Considerations on how to handle glare
Optic Material choice

Led Event 1215
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Sales Manager UK and Benelux

LEDiL®

LEDiL Oy, Est. 2002 in Salo, Finland.

A world-leading Lens and Reflector manufacturer for Leds

2014 Turnover 26 400 000€ euro

Glare - how to combat

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LEDiL

Dynamic Growth

- ✓ From a start-up with 2 engineers 2002 LEDiL today employs 80+ people with 20 sales representatives around the world.
- ✓ > 50% of employees are engineers
- ✓ Production in Finland & in China
- ✓ **Growth 30% year over year**
- ✓ **Over 2000 line items**

THE GROWTH

DYNAMIC FORWARD LOOKING VISION

Glare - different light sources

1000 lm from diffused bulb
vs 1000 lm from tiny LED

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The International Commission on Illumination (CIE) defines glare as:

Visual conditions in which there is excessive contrast or an inappropriate distribution of light sources that disturbs the observer or limits the ability to distinguish details and objects.

- *Reflected Sunlight*
- *Car headlamps*

What is glare?

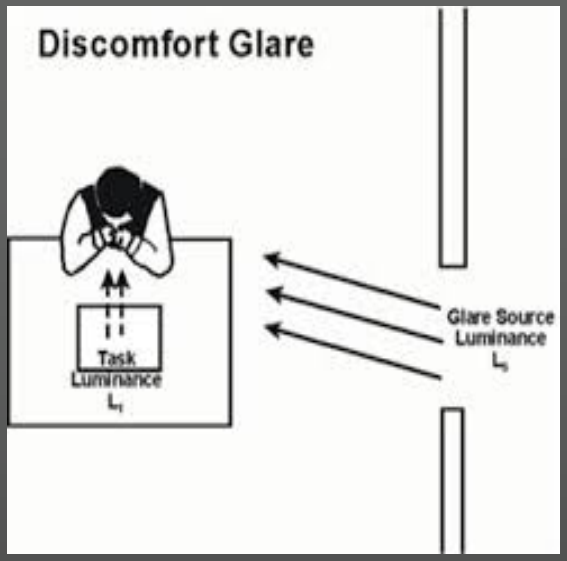
What is glare?

Glare is caused by a significant ratio of luminance (cd/m2) between the object that is being looked at and the glare source.

Factors such as the angle between the task, the source of the glare and eye adaptation have significant impacts on the experience of glare.

Types of glare - Discomfort Glare

- Glare can be generally divided into two types:- **Discomfort glare** and **Disability glare**.



- Discomfort glare results in an instinctive desire to look away from a bright light source or difficulty in seeing a task.
- Occurs when the illumination in a part of the visual field is much greater than the level of illumination for which the retina is adapted.
- Occurs when the highest level of illumination in the visual field and background field has a ratio greater than 3:1

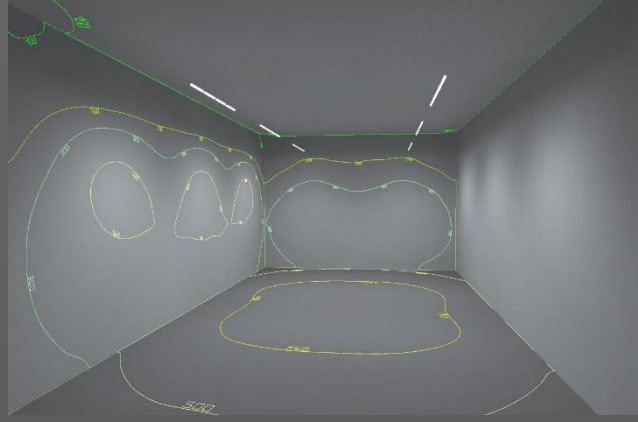
- High Level of discomfort can be caused by the luminance of the glare source and its position.
- Often caused by point sources like LEDs,

- Eliminating Discomfort Glare:-
- Use Luminaires with a Larger surface area.
- Can be reduced with diffusers, shades or matt reflectors.
- Positioning the luminaire closer to the walls.
- Using Luminaires with an up-light component.

