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Understanding the Complexities of Specifying LED Luminaires

It’s no longer a “Bulb in a Box”

It’s an LED TV on a Pole

Legacy Technology – Lamps and Ballasts

- All components are built and rated individually
- Components combined and thermal tests performed
  - Components do not exceed rated maximum temperature
  - Fixtures tested at 25^{o}C Ambient standard
- Components generally function within specs if at or below rated temperature
- Components generally not affected by environmental conditions
  - Wet location is defined as critical components not wet, but moisture can be present in non-critical locations
- Lamps and Ballasts are normally replaced multiple times over the life of the installation independent of the fixture housing

Enter: LEDs, the NEW Bulb in a Box

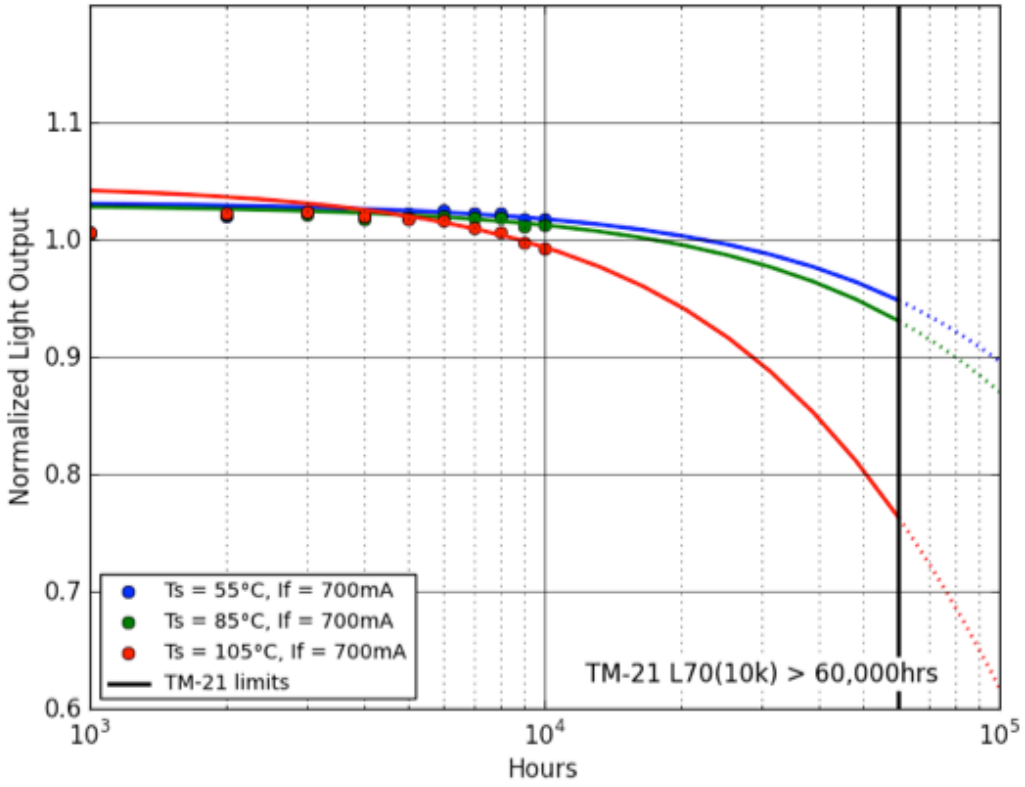
- LEDs initially enter the market as light sources added to existing legacy technology housings:
  - Many fixtures failed in fairly short time periods
  - Many fixtures did not provide the promised lumen output
  - Fixture housings allowed moisture in, causing damage
  - Housing did not have appropriate heat sink needed to manage heat
  - Driver technology was not durable enough for long life
  - Legacy Engineering teams were not competent in DC Circuits
  - Electronics Manufacturers did not understand commercial lighting
  - Initially there were actually no UL standards for LEDs

