Cooke's Panchro lenses. A cinematographic evaluation

By Alfonso Parra AEC

We are going to show in this article our tests on a set of Panchro lenses designed by Cooke in Leicester, England. Theses lenses were made by the same team who made the S4 ones. Before going specially into the issue of evaluation I wish first to express my personal enthusiasm with Cooke's lenses, above all with these last ones that are named as the mythical lenses used in Hollywood during the twenties; this name honors those lenses that overpowered shooting during the last century. The lenses set supplies the next focal lengths: 18, 25, 32, 50, 75 and 100 mm, with T of 2.8-22, moreover, it includes the /i dataLink technology. This technology is able to keep as metadata everything related to the lens values: serial number, focal, diaphragm and zoom values, the closest and the most distant focal values regarding the focal point (deep of field), the horizontal vision angle, and camera values as speed or shutter angle too.

Alfonso Parra AEC, during the Panchro lenses test.

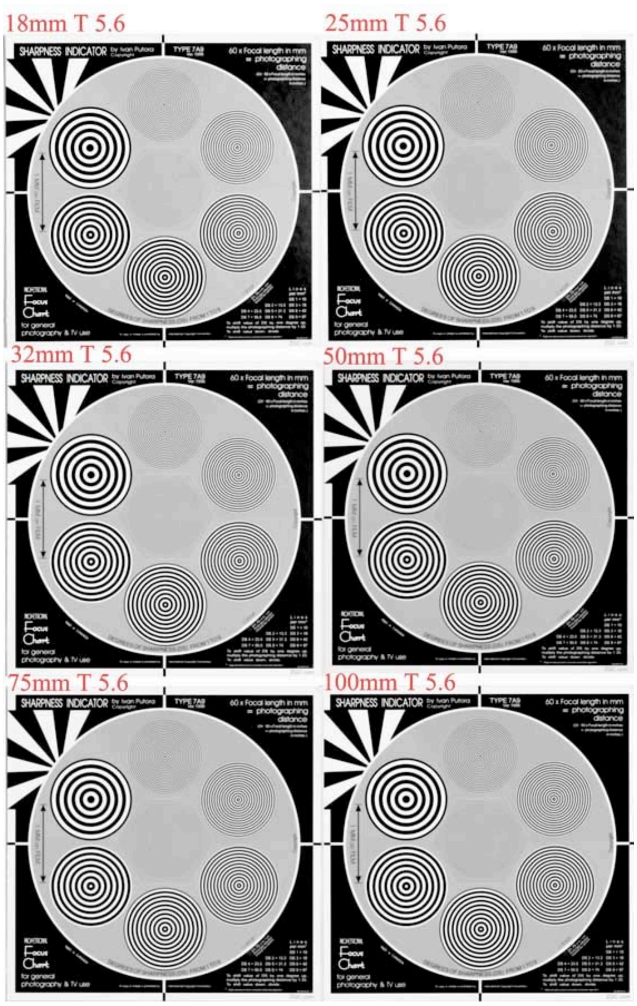
We have shot everything with the REDOneMX camera, 4KHD format, redcode 42. We have exported the material through REDCineX and we have seen it in a Cineimage's Cinetal monitor. We have also carried out some tests with the Sony's F35 camera; our target was to contrast the outcomes. Images in the article are coming from the REDOneMX one.

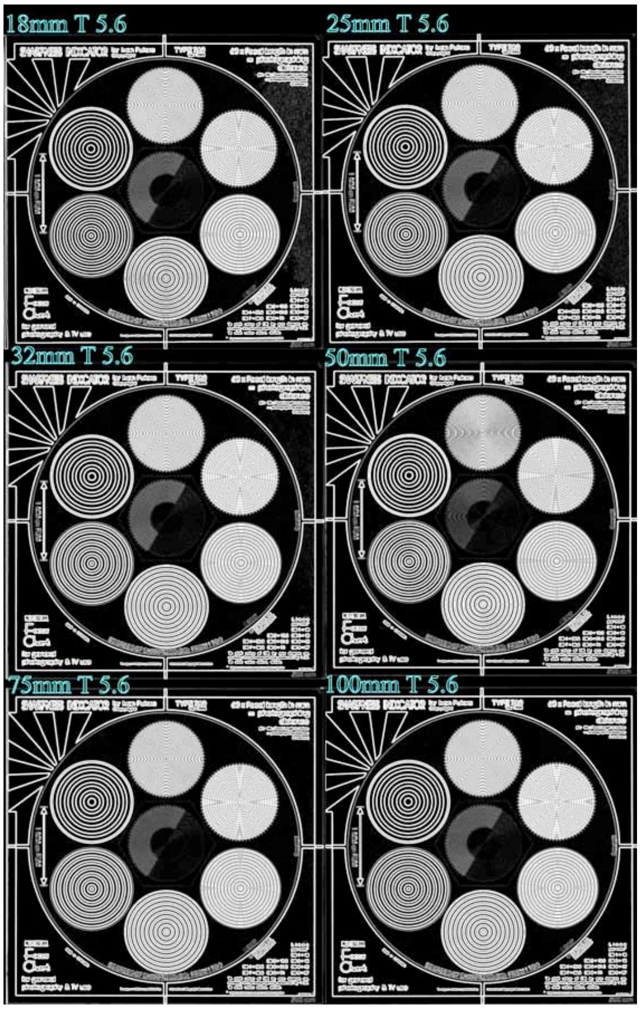
We are going to contrast the Panchro lenses with other high quality ones. We are trying to understand their abilities, but we are not going to compare them to other lenses, because each set of lens depends on the manufacturer. Each one uses different concepts and designs to build lenses, they are looking for the best balance between every optical feature –aberration, brightness, weight, costs, etc- . As Director of Photography I would like to make clear that I would like to understand, to learn how lenses reflect the world when I take pictures. In spite of splitting this survey, I do not want to lose the global performance of the lenses. In conclusion, this is not an optic survey, but a photographic one. I know I have not used the most precise resources intended to make a scientific work, however, I think these resources have been enough to choose the proper lens for creating the image I am looking for.

We have required the Standard & Parr's qualification agency services as a guide for the lenses survey. The agency has provided with their usual ratings. Ratings are purely illustrative, they are not binding.

Resolution / Sharpness. AA

In order to evaluate the resolution power, we have used our usual resolution charts. Nevertheless, I would like to remember our intentions that were stated in a previous article about the UniQoptics lenses, "*As Directors of Photography we are interested in knowing the system of power resolution. This is the reason for choosing the REDOneMX camera* (although we used the F35 one for specific features too) *to check theses lenses. On the one hand, this camera provides nowadays the image with the greatest resolution, on the other hand, we have often used it with other lenses, and therefore we have the bases for making contrasts. It is clear that the final resolution depends on the camera features, the sensor or its associated electronics, among others ones. Therefore, we are not going to evaluate the resolution power for each lens, but we are going to see what resolution reaches at high frequencies, with this camera and with the Putora chart*". That's why the question is: Are these lenses able to reach the limit marked by the camera itself? Or quite the opposite; is its resolution power lower? After conducting the tests, we can conclude that Panchro lenses solve details as well as other lenses (until 55.5l/mm); they work properly at 4K formats. Now, let us see in detail.

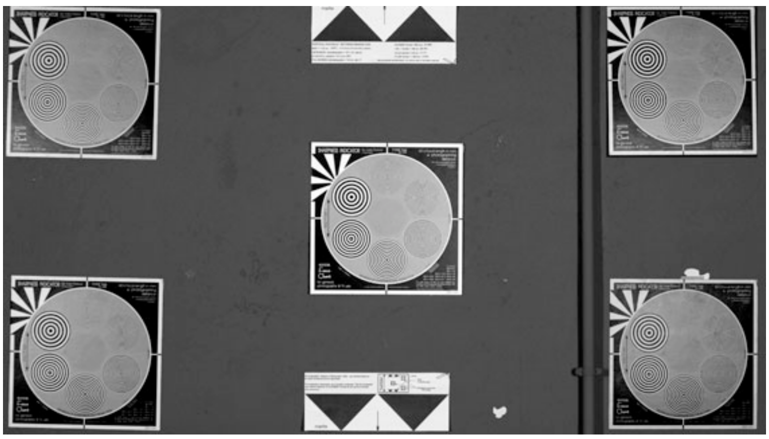


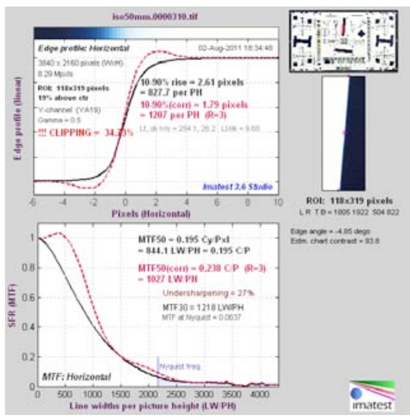


We have checked that every single focal has the same resolution power. On the left image, we show the Putora chart photographed with all the lenses. We have photographed in the center of the frame. On the right, we have applied the edge detector on the previous image because we wanted to see better the resolution limit.

