SONY F-23 CAMERA TEST

By Alfonso Parra AEC

Camera crew of F23 Test.
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Ramiro Sabell. 1º Camera assistant
Saúl Oliveira. 2º Camera assitant
Yaiza González. Video assit

During the past month of April we tested the digital camera Sony F-23. The test was done in HD video 1920x1080, 24fps, 172,8 shutter angle, framed in 1:1.85 and using the S-Log gamma curve with wide extended range and wide colour space, recorded in the SRW-1 docked to the camera in HDCAM SR format in RGB 4:4:4 SQ mode at 10bits. The images were post produced in Evasion and Fotofilm and transferred to film in Fotofilm/Deluxe (Madrid); capturing from a Sony SRW-1+SRPC-1 and a SRW-5500 in RGB, dual link 4:4:4 SQ via a CVS Centaurus card and DVS Clipster respectively, input format RGB,dual link 4:4:4. The video images were converted to data, DPX format 10 bits. The data was stored locally in Baselight or Lustre, depending on the case, where the necessary color corrections were done in linear and logarithmic modes. The transfer to film was done with Arrilaser, on Kodak 5242 negative and Kodak Vision 2383 positive stock.

The test consisted in shooting models and reference charts, over and underexposing them, and images in different natural locations in Madrid and Segovia (Spain). We also used the image analysis software Imatest and ImageJ.

For the adjusting of the light and evaluation of the recorded images we used a waveform vectorscope Astro WM-3208 and a Cinetal Cinemage monitor with 4:4:4 waveform incorporated. We also used a Sekonic L-558/Cine and the Minolta color meter IIIF, all of them suitably calibrated.

We used both Zeiss Digiprime and Angenieux Optimo lenses. The tests established the workflow for the shooting of the feature film "A casa da luz", directed by Carlos Amil and produced by Vimbio Films, that took place last summer and from which we also show some images here. The selection of the Optimo for some tests was because we decided to use this zoom as the main lens since the zoom movement would provide a narrative role in some parts of the film. Test results confirmed the exceptional quality of this lens.

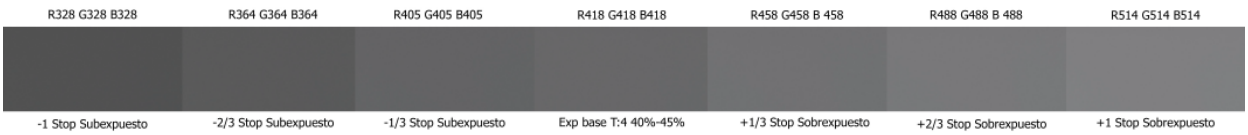
Our target was to get a wide vision of the behavior of the camera, from the DoP point of view, taking into account both objective elements like the resolution, latitude and color analysis from the Imatest software and also subjective elements like noise valuation, texture and general appearance of the images.

For all this, this tests can be considered as a general approximation to the behavior of the camera and can be used as a starting point for the necessary adjustments of your project.

The images presented here come from the original frames though converted to CMYK color space, for what they must be taken as a mere reference.

SENSITIVITY

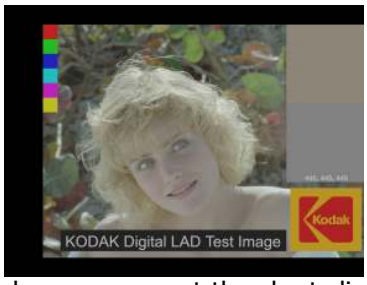
In order to evaluate the sensitivity of the camera we recorded a 18% grey chart taking as our base exposure a value of 40-45% in the waveform monitor with specific T stop (T4). With the Exposure meter adjusted to 24fps and a shutter angle of 172.8º we looked for the correspondent ASA for that T Stop. As we all know, the use of different gamma curves as well as the modification of other camera settings may change the sensitivity of it. There must be said that the determination of the sensitivity is related to the dynamic range and the noise/signal ratio of the camera. For example, we can improve the latitude if we don't mind about noise in the shadows, improving the sensitivity of the camera. On the contrary, if we want the cleanest image possible, in highlights and low light areas, so we restrict the dynamic range and adjust the sensitivity in consequence. Therefore, you should determine sensitivity value as part of the specific tests you plan for your project



We used the S-Log curve, been the rest of the parameters in Preset or Off. So, we have considered that the camera works in logarithmic mode and therefore we used the Kodak Digital LAD values as reference, as well as the grey scale and it's Cineon conversion. According to the tables, the values are as follows:

Cineon .CIN/DPX Density Mapped data

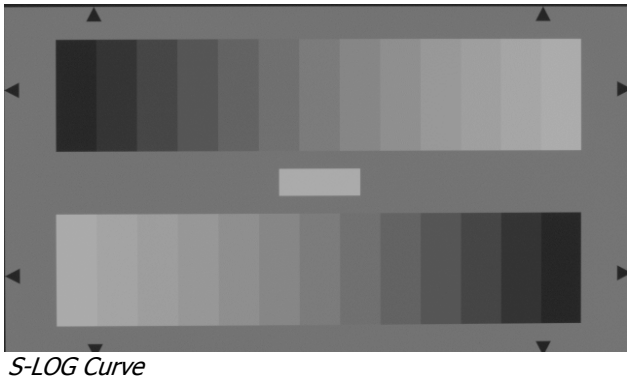
D-Min to D-Max of 2.048
Mapped to 10 bit Log data:
D-Min = 95
2% black = 180
Digital LAD = 445
18% grey = 470
90% white = 685
Granularity of 0.002 density per sample [LSB]



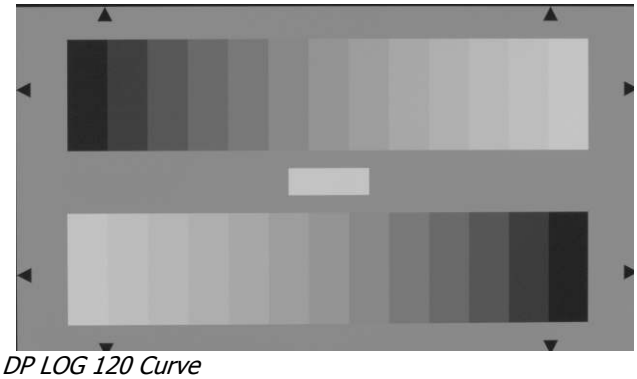
Once the stills were captured and provided that recorded grey cannot be pure, we got the chart slightly out of focus and averaged the pixel value. We compared it with the Kodak Digital LAD reference values and with the Cineon/DPX grey values. When comparing our recorded chart with the 18% grey at 10 bits and with a value of 470, the sensitivity of the camera results in between 160 and 200 ASA. If we take the LAD grey patch of a 445 value as reference, the sensitivity results in between 200 and 250 ASA.

With the grading and filming process in mind, we decided to take the LAD digital as our reference, knowing that it is the main reference for all the postproduction companies and because this value adjusts to the normal value of the % in the waveform monitor.

For exposing shooting outdoors we used a reference value of 250 ASA, though due to the excellent behavior of the camera in the low light areas a value of up to 400 ASA can be used without compromising the shadow detail. Other curves, as we said, change the sensitivity, as an example, here we can see a Digital Praxis curve:



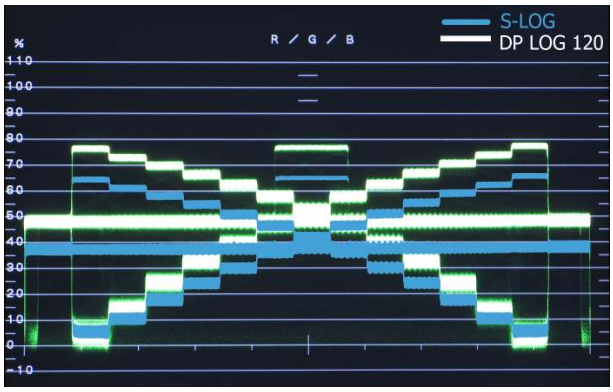
S-LOG Curve



DP LOG 120 Curve

As we can see in the two charts, the DP LOG 120 has a brighter grey at the same T stop compared to the S-Log. We notice that with this Digital Praxis curve the sensitivity of the camera falls between 400 and 500 ASA. In the waveform monitor you can see the difference between the two curves on the grey scale chart.

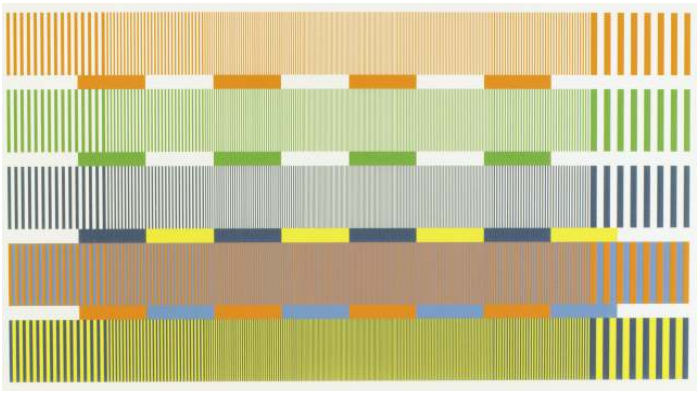
We can conclude that the sensitivity of the camera places between 200 Asa and 400 ASA itself, being 320 ASA a recommended value for the work.

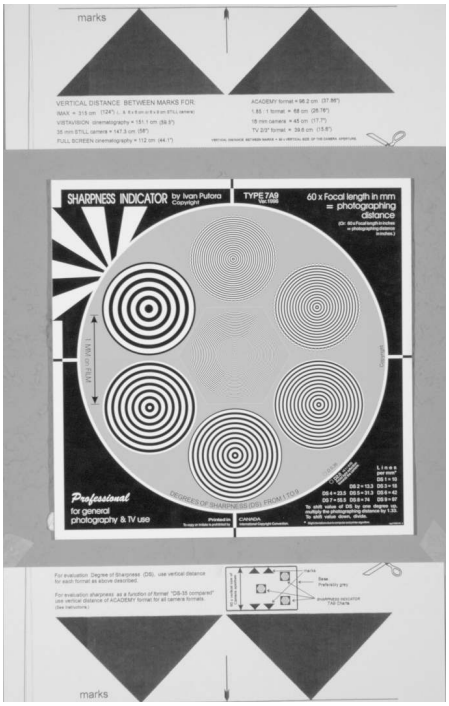


Resolution / Sharpness

We evaluated the general resolution of the system, which includes not just the camera and the lenses but also the projection process, digital or film based. The camera gives a resolution 1920x1080. This is over the typical resolution of the F900 (1440x1080) and closer to the 2K format. As we know, the final resolution, or what we see on the screen, expressed in the form of MTF curve, depends on the MTF curves of each and element that affects the image; so, it depends on the lens, the camera optical head block, the film scanner, the type of film used, the projector and its lenses, etc… The better the MTF curves of each element, the better the final resolution will be. So the resolution we show here is valid for the configuration we used in the test, and it change depending on the elements used. Nevertheless, we used high quality elements in the analysis during shooting and in the postproduction processes and this should be the normal procedure in any professional production.

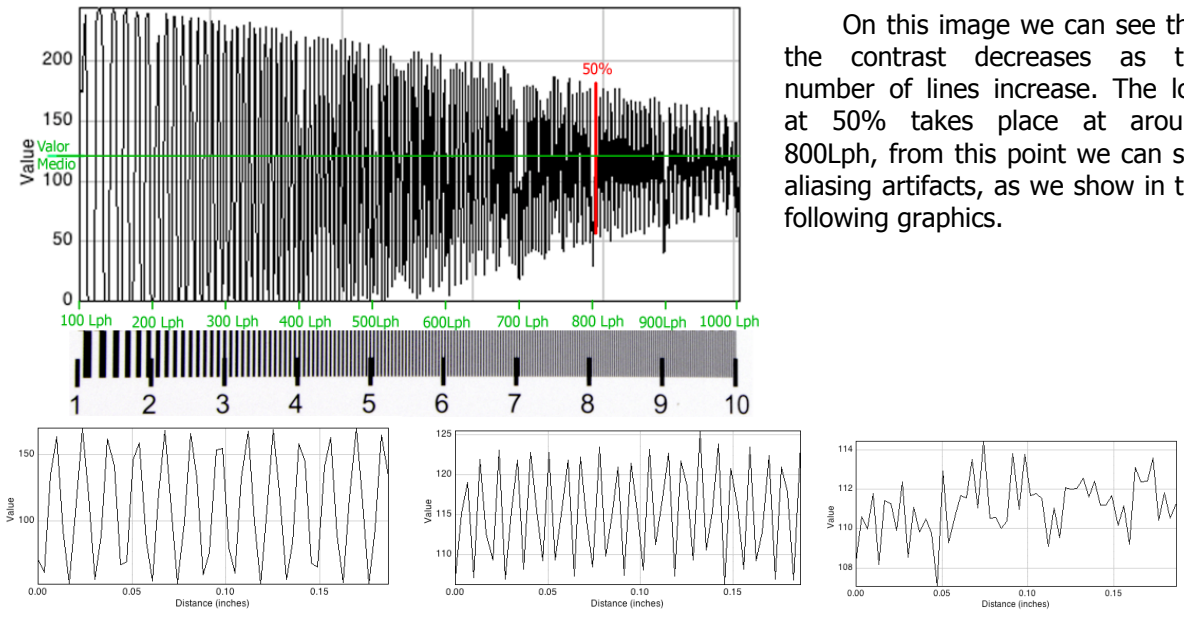
On the Putora Resolution chart we could see clearly up to the pattern number 7, witch is 55.5l/mm. This means an excellent resolution; at higher resolutions we saw some interference artifacts. At the same time, and with the ESSER chart in the image below, we observed that the resolution is the same on each of the RGB channels. Therefore, this is a highly recommended destined for the big screen.





