FM Approvals

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Examination Standard for Remote Fire Watch Systems

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 PURPOSE

1.1.1 This standard states testing and certification requirements for transportable and fixed hot work robots which detect products of combustion in a specific location during and after hot work operations. Hot work robots notify facility operators upon detection of an incipient stage fire. These robots are an alternative to the use of human fire watch personnel.

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 SCOPE

1.2.1 This standard describes performance requirements for hot work robots which detect products of combustion in a specific location during and after hot work operations. Hot work robots use a variety of fire and smoke detection technologies such as video image and infrared to notify facility operators upon detection of an incipient stage fire.

1.2.2 This standard employs test protocols that are tailored to the installation and operating instructions provided by the manufacturer. This zess the issue of toxicity or out-gassing of materials when they are subjected to molten or other fire conditions resulting from hot work operations.

1.3 BASIS FOR REQUIREMENTS

1.3.1 The requirements of this standard are based on experience, research and testing and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of hot work robots for the purpose of obtaining certification. Hot work robots having characteristics not anticipated by this standard may be certified if performance is equal, or superior, to that required by this standard is demonstrated.

1.4 BASIS FOR CERTIFICATION

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product, which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 BASIS FOR CONTINUED CERTIFICATION

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Surveillance Audits conducted as part of the certification agency's product surveillance program.

1.6 EFFECTIVE DATE

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this Standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 SYSTEM OF UNITS

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this Standard.

1.8 NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, American National Standard for Metric Practice

ANSI/IEC 60529 Degrees of Protection provided by Enclosures (IP Code)

ANSI/NFPA 72 National Fire Alarm and Signaling Code

ANSI/UL 268 6th Edition Smoke Detectors for Fire Alarm Signaling Systems Dated August 14, 2009

FM3150 Audible Notification Appliances for Automatic Fire Alarm Signaling

FM3155 Public Mode Visible Signaling Appliances for Automatic Fire Alarm Signaling

NEMA 250 Enclosures for Electrical Equipment

1.9 TERMS AND DEFINITIONS

For purposes of this standard, the following terms apply:

Fault signal — Audible, visible or other type of output, different from the alarm signal, permitting, directly or indirectly, a warning or indication that the apparatus is not working satisfactorily.

Field Of View — The angular extent of what can be seen with an optical instrument or camera.

Fire Watch — A physical inspection conducted when a building's fire alarm, sprinkler or other suppression systems are hindered or temporarily out of service.

Trouble condition — An abnormal condition due to a fault in a portion of a system monitored for integrity.

Hot Work Robot — Any device suitable for monitoring for smoke and flame during a hot work operation.

Hot work — Any temporary or routine work (operation) involving open-flame, producing hot surfaces, and/or generating sparks or molten material of sufficient energy to ignite combustible, ignitable, and/or flammable materials. Examples of hot work operations include torch-applied roofing, pipe brazing, pipe soldering, arc and torch welding, radial-mechanical and torch cutting, grinding, and post-weld heating using a gas-fired burner or electrical resistance heater. For ignition-sensitive materials such as low-flash point ignitable liquids, flammable gas/vapor, and some combustible dusts, hot work may be expanded to include low-energy hot work ignition sources.

Video Image Fire Detector (VIFD) for Automatic Fire Alarm Signaling — A discrete, self contained automatic smoke and flame detection device intended to perform analysis of real time video images representative of smoke and flame as generated by accidental fire and over-heat conditions within the viewing area covered by the video camera. This detection principle typically requires a clear line-of-sight with the area being viewed by the camera and the detector can connect directly to the initiating or signaling line circuits of a fire alarm system. The detection principle might consider the plume, pattern, edge content, movement and colors associated with the smoke and flame signature(s).

Video Image Fire Detection System (VIFDS) for Automatic Fire Alarm Signaling — A combination of camera(s), processing equipment and interfaces that together can operate as an automatic smoke and flame detection system intended to perform analysis of real time video images representative of smoke as generated by accidental fire and over-heat conditions within the viewing area covered by the video camera(s). This detection system typically requires a clear line-of-sight with the area being viewed by the camera and often requires additional equipment (dedicated primary and secondary power systems) be provided as component of a fire alarm system. The detection principle might consider the plume, pattern, edge content, movement and colors associated with the smoke and flame signature(s).

