

# FL4000H MSIR Flame Detector

## Performance Report



General Monitors

## Introduction

The General Monitors FL4000H Multi-Spectral Infrared (MSIR) Flame Detector with neural network technology sets a new industry standard for performance, reliability and value. This is the industry's first MSIR/NNT flame detector designed to operate at a longer range with a wider field of view and at a higher level of accuracy for superior false alarm immunity.

This report presents flame response, horizontal and vertical field of view data for various fuel types, fire sizes and detector sensitivities demonstrating the FL4000H MSIR Flame Detector's exceptional performance. Flame response data in the presence of false alarm sources is also presented exhibiting this detector's superior false alarm immunity.

## 1.1 Flame Response<sup>1</sup>

### 1.1.1 High Sensitivity

No	Fuel	Size	Distance ft. (m)	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	230 (70)	7
2	Methanol	1 x 1 ft. <sup>2</sup>	160 (49)	9
3	Methane	1 ft. plume	80 (24)	7
4	Methane	32 in. plume	125 (38)	8
5	Butane	1 ft. plume	112 (34)	13.1
6	Propane	1 ft. plume	125 (38)	14.9
7	Propane	32 in. plume	125(38)	8
8	Crude Oil	1 x 1 ft. <sup>2</sup>	80 (24)	4.5
9	Ethane	32 in. plume	125(38)	8
10	Ethanol	1 x 1 ft. <sup>2</sup>	170 (52)	8
11	Wood	1 x 1 ft. <sup>2</sup>	130 (40)	9.5
12	JP4	1 x 1 ft. <sup>2</sup>	160 (49)	6.9
13	JP5	1 x 1 ft. <sup>2</sup>	160 (49)	7.5
14	JP8	1 x 1 ft. <sup>2</sup>	160 (49)	9.2
15	Gasoline	1 x 1 ft. <sup>2</sup>	170 (52)	5
16	Jet Fuel A	1 x 1 ft. <sup>2</sup>	170 (52)	15
17	Marina Fuel	1 x 1 ft. <sup>2</sup>	200 (61)	3
18	Kerosene	1 x 1 ft. <sup>2</sup>	170 (52)	4
19	Ethylene glycol	1 x 1 ft. <sup>2</sup>	130 (40)	10
20	Triethylene glycol	1 x 1 ft. <sup>2</sup>	120 (36)	5

### 1.1.2 Medium Sensitivity

No	Fuel	Size	Distance ft. (m)	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	180 (55)	8
2	Methanol	1 x 1 ft. <sup>2</sup>	100 (30)	7
3	Methane	1 ft. plume	50 (15)	6
4	Butane	1 ft. plume	82 (25)	11.3
5	Propane	1 ft. plume	82 (25)	3.2
6	Ethanol	1 x 1 ft. <sup>2</sup>	150 (46)	8
7	Wood	1 x 1 ft. <sup>2</sup>	120 (37)	7.2
8	JP4	1 x 1 ft. <sup>2</sup>	150 (46)	8.2
9	JP5	1 x 1 ft. <sup>2</sup>	150 (46)	7.6
10	JP8	1 x 1 ft. <sup>2</sup>	150 (46)	6.0
11	Gasoline	1 x 1 ft. <sup>2</sup>	150(46)	6
12	Jet Fuel A	1 x 1 ft. <sup>2</sup>	150 (46)	13
13	Marina Fuel	1 x 1 ft. <sup>2</sup>	180 (55)	3
14	Kerosene	1 x 1 ft. <sup>2</sup>	150 (46)	5
15	Crude Oil	1 x 1 ft. <sup>2</sup>	65 (20)	7

### 1.1.3 Low Sensitivity

No	Fuel	Size	Distance ft. (m)	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	90 (27)	4
2	Methanol	1 x 1 ft. <sup>2</sup>	60 (18)	6
3	Methane	1 ft. plume	30 (9)	4
4	Butane	1 ft. plume	49 (15)	3.1
5	Propane	1 ft. plume	49 (15)	3.1
6	Ethanol	1 x 1 ft. <sup>2</sup>	130	9
7	Wood	1 x 1 ft. <sup>2</sup>	70 (21)	12.4
8	JP4	1 x 1 ft. <sup>2</sup>	90 (27)	4.1
9	JP5	1 x 1 ft. <sup>2</sup>	90 (27)	3.6
10	JP8	1 x 1 ft. <sup>2</sup>	90 (27)	6.3
11	Gasoline	1 x 1 ft. <sup>2</sup>	120(37)	17
12	Jet Fuel A	1 x 1 ft. <sup>2</sup>	90(27)	16
13	Marina Fuel	1 x 1 ft. <sup>2</sup>	110(34)	9
14	Kerosene	1 x 1 ft. <sup>2</sup>	90 (27)	7
15	Crude Oil	1 x 1 ft. <sup>2</sup>	55 (18)	3

<sup>1</sup> Source: Design Validation Test (DVT) Report (July 24, 2006)



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## 1.2 Horizontal Field of View<sup>2</sup>