Effects of Heat on LED Performance

LEDs Light Output and Life are affected by heat :

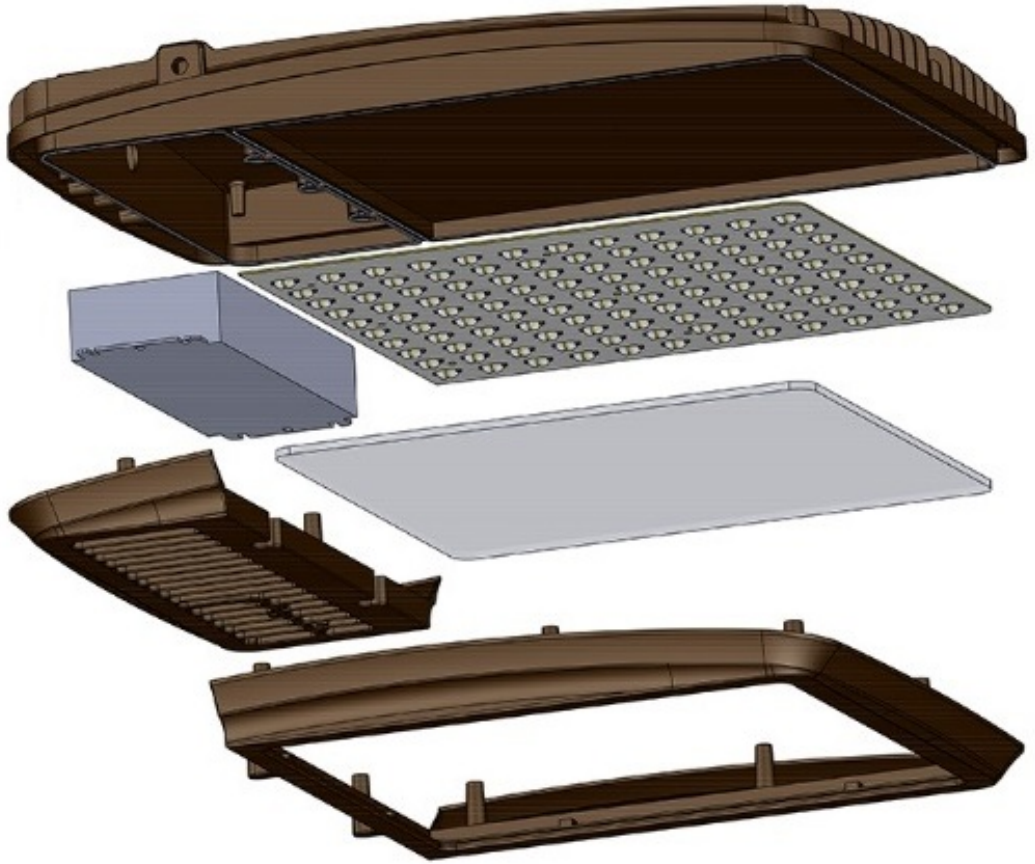
- Higher operating temperatures lower light output
- Lumen deprecation rates increase with higher temperatures
- Potential for catastrophic failures increase with increased temperature
- Running temperatures (In-Situ) should be significantly lower than rated maximum for LED chip
- Chip test data is NOT the same as fixture In-Situ temperature

Typical High Power LED TM-21 projected light output using LM-80 manufacturer test data



