UNIQOPTICS Prime Lenses for Digital Cinematography

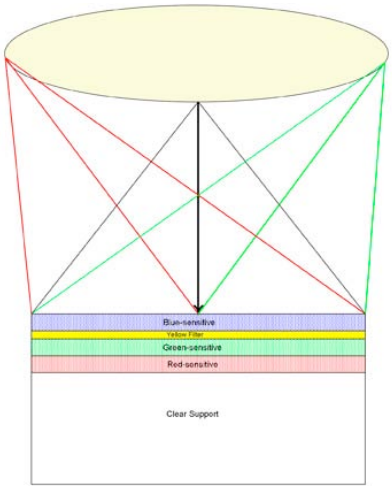
By Alfonso Parra AEC



UniQoptics is the manufacturer of the lenses that we study in this article. This company is based in Simi Valley, California, and has design supported by the legendary Kenji Suematsu, professional with over 50 years experience in lens design and awarded with one of the technical award honored by the American Academy, in collaboration with Hyperion Development, LLC, a company dedicated to optical design, a set of lenses for digital cinematography including focal lengths of 18, 25, 35, 50, 85 and 100mm. All with T 1.9-22 and valid for images in either 4K and 5K.

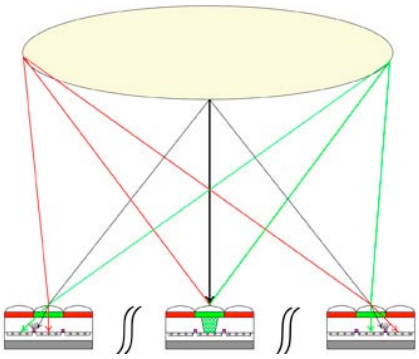
According to the manufacturer this are the first lenses specifically designed considering the characteristics of digital sensors. Can we think that the lenses that we used typically in analog systems will give equally good results in digital? Not necessarily. Here is a very important difference between both systems.

In the analog systems the lens project the image to a surface, the emulsion, that have a random distribution of silver halide in such a way that even the rays that strike with a small angle (the most oblique ones) are captured by the halides. In case of digital sensors this are composed of rows and columns of pixels, and each of them, among other things, contain the photodiode (element that captures the light), on top of this there is the color filter (red, green or blue) and over the filter there is a micro lens that focuses light onto the photodiode to improve the capture of photons. Therefore there is no casual distribution of pixels. The digital sensors capture is optimal when light rays are perpendicular to the photodiodes and what happen is that the oblique rays, those coming from the edges of the lens and have a small incidence angle, are not captured by photodiodes at the corresponding edges of the pixels matrix and will also affect neighboring pixels resulting what is known as pixel-crosstalk effect. This effect, visually leads to a less sharp image, a magnification of chromatic aberrations, either the ones produced by the lens as the created by the microlens over the photodiode and a reduction of the color saturation, creating softer color images.



Proyection of the light rays over a photographic emulsion. Image Courtesy of Applied Color Science Technical

There are a few ways of minimizing this effects, one is the spatial displacement of the microlenses on the edges of the image generator matrix and specially the design of lenses known as telecentric.

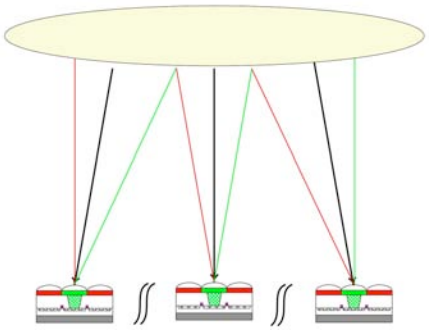


Pixel-crosstalk effect. Image courtesy of Applied Color Science.

Telecentric lenses are those that are designed in a way that all the light rays falling on the sensor are all parallel to the optical axis, or in other words that the entrance pupil of the whole set of rays and/or output pupil is located at infinity. This construction eliminates perspective distortion, improves the uniformity of the light projected by the lens and allows that the magnification of any object is constant in a certain range of distances, also changes in focus do not alter the size of the image and these changes are symmetric, meaning that the blur is equal in all directions. The problem with this design is that it involves a restriction for the different formats and features of the lenses that we use in cinematography, for example the availability of different focals and F numbers.

For this reasons UniQoptics has chosen a third way to develop a lens "near telecentric", by limiting the angles of light rays hitting on the edges of the sensor in order to be accepted by the microlenses but without needing to be completely parallel to the optical axis as in the case of a telecentric lens.

From the perspective of the design of this lens this can be achieved by increasing the image circle created by itself, in another word lenses with larger diameter.



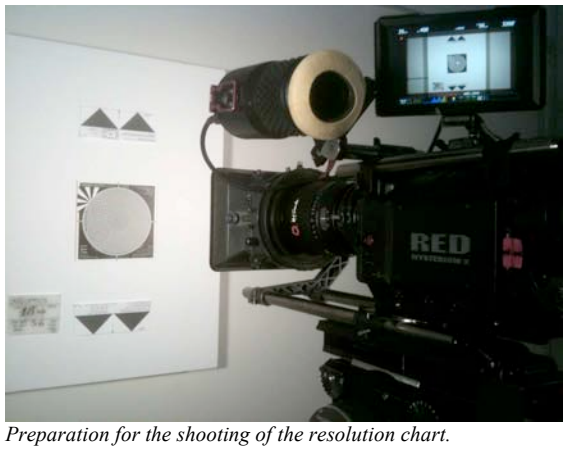
Telecentric almost telecentric using the UniQoptics lenses. Image courtesy of Applied Color Science Technical.

Therefore we can assume that in this lenses there are some associated benefits to telecentric designs without losing the film characteristics. Let us now see in detail the test we have done. We have filmed all tests with the REDOneMX camera 4KHD formats, redcode 42. The material has been exported by REDCineX and displayed on a Cineimage Cinetal monitor. In addition we have used the lenses for shooting clips in chroma that will be projected at the Diocesan Museum of Zaragoza produced by GPD and directed by Ismael Morillo.

Throughout this article we shall contrast the lenses with other very high quality lenses for a better understanding of the conditions of the tested lenses and not to compare with the others, as each manufacturer, seeking the best balance between all the conditions obtained by the optical features (aberrations, brightness, weight, size, cost, etc..) use different designs and concepts when manufacturing.

Resolution. ★★★★½

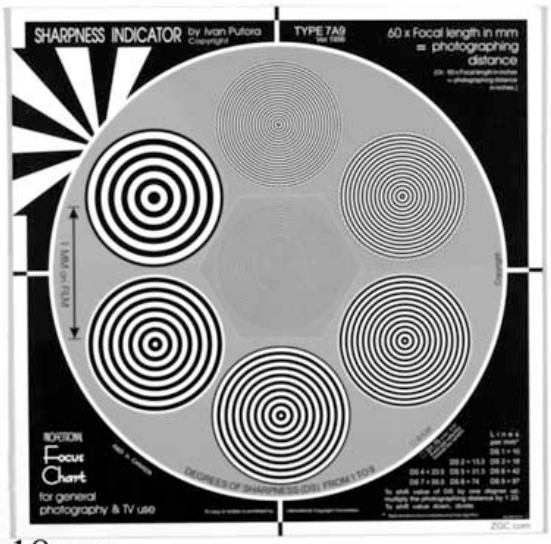
The resolution capacity determines the ability of a lens to resolve fine detail, meaning the highest frequencies, and depends on effects such as diffraction, lens aberrations and contrast of the photographed. We, as Directors of photography are interested in the resolution capacity of the system, and that is why we chose the camera REDOneMX to value this lenses. On one hand, today, the camera provides highest resolution images and on the other it is a camera that we've tested and used many times with other lenses therefore we can have elements for contrast. It is clear that the final resolution is determined by the conditions of the camera, like the sensor and electronics. From this point of view, we will not value the resolution capacity of each of the lenses but we will see till where they are able to resolve at high frequencies with this particular camera and our Putora chart. The result could not be better. The whole set of lenses has the same resolution power. On the picture we see the chart shot with different focal lengths and all have the same resolution reaching to distinguish up to 55.5 l/ mm which is the same around 1300 Lw / ph. This resolution is basically the same we had in our last test of the camera REDoneMX using MasterPrime lens.



