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Video Projection Screen Size & Brightness Formulas Cheat Sheet

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While we live in world with finite budgets, we also live in a world with finite physics; *our budgets cannot wish physics away*, so we must either determine to adjust light levels (if and when possible) or spend more to overcome the physics of light. **It's math, not finances, that determine your needs.**

The *basic* math formulas for calculating projection needs:

Determine screen placement

Sight lines are paramount in determining screen location. Make sure everyone (especially those far away) have a clear, unobstructed view of the screen. In many situation, more than one screen is required.

I won't go into screen viewing angles, but keep in mind that anything beyond 45 degrees (horizontal or vertical) will fatigue the eye. In many venues, the angle of the side walls is insufficient to simply mount the screens flush. It is advisable to mount the screens (assuming front projection) at a greater angle to face across the room the the far side from the screen. Otherwise, if the screens are facing the side of the audience they are closest to, the presenter will often observe people watching the side screens facing away from the stage center - a disconcerting scenario for anyone speaking on stage.

Determine screen size

Measure the distance from the screen to the furthest seat in line-of-sight. If the majority of the content is video (SD or HD), divide that number (the distance) by 8. This will yield the screen height.

Next, *measure the distance from the screen to the closest audience seat that is in line-of-sight to that screen*. The screen should be no taller than twice that distance. Example – 9' tall = 18' away for *closest* viewer. Remember, the *furthest viewers take priority*, as it is better for the screen to be "too big" for those close than "too small" for those in the back.

Determine square footage of the screen surface

Take the screen height (in feet) and multiply it by the screen width (in feet). Ex. 9′ × 16′ = 144 sq. ft. Multiply the square footage of the screen by 20 (ANSI says 18 + or – 2, so we use 20). Example: 20 (ANSI lumens per sq. ft. minimum) multiplied by 144 (sq. ft.) = 2,880 projected lumens. 2,880 lumens isn't hard to find in a projector by today's standards. But before you get too excited, remember that this is assuming NO light is hitting the screen. Pitch black area. Dark. No light. Nada.

Unless you have a black-box environment with no stage light bouncing on the screens (99.999% unlikely), you're going to need far more than a luminance value of 20; we'll explore that example below.

Determine ambient light on the screen surface

Our next measurement is at the screen area itself – the amount of foot-candles of light striking the screen surface from lights, windows, etc. We measure this using a light meter.

Let's assume we measure a tiny amount of 8 foot-candles striking the screen surface (a very low amount of ambient light). *We now take our number (8) and multiply it by 5 (our next formula)*. The answer? 40, of course. THAT (40) is the number we must now reach to have adequate lumens being projected onto the screen surface. In other words, we must project at least 40 lumens per square foot onto the screen to overcome a mere 8 foot candles of light on a small 9' x 16' screen. (Incidentally, this size screen would only be seen up to about 70-ish feet way.)

So, going back to our first example, we have 144 sq. ft. of screen area. We multiply 144 by the new 40 lumens per sq. ft. number to get **5,760** lumens. Therefore, we will need nearly 6,000 lumens projected onto the screen surface from the projector in order to overcome ambient light of only 8 foot candles. That's a lot more than the original 2,880 from our example. And that's only 8 foot candles of ambient light!

A more realistic value may be nearer to 30 foot candles of ambient light. In this case, if we still use our example of a 144 sq. ft. of screen area, then we'll multiply 144 by the new 150 (30 foot candles times our factor of 5) lumens per sq. ft. number to get 21,600 lumens.

2,880 lumens in a pitch dark room compared to **21,600 lumens** on the same size screen in the same room with some lights on or windows shining light. A pretty stark difference, right?

NOTE: This is not all of the math…contrast ratio, screen surface types, lensing…it all has math, too…but this is a helpful way to demonstrate the truth that when you use math to solve your real-world challenges, you'll be better stewards of money than by merely arbitrarily assigning money out of context to an issue.