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MIL-S-16032M(SH)
29 June 1987
SUPERSEDING
MIL-S-16032L(SH)
19 January 1981
(See 6.9)

MILITARY SPECIFICATION

SWITCHES AND DETECTORS, SHIPBOARD ALARM SYSTEMS

This specification is approved for use within the 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 pressure, temperature, thermostatic, door, water, liquid level, liquid flow, and airflow switches, and single-purpose (smoke or combustion gas) detectors and flame detectors used on Naval ships for visual and audible alarm systems (that is, systems utilizing indicator lights, sirens, bells, alarm panels) in conjunction with steam or air systems, diesel engines, turbines, auxiliary machinery. This specification is not intended to cover thermostatic or pressure operated switches used as operating controls, unless interconnected with an alarm system or specifically required by other primary equipment specifications.

1.2 Classification. Types of switches and detectors shall be designated in the forms, as specified (see 3.2.1 through 3.2.1.5 and 6.2.1). (See figures 1, 2, and 3 for schematic representation of type designation.)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS

FEDERAL

QQ-B-613 - Brass, Leaded and Non-Leaded; Flat Products (Plate, Bar, Sheet, and Strip).
QQ-B-626 - Brass, Leaded and Non-Leaded: Rod, Shapes, Forgings, and Flat Products with Finished Edges (Bar and Strip).
QQ-B-637 - Brass, Naval: Rod, Wire, Shapes, Forgings, and Flat Products with Finished Edges (Bar, Flat Wire, and Strip).
QQ-B-639 - Brass, Naval: Flat Products (Plate, Bar, Sheet, and Strip).
QQ-B-750 - Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.
QQ-C-530 - Copper-Beryllium Alloy Bars, Rods, and Wire (Copper Alloy Numbers 172 and 173).
QQ-C-533 - Copper-Beryllium Alloy Strip (Copper Alloy Numbers 170 and 172).
QQ-S-763 - Steel Bars, Wire, Shapes, and Forgings, Corrosion Resisting.
QQ-S-766 - Steel Plates, Sheets, and Strip - Corrosion-Resisting.
UU-P-268 - Paper, Kraft, Wrapping.
PPP-C-850 - Cushioning Material, Polystyrene Expanded, Resilient (For Packaging Use).
PPP-C-1120 - Cushioning Material, Uncompressed Bound Fiber for Packaging.

MILITARY

MIL-R-26 - Resistors, Fixed, Wire-Wound (Power Type), General Specification for.
MIL-R-26/5 - Resistors, Fixed, Wire-Wound (Power Type), Styles RW70, RW74, RW78, and RW79.
MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-F-1183 - Fittings, Tube, Cast Bronze, Silver-Brazing.
MIL-E-2036 - Enclosures for Electric and Electronic Equipment, Naval Shipboard.
MIL-D-2940 - Dampeners, Fluid Pressure, Gage Protection.
MIL-R-6130 - Rubber, Cellular, Chemically Blown.
MIL-S-8805 - Switches and Switch Assemblies, Sensitive and Push, (Snap Action) General Specification for.
MIL-M-10304 - Meters, Electrical Indicating, Panel Type, Ruggedized, General Specification for.
MIL-A-15303 - Audible Signals: Alarms, Bells, Buzzers, Horns, Sirens, and Electronic Shipboard.
MIL-E-16400 - Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore: General Specification for.

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MIL-A-17196 - Alarm Switchboards, Alarm Panels, Signal Units, and Special Alarm Connection Box, Naval Shipboard.
MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Repair Parts; Packaging and Packing of.
MIL-F-18866 - Fittings, Hydraulic Tube, Flared, 37 Degree and Flareless; Steel.
MIL-S-19622 - Stuffing Tubes (Nylon) General Specification.
MIL-S-19622/1 - Stuffing Tube Straight, Nylon.
MIL-R-20092 - Rubber Sheets and Molded Shapes, Cellular, Synthetic, Open Cell (Foamed Latex).
MIL-S-24235 - Stuffing Tubes, Metal, and Packing Assemblies for Electric Cables, General Specification for.
MIL-S-24235/14 - Stuffing Tube for Sheet Metal Enclosures.
MIL-S-24236 - Switches, Thermostatic, (Metallic and Bimetallic) General Specification for.
MIL-S-24236/1 - Switches, Thermostatic, (Bimetallic), Subminiature, Type I, Hermetically Sealed, Single Pole, Single Throw (SPST), 5 Amperes.
MIL-T-24388 - Thermocouples and Resistance Temperature Elements (Naval Shipboard Use).
MIL-C-24643 - Cable and Cord Electrical, Low Smoke, for Shipboard Use, General Specification for.
MIL-C-24643/2 - Cord, Electrical, 300 Volts, Types LSDCOP and LSTCOP.
MIL-C-24643/7 - Cable, Electrical, 600 Volts, Type LSMHOF.
MIL-C-24643/12 - Cable, Electrical, 300 Volts, Type LSTTOP.
MIL-R-39007 - Resistors, Fixed, Wire-Wound (Power Type), Established Reliability, General Specification for.
MIL-R-39007/6 - Resistors, Fixed, Wire-Wound (Power Type), Style RWR74.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
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-278 - Welding and Casting Standard.
MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of.

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MIL-STD-785 - Reliability Program for Systems and Equipment Development and Production.

DOD-STD-1399, Section 300 - Interface Standard for Shipboard Systems Electric Power, Alternating Current. (Metric)

HANDBOOK

MILITARY

MIL-HDBK-217 - Reliability Prediction of Electronic Equipment.

2.1.2 Drawings and publication. The following drawings and publication form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

401-1973965 - Switch, Door, Type IC/DM-1-0.

803-74081 - Magazine Sprinkling Alarm Equipment - Water Switch - P.P., Symbol 2977.

803-1197118 - Switch, Thermostatic (Mercurial), Types IC/J-105, IC/J-125, IC/J-150, Symbols 2805.1, 2806.1 and 2807.1.

804-1385850 - Piping, Gage, For All Service.

804-1853145 - System, Airflow Indicator and Alarm, 115 Volts, AC, 60 Cycles, Circuit HF.

PUBLICATION

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-LP-001-7000 - Fabrication and Inspection of Brazed Piping Systems.

(Copies of specifications, standards, handbooks, drawings and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

B16.5 - Steel Pipe Flanges, Flanged Valves, and Fittings.

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

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CODE OF FEDERAL REGULATIONS (CFR)
Title 10, Chapter 1, Part 30 - Rules of General Applicability to Licensing of Byproduct Material.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

UNDERWRITERS' LABORATORIES (UL)
UL 167 - Combustion Products Type of Smoke Detector.

(Application for copies should be addressed to the Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, IL 60611.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification for types IC/L, N, R, RH, RL, DM, J, W, FS, and ASE only. The switches and detectors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.4).

3.1.1 First article inspection for types IC/F, IC/CG and IC/CGD only. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3.3 and 6.5).

3.2 General features. The switches and detectors shall be in accordance with the following paragraphs of MIL-E-16400 in addition to the requirements specified herein. (Whenever a requirement of MIL-E-16400 conflicts with a requirement of this specification, the requirement of this specification shall govern):

Scope
Definitions
Materials
Parts, materials and processes
Fungus-inert materials
Flammable materials
Arc-resistant materials
Safety (personnel hazard)
Lightweight metal (aluminum alloy)
Unacceptable materials

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Nonferrous metals
Zinc
Springs (material)
Insulating material, electrical
Encapsulation and embedment
Glass
Lubricants
Painting
Corrosion protection/corrosion-resisting treatments
Fastener hardware
Gaskets and seals
Shaft locking devices
Capacitors
Resistors, variables, wire-wound precision
Transformers, inductors, and coils
Relays
Insulating materials, electrical
Switches and associated hardware
Enclosures
Enclosure-degree of (see 3.3.1, 3.4.1, 3.7.1.3(c), 3.8.6, 3.9, 3.11, and 3.12)
Equipment mounting
Rigidity
Through bolting
Cable entrance (see 3.2.7)
Thermal design
Rounded corners and edges
Structural welding
Environmental service conditions
Salt fog spray
Shock, vibration inclination (vital vibration test required) (see 4.9.2 and 4.9.17)
Electrical design and construction
Shipboard alternating current (ac) power service (normal power supply 115 volts, 60 hertz (Hz), single phase ac) (see 3.2.3)
Safety (personnel hazard)
Bonding and grounding
Soldering
Mounting of parts
Modular construction
Terminals (terminal boards and strips, binding posts and lugs)
Internal wiring and cabling
Conductor identification terminal end identification
Dielectric withstanding voltage
Electrical creepage and clearance distances
Interchangeability
Workmanship

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3.2.1 Basic indicator. Basic indicator for this equipment shall be IC/.

3.2.1.1 Type of operation. Type of operation shall be designated by a letter as shown in table I.

TABLE I. Type of operation.

Symbol	Type of operation
F	Flame
L	Pressure or vacuum or both
N	Temperature
R	Liquid level
RH	Liquid level, heavy duty, special purpose
RL	Liquid level, to actuate in 1/2 to 3/4 inch of liquid "rise"
DM	Door
J	Thermostatic (mercurial or nonmercurial)
W	Water
FS	Liquid flow
ASE	Airflow
CG	Single-purpose combustion gas detector
CGD	Single-purpose combustion gas detector for ducts

3.2.1.2 Range. Range shall be indicated by a number as shown in tables II, III, and IV. (Ranges shown are minimum; switches having a wider range are acceptable.) Table II shows pressure switches commonly in use and should not be considered restrictive for requirements other than those ranges and differentials listed therein. Temperature ranges shown in table III shall not be considered restrictive. Table IV indicates liquid flow switches, port sizes and flow setting available, but should not be considered restrictive. Table V shows liquid level switches indicating whether for single level or multiple level detection type. Table VI shows door switches and indicates the mechanical range features. Table VII shows mercurial thermostatic switches and indicates the operating points, but shall not be considered restrictive. Table VIII shows airflow switches and indicates the operating points. Table IX shows the smoke sensing portion of the single purpose detector and indicates operating levels.

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TABLE II. Range for pressure switches.[1/]

Symbol	Adjustment operating/ working pressure range[2/]	Maximum proof pressure[2/]	Maximum allowable variation from setting of operating pressure	Maximum differential	Connection for pressure supply
		lb/in^2	Plus or minus		
1	15 to 28 inches mercury absolute	5	1 inch	2 inches	3/
2	1 to 15 lb/in^2	80	1/2 lb/in^2	1-1/4 lb/in^2	3/
3	15 to 50 lb/in^2	125	2 lb/in^2	5 lb/in^2	3/
4	50 to 100 lb/in^2	200	4 lb/in^2	10 lb/in^2	3/
5	25 to 50 lb/in^2	125	2 lb/in^2	25 lb/in^2	3/
6	20 to 80 lb/in^2	200	2 lb/in^2	10 lb/in^2	3/
7	1000 to 5000 lb/in^2	5100	40 lb/in^2	100 to 200 lb/in^2	3/
4/10	5/	5/	5/	5/	3/ 5/

1/ Unless otherwise specified, for differential pressure switches, the ranges to be specified in 6.2.1 are the operating differential pressure range (decreasing or increasing differential pressure) and the resetting differential pressure range, both ranges relative to gauge pressure.

2/ Unless otherwise specified, is in gauge pressure. Maximum proof pressure is upper pressure at which performance of switch in the operating range will not be disturbed and shall exceed maximum operating pressure.

3/ Unless otherwise specified in the contract or order, type of connection shall be in accordance with Drawing 804-138580, that is, a mechanical flareless type 7/16-20 UN-2A externally threaded connection in accordance with MIL-F-18866 for 1/4-inch outside diameter (od) tubing.

4/ Manufacturer's name and part number shall be given on the identification plate by which to obtain from manufacturer all the information for which headings are given in this table. The information shall be supplied by the manufacturer to the Naval Sea Systems Command (NAVSEA) for each switch type delivered under this specification.

5/ See 6.2.1.

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TABLE III. Range for temperature switches, type IC/N.

Symbol	Operating temperature range	Maximum proof temperature 1/	Maximum allowable variation from setting including cumulative effect of 3.4.1.3 and 3.4.5	Maximum differential (see 3.4.7)	
				At the following or higher setting of	Maximum any other setting
	°F	°F	°F	°F	°F
30	125 to 225	300	±5	8 ± 2 at 165	14
31	150 to 225	300	±5	8 ± 2 at 165	14
32	675 to 925	1000	±5	15 ± 10 at 800	30
33	900 to 1100	1200	±5	15 ± 10 at 1000	50
34	400 to 580	650	±5	10 ± 2 at 450	20
2/ 35	3/	3/	3/	3/	3/

1/ Maximum proof temperature is temperature at which the performance in the operating range will not be disturbed and shall exceed the maximum operating temperature.
2/ The manufacturer's name and part number shall be given on the identification plate by which to obtain from manufacturer all the information for which headings are given in this table. The information shall be supplied by manufacturer to NAVSEA for each switch type delivered under this specification.
3/ See 6.2.1.

TABLE IV. Range for flow switches.

Symbol 1/	Port size nps	Gal/min actuation flow 2/		Flow setting 3/
		Min	Max	
075	3/4	0.40	5.0	4/
100	1	1.00	10.0	4/
125	1-1/4	1.25	20.0	4/
150	1-1/2	1.50	30.0	4/
200	2	2.00	50.0	4/
250	2-1/2	2.50	75.0	4/
300	3	3.00	100.0	4/
5/ 6/ XXX	6/	6/	6/	6/

1/ Symbol designates port size of liquid flow switch.
2/ Specified actuation flow rates are to be maintained within plus or minus 10 percent, and switch differential shall be not greater than 10 percent of the actuating setting.

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3/ Flow setting between minimum and maximum range given shall be specified by the contracting activity. (Example: IC/FS-075-U/2 GAL/MIN.)
4/ Specify gallons per minute (gal/min).
5/ Manufacturer's name and part number shall be given on the identification plate by which to obtain from manufacturer all the information for which headings are given in this table. The information shall be supplied by the manufacturer to NAVSEA for each switch type delivered under this specification.
6/ See 6.2.1.

TABLE V. Liquid level switches.

Type of switch	Symbol	Number of floats on common stem
		Levels
IC/R, RL or RH	1	1
IC/RH	2	2
IC/RH	3	3
IC/RH	4	4
IC/RH	5	5
---	6	6

TABLE VI. Door switches.

Symbol	Mechanical range features
1	Adjustable

TABLE VII. Mercurial or nonmercurial thermostatic switches.

Type	Operating point (close on rise)
	°F
105	105
125	125
150	150
Same as operating point	1/

1/ See 6.2.1.

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TABLE VIII. Airflow switches.

Symbol	Operating point (on drop)	Range
1	Single channel (adjustable)	0 - 1000 ft/min or as specified by the contracting activity
2	Multiple channel (adjustable)	0 - 4000 ft/min

TABLE IX. Smoke sensor of single purpose detector.