Sensitivity — The sensitivity of a Video Image Fire Detector (VIFD) is the result of an engineering evaluation that includes the following parameters as specified by the manufacturer.

- Volume and Size of the smoke and fire signature required for detection
- Fuel Source(s)
- Field of View of the detector
- Minimum & Maximum detection range (fire source to the detector)
- Presence or influence of false alarm sources within the viewing area
- Purpose of the system
- Response time required

Transportable apparatus — Apparatus not intended to be portable, but which can be readily moved from one place to another.

2 GENERAL INFORMATION

2.1 PRODUCT INFORMATION

2.1.1 One of the leading sources of ignition in industrial fires is spark, flame and heat resulting from hot work operations.

2.1.2 The term hot work encompasses a wide range of operations but is generally used to describe welding and its allied processes such as, but not limited to, cutting, heat treating, grinding, chipping, molten splash, sand blasting, pipe thawing, powder driven fastening, hot riveting and any other similar application that produces a spark, flame or heat that can become a source of ignition.

2.1.3 A transportable hot work robot is intended to be placed in the area of hot work operations to provide an alarm signal to facility operators in the event of an incipient fire or a trouble condition. After the fire watch is complete, the hot work robot can be transported to another location to continue monitoring hot work operations.

2.1.4 Hot work robots are intended to detect (i.e. respond to) by-products of combustion within the field of view of the robot. Hot work robots have a limited field of view and rely on a line-of-sight transmission of the monitored image from the source to the hot work robot. Hot work robots employ detectors that monitor a protected area for the plume, pattern, edge content, movement and colors associated with the fire (smoke and flame) signature(s).

2.1.5 Hot work robots are intended to operate in environments as specified in the manufacturer's installation instructions and in accordance with acceptable national, regional, or international codes and standards.

2.2 CERTIFICATION APPLICATION REQUIREMENTS

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures, and
- The number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 REQUIREMENTS FOR SAMPLES FOR EXAMINATION

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- For functional testing described below, the manufacturer must provide a minimum quantity of 2 of each hot work robot which are deemed to be representative of the manufacturer's normal production with regard to construction and calibration.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the hot work robots.

3 GENERAL REQUIREMENTS

3.1 REVIEW OF DOCUMENTATION

During the initial investigation and prior to physical testing, the manufacturer's specifications shall be reviewed to assess the ease and practicality of installation and use. The certification examination results shall define the limits of the final certification.

3.2 PHYSICAL OR STRUCTURAL FEATURES

3.2.1 Means shall be provided to set up the apparatus such that it is stable and capable of remaining stable under varying environmental conditions.

3.2.2 Means shall be provided to indicate trouble condition in the event of tip-over and/or misalignment.

3.2.3 Both visual and audible indication shall be provided to identify that the hot work robot is in alarm.

3.2.4 Means shall be provided to silence an alarm. After silencing the system should return to its prior mode for detection.

3.2.5 Hot work robots intended for use in hazardous (classified) locations shall comply with certification requirements for hazardous (classified) location electrical equipment in addition to this standard.

3.2.6 The hot work robot shall be suitable for the intended environmental exposures as determined by testing in accordance with acceptable national, regional, or international codes and standards.

3.2.7 The hot work robot shall comply with the secure wiring methods specified in NFPA 72.

3.2.8 The hot work robot shall have response times in accordance with Sections 4.1.1. and 4.1.2 of this document and within those defined in the manufacturer’s specifications and installation and operational manual.

3.2.9 A hot work robot rated at or above 30 V ac and 60 V dc shall provide a proper ground terminal.

3.2.10 If a hot work robot is intended to connect to a certified fire alarm system to provide supervision of the robot, it must be it must be tested for compatibility in accordance with NFPA 72 requirements.

3.3 MARKINGS

3.3.1 Marking on the product or, if not possible due to size, on its packaging or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, operating voltage, electrical ratings, and temperature rating.
- FM 3270 qualifier beneath the certification mark.
- When hazard warnings are needed, the markings should be universally recognizable.

3.3.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency’s mark of conformity.

