

Understanding the Lifetime of
**Finelite's
High Performance
LED Luminaires**

By Terry Clark, Chairman and Chief Technology Officer of Finelite

LED luminaires can be far more complex than other light sources when it comes to developing luminaires that are glare-free, easy to maintain and most importantly have a lifetime that meets the potential of the source. Achieving long lifetimes requires a rigorous testing process and an understanding that the life of the luminaire is more than just how long the LED itself will last. All the components of the LED luminaire must be reviewed and designed to last for decades.

Source: U.S. Department of Energy "LED Luminaire Lifetime document on Recommendations for Testing and Reporting." Download the pdf directly from the DOE website. www1.eere.energy.gov/buildings/ssl/advocates.html.

The document can also be downloaded from Finelite's website at www.finelite.com/sustainability/lighting-links.



Unique components of a LED luminaire

STEP 1: Assemble the Data

The first step is to assemble the necessary independently verified data, including:

- LM-79 Performance
- In-Situ temperature measurements
- LM-80 data on LED chip
- DesignLights™ Consortium data
- Temperature specification on LED supply and LED

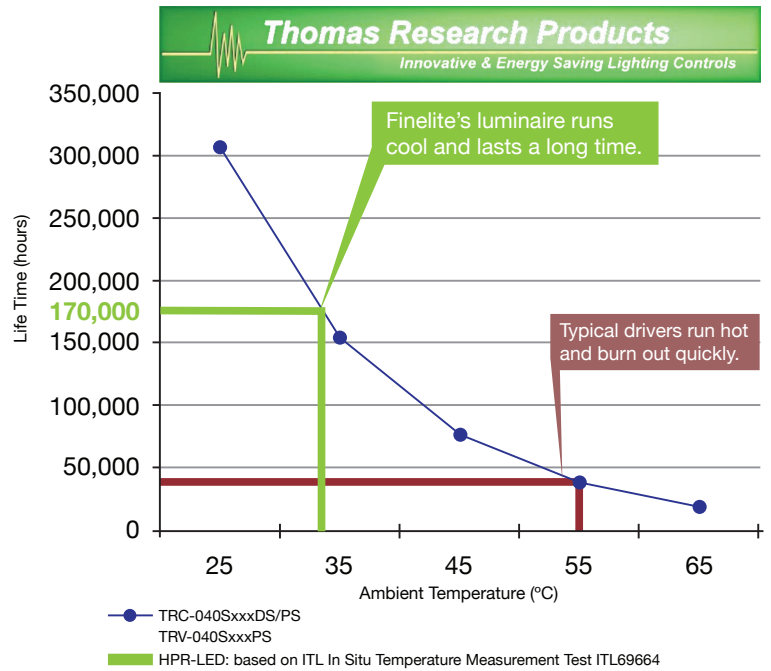
Independent LM-79 testing is used to measure drive current and temperature at the LEDs and the driver.

Thermocouple Location	Temperature in Degrees C	Temperatures Corrected to Reflect a 25°C Ambient
T _A (ambient)	26.0	25.0
T _{LD1} (LED1)	51.2	50.2
T _{LD2} (LED2)	52.0	51.0
T _{LD3} (LED3)	54.4	53.4

STEP 2: Review Each Component

LED DRIVER

The first component you look at is the driver. Luminaire design is very important in extending driver life. The lifetime curve for drivers is based on the ambient temperature within the luminaire and the chart to the right shows that running the driver hot (50-55 degrees C) results in a life of around 35,000 to 50,000 hours. When you run the driver cool like the HPR-LED does, the lifetime is expected to exceed 170,000 hours. Running the driver at 700 mA means the driver can run cooler and extend the expected life to well beyond 170,000 hours.



"When you run a driver this cool, the life of the system becomes extremely long," says Glenn Garbowicz – General Manager of Thomas Research Products

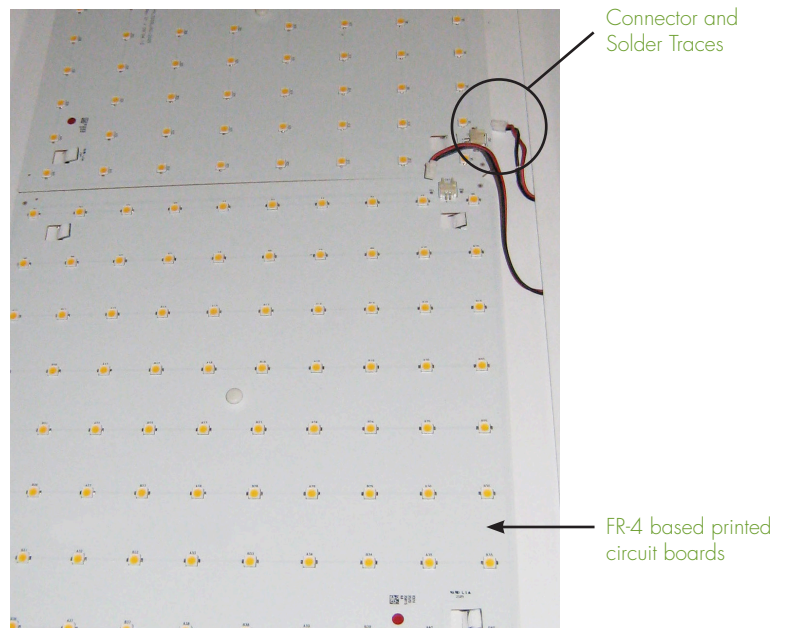
LIGHT ENGINE COMPONENTS

The stability of the light engine components is the next element in determining the luminaire life. The light engine is broken down into the board material, solder traces, plug connectors between driver and light engine, and the mid-power LEDs.

