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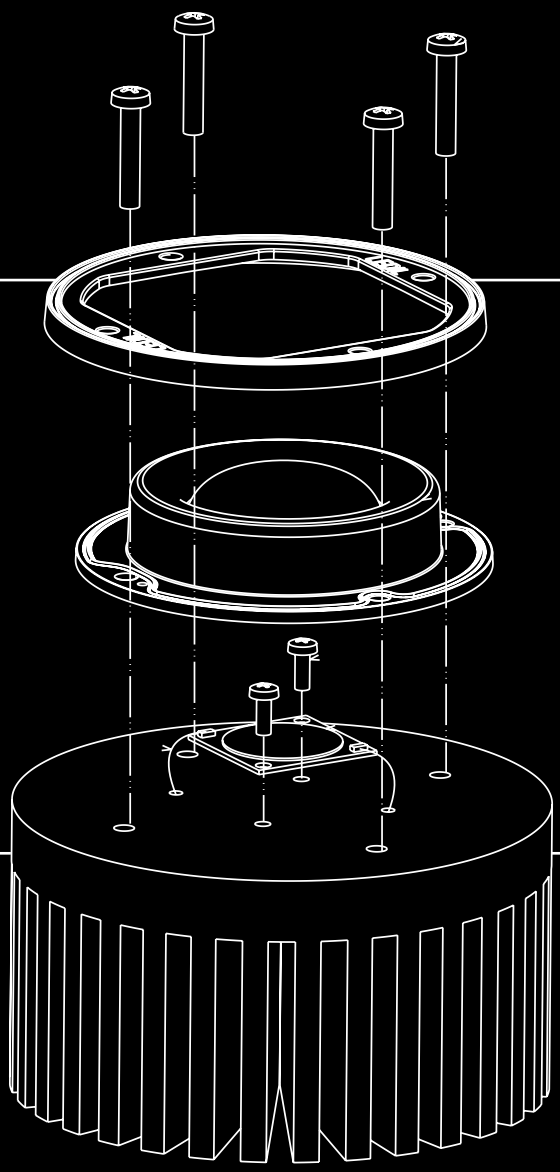
LEDiL

LED optics user and installation guide





General information about assembling LEDiL products

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Read the following instructions before using LEDiL products to ensure reliable assembly.

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Materials

PMMA & PC (Transparent plastic polymers in optics)

PMMA:

- Rigid and hard
- Average chemical resistance
- Good UV-resistance (naturally UV-stable technology)
- Good light transmission

PC:

- Very tough with excellent physical properties
- Good chemical resistance
- Good heat resistance
- Average UV-resistance (LEDiL uses UV-stabilized clear PC-grade)

In general, PMMA is harder and more fragile than PC, which has greater resistance to impact and heat. LEDiL uses many different types of PC in its products and the information given here is only valid for Makrolon 2407. Although other types of PC offer similar properties their performance should be verified separately.

Transparent polymers can reflect, absorb and refract visible light. Absorption causes the temperature to increase in a lens and this should be taken into consideration during heat simulations. In general, PMMA lenses have higher light transmission rates meaning less light is absorbed. PC on the other hand has better heat resistance, but thicker parts can absorb more light resulting in increased internal temperatures. LEDiL uses UV-stabilized clear PC for optics and all materials are f1-rated (UL746C-standard is suitable for outdoor applications and meets UV and water exposure demands).

Recycling: Both PMMA and Polycarbonate are recyclable materials, allowing them to be reprocessed and repurposed, contributing to sustainable and eco-friendly product lifecycles.

Silicone (as a lens material)

Silicone has excellent optical properties, great impact strength, durability and high thermal stability. Silicone's elasticity allows complex optical and functional forms and low viscosity makes microstructural design possible. Silicone has high stability in ultraviolet light and ozone and can be used with UV LEDs where even UV stabilized plastics are unsuitable.

Recycling: Challenging to recycle, but innovative methods are emerging to repurpose and process it.

Silicone:

- Excellent optical properties with even better efficiency than glass
- Elasticity allows complex optical and functional forms
- High thermal and UV stability
- Great impact strength
- Lightweight design (lighter than glass)

As part of our continuous research and improvement processes LEDiL reserves the right of changing material grades without further notice to ensure best possible quality and availability of our products.

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General specifications for LEDiL PMMA grades

All crystal clear PMMA grades we use share the same technical properties as shown in the table below. All grades have been subjected to comprehensive mechanical, environmental, and optical testing to ensure full compliance with our products.

If the exact material grade used for each product is needed, please check the delivery certificate of conformity or contact us directly at tech.support@ledil.com.

To ensure the quality and availability of our products there may be possible material grade changes in our production. We therefore recommend sending product verification documents with all grade options.

	LEDiL standard PMMA	Test method
Colour	Crystal clear	
Transmittance (400nm - 800nm)	92 %	ISO13468-2
Refractive index	1.49	ISO489
Fire rating	HB, 1.5 mm	UL94
Outdoor suitability (IP products)	f1	UL746C
Relative temperature index (RTI)	90°C, 1.5 mm	UL746
Vicat softening temperature	107°C*	ISO306

*As a minimun and can be higher depending on the grade.

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Heat durability of different materials

LED lighting consumes much less power compared to other light sources such as bulbs, fluorescent or energy saving lamps. These tiny light sources are at the focal point of worldwide continuous improvement constantly pushing the edge of heat resistance and luminous output.

If in the early days of LED lighting the power consumption produced around 80°C or 90°C of heat, today the extremely large COBs can produce around 150°C. This direction has led to a situation where luminaire materials need to handle and dispose of more and more heat to ensure safe operation.

Sources of heat

As a general rule 1/3 of an LED's power consumption is turned into visible light and 2/3 into heat. There are three sources that produce heat in LED lighting: **conduction**, **convection** and **radiation**. All of these are extremely important when a new luminaire design is made but there are also other things to consider regarding heat generation.

Some materials absorb more light than others. This means that an optic's efficiency has a direct link to how hot the lens will get. All sorts of **dirt**, **dust** and **grease** on the optical surface block some of the light rays generating more heat inside the luminaire. During the product lifetime both of these effects tend to increase and therefore speed up the aging process. Every luminaire element and component that stops or reflects some of the light such as **protective glass** and **shades**, may also increase heat inside the luminaire and therefore speed up the aging process.

Careful consideration should be given to all of these areas when designing a luminaire to ensure a safe and long product lifetime. LEDiL products are designed and manufactured to meet high efficiency values to help extend the product lifetime.

Choosing the right material

On the following page you can find a list of materials and recommended maximum service temperatures.

Please note that because of the complex nature and numerous variables involved in luminaire design and manufacturing that affect the final product heat control, LEDiL cannot take responsibility for third party solutions and designs we can't control. It is always the customer's responsibility to determine and verify there is sufficient cooling and maintenance in the final product and its components.

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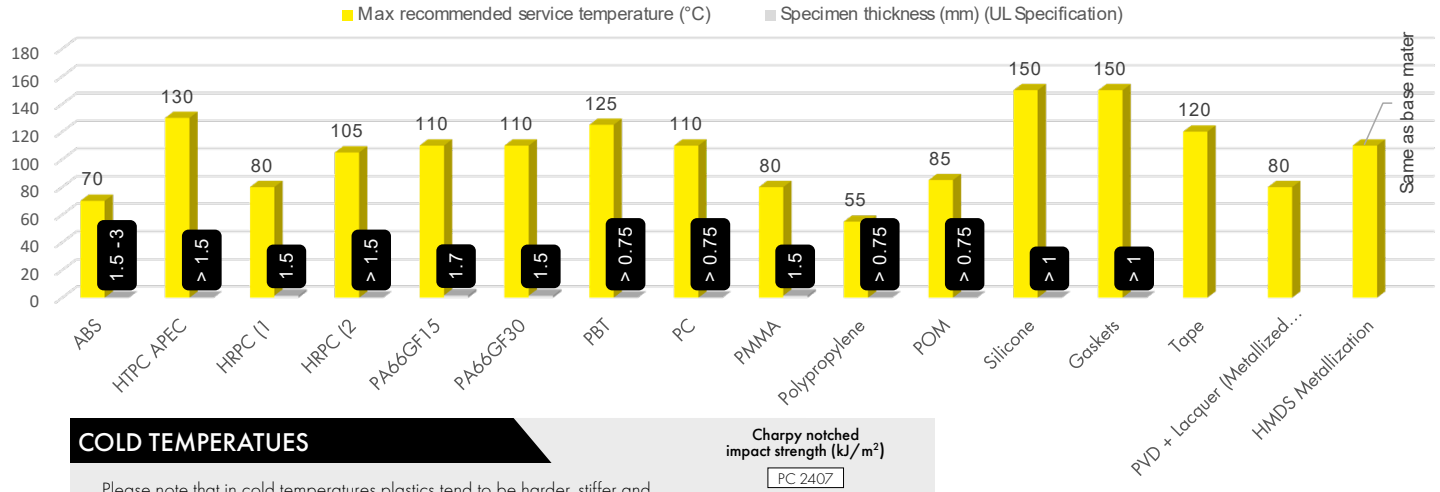
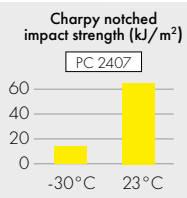
Material link to datasheets	Colours	Max recommended service temperature (°C)	Specimen thickness (mm) (UL Specification)
ABS	black, white, grey	70	1.5 - 3
Aluminium	metal	200*	na
HTPC APEC (High temperature PC)	clear, white	130	> 1.5
HRPC[1] (High reflective PC) (LISA2, RITA-A, RITA-B, RITA-WAS, BRITNEY-XW, BOOM-MC-XW, LENINA-XW, LAURA-R-XW, LENA-X-WAS, TINA2-R-CLIP16, LEILA-R-CLIP16, LEILA, MINNIE-XW, MINNIE-LT-XW, SAGA-FRAME, MIRELLA-XW, MIRELLA-40-XW, MIRELLA-50-XW, MIRELLA-50-WW-PF, REBECCA-RGB-HLD, BROOKE-XW)	white	80**	1.5
HRPC[2] (ANGELA, ANGELINA, BARBARA)	white	105	> 1.5
PA66GF15	black, white	110	1.7
PA66GF30	black, white	110	1.5
PBT	black, white	125	> 0.75
PC	clear	90 (long term) 110 (short term) ***	> 0.75
PMMA	clear	80	1.5
HT PMMA (High temperature PMMA)	clear	90	1.5
Polypropylene	white	55	> 0.75
POM	white	85	> 0.75
Silicone	clear	150	> 1
Gaskets	white	150	> 1
Tape		120	
Metallization methods			**Product families**
PVD + lacquer (Metallized reflectors)		80	ANGELETTE-WAS, BARBARA, BLONDIE, BOOM, BOOMERANG, BRIDGET, BRITNEY, BRITNEY-TE, BROOKE, LENA, LENINA, MINNIE, MIRELLA, REGINA, VENLA
PVD + HMDS Metallization		110 (same as base material)	ANGELA, ANGELETTE, ANGELINA, BARBARA-G2, BARBARA-XX-PF, BROOKE-G2, ELLA, DAISY (SHD-MET), LENINA-HMDS, MIRELLA-G2, TYRA, TYRA2, TYRA3

* Based on our tests, should not be run hotter. **UL nominal value. Heat deflection temperature 0.45 MPa, Unannealed 127 °C. ***Constant operation at maximum limit can cause the material to age prematurely.



