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DETAIL SPECIFICATION

SALINITY INDICATING EQUIPMENT

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

1. SCOPE

1.1 Scope. This specification covers salinity indicating equipment consisting of multi-channel consoles and sensors. Multi-channel consoles provide for individual salinity channel modules, individual visual alarms, a common meter, and a common audible alarm. These consoles have the ability to actuate externally-operated dump valves, indicators, and alarms. Consoles employ temperature compensated salinity sensors.

1.2 Console type designation. The console type designation is in the following form as specified (see 6.2):

IC/SB	15	B	3D	005S	8
Equipment (see 1.2.1)	Salinity channel module capacity (see 1.2.2)	Console type (see 1.2.3)	Dump valve circuits (see 1.2.4)	Maximum indication and scale units (see 1.2.5)	Salinity modules provided (see 1.2.6)

1.2.1 Equipment. The equipment is identified by the four-letter symbol "IC/SB", which denotes that the equipment is part of the interior communication (IC) system, salinity indicating circuit (SB).

1.2.2 Salinity channel module capacity. A number denotes the maximum number of salinity channel modules that can be accommodated by the console. Consoles are available in capacities of 1, 7, and 15 channels for the basic console and 7 and 15 channels for the repeater console.

1.2.3 Console type. A single letter denotes the console type as follows:

B - Basic console.

R - Repeater console (see 3.10.1).

M - Dual meter console (see 3.10.2).

1.2.4 Dump valve circuits. This designation, consisting of one digit and the letter D, denotes the number of dump valve control circuits provided. The possible designations are 3D, 2D, 1D, and 0D (0D signifying that there is no dump capability provided).

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.

1.2.5 Maximum indication and scale units. This designation, as shown below, denotes the maximum range of the transmitter or meter readout and the scale units. Scale units are indicated by S (microsiemens per centimeter [µS/cm]) and P (parts per million [ppm] of chloride). Standard ranges are as follows:

005S	0 to 5 µS/cm
050S	0 to 50 µS/cm
010P	0 to 10 ppm of chloride
050P	0 to 50 ppm of chloride
01000S	0 to 1000 µS/cm
005S/050S	Dual meter console; 0 to 5 µS/cm and 0 to 50 µS/cm

Meters for applications requiring other than the standard meter scales may be approved by NAVSEA. The word "SPECIAL" following the scale unit designation indicates a special meter requirement.

1.2.6 Salinity modules provided. This number denotes the actual number of salinity channel modules provided.

1.2.7 Special console requirements. An "S" following the number of salinity modules provided indicates a special console requirement.

1.3 Salinity sensor type designation. The salinity sensor type designation is in the following form:

IC/SB	1	10
Identification (see 1.3.1)	Material (see 1.3.2)	Sensor constant (see 1.3.3)

1.3.1 Identification. The salinity sensor is identified by the four letters "IC/SB" denoting interior communication salinity indicating circuits.

1.3.2 Material designation. This designation indicates the material of the sensor as follows:

1 - Brass.

2 - Corrosion-resistant steel.

1.3.3 Sensor constant. This designation indicates the sensor constant as follows:

No designation - 0.1/cm

10 - 10.0/cm

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-15024	-	Plates, Tags, and Bands for Identification of Equipment, General Specification for
MIL-P-15024/5	-	Plate, Identification
MIL-A-15303	-	Audible Signals: Alarms, Bells, Buzzers, Horns, and Sirens, Electronic, Shipboard
MIL-V-16556	-	Valve, Solenoid, Three-Way Bypass (Naval Shipboard Use)
MIL-R-19523	-	Relays, Control
MIL-DTL-24643	-	Cables, Electric, Low Smoke Halogen-Free, for Shipboard Use, General Specification for
MIL-DTL-24643/2	-	Cable, Electrical, -20 °C to +90 °C, 300 Volts, Type LSDCOP and LSTCOP
MIL-DTL-28803	-	Display, Optoelectronic, Segmented Readouts, Backlighted, General Specification for
MIL-PRF-39016	-	Relays, Electromagnetic, Established Reliability, General Specification for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-108	-	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-1399-300	-	Electric Power, Alternating Current

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-454	-	General Guidelines for Electronic Equipment

(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.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) DRAWINGS

803-5184176	-	Bronze Valve Assembly for Salinity Indicating Equipment
803-5184177	-	Corrosion Resistant Steel Valve Assembly for Salinity Indicating Equipment

(Copies of these documents are available from the applicable repositories listed in S0005-AE-PRO-010/EDM, which can be obtained online at https://nll.ahf.nmci.navy.mil, may be requested by phone at 215-697-2626, or may be requested by email at nllhelpdesk@navy.mil. Copies of these documents may also be obtained from the Naval Ships Engineering Drawing Repository (NSEDR) online at https://199.208.213.105/webjedmics/index.jsp. To request an NSEDR account for drawing access, send an email to NNSY_JEDMICS_NSEDR_HELP_DESK@navy.mil.)

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.

ASTM INTERNATIONAL

ASTM A269	-	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276	-	Standard Specification for Stainless Steel Bars and Shapes
ASTM B16/B16M	-	Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
ASTM D1125	-	Standard Test Methods for Electrical Conductivity and Resistivity of Water

(Copies of these documents are available online at www.astm.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 Qualification. The salinity indication equipment furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 General requirements. Unless otherwise specified herein, the salinity indicating equipment shall conform to the requirements specified in MIL-DTL-917.

3.3 Console.

3.3.1 Construction. Basic, repeater, and dual meter consoles shall be of modular design.

3.3.2 Mounting. Consoles shall be bulkhead mounted.

3.3.3 Dimensions. Maximum console dimensions shall be as follows:

Console type	Width (inches)	Height (inches)	Depth (inches)
Basic 7 channel	16	19	14
Basic 15 channel	16	26	14
Repeater 7 channel	16	19	14
Repeater 15 channel	16	26	14
Dual meter	16	19	14
Basic 1 channel	13	15	14

3.3.4 Identification. Identification plates shall be metallic in accordance with MIL-DTL-15024 (normal service marking in accordance with MIL-P-15024/5). The following minimum information shall be provided:

Console

a. Contractor's name and serial number.
b. Type designation.
c. Contract number.
d. National stock number.
e. Ratings and ranges.
f. Technical manual number.
g. Contractor's part number.
h. MIL-DTL-15103 and revision level equipment was built to.

Sensor

a. Contractor's name and serial number.
b. Type designation.
c. Cell constant.
d. Contractor's part number.
e. MIL-DTL-15103 and revision level equipment was built to.

3.3.5 Cable entry. Cable entry shall be from the bottom of the console. Sufficient cable entry area shall be provided in order that all cables required for maximum panel operating capacity can be accommodated.

3.3.6 Operating instructions. Instructions for operating and interpreting all controls and indicators of the salinity indicating equipment shall be marked in accordance with MIL-DTL-15024 on aluminum plates and attached to the front of each console. As a minimum, the following instructions shall be provided:

a. Reading the salinity level at a particular location.
b. Testing the meter.
c. Setting and testing salinity channel module alarm points.
d. Operation of bell cutout switch and salinity channel module alarm light.
e. Operation of dump light.

3.3.7 Console cooling. Console cooling shall be accomplished using only external natural air convection circulation, if required.

3.3.8 Access to internal parts. Ready access to all internal parts and terminal boards shall be obtained through the front of the console by removal of modules or enclosure door opening.

