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PERFORMANCE SPECIFICATION

FLAME DETECTOR ZONE MODULE (FDZM), SWITCH CLOSURE ZONE MODULE (SCZM), AND ISOLATOR, ADVANCED FIRE AND SMOKE SENSOR SYSTEM (AFSSS)

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for Flame Detector Zone Modules (FDZM) (see 6.8.6), Switch Closure Zone Modules (SCZM) (see 6.8.16), and isolators (see 6.8.9) and their respective enclosures, which are components of an overall Advanced Fire and Smoke Sensor System (AFSSS) for use on naval ships. These devices may be of commercial-off-the-shelf (COTS) design, but must be rugged (see 6.8.13) enough to meet all of the requirements of this performance specification and the rigors of Navy shipboard service. Performance requirements for the other associated AFSSS components (e.g., ionization (see 6.8.8) and photoelectric (see 6.8.10) smoke sensors (see 6.8.15), heat sensors (see 6.8.7), flame detectors (see 6.8.5), and alarm panel (see 6.8.2)) are contained in their respective AFSSS specifications.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for
MIL-E-2036	-	Enclosures for Electric and Electronic Equipment
MIL-DTL-24643	-	Cables and Cords, Electric, Low Smoke, for Shipboard Use General Specifications for

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

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 72	-	National Fire Alarm Code

(Copies of this document are available from National Fire Protection Association, 11 Tracy Drive, Avon, MA 02322 or online at www.nfpa.org.)

UNDERWRITERS LABORATORES INC. (UL)

UL 864	-	Control Units for Fire-Protective Signaling Systems

(Copies of this document are available from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096 or online at www.ul.com.)

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

3. REQUIREMENTS

3.1 First article. When specified (see 6.2 and 6.3), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Design requirements.

3.2.1 Design, materials, and manufacturing process. The contractor shall select the materials, but the materials shall meet all of the interface, operational, and performance requirements specified herein.

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

3.3 Configuration. The overall FDZM, SCZM, and isolator shall each consist of the appropriate electronics contained inside an appropriate enclosure. The terms “Flame Detector Zone Module”, “Switch Closure Zone Module”, and “isolator”, as used in this specification, refer to the overall FDZM, SCZM, and isolator, consisting of the device’s appropriate electronics and the appropriate enclosure. FDZMs, SCZMs, and isolators shall operate properly in both overhead or bulkhead mounted positions.

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3.3.1 Interchangeability. The AFSSS FDZM shall have a unique model number assigned to it, and shall be physically identical and interchangeable with all other AFSSS FDZMs from the same manufacturer. The AFSSS SCZM shall have a unique model number assigned to it and shall be physically identical and interchangeable with all other AFSSS SCZMs from the same manufacturer. The AFSSS isolator shall have a unique model number assigned to it and shall be physically identical and interchangeable with all other AFSSS isolators from the same manufacturer.

3.3.2 Individual addressability. The FDZM and the SCZM shall each have an adjustable mechanical device or dipswitch that can be easily set to allow each device to be individually identifiable and addressable by the AFSSS alarm panel once installed in a specific location in a shipboard compartment. Once set, this device or dipswitch shall be easily capable of later being set to a different address, without the use of special tools or equipment, to support interchangeability. This individual addressability requirement may also apply to the isolator, but it is not specifically required for the isolator.

3.3.3 Enclosure. An enclosure shall securely house and enclose the FDZM, SCZM, and isolator. The enclosure for the isolator shall possess enough flat surface area to allow two separate LS2SWU-1 cables (see MIL-DTL-24643) (i.e., the sensor loop) with appropriate watertight stuffing tubes (see MIL-E-2036) to penetrate the enclosure. The enclosure for the SCZM shall possess enough flat surface area to allow three separate LS2SWU-1 cables (i.e., two for the sensor loop and one for connection to the switch closure device) with appropriate watertight stuffing tubes to penetrate the enclosure. The enclosure for the FDZM shall possess enough flat surface area to allow five separate cables (i.e., two LS2SWU-1 cables for the sensor loop, two LS2SWU-1 cables for the flame detector power loop, and one appropriate shielded, watertight cable for the connection between the FDZM and the flame detector) with appropriate watertight stuffing tubes to penetrate the enclosure. These flat surface areas do not necessarily have to be all on the same face of the enclosure. All enclosures shall provide a conductive path for the shields of all of their cables to connect to ship's hull to provide shield termination. All enclosures shall possess mounting tabs or brackets with clearance holes for bolts that secure the junction box to 1-inch long threaded-female metal standoffs welded to the overhead or bulkhead of the compartment.

3.4 Degree of enclosure. All enclosures shall be at least NEMA-4 (National Electrical Manufacturers Association) watertight and dust tight. Thus, standard electrical boxes with holes or knockout plugs (which are commonly used for mounting commercial grade FDZMs, SCZMs, and isolators, but are not watertight) are not permitted as enclosures.

3.5 Weight. The total weight of each individual FDZM, SCZM, or isolator (including each of their respective enclosures) shall not exceed 4 pounds.

3.6 Size. FDZMs, SCZMs, and isolators (and their respective enclosures) shall be as compact in size as possible, while allowing sufficient space inside for cable penetrations. The maximum height of each of the FDZM, SCZM, and isolator shall not exceed 9 inches. The maximum width of each of the FDZM, SCZM, and isolator shall not exceed 9 inches. The maximum depth of each of the FDZM, SCZM, and isolator shall not exceed 7 inches.

