PHOTOGRAPHIC STUDY AND ASSESMENT OF THE ZOOMS TO CINEMATOGRAPHY FUJIFILM MK 18-55MM AND 50-135MM

By Alfonso Parra AEC, ADFC.

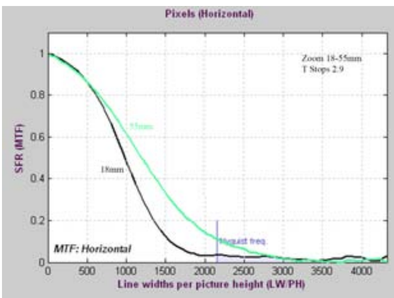
In present paper we are going to test the two FujiFilm zooms to cinematography, the 18-55mm widest-angle and the 50-135mm most telephoto, both with T 2.9 and, by the moment, with a Sony E mount. The study is focused on the whole aspects related to the image regarding the lens, among others, the resolution, color, bokeh and the spatial building. To the tests in both indoor and outdoor locations the Sony FS7 and Alpha a7S cameras were used; with the first one we recorded at UHD in XAVC-I, whereas with the second one in ProRes 422HQ at UHD through Atomos Shogun.

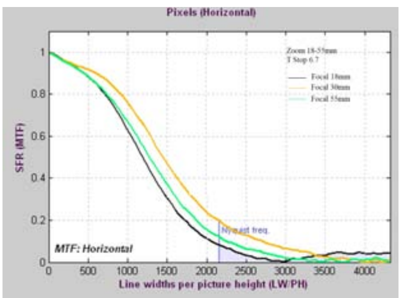
The assessments of the different tests are done under theoretical considerations, using both resolution and color charts and a final analysis through Imatest, Imagej or Color Inspector. We used different light sources suitable for the Sekonic C700 spectrometer and the Sekonic L-558/Cine light meter.

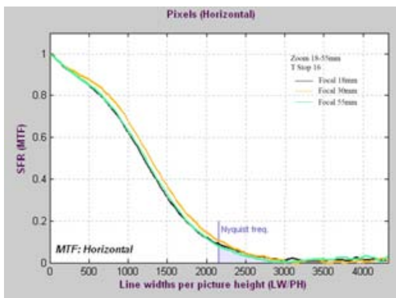
In addition of the technical study, we shot images in natural outdoor locations, recorded in Facatativá (Colombia) and its surroundings, in order to get most personal valuation of final aspect provided by the lenses. In the article the frames are extracted from the original ones and we used as mere references because they are compressed.

Resolution

We photographed frequency charts to study the resolution as well as charts of texture and we shot in outdoor locations, in both the Archaeological Park of Facatativá and the Colibrí Flowers firm. The resolution that we study is the addition of several elements, as the sensor or the compression process, which get involved in the final results; any modification of them would lead to change the results. However, we think that we can extrapolate the results to other cameras with a minimum error. Since we are dealing with zoom lenses, we evaluated the different aspects of the same to the three different focal lengths, the widest, the most telephoto and the standard. In the following graphs we show the MTF curves of the zoom 18-55mm in center of the image provided by the Imatest analysis of the ISO 12232 chart.



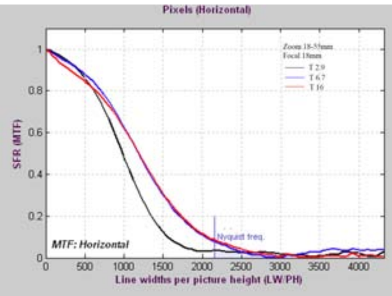


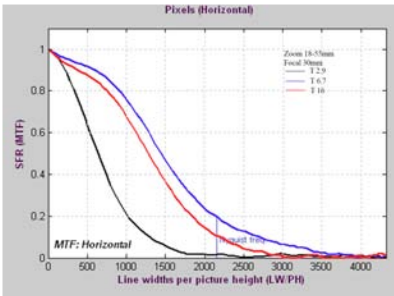


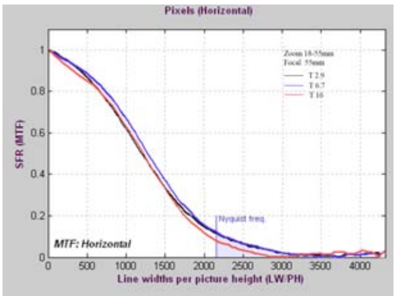
We saw that with T 6.7 value the resolution is similar throughout the focal length range; it is a bit larger to the medium range of the zoom. With the T 2.9 value there is a bit less resolution than to the 18mm widest focal length, and with T 16, the resolution is practically the same throughout the zoom range. It should be pointed out that the resolution, generally speaking, keeps regular throughout the focal length range.

It is usually difficult to zooms keeping the same conditions to all of the focal lengths. That is the reason why manufacturers are trying to optimize the longest range possible.

There is another question to answer: how is the resolution to the different focal lengths regarding the T value? Let us see the performance of the zoom 18-55mm.

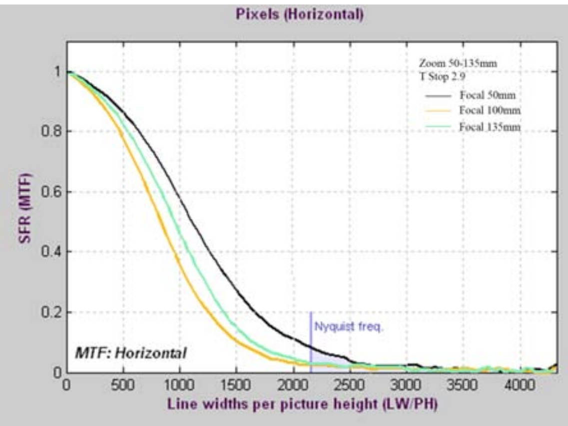


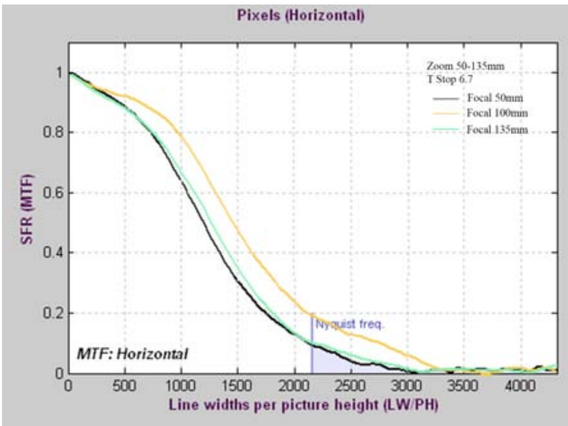




To the 55mm focal length we saw that the resolution is for all of the T values alike, from 2.9 to 16. There is certain lost of resolution with the T 2.9 to shorter focal length regarding the rest of the T values; such difference is more significant to the medium focal length of the zoom. It is common losing a bit of resolution with the widest T values due to the fact that we are using the edge of the lenses; it entails less brightness and more aberrations. In any case, as we will see in the outdoor location tests, the lost of resolution with the widest T value does not affect the images' quality.