COLD TEMPERATUES

Please note that in cold temperatures plastics tend to be harder, stiffer and more brittle. Both PMMA and silicone optics can be used in -40°C, but please note that while PC optics can also be used in cold temperatures its impact strength decreases gradually. E.g. in -30°C polycarbonate impact strenght is equal to PMMA.



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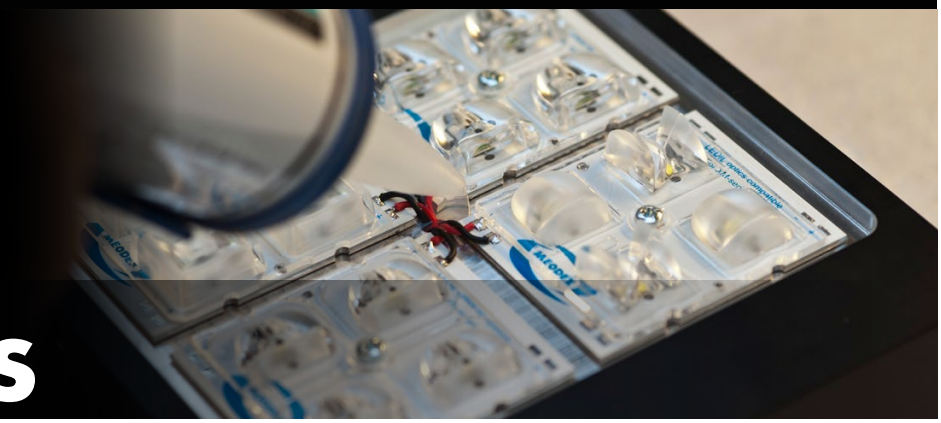

Chemicals

Glues / adhesives / potting / thread lock

We strongly recommend that every customer fully tests and takes the necessary precautions to ensure there is complete chemical compatibility with each particular product, LEDs and other components. Testing and verifying adhesives, potting agents, coatings and their combinations are always the responsibility of the customer. Please also see sealing and ingress protection chapter on page 29.

General instructions of use

All surfaces where adhesive is applied must be clean, dry and free from grease and dirt. If the PCB surfaces need to be cleaned, please follow the LED manufacturer cleaning instructions carefully – this is important as cleaning should, under no circumstances, damage LEDs or other electronic components on the PCB. Please note **optical components should not be cleaned with chemicals** – only a micro fiber cloth should be used to remove fingerprints or other traces from handling. To clean silicone lenses use a low-pressure stream of water. We recommend cleaning metallized reflectors with gentle air pressure or an air ionizer. When using adhesive, please follow the detailed instructions of the adhesive manufacturer. E.g. note that different humidity and/or temperature levels may slow down the curing process of the adhesive bond or shorten its lifetime

LEDiL disclaimer:

LEDiL cannot take responsibility for the results obtained by third party methods we cannot control. It is always the customer's responsibility to determine the chemicals suitability for their product and to take precautions for protection of property and persons against any hazards that may be involved in the handling and use such of chemicals. LEDiL disclaims all warranties, including warranties of merchantability or suitability for a particular purpose, arising from use of any adhesive product. LEDiL disclaims any liability for consequential or incidental damages of any kind, including lost profits.

More information about bonding by DELO or Henkel
www.ledil.com/delo-adhesives
www.ledil.com/henkel-adhesives

Tested materials and test procedure by CREE
www.ledil.com/cree-chemical-compatibility

NOTE: These tests have been made only with LEDs and are not necessarily compatible with optical materials.Compatibility must be tested in advance by the customer.

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Chemical resistance

Silicone

LEDiL silicone lenses are made of VMQ, Vinyl Methyl group, general purpose silicone.

For more information:
www.ledil.com/dow_corning_fluid_resistance_guide

PMMA

The chemical resistance of mouldings made from Plexiglas moulding powder (tables on pages 9-14)

- The behaviour in the tables on pages 9 to 14 relate to a test temperature of 23°C, a relative humidity of 50% and mouldings with few internal stresses.
- The behaviour of injection mouldings made from Plexiglas moulding powder depends in practice on the internal and external stresses, the orientation in the moulding and the change of temperature in the resistance to solvents and swelling.
- Plexiglas moulding powder resists all factors met in normal use such as water, perspiration, ink, lipstick, alkaline solutions and weak acids.
- As a result of the chemical structure, most organic solvents, e.g. aromatics, dissolve Plexiglas moulding powder which does, however, resist aliphatic hydrocarbons.
- Do not join Plexiglas moulding powder to plasticized thermoplastics and elastomers because some plasticisers migrate at high temperatures.
- Mouldings occasionally show residual stresses caused by processing or use, but this does not have a negative effect on their resistance to fracture. Inducing to solvents or swelling agents may however cause crazing.
- The material compatibility should be tested in advance in the actual application conditions.

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PC

General chemical behaviour

The chemical resistance of Makrolon® depends on the concentration of the substance, the temperature, contact time and internal tension level of the polycarbonate sheet depending on fabrication. The following types of damage can arise, sometimes more than one at the same time.

- **Dissolving / Swelling**

Low-molecular, aromatic, halogenated and polar components migrate into the plastic. The damage can range from a sticky surface to complete dissolving.

- **Stress cracking**

Some chemicals migrate to a minor extend and in very low quantity into the surface, and lead to relaxation of tensions in the material. This results in stress cracking, which can be optically disturbing. Because of increased notch occurance, some mechanical properties are negatively influenced. Stress cracking is usually easy to see in transparent sheets.

- **Molecular reduction**

Some properties of materials are determined by the molecular weight. If a substance initiates a molecular reduction through a chemical reaction, the impact resistance and elastic properties of the material will be influenced. Electrical properties are usually not influenced, thermal properties are only slightly influenced by the molecular weight.

In the following tables (pages 9-14) you can find the resistance of Makrolon® to chemicals and several other substances. The test results have been obtained at samples with low internal tensions, which have been stored during 6 months in the substance at a temperature of 20°C, without any mechanical load.

Apart from the nature of the substances, the chemical resistance also depends on the concentration of the substance, the temperature during the contact, the contact time and the internal tension of the tested specimen. This means that our products can be resistant to a number of chemicals for short contacts, but are not resistant in the case of long exposure, such as performed in these tests. Therefore, it is always recommended to execute a test in the actual application conditions. The tested substances have been chosen according to their importance in several areas. In a lot of cases it is possible to assume similar results for other chemically comparable substances, even if these have not been tested.

Our UV-protected materials (Makrolon® UV) are slightly more sensitive to chemicals in comparison to unprotected materials, but in general the results shown in the table still comply.

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Substance	PC	PMMA
Acetaldehyde	X	-
Acetic acid, up to 10% solution	R	-
Acetone	X	X
Acetylene	R	-
Acid-containing combustion gasses	R	-
Acrylate sealing compounds	-	X
Acrylic paints	-	O
Acrylonitril	X	-
Ajax ®	R	R
Alcohol, concentrated	-	X
Alcohol, up to 30%	-	R
All purpose adhesive	-	O
All-purpose glue	O	-
Allylalcohol	O	-
Alum	R	-
Aluminum chloride, saturated aqueous solution	R	-
Aluminum oxalate	R	-
Aluminum sulphate, saturated aqueous solution	R	-
Ammonia	X	R
Ammonia solution acids	-	R
Ammoniacal liquor	X	-
Ammonium chloride, saturated aqueous solution	R	-
Ammonium nitrate, saturated aqueous solution	R	-
Ammonium sulphate, saturated aqueous solution	R	-
Ammonium sulphide, saturated aqueous solution	X	-
Amylo acetate	X	-
Anfistatic plastics cleaner and preserving agent	-	R
Aniline	X	-
Antimony chloride, saturated aqueous solution	R	-
Antistatik C, 5%	X	-
Antistatikum 58	O	-
Antistatischer Kunst-stoff-Reiniger + Pfleger	-	R
Aqueous solutions of pesticides	-	O
Aral BG ® 58	R	-
Arquad 18 ®, 50%	O	-
Arsenic acid, 20% solution	R	-
Baktol®, 5%	R	-
BAKTOLAN, conc.	-	X
BAKTOLAN, up to 5%	-	R
Ballpoint paste Diplomat	O	-
Ballpoint paste Othello	O	-
Ballpoint paste V77 (Linz)	R	-
Basilit ® UAK, 20% in water (wood protection agent)	R	-
Battery acid	R	-
Baysilon ® Silicone oil	R	-

Substance	PC	PMMA
Benzaldehyde	X	-
Benzene	X	-
Benzoic acid	X	-
Benzyl alcohol	X	-
BFK cleaner	-	R
Bitumen emulsion	-	X
Bleach	-	R
Bleaching agent	R	-
Blood	R	-
BOLIMENT	-	O
Borax, saturated aqueous solution	R	-
Boric acid	R	-
BOTTCHERIN	-	R
BP Energol EM 100 ®	R	-
BP Energol HL 100 ®	R	-
BP H LR 65 ®	R	-
Brake fluid (ATE)	X	-
Bromic benzene	X	-
Bromine	X	-
Bromine vapours, dry	-	O
BURMAT	-	R
BURNUS	-	R
Butane (liquid or gaseous)	R	-
Butanol	R	-
Butyl acetate	X	-
Butyl lactate	-	X
Butylene glycol	R	-
Butyric acid	X	-
Cable isolation oil IG 1402	R	-
Cable isolation oil KH 190	R	-
Calcium chloride,saturated aqueous solution,	R	-
Calcium hypochloride	R	-
Calcium nitrate, saturated aqueous solution	R	-
Calcium soap, fat/pure	R	-
Calciumsoap fat	R	-
Calgonit ® dishwassing	X	-
Calgonit ® rinsing agent	R	-
Calgonit D ®, DM, DA, R	X	-
CALGONIT D, DA, S	-	R
Calgonit S ®, 1%	R	-
Camphor oil	X	-
Carbolic acid	X	-
Carbolic acid (sas)	-	X
Carbon acid, wet	R	-
Carbon dioxide	-	R

