

TM-21 and Lumen Maintenance Projections: What the 100,000+ Hour Projections Really Mean

- Three main reports pertaining to LED quality and performance: LM-79, LM-80 & TM-21
- LM-79 examines end product to determine operating environment LED's are subjected to and performance specifications
- LM-80 is issued by the LED manufacturer and measures how quickly light output decreases, not how long LED's will last
- TM-21 takes LM-79 and LM-80 reports and determines likely duration LED's will operate until particular level of light loss occurs in the operating environment of the product being analyzed

Full Discussion

There are three reports that are commonly referred to which pertain to the LED quality and predicted performance; the LM-79, LM-80, and the TM-21.

- a) *IES LM-79-2008, Approved Method for the Electrical and Photometric Testing of Solid-State Lighting Devices*
Specifies a standard test method for measuring the photometric properties of SSL devices, allowing calculation of luminaire efficacy.
- b) *IES LM-80-2008, Approved Method for Measuring Lumen Depreciation of LED Light Sources*
Specifies a standard method for measuring the lumen depreciation of LED's, allowing calculation of LED lifetime.
- c) *IES TM-21-2011, Projecting Long Term Lumen Maintenance of LED Light Sources*
Specifies a recommended method for projecting the lumen maintenance of LED light sources based on LM-80 collected data.

Source: Dept. of Energy Website

LM-80 is a report issued by the manufacturer of the LED stating the projected calculated Lumen Maintenance of the LED's. This is not a measure of how long LED's will last but rather how quickly the light output decreases in various operating environments.

The **LM-79** looks at the end product and determines the performance specifications (photometrics, CRI, CCT, Lm/W, power and in full reports the in-situ measure of the LED diode) of the product as well as the operating environment that the LED diodes are being subjected to.

The **TM-21** report then takes the information regarding the LED operating environment from the LM-79 and, based on the LM-80 manufacturer's data, determines a likely duration that the LED's will continue to operate until they have reached a particular level of light-loss. This is stated as an L90 figure (retains 90% of initial output), L70 figure (70% of initial output), etc.

While these 100,000+ numbers are valid projections of how long the LED's can function in the given operating environment, any number over 50-60,000 hours will have little to no actual bearing on how long the product itself is going to provide a useful function (47,450 hours = 10 years @ 13 hrs. per day).

Questions to Ask:

1. How was the temperature used in the TM-21 report chosen? From verifiable test data?
2. Was the test data for the LM79 and TM21 from a reliable source (Nationally Recognized Testing Laboratory – NRTL, a U.S. certified NVLAP lab from a known source such as provided by a TEMPO report from CREE, Inc., or other recognized U.S. accredited company with proper credentials)?
3. What number are they using; L70, L80, L90? An L90 value of 50,000 hours is much different than an L70 of 50,000 hours. As a side note; L70, or a 30% decrease in light level, is amount of change that it takes to be perceived by the human eye.

Why DEG?

1. DEG tested its products through globally known and recognized stalwart companies in the LED business (such as Cree, Inc.’s TEMPO and LM80), globally recognized Intertek, Inc., a fully accredited NRTL for UL/CSA/CE/IECEE Photobiological and LM79 tests and had an accredited lab perform its FCC certifications. DEG has performed extensive internal thermal testing, cycling and product-in-fixture testing at varying temperatures.

Below is DEG’s Evaluation Report from CREE, Inc.’s TEMPO test for the DEG-600750 LED HI-Bay lamp...should DEG report a 430,000 hour “product” life at 55°C? Some of our competitors would but this is related to the LED itself at a lower than normal operating temperature—this has nothing to do with the “product life” and overstates the LED life unless the product’s normal operating environment is proven to operate at the lower temperature(s).

CREE SERVICES Evaluation Report			CREE
LED	XLamp XM-L White		
I	2000 mA		
	Ts1	Tsi (Interpolated)	Ts2
Tsp	55°C	67°C	85°C
Tsp	328.15 K	340.15 K	358.15 K
Ea/kB	4270.48		
A	3.7998E-01		
α	8.471E-07	1.341E-06	2.520E-06
β	1.008E+00	9.995E-01	9.913E-01
Calculated L70	L70(6k) = 430,000 hours	L70(6k) = 266,000 hours	L70(9k) = 138,000 hours
Reported L70	L70(6k) > 36,300 hours	L70(6k) > 36,300 hours	L70(9k) > 54,400 hours
Calculated Lifetime		L90(6k) = 78,200 hours	
Reported Lifetime		L90(6k) > 36,300 hours	

DEG uses 85°C – L70

Table 16: TM-21 calculation summary table

⁷ LM-80 data set(s) provided by Cree SSL Reliability Lab, accredited under NVLAP Lab Code: 500041-0.

2. DEG understands the importance of accreditation and validation of its products to be successful in the LED market. It also favors taking a hard line on underwhelming and overstated products that proliferate the market—the loser in the end is the unknowing and uneducated consumer who is unaware of the many nuances and differences in LED quality, why test reports from recognized testing facilities are critical, and how to read the spec sheets (or lack thereof) and become knowledgeable enough to separate the “wheat from the chaff” in this still young and *Wild, Wild West* LED product market.

3. DEG is willing to stand up to the most challenging tests and market requirements—whether by the many utilities across the globe or local municipalities wanting a simple solution to save energy costs. We offer a view of all of our testing reports—redacting only the most sensitive and proprietary views of our products or data—and we believe any company that does not post this data or present full reports (redacted in a similar fashion to protect only highly sensitive proprietary material) should be questioned.

There are many factors to consider in determining whether a company’s “stated or rated life” is valid and this will be covered in the *Knowledge Segment* “Lifetime of the Product”.