

Lighting Basics

Associated Lighting Representatives

Lighting Basics

- Techniques and Effects
- Metrics
- Design for General Illumination
- Luminaire Selection
- LED Construction, Performance, Color, and Dimming
- Tunable White
- Acoustical Lighting
- JA8

The background of the slide is a dark blue field filled with numerous out-of-focus light circles, known as bokeh. These circles vary in size and brightness, with some appearing as soft, glowing halos and others as more distinct, though still blurred, points of light. The overall effect is a dreamy, ethereal, and textured backdrop.

Lighting Techniques and Effects



General Illumination

Lighting Technique and Effects



Accent

Lighting Techniques and Effects



Various Accent Options

- Varying beam spreads
- Hexcell louvers
- Soft focus
- Diffusion/spread lens options
- Snoots

	Beam spread (To 50% CBCP)	CBCP
LLMRNS Narrow Spot	12°	14,160
LLMRS Spot	18°	7,103
LLMRNF Narrow Flood	24°	4,891
LLMRF Flood	36°	2,680



Hex cell louvers 7472 = 2" dia.



Only available in matte black. Must order the accessory holder to hold the hex cell louver.

Snoot LC10SN = 2" dia.



Diffusion/special films LC10 = 2" dia.



LS Linear spread film



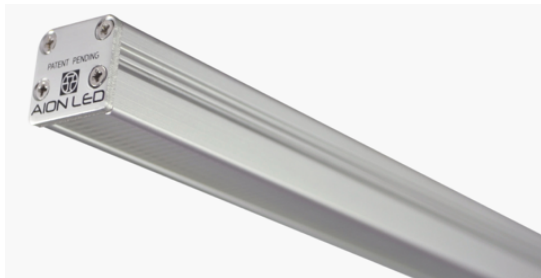
FR Frosted etched film



SF Soft focus film



SY Symmetrical spread film



Graze

Lighting Techniques and Effects





Wall Wash

Lighting Techniques and Effects



Contrast

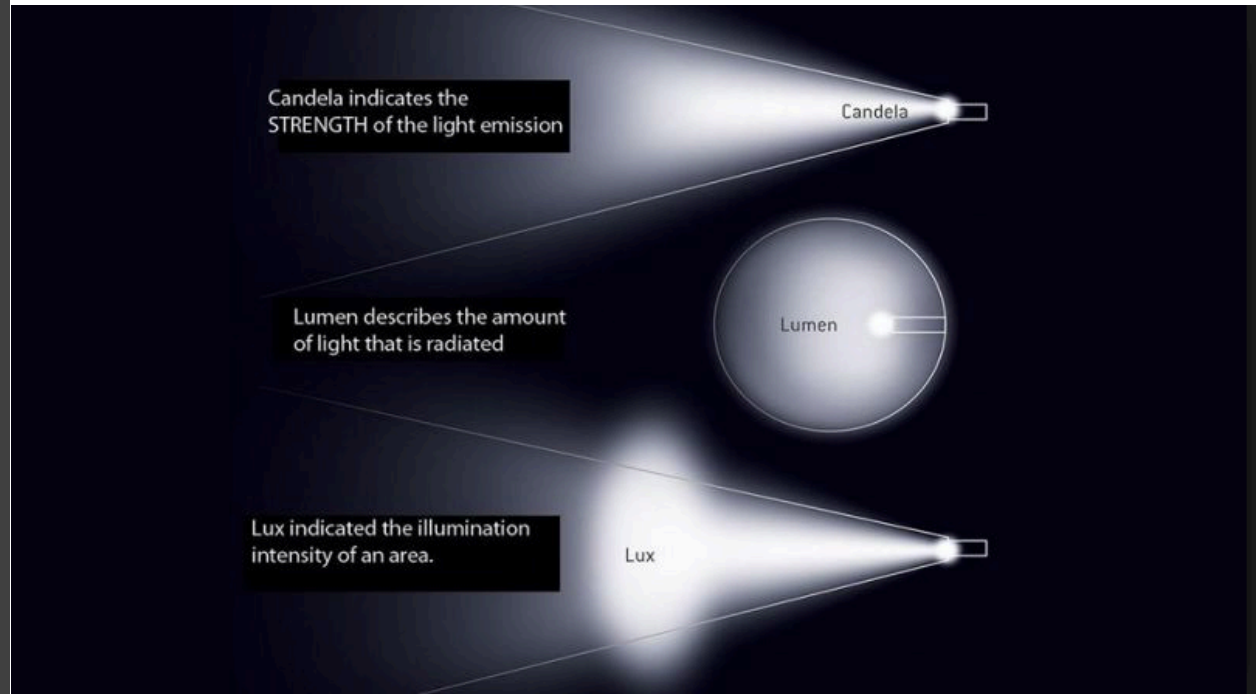
Lighting Techniques and Effects



Lighting Metrics

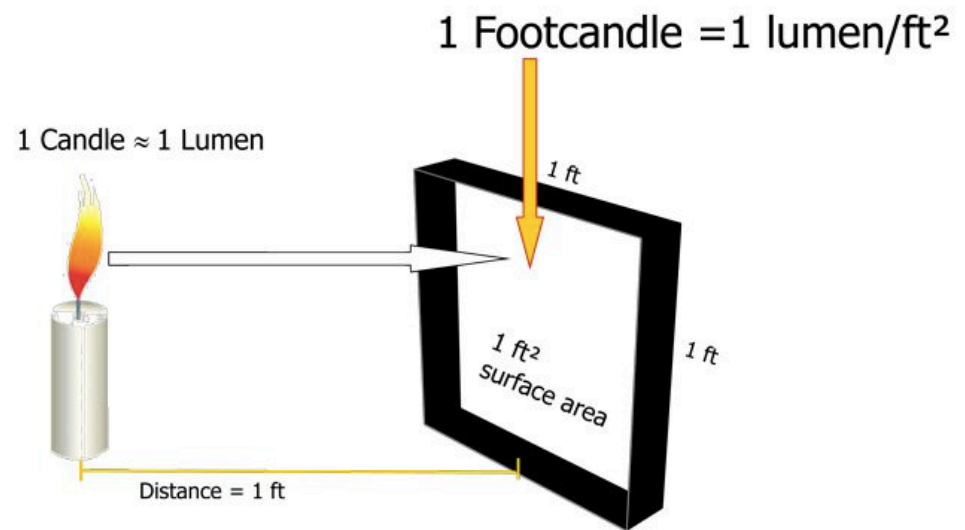
Lighting Metrics

Lumen (lm): unit of measure of luminous flux, used to indicate the total amount of light given off by a light source