Preparation for the shooting of the resolution chart.



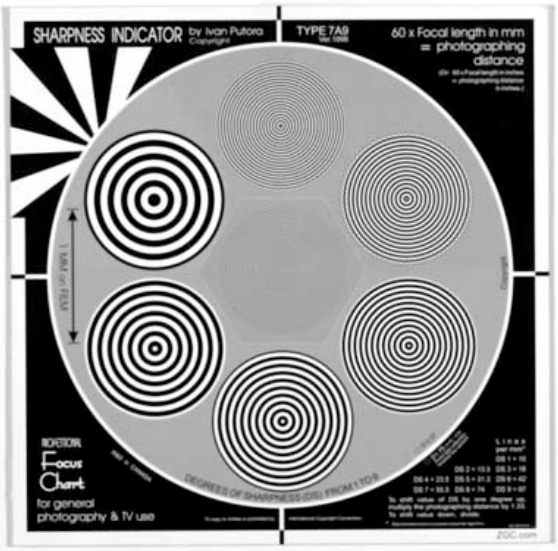
San Valero being filmed by UniQoptics, guardian of Zaragoza. The lenses could not have a bettersupporter.



18mm



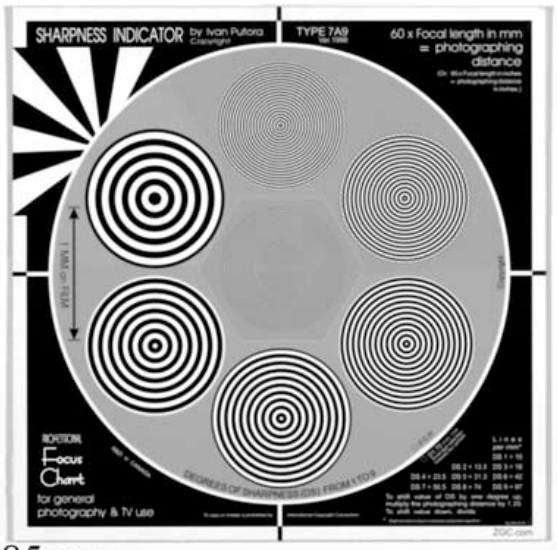
25mm



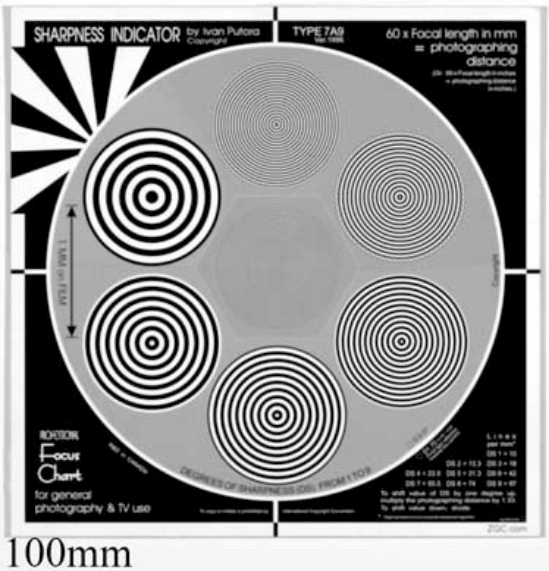
35mm



50mm



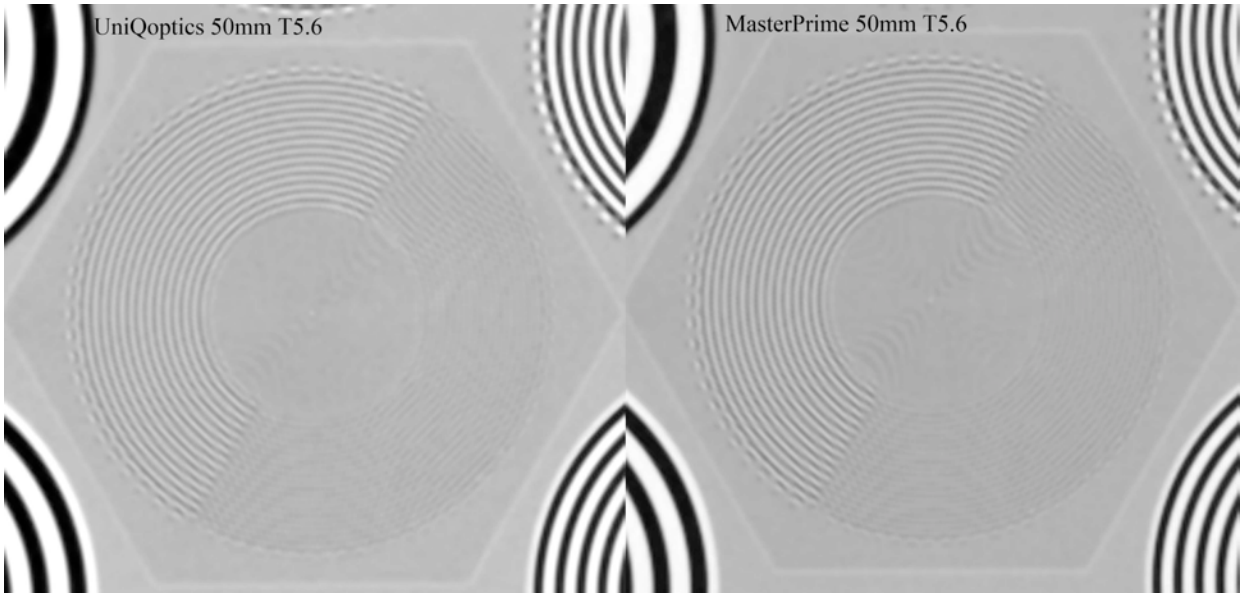
85mm



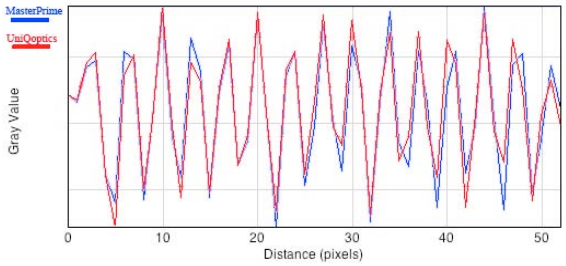
100mm

All images shooted at T 5.6.

See in the picture below the comparison under identical conditions with a 50mm T5.6 MasterPrime.

