

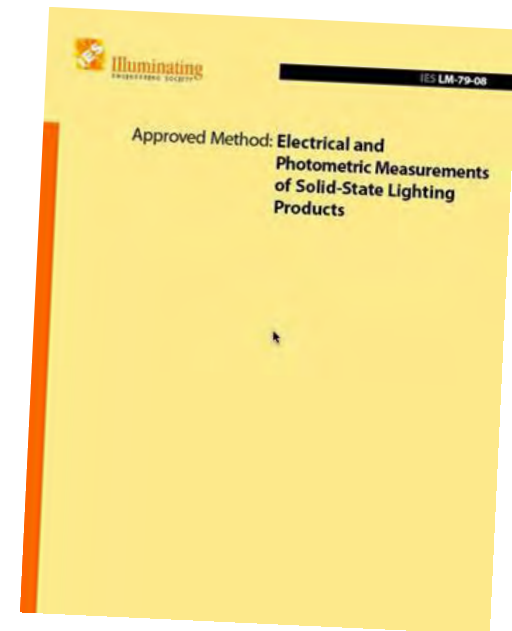
# Understanding IES LM-79 & IES LM-80

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# Electrical and Photometric Measurements of Solid-State Lighting Products

- Approved method describing procedures and precautions in performing reproducible measurements of LEDs:
  - total flux,
  - electrical power,
  - efficacy (lm/watt), and
  - chromaticity



- Applies to LED-based products incorporating control electronics and heat sinks:
  - Products requiring only line voltage or DC power supply
  - Includes complete LED luminaires and
  - Integrated LED sources (LED chips with heat sinks)
- Does *not* cover
  - LED products requiring external operating circuits or heat sinks (bare LED chips, pkgs, and modules)
  - Fixtures designed for LED products but sold without a light source

- LM-79 requires complete luminaire testing
- Traditionally, photometric evaluation of lighting products is based on separate tests for lamps and luminaires (“relative”)
- For SSL products, LED lamps typically *cannot* be separated from their luminaire heat effects (“absolute”)

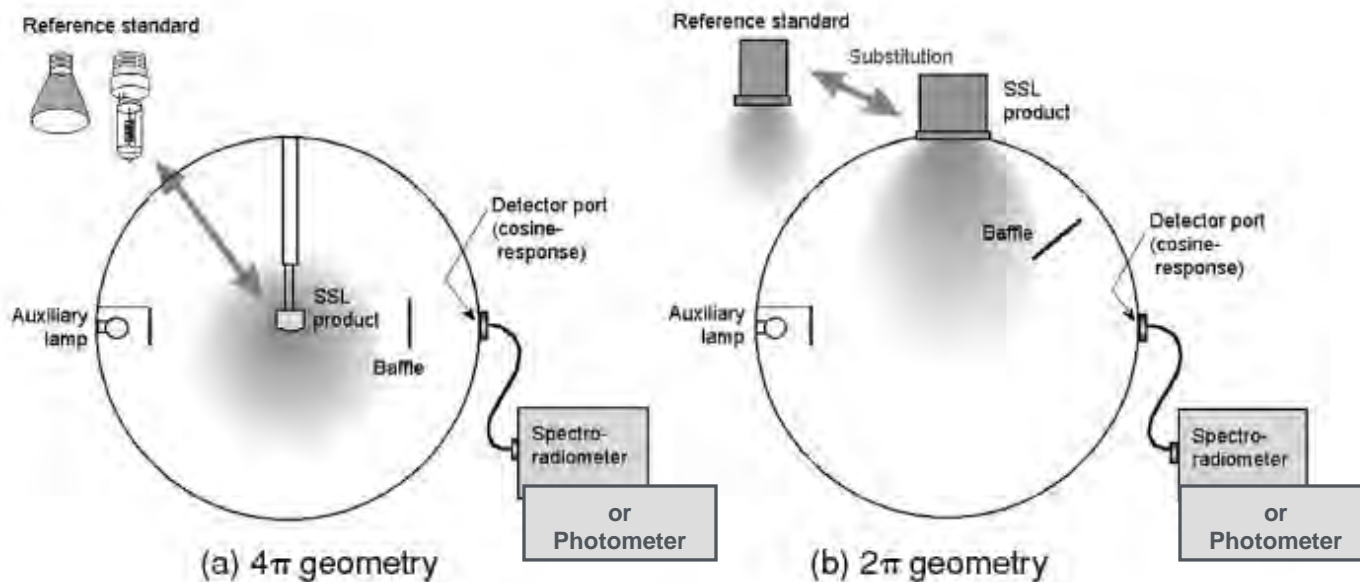


- Relative testing
  - Lamps of interest and luminaire (with reference lamp) are measured separately. Then the actual light distribution and intensity of the complete luminaire of interest is derived by normalization of the test data
- Absolute testing
  - The actual light distribution and intensity of the luminaire of interest is measured directly from the complete luminaire