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3.7 Interface requirements.

3.7.1 Electrical interface.

3.7.1.1 Sensor loop interface. FDZMs, SCZMs, and isolators shall be compatible with the UL listed AFSSS alarm panel and shall communicate their status to the alarm panel via the LS2SWU-1 sensor loop cable. SCZMs and isolators shall obtain power from as well as communicate their status to the alarm panel over this sensor loop LS2SWU-1 cabling. FDZMs shall communicate their status to the alarm panel over the sensor loop cabling, but shall receive power from a separate flame detector power cable (see 3.7.1.2). The LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to the FDZMs, SCZMs, and isolators and various sensors throughout the ship's compartments and then return to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit (see 6.8.14) arrangement so that single opens on the loop shall not result in the loss of any sensors, flame detectors (via their FDZMs) or switch closure devices (via their SCZMs).

3.7.1.2 Flame detector zone module (flame detector power) interface with the alarm panel. Since power is not supplied to the flame detector via the sensor (communication) loop in 3.7.1.1, a separate LS2SWU-1 cable shall be routed from the alarm panel to the various FDZMs and then returned to the alarm panel in a looped arrangement to provide power from the alarm panel to the FDZMs. The FDZM shall provide power to its respective flame detector via the cable identified in 3.7.1.3. Thus, in this arrangement, the FDZM shall obtain power from (and be compatible with) the UL listed AFSSS alarm panel and supply that power to its associated/connected flame detector via the cable identified in 3.7.1.3.

3.7.1.3 Flame detector zone module (power and sense line) interface with the flame detector. An appropriate watertight, shielded cable shall connect the FDZM to its associated flame detector. This cable shall transfer power (that originated at the alarm panel) from the FDZM (see 3.7.1.2) to the flame detector. This cable shall also transmit the alarm and trouble status of the flame detector to the FDZM to send back to the alarm panel.

3.7.1.4 Switch closure zone module (power and sense line) interface with switch closure device. LS2SWU-1 cable shall connect the SCZM to its associated switch closure device. This cable shall transfer power (transmitted over the sensor loop for SCZMs) from the SCZM (see 3.7.1.1) to the switch closure device and shall also transmit the alarm and trouble status of the device to the SCZM to send back to the alarm panel.

3.7.2 Ship interface. The FDZMs, SCZMs, and isolators shall be mounted with bolts to 1-inch long threaded-female metal standoffs welded onto the overheads and bulkheads of the ship's compartments.

3.8 Operating requirements.

3.8.1 Basic operation. When tested in accordance with 4.5.1:

a. An appropriate alarm shall register and latch at the alarm panel for the flame detector. FDZMs shall also comply with 3.8.2.

b. An appropriate alarm shall register and latch at the alarm panel for the SCZM. SCZMs shall also comply with 3.8.3.

c. An appropriate Class A trouble indication shall register at the alarm panel for the sensor loop. In addition, a second trouble indication stating the loss of the SCZM shall register at the alarm panel. Isolators shall also comply with 3.8.4.

d. An appropriate trouble indication shall register at the alarm panel indicating the loss of the flame detector. FDZMs shall also comply with 3.8.2.

e. An appropriate trouble indication shall register at the alarm panel indicating the loss of the flame detector. FDZMs shall also comply with 3.8.2.

f. An appropriate trouble indication shall register at the alarm panel indicating the loss of the SCZM switch. SCZMs shall also comply with 3.8.3.

g. The FDZM, SCZM, and isolator shall sustain no physical damage, such as cracks, loosening, warping, thermal deterioration, or dislodgment of parts.

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3.8.2 Flame detector zone module operation. If flame detectors do not interface directly with the AFSSS alarm panel, flame detectors shall interface with the AFSSS alarm panel via a FDZM, compatible with the AFSSS alarm panel, which provides and identifies the unique address of the flame detector and also channels power from the alarm panel to the flame detector. When a flame detector is exposed to a flame of appropriate and sufficient radiant energy, the FDZM shall transmit its associated alarm to the AFSSS alarm panel. FDZMs shall ensure that flame detectors shall be resettable (see 6.8.11) after alarm, but only after a reset (see 6.8.11) at the alarm panel is manually executed and the flame at the detector has been removed (i.e., flame detector alarms shall latch at the alarm panel). FDZMs shall be supervised such that a distinct trouble signal (see 6.8.17) shall register at the alarm panel if flame detector power is not provided to the flame detector. Furthermore, a separate distinct trouble signal shall register at the alarm panel if either conductor on the flame detector sense line (between the flame detector and the FDZM) is opened.

3.8.3 Switch closure zone module operation. Switch closure type devices shall interface with the AFSSS alarm panel via a SCZM, compatible with the AFSSS alarm panel, which provides and identifies the unique address of the switch closure type device. When any switch closure type device (such as a water flow switch, manual pull station, water switch, and flooding switch) is closed, the SCZM shall transmit its associated alarm to the AFSSS alarm panel. SCZMs shall be resettable after alarm, but only after a reset at the alarm panel is manually executed and the switch closure type device has been restored to its open position (i.e., SCZM alarms shall latch at the alarm panel). SCZMs shall be supervised such that a distinct trouble signal shall register at the alarm panel if either conductor connecting the SCZM to the normally open switch is opened.

