

Guide to Evaluating LED Lumen Maintenance

Useful lifetime estimates for LED lighting products are typically given in terms of the expected operating hours until light output has diminished to 70% of initial levels (denoted L_{70} life).¹ Recommended lumen maintenance requirements are given in the table below to qualify lifetime claims.²

Table 1. Recommended lumen maintenance requirements

L_{70} lifetime claim (hrs)	Minimum lumen maintenance at 6,000 hours (%)
35,000	94.1
50,000	95.8

The applicant may demonstrate compliance with the 6,000 hour lumen maintenance thresholds identified above in one of two ways: Option 1 (Component Performance) or Option 2 (Luminaire Performance).

Option 1: Component Performance

Under this compliance path, the applicant demonstrates that the LED package or module/array³ (light source) tested per the LM-80 test procedure⁴ operates at or below a specified temperature and drive current when operated (in situ) in the luminaire under consideration. To be eligible for the Component Performance option, ALL three of the conditions below must be met. If ANY of the conditions is not met, the component performance option may not be used and the applicant must use Option 2 for compliance.

1. The LED light source has been tested according to LM-80, and the light source must demonstrate minimum percent lumen maintenance as per **Table 1** above.
2. The LED light source manufacturer prescribes/indicates a temperature measurement point (TMP_{LED}) on the light sources.
3. The LED light source TMP_{LED} is accessible to allow temporary attachment of a thermocouple for measurement of in situ temperature. Access via a temporary hole in the housing, tightly resealed during testing with putty or other flexible sealant, is allowable.

¹ See http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_luminaire-lifetime-guide.pdf for additional considerations and guidance

² Method for verifying LED product lumen maintenance is based on requirements of ENERGY STAR for SSL Luminaires, version 1.1.

³ See IES ANSI/IESNA RP-16-05 Addendum b, "Nomenclature and Definitions for Illuminating Engineering" http://www.iesna.org/PDF/Erratas/RP_16_05addendumB.pdf

⁴ See IES LM-80-08, "Approved Method: Measuring Lumen Maintenance of LED Light Sources"

The luminaire complies per Option 1 if:

1. The LED light source drive current specified by the luminaire manufacturer is less than or equal to the drive current specified in the LM-80 test report.
 - a. Note that the input current to the luminaire is often NOT the input current to the LED light source.
2. For the hottest LED light source in the luminaire, the temperature measured at the TMP_{LED} during In Situ Temperature Measurement Testing (ISTMT) is less than or equal to the temperature specified in the LM-80 test report for the corresponding drive current or higher, within the manufacturer's specified operating current range.
 - a. The ISTMT laboratory must be approved by OSHA as a Nationally Recognized Testing Lab (NRTL), must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)'s CALiPER program, or must be recognized through UL's Data Acceptance Program.
 - b. The ISTMT must be conducted with the luminaire installed in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires).

Option 2: Luminaire Performance

Under this compliance path, the applicant demonstrates compliance with the lumen maintenance requirement by submitting LM-79 photometric test data⁵ for the entire luminaire, comparing initial output (time = 0 hours) to output after 6,000 hours of operation (time \geq 6,000 hours). The test report must demonstrate a minimum percent lumen maintenance as per **Table 1** above when operated in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires). The LM-79 test laboratory must hold NVLAP accreditation for the LM-79-08 test procedure or must be qualified, verified, and recognized through DOE's CALiPER program.

⁵ See IES LM-79-08, "Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products"