-way by-pass 1/2 to 1 inch			Drawing 803-1385965	Socket or butt weld ends
	Swing check			MIL-V-18436	
	Control			MIL-V-18030	Flanged
	Relief			MIL-V-20065	
	Pressure-reducing			MIL-V-17848	
	Quick closing root valves			MIL-V-24619	See note A-3-4

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-3, cont'd	Propulsion plant saturated steam and steam drains	600 to 1500	775	See note A-3-1

Item	Types	Material	Applicable documents	Remarks
Fittings	Flanged	Carbon steel ASTM A 216, grade WCB	ANSI B16.5	
	Butt welding	Carbon steel ASTM A 105, ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.9	
	Socket welding	Carbon steel ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Socket welding lateral	ASTM A 234, class WPB	MS18307	See note A-3-3
Flanges	Butt welding	Carbon steel ASTM A 105 or ASTM A 234, class WPB	ANSI B16.5	
	Socket welding	ASTM A 181, class 70		
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nut	Carbon steel	MIL-S-1222, grade 5	

NOTES:

- A-3-1 This category excludes high pressure steam drain main between each low point trap discharge 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 body neck, except that, where a valve is to be used with the flow in one direction, a 1/4-inch hole may be drilled in the upstream side of the disc in lieu of a drain.
- A-3-3 Modified for carbon steel material.
- A-3-4 Valve design proposal in accordance with MIL-V-24619 shall be submitted to NAVSEA for review and approval.

A-3.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-4	Steam and steam drains	600	875	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Chrome molybdenum alloy steel	MIL-T-18165, class I ASTM A 335, grade P-11	
	Gate Globe angle, stop check Swing check Astern Pressure-reducing Control Relief	Chrome molybdenum alloy steel ASTM A 182, grade F-11 or ASTM A 217, grade WC-6	MIL-V-1810 MIL-V-220.? Drawing 80.-5184193 MIL-V-18436 MIL-V-22682 MIL-V-17848	See note A-4-1 Butt weld Socket weld
Fittings	Socket welding	Chrome molybdenum alloy steel	MIL-V-18030	Flanged ends only
	Butt welding	ASTM A 182, grade F-11 or ASTM A 217, grade WC-6 or ASTM A 234, grade WP-11	MIL-V-20065 ANSI B16.11 ANSI B16.9 ANSI B16.5	
	Flanged			
	Socket welding laterals		MS18307	
Flanges	Butt welding	Chrome molybdenum alloy steel	ANSI B16.5	
	Socket welding	ASTM A 182, grade F-11		
Gaskets	Spiral wound	Metalllic	MIL-C-21032	
	Bolt-stud	Alloy steel	MIL-S-1222, grade B16 MIL-S-1222, grade 4	
Flange bolting	Nuts			

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 body neck, except that, where a valve is to be used with the flow in one direction, a 1/4-inch hole may be drilled in the upstream side of the disc in lieu of a drain.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-5	Steam and steam drains	600	775	See note A-5-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-20157 ASTM A 106, grade B	
Valves	Globe angle and stop check	Carbon steel ASTM A 216, grade WCB ASTM A 105	Drawing 803-2177525 MIL-V-22052	Socket weld ends Butt weld ends
	Astern		MIL-V-22682	
	Gate		MIL-V-18110	See note A-5-2
	Swing check		MIL-V-18436	
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Relief		MIL-V-20065	
	Control		MIL-V-18030	
Fittings	Butt welding	Carbon steel ASTM A 234, class WPB ASTM A 105, ASTM A 181, class 70	ANSI B16.9	
	Flanged	Carbon steel ASTM A 216, grade WCB	ANSI B16.5	
	Socket welding	Carbon steel ASTM A 105 or ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.11 MS18307	See note A-5-3
	Socket welding lateral			
Flanges	Butt welding	Carbon steel ASTM A 105 or ASTM A 234, class WPB	ANSI B16.5	
	Socket welding	ASTM A 181, class 70		
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nut	Carbon steel	MIL-S-1222, grade 5	

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 body neck, except that, where a valve is to be used with the flow in one direction, 1/4-inch hole may be drilled in the upstream side of the disc in lieu of a drain.
- A-5-3 Modified for carbon steel material.

Category and group	Services	Maximum system pressure lb/in ²	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-T-20157 ASTM A 106, grade B	
Valves	Gate	Carbon steel ASTM A 105 or ASTM A 216, grade WCB	MIL-V-18110	
	Globe, angle		MIL-V-22052	Butt weld ends
	Stop check		Drawing 803-2177525	
	Lift check		MIL-V-18436	See note A-6-3
	Swing check		MIL-V-18436	
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
	Relief		MIL-V-20065	
	Temperature regulating		MIL-V-19772, type IV	
Quick closing		MIL-V-24569, type IA		
Fittings	Flanged	Carbon steel ASTM A 216, grade WCB	ANSI B16.5	See note A-6-4
	Socket welding	Carbon steel	ANSI B16.11	
	Socket welding lateral	ASTM A 105 or ASTM A 234, class WPB ASTM A 181, class 70	MS18307	See note A-6-5
	Butt welding	Carbon steel ASTM A 105 or ASTM A 234, class WPB ASTM A 181, class 70	MIL-F-20236 ANSI B16.9	
Flanges	Butt welding	Carbon steel ASTM A 181, class 70	ANSI B16.5	See note A-6-4
	Socket welding	ASTM A 105 or ASTM A 234, class WPB		
Gaskets	Spiral wound	Metallic	MIL-G-21032	
	Sheet	Asbestos	HH-P-46	See note A-6-4
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

- A-6-1 The basic ANSI rating for 150 lb/in² series components is 150 lb/in² 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 Modified for carbon steel material.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-7	Steam	100	875	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Chrome molybdenum alloy steel	MIL-T-18165, class 1 ASTM A 335, grade P-11	
Valves	Gate	Chrome molybdenum alloy steel ASTM A 217, grade WC-6 or ASTM A 182, grade F-11	MIL-V-18110	
	Globe, angle		MIL-V-22052	Butt weld ends
	Stop check		Drawing 803-5184193	Socket weld ends
	Lift check		MIL-V-18436	See note A-7-1
	Swing check		MIL-V-18436	
	Pressure-reducing		MIL-V-17848	Flanged ends only
	Control		MIL-V-18030	
	Relief		MIL-V-20065	
Fittings	Flanged	Chrome molybdenum alloy steel ASTM A 182, grade F-11 or ASTM A 217, grade WC-6	ANSI B16.5	
	Socket welding		ANSI B16.11	
	Butt welding		ANSI B16.9	
	Socket welding laterals		MS18307	
Flanges	Butt welding	Chrome molybdenum alloy steel ASTM A 182, grade F-11	ANSI B16.5	
	Socket welding			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B16	
	Nuts		MIL-S-1222, grade 4	

NOTE:

A-7-1 Lift check valves may be constructed similar to MIL-V-22052, modified for check design.

A-7.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-8	Steam and steam drains for auxiliary boiler, reboiler and waste heat boiler installation only	150	358 (Sat. temp.)	See note A-8-1 and A-8-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel 90-10	MIL-T-16420	
Valves	Gate	Bronze	Drawing 803-2177917	See note A-8-2
	Globe, angle and cross		Drawing 803-1385714	
			Drawing 803-1385541	
	Control		Drawing 803-1385623	
	Relief	Drawing 803-4384536		
	Pressure-reducing		MIL-V-18030	
	Check, 2-1/2 inches and above	Bronze	MIL-V-20065	
			MIL-V-17547	
Swing check, 2 inches and below		Drawing 803-1385637		
Quick closing		Drawing 803-1385721		
Fittings	Flanged	Bronze	MIL-V-24569	150°F maximum
	Silver-brazing		Drawing 810-1385915	
	Welding	Copper-nickel 90-10	MIL-F-1183	
	Bulkhead/deck	Copper-nickel 90-10	Drawing 803-1385880	
Take-down joints	Flange	Copper-nickel	Drawing 803-1385866	
		Bronze	Drawing 810-4715319	
	Unions	Bronze	MIL-F-21142	
Gaskets	Sheet	Asbestos	MIL-F-1113	
Flange bolting	Bolt, studs and nuts	Silicon bronze	HH-P-46	
			MIL-S-122z, grade 651 and 655	

NOTES:

- A-8-1 For other boiler installations, use other applicable category.
A-8-2 100 lb/in² maximum for angle and cross configuration only.
A-8-3 Use category A-6 for superheated steam application.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-9	Steam system overboard discharge, steam generator blowdown	1500 600	650	See note A-9-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Nickel-copper alloy	MIL-T-1368, class A	Schedule 80 minimum
Valves	Globe, angle stop and stop checks	Nickel-copper alloy	Drawing 803-2177525	See note A-9-1 Flanged ends 600 lb/in ² maximum
			Drawing 803-5184193	See note A-9-1
Fittings	Socket welding	Nickel-copper alloy, QQ-N-281, class A, annealed	ANSI B16.11, bored as required	See note A-9-3
	Butt welding	Nickel-copper alloy, MIL-T-1368, class A	ANSI B16.9	See note A-9-3
	Socket welding laterals	Nickel-copper alloy, QQ-N-281	MS18307	
	Socket welding outlets	Nickel-copper alloy, QQ-N-281, class A, annealed	Commercial	
	Butt welding outlets			
Flanges	Socket welding, 1/4 and 3/8 inch	Nickel-copper alloy, QQ-N-281, class A, annealed	Commercial MS18308	1/4 inch, raised face 600 lb/in ² maximum See note A-9-3
	Socket welding, 1/2 inch and above		ANSI B16.5	
	Butt welding			
Flange bolting	Bolts or bolt-stud	Nickel-copper aluminum	MIL-S-1222, grades 400, 405 or 500	
	Nuts			
Gaskets	Spiral wound	Metallic	MIL-G-21032	

NOTES:

- A-9-1 Valves of the NAVSEA Drawings 803-5184193 or 803-2177525 type shall be modified to include nickel-copper alloy material with flanged ends in accordance with ANSI B16.5, 1500 or 600 series as applicable. The face to face dimension shall be 15-1/2 inches for the 1-1/2 inch valve and 16-1/4 inches for the 2-inch valve.
- A-9-2 Does not include boiler pressure piping.
- A-9-3 Modified for nickel-copper alloy material.

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A-9-1

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-10	High pressure steam drains between low point trap discharge stop check valve and DFT or gland exhaust piping from turbines, and discharge main	100	425	See note A-10-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Corrosion-resisting steel, 304 or 304L	MIL-P-1144 ASTM A 269, ASTM A 312	
	Seamless	Nickel-copper alloy	MIL-T-1368, class A	
Valves	Gate, stop check globe	Corrosion-resisting steel, QQ-S-763, 304, 304L, 316 or 316L, ASTM A 182, grade F304L, F316L	MIL-V-18110 MIL-V-22052 Drawing 803-2177525	Socket weld ends, ANSI B16.11; butt weld ends, ANSI B16.9 and B16.25, 150 lb/in ² gauge pressure series
	Relief	Nickel-copper alloy, QQ-N-281	MIL-V-20065	
Fittings	Socket welding, 2 inches, maximum	Corrosion-resisting steel in accordance with ASTM A 182, F304 or F304L ASTM A 403, class WP304LS, WP316LS	ANSI B16.11	150 lb/in ² gauge pressure series
	Butt weld, 1-1/4 inches and above	Nickel-copper alloy QQ-N-281	ANSI B16.9	See note A-10-2
	Socket welding laterals		MS18307	
Flanges	Butt welding, 1-1/4 inches and above	Corrosion-resisting steel, ASTM A 182, F304 or F304L	ANSI B16.5, series 150	
	Socket welding	Nickel-copper alloy, QQ-N-281		

A-10.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
A-10, cont'd	High pressure steam drains between low point trap discharge stop check valve and DFT or gland exhaust piping from turbines, and discharge main	100	425	See note A-10-1

Item	Types	Material	Applicable documents	Remarks
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt, studs and nuts	Nickel-copper aluminum	MIL-S-1222, alloy 500 MIL-S-1222, grade 400, 405	

NOTES:

- 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.
- A-10-2 Modified for nickel-copper alloy material.