3.3.9 Front console clearance. Maximum front console clearance shall be 22 inches.

3.3.10 Sensor directory. A sensor directory consisting of an aluminum information plate shall be provided on the front of the console. The directory shall provide space for marking, by the installing activity, of each salinity channel module (SCM) on the console and its location. Minimum space for each cell location shall be ⅜ inch high by 2 inches long.

3.4 Modules.

3.4.1 Console modules. Modules shall be plug-in and installed from the front of the console. Electrical connections shall be effected by insertion of a module into its receptacle. Cables shall not be required to connect modules to console chassis. Modules shall be positively secured to the console by thumb screws.

3.4.2 SCM. The meter module is optional and not required on salinity panels designed with individual salinity digital displays utilized on each individual SCM. Within a specific meter range, SCMs shall be completely interchangeable plug-in type modules, which accept one actual or simulated sensor input as selected by the operator. They shall provide output for readout (local and remote), alarm, and "dump". Console SCM locations shall be connected through an inner console printed circuit board to terminal boards for sensor input, remote readout, and remote alarm. It shall be possible to actuate any one of the dump channels with any of the SCMs using jumpers located on the inner console board, which are field removable and replaceable.

3.4.2.1 SCM sensor number and location identification. Each SCM location shall have a separate aluminum identification plate in accordance with MIL-DTL-15024 attached to the console chassis. The plate shall be provided for identification of sensor number and location. This information will be marked by the installing activity.

3.4.2.2 Alarm level control. The alarm level control shall permit continuous adjustment of the high salinity alarm set point over the full meter range. Where an SCM is connected to a dump circuit, the high salinity alarm set point shall be the dump set point. The alarm level control shall be adjusted from the front of the module. Provisions shall be made to prevent inadvertent adjustment of the alarm set point. Verification of alarm set point shall be accomplished by use of the sensor simulator (see 3.4.3.3). With the sensor simulator variable resistor adjusted to bring the meter to the desired alarm setting, the operator shall be able to observe the SCM alarm light come on and hear the bell actuate.

3.4.2.3 Alarm light. The alarm light shall have a red lens and shall be mounted on the front of the SCM. The alarm light logic shall be as follows:

Salinity condition	Alarm light condition	Bell cutout switch position
Normal	Off	Normal
High	Flashing	Normal
High	On steady	Cutout
Normal	Flashing	Cutout

3.4.2.4 Bell cutout switch. The bell cutout switch shall be mounted on the front of the SCM. In the cutout position, the switch shall cut out the local audible alarm and affect local alarm light logic as specified in 3.4.2.3.

3.4.2.5 Function switch. The SCM function switch shall be front mounted having a normal mode and a simulate mode with a spring return to normal. In the normal mode, input to the SCM shall be connected to the actual sensors. In the simulate mode, input to the SCM shall be connected to the sensor simulator variable resistor (see 3.4.3.3).

3.4.2.6 Remote alarm output. The SCM remote alarm output shall be provided by a single pole single throw (SPST) relay in accordance with MIL-PRF-39016, with contacts having a minimum continuous duty rating of 1 ampere (A) at 115 volts (V), 60 hertz, or 2 amperes at 28 volts direct current (VDC), for operation of an external alarm (supplied by others). Contact closure shall occur when a high salinity condition is reached. Use of the remote output function shall not affect local indication or alarming.

3.4.2.7 Output for local readout. Each SCM shall provide a continuous 0 to 1 or 4 to 20 milliampere direct current (mAdc) signal proportional to conductivity level for local readout.

3.4.2.8 Output for remote readout. Each SCM shall provide a continuous, independent 0 to 1 mAdc signal proportional to conductivity level for remote readout. The signal shall drive a second meter similar to the installed console meter, but located up to 500 feet from the console. Where remote monitoring is desired, it shall be possible to monitor the signal by connecting to a terminal strip located inside the console. Remote monitoring shall not affect local indication, alarm, or dump accuracy and capability. Calibration information for remote output shall be provided; for example, relationship between signal level and conductivity sensed.

3.4.3 Meter module. In a salinity panel design that does not incorporate the salinity meter in the SCM, the meter module shall provide a readout of the conductivity level of the sensor whose channel is selected by the operator. The meter module shall contain a meter, a meter test switch, a channel selector switch, and a sensor simulator variable resistor. The sensor simulator variable resistor may be located in each of the salinity channel modules in lieu of the meter module.

3.4.3.1 Digital meter. The digital meter in accordance with MIL-DTL-28803, whether designed for use in a meter module or an SCM, shall be red or yellow, 0.39 to 0.50 inch in height, and a minimum of 0.063 millicandela (mcd) brightness.

TABLE I. Digital meter displayed resolution.

0-5 µS	**0-50 ppm/50 µS**	**0-10 ppm**
0.00	0.0	0.0
0.05	0.2	0.05
0.10	0.4	0.10
0.15	0.6	0.15
0.20	0.8	0.20
0.25	1.0	0.25
0.30	1.2	0.30
0.35	1.4	0.35
0.40	1.6	0.40
0.45	1.8	0.45
0.50	2.0	0.50
0.55	2.2	0.55
0.60	2.4	0.60
0.65	2.6	0.65
0.70	2.8	0.70
0.75	3.0	0.75
0.80	3.2	0.80
0.85	3.4	0.85
0.90	3.6	0.90
0.95	3.8	0.95
1.0	4.0	1.0
1.1	4.2	1.1
1.2	4.4	1.2
1.3	4.6	1.3
1.4	4.8	1.4
1.5	5.0	1.5
1.6	5.5	1.6
1.7	6.0	1.7
1.8	6.5	1.8
1.9	7.0	1.9
2.0	7.5	2.0

TABLE I. Digital meter displayed resolution – Continued.

0-5 µS	0-50 ppm/50 µS	0-10 ppm
2.1	8.0	2.2
2.2	8.5	2.4
2.3	9.0	2.6
2.4	9.5	2.8
2.5	10.0	3.0
2.6	11.0	3.5
2.7	12.0	4.0
2.8	13.0	4.5
2.9	14.0	5.0
3.0	15.0	6.0
3.2	16.0	7.0
3.4	17.0	8.0
3.6	18.0	9.0
3.8	19.0	10.0
4.0	20.0	—
4.2	22.0	—
4.4	24.0	—
4.6	26.0	—
4.8	28.0	—
5.0	30.0	—
—	35.0	—
—	40.0	—
—	45.0	—
—	50.0	—

3.4.3.2 Selector switch. The selector switch shall permit monitoring the output of any SCM on the meter. Switching from one channel to another shall not cause inadvertent false alarms. The selector switch shall have an off position. The selector switch is not required on salinity panels designed with individual salinity digital displays on each SCM.

3.4.3.3 Sensor simulator variable resistor. The sensor simulator variable resistor shall provide a simulated, adjustable sensor resistance to set and check alarm setpoints of the SCMs. The sensor simulator variable resistor shall contain a front-mounted rotary knob. The full counterclockwise position of the knob shall simulate approximately zero, and the full clockwise position shall simulate meter full scale. The sensor simulator variable resistor shall provide a simulated sensor resistance to the SCM whose function switch is in the simulate mode. This resistance, which shall be readable on the meter, shall be continuously adjustable over the full meter range.

3.4.3.4 Meter test switch. The meter test switch shall be front mounted, push-button type, and used to test meter operation. Depressing this switch shall cause the meter pointer to indicate at the test point (50 percent full scale). The meter test shall conform to the accuracy requirements of 3.8.1.

