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APPROVAL REPORT

SHARPEYE™ MODEL 20/20MI-3 TRIPLE IR FLAME DETECTOR

Prepared for:

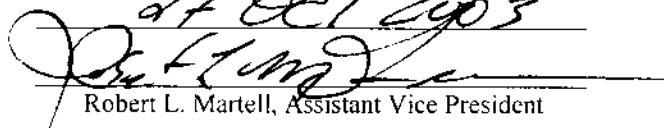
**Spectrex, Inc.
218 Little Falls Road
Cedar Grove, NJ 07009-1277**

Project ID: 3013906

Class: 3260

Date of Approval:

Authorized by:

27 OCT 2003

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**SHARPEYE™ MODEL 20/20MI-3 TRIPLE IR
FLAME DETECTOR**

from

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218 Little Falls Road
Cedar Grove, NJ 07009-1277**

I INTRODUCTION

- 1.1 Spectrex, Inc. requested an Approval examination of their SharpEye™ Model 20/20MI-3 flame detector. The detector is rated NEMA Type 6. The detector can be used to monitor for fires in mobile industrial equipment, such as mining vehicles and other heavy-duty vehicles.
- 1.2 This Report may be reproduced only in its entirety and without modification.
- 1.3 **Standard:**

Title	Class Number	Date
Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling	3260	August, 2000
Enclosures for Electrical Equipment	ANSI/NEMA 250	1991
Standard for Pre-Engineered Dry Chemical Extinguishing System Units	UL 1254	June, 1996

- 1.4 **Listing:** The listing for Spectrex, Inc. in the *Approval Guide*, a publication of FM Approvals, will include this new model as follows:

Fire Detection, Flame-Actuated

Add new listing as follows:

Flame Detector. SharpEye™ Model 20/20MI-3 (Triple IR) flame detector. The firmware revision for the 20/20MI is S78702 A, 02/24/03. The detector operates from 18 to 32 V dc via connection to a compatible Approved fire alarm control providing separate circuits for alarm signaling and for power. One such application is this detector, connected through the relay contacts, to the Ansul Checkfire SC-N System. Detector operating temperature is -40° to 70°C (-40° to 158°F). The detector enclosure is rated NEMA 6P for use in indoor and outdoor locations. This Approval does not include the delay settings of 20 and 30 seconds.

- 1.5 Except as described in this report, components and applications described in the manual and literature are not covered by this Approval.

II DESCRIPTION

- 2.1 A detailed description of specific operation and options can be found in the User and Maintenance Manual, Document Number TM 787100, Rev. September 2002.
- 2.2 The Model 20/20MI flame detector is designated as 20/20MI-XX-X-X. The first digit is 3 for short range (8.2-33 ft (2.5-10 m)). The second digit is either a 1 for cable output or 2 for plug output. The third entry is either "S" for stainless steel 316 or "A" for aluminum enclosure ("P" plastic was not submitted and is not covered by this Approval). The last entry is "C" for ATEX (Cenelec), "F" for FM Approval, or "N" for non-intrinsic safe.
- 2.3 The Model 20/20MI flame detector can be mounted directly to a wall or to the Model 787640 tilt mount.
- 2.4 The detectors have a built-in test feature (BIT) for self-testing the electrical circuits, radiation sensors, and window cleanliness approximately every 20 minutes.
- 2.5 There is the capability of adjusting the time delay for activation of the alarm relay upward to 30 seconds. In the cases of 25 or 30 second delay, the response to a flame source can be in the 30-35 second range. This is not acceptable, as Approval Standard 3260 requires a maximum of 30 seconds. Therefore, the Approval does not include time delays of 25 or 30 seconds, and a note has been added after Table 3.3.4 of the manual.
- 2.6 The software version for this Approval is S78702 A, 02/24/03, with checksum code 26D6.
- 2.7 One application of the Model 20/20MI-3 flame detector is its connection, via relay contacts, to the Approved Ansul Checkfire® SC-N Electric Detection and Actuation System (Report 0B8A8.AF). This system is used as part of a dry chemical fixed extinguishing system for vehicle protection. For that reason, shock and vibration tests were conducted in accordance with UL Standard 1254 as noted.