A-10.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
B-1	Feed systems	600 boilers	400	See notes B-1-1 and B-1-2
		1200 boilers	475	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-20157, ASTM A 106, grade B	
Valves	Globe, angle and stop check	Carbon steel ASTM A 105 or ASTM A 216, grade WCB	Drawing 803-5184193 MIL-V-22052 Drawing 803-2177525	ANSI 600 lb/in ² pressure series shall be used in feed systems for 600 lb/in ² and below boilers. ANSI 900 lb/in ² pressure series shall be used in feed systems for 1200 lb/in ² boilers except for 2 inches and below 1500 lb/in ² series shall be used
	Gate		MIL-V-18110	
	Relief		MIL-V-24332	
	Control Check		MIL-V-18030 MIL-V-18436	
	Fittings		Butt welding	Carbon steel ASTM A 181, class 70 ASTM A 105 or ASTM A 234, class WPB
	Socket welding	Carbon steel	ANSI B16.11	
	Socket welding end branch outlets		Commercial	
	Butt weld end branch outlets 1-1/4 inches and above		ASTM A 181, class 70 ASTM A 105 or ASTM A 234, class WPB	

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B-1.1

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
B-1, cont'd	Feed systems	600 maximum boilers 1200 boilers	400 475	See notes B-1-1 and B-1-2

Item	Types	Material	Applicable documents	Remarks
Flanges	Socket welding	Carbon steel ASTM A 105 ASTM A 181, class 70 or ASTM A 234, class WPB	ANSI B16.5	ANSI 600 lb/in ² for 600 lb/in ² and below boilers
	Butt welding			ANSI 900 lb/in ² for 1200 lb/in ² boilers
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud and nuts	Carbon steel	MIL-S-1222, 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 lb/in² boiler.
- B-1-2 The 75°F temperature applies only to that section of the feed system between the economizer and the drum.

B-1.2

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

Item	Types	Material	Applicable documents	Remarks		
Pipe	Seamless	Carbon steel	ASTM A 106, grade B MIL-T-20157, type E			
Valves	Gate 4 inches and smaller 5 through 16 inches	Carbon steel ASTM A 105 or ASTM A 216, grade WCB	MIL-V-18110 Drawing 803-2177518	Butt weld ends		
	Globe, angle, stop and lift check, 2 inches and smaller 2-1/2 inches 3 and 4 inches 5 and 6 inches 8 inches and larger Swing check Relief Control		Drawing 803-2177525	Socket or butt weld ends		
			Drawing 803-2177140 Drawing 803-2177141 Drawing 803-2177142 MIL-V-22052	Butt weld		
			MIL-V-18436			
			MIL-V-24332	Flanged ends		
			MIL-V-18030			
	Fittings		Butt welding	Carbon steel ASTM A 181, class 70 ASTM A 105 or ASTM A 234, class WPB	ANSI B16.9	
			Socket welding		ANSI B16.11	
			Socket welding end branch outlets		Commercial	
			Butt welding end branch outlets			

B-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
B-2, cont'd	Propulsion plant saturated feed system	600 to 2050	300	See note B-2-1

Item	Types	Material	Applicable documents	Remarks
Flanges	Socket welding	Carbon steel ASTM A 105, ASTM A 234, class WPB or ASTM A 181, class 70	ANSI B16.5	
	Butt welding			
Gaskets	Spiral wound	Metallic	MIL-C-21032	
Flange bolting	Bolt-stud and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

- B-2-1 To be used in conjunction with 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 Drawing 803-2177525 may be used for pressures up to and including 600 lb/in².

B-2.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
C-1	Fresh water, chilled water condensate and electronic fresh water cooling	200	250	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch minimum wall thickness (see note C-1-1)
		Glass reinforced plastic	MIL-P-24608	150°F maximum (see note C-1-6)
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Gate, 2 inches maximum	Bronze	Drawing 803-1385714	
	Globe, 2 inches maximum		Drawing 803-4384536	See note C-1-2
	Check, 2 inches maximum		Drawing 803-1385721	
	Gate, 2-1/2 inches and above		Drawing 803-2177917	
	Globe, 2-1/2 inches and above		Drawing 803-1385623	
	Swing check, 2 inches and above		Drawing 803-1385637	
	Relief		MIL-V-24332	
	Butterfly	Bronze	MIL-V-24624	
	Control	Bronze (nickel-copper alloy trim or 300 series corrosion-resisting steel trim)	MIL-V-18030	100 lb/in ² maximum
	Ball, 1/4 inch - 2-1/2 inches	Bronze	Drawing 803-5001003	
	Ball, 3 inches - 6 inches		Drawing 803-5001004	

C-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
C-1, cont'd	Fresh water, chilled water condensate and electronic fresh water cooling	200	250	

Item	Types	Material	Applicable documents	Remarks
Fittings	Silver-brazing	Bronze	MIL-F-1183	
	Silver-brazing union			
	Butt welding	Copper-nickel (90-10)	Drawing 803-1385880	
	Welded base by silver brazing end outlet boss	90-10 or 70-30 copper-nickel	Drawing 803-1385912 or commercial	Welded to copper-nickel pipe run
	Socket (bonded)	Glass reinforced plastic	MIL-P-24608	150°F maximum (see note C-1-6)
Flanges	Socket weld	Copper-nickel	Drawing 810-4715319	
	Silver-brazing	Bronze	MIL-F-20042, class plain, 150 and 250 pounds	See notes C-1-3 and C-1-4
			Drawing 810-1385892	Special flanges for butterfly valves
Socket bonded	Glass reinforced plastic	MIL-P-24608	150°F maximum (see note C-1-6)	
Gaskets	Sheet	Cloth inserted rubber	HH-P-151	See note C-1-5
		Synthetic rubber	MIL-G-1149	
	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

C-1.2

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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 be in accordance with MIL-S-955 and shall be sized to suit the installation.
- C-1-3 Where 150 lb/in² line flanges bolt up to 250 lb/in² 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 lb/in² flange bolting.
- C-1-4 One hundred fifty pound flanges may be used to 150 lb/in² service, where temperatures do not exceed 150°F. For temperature of 151°F to 250°F, they shall be limited to 100 lb/in² and below.
- C-1-5 Class 4 of HH-P-151 shall be used where service temperature is expected to exceed 200°F.
- C-1-6 Adhesive in accordance with MIL-P-24608 shall be used for joining glass reinforced plastic (GRP) pipe to plastic fittings and flanges.
- C-1-7 Electronics cooling water systems and the chilled water systems serving air conditioning cooling coils classified in the category W and the electronics cooling water systems shall be fabricated of copper-nickel (90-10) piping and fittings with welded joints to the maximum extent practicable.
- C-1-8 For electronic cooling water systems valve gland packing shall be teflon or equal. 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.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
C-2	Fresh water, feed water and condensate, including potable, gas turbine washdown	100	250	See notes C-2-1, C-2-2 and C-2-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch minimum wall thickness
		Brass	MIL-T-20168	
	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
	Seamless	Glass reinforced plastic	MIL-P-24608	150°F maximum (see note C-2-5)
Valves	Globe, angle and globe stop check	Bronze	Drawing 803-4384536	See note C-2-3
	Swing check		Drawing 803-1385721	
			MIL-V-17547	
			Drawing 803-1385637	
			Drawing 803-1385714	
			Drawing 803-1385541	
	Gate			
	Globe, angle, globe stop check and angle stop check			
	Butterfly			
	Gate			
	Relief			
	Control			
	Ball - 1/2 inch - 2-1/2 inches			
Ball - 3 inches - 6 inches				
Fittings	Silver-brazing	Bronze	MIL-F-1183	
	Flanged		Drawing 810-1385915	
	Silver-brazing union		MIL-F-1183	
	Butt welding	Copper-nickel (90-10)	Drawing 810-1385880	Welded to copper-nickel pipe run
	Welded base by silver-brazing end outlet boss	90-10 or 70-30 copper-nickel	Drawing 810-1385912	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	

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C-2.1

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
C-2, cont'd	Fresh water, feed water and condensate, including potable	100	250	See notes C-2-1, C-2-2 and C-2-4

Item	Types	Material	Applicable documents	Remarks
Flanges	Silver-brazing	Bronze	MIL-F-20042, class plain Drawing 810-1385892	Special flanges for butterfly valves
	Socket weld	Copper-nickel	Drawing 810-4715319	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	See note C-2-5
	Gaskets	Sheet	Cloth inserted rubber	HH-P-151
Synthetic rubber			MIL-G-1149	
O-ring		Fluorocarbon	MIL-R-83248, type I, class I	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

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 304 in accordance with MIL-P-1144. Connection to be as close to DFT as possible.
- C-2-3 Globe valves for shower service shall be in accordance with MIL-S-955 and shall be sized to suit the installation.
- C-2-4 Where copper tubing is used in potable water systems which supplies water to equipment containing carbonated water dispensers, the system shall have double check valves installed.
- C-2-5 Adhesive in accordance with MIL-P-24608 shall be used for joining glass reinforced plastic (GRP) pipe to GRP fittings and flanges.
- C-2-6 Class 4 of HH-P-151 shall be used where service temperature is expected to exceed 200°F.
- C-2-7 Electronics cooling water systems and the chilled water systems serving air conditioning cooling coils classified in the category W and the electronics cooling water systems shall be fabricated of copper-nickel (90-10) piping and fittings with welded joints to the maximum extent practicable.
- C-2-8 For electronic cooling water and gas turbine washdown systems valve gland packing shall be Teflon or equal. All other elastomers shall be compatible with the fluid. Natural rubber products are not permitted.
- C-2-9 Expansion tank valves subject to air pressure shall be soft seated.

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C-2.2

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-1	Sea water, main and secondary drainage, ballast	250	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10 or 70-30 copper-nickel	MIL-T-16420	
	Seamless	Glass reinforced plastic	MIL-P-24608	200 lb/in ² maximum See note D-1-2
Valves	Globe, 2-1/2 inches and above	Bronze	Drawing 803-1385623	
	Globe, angle and stop check 1/4 to 2 inches		Drawing 803-4384536	
	Gate, 2-1/2 inches and above		Drawing 803-2177917	Flanged ends
	Gate, 1/4 to 2 inches		Drawing 803-1385714	
	Swing check, 2-1/2 inches and above		Drawing 803-1385637	Flanged ends
	Swing check, 1/4 to 2 inches		MIL-V-17547, type A, class 2, 250 lb/in ²	Flanged ends
	Relief		Drawing 803-1385721	
	Pressure-reducing		MIL-V-2433	Flanged or union ends
	Hose		MIL-V-2042	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-385711	
	Ball, 3 inches - 6 inches		Drawing 803-1385712	
	Butterfly		Drawing 803-5001003	
	Drawing 803-5001004			
	MIL-V-24624			

D-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-1, cont'd	Sea water	250	150	

Item	Types	Material	Applicable documents	Remarks
Fittings	Silver-brazing (including unions and union end fittings)	Bronze	MIL-F-1183	
	Welding	90-10 copper-nickel	Drawing 803-1385880	200 lb/in ² maximum
	Welded base by silver-brazing end outlet boss	90-10 or 70-30 copper-nickel	Drawing 810-1385912	Welded to pipe run
	Socket bonded	Glass reinforced plastic	MIL-P-24608	200 lb/in ² maximum
Flanges	Silver-brazing	Bronze	MIL-F-20042	Special flanges for butterfly valves
			Drawing 810-1385892	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	200 lb/in ² maximum
	Butt weld	Copper-nickel	Drawing 810-1385992	
Gaskets	Sheet	Synthetic rubber	MIL-R-21252, MIL-G-1149	See note D-1-1
		Cloth, inserted rubber	HH-P-151	
	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

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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.

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-2	Sea water missile injection system between fresh water accumulating tank and nozzles, main and secondary drainage, ballast and oily waste transfer	400	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	70-30 copper-nickel	MIL-T-16420, class 700	
	Valves			
Fittings	Gate, 2-1/2 inches and above	Bronze	MIL-V-1189	Flanged 250 lb/in ² minimum
	Globe stop, angle stop and globe stop check, 2 inches and below		Drawing 803-2177917 Drawing 803-4384536	Silbraz union end, soft seat
	Globe stop check, 2-1/2 inches and above		Drawing 803-1385623 Drawing 803-1385541	Flanged See note D-2-1
	Relief		MIL-V-24332	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Diaphragm check		MIL-F-1183	
Flanges	Silver-brazing including unions and union end fittings	Bronze		
	Butt welding	70-30 copper-nickel	MIL-F-24202	
	Silver-brazing	Bronze	MIL-F-20 42	
	Socket welding	Copper-nickel (70-30)	ANSI B16.5, class 400	Flatface

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-2, cont'd	Sea water missile injection system between fresh water accumulating tank and nozzle	400	150	

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Synthetic rubber cloth inserted	HIL-P-151	
		Synthetic rubber	HIL-G-1149	
Plunge bolting	Bolts, studs and nuts	Silicon bronze	HIL-S-1222, grade 655/651	

NOTE:

D-2-1 100 lb/in² maximum for angle and cross configuration only. 2-1/2 inch and larger globe and angle, stop and stop check valves for use in systems exceeding 150 lb/in² shall be of commercial design as approved by NAVSEA.

