



The LED Lighting Facts Lumen Maintenance Metric

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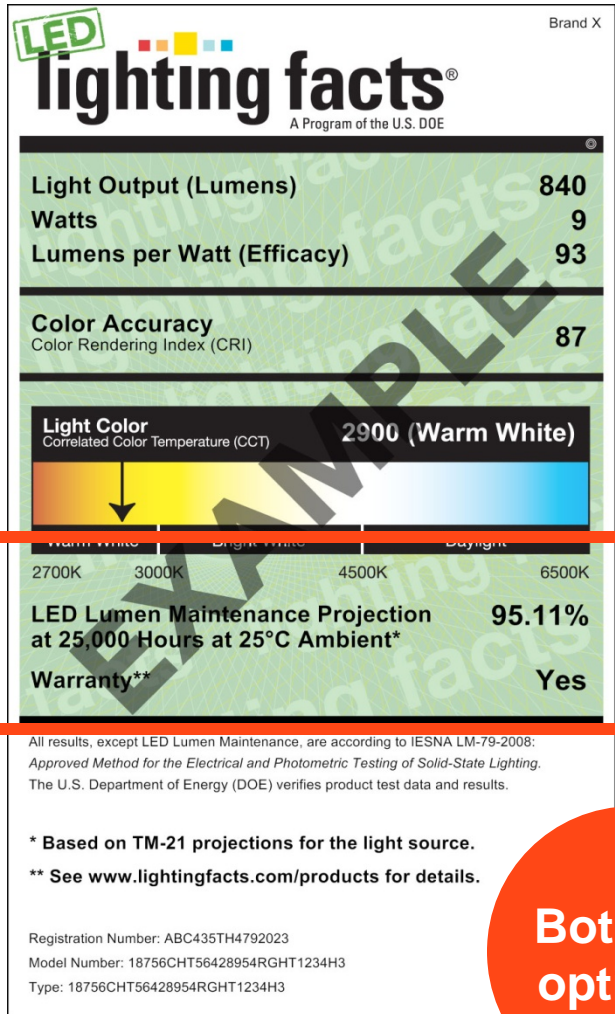
- Why it was developed
- Description of the metric
- What it means in the bigger reliability/lifetime picture
- How to list the new metric

Why develop a lumen maintenance metric?

- Continual need in the industry to verify products' long-term performance
- Very high lifetime claims in the market (50k hours—100k hours); no standard method to verify them
- LED Lighting Facts is a trusted program for delivering accurate, verified performance data
 - Follows standard methods as they become available
- TM-21 was released in August 2011 as a standard method to project LED lumen maintenance data
 - Allows some long-term performance information to be verified


L₇₀: not an ideal solution

- Industry has typically used L₇₀ to report lumen maintenance
- Can be a useful metric...
- ...but it is sometimes incorrectly extended to represent the lamp or luminaire's lifetime
- DOE's Reliability and Lifetime Working Group have published recommendations for alternative solutions
- At last year's Workshop, the reliability/lifetime panel suggested a shift from L₇₀ toward reporting lumen maintenance at a fixed time to avoid misconstruing long L₇₀ times as lifetime



Brand X

LED lighting facts®
A Program of the U.S. DOE

Light Output (Lumens)	840
Watts	9
Lumens per Watt (Efficacy)	93
Color Accuracy	
Color Rendering Index (CRI)	87
Light Color	
Correlated Color Temperature (CCT)	2900 (Warm White)
	
LED Lumen Maintenance Projection at 25,000 Hours at 25°C Ambient*	95.11%
Warranty**	Yes

All results, except LED Lumen Maintenance, are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

* Based on TM-21 projections for the light source.
** See www.lightingfacts.com/products for details.

Registration Number: ABC435TH4792023
Model Number: 18756CHT56428954RGHT1234H3
Type: 18756CHT56428954RGHT1234H3

Both are optional

1. LED Lumen Maintenance

- Listed as percentage of initial light output at 25,000 hours.
- Not a measure of *lifetime* (no standardized test procedure yet).
- Based on TM-21, the standard method for projecting lumen maintenance beyond the test period.
- Requires LM-80 testing of the light source and In-Situ Temperature Measurement Testing (ISTMT) of the light source inside the lamp or luminaire

2. Warranty

- Partners have the option of listing “yes” if a warranty is available.
- The specifics of the warranty are not stated
 - www.lightingfacts.com/products is referenced and users are encouraged to visit the manufacturer’s site for the full warranty statement.

