

Dynamic testing

In the first of a new round of comparison tests of high-end cameras, Geoff Boyle heads off to Shepperton Studios to assess the dynamic range of the first batch of cameras.

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On a rainy Saturday at Shepperton Studios, and with the help and support of Axis Post, around 100 cinematographers and DITs gathered for the first part of a series of tests of the high-end cameras currently on the market. Various film stocks were tested for comparison, and eventually I shall include all the cameras with 2/3in chips or greater, but as yet they are incomplete, because we don't yet have the film scans to compare them with and because I still have to test the Dalsa Origin, Panavision Genesis and the Silicon Imaging SI Mini. So just look at these as interim results – the story so far. But before I go any further, I'd like to thank all the ACs who gave their time to help with these tests, cheers guys. Of course, these test do cost the CML a bit of money in terms of food and drink, and so on, so if there are any suppliers out there who'd like to sponsor the refreshments at future events, by all means make contact :-)

The cameras we did test down at Shepperton were: the Arri D-20 in normal and extended modes; the Grass Valley Viper (with and without magenta filter); the Sony F950; the Sony F900R, and the Panasonic Varicam. All cameras were fitted with Zeiss lenses for consistency.

As many of you will know, these camera represent the top of the range digital cameras from each manufacturer. All have been used to shoot at least some indie features, and in the case of at least some of the cameras, big budget movies too.

What we were looking at in these particular tests was dynamic range – how much detail you can retain in both the highlights and the shadows, as well as the sensitivity of the various cameras/chips.

Sensitivity

First an overall view. We used the VFX chart from DSC Labs for the tests. For each camera, the chart was lit to both T2 and T22 at an ISO of 320. First of all, with the chart lit to T2, a series of exposures was made at half stop intervals, all the way down to T22. Next, with the chart lit to T22, a second series of exposures was made at half stop intervals up to T2. All the charts are clearly identified with base stop and exposed stop. All the film was shot the same way, but then scanned on a variety of scanners; once again these are clearly identified – well they will be once we finish scanning the film negs!

The graphs chart the 8-bit readings of the 18 per cent grey section of the chart. Being 8-bit, these have possible values of 0-255, although some cameras are limited to a slightly smaller, TV safe range.

The area in the 100-150 range of chart 1 is the mid-grey region. If the middle of the camera's exposure curve lies near the centre of the 100-150 area, then the camera or stock has a sensitivity of ISO 320.

However, if the centre of the curve is a stop to the right (plus one stop), then the ISO is 160. If it is one stop to the left (minus one stop), then it is ISO 640. The plus/minus relate to the exposure relative to the ISO 320 'normal' rating.

The values at Base T22 exposed at T22 and Base T2 exposed at T2 are 'normal' (the area marked 'correct exposure' at ISO 320). Interestingly, although my Minolta Flashmeter IV indicated that these two exposures were identical, in reality they're not. That's why I've included both. For those of you who have difficulty reading charts, the results for the various cameras appear to show (approximately):

- Sony F900R is 400-500 ISO;
- Sony F950 is 320 ISO;
- 'Normal' Viper is 320 ISO;
- Panasonic Varicam is 250 ISO;
- Viper with CC30M is 160 ISO;

- D-20 is 125 ISO in either mode.

These results are pretty much as expected, with the exception of the Varicam, which I would have figured to be much more sensitive. I therefore need to double-check these results.

Specific results

So far so good. But there are a few surprises, let's look at a chart (chart 2, above) comparing the Arri D-20, Sony F900R (loaded with the digital Praxis cine log gamma curve) and the Grass Valley Viper. The chart shows the values after we have compensated for the different sensitivities of the cameras.

Apart from the hump in the skin-tone region of the D-20 curve, there isn't a lot of difference in the response curves of the three cameras. This was a surprise, although bearing in mind this is exactly what the Digital Praxis gamma curves were meant to do for the F900R, I guess we shouldn't be surprised!