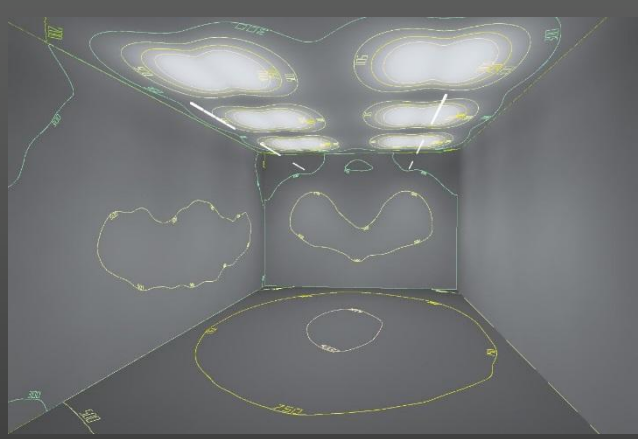
Setup:

- 4 modules per luminaire
- 2 x 3 luminaires installed

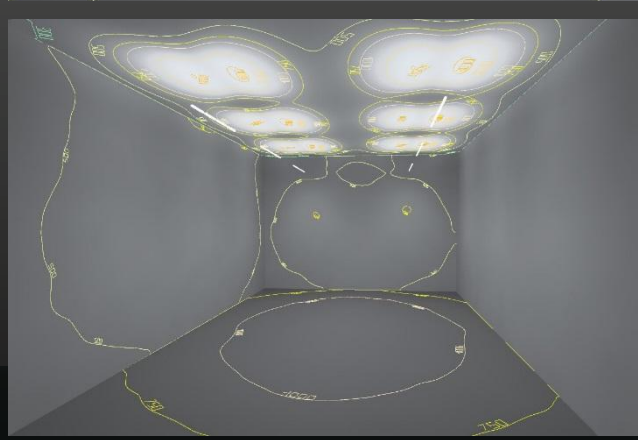
- UP: 0 lm per module
- Z90: 2000 lm per module
- UGR = 19



- UP: 1000 lm per module
- Z90: 2000 lm per module
- UGR <17



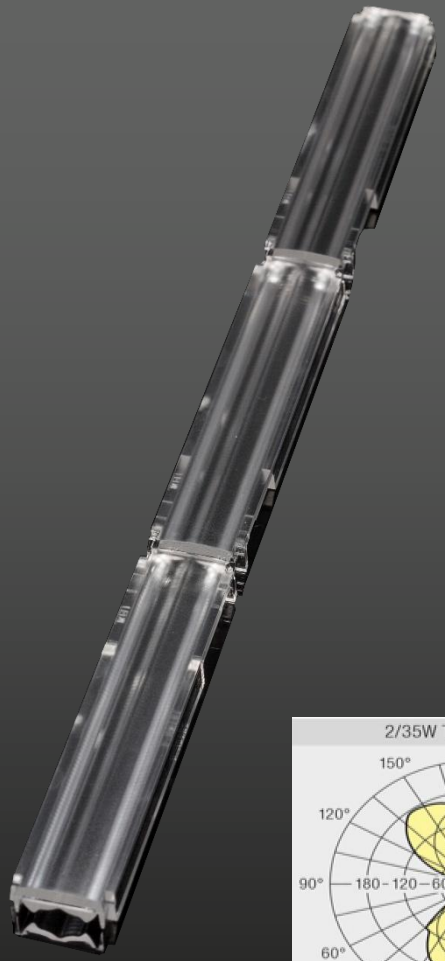
- UP: 2000 lm per module
- Z90: 2000 lm per module
- UGR <15