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

m = Metallic
sas = Saturated aqueous solution
i.w. = In water

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Substance	PC	PMMA
Carbon disulphide	X	X
Carbon monoxide	R	R
Carbon tetrachloride	-	X
Castor oil	R	-
Cellux-sticking foils ®	R	-
Cement	R	R
CHINOSOL, up to 1%	-	R
Chlor. lime paste (sas)	-	R
CHLORAMIN, paste	-	X
CHLORAMIN, solution	-	R
Chlorine benzene	X	-
Chlorine gas, dry	O	-
Chlorine gas, wet	X	-
Chlorine lime slurry	R	-
Chlorine lime, 2% in water	R	-
Chlorine vapours, dry	-	O
Chloroamine	R	-
Chloroform	X	-
Chrom alum, saturated aqueous solution	R	-
Chromic acid, 20% in water	R	-
CILLIT-GRON	-	R
Citric acid	R	-
Citric acid, up to 20% (sas)	-	R
Cleaning gasoline	R	-
CLOPHEN T 55, A 60	-	R
Coal gas, natural gas	-	R
Cod-liver oil	R	-
Contact oil 61	R	-
Copper sulphate, saturated aqueous solution	R	-
Corrosive sublimate	-	R
Cresol	X	-
Cupric chloride, saturated aqueous solution	R	-
Cuprous chloride, saturated aqueous solution	R	-
Cyclo hexane	X	-
Cyclo hexanol	O	-
Cyclo hexanone	X	-
DDT	X	-
DEKALIN	-	O
Dekaline	R	-
Delegol ®, 5%	R	-
Delu-Antistatiklösung ®	R	-
Diamyl phthalate	X	-
Dibutyl phthalate (plasticizer)	X	-
DIEGEL liquid film 23922	-	R
Diesel oil	O	-

Substance	PC	PMMA
Diethylene glykol	R	-
Diethylether	X	-
Diglycolic acid, saturated aqueous solution	R	-
Dimamin T, 5%	O	-
Dimethyl formamide	X	-
Dinonyl phthalate (plasticizer)	O	-
Dioctyl phthalate (plasticizer)	O	-
Dioxane	X	-
Diphyl 5,3	O	-
Dor ®	R	R
DOSYL	-	R
DOSYLAN	-	R
Drilling oil	X	-
E 605 ®, 0,5% (pesticide)	X	-
E 605 ®, conc.	X	-
Electroplating baths	-	R
ELMOCID GAMMA, up to 2%	-	R
Esso Estic 42-45 ®	R	-
Ether	X	-
Ethyl alcohol, 96% pure	R	-
Ethyl amine	X	-
Ethyl bromide	X	-
Ethylene chlorhydrine	X	-
Ethylene chloride	X	-
Ethylene glykol	R	-
FAKO polish	-	R
FAKO polishing paste	-	R
Ferritrichloride, saturated aqueous solution	R	-
Ferro bisulphate	R	-
Fewa ®	R	R
Final-photo developer (normal use concentration)	R	-
Fish oil	R	-
Foam plastics	-	R
Foam plastics, plasticise	-	X
Formaline, 10%ig	R	-
Formic acid, 30%	O	-
FRAPPIN	-	R
Freon ® TF (propellant)	R	-
Freon ® T-WD 602 (propellant)	R	-
Frigen ® 113, R113 (propellant)	R	-
FRIGEN A 12 (CF2 Cl2)	-	O
Fuel oil O	O	-
FULLBOX	-	R
GASOLIN, depending on the blend	-	O
Gasoline	R	-

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

m = Metallic
sas = Saturated aqueous solution
i.w. = In water

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Substance	PC	PMMA
Gasoline, normal	O	-
Gasoline, super	X	-
Geha stamping ink	R	-
GLYBAL A	-	X
Glycerine	O	-
Glycol	R	-
Green chrom oxide (polish paste)	R	-
Green soap	R	-
Gypsum	-	R
HB 155	-	R
Heptane	R	-
Hexane	R	-
Horolith M ®	R	-
Hot bitumen	-	O
Household soap	R	-
Hydraulik oil Vac HLP 16	R	-
Hydrochloric acid (c)	-	R
Hydrochloric acid, 20%	R	-
Hydrochloric acid, conc.	X	-
Hydrofluoric acid, 5%	R	-
Hydrofluoric acid, conc.	X	-
Hydrofluorosilicic acid, 30%	R	-
Hydrogen peroxide	R	-
Hydrogen peroxide, 30%	R	-
Hydrogen peroxide, over 40% i.w.	-	O
Hydrogen peroxide, up to 40% i.w.	-	R
Hydrogen sulphide	R	R
Impact ®, 0,2%	O	-
Indian ink S	X	-
Indian ink T	R	-
Industrial spirit	-	X
Insulating tape	-	R
Into-Fensterklar ®	R	-
Iodine	X	-
Iodine tincture	O	-
Isoamyl alcohol	O	-
Isolation tape	R	-
Isolation tape	R	-
Isopropyl alcohol	R	X
Jet engine fuel JP 4 (Kp 97-209°C)	O	-
Kaltron ® 113 MDR (propellant)	R	-
Kerosene (Flugbenzin)	X	-
KOPPERSCHMIDT covering paste	-	R
Lactic acid, 10% in water	R	-
Lactic acid, up to 20% i.w.	-	O

Substance	PC	PMMA
LAVAPLEX	-	R
Lead tetraethylene, 10% in gasoline	O	-
Lighting gas	R	-
Ligroin (hydrocarbon compound)	R	-
Lime milk, 30% in water	O	-
Lubricant based on nafta	R	-
Lubricant based on paraffin	R	-
Lubricant R2 Darina ®	R	-
Lugol solution	-	R
LYSOFORM	-	X
Lysoform, 2%	R	-
Magnesium chloride	-	R
Magnesium chloride, saturated aqueous solution	R	-
Magnesium sulphate	-	R
Magnesium sulphate, saturated aqueous solution	R	-
Maktol ®	R	-
Manganous sulphate, saturated aqueous solution	R	-
Marlon ®, 1% (moisturizing agent)	R	-
MEFAROL, up to 1%	-	R
MERCKOJOD, up to 1%	-	R
Mercuro chloride, saturated aqueous solution	R	-
Mercury	R	R
Merfen ®, 2%	R	R
Metasystox ®, 0,5% (pesticide)	X	-
Methacrylic acid-methyester (MMA)	X	-
Methane	R	R
Methanol	X	-
Methanol, concentrated	-	X
Methanol, up to 30%	-	O
Methyl amine	X	-
Methyl ethyl ketone (MEK)	X	X
Methylene chloride	X	-
Mobil DTE Oil-Light ®	R	-
Mobil Special Oil 10 W 30 ®	R	-
Molikote ® -Paste	R	-
Molikote ® -Powder	R	-
Monobromonaphthalene	-	R
Mortar	-	R
Motor fuel blend contg. Benzene	-	X
Motor fuel blend, free from benzene	-	R
Multi-Marker (Faber-Castell)	O	-
Nato-Turbine oil 0-250	R	-
Natril ®	R	-
Natural rubber	R	-
Nekal BX ®, 2% (moisturizing agent)	R	-

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

m = Metallic
sas = Saturated aqueous solution
i.w. = In water

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LEDiL

Substance	PC	PMMA
NEOMOSCAN M, M-powder	-	R
Neutol ® photo developer (normal use concentration)	R	-
NEXION stable spray	-	R
Nickel sulphate (sas)	-	R
Niroklar GR liquid	-	R
Niroklar GR powder	-	R
Nitric acid, 10%	R	-
Nitric acid, 10-20%	O	-
Nitric acid, 20 to 70% i.w.	-	O
Nitric acid, 20%	X	-
Nitric acid, over 70% i.w.	-	X
Nitric acid, up to 20% i.w.	-	O
Nitric Gas, dry	X	-
Nitrobenzene	X	-
Nitrocellulose lacquers	-	X
Nitrogen dioxide	-	R
Nitrogen monoxide	-	R
O Sprays (in the surroundings)	-	O
Oil paints, pure	-	R
Oktozon ®, 1%	R	-
Oleic acid, conc.	R	-
Omo ®	R	-
Orthozid ® 50, 0,5% (pesticide)	R	-
Oxalic acid (sas)	-	R
Oxalic acid, 10% in water	R	-
Oxygen	R	R
Ozone	R	R
P 3	-	R
P 3 basic cleaner	-	O
P3 Asepto ®	X	-
PALATINOL K	-	R
PALATINOL O, BB neu	-	O
Pantex ®, 2%	R	-
Paraffin oil	R	-
PATTEX special glue	-	O
Pelikan Royal Blue 4001	R	-
Pentane	R	-
PERBUNAN	-	R
Perbunan C ®	R	-
Perchloric acid, 10% in water	R	-
Perchloric acid, concentrated	O	-
Perchloro ethylene	X	X
Perhydrol	R	R
Perhydrol, 30%	R	-
PERODIN	-	R

Substance	PC	PMMA
Persil ®	O	R
Persoftal ®, 2%	R	-
Perspex Polish 3 ®	R	-
Petrol ether	-	R
Petrol, contg. aromatic substances	-	X
Petrol, non-aromatic	-	R
Petrol, pure	-	R
Petroleum	O	O
Petroleum ether	O	-
Petroleum spirit	R	-
Phenol	X	-
Phenols	-	X
Phenyl ethyl alcohol	X	-
Phosphates	-	R
Phosphonc acid, up to 10% i.w.	-	R
Phosphor trichloride	X	-
Phosphoric acid, conc.	R	-
Phosphoric oxichloride	X	-
Phosphorus trichloride	-	X
Phosphorus, white	-	X
Photochemical baths	-	R
Picric acid, 1% i.w.	-	R
Plaster	R	-
Plasticiserfree glazing kit	R	-
Plexiklar ®	R	R
PLEXISOL adhesive	-	O
PLEXIT	-	O
PLEXTOL adhesive	-	R
PLK 4 (wood protection agent)	R	-
Polifac grinding paste ®	R	-
Polishing wax	R	-
Polyamide	R	R
Polyethylene	R	R
Polymer plasticizer O	O	-
Polyran ® MM 25 (lubricant)	R	-
Polyvinylchloride (plasticizer free)	R	-
Polyvinylchloride, (containing plasticizer)	O	-
Potassium aluminum sulpate, (sas)	R	-
Potassium bichromate, (sas)	R	-
Potassium bromide, (sas)	R	-
Potassium carbonate, (sas)	R	-
Potassium chloride, (sas)	R	-
Potassium cyanide	X	-
Potassium hydroxide	X	-
Potassium metabisulphide, 4% in water	R	-

