

KHATOD

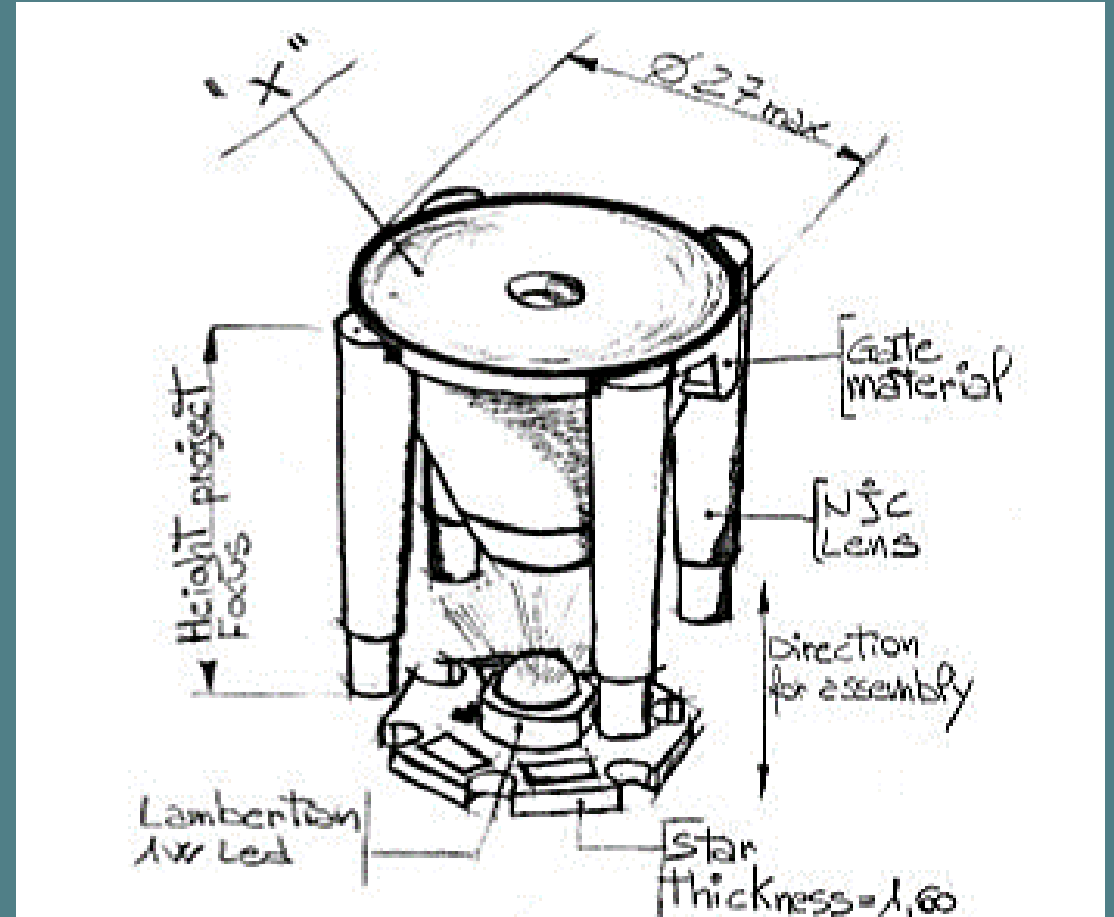
1 0 0 % M A D E I N I T A L Y

An aerial photograph of a large, modern industrial building with a curved roof. The building features horizontal bands of windows and a prominent 'KHATOD' logo on the curved section of the roof. The surrounding area includes a paved parking lot, a green lawn with a winding path, and a tall metal tower structure. The sky is clear and blue.

KHATOD

Christian Todaro
VP Sales

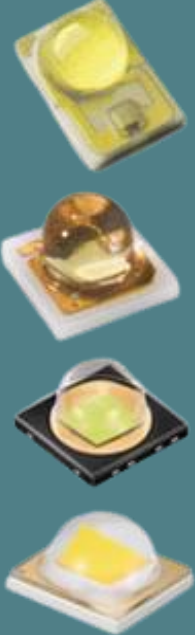
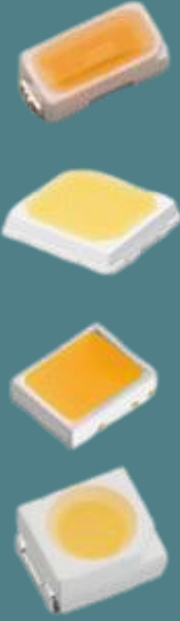
TAILORS OF LIGHT



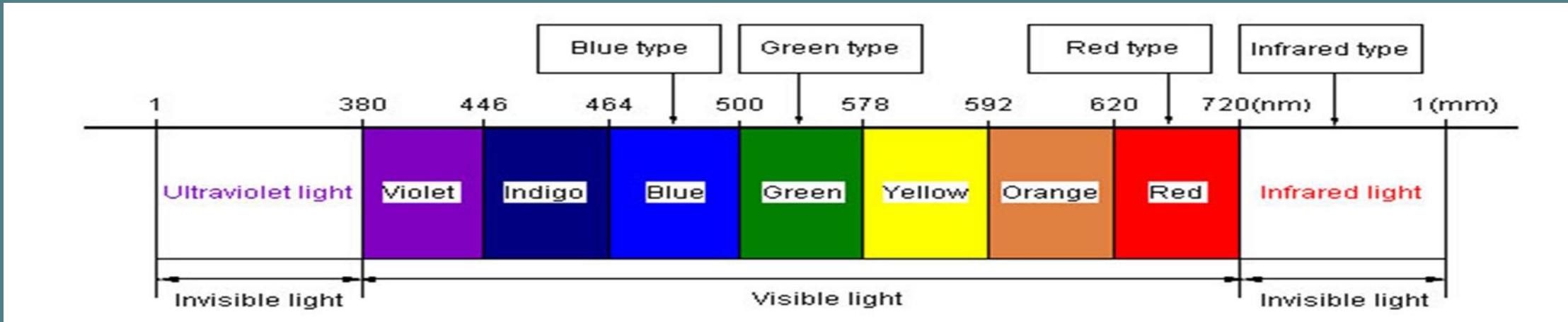
Lens dimension is always related to the size of the emitting surface



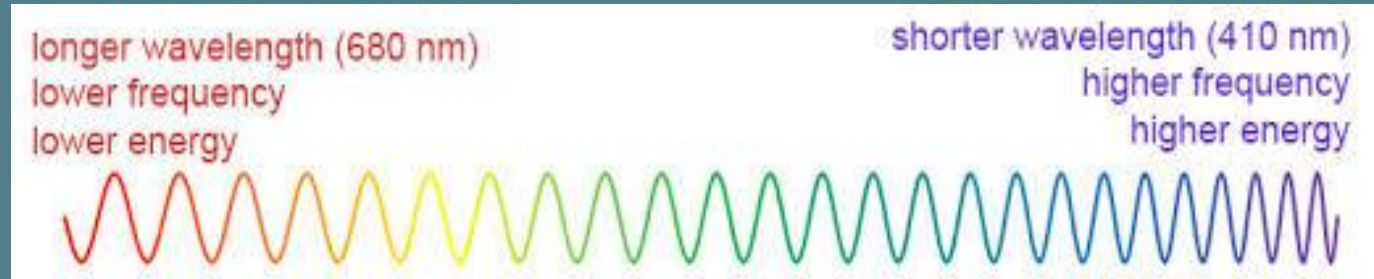
Mid-Power LEDs	High-Power LEDs	Multichip LEDs	COBs (6mm up to 50mm LES)
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Electromagnetic Spectrum and Visible light



Color	Wavelength	Frequency	Photon energy
Violet	380–450 nm	680–790 THz	2.95–3.10 eV
Blue	450–485 nm	620–680 THz	2.64–2.75 eV
Cyan	485–500 nm	600–620 THz	2.48–2.52 eV
Green	500–565 nm	530–600 THz	2.25–2.34 eV
Yellow	565–590 nm	510–530 THz	2.10–2.17 eV
Orange	590–625 nm	480–510 THz	2.00–2.10 eV
Red	625–740 nm	405–480 THz	1.65–2.00 eV

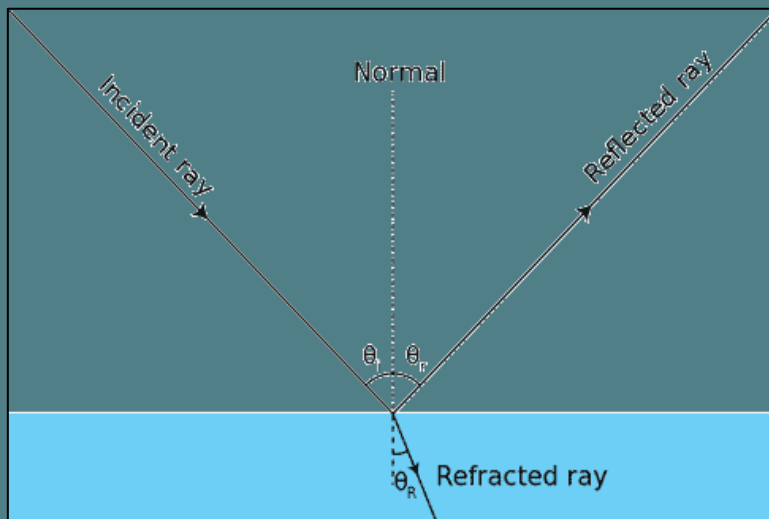


The main laws

Geometrical optics is used as the basic tool in designing almost any optical system, and is based on the idea of a ray of light, defined as the path along which light energy travels, together with surfaces that reflect or transmit the light.

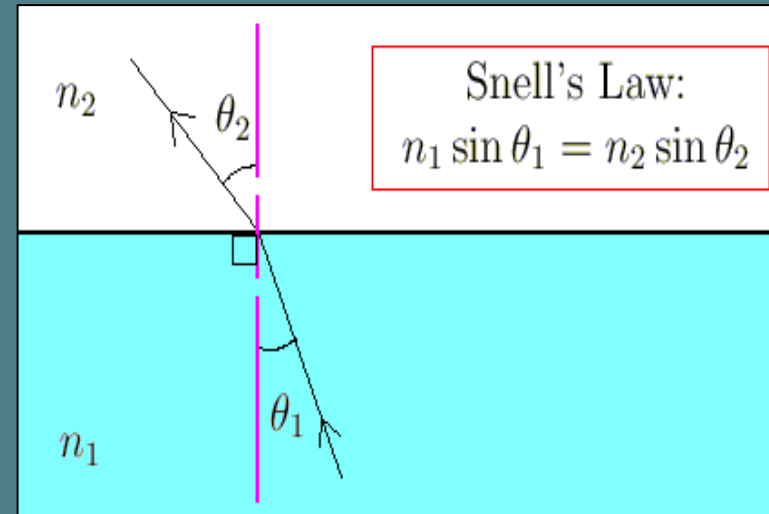
Geometrical optics can be used when the wavelength is small compared to the size of objects with which the light interacts, and does not account for phenomena like diffraction and interference.

When light is reflected, it obeys the law of reflection:



Incident and reflected rays make equal angles with the normal to the surface, and that both rays and the normal lie in one plane.

