Sam Noble Museum

Imaging Station Set-up And Configuration

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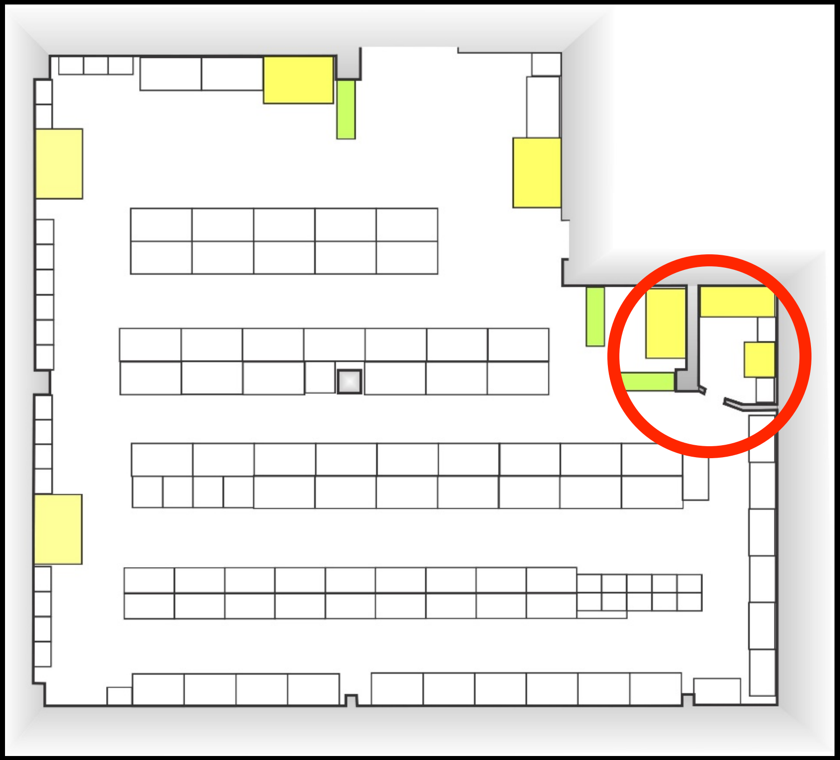
Imaging Stations have few essential needs:

- **A flat working area such as a desk or table.**
- **A layout area for staging specimens or supplemental materials.**
- **Digital camera and lenses.**
- **Copy stand.**
- **Lighting.**
- **Computer.**

Imaging Station Location:

- **Secure with easy access but not in high traffic areas.**
- **Lighting and power.**
- **Ethernet or wireless access.**
- **Climate control (HVAC and humidity).**



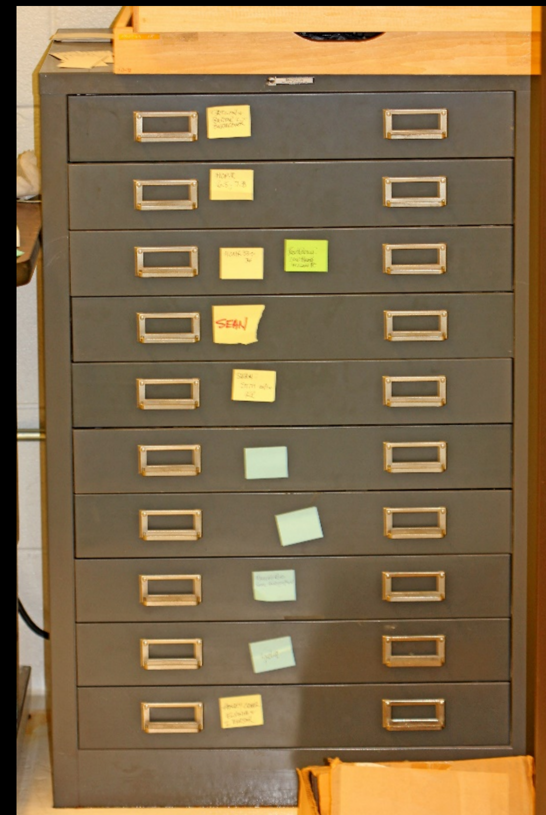
The primary imaging room has a door that can be closed, separate lighting and independent humidity controls.

The secondary imaging area is configured for less environmentaly sensitive objects.

Sturdy tables or desks are a must. They should be leveled and have sufficient space for the copy stand, lights, and computer.

Folding tables should be considered temporary at best. These are rarely adequately sturdy and put specimens and equipment at risk.

Sturdy tables are used for layout. If space is at a premium, or if specimens need special care, storage cases in the imaging area are used. If specimens are moved between rooms, wheeled carts or cases are used.

