



Member of the FM Global Group

Not to be distributed outside of FM Approvals and its affiliates except by Customer

APPROVAL REPORT

Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH and 20/20CTIP/CTIN flame detectors, including additional flame response tests for models 20/20I, 20/20SI, 20/20LB, and 20/20UB flame detectors

Prepared for:

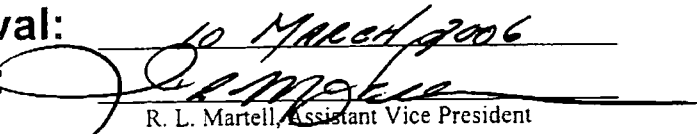
**Spectrex, Inc.
218 Little Falls Road
Cedar Grove, NJ 07009**

Project ID: 3020071

Class: 3260

Date of Approval:

Authorized by:

10 March 2006

R. L. Martell, Assistant Vice President

FM Approvals
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH and 20/20CTIP/CTIN flame detectors, including additional flame response tests for models 20/20I, 20/20SI, 20/20LB and 20/20UB flame detectors

from

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

I INTRODUCTION

- 1.1 Spectrex, Inc. requested an Approval examination of their Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20CTIP, 20/20CTIN flame detectors, including additional flame response tests for the previously Approved models 20/20I, 20/20SI, 20/20LB/L, and 20/20UB/U flame detectors (FM Approval reports 3013474 and 3013906) to the FM Approval Standard 3260 "Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling" and ANSI/FM Approval Standard 3260 "Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling".
- 1.2 This Report may be reproduced only in its entirety and without modification.
- 1.3 **Standard:** The scope of this report is limited to the examination and tests of the Spextrex, Inc. Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20CTIP/CTIN, 20/20I, 20/20SI, 20/20LB/L, and 20/20UB/U Flame Detectors towards the applicable portions of the following standard:

Title	Class Number	Date
Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling	FM 3260	August, 2000
Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling	ANSI/FM 3260	February, 2004

- 1.4 **Listing:** These detectors will be listed under the "Alarm Signal Initiating Devices" Section of the FM Approvals' *Approval Guide* Fire Protection Volume 1, Chapter 14 - under the heading "Fire Detection, Flame Actuated" as follows:

Fire Detection, Flame-Actuated

Flame Detector. Models 20/20U and 20/20UB (ultraviolet); 20/20L and 20/20LB (ultraviolet-infrared); 20/20I (infrared); 20/20H (Infrared); 20/20SI (infrared); 20/20SH (infrared) SharpEye flame detectors. The firmware revision for the 20/20U, UB, L, and LB is E830229F, 2-6-05. The firmware revision for the 20/20I and 20/20H is E780029P, 14-11-00, and the firmware revision for the 20/20SI and 20/20SH is E784011D, 21-09-05. Each detector operates from 18 to 32 V dc via connection to a compatible FM 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.

FM APPROVALS
Project ID: 3020071

Flame Detector. SharpEye™ Models 20/20MI-1 and 20/20MI-3 (Triple IR) flame detectors. The software revision for the 20/20MI is E787411B 7-6-05. The detector operates from 18 to 32 V dc via connection to a compatible FM Approved fire alarm control providing separate circuits for alarm signaling and for power. The sensitivity ranges to detect a 0.1m² (1 ft²) gasoline fire is 10m (33ft) to 40m (133ft) for model 20/20MI-1 detector and 2.5m (7.5ft) to 10m (33ft) for model 20/20MI-3 detector. 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.

Flame Detector. SharpEye™ Model 20/20MH (Triple IR) flame detector. The software revision for the 20/20MH is E787411B, 7-6-05. The detector operates from 18 to 32 V dc via connection to a compatible FM Approved fire alarm control providing separate circuits for alarm signaling and for power. Detects only hydrogen, ethanol and methane fires. 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.

Flame Detector. SharpEye™ Model 20/20MR (Mini Single IR) flame detector (hydrocarbon fuels and vapors based fires). The software revision for the 20/20MR is E787211C, 29-12-05. The detector operates from 18 to 32 V dc via connection to a compatible FM 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). 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.

Flame Detector. SharpEye™ Model 20/20ML (Mini Dual IR and UV) flame detector (hydrocarbon based fuels fires, hydroxy and hydrogen fires, metal and inorganic fires). The software revision for the 20/20ML is E767011, 16-5-05. The detector operates from 18 to 32 V dc via connection to a compatible FM 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). 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.

Flame Detector. SharpEye™ Model 20/20MU (Mini Single UV) flame detector (hydrogen, hydrides, ammonia, Silane fires). The software revision for the 20/20MU is E767011, 16-05-05. The detector operates from 18 to 32 V dc via connection to a compatible FM 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). 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.

Flame Detector SharpEye™ Model 20/20CTIP, 20/20CTIN, C.C.T.V Flame Detector (Triple IR incorporates supplemental video camera). The software revision for the 20/20CTIN, CTIN is E784011D, 21-09-05 The detector operates from 18 to 32 V dc via connection to a compatible FM Approved fire alarm control providing separate circuits for alarm signaling and for power. Detector operating temperature is -40° to 55°C (-40° to 131°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 The Hazardous Location suitability as well as the environmental suitability ratings were previously established and documented in FM Approval reports 3013474 and 3013906.
- 1.6 Except as described in *this* report and other reports referenced herein; any operation, components, features or applications are not covered by this Approval.