3.4.4 Power supply module. Input power to the salinity indicating equipment shall be 115 volts, 60 hertz, Type I in accordance with MIL-STD-1399-300 (see 3.8.2 and 3.8.3). The power supply module shall provide power to all the salinity channels in the console, under all conditions of operation. Power to the external dump valve solenoids shall not be routed through the power supply module. A yellow label on black background shall be attached to the front of the power supply module and shall read:

"CAUTION
115 VOLTS ON
DUMP CIRCUIT AT
ALL TIMES"

The power supply module shall contain fusing with indicating fuseholders for both sides of the incoming power line and a power on light with green lens cover.

3.4.5 Dump module. Dump circuitry shall actuate an independent, solenoid-operated dump valve. Dump operation shall occur when the SCM connected to a particular dump circuit senses the salinity alarm set point. It shall be possible to connect any one of the dump circuits to any SCM by the use of jumper wires located inside the console (see 3.4.2). The ability of the equipment to provide zero, one, two, or three dump circuits can be accomplished by either one dump module having the capability of up to three dump circuits, or by three dump modules each having one dump circuit. In either case, the maximum salinity channel module capacity of the console shall not be compromised.

3.4.5.1 Dump relay. A dump relay shall be provided for each dump circuit. The relay with contacts shall be in accordance with MIL-PRF-39016 or MIL-R-19523, shall have a minimum rating at 115 volts, 60 hertz of 5 amperes continuous, and shall handle a 10 ampere surge. A solid state dump circuit may also be used. The dump valve solenoid will normally be energized in the non-dumping position. The dump relay contact shall open within ¼ second after the sensed salinity level reaches the dump set point (alarm setting of the associated SCM).

3.4.5.2 Dump light. The dump light shall be mounted on the front of the dump module. It shall have a yellow lens cover and shall indicate the position of the dump valve as follows:

a. Dump valve closed (nondumping) – On steady.

b. Dump valve open (dumping) – Flashing.

3.4.6 Bell module. The bell module shall contain an externally-mounted bell conforming to Type IC/BlS4 of MIL-A-15303. The alarm bell shall provide the common audible alarm signal for all the SCMs. Silencing of the alarm bell during a high salinity condition shall be accomplished by placing the appropriate SCM bell cutout switch in the cutout position (see 3.4.2.4). The operation of the alarm bell shall be independent of the position of the SCM function switch. Silencing of the alarm bell on one channel shall not prohibit an audible alarm for any of the other channels receiving an alarm signal. The bell module may be mounted on the front or side of the console.

3.5 Calibration information. The equivalent resistance values of water between the sensor electrodes shall be as shown in table II (µS/cm) and table III (ppm chloride) for a 0.1 sensor constant. Table IV lists the equivalent resistance values of water between the electrodes of a 10.0 constant sensor (µS/cm). The required resistance versus temperature characteristics for the temperature compensator are shown in table V. Resistance values for the temperature compensator at any particular temperature may also be determined by the relationship:

$$\frac{1}{R} = 0.26858 \times 10^{-4} + 0.70655 \times 10^{-6} T + 0.38322 \times 10^{-8} T^2 - 0.80601 \times 10^{-11} T^3$$

Where:

R = resistance in ohms.

T = temperature in degrees Fahrenheit (°F).

Console calibration shall be accomplished by substitution of the normal sensor input with resistance values from table II, III, or IV as applicable, and table V. For example, to simulate a solution of 2 µS/cm conductivity and 175 °F temperature, for a 0.1/cm sensor constant, resistances of 22,300 ohms and 4,460 ohms shall be substituted for the sensor electrode input and temperature compensator input, respectively.

TABLE II. Equivalent resistance of water (in ohms) using 0.1/cm sensor constant.

(µS/cm [77 °F reference])									
Temp (°F)	**0.2**	**0.5**	**1.0**	**2.0**	**5.0**	**10.0**	**20.0**	**50.0**	**100.0**
40	825K	330K	165K	82,500	33,000	16,500	8,250	3,300	1,650
75	510K	204K	102K	51,000	20,400	10,200	5,100	2,040	1,020
77	500K	200K	100K	50,000	20,000	10,000	5,000	2,000	1,000
100	391K	156.4K	78,200	39,100	15,640	7,820	3,910	1,564	782
125	314K	125.6K	62,800	31,400	12,560	6,280	3,140	1,256	628
150	260K	104K	52,000	26,000	10,400	5,200	2,600	1,040	520
175	223K	89,200	44,600	22,300	8,920	4,460	2,230	892	446
200	194.5K	77,800	38,900	19,450	7,780	3,890	1,945	778	389
225	173.5K	69,400	34,700	17,350	6,940	3,470	1,735	694	347
250	158K	63,200	31,600	15,800	6,320	3,160	1,580	632	316

TABLE III. Equivalent resistance of water (in ohms) using 0.1/cm sensor constant.

(ppm chloride [77 °F reference])									
Temp. (°F)	**0.1**	**0.2**	**0.5**	**1.0**	**2.0**	**5.0**	**10.0**	**20.0**	**50.0**
40	403.4K	201.8K	80,700	40,340	20,180	8,070	4,034	2018	807
75	249.4K	124.7K	49,890	24,940	12,470	4,989	2,494	1247	499
77	244.5K	122.3K	48,910	24,450	12,230	4,891	2,445	1223	489
100	191.2K	95,640	38,250	19,120	9,564	3,825	1,912	956	382
125	153.5K	76,800	30,720	15,350	7,680	3,072	1,535	768	307
150	127.1K	63,600	25,430	12,710	6,360	2,543	1,271	636	254
175	109.0K	54,550	21,810	10,900	5,455	2,181	1,090	546	218
200	95,110	47,570	19,030	9,511	4,757	1,903	951.1	476	190
225	84,840	42,440	16,970	8,484	4,244	1,697	848.4	424	170
250	77,260	38,650	15,460	7,726	3,865	1,546	772.6	386	155

TABLE IV. Equivalent resistance of water (in ohms) using 10.0/cm sensor constant.

(µS/cm [77 °F reference])								
Temp. (°F)	**20.0**	**50.0**	**100.0**	**200.0**	**500.0**	**1000.0**	**2000.0**	**5000.0**
40	825K	330K	165K	82,500	33,000	16,500	8,250	3,300
75	510K	204K	102K	51,000	20,400	10,200	5,100	2,040
77	500K	200K	100K	50,000	20,000	10,000	5,000	2,000
100	391K	156.4K	78,200	39,100	15,640	7,820	3,910	1,564
125	314K	125.6K	62,800	31,400	12,560	6,280	3,140	1,256
150	260K	104K	52,000	26,000	10,400	5,200	2,600	1,040
175	223K	89,200	44,600	22,300	8,920	4,460	2,230	892
200	194.5K	77,800	38,900	19,450	7,780	3,890	1,945	778
225	173.5K	69,400	34,700	17,350	6,940	3,470	1,735	694
250	158K	63,200	31,600	15,800	6,320	3,160	1,580	632

TABLE V. Resistance versus temperature characteristics of temperature compensator.

Temp. (°F)	**Resistance (ohms)**	**Allowable tolerance (±) (ohms)**
40	16,500	330
75	10,200	204
77	10,000	200
100	7,820	156
125	6,280	126
150	5,200	104
175	4,460	89
200	3,890	78
225	3,470	69

250	3,160	63

3.6 Sensor and valve assembly. The sensor and valve assembly for 0.1/cm and the 10.0/cm constant sensor shall consist of a gate valve with connection pieces and a conductivity sensor. The valve assembly shall hold the sensor electrodes within the water flow stream of the piping system. In addition, the assembly shall allow for insertion and removal of the sensor in a pressurized working system (at a gauge pressure of 65 pounds per square inch [lb/in²], 250 °F water) by one man without discharge of system fluid. The sensor and valve assembly shall operate at working pressures from 30 inches of mercury vacuum to a gauge pressure of 250 lb/in² at 300 °F, without leakage.

