

Specification for Boiler, Deaerating Feed Tank Installation (SLEP)

1. SCOPE

1.1 Intent. This Specification describes the requirements for the Contractor to provide and install one (1) deaerating feed tank (DFT) and feedwater treatment system, as well as renew the existing obsolete boiler PLC and burner sequencing controls on board USCGC HEALY. This Specification includes limited technical support by the Contractor to the United States Coast Guard (USCG) to ensure that the equipment is installed and functions correctly. Component, documentation, and technical support items covered under this Specification are as follows:

- Deaerating Feed Tank is defined as the DFT assembly, controls, pumps, and piping.
- Feedwater Treatment System is defined as the dosing tanks, controls, foundations, pumps, piping, and dosing instructions.
- Boiler PLC Control System is defined as the PLC controls, PLC logic, enclosures, switches, indicators, wiring, and related field devices.

1.2 Government-furnished property.

None.

2. REFERENCES

COAST GUARD DRAWINGS

Coast Guard Drawing 420-WAGB-180-002, Rev F, Mech & Elec Foundations for Units

13,104,113,114,123,124,125,133,134,135,143,144,145,251,252,270,440,601,602,603,604 & 820

Coast Guard Drawing 420-WAGB-180-004, Rev J, Mech & Elec Foundations for Units 106, 127, 147, 257, 258, 263, 264, 420, 421, 430, 431, 444-449, 470, 626, 701, 703, 704 & 710

Coast Guard Drawing 420-WAGB-182-005, Rev A, Boiler Foundations

Coast Guard Drawing 420-WAGB-505-001 Rev D, Piping General Notes & Installation Details

Coast Guard Drawing 420-WAGB-505-012, Rev T, Piping Arrangement Units 420, 421, 422, 423, 426, 430, 431, 432, & 433

Coast Guard Drawing 420-WAGB-505-013, Rev D, Piping Arrangement Units 420, 421, 422, 423, 426, 430, 431, 432, & 433 – L/M

Coast Guard Drawing 420-WAGB-505-084, Rev J, Piping Arrangement Unit 135

Coast Guard Drawing 420-WAGB-505-085, Rev B, Piping Arrangement Unit 135 – L/M

Coast Guard Drawing 420-WAGB-505-086, Rev J, Piping Arrangement Unit 136

Coast Guard Drawing 420-WAGB-505-087, Rev B, Piping Arrangement Unit 136 – L/M

Coast Guard Drawing 420-WAGB-517-001, Rev A, Reserve Feed Tank

Coast Guard Drawing 420-WAGB-517-002, Rev A, Condensate Drain & Feed Water Tank

Coast Guard Drawing 420-WAGB-517-003, Rev C, Boiler Water Chemistry Monitoring & Control Installation

Coast Guard Drawing 420-WAGB-524-001, Rev P, Diagram Auxiliary Seawater System

Coast Guard Drawing 420-WAGB-535-001, Rev M, Diagram Steam, Feed & Condensate System

Coast Guard Drawing 420-WAGB-535-002, Rev A, Steam Sys Isolation Valve Install & Condensate Temp. Reg. Valve. Mods.

Coast Guard Drawing 420-WAGB-535-005, Rev -, Hotel Condensate Cooler Temp. Reg. Valve Mods

Coast Guard Drawing 420-WAGB-801-001, Rev K, Booklet of General Plans

Coast Guard Drawing 420-WAGB-835-020, Rev -, Steam, Feed & Condensate Sys Flow Calcs

Coast Guard Drawing 420-WAGB-835-027, Rev -, Distilling Plant Sys Flow Calcs

Coast Guard Drawing FI-504-001, Rev -, Instrumentation Piping & Gauge Assembly Installation

Coast Guard Drawing YD-505-001, Rev A, Orifice Plate Standard Detail

COAST GUARD PUBLICATIONS

Coast Guard Technical Publication (TP) 5162A, SWBS 517, Section A, Rev -, Boiler, Oil Fired Auxiliary – Model H3S-500-02 – Technical Manual
Coast Guard Technical Publication (TP) 5359, SWBS 517, Section A, Boiler Water Management System – Chem-Aqua – Operation and Maintenance Manual
Coast Guard Technical Publication (TP) 5377, SWBS 517, Section A, Boiler Feedwater Pump – Model CRN10
Surface Forces Logistics Center Standard Specification 0000 (SFLC Std Spec 0000), Series General Requirements
Surface Forces Logistics Center Standard Specification 0740 (SFLC Std Spec 0740), Series Welding and Allied Processes
Surface Forces Logistics Center Standard Specification 3041 (SFLC Std Spec 3041), Series Shipboard Electrical Cable Test
Surface Forces Logistics Center Standard Specification 3042 (SFLC Std Spec 3042), Series Shipboard Electrical Cable Removal, Relocation, Splice, Repair, and Installation
Surface Forces Logistics Center Standard Specification 6310 (SFLC Std Spec 6310), Series Requirements for Preservation of Ship Structures

OTHER REFERENCES

American Society of Mechanical Engineers (ASME) BPVC, 2017, Boiler and Pressure Vessel Code (Series)
American Society of Mechanical Engineers (ASME) B31.1, 2022, Power Piping Code
American Society of Mechanical Engineers (ASME) CSD-1, 2018 Controls and Safety Devices for Automatically Fired Boilers
American Society of Testing and Materials (ASTM) B61, 2015, Standard Specification for Steam or Valve Bronze Castings
American Society of Testing and Materials (ASTM) B127, 2005, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
American Society of Testing and Materials (ASTM) B164, 2003, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM International (ASTM) B171, 2018 Standard Specification for Copper-Alloy Plate and Sheet for Pressure Vessels, Condensers, and Heat Exchangers
ASTM International (ASTM) B369-09, 2016, Standard Specification for Copper-Nickel Alloy Castings
ASTM International (ASTM) B584, 2014, Standard Specification for Copper Alloy Sand Castings for General Applications
American Society of Testing and Materials (ASTM) F998-12, 2022, Standard Specification for Centrifugal Pump, Shipboard Use
American Society of Testing and Materials (ASTM) F1309-23, 2023, Standard Practice for Fitting Chocks to Marine Machinery Foundations
American Society of Testing and Materials (ASTM) F1510-21, 2021, Standard Specification for Rotary Positive Displacement Pumps, Ships Use
American Society of Testing and Materials (ASTM) F1511-18, 2023, Standard Specification for Mechanical Seals for Shipboard Pump Applications
Military Detail Specification MIL-B-16907, Rev G, Boilers, Steam, High Pressure, Auxiliary Fire Tube Type Naval Shipboard
Military Detail Specification MIL-B-24480, 1991, Bronze, Nickel-Aluminum (UNS No. C95800) Casting for Seawater Service
Military Detail Specification MIL-C-15726, Rev F, Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod and Wire
Military Detail Specification MIL-STD-167-1A, Rev A, Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)

Military Detail Specification MIL-STD-1399-300-1, Rev -, Department of Defense Interface Standard Section 300, Part 1, Low Voltage Electric Power, Alternating Current

Military Detail Specification MIL-STD-777, Rev F, Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships

Military Detail Specification MIL-T-15005, Rev F, Tubes, Condenser And Heat Exchanger, Copper-Nickel Alloys (UNS C70600 & C71500)

Military Detail Specification MIL-T-22214, Rev C, Tube, Condenser And Heat Exchanger With Integral Fins (UNS ALLOY NOS. C17500, C70600, C12200)

Military Detail Specification MIL-V-16556, Rev F, Valve, Solenoid, Three-Way Bypass (Naval Shipboard Use)

Military Performance Specification MIL-PRF-907, Rev H, Anti-sieze Thread Compound, High Temperature

National Electrical Manufacturers Association (NEMA) ICS-6, 1993, Industrial Control and Systems: Enclosures

NAVSEA S9086-GX-STM-020/CH-220v2R8 - Naval Ships Technical Manual Chapter 220 Volume 2: Boiler Water/Feedwater Test and Treatment Revision 8, Dec 31, 2000

NAVSEA Drawing 803-1385735, Sample Cooler and Compound Injection Piping System Arrangement, November 22, 1982

Tubular Exchanger Manufacturers Association, Inc. (TEMA) Standards, 2019, TEMA Standards Title 46, Code of Federal Regulations, Shipping

Underwriters Laboratory (UL) 726, 1995, Standard for Oil-Fired Boiler Assemblies

2.1 Order of Precedence. In the event of a conflict between the text of this Specification and the references cited herein, this Specification takes precedence. The Contractor must notify the Contracting Officer (KO) in writing for a resolution of any ambiguity or conflict found in these Specifications prior to proceeding with any work.

3. REQUIREMENTS

3.1 Background. USCGC HEALY has two auxiliary boilers located in Boiler Room #1 1-65-1-E and Boiler Room #2 1-65-2-E. The boilers are oil-fired, Scotch marine units with a rated capacity of 17,250 lb/hr (nominally 500 HP, 16,738 kBTU/hr) of steam and a working pressure of 125 psig. Fuel is normally #2 Fuel Oil (F-76), although the boilers also burn JP-5. In addition to steam heat, they provide steam for the evaporators, humidifiers, hot water tanks, lube oil tank heaters, steam jacketed kettles, and the boosters for the dishwashers.

3.1.1 Existing Boiler Specifications. The existing boiler manufacturer specifications are as follows:

- Manufacturer: Kewanee Inc.
- Model: Boiler, Auxiliary, Oil Fired H3S-500-02
- Boiler Max Working Pressure: 150 PSIG
- Boiler Horsepower: 500 BHP
- Boiler MBH Output: 16,738
- Max Firing Rate: 20,992 MBH
- Boiler Steam Output (from and @ 212 °F): 17,250 lb/hr
- Feedwater Pump Capacity: 42.7 gpm
- Heating Surface: 2500 sq ft
- Electrical Supply: 460 VAC/3 phase/60 Hz

3.2 PLC Control System Functions. The existing PLC and boiler systems utilize a Koyo DL 405 programmable controller. The existing PLC is obsolete. The PLC logic is responsible for managing various control, status, and alarm functions for the boiler system components. Typical functions of the existing and replacement PLC, PLC cabinet, and associated devices include but are not limited to the following:

3.2.1 Control Functions:

- Fuel Control: Managing the fuel supply to the boiler burners.
- Water Level Control: Ensuring the water level within the boiler is maintained within safe limits via three element feedwater control system.
- Startup and Shutdown Sequences: Automated sequences for safely starting up and shutting down the boiler.