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LEDiL

Substance	PC	PMMA
Potassium nitrate, saturated aqueous solution	R	-
Potassium perchlorate, 10% i.w.	R	-
Potassium permanganate, 10% i.w	R	-
Potassium persulphate, 10% i.w.	R	-
Potassium rhodanide, (sas)	R	-
Potassium sulphate, (sas)	R	-
Pril ®	R	R
Propane gas	R	-
Propargyl alcohol	R	-
Propionic acid, 20%	R	-
Propionic acid, conc.	X	-
Propyl alcohol	R	-
Propylene	-	R
Putty	R	-
PVC	-	R
PVC, plasticised	-	X
Pyridine	X	X
RABOND stable spray	-	R
Rapdosept ®	O	-
Rape oil	R	-
Red lead	-	R
Register-ink DIA type U rot	R	-
Rei ®	R	R
Resorcin oil solution, 1%	R	-
Resorcinol solutions, 1%	R	-
Riseptin ®	R	-
Rubber	-	R
Rubber, plasticised	-	X
Sagrotan ®, 5%	O	O
SAGROTAN, up to 2%	-	R
SANGAJOL	-	R
Sea water	R	-
Sealing strips, (FAKO, TEROSTAT, PRESTIK)	-	R
SEIFIX	-	R
Sewing machine oil	R	-
Shell IP 4 (fuel)	X	-
Shell Spirax 90 EP ®	R	-
Shell Tellus 11-33 ®	O	-
Shell Tellus 33 ®	O	-
Sidolin ®	R	X
Silicon tetrachloride	-	X
Silicone oil	R	-
Silicone rubber (acetic acid curing)	-	O
Silicone rubber (Camino curing)	-	R
Siliconoil emulsion	R	-

Substance	PC	PMMA
Silver nitrate (sas)	-	R
Skydrol 500 A ®	X	-
Soap solution	-	R
Soap suds	O	-
Sod. hydroxide soln.	-	R
Soda	R	R
Soda water	-	R
Sodium bicarbonate, (sas)	R	-
Sodium bisulphate, (sas)	R	-
Sodium bisulphide, (sas)	R	-
Sodium bisulphite	-	R
Sodium carbonate	-	R
Sodium carbonate, (sas)	R	-
Sodium chlorate (sas)	R	R
Sodium chloride (sas)	R	R
Sodium hydroxide	X	-
Sodium hypochloride, 5% in water	R	-
Sodium hypochlorite	-	R
Sodium soap fat	R	-
Sodium sulphate	-	R
Sodium sulphate, (sas)	R	-
Sodium sulphide	-	R
Sodium sulphide, (sas)	O	-
Somat W ® 731	O	-
SPECTROL	-	X
Spirit, pure	R	-
SPRAYLAT	-	O
SPULI	-	R
Stain remover Alkaline solutions	-	X
Stannous chloride	-	R
Starch	R	-
Statexan AN ®	R	-
Stearic acid	-	R
Styrene	X	-
Sublimate	R	-
Sublimate, (sas)	R	-
Sulphur	R	-
Sulphur (c)	-	R
Sulphur dioxide	O	-
Sulphur dioxide (dry)	-	R
Sulphur dioxide, liquid	-	X
Sulphuric acid, 50%	R	-
Sulphuric acid, 70%	O	-
Sulphuric acid, conc.	X	-
Sulphuric acid, up to 30% i.w.	-	R

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Substance	PC	PMMA
Sulphurous acid, 10%	X	-
Sulphurous acid, (c)	-	O
Sulphurous acid, up to 5%	-	R
Sulphuryl chloride	X	R
Suwa ®	R	-
Sweat, acid (pH 4,7)	R	-
sweat, alkaline (pH 9,5)	O	-
Tanigan ® CLS, 30%	O	-
Tanigan ® CV	O	-
Tannic acid	X	-
Tanning oil Brunofix ®	R	-
Tartaric acid, 10%	R	-
Tartaric acid, 50% i.w	-	R
TB Lysoform	X	-
TERAPIN	-	R
Terostat ®	R	-
Tesafilm ®	R	-
Tesamoll ®	R	-
Test fuel	X	-
Tetrachlorocarbon	X	-
Tetrachloroethane	X	-
Tetrahydrofurane	X	-
Tetralin	-	X
Tetraline	X	-
Texaco Regal Oil BRUO ®	R	-
Texaco Regal Oil CRUO ®	R	-
Thenocalor N	R	-
Thinners in general	-	X
Thiokol rubber (one- and two-component grades)	-	X
Thionyl chloride	-	X
Thiophene	X	-
Tincture of iodine, 5%	-	X
Toluene	X	X
Trichloro acetic acid, 10%	O	-
Trichloroacetic acid	-	X
Trichloroethyl amine	X	-
Trichloroethyl phosphate (plasticizer)	O	-
Trichloroethylene	X	-
Tricresyl phosphate	-	R
Tricresyl phosphate (plasticizer)	X	-
Triethylamine	-	R
Trosilin F ® extra, 2%	R	-
Trosilin G extra ®, 1,5%	R	-
Tuba ® carpet shampoo, (c)	O	-
Turbo oil 29	R	-

Substance	PC	PMMA
Turpentine	-	O
Turpentine ersatz	R	-
Turpentine substitute	-	O
Urea, (sas)	R	-
VALVANOL, up to 2%	-	O
Valvoline WA 4-7	O	-
Varnish	O	-
Waste gases contg. hydrochloric acid	-	R
Waste gases contg. sulphuric acid	-	R
Water	R	-
WC-00	-	R
Whale fat	R	-
Visor-Pen 7 blau	R	-
WK 60 ® (Kron-Chemie)	R	-
X Sprays (applied directly)	-	X
Xylene	X	X
Zephirol ®	O	-
ZEPHIROL, up to 5%	-	R
Zinc chloride, (sas)	R	-
Zinc oxide	R	-
Zinc sulphate, aqueous	-	R
Zinc sulphate, (sas)	R	-
Zinc sulphate, solid	-	R
ÄTHROL, up to 5%	-	O

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LEDiL



Stress cracking

LEDiL products are designed and manufactured to avoid internal stress as much as possible, but this can't be totally avoided. Common optical grade thermoplastics are vulnerable to cracking from a combination of external or internal stress sources and chemicals.

Even relatively small concentrations of stress-cracking agent may be sufficient to cause the cracking, but in many cases it´s caused by a combination of several factors.

Possible factors that cause cracking

- Manufacturing process
- Temperature changes
  - Thermal expansion and shrinking
- Chemical exposure
  - Detergents
  - Surface active chemicals
  - Lubricants
  - Oils
  - Ultra-pure water
  - Plating additives such as brighteners and wetting agents
  - Lock-thread fluids
- Screw type, torque and other fastening methods

See our video about chemicals in LED lighting



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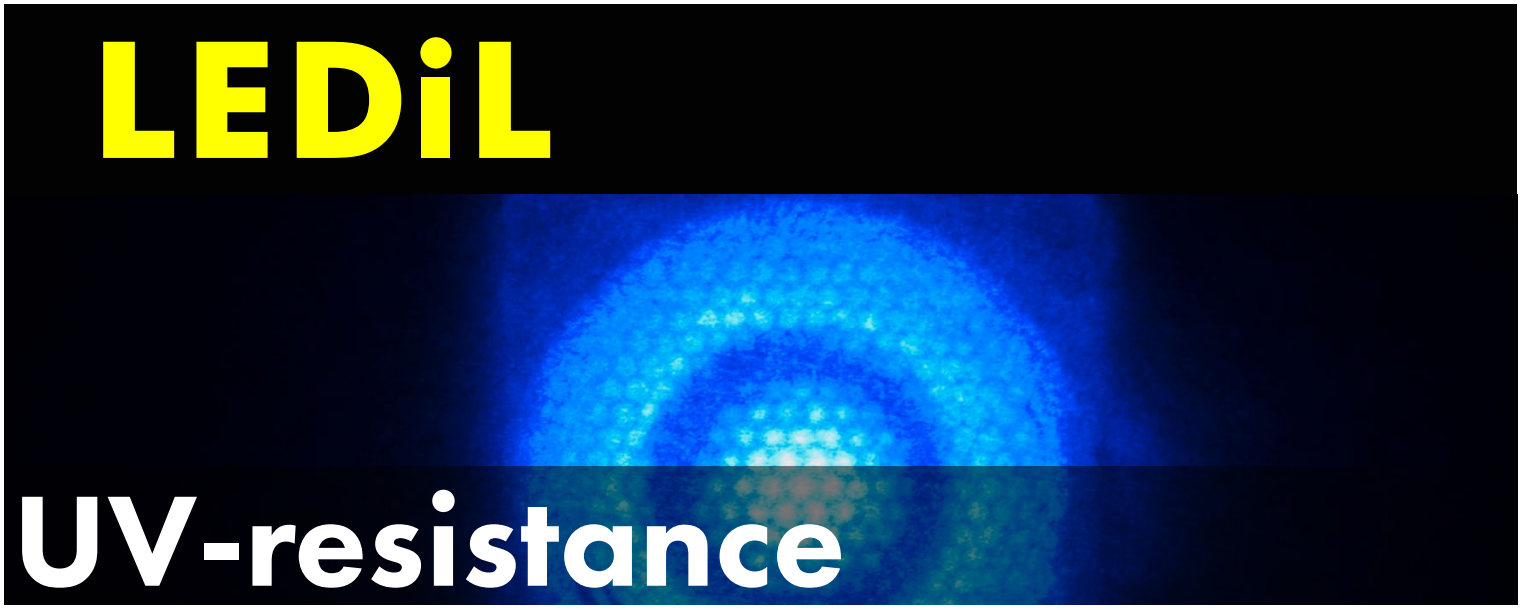

UV-resistance

Plastics degenerate differently when exposed to UV-light. Some plastics may show dramatic changes, turning yellow or losing some of their transmission properties over a long period of time. This must be considered when choosing materials for your application.