### 1.2.1 High Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	230 (70)	+30/-30	13/13
2	Heptane	1 x 1 ft. <sup>2</sup>	105 (32)	+45/-45	8/13
3	Heptane	1 x 1 ft. <sup>2</sup>	50 (15)	+45/-45	4/7
4	Methanol	1 x 1 ft. <sup>2</sup>	70 (21)	+45/-45	15/11
5	Methane	1 ft. plume	40 (12)	+45/-45	6/13
6	Butane	1 ft. plume	35 (11)	+45/-45	6/5
7	Propane	1 ft. plume	70 (21)	+45/-45	7/10
8	Crude Oil	1 x 1 ft. <sup>2</sup>	50 (15)	+45/-45	9/9
9	Ethanol	1 x 1 ft. <sup>2</sup>	75 (23)	+45/-45	4/8
10	Wood	1 x 1 ft. <sup>2</sup>	65(19.8)	+45/-45	10/17
11	JP4	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	10/14
12	JP5	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	8/12
13	JP8	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	12/18
14	Gasoline	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	2/3
15	Jet Fuel A	1 x 1 ft. <sup>2</sup>	90 (27)	+45/-45	19/15
16	Marina Fuel	1 x 1 ft. <sup>2</sup>	110 (34)	+45/-45	2/2
17	Kerosene	1 x 1 ft. <sup>2</sup>	80(24)	+45/-45	7/9

### 1.2.3 Low Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	60 (18)	+35/-35	4/3
2	Heptane	1 x 1 ft. <sup>2</sup>	40 (12)	+45/-45	5/6
3	Heptane	1 x 1 ft. <sup>2</sup>	20 (6)	+45/-45	3/6
4	Methanol	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	NA/10
5	JP4	1 x 1 ft. <sup>2</sup>	30 (9)	+45/-45	7/4
6	Methane	1 ft. plume	15 (5)	+45/-45	NA/3
7	Methane	1 ft. plume	12 (4)	+45/-45	3/NA
8	Wood	1 x 1 ft. <sup>2</sup>	35 (11)	+45/-45	14/14
9	JP4	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	10/9
10	JP5	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	11/10
11	JP8	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	11/13
12	Gasoline	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	4/2
13	Jet Fuel A	1 x 1 ft. <sup>2</sup>	40 (12)	+45/-45	13/13
14	Marina Fuel	1 x 1 ft. <sup>2</sup>	50 (15)	+45/-45	2/2
15	Kerosene	1 x 1 ft. <sup>2</sup>	40 (12)	+45/-45	8/10

<sup>2</sup> Data for heptane: FM file update test results (July 31 – August 3, 2006); data for methanol, JP4, and methane: Design Validation Test (DVT) Report (July 24, 2006)

### 1.2.2 Medium Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	120 (37)	+30/-30	5/4
2	Heptane	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	6/8
3	Heptane	1 x 1 ft. <sup>2</sup>	70 (21)	+45/-45	4/4
4	Heptane	1 x 1 ft. <sup>2</sup>	50 (15)	+50/-50	15/6
5	Heptane	1 x 1 ft. <sup>2</sup>	45 (14)	+45/-45	5/6
6	Methanol	1 x 1 ft. <sup>2</sup>	70 (21)	+45/-45	NA/5
7	JP4	1 x 1 ft. <sup>2</sup>	60 (18)	+45/-45	15/6
8	JP4	1 x 1 ft. <sup>2</sup>	50 (15)	+45/-45	4/NA
9	Methane	1 ft. plume	25 (8)	+45/-45	22/3
10	Methane	1 ft. plume	20 (6)	+45/-45	22/NA
11	Wood	1 x 1 ft. <sup>2</sup>	35 (11)	+45/-45	12/12
12	JP4	1 x 1 ft. <sup>2</sup>	75 (23)	+45/-45	11/8
13	JP5	1 x 1 ft. <sup>2</sup>	75 (23)	+45/-45	9/10
14	JP8	1 x 1 ft. <sup>2</sup>	75 (23)	+45/-45	14/19
15	Gasoline	1 x 1 ft. <sup>2</sup>	70 (21)	+45/-45	2/2
16	Jet Fuel A	1 x 1 ft. <sup>2</sup>	70 (21)	+45/-45	10/13
17	Marina Fuel	1 x 1 ft. <sup>2</sup>	80 (24)	+45/-45	2/2
18	Kerosene	1 x 1 ft. <sup>2</sup>	60 (18)	+45/-45	7/8

