


Lenses 101

PROBABLY MORE
THAN YOU REALLY
WANTED TO KNOW
ABOUT LENSES


What Lens Should I Buy?

Canon EF Lenses
Limited only by your imagination.


Zoom Lenses




Single Focal Length Lenses




TS-E Lenses




Extenders



Extension Tubes



Close-Up Lenses



The image displays a comprehensive collection of Canon EF lenses, categorized into Zoom Lenses, Single Focal Length Lenses, TS-E Lenses, Extenders, Extension Tubes, and Close-Up Lenses. Each lens is shown with its model number and specifications.

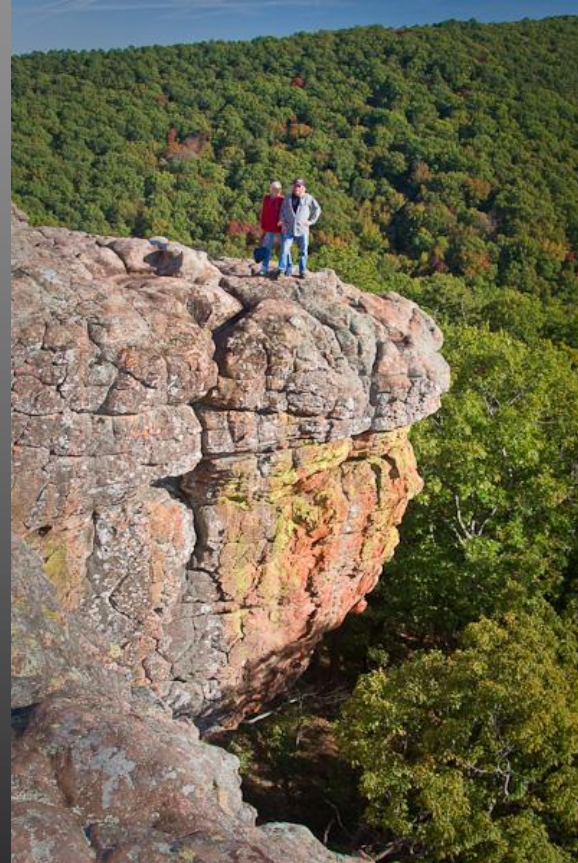
What exactly are you going to be photographing?

- Your photographic goals and objectives essentially inform all of the other decisions.
- Will you be shooting
 - Landscapes?
 - Portraits?
 - Your kids or pets?
 - Flowers?
 - Wild birds?
 - Sports?
 - Architecture?
 - Will you be doing travel photography?
 - Will you be hiking with your gear?
- These sorts of questions are critical to ask yourself first.



How much money do you want to spend?

- You can spend huge amounts of money on lenses, so determining your budget, as with cameras, is pretty important.



Do you want a prime (fixed focal length) or a zoom (variable focal length) lens?

- Prime lenses generally afford higher optical quality than zooms, except in the case of really expensive pro zoom lenses.
- However prime lenses mean you have to walk around more - you can't simply adjust the zoom setting to get the framing you need.



What focal length or focal length range do you want to cover?

- I'd sit down with your photos and think about what focal lengths you tend to use most and where there are gaps.
- Maybe you want an extreme wide angle, for example. If so there's no point getting another telephoto.



Do you need a fast lens?

- Do you want to do low-light photography without a tripod or flash?
- Do you want to do portrait photos while blurring the background?
- Do you shoot sports at night or indoors?
- These applications call for a faster lens which can let in more light.



Do You Need a Really Big Lens?



Main Types of Lenses

- Ultra Wide Angle
- Wide Angle
- Normal
- Telephoto
- Super Telephoto
- Zoom
- Prime



The-Digital-Picture.com Reviews

Prime Lens

- A Prime lens is a lens with a fixed focal length



Zoom Lens

- A zoom lens is a lens in which the focal length can be changed or “zoomed”



Zoom

- Normally listed as 3X, 5X, 10X, Etc. on all but DSLR digital cameras
- Optical Zoom- the lens magnifies the image
- Digital Zoom- the image is digitally magnified



2 Types of Zoom Lenses

- Almost all DSLR lenses are manual zooms.
- That is to say you adjust the focal length either by
 - turning a ring (two touch)
 - or sliding the lens in and out (push-pull)



Macro Lens

- A **Macro lens** is a close-up lens.
- The classical definition is that the image projected on the "film plane" (i.e., film or a digital sensor) is close to the same size as the subject.



Mirror Lens

- Mirror or, as they're more accurately known, catadioptric lenses.
- Such lenses use a pair of mirrors to fold the light path in half, in addition to containing regular glass elements.



Mirror Lens

Advantages

- Mirror lenses can be made fairly cheaply.
- They will also be shorter and lighter than all-glass (refracting) lenses of the same focal length.
- Mirror lenses come with focal lengths of 500mm to 1000mm.

Disadvantages

- They're manual-focus only.
- They are optically really slow lenses - usually around f/8 or so.
- They don't have aperture diaphragms, so the only way to adjust the exposure is to adjust the shutter speed, the film speed/digital ISO or to put a neutral density (darkening) filter on the lens.
- They tend to be of a lower optical and build quality.

Tilt Shift Lens

- Allows you to shift the front element of the lens up and down and side to side to correct for perspective.
- Very expensive
- Requires time consuming setup and adjustments
- Primarily used for architecture



Fisheye Lens

- A super-wide angle lens that does not include geometric correction.
- Typically 8 to 16 mm
- Are not corrected for barrel distortion



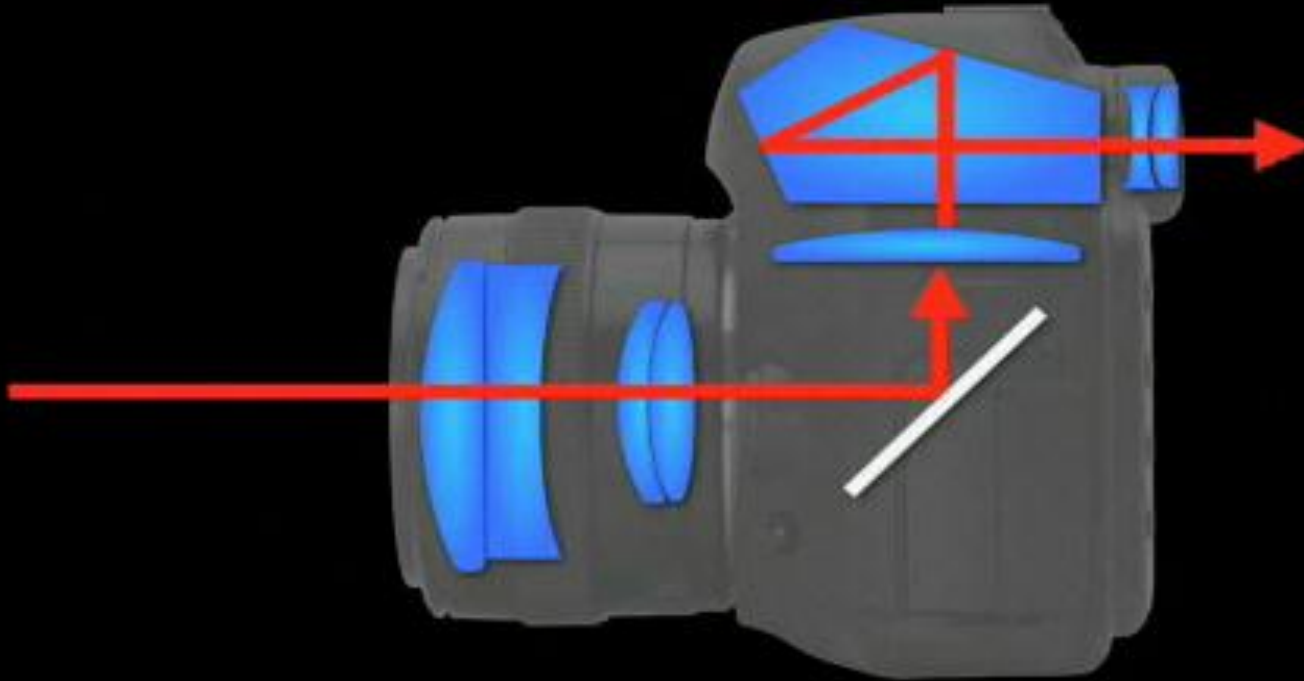
Soft Focus

- Soft Focus (Lensbaby)
- The lens is mounted on bellows which allow you to change the center of focus and create blurred areas



SLR Lens View through the lens

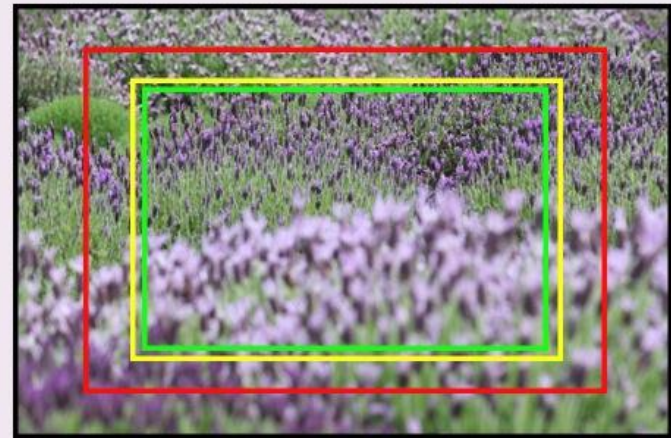
SLR - Focal Plane Shutter



Full Frame or Crop Sensor

- Let's say you have a 100mm lens. When used on a 35mm film camera you get a certain coverage of the scene.
- But if you were to put the same lens on a digital camera with a 1.6x crop factor
- The view you would see on your 1.6x digital camera would be the same as if you had a 160mm lens

Crop Factors Explained



Black - Full Frame
Red - 1.3x Crop Factor
Yellow - 1.5x Crop Factor
Green - 1.6x Crop Factor

Canon EF and EF-S

- Digital camera bodies with EF-S lens mounts are totally compatible with all regular EF lenses.
- However an EF-S lens can fit only EF-S compatible cameras and no others.
- This is because the lens fits farther into the camera and the mirror would hit the lens in a full frame camera.



Canon – Lens Mounts

- Regular EF bodies and lenses use raised red dots for aligning lens and body.
- EF-S bodies have a white square as well, which must be lined up to the white square on EF-S lenses.



Lens Speed

- This is the maximum aperture
- Aperture is the size of the opening in the lens
- Expressed as a ratio 1:2.8
- Also referred to as the f-stop



Why Does Lens Speed Matter

- Faster shutter speeds
- Use lower ISO settings
- Shallow dept of field
- Brighter viewfinder
- Faster focusing
- Better lens construction



Understanding Lens Markings

- Lens markings tell you about the specifics of a lens
- There is a lot more to know than just price and focal length



CANON LENS EF 28-80mm

1:3.5-5.6. Ø58mm.

- EF means that the lens is of the Canon EF type.
- 28-80mm refers to the focal length of the lens. In this case there are two values since the lens is a zoom lens which can go from 28mm at its widest to 80mm at its longest.
- 1:3.5-5.6 refers to the widest aperture of which the lens is capable. Since the lens is a zoom there are two aperture values - f/3.5 and f/5.6.
- Ø58mm refers to the filter ring diameter. In other words, screw-on filters 58mm in diameter will fit this lens.



CANON LENS EF 200mm 1:2.8L II USM. Ø72mm

- EF means that the lens is a Canon EF lens for EOS cameras.
- 200mm refers to the focal length. Since only one value is indicated, this lens is a prime lens.
- 1:2.8 refers to the widest aperture of which the lens is capable. f/2.8 is reasonably wide, especially for a 200mm telephoto lens, and so this is considered a fast lens.
- L indicates that the lens is an L or “luxury” series Canon lens. Such lenses are generally the best that Canon manufacture. They are marked with a characteristic red stripe around the end of the lens barrel.
- II indicates that this is the second version of this lens with these particular numerical specifications that Canon have made.
- USM refers to the autofocus motor type used by the lens. In this case it uses an ultrasonic motor
- Ø72mm refers to the filter ring diameter. In other words, screw-on filters 72mm in diameter will fit this lens, making it a fairly large lens.

Distance Scale

- Most Canon EF midrange and better lenses have distance scales - clear rectangular plastic windows set into the lens barrel.
- A series of numbers can be seen through this window indicating the distance, in both meters and feet, from the lens to the point in focus.
- Inexpensive consumer lenses generally do not have distance scales.



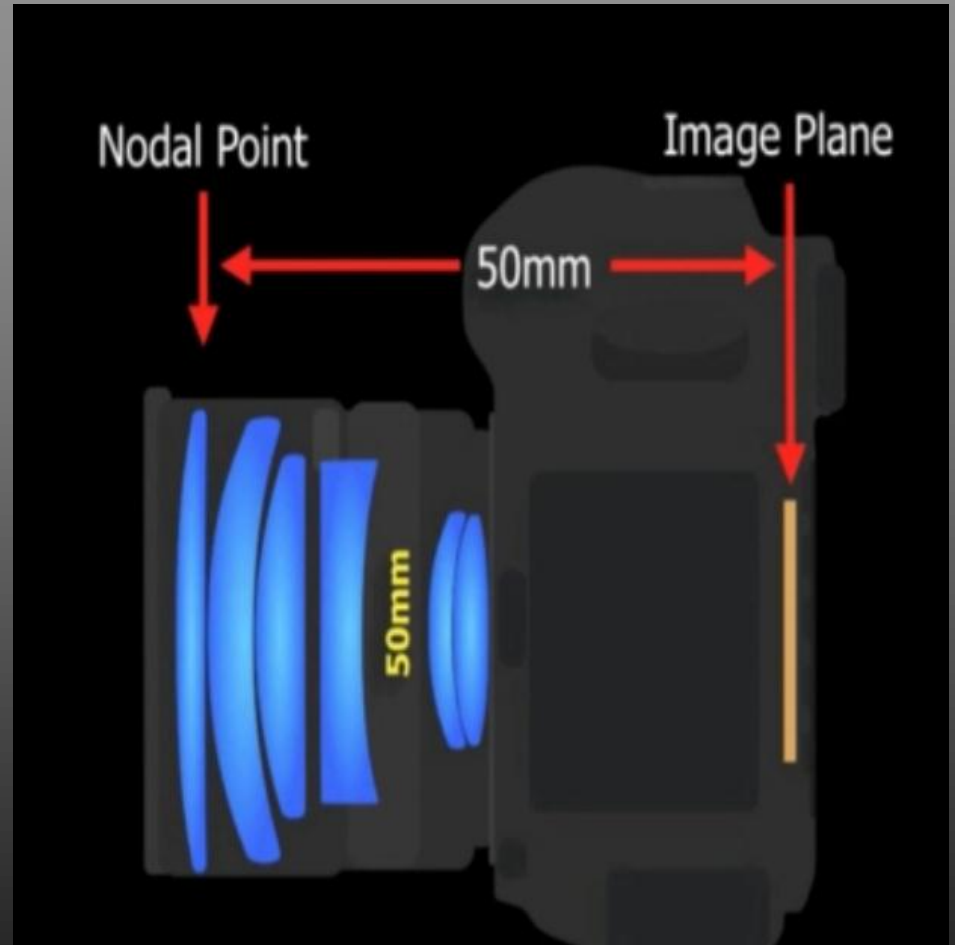
Depth of Field Scale

- Canon EF prime lenses also have simple depth of field scales marked on the barrel below the window.
- These marks indicate the acceptable depth of field distances from the current focus distance, usually for a small number of apertures - $f/11$ and $f/22$, say, or $f/5.6$, $f/11$ and $f/16$.
- Canon EF zoom lenses, however, do not have any depth of field scales .