We take account of two determinant factors related with the power resolution: the diffraction and the resolution values over the square corners and sides. As we know, the resolutions of all the lenses are not the same in the center as on the sides, i.e., the resolution decreases as we move away from the center of image, meanwhile the diffraction effect depends on the diameter of Airy disk regarding the pixel size.

For checking resolution changes, we have photographed the Putora chart, in both the center and on the sides. We have used the ISO12332 chart; we have got the MTF curve, in both center and sides through Imatest program.





Panchro 50mm T4. Its MTF curve through IMATEST in the center of image

As we expected, we can appreciate the loss of resolution on sides. The loss with the wide-angle lenses is larger than the loss with the longest ones. The 75 mm and 100 mm lenses have less resolution gap; the 18 mm one has the largest gap. Next, table shows outcomes from Imatest.

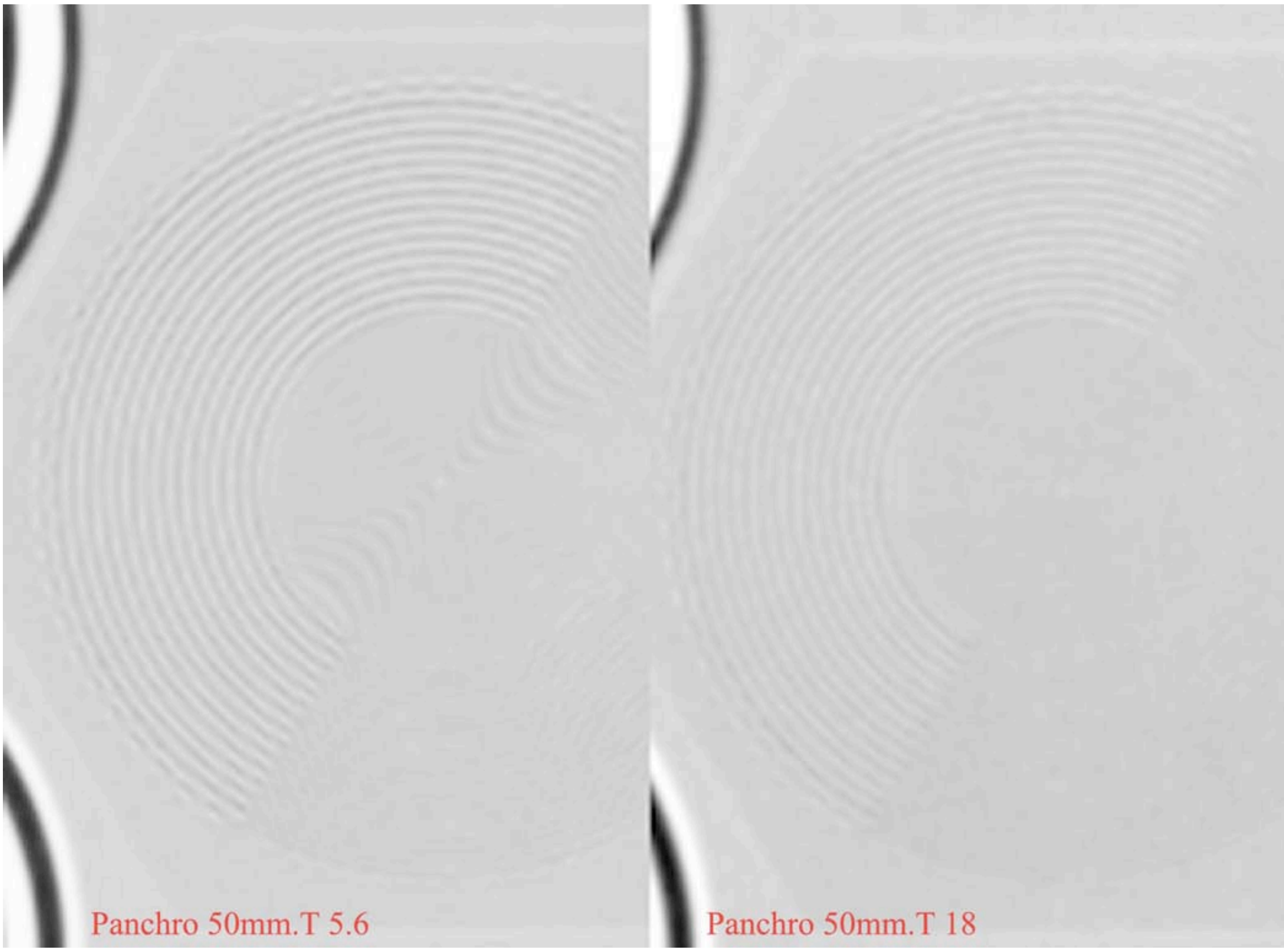
PANCHRO LENS	CENTER	SIDE	GAP %
18MM	1021 LW/PH	596.7 LW/PH	41.5%
25MM	1040 LW/PH	612.8 LW/PH	41.07%
32MM	983 LW/PH	704.5 LW/PH	28.3%
50MM	844.1 LW/PH	599 LW/PH	29%
75MM	956 LW/PH	860.1 LW/PH	10%
100MM	983.4 LW/PH	884.6 LW/PH	10%

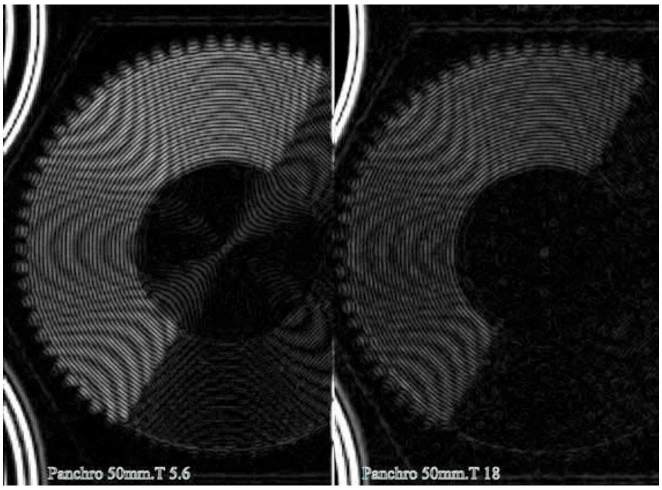
Panchro 18mm. T 7.1. MTD640. 6000ºK..Obt180º.25fps. RedGamma2. Redcolor2. (Madrid). Edge outlines do not have only less sharpness, but also less brightness.

In spite of the difficulty of seeing the resolution losses without the charts, I try to do with this image from the Temple of Debob in Madrid (Spain). Small boxes inside the image are related with the parts of the image marked with arrows; we have applied the edge detector on these parts. We can appreciate how sides are less sharp (lower definition)

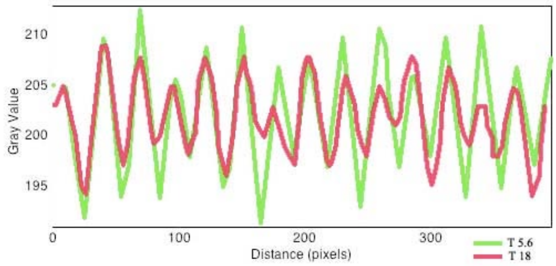
Regarding the diffraction, we have seen a slight loss of sharpness (contrast) from T 16 upwards. Evaluation was made on the resolution limit at 55.5l/mm.

Camera crew in Temple of Debob, Madrid (Spain)





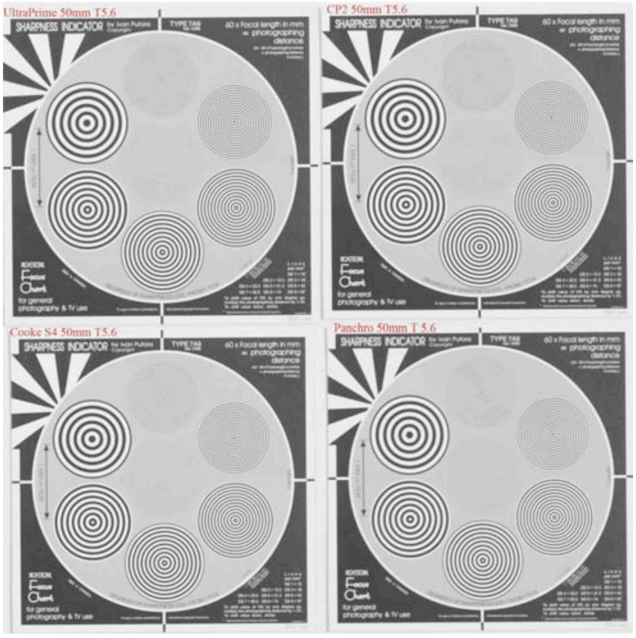
Putora test chart through edge detector, with Panchro 50 mm.