When light is transmitted, it obeys the law of refraction:



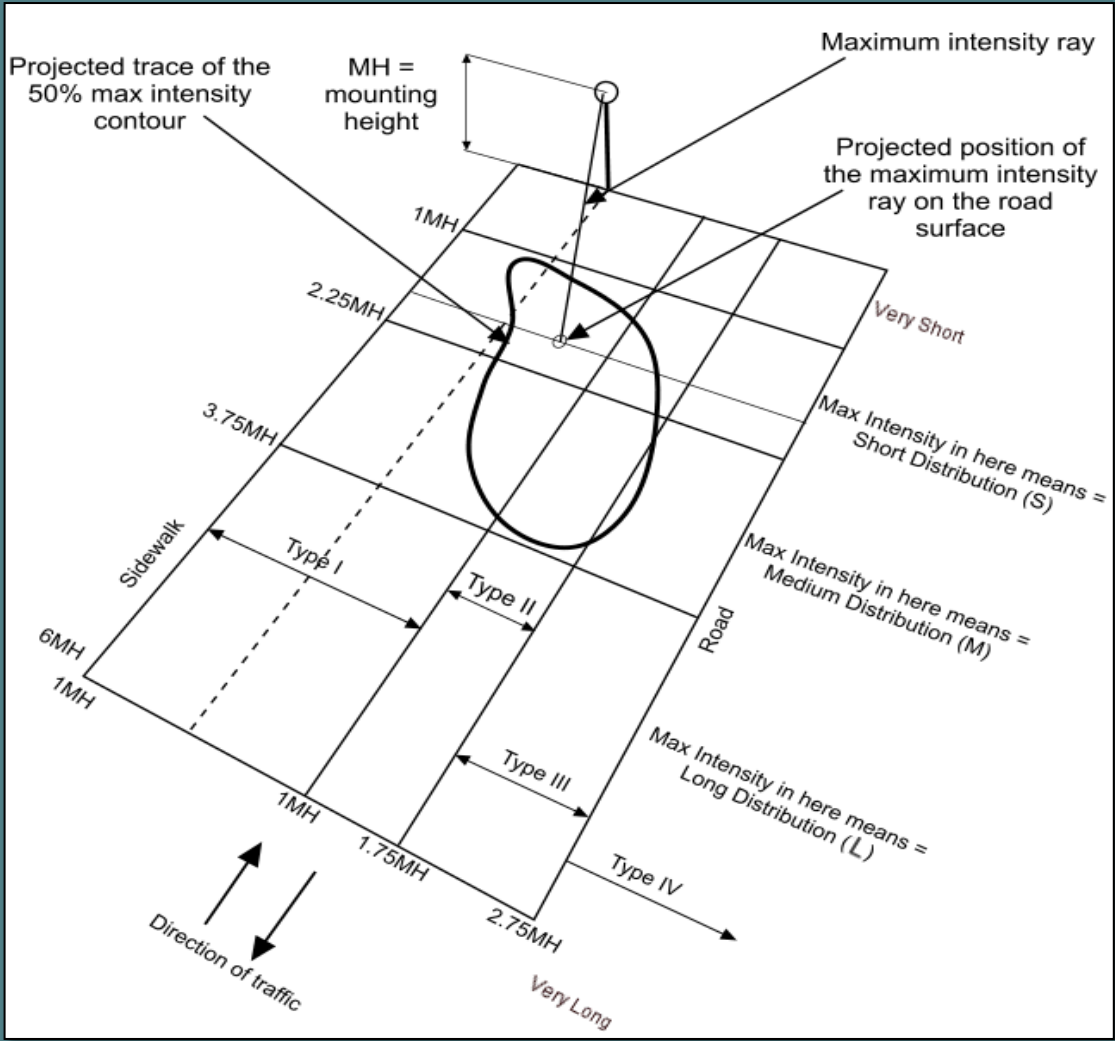
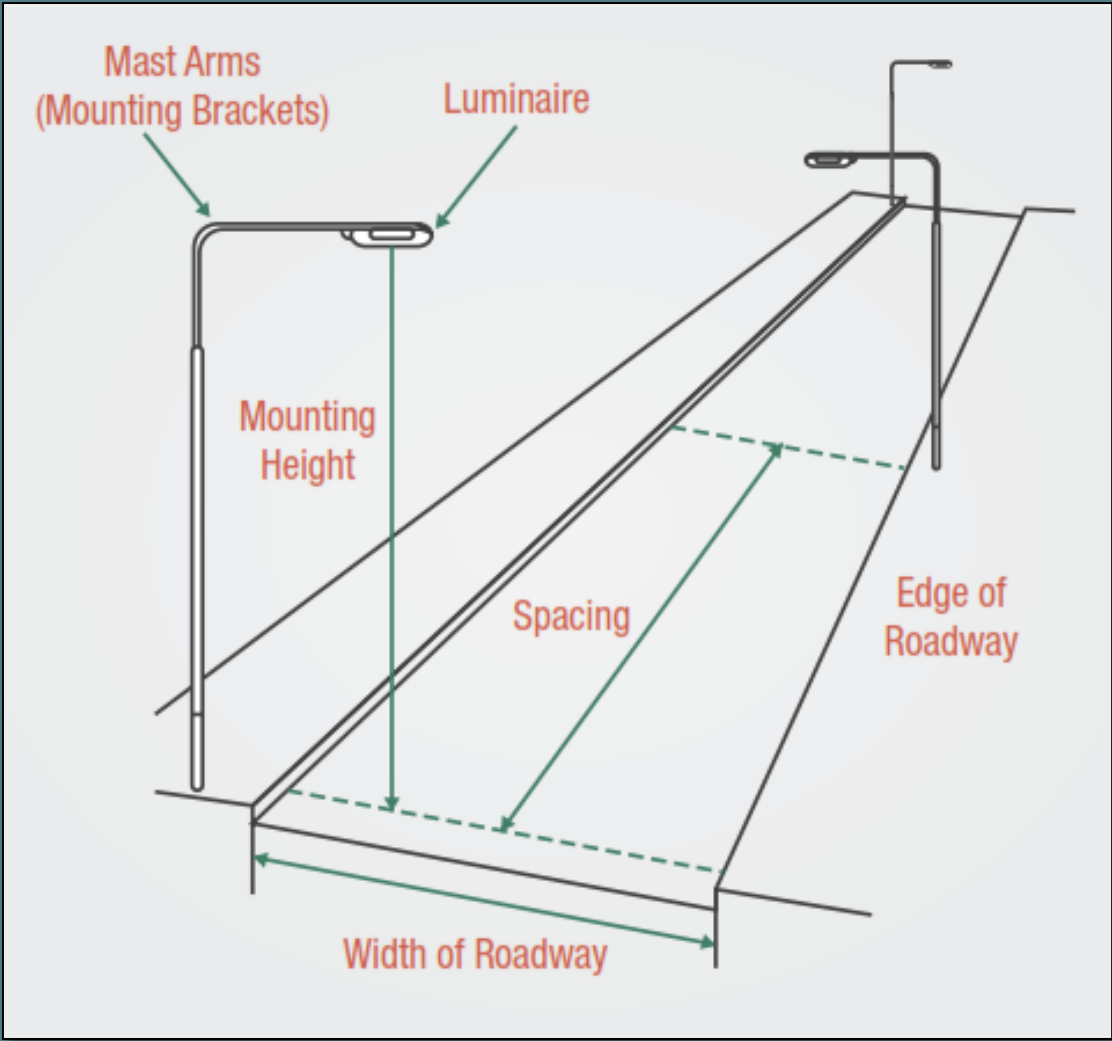
The sine of the angle between the normal and the incident ray leads a constant ratio to the sine of the angle between the normal and the refracted ray. All three directions lie in one plane.

PROJECT SPECIFICATIONS

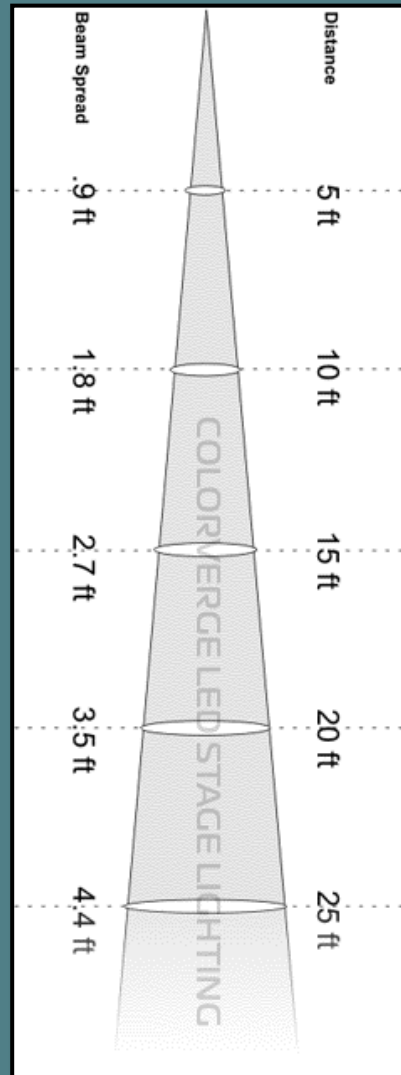


- LED Type
- Requested Beam Angle
- Requested Material
- Luminous Flux
- Dimension of the Target Area
- Lumens on target
- IP/IK Protection
- Chemical Resistance
- UV Resistance
- Wavelength
- Mecanical Dimensions