Focal Length

- 50mm
- The distance from the nodal point to the image plane
- The length of the lens



10 (16) MM Focal Length



20 (32) MM Focal Length



24 (38) MM Focal Length



35 (56) MM Focal Length



50 (80) MM Focal Length



100 (160) MM Focal Length



200 (320) MM Focal Length



300 (480) MM Focal Length

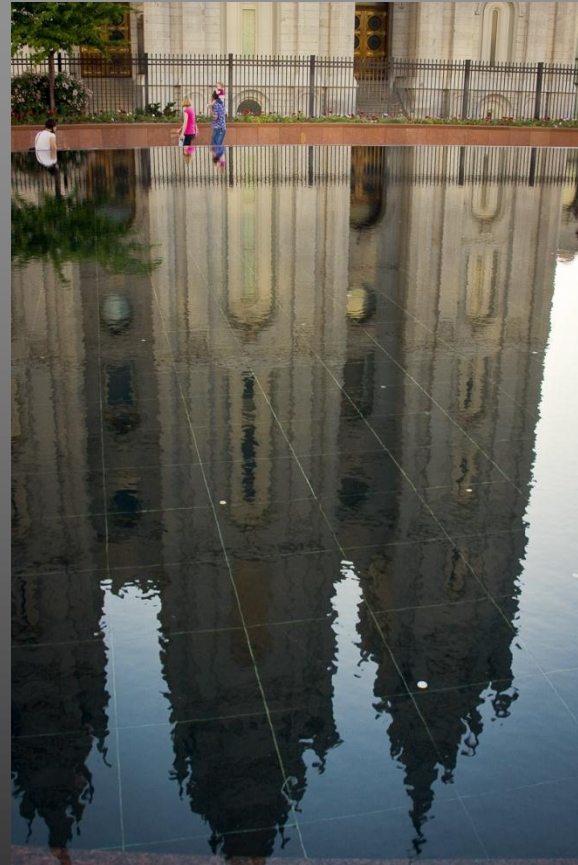


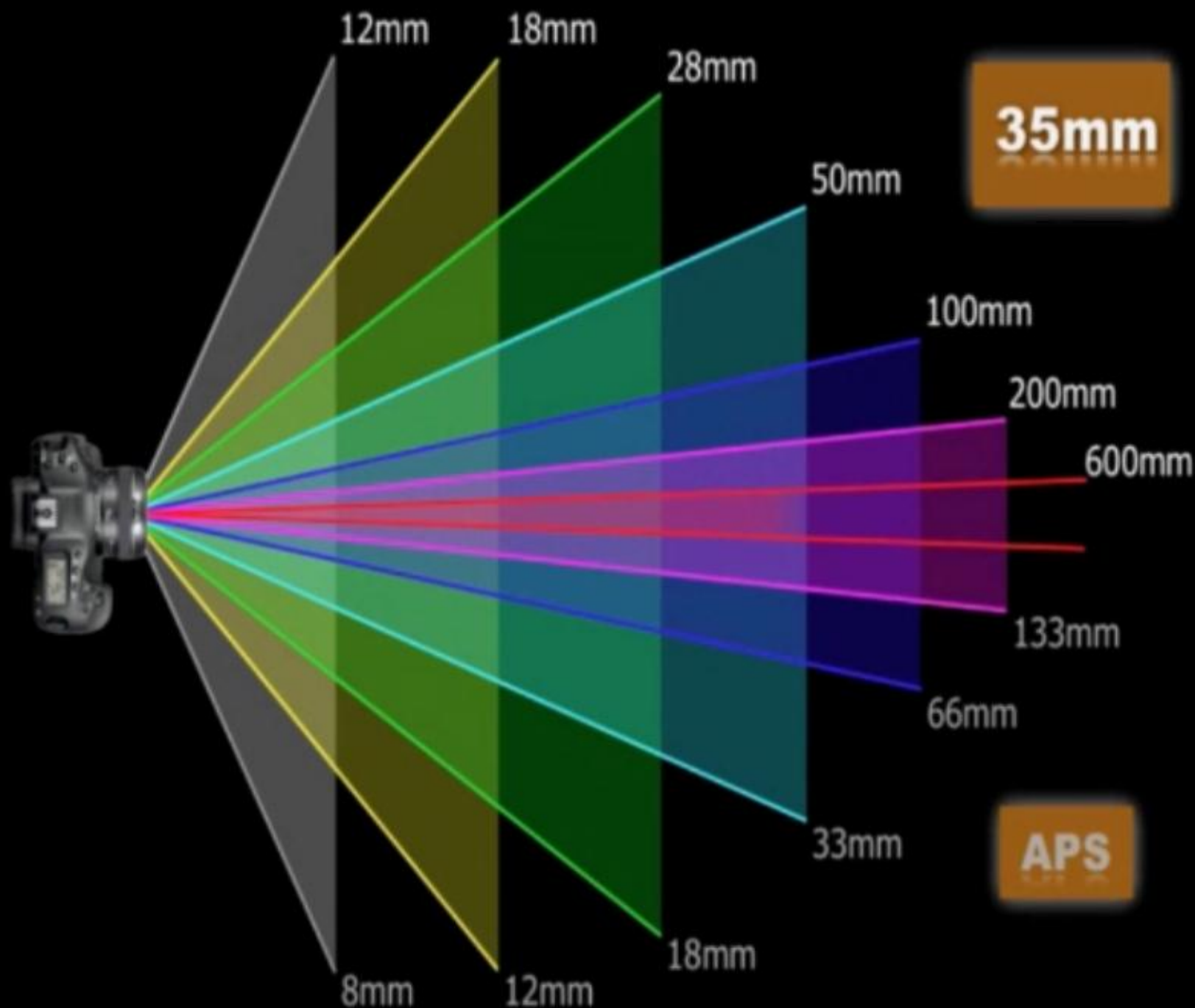
400 (640) MM Focal Length



Angle of View

- Angle of view describes the angular extent of a given scene that is imaged by a camera.
- Focal length is not the same as angle of view.





Perspective

- Capturing a subject the same size with different focal length lenses yields very different results.
- When using a wider lens, more of the background is depicted.
- In contrast, with a telephoto focal length, the background view is narrower and will appear closer to the subject (compressed).

16mm



24mm



50mm



200mm

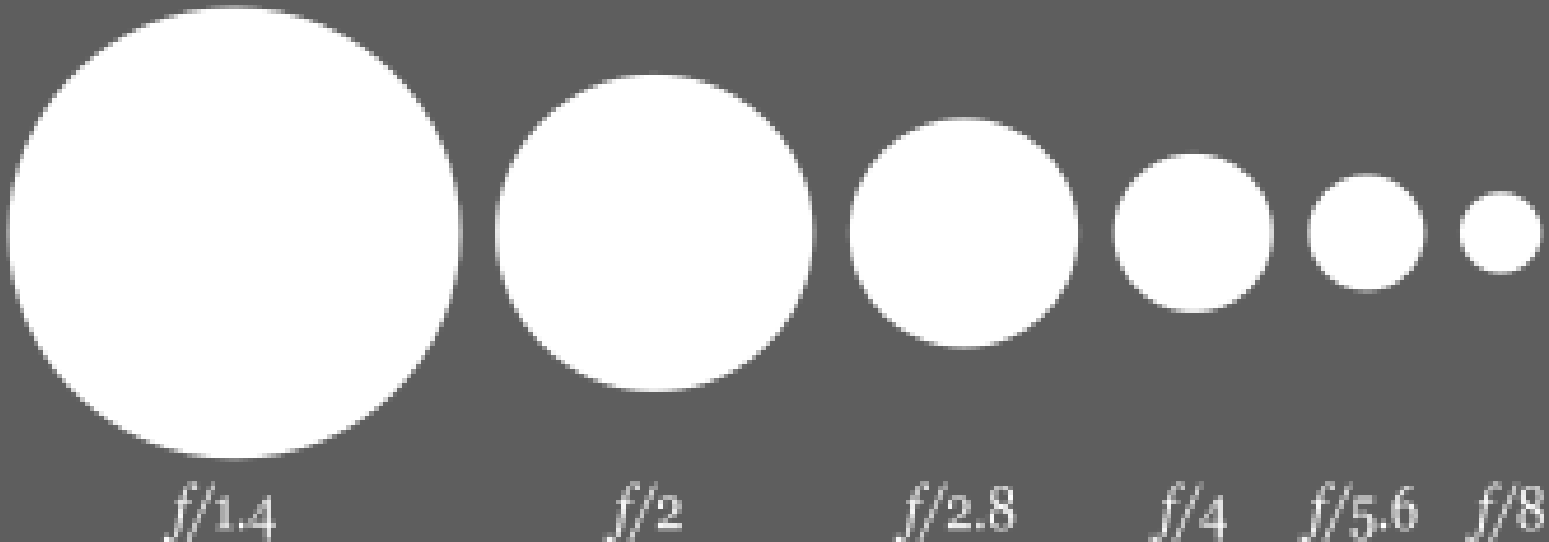


135mm



Aperture

- The size of the diaphragm opening in a camera lens, which REGULATES the amount of light that passes through onto sensor inside the camera when the shutter curtain opens during an exposure process.



What the numbers mean



50mm f/1.4



50mm 1:1.4

50mm/1.4

$$50\text{mm} \div 1.4 = 35\text{mm}$$



f/1.8

f/1.4

f/1.2

$$50\text{mm} \div 1.8 = 28\text{mm}$$

$$50\text{mm} \div 1.4 = 35\text{mm}$$

$$50\text{mm} \div 1.2 = 42\text{mm}$$



Standard Full Stop Apertures

1	2	4	8	16	32
1.4	2.8	5.6	11	22	

Ok everyone needs to memorize the full stop apertures, there will be a test!

