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APPROVAL REPORT

MODELS 20/20I, 20/20L/LB, 20/20U/UB, and 20/20SI FLAME DETECTORS

Prepared for:

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

Project ID. 3013474
Class 3260
Date: June 12, 2003

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An FM Global Enterprise

MODELS 20/20I, 20/20L/LB, 20/20U/UB, and 20/20SI
FLAME DETECTORS

June 12, 2003

from

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218 Little Falls Road
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I INTRODUCTION

1.1 Spectrex, Inc. requested an Approval reexamination of their Models 20/20I, 20/20L/LB, and 20/20U/UB flame detectors, and an Approval examination of their Model 20/20 SI flame detector to the latest edition of Approval Standard 3260.

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

1.4 **Listing**: The listing for Spectrex, Inc. in the *Approval Guide*, a publication of FM Approvals, will be completely revised as follows:

Fire Detection, Flame-Actuated

Delete present listings as follows:

~~Flame Detector. Model 20/20I SharpEye infrared flame detector. The detector operates from 18 to 32 V dc via connection to a compatible Approved control panel providing separate circuits for alarm signaling and for power. Detectors are rated NEMA Type 6P and are suitable for indoor and outdoor use, in ambient temperatures from -40° to 70°C (-40° to 160°F). Explosionproof, suitable for use in Class I, Division 1, Groups B, C and D and Class II, Division 1, Groups E, F and G hazardous (classified) locations.~~

~~Flame Detector. Models 20/20L ultraviolet-infrared flame detector and 20/20U ultraviolet flame detector. Each operates from 20 to 32 V dc via connection to a compatible Approved control panel providing separate circuits for alarm signaling and for power. Detector operating temperature is -40° to 70°C (-40° to 158°F). Both models may be field tested using the 20/20-509 fire simulator. Detectors and fire simulator are explosionproof for use in Class I, Division 1, Groups B, C and D and Class II,~~

~~Division 1, Groups E, F and G hazardous (classified) locations. Detectors and fire simulator are rated NEMA Type 6P and are suitable for both indoor and outdoor use.~~

~~Flame Detector. Models 20/20LB and 20/20LA ultraviolet-infrared flame detector. Model 20/20UB ultraviolet flame detector. Each operates from 18 to 32 V dc via connection to a compatible Approved control panel providing separate circuits for alarm signaling and for power. Model 20/20-509 fire simulator is used for field testing of these detectors. Detectors are rated NEMA Type 6P and are suitable for indoor and outdoor use in ambient temperatures from -40° to 70°C (-40° to 158°F). Explosionproof, suitable for use in Class I, Division 1, Groups B, C and D; Class II, Division 1, Groups E, F and G hazardous (classified) locations.~~

Add new listing as follows:

Flame Detector. Models 20/20U and 20/20UB (ultraviolet); 20/20L and 20/20LB (ultraviolet-infrared); 20/20I (infrared); and 20/20SI (infrared) SharpEye flame detectors. The firmware revision for the 20/20U, UB, L, and LB is S83002J. The firmware revision for the 20/20I is S78029ZA, and the firmware revision for the 20/20SI is S78401. Each 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. Detector operating temperature is -40° to 70°C (-40° to 158°F). Explosionproof, suitable for use in Class I, Division 1, Groups B, C, and D and Class II, Division 1, Groups E, F, and G hazardous (classified) locations. The detector enclosure is rated NEMA 6P for use in indoor and outdoor locations. This Approval does not include the delay settings of 25 and 30 seconds.

1.5 This Approval Report is a supplement to the previous Approval Reports for the Model 20/20I (0X5A8.AY) and the Models 20/20L/LB and 20/20U/UB (0Z6A6.AY). The examination of these models was limited to the application of new requirements in the above referenced standard.

1.6 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's and Maintenance Manuals, Document Numbers TM 784100, Rev. A (20/20SI); TM 20/20I, Rev. 5; TM 20/20LB, Rev. D; and TM 20/20UB, Rev. D.

2.2 The Models 20/20I, 20/20L/LB, 20/20U/UB, and 20/20SI flame detectors are mounted to the Model 20/20-003 (p/n 780765) swivel mount.

2.3 The only difference between the 20/20L and 20/20LB detectors and between the 20/20U and 20/20UB detectors is that the versions with "B" have a built-in test feature (BIT) for self-testing the electrical circuits, radiation sensors, and window cleanliness approximately every 20 minutes.

2.4 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.

2.5 No changes have been made to the construction or operation of the Models 20/20L, 20/20LB, 20/20U, 20/20UB, and 20/20I flame detectors since the original Approvals.