Putora test chart recorded with a digiprime 20mm

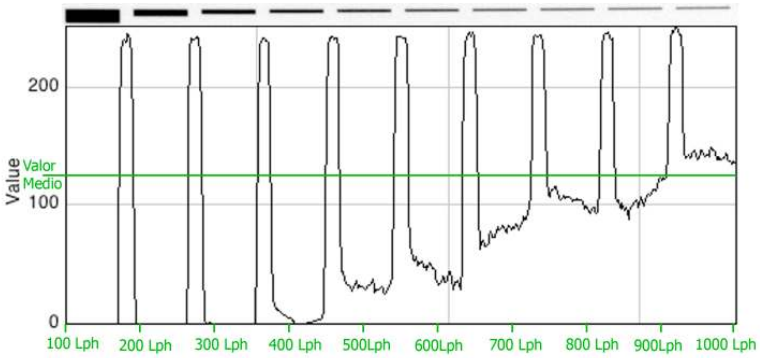
We also show here the results of the Imatest and imageJ analysis software's shooting an ISO 12233 chart. This was done with the Angenieux Optimo HD Zoom and with the Detail Adjustment in the OFF position.

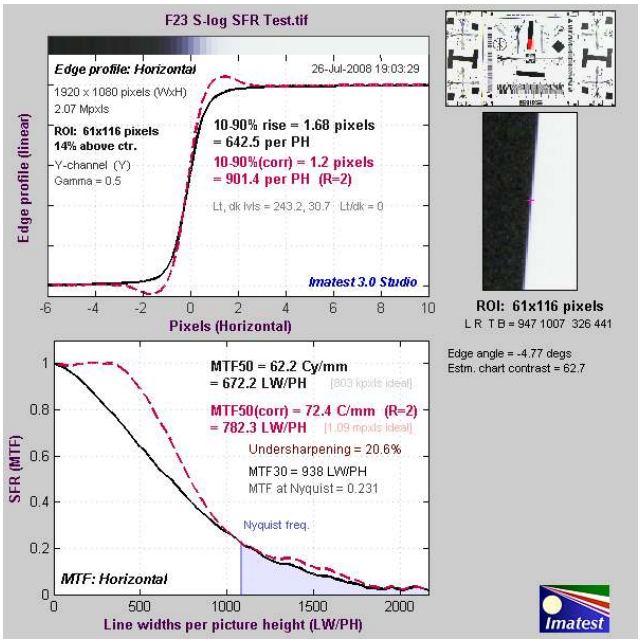


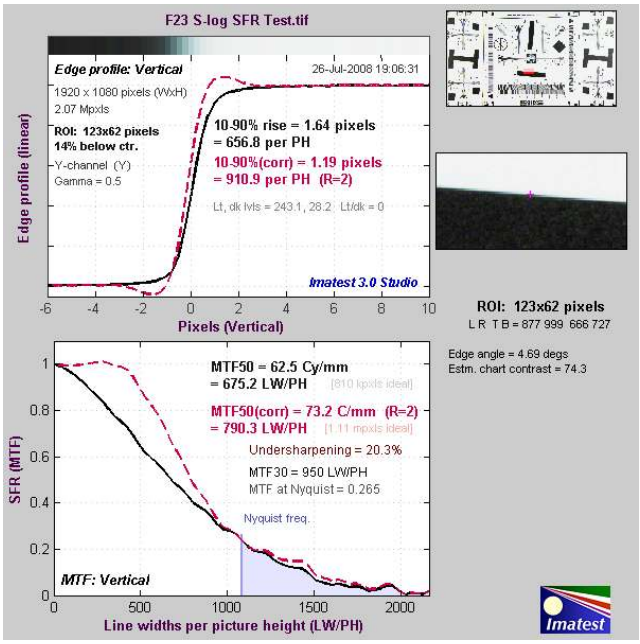
On this image we can see that the contrast decreases as the number of lines increase. The lost at 50% takes place at around 800Lph, from this point we can see aliasing artifacts, as we show in the following graphics.

We can observe the decrease in the detail on this image (right). There must be said that the graphic corresponds to the image captured with the camera and the Optimo HD Zoom and therefore a change of lens would mean a change in the result.

Let's now see in detail the result of the horizontal and vertical resolution of the camera/Optimo HD zoom set.







The horizontal resolution (left) is 672,2 Lw/ph (black curve). Once applied the standard correction of the Imatest (red curve), it becomes 782,3 Lw/ph for a MTF of 50%. The vertical resolution (right) is very similar as we see in the MTF curve.

Outdoors we shot with wide angle lenses to verify the amount of detail we could see in the vegetation as well as the texture on the stones.

View left to right. F: Digiprime 5mm T: 4. Filters: Pola+ N1.2 (built in camera).

F: Digiprime 10mm.T:3.4 Filter Pola+N1.2 (built in camera).

On this shot we can clearly distinguish the studding of trees on the frame.

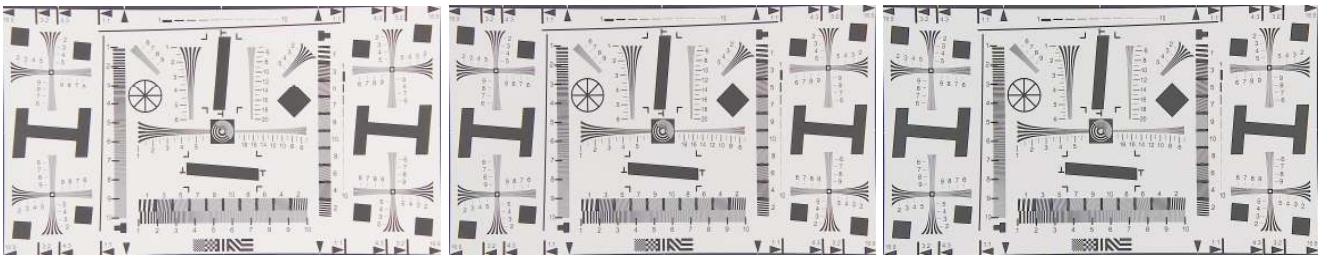
We observed that unlike in the F900, the transition between pixels with different levels is softer, having more information and resulting in a more natural image. Undoubtedly the reason for this is, among other factors, the use of 10 bits instead of the 8 bits of elder cameras.

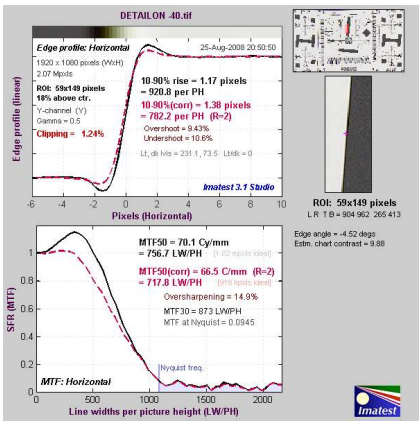
Conclusion: The camera proves a clear improvement in resolution comparing to older CineAlta models and allow to capture images with more detail and sharpness, this means it allows bigger projected images. In the configuration we used we can say the camera sees 800 Lw/ph or between 55,5 l/mm and 74l/mm that we can qualify of excellent resolution and that results in images with more texture, depth and detail. We must remember that, according to the ITU analysis, the cinematographic positive film as it is seen in the theatres, for example in Los Angeles, has 825 Lph horizontally and 540 Lph vertically, though other theatres analysed by them were below that resolution (the resolution in theatres is actually around 500Lph and 800Lph).

Evaluation of ISO chart in test room of INFOTV.

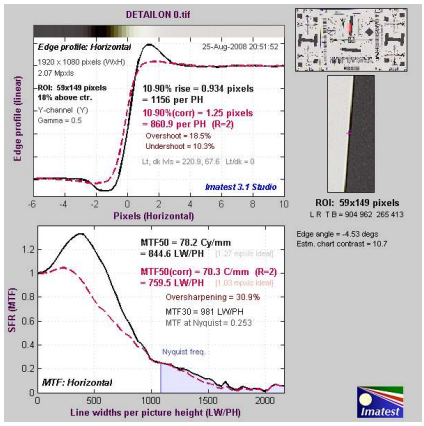
The effects of the Detail Correction

As we all know, the detail is an electronic process that increases the sharpness of the image. On the graphics below you can see the effect of the detail ON at various levels, positive and negative.

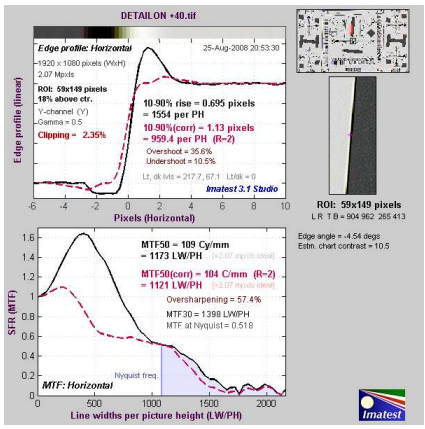




Detail -40



Detail 0



Detail +40

If we look at the top and bottom of the black curve ("shoulder and toe") of the graphic drawing, the profile of the edges (limit between white and black), we see that as we increase the detail it produces a increment in the sharpness (a decrease in the value 10-90% rise) so that in the extremes the curve rises below the black/white values, and with high positive numbers it means an over sharpness effect that gives an artificial feeling in the image. With negative values the over sharpness effect becomes closer to the standard correction applied (red curves), giving a more natural look. This effect is clearly seen on the SFR(MTF) curve, where we can see that the detail enhancement goes, in the case of +40, to a value of 1.6

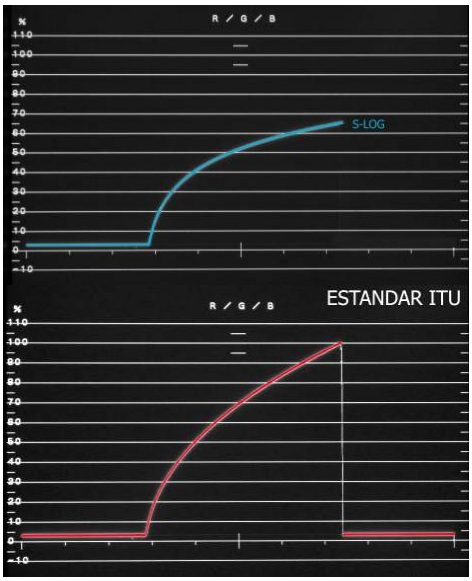
If we compare this curves to the one corresponding to Detail OFF we see the increase in resolution; for example, with Detail ON at +40 the MTF curve without correction shows 1173 LW/pH. With Detail ON at 0, the MTF curve without correction shows 844.6 LW/pH versus the 672.2 LW/pH of Detail OFF setting.

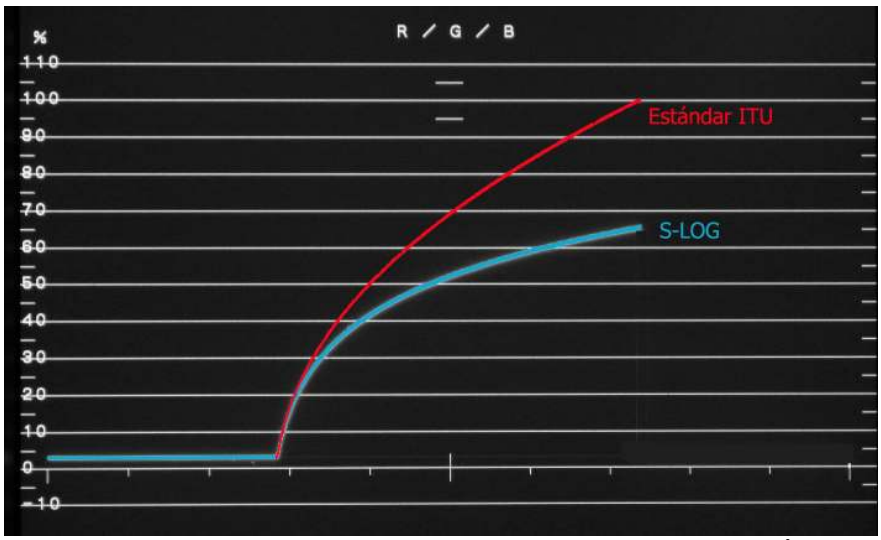
It must be said that to a certain level of detail, the result of correction (red curves) that we apply to the image (at posproduction) to get a standard sharpness and resolution is similar to the one we apply to the Detail OFF; and even gives better results, talking about resolution, applied to the image with Detail OFF.

So, it is interesting to do an evaluation of the amount of detail that we can apply to the image. In our case, during the shoot of "A casa da luz" (Light's house), we used a value of -80 in some parts of the film, this lightly increases the sharpness of the image without an artificial sensation. We can deal with values between -40 and -80 to increase the sharpness of the image without having that electronic edge effect so artificial in the use of the Detail.

Latitude / dynamic range: S-Log curve

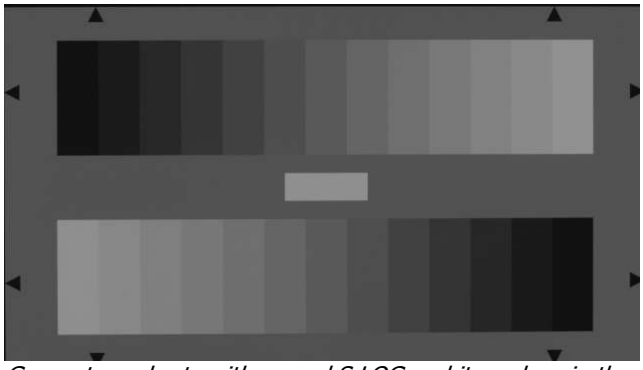
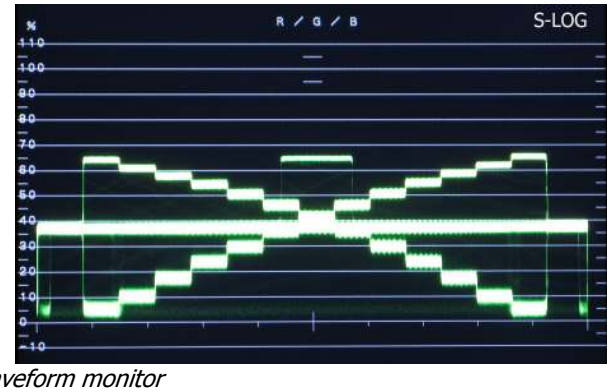
We used for testing the S-Log gamma curve because we consider it's the one that gives more latitude, as well as a more natural look, less electronic, closer to the cinematographic film look and to the way we humans see nature. We just have to compare the S-Log curve with the standard ITU 709 in order to show these differences. In the waveform vectorscope we see the performance of both curves using the Test signal generated by the camera. As we see, the ITU gamma curve covers the whole signal range from black (0%) to white (100%). Nevertheless, with the log curve the white stays at 65%, that means we can still register white values over 100% without clipping (and to 120% with some other log curves). This results in more latitude, and not only that, if we look at the way the S-Log curve captures the highlights, we notice that the transitions between white values are softer, with more detail, versus the standard curve that with a more aggressive slope provides brighter whites but with less shades.



