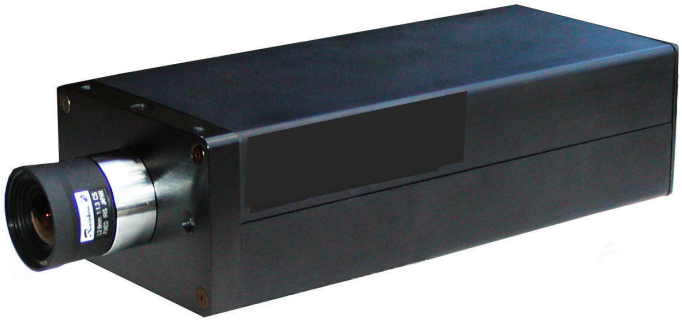
Guide to the Impact of Illumination on Fike Video Analytics® IP Camera Operation



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Fike®
Video Analytics Corporation

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1.0 Introduction

All camera systems need illumination to function correctly. This illumination is either Infra Red (IR) or white light. Statistics show that a majority of fire incidents reported to the fire department occur at night while a business is closed or has a reduced staff on hand. The challenge to the end user and installer is to ensure that video is effective on a 24 hour, 7 days a week, 365 days a year basis. Proper illumination is fundamental in achieving this.

2.0 White Light and Infrared

The Fike Video Analytics IP camera only responds to white light illumination. However, some systems allow for illumination to be supplied by an Infra-Red (IR) illuminator. Fike Video Analytics chose white light illumination because it provides color where as IR can only deliver a black and white image. This is due to the fact that IR light is light the human eye can not see but that a monochrome CCTV camera can. In addition, switching between IR at night and white light during the day can result in a focus shift. The different wavelengths create different focus points through the lens onto the camera chip. This can lead to a loss of image focus at night, particularly if the camera is set up during day time operation. IR light that is used in CCTV applications is in the 700 to 1,100 nm range just beyond the visible spectrum, Fig. 1. As white light is visible to the human eye we have natural protection against an overexposure to white light but because we can not see IR our eyes can not automatically adjust to overexposure and potential eye damage. Applications that require covert surveillance or where no light is allowed due to light pollution on light sensitive materials are ideal for IR. However the majority of installations are better served using white light illumination as it provides a color image and is visible to humans resulting in a higher level of safety and security. In addition, system performance is not changed and light levels can be as low as 1 ft-candle, the emergency light level set by NFPA standards.

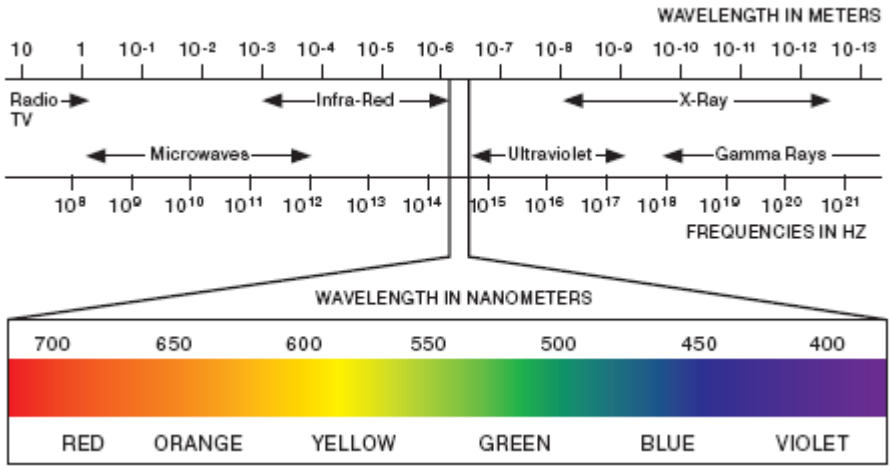


Figure 1 – Wavelengths of varying spectrums

White light also provides more options to the end user because it can be supplied by a number of sources including incandescent, fluorescent, High Intensity Discharge (HID), or LED lamps. LEDs are the fastest growing lighting solution for VID applications. They are extremely efficient and offer unbeatable reliability. LEDs may cost more upfront but they offer the lowest possible running cost (less than 100 watts for higher power units) with longer operating life (up to 10 years).