D-2-2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-3	Sea water	50	150	

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless or welded	90-10 copper-nickel	MIL-T-16420, class 50	See note D-3-1	
		70-30 copper-nickel	MIL-T-16420	See note D-3-5	
	Seamless	Glass reinforced plastic	MIL-P-24608	See note D-3-4	
Valves	Gate	Bronze	Drawing 803-2177917		
	Globe, angle and stop check		Drawing 803-1385714		
			Drawing 803-1385541		
			Drawing 803-4384536		
	Check, swing	Bronze or (90-10) cast copper-nickel, MIL-C-20159	Drawing 803-1385721 or Drawing 803-1385637		
	Ball, 1/4 - 2-1/2 inches	Bronze	Drawing 803-5001003		
	Ball, 3 inches - 6 inches		Drawing 803-5001004		
Butterfly	MIL-V-24624				
Fittings	Flanged	Bronze	Drawing 810-1385915		
	Silver-brazing (including unions and union end fittings)		MIL-F-1183		
	Welding	90-10 copper-nickel	Drawing 810-1385880 ANSI B16.9 or ANSI B16.11		
	Welded base by silver-brazing end outlet boss	90-10 or 70-30 copper-nickel	Drawing 810-1385912		Welded to copper-nickel pipe run
	Socket bonded	Glass reinforced plastic	MIL-P-24608		See note D-3-4
Flanges	Silver-brazing	Bronze	MIL-F-20042	Special flanges for butterfly valves	
			Drawing 810-1385892		
	Socket weld	Copper-nickel	Drawing 810-4715319		
	Slip-on 12 inches and larger	Copper-nickel, 90-10	MIL-C-15726	See note D-3-2	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	See note D-3-4	

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D-3-1

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
D-3, cont'd	Sea water	50	150	

Item	Types	Material	Applicable documents	Remarks	
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1		
	Sheet	Synthetic rubber	MIL-G-1149	See note D-3-6	
				MIL-R-21252	See note D-3-3
			Cloth inserted rubber	HH-P-151	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661		

NOTES:

- D-3-1 For sizes not covered by MIL-T-16420, pipe fabricated from copper-nickel sheet specified in MIL-C-15726 may be used.
- D-3-2 Slip-on flanges shall be bored to suit outside diameter of the tube with flange thickness, drilling and facing in accordance with class 50 lb/in² of MIL-F-20042.
- D-3-3 For use in piping systems subject to acid flush path.
- D-3-4 Adhesive in accordance with MIL-P-24608 shall be used for joining GRP pipe to GRP fittings and flanges.
- D-3-5 70-30 copper-nickel alloy shall be used inside of compensated fuel tanks and 90-10 copper-nickel shall be used elsewhere.
- D-3-6 Gasket in accordance with MIL-G-1149 shall not be used for suction side of sea chest which uses steam for blow-up.

D-3.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
E-1	Fuel	1200		

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A 106, grade B MIL-T-20157, type E	
Valves	Gate, 2-1/2 inches and above	Carbon steel ASTM A 216 grade WCB or ASTM A 105	MIL-V-18110	Flanged ends, ANSI B16.5
	Globe, angle		MIL-V-22052 Drawing 803-5184193	
	Check		Commercial	
	Control		MIL-V-18030	
	Needle	Carbon steel	MIL-V-24586	Flanged ends only 200°F maximum
	Relief		MIL-V-24332	
	Quick closing		MIL-V-24569	150°F maximum
	Vent, drain and sampling	Carbon steel	MIL-V-24586	200°F maximum
Fittings	Flanged	Carbon steel, ASTM A 216, grade WCB	ANSI B16.5	
	Socket welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.11	
	Butt welding	Carbon steel ASTM A 181 ASTM A 105 or ASTM A 234, class WPB	ANSI B16.9	
Flanges	Socket welding	Carbon steel, ASTM A 105 ASTM A 181, class 70 or ASTM A 234, class WPB	ANSI B16.5	
	Butt welding			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 2 or 5	

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
E-2	Fuel	600		

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel except for special application	MIL-T-20157 ASTM A 106, grade B	
Valves	Gate, 2-1/2 inches and above	Carbon steel ASTM A 216, grade WCB or ASTM A 105	MIL-V-18110	
	Globe, angle		MIL-V-22052 Drawing 803-2177525	
	Check		Commercial	Flanged ends, ANSI B16.5
	Control		MIL-V-18030	Flanged ends only
	Needle	Carbon steel	MIL-V-24586	200°F maximum
	Relief		MIL-V-24132	Flanged ends only
	Quick closing		MIL-V-24569	
	Vent, drain and sampling	Carbon steel	MIL-V-24566	200°F maximum
Fittings	Flanged	Carbon steel, ASTM A 216, grade WCB	ANSI B16.5	
	Socket welding	Carbon steel, ASTM A 181, class 70 ASTM A 234, class WPB, or ASTM A 105	ANSI B16.11	
	Butt welding	Carbon steel, ASTM A 181, class 70 ASTM A 105 or ASTM A 234, class WPB	ANSI B16.9	
Flanges	Butt welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.5	
	Socket welding			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt, studs	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 5	

E-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
E-3	Fuel	200		See notes E-3-1 and E-3-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel, except for special applications	MIL-T-20157, ASTM A 106, grade A	
Valves	Gate, 2-1/2 inches and above	Carbon steel ASTM A 216, grade WCB or ASTM A 105	MIL-V-18110	
	Globe, angle		MIL-V-22052	
	Check		Drawing 803-2177525	Flanged ends
	Control		Commercial	Flanged ends only
	Relief		MIL-V-18030	
	Needle		MIL-V-24332	
	Ball, 1/4 inch - 2-1/2 inches	Carbon steel	MIL-V-24586	200°F maximum
	Butterfly	Corrosion-resisting steel	Drawing 803-5001003	
Fittings	Flanged	Carbon steel, ASTM A 216, grade WCB	MIL-V-24624	Type I
	Socket welding	Carbon steel, ASTM A 181, class 70 ASTM A 234, class WPB or ASTM A 105	ANSI B16.5	
	Butt welding	Carbon steel, ASTM A 105 ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.11	
Flanges	Butt welding	Carbon steel, ASTM A 105 ASTM A 181	MIL-F-20236 or ANSI B16.9	
	Socket welding	ASTM A 234, class WPB	ANSI B16.5	
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

E-3-1 This category does not include fuel overflows, sounding tubes, vents or air escapes. (See category Y for these items.)

E-3-2 This category includes cargo fuel and cargo oil systems.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
E-4	Fuel (gas turbine powered ships)	200	150	See notes E-4-1 and E-4-3

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel except for special applications	MIL-P-1144, 304L or 316L or ASTM A 312, grade TP316L or TP304L	
Valves	Gate	Corrosion-resisting steel, ASTM A 351, grade CF-8M; ASTM A 182, F316L or F304L	MIL-V-18110	Stellite disc
	Globe, angle, 2-1/2 inches and above		MIL-V-22052	
	Globe, angle, 2 inches maximum		Drawing 803-2177525	
	Check		Commercial	Flanged ends, ANSI B16.5
	Control	Corrosion-resisting steel, ASTM A 351, grade CF-8M	MIL-V-18030	Flanged ends only
	Relief		MIL-V-24332	
	Butterfly	Corrosion-resisting steel	MIL-V-24624	Type I
Fittings	Flanged	Corrosion-resisting steel, ASTM A 182, F304L or F316L ASTM A 403, WP304LS or WP316LS	ANSI B16.5	
	Socket welding		ANSI B16.11	
	Butt welding		ANSI B16.9	
Flanges	Butt welding	Corrosion-resisting steel, ASTM A 182, F304L or F316L ASTM A 403, WP304LS or WP316LS	ANSI B16.5	
	Socket welding			See note E-4-2
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTES:

- E-4-1 This category does not include overflows, sounding tubes, vents or air escapes. (See category Y for these items.)
- E-4-2 Where required ANSI flanges shall be modified for use with butterfly valves.
- E-4-3 Use category U-1 for stripping systems.

E-4.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
F-1	Lubricating oil	150	250	See note F-1-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-20157, ASTM A 106, grade A or B	
Valves	Globe, angle and stop check, 2 inches maximum	Carbon steel ASTM A 216, grade WCB or ASTM A 105	MIL-V-22012	
	Globe, angle and stop check, 2-1/2 inches and larger			
	Gate		MIL-V-18110	
	Check		ANSI B16.34, class 150	Flanged end
	Relief		MIL-V-24332	Flanged ends only
	Control		MIL-V-18030	
	Pressure-reducing			
	Butterfly	Corrosion-resisting steel	MIL-V-24624	Type I
	Needle	Carbon steel	MIL-V-24586	200°F maximum
	Ball, 1/4 inch - 2-1/2 inches	Carbon steel	Drawing 803-5001003	
	Vent, drain and sampling	Carbon steel	MIL-V-24586	200°F maximum
Fittings	Flanged, 1/2 inch and larger	Carbon steel, ASTM A 216, grade WCB	ANSI B16.5, series 150	
	Socket weld	Carbon steel ASTM A 105 or ASTM A 234, class WPB ASTM A 181, class 70	ANSI B16.11	
	Butt weld	Carbon steel ASTM A 105 ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.9 MIL-F-20236	

F-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
F-1, cont'd	Lubricating oil	150	250	See note F-1-1

Item	Types	Material	Applicable documents	Remarks
Fittings, cont'd	Socket welding end branch outlets		Commercial	
	Butt welding end branch outlets			
Flanges	Socket weld, 1/4 inch and 3/8 inch	Carbon steel ASTM A 181, class 70 ASTM A 105 or ASTM A 234, class WPB	Commercial	1/16-inch raised face
	Socket weld, 1/2 inch and above		ANSI B16.5	
	Butt weld			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTE:

F-1-1 Gas turbine lube oil piping shall be corrosion-resisting steel.

F-1.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-1	Steam catapult, hydraulic oil	3000	150	See notes G-1-1 through G-1-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-20157, type E or ASTM A 106, grade B	
Valves	Globe, angle gate	Carbon steel ASTM A 216, grade WCB ASTM A 105	Drawing 803-5184193 MIL-V-22052 MIL-V-18110	
	Special		Commercial	
Fittings	Butt weld	Carbon steel ASTM A 105	ANSI B16.9	
	Socket weld	ASTM A 181, class 70 ASTM A 234, class WPB	ANSI B16.11	
Take-down joints	Flanges 2 inches and above	Carbon steel ASTM A 105	ANSI B16.5	
Gaskets	Spiral wound	Metallic	MIL-G-2103A	
	O-ring	Fluorocarbon	MIL-R-8324, type I, class 1	
Flange bolting	Bolt-studs	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

- G-1-1 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.
- G-1-2 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 size pipe 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:

$$P_s = 70V$$

Where:

P_s = Pressure increase due to shock lb/in².

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

- G-1-3 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-1-4 All joints shall be welded except where take-down joints are required.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-2	Steam catapult, hydraulic oil	200	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A 106, grade A or B MIL-T-20157	
Valves	Gate	Carbon steel, ASTM A 216, grade WCB or ASTM A 105	MIL-V-18110	
	Globe and angle		Drawing 803-2177525	
	Stop check		MIL-V-22052	
	Relief			
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
Fittings	Butt weld	Carbon steel, ASTM A 105, ASTM A 181, class 70 ASTM A 106, grade B	MIL-F-20236, ANSI B16.9	
	Socket weld	Carbon steel, ASTM A 105 ASTM A 181, class 70	ANSI B16.11	
Flanges	Butt welding	Carbon steel ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	See note G-2-1
	Socket welding			
Gaskets	Spiral wound	Metallic	MIL-G-21032	
	O-ring	Fluorocarbon	MIL-R-83248, type 1, class 1	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

G-2-1 ANSI flanges may be modified to use O-ring gaskets.