- Ambient conditions
  - Temperature – maintain at 25C +/-1C (within 1m)
  - Mounting – limit thermal transfer
  - Air flow - limited
- Power Supply characteristics
  - AC waveshape limit to harmonic RMS of 3%
  - Voltage regulation to +/- 2%
- Seasoning and stabilization
- Testing orientation
- Electrical settings
- Instrumentation

For measuring Total luminous flux and color:

- Photometer – Total Luminous Flux
- Spectral Radiometer (preferred) - Spectral Radiant Flux (to derive total luminous flux and color qualities)

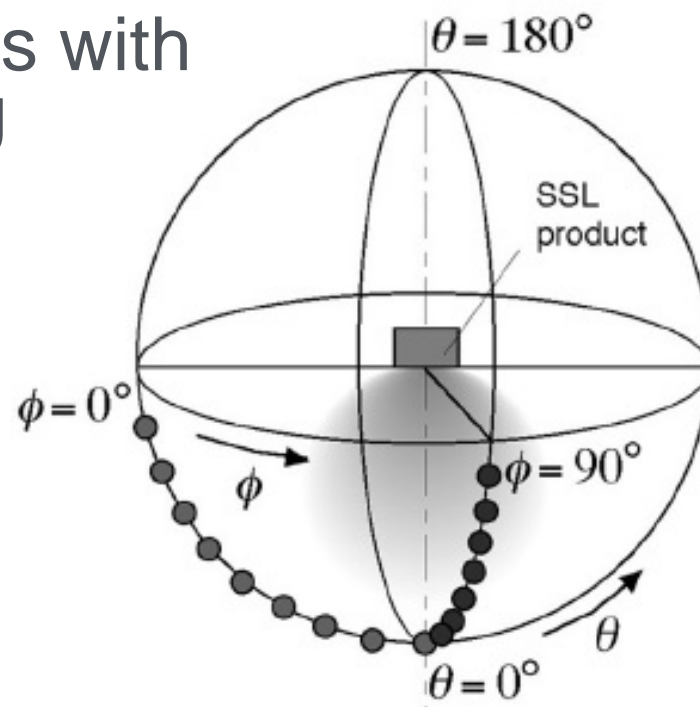


(a) Setup for all types of SSL products emission

(b) Setup for SSL products with only forward output

For measuring luminous Intensity Distribution

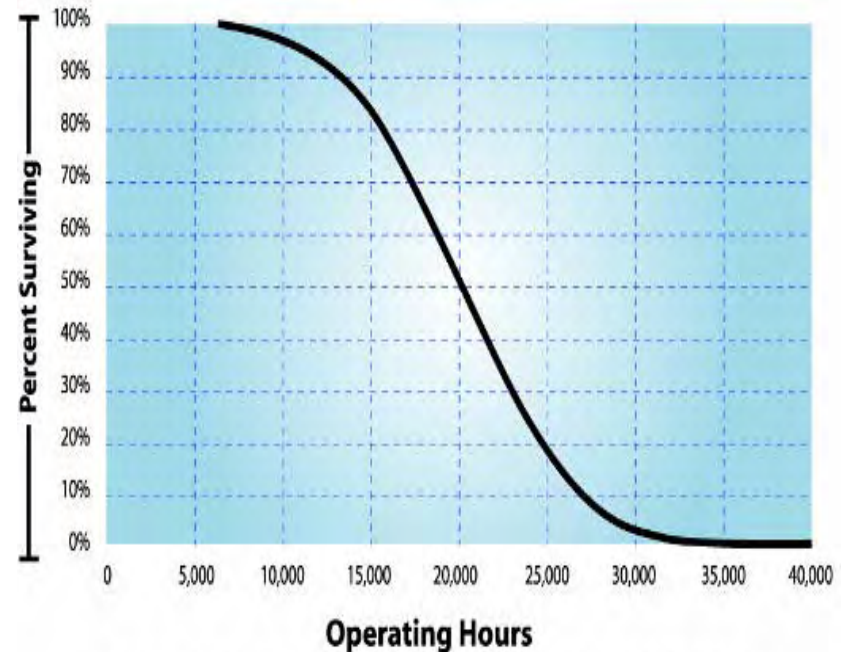
- Total Luminous Flux is derived
- Provides color characteristics with Spectral radiometer including CCT, CRI



- Total Luminous Flux
- Luminous Intensity Distribution
- Electrical Power
- Luminous Efficacy (calculation)
- Color Characteristics
  - Chromaticity
  - CCT
  - CRI

