Video Installation Tips

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Understanding and Selecting Lenses

Lens Basics

The camera lens is the front line of the CCTV system. The type of lens used determines what image the camera will capture and transmit to the system monitors and recording equipment. Lenses can be either fixed or varifocal (ie: adjustable) and can have either manual or automatic irises, which in turn control the amount of light passed through to the image sensor of the camera.

The aperture of an auto-iris lens is controlled by signals sent from the camera circuitry which continually samples the light level and adjusts the iris to optimize the picture quality. All CCTV cameras have an automatic electronic shutter (AES) feature whereby the image sensor digitally corrects for changing light levels. Because of this feature, some fixed lens cameras with manual iris are capable of providing good image quality in low light conditions.

Field of View

The area that a CCTV camera sees is known as its Field of View (FOV). The FOV is inversely proportional to the size of lens used. A lens with a focal length of 2.9mm provides a very wide angle viewing area and this angle decreases as the focal length is increased.

As the Lens Chart diagram to the right illustrates, a 2.9mm lens covers an area nearly 62 feet wide at a distance of 25 feet from the camera. A 12mm lens can capture less than 10 feet at the same distance. However the 12mm lens is capturing an image that is six times larger at 25 feet so it provides much greater detail at this distance.

For CCTV applications it is essential to match the focal length of the lens to the desired target.

	Target Distance from Camera (in Feet)			
	5	10	25	100
	Horizontal Width of Target (in feet)			
2.9mm	12.3	24.6	61.5	246
4.3mm	6.1	12.2	30.5	122
6.0mm	3.8	7.6	19.0	76
8.0mm	2.9	4.8	14.5	58
12.0mm	1.9	3.8	9.5	38
16.0mm	1.4	2.8	7.0	28

To determine the approximate vertical distance multiply the width by 0.75

Diagram 1: Lens Selection Chart

Selecting the Correct Focal Length:

1. Measure the distance from camera to the desired target area.
2. Determine the maximum width of the target.
3. Find the lens size on the chart that most closely matches the distance/width measurements.
4. Make a quick calculation if the distance is not on the chart. Ex. Target is 50 feet; a 4.3mm lens will have a horizontal FOV of 61 feet at this range (6.1 ft width at 5 ft. distance multiplied by 10 times the distance).

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Types of CCTV Lenses

Board Camera Lenses

Board camera lenses have a fixed focal length. The iris is also fixed but the camera's AES function does provide some compensation for light changes. Being both small and economical these lenses have popularized many compact dome and bullet style CCTV cameras.

Board CameraLens

Fixed Lenses

Fixed lenses have a set focal length with a manually adjustable iris. Since the introduction of the varifocal lens, fixed lenses have all but disappeared from the CCTV industry.

Fixed Lens

Varifocal Lenses

Varifocal lenses are typically adjusted using set screws so that the installer can focus the camera to capture specific targets within the focal range of the lens. They typically feature an auto-iris that is controlled by a cable connected to the camera. These lenses simplify camera selection and allow for readjustment of the viewing area should the needs of the end user change.

Varifocal Lens

It should be noted that in high vibration environments the adjustment screws on a varifocal lens will loosen causing the camera to lose focus. Fixed lens cameras are recommended for this type of installation.

Motorized Zoom Lenses

Motorized varifocal lenses are most commonly integrated into pan-tilt-zoom (PTZ) cameras and can be remotely controlled to scan large areas and zoom in on specific targets. Motorized zoom lenses provide the greatest range of focal length with some PTZ models providing up to 40X optical zoom. This is usually augmented by digital zoom functions within the operating software for further image magnification.

IR (Infrared) Corrected Lenses

IR light adversely affects the accuracy of color reproduction. IR cut filters are used in all color cameras to correct this problem. But Day/Night cameras (combination color and monochrome) and cameras using IR illumination should be equipped with IR corrected lenses to ensure the scene is accurately focused for the image sensor. This is necessary because the wavelengths of visible light and IR light are different. Using a regular lens on Day/Night or monochrome cameras will result in image distortion.

Look for the next issue of Video Installation Tips: Camera Selection

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