Many camera systems have built in illuminators attached to the camera. This results in unneeded expense to those who don't need added illumination. It is also an attempt to have a one size fits all approach to lighting, a single source in many cases will not provide the necessary and proper lighting for a facility. A single high powered light will create large pockets of light with dark areas in the image. Lighting should be placed to provide uniform illumination within the cameras field of view.

Another advantage of white light illumination is that many facilities already have the required 1 Fc of illumination. The life safety code (NFPA 101) Section 7.9 describes the required emergency lighting levels for safe egress in case of loss of power during an evacuation. Specifically section 7.9.2 Performance of System with sub section 7.9.2.1 emergency illumination, outline the illumination level. The code states that "emergency illumination shall be provided for not less than 1.5 hours in the event of failure of normal lighting. Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 ft-candle (10 lux) and, at any point, not less than 0.1 ft-candle (1 lux), measured along the path of egress at floor level. Illumination levels shall be permitted to decline to no less than an average of 0.6 ft-candles (6 lux) and, at any point, no less than 0.06 ft-candles (0.6 lux) at the end of the 1.5 hours.

A maximum to minimum illumination uniformity ratio of 40 to 1 shall not be exceeded." Therefore any area designed to meet the life safety code will already comply with the lighting requirements for a Fike Video Analytics system.

3.0 Calculating illumination

A foot-candle (FC) is the English measure for light intensity. Lux is the metric equivalent with 1 FC = 10.76 Lux. Both are measurements of illumination produced by one candela or lumen over one square foot or meter respectively. As Lux and Fc are measurements of visible light, and by definition IR produces invisible light, how do you measure the appropriate IR illumination level? In order to measure light radiation in terms of Watts it is necessary to use a radiometer which normally only exists in laboratories and tend to be very expensive and beyond the means of normal installation companies.

3.1 Inverse Square law

The intensity of a light is inversely proportional to the square of the distance from the light source. This is known as the inverse square law, equation. 1. As an example, if 1 Fc is measured at the floor of a facility with lighting being supplied overhead at 30 ft. when the light meter is moved to 15 ft the illumination level increases to 4 Fc then again at 7 ft the resulting illumination is 16 Fc. This would work the same way when lighting is mounted to a camera. At the camera location the light intensity will be very high but this intensity will quickly dissipate and be minimal at longer distances resulting in an uneven distribution of light.

Equation 1 $E=I/D^2$

E = Illumination at given point
I = candlepower of the source
D = distance to given pint from source

If the illumination measurement is not taken directly under the lamp, the angle can be accounted for by incorporating Cos into the equation, equation 2.