Scope of the metric

- What this metric is, precisely:

The LED light source lumen maintenance while operating in the thermal environment of the lamp or luminaire.

- What this metric isn't:

A measure of lamp or luminaire lifetime or reliability.

- Does not take into account failure or degradation mechanisms beyond the LED light source (optics, driver, other electronics, mechanical, thermal management)
- No standard method yet

Projecting lumen maintenance with TM-21

TM-21 uses the longest-reaching LM-80 test data available and extrapolates to longer times for each case temperature

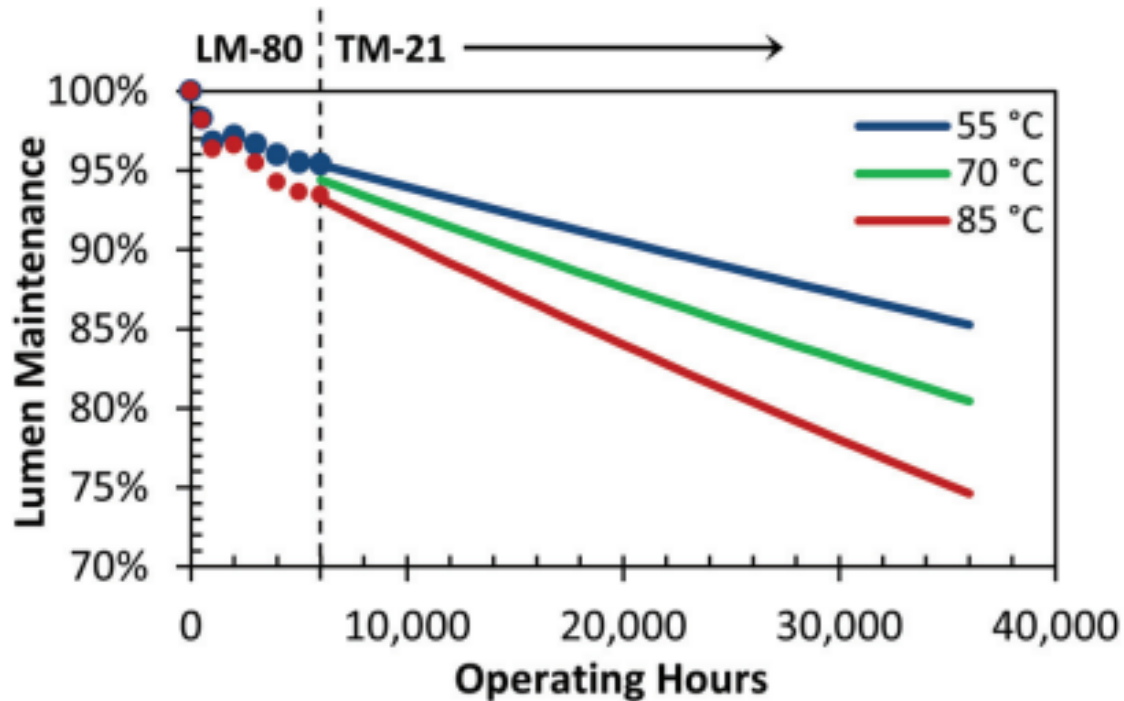


Figure 1. IES TM-21 extrapolation from IES LM-80 data

Projecting lumen maintenance with TM-21

L_{70} :

