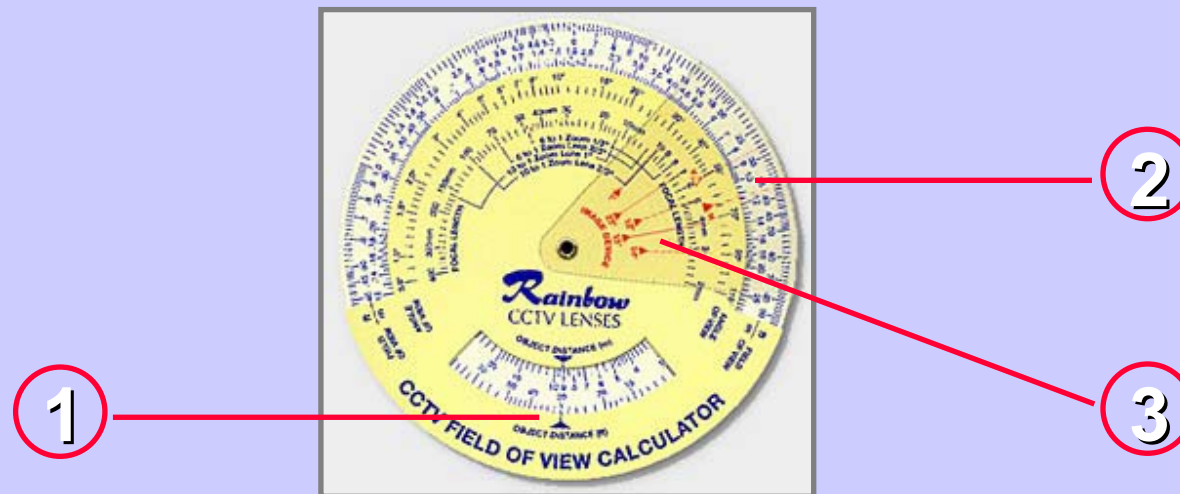


# LENSES

# Lens Selection

- Lenses are the “EYES” of a CCTV system
- Camera specifications are based on certain F-STOP ratings of the lens.
- The lower the F-STOP, the more light a lens will pass to the CCD of the camera.
- Each point increase in F-STOP reduces light available to the CCD by 50%.

# Field of View Calculator



- 1** Set OBJECT DISTANCE arrow at the distance your subject will be from the camera.
- 2** Set the clear plastic so that the desired Horizontal (H) or Vertical (V) view of the subject is correct.
- 3** Now look at the IMAGE DEVICE setting of the camera format you are using to determine the proper lens.

# Lens Terminology

- Focal Length (2.8mm)
- Focus
- F-Stop (F1.3)
- Format
- Mount
- Iris
  - No Iris
  - Manual-Iris
  - Video/DC Auto-Iris
  - Motorized (zoom lens)

## *Fixed*

- Fixed view (3.5mm)
- Focus Ring
- C or CS mount
- Inexpensive
- Available in:
  - No Iris, Manual Iris,  
Auto-Iris (Video or DC)

## *Vari-Focal*

- Lens which gives you variable focal lengths (ex. 3.3mm-8mm)
- Must be re-focused after changing focal length
- Allows you to stock/carry fewer lenses

# *Zoom*

Gives you variable focal lengths

Maintains focus while changing focal lengths (tracking)

Zoom lenses generally have motorized zoom, focus, and iris functions. These are controlled by the lens controller.

# Example of Zooms And Their Ratios

<i>Format</i>	<i>Starting Focal Length</i>	<i>Ending Focal Length</i>	<i>Zoom Ratio</i>
<b>1/3"</b>	6.5mm	39mm	<b>6X</b>
	6mm	60mm	<b>10X</b>
<b>1/2"</b>	8mm	48mm	<b>6X</b>
	8mm	80mm	<b>10X</b>
<b>2/3"</b>	11.5mm	69mm	<b>6X</b>
	10mm	100mm	<b>10X</b>
	9.5mm	152mm	<b>16X</b>
<b>1"</b>	16mm	160mm	<b>10X</b>