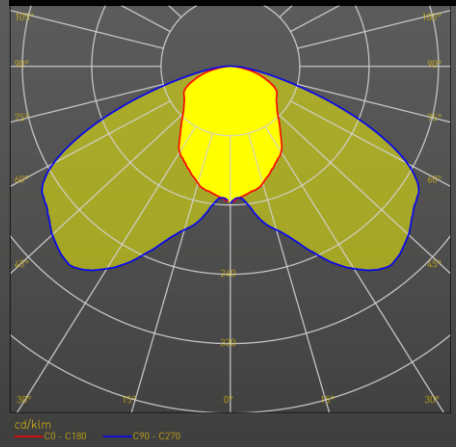


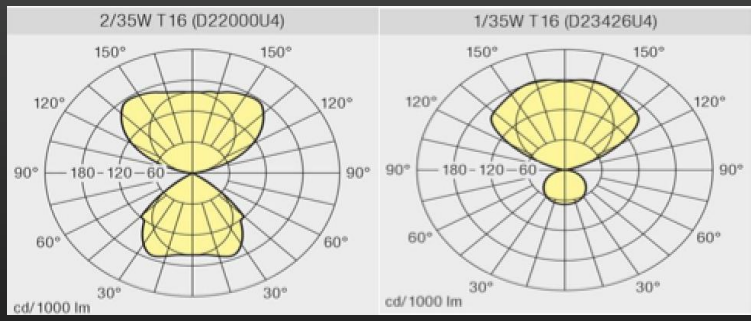
FLORENCE-1R-UP

The latest addition to the FLORENCE-1R family is FLORENCE-1R-UP

- ✓ Wide batwing type beam (like Julia) for up- and indirect lighting
- ✓ Typical efficiency over 85%
- ✓ illumination in pendant lights for office environments. Designed to replace fluorescent lights.
- ✓ Mounting into aluminium profile with typical installation distance of 20…50 cm from the ceiling
- ✓ Combine Florence-1R-UP with Z60 or Z90 to achieve any office lighting light distribution requirement and easily adjust direct light output
- ✓ Pendant luminaires are suitable for planar office lighting and double as an element of interior design
- ✓ They combine efficient direct light for the workplace with indirect light for agreeable ceiling illumination







FLORENCE-1R family got new member: Florence-1R UP

No light at roof? No problem!

