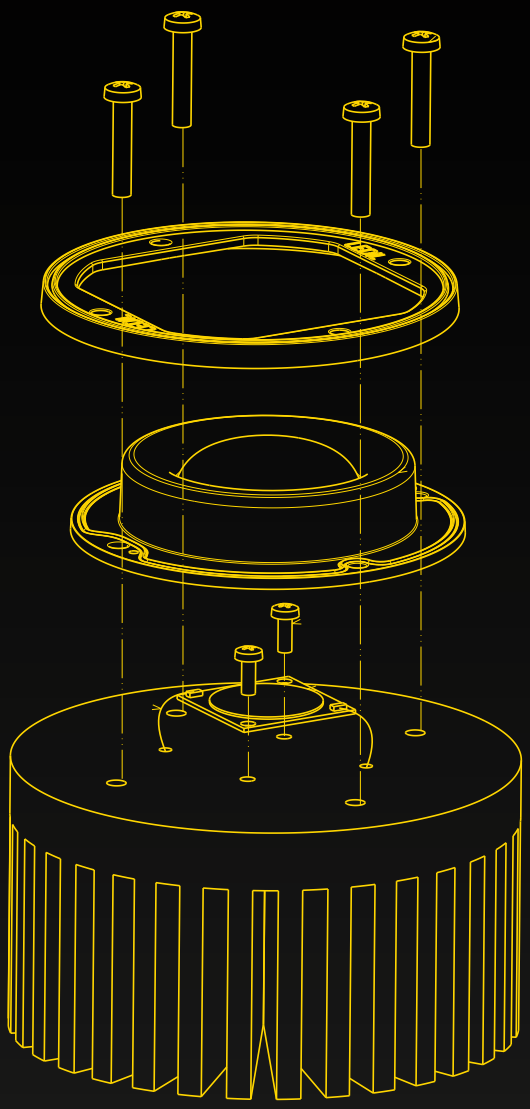
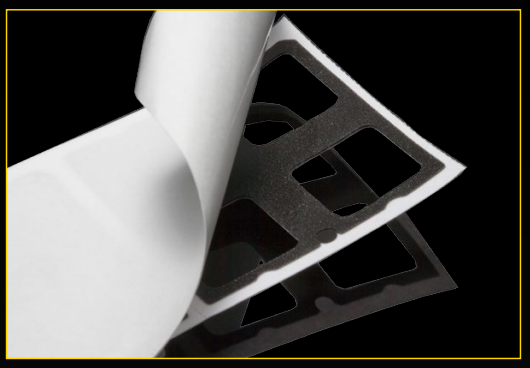
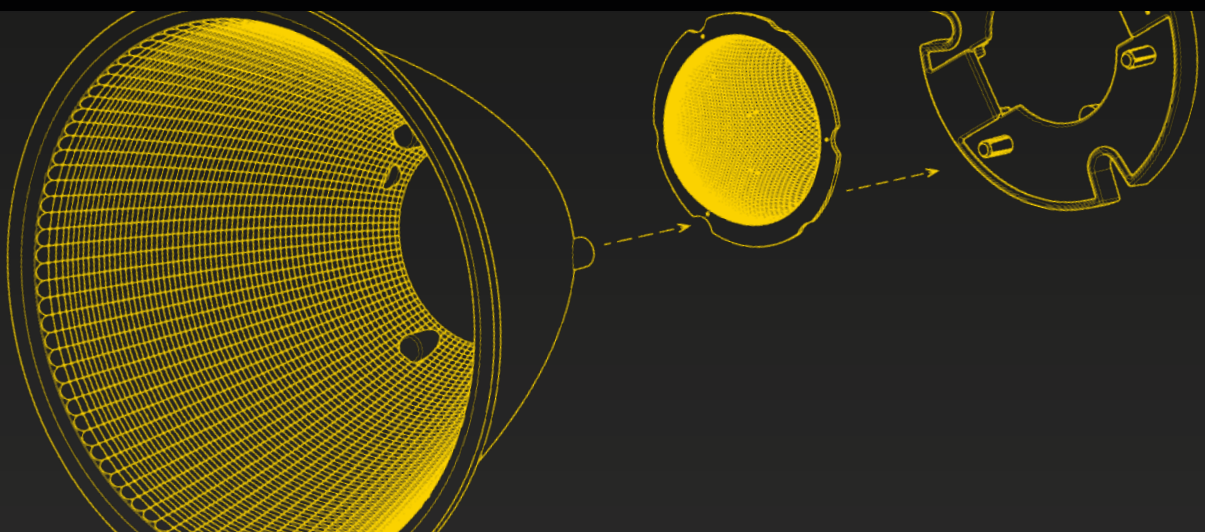
LEDiL





Installation guide

General information about assembling LEDiL products



Dear Customer,

The following instructions should be observed before using the LEDiL products to ensure reliable assembly.