G-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-3	Hydraulic oil - other than steam catapult	3000	180	See note G-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	
		Carbon steel	MIL-T-20157, type E or ASTM A 106, grade B	
Valves	Globe, angle	Corrosion-resisting steel	MIL-P-1144, 316L or 304L, ASTM 312, TP316L or TP304L	
		Aluminum-bronze	MIL-V-24109	
	Gate	Carbon steel	Drawing 803-5184193	
		Aluminum-bronze, corrosion-resisting steel	MIL-V-22052	
	Check-lift or in-line	Corrosion-resisting steel	MIL-V-18110	
		Aluminum-bronze, corrosion-resisting steel	Soft or metal seating	
	Ball	Corrosion-resisting steel	MIL-V-22687	
		Bronze		
	Relief	Carbon steel, corrosion-resisting steel		
		Bronze		
Control				
Sawling and banded				
Fittings	Silver-brazing	Nickel-aluminum-bronze	MIL-V-81940 and MIL-V-81940/1	
	Unions, silver-brazing	Bronze	Drawing 810-1385963	
		Nickel-aluminum-bronze	Drawing 303-1385941	
	Union welding	Bronze	Drawing 03-1385943	
		Carbon steel, ASTM A 105		
	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70, ASTM A 106, grade B or corrosion-resisting steel		
		ASTM A 182, 304L or 316L		
	Socket welding	Carbon steel, ASTM A 105, ASTM A 181, class 70, Corrosion-resisting steel		
		ASTM A 182, 304L or 316L	ANSI B16.11	
				NAEL Drawing A404734 ANSI B16.9

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-3, cont'd	Hydraulic oil - other than steam catapult	3000	180	See note G-3-1

Item	Types	Material	Applicable documents	Remarks
Flanges	Butt welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	See note G-3-3
	Socket welding	Corrosion-resisting steel, ASTM A 182, 304L or 316L		
	Silver-brazing	Bronze		
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt studs	Carbon steel	MIL-S-1222, grade 8	
	Nuts			

NOTES:

- G-3-1 Hydraulic piping and fittings which are located on weather decks or other locations where they are, or may be exposed to the weather shall be corrosion-resisting steel.
- G-3-2 Where unions to NAEL Drawing A404734 are used, the material for union nut shall be of nickel-copper alloy in accordance with QQ-N-281.
- G-3-3 ANSI flanges may be modified to use O-ring gaskets.

G-3.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-4	Hydraulic oil - other than steam catapult	1500	180	See note G-4-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	
		Carbon steel	MIL-T-20157, type E or ASTM A 106, grade B	
		Corrosion-resisting steel	MIL-P-1144, 304L or 316L ASTM A 312, TP316L or TP304L	
Valves	Gate	Carbon steel	MIL-V-18110	
	Globe, angle	Carbon steel	Drawing 803-5184193	
		Aluminum-bronze	MIL-V-22052	
	Check	Aluminum-bronze	MIL-V-24109	
		Bronze Corrosion-resisting steel		
	Relief	Carbon steel or corrosion-resisting steel		
	Ball	Corrosion-resisting steel Bronze	MIL-V-22687	
Sampling and bleed		MIL-V-81940 and MIL-V-81940/1		
Fittings	Silver-brazing	Bronze	Drawing 803-1385942	
		Copper-nickel (70-30) MIL-C-15726	Drawing 803-1385945	
		Nickel-aluminum-bronze	Drawing 810-1385963	
	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70 ASTM A 106, grade B Corrosion-resisting steel ASTM A 182, 304L or 316L	ANSI B16.9	
		Socket welding	Carbon steel, ASTM A 105, ASTM A 181, class 70 Corrosion-resisting steel ASTM A 182, 304L or 316L	
	Unions, silver-brazing		Bronze	
		Nickel-aluminum-bronze	Drawing 803-1385943	
	Union welding	Carbon steel, ASTM A 105	NAEL Drawing A404734	

G-4.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-4, cont'd	Hydraulic oil - other than steam catapult	1500	180	See note G-4-1

Item	Types	Material	Applicable documents	Remarks
Flanges	Butt welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	See note G-4-3
	Socket welding	Corrosion-resisting steel, ASTM A 182, 304L or 316L		
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts or bolt-stud	Carbon steel	MIL-S-1222, grade 8	
	Nuts			

NOTES:

- G-4-1 Hydraulic piping and fittings which are located on weather decks or other locations where they are, or may be exposed to the weather shall be corrosion-resisting steel.
- G-4-2 Where unions to NAEL Drawing A404734 are used, the material for union nut shall be of nickel-copper alloy in accordance with QQ-N-281.
- G-4-3 ANSI flanges may be modified to use O-ring gaskets.

G-4.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-5	Hydraulic oil - other than steam catapult	900	180	See note G-5-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	
		Carbon steel	MIL-T-20157, type E	
		Corrosion-resisting steel	MIL-P-1144, 304L or 316L ASTM A 312, TP316L or TP304L	
Valves	Gate, 1 inch and above	Carbon steel	MIL-V-18110	
	Globe, angle	Carbon steel	Drawing 803-5184193 MIL-V-22052	
		Bronze	MIL-V-24109 MIL-V-18436	
	Check			
	Relief	Bronze Carbon steel		
	Ball	Corrosion-resisting steel	MIL-V-22687	
Sampling and bleeding		MIL-V-81940 and MIL-V-81940/1		
Fittings	Silver-brazing	Bronze	Drawing 803-1385942	2 inches maximum
		Copper-nickel (70-30) MIL-C-15726	Drawing 803-1385945	
		Bronze	Drawing 803-1385941	
	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70,	ANSI B16.9	
	Socket welding	ASTM A 106, grade B, or corrosion-resisting steel, ASTM A 182, 304L, or 316L	ANSI B16.11	
Take-down joints	Union, silver-brazing	Bronze	Drawing 803-1385946	2 inches maximum
		Nickel-aluminum-bronze	Drawing 803-1385943	
	Union, welding	Carbon steel, ASTM A 105	NAEL Drawing A404734	See note G-5-2
	Flanged butt weld	Carbon steel, ASTM A 105, ASTM A 181, class 70, or corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.5	See note G-5-3
	Flanged socket welding			

G-5.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-5, cont'd	Hydraulic oil - other than steam catapult	900	180	See note G-5-1

Item	Types	Material	Applicable documents	Remarks
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class I	
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts or bolt-stud	Carbon steel	MIL-S-1222, grade 5 or 8	
	Nuts			

NOTES:

- G-5-1 Hydraulic piping and fittings which are located on weather decks or other locations where they are, or may be, exposed to the weather shall be corrosion-resisting steel.
- G-5-2 Where unions to NAEL Drawing A404734 are based, the material for union nuts shall be of nickel-copper alloy in accordance with QQ-N-281.
- G-5-3 ANSI flanges may be modified to use O-ring gaskets.

G-5.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-6	Hydraulic oil - other than steam catapult	300	180	See note G-6-1

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless	Copper	MIL-T-24107		
		Carbon steel	MIL-T-20157, ASTM A 106, grade B		
		Corrosion-resisting steel	MIL-P-1144, ASTM A 312, 316L or 304L		
Valves	Gate	Bronze	MIL-V-1189 Drawing 803-1385714		
		Carbon steel	MIL-V-18110		
	Globe, angle	Bronze	Drawing 803-4384536		
		Carbon steel	Drawing 803-2177525 MIL-V-22052		
	Swing check	Bronze	Drawing 803-1385721		
	Relief	Bronze or steel			
	Sampling and bleed		MIL-V-81940 and MIL-V-81940/1		
	Ball, 1/4 inch - 2-1/2 inches	Corrosion-resisting steel	Drawing 803-5001003		
Fittings	Silver-brazing	Bronze	MIL-F-1183		
	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70 ASTM A 106, grade B or corrosion-resisting steel, ASTM A 182, 304L or 316L	MIL-F-20236 ANSI B16.9		
			ANSI B16.11		
Take-down joints	Union, silver-brazing	Bronze	MIL-F-1183		
	Flanged, silver-brazing		MIL-F-20042		
	Flanged	Carbon steel, ASTM A 105, ASTM A 181, class 70 or corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.5		See note G-6-2
	Unions, welding	Carbon steel, ASTM A 105	NAEL Drawing A404734		See note G-6-3

G-6.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-6, cont'd	Hydraulic oil - other than steam catapult	300	180	See note G-6-1

Item	Types	Material	Applicable documents	Remarks
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts or bolt-studs	Carbon steel	MIL-S-1222, grade 5	
	Nuts			

NOTES:

- G-6-1 Hydraulic piping and fittings which are located on weather decks or other locations where they are, or may be, exposed to the weather, shall be corrosion-resisting steel.
- G-6-2 ANSI flanges may be modified to use O-ring gaskets.
- G-6-3 Where unions to NAEL Drawing A404734 are used, the material for union nuts shall be of nickel-copper alloy in accordance with QQ-N-281.

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-7	Hydraulic oil - other than steam catapult	150	150	See note G-7-1

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless	Copper	MIL-T-24107		
		Carbon steel	MIL-T-20157		
	Seamless or welded	70-30 copper-nickel alloy	ASTM A 106, grade A		
	Seamless		MIL-T-16420		
Valves		Corrosion-resisting steel	MIL-P-1144, 304 or 316L, ASTM A 312, TP304 or TP316L		
	Gate	Bronze	Drawing 803-2177917		
		Carbon steel	Drawing 803-1385714		
	Globe, angle	Bronze	MIL-V-18110		
		Carbon steel	Drawing 803-1385623		
	Globe, angle and cross	Carbon steel	Drawing 803-4384536		
	Swing check	Carbon steel	Drawing 803-2177525		
	Relief	Bronze	MIL-V-22052		
	Sampling and bleed	Bronze or steel	Drawing 803-1385721		
	Ball, 1/4 inch - 2-1/2 inches	Carbon steel	MIL-V-81940 and MIL-V-81940/1		
	Butterfly	Corrosion-resisting steel, Bronze	Drawing 803-5001003		
	Fittings	Silver-brazing	Bronze	MIL-V-24624	
		Socket welding	Bronze	MIL-F-1183	
		Carbon steel, ASTM A 105, ASTM A 181, class 70, ASTM A 106, grade B or corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.11		
Butt welding			MIL-F-20236, ANSI B16.9		

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
G-7, cont'd	Hydraulic oil - other than steam catapult	150	150	See note G-7-1

Item	Types	Material	Applicable documents	Remarks
Take-down joints	Union, silver-brazing	Bronze	MIL-F-1183	
	Unions, welding	Carbon steel, ASTM A 105	NAEL Drawing A404734	See note G-7-3
	Flanged, silver-brazing	Bronze	MIL-F-20042	See note G-7-2
	Flanged	Carbon steel, ASTM A 181, class 70, ASTM A 105, corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.5, flat face	See note G-7-4
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 1	
	Flat	Asbestos	HH-P-46	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTES:

- G-7-1 Hydraulic piping and fittings which are located on weather decks or other locations where they are, or may be, exposed to the weather shall be corrosion-resisting steel.
- G-7-2 Where bronze 150 lb/in² line flanges bolt up to 250 lb/in² 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 lb/in² flange bolting.
- G-7-3 Where unions to NAEL Drawing A404734 are used, the material for union nuts shall be of nickel-copper alloy in accordance with QQ-N-281.
- G-7-4 ANSI flanges may be modified to use O-ring gaskets.

G-7.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
H-1	Gasoline	150	150	

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless or welded	Copper-nickel alloy 90-10	MIL-T-16420, class 200	See note H-1-1	
	Seamless	Copper	MIL-T-24107		
Valves	Gate	Bronze	Drawing 803-2177917		
	Globe, angle and cross		Drawing 803-1385714		
			Drawing 803-4384536		
			MIL-V-17547		
	Swing check		MIL-V-24624		Type III
	Butterfly		MIL-V-24332		
Relief	MIL-V-15358				
Fittings	Socket welding	Copper-nickel alloy	ANSI B16.11		
	Butt welding		Drawing 803-1385880		
	Brazing		MIL-F-24227, MIL-F-1183		
Take-down joints	Flanged	Bronze	MIL-F-20042, MIL-F-24227	Special flange for butterfly valves	
			Drawing 810-1385892		
	Unions		MIL-F-1183, MIL-F-24227		
Gaskets	Flat	Buna-N and cork	MIL-C-6183, class 1, grade C-firm		
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661		

H-1.1

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NOTE:

H-1-1 Within gasoline tanks and for salt water compensating system.

