

# Hi-spec shoot-out

Geoff Boyle heads out to Cinegear in LA to witness a test of the three new Digital Cinema cameras – the Arri D-20, the Dalsa Origin and the Panavision Genesis.

Article first published: Autumn 2005



There are big changes happening in the world of digital moving picture cameras. The main thrust of this change is towards the use of single chips, instead of three chips and a prism system; the advantage of this being that it enables designers to make cameras that can use the entire range of existing motion picture lenses. It also opens up the welcome possibility of optical viewfinders.

This means that, with the addition of on-board uncompressed recorders such as the Thomson Venom, we face the exciting prospect of cameras that those of us familiar with a filmic way of working can use without any change to our working practices. And as these new cameras are all 2K at least and 4:4:4 (no chroma or luma compression), it's much easier to make the switch to digital cinema production.

It's interesting to see the different directions that manufacturers have taken. Arri, with its D-20, has elected to take a known film camera and chop off the mechanical bits that pull film and replace them with a digital sensor and the electronics required for processing the images. Anyone familiar with an Arri 35mm camera will feel totally at home with this and will require zero acclimatization time, as it uses all the lenses and accessories that they are used to in the way that they are used to using them. The D-20 uses a CMOS 3Kx2K pixel chip, which after de-Bayering produces an image of 1920x1080. This can be recorded to a number of devices, but as Arri has an agreement with Thomson about the use of the Venom, the logical approach is to record uncompressed to this.

Dalsa with its Origin has started from the ground up. As Dalsa is a chip manufacturer, it obviously has a huge advantage here. The Origin uses a 4Kx3K CCD chip which, because of the way it responds and its unique processing method, produces an image – according to Dalsa – that is 4Kx3K (more on this later).

Like Arri, Dalsa has gone for an optical viewfinder, in this case from P+S Technik. The camera takes regular 35mm lenses and accessories, but records onto a custom hard disk system, as there is nothing else that can cope with the amount of data the camera produces. This recorded signal needs digital processing to produce an image you can use. Panavision with the Genesis has trodden a different route again. While it uses a single chip, it doesn't use Bayer patterning, but rather a pattern of its own. The chip is made by Sony, as are the camera electronics, which are basically a modified Sony 950. Unlike Dalsa and Arri, Panavision has opted against an optical viewfinder, but offers a range of electronic finders, including the Accuscene. Physically, it is much like current Panavision film cameras and takes all the lenses and accessories that they do. The choice of recorder in this case is an integrated version of the Sony HDCAM SR1, making the Genesis the only one not offering uncompressed recording.

Now we get to the interesting bit, how do they look alongside each other – and just for good measure let's throw in 35mm film?

## Shoot out

As one of the Cinegear-related events, Mole-Richardson Studios hosted a side-by-side comparison of the Arri 435 film camera, Dalsa Origin, Panavision Genesis and the Arri D20. The event was organised by Bill Bennett ASC and lit by Russell Carpenter ASC. The test set-ups were as follows: a model in a soft side-lit situation with lots of shadow references in the background and a Kino 4 bank with graduated layers of ND on it to give a highlight tolerance test. This went to +5.5 stops over mid-grey. This had been altered from the original plan, with an extra layer of ND 3 added overall, as +6.5 was seen by some camera companies to be too much for the digital cameras. The set-up was shot with key light on and off and with both blue and green screens.

The final set-up was the same, but with the model lit by six candles on the table in front of her and candles at various distances behind, lighting the set. Exposure for the first set at EI 400 was T2.8 and for the candle set-up T1.3.

The first camera up was the 435 and a range of stocks was used. The main set was shot with '18 & '29, the screens were shot with '17 and

an additional scene was shot that was effectively a speed ramp from .2fps to 150fps. We watched the images via an SD IVS tap on HD monitors.

Next was the Dalsa, with the same scenes being shot, except for the speed ramp. There was much discussion as to what the EI was, stated as 320 daylight 200 tungsten, with algorithms correcting the difference. When asked if, as the CT was 2,600, shouldn't the camera be rated at 160 (a reasonable question, I thought), the answer was that the algorithms would take care of it.

We then asked if it would be better to optically filter the camera so that the correct CT light hit the sensor (that is, the camera is daylight balanced therefore we thought we should correct), but no, we were told, the algorithms would take care of this.

There was much to and fro'ing on this; we'd been here before with the Viper several years ago and had finally established that to get the best possible latitude you had to correct for the light. Groundhog Day! No, the algorithms would take care of this. When we finally got Lucien the designer to reply he said that of course there were trade-offs and that if we wanted the greatest latitude we would need to filter, thank you.