Equation 2 $E = (\text{Cos} \times I)/D^2$

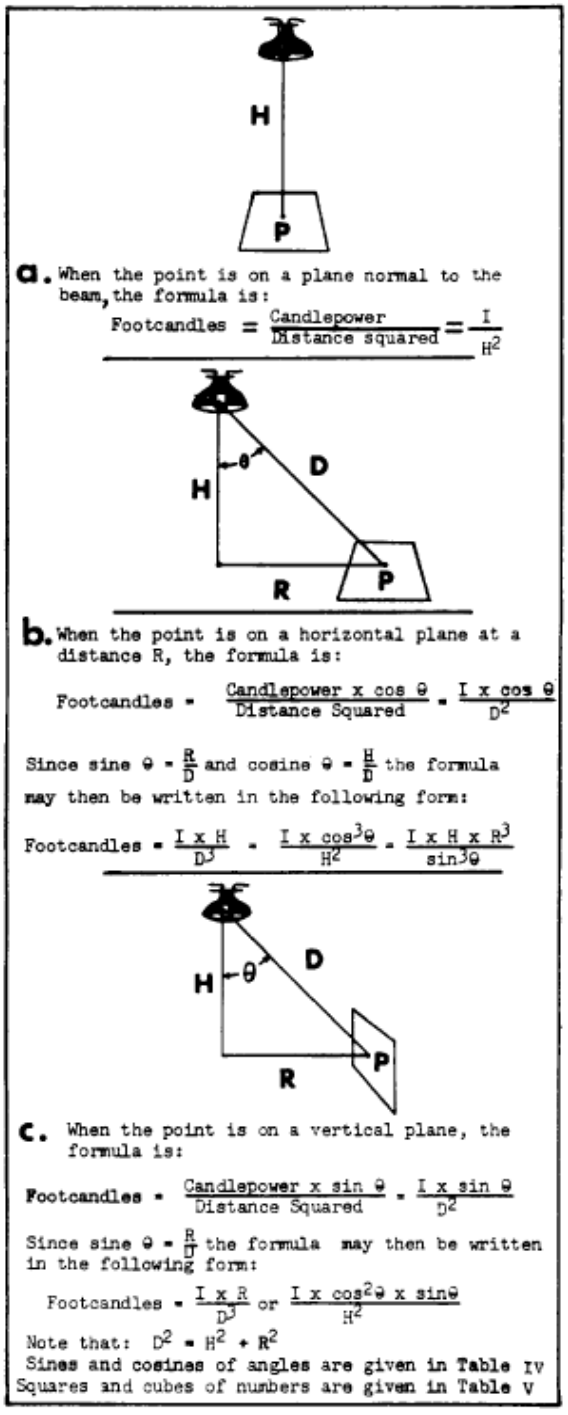


Figure 2 – Methods for calculating light intensity at a point.

Example Calculation

Using the inverse square law and given a mounting height of 4 feet from the lighting fixture that supplies approximately 350 candlepower to the working plane, the illumination at the working plane can be calculated as follows:

$E=I/D^2 = 350/4^2=350/16 = 22$ foot-candles

3.2 Lighting design

The number of light fixtures needed to illuminate a plane to a specific level can be calculated based on the room's geometry, the reflectivity of the room's surfaces, and the lighting supplied by each light. Below is an example calculation to determine how many Fluorescent fixtures are needed to supply 1 Fc to a 60x30x20 ft room. There are free software tools that can be found on the internet to help design and calculate lighting levels in a given space.

Example Calculation

Determine the number of light fixtures required to provide 1 Fc in a room 60 feet long by 30 feet wide with a 20 foot ceiling using 40 watt fluorescent fixtures. The reflectance of the overhead is 70 percent, the wall is 50 percent and the floor is 30 percent. Table 1 provides reflectance levels for various materials. The lighting fixtures are to be mounted 18 feet from the floor. The illumination measuring plane is at floor level.

General Information

Fill in the following data:

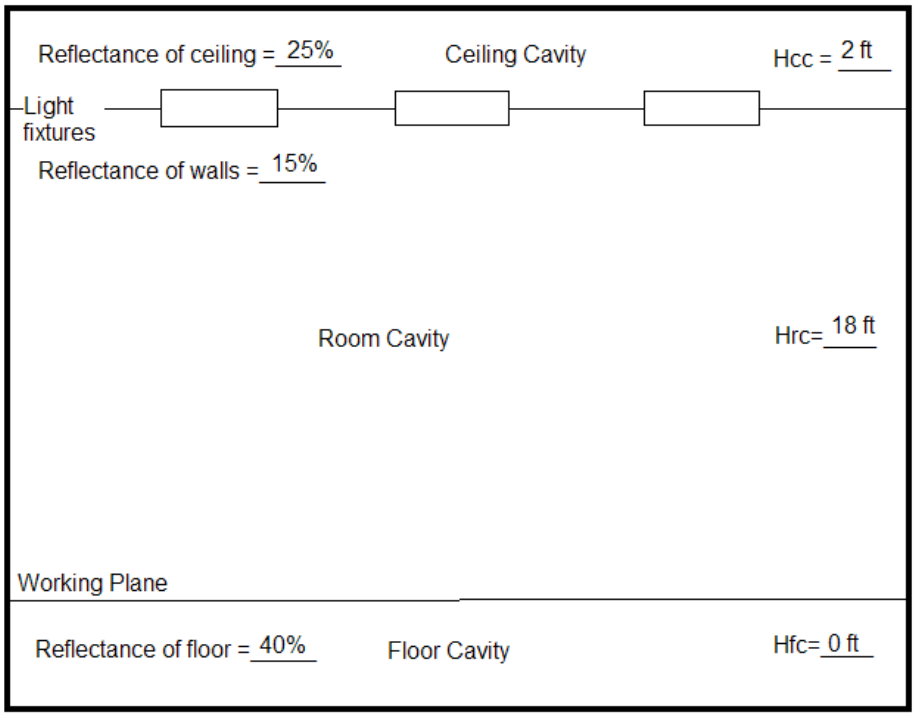
Average initial foot-candles required: __1__ Fc

Lighting Fixture data

Fixture make and model:	GE FL12/xbs
Lamps:	Fluorescent
Rated Lumen per Lamp:	1030
Number of Fixtures:	2
Total Lumens per fixture:	2060

Selection of coefficient of utilization

Fill in sketch



Length = 60 ft. Width = 30 ft. Height = 20 ft.

