EVALUATION AND PHOTOGRAPHYGRAPHIC TEST OF THE CANON CAMERA C700

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I N T R O D U C T I O N

In this document we are studying the new Canon Camera C700 from the viewpoint of a Director of Photography. We have centered in the fundamental pillars of the digital image quality such: as resolution, dynamic range , noise, sensitivity and color; while contemplating the subjective valuations of the participant in the test: such as DPs, assistant and post producers. The analysis of the different tests has been performed on theoretical considerations, working with resolution and through later analysis with programs like Imatest, ImagJ or Color inspector. We have also used several light sources calibrated with the Spectrometer Sekonic C700 and the Photography meter Sekonic L558-Cine. We have work with UltraPrime Lens and the Canon Zoom 30-300.

We certainly have tested with several camera configurations, most of them were recorded in XF-AVC at 3840x2160 with a variable bit rate of 410 Mbps, with the Canon log 2 curves, the widest Cinema Gamut color space and an ISO800, IE recommended by the manufacturer to this curve.

The theoretical test likewise, has been complemented with natural outdoors and indoors recordings in Cucunubá, small Colombian village located just a few hours away from Bogota.

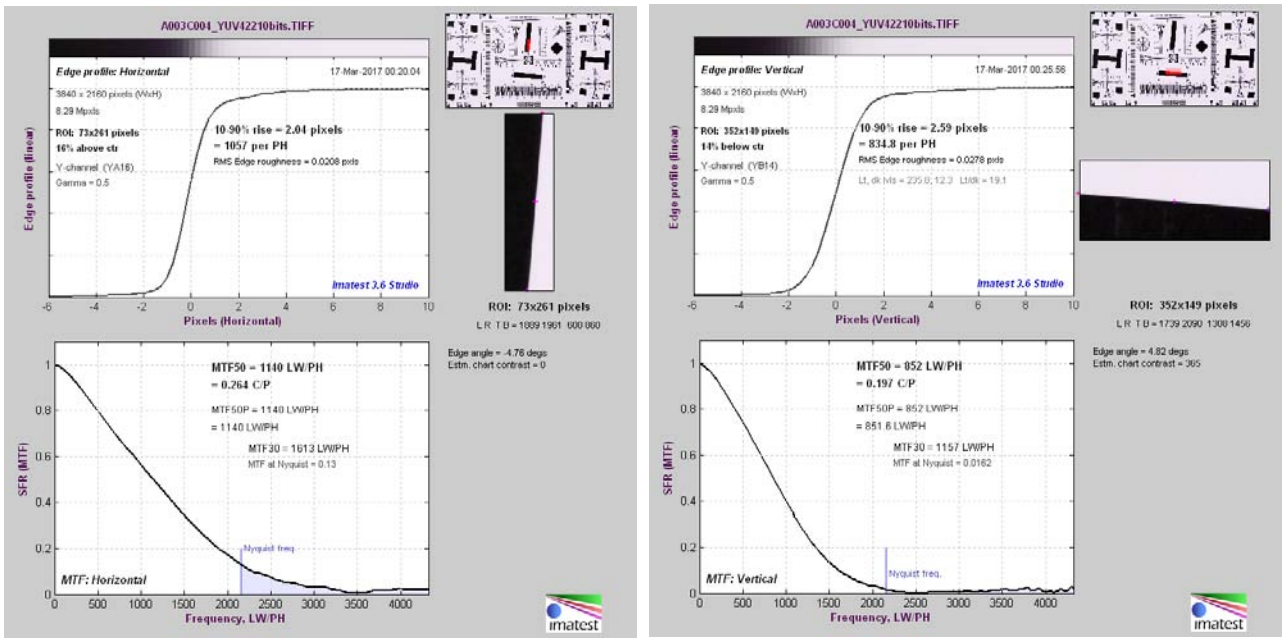
There, we made a recording on how people produce "native clothes" with hand looms, on how they work in a small farm or inside a mine at 300 meters depth. The postproduction job regarding colorization and assemble has done with a Scratch and Adobe Premier.

The images included in this document come from the original photographs, but compressed. So please take them only as references. Likewise the video are compressed to HD (1920x1080)

RESOLUTION

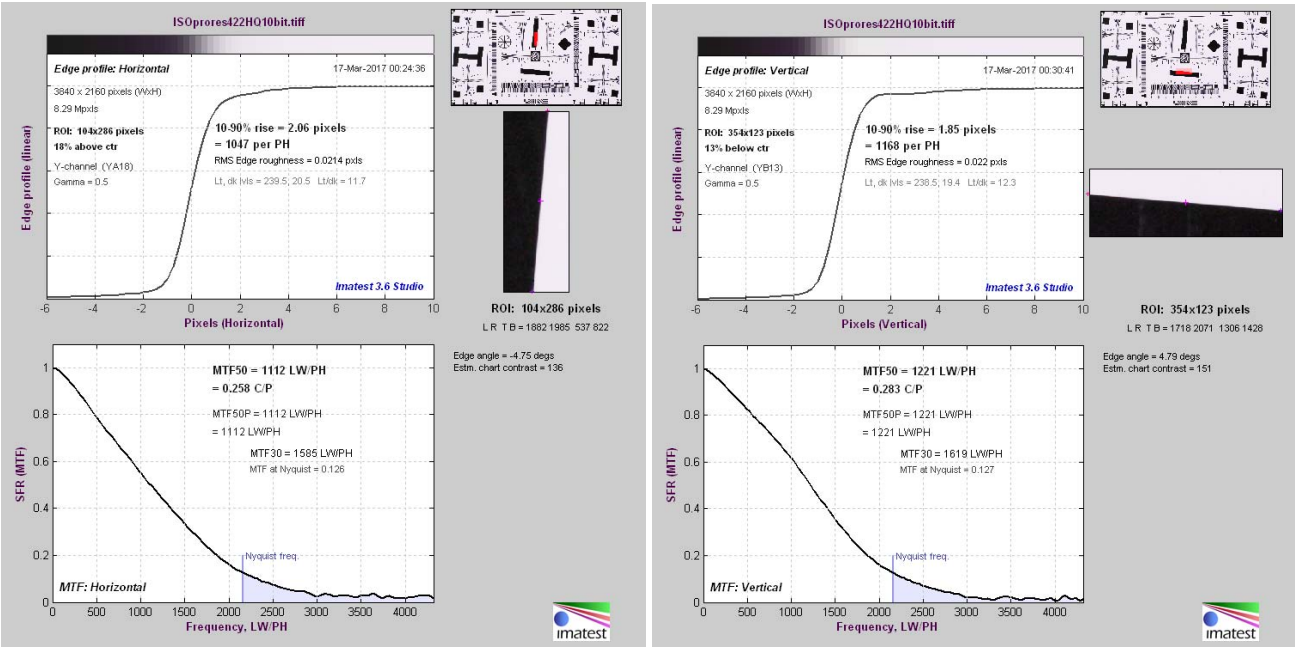
In this section we study the camera capabilities to represent detail, from the lowest frequencies to the highest; or how the image sharpness is built by the camera through different formats and with different codecs.

The Resolution.
For the resolution tests we have used the charts ISO12332 and the Putora to recreate the MTF curves. Likewise we have studied the still life with different textures and last the planes recorded outdoors, normally the general scenes with high level of detail. The camera as it is normal in high-end cameras offers different recording formats and compression codecs . The C700 offers from 4K down to HD 1920x1080 passing through 2K and UHD. Not in all the formats we have the same sampling , In 4K or UHD, if we record in XF-AVC we use the codec YCbCr 4:2:2 at 10 bits; or if we record in ProRes we use the Codec 4:2:2HQ 10bits.
In 2K or HD we can record at 10 or 12 bits in RGB4:4:4, Pro Res4:4:4 or YCbCr4:2:2 and ProRes 4:2:2 HQ. The camera also records in RAW format with a Codex recorder specifically designed for it.
At the time of making the tests, we did not have the Codex recorder so we had to record in UHD in the internal memory cards. As we already pointed out the camera can record in XF-AVC which is Codec H264 v5 that can works at different bit rates. From the basic 50 Mbps long GOP up to the 810Mbps Intraframe passing through other bitrates from 310Mbps up to the 440 Mbps.
The camera can also record in ProRes.
Below we show the MTF curves obtained from UHD in XF-AVC and ProRes.



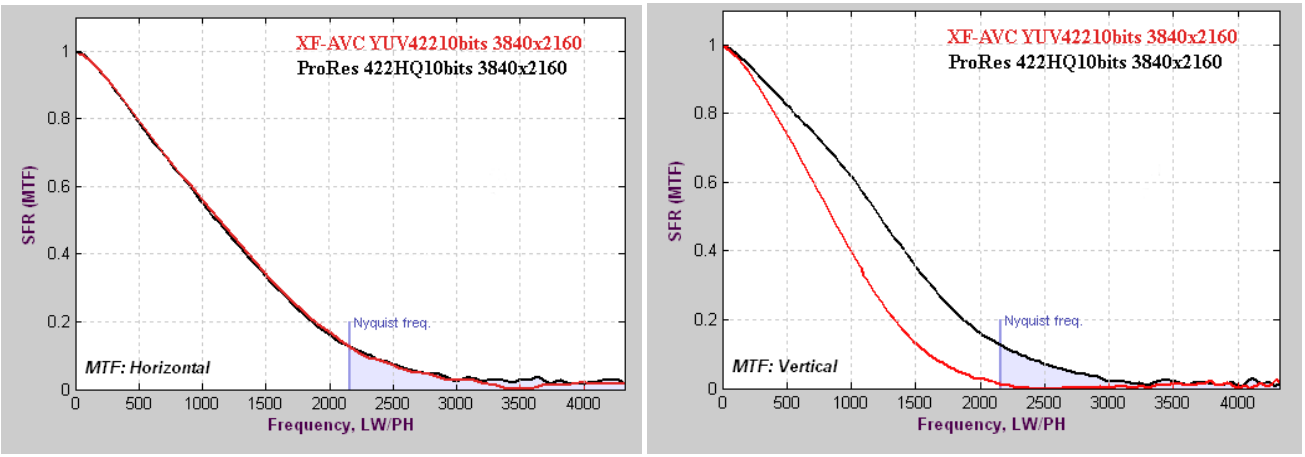
Format 3840x2160 XF-AVC YCC 10 bits with Ultraprime lens

The graphic at the right shows a horizontal resolution in UHD YUV422 10 bit with an MTF value at 50% of 1140 lw/ph, while the vertical resolution is 852 lw/ph at 50% of contrast.
Next in the same format but recorded with ProRes 422HQ 10 bits. The horizontal resoltion is very similar to the XF-AVC format, but the vertical resolution in this case is 1221 lw/ph at 50%, quite over the other format. It is also true that the weigth of ProRes is heavier than the XF-AVC. Therefore a photograhs of the last weighs 25Mb while the one in ProRes is 49.9Mb, almost double.

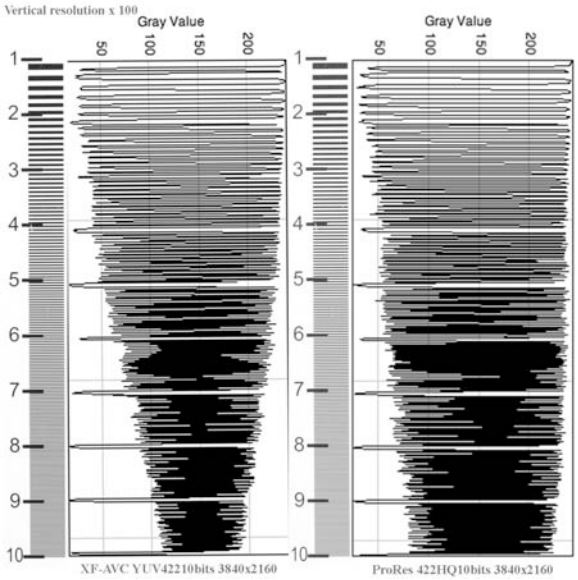


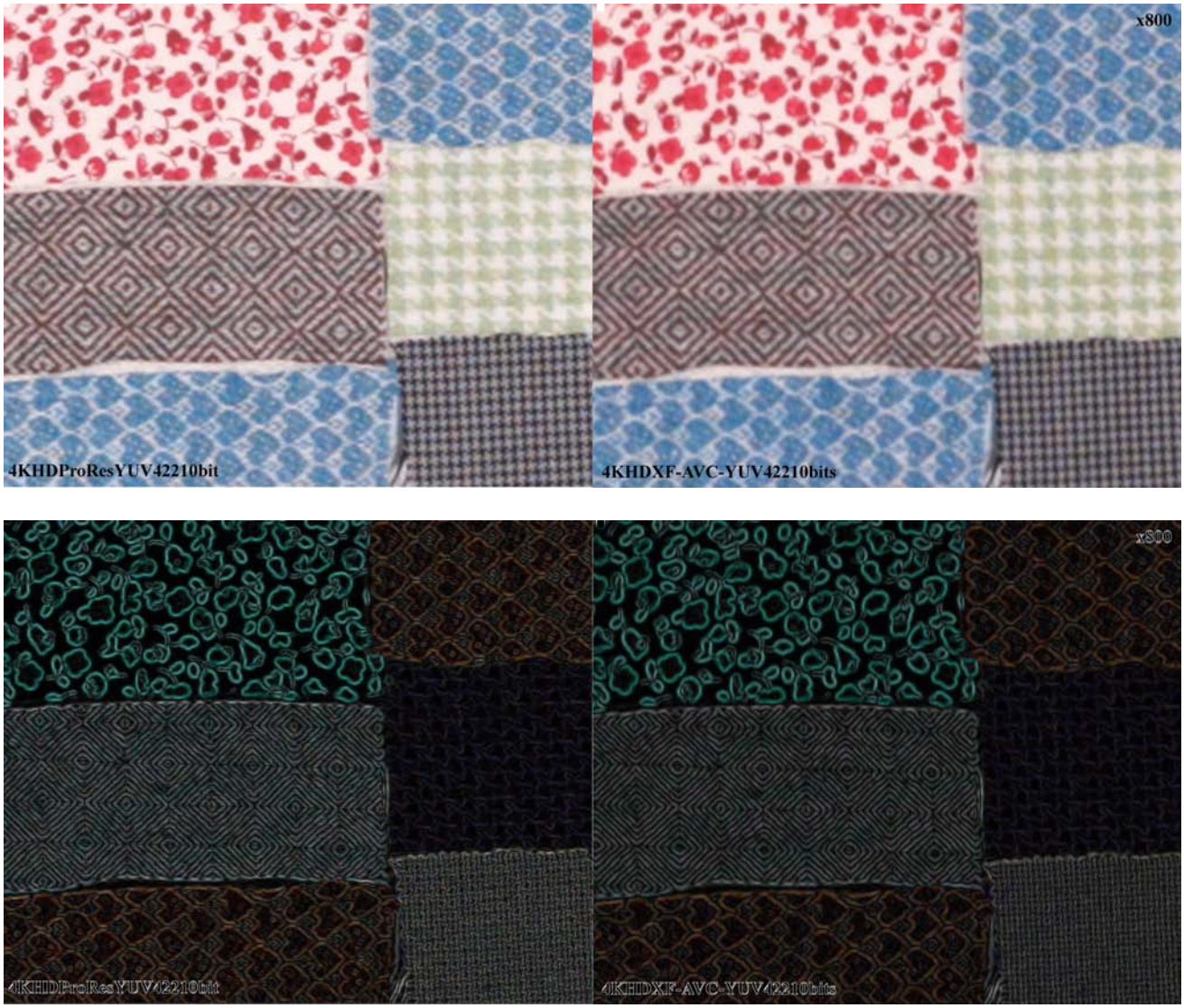
Format 3840x2160 ProRes 422HQ 10 bits with Ultraprime Lens

Let's see both curves at the same time side by side to better understand the differences.



