

NOTICE OF  
CHANGE

INCH- POUND

MIL-STD-777E(SH)

NOTICE 1

17 January 1990

MILITARY STANDARD

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

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

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

| NEW PAGE | DATE            | SUPERSEDED PAGE | DATE                     |
|----------|-----------------|-----------------|--------------------------|
| 5        | 17 January 1990 | 5               | 7 February 1986          |
| 5a       | 17 January 1990 | NEW PAGE        |                          |
| 6        | 7 February 1986 | 6               | REPRINTED WITHOUT CHANGE |
| G-3.1    | 17 January 1990 | G-3.1           | 7 February 1986          |
| G-3.2    | 17 January 1990 | G-3.2           | 7 February 1986          |
| G-4.1    | 17 January 1990 | G-4.1           | 7 February 1986          |
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| G-6.1    | 17 January 1990 | G-6.1           | 7 February 1986          |
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| G-7.1    | 17 January 1990 | G-7.1           | 7 February 1986          |
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| S-1.2    | 17 January 1990 | NEW PAGE        |                          |
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2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

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

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4.13 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/in<sup>2</sup>.
- (c) Instrumentation, controls, vents and filling and drain connections for applications where gauge pressures are 50 lb/in<sup>2</sup> 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-brazed fittings. Silver-brazed joints are prohibited in fire hazardous areas for the following systems:

- I-1: JP-5
- H-1: Gasoline
- G-3, G-4, G-5, G-6, and G-7: Hydraulic oil
- J-2, J-3, J-4, and J-7: Air
- K-3, K-5, and K-7: Oxygen, nitrogen and propane
- S-1: AFFF (dry piping-only)

Fire hazardous areas are defined as those spaces where requirements for protecting flammable liquid hazards require fixed halon fire extinguishing systems. These spaces include:

- Main machinery rooms
- Auxiliary machinery rooms with fuel pumps or fossil-fueled equipment
- Fire rooms and engine rooms of fossil-fuel powered ships
- Propulsion engine enclosures
- Electric power generator engine enclosures
- Auxiliary fossil-fuel boiler rooms
- Aviation storerooms (flammable)
- Enclosed gasoline service stations
- Flammable gas cylinder storerooms
- Flammable liquid issue rooms
- Flammable liquid storerooms and cargo holds
- Fuel pump rooms (DFM, fuel oil, JP-5, LCAC, or MOGAS)

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Paint mixing and issue rooms  
RAST machinery rooms  
Ship service or emergency generator rooms  
Storerooms for gasoline-powered bomb hoists  
TACTAS handling rooms

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

- (a) In sizes 1/2 nominal pipe size (NPS) and below.
- (b) Fittings without preinserted brazing rings may be used in the refrigeration system (see category Q-1).
- (c) Expanded copper sleeves without preinserted brazing rings may be used in the inner wall of a double-walled gasoline piping system.
- (d) 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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|--------------------|---|--|-------------------------------|--|
| G-3                | Hydraulic oil - other than steam catapult | 3000                                       | 180                           | Silver-braze restriction See paragraph 4.14 See note G-3-1 |