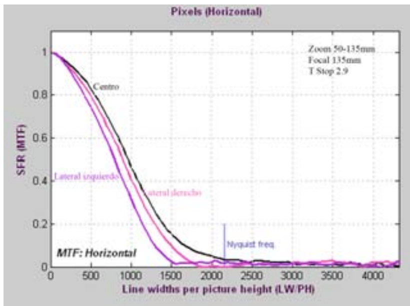
Let us see now the zoom 50-135mm

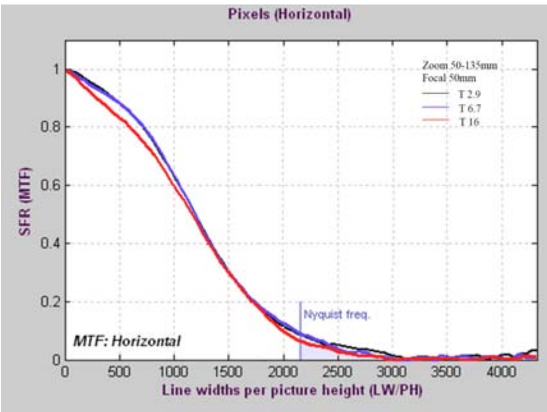


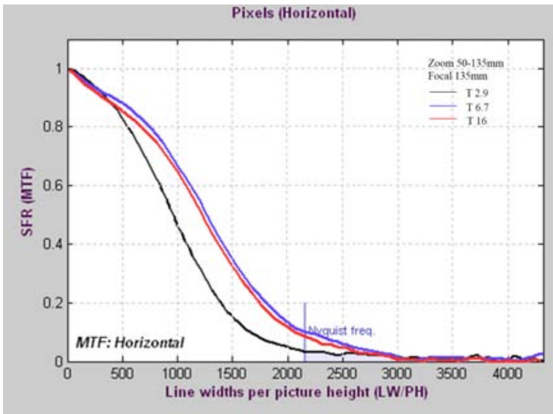


With the T 2.9 widest the resolution is larger to the shortest focal length and smaller to the standard distance, although, with the T 6.7 value, the standard distance shows more resolution, whereas the other focal lengths show resolution alike.
Such differences are not easy to detect visually, far away from the frequency charts. However, for example, if we enlarge the image enough, it is a bit softer with the T 2.9 value than with T 6.7 one to the 100mm focal length. We can see it in the following enlarged cutting of the *Prêt-à-porter* chart (x 1000). We can see loss of sharpness caused by the diffraction effect.

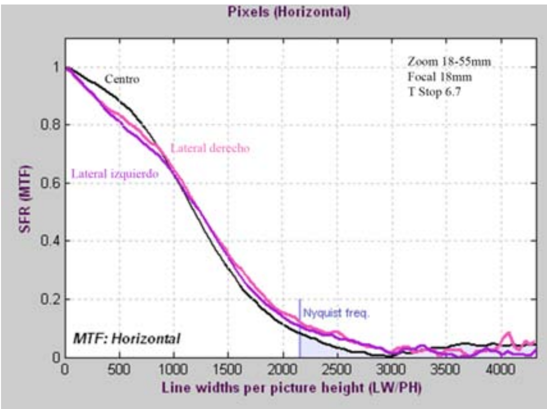
If we check the resolution in the edges of the zoom, we can see that hardly there is a loss of it. We show in the right the graphs the MTF curves in the center and edge of the image to the focal length 135mm with the T 2.9 value. To appreciate the resolution variation regarding the T value we show two graphs of the shortest and the most telephoto focal lengths, that is, 50mm and 135mm respectively. To the 50mm focal length the sharpness keeps constant throughout T values, whereas with the 135mm most telephoto focal length the resolution is smaller with the T 2.9 widest.

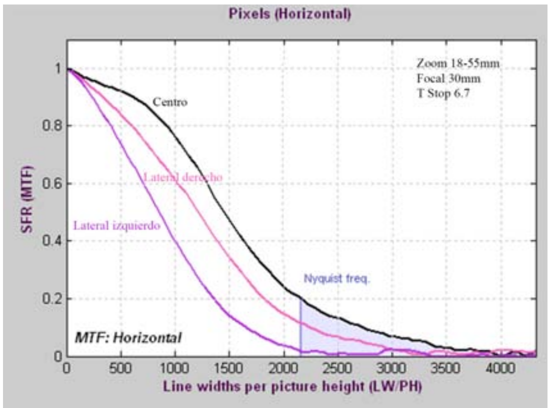




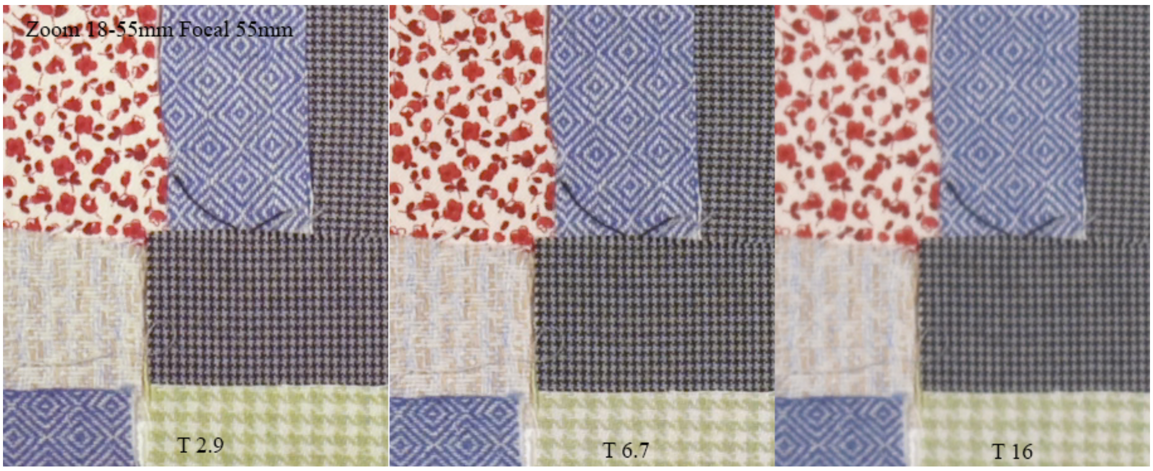


We could see such loss of sharpness to the zoom 18-55mm in the edges, above all to the longest focal lengths. Next, we show the MTF curves, with T 6.7 value and to two focal lengths, 18mm and 30mm.





