INCH-POUND

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PERFORMANCE SPECIFICATION

FLAME DETECTOR, 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 detectors (see 6.8.5), which are components of an overall Advanced Fire and Smoke Sensor System (AFSSS) for use on naval ships. These flame detectors may be of commercial-off-the-shelf (COTS) design, but must be rugged (see 6.8.12) 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 Detector Zone Modules (FDZM) (see 6.8.6), Switch Closure Zone Modules (SCZM) (see 6.8.16), isolators (see 6.8.9), 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-PRF-16884	-	Fuel, Naval Distillate
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.

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.

FACTORY MUTUAL RESEARCH CORPORATION (FMRC)

ANSI/FM 3260	-	American National Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling

(Copies of this document are available from Factory Mutual Research Corporation, 1151 Boston-Providence Turnpike, Norwood, MA 02062 or online at www.fmglobal.com.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 72	-	National Fire Alarm Code

(Copies of this document are available from National Fire Protection Association, One Batterymarch Park, Quincy, MA 02269 or online at http://www.nfpa.org/.)

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 processes. 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 flame detector shall consist of the appropriate electronics and viewing lens(es) housed in an appropriate enclosure. The flame detector shall also have appropriate mounting hardware that allows for mounting to the ship as well as adjustments for aligning the flame detector's orientation after mounting (see 3.3.4 and 3.7.2). The term, "flame detector," as used in this specification, refers to the overall flame detector consisting of the enclosed flame detector and its mounting and line-of-sight adjusting hardware. Flame detectors shall operate properly in both overhead (vertical) or bulkhead (horizontal) mounted positions. Flame detectors shall operate properly when oriented/aimed in any direction.

3.3.1 Interchangeability. The AFSSS flame detector shall have a unique model number and shall be physically identical and interchangeable with all other AFSSS flame detectors from the same manufacturer.

3.3.2 Flame detector principle of operation. Flame detectors shall be the discriminating type that requires radiation of two or more different frequencies (e.g., one in the ultraviolet range and one in the infrared range, or two or three in the infrared range, etc.) before an alarm is generated, in order to minimize false alarms (see 6.8.4) from non-fire sources and nuisance alarms from welding or other light-emitting operations. In addition, flame detectors shall have a flicker discrimination (characteristic of the natural flicker frequency of a fire) to further prevent false or nuisance alarms from non-fire sources. Flame detectors shall be restorable after alarm, but only after a reset (see 6.8.11) at the alarm panel is manually executed and the detector is no longer viewing the radiation from the fire (i.e., flame detector alarms shall latch at the alarm panel).

3.3.3 Individual addressability and LED. Either the flame detector or the FDZM shall have an adjustable mechanical device or dipswitch that shall be easily set to allow each flame detector to be individually identifiable and addressable (see 6.8.1) by the 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 flame detector interchangeability. The flame detector shall also contain one or more LEDs. Failure of any LED shall not interfere with the operation of the flame detector nor the transmission of flame detector alarm or trouble signals (see 6.8.17) to the alarm panel. The LED(s) shall be capable of visually showing the condition of the flame detector. The LED(s) shall distinctly identify the three possible flame detector states:

State 1: Power is not being supplied to the flame detector or the detector is not properly operating (darkened LED).

State 2: Power is being supplied to the flame detector and the detector is operating but is not in an alarm state.

State 3: Power is being supplied to the flame detector and the detector is in an alarm state.