FM APPROVALS
Project ID: 3020071

II DESCRIPTION

- 2.1 The following section contains a brief description of the equipment covered by this report. Additional information can be found in the original manufacturers "User Manuals" referenced below, with portions attached to this report.
- 2.2 The previously Approved Models examined as part of this project for the expanded (compatibility with additional fuels) use were models 20/20I, 20/20SI, 20/20LB/L, and 20/20UB/U flame detectors.
- 2.3 The new Models examined as a part of this project (20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20CTIP/CTIN flame detectors) were similar in construction with enclosures constructed of aluminum or stainless steel. Mounting techniques are identical regardless of Model designation and employ an internal junction block for field terminations. The flame detectors can be mounted directly to a wall or to the Models 20/20-005 (for M series devices) or 20/20-003 tilt mount.
- 2.4 The enclosure for the models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1 and 20/20MH flame detectors was previously examined by FM Approval report ID 3013906 as part of Approval of Model 20/20MI-3 flame detector. The enclosure for the models 20/20H, 20/20CTIP/CTIN and 20/20SH flame detectors was previously examined by FM Approval report ID 3013474 as part of Approval of Models 20/20I, 20/20LB, 20/20UB and 20/20SI flame detectors.
- 2.5 The Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20MH, 20/20SH and 20/20CTIP/CTIN flame detectors are described in the table below:

Model	Method of Detection	Firmware	Fuels
20/20ML	UV/IR dual sensor	E767011 – 16-05-05	Hydrocarbon-based fuel fires, hydroxyl, hydrogen fires, metal and other inorganic fires
20/20MU	UV single sensor	E767011 – 16-05-05	Inorganic fuel fires: hydrogen, hydrides, ammonia, silane
20/20MR	IR single sensor	E787211C – 29-12-05	Organic hydrocarbon fuel (CO ₂ emission spectral band) fires
20/20MI-1	IR triple spectrum sensor	E787411B – 07-06-05	Hydrocarbon based fuel and gas fires
20/20MH	IR triple spectrum sensor	E787411B – 07-06-05	Hydrogen, methanol and ethanol fires
20/20H	IR triple spectrum sensor	E780029P – 14-11-00	Hydrogen fires
20/20CTIP/CTIN	Triple IR Sensor incorporated with a color video camera	E784011D – 21-09-05	Hydrocarbon based fuel and gas fires
20/20SH	IR single sensor	E784011D – 21-09-05	Hydrogen, ethanol, methane fires

FM APPROVALS
Project ID: 3020071

- 2.6 The new model 20/20SII examined as part of this project is an infrared detector similar to the previously Approved 20/20SI (FM Approval report ID 3013474). It employs a different optical filter thus limiting its response to hydrogen, ethanol, and methane fires.
- 2.7 The new model 20/20H examined as part of this project is an infrared detector similar to the previously Approved 20/20I (FM Approval report ID 3013474). It employs a different optical filter thus limiting its response to hydrogen, ethanol, and methane fires.
- 2.8 The new model 20/20CTIP/CTIN examined as part of this project is a Triple IR incorporates a supplemental video color camera.
- 2.9 The detectors are nominal 24Vdc devices intended for connection to FM Approved compatible controls that provide separate power and alarm initiating circuits.
- 2.10 Refer to the attached manufacturers data for more information on the tested flame detectors.

III EXAMINATIONS AND TESTS

Note: The applicable section of the above noted Approval Standard is referenced at the end of each paragraph where applicable.

- 3.1 Four samples each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detectors, representative of production units, were examined and tested at the Spectrex, Inc. and FM Approvals facilities in Norwood, MA. All documentation applicable to this program is on file at FM Approvals.
- 3.2 Examination showed that the samples were constructed in accordance with the manufacturer's drawings and specifications. Refer to Section VII of this report – CRITICAL DOCUMENT FILE for a list of the drawings and specification used in this evaluation.
- 3.3 Samples of each detector were found to have satisfactory means for secure mounting and are capable of normal handling and installation. (Section 3.2.1 & 3.2.2)
- 3.4 Samples of each model were found to include integral red alarm LEDs for alarm indication which is satisfactory. (Section 3.2.3).
- 3.5 **Stability Test** - One sample each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20CTIP/CTIN and 20/20MH flame detectors was energized and tested to verify proper operation under normal, standby conditions. Continuous operation of the flame detectors was monitored for 30 days in clean-air (working office type); there was no evidence of instability or false signal during that period. This result is satisfactory.

FM APPROVALS
Project ID: 3020071

- 3.6 **Baseline Sensitivity Test** - Four samples each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detectors were subjected to a small-scale sensitivity test fire. Averaged response times and the respective distances are shown below. (Section 4.1)

Model	Fuel	Distance	Time Average
20/20ML	Gasoline, 7.6 cm (3in) pan	2.8 m (9.2 ft)	6.5 sec
20/20MU	Gasoline, 7.6 cm (3in) pan	4.0 m (13.1 ft)	6.1 sec
20/20MR	Gasoline, 7.6 cm (3in) pan	3.6 m (11.8 ft)	5.2 sec
20/20MI-1	Gasoline, 7.6 cm (3in) pan	4.5 m (14.8 ft)	1.0 sec
20/20SH	Alcohol, 7.6 cm (3in) pan	2.3 m (7.5 ft)	7.0 sec
20/20H	Alcohol, 7.6 cm (3in) pan	2.4 m (7.8 ft)	3.5 sec
20/20MH	Alcohol, 7.6 cm (3in) pan	2.3 m (7.5 ft)	2.1 sec
20/20I	Gasoline, 7.6 cm (3in) pan	4.6 m (15 ft)	1.0 sec
20/20SI	Gasoline, 7.6 cm (3in) pan	4.6 m (15 ft)	2.9 sec
20/20LB	Gasoline, 7.6 cm (3in) pan	2.8 m (9.2 ft)	6.7 sec
20/20UB	Gasoline, 7.6 cm (3in) pan	3.0 m (9.8 ft)	6.8 sec
20/20CTIP/CTIN	Gasoline, 7.6 cm (3in) pan	4.6 m (15 ft)	1.0 sec

- 3.7 **Flame Response Sensitivity Test** - Four samples of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detectors were subjected to a series of full scale fire tests located along the centerline (0 degree viewing angle) and various fuel sources. The tests were conducted at Spectrex Inc., NJ, to various fuels. The averaged results are shown below when tested in both outdoor and indoor environments. These results are acceptable. (Section 4.2)

Note: Testing for the data contained below reflects maximum sensitivity for each detector unless noted otherwise!

Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detectors

Outdoor Test Results: Model 20/20ML

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20ML	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	6.3 seconds
13-25	20/20ML	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	4.9 seconds
26-38	20/20ML	Diesel	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	4.4 seconds
39-51	20/20ML	JP5	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	5.9 seconds
52-64	20/20ML	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	5.9 seconds
65-77	20/20ML	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	4.8 seconds
78-90	20/20ML	IPA	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	3.4 seconds
91-102	20/20ML	Methanol	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	5.8 seconds
103-114	20/20ML	Methane	20" (0.5m) plume fire	5m (15ft)	3.5 seconds
115-127	20/20ML	LPG	20" (0.5m) plume fire	5m (15ft)	3.8 seconds
128-140	20/20ML	Hydrogen	20" (0.5m) plume fire	5m (15ft)	3.9 seconds

FM APPROVALS
Project ID: 3020071

141-153	20/20ML	Silane	20" (0.5m) plume fire	5m (15ft)	3.4 seconds
154-165	20/20ML	Polypropylene	8" x 8" (0.2m x 0.2m) pan	5m (15ft)	4.4 seconds
166-178	20/20ML	Paper	1ft x 1ft (0.3m x 0.3m) pan	4m (13ft)	4.2 seconds

Outdoor Test Results: Model 20/20MU

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20MU	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	4.5 seconds
13-25	20/20MU	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	3.6 seconds
26-38	20/20MU	Diesel	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	3.9 seconds
39-51	20/20MU	JP5	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	3.5 seconds
52-64	20/20MU	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	3.8 seconds
65-77	20/20MU	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	4.6 seconds
78-90	20/20MU	IPA	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	2.6 seconds
91-102	20/20MU	Methanol	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	4.3 seconds
103-114	20/20MU	Methane	20" (0.5m) plume fire	12m (40ft)	3.8 seconds
115-127	20/20MU	LPG	20" (0.5m) plume fire	12m (40ft)	3.6 seconds
128-140	20/20MU	Hydrogen	20" (0.5m) plume fire	20m (66ft)	6.2 seconds
141-153	20/20MU	Silane	20" (0.5m) plume fire	10m (33ft)	3.4 seconds
154-165	20/20MU	Polypropylene	8" x 8" (0.2m x 0.2m) pan	6m (20ft)	3.3 seconds
166-178	20/20MU	Paper	1ft x 1ft (0.3m x 0.3m) pan	6m (20ft)	4.3 seconds

Outdoor Test Results: Model 20/20MR

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20MR	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	4.5 seconds
13-25	20/20MR	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	3.3 seconds
26-38	20/20MR	Diesel	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	3.8 seconds
39-51	20/20MR	JP5	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	3.2 seconds
52-64	20/20MR	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	3.7 seconds
65-77	20/20MR	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	3.5 seconds
78-90	20/20MR	IPA	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	2.2 seconds
91-102	20/20MR	Methanol	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	2.1 seconds
103-114	20/20MR	Methane	20" (0.5m) plume fire	10m (33ft)	2.8 seconds
115-127	20/20MR	LPG	20" (0.5m) plume fire	10m (33ft)	4.2 seconds
128-140	20/20MR	Polypropylene	8" x 8" (0.2m x 0.2m) pan	4m (13ft)	2.4 seconds
141-153	20/20MR	Paper	1ft x 1ft (0.3m x 0.3m) pan	6m (20ft)	2.7 seconds

Outdoor Test Results: Model 20/20UB

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20UB	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	7.2 seconds
13-25	20/20UB	JP5	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	7.1 seconds
26-38	20/20UB	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	7.3 seconds
39-51	20/20UB	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	7.0 seconds
52-64	20/20UB	IPA	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	6.7 seconds
65-77	20/20UB	Methanol	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	7.2 seconds
78-90	20/20UB	Methane	20" (0.5m) plume fire	12m (40ft)	7.4 seconds

FM APPROVALS
Project ID: 3020071

91-102	20/20UB	LPG	20" (0.5m) plume fire	12m (40ft)	7.2 seconds
103-114	20/20UB	Hydrogen	20" (0.5m) plume fire	20m (60ft)	9.0 seconds
115-127	20/20UB	Silane	20" (0.5m) plume fire	10m (33ft)	6.7 seconds
128-140	20/20UB	Polypropylene	8" x 8" (0.2m x 0.2m) pan	6m (20ft)	6.6 seconds
141-153	20/20UB	Paper	1ft x 1ft (0.3m x 0.3m) pan	6m (20ft)	7.9 seconds

Outdoor Test Results: Model 20/20LB

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20LB	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	6.0 seconds
13-25	20/20LB	JP5	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	5.0 seconds
26-38	20/20LB	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	11m (37ft)	5.8 seconds
39-51	20/20LB	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	7.5m (37ft)	5.0 seconds
52-64	20/20LB	IPA	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	4.5 seconds
65-77	20/20LB	Methanol	1ft x 1ft (0.3m x 0.3m) pan	7.5m (25ft)	5.2 seconds
78-90	20/20LB	Methane	20" (0.5m) plume fire	5m (15ft)	4.7 seconds
91-102	20/20LB	LPG	20" (0.5m) plume fire	5m (15ft)	4.6 seconds
103-114	20/20LB	Hydrogen	20" (0.5m) plume fire	5m (15ft)	4.8 seconds
115-127	20/20LB	Silane	20" (0.5m) plume fire	5m (15ft)	6.3 seconds
128-140	20/20LB	Polypropylene	8" x 8" (0.2m x 0.2m) pan	4m (13ft)	6.5 seconds
141-153	20/20LB	Paper	1ft x 1ft (0.3m x 0.3m) pan	4m (13ft)	4.4 seconds