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
H-2	Cleaning fluid and contaminated aviation lubricating system	100	150	

Item	Types	Material	Applicable documents	Remarks	
Pipe	Seamless	Copper	MIL-T-24107		
	Seamless or welded	Copper-nickel, 90-10	MIL-T-16420	See note H-2-1	
Valves	Gate	Bronze	Drawing 803-2177917		
	Globe, angle and cross			Drawing 803-1385714	
				Drawing 803-1385541	
				Drawing 803-4384536	
				MIL-V-24624	Type III
	Butterfly		MIL-V-17547		
	Swing check		Drawing 803-1385721		
	Relief		MIL-V-24332		
	Regulating		MIL-V-15358		
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003		
Ball, 3 inches - 6 inches		Drawing 803-5001004			
Fittings	Welding	Copper-nickel alloy	Drawing 803-1385880 or ANSI B16.11		
	Silver-brazing	Bronze	MIL-F-1183		
Take-down joints	Flanged	Bronze	MIL-F-24227		
			MIL-F-20042		
			Drawing 810-1385892	Special flange for butterfly valves	
Gaskets	Union		MIL-F-1183 ^{INT}		
	Flat	Buna-N and cork	MIL-F-24227		
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-C-6183, class 1, grade C-firm		
			MIL-S-1222, grade 655, 661		

NOTE:

H-2-1 Within gasoline tanks and for salt water compensating system.

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
I-1	JP-5	200	100	See notes I-1-1 and I-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10 copper-nickel except for special applications	MIL-T-16420, class 200	
	Gate	Bronze	Drawing 803-2177917 Drawing 803-1385714 Drawing 803-1385541 Drawing 803-1385623 Drawing 803-4384536 MIL-V-2462 MIL-V-2433	100 lb/in ² maximum
Valves	Globe, angle and cross			
	Butterfly	Bronze		Type III
	Relief			
	Swing check		Drawing 803-1385637	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Ball, 3 inches - 6 inches		Drawing 803-5001004	
Fittings	Silver-brazing	Bronze	MIL-F-1183 MIL-F-24227	
	Butt welding Socket welding	90-10 copper-nickel	Drawing 803-1385880 ANSI B16.11	
Take-down joints	Flanges (silver-brazing)	Bronze	MIL-F-20042 MIL-F-24227 Drawing 810-1385892	Special flange for butterfly valves
	Flanges (butt weld)	Copper-nickel	Drawing 810-1385992	
	Flanges (socket weld)	Copper-nickel	Drawing 810-4715319	
	Unions	Bronze	MIL-F-1183 MIL-F-24227	

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
I-1, cont'd	JP-5	200	100	See notes I-1-1 and I-1-2

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Buna-N and cork	MIL-C-6183, class 1, grade C-firm	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTES:

I-1-1 See category U-1 for those sections of tank stripping which discharge overboard.

I-1-2 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.

I-1.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-1	Air, nitrogen and helium	6000	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	70-30 copper-nickel alloy	MIL-T-16420	
		Corrosion-resisting steel	MIL-P-1144, composition 304L or 316L, ASTM A 312, TP304L or TP316L	
Valves	Globe and angle	Aluminum-bronze	MIL-V-24109	
	Check, lift and in-line	Bronze	Soft seating design	
		Aluminum-bronze		
	Ball		MIL-V-22687	
	Relief		MIL-V-22549	
	Control-special			
	Pressure-reducing		MIL-V-2961	
Manifolds pressure-reducing		MIL-V-24272		
	Automatic shut-off		MIL-V-24394	
Fittings	Socket welding	Forged copper-nickel alloy, MIL-C-15726 (70-30) or corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.11	
	Butt welding		ANSI B16.5	
	Unions	Forged copper-nickel, MIL-C-15726 or corrosion-resisting steel, QQ-S-763, 304L or 316L	Drawing 803-1385884	See note J-1-1
	Socket or butt welding outlets	Corrosion-resisting steel, ASTM A 182, 304L or 316L or 70-30 copper-nickel	Commercial	Welded to pipe run
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 2	

NOTE:

J-1-1 To prevent or minimize galling, the union nut shall be of dissimilar metal than the thread piece.

J-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-2	Air and nitrogen	3300	150	See note J-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper 70-30 copper-nickel alloy Corrosion-resisting steel	MIL-T-24107 MIL-T-16420 MIL-P-1144, 304L or 316L ASTM A 312, TP304L, TP316L	
Valves	Globe and angle	Aluminum-bronze	MIL-V-24109	
	Check-lift and in-line	Bronze, aluminum-bronze, copper-nickel	Soft seating design	
	Ball		MIL-V-22687	
	Relief		MIL-V-22549	
	Pressure-reducing		MIL-V-2961	
	Manifolds pressure-reducing		MIL-V-24272	
	Automatic shut-off		MIL-V-24394	
Fittings	Silver-brazed	Nickel-aluminum-bronze	Drawing 803-1385963	1500 lb/in ² maximum
		Bronze	Drawing 803-1385941	
			Drawing 803-1385942	
	Socket welded	Corrosion-resisting steel ASTM A 182, 304L or 316L	ANSI B16.11	
	Booses	70-30 copper-nickel alloy	Drawing 803-1385950	
	Socket welded end outlet	70-30 copper-nickel, MIL-C-15726	Commercial	See note J-2-2
Unions	Silver-brazed	Bronze	Drawing 803-1385943	1500 lb/in ² maximum
			Drawing 803-1385883	
			Drawing 803-1385946	
	Socket welded	Forged copper-nickel, MIL-C-15726, or corrosion-resisting steel, 304L or 316L	Drawing 803-1385884	
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 2	

NOTE:

J-2-1 Piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or corrosion-resisting steel. Valves in these spaces shall be welded, flanged, or union ended with copper-nickel or corrosion-resisting steel tail pieces. Silver-brazed joints shall not be used in these spaces.

J-2-2 Commercial fittings shall be approved by the Supervisor or NAVSEA.

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J-2.1

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-3	Air and nitrogen	600	150	See note J-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper 70-30 copper-nickel alloy Corrosion-resisting steel	MIL-T-24107, ASTM B 88 MIL-T-16420 MIL-P-1144, 304L or 316L ASTM A 312, TP304L, TP316L	
Valves	Globe, angle and check	Bronze, aluminum-bronze	MIL-V-24109, soft-seating design	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Relief		MIL-V-22549	
	Pressure-reducing		MIL-V-2961	
	Manifolds, pressure-reducing		MIL-V-24272	
	Automatic shut-off		MIL-V-24394	
Fittings	Silver-brazed	Bronze	Drawing 810-1385766 MIL-F-1183	400 lb/in ² maximum
	Socket weld	Corrosion-resisting steel ASTM A 182, 304L, or 316L	ANSI B16.11	
	Bosses	70-30 copper-nickel alloy	Drawing 803-1385950	
	Socket welding end outlet	70-30 copper-nickel, MIL-C-15726	Commercial	See note J-3-2
Unions	Silver-brazed	Bronze	Drawing 810-1385859 Drawing 810-1385889 MIL-F-1183	400 lb/in ² maximum
	Socket welded	Forged copper-nickel, MIL-C-15726, or corrosion-resisting steel, 304L or 316L	Drawing 803-1385884	
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I class 1	

NOTES:

- J-3-1 Piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or corrosion-resisting steel. Valves in these spaces shall be welded, flanged, or union ended with copper-nickel or corrosion-resisting steel tail pieces. Silver-brazed joints shall not be used in these spaces.
- J-3-2 Commercial fittings shall be approved by the Supervisor or NAVSEA.

J-3-1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-4	Air and nitrogen	200	150	See note J-4-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper Copper-nickel alloy Corrosion-resisting steel Glass reinforced plastic	MIL-T-24107, ASTM B 88 MIL-T-16420 MIL-P-1144, 304L or 316L ASTM A 312, TP304L or TP316L MIL-P-24608	See note J-4-3
Valves	Gate	Bronze	Drawing 803-1385714	Soft seat design, except needle valve
	Swing check		Drawing 803-1385721	
	Globe, angle, needle, stop check and check		Drawing 803-4384536	
	Pressure-reducing		MIL-V-24384	
	Relief		MIL-V-22549	
	Automatic shut-off		MIL-V-24394	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
Fittings	Silver-brazed	Bronze	MIL-F-1183	See note J-4-2
	Socket welded	Corrosion-resisting steel, ASTM A 182, F304L, F316L	ANSI B16.11	
	Socket welded end outlet	70-30 copper-nickel, MIL-C-15726	Commercial	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	
Unions	Silver-brazed	Bronze	MIL-F-1183	
	Butt and socket welded	Corrosion-resisting steel or copper-nickel (70-30)	Drawings 803-1385884, 810-1385888	
Flanges	Silver-brazed	Bronze	MIL-F-20042, ANSI B16.24	
	Socket welded	Corrosion-resisting steel ASTM A 182, F304L, F316L 70-30 copper-nickel	ANSI B16.5 ANSI B16.5, class 150	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	

J-4.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-4, cont'd	Air and nitrogen	200	150	See note J-4-1

Item	Types	Material	Applicable documents	Remarks
Flange bolting	Bolts	Silicon bronze	MIL-S-1222, grade 655 or 661	
	Nuts			
Gaskets	Sheet	Synthetic rubber	MIL-G-1149	
	O-ring	Fluorocarbon	MIL-R-83248, type I, class 2	

NOTES:

- J-4-1 Piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or corrosion-resisting steel. Valves in these spaces shall be welded, flanged, or union ended with copper-nickel or corrosion-resisting steel tail pieces. Silver-brazed joints shall not be used in these spaces.
- J-4-2 Commercial fittings shall be approved by the Supervisor or NAVSEA.
- J-4-3 GRP may be used for L.P. non-vital air system.

J-4.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-5	Air, aircraft starting and cooling, bleed-off and 20.2 lb/in ² absolute systems	150	550	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	MIL-T-20157 ASTM A 106, grade A or B	
Valves	Gate, 1 inch and above	Carbon steel ASTM A 105	MIL-V-18110	Flanged ends only, ANSI B16.5
	Control		MIL-V-18030	
	Relief		MIL-V-20065	
Fittings	Butt welding	Carbon steel ASTM A 105, ASTM A 181, class 70, or ASTM A 234, class WPB	MIL-F-20236, ANSI B16.9	
	Socket welding	Carbon steel ASTM A 105, ASTM A 181, class 70, or ASTM A 234, class WPB	ANSI B16.11	
Flanges		Carbon steel ASTM A 105, ASTM A 181, class 70, or ASTM A 234, class WPB	ANSI B16.5	Flat face
Gaskets	Sheet	Commercial	Commercial	1/16 inch thick
Flange bolting	Bolts or bolt-stud	Alloy steel	MIL-S-1222, grade B7	
	Nuts	Carbon steel	MIL-S-1222, grade 5	

J-5.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-6	Air, aircraft starting and cooling, main system	150	450	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Corrosion-resisting steel	MIL-P-1144, composition 304L or ASTM A 312, TP 304L	
Valves	Gate	Corrosion-resisting steel ASTM A 744, grade CF-8	MIL-V-18110	Flanged ends only ANSI B16.5
	Control		MIL-V-18030	
	Relief		MIL-V-20065	
Fittings	Butt welding	Corrosion-resisting steel ASTM A 182, 304L	ANSI B16.9	
	Socket welding		ANSI B16.11	
Flanges	Butt welding	Corrosion-resisting steel ASTM A 182, 304L	ANSI B16.5	Flat face
	Socket welding			
Gaskets	Sheet	Commercial	Commercial	1/16 inch thick
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

J-6.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-7	Air, prairie-masker, gas turbine starting	100	600	See note J-7-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless Seamless or welded	Copper Copper-nickel Corrosion-resisting steel	MIL-T-24107 MIL-T-16420 MIL-P-1144 or ASTM A 312, TP321 or TP347	See note J-7-2
Valves	Gate	Bronze	Drawing 803-2177917	425°F maximum
	Globe, angle and stop check		Drawing 803-1385541	
	Swing check		Drawing 803-4384536	
	Butterfly		MIL-V-17547	2-1/2 inches and above
			Drawing 803-1385721	2 inches and below, 425°F maximum
			MIL-V-24624	See note J-7-3
Automatic shut-off	Drawing 810-1385892	Special flanges for butterfly valves		
Fittings	Silver-brazed	Bronze	MIL-F-1183	See notes J-7-4 and J-7-5
	Socket welded end outlet	70-30 copper-nickel, MIL-C-15726	Commercial	
	Socket welded	Corrosion-resisting steel, ASTM A 182, 316, 321 or 347	ANSI B16.11	
	Butt welded		ANSI B16.9	
Flanges	Silver-brazed Butt and socket welded	Bronze 70-30 copper-nickel or corrosion-resisting steel	MIL-F-20042 ANSI B16.5, class 300	
Unions	Silver-brazed	Bronze	MIL-F-20042	
	Butt and socket welded	70-30 copper-nickel or corrosion-resisting steel	Drawings 803-1385884, 810-1385888	

J-7.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-7, cont'd	Air, prairie-masker, gas turbine starting	100	600	See note J-7-1

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Non-asbestos	Commercial	1/16 inch thick See note J-7-5
Flange bolting	Bolt stud	Silicon bronze	MIL-S-1222, grade 655, 661	
	Nuts			

NOTES:

- J-7-1 Piping and fittings in fire hazardous areas, such as machinery spaces, shall be fabricated of copper-nickel or corrosion-resisting steel. Valves in these spaces shall be welded, flanged, or union ended with copper-nickel or corrosion-resisting steel 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 Commercial items shall be approved by the Supervisor or NAVSEA.