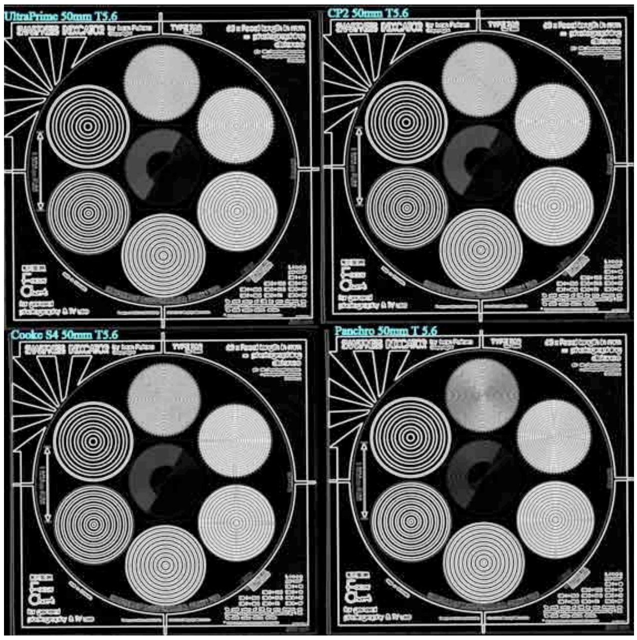


On the left, we show the chart outlines with two diaphragms. Above, image is the graph of resolution at 55.5l/mm. Because of the diffraction effect, we can see that the sharpness is slightly lower at T 18 than at T 5.6.

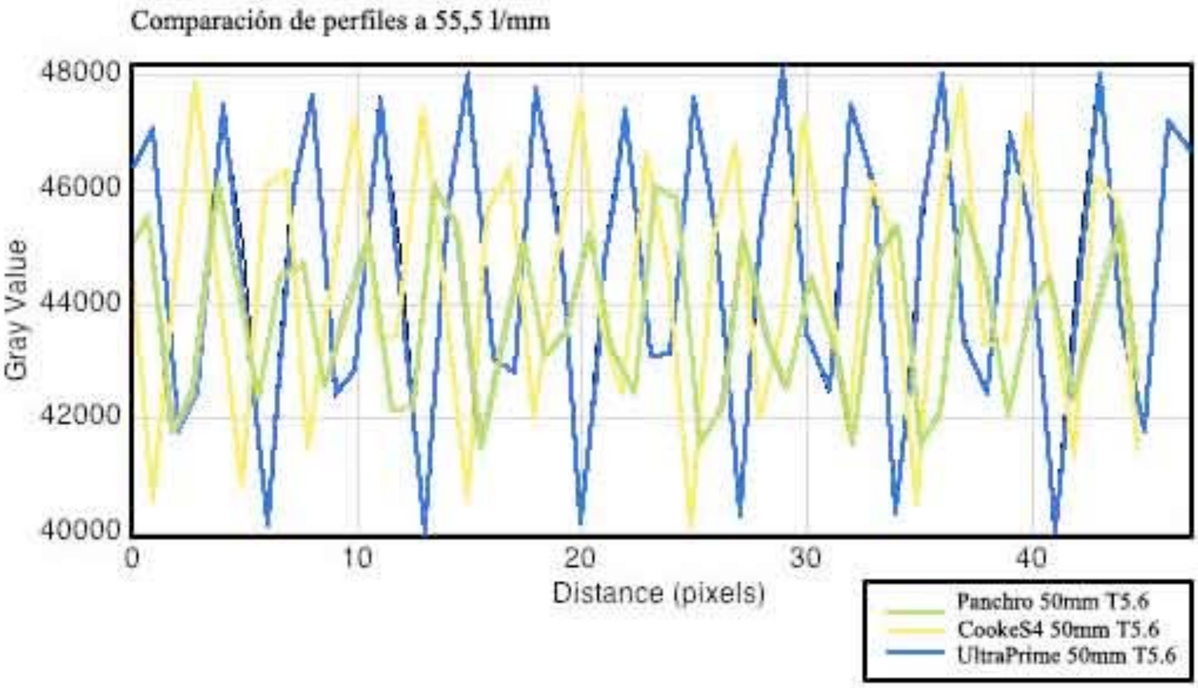
In order to have a more precise idea about these lenses, we have compared to other ones. Next, image shows how Panchro lenses reach the same limit resolution marked by the camera as the other ones. Differences are showed at the sharpness: it has reached its limit of resolution; at 55.5l/mm.

Test preparing through INFOTV, with F35 and Panchro 75 mm





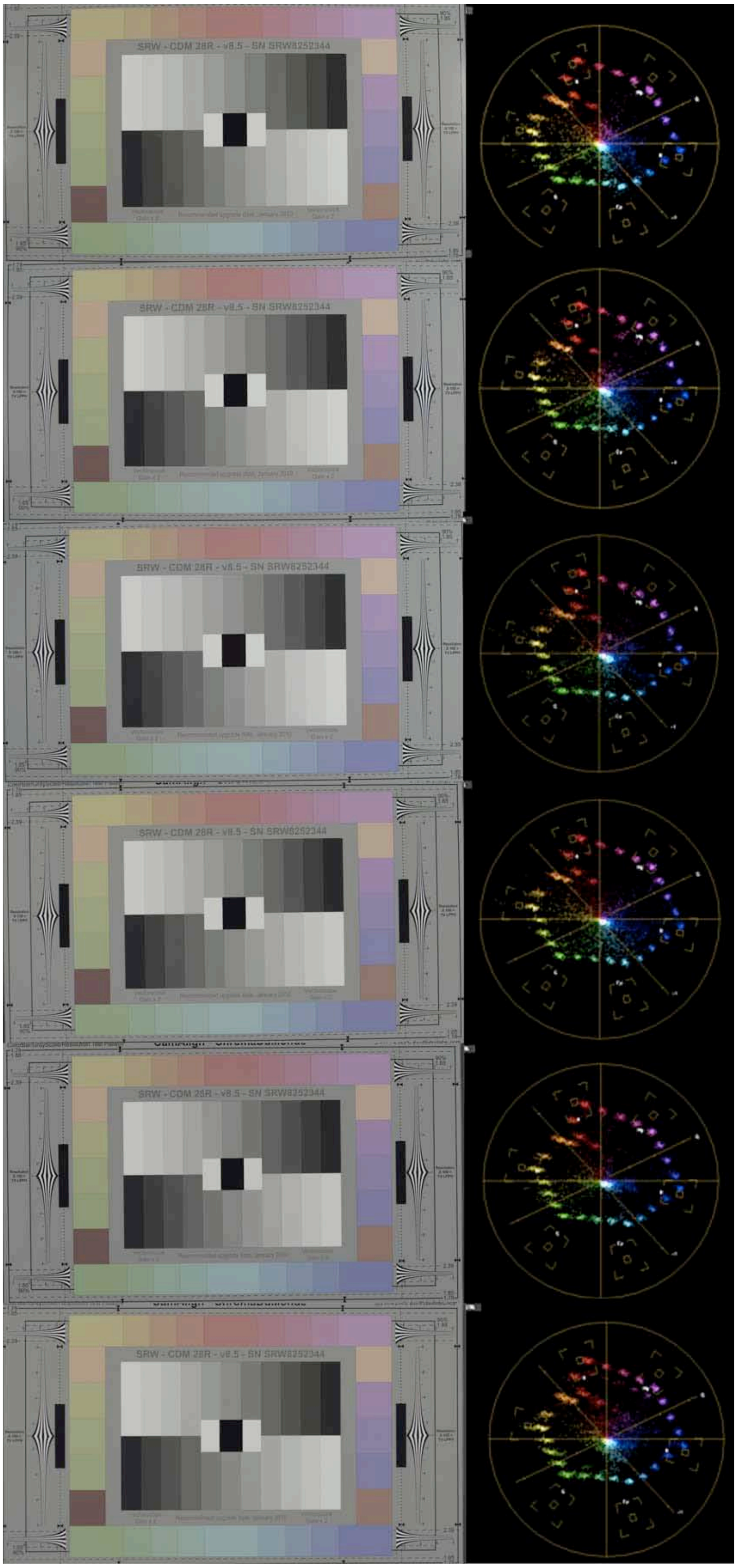
The chart is photographed in the center of the frame, all of the photographs with 50 mm lens at T 5.6 (lenses, each image, from left to right, from top to bottom: Ultraprime, CP2 CookeS4, and Panchro). From the left image to the right one: original images from the camera, outcomes after applying the edge detector.




Test with Putora resolution chart through Technok

Above, the graph shows that Pancrho lens has less contrast at the highest frequencies than the S4 or Ultrapime ones, i.e., in spite of showing clearly the resolution lines at 55.5 l/mm, these are slightly less sharp than the other ones. We could understand the lens feature as its “charisma” by itself: the smoothness to show the finest details, according to the spirit of the old Panchro lenses and the main idea that involves their lenses, i.e., smooth images without detail losses.

Color. AAA



For all of the lenses, from top to bottom: 18, 25, 32, 50, 75 y 100mm. T4 MTD800. 3800ºK. Tint -6. Obt180º 25fps. RedGamma2. Redcolor2. Original frames from camera without grading
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We have evaluated the color through the ChrormaDuMonde chart and the skin tones. We have photographed the chart with all of the lenses at T 4, under the same circumstances of lighting, camera parameters and "developing".