# Back Focus Procedure

- 1. Determine the lens and camera mount types are compatible. CS-mount to CS-mount, or C-mount to C-mount. C-mount lenses can be mounted on CS-mount cameras by using a 5mm adapter normally supplied with the camera (some cameras have a lens mount adjustable between C and CS).**
- 2. Set up subject or test pattern 25 feet or more away from the camera. If this is not possible, choose the farthest object from the camera.**
- 3. *Important*, set the iris at wide open. This can be achieved by adjusting the lens iris ring (manual iris), lens Level control (Video type lens), or camera Level control (DC type lens). If the scene is too bright reduce illumination or use a filter to reduce the amount of light coming into the lens or if the camera has an Automatic Electronic Shutter, temporarily turn this on. If the iris is not set all the way open, objects that are in focus during the day may fall out of focus during nighttime viewing.**
- 4. Adjust the focus at extreme far.**
- 5. Adjust the zoom to extreme wide angle.**

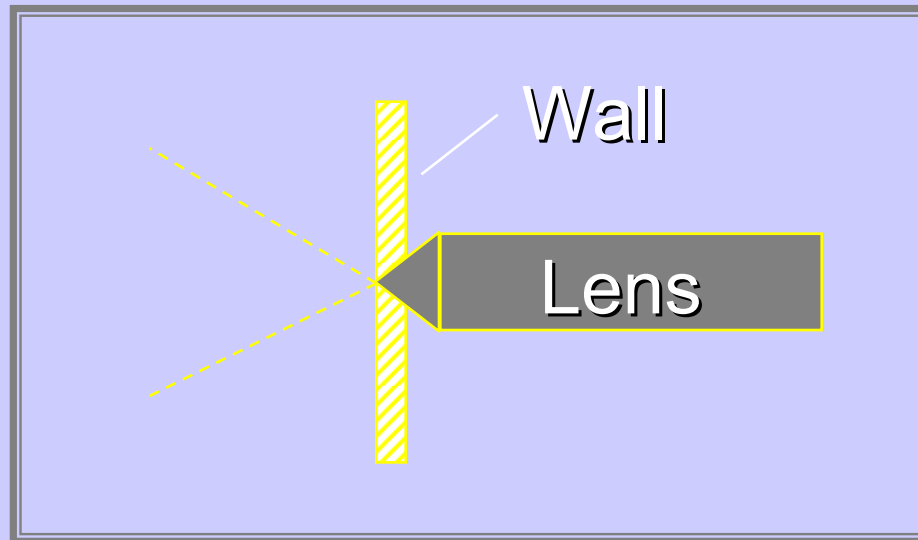
**continued next slide...**

# Back Focus Procedure

6. **Camera backfocus adjustment is achieved by adjusting one of the following: A rotating lens mount held by a set screw(s), an adjustable ring to move the pick-up device back and forth, or a back focus screw on the camera.**
7. **Adjust the back focus to obtain a clear picture.**
8. **Adjust the zoom to extreme telephoto.**
9. **Using the lens controller, adjust the lens for best focus.**  
***Do not adjust the camera!***
10. **Adjust lens back to extreme wide angle.**
11. **Readjust the camera for a clear picture if necessary.**
12. **Tighten the pick-up device or camera lens mount set screw to ensure it does not change position. If you turned the Automatic Electronic Shutter on, *turn this off*. Adjust the Level control back for a good picture.**
13. **Focus should remain clear throughout the zoom range.**

# *Pinhole*

- Covert Applications
- High F-stop (needs good light)
- Needs only a very small hole to see through (.06 to .25 inches)
- Straight or right angle, manual or auto iris



# *Aspherical Lenses*

- Low F-stop (F.75 to F 1.0)
- Perfect for outdoor low light applications
- Can eliminate need for additional lighting
- Expensive vs. conventional lenses

## *Color Corrected Lenses*

- Required for use with color cameras
- Without Color corrected optics, all colors of the light spectrum will pass through the lens but will not focus at the same point of the image plane (Chromatic Aberration)
- Coated with special material to allow light spectrum to focus at the same point on the image plane
- Available on most manufacturers lenses