3.6.1 Sensor. The 0.1/cm and 10.0/cm constant sensors shall consist of two conductivity sensing electrodes, a temperature compensating element, an extender tube, with packing nut and packing, and a 6-foot long cable with wire markers and terminal lugs. The sensor body, including packing nut and extender tube, of the Type IC/SB-l shall be made of brass conforming to ASTM B16/B16M; and the Type IC/SB-2 shall be made of corrosion-resistant steel conforming to Type 316 of ASTM A276 and ASTM A269. The sensor assembly shall be physically stopped at the proper full insertion position and at the extracted position where the gate valve can be closed. The sensor shall be physically compatible with the 1¼-inch gate valve (see 3.6.2.1 and 3.6.2.2). Threads exposed to water shall not require use of thread sealing compounds of any kind.

3.6.1.1 Electrodes. The electrode surfaces shall be clad with a minimum of 0.003-inch thick platinum or palladium. Use of alternate electrode surface cladding materials is prohibited, unless prior approval is obtained from NAVSEA. Platinum black shall not be used on electrode surfaces. Electrode surfaces shall be separated as much as practicable, consistent with the design of the valve assembly as specified herein. Minimum spacing between electrodes shall be 0.025 inch. Sensors shall permit water flow between the electrode surfaces. Electrode construction shall permit cleaning. Electrode construction shall prevent electrodes from dropping into system piping in the event electrodes become separated from the extender tube.

3.6.1.2 Temperature compensator. The temperature compensator shall have characteristics as specified in 3.5 (see table V). The temperature compensating element shall be located as close as practicable to the electrodes, in order to adequately respond to fluid temperature changes (see 3.8.9). Self-heating of the temperature compensator shall not cause system error to exceed the limits specified in 3.8.1.

3.6.1.3 Extender tube. The extender tube shall hold the electrodes and temperature compensating element in the fluid piping system. A shoulder on the extender tube of all sensors except the IC/SB-2-5 shall prevent the cell from being completely withdrawn from the valve assembly until removal of the packing nut. A groove shall be machined into the surface of the extender tube to indicate when the sensor has been withdrawn sufficiently to permit closing the gate valve. A stop shall be provided to visually and mechanically indicate when the cell has been inserted the required distance into the valve.

3.6.1.4 Packing nut and packing. The packing nut and packing shall mechanically hold the extender tube in place in either the inserted or extracted positions and prevent leakage around the outside of the extender tube. Engaging of the threads of the packing nut shall prevent removal of the extender tube from the valve assembly. The packing nut shall be mechanically locked in place in any required position. The packing nut shall mate with the sensor and valve assembly adapter as shown on 803-5184176 and 803-5184177.

3.6.1.5 Sensor cable. The sensor cable shall be made in accordance with MIL-DTL-24643 and MIL-DTL-24643/2 and shall be 6 feet long. Individual conductors shall have ring tongue terminations and shall be labeled with letter designations. The outer electrode (SBB-0) lead shall be red, the inner electrode (SB-0) lead shall be white, and the temperature compensator (SB-1) lead shall be black.

3.6.1.6 Sensor constant. The sensor constant shall be 0.100±0.002/cm, 5.0±0.1/cm, or 10.0±0.2/cm. The sensor constant shall not be adjustable.

3.6.1.7 Sensor electrical design. A reference voltage shall be applied between the terminals SB-1 and SBB-0. The reference voltage shall be an 11.5 volts peak-to-peak, 170 hertz square wave. The voltage drop across the temperature compensator (V_t) is proportional to conductivity and shall be used as the basis of system calibration (see 3.5).

3.6.2 Valve assembly. The valve assembly shall operate in water pressures from 30 inches of mercury vacuum to a gauge pressure of 250 lb/in², and at temperatures up to 300 °F. The design hydrostatic pressure limit shall be at a gauge pressure of at least 375 lb/in² at an ambient temperature of 75±5 °F.

3.6.2.1 Bronze construction. The valve assembly shall be in accordance with 803-5184176 and shall consist of a bronze, silver brazed end connection, 1¼-inch gate valve, and connection pieces for connecting the sensor and valve to the piping system.

3.6.2.2 Corrosion-resistant steel construction. The valve assembly shall be in accordance with 803-5184177 and shall consist of a corrosion-resistant steel, socket weld end connection, 1¼-inch gate valve, and connection pieces for connecting the sensor and valve to the piping system.

3.7 Detailed requirements. Electrical and electronic parts shall be provided in accordance with MIL-DTL-917.

3.7.1 Printed circuit boards. Guidance for printed circuit boards can be found in Guideline 17 of MIL-HDBK-454.

3.8 Performance requirements.

3.8.1 Accuracy. The accuracies of the salinity indicating equipment shall be as follows:

a. Console accuracy (simulated input at the console) ±3 percent of full scale meter arc length (see 4.4.3).

b. System accuracy (actual input from sensors). The console meter shall duplicate the standard reference instrument within ±2 percent of console meter full scale (see 4.4.12).

c. Sensor cell constant accuracy shall be ±2 percent (see 3.6.1.6) when tested in accordance with Method A of ASTM D1125 (see 4.4.9).

d. Alarm accuracy shall be ±5 percent of set point (see 4.4.3.7).

3.8.2 Supply voltage and frequency (steady state). Salinity indicating equipment shall operate satisfactorily with metering and alarming errors within the tolerances specified in 3.8.1 (see 4.4.4.1).

3.8.3 Supply voltage and frequency (transient). A shift in the console or remote readout indication, or inadvertent alarm or dump actuation, shall not occur (see 4.4.4.2 and 4.4.4.3). Metering and alarming errors shall be within the tolerances specified in 3.8.1.

3.8.4 Console ambient temperature. Salinity indicating equipment shall operate satisfactorily with metering and alarming errors within the tolerances specified in 3.8.1 (see 4.4.6).

3.8.5 Console humidity and temperature cycle. Salinity indicating equipment shall operate satisfactorily with metering and alarming errors within the tolerances specified in 3.8.1 (see 4.4.7). After testing is completed, there shall be no evidence of physical degradation, such as corrosion of metal parts or distortion of plastic parts.

3.8.6 Console enclosure. The degree of enclosure of the console shall be splashproof in accordance with MIL-STD-108. Blank cover plates shall be provided for all unused module locations. The console, including salinity meter and alarms, shall operate satisfactorily during and after performance of the enclosure test (see 4.4.8).

3.8.7 Dielectric withstanding voltage. The salinity indicating equipment shall withstand the dielectric withstanding voltage test specified in 4.4.19. There shall be no disruptive discharge or deterioration to the circuit or parts within the circuit. Disruptive discharge is evidenced by flash-over (surface discharge), spark-over (air discharge), or breakdown (puncture discharge). The dielectric withstanding voltage test specified in 4.4.19 shall be monitored by means of a device that shall indicate the occurrence of disruptive discharge and leakage current in case it is not visually evident in the item under test.

3.8.8 Overrange. The salinity indicating equipment shall be overranged, including having a short circuit across sensor electrodes, temperature compensator, and both electrodes and temperature compensator without damage to sensor or console (see 4.4.13).