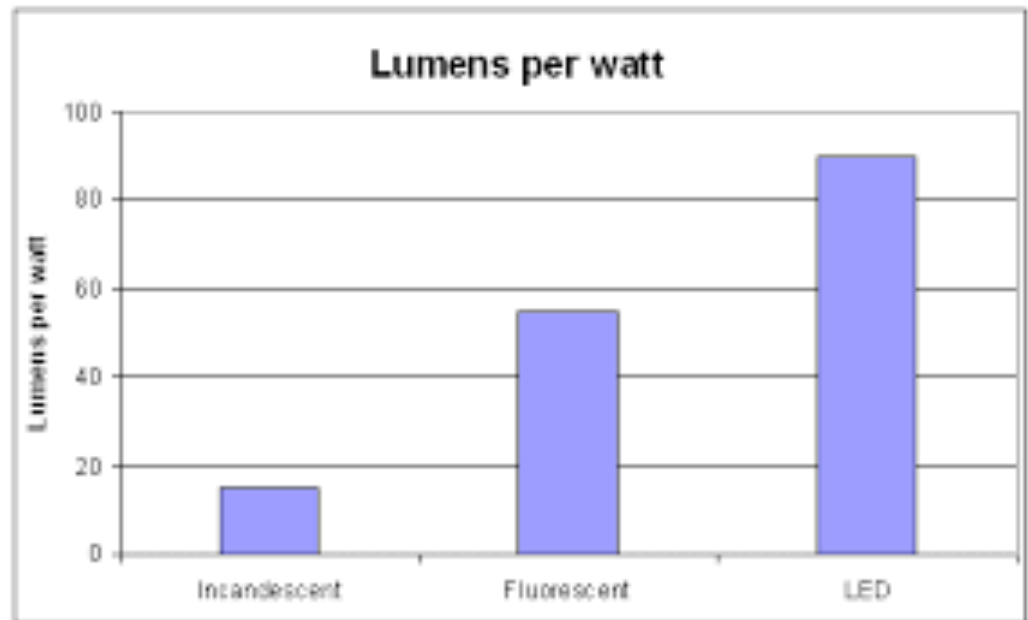
Lighting Metrics

Footcandle (fc): the density of light at a given point on a surface



Lighting Metrics

Efficacy (lm/W): number of lumens emitted per watt of energy consumed, used to compare the relative efficiency of light sources



Design for General Illumination

What does it mean to have the right quantity and quality of light?

Designing for General Illumination

Intensity (Footcandles)

Uniformity

Reflectance

Aesthetics

Glare Control



Clif Bar & Company, Emeryville, CA

ZGF Architects; Biella Lighting; PAE Consulting Engineers; One Work Place; photo Robert Canfield

Designing for General Illumination

IES publishes ranges of recommended light levels for many interior and exterior spaces.

Building Area & Task	Average Maintained Footcandles (Horizontal) (FC)	Range of Maintained Footcandles (Horizontal) (FC)	Average Maintained Footcandles (Vertical) (FC)	Range of Maintained Footcandles (Vertical) (FC)	Comments
WAREHOUSING & STORAGE					
Bulky Items—Large Labels	10		5		
Small Items—Small Labels	30		15		
Cold Storage	20	10 - 30	10	5 - 15	
Open Warehouse	20	10 - 30			
Warehouse w/Aisles	20	10 - 30	10	5 - 15	
COMMERCIAL OFFICE					
Open Office	40	30 - 50			@30" Above Finished Floor (AFF)
Private Office	40	30 - 50			@30" AFF
Conference Room	30				Matte surface reflectance for the table 40% recommended
Restroom	18	7.5 - 30			
Lunch & Break Room	15	5 - 20			

Designing for General Illumination

Uniformity:

- Uniformity is ratio of the highest to lowest light levels
- Incredibly important for visual acuity, visual comfort, and aesthetics
- The goal is adequate lighting without drawing your attention to the light; no hot or dark spots
- Achieving good uniformity is at least as important as light level in good lighting design

Designing for General Illumination

Reflectance:

- Remember your reflectance values when requesting photometric layouts
- Assumption is 80/50/20 for ceiling, wall, and carpet
- Deviations can have unpredictable results







Luminaire Selection: Efficacy and Glare



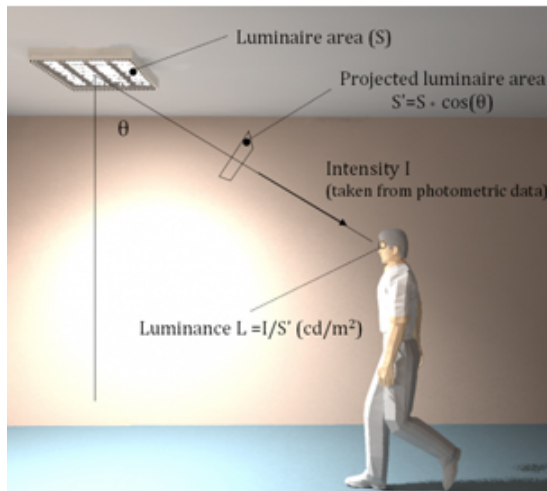
Efficacy versus Efficiency

Efficacy specifically refers to the number of lumens emitted per watt of energy consumed, and is used to compare relative efficiency of light sources.