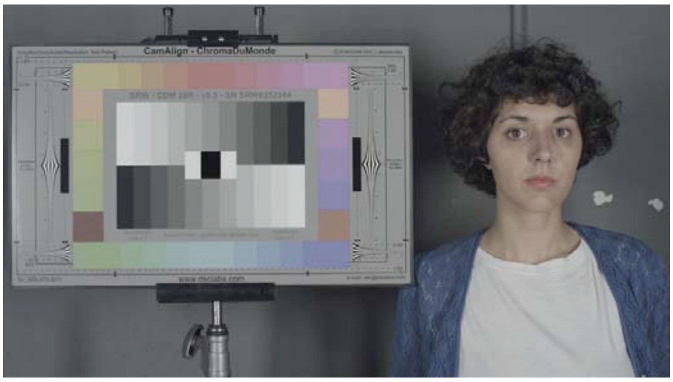
We have checked that all of the lenses reproduce accurately the color patches. Colors are within their ranges with very small variations, in the accepted manner. Because we want to see the consistency of the color reproduction, we have taken as a reference the image from the 50 mm lens. We have graded to reach the neutral gray; we have applied the same correction to the rest of the images from the other lenses. In all of the images, we have adjusted to the same value of luminance at black, white and middle gray, i.e., white at 100%, black of chart cavity at 0%, and gray at 50%.

We have seen the differences through the vectorscope. These are very small, although we can see that the tone from the 32 mm lens is colder than other ones from the rest of the set. Moreover, tone from the 18 mm and 100 mm lenses are warmer than the rest (yellow/orange). We can see this effect in the blue patch as an example.

These variations are practically imperceptible with natural and everyday images, outside of the wonderful world of the charts.

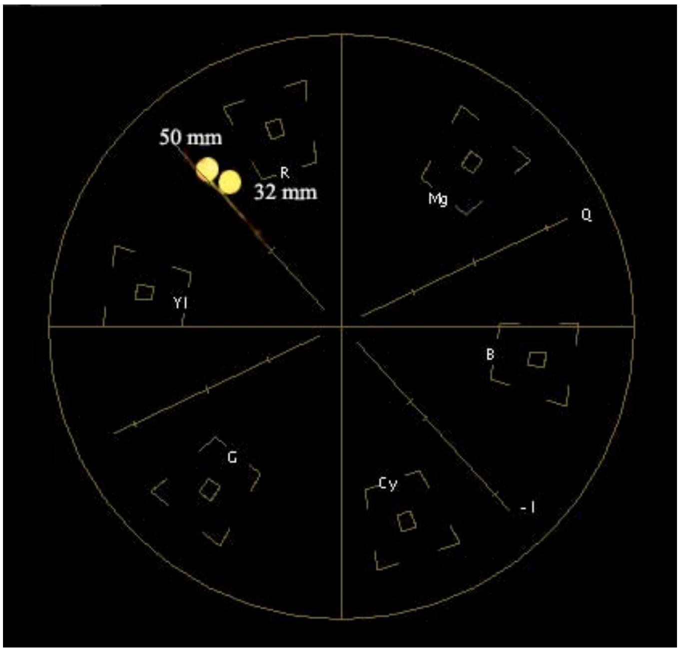
Regarding skin tone, I can only declare my personal enthusiasm owing to face textures got with the Panchros lenses: natural, smooth, delicate, and very elegant. Just only, as we did with charts, we would like to state that Gema's face is a bit colder with the 32 mm lens than with 75 mm one.

Both images, T 2.8 MTD800.3700ºK.Tint -6. Obt180º 25fps. RedGamma2. Redcolor2. Original frames from camera without grading



Panchro 32mm T4 MTD800.3700ºK.Tint -6. Obt180º . 25fps. RedGamma2. Redcolor2. Original frames from camera

Panchro 50mm T4 MTD800.3700ºK.Tint -6. Obt180º 25fps. RedGamma2 Redcolor2. Original frames from camera



Vectorscope shows values of skin tone from Gema's image with the DSClab chart. We have photographed both images under the same circumstances of lighting, camera parameters and "developing". We can see that in comparison with 50 mm lens the tone with the 32 mm one is slightly colder and less saturated; in general, regarding the rest of lenses too. However, differences are really irrelevant when we are working under normal circumstances.

In short, Panchro lenses not only show a precise reproduction of the color series, but also contribute clearly to a nice reproduction of skin tones. We can check it again with the frame shot in the Temple of Debob Park.

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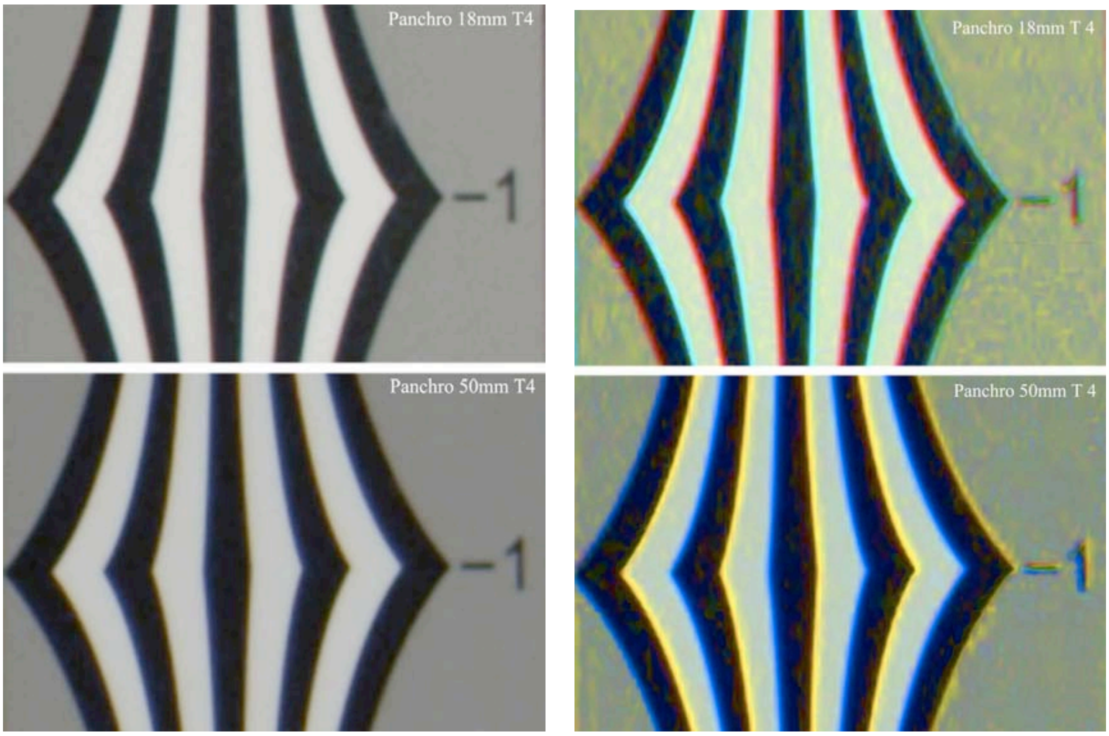
Panchro 100mm. T 2.8. MTD640. 6000ºK..Obt180º.25fps. RedGamma2. Redcolor2. Graded frame regarding neutral gray. Temple of Debob, Madrid (Spain)

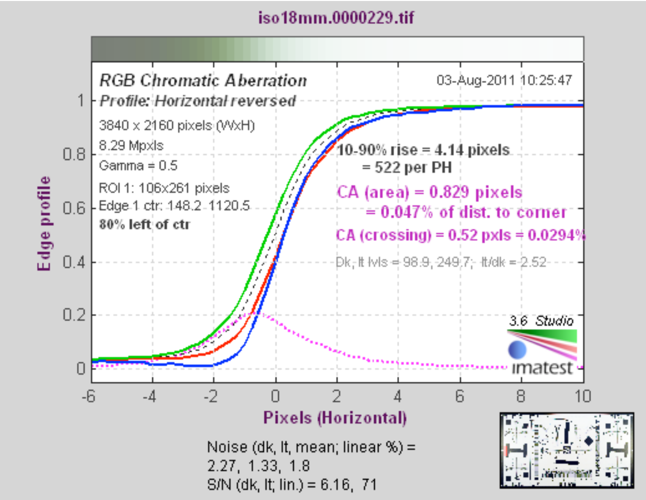
Chromatic aberrations. A

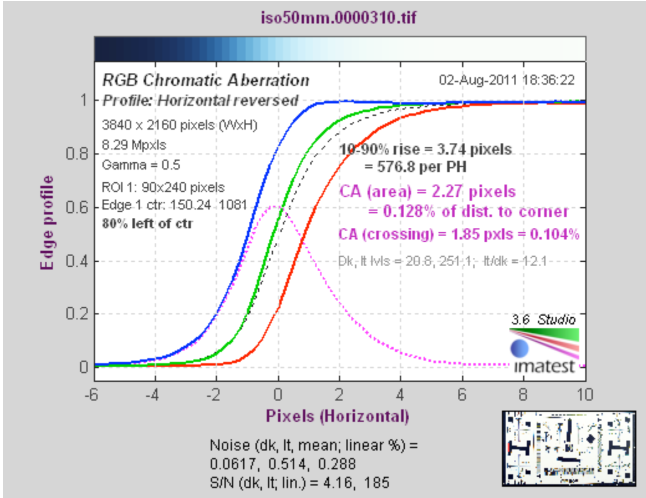
One of the most common and well-known aberrations between digital images is the chromatic aberration, either it is lateral or it is longitudinal. Its main feature is that the image is surrounded by a color line series, above all, between the most contrasted edges. Lateral aberration increases as we approach to the image edges, while longitudinal one appears over the whole image, in both the center and sides.