## Horizontal Field of View Charts

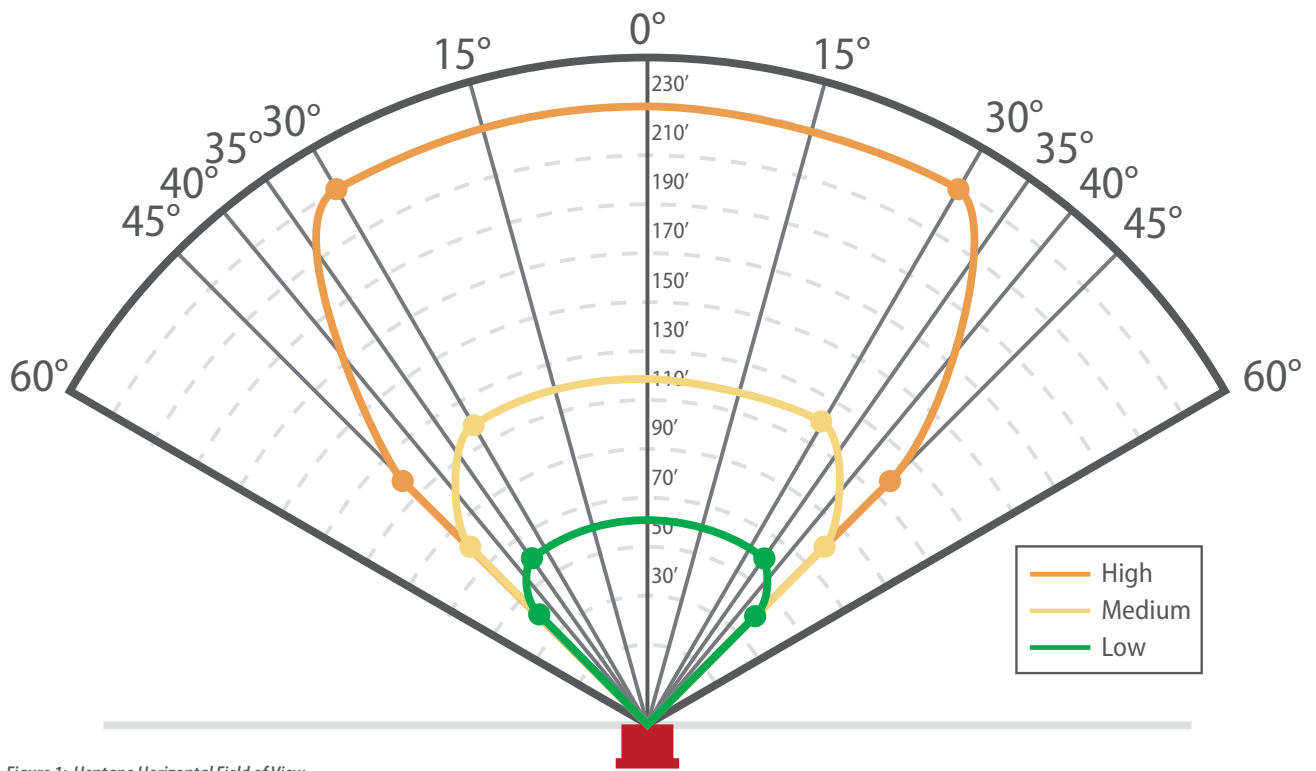