Type	Operating level	Range of sensitivity adjustment	Remarks
CG	(Adjustable) preset at factory 2 to 3 percent smoke measured using the meter of 3.11.3	0.2 to 4 percent per foot obscuration	Overhead mounting (only)
CGD	(Adjustable) preset at factory 2 to 3 percent smoke measured using the meter of 3.11.3	Same as above	For duct use (only)

3.2.1.3 Electrical features for type IC/L, IC/N, IC/DM, and IC/FS switches) (see 3.2.2 and 3.10). Whether the contacts are single pole and single throw or single pole and double throw, whether the main contacts close on rise or drop in pressure, temperature, or level the voltage and current rating of the main contact are indicated by a letter as shown in table X. (Voltage and currents specified are minimum. Switches rated for higher voltages and currents are acceptable.) The electrical switch for table X may be of manufacturer's design for type IC/L, IC/N and IC/FS switches.

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TABLE X. Electrical features.

Symbol	Switch	Contacts close on	Voltage	Current	
				Ac 1/	Dc
A	SPST	Rise	115	4.0	3.0
C	SPST	Rise	115 230 440 500	7.5 5.0 3.0 ---	4.6 2.3 1.2 1.0
D	SPST	Drop	115	4.0	3.0
F	SPST	Drop	115 230 440 500	7.5 5.0 3.0 ---	4.6 2.3 1.2 1.0
G	SPDT	Rise	115	4.0	3.0
J	SPDT	Rise	115 230 440 500	7.5 5.0 3.0 ---	4.6 2.3 1.2 1.0
K	SPDT	Drop	115	4.0	3.0
M	SPDT	Drop	115 230 440 500	7.5 5.0 3.0 ---	4.6 2.3 1.2 1.0
O	SPST or SPDT	As required	120	0.5	0.5
P	SPST	Drop	1000	---	1.0
S	SPST	Rise	115	3.0	0.5
T	SPST	Drop	115	3.0	.5
U	SPST	Rise	115	0.05	.05
V	SPST	Drop	115	0.05	0.05
W	DPST	----	115	.3	.2
Z 2/	3/	3/	3/	3/	3/

See footnotes at top of next page.

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1/ Alternating current (ac) 60 Hertz inductive, 0.5 power factor (pf).
2/ Manufacturer, on the equipment identification plate, shall identify all information for the columns of this table and shall furnish the information to NAVSEA for each switch delivered under this specification.
3/ See 6.2.1.

3.2.1.4 Mechanical range features. Travel range of the type IC/DM-1-0 door switch roller shall be 3/16-inch, minimum. Full travel of the roller will not be injurious to the door switch mechanism. Location of the dead band of the switch shall be adjustable to facilitate installation and maintenance. Adjustment of the dead band width shall be provided.

3.2.1.5 Length of capillary tube and bulb. The length of capillary tube, dimensions of bulb, and type of connection shall be indicated by a number as shown in table XI. Longer lengths or dimensions other than those shown in table XI shall be specified in the contract or order, as required. Lengths of capillary tubing in excess of those lengths shown in table XI shall be in increments of 5 feet.

TABLE XI. Length of capillary tube and bulb for type IC/N switches.

Symbol	Length of capillary tube	Length of bulb (nominal) 1/	Diameter of bulb (max)	Type of connection	Special bulb application characteristics
	Feet	Inches	Inch		
1	0	3	3/4	3/4-14 NPT male	4/
2	0	3	3/4	1/2-14 NPT male	4/
4	0	6	3/4	Flanged 2/	4/
5	0	9	3/4	Flanged 2/	4/
6	0	10	3/4	Flanged 2/	4/
7	0	10	3/4	Flanged 2/	4/
9	0	11	3/4	Flanged 2/	4/
11	10	3	3/4	3/4-14 NPT male	4/
12	10	3	3/4	1/2-14 NPT male	4/
15	10	10	3/4	Flanged 2/	4/
16	0	1	7/16	1/2-14 NPT male	4/
3/ 17	4/	4/	4/	4/	4/

1/ Length of the bulb is the length of the projection of the bulb beyond the face of the connection.
2/ See 3.4.2.
3/ Manufacturer's name and part number shall be applied on the connection or on an affixed identification plate by which to obtain from manufacturer all the information for the headings of this table. Manufacturer shall supply the information to NAVSEA for each switch delivered under this specification.
4/ See 6.2.1.

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3.2.2 Contact resistance, temperature rise, and capacity. When the switch is in the closed position and after completing the tests of section 4, the resistance between the primary contacts shall not exceed 0.05 ohm. Except for IC/R, IC/RL, IC/RH and IC/FS switches using reed switches and as indicated herein, the contacts shall continuously carry the currents and voltages shown in table X or specified hereinafter without exceeding a temperature rise of 50 degrees Celsius (°C) over a 50°C ambient for solid contacts or 65°C over a 50°C ambient for silver-plated solid contacts. For IC/R, RL, RH, or FS switches, the reed switch contacts shall be rated for a minimum of 10 watts lamp load at 115 volts and 220 volts, 60 Hz or a higher rating as specified (see 6.2.1). If the switch for the flow switch is a sensitive switch to MIL-E-16400, then table X shall apply. Contacts shall be able to have a minimum of 100,000 make and break cycles under load. Single purpose detectors shall conduct alarm currents of about 0.014 amperes continuously with no damaging effect from 220 volts direct current (Vdc). Flame detector relay contacts shall be rated to carry continuously 1 ampere at 60 Hz, 115 volts, 0.5 pf. Current-carrying springs shall be of beryllium-copper or phosphor bronze conforming to QQ-C-530 and QQ-C-533 or QQ-B-750, respectively.

3.2.2.1 Pressure, temperature, door, thermostatic and water switches when used in conjunction with alarm panels (2-circuit or 4-circuit) as specified in MIL-A-17196 or alarm switchboards of MIL-A-17196, shall contain a resistor rated 7000 ohms, 5 watts or shall contain a type RW79 resistor in accordance with MIL-R-26 and MIL-R-26/5 or RWR74 in accordance with MIL-R-39007 and MIL-R-39007/6 6810 ohm resistor. Resistor shall be connected across the switch terminals. Liquid level switch and liquid flow switch shall be used with alarm panels or alarm switchboards of MIL-A-17196, but the 7000 or 6810 ohm resistor specified above may be contained internally or may be used externally to the switch. Single purpose detector shall be used with the type IC/SCG and IC/BCG alarm switchboards and panels of MIL-A-17196 and shall be used with a 40,000 ohm end-of-line 10 watt resistor, type RWR78 in accordance with MIL-R-39007 and MIL-R-39007/6, or equivalent.

3.2.3 Power supply tolerance. Equipment shall operate on voltages and currents and with voltages and frequency tolerances shown in table XII.

TABLE XII. Power supply tolerance.

Nominal voltages and frequency	Voltage tolerance	Frequency tolerance
115 ac, 60 Hz	± 6	± 3 Hz
115 dc	± 11	-----
230 dc	± 23	-----
230 ac, 60 Hz	± 23	± 5 Hz
230 ac, 400 Hz	± 23	± 15 Hz
440 ac, 60 Hz	± 23	± 3 Hz
500 dc	-150 +210	-----

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3.2.4 Wearing surfaces shall be material that will prevent undue wear. Moving parts shall be as light as possible, consistant with the requirements of this specification. Operating mechanism shall be supported in such a manner that working or twisting of the switch enclosure will not affect the operation of the switch mechanism. Stops shall be provided to prevent moving the operating mechanism beyond the extreme operating positions. Adjustments shall be stiffly operable or lockable and without a drifting characteristic so that the adjustment will be maintained for shipping, storage, installation, and service.

3.2.5 Accelerated life. Switches and detectors shall pass the accelerated life test specified in 4.9.2.

3.2.6 Centrifuge. Mercury column of mercury-in-glass thermal elements of thermostatic switches shall not be broken at acceleration values 25 times the force of gravity (g) in the centrifuge test specified in 4.9.5.

3.2.7 For the type IC/L and IC/N switches, provisions for a size C stuffing tube of MIL-S-24235 and MIL-S-24235/14 shall be provided for cable entrance or provisions for a size 2 straight, nylon stuffing tube of MIL-S-19622 and MIL-S-19622/1 shall be provided for cable entrance or an electrical connector shall be provided. Both halves of the connector shall be provided unless otherwise specified (see 6.2.1). No special conductor insertion tools shall be needed. Connector shall withstand the salt spray test and shall be installed for the enclosure test. Cable entrance for the IC/RL-1 level switch shall be through a fitting having external 5/8-18 UNF-2A threads provided for a nut to secure 3/8-inch od thin-walled flared tubing to afford cable protection. Cable entrance for the IC/R and RH level switches, if by stuffing tube accommodation, shall be for the washers, grommet, and cap for a size 2 stuffing tube in accordance with MIL-S-19622. Washers, grommet, and cap shall be provided only when specified (see 6.2.1). For the single purpose detectors, provisions for the required quantity of size 2 or 3 stuffing tubes for cable entrance shall be provided.

3.2.8 Recovered materials. Unless otherwise specified herein, all equipment and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3 Pressure operated switches (type IC/L). Switches shall consist of a pressure chamber, electrical contacts, and connecting linkage arranged to operate contacts of the type and in the manner specified in table X. Switches shall operate over a pressure range shown in table II or over a range as specified (see 6.2.1). Pressure switches shall be single pressure chamber switches or vacuum switches or differential/vacuum switches.

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3.3.1 Mechanical details. Switch shall be compact with a splashproof enclosure in accordance with MIL-STD-108 and painted and protected against corrosion in accordance with MIL-E-16400. Switch shall contain a scale by which to set the switch set point approximately. Enclosure shall have a safety vent so that inside pressure will be equalized with the outside pressure.

3.3.1.1 Pressure chamber shall be of phosphor-bronze or beryllium-copper conforming to QQ-B-750, QQ-C-530, or QQ-C-533, or of brass conforming to QQ-B-613, QQ-B-626, QQ-B-637 or QQ-B-639, or of corrosion-resisting steel conforming to QQ-S-763 or QQ-S-766, or equivalent commercial material and may be either of the bellows, diaphragm, piston, or Bourdon tube type. For seawater service, the parts in contact shall not contain zinc. Pressure chamber shall be provided with a connection for the pressure supply in accordance with table II and shall withstand 15 applications of maximum proof pressure (see table II) applied hydraulically for a period of 10 seconds for each application, at a pressure increase rate of approximately 15 percent of rated pressure per second, and then meet the tolerances of table II. Differential pressure switches shall not be strained by the maximum differential of table II with limits specified by the manufacturer. A drain hole, 1/4-inch NPT, with plug shall be provided in the pressure element chamber for cleanout or calibration purposes. Pressure chamber shall have a burst pressure about or greater than two times the maximum proof pressure.

3.3.1.2 No electrical circuit or switch mechanism shall be contained within the pressure chamber. In order to reduce arcing to a minimum, the switch shall be of a quick make and break type. Pressure switch shall operate with specified accuracy at any pressure supply temperature within the range of 50 to 250 degrees Fahrenheit (°F) and at any ambient temperature within the range of 40 to 158°F. Pressure switch shall be suited for the non-operating temperature range of MIL-E-16400. Pressure switches for pressures above atmospheric shall be provided with an information plate adjacent to the pressure connection with the following inscription: "CAUTION - DO NOT LOOSEN UNDER PRESSURE".

3.3.2 Adjustment. Switch shall be adjustable to any operating pressure within the range specified (see 6.2.1). Adjusting device shall be protected with a cover.

3.3.3 Variation from setting. Variation from setting for either a decreasing or increasing pressure for any constant setting within the pressure range specified and for any rate of pressure variation of less than 25 pounds per square inch (lb/in^2) per second, shall not exceed that specified in table II.

3.3.4 Pressure differential. Pressure differential between closing and opening of the electrical contacts may be nonadjustable and shall not exceed the values specified in table II. For special applications, adjustable differential may be obtained, as specified (see 6.2.1).

3.3.5 Dimensions. Mounting dimensions for switches in the 15 inches of mercury to 1000 lb/in^2 range shall be as shown on figure 4 or shall be adaptable to be mounted as shown on figure 4.

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3.3.6 Pulsation damper. Pressure operated switches where used to operate alarms for pressure condition in piping systems shall be provided with a pulsation dampening device, as specified (see 6.2.1). Dampening device shall be in accordance with MIL-D-2940.

3.4 Temperature switches (type IC/N). Switches shall consist of a temperature sensitive element, electrical contacts, and operating linkage arranged to operate contacts of the type and in the manner shown in table X. Switches shall operate over one of the ranges shown in table III. Bulb and capillary tube lengths shall be as shown in table XI. Operating medium shall be either liquid, gas, thermocouple, or differential expansion of solids or other acceptable principle. Operating temperature, operating on rise or drop in temperature, and length of capillary tubing and bulb shall be as specified (see 6.2.1). Type IC/N switches of electronic or thermocouple design shall operate from 115 volts, 1-phase, 60 Hz power when power is needed. Thermocouple or electronic type IC/N switches shall not be disrupted by transient and spike voltages and frequencies of DOD-STD-1399, section 300 and shall meet the electromagnetic interference (EMI) requirements of MIL-STD-461 for class IC equipment. Thermocouples shall be in accordance with MIL-T-24388 except that the connection head may adapt a signal processing and switch unit for integral mounting and connection when specified. When not integrally mounted, the signal processing and switch unit shall be for bulkhead mounting as shown on figure 4.

3.4.1 Mechanical details. Switch shall be compact with a splashproof enclosure meeting the requirements of MIL-STD-108, painted, and protected against corrosion in accordance with MIL-E-16400.

3.4.1.1 Switches with capillary tubes shall be arranged for three point bulkhead mounting of the enclosure in accordance with figure 4 or shall be adaptable to be mounted as shown on figure 4. Switches without capillary tubes shall be arranged for mounting by means of the provision for the sensitive element as specified in table XI. The switch shall be for the extended storage conditions of MIL-E-16400.

3.4.1.2 Material used in construction of the temperature sensitive element shall be class 304 corrosion-resisting steel conforming to QQ-S-763 or QQ-S-766, or brass conforming to QQ-B-613 or QQ-B-626, or berryllium-copper conforming to QQ-C-530 or QQ-C-533, or equivalent commercial material. Joints in the bulb, where used, shall be closed by full seal welds of adequate strength. Use of screwed joints alone in the temperature sensitive element shall not be permitted. Temperature sensitive element (bulb) shall be arranged to thread into a tapped hole or mount by a flange, in accordance with table XI. Thermocouples shall be made to mount in wells as required in MIL-T-24388. Bulbs mounted with 150-pound standard flanges (see 3.4.2) shall be used directly in contact with superheated steam at a gauge pressure of 150 lb/in^2 and 600°F total temperature. Bulbs mounted with 600-pound standard flanges (see 3.4.2) shall be used directly in contact with superheated steam at a gauge pressure of 600 lb/in^2 and 900°F total temperature. Bulbs mounted with 1,500-pound standard flanges (see 3.4.2) shall be suitable for use when directly in contact with superheated steam at a gauge pressure of 1500 lb/in^2 and 1050°F total temperature. Any brazing shall be in accordance with NAVSEA 0900-LP-001-7000.

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3.4.1.3 For switches provided with capillary tubes, installing the switch mechanism enclosure the maximum distance permitted by the length of capillary tube above or below the sensitive element bulb shall not cause a variation greater than plus or minus 5°F in the operating temperature for which the switch is set. Capillary tube connection shall be through the bottom of the switch mechanism enclosure. At the point where the capillary tube joins the switch enclosure, it shall be reinforced for a minimum distance of 2 inches to prevent kinking or mechanical failure at this point.

