DoF Viewer v2.0
User Guide

DoF Viewer calculates near and far boundaries for acceptable sharpness, hyperfocal distance and depth of field - as do many such calculators - but it does a little more ...

The user guide describes both the iPhone and iPad version. The iPad version adds an extended feature allowing to compare 2 camera setups at the same time

Its unique interface allows to check the results for the whole aperture range. A «simple» swipe on the graphic zone will change the aperture values.

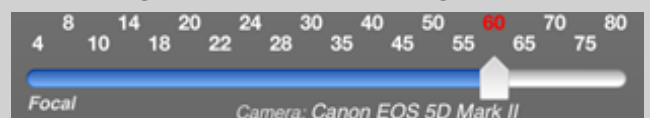2 sliders allow you to «play» with the shooting parameters
- Distance Focus (distance scale is linked to the Focal choice)

- Registered Focal from 4mm to 1200mm.
  Focal length selection is configurable (via the setup page). A new mode using a «picker»


or a legacy mode using a «slider».

In case of «slider» mode, the buttons Wide/Tele allow to choose between wide lens and tele lens.

«Info» button allows to access the DoFViewer setup page.

A control button allows to select the aperture range from f/1 to f/64 with full-stop, one-half-stop and one-third-stop f-number scale.

Layout of the iPad version is different as the two main views are displayed at the same time : The graphical sharpness zone and DoF distribution
Moreover, the iPad adds the possibility to compare 2 camera setups then the graphics are duplicated
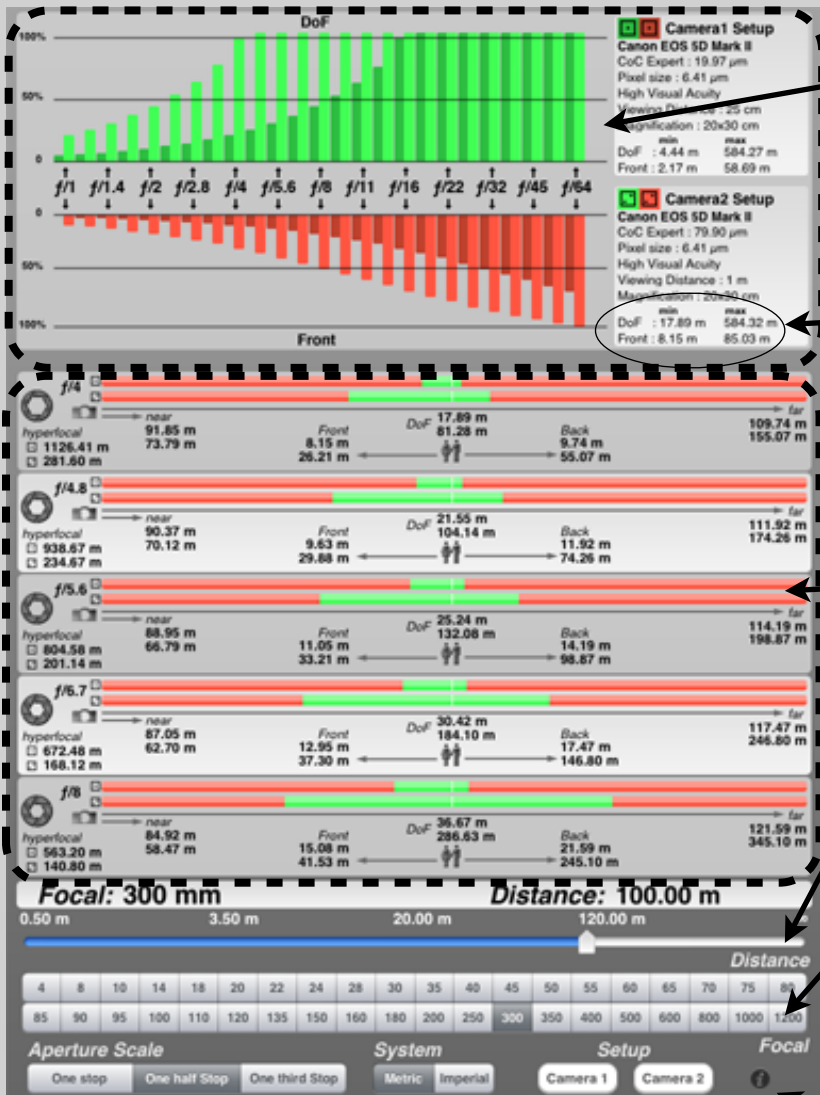
The bar graph view represents the distribution of the DoF and the Front boundary over the aperture range.
function of the aperture.