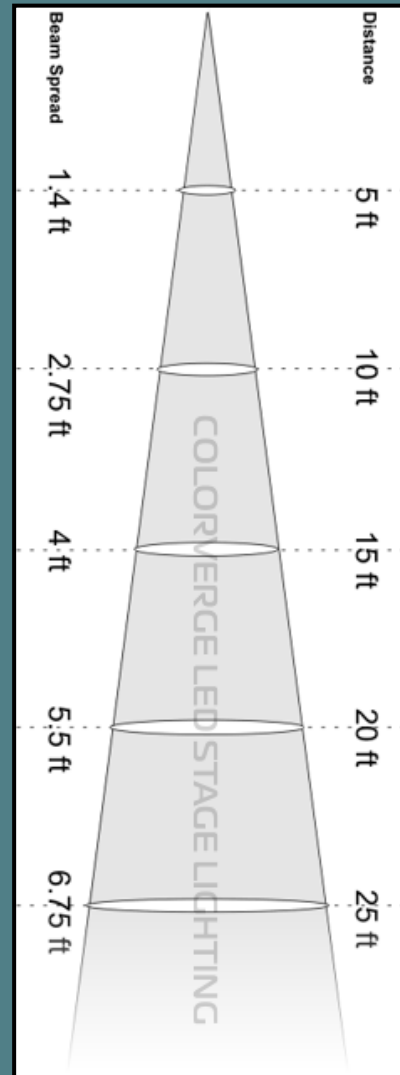
Road Parameters



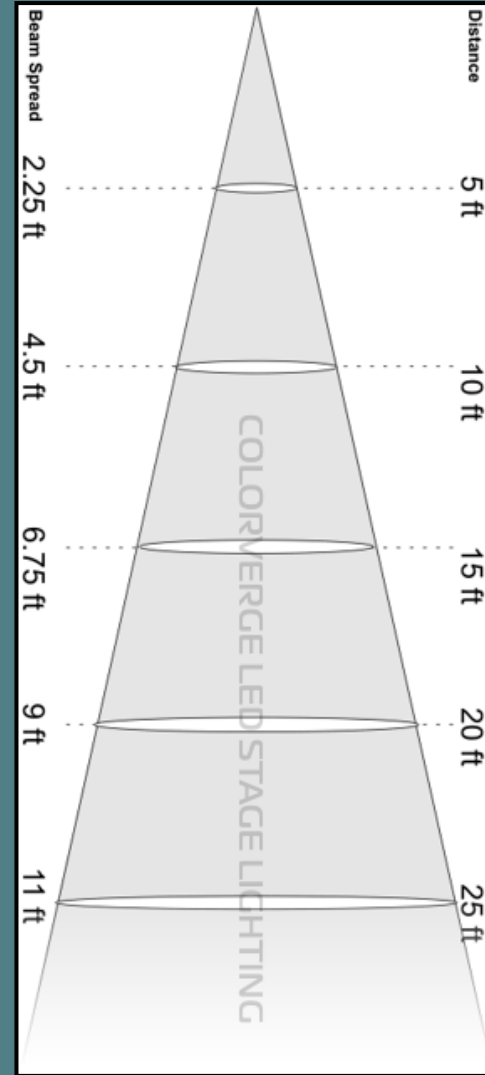
Flood Light



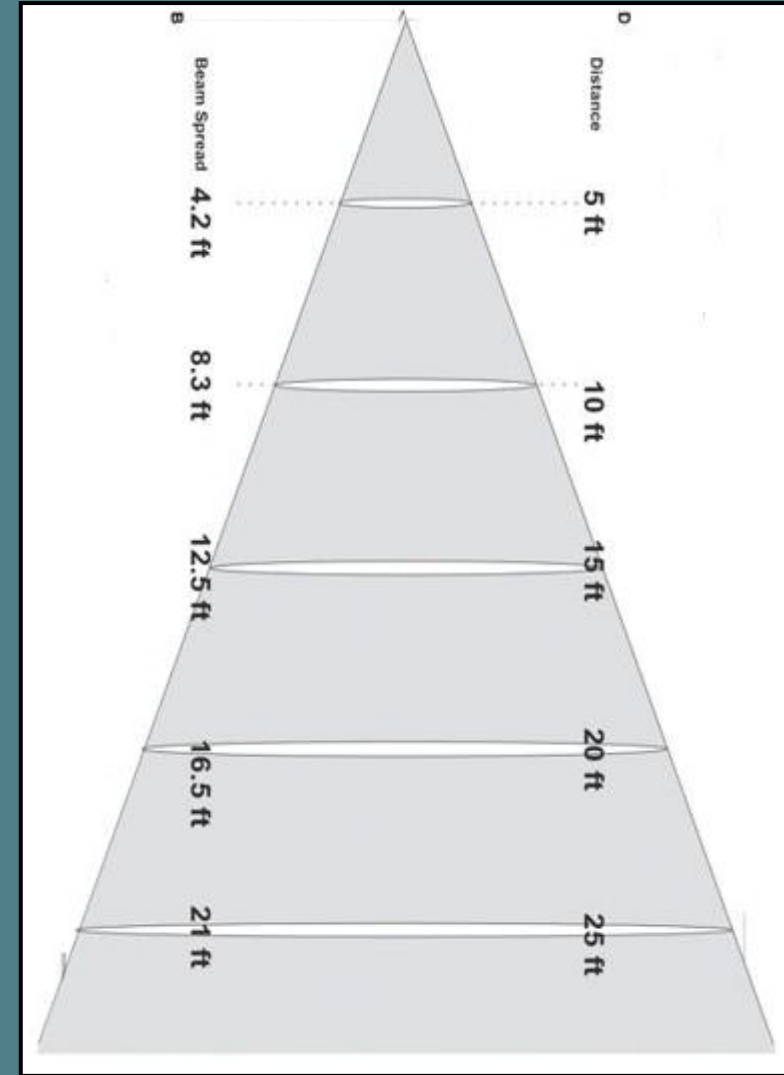
10° Beam spread



15° Beam spread



25° Beam spread



45° Beam spread



ecologica
& casalinga
BY THE STRONG



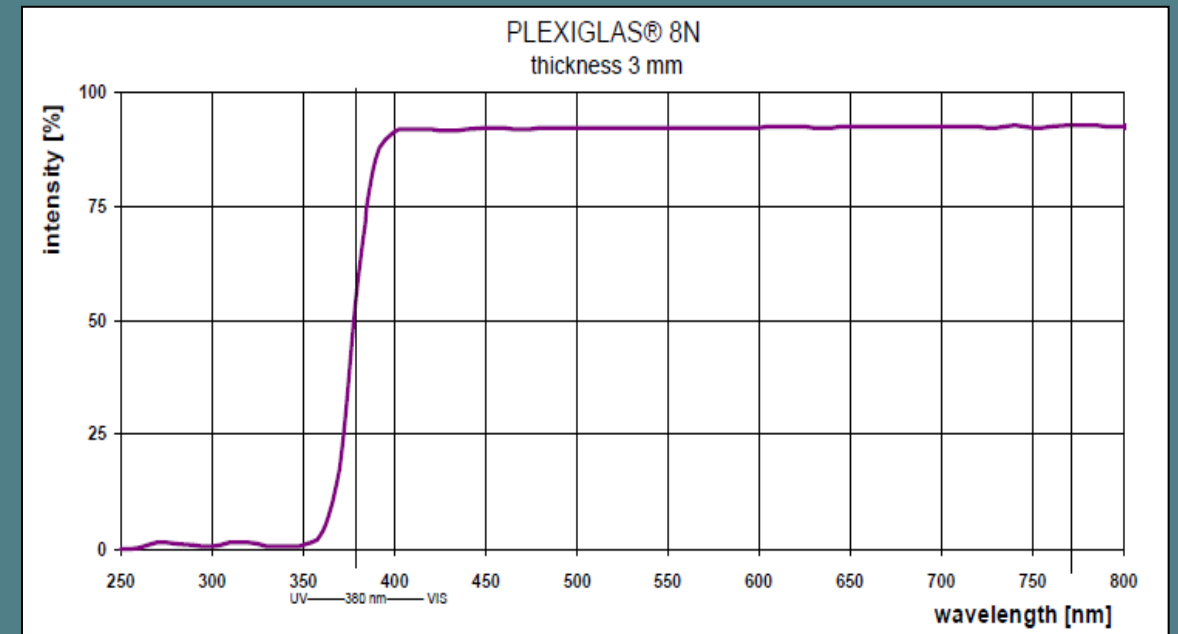
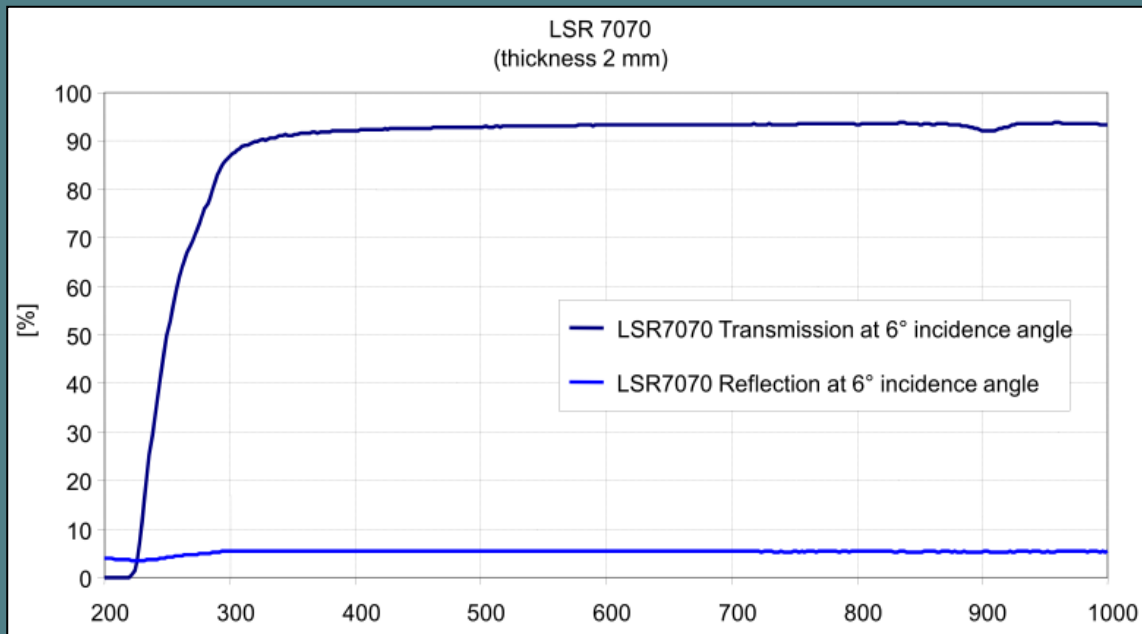
The right choice of Materials



Optics / Lens Material	Maximum Operating Temperature
PMMA	Operating temperature up to 85° C
PMMA HT	Operating Temperature up to 120° C
PMMI/TT70	Operating temperature up to 160° C
POLYCARBONATE	Operating Temperature up to 120° C
Ultra Clear Silicone	Operating Temperature -50°C/+200° C

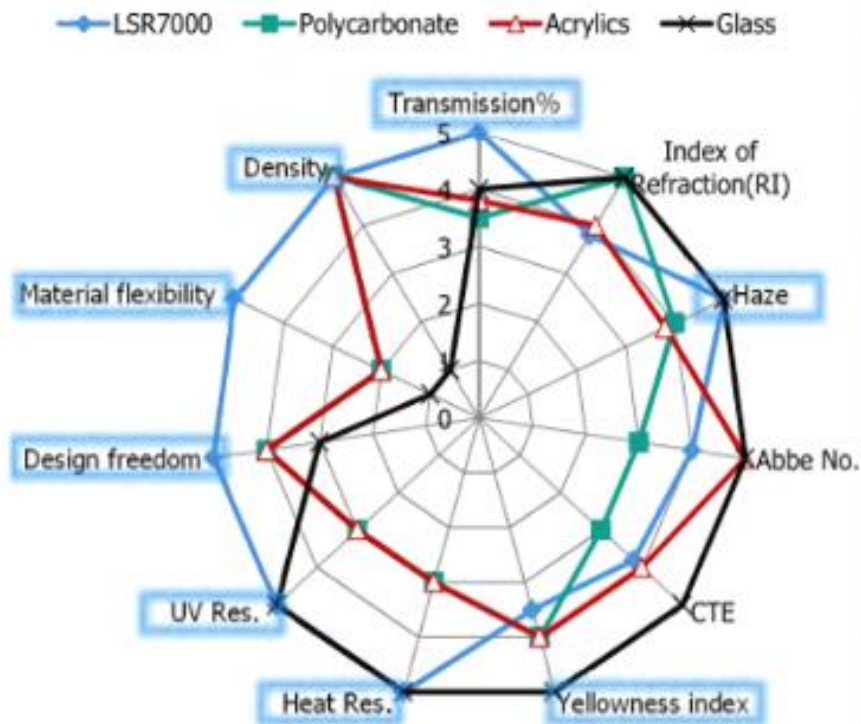
Transmission Efficiency of Materials in different wavelengths

The choice of the material for an optical system is very important, and it is defined by different factors like working temperature, environment, technical requirements, etc.. As written before, different materials, both in refraction and reflection, have different behaviour in transmitting or reflecting a ray, depending on wavelengths. Here below an example of transmittance and reflectance of the most common used materials:



Materials

Technical specifications



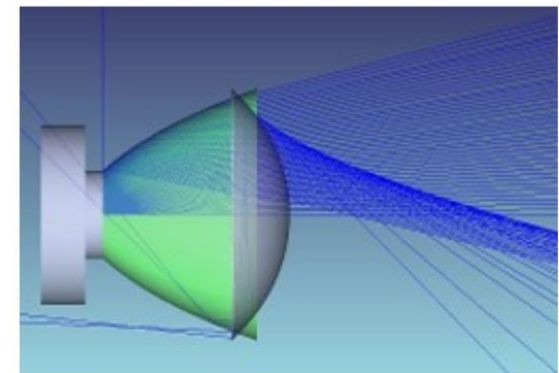
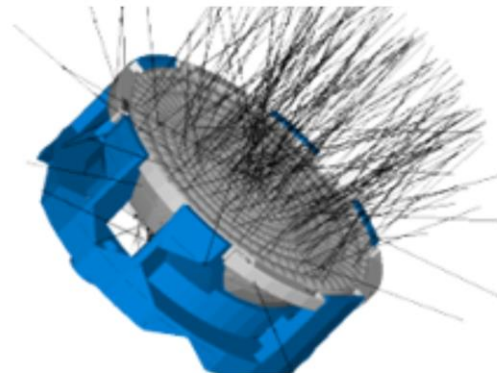
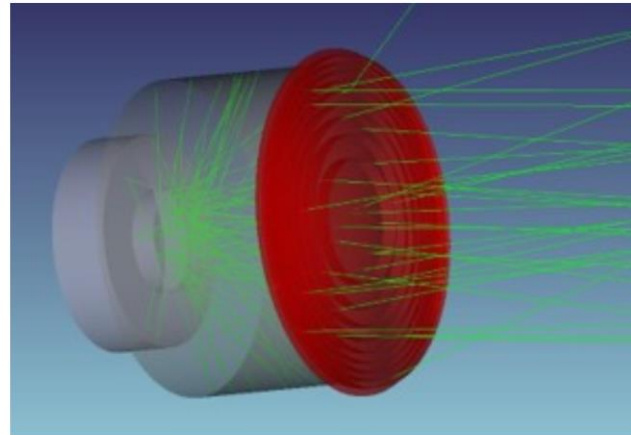
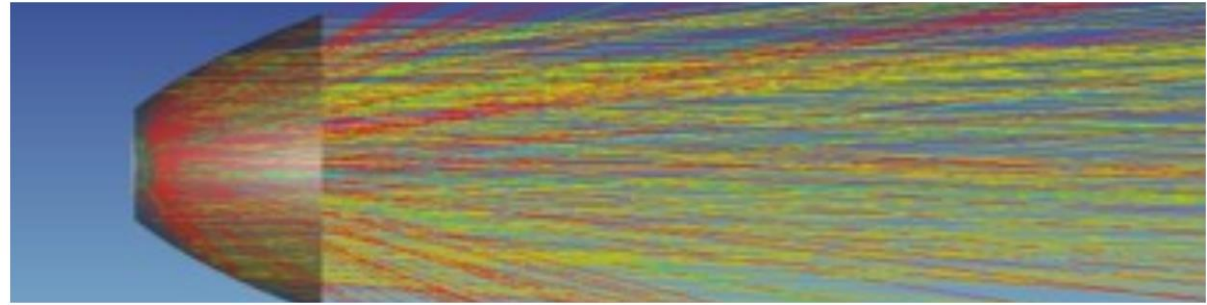
LSR 7000 is most reliable optical material for high durable and micro-structure/complex design applications

Category	Property	LSR 7000	Polycarbonate	Acrylics	Glass
Properties of Optical Clarity , 2mm	Transmission %	94%	86-89%	89-92%	92%
	Index of Refraction(RI)	1.41	1.59	1.49	1.5-1.6
	Haze	1	1-3	2-4	
	Abbe No.	48.9-51.4	34	57	39-59
	CTE	High	Med.	Med.	Lower
	Yellowness index	<1	1.0-3.0	1.0-3.0	
Durability	Heat Res.	Excellent	Poor	Poor	Excellent
	UV Res.	Excellent	Poor	Poor	Excellent
Design flexibility	Complex/micro design	Excellent	Med.	Med.	Poor
	Material flexibility	Excellent	Poor	Poor	Poor
Density		Light	Light	Light	Heavy

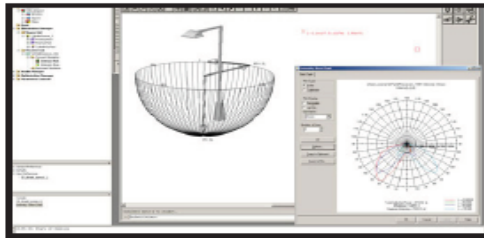
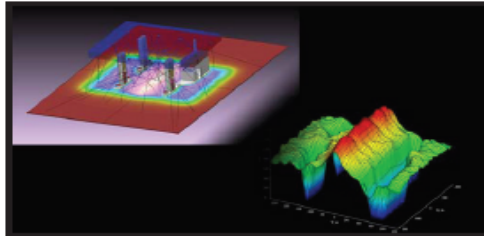
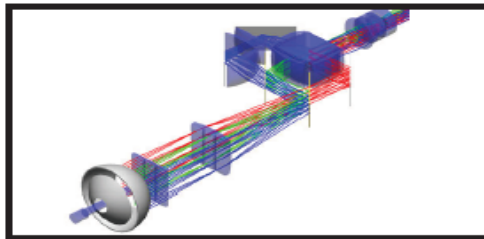
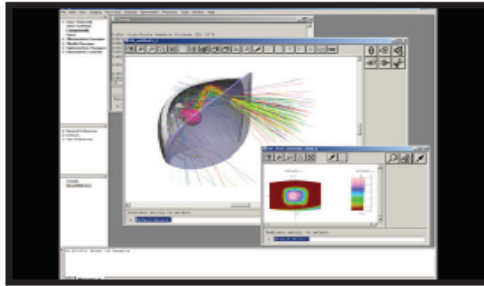
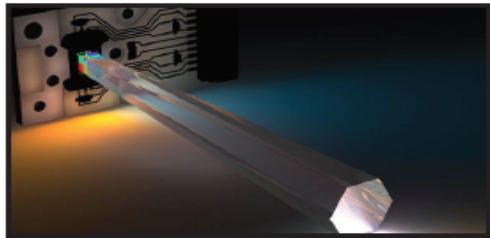
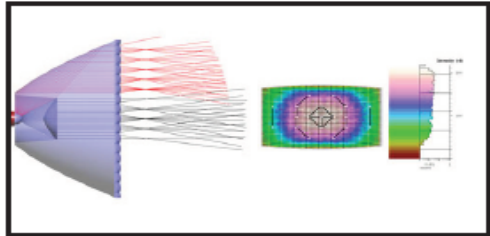
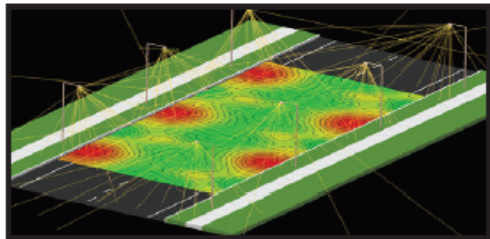
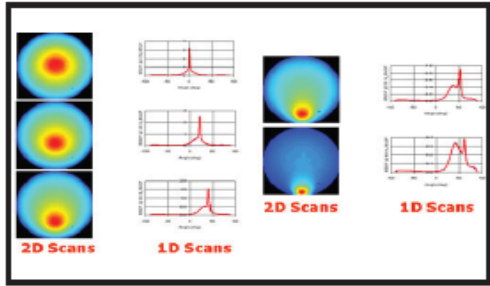
Silopren® LSR - Resistance to chemicals

Swelling of Silopren LSR by chemicals (immersion 8 days)				
Chemical	Test temperature °C	Silopren® LSR	Change in Shore-hardness	Swelling, Vol.-%
Acetone	20	2050	-8	33
Ammonia, 25% aqueous solution	20	2050	3	4
Baysilone Fluid M10 (100cSt at 25°C)	150	2050	-10	72
Carbon tetrachloride	20	2050	-40	192
Chloroform	20	2050	-12	218
Cyclohexane	20	2050	-10	10
Ethanol	20	2050	-5	10
Ethyl acetate	20	2050	-11	113
Glacial acetic acid	20	2050	-2	128
Glycol	20	2050	0	0
Hydrochloric acid 20%ig	20	2050	0	0
Methanol	20	2050	-3	8
Methyl ethyl ketone	20	2050	-10	80
Methylene chloride	20	2050	-10	103
Mineral oil ASTM Nr.2	150, 72 h	2050	-4	9
Mineral oil ASTM Nr.3	150, 72 h	2050	-12	42
n-Butanol	20	2050	-8	19
Nitric acid 10%ig	20	2050	0	0
Olive oil	100	2050	0	0
Petroleum ether	20	2050	-10	237
Phosphoric acid 50%ig	20	2050	0	0
Sodium hydroxide solution 20%ig	20	2050	0	0
Sulphuric acid 20%ig	20	2050	0	1
Trichloroethylene	20	2050	-13	150
Vaseline	100	2050	-8	14
Xylene	20	2050	-20	127
				Edition 11/2014

Optical Development of a 3D Model

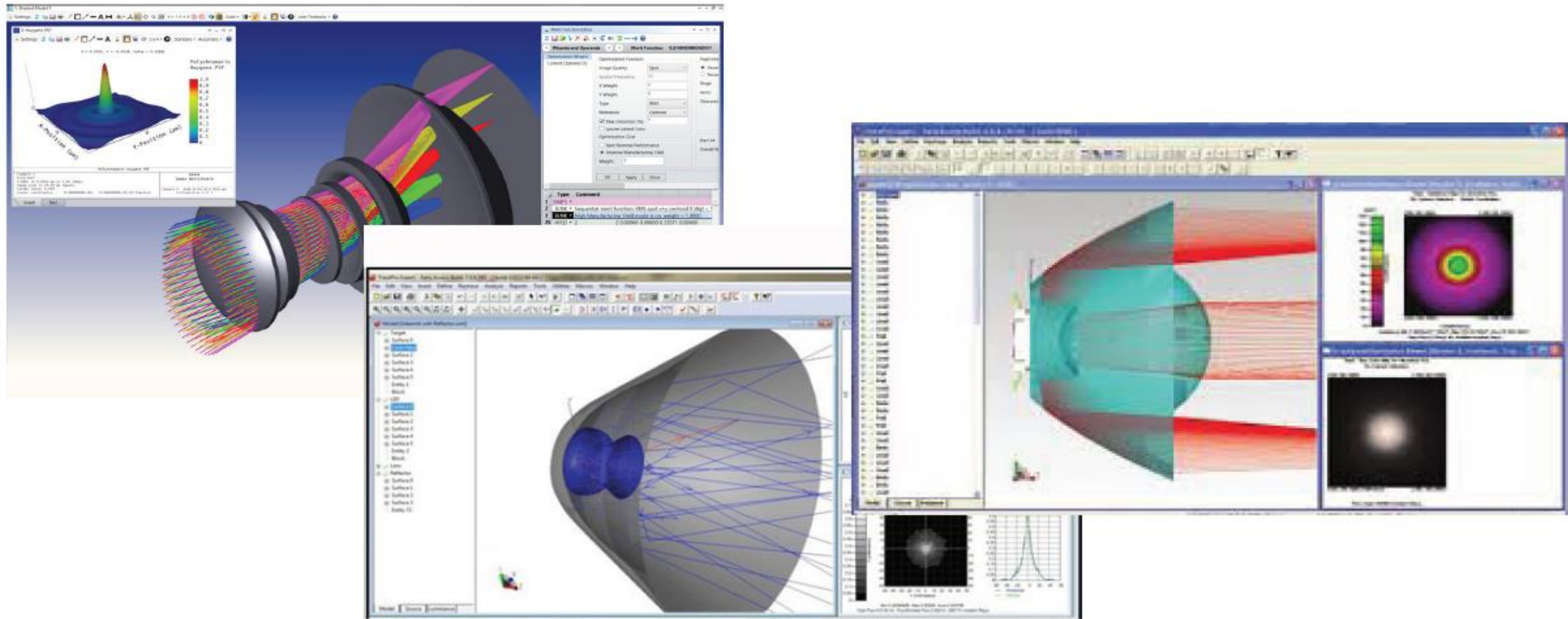


Optical CAD - Lighttools



- Sophisticated solid modeling with full optical accuracy
- State-of-the-art ray tracing speed, with full user control of accuracy and resolution requirements
- Create a light source from any geometric model, for unlimited flexibility in custom sources creation
- Application-specific utilities to help you quickly build a complete model
- Extensive source and materials libraries, including LEDs and BSDF measurements
- Robust data exchange support for mechanical CAD data
- Interactive, dynamic link with SOLIDWORKS
- Multiple immersion for modeling the embedded phosphor in an encapsulated LED
- Angular and spatial luminance analysis
- Simulations of real-world conditions, including surface effects like polarization, scatter, reflection, refraction, and performance of thin film coatings. Material effects such as dispersion, volumetric absorption, volume scattering, and color filtering can also be included.
- Fast and robust forward and backward Monte Carlo ray tracing
- Accurate, fast predictions of your illumination system's color performance