A VFX person brought up the issue of a 4K Bayer chip not giving 4K, but in fact giving more like 2.8K and we then went down a well trodden route – the algorithms would deal with it. No, they won't, was the audience response – if it isn't there it isn't there. The reply from Alan at Dalsa was that they didn't throw anything away. This response confused the VFX person, who said they hadn't mentioned throwing anything away; what they had said was that it wasn't there in the first place. The reply from Alan was: you can join in the chorus now; we have algorithms that deal with that.

Asked why there was no picture to be seen while we were shooting, we were told that the monitors couldn't show the picture, that a 2K DVI output was available for monitoring but that they hadn't brought it, and that anyway it didn't show what we were getting. Like an SD video tap did show us what we were getting from the film camera. Anyway they had brought with them the only 4:4:4 monitor there.

Next up was the D20. Picture output was monitored at 4.4.4 directly from the camera on one monitor and at 4.2.2 from the output of the HDCam SR1 recorder. I'm not sure about the monitor calibration: it seemed that the differences between the two sources was much more than it should have been; it looked like some kind of gamma correction was applied to the SR1 output. Not much to say really: it worked, output looked flat on the 4.4.4 monitor, as it should, but everything was there.

Panavision's Genesis was next and monitoring was only available via the 4.2.2 output of the SR1 – in this case it was the low contrast flat look I would expect. This was the only camera test that didn't use the Zeiss Master Primes and suffered for it. The lenses were – er, variable; the high-speed lens used for the candle test was not good, but was apparently a 30-year old design. The other two lenses used were fine – the 100mm in particular was sharp as hell.

Again the pictures were as I would expect them, with the exception of the candlelight test, where vertical white streaks, low level, were visible from the flames of the candles. This used to be a problem with CCD cameras, but one that I thought had been fixed years ago.

### Post production

So, on to Laser Pacific. The order of the afternoon showing was altered to fit in with my flight schedule, so this is a good time to thank Bill and everyone who assisted him in producing such a great event. Well worth the late flight from London and the quick return.

The film had been processed and scanned at one facility and microwaved to Laser Pacific. The Dalsa material had been rendered on a portable renderfarm and the disk array taken to the facility; both the D20 and the Genesis were transferred from the SR at LP. Material was then shown via a Lustre and a Christie 2K projector: first flat and then with a film print LUT applied, with grading instruction from Russell Carpenter ASC.

This is where it went a bit wrong. Actually, wrong in a very instructive way. The Dalsa material was unwatchable, as it had been rendered using the wrong settings. This has to open up a lot of discussion about the Dalsa approach. You can't see what you're shooting. OK you can see a still on a laptop, but you have to process it, and you don't know that the process has gone wrong until you run it afterwards. Hmm, I know of a system just like that.

Talking of which... the film couldn't be run real time on the Lustre, as it had been scanned at 4:3 not 16:9 – ie, the whole gate area and the amount of extra data choked the Lustre, so we had to wait for proxies to be rendered and watch those. The right colour, but half definition. I think I'd rather have watched the stuttering pictures at full res. It was somewhere around here that Lustre crashed. The film was sharp and had a very wide latitude with the '29 winning out. There was some grain visible in the shadows, but nothing I found objectionable.

The projected D-20 footage looked nothing like the footage I'd seen on the 4.4.4 monitor at the shoot; it was much more contrasty and redder in the skintones, but nothing that couldn't be corrected. Other than that, it handled all scenes that were thrown at it. The Genesis footage looked like it had in the studio, and likewise handled everything just fine, with the exception of the candle flames. I was only able to stay for a part of the graded footage session, but I wish we'd been able to see graded footage without the print LUT applied – I think we'd have learned a lot more.

The only thing that would have improved this test would have been the addition of a Viper; I'd really love to have seen it up against these cameras. The Viper has been out gathering experience for the likes of Dion Beebe and Paul Cameron in the Michael Mann feature *Collateral*, which received an Oscar nomination for best cinematography in 2004. With the introduction of the Venom FlashPack on board recorder, the Viper is now fully portable and capable of being detached from any cables or connections, giving complete freedom of movement on steadicam, cranes, helicopters and other like environments. I have a feeling that right now the only difference between the Viper and the three digital cameras tested here would be down to the lens characteristics.

### Results

I approached all the companies afterwards asking both for full res scans of the various scenes and their comments on where they thought that things may have gone wrong for them.

Panavision has refused on all counts. John Galt of Panavision told me, "we provided a Genesis for a lighting and photography demonstration, unaware that there would be cameras from other manufacturers involved in the project. At the time we agreed to provide a camera we did not expect this accommodation to become a 'shoot out' between ourselves, Arri and Dalsa."