The view gives the minimum DoF and the maximum DoF (*see iPhone section to have more detail on this view*)

A «simple» swipe on the graphic zone will change the aperture values.

- Distance Focus (distance scale is linked to the Focal choice)

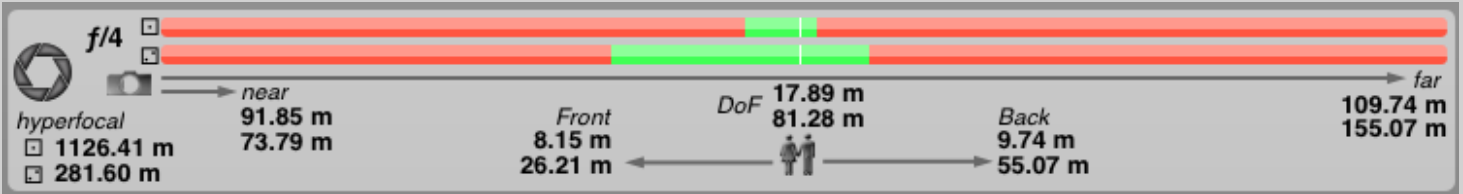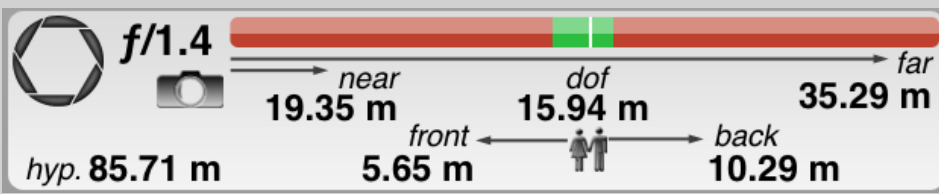- Registered Focal from 4mm to 1200mm can be directly selected

Help button : Provide the Help file you are reading !

A control button allows to select the aperture range from f/1 to f/64 with full-stop, one-half-stop and one-third-stop f-number scale.

Access to the camera setup.
You can configure 2 cameras, then compare the differents results.
Two different brands and models can be chosen **BUT the very usefull feature is to have the same model with different viewing conditions and print size (**«**CoC Expert Mode**» **then you will be able to appreciate the difference of DoF according to your own parameters**

see section : *Concept of the «Expert CoC calculation» mode*

Camera setup are identified with different colors and pictograms

f/1.4
hyp. 85.71 m
near 19.35 m
dof 15.94 m
far 35.29 m
front 5.65 m
back 10.29 m

f/4
hyperfocal 1126.41 m 281.60 m
near 91.85 m 73.79 m
Front 8.15 m 26.21 m
DoF 17.89 m 81.28 m
Back 9.74 m 55.07 m
far 109.74 m 155.07 m

For a set of parameters, DoF Viewer gives the Hyperfocal value, the Depth of field (DoF), as well as the near and far boundaries for acceptable sharpness. All the information (near/far, front/back, DoF and Hyperfocal) is displayed at the same time .

In one look, you have all the information you need.
The diaphragm picture is a reminder to show how it is open or not ! The Aperture value as well as a graphical representation of the sharpness zone are provided. The graphical representation allows you to have a very quick check at the DoF even without reading the figures !
The Camera and People pictograms are there to remind the concept of DoF, Near, Far, Front and Back figures.

Some definitions :

DoF (Depth of Field): This is the area in front of and behind the sharp focus plane that is also sharp or clear (green zone on the graphe).

Near Distance: This is the distance **to the camera** from where acceptable sharpness starts, when you focus at a given distance.

Far Distance: This is the distance **to the camera** where acceptable sharpness ends, when you focus at a given distance

Front Distance: This is a complementary value to the Near Distance. Front distance is the distance **from the subject** where acceptable sharpness starts

Back Distance: Complementary value to the Far Distance. Back distance is the distance **from the subject** where acceptable sharpness ends.

Hyperfocal: This is the nearest point to the camera in acceptable sharpness if the lens is focused at infinity. If you focus at the hyperfocal distance, everything from one-half the hyperfocal distance to infinity will be in acceptable sharpness.