3.2.2 Status Functions:

- Operational Status: Indicating whether the boiler is running, in standby, or shut down.
- Component Status: Monitoring the status of various components such as pumps, valves, and burners.
- Sensor Readings: Display real-time data from temperature, pressure, and level sensors.

3.2.3 Alarm Functions:

- High/Low Temperature Alarms: Alerts for temperatures outside of safe operating ranges.
- High/Low Pressure Alarms: Alerts for pressures outside of safe operating ranges.
- Water Level Alarms: Alerts for water levels that are too high or too low.
- Fault Alarms: Indicating faults or failures in system components or sensors.
- Emergency Shutdown Alarms: Triggering an emergency shutdown in case of critical failures.

3.2.4 User Interface:

- Switches and Indicators: Physical controls and indicators for manual operation and status monitoring.

3.3 Existing Burner Sequencing Controls. The existing boiler controls utilize a Honeywell 7840 burner sequencing unit.

3.4 Operating Conditions.

3.4.1 All equipment furnished shall be suitable for use indoors and below decks in a marine environment.

3.4.2 The equipment shall be capable of continuous operation in interior spaces with ambient air temperature ranging from 50°F to 120°F and with relative humidity from 0% to 95% inclusive.

3.4.3 Machinery installations shall provide functionality under anticipated environmental conditions, as well as the following static and dynamic operating conditions.

3.4.4 Dynamic Operating Conditions – A ship roll of 45 degrees (single amplitude) in 10 seconds, a pitch of 10 degrees (single amplitude) in 4.5 seconds and a heave of 9 feet (single amplitude) in 5 seconds.

3.4.5 Static Conditions - A 15-degree list (either side) and a trim of 5 degrees (either direction).

3.4.6 Vibration – Equipment installed under this Specification shall be able to withstand, but need not be tested to, Type 1 (environmental) vibrations as defined by MIL-STD-167-1A.

3.5 Design and Performance Requirements. The intention of this Specification is to provide and install one (1) deaerating feed tank with associated piping, controls, and pumps, as well as replacement boiler PLCs, burner sequencing controls, an NSTM 220 V2 compliant feedwater treatment system, and replace the burner nozzles to achieve a firing rate of 16,738 MBH.

3.5.1 Deaerating Feed Tank. DFT - One (1) DFT shall be provided for the two (2) boilers and shall be located in Engineering Storeroom 2-63-4-A. The DFT and existing condensate tank shall be cross-connected via the main feed suction header which supplies all boilers. The DFT outlet to the header shall be provided with a check valve and a cutout valve.

3.5.1.1 The DFT shall be designed for operation at a positive pressure not to exceed 10 psig, and not less than 4 psig. They shall be designed and certified (stamped) to ASME BPVC Section VIII Division I.

3.5.1.2 The DFT shall be cylindrical and is preferred to be vertically mounted; however, any orientation that meets the conditions specified in Section 3.2 and OEM maintenance envelope is acceptable.

3.5.1.3 The DFT shall be made from Alloy 400 Monel, 90-10 copper-nickel, duplex stainless steel, Alloy 316 stainless steel, or C276 Hastelloy. The DFT shall be provided with pressure relief valves, vacuum breakers, sight level gauges, level controls, drain to deck drain, high- and low-level alarms, inspection holes, lifting lugs and mounting brackets. Tank level alarms shall be local and shall provide feedback signals to MPCMS; See Section 3.5.12 for signal requirements. USCG will handle integration to MPCMS. Internal coatings shall not be applied to the DFT.

3.5.1.4 The DFT shall employ mechanical separation of noncondensibles and steam heat to raise the feedwater temperature to the saturation point thereby ensuring zero solubility of entrained gases. The hot

gas-free water shall then be collected in the bottom storage section of the DFT, and the gases shall be vented from the top.

3.5.1.5 The DFT shall be sized for 20,000 lb/hr steaming capacity and a 600-gallon storage capacity (minimum). It shall achieve a dissolved oxygen content of 7 ppb at rated capacity and not exceed 15 ppb when turned down to 10% of rated capacity and in the dynamic operating conditions specified in Section 3.2.

3.5.1.6 The DFT shall have provisions to fill the standby boiler from operating water level to fully flooded to facilitate layup. This may be done through the standby feedwater pump or via a dedicated layup fill pump.

3.5.1.7 The vent from the DFT shall be routed to atmosphere at stack top via an orifice sized to maintain the specified pressure in the DFT and ensure the removal of the entrained gases. A vent condenser shall be installed and sized to remove all water vapor from the vent line down to a dewpoint of 95°F using 90°F seawater. No valves shall be installed between the tank vent, the orifice, and the vent condenser. A valved bypass shall be installed around the orifice for purging the DFT during initial start-up.

3.5.1.8 Condensate diversion valves - Three-way, solenoid operated, manual reset valves shall be provided downstream of seawater supplied vent condensers and condensate coolers. The valves shall be arranged for the condensate to bypass the coolers in the event of high salinity condensate. The salinity cell downstream of a cooler as well as the cell immediately downstream of the respective condensate tank shall be connected to trip the diversion valve in the event of high salinity or loss of power to a cell or the solenoid. The valve shall be constructed so that it must be repositioned manually to allow flow through the condenser or cooler and that it can be easily tripped manually to allow flow to bypass the condenser or cooler. The valve shall be designed to operate with a working pressure of at least 50 psig. The valve body and bonnet shall be constructed of valve bronze; ASTM B-61. Wetted trim parts shall be nickel-copper alloy (Monel); ASTM specifications B-127 and B-164 apply. Diversion valves in accordance with MIL-V-16556 which meet the requirements herein may be used.

3.5.2 Vent condensers and condensate coolers. Condensers and condensate coolers may be of the shell and tube type or plate type.

3.5.2.1 Shell and tube heat exchangers shall be provided with double tube sheets to prevent seawater contamination of the condensate due to a leaking tube to tube sheet joint. The shell and baffle plates on the condensate side shall be copper. Tubes, tube sheets and components on the seawater side shall be 90-10 copper-nickel. Tubes shall be seamless and shall have a minimum 5/8-inch outside diameter and a minimum wall thickness of 0.049-inch. Seamless tubes having ribs, flutes, integral fins and other similar means to enhance heat transfer are permissible provided that the minimum wall thickness specified herein is met at the thinnest point. Tube supports shall be provided such that the maximum unsupported tube span will not exceed the standards set forth by TEMA for class C heat exchangers. The tube span selected shall ensure that tube bumping and rubbing does not occur under shipboard motion conditions. Bolts and nuts shall be nickel-copper (class A), aluminum bronze (alloy 3, stress relieved), or phosphor bronze (alloy A or D) ASTM specifications B164, B150, and B139 apply. Condensers and coolers shall be sized based for 95°F seawater at a tube velocity not exceeding 6 ft/s.

3.5.2.2 Plate heat exchangers shall be of double wall design with titanium plates. Titanium plate heat exchangers shall be galvanically isolated from the surrounding piping through isolation at the flanges as well as isolation of the foundation.

3.5.3 Feedwater Pumps. Two (2) feedwater pumps shall be installed local to the DFT with cross-connects meeting the requirements of Section 3.5.7. Feedwater pumps shall be multistage centrifugal or regenerative turbine, capable of delivering 44 gpm at the calculated head requirement. NPSH margin greater than 1 must be maintained for all conditions of permanent list and trim defined in Section 3.2. If NPSHa is inadequate for the pump selected, a booster feed pump shall be installed. The existing feedwater pumps shall be retained to provide feedwater to the boilers in event of a DFT casualty.

3.5.4 Condensate Pumps. Dedicated condensate pumps shall be installed for the purpose of feeding the DFT. Pumps shall be constantly running.

3.5.5 General Requirements for Pumps.

3.5.5.1 Centrifugal pumps shall be designed in accordance with ASTM F998. Centrifugal pumps shall meet the requirements of connected systems, machinery, and equipment during all specified service conditions. Unless otherwise specified, centrifugal pump drive electric motors shall be continuous duty and as specified in Part 3.5.6. Pump units shall not overload the motor at any condition of operation from shut-off capacity to free delivery while pumping the specified fluid. Where identical pumps are used, they shall have the same rotation. Where pumps of different capacities are required to operate in parallel or take suction from different sources and discharge into a common line, their characteristics shall be such that each pump will carry its appropriate share of the load. Centrifugal pumps shall be selected at or near the best efficiency point (BEP) on the head-capacity curve.

3.5.5.2 Centrifugal pumps shall have means for recirculation. The pump shall not overheat when operating at shutoff and the liquid being pumped shall not vaporize. Minimum recirculation flow shall be 5 percent of pump rated capacity or as specified by the pump manufacturer. If an orifice is used to control pump recirculation, a differential pressure gauge or other means shall be installed around the first orifice to verify adequate flow. Where practicable, the recirculation discharge shall be directed away from the pump suction.

3.5.5.3 Regenerative turbine pumps shall meet the general construction requirements set for centrifugal pumps in Section 3.5.5.1. Regenerative turbine pumps shall be fitted with relief valves on the discharge side of the pump. The relief valves shall be installed within the pump casing and shall be externally adjustable. Other arrangements will be considered. The relief valve shall pass full rated pump capacity at a pressure not exceeding 125 percent of the pump rated discharge pressure. Electric motors shall be continuous duty and as specified in Part 3.5.6.

3.5.5.4 Mechanical shaft seals - Centrifugal and rotary positive displacement pumps shall be provided with mechanical seals in accordance with ASTM F1511 including the US Navy supplement.