f/1.4 Lens is open all the way



f/2.8 Lens is open part way

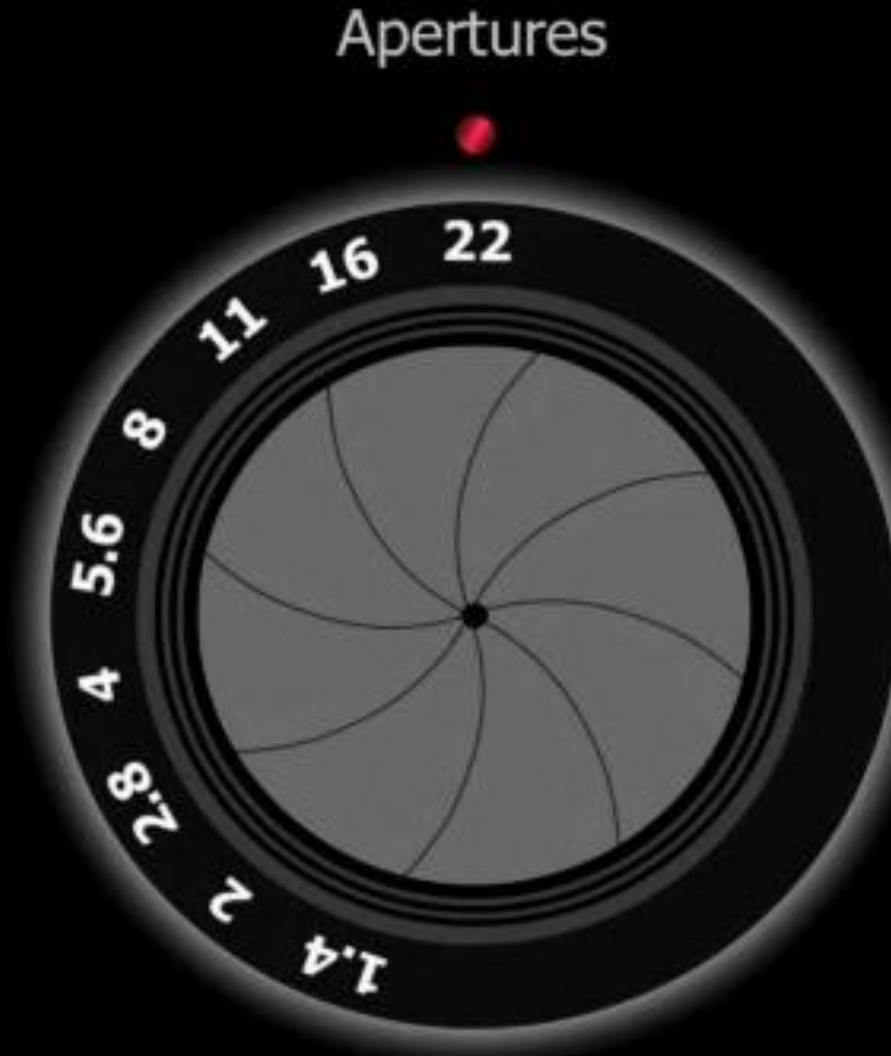
Apertures



f/8 Lens is open half way

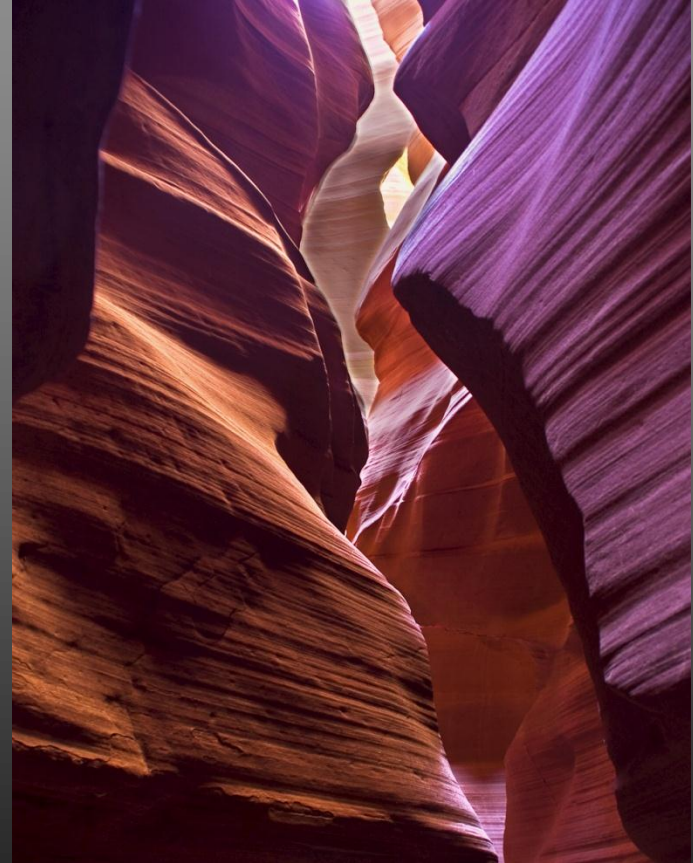


f/22 Lens is barely open

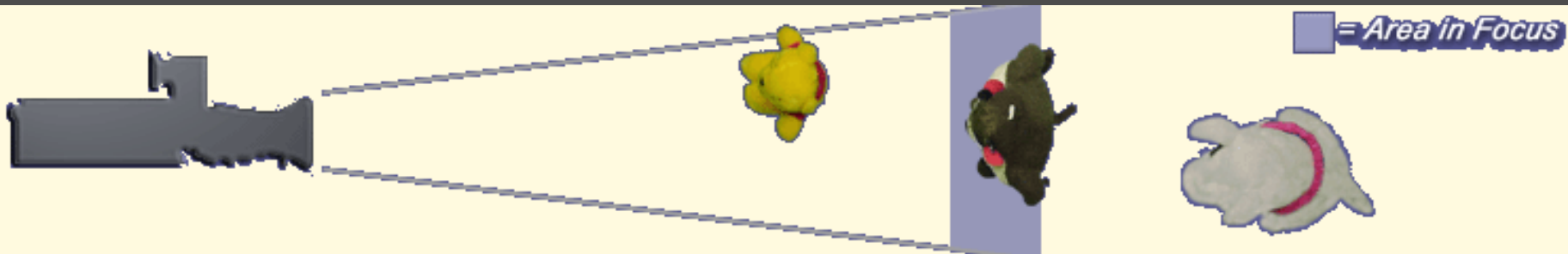
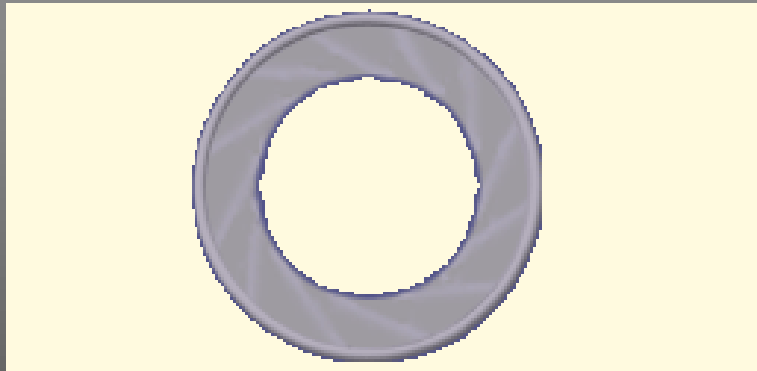


What's A lens's Best Aperture

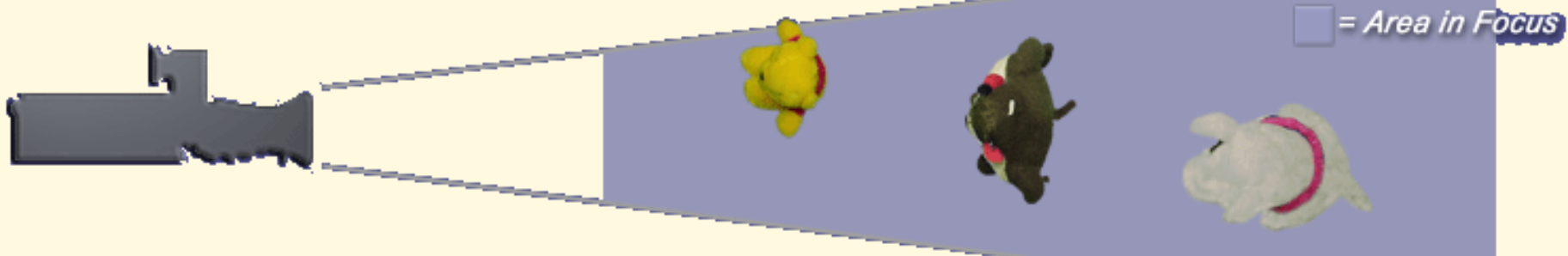
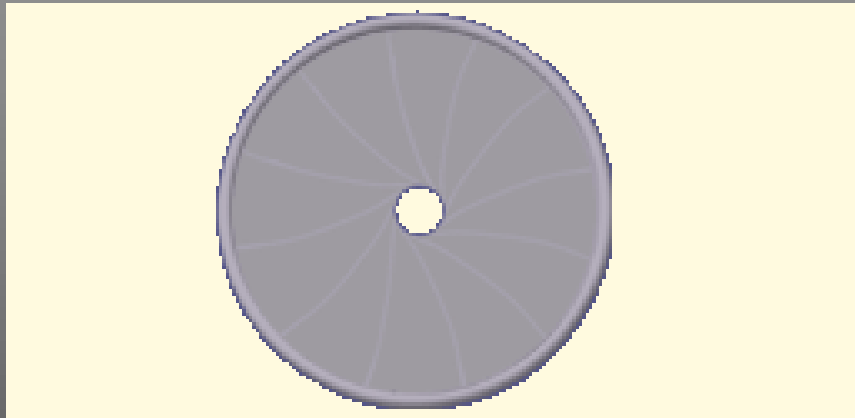
- Most lenses provide sharpest results when used in the middle part of their aperture range.
- Lenses usually have performance problems when used wide-open. Stopping down helps a great deal, but once the aperture becomes too small then an optical phenomenon known as diffraction comes into play and the quality deteriorates once again.
- So most lenses work best at around $f/8$ or $f/11$ or so.



Large Aperture (2.8)



Small Aperture (f 22)

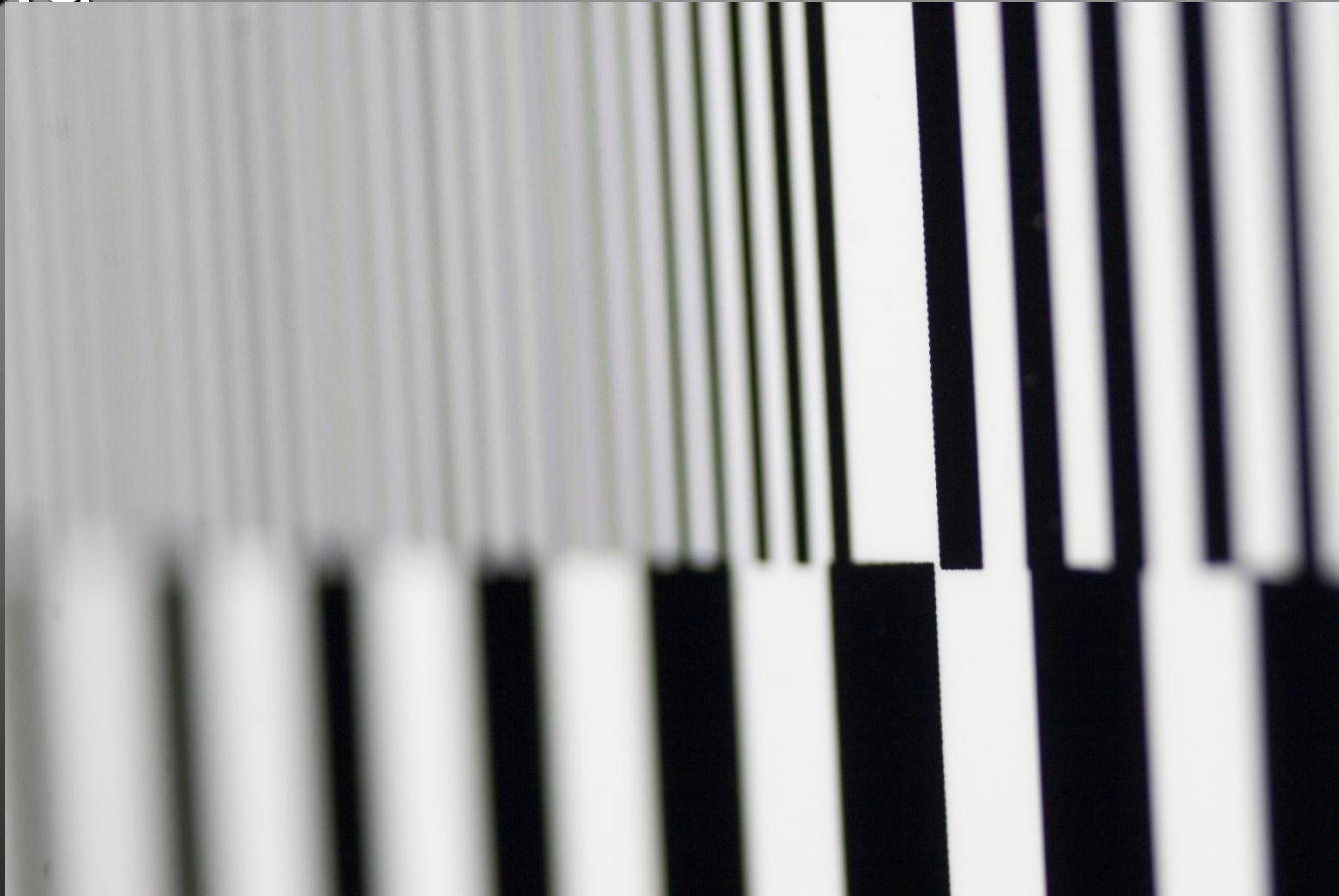


Aperture controls the Depth of Field



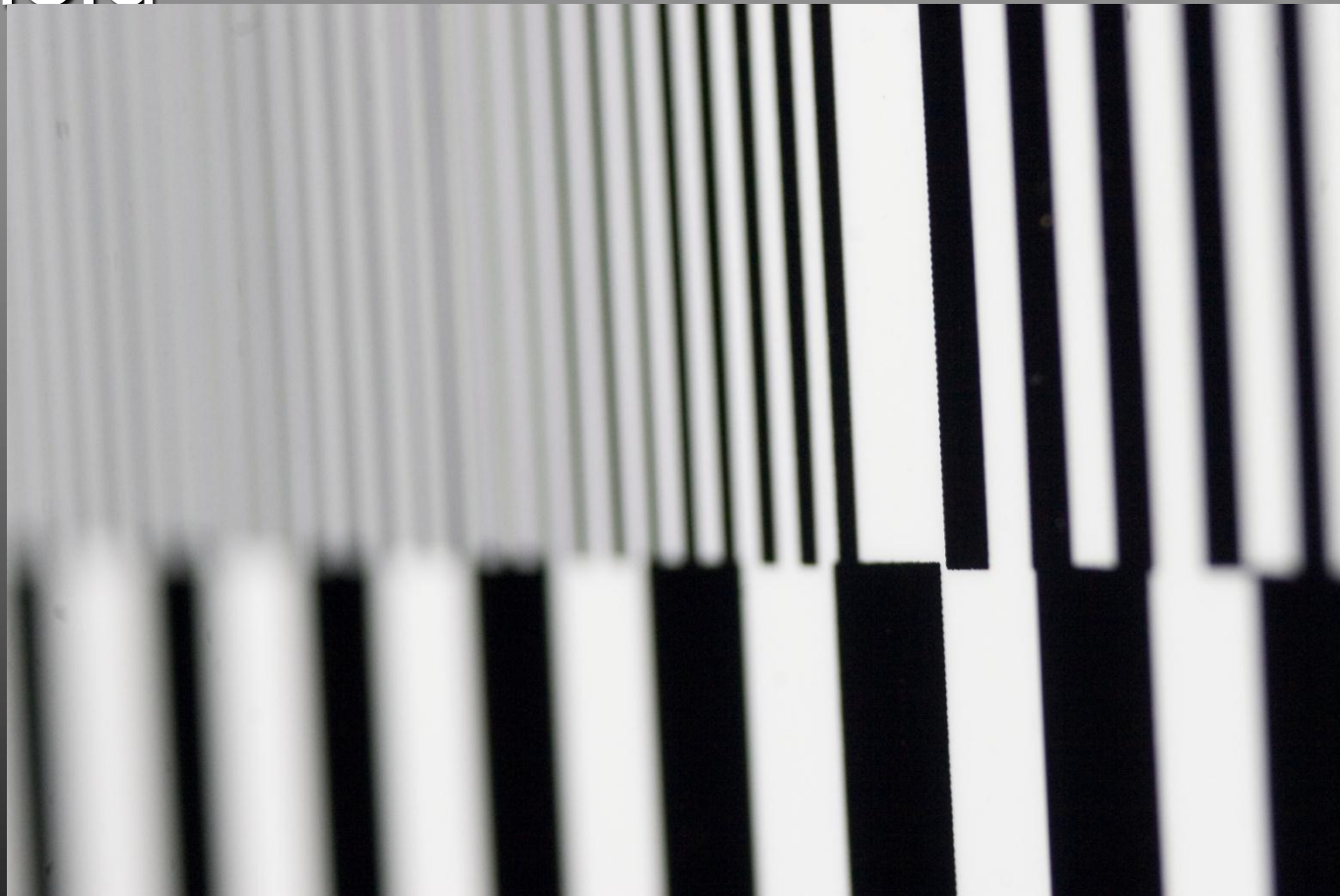
Aperture f:3.2 Target at 45 degree angle.