With the iPhone version, a second view improves the DoF visualization with respect to the aperture/focal/distance parameters. ... Just swipe horizontaly the graphic zone to access the view
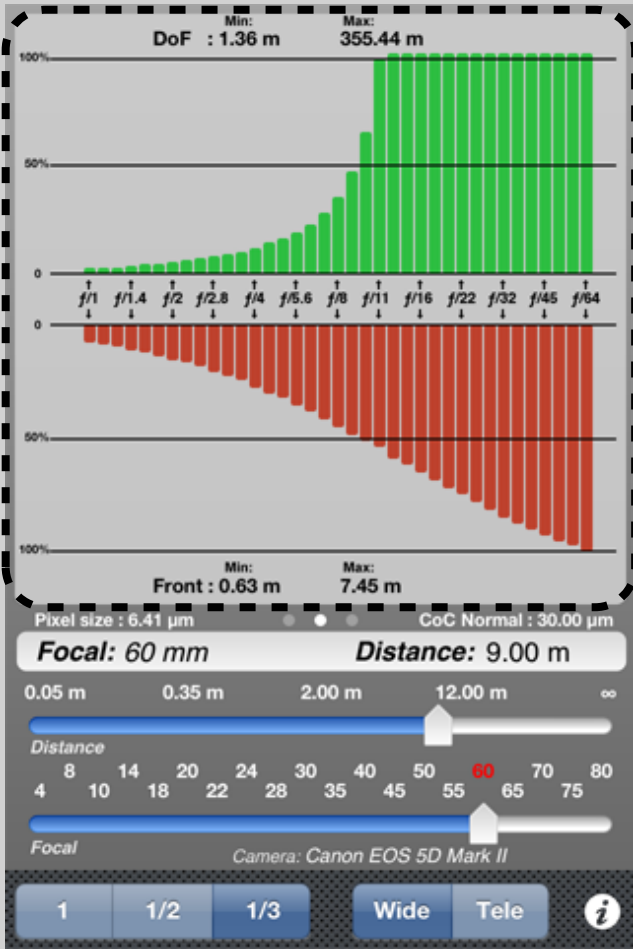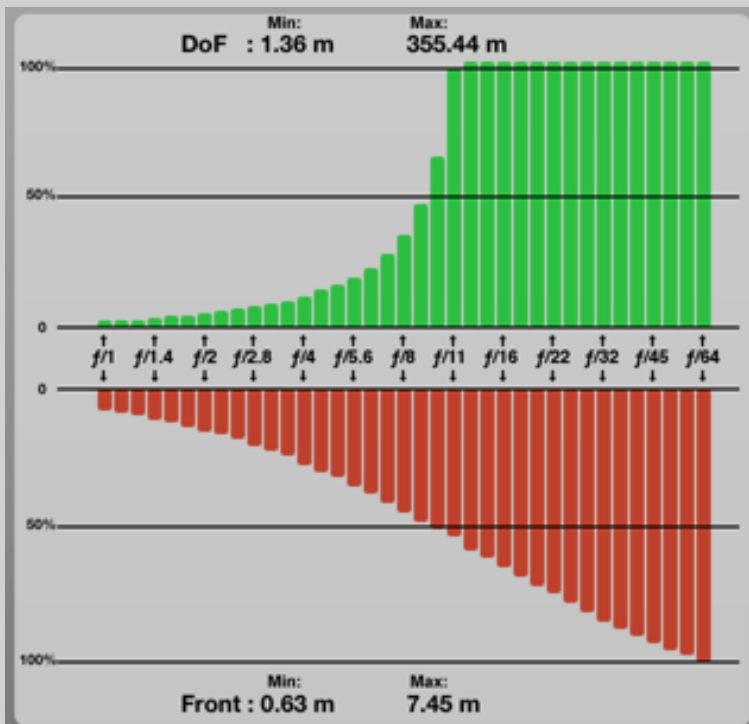

The bar graph view represents the distribution of the DoF and the Front boundary over the aperture range. You can quickly check the DoF and Near improvements in function of the aperture.

The view gives the minimum DoF and the maximum DoF (differente from infinite) If the DoF is infinite the bar is over 100%.


The «100%» and «50%» lines allow you to estimate the DoF.

100% corresponds to the maximum DoF. The 50% line represents a DoF divided by 2 compare to the maximum DoF displayed.