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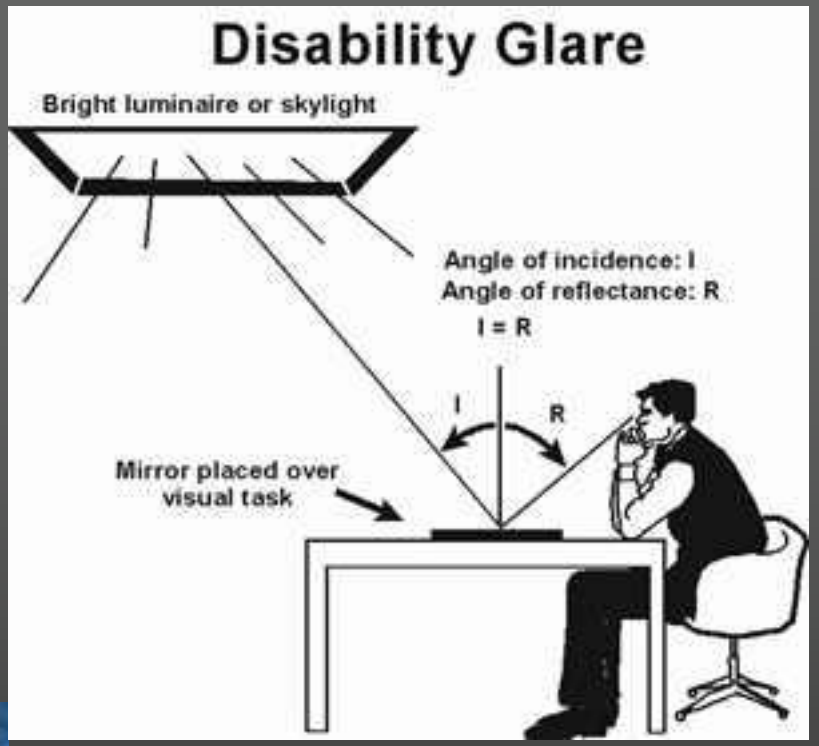
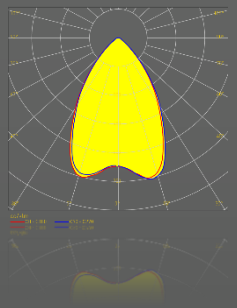
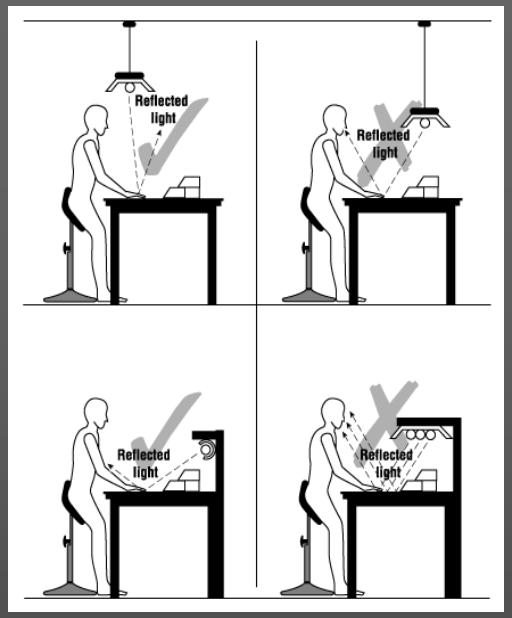
✓Disability glare impairs the vision of objects without necessarily causing discomfort.
✓It degrades visual performance by reducing contrast.
✓ E.g:-
✓ The sun directly on a car dash board
✓ Stars in the sky