Optical CAD - Zemax

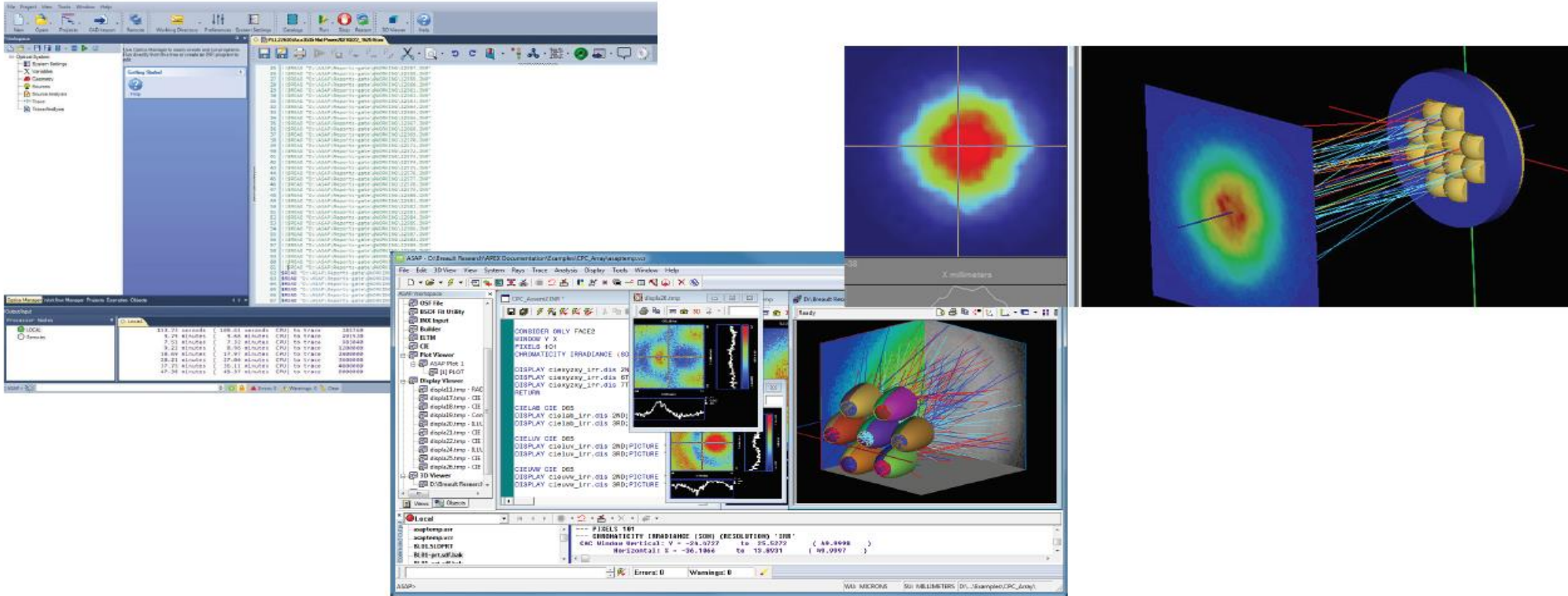


OpticStudio's intuitive user interface includes easy-to-learn tools and wizards which enable efficient simulation and design of any optical system.

With more than 200 field points you can set up even the most complex freeform and non-rotationally symmetric systems.

This tool allows to create high-confidence virtual prototypes and model everything from imaging optics to illumination, including stray light analysis.

Optical CAD - ASAP BRO



ASAP® NextGen is powered by the ASAP non-sequential raytracing engine – known throughout the optics industry for its accuracy and efficiency. Rays can encounter surfaces in any order and any number of times, with automatic ray splitting and/or scattering. Optimized for speed with new CoreMax parallel processing technology, ASAP will trace millions of rays in minutes.

ASAP NextGen allows to model complex imaging systems, illumination systems, and light concentrating devices. Creates highly accurate source models using source images, point sources, ray grids, and ray fans. Models LED's, incandescent bulbs, HID arc lamps or CCFL's or imports from the BRO Light Sources Catalog. Performs the analysis necessary to validate your designs without experimental prototyping.