Same bar graph is used to represents the Front boundary for acceptable sharpness. it gives the minimum and the maximum value over the aperture range.

To Calculate the Depth of Field, the application needs a sharpness criterion. This criterion is taken as the so-called circle of confusion (CoC). CoC is influenced by a variety of factors, including film format, print size, viewing distance, etc.
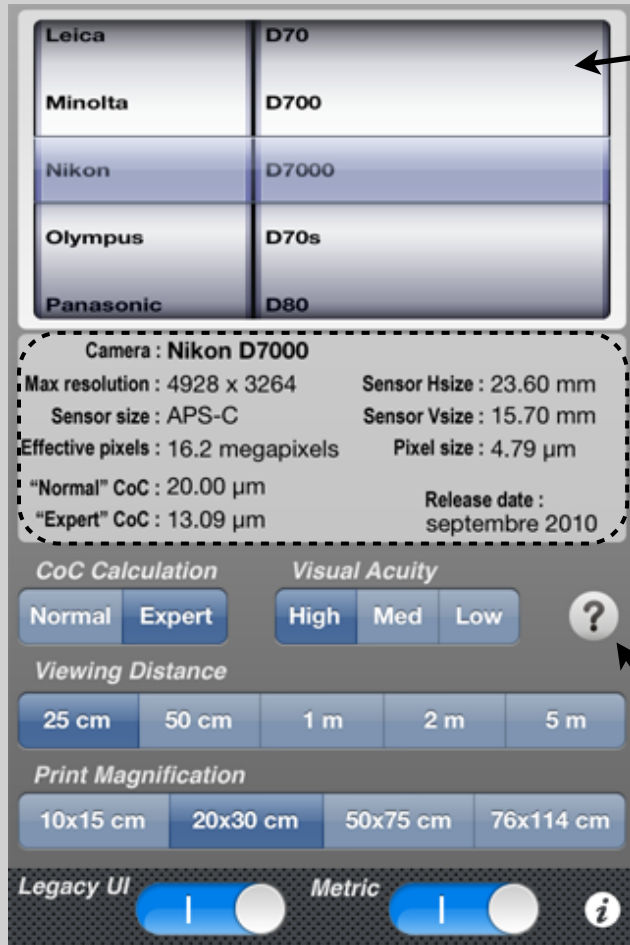
DoFViewer provides a camera database which gives the corresponding CoC for each model.

As a «bonus», you can also find some characteristics of the selected camera as : maximum resolution, sensor size, pixel size ...

The CoC provided with the database is based on the a «modified» Zeiss formula which gives a widely used value of 0.030 mm for full-frame 35 mm format. The CoC coming from the database is displayed as «Normal CoC» and is used in «Normal CoC calculation» mode

Help button : Provide the Help file you are reading !

New feature in DoFViewer is the «Expert CoC calculation» mode. Instead of using the «normal CoC» based on the appearance of a standard sized print at a standard viewing distance, the Expert mode will calculate the CoC based on the factors described before : film format, print size, viewing distance and visual accuity. You have to define your criteria, and the application will compute the CoC.

In some configuration in «Expert CoC calculation» mode, the calculated CoC could be smaller than the pixel size. Even if DoFViewer will continue to estimate the DoF, it will not be realistic as the resolution required is greater than the sensor resolution ! In that case «Expert CoC» and Pixel size indicators will go to red.
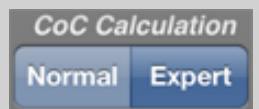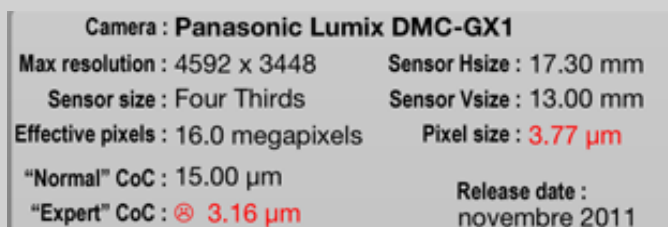
Concept of the «Expert CoC calculation» mode

Back to a some theory.

The circle of confusion ("CoC") is defined as the largest blur spot that will still be perceived by the human eye as a point.
With this definition, the CoC depends on two factors: Visual acuity and Viewing conditions (viewing distance in our case).