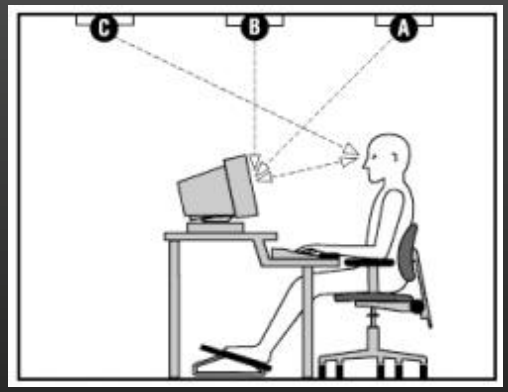


Types of Glare - Disability Glare



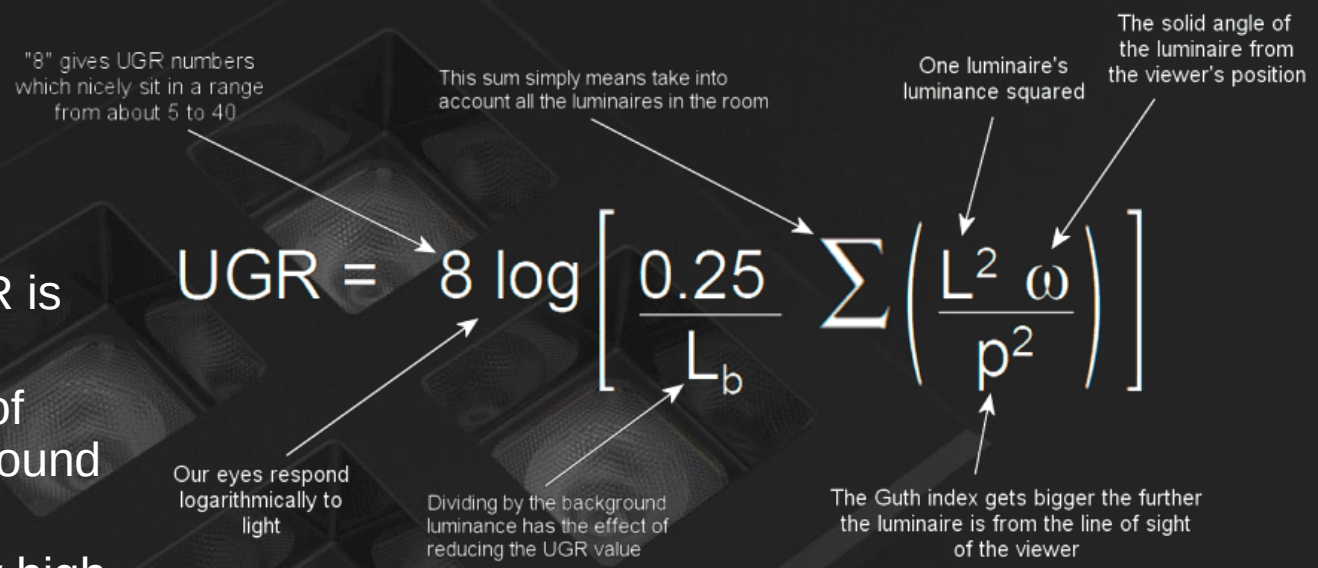


- ✓ Suitable beam for the purpose
- ✓ Increased luminous emitting area size
  - Same lumen output from bigger area > less bright
- ✓ Blocking visibility to source (Shading/Shielding)
- ✓ Decreasing light output
- ✓ Luminaire placement (light planning)
- ✓ Increasing ambient lighting level
  -less contrast, eyes can adapt to more brightness



How to reduce glare

What we consider in our optical designs?



- In indoor lighting UGR is most often used
- Compare luminance of lamps against background luminance of room
- Point glare caused by high intensity, not calculated in UGR
- To reduce point glare > spread luminance over wider area (Florence, Olivia)
- Glare cannot be judged by UGR alone

- Minimize stray light
- High quality surface finish
- Spread high intensity over large area

UGR Unified Glare Rating

One UGR unit represents the least detectable step in discomfort glare evaluation, and three UGR units represent an acceptability step in glare criteria.
Average UGR value range from 10-13-16-19-22-25-28. The relationship between calculated UGR value and Hopkinson's discomfort glare criteria is as follows:

UGR	Discomfort Glare Criterion
10 and under	Imperceptible
13	Just perceptible
16	Perceptible
19	Just acceptable
22	Unacceptable
25	Just uncomfortable
28 and over	Uncomfortable

UGR Range

FLORENCE-3R SHADES

UGR

≤16 = Good for most lighting applications

≤19 = Good for most office lighting etc.

Spacing – 0.25 x height

Minimum “defacto” installation spacing for low glare beams.