However, the curves don't tell the full story; they ignore the vital component of noise, and this is where the stretching of the F900R shows a little – in noisier shadows. Having said that, I think that the F900R has come a long way since it was first introduced, and the only thing holding it back now is the HDCAM recorder. Can we have an HDCAM SR version please (you'll get an F23 soon enough! – Steve)?

I've always felt that the D-20 had really nice mid to upper mid greys and maybe that hump explains why. Or maybe not, as the D-20 was in linear mode, whereas the other two were in Log!

The Viper filter debate

Now for the real shock for me: the Viper 'with or without magenta filter' debate. When the Viper was introduced in 2002 – and bear in mind that I shot the launch footage – Thomson recommended that no filters should be used in any situation. From my own testing, I quickly established that, like film, the Viper benefited from an 85B filter in daylight, but I was never able to conclusively show whether Magenta CC filters worked or not. Oh, they definitely made things better for people viewing the camera output, but did they benefit the recordings?

I did tests for the greenscreen of *Mutant Chronicles*, and the best keys came from unfiltered shots, so that's how we shot, bearing in mind that we were using super green 525 Kino tubes to light the screen, and this could have been a major factor.

So, we get to Shepperton and we test with and without CC30 Magenta filters. The results on the monitors certainly looked nicer with the filter, but did it improve the response of the camera? Well no, in fact it clipped half a stop earlier than without the filter.

In the chart (chart 3) you can clearly see that the unfiltered image straight lines at the top of the curve. This is because it clipped in the green before it clipped in the other two channels, but I logged the data until it clipped in all three. With the filtered image they all clipped at pretty much the same point.

Aha! You say, but that means that the unfiltered signal's extra highlight detail is colour distorted and therefore useless. Well no, I can always correct the very top end back to mono if I want and I'll still have some detail in there, whereas with the filtered image I'll have nothing! This is really not what I expected.

Also, think about some of the situations where you may be hitting the peaks, flames, explosions, etc. OK, I've been shooting a lot of these recently, but there's not a lot of green info there, and in the case of the candles, I really don't want to lose a stop with a magenta filter anyway. Oh no! Don't tell me! The manufacturer got it right!

Another really impressive thing for me was how close the F900R with the cinelog curves came to the Viper. Now OK, I'm only looking at the green channel here but it is none the less impressive. The big factor with all of these cameras is that, although the results can look great on paper like this, the reality is somewhat different, how do they survive with 25 frames per second? What will that show? In most cases the answer is noise in the shadows. And this is another crucial factor for us to look at.

Anyway, these are my initial thoughts on the tests. I shall carry out tests on the Genesis, SI-2K and Origin as soon as is practical, and I'll also have the results of the film tests. There'll also be some additional tests being carried out at NAB this year, so there's plenty more to come.

Extra copy

The post perspective

Axis Post's Steve Shaw gives his take on the tests

The idea behind the CML/Axis Post camera test day goes back to Geoff Boyle and the camera tests he has performed a number of times previously. However, this time Axis Post and sister company, Axis Films, were available to provide a selection of additional cameras to play with within a studio environment, along with knowledgeable users and operators, as well as enabling Geoff to organise the actual latitude tests, this time hooked up to Axis Post's iQ Pablo and D-Cinema projector, with the live output of the cameras being monitored on the big screen, while the Pablo captured the images in fully uncompressed form.

Therefore, Axis Films set up a varied range of cameras in Shepperton Studio's E-Stage, allowing the operators and cinematographers who attended unfettered access to cameras they may not have previously had access to, with a selection of qualified and knowledgeable camera technicians there to answer question and setup the cameras for various live tests and general playing. Over at Axis Post we had the iQ Pablo patched into a second room for the latitude camera tests, where each camera in turn was put through its paces, and the images seen and recorded onto the Pablo. After recording, we could quickly compare the results side-by-side on the big screen! All very interesting...