Determine Cavity Ratios from Table 2 or use below formulas to calculate.

Room Cavity Ratio (RCR) = $\frac{5\ Hrc\ (L+W)}{L \times W}$

Ceiling Cavity Ratio (CCR) = $\frac{5\ Hcc\ (L+W)}{L \times W}$

Floor Cavity Ratio (FCR) = $\frac{5\ Hfc\ (L+W)}{L \times W}$

Room Cavity Ratio (RCR) = 4.5
Ceiling Cavity Ratio (CCR) = 0.5
Floor Cavity Ratio (FCR) = 0.0

Obtain Effective Ceiling Cavity Reflectance (ECC) from Table 3 ECC = ~25
Obtain Effective Floor Cavity Reflectance (EFC) from Table 3 EFC = ~30
Obtain Coefficient of Utilization (CU) from Table 4 CU = ~30

Calculations

Number of lighting fixtures required =

$$\frac{\text{(Average initial Fc x room length x room width)}}{\text{(Lamps per fixture x lumens per lamp x coefficient of utilization)}}$$

Number of lighting fixtures required = 1800/618=2.9 (3.0 fixtures)

Table 1: Reflectance values for some basic materials

Material	Typical Reflectance (%) White-Light
Standard white paper	75
Aluminium	75
Glass windows	70
White cloth / fabric	65
Concrete (new)	40-50
Light oak wood (varnished)	40-50
Plasterboard	30-60
Bright steel	25
Cast iron	25
Open country (trees / grass)	20
Wood (mahogany / walnut)	15-40
Brickwork (new)	10-30
Brickwork (old)	5-15
Concrete (old)	5-15
Matt black paper	5