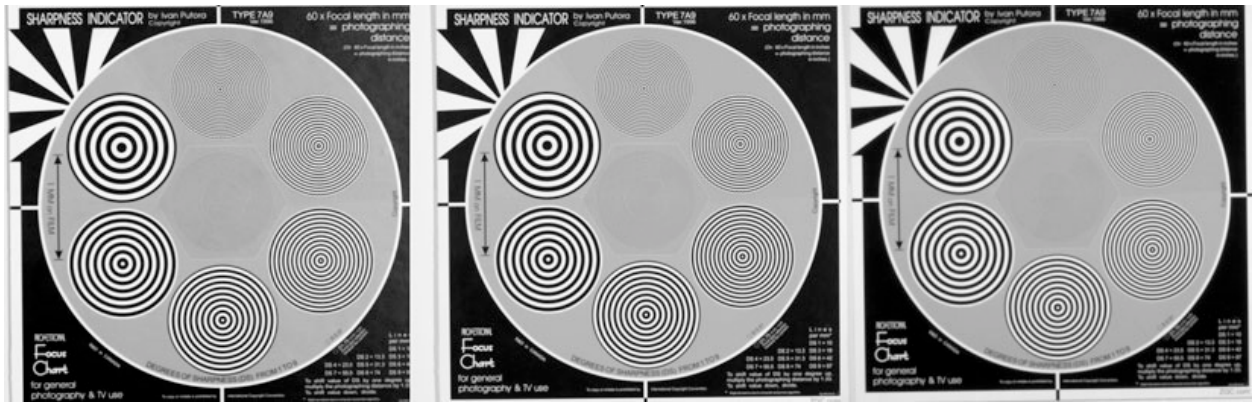


Enlargement of the resolución chart to 800%.

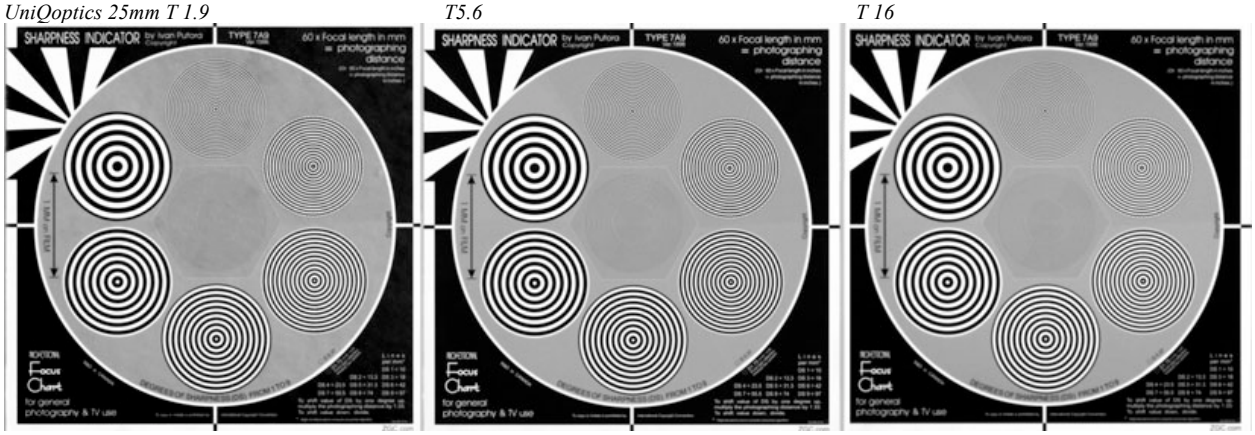


Comparison of the profiles of the MaterPrime and UniQoptics lenses to 55.5 l/mm. As we can see they are very similar

We have seen how the resolution capacity is maintained not only with all the focals, but with all the T-Stops in each of the lenses. Not to be exhaustive here are two examples, one with a 25mm and other with the 100mm. We have also found that the resolution remains the same both in the corners as in the sides as shown in this example with the 50mm lens.



UniQoptics 25mm T 1.9 *T5.6* *T 16*



UniQoptics 100mm T 1.9 *T5.6* *T 16*

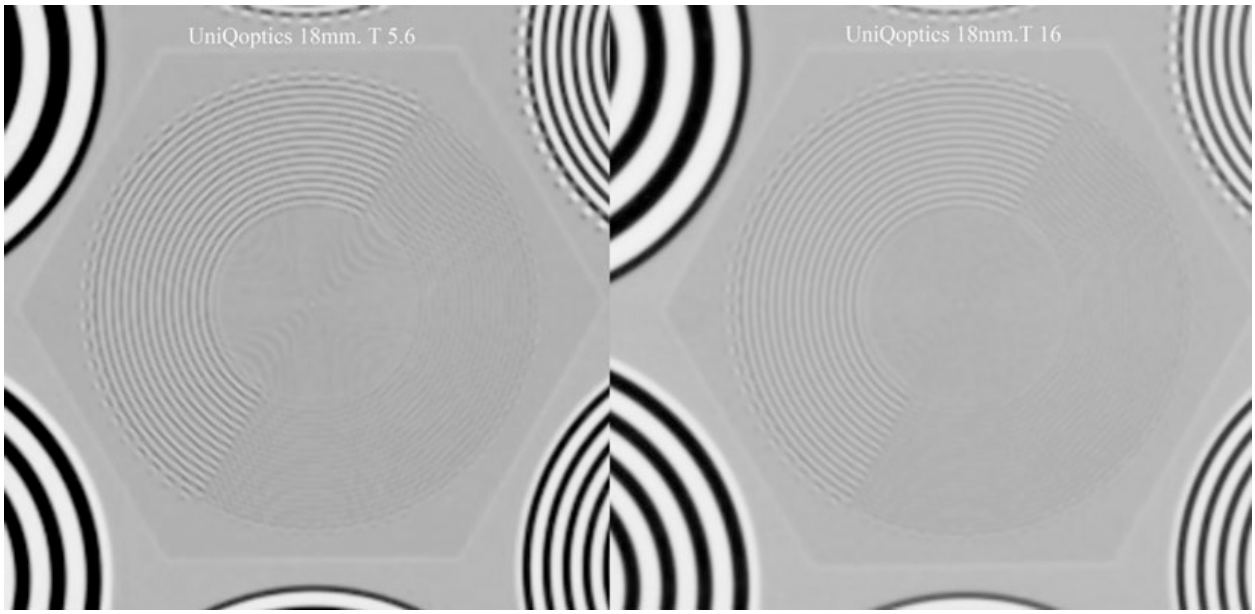


UniQoptics. 50mm T 6.3. We have put our chart in each of the corners of the frame to study there the resolution. To have a clear image of the process we have mounted this image with each of the charts recorded.