3.8.4 Isolator operation. Isolators shall be installed on the sensor loops in series with other heat and smoke sensors, FDZMs and flame detectors, and SCZMs. The quantity and placement of isolators on each sensor loop will vary with different installations, depending on the degree of survivability desired for the sensors, detectors and devices on the sensor loop. Isolators shall protect sensors, detectors and devices on sections of sensor loops from short circuits. In the event of a short circuit, two isolators shall open, removing the shorted section of line from the sensor loop. The sensors, detectors, and zone modules remaining on both powered sections of the sensor loop shall continue to operate and communicate with the AFSSS alarm panel. The sensors, detectors, and zone modules located between the isolators (within the shorted section of cabling) shall not be powered or operational, and the alarm panel shall report those sensors, detectors, and zone modules as troubles (missing). Each sensor loop shall be capable of powering and monitoring up to at least 60 addressable devices (see 6.8.1) (sensors, flame detectors and FDZMs, and SCZMs), along with at least seven isolators. The inclusion of isolators on the sensor loop (above the original seven) shall not decrease the amount of devices capable of being supported on the sensor loop by more than five devices per added isolator.

3.9 Performance requirements.

3.9.1 Commercial performance requirements. FDZMs, SCZMs, and isolators shall be UL listed and be compatible with the UL listed AFSSS alarm panel, flame detectors, switch closure devices and sensors. FDZMs, SCZMs, and isolators shall comply with UL 864, with the following exceptions/clarifications:

a. FDZMs, SCZMs, and isolators shall withstand jarring as required for UL 864 listing, and shall also comply with the Government performance requirements for shock in 3.9.2.2 of this specification. A momentary trouble signal or alarm, resulting from jarring, is not acceptable (regardless of whether that momentary trouble clears by itself or not after the jarring/shock). Operation of the FDZM, SCZM, isolator, flame detector (not being subjected to shock), test switch (not being subjected to shock), or other heat or smoke sensors on the sensor loop shall not be affected. Dislodgment of internal or external parts is not acceptable, whether dislodged parts affect the operation of the unit or not.

b. FDZMs, SCZMs, and isolators shall withstand transient tests as required for UL 864 listing, and shall also comply with the Government performance requirements for electromagnetic interference (EMI) in 3.9.2.3 of this specification.

c. FDZMs, SCZMs, and isolators shall withstand variable ambient temperature testing from 32 °F to 150 °F (vice 120 °F).

3.9.1.1 Operating temperature range. FDZMs, SCZMs, and isolators shall operate properly at temperatures ranging from 32 °F to 150 °F.

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3.9.2 Government performance requirements. In addition to the UL 864 requirements and listing, the following Government requirements shall be met.

3.9.2.1 Vibration. When tested in accordance with 4.6.2.1, FDZMs, SCZMs, and isolators shall meet the requirements of MIL-STD-167-1. FDZMs, SCZMs, and isolators shall operate normally without interruption, trouble indications (whether momentary or latched), nor alarm indications (other than those alarms specifically caused by operational tests) throughout the vibration test. FDZMs, SCZMs, and isolators shall not show any evidence of physical damage throughout the vibration test. No excessive resonances of any parts shall be present during the test such that FDZM, SCZM, or isolator operation is affected or early failure can be expected. FDZMs, SCZMs, and isolators shall comply with the requirements of 3.8.1 and shall not exhibit any of the failures listed in 3.10 during or after the vibration test.

3.9.2.2 Shock. When tested in accordance with 4.6.2.2, FDZMs, SCZMs, and isolators shall meet the Grade A, Class I, Type A requirements of the lightweight MIL-S-901 shock test. FDZMs, SCZMs, and isolators shall operate normally without interruption, trouble indications (whether momentary or latched), nor alarm indications (other than those alarms specifically caused by operational tests) throughout the shock test. FDZMs, SCZMs, and isolators shall not show any evidence of physical damage throughout the shock test. No excessive resonances of any parts shall be present during the test such that FDZM, SCZM, or isolator operation is affected or early failure can be expected. FDZM, SCZM, and isolators shall comply with the requirements of 3.8.1 and shall not exhibit any of the failures listed in 3.10 during or after the shock test.

3.9.2.3 Electromagnetic interference (EMI). When tested in accordance with 4.6.2.3 (including 4.6.2.3.1 through 4.6.2.3.8), FDZMs, SCZMs, and isolators shall meet the requirements of MIL-STD-461. FDZMs, SCZMs, and isolators shall operate normally without interruption, trouble indications (whether momentary or latched), nor alarm indications (other than those alarms specifically caused by operational tests) throughout the EMI test. FDZMs, SCZMs, and isolators shall not show any evidence of physical damage throughout the EMI test. FDZMs, SCZMs, and isolators shall comply with the requirements of 3.8.1 and shall not exhibit any of the failures listed in 3.10 during or after the EMI test.

