Reading, Understanding and Applying the LM-80 Standard

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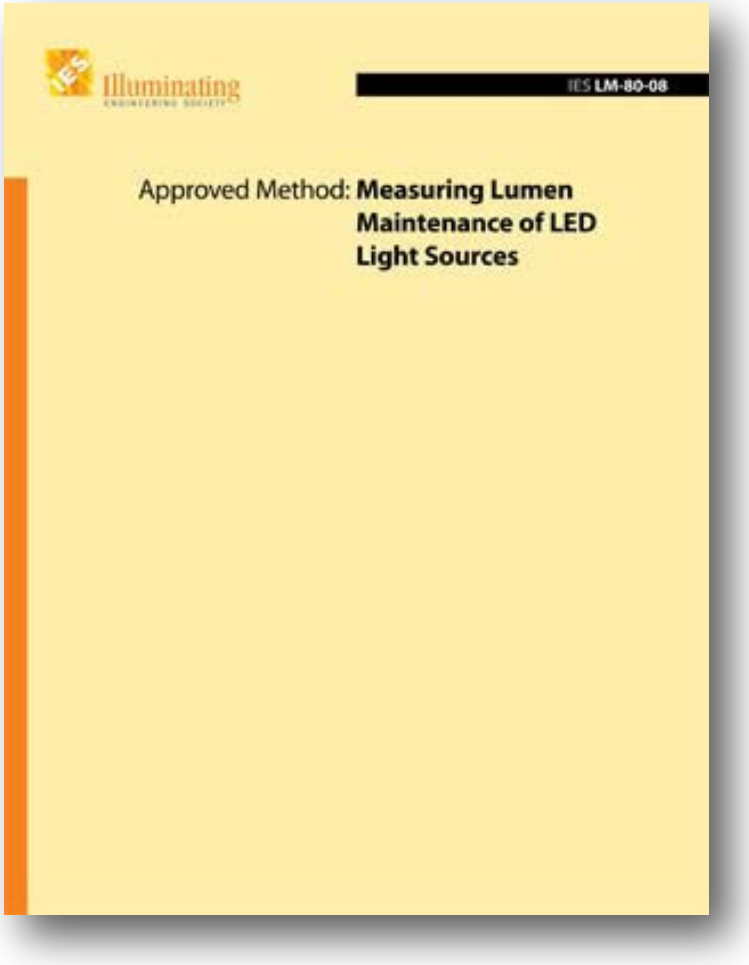
Reading, Understanding and Applying the LM-80 Standard

- What is the LM-80 Standard?
- What do you get from an LM-80 Report?
- How is it used?
- What does it mean to the End-User Community?

What is LM-80

- Lumen maintenance test method written by IESNA (Illuminating Engineering Society of North America)
- LED package, array or module driven by auxiliary driver
- LEDs are driven with external current sources during operation and lumen maintenance testing
- LED Case temperature is controlled during operation
- During lumen maintenance testing, LED is allowed to cool to room temperature and tested at air temperature of 25°C