How are glare and efficacy related?

Various methods of control (optics, fixture construction, lens, etc.) are used to control brightness but generally reduce lumen output.



UGR and Visual Comfort

- Unified Glare Rating (UGR) range from 10-28
- <19 acceptable for offices, <16 great
- <19 accepted for Well Building via addendum
- UGR is a good start but is flawed

CLARIS Evo
Individual and Straight Runs

- Four by six color combinations
- Choice of louver finishes for different visual tasks
- UGR < 16
- Soft edge prismatic (SEP) with gentle rounded micro-prisms for reduced luminance levels at all viewing angles
- Wireless dimming via Bluetooth
- Efficacy up to 129 lm/W

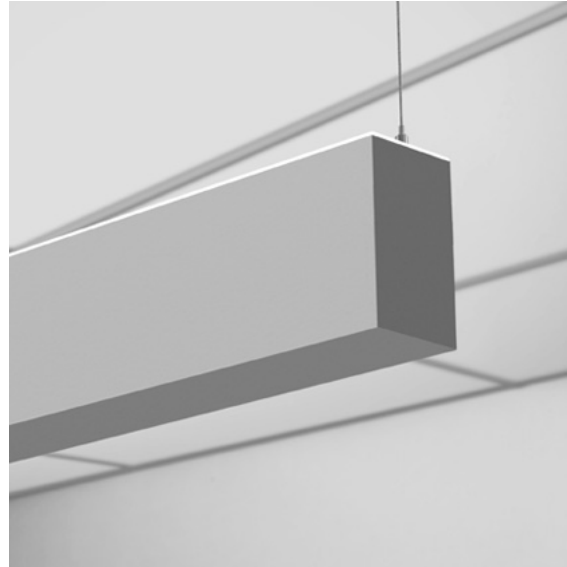
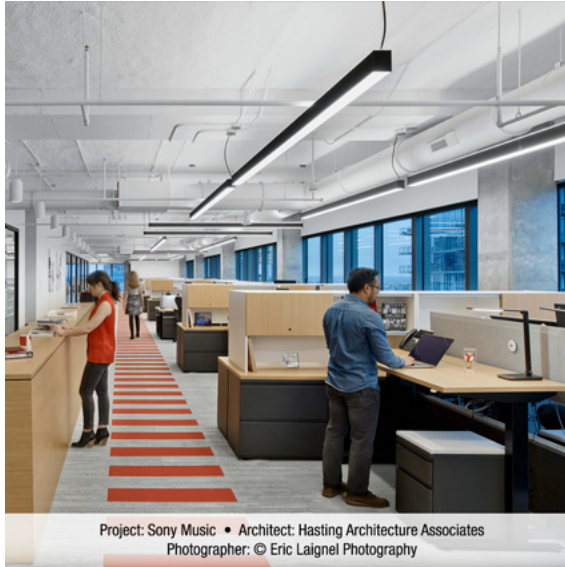
CR	RENDERING	WATTS	UGR
80+		8.5 W/ft	< 16



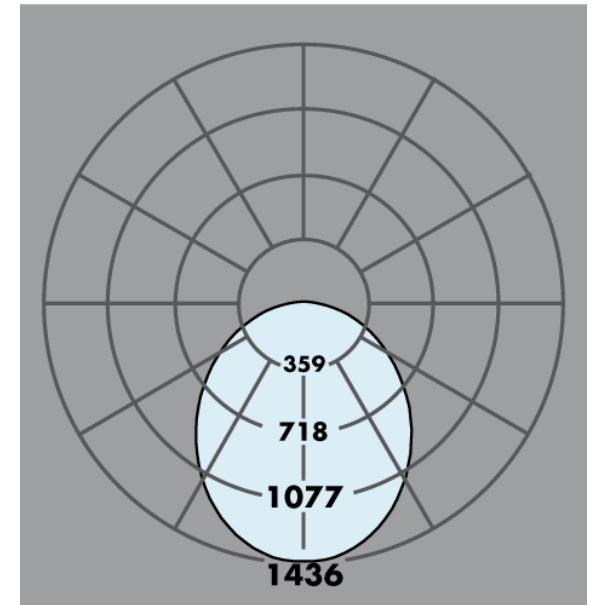
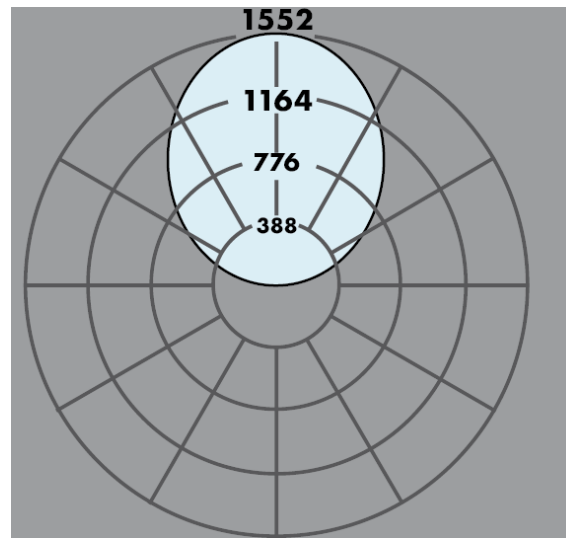
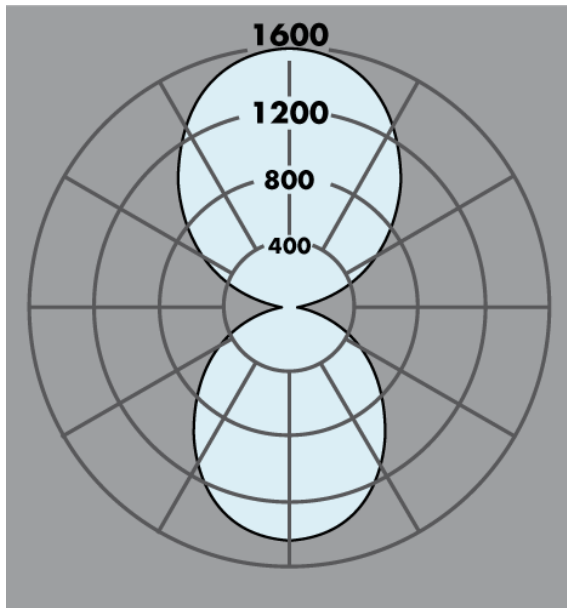
Luminaire Selection