As we have already pointed out upper, we put in comparison the results with the *Prêt-à-porter* chart. Next, we can see the difference of sharpness with different T values to the 55mm focal length of the zoom 18-55mm; it is a bit smaller with T 16 and it is hardly significant with T 2.9.



The following table shows the horizontal resolution to 50%.

Zoom Lens 18-55mm T values	Horizontal Resolution MTF 50%Center LW/PH	Zoom Lens 50-135mm T values	Horizontal Resolution MTF 50%Center LW/PH
T 2.9	**942**	T 2.9	**969**
T 6.7	**1309**	T 6.7	**1207**
T 16	**1236**	T 16	**1090**
AVERAGE	**1162**	AVERAGE	**1088**

Based on the results we can deduce that both zooms are alike regarding the resolution, absolutely matched. Moreover, we could conclude that they show enough resolution to work at UHD, although they provide slightly smooth images with defined but not excessively clear outlines. This is already a feature of the personality of the lenses.

Let us see some frames from outdoor location shooting.

Zoom 18-55mm. Focal 55mm T 5.6. On the right x1000 enlarged shooting.

In the upper frame we can see the definition provided by the lens in an area where there are a lot of fine details: carnations' stems, wooden posts or the texture of the plastic. As we have already said, the sharpness of the image depends not only on the lens but also on the sensor, on the camera processing and the compressing system, not to mention the postproduction and the final viewing. In the vast majority of the cases the lenses' resolution exceeds the camera resolution; for this reason the resolution limit is determined by the camera. The image sharpness, which is significantly caused by the lens, places to these zooms among the soft lenses zone, as we have already said showing the MTF curves. We can always see the resolution in the frame from a long shot of the Archaeological Park of Facatativá in Colombia. We can see the texture of both the grass and the stones, the clouds nuances, as well the fine detail of the trees.


Zoom 18-55mm. Focal 55mm T 5.6

Finally, here you are the results with the zoom 50-135mm


Zoom 50-135mm. Focal 135mm T 2.9

In the image we can see the texture of the carnation, plenty of subtleties; we can also check the bokeh, soft, with a quite natural progressive gradation.

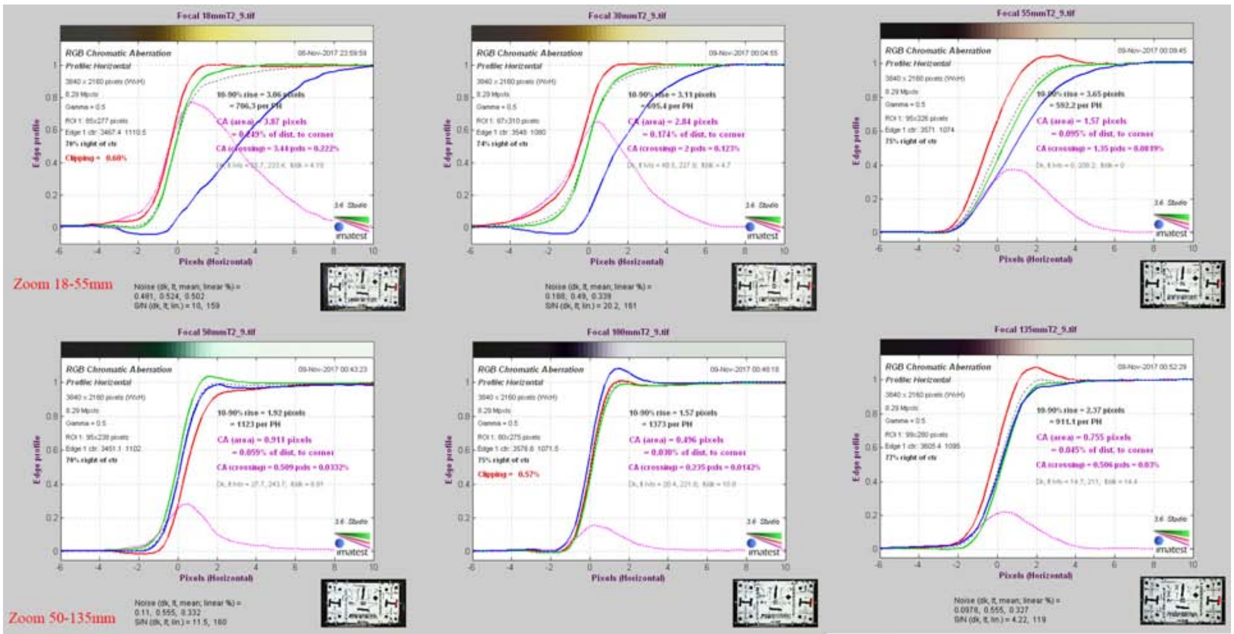

Flowers crop. Colibrí Flowers. Sony FS7 camera

Chromatic aberrations

One of the most typical aberrations that can be observed on digital images is the chromatic aberration, either axial or transverse. It is characterized by a sequence of color strips which contour the image outline, being more visible on the most contrasted edges. The closer to the image edges we are, the larger the transverse aberration is, whereas the axial appears on the whole image, in both the center and on the edges. It is sure that such aberration is one of the most difficult ones to fix, above all when the lenses are working with digital sensors. In the latest lenses, manufacturers bear in mind the particular features of the sensors in order to make designs which are more or less telecentric, including also aspheric elements; such improvements minimize the aberration and increase the image sharpness.

To evaluate this aberration we analyzed the ISO 12232 chart with Imatest, as well as the *Vía Stellae* chart. We also analyzed the frames shot in outdoor locations.

Next, we show the values provided by Imatest of the chromatic transverse aberration. The graphs present the RGB shifting, which is shown by the CA area under the magenta dotted line, expressed in number of pixels. The greater the CA value is, the clearer the aberration appears. We have also evaluated the aberration showing the distance of the center of the image (percentage ratio), according to the table provided by Imatest. We have to bear in mind that such gradation is regarding the still-photography, rather than motion picture which is obviously enlarged, above all on the theatre screens.



To the zoom 18-55mm the chromatic aberrations are significant; we can see them even under a moderate enlargement, above all with the widest focal lengths. The values are around 0.249%, 0.174% and 0.095% at the 18mm, 30mm and 55mm focal lengths respectively. On the contrary, to the zoom 50-135mm the values go from 0.030% at the shorter focal length to 0.045% at the 135mm focal length. It means that we will not able to see the aberrations to this zoom, whereas to the zoom 18-55mm we will be able to see clearly.