3.4.1.4 Switches in the 675 to 925°F and 900 to 1,100°F ranges or for temperature exceeding 675°F shall have the entire length of capillary tubing covered with a spirally wound, flexible, corrosion-resisting steel casing covered with braided corrosion-resisting braid so constructed that the flexibility of the tubing shall not be unduly reduced, in addition to the 2-inch reinforcing specified in 3.4.1.3.

3.4.2 Flanges. When specified in table XI, bulbs shall incorporate a flange for securing the bulb in its respective fitting. The flange and bulb shall be of similar materials. Welding processes, where used, shall be in accordance with MIL-STD-278. Flanges shall be in accordance with ANSI B16.5, series 150, 600, and 1500, for size 1-inch pipe.

3.4.3 Over temperature. Temperature sensitive element shall withstand temperatures as specified in table XIII and then meet the tolerance of table III.

TABLE XIII. Over temperature.

Temperature range of switch	Maximum temperature of sensitive element	Length of time
°F	°F	Minutes
100 to 225	300	5
400 to 580	650	5
675 to 925	1000	5
900 to 1100	1200	5
As specified (see table III)	As specified (see table III)	5

3.4.4 Adjustment. Switch mechanism shall be able to adjust set point for any operating temperature within a range listed in table III as specified (see 6.2.1) and shall be self-compensating for any ambient temperature between the limits specified in table XIV. Indication (that is, arrow or punch mark) shall be provided at the adjustment screw to show direction for increase or decrease in temperature setting. A scale shall be affixed by which to set the switch set point approximately.

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TABLE XIV. Temperature adjustment.

Temperature range of switch	Ambient temperature range
°F	°F
100 to 225	50 to 158
400 to 580	80 to 149
675 to 925	80 to 149
900 to 1100	80 to 149
As specified (see table III)	50 to 158 for range to 225 80 to 149 for range above 225

3.4.5 Ambient temperature. Switch shall operate at any ambient temperature within the ranges specified in table XIV. Temperature at which the switch operates shall vary not more than plus or minus 5°F from the switch setting (see 4.9.9).

3.4.6 Variation from setting and time lag. Variations from setting shall not exceed those specified in table III for any rate of change of temperature of the medium being measured of less than 5°F per minute, at any ambient temperature within the range specified in table XIV. The time lag of the switch for 675 to 925°F and 900 to 1,100°F ranges or for temperatures exceeding 675°F shall not exceed 8 seconds (see 4.9.7).

3.4.7 Temperature differential. Temperature differential between closing and opening of the electrical contacts may be nonadjustable, and shall not exceed the values specified in table III. For special applications, adjustable differential may be obtained if specified (see 6.2.1).

3.4.8 Temperature switches shall be provided with an information plate adjacent to or on the outer end of the bulb or well with the following inscription: "CAUTION - DO NOT REMOVE UNDER PRESSURE".

3.5 Liquid level switches. Switches shall contain one or more glass, enclosed reed switches that are actuated by a magnet. The magnet shall be a permanent magnet securely fitted in a float. The glass enclosed reed switch shall be potted in a protective capsule. Electric leads of adequate length shall be taken from the reeds of the reed switch to connect to ship's wiring. For the type IC/RL switch, 10 feet of wiring (type DCOP 1) shall be furnished extending through a fitting of the switch having external 5/8-18 UNF-2A threads and suited for accepting a nut to secure a 3/8-inch diameter thin-walled flared tubing for protecting the wiring. The wiring in the IC/RL switch shall be potted in to be watertight. For the type IC/R and RH switches, connection to ship's wiring shall be by stuffing tube or watertight electrical connector. If ship's wiring entrance is by stuffing tube, the wires may be spliced to the wires from the reed switch using insulated crimp type of connectors. Spliced and folded leads shall be sheltered inside the stem of the liquid level switch. Reed switches shall be securely fitted inside a stem upon which the floats shall slide, to which the electrical connector or stuffing tube is adapted, and to

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which a mounting accommodation is adapted. Stem shall be sealed watertight at its extreme end from the mounting end and may be sealed with a removable plastic compound internally to keep liquid from the reed switch capsules. Only the type IC/R-1-U or V switch shall be manufactured for the IC/R switch. Only the type IC/RL-1-U switch shall be manufactured for the IC/RL switch. Type IC/RH( )-U or V shall be manufactured for the IC/RH series.

3.5.1 Mechanical features. The three basic types of liquid level switches are different, as specified in 3.5.1.1 through 3.5.1.3.

3.5.1.1 Type IC/RL. Type IC/RL switch is for the application of alarming for the rise of bilge liquid from 1/2 to 3/4 inch above the deck. The float of the type IC/RL switch may be spring loaded to actuate the reed switch for such a small liquid level rise. Type IC/RL switch shall fit within a 3-inch square 7 inches high. This dimensional envelope shall include the installed fitting for cable entry and for adapting protective tubing. Mounting of the type IC/RL switch shall be by a vertical mounting plate of the switch, having mounting holes as shown on figure 5. On the type IC/RL switch, indicate on an information plate or by stamping metal how high off the deck the mounting hole centerline shall be for an alarm to be given for 1/2 to 3/4 inch of liquid on the deck. A slosh shield provided with adequate openings for inflow and outflow of liquid and to avoid entrapping air shall be provided integrally with the type of IC/RL switch.

3.5.1.2 Type IC/R. Type IC/R switch is similar to the type IC/RL switch, except that the type IC/R switch is for other than bilge level application and has an invertible float. Type IC/R switch shall fit within a 3-inch square 7 inches high. The dimensional envelope shall include the installed cable connector or stuffing tube. Mounting of the type IC/R switch shall be by vertical mounting of the switch having mounting holes as shown on figure 5. A slosh shield provided with adequate openings for inflow and outflow of liquid and to avoid entrapping air shall be provided integrally with the type IC/R switch. An information plate shall be provided to indicate the liquid level in inches below the centerline of mounting holes at which the reed switch will be actuated.

3.5.1.3 Type IC/RH. Type IC/RH switch is for applications for which the type IC/R and IC/RL switches are not suited. Type IC/RH switch is for alarming at single or multiple levels and for more difficult mounting arrangements than the IC/R and IC/RL types. Type IC/RH switch shall be built to accommodate one or more floats for different actuation levels as specified (see 6.2.1) and shall have switch action (open for rise or close for rise) as specified (see 6.2.1). Actuation levels shall be established from the end of the stem from which the float rises or from some other convenient reference point and this information shall be included on the manufacturer's information sheet (see 3.15.1). Type IC/RH switch shall consist of the glass enclosed reed switches and the protective capsule for the glass enclosed reed switches, a stem assembly into which the reed switches and their protective capsule are securely fixed in location and upon which the floats travel and to the top of which a cable connector or stuffing tube is provided, or a 2-1/2 inch NPT internally threaded mounting cap or an American Standard steel pipe size flange or similar flange as specified (see 6.2.1) by which to install the level switch and seal the installation. Float and stem assembly just described shall be of such size as to fit inside a 2-1/2 inch steel pipe size slosh/protective shield. Mounting cap shall secure the level switch to the steel pipe. The stem may be of a bent

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shape to facilitate side mounting or difficult entry conditions. Slosh shields for the type IC/RH switch shall be provided as specified (see 6.2.1) and shall have drilled holes to permit the escape of entrapped air and to permit the inflow and outflow of liquid. Any flanged pipe or other container for adapting the type IC/RH switch externally to a tank shall not be considered as covered by this specification but may be furnished as specified (see 6.2.1).

3.5.2 Mechanical and electrical features. Float shall be of plastic or other corrosion-resistant material for use with seawater, fuel oil, lubricating oil, hydraulic oil, or any combination of these. Material and serviceability of the whole liquid level switch shall be physically unaffected when the float is immersed in any and all of the foregoing liquids at a temperature of 0 to 150°F for the type IC/RL switch and at a temperature of 0 to 200°F for the other types of switches. Serviceability of the float shall be physically unaffected when immersed in any and all of the foregoing liquids at room temperature at atmospheric pressure for the type IC/RL switch and at room temperature at a pressure of 15 lb/in^2 or greater (as specified) above the normal atmospheric pressure of a nominal 14.7 lb/in^2 for the other types of switches. The total weight of a float soaked for a total of 7 days at atmospheric pressure or a gauge pressure of 15 lb/in^2 or greater, as applicable, in each of the above liquids equal time at 0°F, room temperature, and 150 or 200°F, as applicable, shall not exceed 115 percent of the original weight of the float. No increased change in weight of the same float used in the 7-day soak test shall be evident when the float is soaked an additional 23 days in a combination of the above liquids at room temperature. The float shall have a specific gravity of about 33 percent or less of that of tap water at room temperature, except when otherwise specified (see 6.2.1). Except for the type IC/RL switch, each float shall be marked with the words "open" and "closed" to denote the switch action for a rising or dropping float. Except for the type IC/RL switch, each float shall be marked with an arrow adjacent to the words "open" and "closed" to indicate the direction of float movement relative to the mounting end of the stem to get that switch action. Except for the type IC/RL switch, each float shall be invertible for obtaining the opposite switching action. For the type IC/RL switch, the float shall be marked "TOP" or "UP" to indicate which end is to be up, unless the end to be up is otherwise obvious. Adjustable stops shall be provided to establish the range of movement and separateness of action for each float of a type IC/RH switch.

3.5.2.1 Materials used in the liquid level switch shall be corrosion-resistant by composition in lieu of by surface treatments, including the electrical connector or stuffing tube. Liquid level switches shall be easy to disassemble and reassemble for cleaning, replacement of the electrical switch capsules, adjustment of stops for establishing the range of travel of each float (type IC/RH), or replacement of any or all parts. Maximum interchangeability of parts shall be maintained for liquid level switches of each of the three basic types covered by this specification.

3.5.2.2 Reed switch capsule shall withstand a hydrostatic gauge pressure of 20 lb/in^2 for 1 hour and immediately thereafter meet the insulation resistance tests of MIL-E-16400. The electrical connector and reed switch shall also meet the insulation resistance and dielectric strength tests of MIL-E-16400 after the shock test is performed.

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3.5.2.3 Float and stem material shall be such that no abrading shall be evident during the testing of this specification and there shall not be any likelihood of significant abrading over 10 years of use. The float shall not be subject to binding on the stem nor be subject to a change of shape in 10 years of usage as determined during the testing of this specification.

3.5.2.4 Each type of liquid level switch shall be metal stamped with 1/8-inch high characters as follows: Military specification (MIL-S-16032), type designation, manufacturer's name and part number, in a readily apparent location or provide the same information on an identification plate attached to the integral mounting cap or flange.

3.5.2.5 Stuffing tube or both halves of the electrical connector shall be supplied with each liquid level switch. If used by the manufacturer, the connector shall be a watertight type (commercial design is permitted) and shall satisfactorily pass the salt spray test (see 4.9.20). No special conductor insertion tool shall be needed. The cable for connector and the stuffing tube shall be in accordance with MIL-C-24643 and MIL-C-24643/2, types LSDCOP and LSTCOP, MIL-C-24643/12, type LSTTOP and MIL-C-24643/7, type LSMHOF as required. Cable for the type IC/RL and IC/RH switches shall be supplied and connected by the shipbuilder.

3.5.2.6 Liquid level switch stem with its wiring shall be watertight when a cable is fitted.

3.6 Door switches. Switches shall employ the mechanical and electrical features and components to render them temper-resistant. Details of this switch shall be as shown on Drawing 401-1973965. Components shall be in accordance with the requirements of this specification; however, in case there is a conflict, the requirements shown on Drawing 401-1973965 shall govern.

3.6.1 Three case-hardened steel, zinc-plated, strikers, and mounting hardware shall be furnished and packaged with each door switch.

3.6.2 Safety wire and seals shall be furnished with each door switch.

3.6.3 Door switch shall be mounted in any position. Design shall be such that the entire inner switch assembly may be rotated 90 degrees within the case-hardened enclosure.

3.6.4 Two resistors in accordance with Drawing 401-1973965 shall be supplied, installed for the cover and door circuits with each door switch.

3.6.5 Door switch shall not employ terminal tubes. A 1/2-inch nominal pipe size (nps) steel conduit connection shall be provided.

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3.7 Thermostatic switches (mercurial or nonmercurial). Nonmercurial thermostatic switches shall be used unless otherwise specified (see 6.2.1).

3.7.1 Thermostatic switches (mercurial).

3.7.1.1 Thermostatic switches shall be able to short out the current limiting resistor of a high temperature alarm line when the temperature in the vicinity of the thermostatic switch reaches a predetermined limit. Switches shall make and break 0.07 ampere at 115 Vdc with an inductance of 0.5 henry in the circuit, 50 times without a change in operating point. The time lag of the thermostatic switch shall not exceed 30 seconds (see 4.9.4). Switches with an operating point up to 150°F shall be permitted a tolerance of plus or minus 2°F and switches with an operating point 150°F and above shall be permitted a tolerance of plus or minus 3°F.

3.7.1.1.1 Type IC/J-105. Type IC/J-105 thermostatic switches shall be set to close the electrical circuit at 105 ± 2°F.

3.7.1.1.2 Type IC/J-125. Type IC/J-125 thermostatic switches shall be set to close the electrical circuit at 125 ± 2°F.

3.7.1.1.3 Type IC/J-150. Type IC/J-150 thermostatic switches shall be set to close the electrical circuit at 150 ± 3°F.

3.7.1.2 Thermostatic switches shall be in accordance with Drawing 803-1197118 and the thermal elements shall conform to the following:

(a) Elements shall be of the three-wire type. Platinum wire contacts shall be installed in the element so as to contact the mercury column as follows:
  (1) One contact shall be placed at the specified alarm point of a particular type of thermostat (105 ± 2°F, 125 ± 2°F, 150 ± 3°F).
  (2) One contact shall be placed at the supervisory point which shall be minus 45 ± 5°F.
  (3) The common or lowest contact shall be installed so that it will be at least 5 degrees lower than the supervisory point.

(b) Contacts to the mercury column shall be made by platinum wire terminated on the outside in metal rings formed by wrapping fine, copper wire covered with a layer of a solder or in metal rings formed by electrolytically deposited copper.

(c) Wiring to the metal rings on the outside of the glass stem of the thermostatic switch shall be flexible, multiple stranded, with a synthetic resinous jacket. Each conductor shall be not longer than 8-1/2 inches and shall have a terminal lug.

(d) Mercury used in thermal elements shall be bright in appearance, free from drag or stickiness, foreign material, and air. Amount of mercury used shall not exceed 2.0 grams.

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(e) Capillary tubing and bulb shall be of the best commercial grade of thermometer tubing. The capillary bore shall be approximately 0.0075 to 0.010 inch in diameter and shall be approximately the same diameter from the top of the bulb to the expansion chamber in the top of the stem.

(f) After bulb has been fused to the capillary tubing, the inside surface of both the capillary and bulb shall be cleansed thoroughly before filling with purified mercury.

(g) Thermal element shall be made with an expansion chamber above the last contact to prevent damage in case the temperature accidentally rises to 175°F.