After testing on Panchro lenses, we have seen different lateral chromatic aberrations; aberration is red/cyan to wide-angles, 18 mm, 25 mm, and 32 mm, while aberration is blue/yellow to longest lenses, 50 mm, 75 mm, and 100 mm. Next, image shows this fact.

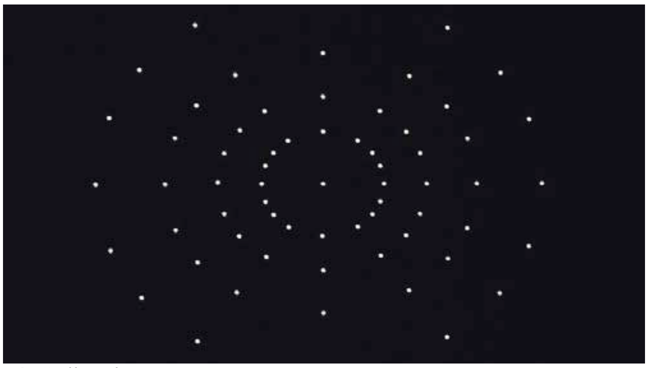


On the left, we can see lateral chromatic aberration; image is ChromaDuMonde chart cutting, the right lateral trumpet, enlarged 800%, to be exact. On the right, we have fiercely oversaturated the image because we wanted to see the aberration on paper. We can see in a different way studying the ISO12332 chart, through Imatest program.





Graphs show lateral chromatic aberration regarding the CA Area in pixels. We can really see color difference of the aberration among the 18 mm lens and 50 mm one. Moreover, we can check that the aberration with the 50 mm lens is larger than with the 18 mm (2.27 CA pixels value opposite 0.82 one). In order to get a great visualization about previous depiction, we have photographed our chart through *Vía Stellae* -sheet of metal with tiny punch-holes-; we have photographed punch-holes with all of the lenses at different T values.



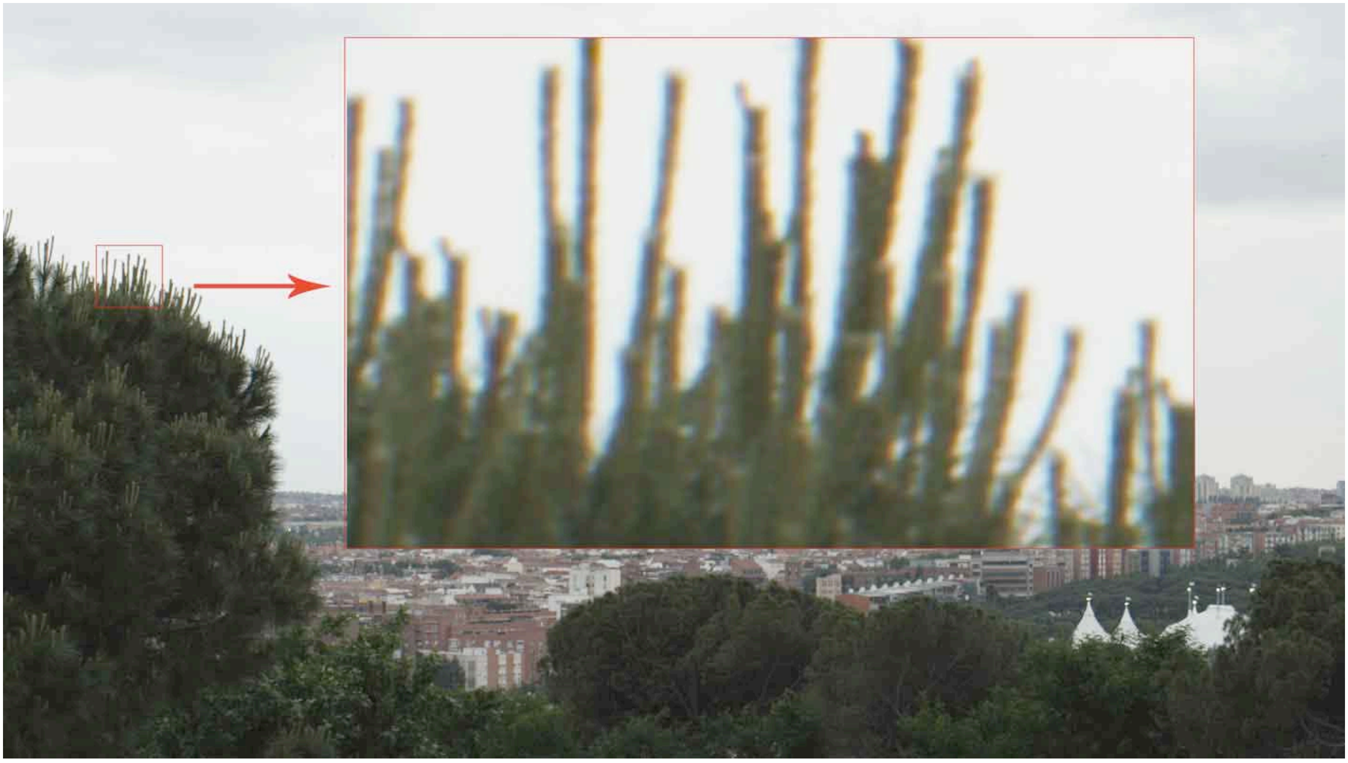
Vía Stellae chart.

Detail from one of the peripherical punch-holes of the Vía Stellae chart. Enlarged 2000%

Veiling glare test.

Let us check again the same, but in an outdoor frame.

Panchro 18mm T 7.1. Original frames from camera. We have enlarged marked area at 1000%



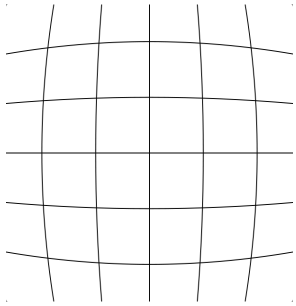
Panchro 50 mm T 5.6. Original frames from camera. We have enlarged marked area at 1000%

Among the optical set, the 75 mm lens gives the lowest chromatic aberration. In general, the set shows moderate chromatic aberration. As we have written, it is significant over the color edges; this color is different with regard to the wide-angles or to the most Teles.

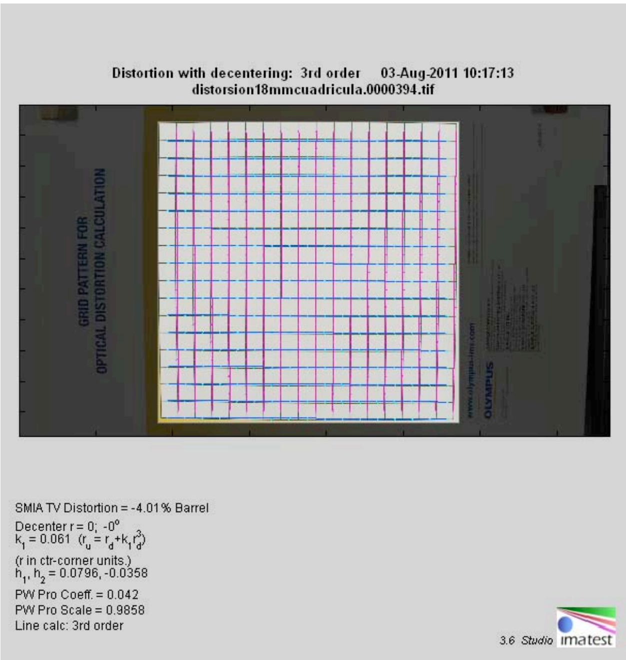
Distortions. AA

Geometric aberrations.

The barrel geometric distortion is produced when the effect from a lens over its field has a different magnification. In order to evaluate this kind of distortion, we have used a grid through the Imatest program, an ESSER chart, and finally, outdoor frames. Next, table shows distortion through Imatest in SMIA* TV values. The SMIA value is different from the traditional definition by television industry –SMIA distortion value is twice as much as the traditional one-.