Figure 1: Heptane Horizontal Field of View

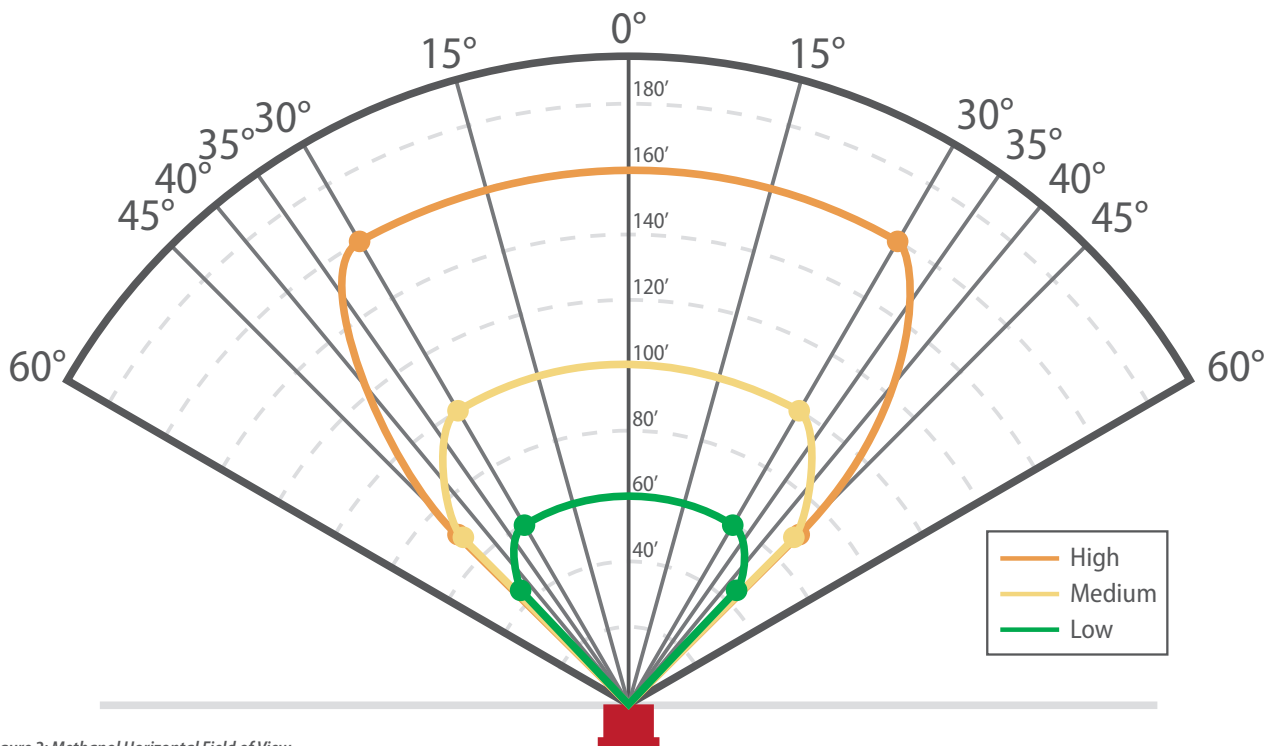