3.5.5.5 Mounting and Supports - Vertical pumps shall be provided with substantial brackets to support the drivers, and with bases for units mounted on tank top, or with supporting lugs if mounted on bulkhead. On horizontal units, the pump and its driver shall be mounted on a common base of rugged construction. Pumps and motors shall be provided with coaming or drip pan to eliminate leakage on to deck or into bilge.

3.5.5.6 Installation - Location of pumps, together with piping design and arrangement, shall provide the highest practicable net positive suction head for the pumps. Where this is impractical, and for centrifugal pumps for other services located where they do not have a submerged suction, a priming pump unit shall be furnished with the pump, or a separate vacuum priming pump shall be installed. Sealing water for vacuum priming pumps shall be from a freshwater storage tank.

3.5.5.7 Alignment - The pump, driver, and attached piping must be properly aligned at normal operating temperatures to eliminate undue mechanical stresses on the shafts, bearings, coupling, and mechanical seals. In addition, alignment of flexible coupled pumps shall be checked in accordance with manufacturer's recommendations.

3.5.5.8 Gauges - Each pump shall have a suction and discharge pressure gauge connected close to the pump and on the pump side of the stop valves and check valve; however, the gauge may be mounted on a nearby gauge board.

3.5.6 Motors. Motors shall be of the totally enclosed fan cooled type with a speed rating not exceeding 3600 rpm. They shall be compatible with Type 1 power in accordance with MIL-STD-1399 Section 300, 460 VAC/3 phase/60Hz ungrounded. Motors meet the design, performance, application and installation requirements of IEEE-STD-45; 46 CFR, Subchapter J; and National Electric Manufacturer's Association (NEMA) standards MG1 and ICS.

3.5.7 Feedwater Piping. Feedwater piping shall duplicate the level control arrangement of the current installation but take suction from the DFT; see USCG drawing no. 420-WAGB-535-001. The feedwater pumps shall be constant-running with excess feedwater returned to the DFT or condensate tank. The existing configuration of the reserve feed connection to the condensate tank may be maintained.

Feedwater piping shall include cross-connects to allow any combination of pump, DFT, and boiler to be

used in a parallel or lead-lag configuration. A cross-connect shall be furnished to allow the boilers to run off of the condensate tank and existing condensate/feed pumps in event of a DFT casualty.

3.5.7.1 Material and component selection shall be compliant with USCG Drawing No. 420-WAGB-535-001. Configuration and safety features shall comply with ASME BPVC Section 1, ASME B31.1, and 46 CFR 56.50-30. Piping shall meet the general requirements of Appendix A.

3.5.8 Salinity Monitoring System. Salinity cells at the outlet of the condensate drain tank shall be retained and shall be installed in the condensate piping prior to the DFT. See USCG Dwg. No. 420-WAGB-535-001.

3.5.9 Condensate Piping. Condensate piping arrangement shall supply water from the existing condensate drain tank in Auxiliary Machinery Room #1 4-63-0-E (upper level) to the DFT using the level control arrangement recommended by the DFT manufacturer. The existing configuration of the reserve feed connection to the condensate tank may be maintained. Piping shall be modified to feed the DFT while providing a normally-closed cross-connect to allow backup boiler feed bypassing the DFT.

3.5.9.1 Material and component selection shall be compliant with USCG Dwg. No. 420-WAGB-535-001. Configuration and safety features shall comply with ASME BPVC Section 1 and ASME B31.1. Piping shall meet the general requirements of Appendix A.

3.5.10 Condensate Cooler. The temperature control arrangement for the existing condensate drain tank in AMR #1 4-63-0-E (Lower Level) shall be modified to support the condensate entering temperature required by the DFT manufacturer. For the existing arrangement, see USCG Drawing No. 420-WAGB-505-084, 420-WAGB-517-002, and 420-WAGB-535-001.

3.5.11 Seawater Piping. Seawater piping for the condensate cooler and vent condenser shall be in accordance with USCG Drawing No. 420-WAGB-524-001 and Appendix A. Seawater system flow calculations will be provided by the COR; heat exchanger pressure drop, flow, and control requirements shall be submitted to the COR to facilitate the calculations. USCGC Healy has a central Auxiliary Seawater System which will require installation of flow control devices (typically orifice plates) for balancing in addition to any control valves required for the equipment and piping from the supply main to the return main.

3.5.12 General Requirements for Controls. Controls and safety devices shall be in accordance with MIL-B-16907, 46 CFR Part 63, UL726, ASME CSD-1, and NFPA 85 as applicable.

3.5.12.1 Boiler and DFT system controls, alarms, and indicators added or modified in support of this installation shall operate on 115VAC single phase, 60-Hz power.

3.5.12.2 Automatic control must keep process equipment variables within the limits specified for the equipment during normal operating conditions.

3.5.12.3 The automatic control must be stable over the entire range of operation. The controlled equipment must have a margin of stability which allows for normal variations in operating conditions without causing instability.

3.5.12.4 Automatic starting and other automatic operations must include provisions for manually overriding the automatic controls unless safe manual operation is not feasible. Failure of any part of such systems must not prevent the use of manual override.

3.5.12.5 In closed loop systems, feedback failures must initiate an alarm and the system must enter a known, safe state. Typically, a system either remains in its present state or moves to a "neutral" state.

3.5.12.6 Where indication of the automatically controlled parameter is required, the sensor for indication must not be common with the sensor for the feedback to the automatic control.

3.5.12.7 Failure of a remote control and monitoring system must not prevent local control.

3.5.12.8 Emergency stop functions shall be independent of control and monitoring systems. Emergency stop functions included in control and monitoring systems do not fulfill requirements to have an emergency stop for a piece of equipment or system. Where wiring is part of the emergency stop system, emergency stop functions must be hardwired to the equipment being controlled. Emergency stops for fired machinery shall be located outside the entrance to the compartment.

3.5.12.9 Instrumentation at manual control locations (i.e. independent of remote-control system) must be independent of the remote-control system.

3.5.12.10 Analog signals to MPCMS shall be 4-20mA (passive).

3.5.12.11 Alarm signals to MPCMS shall be a set of normally open contacts.

3.5.12.12 Control locations (remote and local control locations) must be provided with the instrumentation necessary for safe operation from that location. Instrumentation typically includes means to monitor the output of the monitored system.

3.5.12.13 For general requirements for control valves, actuators, orifice plates, and other control devices, see Appendix A.

3.5.12.14 Gauges and thermometers shall be installed to indicate pressures, temperatures, liquid levels, and flow rates for the safe operation, control and troubleshooting of systems, machinery, tanks and equipment.

3.5.13 Motor Controllers. Motor controller enclosures shall be NEMA class ICS-18. The overload protective devices of motors shall be compatible with the motor overload thermal characteristics and shall be set at 100% of the motor rated current for continuous rated motor. If this is not practicable, the setting may be increased to, but not to exceed 125% of the motor rated current. This overload protective device may also be considered the overload protection of the cable between the controller and the motor. Under-voltage protection (LVP) shall be provided for motors over 0.5 kW (0.7 hp). Feedwater pumps shall be provided with a time delay relay adjustable from 0 to 20 seconds to minimize on-off cycling due to the wave action of the boiler water.

3.5.14 DFT and Boiler PLC Controls.

3.5.14.1 A dedicated PLC shall be furnished for each boiler. DFT controls shall be either standalone or integrated with the boiler PLCs such that failure of one PLC does not preclude operation of the unaffected boiler(s). Boiler PLCs shall duplicate all of the functions, interlocks, safeties, and display features provided by the original Koyo units.

3.5.14.2 Boilers shall be equipped with a "first-out" safety alarm and indicating system which will (1) shutdown the unit in the event any condition exists which could cause damage to the equipment, (2) sound an audible alarm and (3) give a visual indication for the initial cause for shutdown. The alarms shall sound locally and in the Engineering Control Center.

3.5.14.3 The set points and operating differentials for pressure controls and the set time interval for timer controls shall be adjustable. These controls shall be adjusted to optimize performance and minimize pressure fluctuations within the steam system.

3.5.14.4 In the event of safety shutdown of any boiler, an alarm shall be sounded locally and in the Engineering Control Center. The interrupted boiler shall not restart but the next boiler in sequence shall automatically respond.

3.5.14.5 Safety and operating controls and temperature and pressure gauges to be furnished for each boiler shall include:

a. Front control center mounted LOCAL-OFF-AUTOMATIC selector switch with visual indicators (lights) for operating the unit. This switch shall provide for operating the unit locally independent of the master controllers having the unit and its auxiliaries secured or having the unit operate in conjunction with the master controllers.

b. Front control center mounted switch with (light) for operating the remotely located booster feed pump. shall provide for running of the pump separately or having it automatically with the boiler.

c. Front control center mounted hour meter to show the total operating hours of the fuel pump.

d. Front control center mounted safety and indicating lights for:

- (1) Booster feed pump low discharge pressure.
- (2) Feed pump low discharge pressure.
- (3) Fuel pump low discharge pressure.
- (4) Burner firing rate (one for each firing step).
- (5) Burner atomizing air low pressure.
- (6) Combustion air blower low pressure or no flow.
- (7) Automatic blowdown valve open.

e. Appropriate safety controls to secure the unit and booster feed pump in the event any abnormal condition exists which could cause damage to the equipment.

f. Low voltage protection with manual reset and overload protection for all motors.

g. Pressure switches shall be provided for start-stop and firing control of the boiler independent of the master controllers.

h. Interlock relays for the control circuit to the booster feed pump unit and for the control circuit to the combustion air heaters.

i. Pressure relief valves.

j. Temperature gauges for:

(1) Combustion air to burner

(2) Combustion exhaust discharge from boiler.

(3) Feed pump discharge.

k. Pressure gauges for:

(1) Booster feed pump discharge (at the feed pump

(2) Feed pump discharge.

(3) Fuel pump discharge.

(4) Steam discharge.

(5) Control air supply for pneumatic controls.

(6) Fire side draft.

3.5.14.6 1. A pressure switch to shutdown the unit in the event of loss of air pressure to the burner assembly atomizer or pneumatic controls.

