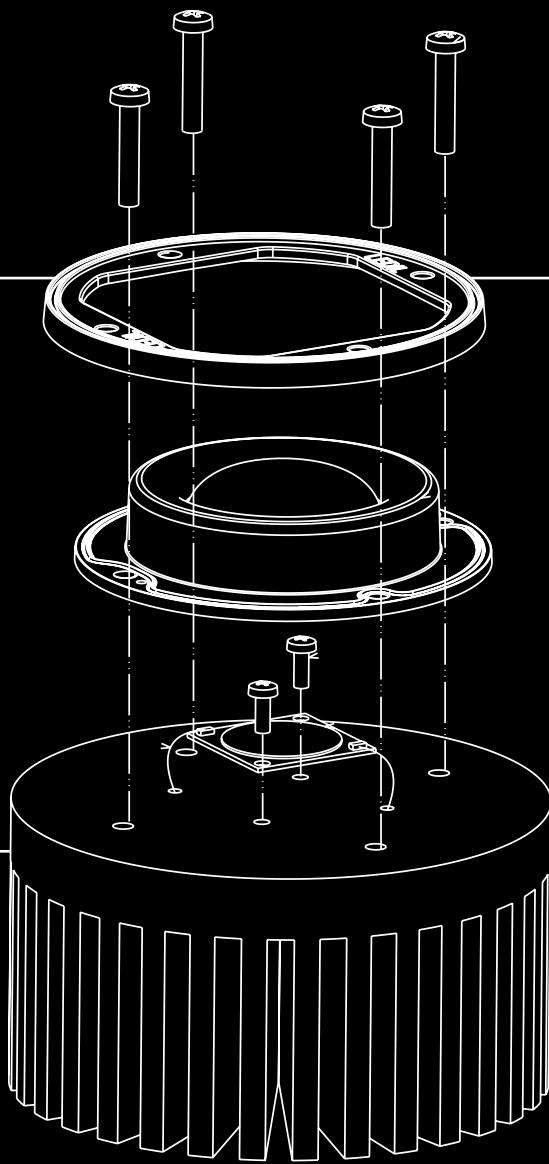


LEDiL®

INSTALLATION GUIDE



GENERAL INFORMATION ABOUT ASSEMBLING LEDiL PRODUCTS



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).

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.

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.



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.

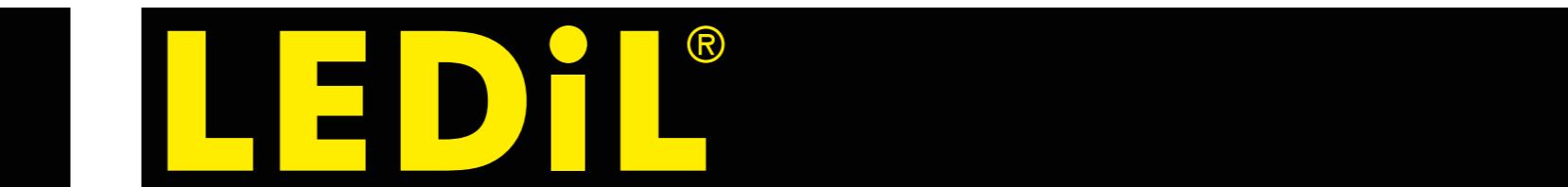
Some materials absorb more light than others. This means that an optic's efficiency has a direct link to how hot the lens will get. All sorts of **dirt**, **dust** and **grease** on the optical surface block some of the light rays generating more heat inside the luminaire. During the product lifetime 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

