Fountain Hills Photography Club
Information Series

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9/2/14

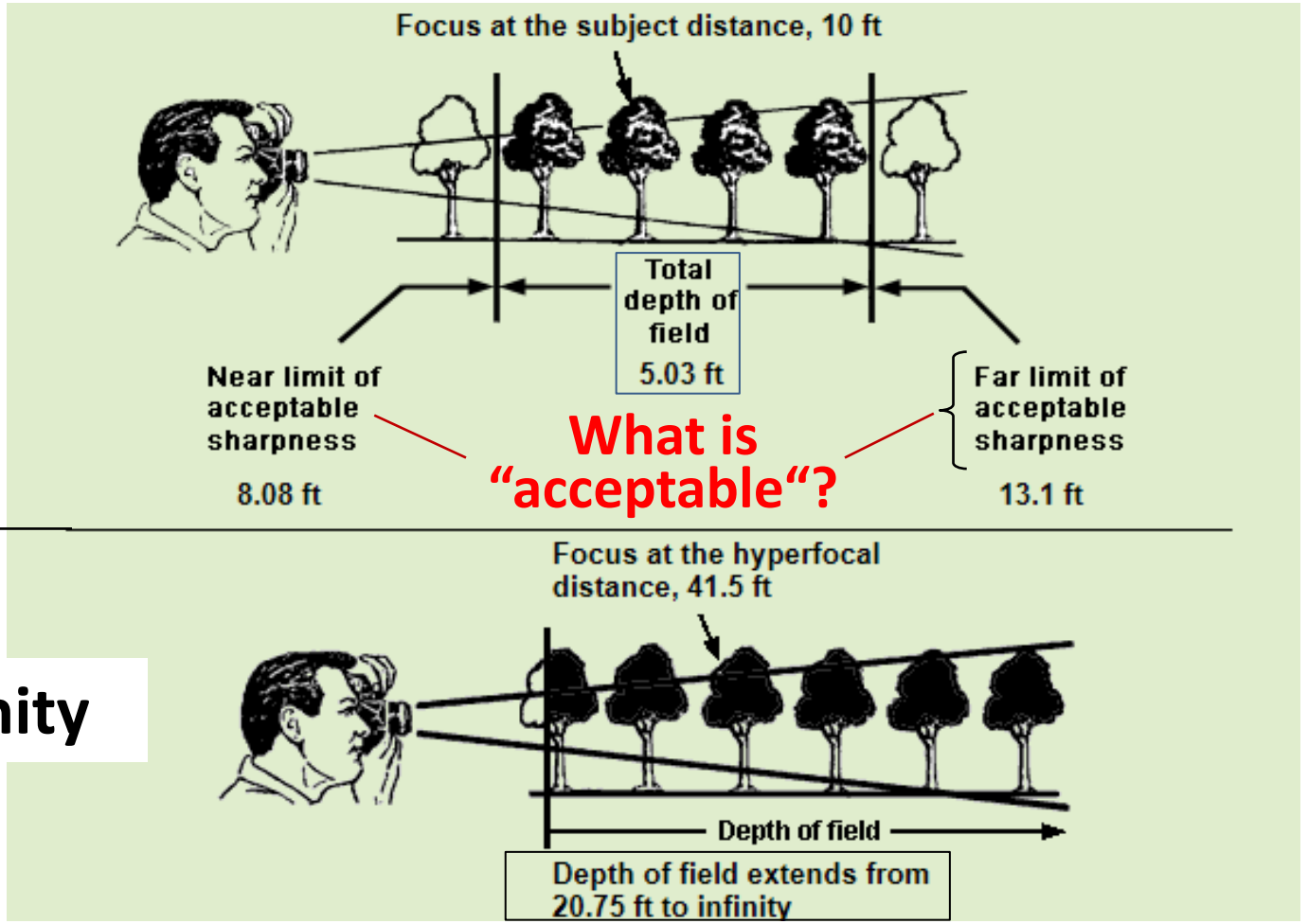
Warning : Be Aware that Some HyperFocal Distance (HFD) Calculators on the Web will give you misleading Hyperfocal Distance and DOF values

Disclaimer : Internet HFD calculators have the math right; I'm questioning the validity of using an outdated criterion for acceptable sharpness

3 Uses of HyperFocal Distance (HFD)

Depth of Field

Numbers shown are DOFMaster website results



1. Near / Far

2. ½ HFD / Infinity

3. If you focus on infinity, objects from HFD to infinity will be in focus

What is “Acceptable” Blur?