3.5.14.7 Three-Element boiler level controls shall be provided and be compliant with USCG TP 5162A, SWBS 517, Section A as well as ASME CSD-1.

3.5.14.8 DFT Level High Alarm - The DFT controls must monitor a level switch in the DFT tank for indication of a high level. An open contact must indicate normal level and a closed contact shall actuate high-level alarm. These alarms are to be output as a signal to the MCS system. See Section 3.5.12.11 for signal requirements. USCG will handle integration to MPCMS.

3.5.14.9 DFT Level Low Alarm - The DFT controls must monitor a level switch in the DFT for indication of a low level. An open contact must indicate a normal level and a closed contact shall actuate a low-level alarm. These alarms are to be output to the MCS system. as a signal to the MCS system. See Section 3.3.12.16 for signal requirements. USCG will handle integration to MPCMS.

3.5.14.10 All boiler status and alarm functions listed in Section 3.2 must be provided as an output to MPCMS.

3.5.15 Burners.

3.5.15.1 Burner controls must retain the existing fuel oil control valve, linkage, modutrol valve, and damper. Fuel and air control shall not be made independent.

3.5.15.2 The existing 150 gph Monarch C-169-WA nozzle shall be resized using the same make/model nozzle to support a firing rate of 16,738 MBH (120 gph).

3.5.15.3 The existing Honeywell 7840 burner sequencing controls shall be replaced with a supportable, commercial off the shelf (COTs) unit or incorporated into the PLC control. In either case all existing control functions shall be retained and any add-ons such as flame scanners, flame scanner cards, etc. shall be COTs.

3.5.16 Surface Blowdown System. The existing continuous surface blowdown equipment shall be removed. Each boiler shall be provided with manual surface blowdown in accordance with ASME BPVC Section I. Blowdown piping shall be in accordance with 46 CFR 56.40.

3.5.17 Boiler Feedwater Treatment. The existing Chem-Aqua feedwater treatment system shall be removed. Each boiler shall be provided with a continuous feedwater treatment unit that automatically adds chemicals to the feedwater leaving the DFT or condensate tank. These units shall be in accordance with NSTM 220 v2 Revision 8 Section 32. Each unit shall consist of mixing tanks, pumps, valves, fittings, controls and accessories for automatic metering of chemicals for controlling water chemistry of the feedwater and for injecting oxygen removal compounds. Each unit shall be capable of continuous

metering of chemicals. The units shall be cross connected so that either unit can be used to treat both boilers. Chemical tanks shall be sized to hold sufficient chemical solution for at least 24 hours of operation of the plant. The chemical tanks shall be arranged for filling from the condensate return system. If required, the tank shall be equipped with a low-pressure steam lance for mixing and heating the chemical solution to ensure that dry chemical compounds are completely dissolved. Chemical pumps shall be protected by line strainers. Check valves shall be provided to prevent backflow in the piping systems. Continuous Injection Systems shall be arranged in accordance with NSTM 220 v2 Figure 220-32-3.

3.5.17.1 Batch treatment systems shall be provided and shall comply with NAVSEA drawing no. 803-1385735 and NSTM 220 v2 Revision 8 Figure 220-29-2 or 220-22-4. The compound injection tank shall have a volume of 3 gallons. The following test outfits shall be provided: boiler water test outfit in accordance with Mil. Spec. MIL-W-16642, a NAVSEA approved dissolved oxygen test outfit, one conductivity meter and dip cell (cell constant of 2.0). The meter shall be equipped with a bridge, calibrated in the range (50-8,000 microohms/cm), suitable for determining boiler water conductivity.

3.5.17.2 Water sample coolers conforming to NAVSEA drawing no. 803-6397400 shall be installed for DFT feedwater and boiler water sampling.

3.5.18 Equipment Isolation. All equipment, automatic controls and traps shall be provided with cutout valves and union fittings (or flanges) on the steam and condensate systems so that each piece of equipment can be removed without the need to shut down the systems or secure steam to other equipment or services. The cutout valves on the downstream side of traps shall be of the stop check type. To meet this requirement, union (or flange) end valves are preferred in lieu of separate components. Where a branch line serves only one piece of equipment, a branch cutout valve may serve as the equipment cutout valve if the branch line is less than ten feet in length and the cutout valve is in the same watertight subdivision as the equipment served. Thermometers shall be mounted in thermowells to facilitate removal without shutdown. Butterfly valves shall not be used for system isolation.

3.5.19 Foundations. This section contains the general requirements for foundations.

3.5.20 Design.

3.5.20.1 The Contractor shall develop the details and scantlings for all equipment and machinery foundations. Requirements for rigidity and dynamic performance are specified in respective sections.

3.5.20.2 Strength and rigidity of foundations shall be sufficient to withstand the following loads and to distribute such loads into the structure of the hull:

- a) Weights of machinery and equipment, including liquids at operating levels and one-half of the unsupported lengths of connected piping and cables. Foundations for equipment subjected to added weights, including liquids for testing for leaks, shall be designed to support the following loads:

- b) The dynamic effects of the cutter's motion and vibration.

- c) Loads caused by the operation of the machinery or equipment itself and from connected systems.

- d) In exposed locations, the loadings caused by icing and snow, wave impact and wind shall be included.

3.5.20.3 Foundations subject to cyclic or reversed loadings shall be designed to withstand fatigue.

3.5.20.4 Piping connections to machinery and equipment shall not be considered as reducing the load to be supported by foundations.

3.5.20.5 Insert plates shall not be used to stiffen the deck in way of foundations if it is possible to accomplish the same by installing headers below the deck.

3.5.20.6 In cases where insert plates are required to increase the section modulus of structural members in way of foundations, the insert plates shall extend past the point of maximum moment in the direction of loading. The extent of the insert shall be based on the reduction in moment and a minimum of 12 inches past the point of maximum moment.

3.5.20.7 Doubler plates shall not be used in foundations or to stiffen the deck in way of foundations.

3.5.21 Structural Arrangement.

3.5.21.1 Continuity of structure shall be provided so that loads are properly distributed into hull structure of adequate strength and rigidity. To minimize weight, structural members of the hull, reinforced as necessary to carry the additional loads, shall be used as parts of foundations wherever practicable. Lightening holes shall be used, wherever possible, provided the required strength and rigidity is not adversely affected.

3.5.21.2 Equipment shall be supported without direct connection to the shell or other structure subject to wave impact, contact with waves, propeller excited vibrations or similar loadings, where the distortion or vibration would damage the equipment or impair its performance. Machinery and equipment shall not be attached to two structures which can deflect relative to each other under dynamic loadings. Equipment shall not be attached to watertight bulkheads if the deflection caused by flooding of adjacent compartments could render such equipment inoperative.

3.5.21.3 Accessibility shall be provided for inspection and maintenance of equipment. Foundations shall be constructed so as not to contain pockets which could retain liquids.

3.5.21.4 The foundation structures shall be arranged so that under dynamic loadings, distributed equal loading is developed in all hold down bolts.

3.5.21.5 Complete drainage of foundations shall be provided.

3.5.22 Alignment.

3.5.22.1 Provision shall be made for maintaining positive and accurate alignment for satisfactory operation of the machinery or equipment.

3.5.22.2 Foundations and bedplates shall be aligned to prevent distortion of the structure and the equipment.

3.5.22.3 The rigidity of foundations and supporting structure shall be sufficient to prevent misalignment which would interfere with operation of the machinery and equipment and to preclude excessive vibratory motion or rocking on the foundation. For electronic equipment, top sway braces shall be installed if the ratio of height to the smaller base dimension is three or greater. These braces shall not restrain the equipment vertically.

3.5.22.4 Foundations shall be designed to minimize misalignment or strain caused by thermal expansion under any operating condition.

3.5.22.5 Small bearings (i.e., less than 4-inch O.D.) which require permanent and accurate alignment, but which are not subject to heavy stresses, may be kept in alignment with accurately fitted tapered pins.

3.5.23 Attachment of Equipment to Foundations.

3.5.23.1 Coamings, liners, gaskets, bolts, foundation blocks and other material and fastenings shall be fitted, as required, for the attachment of machinery and equipment to foundations.

3.5.23.2 Unless otherwise specified, self-locking nuts of plastic insert type or all-metal self-locking nuts of distorted type, shall be provided to prevent loosening of hold-down bolts caused by shock or vibration.

3.5.23.3 The attachment of machinery and equipment to foundations shall provide for relative movement caused by thermal expansion.

3.5.23.4 Equipment without rotating parts, and not requiring removal for maintenance, may be secured by welding. Equipment which contains rotating parts may be welded to foundations provided it is mounted on a sub-base which is used as the attaching member. Main propulsion machinery and generators shall not be welded to their foundations.

3.5.23.5 Bolts, studs, lock washers and cap nuts used to fasten aluminum components shall be of stainless steel. Threads shall be coated with anti-seize lubricant MIL-PRF-907.

3.6 Deviation from Specification. Departure from the specifications will not be allowed unless some benefit to the Government results.

3.6.1 If the Contractor finds it necessary to change or depart from any of the applicable requirements, he must request permission to do so from the Contracting Officer (KO) at the earliest possible time.

3.6.2 Requests by the Contractor for changes shall clearly describe the changes proposed, the reason for, and the advantages to the Government of the changes proposed. In addition, a detailed list of additional costs or savings (if any) that would result, shall also be included.

3.6.3 If the proposed change involves the substitution of another material or method for one specifically required, the Contractor shall submit the complete Specification(s) covering the requested method or material.

3.7 Design Improvement. Proposals submitted for design improvements to equipment or process that simplify or improve reliability and or maintainability, and or to improve performance, are encouraged. Such proposals may be submitted at any time during the contract using the Specification departure procedures as outlined herein.

3.8 Workmanship.

3.8.1 All workmanship, materials, and components must be of the highest quality in every respect and of new manufacture and in full conformance with this Specification and associated drawings and documents. No used materials or components will be permitted.

