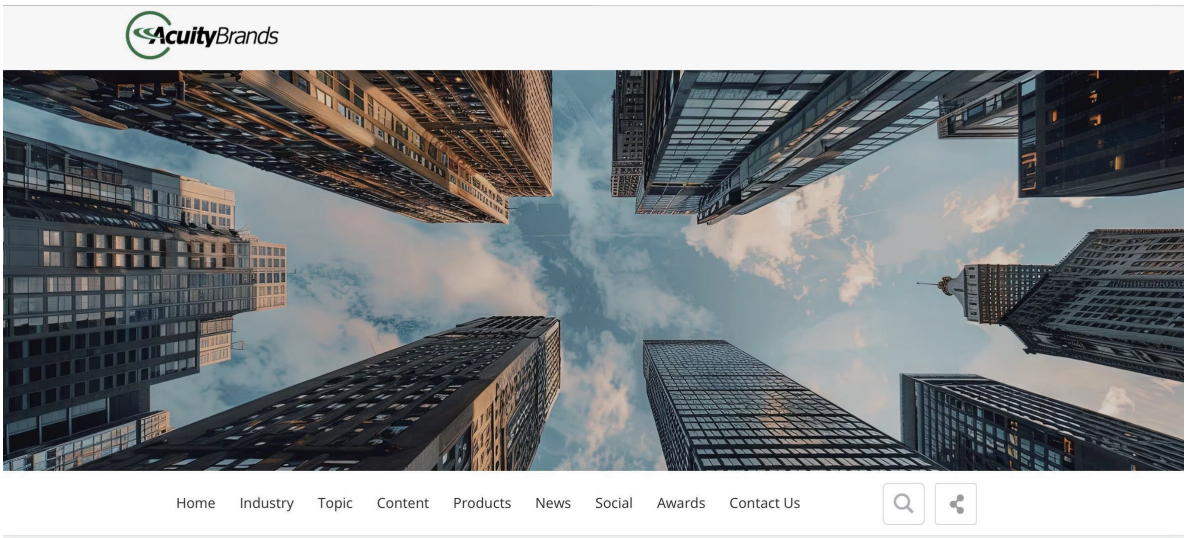
Topic 11




# Article: LED Driver Lifetime: Economic and Environmental Issue

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In commercial lighting, the cost of a new installation is closely observed. The efficiency of a new lighting is also a critical parameter given the power for lights is normally the largest contributor to the running costs of a large office building.

What about repair and replacement cost? And its correlation with the lifetime rating of the lighting fixtures, and of the components inside them? These are complex sums to estimate and require a thorough understanding of a fixture's failure risk in the installation's specific operating conditions. The factors are also harder to assess and calculate than the straightforward purchase price of lighting equipment and the cost of its energy usage.

## The Standard Lifetime Rating

This is why the lighting industry makes widespread use of the standard one-size-fits-all lifetime ratings specified by industry bodies such as the DesignLights Consortium (https://www.designlights.org/) (DLC). Its requirement for compliant lighting fixtures is a minimum 50,000-hour lifetime rating—which is at least 5.7 years of continuous 24/7 operation at full power.

In fact, the industry could benefit from a deeper understanding of the factors which affect the lifetime of an LED luminaire and of its LED driver—the component which poses the highest risk of failure.

This understanding can help designers, specifiers and building operators to reduce an installation's repair and maintenance costs and to improve reliability.

If it can succeed, it has a beneficial impact both on the user experience and on the industry's contribution to the more sustainable use of the planet's resources. As you'll see, **there is much more to the lifetime of a luminaire than a standard 50,000 hour rating.**

## Critical Determinants Of a Fixture's Lifetime

Every LED fixture consists of the three standard elements: 1) an LED light engine 2) an LED driver and 3) a system assembly—the PCB, enclosure, fasteners and so on.

The light engine and assembly have almost no impact when estimating the fixture's lifetime. High quality LEDs suffer almost no total failures—so their main failure mode is lumen depreciation. This occurs over such long timescales that it has no material impact on most installations. Likewise, you can specify plastic and metal components—such as enclosures and screws— to provide practically an infinite lifetime.

## Why LED Drivers Fail First

All this said, the LED driver is the most influential factor when it comes to a fixture's lifetime and the mostly likely to fail first. This is because the LED driver is a complex system—typically containing more components than a modern TV.

