White Paper

Understanding **Family Correlated Photometric Data** For Finelite LED Luminaires

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Introduction

The US Department of Energy (DOE) acknowledges that as the LED market has matured, lighting manufacturers have developed methods to accurately calculate product performance within a product family. Creating a calculated set of results helps manufactures and customers by reducing testing costs without sacrificing the quality of the products or the ability to accurately calculate lighting performance.

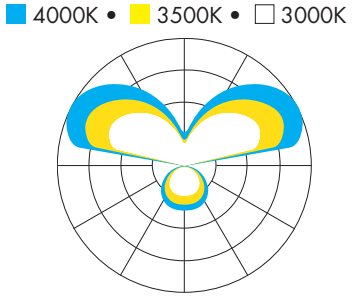
This paper describes Finelite's approach to creating a family of LED luminaires. It will discuss what a family is, identify what performance characteristics scale well and which do not, provide examples of how family calculations are applied, and outline the reports made from these family calculations.

Family correlation is currently being supported by groups such as The U.S. Department of Energy, Lighting Facts® (a program of the U.S. DOE), and the Design Lights Consortium® (a project of the Northeast Energy Efficiency Partnerships).

What is a family of products?

Finelite's fixture families are groups of luminaires where the critical metrics, including photometric, thermal, life, and electrical performance, can be accurately scaled using a combination of LM-79 tests at the luminaire level and well documented specifications at the component level.

The following luminaire characteristics scale well.



Lumen differences due to LED color temperature

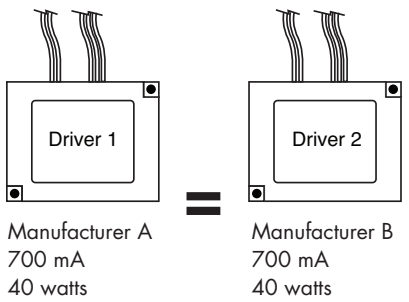
- LEDs are available in different color temperatures. The color temperature of the LED affects its lumen output; these lumen differences scale well, and are easily calculated.

Lumen differences due to LED technology improvements

- LED manufacturers regularly update chip performance. Improvements to the lumen performance of a chip that do not affect thermal performance and life will allow for predictable scaling of the lumen output of the luminaire.

Equal driver performance specification

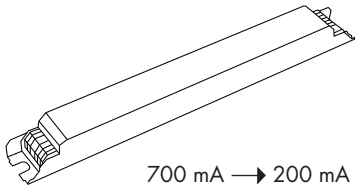
- Equal performance should be expected.
- Power supplies may be specified from different manufacturers for any number of application reasons or because new improved drivers enter the market and offer overall enhanced performance. Changing a driver used in a luminaire will not impact the performance of the luminaire when operated within its performance specification.



Luminaire Characteristics & Scaling

Lumen differences due to programmable power supplies

- Programmable supplies allow LEDs to be driven at a range of currents and lumen outputs.
- The thermal and lifetime performance will improve as LED current is reduced from the max operating specification of the luminaire. The lumen performance scales well and is easily calculated.



The following luminaire characteristics do not scale well.

Changes to the luminaires optics

- When the optics of a luminaire change, the distribution of the luminaire will be different. Therefore any changes to the luminaire that would change the distribution would not scale well.
- Optics can be changed in a variety of ways including, but not limited to, changes to materials, secondary optics, diffusers, and reflector systems.


Reflector Difference

Operating the LED beyond the specified rated operating conditions of the luminaire

- The fixture design and the LED array design are matched to provide a specified performance. Operating the LEDs beyond this matched performance may subject the LEDs to non linear thermal effects which makes predicting the lumen output less predictable and therefore would not scale well.

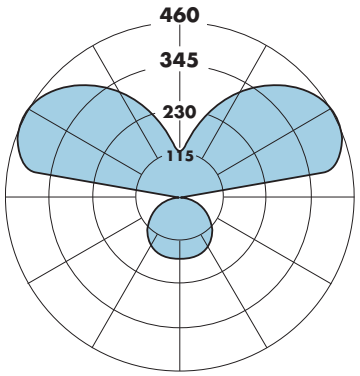
Changing the LED chip type

- Changing the LED chip type may change the distribution of the luminaire and therefore this change does not scale well.

Any alteration to the luminaire that results in a change to the optical design or any change that would exceed the maximum designed electrical or thermal performance of the current luminaire family definition would not scale well, and a new family definition, requiring new testing and scaling profiles, would be required.

How is the calculation method applied?

For each luminaire family, Finelite uses LM-79 test data gathered by an independent testing lab from one member of the family, calculations of luminaire efficiency, and individual LED lumen data to create Finelite's family correlated photometry files. This method takes into account the thermal stabilization of the luminaire required for LM-79 testing, and the efficiency of the LED chip for different drive currents and color temperatures. Independent thermal and electrical tests are also conducted on the highest-power luminaire in the family. Finelite uses its own calibrated thermal and electrical testing equipment to verify the thermal and electrical performance of luminaires not independently tested. This data is used to spot-check and validate the family correlation model. Finelite also works with its partners to verify the performance of the LEDs that make up the lighting panels installed in its luminaires.