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3.10 Failure criteria. FDZMs, SCZMs, and isolators shall be reliable and not exhibit any failures such as:

a. Failure to meet all applicable UL 864 requirements.

b. Failure to be UL listed.

c. Failure to meet any Government requirements in this specification.

d. Inability to transmit an alarm signal (see 6.8.3) to the alarm panel when an actual alarm condition is present at the flame detector (for FDZMs) or switch (for SCZMs).

e. Inability to transmit appropriate trouble data or a trouble indication to the alarm panel when an actual trouble condition is present at the flame detector or FDZM (for FDZMs), or switch or SCZM (for SCZMs), or when a short exists on the sensor loop (for isolators). FDZM and flame detector troubles include loss of flame detector power and any break in the FDZM-to-flame detector sense line cable. SCZM and switch troubles include any break in the SCZM to switch cable connection or loss of the switch. Isolator troubles include failure of the isolators to detect and isolate shorts on the sensor loop.

f. Transmission of an alarm indication, whether temporary, intermittent or latched, when no such condition exists at the flame detector (for FDZMs) or switch (for SCZMs) or when caused by the isolator.

g. Transmission of trouble data or a trouble indication, whether temporary, intermittent or latched, when no such condition exists at the flame detector (for FDZMs) or switch (for SCZMs) or when a short does not exist on the sensor loop (for isolators).

h. Any physical damage, warping, or cracking of the FDZM, SCZM, or isolator or their enclosures. Any physical damage, warping, cracking, or dislodging of any components from the FDZM, SCZM, or isolator. Any dislodging of the FDZM, SCZM, or isolator from its enclosure or any dislodging of the entire enclosure from its installation mounts (standoffs). Any physical damage that would render the FDZM, SCZM, or isolator no longer watertight. Any breakage, loosening, fraying or disconnection of FDZM, SCZM, or isolator wiring, electrical connectors, wiring harnesses, or soldered terminals.

i. Any mechanical failure or alteration of the FDZM's or SCZM's mechanical device or dipswitch (which sets the device's individual address) that results in a trouble signal, renders the device inaddressable from the alarm panel, or changes the address of the device.

3.11 Maintainability. To the maximum extent possible, FDZMs, SCZMs, and isolators shall require minimum planned maintenance, cleaning, and replacement while maintaining performance.

3.12 Reliability. To the maximum extent possible, FDZMs, SCZMs, and isolators shall be highly reliable devices that eliminate or significantly minimize the occurrence of false alarms (see 6.8.4) or trouble signals while maintaining an acceptable level of flame detection capability, switch closure alarm capability, and short protection, respectively. Numerous false alarms or trouble signals for an installed shipboard system can erode crew confidence in the system. As specified in 3.10, any alarm indication, whether temporary, intermittent or latched, when no such condition exists at the flame detector or switch is considered a failure during the conductance of all first article tests.

4. VERIFICATION

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

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on FDZM, SCZM, and isolators when a first article sample is required (see 3.1). This inspection shall include the examination and tests listed in Table I.

4.2.1 Disposition of first article units. Final disposition of first article samples shall be as specified (see 6.2 and 6.3).

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4.3 Conformance inspection. Conformance inspection shall include the examination and tests of Table I.

TABLE I. First article and conformance inspections.

Name	Requirements paragraph	Verification paragraph	First article inspection	Conformance inspection
Configuration	3.3	4.4	X	X
Degree of enclosure	3.4	4.4	X	X
Weight	3.5	4.4	X	X
Size	3.6	4.4	X	X
Interface requirements	3.7	4.4	X	X
Basic operation	3.8.1	4.5.1	X	X
FDZM operation	3.8.2	4.4, 4.5	X	X
SCZM operation	3.8.3	4.4, 4.5	X	X
Isolator operation	3.8.4	4.4, 4.5	X	X
Commercial performance requirements	3.9.1	4.6.1	X	
Operating temperature range	3.9.1.1	4.6.1	X	
Vibration	3.9.2.1	4.6.2.1	X	
Shock	3.9.2.2	4.6.2.2	X	
Electromagnetic interference	3.9.2.3	4.6.2.3	X	

4.4 General examination. FDZMs, SCZMs, and isolators shall be thoroughly examined for compliance with the requirements specified in 3.3 through 3.7. A visual examination shall be made to ensure the proper overall configuration, the inclusion of an adjustable mechanical device or dipswitch for individually identifiable addressability (for the FDZM and the SCZM, and, if applicable, the isolator), and the watertight classification of the overall device and enclosure (as required in 3.4). The devices shall also be weighed and measured for compliance with 3.5 and 3.6, respectively. FDZMs, SCZMs, and isolators shall comply with the requirements of 3.3 through 3.7.

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4.5 Operational tests.

4.5.1 Basic operational tests. Figure 1 shows the basic operational test configuration for the FDZM, SCZM, and isolator. One FDZM, one SCZM, and at least one isolator shall be connected to and powered and monitored by the AFSSS alarm panel in loop fashion as shown in Figure 1. The FDZM, SCZM and isolator(s) shall be housed in their appropriate enclosures. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect all of the devices to the alarm panel. The LS2SWU-1 cabling shall be routed from the alarm panel to the devices and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. A flame detector shall be connected to the FDZM with appropriate shielded, watertight, low-smoke cable and appropriate stuffing tubes. An LS2SWU-1 cable, providing flame detector power, shall be routed from the alarm panel and then returned to the alarm panel, so that a single open on this cable shall not cause power to be lost at the flame detector. The flame detector shall provide an appropriate alarm signal that shall latch at the alarm panel until manually reset at the alarm panel (once the flame is no longer present). An on/off switch shall be connected to the SCZM with LS2SWU-1 cable. The alarm panel shall be programmed to provide an appropriate alarm signal when the on/off switch is closed, and that alarm shall latch at the alarm panel until the switch is opened and a manual reset is accomplished at the alarm panel. For testing purposes, an additional enclosure (J-box) shall be located on this sensor loop. An LS2SWU-1 cable shall penetrate this enclosure with an appropriate stuffing tube and shall be directly connected across the two sensor loop LS2SWU-1 conductors. On the other end of this cable, a test (on/off) switch shall be connected that will be used to intentionally cause a short across the two conductors on the sensor loop. If the alarm panel itself does not have the capability to isolate shorts on the two LS2SWU-1 cables entering it at the ends of the sensor loop, then two additional isolators (housed in appropriate enclosures) shall be installed on the sensor loop at the beginning and end of the sensor loop as shown in Figure 1. Operational tests shall be conducted on all devices. The operational tests shall consist of:

a. Subjecting the flame detector to a flame of appropriate and sufficient radiant energy to cause an alarm at the alarm panel.

b. Closing, then opening, the switch attached to the SCZM to cause an appropriate alarm at the alarm panel.

c. Closing the test switch, which will short the two LS2SWU-1 loop 1 conductors inside the enclosure, to ensure proper operation of the isolators and appropriate trouble indications at the alarm panel.

d. Disconnecting the flame detector from the alarm panel’s looped flame detector power supply to ensure an appropriate trouble indication occurs at the alarm panel.

e. Disconnecting a conductor on the sense-line cable that connects the flame detector to the FDZM to ensure an appropriate trouble indication occurs at the alarm panel.

f. Removing the SCZM switch or opening a switch lead to ensure an appropriate trouble indication occurs at the alarm panel.

g. Visually inspecting the SCZM, FDZM, and isolators for physical damage, cracks, loosening, warping, thermal deterioration, or dislodgment of parts.

The FDZM, SCZM, and isolator shall comply with the requirements of 3.8.1 and shall not exhibit any of the failures listed in 3.10.

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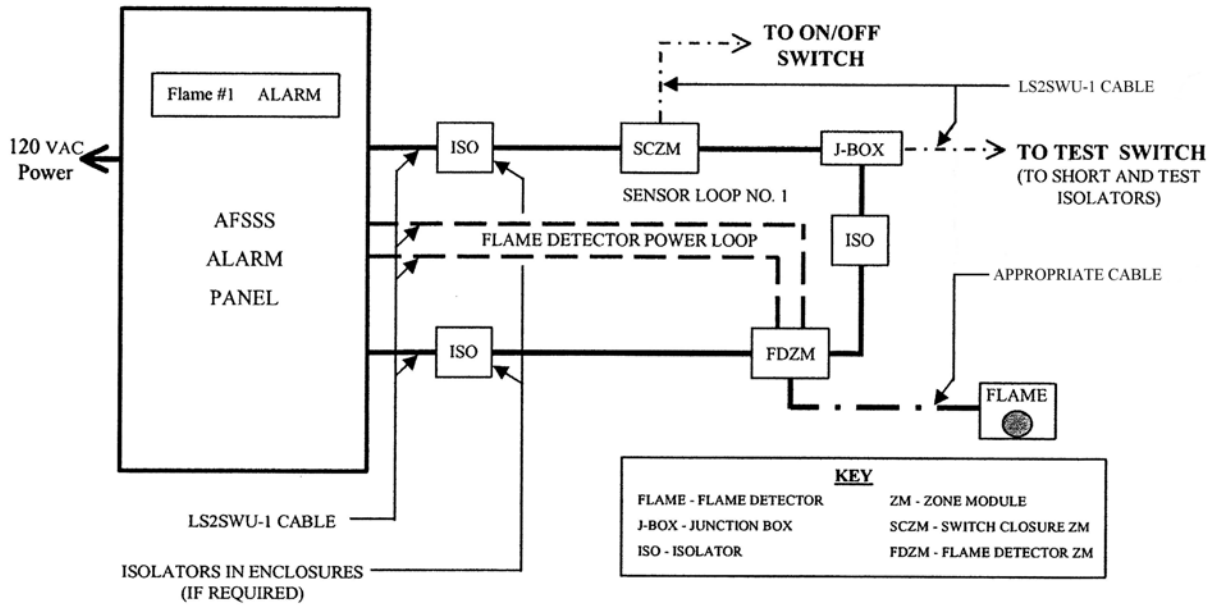

FIGURE 1. Test configuration for AFSSS flame detector zone module (FDZM), switch closure zone module (SCZM), and isolator(s) for basic operational, vibration, shock and EMI tests.[1/]

NOTE:

1/ For vibration and shock testing, the ON/OFF switch, test switch, and flame detector shall not be located on the vibration and shock machine, respectively. For EMI testing, the ON/OFF switch, test switch, and flame detector shall be located outside the EMI environment.

4.6 Performance tests.

4.6.1 Commercial performance tests. FDZMs, SCZMs, and isolators shall be inspected for UL listing, compliance with UL 864, and compatibility with the AFSSS alarm panel, flame detectors, and switch closure devices. FDZMs, SCZMs, and isolators shall also be inspected to ensure that the UL 864 exceptions and clarifications of 3.9.1 are met as specified (see 6.2). The UL 864 variable temperature test shall be conducted with the operating temperature range of 32 °F to 150 °F. FDZM, SCZM, and isolator operating temperature range shall be verified to comply with the requirements of 3.9.1.1.