# Types of Iris Mechanisms

- No Iris
- Manual Iris
- DC Auto-Iris
- Video Auto-Iris
- Motorized Iris

# Using No Iris vs. Manual Iris

- **No Iris**

- Indoor use
- Lower cost
- Camera must have Automatic Electronic Shutter (AES)
- Limited depth of focus

- **Manual Iris**

- Indoor use
- Better depth of focus (better picture quality)
- Can be used outdoors with cameras with AES

# Using Video or DC Auto-Iris

- **Video Auto-Iris**

- Indoor/Outdoor use
- Higher cost
- Wider range for changing light levels
- Circuit to control iris is located in lens

- **DC Auto-Iris**

*Same benefits as Video type except:*

- Lower cost than Video Type
- Circuit to control iris is located in camera
- Easy set-up (Plug and Play)

# Motorized Iris (Zoom Lens)

- Indoor use
- Allows manual control for changing light levels
- Ability to drive iris farther open or closed than auto-iris circuit would allow

# Example of Focal Lengths Available

## 1/3" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
2.8mm	85°	Super-Wide angle
4mm	60°	Wide angle
8mm	30°	Standard
6.5-39mm	40.5° - 7°	Variable from wide angle to telephoto (Zoom lens)

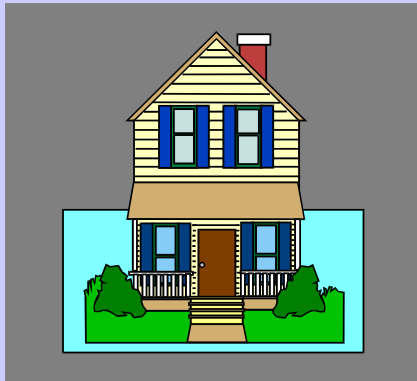
## 1/2" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
3.5mm	85°	Super-Wide angle
6mm	56°	Wide angle
12mm	30°	Standard
8-48mm	43.6° - 7.7°	Variable from wide angle to telephoto (Zoom lens)

# Format Comparison

*“A Focal Length Is A Focal Length”*

**- 12mm Lens -**



1" Camera



1/2" Camera



1/3" Camera

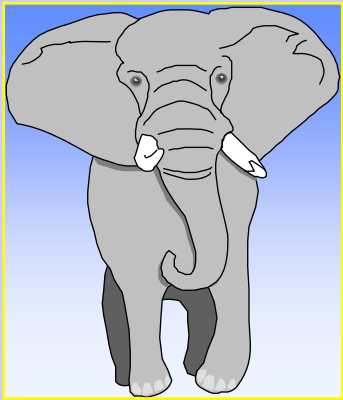
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**The Field Of View, *not the focal length,*  
will change depending on the  
format of the camera**

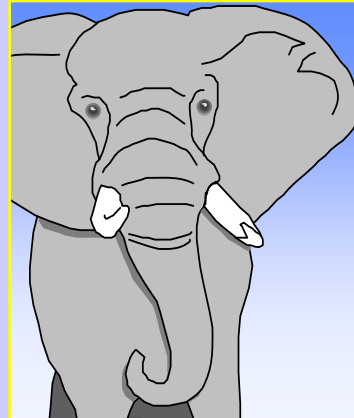
# Format Comparison

*“A Focal Length Is A Focal Length”*

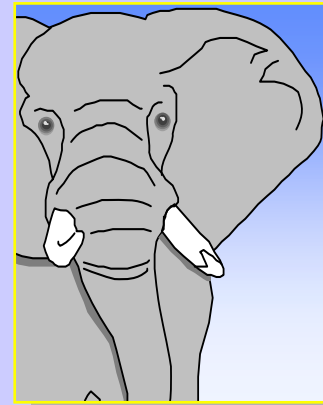
**- 16mm Lens -**



1" Camera



1/2" Camera



1/3" Camera

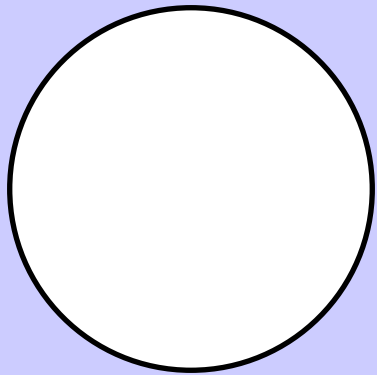
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**The Field Of View, *not the focal length,*  
will change depending on the  
format of the camera**

