Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 14 : Comparison of Camera "Speeds"

This document is a report of the results of tests that are the precursor of those described in the EBU technical document Tech3335. It is not an endorsement of the product.

Measurements have been made of the relative sensitivities of some cameras (Sony HDW750P, Panasonic HDC27F Varicam, and Thomson LDK 6000).

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One "frequently asked question" about HDTV concerns the sensitivities of the cameras. While the published specifications are readily available, they seem rarely to be available to those asking the questions. Accordingly, we have made a simple set of tests to establish the sensitivity relationships between the three most commonly used HDTV cameras.

Camera Sensitivity

One experiment, conducted in Bristol using cameras owned by BBC Natural History Unit, compared Sony HDW750P and Panasonic 27F Varicam. Both cameras were set into linear mode (gamma, peak clipper, and all other transfer characteristic modifiers switched off), and confirmed using the sawtooth test signal and a waveform monitor. Both cameras were set to 25 frames/second with 180° shutter (i.e. 20msec exposure), zero dB gain and all filters set to "clear". Both cameras were then exposed to a test card containing a white patch (actually a standard Macbeth colour test chart, but any white reflecting sample would have done), and colour balanced. Thus the cameras produced output voltages that were directly proportional to light level. A reference lens was fitted to the Varicam, expected to be the more sensitive of the two, and adjusted to produce 700mV video level on the peak white. The iris, zoom and focus rings on the lens were then locked with sticky tape and the lens was swapped onto the Sony camera. Thus the same light level illuminated the camera, which produced exactly 350mV video level.

A second experiment was conducted at Presteigne Hire in New Malden, to compare a Thomson LDK6000 with a Sony HDW750. The same procedure was followed, but because of time limitations it was not possible to be as precise in setting the chart illumination, so 700mV could not be achieved in standard gain setting. The Sony produced 560mV and the Thomson 320mV, which can be scaled for comparison with the Varicam.

The specification of the HDW750 claims that sensitivity is F/10 for 2000 lux with a sample reflectance of 89.9%. So a card that reflects 89.9% relative to a perfect diffuser, when lit at 2000 lux, causes full exposure with a lens aperture of F/10. Since the Varicam produces exactly double the signal level, its sensitivity must be exactly one photographic stop faster, i.e. F/(10/√2) or F/14, whereas the Thomson produces 4/7 times the signal of the Sony, about ¾ stop slower or about F/8. Also, since the Varicam is claimed to have a photographic "speed" of 640ASA, the Sony must be 320 and the Thomson about 180ASA. Therefore, using the cameras as light meters, the following table describes the relationships between them.

	Panasonic 27F	Sony HDW750P	Thomson LDK6000
Signal level for F/14, 2000 lux, 89.9% reflectance	700mV	350mV	200mV
Aperture for 700mV, 200 lux 89.9% reflectance	F/14	F/10	F/8
Photographic speed	640ASA	320ASA	180ASA

The effective "photographic speed" of the camera is determined by the light level needed to illuminate an 18% reflectance card to produce a normalised output on film. It is not an entirely satisfactory measure for video cameras, but serves well enough as long as the limitations are understood. For these reasons, Sony have claimed that the 750 has a speed of 400 ASA rather than 320, while Panasonic often claim 800 ASA. These values encourage the

videographer to underexpose the camera, thus protecting the highlights from clipping, a worthy aim that contributes greatly to the "film-look" which is often the goal for HDTV. Thus it would be highly misleading to regard these figures as definitive, but the comparisons are relevant.

The reader should bear in mind that these measurements take no account of noise levels. It may be appropriate to set camera gain to a value other than 0dB just to achieve a specific noise performance. A gain change of 6dB effectively changes the "speed" of the camera by one stop or a factor of 2 in ASA rating. Use of shutters does the same, these measurements were all made with the cameras set to 25 frames/second and 50% or 180° shutter. Similarly, changing the camera frame rate will affect the speed. Caveat emptor.