Transverse chromatic aberration in percentage ratio of the distance to the image center	Grade
0-0.04	Negligible
0.04-0.08	Low. Difficult to see unless it is looked in detail
0.08-0.15	Moderate. It can be seen when the image is substantially enlarged.
Por encima de 0.15	High. It can be clearly seen when the image is enlarged

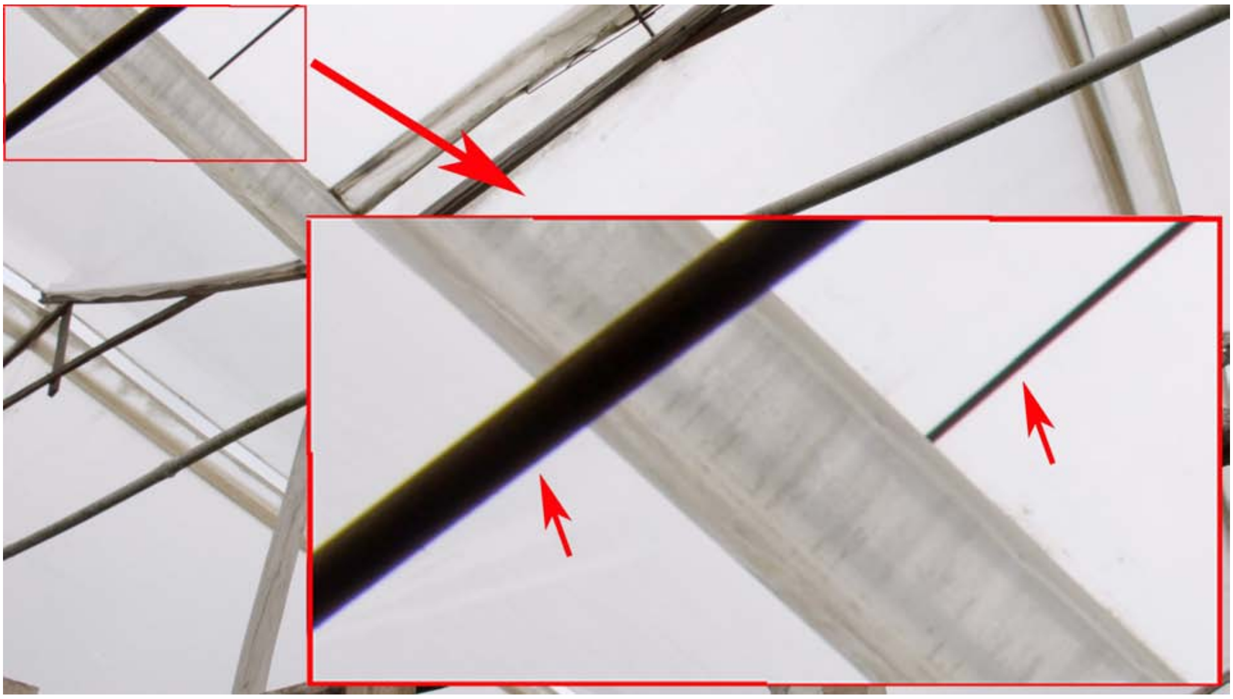
We used the *Vía Stellae* chart to test the aberrations. The chart is made of a group of back lighted small holes. We checked the aberrations enlarging the image size in 1500%.

Aberrations can be observed in the following images shot in the outdoor locations of Colibrí Flowers, Facatativá-Rosales, Colombia.

Zoom 18-55mm. Focal 18mm T 5.6.

We can see in the frame the typical secondary CA red/cyan on the left post.

Let us see another example in the greenhouse ceiling. We can see the CA on the tubes structures.



Zoom 18-55mm. Focal 35mm T 5.6.

Geometric aberrations

The different magnification of the field covered by the lens causes the barrel and pincushion distortions. In order to evaluate these distortions we used a grid that we have analyzed with Imatest. Table shows the distortions measured by Imatest in SMIA* TV. The SMIA value differs from the traditional definition given by the television industry: the SMIA distortion value is double than the one traditionally used. We got high values, so it entails that we can see such distortions in the outdoor location frames, above all with the widest aperture. Let us see the following frame.

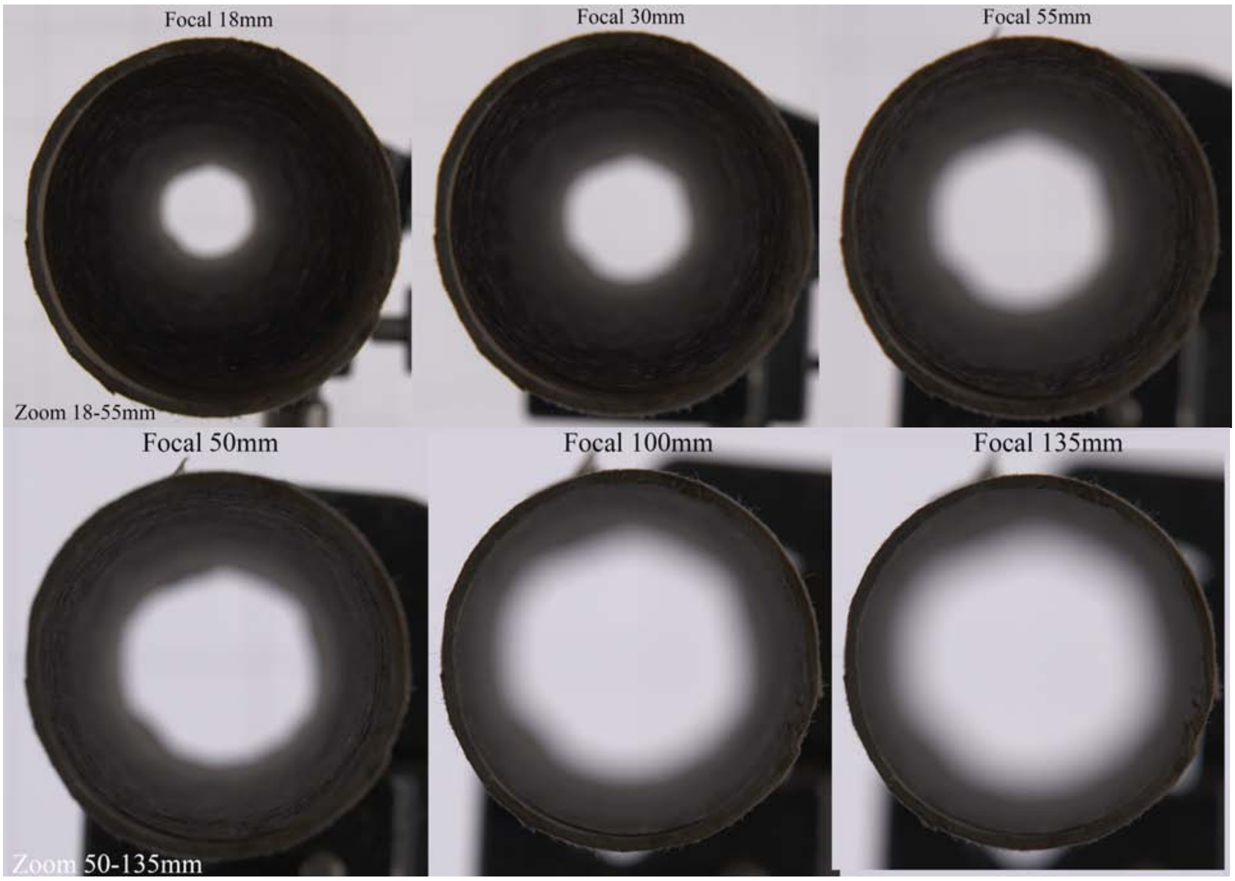
Zoom lens 18-55mm	SMIA TV distortion %
18mm	- 2.79 barrel
30mm	1.79 pincushion
55mm	2.08 pincushion
Zoom lens 50-100mm	SMIA TV distortion %
50mm	- 1.45 barrel
100mm	0.927 pincushion
135mm	1.54 pincushion

We can see the curvature of the posts, above all the ones in the foreground. The focal length is 18mm.