Aperture controls the Depth of Field



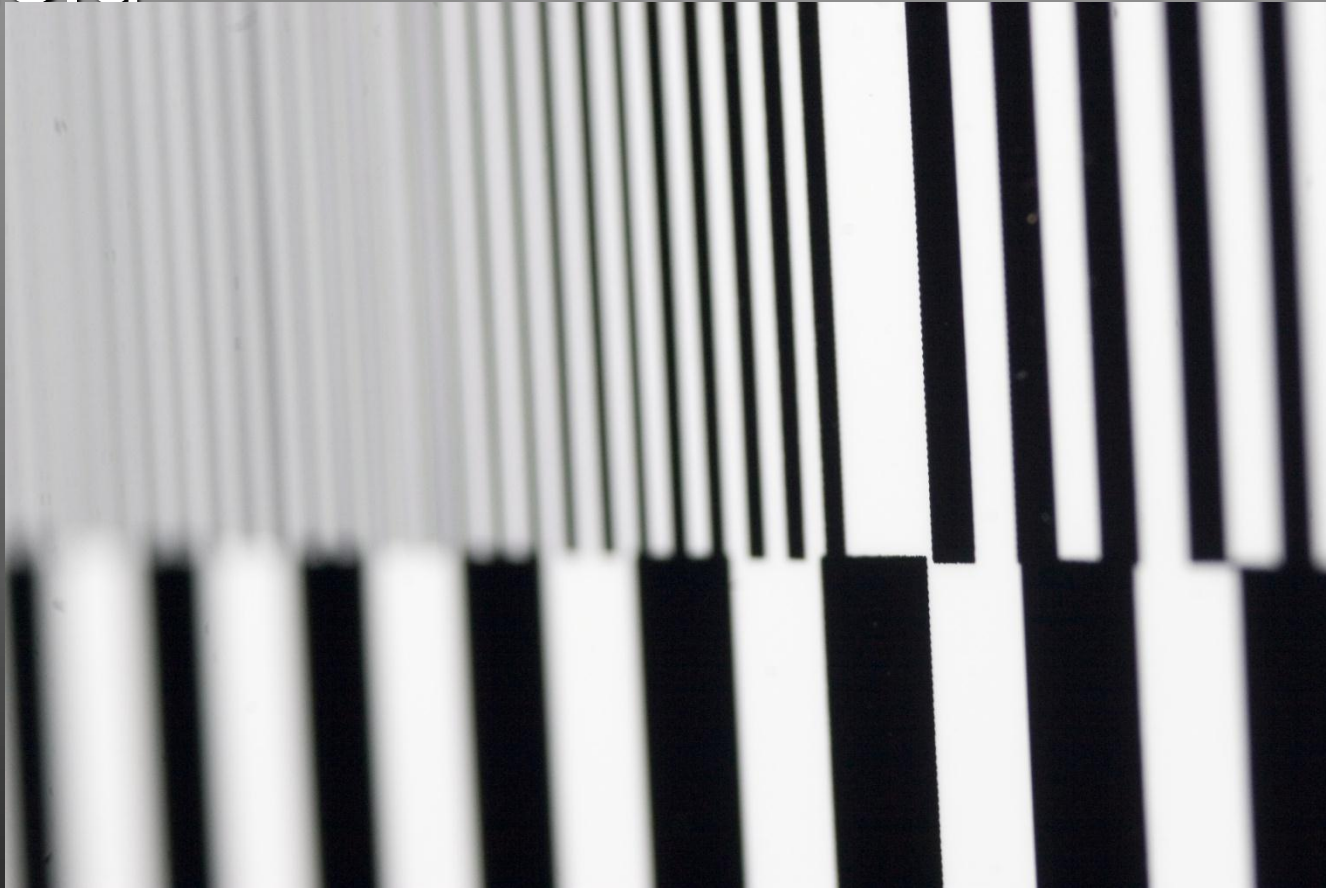
Aperture f:4.0 Target at 45 degree angle

Aperture controls the Depth of Field



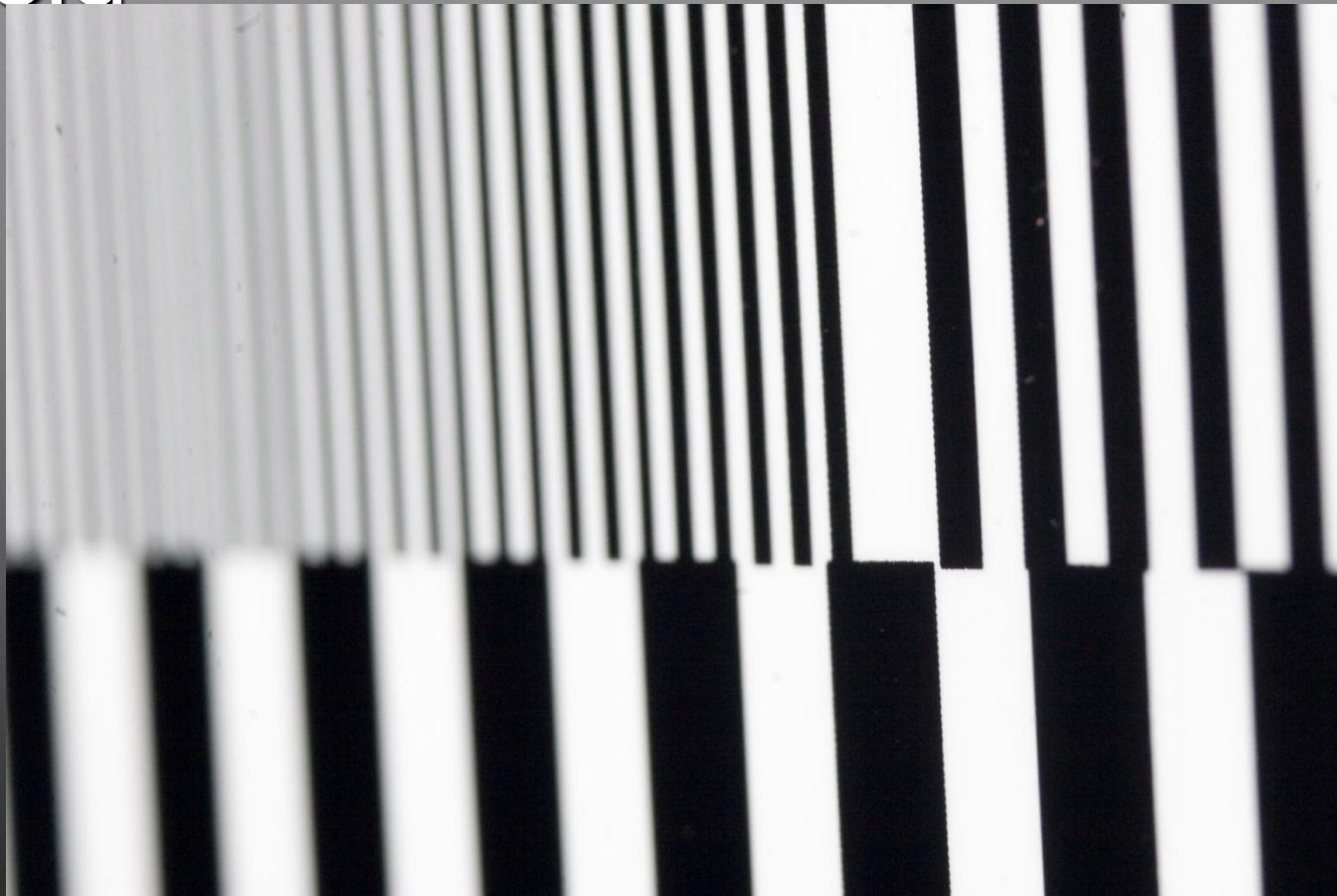
Aperture f:6.3 Target at 45 degree angle

Aperture controls the Depth of Field



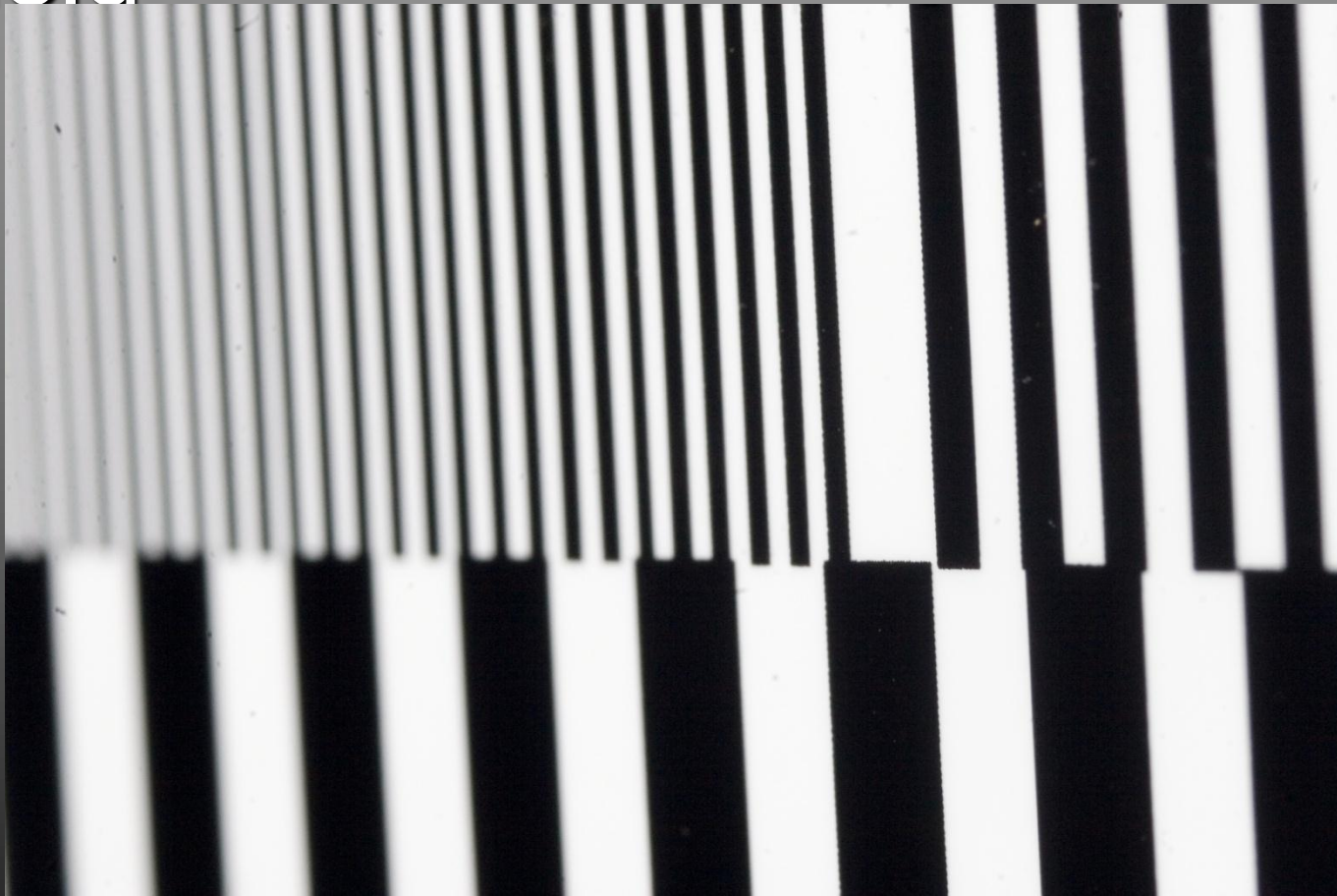
Aperture f:8.0 Target at 45 degree angle

Aperture controls the Depth of Field



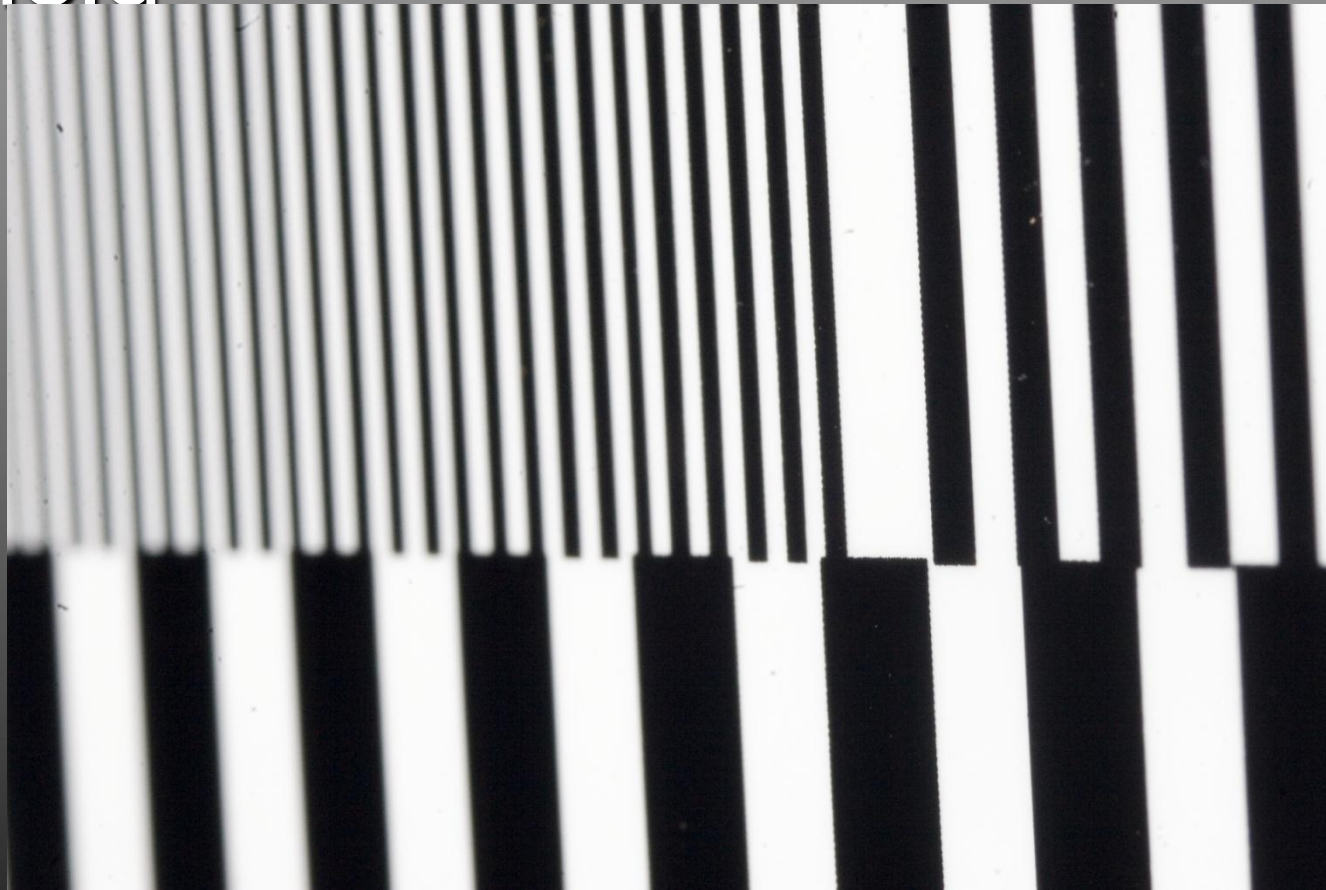
Aperture f:11.0 Target at 45 degree angle

