

are subject to severe restrictions. The use in movie projection is different, as the laser beams are spread over a large area, the screen, rather than being concentrated as they are in light shows. That is why manufacturers of laser sources created LIPA (Laser Illuminated Projection Association, [www.lipainfo.org](http://www.lipainfo.org)), a lobby pushing for adequate U.S. regulation, in 2010.



No doubt other countries will follow suit once this goal is achieved. LIPA's founding members are Barco, Christie Digital, Disney, IMAX, Kodak, Laser Light Engines, NEC, Necsel, and Sony.

## Choosing a 3D Projection System

What is the best choice among all possible technologies? The main criteria are the budget, the size and type of audience, and quality. Active solutions are the best, but they are the most expensive per viewer and therefore used mainly for small meetings. The type of content to project, ease of handling glasses (disposable or not), and number of shows will also influence the choice. The table below helps tease out the problem.

### 3D projection solutions compared

3D Display	Glasses	Screen (m)	# viewers	Source	Cost (K\$)	Quality	Ease of use
<b>LCD monitor</b>	Active	0.4-0.5	1-3	TV/PC	<1	++	++
<b>Control monitor</b>	Active	0.4-0.7	1-3	Server	5-10	+++	++
<b>TV3D</b>	Active	0.7-1.4	1-5	TV	2-6	+++	+++
<b>Projector</b>	Active	2-3	5-15	TV/PC	4-10	++	+
<b>Projector</b>	Passive	2-3*	10-30	TV/PC	4-15	++	++
<b>Double projector</b>	Passive	2.5-4*	10-100	TV/PC	4-30	++	++
<b>D-Cinema 2K Projector</b>	Passive	10-17*	100-500	DCI Server	60-90	+++	++++
<b>D-Cinema 2K Projector</b>	Active	10-22	100-800	DCI Server	70-130	++++	++
<b>D-Cinema 4K Projector</b>	Passive	15-30*	300-1 000	DCI Server (Sony or Doremi)	>130	++++	++

Note: Screens marked (\*) require a special silver canvas that can be removed if 2D movies are also to be shown.

## Theater Size

Once the method is selected, one has to choose the ideal projector and its screen according to the room characteristics. The projector's position with respect to the screen is determined by the theater's geometry, which will also determine the choice of lens throw. The required brightness will dictate the projector's power. We must also take into account the fact that the brightness may drop by almost 40% during the lifetime of a projection lamp (600 to 2,500 hours). If we want a minimum brightness at any time, we have to take a "lamp-wear margin" into account.

For optimal 3D projection, in a well darkened room, brightness should ideally be between 4.5 and 7 foot-lamberts, or 17-24 nits. For an optimal 2D projection, the values are usually much higher, from 11 to 17 foot-lamberts or 38-58 nits.

### Brightness required for movie theater projection

Screen	Brightness (foot-lamberts)	Brightness (nits)
SMPTE D-Cinema standard	11-17	38-58
SMPTE 35 mm cinema standard	16	55
Minimum allowed for 3D	4.5	15
Optimum 3D	7	24
Optimum 3D with lamp-wear margin	10	34

Note: 1 foot-lambert = 3.426 nits = 3.426 lumens/square meter/steradian.

1 nit = 0.291 foot-lambert = 1 lumen/square meter/steradian.

## Brightness

If you know a projector's characteristics, you can determine the zoom value needed to achieve the correct image size and calculate the brightness. But this is not a trivial calculation, and computational errors can have serious consequences! Fortunately, there is a comprehensive online calculator on Projector Central ([www.projectorcentral.com](http://www.projectorcentral.com)) that lets you find the brightness achieved with a typical configuration. You then have to check whether this light level is sufficient to meet your requirements.

The input parameters of the calculation are:

- projector model (giving the lamp's power and extreme zoom values);
- screen size;
- screen gain;
- distance between projector and screen (throw distance); and
- aspect ratio: 4:3, 16:9, or another ratio.

The online calculator determines instantly the screen’s brightness under normal circumstances for flat (2D) projection. To account for the stereoscopic system loss, the resulting brightness, given in nits (1 nit = 1 candela/m<sup>2</sup>), must be multiplied by the efficiency factor of the 3D system used. This factor depends on the type of filter, type of glasses, and number of projectors (1 or 2).

**Efficiency factors for various 3D projection systems**

3D glasses system	# of projectors	Screen Gain	efficiency in percentage of standard projector nominal brightness (estimated)
Active XpanD, NVIDIA	1	1.2	18%
Active XpanD, NVIDIA	1	2.2	32%
Passive Dolby	1	1.2	7%
Passive Dolby	1	2.2	12%
Polarized, dynamic filters (MasterImage, RealD, others)	1	2.4*	18%
Polarized RealD XL	1	2.4*	25%
Polarized, passive filters	2	2.4*	36 %

Note: Screens marked \* are silver coated.

The online brightness calculator from [www.projectorcentral.com](http://www.projectorcentral.com)

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