There's two stressors which cause failure in all types of electronic systems: heat and power. The lifetime of an LED fixture is, to all intents and purposes, the same as the lifetime of its driver.

## What an LED Driver's Lifetime Rating Means to Designers and Specifiers

The DLC specification—which sets a minimum luminaire lifetime of 50,000 hours of operation at full power—is heralded as the standard requirement industry-wide for commercial installations.

To maintain trust in the standard, the DLC imposes strict specifications for testing a luminaire's compliance in simulated conditions. This accelerates system failure by exposing luminaires to thermal stress. DLC-compliant fixtures contain an LED driver which also offers a 50,000 hour minimum lifetime verified after accelerated lifetime testing.

**LED Driver Lifetime Value Example: eldoLED SOLOdrive**

What information can you draw from a driver's 50,000 hour rating? Let's use one of our LED drivers as an example: SOLOdrive 360A (https://eldoled.com/products/detail/1992718), a single-channel, 30W driver. Page 7 of our datasheet provides a simple statement:

> ***Lifetime: 50,000 hours at a maximum case temperature (Tc) of 85°C***

The 50,000 hours statement gives our customer confidence that our driver is consistent with the DLC lifetime standard—but what does the qualifier, 'at a maximum case temperature of 85°C/185°F' mean? eldoLED marks a point on the enclosure of every driver at which a temperature probe should measure this case temperature.

## Why Temperature Matters for LED Driver and Fixture Lifetime

Temperature specification is crucial because heat is the force that accelerates component failure. On the same page, the datasheet also states that the maximum allowable case temperature is 85°C/185°F—so the fixture manufacturer should have implemented a design that includes temperature protection measures. Ensuring that the case temperature never rises above 85°C/185°F.

What if the application case temperature is on average 75°C/167°F? An engineering rule-of-thumb: For every 10°C reduction in temperature, the lifetime doubles. In this application, the minimum lifetime will be 100,000 hours—almost 11.5 years of

continuous operation—versus 50,000 hours. Likewise, if the average case temperature is 65°C/149°F, the lifetime of the SOLOdrive 360A will be 200,000 hours.

### Considerations for Fixture Manufacturers, Lighting Designers and Building Operators

This has two important implications for fixture manufacturers, lighting designers, specifiers and building operators.

### 1. Check the LED Driver Lifetime (and Temperature)

**The first** is that it is a good precaution to check the lifetime rating of the driver inside any fixture that is under evaluation. If the fixture is DLC-compliant, the driver will carry a 50,000 hour rating—but at what case temperature?

A rating of 50,000 hours at a Tc of 65°C can be achieved much more easily with cheaper components and a less well engineered design versus 50,000 hours at 85°C. If the application is subject to thermal stress – this is true for instance of exterior lighting operating in hot and sunny equatorial or tropical climates – then the case temperature might be continuously at or even higher than 65°C.

By insisting on a driver with a 50,000 hour rating at a high case temperature, the specifier can provide greater headroom in the system design and in the installation to cope with operation at higher temperatures without compromising the application's lifetime requirement.

### 2. Choose Factors That Affect Case Temperature Wisely

**The second** implication is the lifetime of the driver is also determined by real-time choices that the fixture manufacturer, the designer, specifier and/or installer make. Those choices directly affect the case temperature—and ultimately the lifetime. These choices include:

- **Fixture Enclosure Design**: Is the system tightly packed inside the enclosure or is there room for cooling air to circulate?

- **Thermal Dissipation Provision**: Affixing a heat sink to the driver increases the rate of heat dissipation to the ambient environment —lowering the case temperature

- **Driver Supply Load**: By leaving some headroom below the maximum rated power output of the driver, the fixture manufacturer reduces the electrical and thermal stress on the driver

- **Fixture Position:** The simple measure of mounting the fixture in shade rather than in direct sunlight reduces its operating temperature and extends its lifetime

What this means is that the lifetime rating in the LED driver's datasheet and the fixture's compliance with the DLC 50,000 hours requirement are not a definitive guarantee of the lifetime of the luminaire. Rather, they are a scientifically tested data point which allows the user to calculate an exact estimate of the lifetime of the luminaire when used in the conditions specific to their application.

### How to Evaluate Competing LED Drivers for Lifetime Value

The 50,000 hour lifetime rating, then, is one important indicator of a driver's reliability. If all reputable drivers offer a 50,000 hour rating, how can you compare the reliability of competing drivers?