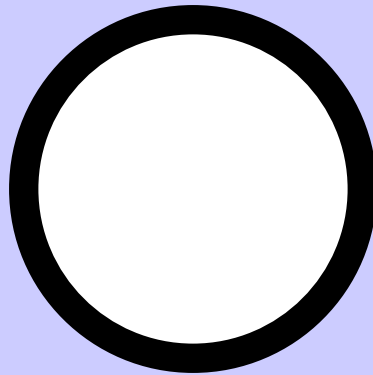
# Definition of F-Stops

- F-Stop is a ratio of focal length divided by maximum aperture
- The lower the F-Stop number, the more light or faster the lens.
- The higher the F-Stop number, the less light or slower the lens.
- Each single F-Stop increase produces a 50% reduction of illumination to the camera sensor (F1.0 to F2.0)
- The speed of a lens relates to how well the lens can pass light.

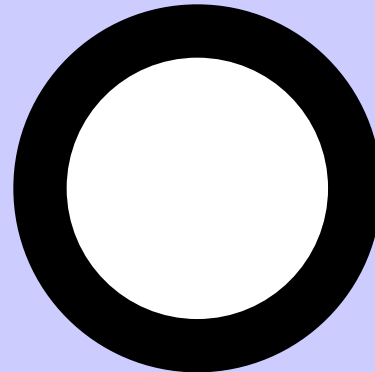
# Iris Opening at Various F-Stops



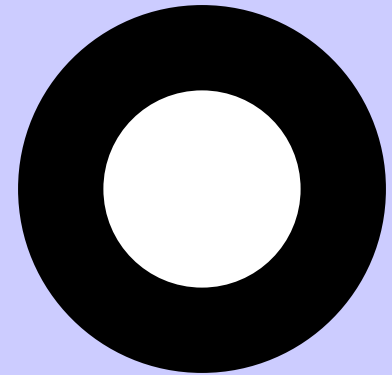
**F/1.4**



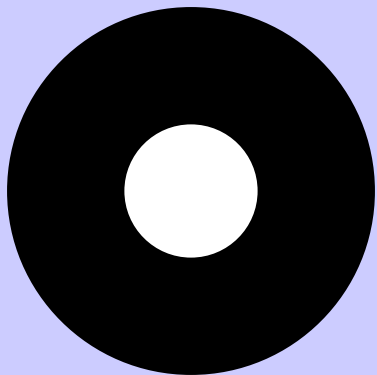
**F/2**



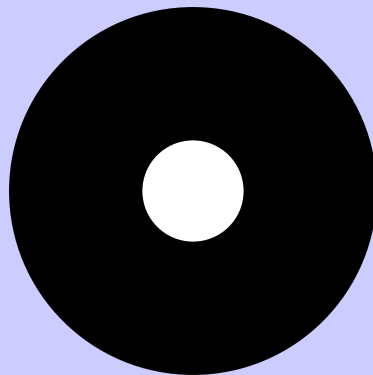
**F/2.8**



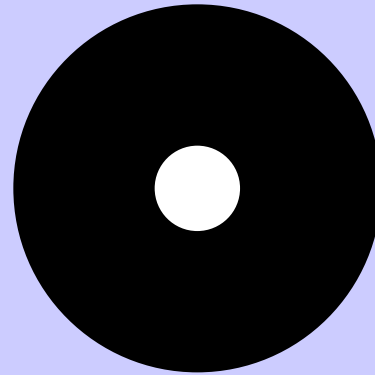
**F/4**



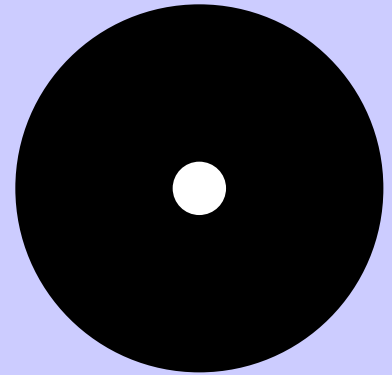
**F/5.6**



**F/8**



**F/11**



**F/16**

# Zoom Lenses and Their Ratios

<i>Format</i>	<i>Starting Focal Length</i>	<i>Ending Focal Length</i>	<i>Zoom Ratio</i>