EQUIPMENT

Tooling Department

5 CNC
Machines

3 CMD

3
Grinding
machines

2 Lathe
3D CAD
CAM
System

PRODUCTION

PLASTIC INJECTION

68 from 25 tons to 850 tons

5 from 80 to 120 tons LSR

3 shift for day

< 20 MILION OPTO DEVICE

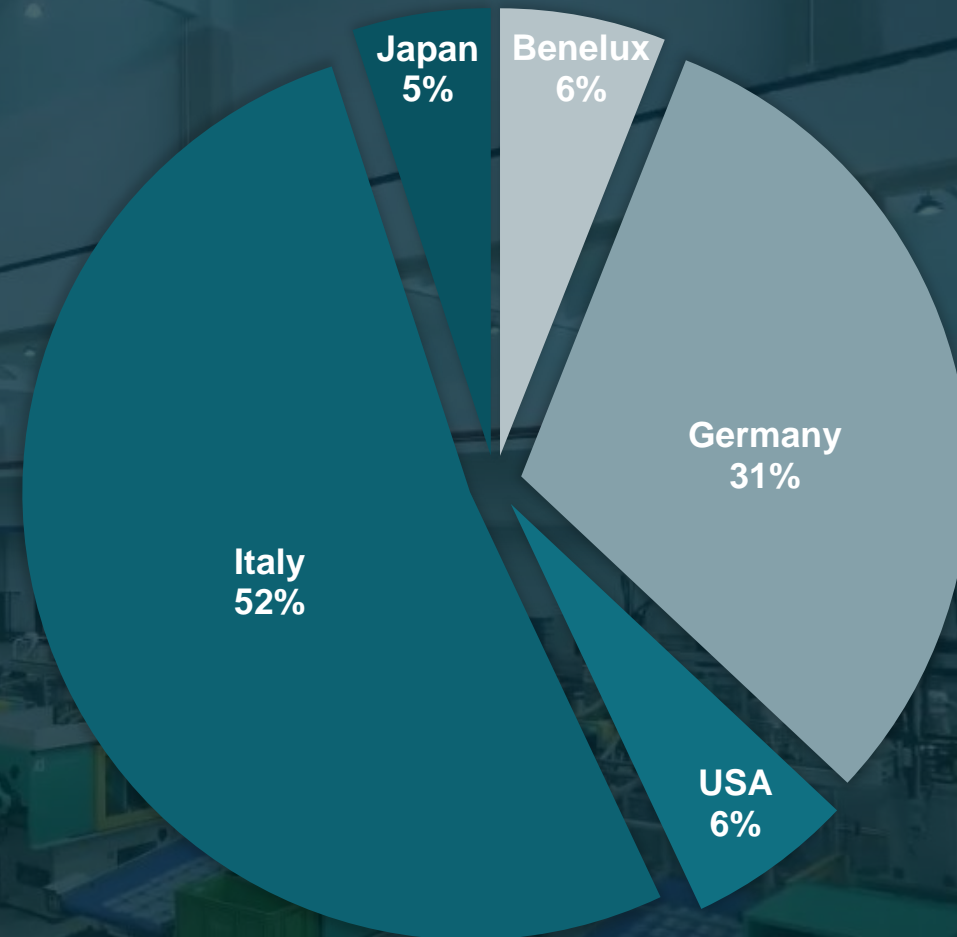
< 50 MILION SINGLE LENS

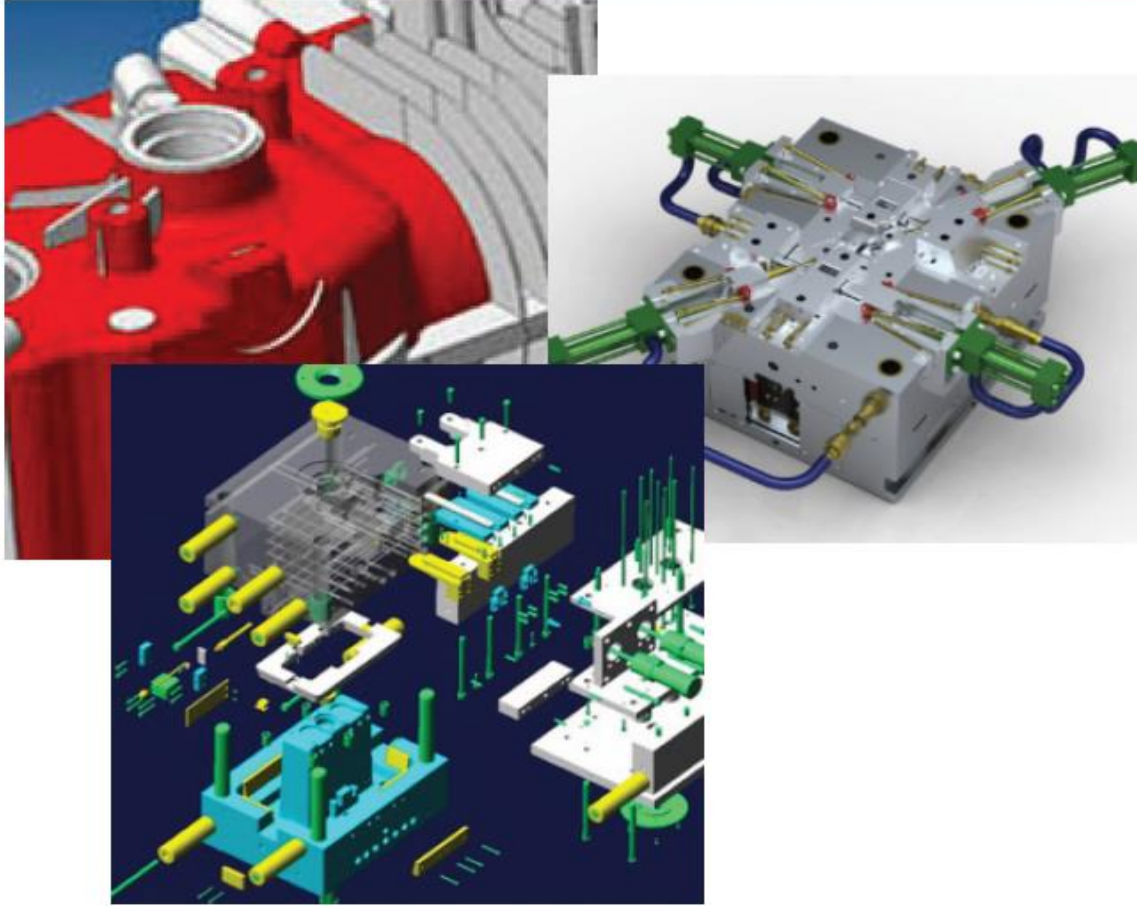
< 6 MILION CLUSTER LENS

> 2,5 MILION REFLECTOR

CUSTOM DESIGN < 68%

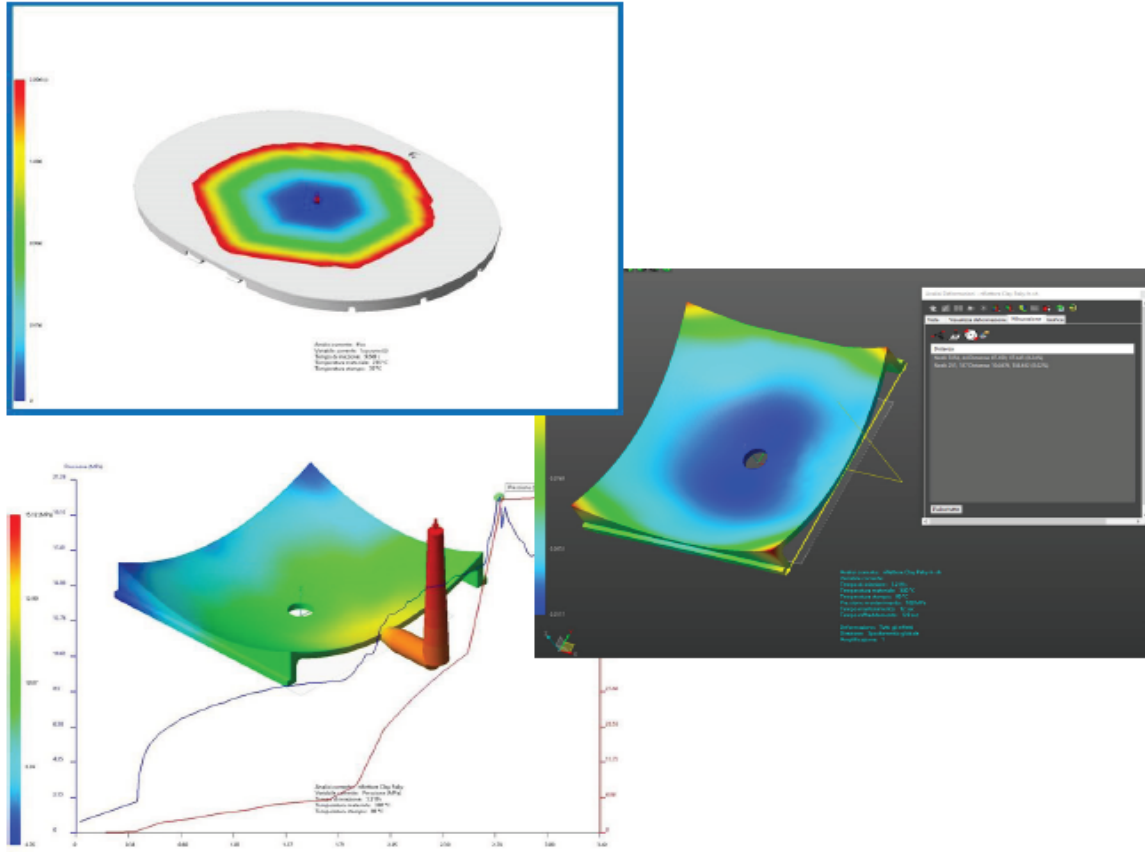
SUPPLIERS





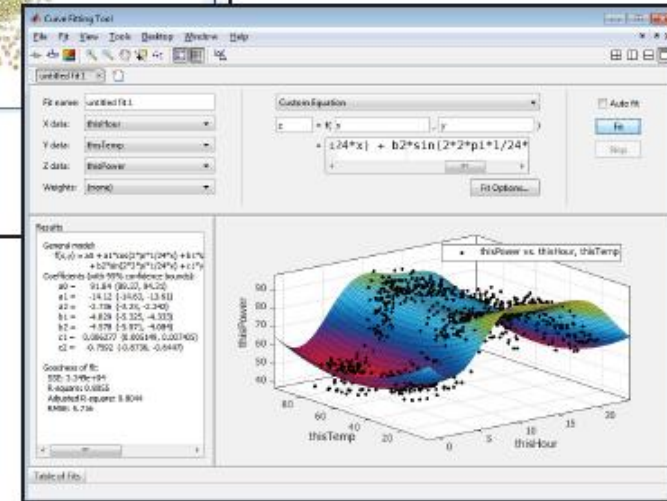
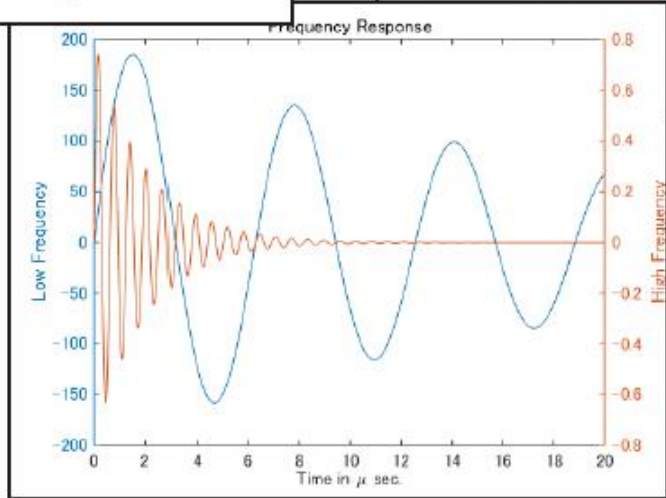
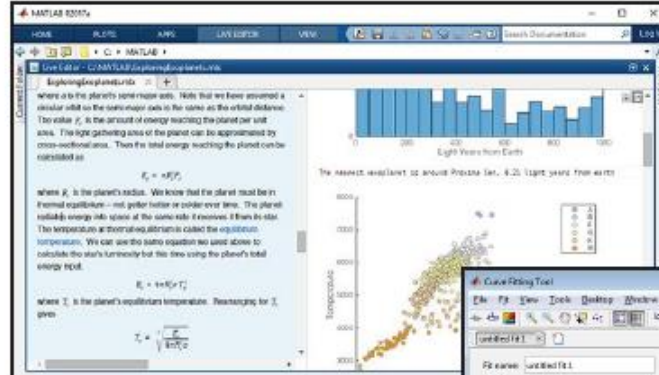
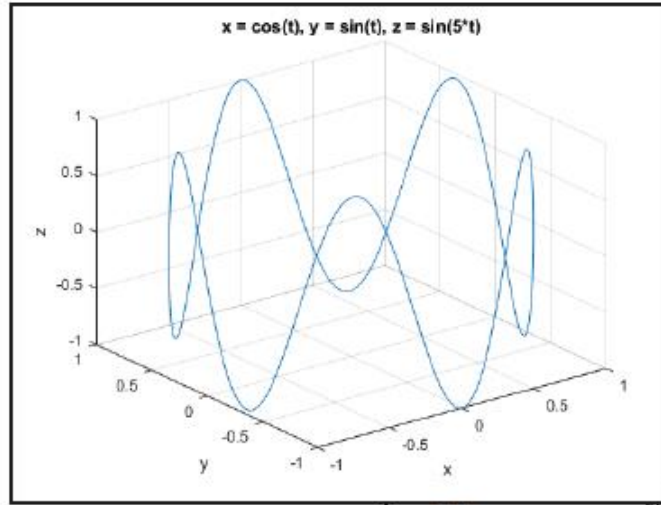
VISI Modeling is a powerful solid and surface modeler that combines the Parasolid® market standard for solids with surfaces, analysis tools, and 2D drawing. It offers complete flexibility in the construction, modification or correction of complex 3D mathematics.

- Intuitive graphical interface
- Wide range of CAD interfaces
- Parasolid market standard
- Combined solid & surface modeling in wireframe environment
- Boolean operations for solids & surfaces
- Surface repair and analysis
- Management of edges with tolerances
- Fast Rendering and Texture Mapping
- Construction of curves for mechanics
- Automatic creation of the material list (B.O.M.)
- **Extensive range of CAD interfaces as PARASOLID, IGES, CATIA v4, v5, v6, Pro-E, Creo, Inventor, STEP, Solid Works, Solid Edge, DXF, DWG, STL and VDA files**
- Real hybrid solid-surface modeling
- Powerful commands for the construction of 3D curves and mold division curves
- Automatic creation of 2D tables



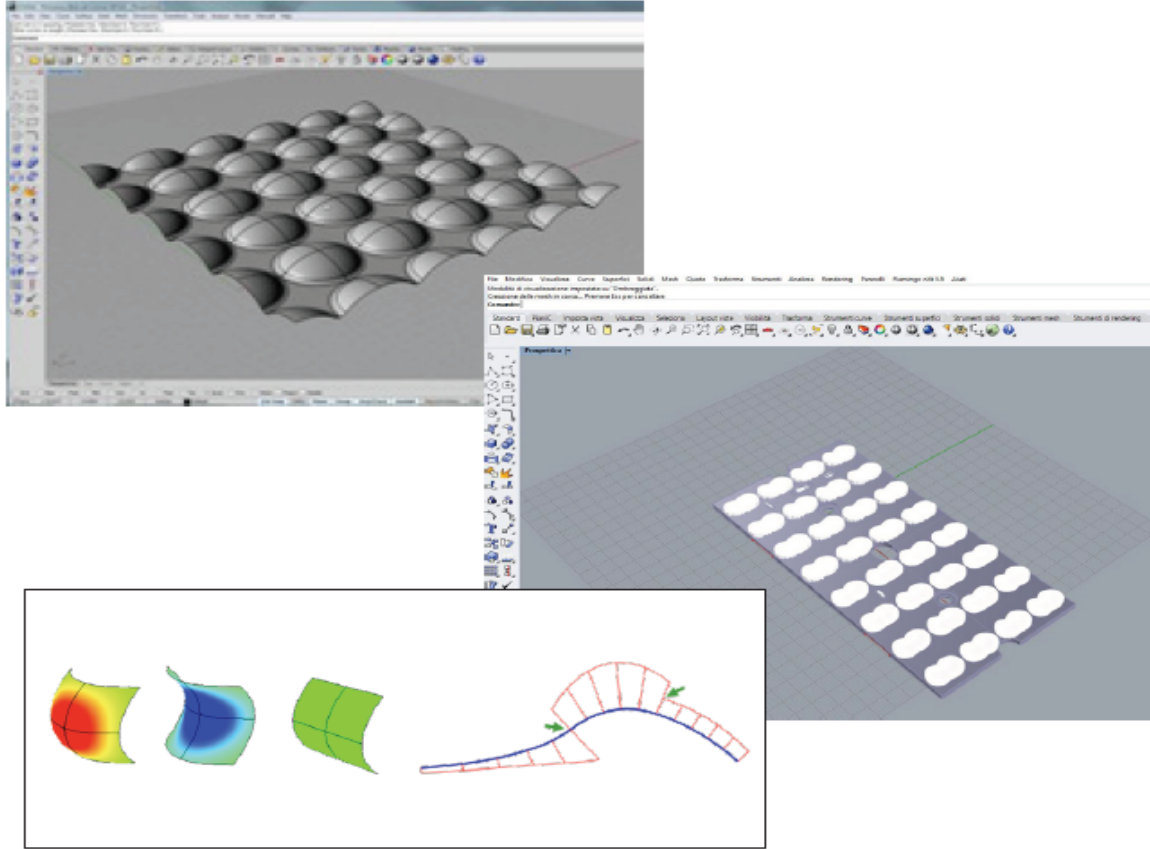
All stages of piece production benefit from the molding design approach: concept design, piece engineering, mold design and industrialization, optimization of molding parameters. VERO Flow is a unique forecasting and analysis tool that helps to perform a significant number of accurate assessments with very short model preparation and calculation times, allowing multiple comparative tests in a short time.