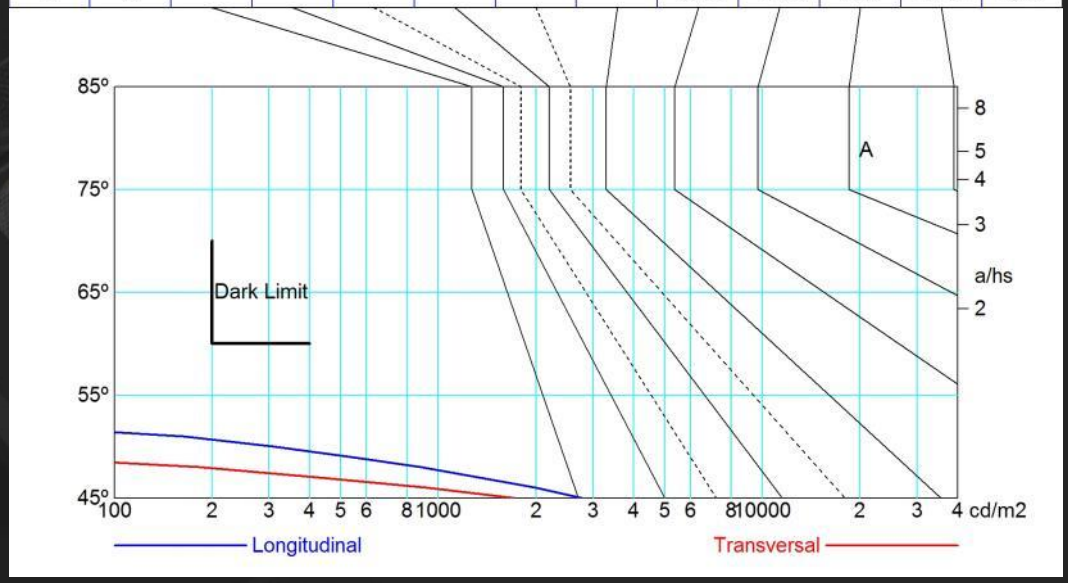
Spacing	FLORENCE -3R-Z90	FLORENCE -3R-Z60	FLORENCE -3R-Z60	FLORENCE -3R-Z60
0.25	>20	20	<19	>22
0.50	<16	<16	<16	<16

Can be used for office lighting etc.

FLORENCE-3R Shade and glaring

- Zero-Glare designs
- Glare below Sollner dark limit
- No visible light sources, only effect of light itself
- Based on black reflectors
- Sold as additional accessories to existing families for versatility

Flush mounted or longitudinal view												
		Illumination(lx)										
A	A	2000	1000	750	500		<300					1.15
B	1		2000	1500	1000	750	500	<300				1.5
C					2000		1000	500	<300			1.85
D	2						2000	1000	500	<300		2.2
E	3							2000	1000	500	<300	2.55



LEDiL Dark Light concept

LEDiL

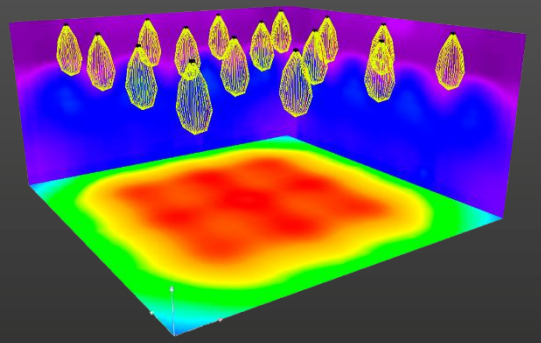
- ✓ Part of LEDiL's Dark Light portfolio - very low UGR can be achieved
- ✓ Allows several different types of mounting options, even with easily adjustable tilt angle
- ✓ Designed to be used with a range of ROSE and LAURA lenses up to XM-L sized LEDs
- ✓ Compatible with upcoming ROSE lenses supporting Super High-power LEDs)
- ✓ Available with either black or white shade

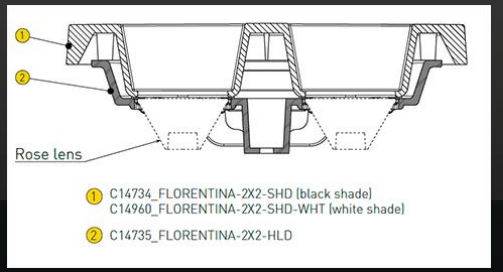
TYPICAL APPLICATIONS

- ✓ Office lighting
- ✓ Downlight applications
- ✓ Track lighting
- ✓ Indoor architectural lighting

Application simulation of FLORENTINA-2X2 with F10341_ROSE-C-C-W-V4 optics

- Spacing between luminaires 2.5 m
- Assembly height 5 m
- Flux 3000 lm
- UGR ≤13
- FWHM 48˚