III EXAMINATIONS AND TESTS

- 3.1 Four samples of the Model 20/20MI-3 flame detector, representative of production units, were examined and tested at FM Approvals in Norwood, Massachusetts. One sample was examined, tested, and compared to the manufacturer's drawings. All documentation applicable to this program is on file at FM Approvals.
- 3.2 **Stability Test** - One Model 20/20MI-3 flame detector was energized and tested to verify proper operation under normal, standby conditions. Continuous operation of this sample was monitored for 30 days in clean-air (working office type); there was no evidence of instability or false signal during that period.
- 3.3 **Baseline Sensitivity Test** - All four samples of the 20/20MI-3 flame detector were subjected to a small-scale sensitivity test consisting of a 1.75 in. (4.5 cm) diameter fire of n-Heptane at a distance of 3 ft. (1 m) from the detector. The average results for all four samples were as follows:

Model 20/20MI-3 at 3 ft. (1 m): 1.5 seconds

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3.4 **Flame Response Sensitivity Test** - All four samples of the Model 20/20MI-3 were exposed to the standard test consisting of a 12 in. x 12 in. (0.3 m x 0.3 m) pan fire with fuels noted below. The tests were conducted at FM Approvals in Norwood, MA, and the average results for all four samples are as follows:

Detector Model	Fuel	Distance to Fire	Sensitivity Setting	Response (avg.)
20/20MI-3	n-heptane	33 ft. (10 m)	10	3.0 seconds
20/20MI-3	n-heptane	24.7 ft. (7.5 m)	7.5	4.2 seconds
20/20MI-3	n-heptane	16.5 ft. (5 m)	5	4.1 seconds
20/20MI-3	n-heptane	8.2 ft. (2.5 m)	2.5	8.2 seconds
20/20MI-3	Diesel	23.1 ft (7 m)	10	3.8 seconds
20/20MI-3	Diesel	17.3 ft. (5.3 m)	7.5	5.5 seconds
20/20MI-3	Diesel	11.5 ft. (3.5 m)	5	6.4 seconds
20/20MI-3	Diesel	5.7 ft. (1.7 m)	2.5	9.2 seconds
20/20MI-3	Ethyl Alcohol	24.8 ft. (7.5 m)	10	4.6 seconds
20/20MI-3	Ethyl Alcohol	18.5 ft. (5.6 m)	7.5	3.2 seconds
20/20MI-3	Ethyl Alcohol	12.4 ft. (3.8 m)	5	4.8 seconds
20/20MI-3	Ethyl Alcohol	6.1 ft. (1.8 m)	2.5	3.6 seconds
20/20MI-3	Jet A	23.1 ft. (7 m)	10	1.9 seconds
20/20MI-3	Jet A	17.3 ft. (5.3 m)	7.5	4.3 seconds
20/20MI-3	Jet A	11.5 ft. (3.5 m)	5	6.1 seconds
20/20MI-3	8 in. (20 cm) dia. pan- polypropylene pellets	8 ft. (2.4 m)	10	1.9 seconds

3.5 **Field of View Test** - One sample of the Model 20/20MI-1, which has an identical enclosure to the 20/20MI-3 and is considered representative of the series, was exposed to the 12 in. x 12 in. (0.3 m x 0.3 m) N-heptane pan fire during which time the viewing angle was varied +/-50° from the centerline along the horizontal and vertical axes. The following results were obtained:

Model 20/20MI-1, sensitivity 10:

Angle (Approximate)	Distance	Average Response Time
On centerline	33 ft. (10 m)	3 sec.
+50° horizontal	16.5 ft. (3 m)	8.7 sec.
-50° horizontal	16.5 ft. (3 m)	8.1 sec.
+50° vertical	16.5 ft. (3 m)	8.8 sec.
-50° vertical	16.5 ft. (3 m)	12 sec.