Fixed lumen maintenance level of 70%;
Solve for time

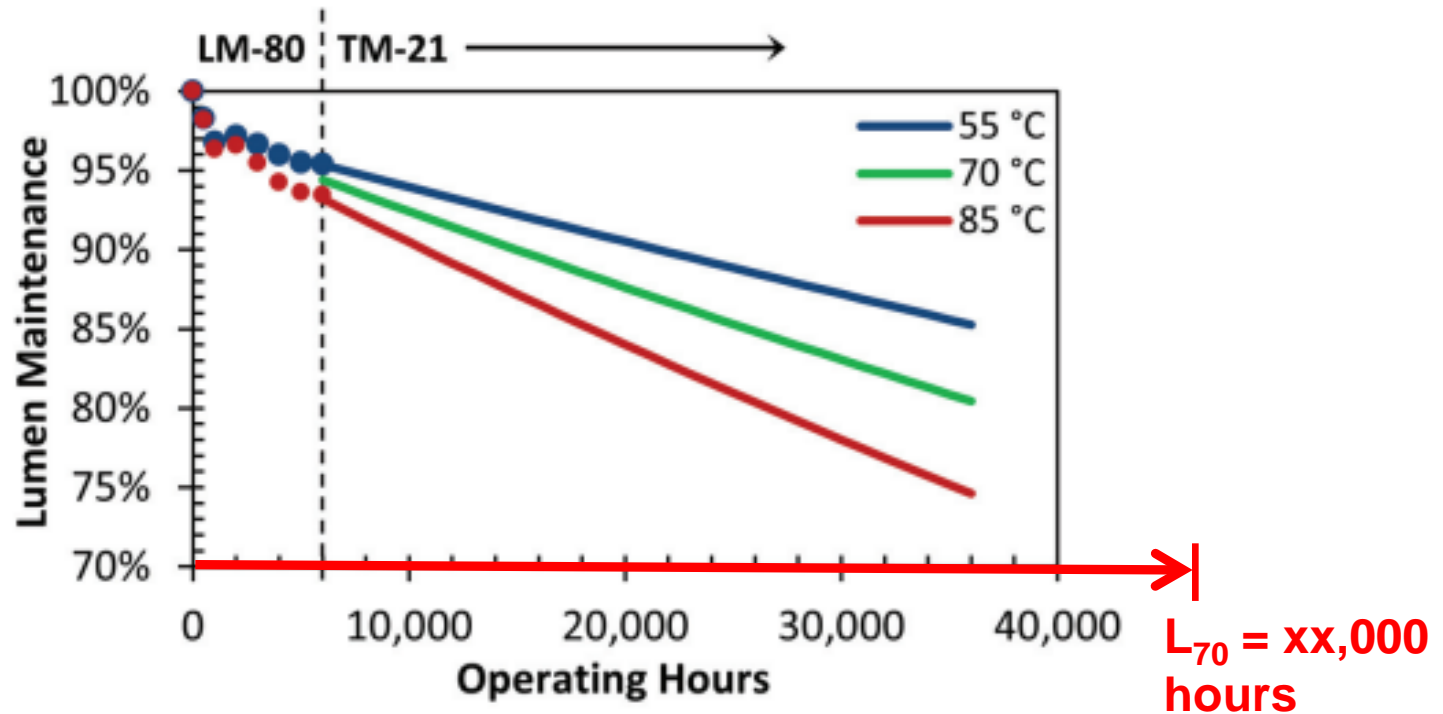


Figure 1. IES TM-21 extrapolation from IES LM-80 data

Projecting lumen maintenance with TM-21

LED Lighting Facts metric:
Fixed time (25,000 hours, 15,000 hours, or 10,000 hours);
Solve for lumen maintenance