Outdoor Test Results: Model 20/20MI-1

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20MI-1	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	40m (133ft)	1.1 seconds
13-25	20/20MI-1	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	40m (133ft)	1.0 seconds
26-38	20/20MI-1	Diesel	1ft x 1ft (0.3m x 0.3m) pan	27m (90ft)	1.7 seconds
39-51	20/20MI-1	JP5	1ft x 1ft (0.3m x 0.3m) pan	30m (100ft)	1.1 seconds
52-64	20/20MI-1	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	30m (100ft)	1.1 seconds
65-77	20/20MI-1	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	30m (100ft)	2.3 seconds
78-90	20/20MI-1	IPA	1ft x 1ft (0.3m x 0.3m) pan	30m (100ft)	1.8 seconds
91-102	20/20MI-1	Methanol	1ft x 1ft (0.3m x 0.3m) pan	27m (86ft)	2.7 seconds
103-114	20/20MI-1	Methane	20" (0.5m) plume fire	12m (40ft)	1.0 seconds
115-127	20/20MI-1	LPG	20" (0.5m) plume fire	12m (40ft)	1.0 seconds
128-140	20/20MI-1	Polypropylene	8" x 8" (0.2m x 0.2m) pan	5m (15ft)	1.4 seconds
141-153	20/20MI-1	Paper	1ft x 1ft (0.3m x 0.3m) pan	15m (50ft)	1.5 seconds
154-165	20/20MI-1	JP5	2ft x 2ft (0.6m x 0.6m) pan	70m(230ft)	6.8 seconds

Outdoor Test Results: Model 20/20I

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20I	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	1.3 seconds
13-25	20/20I	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	1.7 seconds
26-38	20/20I	JP5	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	5.4 seconds
39-51	20/20I	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	5.5 seconds

FM APPROVALS
Project ID: 3020071

52-64	20/20I	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	1.0 seconds
65-77	20/20I	IPA	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	3.2 seconds
78-90	20/20I	Methanol	1ft x 1ft (0.3m x 0.3m) pan	30m (100ft)	4.0 seconds
91-102	20/20I	Methane	20" (0.5m) plume fire	20m (60ft)	1.0 seconds
103-114	20/20I	LPG	20" (0.5m) plume fire	20m (60ft)	4.7 seconds
115-127	20/20I	Polypropylene	8" x 8" (0.2m x 0.2m) pan	5m (15ft)	1.0 seconds
128-140	20/20I	Paper	1ft x 1ft (0.3m x 0.3m) pan	20m (60ft)	1.0 seconds
141-153	20/20I	JP5	2ft x 2ft (0.6m x 0.6m) pan	90m (300ft)	9.2 seconds

Outdoor Test Results: Model 20/20SI

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20SI	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	1.4 seconds
13-25	20/20SI	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	2.8 seconds
26-38	20/20SI	JP5	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	5.8 seconds
39-51	20/20SI	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	6.9 seconds
52-64	20/20SI	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	27m (86ft)	4.1 seconds
65-77	20/20SI	IPA	1ft x 1ft (0.3m x 0.3m) pan	27m (86ft)	1.1 seconds
78-90	20/20SI	Methanol	1ft x 1ft (0.3m x 0.3m) pan	23m (75ft)	4.4 seconds
91-102	20/20SI	Methane	20" (0.5m) plume fire	20m (60ft)	3.1 seconds
103-114	20/20SI	LPG	20" (0.5m) plume fire	20m (60ft)	2.0 seconds
115-127	20/20SI	Polypropylene	8" x 8" (0.2m x 0.2m) pan	5m (15ft)	7.1 seconds
128-140	20/20SI	Paper	1ft x 1ft (0.3m x 0.3m) pan	20m (60ft)	4.9 seconds
141-153	20/20SI	JP5	2ft x 2ft (0.6m x 0.6m) pan	90m (300ft)	7.2 seconds

Outdoor Test Results: Models 20/20CTIN and 20/20CTIP

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20CTIP/CTIN	Gasoline	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	2.6 seconds
13-25	20/20CTIP/CTIN	N-heptane	1ft x 1ft (0.3m x 0.3m) pan	60m (200ft)	3.9 seconds
26-38	20/20CTIP/CTIN	JP5	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	6.2 seconds
39-51	20/20CTIP/CTIN	Kerosene	1ft x 1ft (0.3m x 0.3m) pan	45m (150ft)	5.3 seconds
52-64	20/20CTIP/CTIN	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	25m (82ft)	6.5 seconds
65-77	20/20CTIP/CTIN	IPA	1ft x 1ft (0.3m x 0.3m) pan	25m (83ft)	5.8 seconds
78-90	20/20CTIP/CTIN	Methanol	1ft x 1ft (0.3m x 0.3m) pan	20m (60ft)	8.9 seconds
91-102	20/20CTIP/CTIN	Methane	20" (0.5m) plume fire	20m (60ft)	3.6 seconds
103-114	20/20CTIP/CTIN	LPG	20" (0.5m) plume fire	20m (60ft)	3.2 seconds
115-127	20/20CTIP/CTIN	Polypropylene	8" x 8" (0.2m x 0.2m) pan	5m (15ft)	5.6 seconds
128-140	20/20CTIP/CTIN	Paper	1ft x 1ft (0.3m x 0.3m) pan	20m (60ft)	7.2 seconds
141-153	20/20CTIP/CTIN	JP5	2ft x 2ft (0.6m x 0.6m) pan	90m (300ft)	4.8 seconds

Outdoor Test Results: Model 20/20H

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20H	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	19m (62ft)	7.1 seconds
13-25	20/20H	Methanol	1ft x 1ft (0.3m x 0.3m) pan	8m (26ft)	3.5 seconds
26-38	20/20H	Hydrogen	20" (0.5m) plume fire	30m (98ft)	5.5 seconds

FM APPROVALS
Project ID: 3020071

Outdoor Test Results: Model 20/20SH

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20SH	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	19m (62ft)	5.1 seconds
13-25	20/20SH	Methanol	1ft x 1ft (0.3m x 0.3m) pan	8m (26ft)	5.6 seconds
26-38	20/20SH	Hydrogen	20" (0.5m) plume fire	30m (98ft)	1.8 seconds

Outdoor Test Results: Model 20/20MH

Test	Model	Fuel	Fire Size	Distance	Time Average
1-12	20/20MH	Alcohol 95%	1ft x 1ft (0.3m x 0.3m) pan	13m (43ft)	7.1 seconds
13-25	20/20MH	Methanol	1ft x 1ft (0.3m x 0.3m) pan	8m (26ft)	1.4 seconds
26-38	20/20MH	Hydrogen	20" (0.5m) plume fire	20m (66ft)	1.4 seconds
39-51	20/20MH	Silane	20" (0.5m) plume fire	7m (23ft)	6.4 seconds

