



Performance Media Industries, Ltd.

Home Theater Video System Standards – What are we trying to do?

by A. Grimani

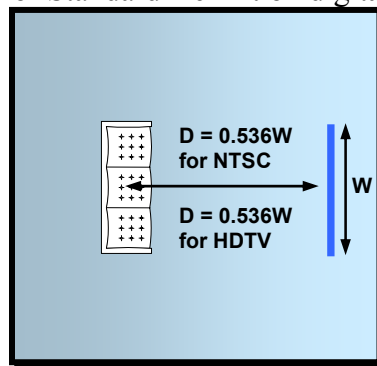
To better understand the right way to set up the video display system of a home theatre, it is a good idea to know the conditions under which the source material was created, and what standards are expected for a correct presentation experience in a film projection screening room. As opposed to sound, where you can absolutely translate the experience from the larger room, picture is a different kettle of fish. Standard NTSC video, even at its digital best in DVD, is unable to convey the picture detail, color depth, dynamic range, and resolution of 35 mm film. So, program material for home theatres is inherently limited. Now, some of video's limitations will change as we get into High Definition and the size of the performance window opens up to better match the original film format. It's up to you to understand how to best exploit the outer limits of Standard and High Definition formats and set up killer video displays.

Let's look at picture monitoring standards in film studios, since they're what we should be emulating in our clients' home theatres:

- 1) Screen size: A motion picture screen should be large enough to subtend a 45 degree viewing angle in the middle of the cinema theatre, and no less than 30 degrees at the back of the room. But don't try this at home! The resolution of film is still better than HDTV (by a factor of 2), so in reality the viewing angle of a home theatre should be less than 45 degrees. OK, then, what should it be? The theoretical limit for Standard Definition digital TV (like DVD) is under 20 degrees, before lines, video noise, motion artifacts, etc., become visible. You can push that to 30 degrees if you have a top-of-the-line video scaler with a well-tuned projector and don't mind some loss of sharpness. For HDTV, you can perhaps push that to 40 degrees, but don't go much further, or else your picture just won't be sharp enough.

So, how do you calculate this business of 30 and 40 degrees? You could remember your trigonometry lessons and calculate that screen width is the viewing distance times tangent 15 times two...or simply apply this easy equation: Width = 0.536 times the Viewing Distance for 30 degrees, and Width = 0.728 times the Viewing Distance for 40 degrees.

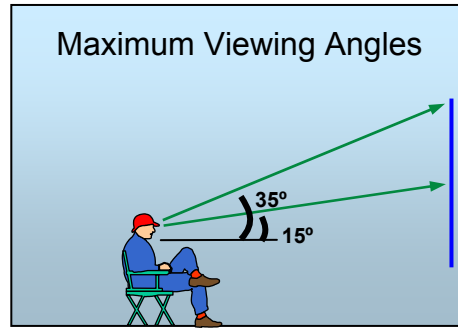
- 2) Screen Illumination: The light coming off the screen at maximum white level should be 16 footLamberts. That's a measure of reflectance, and is different and much more useful than the ol' ANSI lumens thing. A typical 9" CRT projector lighting up a 100" wide,



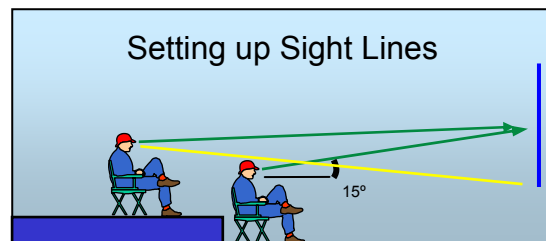
16x9, 1.3 gain screen might produce 6 footLamberts on a good day. A single chip DLP with a rating of 800 lumens might get you 12 footLamberts on the same 100" screen, so you're definitely more in the ballpark of a film screening room. Now beware, you can have too much illumination with one of the super-large projectors, which would cause you to notice film rate flicker much more. The eye gets increasingly more sensitive to frame cuts as projected light levels go up.

- 3) Viewing Height: Screening room projection standards call for the viewer to be looking straight at the middle for the screen or no more than 15 degrees up to mid-screen. Also, viewers should not have to look up past 35 degrees to see the top of the screen.

Human vision is, in fact, most comfortable viewing an image that is 12 degrees below horizontal, so screening room seats are often tilted back 12 degrees to give the audience the best possible vertical viewing angle. So consider vertical viewing angle when figuring out where to hang a screen, and notice how much of a drag it can be to get the projector/screen/sight line relationship to work.



- 4) Sight Lines: Screening rooms are set up for full sight lines. No one should block your view of the screen. The simplest approach here is to tier the seating heights from front to back, while working to respect the 15 degree maximum vertical viewing angle standard stated above. In a way, unobstructed sight lines are easier to achieve with video displays, because screens are typically so much smaller, while the room has to be pretty tall if you plan on four tiers, since you will need at least one foot per tier.



- 5) Ambient Light: Projection should take place in absolute darkness, so that your eyes get to see the whole range from 0 to 16 footLamberts. Any light falling on the screen will cause loss of black level detail, even if you have a monster, super-bright three chip DLP projector. In film screening rooms, the ratio of peak white-to-ambient light should ideally be 600:1. Thus, ambient light levels may not exceed 0.025 footLamberts.
- 6) Room Colors and Environments: Good projection screening rooms are painted very dark colors to absorb light reflections from the screen. Stray light from the screen can reflect off the walls back onto the screen, washing out the picture. If the room walls have strong colors, reflections from them can tint the screen with the primary color tone. That's a bad thing! Most screening rooms at least have a really dark ceiling and a dark zone around the screen.
- 7) Screen Light Uniformity. The light coming off the screen should be totally uniform. The maximum limits are 20% deviation from area to area. In film screening rooms, uniformity is achieved by tuning the bulb/mirror assembly. Since we "don't got those" in a home theatre, you should be all good unless your screen gain is too high, or you have a

defective projector. Make sure you test for uniformity when you're calibrating the video display system by using a spot meter.

- 8) Dynamic Range: As mentioned in the section on Ambient Light, a film screening room will have a contrast ratio of 600:1, which corresponds to 55dB. The best 8-bit NTSC and HD video can manage is 48dB. What can you do about this? Nothing, unless you want to install and maintain 35 mm projectors in all of your installations!
- 9) Color Temperature: Xenon projection screening rooms are set up for a color temperature of 5400 Kelvin. During telecine, a transfer technician re-times the film's color for viewing over video displays calibrated to 6500 Kelvin. Make sure to set, or hire an expert to set, your display system to the right color temperature.
- 10) Jump and Weave. The film needs to go through the projector mechanism as smoothly as possible so that the picture is rock solid on the screen. Thank goodness we are working with video; no moving parts! Of course, the original film used to make the video master could have weave in it, or the telecine machine could have had weave problems; there's nothing you can do about it. Just don't demo that video for your clients!

Now you know the key specs and features of film industry screening room picture standards. It's up to you to take these into account and accurately translate movies into the more limited video applications. HD is bringing video ever close to film, so you had best think in terms of film standards starting now, because a killer presentation of High Definition will separate you from the amateurs!

This paper is based on an article published by A. Grimani in Residential Systems magazine March 2003