Aperture controls the Depth of Field



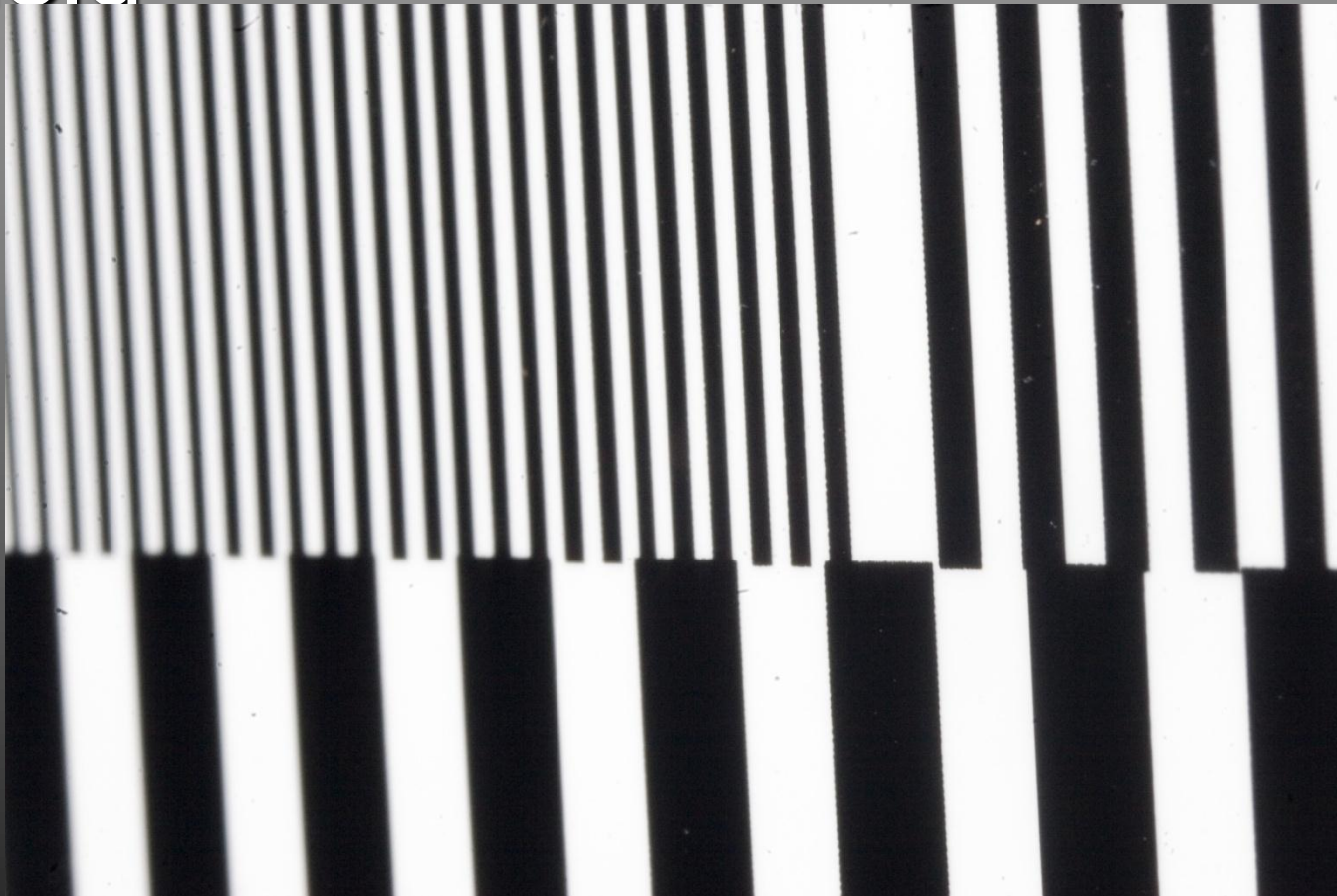
Aperture f:16.0 Target at 45 degree angle

Aperture controls the Depth of Field



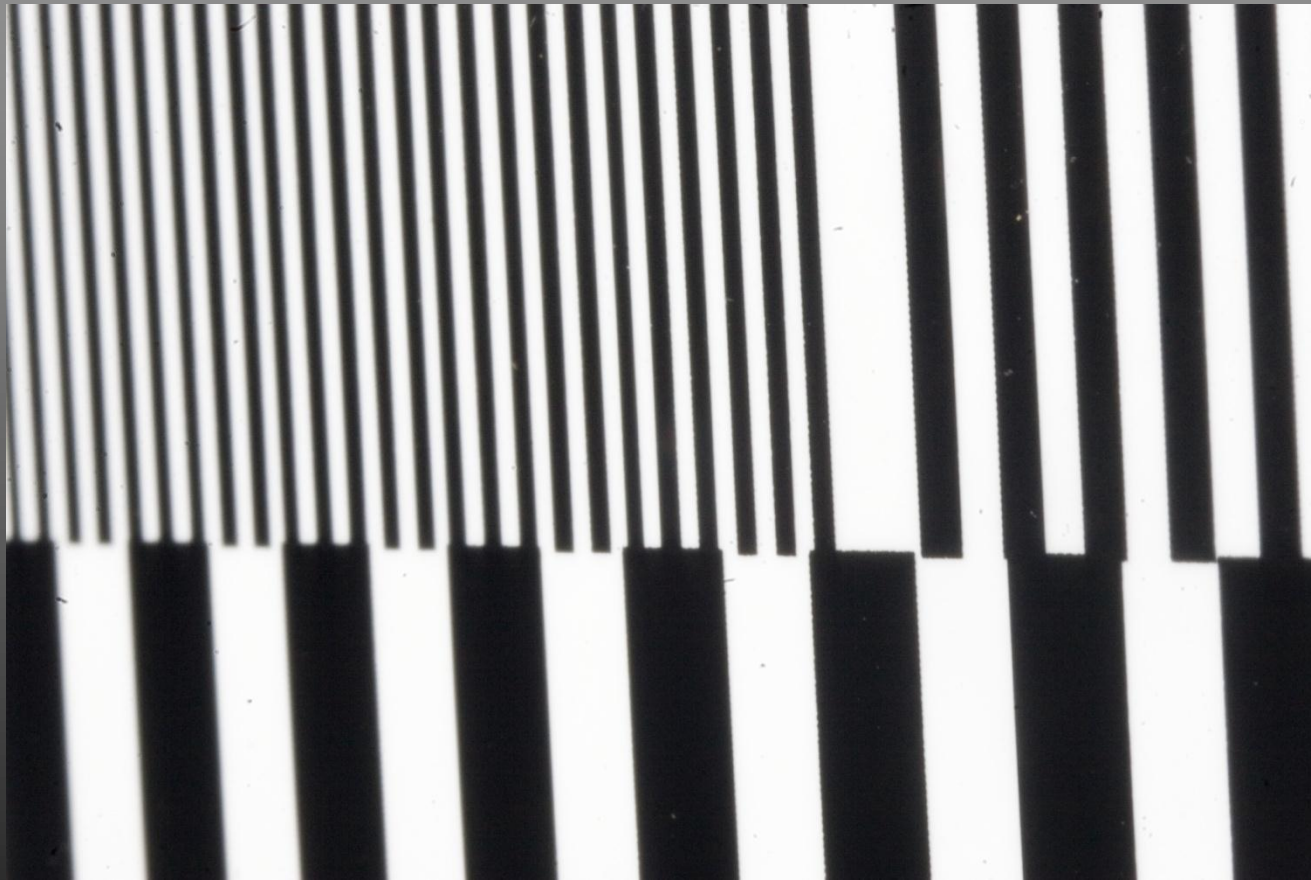
Aperture f:20.0 Target at 45 degree angle

Aperture controls the Depth of Field



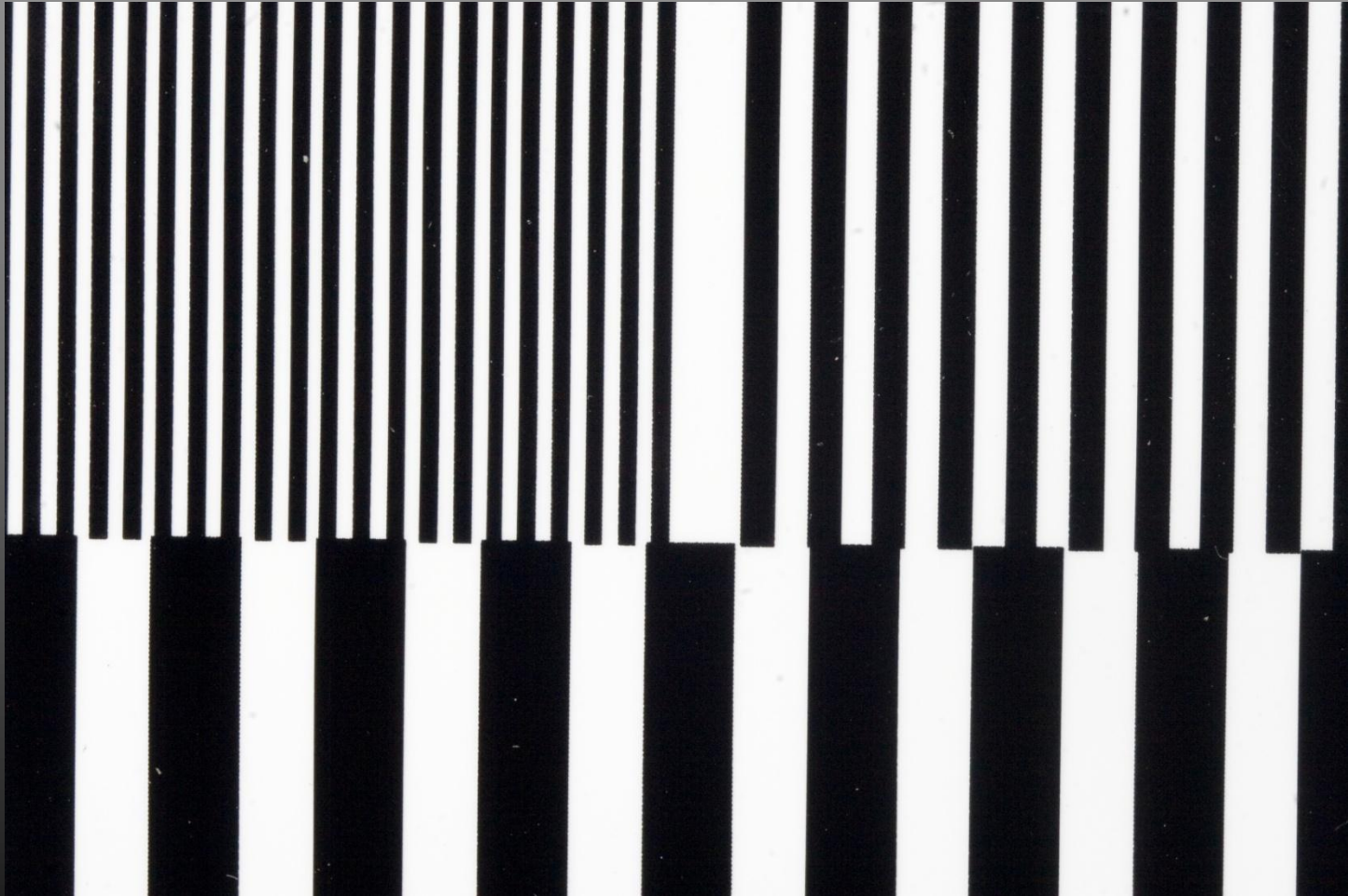
Aperture f:32.0 Target at 45 degree angle

Aperture controls the Depth of Field



Aperture f:45.0 Target at 45 degree angle

Target Shot lined up with Focal Plane



Depth of Field Preview

- Your camera normally has the aperture all the way open until the instant that you take the photo.
- The DOF preview will close the aperture to what will be used for the picture so you can see what is actually in focus.
- Because the aperture closes down the viewfinder will become very dark



Optical Image Stabilization

- Image stabilization (IS) is a family of techniques used to reduce blurring associated with the motion of a camera during exposure.
- Specifically, it compensates for pan and tilt (angular movement, equivalent to yaw and pitch) of a camera or other imaging device.