3.3.4 Enclosure. The flame detector shall be housed in an enclosure. If the flame detector receives power from and communicates with a FDZM, the flame detector enclosure shall possess a flat area (or actual stuffing tube) to allow an appropriate watertight, shielded cable from the FDZM to penetrate the flame detector with an appropriate watertight stuffing tube (see MIL-E-2036). If the flame detector connects to the sensor loop and receives power from and communicates with the alarm panel directly, then the flame detector enclosure shall possess sufficient flat areas to allow two LS-2SWU-1 cables (see MIL-DTL-24643) to penetrate (for the sensor loop and power connections). The flame detector enclosure shall provide a conductive path for the shields of all cables to connect to ship's hull to provide shield termination. The flame detector shall also have appropriate mounting hardware that allows for mounting to the ship as well as adjustments for aligning the flame detector's orientation after mounting. This mounting hardware shall be a bracket, swivel mount, or some mechanical means to align or position the flame detector viewing lens(es) to point in the direction of desired coverage, after the mounting hardware bolts are securely connected to the 1-inch long threaded-female metal standoffs welded to the bulkhead or overhead. Once the flame detector's viewing lens(es) is (are) properly positioned, the flame detector bracket, swivel, or mechanical means shall be capable of being secured so that the lens(es) stays aimed at its intended coverage area. The flame detector shall be compatible with the mounting and alignment hardware and shall securely attach to it but be easily adjusted/realigned without the need for special tools.

3.4 Degree of enclosure. The overall flame detector shall be at least NEMA-4 (National Electrical Manufacturers Association) watertight and dust tight and shall be rated for use in hazardous locations classified as Class I, Division 1, Groups B, C, D. The approval agency's decal must appear on the flame detector.

3.5 Weight. The total weight of the flame detector (including all mounting and adjustment hardware) shall not exceed 6 pounds.

3.6 Size. The maximum height, width, and depth of the flame detector (not including the mounting and adjustment hardware) shall not exceed 10 inches (for each direction).

3.7 Interface requirements.

3.7.1 Electrical interface. Flame detectors shall obtain power from and be compatible with the UL listed AFSSS alarm panel. The sensor loop cable used to interface the alarm panel with the flame detector (either directly or via the FDZM) shall be LS2SWU-1. The LS2SWU-1 cabling shall be routed from the alarm panel to the various sensors and flame detectors (or sensors and FDZMs) 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 will not result in the loss of any sensors. If the sensor loop does not supply power to the flame detector, then a separate flame detector LS2SWU-1 power cable shall be routed from the alarm panel to all of the flame detectors (or via their FDZMs, if required) in a looped fashion so that single opens on this loop will not result in the loss of power to any flame detectors.

3.7.2 Ship interface. The flame detector shall mount to a bracket, swivel mount, or some mechanical means, which, in turn, shall mount with bolts to 1-inch long threaded-female metal standoffs welded onto the overheads and bulkheads of the ship's compartments. The bracket or swivel mount shall allow for adjusting or aligning the flame detector's orientation (view) after mounting. This mounting hardware shall align or position the flame detector viewing lens(es) to point in the direction of desired coverage, after the mounting hardware bolts are securely attached to the bulkhead or overhead. Once the flame detector's viewing lens(es) is (are) properly positioned, the flame detector bracket or swivel mount shall be capable of being secured, without the need for special tools, so that the lens(es) stays aimed at its intended coverage area.

3.8 Operating requirements.

3.8.1 Basic operation. When tested in accordance with 4.5.1, flame detectors shall alarm when subjected to appropriate and sufficient radiant energy and shall send an alarm signal (see 6.8.3) to the alarm panel. Flame detectors shall generate appropriate trouble indications at the alarm panel when flame detector power is disconnected and when their sense-line cable that connects the flame detector to the FDZM (if an FDZM is used) is disconnected.

3.8.2 Sensitivity. When tested in accordance with 4.5.2.1 and 4.5.2.2, flame detectors shall alarm to the all test fires within 30 seconds (after the shield is removed). Flame detectors shall have a solid angle field of view of at least 90 degrees.

3.8.3 Self-testing circuitry. Flame detectors shall perform an automatic functional self-test (see 6.8.13) that checks the transparency of the flame detector lens(es) to ensure the lens(es) is (are) free from contaminants that could block flame radiation from reaching the flame detector. In addition, this self-test shall automatically test the operation of the flame detector's electronic circuitry (without the need to generate an actual flame at the flame detector or attach meters to the detector) without causing an actual alarm to register at the alarm panel. Any components that are located on the outside of the flame detector enclosure for this self-test shall be securely attached to prevent removal by tampering, vibration, or shock. Any failure of this self-test shall be appropriately communicated to and displayed on the alarm panel.