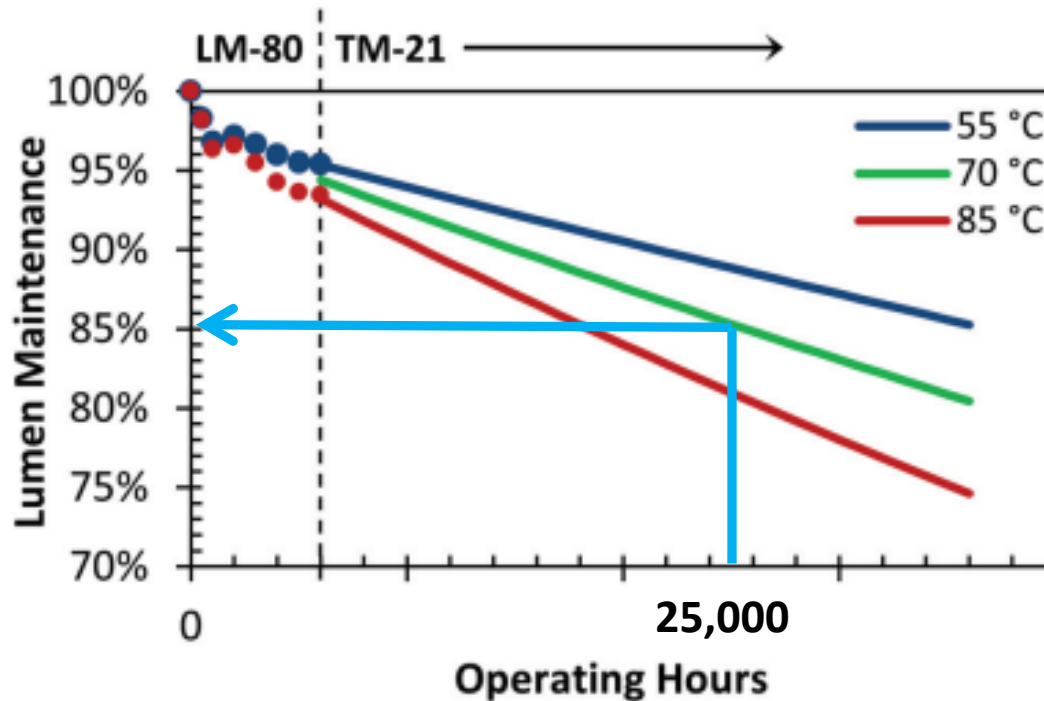
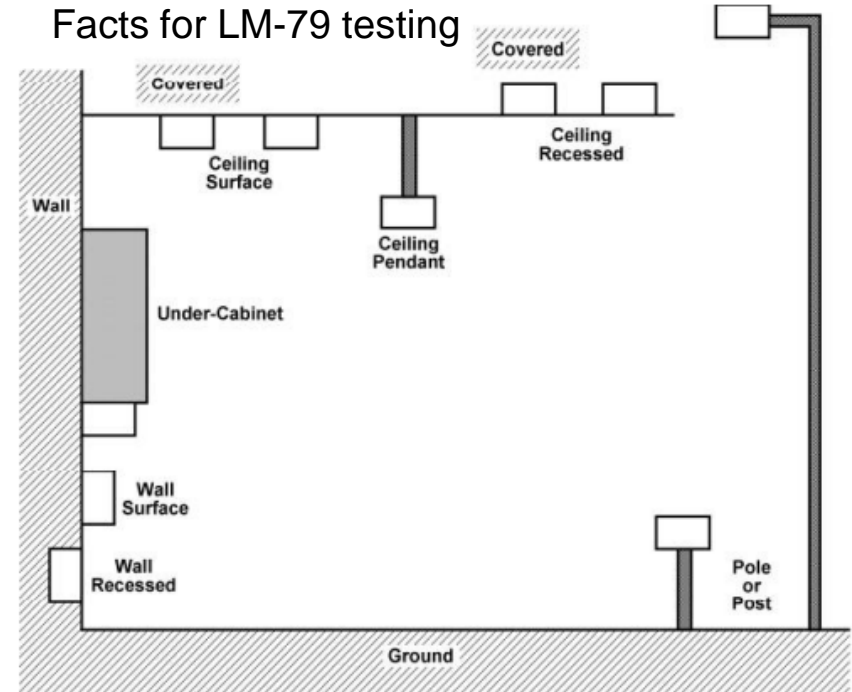
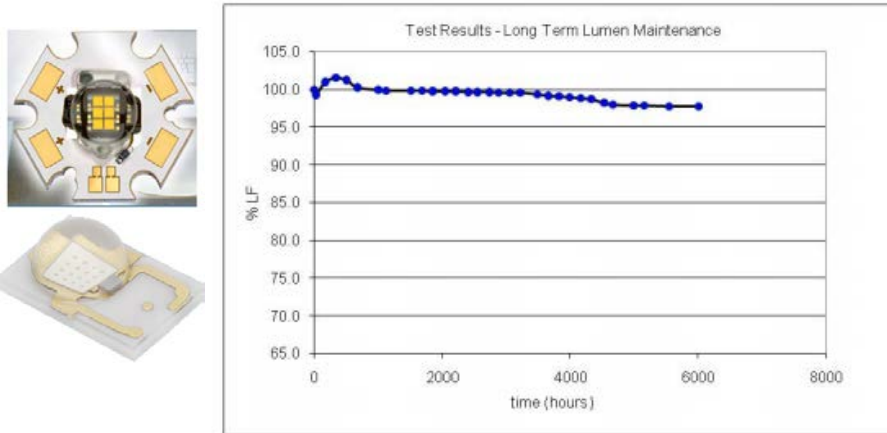