It is good to point out that this difference it is also shown in HD format. Another way to see it is through the profile that we have traced with the ImageJ. We can see that the width of the trace is larger in Pro Res (right) than in XF-AVC (left). At 1000 Lw/Ph, the contrast value is 60% in ProRes while in XF-AVC is only 40%. This notable difference can be appreciated in our chart *Prêt-à-porter*, where the lower sharpness of the XF-AVC is notorious especially in the small flowers and the cloth at the right bottom.





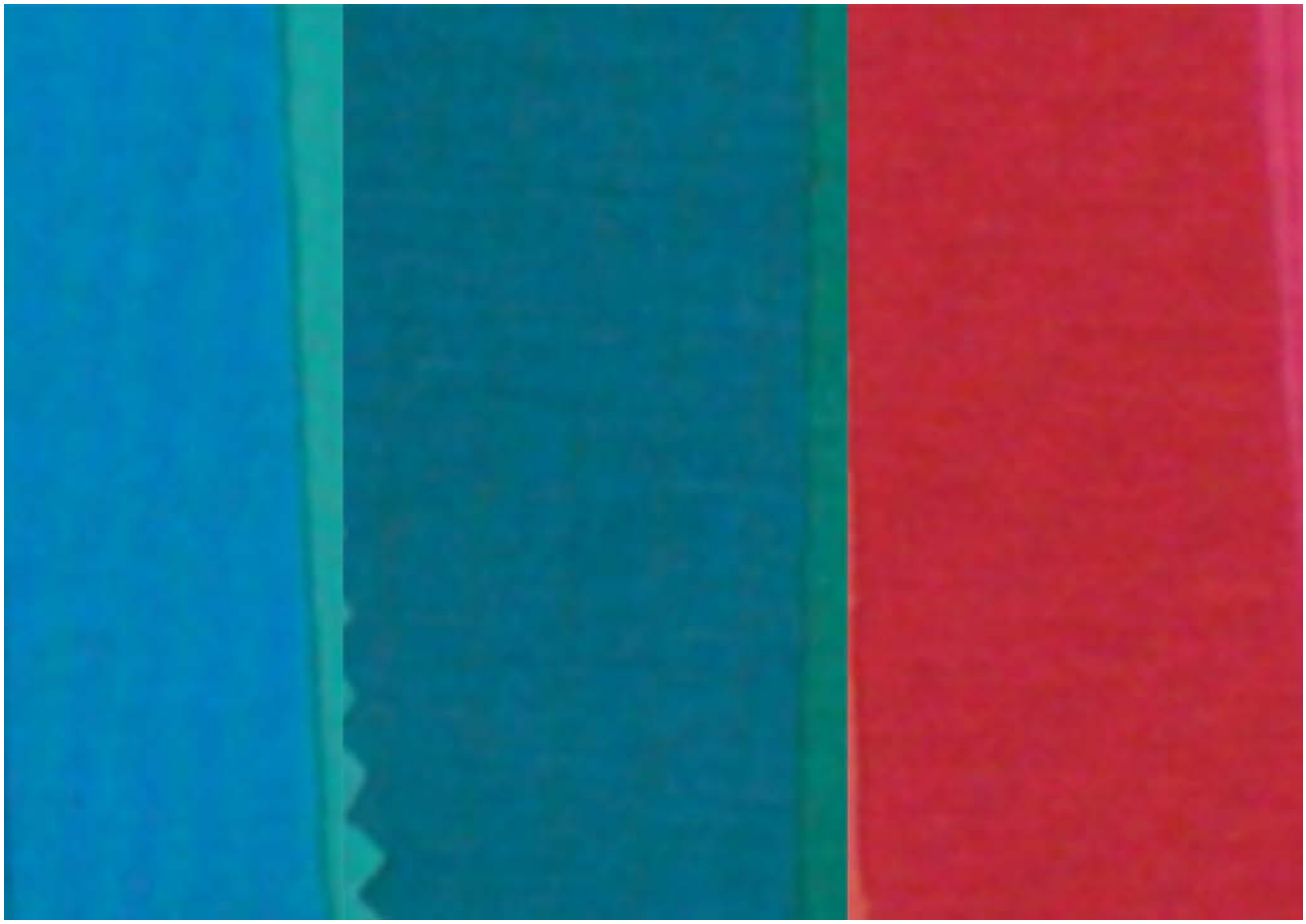
The former image passed through the border detector to better appreciate the sharpness of both images.

From all above we can conclude that from the point of view of the resolution, the ProRes Codec is better but due its files are heavier requires more storage and processing capabilities.

For the following tests, we have used the XF-AVC codec as this is a Canon proprietary and due the ProRes is enough known in the market.

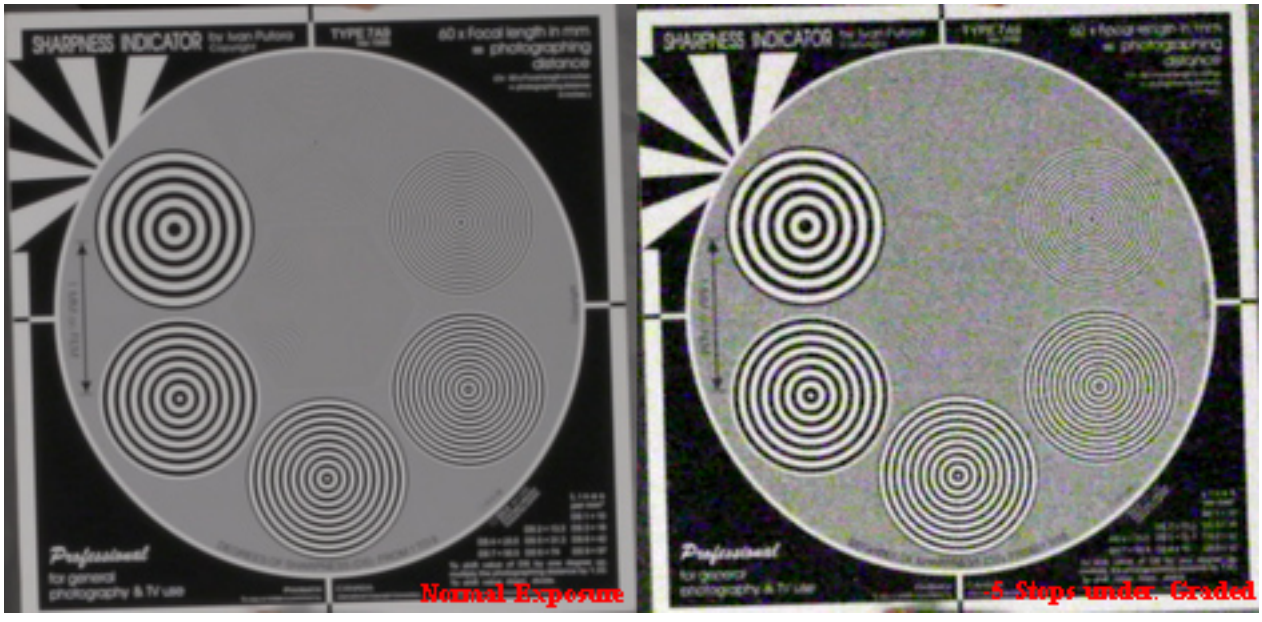
In our Rainbow chart, we have observed some color patterns with Chroma moiré in both XF-AVC as in ProRes but in ProRes the color saturation is slightly lower than in XF-AVC.

Rainbow chart. Color patterns with texture. We can see some moire in some samples.



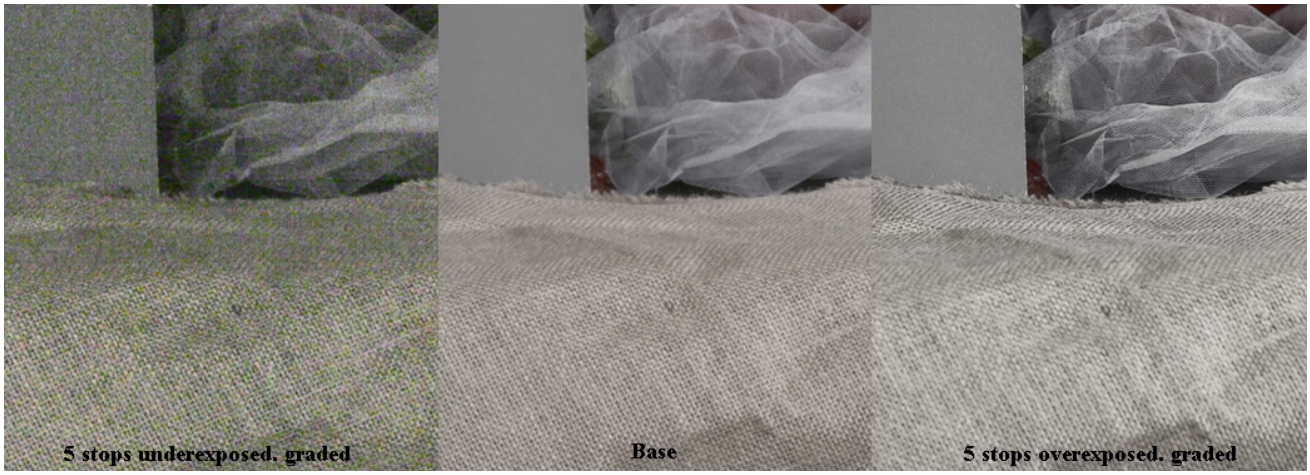
In the extended image we can observe several bands with the three tones of color.

As we know, the illumination also influences in the resolution perception. We have shot a Putora chart with different exposures together with the models and we have found that the resolution and the texture are maintained even in the darker areas.



In the chart we can see clearly in normal exposure up to a frequency of 31.3 lp/mm (circle DS5) and we can see even further to the higher frequencies but a little fuzzy. With -5 stops and correcting the exposure to be as normal as possible, we can still see the circle DS5 in spite of the noise. Without

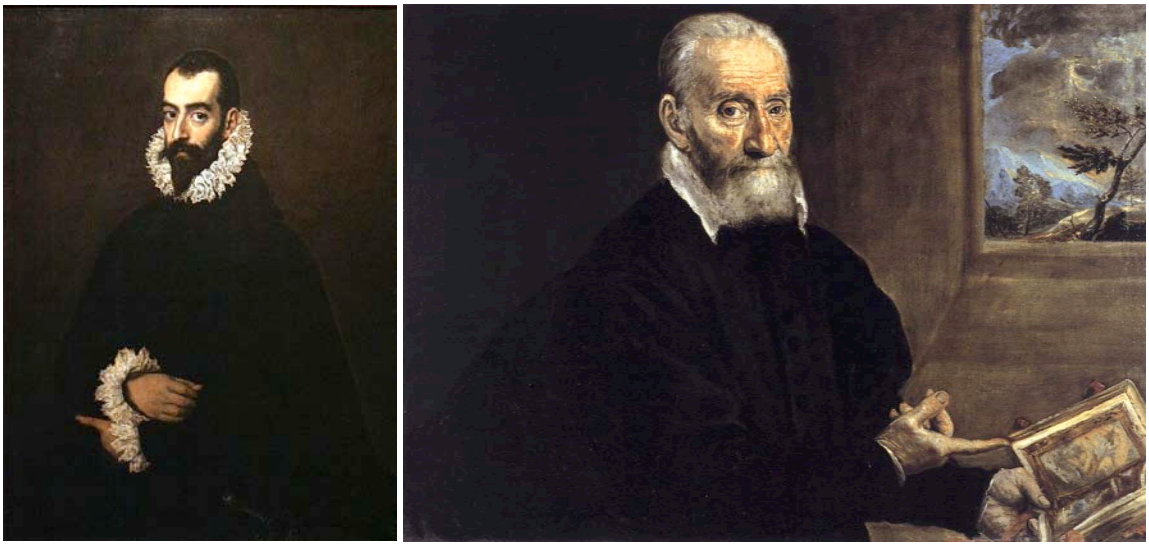
doubt, this makes possible to see the details in the shadows and these with all they have still show texture. For us this is one of the superb features of this camera together with the sensitivity and the treatment of the noise. In this take of the still life we can still appreciate the image of the cloth fabric at -5 stops while the screen still maintains certain texture.



Our impression is like if the noise is over or below the image, as even though it is part of the image but it is not in it.
In the next frame extracted from the video, we can observe the details of the different cauldrons from the first one and we can see they maintain an excellent texture, even where we can almost see nothing but we can perceive the form.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 CinemaGamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon zoom 30-300mm 29.97P. Shutter180. Original material of the camera without color matching.

And we not only see texture in the depth but it can also be seen with softness all the metal details and the charcoal firing. The image created with the C700 is sharp but soft in the textures.
My impression is looking at some images that resemble some paintings from the Greco.



To the left the portrait of Juan Alonso Pimentel de Herrera and to the right the portrait of Giulio Clovio (1571). In both of them, it fascinates me the depth of the blacks in the dresses in contrast with the depth dark golden ocher, the texture of the darkness; the clothes have volume, form and plot in the different grades of black and it is this that seems the C700 does.
At last, let's see a frame of the panoramic view of Cucunubá where there is a lot of fine detail and where the camera not only resolves but it does with a very natural aspect quite different from a digital appearance sometimes so unnatural.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 CinemaGamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon Zoom 30-300mm 29.97P. Shutter180. ND 4 stops. Original material of the Camera without color correction.