# What is “Life” for Lighting?

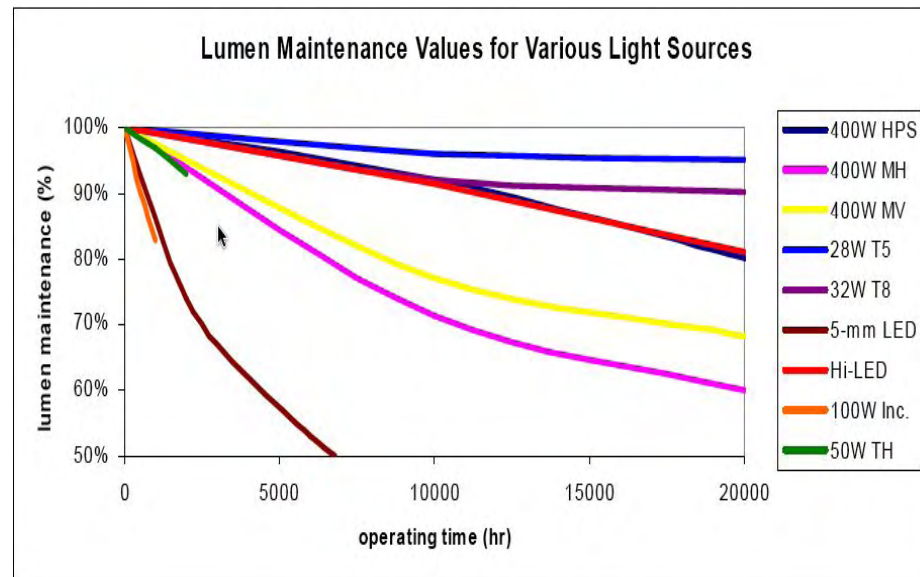
- “Operational failure”
  - Most light sources “burn out” (End of “Life”)
  - Lamp life is typically rated at 50% failure rate
  - *LEDs typically don’t fail (no filament to “burn”)*



Rated lamp life is point where 50% of lamps have failed, or 20,000 hours on this curve.

## Useful light output (Lumen Maintenance)

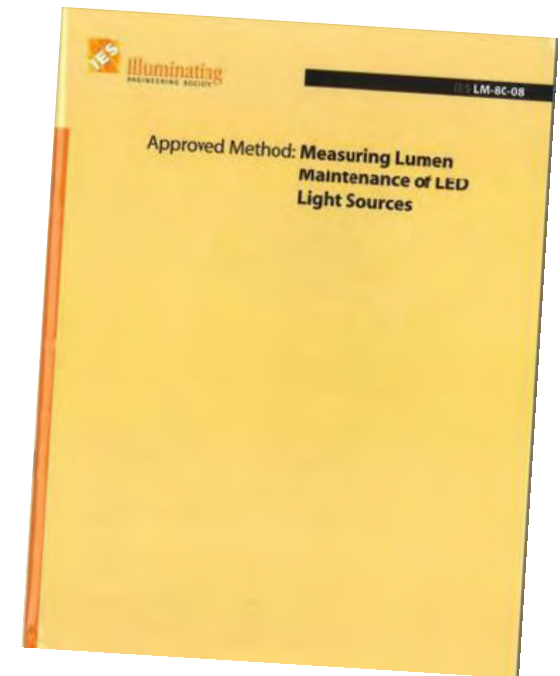
- All light sources degrade but most just “burn out” before serious loss of light output
- LEDs continue to degrade – eventually beyond useful light output



Source: Lighting Research Center - Rea 2000; Bullough 2003

## Measuring Lumen Maintenance of LED Light Sources

- Approved method for measuring lumen depreciation of solid-state (LED) light sources, arrays and modules.
- Does not cover measurement of luminaires.
- Does not define or provide methods for estimation of life.



- Ambient conditions and setup
  - Case Temperature measured and maintained
  - Case Temperature measurement point
  - Airflow minimized
  - Operating orientation & spacing per manufacturer
- Electrical
  - Voltage and Current (AC or DC levels)
  - Voltage waveshape (harmonic distortion <3%)
  - Current Regulation
- Instrumentation

- Case Temperatures
  - Measurement performed at multiple temperatures to address in-situ conditions
  - 55C, 85C and 3rd manufacturer selected temperature
- Photometry
  - Spectral radiometer preferred method
  - Temperature: 25C ambient
  - Drive current per manufacturer
- Testing Intervals
  - 6000 hours min testing period. 10K preferred.
  - Minimum at least every 1000 hours

- Test report basics
  - Description of Sources tested
  - Ambient conditions (Airflow, temperature, RH etc)
  - Case Test point temperature
  - Electrical conditions
  - Lumen maintenance data
  - Observation of failures
  - LED monitoring interval
  - Chromaticity shift over time

**LM-80 provides no determination or estimation of expected life or lumen output beyond test data.**

**Separate estimation method (TM-21) is in development**