3.8.9 Sensor temperature compensator response. The time required to reach 63 percent of a 50 °F change in fluid temperature (that is, 63 percent of the difference in resistance between two stabilized baths) shall be less than 30 seconds for brass sensors (IC/SB-1) and less than 60 seconds for CRES sensors (IC/SB-2) (see 4.4.11).

3.8.10 Sensor and valve assembly leakage. When subjected to the hydrostatic conditions of a gauge pressure of 375 lb/in² at an ambient temperature of 75±5 °F, the maximum leakage rate through the valve seat with the sensor removed shall be 12.5 cubic centimeters per minute. For valve assemblies in accordance with 803-5184176 and 803-5184177, no leakage is permitted from the ship's piping system with the sensor inserted under working conditions of a gauge pressure of 250 lb/in² and 300 °F (see 4.4.14). For the IC/SB-2-5 sensor and sensor holder, no leakage is permitted from the ship's piping system with the sensor inserted under working conditions of a gauge pressure of 25 lb/in² and 300 °F (see 4.4.14). Following the test specified in 4.4.14, the sensor shall conform to the temperature compensator requirement of 3.6.1.2 and the sensor constant requirements of 3.6.1.6.

3.8.11 Console insulation resistance. The insulation resistance between ground and console input (sensor terminals), and between ground and console outputs (remote output, remote alarm, and dump contacts), shall be not less than 10 megohms at 50Vdc (minimum) when applied for not less than 60 seconds (see 4.4.16).

3.8.12 Vibration. Salinity indicating equipment shall conform to Type I of MIL-STD-167-1 and shall operate satisfactorily with metering and alarming errors within the tolerances specified in 3.8.1 (see 4.4.17).

3.8.13 Shock. Salinity indicating equipment shall conform to Grade A, Class 1, Type C of MIL-S-901 (see 4.4.18). False alarm actuation is not permitted. Following the shock test (but prior to any adjustments), the console shall meet the accuracy requirements specified in 3.8.1.

3.8.14 Operating. The equipment shall withstand the operating test specified in 4.4.2. The equipment, including all operating controls and adjustments and all visual and audible alarm functions, shall operate within the requirements of this specification.

3.8.15 Electromagnetic interference emission and susceptibility. Salinity indicating equipment shall meet and demonstrate compliance with the requirements of MIL-STD-461 for surface ship, below deck and submarine, internal to pressure hull, installations. The following MIL-STD-461 tests are applicable to this equipment: CE101, CE102, CS101, CS106, CS109, CS114, CS116, RE101, RE102, RS101, and RS103.

3.9 Safety. Guidance for safety provisions of the salinity indicating equipment can be found in Guideline 1 of MIL-HDBK-454.

3.10 Special consoles.

3.10.1 Repeater console. Repeater consoles shall function as a remote monitoring station displaying digital meter and alarm signals from the salinity channels of the basic console. Repeater consoles, when specified (see 6.2), shall contain individual visual alarms, a common meter, and a common audible alarm with cutout switch for each salinity channel module being monitored, and a power supply module. The repeater console shall accept the remote readout and alarm signals from the basic console. The repeater console shall conform to the requirements of this specification. The digital meter shall conform to the requirements of 3.4.3.1.

3.10.2 Dual meter console. Dual meter consoles shall have features similar to the seven channel basic console, except as follows:

a. The console shall have two channels. The ranges shall be 0 to 5 µS/cm on one, and 0 to 50 µS on the other.

b. Two separate meter modules shall be used, providing continuous monitoring of each channel.

c. The console shall control up to two dump valves.

3.11 Drawings. When specified (see 6.2), drawings shall be prepared.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall be conducted at a laboratory acceptable to NAVSEA. Qualification inspection shall be as shown in table VI and shall be conducted in the order listed.

TABLE VI. Qualification inspection.

Inspection	Requirement paragraph	Test paragraph
General examination	3.2, 3.3, 3.4, 3.6, 3.7, and 3.10	4.4.1
Operating	3.8.14	4.4.2
Dielectric withstanding voltage	3.8.7	4.4.19
Insulation resistance (console)	3.8.11	4.4.16
Console accuracy (simulate input to console)	3.8.1	4.4.3
Steady state voltage and frequency	3.4.4, 3.8.2	4.4.4.1
Transient voltage	3.4.4, 3.8.3	4.4.4.2
Transient frequency	3.4.4, 3.8.3	4.4.4.3
Power interruption	3.4.4	4.4.4.4
Console ambient temperature	3.8.4	4.4.6
Console humidity and temperature cycle	3.8.5	4.4.7
Console enclosure	3.8.6	4.4.8
Sensor constant	3.6.1.6	4.4.9.1
Sensor temperature compensator	3.6.1.2	4.4.10
Sensor temperature compensator response	3.8.9	4.4.11
Electromagnetic interference emission and susceptibility	3.8.15	4.4.5
Overrange (sensor short circuit)	3.8.8	4.4.13
System accuracy (using test solution)	3.8.1	4.4.12
Sensor and valve assembly leakage	3.8.10	4.4.14
Sensor insertion	3.6	4.4.15
Vibration	3.8.12	4.4.17
Shock	3.8.13	4.4.18

4.2.1 Repeater consoles. Repeater consoles shall be subjected to all the qualification tests shown in table VI, which are required to be performed on the basic console. The repeater console shall receive meter and alarm signals from the basic console during the applicable tests.

4.2.2 Qualification samples. The salinity indicating equipment required for qualification inspection shall be as follows:

a. One 15-channel console and one 7-channel console and 1-channel console.

b. Six sensor and valve assemblies for each type.

c. One each repeater console, 15-channel and 7-channel.

d. One each panel meter in accordance with 3.4.3.1.

4.3 Conformance inspection. Each salinity indicating equipment produced shall be subjected to the tests shown in table VII in the order listed. The results of each test shall be compared with the requirements of this specification. Failure to conform to the requirements of this specification shall be counted as a defect and the salinity indicating equipment shall not be acceptable for delivery.

TABLE VII. Conformance inspection.

Inspection	Requirement paragraph	Test paragraph
General examination	3.2, 3.3, 3.4, 3.6, 3.7, and 3.10	4.4.1
Operating (console)	3.8.14	4.4.2
Dielectric withstanding voltage	3.8.7	4.4.19
Console insulation resistance	3.8.11	4.4.16
Console accuracy	3.8.1	4.4.3.8
Sensor constant	3.6.1.6	4.4.9.2
Sensor and valve assembly leakage	3.8.10	4.4.14

4.3.1 Repeater consoles. When provided as separate items under this specification, each repeater console shall be subjected to the conformance inspection shown in table VII, with the exception of the sensor constant and sensor and valve leakage tests.

4.3.2 Conformance inspection report. When specified (see 6.2), a conformance inspection report shall be prepared.

4.4 Visual and dimensional examination and test procedures.

4.4.1 Visual and dimensional examination. The salinity indicating equipment shall be given a thorough examination to determine if it conforms to this specification and the approved drawings with respect to material, finish, construction, assembly, dimensions, workmanship, marking, identification, and information plates. This examination shall be limited to those examinations that may be performed without disassembling the unit in such a manner that its performance, durability, and appearance would be affected. This examination shall include a mechanical check of all operating controls and adjustments, as applicable.