Optical Image Stabilization

- Canon calls it IS (Image Stabilization)
- Nikon call is VR (Vibration Reduction)
- Pentax calls it SR (Shake Reduction)
- Sigma calls it OS (Optical Stabilization)
- Tamron calls it VC (Vibration Compensation)



Optical Image Stabilization

- Works by using a floating lens element that is moved orthogonally to the optical axis of the lens using electromagnets.
- Vibration is detected using two piezoelectric angular velocity sensors (often called gyroscopic sensors), one to detect horizontal movement and the other to detect vertical movement.



Optical Image Stabilization

- Some lenses have a secondary mode that counteracts vertical camera shake only.
- This mode is useful when using a panning technique, and switching into this mode depends on the lens; sometimes it is done by using a switch on the lens, or it can be automatic.



Image Stabilization

Benefits

- Allows better handheld images in low light.
- Good for shooting from a moving vehicle or boat.
- Reduces the need for a tripod.
- Permits use of shutter speeds 2-4 stops slower.

Drawbacks

- Increases the cost of the lens significantly
- Uses additional battery power.
- Can be annoying when looking through the viewfinder.
- Does not prevent “motion blur” from a moving subject.

Constant Aperture

- Constant aperture lenses provide a static maximum aperture regardless of the focal length you're zoomed to.
- This better enables you to achieve narrow depth of field so as to isolate your subject from your background.
- These lenses typically let more light in, which lets you shoot sharp photos in dimmer lighting conditions.



Variable Aperture

- Variable aperture accounts for the majority of zoom lenses.
- Causes the maximum aperture to decrease as you zoom from wider focal lengths to telephoto focal lengths.
- The advantage of variable aperture zoom lenses is that they're cheaper to manufacture
- Are typically lighter and more compact than constant aperture lenses.



Auto Focus

- The speed of the AF system is highly dependent on the maximum aperture offered by the lens.
- F-stops of around $f/2$ to $f/2.8$ are generally considered optimal in terms of focusing speed and accuracy.
- Faster lenses than this (e.g.: $f/1.4$ or $f/1.8$) typically have very low depth of field, meaning that it takes longer to achieve correct focus, despite the increased amount of light.



Auto Focus

- Most consumer camera systems will only autofocus reliably with lenses that have a maximum aperture of at least $f/5.6$.
- Professional models can often cope with lenses that have a maximum aperture of $f/8$, which is particularly useful for lenses used in conjunction with Teleconverters.



Auto Focus Nikon

- Motor can be in camera or in lens.
- Nikon AF-S have integrated autofocus motors.
- AF-D lenses do not and the focusing comes from the camera.

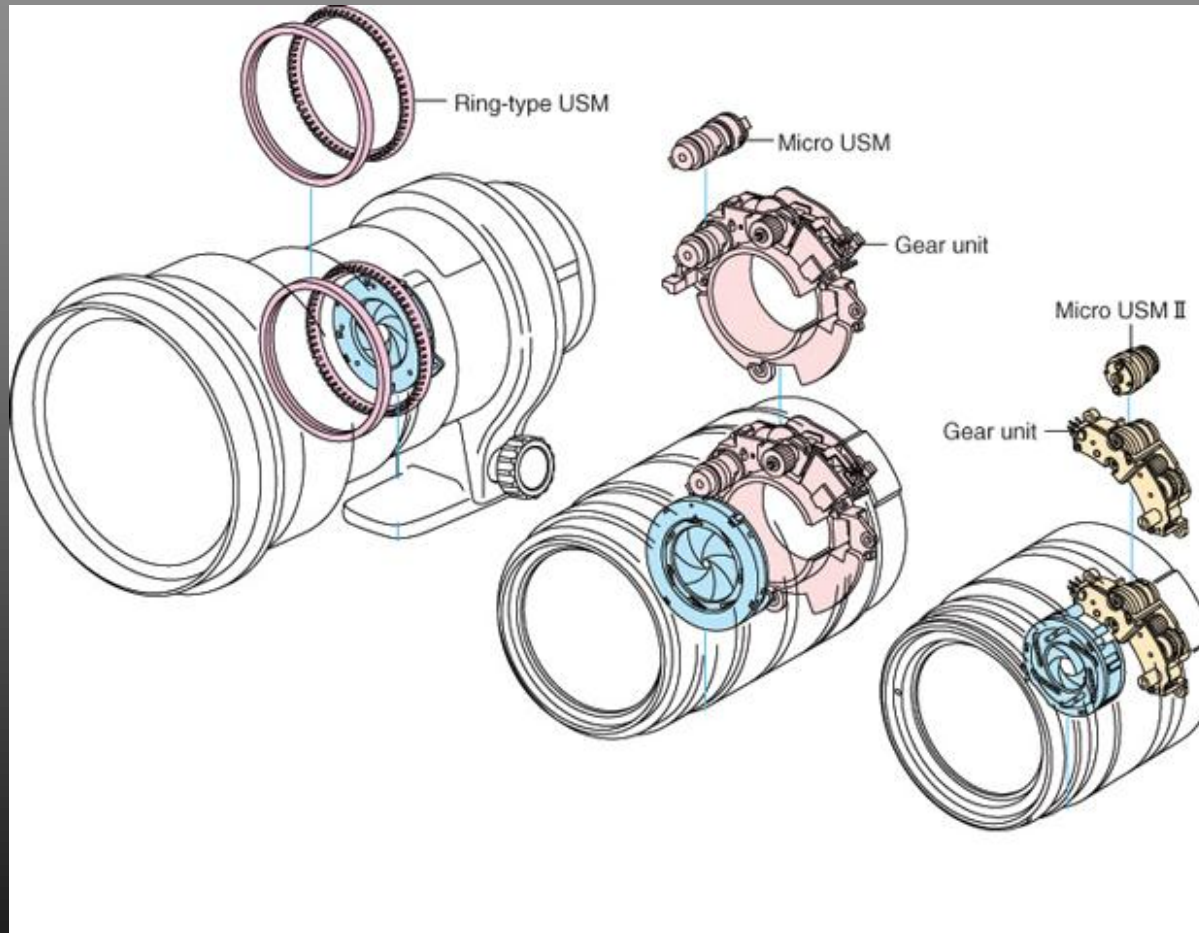


Auto Focus Canon

- Canon EF (Electro-Focus) lenses all have built in motors.
- If the autofocus motor type is not indicated on the lens, it means that the lens uses either an AFD (arc-form drive) or micromotor drive.
- Both types are slow and noisy compared to ultrasonic (USM) motors.

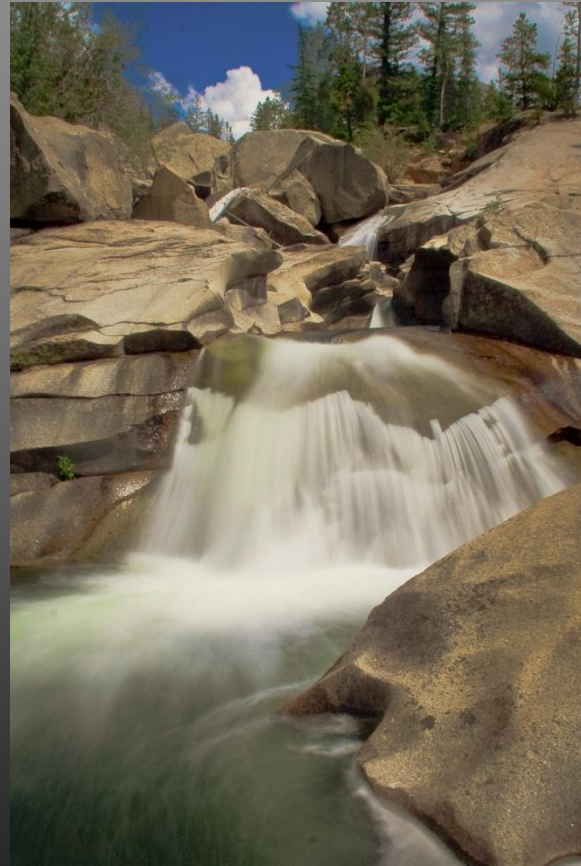


Auto Focus



Internal Focusing

- All lens movement is internal
- The front barrel of the lens does not turn.
- Excellent for use with filters such as Polarizers or Graduated neutral-density.



Low-Dispersion Glass

- Some lenses are made with high-quality glass specially manufactured to more accurately transmit the full visible color spectrum, called low-dispersion glass.
- You may also hear of ED (extra-low dispersion), SLD (super-low dispersion) or UD (ultra-low dispersion), which really just means truer colors.



Apochromatic lenses (APO)

- Apochromatic lenses have high color fidelity and sharpness and should be used by anyone obsessed with getting to the most accurate colors possible.



Aspherical Elements (ASP)

- Aspherical lenses are made with a different curvature than traditional spherical lenses to correct for distortions at the edge of the image.
- They are particularly useful in wide-angle lenses where vignetting or distortion can be seen in the corners of the image.



Weather Sealing

- lenses are specially weather sealed, using 'O'-rings and gaskets to keep out water and dust.
- This doesn't mean that they are weather or waterproof and eventually, after enough hard rain, almost any lens will fail, but these lenses will probably go on working after all the others have quit!
- The camera body must also be weather sealed.



Bokeh

- Bokeh is the blur, or the aesthetic quality of the blur, in out-of-focus areas of an image.
- The way the lens renders out-of-focus points of light.
- Differences in lens aberrations and aperture shape cause some lens designs to blur the image in a way that is pleasing to the eye.
- Others produce blurring that is unpleasant or distracting.



Lens Accessories

- Lens Hoods
- Filters
- Teleconverters
- Tripod Mounts
- Extension Tubes



Lens Hood

- Aside from making the lens look longer and bigger and thus more impressive to non-photographers, lens hoods (sometimes called shades) serve two basic functions.
- First, they help reduce the amount of stray light hitting the surface of the lens.
 - This is a good thing, since non-image-forming light coming into the lens at an angle results in lens flare.
- Second, lens hoods serve as physical protection for the lens - the plastic or metal tube can absorb blows that might otherwise hit the glass itself.



Filters

- Primary Filter types include:
 - Clear and UV
 - Color Correction
 - Polarizer
 - Neutral Density
 - Special Effects



Polarizing Filter

- Circular Polarizers are specifically designed for use with auto-focus SLR cameras, but they will also work on manual systems without problems.
- Linear Polarizers are used with most video and manual focus photo cameras. They are not recommended for auto-focus SLR cameras.
- A polarizer must be rotated to obtain maximum effect.
- Works best at a 90° angle to the light source.



Teleconverters

- A 2x teleconverter or “doubler” is mounted between the camera and the lens. In effect it doubles the focal length of the lens (200mm becomes 400mm) without changing the minimum focusing distance making the subject twice the size.
- It also decreases the light reaching the sensor or film by two stops and causes a loss of quality.



Tripod Mounts

- Lenses that are bigger and heavier than your camera body should have a tripod mount built-in.
- By attaching the lens to the tripod instead of the camera, you will remove tension on the camera-to-lens mount joint, and you will improve tripod balancing in the field.





Lenses for Macro Photography

What is Macro?

- Macro is simply Close-up Photography.
- Technically Macro is when the image captured on the film is at the same size as the object is in real life 1:1
- To lens makers macro means being able to produce an image that when printed at 4"x6" will be a 1:4 or ¼ life size.



Close up lenses - Diopters

- Close-up lenses simply screw into the filter threads of your lens and bring the focusing range of the lens closer to the camera.
- When the camera lens is focused on infinity with a +1, the maximum focusing distance becomes 1 meter, with a +2 it becomes 0.5 meters, with a +4 it becomes 0.25 meters.
- Close-up lenses are cheap, easy to use, and cause no exposure problems, but can cause a loss of picture quality.



Macro Lenses

- True Macro lenses are the best method for taking close-ups, and are probably the most expensive way.
- Focal length = working distance
 - 50 mm 4"
 - 105mm 9.5"
 - 200mm 24"



Extension Tubes

- Extension tubes mount between the lens and the camera and allow the lens to focus at a closer distance, which makes the image larger.
- Extension tubes have no optics and therefore do not cause any loss of quality.
- $\text{tube length} \div \text{focal length} = \text{added magnification}$