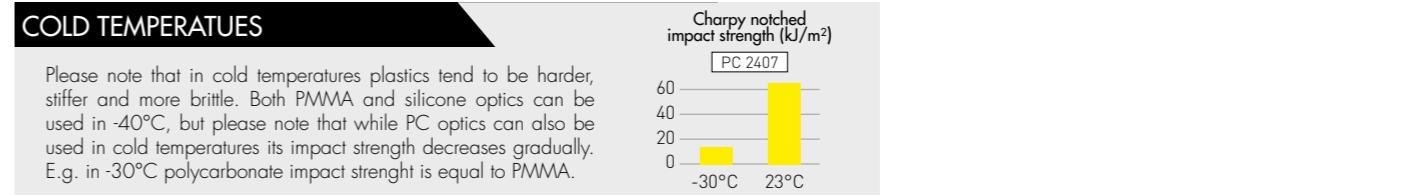
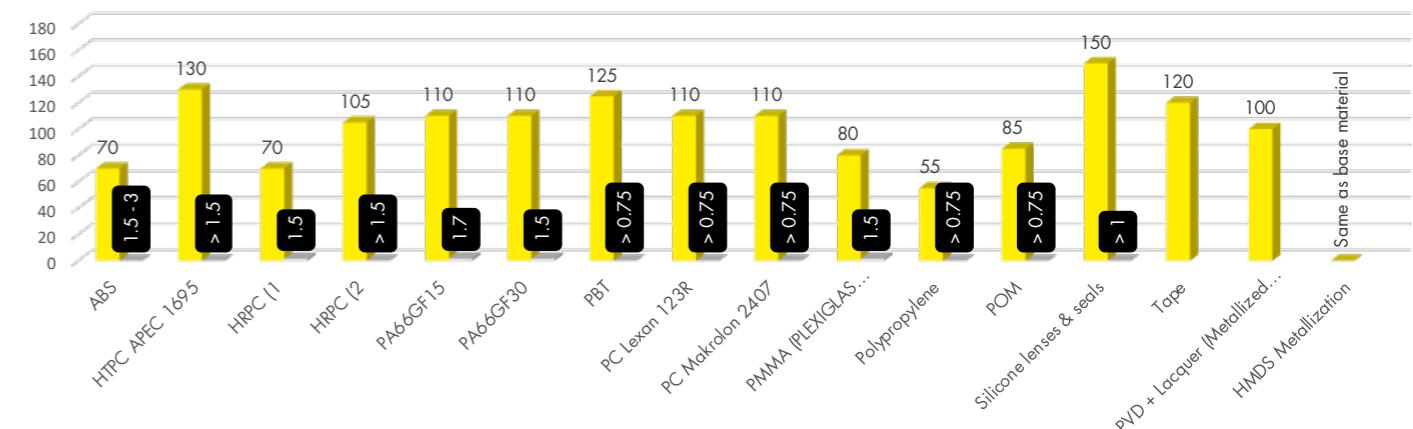
On the following page you can find a list of materials and recommended maximum service temperatures.

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.



| MATERIAL LINK TO DATASHEETS | MAX RECOMMENDED SERVICE TEMPERATURE (°C) | SPECIMEN THICKNESS (MM) (UL SPECIFICATION) |
|---|---|--|
| ABS | 70 | 1.5 - 3 |
| HTPC APEC 1695 | 130 | > 1.5 |
| HRPC ¹⁾ (LISA2, RITA-A, RITA-B, RITA-WAS, BRITNEY-XW, BOOM-MC-XW, LENINA-XW, LAURA-R-XW, LENAXWAS, TINA2-R-CLIP16, LEILA-R-CLIP16 LEILA, MINNIE-XW, MINNIE-LT-XW, SAGA-FRAME, MIRELLAXW, MIRELLA-40-XW, MIRELLA-50-XW, MIRELLA-50-WW-PF, REBECCA-RGB-HLD, BROOKE-XW, BARBARA-XW) | 70 | 1.5 |
| HRPC ²⁾ (ANGELA, ANGELINA, BARBARA, MIRELLA-G2) | 105 | > 1.5 |
| PA66GF15 | 110 | 1.7 |
| PA66GF30 | 110 | 1.5 |
| PBT | 125 | > 0.75 |
| PC LEXAN 123R | 90 (LONG TERM) 110 (SHORT TERM) | > 0.75 |
| PC MAKROLON 2407 | 90 (LONG TERM) 110 (SHORT TERM) | > 0.75 |
| PMMA (PLEXIGLAS 8N/ALTUGLAS V040) | 80 | 1.5 |
| POLYPROPYLENE | 55 | > 0.75 |
| POM | 85 | > 0.75 |
| SILICONE LENSES & SEALS | 150 | > 1 |
| TAPE | 120 | |
| METALIZATION 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 |
| HMDS METALIZATION | SAME AS BASE MATERIAL | ANGELA, ANGELETTE, ANGELINA, BARBARA-XX-PF, BROOKE-G2, MIRELLA-G2, BARBARA-G2, TYRA, TYRA2, TYRA3 |

■ Max recommended service temperature (°C) ■ Specimen thickness (mm) (UL Specification)





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®
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, 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.



