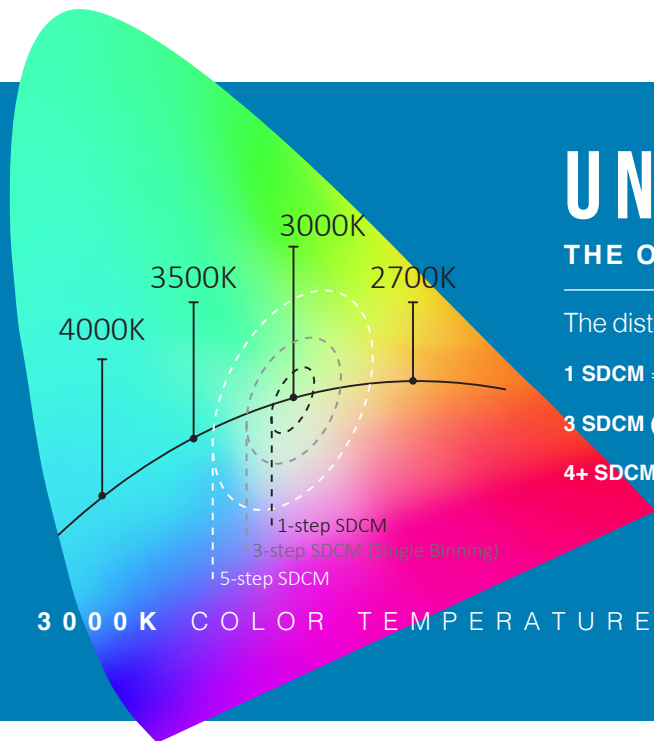


# SINGLE-BINNING LEDs & OTHER MISLEADING LIGHT QUALITY METRICS



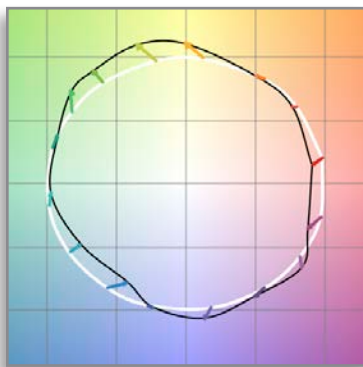
## UNDERSTANDING SDCM

### THE OBJECTIVE MEASURE OF HIGH-QUALITY LIGHTING

The distance from the target color point in each ellipse is measured in SDCM.

- 1 SDCM** = Complete color consistency between thousands of LEDs in a run of lighting.
- 3 SDCM (Single Binning)** = Color shift and temperature can start to become inconsistent
- 4+ SDCM** = Noticeable color difference by the human eye

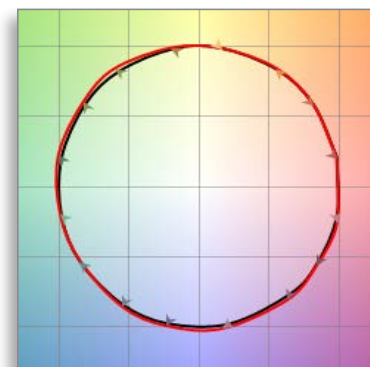
## SINGLE BINNING



### SINGLE BINNING DOES NOT MEAN SUPERIOR

- “Single Binning” is a marketing term that isn’t backed by data
- Quality of light is dependent on factors outside of the control of the seller
- “Micro-Binning” may claim to indicate consistent color temperature (CCT) but at the sacrifice of true light quality: color rendering

## SINGLE SDCM



### HOW SDCM PROVES COLOR CONSISTENCY AND PERFORMANCE

- Single Standard Deviation Color Matching – One Macadam Ellipse from the black body curve
- Statistically measurable and proven color rendering and consistency
- References Fidelity and Gamut values which are truer measurements of color rendering
- Color Vector graphic reveals how each color in the spectrum is truly rendered

# SINGLE BINNING

The color consistency, or chromaticity consistency, of an LED light source is critically important for lighting design. Non-experts can distinguish light sources that do not match, drawing attention to the defects in poor-quality illumination and away from the design intent. The marketing term “single binning” is not an objective measure of light quality and is used to mask the inconsistencies of imperfect light sources. Even industry-standard brands produce linear LEDs that vary noticeably in color temperature or other color quality different production batches do not match; and different products from the same manufacturer will have different color qualities that are noticeable to the human eye.