3.3.3 The certification agency’s mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.3.4 All markings shall be legible and durable.

3.4 MANUFACTURER'S INSTALLATION AND OPERATION INSTRUCTIONS

3.4.1 The product installation, operating, and maintenance instructions shall be reviewed for each type and model of the hot work robot examined; the instructions shall be complete and appropriate for the hot work robot. The installation instructions or manual shall be marked with a document name, number, revision, and date. The following items are required:

- Operating temperature
- Humidity
- Minimum and maximum lighting (for natural white light and IR if applicable)
- Electrical ratings
- Enclosure ratings
- Fuel, size of fire, distance from the Hot Work Robot
- False alarm sources as enumerated in paragraph 4.4
- Instructions for determining the Hot Work Robot functionality and operation.
- Instructions for the installation, maintenance, and operation of the product;
- Facilities for repair of the product and supply replacement parts; and
- Services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.5 CALIBRATION

3.5.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.5.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

3.6 SOFTWARE REQUIREMENTS

3.6.1 All software and firmware shall be identified by release level, which is clearly marked on, or capable of being displayed by, the product for ease of identification.

3.6.2 Any changes to the software /firmware shall result in a revision to the release level.

3.6.3 The operating software and firmware shall not be accessible for any changes or modification beyond what it has been certified for.

3.6.4 Any software failure that renders the hot work robot inoperable shall result in a trouble condition both locally and at the monitoring station (e.g. watchdog timer).

4 PERFORMANCE REQUIREMENTS

4.1 NORMAL OPERATION-SENSITIVITY

4.1.1 Smoke Test

The hot work robot installed per the manufacturer's instructions, will be tested as described in Sections 41 & 42 of ANSI/UL 268 6th Edition and shall respond in accordance with the parameters defined for these four standard test fires.

- Paper fire
- Wood fire
- Flammable liquid fire
- Smoldering smoke

4.1.2 Fire Tests

The hot work robot sensitivity as specified (i.e. fuel, size, minimum and maximum distances and response time) shall be tested during the examination. The manufacturer shall identify the sensitivity of the hot work robot to all of the fires defined below:

- 12 x 12 in. (0.3 x 0.3 m) N-heptane pan fire
- 12 x 12 in. (0.3 x 0.3 m) alcohol (type specific) pan fire
- 39 in. (1m) methane flame from a 0.375-inch (9.5 mm) orifice
- 2 flaming, 10in. x 10 in. x 4 in. cardboard containers each loaded with 4 crumbled sheets of standard letter size paper.

The sensitivity shall be verified at the minimum and maximum distance from the center of the fire source in accordance with the manufacturer's specifications. The hot work robot will give consistent alarm responses in a specified time not to exceed thirty seconds.

4.1.3 Optional Smoke-Fire Test (As Specified By Product)

When fuels other than those described in 4.1.1 and 4.1.2 above are specified by the manufacturer, the sensitivity shall be specified (i. e. fuel, size, minimum and maximum distances and response time shall be tested during the examination to each additional fuel source. The sensitivity shall be verified at the minimum and maximum distances from the center of the fire source in accordance with the manufacturer's specifications. The hot work robot will give consistent alarm responses as specified by the manufacturer.

4.2 FIELD OF VIEW

The hot work robot will be tested to confirm the manufacturer's claims for field of view. Hot work robots will be tested using at least one of the fires specified by the manufacturer. The field of view will be verified in four (4) off axis directions (+/- Left and Right and +/- Up and Down) as defined by the manufacturer's specifications. The hot work robot's response (sensitivity) shall remain consistent and not decrease by more than - 10% at the specified field of view limits to the results obtained when tested on-axis to the lens of the hot work robot.

4.3 SWITCHING

The hot work robot's alarm signal processing time shall occur within the manufacturer's specified response time and not to exceed 30 seconds for any of the following conditions.

- For any hot work robot, an alarm operation within the defined parameters (smoke curves and time) of 4.4
- Additionally, all hot work robots when exposed to the fire sources 4.1.2 and 4.1.3 shall be monitored to ensure actuation according to the manufacturer's specifications and in no case to exceed 30 seconds following the introduction of the fire source to the hot work robot.