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 occurrence, 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.



| 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 | - | ○ |
| Acrylonitril | X | - |
| Ajax ® | R | R |
| Alcohol, concentrated | - | X |
| Alcohol, up to 30% | - | R |
| All purpose adhesive | - | ○ |
| All-purpose glue | ○ | - |
| Allylalcohol | ○ | - |
| 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 | - |
| Amyl acetate | X | - |
| Anfistatic plastics cleaner and preserving agent | - | R |
| Aniline | X | - |
| Antimony chloride, saturated aqueous solution | R | - |
| Antistatik C, 5% | X | - |
| Antistatikum 58 | ○ | - |
| Antistatischer Kunst-stoff-Reiniger + Pfleger | - | R |
| Aqueous solutions of pesticides | - | ○ |
| Aral BG ® 58 | R | - |
| Arquad 18 ®, 50% | ○ | - |
| Arsenic acid, 20% solution | R | - |
| Baktol®, 5% | R | - |
| BAKTOLAN, conc. | - | X |
| BAKTOLAN, up to 5% | - | R |
| Ballpoint paste Diplomat | ○ | - |
| Ballpoint paste Othello | ○ | - |
| Ballpoint paste V77 (Linz) | R | - |
| Basilit ® UAK, 20% in water (wood protection agent) | R | - |
| Battery acid | R | - |

R = Resistant
○ = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

| 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 | - | ○ |
| 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 | - | ○ |
| 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 ® dishwashing | 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 |

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 | - |

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

| 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 | - |
| Diocyl 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 chlorhydride | 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 ® TWD 602 (propellant) | R | - |
| Frigen ® 113, R113 (propellant) | R | - |
| FRIGEN A 12 (CF2 Cl2) | - | O |

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



| SUBSTANCE | PC | PMMA | SUBSTANCE | PC | PMMA |
|------------------------------------|----|------|--|----|------|
| Fuel oil O | O | - | Kaltron ® 113 MDR (propellant) | R | - |
| FULLBOX | - | R | Kerosene (Flugbenzin) | X | - |
| GASOLIN, depending on the blend | - | O | KOPPERSCHMIDT covering paste | - | R |
| Gasoline | R | - | Lactic acid, 10% in water | R | - |
| Gasoline, normal | O | - | Lactic acid, up to 20% i.w. | - | O |
| Gasoline, super | X | - | LAVAPLEX | - | R |
| Geha stamping ink | R | - | Lead tetraethylene, 10% in gasoline | O | - |
| GLYBAL A | - | X | Lighting gas | R | - |
| Glycerine | O | - | Ligroin (hydrocarbon compound) | R | - |
| Glycol | R | - | Lime milk, 30% in water | O | - |
| Green chrom oxide (polish paste) | R | - | Lubricant based on nafta | R | - |
| Green soap | R | - | Lubricant based on paraffin | R | - |
| Gypsum | - | R | Lubricant R2 Darina ® | R | - |
| HB 155 | - | R | Lugol solution | - | R |
| Heptane | R | - | LYSOFORM | - | X |
| Hexane | R | - | Lysoform, 2% | R | - |
| Horolith M ® | R | - | Magnesium chloride | - | R |
| Hot bitumen | - | O | Magnesium chloride, saturated aqueous solution | R | - |
| Household soap | R | - | Magnesium sulphate | - | R |
| Hydraulik oil Vac HLP 16 | R | - | Magnesium sulphate, saturated aqueous solution | R | - |
| Hydrochloric acid (c) | - | R | Maktool ® | R | - |
| Hydrochloric acid, 20% | R | - | Manganous sulphate, saturated aqueous solution | R | - |
| Hydrochloric acid, conc. | X | - | Marlon ®, 1% (moisturizing agent) | R | - |
| Hydrofluoric acid, 5% | R | - | MEFAROL, up to 1% | - | R |
| Hydrofluoric acid, conc. | X | - | MERCKOJOD, up to 1% | - | R |
| Hydrofluorosilicic acid, 30% | R | - | Mercurio chloride, saturated aqueous solution | R | - |
| Hydrogen peroxide | R | - | Mercury | R | R |
| Hydrogen peroxide, 30% | R | - | Merfen ®, 2% | R | R |
| Hydrogen peroxide, over 40% i.w. | - | O | Metasystox ®, 0,5% (pesticide) | X | - |
| Hydrogen peroxide, up to 40% i.w. | - | R | Methacrylic acid-methylester (MMA) | X | - |
| Hydrogen sulphide | R | R | Methane | R | R |
| Impact ®, 0,2% | O | - | Methanol | X | - |
| Indian ink S | X | - | Methanol, concentrated | - | X |
| Indian ink T | R | - | Methanol, up to 30% | - | O |
| Industrial spirit | - | X | Methyl amine | X | - |
| Insulating tape | - | R | Methyl ethyl ketone (MEK) | X | X |
| Into-Fensterklar ® | R | - | Methylene chloride | X | - |
| Iodine | X | - | Mobil DTE Oil-Light ® | R | - |
| Iodine tincture | O | - | Mobil Special Oil 10 W 30 ® | R | - |
| Isoamyl alcohol | O | - | Molikote ®-Paste | R | - |
| Isolation tape | R | - | Molikote ®-Powder | R | - |
| Isolation tape | R | - | Monobromonaphthalene | - | R |
| Isopropyl alcohol | R | X | Mortar | - | R |
| Jet engine fuel JP 4 (Kp 97-209°C) | O | - | Motor fuel blend contg. Benzene | - | 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 |
|---|----|------|
| 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 |
| Okozon ®, 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 |