III EXAMINATIONS AND TESTS

3.1 Four samples each of the Models 20/20I, 20/20LB, 20/20UB, and 20/20SI flame detectors, representative of production units, were examined and tested at FM Approvals in Norwood, Massachusetts and West Gloucester, RI. The 20/20LB was considered representative of the 20/20L, and the 20/20UB was considered representative of the 20/20U. One sample of each model 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 of each model flame detector was energized and tested to verify proper operation under normal, standby conditions. Continuous operation of these samples 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 each model of flame detector were subjected to a small-scale sensitivity test consisting of a 1.75 in. (4.5 cm) diameter fire of denatured ethyl alcohol at varying distances from the detector. The average results for all four samples were as follows:

Model 20/20UB at 80 in. (2 m): 3.4 seconds

Model 20/20LB at 63 in. (1.6 m): 3.6 seconds

Model 20/20I at 36 in. (1 m): 5 seconds

Model 20/20SI at 34 in. (0.9 m): 3 seconds

3.4 **Flame Response Sensitivity Test** - All four samples of the Models 20/20UB, 20/20LB, and 20/20I were exposed to the standard test consisting of a 12 in.× 12 in. (0.3 m × 0.3 m) N-heptane pan fire. The tests were conducted at the FM Global Technology Center in West Gloucester, RI, and the average results for all four samples are as follows:

Model 20/20UB (also representative of 20/20U):

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) and 0 sec. delay: 3.5 sec.

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) and 25 sec. delay: 29 sec.

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) and 30 sec. delay: 33 sec.

Model 20/20LB (also representative of 20/20L):

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) and 0 sec. delay: 3.8 sec.

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) and 25 sec. delay: 28.4 sec.

Model 20/20I (also representative of 20/20SI):

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) sensitivity level 1 and 0 sec. delay: 2.5 sec.

0.3 m × 0.3 m (12 in. × 12 in.) at 50 ft. (15 m) sensitivity level 1 and 20 sec. delay: 23.9 sec.

0.3 m × 0.3 m (12 in. × 12 in.) at 175 ft. (53 m) sensitivity level 4 and 0 sec. delay: 5.8 sec.

3.4.1 Additional fuels were tested at the request of the manufacturer as follows:

Alcohol (99%)

Model 20/20UB: 0.3 m × 0.3 m (12 in. × 12 in.) at 37.5 ft. (11 m) and 0 sec. delay: 4.6 sec.

Model 20/20LB: 0.3 m × 0.3 m (12 in. × 12 in.) at 37.5 ft. (11 m) and 0 sec. delay: 4.3 sec.

Model 20/20I: 0.3 m × 0.3 m (12 in. × 12 in.) at 150 ft. (46 m) and 0 sec. delay: 8 sec. (sens. 4)

Model 20/20I: 0.3 m × 0.3 m (12 in. × 12 in.) at 37.5 ft. (11 m) and 0 sec. delay: 1.4 sec. (sens.1)

Diesel fuel:

Model 20/20UB: 0.3 m × 0.3 m (12 in. × 12 in.) at 37.5 ft. (11 m) and 0 sec. delay: 5 sec.

Model 20/20LB: 0.3 m × 0.3 m (12 in. × 12 in.) at 37.5 ft. (11 m) and 0 sec. delay: 5.6 sec.

Model 20/20I: 0.3 m × 0.3 m (12 in. × 12 in.) at 140 ft. (43 m) and 0 sec. delay: 7 sec. (sens. 4)

Model 20/20I: 0.3 m × 0.3 m (12 in. × 12 in.) at 35 ft. (10 m) and 0 sec. delay: 2.9 sec. (sens.1)

3.5 **Field of View Test** - One of each model was exposed to the 12 in. × 12 in. (0.3 m × 0.3 m) N-heptane pan fire during which time the viewing angle was varied +/-45° from the centerline along the horizontal and vertical axes. The following results were obtained:

Angle (Approx.)	Distance	Average Response Time (sec)
Model 20/20UB:		
on centerline	15 m (50 ft.)	3.5 sec.
+45° horizontal	7.5 m (25 ft.)	2.3 sec.
-45° horizontal	7.5 m (25 ft.)	2.1 sec.
+45°vertical	7.5 m (25 ft.)	2.0 sec.
-45° vertical	7.5 m (25 ft.)	2.4 sec.
+35° horizontal	12.5 m (41 ft.)	2.2 sec.
-35° horizontal	12.5 m (41 ft.)	2.6 sec.
+35°vertical	12.5 m (41 ft.)	2.4 sec.
-35° vertical	12.5 m (41 ft.)	2.5 sec.
Model 20/20LB:		
on centerline	15 m (50 ft.)	3.8 sec.
+45° horizontal	7.5 m (25 ft.)	2.4 sec.
-45° horizontal	7.5 m (25 ft.)	2.3 sec.
+45°vertical	7.5 m (25 ft.)	3.5 sec.
-45° vertical	7.5 m (25 ft.)	2.5 sec.
+35° horizontal	12.5 m (41 ft.)	2.8 sec.
-35° horizontal	12.5 m (41 ft.)	2.3 sec.
+35°vertical	12.5 m (41 ft.)	2.2 sec.
-35° vertical	12.5 m (41 ft.)	3.9 sec.
Model 20/20I (sensitivity 1, no delay):		
on centerline	15 m (50 ft.)	2.5 sec.
+35° horizontal	15 m (50 ft.)	1.2 sec.
-35° horizontal	15 m (50 ft.)	1.2 sec.
+35°vertical	15 m (50 ft.)	1.0 sec.
-35° vertical	15 m (50 ft.)	2.5 sec.
+45° horizontal	9.5 m (31 ft.)	1.0 sec.
-45° horizontal	9.5 m (31 ft.)	1.7 sec.
+45°vertical	9.5 m (31 ft.)	2.2 sec.
-45° vertical	9.5 m (31 ft.)	1.0 sec.
+45° horizontal	7.5 m (25 ft.)	1.0 sec.
-45° horizontal	7.5 m (25 ft.)	1.0 sec.
+45°vertical	7.5 m (25 ft.)	3.0 sec.
-45° vertical	7.5 m (25 ft.)	1.0 sec.

3.6 **False Stimuli Response Test** - All four samples of each 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. × 12 in. (0.3 m × 0.3 m) N-heptane pan fire. The false stimuli sources were as follows:

3.6.1 Resistive Electric Heater (1500 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 190 Amperes at 10 ft (3 m) using 7018 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 each of the Models 20/20I, 20/20LB, 20/20UB, and 20/20SI flame detectors 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 25 second and 30 second delay settings are not used.

3.8 **Environmental Conditioning** - One sample each of the Models 20/20I, 20/20LB, 20/20UB, and 20/20SI 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**- The detector samples were 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 which was satisfactory.

3.10 **Vibration Test** - One sample each of the Models 20/20I, 20/20LB, 20/20UB, and 20/20SI flame detectors, mounted on the Model 20/20-003 swivel mount (p/n 780765), was subjected to a four-hour vibration test of 0.02 inches (0.5 mm) displacement at a frequency sweep of 10 to 30 Hz. The detectors operated properly during and after these vibration tests, and there was no loosening of parts or permanent deformation as a result of these tests. There was less than 10% shift in measured sensitivity using the baseline test at the conclusion of the tests.

3.11 **Measurement of Current Draw** -

Detector Model	standby current specified (mA)	standby current measured (mA)	alarm current specified (mA)	alarm current measured (mA)
20/20UB	80	60	120	99
20/20LB	100	60	150	100
20/20I	150	99	200	160
20/20SI	100	63	150	100

3.12 **Dielectric Test**

3.12.1 Since the detectors are rated at 30 V dc or less, 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.

3.12.2 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.

3.12.3 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.

3.12.4 The voltages were applied for one minute each. There was no evidence of leakage or breakdown during these tests.

3.13 **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 these flame detectors 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.

3.14 **Extraneous Transients** - The following tests were conducted on one sample of each sample of flame detector:

3.14.1 Radio frequency transmissions with radiation power levels equivalent to 5 Watts at 24 in. (0.6 m) in the 27 MHz, 850-870 MHz, and 900-920 MHz bands.

3.14.2 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.

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

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

3.14.5 Operation of a 6 in. (150 mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 V dc.

3.14.6 The flame detectors produced no false alarm or trouble signal in the presence of these extraneous transients, and they responded satisfactorily to the baseline test fire source in the presence of these extraneous transients.

3.15 **Bonding** - This test was waived, since all voltage ratings are less than 30 V rms or 60 V dc.

3.16 **Surge Transient Tests** - One powered sample of the Model 20/20I 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.

3.17 Because of testing conducted on the previously Approved versions, no further testing was required.

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, city, and state
- Model designation
- Part Number or serial number which indicates date of manufacture
- Operating voltage and electrical load ratings
- Hazardous location ratings
- Enclosure rating
- The FM Approvals mark

4.2 The firmware revision level is shown by a paper adhesive label on the EPROM of each flame detector.

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 must be considered in the application of these models 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.