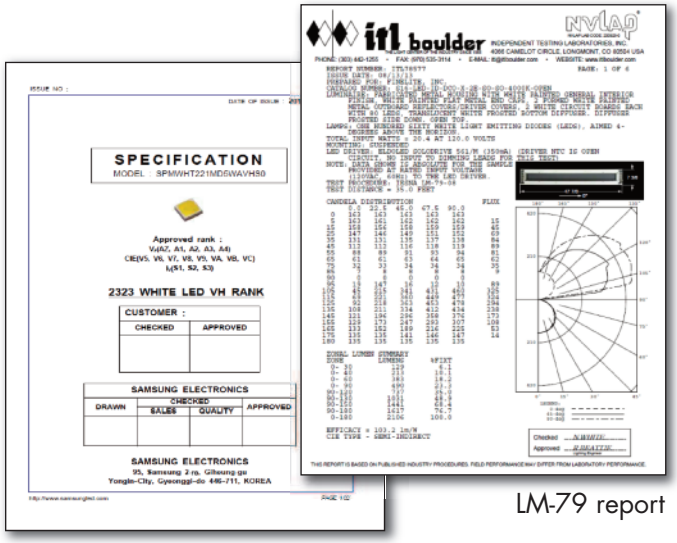


Implementation

Step 1: Assemble the data

Our first step is to assemble the independently verified data.

- LM-79 reports from an NVLAP-qualified test lab for one color temp of the representative luminaire in the family.
- LED chip performance data from LED manufacturer.



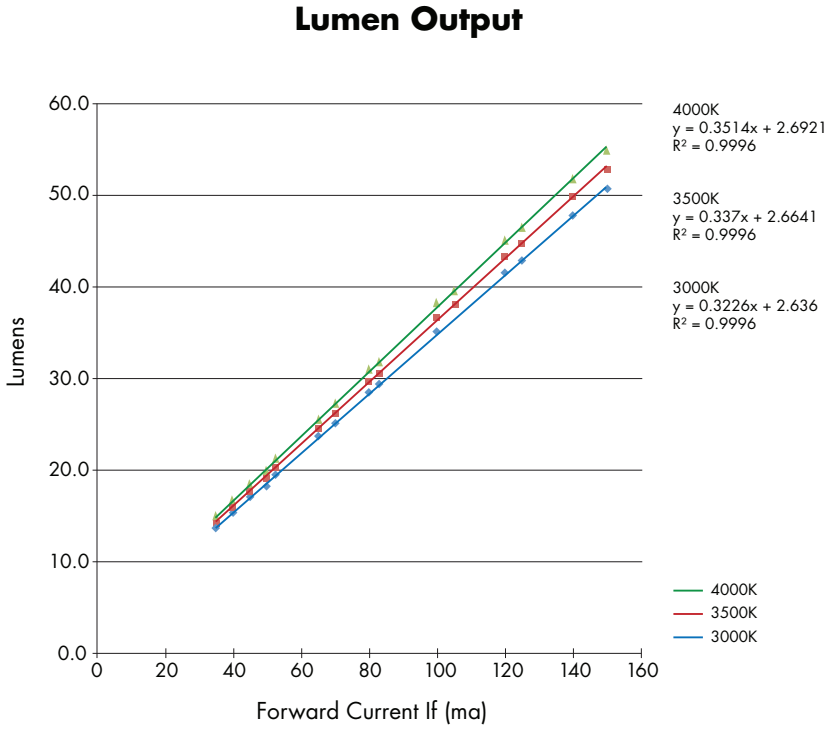
LM-79 report

LED chip performance data

Step 2: Calculate luminous flux per chip for each color temperature (CCT)

We use the data from the LED specification provided by the LED manufacturer to calculate the lumens produced per chip for each available color temperature.

