How to FIT CCTV

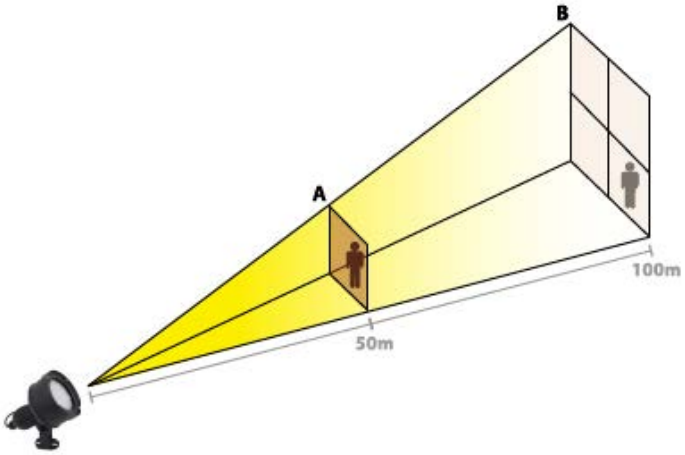
Tip No: 161

Question: Infra Red Illumination: What is the inverse square rule?

Answer: The further you get away from the point of illumination, the weaker the illumination becomes. it is inversely proportionate to the square of the distance away from the light. So if you double the distance you will get ¼ of the illumination!

Remember that Infra red light is just like any other illumination, the further you get away from the point of illumination (called the Point source) the weaker the illumination becomes. The level of illumination drops off sharply as the distance increases as it is inversely proportionally to the square of the distance away from the light. So if you double the distance you will get ¼ of the illumination! This is called the "Inverse Square rule".

The inverse square law tells us that the illumination is inversely proportional to the square of the distance between the point source and the surface. This is because infrared light is spread both horizontally and vertically in 2 separate X & Y planes and the area of which (X*Y) is where the illumination is distributed.



This means that if we say point **A** is at 50 metres and point **B** is at 100m, the illumination at **B** will be the ¼ the strength of that at **A** (½ x 2). This is an important rule as if we double the distance again from the point source the illumination would fall to 1/16th (¼ x 4) at such distance.

Please bear this in mind when specifying IR illuminators that the illumination near the light is obviously far, far stronger than at the extremities of its stated range, which is used as a guide only.

What about the angle of the IR-light to the object it's trying to illuminate?

If you have ever used a flash in photography you will be aware that if light hits a surface head on at 90 degrees is reflects back well and can ruin the picture! The lesson here is that the closer to 90 degrees that the illumination hits its target it will illuminate it better. The greater the angle of incidence to the area to be illuminated the weaker the reflected light back in to the CCTV camera. This rule we call the cosine rule. The cosine rule is stated as below:

This CCTV installation tip is aimed at helping you to install CCTV equipment. If you are looking for answers on "how to fit CCTV" or perhaps "how to network a DVR or NVR" or even "how to get CCTV on your mobile phone" why not check out our full range of CCTV installation tips at: **www.systemq.com**

How to guides aim to answer commonly asked questions in a concise and informative manner. They are for advice & guidance only and do not replace any of the manuals or other literature supplied with our products.

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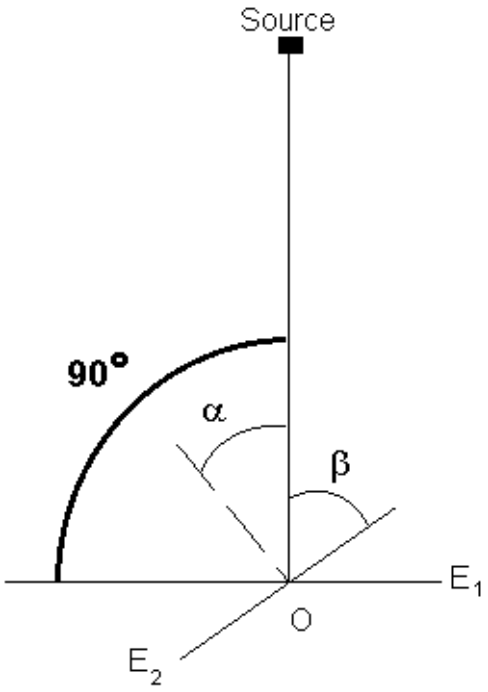

Effective illumination is proportional to the cosine of the angle of incidence of the light on the surface (angle between the direction of the light and the perpendicular to the surface)

Illumination at the O point on surfaces 1 and 2:

$$E_2 = E_1 \cos \alpha = E_1 \sin \beta$$

Here are a few cases:
When the surface is tilted so the angle of illumination is now 70°, the illumination is reduced by a factor of 0.87 i.e. it is now only 87% as good! Similarly 45 degrees reduce the illumination to 71% and so on.

We can use the Cosine law to indicate the loss of effectiveness of the IR lighting as the angle between the light and the object changes.

To summarise

Angle of illumination to subject	Effective power
90°	100%
70°	87%
45°	71%
30°	50%

We can see from the above table that if we start illuminating areas and the infra-red light is at angle to the surface to be illuminated the effective output of the illuminators is cut reducing its distance. Obviously bear this in mind with all system designs.

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