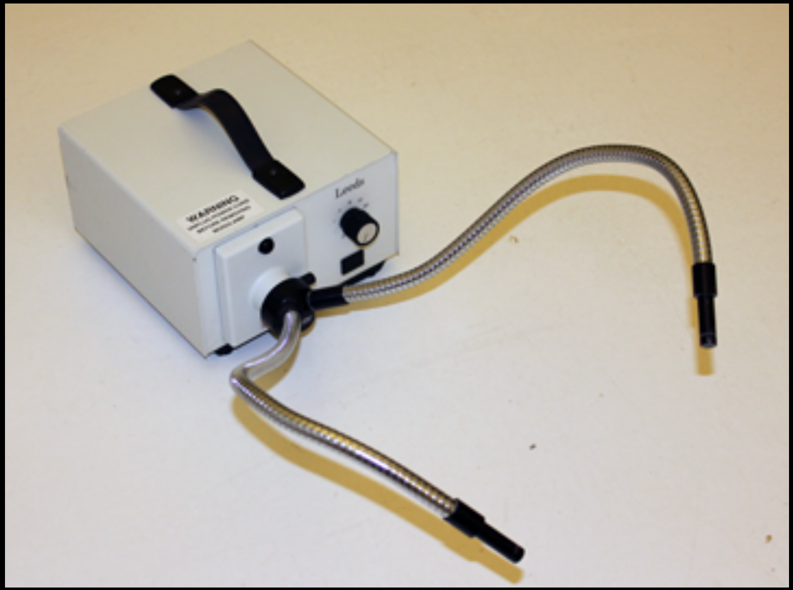


Camera and lens choices are vast. We started with what the collection already had, repurposed existing equipment, and added components and upgrades as needed.

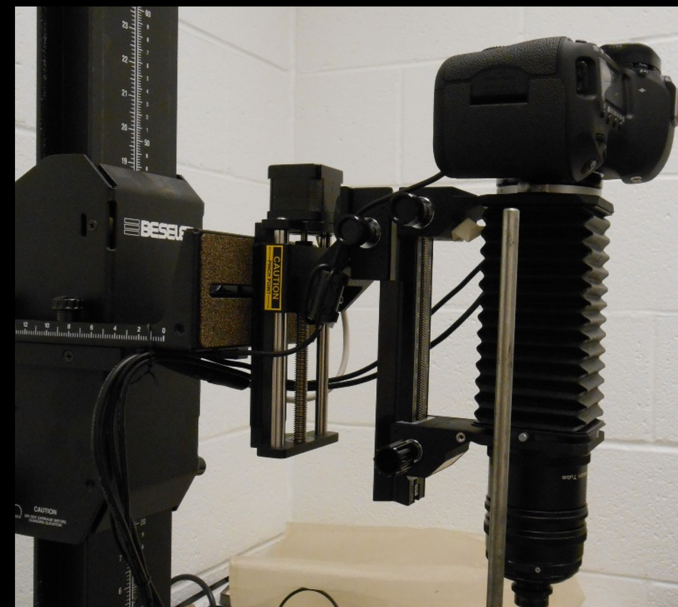
The copy stand should be heavy duty, typically ones made for supporting a medium to large format camera with a 36-inch square or “H” rail and a hand crank with adjustable tension and the ability to level to base.

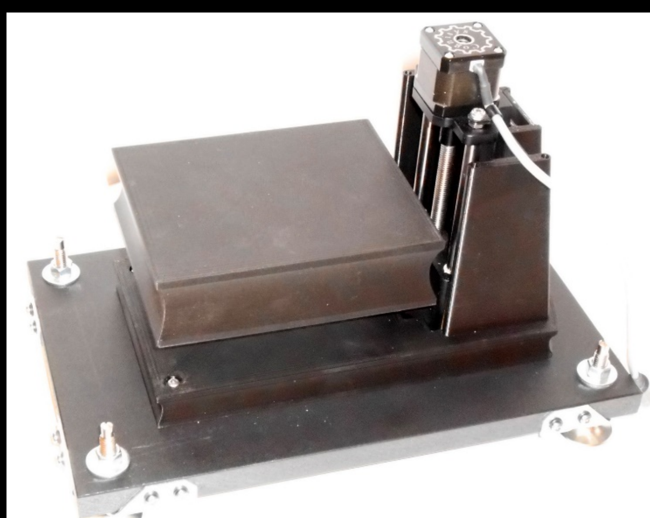
Lighting is a critical element for accurate and useful imaging. Lighting should be tailored to your unique needs and based on color accuracy, specimen size, and materials. Shutting out ambient light via a separate room or the use of curtains may be in order, especially if infrared, ultraviolet, polarized, or other specialized lighting is needed.