- Integrated CAD / CAE software
- Proprietary solid mesh technology
- Short times of calculation and preparation of the model
- Accurate simulation of the filling phase
- Identification of the aesthetic problems of the piece
- Calculation of the most important molding variables
- Orientation of the fibers
- Customization of the materials database
- Accurate prediction of deformations
- Thermal analysis
- Optimization of the layout of conditioning and power supply circuits
- Gas, co-injection, over-molding, thermoset



Matlab is a multi-paradigm numerical computing environment that allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

CAD 3D - RHINOCEROS



Rhino allows you to create, edit, analyze, document, render, animate and translate NURBS curves, surfaces, solids, SubD subdivision geometry, point clouds and polygon meshes with no limits to complexity, grade and size. This tool guarantees unlimited free form 3D modelling.

- Accuracy required for the design, prototyping, design, analysis and manufacture of any model, from an airplane to a jewel.
- Compatibility with all other design, technical drawing, CAM, design, analysis, rendering, animation and illustration programs.
- Extremely complicated mesh and IGES file reading and repair.
- Accessibility.
- Easy to learn and use: the user can concentrate on design and visualization without being distracted by the software.
- Speed, even on a regular laptop. It does not require any specific hardware.
- Development platform for hundreds of specialized 3D products.

Goniophotometer Type C - PHOTOGLOBE 4FA



This tool measures the spatial distribution of the luminous intensity of luminaires, the luminous flux of light sources as well as all the colorimetric parameters.

- Far-field goniophotometer with no mirrors - Type C
- Fixed position of the luminaire throughout the entire photometric measurement
- Possibility to measure luminaires in any working position
100% compliant with UNI EN 13031-1 and IES LM-79-08 standards
- Fast measurement: 19 L class sensors acquiring data simultaneously (0,01÷300.000,00 Lux)
- Possibility to measure luminaires with maximum weight of 70 kg
- Possibility to measure luminaires with maximum dimensions of 1,8 meters

Custom Goniophotometer for Khatod - Type A



- Far-field goniophotometer with no mirrors - Type A
- Equipped with 2 detectors up to **12 Meters distance**
- Fixed position of the detectors
- Angular resolution $< 0.5^\circ$
- Possibility to measure luminaires with maximum weight of 5 kg
- Possibility to measure luminaires with maximum dimensions of 300x300x300 mm
- Sensors acquiring data simultaneously (0,01÷300.000,00 Lux)
- Especially designed for very narrow beam angles

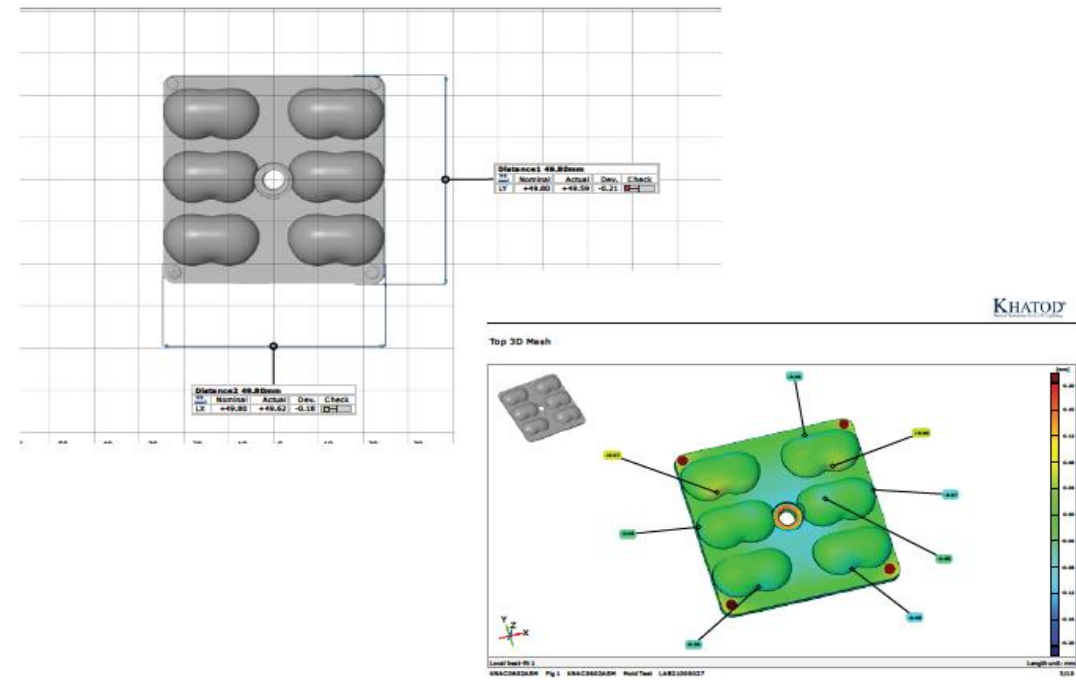
This tool measures the angular distribution of the luminous intensity of luminaires. Customized software calculates illuminance distribution at working distance.

3D scanner - GOM - ATOS Scan



ATOS 3D scanners are high-resolution optical digitizers, delivering three-dimensional measuring data quickly and precisely. The measurement system uses a structured blue light contactless technology, able to guarantee precise scans with detailed resolution at high speed.

- Light source : LED, blue (400-500nm)
- Points per scan : 2 x 5 million
- Measuring area [mm²] : 150x110x110
- Point distance [mm] : 0.017-0.063
- Working distance [mm] : 420
- Weight : approx. 4 kg
- Dimensions : approx. 340 x 240 x 83 mm



Light Scattering Characterization - Mini Diff - LIGHT TEC



Mini-Diff V2 is a compact and portable optical system for scattering characterization able to measure BRDF & BTDF of any kind of material and object.

Mini-Diff V2 is designed to measure luminous energy distribution and consequently characterize surfaces of examined regions such as roughness, defects, as well as types of coatings and paintings.

- Light Sources: 3-color collimated sources: Red, Green and Blue for RGB measurements
 - Red: 630nm [$\Delta\lambda/2=25\text{nm}$]
 - Green: 525nm [$\Delta\lambda/2=35\text{nm}$]
 - Blue: 465nm [$\Delta\lambda/2=25\text{nm}$]
- Angle of Incidence
 - reflection measurements: 0°, 20°, 40° and 60°
 - transmission measurements: 0°, 20°, 40° and 60°
- Dynamic Range : 10^5
- BSDF Accuracy < 5% (For Lambertian sample)
- BSDF Repeatability < 2% (For Lambertian sample)
- Angular Aperture-75° to +75° -Hemispherical measurement
- Effective Measured Area $\Phi 1\text{ mm}$
- Angular Resolution : 1°
- Output Data 3D BSDF, 3D Angular Resolved Scatter (ARS)
Exportation File FormatExportation to optical simulation software

UV Spectroradiometer

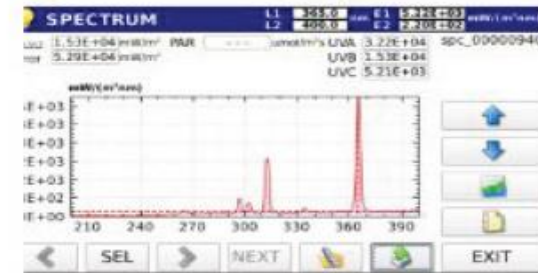


The system consists of two elements connected by a cable: the data logger-indicator HD30.1 and the measurement sensors (also available all together as a kit with code HD30.1K).

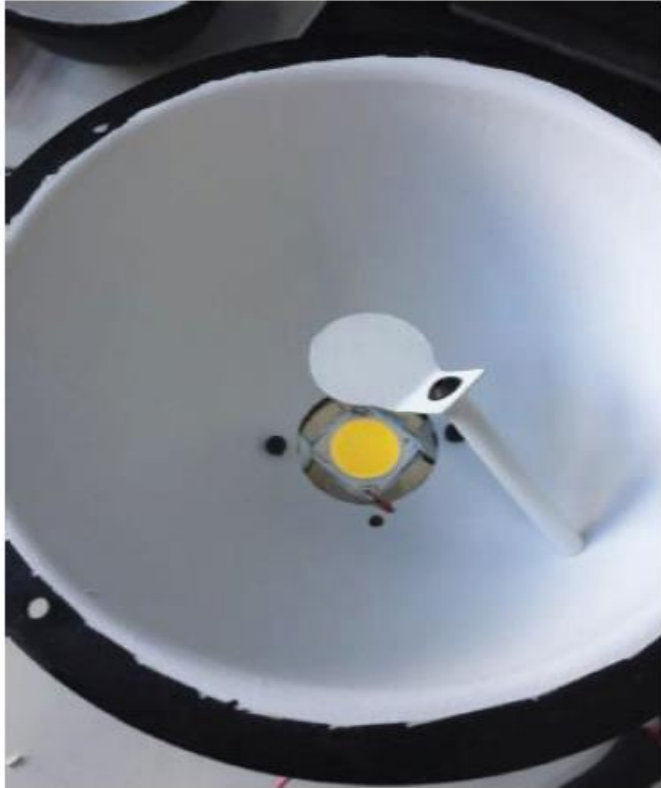
The probe HD30.S2 analyzes the ultraviolet spectral region (220 nm-400 nm) and calculates the following radiometric quantities: UVA Irradiance (W/m^2), UVB Irradiance (W/m^2) and UVC Irradiance (W/m^2)

- Sensor : CCD linear (2048 elements)
- Spectral Field : 220 nm - 400 nm
- Wavelength accuracy : 0.3 nm
- Measuring mode: Spectral Irradiance, UVA Irradiance, UVB Irradiance, UVC Irradiance, Spectral Transmittance
- Accuracy : Spectral Irradiance $\pm 15\%$
UVA Irradiance $\pm 6\%$
UVB Irradiance $\pm 8\%$
UVC Irradiance $\pm 10\%$

HD30.S2



Integrating Sphere



An integrating sphere is one of the most used devices for the measurement of photometric quantities, especially in research laboratories; it is a hollow sphere with a perfectly diffusing internal surface which allows a total reflection of the light, which can enter through a small slot.

- Integrating Sphere: 500mm Diameter
- Barium Sulfate coated
- Suitable for single LED and small arrays

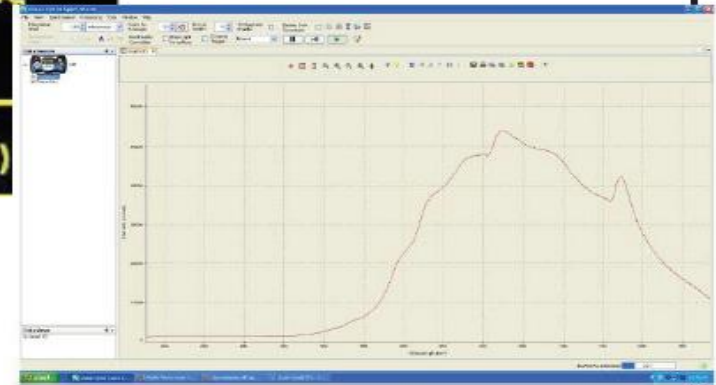
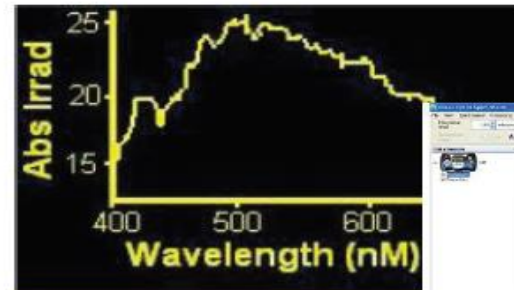