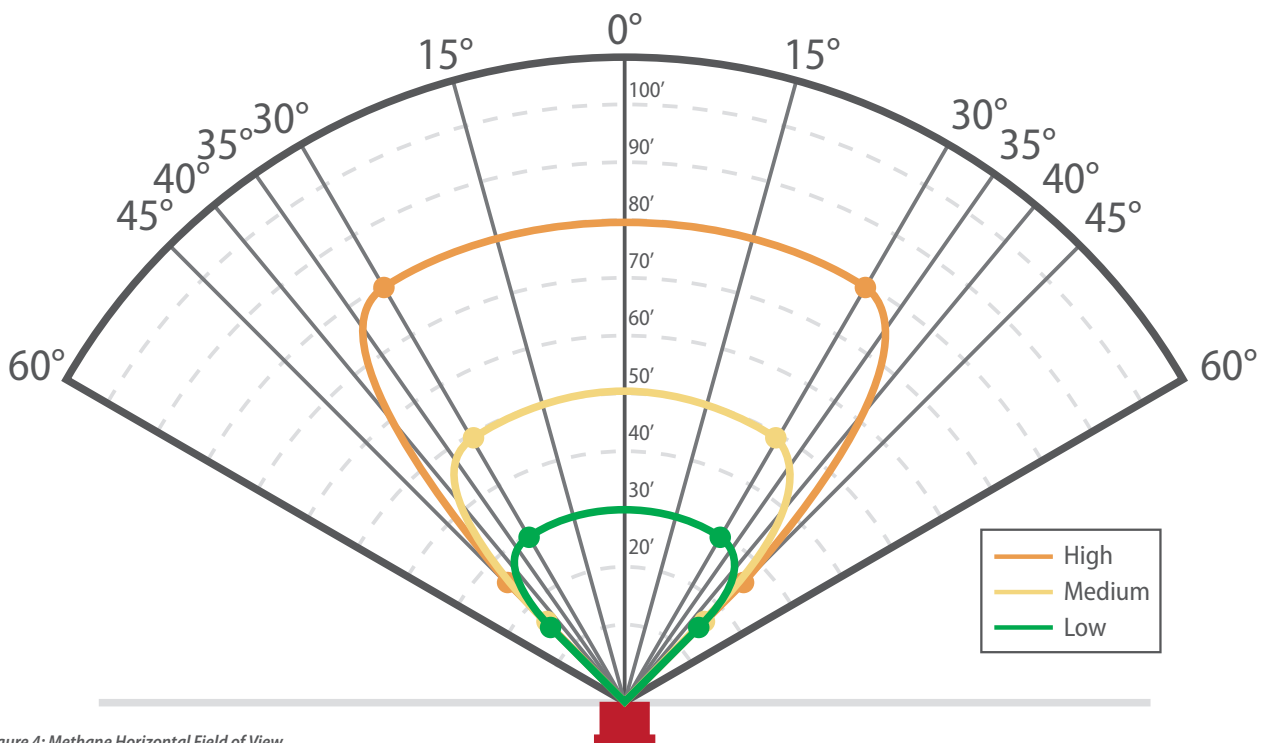
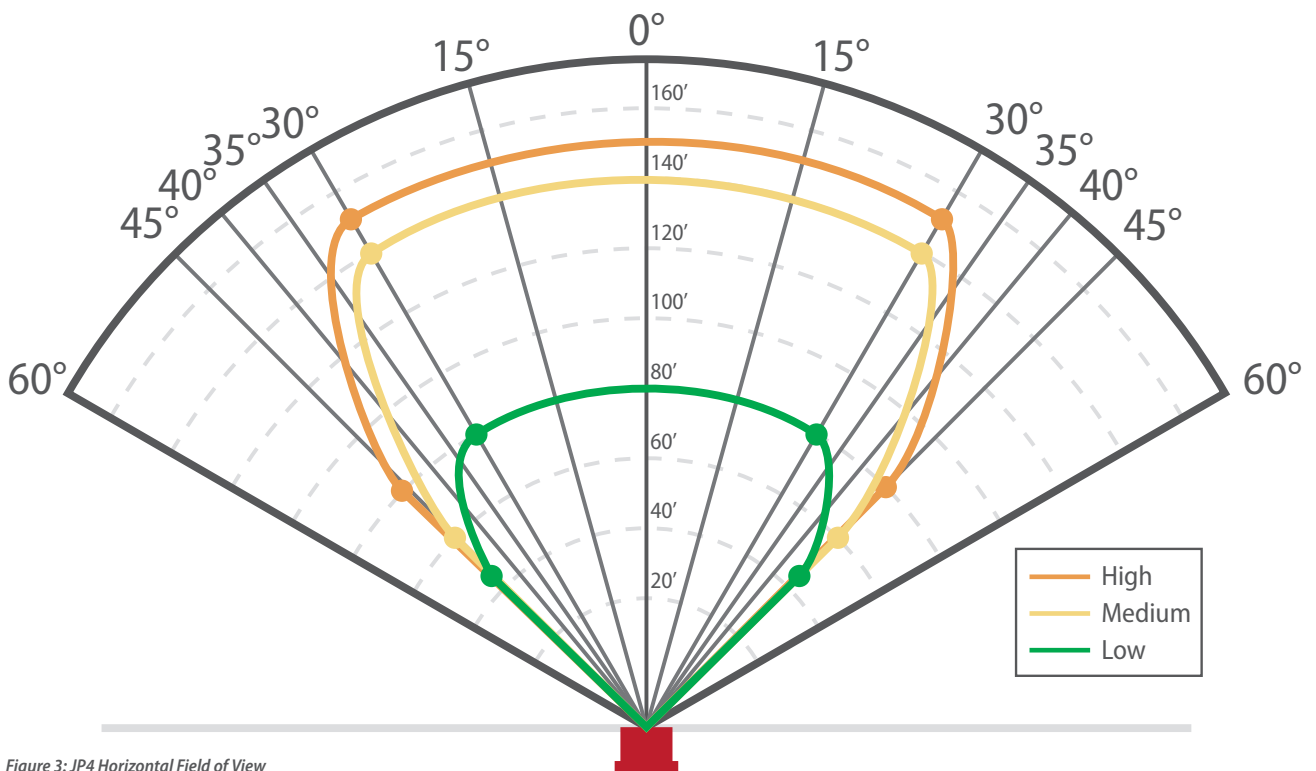