BRILLIANT, TRUE-TO-LIFE COLOR



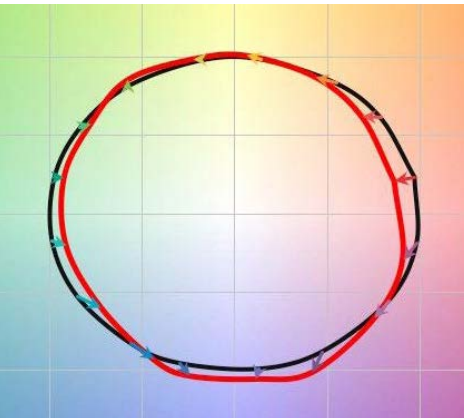
## SINGLE-SDCM (MACADAM ELLIPSE) VS “SINGLE BIN” OR “MICRO-BIN”

Legacy LED lighting manufacturers say they offer the best LED light quality in the industry -- but they do not.

Outdated marketing jargon like “*single binning*” and “*micro binned*” is commonplace. True **Single-SDCM** or Single MacAdam Ellipse is the objective measure of light quality, and ultimately, a strong measure of the accuracy and quality of a light source.

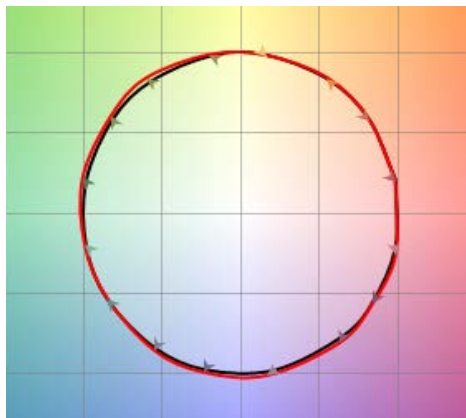
The MacAdam ellipse is a system of color measurement that measures how much color variation exists around the black body curve before the human eye detects a color shift. A series of ellipses can then be drawn around any specific color, and the closer any given light is to the specific color, the less deviation will be experienced when these lights are positioned next to one another.

### UNDER-SATURATED

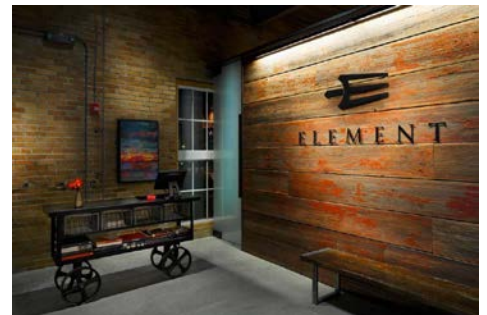
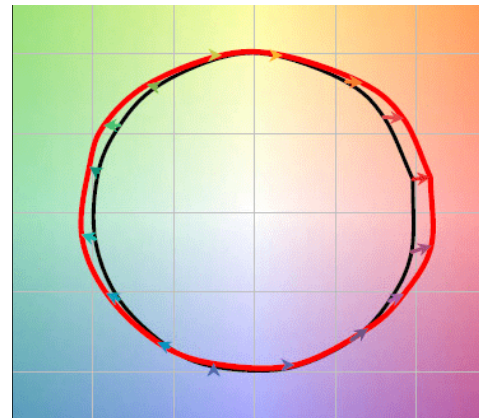


### TRUE COLOR

Single-SDCM (Single MacAdam Ellipse)



### OVER-SATURATED





# QUALITY THROUGH MANUFACTURING

To build linear LED products, billions of LED chips are produced and phosphor mix applied on an automated manufacturing line. Inevitably there will be color inconsistencies between individual chips and the modules built from them. In the early days of LED production, product quality was determined by the accuracy of the binning process of chips. Manufacturers referred to “binning” as

the method by which LEDs were sorted according to their color output. This was a subjective process and each manufacturer “binned” differently. A batch of LED chips in a “single bin” would not necessarily result in consistent quality light -- what if that “bin” was defined loosely, or to poor standards?



# SINGLE SDCM ( SINGLE MACADAM ELLIPSE ) THE OBJECTIVE QUALITY STANDARD

Improvements in LED module design have brought the MacAdam Ellipse to the forefront of color analysis. The term “single binning” no longer accurately represents the consistent superior quality in LED chips. A perfect LED module manufacturing line will produce batches of modules operating within one MacAdam Ellipse. There will be no discernible difference in light quality and color temperature between any of the modules. LED modules produced at this quality level are used where color performance and accuracy between lighting fixtures and runs of linear light is critical. Hence, single SDCM is the highest standard of measurement of light quality.

