Projector Positioning

Positioning Overview

A projectior’s physical location in a space is specified by someone who understands throw ratio and someone who understands physical limitations of a space. That could be you! In most cases, you can get a rough projector positioning using a generic or brand specific projection calculator. If you have a more complex situation, or you’re the type of person who just likes to make sure, you can calculate this yourself fairly easily.

Understanding Projector Lens Types and Projector Math is critical to understanding where a projector can go. You can learn to draw a frustum to figure out, or you can use formulas on their own, or (my personal recommendation), is a combination of both.

Projector positioning is based on a projector’s **frustum**, which is the light cone that is emitted from a lens. You can build a frustum in 2D space and do a top view and a side view to manually calculate your projector body position.

I did this in Adobe Illustrator for 10 years before I moved into 3D space. It makes a huge difference. I use Vectorworks, which has a projector tool, but it is limited and working from scratch is a good way to learn anyway.

Projector Fans

All projectors have fans, which means all projectors have clearance requirements. If you put a projector in a box without airflow, you’ll break it. The clearance requirements are mixed, per side, based on the airflow required from the intake fans and outtake fans. It’s usually something weird like 8” from one side, 16” from another, nothing in front (duh), 13” from the back, and 1’ above and below. If you want to be stupid about it, you can also just see what the biggest dimension is and use that for all sides (except the front). This, too, is a good example of RTFM.

Projector Rotation

Many projectors have specifications for how they can be rotated. Some can be tilted up or down a certain amount of degrees. Some can be in both a vertical orientation in addition to a traditional landscape orientation. Some can be rotated 360° in any direction and be just fine.

Technically all projectors will *work* when you rotate them, but certain projectors aren't designed to be in non-traditional angles, and doing so will result in burning the lamp out faster, breaking the fans, voiding the warranty. This is a really good example of RTFM.

Projector Lens Shift

Calculating projector lens shift if you need the projector to live somewhere outside of the "home position" is very easy. For higher end projectors, the "home position," where the lens has 0% shift, is usually the top (or bottom) middle, or the absolute center of the projected image. The projector living at the top of the image is usually good for "grid" or ceiling positions. The projector living at the bottom is usually good for floor positions.

Projection-Lens-Shift-01.png

Overshooting & Keystoning

If you need to put your projector in a position that the lens cone doesn't support, you can overshoot and crop your image, or overshoot and keystone your image. These two options cover your target at the expense of both your brightness (fL) and your resolution. A good example of this is installing a home projector. You might install the projector in the ceiling, but there's no shift on the lens and the lens cone is center aligned. If your projector is far enough away, you'll tile the projector to hit the screen, and then you can overshoot your target (project slightly bigger than is ideal), and finally, you can keystone.

In the below example, we want to cover the entire 16'x9' viewing area with our 1.2:1 top-aligned center cone projector, but our projector lens' center can only live at a height of 1' above the projection field! What do we do?

Projection-Ted-01.png

Under these requirements, we can achieve coverage with a little fine tuning. A 1.2:1 throw ratio to cover this target means we need to be approximately 19'3" from the surface. If we instead are a few inches further away, say 19'6", we can place the projector at 1' above the target field and angle it down a few degrees. It will result in an image that is just slightly trapezoidal (wider at the bottom).

Projection-Ted-02.png

From here, within the projector we can "keystone" the image to correct for the slight trapezoidal visual. We can also achieve this by corner pinning if the projector offers it, corner pinning via a media server, or corner pinning in content (baking). All of these solves will turn it back into a squared rectangle, which is what we want!

Now we're covering the target correctly.

Projection-Ted-03.png

Basic Positioning Example

If your projector doesn’t have lens shift, then calculating the position of the projector is determined by the throw ratio against your desired coverage and the frustum *type*. The simplest version of this is a center cone (where the projector is aligned in the center of the image). Where a projector has a center cone, your throw ratio is .5:1, and you’re projecting 16’ wide by 9’ tall, this means that your projector needs to be 8’ from the target surface and 4’6”’ off the ground. This is a good opportunity to mount your projector to a tripod or C-stand!

Projection-Lens-HV-Center-Dual.png

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