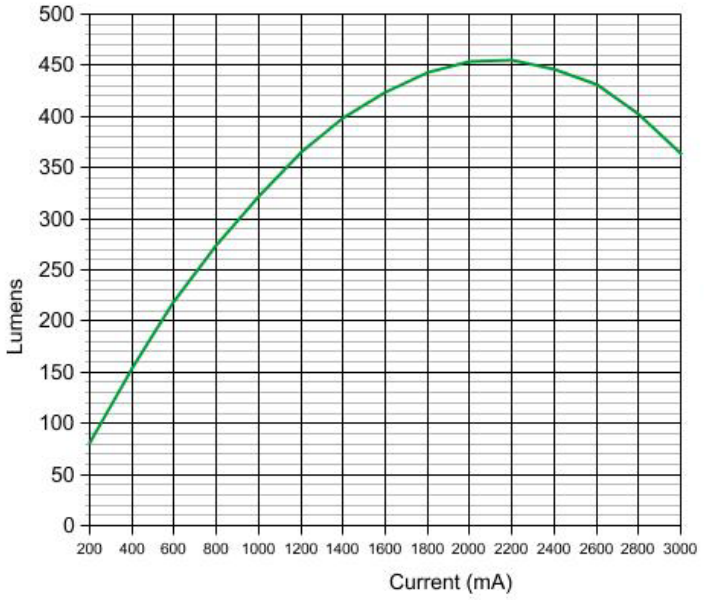
Effects of Heat on LED Performance

- Heat Management Engineered Solutions ARE the DIFFERENTIATOR
  - Housing design – Die cast aluminum thermal mass for dissipation
  - Heat transfer – LED -> Circuit Board -> Bonding to Heat Sink (housing)
  - LED Array board Aluminum core
  - Larger LED chip spacing allows for even heat distribution
  - Separate heat sink/compartment for driver to stop added heat to LEDs
  - IP67 Potted Driver has better heat dissipation

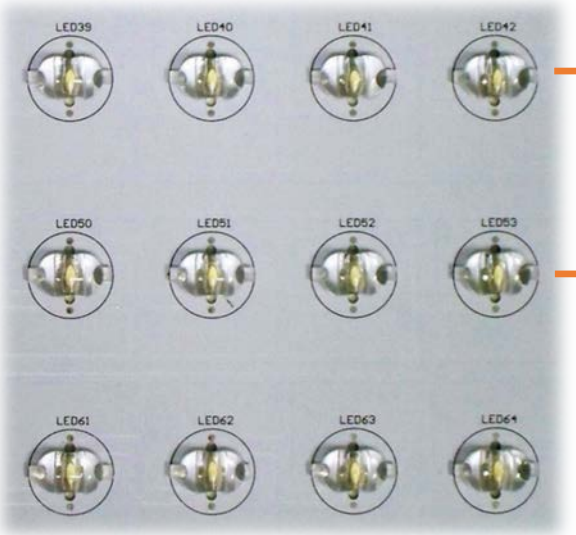


Effects of Heat on LED Performance

- LED Array and Electrical Circuitry Design affects operating temperatures
  - Optimum drive current for peak performance
  - Parallel circuits designed for balanced forward voltage at each LED
  - LED Array spacing improves heat dissipation



Higher drive current produces more total lumens, but higher temperature with lower lumens/watt