3.6 **False Stimuli Response Test** - All four samples of the Model 20/20MI-1 with sensitivity setting 10, considered representative of the series, were tested in the presence of modulated and non-modulated artificial sources of light and other heated bodies, then, in the presence of each of the false stimuli, were exposed to the standard test consisting of a 12 in. x 12 in. (0.3 m x 0.3 m) N-heptane pan fire. The false stimuli sources were as follows:

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- 3.6.1 Resistive Electric Heater (1350 W) at 3 ft. (1 m)
- 3.6.2 Fluorescent Light (40 W) at 3 ft. (1 m)
- 3.6.3 Halogen Light (500 W with lens) at 3 ft. (1 m)
- 3.6.4 Incandescent Light (100 W) at 3 ft. (1 m)
- 3.6.5 Arc welding with setting at 200 Amperes at 10 ft (3 m) using 7011 rod and steel plate.
- 3.6.6 The detectors produced no trouble or false alarm signal in the presence of these false stimuli at the distance specified, and they continued to respond satisfactorily to the test fire in the presence of these sources.
- 3.7 **Switching** - One sample 20/20MI-3 flame detector was exposed to flame radiation, and its response was found to be within the manufacturer's specified response time of 30 seconds, as long as the 20 second and 30 second delay settings are not used.
- 3.8 **Environmental Conditioning** - One sample of the Model 20/20MI-3 flame detector was subjected to the following conditions:
 - 3.8.1 a temperature of -40°F (-40°C) for a period of 24 hours.
 - 3.8.2 a temperature of 158°F (60°C) for a period of 24 hours.
 - 3.8.3 an atmosphere of 95% relative humidity at 140°F (60°C) for a period of 24 hours.
 - 3.8.4 a change from 50% relative humidity at 70°F (21°C), to 90% relative humidity at 100°F (38°C) in 15 minutes.
 - 3.8.5 There was no trouble signal and no false indication of fire during these tests, and there was less than 10% shift in sensitivity as measured by the baseline sensitivity test following the environmental conditioning.
- 3.9 **Voltage Range**- One sample of the Model 20/20MI-3 was tested at supply voltage variation using the manufacturer's specified range of 18 to 32 V dc. These values were outside the 85% to 110% values normally tested and were satisfactory. There was no trouble signal or false indication of fire, and there was less than a 10% shift in measured sensitivity over the entire voltage range . These results were satisfactory.
- 3.10 **Vibration Test** - One sample of the Model 20/20MI-3 flame detector was subjected to a vibration test in each of the horizontal, lateral, and vertical axes for 4 hours in each orientation, at a sweep frequency range of 10 to 60 Hz and a displacement of 0.06 in (1.52 mm). The sweep rate was set at four cycles per minute. The detector operated properly during and after this vibration test, and there was no loosening of parts or permanent deformation as a result of this test. The detector sample was submitted to FM Approvals, and it responded successfully to the baseline test at the conclusion of the test. The vibration test was conducted at the manufacturing facility, and complete documentation was submitted, reviewed, and found to be satisfactory.
- 3.11 **Shock Resistance Test** – The sample Model 20/20MI-3 flame detector was then subjected to a shock resistance test in a vertical orientation, at an acceleration of 322 ft/s² (98 m/s²) or (10 g) and

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a duration of 25 milliseconds as measured at the base of the half-sine shock envelope, for 5000 shock impacts. Following this test, the sample was examined. No visible damage was found to any of the components of the 20/20MI-3. The detector sample was submitted to FM Approvals, and it responded successfully to the baseline test at the conclusion of the shock resistance test. The shock resistance test was conducted at the manufacturing facility, and complete documentation was submitted, reviewed, and found to be satisfactory.

3.12 **Measurement of Current Draw** -

Detector Model	standby current specified (mA)	standby current measured (mA)	alarm current specified (mA)	alarm current measured (mA)
20/20MI-3	15	15	25	25

3.13 **Dielectric Test**

3.13.1 Since the detector is rated at 32 V dc, test voltages of 500 V ac and 710 V dc were applied to the 24 volt power leads to the detector. Return was from the enclosure ground.

3.13.2 Test voltages of 500 V ac and 710 V dc were applied to all relay contacts tied together, and return was from the 24 volt power leads tied together.

3.13.3 The alarm, accessory, and trouble relays are rated at 250 V ac. A test voltage of 1,500 V ac was applied to all relay contacts tied together, and return was from the enclosure ground.