Table 2: Cavity Ratios

DIMENSIONS		CAVITY DEPTH																		
Width	Length	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10	11	12	14	16	20	25	30
8	8	1.2	1.9	2.5	3.1	3.7	4.4	5.0	6.2	7.5	8.8	10.0	11.2	12.5							
	10	1.1	1.7	2.2	2.8	3.4	3.9	4.5	5.6	6.7	7.9	9.0	10.1	11.3	12.4						
	14	1.0	1.5	2.0	2.5	3.0	3.4	3.9	4.9	5.9	6.9	7.8	8.8	9.7	10.7	11.7					
	20	0.9	1.3	1.7	2.2	2.6	3.1	3.5	4.4	5.2	6.1	7.0	7.9	8.8	9.6	10.5	12.2				
	30	0.8	1.2	1.6	2.0	2.4	2.8	3.2	4.0	4.7	5.5	6.3	7.1	7.9	8.7	9.5	11.0				
	40	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.7	4.5	5.3	5.9	6.5	7.4	8.1	8.8	10.3	11.8			
10	10	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0					
	14	0.9	1.3	1.7	2.1	2.6	3.0	3.4	4.3	5.1	6.0	6.9	7.8	8.6	9.5	10.4	12.0				
	20	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.7	4.5	5.3	6.0	6.8	7.5	8.3	9.0	10.5	12.0			
	30	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.3	4.0	4.7	5.3	6.0	6.6	7.3	8.0	9.4	10.6			
	40	0.6	0.9	1.2	1.6	1.9	2.2	2.5	3.1	3.7	4.4	5.0	5.6	6.2	6.9	7.5	8.7	10.0	12.5		
	60	0.6	0.9	1.2	1.5	1.7	2.0	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.1	8.2	9.4	11.7		
12	12	0.8	1.2	1.7	2.1	2.5	2.9	3.3	4.2	5.0	5.8	6.7	7.5	8.4	9.2	10.0	11.7				
	16	0.7	1.1	1.5	1.8	2.2	2.5	2.9	3.6	4.4	5.1	5.8	6.5	7.2	8.0	8.7	10.2	11.6			
	24	0.6	0.9	1.2	1.6	1.9	2.2	2.5	3.1	3.7	4.4	5.0	5.8	6.2	6.9	7.5	8.7	10.0	12.5		
	36	0.6	0.8	1.1	1.4	1.7	1.9	2.2	2.8	3.3	3.9	4.4	5.0	5.5	6.0	6.6	7.8	8.8	11.0		
	50	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.6	3.1	3.6	4.1	4.6	5.1	5.6	6.2	7.2	8.2	10.2		
	70	0.5	0.7	0.9	1.1	1.4	1.6	1.8	2.3	2.8	3.3	3.9	4.4	4.9	5.4	5.9	6.8	7.8	9.7	12.2	
14	14	0.7	1.1	1.4	1.8	2.1	2.5	2.9	3.6	4.3	5.0	5.7	6.4	7.1	7.8	8.5	10.0	11.4			
	20	0.6	0.9	1.2	1.5	1.8	2.1	2.4	3.0	3.6	4.2	4.9	5.5	6.1	6.7	7.3	8.6	9.8	12.3		
	30	0.5	0.8	1.0	1.3	1.6	1.8	2.1	2.6	3.1	3.7	4.2	4.7	5.2	5.8	6.3	7.3	8.4	10.5		
	42	0.5	0.7	1.0	1.2	1.4	1.7	1.9	2.4	2.9	3.4	3.8	4.3	4.7	5.2	5.7	6.7	7.6	9.5	11.9	
	60	0.4	0.7	0.9	1.1	1.3	1.5	1.8	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	6.1	7.0	8.8	10.9	
	90	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.5	2.9	3.3	3.7	4.1	4.5	5.0	5.8	6.6	8.3	10.3	12.4
17	17	0.6	0.9	1.2	1.5	1.8	2.1	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.0	8.2	9.4	11.7		
	25	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	10.0	12.5	
	35	0.4	0.7	0.9	1.1	1.3	1.5	1.7	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	6.1	7.0	8.7	10.9	
	50	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.4	2.8	3.1	3.5	3.9	4.3	4.5	5.4	6.2	7.7	9.7	11.6
	80	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.8	2.1	2.5	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.0	10.9
	120	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.7	5.4	6.7	8.4	10.1
20	20	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	10.0	12.5	
	30	0.4	0.6	0.8	1.0	1.2	1.5	1.7	2.1	2.5	2.9	3.3	3.7	4.1	4.5	4.9	5.8	6.6	8.2	10.3	12.4
	45	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.8	2.2	2.5	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.1	10.9
	60	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.7	5.4	6.7	8.4	10.1
	90	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.2	4.8	6.0	7.5	9.0
	150	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.4	4.0	4.6	5.7	7.2	8.6