(h) Thermal elements shall be constructed with provision in the capillary to prevent the mercury from totally contracting into the bulb or the gas from being entrapped in the bulb at any point below the lowest contact setting.

(i) Space above the mercury column shall be filled with a hydrogen gas charge and pressurized to pass the acceleration test (see (j)).

(j) Thermal elements shall withstand an acceleration of 25g in a direction parallel to and away from the bulb without any break in the mercury column (see 4.9.5).

(k) Construction of the thermal elements shall be such that the mercury column will not separate when shipped. When mounted in the standard thermostatic switch assembly as shown on Drawing 803-1197118, there shall be no breakage of the thermal element or mercury column separation when subjected to vibration and shock.

(l) Overall length of the thermal element shall not exceed 2-1/4 inches $\pm$ 1/16 inch. Diameter of the stem shall be 5-1/2 $\pm$ 1/2 millimeters, not including contact rings. The thermal elements shall be able to be fitted in the thermostatic switch as shown on Drawing 803-1197118.

3.7.1.3 Thermostatic switch shall conform to the following:

(a) Overall dimensions shall not exceed the overall dimensions of the standard thermostatic switch shown on Drawing 803-1197118, and mounting dimensions shall be identical for all types of thermostatic switches.

(b) Construction shall include a terminal block and provision for mounting and connecting the resistor of 3.2.2 in accordance with Drawing 803-1197118. Resistor shall be supplied installed in the thermostatic switch.

(c) Thermostatic switch shall be spraytight in accordance with MIL-STD-108.

(d) Box assembly of the thermostatic switch shall have two flats, both to accommodate a size 1 or 2 stuffing tube of MIL-S-19622 or a size A or B stuffing tube of MIL-S-24235.

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3.7.2 Thermostatic switches (nonmercurial). Thermostatic switches shall short out the current limiting resistor of a high temperature alarm line when the temperature in the vicinity of the thermostatic switch reaches a predetermined limit. The switch portion of the assembly described hereinafter shall be a category II switch to be obtained from a QPL listed source of a similiar product in category I of MIL-S-24236. The switch portion shall be in accordance with part number M24236/1-F of MIL-S-24236/1 with the differences that are described hereinafter. The switch shall meet the class 1 switch requirement of MIL-S-24236 for vibration and shall meet the class 4 switch requirement of MIL-S-24236 for shock. The switch shall meet the regular test requirements of MIL-S-24236 as affected by designation of one of the following or other set points (see 6.2.1). The switch shall be basically like configuration A2 of part number M24236/1 and shall close contacts on rising temperature at 105 $\pm$ 3°F, 125 $\pm$ 3°F, or 150 $\pm$ 3°F, or other specified temperature within plus or minus 3°F. The differential between the temperature at which the switch closes and reopens shall be a minus 2 to minus 5°F. The switch shall be furnished integrally with a cover to fit the box assembly of Drawing 803-1197118 or shall be adapted to a cover to fit the same box assembly for the whole assembly, including the box, to be spraytight in accordance with MIL-STD-108. The cover shall be of aluminum and the switch housing shall be of compatible material or so protected as to not allow corrosion by galvanic action. Terminals of the switch shall be provided with hookup wire with terminal lugs to fit the terminal board in the box of Drawing 803-1197118. Each thermostatic switch shall be complete with the thermostatic switch portion, cover, and box assembly and shall meet the inspection specified in tables XV and XVIII. To furnish the nonmercurial IC/J unit to the Navy, the manufacturer shall first certify to the availability of an adequately accurate and portable calibration and test equipment that uses a heated surface block of high conductivity metal and that can be used for in-place testing of the nonmercurial thermostat.

3.8 Water switches.

3.8.1 Water switches shall be in accordance with Drawing 803-74081 and shall short out the line resistor and close a circuit when the electrodes are shorted by sea-like salt water.

3.8.2 Water switch shall have a power supply of 120 Vdc from the alarm switchboard of MIL-A-17196.

3.8.3 Resistor. A resistor shall be provided in accordance with 3.2.2.1 as an integral part of the water switch and shall be connected to the electrodes for use in a supervisory circuit.

3.8.4 Electrodes. The two electrodes shall be made of copper-nickel alloy for minimum corrosion in the presence of sea-like salt water. The electrodes shall be located in order to permit an accumulation of between 1/4 and 3/4 of an inch of water at the drain point before operation of the alarm takes place.

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3.8.5 Hydrostatic. The complete water switch shall withstand a hydrostatic gauge pressure of 150 lb/in^2 applied to the water inlet portion of the water switch without leaking into the cover or through the water switch body.

3.8.6 Water switch enclosure shall be 3-foot watertight.

3.9 Air flow switches. Airflow switches shall be single or multiple channel types. When the sensed airflow has decreased to an adjustable alarm point setting, airflow switches shall indicate airflow and switch alarm electrical contacts in each channel. Once switched, the contacts shall remain in that condition until the flow has returned above the alarm set point, and the airflow switch has been reset by manual operation of a switch.

3.9.1 Single channel airflow switch. Airflow switch shall be in accordance with Drawing 804-1853145 for form, fit, and function. The sensor and control panel shall work properly together when interconnected with 500 feet of cable. The airflow switch shall meet the EMI requirements of MIL-STD-461 for class IC equipment. Units of the airflow switch shall be dripproof.

3.9.1.1 Airflow meter. Airflow meter shall be a meter conforming to MIL-M-10304 as a meter only. When wired in the indicating and control panel, the meter shall supply a visual indication of airspeed in feet per minute (ft/min) when the airflow is above the alarm condition. Meter shall have an adjustable, independent pointer by which to set the alarm point on decreasing airflow. This latter pointer shall be settable to a point below zero airflow in order to preclude an alarm when it is desired to work on or idle the system. The scale shall be about 95 degree, 2-1/2-inch long arc at the pointer tip, and shall read over 0 - 1000 ft/min in 50 ft/min intervals.

3.9.1.2 Signal converter of the indicating and control panel shall convert the signals from the sensor to an output for the meter so that the airflow meter shall visually indicate the airflow being sensed. The signal converter shall have the means of adjusting the scale factor of the meter. The signal converter shall use the signal transmitted from the meter to operate electrical contacts when the low flow alarm set point has been reached. The electrical contacts shall control the airflow alarm system to indicate either no airflow, airflow that has decreased to the alarm condition set point, or loss of power to the airflow switch. One set of the electrical contacts shall be provided to close an isolated alarm circuit in which an external audible alarm can be connected to operate from ship's power for low airflow or loss of airflow.

3.9.1.3 Accuracy. Airflow system shall indicate the sensed airflow with an accuracy of 5 percent of full scale above 200 ft/min. The electrical contacts shall operate for an alarm condition within 3 percent of full scale of the indicated airflow.

3.9.1.4 Power supply. Airflow switch shall function on 115 volts, 60 Hz, ac normally and on a self-contained, sealed, nicad, 12-volt battery in an emergency. When specified (see 6.2.1), the airflow switch shall withstand without damage the transient and spike voltage of DOD-STD-1399, section 300.

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3.9.1.5 Contacts. The electrical contacts of the isolated alarm circuit shall be rated for a minimum of 1-ampere at 115 volts, 60 Hz at 0.5 pf inductive and shall be suited for 100,000 make and break cycles.

3.9.2 Multiple channel air flow switch. Airflow switch shall be made up of two separate units; the airflow sensor (in the quantity specified (see 6.2.1)) and an airflow alarm control panel.

3.9.2.1 Sensor. Sensor shall be an electrical signal switching/generating device operated by airflow from 0 to 4000 ft/min. The generated signal shall be directly proportional to the airspeed. Electrical connection between the sensor and the airflow control panel shall be by one multiple wire cable. The manufacturer shall specify whether or not the cable should be shielded, the recommended conductor size for cable length up to 500 feet long. Any bearings used in the sensor shall be permanently lubricated, shielded, and easily replaceable. The sensor shall be attached to a gasketed 6- by 8-inch plate that may be mounted on an air duct. The plate on its exterior side shall show an arrow on an information plate giving the direction of airflow by which to orient the sensor. The sensor shall be able to extend from a minimum of 2-1/2 inches to as much as 12 inches into the airstream. The extension shall then be able to be locked in place from outside the air duct. The sensor shall be supplied with 8 feet of nondetachable, shielded cable for signal transmission. The sensor shall not extend external to the duct more than 3 inches with the sensor fully extended into the duct. There shall be an identification plate on the sensor to show the name "Airflow Sensor", specification MIL-S-16032, manufacturer's name and part number.

3.9.2.2 Airflow alarm control panel. Control panel shall provide or process an electrical signal to or from the sensor to develop a measure and indication of airflow being sensed. Airflow shall be indicated on a meter that reads from 0 - 4000 ft/min in divisions of 50 - 100 ft/min and that conforms to MIL-M-10304 as a meter only. The scale shall be about a 95 degree, 2-1/2-inch long arc at the pointer tip. Control panel shall be able to work with one sensor or more, up to and including 10 sensors, as specified (see 6.2.1). A dial shall be provided to dial any sensor from which the airflow reading is desired. The dial shall be provided with a "meter OFF position". Sensors shall be constantly monitored, and the alarm status indicated on the panel face by means of an individual, red indicator light for each sensor even with the sensor selector switch in "meter OFF position". Ten sensor location identification plates (markable) shall be provided, one opposite each indicator light. The lights shall operate from a sealed 12-volt nicad battery contained in the control panel. The light shall illuminate for an alarm condition. The control panel shall contain for each sensor a separate signal converter with an adjustment by which to adjust the scale factor of the meter for that sensor. Each converter shall operate a relay for actuating a remote, external alarm device serving a particular coverter, for actuating a local audible alarm serving all converters, and for actuating the associated alarm indicator light, when the low flow alarm set point has been reached. Each converter shall have its own single control for setting the alarm point of airflow. The alarm relay shall close the battery circuit to the alarm light and the battery circuit to a type IC/B1D1 or IC/B1D2 alarm bell (takes 1/2 ampere) of MIL-A-15303 serving all converters and which bell shall be installed adjacent to the control panel. Another set of contacts of the relay shall connect a remote, audible signal

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that is supplied power from an external power supply. An on-off switch shall be installed in the control panel in the circuit to each indicator light and to the alarm bell serving all converters. Each set of relay contacts shall be rated for a minimum of 2 amperes, 115 volts, 60 Hz resistive load. The alarm relay shall operate for an alarm condition when normal ac power is available and shall operate for an alarm condition when the emergency battery power of the control panel is all that is available. Switching provision shall be included for each converter to be disconnected completely from all electrical power when use of that converter is not desired. The control panel size shall be kept as small as practicable and shall be for three point bulkhead mounting. The control panel shall be dripproof. The loss of ac power shall cause an audible alarm condition indication from the bell serving all converters in an alarm condition and be indicated by the extinguishing of a separate, white indicator light for power on. The audible alarm for power failure shall be shut off by operating a switch on the control panel. Operation of this switch shall not disable the audible alarm for operation of the airflow switch on battery power. A self-contained testing system shall be included in the control panel to test all converters simultaneously with inputs from the test system. The test signal shall be adjustable and readable in ft/min to simulate airflow over the 200 to 4000 ft/min range. This test system shall be unenergized until a test switch is actuated on the control panel. When the test switch is actuated the actual airflow input signals shall be disconnected to all converters simultaneously and the simulated airflow signals shall be connected to all converters simultaneously. The simulated airflow signal shall be accurate. Each converter shall be adjustable to give a correct reading of airflow by means of the scale factor adjustment when each converter is dialed. Operation of the test switch shall not produce an audible alarm, but the alarm indicator light of each converter shall be activated when the simulated input is at or below the alarm set point. The test system shall be calibrated by ship's force. The test switch shall be returned to the OPERATE position when the cover to the control panel is closed. Terminal board terminals shall be provided for all needed ship's wiring and for spare terminals. Terminal identification strips shall be installed. Ship's cable entrance to the control panel shall be by cable entrance plates on the top or bottom for accommodating stuffing tubes. Circuit boards of each converter shall be separately replaceable by ship's force. Except for the test switch and the scale factor adjustment, all control shall be accessible on the front of the control panel.

3.9.2.3 EMI. Airflow switch shall meet the EMI requirements of MIL-STD-461 for class A4 and A5 equipment.

3.9.2.4 Power supply. Airflow switch shall function on 115 volts, 60 Hz ac normally and on a self-contained, sealed, nicad, 12-volt battery in an emergency. The battery shall have a capacity to operate simultaneously all 10 converters for 1 hour minimum in a non-alarm condition and shall be able to operate simultaneously all channels, including alarm indicator lights and one local alarm bell, type IC/B1D1 or IC/B1D2 of MIL-A-15303, a minimum of 15 minutes in an alarm condition. A battery charging circuit shall be included in the control panel to trickle charge or taper charge the battery. If a trickle charger is provided, the charging rate shall be adjustable with a single control and be limited to a safe charging current in accordance with the battery manufacturer's recommendations. The airflow switch shall be able to withstand without damage the transient and spike voltage of DOD-STD-1399, section 300, when specified (see 6.2.1).

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3.9.2.5 Accuracy. Airflow system shall indicate the sensed airflow with an accuracy of 5 percent of full scale above 200 ft/min. The alarm contacts shall operate for an alarm condition within 3 percent of full scale of the indicated airflow.

3.10 Liquid flow switches. Flow switch shall close or open an alarm circuit for a low or high flow rate setting as specified (see 6.2.1). The switch shall consist of a bronze or corrosion-resisting steel or nickel-copper alloy body and bonnet or cap assembly, a flow sensing mechanism of corrosion-resistant metal or plastic material, and a switch assembly. The switch shall be installed directly in the fluid flow line and shall be furnished in various sizes to cover a variety of flow rate ranges. The flow switch shall be able to be used in seawater, various fuels, lubrication, and hydraulic oils. The flow sensing element shall be impervious to and unaffected by the above liquids. The switch shall be suitable for flow temperatures from 0 to 200°F.

3.10.1 Mechanical features. Body shall be provided with socket end fittings with streamlined interior and with a groove for a preinserted ring (furnished by customer) of silver-brazing alloy in accordance with MIL-F-1183 or shall have NPT threads, as specified (see 6.2.1). The switch assembly shall be easily removed from the body by removing a holding nut. A leak-tight seal shall be provided between the body and the bonnet or cap assembly and the switch assembly. The actuating flow shall have a tolerance of plus or minus 10 percent of the actuation setting over the actuation flow range for temperatures of 32 - 150°F. The switch differential (the flow change to reset the switch after alarm) shall be not greater than 10 percent of the actuating setting. It shall be constructed to offer the minimum pressure drop over the actuation flow range. The switch proof gauge pressure shall be a minimum of 400 lb/in^2 at 100°F. The flow direction shall be indicated by an arrow cast on the body or the words "IN" and "OUT" shall be cast on the tube or pipe connections of the body. The range of flow rates inside of which the actuation flow rate setting may be specified shall be fixed. The type designation of the switch and the manufacturer's part number shall be cast on the body of the switch or on the tube or pipe connections or shall be provided by an attached identification plate. The switch shall be constructed as small and as light in weight as practical.