When apply to photography, the CoC is the translation (magnification) of the original CoC to the camera sensor size. The CoC for photography will then depends on three factors : Visual acuity, Viewing conditions (viewing distance) and Enlargement (Enlargement from the original image to the final image).

Calculation of the CoC :
• Visual acuity for human is around 0.1mm at 25 cm. It means, we can distinguish an image resolution of 5 line pairs per millimeter (lp/mm), equivalent to a CoC of 0.2 mm in the final image.
• Viewing distance : Human angle of view is approximately 60° which correspond to cover a surface equivalent to a diameter of 29 cm when viewed at 25 cm. This diameter of 29 cm corresponds to a rectangle of 16 cm x 24 cm

First conclusion : The CoC calculation applied to our camera is based on these assumptions : viewing a print of 16 cm x 24 cm with a visual acuity of 0.1 mm and at a distance of 25 cm. This print can be represent like this :
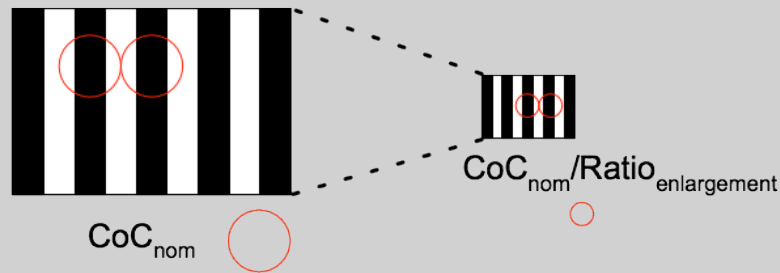

CoC_{nom}
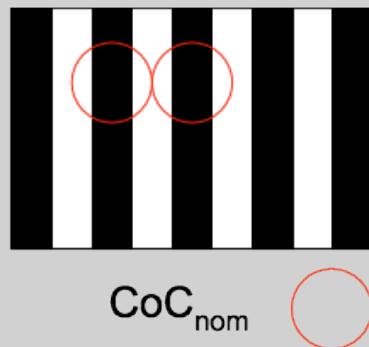
CoC apply to photography :
According to the fact we will «observe» the 16 cm x 24 cm print (described above) at 25cm, we have to translate this print to the sensor size in order to define the CoC of the camera
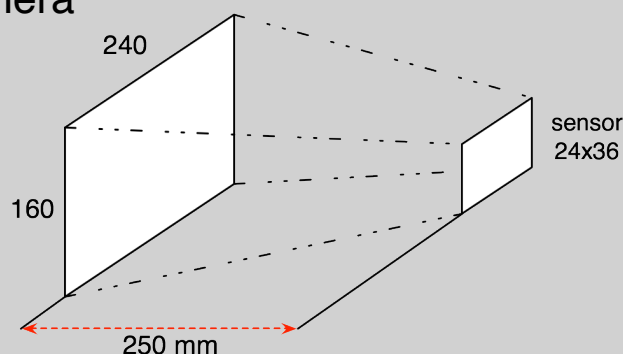
For full-frame 35 mm format, the enlargement factor to go from 24x36 to 240x160 is 6.7 which give a camera CoC of 0.2/6.7 ≈ 0.03 mm

CoC_{nom}

$CoC_{nom}/Ratio_{enlargement}$

Second conclusion : The full-frame 35 mm format CoC is 0.03mm **BUT** it is for very specific conditions : viewing a print of 16 cm x 24 cm with a visual acuity of 0.1 mm and at a distance of 25 cm.
What happens if the conditions are changing :
viewing a print of 50 cm x 75 cm,   or viewing at a distance of 50 cm ?
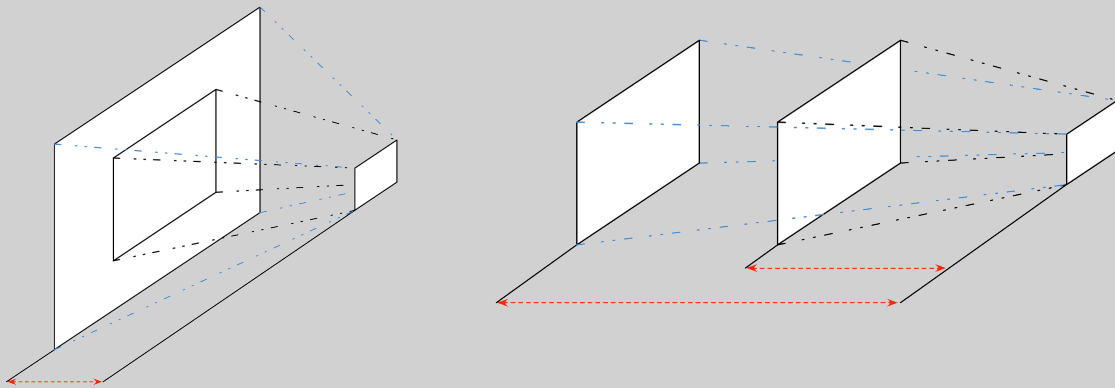
CoC of 0.03 mm is no more acurate, nor the DoF calculation !
⇒ **Expert Mode of DoFViewer should be used**