4.4.2 Operating test. The salinity indicating equipment, including all console modules and sensors, shall be energized and placed in normal operating conditions for a period of 48 continuous hours at an ambient temperature of 75±5 °F. The solution concentration and temperature and the panel meter reading shall be recorded periodically throughout the test. During the test, all controls and adjustments shall be operated in each position at least 10 times after burn-in hour 40. A determination shall also be made that, when the fuses are removed, the associated circuit is de-energized and that the entire circuit is protected by the fuse, with the exception of the dump circuit. The operating test shall meet the requirements specified in 3.8.14.

4.4.3 Console accuracy (simulated input to console). Simulated input to the sensor terminals of the console shall be provided by the decade boxes. Unless otherwise specified herein, the console meter shall be used to monitor the channel being tested. Console remote alarm and remote readout shall be monitored. Dump valves in accordance with MIL-V-16556, or equivalent electrical load, shall be connected to dump output terminals. Console calibration shall be performed by substituting the resistance values from table II, III, or IV, as applicable, and table V. The data points from the tables shall be substituted to any one SCM to verify that the accuracy of the console is as specified in 3.8.1. In addition, nine data points (three conductivity levels at three temperatures for each) shall be substituted to each of the remaining SCMs to verify console accuracies. The accuracy of salinity alarm and remote alarm and dump alarm for each SCM shall be verified to be as specified in 3.8.1 by simulating a fixed temperature and slowly increasing the simulated conductivity until alarm actuation occurs. The resistance level, in ohms, of the simulated electrode and temperature compensator signals shall be documented for use as a reference level as specified in 4.4.3.1.

4.4.3.1 Effect of console meter on SCM alarm actuation. It shall be verified that monitoring of an SCM with the console meter does not affect the SCM alarm point by triggering the alarm as specified in 4.4.3 (at the same simulated temperature) but without monitoring the signal on the console meter. The simulated electrode signal required to trigger the alarm (in ohms) shall then be compared to that specified in 4.4.3. This operation shall be repeated for each SCM. The difference in ohms shall not exceed 1 percent of the nominal electrode resistance at the alarm condition.

4.4.3.2 Effect of remote readout on console meter. It shall be verified that monitoring of an SCM remote readout does not affect the local console meter readout by operating equipment with a fixed input as specified in 4.4.3 and then disconnecting the remote meter while observing the effect on the console meter. This operation shall be repeated at three conductivity and temperature levels for each SCM. There shall be no noticeable shift in console meter readings.

4.4.3.3 Effect of remote readout on SCM alarm actuation. It shall be verified that monitoring of an SCM remote readout output does not affect SCM alarm actuation by triggering the alarm specified in 4.4.3, but without monitoring of remote readout signal. The alarm trip point (in µS/cm or ppm chloride) shall be compared to that specified in 4.4.3. This operation shall be repeated for each SCM. The difference between the alarm trip points shall not exceed 1 percent of meter reading.

4.4.3.4 Effect of remote alarm on SCM alarm actuation. It shall be verified that monitoring of remote alarm output does not affect SCM alarm actuation by triggering the alarm specified in 4.4.3, but without monitoring of remote alarm output. The alarm trip point (in µS/cm or ppm chloride) shall be compared to that specified 4.4.3. This operation shall be repeated for each SCM. The difference between the alarm trip points shall not exceed 1 percent of meter reading.

4.4.3.5 Effect of dump on console meter. It shall be verified that monitoring of dump output with a dump valve, or equivalent electrical load, does not affect the local console meter readout by operating equipment with a fixed input as specified in 4.4.3. The dump circuit shall then be disconnected while the effect on the console meter is observed. This operation shall be repeated at three conductivity and temperature levels for each channel. There shall be no noticeable effect on the console meter reading.

4.4.3.6 Effect of dump on SCM alarm actuation. It shall be verified that monitoring of dump output with a dump valve or equivalent electrical load does not affect SCM alarm actuation by triggering the alarm as specified in 4.4.3, except without monitoring of dump output. The alarm trip point (in µS/cm or ppm chloride) shall be compared to that specified in 4.4.3. This operation shall be repeated for each SCM. The difference between the alarm trip points shall not exceed 1 percent of meter reading.

4.4.3.7 Alarm and dump reset points. The SCM alarm reset, remote alarm reset, and dump reset points shall be determined by triggering the alarms and dump using the simulated sensor variable resistor while observing console meter. The simulated salinity level shall then be reduced using the simulated sensor variable resistor until the alarms and dump reset. The accuracy of the alarm reset points shall be as specified in 3.8.1. This operation shall be repeated with each SCM.

4.4.3.8 Conformance console accuracy. Simulated input to the sensor terminals of the console shall be provided by decade boxes. The console meter shall be used to monitor the channel being tested. Console remote alarm and remote readout shall be monitored. Dump valves in accordance with MIL-V-16556, or equivalent electrical load, shall be connected to dump output terminals. Console calibration shall be performed by substituting resistance values from table II, III, or IV, as applicable, and table V. Nine data points (three conductivity levels at three temperatures for each) shall be input to each SCM to verify console accuracy. Accuracy of salinity alarm, remote alarm, and dump alarm for each SCM shall be verified by simulating a fixed temperature and slowly increasing the simulated conductivity until alarm actuation occurs. Accuracies shall be as specified in 3.8.1.

4.4.4 Electrical tests.

4.4.4.1 Steady state voltage and frequency. The salinity indicating equipment shall be operated for at least 15 minutes in each of the conditions A through E as specified in table VIII. Performance data shall be measured and recorded for each condition. Failure in any performance parameter shall be cause for rejection. Performance shall be as specified in 3.8.2.

TABLE VIII. Steady state voltage and frequency.

Condition	Voltage			Frequency		
	Lower limit	Normal	Upper limit	Lower limit	Normal	Upper limit
A (Reference condition)		115			60	
B	103.5			57		
C			126.5	57		
D			126.5			63
E	103.5					63

4.4.4.2 Transient voltage.

4.4.4.2.1 Upper limit. With the salinity indicating equipment operating in the upper limit of steady voltage, a transient voltage of +16 percent of normal voltage, recovering to the steady stage voltage within 2 seconds, shall be superimposed. The salinity indicating equipment shall operate normally following the transient. Performance shall be as specified in 3.8.3.

4.4.4.2.2 Lower limit. With the salinity indicating equipment operating in the lower limit of steady voltage, transient voltage of -16 percent of normal voltage, recovering to the steady state voltage within 2 seconds, shall be superimposed. The salinity indicating equipment shall operate normally following the transient. Performance shall be as specified in 3.8.3.

4.4.4.3 Transient frequency.

4.4.4.3.1 Upper limit. With the salinity indicating equipment operating at 3 percent above the normal frequency, the frequency shall be increased by an additional 4 percent, recovering to the steady state frequency (±3 percent of normal) within 2 seconds. The equipment shall operate normally following the transient. Performance shall be as specified in 3.8.3.

4.4.4.3.2 Lower limit. With the salinity indicating equipment operating at 3 percent below the normal frequency, the frequency shall be decreased by an additional 4 percent, recovering to the steady state frequency (±3 percent of normal) within 2 seconds. The equipment shall operate normally following the transient. Performance shall be as specified in 3.8.3.

4.4.4.4 Power interruption. With the salinity indicating equipment operating within the steady state tolerances of voltage and frequency, the external power supply shall be suddenly interrupted, and after an interval between 3 and 4 seconds, the power supply, within the steady state tolerances, shall be reapplied. After the salinity indicating equipment has been operated long enough to detect any major performance degradation and to include any recycling time, the power shall be interrupted for an interval of 29 to 30 seconds. The cycle, consisting of three such interruptions, shall be repeated for a total of four times. During, and as a result of these tests, no damage to the equipment shall be incurred, and any noted effects of power interruption or reapplication shall fall within the performance tolerances of this specification. Power supply shall meet the requirements specified in 3.4.4.