R = Resistant
O = Limited resistance
X = No resistance

v = Vapour
c = Concentrate
g = Gas

| 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 |
| Phosphoric 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 | - |

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



| SUBSTANCE | PC | PMMA | SUBSTANCE | PC | PMMA |
|---|----|------|--------------------------------------|----|------|
| Potassium aluminium sulphate, (sas) | R | - | Shell Spirax 90 EP ® | R | - |
| Potassium bichromate, (sas) | R | - | Shell Tellus 11-33 ® | O | - |
| Potassium bromide, (sas) | R | - | Shell Tellus 33 ® | O | - |
| Potassium carbonate, (sas) | R | - | Sidolin ® | R | X |
| Potassium chloride, (sas) | R | - | Silicon tetrachloride | - | X |
| Potassium cyanide | X | - | Silicone oil | R | - |
| Potassium hydroxide | X | - | Silicone rubber (acetic acid curing) | - | O |
| Potassium metabisulphide, 4% in water | R | - | Silicone rubber (Camino curing) | - | R |
| Potassium nitrate, saturated aqueous solution | R | - | Siliconoil emulsion | R | - |
| Potassium perchlorate, 10% i.w. | R | - | Silver nitrate (sas) | - | R |
| Potassium permanganate, 10% i.w. | R | - | Skydrol 500 A ® | X | - |
| Potassium persulphate, 10% i.w. | R | - | Soap solution | - | R |
| Potassium rhodanide, (sas) | R | - | Soap suds | O | - |
| Potassium sulphate, (sas) | R | - | Sod. hydroxide soln. | - | R |
| Pril ® | R | R | Soda | R | R |
| Propane gas | R | - | Soda water | - | R |
| Propargyl alcohol | R | - | Sodium bicarbonate, (sas) | R | - |
| Propionic acid, 20% | R | - | Sodium bisulphate, (sas) | R | - |
| Propionic acid, conc. | X | - | Sodium bisulphide, (sas) | R | - |
| Propyl alcohol | R | - | Sodium bisulphite | - | R |
| Propylene | - | R | Sodium carbonate | - | R |
| Putty | R | - | Sodium carbonate, (sas) | R | - |
| PVC | - | R | Sodium chlorate (sas) | R | R |
| PVC, plasticised | - | X | Sodium chloride (sas) | R | R |
| Pyridine | X | X | Sodium hydroxide | X | - |
| RABOND stable spray | - | R | Sodium hypochloride, 5% in water | R | - |
| Rapdosept ® | O | - | Sodium hypochlorite | - | R |
| Rape oil | R | - | Sodium soap fat | R | - |
| Red lead | - | R | Sodium sulphate | - | R |
| Register-ink DIA type U rot | R | - | Sodium sulphate, (sas) | R | - |
| Rei ® | R | R | Sodium sulphide | - | R |
| Resorcin oil solution, 1% | R | - | Sodium sulphide, (sas) | O | - |
| Resorcinol solutions, 1% | R | - | Somat W ® 731 | O | - |
| Riseplin ® | R | - | SPECTROL | - | X |
| Rubber | - | R | Spirit, pure | R | - |
| Rubber, plasticised | - | X | SPRAYLAT | - | O |
| Sagrotan ®, 5% | O | O | SPULLI | - | R |
| SAGROTAN, up to 2% | - | R | Stain remover Alkaline solutions | - | X |
| SANGAJOL | - | R | Stannous chloride | - | R |
| Sea water | R | - | Starch | R | - |
| Sealing strips, (FAKO, TEROSTAT, PRESTIK) | - | R | Statexan AN ® | R | - |
| SEIFIX | - | R | Stearic acid | - | R |
| Sewing machine oil | R | - | Styrene | X | - |
| Shell IP 4 (fuel) | X | - | Sublimate | R | - |

R = Resistant
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LEDiL®

| 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 | - |
| Thinner 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 | - |

R = Resistant
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v = Vapour
c = Concentrate
g = Gas

| 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 VVA 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 |

m = Metallic
sas = Saturated aqueous solution
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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



<https://youtu.be/lZUkBsXcnCU>



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.



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.