Zoom 18-55mm. Focal 55mm

In the frame we can see the pincushion distortion at the 55mm focal length. The posts are curved regarding the vertical line.

Perspective distortion and spatial configuration

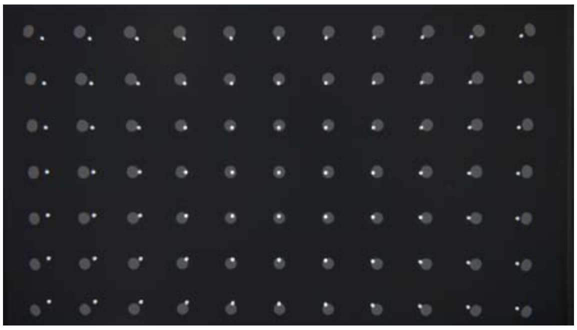


We show the perspective distortion in the upper images to the two zooms with their different focal lengths. To make it we shot a cylinder perpendicularly to the sensor in a manner that the optical axis coincides with the cylinder one. If we compare the distance between the cylinder bases, we can see how each lens builds the spatial relation, not only regarding the appearance of the relative distances but also the size of the objects placed in different depth of field. So, for example, the objects placed in the background look more distant with the 18mm, they are smaller, and vanishing quicker than the ones shot with the 55mm. To the zoom 50-135mm the relation between the 100mm and 135mm focal lengths are alike; the 50mm shows the objects in the background slightly smaller than with the other two focal lengths.

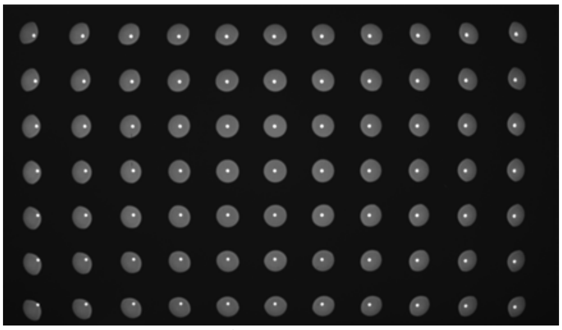
We can see the relative size of the chart regarding the model's face. We can also see how the 18mm and 50mm focal lengths alter her face, not only changing the face's size, but also its whole bone structure.

The differences of sizes and relative distances are not enough consistent. There is a great variation among the different focal lengths; it is typical of zooms, however, in this case we believe that it is a bit significant.

We also paid attention to other aspects, such as the lens "breathing", in other words, whether the frame size changes when we change the focal point to the different focal lengths. To do this, we have again used the *Vía Stellae* chart. We have overlapped a focused chart on other unfocused one; the small white point is focused and the largest one is unfocused. If both points are concentric we can state that the lens does not breathe. The less concentric are the circles; the larger is the frame variation regarding the focal point changing.

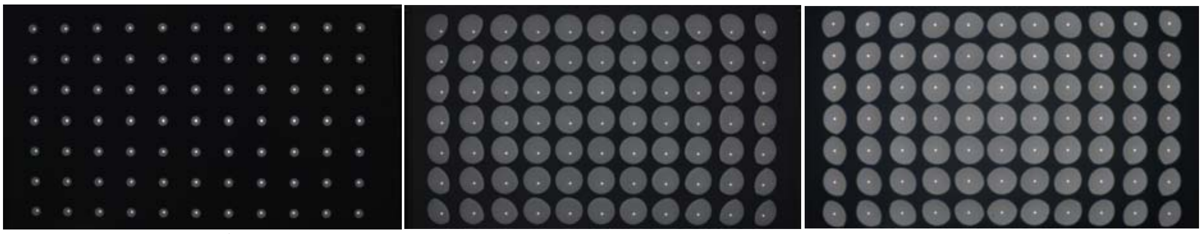


Zoom 18-55mm. Focal 30mm



Zoom 18-55mm. Focal 55mm

The zoom 18-55mm breathes at the shortest focal lengths, above all at the widest. We can see the breathing in the video which is posted in the article. With the longest focal lengths the breathing is insignificant.



Zoom 50-135mm. Focal 50, 100 y 135mm

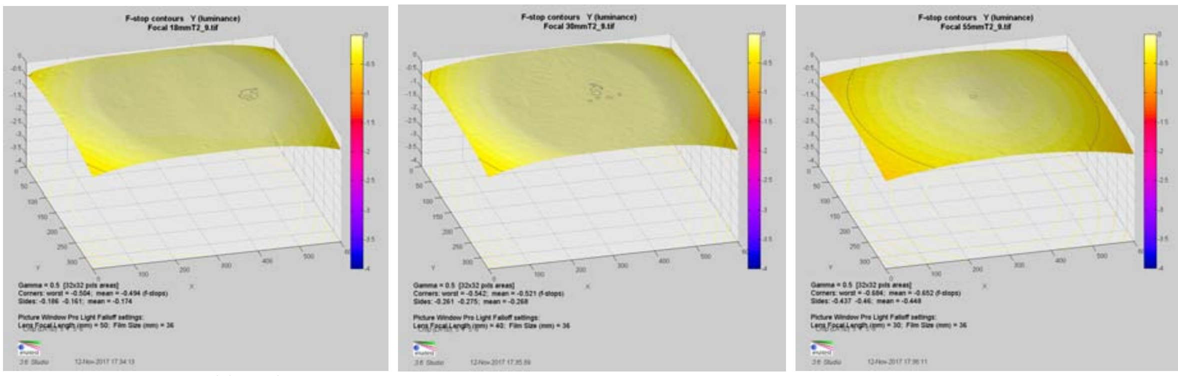
On the contrary, the zoom 50-135mm breathing is negligible throughout the focal length.
We have to take into account the bokeh too; in other words, how the soft-focus generated by the lens looks. As we already know, the bokeh depends principally on the number of iris diaphragm blades and on how they are placed from the optical design view. In the upper images from the *Vía Stellae* charts, we can see that the unfocused circles do not look like circles but a nine sided polygon, which is directly related to the number of iris blades. The more blades we have, the more circle-like the circle looks, and consequently, looks less polygon-like. Moreover, the opener the diaphragm is, the less polygon-like the circle looks.