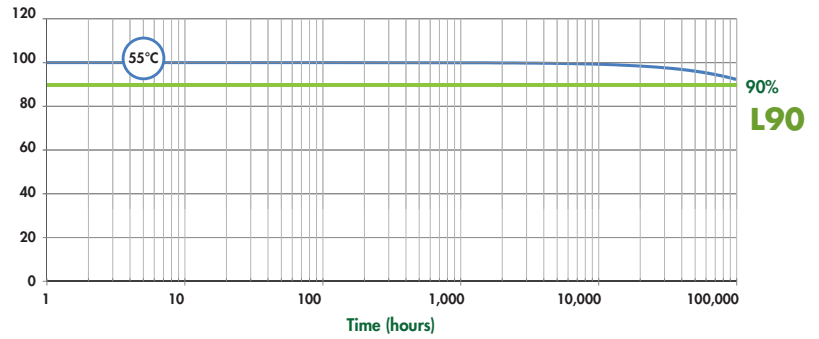
Board Material: High Performance Recessed (HPR-LED) uses FR-4 based printed circuit boards which have excellent thermal properties and are incredibly stable over time.

Solder Traces: Solder traces can creep over time when exposed to cycles of hot and cold temperatures. The ambient temperature in the ceiling plenum is relatively stable so this is not a factor with indoor luminaires.

Plug Connectors: Connectors between the driver and light engine are very durable and rated for input exceeding what High Performance Recessed (HPR-LED) delivers yielding long life.



Mid-powered LED's: Finelite works closely with the LED manufacturer to develop the right technology for long-lasting luminaires. Long life is achieved through the use of the mid-powered LEDs operating at 70 mA. This design yields lower overall temperatures, as recorded in the LM-79. The combination of low drive current and low temperature will deliver 90% of the initial light output at 100,000 hours.



		Lumen Maintenance (%)			
If(mA)	Tj(°C)	0h	10,000h	30,000h	100,000h
70	55	100.0	99.2	97.6	92

Mid-powered LEDs are driven at 70 mA. The LED manufacturer used this information and the measured junction temperature (Tj) to predict the lifetime of High Performance Recessed (HPR-LED) at 100,000 hours to 90% light output.

COLOR

The proprietary fabrication approach used by Finelite ensures excellent initial color consistency from luminaire to luminaire. Low operating temperature combined with 70 mA drive currents ensure color consistency over its operating life.



Color consistency is tested at the LED manufacturer and luminaire manufacturer.

DIFFUSER

Diffusers must also withstand the test of time and not yellow or crack. High Performance Recessed (HPR-LED) diffusers provide the appropriate balance of glare control and light transmission to yield very efficient luminaires. The lenses have been tested extensively with T5HO lamps that emit ultraviolet radiation and do not yellow over time. As LEDs emit no UV the lens material will be even more stable and easily last 100,000 hours.



Diffuse Center Optic (DCO)

PAINT

The finish of luminaires must be able to withstand years of exposure to light and possibly heat without degrading (yellowing or cracking). High Performance Recessed (HPR-LED) is finished with a durable powder coat paint finish that has been developed specifically for luminaires and used by Finelite for many years. This finish has proven to maintain its integrity and not yellow or degrade over time. The paint is applied after fabrication to ensure the forming process does not create defects in the finish.



Durable high reflectance powder coat paint is applied after fabrication and reflectivity is tested.

GASKETS

Even the smallest details must be factored into the design of LED luminaires. Luminaires require gaskets to keep the interior clean over time which ensures the light output remains stable. The High Performance Recessed (HPR-LED) luminaire uses gaskets constructed of high density pile material that will remain stable over time and not crack like foam gaskets.

STEP 3: Understand the Luminaire Serviceability and Warranty

SERVICEABILITY

Developing a luminaire to last 100,000 hours is really just the beginning. Buildings across the country have fluorescent luminaires that have lasted far longer through routine maintenance. Developing a long life luminaire requires a design that can be easily serviced from below ceiling. High Performance Recessed (HPR-LED) light engines and LED power supplies are as easy to replace as those found in fluorescent luminaires.



WARRANTY

Beyond examining LED luminaire design, customers considering LED luminaires should also look at the warranty offered by the manufacturer. Finelite is absolutely confident in the robust design of our High Performance Recessed (HPR-LED) luminaire and provides a 10-year warranty on the luminaire housing, driver and light engine. Should the luminaire fail to deliver 90% light over the 100,000 hour life Finelite will replace the driver and/or light engines.



SUMMARY

Finelite luminaire design takes into consideration all the elements from the LEDs to the paint finish and has tested and proven each of these components will stand the test of time. We are very confident that the robust design of the High Performance Recessed (HPR-LED) luminaire will last considerably longer than 10 years. Supporting the luminaire with a 10-year warranty is the logical result for any responsible manufacturer to reach.



Q: Can we get this Data?

A: Yes, download LM-79 data at www.finelite.com. Out of respect for our LED partners contact us (510) 441-1100 for LM-80 data.

Q: Where does TM-21 fit in?

A: TM-21 is a technical memorandum from the Illumination Engineering Society of North America (IES). It is a methodology for estimating lumen maintenance of an LED using data from the LM-80 report. Currently 6x the test duration has been approved for use. Projected lumen maintenance can exceed reported lumen maintenance. Warranties should be based on projections for each key element of the luminaire and not limited by TM-21 reporting conventions.

Q: How will you track luminaires for 10 years?

A: Finelite puts unique identification numbers on every luminaire that tracks the project. We can identify the exact date the luminaire was manufactured and shipped. Customers need only use this information to communicate with Finelite who will provide replacement parts matching the existing product.