- **The “Circle of Confusion” (CoC) defines how much defocus blur is acceptable**
  - **In the “old days”, it was 30 microns (film & typical lenses)**
  - **30 microns is still used in Hyperfocal tables found on the Internet today**
- **For digital cameras, the CoC is now determined by the sensor pixel size (good lenses are much better than 30 years ago)**
- **Hyperfocal distance calculators need to be reformulated to suitably calculate CoC for digital cameras**

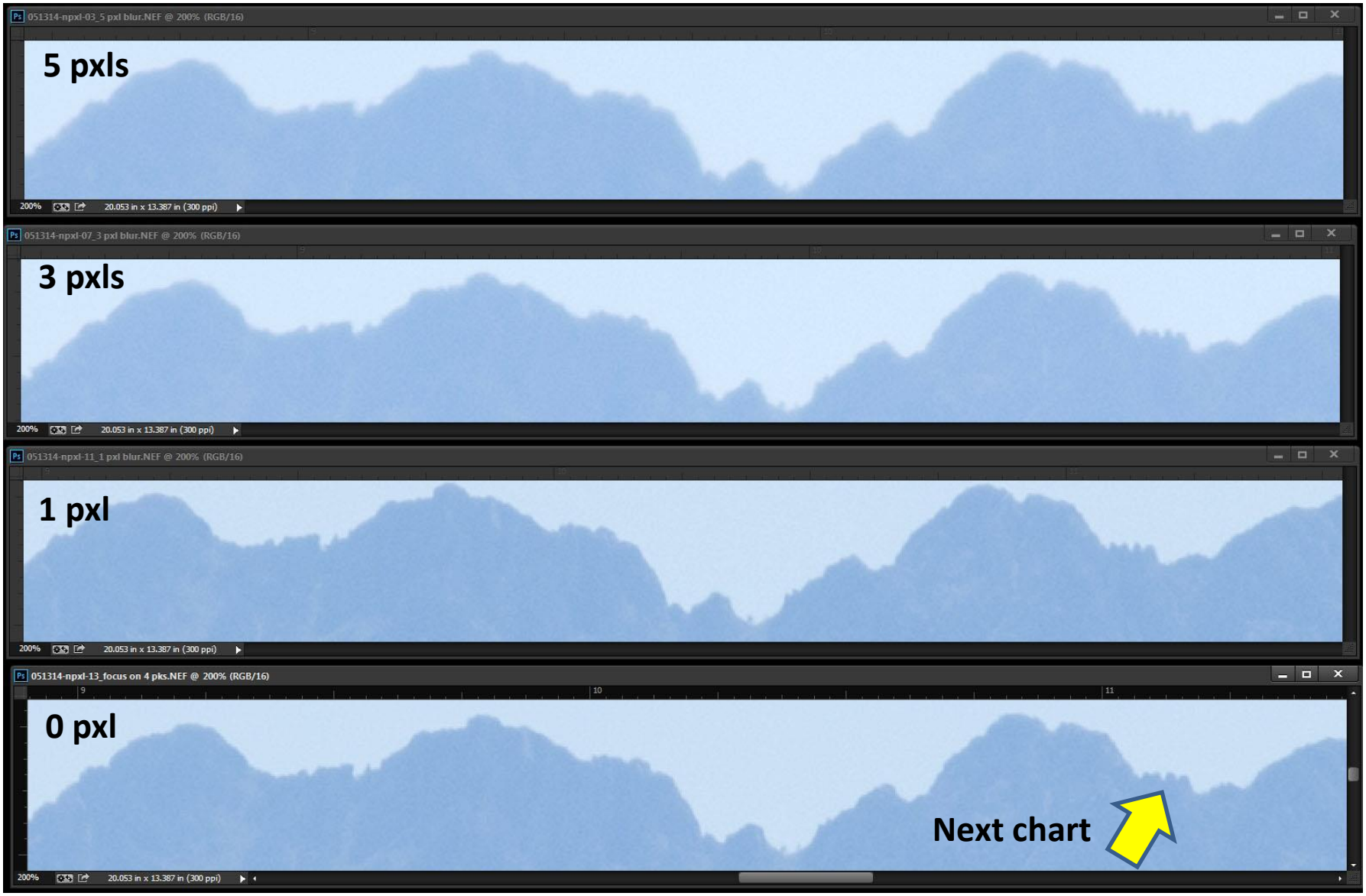
What is “Acceptable” Blur?