We can appreciate all the texture of greens, the meadows and the fine lines of the roof tiles. We can also see the trees and the background of the mountains.

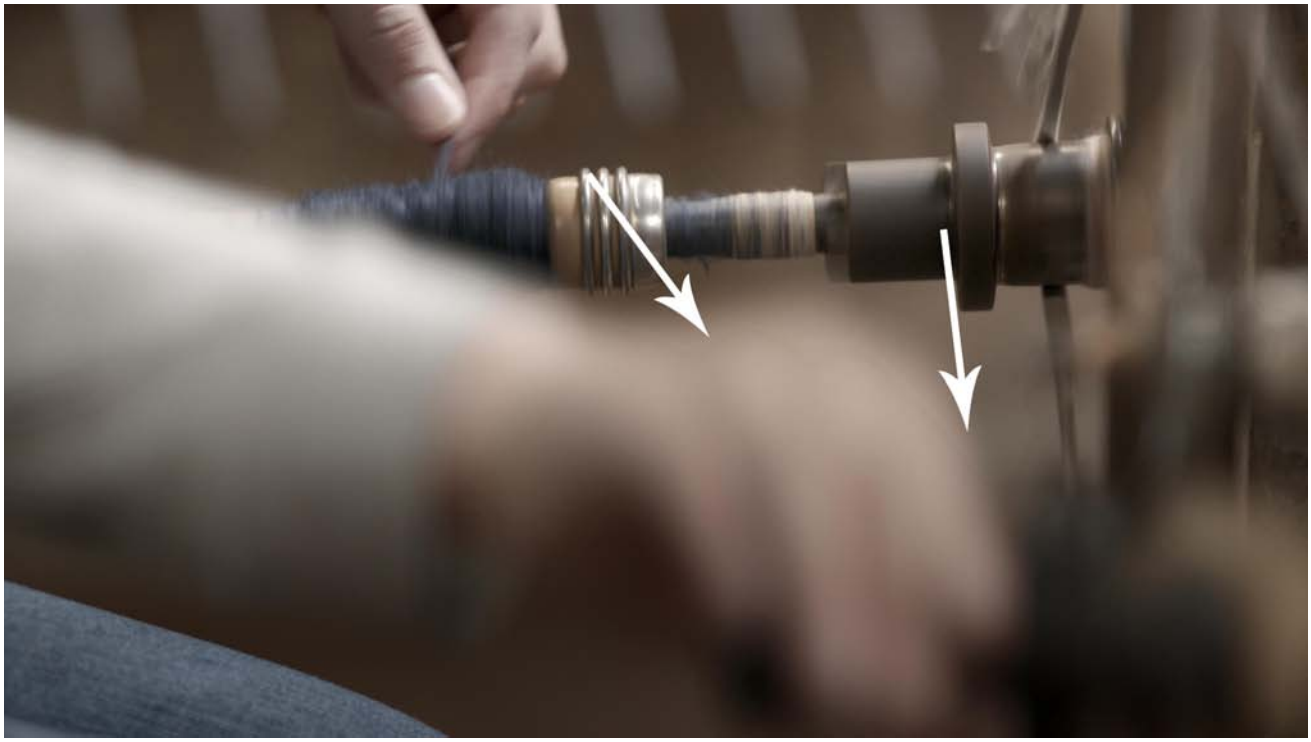
3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 CinemaGamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon Zoom 30-300mm 29.97P. Shutter 180. Graded.

Another photography full of texture: the wool thread, the wood of the loom; the thread coming and going, the Stone of the walls or Jennifer's hair (our model).
We can point out that the camera has very good resolution with both codecs and this also shows as the other face of the coin a soft texture, pictorial overall in the dark blacks and grays. It will be up to us depending on our project and our work system to choose XF-AVC, Pro Res or Raw recording.
The results that we are showing here can easily extrapolate to different formats as 2K or HD.
The Codec XF-AVC uses the compression system MPEG4 AVC/H264 in Intraframe or in Long GOP.
These are the specifications of the C700 Codec:

Resolution and color sampling		Bit rate and compression[1]	System frequency/Frame rate			
			50.00 Hz			24.00 Hz
			50.00P	50.00i[2]	25.00P	24.00P
4096x2160 3840x2160	YCbCr 4:2:2, 10 bit	810 Mbps, Intra-frame	●	–	–	–
		410 Mbps, Intra-frame	–	–	●	●
2048x1080 1920x1080	RGB 4:4:4, 12 bit	440 Mbps, Intra-frame	●	–	–	–
		225 Mbps, Intra-frame	–	–	●	●
	RGB 4:4:4, 10 bit	410 Mbps, Intra-frame	●	–	–	–
		210 Mbps, Intra-frame	–	–	●	●
	YCbCr 4:2:2, 10 bit	310 Mbps, Intra-frame	●	–	–	–
		160 Mbps, Intra-frame	–	–	●	●
		50 Mbps, Long GOP	●	●	●	●

Take in the kitchen while doing the process of tinting the wool.

The remarks are the formats in which we have done the distinct tests. The material recorded has been colored without major problems and have not observed degradation of the image during the process with the exception of two planes with forms moving fast.. Here it is a frame where you can observe the border surrounding the hand in its fast circular movement.



3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 1600. Zoom canon 30-300mm 29.97P. Shutter 180. Original material of the camera without color correction.

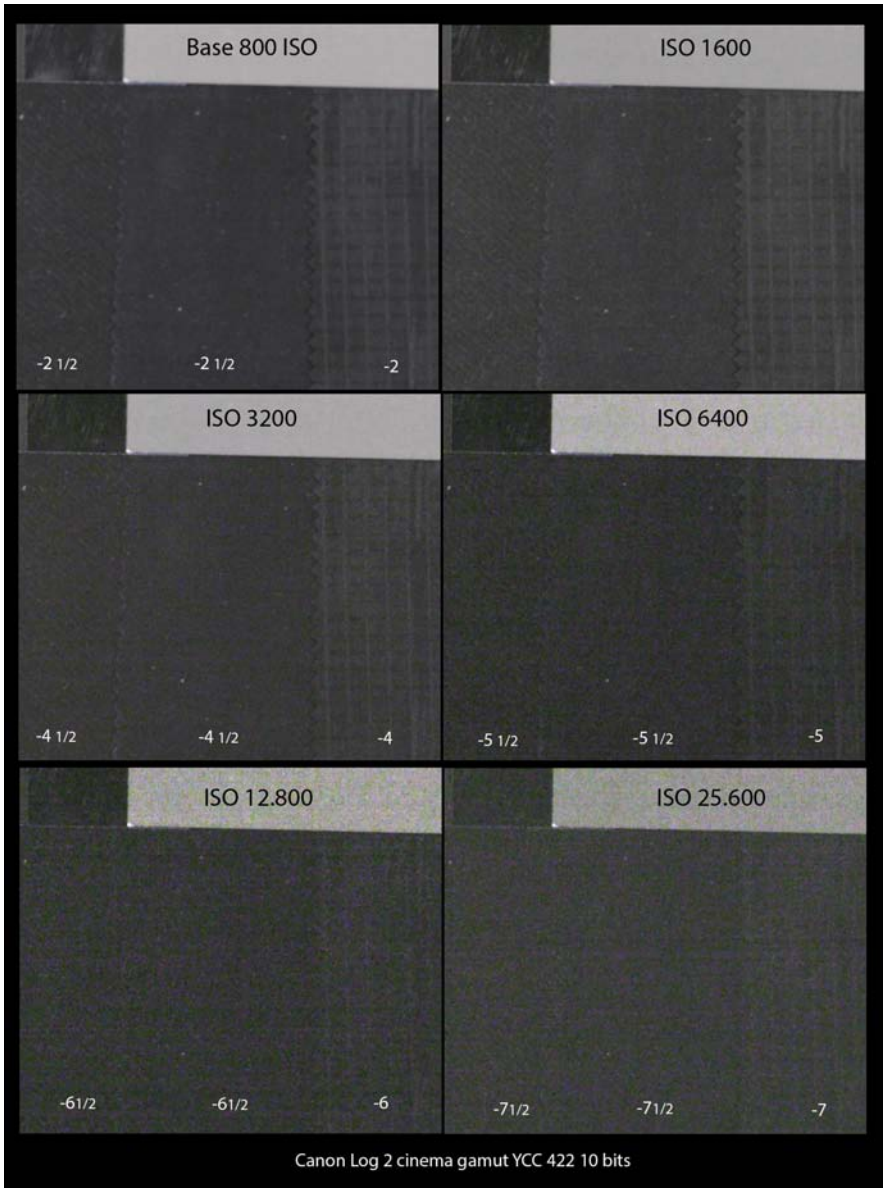
3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon zoom 30-300mm 29.97P. Shutter 180. Original material of the camera without color correction.

In the above photography where the person is standing rapidly it can be seen a line of contour in movement. These artifacts are not visible during the movement and only by freezing and capturing the photography can this be clearly observed. To our judgment, the Codec XF-AVC is reliable and even while using a high degree of compression, the image only slightly suffers a visible degradation being very flexible while working in postproduction with a very good ratio quality vs. compression.

EXPOSURE INDEX AND NOISE

In this section we study the camera sensitivity in relation with the exposure index, looking first the nominal camera sensitivity to determine the effective exposure index considering the level of noise and how this mask the detail and texture.

NOMINAL/EFFECTIVE EVALUATION OF THE EXPOSURE INDEX (IE).



The recommended IE by the manufacturer depends on the camera model. IE is in ISO400 for the STD, Canon Log and WDR curves, while for the Canon Log2 and 3, the IE is in ISO800.With the GS model these values change.

In any case to contrast the manufacturer's recommended ISO value, we have taken a photography for the 18% Gray and White of 90% according to the considerations and the formula proposed by Kodak in its application note MTD/PS-0234, formula that creates the norm ISO 12232 that determines the ISO value due the consideration of noise or due the saturation base of the digital still cameras, but we believe we can extrapolate this to our Cinema cameras.

Applied this formula, we can verify that the result adjusts itself to the ISO recommended by Canon. Therefore we have adopted this value as base to determine the effective IE.

Considering how the noise affects the texture, we have taken a frame of the Chart called CDM which means "Chart of the Death" that contains white and black fabric.

We have the chart with a variation in the exposure not in the ISO value of the camera or as we have exposed the ISO value is the one marked in the image that we show above correcting later in Postproduction to have the base gray value..

We have also photographed the chart but with variations in the camera ISO value obtaining similar results.

In the take of the black fabric we can appreciate very clear the detail and texture up to an ISO6400. With an ISO 12800 the noise masks the detail but we can still perceive some texture. With an ISO 25600 we can see some texture but with small squares.

It is really awesome how the camera works the noise, not only by minimizing it but how it works with it like in an analog way, making the noise soft not annoy, neither sharp nor defined. That is why we conclude after examining carefully the images during the colorization process that we can use an effective IE between the ISO400 and ISO8000. As my colorist Jorge Roman pointed out from a subjective point we can consider to work with an extended sensitivity among the ISO 51200, ISO 64000 and in the limit of ISO 102400.

Below we have the tables with Noise Data analyzed by IMATEST over a Macbeth chart.

NOISE IN THE MID GRAY. VALUE IN % FROM THE WHITE AND BLACK VALUES IN THE MAC BETH CHART. Sample 4 of the chart. CanonLog2 Cinema Gamut

ISO	R	G	B	Y
800	0.44	0.39	0.47	0.28
1.600	0.57	0.37	0.52	0.29
3.200	0.63	0.39	0.63	0.33
6.400	0.73	0.57	0.78	0.46
12.800	0.94	0.72	1.00	0.61
25.600	0.99	0.70	1.10	0.60
51.200	1.26	0.96	1.45	0.83
102.400	1.78	1.40	2.41	1.30

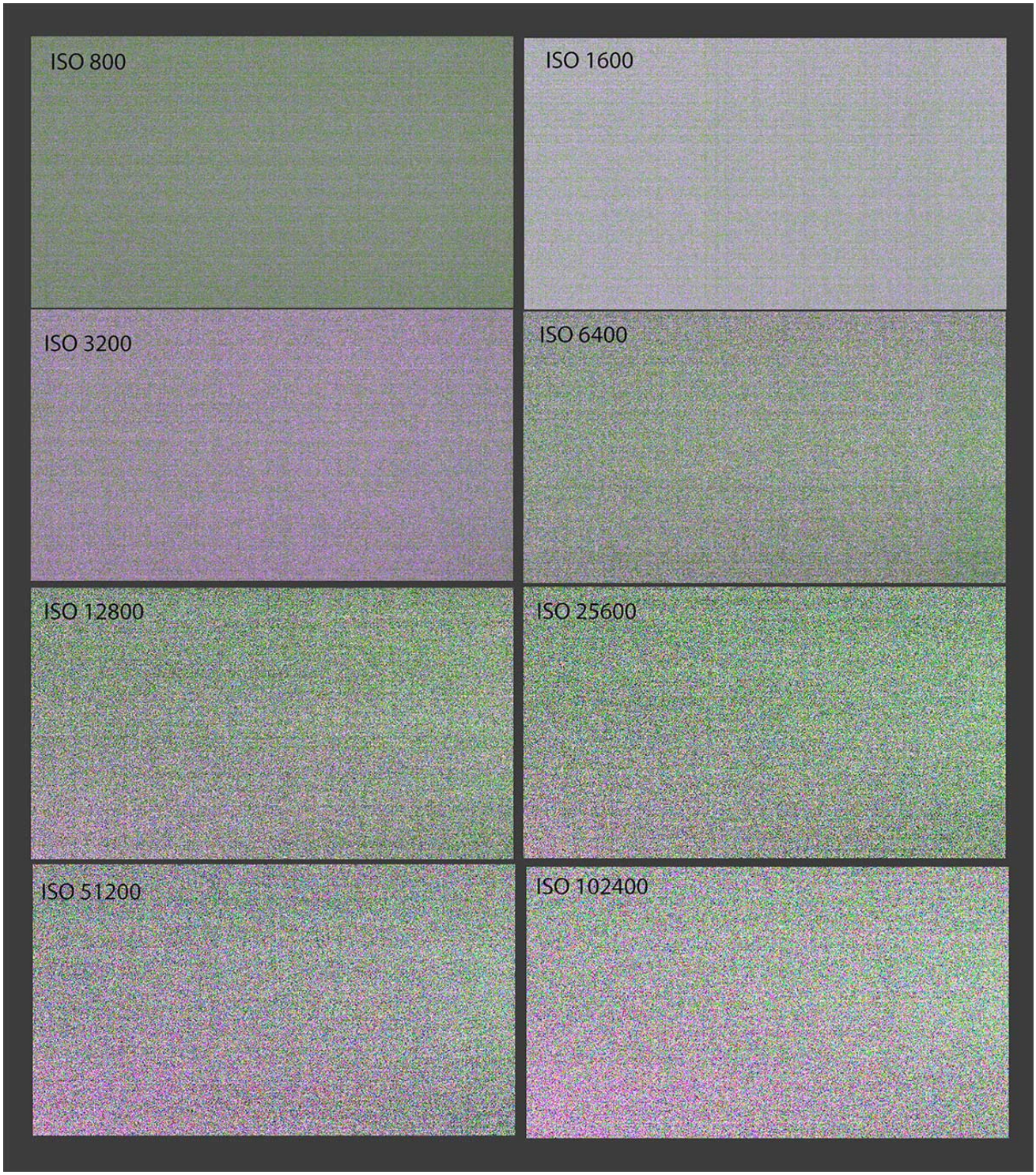
AVERAGE NOISE IN ZONES 2 TO 5 IN PERCENTAGE FROM THE BLACK AND WHITE VALUES IN THE MAC BETH CHART. Sample 2-5 of the Chart. CanonLog2 Cinema Gamut

ISO	R	G	B	Y
800	0.52	0.44	0.59	0.36
1.600	0.65	0.48	0.66	0.39
3.200	0.78	0.57	0.84	0.48
6.400	0.94	0.76	1.08	0.64
12.800	1.21	0.96	1.40	0.84
25.600	1.62	1.33	1.95	1.19
51.200	2.35	1.99	3.24	1.86
102.400	4.95	4.23	7.34	4.12

If we observe the average Y values, we will see the excellent handle of the noise with values below 0.8% that are more than visually acceptable.
To better clarify we should remember that for the same analysis we made with the Alexa at ISO 800, we had a Y average of 0.77% with ISO 800 or with the first Canon C300 we had a 0.52% value against the 0.36% of the C700.
Following we show the noise floor of the camera at different ISO values, it means the noise generated by the sensor and all the electronics in absence of light. We can see how the "color' of the noise varies at different ISO values, besides we can observe some horizontal and vertical movements randomly. Noise movement is very organic, random and with an analog sensation.