<b><i>1/3"</i></b>	6.5mm	39mm	<b>6X</b>
	6mm	60mm	<b>10X</b>
<b><i>1/2"</i></b>	8mm	48mm	<b>6X</b>
	8mm	80mm	<b>10X</b>
<b><i>2/3"</i></b>	11.5mm	69mm	<b>6X</b>
	10mm	100mm	<b>10X</b>
	9.5mm	152mm	<b>16X</b>
<b><i>1"</i></b>	16mm	160mm	<b>10X</b>

# Focal Length Comparison

## 1/3" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
2.8mm	85°	Super-Wide angle
4mm	60°	Wide angle
8mm	30°	Standard
6.5-39mm	40.5° - 7°	Variable from wide angle to telephoto (Zoom lens)

## 1/2" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
3.5mm	85°	Super-Wide angle
6mm	56°	Wide angle
12mm	30°	Standard
8-48mm	43.6° - 7.7°	Variable from wide angle to telephoto (Zoom lens)

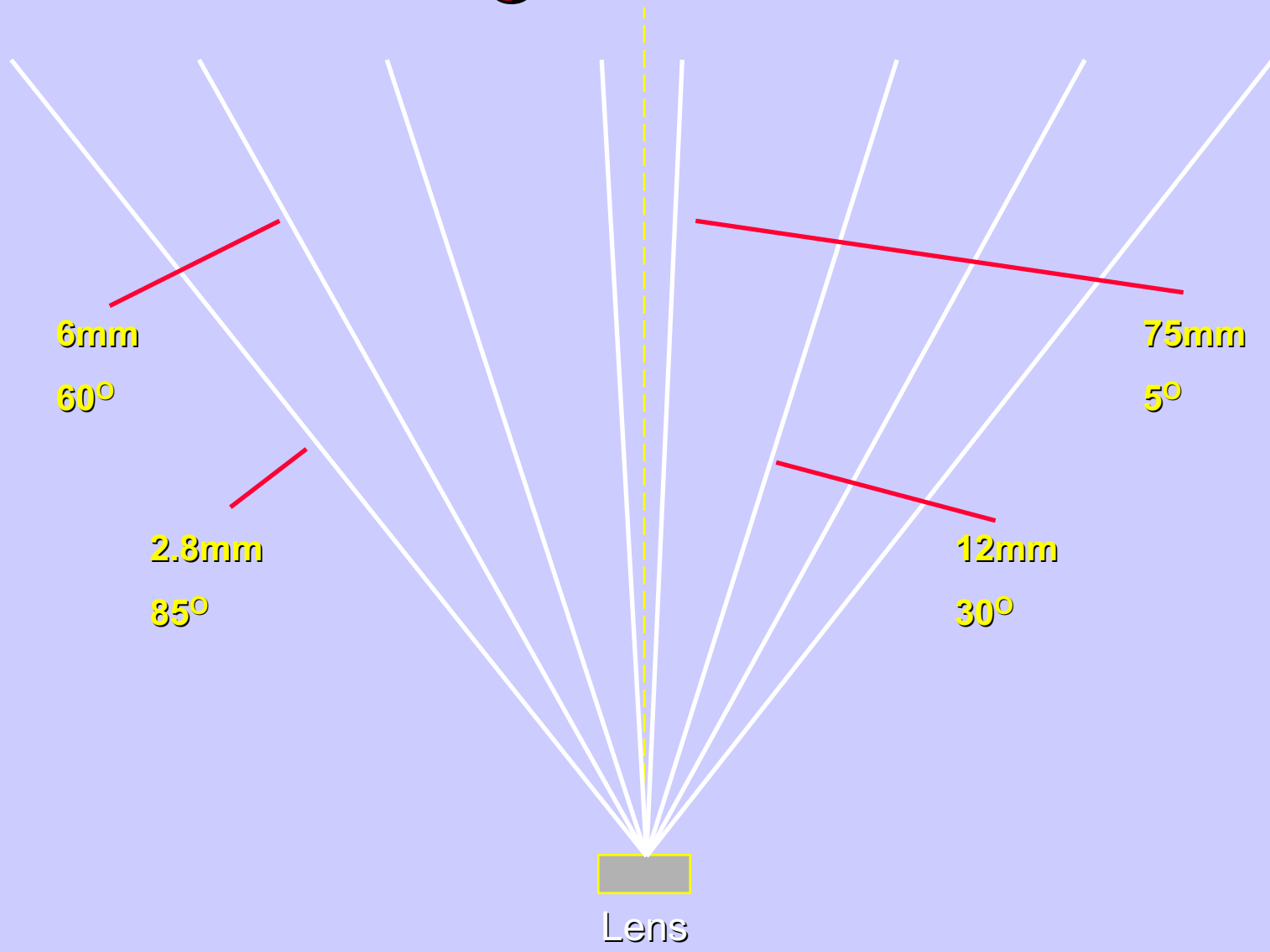
## 2/3" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
4.8mm	85°	Super-Wide angle
8mm	58°	Wide angle
16mm	30°	Standard
10-100mm	47.5° - 5°	Variable from wide angle to telephoto (Zoom lens)