Contents

Materials

PMMA & PC (Transparent plastic polymers in optics)

PMMA:
- Rigid and hard
- Fair 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
- Fair UV-resistance (LEDiL uses UV-stabilized PC-grade)

In general, PMMA is harder and more fragile than PC. PC has also bigger strength for impact and heat. LEDiL uses many different types of PC in its products and the information given here is only valid for Makrolon 2407. Other types of PC perform very similarly, but this is recommended to verify separately.

LEDiL uses PMMA mostly for lenses and PC for holders, reflectors and for some of the lenses. Polymers can reflect, absorb and refract visible light. Absorption leads to temperature growth within a lens and therefore the effect is reasonable to take into consideration during a heat simulation of applications. The materials used by LEDiL are UV-stabilized and f1-rated (the UL746C-standard indicating polymer is suitable for outdoor applications and has met the UV and water exposure demands).

Silicone (as a lens material)

Silicone has excellent optical properties, great impact strength, durability and high thermal stability. Elasticity enables complex optical and functional forms and low viscosity makes microstructural design possible. Silicone has high stability to heat, ultraviolet light and ozone, and it can be used with UV LEDs, which even UV stabilized plastics are unfit for.

Silicone:
- Excellent optical properties with an even better efficiency than glass
- Elastacity enables complex optical and functional forms
- High thermal and UV stability
- Great impact strenght
- Light-weight design (lighter than glass)

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 created around 80°C or 90°C of heat, today the monstrous sized COBs can create 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 and bright operation.

Sources of heat

As a general rule 1/3 of an LEDs 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 considerations when a new luminaire design is made but not the whole truth in the heat generating process.

Some materials **absorb** more light than others. This means that an optics efficiency has a direct link on 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.

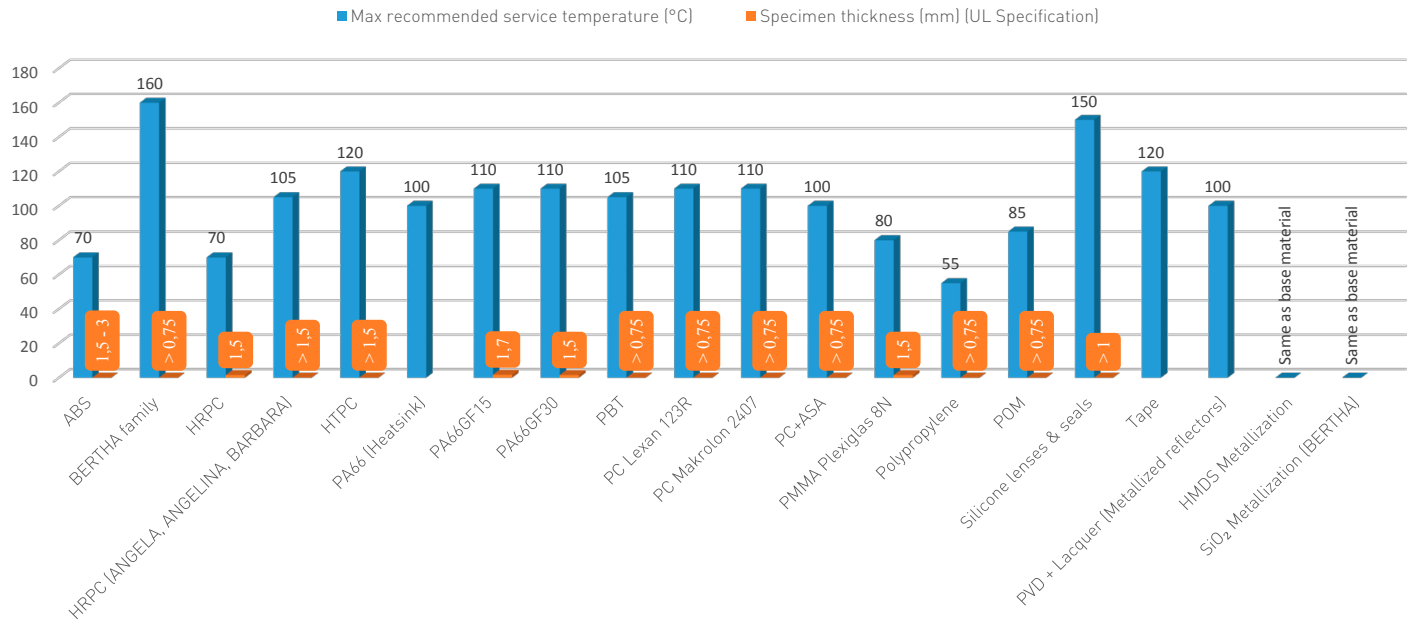
Careful consideration should be given to all of these areas when designing the luminaire to ensure a safe and long lifetime of the product. LEDiL products are designed and manufactured to meet high efficiency values to help extend the product lifetime.

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 other parties 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.