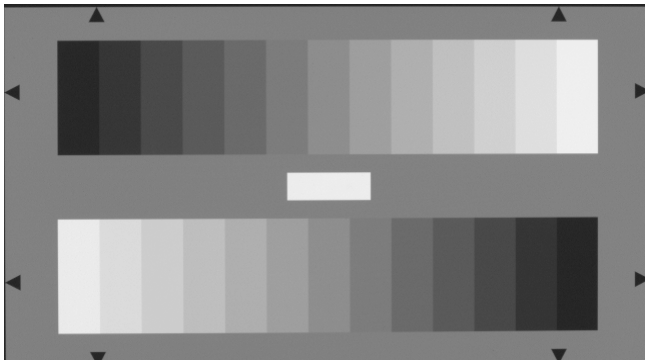
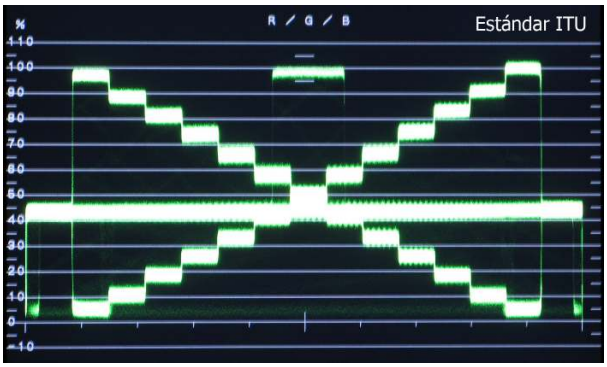


Comparison of the sign TEST between the curve of gamma S log and estándar.

The chosen gamma curve affects the sensitivity. For example, in the middle tones, at the same exposure the ITU curve is brighter than the S-Log, this means it has a higher sensitivity.
Let's see this looking at a the grey scale:

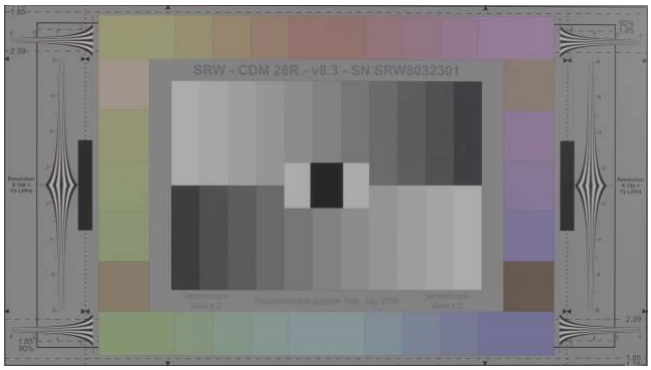
Grays steps charts with curved S LOG and it,s values in the waveform monitor

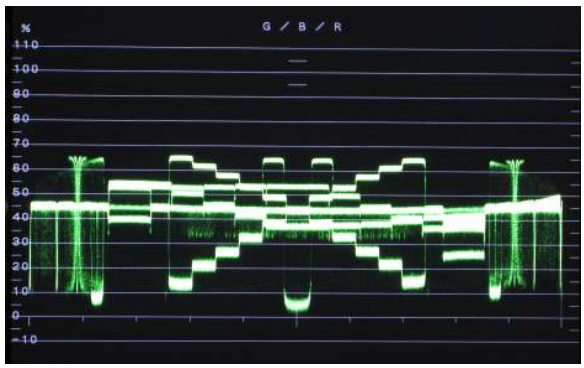



Grays steps charts with ITU curved and it,s values in the waveform monitor.

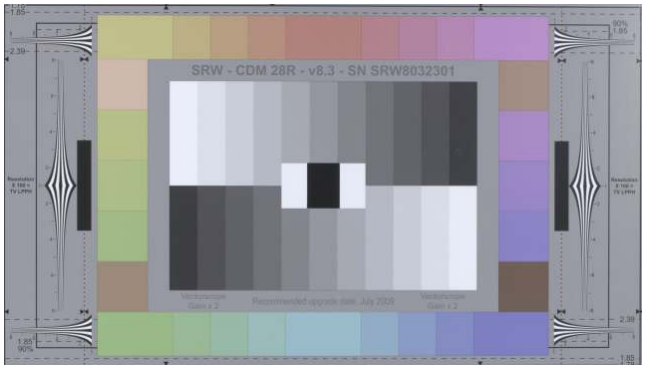
As we can see, the values of the blacks 1,2 and 3 are similar, the value 4 is lighter with the Standard ITU and in the 18% grey the ITU curve is ½ stop lighter than the S-Log. Clearly we must adjust our light meter depending on the curve we used.

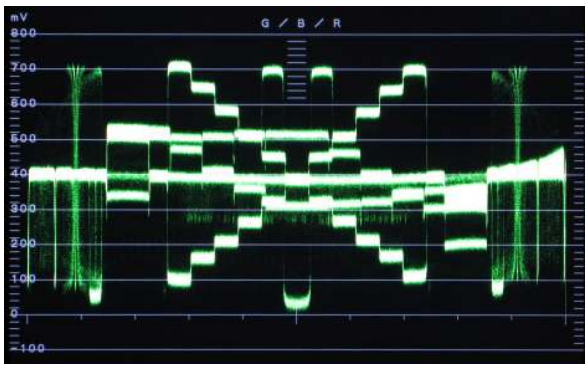
Let's see another example with the DSC Labs chart.





Observe in this chart with S - log gamma, the minor luminosity of the half grays and the high lights.
Note: The values in the waveform *are in %*

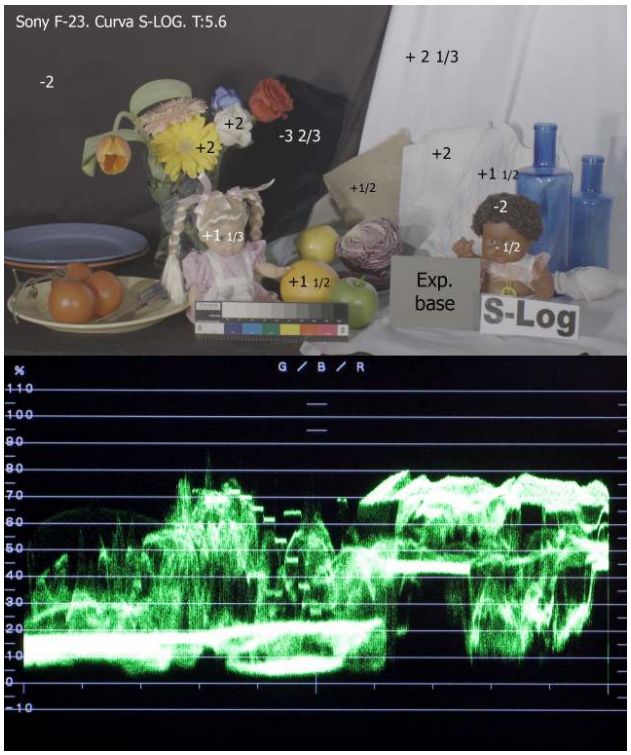


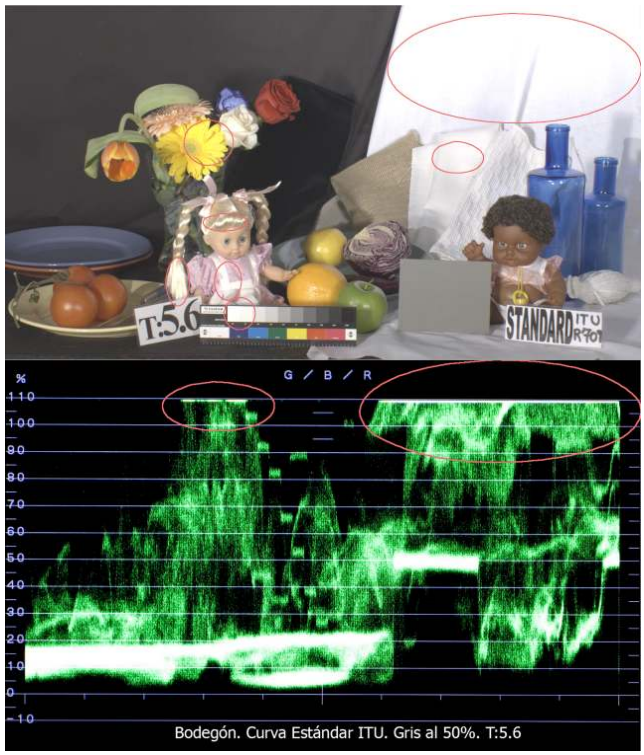


Test chart with the curve ITU
Note: The values in the waveform are mv

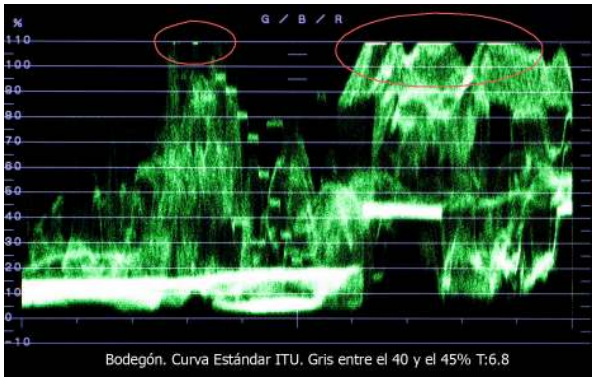
The S-Log curve needs for a careful grading process to obtain all the details the curve can generate. On the contrary, with the ITU curve the images can be seen directly with some few corrections. The logarithmic image looks washed, with desaturated color, (particularly if we use the WIDE color space) because of the great amount of detail it retains both in the highlights and in the shadows. We can use the ITU standard curve for example when shooting indoor with no highlights and when we need deeper black and middle tones with more contrast. But in general, and thinking in the grading process, the S-Log curve gives more detail to the image. Let's see this still life as an example

Images of the test room at Info Tv during a still life shot where we can see the different configurations of the camera. Also shooting the Stouffer Transmission Step Wedge mounted on a light sphere.
In the picture, Ramiro Sabell, First Assistant Camera.





As we can observe, at the same T stop the ITU gamma curve clips the white highlights on the fabrics as well as the lighter areas on the flowers and white toy.

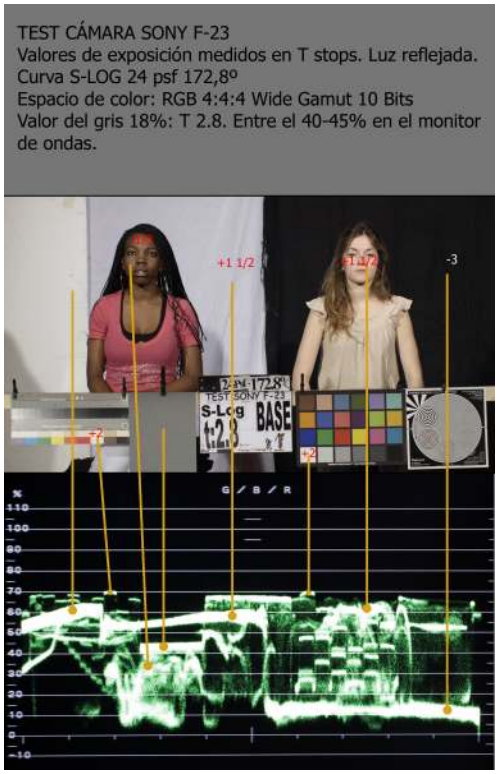


On the image (left) we show the result, on the waveform monitor, after underexpose the image ½ stop with the ITU gamma curve. We see that even here there is a lot of highlight areas clipping, been the middle tones in the correct values. We can stop down a little bit more but loosing detail mainly in the middle tones.
Now we will see both images once corrected.

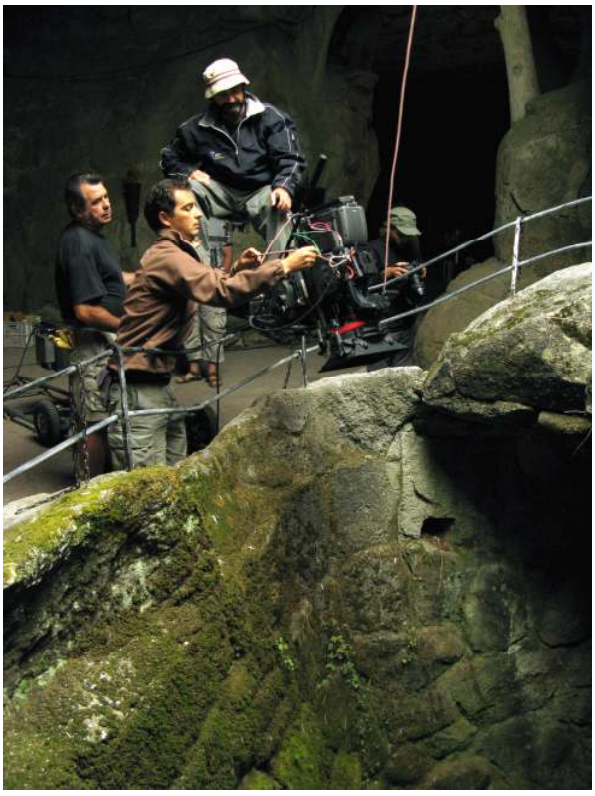
From now on we can see the two images once corrected.

To evaluate the latitude of the camera we used the Imatest software as well as shots with models and charts, over and underexposing in steps of 1 stop. We have corrected this exposures one light grading and also adjusting each exposure.