If we put attention on the focused image of our model and her unfocused background of Christmas lighting, we can see, on the one hand, that the points look more polygonal-like to T 5.6 as we have already said. On the other hand, to wider T values, the points are large and they show vignetting. Anyway, the soft-focus is smooth with natural transitions from the focused to unfocused. We can see also this fact on the posted video in the article. Meanwhile, we show a frame to see the soft-focus.

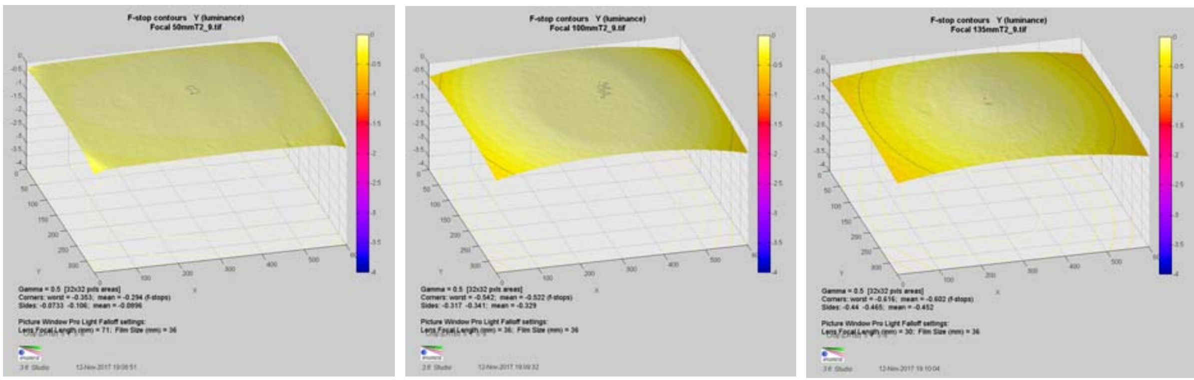
Zoom 50-135mm. Focal 135mm. T 2.9

Illuminance uniformity

The illuminance uniformity assesses whether the luminance of the whole frame is uniform or there are deviations on edges and corners (vignetting). To this test we shot a white surface homogeneously illuminated which covers the whole frame, and then we analyzed the images through Imatest. The difference of illuminance contributes to the resolution and sharpness of the image. The graph that we insert is a 3D-model which shows the illuminance values over the whole frame.



Zoom 18-55mm. Focal lengths 18, 30 y 55mm a T 2.9



Zoom 50-135mm. Focal lengths 50, 100 y 135mm a T 2.9

We show the values in the following table

Zoom 18-55mm T2.9	Average of corners in f-stops regarding the center	Average of edges in f-stops regarding the center
18mm	-0.494	-0.174
30mm	-0.521	-0.268
55mm	-0.652	-0.448
Zoom 50-135mm T2.9		
50mm	-0.294	-0.0896
100mm	-0.522	-0.329
135mm	-0.602	-0.452

The values are moderate, even if we take into account the range of the zoom as well as its size and the diameter of the crystals. For practical purposes, we cannot see such loss of luminance.

Flare and veiling glare

Both flare and veiling glare refer to how the reflections of the beam of light inside the lens system contribute to change the contrast, sharpness and resolution.
To the test we used a gray scale with a built black hole and then we analyzed it through Imatest. The veiling glare measure is the ratio between the light which falls upon the black sensor regarding the surrounding white. Next, we can see the results

Zoom 18-55mm. T 2.9	Veiling Glare %	Zoom 50-135mm. T 2.9	Veiling Glare %
18mm	0.241	50mm	0.239
30mm	0.261	100mm	0.209
55mm	0.291	135mm	0.253
AVERAGE	**0.264**	AVERAGE	**0.233**

The values show a well control of the veiling glare. It entails that the blacks will not become gray-like. Let us see the extreme example.