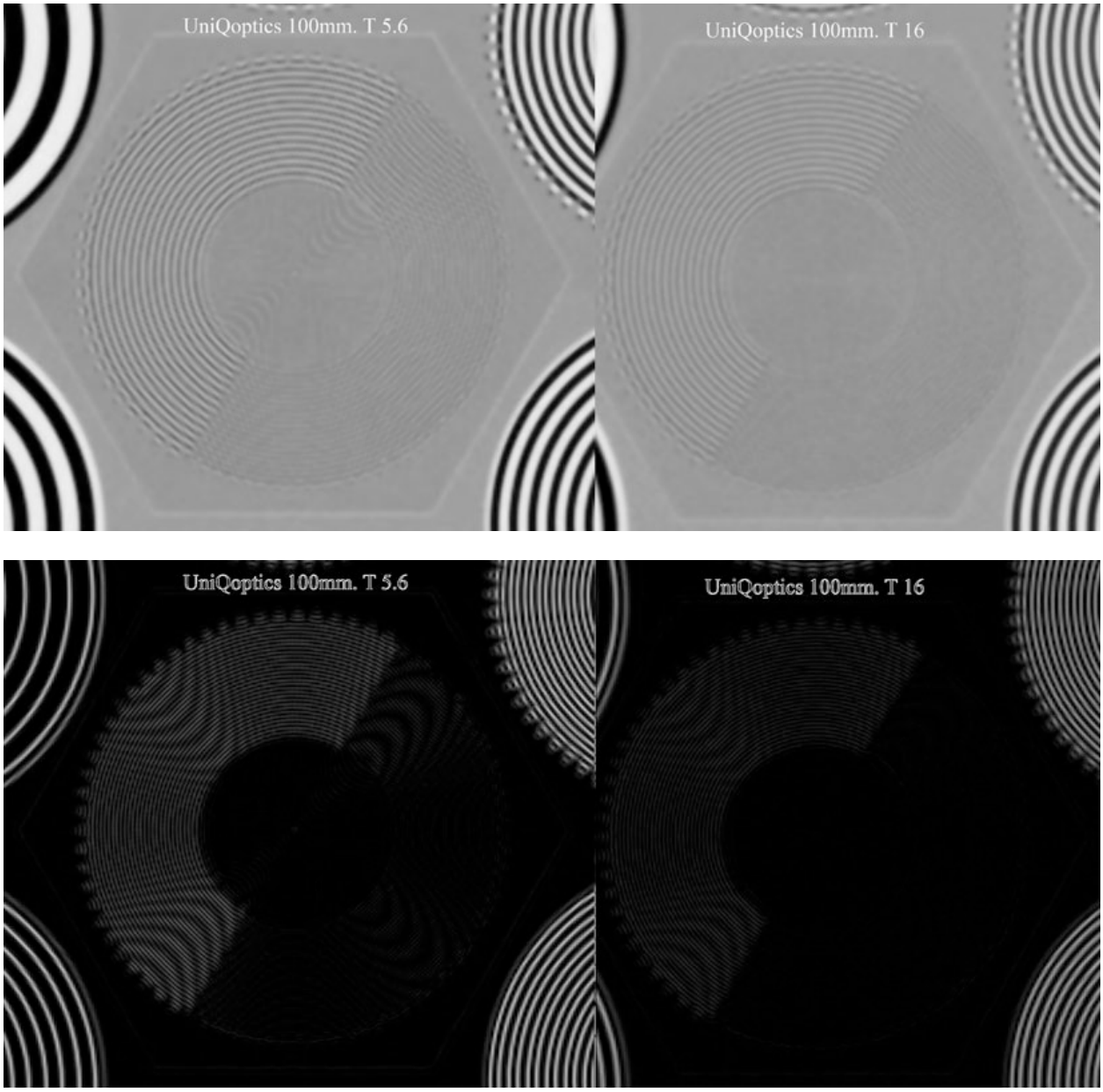
Concluding, we can say that the lenses provide very good resolution that covers more than necessarily the current 4K sensors.

Sharpness. ★★★☆☆

We observed that in general, the lenses show diaphanous and moderate contrasted images being the angled lenses slightly sharper than the most tele lenses. A detailed study has allowed us to observe minimum differences in sharpness at high frequencies using high aperture due to the diffraction effect maintaining, of course, the resolution power

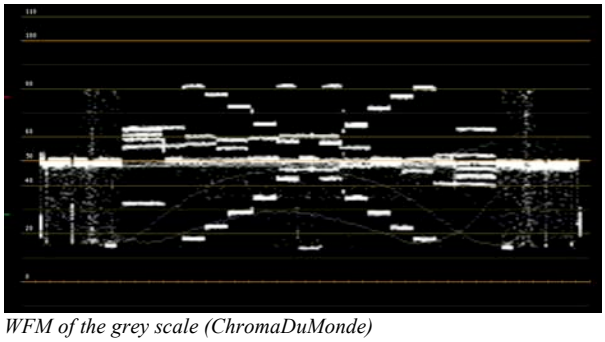


Zoomed image at 800%

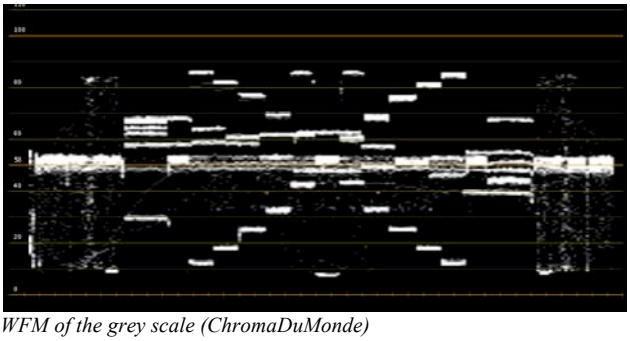


We have passed the image of the photographed resolution chart with the 100mm through the edge detector and found effectively how with a T16 the edges are less sharp and therefore are less visible. The image is enlarged to 800%

Regarding the contrast, as we can see in this image on the waveform Monitor, is less than MasterPrime lenses and is closer to softer lenses, but not reaching the softness of some of the Cooke lenses, therefore this set of lenses seems to be in an intermediate position. We have to remember that the contrast range of the lens determines the sharpness of the final image, like black reproduction affects the dynamic range. In this sense, the moderate contrast of the UniQoptics is especially useful in digital systems where we know the highlights are always hard to control (at least until Alexa arrived).

