Theory and formulation for approximating focal distance of a system

The correct focal length of a lens for an application can be calculated very easily using one of the two formulas:

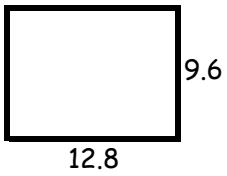
$$\text{Focal Length} = \frac{\text{FDH X distance (sensor to specimen)}}{\text{height of specimen}}$$

$$\text{Focal Length} = \frac{\text{FDW X distance (sensor to specimen)}}{\text{width of specimen}}$$

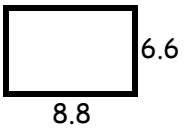
where FDH represents the format dimension height and FDW represents format dimension width.

The image sensor in the camera is a rectangle. Therefore, the height and width (in millimeters) of the rectangle for each sensor format is:

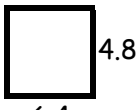
1 inch format



2/3 inch format

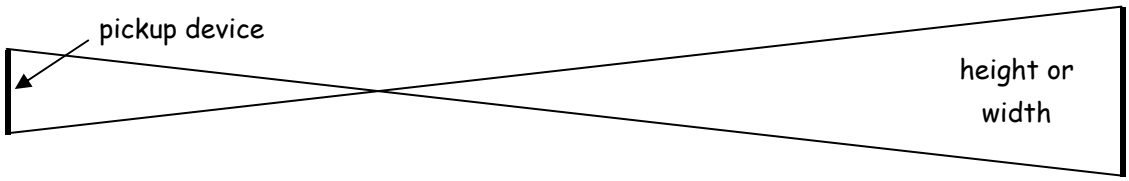


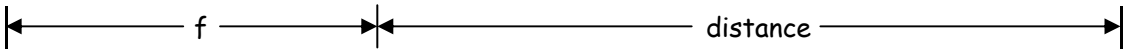
1/2 inch format



1/3 inch format

NOTE: You do not have to remember the following diagram as long as you remember how to use the two formulas above.





1 INCH FORMAT LENS

$$\text{focal length (f)} = \frac{9.6 \times (\text{distance})}{(\text{height})}$$

$$\text{focal length (f)} = \frac{12.8 \times (\text{distance})}{(\text{width})}$$

2/3 INCH FORMAT LENS

$$\text{focal length (f)} = \frac{6.6 \times (\text{distance})}{(\text{height})}$$

$$\text{focal length (f)} = \frac{8.8 \times (\text{distance})}{(\text{width})}$$

1/2 INCH FORMAT LENS

$$\text{focal length (f)} = \frac{4.8 \times (\text{distance})}{(\text{height})}$$

$$\text{focal length (f)} = \frac{6.4 \times (\text{distance})}{(\text{width})}$$

1/3 INCH FORMAT LENS

$$\text{focal length (f)} = \frac{3.6 \times (\text{distance})}{(\text{height})}$$

$$\text{focal length (f)} = \frac{4.8 \times (\text{distance})}{(\text{width})}$$