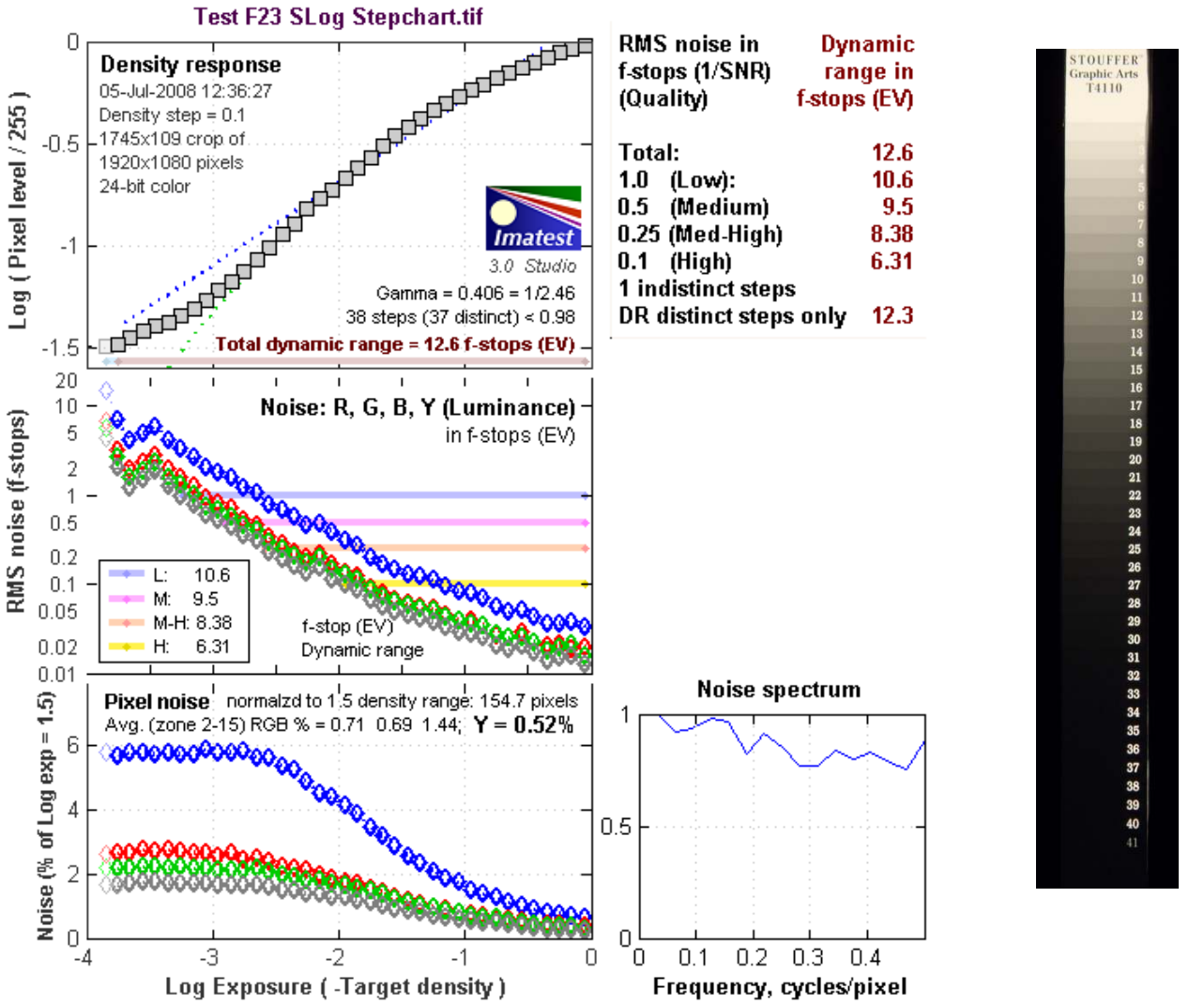
The camera can work with a Normal Dynamic Range or Extend Dynamic Range. The last one is ½ stop more sensitive but it increases the image noise; we loose around 2 dB of signal-noise ratio. We chose the Extend Dynamic Range to determine the higher latitude of the camera and evaluate the noise, specially in the shadows. We used 250 Asa as a reference value, though, as we said before, we can underexpose up to 400 Asa, because of the excellent behavior of the camera in the shadows. For the Imatest software analysis we shot a Stouffer Transmission Step Wedge T4110 of 41 steps equivalent to 13.3 T stops.
The results are as follows:



Reflected light Exposure values and its correspondents in the waveform monitor.



During the shot of "A casa da Luz" we worked in some very low light conditions, where we could verify the capability of the camera to capture great amount of detail in these conditions. On the left, shooting inside the artificial caves in Betanzos. Above, director Carlos Amil in the forest of Torres do Allo.



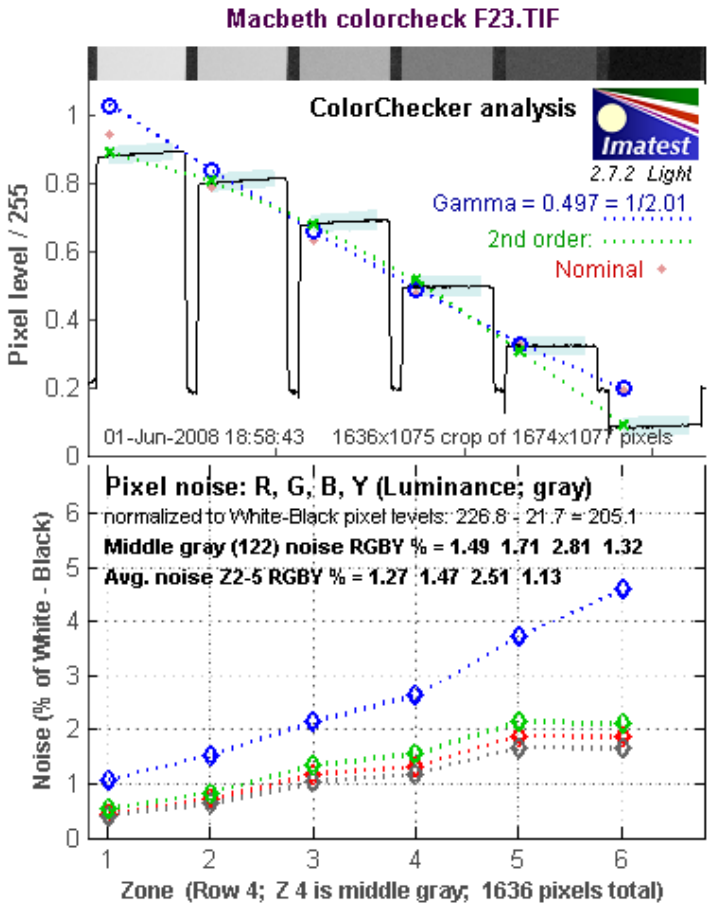
As we can observe in the graphic above (Density Response), the camera can see up to 12.6 stops, though according to the generated noise the Dynamic Range can be reduced to 6.31 stops at the highest quality. Notice that the form of the curve is very similar to the traditional response of a 35mm negative stock. As we'll see later on in the test with the models, it's reasonable consider a latitude of 10 stops, four over the middle grey 18% and six under it, though the camera can see two more stops in the low light areas (shadows).

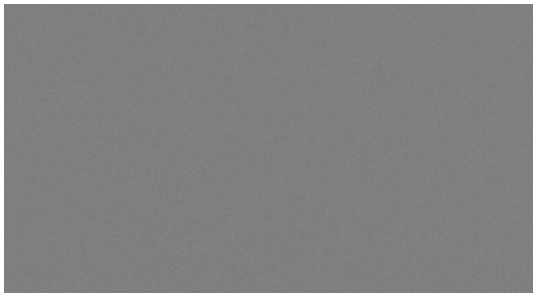
Therefore there is an important improvement in the latitude comparing to previous Cinealta models, the F23 can deal with contrast ratios of 800:1 and 1000:1. Remember that conventional video cameras hardly reach 200:1 and the F23 predecessors like the F900 with specific gamma curves (Digital Praxis, Hyper Gammas) reached a contrast ratio of 500:1.

The Noise

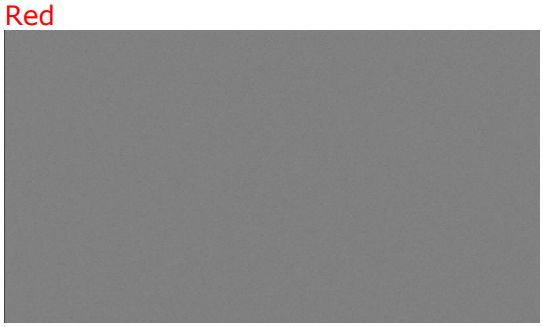
The two graphics below of the frame above show the noise in RGB and Y. As we can see, the noise in the Blue channel is clearly higher than in the red and green channels that are very similar. On the graphic in the middle, we can see the DR according to the noise (in F-stops), so an average RD value of 9.5 stops (M) shows a maximum noise of 0.5 f-stops while noise is 0.1 f-stops High DR (H) value. (For an extended explanation of this representation visit www.imatest.com/docs/tour_q13.html#f-stop). From the graphic below we can understand that the noise in the blue channel increases with the underexposure in a way that with 3 stops the noise in it comparing to the noise in the red or green channels is almost double. (The noise of the blue channel is a 3.1% of the logarithm of exposure, while it is the 1.5% of the green and red channels). As we could see with the models shot in studio, the image noise is acceptable up to 3 stops of underexposure; with 5 stops below the middle grey 18% the noise in the blue channel becomes too high compared to that on the red and green channels (the noise in the blue channel is 5.4% of the log of the exposure, versus the 2.1% of the green channel and the 2.5% of the red channel). As underexposures increases the noise in the blue channel increases, though at a certain level of underexposure (7 stops) the noise stabilizes. We also see that the blue channel shows a sharper increase in the noise, witch is softer in the red and green channels.

Let's see another way to evaluate the noise with a middle grey 18% chart:

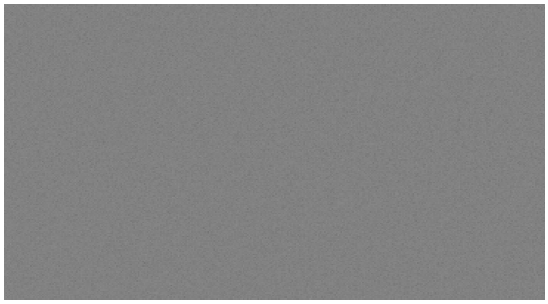




Red



Green

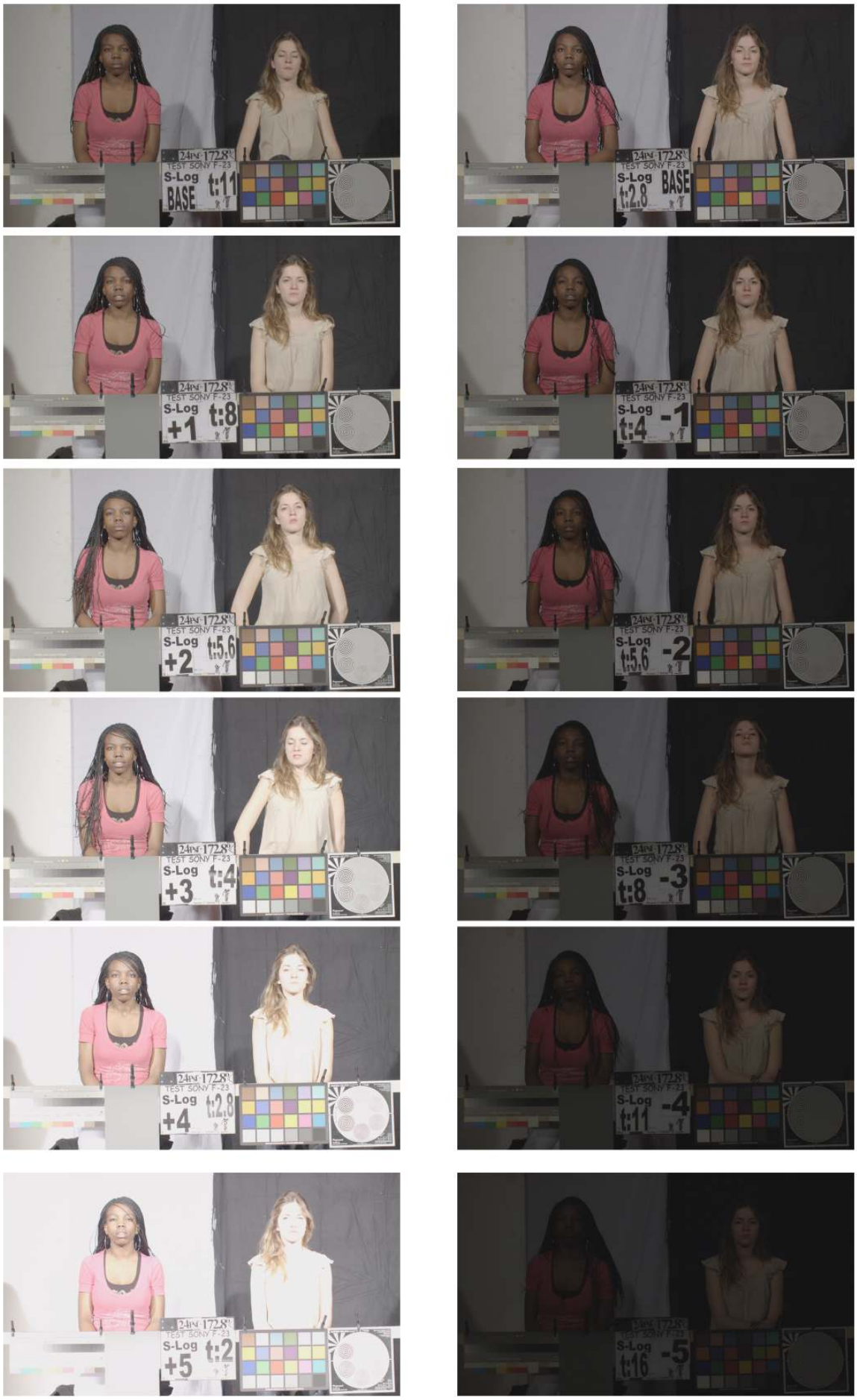


Blue

Shooting a Macbeth chart we can observe that for the 18% grey (patch number 4) the blue channel is 2.81% of the average value between white and black while the value is lower for the green and blue channels. On the frames of the grey chart in RGB (zooming a 300%) this relation can be seen.