Barrel distortion

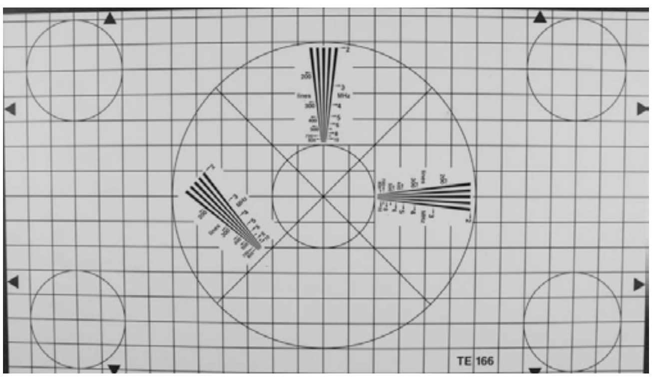


Panchro 18mm T2.8. Grid pattern. *Panchro 100mm T2.8 .Grid pattern.*
Magenta lines represent the right vertical ones. Blue lines represent the right horizontal ones

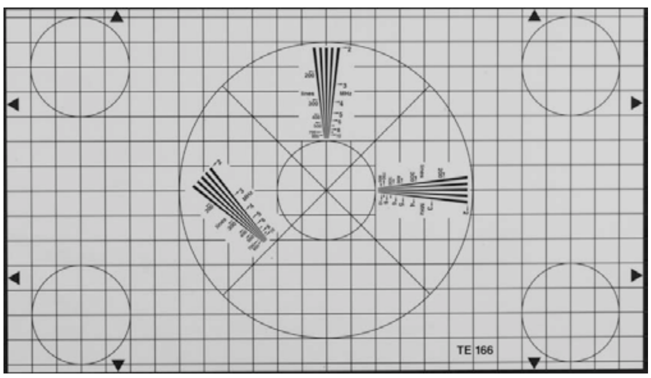
PANCHRO LENS	SMIA TV Distortion %
18MM	-4.01% Barrel
25MM	-2.41% Barrel
32MM	-1.76% Barrel
50MM	-1.11% Barrel
75MM	-0.62% Barrel
100MM	-0-15% Barrel

As we expect, the 18 mm lens shows the largest distortion and the longest lens shows the smallest. We can state distortion is irrelevant parting from 32 mm.

Next, let us see the difference in the two images from the ESSER TE 166 chart.



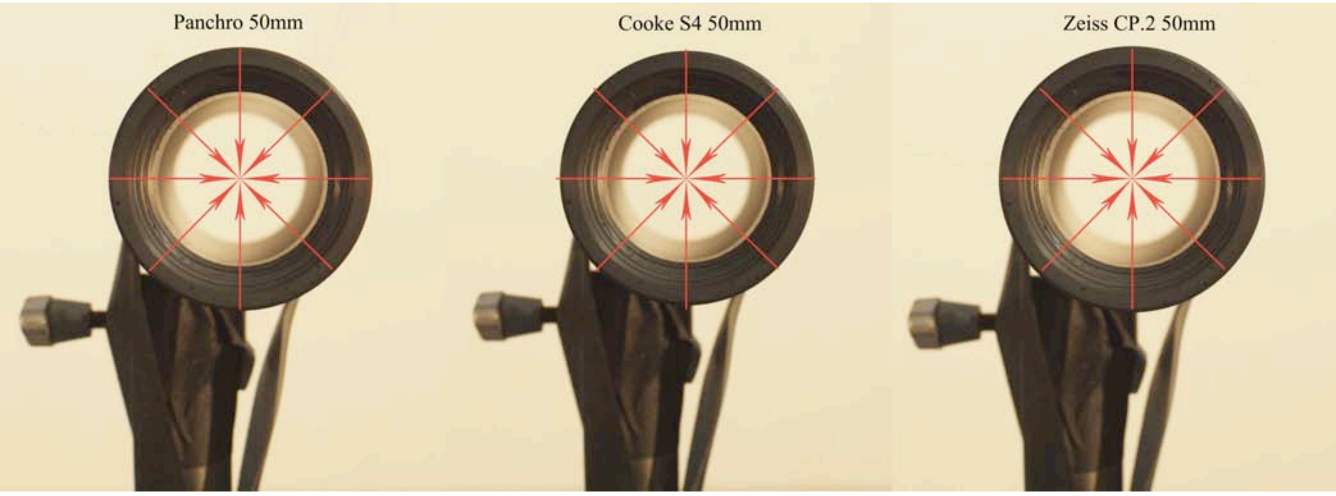
Panchro 18mm T5.6.



Panchro 100mm T5.6.

Panchro 18mm. T 5.0. MTD640. 6000ºK..Obt180º.25fps. RedGamma2. Redcolor2. Graded frame. Temple of Debod, Madrid, (Spain). As we have seen on charts, we can check the distortion from barrel effect in this "real" image

Perspective distortion and other ones, AAA



Above, image shows the perspective distortion on a cylinder; its axis matches up with the optical one. The three lenses show equal perspective. It should be only pointed out that lens magnification of the S4 lens is smaller than Panchro or Zeiss ones.

In order to find another kind of aberrations, we have again used the *Vía Stellae* chart. We have seen in detail how lenses show the tiny punch-holes.

We have not found neither spherical aberrations nor astigmatism; neither coma nor significant effects of the field curvature.

Vía Stellae chart. Panchro 18mm T 2.8

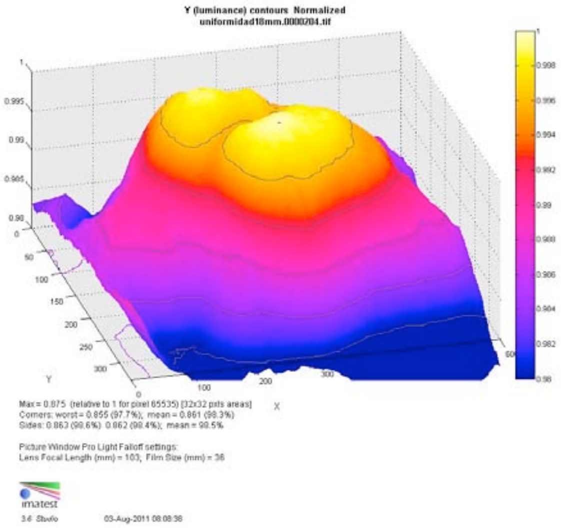
Light uniformity

-Each lens **AA**

We have checked the good light uniformity of each lens through this test section. The light uniformity evaluates if brightness of the whole image frame is uniform, or if there are deviations on sides and corners (vignetting). We have use the LV5 light sphere; it grants a homogeneous illuminated surface.

We have analyzed each single frame from each lens through Imatest. As example, we show the 18 mm lens outcomes.

Light uniformity test with LV5 sphere from INFOTV

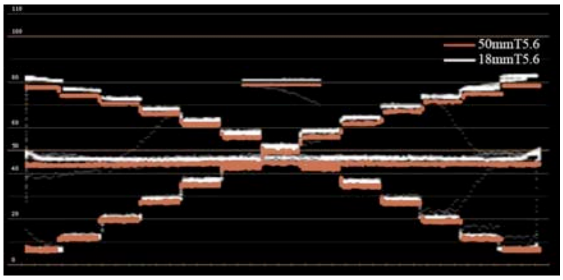


Graph shows brightness value, standardized at 1 one (yellow tone) in the center. The value is smaller as we come closer to the corners and to the sides (violet and blue). Brightness differences of the program outcomes are in %. Next, table shows outcomes for each lens.

The 32 mm lens loses more on corners, 2.1%, opposite 1.7% from 18 mm one. The 75 mm lens offers a great uniformity.

In short, we can conclude each lens works suitably. Differences are irrelevant during an "actual" shooting, far from chart tests.

PANCHRO LENS	Corners average %	Sides average %
18MM	98.3	98.5
25MM	98.9	99
32MM	97.9	98.3
50MM	98.5	99.2
75MM	99.1	99.3
100MM	98.5	99