As stated above, take note of the case temperature qualifier to the 50,000 hour statement. The higher the case temperature, the longer the driver's lifetime under any given operating conditions.

Evaluation can also take account of other standard measures of reliability. Some drivers' datasheets will display a Telcordia (https://www.reliasoft.com/resources/resource-center/mil-217-bellcore-telcordia-and-other-reliability-prediction-methods-for-electronic-products) lifetime rating, a calculated measure derived from analysis of all the components inside a system.

Prospective buyers can also learn from the lived experience of users. We pride ourselves on providing reliable LED drivers in the field. As in any other field of technology, high quality of design and components results in high reliability and a long operating lifetime.

**Quality of Light Is Key for Designers and Specifiers**

The eldoLED Experience | Quality of Light Introduction - YouTube (https://www.youtube.com/watch?v=6bmlFrik60U&list=TLGG2mfC0oKk0SUxNTExMjAyMw)

Of course, reliability and lifetime are rarely the primary decision factors for lighting designers and specifiers. The user experience is most strongly affected by the Quality of Light. Specifiers and Lighting Designers alike typically look for smooth and safe dimming. This includes Dim to Dark capabilities, accurate and consistent color tuning in dual- or multi-channel systems and compatibility with all common control interfaces.

**Benefits of Longer Driver Lifetime**

The growing importance in the lighting industry of the concepts of lifetime value and sustainability are a valuable counterweight to the throwaway culture that's evident in developed world economies. Sophisticated electronics devices such as smartphones, tablets and laptop computers are often treated as though they are obsolete after as little as two or three years of use.

Groups such as the GreenLight Alliance (https://www.greenlight-alliance.com/) are pushing the lighting industry in the opposite direction. Moving towards design and manufacturing approaches extending life of installed equipment as long as possible. This more sustainable approach reduces the industry's use of materials and the amount of waste going to landfill or for recycling.

Specifiers and lighting designers have an important role to play in sustainability—as their demands will drive luminaire manufacturers to design for longer lifetime. The specification for lighting at the Scottish Parliament building in Edinburgh—the lifetime requirement for fixtures is 25 years—sets an example that others

can follow. By combining a high-quality LED driver with design features that extend lifetime (i.e. active cooling), you can specify new installations for lifetimes far beyond 50,000 hours.

### How Real-World Lifetime Benefits the End-User

Extending real-world lifetime also benefits the user because it reduces the risk of the premature failure of a fixture. Every failure leads to a temporary impairment of the space's illumination and a disruption of the intended lighting experience. The shorter the lifetime, the higher the repair and maintenance costs to which the building operator is exposed.

### The Future for IoT and Lifetime Ratings

Today, an LED driver's lifetime rating is a once-only value which applies to a newly shipped product before its installation. In the future, a lifetime rating could become a real-time, dynamic value that reflects the conditions in which the driver operates.

This is the promise of the IoT in lighting. Smart, connected driver products will feature data-rich telemetry, continuously tracking key parameters such as case temperature, power output and operating time. Connected to the cloud, the driver can upload this telemetry data to an application which will calculate in real time the impact on driver lifetime.

Users can then log in to the cloud to monitor periodically the remaining lifetime of the driver and adjust repair, maintenance and replacement programs accordingly.

At eldoLED, this new era of the IoT in lighting also offers the enticing prospect of building a real-world data set of driver reliability and lifetime data. By aggregating data from across a fleet of installed drivers, we'll be able to track actual lifetime data from installed devices and compare it to its lifetime estimates derived from accelerated high-temperature testing on new products.

This offers the potential to fine-tune both its lifetime ratings for new products, and to refine driver designs to eliminate failure modes and at-risk components, and so to improve reliability beyond even the high levels achieved in today's products.

**Quality and Reliability Hand-In-Hand**

The eldoLED brand promise is to provide users with high-quality digital lighting components that emulate natural light and expand superior lighting across all application spaces. This high quality is reflected in the lighting performance of the drivers—the smooth and predictable way they dim, and the precise control of power to produce accurate color tuning.

It also underpins the superior lifetime ratings of eldoLED drivers at case temperatures up to 85°C/185°F and in the products' reputation for high reliability. Whether to reduce operating costs or to contribute to a more sustainable future, the long lifetime of eldoLED drivers provides benefits across the board, for designers, specifiers, building operators and end users.

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