The latitude tests are performed to Geoff's recipe, and attempt to show the full dynamic range of the camera in incremental exposure steps.

Without getting into the specifics of camera rating, illumination and stop values to run these tests, there are a number of things that stand out immediately from what we were seeing on the iQ Pablo and the big screen, the most obvious difference being that even though the cameras were rated to have the same mid exposure, none were actually the same, giving different 'correct' mid exposure positions, and making their relative under- and over-exposure capabilities difficult to compare accurately.

We also saw some very strange results when compared to the manufacturer's information. The most obvious was with the Arri D-20, which we were not allowed to test in LOG mode – either of them. The second D-20 issue was with its two LIN modes – normal and extended range. To me, extended range means increasing the captured dynamic range, and so we were obliged to test the camera twice; once in each mode. However, the outcome of these two tests was that the two modes simply map the captured dynamic range to either the full dual link output data range (3-1019) or to the single link's data range (64-940). The captured range is identical! The second surprise was with the F950, which when used with a CVP Gamma Curve, as is the best way to gain the most out of the CineAlta cameras, its data output is limited to 64-940. Without a CVP Gamma Curve the output is the full Dual Link 3-1019, as you would expect. Weird; and I can't find reference to this in the user's manual...

From a post-production perspective, the Viper came out on top, with the best overall latitude for later colour correction, with or without a magenta filter aimed at better balancing the RGB colour levels.

The D20 was very clean, but ran out of shadow detail so quickly as to severely limit later post-production grading. The F900R with Digital Praxis Gamma Curve looked much as previous F900/3 I've worked with. The f950 seemed to match the F900R, which I guess makes some sense as its output was limited to the same data levels as the single link F900R. The surprise to me was how well the Varicam in film rec mode seemed to cope with over- and underexposure.

As I write this, I have not had access to the film tests, nor the Genesis or Dalsa Origin, but I will be very interested to see how they compare. However, my personal reaction to these tests is that they are very 'technical', but actually don't tell the full story.

In the real world, high latitude actually matters most when the scene you are shooting contains deep shadows and bright highlights simultaneously, and these test do little to tell how the cameras will react under such conditions. And then there is the need to understand how well a camera can see into shadows and have the image it sees as usable. My previous tests with the D-20, for example, seem to suggest that it reaches a 'knee point' with illumination/shadow detail, below which the level of noise becomes too great to be of any use. This is probably why we were told to test the D-20 in LIN mode only.

One of my personal favourite tests is to take a high dynamic range image, view it through a 'print' LUT, grade it for nominal exposure and then see how much detail I can 'bring back' within the shadows and highlights. This tells a lot about the capabilities of a given camera. As a result, Axis Post, Axis Film and the CML will be getting together again in the near future to run a serious of 'real life tests', where scenes will be setup to test the cameras when shooting wide dynamic range scenes within a single frame. Watch this space for the invites.



Geoff Boyle

Reel Show cinematography editor Geoff Boyle's recent feature films as director of photography include *The Mutant Chronicles*, *Dark Country* and, currently, *Street Fighter 2*. He received his first camera, a Brownie 127, when he was eight. From then on the future was clear. After art school in the late 60s, he worked as a stills assistant. One day he was asked if he knew anyone who could film a concert. Of course he did! He moved into film and shot documentaries for TV, 10 years or so of 20/20 for ABC and a lot of music videos. In 1985 he shot a 'making of' about the Pirelli calendar. Terence Donovan liked the way he lit and asked him if he shot commercials. From 1990 to 2005, he has shot almost entirely commercials, with occasional sidetrips into drama, a short he shot – *About A Girl* – winning a BAFTA in 2001. He also shot special effects on *Enemy at the Gates*, won the SMPTE Eastman Gold medal in 2000 and was made a fellow of the BKSTS that year. He started the cinematography mailing list (CML) in 1996 with 60 members. It now has over 3,000 members in 148 countries and is acknowledged as the pre-eminent internet site for cinematography.