J-7.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-8	Air deballast	50	400	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10 copper-nickel	MIL-T-16420, class 200	
Valves	Gate	Bronze	Drawing 803-2177917	
	Globe and angle		Drawing 803-1385714	
	Check, swing		Drawing 803-1385541	
	Butterfly		Drawing 803-4384536	
	Relief		Drawing 803-1385637	
	Control		Drawing 803-1385721	
Fittings	Silver-brazing	Bronze	MIL-V-24624	See note J-8-2
	Butt welding	90-10 copper-nickel	MIL-V-20065	
	Socket welding		MIL-V-18030	
	Unions, silver-brazing	Bronze	MIL-F-1183	
Flanges	Silver-brazing	Bronze	MIL-F-20042	Special flanges for butterfly valves
	Butt weld	90-10 copper-nickel, MIL-C-15726	Drawing 810-1385892	
	Slip-on		Drawing 810-1385992	See note J-8-1
Gasket	Sheet	Asbestos	HH-P-46	1/16 inch thick
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTE:

- 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-F-20042.
- J-8-2 Valve must be suitable for a temperature of 400°F.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
J-9	Air: Gas turbine bleed, anti-icing	250	950	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel	MIL-P-1144 or ASTM A 312, TP321 or TP347	
Valves	Gate	Corrosion-resisting steel, ASTM A 182, F321 or F347	MIL-V-18110, modified	See note J-9-1
	Globe, lift check		Drawing 803-5184193, MIL-V-22052, modified	
	Swing check		Commercial	
	Ball		Drawing 803-5001003 or commercial	See note J-9-2
Fittings	Socket welded	Corrosion-resisting steel, ASTM A 182, F321 or F347	ANSI B16.11	
	Butt welded		ANSI B16.9	
Take-down joints	Flanges	Corrosion-resisting steel, ASTM A 182, F321 or F347	ANSI B16.5	
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt studs	Alloy steel	MIL-S-1222, grade B16	
	Nuts		MIL-S-1222, grade 4	

NOTE:

- J-9-1 Composition E: Corrosion-resisting steel 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 Commercial items shall be approved by the Supervisor or NAVSEA.

J-9.1

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

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper-nickel	MIL-T-16420	3000 lb/in ² maximum
		Copper	MIL-T-24107	
Valves	Globe and angle	Bronze, aluminum bronze, copper-nickel	Soft seat design MIL-V-24109	Union end
	Check-lift	Nickel-copper alloy	MIL-V-22549	
	Relief		MIL-V-24336	
Fittings	Silver-brazing	Nickel-aluminum bronze Bronze	Drawing 810-1385963 Drawing 803-1385941	3000 lb/in ² maximum
	Socket welding	Nickel-copper alloy	ANSI B16.11	
Unions	Silver-brazing	Bronze	Drawing 803-1385943	3000 lb/in ² maximum
	Socket welding	Nickel-copper alloy	Drawing 810-1385884	See note K-1-3
Gaskets	O-ring	Fluorocarbon	MIL-R-83248, type I, class 2	

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 Supervisor of Shipbuilding.)
- K-1-3 Union nut shall be of nickel-copper-aluminum.

K-1.1

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

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Nickel-copper alloy	MIL-T-1368, class A	
Valves	Globe and angle	Nickel-copper alloy	MIL-V-24439	With nickel-copper nipples welded to body
	Relief		MIL-V-22549	
	Pressure-reducing		MIL-V-24336	
Fittings	Socket welding	Nickel-copper alloy, QQ-N-281, class A, annealed	ANSI B16.11	
Take-down joints	Unions	Nickel-copper alloy	Drawing 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 Supervisor of Shipbuilding.)
- 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 MIL-STD-278. The O-ring shall be removed prior to seal welding each joint. Union nut shall be of nickel-copper-aluminum.

K-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
K-3	Gaseous oxygen	100	Ambient	See notes K-3-1 and K-3-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch minimum wall thickness
Valves	Globe Gate Swing check	Bronze	Drawings 803-4384536, 803-1385714, 803-1385721	Socket ends for silver-brazing, soft seated globe valves See note K-3-4
	Pressure-reducing	Bronze	MIL-V-24336	Union ends
	Diaphragm, packless	Bronze, ASTM B 61	Commercial	Socket ends for silver-brazing, teflon or nylon disc washer
	Relief	Bronze	MIL-V-22549	See note K-3-3
Fittings	Silver-brazing	Bronze	MIL-F-1183	With O-ring material to MIL-R-83248, type I, class 1
	Unions, silver-brazing		Drawing 810-1385859	
			MIL-F-1183	

NOTES:

- K-3-1 Components shall be cleaned in accordance with the requirements of MIL-STD-1330.
- 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 Supervisor of Shipbuilding.)
- K-3-3 Relief valves shall conform with the basic requirements of MIL-V-22549. Seat or disc material shall be suitable for oxygen service.
- K-3-4 Valve packing shall be in accordance with MIL-P-24396, type C.

K-3-1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
K-4	Liquid oxygen and nitrogen	6000		See notes K-4-1 and K-4-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel	MIL-P-1144, 316L ASTM A 312, 316L	
Valves	Globe		MIL-V-24109	
Fittings	Socket welding	Corrosion-resisting steel ASTM A 182, 316L	ANSI B16.11	
	Butt welding, seamless	Corrosion-resisting steel MIL-P-1144, 316L ASTM A 182, 316L	ANSI B16.9	

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

K-4.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
K-5	Liquid oxygen and nitrogen	250		See notes K-5-1 and K-5-2

Item	Type	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	0.065 inch minimum wall thickness
		Corrosion-resisting steel	MIL-P-1144, 304 or 316	
Valves	Globe, gate, and swing check	Bronze	Drawings 803-4384536, 803-1385714, 803-1385721	Silbraze union end See note K-5-3
	Relief	Corrosion-resisting steel	Commercial	
Fittings	Silver-brazing	Bronze	MIL-F-1183	With suitable O-ring gasket material
	Unions, silver-brazing		Drawing 810-1385859 MIL-F-1183	
	Socket welding	Corrosion-resisting steel ASTM A 182, 304 or 316	ANSI B16.11	

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 Supervisor of Shipbuilding.)
- K-5-3 Valve packing shall be in accordance with MIL-P-24396, type C.

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K-5-1

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

Item	Type	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel	MIL-P-1144, or ASTM A 312, 304L or 316L	
Valves	Globe and angle	Corrosion-resisting steel	MIL-V-24109	Union ends to Drawing 803-1385884 See note K-6-3
	Relief		MIL-V-22549	
	Pressure-reducing		MIL-V-24336	
Fittings	Socket welding	Corrosion-resisting steel, ASTM A 182, 304L or 316L	ANSI B16.11	
	Butt welding		ANSI B16.9	
Take-down joints	Unions	Corrosion-resisting steel, QQ-S-763, 304L or 316L or ASTM A 182, 304L or 316L	Drawing 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 Supervisor of Shipbuilding.)
- K-6-3 Valves intended for use where system operating gauge pressure exceeds 3000 lb/in² 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 category K-1 or K-2.

K-6.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
K-7	Propane	200		

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
Valves	Globe, angle, stop and stop check	Bronze	Drawing 803-4384536	
Fittings	Silver-brazing Unions, silver-brazing	Bronze	MIL-F-1183	

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

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Corrosion-resisting steel	MIL-P-1144, 304L or ASTM A 312, TP304L	
		Copper-nickel, 90-10	MIL-T-16420	See note L-1-1
Valves	Globe	Bronze	Drawing 803-4384536	
	Gate and stop	Corrosion-resisting steel, bronze	Commercial Drawing 803-1355714	
	Swing check	ASTM A 743, grade CF-8		
	Relief	Bronze	MIL-V-24332	
	Temperature regulating	Bronze	MIL-V-19772	
	Ball, 1/4 inch - 2-1/2 inches	Corrosion-resisting steel, bronze	Drawing 803-5001003	
	Butterfly	Corrosion-resisting steel, bronze	MIL-V-24624	
Fittings	Socket weld	Corrosion-resisting steel, ASTM A 182, 304L	ANSI B16.11	
	Butt weld		ANSI B16.9	
	Silver-brazing	Bronze	MIL-F-1183	
Take-down joints	Flanges	Corrosion-resisting steel, ASTM A 182, 304L	ANSI B16.5	
		Bronze	MIL-F-20042	
	Unions, silver-brazing	Bronze	MIL-F-1183	
Gaskets	Flat	Synthetic rubber	MIL-G-1149	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTE:

- 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 categories C-1 or C-2.

L-1-1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
M-1	Sea water-washdown countermeasure system	200	100	See notes M-1-1 and M-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel (90-10)	MIL-T-16420	
		Aluminum	WW-T-700/5	
Valves	Gate	Bronze	Drawing 803-2177917	
	Globe		Drawing 803-4384536	
	Control		MIL-V-17501	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Ball, 3 inches - 6 inches		Drawing 803-5001004	
	Butterfly		MIL-V-24624	
Fittings	Silver-brazing	Bronze	MIL-P-1183	
	Butt welding	Aluminum alloy, 5086	ANSI B16.9	
Take-down joints	Flanges	Bronze	MIL-P-20042	Special flanges for butterfly valves
			Drawing 810-1385892	
	Union, silver-brazing		MIL-P-1183	
Gaskets	Full face (flat)	Rubber	MIL-G-1149	
Flange bolting	Bolts, studs, nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

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NOTES:

- M-1-1 For attachment of type S corrosion-resisting steel spray heads a nickel-copper transition piece in accordance with MIL-T-1368, 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 Aluminum pipe and fittings are to be used in areas of aluminum structures only. An aluminum flanged spacer (waster piece) approximately 2 feet in length shall connect the CU-NI piping to the aluminum piping.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
N-1	Sprinkling system (dry) other than foam	175		

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	90-10 copper-nickel	MIL-T-16420	
Valves	Sprinkling control	Bronze	MIL-V-17501	See note N-1-1
			MIL-V-2187	See note N-1-2
Fittings	Welding	90-10 copper-nickel	Drawing 803-1385880	
	Socket welding	90-10 copper-nickel	ANSI B16.11	
Flanges	Socket welding	90-10 copper-nickel	Drawing 810-4715319	
	Butt welding		Drawing 810-1385992	
Unions	Welding	90-10 copper-nickel	Drawing 803-1385884	
Gaskets	Sheet	Synthetic rubber	MIL-G-1149	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTES:

N-1-1 For automatic or remote manual control.

N-1-2 For local manual control.

N-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
N-2	Magazine sprinkling system (wet)	175		See Drawing 810-1385958

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	Copper-nickel, 90-10	MIL-T-16420	Sea water filled
Valves	Gate, 2 inches maximum	Bronze	Drawing 803-1385714	Union end
	Globe, 2 inches maximum		Drawing 803-4384536	
	Swing check, 2 inches maximum		Drawing 803-1385721	
	Gate, 2-1/2 inches and above		Drawing 803-2177917	Flanged end
	Globe, 2-1/2 inches and above		Drawing 803-1385623	
	Swing check, 2-1/2 inches and above		Drawing 803-1385637	
	Sprinkling control			MIL-V-17501
	Butterfly	Bronze	MIL-V-24624	
Fittings	Welding	90-10 copper-nickel	Drawing 803-1385880	
	Socket welding		ANSI B16.11	
Flanges	Socket welding	90-10 copper-nickel	Drawing 810-4715319	
	Butt welding		Drawing 810-1385992	
Gaskets	Sheet	Synthetic rubber	MIL-G-1149	
		Cloth, inserted rubber	HH-P-151	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

N-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
O-1	Diesel, sewage treatment, incinerator and gas turbine exhaust		1125	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 ASTM A 106, grade B	775°F maximum
		Corrosion-resisting steel 321, or 347	ASTM A 376 MIL-P-1144 ASTM A 167	
Fittings	Special fabricated	Corrosion-resisting steel ASTM A 182, ASTM A 376, MIL-P-1144	Commercial	
	Socket welding	Carbon steel, ASTM A 105 or A 181, class 70	ANSI B16.11	775°F maximum
	Butt welding	Carbon steel, ASTM A 105 ASTM A 100, grade B or ASTM A 181, class 70	ANSI B16.9	
Take-down joints	Flanges	Corrosion-resisting steel, ASTM A 182, 321, or 347	ANSI B16.5 or specially fabricated	
		Cast carbon steel ASTM A 216, grade WCB	ANSI B16.5	775°F maximum
Gaskets	Sheet	Asbestos	HH-F-46	
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts - stud	Alloy steel	MIL-S-1222, grade B16	
	Nuts		MIL-S-1222, grade 4	

NOTES:

- O-1-1 Grade 316L corrosion-resisting steel 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 B 443 or ASTM B 444.

