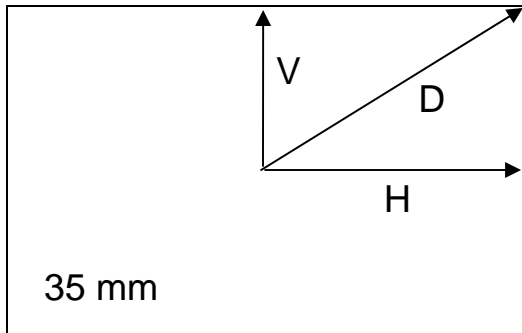


DX or APS-C Format DSLR

a) Required FOV – based upon 35 mm format with a 38 mm lens. Can use either the Horizontal, Vertical or Diagonal dimensions:



V: 12 mm
H: 18 mm
D: 21.6 mm

Chief Ray Angles:

$$\bar{u}_V = \frac{12\text{mm}}{38\text{mm}} = .316$$

$$HFOV_V = \tan^{-1}(\bar{u}_V) = 17.5\text{deg}$$

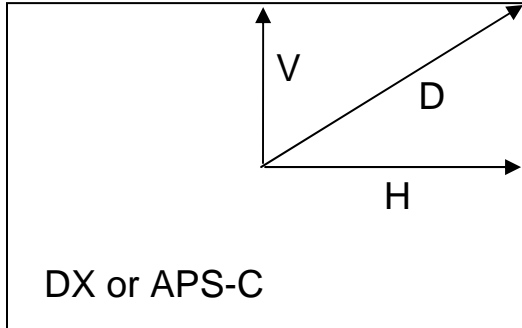
$$\bar{u}_H = \frac{18\text{mm}}{38\text{mm}} = .474$$

$$HFOV_H = \tan^{-1}(\bar{u}_H) = 25.3\text{deg}$$

$$\bar{u}_D = \frac{21.6\text{mm}}{38\text{mm}} = .569$$

$$HFOV_D = \tan^{-1}(\bar{u}_D) = 29.7\text{deg}$$

To determine the DX format focal length, these FOV's from the 35 mm system must be matched. Since the dimensions of the DX sensor are in the same ratio, any of the dimensions can be used to determine the focal length.



V: 8 mm
H: 12 mm
D: 14.4 mm

Using the Vertical dimension:

$$\bar{u}_v = .316 = \frac{8mm}{f}$$

$$f = 25.3mm$$

b) The focus zones are determined by using the equations for Depth of Field:

$$L_{FAR} \approx \frac{L_o f D}{f D + L_o B'}$$

$$L_{NEAR} \approx \frac{L_o f D}{f D - L_o B'}$$

and solving for L_0 in terms of L_{FAR} :

$$L_0 \approx \frac{L_{FAR} f D}{f D - L_{FAR} B'}$$

Also $f/4 \rightarrow D = 6.33mm$
 $B' = 0.010mm$

For zone 1, L_{FAR} is infinity. L_0 and L_{NEAR} are then determined. The image plane for the sensor is found by imaging L_0 :

$$\frac{1}{L'_0} = \frac{1}{L_0} + \frac{1}{f}$$

The following spreadsheet provides the results:

Zone	L FAR	L 0	L NEAR	Image Plane	Focus Shift
1	1E+20	-16014.90	-8007.45	25.34	0.040
2	-8007.45	-5338.30	-4003.73	25.42	0.120
3	-4003.73	-3202.98	-2669.15	25.50	0.201
4	-2669.15	-2287.84	-2001.86	25.58	0.283
5	-2001.86	-1779.43	-1601.49	25.66	0.365
6	-1601.49	-1455.90	-1334.58	25.75	0.447
7	-1334.58	-1231.92	-1143.92	25.83	0.530
8	-1143.92	-1067.66	-1000.93	25.91	0.614
9	-1000.93	-942.05	-889.72	26.00	0.698
10	-889.72	-842.89	-800.75	26.08	0.783
11	-800.75	-762.61	-727.95	26.17	0.868
12	-727.95	-696.30	-667.29	26.25	0.954
13	-667.29	-640.60	-615.96	26.34	1.040
14	-615.96	-593.14	-571.96	26.43	1.127
15	-571.96	-552.24	-533.83	26.51	1.215
16	-533.83	-516.61	-500.47	26.60	1.303
17	-500.47	-485.30	-471.03	26.69	1.392
18	-471.03	-457.57	-444.86	26.78	1.481
19	-444.86	-432.84	-421.44	26.87	1.571
20	-421.44	-410.64	-400.37	26.96	1.661
21	-400.37	-390.61	-381.31	27.05	1.752
22	-381.31	-372.44	-363.98	27.14	1.844
23	-363.98	-355.89	-348.15	27.24	1.936
24	-348.15	-340.74	-333.64	27.33	2.029
25	-333.64	-326.83	-320.30	27.42	2.123

16 zones are required to image objects as close as 500 mm. The lens position must shift by about 1.3 mm for the full range of object positions.

Note that the focus zones get small for close object positions.