3.8 **False Stimuli Response Test** - Four samples each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB detectors did not false alarm or show any signs of instability during a 30 second exposure to the sources and distances listed in the table below. It also was verified that the detector still responded to an actual fire condition using the gasoline pan or hydrogen plume fire while under the influence of the false source. These results are satisfactory. (Section 4.3)

Model	FAS Direct Sunlight	FAS Indirect Sunlight	FAS 1,500W Resistive Electric Heater	FAS (2) 40W Fluorescent Light	FAS 750W Halogen Lamp w/lens	FAS 100 W Incandescent Lamp	FAS Arc welder
20/20ML	OK	OK	OK	OK	7m (23ft)	0.3m (1ft)	3.2m (11ft)
20/20MU	OK	OK	OK	OK	N/A	OK	N/A
20/20MR	OK	OK	8m (26ft)	OK	4m (13ft)	0.8m (3ft)	3m (10ft)
20/20 MI-1	OK	OK	OK	OK	OK	0.3m (1ft)	7.5m (25ft)
20/20H	OK	OK	OK	OK	OK	OK	OK
20/20SH	OK	OK	OK	OK	OK	OK	OK
20/20MH	OK	OK	OK	OK	OK	0.3m (1ft)	9m (30ft)
20/20I	OK	OK	3m (9ft)	OK	6m (20ft)	OK	9.5m(31ft)
20/20LB	OK	OK	OK	OK	5m (16ft)	OK	3m (10ft)
20/20 CTIP/CTIN	OK	OK	0.5m (1.6ft)	OK	OK	0.5m (1.6ft)	10m (33ft)
20/20SI	OK	OK	OK	OK	OK	OK	10m (33ft)
20/20UB	OK	OK	OK	OK	N/A	OK	N/A

3.9 Field of View Test - One sample each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detector was exposed to either a gasoline fire (0.3m x 0.3m x 1 ft pan fire) or hydrogen fire (0.5m (20") plume fire - models 20/20H, 20/20SH and 20/20MH only) during which time the viewing angle was varied from the centerline along the horizontal and vertical axes. All samples were found to have no reduction in sensitivity at the extremes of the viewing angle. This performance is satisfactory and exceeds the FOV requirements. (Section 4.4)

Test	Model	Fuel	Fire Size	Angle	Distance	Time Average
1-3	20/20H	Hydrogen	20" (0.5m) plume fire	45° Up	15m (50ft)	7.1 seconds
4-6	20/20H	Hydrogen	20" (0.5m) plume fire	45° Right	15m (50ft)	4.6 seconds
7-9	20/20H	Hydrogen	20" (0.5m) plume fire	45° Down	15m (50ft)	8.6 seconds
10-12	20/20H	Hydrogen	20" (0.5m) plume fire	45° Left	15m (50ft)	4.0 seconds
1-3	20/20SH	Hydrogen	20" (0.5m) plume fire	45° Up	15m (50ft)	3.7 seconds
4-6	20/20SH	Hydrogen	20" (0.5m) plume fire	45° Right	15m (50ft)	5.0 seconds
7-9	20/20SH	Hydrogen	20" (0.5m) plume fire	45° Down	15m (50ft)	7.7 seconds
10-12	20/20SH	Hydrogen	20" (0.5m) plume fire	45° Left	15m (50ft)	6.0 seconds
1-3	20/20MH	Hydrogen	20" (0.5m) plume fire	50° Up	10m (32ft)	6.3 seconds
4-6	20/20MH	Hydrogen	20" (0.5m) plume fire	50° Right	10m (32ft)	7.2 seconds
7-9	20/20MH	Hydrogen	20" (0.5m) plume fire	50° Down	10m (32ft)	5.5 seconds
10-12	20/20MH	Hydrogen	20" (0.5m) plume fire	50° Left	10m (32ft)	4.5 seconds

FM APPROVALS
Project ID: 3020071

Test	Model	Fuel	Fire Size	Angle	Distance	Time Average
1-3	20/20I	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Up	30m (98ft)	1.9 seconds
4-6	20/20I	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Right	30m (98ft)	2.8 seconds
7-9	20/20I	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Down	30m (98ft)	3.3 seconds
10-12	20/20I	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Left	30m (98ft)	1.6 seconds
1-3	20/20SI	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Up	30m (98ft)	6.4 seconds
4-6	20/20SI	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Right	30m (98ft)	3.0 seconds
7-9	20/20SI	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Down	30m (98ft)	4.0 seconds
10-12	20/20SI	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Left	30m (98ft)	5.1 seconds
1-3	20/20CTIP/CTIN	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Up	30m (98ft)	3.6 seconds
4-6	20/20CTIP/CTIN	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Right	30m (98ft)	4.3 seconds
7-9	20/20CTIP/CTIN	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Down	30m (98ft)	3.9 seconds
10-12	20/20CTIP/CTIN	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Left	30m (98ft)	1.6 seconds
1-3	20/20MI-1	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Up	20m (66ft)	1.5 seconds
4-6	20/20MI-1	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Right	20m (66ft)	1.1 seconds
7-9	20/20MI-1	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Down	20m (66ft)	2.6 seconds
10-12	20/20MI-1	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Left	20m (66ft)	1.9 seconds
1-3	20/20LB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Up	7.5m (25ft)	7.7 seconds
4-6	20/20LB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Right	7.5m (25ft)	5.4 seconds
7-9	20/20LB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Down	7.5m (25ft)	7.2 seconds
10-12	20/20LB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Left	7.5m (25ft)	5.3 seconds
1-3	20/20UB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Up	7.5m (25ft)	8.2 seconds
4-6	20/20UB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Right	7.5m (25ft)	7.1 seconds
7-9	20/20UB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Down	7.5m (25ft)	6.9 seconds
10-12	20/20UB	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	45° Left	7.5m (25ft)	7.2 seconds
1-3	20/20ML	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Up	7.5m (25ft)	3.6 seconds
4-6	20/20ML	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Right	7.5m (25ft)	3.8 seconds
7-9	20/20ML	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Down	7.5m (25ft)	4.2 seconds
10-12	20/20ML	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Left	7.5m (25ft)	3.9 seconds
1-3	20/20MU	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Up	7.5m (25ft)	3.8 seconds
4-6	20/20MU	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Right	7.5m (25ft)	4.4 seconds
7-9	20/20MU	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Down	7.5m (25ft)	8.8 seconds
10-12	20/20MU	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Left	7.5m (25ft)	3.8 seconds
1-3	20/20MR	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Up	7.5m (25ft)	2.7 seconds
4-6	20/20MR	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Right	7.5m (25ft)	1.5 seconds
7-9	20/20MR	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Down	7.5m (25ft)	2.1 seconds
10-12	20/20MR	Gasoline	1 ft x 1 ft (0.3m x 0.3m) pan	50° Left	7.5m (25ft)	1.1 seconds