Material	Max recommended service temperature (°C)	Specimen thickness (mm) (UL Specification)
ABS	70	1,5 - 3
BERTHA family	160	> 0,75
HRPC	70	1,5
HRPC (ANGELA, ANGELINA, BARBARA)	105	> 1,5
HTPC	120	> 1,5
PA66 (Heatsink)	100	
PA66GF15	110	1,7
PA66GF30	110	1,5
PBT	105	> 0,75
PC Lexan 123R	110	> 0,75
PC Makrolon 2407	110	> 0,75
PC+ASA	100	> 0,75
PMMA Plexiglas 8N	80	1,5
Polypropylene	55	> 0,75
POM	85	> 0,75
Silicone lenses & seals	150	> 1
Tape	120	
Metallization methods		
PVD + Lacquer (Metallized reflectors)	100	
HMDS Metallization	Same as base material	
SiO_2 Metallization (BERTHA)	Same as base material	



Chemicals

Glues / adhesives / potting / thread lock

We strongly recommend that every customer fully tests and takes the necessary measures to ensure that there is a complete compatibility of the chemical used with one's particular product, LEDs and other components. Testing and verifying of the adhesives, potting agents, coatings and their combinations are always on the responsibility of the customer.

General instructions of use

All surfaces where adhesive is applied must be clean, dry and free from grease and dirt. If cleaning of the PCB surfaces is needed, please follow strictly the cleaning instructions of your LED manufacturer – this is important as cleaning shall under no circumstances damage LEDs or other electronics components on the PCB. Further note that **optical components shall not be cleaned with any chemicals** – only micro fiber cloth may be used to remove fingerprints or other traces from handling. 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's note:

LEDiL cannot take responsibility for the results obtained by others whose 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 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®
www.ledil.com/delo-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.

Chemical resistance

Silicone

LEDiL silicone lenses are made of VMQ general purpose stocks.

http://www.ledil.com/dowcorning_materials

PMMA

The chemical resistance of mouldings made from Plexiglas moulding powder (tables on pages 7-12)

- The behaviour given below relates 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 with 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.
- Be warned against joining Plexiglas moulding powder to plasticized thermoplastics and elastomers because some plasticisers migrate at elevated temperatures and attack the articles.
- Mouldings occasionally show residual stresses caused by processing or use, but they do not impair the resistance to fracture; they may, on other hand, induce crazing on exposure to solvents or swelling agents.
- The material compatibility should be tested in advance in the actual application conditions.

PC

General chemical behaviour

The chemical resistance of Makrolon® depends on the concentration of the substance, the temperature, the contact time and the internal tension level of the polycarbonate sheet due to fabrication etc. 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 almost not influenced, thermal properties are only slightly influenced by the molecular weight.

In the following tables (pages 7-12) 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 is also depending 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 case of long exposure, such as performed in these tests. Therefore, it is always recommendable to execute a test in the actual application conditions. The tested substances have been chosen in function of their importance in several areas. In a lot of cases it is possible to deduct results to 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 the unprotected materials, but in general the results shown in the table still comply.

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	-

Substance	PC	PMMA
Baysilon ® Silicone oil	R	-
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

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

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

Substance	PC	PMMA
Carbon acid, wet	R	-
Carbon dioxide	-	R
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	-

Substance	PC	PMMA
Dibutyl phthalate (plasticizer)	X	-
DIEGEL liquid film 23922	-	R
Diesel oil	O	-
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

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Substance	PC	PMMA
Fuel oil O	O	-
FULLBOX	-	R
GASOLIN, depending on the blend	-	O
Gasoline	R	-
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	-

Substance	PC	PMMA
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
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

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Substance	PC	PMMA
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	-
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

Substance	PC	PMMA
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
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	-

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Substance	PC	PMMA
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	-
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	-

Substance	PC	PMMA
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	-
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	-

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

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

Substance	PC	PMMA
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
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	-

Substance	PC	PMMA
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	-
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

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

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

Stress cracking

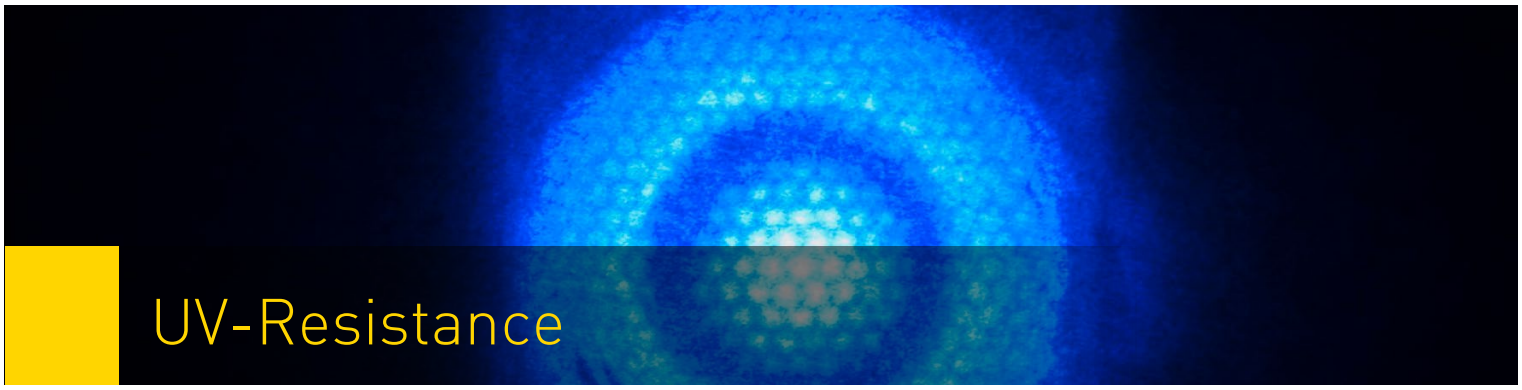
LEDiL products are designed and manufactured to avoid internal stress as much as possible, but this can't be totally avoided. Common optical grade thermoplastics are vulnerable to crack by combination of external or internal stress sources and chemicals.