Working at the Congo Films facilities in Bogota, Colombia

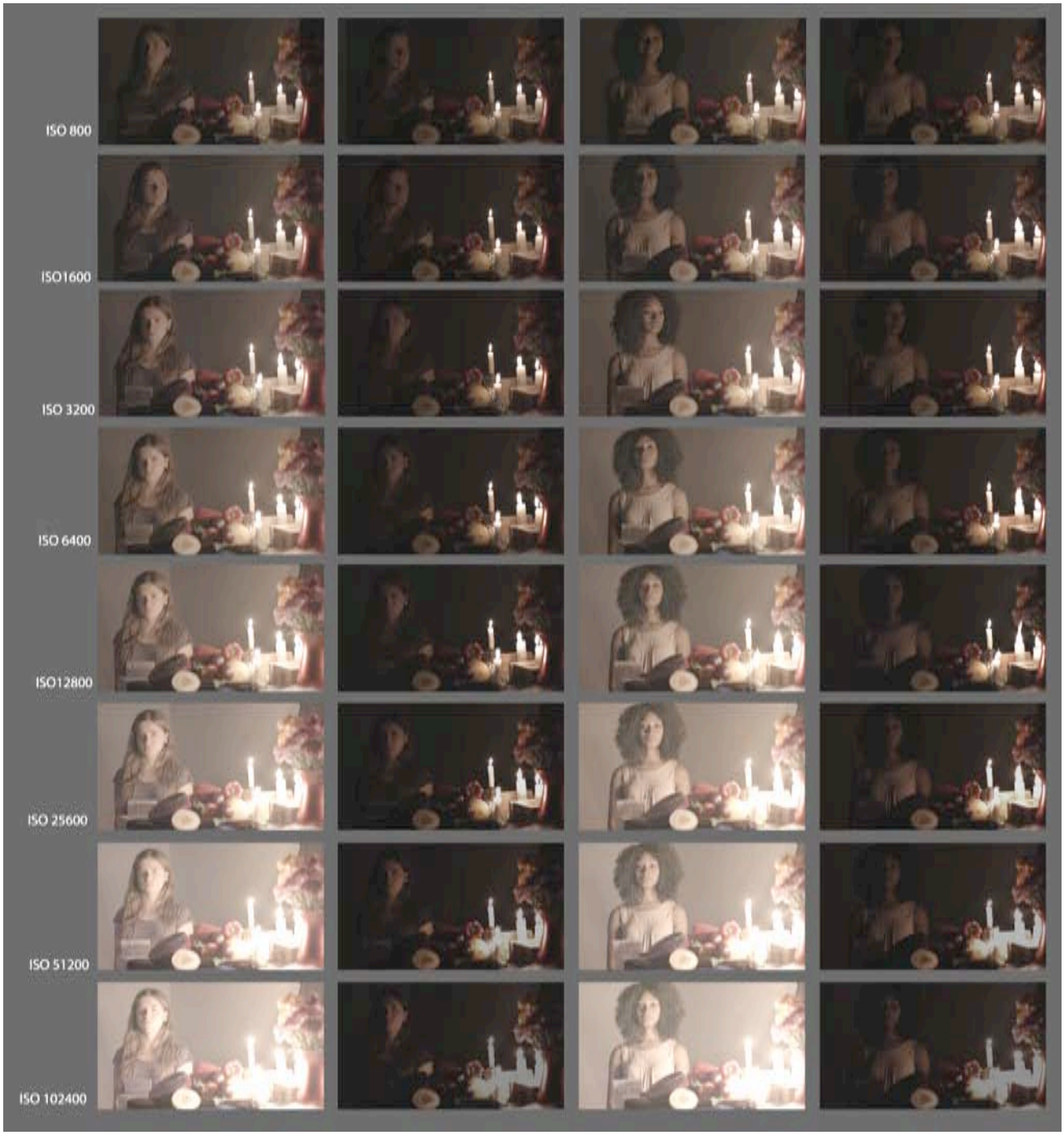
In these photographs we have modified the high, medium and low levels to better visualize the noise level.



In these series of images we see the still life illuminated just by candle light at different ISO values and the correction with LUT 709. At high ISO values, the fabric and the fruits texture are very visible but when ISO values are very high they are overexposed. Even though the color maintains their tone and saturation in spite of variation in brightness.

In the take of the base at the right, we can see the original in comparison with the Blue channel, which as we know is the one that increases more the noise in the image.

The noise level in this channel is more than acceptable considering practically the absence of blue tones, the warm temperature of the candles and the high values of Gain/ ISO.



The result with noise is excellent with the flesh tones maintaining the texture and tones up to high ISO values, not showing any color deviation.

Next we show two photographs of the image we recorded inside the coal mine at more than 300 meters deep with the only light coming from the helmet lights.

In both cases we can prove the excellent response to the noise that did not mask the detail, texture or the color. In the below video link you can see the noise movement as the image quality once colorized. https://vimeo.com/216461125

Recording inside the coal mine

3840x2160 XF-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 4650K ISO 12800. Ultraprime 16mm T1.9 29.97P. Shutter180. Original material of the camera without color matching

3840x2160 XF-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 4650K ISO 6400. Ultraprime 16mm T1.9 29.97P. Shutter180. Original material of the camera without color matching.

Last, we show the recording at Caracol TV with the proper lighting at different ISO values where we can confirm the good performance of the camera not only handling the noise but the good response that the camera offers at different color temperatures: Sodium and Mercury evaporated and Fluorescents.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 3200K ISO 6400. 29.97P. Shutter180. Color graded

Red Channel

Green Channel

Blue Channel

A frame of exterior location at night with the take of the channels red, Green and blue separated so we can appreciate the noise level in each channel and the consolidated noise level.
Images by courtesy of Caracol TV.

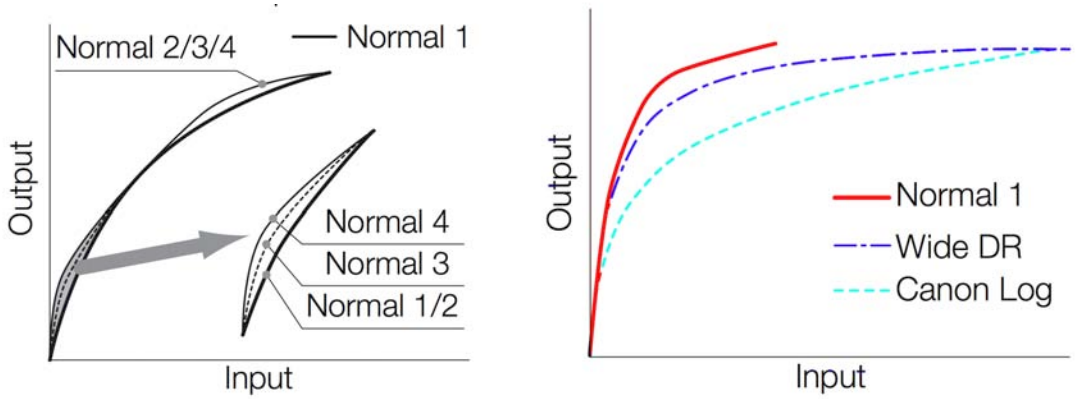
Tests at the Studio. From left to right: Adriana Bernal ADFC, Rodrigo Lalinde ADFC, Alfonso Parra AEC, ADFC, Julián Lalinde, camera assistant, Fernando Parra, data manager.

DYNAMIC RANGE

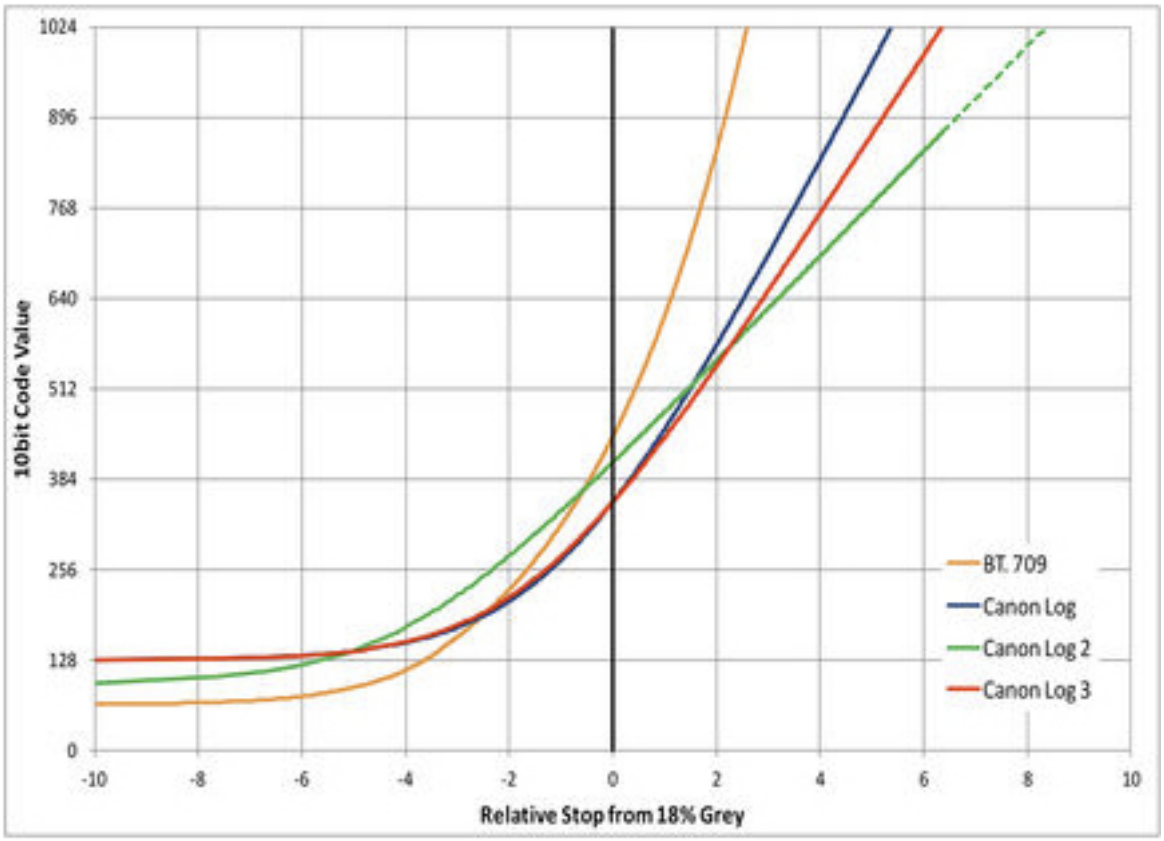
Here we study the capability of the camera to show details at highlights and in the shadows with the same exposure to value the T stops with reference to the Neutral gray at 18%.

The Dynamic Range.

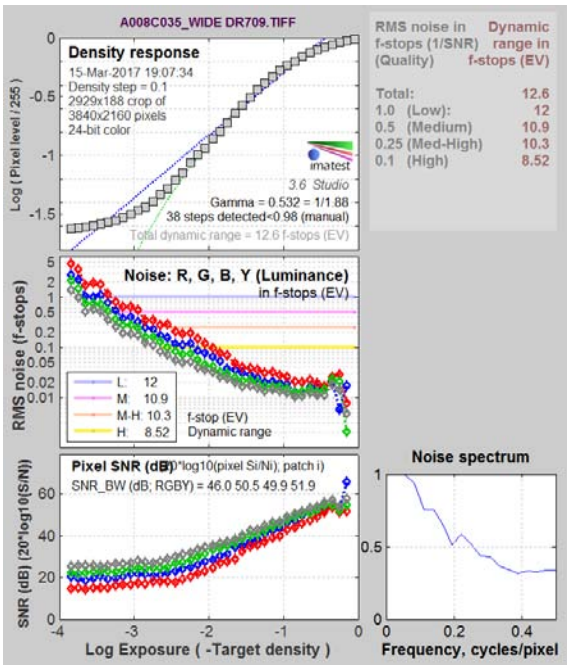
To study this we have started by shooting a Stouffer strip with calibrated densities and later analyzing this with Imatest. The camera offers different gamma curves from STD(1 to 4) with different gain levels to the Log curves(Canon Log, Canon Log 2 and Canon Log3) passing through the Wide DR curve.