FM APPROVALS
Project ID: 3020071

3.10 **Response Characteristics in the Presence of False Alarm Source**

In addition to the tests described in 3.8, response characteristics in the presence of false alarm source were verified. Four samples of each of the models: 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB Flame Detectors were exposed to a full sale of gasoline fire along the centerline (0 degrees viewing angle) with presence of false alarm stimuli of Halogen 750W or heater 1500W. The maximum distance of detection was recorded. The results are satisfactory.

Detector Model	Distance	Fuel	False Alarm Source	Distance
20/20I	60m (200ft)	Gasoline	Halogen 750W	6m (18ft)
20/20I	15m (50ft)	Gasoline	Halogen 750W	4m (12ft)
20/20I	60m (200ft)	Gasoline	Heater 1500W	12m (33ft)
20/20I	15m (50ft)	Gasoline	Heater 1500W	4m (12ft)
20/20SI	60m (200ft)	Gasoline	Halogen 750W	6m (18ft)
20/20SI	15m (50ft)	Gasoline	Halogen 750W	4m (12ft)
20/20SI	60m (200ft)	Gasoline	Heater 1500W	12m (33ft)
20/20SI	15m (50ft)	Gasoline	Heater 1500W	4m (12ft)
20/20CTIP/CTIN	60m (200ft)	Gasoline	Halogen 750W	6m (18ft)
20/20CTIP/CTIN	15m (50ft)	Gasoline	Halogen 750W	4m (12ft)
20/20CTIP/CTIN	60m (200ft)	Gasoline	Heater 1500W	12m (33ft)
20/20CTIP/CTIN	15m (50ft)	Gasoline	Heater 1500W	4m (12ft)
20/20MI-1	20m (60ft)	Gasoline	Halogen 750W	2.5m (8ft)
20/20MI-1	20m (60ft)	Gasoline	Heater 1500W	4.5m (14ft)
20/20ML	15m (50ft)	Gasoline	Halogen 750W	Any Distance
20/20ML	15m (50ft)	Gasoline	Heater 1500W	Any Distance
20/20MU	15m (50ft)	Gasoline	Halogen 750W	Any Distance
20/20MU	15m (50ft)	Gasoline	Heater 1500W	Any Distance
20/20MR	15m (50ft)	Gasoline	Halogen 750W	Any Distance
20/20MR	15m (50ft)	Gasoline	Heater 1500W	Any Distance
20/20UB	15m (50ft)	Gasoline	Halogen 750W	Any Distance
20/20UB	15m (50ft)	Gasoline	Heater 1500W	Any Distance
20/20LB	15m (50ft)	Gasoline	Halogen 750W	Any Distance
20/20LB	15m (50ft)	Gasoline	Heater 1500W	Any Distance
20/20I1	20m (60ft)	Hydrogen	Halogen 750W	4m (12ft)
20/20H	20m (60ft)	Hydrogen	Heater 1500W	4m (12ft)
20/20SH	20m (60ft)	Hydrogen	Halogen 750W	4m (12ft)
20/20SH	20m (60ft)	Hydrogen	Heater 1500W	4m (12ft)
20/20MH	20m (60ft)	Hydrogen	Halogen 750W	4m (12ft)
20/20MH	20m (60ft)	Hydrogen	Heater 1500W	4m (12ft)

FM APPROVALS
Project ID: 3020071

- 3.11 **Environmental Extremes and Humidity Cycling** - One powered sample each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20SI, 20/20I, 20/20UB, 20/20LB, and 20/20CTIP/CTIN was conditioned in the following environmental extremes: (Section 4.6 & 4.8)
- 3.11.1 A temperature of -40° F (-40°C) for 24 hours.
- 3.11.2 A temperature of 185°F (85°C) for 24 hours.
- 3.11.3 An atmosphere of 95% relative humidity at 140°F (60°C) for a period of 24 hours.
- 3.11.4 The powered samples were subjected to a change from 70°F (21°C) and 50% RH to 100°F (38°C) at 90% RH within 15 minutes.
- 3.11.5 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 at the end of the conditioning and found acceptable.
- 3.12 **Voltage Variation** – One sample each of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20LB, 20/20I, 20/20UB, 20/20SI and 20/20CTIP/CTIN was operated at the rated supply voltage extremes of 18 and 32 V dc. These values are outside the 85% to 110% extremes usually tested and are satisfactory. While operating at each supply voltage extreme, detector operation was confirmed with the baseline fire, and there was less than a 10% shift in measured sensitivity. These results were satisfactory. (Section 4.7)
- 3.13 **Vibration Test** - One powered sample of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20LB, 20/20I, 20/20SI, 20/20UB and 20/20CTIP/CTIN was subjected to a four-hour vibration test of 0.02 inches (0.5 mm) displacement at a frequency sweep of 10 to 30Hz. The detectors operated properly during and after this vibration test, and there was no loosening of parts or permanent deformation as a result of this test. There was less than 10% shift in measured sensitivity using the baseline test at the conclusion of the test. This is satisfactory. (Section 4.9)
- 3.14 **Dielectric Tests** - The Dielectric Strength test was performed by applying 500 Vac between: the power input terminals, input and output circuits (tied together) to ground. The alarm and accessory relays are rated at 250 Vac. A test voltage of 1500 Vac was applied to all relay contacts tied together, and return was from enclosure to ground. The voltages were applied for one minute each. There was no evidence of arcing or breakdown. This is acceptable. (Section 4.10)
- 3.15 **Bonding** – The bonding resistance measured between the grounding terminal and accessible parts of the metal case was found to be less than 1 ohm. This is acceptable (Section 4.11)
- 3.16 **Durability** – A durability test of 500 operation/reset cycles was performed on a sample detector. This routine placed the detector into an alarm condition activating the output relays and then resetting the device. The output relay was connected at the maximum resistive rated load of 30Vdc@ 1A. The device operated normally at the end of this test and found to be acceptable. (Section 4.12)