Even a 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 to 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
- Screw type, torque and other fastening methods

You can find an instructional video about chemicals on our youtube channel
https://youtu.be/lZUkBsXcnCU



UV-Resistance

Plastics degenerate differently on the exposure to the 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 kept in mind when choosing the materials for your application.

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

Plexiglas guarantee

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

http://www.ledil.com/plexiglas_guarantee

PMMA

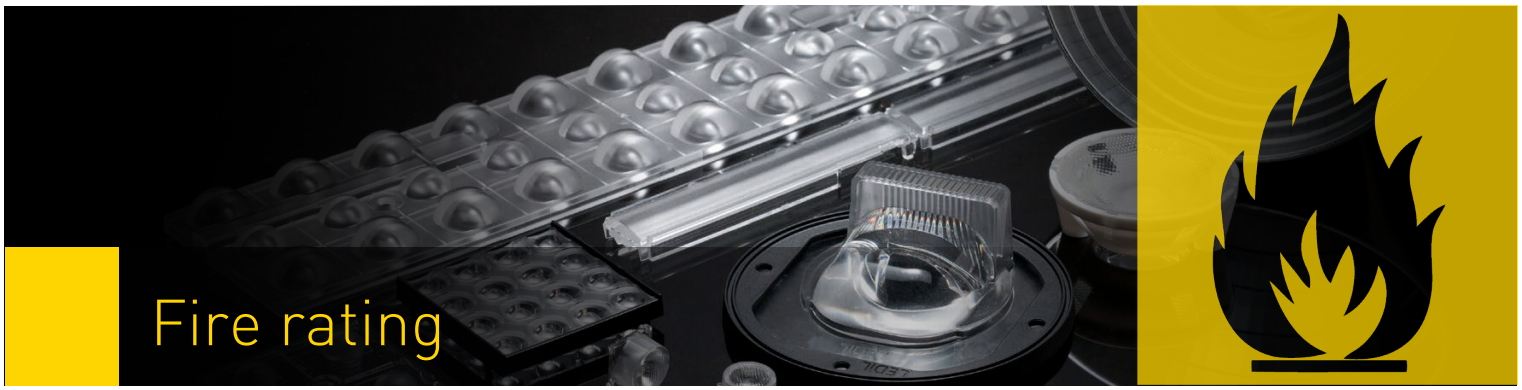
High UV-resistance with no yellowing. For better impact resistance protective glass is needed.

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 overtime when exposed to UV-radiation. Therefore LEDiL does not recommend to use products made out 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 the sunlight. After a very long period of time ultraviolet light may also cause some brittleness on the material and LEDiL recommends to use plastic washers with fasteners to decrease mechanical stresses.



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. To metallized products UL-class confirmation tests are done 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
PLC1	60 through 119
PLC2	30 through 59
PLC3	15 through 29
PLC4	7 through 14
PLC5	< 7

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.

LEDiL materials fire rating

- HWI, HAI, RTI and physical

			Material								
			PMMA	PC	PC	PC	PC	Silicone	Silicone	Silicone seal	Ultramid
			Manufacturer								
			Evonik plexiglas 8N	Bayer Makrolon 2407	Sabic Lexan 123R	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						