24	24	0.4	0.6	0.8	1.0	1.2	1.5	1.7	2.1	2.5	2.9	3.3	3.7	4.1	4.5	5.0	5.8	6.7	8.2	10.3	12.4
	32	0.4	0.5	0.7	0.9	1.1	1.3	1.5	1.8	2.2	2.6	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.0	11.0
	50	0.3	0.5	0.6	0.8	1.1	1.2	1.5	1.8	2.2	2.5	2.8	3.1	3.4	3.7	4.4	5.0	5.8	6.2	7.8	9.4
	70	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	2.0	2.2	2.5	2.8	3.0	3.3	3.8	4.4	5.5	6.9	8.2
	100	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.3	1.6	1.8	2.1	2.4	2.6	2.9	3.1	3.7	4.2	5.2	6.5	7.9
	160	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.8	3.3	3.8	4.7	5.9	7.1
30	30	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.7	5.4	6.7	8.4	10.0
	45	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	1.9	2.2	2.5	2.7	3.0	3.3	3.8	4.4	5.5	6.9	8.2
	60	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.5	4.0	5.0	6.2	7.4
	90	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.1	1.3	1.6	1.8	2.0	2.2	2.5	2.7	3.1	3.6	4.5	5.6	6.7
	150	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	5.9
	200	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.9	2.0	2.2	2.6	3.0	3.7	4.7	5.6
36	36	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	1.9	2.2	2.5	2.8	3.0	3.3	3.9	4.4	5.5	6.9	8.3
	50	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.5	2.6	2.9	3.3	3.8	4.8	5.9	7.2
	75	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.5	2.9	3.3	4.1	5.1	6.1
	100	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.8	3.0	3.8	4.7	5.7
	150	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.4	2.8	3.5	4.3	5.2
	200	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.6	1.8	2.0	2.3	2.6	3.3	4.1	4.9
42	42	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.9	2.1	2.4	2.6	2.8	3.3	3.8	4.7	5.9	7.1
	60	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	6.0
	90	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.4	2.8	3.5	4.4	5.2
	140	0.2	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.9	2.2	2.5	3.1	3.9	4.6	
	200	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.3	1.4	1.6	1.7	2.0	2.3	2.9	3.6	4.3
	300	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.3	1.4	1.5	1.7	1.9	2.2	2.8	3.5	4.2
50	50	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	6.0
	70	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.5	1.7	1.9	2.0	2.4	2.7	3.4	4.3	5.1
	100	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.1	2.4	3.0	3.7	4.5
	150	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	300	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.4	1.6	1.9	2.3	2.9	3.5
60	60	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.3	2.7	3.3	4.2	5.0
	100	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	150	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.4	1.6	1.9	2.3	2.9	3.5
	300	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.6	2.0	2.5	3.0
75	75	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	120	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.7	2.2	2.7	3.3
	200	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.8	2.3	2.7
	300	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.2	1.3	1.7	2.1	2.5
100	100	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.6	2.0	2.5	3.0
	200	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	1.9	2.2
	300	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.1	1.4	1.8	2.3	2.7