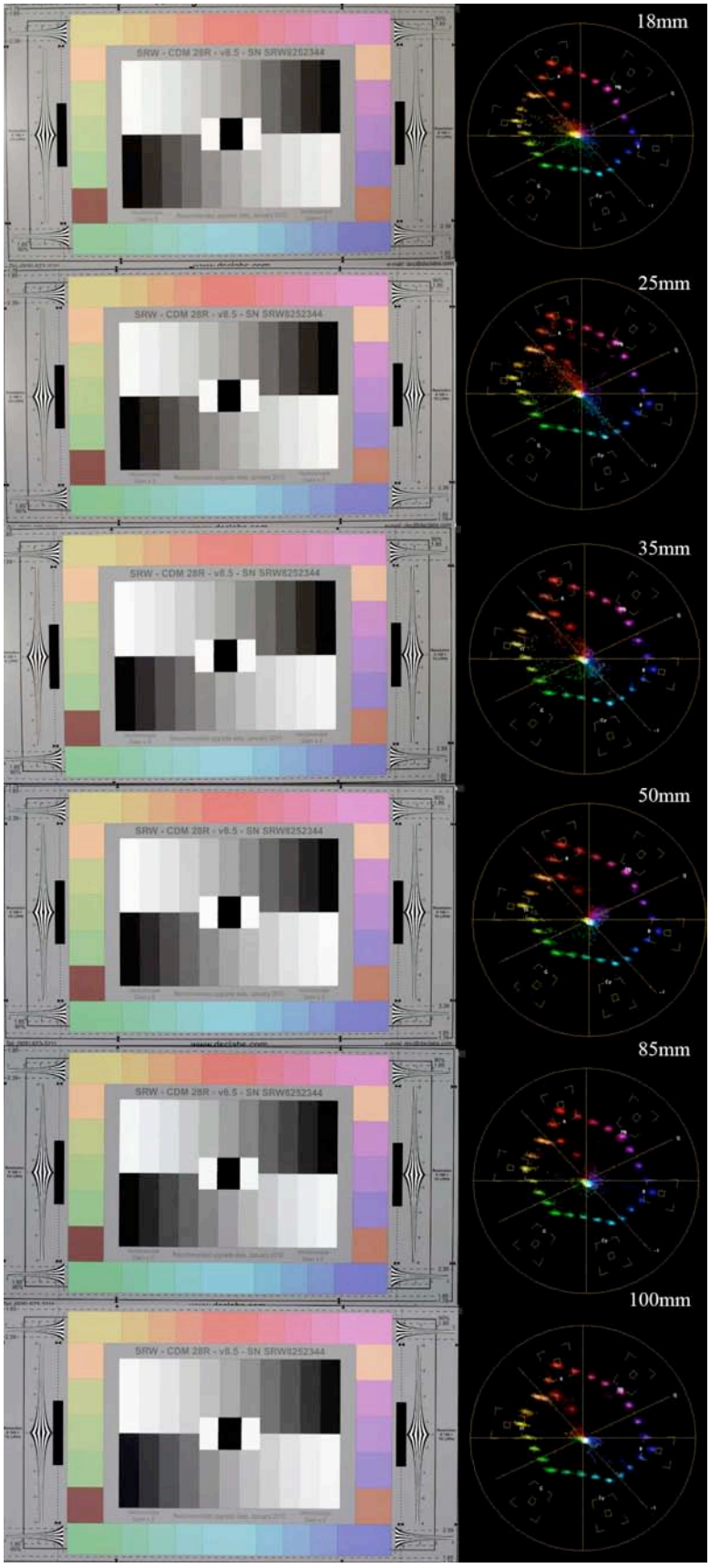


WFM of the grey scale (ChromaDuMonde)
UniqOptics 50mm T 5.6



WFM of the grey scale (ChromaDuMonde)
MasterPrime 50mm T 5.6

The Color. ★★★★½



To evaluate the color we have used a ChromaDuMonde chart from DSCLab we have photographed it with each of the lenses with the same T-stop, T 5.6. What we first notice is that each of the lenses correctly reproduces the color tone of the test chart and also among them there is very small difference in intonation. To verify this we have used as a reference the photographed test chart with the 50mm and have done grading to get the medium gray, the black and the white in the right place, in both: luminance and intonation. We have applied the same correction to all the other pictures taken with each one of the lenses and we have found in the vectorscope the differences, which are minimal across the range, while the widest angle, the 18mm developes slightly warmer the 100mm does slightly cooler. In any case, these deviations have so low impact that do not change the color shades of the chart. We conclude that the lenses show an accurate color reproduction and a great homogeneity among all focal lengths

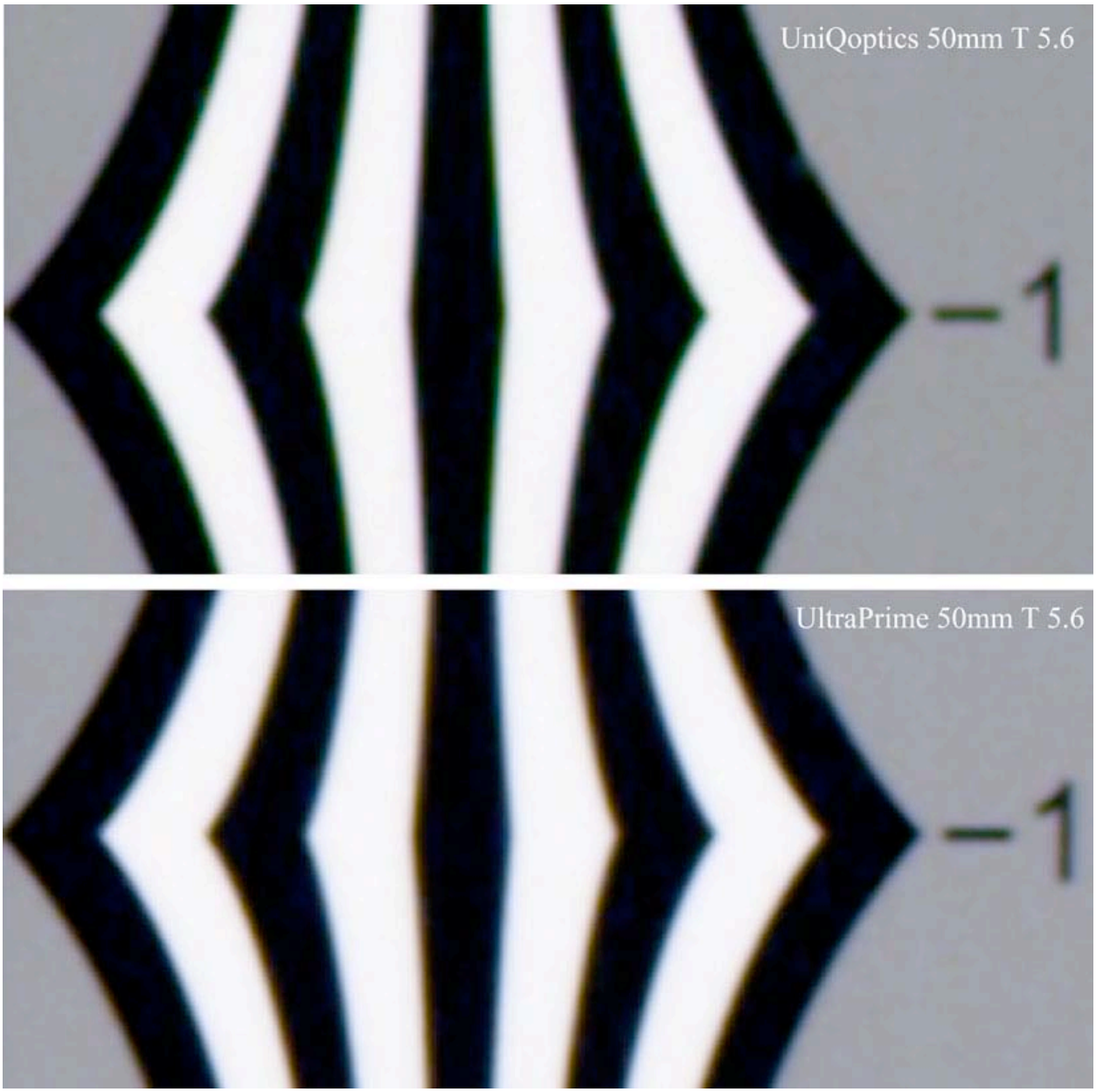




The images on the right show Agustín de Lezo and Pedro López de Luna. The lenses show with an excellent quality, both the textures of the dresses and the cuttings for the chrome background that was being used. Skin tones are soft.

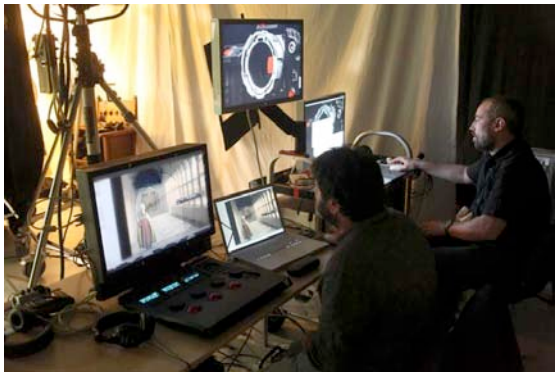
Chromatic Aberrations.★★★☆☆

One of the most common and notorious aberrations that we meet in digital images is the lateral or transverse chromatic aberration and is characterized by a series of color stripes on the edges of the image. This aberration is very difficult to remove especially at longer focal lengths. In these lenses and thanks to the near Telecentric design, the aberration is minimized but not disappeared. Of course it can not be observed in the central part of the image in any of the focal lengths, and on the edges we can see “soft” fringes of magenta/green", being more visible in the 18mm and 25mm than in the rest.



Side of the ChromaDuMonde Chart cut and enlarged a 800%.

In the above image we can compare the transverse chromatic aberration among 50mm UniQoptics and 50mm Ultraprime, with the same T-Stop. Both lenses show a slight aberration. In the case of UniQptics it is green / magenta and in the case of Ultraprime it is blue / red. And hereafter a frame where we have expanded the side of the vine image shows the effect correctly.