3.9 Performance requirements.

3.9.1 Commercial performance requirements. Flame detectors shall be FM approved and be compatible with a UL listed AFSSS alarm panel (either directly or via FDZMs). Flame detectors shall comply with ANSI/FM 3260, with the following exceptions/clarifications:

a. The flame detector shall alarm within 30 seconds to the 12-inch by 12-inch gasoline pan fire at a distance of at least 40 feet. Sensitivities to other ANSI/FM 3260 test fires may also be identified.

b. At least one LED shall be provided on the flame detector to identify that it is the unit from which the alarm was initiated. This LED must also distinguish between the sensors three states: not powered, powered without an alarm, and powered with an alarm.

c. After flame radiation exposure ceases, the flame detector shall latch positively until reset at the alarm panel. The flame detector shall not restore to normal condition promptly after flame radiation exposure ceases until after a reset at the alarm panel is accomplished.

d. Flame detectors shall withstand vibration as required for ANSI/FM 3260 approval and shall also comply with the Government performance requirements for vibration in 3.9.2.1 of this specification.

e. For the temperature extreme test, flame detectors shall be exposed to a minimum range of 32 °F to 150 °F (vice 125 °F) for a period of at least 12 hours each, then exposed to a flame radiation source.

3.9.1.1 Operating temperature range. Flame detectors shall operate properly at temperatures ranging from at least 32 °F to at least 150 °F.

3.9.2 Government performance requirements. In addition to the ANSI/FM 3260 requirements and approval, the following Government requirements shall be met.

3.9.2.1 Vibration. When tested in accordance with 4.6.2.1, flame detectors and their mounting brackets shall meet the requirements of MIL-STD-167-1. Flame detectors shall operate normally without interruption, trouble indications, nor alarm indications (other than those alarms specifically caused by operational tests) throughout the vibration test. Flame detectors and their mounting brackets 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 flame detector operation is affected or early failure can be expected. Flame detectors 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. Both flame detectors shall also comply with the requirements of 3.8.2 and ANSI/FM 3260 after the vibration test when tested in accordance with 4.5.2.1.

3.9.2.2 Shock. When tested in accordance with 4.6.2.2, flame detectors and their mounting brackets shall meet the Grade A, Class I, Type A requirements of the lightweight MIL-S-901 shock test. Flame detectors shall operate normally without interruption, trouble indications, nor alarm indications (other than those alarms specifically caused by operational tests) throughout the shock test. Flame detectors and their mounting brackets 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 flame detector operation is affected or early failure can be expected. Flame detectors 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. Both flame detectors shall also comply with the requirements of 3.8.2 and ANSI/FM 3260 after the shock test when tested in accordance with 4.5.2.1.

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), flame detectors shall meet the requirements of MIL-STD-461. Flame detectors shall operate normally without interruption, trouble indications, nor alarm indications (other than those alarms specifically caused by operational tests) throughout the EMI test. Flame detectors shall not show any evidence of physical damage throughout the EMI test. Flame detectors 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. Both flame detectors shall also comply with the requirements of 3.8.2 and ANSI/FM 3260 after the EMI test when tested in accordance with 4.5.2.1.

3.9.2.4 False alarm susceptibility. When tested in accordance with 4.6.2.4 (including 4.6.2.4.1 through 4.6.2.4.6), flame detectors shall operate normally without interruption, trouble indications, nor alarm indications (other than those alarms specifically caused by operational tests) throughout their exposure to the false alarm radiation sources. Flame detectors shall not show any evidence of physical damage throughout the test. Flame detectors 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 test.

3.10 Failure criteria. Flame detectors (including their mounting brackets) shall be reliable and not exhibit any failures such as:

a. Failure to meet all applicable ANSI/FM 3260 requirements.

b. Failure to be Factory Mutual approved.