Zoom 18-55mm. Focal 18mm T 16

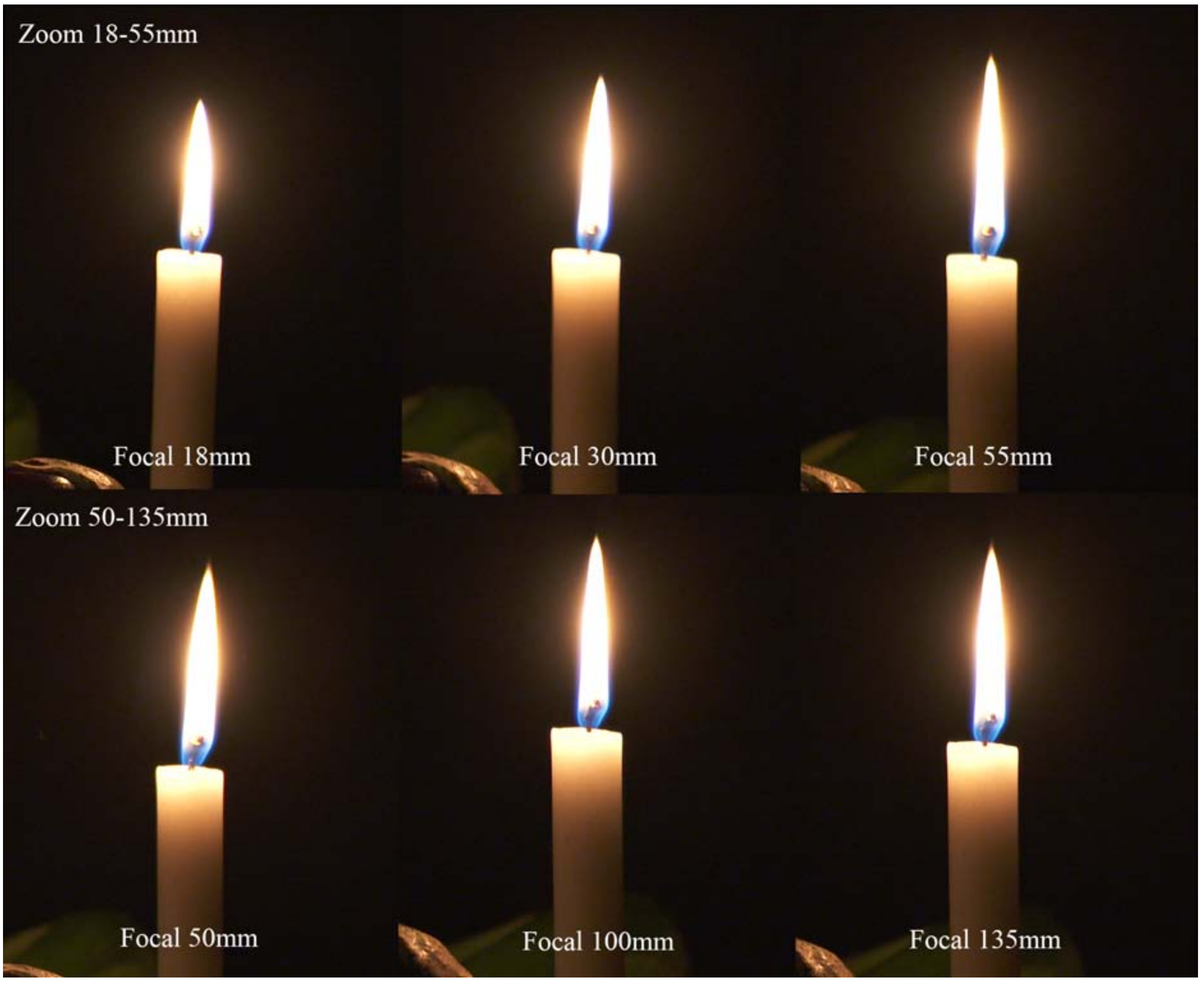
Zoom 18-55mm. Focal 18mm T 2.9

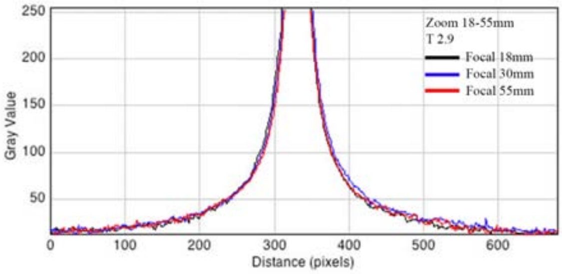
Archaeological Park of Facatativá. Colombia. Adriana Bernal ADFC with the Sony Alpha a7S camera.

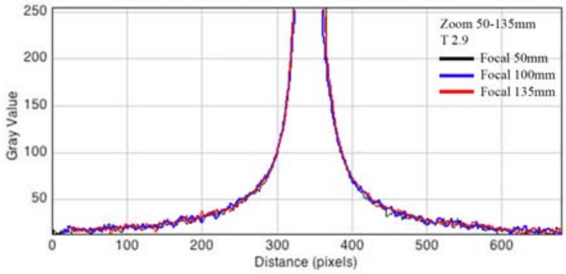
On the left frame we closed the diaphragm framing the sun. As we can see, the black keeps quite well, with depth and none milk-like. On the second image, we have exposed up to T 2.9 and then the black keep deep, with nuances and without an excessive cleaning.

With regard to the flare, we show it through a lantern in direct light to the camera. We can see that flare is quite controlled, above all with the standard focal lengths to both zooms. The 18mm and 135mm focal lengths make the largest aureoles and internal reflections.

Generally speaking, the two zooms are similar regarding the flare management. In order to see it clearer, I shot a still-life illuminated only with candles, measuring the bright values of one of the flames through ImageJ. The graphs show the bright pixel values from the black up to the extreme white of the flame, and then being back again to the black with the three chosen focal lengths.
The appearance of the flare is very similar throughout the range of the focal lengths.







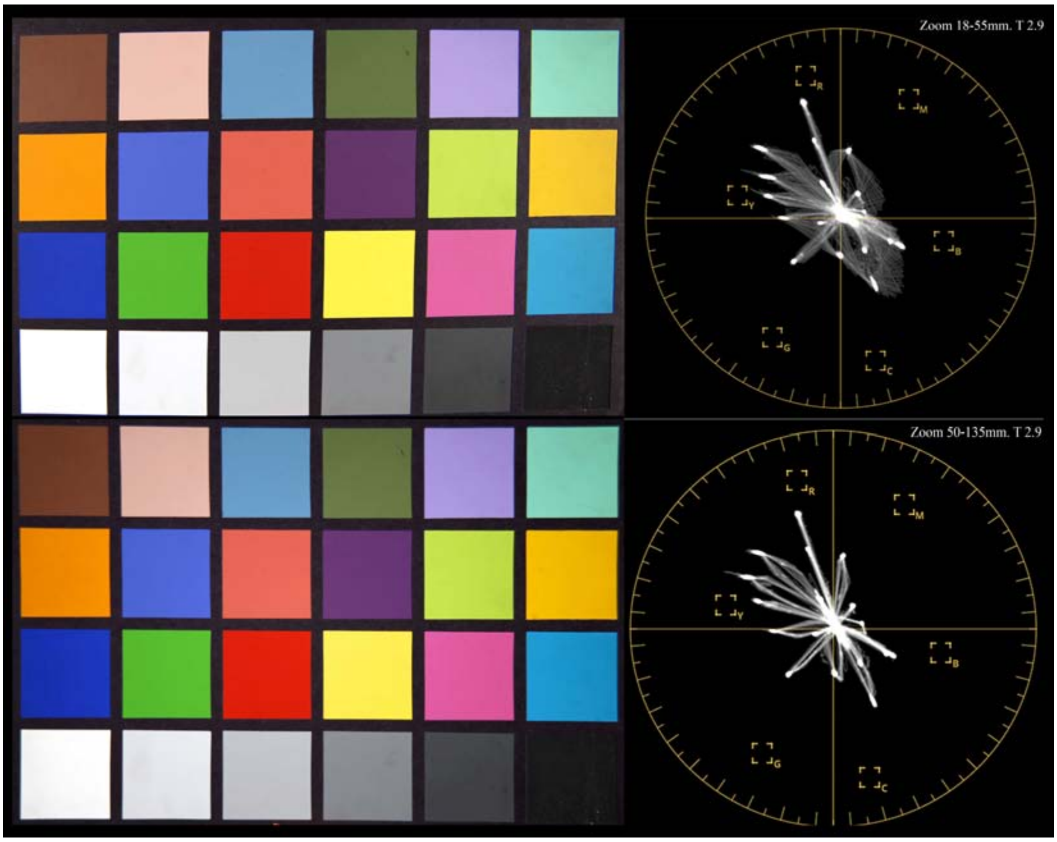
The appearance of the flare is very similar throughout the range of the focal lengths.