- Thus the “Circle of Confusion” should be computed as a factor times the sensor pixel size
  - For example ; a Nikon D610 has 6 micron pixels
  - If CoC = acceptable 2 full pixels of blur, then CoC = 12 microns
- Why does this matter?
  - Achieving a Depth Of Field (DOF) is tougher with today’s cameras because of better image quality (amount of acceptable blur is down)
  - If you ignore this, then you likely will be disappointed in the sharpness of portions of your images
- Lets look at some pictures

Let's Look at some Pictures

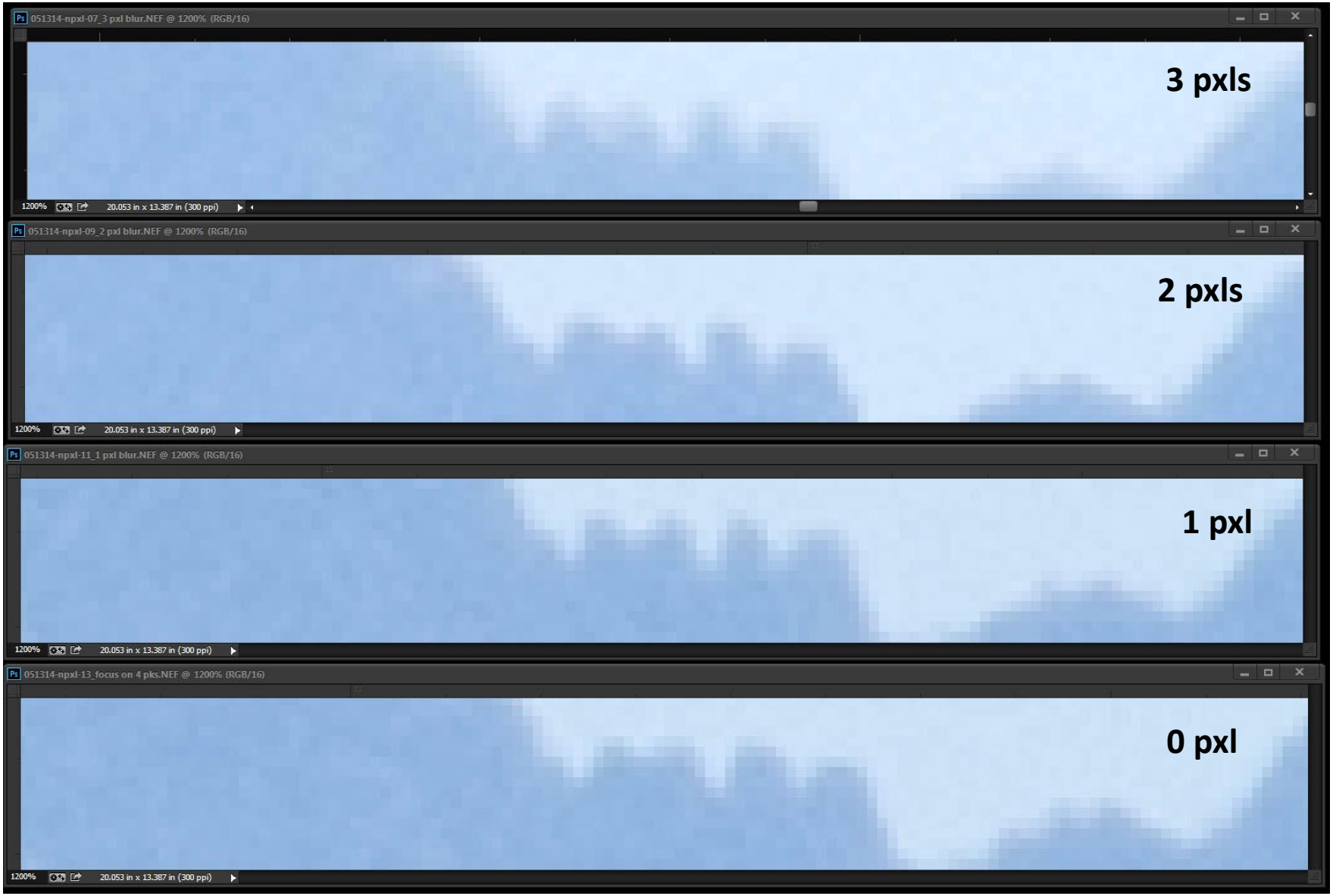
- Pictures taken of 4 Peaks, for different numbers of pixels of allowed defocus blur (5, 3, 2, 1, 0 pixels)
  - Nikon D610 with set at FL = 120 mm, f/8
  - Focus camera on selected HFDs, take pics of 4 Peaks
- Look for point of diminishing return on improved far field image sharpness