LEDiL has conducted extensive UV-testing over the years for various different materials and found that even materials that tend to have very heavy yellowing will not significantly suffer from efficiency loss. However yellowing may cause the colour temperature to change to warmer tones.

Plexiglas guarantee

PLEXIGLAS® guarantees their materials will not show yellowing and will retain a high level of light transmission for 30 years.

For more information:
www.ledil.com/plexiglas_guarantee

PMMA

High UV-resistance with no yellowing. For better impact resistance protective glass is needed.

Silicone

Dow Corning ® MS silicones have very high UV-resistance with no yellowing, and are highly transparent to radiation all the way down to IR-wavelengths.

PC

Good for applications that require higher impact resistance, but will show noticeable yellowing over time when exposed to UV-radiation. Therefore LEDiL does not recommend using products made of PC in applications where exposure to UV-radiation is high. To avoid yellowing special filtering glasses can be used to block out all the damaging UV from sunlight. After a very long period of time ultraviolet light may also cause some brittleness in the material and LEDiL recommends using plastic washers with fasteners to decrease mechanical stresses.

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Fire rating

Fire resistance testing is carried out as stated in the UL94 standard. The standard classifies plastics according to the burning rate in different positions and different-sized pieces. All LEDiL materials have UL94 standard fire rating. For metallized products UL-class confirmation tests were carried out by Tampere University of Technology.

Fire ratings

- **HB** Slow burning on a horizontal specimen;
  burning rate < 76mm/min for thickness < 3mm or burning stops before 100mm
- **V-2** Burning stops within 30 seconds on a vertical specimen;
  drips of flaming particles are allowed.
- **V-1** Burning stops within 30 seconds on a vertical specimen;
  drips of particles allowed as long as they are not inflamed.
- **V-0** Burning stops within 10 seconds on a vertical specimen;
  drips of particles allowed as long as they are not inflamed.
- **5VB** Burning stops within 60 seconds on a vertical specimen;
  no drips allowed; plaque specimens may develop a hole.
- **5VA** Burning stops within 60 seconds on a vertical specimen;
  no drips allowed; plaque specimens may not develop a hole

Hot Wire Ignition (HWI)

Test specimens are wrapped with resistance wire that dissipates a specified level of energy. HWI is the time it takes to either ignite or burn through a specimen. Performance Level Categories (PLC) were introduced to avoid excessive implied precision and bias.

HWI Mean Ignition Time (sec)

PLC0	120 and longer	PLC3	15 through 29
PLC1	60 through 119	PLC4	7 through 14
PLC2	30 through 59	PLC5	< 7

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LEDiL

Glow-wire testing

The glow-wire test series simulates short-term thermal stress caused by glowing components or overloaded resistors. A standardised electrically heated wire is applied to a test specimen, and ignition, flame duration and burning particles are assessed. For the material data in this guide, performance is reported as GWFI and GWIT.

Glow-Wire Flammability Index (GWFI)

GWFI is the highest test temperature passed under the material flammability procedure. The specimen must either not ignite or self-extinguish within 30 seconds after the glow wire is removed, must not be completely consumed, and must not produce molten material that ignites the wrapping tissue.

Test method: IEC 60695-2-12

Glow-Wire Ignition Temperature (GWIT)

GWIT indicates a material's resistance to ignition. The reported value is 25 K or 30 K above the highest test temperature at which the specimen does not ignite, or any flame event lasts no longer than five seconds, and the specimen is not completely consumed.

Test method: IEC 60695-2-13

High Amp Arc Ignition (HAI)

The number of arc rupture exposures necessary to ignite a material when they are applied at a standard rate on the surface of the material. Performance Level Categories (PLC) were introduced to avoid excessive implied precision and bias.

HAI	Mean Number of Arcs
PLC0	120 and greater
PLC1	60 through 119
PLC2	30 through 59
PLC3	15 through 29
PLC4	<15

Outdoor suitability

Materials considered suitable for outdoor use have been subjected to ultraviolet (UV) light exposure and/or water immersion. UV exposure is performed by using either a twin-enclosed carbon weatherometer for 720 hours, or a xenon-arc weatherometer for 1000 hours. Water immersion testing is performed for 7 days at 70°C. Specimens are tested before and after exposure for flammability, mechanical impact and mechanical strength. Materials whose properties are not significantly degraded in any of these areas are considered to have passed and are suitable for outdoor use.

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LEDiL material ratings

- UL 94, GWFI, GWIT, HWI, HAI, RTI and outdoor suitability

			Material								
			PMMA	PC	PC	PC	PC	Silicone	Silicone	Silicone seal	Ultramid
			Manufacturer								
			Röhm plexiglas 8N (or equal)	Covestro Makrolon 2407 (or equal)	Sabic Lexan 123R (or equal)	HRPC	HTPC	harder	softer	Silicone seal	BASF A3EG6
		Test method	Value								
Flammability	**Flame rating**										
	0.75 mm	UL 94		V-2	HB		HB				HB
	0.75 mm	IEC 60695-11-10,20		V-2	HB40		HB75				HB75
	1.00 mm	UL 94						HB	HB		
	1.00 mm	IEC 60695-11-10,20						HB75	HB75		
	1.50 mm	UL 94	HB		HB	V-0	HB				HB
	1.50 mm	IEC 60695-11-10,20	HB75		HB75	V-0	HB75				HB75
	1.50 mm - 2.60 mm	UL 94, IEC 60695-11-10,20		V-2							
	2.50 mm	UL 94				V-0, 5VB					
	2.50 mm	IEC 60695-11-10,20				V-0, 5VB					
	2.70 mm	UL 94		HB							
	2.70 mm	IEC 60695-11-10,20		HB75							
	3.00 mm	UL 94		HB	HB	V-0, 5VA	HB	HB	HB		HB
	3.00 mm	IEC 60695-11-10,20		HB40	HB75	V-0, 5VA	HB40	HB40	HB40		HB40
	4.00 mm - 4.3 mm	UL 94								V-0	
	4.00 mm - 4.3 mm	IEC 60695-11-10,20								V-0	
	6.00 mm	UL 94		HB							HB
	6.00 mm	IEC 60695-11-10,20		HB40							HB40
	Glow-Wire Flammability Index (GWFI)										
	3.00 mm	IEC 60695-2-12	650°C	850°C	850°C	850°C	850°C				
	Glow-Wire Ignition Temperature (GWIT)			875°C							
	3.00 mm	IEC 60695-2-13									
Electrical	**Hot-wire ignition (HWI)**										
	1.00 mm	UL746						PLC4	PLC4		PLC4
	1.50 mm	UL746			PLC4						
	1.50 mm -2.60 mm	UL746		PLC3							
	2.70 mm	UL746		PLC3							
	3.00 mm	UL746		PLC2	PLC4			PLC2	PLC4		PLC1
	6.00 mm	UL746		PLC0							PLC0
	High Amp Arc Ignition (HAI)										
	1.00 mm	UL746						PLC1	PLC0		PLC0
	1.50 mm	UL746			PLC2						
	1.50 mm - 2.60 mm	UL746		PLC0							
	2.70 mm	UL746		PLC0							
	3.00 mm	UL746		PLC0	PLC1			PLC0	PLC0		PLC0
	6.00 mm	UL746		PLC0							PLC0
Thermal	RTI Elec. (1.50 mm)	UL 94	90°C	125°C	130°C	120°C	140°C	150°C	150°C	150°C (4,0-4,3mm)	120°C
	RTI Imp. (1.50 mm)	UL 94	90°C	115°C	125°C	105°C	130°C	150°C	150°C	150°C (4,0-4,3mm)	120°C
	RTI Str. (1.50 mm)	UL 94	90°C	125°C	125°C	120°C	140°C	150°C	150°C	150°C (4,0-4,3mm)	130°C
Physical	**Outdoor suitability**	UL 746C	f1	f1	f1			f1	f1		

Rating Description

f1 The material has met both UV and water immersion requirements.

f2 The material has met either UV or water immersion requirements, or has only been partially tested.

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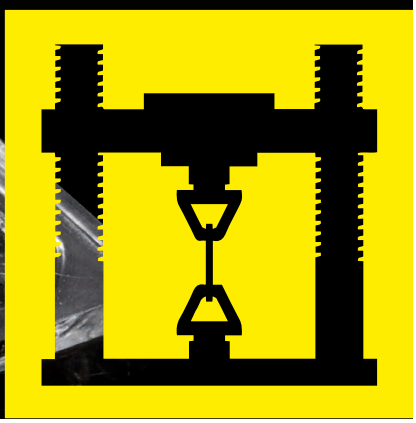
LEDiL





Tensile strength

LEDiL tests its products to meet or exceed tensile strength requirements and standards; this includes tape fastening, third party adhesives and mechanical structures such as pins.

LEDiL Disclaimer:

LEDiL cannot take responsibility for the results obtained by third party methods we cannot control. It is always the customer's responsibility to determine and verify the sufficient tensile strenght in the final product and its components.