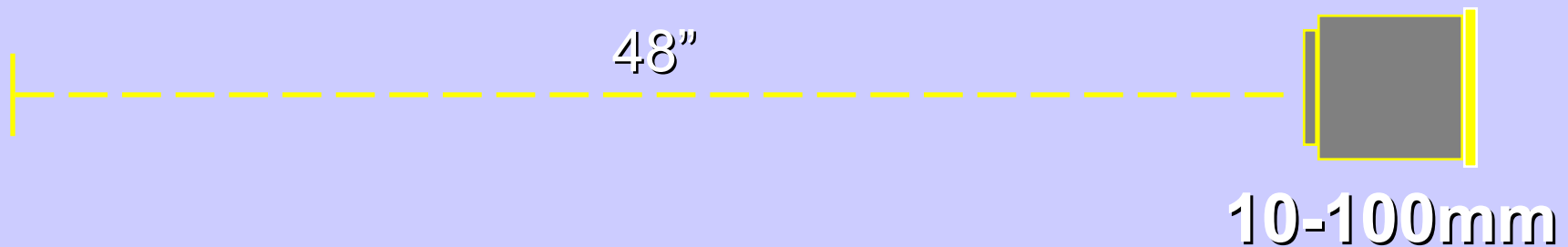
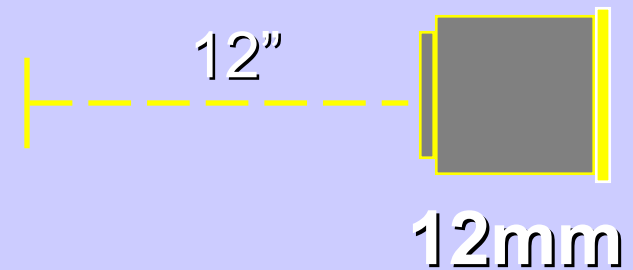
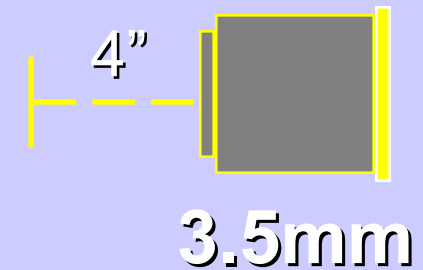
## 1" FORMAT

<u>FOCAL LENGTH</u>	<u>ANGLE OF VIEW</u>	<u>DESCRIPTION</u>
8.5mm	80°	Super-Wide angle
12.5mm	54°	Wide angle
25mm	29°	Standard
16-160mm	43° - 4.6°	Variable from wide angle to telephoto (Zoom lens)

# Angle of View



# Minimum Object Distance (M.O.D.)



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**Lens will not focus below the Minimum Object Distance**