

SPECIFYING AND ASSESSING PROJECTED IMAGE QUALITY – a digest

(Draft 1.0 – 19 October 2007)

The projected image, whether front or rear, tends to be specified in vague and unscientific terms, although it's often the focal point of the installation. The deliverable is the projected image – we are creating a display. But because this display comprises the discrete elements of projector, screen and that cruel image killer – ambient light – in infinite permutations, it was previously regarded as a no-go area. But now there are simple guidelines and Excel calculators available as free downloads, which means that specifying, predicting and measuring projected image quality – front and rear – can be carried out easily.

This paper is a digest of key points from a best practice 'white paper' on specifying and assessing projected image quality. If you want to explore the background and reasoning behind facts and guidelines here, the paper is also available for free download from the InfoComm web site.

The first step is to set out the key elements and a limited glossary to establish the basic principles. Once we have this common ground established, the guidelines are simple and straightforward. (Terms not explained here can be found in the full best practice document.)

GLOSSARY, KEY ISSUES & DEFINITIONS

Light

Think of projected images as organised – and organisable – light and think of ambient light as a form of interference we need to understand and factor. But let's be specific about the three key terms we need to understand.

Brightness. Brightness is not a scientific word. It refers to the human experience and perception of light – not its true properties. For that we look to *luminance* and *illuminance*. 'Brightness' tends to be used as a catch-all word in describing projected image attributes. Its use can be a trap because it keeps you in a subjective dialogue.

Illuminance. This is what we usually call 'ambient light' and describes the light falling on any given environment. We measure it in lux (or sometimes foot-candles). The paradox is that illuminance is invisible: we can't see it passing through the air until it strikes an object and we see its reflection in the form of *luminance*.

Luminance. This is light reflecting or radiating from a given object – whether a projection screen, a computer monitor, or the paper you take notes on. We measure it in *candela per square meter [cd/m² or nit]* (or sometimes foot-Lamberts).

Projector specifications

- Brochure data is generally not suitable for professional specification processes. Simple Excel calculators (also available for free download from InfoComm) allow you to predict accurately image luminance ('brightness') and contrast. But without accurate input data the process is meaningless. So you might ask the projector manufacturer a question like this: *'Your projector model x is being considered for a project. To this end I need to know the ANSI contrast and ANSI lumens for this projector fitted with lens type y [different lens types create different results meaning so you must be specific about the projector/lens combination]. Specifically, the projector and lens combination should have been adjusted to show a properly graduated grey scale from an external pattern generator, and the contrast data required is the ANSI checkerboard average methodology. This conforms to the sign off criteria we will apply to the installation and is therefore required for planning calculations.'*
- You will also need to apply a compensation factor for lamp decay, remembering that lamp life is normally defined as the time taken to reach 50% of initial luminous output (and decays further until eventual failure). Therefore you might consider applying a further reduction of, say, 25% (representing the 'half life' of the lamp) of the expected true projector lumens.

Contrast

The only contrast ratio usable for this project is ANSI contrast, the key points being:

- That the projector should have been adjusted to a grey scale from an external pattern generator before being tested
- That the measurements are taken from a sixteen section checkerboard pattern; and that the ratio comprises an average of the eight white squares relative to the average of the eight black squares. We need to know what black and white levels we can get **on the same image** (not consecutive images, as the on/off contrast figures in projector brochures might imply).
- On the basis that the working committee from which this paper emanates agreed that:
 - o From 5:1 PowerPoint slides are reasonably visible
 - o From 10:1 photos and high definition images are reasonably visible
 - o From 20:1 all images are described are good, if not excellent
 - o Remember that normal front projection contrast ratios (e.g. meeting rooms) are entirely a function of ambient light. Projector contrast ratios only become relevant in conditions of near or total blackout (e.g. home cinema).
- Refer also to ***Projector specifications***.

'Brightness' [luminance] uniformity.

- Uniformity is a combined product of projector/lens uniformity and screen uniformity. See the full white paper for full explanation.
- Remember that figures for projector uniformity relate to the standard lens, so obtain the adjusted figure when using wide angle or long throw lenses.
- Wide angle lenses typically produce worse uniformity than standard or long throw lenses – sometimes much worse.
- Wide angle lenses used with diffusion rear projection screens and high gain front projection screens can generate image hot spots. Testing is advised before specification.
- Committee work agreed that, for single screen installations, >90% projector uniformity is 'good'; 85% is 'acceptable'; 80% is at the lower end of acceptability – but be prepared to witness much lower than this, especially with cheaper wide angle lenses.
- Multi-screen systems such as videowalls and control room walls require higher uniformity because close proximity of screens makes the eye more critical of uniformity shortcomings.