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

d. Inability to transmit an appropriate alarm signal to the alarm panel when an actual alarm condition is present at the detector.

e. Inability to transmit an appropriate trouble indication to the alarm panel when an actual trouble condition is present at the detector.

f. Transmission of an alarm indication, whether temporary, intermittent or latched, when no such condition exists at the detector, including when the flame detector is exposed to non-fire radiation sources (see 3.9.2.4).

g. Transmission of a trouble indication, whether temporary, intermittent or latched, when no such condition exists at the detector, including when the flame detector is exposed to non-fire radiation sources (see 3.9.2.4).

h. Failure of the detector LED(s) or any incorrect LED indication for any of the three detector states.

i. Any physical damage, warping, or cracking of the flame detector or its mounting bracket. Any physical damage, warping, cracking, or dislodging of any components from the detector (whether contained within the flame detector enclosure or attached to the outside of the enclosure or mounting bracket). Any dislodging of the entire flame detector enclosure from its mounting bracket or the mounting bracket from its installation mounts (standoffs). Any physical damage that would cause the overall flame detector's degree of enclosure to be compromised.

j. Any mechanical failure or alteration of the flame detector's mechanical device or dipswitch (which sets the detector's individual address) that results in a trouble signal, renders the detector inaddressable from the alarm panel, or changes the address of the detector (applicable if this dipswitch is located in the flame detector vice the FDZM).

k. Any failure of the mounting bracket to stay secure and aligned/aimed in its original position as a result of vibration or shock. Any realignment of the flame detector's viewing lens(es) as a result of vibration or shock.

l. Any removal or realignment of the flame detector's self-test components, located on the outside of the flame detector's enclosure, as a result of tampering, vibration, or shock.

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

3.12 Reliability. To the maximum extent possible, flame detectors shall be highly reliable devices that eliminate or significantly minimize the occurrence of false alarms while maintaining an acceptable level of fire detection capability. Numerous false alarms for an installed shipboard system can erode crew confidence in the system. As specified in 3.10, any transmission of an alarm indication, whether temporary, intermittent or latched, when no such condition exists at the detector 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 flame detectors 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. Samples subjected to first article inspection shall be considered consumed and non-deliverable as part of the contract. Final disposition of first article samples shall be as specified (see 6.2).

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

TABLE I. First article and conformance inspections.

Name	Requirement 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
Sensitivity	3.8.2	4.5.2.1, 4.5.2.2	X	X
Self-testing circuitry	3.8.3	4.4	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	
False alarm susceptibility	3.9.2.4	4.6.2.4	X	

4.4 General examination. Flame detectors (including their mounting brackets) shall be thoroughly examined for compliance with the requirements specified in 3.3 through 3.7 and 3.8.3. A visual examination shall be made to ensure the proper overall detector configuration, appropriate mounting and alignment hardware, the inclusion of an adjustable mechanical device or dipswitch for individually identifiable addressability (if included in the flame detector vice the FDZM), and the degree of enclosure of the overall detector as required in 3.4. The requirement for detecting two or more different frequencies of radiation as well as the inclusion of a flicker discrimination prior to generating an alarm shall be verified in compliance with 3.3.2. The ability to latch alarms at the alarm panel until reset shall be verified for compliance with 3.3.2. The flame detectors shall also be weighed and measured for compliance with 3.5 and 3.6, respectively. The inspection shall also include operational checks of proper LED operation, as specified in 3.3.3, when the detectors, powered and monitored by the alarm panel in accordance with 3.7, are in their non-powered, powered/normal, and powered/alarm states. The inclusion of self-testing circuitry, as specified in 3.8.3, shall be verified.

4.5 Operational tests.

4.5.1 Basic operational tests. Four flame detectors shall be powered and monitored by the AFSSS alarm panel. These four flame detectors shall be designated F1, F2, F3, and F4. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect the four detectors to the alarm panel either directly or via each flame detector's FDZM. This LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to the four flame detectors (or their FDZMs) and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. If required, a second LS2SWU-1 cable and appropriate stuffing tubes shall be used to connect flame detector power from the alarm panel to all four flame detectors (in a looped arrangement) either directly or via each flame detector's FDZM. Operational tests shall be conducted on all four detectors. The operational tests shall consist of:

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

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

c. Disconnecting a conductor on the sense-line cable that connects the flame detector to the FDZM (if a FDZM is used) to ensure an appropriate trouble indication occurs at the alarm panel.

d. Visually inspecting the flame detector and mounting hardware for physical damage, cracks, loosening, warping, or thermal deterioration.