FLORENTINA-2X2

Versatile module solution for comfortable lighting

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LEDiL

- ✓ 12-up multiholder for TINA lenses
- ✓ Over 30 different optics available, astonishing range of combinations
- ✓ Additional glare eliminating shade available
- ✓ Release your creativity by combining different types of lenses
- ✓ Automatic line-up of optics
- ✓ Simplifies assembly
- ✓ Modular solution

Optics Avg. FVHM	Real spot	Smooth spot	Medium	Wide	Very Wide	Diffuser	Oval
Tina	13˚	N/A	29˚	41˚	52˚	16˚	36˚x 16˚
Tina2	14˚	23˚	20˚	46˚	58˚	16˚	35˚x 17˚

FLORENTINA

Glare free solution for linear lighting

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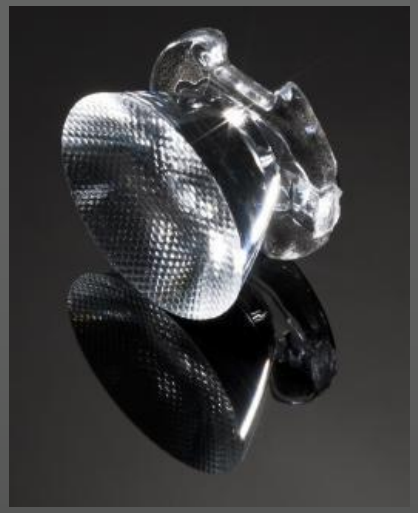
Optic Material choice

- PMMA
- PC
- Silicone

Optic materials



- ✓ PMMA: using Automotive grade PMMA
  - ✓ High resistance for Outdoor UV aging (30years without significant yellowing)
  - ✓ High transmittance 92%
  - ✓ Available, cost efficient
  - ✓ Lower temperature softening point
  - ✓ Brittle

Outdoor UV test

German PMMA
PC

Chinese

PLEXIGLAS® will not yellow! Guarantee Statement

Optic materials?

What we consider in our optical designs?

Optic materials

- Polycarbonate (PC)
  - Possible for special requirements
  - Higher temperature resistance
  - High IK rating.
  - UV stability is not good -> UV coating needed

Optic materials?