3.8.2 Welded parts shall be free of weld splatter, porosity, undercuts and other defects.

3.8.3 All parts shall be free of burrs and sharp or ragged edges.

3.8.4 Poor molding fabrication, loose materials, damaged or improperly assembled equipment, galling of mating parts, nicks, and burrs of metal parts, post molding warpage will be considered basis for rejection of items being of inferior quality for the purpose intended.

3.9 Protective measures. The Contractor shall furnish and install suitable covering to seal off and protect all non-affected surfaces/equipment and spaces in the vicinity of the work area against contamination during the performance of work. Upon completion of work, remove protective material and inspect for the presence of contamination. Clean all equipment and spaces, contaminated due to improper protection, to original condition of cleanliness.

3.10 Interferences. The Contractor shall handle all interferences encountered during the installation of the recapitalized system in accordance with SFLC Std Spec 0000, paragraph 3.3.5 (Interferences).

3.11 Touch-Up Preservation. The Contractor shall prepare and coat all new and disturbed exterior and interior surfaces to match existing adjacent surfaces, in accordance with SFLC Std Spec 6310.

4. NOTES

4.1 Government and Commercial Document Sources.

4.1.1 Government Documents.

4.1.1.1 DOD & Navy Publications and Forms (Other Than DODISS)

Naval Publication and Forms Center

5801 Tabor Ave.

Philadelphia, PA. 19120

215-697-2000

4.1.1.2 Specification and Standards (DODISS Documents)

Standardizations Document Order Desk

700 Robbins Avenue

Building #4, Section D

Philadelphia, PA. 19111-5094

215-697-1187

<http://assist.daps.dla.mil/quicksearch/>

4.1.1.3 USCG Surface Forces Logistics Center

2401 Hawkins Point Road

Baltimore, MD 21226-5000

ATTN: SFLC-ESD-NAME-ISVS Section

410-582-4727

4.1.1.4 Code of Federal Regulations (CFR)

U.S. Government Printing Office

732 N. Capitol Street, NW
Washington, DC 20401
866-512-1800
<http://www.gpoaccess.gov/cfr/index.html>

6.1.2 Commercial Documents.

4.1.1.5 American National Standards Institute (ANSI)
1430 Broadway
New York, NY 10018
212-642-4900

4.1.1.6 American Society of Mechanical Engineers (ASME)
Three Park Avenue
New York, NY 10016-5990
800-843-2763
Email: CustomerCare@asme.org

4.1.1.7 American Society for Quality Control (ASQC)
600 North Plankinton Avenue
Milwaukee, Wisconsin 53203
800-248-1946
FAX 414-272-1734

4.1.1.8 American Society for Testing & Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA. 19428-2959
610-832-9585
FAX 610-832-9555

4.1.1.9 Institute of Electrical and Electronics Engineers (IEEE)
3 Park Avenue, 17th Floor
New York, NY 10016-5997
212-299-5585

4.1.1.10 International Organization for Standardization (ISO)
1, ch. de la Voie-Creuse,
Case postale 56
CH-1211 Geneva 20, Switzerland
41-22-749-01-11
Fax 41-22-733-34-30

4.1.1.11 National Electrical Manufacturers Association (NEMA)
1300 North 17th Street
Suite 1847
Rosslyn, Virginia 22209
703-841-3200
Fax: 703-841-5900

4.1.1.12 Society of Naval Architects and Marine Engineers (SNAME)
99 Canal Center Plaza
Suite 310

Alexandria, Virginia 22314
703-997-6701

5. NOTES

This section is not applicable to this work item.

APPENDIX A

GENERAL REQUIREMENTS FOR PIPING

A1. SCOPE

A1.1 Intent . This appendix describes the general design requirements for piping for cutters and boats. Contact SFLC-ESD-NAME-AUX MACH for concurrence on the application of the requirements.

A2. DEFINITIONS

A2.1 Cutout or Isolation Valve. A valve provided supporting operation, maintenance, and overhaul of the equipment or system. The valve provides isolation without necessitating shutdown of other services provided by the same system.

A2.2 Combustible Liquid. Any liquid that meets the combustible liquid definition in 46 CFR 30.10-15, including fuel, lubricating, and hydraulic oils.

A2.3 Damage Control Valve. A valve with one or more of the following assigned functions:

A2.3.1 Preventing progressive flooding between main watertight subdivisions.

A2.3.2 Isolating machinery, equipment, or sections of piping systems in the event of damage to the machinery, equipment, or section of the system. These valves may be operable from local and remote stations or they may consist of two valves in a machinery plant system on opposite sides of a watertight boundary. In this regard, the damage valves serve the same function as valves commonly referred to as "casualty control" valves. The primary purpose is to minimize the effect of loss of machinery plant vice performing the function of maintaining watertight integrity or providing a material condition of readiness for a specific system.

A2.4 Design Pressure. Design pressure is the pressure to which each piping component of a piping system is designed. It shall not be less than the pressure at the most severe condition of coincidental internal or external pressure and temperature (maximum or minimum) expected during service.

A2.5 Design Temperature. The design temperature is the maximum temperature at which each piping component is designed to operate. It shall not be less than the temperature of the piping component material at the most severe condition of temperature and coincidental pressure expected during service.

A2.6 Flammable Liquid. Any liquid that gives off vapors meeting the flammable liquid definition in 46 CFR 30.10-22, such as paint thinner, acetone, or acetylene.

A2.7 Hot Surface. A surface with a temperature of 400°F or higher. However, for lube oil and hydraulic oil systems, a hot surface is one having a temperature of 650°F or higher. For insulated surfaces, the temperature under the insulation is the reference temperature.

A2.8 Maximum Allowable Working Pressure (MAWP). The pressure at coincident temperature to which a boiler or pressure vessel can be subjected without exceeding the maximum allowable stress of the material or pressure-temperature rating of the equipment.

A2.9 Open Piping Path. A path for the free flow of fluid between a compartment or boundary containing the piping and the interior of the piping. A path, otherwise open, shall be considered not open if it contains valves or other type closures which are closed during normal operation and which, if left open during normal ship operation, would result in escape of fluid or system performance indication detectable by operating personnel. A path, otherwise open, shall also be considered not open if it embodies piping arrangements, such as loop seals, which will prevent the flow of water.

A2.10 Readily Accessible. Where the compartments and components are required to be readily accessible, their controls during normal operating conditions are to be:

A2.10.1 Located in a space normally entered without using tools and an atmosphere acceptable for human occupancy;

A2.10.2 Clear of or protected from obstructions, moving equipment, and hot surfaces that prevent

operation or servicing; and

A2.10.3 Within operator's reach.

A2.11 Sea Connected Piping. Piping in any system that has a connection or connections open to the sea below the limiting displacement waterline.

A2.12 Supporting Elements. Various methods of carrying the weight of the piping, piping components, insulation, and the fluid carried, including:

A2.13 Hangers. Elements which carry the weight from above with the supporting members being mainly in tension.

A2.14 Supports. Elements which carry the weight from below with the supporting members being mainly in compression. A supporting element may be a combination of both of these.

A2.15 Takedown Joints. A section of piping that may be installed or removed by mechanical means, allowing access for maintenance, repairs, or modifications

A3. REQUIREMENTS

A3.1 General Requirements.

A3.1.1 This Section specifies additional general requirements for the design, construction, material, fabrication, arrangement, installation, testing, and cleaning of piping systems and piping components. Requirements peculiar or supplemental to a specific system are specified in the section governing that system. Where supplemental or differing requirements are specified in the section governing the system, the system section requirements take precedence.

A3.1.2 Design pressures shall not be less than boiler and/or pressure vessel maximum allowable working pressures. Normal, abnormal, and emergency operation and casualty conditions shall be considered in determining the maximum allowable working pressure.

A3.1.3 Normal, abnormal, emergency, and casualty conditions shall be considered in determining the maximum system temperature. The design temperature shall equal or exceed the maximum system temperature.

A3.1 In addition to the requirements of the most recent edition of ABS MVR Part 4 Vessels and Machinery, Section 6 Metallic Piping, the following shall apply.

A3.1.1 Branch connections for shipboard piping systems shall be in accordance with ASTM F681.

A3.2 Material Requirements. Piping and components shall be selected in accordance with the following.

A3.2.1 Piping and components, except potable water systems as stated below, shall be in accordance with the piping materials schedule in the USCG diagrams for the systems being modified. Copper pipe shall not be used in aluminum structure without proper galvanic isolation.

A3.2.2 Dissimilar Metals. Where piping and components interface with dissimilar metals other than what is permitted in the allowable materials schedule as outlined in A3.2.1, they shall be galvanically isolated with dielectric flange gaskets, hardware, or couplings or where appropriate, with non-metallic hoses or rubber flex couplings.

A3.2.3 Takedown Joints. The following components shall be provided with takedown joints:

A3.2.3.1 Instrumentation such as sensors, pilot lines for control valves, and flow control valves.

A3.2.3.2 Valves which operate automatically or semi-automatically such as safety, relief, regulating, solenoid and governing valves.

A3.2.3.3 High maintenance items which cannot normally be repaired in place.

A3.2.3.4 Threaded connections employed as takedown joints shall be in accordance with MIL-STD-777 Note 4.13.

A3.2.3.5 Valves which operate automatically or semi-automatically such as safety, relief, regulating, solenoid and governing valves.

A3.2.4 Flanged Joints. Raised face flanges shall not be used against bronze or other relatively low strength composition valves, fittings or flanges. To prevent extrusion of the gasket into the flow stream, the inside diameter of flat faced flange gaskets shall be cut 1/4 inch larger than the waterway diameter.

A3.2.5 Joint Fasteners. Bolting lengths shall be in accordance with ASTM F704.

A3.3 Piping Velocity Limits. Except for the specific free stream velocity limits specified herein, velocity

in pipes shall be based on meeting the following criteria:

A3.3.1 Minimum required inlet pressures of machinery, equipment, and components under maximum required flow conditions.

A3.3.2 Inlet velocity limitations of machinery, equipment, and components.

A3.3.3 Seawater velocities shall be in accordance with A3.4.2.