| Item     | Types                     | Material   | Applicable documents                       | Remarks        |                |
|----------|---------------------------|--|--|----------------|----------------|
| Pipe     | Seamless                  | 70-30 Copper-nickel alloy  | MIL-T-16420                                |                |                |
|          |                           | Copper   | MIL-T-24107                                |                |                |
|          |                           | Carbon steel   | MIL-T-20157, type E or ASTM A 106, grade B |                |                |
|          |                           | Corrosion-resisting steel, TP 304L or TP 316L  | MIL-P-24691/3, ASTM 312                    |                |                |
| Valves   | Globe, angle              | Aluminum-bronze  | MIL-V-24109                                |                |                |
|          |                           | Carbon steel   | Drawing 803-5184193                        |                |                |
|          | Gate                      |  | MIL-V-22052                                |                | See note G-3-4 |
|          |                           |  | MIL-V-18110                                |                |                |
|          | Check-lift or in-line     | Aluminum-bronze  | Commercial                                 |                |                |
|          | Ball                      | Corrosion-resisting steel  | MIL-V-24630/1A                             |                |                |
|          | Corrosion-resisting steel | MIL-V-22687 with end connections: Drawing 810-1385883  |  |                |                |
| Fittings | Relief                    | Carbon steel, corrosion-resisting steel  | Drawing 803-1385884                        | See note G-3-4 |                |
|          | Control                   | As approved  | Commercial                                 | See note G-3-4 |                |
|          | Sampling and bleed        | Aluminum-bronze  | MIL-V-81940 and                            |                |                |
|          |                           | Corrosion-resisting steel  | MIL-V-81940/1                              |                |                |
|          | Silver-brazing            | Nickel-aluminum-bronze   | Drawing 810-1385963                        |                |                |
|          |                           | Bronze   | Drawing 803-1385941                        |                |                |
|          | Unions, silver-brazing    | Nickel-aluminum-bronze   | Drawing 803-1385943                        |                |                |
|          | Union welding             | Carbon steel, ASTM A 105   | NAEL Drawing A404734                       | See note G-3-2 |                |
|          |                           | Carbon steel, ASTM A 105, ASTM A 181, class 70, ASTM A 106, grade B or corrosion-resisting steel | ANSI B16.9                                 |                |                |
|          | Butt welding              | Carbon steel, ASTM A 105, ASTM A 181, class 70, ASTM A 106, grade B or corrosion-resisting steel |  |                | See note G-3-5 |

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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-3, cont'd        | Hydraulic oil - other than steam catapult | 3000                                       | 180                           | Silver-braze restriction<br>See paragraph 4.14<br>See note G-3-1 |

| Item           | Types          | Material  | Applicable documents         | Remarks        |
|----------------|----------------|---|------------------------------|----------------|
|                | Socket welding | Carbon steel, ASTM A 105, ASTM A 181, class 70, Corrosion-resisting steel ASTM A 182, 304L or 316L<br>Copper-nickel alloy, MIL-C-15726      | ANSI B16.11                  | See note G-3-5 |
| Flanges        | Butt welding   | Carbon steel, ASTM A 105 or ASTM A 181, class 70<br>Corrosion-resisting steel, ASTM A 182, 304L or 316L<br>Copper-nickel alloy, MIL-C-15726 | ANSI B16.5                   | See note G-3-3 |
|                | Socket welding |   |                              | See note G-3-5 |
|                | Silver-brazing | Bronze  | MIL-F-20042                  |                |
| 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-3-4 The use of commercial items shall be subject to NAVSEA approval.
- G-3-5 The forged copper-nickel alloy, soft condition, shall conform to the chemical composition of MIL-C-15726.



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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-4                | Hydraulic oil - other than steam catapult | 1500                                       | 180                           | Silver-braze restriction<br>See paragraph 4.14<br>See note G-4-1 |