Array spacing directly affects LED temperature

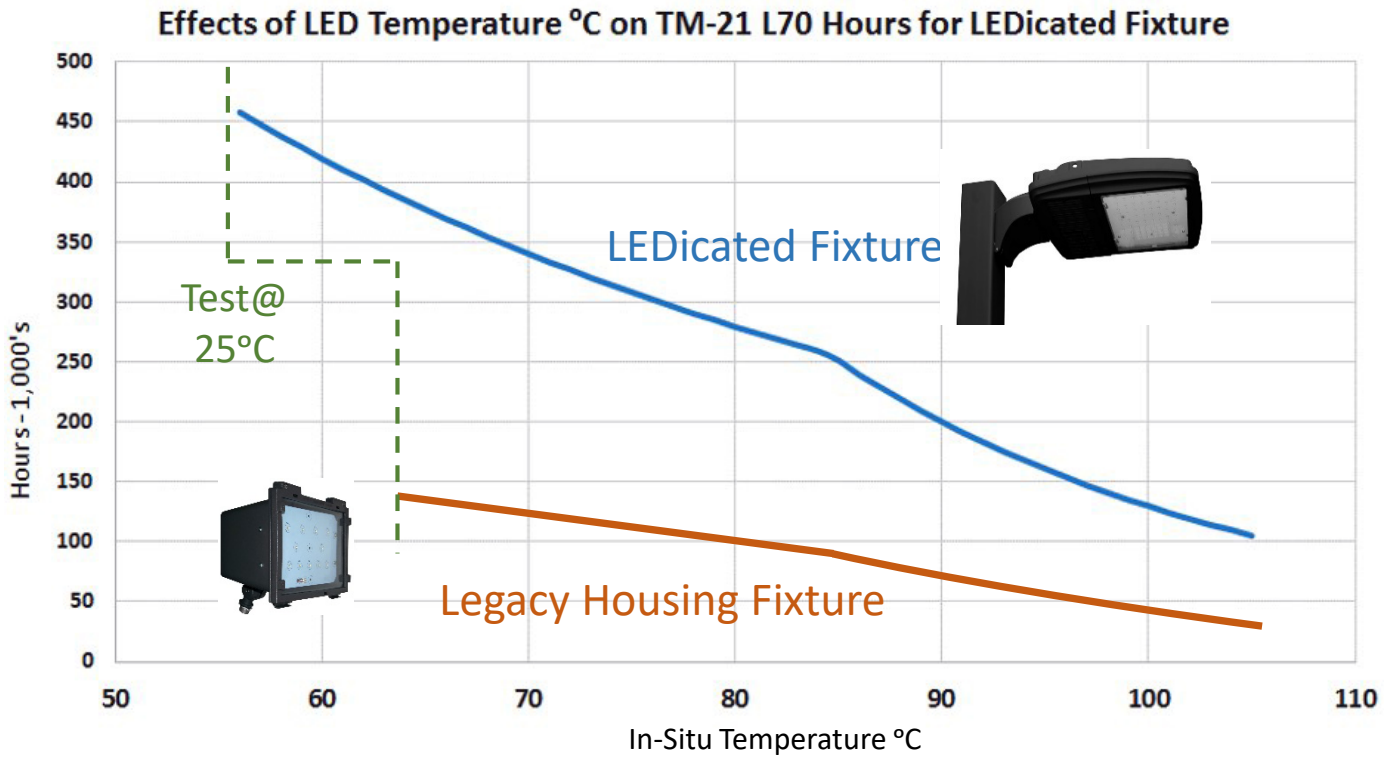
Basics of LED Fixture Design

ENERGY STAR® TM-21 Calculator

- Heat Management – Factors combined and calculated
  - Luminaire is now a complete system using In-Situ Thermal Test to determine exact operating performance (Determined using IES TM-21 Energy Star Calculator)
- Fixture Enclosure – Combined heat sink and sealed environment
  - Balance heat management, needed options, sealed environment (IP Rating), mounting and serviceability
- Optical Control – The Differentiator in Delivered Light
  - Legacy reflector systems are now null and void
  - Single piece multiple optic, individual LED lens, or no lens options
  - Balanced forward voltage at each LED provides uniform brightness