The four flame detectors shall comply with the requirements of 3.8.1 and shall not exhibit any of the failures listed in 3.10.

4.5.2 Sensitivity tests.

4.5.2.1 Diesel fuel marine fire tests. The four flame detectors previously tested in 4.5.1 (flame detectors F1, F2, F3, and F4) shall be powered and monitored by the AFSSS alarm panel as described in 4.5.1 and subjected to fire tests. If required, FDZMs shall be used to power and monitor each flame detector. A 12-inch long by 12-inch wide by ½-inch deep pan shall be filled with Diesel Fuel Marine (DFM) (MIL-PRF-16884), located 40 feet dead ahead of the flame detectors, primed with not more than 10 ounces of alcohol, and set afire. Flame detectors shall be shielded from the fire for two minutes (or until the alcohol stops burning and the diesel fuel ignites) after which the shield shall be removed. The time required for each flame detector to alarm (after the shield has been removed) shall be recorded. This fire test shall be repeated once. Flame detectors shall comply with the requirements of 3.8.2 and shall not exhibit any of the failures listed in 3.10. The primary purpose of this test is to ensure detection capability for shipboard diesel fuel fires and to establish a baseline for each flame detector's sensitivity for such a fire. This diesel fuel test will then be repeated after each of the vibration, shock and EMI tests to ensure that the flame detector's sensitivity does not change/vary.

4.5.2.2 Field of view tests. Two flame detectors (F1 and F2) previously tested in 4.5.2.1 shall be powered and monitored by the AFSSS alarm panel as described in 4.5.1 and subjected to field of view fire tests. If required, FDZMs shall be used to power and monitor each flame detector. A 12-inch long by 12-inch wide by ½-inch deep pan shall be filled with diesel fuel marine (MIL-PRF-16884) and located 20 feet from each flame detector. Both flame detectors shall not be aimed directly at the fire pan but shall be rotated so that they are aiming 45 degrees to the right of the fire pan. The diesel fuel shall be primed with not more than 10 ounces of alcohol and set afire. Flame detectors shall be shielded from the fire for two minutes (or until the alcohol stops burning and the diesel fuel ignites) after which the shield shall be removed. The time required for each flame detector to alarm (after the shield has been removed) shall be recorded. Both flame detectors shall then be rotated so that they are aiming 45 degrees to the left of the fire pan. The diesel fuel pan, primed with alcohol and located 20 feet from each flame detector, shall be set afire. Flame detectors shall be shielded from the fire for two minutes (or until the alcohol stops burning and the diesel fuel ignites) after which the shield shall be removed. The time required for each flame detector to alarm (after the shield has been removed) shall be recorded. Both flame detectors shall then be subjected to this same fire test, but rotated so that they are aiming, first, 45 degrees above the fire pan, then, 45 degrees below the fire pan. The time required for each flame detector to alarm, in both cases, shall be recorded. Flame detectors shall comply with the requirements of 3.8.2 and shall not exhibit any of the failures listed in 3.10. The purpose of this test is to ensure a 90 degree cone of vision detection capability for shipboard diesel fuel fires.

4.6 Performance tests.

4.6.1 Commercial performance tests. Flame detectors shall be inspected for Factory Mutual (FM) approval, compliance with ANSI/FM 3260, and compatibility with the AFSSS alarm panel (either directly or via a FDZM). Flame detectors shall also be inspected to ensure that the ANSI/FM 3260 exceptions/clarifications of 3.9.1 are met as specified (see 6.2). The FM temperature extreme test (32 °F to 150 °F) and the 12-inch by 12-inch gasoline pan fire test at 40 feet dead ahead (with the detector responding within 30 seconds) shall be conducted. Sensor operating temperature ranges shall be verified to comply with the requirements of 3.9.1.1.