3.10.2 Electrical details. Electrical switch shall be hermetically sealed and switching action shall be for quick make and break. The switch shall be a sensitive switch in accordance with MIL-S-8805. The switch shall be securely fitted inside the flow switch assembly. The switch action shall be in accordance with table X, as specified (see 6.2.1). Electric wiring to or from the electrical switch shall be either by stuffing tube, electrical connector (commercial design is permitted) or shall be sealed watertight with a removable sealant with a minimum of 24 inches of wiring extending. In the latter instance, a 1/2-inch NPT male fitting shall be provided when specified (see 6.2.1) to accommodate conduit in which to run and protect the wiring. Both halves of the electrical connector shall be supplied with each switch and no special conductor insertion tool shall be needed. The connector, if used by the manufacturer, shall be a watertight type and shall satisfactorily pass the salt spray test (see 4.9.20). The connector and the stuffing tube shall be for Navy type DCOP or TCOP cable to be furnished and connected by the shipbuilder. Splicing of wires shall be by insulated crimp type of connectors when a stuffing tube is used. Connection of leads from the reed switch to the connector shall be accomplished by the flow switch manufacturer.

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3.11 Single-purpose detectors. Single-purpose detectors shall be as follows:

3.11.1 Single-purpose detectors shall detect smoke and particulates of combustion and of triggering an alarm when used with the type IC/SCG alarm switchboard or the IC/BCG51 or 52 alarm panels of MIL-A-17196. If the detector uses radioactive material, it shall use such material in such a quantity that the useful life of the detector in meeting performance requirements of this specification will be, not less than 40 years. The detector shall be installable, adjustable, maintainable, and be able to be tested by unskilled personnel and shall be repairable. The enclosure shall be dripproof to the extent performance is not impaired by entry of water when the detector is mounted to the overhead or into the side or bottom of a duct. The IC/CG detector shall be able to be used for mounting to the overhead. The IC/CGD detector shall be able to be used for mounting to the overhead and for connecting to the duct by flexible hose and probes and shall be able to be used for mounting directly to the side or bottom of the duct. The detector shall meet the EMI requirements of MIL-STD-461 for class IC equipment. The detector shall be able to have its sensitivity adjusted and verified by using on shipboard a portable calibration test set. The detectors will not be deliverable to the Navy without the availability of a portable calibration test set acceptable to NAVSEA. Each detector shall be able to be tested at its installed location for its sensitivity.

3.11.2 Type IC/CGD detectors are designed to monitor smoke and high temperature in air conditioning or ventilating ducts in Naval ships and shall be furnished with a probe or probes to extend from 1 to 12 inches into the airstream. The probe shall be an inlet probe and a probe that returns the sampled air to the duct. The probes and their mount shall be able to withstand without damage 4000 ft/min airflow and shall be adequate in size to ensure immediate response.

3.11.3 Smoke detector. Smoke detector shall be provided with a calibrated adjustment that will, without disassembly, permit an operator to vary the set point or operating level to any value between the limits of visible smoke obscuration of UL 167. Test equipment like that of UL 167 shall be used for testing and setting the smoke detector or for calibrating any production tester. The alarm over the range of adjustment shall be produced within plus or minus 25 percent of the set point. Any smoke detector using radioactive material shall not be acceptable under this specification unless and until an exempt license has been issued to the manufacturer by the Nuclear Regulatory Commission (NRC) for the smoke detector pursuant to the Atomic Energy Act and Title 10 of the Code of Federal Regulations, Chapter 1, Part 30. The responsibility for obtaining the license shall wholly be that of the manufacturer. Each detector shall be tested for meeting the NRC requirements. The smoke detector shall be automatically resettable for reuse once the alarm condition has cleared. Detector shall meet the fire tests and 90-day stability tests of UL 167 and shall not be prone to false alarming. The words "do not paint" shall be applied on the enclosure of the detector (other than the duct type) in at least 1/4-inch high letters in the vicinity of the air entrances.

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3.11.4 Operating level. Detectors shall be set at the factory to operate (cause an alarm) at 2-3 percent per foot obscuration (using a smoldering cotton wick). Each detector shall be operated and at least five test readings shall be made. These readings shall not vary from the initial set point by more than plus or minus 25 percent and shall be made at ambient temperature.

3.11.5 Size and weight. Size and weight shall be kept to a minimum. The detector weight goal shall be no more than 1 pound.

3.11.6 Vibration and shock. Detector shall withstand the requirements of grade A shock in accordance with MIL-S-901 and the vibration requirements in accordance with MIL-STD-167-1, type I.

3.11.7 Accelerate life and temperature and humidity. Detector shall pass the accelerated life and the temperature and humidity tests and other tests of tables XV and XVIII. Each detector shall be built with the capability of being tested where installed for all of the functions it is to perform.

3.11.8 Electrical requirements. Detector shall be used with a 40,000 ohm end-of-line resistor furnished by the manufacturer when specified (see 6.2.1). Detector shall operate properly without damage with 220 Vdc supervisory voltage of MIL-A-17196, subject to voltage and frequency variation of input power to the alarm switchboard.

3.11.9 Performance requirements. Up to five detectors shall reliably operate off each line of the 2-line alarm unit of the switchboard or alarm panel.

3.12 Flame detector.

3.12.1 Flame detector shall operate off a nominal 115-volt, 60 Hz power supply. Each detector shall contain an isolation transformer. Detector shall be watertight (3-foot) and have an aluminum enclosure for three-point mounting. Cable entry for power and for connection to the alarm switchboard discussed below and for interconnecting detectors shall be by means of stuffing tubes. The detector shall singly or in parallel operate an IC/M module of a type IC/SM alarm switchboard of MIL-A-17196 or a two-line alarm unit of a type IC/S alarm switchboard of MIL-A-17196 for an alarm condition upon sensing a flame and for a supervisory alarm condition upon loss of 60 Hz power to the detector and for a break in the lines to the IC/M module or two-line alarm unit. To operate an IC/M module or two-line alarm unit, the detector used singly shall contain an end-of-line resistor to connect to the IC/M module or two-line alarm unit. Detector shall apparently short this resistor for an alarm condition and shall apparently open the circuit to the resistor for a power failure condition. For detectors used in parallel on an IC/M module, only one detector will have to contain the resistor. Detector size shall be not greater than 150 cubic-inches. Detector shall be explosion-proof against highly volatile petroleum vapor, when tested in accordance with MIL-E-2036.

3.12.2 Each detector shall have a cone of view of 90 degrees minimum. From 0 to 45 degrees off the center of the cone, the response time for the detector to initiate an alarm shall not exceed 3 seconds in detecting the following flames in a room with 14 foot-candles illuminance by incandescent or fluorescent lighting:

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(a) At a distance of 30 feet:
1 square foot pan of gasoline
1 square foot pan of diesel fuel
1 square foot pan of alcohol
Electric welding arc
(b) At a distance of 6 feet:
1 paper match
1 propane soldering torch flame 1- to 2-inches long in blue flame condition

Detector shall meet the response time for each different flame at the four cardinal points of the circular section of a right cone at the maximum of 45 degrees off the center of the cone at the distances specified above. For all flames and at all angles specified above, the detector shall initiate an alarm without a miss. Detector shall be a response time adjustment range of 2 - 4 seconds minimum adjustable without assembly of detector. Detector shall not initiate an alarm for sunlight, incandescent, or fluorescent lights of lighting systems, a hot radiator or engine at 170 to 212°F and at a distance of 3 feet, a flickering light of a lighting system, or of sunlight flickering off water, a flashlight, or a red lamp. Detector shall perform at any inclination or attitude with the above response and sensitivity in the ambient temperature of 40 to 149°F. Detector shall provide a light indication that the detector has alarmed which shall remain lit until manually reset.

3.12.3 Detector shall withstand the shock and vibration requirements of MIL-E-16400, the range 4 temperature requirements of MIL-E-16400, the non-operating temperature requirements of MIL-E-16400, the voltage and frequency variation of MIL-E-16400 for 115-volt, 60-Hz power without any impairment of performance (see 6.2.1).

3.12.4 Detector shall meet the EMI requirements of MIL-STD-461 for class A4 and A5 equipment.

3.12.5 Detector shall withstand without damage, the transient and spike voltage of DOD-STD-1399, section 300.

3.13 Marking. Name of switch and type designation in accordance with 1.2 and the manufacturer's name and part number shall be shown on an identification plate or shall be stamped on each detector, as specified. Identification plate shall be in accordance with 3.2. Information plates shall be in accordance with 3.2. Radioactive material warning plate shall be marked in accordance with the *Nuclear Regulatory Commission (NRC) requirements and of the same material as* specified for the above plates.

3.14 Drawings. When specified in the contract order, drawings shall be prepared (see 6.2.2).

3.15 Reliability. For type IC/N (thermocouple or other type involving electronics), IC/F, IC/ASE, IC/CG, and IC/CGD units, the contractor shall conduct a reliability program in accordance with MIL-STD-785 and shall develop the reliability data items. Each item shall meet a specified mean-time-between-failure of not less than 3×10^4 hours (failure rate not greater than 1 failure per 3×10^4 hours).

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3.15.1 Reliability prediction. A reliability prediction shall be developed using the stress analysis procedures and failure rates of MIL-HDBK-217.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 an 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Inspection system. When specified in the contract or order, an inspection plan shall be prepared (see 6.2.2).

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

(a) Qualification inspection (see 4.3).
(b) First article inspection (see 4.3.3).
(c) Quality conformance inspection (see 4.5).

4.3 Qualification inspection for types ICL, N, R, RH, RL, DM, J, W, FS and ASE only. Qualification inspection shall be conducted at a laboratory satisfactory to NAVSEA. Qualification inspection shall consist of the examination and tests specified in table XV.

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TABLE XV. Qualification and first article inspection.

Examination and test	Requirement	Inspection
General examination	----	4.8
Operating	3.3 through 3.12	4.9.1 and 4.9.13
Physical and electrical design features 3/4/5/6/7/8/9/10/12/	3.2.1.4 and 3.5	4.9.18
Dielectric strength and insulation resistance clearances	3.2 and 3.5.2.2	MIL-E-16400
Endurance 1/2/4/5/6/7/8/9/12/	3.7.1	4.9.3
Fire and 90-day stability 1/2/ 3/4/5/6/7/8/10/12/	3.11.3	4.9.23
Supply line voltage and frequency variation 1/2/3/4/5/ 7/8/12/		
For flame detector	3.12.3	4.9.1.3
For single-purpose detector	3.11.8	4.9.1.2
For temperature switch, IC/N	3.2	MIL-E-16400
For airflow switch	3.2 and 3.2.3	MIL-E-16400 and 4.9.1.1
Means of adjustment and variation from setting 1/2/3/4/5/10/12/	3.3.2, 3.3.3, 3.4.4, 3.4.6, 3.9, 3.11.1, and 3.11.3	4.9.10
Differential 1/2/3/4/6/9/10/12/	3.3.4, 3.4.7, and 3.10.1	4.9.2.7 and 4.9.11
Carrying capacity of contacts and contact resistance 2/3/4/12/ (to be done after all other tests are completed)	3.2.2 and 3.9	4.9.12
Contact temperature rise 2/3/4/ 9/12/ (to be done after all other tests are done)	3.2.2	4.9.14
Time lag 1/2/3/4/5/6/7/ 9/10/12/	3.4.6	4.9.7
Over pressure or over temperature 1/2/3/4/5/6/9/10/12/	3.3.1.1 and 3.4.3	4.9.8 and 4.9.15
Elevation of case 1/2/3/4/ 5/6/7/9/10/12/	3.4.1.3	4.9.16
Effect of ambient temperature 1/2/3/4/5/6/7/9/10/12/	3.4.5	4.9.9
Centrifuge 1/2/4/5/6/7/8/ 9/10/12/	3.2.6	4.9.5
Accuracy and time lag 1/2/ 4/7/8/10/12/	3.7.1, 3.9, 3.10.1 and 3.11	4.9.2.7 and 4.9.4

See footnotes at end of table.

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TABLE XV. Qualification and first article inspection. - Continued

Examination and test	Requirement	Inspection
Hydrostatic 2/3/6/7/8/9/10/12/	3.5.2.2, 3.8.5, and 3.10.1	4.9.6
Temperature and humidity and non-operating temperature test:	3.2 and 3.11.7	MIL-E-16400
Temperature test 1/3/4/5/7/8/9/10/12/		
Non-operating temperature test		
Humidity test 1/3/4/5/7/8/10/12/	3.2	MIL-E-16400
Accelerated life 3/4/12/ and inclination	3.2.5 and 3.11.7	4.9.2
Enclosures 1/2/5/ (electrical connectors, if used, are to be installed)	3.2, 3.3.1, 3.4.1, 3.7.1.3(c), 3.8.6, 3.9, 3.11 and 3.12	MIL-E-16400 and 4.9.22
Electromagnetic interference 1/2/3/4/5/6/7/8/12/	3.4, 3.9, 3.11 and 3.12	4.9.19
Transient and spike voltage 1/2/3/4/5/6/7/8/9/12/	3.9 and 3.12.5	4.9.21
Salt spray 2/3/4/6/10/12/	3.2	MIL-E-16400 and 4.9.20
Vibration 11/12/	3.2 and 3.11.6	MIL-E-16400 and 4.9.17
Shock 11/12/	3.2 and 3.11.6	MIL-E-16400 and 4.9.17

1/ Does not apply for liquid level switches.
2/ Does not apply for door switches.
3/ Does not apply for thermostatic switches (mercurial), type IC/J.
4/ Does not apply for water switches.
5/ Does not apply for liquid flow switches.
6/ Does not apply for airflow switches.
7/ Does not apply for pressure switches.
8/ Does not apply for temperature switches, type IC/N, except for thermocouple or electronic type.
9/ Does not apply for single purpose detectors.
10/ Does not apply for flame detector.
11/ To successfully complete this test the switch or detector under test shall not suffer any broken or detached part nor any impairment of its proper normal operation as determined by accuracy tests conducted after shock and vibration. No alarm condition shall be triggered by the switch or detector while undergoing the vibration test.
12/ Does not apply for nonmercurial IC/J thermostatic switches.

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4.3.1 Samples for qualification and first article inspection. Two switches or detectors of each type for which qualification and first article are desired shall be subjected to the examination and tests specified in table XV.

4.3.1.1 In lieu of conducting the full list of qualification tests or comparison tests (see 4.6) on each different unit of a series of a type of switch or detector, the manufacturer shall consult NAVSEA for those tests for which one switch or detector can be representative of the series or some portion of a series.

4.3.2 Before authorization of qualification tests, the manufacturer shall submit drawings to NAVSEA for review. In addition, the reliability prediction (see 3.15.1) shall be furnished with the application for qualification.

4.3.3 First article inspection for types IC/F, CG and CGD only. First article inspection for types IC/F, CG and CGD shall consist of the examination and tests specified in table XV.

4.3.3.1 First article inspection report. When specified in the contract or order, a first article inspection report shall be prepared (see 6.2.2).

4.4 Sampling for quality conformance inspection.

4.4.1 Lot. Switches or detectors of the same type presented for delivery at one time shall be considered a lot. The lot may include the entire contract quantity or it may be the production of any convenient time period.

4.4.2 Sampling for group A inspection. A sample of switches or detectors shall be selected from each lot in accordance with table XVI and subjected to the group A examination and tests specified in 4.5.

