



lumencor®

LIGHT FOR LIFE SCIENCES

SUSTAINABLE LIGHTING

BRIGHT. CLEAN. **GREEN.**

LIGHT ENGINES

MERCURY-FREE

LIGHT FOR LIFE SCIENCES

The **BEST** new light in fluorescence illumination.

Lumencor's light engines employ
SOLID STATE technologies to provide:

- Powerful and intense light
- Spectral breadth and purity
- Fast switching speed
- Long lived, stable outputs
- Mercury-free, efficient products
- Cool, clean, compact & easy-to-use box





The need for **MERCURY-FREE** lighting for sciences

The mercury arc lamp has long been used as a fluorescent microscope light source because of the bright spectral bands available within the visible wavelengths. The vast majority of new research or clinical grade fluorescent microscopes are equipped with a mercury arc lamp.

However, mercury arc lamps are:

- Hazardous
- Consume a lot of energy
- Have a high cost of ownership
- Unreliable.

Metal halide doped mercury arc lamps have become widely employed because they address the reliability concerns around traditional mercury bulbs, increasing bulb longevity ten-fold. Unfortunately, metal halides contain about three times higher mercury concentration than traditional mercury bulbs. Ozone-free Xenon sources have no mercury, reducing amount of hazardous waste. But they perform at a lower intensity.

Solid state technologies, like LED illumination, have the potential to solve all the concerns associated with the use of mercury. But LEDs alone have yet to achieve the brightness needed for microscopy. Thus, the use of mercury lamps has remained a necessary and wide-spread source of mercury in research laboratories for decades. This is despite the notorious detrimental environmental and health hazards of mercury.

Lumencor has overcome the frustration associated with this dependence on mercury and revolutionized the solid state technology world by manufacturing Light Engines capable of replicating and exceeding the spectral properties of the mercury arc lamp.

In so doing, Lumencor has obviated the toxic disadvantages previously associated with microscopy. Light Engines allow scientists to utilize high-performance, solid state, sustainable lighting solutions in clean, safe laboratories using mercury-free microscopes.

a light engine

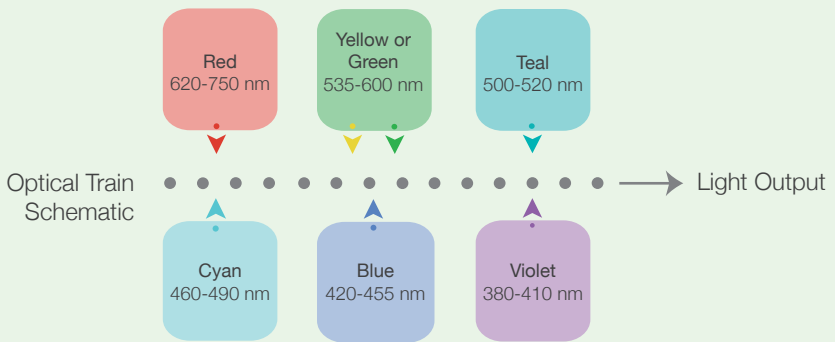
IS A HYBRID OF SOLID STATE TECHNOLOGIES

Lumencor's proprietary light engines are excitation subsystems.

They Include:

- Up to six light sources with a single, aligned output
- UV-VIS light with optional NIR
- Optics to tailor the spectral output and direct the light
- An optical adapter to couple the light to an instrument (i.e., a microscope)
- Electronics to support spectral, temporal and quantitative control of the light

Multiple Light Engine Sources



NOTE: Optional NIR source available.

The optics and mechanics of coupling are optimized for a microscope, high content screener, gene expression chip reader or for a customized instrument. All these elements combined constitute a light engine. They are considered in each design and included in the purchase price.

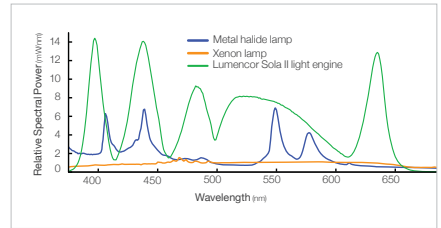
Lumencor's technology incorporates the use of a variety of solid state sources in one optical train. Any one light engine can embody as many as three types of sources: LED, light pipe and laser. Lumencor employs these sources in customized designs to meet the wide array of spectral and power demands on the part of the end user. This flexibility means optical designs can readily be tailored to provide outputs from 370 to 900 nm. Lasers are employed as needed or specified by the user. Laser speckle patterns are eliminated. Modular in design, configured in many ways, lighting systems are designed to best meet the requirements of the user.