4.4.5 Electromagnetic interference emission and susceptibility. Electromagnetic interference emission and susceptibility tests shall be in accordance with Electromagnetic Interference Test Procedures (EMITP) and Electromagnetic Interference Test Report (EMITR) requirements of MIL-STD-461. Performance shall be as specified in 3.8.15.

4.4.6 Console ambient temperature. The console shall be placed inside a controlled temperature or humidity chamber and connected to inputs and outputs as specified in 4.4.3. The chamber temperature shall be maintained at 40±3 °F and a relative humidity of 50±10 percent for at least 4 hours, after which the following accuracies should be determined:

a. Console accuracy at nine data points from tables II, III, or IV, as applicable, and table V (three conductivity levels at three temperatures for each).

b. Alarm accuracy of each SCM using the procedures specified in 4.4.3.

The chamber temperature shall then be adjusted to 150±3 °F and held at this temperature for at least 4 hours after which the console and alarm accuracies shall be determined in accordance with items (a) and (b). Finally, the chamber temperature shall be lowered to 77±3 °F and held at this temperature for at least 4 hours, after which the console and alarm accuracies shall be determined in accordance with items (a) and (b). Performance shall be as specified in 3.8.4.

4.4.7 Console humidity and temperature test. The console shall be set up inside a controlled temperature or humidity chamber as specified in 4.4.6. The test shall consist of 20 hours operation at 150±3 °F followed by 12 hours operation at 40±3 °F. The relative humidity shall be maintained at 95 percent during steady temperature operation. During steady operation at both 150 and 40 °F, the console accuracies shall be verified using 16 data points from tables II, III, or IV, as applicable, and table V (four conductivity levels at four temperatures for each) to any one preselected SCM. The alarm accuracy of the same SCM shall be verified using the procedure specified in 4.4.3. These checks shall be performed during the third and last hours of operation at each temperature. After completion of the 40 °F portion, but before removal of the console from the chamber, the chamber shall be brought to ambient conditions (77±3 °F, 50±10 percent relative humidity). The console accuracies shall then be verified using nine data points from tables II, III, or IV, as applicable, and table V (three conductivity levels at three temperatures for each input) to each of the SMCs. The alarm accuracy of each SCM shall be verified using the procedure specified in 4.4.3. The console shall then be removed from the chamber and thoroughly examined for evidence of physical degradation. Performance shall be as specified in 3.8.5.

4.4.8 Console enclosure. The salinity indicating equipment shall be tested for tightness as specified in the splashproof test of MIL-STD-108. During and after completion of the testing, the salinity indicating equipment shall meet the performance requirements specified in 3.8.6.

4.4.9 Sensor constant. The sensor constant shall meet the requirements specified in 3.6.1.6 and 3.8.1.c.

4.4.9.1 Qualification inspection. The sensor constant shall be verified using the procedure specified in Method A of ASTM D1125 to determine conformance to 3.6.1.6. The measuring instrument shall energize the sensor at a frequency of 1000±10 Hertz. Cleaning solutions shall be used that are compatible with sensor materials.

4.4.9.2 Conformance inspection. The sensor constant shall be determined to ensure that the sensor shall pass the test specified in 4.4.9.1. The method used for this determination may be at the option of the manufacturer. The sensor constant shall meet the requirements specified in 3.6.1.6.

4.4.10 Sensor temperature compensator. The sensor shall be immersed in a controlled temperature and shall have the temperature compensator leads connected to an ohmmeter. The bath temperature shall be increased in steps of approximately 25 °F from 40±5 °F to 250±5 °F. At each step (bath temperature), the resistance of the temperature compensator shall be measured as specified in 3.6.1.2.

4.4.11 Sensor temperature compensator response. In order to determine the response of the temperature compensator to changes in fluid temperature, three distilled water baths shall be set up at the following temperatures: 75±0.5 °F, 125±0.5 °F, 175±0.5 °F. The baths shall be of sufficient volume that the temperatures will not be significantly affected by the immersion of the sensors as specified herein. The sensor temperature compensator leads shall be connected to an ohmmeter. The sensors shall be immersed in the 75 °F bath for at least 5 minutes and a resistance measurement shall be taken. The sensors shall then be quickly transferred (in approximately 1 second) to the 125 °F bath. Resistance readings shall be continuously recorded. The above-mentioned procedure shall be repeated with the sensors being transferred from the 125 °F bath to the 175 °F. The response of sensor temperature compensator resistance to step changes in temperature shall be as specified in 3.8.9.

4.4.12 System accuracy (using test solution). In order to determine system accuracy, sensors (having passed the sensor constant test specified in 4.4.9 and the sensor temperature compensator test specified in 4.4.10) shall be installed in a flow loop and connected to a console (which has passed the console accuracy test specified in 4.4.3). If a flow loop is unavailable, the sensors shall be inserted in a beaker. Remote alarms, remote readouts, and dumps shall be monitored as specified in 4.4.3. Sensor and valve assemblies shall be installed. Solution temperature, solution concentration, and pressure shall be monitored by reference instruments throughout the testing. Five sensor and valve assemblies shall be monitored during system testing. System accuracy of console readouts and alarms shall be as specified in 3.8.1. Data tables shall include a tabulation of reference instruments, local and remote console meters, limits of error and alarm actuation points. In the first sequence, solution temperature shall be maintained at 77±l °F for the duration of the test sequence while the solution concentration is increased in steps. Test points shall cover the full meter range. As a minimum, the applicable values specified in tables II, III or IV, as applicable, and table V shall be selected. At least two of the test points shall be alarm actuation points. Each test point value shall be maintained for at least 5 minutes. At each test point, comparative readings shall be taken for all channels of local and remote console meters, as well as the reference instruments. In addition, alarms and dumps shall be observed for correct actuation. In the second sequence, the solution concentration shall be maintained at a value within the range of the particular console meter. The value shall be selected from tables II, III, or IV, as applicable, and table V, and shall be maintained at this value, as closely as possible while being monitored on the reference instrument. While holding the concentration constant, the temperature of the solution shall be varied over the following points: 40 °F, 77 °F, 100 °F, 150 °F, and 200 °F. The tolerance for each temperature shall be ±1 °F. Each test point value shall be maintained for at least 5 minutes. At each test point, comparative readings shall be taken for all channels on local and remote console meters, as well as the reference instruments.

4.4.13 Overrange (sensor short circuit). The salinity indicating equipment shall be set up as specified in 4.4.12, except that the sensors shall not be immersed in a bath. A short circuit shall be applied across the electrodes of each sensor, one at a time, for 5 minutes each. Following the application of short circuits, the equipment shall be subjected to the system accuracy test specified in 4.4.12. Performance of the console shall be as specified in 3.8.1 and 3.8.8.

4.4.14 Sensor and valve assembly leakage. Sensor and valve assembly leakage shall meet the requirements specified in 3.8.10.