GUIDELINES

What comprises good image quality?

There are two key criteria:

- a. Grey scale. Before any further evaluations are made ensure your image can display a properly graduated grey scale on all connected sources. For PCs you can download a free PowerPoint file which includes a grey scale. But you will need grey scale content for all sources and resolutions the installation is specified for.
- b. Contrast. You should aim for a contrast ratio of at least 10:1, but preferably over 20:1. You can use an illuminance meter (lux) and a simple spreadsheet to plan and estimate the installed result. You will need a luminance meter to measure the installed result.

How do I specify image quality relative to the location?

The vital thing to remember is that the projected image has to balance with its surroundings. In many cases it's possible to design eye strain into a system – particularly meeting rooms, where sessions can be extensive. Not only does this aspect have to be addressed, it must be seen to have been addressed.

The eye works constantly to adjust to changing **adaptation levels**. Sometimes this can be debilitating (e.g. if you turn the light on in the middle of the night). If the differences in luminances of the key **tasks** [specific objects one views] are great, the eye will be working excessively, leading to possible fatigue. Hence the use of the **task luminance factor** to limit the range of luminances – typically no greater than 3:1.

Notepaper can be regarded as a benchmark **task** in meeting rooms, because its use is nearly universal. Its luminance is a product of the room's illuminance. Example: white paper has typical gain of 1 and under typical room illuminance of 500 lux the paper will have a luminance of 159 nit. So, using a task luminance ratio of 3:1, we're effectively saying the screen has to deliver its contrast objectives and grey scale rendition at a peak white luminance no greater than (3 x 159 =) 477 nit. These numbers are not 'set in stone' – of course you can adjust them according to your professional opinion and experience. But ideally you should both address – and been seen to have addressed – the question of what luminance (i.e. how 'bright') the image should have in its given location.

How do I specify image quality?

As discussed above, projected image attributes have to relate to its specific location. Here are two example specification options:

- 1 In an existing site where conditions will not change be after installation you might say: 'we require an image which will be signed off having firstly demonstrated a well-gradated grey scale on all sources under working lighting conditions and, secondly, having demonstrated a minimum contrast ratio of at least 20:1 [change as appropriate] using the ANSI checker board pattern.
- 2 Example 1 could be modified in cases where the location is not built, where you say you will demand the above deliverables assuming the ambient light does not exceed x lux.

NB In standard front projection, contrast is entirely a function of ambient light. Consequently the installer might be driven to achieve the required contrast by making the image too bright (i.e. by exceeding an acceptable **task luminance ratio**). As specifier you can have made previous calculations and specified either special front projection materials or rear projection (i.e. materials or techniques less affected by ambient light) to render the required contrast levels feasible under otherwise impossible circumstances.

How do I measure image quality?

Actually, this is where you'll need to refer to the main white paper. All you need to know is that it can be done easily. But you'll need meters. Generally it's feasible and desirable to own an illuminance (lux) meter because you can measure environmental illuminance, projector lumens and projector contrast (but **not** image contrast) – and it looks very professional to the

client if you wield a meter! A luminance meter is more expensive, but is required for measuring image luminance and image contrast. Good quality photographic meters can be used (with qualifications) and can be sourced cheaply from eBay etc.

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This digest paper has been created by selecting elements from the detailed best practice white paper 'Specifying and Assessing Projected Image Quality'. At time of writing the latest draft of which is dated 17 August 2007.

The project emanated from academic work I undertook in 2002/3 and a committee formed subsequently in 2004 with the original objective of creating a quality standard. On the basis of practicality, we decided the first step should be the best practice paper, which consequently followed, with two main revisions following invaluable peer review and the inspiring and continuous support of my InfoComm colleagues. Rather later than envisaged, this compact digest sees the light of day! Like the main white paper, peer review and comments are actively sought.

Since the project began, InfoComm has elected to become a standards body. Therefore this work will be incorporated into a relevant quality standard as deemed appropriate by the committee.

All the calculators, grey scale slides and white paper mentioned here are available for download from www.infocomm.org (and search for 'white paper' or 'projected image quality').

If you have any comments or criticisms, or would like me to email any of the materials mentioned, I'd be delighted to hear from you.

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