A3.3.4 Tables 505-1 and 505-2 shall not be exceeded:

Table 505-1 Piping System Free Stream Velocity Limits (ft/sec)

<u>Freshwater Systems, Copper</u>	<u>Maximum</u>
Chilled/Cold water piping, ASTM B88 Type K	$5\sqrt{d}$ up to 8 ft/sec
Hot water piping at or below 140°F	$3\sqrt{d}$ up to 5 ft/sec
Hot water piping above 140°F	$3\sqrt{d}$ up to 2.5 ft/sec
<u>Freshwater Systems, 90/10 Copper Nickel*</u>	<u>Maximum</u>
Constantly running systems below 110°F	$5\sqrt{d}$ up to 12 ft/sec
Constantly running systems above 110°F and below 140°F	$3\sqrt{d}$ up to 7 ft/sec
Constantly running systems above 140°F	$3\sqrt{d}$ up to 3.5 ft/sec
Systems above 140°F with ethylene glycol or propylene glycol freshwater solutions	$3\sqrt{d}$ up to 4 ft/sec
Chilled water piping	$5\sqrt{d}$ up to 12 ft/sec
<u>Fuel Systems</u>	<u>Maximum</u>
Service and transfer system suction	$2\sqrt{d}$ up to 7 ft/sec
Service and transfer system discharge	$5\sqrt{d}$ up to 12 ft/sec
Loading and unloading, maximum	25 ft/sec
<u>Lubricating Oil System</u>	<u>Maximum</u>
Lubrication oil pump suction, maximum	$\sqrt{d}$ up to 4 ft/sec
Transfer system, maximum	$2\sqrt{d}$ up to 6 ft/sec
Note: d is the ID of the pipe or tube.	

Table 505-2 Seawater Velocity Limits for 90-10 Cu-Ni Piping

Pipe Size (NPS)	Velocity (fps)	Flow (gpm)
1/2	4.2	5.2
3/4	4.8	9.9
1	5.4	18.6
1-1/4	6.2	34.9
1-1/2	6.6	49.8
2	7.4	88.4
2-1/2	8.2	147
3	9.1	244
3-1/2	9.8	348
4	10.3	462
5	11.5	794
6 and larger	12.0	1187
NOTE		
The velocity levels can be increased by approximately 2 fps for 70-30 copper-nickel alloys.		
Minimum recommended seawater velocity for any pipe size in a flowing system is 3 fps.		

A3.4 Corrosion and Erosion Prevention.

A3.4.1 Piping conveying fluids that is subject to constant or frequent flow shall be protected from erosion by the following mitigations:

A3.4.1.1 Using long radius elbows, sweep tees, welded sweep-o-lets, and Y and lateral type fittings.

A3.4.1.2 Sizing pumps, including flow and head characteristics to match system and attached equipment design flow requirements.

A3.4.1.3 Systems constructed from 90-10 Cu-Ni shall utilize 70-30 Cu-Ni piping for at least 10 pipe diameters downstream of any turbulence or cavitation-inducing device. These include but are not limited to throttling devices, control valves, orifice plates, and pumps.

A3.4.1.4 Systems constructed from MIL-T-24107 copper piping shall utilize 90-10 Cu-Ni piping in the locations described in A3.4.1.3.

A3.4.1.5 Avoiding the use of tees or other fittings which cause a sudden change in direction or size, such as bushings.

A3.4.2 Components. Body passages in throttling devices shall provide for gradual changes in flow direction. The downstream cavity shall permit dissipation of the issuing jet before making wall contact. Where direct impingement at close range occurs and cannot be eliminated, section thickness shall be increased to provide material to withstand the additional erosion effect

A3.5 Valves.

A3.5.1 General. Valves shall be installed in accordance ASTM F1166 Section 12, Valve placement, Orientation, and Location, and the following:

A3.5.1.1 Valves shall be installed in their Preferred Choice Location Requirements as defined in ASTM

F1166.

A3.5.1.2 Valves shall be installed in readily accessible spaces.

A3.5.1.3 Valves shall be installed in their proper orientation to support operation of the system.

A3.5.1.4 Globe and angle valves shall be arranged with the system pressure or vacuum under the disc so that in the shut position, the pressure or vacuum is not exerted on the bonnet joint or stem packing.

A3.5.1.5 Gate valves, butterfly valves, and ball valves other than v-ball valves shall not be installed for throttling services.

A3.5.1.6 Valves installed as throttling devices for the purpose of achieving system balance shall have some means of permanently retaining their adjustment.

A3.5.1.7 Manifolds may be used, provided such usage results in a simplified piping arrangement or advantageous operational features. Manifolds shall allow valve maintenance without removing the entire manifold.

A3.5.1.8 On valves having sliding stems or stem rotation less than 360 degrees mechanical position, position indication shall be accomplished by comparison of the lever or stem position with a fixed travel indicator plate. Where electrical switches are used on these valves, they shall be actuated by the valve stem or actuating lever.

A3.5.1.9 Hose valves with an exposed male threaded connection shall have a threaded cap for thread protection. The threaded cap shall remain attached to the valve using a metallic tether and allow for the equalization of pressure while threads are still partially engaged.

A3.5.1.10 Stop check valves, or combinations of stop and check valves, shall be installed where there is a possibility that reversal of flow could flood a space.

A3.5.1.11 Line-blind valves shall be in accordance with ASTM F1020.

A3.5.2 Check Valves.

A3.5.2.1 Check valves shall be selected and oriented so that their characteristics are compatible with system and motion requirements.

A3.5.2.2 Check valves shall be installed where reversal of flow would be detrimental to proper functioning of the system.

A3.5.2.3 Check valves shall be installed in pump discharges where multiple pumps serve the system.

A3.5.2.4 Non-slam type check valves shall be employed where pumps are started at or near dead-head conditions.

A3.5.3 Butterfly Valves. Butterfly valve applications shall be in accordance MIL-STD-777 Note 4.30

and the following requirements:

A3.5.3.1 Butterfly valves shall not be used for the following:

A3.5.3.2 For equipment isolation around pumps or strainers.

A3.5.3.3 For throttling of flow.

A3.5.3.4 Commercial valves for fuel and lube oil systems shall comply with API-STD-607.

A3.5.4 Safety Pressure Relief Valves (SPRV). SPRV shall be installed in accordance with the following:

A3.5.4.1 SPRVs used in a fired or otherwise heated pressure vessel shall be sized for the maximum heating rate, and the maximum accumulation and reseal pressures shall be in accordance with the appropriate section of the ASME BPVC.

A3.5.4.2 SPRV on non-fired pressure vessels shall take into account maximum filling rate AND the possibility of fire in the compartment and sized in accordance with ASME BPVC Section VIII.

A3.5.4.3 SPRV used to protect systems or equipment shall have a maximum accumulation pressure not exceeding the MAWP of the equipment. SPRV shall be installed and not require any external source of power (air, electricity, etc.) to operate.

A3.5.4.4 Where deadhead pressure can damage equipment, a SPRV or Back Pressure Regulating Valve shall be installed and not require any external source of power (air, electricity, etc.) to operate. SPRV shall be sized to pass the full pump relief volume at no more than 90% open. SPRVs used in a fired or otherwise heated pressure vessel shall be sized for the maximum heating rate, and the maximum accumulation and reseal pressures shall be in accordance with the appropriate section of the ASME BPVC.

A3.5.4.5 Inlet piping connecting the pressure vessel, main or other component being protected to the relief valve shall be as short and direct as possible. The inlet piping shall be arranged and sized so that the total pressure drop does not exceed 25% of the difference between set pressure and reseating pressure of the installed relief valve when passing a flow equal to the maximum capacity of the relief valve. Valves or blocking devices in relief piping shall not be installed unless specified or authorized.

3.5.4.5.1 Where relief valve discharge piping is provided, it shall be arranged and sized so that the backpressure does not cause unsatisfactory relief valve operation, either from a stability or capacity standpoint. Backpressure build-up shall be based on the maximum capacity of the installed relief valve rather than the minimum required relief valve flow rate based on source flow.

3.5.4.5.2 The open ends of discharge piping shall be located so that discharge does not damage machinery or equipment or endanger personnel. Reliefs from toxic, combustible, and inert gas systems shall be led to the atmosphere above the weather decks and shall not terminate where their discharge could be picked up by intakes. Relief of combustible liquids shall be to a lower pressure part of the system.

3.5.4.5.3 SPRV with enclosed spring design with tight covers shall be used for the following services:

3.5.4.5.3.1 Discharge to a closed system, tank, or equipment that subjects the valve outlet to a pressure

that is not at atmospheric pressure.

3.5.4.5.3.2 Combustible liquids.

3.5.4.5.4 Toxic or explosive gases.

A3.5.5 Backpressure Regulating Valves (BRV). BRV shall be sized to pass the full delivery rate of the pump at set pressure with a valve opening of 70% to 90%. BRV shall use linear, modified linear, and modified equal percentage curves with linear being preferred. Other curves may be utilized where approved.

A3.5.5.1 Where analysis determines that the low pressure on the discharge side of the BRV and backpressure will not affect set, accumulation, or reseal pressures, orifice plate(s) or anti-cavitation trim shall be installed to eliminate cavitation noise and damage. See Section A3.9.2.4 for details on control valve cavitation analysis.

A3.5.5.2 Where a BRV is affected by downstream pressure, the valve shall be for anti-cavitation service and designed using alternate geometries and trim to correct the cavitation condition.

A3.5.6 Pressure Regulating Valves (PRV).

A3.5.6.1 PRV shall maintain their regulated pressure within specified limits from no flow to full flow under the ambient temperature and inlet pressure variation to which the valve will be subjected.

A3.5.6.2 Consideration shall be given to the interactions between valves when selecting pressure regulating valves for a particular system. Where valves are installed in series, volume shall be provided between valves to ensure proper operation per manufacturers recommendations.

A3.5.6.3 Where leak-by of a seated PRV or failure of the PRV in the open position can result in system overpressure and/or damage, a relief valve shall be installed downstream of the PRV. The relief valve shall be sized to exceed the flow of the PRV when fully open at an upstream pressure corresponding to maximum system pressure.

A3.6 Pressure Reducing Stations (PRS).