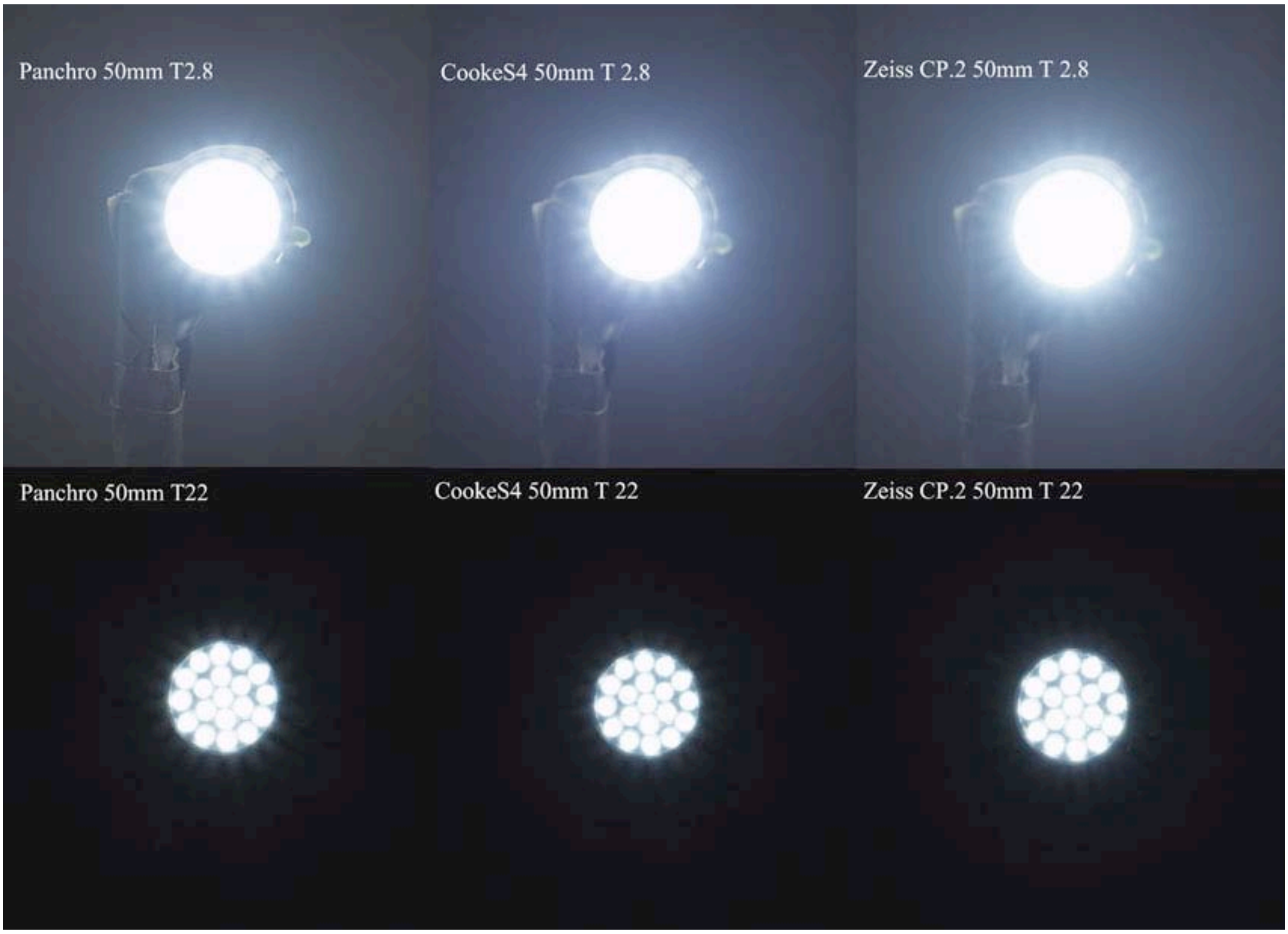
Superposition of the two signals from the chart gray scale. In this order, 50mm and 18 mm

The whole set. **AAA**

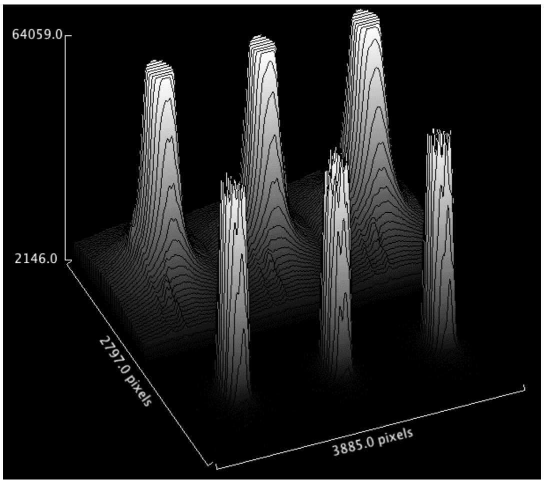
We have photographed the ESSER chart with each lens; we have used the same diaphragm and we have only changed distances to achieve similar frames. We have only found a noteworthy difference with the 18 mm lens. It shows slightly more contrasted than the rest of the set. White is slightly above 80% in the waveform monitor, while the rest of lenses are a bit below 80%.

Flare y veiling glare. AAA

In order to see the Flare, we have pointed a flashlight towards the camera. We have photographed with three sorts of lenses for checking better the differences. Beside Panchro lenses, we have used a S4 and a CP2 Zeiss ones, all of them at the same T, and of course, the same focal length.



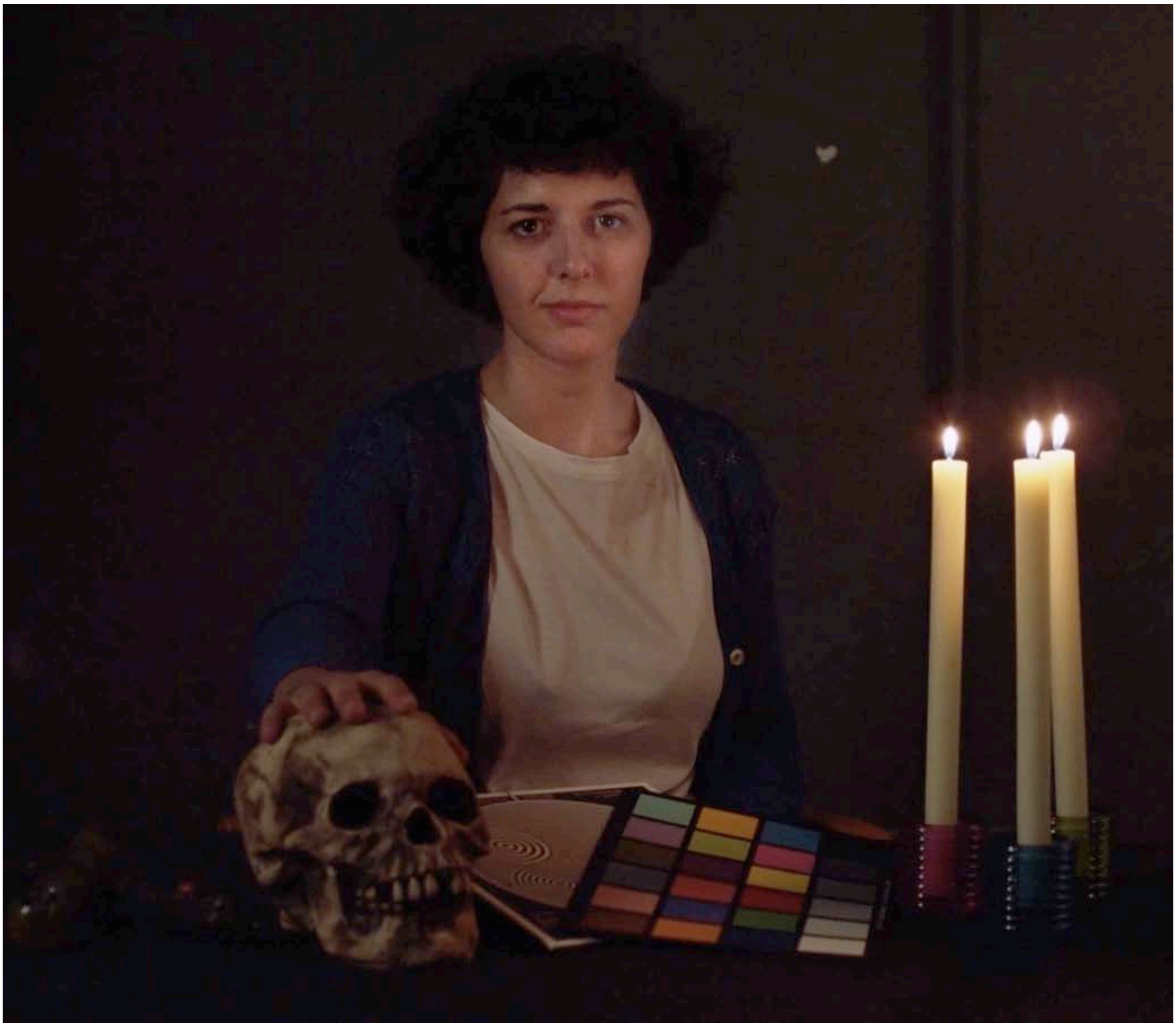
PANCHRO LENS	VEILING GLARE %
18MM	0.09%
25MM	0.10%
32MM	0.13%
50MM	0.28%
75MM	0.26%
100MM	0.25%



Panchro lenses and S4 ones offer an excellent behavior; it is practically the same, with both the most open diaphragm and the narrowest one. However, the Zeiss lenses in comparison to those ones show some more Flare with the open diaphragm. 3D graph shows these differences through brightness values. Left column matches with the Panchro lens, center column with the S4 one, and right column with the Zeiss one. We can see that the last column is wider and higher at 2.8 value (less contrast because there are more gray values).

We have evaluated the veiling glare by means of the use of the absolute black from gray scale (Black Hole). We can see that this effect is very small too. Table shows outcomes for each lens.

Image shows Flare caused by candles.



The fortune-teller*. Panchro 32mm T 2.8 MTD3200. 3700ºK..Obt180º.25fps. RedGamma2. Redcolor2. Graded frame*

Focused and, out of focus frame. Panchro 100mm.T2.8. MTD800. 3700ºK..Obt180º.25fps. RedGamma2. Redcolor2. Image shows the minimum flare owing to both the flames and their extraordinary out of focus.