Luminaire Selection

- Distribution
- Lumen Output
- Spacing



Luminaire Selection: Distribution

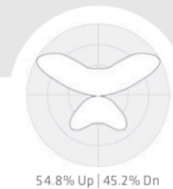
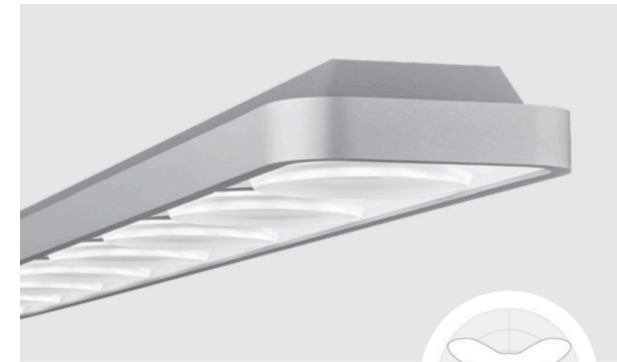
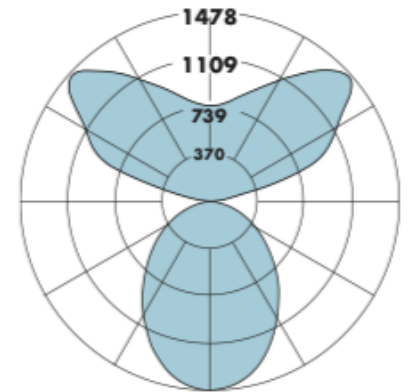
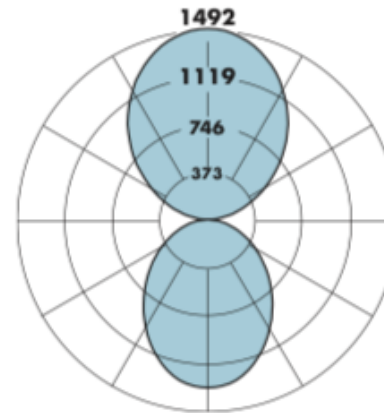


Luminaire Selection: Distribution

Direct/Indirect, Indirect only, Direct only

Luminaire Selection: Optical Distribution

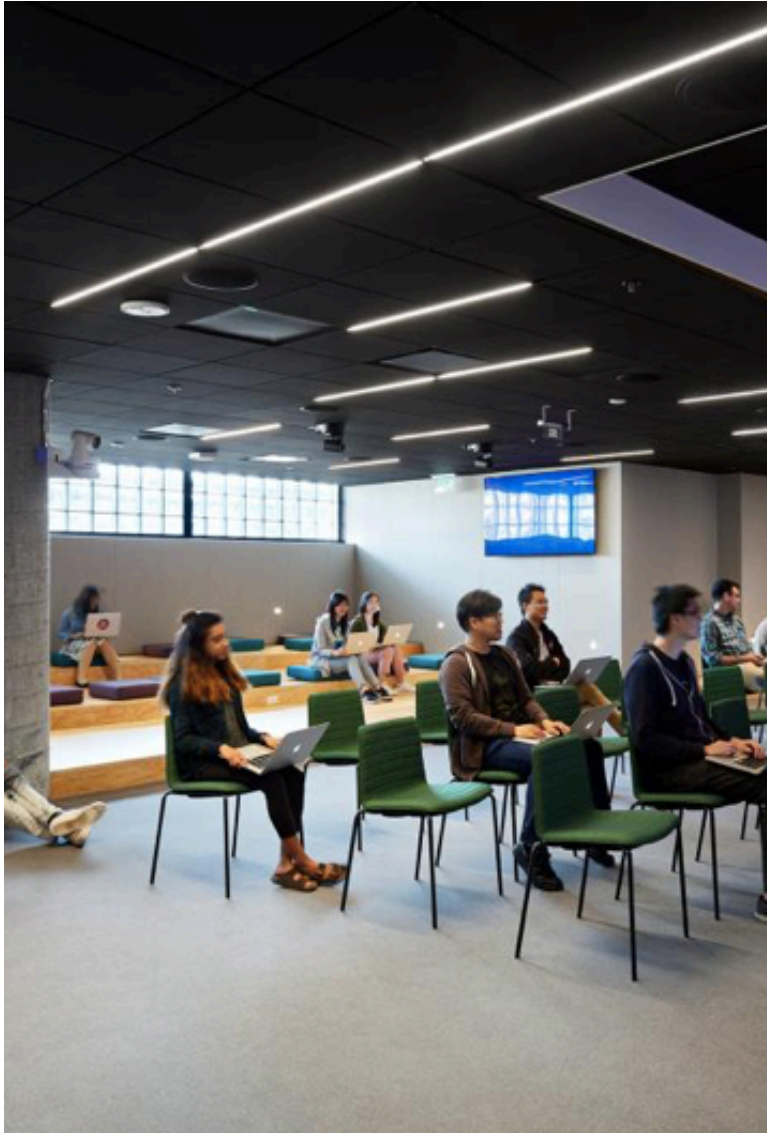
Batwing distributions allow for improved
uniformity