Figure 1. IES TM-21 extrapolation from IES LM-80 data

Five Steps to listing the new metric

- **Step 1:** request LM-80 testing for the LED light source
 - Three case temperatures (55C, 85C, and a third temperature)
 - Drive current clearly indicated
 - **Output: ≥6,000 hours of test data**
 - Conducted at a lab accredited by an ILAC MRA signatory
- **Step 2:** request an ISTMT for the lamp or luminaire
 - Using test environments described in UL1598, UL 153, UL 1993, etc.
 - Ambient temperature clearly indicated
 - **Output: LED case temperature**
 - Conducted at a lab approved by LED Lighting Facts for LM-79 testing



Light Source images: republished from www.ssl.energy.gov. Credits : bottom: Philips Lumileds® Rebel, top: Osram OPTO Semiconductors – OSTAR™ Lighting

Test results image: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/richman_tests_sslmiw2011.pdf http://www.energystar.gov/ia/partners/manuf_res/downloads/ENERGYSTAR_Manufacturers_Guide_v2.1.pdf

April 2010 ENERGY STAR Manufacturer's Guide for Qualifying Solid-State Lighting Luminaires:

Step 3: Download the ENERGY STAR[®] TM-21 Calculator Tool and Enter the Test Data

TM-21 Inputs

LM-80 Test Inputs

Description of LED Light Source Tested (manufacturer, model, catalog number)	Test Data for 55°C Case Temperature		Test Data for 85°C Case Temperature		Test Data for 120°C Case Temperature	
Description of LED Light Source...	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)
	0	100.00%	0	100.00%	0	100.00%
	24	99.05%	24	99.06%	24	99.05%
	168	98.90%	168	98.00%	168	98.49%
	500	98.81%	500	97.50%	500	98.81%
	1000	98.80%	1000	97.40%	1000	99.29%
	2000	98.50%	2000	97.00%	2000	98.35%
	3000	98.60%	3000	95.00%	3000	99.51%
	4000	98.00%	4000	94.00%	4000	99.18%
	5000	98.50%	5000	94.00%	5000	97.75%
	6000	98.21%	6000	98.80%	6000	97.05%

LM-80 Testing Details	
Total number of units tested per case temperature:	25
Number of failures:	0
Number of units measured:	25
Test duration (hours):	6000
Tested drive current (mA):	350
Tested case temperature 1 (T _c , °C):	55
Tested case temperature 2 (T _c , °C):	85
Tested case temperature 3 (T _c , °C):	120

In-Situ Inputs

Drive current for each LED package/array/module (mA):	350
In-situ case temperature (T _c , °C):	60
Percentage of initial lumens to project to (e.g. for L ₇₀ , enter 70):	70

Results

Time (t) at which to estimate lumen maintenance (hours):	25,000
Lumen maintenance at time (t) (%):	95.11%
Calculated L70 (hours):	327,000
Reported L70 (hours):	>36000

- Developed in cooperation with NIST; LED Lighting Facts uses it to streamline the process
- The tool performs the calculation – you just enter the test data.

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TM-21 Inputs

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Description of LED Light Source...

LM-80 Test Inputs

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Enter data from the light source LM-80 report. Provide as much data as possible.

Enter LED drive current and case temperature from the ISTMT.

Enter desired time period (25,000, 15,000, or 10,000 hours)

Output:
lumen maintenance at time (t)
(as a percentage)

Step 4: Create an LED Lighting Facts submission and fill out the submission form


Select the checkboxes that describe any special design features of the product.

Manage Your Products

Save

Cancel

View or make changes to your product.

Current Draft Status:  Incomplete

Product Code: MQB3T3

• This product draft is incomplete.