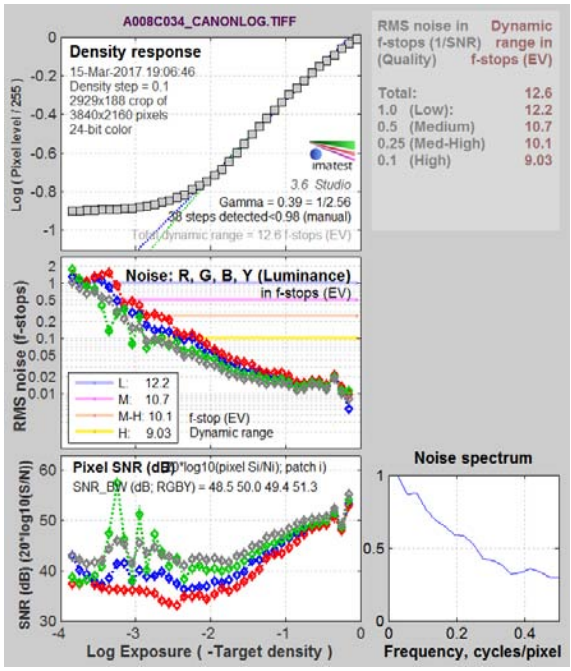
The graphic at the left shows the normal STD gamma curves with different gain levels in the dark and medium dark tones. The graphic to the right compares the normal STD curve to the Wide DR (similar to the Sony Hyper Gamma) and the Canon Log curve.
The lower graphic compares the Normal STD curve with the three Canon Log curves, examining the brightness values with the T stops in reference with the Gray 18%.



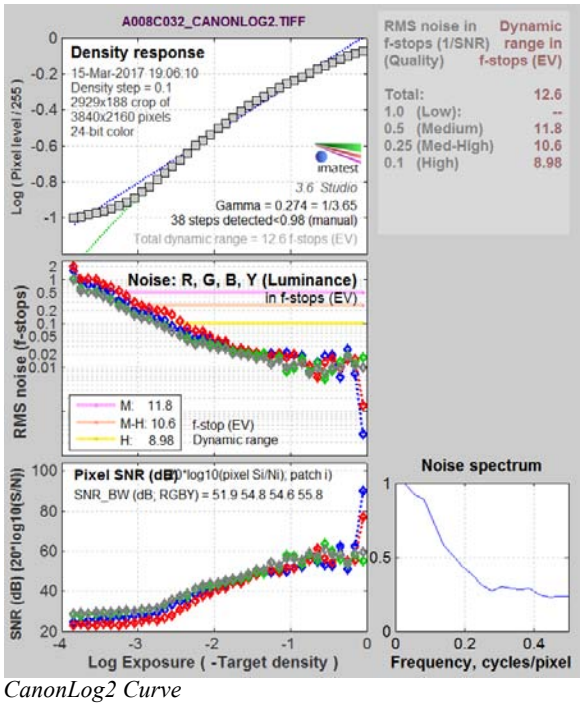
Let's see the Imatest analysis of the Stouffer strip.



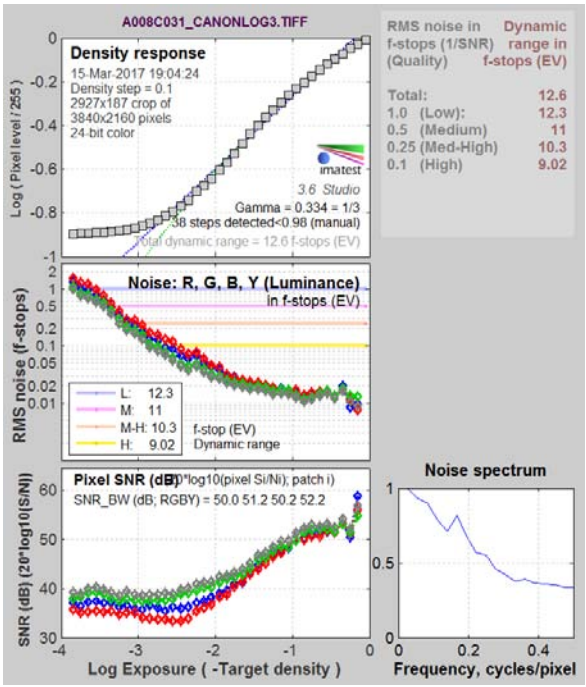
Wide DR Curve



CanonLog



CanonLog2 Curve

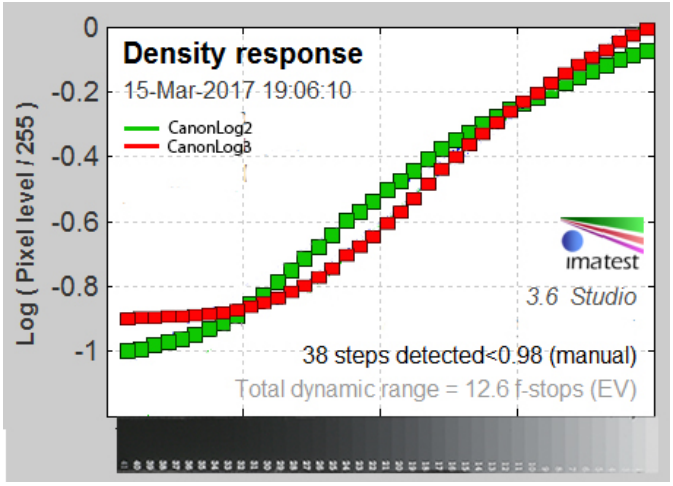


CanonLog3 Curve

With all the curves, the Total Dynamic Range without considering the noise level, the camera is in the 12.6 stops. If we consider the average noise level of 0.5 stops, that according to our experience is the one that is closest to the effective DR, we should have this table.

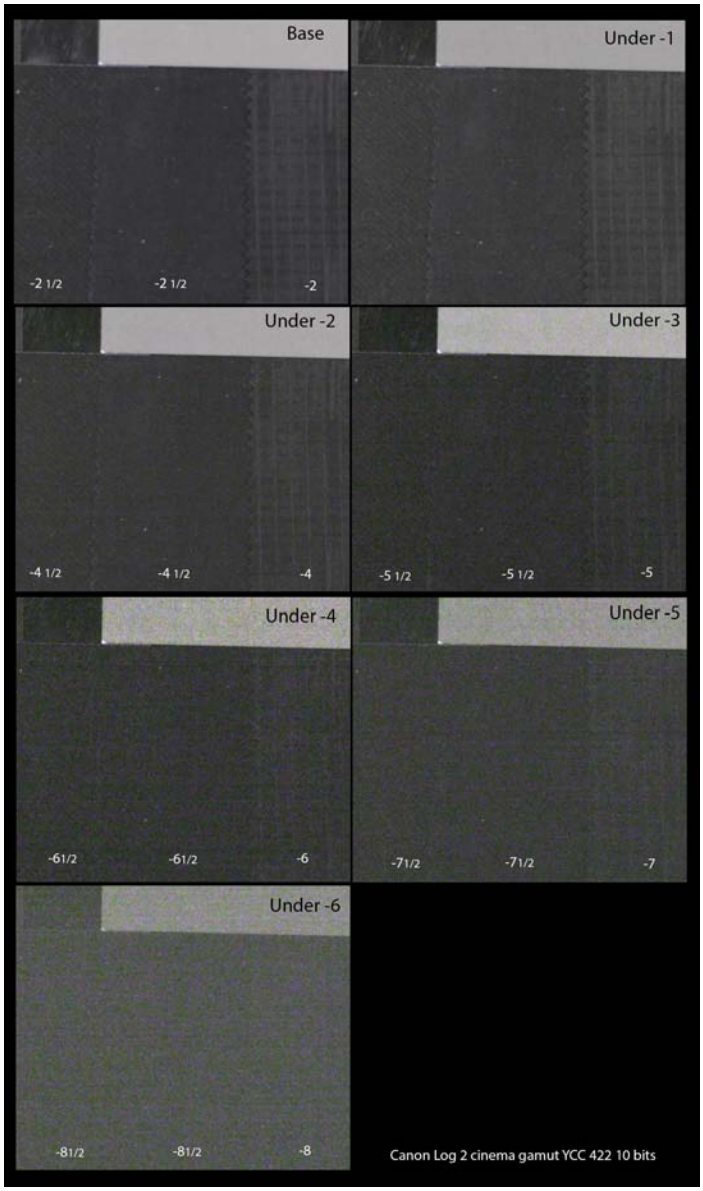
GAMMA CURVE	Wide DR	CanonLog	CanonLog2	CanonLog3
RD (0.5 Medium) T-STOPS	**10.9**	**10.7**	**11.8**	**11**
SNR (dB)	**51.9**	**51.3**	**55.8**	**52.2**

The comparison between the curves Log2 y Log3 measured by shooting a frame of the Stouffer strip where you can see the differences between them. The Canon Log2 has better response in the darker areas with brighter mid tones and with gray value at 18% in CV407 (39.8%) closer to the Cineon (CV445). In highlights shows less brightness than Canon Log3 and with a value of the Mid Gray of CV 351 (34.3%).



Let's see now the same but with the chart of black and white fabrics, to see how many stops above and below of the Mid Gray we can use. Or to say in other way up to where we have detail and texture.

We have done a series of multi exposure overexposing and underexposing the chart, correcting later each exposure to have the Midgray value of 18% close to the reference base. We have taken the Canon Log2 curve as the base for the later tests as this is the one with more dynamic range.

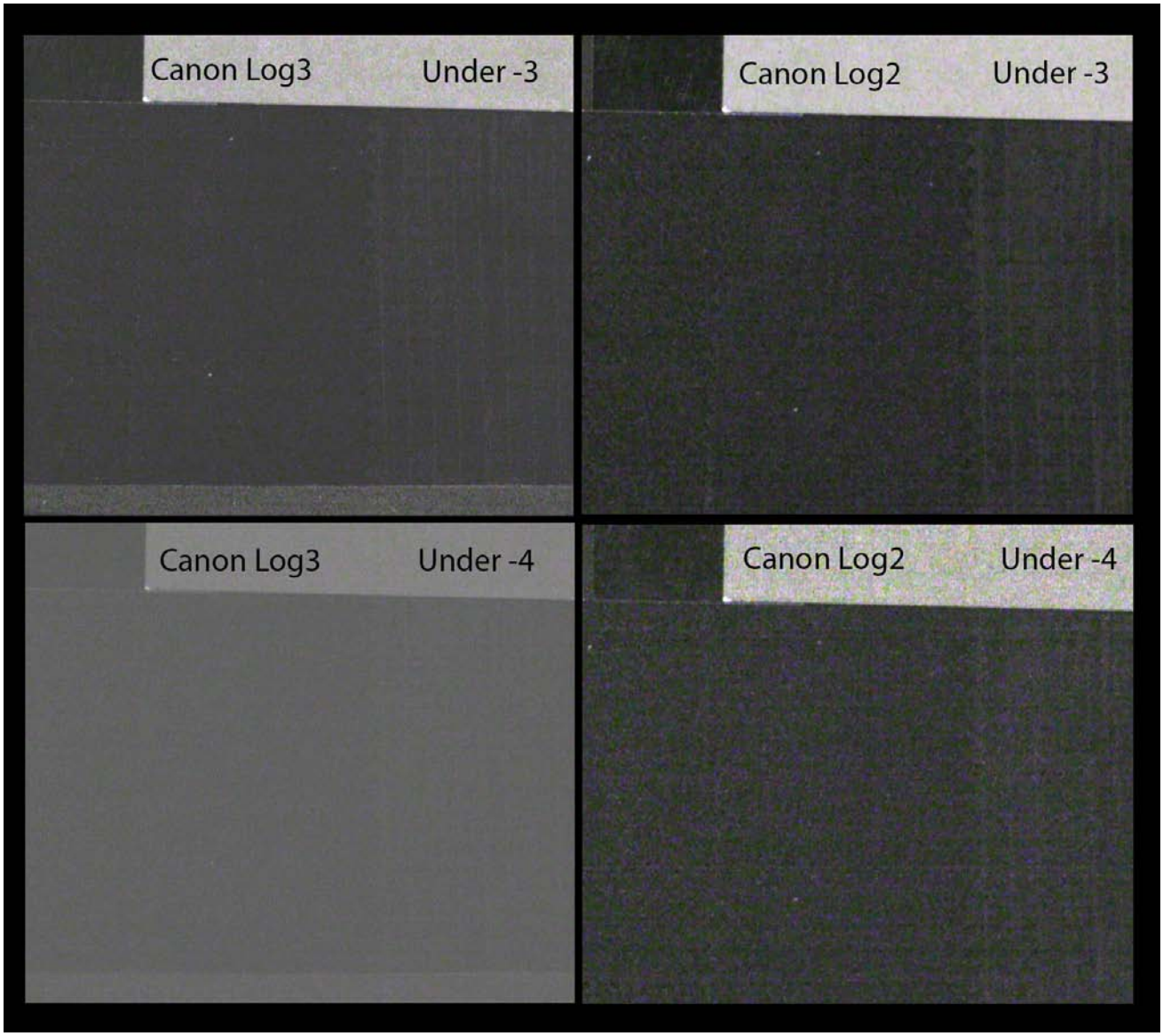


If we see the samples of black fabric with different sub exposures, we can see that with -3 stops (the fabrics are at -5 ½ stops) still we can see the texture of the samples, with -4 stops we can perceive the textures but the noise level is already noticeable , with -5 still we can perceive the texture of the black sample 3 that is at -7 stops in reference to the base and with -6 we cannot see anymore the texture on the blacks, or more explicit at -8 stops.