| Item               | Types  | Material   | Applicable documents  | Remarks    |                |
|--------------------|--|--|---|------------|----------------|
| Pipe               | Seamless                                     | 70-30 Copper-nickel alloy  | MIL-T-16420   |            |                |
|                    |  | Copper   | MIL-T-24107   |            |                |
|                    |  | Carbon steel   | MIL-T-20157, type E or<br>ASTM A 106, grade B                                   |            |                |
|                    |  | Corrosion-resisting steel,<br>TP 304L or TP 316L   | MIL-P-24691/3,<br>ASTM A 312  |            |                |
| Valves             | Gate   | Carbon steel   | MIL-V-18110   |            |                |
|                    | Globe, angle                                 | Carbon steel   | Drawing 803-5184193   |            |                |
|                    |  | Aluminum-bronze  | MIL-V-22052   |            |                |
|                    | Check  | Aluminum-bronze<br>Bronze  | MIL-V-24109   | Commercial | See note G-4-4 |
|                    |  | Corrosion-resisting steel  | MIL-V-24630/1   |            |                |
|                    | Relief                                       | Carbon steel or corrosion-resisting steel  | Commercial  |            | See note G-4-4 |
|                    | Ball   | Corrosion-resisting steel<br>Bronze  | MIL-V-22687 with end connections:<br>Drawing 810-1385883<br>Drawing 803-1385884 |            |                |
| Sampling and bleed | Aluminum-bronze<br>Corrosion-resisting steel | MIL-V-81940 and<br>MIL-V-81940/1   |   |            |                |
| Fittings           | Silver-brazing                               | Bronze   | Drawing 803-1385942   |            |                |
|                    |  | Copper-nickel (70-30)<br>MIL-C-15726   | Drawing 803-1385945   |            |                |
|                    |  | Nickel-aluminum-bronze   | Drawing 810-1385963   |            |                |
|                    | Butt welding                                 | Carbon steel, ASTM A 105,<br>ASTM A 181, class 70<br>ASTM A 106, grade B<br>Corrosion-resisting steel<br>ASTM A 182, 304L or 316L<br>Copper-nickel alloy,<br>MIL-C-15726 | ANSI B16.9  |            |                |

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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-4, cont'd        | Hydraulic oil - other than steam catapult | 1500                                       | 180                           | Silver-braze restriction<br>See paragraph 4.14<br>See note G-4-1 |

| Item           | Types                  | Material  | Applicable documents         | Remarks        |
|----------------|------------------------|---|------------------------------|----------------|
|                | Socket welding         | Carbon steel, ASTM A 105, ASTM A 181, class 70<br>Corrosion-resisting steel<br>ASTM A 182, 304L or 316L<br>Copper-nickel alloy,<br>MIL-C-15726    | ANSI B16.11                  |                |
|                | Unions, silver-brazing | Bronze  | Drawing 803-1385946          |                |
|                |                        | Nickel-aluminum-bronze  | Drawing 803-1385943          |                |
|                | Union welding          | Carbon steel, ASTM A 105  | NAEL Drawing A404734         | See note G-4-2 |
| Flanges        | Butt welding           | Carbon steel, ASTM A 105 or ASTM A 181, class 70<br>Corrosion-resisting steel,<br>ASTM A 182, 304L or 316L<br>Copper-nickel alloy,<br>MIL-C-15726 | ANSI B16.5                   | See note G-4-3 |
|                | Socket welding         |   |                              |                |
| 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-4-4 The use of commercial items shall be subject to NAVSEA approval.

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G-4.2

| Category and group | Services                                  | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks  |
|--------------------|---|---|----------------------------------|--|
| G-6                | Hydraulic oil - other than steam catapult | 300   | 180                              | Silver-braze restriction<br>See paragraph 4.14<br>See note G-6-1 |

| Item             | Types                         | Material   | Applicable documents               | Remarks |                |
|------------------|-------------------------------|--|------------------------------------|---------|----------------|
| Pipe             | Seamless                      | Copper-nickel alloy  | MIL-T-16420                        |         |                |
|                  |                               | Copper   | MIL-T-24107                        |         |                |
|                  |                               | Carbon steel   | MIL-T-20157, ASTM A 106, grade B   |         |                |
|                  |                               | Corrosion-resisting steel, TP 304L or 316L   | MIL-P-24691/3, ASTM A 312          |         |                |
| Valves           | Gate                          | Bronze   | MIL-V-1189<br>Drawing 803-1385714  |         |                |
|                  |                               | Carbon steel   | MIL-V-18110                        |         |                |
|                  | Globe, angle                  | Bronze   | Drawing 803-4384536                |         |                |
|                  |                               | Carbon steel   | Drawing 803-2177525<br>MIL-V-22052 |         |                |
|                  | Swing check                   | Bronze   | Drawing 803-1385721                |         |                |
|                  | Relief                        | Bronze or steel  | Commercial                         |         | See note G-6-4 |
|                  | Sampling and bleed            | Aluminum-bronze<br>Corrosion-resisting steel   | MIL-V-81940 and<br>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<br>ASTM A 106, grade B or corrosion-resisting steel,<br>ASTM A 182, 304L or 316L<br>Copper-nickel alloy,<br>MIL-C-15726 | MIL-F-20236<br>ANSI B16.9          |         |                |
|                  |                               | Socket welding   |                                    |         | ANSI B16.11    |
| Take-down joints | Union, silver-brazing         | Bronze   | MIL-F-1183                         |         |                |
|                  | Flanged, silver-brazing       |  | MIL-F-20042                        |         |                |