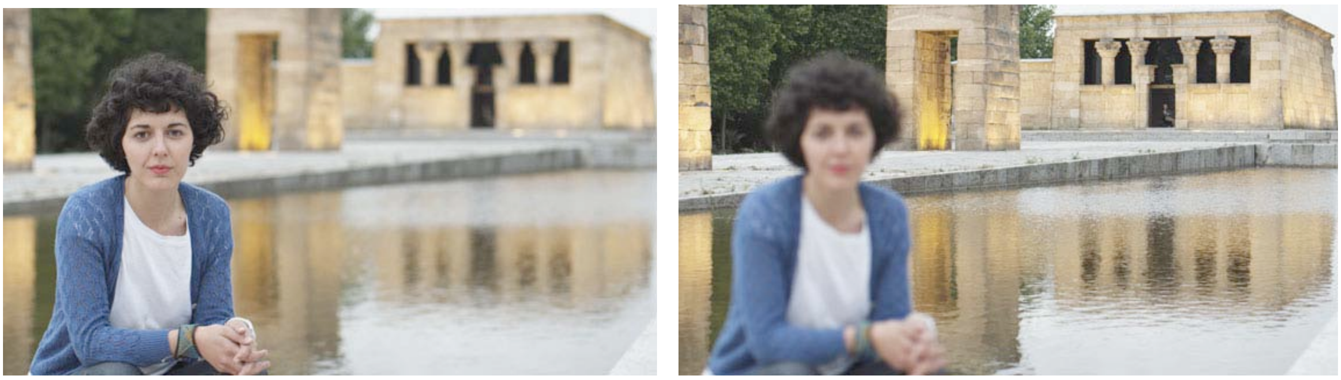
We can say that the lenses behave excellently as a whole, regarding veiling glare. Flare is very moderate, above all with the longest lenses; it is only slightly more relevant with the shortest ones, especially with the 32 mm one.

Focus. AAA

We have not seen any variation of the frame size after changing focus; even when it has a long turn. Focus change is very smooth and uniform on the whole frame surface. We could not appreciate aberrations during its change.

The focus setting ring is perfectly visible; it does not have difficulty in moving. It can be made suitable for all usual accessories.

Panchro 75mm. T 2.8. MTD640. 6000ºK..Obt180º.25fps. RedGamma. Redcolor. Temple of Debod, Madrid, (Spain). Image shows the focus variation.



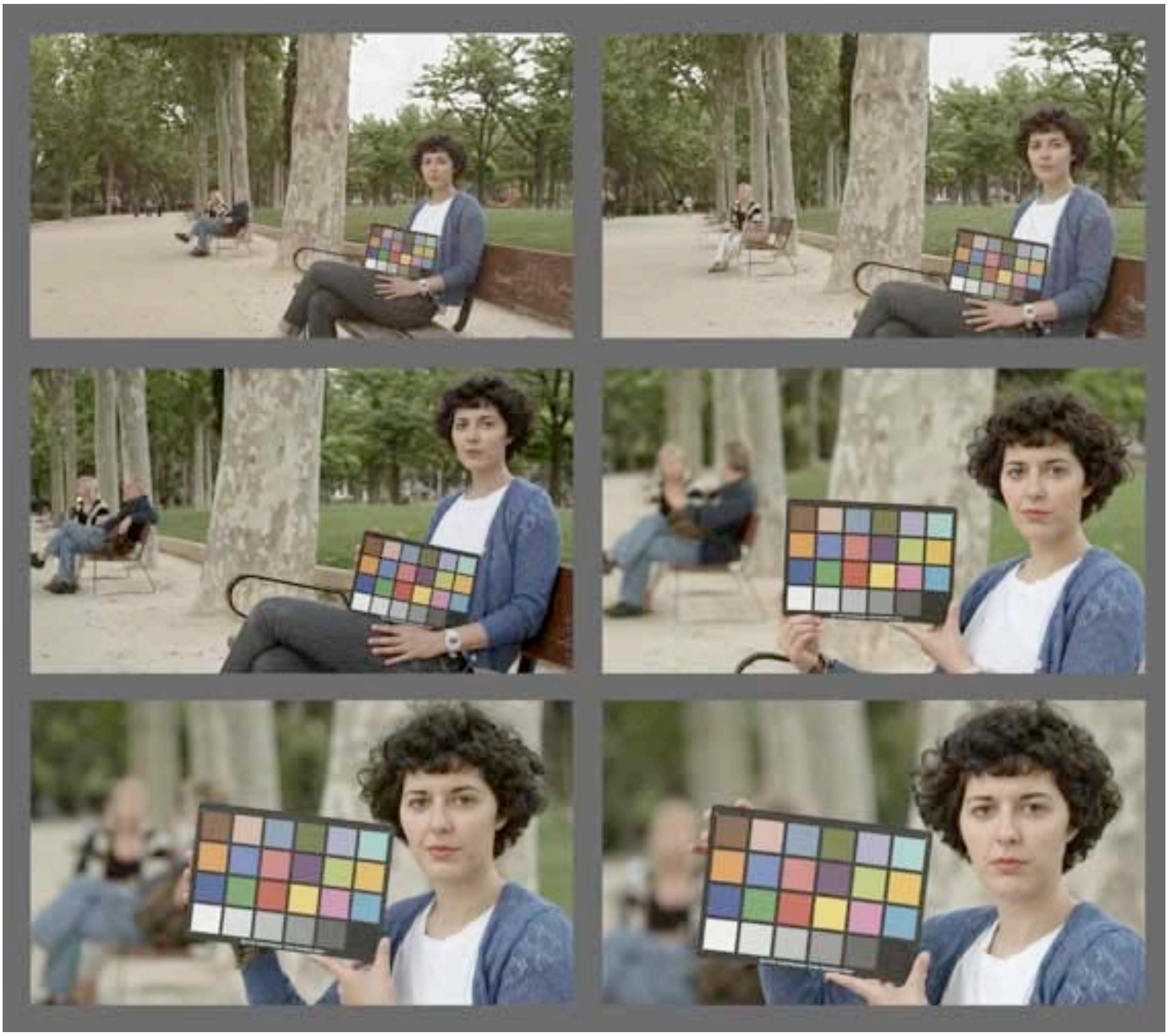
Panchro 50mm. T 2.8. MTD640. 6000ºK..Obt180º.25fps. RedGamma. Redcolor. Temple of Debod, Madrid, (Spain)

Weight, Volume and other features. Conclusions

You can visit the Cook's website for a more detailed technical description of the lenses. Our work was very easy with the lenses. They are not voluminous, and they have a moderate weight. Mechanics is very soft, with both focus and diaphragm. Marks are entirely visible, both by light and in darkness.
In conclusion, the lenses resolve enough to work at 4K without problems. Their diffraction limits are very high, above T 16; they show a very *smooth* sharpness at higher frequencies. Resolution of the lenses set is homogeneous and uniform; the only thing that should be mentioned is the loss of sharpness on image sides with the wide-angle lenses. Therefore, we can conclude that Panchro lenses are "smooth" lenses, even smoother than the S4 ones; they offer moderate contrast and sharpness, above all at higher frequencies. Lenses set behavior regarding color is very alike, with very small variations among the different focal lengths; the negative aspects are the chromatic aberrations. The lenses work properly regarding optical aberrations too. We should pointed out the excellent behavior with the veiling glare and the non-existence of spherical aberration.

I would like to show my real enthusiasm for these lenses after ending tests. I am sure my enthusiasm is owing to my personal taste and lenses outcomes are very alike: smooth lenses with moderate contrast which civilize the primitive and savage digital sharpness without losing details. I take my hat off to the beauty and elegance of tone and texture of the face, above all, with the 75 mm lens. Whereas, I do not think to be a disadvantage that T set is at 2.8; unless we want a minimum deep of field owing to narrative skill matters. Nowadays, digital cameras do not have problems with exposure level; they already work at ISO 800value as reference. This diaphragm allows to Cooke to reduce the lenses size, resulted in a lower cost. However, I miss more focal lengths, for example, the 40 mm one.

In spite of the Standard & Parr's rate is **AA-**, everyone knows how this kind of agencies are mistaken and wrong; Panchro lenses are, and they will be forever, triple **A** for me.



How lenses see. From left to right, from top to bottom. : Panchro 18mm. T 6.3 Panchro 25mm. T 6.3 Panchro 32mm. T 3.3. Panchro 50mm. T 2.8 Panchro 75mm. T 2.8 Panchro 100mm. T 2.8. For all the lenses: MTD640. 6000ºK..Obt180º.25fps. RedGamma2. Redcolor2. Graded frames.

Credits:

Cinematographer: Alfonso Parra AEC
First Assistants: David Panizo
Second Assintant: Gema Segura

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References:

http://www.cookeoptics.com/
http://www.imatest.com
http://www.alfonsoparra.com/

Standard & Parr's rating::

AAA: The highest rate to a feature; reliable and stable

AA: High quality feature; very stable and minimum consequences on final quality

A: Features could jeopardize final quality

Contributions: