

## Covering All the Angles: CCTV Lens Selection Tools

What do digital and analog CCTV cameras have in common? They all electronically capture images. Capturing images involves the science of optics and light, or to be more specific, the reflection of light. The common component in controlling the process of capturing these images is the camera lens assembly.

In order to capture the image the customer wants, security technicians and salespeople must have a good understanding of how to select the correct lens. How often have you asked a customer, "What are you interested in observing?" and the customer's reply is, "Everything!" We could fill this customer's demanding requirement with pan, tilt and zoom technology; however, this often is not within the budget or practicality of a basic security CCTV system.

It is now our responsibility to select the best camera lens for the observation application.

### Learning Lens Terms

This month, we are going to take a look at some of the tools, both high and low tech, that are available for help in selecting the correct camera lens. Let's start out with some needed CCTV lens terminology and acronyms that will be used with these tools.

**Focal length (FL)** -- The distance from the center of the lens to the pickup device.

**Object distance (OD)** -- The distance from the lens to the object being viewed.

**Camera formats** -- The imager format area of camera. The ranges are 1/4 inch, 1/3 inch, 1/2 inch, 2/3 inch and 1 inch.

**Field of view (FOV)** -- The horizontal and vertical area that is to be viewed.

**Angle of view (AOV)** -- The angular range that can be focused within the image size.

**Depth of field (DOF)** -- The front-to-back zone in a field of view, which



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### BOB'S TIPS

- Increasing the field of view (FOV) decreases the size of images being viewed.
- Never use a lens format size that is larger than the camera image format.
- Camera image format, not lens format dictates angle of view (AOV) and FOV.
- Use the Pythagorean Theorem to calculate true distances for high mounted cameras.
- Confirm customer's view selection with either a viewfinder photo or video recorded view.

is in focus in the camera scene.

In this article, we will mainly be concentrating on the proper viewing angles of a CCTV system. There are other important factors, such as lighting, that should also be seriously considered when specifying lenses.

### Using a Lens Selector Wheel

One of the handiest and most economical CCTV design tools is the lens selector wheel. This circular sliding calculator is a compact, lightweight tool that should be in every CCTV specifier's pocket. These calculators are typically available at no charge from your favorite distributor or CCTV manufacturer.

When looking at a lens selector wheel, you can see there are two adjustable clear plastic screens. The first is a large circular back screen used for selecting the OD and accordingly displaying the FOV values. Second, is a small, clear wedge-shaped screen with camera image format (1/3 inch, 2/3 inch, etc.) selection marks and vertical (V) and horizontal (H) FOV selection marks.

As an example, a customer has

### 35mm to CCTV Focal Length Conversion Chart

35 mm	1/4"	1/3"	1/2"	2/3"	1"	Angle
10	0.9	1.4	1.8	2.5	3.7	120.6
35	3.2	4.8	6.4	8.8	12.8	53.2
60	5.5	8.2	11.0	15.1	22.0	32.6
85	7.7	11.6	15.6	21.3	31.1	23.3
110	10.0	15.1	20.1	27.6	40.3	18.1
135	12.3	18.5	24.7	33.9	49.4	14.8
160	14.6	21.9	29.3	40.2	58.6	12.5
185	16.8	25.3	33.9	46.4	67.7	10.8
210	19.1	28.8	38.4	52.7	76.9	9.5
235	21.4	32.2	43.0	59.0	86.0	8.5
260	23.7	35.6	47.6	65.3	95.2	7.7

CCTV focal length numbers shown converted from a 35mm camera zoom lens.

# Tech Talk

## With Bob Dolph

stated they want to view people in an area 20-feet wide (FOV) and at a distance (OD) of 40 feet from the camera. For starters, we will assume that the lens is for a 1/3-inch camera image format.

In the lens selector wheel (see diagram below), a distance of 40 feet has been selected in the OD window at the bottom of the wheel. This in turn lines up the viewing range numbers (FOV) in the window around the top of the wheel. (Notice the AOV numbers at the very top.)

Holding the OD selection wheel in place at 40 feet, slide the clear plastic wedge-shaped screen so the (H) FOV marker is on 20 feet at the top. Now, holding both movable selectors in place, look to see where the 1/3-inch marker is on the middle focal length (FL) range window. The FL marker indicates that a lens with a focal length of 8.8 mm is needed. The closest lens available is 8 mm.

Readjusting the wheel, an 8mm lens will give a FOV of 22 feet at an OD of 40 feet. This may be close enough;

however, remember that the larger the FOV, the smaller images will appear in the CCTV monitor. When selecting lens formats to match camera formats, remember to select a lens format size equal or larger than the camera format size.

If your customer is not sure of the exact FOV, then take a look at using a varifocal lens, which can be manually adjusted over a range, such as 3.5 mm to 8 mm. Now use your lens selector tools to calculate the FOV range for the varifocal lens.

### Use a Viewfinder to See

Using a lens selector wheel helps in finding the correct lens, but does not give the customer any idea of what they will be seeing. Viewfinders, on the other hand, will help in selecting the correct lens and give a view of the image.

One popular viewfinder is the Computar VM-300 ([www.cbcamerica.com/cctvprod/computar](http://www.cbcamerica.com/cctvprod/computar)). It is an adjustable telescopic device with focal length indicators marked on the viewfinder's

casing. This is a mid-priced professional CCTV tool that is not only very handy but will impress the heck out of your prospects when doing a CCTV survey.

Remember; if, when using a viewfinder, the camera is to be mounted high on a building, use the Pythagorean Theorem ( $C^2 = A^2 + B^2$ ) where the hypotenuse is the true camera OD.

### New Use for 35 mm Cameras

Are you one of the many who have an old 35 mm SLR camera lying around, now that digital photography is so popular? You can take that 35 mm camera, along with a zoom lens, and use it as a recording CCTV lens viewfinder.

To do this, a conversion chart (see diagram on previous page) is needed to cross-reference the 35 mm zoom lens FL to a CCTV lens FL, which will also allow you to estimate AOV).

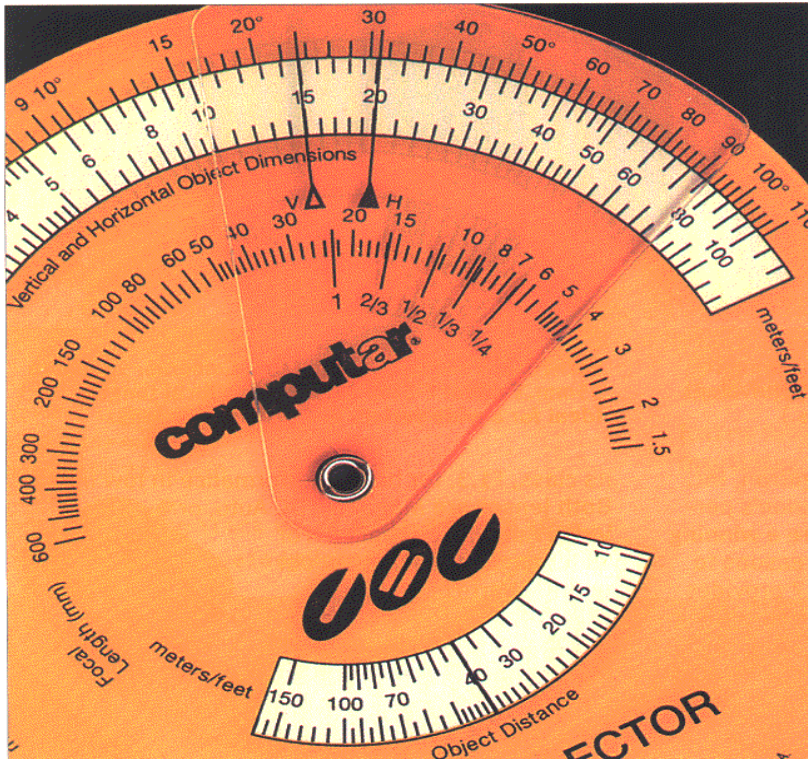
Another advantage in using the camera viewfinder is that a picture of the FOV can be taken for future reference.

### Palm Program Knows Lenses

Get ready, I have saved the best high-tech tool for last. Many sales and even technical personnel are finding the use of a PDA, such as the Palm Pilot, a daily business necessity. If you are looking for more uses for your Palm, then I have found the program for you.

The Palm OS program is called "pCAM". It is a shareware program designed for making CCTV camera lens selections and then graphically viewing them on your handheld PDA screen.

pCAM is a very versatile program for today's CCTV specifier. It will graphically demonstrate FOV, OD, FL and DOF, just to name a few. It will also show the AOV and simulate the size of a person being viewed in the system monitor. There is an option that allows for a customized list of your favorite lens types. This is truly a well thought-out and economical program. The program can be downloaded at [www.davideubank.com](http://www.davideubank.com).



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