TABLE XVI. Sampling for group A inspection AQL (Approx) = 4.0 percent.

Number of switches or detectors in lot	Number of switches or detectors in sample	Number of switches or detectors nonconforming on any group A inspection	
		Acceptable number	Rejection number
7 and under	All	0	1
8 to 15	7	0	1
16 to 40	15	0	1
41 to 110	25	1	2
111 to 300	35	1	2
301 to 500	50	2	3
501 to over	75	3	4

4.4.3 Sampling for group B tests. A sample of switches or detectors shall be selected from each lot in accordance with table XVII and subjected to the group B tests specified in 4.5.

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TABLE XVII. Sampling for group B tests AQL (Approx) = 7 percent.

Number of switches or detectors in lot	Number of switches or detectors in sample	Number of switches or detectors nonconforming on any group B tests	
		Acceptance number	Rejection number
3 and under	All	0	1
4 to 15	3	0	1
16 to 40	5	0	1
41 to 110	7	0	1
111 to 300	10	0	1
301 to 500	15	1	2
501 and over	25	2	3

4.4.4 Sampling for group C tests. Group C tests shall be required by NAVSEA only when the basic design of the switches or detector or the material of a vital part has been changed. Two switches or detectors shall be selected and subjected to the group C tests specified in 4.5.

4.5 Quality conformance inspection. Pressure and thermostatic switches covered in the contract or order shall be subjected to the operating temperature or pressure and differential test specified in 4.9.11 and 4.9.12. Sample switches or detectors selected in accordance with 4.4 shall be subjected to the examination and tests specified in table XVIII. Tests shall be performed, in general, in the order listed.

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TABLE XVIII. Quality conformance inspection.

Inspection	Requirement	Inspection reference
Group A		
General examination	------	4.8
Operating	3.3 through 3.12	4.9.1, 4.9.1.1, and 4.9.13
Dielectric strength and insulation resistance clearances	3.2 and 3.5.2.2	MIL-E-16400
Endurance 1/2/4/5/6/7/8/9/10/13/	3.7.1	4.9.3
Physical and electrical design features 3/4/5/6/7/8/9/10/13/	3.2.1.4 and 3.5	4.9.18
Differential 1/2/3/4/6/9/10/13/	3.3.4, 3.4.7, and 3.10.1	4.9.2.7 and 4.9.11
Group B		
Supply line voltage and frequency variation 1/2/3/4/5/7/8/13/		
For single-purpose detector	3.11	4.9.1.2
For airflow switch	3.2 and 3.2.3	MIL-E-16400 and 4.9.1.1
For temperature switch IC/N	3.2	MIL-E-16400
For flame detector	3.12.3	4.9.1.3
Means of adjustment and variation from setting 1/2/3/4/5/10/13/	3.3.2, 3.3.3, 3.4.4, 3.4.6, 3.9, and 3.11.3	4.9.10
Carrying capacity of contacts and contact resistance 2/3/4/11/13/	3.2.2 and 3.9	4.9.12
Contact temperature rise 2/3/4/9/13/	3.2.2	4.9.14
Time lag 1/2/3/4/5/6/7/9/10/13/	3.4.6	4.9.7
Over pressure or over temperature 1/2/3/4/5/6/8/10/13/	3.3.1.1 and 3.4.3	4.9.8 and 4.9.15
Elevation of case 1/2/3/4/5/6/7/9/10/13/	3.4.1.3	4.9.16
Effect of ambient temperature 1/2/3/4/5/6/7/9/10/13/	3.4.5	4.9.9
Centrifuge 1/2/4/5/6/7/8/9/10/13/	3.2.6	4.9.5
Accuracy and time lag 1/2/4/7/8/10/13/	3.7.1, 3.9, 3.10.1, and 3.11	4.9.2.7 and 4.9.4
Hydrostatic 2/3/6/7/8/9/10/13/	3.5.2.2, 3.8.5, and 3.10.1	4.9.6

See footnotes at end of table.

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TABLE XVIII. Quality conformance inspection. - Continued

Inspection	Requirement	Inspection reference
Group C		
Fire and 90-day stability 1/2/3/4/5/6/7/8/10/13/	3.11.3	4.9.23
Temperature (range 4) and humidity: Temperature test 1/3/4/5/7/8/9/10/13/ (non-operating temperature (for IC/J switches))	3.2	MIL-E-16400
Humidity test 1/3/4/5/7/8/10/13/	3.2	MIL-E-16400
Enclosures 1/2/5/ (Electrical connectors, if used, are to be installed.)	3.2, 3.3.1, 3.4.1, 3.7.1.3(c), 3.8.6, 3.9, 3.11 and 3.12	MIL-E-16400 and 4.9.22
Salt spray 2/3/4/6/10/13/	3.2	MIL-E-16400 and 4.9.20
Accelerated life and inclination 3/4/13/	3.2 and 3.2.5	MIL-E-16400 and 4.9.2
Electromagnetic interference 1/2/3/4/5/7/8/13/	3.4, 3.9, 3.11, and 3.12	4.9.19
Transient and spike voltage 1/2/3/4/5/7/8/9/13/	3.4, 3.9, and 3.12	4.9.21
Vibration 12/13/	3.2 and 3.11.6	MIL-E-16400 and 4.9.17
Shock 12/13/	3.2 and 3.11.6	MIL-E-16400 and 4.9.17
Endurance 1/2/4/5/6/7/8/9/10/13/	3.7.1	4.9.3

1/ Does not apply for liquid level switches.
2/ Does not apply for door switches.
3/ Does not apply for thermostatic switches (mercurial).
4/ Does not apply for water switches.
5/ Does not apply for liquid flow switches.
6/ Does not apply for airflow switches.
7/ Does not apply for pressure switches.
8/ Does not apply for temperature switches, type IC/N, except for thermocouple or electronic type.
9/ Does not apply for single purpose detectors.
10/ Does not apply for flame detectors, type IC/F.
11/ To be done after all other tests are done.
12/ To successfully complete this test the switch or detector under test shall not suffer any broken or detached part nor any impairment of its proper, normal operation as determined by accuracy tests conducted after shock and vibration. No alarm condition shall be triggered by the switch or detector while undergoing the vibration test.
13/ Does not apply for nonmercurial IC/J thermostatic switches.

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4.5.1 Quality conformance inspection report. When specified in the contract or order, a quality conformance inspection report shall be prepared (see 6.2.2).

4.6 Comparison inspection. One representative sample of each qualified switch or detector from the current production shall be subjected to a comparison inspection consisting of all qualification tests of table XV and shall successfully pass all of the tests of the comparison inspection at the end of every 2 years after initial qualification or once for each 50 units produced, whichever required the lower frequency of testing. In the event 50 units are not produced over a period of 3 consecutive years, the comparison inspection shall be performed at no less frequency than at the end of every 3 years after initial qualification or the previous comparison inspection. Completion of the first necessary comparison test that is imposed by the above stipulations shall be done within 1 year of the issue date of this requirement. Test procedures shall be reviewed by NAVSEA before testing is conducted.

4.7 Rejection. Results of operating temperature or pressure tests shall be compared with the requirements of 3.3 and 3.4. Results of groups A, B, and C examination and tests shall be compared with all the requirements of this specification. Failure to conform to this specification for any test shall be counted as a defect, and the switches or detectors shall not be offered for delivery except under the criteria of section 6 of MIL-STD-105. Failure of tests specified in 4.9.2 and 4.9.3 shall result in the formulation of a corrective action plan, including the analysis of the failure and the proposed actions (design processing, workmanship, and so forth), to preclude recurrence.

4.8 General examination. Examination shall be conducted in accordance with MIL-E-16400.

4.9 Tests.

4.9.1 Operating test (for all types of switches). Operating test shall determine conformity to the applicable operational requirements of 3.3 through 3.12.

4.9.1.1 Variation in supply voltage (airflow switch). Test is identical to the operating test except that the test shall be performed with the voltage and frequency variations of 3.2.3, and the accuracy shall be as specified in 3.9.1.3 and 3.9.2.5.

4.9.1.2 Variation in supply voltage (single purpose detector). Detector shall be tested to meet the requirements of 3.11.8.

4.9.1.3 Variation in supply voltage and frequency (flame detector). Detector shall be tested to meet the requirements of 3.12.3.

4.9.1.4 Operating test (flame detector). Detectors shall be tested to meet the requirements of 3.12.2.

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4.9.2 Accelerated life and inclination tests.

4.9.2.1 Pressure switches. Switch shall be operated by pressure at the upper end of the working range for a period of 24 hours at a rate of one complete, operational cycle each 30 seconds. The first 12 hours of the accelerated life test shall be made at an ambient temperature of 40°F (3 hours with 60 degrees forward inclination, 3 hours with 60 degrees backward inclination, and 3 hours each with 60 degrees left and right inclination) and the final 12 hours at an ambient temperature of 158°F with the same inclination procedure as for 40°F. Accelerated life test shall be made with the primary contacts and secondary contacts (if any) carrying rated load. At each extreme ambient temperature, the extreme pressure supply temperatures of 3.3.1.2 shall be applied. Immediately following completion of the accelerated life test contact resistance measurements shall be made to determine conformance to 3.2.2. After the testing specified herein, the nonoperating temperature test of MIL-E-16400 shall be performed. Tests of 4.9.10 and 4.9.11 shall be conducted afterwards to assure switches are still operating.

4.9.2.2 Temperature switches (125 to 225°F, 150 to 225°F, 400 to 580°F or any range between 0 and 675°F). Switches shall be operated by temperature at the upper end of the working range for a period of 48 hours at the rate of one complete cycle each 5 minutes with the primary contacts carrying rated load. The first 24 hours of the test shall be made at the minimum ambient temperature (6 hours with 60 degrees forward inclination, 6 hours with 60 degrees backward inclination, and 6 hours each with 60 degrees left and right inclination) and the final 24 hours at the maximum ambient temperature specified in 3.4.4 with the same inclination schedule as for minimum ambient temperature. Immediately following the completion of the accelerated life test, contact resistance measurements shall be made to determine conformance to 3.2.2.

4.9.2.3 Temperature switches (675 to 925°F, 900 to 1100°F ranges). Switches shall be tested by installation and operation on an active boiler for a period of approximately 2 weeks, after which the opening and closing settings shall be verified and shall not have changed more than plus or minus 5°F. Operation during this trial shall be reliable.

4.9.2.4 Liquid level switches. Switch action shall be monitored electrically throughout this test. In conducting the accelerated life test, the liquid level switch shall be cycled, actuated and deactuated by mechanical means without submergence 2000 times under maximum load conditions. After all tests of 4.3 or 4.5, as applicable, have been completed (including shock), the switch shall be cycled for an additional 400 times to ensure proper electrical operation. Switch shall then be installed in a tank that is filled with a liquid of like consistency and substance to that which would be present in a ship's bilge. Tank shall be so arranged that it will move constantly to simulate the rolling and pitching of a ship at bilge level. Provisions shall be made to change the liquid level in the tank to actuate the switch. Switch shall be cycled while in the tank a minimum of 100 times over a period of from 4 to 5 days and then remain in the tank for 30 days, after which time the switch shall be cycled an additional 50 times by changing the liquid level in the tank. For 40 of the 50 times the tank shall be inclined from the vertical 60 degrees forward, backward, left and right while the switch is cycled 10 times for each inclination. Switch shall perform properly throughout this test without needing any maintenance.

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4.9.2.5 Door switches. For the accelerated life test, the door switch shall be cycled by mechanical means simulating 2000 times actual operating conditions and after the vibration and shock tests of 4.3 or 4.5 are completed the switch shall be cycled for an additional 400 times to ensure proper mechanical and electrical operation. An examination shall then be made to insure that no mechanical or electrical components have been damaged.

4.9.2.6 Airflow switches. In conducting the accelerated life test, the airflow switch shall be cycled by varying the airflow through the alarm condition set point 2000 times with the alarm electrical contacts carrying maximum load. After all applicable tests of 4.3 or 4.5 are complete, the switches and contacts shall be cycled an additional 400 times to ensure proper electrical operation. Airflow switch shall be tested and be required to meet the accuracy of 4.9.4.7 after the life test.

4.9.2.7 Liquid flow switches. In conducting the accelerated life test, the liquid flow switch shall be cycled (by mechanical means without liquid flow) 2000 times under maximum electrical load conditions. After all tests of 4.3 or 4.5, as applicable, have been completed (including shock), switch shall be cycled for an additional 400 times to ensure proper electrical operation. Switch shall then be installed in a line through which liquid is flowing at or above the predetermined flow setting. Provisions shall be made to change the liquid flow in the line and the liquid temperature. Switch shall be cycled a minimum of 100 times by liquid flow over a period of from 4 to 5 days with temperatures of the liquid at 32°F for 1 day, at 200°F for 1 day and at any temperature between 32 and 200°F for the remainder of the time. At the extreme temperatures, the switch shall be inclined 60 degrees forward, backward, left and right to test that there is no significant effect on the operation of the switch. Actuation flow rate shall be ascertained for each different temperature and inclination to be at the set point plus or minus 10 percent of the set point and the differential shall be ascertained to be no greater than 10 percent of the actuating setting. Then the switch shall remain in the line with liquid flowing for 30 days, after which time the switch shall be cycled an additional 50 times with the actuation flow rate being ascertained to be at the set point plus or minus 10 percent of the set point, and with the differential being ascertained to be no greater than 10 percent of the set point.

4.9.2.8 Single purpose detectors. Accelerated life test shall be conducted with the detector energized for a period of 225 hours. Minimum period of alarm condition current flow operation that may be induced synthetically instead of by the actual smoke shall be 7 hours, except as indicated. The 225 hour test shall be divided as follows:

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Hours	Inclination during test	Ambient temperature during test
0 - 50		75°F nominal (room temperature). Upon completion repeat operating test.
50 - 100 continuous	3 hours at 60 degrees forward, 3 hours at 60 degrees backward, 3 hours at 60 degrees left, 3 hours at 60 degrees right.	40°F. At end of test record alarm point at 40°F then repeat operating test.
100 - 225 continuous	Same as above	149°F at approximately 95 percent relative humidity for alternate 1 hour periods. At end of test, record alarm point at 149°F and repeat operating test.

NOTE: Humidity tests may be conducted concurrently and as a part of the accelerated life test. The set point of the detector shall be 2 - 3 percent per foot smoke obscuration with the supply voltage at 220 volts. This setting shall not be altered during the qualification tests. The alarm actuation point of the smoke detecting portion of the detector at the extreme temperatures of this test shall be within plus or minus 30 percent of the set point to successfully pass this test.

4.9.2.9 Flame detector. Detector shall without a failure sense 500 separate alarm conditions distributed as follows and shall be energized all the while:

(a) 100 operations at 40°F over a minimum of 10 hours.
(b) 300 operations at 75°F over a minimum of 30 hours.
(c) 100 operations at 149°F over a minimum of 10 hours.

4.9.3 Endurance test for IC/J switches. Thermal elements shall be subjected to tests to determine conformance to 3.7.1 as to the current carrying capacity and operating point stability. Thermal elements shall be heated and cooled at a rate to cause approximate periods of 1 minute on and 1 minute off. A minimum of 50 on-off cycles shall be performed on each unit without a failure.