# WHO IS BUILDING TRUE SINGLE SDCM LINEAR LIGHTING?

Elemental LED's Lucetta Lighting division is dedicated to producing a high performance, architectural-grade lighting line: CELESTE™ Linear Lighting. Elemental LED is able to achieve this by producing **billions** of color consistent LEDs a year. This low-voltage linear light is engineered to produce the kind of true-color output lighting designers require for their most demanding applications. Using a proprietary formula of LED phosphor, Elemental LED has exceeded the color performance and lifespan requirements of its most discerning customers. Lighting specifiers are able to create true-color environments for hospitality, retail, and luxury residential applications. The color rendering quality, consistency, and lifespan of CELESTE™ Linear Lighting line is unmatched in the marketplace.

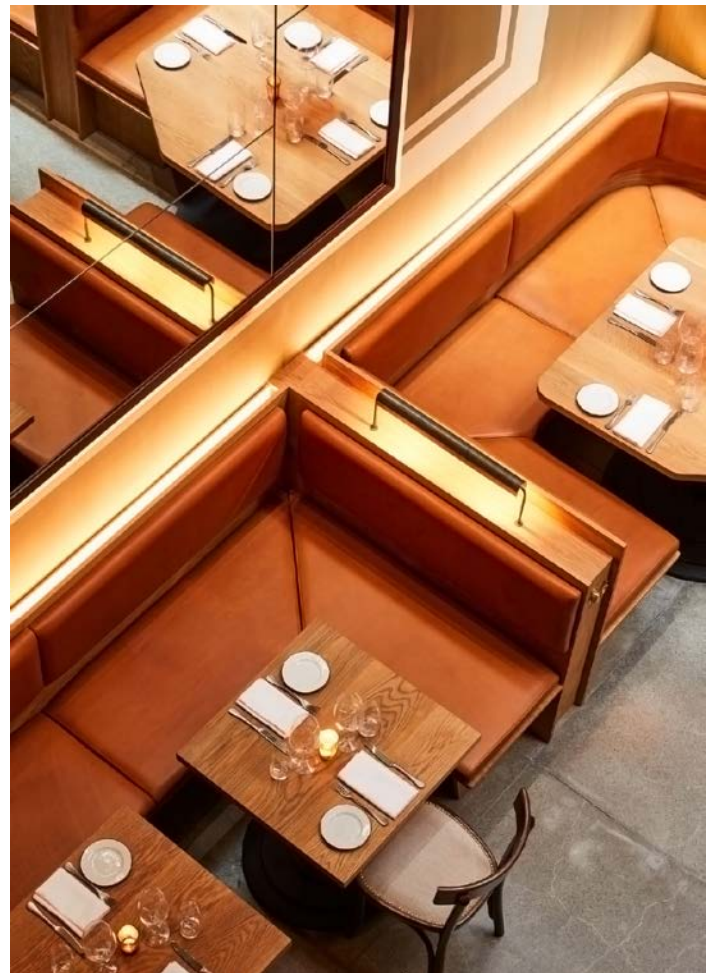
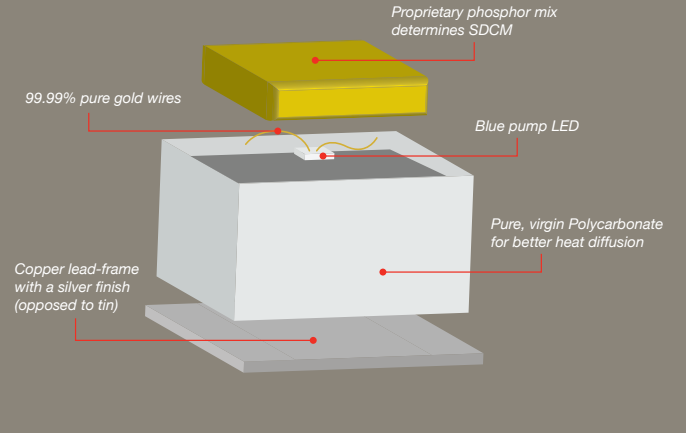
## CELESTE™ LINEAR LIGHTING DELIVERS SINGLE SDCM

- LEDs are constructed from the highest quality raw materials
- Design and material control of LED modules are under control of the manufacturer, as opposed to third-party tape light manufacturers
- Proprietary phosphor mix delivers Single-SDCM color rendering
- Highest-quality plastics, wires, metallurgy, phosphor mix, and wafers deliver long-lasting color consistency and color quality



# IN-HOUSE DESIGN, ENGINEERING AND MANUFACTURING RESULTS IN HIGHER BUILD QUALITY AND COLOR CONSISTENCY OVER TIME

## CELESTE™ LED CHIP CONSTRUCTION



SINGLE-SDCM  
THE OBJECTIVE MEASURE OF HIGH-QUALITY LINEAR LIGHT