4.6.2 Government performance tests.

4.6.2.1 Vibration. Two flame detectors (F1 and F2) (each including its appropriate mounting bracket) shall be subjected to MIL-STD-167-1 vibration testing. Flame detectors F1 and F2 shall have been subjected to the operational tests of 4.5.1 and the sensitivity tests of 4.5.2.1 prior to this vibration test. Both detectors shall be mounted on the vertical bracket of the vibration platform. The mounting brackets of both detectors shall be bolted to the vibration platform using 1-inch long threaded-female standoffs to duplicate actual shipboard mounting conditions. (The bottoms of the mounting brackets shall not rest flush against the vibration platform. The bottoms of the mounting brackets shall rest flush against the faces of the 1-inch standoffs.) Both flame detectors shall be powered and monitored by the AFSSS alarm panel, either directly or via FDZMs. The AFSSS alarm panel shall not be mounted on the vibration platform nor subjected to this vibration test. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect both detectors to the alarm panel via the sensor loop. The LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to both detectors (or both FDZMs, if required) and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. If required, a separate LS2SWU-1 cable and appropriate stuffing tubes shall be used to connect the flame detectors (or FDZMs) to the alarm panel for flame detector power. Additional AFSSS sensors, detectors, and devices (e.g., other flame detectors not being subjected to this vibration testing or other heat sensors, smoke sensors, FDZMs, SCZMs, and isolators also being subjected to this vibration testing) may be included on this 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 test specified in 4.5.1.a shall be conducted on each of the flame detectors (while mounted on the vibration platform) once after the exploratory test, once after the variable frequency test, and once midway during the endurance test (or midway at each resonant frequency, if tested at more than one frequency during the endurance test). After the vibration test, the flame detectors shall also be subjected to the sensitivity tests of 4.5.2.1. Both flame detectors shall meet the requirements of 3.9.2.1.

4.6.2.2 Shock. Two flame detectors (F1 and F2) (each including its appropriate mounting bracket) shall be subjected to lightweight, Grade A, Class I, Type A, MIL-S-901 shock testing. Flame detectors F1 and F2 shall have been subjected to the operational tests of 4.5.1 and the sensitivity tests of 4.5.2.1 immediately prior to this shock test. Both detectors shall have also been subjected to the vibration test of 4.6.2.1 prior to this shock test. Both detectors shall be mounted on the (vertical) Fixture 4A of the shock machine. The mounting brackets of both detectors 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 mounting brackets shall not rest flush against the shock machine fixture. The bottoms of the mounting brackets shall rest flush against the faces of the 1-inch standoffs.) Both flame detectors shall be powered and monitored by the AFSSS alarm panel, either directly or via FDZMs. The AFSSS alarm panel shall not be mounted on the shock machine nor subjected to this shock test. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect both detectors to the alarm panel via the sensor loop. The LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to both detectors (or both FDZMs, if required) and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. If required, a separate LS2SWU-1 cable and appropriate stuffing tubes shall be used to connect the flame detectors (or FDZMs) to the alarm panel for flame detector power. Additional AFSSS sensors, detectors, and devices (e.g., other flame detectors not being subjected to this shock testing or other heat sensors, smoke sensors, FDZMs, SCZMs, and isolators also being subjected to this shock testing) may be included on this sensor loop. After each of the nine shock blows, the operational test specified in 4.5.1.a shall be conducted on each of the flame detectors (while mounted on the shock machine). After the shock test, the flame detectors shall also be subjected to the sensitivity tests of 4.5.2.1. Both flame detectors shall meet the requirements of 3.9.2.2.