Images of 4 Peaks Taken For 5, 3, 1 and 0 Pixels of Blur



Clearly, 5 Pixels of Blur is Too Much

Images of 4 Peaks Taken For 3, 2, 1 and 0 Pixels of Blur



Conclusion : Allow ≈ 2 Pixels of Blur

Using a Hyperfocal Distance Calculator - 1

- **Using the "Old" CoC of 0.030**

DOFMaster graphic

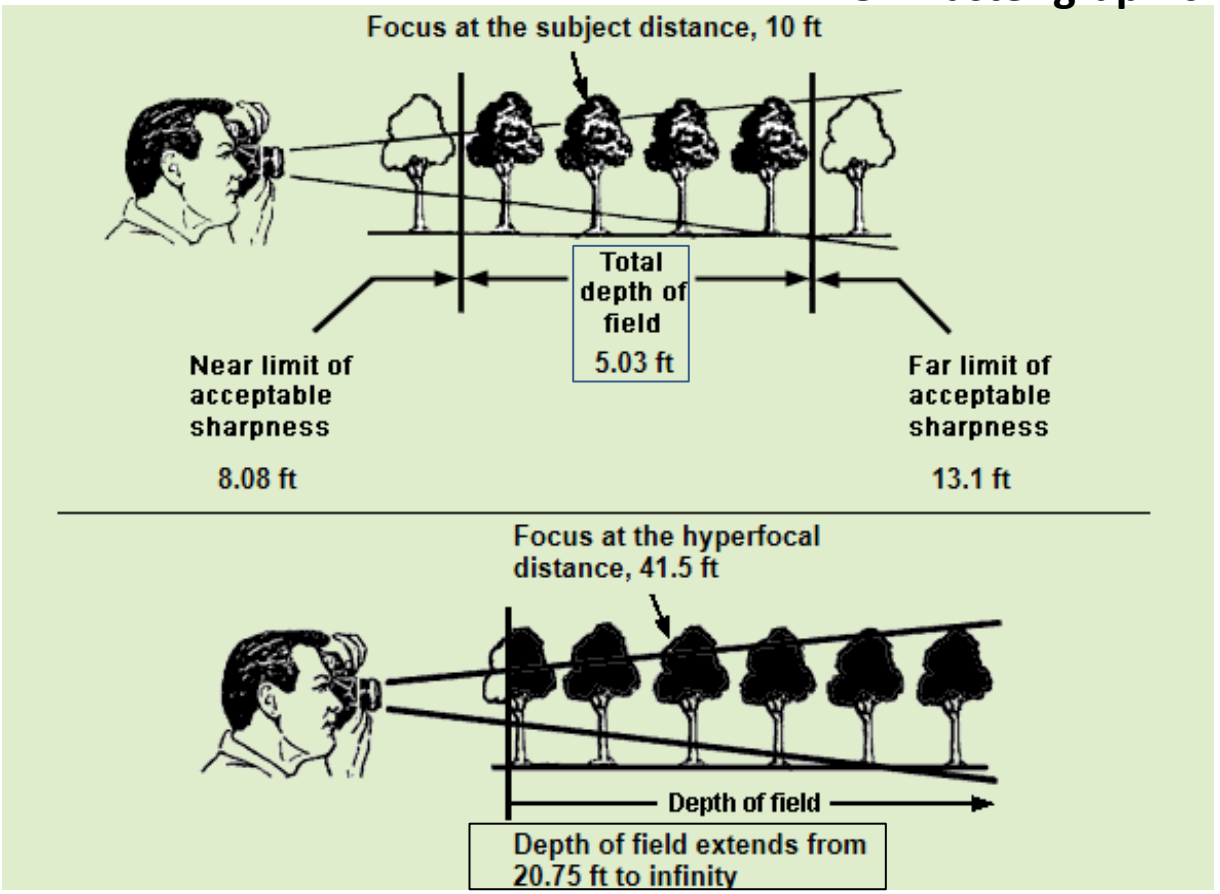
BOYCE'S DIGITAL CAMERA DEPTH OF FOCUS AND HYPERFOCAL DISTANCE CALCULATOR

INPUTS

Fractional Pixel Blur =	6.13
Camera =	D800
Lens focal length [mm] =	55
Lens f/no =	8
Focus distance [ft] =	10
OR Focus distance [in] =	

OUTPUTS

Hyperfocal distance [ft] =	41.6
Nearest focus [in] =	8.12
Farthest focus [in] =	13.05
Total DOF [in] =	4.94
Image magnification =	1 : 0.018
Circle of Confusion [mm] =	0.030