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LEDiL

LEDiL materials fire rating

- HWI, HAI, RTI and physical

			Material								
			PMMA	PC	PC	PC	PC	Silicone	Silicone	Silicone seal	Ultramid
			Manufacturer								
			Röhm plexiglas 8N (or equal)	Covestro Makrolon 2407 (or equal)	Sabic Lexan 123R (or equal)	HRPC	HTPC	harder	softer	Silicone seal	BASF A3EG6
	Flame rating	**Test method**	**Value**								
Flammability	0.75mm	UL 94		V-2	HB		HB				HB
	0.75mm	IEC 60695-11-10,20		V-2	HB40		HB75				HB75
	1.00mm	UL 94						HB	HB		
	1.00mm	IEC 60695-11-10,20						HB75	HB75		
	1.50mm	UL 94	HB		HB	V-0	HB				HB
	1.50mm	IEC 60695-11-10,20	HB75		HB75	V-0	HB75				HB75
	1.50mm to 2.60mm	UL 94, IEC 60695-11-10,20		V-2							
	2.50mm	UL 94				V-0, 5VB					
	2.50mm	IEC 60695-11-10,20				V-0, 5VB					
	2.70mm	UL 94		HB							
	2.70mm	IEC 60695-11-10,20		HB75							
	3.00mm	UL 94		HB	HB	V-0, 5VA	HB	HB	HB		HB
	3.00mm	IEC 60695-11-10,20		HB40	HB75	V-0, 5VA	HB40	HB40	HB40		HB40
	4.00mm - 4.3mm	UL 94								V-0	
	4.00mm - 4.3mm	IEC 60695-11-10,20								V-0	
	6.00mm	UL 94		HB							HB
	6.00mm	IEC 60695-11-10,20		HB40							HB40
Electrical	**Hot-wire ignition (HWI)**										
	1.00mm	UL746						PLC4	PLC4		PLC4
	1.50mm	UL746			PLC4						
	1.50-2.60mm	UL746		PLC3							
	2.70mm	UL746		PLC3							
	3.00mm	UL746		PLC2	PLC4			PLC2	PLC4		PLC1
	6.00mm	UL746		PLC0							PLC0
	High Amp Arc Ignition (HAI)										
	1.00mm	UL746						PLC1	PLC0		PLC0
	1.50mm	UL746			PLC2						
	1.50-2.60mm	UL746		PLC0							
	2.70mm	UL746		PLC0							
	3.00mm	UL746		PLC0	PLC1			PLC0	PLC0		PLC0
	6.00mm	UL746		PLC0							PLC0
Thermal	RTI Elec. (1.50mm)	UL 94	90°C	125°C	130°C	120°C	140°C	150°C	150°C	150°C (4,0-4,3mm)	120°C
	RTI Imp. (1.50mm)	UL 94	90°C	115°C	125°C	105°C	130°C	150°C	150°C	150°C (4,0-4,3mm)	120°C
	RTI Str. (1.50mm)	UL 94	90°C	125°C	125°C	120°C	140°C	150°C	150°C	150°C (4,0-4,3mm)	130°C
Physical	Outdoor suitability	UL 746C	f1	f1	f1			f1	f1		

Rating Description

f1 The material has met both UV and water immersion requirements.

f2 The material has met either UV or water immersion requirements, or has only been partially tested.

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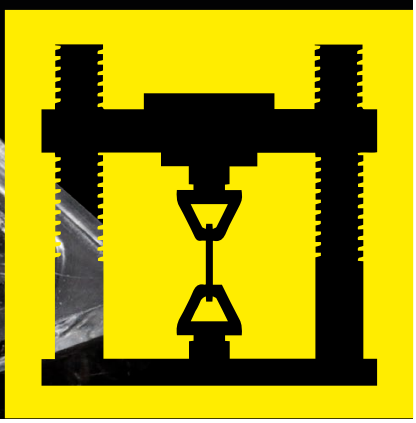

Tensile strength

LEDiL tests its products to meet or exceed tensile strength requirements and standards; this includes tape fastening, third party adhesives and mechanical structures such as pins.

LEDiL Disclaimer:

LEDiL cannot take responsibility for the results obtained by third party methods we cannot control. It is always the customer's responsibility to determine and verify the sufficient tensile strenght in the final product and its components.

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Tolerances

General tolerances for linear dimensions (DIN 16901-130)	
Linear dimensions (mm)	**(mm)**
a ≤ 1	± 0.18
1 < a ≤ 3	± 0.19
3 < a ≤ 6	± 0.20
6 < a ≤ 10	± 0.21
10 < a ≤ 15	± 0.23
15 < a ≤ 22	± 0.25
22 < a ≤ 30	± 0.27
30 < a ≤ 40	± 0.30
40 < a ≤ 53	± 0.34
53 < a ≤ 70	± 0.38
70 < a ≤ 90	± 0.44
90 < a ≤ 120	± 0.51
120 < a ≤ 160	± 0.60
160 < a ≤ 200	± 0.70
200 < a ≤ 250	± 0.90
250 < a≤ 315	± 1.10
315 < a ≤ 400	± 1.30

DIN 16901-130

The tolerances in this standard

are applicable to the dimensions of plastic mouldings produced from thermoplastic and thermosetting moulding materials by compression moulding, transfer moulding, compression injection moulding or injection moulding;

are not applicable to extrusions, blow-moulded or foamed mouldings, deep drawn parts, sintered parts and parts produced by a chip removal machining process.

General tolerances for products made out from silicone (ISO 3302-1 CLASS M3)	
Dimensions (mm)	**(mm)**
a ≤ 6.3	± 0.40
6.3 < a ≤ 10	± 0.50
10 < a ≤ 16	± 0.60
16 < a ≤ 25	± 0.80
25 < a ≤ 40	± 1.00
40 < a ≤ 63	± 1.30
63 < a ≤ 100	± 1.60
100 < a ≤ 160	± 2.00
> 160	± 1.3%

ISO 3302-1 Class M3

International Standard **ISO 3302-1** was prepared by Technical Committee ISO/TC 45, Rubber and rubber products, Subcommittee SC 4, Miscellaneous products.

The tolerances are primarily intended for use with vulcanized rubber but may also be suitable for products made of thermoplastic rubbers.

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SFS 3947

General tolerances for EXTRUDED products (SFS 3947)	
Dimensions (mm)	**(mm)**
0.1 < a ≤ 0.4	± 0.05
0.5 < a ≤ 0.9	± 0.1
1 < a ≤ 2.9	± 0.2
3 < a ≤ 5.9	± 0.3
6 < a ≤ 9.9	± 0.35
10 < a ≤ 15.9	± 0.45
16 < a ≤ 21.9	± 0.55
22 < a ≤ 29.9	± 0.7
30 < a ≤ 49.9	± 0.8
50 < a ≤ 80	± 1.2
> 80	± 1.6

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Installation

We ask customers to check and fully test the suitability of the fastening and bonding integrity for their product. For example, mechanical stress, humidity, temperature fluctuation, vibration and holes on the surface of the circuit board can weaken the strength of the fastening and bonding. Final testing and verifying of fastening methods, adhesives and their combinations are always the customer's responsibility. Always wear cotton gloves when handling optical parts and their accessories.

Tape

LEDiL products supplied with tape use double-sided high-performance acrylic, with an acrylic pressure-sensitive adhesive coating on both sides.

All surfaces where tape is applied must be straight, clean, dry and free from grease and dirt. The taped components should be firmly held for 3-5 seconds to ensure the best possible bond. The tape will reach its final strength in 24 hours.

Any chemical used during the installation process may damage both the LED or the lens. Please ensure that all harmful chemicals have been fully removed before applying these components. Optical components should not be cleaned with any chemicals – only a micro fibre cloth should be used for cleaning.

In extreme conditions (heavy or prolonged exposure to high ultraviolet radiation, moisture, temperature changes, constant or sudden vibrations etc.) LEDiL recommends using glue or screws to ensure reliable operation. Alternatively tapes can be used to absorb small vibrations.

See specific technical properties from the document below.

Adhesive tape used in LEDiL optics and assemblies (Acrylic)
www.ledil.com/adhesive_tape_(acrylic)

Please also see chapter about chemicals on page 7.

For more information:
www.ledil.com/support/#datasheets

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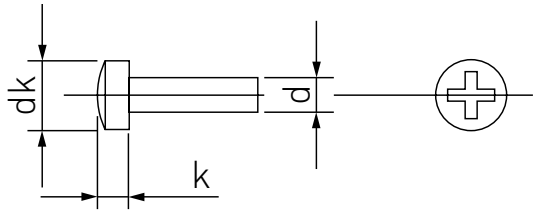
Screw

The following is only general information and for more details about tightening and exceptions please download the datasheet for each product.

For most of the products screws are of type M3. (DIN 7985, ISO 7045/ISO 14583 TX), with maximum tightening torque of 0.6 Nm.

Countersunk screws **are not allowed**, and self-tapping screws are not recommended.

Thread forming or rolling screws **are not allowed** due to lack of control of the tightening torque. (Screws will most likely exceed the recommended 0.6 Nm. Make sure there is a chamfer in the screw hole to avoid rising of the hole edges.)



DIN 7985 / ISO 7045 / SFS 2976	
Thread Size	M3
dk	6 mm
d	3 mm
k max	2.52 mm
L	4-22 mm

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Glue

Contact your local bonding manufacturer such as DELO® or LOCTITE® for recommended adhesives for your product.

Potting

Contact your local bonding manufacturer such as DELO® or LOCTITE® for recommended adhesives for your product.

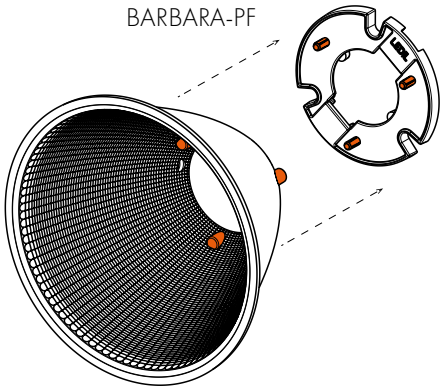
More information about bonding by Henkel
www.ledil.com/henkel-adhesives

Press-fit

Please note that LEDiL's press-fit products are designed to be assembled only once and pins won't withstand unfastening.

Align the pins in the socket with the holes in the reflector feet and press the reflector fully into the socket. Make sure you push the reflector evenly.

LEDiL's press-fit fasteners for the FLORENCE-3R product family are designed for electrical appliances that may, for security or safety reasons, require restricted access. They feature tamper-proof luminaire assembly and class 1 light fitting.



Holder

LEDiL´s holders are generally very straightforward and easy to assemble. They can be fastened with either positioning pins, clips or screws. If there is a certain installation requirement, for example in some of the ROSE-lenses, it is mentioned in the corresponding datasheet or application note.

LEDiL Disclaimer:

Some holders may allow multiple installations after the optics are removed, but LEDiL does not guarantee this or accept liability in any circumstances where possible malfunctioning or damage to the product, component, individual or property is caused by such actions.

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Profiles

Some LEDiL lenses are designed to fit existing aluminium profiles like GIZA from Klus for example. (https://klusdesign.com/product/42)

Currently supported product families:

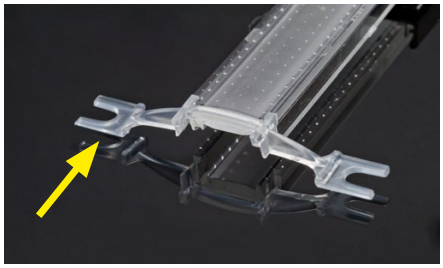
- FLORENCE-1R
- FLORENTINA

LEDiL Clips:

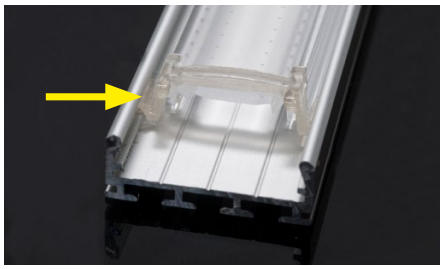
Achieve a sleak and uniform luminaire exterior by connecting lenses in continuous rows with LEDiL retaining clips.