4.4 FALSE STIMULI TEST RESPONSE

The hot work robot shall respond to the specified fire samples as define in their specifications without false alarm due to modulated and non-modulated direct and reflected sunlight, or to various modulated and non-modulated sources of artificial light when installed in accordance with the manufacturer's instructions.

The hot work robot will be tested in the presence of both modulated and non-modulated sources. Distances from these sources will vary accordance with the manufacturer's claims and the type of hot work robot.

- direct and reflected sunlight (outdoor rated VID's only)
- arc welding (1⁄8 in. (0.3 cm) or 3/16 in. (0.5 cm) type 7014, 7013 or 6012 rod, and a 180-200 Ampere setting
- heated bodies (1,500w electrical heater)
- artificial light (100w incandescent)
- artificial light (40w fluorescent)
- artificial light (500w halogen)

The unit shall operate normally prior to ignition and provide an alarm indication consistent with the results obtained in Section 4.1. While subjected to the false stimuli, there shall be no false signals (alarm or trouble) and no evidence of instability during or at the end of this test. In addition, the hot work robot will respond satisfactorily to a test fire while under the influence of the false stimuli placed directly within the field of view of the hot work robot.

4.5 ELECTRICAL SUPERVISION AND VIDEO IMAGE MONITORING

The integrity of the video image and its transmission pathway must be supervised to provide complete end-to-end supervision of the video transmission system (i.e. camera to processing equipment).

The hot work robot shall produce a trouble indication for:

- Loss of camera power
- Loss of video transmission pathway
- Loss of image contrast
- Loss of image clarity
- Operation of any manual switching component from its "normal" position

The hot work robot shall not produce an alarm signal for the interruption and restoration of either primary or secondary power sources.

4.6 VOLTAGE VARIATIONS OF LINE POWERED EQUIPMENT

The hot work robot, with nominal rated voltage applied, shall be exposed to a standard test fire. The input voltage shall then be varied from 85 to 110% of nominal, or the manufacturer's range (whichever is wider), and the unit again exposed to a specified source (a single smoke room test) at both of these voltage extremes. The sensitivity of the device shall be +/- 10% from the vale obtained in the original sensitivity test, no trouble signal, and no false indication of fire during these tests.

There shall be:

- No false signals (alarm or trouble) and
- No evidence of instability during or at the end of this test
- and remain fully operational at the conclusion of this test.

The unit shall operate normally following this test.

Exception: This test can be waived if the power supplies are found to regulate the Hot Work Robot voltage so as to not be subject to any variations.

4.7 BATTERY POWERED HOT WORK ROBOTS

Hot work robots intended to be powered by an internal or external battery shall:

- Have a battery life of at least 13 hours. Battery life shall be calculated based on normal operation with no alarms present.
- Produce a low battery indication. The nature and purpose of this indication shall be explained in the manual.
- The hot work robot shall continue to operate for 5 hours under the low battery indication. At the end of 5 hours the hot work robot shall be capable of generating and an alarm indication for 30 minutes.

4.8 TEMPERATURE EXTREME

The hot work robot shall produce no (unexpected) trouble signal and no false indication of fire during or following exposure to the temperature extremes described below.

- For indoor applications, the device shall be exposed to minimum limits of 32° and 120°F (0° and 49°C) for a period of at least 24 hours at each limit.
- For outdoor applications, the device shall be exposed to minimum limits of -40° to 140°F (-40° to 60°C) for at least 24 hours at each limit.

Note: Hot work robots intended for use at higher or lower temperature s than those shown above shall be tested at the rated temperature extremes and specially marked for use at the specified temperatures.

4.9 HUMIDITY CYCLING AND CONDITIONING

The hot work robot shall be powered and mounted as intended. The hot work robot shall withstand the effects of heat and humidity, remain functional and produce no (unexpected) trouble signals or false indication of fire under the following conditions.