Figure 2: Methanol Horizontal Field of View

## Horizontal Field of View Charts



## Horizontal Field of View Charts

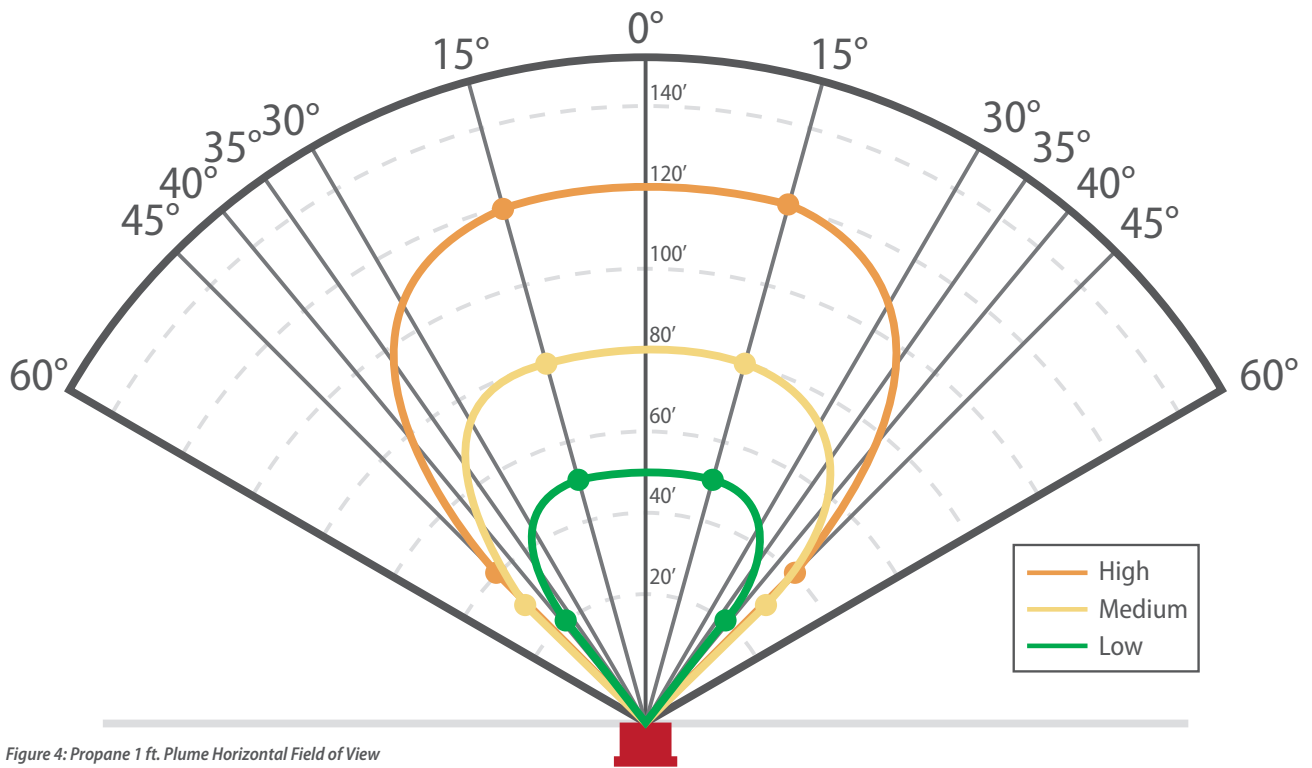


Figure 4: Propane 1 ft. Plume Horizontal Field of View

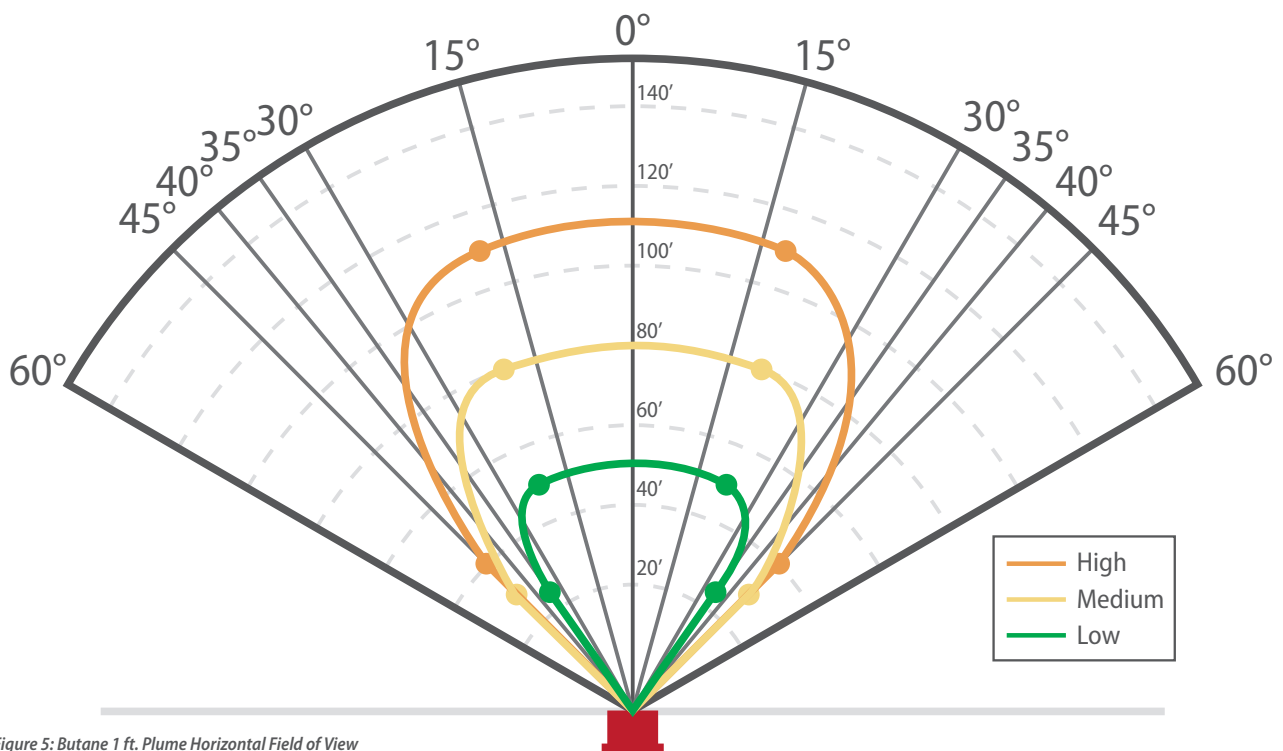


Figure 5: Butane 1 ft. Plume Horizontal Field of View

## 1.3 Vertical Field of View<sup>3</sup>

### 1.3.1 High Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	230 (70)	+25/-30	8/11
2	Heptane	1 x 1 ft. <sup>2</sup>	200 (61)	+30/-35	9/12
3	Heptane	1 x 1 ft. <sup>2</sup>	120 (37)	-45	13
4	Heptane	1 x 1 ft. <sup>2</sup>	50 (15)	+35	4
5	Heptane	1 x 1 ft. <sup>2</sup>	30 (9)	+50	6
6	Methanol	1 x 1 ft. <sup>2</sup>	110 (34)	+30/-45	7/20
7	JP4	1 x 1 ft. <sup>2</sup>	100 (30)	+35/-45	5/14
8	Methane	1 ft. plume	60 (18)	+35	6
9	Methane	1 ft. plume	45 (14)	-45	12
10	Crude Oil	1 x 1 ft. <sup>2</sup>	50 (15)	+40/-45	3/3