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4.6.2 Government performance tests.

4.6.2.1 Vibration. One FDZM, one SCZM, and at least one isolator shall be subjected to MIL-STD-167-1 vibration testing. All of these devices shall have been subjected to the operational tests of 4.5.1 prior to this vibration test. All of these devices shall be mounted on the vertical bracket of the vibration platform. The enclosures of all three devices shall be bolted to the vibration platform using 1-inch long threaded-female standoffs to duplicate actual shipboard mounting conditions. (The bottoms of the enclosures shall not rest flush against the vibration platform. The bottoms of the enclosures shall rest flush against the faces of the 1-inch standoffs.) All three devices shall be powered and monitored by the AFSSS alarm panel. The AFSSS alarm panel shall not be mounted on the vibration platform. All cabling shall be as described in 4.5.1 and shown in Figure 1. Additional AFSSS sensors and detectors (e.g., other FDZMs, SCZMs, and isolators not being subjected to this vibration testing or other ionization smoke sensors, photoelectric smoke sensors, heat sensors, or flame detectors also being subjected to this vibration testing) may be included on the sensor loop. The exploratory, variable frequency, and endurance tests shall be conducted for each of the three rectilinear orientation axes. The full frequency range (4 through 50 Hz) shall be tested with vibration amplitudes as specified in MIL-STD-167-1. For each of the three orientations, the operational tests of 4.5.1 shall be conducted on the FDZM, SCZM, and isolator (while the devices are mounted on the vibration platform but are not vibrating) once after the exploratory test, once after the variable frequency test, and once after the endurance test. Also, for each of the three orientations, the operational tests of 4.5.1 (a through c only) shall be conducted (while the devices are mounted on the vibration platform and are vibrating) once midway during the endurance test (or midway at each resonant frequency, if tested at more than one frequency during the endurance test). The FDZM, SCZM, and isolator shall meet the requirements of 3.9.2.1.

4.6.2.2 Shock. One FDZM, one SCZM, and at least one isolator shall be subjected to lightweight, Grade A, Class I, Type A, MIL-S-901 shock testing. All of these devices shall have been subjected to the operational tests of 4.5.1 prior to this shock test. All of these devices shall be mounted on the (vertical) Fixture 4A of the shock machine. The enclosures of all three devices shall be bolted to the shock machine fixture using 1-inch long threaded-female standoffs to duplicate actual shipboard mounting conditions. (The bottoms of the enclosures shall not rest flush against the shock machine fixture. The bottoms of the enclosures shall rest flush against the faces of the 1-inch standoffs.) All three devices shall be powered and monitored by the AFSSS alarm panel. The AFSSS alarm panel shall not be mounted on the shock machine. All cabling shall be as described in 4.5.1 and shown in Figure 1. Additional AFSSS sensors and detectors (e.g., other FDZMs, SCZMs, and isolators not being subjected to this vibration testing or other ionization smoke sensors, photoelectric smoke sensors, heat sensors, or flame detectors also being subjected to this shock testing) may be included on the sensor loop. After each of the nine shock blows, the operational tests of 4.5.1 shall be conducted on the FDZM, SCZM, and isolator (while mounted on the shock machine). The FDZM, SCZM, and isolator shall meet the requirements of 3.9.2.2.

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4.6.2.3 Electromagnetic interference (EMI). One FDZM, one SCZM, and at least one isolator shall be subjected to EMI testing in accordance with MIL-STD-461. All of these devices shall have been subjected to the operational tests of 4.5.1 prior to this EMI test. The enclosures of all three devices shall be bolted to the EMI ground plane using 1-inch long threaded-female standoffs to duplicate actual shipboard mounting conditions. (The bottoms of the enclosures shall not rest flush against the ground plane. The bottoms of the enclosures shall rest flush against the faces of the 1-inch standoffs.) All three devices shall be powered and monitored by the AFSSS alarm panel. The AFSSS shall be EMI tested as a system; thus, the AFSSS alarm panel shall be included in the EMI test. All cabling shall be as described in 4.5.1 and shown in Figure 1. The test switch and switch connected to the SCZM shall not be subjected to the EMI test and shall be located outside of the EMI environment during testing. Additional AFSSS sensors and detectors (e.g., other ionization smoke, photoelectric smoke, and heat sensors and flame detectors also being subjected to this EMI testing) may be included on this sensor loop. The shields of the LS2SWU-1 cables shall connect to the EMI ground plane to provide shield termination (electrical conductivity) at each sensor. The shields of the LS2SWU-1 sensor cables at the alarm panel shall connect to the chassis of the alarm panel, which shall be attached and grounded to the EMI ground plane. The EMI tests of 4.6.2.3.1 through 4.6.2.3.8 shall be conducted in accordance with MIL-STD-461 on all three devices and the alarm panel (and any additional smoke and heat sensors or flame detectors included in the sensor loop for this EMI test). The operational tests of 4.5.1 (a through c only) shall be conducted on each of the three devices during the EMI tests as specified in 4.6.2.3.1 through 4.6.2.3.8. After all of the 4.6.2.3.1 through 4.6.2.3.8 EMI tests are conducted, the three devices shall be subjected to all of the operational tests of 4.5.1. The FDZM, SCZM, and isolator shall meet the requirements of 3.9.2.3. EMI requirements for the alarm panel and other AFSSS sensors and detectors are contained in separate AFSSS component specifications.