Table 3: Percent effective ceiling or floor cavity reflectance for various reflectance combinations.

Per Cent Ceiling or Floor Reflectance		90				80				70			50			30				10		
Per Cent Wall Reflectance		90	70	50	30	80	70	50	30	70	50	30	70	50	30	65	50	30	10	50	30	10
Ceiling or Floor Cavity Ratio	0	90	90	90	90	80	80	80	80	70	70	70	50	50	50	30	30	30	30	10	10	10
	0.1	90	89	88	87	79	79	78	78	69	69	68	59	49	48	30	30	29	29	10	10	10
	0.2	89	88	86	85	79	78	77	76	68	67	66	49	48	47	30	29	29	28	10	10	9
	0.3	89	87	85	83	78	77	75	74	68	66	64	49	47	46	30	29	28	27	10	10	9
	0.4	88	86	83	81	78	76	74	72	67	65	63	48	46	45	30	29	27	26	11	10	9
	0.5	88	85	81	78	77	75	73	70	66	64	61	48	46	44	29	28	27	25	11	10	9
	0.6	88	84	80	76	77	75	71	68	65	62	59	47	45	43	29	28	26	25	11	10	9
	0.7	88	83	78	74	76	74	70	66	65	61	58	47	44	42	29	28	26	24	11	10	8
	0.8	87	82	77	73	75	73	69	65	64	60	56	47	43	41	29	27	25	23	11	10	8
	0.9	87	81	76	71	75	72	68	63	63	59	55	46	43	40	29	27	25	22	11	9	8
	1.0	86	80	74	69	74	71	66	61	63	58	53	46	42	39	29	27	24	22	11	9	8
	1.1	86	79	73	67	74	71	65	60	62	57	52	46	41	38	29	26	24	21	11	9	8
	1.2	86	78	72	65	73	70	64	58	61	56	50	45	41	37	29	26	23	20	12	9	7
	1.3	85	78	70	64	73	69	63	57	61	55	49	45	40	36	29	26	23	20	12	9	7
	1.4	85	77	69	62	72	68	62	55	60	54	48	45	40	35	28	26	22	19	12	9	7
	1.5	85	76	68	61	72	68	61	54	59	53	47	44	39	34	28	25	22	18	12	9	7
	1.6	85	75	66	59	71	67	60	53	59	52	45	44	39	33	28	25	21	18	12	9	7
	1.7	84	74	65	58	71	66	59	52	58	51	44	44	38	32	28	25	21	17	12	9	7
	1.8	84	73	64	56	70	65	58	50	57	50	43	43	37	32	28	25	21	17	12	9	6
	1.9	84	73	63	55	70	65	57	49	57	49	42	43	37	31	28	25	20	16	12	9	6
	2.0	83	72	62	53	69	64	56	48	56	48	41	43	37	30	28	24	20	16	12	9	6
	2.1	83	71	61	52	69	63	55	47	56	47	40	43	36	29	28	24	20	16	13	9	6
	2.2	83	70	60	51	68	63	54	45	55	46	39	42	36	29	28	24	19	15	13	9	6
	2.3	83	69	59	50	68	62	53	44	54	46	38	42	35	28	28	24	19	15	13	9	6
	2.4	82	68	58	48	67	61	52	43	54	45	37	42	35	27	28	24	19	14	13	9	6
	2.5	82	68	57	47	67	61	51	42	53	44	36	41	34	27	27	23	18	14	13	9	6
	2.6	82	67	56	46	66	60	50	41	53	43	35	41	34	26	27	23	18	13	13	9	5
	2.7	82	66	55	45	66	60	49	40	52	43	34	41	33	26	27	23	18	13	13	9	5
	2.8	81	66	54	44	66	59	48	39	52	42	33	41	33	25	27	23	18	13	13	9	5
	2.9	81	65	53	43	65	58	48	38	51	41	33	40	33	25	27	23	17	12	13	9	5
	3.0	81	64	52	42	65	58	47	38	51	40	32	40	32	24	27	22	17	12	13	8	5
	3.1	80	64	51	41	64	57	46	37	50	40	31	40	32	24	27	22	17	12	13	8	5
	3.2	80	63	50	40	64	57	45	36	50	39	30	40	31	23	27	22	16	11	13	8	5
	3.3	80	62	49	39	64	56	44	35	49	39	30	39	31	23	27	22	16	11	13	8	5
	3.4	80	62	48	38	63	56	44	34	49	38	29	39	31	22	27	22	16	11	13	8	5
	3.5	79	61	48	37	63	55	43	33	48	38	29	39	30	22	26	22	16	11	13	8	5
	3.6	79	60	47	36	62	54	42	33	48	37	28	39	30	21	26	21	15	10	13	8	5
	3.7	79	60	46	35	62	54	42	32	48	37	27	38	30	21	26	21	15	10	13	8	4
	3.8	79	59	45	35	62	53	41	31	47	36	27	38	29	21	26	21	15	10	13	8	4
	3.9	78	59	45	34	61	53	40	30	47	36	26	38	29	20	26	21	15	10	13	8	4
	4.0	78	58	44	33	61	52	40	30	46	35	26	38	29	20	26	21	15	9	13	8	4
	4.1	78	57	43	32	60	52	39	29	46	35	25	37	28	20	26	21	14	9	13	8	4
	4.2	78	57	43	32	60	51	39	29	46	34	25	37	28	19	26	20	14	9	13	8	4
	4.3	78	56	42	31	60	51	38	28	45	34	25	37	28	19	26	20	14	9	13	8	4
	4.4	77	56	41	30	59	51	38	28	45	34	24	37	27	19	26	20	14	8	13	8	4
	4.5	77	55	41	30	59	50	37	27	45	33	24	37	27	19	25	20	14	8	14	8	4
	4.6	77	55	40	29	59	50	37	26	44	33	24	36	27	18	25	20	14	8	14	8	4
	4.7	77	54	40	29	58	49	36	26	44	33	23	36	26	18	25	20	13	8	14	8	4
	4.8	76	54	39	28	58	49	36	25	44	32	23	36	26	18	25	19	13	8	14	8	4
	4.9	76	53	38	28	58	49	35	25	44	32	23	36	26	18	25	19	13	7	14	8	4
	5.0	76	53	38	27	57	48	35	25	43	32	22	36	26	17	25	19	13	7	14	8	4

Table 4: Coefficients of Utilization

% EFFECTIVE CEILING CAVITY REFLECTANCE RC →	80	70	50	30	10	0
% WALL REFLECTANCE RW →	70 50 30 10	70 50 30 10	50 30 10	50 30 10	50 30 10	0
ROOM CAVITY RATIO RCR ↓	EFFECTIVE FLOOR CAVITY REFLECTANCE 0.20 - ZONAL CAVITY METHOD					
1	77 73 69 65	74 70 67 64	66 63 60	61 59 57	57 56 54	52
2	69 62 56 52	66 60 55 50	56 52 48	52 49 46	49 46 44	42
3	63 54 48 42	60 52 46 42	49 44 40	45 42 38	43 40 37	34
4	57 48 41 35	55 46 40 35	43 38 33	41 36 32	38 34 31	29
5	52 42 35 30	50 41 34 29	38 32 28	36 31 27	34 29 26	24
6	48 37 30 25	46 36 30 25	34 28 24	32 27 23	30 26 22	21
7	44 33 27 22	42 32 26 21	30 25 21	29 24 20	27 23 19	18
8	40 30 23 19	39 29 23 18	27 22 18	26 21 17	24 20 17	16
9	37 27 20 16	36 26 20 16	25 19 15	23 18 15	22 18 14	13
10	35 24 18 14	33 24 18 14	22 17 13	21 16 13	20 16 13	11