4.9.4 Accuracy and time lag tests. Accuracy and time lag tests shall be as follows:

4.9.4.1 For IC/J switches. Thermal elements shall be tested for accuracy and time lag by immersion of the exposed portion of the thermal element in oil baths utilizing SAE 30 quality oil or equal. Thermostatic elements shall be connected with an alarm system similar to service installations.

4.9.4.2 For IC/J switches. Thermostatic elements shall be conditioned for 5 minutes in oil at a constant temperature of 5°F below the element-rated operating temperature before starting any accuracy or time-lag tests. Upon completion of the "conditioning" period in oil, the thermostatic element shall be tested for accuracy of operation temperature by immersion in a bath of oil rising in temperature at a rate of not more than 1°F per minute. The temperature of operation of the element shall be recorded.

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4.9.4.3 For IC/J switches. Upon completion of the accuracy test the thermostatic element shall be again conditioned as specified in 4.9.4.2. Having completed the required conditioning period, the thermostatic element shall be tested for time lag by immersion in a bath of oil, continuously stirred, at a constant temperature of 5°F above the rated operating temperature of the thermostatic element. Time lag between immersion and operation of the thermostatic element shall be recorded.

4.9.4.4 For IC/J switches. Operation under the accuracy tests shall be within the limits specified in 3.7.1. Time lag shall not exceed that specified in 3.7.1.

4.9.4.5 For IC/J switches. Each thermostat shall be tested for accuracy of the supervisory contact setting at minus 45 $\pm$ 5°F.

4.9.4.6 Accuracy (water switch). Alarm circuit connected to the contacts shall operate when there is an accumulation of between 1/4 and 3/4 of an inch of water in the water switch.

4.9.4.7 Accuracy (airflow switch). Airflow sensor shall be subjected to monitored airflows in 10 percent increments over the indicated range. Airflow meter shall indicate flow with an accuracy of 5 percent of full scale. While the meter is indicating an airflow within its required range, the switch point indicator shall be adjusted upward until the system switches its alarm contacts. Alarm set point control shall be within 3 percent of full scale of the indicated airflow when this occurs. System alarm set point shall be tested at three different airflows (that is, lower, middle, and upper range).

4.9.4.8 Accuracy and time lag (single-purpose detector). A test shall be performed to assure conformance to 3.11.3 and 3.11.4.

4.9.5 Centrifuge test for IC/J switches. Mercury-in-glass thermal elements of mercurial thermostatic switches shall be subjected to a centrifuge test. Thermal element shall be placed in a centrifuge at the normal room temperature of approximately 70°F and spun at various acceleration values in the direction parallel to the capillary tube and away from the bulb. Acceleration values shall be computed, using as a radius the end of the mercury column in the capillary tube. Mercury column shall not be broken in the centrifuge test at acceleration values specified in 3.2.6.

4.9.6 Hydrostatic test for type IC/W, IC/FS, and liquid level switches. Complete water switch shall be tested hydrostatically to determine conformance to 3.8.5. Reed switch capsule of the liquid level switch shall be tested to meet 3.5.2.2. Liquid flow switch shall be tested for conformance to a proof pressure of 400 lb/in^2 at 100°F temperature of flowing medium.

4.9.7 Time lag for type IC/N switches. Thermostatic switches for the range 675 to 925°F and 900 to 1100°F shall be tested for conformance to the time lag requirements of 3.4.6 as follows: switch shall be adjusted to close the electric lamp circuit at a temperature setting of 726 or 950°F, as applicable. Bare bulb shall be immersed in a bath (moderately agitated) at 520 or 700°F, as applicable, and held in the bath for 20 minutes. Bulb shall be quickly immersed in another bath (moderately agitated), the temperature of which shall be 850 or 1100°F, as applicable. Immersion in each bath shall be to a point 1-1/2 inches from the

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flange. The interval between the time the bulb is immersed in the high temperature bath, and the time the electrical contact is established shall be designated as the "time lag". The above temperature settings are based on a time constant that is defined as the time it takes a thermostatic switch to correspond to a temperature that is 62.3 percent of the difference between the two test temperatures.

4.9.8 Over temperature for type IC/N switches. The lower portion of the bare bulb shall be immersed to a point 1-1/2 inches from the flange for the period of time specified in 3.4.3 in a liquid bath having a temperature of the sensitive element. Bulb shall be allowed to cool at atmospheric temperature in air. Switch shall then be retested for accuracy.

4.9.9 Effect of ambient temperature for type IC/N switches. Switch case and capillary tubing shall be successively subjected to ambient temperatures as specified in 3.4.4 to determine conformance to 3.4.5. Effect of ambient temperature shall be checked for at least three settings (that is, lower, middle, and upper). Precise settings shall be left to the discretion of the testing activity.

4.9.10 Means of adjustment and variation from setting for type IC/L, IC/N, and IC/ASE switches and single purpose detectors. Pressure, thermostatic, and airflow switches and single purpose detectors shall be tested to determine that the means of adjustment provides for the adjustment required in 3.3.2, 3.3.3, 3.4.4, 3.4.6, 3.9, and 3.11, as applicable. The means of adjustment test and variation from setting test shall be checked for at least three settings (that is, lower, middle, and upper), which settings will be left to the discretion of the testing activity.

4.9.11 Differential for type IC/L and IC/N switches. Pressure and thermostatic switches shall be tested to determine that the differential is within the limits specified in 3.3.4 and 3.4.7, as applicable. Differential test shall be checked for at least three settings (that is, lower, middle, and upper), which settings will be left to the discretion of the testing activity.

4.9.12 Contact resistance and carrying capacity of contacts for all types of switches and detectors. Relays and switches shall be tested to determine that the current capacity and contact resistance of the contacts are in accordance with 3.2.2 and 3.9.

4.9.13 Operating temperature or pressure for type IC/L and IC/N switches. Pressure and thermostatic switches shall be tested to determine that the operating pressure or temperature conform to 3.3 or 3.4. Operating temperature or pressure test shall be checked for at least three settings (that is, lower, middle, and upper). Precise settings will be left to the discretion of the testing activity.

4.9.14 Contact temperature rise for all types of switches. Switch contacts shall be tested to determine conformance to the temperature rise requirements of 3.2.2.

4.9.15 Over pressure for type IC/L switches. Pressure switches shall be tested for conformance to 3.3.1.1.

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4.9.16 Elevation of case for type IC/N switches. Thermostatic switches provided with capillary tubes shall be tested for the elevation requirements of 3.4.1.3.

4.9.17 Vibration of shock. Vibration and shock tests shall be as follows:

4.9.17.1 Single purpose detectors. Complete units shall be vibration tested to assure conformance to the requirements specified in 3.11.6, except that the variable frequency test shall be eliminated. Complete unit shall be shock tested to assure conformance to 3.11.6. Operating test of the smoke detector shall be performed inside a chamber having a measured concentration of smoke; therefore, the operating test cannot be performed during shock and vibration tests. Operating test shall be performed, before shock and vibration tests.

4.9.17.2 Type IC/N and IC/L switches. Pressure or temperature switches shall be tested at the nominal, maximum working pressure or maximum working temperature specified in tables II and III. To acceptably pass the test, the unit under test shall not erroneously trigger an alarm while being vibrated, shall not mechanically fail, and shall be able to pass the tests of 4.9.10 and 4.9.11 afterwards.

4.9.17.3 Shock and vibration (for liquid level switches). Type IC/R, RL or RH liquid level switches shall be tested for shock and vibration. Type IC/RH switch having the longest stem that is supplied shall be tested for shock and vibration.

4.9.18 Physical and electrical design features for type IC/R, RL, RH, and IC/DM switches. Tests shall be performed to assure the floats and reed switches of liquid level switches meet the physical and electrical design requirements of 3.5. Tests shall be performed to assure conformance to 3.2.1.4.

4.9.19 EMI (airflow switches, temperature switch, single-purpose detectors, and flame detector). Test shall be conducted in accordance with MIL-STD-462 to show the switches and detectors meet the requirements of 3.4, 3.9, 3.11, and 3.12.

4.9.20 Salt spray (for type IC/L, IC/N switches liquid level and liquid flow switches and single-purpose detectors. Only the electrical connectors to be used for cable entrance in these switches and the case of the single purpose detectors shall be subjected to the salt spray test.

4.9.21 Transient and spike voltage (airflow switch, temperature switch, and flame detector. Airflow switch, flame detector, and electronic or thermocouple type temperature switch shall be tested to withstand without damage the transient voltage and spike voltage of DOD-STD-1399, section 300.

4.9.22 Enclosure test. For explosionproofness, the flame detector shall be tested in accordance with MIL-E-2036. Acceptance criteria shall be as specified in MIL-STD-108.

4.9.23 Fire stability tests. Single-purpose detectors shall be tested to meet the fire and 90-day stability tests of UL 167.

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4.10 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.7.)

5.1 Preservation-packaging, packing, and marking. Equipment, accessories, and manuals shall be preserved-packaged level A or C, packed level A, B, or C as specified (see 6.2.1), and marked in accordance with MIL-E-17555. For IC/J units, a warning label shall be applied to the unit, intermediate, and shipping containers as follows:

"WARNING:
Contains equipment using mercury
which may be injurious to your health
if spilled."

In addition, poison labels as required by Department of Transportation regulations shall be applied to the shipping container.

5.2 Cushioning, dunnage, and wrapping materials.

5.2.1 Level A preservation-packaging, level A and B packing. Use of all types of loose-fill materials for applications such as cushioning, filler, stuffing, and dunnage for material destined for shipboard use is prohibited. Cushioning and wrapping materials selected, whenever available, shall exhibit improved performance characteristics for resistance to fire. Examples are:

UU-P-268	- Type II, grade C or D
PPP-C-850	- Grade SE, type I or II only
PPP-C-1120	- Type III or IV, class C
MIL-R-6130	- Grade A
MIL-R-20092	- Class 1 or 4

5.2.2 Level C preservation-packaging, and packing. Unless otherwise specified in the contract or order, use of all types of loose-fill materials for applications such as cushioning, filler, stuffing, and dunnage for material destined for shipboard use is prohibited. When approved for use by the contract or order, unit packages and containers (interior and exterior) shall be marked or labeled as follows:

"CAUTION
Contents cushioned, etc. with loose-fill material.
Not to be taken on board ship.
Remove and discard loose-fill material before
shipboard stowage.
If required, recushion with cellulosic material,
bound fiber, fiberboard, or transparent flexible
cellular material."

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6. NOTES

6.1 Intended use. Switches covered by this specification and their intended use are shown in tables XIX through XXV and 6.1.1.

TABLE XIX. Pressure switches.

Type	Range	Contacts close on	Voltage ac
IC/L1D	15 to 28 inches mercury absolute	Drop	115
IC/L2D	1 to 15 lb/in^2	Drop	115
IC/L2T	1 to 15 lb/in^2	Drop	115
IC/L3D	15 to 50 lb/in^2	Drop	115
IC/L3T	15 to 50 lb/in^2	Drop	115
IC/L4D	50 to 100 lb/in^2	Drop	115
IC/L5D	25 to 50 lb/in^2	Drop	115
IC/L5F	25 to 50 lb/in^2	Drop	440
IC/L6C	20 to 80 lb/in^2	Rise	440
IC/L7M	1000 to 5000 lb/in^2	Drop	440

TABLE XX. Temperature switches.

Type	Range °F	Contacts close on	Length of capillary tube (feet)	Length of bulb (inches)	Connection
IC/N30S16	125 to 225	Rise	None	1	1/2 inch
IC/N31A1	150 to 225	Rise	None	3	3/4 inch
IC/N31A2	150 to 225	Rise	None	3	1/2 inch
IC/N31A11	150 to 225	Rise	10	3	3/4 inch
IC/N31A12	150 to 225	Rise	10	3	1/2 inch
IC/N32A5	675 to 925	Rise	None	9	Flanged
IC/N32A15	675 to 925	Rise	20	10	Flanged
IC/N32A9	675 to 925	Rise	None	11	Flanged
IC/N33A6	900 to 1100	Rise	None	10	Flanged
IC/N33A16	900 to 1100	Rise	20	10	Flanged

TABLE XXI. Liquid level switches.

Type	Contacts close on
IC/R1-U	Rise
IC/R1-V	Drop
IC/RH1-U	Rise
IC/RH1-V	Drop
IC/RH2-U	Rise
IC/RH2-V	Drop
IC/RL1-U	Rise

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TABLE XXII. Door switches.

Type	Mechanical range feature	Contacts close on
IC/DM-1-0	Adjustable	As required

TABLE XXIII. Mercurial thermostatic switches.

Type	Operating point °F	Primary use
IC/J-105	105	Magazines or spaces having similar hazards
IC/J-125	125	Film rooms, paint rooms
IC/J-150	150	Storerooms, cargo holds and refrigerated cargo holds

TABLE XXIV. Airflow switches.

Type	Range (ft/min)	Operating point	Contacts operate on
IC/ASE-1-W1000	200 - 1000	Adjustable	Drop

TABLE XXV. Liquid flow switches.

Type	Contacts close on	Flow setting see table IV minimum and maximum
IC/FS-075-U	Rise (increased flow)	Various
IC/FS-075-V	Drop (decreased flow)	Various
IC/FS-100-U	Rise	Various
IC/FS-100-V	Drop	Various
IC/FS-125-U	Rise	Various
IC/FS-125-V	Drop	Various
IC/FS-150-U	Rise	Various
IC/FS-150-V	Drop	Various
IC/FS-200-U	Rise	Various
IC/FS-200-V	Drop	Various
IC/FS-250-U	Rise	Various
IC/FS-250-V	Drop	Various
IC/FS-300-U	Rise	Various
IC/FS-300-V	Drop	Various

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6.1.1 Water switches are provided in one type only and designed as type IC/W (see table I).

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type of switch or detector required as determined from tables I through XI as applicable, and 1.2, 3.3, 3.3.2, 3.4, and 3.4.4.

Examples:

(1) A pressure switch, type IC/L4D, would signify pressure operated (L-table I), 50 to 100 lb/in^2 range (4-table II), operating on drop in pressure with contacts designed for operation on 115 Vac, 60 Hz, 4 amperes (D-table X).
(2) A temperature switch, type IC/N31A12, would signify temperature operated (N-table I), 150 to 225°F range (31-table III), contacts close on rise in temperature with single pole, single throw switch, with contacts designed for operation on 115 Vac, 60 Hz, 4 amperes, 115 Vdc, 3 amperes (A-table X), with a 10-foot capillary tube and 3-inch bulb (12-table XI).
(3) A liquid level switch, type IC/R1-U, would indicate that the switch is liquid actuated (R-table I), single float (1-table V) with the contacts opening on the "rise" of the liquid level (U-table X).
(4) A door switch, type IC/DM-1-0, would indicate that the switch is mechanically operated by a door (DM-table I), the proper contacts closing on door opening (table VI).
(5) A mercurial or nonmercurial thermostatic switch, type IC/J-105, would, for instance, indicate that on rise of temperature at 105°F the switch would short out contacts that would serve to energize an alarm device (tables I and VII).
(6) A water switch, type IC/W, would indicate that water induced into the switch would short contacts that would serve to energize an alarm device (see 6.1.1).
(7) A liquid flow switch, type IC/FS-100-U/1 gal/min would indicate that the switch is flow actuated (FS-table I) port size (1 inch-table IV) flow setting (1 gal/min, table IV) with the contacts opening on "rise" or increase in the liquid flow (U-table X).
(8) A single purpose detector, type IC/CGD, would indicate that the smoke (CG-table I) would actuate to cause an alarm at a predetermined high level of smoke concentration or combustion gas concentration. The D (table I) would indicate that the single purpose detector was designed for operation with air conditioning and ventilation ducts.

