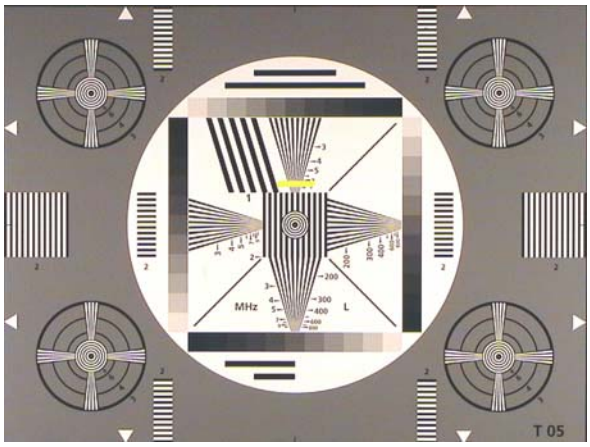
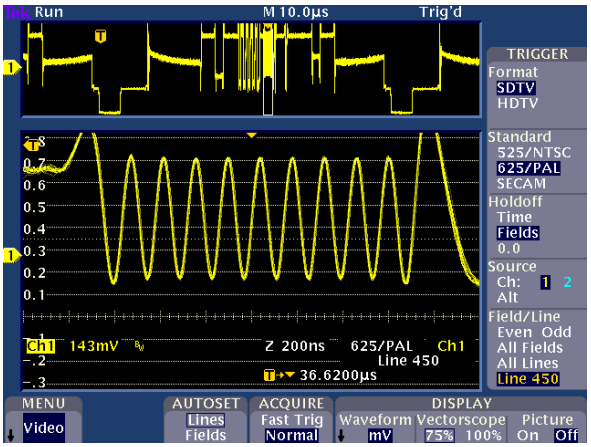
By Les Simmonds

Subjective and Objective CCTV Camera Testing

The performance of CCTV cameras is the most talked about and exaggerated issue in the security industry. Most security industry camera evaluations are very basic and subjective so the actual true performance of the camera may still remain a mystery. The television professionals in the industry nearly always use a standard of some type; it may be objective measurements by testing to a published technical standard or subjective measurement/assessment systems learned over many years, or to a published standard.



Universal camera test chart (RETMA) image showing position of resolution measurement in yellow.



High performance monochrome CCTV camera resolution waveform showing about 80% depth of modulation at 570 TV lines.

In several articles on CCTV cameras in the past I have mentioned that you should test cameras under your conditions and lighting. What I didn't expect was for some in the industry to carry out this type of basic subjective test under conditions that would not allow for reasonable camera assessment. In a number of cases low quality monitors and lenses have totally masked the good or bad features of a camera. For example, it's not much use testing a 480 TV line colour camera on a 300 TV line colour monitor and/or with a low quality lens which is struggling to pass 350 TV line resolution and may also suffer from flair. But believe me, it happens!

There are also those in the industry who may find it difficult to believe what they see. For example, during a subjective comparative test of 11 cameras which we carried out for a client employing two technical, one operation and one management personnel as the evaluation team, the supplier of the camera which came tenth was convinced his was the best. Yet the evaluation results were virtually unanimous. It is situations like this that causes me to be concerned about security industry subjective CCTV camera tests. But in the hands of unbiased television professionals subjective tests can yield reasonably accurate results.

Subjective Measurements

For many years, ITU-R BT.500 has provided standards for subjective picture quality measurement. Over the last few years this has been extended to deal with the changing measurement requirements for compressed systems. Several measurement techniques are described within this standard, two of which are described below in greater detail.

The first, referred to as "The double-stimulus impairment scale method (the EBU method)" provides a measurement that can be represented within a five-grade impairment scale.

5 = Imperceptible
4 = Perceptible
3 = Slightly annoying
2 = Annoying
1 = Very annoying

Observers see the reference image sequence followed by three seconds of mid-grey followed by the test image sequence. Voting on the impairment is performed based on the adjectival scale described above.

An alternative measurement referred to as "The double stimulus continuous quality scale method" (DSCQS), replaces the five-grade scale above with voting on the quality of both the reference image sequence and the test image sequence. The difference between the two represents the impairment. Typically, the two images are displayed in turn, but the viewer is not told which the reference is.

