

**CHRISTIE®**

WHITE PAPER

**CHRISTIE REALLASER™  
ILLUMINATION TECHNOLOGY  
FOR CINEMA:**

The dynamic relationship between  
brightness maintenance and  
environmental operating factors

# Christie RealLaser™ illumination technology for cinema

The LOS, or laser optical system, is the heart of Christie's RealLaser™ projectors. Manufactured by Christie, the LOS integrates many lasers and optical elements such as lenses and mirrors into one package that acts as the illumination engine for the RGB RealLaser projectors.

This document is an introduction to the factors affecting the longevity of the LOS. It includes a brief description of the ways that Christie has sought to minimize the effects of brightness degradation and provides insights on predicting how long the LOS can maintain various brightness output settings.

## Making the LOS last

### Optical surface cleanliness

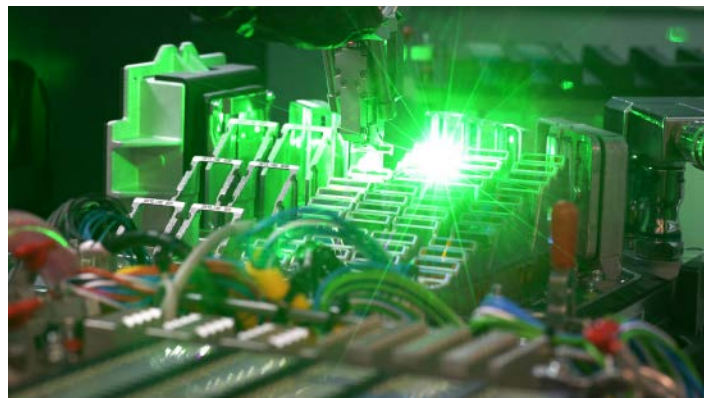
Inside the LOS, there are many optical surfaces. Any debris or contamination that falls onto these optical surfaces during assembly can diffract light away from the optical path and cause output brightness loss. Christie mitigates this by assembling the LOS in a state-of-the-art target class 1000 cleanroom equivalent to ISO 6 standard, keeping the optical surfaces pristine throughout the assembly process. Christie uses a robust, fully sealed design to prevent dust and other contaminants from getting into the finished optical system ensuring brightness is maintained over a long lifetime. The LOS itself is maintenance free as a result.

### Laser alignment robustness

The mirrors and lenses inside the LOS are held in place using spring clips and adhesives. These components must remain in place in order to keep the LOS light output within its specification. Through many years of optomechanical manufacturing experience, Christie has developed very rigorous processes to make the clipped and glued optical elements resistant to extreme shock, vibration and temperature changes. To achieve this, Christie employs advanced robotic automation equipment for assembly so every LOS is manufactured to the same consistent high-quality standards.

### Humidity control

Laser elements generate heat which must be dissipated for efficient lifetime operation. Overly aggressive cooling can result in condensation on the optical elements in the LOS that can cause output brightness loss. Christie solves this with a control circuit that can detect moisture levels using a humidity sensor, automatically adjusting system settings to prevent condensation and potential damage.



Robotic assembly of Christie Laser Optical System

### Laser longevity

All illumination sources, whether xenon or laser, degrade over time. Laser degradation is mostly attributed to two factors: temperature and power.

Laser diodes can achieve extremely high brightness. Their function is simple, and they can have a very long operational life. Christie has worked diligently with laser suppliers to understand and optimize the design parameters providing the best value for cinema use. A careful balance between laser temperature and drive level can reduce laser degradation and ensure long life.

## Temperature

Lasers operate more efficiently at lower temperatures. This means lasers can achieve greater brightness (lumens per watt) when they are adequately cooled. Maintaining a low ambient temperature in the projection booth is important for long laser lifetime. For the best results, Christie recommends a maximum booth temperature of 25°C (77°F).

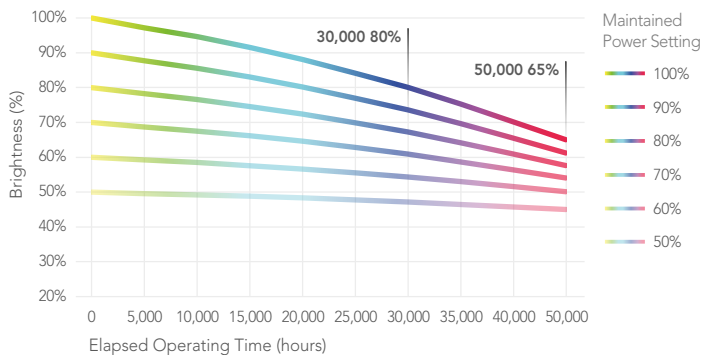
The Christie LOS employs advanced cooling plates and heat exchangers to efficiently remove heat from the laser diodes. The temperature for all three laser colors are controlled, but red lasers are the most sensitive to temperature fluctuations. Christie uses specific thermal management techniques to keep red laser diodes at optimal operational temperature.

## Power

The power level that lasers are driven at have a big effect on the lifetime of the laser diode. The result of excessive drive current will initially appear as optical damage on the microscopic reflective surfaces that exist at the ends of the laser diodes. Performance of the laser cavity gradually decays resulting in a negative impact to the laser's efficiency. Lasers require additional power to maintain initial brightness levels as they age.

### Estimated Brightness Drop-off

Different Maintained Power Settings



The graph above shows the laser output degradation for six different maintained power settings. If the projector is initially turned on to 100% of its brightness, it will degrade to about 80% of its original brightness at 30,000 hours of operation. If the same lasers are used at a lower initial power setting, the brightness output decreases at a slower rate. Christie RGB RealLaser projectors feature our renowned LiteLOC™ technology, which has innovative algorithms that can control power settings optimizing laser lifetime.

## LiteLOC™

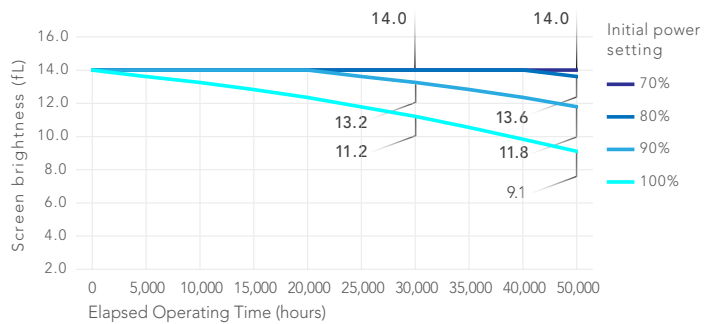
Christie's LiteLOC technology senses light output and adjusts laser drive power for constant light output while always maintaining white point accuracy. When the laser power setting reaches 100% of its capability, the brightness output begins to decrease.

Brightness headroom is very important to consider when selecting a projector that can accommodate light level requirements for a specific screen. LiteLOC uses this headroom to compensate over time for aging lamps or lasers. In the graphs below, starting the laser at less than its maximum power initially yields favorable lifetime results. A typical cinema application with about 20% headroom where you start at about 80% power setting, should maintain that initial brightness level for at least 50,000 hours with proper environmental controls. Environmental controls include maintaining the recommended booth ambient temperature and humidity along with a clean, dust-free environment.

The following graph shows a few different initial power settings and how LiteLOC can maintain brightness before reaching the lifetime limit condition.

### Maintaining brightness

Starting at different power levels, using LiteLOC to maintain brightness



## Conclusion

Christie cinema projectors have always been designed with stringent industry performance requirements in mind. The RGB RealLaser cinema projectors featuring innovative LOS and LiteLOC technologies are no different. These new Christie innovations optimize and protect the entire system from manufacturing to operation. Brightness output, power levels and white-point accuracy are maintained against variations in operating environment for a long and trouble-free life.

Peak efficiency is the perfect balance of economy and performance.

## Pioneering RGB laser projection:

- ✓ Cinema industry's first deployment of RGB laser projectors (CP42LH) in 2014
- ✓ Cinema industry's first integrated RGB laser projector without an external chiller (CP4325-RGB) incorporating Christie's RealLaser technology
- ✓ Cinema industry's only 2K RGB laser projectors (CP2315-RGB and CP2320-RGB)
- ✓ First and only true HDR capable RGB laser cinema projection system (used in all Dolby Cinema installations)
- ✓ First "maintenance free" laser illumination technology

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CD3836-LOS-Lifetime-White-Paper-Aug-23-EN