Rating Description

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

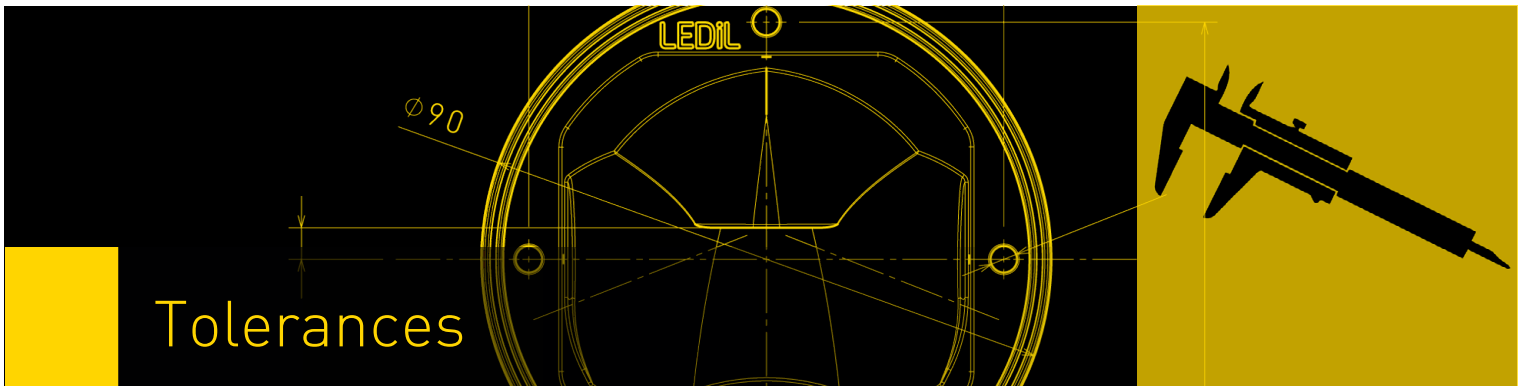
f2 The material has met either UV or water immersion requirements, or has only been partially tested.

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's note:

LEDiL cannot take responsibility for the results obtained by others whose 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.



Tolerances

General tolerances for linear and angular dimensions (DIN ISO 2768-1)

Linear dimensions

Permissible deviations in mm for ranges in nominal lengths	Tolerance class designation (description)			
	f (fine)	m (medium)	c (coarse)	v (very coarse)
0.5 up to 3	±0.05	±0.1	±0.2	-
over 3 up to 6	±0.05	±0.1	±0.3	±0.5
over 6 up to 30	±0.1	±0.2	±0.5	±1.0
over 30 up to 120	±0.15	±0.3	±0.8	±1.5
over 120 up to 400	±0.2	±0.5	±1.2	±2.5
over 400 up to 1000	±0.3	±0.8	±2.0	±4.0

Straightness and flatness

Ranges in nominal lenghts in mm	Tolerance class		
	H	K	L
up to 10	0.02	0.05	0.1
over 10 up to 30	0.05	0.1	0.2
over 30 up to 100	0.1	0.2	0.4
over 100 up to 300	0.2	0.4	0.8

LEDiL tolerances

Fastening

We request the customer to ensure and fully test the suitability and sufficiency of the fastening and bonding in his 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 on customer's responsibility.

Tape

Unless otherwise mentioned, all LEDiL products supplied with tape use the same double-sided foam (polyurethane), 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 1-5 seconds to ensure the best possible bond. The tape will reach its final strength in 72 hours, depending on the material and the ambient conditions.

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

For extreme conditions (heavy or prolonged exposure to high ultraviolet radiation, moisture, temperature or its changes etc.) LEDiL recommends to use glue or screws to ensure reliable operation. Tapes can also be used to absorb some of the vibrations.

Technical properties

- Installation pressure: 11N/cm2
- Maximum recommended weight load: 15g/cm²
- Assembly temperature range: +10°C ... +40°C
- Usage temperature range, when cured: -40°C ... +120°C
- Resistance to abrasion, corrosion, moisture, dilute acids and alkalis
- UV light resistance tested according to ASTM G53-84 by tape manufacturer
- 1 year expected shelf-life from purchase

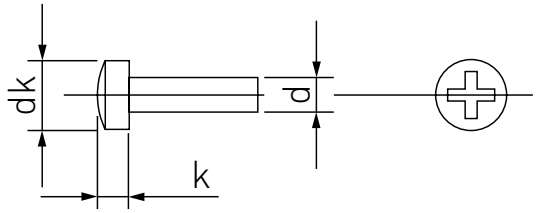
For more information:
http://www.ledil.com/adhesive_tape

Screw

The following is only general information and for more details about tightening orders 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.

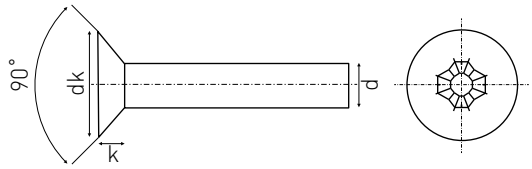
LEDiL recommends the use of the M3 nylon washers (DIN 125 / ISO 7089) between the screws and the lens to minimize stresses induced by fastening torque.



DIN 7985 / ISO 7045 / SFS 2976	
Thread Size	M3
dk	6mm
d	3mm
k max	2,52mm
L	4-22mm

Please note:

Differing from other lenses, the **CS14145_STRADA-IP-2X6-DWC-90** module needs countersunk screws of type M3 (DIN 965) for fastening the PCB to heatsink.