3.13.4 The voltages were applied for one minute each. One of the samples displayed evidence of leakage during these tests. This leakage was traced to the cable connection to the detector. For this reason, dielectric tests on 100% of production are required (see Section 7.3).

3.14 **Software failure** - Any software failure that renders the detector inoperable shall result in a trouble condition at the detector and be appropriately transmitted to the fire alarm control. The software code for this flame detector was reviewed and retained as part of the Project Data Record. The processor has an internal watchdog that resets the operation if the software fails. A trouble signal is generated. This is satisfactory.

3.15 **Extraneous Transients** - The following tests were conducted on one sample of the Model 20/20MI-3 flame detector:

3.15.1 Radio frequency transmissions with radiation power levels equivalent to 5 Watts at 24 in. (0.6 m) in the 27 MHz, 154 MHz, 467 MHz, 850 MHz, and 900 MHz bands.

3.15.2 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 rated 120 V, 60 Hz primary; 10,000 V, 60 Hz, 23 mA secondary. The two wires are 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.

3.15.3 Operation of an electric drill rated 120 V, 60 Hz, 2.5 A.

3.15.4 Operation of a soldering gun rated 120 V, 60 Hz, 2.5 A.

- 3.15.5 Operation of a 6 in. (150 mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 V dc.
- 3.15.6 The flame detector produced no false alarm or trouble signal in the presence of these extraneous transients, and it responded satisfactorily to the baseline test fire source in the presence of these extraneous transients.
- 3.16 **Bonding** - This test was waived, since all voltage ratings are less than 30 V rms or 60 V dc.
- 3.17 **Surge Transient Tests** - One powered sample of the Model 20/20MI-3 flame detector was subjected to transient waveforms having peak levels of 100, 500, 1000, 1500, and 2400 V dc as delivered into a 200 ohm load. The test was conducted on all field wiring terminals that have a possibility of being subjected to line-induced voltage. No alarm signals, non self-restoring trouble signals, or any other signs of instability were noted during these tests.
- 3.18 **Environmental Tests** - The following tests verified the Type 6P rating for the Model 20/20MI-3 flame detector (stainless steel and aluminum models). The sample was prepared for testing by removing the indicator assembly.
- 3.19 **Hosedown Test (Aluminum)** - A sample of the Model 20/20MI-3 flame detector was subjected to a stream of water from a hose with a 1 inch (25.4 mm) nozzle delivering 65 gallons (246 liters) a minute. The water was directed at the housing from all angles from a distance of 10 to 12 feet (3 to 3.7 m) for five minutes. At the conclusion of the test the housing was opened and was found to have excluded the entry of water. This is satisfactory.
- 3.20 **Hosedown Test (Stainless Steel)** - A sample of the Model 20/20MI-3 flame detector was subjected to a stream of water from a hose with a 1 inch (25.4 mm) nozzle delivering 65 gallons (246 liters) a minute. The water was directed at the housing from all angles from a distance of 10 to 12 feet (3 to 3.7 m) for five minutes. At the conclusion of the test the housing was opened and was found to have excluded the entry of water. This is satisfactory.
- 3.21 **Air Pressure Test (Aluminum)** - A sample of the Model 20/20MI-3 flame detector was subjected to an internal air pressure of 6 psi for a 24 hour period. Results were satisfactory in that following the 24 hour period the pressure drop was less than 2 psi.
- 3.22 **Air Pressure Test (Stainless Steel)** – This test was waived for the stainless steel model based on satisfactory results for the aluminum model with the stainless steel being a stronger material.
- 3.23 **Corrosion Test (Aluminum)** - The test sample was subjected to a 5% salt spray at a temperature of 95°F (35°C) for a period of 200 continuous hours. At the conclusion of the 200 hours, the sample was removed, washed and dried. The results are satisfactory as there were no signs of pitting, cracking, or other deterioration more severe than that of a bar of 304 stainless steel exposed to the same conditions. This is satisfactory.
- 3.24 **Corrosion Test (Stainless Steel)** – This test was waived for the stainless steel model based on the detector being constructed from stainless steel which would show no signs of pitting, cracking, or other deterioration more severe than that of the 304 stainless steel test bar exposed to the same conditions during this test.