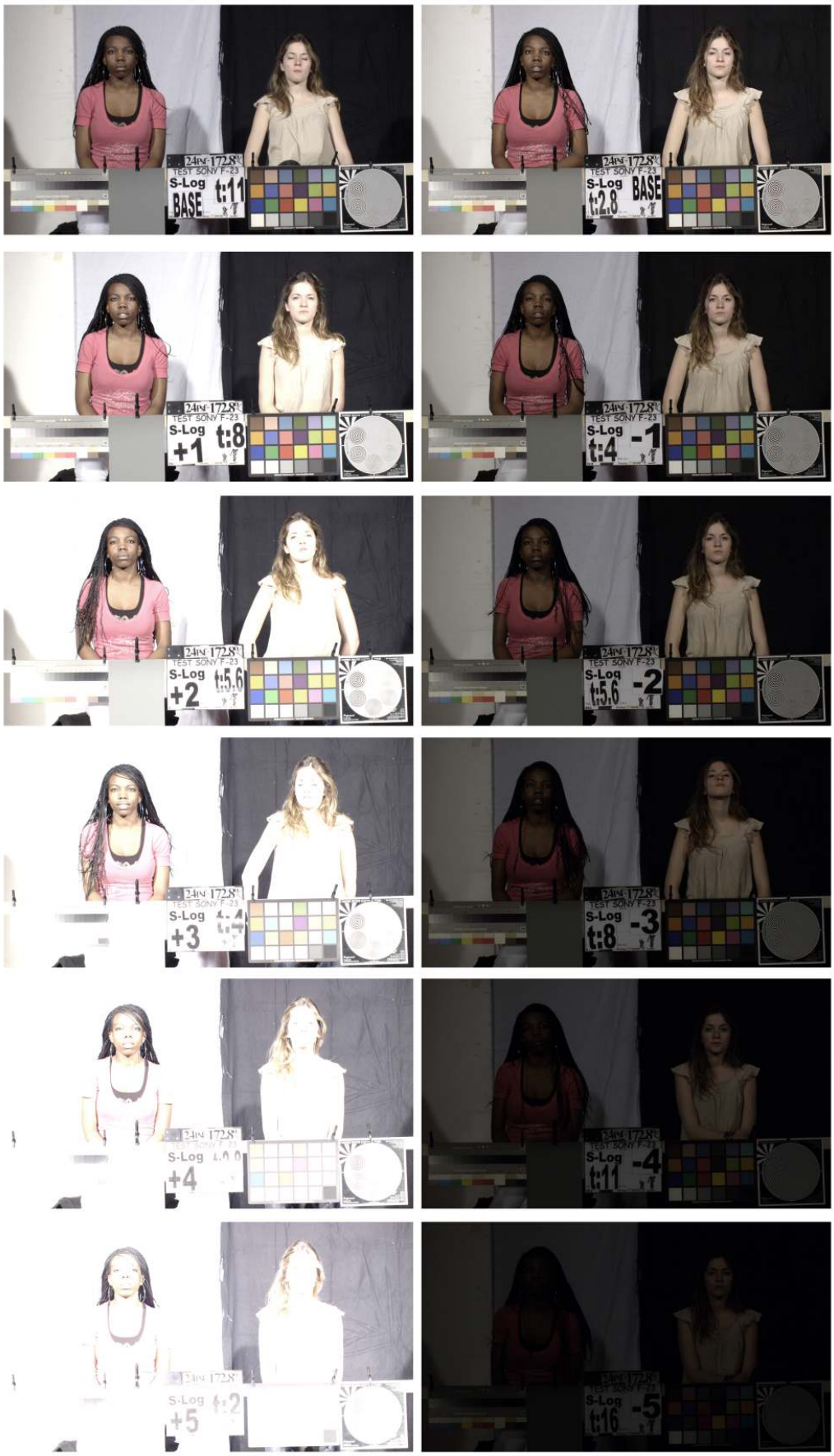
The noise in Isabel can be appreciated in the superior image. I have enlarged a 400 % the face.

We can say as a conclusion that the camera has a good signal/noise ratio, though from a certain level of underexposure the noise in the blue channel is considerable. As we know there are factors that can increase or decrease the noise level: gamma curves, the gain, modifications in the Paint menu (gamma, video level, black, matrix, etc).



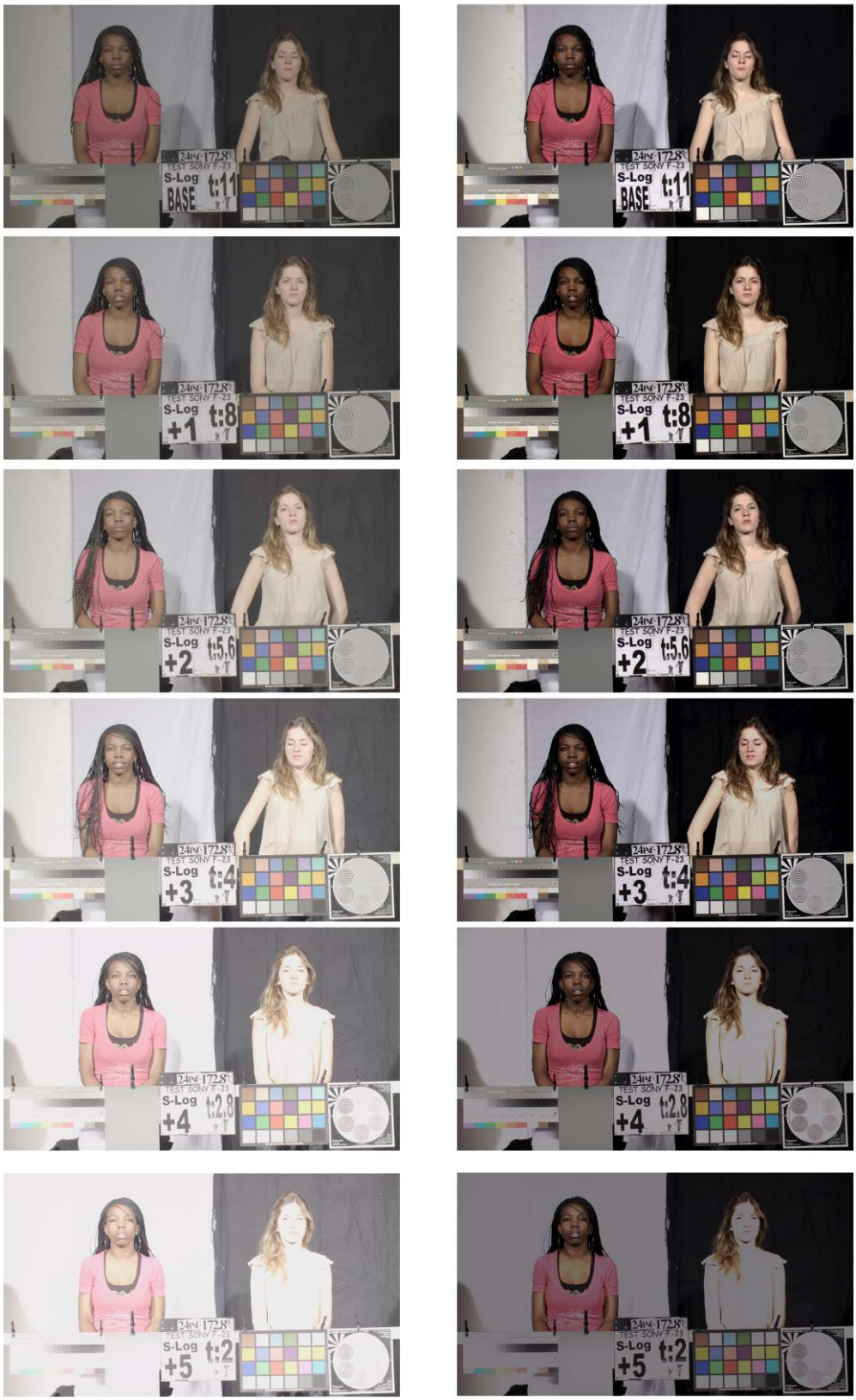
Fotogramas originales de cámara

Original frames from camera



Etalonado a una luz

In the **one light grading process**, this means correcting the S-Log in the same way for all of the exposures, we see that the latitude the camera can deal with is around 7 stops, like the Imatest software indicates, though as we'll see later the camera can register much more detail, up to 12 stops. It is the grading process aim to recover all that information. We didn't observe compression artifacts, or banding .We also see that the camera keeps a good color balance in all the exposures.



Fotogramas originales

Original Frames from camera

Etalonada cada exposición

Overexposed Grading Frames

In the highlights the camera has an improvement over previous Cinealta models,. At 2 stops of overexposure all the detail can be recovered, including the face of the white girl that is 1 stop an a half over the 18% grey (base of the exposure). With 3 stops overexposure we almost recover all the detail though in some areas of Isabel's face there is a small loss in the detail. With 4 stops of overexposure we loose the detail in the white areas though we can still correct quite well the 18% grey, that can no longer be recovered at 5 stops of overexposure.

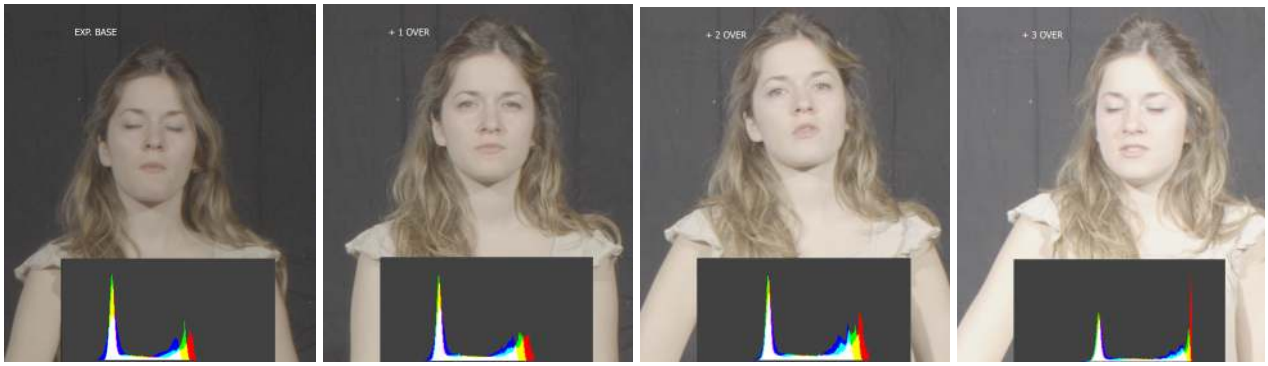
This loss in the white detail is quite soft until clipping effect. From this we understand that the camera can capture up to 4 stops over the base exposure value.

Fotogramas originales

Original Frames from camera

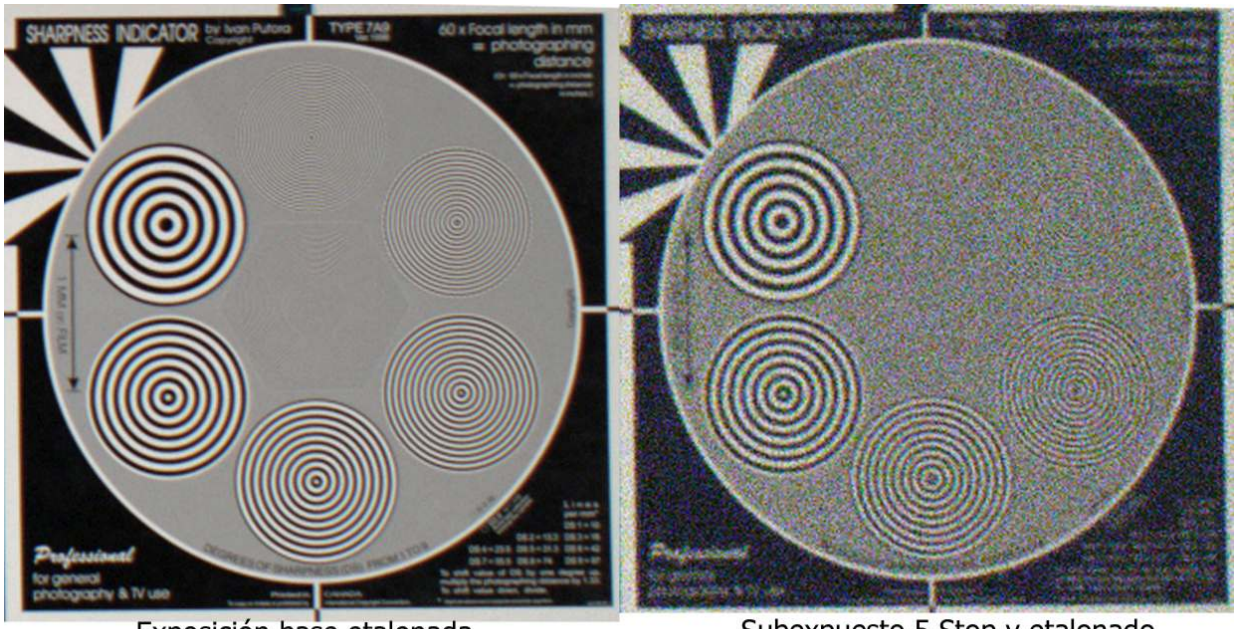
Etalonada cada exposición

Underexposed Grading Frames



Here we show Isabel's face 3 stops overexposed, as we can see in the histogram there is no clipping until 2 stops of overexposure, witch means that with the face 1 ½ stop over the base value we will have detail at more than 3 stops over. With 3 stops of overexposure there is a little clipping specially in the red channel. In postproduction we saw that there´s still some detail that can be recovered though the clip is already visible. In consequence and as we said before, we can consider that the camera can work up to 4 stops over the base middle value capturing all the detail.