Clip A and C for installation on a plate and Clip B for profile installation

- **C14353_FLORENCE-1R-CLIP-A** for 40 mm wide PCB´s (like Philips Fortimo) and screw mount
- **C14409_FLORENCE-1R-CLIP-B** fits straight into aluminum profile, no screws needed.
- **C14751_FLORENCE-1R-CLIP-C** for 24 mm wide PCB´s and screw mount



C14353_FLORENCE-1R-CLIP-A

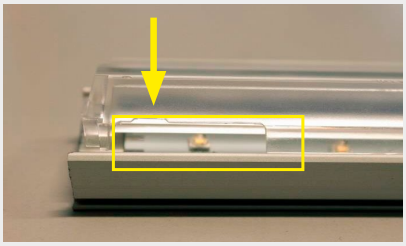


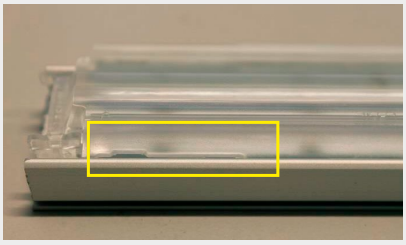
C14409_FLORENCE-1R-CLIP-B

FLORENCE-1R assembly

Place the lens in the aluminium profile and fasten it with the clips. Make sure the whole lens is evened out and that every hole reserved for connectors are hidden inside the profile.

The fastening clips will be installed on both sides of every lens. This allows lenses to be connected in a continuous row to achieve uniform appearance.







See our video about FLORENCE-1R assembly



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PCB design

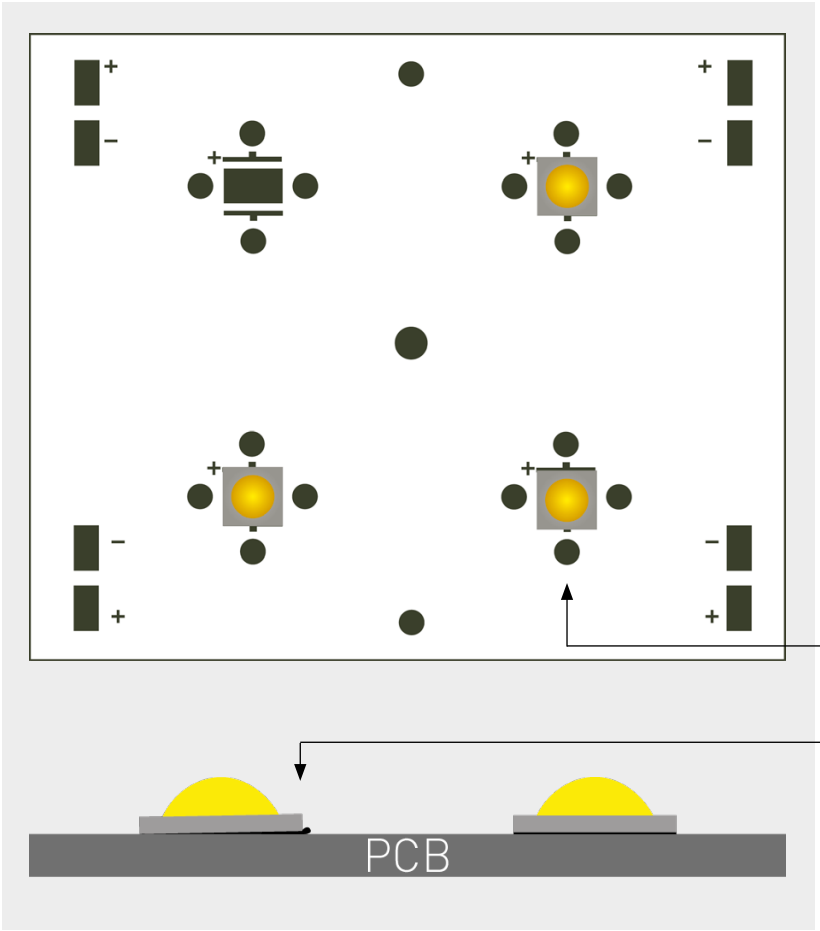
Make sure that the LEDs optical center is aligned correctly under the lens, for it may not always be at the centre of the LEDs frame (for example in the Philips Lumileds Rebel series). The recommended tolerance for LED positioning is ±0.1 mm.

Many LEDiL optics have positioning pins that require holes in the PCB. The holes need to be 0.1 mm larger than the pin size with +0.1/-0 mm tolerance limits. The tolerance for the holes location is ±0.1 mm. Some LEDiL optics have position pins shaped as + and – . In these cases the + shaped pin needs to have a round hole and the – shaped pin an oblong hole. This leaves more room for thermal expansion.

Some LEDiL products have clips to fasten the optics straight on to the PCB. The little claws that go under the PCB need to have enough empty space reserved for them. Note that the clips can only be used with 1.6 mm thick PCBs. In most cases the PCB needs to be 1.6 mm thick, but in some special cases this may also vary.

Always remember to check the corresponding product datasheet for any special requirements.

LED assembly



We recommend LED assembly tolerance of ±0.1 mm. For accurate positioning good solder pad design is necessary. If the solder pad is not the right size and shape the LED alignment may suffer significantly.

The amount of solder paste is also important. The height of the LED might vary a lot depending on the quantity of solder paste, and may even cause the LED to be askew.

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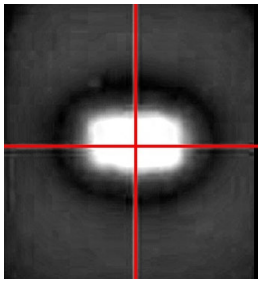
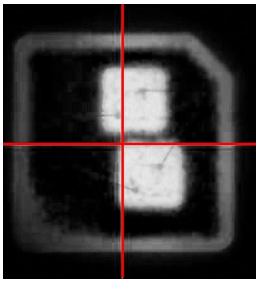
LED chip positions

Please note that due to varying asymmetric chip locations, especially on mid-power LEDs, the exact source of light is not always located at the centre of the LED packet. Take this into account when making or choosing PCB designs.

If maximum uniformity is required LEDiL recommends rotating such LEDs on the PCB in a regular pattern for smoother results.





LED compatibility tolerances

For an LED to be mechanically compatible with our lenses there must be 0.2 mm safety distance between the LED and the closest part of he lens design. With products that come with installation tape this safety margin must be 0.3 mm. These numbers come from the fact that the TIM or soldering paste between the LED and the heat sink is approximately 0.1 mm thick, and installation tape requires an additional 0.1 mm for natural shrinkage.

Distance between lenses

Many LEDiL products have a module based structure and can be installed next to each other without any noticeable shading. Some lenses from the same product family can even be mixed together and used inside the same luminaire.

As a general guideline, we recommend lens distances follow the same pattern as the LED pitches inside one module. Usually the easiest way to calculate position to the next module is between the centre points, rather than using sides or optics.

Please remember to visit our website www.ledil.com to see if there are more recent installation guides or application notes available for individual products.

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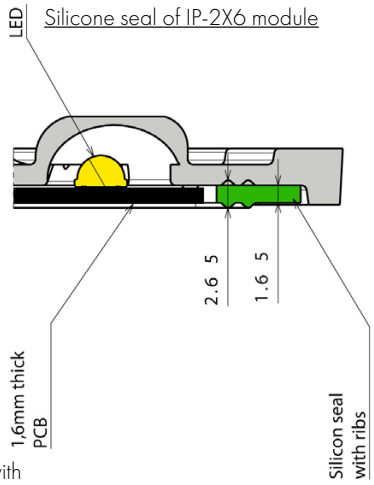
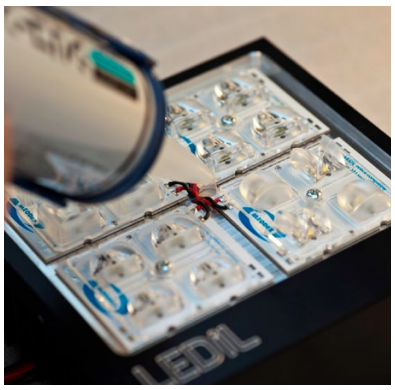
Sealing and ingress protection of LEDiL optics

Many LEDiL modules are designed to be sealed against environmental hazards with commonly available potting compounds. Sealant can be applied with a dispenser either manually or with an automated XY-table.

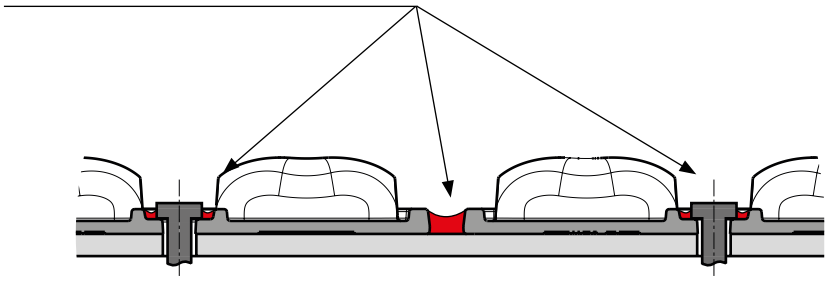
Before adding any sealing compounds, ensure the installation surface, and the optic with its accessories are even.

Modules that have an integrated silicone gasket do not need to be potted. To ensure intended level of ingress protection, please make sure that the silicone gasket is correctly in place before installation.





Only apply potting compound outside the optical areas. STRADA lenses for example are designed with barrier walls to keep the compound out of the lenses.



Note! In order to maintain the desired level of ingress protection, screws with thread-locking fluids should be thoroughly tested in advance for VOC (volatile organic compounds) or stress cracking, and any remaining cutting fluids used in heat sink machining must be carefully removed. Solid thread-locking screws should be used. The temperature and pressure differentials inside and outside the lens can cause seal performance to degrade over time. If more ventilation is needed inside the lens this must be done in such a way as to not compromise the ingress protection. E.g. by using ventilation solutions from 3rd party manufacturers.