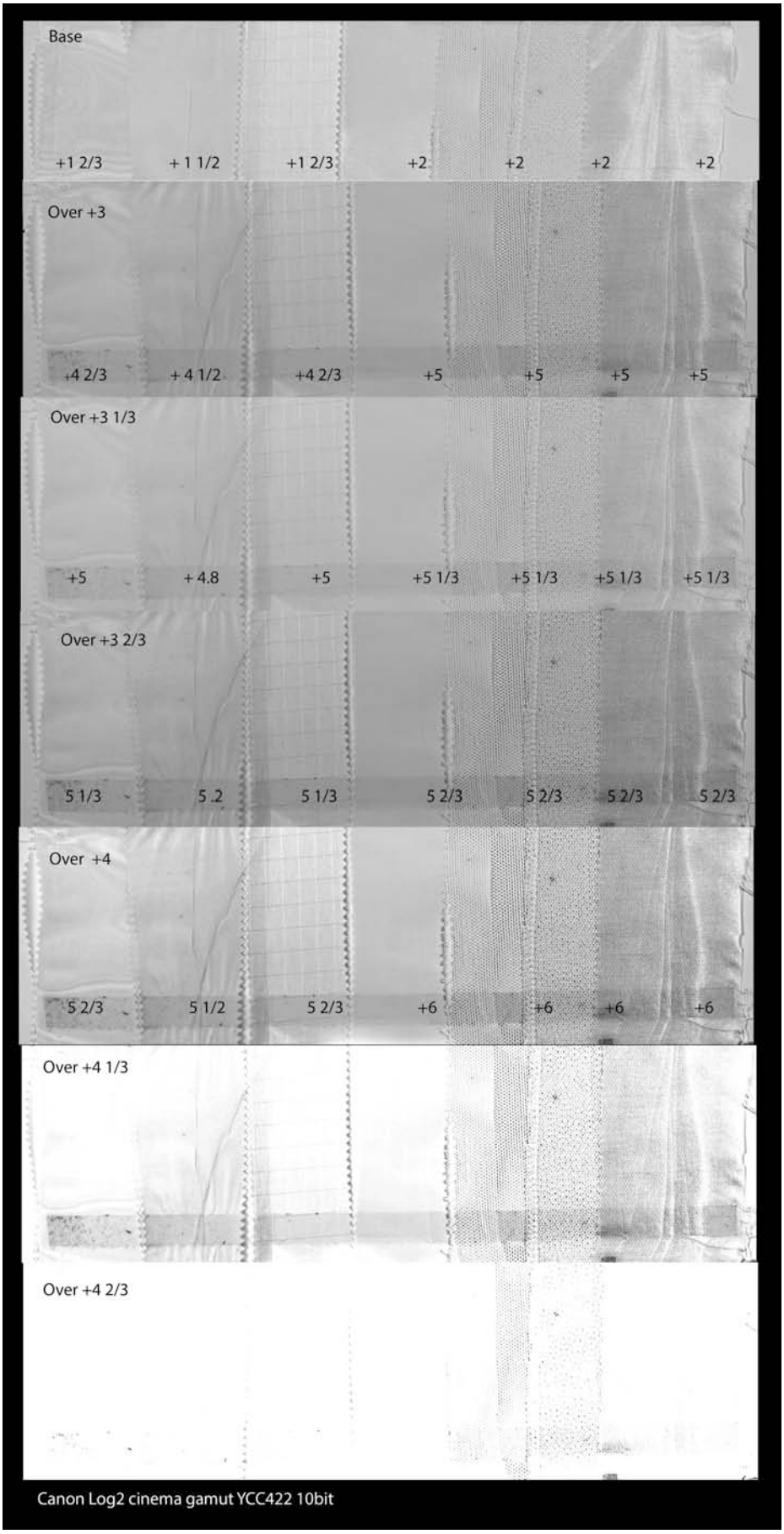
With this test , we can approach to the effective DR that should be around the 6 stops but the camera with this gamma curve still perceive details up to 1 1/3 more, that allows to manage the blacks that we have already talked in the section about Resolution. Deep without cuts with texture and seeing the smallest brightness variations in the darker zones.

If we compare the fabrics with the Canon Log 3, we will see what the curves were indicating. The Canon Log3 curve reveals less in the shadows with less detail and equaling the same level of brightness practically in the last 10 density values of the strip. At -4 stops with the Canon Log3 practically there is only one continuous gray without texture and detail and with null depth,

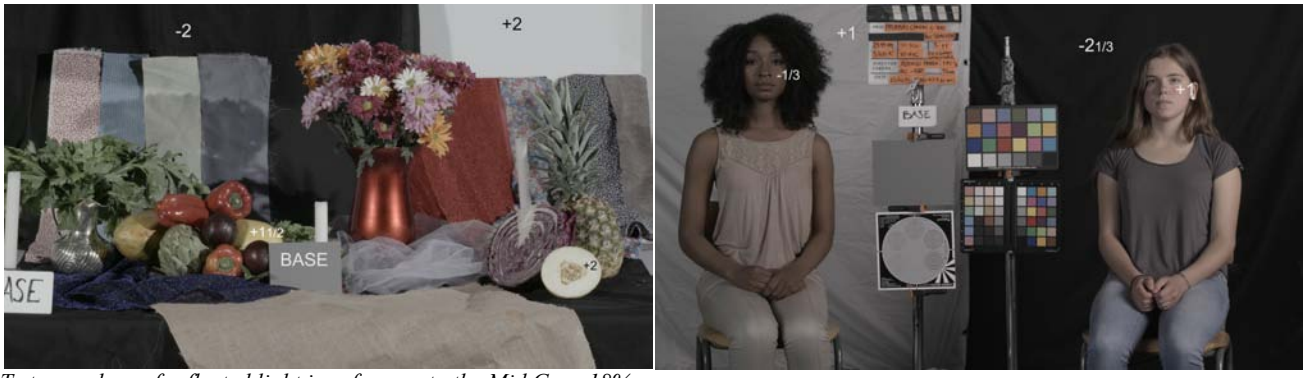
conversely with the Canon Log2 where you can perceive texture but with noise.



For the overexposure we have used a chart of White fabric with different textures but similar brightness values. We have overexposed until we can define the limits where we lose the texture and the detail. Besides we observe how the White clip at the maximum saturation is and how we start losing detail in high lights, or the roll-off of the curve.
We have modified the brightness and the contrast to better define the presence or not of texture.
With +4 stops of overexposure, we still can see the texture in the fabrics that are around 6stops.
With 4 1/3 the detail disappears and some zones are clipped in the samples. With this test we can say that the range over the Mid Gray will be around 6 stops. The relation of brightness and detail up to the 6 stops is according to our judgment soft, cinematographic while when it goes to the white clip point it does it with harshness, giving a harsh white but without the classic digital cut.

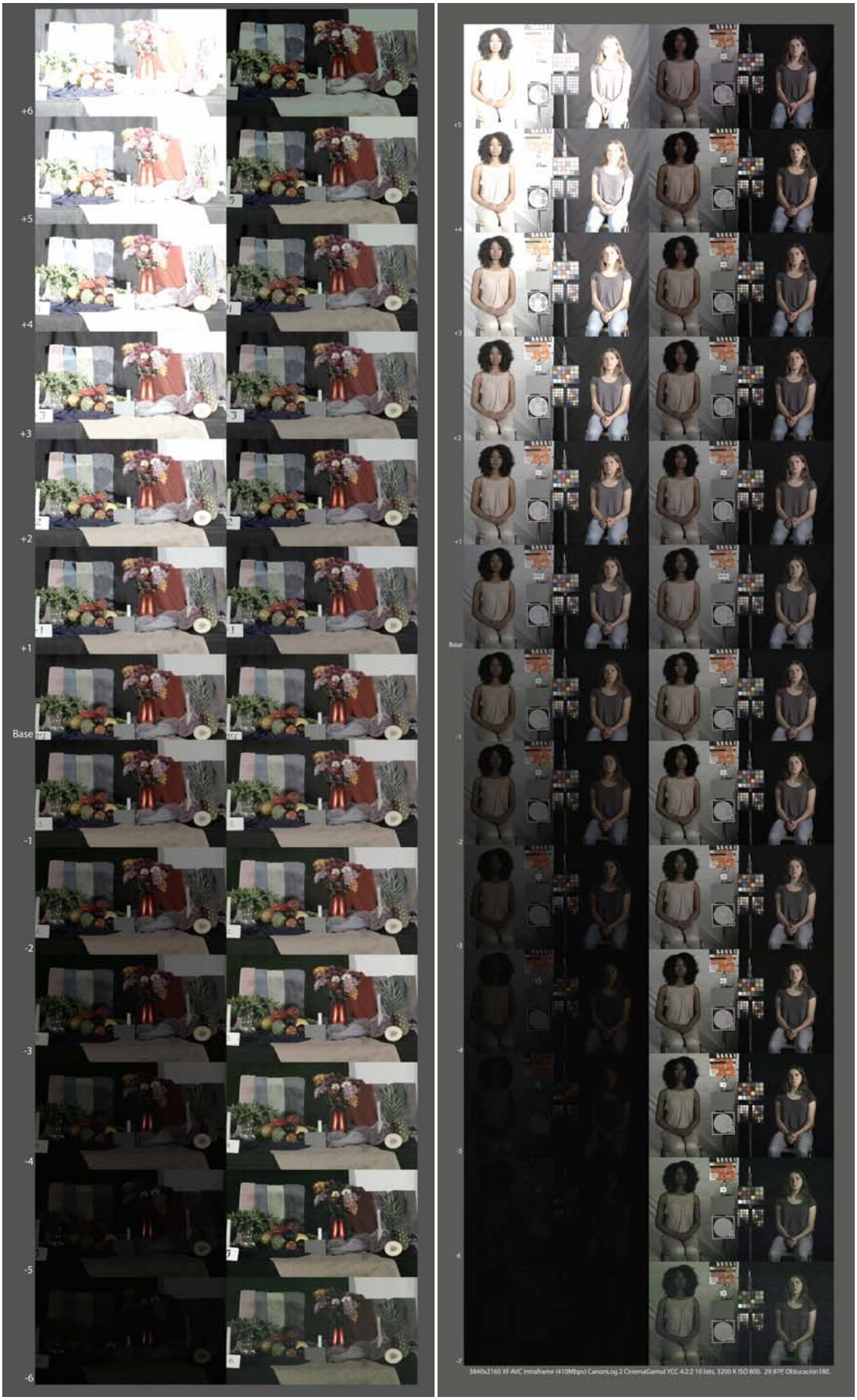

Base
+1 2/3
+ 1 1/2
+1 2/3
+2
+2
+2
+2
Over +3
+4 2/3
+ 4 1/2
+4 2/3
+5
+5
+5
+5
Over +3 1/3
+5
+ 4.8
+5
+5 1/3
+5 1/3
+5 1/3
+5 1/3
Over +3 2/3
5 1/3
5 .2
5 1/3
5 2/3
5 2/3
5 2/3
5 2/3
Over +4
5 2/3
5 1/2
5 2/3
+6
+6
+6
+6
Over +4 1/3
Over +4 2/3
Canon Log2 cinema gamut YCC422 10bit

Beyond the charts, in the world of objects with volume, we are going to corroborate these first results with two multi exposures: A still-life and one of models, where we will see what happens with skin tones for different exposures, as well as color and resolution.



T stops values of reflected light in reference to the Mid Gray 18%

In the next page, we will see the corresponding multi exposures.
In the still life, we observed that we can recover texture and detail with +4 stops, being the White reference at +6 stops in reference to the Mid Gray. As well as we have recovered the texture of the melon in the right side of the image. With +5 Stops still we can recover part of the texture of the fabric while we already lost the candle and part of the white margaritas and the melon. The yellow fruit at +6 ½ has also lost the texture of its skin. It is good to point out that all the exposures maintain the tone of the color of the different elements of the still life and that the limits of overexposure in the white clips show some tone yellowish green.
In the multi exposure strip with the models, we observe that we maintain detail and texture in the Gertrude's White face up to +5 stops, if then we see a slight overexposure in the brighter skin zones but without clips.
Also the skin tone and texture remains in all the several overexposure values.
With this information we can conclude that the Dynamic Range above the Mid Gray is located in the 6 Stops. But I would prefer to use a value of 5 2/3 stops to guarantee all the detail and texture.
In relation to the underexposures, in the still life, up to -3 or when the black fabric is at -5 stops in reference of the Mid Gray we still maintain the texture and detail. With the -4, still we perceive the texture of the black fabric but with a notorious presence of noise. Even with -5 we still can see the folds of the black curtains. With the underexposure of -4 Stops still we see the texture of the fabric and most notorious of the red sample that disappears completely at -6 Stops.
With this amount of detail in the blacks, these show themselves deep with diverse tones and brightness differences.
In this sense the camera seems to us as an excellent tool to work in the gloom.
With regard to the multi exposures strip with the models we can see that up to -6, we can see detail in Jennifer's face (Afro model). In spite of the noise up to -7 we still can recognize her.
The black fabric still keeps detail up to -4 Stops; this is when the value of the fabric is already at 6 1/3.
We have observed that Jennifer's skin tone turns slightly to green starting at the -3 stops and Gertrude's at -4. Same in the deep underexposures when working to correct them we observe that the horizontal lines that moves along the sensor image.
Now we will see some photography of the Outdoors recording, we can conclude from all the former tests that with the Canon Log2 curve, the effective dynamic range sets around the 12 stops. 6 stops over the mid gray and 6 under it. In reality with the overexposures, we will adjust up to 5 2/3 to guarantee all the texture with the whites. This value adjusts itself to the one we obtained with the Stouffer strip at the mid gray; it means 11.8 stops considering the noise.
As we have indicated the camera does not clip the whites up to 6 ½ stops and in the shadows still sees brightness variations up to -8 stops.



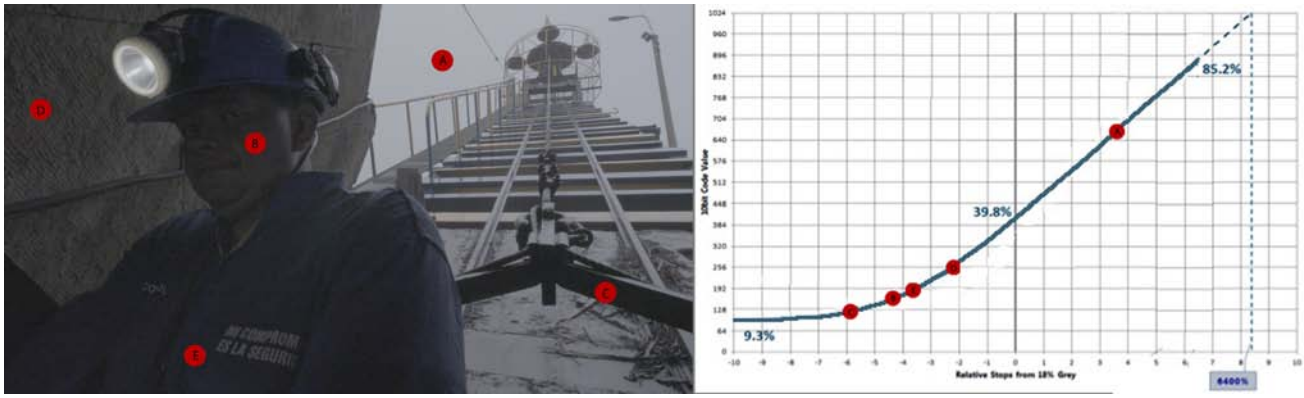
Originals *Graded* *Originals* *Graded*


BASE
+1
+2
+3
+4
TUNGSTEN OVER EXPOSED GRADED
BASE
+1
+2
+3
+4


BASE
-1
-2
-3
-4
TUNGSTEN UNDER EXPOSED GRADED
BASE
-1
-2
-3
-4

Next we will show a couple of frames where we have set the values of brightness for different zones of the images over the Canon Log 2 curve.
In the first photography, the darkest zone is Jennifer's hair that is practically at -8 stops and even there it is perceived some texture, the darker skin zones are between -6 y -7 while the brighter zones are between -3 y -4.
Visually the dark zones have depth; they are not flat and keep a lot of detail in contrast with the outdoor patio, specially the white Wall that is between the 4 y 5 stops over the reference diaphragm.
Such as in the first image as the one with the miner, the dynamic range of the scene is within the curve including in the darker ends.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon zoom 30-300mm 29.97P. Shutter180. Original Material of the camera without color grading.