If we look at the amount of detail there is in the underexposed images we can check that in the shadows we see up to 7 stops. At 5 stops of underexposure we recover most of the image and with 4 we still can see some texture on the black fabrics that are 3 stops below. This latitude in the shadows has not taking into account the noise generated, that begins to be relevant at 3 stops of underexposure. Nevertheless, the amount of detail the camera can see in the shadows is so amazing that to have a face in semidarkness we can underexpose up to 4 T stops.



Exposición base etalonada.
Aumentado 400%

Grading Base exposure. . Magnified a 400 %

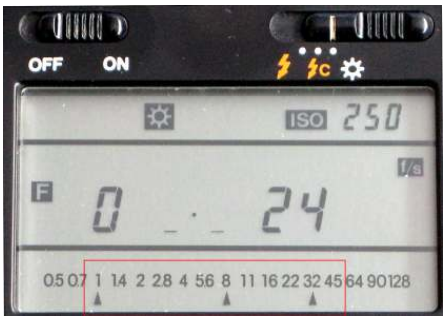
Subexpuesto 5 Stop y etalonado.
Aumentado 400%

Grading frame underexposed 5 stop. Magnified a 400 %

We also can see loss of resolution and sharpness at high levels of underexposure, as we see on this magnified chart.

In general, the camera can reach a latitude of 12 stops, very close to a 35mm camera negative though inversely, this means having more latitude in the shadows than in the highlights. This with no consideration for the latitude in relation to the noise in the image and for the loss in quality it produces.

On the set, as well as the waveform monitor, I used the reflected light exposure meter, adjusting it as you can see on the picture, so I could have instant information about the exposure value of any element on the image and know if it was inside the dynamic range of the camera.
In the overexposed areas as well as in the underexposed the camera keeps a good color balance though at very low graded underexposed images there is a reddish tonality in middle tones and highlights.



Let's see know some frames shot in natural locations.

Digiprime 20mm T5.6. Pola+N1.2 (built in camera).

On this image we see Isabel against a snow background under the sun, with a contrast ratio on the face of 4:1, this is 2 stops of difference. As we can see, with the S-Log curve we have detail in all areas, including texture on the snow.

Digiprime 20mm T5.6. Pola+N1.2 (built in camera)

Here we shot one of the most difficult situations for a camera. The snow is 3 stops over the middle value and Lucrecia´s face is 2 1/3 stops under that value. Again, the S-Log gives a fantastic result, capturing detail in the snow as well as in the face.

Here we see the two images already graded. No masks used. This are the corrections applied:

-Primary correction balancing the camera logarithmic response, to get an inverse curve to the S-Log.
-Exposure reduction (around 2 stops)
-Contrast raise (about a 30%)
-Highlights slightly to magenta.
-Exposure in the middle tones reduced around 30%
-In shadows, everything was raised 1 stop, except the green channel that was raised less than 1 stop. The point at witch we start to affect the shadows was reduced to restrict a little bit the range we affect.
-The saturation was reduced

Digiprime 20mm T:2 Pola+N0.6 (built in camera)

Digiprime 20mm T:2.8 Pola+ N1.2 (built in camera)

Two examples of the work that can be done with the S-Log. On the image above (left) the exposure was for the shadows, this is for Lucrecia, and in the grading process we applied a general reduction in the exposure (-3, in a total range of +/-20) raising the contrast a 30%. We corrected the excess of green in the shadows adding magenta and finally we reduced the middle tones in general. Nevertheless, for the image on the right with Isabel we created a mask to correct the background independently. It must be said that the exposure was adjusted for the highlights, i.e. the river on the background, and that Isabel's face was 2 stops underexposed. The exposure in the background was reduced, giving it more contrast. As we saw in the tests in studio we can recover all the detail at 2 stops of underexposure without loosing quality on the image.

Original from camera *Graded frame*

Digiprime 14mm T :5.6 Filter Pola+N0.6 (built in camera)). Curve S-Log.Wide Gamut. Preset 5.600ºK

Again it can be seen the amount of detail the camera can see in the shadows. For example, the contrast between the alley where the models are walking and the sun on the ground.

Digiprime 14mm T: 5.6 Filters Pola+N0.6 (built in camera).Curve S-Log. Wide Gamut. Preset 5.600ºK

Notice the excellent recover on the sky, with all the color information, been this at 3 ½ stops over the exposure value, as well as the detail in the shadows of the doors.

Digiprime 40mm T:5.6 Filter N 1.2 (built in camera) curve S-log. Wide Gamut. Preset 5.600ºK

On this frame we applied the correction curve for the S-Log and then adjusted the contrast, reserving the very background so we don't loose light there.

Digiprime 10mm T:9.6 N1.2 (built in camera).Curve S-Log. Wide Gamut. Preset 5.600ºK.
The difference between light and shades is by three stop.

Here we show some frames of "A casa da Luz", shot inside the artificial caves in Betanzos, Galicia.

Original frame from camera *Graded Frame*

The frames were recorded with the Optimo HD Zoom and captured via a Cinetal monitor.

These images serve as examples of the excellent behavior of the camera in the underexposed areas:

The image on the left is recorded with the standard ITU gamma curve. Notice the white of the flame as well as the reflections of it on the wax compared with the same areas in the S-Log. The last one looks more natural, with more detail in the skin and more texture in general, especially on the top of the candles.

The light was only generated by the candles.

Lucrecia and Isabel. Digiprime 20mm T.2. Curve S-Log. Wide Gamut. Preset 3200ºK

Shooting "A casa da luz". On the left the original frame of the camera and on the right the corrected image. The difference of light between the sun where the children are and the shadows is around 6 stops. The exposure was mainly for the highlights. You can see the amount of information in the shadows and the detail we still have in the highlights.

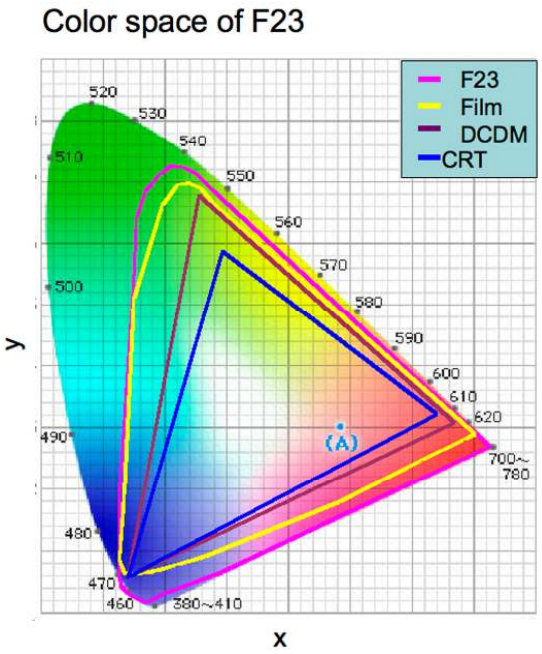
The color

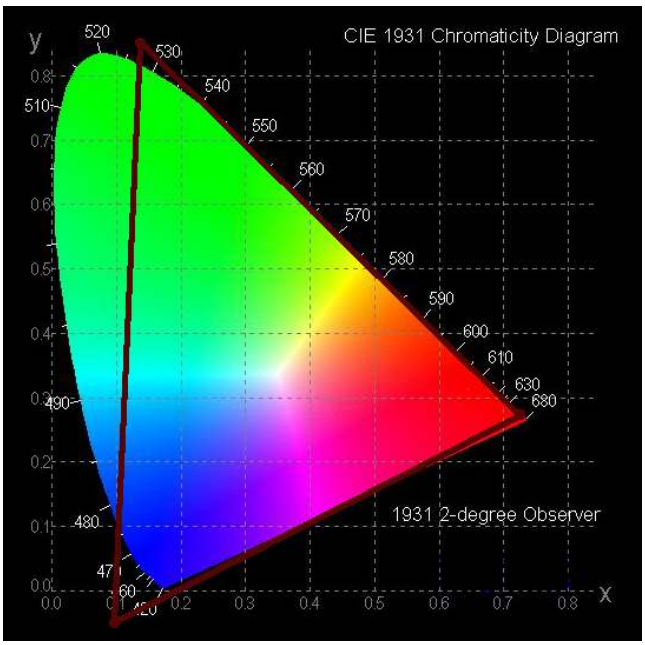
Regarding the color we observed an important improvement compared to previous cameras. The used of 10 bits as well as the RGB 4:4:4 recording gives the image a more natural feeling, richer in shades and with more textures.

The camera can work in three different color spaces: F-900, Wide and DCDM (Digital Cinema Distribution Master)

F-900 Color Space: is the usual HDTV color space (Y,Cb,Cr), defined by the ITU standard. This is the commonly used color space till now and which every postproduction company can work with.

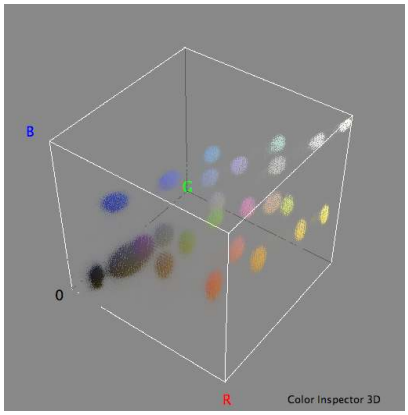
Wide Color Space: this RGB color space expands the capabilities of the camera, thanks to a new Optical Head Block design unique for this camera, to reproduce a wider range of colors. It is recommended for a 35mm film release or any other format able to supply a wide color spectrum



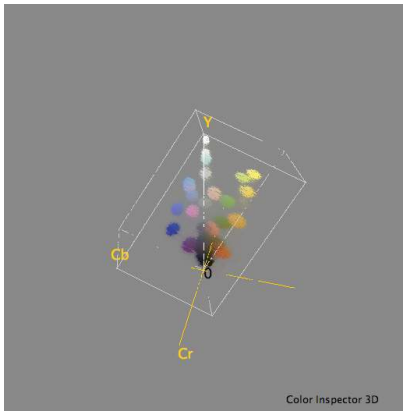


The Wide color space is not clearly defined and so there are various RGB spaces that can be considered as Wide Gamut. For example, we have the ProPhoto space, the Adobe Wide Gamut, and also the one designed by Sony. As we can see on the graphic below the Wide color space use three virtual primary colors (including a negative value for blue) that allow to capture a greater amount of colors inside the visible space. This color space and Adobe Wide Gamut,, even with different RGB values have very similar color spaces and for this reason I used this one for the comparison in the Imatest software. On the graphic (left) we can observe how the F23 can represent, with the Wide color space, more colors than even film emulsion or the digital projection.

A 3D representation let us observe how the Macbeth chart colors are restricted under different color spaces.



RGB color space



HDTV (YcbCr)

YUV

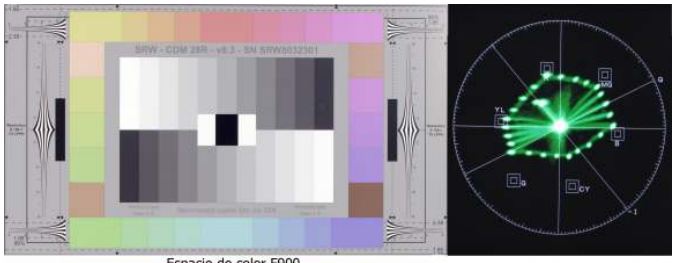
	X	Y
R	0.73	0.28
G	0.14	0.855
B	0.1	-0.05

Virtual RGB values. The values are virtual because they don't represent the real color space captured by the camera but they are used to calculate conversions between different color spaces.

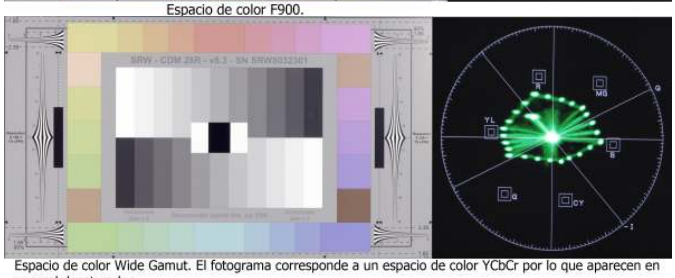
The use of Wide color space brings some difficulties, the first one is the need of monitors and projectors that can handle this color and show all the tones in order to be able to grade the images properly. If we see a wide color space in a conventional monitor the color look desaturated. A issue that will have to be solved with the postproduction team, for example, when we change from one color space to another, for example from Wide to the ITU standard defined for HDTV, is what happen with all the colors that don't fit in the last one? Are these colors converted from the Wide Gamut to another space for HDTV or DVD using a 3D Lut?. All this makes me think that when deciding what color space to use it's necessary to take postproduction and the distribution channels into account.

For solving these problems in advance, we used the new Sony BVM-L230 monitor that includes the possibility to represent the Wide color space during the tests for A casa da Luz in Fotofilm. With this monitor we adjusted both the digital and analog projections till we had a clear idea about how to use this color space in the grading process.

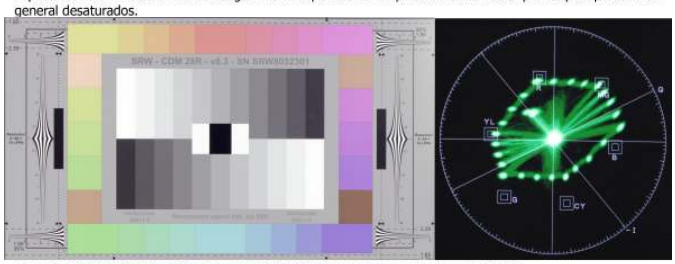
DCDM color space: works under the XYZ color space defined by the DCI. This last color space will be commonly used in the future with the massive implantation of digital projectors in the theaters.
We used the Wide color space since the tests should be transferred to film.



Espacio de color F900.



Espacio de color Wide Gamut. El fotograma corresponde a un espacio de color YCbCr por lo que aparecen en general desaturados.