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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-6, cont'd        | Hydraulic oil - other than steam catapult | 300  | 180                           | Silver-braze restriction See paragraph 4.14 See note G-6-1 |

| Item           | Types               | Material   | Applicable documents         | Remarks        |
|----------------|---------------------|--|------------------------------|----------------|
| Gaskets        | Flanged             | Carbon steel, ASTM A 105, ASTM A 181, class 70 or corrosion-resisting steel, ASTM A 182, 304L or 316L Copper-nickel alloy, MIL-C-15726 | ANSI B16.5                   | See note G-6-2 |
|                | Unions, welding     | Carbon steel, ASTM A 105   | NAEL Drawing A404734         | See note G-6-3 |
| Flange bolting | 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.
- G-6-4 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-7                | Hydraulic oil - other than steam catapult | 150  | 150                           | Silver-braze restriction<br>See paragraph 4.14<br>See note G-7-1 |

| Item         | Types   | Material  | Applicable documents             | Remarks |                |
|--------------|---|---|----------------------------------|---------|----------------|
| Pipe         | Seamless                                      | Copper-nickel alloy   | MIL-T-16420                      |         |                |
|              |   | Copper  | MIL-T-24107                      |         |                |
|              |   | Carbon steel  | MIL-T-20157                      |         |                |
|              |   | ASTM A 106, grade A   |                                  |         |                |
|              | Seamless or welded                            | 70-30 copper-nickel alloy   | MIL-T-16420                      |         |                |
| Seamless     | Corrosion-resisting steel, TP 304L or TP 316L | MIL-P-24691/3 MIL-P-1144<br>ASTM A 312  |                                  |         |                |
| Valves       | Gate  | Bronze  | Drawing 803-2177917              |         |                |
|              |   | Carbon steel  | Drawing 803-1385714              |         |                |
|              | Globe, angle                                  | Bronze  | MIL-V-18110                      |         |                |
|              |   | Carbon steel  | Drawing 803-1385623              |         |                |
|              | Globe, angle                                  | Bronze  | Drawing 803-4384536              |         |                |
|              |   | Carbon steel  | Drawing 803-2177525              |         |                |
|              | Swing check                                   | Bronze  | MIL-V-22052                      |         |                |
|              |   | Relief  | Drawing 803-1385721              |         |                |
|              | Sampling and bleed                            | Bronze or steel   | Commercial                       |         | See note G-7-5 |
|              | Ball, 1/4 inch - 2-1/2 inches                 | Aluminum-bronze<br>Corrosion-resisting steel  | MIL-V-81940 and<br>MIL-V-81940/1 |         |                |
| Butterfly    | Carbon steel                                  | Drawing 803-5001003   |                                  |         |                |
| Fittings     | Silver-brazing                                | Corrosion-resisting steel,<br>Bronze  | MIL-V-24624                      |         |                |
|              | Socket welding                                | Bronze  | MIL-F-1183                       |         |                |
|              |   | Carbon steel, ASTM A 105,<br>ASTM A 181, class 70,<br>ASTM A 106, grade B or<br>corrosion-resisting steel,<br>ASTM A 182, 304L or 316L<br>Copper-nickel alloy,<br>MIL-C-15726 | ANSI B16.11                      |         |                |
| Butt welding |   | MIL-F-20236, ANSI B16.9   |                                  |         |                |