### 1.2.2 Medium Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	100 (30)	+25/-45	4/10
2	Heptane	1 x 1 ft. <sup>2</sup>	120 (37)	+35/-35	4/9
3	Heptane	1 x 1 ft. <sup>2</sup>	100 (31)	+35	4
4	Heptane	1 x 1 ft. <sup>2</sup>	90 (27)	-45	14
5	Heptane	1 x 1 ft. <sup>2</sup>	50 (15)	+35/-50	4/11
6	Methanol	1 x 1 ft. <sup>2</sup>	60 (18)	+25/-45	4/8
7	JP4	1 x 1 ft. <sup>2</sup>	80 (24)	+35/-45	5/19
8	Methane	1 ft. plume	50 (15)	+35	4
9	Methane	1 ft. plume	45 (14)	-45	16
10	Crude Oil	1 x 1 ft. <sup>2</sup>	40 (12)	+40	4
11	Crude Oil	1 x 1 ft. <sup>2</sup>	35 (11)	-45	3

### 1.2.3 Low Sensitivity

No	Fuel	Size	Distance ft. (m)	Angle, °	Average Response Times
1	Heptane	1 x 1 ft. <sup>2</sup>	45 (14)	+25/-45	3/5
2	Heptane	1 x 1 ft. <sup>2</sup>	60 (18)	+30/-30	4/4
3	Heptane	1 x 1 ft. <sup>2</sup>	50 (15)	+40/-40	4/4
4	Heptane	1 x 1 ft. <sup>2</sup>	40 (12)	+35/-45	3/6
5	Heptane	1 x 1 ft. <sup>2</sup>	25 (8)	+35/-50	3/7
6	Methanol	1 x 1 ft. <sup>2</sup>	50 (15)	+25	6
7	Methanol	1 x 1 ft. <sup>2</sup>	40 (12)	-45	14
8	JP4	1 x 1 ft. <sup>2</sup>	60 (18)	+35	5
9	JP4	1 x 1 ft. <sup>2</sup>	45 (14)	-45	12
10	Methane	1 ft. plume	25 (8)	+35	11
11	Methane	1 ft. plume	20 (6)	-45	8
12	Crude Oil	1 x 1 ft. <sup>2</sup>	35 (11)	+40	3
13	Crude Oil	1 x 1 ft. <sup>2</sup>	30 (9)	-45	8.5

<sup>3</sup> Data for heptane: FM file update test results (July 31 – August 3, 2006); data for methanol, JP4, and methane: Design Validation Test (DVT) Report (July 24, 2006)

## 1.4 False Alarm Immunity<sup>4</sup>

### 1.4.1 High Sensitivity

No	False Alarm Source	Minimum Immunity Distance, ft. (m)	
		Modulated Response	Unmodulated Responseft. (m)
1	Arc welding (#7014, 1/8", 180 – 200 A, DC)	15 (5)	12 (4)
2	Arc welding (#7014, 1/8", 90 A, AC)	15 (5)	15 (5)
3	Arc welding (#7018, 1/8", 180 – 200 A, DC)	15 (5)	13 (4)
4	Arc welding (#7018, 1/8", 9 A, AC)	12 (4)	10 (3)
5	Arc welding (#6012, 1/8", 180 – 200 A, DC)	5 (1.5)	11 (3)
6	Arc welding (#6012, 1/8", 90 A, AC)	5 (1.5)	9 (2.7)
7	Arc welding (#6011, 1/8", 180 – 200 A, DC)	7 (2.1)	20 (6)
8	Arc welding (#6011, 1/8", 90 A, AC)	9 (2.7)	14 (4)
9	Flashlight	IAD <sup>5</sup>	IAD
10	Fluorescent lamp (25 W)	IAD	IAD
11	Halogen lamp (500 W)	2 (0.6)	IAD
12	Heater, radiant (1,500 W)	6 (1.8)	1 (0.3)
13	Hose down facing sun	IAD	IAD
14	Hot plate (200°C)	3 (0.9)	1 (0.3)
15	Human hand wave	IAD	IAD
16	Incandescent lamp (100 W)	1 (0.3)	1 (0.3)
17	Laser pointer	IAD	10 (3)
18	Sunlight, direct	IAD	IAD
19	Sunlight, reflected	IAD	IAD
20	TL103 lamp	2.5 (0.8)	NA
21	UV backlight	IAD	IAD

<sup>4</sup> Source: Design Validation Test (DVT) Report (July 24, 2006)

<sup>5</sup> IAD: Immune at all distances

<sup>6</sup> Source: Design Validation Test (DVT) Report (July 24, 2006)