IV MARKING

4.1 The following information appears on the adhesive label affixed to the outside of the enclosure and meets Standard requirements:

- Manufacturer's name and address
- Model designation
- Serial number
- Operating voltage, temperature, and electrical load ratings
- The FM Approvals mark

4.2 The firmware revision level is shown by a paper adhesive label on the EPROM of each flame detector. This label is shown on Drawing No. E787011, Revision 02/03.

V REMARKS

5.1 Installations shall comply with the latest edition of the manufacturer's instruction manual.

5.2 An engineering study of the hazard, detector location, and detector characteristic response is necessary for any application of radiant energy-sensing fire detectors.

5.3 As is characteristic of all radiant energy-sensing fire detectors, dust, dirt, condensation, and other foreign material on the lens may impair response to fire. This factor must be considered in the application of this model of flame detector.

VI FACILITIES AND PROCEDURES AUDIT

The manufacturing site is currently included in the FM Approvals Facilities and Procedures Audit program. The facilities and quality control procedures in place have been found to be satisfactory to manufacture product identical to that examined and tested as described in this report.

VII MANUFACTURER'S RESPONSIBILITIES

7.1 Documentation considered critical to this Approval is on file at FM Approvals and listed in the Documentation File, Section VIII of this report. No changes of any nature shall be implemented unless notice of the proposed change has been given and written authorization obtained from FM Approvals. The Approved Product Revision Report, Form 797, shall be forwarded to FM Approvals as notice of proposed changes.

7.2 A copy of the latest version of the Instruction Manual must be provided with each shipment.

7.3 Because of leakage current noted during the dielectric test, it is required that the final assembly of all Model 20/20MI-3 flame detectors including the cable assembly be dielectric tested on 100% of production. The power input connections and alarm and trouble relay contacts shall withstand, for one minute and with no insulation breakdown, the application of 1000 V ac (or 1400 V dc) with respect to the protective ground. Alternatively, a test potential of 1200 V ac (or 1700 V dc) may be applied for at least one second. This procedure is detailed in Document No. TP787049,

Revision 7/14/03, of the Quality Control Department.

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

VIII DOCUMENTATION

The following documents comprise the controlled documentation list and are filed under Project 3013906:

Drawing No	Drawing Title	Revision
787002	IR/3 DETECTOR ASSEMBLY	02/03
787007	RING	D
787008	GASKET	E
787011	P. C. BOARDS ASSEMBLY	B
787048	INNER HARNESS ASSEMBLY	B
787049	INNER HARNESS ASSEMBLY	F
787076	WINDOW	A
787205	REFLECTOR	B
787218	I/O PC BOARD ELECTRICAL SCHEMATIC	D
787219	I/O PC BOARD ASSEMBLY	A
787313	SENSORS HOLDER	C
787408	BLOCK AND WIRING DIAGRAM	B
787428	SENSORS+CPU ELECTRICAL	08/02
787429	SENS.+CPU P.C.BOARD ASSEMBLY	A
787479	SENS+CPU P.C.BOARD ASSEMBLY	A
787702	IR/3 DETECTOR ASSEMBLY	02/03
787703	HOUSING	B
787715	FRONT LABEL	01/02
787716	LABEL	B
787804	COVER	C
E787011	SOFTWARE LABEL AND PROGRAMMING	02/03
TM787100	SHARPEYE 20/20MI USER MANUAL	09/02

IX CONCLUSION

The Model 20/20MI-3 flame detector described in Section 1.4 meets FM Approvals requirements. Since a duly signed Master Agreement is on file for this manufacturer, Approval is effective the date of this report.

EXAMINATION AND TESTING BY: P. K. Schoenheiter
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PROJECT DATA RECORD: 3013906

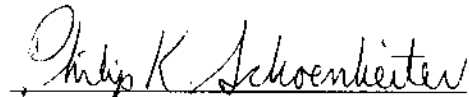
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ATTACHMENTS:

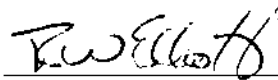
User and Maintenance Manual, Doc. TM 787100, Sept.
2002, pages 28-33 only

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