However, the Cinegear promotional material said: "Bill Bennett ASC, Russel Carpenter ASC and Marinder Snie will conduct an all-day class revolving around the presently available large format chip cameras like the Arri D20, Dalsa Origin and the Panavision Genesis. During the morning session material will be acquired in a studio. These elements will be reviewed and compared after the lunch break. Great attention will be given to the various processing of elements in respect to output to film, visual effects. The second part of the digital camera workshop will be held in a digital post theatre environment with optimum viewing capabilities and support equipment." Seems to me that it was fairly clear from the start that there would be a chance for comparison and evaluation. Why on earth would I have done a weekend return to LA from London if this wasn't the case?

Arri provided material from all three of the main shots on the D-20 and Dalsa provided two images. So what conclusions can we take from these tests? The images

First and very clear is that all the digital cameras are still a long way behind film in the area of latitude. The tests that showed highlight response was limited to +5.5 stops – a highlight level that was either at or beyond the level apparently possible for these cameras. I say apparently because there were problems with the Dalsa material that I'll address later. The skintones were not as smooth; during the grading it was much easier to get the skintones that Bill and Russ wanted from the film-originated material, and it required considerable work to get the digitally originated ones there, regardless of camera.

In the case of the Genesis pictures, I have to rely on memory, as they have not made any images available, but my overall impression was that in the lit scenes the images were fine, but that in the low light tests the highlight streaking was unacceptable. In the Arri D-20 pictures there is evidence of some noise in the red and also some missing pixels. I was also puzzled at the use of a LIN output rather than a LOG one. I put these points to Bill Lovell of Arri:

"We are currently working on a log LUT, which will be ready in a few weeks and will be an option selectable in a menu on the camera; the camera is currently able to store 10 LUTs, but at the time of the masterclass only four useful ones had been loaded. While the log LUT will allow an HD recording made with this characteristic to be taken directly into a log-based environment (such as some colour grading systems) and will also provide an extended latitude in terms of signal handling, it will not (of course) extend the latitude actually captured by the sensor. It will provide a 'flat' looking image if viewed directly on a conventionally aligned HD monitor.

"There are some defective pixels visible, particularly in dark areas in the candlelit scene, due to a less than optimal alignment of the pixel-by-pixel gain and offset correction in the particular camera used at the time of this test, combined with the fact that the camera was set to the highest currently available sensitivity (LUT User 7, equivalent to approximately 400 ISO) for these scenes. The alignment has since been substantially improved, and defective pixels are much less significant."

### Dalsa Origin

As I mentioned, there were major problems with the exposure levels, which means that the highlights are clipping at a level much lower than I would have expected for the Origin. I asked John Coghill of Dalsa about this:

"The first was our fault in that we were being too conservative with the camera sensitivity rating, and that resulted in some of the takes being truly overexposed (there is no magic algorithm to deal with this). If you recall, we have been talking for some time about getting new sensors from our foundry in Quebec, which we did indeed get last fall but, to be honest, when we got into the detailed testing, particularly after we opened the LA office and got an opportunity to work with more people, we realized it is actually difficult to quantify the ASA of this camera because of the wide exposure latitude. The strict mathematical/analytical approach would say it's ASA 200-300, but we've had professional DoPs rate it 'subjectively' at ASA 500. Allen Daviau did some exterior night shots that he pegged at this. So anyway, when we got to the shoot-out (contrary to what John Galt says I knew it was a shoot-out), Lucian told Bill Bennett it was ASA 200, based on his guess of the colour temperature of the lights. Well, guess what – it was more like 400. There was a lot more red in those lights than was indicated by the meter. Bottom line, those shots were at least two stops over-exposed; we blew out the highlights and got the 'darks' to high.

"The second problem was the display pipeline at Laser Pacific – without going into all the gory detail, the thing was rushed and some of the LIN-LOG mapping was not done correctly. We took the images back to our shop that night and ran them through our server and projector and everything looked great – other than the overexposure thing. We have since worked this out with LP and are working to get the film-out LUTs done so that the outcome is more pleasing this time. Again, no magic algorithms for this, just some hard work from some smart people who are now back from vacation."

It seems to me that while Arri and Dalsa are being open and helpful – in fact keen to learn from the experience and move on, the Panavision approach is one that ignores potential users.

I will be shooting totally objective and repeatable tests of all these cameras in the future, assuming that the companies concerned will loan or even hire me the kit. The tests will concentrate on dynamic range and colour response. I will also include other cameras such as the Viper.



## 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.