VIII DOCUMENTATION

The following documents comprise the controlled documentation list and are filed under Project 3013474:

Drawing No	Drawing Title	Revision
770072	PIPE PLUG-780002-IR3 DETECTOR ASSY	A
780022	INTERFACE - PC BOARD	D
780019	PCB INTERFACE, IR3 DETECTOR	D
780018	IR3 DETECTOR-INTERFACE BRD ELEC.	B
780711	CONICAL REFLECTOR	B
600067	4 OPERATIONAL AMP.	D
780010	SENSOR ASSY	E
780008	BLOCK & WIRING DIAGRAM	7/1/93
780007	COVER ASSY	B
780006	HOUSING ASSY	A
780005	ADAPTER	C
780028	IR3 DETECTOR - CPU & EPROM BRD SCEM.	A
780002	IR3 DETECTOR ASSY	E
780011	PC BOARD ASSY	B
750003	HOUSING	E
796706	HOUSING ASSEMBLY	06/96
780702	IR3 DETECTOR ASSEMBLY	04/02
780815	FRONT LABEL	A
E780029	EPROM LABEL AND PROGRAMMING	P
780751	LABEL	04/02
780727	LABEL	A
796703	HOUSING	06/96
785033	IE SENSOR ASSEMBLY	D
785078	FILTER	A
780775	WINDOW HOLDER	09/94
780504	COVER	C

7780117	LABEL	06/06/00
780029	CPU - PCB ASSY	D
7770416	LABEL	A
780009	NUT	D
780115	FRONT LABEL	E
780704	COVER	E
780075	WINDOW HOLDER	B
780049	I/O - PCB ASSY	C
780048	IR3 DETECTOR - I/O BRD - SCHEM.	A
780039	IR3 SENSOR - PCB ASSY	D
780038	IR3 DETECTOR - SENSOR BRD, SCHEM.	A
780032	CPU - PC BOARD	C
780276	WINDOW	B
834238	IR ELECTRICAL SCHEME	B
834506	HOUSING ASSEMBLY	11/19/95
834211	PC BOARD ASSEMBLY	A
834239	IR PC BOARD ASSEMBLY	C
834208	BLOCK DIAGRAM	A
834228	UV ELECTRICAL SCHEME	D
834229	UV PC BOARD ASSEMBLY	D
834218	INTERFACE ELECTRICAL SCHEME	C
834002	UV-IR DETECTOR ASSY	B
832239	IR PCB BOARD	A
832238	IR ELECTRICAL SCHEME	B
834219	INTERFACE - PC BOARD ASSEMBLY	D
836702	UV DETECTOR ASSY	B
836002	UV DETECTOR ASSY	B
834703	HOUSING	B
834702	UV-IR DETECTOR ASSY	B
834014	GUARD PLATE	A
832702	UV DETECTOR ASSY	B
8834117	LABEL	06/06/00
832002	UV DETECTOR ASSY	B
830702	UV-IR DETECTOR ASSY	B
830002	UV-IR DETECTOR ASSY	B
770415	FRONT LABEL	A
770271	WINDOW	A
834706	HOUSING ASSEMBLY	11/19/95
834503	HOUSING	A
784038	IR3 SENSORS CIRCUIT ELECTR SCHEME	B
TM 20/20UB	20/20U, 20/20UB USER'S AND MAINT	D
TM 20/20I	20/20I USER'S AND MAINTENANCE	5
TM784100	20/20SI USER'S AND MAINTENANCE	A
E784001	EPROM LABEL	B
784702	IR3 DETECTOR ASSEMBLY	05/02
784706-1	HOUSING ASSEMBLY	A
784327	SEALING PLATE	B
784703	HOUSING	B
TM 20/20LB	20/20L, 20/20LB USER'S AND MAINT	D
784039	IR3 SENSORS PCB ASSEMBLY	D
784002	IR3 DETECTOR ASSEMBLY	05/01
784029	CONNECTORS PCB ASSEMBLY	E

784028	CONNECTORS PCB ELECT SCHEME	A
784019	INTERFACE + CPU - PCB ASSEMBLY	B
784018	CPU + INTERFACE ELECTR. SCHEME	C
784008	BLOCK AND WIRING DIAGRAM	B
784011	PC BOARDS ASSEMBLY	F
784006-1	HOUSING ASSEMBLY	A
784503	HOUSING	B
784079	IR3 SENSORS PCB ASSEMBLY	B
E830229	EPROM LABEL AND PROGRAMMING INSTR	E

IX CONCLUSION

The apparatus described in Section II meets FM Approvals requirements. Approval is effective when the Approval Agreement is signed and received by FM Approvals.

EXAMINATION AND TESTING BY: P. K. Schoenheiter

PROJECT DATA RECORD: 3013474

ORIGINAL TEST DATA: 0X5A8.AY and 0Z6A6.AY

ATTACHMENTS: (none)

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