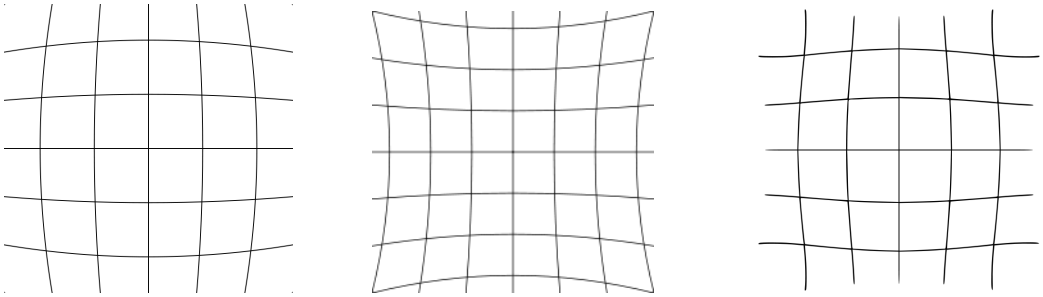


UniQoptics 18mm T 22. Original frame without grading.

Distorsions.

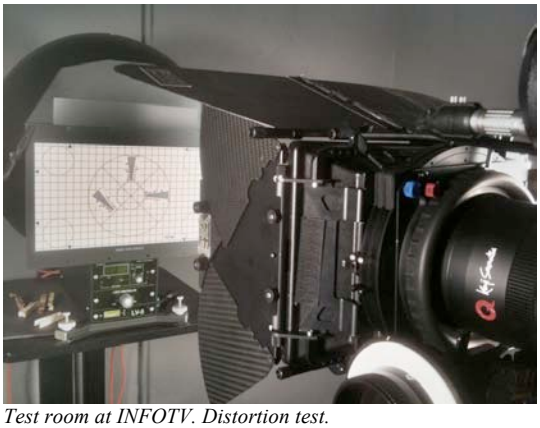
Geometric Aberrations.★★★½☆

These distortions take the form of a side curvature of the image produced by a different magnification in the area covered by the lens. The image of a rectangle (or square) produced by the lens suffers distortion when the image magnification decreases by increasing distance from the optical axis, barrel effect, or increases in the same way, pincushion effect. If in the center of the image the lines bulge out and as we move away from the optical axis there is a warp towards the edges then the distortion is known as "mustache. "

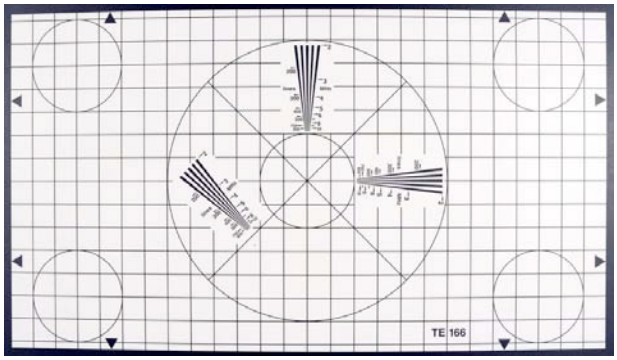


Barrel *Pincushion* *Mustage*

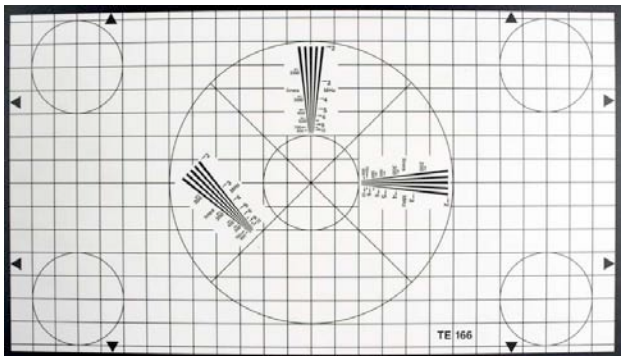
The pincushion effect appears easier on the lenses with longer focal, whereas the barrel distortion takes place more often on the wide angle lenses. Again in this case these lenses, they play a good roll, and are from the 35mm focal and up practically free of geometric distortions. The 18mm, the widest of the series, shows the barrel distortion with a value SMIA* TV of -3.54% (this has been calculated with IMATEST), and lowers to -2.3% with the 35mm. From 50mm there is no geometrical aberration. We can consider these values as low values meaning that in practice we will not see big distortions on the lines of the frame except with the 18mm, and if these are close to the lens and towards the edges of it



Test room at INFOTV. Distortion test.



UniQoptics 18mm T 7



UniQoptics 25mm T 7



UniQoptics 18mm. T 8 ND9 Filter. Graded. Parque Juan Carlos I. In this "real" image we can see the moderate effect of the Barrel distortion that we have already seen on the charts.

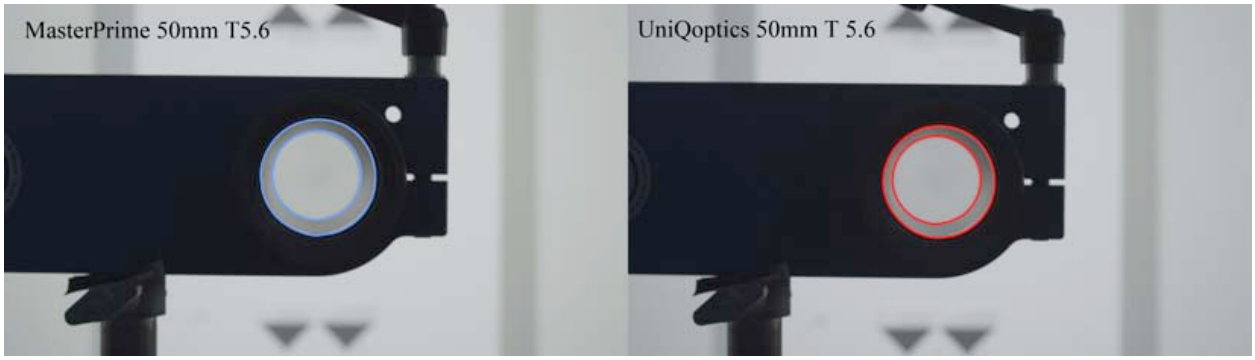
** Imatest is using the SMIA specifications that differs from the traditional definition on the Broadcast Industry, in such a way that the distortion value SMIA is double than the one traditionally used.*

The Perspective Distortion. ★★★★☆



Alfonso Parra AEC and Miguel Ángel in Technok.

The perspective distortion is the deformation of an object and of what surround it. To view this distortion we have used a photographic cylinder in such a way that the center of it coincides with the optical axis and the front is parallel to the sensor. In the case of for example a lens with an absolute Telecentric design we would just see a circle because the input and the output of the cylinder are shown in identical way. In the conventional lenses we see some distortion, as we show hereafter.



Both lenses have very similar distortion and what we can point out is that the Master Prime lense make a higher magnification than the UniQoptics, we also can say that UniQ results a little colder, or MasterPrime a little warmer.

Finally we have not detected other type of aberrations, as astigmatism, coma, field curvature, etc.

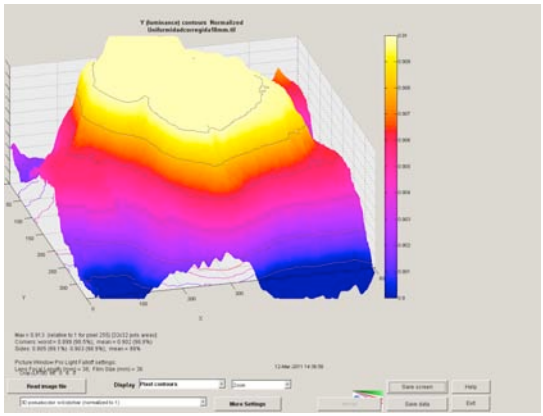
Light Uniformity.

-In each lense★★★★★

In this part of the test we have found the excelent light uniformity that has each of the focals on the serie. As we know the light uniformity asseses wether brightness of the surface of the entire frame is uniform or if there are deviations on the sides and the corners (vigneting). For this evaluation we have used both: the luminous sphere that gives an evenly lit surface, and a white surface homogeneously lit with devices to 45% across all the surface captured by the lens. At first glance we must say that there is no variation of brightness and that only the 18mm and 25mm focals show variations on IMATEST.