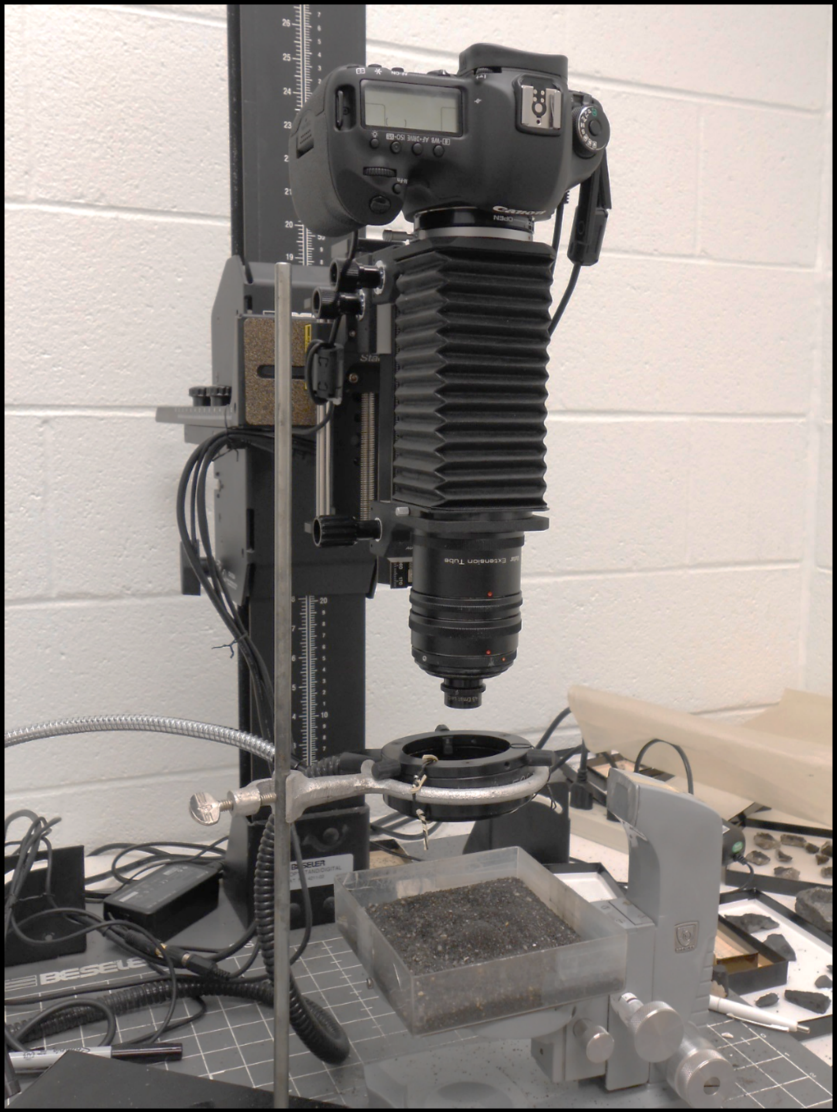
If much of your imaging is in gray-scale (black and white imaging), lighting typically associated with dissection microscopes can be used. These can provide a wide range of lighting possibilities. With the proper attachments, they can also be used for transmitted light.



Accessories to assist in layout, focus, and stacking images may be desired.



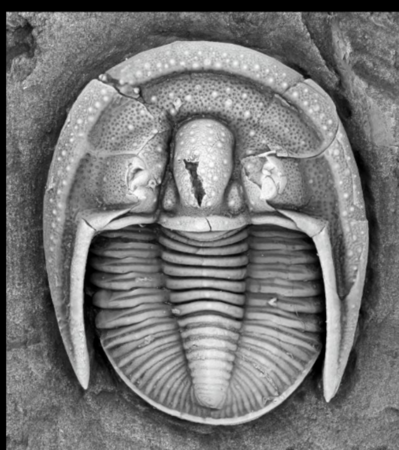




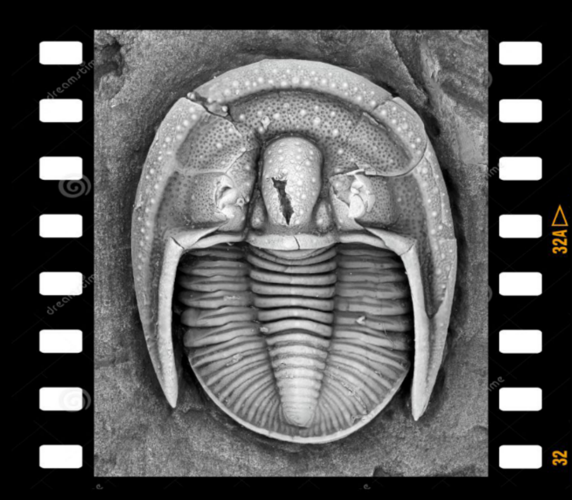
What is essentially assembled is a moden version of a classic macrophotography system.

Before getting too deep into this, a few important concepts:

Macro lenses are defined by the ability to produce 1:1 (or greater) images. So, the image on the film is the same size as the actual object. This holds true for full-frame sensors.



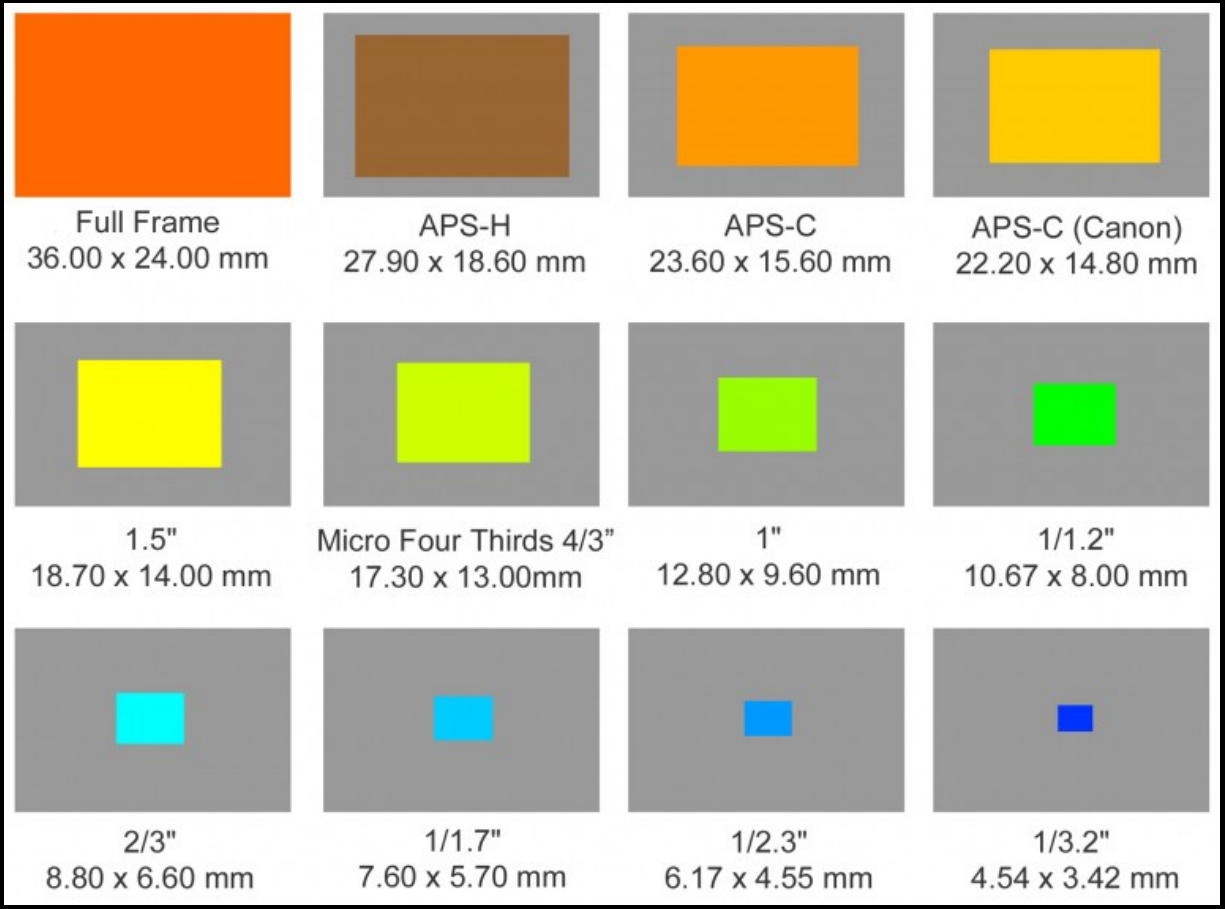
Object



35-mm film

Full frame sensor

The same does not hold true for various sensor sizes!



Full frame sensor

This is an example of what would be captured by three camera bodies with identical megapixel counts using the same lens, from the same location.

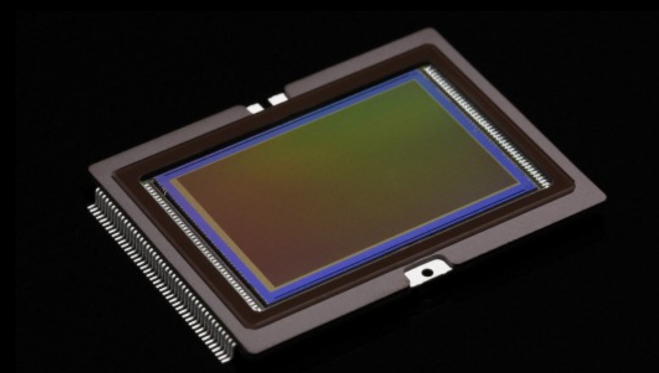
APS-C (Canon) sensor

Micro 4/3 sensor

Why calibrate your imaging system?

Some practical advice.

Calibration helps determine the performance of various lenses in combination with the performance of the image sensor.



This involves experimentation.

The first step regards the camera or camera body itself:

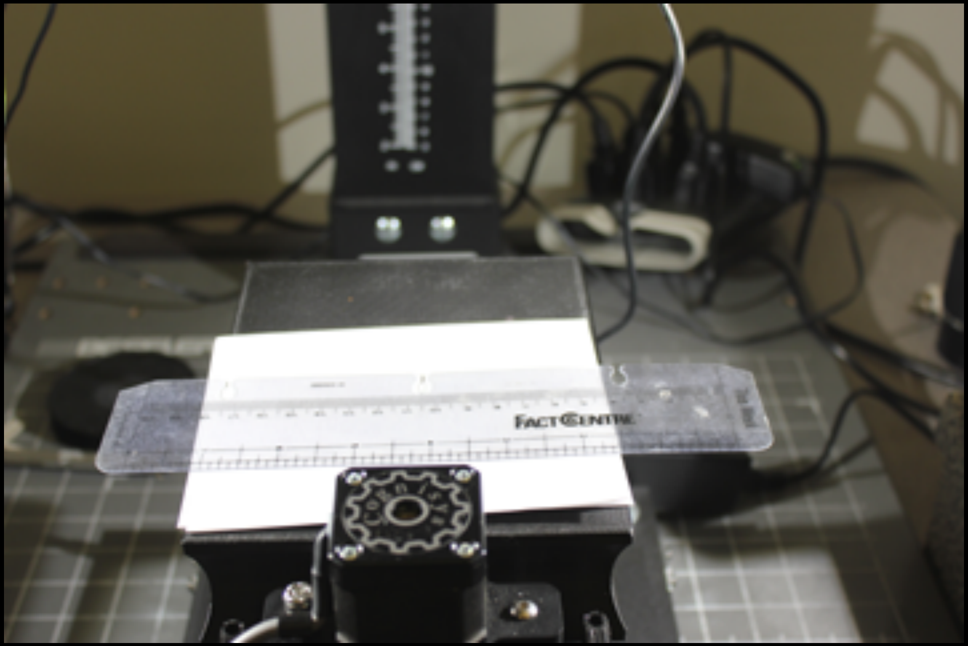
In the camera settings:

- **Set the camera mode to "Manual"**
- **Turn off all pre- or post-processing filters, including AA filters.**
- **Check the exposure compensation, it should be set to "0" or "none".**
- **Set the ISO to 100.**
- **Turn off Autofocus and Image Stabilization**

Locate suitable targets for the initial calibration

- **Scale, in millimeters, high magnification will require a stage micrometer.**
- **Millimeter scale mounted at a 45 degree angle.**

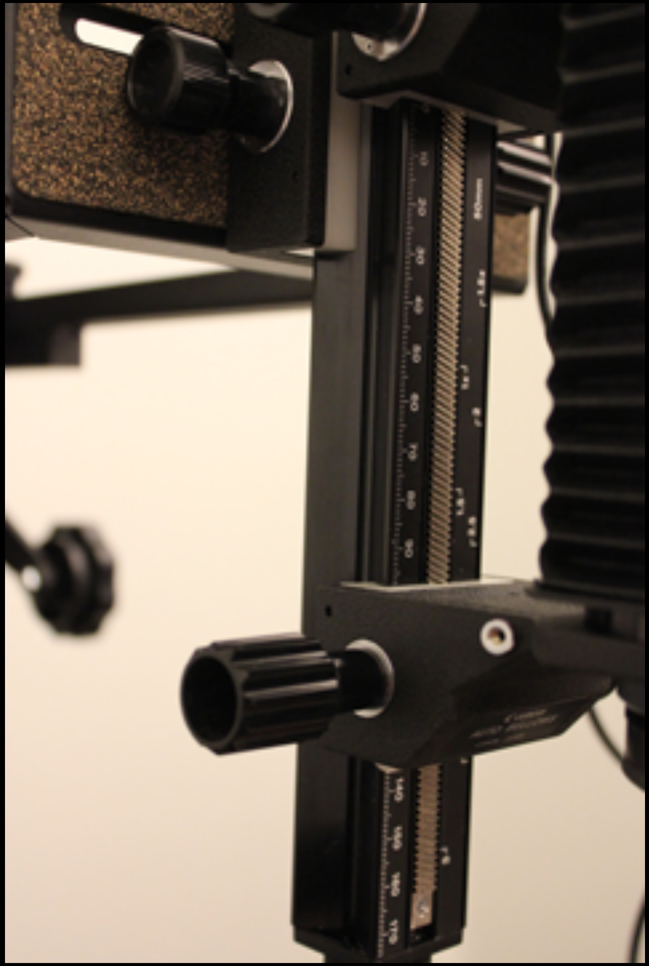
Calibrating the final magnification* of a lens/sensor combination:



***The final magnification is a 600dpi image.**

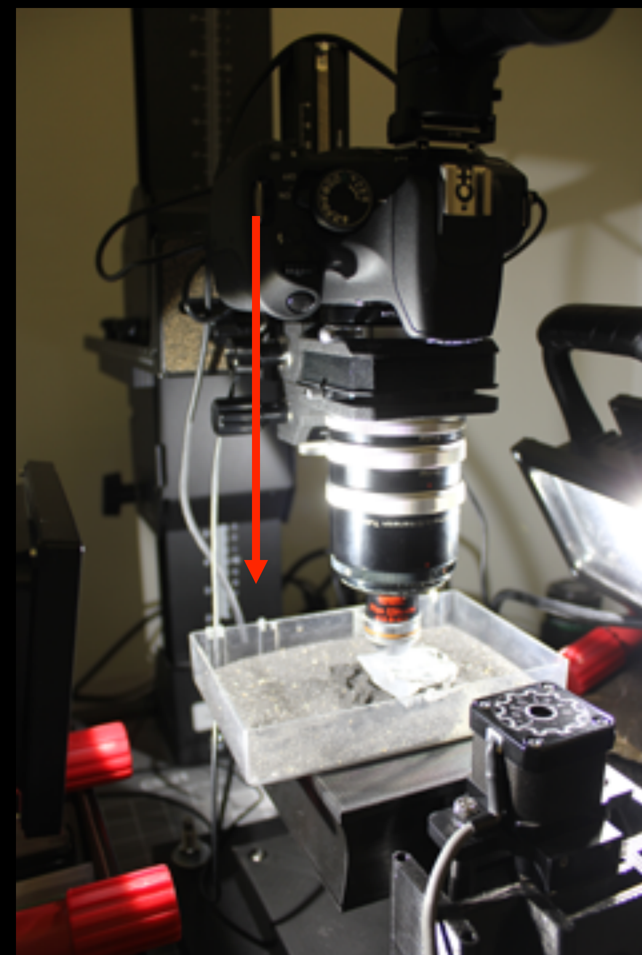
For a “standard or macro lens” first make sure the lens apature is wide open and take an image of a scale at the highest, middle and lowest “focusable” copy stand position. Note the copy stand scale position (always reading from the same location on the copy stand).

A similar method is used for bellows mounted lenses: first take an image of a scale at the highest, middle and lowest "focusable" bellows position. Note the bellows scale position (always reading from the same location).



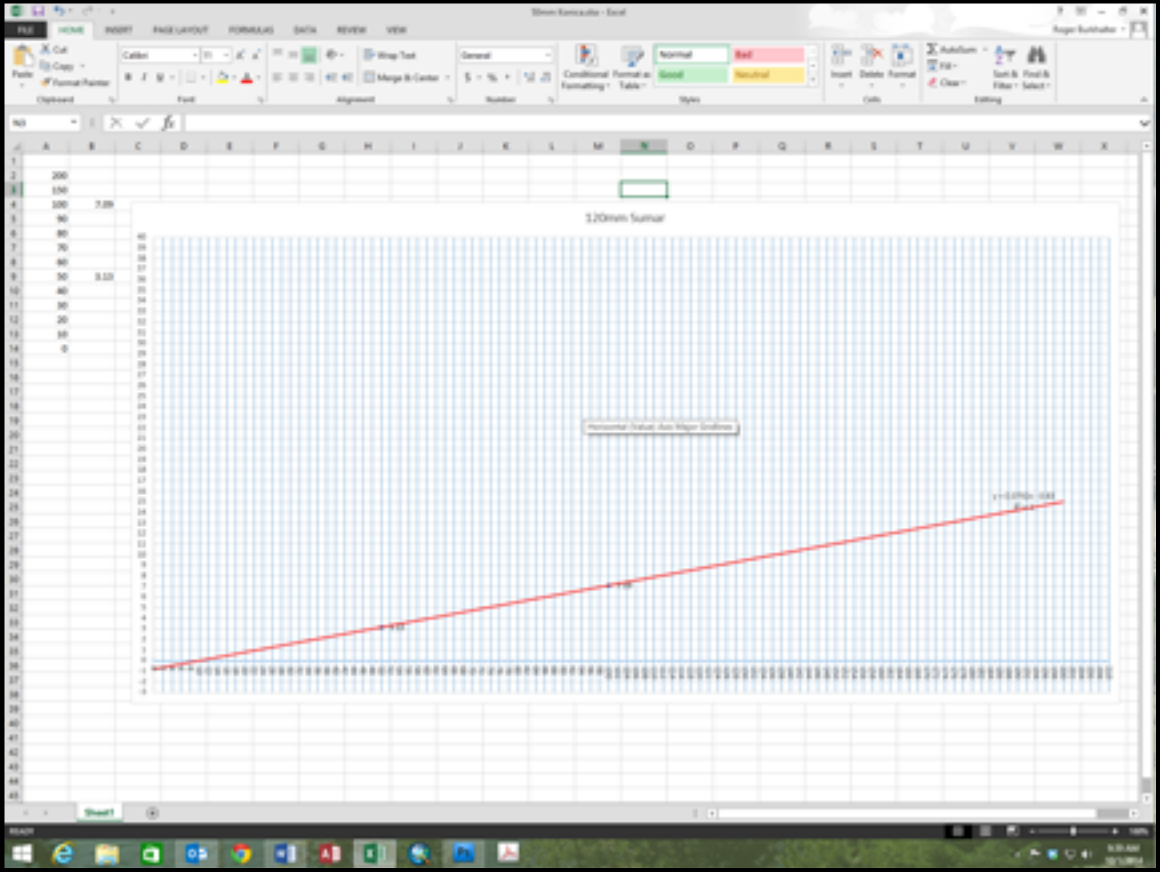
Various bellows lenses from a Leica Aristophot with adapters.

Microscope objective lenses require a slightly different setup for calibration. Determine the focal length of the lens, marked on the lens. Extend the lens from the sensor plain of the camera to that distance, minus 10mm. Take an initial calibration image.



Repeat for each lens that needs to be calibrated. Open the images in the image-editing software you will be using, convert each image to 600dpi WITHOUT RESAMPLING , make sure your ruler units are in an appropriate scale (cm or mm), using the measuring tool in the image editing software, measure the scale. Note the measurement obtained.

Transfer those measurements into a spreadsheet and plot a scatter chart for each lens. Place a tren line on the chart. Note the linear relationship between the (in this case) bellows extension and the magnification.