DIN 965 / ISO 7046 / SFS 2977	
Thread Size	M3
dk	5,6 mm
d	3 mm
k max	1,65 mm
L	4 – 22 mm

If design requires, it is possible to use ultra low head cap screws.

https://www.ledil.com/ultra-low-screw

Glue

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

www.ledil.com/delo-adhesives

Potting

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

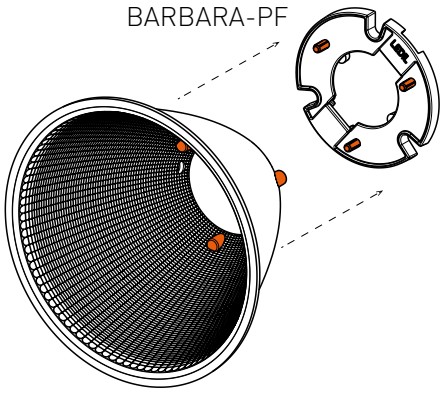
www.ledil.com/delo-adhesives

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. Fastening happens either with positioning pins, clips or screws. If there is a certain installation direction, for example in some of the ROSE-lenses, it is mentioned in the corresponding datasheet or application note.

LEDiL's note:

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

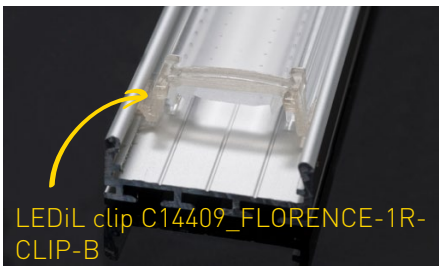
Profiles

Some LEDiL lenses are designed to fit into already existing aluminium profiles like for example GIZA from Klus. (http://www.klusdesign.com/products/show/235)

Currently supported product families:

- FLORENCE-1R
- FLORENTINA
- ZENIA


LEDiL clip C14353_FLORENCE-1R-CLIP-A


LEDiL clip C14409_FLORENCE-1R-CLIP-B

LEDiL Clips:

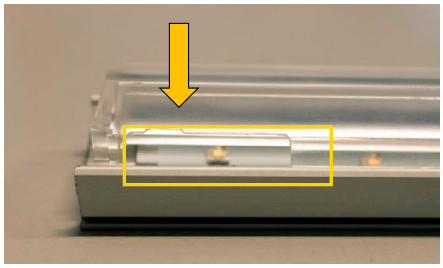
Achieve sleak and uniform luminaire exterior by connecting lenses into continuous row with LEDiL retaining clips.
Clip A and C for installation on a plate and Clip B for profile installation

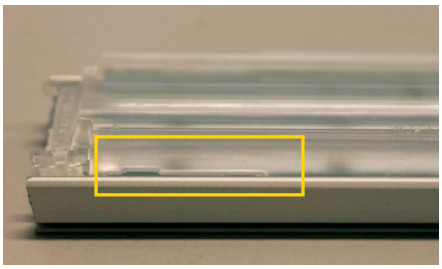
- **C14353_FLORENCE-1R-CLIP-A** for 40mm wide PCB´s (like Philips Fortimo) and screw mount
- **C14409_FLORENCE-1R-CLIP-B** fits straight into aluminum profile, no screws needed.
- **C14751_FLORENCE-1R-CLIP-C** for 24mm wide PCB´s and screw mount

FLORENCE-1R assembly

Place the lens into 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 into a continuous row to achieve uniform appearance.





You can find assembly instructions for FLORENCE-1R on our youtube channel
https://youtu.be/ZP6QxR3hS6Q

PCB design

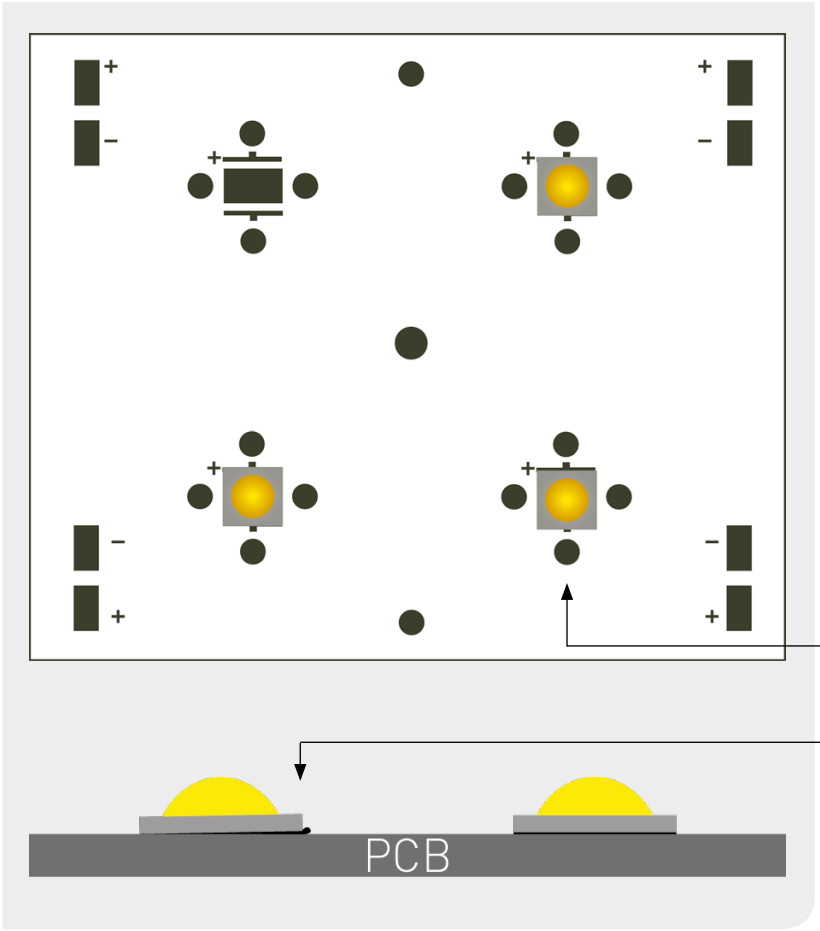
Make sure that the LEDs optical center is aligned correctly under the lens, for it may not always be at the center of the LEDs frame. For example in the Philips Lumileds Rebel series. The tolerance for LED positioning is ±0,1mm.