Effects of LED In-Situ °C on the TM-21/L70

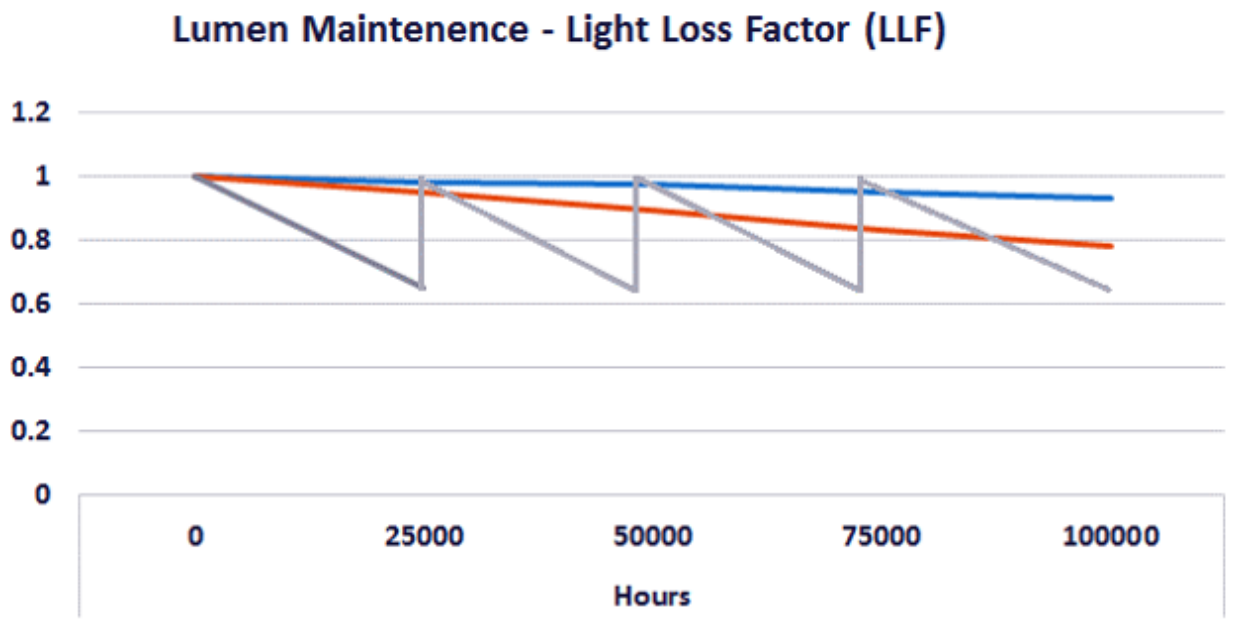
- TM-21 Inputs and Results – LED LM-80 6,000-10,000 Hour Temperature/Light output tests are input with the specific fixture In-Situ temperature
  - LED Maximum Rated Temperature should not be used
  - Rated maximum temperature will produce low Life Rating
  - LEDicated fixtures outperform legacy housings
  - Same chip with higher test temperature in a different fixture will have a lower L70 rating



Lumen Depreciation for LEDs vs. Legacy HID

Light Loss Factor (LLF)

- HID LLF is based on the lamp. LED LLF is based on calculated lumen depreciation FOR A SPECIFIC FIXTURE.
- Traditional LLFs cannot be applied to LED light sources.
- Fixtures designed specifically for LED sources (LEDicated fixtures) outperform legacy housings and HID.
- Higher Quality = Fewer Fixtures or Lower Luminaire Watts