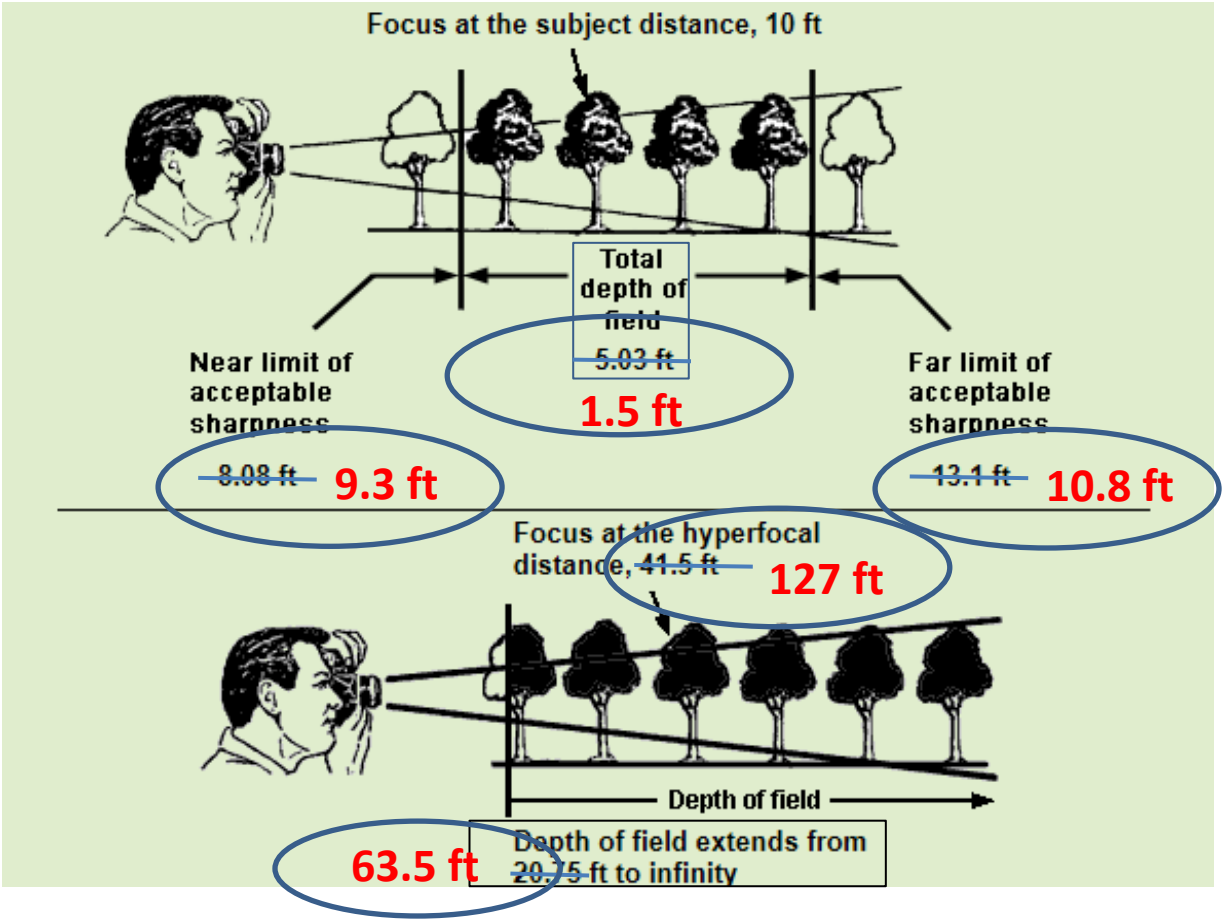


- **Digital Camera DOF and Hyperfocal Distance Calculator on left is reformulated for digital cameras to define CoC (acceptable blur) as a number of pixels**

Using a Hyperfocal Distance Calculator - 2

- Using "New" CoC of 2 pixels

BOYCE'S DIGITAL CAMERA DEPTH OF FOCUS AND HYPERFOCAL DISTANCE CALCULATOR	
INPUTS	
Fractional Pixel Blur =	2.00
Camera =	D800
Lens focal length [mm] =	55
Lens f/no =	8
Focus distance [ft] =	10
OR Focus distance [in] =	
OUTPUTS	
Hyperfocal distance [ft] =	127.0
Nearest focus [in] =	9.294
Farthest focus [in] =	10.824
Total DOF [in] =	1.5295
Image magnification =	1 : 0.018
Circle of Confusion [mm] =	0.0098



- "New" CoC assumption changes HFD and DOF
- Benefit is that at edge of DOF, objects will be in focus

I Looked at 3 HyperFocal Distance (HFD) Calculators Currently Found on the Internet

Two were found to be using the old value of CoC = 0.030 mm

One asks you to manually enter your camera's CoC value

PanoHelp, The One Website That Asks You to enter CoC

http://www.panohelp.com/hyperfocaldistance.html

Focal length: 50 mm

Circle of confusion: 0.005 mm - find constant for your digital camera

Units: feet

Recalculate Table

Input = 1 pixel for D800

50-mm Hyperfocal Distance Table

Aperture	1	1.1	1.2	1.4	1.6	1.8	2	2.2	2.5	2.8	3.3
$h = \frac{f^2}{Ac} + f$	1641	1491	1367	1172	1025	912	820	746	656	586	497