The form used for voting contains five adjectives relating to the absolute picture quality: excellent, good, fair, poor, and bad. However, voting scores are not restricted to these five adjectives and are instead given values on a continuous scale with values between 0 and 100, where 0 and 100 represent, respectively, bad and excellent picture quality. The resulting difference values will also generally lie within the range of 0 to 100 where 0 and 100 represent respectively low and high levels of impairments. (Negative values can exist when voters consider the picture quality of the test image to be better than

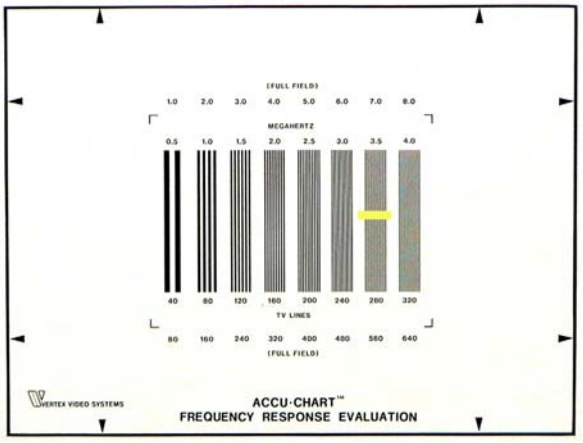
that of the reference image.)

Picture quality measurements obtained from subjective tests are subject to variations caused by many factors. These include physical details of the experiment, including, viewing distance and instructions to voters to weight their judgement more heavily on loss of detail rather than the overall image (usually observers are asked to assess the overall quality) or interpretation of the adjectives used for describing either the impairment or the absolute quality as they are translated into different languages).

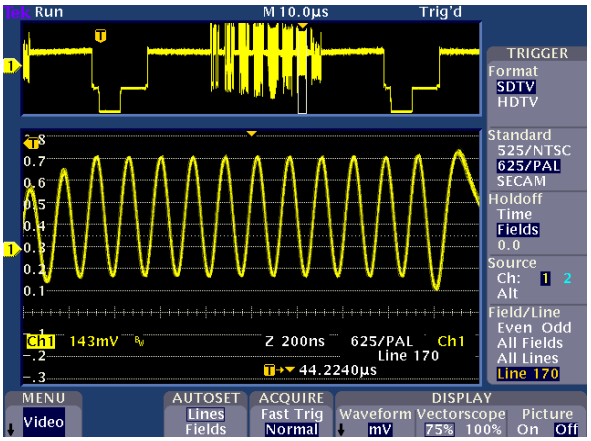
CCTV camera, which is due to the lack of television professionals in the CCTV industry. So let's look at Objective measurements which can show a clear outcome shown on waveform images as proof of the cameras selection or elimination.

Objective Measurements

The European Standard EN 61146-1 Video Cameras (PAL/SECAM/NTSC) – Methods of measurement – Part 1: Non-broadcast single-sensor camera is the best known single-sensor objective testing procedure and has a common sense and accurate approach and start off with simple ground rules similar to the following:



Frequency response evaluation test chart image showing 7 MHz measurement area in yellow.



High performance monochrome CCTV camera frequency response waveform image showing magnified 7.0 MHz burst. Note: 7.0 MHz is equal to 560 TV lines.

Finally, different viewing panels will produce differing subjective results. While increasing the number of participants in the panel may reduce this factor, financial constraints normally preclude this option. Many of these factors may be regarded as virtues of subjective picture measurement in that they enable the selection of test conditions to meet specific test requirements, but they lead to inevitable differences in results obtained from different laboratories.

ITU-R BT.500 states that a study of consistency between results obtained from tests performed by different laboratories shows that there can be systematic differences.

Well that's how television professionals carry out subjective camera measurements. Unfortunately, this system is not robust enough to offer a CCTV client comfort and certainty regarding their selection or elimination of any particular

Conditions of Measurements

Except when otherwise indicated, the measurements depending on the characteristic to be measured shall be carried out by measuring the output signal of the camera when it is shooting different test charts.

Each test pattern shall be specified, together with the lighting conditions (illumination intensity, correlated colour temperature of the light source, etc.). The use of transparent test charts instead of the reflection types may be allowed, however, the reflection types should be used in questionable cases. Unless otherwise stated, all measurements shall be made in automatic mode.