O-1.1

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Category and group	Services	Maximum system pressure lb/in ²	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-20157 ASTM A 106, grade B	See note P-1-1
Fittings	Butt welding	Carbon steel, ASTM A 105, ASTM A 106, grade B, or ASTM A 181, class 70	ANSI B16.9	
Flanges	Butt welding	Carbon steel ASTM A 181, class 70, or ASTM A 105	ANSI B16.5, series 150	
Gaskets	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt - stud	Alloy steel	MIL-S-1222, grade B16	
	Nuts		MIL-S-1222, grade 4	

NOTE:

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

P-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
Q-1	Refrigerant piping	30 inches vacuum to 300 lb/in ²	minus 85 to plus 250	See notes Q-1-1 and Q-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	ASTM B 88, hard drawn	
		Copper-nickel	MIL-T-16420	
Valves	Manual	Bronze	MIL-V-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	ANSI B16.22	See note Q-1-3
	Socket and butt weld	Copper-nickel	ANSI B16.11 or B16.9	
Mechanical take-down joints	O-ring face seal unions, brazed or welded	Corrosion-resisting steel Copper-nickel	Commercial Drawing 810-1385889 Drawing 803-1385948	O-ring material shall be compatible with refrigerant in system
Flanges	Silver-brazing, 4-bolt tongue and groove	Steel	ASTM A 105	Flange
		Brass	Commercial	Adapter
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	
Gaskets	Sheet	Asbestos	HH-P-46	

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 lb/in²; R-12, 225 lb/in²; R-22, 300 lb/in², and R-114, 50 lb/in².
- Q-1-3 ANSI B16.22 fittings shall be silver-brazed.

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Q-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
R-1	Waste water and oily water drainage, oily waste transfer and weather deck drainage systems	50	150	See notes R-1-1 through R-1-4
Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10 copper-nickel	MIL-T-16420	
	Seamless	Aluminum alloy, 5086 Carbon steel, galvanized Glass reinforced plastic	WW-T-700/5 ASTM A 106, grade B MIL-P-24608	See note R-1-5
Valves	Gate	Bronze	Drawing 803-2177917	
	Globe, angle, and stop check		Drawing 803-1385714	
	Swing check		Drawing 803-1385541	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-4384536	
	Ball, 3 inches - 6 inches		Drawing 803-1385637 Drawing 803-1385721 Drawing 803-5001003	
Fittings	Flanged		Drawing 803-5001004	
	Silver-brazing	Bronze	Drawing 810-1385915	
	Deck drain	Copper-nickel	MIL-F-1183	
		Carbon steel	Drawing 803-1385789	
	Butt welding	90-10 copper-nickel	Commercial	
		Aluminum alloy, 5086 or carbon steel	Drawing 803-1385880 ANSI B16.9	
Flanges	Socket bonded	Glass reinforced plastic	MIL-P-24608	See note R-1-5
	Socket welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Silver-brazing	Bronze	MIL-F-20042	
	Socket bonded	Glass reinforced plastic	MIL-P-24608	See note R-1-5
	Socket welding	Carbon steel, galvanized ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	See note R-1-5

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
R-1, cont'd	Waste water and oily water drainage, oily waste transfer and weather deck drainage systems	50	150	See notes R-1-1 and R-1-4

Item	Types	Material	Applicable documents	Remarks
Gaskets	Sheet	Synthetic rubber	MIL-G-1149	
		Synthetic rubber cloth inserted	HH-P-151	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

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 Glass reinforced plastic 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 glass reinforced GRP pipe to GRP fittings and flanges.

R-1.2

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
R-2	Chemical drains	30	150	See note R-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel	MIL-P-1144, 316L or ASTM A 312	
		Carbon steel (lead lined)	ASTM A 106, grade B	
		Lead lined	MIL-L-24055	
Valves	Gate	Bronze	Drawing 803-2177917	
	Swing check	Corrosion-resisting steel, ASTM A 351, grade CF-8M	Drawing 803-1385721	
			Drawing 803-5001003	
			Drawing 803-5001004	
Ball, 1/4 inch - 2-1/2 inches				
Ball, 3 inches - 6 inches				
Fittings	Flanged	Corrosion-resisting steel ASTM A 182, 316L	ANSI B16.5	
		Carbon steel (lead lined)		
Flanges	Butt welding	Corrosion-resisting steel, ASTM A 182, 316L	ANSI B16.5	
	Socket welding	Carbon steel (lead lined)		
	Silver-brazing	Bronze		
Gaskets	Sheet	Lead		
	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

R-2.1

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NOTE:

R-2-1 Corrosion-resisting steel material to be used for photo lab drainage piping system.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
R-3	Drains and vents, deck drains and plumbing	50	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10, copper-nickel	MIL-T-16420	See note R-3-1
	Seamless	Carbon steel (galvanized)	ASTM A 106	See note R-3-2
		Copper	MIL-T-24107	See note R-3-3
		Aluminum alloy 5086	ASTM B 210	See note R-3-5
Valves	Flanged, 50 lb/in ² scupper	Bronze	Drawing 810-1385707	
	Full port, ball or plug		MIL-V-24509	See note R-3-4
Fittings	Silver-brazing	Bronze	MIL-F-1183	
	Socket welding	Carbon steel, ASTM A 105, ASTM A 181, class 70	ANSI B16.11	
		Carbon steel, ASTM A 105, ASTM A 106, grade B, and ASTM A 181, class 70	ANSI B16.9	
		Copper-nickel	Drawing 803-1385880	
	Deck drain	Aluminum alloy 5086 Copper-nickel	Drawing 803-1385789	See note R-3-5
Take-down joints	Flanges, 150 lb/in ² silver-brazing	Bronze	MIL-F-20042	
	Union, silver-brazing		MIL-F-1183	
Gaskets	Sheet	Synthetic rubber	MIL-G-1149	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

R-3.1

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NOTES:

- R-3-1 Required for water closet and urinal drains, and sea water waste drains, and vent piping subjected to sea water 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 Use for fresh water waste drains and vents up to a height of fixture overflow.
- R-3-4 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 MIL-STD-278 are applicable.
- R-3-5 Use for fresh water drains in interior aluminum superstructure.
- R-3-6 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.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
R-4	Sewage collection, holding and transfer (CHT)	50	150	See notes R-4-1 and R-4-4

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	See note R-4-3
	Seamless or welded	Copper-nickel, 90-10	MIL-T-16420	
Valves	Swing check	Bronze	MIL-V-17547 Drawing 803-1385637	See note R-4-2
	Swing check with manual jack-open device			
	Full port		MIL-V-24509	
	3 port, two position			
Fittings	Welding	Copper-nickel	Drawing 803-1385880	
	Silver-brazing	Bronze	MIL-F-1183	
Take-down joints	Flanges	Bronze	MIL-F-20042	
	Union		MIL-F-1183	
Gaskets	Sheets	Synthetic rubber	MIL-G-1149 HH-P-151	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

NOTES:

- R-4-1 Deck discharge connections shall be in accordance with Drawing 803-4444650.
- 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 MIL-STD-278 are applicable.
- R-4-3 Use for fresh water collection piping.
- R-4-4 This category and group shall apply to soil and waste drain piping, waste drain pump and sewage pump suction and discharge piping, and overflow and vent piping for waste drain tanks.

R-4.1

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

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10, copper-nickel alloy	MIL-T-16420	
Valves	Gate	Bronze	Drawing 803-1385714	
	Globe and angle		Drawing 803-2177917	
			Drawing 803-1385623	
	Swing check		Drawing 803-4384536	
			Drawing 803-1385721	
	Hose end		Drawing 803-1385637	
			Drawing 803-1385711	
	Remote control		Drawing 803-1385712	
			MIL-V-15508	
			MIL-V-17501	With ethylene propylene terpolymer (EPT diaphragms)
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Ball, 3 inches - 6 inches		Drawing 803-5001004	
Fittings	Butterfly	Bronze	MIL-V-24624	
	Silver-brazing	Bronze	MIL-F-1183	
	Welding	90-10 copper-nickel alloy	Drawing 803-1385880	
			ANSI B16.9	
		ANSI B16.11		
Take-down joints	Flanges	Bronze	MIL-F-20042	
			Drawing 810-1385892	Special flanges for butterfly valves. 200 lb/in ² maximum
Gaskets	Unions, silver-brazing	Bronze	Drawing 810-1385992	
			Drawing 810-4715319	
			MIL-F-1183	With ethylene propylene terpolymer O-rings
Flange bolting	Sheet	Ethylene propylene terpolymer (EPT)	MIL-G-22050	
	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
T-1	Fixed CO ₂ cofferdam inerting systems	1900		See note T-1-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Copper	MIL-T-24107	
		Carbon steel	MIL-T-20157, type E	
Valves	Globe and angle	Bronze or carbon steel	Drawing 803-4384536	400 lb/in ² maximum
	Ball		MIL-V-22687	
	Pressure-reducing		MIL-V-2961	
	Relief		MIL-V-22549	
	Cylinder	Bronze	MIL-V-2/15	
Fittings	Silver-brazing	Bronze	Drawing 5000-S4823-1385766, Drawing 803-1385942	
			Drawing 810-1385863, Drawing 803-1385945	
	Unions, silver-brazing	Drawing 810-1385859 Drawing 803-1385946		
	Socket welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70 or ASTM A 106, grade B	ANSI B16.9	
Gaskets	O-ring			
Cylinders	Non-shatterable	Steel	RR-C-901	

NOTE:

T-1-1 For CO₂ fire fighting systems see MIL-E-2185, or MIL-E-2186 for specifications and applicable material and pressure requirements.

T-1.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
T-2	HALON 1301 fire extinguishing systems Distribution piping and discharge piping	2010 upstream of distribution valves 1170 elsewhere (see note)	200 140	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A 106, grade B, schedule 80	
Valves	Ball, plug and check	Corrosion-resisting steel, ASTM A 182, grade 316	MIL-E-24572	Valves shall meet the requirements of MIL-STD-167-1 and MIL-S-901
Fittings	Butt welding	Carbon steel, ASTM A 105, ASTM A 181, class 70 or ASTM A 106, grade B	ANSI B16.9	
	Socket welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
Flanges	Butt welding	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	
	Socket welding			
Gasket	Spiral wound	Metallic	MIL-G-21032	
Flange bolting	Bolt-stud	Carbon steel	MIL-S-1222, grade 8	
	Nuts			
Nozzle	Various orifice sizes with: 360 pattern or 180 pattern	Corrosion-resisting steel, ASTM A 182, grade 316	MIL-E-24572	Orifice code to be in accordance with NFPA Standard 12A

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NOTE:

T-2-1 1170 lb/in² 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 Halon system. For modular type Halon systems the 1170 lb/in² design pressure applies to all of the discharge piping.

T-2.1

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Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
T-3	HALON 1301 fire extinguishing systems actuation piping	2010	200	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Corrosion-resisting steel	ASTM A 312, grade 316L	
Valves	Check	Corrosion-resisting steel, ASTM A 182, grade 316	schedule 80 MIL-E-24572	
	Ball		MIL-E-24572	Valves shall meet the requirements of MIL-STD-167-1 and MIL-S-901
Fittings	Butt welding	Corrosion-resisting steel, ASTM A 182, grade 316L	ANSI B16.9	
	Socket welding	Corrosion-resisting steel, ASTM A 182, grade 316L	ANSI B16.11	

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
U-1	Stripping, fuel	150		See notes U-1-1 and U-1-2

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Steel	ASTM A 106, grade A	
Valves	Gate	Carbon steel	MIL-V-18110	
	Globe, angle and cross		MIL-V-22052	
	Ball, 1/4 inch - 2-1/2 inches		Drawings 803-2177525, 803-5184193 Drawing 803-5001003	
Fittings	Flanged	Carbon steel, ASTM A 181, ASTM A 105	ANSI B16.5	Flat face
	Socket welding		ANSI B16.11	
	Butt welding	Carbon steel, ASTM A 181, ASTM A 105 or ASTM A 106, grade B	MIL-F-20236 ANSI B16.9	
Flanges	Butt welding	Carbon steel, ASTM A 181, ASTM A 105	ANSI B16.5	Flat face
	Socket welding			
Gaskets	Sheet	Synthetic rubber	MIL-G-1149,	
		Cloth inserted rubber	HH-P-151, class 4	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

U-1.1

NOTES:

U-1-1 Gasoline tank stripping shall be in accordance with category H-1.