4.4.14.1 Qualification inspection. The sensor and valve assembly shall be connected to a piping system or vessel capable of supplying water at a gauge pressure of 375 lb/in² and 300 °F. The valve assembly, with the sensor inserted, shall be subjected to water at a gauge pressure of 250 lb/in² and 300 °F for a sufficient period of time to determine that no leakage occurs (minimum 1 hour). The sensor shall then be removed from the valve assembly and the valve shall be closed. The valve assembly shall then be subjected to 375 lb/in² and 300 °F at ambient for a minimum of 1 hour. The IC/SB-2-5 sensor and sensor holder shall be connected to a piping system supplying water at a gauge pressure of 25 lb/in² and 300 °F. The sensor holder, with the sensor inserted, shall be subjected to water at a gauge pressure of 25 lb/in² and 300 °F for a sufficient period of time to determine that no leakage occurs (minimum 1 hour). Maximum leakage rate shall be verified as specified in 3.8.10. Following the leakage test, the sensor constant shall be verified as specified in 4.4.9.1, the temperature compensator resistance shall be verified at one temperature as specified in 4.4.10 and insulation resistance measurements shall be made between sensor electrodes and between temperature compensator and outer electrode at the sensor cable ring terminations. Insulation resistance measurements shall be not less than 10 megohms at 50 VDC (minimum) when applied for not less than 60 seconds at ambient temperature. Also, continuity shall be verified between outer electrode (ground) and extender tube.

4.4.14.2 Conformance inspection. The following tests may be performed in lieu of the test specified in 4.4.14.1.

4.4.14.2.1 Sensor. The sensors, except Type IC/SB-2-5, shall be tested by connection to a piping system or vessel capable of supplying water at a gauge pressure of 600 lb/in² at ambient temperature. The sensor shall be connected to the applicable thread adapter, piece 2 on 803-5184176 and 803-5184177, in order that the packing nut-adapter connection is included in the test. The pressure shall be applied for a sufficient period of time to determine that no leakage occurs (minimum 10 minutes). Following the leakage test, verification of sensor constant, temperature compensator resistance, insulation resistance, and continuity shall be made as specified in 4.4.14.1, except 4.4.9.2 shall apply.

4.4.14.2.2 Valve assembly. Complete valve assemblies in accordance with 803-5184176 and 803-5184177 shall be tested by connection to a piping system or vessel capable of supplying water at a gauge pressure of 375 lb/in² at ambient temperature. The pressure shall be applied for a sufficient period of time (minimum 10 minutes) to determine that no leakage occurs. The maximum leakage rate permitted through the valve seat shall be 12.5 cubic centimeters per minute.

4.4.15 Sensor insertion. The sensor and valve assembly shall be installed as specified in 4.4.14. The water conditions shall be adjusted to a gauge pressure of 65 lb/in² and 250 °F. The sensor shall be inserted and withdrawn from the valve assembly a minimum of ten times. Performance shall be as specified in 3.6.

4.4.16 Console insulation resistance. The insulation resistance of the consoles shall be determined by applying 50 VDC (minimum) between ground and console input (sensor terminals) and between ground and console outputs (remote readout, remote alarm, and dump), with console at a temperature of 77±3 °F and at a relative humidity of 50±10 percent. The resistance, measured in megohms, shall be as specified in 3.8.11. Voltage sensitive parts shall be disconnected during this test.

4.4.17 Vibration.

4.4.17.1 Console vibration. The console shall be vibrated in accordance with Type I of MIL-STD-167-1. During the test, the console shall be set up as specified in 4.4.3. An input signal, 10 percent below alarm set point, shall be applied to each channel. The meter shall be observed for any unusual movement on each channel. There shall be no false alarms during the test. After the test, console accuracy shall be verified by substituting nine data points from tables II, III, or IV, as applicable, and table V (three conductivity levels at three temperatures for each) to each SCM. Accuracy of alarm and dump for each SCM shall be verified by simulating a fixed temperature at the temperature compensator terminals and slowly increasing the simulated conductivity until alarm actuation occurs. Performance shall be as specified in 3.8.12.

4.4.17.2 Sensor and valve assembly vibration. The sensor and valve assembly shall be connected to a 1¼-inch nominal pipe size tee in the normal configuration. It shall be vibrated in accordance with Type I of MIL-STD-167-1. The temperature compensator resistance shall be monitored during the test. After completion of vibration, the assembly shall be examined for damage and shall be subjected to the sensor constant test specified in 4.4.9, the sensor temperature compensator test specified in 4.4.10, and the sensor and valve assembly leakage test specified in 4.4.14. Performance shall be as specified in 3.8.12, 3.6.1.6, 3.6.1.2, and 3.8.10.

4.4.18 Shock.

4.4.18.1 Console shock. The console shall be bulkhead mounted and shall be tested in accordance with Grade A, Class I, Type C of MIL-S-901. During the test, the console shall be set up and energized as specified in 4.4.3. An input signal, 10 percent below the alarm set point, shall be applied to each channel. After each blow, the console shall be examined for damage and each channel shall be checked for proper reading. There shall be no false alarms during the test. Following the shock test, console accuracy for each channel shall be verified using the procedure specified in 4.4.3. Performance shall be as specified in 3.8.13.

4.4.18.2 Sensor and valve assembly shock. The sensor and valve assembly, and the IC/SB-2-5 sensor and sensor holder, connected as specified in 4.4.17.2, shall be tested in accordance with Grade A, Class I, Type C of MIL-S-901. After the shock test, the assembly shall be examined for damage and then subjected to the sensor constant test specified in 4.4.9, the sensor temperature compensator test specified in 4.4.10, and the sensor and valve assembly leakage test specified in 4.4.14. Performance shall be as specified in 3.8.13, 3.6.1.6, 3.6.1.2, and 3.8.10.

4.4.19 Dielectric withstanding voltage. Dielectric withstanding voltage between electrical circuits and ground shall be determined with a closely sinusoidal source of 60 hertz having a capacity of at least 1 kilowatt (kW). Root mean square (rms) values of test voltage shall be as shown in table IX.

TABLE IX. Rms values of test voltage.

Circuit voltage of equipment tested	rms value of dielectric withstanding voltage
Less than 60	450
60 to 120	900
Above 120 and less than 240	1200
240 to 480	1500
Above 480	Twice rated voltage, plus 1000

Radio interference filters or capacitors having a voltage rating of less than the test voltage specified herein shall be disconnected from the equipment during this test. The voltage shall be raised gradually to the value shown in table IX and shall be maintained at that value for the following period of time:

a. Qualification inspection: 1 minute ±5 seconds.
b. Conformance inspection: 5±1 seconds.

The dielectric withstanding voltage test shall not be applied to electronic or electrical circuitry, which uses low voltage parts such as transistors, electrolytic capacitors, diodes, and other voltage-sensitive parts. Chassis and other removable assemblies shall be removed during the tests. The tests shall be monitored for evidence of disruptive discharge and leakage current as specified in 3.8.7.

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. The salinity indicating equipment covered by this specification is intended for naval shipboard use for detecting and indicating the amount of dissolved salts in systems such as propulsion condensate, fresh water distillate, cooling water, and others. The equipment is in each case a semi-vital unit which, if disabled, would impair the effectiveness of the ship.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type designation and quantity (see 1.2 and 1.3).
c. Repeater consoles, when required (see 1.2.3 and 3.10.1).
d. Requirement for the preparation of drawings (see 3.11).
e. Requirement for the preparation of a conformance inspection report (see 4.3.2).
f. Packaging requirements (see 5.1).
g. Provisioning requirements (see 6.5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 15103 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from 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. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.4 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.5 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract (see 6.2). When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and verification provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.6 Subject term (key word) listing.

Alarm level control

Power supply module

Salinity channel module

Supply voltage and frequency (steady state)

Supply voltage and frequency (transient)

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Preparing Activity:
Navy – SH
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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.