Conditions of Shooting

Unless otherwise stated, the conditions of shooting shall be as follows:

The subject illumination of a reflective test chart shall be 2000 lux ± 5% (see note below).

The luminance of a transparent test chart, at peak white, shall be 636 cd/m2 ± 5%.

The non-uniformity of the subject illumination shall be less than 5%.

The correlated colour temperature of the light source shall be 3100 degrees K ± 100 degrees K.

The white balance shall be set manually or automatically to 3100 degrees K ± 100 degrees K.

The test chart shall be shot by the camera so that the frame limited by the arrows coincides exactly with the edges of the picture displayed on the video monitor in under-scan mode.

The focus control shall be in auto or manual mode, and shall be in optimum focus.

The iris control shall be in auto or manual mode depending on lens.

In order to obtain the desired exposure level, it may be advantageous to add an illuminated white card or a black area and to adjust the lens zoom so that the measurement does not depend on exactly filling the screen to the arrows of the test chart.

The gain control, if any, shall be set to "0 dB" gain.

The optical filter, if any, shall be set to "open position".

NOTE: Measured by a lux meter at the centre of the test chart, the receptor pointing in the direction of the camera.

Reference Conditions
Unless otherwise specified, the reference luminance output signal level is assumed to be 700 mV peak-to-peak (p-p) for PAL and SECAM systems and 714 mV peak-to-peak for NTSC systems (from the blanking level to the peak white level).

Camera Measurements
Measurement of cameras is now a matter of testing to make purchase decisions or to deal with faulty operation (troubleshooting).

Many camera measurements involve placing test images or charts in front of the camera for viewing through the lens. That may be as simple as pasting a paper chart on the wall or using a rear-illuminated box on which transparency charts are displayed. Measurement is usually accomplished by viewing the camera output on a picture monitor or a waveform monitor
(WFM), which is a type of oscilloscope designed specifically for video signals. Most measurements are quantitative and hard numbers can be obtained.

The majority of measurements require examination of the camera signal in analogue form. Very little picture quality testing is possible when the signals are in digital form; they must first be decoded back to analogue. The test instruments must synchronise to the scanning of the camera so that pictures can be viewed or specific parts of the waveform can be evaluated.

Objective measurements give hard core results which can give confidence accepting or rejecting one to thousands of cameras on a project without fear of contradiction!

Acknowledgements:
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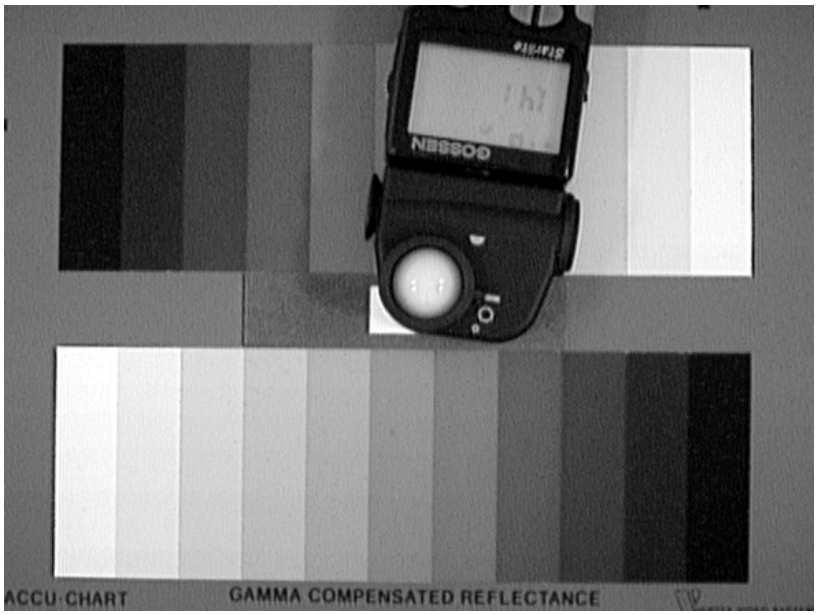

High performance monochrome CCTV camera showing 1.41 lux as per objective test. I don't know were some manufacturers get their fictitious camera sensitivity figures?

Les Simmonds is a truly independent CCTV consultant and CCTV testing authority.

Email:
les@cctvconsultants.com.au

Web:
www.cctvconsultants.com.au

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