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| Category and group | Services                                  | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|---|--|-------------------------------|--|
| G-7, cont'd        | Hydraulic oil - other than steam catapult | 150  | 150                           | Silver-braze restriction<br>See paragraph 4.14<br>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<br>Copper-nickel alloy, MIL-C-15726 | 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/in<sup>2</sup> line flanges bolt up to 250 lb/in<sup>2</sup> 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/in<sup>2</sup> 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-7-5 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Services | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|----------|--|-------------------------------|--|
| H-1                | Gasoline | 150  | 150                           | Silver-braze restriction<br>See paragraph 4.14 |

| 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   | 90-10 Copper-nickel alloy | Drawing 803-1385714               |                                     |
|                  |                          |                           | Drawing 803-4384536               |                                     |
|                  | Swing check              | Commercial                |                                   | See note H-1-2                      |
| Fittings         | Butterfly                | Commercial                | MIL-V-17547                       | See note H-1-2                      |
|                  | Relief                   | Commercial                |                                   | Type III                            |
|                  | Regulating               | Commercial                | MIL-V-24624                       | See note H-1-2                      |
|                  | Socket welding           | Copper-nickel alloy       | MIL-V-24332                       | See note H-1-2                      |
|                  | Butt welding             |                           | Commercial                        | See note H-1-2                      |
|                  | Silver-brazing           | Bronze                    | Drawing 803-1385880               |                                     |
| Take-down joints | Flanged (silver-brazing) | Bronze                    | MIL-F-24227, MIL-F-1183           |                                     |
|                  | Flanges (butt weld)      | Copper-nickel alloy       | MIL-F-20042, MIL-F-24227          | Special flange for butterfly valves |
|                  |                          |                           | Drawing 810-1385892               |                                     |
|                  | Flanges (socket weld)    |                           |                                   | Drawing 810-1385992                 |
| Gaskets          | Unions (silver-brazing)  |                           | Drawing 810-4715319               |                                     |
|                  | Unions (welded)          | 90-10 Copper-nickel alloy | MIL-F-1183, MIL-F-24227           |                                     |
|                  | Flat                     | Buna-N and cork           | Commercial                        | See note H-1-2                      |
| Flange bolting   | Bolts, studs and nuts    | Silicon bronze            | MIL-C-6183, class 1, grade C-firm |                                     |
|                  |                          |                           | MIL-S-1222, grade 655, 661        |                                     |

## NOTES:

- H-1-1 Within gasoline tanks and for salt water compensating system.  
H-1-2 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Services  | Maximum system pressure lb/in <sup>2</sup> | 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                |                                     |
|                           |                               |                      | Drawing 803-1385714                |                                     |
|                           | Globe, angle and cross        |                      | Drawing 803-1385541                |                                     |
|                           |                               |                      | Drawing 803-4384536                |                                     |
|                           | Butterfly                     |                      | MIL-V-24624                        | Type III                            |
|                           | Swing check                   |                      | MIL-V-17547                        |                                     |
|                           |                               |                      | 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<br>MIL-F-24227          |                                     |
| Take-down joints          | Flanged                       | Bronze               | MIL-F-20042<br>MIL-F-24227         |                                     |
|                           |                               |                      | Drawing 810-1385892                | Special flange for butterfly valves |
|                           | Union                         |                      | MIL-F-1183<br>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         |                                     |