LUMENCOR

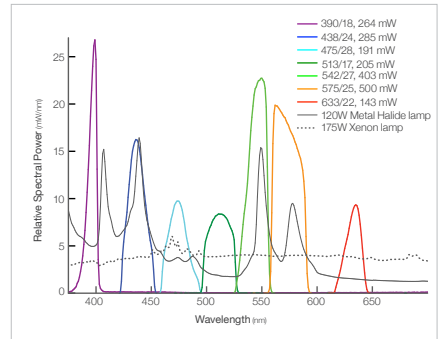
manufactures both spectrally pure outputs and bright white lamps

Lumencor's illuminators are designed to support the broad and varied need for high performance lighting throughout the life sciences. Discrete color bands are available for excitation of any of the numerous fluorophores of interest. Bright, white light is produced as a solid state alternative to the arc lamp. Light engine power levels match or best those of comparable metal halide and Xenon lamps. Light engine outputs require no compromise in power, while offering the added benefits of stability, durability and ease of use. Solid state, white light engine spectral outputs span the range of 380 to 680 nm. The SPECTRA family of light engines outputs can be tailored to provide discrete VIS and NIR bands. Instant on/off switching, (manual or electronic), means no warm-up or cool-down waiting periods that are required for traditional bulb-based, mercury containing lamps.

SOLA light engine



SPECTRA light engine



LIGHT FOR LIFE SCIENCES

ENERGY CONSUMPTION

light engine uses **LESS** power

Typical mercury arc lamps stabilize 30 minutes post-ignition and require a 30 minute cool-down before re-ignition. This necessitates most microscope operators to keep the lamp lit when illumination is not needed which draws a significant amount of unnecessary power. Data demonstrates that a 130W metal halide lamp requires 160W in a typical microscope core facility, while a light engine operates at an average of 5W. Light Engines have instant on/off excitation so that energy is consumed only when illumination is needed. For example, if an experiment requires illumination for one second every hour over three days, an arc lamp would be required to be on for the entire 72 hours. In sharp contrast, a light engine would be on only 72 seconds. The table below shows that because of the operational conditions of each light source, light engines use 1000% less energy and dramatically lower the carbon footprint of the instrument.

Statistic	130W Metal halide lamp	Lumencor light engine	Difference
ON Time	72 hrs	72 sec	3,600x
Energy Use	11.5 kWh	0.0001 kWh	115,000x
CO2 (2 lbs/ kWh)	23 lbs	0.0002 lbs	115,000x
Unit Lifetime Use	4%	0.0001%	40,000x
Operational Cost	\$25.78	\$0.02	1,610x

Mercury Bulbs = \$0.75/hr | Metal Halide Bulbs = \$0.35/hr | Light Engines \$0.25 - \$0.80/hr
Energy use based on third party empirical measurements. Unit lifetime of 2000 and 20,000 hrs for lamp and light engine. Operational cost based on average 5¢/kWh.

COST OF OWNERSHIP

the light engine is
LESS expensive

As a result of high operating temperatures, mercury arc lamps suffer from frequent burn-out and replacement of a relatively expensive bulb. This notorious shortcoming is further magnified during the lamp's employment, by the need for the user to burn the lamp when not in use to avoid stability constraints. Replacing a mercury arc lamp with a light engine reduces the ON time of the system from 100% duty cycle to actual time consumed in making an observation or recording a data point. This benefit is a result of the inherent stability of the light engine in allowing for a system's operation in an ON/OFF mode. The following table estimates the cost differential between a microscope equipped with a mercury arc lamp vs. a light engine.

MERCURY LEVELS OF BULBS

only the light engine is
MERCURY free

Calculations demonstrate that a single light engine can replace 15-150 mercury containing bulbs. This assumes that the mercury arc lamp is ignited but idle during half the time it is in the ON state. The table below illustrates the amount of mercury contained within these sources. The mercury is the equivalent of 9762 CFL bulbs and the metal halide lamp is the equivalent of 1242 CFL bulbs. By comparison the light engine eliminates nearly all potential mercury hazards associated with the use of illumination in scientific equipment, while providing superior performance.

Statistic	Mercury arc lamp	Metal halide lamp	Light engine
Replacement Bulbs	150	15	0
Total Bulb Costs	\$22,500	\$10,500	\$0
Total Energy Costs (\$0.05/ kW/hr)	\$1,600	\$1,600	\$50
Total Disposal Costs (\$5/ bulb)	\$750	\$75	\$0
Total Management Costs (15 min. @ \$10/hr)	\$375	\$38	\$0
Cost of Ownership	\$25,225	\$12,213	\$50
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Bulbs	150	15	0.00
Mercury/ Bulb (g)	0	0.34	0.00
Coal Emission/ Bulb (g) (0.023 mg/ kW/hr)	0.74	0.74	0.00
Total Mercury (g)	126.90	16.14	0.00



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