FM APPROVALS
Project ID: 3020071

- 3.17 **Stability** – A sample each of the Model 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20LB, 20/20I, 20/20SI, 20/20UB and 20/20CTIP/CTIN were energized in a clean air environment for a minimum of 30 days. During this period there were no false alarms or evidence of instability. This is acceptable. (Section 4.13)
- 3.18 **Extraneous Transients** - The following tests were conducted on one powered sample of the Model 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20LB, 20/20I, 20/20SI, 20/20UB and 20/20CTIP/CTIN flame detector:
- 3.18.1 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.
- 3.18.2 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.
- 3.18.3 Operation of an electric drill rated 120 V, 60 Hz, 2.5 A.
- 3.18.4 Operation of a soldering gun rated 120 V, 60 Hz, 2.5 A.
- 3.18.5 Operation of a 6 in. (150 mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 V dc.
- 3.18.6 The flame detectors produced no false alarm or trouble signal in the presence of these extraneous transients, and they responded satisfactorily to a test fire source in the presence of these extraneous transients. These results are acceptable. (Section 4.14)
- 3.19 **Surge Transient Test** – The flame detector samples were tested for protection against surge transients. All input and output circuits of the powered samples of the Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20LB, 20/20I, 20/20SI, 20/20UB and 20/20CTIP/CTIN were subjected to five transient waveforms having peak levels of 100, 500, 1000, 1500, and 2400 V dc, as delivered into a 200 ohm load. The samples did not exhibit any instability such as alarm signals and non-restoring trouble signals during the test, and they performed satisfactorily at the conclusion of the test. This is satisfactory. (Section 4.15)

IV MARKING

- 4.1 The following information appears on the adhesive label affixed to the inside of the enclosure and meets Standard requirements:
- Manufacturer's name
 - Model number
 - Part Number
 - Electrical ratings
 - The FM Approval mark
- 4.2 The firmware revision levels as tested are: Per Section 2.5. Software version information

FM APPROVALS
Project ID: 3020071

is readable through an RS-485 digital data port which is integral to each detector.

V REMARKS

- 5.1 An engineering study of the hazard, detector location, and detector characteristic response is necessary for any application of flame radiation detectors.
- 5.2 As is characteristic of all optical flame radiation sensors, dust, dirt, condensation, and other foreign material on the lens may impair the response to fire. This must be considered in the application of these sensor units.
- 5.3 Installation, use and maintenance shall comply with the latest edition of the manufacturer's instruction manual and the National Fire Alarm Code, ANSI/NFPA 72.

VI FACILITIES AND PROCEDURES AUDIT

The Spextrex, Inc. 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 As part of the listing requirements, FM Approvals requires assurance that subsequent units produced will present the same quality and reliability as the specific unit(s) examined. The manufacturer shall maintain a Quality Assurance Program which includes as a minimum: incoming, in-process, and final inspection and testing, equipment calibration, and drawing change control. The specific procedures used to control quality are best determined by the manufacturer.
- 7.2 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 to and written authorization obtained from FM Approvals. The Approved Product Revision Report, Form 797, shall be forwarded to FM Approvals as notice of the proposed changes. Unauthorized changes may result in withdrawal of Approval.
- 7.3 A copy of the latest version of the Instruction Manual must be provided with each shipment.

FM APPROVALS
Project ID: 3020071

VIII DOCUMENTATION

The following documents pertain to these flame detectors and are filed under Project 3020071, 3013474 and 3013906, 0Z6A6.AY and 0X5A8.AY:

Drawing No	Drawing Title	Date
20/20I		
780002	IR/3 Detector Assy	F, 27-04-05
780702	IR/3 Detector Assy	A, 02-05-05
780011	P.C. Boards Assy	C, 27-04-05
780019	P.C.B Interface, IR/3 Detector	E, 02-05-05
780029	CPU - P.C.B Assy	E, 02-05-05
780039	IR/3 Sensors - P.C. Assy	E, 02-05-05
785078	Details - Parameters	B, 09-05-05
7780117	Label	A, 09-06-05
20/20SI		
784002	IR/3 Detector Assy (Stand)	A, 08-05-05
784702	IR/3 Detector Assy (Stand)	A, 08-05-05
784008	Block and Wiring Diagram	C, 09-05-05
784011	P.C. Boards Assy	G, 08-05-05
784038	IR/3 Sensors Circuit El. Scheme	C, 16-05-05
784039	IR/3 Sensors - P.C.B Assy	E, 08-05-05
784079	IR/3 Sensors - P.C.B Assy	E, 09-05-05
889019	CPU P.C. Board Assy	B, 27-06-05
889018	CPU Electrical Scheme	B, 27-06-05
784049	I/O P.C.B Assy	, 27-06-03
E784011	Eprom Label	D, 21-09-06
20/20L and 20/20U		
836002	UV Detector Assy	D, 23-05-05
834002	UV/IR Detector Assy	C, 23-05-05
832002	UV Detector Assy	C, 24-05-05
830002	UV-IR Detector	D, 24-05-05
836702	UV Detector Assy	D, 31-05-05
834702	UV/IR Detector Assy	C, 30-05-05
832702	UVDetector Assy	C, 31-05-05
830702	UV/IR Detector Assy	C, 31-05-05
834218	Interface - Electrical Scheme	D, 30-05-05
834219	Interface P.C Board	E, 31-05-05
834228	UV Electrical Scheme	E, 30-05-05
834229	UV P.C Board Assy	E, 25-05-05
834238	IR Electrical Scheme	C, 01-06-05
834239	IR P.C Board Assy	D, 01-06-05
E830229	Eprom Label	F, 02-06-05
834703	Housing	C, 02-06-05