## NOTE:

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

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| Category and group | Services | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks   |
|--------------------|----------|---|----------------------------------|---|
| I-1                | JP-5     | 200   | 100                              | Silver-braze restriction<br>See paragraph 4.14<br>See notes I-1-1 and I-1-2 |

| Item                         | Types                            | Material                  | Applicable documents       | Remarks                                |
|------------------------------|----------------------------------|---------------------------|----------------------------|--|
| Pipe                         | Seamless or welded               | 90-10 copper-nickel alloy | MIL-T-16420, class 200     |  |
| Valves                       | Gate                             | Bronze                    | Drawing 803-2177917        | 100 lb/in <sup>2</sup> maximum         |
|                              |                                  |                           | Drawing 803-1385714        |  |
|                              | Drawing 803-1385541              |                           |                            |  |
|                              | Drawing 803-1385623              |                           |                            |  |
|                              | Drawing 803-4384536              |                           |                            |  |
|                              |                                  | 90-10 copper-nickel alloy | Commercial                 | See note I-1-3                         |
|                              | Butterfly                        | Bronze                    | MIL-V-24624                | Type III                               |
|                              | Relief                           |                           | MIL-V-24332                |  |
|                              | Swing check                      |                           | Drawing 803-1385637        |  |
|                              | Ball, 1/4 inch -<br>2-1/2 inches |                           | Drawing 803-5001003        |  |
| Ball, 3 inches -<br>6 inches | Drawing 803-5001004              |                           |                            |  |
| Fittings                     | Silver-brazing                   | Bronze                    | MIL-F-1183<br>MIL-F-24227  |  |
|                              | Butt welding                     | 90-10 copper-nickel       | Commercial                 | See note I-1-3                         |
|                              | Socket welding                   |                           | Drawing 803-1385880        |  |
| Take-down joints             | Flanges (silver-brazing)         | Bronze                    | MIL-F-20042<br>MIL-F-24227 | Special flange for<br>butterfly valves |
|                              |                                  |                           | Drawing 810-1385892        |  |
|                              | Flanges (butt weld)              | Copper-nickel             | Drawing 810-1385992        |  |
|                              | Flanges (socket weld)            | Copper-nickel             | Drawing 810-4715319        |  |
|                              | Unions (silver-brazing)          | Bronze                    | MIL-F-1183<br>MIL-F-24227  |  |
| Unions (welded)              | 90-10 copper-nickel alloy        | Commercial                | See note I-1-3             |  |

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| Category and group | Services | Maximum system pressure lb/in <sup>2</sup> | Maximum system temperature °F | Remarks  |
|--------------------|----------|--|-------------------------------|--|
| I-1, cont'd        | JP-5     | 200  | 100 •                         | Silver-braze restriction<br>See paragraph 4.14<br>See notes I-1-1<br>and I-1-2 |

| Item           | Types                 | Material        | Applicable documents                 | Remarks |
|----------------|-----------------------|-----------------|--------------------------------------|---------|
| Gaskets        | Sheet                 | Buna-N and cork | MIL-C-6183, class 1,<br>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-1-3 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Services       | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks   |
|--------------------|----------------|---|----------------------------------|---|
| K-3                | Gaseous oxygen | 100   | Ambient                          | Silver-braze restriction<br>See paragraph 4.14<br>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                    |
|          |                              | Copper-Nickel Alloy                 | MIL-T-16420                                       |  |
| Valves   | Globe<br>Gate<br>Swing check | Bronze                              | Drawings 803-4384536,<br>803-1385714, 803-1385721 | Soft seated globe valves<br>See note K-3-4           |
|          | Pressure-reducing            | Bronze                              | MIL-V-24336                                       | Union ends   |
|          | Diaphragm,<br>packless       | Bronze, ASTM B 61                   | Commercial  | See note K-3-5,<br>teflon or nylon disc washer       |
|          | Relief                       | Bronze, ASTM B 61                   | MIL-V-22549                                       | See note K-3-3                                       |
| Fittings | Silver-brazing               | Bronze                              | MIL-F-1183  |  |
|          | Unions, silver-brazing       |                                     | Drawing 810-1385859                               | With O-ring material to MIL-R-83248, type I, class 1 |
|          | Unions, weld                 | Copper-nickel alloy,<br>MIL-C-15726 | Commercial  | See note K-3-5                                       |

## 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-3-5 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Services                   | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°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<br>ASTM A 312, 316L |         |
| Valves   | Globe                     |  | MIL-V-24109                          |         |
| Fittings | Socket welding            | Corrosion-resisting steel,<br>ASTM A 182, 316L                     | ANSI B16.11                          |         |
|          | Butt welding,<br>seamless | Corrosion-resisting steel,<br>MIL-P-1144, 316L<br>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.