h / 2	820	746	684	586	513	456	410	373	328	293	249
Aperture	**3.5**	**4**	**4.5**	**5**	**5.6**	**6.3**	**7.1**	**8**	**9**	**10**	**11**
$h = \frac{f^2}{Ac} + f$	469	410	365	328	293	261	231	205	182	164	149
h / 2	234	205	182	164	147	130	116	103	91.2	82.1	74.6
Aperture	**13**	**14**	**16**	**18**	**20**	**22**	**25**	**29**	**32**	**36**	**40**
$h = \frac{f^2}{Ac} + f$	126	117	103	91.3	82.2	74.7	65.8	56.7	51.4	45.7	41.2
h / 2	63.2	58.7	51.3	45.6	41.1	37.4	32.9	28.4	25.7	22.9	20.6

Distances are in feet with a 'circle of confusion' constant of 0.005 mm

- **Only website I found that asks you to enter a CoC value**
- **To use this site, know your pixel size, calculate your CoC, and enter it manually**

Summary - 1

- **Beware of HFD calculators on the internet using outdated CoC values**
- **Outdated calculators will compute a hyperfocal distance that is too small & DOF values that are too large, resulting in images with unplanned blur**
- **You can use PanoHelp; manually enter digital CoC**
  - **Digital CoC = #pxlsofblur x pixel size [in mm]**
  - **Using a HFD calculator and with the right CoC assumption, you will have**
    - **Sharp images within DOF, but you will have …**
    - **A harder time keeping foreground objects in focus along with objects at or near infinity (need higher f/no and/or shorter EFL)**