Many of the LEDiL optics have position pins that require holes on the PCB. The holes needs to be 0,1mm larger than the pin size with +0,1/-0mm tolerance limits. The tolerance for the holes location is ±0,1mm. 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 expanding.

Some LEDiL products have clips to fasten the optics straight on to the PCB. With little claws that go under the PCB they need to have enough empty space reserved for them. Notice that the clips can only be used with 1,6 mm thick PCBs. In most cases the PCB needs to be a 1,6mm 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 to be ±0,1mm. For an 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 quite much depending on the quantity of solder paste, and may even cause the LED to be askew.

Distance between lenses

Many LEDiL products have a module based structure, and can be installed right 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, it is recommended to keep the lens distances following the same pattern as the LED pitches are inside one module. Usually the easiest way to calculate position to the next module is between the center 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.

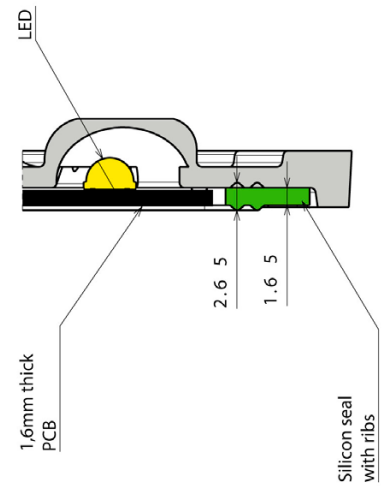
Sealing

Ingress protection of LEDiL optics

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

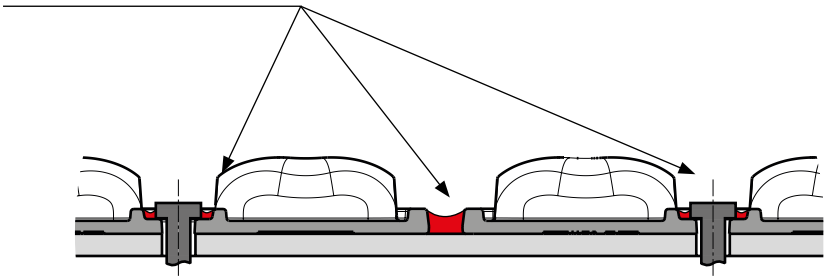
Before adding any sealing compounds, ensure the installation surface, and the optic with its accessories are even.

Modules that have integrated silicone gasket do not need to be potted.



Silicone seal of 2x6 IP module

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



Thermal solutions

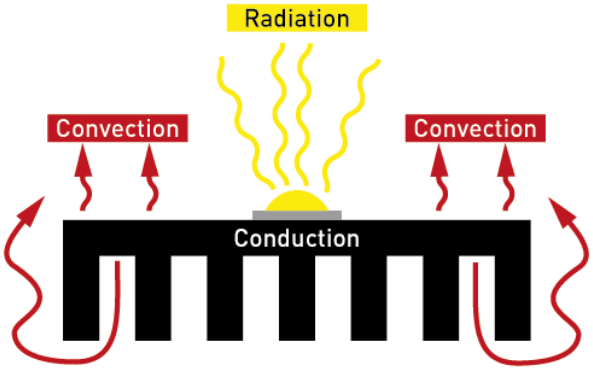
When working with LED lighting one important issue to take into consideration is heat. Good thermal design is in a key role when speaking about performance and lifetime of the application. There are three different ways for heat to transfer: conduction, convection and radiation. Always make sure that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

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

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

Radiation is 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 on the light itself. This is extremely important to keep in mind since LEDs keep getting more and more powerful.

Best choice for optic is not always the material that can handle more heat, because some materials absorb more light than others. This basically means that optics efficiency has direct link to the fact how hot the lens will get.



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

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 IP2x6 products need to be fastened with screws to the heat sink. After cable holes and threaded screw holes are machined, ensure that anodized heat sink surface is even. Screw thread hole accuracy is ±0,1mm. Screw vertical straightness tolerance is ±⊥0,1mm A. Please be sure to remove all aluminum scraps from the holes and the heat sink surface.

Thermal interface materials

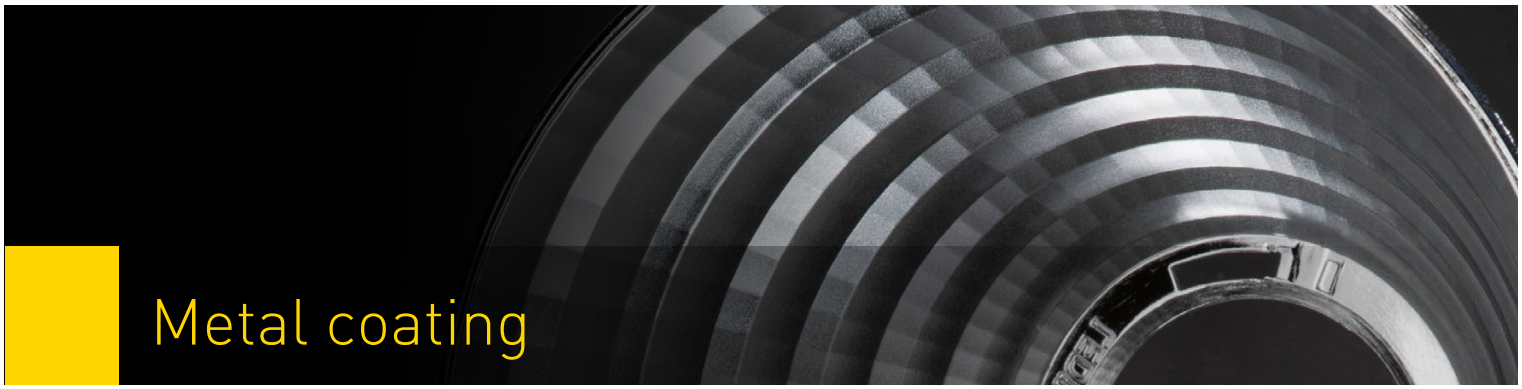
For a good heat transfer, a thermal interface material must be used between the heat sink and the PCB. This material can be thermal pads, thermal glue, thermal paste or double-sided thermal tape. The material choice depends on the situation and power used by the application. The thermal resistance of the thermal interface depends on thermal conductivity of the material, material thickness and the pressure applied to the interface. Therefore - because of the small layer thickness - thermal paste or thermal glue are usually best solutions even though the thermal conductivity can be equal or even lower than thermal pads.

It is always on customer's responsibility to ensure reliable cooling and heat transfer between all luminaire components. If the sufficient amount of pressure to the heat sink cannot be maintained over time it is recommended to use 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.

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.



Metal coating

Different materials and coatings used by LEDiL have to undergo numerous tests before getting acceptance. All the materials and coatings must be permanent, durable and show no signs of peeling, fingerprints, cracks, black spots, scratches, smudging, colorful phenomenon or discoloration.

Heat testing has always been made beyond our recommended limits, to ensure safe usage of the product. Coating durability is verified according to standard ASTM D 3359. This is done by making intersecting cuts with the cross-cut tool to form a hatch pattern, and then peeling the tape off rapidly. To pass the product can't show any grading (Class 5B).

For more extreme environments, some materials have been tested with dilute NaOH liquid and in artificially created salt mist. These surfaces should be completely unharmed to pass.

Vacuum Evaporation PVD

LEDiL uses vacuum evaporation PVD (Physical Vapor deposition) to add a reflective aluminum coating onto PC reflectors. Before aluminum can be added, adhesion between the reflectors and the aluminum coating must be improved. This is conventionally done by adding a layer of lacquer to the reflector surfaces.

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

HMDS

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.

The HMDS and lacquer layers increase aluminium coating durability, but the reflector must be protected from water and other hazards. Weatherability tests must be carried out during the design process.

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

Useful information:

Application notes – Glare Shielding and Protective Covers
http://www.ledil.com/glare_shielding

Application notes – Strada-2X2 Installation guide
http://www.ledil.com/strada-2x2_guide

Application notes – Strada- IP2X6 Installation guide
http://www.ledil.com/strada-IP2x6_guide

TIR Lens Guide
http://www.ledil.com/tir_lens_guide

Strada Lens Guide
http://www.ledil.com/strada_lens_guide

Application notes – Effects of the front glass in luminaire design
http://www.ledil.com/protective_glass

Guide to the LEDiL lens modules
http://www.ledil.com/module_guide