Espacio de Color DCDM. El fotograma esta visualizado con un espacio de color YCbCr.

On these images we show how confusing it can be to decide what color space to use. Only the F900 color space image is correctly reproduced, both on the image and in the vectorscope (of course without considering the conversion to CMYK for printing). The other two pictures show frames visualized in different color spaces and their image in the vectorscope). It is clear that in the wide color space the colors look desaturated and "converted". In the DCDM color space the magentas are highly saturated compared with the rest of the colors. Which is the true color? How are we going to correct the color in postproduction? For all this, it is very important to determine the color space taking into account the camera, the postproduction and the final distribution the production is aimed to.

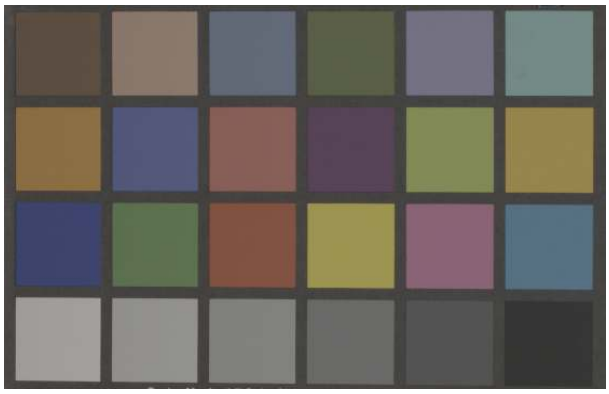
Of course, nowadays most movies end up in 35mm projection, HD video and even in digital projection format. Therefore, it seems best thing to do is to use the same color space for all the formats verifying, on each case, the 3D Luts that convert one space into another to go as closer as possible to the colors we want for our image.

For the shooting of "A casa da Luz" we used the Wide color space and we observed both the color richness the camera offers and the possibility to make extreme corrections, like in some parts of the film, where starting from the application of Technicolor (three negatives) we saturated and modified the color to get a intense and highly saturated look.

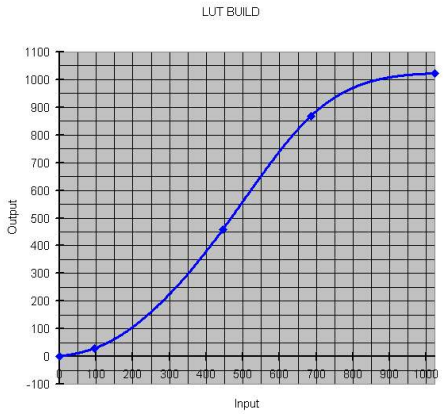
Evaluation of the color with the Macbeth color chart.

We corrected the original camera image using the Digital Praxis DPX curve an then adjusted the exposure automatically in CS Bridge working in the Wide Gamut color space. That uses RGB, 450, 525 and 700 microns as primaries, a white D50 (5000K) and gamma 2.2

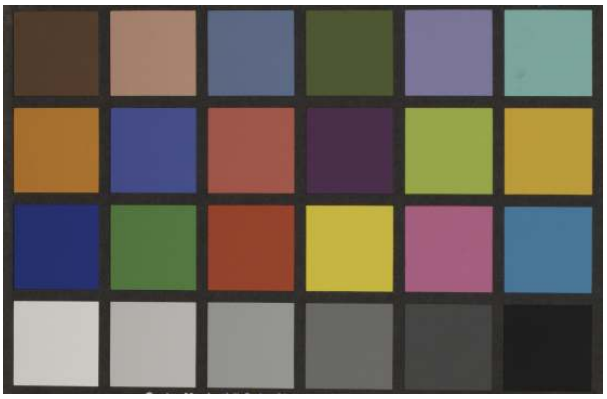
The process we followed is not very different from the one we apply in postproduction: first we corrected the LOG images with a given curve and then we graded the result by adjusting levels and color balance. Therefore, we consider that this test can be used as a good starting point for any adjustments anyone wants to check for each production.



Original frame from camera. Curva S-Log. Dynamic Range: Ext. Wide. Camera in Preset.(CineMode)



Curve Cineon/Dpx de Digital Praxis.



Frame of the Chart with the curve of DP applied.

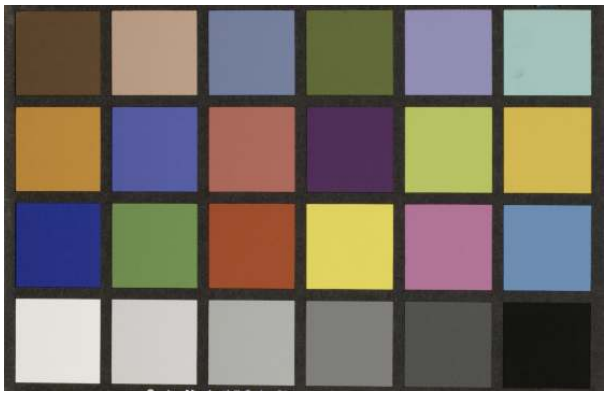
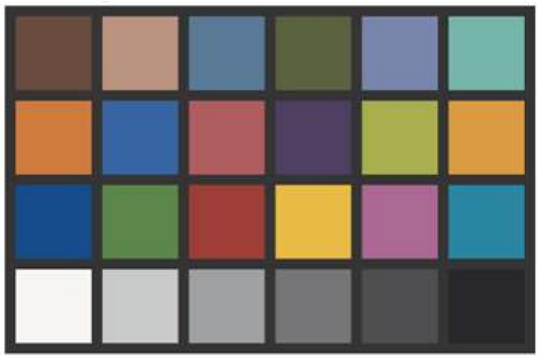
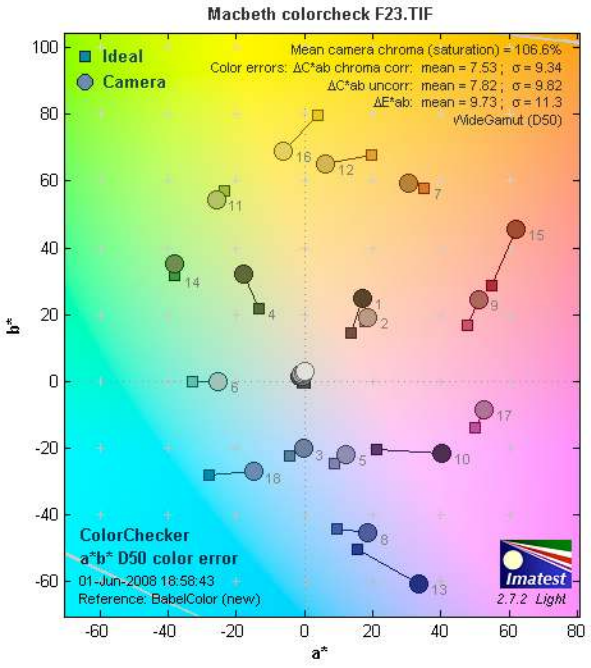


Image of the chart with the correction of exposition in Bridge CS3

Once the chart was adjusted as we detailed, we analyzed it with the Imatest analysis software. The software uses LB values transformed to RGB changing the illuminant to 6500 according to the Bradford transformations (for detailed information see www.babelcolor.com).



1. dark skin	2. light skin	3. blue sky	4. foliage	5. blue flower	6. bluish green
7. orange	8. purplish blue	9. moderate red	10. purple	11. yellow green	12. orange yellow
13. blue	14. green	15. red	16. yellow	17. magenta	18. cyan
19. white (.05)	20. neutral 8 (.23)	21. neutral 6.5 (.44)	22. neutral 5 (.70)	23. neutral 3.5 (1.05)	24. black (1.50)



The sigma value (RMS) is a magnitude that evaluates the drift of the colors photographed by the camera from the "ideal" values. In our case the sigma value, correcting the saturation, is a average drift of 9.34 or 7,53 that we can consider as a normal/good reproduction.

The blue tones:

All colors have a small drift to magenta, specially the deep blue tones. In the case of the blue (13) it has also a higher color saturation. The color number 3 that corresponds to the blue of the sky practically matches the ideal value though is lighter than it.

This means you will need to slightly darken the sky (for example with the use of a polarize filter) to obtain a more appropriate tone.

On the outdoors shots we observe a light purple tone (magenta) in the sky.

In the patch number 10 (purple) we clearly see a drift to magenta. Definitively, the deep blue and purple tones have a higher drift to magenta than the reference.

The rest of the blue tones also have a drift to magenta though in the light blues is less noticeable. The camera tends to reproduce lighter middle blues.

The Green tones:

In general the green tones photographed by the camera are very close to the reference values. The patch number 14 matches ideally though is a little bit lighter than the reference. The patch number 4, that corresponds to the forest green, is slightly more saturated though darker than the reference. The yellow/green (11) matches in the ideal tone with just a little luminosity difference.

The green tones fit pretty well in the reference values and in general they show more saturation and Luminosity compared to then.

In general the Yellow and Orange tones show less saturation and a little bit less of red.

The Red tones show more saturation and are slightly warmer and lighter than the reference.

Finally,, the skin tones are very close to the ideal value, though in the dark skin tones there is a higher saturation. We checked that for Lucrecia (the dark skin model) who looked better with a slight desaturation, unlike Isabel (the white skin model) who needed a small exposure reduction to maintain a natural skin tone.

In general we can say that the camera, under the indicated conditions, tend to slightly saturate the red tones and maintain the normal look in the green tones. The blue and purple tones show a drift to magenta.

It must be said that this evaluations are mere references that refer to the way the camera is set up. Any modification in the parameters of the camera, as well as modifications in the reference values of the color space will mean different results. There must be also took into account that much of the manufacturers modify the color representation in order to then to look more natural or intense, without consideration for the "ideal" colors.

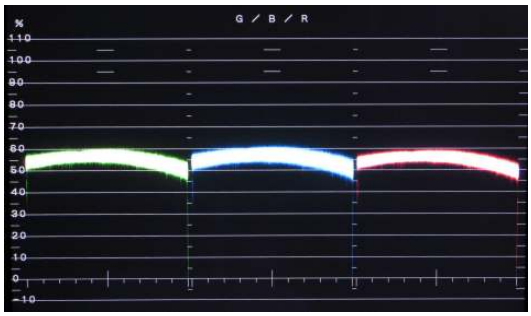
Anyway, this test, along with the tests shot outdoors, is so useful as a real evaluation of the camera's color rendition and performance.

I observed that the use of a Polarize filter to accentuate the color (specially on the sky) and a IR filter to minimize the magenta diversion (specially in the shadows) makes the colors look cleaner. Also a small underexposure (adjusting the camera at 320 Asa instead of 250 Asa) helps for a good color rendition.

It's interesting to test a little saturation of the yellow/orange tones and a little desaturation of the red tones with the Multimatrix. At the same time, it's possible to slightly correct the blue to cyan and so eliminate some magenta.

We understand that these modifications are aimed to reach more natural colors in camera though much of this adjustments can be done during the postproduction stage.

We also analyzed the quality of the camera filters as well as the Preset 5600 (or Daylight). We saw that at Preset the quality of the image doesn't change, specially, we didn't observe an increase in the noise. The use of the camera CC filters perfectly balances the color temperature as we show on this picture. The neutral density filters act like the external filters. We also observed that shooting outdoors and with the use of high neutral density filters, the IR built in the camera filter is not enough to completely absorb the infrared light spectrum so it's recommended to use a filter (Schneider True IR or similar) for a good color reproduction, specially in the shadows.

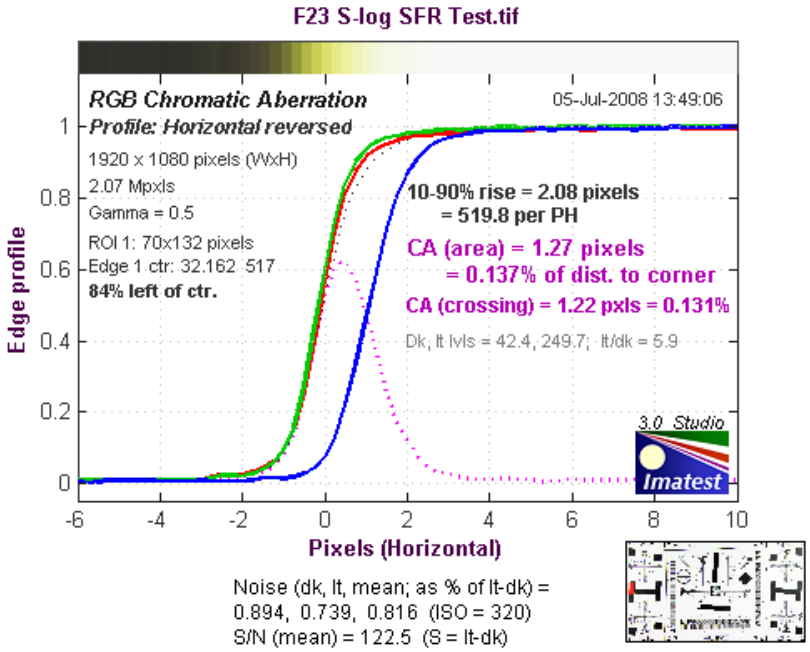


A white background under 5600ºk HMI lighting properly corrected. We shooted it with Preset 5600k. Observe the perfect RGB color balance.

Consequently, for outdoor shooting I used the camera filters, understanding that, as we know, it's better to filter from the back of the lens and not from the front, specially with 3 ccd´s cameras with dicroic filter block and backfocus adjustment.

Again we observed the chromatic aberrations produced by the lens-optical head block set. In certain situations the bordering line in all profiles of the image (in our case Cyan/Red) is more noticeable depending on the lens and the camera configuration (for example, activating the Matrix and increasing the saturation can accentuate the effect).

It is clear that the higher the resolution and sharpness of the camera, as well as the color depth, the more visible these aberrations are. In any case, some of these chromatic aberrations can be corrected in postproduction with the appropriate filter.



Evaluation of the chromatic aberration with the F23 camera and the Optimo HD zoom. According to the Imatest software it can be considered as a moderate aberration. Nevertheless, this aberration can be clearly noticeable when projected on a big screen. See the two following frames as an example.