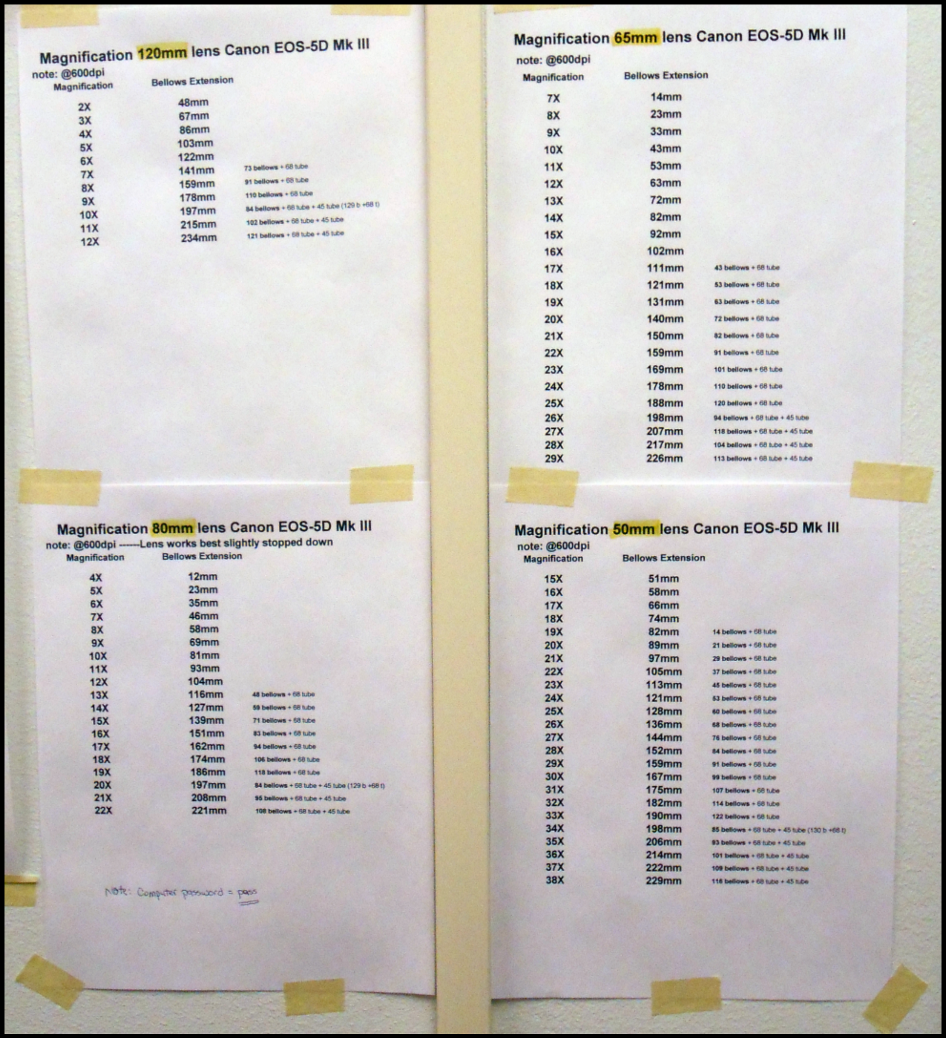
Those readings are then used to creat a chart of possible magnifications possible with a particular lens on that particular camera. The tren line formula can also be used, solving for x.

$y = 0.0792x – 0.83$

$y + 0.83/0.0792 = x$

example if $y = 10$ then $10 + 0.83/0.0792 = 136.74$

Lens/bellows extension Tables



Magnification 120mm lens Canon EOS-5D Mk III

note: @600dpi

Magnification	Bellows Extension	
2X	48mm	
3X	67mm	
4X	86mm	
5X	103mm	
6X	122mm	
7X	141mm	73 bellows + 68 tube
8X	159mm	91 bellows + 68 tube
9X	178mm	110 bellows + 68 tube
10X	197mm	84 bellows + 68 tube + 45 tube (129 b +68 t)
11X	215mm	102 bellows + 68 tube + 45 tube
12X	234mm	121 bellows + 68 tube + 45 tube

Magnification 65mm lens Canon EOS-5D Mk III

note: @600dpi

Magnification	Bellows Extension	
7X	14mm	
8X	23mm	
9X	33mm	
10X	43mm	
11X	53mm	
12X	63mm	
13X	72mm	
14X	82mm	
15X	92mm	
16X	102mm	
17X	111mm	43 bellows + 68 tube
18X	121mm	53 bellows + 68 tube
19X	131mm	63 bellows + 68 tube
20X	140mm	72 bellows + 68 tube
21X	150mm	82 bellows + 68 tube
22X	159mm	91 bellows + 68 tube
23X	169mm	101 bellows + 68 tube
24X	178mm	110 bellows + 68 tube
25X	188mm	120 bellows + 68 tube
26X	198mm	94 bellows + 68 tube + 45 tube
27X	207mm	118 bellows + 68 tube + 45 tube
28X	217mm	104 bellows + 68 tube + 45 tube
29X	226mm	113 bellows + 68 tube + 45 tube

Magnification 80mm lens Canon EOS-5D Mk III

note: @600dpi ------Lens works best slightly stopped down

Magnification	Bellows Extension	
4X	12mm	
5X	23mm	
6X	35mm	
7X	46mm	
8X	58mm	
9X	69mm	
10X	81mm	
11X	93mm	
12X	104mm	
13X	116mm	48 bellows + 68 tube
14X	127mm	59 bellows + 68 tube
15X	139mm	71 bellows + 68 tube
16X	151mm	83 bellows + 68 tube
17X	162mm	94 bellows + 68 tube
18X	174mm	106 bellows + 68 tube
19X	186mm	118 bellows + 68 tube
20X	197mm	84 bellows + 68 tube + 45 tube (129 b +68 t)
21X	208mm	95 bellows + 68 tube + 45 tube
22X	221mm	108 bellows + 68 tube + 45 tube