How the «Expert CoC calculation» works

The calculator always takes for reference the viewing of a 16 cm x 24 cm print but it will re-calculate the CoC according to the conditions

• Visual acuity
    Three visual acuity can be selected
    High : acuity of 0.083 mm @ 25 cm, acuity is proportional 1/3000 to of the viewing distance
    Medium : acuity of 0.1 mm @ 25 cm, acuity is proportional 1/2500 to of the viewing distance
    Low : acuity of 0.2 mm @ 25 cm, acuity is proportional 1/1250 to of the viewing distance

• Viewing distance
   Acuity will decrease when viewing distance increase

- <u>Print size</u>

    A new ratio of enlargement is calculated to keep the reference CoC in line with the visual acuity and the viewing distance.

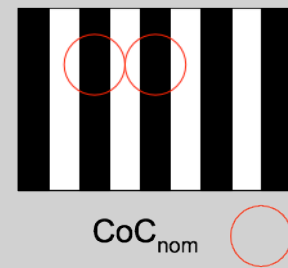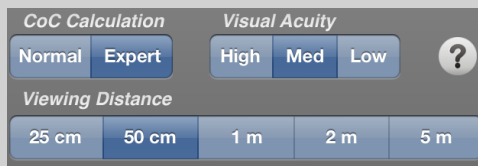**The final CoC should take into account the three conditions**

To finish, an example how the Expert CoC is calculated with a small use case :
⇒ Viewing an enlarged print at a given distance

The choice of the Visual acuity and the Viewing distance will fix the reference CoC.
Then the calculator has to handle the enlargement ...
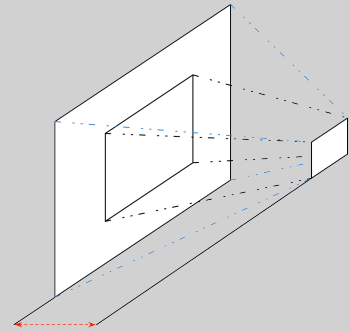
<u>Some pictures to illustrate</u> :

The 16 cm x 24 cm print with the reference CoC. The reference CoC is representative of the visual acuity and the viewing distance selected

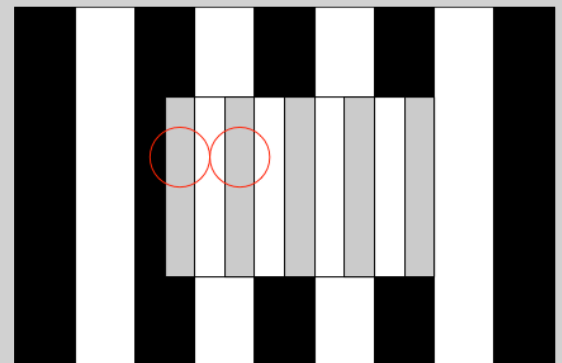| CoC Calculation		Visual Acuity			
Normal	**Expert**	High	**Med**	Low	?
Viewing Distance					
25 cm	**50 cm**	1 m	2 m	5 m	

CoC_{nom}

the print is enlarged to a given ratio (selected by the user).
As the print is increasing, the lines representing the limit of the visual acuity are increasing too.