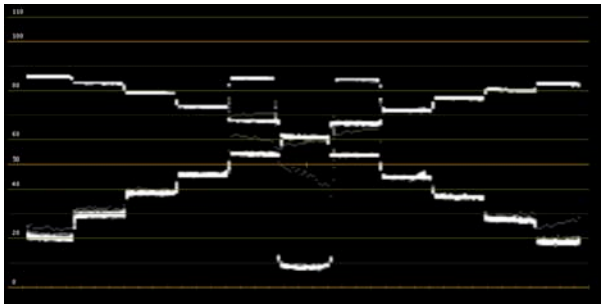
Brightness Uniformity tests with INFO TV´s LV5 sphere.



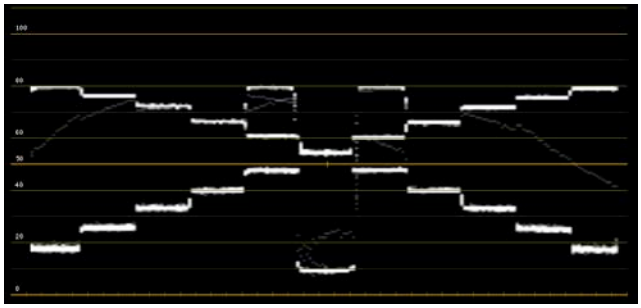
From the 35mm you cannot see the differences even if you use the program. Hereafter we show the chart with the data obtained for the 18mm. As we can see the average of deviation on the corners is 98,8%, this is a brightness difference with respect to the center of 1.2% and on the sides it is 99%, meaning that actually for the wide angle focal, which are always the most complicated, the result is excellent.

-In all the serie. ★★½☆☆

We have photographed the DSClab chart evenly lit with each one of the lenses at the same aperture and only varying the distance to the chart to make simmilar frames (and therefore focusing). Here we have found some variations: In this serie, the 50mm, the 100mm and the 25mm present similar luminance values, like the 18mm with the 35mm. It is the 85mm the one that presents a lower luminance value at the same aperture than all the serie and the 18mm the highest. This variations allthought small need to be considered, and it would be necessary to make aditional tests to check its extent. The difference beteen the 18mm and the 85mm, meaning the one that transmit more light and the one that less, is significant as we can see comparing the values on the WFM on the greyscale.



WFM of the grey scale (ChromaDuMonde)
UniQptics 18mm T 5.6

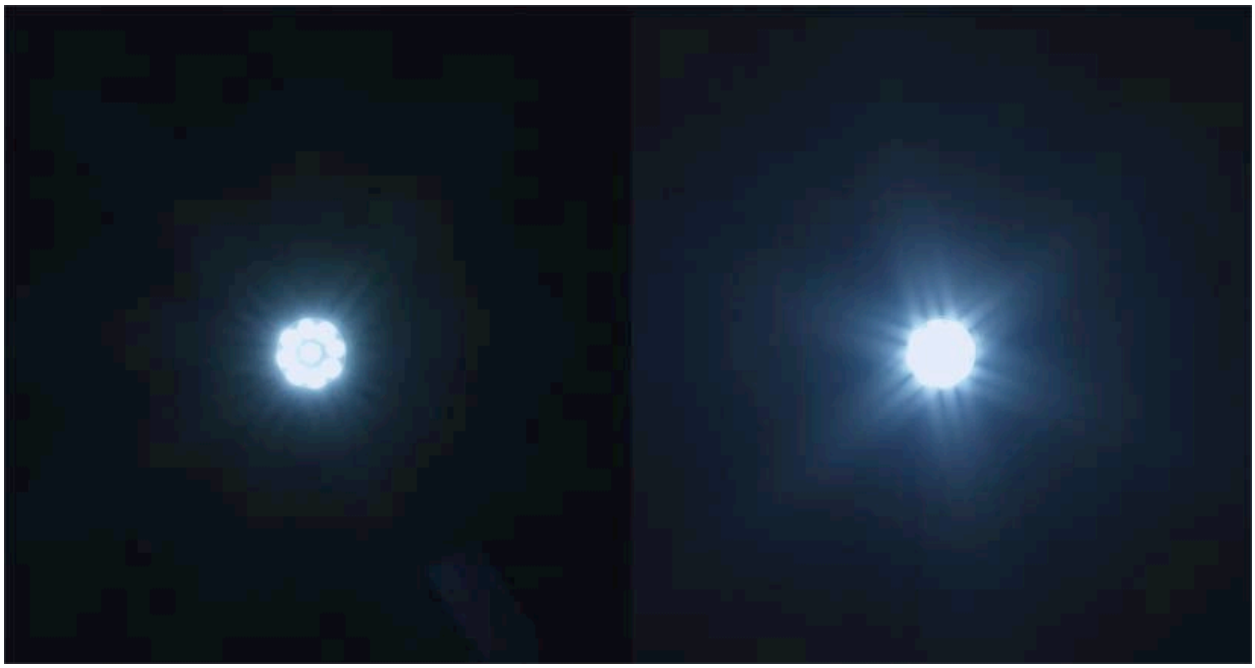


WFM of the grey scale (ChromaDuMonde)
UniQoptics 85mm T 5.6

However it needs to be considered that these variations are like this in this set of lenses that we are testing and can be different in other. UniQlenses are manufactured using traditional methods, one by one, in such a way that there are no identical lenses, as on the other hand we know from our own experience.
We have found that under equal conditions, the brightness of the lense is very similar to UltraPrime although with less contrast, but less than a MasterPrime, that shows more contrast and brightness.

Flare and veiling glare. ★★★☆☆

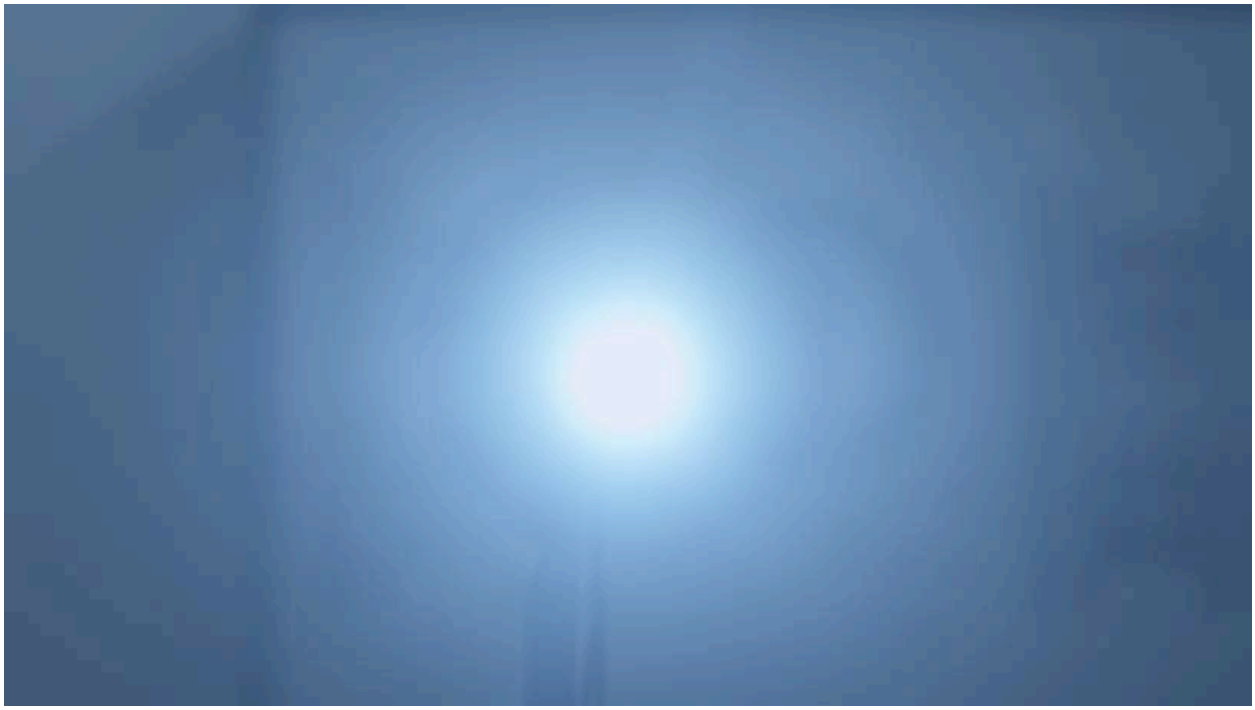
This two interrelated effects show the ability of the lens to shoot punctual light sources that directly fall on the camera (flare) and the loss of contrast, i.e. a veil in the shadows and halftones due to unwanted light inputs and unwanted reflections of the optical elements of the lens itself.
In this comparison we see how with a T22 in both lenses the Ultraprime still reveals the shape of the LEDs of the flashlight whereas with UniQoptics those are barely noticeable. With full-aperture T 1.9 UniQ present some more halos (flares) surrounding the light source.