4.6.2.3.1 Conducted emissions (CE 102)(10 kHz to 10 MHz). Conducted emissions on all power leads shall be measured over the range of 10 kHz to 10 MHz. The operational tests of 4.5.1 shall not be conducted during or after this portion of the EMI test.

4.6.2.3.2 Radiated emissions (RE 101)(30 Hz to 100 kHz). Radiated magnetic field emissions from all power and interconnecting leads, devices and the alarm panel shall be measured over the range of 30 Hz to 100 kHz. The operational tests of 4.5.1 shall not be conducted during or after this portion of the EMI test.

4.6.2.3.3 Radiated emissions (RE 102)(10 kHz to 18 GHz). Radiated electric field emissions from all power and interconnecting leads, devices, and the alarm panel shall be measured over the range of 10 kHz to 18 GHz. The operational tests of 4.5.1 shall not be conducted during or after this portion of the EMI test.

4.6.2.3.4 Conducted susceptibility (CS 101)(30 Hz to 150 kHz). All power leads shall be subjected to CS 101 test signals as specified in MIL-STD-461 over the range of 30 Hz to 150 kHz. The test switch and the switch connected to the SCZM shall not be subjected to this EMI test and shall be located outside of the EMI environment during testing. The operational tests of 4.5.1 (a. through c. only) shall be conducted after this portion of the EMI test.

4.6.2.3.5 Conducted susceptibility (CS 114)(10 kHz to 200 MHz). All interconnecting cables shall be subjected to CS 114 test signals as specified in MIL-STD-461 over the range of 10 kHz to 200 MHz. The test switch and the switch connected to the SCZM shall not be subjected to this EMI test and shall be located outside of the EMI environment during testing. The operational tests of 4.5.1 (a through c only) shall be conducted after this portion of the EMI test.

4.6.2.3.6 Conducted susceptibility (CS 116)(10 kHz to 100 MHz). All interconnecting cables shall be subjected to CS 116 test signals as specified in MIL-STD-461 over the range of 10k Hz to 100 MHz. The operational tests of 4.5.1 shall be conducted after this portion of the EMI test.

4.5.2.3.7 Radiated susceptibility (RS 101)(30 Hz to 100 kHz). All power and interconnecting leads, devices, and the alarm panel shall be subjected to radiated magnetic fields over the range of 30 Hz to 100 kHz as specified in RS 101 of MIL-STD-461. The test switch and the switch connected to the SCZM shall not be subjected to this EMI test and shall be located outside of the EMI environment during testing. The operational tests of 4.5.1 (a through c only) shall be conducted after this portion of the EMI test.

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4.6.2.3.8 Radiated susceptibility (RS 103)(2 MHz to 40 GHz). All power and interconnecting leads and devices shall be subjected to radiated electric fields over the range of 2 MHz to 40 GHz at 25 volts per meter as specified in RS 103 of MIL-STD-461. The alarm panel shall be shielded from the effects of the 25 volts per meter field. The alarm panel shall be subjected to radiated electric fields over the range of 2 MHz to 40 GHz at 10 volts per meter as specified in RS 103 of MIL-STD-461. The test switch and the switch connected to the SCZM shall not be subjected to this EMI test and shall be located outside of the EMI environment during testing. The operational tests of 4.5.1 (a through c only) shall be conducted after this portion of the EMI test.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The FDZM is intended to interface one AFSSS flame detector with the AFSSS alarm panel for power and monitoring purposes. If AFSSS flame detectors are actually equipped to be powered and monitored directly on the AFSSS (multiplexed) sensor loop, then FDZMs are not required and can be ignored throughout this specification. This specification, however, assumes that the AFSSS flame detectors are not equipped to be powered and monitored directly on the AFSSS sensor loop. (The AFSSS ionization and photoelectric smoke and heat sensors are so equipped.) Thus, FDZMs are assumed to be required to provide the individually addressable flame detector alarm signal to the alarm panel and to connect appropriate power from the alarm panel to the flame detector for operation via separate cabling (i.e., a separate power cable is used, different from the sensor loop cabling). The SCZM is intended to interface an individual switch closure device that does not require power (e.g., a water flow switch, manual pull station, water switch, and flooding switch) with the AFSSS alarm panel for monitoring purposes. Isolators are intended to protect sections of AFSSS alarm panel sensor loops from short circuits. Isolators are placed in series on the sensor loops, where they monitor for short circuits. Isolators are installed after groups of heat and smoke sensors, FDZMs and flame detectors, and SCZMs depending on the degree of overall sensor loop survivability desired. In the event of a short circuit, two isolators open, removing the shorted section of cabling from the sensor loop. The sensors, detectors, and zone modules remaining on both isolated sections of the sensor loop will continue to operate and communicate with the AFSSS alarm panel. The sensors, detectors, and zone modules located between the isolators (within the shorted section of cabling) will not be powered or operational. FDZMs, SCZMs, and isolators are three of several types of devices, detectors, or sensors used in the AFSSS and intended for use on Navy ships.