Zoom 18-55mm. Focal 18mm. T 5.6

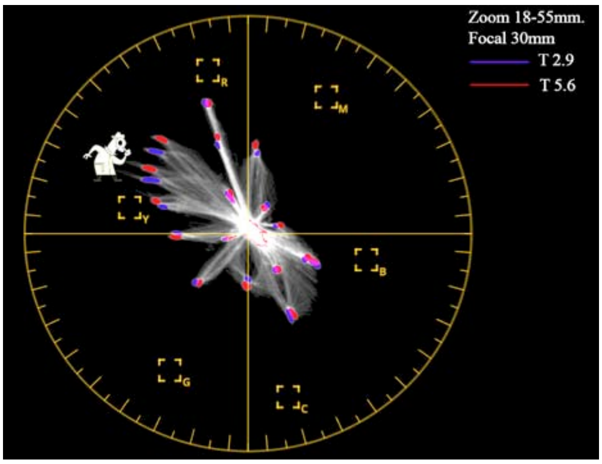
Zoom 18-55mm. Focal 55mm. T 8

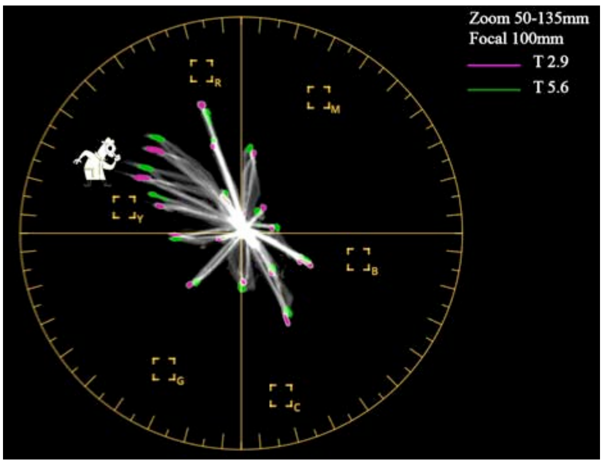
Color

We studied the color response through Macbeth chart as well as the observation of frames from outdoor locations. We shot the Macbeth chart to every zoom at the three focal lengths. We used the tungsten light to 3200ºK as well as Leds panels regarding its related color temperature. In addition to shoot the chart at the different focal lengths, we did it also with different T-values. The two zooms match properly, without color deviations to each other as we can see in the following image. We can see such similarity of both charts in the vectorscope.
We adjusted the charts at the gamma, blacks and high lights alike.



We see indeed to the two zooms a slight change of tone in the samples 7, 12 and 16, which are related to the colors orange, orange-yellow and yellow respectively. With the widest T value, such colors are slightly more yellow, as we can see in the following comparison in the vectorscope.





Other issues

Alfonso Parra AEC, ADFC in the EFD's testing room

Taking into account in what focal length the zooms work, we believe that they are to us extraordinarily slight with an easy driving size. Despite their reduced weight, they look compact and robust. Since the two zooms have the same diameters, we can use all of the necessary accessories without exchange, from hoods until the different focus selectors. Although we have to take care with the motor power, because if it is excessive they can damage the mount and the lens itself; as one of our assistant, Juan Sebastián Rojas Díaz, told us; "… during the tests, we find that iris rings, zoom and focus of the lenses have a design which engages perfectly the motor gears of the HEDÉN lens control system. During the test the engines make the whole ring range, however, we found, despite the motor were adjusted to the lowest torque, such torque made still an excessive press over the lens, moving it up and down during the ring rotation". Every ring of the zooms moves softly, with an appropriate friction, neither too much soft nor too much hard. The focus ring has an ample range (200º) which entails that the focus is quite accurate. It should be pointed out the Backfocus function which allows that the user adjusts the lens to the camera as well as the Macro option which allows focusing quite close. The two zooms have their own mounts to use with sticks. It should be also pointed out that the zooms do not lose focus meanwhile we move the zoom, keeping always the same axis on the frame.

Conclusions

In order to evaluate the two zooms, we have to take into consideration not only the technical conditions which determine the lens *personality*, which that is provided by the decisions that the manufacturer makes during its design, but also the Director of Photography experience and his/her taste regarding his/her photographic style.

From the technical point of view, it should be pointed out that the quality of both lenses is good regarding both the resolution and veiling and color. Both zooms performance quite good resolution, enough to the UHD formats, but it is not *extreme,* giving a subtle touch on the whole image.

The illuminance uniformity to the two zooms is good without being excellent caused by the loss in both corners and edges, which is in average a bit larger than 1/3 stops; however such variation are practically imperceptible while we are shooting under normal conditions. The geometric aberrations are significant, both the barrel aberration and the pincushion one. The chromatic aberrations are perceptible to the 18-55mm, especially significant with the shortest focal lengths; we cannot practically see to the 50-135mm zoom. The lenses have a good control of the veil which entails that, despite being smooth regarding the resolution, they show a good contrast with the blacks quite definite. The flare is enough sharp with elegant pearls of violet, blue and yellow/green–like tones. With regard to the color, the lenses are close to be neutral, without being cold, and without a dominant tone. The two zooms by themselves and regarding each other keep an excellent coherence, not only with the color, but also with all of the parameters tested. Finally, it should be pointed out their bokeh and how the lenses manage the depth of field. The soft-focus, above all with wider T values, has certain taste of the watercolors brushstrokes, with a beautiful plasticity during the transitions.

Ōgata Kōrin. Irises

We could definite the lenses as smooth, with a moderate contrast and neutral.

As a Director of Photography, from my personal taste, I am pleased with the two zooms because I like their versatility, their smooth image but at the same time strong, I like certain personality which builds the blacks clean, mixing up them at the same time with the soft-focuses, with a quite pictorial depth. However, the geometric distortion and their chromatic aberrations of the 18-55m as well, reveal certain insufficiencies. I am not pleased by the management of the perspective that the zooms do either; it is too much obvious and a bit *artificial*, although the distinction between the foreground and background in the frame, to both the focused and soft-focused is very good. It should be pointed out the excellent price-performance ratio as well; it placed the zooms as a great option to the middle and low cost productions. I think also that the set of the two Sony cameras and the lenses provided an excellent quality; they have proven match.

The lenses, regarding their personality, belong to the rest of the Cabrio lenses. As I noted in the assessment of the 20-120mm, they remember me the works of the Japanese lacquer-worker Ōgata Kōrin..

The following table resumes the assesment.

	Zoom 18-55mm	Zoom 50-135mm
-Resolution	★★★☆☆	★★★☆☆
-Chromatic aberrations	★★☆☆☆	★★★★☆
-Geometric distortion	★★☆☆☆	★★☆☆☆
-Perspective distortion	★★★☆☆	★★★☆☆
-Breathing	★★★★★	★★★★★
-Bokeh	★★★★☆	★★★★☆
-Vignetting and illuminance uniformity	★★★☆☆	★★★☆☆
-Veiling glare	★★★★☆	★★★★☆
-Flare	★★★★☆	★★★★☆
-Color	★★★★☆	★★★★☆
-Ergonomic and handling	★★★★★	★★★★★
-Price-performance ratio	★★★★★	★★★★★
Overall evaluation	★★★☆☆	★★★½☆

Video
https://vimeo.com/242824919

Credits

Producer: La Olimpo SAS
Director of Photography and Technical Director: Alfonso Parra AEC, ADFC
Second unit photographer: Adriana Bernal ADFC
EFD coordinator: Santiago Ortega
FUJI coordinator: Luis Gutiérrrez
First assistent camera: José Novillo
Dit: Daniel David González
Model: Diana Paola Ariza

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