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 |
| 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

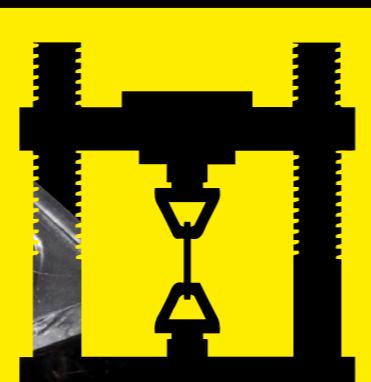
• HWI, HAI, RTI and physical

| Flammability | FLAME RATING | TEST METHOD | MATERIAL | | | | | | | | |
|--------------|-----------------------------|---------------------------|---------------------|---------------------|------------------|----------|-------|--------|--------|---------------|-------------------|
| | | | MANUFACTURER | | | | | | | | |
| | | | Evonik plexiglas 8N | Bayer Makrolon 2407 | Sabic Lexan 123R | HRPC | HTPC | harder | softer | Silicone seal | BASF A3EG6 |
| Flammability | 0.75mm | UL 94 | | V-2 | HB | | HB | | | | HB |
| | 0.75mm | IEC 60695-11-10,20 | | V-2 | HB40 | | HB75 | | | | HB75 |
| Electrical | 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 | |
| Thermal | Hot-wire ignition (HWI) | | | | | | | | | | |
| | 1.00mm | UL746 | | | | | | | | PLC4 | PLC4 |
| | 1.50mm | UL746 | | | | | | | | PLC4 | PLC4 |
| | 1.50-2.60mm | UL746 | | PLC3 | | | | | | | |
| | 2.70mm | UL746 | | PLC3 | | | | | | | |
| | 3.00mm | UL746 | | PLC2 | PLC4 | | | | PLC2 | PLC4 | PLC1 |
| Physical | High Amp Arc Ignition (HAI) | | | | | | | | | | |
| | 1.00mm | UL746 | | | | | | | | PLC1 | PLC0 |
| | 1.50mm | UL746 | | | | | PLC2 | | | | |
| | 1.50-2.60mm | UL746 | | | PLC0 | | | | | | |
| | 2.70mm | UL746 | | | PLC0 | | | | | | |
| | 3.00mm | UL746 | | | PLC0 | PLC1 | | | PLC0 | PLC0 | |
| Thermal | 6.00mm | UL746 | | | PLC0 | | | | | | PLC0 |
| | 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) |
| | 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) |
| | 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) |
| | 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.

LEDiL®



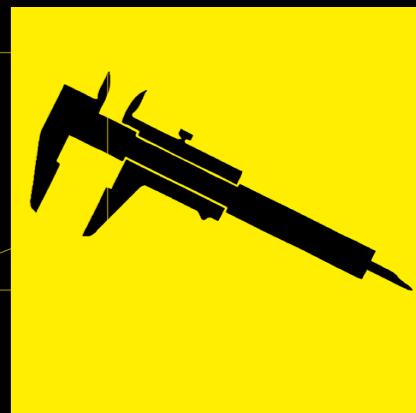
TENSILE STRENGTH

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 strength in the final product and its components.

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TOLERANCES

GENERAL TOLERANCES FOR LINEAR DIMENSIONS (DIN 16901-130)

| Linear dimensions (mm) | (mm) |
|------------------------|------------|
| $a \leq 1$ | ± 0.18 |
| $1 < a \leq 3$ | ± 0.19 |
| $3 < a \leq 6$ | ± 0.20 |
| $6 < a \leq 10$ | ± 0.21 |
| $10 < a \leq 15$ | ± 0.23 |
| $15 < a \leq 22$ | ± 0.25 |
| $22 < a \leq 30$ | ± 0.27 |
| $30 < a \leq 40$ | ± 0.30 |
| $40 < a \leq 53$ | ± 0.34 |
| $53 < a \leq 70$ | ± 0.38 |
| $70 < a \leq 90$ | ± 0.44 |
| $90 < a \leq 120$ | ± 0.51 |
| $120 < a \leq 160$ | ± 0.60 |
| $160 < a \leq 200$ | ± 0.70 |
| $200 < a \leq 250$ | ± 0.90 |
| $250 < a \leq 315$ | ± 1.10 |
| $315 < a \leq 400$ | ± 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) |
|--------------------|-------------|
| $a \leq 6.3$ | ± 0.40 |
| $6.3 < a \leq 10$ | ± 0.50 |
| $10 < a \leq 16$ | ± 0.60 |
| $16 < a \leq 25$ | ± 0.80 |
| $25 < a \leq 40$ | ± 1.00 |
| $40 < a \leq 63$ | ± 1.30 |
| $63 < a \leq 100$ | ± 1.60 |
| $100 < a \leq 160$ | ± 2.00 |
| > 160 | $\pm 1.3\%$ |

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.



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 |



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 either double-sided foam (polyurethane) or 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 1-5 seconds to ensure the best possible bond. The tape will reach its final strength in 24-72 hours, depending on the tape, materials and the ambient conditions.

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 documents below.

Adhesive tape used in LEDiL optics and assemblies (PU-tape)
[www.ledil.com/adhesive_tape_\(pu\)](http://www.ledil.com/adhesive_tape_(pu))

Adhesive tape used in LEDiL optics and assemblies (Acrylic)
[www.ledil.com/adhesive_tape_\(acrylic\)](http://www.ledil.com/adhesive_tape_(acrylic))



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



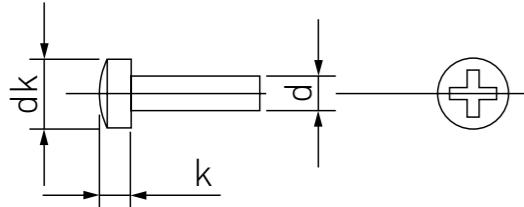
SCREW

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.

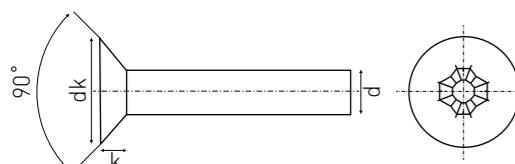
LEDiL recommends using M3 nylon washers (DIN 125 / ISO 7089) between the screws and the lens to minimize stresses induced by fastening torque.



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

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

For more information:
www.ledil.com/ultra-low-screw



GLUE

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



More information about bonding by DELO®
www.ledil.com/delo-adhesives

POTTING

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



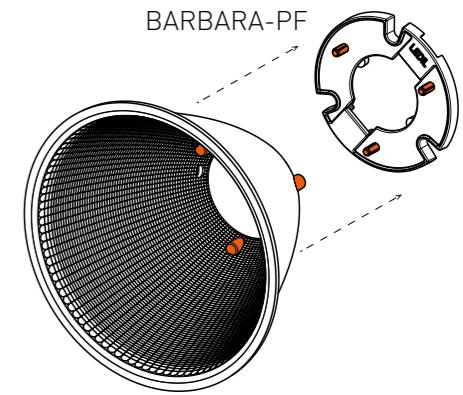
More information about bonding by DELO®
www.ledil.com/delo-adhesives

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. 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.



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
- ZENIA

LEDiL Clips:

Achieve a sleek 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

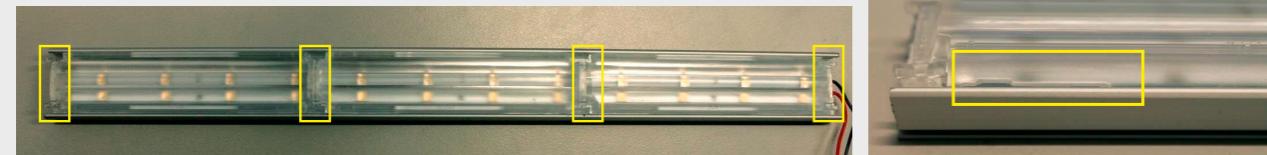
- **C14353_FLORENCE-1R-CLIP-A** for 40 mm wide PCB's (like Philips Fortimo) and screw mount
- **C14409_FLORENCE-1R-CLIP-B** fits straight into aluminum profile, no screws needed.
- **C14751_FLORENCE-1R-CLIP-C** for 24 mm wide PCB's and screw mount



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**



<https://youtu.be/ZP6QxR3hS6Q>



PCB DESIGN

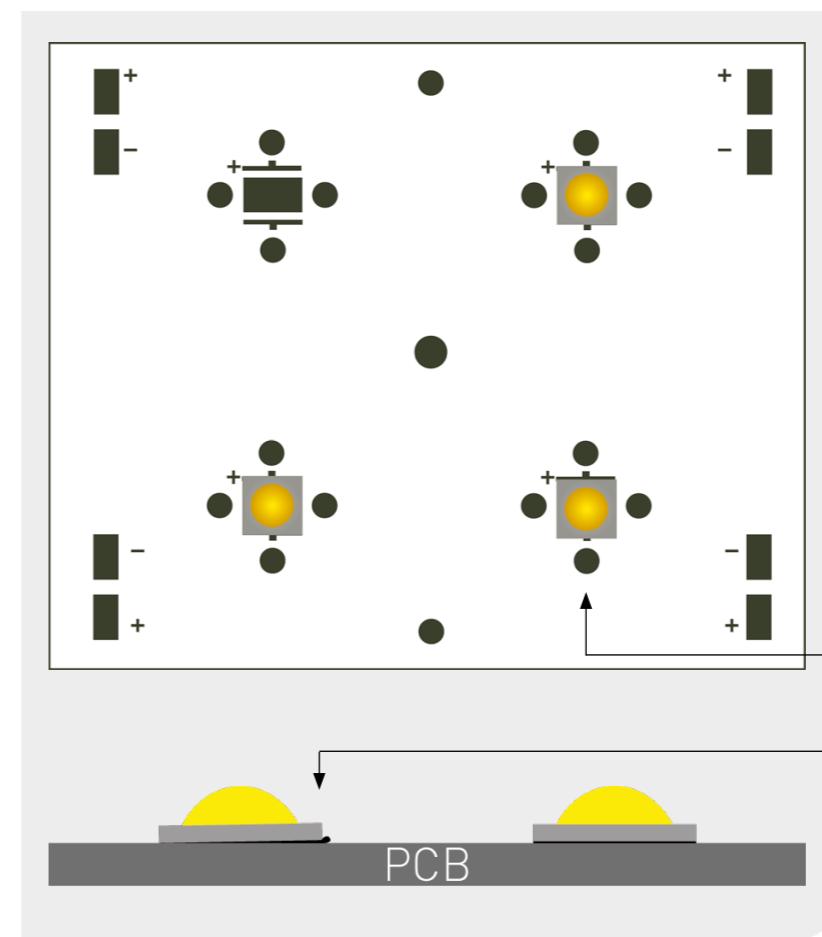
Make sure that the LEDs optical center is aligned correctly under the lens, for it may not always be at the centre of the LEDs frame. For example in the Philips Lumileds Rebel series, the tolerance for LED positioning is ± 0.1 mm.

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.

LED not aligned correctly

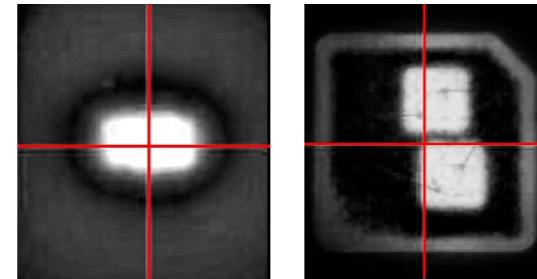
Too much solder paste under the LED



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 the 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.



SEALING AND INGRESS PROTECTION OF LEDiL OPTICS

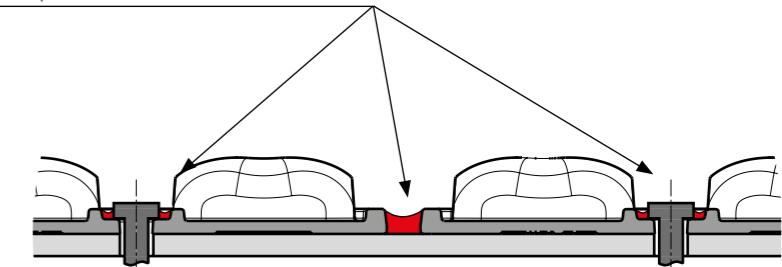
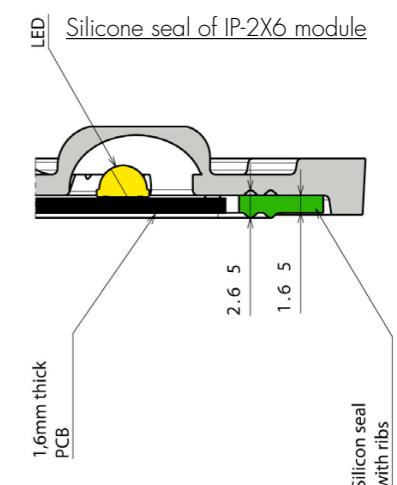
Many LEDiL modules are designed to be sealed against environmental hazards with commonly available potting compounds. Sealant can be applied with a dispenser either manually or with an automated XY-table.

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.

LEDiL®



THERMAL MANAGEMENT

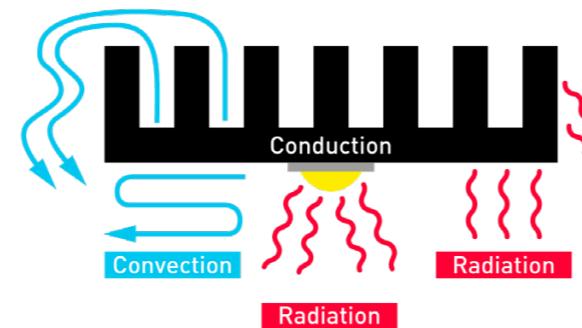
When working with LED lighting one important issue to take into consideration is heat. Good thermal design plays a key role in the performance and lifetime of the application. There are three different ways for heat to transfer: conduction, convection and radiation. Always make sure that the thermal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

LEDiL®

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 ± 10.1 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 recommend using either thermal glue and/or screws for the PCB/LED fastening.

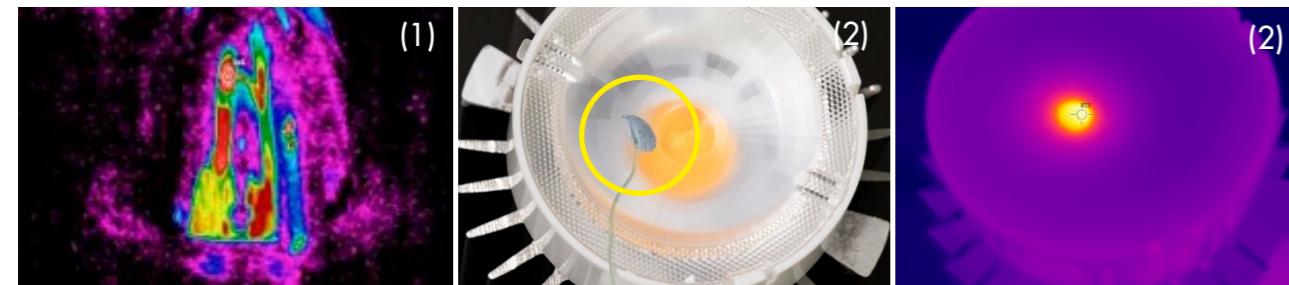
While using thermal interface materials, remember that the material needs to be chemically compatible with the LEDs. Bad material choice might significantly reduce the LEDs lifetime. For example Cree has created a test method for chemical compatibility. More information about the test can be found on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



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
- 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 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



LENSES

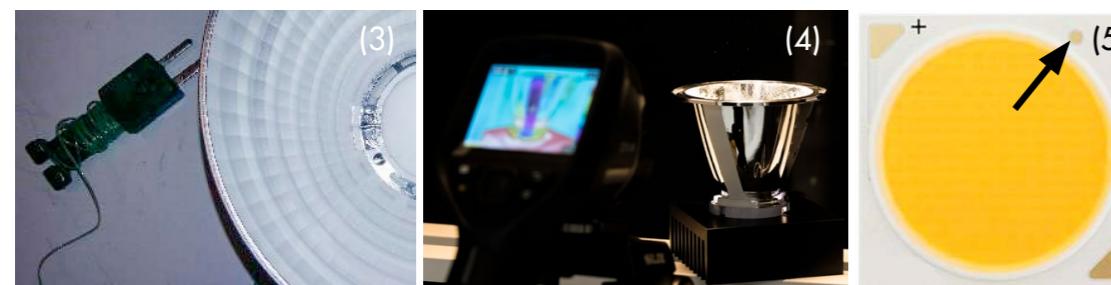
Switch on the light and let temperatures rise until they stabilize. Remove any obstacles (e.g. glass cover) quickly to expose the target surface and take an image on the top surface of the lens. Start to record video sequence and turn the lens over quickly to catch the maximum temperature from the bottom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

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, T_c , can be measured with a thermocouple that is firmly glued/soldered to the T_c measurement point of the LED module (5).



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

We always heat test beyond our recommended limits to fully ensure our products quality. For more extreme environments some materials have been tested with diluted NaOH liquid and in an artificially created salt mist. These surfaces should be completely undamaged to pass.

Both the HMDS and lacquer layer increase aluminium coating durability, but the reflector must be protected from water and other hazards. Weather exposure tests must be carried out during the design process.



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. 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 or thermal stress
- Good performance in cross-cut test

1) **Top lacquer** (to protect surface)

2) **Al coat** (in vacuum)

3) **Base lacquer** (to improve adhesion)

4) **Substrate** (part to be coated)



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.

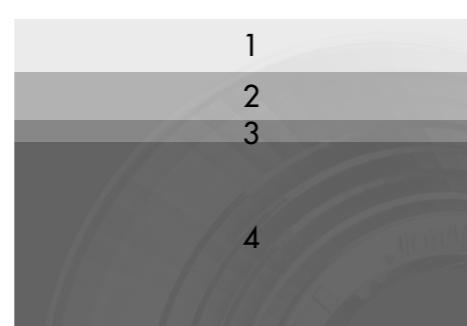
- Thin and protective layer
- Good optical performance
- Good durability against heat

1) **HMDS plasmapolymerisation** (to protect surface)

2) **Al coat** (in vacuum)

3) **Glow discharge activation of surface** (to improve adhesion)

4) **Substrate** (part to be coated)



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/

Product catalogue
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