4.6.2.3 Electromagnetic interference (EMI). Two flame detectors (F3 and F4) (each including its appropriate mounting bracket) shall be subjected to EMI testing in accordance with MIL-STD-461. Flame detectors F3 and F4 shall have been subjected to the operational tests of 4.5.1 and the sensitivity tests of 4.5.2.1 prior to this EMI test. The mounting brackets of both detectors 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 mounting brackets shall not rest flush against the ground plane. The bottoms of the mounting brackets shall rest flush against the faces of the 1-inch standoffs.) Both flame detectors shall be powered and monitored by the AFSSS alarm panel, either directly or via FDZMs. The AFSSS will be EMI tested as a system; thus, the AFSSS alarm panel shall be included in the EMI test. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect both detectors to the alarm panel via the sensor loop. The LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to both detectors (or both FDZMs, if required) and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. If required, a separate LS2SWU-1 cable and appropriate stuffing tubes shall be used to connect the flame detectors (or FDZMs) to the alarm panel for flame detector power. Additional AFSSS sensors, detectors, and devices (e.g., other heat sensors, smoke sensors, FDZMs, SCZMs, and isolators 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 flame detector, sensor, isolator, FDZM, and SCZM. 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 both flame detectors and the alarm panel (and any additional heat sensors, smoke sensors, FDZMs, SCZMs, and isolators included in the sensor loop for this EMI test). The operational tests of 4.5.1 shall be conducted on each of the flame detectors 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 flame detectors shall be subjected to the sensitivity tests of 4.5.2.1. Both flame detectors shall meet the requirements of 3.9.2.3. EMI requirements for the alarm panel and other AFSSS sensors and devices are contained in separate AFSSS component specifications.

4.6.2.3.1 Conducted emissions (CE102)(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, detectors and the alarm panel shall be measured over the range of 30 Hz to 100kHz. 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, detectors, and the alarm panel shall be measured over the range of 10 kHz to 18GHz. 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 operational test specified in 4.5.1.a 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 operational test specified in 4.5.1.a shall be conducted after this portion of the EMI test.

4.6.2.3.6 Conducted susceptibility (CS 116)(10kHz to 100 MHz). All interconnecting cables shall be subjected to CS116 test signals as specified in MIL-STD-461 over the range of 10kHz to 100MHz. The operational tests of 4.5.1 shall be conducted after this portion of the EMI test.

4.6.2.3.7 Radiated susceptibility (RS 101)(30 Hz to 100 kHz). All power and interconnecting leads, detectors, 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 operational test specified in 4.5.1.a shall be conducted after this portion of the EMI test.

4.6.2.3.8 Radiated susceptibility (RS 103)(2 MHz to 40 GHz). All power and interconnecting leads and detectors 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 operational test specified in 4.5.1.a shall be conducted after this portion of the EMI test.

4.6.2.4 False alarm susceptibility. Two flame detectors (F3 and F4) shall be subjected to testing for false alarm susceptibility to various non-fire radiation sources. Flame detectors F3 and F4 shall have been subjected to the operational tests of 4.5.1 prior to these false alarm susceptibility tests. Both flame detectors shall be powered and monitored by the AFSSS alarm panel, either directly or via FDZMs, throughout all these tests. LS2SWU-1 cables and appropriate stuffing tubes shall be used to connect both detectors to the alarm panel via the sensor loop. The LS2SWU-1 sensor loop cabling shall be routed from the alarm panel to both detectors (or both FDZMs, if required) and then returned to the alarm panel in a looped NFPA 72, Style 6, Class A signaling line circuit arrangement. If required, a separate LS2SWU-1 cable and appropriate stuffing tubes shall be used to connect the flame detectors (or FDZMs) to the alarm panel for flame detector power. The false alarm susceptibility tests of 4.6.2.4.1 through 4.6.2.4.6 shall be conducted on both flame detectors. After all of the 4.6.2.4.1 through 4.6.2.4.6 tests are conducted, the flame detectors shall be subjected to the operational tests of 4.5.1. Both flame detectors shall meet the requirements of 3.9.2.4.

4.6.2.4.1 Sunlight. Two flame detectors (F3 and F4) shall be positioned to directly face the sun and shall be subjected to direct sunlight for at least 2 minutes. These two flame detectors shall then be subjected to chopped sunlight for at least 1 minute by waving a shield or hand in front of both flame detectors' lenses as fast as possible (thereby intermittently blocking, then allowing, the sunlight to shine on the detectors).