4.0 Conclusion

Irrelevant of what video system is installed or its purpose, proper camera placement and illumination is vital in making it effective and valuable. Video image smoke and fire systems rely on proper illumination that is provided by designing a lighting scheme that generates uniform and adequate levels of light. Fike Video Analytics relies on white light because of many of the issues associated with using IR illumination, such as focus issues and inability to measure illumination level, as well as white lights fixture options, increase safety, and ability to deliver color images.

Appendix A

Lighting Design Calculation Sheet

Lighting Design Calculation Sheet

Fill in the following data:

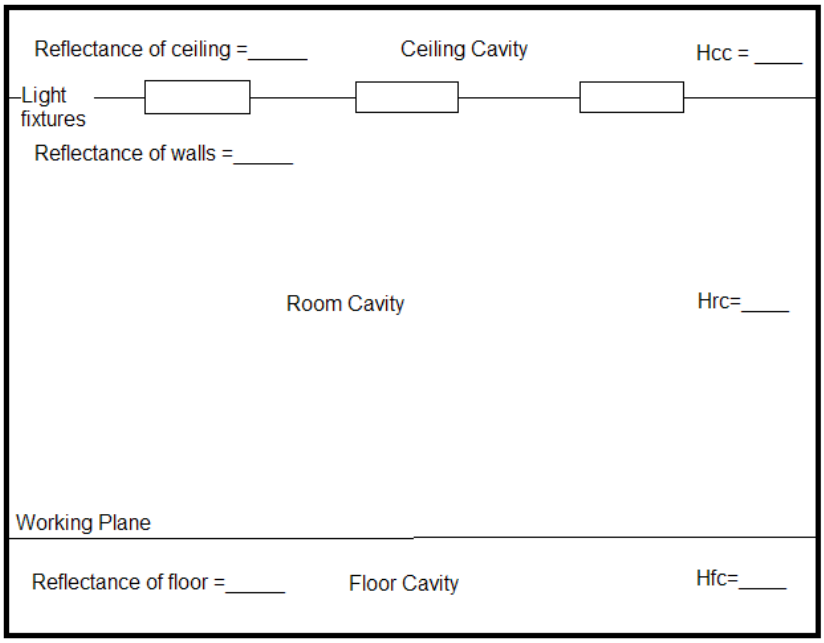
Average initial foot-candles required: ____Fc

Lighting Fixture data

Fixtures make and model: _____
Lamps: _____
Rated Lumen per Lamp: _____
Number of Fixtures: _____
Total Lumens per Fixture: _____

Selection of coefficient of utilization

Fill in sketch



Length = _____ Width = _____ Height = _____

Determine Cavity Ratios from Table 2 or below formulas

Room Cavity Ratio (RCR) = 5 Hrc x (L + W) / L x W
Ceiling Cavity Ratio (CCR) = 5 Hcc x (L + W) / L x W
Floor Cavity Ratio (FCR) = 5 Hfc x (L + W) / L x W

Room Cavity Ratio (RCR) = _____
Ceiling Cavity Ratio (CCR) = _____
Floor Cavity Ratio (FCR) = _____

Obtain Effective Ceiling Cavity Reflectance (ECC) from Table 3 ECC = _____
Obtain Effective Floor Cavity Reflectance (EFC) from Table 3 EFC = _____
Obtain Coefficient of Utilization (CU) from Table 4 CU = _____

Calculations

Number of lighting fixtures required = (Average initial Fc x room length x room width)
(Lamps per fixture x lumens per lamp x coefficient of utilization)

Revision History

Revision	Date	Revision Description
2	06/19	Revised to reflect new Fike document standard.

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