IP ratings indicated in LEDiL product specifications are based on IEC 60598-1:2014 ed. 8.0 and are conducted internally. The final IP rating is subject to design and surface finish of luminaire parts and must be individually tested.

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Thermal management

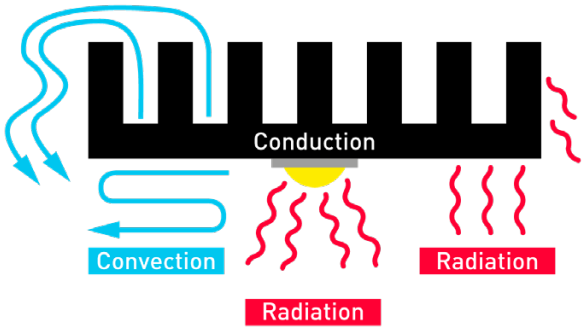
When working with LED lighting one important issue to take into consideration is heat. Good thermal design plays a key role in the performance and lifetime of the application. There are three different ways for heat to transfer: conduction, convection and radiation. Always make sure that the thermal management is sufficient enough for the application.

Conduction is the transfer of heat through solid materials with direct contact. For example the heat from an LED junction to the heat sink is transferred by conduction.

Convection is the transfer of heat through the movement of gases or fluids. A typical example in LED applications is the heat transferred from heat sink to air.

Radiation is the transfer of thermal energy by electromagnetic radiation. This radiation causes thermal motion of charged particles in matter. In LED applications transfer through radiation is found in the light itself. This is extremely important to remember since LEDs keep getting more and more powerful.

The best choice of optic is not always the material that can handle more heat, because some materials absorb more radiant flux than others. This basically means that an optics efficiency is directly linked to how hot the lens will get.



LEDiL secondary optics are designed and manufactured to meet the highest possible efficiency rates. This not only provides good lighting results, but gives the product a longer lifetime as well.

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Heat sink machining

All heat sink machining needs to be done before lens assembly. Some lenses need holes for wires and for fastening. For example LEDiL's STRADA-IP-2X6 products need to be fastened to the heat sink with screws. After cable holes and threaded screw holes are machined, ensure that the anodized heat sink surface is even. Screw thread hole accuracy is ±0.1 mm. Vertical straightness tolerance for screws is ± 0.1 mm A. Please be sure to remove all aluminum particles from the holes and the heat sink surface.

Thermal interface materials

For good heat transfer, a thermal interface material must be used between the heat sink and the PCB/ COB LED. This material can be thermal pad, thermal glue, thermal paste, phase change material or double-sided thermal tape. The material choice depends on the situation and power used by the application. The thermal resistance of the thermal interface depends on the thermal conductivity of the material, material thickness, area and the pressure applied to the interface. We recommend using a thin layer of thermal interface material to minimize thermal resistance.

It is always the customer's responsibility to ensure reliable and sufficient cooling and heat transfer between all luminaire components. If a sufficient amount of pressure on the heat sink cannot be maintained over time we recommended using either thermal glue and/or screws for the PCB/LED fastening.

While using thermal interface materials, remember that the material needs to be chemically compatible with the LEDs. Bad material choice might significantly reduce the LEDs lifetime. For example Cree has created a test method for chemical compatibility. More information about the test can be found on Cree's web page.

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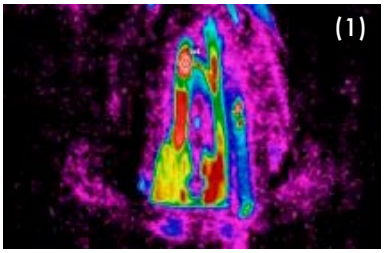
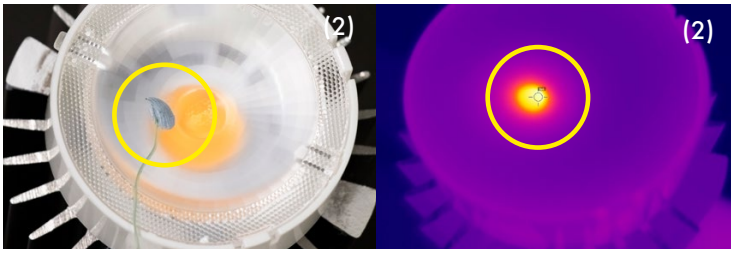
Thermal measurements

Infrared (IR) imaging and thermocouple measurement systems can be used for monitoring temperatures in LED applications, but the following must be acknowledged.

- IR imaging is a preferred method for lens and reflector temperature measurements, but emissivity of the target area must be known (typical emissivity of a transparent lens is 0.88 - 0.93)
- Low emissivity surfaces are challenging to measure with an IR camera because reflected temperatures can also be seen in thermal image **(1)**
- Thermocouples cannot be placed on top of a lens or in direct light due to the absorption of the radiant flux **(2)**
- Tiny thermocouples (AWG 40 recommended) can be used to measure LED case, PCB and heat sink temperatures where radiant flux doesn't interfere, and target surfaces cannot be exposed to the IR camera
- A white thermal paste can be used to attach thermocouples for better accuracy and to avoid drilling, glueing or taping





Lenses

Method a) Switch on the light and let temperatures rise until they stabilize. Remove any obstacles (e.g. glass cover) quickly to expose the target surface and take an image on the top surface of the lens. Start to record video sequence and turn the lens over quickly to catch the maximum temperature from the bottom side of the lens.

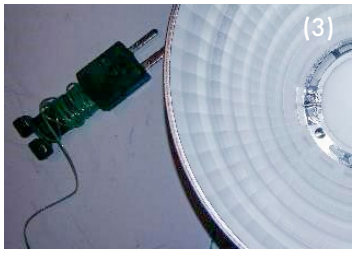
Method b) Let temperatures stabilize like in the previous method, but instead of removing or turning any parts just start the measurements and switch off the light. Do not include the first 10 seconds but take temperature values every 5 seconds to create a linear graph of the changes. (See UL standard 8750-873).

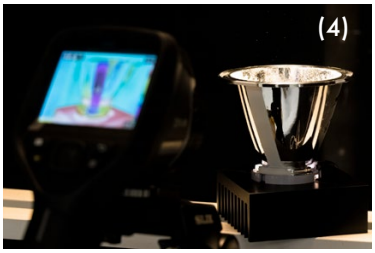
Reflectors

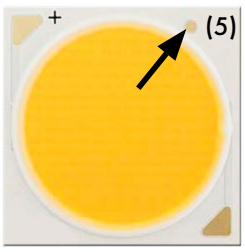
Attach a thermocouple on the surface of the reflector with a small aluminum tape and monitor temperatures until they stabilize **(3)**. Paint the target area, attach a tape with known emissivity or remove metallization on the outer surface of the reflector and take an IR image from that area **(4)**.

COB LEDs

LED case temperature, Tc, can be measured with a thermocouple (Type T) that is firmly glued/soldered to the Tc measurement point of the LED module **(5)**.







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Metal coating

All materials and coatings used by LEDiL must undergo numerous tests before approval. They must be durable and permanent, showing no signs of peeling, fingerprints, cracks, black spots, scratches, smudging or discolouration.

To ensure product quality, we always conduct heat testing at temperatures exceeding our recommended operating limits.

For more demanding environments, lacquer-treated materials have been tested using a diluted sodium hydroxide (NaOH) solution and under controlled salt mist conditions. To pass these tests, the treated surfaces must remain completely undamaged. HMDS-treated materials are not suitable for environments with salt exposure.

Although both HMDS and lacquer treatments improve the durability of the aluminium coating, the reflector must still be protected from water and other environmental hazards. Weather exposure testing must be carried out during the design process.

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Vacuum evaporation PVD

LEDiL uses vacuum evaporation PVD (Physical Vapor Deposition) to add a reflective aluminum coating to PC reflectors. Before aluminum can be added, adhesion between the reflectors and the aluminum coating must be improved by laquer or plasma treatment.

PVD + Laquer (Protective coating for aluminium surfaces.)

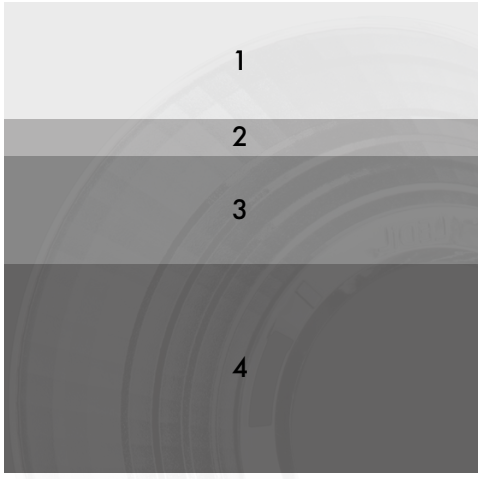
- High quality both functionally and decoratively
- Reflectors will not be subject to chemical of thermal stress
- Good performance in cross-cut test

1) Top lacquer (to protect surface)

2) Al metallization (PVD)

3) Base lacquer (to improve adhesion)

4) Substrate (part to be coated)



PVD + HMDS (Protective coating for aluminium surfaces.)

HMDS is a simplified name for a glow polymerization method. Plasma treatment is first used to clean the reflector surfaces of any unfavorable materials to improve adhesion. Then the aluminum coating is added via vacuum evaporation and finally HMDS-monomers are added and a polymerization reaction takes place.

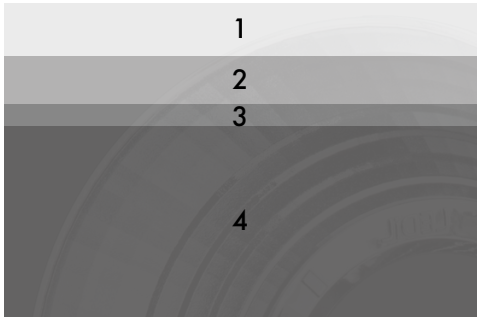
- Thin and protective layer
- Good optical performance
- Good durability against heat

1) HMDS plasmapolymerisation (to protect surface)

2) Al metallization (PVD)

3) Plasma activation of surface (to improve adhesion)

4) Substrate (part to be coated)



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Storage

To maintain long-term product quality under storage, please ensure that the environment is kept at normal room temperature without too much humidity and that the products are kept in their original packaging.

Links to useful information

Guides documents and certificates
www.ledil.com/support/

Application related guides and examples
www.ledil.com/application-areas/

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