4.6.2.4.2 Incandescent light. Two flame detectors (F3 and F4) shall be positioned to directly face an energized, clear glass, 100 watt incandescent light bulb, located 3 feet dead ahead of both flame detectors, and shall be subjected to its direct light for at least 2 minutes. These two flame detectors shall then be subjected to its chopped light for at least 1 minute by waving a shield or hand in front of both flame detectors' lenses as fast as possible (thereby intermittently blocking, then allowing, the light to shine on the detectors).

4.6.2.4.3 Fluorescent light. Two flame detectors (F3 and F4) shall be positioned to directly face an energized, 40 watt, fluorescent light with a white enamel reflector (standard shop or office light), located 3 feet ahead of both flame detectors, and shall be subjected to its direct light for at least 2 minutes. These two flame detectors shall then be subjected to its chopped light for at least 1 minute by waving a shield or hand in front of both flame detectors' lenses as fast as possible (thereby intermittently blocking, then allowing, the light to shine on the detectors).

4.6.2.4.4 Flashlight. Two flame detectors (F3 and F4) shall be positioned, one at a time, to directly face an energized, standard commercial, 2-D cell flashlight, located 3 feet ahead, and shall be subjected to its direct light for at least 2 minutes. These two flame detectors shall then be subjected, one at a time, to its chopped light for at least 1 minute by waving a shield or hand in front of each flame detector's lens(es) as fast as possible (thereby intermittently blocking, then allowing, the light to shine on the detector).

4.6.2.4.5 Lit cigarette. Two flame detectors (F3 and F4) shall be positioned to directly face a lit cigarette, located 1 foot in front of both flame detectors, and shall be subjected to its direct light for at least 2 minutes. These two flame detectors shall then be subjected to its chopped light for at least 1 minute by waving a shield or hand in front of both flame detectors' lenses as fast as possible (thereby intermittently blocking, then allowing, the light to shine on the detectors).

4.6.2.4.6 Arc welding. Two flame detectors (F3 and F4) shall be positioned to directly face the shielded metal arc (SMA) welding (at maximum amperage) of two carbon steel plates, located 3 feet in front of both flame detectors, and shall be subjected to this direct welding light for at least 1 minute.

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 flame detector is a sensing device that is effective at detecting the radiation emitted from a flaming fire. This detector is one of several types of devices used in the AFSSS and intended for use on Navy ships.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Quantity of first article flame detectors (and FDZMs and an alarm panel, if applicable) required.

c. When the first article inspection is required. (see 3.1 and 6.3)

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

e. Proof of FM approval including a full copy of the FM testing report for the flame detectors. This FM testing report shall verify that the requirements of the temperature extreme test (32 °F to 150 °F) and the 12-inch by 12-inch gasoline pan fire at 40 feet dead ahead (with the detector responding within 30 seconds) have been met.

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 flame detectors are being procured for use with a previously procured or existing system, ensure that these detectors are compatible with the specific alarm panel (or FDZMs, if required) in that system. Flame detectors from one manufacturer may not be compatible with an alarm panel (or FDZMs, if required) from another manufacturer.

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

6.8 Definitions.

6.8.1 Addressable detector. A detector 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 and detectors 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) appropriate for that type of sensor.

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.

6.8.6 Flame detector zone module (FDZM). An individually addressable device that is used to interface flame detectors 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 or flame detectors, 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 and detectors remaining on both non-isolated sections of the sensor loop will continue to operate and communicate with the AFSSS alarm panel. The sensors and detectors 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 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 Ruggedized. Physical and operational characteristics that allow equipment to withstand rough handling and extreme or hostile environments.

6.8.13 Self-test. A test or series of tests, performed by a device upon itself, that shows whether or not the device is operating within designed limits.

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

Flame Detector Zone Module

Signaling line circuit

Smoke detector

Switch Closure Zone Module

Custodians:
Army – CR4
Navy – SH
Air Force – 99

Review Activities:
DLA – GS, GS2

Preparing Activity:
Navy – SH
(Project 6320-2005-005)

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