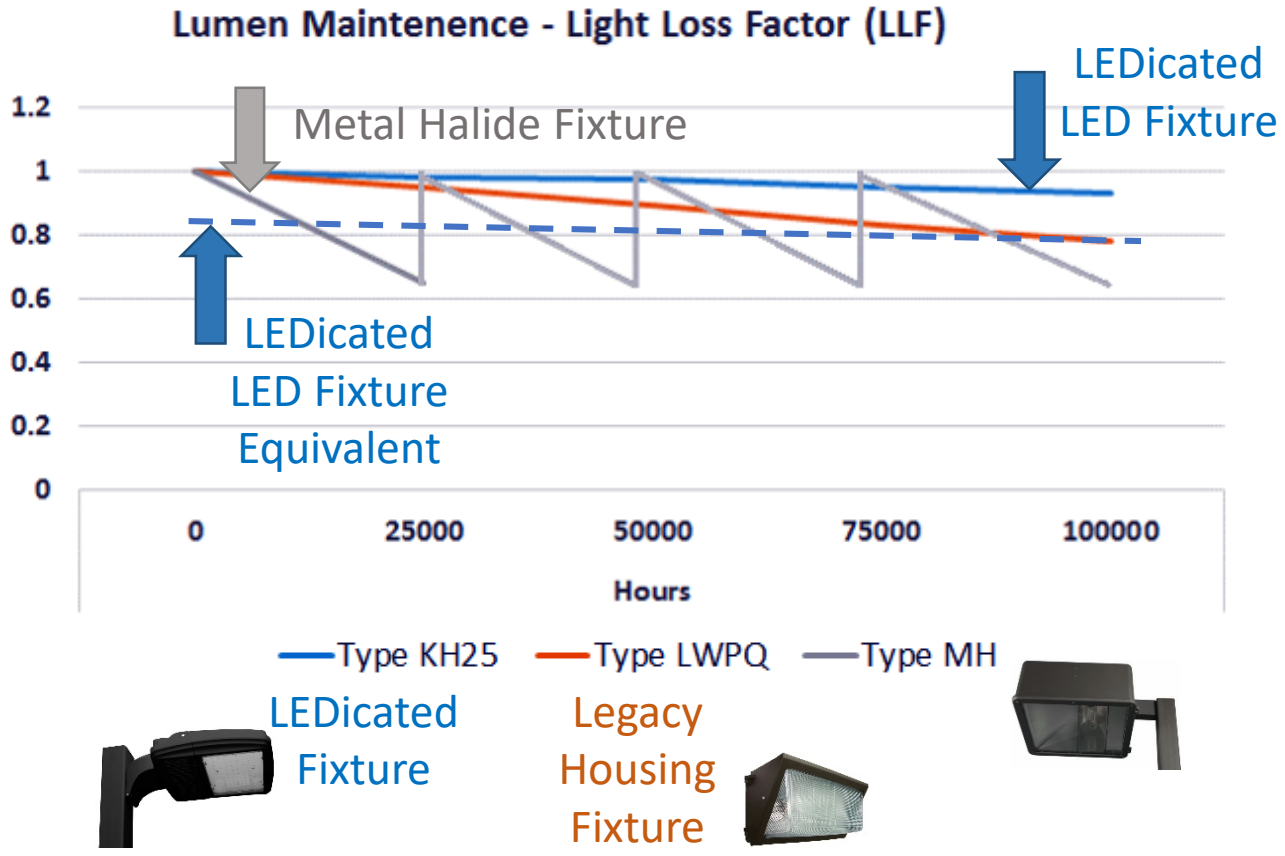
LEDicated Fixture

Legacy Housing Fixture

Lumen Depreciation for LEDs vs. Legacy HID

- Metal Halide Initial = 24,000 Lumens
- Equivalent LED = 19,600 Lumens
- Consider LLF when comparing Lumen rating and use appropriate value when preparing calculations
- Optical control adds additional reduction – Compare actual delivered foot-candles

LED Fixture Equivalent to Metal Halide



Recommended Fixture Specification Guidelines

- New Generation fixtures designed for LEDs have better performance
- Housing construction including reasonable heat sink
  - Plastic and sheet metal do not provide reasonable heat dissipation
  - LED Array/COB should be bonded to heat sink
  - Driver should have a designed heat sink
- Die cast or heavy extruded aluminum housings
  - For all fixtures over 50 watts and for all recessed luminaires
  - Recommended for all other if available
- Spacing between LEDs on arrays should be maximized, metal core boards provide better heat dissipation

Recommended Fixture Specification Guidelines

- L70 50,000 Hours developed 10 years ago – unacceptable today
  - Minimum L70 120,000 Hours for Arrays, L70 80,000 for COBs
- Published L70 Life ratings specific to the fixture for evaluation
- Listed Intrusion Protection Rating of at least IP65, IP66 preferred
- Robotically applied gaskets insure consistent production fixtures
- Select lower drive current, as higher drive currents typically increase heat on the LEDs (max 1100mA)
- When comparing fixtures run calculations for delivered light level
  - Consider delivered light levels rather than higher Lumens/Watt
- Reputable company with history of U.S. Market presence

Thank You for your Time

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