54.8% Up | 45.2% Dn

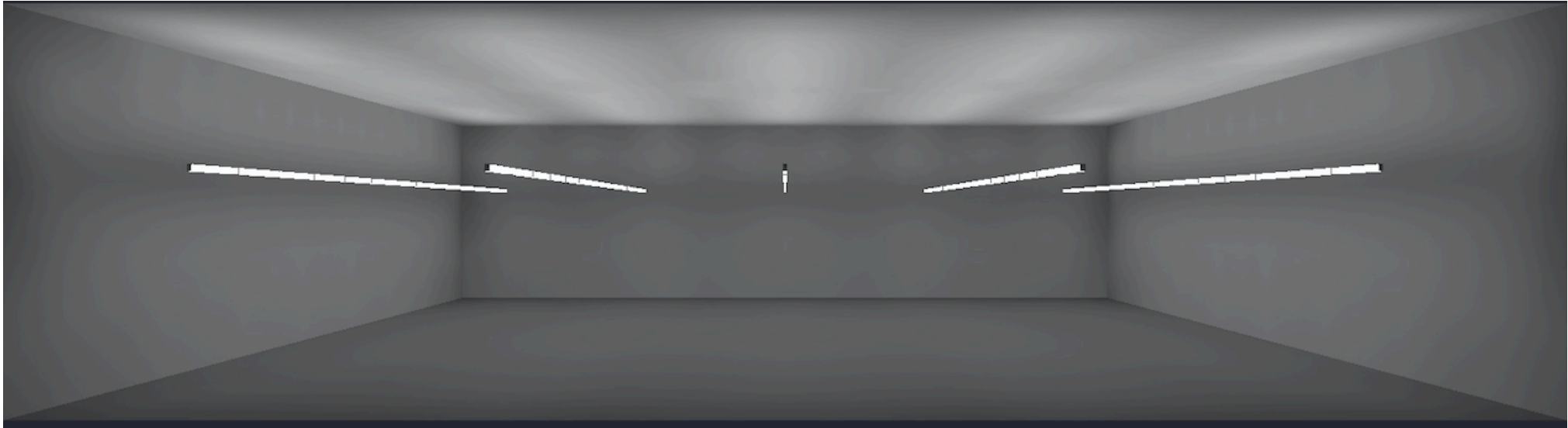


Luminaire Selection: Distribution



Luminaire Selection: Spacing

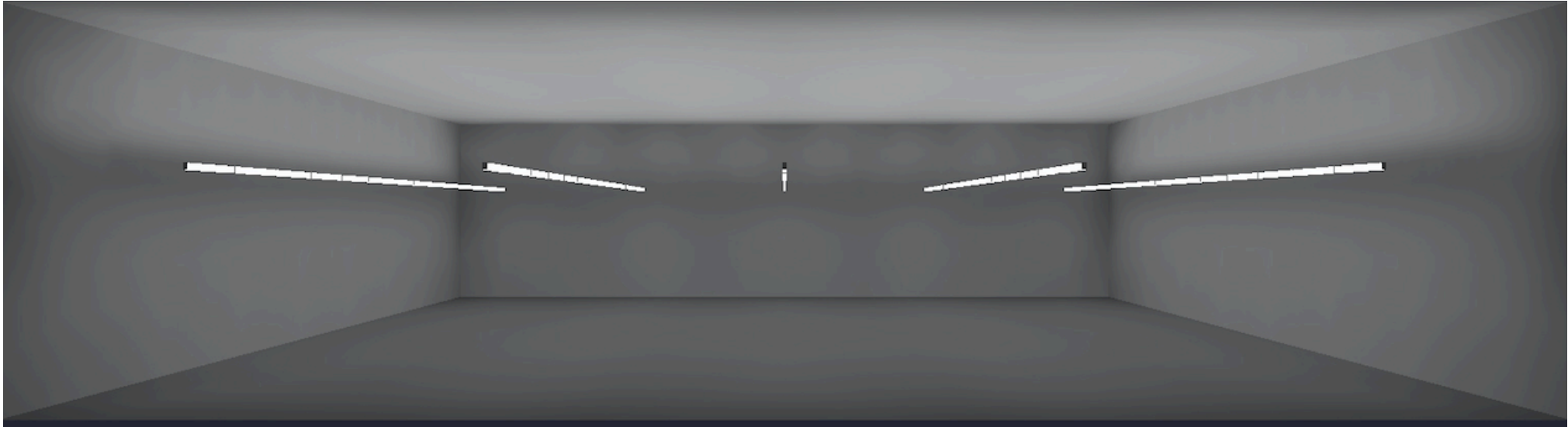
- Linear fixtures are treated differently because of their physical shape
- 10'-12' OC is considered acceptable for linear fixtures
- 12'-15' or greater considered very good
- Photometric layouts can help confirm uniformity and light levels




- 16' ceiling height, 10' mounting height
- 12' On Center Spacing, 35fc average targeted
- HP2 Direct/Indirect, 55% Up, 45% Down
- 65 total 4' fixtures @ .52w/sf LPW

Luminaire Schedule										
Symbol	Qty	Label	Description	Lum. Watts	Lum. Lumens	LLD	LDD	UDF	LLF	Filename
	65	F3	FINELITE - HP-2-ID-4ft-S-S-835	28.9	2860	0.944	0.900	1.000	0.850	HP-2-ID-4ft-S-S-835-ITL85132.001

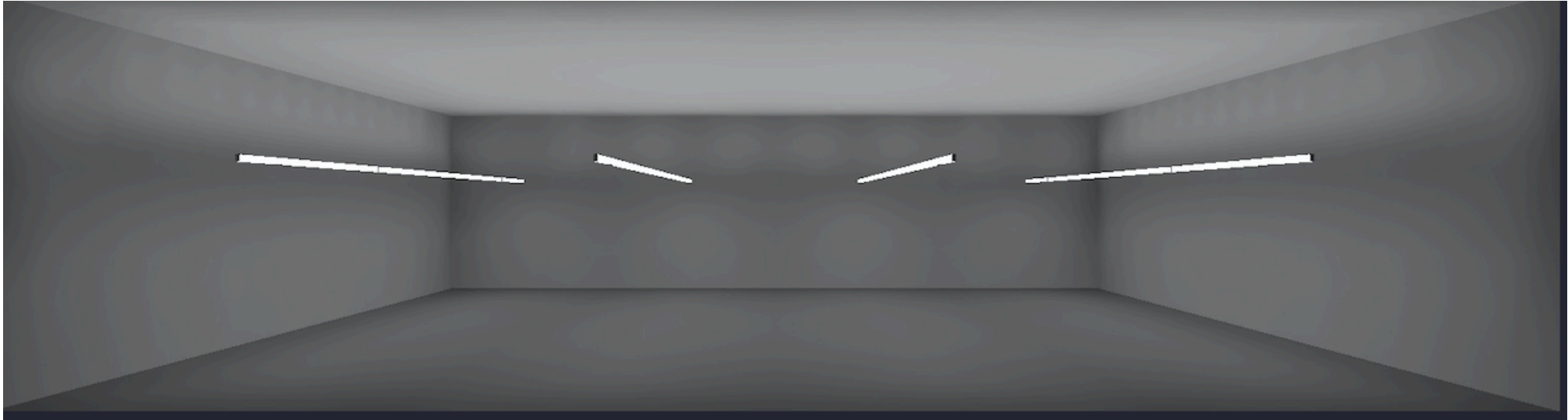
Calculation Summary								
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min	Description
Open Office	Illuminance	Fc	35.35	47.8	14.1	2.51	3.39	Target: 35fc Average Target




- 16' ceiling height, 10' mounting height
- 12' On Center Spacing, 35fc average targeted
- HP2 Direct/Indirect, 55% Up, 45% Down
- WSO Batwing Optic
- 65 total 4' fixtures @ .51w/sf LPW

Luminaire Schedule										
Symbol	Qty	Label	Description	Lum. Watts	Lum. Lumens	LLD	LDD	UDF	LLF	Filename
	65	F4	FINELITE - HP-2-ID-4ft-S-S-835-WSO	28.4	3001	0.944	0.900	1.000	0.850	HP-2-ID-4ft-S-S-835-WSO-ITL89456

Calculation Summary								
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min	Description
Open Office	Illuminance	Fc	36.86	50.6	14.3	2.58	3.54	Target: 35fc Average Target



- 16' ceiling height, 10' mounting height
- 15' On Center Spacing, 35fc average targeted
- HP2 Direct/Indirect, 49% Up, 51% Down
- WSO Batwing Optic
- 52 total 4' fixtures @ .47w/sf LPW

Luminaire Schedule										
Symbol	Qty	Label	Description	Lum. Watts	Lum. Lumens	LLD	LDD	UDF	LLF	Filename
	52	F4A	FINELITE - HP-2-ID-4ft-S-B-835-WSO	32.2	3349	0.944	0.900	1.000	0.850	HP-2-ID-4ft-S-B-835-WSO-ITL89456

Calculation Summary								
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min	Description
Open Office	Illuminance	Fc	34.42	52.3	11.7	2.94	4.47	Target: 35fc Average Target






Luminaire Selection: Spacing

Spacing Criterion (SC) is an estimated maximum ratio of the luminaire spacing to the luminaire mounting height achieve acceptable uniformity on the work plane.

This applies to downlight-only fixtures, like recessed cans, cylinders, and troffers.

Luminaire Selection: Spacing

Focal Point ID 3.5"

Ordering Code	Cut-Off Degree	Distribution Beam Spread Spacing Criteria					Housing Depth
		NFL	FL	WFL	VWFL	SWFL	
DNT	 50°	26° 0.43	44° 0.67	59° 0.91	-	-	3.16"
DNS	 60°	24° 0.39	44° 0.67	56° 0.81	-	-	2.64"
DSS	 75°	-	-	-	70° 0.91	94° 1.22	2.64"

The background of the slide is a dark blue field filled with numerous out-of-focus light circles, known as bokeh. These circles vary in size and brightness, creating a soft, glowing effect. The colors of the bokeh are primarily light blue and white, with some hints of a slightly warmer, yellowish-white, giving it a dreamy, ethereal appearance.

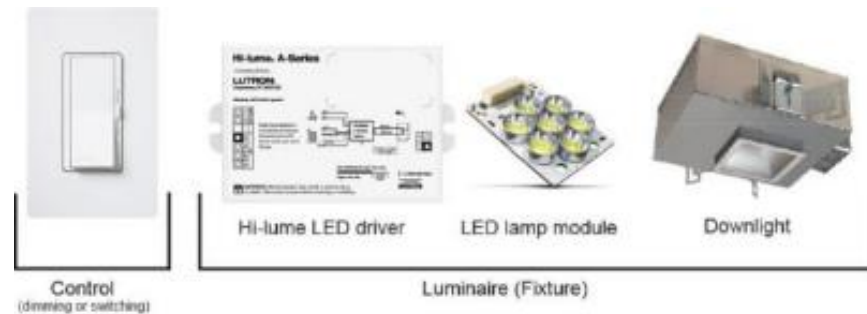
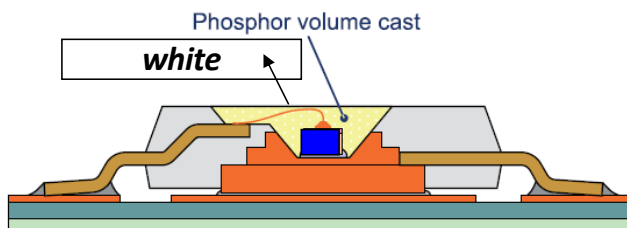
LED's

Construction, Performance, Color, and Dimming



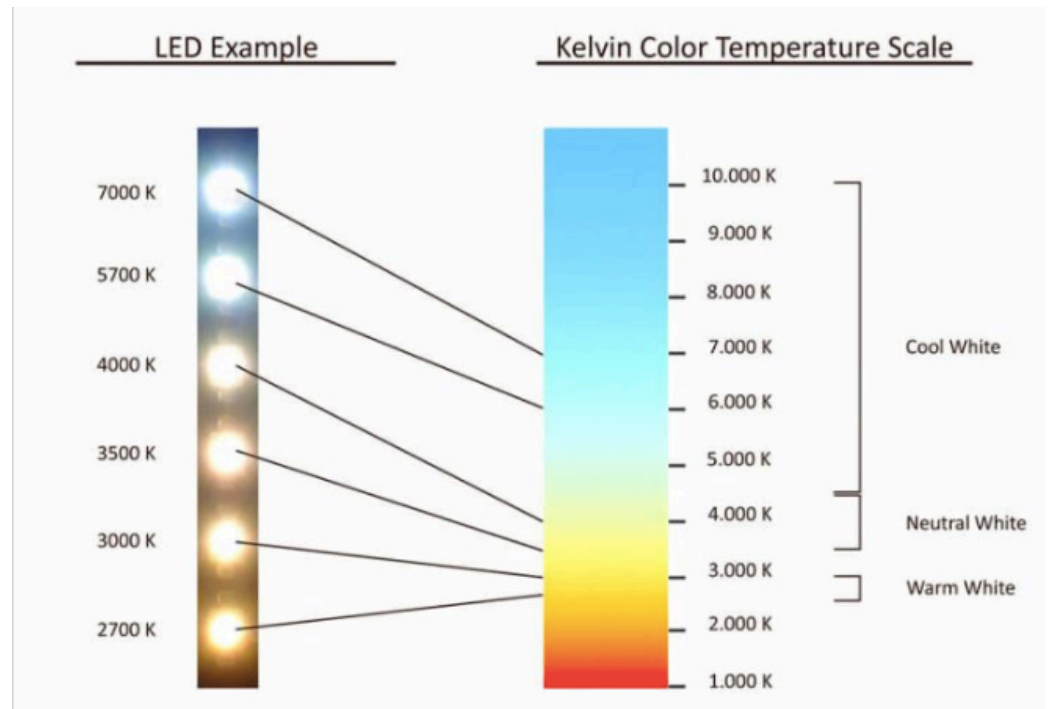
LED Construction

- Blue LED chips mounted to a circuit board, typically covered with yellow phosphor to create white light
- Driver provides appropriate voltage to board
- Heat sink helps pull heat away from the board housing the chips
- Optic manages glare and helps direct light
- Housing includes the body of the fixture and brings it all together



LED Color

- CCT: Kelvin Temperature is a measure of the overall appearance of a white light source (warm or cool)

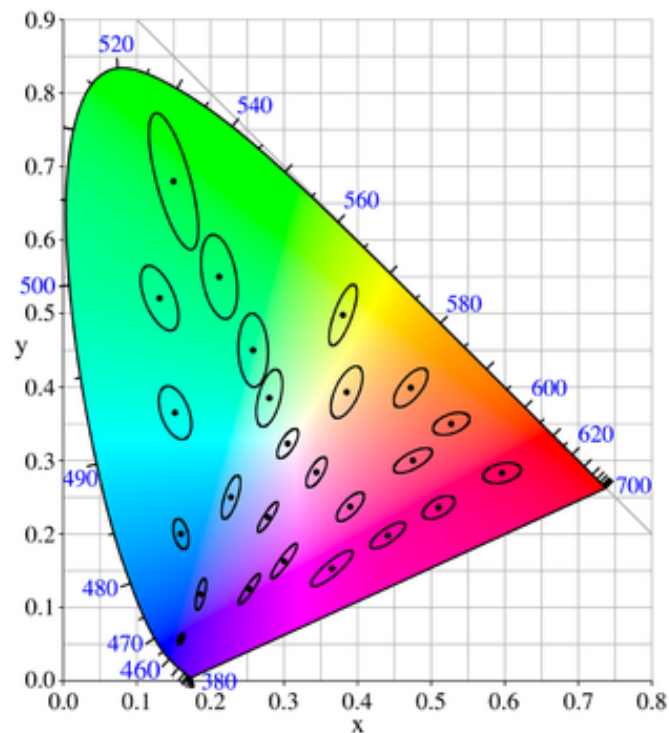




Tunable White

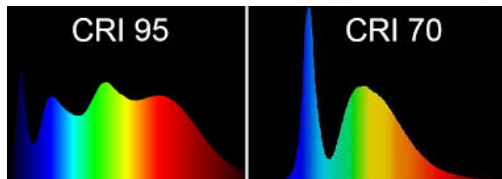
- “Human Centric” Lighting
- Map circadian rhythm
- Trigger a stimulus

LED and Color Consistency



- Color Consistency
 - LED chips have some inconsistencies, binning is the process by which like chips are sorted
 - MacAdam Ellipse is a way to measure color consistency between LED chips
 - 1 Standard Deviation Color Match (SCDM) from the color at the center of the ellipse
 - Colors within 1 step MacAdam Ellipse are indistinguishable to the human eye
 - Colors within 2 to 4 steps are considered barely distinguishable
 - Colors within 5 steps and up are readily distinguishable

LED and Color Quality



- CRI: Color Rendering Index is the most common metric; it measures the ability of the light source to render color well (scale of 0-100)
 - 80+ CRI is standard
 - 90+ CRI is preferred

CRI vs. TM30

- 8 pastel colors vs. 99 natural colors
- Measures Fidelity (color accuracy) and Gamut (color saturation)
- Oversaturation in reds results in more natural skin tones, warmer wood tones, and increased vibrancy in objects
- Manufacturers are starting to use their own hue/saturation blends to create more preferred light



