INCH-POUND
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DETAIL SPECIFICATION

DESALINATION UNITS, WATER: REVERSE OSMOSIS NAVAL SHIPBOARD

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers electrically operated, self-contained reverse osmosis (RO) desalination units for making water of potable drinking quality, from seawater, in naval shipboard installations.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-917	-	Electric Power Equipment, Basic Requirements for
MIL-DTL-2212	-	Contactors and Controllers, Electric Motor AC or DC, and Associated Switching Devices
MIL-DTL-15103	-	Salinity Indicating Equipment
MIL-V-16556	-	Valve, Solenoid, Three-Way Bypass (Naval Shipboard Use)
MIL-PRF-32006	-	Programmable Controller, Naval Shipboard
MIL-PRF-32407	-	Mounts, Resilient (Surface Ship Application)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-108	-	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-130	-	Identification Marking of U.S. Military Property
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)

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

MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-740-2	-	Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-777	-	Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships
MIL-STD-1472	-	Human Engineering
MIL-STD-1474	-	Noise Limits

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-470	-	Designing and Developing Maintainable Products and Systems, Volume I

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

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

BUREAU OF MEDICINE AND SURGERY (BUMED)

NAVMED P-5010-6	-	Manual of Naval Preventive Medicine, Chapter 6, Water Supply Afloat

(Copies of this document are available online at www.med.navy.mil.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 800-53	-	Security and Privacy Controls for Federal Information Systems and Organizations
NIST SP 800-82	-	Guide to Industrial Control Systems (ICS) Security

(Copies of these documents are available online at http://nvl.nist.gov/.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S6430-AE-TED-010	-	Technical Directive for Piping Devices, Flexible Hose Assemblies; Volume 1
S9073-A2-HBK-010	-	Installation and Inspection Information; Resilient Mount Handbook
S9074-AR-GIB-010/278	-	Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels
S9086-T8-STM-010/593	-	NSTM Chapter 593, Pollution Control
S9086-VD-STM-010/631	-	NSTM Chapter 631, Preservation of Ships in Service – General
0948-LP-012-5000	-	Standard Navy Valves

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

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

UNDS	-	Uniform National Discharge Standards (UNDS) for Vessels of the Armed Forces

(Copies of this document are available online at www.epa.gov.)

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

NSF/ANSI 60	-	Drinking Water Treatment Chemicals – Health Effects
NSF/ANSI 61	-	Drinking Water System Components – Health Effects

(Copies of these documents are available online at http://webstore.ansi.org/.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Boiler and Pressure Vessel Code

ASME B40.100	-	Pressure Gauges and Gauge Attachments
ASME B40.200	-	Thermometers, Direct Reading and Remote Reading

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

ASTM INTERNATIONAL

ASTM B61	-	Standard Specification for Steam or Valve Bronze Castings
ASTM D1141	-	Standard Practice for the Preparation of Substitute Ocean Water
ASTM D4189	-	Standard Test Method for Silt Density Index (SDI) of Water
ASTM D4516	-	Standard Practice for Standardizing Reverse Osmosis Performance Data
ASTM F992	-	Standard Specification for Valve Label Plates
ASTM F1166	-	Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 45	-	Recommended Practice for Electrical Installations on Shipboard

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

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1182	-	Reaction to Fire Tests for Products – Non-combustibility Test
ISO/IEC 17025	-	General Requirements for the Competence of Testing and Calibration Laboratories

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	-	Industrial Control and Systems: General Requirements
NEMA ICS 2	-	Controllers, Contactors and Overload Relays Rated 600 V
NEMA ICS 4	-	Application Guideline for Terminal Blocks
NEMA MG 1	-	Motors and Generators
NEMA 250	-	Enclosures for Electrical Equipment (1000 Volts Maximum)

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

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

3. REQUIREMENTS

3.1 Characteristics. The RO unit shall produce fresh water (potable grade) from seawater under all conditions of salinity, temperature, and Silt Density Index (SDI) as specified in 3.5.1. The unit shall require minimal operator attention and manning as specified in 3.7. The RO desalination unit shall be an electrically operated (as specified in 3.16), package-type (skid mounted) unit ready for operation (turn-key system). The envelope size and weight shall be as specified in 6.2. The envelope size shall include any required maintenance access area.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.3 Configuration changes. Any modifications to a previously approved RO unit design shall be the basis for repeating first article testing (see 3.2) of the entire unit or component. A waiver from all or part of the first article tests may be requested from the procuring activity as specified (see 6.2).

3.4 Materials. Materials used in the RO unit shall be compatible with the environment in which they will operate (see 3.5.1). The maximum general corrosion rate or pitting corrosion rate shall be limited to 2 mils per year for those internal surfaces and materials used to contain, carry, or transport seawater. All materials that may come in contact with permeate (product water [see 6.4.4]) shall be in accordance with NSF/ANSI 60 and NSF/ANSI 61. This includes thread lubricants, O-ring lubricants, and hoses. All piping, valves, and associated components shall be in accordance with MIL-STD-777.

3.4.1 Seawater piping. For seawater wetted components, mating materials shall be galvanically compatible or properly isolated.

3.4.2 Piping. All piping components shall be in accordance with MIL-STD-777. Flexible hose assemblies shall be in accordance with S6430-AE-TED-010.

3.4.3 Pressure vessels. Pressure vessels in the unit shall be in accordance with ASME Boiler and Pressure Vessel Code (but need not be stamped). All components containing pressurized fluids that are not otherwise covered by Government specifications, standard drawings, or approved industry standards shall be subject to the verification in 4.5.3.

3.4.4 Non-combustibility of materials. The use of metallic materials for external components is preferred. If non-metallic components are used, they shall neither burn, nor give off flammable vapors in sufficient quantity for self-ignition when heated to 1382 °F (750 °C), in accordance with ISO 1182.