- A change from 50% relative humidity at 70F (21C) to a relative humidity of 90% relative humidity at 100F (38C) in 15 minutes
- For hot work robots intended solely for indoor dry environments, a relative humidity of 93% +/- 2% and a temperature of 90F+/-3F (32C+/-2C) for a period of 24 hours or.
- For hot work robots intended for indoor/outdoor damp or wet environments, a relative humidity of 95% +/- 3% and a temperature of 140F+/-3F (60C+/-2C) for a period of 24 hours

4.10 VIBRATION

The hot work robot and mounting hardware, shall be powered with rated input voltage applied and mounted in its intended orientation the hot work robot shall be subjected to a 4-hour vertical vibration test of 0.02 in. (0.5 mm) total displacement at a linear frequency sweep of 10 to 30 Hz, at a sweep rate of approximately two cycles per minute.

The hot work robot shall produce no false signals (alarm or trouble). There shall be no loosening of parts or permanent deformation and it shall remain operational at the conclusion of this test.

4.11 DIELECTRIC VOLTAGE-WITHSTAND

The hot work robot shall successfully withstand following test voltages for one minute

- Rated ≥ 30 V ac or 60 V dc 60 Hz, a dielectric strength test of 1000 V ac plus twice the maximum rated voltage.
- Rated ≤ 30 V ac or 60 V dc, a dielectric strength of 500 V ac or 710 V dc.

The dielectric strength test shall be conducted between all applicable combinations of the following: power supply conductors, signaling circuit conductors, ground connection, other output conductors, and hot work robot body.

4.12 BONDING

For hot work robots in which the maximum voltage is ≥ 30 V ac or 60 Vdc. Any accessible conductive surface which is likely to become energized in the event of a fault shall be bonded to a ground terminal or bonding conductor(s) with a circuit resistance of less than or equal to 0.1 ohm.

- The ground terminal shall be green or identified with a universally recognizable symbol.
- The bonding conductor(s) shall be green or green with one or more yellow stripes.
- The size of the bonding conductor(s) shall be at least equivalent in size to the primary circuit conductors.

4.13 INTERNAL TRANSIENT

One sample (or more if required) shall be cycled through 500 power on/off cycles conducted at a rate of not more than 6 interruptions per minute with a power off cycle of 1 second.

There shall be:

- No false signals (alarm or unexplained trouble) and
- No evidence of instability during or at the end of this test.

The unit shall operate normally following this test.

4.14 DURABILITY

Any hot work robot susceptible to the wearing of parts (i.e., a mechanical relay) shall be cycled through 500 alarm-reset functions under maximum rated load conditions.

There shall be:

- No false signals (alarm or trouble) and
- No evidence of instability during or at the end of this test.
- The unit shall operate normally following this test.

The unit shall operate normally following this test.

4.15 EXTRANEOUS TRANSIENTS

One powered sample of the hot work robot will be subjected to extraneous transients described below

- Radio frequency transmissions with radiation power levels equivalent to 5 Watts at 24 inches (0.6 m) in the 27 MHz, 150-174 MHZ, 450-467 MHZ, 850-870 MHz, and 900-920 MHz bands.
- A sequential arc (Jacob's ladder) generated between two 15 in. (0.4 m) long, No. 14 AWG (2.1 mm) solid copper conductors attached rigidly in a vertical position to the output terminals of an oil burner ignition transformer or gas tube transformer rated 120 volts, 60 hertz primary; 10,000 volts, 60 hertz, 23 mA secondary. The two wires are to be formed in a taper, starting with a 1⁄8 in. (3.2 mm) separation at the bottom (adjacent to terminals) and extending to 1.25 in (32 mm) at the top.
- operation of an electric drill rated 120 V, 60 Hz, 2.5 A.
- operation of a soldering gun rated 120 V, 60 Hz, 2.5 A.
- Operation of a 6 in (150 mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 V dc.

There shall be:

- No false signals (alarm or trouble) and
- No evidence of instability during or at the end of this test.

The unit shall operate normally following this test.

4.16 SURGE TRANSIENTS

All field wiring terminals that have a possibility of being subjected to line-induced voltage (i.e., initiating device circuits, power circuits, and remote/auxiliary connections) will be subjected to transient waveforms having peak levels of;

- 100 V dc
- 500 V dc
- 1,000 V dc
- 1,500 V dc
- 2,400 V dc

There shall be:

- No false alarm signals or non-self-restoring trouble signals and
- No evidence of instability during or at the end of this test and

The unit shall operate normally following this test.