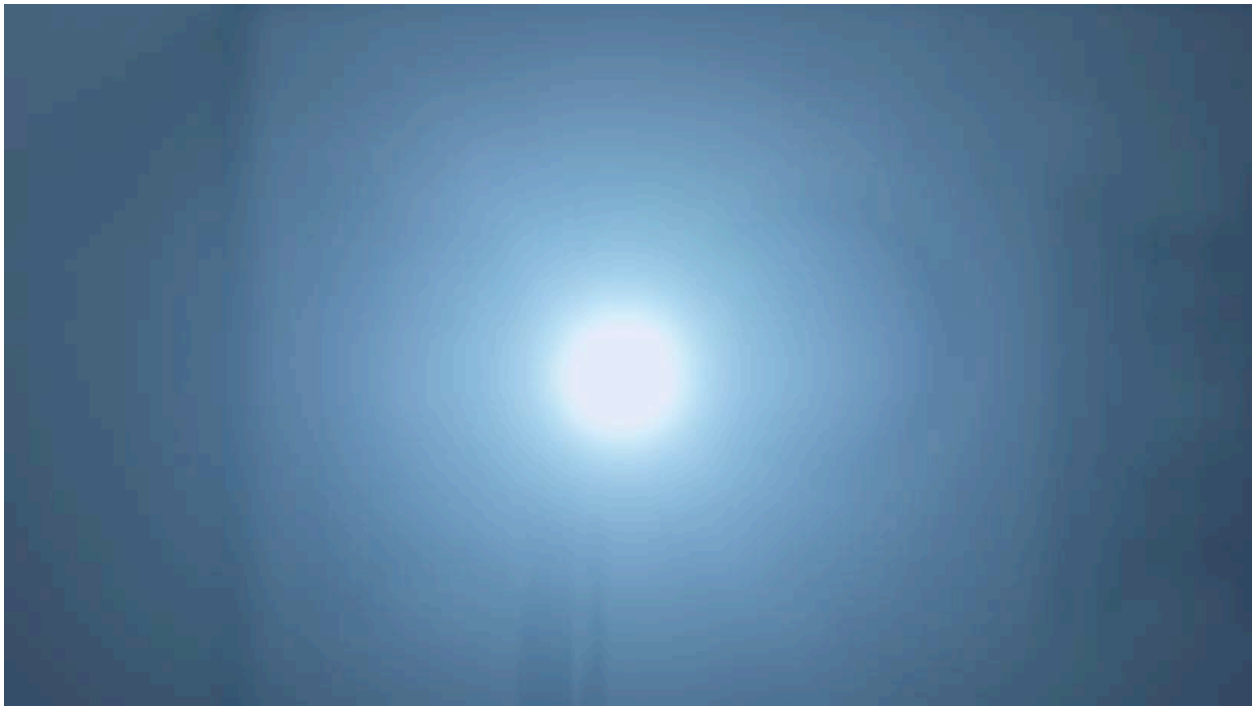
UltraPrime 50mm T22

UniQoptics 50mm T 22

Using the absolute Black Hole of the chart with Imatest we have manage to value the veiling glare. The Veiling glare due to light reflections among the different elements that integrate the lens as well as in the lens surface causes a loss of details on the shadows and of color on top of ghost images. The veiling glare is controlled by a careful design of the lens and the use of several coating of refracting layers on the lense and of course, during the capture of the image by using sunshades, flags and other elements for the control of the light that fall into the lens. As expected the 18mm presents higher Veiling Glare, a 0.545%. The 50mm leads to a result of 0.51% and just to have an idea, a 50mm MasterPrime in the same conditions has resulted to be 0.42%. These values are altered of course with the use of filters or under less controlled lighting conditions.



UniQoptics 50mm T1.9.



UltraPrime 50mm T 1.9.

Altogether we can say that the lenses have good performance regarding the veiling glare allowing them to show good contrast and rich colors.



Final composition of Archbishop Agustin de Lezo and Palomeque. UniQoptics lense 35mm T 5.6MTD400.3200ºK.180 25fps. UltraPola Filter.

The Focus. ★★★★★



Daviz Panizo, camera assitant during the filming of MDZ

We have observed no variation in the size of the frame as we change focus in any of the focals, even when it has a long run. The scales are clearly visible and their movement is completely smooth. Of course the focus ring is adapted to usual knobs in our work. The blurs are soft and uniform across the surface of the plane.

Weight, volume and other features.★★★☆☆

Without saying as a friend did, that the quality of the lenses are measured by their weight, the more they weigh the better they are, it is true that some optical properties are Improved with larger diameter lenses. UniQoptics lenses are voluminous and heavy, the most heavy is, 2.6 kilos and 1.8 kilos the least



and all of them with a front diameter of 110mm.

During the tests and on a later shooting we have found that the lenses are robust while the mechanics are smooth, both the focus scale and the iris. We can use the sunshades, bars and common brackets. The lenses besides the logo of the manufacturer include the designer's signature as a showcase and to guaranty their quality.

Finally, the use of the lenses is like the use of the glasses, some projects need some sort and other projects another, and it also comes into play the personal taste. All the tests that we have done are to show its place within the range of lenses that we have available. For us it is clear that they belong to the high-quality lenses group but this does not necessarily mean that all directors of photography would like them. I personally think that they come to fill a needed gap between the "hard" and "soft" lenses as they provide good contrast, great color consistency, a slightly cool general tuning and a smooth image texture but without losing definition. From mi point of view they are closer to the philosophy of Cooke lenses more than to the Zeiss´s. I miss that there are no more available focal lengths, specially the 40mm lens that I regularly use and with the one I feel very comfortable. Hopefully in the future the range of focals available will increase.

To finish let us see some final frames from MDZ´s shooting.



UniQoptics 50mm T 4.5MTD400.3200ºK.Obt.180 25fps. UltraPola filter



UniQoptics 50mm T 6.3. MTD400.3200ºK. Obt.180 25fps. UltraPola Filter

And our global punctuation "*Michelin´s stars*" considering all the above comments and my personal assessment of the overall behavior of the lenses: ★★★☆☆

Credits:
Cinematographer: Alfonso Parra AEC
Camera assistant: David Panizo
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References:

http://www.uniqoptics.net/
http://www.appliedcolorscience.com/index.htm
http://www.imatest.com
http://toothwalker.org/optics
http://www.alfonsoparra.com/