3.4.5 Moisture and fungus resistance. Constituent materials in the RO unit shall not be nutrients for fungi. The materials used, other than the RO elements and filter media, shall not absorb and hold moisture. No materials in the RO unit shall degrade in the presence of moisture.

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

3.4.7 Prohibited materials. The materials noted in 3.4.7.1 through 3.4.7.9 are limited in use as stated.

3.4.7.1 Stainless steel. Stainless steels (UNS 300 and UNS 400 series) and high ferrous alloy steels shall not be used in any components or piping used for containing, carrying, or transporting seawater or brine.

3.4.7.2 Copper-silicon and silicon-bronze fasteners. Copper-silicon and silicon-bronze fasteners shall not be used.

3.4.7.3 Mercury. Mercury, in any form, shall not be used.

3.4.7.4 Magnesium and magnesium alloys. Magnesium and magnesium alloys shall not be used in any component.

3.4.7.5 Aluminum and aluminum alloys. Aluminum and aluminum alloys shall not be used for water-wetted applications.

3.4.7.6 Cadmium plating. Cadmium plating shall not be used on any component.

3.4.7.7 Plastics. Plastic materials that generate toxic gases when combusted (such as polyvinyl chloride [PVC], chlorinated polyvinyl chloride [CPVC], polybutadienes [PB], polyethylene [PE], and acrylonitrile-butadiene-styrene [ABS]) shall not be used in any external component. Wetted components such as filter media, membrane elements, and carbon filters are not considered external components.

3.4.7.8 Silicone. The use of silicone lubricants and sealants shall be minimized anywhere they can come in contact with the direct feed to the membranes to eliminate the potential for fouling the RO membrane. Where silicone is in contact with the direct feed to the membranes, care shall be taken to ensure sparing application of the silicone. Silicone materials in contact with product water shall be “food grade” in accordance with NSF/ANSI 61 and NAVMED P-5010-6.

3.4.7.9 Lead. With the exception of bronze valves, all components used within the RO system shall be “lead free” (see 6.4.3). Bronze valves shall be in accordance with ASTM B61.

3.4.8 Hazardous and ozone depleting materials. Unless otherwise specified (see 6.2), the materials and operational processes used for the treatment system shall not rely on hazardous materials, toxic materials, or ozone depleting chemicals prohibited from use aboard the intended ship unless approved by the appropriate Government authority. Any oxidizing agents generated or consumed within the treatment system shall be enclosed at all times within corrosion-resistant containers and piping to prevent the possibility of explosive decomposition.

3.5 Environmental considerations.

3.5.1 Operating environment. The desalination units shall operate within the environmental considerations listed in sections 3.5.1.a and 3.5.1.b.

a. Seawater supply characteristics:
   (1) Total Dissolved Solids (TDS): 25,000 to 42,000 parts per million (ppm)
   (2) Maximum SDI: 5.6 (max. 15 minutes) (see ASTM D4189)
   (3) High density suspended solids: 10 ppm (max.) (specific gravity >1.7, size >75 micron)
   (4) Low density suspended solids: 15 ppm (max.) (specific gravity <1.7, size <75 micron)
   (5) pH range: 7.0 to 8.4
   (6) Normal temperature range: 28 to 95 °F
   (7) Maximum temperature: 103 °F
   (8) Seawater supply flow and pressure as specified (see 6.2)

b. Machinery room characteristics:

(1) Ambient air temperature: 40 to 125 ºF

(2) Absolute pressure: 24 inches of mercury (inHg) to 36 inHg

(3) Relative humidity: 0 to 100 percent

(4) Seawater can be expected to splash onto units during filter and RO membrane element replacement (if applicable).

3.5.2 External environment.

3.5.2.1 Discharges. Discharges to the environment shall not exceed the Federal Water Quality Criteria in accordance with Uniform National Discharge Standards (UNDS) for Vessels of the Armed Forces regulations. Discharges to the environment shall be in accordance with S9086-T8-STM-010/593.

3.6 Design. The RO unit design shall include the appropriate piping components (for example: piping, fittings, valves, check valves, relief valves, back flow preventers, and pressure reducers), pumps, and flowmeters to ensure that the following design requirements are satisfied:

a. Isolating and draining the filter vessels to permit filter media replacement.

b. Protecting the brine, permeate, and high pressure seawater feed systems from over-pressurization.

c. Isolating the seawater feed to the RO unit, if required (see 6.2).

d. Maintaining seawater feed pressure to the pump within its limits.

e. Switching the feed to the RO unit between normal operation and fresh water flushing.

f. Preventing the brine and permeate from back-flowing into the RO unit.

g. Preventing the reverse flow (with positive isolation) of fluids back into the tie-in piping to the ship's fresh water system. Check valves are not acceptable for this application.

h. Measuring the brine and permeate flow rates in gallons per minute and the cumulative total of permeate in gallons.

i. Continuous venting for removal of entrained air from incoming feed.

j. Minimizing entrapped air in the RO unit.

k. Permitting operator-initiated continuous operation of the RO unit when salinity monitoring device is removed for repair or replacement.

l. Collecting unit drainage (pump leakage, relief valve discharge, backflow preventer discharge, filter vessel drainage) to common points. The frames and bedplates used to mount the RO unit components shall not contain pockets where moisture can accumulate. The bedplate shall incorporate protection from spillage to areas below.

m. When more than one unit is installed on a ship (if required, see 6.2), design shall not prohibit independent operation of other installed units.

n. Output shall be dumped to drain when not meeting quality requirements. Dump valves shall be in accordance with MIL-V-16556.

o. Prefiltration shall provide filtered water meeting a 15-minute SDI of 5.0.

p. Monitoring TDS and salinity. The salinity monitoring system shall be in accordance with MIL-DTL-15103. If required (see 6.2), panels shall have the capability of being bulkhead mounted.

q. Design shall meet the RO element manufacturer's membrane flux density (see 6.4.2) guidance.

r. There shall be no hard piping connections between stationary and resiliently mounted components.

s. Design shall include an elapsed-time meter. This item shall be provided to measure total hours of high pressure (HP) pump operation. There shall be no manual reset feature.

t. Fresh water flushing. The RO unit shall include provisions to fresh water flush the complete system using permeate or shipboard fresh water. To protect against chemical damage to the membranes, the unit shall include provision for removing chlorine and bromine from the incoming fresh water. Shipboard fresh water has a maximum concentration of 2.0 ppm chlorine or bromine.

u. Means shall be provided for obtaining samples of the permeate from each pressure vessel without disrupting the permeate output flow or dismantling piping or fittings.

3.7 Reliability and maintainability. The RO units shall meet or exceed the following requirements:

a. Mean time between (mission critical) failure (operating hours): 2000

b. Operational availability-Ao (percent):

(1) 99 in open ocean conditions, or waters with turbidity less than 1.0 Nephelometric Turbidity Unit (NTU) and SDI (15-minute) less than 5.

(2) 95 in littoral conditions, or waters with turbidity greater than 1.0 NTU and SDI (15-minute) greater than 5.

c. Unit design life (years): 30 or as specified (see 6.2)

d. Mean time to repair (hours): 3.0

e. Maximum time to repair (hours): 6.0

f. Mean preventative maintenance time (hours): 1.1

g. Maximum preventative maintenance time (hours): 3.0

h. Minimum time between pump overhauls (operating hours): 10,000, or as specified (see 6.2)

i. Mean maintenance time (hours per month): 3.0

3.8 Controls and indicators. Monitors, alarms, startup, and shutdown functions shall be centralized. The minimum instrumentation for an RO unit shall be as listed in table I. Electrical controls and instrumentation shall not be located in areas where they could be exposed to fluid leakage during calibration and maintenance.

TABLE I. List of monitors, alarms, and shutdowns.

Description	Gauge/Meter	Alarm Switch	Shutdown Switch
I. Pressure			
Feedwater	X		
HP pump suction	X		LO
HP pump discharge	X		HI
RO module brine discharge	X		
Filter (each)			
Inlet	X		
Outlet	X		
II. Differential Pressure			
Filter (if specified, see 6.2)		HI	
III. Temperature			
Feed inlet	X		
Permeate	X		LO
IV. Flow			
Brine	X		
Permeate	X		
Permeate (totalizing)	X		
V. Permeate Salinity			
Conductivity controller (trips dumping system)	X	HI	
VI. Elapsed Operating Time	X		

3.8.1 Installation. Pressure instruments and associated piping shall be installed in accordance with MIL-STD-777. In addition, the following shall apply:

a. If specified (see 6.2), each instrument shall have an individual gauge isolation valve. The isolation valve shall feature a capped stem connection. A swaged connection is not permitted for securing the bonnet to the valve body.

b. Instrument tubing below ¼-inch outside diameter is prohibited.

c. Tapered pipe threads are prohibited.

d. Materials selected for the fluid containing components shall be in accordance with 3.4.

e. Components used shall meet the pressure rating and temperature of the fluid that is being monitored.

3.8.1.1 Pressure gauges. Pressure gauges shall use customary (English) units of measurement. The range of scale chosen shall be such that the normal operating point is in the middle half (25 to 75 percent) of the scale. The accuracy shall be within ±1 percent of the full scale. The performance shall be in accordance with B40.1 of ASME B40.100. Gauges shall meet the visibility requirements in accordance with ASTM F1166.

3.8.1.2 Thermometers. Thermometers shall use customary (English) units of measurement. The range of scale chosen shall be such that the normal operating point is in the middle half (25 to 75 percent) of the scale. The accuracy shall be within ±1 percent of the full scale. If specified (see 6.2), the performance requirements of bimetallic thermometers shall be in accordance with B40.3 of ASME B40.200 for naval shipboard application. The thermometer scale shall meet the visibility requirements in accordance with ASTM F1166.

3.8.1.3 Pressure and temperature switches. Pressure and temperature switches shall be installed such that adjustments can be easily accomplished. All switches with indicators shall be clearly identified and labeled to show the measured variable and the measurement unit used.

3.8.1.4 Manually operated switches. Manually operated switches, controllers, master switches, and relays shall be in accordance with NEMA ICS 2. Table II lists typical switches, applicable indicators, and their function. Switches shall preclude inadvertent actuation and be readily accessible.

TABLE II. List of manual switches (typical).

Switch Description	Indicators	Function
1. Start	X	Energizes system to operate in selected mode and starts HP pump
2. Booster pump (if used)	X	Controls booster pump operation
3. High-pressure pump	X	Controls HP pump operation
4. Heater	X	Controls heater operation
5. Alarm acknowledge	X	Defeats audible portion of alarm
6. Alarm reset	X	Clears alarm after problem has been identified and corrected
7. Stop		Initiates system shutdown and secures HP pump and heater

3.8.2 Flow measurement. The instrument shall have an accuracy of ±5 percent or better at full flow. Paddle-wheel flowmeters shall not be used. If specified (see 6.2), the RO unit shall be provided with two independent permeate flow meters. One permeate flow meter shall be capable of providing an analog 4 to 20 milliamp signal suitable for remote display of plant capacity. The second permeate flow meter shall provide a local indication of permeate flow suitable for use while manually controlling the brine backpressure.

3.8.3 Totalizing flowmeter. The totalizing flowmeter shall have a repeatability of ±½ percent over the full range of flows at a constant temperature. The accuracy over the full range shall be ±2 percent. The totalizing flowmeter shall measure the permeate flowing into the fresh water tanks.

3.9 Performance characteristics.

3.9.1 Operating pressure. The RO unit operation shall not exceed the RO membrane element manufacturer's operating pressure limitations.

3.9.2 Product water quality. When operating in the conditions stated in 3.5.1 and within normal manufacturer's designed operating pressures and temperatures, the RO unit shall produce water of the following quality. The output water (permeate) quality shall at all times meet that required by the Navy medical community (in accordance with NAVMED P-5010-6), which is 500 ppm TDS or fewer. With new RO membrane elements installed and operating with 35,000 ppm TDS seawater feed, permeate salinity shall not exceed 350 ppm TDS (700 micromhos per centimeter) throughout the seawater inlet temperature range given in 3.5.1.

3.9.3 Product water quantity. When operating in the conditions stated in 3.5.1 and within normal manufacturer's design operating pressures and temperatures, the RO unit shall output water of the quality required by 3.9.2 in the quantity (volume) as specified (see 6.2).

3.9.4 Permeate production rate. With new RO membrane elements installed and operating with 35,000 ppm TDS seawater feed, with a feed temperature between 55 °F and 95 °F, the RO unit shall meet 115 percent of the full production rate (see 3.9.3). The 15-percent overproduction is to account for expected reduction in permeate output due to fouling of the membranes over operating time. For a 40 °F seawater feed temperature and feed salinity of 35,000 ppm TDS, the allowed percentage reduction from full production rate (see 3.9.3) shall be not greater than 15 percent. At the feed salinity of 42,000 ppm TDS and a feed temperature of 70 °F, the unit shall meet full production rate without exceeding the allowable operating pressure. A means shall be provided for ensuring uniform permeate flow rate over time such that a variation in permeate flow does not deviate by more than ±1 percent of the set value during any 15-minute operating period. A brine throttling device may be utilized to ensure uniformity of flow with operating time. Additional guidance on throttling valves may be found in 0948-LP-012-5000.

3.9.5 Operability. The unit shall operate in the environmental conditions of 3.5.1, producing water of quality and quantity required per 3.9.2 and 3.9.3, without operator intervention, once started.

3.9.5.1 Normal operation. RO units shall start up and produce the specified quantity and quality of permeate within 15 minutes or less (see 3.9.2 and 3.9.3). Normal operation shall require no more than 5 minutes of single operator attention for every 2 hours of operation. The maximum time for normal shutdown, including fresh water flushing, is 15 minutes.

3.9.5.2 Ship attitude or motion. Unless otherwise specified (see 6.2), the RO unit shall maintain design performance without damage or degradation when subjected to angles or motions up to 45 degrees at all orientations.

3.9.6 Shock. The assembled and operating RO units shall conform to Grade A shock requirements in accordance with MIL-S-901. Flexible mounts may be used to meet this requirement. If used, flexible mounts shall be in accordance with S9073-A2-HBK-010 and MIL-PRF-32407, or shall be as specified (see 6.2).

3.9.7 Vibration. The assembled and operating RO units shall be in accordance with MIL-STD-167-1 for the frequency range specified (see 6.2). Flexible mounts may be used to meet this requirement. If used, flexible mounts shall be in accordance with S9073-A2-HBK-010, MIL-PRF-32407, and MIL-STD-167-1, or shall be as specified (see 6.2).

3.9.8 Noise. The assembled and operating RO units shall meet the Grade D equipment airborne noise limits given in MIL-STD-1474 when measured in accordance with MIL-STD-1474. Flexible mounts may be used to meet this requirement. If used, flexible mounts shall be in accordance with S9073-A2-HBK-010, MIL-PRF-32407, MIL-STD-167-1, or shall be as specified (see 6.2). When specified (see 6.2), the assembled unit shall meet the structureborne noise limits when measured in accordance with MIL-STD-740-2. Airborne and structureborne noise acceptance criteria shall not be exceeded for any operating condition.

3.10 Energy efficiency. The RO unit shall be as energy efficient as its design requirements and performance allow. Energy recovery methods shall be used when feasible (that is, recovery of energy from the pressurized brine stream to partially pressurize the feed). When energy recovery is used, the total system usage, while producing the specified quantity and quality of product water, shall be no more than 20 kilowatt-hours (kWh) per 1,000-gallon output, not including the use of a feedwater heater. If energy recovery is not used, total system usage shall be no more than 76 kWh per 1,000-gallon output. Energy consumption shall be calculated on the basis of the pumping energy consumed by electrical motors and the electrical power consumed by other electrical components used in the process of desalinating the feed seawater at a salinity of 35,000 ppm TDS and 77 °F temperature.

3.11 Human factors. The RO unit design shall incorporate the human engineering requirements in accordance with ASTM F1166 and MIL-STD-1472.

3.12 Safety. The RO units shall be free of personnel hazards. All safety features shall be such that their functions cannot be inadvertently degraded or negated during operation, storage, shipping, handling, or maintenance. All parts, components, and assemblies of the RO units shall be free from sharp edges, burrs, protruding surfaces, and other harmful extraneous material. Means shall be provided to ensure against damage to wires and cables from contact with rough or irregular surfaces and sharp edges.

3.12.1 Electrical components. Electrical components shall be in accordance with IEEE 45 requirements, including, but not limited to, dielectric strength, insulation resistance, and grounding.

3.12.1.1 Electrical enclosures. All electrical enclosures shall be spraytight in accordance with NEMA 250.

3.13 Electromagnetic interference (EMI) suppression. The RO units shall be in accordance with the EMI requirements of MIL-STD-461, or shall be as specified (see 6.2).

3.14 Dimensions and weight. The RO units shall fit into the envelope size as specified (see 6.2). Required maintenance access areas shall be included in this envelope size plus the adjacent space (see 6.2). Individual components shall fit through hatches and walkways as specified (see 6.2). Unless otherwise specified (see 6.2), the maximum allowable dimensions are 1 cubic foot per 25 gallons per day rated capacity. The maximum allowable weight (empty) is 1 pound per 1.5 gallons per day rated capacity.

3.15 Color, finish, and workmanship. Color, surface finishes, and painting shall be in accordance with S9086-VD-STM-010/631. RO units shall be free of imperfections that affect durability, operability, serviceability, or safety. Welded joints shall be in accordance with S9074-AR-GIB-010/278.

3.15.1 Mechanical indexing. Mating lines, cables, and connections shall have mechanical indexing features to prevent improper connection. Wiring markings and indexing shall correspond to the manufacturer's applicable drawings.

3.16 Electrical equipment.

3.16.1 General. Unless otherwise specified (see 6.2), the equipment shall operate from a single 440-volt alternating current (VAC), 60-Hertz, three-phrase, ungrounded delta power source.

3.16.2 Motors. Electric motors shall be in accordance with IEEE 45 and NEMA MG 1.

3.16.3 Control system components. The motor controls, control logic devices, switches, and annunciator system shall be in accordance with NEMA ICS 4. The annunciator shall provide both visual and audible alarms. Manually operated switches, controllers, master switches, and relays shall be in accordance with NEMA ICS 2. These components shall be wired with low-smoke cable. Electrical cabling shall be wired in accordance with IEEE 45.

3.16.3.1 Control panel. The control panel and its components shall be in accordance with NEMA ICS 1. The control panel shall contain the devices necessary to operate the RO unit. Devices necessary for operation, but not feasible for mounting on the control panel (for example, brine restrictor valves), are excluded from this requirement.

3.16.3.2 Controller. A method shall be provided to automatically control the RO unit in each operating mode selected, including the preset timed operation of the pump. The motor controller shall be in accordance with MIL-DTL-2212. All electrical equipment shall be in accordance with MIL-DTL-917 and MIL-STD-108, except as specified in this section. Programmable logic controllers (if used) shall be in accordance with MIL-PRF-32006 as specified (see 6.2) and meet the cybersecurity requirements of Appendix A.

3.16.3.2.1 Data logging. If required (see 6.2), units shall have the capability of recording operating data (such as those defined in table I, or as required). Data shall be downloaded to a portable data recorder via Ethernet port with storage up to 12 months' worth of data without changing storage media.

3.16.3.3 Cybersecurity. RO unit cybersecurity (see 6.4.1) design shall follow requirements for a secure industrial control system (ICS) in accordance with NIST Special Publications 800-53 and 800-82. ICS includes supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other control system configurations such as Programmable Logic Controllers (PLC) that are often found in the industrial control sectors. Cybersecurity shall be in accordance with Appendix A.

3.16.3.3.1 Cybersecurity plan. An RO unit cybersecurity plan shall be as specified (see 6.2) and approved by NAVSEA.

3.17 Identification plates. RO units shall be marked with an identification plate in accordance with MIL-STD-130. Identification plates shall be clearly legible, permanently secured, and shall last for the life of the RO unit. The identification plate shall contain the following information: Item identification (equipment title, serial number, part number), size (capacity), name and address of manufacturer, contract or order number (use width of plate to allow maximum number of spaces), national stock number (NSN) (allow 20 spaces), and date of manufacture.

3.17.1 Valve identification plates. Valves shall be marked in accordance with ASTM F992, with the valve number corresponding to the number identified in the flow schematic.

3.18 Ship interface connections. Piping interfaces shall terminate at the edges of the respective skid. The type, size, and location of the pipe terminal connections shall be as specified (see 6.2). When flanges are specified, the type shall be as specified (see 6.2). Connections shall include a unit drain. The pressures at the terminal connections shall be as specified (see 6.2).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on RO units when a first article sample is required (see 3.2). The inspection shall include the examination of 4.4 and the tests specified in table III.

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.4 and the tests specified in table III.

4.4 Examination. After the detailed testing specified in table III, each RO unit shall be examined for overall compliance with the requirements specified in section 3. Any necessary redesign or modification following failure to meet the specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Where possible, pressure boundary welds for both fresh water and seawater service shall be examined to verify that the welds are free of crevices, notches, porosity, and pockets. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection. The purification units shall be checked with respect to material, finish, construction, assembly, dimensions, weight, and marking of identification plates.

TABLE III. Examination and tests.

Characteristics	Requirement	First Article	Conformance
Materials	3.4	4.5.1, 4.5.3	4.5.2, 4.5.3
Environmentals	3.5	4.5.1	
Design	3.6	4.5.1	
Reliability	3.7	4.5.4	4.5.2
Maintainability	3.7	4.5.5	
Controls and indicators	3.8	4.5.1	
Performance	3.9	4.5.1, 4.5.6, 4.5.7, and 4.5.8	4.5.2
Energy efficiency	3.10	4.5.9	4.5.9
Human factors	3.11	4.5.10	4.5.10
Safety	3.12	4.5.11	4.5.11
Electrical components	3.12.1	4.5.1	4.5.2
Electrical enclosures	3.12.1.1		4.5.11
Electromagnetic interference	3.13	4.5.12	
Dimensions and weight	3.14	4.5.13	4.5.13
Color, finish, workmanship	3.15	4.5.14	4.5.14
Electrical equipment	3.16	4.5.1	
Identification plates	3.17	4.4	

4.5 Tests. Parallel or combined testing shall be permitted; however, the intent of any test shall not be compromised.

4.5.1 90-day endurance testing. For new RO unit designs and vendor first article testing, a 90-day test on natural seawater shall be required (see 4.2). Testing shall be performed by an independent test facility, certified in accordance with ISO/IEC 17025. For this test, the unit shall be operated continuously (or as nearly so as practical) for 90 days using natural, full-density seawater of 35,000±3,000 ppm TDS, at simulated shipboard inlet feed conditions (see 6.2), with a seawater feed temperature between 55 and 95 °F, for the duration of the test. A closed loop test facility is prohibited for this test. The performance requirements of 3.9 shall be met during the endurance test (specifically, 3.9.1 through 3.9.5.1). Additionally, at least 1 hour of testing shall be conducted at 40 °F seawater feed. It shall be demonstrated that the capacity over the specified period of operation is not less than the specified rated capacity. There shall be no more than a 15-percent reduction in normalized production rate between the start and completion of the test. Normalization shall be determined in accordance with ASTM D4516 to standard conditions of 35,000 ppm inlet salinity, 70 °F, and 800 pounds per square inch, gauge, inlet pressure to the membrane modules. Product water quality shall meet the requirements of 3.9.2 at all times during the test, based on 35,000 ppm feedwater. The required performance at 42,000 ppm and 70 °F shall be demonstrated by an 8-hour test at the conclusion of the 90-day test. Analysis shall be utilized to verify RO unit performance at minimum feed temperatures (see 3.5.1). Analysis shall also be utilized to verify the capability of the unit to meet production in fouled condition. Analysis shall be utilized to demonstrate performance when new RO elements are used (see 3.9.2 and 3.9.4), specifically, a permeate quality of no more than 350 ppm TDS and quantity of 115 percent of specified capacity. During the 90-day test, the heater(s) (if present) shall be operated for a minimum of 500 hours. The accuracy of the monitoring system and dump valve shall be demonstrated during this test. RO units shall be inspected to ensure electrical equipment is in accordance with 3.16. During the 90-day test, cybersecurity verification (see A.4) shall also be conducted. To pass the 90-day operational test, no component shall cause the RO unit to fail to provide acceptable permeate at any time during the testing (see 3.9), and there shall be no visual indications of localized pitting greater than 1 mil internal to the unit. Corrosion over 2 mils and pits in excess of 1.5 mils deep shall constitute failure. External surface oxidation or rust shall not exceed 1 square inch per any square foot area of the assembly. The electrical component requirements of 3.12.1 shall be met during the endurance test.

4.5.2 8-hour operational test. An operational test shall be conducted on each production unit offered for delivery. Each unit shall be operated for 8 hours continuously with either: (a) a test solution having a concentration consisting of 35,000±3,000 ppm sodium chloride in water or (b) a synthetic seawater solution prepared in accordance with Section 6 of ASTM D1141. It shall be demonstrated by test that the full rated capacity can be met with an inlet feed temperature within the temperature range of 55 to 95 °F. The product water shall not exceed that specified in 3.9. All components and controls shall be functional during the entire test. The accuracy of the monitoring system and dump valve shall be demonstrated during this test. The acceptance criteria for the 8-hour operational test shall be that no component causes the RO unit to fail to provide acceptable product water at required capacity during the 8-hour run (see 3.9). The electrical component requirements of 3.12.1 shall be met during the operational test.

4.5.3 Pressurized components. Pressurized components (see 3.4.3), shall be subjected to a hydrostatic pressure test of at least 1.5 times the system design pressure to check joint tightness and soundness of the pressure containing boundary. There shall be no permanent distortion, or other distortion, which could adversely affect operation of the component. Length of test shall be a minimum of 30 minutes.

4.5.4 Reliability. The RO unit shall meet the requirements of 3.7. If required (see 6.2), new designs or major redesigns shall have a Failure Modes, Effects and Criticality Analysis (FMECA) performed. For testing, a Failure Reporting, Analysis, and Corrective Action System shall be used to record failures and document corrective actions. The duration of a test and the allowable number of failures for the purpose of demonstrating a Mean Time Between Failure of 2,000 hours will be in accordance with table IV. A failure in this context is any event that results in the need for corrective maintenance or repair in order for the RO unit to provide acceptable permeate (see 3.9.2 and 3.9.3). The 90-day endurance test (see 4.5.1) may be counted towards this demonstration, and multiple units may be tested concurrently to meet the time requirements in table IV.

TABLE IV. Mean time between failure criteria.

Duration of Demonstration Test (Hours)	Maximum Allowable Failures
3,220	0
5,990	1
8,560	2
11,000	3

4.5.5 Maintainability. The RO unit shall meet the requirements for maintenance and repair as specified in 3.7. The maintenance procedures, removal of parts for repair, and the time required for accomplishment shall be verified during first article testing. The demonstration procedures in MIL-HDBK-470 may be used.

4.5.6 Shock. When specified (see 6.2), the assembled RO unit shall meet the shock requirements specified in 3.9.6 and shall be shock tested in accordance with MIL-S-901 while operating using a test solution consisting of 35,000±3,000 ppm sodium chloride in water. Testing shall be performed by an independent test facility, certified in accordance with ISO/IEC 17025. The requirement for ship attitude and motion (3.9.5.2) shall be demonstrated while the RO unit is mounted on the inclined fixture. After the shock test, an 8-hour performance test shall be performed.

4.5.7 Vibration. When specified (see 6.2), the first article RO unit and all components shall meet the vibration requirements specified in 3.9.7 and shall be tested in accordance with MIL-STD-167-1. Testing shall be performed by an independent test facility, certified in accordance with ISO/IEC 17025. Type II vibration requirements apply through first-order rotational excitations only. More than three interruptions during the endurance portion of the test, in any one axis, will require retesting after the problem has been resolved. The unit shall be operational during testing using a test solution consisting of 35,000±3,000 ppm sodium chloride in water. After the vibration test, a 4-hour performance test shall be performed. This test may be combined with the 8-hour performance test after shock testing.

4.5.8 Noise. When specified (see 6.2), the unit shall meet the noise requirements specified in 3.9.8 and shall be tested in accordance with MIL-STD-1474 using synthetic (prepared in accordance with Section 6 of ASTM D1141) or natural full-density seawater at the performance characteristics specified in 3.9.

4.5.9 Energy efficiency. The RO unit shall be tested to determine maximum power required for operation (see 3.10). Maximum power shall include all electric components operating at maximum load. Tests shall be conducted both with and without electric heater(s), if used. If energy recovery is present, the total system efficiency, while producing the specified quantity and quality of product water (see 3.9.2 and 3.9.3), shall be no greater than 20 kWh per 1,000 gallon output. If energy recovery is not present, the total system efficiency, while producing the specified quality and quantity of product water (see 3.9.2 and 3.9.3), shall be no greater than 76 kWh per 1,000 gallons produced. Maximum energy usage shall be considered without the use of electric heater(s), if present.

4.5.10 Human factors. It shall be verified by inspection that the RO unit design is in accordance with MIL-STD-1472. The RO unit design may use the guidance in ASTM F1166.

4.5.11 Safety. It shall be verified by inspection that all parts, components, and assemblies of the RO units are free from sharp edges, burrs, protruding surfaces, and other harmful extraneous material (see 3.12), and that the electrical enclosures are spraytight in accordance with NEMA 250 (see 3.12.1.1).

4.5.12 EMI. When specified (see 6.2), the RO unit shall be in accordance with the EMI emission and susceptibility tests of MIL-STD-461, Class A4.

4.5.13 Dimensions and weight. Completed units shall be measured and weighed.

4.5.14 Color, finish, and workmanship. Inspections shall ensure that painted surfaces are free of mechanical damage, blisters, cracks, or flakes. The product shall be free of imperfections that affect durability, operability, serviceability, or safety. Welded joints shall be in accordance with S9074-AR-GIB-010/278.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. RO units will be permanent installations on naval ships and will be used for producing fresh water from seawater whilst meeting naval ruggedization and water quality requirements.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. When first article is required (see 3.2 and 4.2).

c. Requesting a waiver from all or part of first article test requirements (see 3.3).

d. Requirements of hazardous and ozone-depleting materials (see 3.4.8).

e. Shipboard seawater inlet feed conditions (flow and pressure) (see 3.5.1).

f. Whether seawater isolation valve is required (see 3.6).

g. Whether multiple simultaneous unit operation is required (see 3.6).

h. Mounting requirements for salinity indicating panel (see 3.6).

i. Unit design life, if other than 30 years (see 3.7).

j. Intervals between pump overhauls, if other than 10,000 hours (see 3.7).

k. Display of filter differential pressure (see table I).

l. Whether isolation valves are required for individual gauges (see 3.8.1).

m. Requirements of bimetallic actuated thermometers in accordance with B.40.3 of ASME B40.200 (see 3.8.1.2).

n. Requirements for permeate flow measurement (see 3.8.2).

o. Product water quantity (rated capacity) (see 3.9.3).

p. Ship attitude requirements, if other than herein (see 3.9.5.2).

q. Flexible mount requirements, if other than herein (see 3.9.6, 3.9.7, and 3.9.8).

r. Applicable frequency range for vibration testing (see 3.9.7).

s. Structureborne noise requirements (see 3.9.8 and 4.5.8).

t. EMI requirements (see 3.13 and 4.5.12).

u. Envelope size, including maintenance access requirements (see 3.14).

v. Maximum component dimensions to fit through hatches and walkways, as applicable (see 3.14).

w. Maximum allowable unit dimensions and weight, if other than herein (see 3.14).

x. Electrical power availability (see 3.16.1).

y. Controller requirements (see 3.16.3.2).

z. Requirements for data acquisition, including what parameters should be recorded, if different than table I (see 3.16.3.2.1).

aa. Cybersecurity plan requirements (see 3.16.3.3.1).

bb. Type, size, and locations of pipe terminal connections (see 3.18).

cc. Type of flanges (see 3.18).

dd. Pressures at terminal connections (see 3.18).

ee. Conformance inspection (see 4.3).

ff. Shipboard inlet feed conditions (see 4.5.1).

gg. Requirements for the performance of Failure Modes, Effects and Criticality Analysis (FMECA) (see 4.5.4).

hh. Shock requirements (see 4.5.6).

ii. Vibration requirements (see 4.5.7).

jj. Packaging requirements (see 5.1).

kk. Requirements for Piping and Instrumentation Diagram (P&ID) (see 6.3).

ll. Requirements for wiring diagrams for overall components as well as all control wiring (see 6.3).

mm. Requirements for General Arrangements (GA) drawings of the RO unit (see 6.3).

nn. Technical manual requirements (see 6.3).

oo. Appropriate security category for the application (see A.3.1).

pp. When a cybersecurity analysis of threats is required (see A.3.2).

qq. Intrusion detection security measures (see A.3.3).

rr. Additional cybersecurity requirements (see A.4.2).

6.3 Recommended documentation. The following list of documentation is recommended to be requested as part of the acquisition of an RO unit, when specified (see 6.2):

a. Piping and Instrumentation Diagram (P&ID).

b. Wiring diagrams for overall components as well as all control wiring.

c. GA drawings of the RO unit.

d. Technical Manual.

6.4 Definitions.

6.4.1 Cybersecurity. Prevention of damage to, protection of, and restoration of computers, electronic communication systems, electronic communication services, wire communication, and electronic communication, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and non-repudiation.

6.4.2 Flux density. Flux is the throughput of a pressure-driven membrane filtration system expressed as flow per unit of membrane area (for example, gallons per square-foot per day). Flux density is the amount of throughput on a membrane element basis.

6.4.3 Lead free. “Lead free” is defined as not containing more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. The definition of what constitutes “lead free” is specified in the Safe Drinking Water Act (SDWA), and designers should ensure they are using the current definition when developing or designing new RO units.

6.4.4 Permeate. “Permeate” is the water that passes through a RO membrane; synonymous with the term “product”.

6.5 Subject term (key word) listing.

Brine
Potable Water
Seawater
Total Dissolved Solids
Water Purification

RO UNIT CYBERSECURITY REQUIREMENTS

A.1 SCOPE

A.1.1 Scope. This appendix covers cybersecurity requirements. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

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

A.2.2 Government documents.

A.2.2.1 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE ISSUANCES

DoDI 8500.01	-	Cybersecurity
DoDI 8510.01	-	Risk Management Framework (RMF) for DoD Information Technology (IT)
DoDI 8551.01		Ports, Protocols, and Services Management (PPSM)

(Copies of these documents are available online at www.dtic mil/whs/directives/.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 800-53	-	Security and Privacy Controls for Federal Information Systems and Organizations

(Copies of this document are available online at http://www.nist.gov.)

SPACE AND NAVAL WARFARE SYSTEMS COMMAND (SPAWAR) STANDARDS

STD-DFIA-004R0	-	Defense-in-Depth Functional Implementation Architecture (DFIA) Standard

(Copies of this document are available online at https://nserc nswc navy mil/spawar/HQ/chengws/ta/Shared%20Documents/Forms/IA_Standards.aspx.)

A.2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3 CYBERSECURITY REQUIREMENTS

A.3.1 Security category. The generalized format for expressing the security category is confidentiality, integrity, availability, and specific impact where the acceptable values for potential impact are low, moderate, or high. The RO unit shall include the appropriate security category for the application (see 6.2). Tailored security controls from the low baseline of security controls defined in NIST Special Publication 800-53 shall ensure that the minimum assurance requirements are satisfied. The minimum security control requirements for RO units shall be as follows:

a. Access control shall include remote control capability. No wireless access shall be allowed.

b. Security assessment and authorization shall include continuous monitoring of RO unit interconnections.

c. Audit and accountability controls shall include time stamps.

d. Configuration management controls shall include access restrictions and configuration settings.

e. Identification and authentication controls shall include password based authentication.

f. Physical and environmental protection shall include monitoring and alarms notification.

g. System and communication protection shall include failure in a known state.

A.3.2 Analysis of threats. When specified (see 6.2), an analysis of threats shall drive the RO unit control system implementation details, both physically and with respect to cybersecurity, to mitigate those threats and the impacts of attacks. The analysis of threats shall identify RO unit assets (e.g., control consoles, Human-Machine Interfaces [HMIs], backbone networks, control processors, communication interfaces, input/output [I/O], networks, and other such assets) and RO unit threats, both accidental and malicious (e.g., advanced persistent threats [APTs] and threats on system availability, integrity, and authenticity). Analysis shall also identify mitigation considerations.

A.3.3 Security measures. The RO unit should consider the following security measures:

a. Physical security should provide the following:
   (1) Proper signage of equipment.
   (2) Locked enclosures for primary control elements.
   (3) Enclosures with intrusion detection.
   (4) Obstructed or removed external ports.

b. Network security should provide the following:
   (1) Disabling unused ports.
   (2) Port-based security.
   (3) Media Access Control (MAC) based security.
   (4) Disabling unused services and protocols.
   (5) Default security parameters.
   (6) Secure network protocols.
   (7) Intrusion detection (see 6.2).

c. Controller security should provide the following:
   (1) Password authentication.
   (2) Login failure lockout.
   (3) Password failure lockout.
   (4) Code protection.
   (5) Control firmware validation.

d. Console and computing security should provide the following:
   (1) User access.
   (2) Application white-listing (such as running executable files other than control systems).
   (3) Operating system patching.

e. Application security should provide the following:
   (1) Secure coding practices (use SEI CERT Coding Standards for guidance as the following link: https://www.securecoding.cert.org/confluence/display/seccode/SEI+CERT+Coding+Standards).
   (2) Application authentication.

f. System security should provide the following:
   (1) Operator-initiated virus scanning. Automated virus scanning is not allowed.
   (2) Change logs.

(3) User authorization.

(4) Secure password practices.

(5) Vendor default modifications.

(6) Disabling or removal of unused ports.

(7) Ports, protocols and services in accordance with DoDI 8551.01.

(8) System security training.

g. External interface security should provide firewalls.

A.3.4 Implementation. The RO unit design shall be implemented in consideration of the above security measures and in accordance with DoDI 8500.01, DoDI 8510.01, and STD-DFIA-004R0.

A.4 CYBERSECURITY VERIFICATION

A.4.1 Security requirements. The requirements specified in A.3 shall be verified. Any failure to meet these requirements is cause for rejection of the RO unit.

A.4.2 Additional specified cybersecurity requirements. Any additional cybersecurity requirements as specified in 6.2 shall be verified. Any failure to meet these requirements is cause for rejection of the RO unit.

Custodians:
Army – AV
Navy – SH
Air Force – 03

Review activities:
Army – MI
DLA – CC

Civil agency:
GSA – FAS

Preparing activity:
Navy – SH
(Project 4620-2016-001)

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