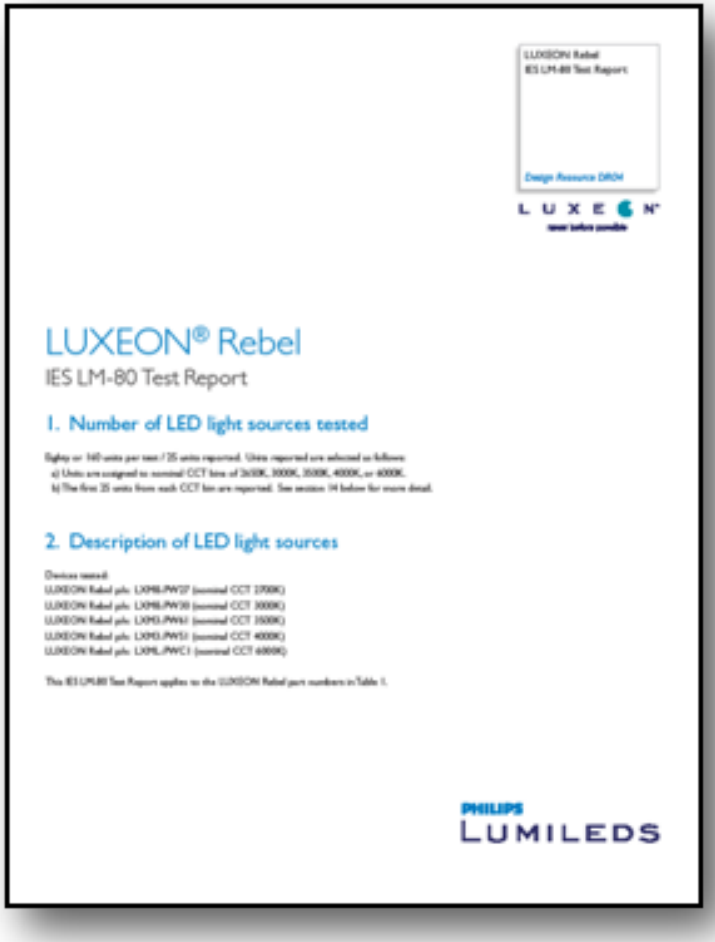


LM-80 Test Method

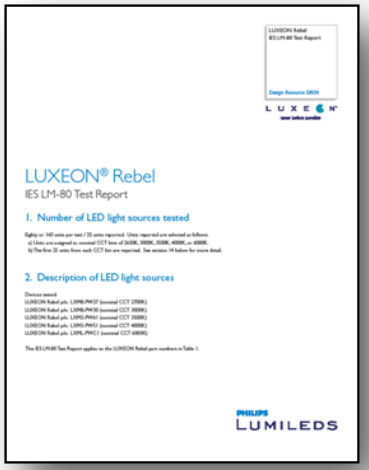
- Operation at three case temperatures (55°C, 85°C and one selected by manufacturer)
- Air Temperature to within +/-5°C, Case Temperature to within +/-2°C
- RH less than 65%
- Minimum 6,000 hours, data collected every 1,000 hours
- Data collection at 25°C
- Constant current, rated voltage
- Record Lumen Maintenance, Chromaticity, Catastrophic Failures
- Reporting Format

What Do You Get?

- Over 100 pages of raw data
  - w/ Summary report


LUXEON® Rebel
IES LM-80 Test Report
1. Number of LED light sources tested
2. Description of LED light sources
PHILIPS
LUMILEDS

What You Don't Get…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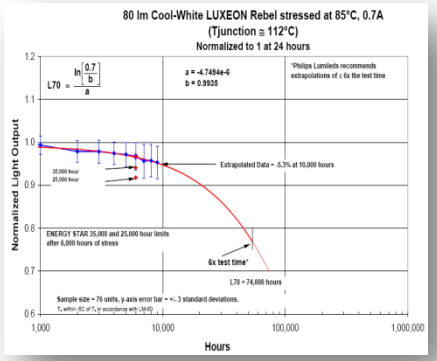
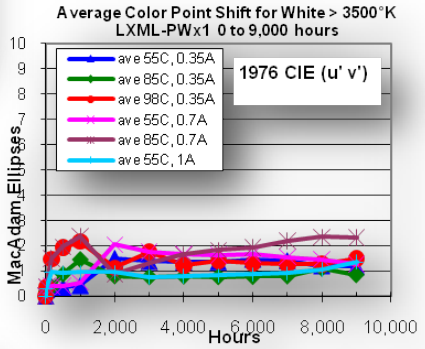
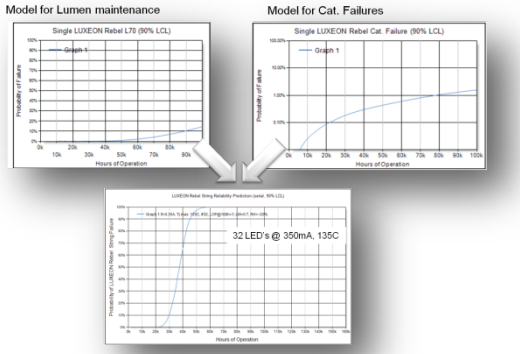
- **LM-80 does NOT specify:**
  - Pass/Fail Criteria
  - Graphing of results
  - Curve fitting methods
  - Extrapolation and L70 prediction methods
  - Sample Size
  - How many drive currents
  - What changes to an LED package require new testing

What Can You Do With It?

- Lumen Depreciation
  - Extrapolation (per TM-21)
  - Reference for LM-79 testing
- Chromaticity Stability
- Sub-System Reliability Modeling