Exception: The video cable and any circuit specified to be 20 ft (6 m) or less in length and in conduit.

4.17 STABILITY TEST

One sample, adjusted to maximum sensitivity, will be energized for normal standby operation in a clean-air (working-office type) atmosphere for a period of at least 24 hours or until a low battery indication has occurred.

There shall be:

- No false signals (alarm or trouble) and
- No evidence of instability during or at the end of this test.

4.18 ENCLOSURE REQUIREMENTS (INCLUDING POLYMERIC HOUSINGS)

The enclosure(s) must meet the ingress protection requirement of a NEMA 250 Type 1 and / or ANSI/IEC 60529 IP30 enclosure ratings as a minimum for indoor applications. It is not necessary to mark the product for Type 1 enclosures. Additional claims made by the manufacturer will be verified according to appropriate enclosure classifications.

Enclosures using Polymeric Materials shall be mounted as intended and placed in an circulating air-oven shall be aged at 194°F (90°C) for seven days or at 158°F (70°C) for twenty eight days prior to the above enclosure evaluations.

4.19 VISUAL ALARM INDICATION

The hot work robot shall be provided with a visual alarm indication in compliance with FM 3155.

4.20 AUDIBLE ALARM INDICATION

The hot work robot shall be provided with an audible alarm indication in compliance with FM 3150 for **Private Mode Audible Requirements.**

4.21 TIP-OVER INDICATION

One sample of transportable hot work robots shall be adjusted to maximum sensitivity and will be energized for normal operation in a clean-air (working-office type) atmosphere. The hot work robot shall be gradually tipped until the unit falls over. There shall be no false signals (alarm or trouble) and shall provide a fault indication that the hot work robot has been tipped over.

4.22 MISALIGNMENT AND JARRING INDICATION

The hot work robot shall provide either a misalignment and/or jarring indication.

4.22.1 Misalignment Indication

One sample of transportable hot work robots shall be adjusted to maximum sensitivity and will be energized for normal operation in a clean-air (working-office type) atmosphere. The monitoring area shall be identified. The hot robot shall be rotated in four (4) off axis directions (+/- Left and Right and +/- Up and Down) until the monitoring area is no longer in the field of view. There shall be no false signals (alarm or trouble) and shall provide a fault indication that the hot work robot has been misaligned.

4.22.2 Jarring Indication

One sample of transportable hot work robots shall be adjusted to maximum sensitivity and will be energized for normal operation in a clean-air (working-office type) atmosphere. The hot work robot shall be impacted on the side at the base and at the height of the sensor. This impact is to be produced by dropping a steel sphere, 50.8 mm (2 inches) in diameter, and weighing 0.535 kg (1.18 lb) mass from the height necessary to produce a 6.8 Jules impact. There shall be no false signals (alarm or trouble) and shall provide a fault indication that the hot work robot has been impacted.

5 OPERATIONS REQUIREMENTS

5.1 DEMONSTRATED QUALITY CONTROL PROGRAM

5.1.1 A quality assurance program is required to assure that subsequent hot work robot(s) produced by the manufacturer shall present the same quality and reliability as the specific hot work robot(s) examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and is documented in the certification Report.
- Continued conformance to this standard is verified by the certifier's surveillance audit.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification Report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 SURVEILLANCE AUDIT

5.2.1 An audit of the manufacturing facility is part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at or, provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 MANUFACTURER'S RESPONSIBILITIES

The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

5.4 MANUFACTURING AND PRODUCTION TESTS

Equipment rated at 30 V rms or 60 V dc and above shall be dielectric tested on 100% of production. The power leads and/or relay terminal leads and associated circuitry shall withstand, for one minute with no insulation breakdown, the application of 1000 V ac, 60 Hz, or 1400 V dc with respect to the protective ground lead. Alternatively, test potentials 20% higher may be applied for at least one second.

WARNING

The dielectric test required may present a hazard of injury to personnel and/or property and should be performed only under controlled conditions, and by persons knowledgeable of the potential hazards of such.

6 BIBLIOGRAPHY

ANSI/FM 3260 Radiant Energy Fire Detector for Automatic Fire Alarm Signaling

ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.