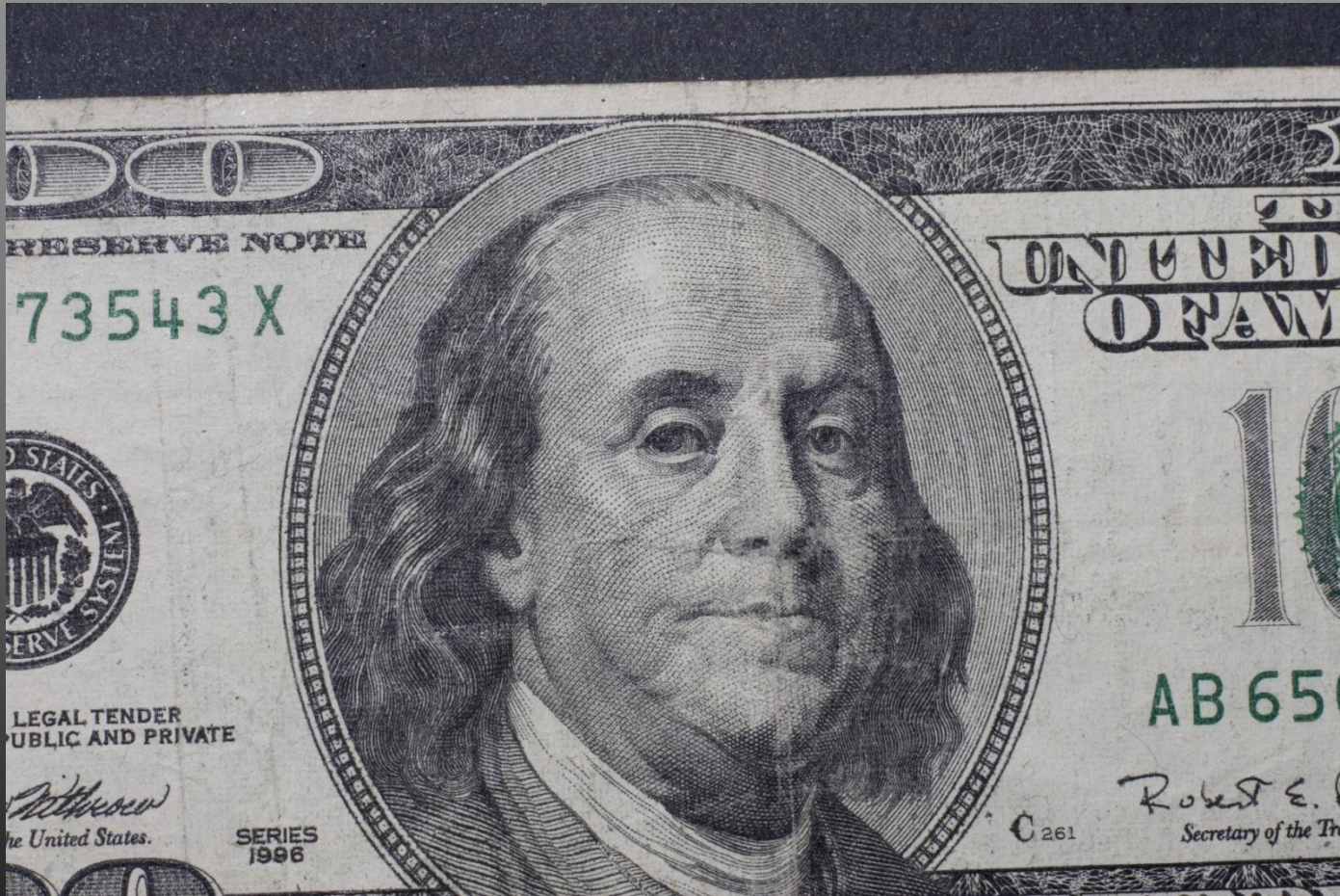
50 mm normal lens



14" Working Distance

Greg Disch
PHOTOGRAPHY

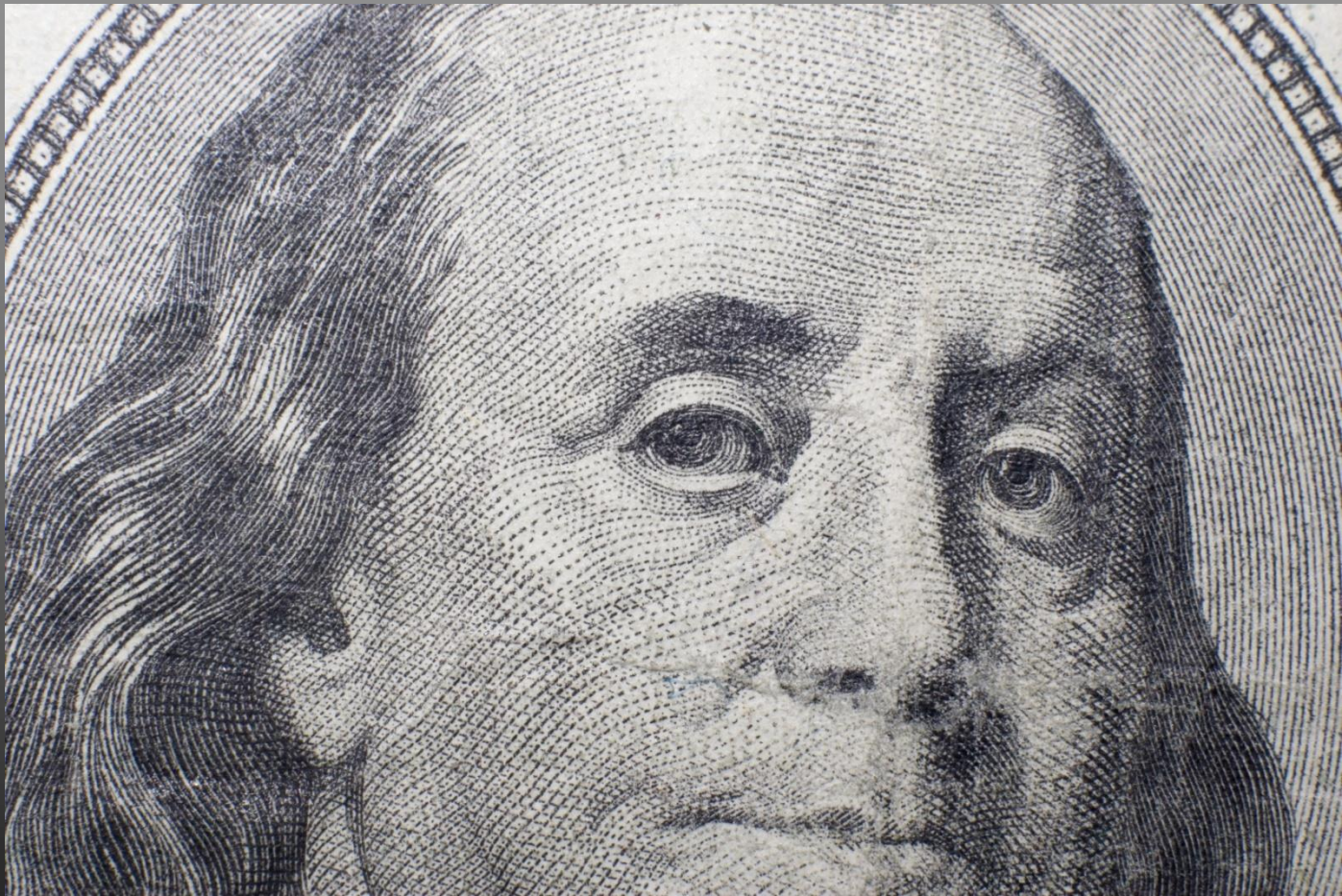
50 mm + 500D



8 1/2" Working Distance

Greg Disch
PHOTOGRAPHY

50 mm + 20mm Extension Tube



4" Working Distance

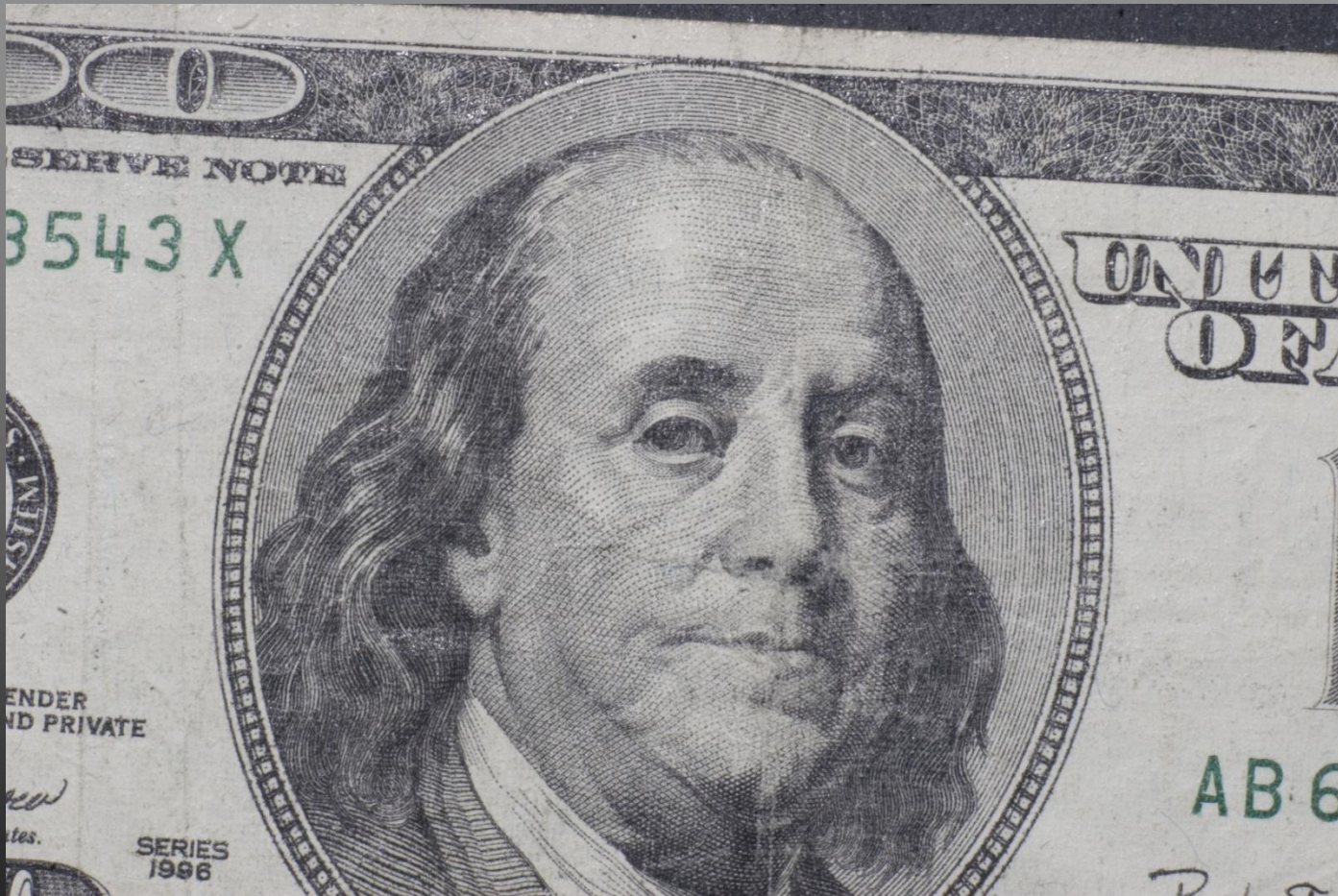
Greg Disch
PHOTOGRAPHY

50mm + 12+20+36 Extension Tube



1 1/2" Working Distance

50 mm + 2X Teleconverter



14" Working Distance

Greg Disch
PHOTOGRAPHY

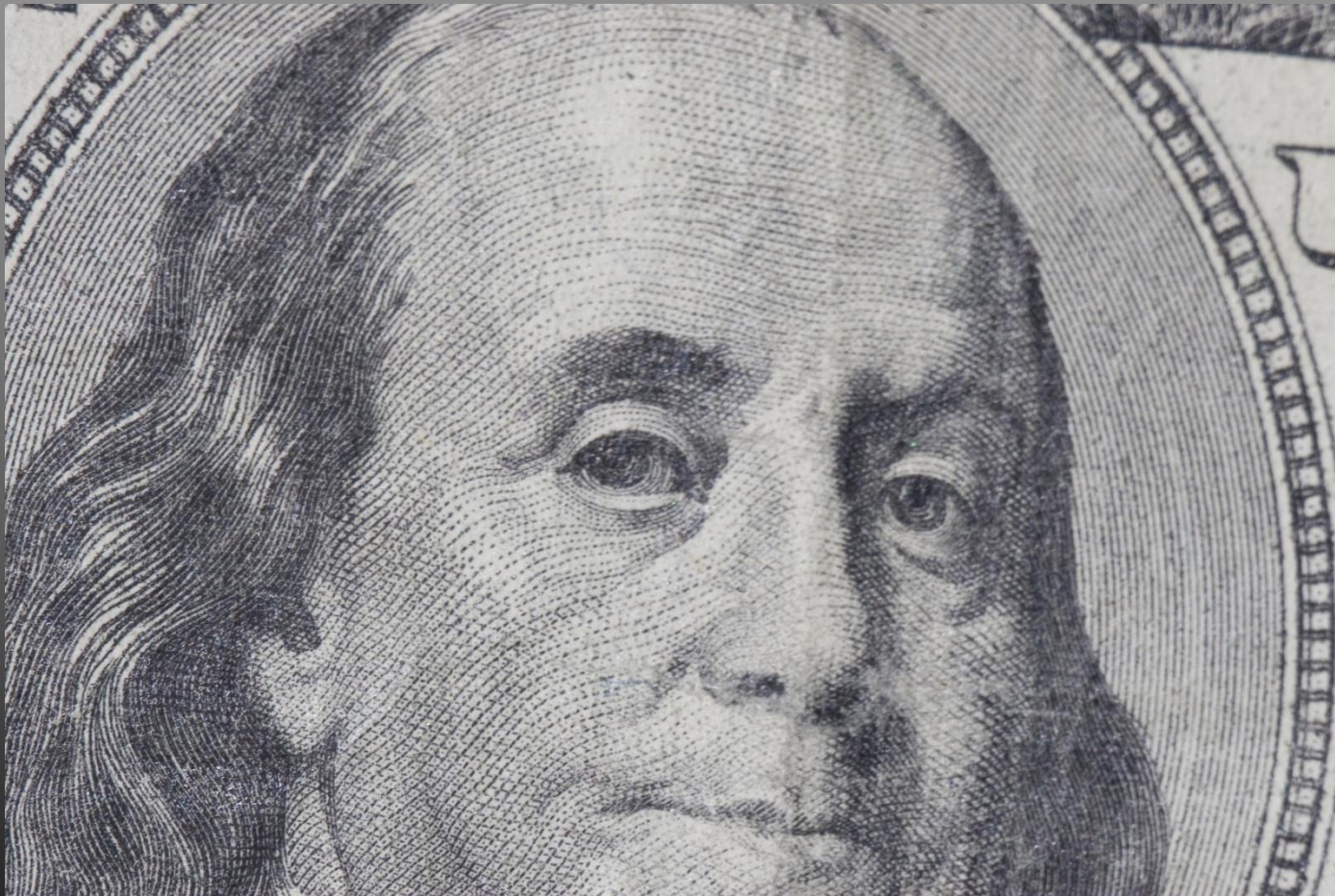
400mm



5 1/2 feet Working Distance

Greg Disch
PHOTOGRAPHY

400mm + 12+20+36 Extension Tube



2 ½ feet Working Distance

Greg Disch
PHOTOGRAPHY

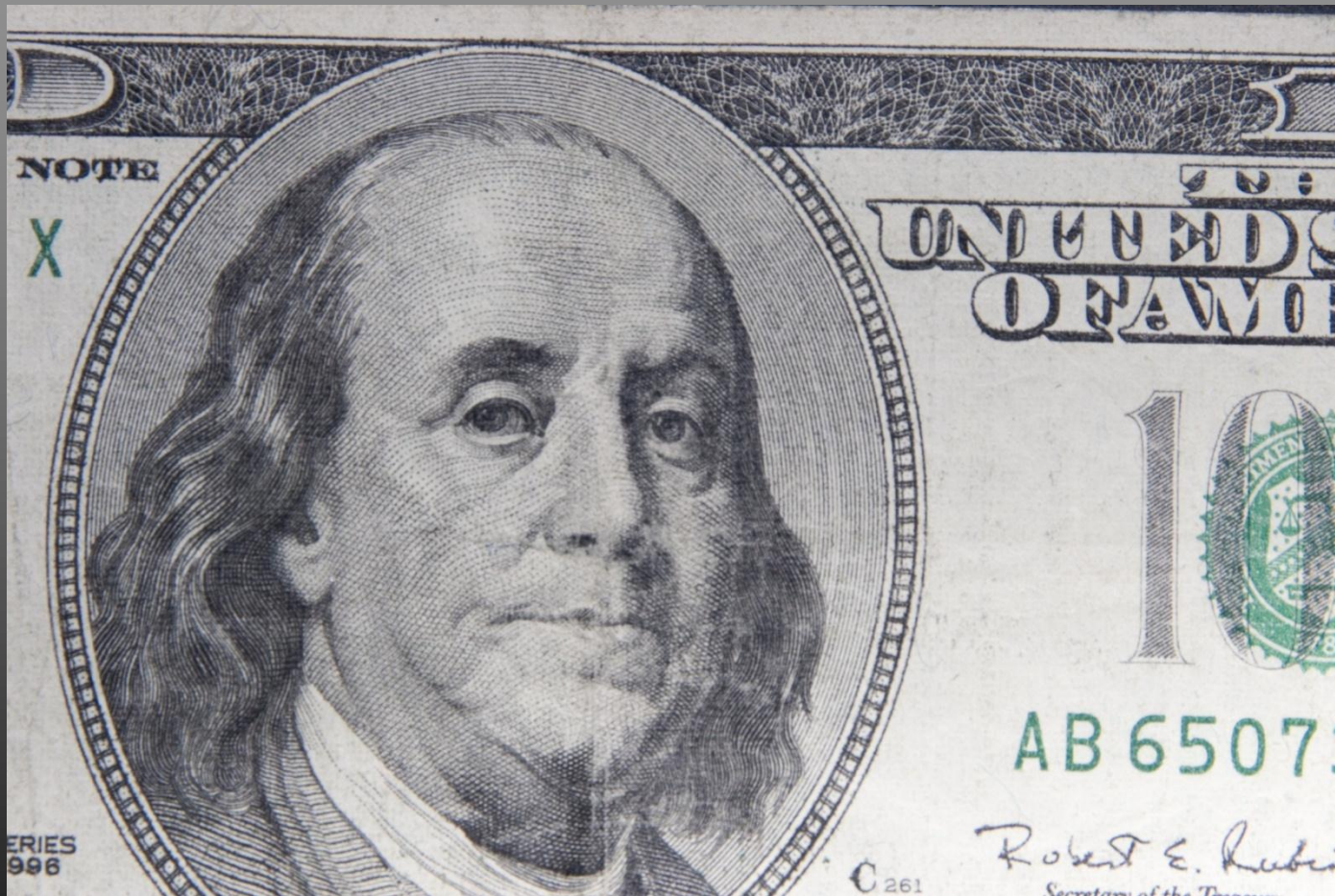
400mm +12+20+36 ET +2X



4 ½ feet Working Distance

Greg Disch
PHOTOGRAPHY

200mm (Macro-close focusing)



9" Working Distance

200mm (macro) + 12+20+36 ET



1" Working Distance

Greg Disch
PHOTOGRAPHY

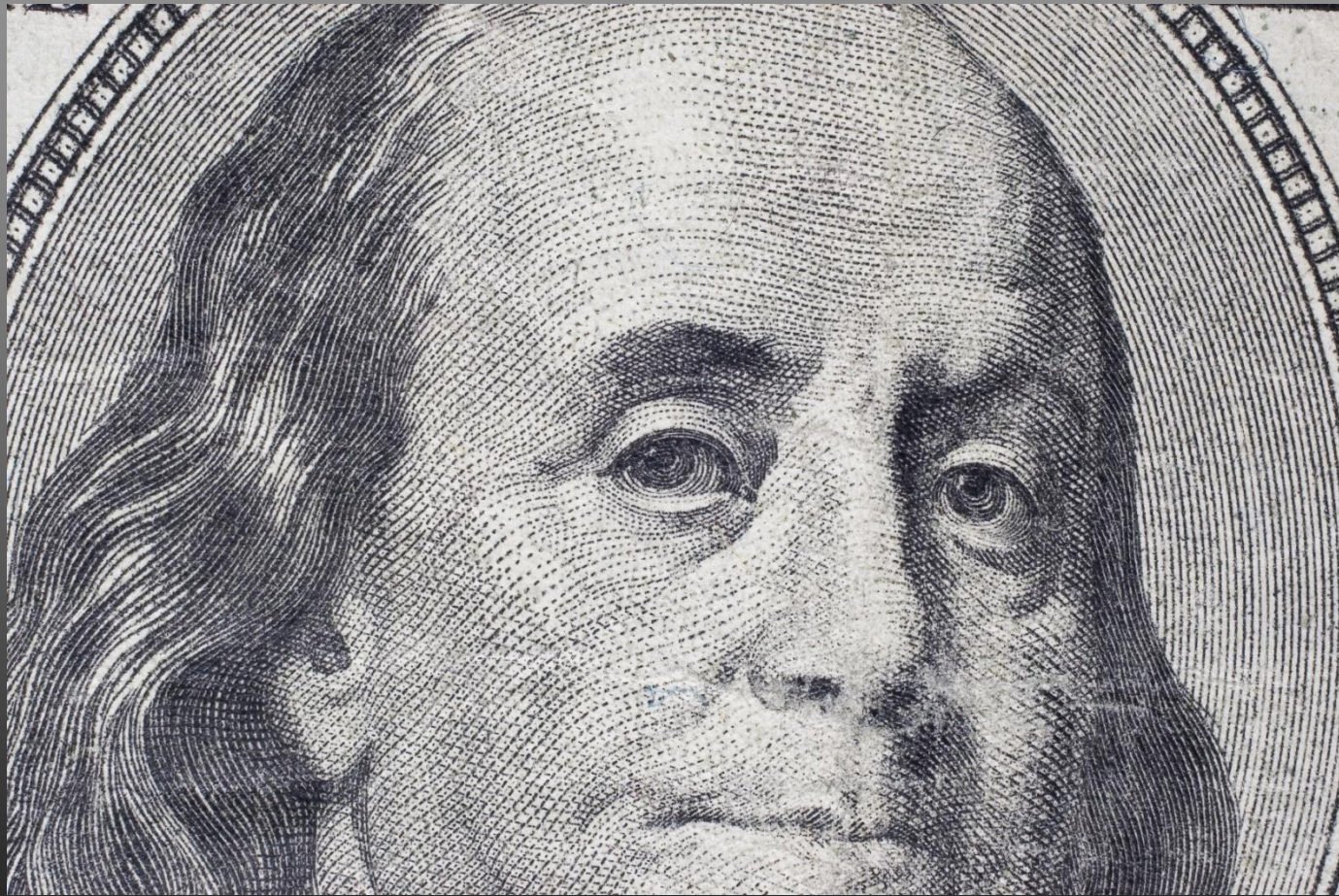
200mm (macro) + 12+20+36 ET + 2X Teleconverter



2 1/2" Working Distance

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PHOTOGRAPHY

50mm Macro



4" Working Distance

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50mm Macro + life-size



2 3/4" Working Distance

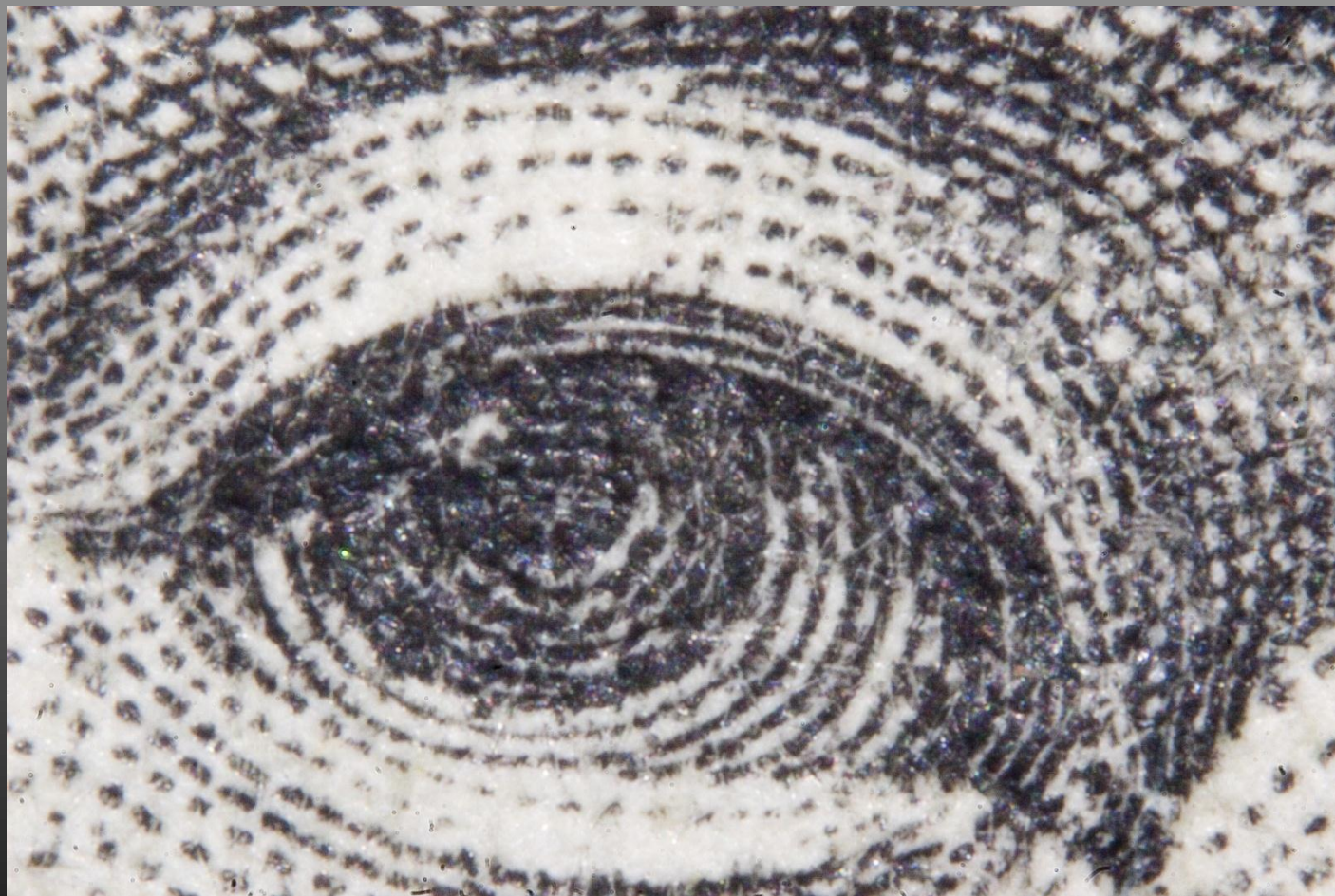
Greg Disch
PHOTOGRAPHY

50mm Macro + life-size + 12+20+36 Extension Tubes



2" Working Distance

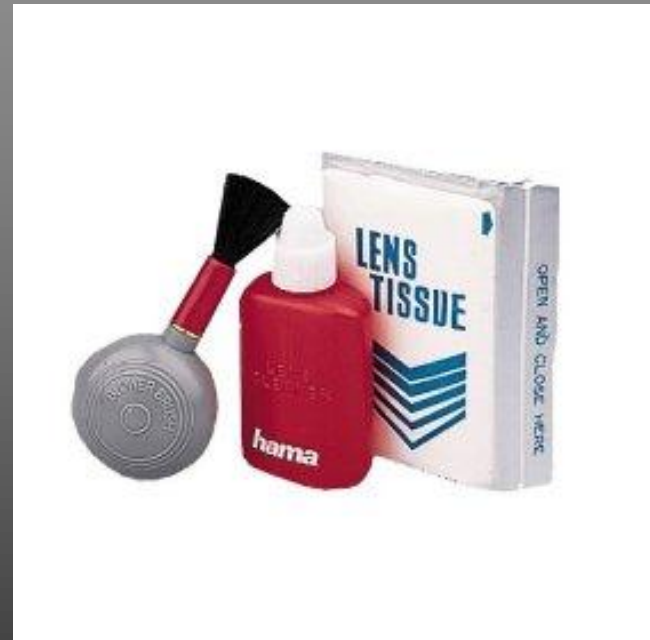
50mm Macro + life-size + 2X +12+20+36 Extension Tube



2 1/2" Working Distance

Lens Cleaning

- Blow off any dust or dirt with a blower brush or compressed air.
- Place a drop of lens cleaning fluid on a lens cleaning tissue.