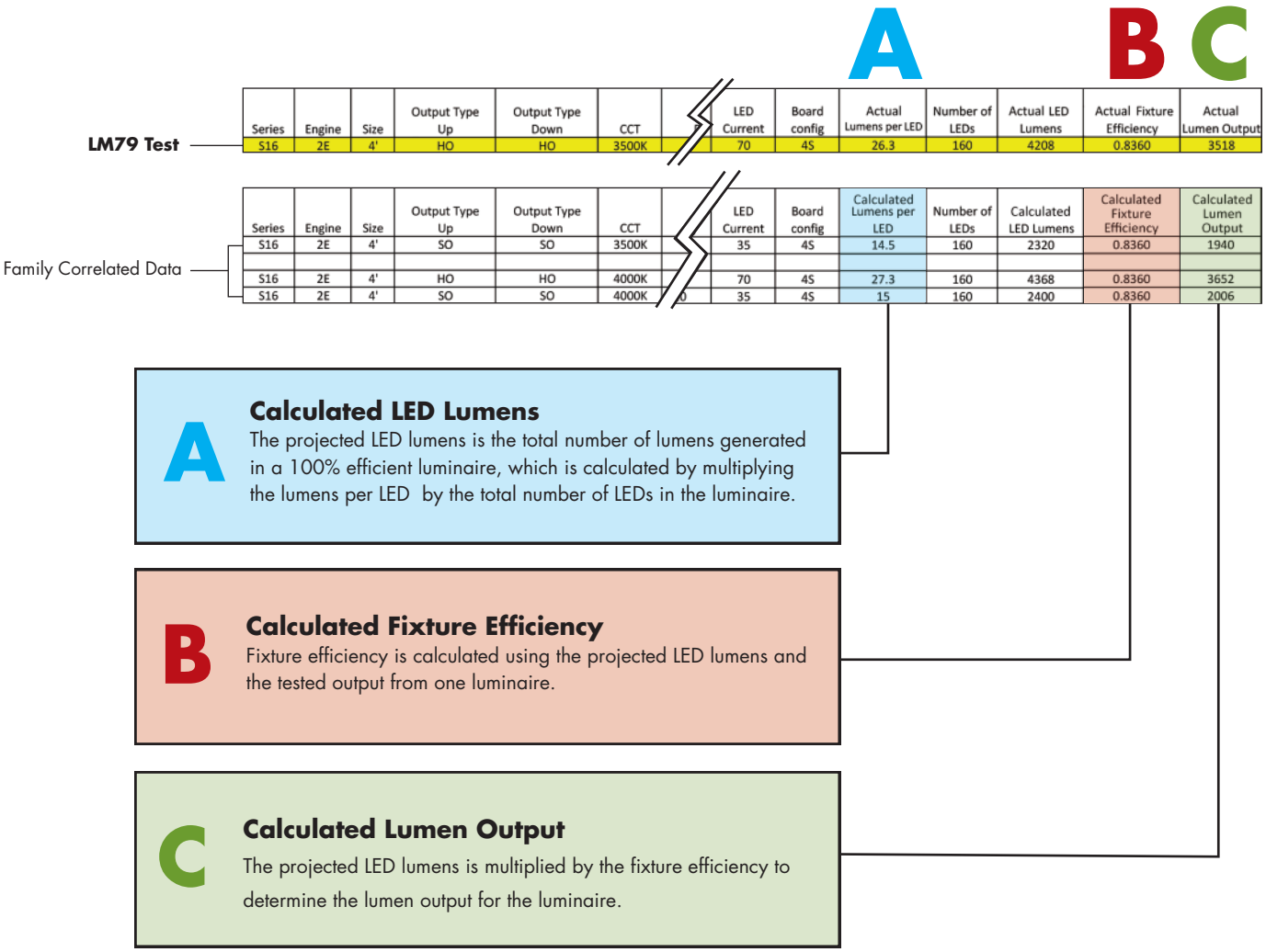
Lumens per LED are calculated for each color temperature (CCT) based on the electrical current delivered to each LED. The chart to the right is a sample summary of those calculations.



Implementation

Step 3: Use the luminous flux information to calculate the lumens per color temp for each luminaire in the family.

We use the data available in the LED specification from the LED manufacturer to calculate the lumens produced per chip for each available color temperature. This data is used to develop a spreadsheet showing lumen output for each luminaire in the family.



A **Calculated LED Lumens**
The projected LED lumens is the total number of lumens generated in a 100% efficient luminaire, which is calculated by multiplying the lumens per LED by the total number of LEDs in the luminaire.

B **Calculated Fixture Efficiency**
Fixture efficiency is calculated using the projected LED lumens and the tested output from one luminaire.

C **Calculated Lumen Output**
The projected LED lumens is multiplied by the fixture efficiency to determine the lumen output for the luminaire.

Formula: A x B = C (Calculated Lumen Output)

Step 4: Output IES file for simulation

Finelite provides family correlated files and they can be downloaded from each product page at www.finelite.com.

Q&A

Q: Can I get an IES File for products that have correlated data?

A: Yes, IES files are generated by combining independent testing performance with family correlation data.

Q: Can I get an IES File for a specific lumen output for the luminaire for my project?

A: Yes

Q: Will Finelite share the scale factors used and the backup data with customers?

A: Yes, we are transparent

Q: How close is the correlated data to an actual test?

A: Calculated lumen output is within ±10%. The lumen output ±10% shows better accuracy compared to fluorescent luminaires systems. For more information refer to U.S. Department of Energy's report on "Lumen Maintenance and Light Loss Factors".

Q: Can you create family correlations for different luminous outputs?

A: Yes. Knowing the fixture efficiency and individual LED lumens at a given input current allows the calculation of alternative luminous outputs.

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