Note: Computer password = pass

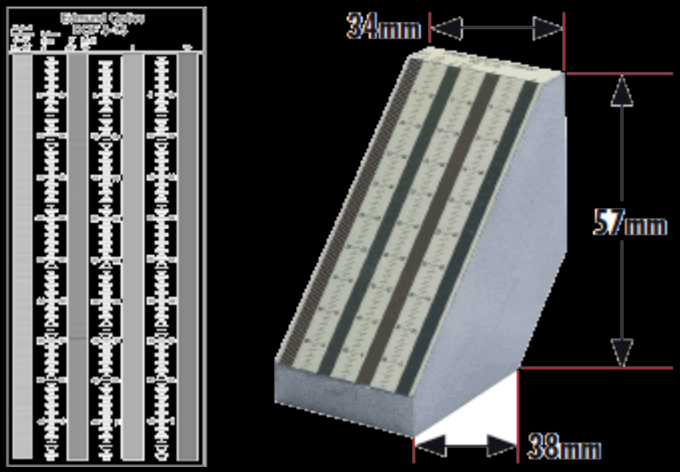
Magnification 50mm lens Canon EOS-5D Mk III

note: @600dpi

Magnification	Bellows Extension	
15X	51mm	
16X	58mm	
17X	66mm	
18X	74mm	
19X	82mm	14 bellows + 68 tube
20X	89mm	21 bellows + 68 tube
21X	97mm	29 bellows + 68 tube
22X	105mm	37 bellows + 68 tube
23X	113mm	45 bellows + 68 tube
24X	121mm	53 bellows + 68 tube
25X	128mm	60 bellows + 68 tube
26X	136mm	68 bellows + 68 tube
27X	144mm	76 bellows + 68 tube
28X	152mm	84 bellows + 68 tube
29X	159mm	91 bellows + 68 tube
30X	167mm	99 bellows + 68 tube
31X	175mm	107 bellows + 68 tube
32X	182mm	114 bellows + 68 tube
33X	190mm	122 bellows + 68 tube
34X	198mm	85 bellows + 68 tube + 45 tube (130 b +68 t)
35X	206mm	93 bellows + 68 tube + 45 tube
36X	214mm	101 bellows + 68 tube + 45 tube
37X	222mm	109 bellows + 68 tube + 45 tube
38X	229mm	116 bellows + 68 tube + 45 tube

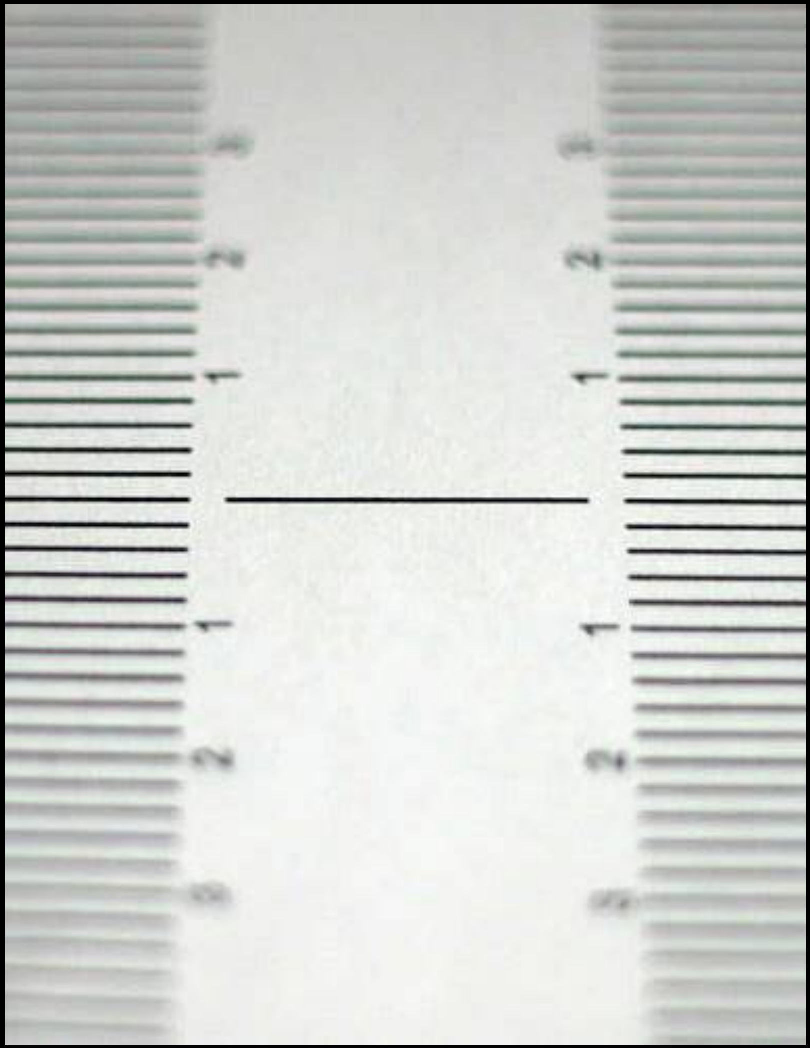
Calibrating the depth of field:

The Depth of Field can be determined by using a commercially available target or using a mm scale bar mounted on a 45-degree slope.



Commercial Depth of Field target

Using the magnification table just created, set the camera/lens combination at the highest magnification and shoot a series of images of the target at different aperture settings, from wide open to fully closed.



If using a scale bar, note that because it is mounted at a 45-degree angle, each mm is actually ~0.7mm. Count the mm in focus to determine the Depth of Field for that lens at that aperture. Use this as a guide in stacking distance determination.

Additional Calibration:

Calibrate for each lens at various magnification and apurature settings.

- **Overall lens “sharpness”.**
- **Spherical aberration.**
- **Color aberration.**
- **Color correction.**
- **White Balance.**