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(c) Where switches are to be used for saltwater service, the bellows materials shall be specified as copper-nickel alloy.
(d) Reed switch current and voltage rating for liquid level and liquid flow switches (see 3.2.2).
(e) Type of washers, grommet, and caps when required, and whether both halves of connector shall be provided (see 3.2.7).
(f) When an adjustable differential is required for IC/N and IC/L switches (see 3.3.4 and 3.4.7).
(g) Pulsation dampening device, when required (see 3.3.6).
(h) Operating temperature, length of capillary tubing and bulb required (see 3.4).
(i) Actuation levels required for type IC/RH switch, switch action, steel pipe size flange, mounting adapters, specific gravity of float and slosh shields required (see 3.5.1.3, 3.5.2, and 3.10.2).
(j) Whether a mercurial or nonmercurial type IC/J thermostatic switch is required (see 3.7).
(k) Operating temperature settings for thermostatic switches (see 3.7.2).
(l) Transient and spike voltage of airflow switch (see 3.9.1.4 and 3.9.2.4).
(m) Quantity required for airflow sensor and airflow alarm control panel (see 3.9.2 and 3.9.2.2).
(n) Low or high rate setting required for flow switch (see 3.10).
(o) Body design as specified (see 3.10.1).
(p) End-of-line resistor supplied when required (see 3.11.8).
(q) Mounting requirements for single-purpose detectors (see 3.11.1).
(r) Operating level adjustment and set point for detector when specified (see 3.12.3).
(s) Pressure switch range (see 3.3 and 3.3.2), actuation pressure, electrical switch features (see table X), maximum proof pressure, maximum allowable variation from setting, maximum differential, operating differential pressure range, resetting differential pressure range.
(t) Temperature switch range, maximum temperature, total maximum allowable variation from setting, maximum differential, length of capillary tube, length of bulb, bulb diameter, type of connection, actuation setting, electrical features (see table X).
(u) Levels of preservation-packaging and packing required (see 5.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

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Paragraph no.	Data requirement title	Applicable DID no.	Option
3.14	Drawings, engineering and associated lists	DI-E-7031	Level 3
4.1.2	Inspection system program plan	DI-R-4803	----
4.3.3.1	First article inspection report	DI-T-4902	----
4.5.1	Inspection and test reports	DI-T-5329	----

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Technical manuals. The requirement for technical manuals should be considered when this specification is cited on a contract. If technical manuals are required, a contract exhibit must be prepared to fully describe statement of work criteria and delivery instructions, and cite the applicable technical manual specification. The technical manuals must be acquired by separate Contract Line Number (CLIN) in the contract.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List QPL-16302 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.4.1).

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6.4.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.5 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of two units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.6 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.6.1 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 quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

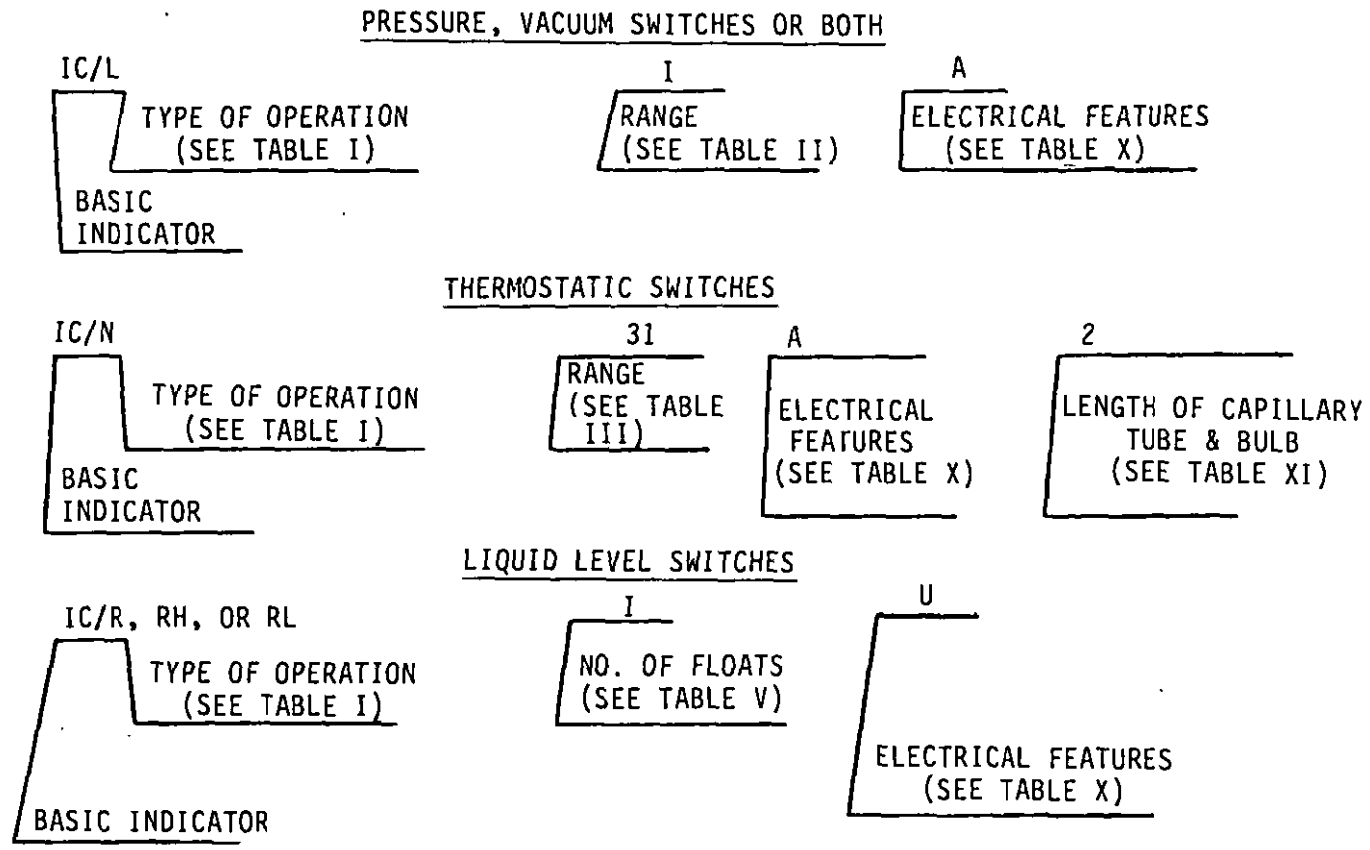
6.7 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.8 Subject term (key word) listing.

Airflow
Alarm system
Door
Liquid flow
Liquid level
Pressure
Temperature
Thermostatic
Water

6.9 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 5930-N640)



SH 4413B

FIGURE 1. Schematic representation of type designations.

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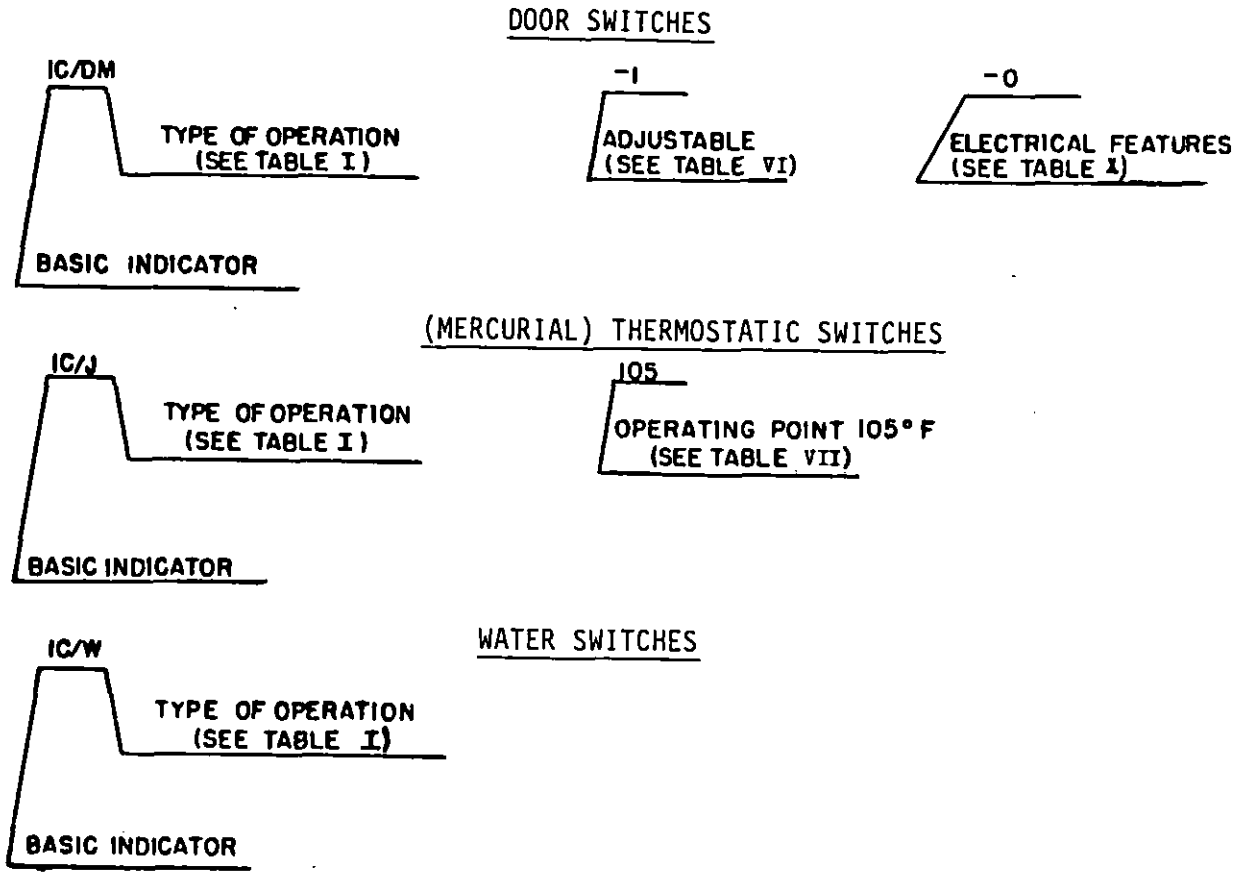

SH 9861

FIGURE 2. Schematic representation of type designations.

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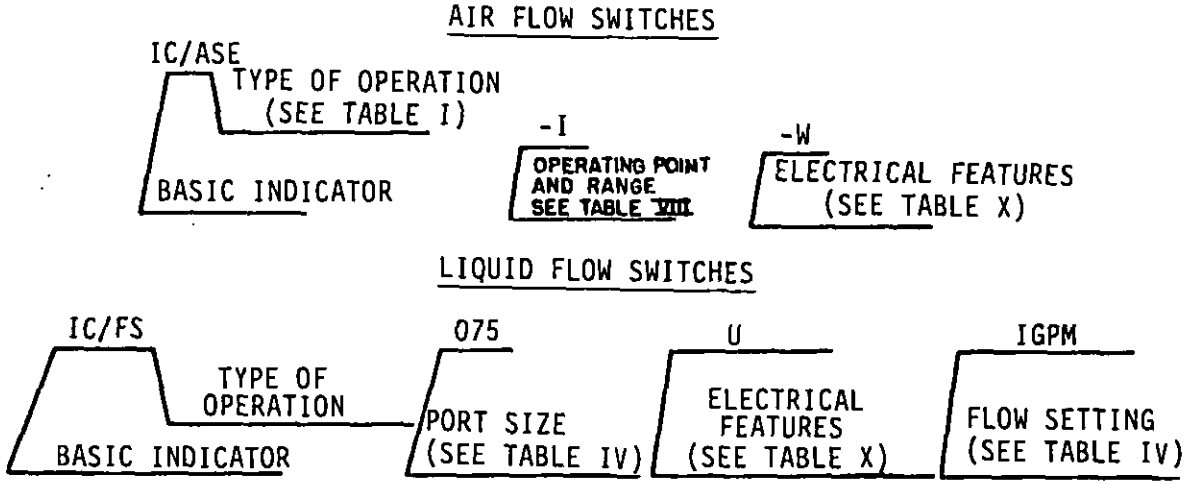

SH 9862

FIGURE 3. Schematic representation of type designations.

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MIL-S-16032M(SH)

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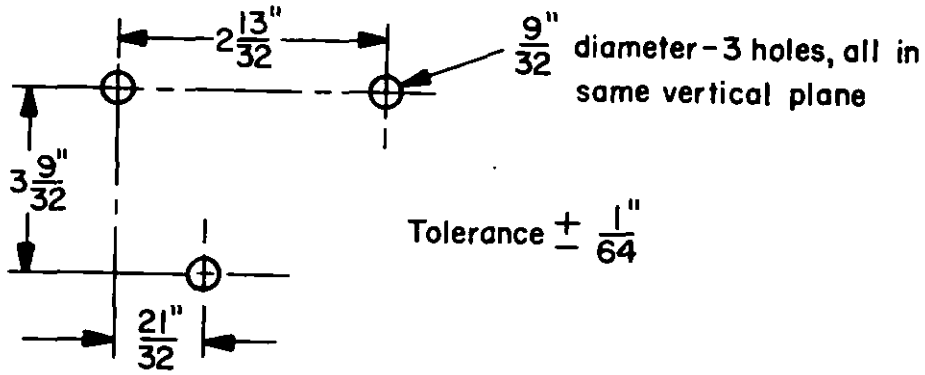
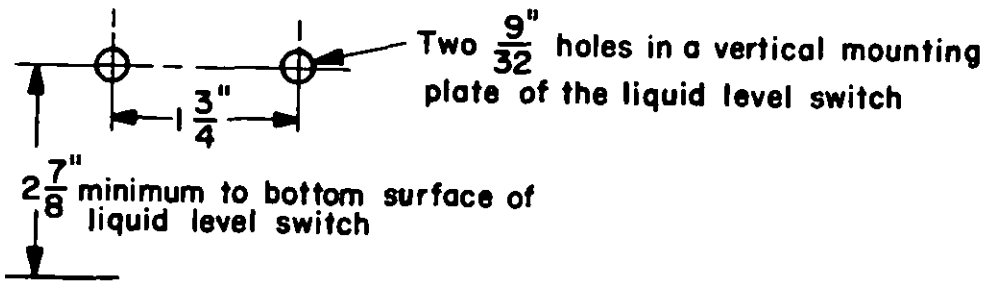


SH 11140

FIGURE 4. Enclosure assembly mounting dimensions for remote operated IC/N switches and for IC/L switches.



SH 11141

FIGURE 5. Mounting arrangement for type IC/R and IC/RL switches.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-S-16032M(SH)	SWITCHES AND DETECTORS, SHIPBOARD ALARM SYSTEMS

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)