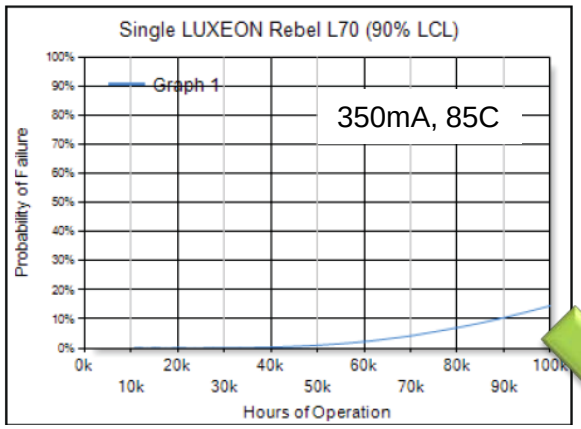




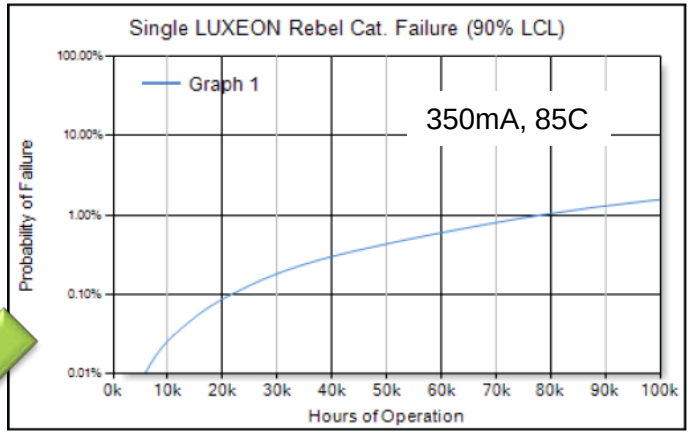


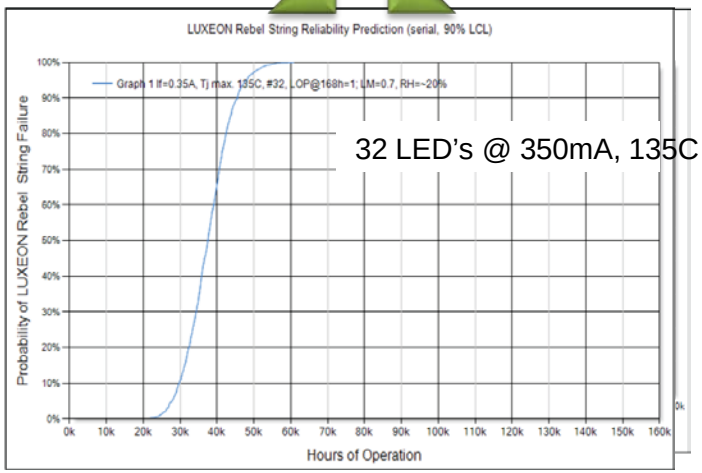
Scaling Single LED "End-of-Life Behavior" to a Sub-System

Model for Lumen maintenance



Model for Cat. Failures

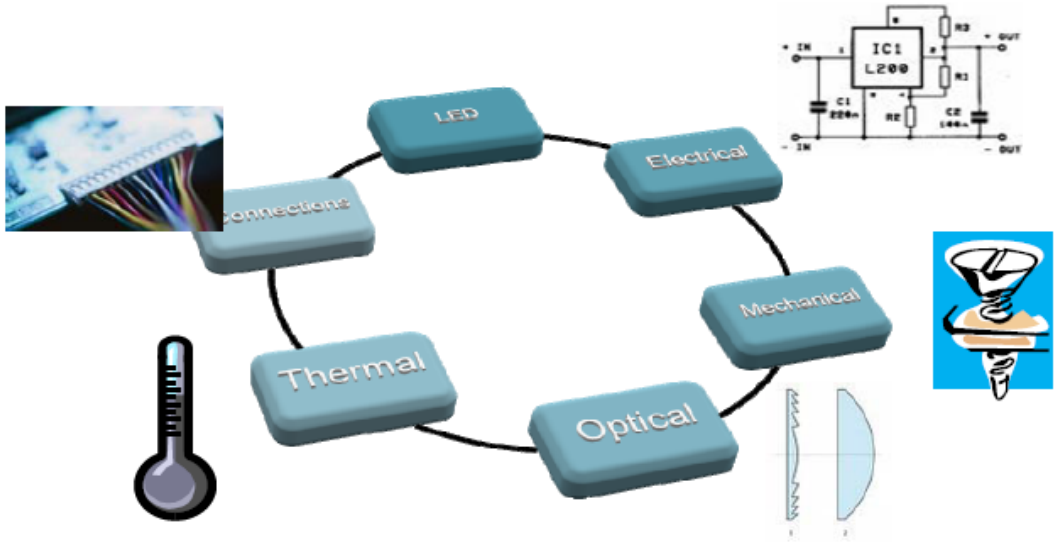




Lumen maintenance is not the whole story…

- LM-80 and TM-21 provide an industry standard for lumen maintenance testing and for lumen maintenance extrapolations for LED components. LM-79 is the lumen maintenance standard for SSL systems.
- Next Generation Industry Alliance and US Department of Energy 'LED Luminaire Lifetime: Recommendations for Testing and Reporting', May 2010, discusses practical lifetime considerations for SSL luminaires.
- Lumen maintenance is not the dominant failure mode for most SSL products.

System Reliability ≠ LED Reliability



$$R_{system} = R_{electrical} * R_{connections} * R_{LEDs} * R_{optical} * R_{thermal} * R_{mechanical}$$

Philips Lumileds has developed reliability and lumen maintenance models in order to predict long-term reliability performance of LUXEON Rebel products. See WP15 ‘Evaluating the Lifetime Behavior of LED systems’ for more information.

What's This All Mean To The End Users?

- Accurate and reliable LM-80 data carries through to follow-on system qualification/testing (e.g. LM-79, Lighting Facts, Design Lights, EnergyStar, etc.)

- LED performance ≠ Lamp performance
  - LED lifetime (per LM-80) is not the same as Lamp life
  - LED lumen depreciation (per LM-80) is not the same as Lamp lumen depreciation

- LM-80 should not be part of final system/installation specifications
  - That is what DLC, EnergyStar, Lighting Facts, etc. are for…