On these two images (300% magnified) we show the chromatic aberration. On the image on the left the aberration corresponds to the camera with a Digiprime lens 20mm and increased by a Multimatrix adjustment to accentuate the saturation, (without this modification the aberration is much less noticeable). On the image on the right, with the Optimo Hd zoom, the chromatic aberration can be observed on the white post.

Now we show the corrected frames of the models with the Macbeth chart, where we can see the better skin tone, more natural and with better color balance under different contrast ratios.

The camera maintains a good skin tone color reproduction even with a 8:1 contrast ratio, (this means a difference of 3 stops between the key light and the fill light), with no black clipping nor lack of color information posterization, even in the dark skin tone model, maintaining a very natural feeling in general.
The skin tones in the Macbeth color chart doesn't show any important drift as we saw before, matching to the original color.

As we said before, the S-Log needs for a precise grading process to obtain all the detail it can give and maintain a good color balance on the different tones.

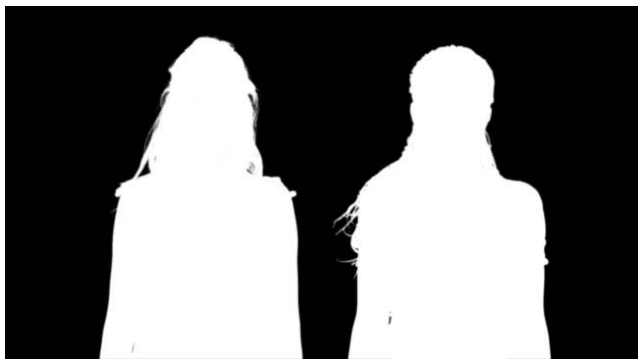
Digiprime 40mm T:4 Filters:Pola+N0.6 (built in camera)+Classic Soft 1/2. Curve S-Log WideGamut.

Digiprime 10mm T:9.6 N 1.2 (built in camera).Curve S-Log. Wide Gamut. Preset 5.600ºK.

The Chroma keys:

We also made some green screen work and we observed that the "Mate" can be easily selected. The grain in the image looks similar to a 35mm scanned at 2K resolution and in general we observed low noise. Also the green contamination in the edges was easy to clean. Composition was made in linear mode.

Setting up a blue screen shot for "A casa da Luz"



On these two images we show the chroma key process. The matte of the original frame, the background and the final result. There is a substantial improve compared to the F900 camera when doing special effects work.

On certain FX shots of "A casa da luz" we used the possibility of the camera to shoot at 60fps (in 4:4:4 mode) and also changing the shutter angle to get more information and sharpness in the movements against the green screen. Another feature that helps in the FX work is the possibility for the camera to mix both, the recorded image with the live camera image. This helps to correct movements and to fit different shuts that must have similar frames.

Daily work with Sony F23

Por Saúl Oliveira

Now we are going to detail some practical considerations of the 2 months daily work with the camera of shooting "A casa da luz" in various conditions including rain, dust, cold and humidity.

In general it is not difficult to learn to work with the camera if we understand the system. The necessary adjustments are reduced and simplified, but it'll be necessary to know some menus in the F23 as well as the operation of the SRW-1. This means that the Dop can decide not to makes any gamma or color changes on set, but for the most basic features, like format change, a minimum knowledge of the menus it's necessary.

Though it is a easier than previous Hd models, we understand that for most of the camera crews it would be useful to have a quick guide for the adjustments they will require on set.

The normal equipment on set compared to a film camera is reduced in the absence of magazines and film stock, though it is still necessary to have at least a medium size truck for the camera stuff, been insufficient the typical vans used with lighter video equipments. Compared to the typical video equipment, there is a considerable increase of weight, numerous lenses and accessories as well as heavy batteries.

The camera is notably heavy, similar to a 35mm camera like Arriflex 535. Normally 2 assistants are needed for operation and transport, especially with long heavy lenses like Cooke S4 or Angenieux Optimo.

The L handle gives a big surface to hold and transport the camera. It is located on the top right side of the body so the weight is not balance when you grab it but it's still indispensable for any movement. For mounting and dismounting it you can used one of the two Allen keys located on the back of the Riser Plate(base plate the camera always have attached to the bottom of the body), pan the camera to the floor and you'll see them. There is a simple handle that can be mounted on the top or rear connector port (the one the SRW-1 leaves unused) and that gives a good top surface to hold and manipulate the camera. The free connector port must be occupied by the Interface Box in order to have the Dual Link output, so the simple handle can not be mounted if the SRW-1 and the Interface box are mounted. This could be solved in the camera body would provide a Dual Link output..

The handle in L hinders the connection Dual Link

In addiction, if the Interface Box is on top (the most common place for it, bearing in mind that the SRW-1 is better located on the rear for weight balance, comfort and aesthetics considerations), the L handle hinder to connect the dual link cables because it almost covers the bnc connectors.

Back to the base plate, called **Riser plate**, on the sides of it you can find various screw points, one of them with the focal plane mark. On the camera top you'll find a measure hook for the camera assistant, this hook can be unscrew from there and screwed in the base plate. It would be better to have two of them, and even a third one on the L handle.

Pivot to mark the focal plane and gadget on the camera for holding the decameter.

Though is not recommended for the camera operator to hold the camera from the vtr as with film camera from the magazine, we found no problems in the camera-vtr junction and it can be use as a grasp point to operate some shots.

The external menu display panel allows a similar control as a typical film camera, It has 8 simple menu pages.

If we don't make any special changes in the camera menus on set, after configuring the camera in the preparation days, all necessary adjustments can be controled just with the external display menu.

Also, it would be very helpful is operator can customize one of the pages to include the more used items like Frame Rate, shutter, gain, gamma curve, recording format… all in one page in order to be able to know the most basic and important state of the camera at a glance. This could mean a bigger display.

They also provide a remote control for short distance, the **Assistant Panel**, that normally will be positioned on the right side of the camera in order to have there the same controls the body has on the left side. The Assistant Panel is provided with a short cable (approximately 1.5m) not enough for remote control on a crane; nevertheless, for this purpose we can use the typical Sony RCU.

Be careful with the clip that mounts the Assistant Panel on the L handle because it can become fragile with the use.

Note for the assistants: it's easy, while mounting the Assistant panel, to push the assignable buttoms of it by mistake; if they are configured to control the internal camera filters it can result in a serious confussion.

The new **C35 viewfinder** still have the disadvantage it can't be mounted on the right side of the camera. It's body is bigger than the previous C30 model and so a little bit more cumbersome to manipulate, for a bigger lcd screen, though it would be more interesting to have a 1080 resolution. We understand there are third party accessories that will allow us to put the viewfinder on the right side as well as at a closer position to the operator, working as a viewfinder extension, but this is not supplied with the camera. Also it has no eyepiece heater, so essential on the cinematographic sets.

The assistant monitors have always been of great help, with no need for a very high quality. The camera body has 2 viewfinder outputs but it doesn't have two points for mounting then. It would be very useful to have an assistant mini monitor that could be plugged to that second viewfinder output and from witch it could get image and power supply.

The camera filters are now electronic controlled. It's very comfortable to have a CAP position that covers the light pass to the ccd´s and that activates automatically when you run the auto black balance. There are 5 filters of each type now (color and neutral density) compared to the 4 of previous cameras. The external info label that indicates the actual filters in use has the same inconvenient as previous cameras: on the color correction filters what it shows is only valid when the camera is working in Preset 3200ºK (Tungsten). If you adjust the camera for Preset 5600K, forget about the color temperatures of the label. When you change a color filter, the correspondent menu screen in the external menu display shows the color temperature and neutral density filter used. Again, forget about what it says about temperature if you work with Preset 5600K, the camera doesn't take it into account for the indication. For example: The camera in D5600 ON (or DAYLIGHT), camera filter used 3200 . Then the camera working at 5600ºK, while the external label and the filters menu screen shows 3200. Don't let this confused you.

Another inconvenient of the camera filters is that the N3 is located with the color filters, so if you are working with, for example, filter 5600 you can't use the N3 at the same time because they are in the same filter wheel. This could be solved by putting the CAP position in the color filters wheel and the N3 with the neutral density filters.

Anyway, in our opinion, it would be better to have only some well known neutral density filters, the ones commonly used on set (N3,N6,N9 and N1.2);these filters make DoP´s feel more comfortable.

The camera power demand is high. It's necessary to use film style block batteries. The Anton Bauer CINE-VCLX CA are the more appropriate ones. 3 of these for each camera are the minimum. As an example: if you shot at 24,25 or 30 fps, turn off the video outputs you don't need (Maintenance menu Power Save page), turn on the SRW-1 just for when recording (this can be done because the viewfinder and the monitors depend on video outputs from the camera body), and if we are not powering any external devices, you can make one of this to last the whole day.

If we shoot at 60 fps or if we power a remote follow focus or mini monitor from the camera the power consumption raises considerably.

Video style normal small batteries can be used for steadycam configuration, giving a short running time and requiring many of them. To use them on the camera you must have an V mount plate for standard batteries mounted on top of the Interface Box. Having one of these batteries on camera all the time can be useful when the block battery is not yet at the new camera position and the operator wants to start framing right now. Power the camera just with these small batteries is a logistics nightmare, they don't last more than one hour and they fall with no battery end alarm.

Maybe the Vtr could have a power save system, a Save Mode which it just ready to push a bottom and start recording, this would be interesting as the high power requirement of the unit.

We understand the most interesting target is to reduce the overall consumption.

We didn't observe serious problems in the daily work with the camera, neither power nor collimation problems nor electronic instability in general, but of course, having the proper batteries and accessories for a cinematographic shooting.

Workflow on set for a feature film "A casa da luz"

All the common film accessories were used, O´connor 2575 fluid head, Arri FF-4 Follow Focus, Arri 6x6 Matebox, Chroszield fluid zoom drive,…

We powered the camera with Anton Bauer Cine VCLX CA batteries, that with our configuration the consume was around 1 ½ batteries per day; this means, like a film camera, so we didn't have to worry for the batteries because they lasted for nearly the whole day. These batteries are the same size as the common ones used with film so you can use them on a crane, tripod, etc… same configuration. The inconvenient they have is the lack of longer battery cables for big cranes and the fact that to see the image on the viewfinder the camera must be turned On, unlike a film camera, so the battery must reach the new camera position as soon as possible.

We always recorded in RGB 444, always installed on the camera so we always had the Dual Link connection that allowed us to watch the 444 signal. The only cable attached to the camera was a cable hose with 3 bnc lines inside, 2 of them used for the dual link transport and the third one for the down converter to Pal (output from the camera as a standard feature). That cable hose can be quite long, 50 meters and more with no problems.

On the monitor side we had a Magliner cart where we had a Cinetal monitor, capable not only of showing the RGB 444 signal, but also can capture frames at full resolution in DPX, TIFF and JPEG formats, and also it can load custom designed Luts in order to see the final look of the image on the set.

In our case, the routine was to capture one frame for each shot and store then in a USB pen drive on TIFF format, these frames were downloaded to a laptop and organized right there in folders properly named as scenes. At the same time, close to the Cinetal we had a Mac Book Pro with different image treatment software, the most important one the Iridas Speed Grade On set. The frames captured with the monitor can be graded on Iridas.

Cine-Tal Monitor y video assit

We connected the laptop directly to the Cinetal Monitor via an Ethernet cable, the software is fully compatible with the monitor and can capture frames directly, grade then and send the Lut back to the monitor witch loads it quickly. This is a great tool for on set correction the DoP use. Our Luts to load in the monitor that were, previously configured by the colorist of the movie and the DoP in the Lab. The communication between the laboratory and the production flowed well by sending frames and Luts in both directions during the production.

As we said, the third bnc in the cable hose was used to send down converted Pal image from camera to a Mini Dv Sony shell recorder also located on the monitor cart and that worked as the video assist system.

The whole cart was always inside a Village Blackout Tend, black inside and white outside that ensures a good viewing condition for the monitor and also that it can be mounted by one person in 30 seconds and can stand wind and rain with no problems.

As we can see in the following pictures, we used different camera configurations depending on the needs on set.

On the left, F23 with zeiss Digiprime lenses on Steady Cam operated by Raul Manchado. Below, the camera with the SRW-1 mounted on top for a very low shot with a 5mm Digiprime lens. On the next picture, the typical configuration during the shot with the SRW-1 mounted on the rear and with the Optimo HD Zoom lens.

After the test and after shooting "A casa da luz" for 7 weeks, in my opinion, the F23 has given an excellent result, regarding latitude, texture, color and practical considerations. Nevertheless, I'm going to detail what we liked most and what we didn't like so much:

We like……	**We don't like so much….**
-The **extended dynamic range** of the camera. What give us more flexibility to capture better high contrast scenes. The latitude can be established in around 10 stops. -The best color reproduction, more shades and more natural colors. -**Higher color depth**, that helps a lot in chroma key work and digital effects. -**Better resolution** than it's predecessors, this means a considerable help when working with digital effects. The resolution can be established between 700 and 800 LpH, similar to a positive projected on big screen. -The way the detail disappear both in the shadows and in the highlights is soft, and we don't observe excessive clipping till extreme overexposures and underexposures. - An important improvement in the way it reproduces **the textures**. -A more cinematographic look, with a simple operation of the parameters we Dop´s need. -Also it is a very solid and robust camera, specially noticeable is the **robustness of the lens** mount. -The **recording system is reliable**, stable and clearly established among the postproduction companies.	-The optical problems always generated by the lens-optical head block set (**chromatic aberrations**) -The **electronic viewfinder**, Achilles' heel of the camera, though has a good quality it is still not enough to evaluate the image. Specially is still bothering not been able to see image outside the actual recorded frame, as well as an insufficient resolution, detail and color response. The lenses in the eyepiece are also very poor. As a DoP that operates the camera I found it very uncomfortable to work with this viewfinder. -Not been able to **load custom LUTS** directly in the camera via Ethernet. We miss some device like a gamma (Luther) box. -The in camera **IR filter** is insufficient for certain outdoors filtering conditions. -An **excessive weight** that makes it difficult to handle, specially for handle camera shots. -A **high noise level** in the blue channel comparing to the other two, noise that becomes excessive in the underexposures.

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