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6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. When first article is required. (see 3.1 and 6.3)

c. Quantity of first article FDZMs, SCZMs, and isolators (and an alarm panel and flame detector, if applicable) required.

d. Final disposition of first article test samples, which are considered consumed and nondeliverable. (see 4.2.1 and 6.3)

e. Proof of UL compliance including a full copy of the UL listing report for the FSZMs, SCZMs, and isolators (with UL 864 testing data and results). This UL listing report will verify that the requirements of the variable temperature test (operating temperature range 32 °F to 150 °F) have been met. (see 4.6.1)

f. Packaging requirements. (see 5.1)

g. Technical manual requirements. (see 6.4)

h. Provisioning requirements. (see 6.5)

i. Warranty requirements. (see 6.7)

6.3 First article. When requiring a first article inspection, contracting documents should provide specific guidance to offerors. This guidance should cover the number of test items. These documents should also include specific instructions regarding arrangements for examination, approval of first article test results, and disposition of first articles. (see 3.1 and 6.2)

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, a technical manual contract requirement (TMCR) should be obtained and cited in the contract. (see 6.2)

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

6.6 Compatibility. If FDZMs, SCZMs, and isolators are being procured for use with a previously procured or existing system, ensure that the devices are compatible and UL listed with the specific alarm panel in that system. FDZMs, SCZMs, and isolators from one manufacturer are generally not compatible nor UL listed with an alarm panel from another manufacturer.

6.7 Warranty. Warranty requirements should be as specified (see 6.2).

6.8 Definitions.

6.8.1 Addressable sensor or device. A sensor or device with discrete identification that can have its status individually identified by the alarm panel.

6.8.2 Alarm panel. A system component that provides power to various fire sensors, detectors and devices and monitors and visually and audibly displays their status. The alarm panel might also provide transfer of this information to a graphic display system.

6.8.3 Alarm signal. A signal indicating an emergency requiring immediate action, such as a signal indicative of fire.

6.8.4 False alarm. Any alarm caused by mechanical or electrical failure, malfunction, or environmental effects other than the actual signature (e.g., smoke, high temperature, high rate of temperature rise, actual flame radiation, switch closure) appropriate for that type of sensor or device.

6.8.5 Flame detector. A fire detector that detects radiant energy (such as ultraviolet, visible, or infrared) that is emitted as a product of combustion reaction and obeys the laws of optics.

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6.8.6 Flame detector zone module (FDZM). An individually addressable device that is used to interface a flame detector with the alarm panel for monitoring purposes. FDZMs generally connect appropriate power from the alarm panel to the flame detector for operation as well as provide the individually addressable flame detector alarm signal to the alarm panel.

6.8.7 Heat sensor. A fire sensor that senses heat. Heat sensors could be of the fixed temperature type (where the sensor responds when its operating element becomes heated to a predetermined level), the rate of temperature rise type (where the sensor responds when the temperature rises at a rate exceeding a predetermined value), or both.

6.8.8 Ionization smoke sensor. A sensor that uses a small amount of radioactive material to ionize the air between two differentially charged electrodes to sense the presence of smoke particles. Smoke particles entering the ionization volume decrease the conductance of the air by reducing ion mobility. The reduced conductance signal is processed and used to convey an alarm condition when it meets preset criteria.

6.8.9 Isolators. Devices that protect sections of sensor loops from short circuits. Isolators are placed in series on the sensor loops, where they monitor for short circuits. Isolators are installed after groups of heat or smoke sensors, FDZMs and flame detectors, and SCZMs depending on the degree of overall sensor loop survivability desired. In the event of a short circuit, two isolators open, removing the shorted section of line from the sensor loop. The sensors, detectors, and zone modules remaining on both non-isolated sections of the sensor loop will continue to operate and communicate with the AFSSS alarm panel. The sensors, detectors, and zone modules located between the isolators (within the shorted section of cabling) will not be powered nor operational, and the alarm panel will report those sensors, detectors, and zone modules as troubles (missing), thus assisting in isolating the location of the short circuit.

6.8.10 Photoelectric (light-scattering) smoke sensor. A sensor that uses a light source and a photosensitive sensor arranged in a manner so that the rays from the light source do not normally fall onto the photosensitive sensor. When smoke particles enter the light path, some of the light is scattered by reflection onto the sensor. The light signal is processed and used to convey an alarm condition when it meets preset criteria.

6.8.11 Reset. A control function performed by a system operator, that attempts to return a system or device to its normal, non-alarm state.

6.8.12 Restorable initiating device. A device (sensor) whose sensing element is not ordinarily destroyed in the process of operation.

6.8.13 Ruggedized. Physical and operational characteristics that allow equipment to withstand rough handling and extreme or hostile environments.

6.8.14 Signaling line circuit. A circuit or path between any combination of circuit interfaces, control units, or transmitters over which multiple system input signals or output signals, or both, are carried.

6.8.15 Smoke detector (sensor). A device that detects visible or invisible particles of combustion.

6.8.16 Switch closure zone module (SCZM). An individually addressable device that is used to interface switch closure devices (such as water flow switches, manual pull stations, water switches, and flooding switches) with the alarm panel for monitoring purposes.

6.8.17 Trouble signal. A signal initiated by the fire alarm system or sensor indicative of a fault in a monitored circuit or component.

6.9 Subject term (key word) listing.

Alarm signal

Heat sensor

Signaling line circuit

Smoke detector

Trouble signal

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