CIE CRI
(1964/1975)

FIDELITY ONLY

TM-30-15
(2015)

FIDELITY GAMUT, COLOR VECTOR

LED Performance

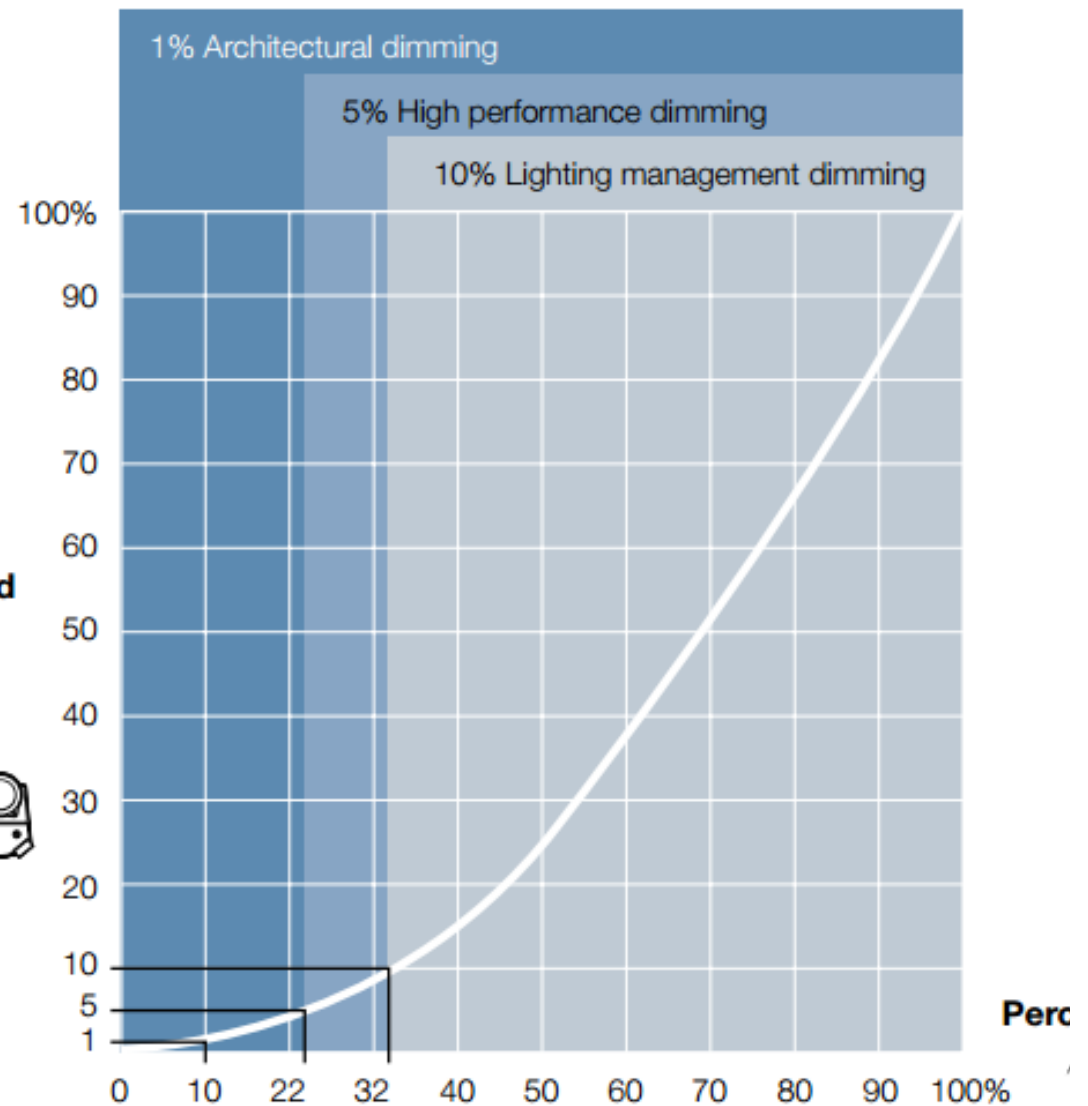
- L70: The duration at which the source reaches 70% of it's original light output
- 50,000 hours is standard
- Based on LM-79 Testing

LED Dimming

Measured light is the amount of light measured by a light meter, Perceived light is the amount of light a person sees, based on dilation.

Our perception of a fixture's light level is often 10-20% higher than the measured light level

**Measured
Light**



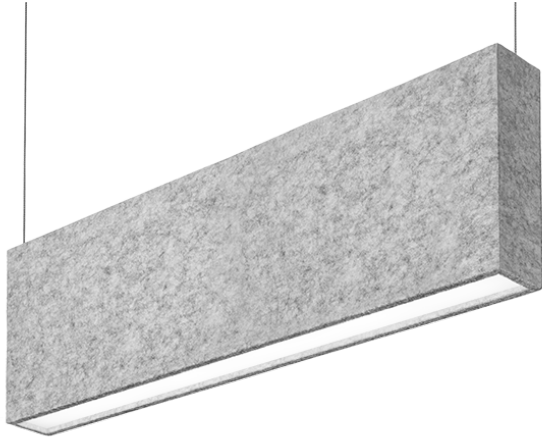


LED Dimming

- Dimming Quality Metrics
- 0.1% dimming may be necessary to create a desired effect or atmosphere
- 1% dimming is common for hospitality, residential, and restaurants
- 10% dimming is appropriate for many commercial applications



Acoustical Lighting



Acoustical Lighting







JA8

- Color (90+ CRI)
 - Dimming performance
 - Rated life
 - Start time
 - Audible noise
- Applies to residential single and multi-family dwellings
 - Residential spaces in non-residential projects like fire-stations, dorms, hospitality, etc.

Thank You

JD Stephens

Associated Lighting Representatives

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