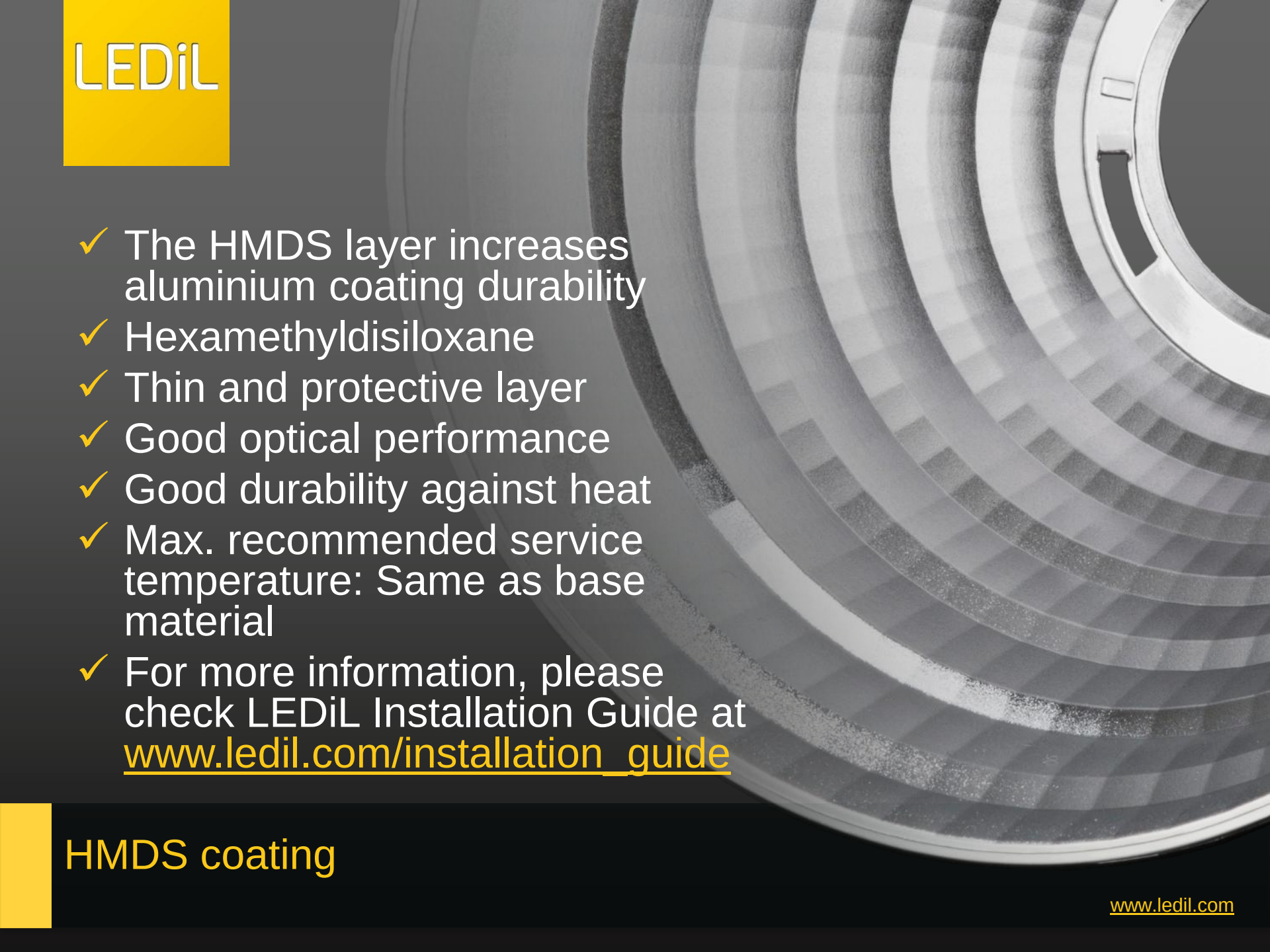
What we consider in our optical designs?

Optic materials

- Optical silicone
  - Great UV stability.
  - Excellent Thermal resistance
  - Sealable designs
  - Mainly used for high power LEDs like COBs
  - Higher material cost but can reduce system cost

Optic materials?

What we consider in our optical designs?

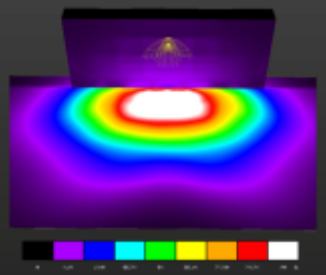


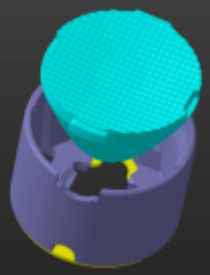
- ✓ The HMDS layer increases aluminium coating durability
- ✓ Hexamethyldisiloxane
- ✓ Thin and protective layer
- ✓ Good optical performance
- ✓ Good durability against heat
- ✓ Max. recommended service temperature: Same as base material
- ✓ For more information, please check LEDiL Installation Guide at www.ledil.com/installation_guide

HMDS coating

LEDiL

- ✓ FREE: Technical support and simulations
- ✓ Photometric data (IES/EULUMDAT)
- ✓ Mechanical 3D files
- ✓ Application notes and guides
- ✓ Guaranteed response in 24 hours for all inquiries coming ledil@ledil.com





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Application Engineering

FREE TECHNICAL SUPPORT AND SIMULATIONS

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MANY THANKS
ANY QUESTIONS ?