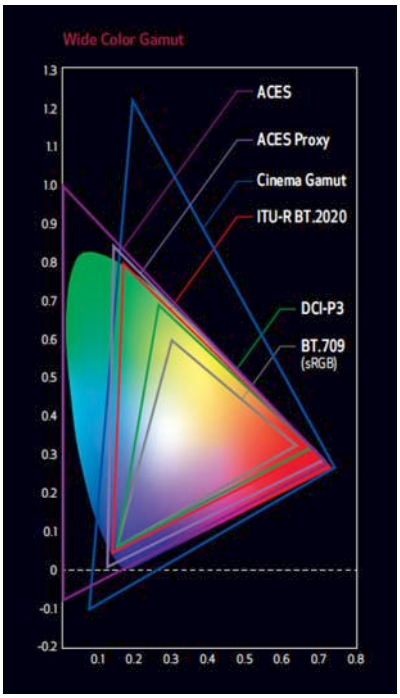
3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 4650K ISO 12800. Ultraprime 16mm T1.9 29.97P. Shutter180. Original Material of the camera without color grading.

Recording in Cucunubá. Panoramic View.

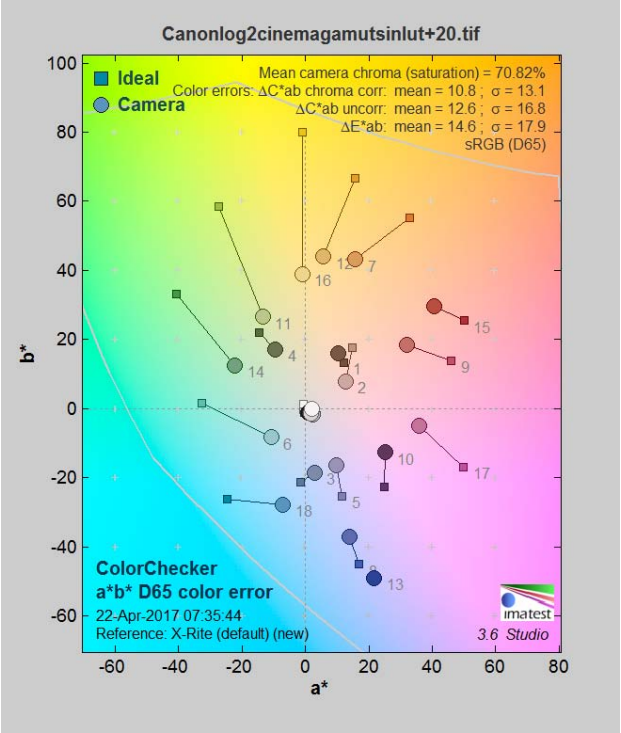
COLOR

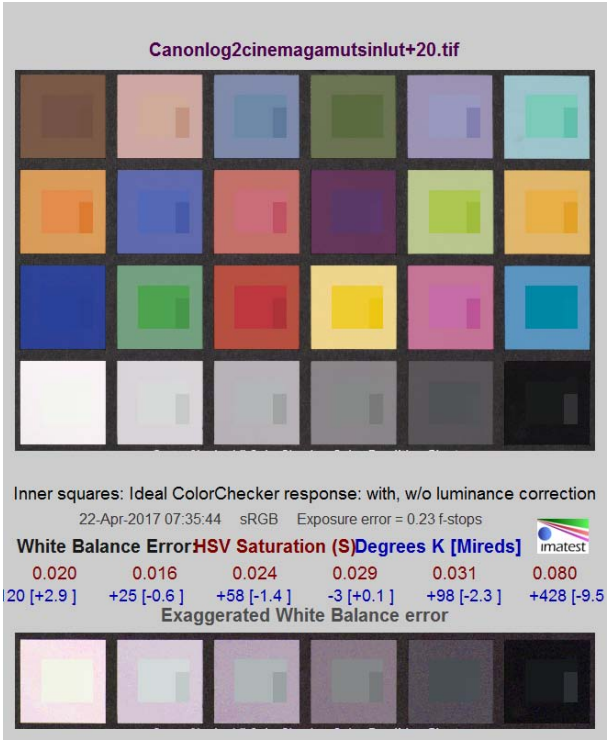
This section is dedicated to the study on how the camera responds to color, from the objective analysis of the charts up to the most subjective opinion on how he feels himself.

The Color



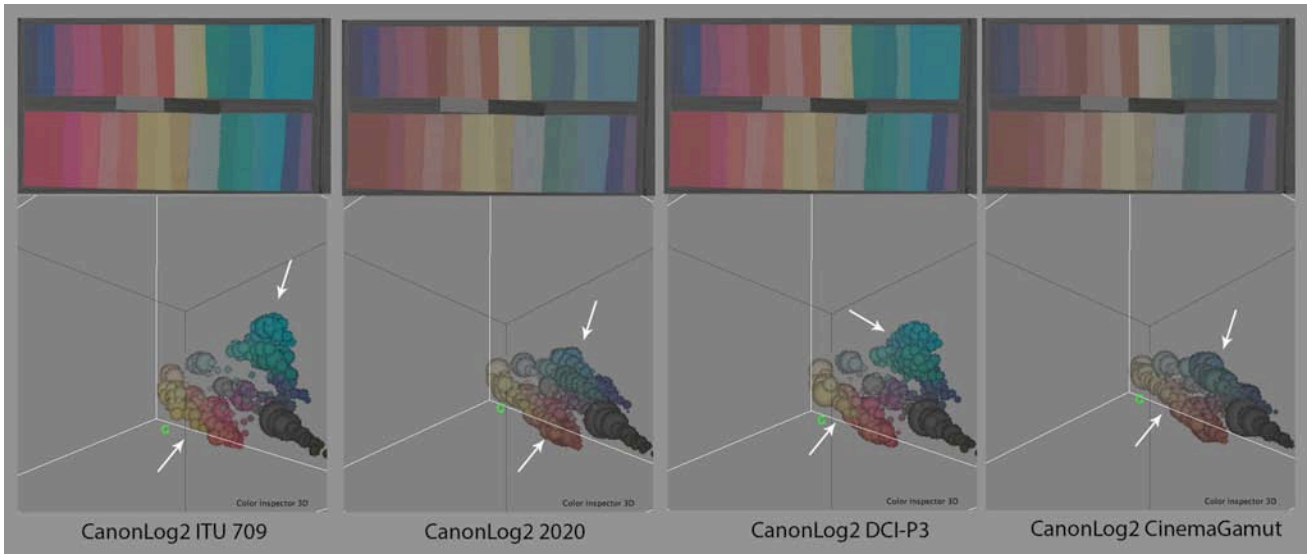
For the study of the color we have to start by analyzing the different color charts, besides of the observation of the colors of the still life and of the skin tones.
We have elected the Canon Log2 curve with different color profiles as well as two color temperatures at 3.200 y 5.600ºK.
The camera allows several combinations of gamma curves with different color space that go from the STD 709 to the widest Canon space the Cinema Gamut, passing through by the 2020 or the DCP-P3.
In the graphic to the right, we can see the four color space related to ACES. The color space of Cinema Gamut covers not only the conventional spaces 709 but the cinematographic and the 2020; the color space associated to the HDR systems.
For the tests we have used mainly the Cinema Gamut as the base but to compare we have used others too.
We have photographed the Macbeth chart with the different color spaces to see how we can refer to the different color samples.
In the graphics we have set next, we evaluate the Cinema Gamut color space in reference to the theoretical values of the color chart with Imatest.
As we have indicated in several occasions this approach helps us to know how the camera, in certain conditions represents the color in reference with some standard values. This appraisal comes indicated by the sigma value (RMS) that quantifies such deviation. The graphic at the right side, interesting to study, the biggest square, is the color as it is photographed and corresponds to the circles in the graphic to the left.
The smallest square and placed at the center of the biggest is the ideal value of the color chart corrected by the luminance of the photographed. And last the small rectangle is the ideal value of the color without luminance correction.
When the similarity of the squares is the biggest then the color reproduction of the camera is closest to the reference.



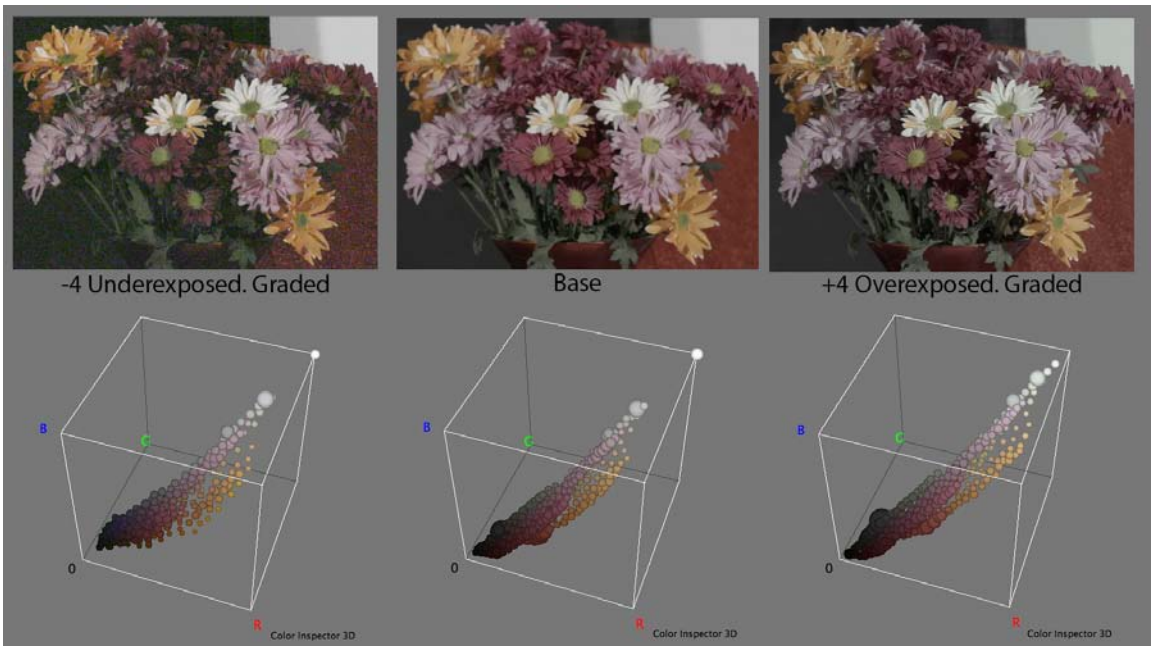


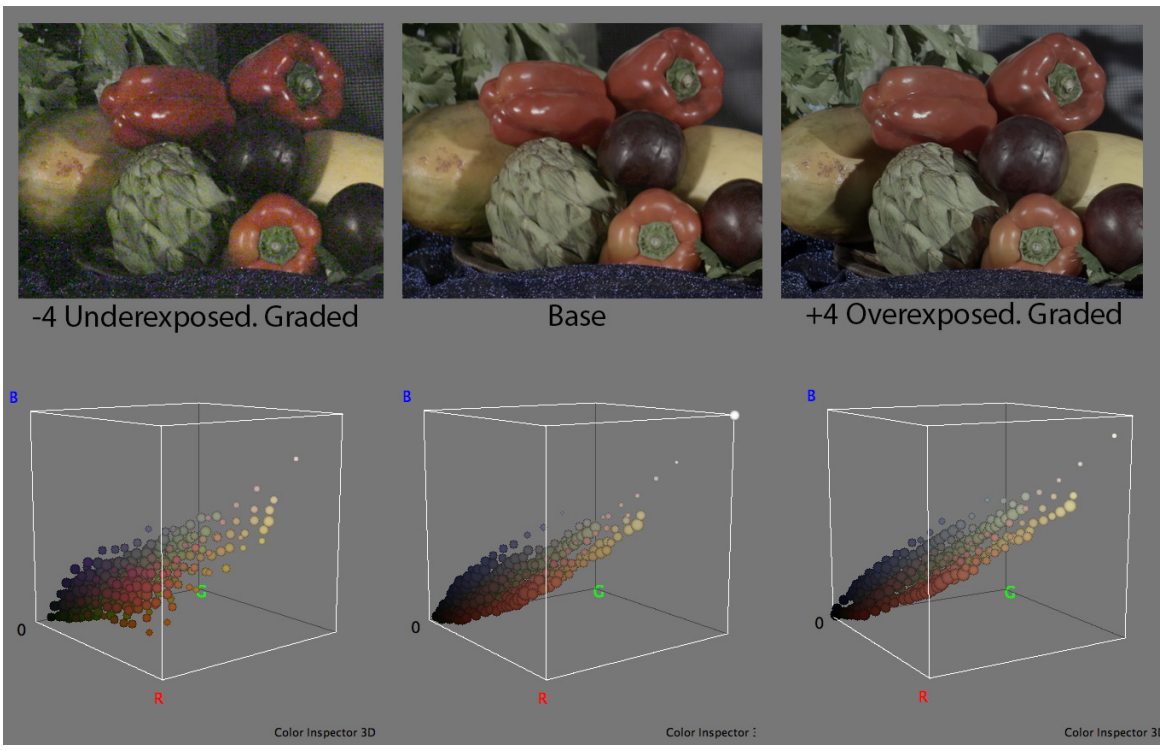
If we observe the values of the red, green and blue plus the complementary in the third line of the chart we will notice that the green (14) is slightly more cyan, the red color is slightly more magenta and the blue (13) is practically same as the ideal. The yellow (16) is very similar to the norm, the magenta (17) is more reddish and the Cyan is slightly colder. When looking at these patterns and the slight deviations we can see how the camera favors that the reddish tones become colder while the magentas become more reddish which translates in a very good reproduction of the caucasic skin tone. The blues are much closed to the ideal values of the chart as well as the greens. Cyans and Reds are the one showing more deviation. The sigma value of 13.1, with the corrected Chroma is in the normal values of the high gamma cameras.

In studying of the color, it is important not only to know how the camera captures them, its tone, brightness and saturation but how they appear in different light conditions and how the skin tones shows and how they responds to different ISO values. As we indicated above, the camera uses different color spaces and a way to see this is through the analysis of the Rainbow chart evaluated by the Color inspector through the quantification system Wu.