A3.6.1 PRS for services other than compressed air tool stations shall include the following:

A3.6.1.1 Automatic means of regulating outlet pressure.

A3.6.1.2 Pressure gauges for monitoring both inlet and outlet pressure.

A3.6.1.3 Filtration equipment for particulate protection of pressure regulators.

A3.6.1.4 Provision for bypassing the regulator.

A3.6.1.5 Provision for isolating regulators and filtration equipment.

A3.6.1.6 SPRV protection of downstream piping which cannot be isolated, unless downstream piping and components which could be subjected to full inlet pressure on failure of the regulator have the same

design pressure as the inlet piping.

A3.6.1.7 Means to bleed pressure out of regulators and filtration equipment.

A3.6.1.8 Provision for pressurizing SPRV to facilitate setting without readjusting the pressure regulator.

A3.6.1.9 Bypasses, manual or automatic, except those used exclusively to facilitate relief valve settings, shall be sized to pass system maximum flow requirements. Manual bypasses shall be capable of throttling flow smoothly. A warning plate with the following inscription shall be installed at each bypass valve in high pressure, toxic, steam, or otherwise hazardous fluid systems:

**WARNING
ENSURE THAT ISOLATION VALVES ON EACH SIDE OF
PRESSURE REGULATOR ARE CLOSED BEFORE OPENING BYPASS VALVE**

A3.6.1.10 SPRV shall be sized to pass the larger of the following:

3.6.1.10.1 Full open regulating valve capacity.

3.6.1.10.2 Full open manual bypass capacity.

3.6.1.10.3 PRS which include flow limiting orifices shall have SPRV sized for the maximum capacity of the orifice if installed downstream of the orifice.

A3.6.2 Seawater PRS. Seawater PRS shall have strainers located upstream of the bypass. SPRV shall be directed to bilge.

A3.7 Locking Devices. Unless a lock-shield type of valve is specified, a simple mechanical locking device shall be provided for valves which are specified to be locked open or locked shut.

A3.7.1 Unless electrical or other means are specified, valve interlocks for adjacent valves shall be a mechanical device in which one (1) valve can be opened only when the other is closed.

A3.7.2 Label plates shall be installed near locking devices to warn or instruct the operator as applicable where inadvertent operation of the valve is detrimental.

A3.7.3 ASTM F993 depicts several acceptable types of locking devices. Alternatively, lanyard locking devices similar to BUSHIP Dwg 845-1889758 may be used. The Lanyard-type locking device consists of a Monel or stainless steel braided wire, one loop around the piping and another loop attached to the hand wheel of valve. Closure of both wire loops is attained by use of a Monel or stainless steel plate clip. The function of the locking device ("locked open" or "locked closed") shall be die-stamped onto the clip.

A3.8 Equipment Isolation, System Isolation and Damage Control Valve Requirements.

A3.8.1 Equipment Isolation Valve. Machinery, equipment, and piping components requiring maintenance, except SPRV, shall be fitted with cutout valves. Isolation shall be accomplished without necessitating shut down of other services provided by the same system.

A3.8.2 System Isolation Valve. Cutout valves shall be installed for the following:

A3.8.2.1 Where systems are cross-connected, a cutout valve shall be installed in the cross-connect

pipng.

A3.8.2.2 Systems serving machinery shall be provided with cutout valves in the branch from the main to the equipment.

A3.8.2.3 Drain lines, test connections, pressure fill connections and similar lines terminating to the atmosphere shall be provided with a cutout valve for positive isolation from the atmosphere. Plugs or caps may be used instead of valves in infrequently used applications where the plug or cap is accessible. Plugs and caps shall be tethered by corrosion-resistant chain or nylon line.

A3.9 Pressure, Temperature, Level and Flow Controls.

A3.9.1 Gauges and thermometers shall be installed to indicate pressures, temperatures, liquid levels, and flow rates for the safe operation, control and troubleshooting of systems, machinery, tanks and equipment.

A3.9.2 Automatic control valves shall be provided in accordance with the following:

A3.9.2.1 Automatic control shall be provided to maintain system set points.

A3.9.2.2 Automatic control valve failure modes shall be designed to assume a fail position which will satisfy the requirements of system safety while affording continued operation of propulsion plant systems and other vital systems.

A3.9.2.3 Modulating control valves serving heat exchangers shall have an equal percentage characteristic curve and be sized for proper flow authority. Three-way control valves are preferred.

A3.9.2.4 Control valves shall be evaluated for cavitation. The valve shall be designed and configured such that the downstream restriction does not affect valve performance other than for the intended purpose of correcting cavitation using the following formula for cavitation index:

$$K = \frac{(P2 - Pv)}{(P1 - P2)}$$

Where:

K = cavitation index

P2 = absolute pressure downstream of the valve

P1 = absolute pressure upstream of the valve

Pv = absolute fluid vapor pressure.

The cavitation index shall be in accordance with the manufacturer's data for avoidance of incipient cavitation. Installation of cavitation trim, downstream orifice plate(s) or downstream Cascading Orificial Restrictive Device (CORD) are permitted means to bring the cavitation index into compliance, provided that they do not affect the operation of the valve.

A3.9.3 Orifices. Orifices shall be installed where necessary to balance flows through systems having multiple paths, and to ensure proper flow rates are maintained during every operating condition. Sizing

criteria shall be in accordance with NAVSEA T9500-AA-PRO-140/3.5.1.

A3.9.3.1 Unless otherwise approved, where one or more orifices are required in constantly running water systems, they shall be provided with a differential pressure indicator and an information plate indicating associated flow rates with the various differential pressures expected. Where multiple orifices are installed in series, the differential pressure indicator shall only be installed across the upstream orifice.

A3.9.3.2 Orifices shall be designed to be installed in a flanged joint unless otherwise approved. Orifice plates shall be manufactured in accordance with USCG Dwg. No. YD-505-001. For systems not specified, orifices materials shall be suitable for the system fluid and velocity and compatible with associated piping components.

A3.9.3.3 Orifices shall have a part protruding beyond the adjacent pipe flanges and beyond insulation so that presence of the orifice is evident. The size of the orifice hole shall be stamped on both sides of the protruding part.

A3.9.3.4 Where orifices are installed in copper nickel piping systems, piping downstream of each orifice shall be 70-30 copper-nickel for at least ten (10) pipe diameters.

A3.9.3.5 Orifices provided with equipment and machinery shall be installed in accordance with their specifications or the manufacturer's standard recommendations. Orifice plates installed for balancing purposes shall be installed downstream of the cooler(s) served, unless otherwise approved by SFLC-ESD-NAME-AUX MACH.

A3.9.3.6 Orifices shall have a cavitation index K of 1.0 or greater calculated as follows:

$$K = \left[\frac{(H_u - H_v)(1 - (D_o/D_i)^2)}{H_u - H_d} \right] - 1$$

Where:

K = cavitation index

H_u = static head upstream of the orifice, ft.

H_d = static head downstream of the orifice at 10 pipe diameters, ft.

H_v = absolute fluid vapor pressure, ft.

D_o = orifice diameter, in.

D_i = pipe inside diameter, in.

Where the cavitation index is found to be less than or equal to 1, the condition shall be corrected either by installing a Cascading Orificial Restrictive Device (CORD) or a multistage orifice sized and installed in accordance with Section 3.5.1 of NAVSEA T9500-AA-PRO-140.

Cavitation Indexes of less than one for orifice installations may be approved by SFLC-ESD-NAME-AUX MACH on a case-by-case basis.

A3.10 Piping Structural Requirements.

A3.10.1 General. Pressure, weight, thermal expansion, supports, vibrations, including that caused by attached machinery, and movements and rotations of terminal points caused by thermal and mechanical deflections and rotations of the ship's structure at piping attachment points and working of the ship shall

be considered in ensuring system flexibility.

A3.10.1.1 Piping systems shall have the flexibility to prevent overstressing of piping materials or supports, leakage of joints and unacceptable distortion of connected equipment.

A3.10.1.2 Flexibility shall be incorporated into system design by changes of direction in the piping through the use of bends, loops, and offsets. Use of expansion joints shall be minimized.

A3.10.1.3 Line configurations where most of the piping run lies near or on the straight line between end terminals or anchors shall be avoided.

A3.10.2 Design for Pressure Transients. Pressure transients which occur upon change in flow velocity shall not result in vibration, impact, noise, or internal pressure such that the calculated stress in the pipe does not exceed the allowable stress specified in ASME B31.1.

A3.11 Pipe Supports.

A3.11.1 Pipe supports shall be selected and designed to account for weight effects of piping components and other load effects such as those introduced by maximum operating pressure, thermal expansion and motion of the ship. Supporting elements shall permit the movement of piping caused by external forces or by thermal motion through the full range of operating conditions.

A3.11.2 Supports shall be installed on or adjacent to concentrated weights in the piping system to preclude contact with adjacent pipe, equipment, and structure under loading or under working of the ship.

A3.11.3 Where resonance with imposed vibration or other unacceptable vibration occurs during operation, supporting elements shall be added to remove these effects.

A3.11.4 Flange bolts or valve bonnet bolts shall not be used for attaching hangers or foundations or support for piping. Supports shall not be installed on takedown joints or in any way interfere with the installation of takedown joint spray shields.

A3.11.5 Rigid Pipe Support Elements. Design and installation of rigid pipe hangers shall be in accordance with ASTM F708.

A3.11.6 Liners. For services up to 650 degrees F, rigid and resilient pipe support elements shall employ a liner to prevent metal-to-metal contact between the pipe clamp and pipe. Applicable liner materials shall be in accordance with the ASTM F708 Table 7 Pipe Hanger Liner Materials. Other materials may be used where approved.

A3.12 Arrangements.

A3.12.1 General. Piping shall permit free passage in walking areas and the performance of all normal and emergency operations in designated working areas. Piping shall not obstruct or interfere with the operation of doors, hatches, manholes, scuttles, or openings covered by portable plates, nor obstruct or interfere with access to access panels, access doors, inspection manholes, hand holes, sight glasses, drain plugs, or test cocks used for inspection and maintenance of machinery and equipment.