- Gently wipe the lens surface from the edges to the center.
- A microfiber cleaning cloth is good for quick cleanings.



It's 10:00, Do You Know Where Your Lens Cap Is???

- Lens caps, both front and rear should be attached when the Camera-Lens is not in use.
- Do as I say, Not as I do.



Lens Protection

- Use a skylight or UV filter for protection.
- Using a Lens Hood is a good way to help protect the front elements.
- Protect them from shock with an appropriate lens case.

Dust Inside Lens

- This is fairly normal with non weather sealed lenses.
- Normally a little bit of dust will not make any noticeable difference.


Scratches on Lenses

- A tiny scratch or chip on the front glass of a lens, alarming as it may look, won't actually make much difference in image quality under most circumstances since it's far enough from the film or image sensor plane not to be in focus.
- Chips on the rear glass of a lens are more of a problem.


What Lens Should I Buy?

Canon EF Lenses
Limited only by your imagination.


Zoom Lenses




Single Focal Length Lenses




TS-E Lenses




Extenders



Extension Tubes



Close-Up Lenses



Nobody Can Buy Just One!

- With a DSLR you are defeating the point of having it, if you do not have multiple lenses to change out.



Price Matters

- Prices vary dramatically based on quality.
- Pick a starting point and then start adding for all the improvements that we have covered.
- High quality lenses maintain their value.



If You Don't Know You
Need It,

Then You Probably
Don't.

Lenses 101

Greg Disch
P H O T O G R A P H Y

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