U-1-2 For JP-5 tank stripping, see category I-1.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
V-1	Voice tubes			

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Brass	MIL-T-20219	
Fittings		Brass	Commercial	

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
W-1	Pneumatic tubes			

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Brass	MIL-T-20219	
Fittings	Socket sweated	Brass	Commercial	

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
Y-1	Overflows, sounding tubes, vents and air escapes for JP-5, tanks	50	150	

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless or welded	90-10 copper-nickel, except for special applications	MIL-T-16420	See note Y-1-1
Valves	Gate	Bronze	Drawing 803-2177917/803-1355714	
	Swing check		Drawing 803-1385637	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-1385721	
	Ball, 3 inches - 6 inches		Drawing 803-5001003	
Fittings	Silver-brazing	Bronze	MIL-F-1183	
	Deck (sounding and filling)	As specified	Drawing 803-1385848	
	Butt weld	Copper-nickel	ANSI B16.9	
	Socket weld		Drawing 803-1385880	
Take-down joints	Flanges	Copper-nickel	ANSI B16.11	
	Silver-brazing unions	Bronze	Drawing 810-1385992	
Gaskets	Sheet	Buna-N and cork	MIL-F-20042	
			MIL-F-1183	
Flange bolting	Bolts	Silicon bronze	MIL-C-6183, class 1, grade C-firm	
	Nuts		MIL-S-1222, grade 655, 661	

Y-1.1

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NOTE:

Y-1-1 Air escapes and sounding tubes above the height of the overflow loop may be black steel in accordance with the requirement delineated in category Y-2 or galvanized steel in accordance with the requirements delineated in category Y-3 if the tank can contain ballast.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
Y-2	Overflows, sounding tubes, vents and air escapes for fuel tanks (except JP-5)	50	150	See note Y-2-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel	ASTM A 53	
Valves	Gate	Bronze	Drawing 803-2177917/803-1355714	
	Swing check		MIL-V-17547	
			Drawing 803-1385721	
			Drawing 803-1385637	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-5001003	
	Ball, 3 inches - 6 inches		Drawing 803-5001004	
Fittings	Flanged	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	Flat face
	Butt weld	Carbon steel, ASTM A 105, ASTM A 106, grade B or ASTM A 181, class 70	ANSI B16.9 MIL-F-20236	
	Socket weld	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Deck	Bronze	Drawing 810-1385848	
Carbon steel		Drawing 810-1385791		
Take-down joints	Flanged	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	Flat face
	Unions		MIL-F-20670	
Gaskets	Sheet	Commercial	Commercial	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

Y-2.1

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NOTE:

Y-2-1 For JP-5 use category Y-1.

Category and group	Services	Maximum system pressure lb/in ²	Maximum system temperature °F	Remarks
Y-3	Overflows, sounding tubes, vents and air escapes for other than fuel tanks (fresh water (except potable) clean ballast, voids, etc.)	50	150	See note Y-3-1

Item	Types	Material	Applicable documents	Remarks
Pipe	Seamless	Carbon steel, galvanized	ASTM A 53	
Valves	Gate	Bronze	Drawing 803-2177917/803-1355714	
	Swing check		Drawing 803-1385637	
	Ball, 1/4 inch - 2-1/2 inches		Drawing 803-1385721	
	Ball, 3 inches - 6 inches		Drawing 803-5001003	
Fittings	Flanged	Carbon steel, galvanized ASTM A 105 or ASTM A 181, class 70	ANSI B16.5	Flat face
	Butt	Carbon steel, ASTM A 105, ASTM A 106, grade B or ASTM A 181, class 70	ANSI B16.9 MIL-F-20236	
	Socket weld	Carbon steel, ASTM A 105 or ASTM A 181, class 70	ANSI B16.11	
	Deck	Bronze Carbon steel	Drawing 810-1385848 Drawing 810-1385791	
Take-down joints	Flanged	Carbon steel, galvanized ASTM A 105 or ASTM A 181, class 70	ANSI B16.5 MIL-F-20670	Flat face
	Unions		Commercial	
Gaskets	Sheet	Commercial	Commercial	
Flange bolting	Bolts, studs and nuts	Carbon steel	MIL-S-1222, grade 5	

NOTE:

Y-3-1 For potable water use category C-2.

Y-3-1

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Category and group	Services	Maximum system pressure lb/in ²	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	MIL-T-16420	
Fittings	Silver-brazing	Bronze	MIL-F-1183	
Flanges	Silver-brazing	Bronze	MIL-F-20042	
Gaskets	Sheet	Commercial	Commercial	
Flange bolting	Bolts, studs and nuts	Silicon bronze	MIL-S-1222, grade 655, 661	

Y-4.1

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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>
A	
Air and nitrogen	J-3 and J-4
Air, aircraft starting and cooling bleed-off and 20.2 lb/in ² absolute systems	J-5
Air, aircraft, starting and cooling, main system	J-6
Air deballast	J-8
Air escapes, overflows, sounding tubes and vents for JP-5 outside tank beyond first connection	Y-1
Air escapes, overflows, sounding tubes and vents for fuel tanks (diesel oil, fuel, lubricating oil)	Y-2
Air escapes, overflows, sounding tubes and vents for tanks other than fuel tanks (fresh water (except potable) clean ballast, voids, and so forth)	Y-3
Air, nitrogen and helium	J-1 or J-2
Air, prairie-masker ships gas turbine starting, sewage, aerating	J-7
Aircraft starting and cooling, bleed-off and 20.2 lb/in ² absolute system, air	J-5
Aqueous film-forming foam (AFFF) concentrate and AFFF/SW solution	S-1
Aviation lubricating system, cleaning fluid, contaminated	H-2
B	
Bleed-off and 20.2 lb/in ² absolute system, air, aircraft starting and cooling	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
C	
Catapult steam, hydraulic oil	G-1
Chemical drains	R-2
Chilled water	C-2
Clean ballast	D-1

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Applicable category
and group

C

Cleaning fluids and contaminated aviation lubricating system	H-2
CO ₂ fixed	T-1
Condensate, fresh water and electronic fresh water cooling	C-1
Condensate, fresh water - feed water, including potable	C-2
Contaminated aviation lubricating system and gasoline cleaning fluid	H-2
Contaminated, deck waste, oily water and weather deck drains	R-1
Cooling for electronic equipment diesel engine and so forth - ethylene glycol, fresh water solution	L-1
Cooling for electronic equipment - sea water	D-1
Cooling, condensate and electronic fresh water	C-1
Countermeasure system, sea water - washdown	M-1

D

Deck waste drains and oily water and weather deck drains, contaminated	R-1
Diesel, sewage treatment, incinerator and gas turbine exhaust	O-1
Distilled water	C-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, A-5, A-6, A-8 or A-10

E

Electronic equipment, cooling for ethylene glycol, fresh water solution	L-1
Electronic fresh water cooling and fresh water, condensate	C-1
Escape, boiler safety valve and superheater outlet safety valve	P-1
Exhaust, diesel, sewage treatment, incinerator and gas turbine	O-1
Exhaust, auxiliary	A-6
Exhaust, gland	A-6
Exhaust, relief	A-6

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	<u>Applicable category and group</u>
F	
Feed boiler	B-1
Feed systems propulsion plant saturated	B-2
Feed water - fresh water and condensate, including potable	C-2
Filling transfer and tank stripping, JP-5 fuel service	I-1, U-1
Film-forming foam (AFFF) concentrate and AFFF/SW solution, aqueous	S
Fixed CO ₂ , cofferdam inerting systems	T
Fresh water, condensate and electronic fresh water cooling	C-1
Fresh water, chilled water, feed water and condensate, including potable	C-2
Fuel and tank stripping, JP-5	I-1, U-1
Fuel	E-1, E-2 and E-3
Fuel, gas turbine powered ships	E-4
Fuel, stripping	U
G	
Gas, mixed	K-6
Gaseous oxygen	K-3
Gaseous oxygen, outside hull	K-1
Gasoline	H-1
Gas turbine bleed air system	J-9
Gas turbine and diesel, sewage treatment, incinerator, exhaust	O-1
Gauge piping	Dwg. 804-1385850
Gland, exhaust	A-6
HALON 1301 (fire extinguishing system)	T-2
Helium, air and nitrogen	J-1 or J-2
Hull, gaseous inside; oxygen	K-2
Hull, gaseous outside; oxygen	K-1
Hydraulic oil - other than steam catapult	G-3, G-4, G-5, G-6, or G-7
Hydraulic oil, steam catapult	G-1 or G-2
I	
Inside hull, gaseous oxygen	K-2
J	
JP-5 fuel service, filling transfer or tank stripping ...	I-1, U-1

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	<u>Applicable category and group</u>
L	
Liquid oxygen and nitrogen	K-4 and K-5
Lubricating oil	F-1
M	
Main steam and steam drains	A-3
Magazine sprinkling systems (wet)	N-2
Main system, air, aircraft starting and cooling	J-6
Mixed gas	K-6
N	
Nitrogen and air	J-1, J-2, J-4 or J-5
Nitrogen, helium and air	J-1 or J-2
Nitrogen and oxygen, liquid	K-4 and K-5
O	
Oil, fuel	E
Oil, hydraulic - other than steam catapult	G-3, G-4, G-5, G-6 and G-7
Oil, hydraulic, steam catapult	G-1 or G-2
Oil, lubrication	F-1
Overflows, sounding tubes, vents and air escapes for fuel tanks except JP-5	Y-2
Other than steam catapult, hydraulic oil	G-3, G-4, G-5, G-6 and G-7
Overflows, sounding tubes, vents and air escapes for JP-5 tanks	Y-1
Overflows, sounding tubes, vents and air escapes for tanks other than oil tanks (fresh water (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
P	
Plants, refrigeration and air conditioning, R-12, R-22 and R-114 refrigerants	Q-1
Plumbing, drains, vents and deck drains	R-3
Pneumatic tubes	W-1
Prairie maskers, air	J-7
Propane	K-7

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	<u>Applicable category and group</u>
R	
Reduction gear, vents	Y-4
Refrigeration and air conditioning plant R-12 and R-22 refrigerants	Q-1
Relief, exhaust	A-6
S	
Safety valve, boiler, escape	P-1
Sea water, ballast and oily waste	D-1 or D-3
Sea water missile injection system between fresh water accumulating tank and nozzles	D-2
Sea water, washdown, countermeasure system	M-1
Sewage collection, holding and transfer system (CHT)	R-4
Sounding tubes, overflows, vents and air escapes for JP-5 tanks	Y-1
Sounding tubes, overflows, vents and air escapes for fuel tanks (except JP-5)	Y-2
Sounding tubes, overflows, vents and air escapes for tanks other than fuel tanks (fresh water (except potable) clean ballast, voids, and so forth)	Y-3
Sprinkling system (dry) other than foam	N-1
Sprinkling system (wet) magazine	N-2
Starting and cooling, air, aircraft	J-6
Steam	A-7
Steam and steam drains	A-1, A-2, A-3, A-4, A-5, A-6, A-8, and A-10
Steam catapult, hydraulic oil	G-1 and G-2
Steam system overboard discharge, steam generator blowdown	A-9
Stripping, JP-5	I-1
Stripping, fuel	U-1
Superheater outlet safety valve escape	P-1
System (dry), sprinkling other than foam	N-1
System (wet), magazine sprinkling	N-2
Systems, feed	B-1
T	
Tank stripping and JP-5 fuel service, filling transfer	I-1, U-1
Tube, voice	V-1
Tubes, pneumatic	W-1

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Applicable category
and group

V

Valve, boiler safety and superheaters outlet safety escape	P-1
Vents and drains, deck drains and plumbing	R-3
Vents, reduction gear	Y-4
Vents, overflows, sounding tubes, and air escapes for JP-5 tanks	Y-1
Vents, overflows, sounding tubes, and air escapes for oil tanks except JP-5	Y-2
Vents, overflows, sounding tubes, and air escapes for other than oil tanks (fresh water (except potable) clean ballast, voids, and so forth)	Y-3
Voice tubes	V-1

W

Washdown - sea water, countermeasure system	M-1
Water, fresh, condensate and electronic fresh water cooling (chilled)	C-1
Water, fresh, feed, condensate, including potable	C-2

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