FM APPROVALS
Project ID: 3020071

20/20H		
780692	IR/3 Detector Assy (Hydrogen)	, 16-05-05
780792	IR/3 Detector Assy (Hydrogen)	, 16-05-05
780139	R/3 Sensors – P.C.B Assy	, 16-05-05

20/20SH		
784692	IR3 Detector Assy (Hydrogen)	, 16-05-05
784792	IR/3 Detector Assy (Hydrogen)	, 16-05-05
784139	R/3 Sensors – P.C.B Assy	, 16-05-05

20/20MI		
787002	IR/3 Detector Assy	B, 10-05-05
787703	Housing	E, 17-05-05
787049	Inner Harness Assy	J, 10-05-05
787313	Sensors Holder	D, 10-05-05
787429	Sensors + CPU P.C.B Assy	D, 17-05-05
787428	Sensors + CPU El. Scheme	A, 23-11-04
787419	Interface P.C.B Assy	E, 22-11-04
787479	Sensors + CPU P.C.B Assy	C, 23-11-04
787418	Interface El. Scheme	H, 22-11-05
E787411	Software Label	C, 29-12-05

20/20MR		
787822	Single IR Detector Assy	B, 10-05-05
787208	Block and Wiring Diagram	, 16-05-05
787211	P.C. Boards Assy	A, 10-05-05
E787211	Software Label	A, 06-05-05
787229	Sensor + CPU P.C. Board Assy	, 25-10-04

20/20MH		
787692	IR/3 Detector Assy (Hydrogen)	, 16-05-05
787792	IR/3 Detector Assy (Hydrogen)	, 16-05-05
787111	P.C. Boards Assy	J, 16-05-05 ← (L)
787139	Sensor + CPU P.C. Board Assy (H2)	, 16-05-05

20/20ML and 20/20MU		
767702	UV-IR Detector Assy	A, 10-05-05
767712	UV Detector Assy	A, 10-05-05
767039	Sensor + CPU P.C. Board Assy	B, 06-05-05
E767011	Software Label	, 16-05-05
767089	I/O P.C. Board Sub-Assy	B, 27-03-05
767079	Sensors + CPU P.C. Board Sub Assy	A, 27-03-05
767018	I/O P.C. Board El. Scheme	B, 06-03-05
767038	Sensor + CPU P.C.B. El. Scheme	A, 06-03-05
767019	I/O P.C. Board Assy	B, 27-03-05
767048	Inner Harness Assy	, 21-04-05
767049	Inner Harness Assy	, 21-04-05
767011	P.C. Boards Assy	, 21-04-05

FM APPROVALS
Project ID: 3020071

20/20 CTIN/CTIP		
788002	CCTV and IR3 Flame Detector	, 16-05-05
788702	CCTV and IR3 Flame Detector	, 16-05-05
788011	P.C. Boards Assy	C, 06-05-05
788038	IR3 Sensors Circuit El. Scheme	B, 27-06-05
788039	IR/3 Sensors with Camera P.C.B Assy	E, 28-06-05
788059	P.C. Board for Camera Assy	B, 27-04-03
788058	Electrical Scheme	, 12-06-01
788711	Conical Reflector	J, 12-04-05
Manuals		
TM 20/20I	20/20I Manual	(6), 08-04
TM 20/20LB	20/20L, LB Manual	E, 08-04
TM 20/20UB	20/20U, UB Manual	E, 08-04
TM 787100	20/20MI Manual	C, 08-04
TM 788100	C.C.T.V Manual	A, 01-05
TM 784100	20/20 SI Manual	B, 08-04
TM 767100	20/20ML and 20/20MU Manual	A, 04-05
TM 787800	20/20MR Manual	A, 04-05
TM 780600	20/20H Manual	A, 05-05
TM 784600	20/20SH Manual	A, 05-05
TM 787600	20/20MH Manual	A, 05-05

FM APPROVALS
Project ID: 3020071

IX CONCLUSION

The Models 20/20ML, 20/20MU, 20/20MR, 20/20MI-1, 20/20H, 20/20SH, 20/20MH, 20/20I, 20/20SI, 20/20LB, 20/20CTIP/CTIN and 20/20UB flame detectors described in Section II meet 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: M. J. Grossman

PROJECT DATA RECORD 3020071

ATTACHMENTS: Specifications Model 20/20SH, P/N DS-F-SH, Rev. Nov. 2005; Specifications Model 20/20H, P/N DS-F-H, Rev. Nov. 2005; Specifications Model 20/20MI, P/N DS-F-MI, Rev. May 2005; Specifications Model 20/20MU, P/N DS-F-MU, Rev. May 2005; Specifications Model 20/20ML, P/N DS-F-ML, Rev. March 2005; Specifications Model 20/20MR, P/N DS-F-MR, Rev. Nov. 2005; Specifications Model 20/20CTIN & CTIP, P/N DS-F-CCTV, Rev. Nov. 2003; Specifications Model 20/20I, P/N DS-F-IR3, Rev. May 2005; Specifications Model 20/20SI, P/N DS-F-IR3 (SI), Rev. May 2005; Specifications Model 20/20L-LB, P/N DS-F-UV/IR, Rev. May 2005; Specifications Model 20/20U-UB, P/N DS-F-UV, Rev. May 2005; Common Label, P/N 7780117, Rev. A; FM Label, P/N 9780200, Rev. A.

REPORT BY:

Michael J. Grossman.

M. J. Grossman
Senior Engineer
Electrical Systems

REPORT REVIEWED BY:

R. W. Elliott

R. W. Elliott
Senior Engineering Specialist
Electrical Systems