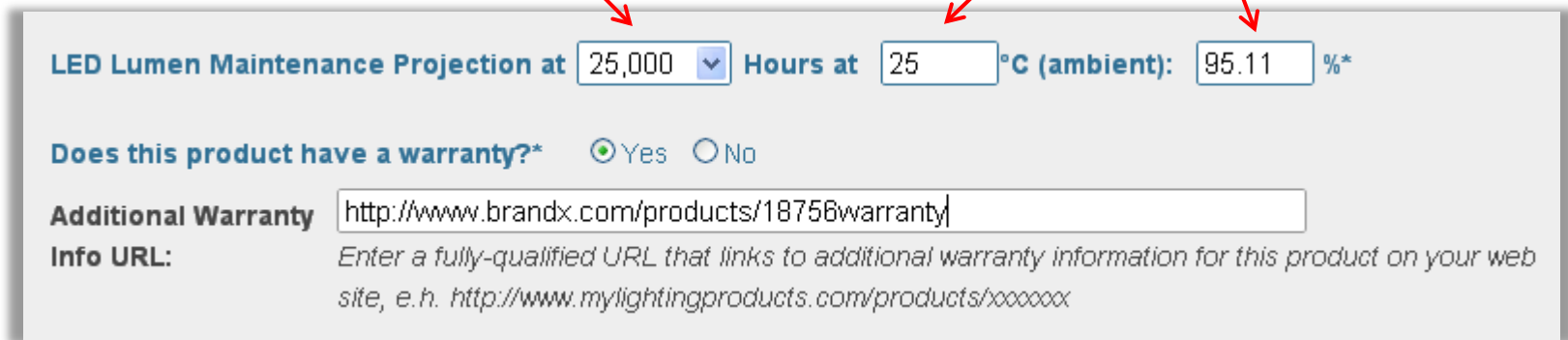
- You have indicated that this product is not available. Only currently available products may be listed.
- You have not uploaded your product test report. This is required before a product can be approved.

- Check this box if you would like to indicate the performance claims entered are exact tested values. Claimed values may be rounded to the nearest hundredths decimal and still considered exact values.
- Check this box if this product incorporates variable LED drive current controls for a purpose other than maintaining light output over its lifetime.
- Check this box if this product uses two or more unique LED light sources (packages, arrays, or modules). See the LED Lighting Facts Partner Participation Manual for information about calculating LED Lumen Maintenance.
- Check this box if this product incorporates variable LED drive current controls over its lifetime.
- Check this box if this product incorporates any secondary optics with remote phosphor or other material that will significantly affect the light output and/or color of the LED light source. Do not check this box if the secondary optic was tested with the LED light source in the LM-80 measurements.
(NOTE: Checking this box will remove all Lumen Maintenance data entered below.)

Step 4, continued: lumen maintenance and warranty metrics

Partners have the option to claim LED lumen maintenance at 25,000, 15,000, or 10,000 hours. Choose the appropriate selection with the drop-down menu.

Enter ambient temperature (from ISTMT) and lumen maintenance (from TM-21 calculator tool)



LED Lumen Maintenance Projection at Hours at °C (ambient): %*

Does this product have a warranty?* Yes No

Additional Warranty Info URL:
Enter a fully-qualified URL that links to additional warranty information for this product on your web site, e. h. <http://www.mylightingproducts.com/products/xxxxxxx>

If a warranty is available, a valid URL is required for the web page where the warranty conditions are described.

Step 5: upload supporting files, save, and submit!

- LM-80 test report
- ISTMT
- Saved copy of ENERGY STAR TM-21 Calculator (Excel file format)
- Product specification sheet

Additional Product

Data URL: *Enter a fully-qualified URL that links to additional product data or specifications on your web site, e.g. <http://www.mylightingproducts.com/products/xxxxxxx>*

LED Lumen Maintenance Projection at **Hours at** **°C (ambient):** %*

Does this product have a warranty?* Yes No

Additional Warranty






Info URL: *Enter a fully-qualified URL that links to additional warranty information for this product on your web site, e.h. <http://www.mylightingproducts.com/products/xxxxxxx>*

Upload Files

Add support files to this product submission here.

Click to select file, or drag and drop files to upload files

Files received:

-  Successfully received file "18756_TM-21 Workbook.xlsx" (47061 bytes) [View Download](#)
-  Successfully received file "Generic_IES_File.IES" (5056 bytes) [View Download](#)
-  Successfully received file "Generic_LM79_Report.pdf" (280818 bytes) [View Download](#)
-  Successfully received file "Generic_LM80_Report.pdf" (547222 bytes) [View Download](#)
-  Successfully received file "Generic_Product_Spec_Sheet.pdf" (547222 bytes) [View Download](#)

Final Thoughts

- LED lumen maintenance and warranty are **OPTIONAL** for LED Lighting Facts
 - Manufacturers that have access to lumen maintenance data may or may not choose to include it in product submissions
- Retailers, distributors, utilities, EE sponsors, and lighting pros: if you want to see this metric when reviewing LED Lighting Facts products, request that manufacturers list it!!
- LED Lighting Facts is constantly evolving with the industry; new methods and standards will be considered as they are released

Questions?

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