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| Category and group | Services                   | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks  |
|--------------------|----------------------------|---|----------------------------------|--|
| K-5                | Liquid oxygen and nitrogen | 250   |                                  | Silver-braze restriction<br>See paragraph 4.14<br>See notes K-5-1<br>and K-5-2 |

| Item     | Types                        | Material  | Applicable documents                           | Remarks                              |
|----------|------------------------------|---|--|--------------------------------------|
| Pipe     | Seamless                     | Copper-nickel alloy                               | MIL-T-16420                                    | 0.065 inch minimum wall thickness    |
|          |                              | Copper  | MIL-T-24107                                    |                                      |
|          |                              | Corrosion-resisting steel, Grade TP 304 or TP 316 | MIL-P-24691/3                                  |                                      |
| Valves   | Globe, gate, and swing check | Bronze  | Drawings 803-4384536, 803-1385714, 803-1385721 | See note K-5-3                       |
|          | Relief                       | Corrosion-resisting steel                         | Commercial                                     | See note K-5-4                       |
| Fittings | Silver-brazing               | Bronze  | MIL-F-1183                                     | With suitable O-ring gasket material |
|          | Unions, silver-brazing       |   | Drawing 810-1385859                            |                                      |
|          | Unions, weld                 | Copper-nickel alloy, MIL-C-15726                  | Commercial                                     | See note K-5-4                       |
|          | 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.
- K-5-4 The use of commercial items shall be subject to NAVSEA approval.

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

| Item             | Types             | 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<br>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/in<sup>2</sup> 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.

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| Category and group | Services | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks  |
|--------------------|----------|---|----------------------------------|--|
| K-7                | Propane  | 200   |                                  | Silver-braze restriction<br>See paragraph 4.14 |

| 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<br>Commercial | See note K-7-1 |
| Fittings | Silver-brazing<br>Unions, silver-brazing | Bronze                              | MIL-F-1183                        |                |
|          | Unions, weld                             | Copper-nickel alloy,<br>MIL-C-15726 | Commercial                        | See note K-7-1 |

## NOTES:

K-7-1 The use of commercial items shall be subject to NAVSEA approval.

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| Category and group | Service  | Maximum system pressure<br>lb/in <sup>2</sup> | Maximum system temperature<br>°F | Remarks        |
|--------------------|--|---|----------------------------------|----------------|
| T-1                | Fixed CO <sub>2</sub> fire fighting<br>inerting system | 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 <sup>2</sup> 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,<br>Drawing 803-1385942 |                                |
|              |   |   | Drawing 810-1385863,<br>Drawing 803-1385945        |                                |
|              | Drawing 810-1385859<br>Drawing 803-1385946                                  |   |  |                                |
|              | Unions, silver-brazing  |   |  |                                |
|              | Socket welding  | Carbon steel, ASTM A 105 or<br>ASTM A 181, class 70 | ANSI B16.11  |                                |
| Butt welding | Carbon steel, ASTM A 105,<br>ASTM A 181, class 70 or<br>ASTM A 106, grade B | ANSI B16.9  |  |                                |
| Gaskets      | O-ring  |   |  |                                |
| Cylinders    | Non-shatterable   | Steel   | RR-C-901   |                                |

## NOTE:

T-1-1 For CO<sub>2</sub> fire fighting systems see MIL-E-2185, or MIL-E-2186 for specifications and applicable material and pressure requirements.

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