| Print Size			
10x15 cm	**20x30 cm**	50x75 cm	76x114 cm
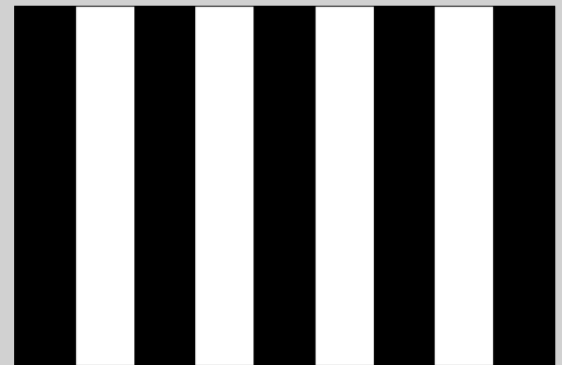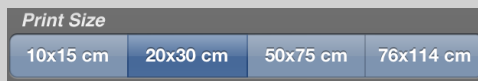
But, the print is still viewed at the selected distance defined below.
As a consequence if we map the reference CoC previously calculated on the new enlarged print, the visual acuity and the CoC does not match !
A new CoC has to be calculated to really appreciate the DoF of the enlarged print
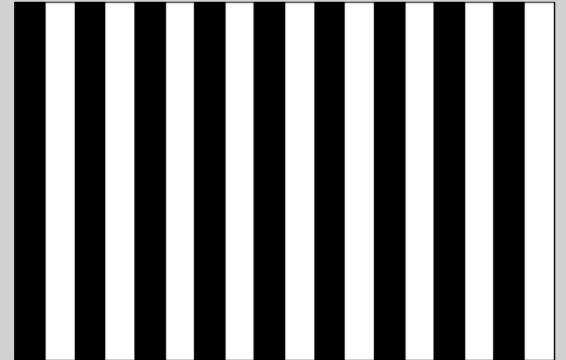
A new reference CoC is calculated taking into account the enlargement ratio. The reference CoC is now representative of the «potential» visual acuity.
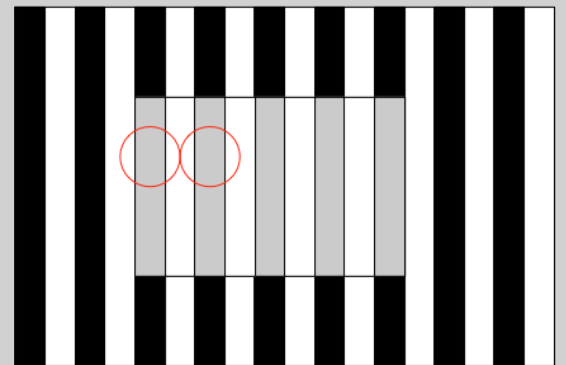
$CoC_{nom}/Ratio_{enlargement}$
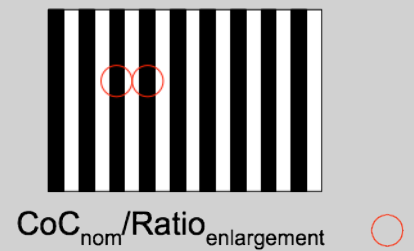
The print is then enlarged to the given ratio (and with the representation of the new limit of the visual acuity) .
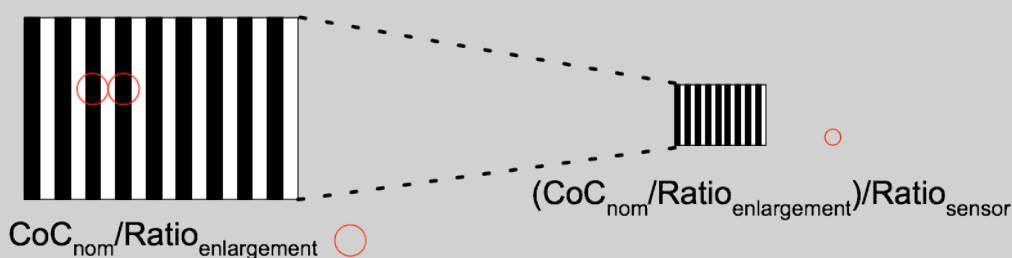
The lines representing the limit of the visual acuity and thus the reference CoC now match with initial conditions fixed by the user.
The new CoC can be used to really appreciate the DoF of the enlarged print

Last operation consists to map the new reference CoC to the Camera sensor

$CoC_{nom}/Ratio_{enlargement}$

$(CoC_{nom}/Ratio_{enlargement})/Ratio_{sensor}$

In conclusion, the «Expert CoC» mode should provide more accurate estimation of the DoF as it takes into account the viewing conditions and the print size.

Feedback are welcome if you appreciate the application

Arnaud K.