A3.12.2 Machinery Access. Piping shall not interfere with the visibility, access, operation or control, inspection, and maintenance of machinery and equipment. Piping shall be arranged so that machinery and equipment that requires periodic overhaul may be dismantled with a minimum amount of disturbance

to the piping. Cutout valves and takedown joints shall be located to isolate sections of piping intended for removal during maintenance, overhaul, and in way of removable plates or panels., Double valve protection shall be provided for hazardous fluids.

A3.12.3 Protection of Piping and Insulation. Piping shall be arranged so that it will not be subjected to damage and to preclude its use for other purposes (such as grab rods, hand rails, and steps). Where this is impracticable, means shall be installed for protecting the piping. Insulated piping shall not be located where it is subject to wetting from leakage, condensation, or splashing. In unavoidable situations, the lagging shall be shielded in a manner that will prevent wetting of the insulation.

A3.12.4 The number of joints in piping systems shall be minimized through the application of pipe bends. Pipe bends shall be in accordance with MIL-STD-1627C. Takedown joints shall be located where they are least affected by pipeline forces due to thermal expansion or other external loadings.

A3.12.5 Inlet piping for centrifugal pumps shall be arranged to prevent air pockets and uneven velocity distribution at the impeller inlet. If an elbow at the pump suction cannot be avoided long radius type elbows or suction diffusers shall be used.

A3.12.6 Where necessary for the proper functioning or layup of the system and its connected machinery and equipment, vents, and drains shall be installed at local high and low points.

A3.12.7 Branch connections shall be located to minimize turbulence and the type of connection used, such as straight or sweep tees and lateral fittings, shall be suitable for the flow characteristics of the system.

A3.12.8 Connections to pumps, tanks, and equipment shall have take down joints to facilitate maintenance.

A3.12.9 Piping shall be arranged to permit inspection, maintenance and replacement of heat exchangers and components with minimum disruption of the piping. Where such piping arrangements are not possible, the piping shall be arranged to permit removal by sections in portable lengths.

A3.12.10 Piping which is normally under pressure shall not be led through voids or other normally non-vented spaces. Where this is unavoidable, vents shall be installed in accordance with requirements specified in Specification 506.

A3.12.11 Piping in Tanks and Compartments.

A3.12.11.1 Except as necessary to serve the tank, space, or equipment contained therein, , or to suit unavoidable situations as approved by the SFLC-ESD-NAME-AUX MACH, piping shall not be led through spaces or tanks where a hazard to the space, space contents, or piping, would result. Such spaces or tanks include:

3.12.11.1.1 Fuel and oil tanks, such as those which may contain gasoline, diesel; JP-5, lube oil, and oily

waste

3.12.11.1.2 Innerbottom and voids

3.12.11.1.3 Potable water tanks

3.12.11.1.4 Sewage Collecting, Holding, and Transfer (CHT) tanks

3.12.11.1.5 Wiring trunks and enclosures

3.12.11.1.6 Uptake spaces, with the exception of continuous piping for combustible liquids with a flash point at or above 140 degrees F.

A3.12.11.2 Other spaces as deemed necessary by the SFLC-ESD-NAME-AUX SYS

A3.12.11.3 Piping cleanouts and takedown joints shall not be located in food service spaces, medical spaces, electronics spaces, or magazines. Cleanouts and takedown joints shall not be located above any electrical component.

A3.12.11.4 Piping within tanks shall be of a material which will not cause contamination of the tank contents, and the material for this piping shall be suitable for both the tank and pipe contents.

A3.13 Interfaces with Ships Structure.

A3.13.1 Piping shall be arranged to permit maintenance of ship structure.

A3.13.2 Piping penetrations shall be arranged to avoid cutting plating butts and seams, bulkhead stiffeners and deck beams. Where cutting welded butt or seam joints is unavoidable, the piping penetration shall be made across the joint and shall not notch the joint.

A3.13.3 Piping shall be kept clear of Bolted Equipment Removal Plates (BERP) and Welded Equipment Removal Plates (WERP). Where it is impracticable to keep clear of BERPs and WERPs, takedown joints shall be provided.

A3.13.4 Piping penetrations through watertight bulkheads and decks shall be installed in accordance with NAVSHIPS drawing 803-1385866, Figure 1C.

A3.13.5 Where the system piping is ASTM B88 Copper Water Tube, penetration sleeve dimensions shall be in accordance with refrigeration system sleeve dimensions for plain sleeves.

A3.13.6 Where piping passes through holes in non-tight structure, provision shall be made to keep the pipe from bearing on the structure.

A3.14 Hoses.

A3.14.1 Application. Hoses may be installed between two points to provide flexibility, or to isolate or control vibrations. Hoses shall be in accordance with Specification 505-2.

APPENDIX B

PIPE CLEANING, FLUSHING, and Test REQUIREMENTS

B1. SCOPE

B1.1 Intent. This appendix covers requirements for cleaning, flushing, and testing of repaired, modified and new piping systems.

B2. REQUIREMENTS

B2.1 General. Processes and fluids used for cleaning and flushing shall be compatible with the materials of system construction and shall not damage or induce defects which could result in system failure. Operational tests shall be conducted using the system fluid.

B2.1.1 Except where the operating fluid or system material may be adversely affected, the test liquid shall be either clean fresh water (drinking water grade or better), or clean (strained) seawater (seawater systems only). Use of test liquids other than water shall be approved by the SFLC-ESD-NAME-AUX MACH. See SFLC STD SPECIFICATION 0740 for additional guidance.

B2.1.2 Piping system flush, hydrostatic test, care-in-yard, and operational test procedures shall be approved by USCG.

B2.2 Cleaning and Flushing. Prior to conducting hydrostatic testing, systems or affected portions of systems shall be cleaned and flushed to ensure that dirt, slag, grit, or other debris which could impact the test and system operation is removed. Generally, clean and flushed is defined as being free of all loose scale, rust, grit, filings, and other foreign substances, and oils or grease, where presence of hydrocarbons would be detrimental to system operation, personnel health, or the environment.

B2.3 Hydrostatic Tests. After a system is repaired, modified or installed, and cleaned and flushed, but before the system is operated, the system shall be hydrostatically tested. Inspections and hydrostatic tests shall occur prior to painting, installation of insulation, and lagging, and system operation.

B2.3.1 Hydrostatic tests shall occur on all new segments of piping. Joints, including welds, shall be left uninsulated and uncoated, and exposed for examination during the test, unless they have been previously satisfactorily tested to at least the pressure specified herein. Deficiencies revealed during tests shall be corrected followed by a repeat of the test.

B2.3.2 After hydrostatic tests and prior to operational tests, piping shall be blown out with compressed air to remove the hydrotest fluid and dry the pipe to the maximum extent practicable supporting care-in-yard practices. Vacuum drying may be employed as an alternative.

B2.3.3 Equipment, tanks, components, and machinery which could be damaged by the test liquid or would be subjected to a test pressure higher than their specified test pressures shall be by disconnected from the system, or otherwise isolated from the test. Isolation from the test shall be by means of blank flanges, or valves (where provided). Valves shall not be used for test isolation where the test pressure would exceed the design tightness pressure of the valve in the closed position. Where contamination from water used for hydrostatic testing would damage equipment, the system shall be evacuated under vacuum

and then flushed with system fluid. System fluid used for flushing shall be contained and disposed of in accordance with all federal, state, and local regulations.

B2.3.4 Standard Hydrostatic Test. Any modified or repaired system shall undergo a Standard Hydrostatic Test and comply with following:

B2.3.4.1 Unless otherwise specified, systems shall be tested to 135 percent of the system design pressure, but not less than 50 psi. Systems having a backup supply from a higher-pressure source which are not open ended and do not have relief valve protection, such as firemain backup, shall be tested at the test pressure required for the high-pressure source. Gravity drains, plumbing vents, and tank vents shall be tested to the hydrostatic head of the system high point or 50 psi. The section of piping being isolated and tested shall be pressurized and uninsulated and exposed joints shall be checked for leakage. At least 30 minutes shall elapse between application of the test pressure and inspection of the first joint.

B2.3.4.2 The exemption for a full hydrotest using the Operational Pressure Test Option mandates that all the requirements of NSTM 505-11.1.2.6 are met. Requests for Operational Pressure Test exemptions shall be reviewed and approved by SFLC-ESD-NAME-AUX MACH.

B2.3.4.3 Expansion joints shall be provided with temporary restraint, if required for the additional test pressure load, or else they shall be isolated from the test.

B2.3.5 Hydrostatic Tests For New Construction. All systems on new construction vessels shall be hydrostatically tested.

B2.3.5.1 ABS Requirement. In accordance with ABS MVR 4-6-2/7.3, hydrostatic tests shall be conducted for the systems specified.

B2.3.5.2 Hydrostatic Tests for Repairs and Overhauls. All systems shall be tested to the ABS requirement or Standard Hydrostatic Test requirement, whichever is more stringent.

B2.3.5.3 Segmented Hydrostatic Tests. Hydrostatic testing of a system or effected portions of a system in their entirety is not required. Testing of piping in segments or spools may be approved provided testing occurs between takedown joints using blank flanges or valves. Care-in-yard processes shall ensure that spools are appropriately protected prior installing by using additional plugs, blanks or valves to ensure foreign material does not enter the system segments prior to installation. Pipe segments may be painted after hydro tests prior to installation. After segment installation, an operational test shall be performed to verify that there are no leaks are at the connections. Segmented hydrotests processes shall be documented in the hydrostatic test procedure approved by the USCG.

B2.3.5.4

B2.4 Operational Tests. After system cleaning, flushing and hydrostatic testing, the system shall be returned to the normal configuration and tested to ensure the following conformance with system design requirements regarding flow, temperature, and setting of over pressure and over temperature protection devices. Performance shall be verified in the normal, emergency, and manual modes of operation.

B2.4.1 Testing of bolt-in form-fit-function components, i.e. valves or hoses, shall be in accordance with Section 3.7.

B3. NOTES

None.

THIS PAGE INTENTIONALLY LEFT BLANK