Below of each chart there is a wide RGB space where it is represented the color of itself, there we can see the distinct color distribution in each space (see the arrows), there the wider spaces as the 2020 and the Cinema Gamut show a more precise tonal distribution with less saturation and tones of different colors, for example in the blues, cyans or yellows,
The ITU space shows the blues and cyans with less tonal differences and more saturated. Same the reds and oranges are less than in wider spaces.
As it can be otherwise, the wider spaces will provide better color tones, more subtle and overall the image aspect will be more natural.
Other aspect that needs to be considered is the color consistence. It means what transformations the color tone will suffer due the different variables such as the exposition. To study this we have considered our still life. In the image that follows we have clipped two zones of the same.





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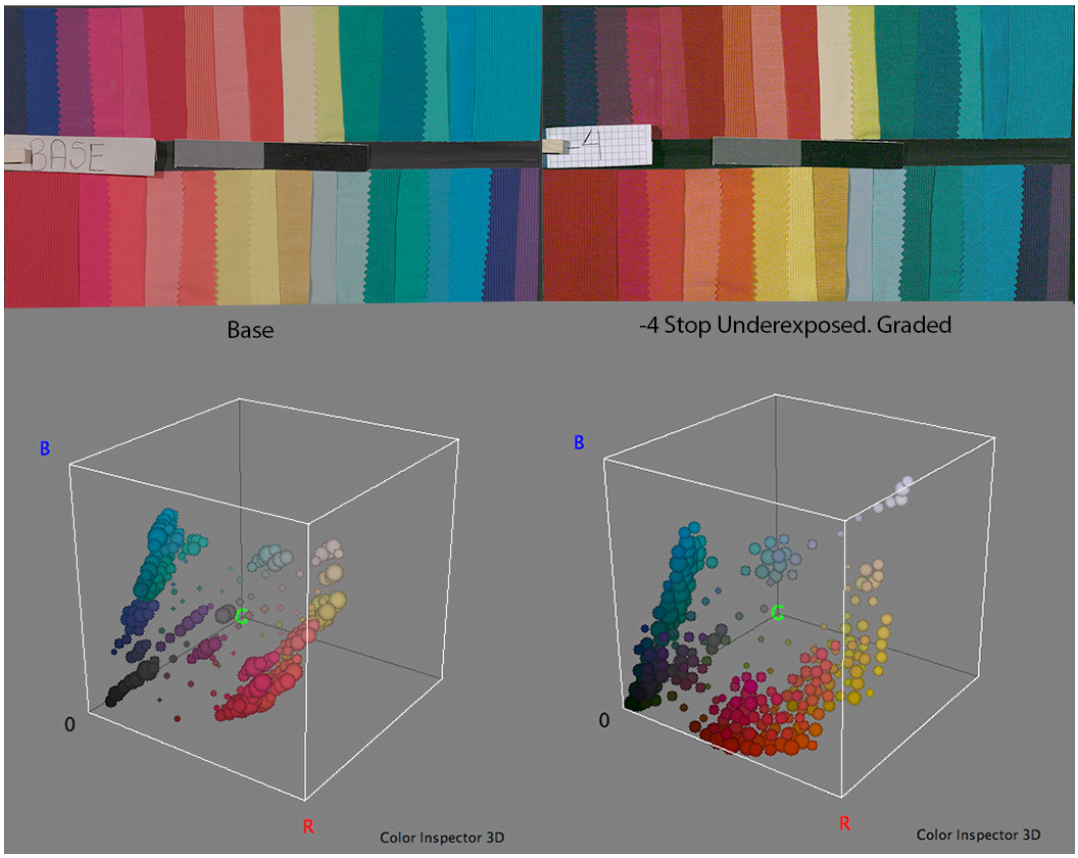
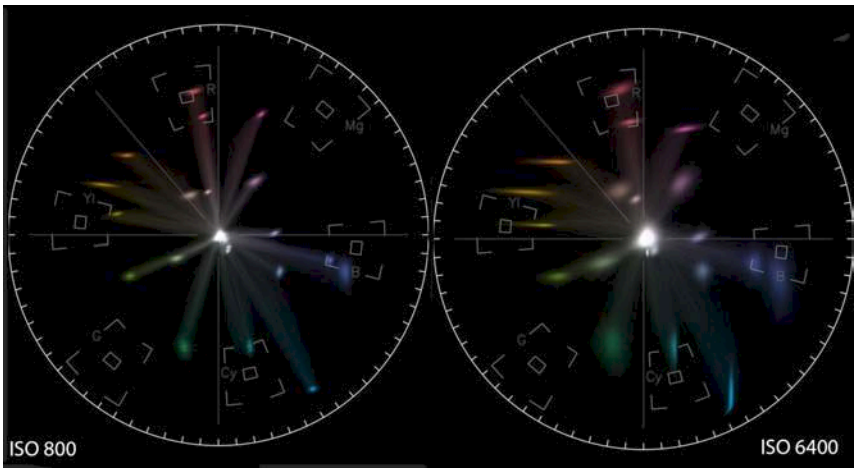


We have also proved the effect of different ISO values in the color through a photography of the Mac Beth chart with different sensitivity values without noticing any modification as it can be shown in the vector scope at ISO 800 and 6400.



The skin tones are maybe one of the more important aspects to consider, as in color as in texture.
To study this we have photographed our models with the color chart and have corrected the image maintaining the Mid Gray 18% reference.

The skin tones look natural, soft and with smooth color gradations, as in the caucasic skin tones as in the afro ones. But in the afro we could see a slight intonation towards green in the deep underexposures starting at -3.
The skin tones also look different with different light sources, even when the K number is in equilibrium between the camera and the lighting. Let's see as follows:

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. ISO 800. Canon zoom 30-300mm 29.97P. Shutter180. Graded

Gertrude's skin tone is more red with con Tungsten, more cyan/Green with cold, HMI or fluorescent lights.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. ISO 800. Canon zoom 30-300mm 29.97P. Shutter 180. Color matching

Same it happens with Jennifer's face that looks greenish with HMI light but no so much with fluorescent light.

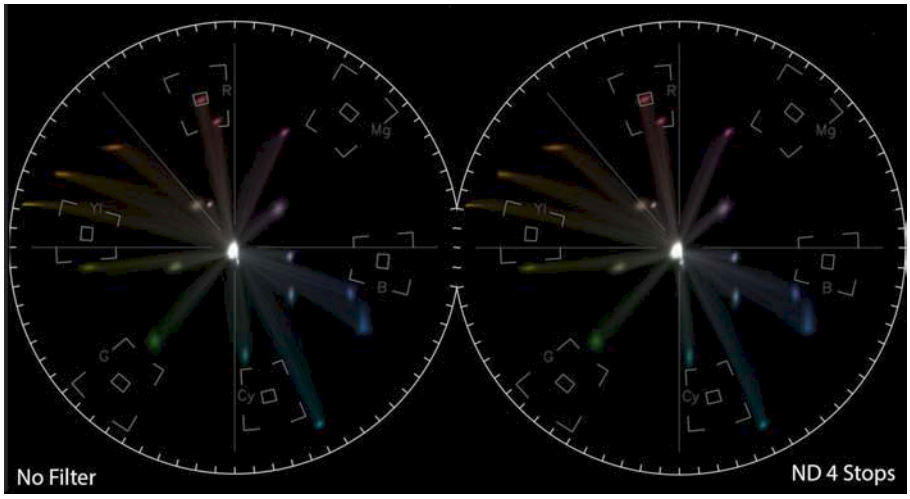
3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon zoom 30-300mm 29.97P. Shutter180. Graded.

In the above image we can see three skin tones of our models. A very natural appearance.
We will place two photographed with natural light outdoors and indoors.

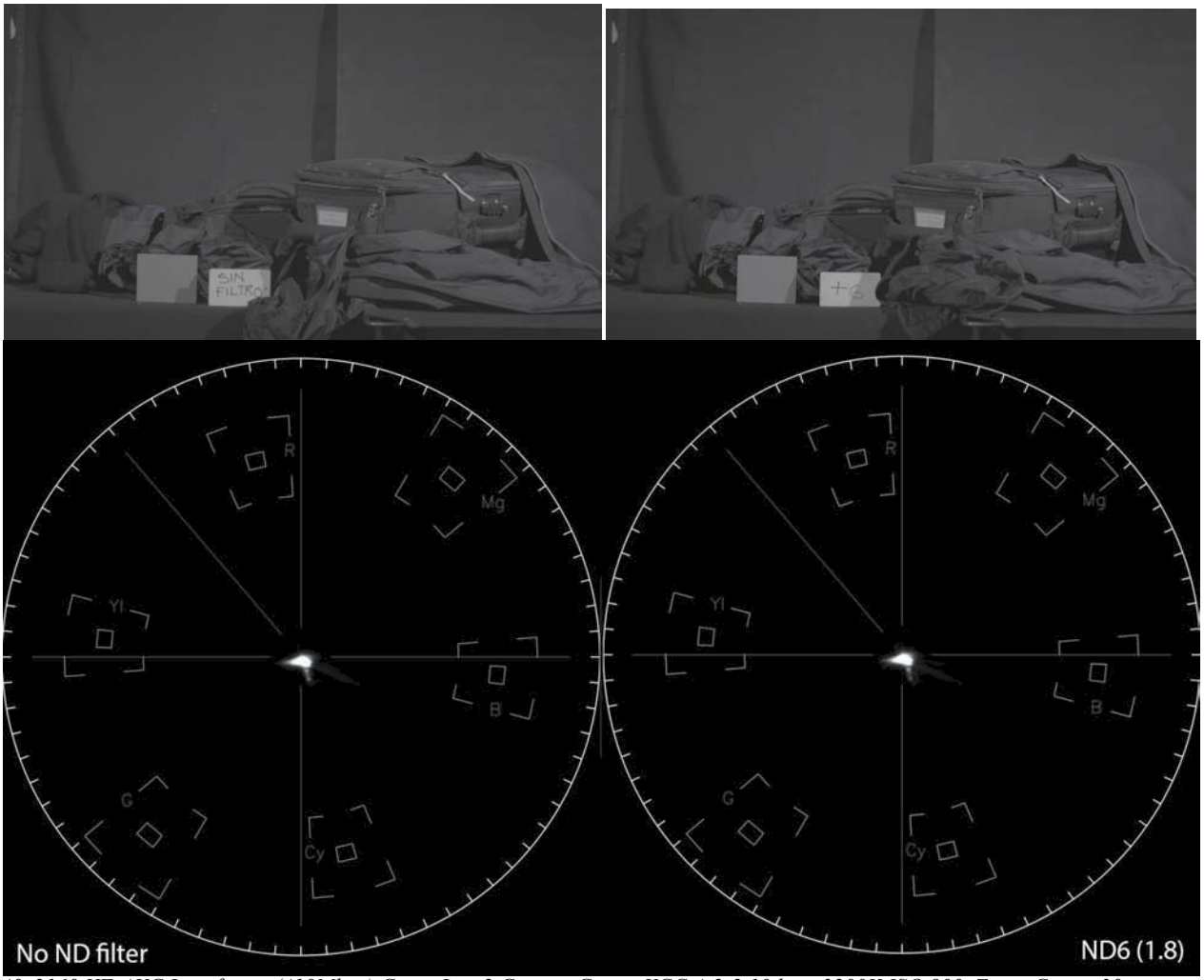
3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 4650K ISO 6400. Ultraprime 16mm T1.9 29.97P. shutter180. Graded.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon zoom 30-300mm 29.97P. ND 2 stops. Shutter180. Graded.

Other aspect that we have studied is the ND filters effect. To know if they influence in any way the color. We have photographed the Mac Beth chart with different NDs keeping the same exposure in all the takes without noticing any change.
Here we can see the two exposures in the vector scope, without filter and with a ND4.



We cannot see also any effect with an IR filter.



3840x2160 XF-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 3200K ISO 800. Zoom Canon 30-300mm29.97P. Shutter180. Original material from Camera without correction. Illuminated with Tungsten light.

Last, we have done a Chroma key without finding any problem when generating the mask but we see some compression artifacts over the Green CK especially in the red and blue channels.

3840x2160 Xf-AVC Intraframe (410Mbps) CanonLog 2 Cinema Gamut YCC 4:2:2 10 bits. 5600K ISO 800. Canon Zoom 30-300mm 29.97P. Shutter180. Camera original.

Red Channel

Green Channel

Blue Channel

Other considerations. Camera handling.

With the C700, Canon is targeting the request made by DPs of having an ergonomic digital camera designed thinking in the operator who handles the camera for long hours. The camera shows a good balance, adequate weight not too heavy but not too light. Our experience with the camera on hand in the coal mine manifest exactly what we pointed out. The camera menu is simple, intuitive with good visibility for the operator as for the assistant. Conexions for SDI, monitor and power are well distributed and with multiple configurations options. It is a camera very easy to operate without confusion in the buttons distribution. Besides, the camera has in the top and bottom all different size of threads for different screw sizes allowing the camera to work with several supports, rigs and accessories.
The camera assistant as the DIT found no difficulty in the access to the menus or recorded files.
The camera case is robust, resistant and very solid. We did not observe any noise and the heat level is the normal on this type of cameras.

The crew getting ready to go down into the coal mine.

Conclusions

As a DP, I give a warm welcome to this new Canon camera. Its sensitivity, noise level and texture have impressed on me, specially the camera capability to show a friendly noise when using the high ISO numbers maintaining the texture and color. The skin tones are soft but full of detail with smooth tones that remain under different conditions: under and over exposure.
Of special relevance is the way the camera handles the blacks that are deep, with texture and not at all opaque but full of volume going up to -8 stops. If in the highlights the camera has a good performance up to +6 stops, I believe there is enough room to improve not only to reach a higher range but to make the white clip becomes more natural and less digital with a softer *roll-off*.
In regards to the codec XF-AVC, it seems very efficient even though we have detected some artifacts; it is flexible in his handling of all the work chain and with a very good relationship quality vs. weight.
The relationship among the good handling of color, texture, sharpness and the deep of blacks provides the camera with very pictorial tone plasticity proper of oleo painting. We could not test in this occasion the RAW recording due the unavailability of the recorder and the evaluation of the new Viewfinder of the camera.

Links:
Natural Outdoors and Indoors Tests
https://vimeo.com/215791088
Studio Technical Tests
https://vimeo.com/216461125
Making Of
https://vimeo.com/215827840

Thanks Notes:

This test is the result of the cooperation among many people. I cannot less that give thanks for their love, support, friendship and professionalism to all the people that have participated in this Project.
To all of them my deepest and sincere recognition.