## 1.5 Flame Response in the Presence of False Alarm Sources<sup>6</sup>

### 1.5.1 High Sensitivity

No	False Alarm Source	Distance ft. (m)	Fire Source	Fire Distance ft. (m)	Average Response Times
1	Arc welding (#7014, 1/8", 180 – 200 A, DC), modulated	18 (6)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	3 – 6
2	Arc welding (#7014, 1/8", 180 – 200 A, DC), unmodulated	18 (6)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	3 – 6
3	Arc welding (#7014, 3/16", 180 – 200 A, DC), modulated	15 (5)	1 x 1 ft. <sup>2</sup> heptane	80 (24)	7
4	Arc welding (#7014, 3/16", 90 A, AC), unmodulated	12 (4)	1 x 1 ft. <sup>2</sup> heptane	80 (24)	4
5	Arc welding (#6012, 1/8", 90 A, AC), modulated	18 (6)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	3 – 6
6	Arc welding (#6012, 1/8", 180 – 200 A, DC), unmodulated	18 (6)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	3 – 6
7	Fluorescent lamp, modulated	2.5 (0.8)	1 x 1 ft. <sup>2</sup> heptane	70 (21)	10
8	Fluorescent lamp, unmodulated	2.5 (0.8)	1 x 1 ft. <sup>2</sup> heptane	80 (24)	11
9	Halogen lamp (100 W), modulated	4 (1.2)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	NA
10	Halogen lamp (100 W), unmodulated	2 (0.6)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	13
11	Heater, IR (1,500 W), modulated	12 (4)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	5
12	Heater, IR (1,500 W), unmodulated	1 (0.3)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	6
13	Incandescent light (100 W), modulated	2.5 (0.8)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	10
14	Incandescent light (100 W), unmodulated	2.5 (0.8)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	18
15	Sunlight, reflected, modulated	30 (9)	1 x 1 ft. <sup>2</sup> heptane	30 (9)	10
16	Sunlight, reflected, unmodulated	6 (1.8)	1 x 1 ft. <sup>2</sup> heptane	35 (11)	7

## Vertical Field of View Charts

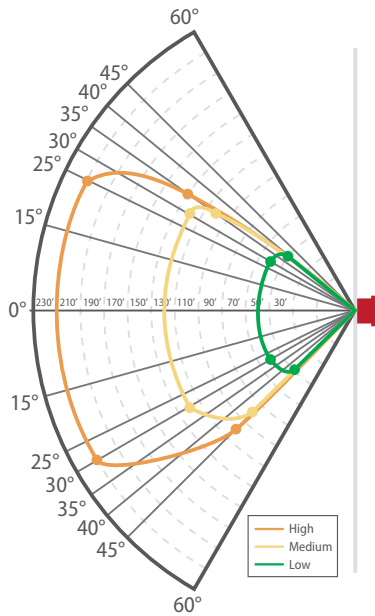


Figure 6: Heptane Vertical Field of View

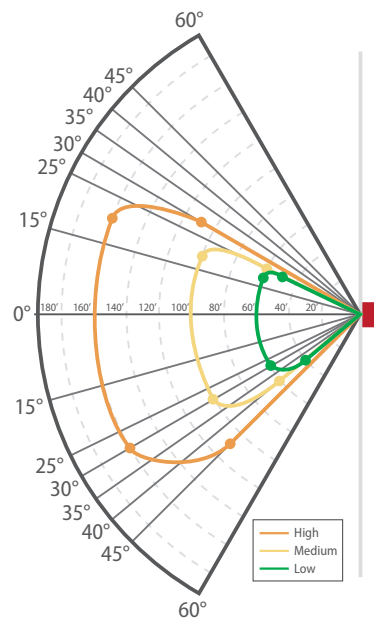


Figure 7: Methanol Vertical Field of View

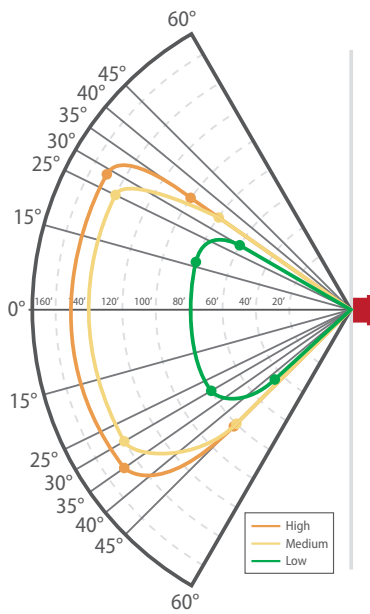


Figure 8: JP4 Vertical Field of View

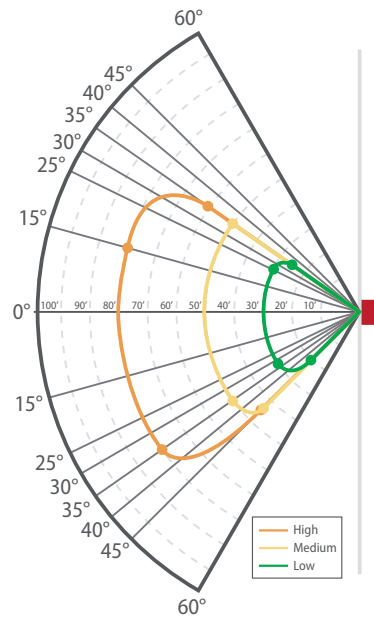


Figure 9: Methane Vertical Field of View

Note: This Bulletin contains only a general description of the products shown. While product uses and performance capabilities are generally described, the products shall not, under any circumstances, be used by untrained or unqualified individuals. The products shall not be used until the product instructions/user manual, which contains detailed information concerning the proper use and care of the products, including any warnings or cautions, have been thoroughly read and understood. Specifications are subject to change without prior notice.

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