Summary - 2

- **One convenient way to use HFD in the field is to use a table of HFD vs. focal length and f/no for each camera and # pixels of allowable blur.**

Hyperfocal Distance (HFD) [ft]										
Camera =	D600	f/no								
# pxl Bl =	2.00	1.4	2	2.8	4	5.6	8	11	16	22
focal length [mm]	14	38.4	26.9	19.2	13.4	9.6	6.7	4.9	3.4	2.4
	24	112.9	79.0	56.4	39.5	28.2	19.8	14.4	9.9	7.2
	35	240.0	168.0	120.0	84.0	60.0	42.0	30.5	21.0	15.3
	50	489.9	342.9	244.9	171.4	122.5	85.7	62.3	42.9	31.2
	80	1254.0	877.8	627.0	438.9	313.5	219.5	159.6	109.7	79.8
	120	2821.6	1975.1	1410.8	987.5	705.4	493.8	359.1	246.9	179.6
	200	7837.6	5486.4	3918.8	2743.2	1959.4	1371.6	997.5	685.8	498.8
	300	17634.7	12344.3	8817.4	6172.1	4408.7	3086.1	2244.4	1543.0	1122.2
	450	39678.1	27774.7	19839.0	13887.3	9919.5	6943.7	5049.9	3471.8	2525.0

- **Is that all you need to know to get optimal focus across your images?**
- **No – see next page**

Doing AF Micro-Adjust on your Camera – Lens Pairs

- **To take full advantage of your digital camera with lens, be sure it is in perfect focus.**
- **Fact : Any high end camera and any lens can individually meet manufacturer specified tolerances for assembly quality, but together they often do not achieve optimal focus.**
  - **Tolerance buildup for any specific combination of camera and lens can work against achieving perfect focus**
- **Camera manufacturers' solution is to provide the capability to save a defocus calibration constant for each lens in the camera (for high end cameras only).**

Which cameras have the AF Micro Adjustment?

Updated Apr 13, 2013

Canon

- 1Dx
- 1DsMk3
- 1DMk3
- 1DMk4
- 5DMk2
- 5DMk3
- 7D
- 6D
- 50D

Nikon

- D4
- D3
- D3x
- D3s
- D300
- D300s
- D600
- D700
- D800
- D800E
- D7000

Sony

- A900
- A850
- SLT-A77
- SLT-99

Olympus

- E-30
- E-620
- E-5

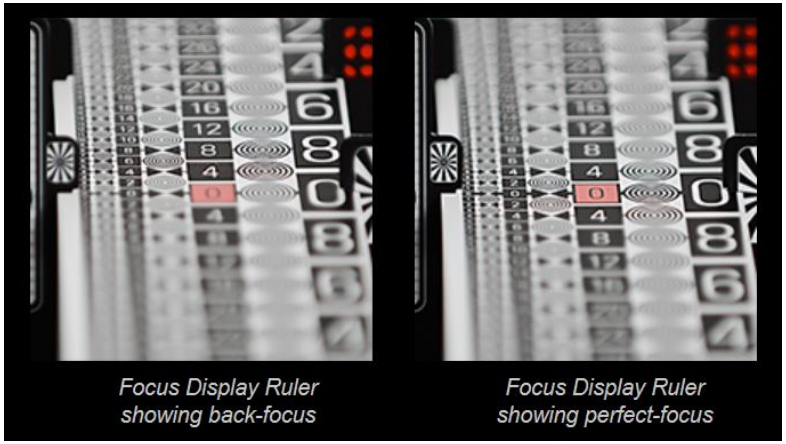
Pentax

- K20D
- K2000
- K200D
- K-5
- K7D
- 645D

Canon, Sony : AF Micro Adjustment
Nikon : AF Fine Tune
Olympus : AF Focus Adjust
Pentax : AF Fine Adjustment

MICHAEL TAPES DESIGN

http://michaeltapesdesign.com/



Before Fine Tune Adjustment

After Fine Tune Adjustment