Spectrometer

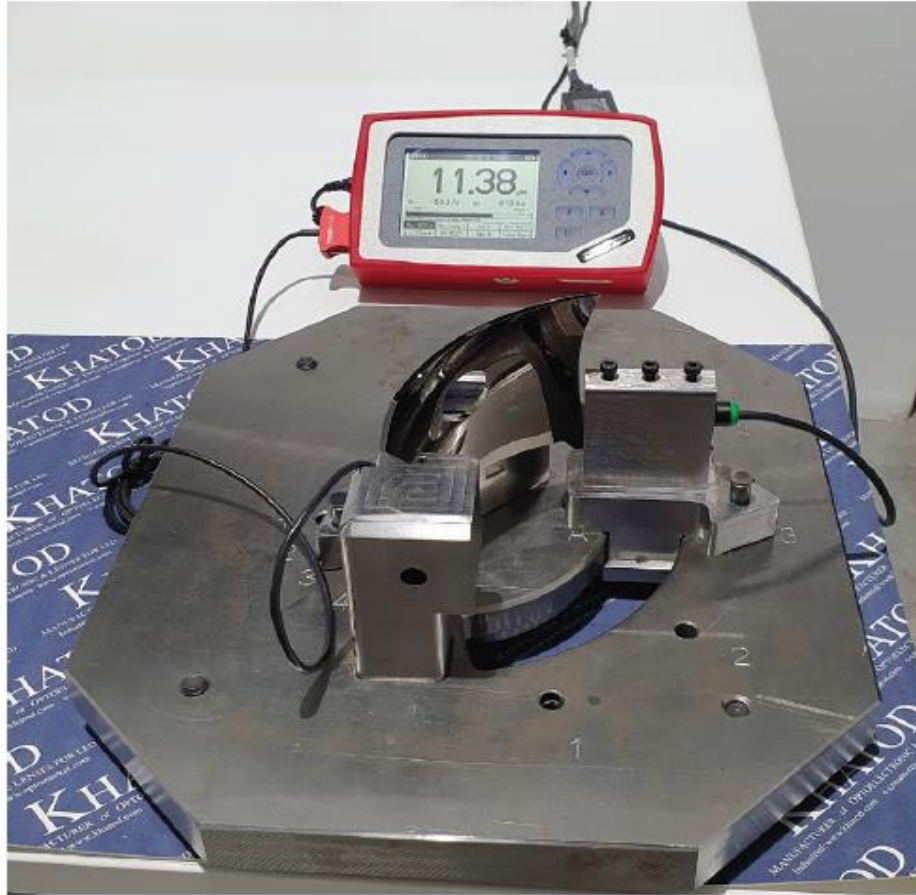


The Jaz Light Meter / Colorimeter is a preconfigured spectrophotometer ideal for field and laboratory light measurements. The Jaz-ULM-200 colorimeter has all the necessary components for spectral irradiance measurements comprised in a 350-900 nm range, and it is versatile enough to be used in both indoors and outdoors applications. The system monitors LEDs and other sources in the lab or on the line and measures solar irradiance in the field. With the Jaz Light Meter you can measure the spectral characteristics and calculate key parameters such as Lux, Lumen, PAR, Watts, CIE, CRI and x, y values.

- Detector: Sony ILX511B linear silicon CCD array (200-1100 nm)
- Wavelength range: Grating dependent (extended-range grating available for 200-1025 nm coverage)
- Optical resolution: ~ 0.3 -10.0 nm FWHM
- Signal-to-noise ratio: 250:1 (at full signal)
- A/D resolution: 16 bit
- Dark noise: 50 RMS counts
- Dynamic range: 8.5×10^7 (system); 1300:1 for a single acquisition
- Integration time: 870 μ s to 65 seconds (20 s typical maximum)
- Stray light: $<0.05\%$ at 600 nm; $<0.10\%$ at 435 nm
- Sensitivity: 75 photons/count at 400 nm; 41 photons/count at 600 nm



Reflectometer



Khatod Reflectometer is a compact desk instrument for specular reflection measurement.

Specially designed for production quality control

- Light Sources: collimated laser Diode Green 1mW
- Wavelength : 520 nm
- Angle of Incidence
 - Reflection measurements: 15°, 30°, 45° and 60°
- Angular accuracy : +/- 1°
- Aperture Size : Ø 9.5 mm
- Wavelength Range : 400 - 1100 nm
- Power Range : 50 nW - 50 mW
- Measurement Uncertainty :
 - ±3% (440 - 980 nm)
 - ±5% (400 - 439 nm)
 - ±7% (981 - 1100 nm)

MINOLTA - Luminance Meter



The lightweight, handheld LS-100 luminance meter is a compact and portable device ideal for measuring a variety of luminance conditions with a $\Phi 14.4\text{mm}$ area.

- Type: SLR spot luminance meter for light-source and surface brightness measurement
- Acceptance angle : 1°
- Angle of view : 9°
- Focusing distance : 014mm (40 in.) to infinity
- Minimum measuring area : $\Phi 14.4\text{mm}$
- Receptor: Silicon photocell
- Relative Spectral Response: Within 8% (f1) of the CIE spectral luminous efficiency $V(\lambda)$
- Luminance units : cd/m^2 or fL (switchable)
- Measuring range : FAST: 0.001 to 299,900 cd/m^2 (0.001 to 87,530 fL) SLOW: 0.001 to 49,990 cd/m^2 (0.001 to 14,590 fL)
- Accuracy : 0.001 to 0.999 cd/m^2 (or fL): $\pm 2\% \pm 2$ digits of displayed value 1.000 cd/m^2 (or fL) or greater: $\pm 2\% \pm 1$ digit of displayed value (Illuminant A measured at ambient temperature of 20 to 30°C/68 to 86°F)
- Repeatability: 0.001 to 0.999 cd/m^2 (or fL): $\pm 0.2\% \pm 2$ digits of displayed value 1.000 cd/m^2 (or fL) or greater: $\pm 0.2\% \pm 1$ digit of displayed value (Measurement subject: Illuminant A)

3D Printer



MakerBot's desktop 3D printer is engineered for fast and reliable 3D printing.

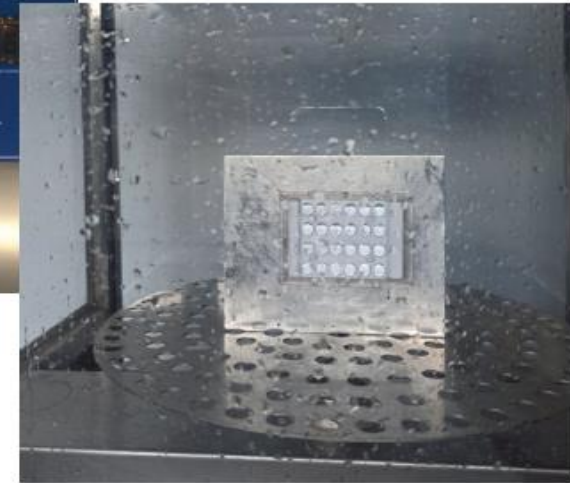
- Print Technology: Fused Deposition Modeling
- Build Volume: 29.5 L x 19.5 W x 16.5 H cm
- 9,492 Cubic Centimeters
- Layer Resolution: 100 microns [0.0039 IN]
- Material: PLA 1.75 mm [0.069 in]

IP Chamber



The IPX Material Waterproof / Rain Spray Chamber is used to test the sealing and water-proof property of products installed outdoor, such as, signal devices and vehicle lamps shell protections. Electronic products and components will be tested under a realistic simulation of water spray conditions.

- Testing rain dimensions Diameter (mm) : 500
- Water Pump power IP5/6 : 5kw
- Chamber test Dimensions (mm) : 800x800x800
- 6.3mm nozzle diameter, for IPX5 test. Water flow: 12.5L/min.
- 12.5mm nozzle diameter, for IPX6 test. Water flow: 100L/min.



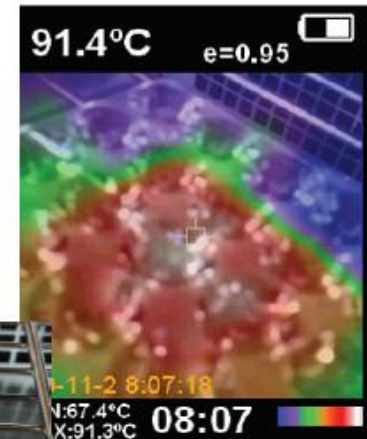
Climate Chamber



The climatic chamber is a fundamental laboratory instrument for accelerating the aging process of various types of samples. It recreates extreme weather conditions of temperature and humidity in a dedicated environment.

This high-precision instrument allows to know in advance the material's reactions to certain climatic variations.

- Maximum DUT Dimensions (mm) : 500x750x600
- Temperature Range : $-70^{\circ}\text{C} - 150^{\circ}\text{C}$
- Humidity Range : 20% - 98% RH
- Heating Speed : $\sim 1 - 3^{\circ}\text{C}$
- Cooling Speed : $\sim 0.7 - 1^{\circ}\text{C}$
- Temperature Accuracy : $\pm 0.5^{\circ}\text{C}$
- Humidity Accuracy : $\pm 2.5\% \text{ RH}$
- Temperature Uniformity : $\pm 2.5^{\circ}\text{C}$

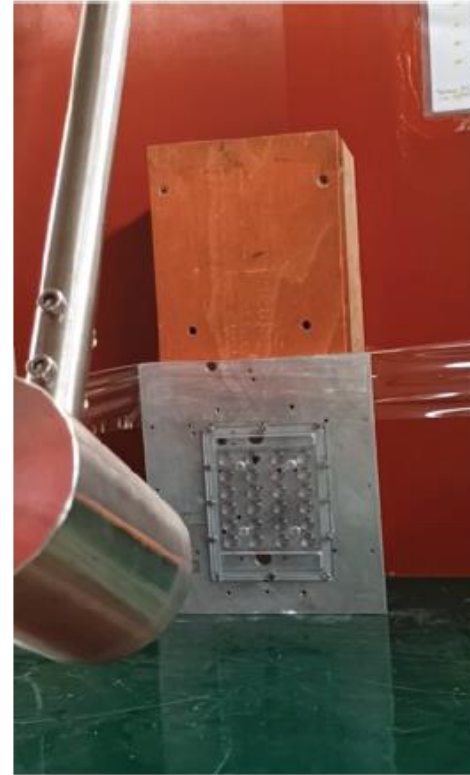


IK07-10 Impact Test Pendulum



This equipment tests the enclosure resistance to impact energy levels measured in joules (J). IEC 62262 specifies how the enclosure must be mounted for testing, the atmospheric conditions required, the quantity and distribution of the test impacts and the impact hammer to be used for each level of IK rating.

- IK07-10 Level glass impact testing on lighting luminaires testing
- 4 different Hammers with adjustable distance
- Maximum DUT weight : 15 Kg
- Maximum DUT dimensions : 600x600x300 mm



Vibration machine



- Speed : 150 – 300 RPM (RPM/min)
- Speed accuracy : 1 RPM (RPM/min)
- Elliptical Vibration
- Vibration Amplitude (P-P) (mm) : 25.40
- Maximum DUT Weight (kg) : 100
- Maximum DUT dimensions (mm) : 1200x1000

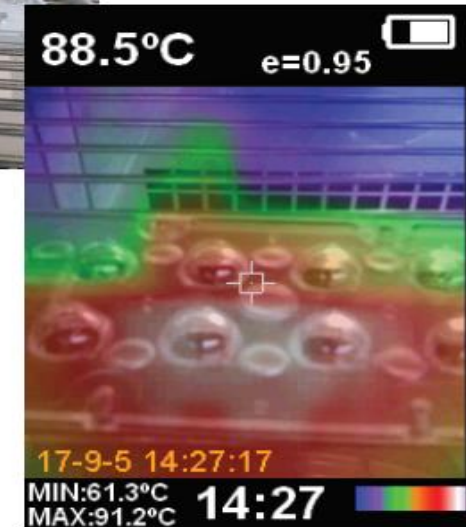
The vibration test simulates environmental conditions that a product or structure may undergo during its lifetime.

The vibration test can be used to avoid unexpected performance or premature field failures and to ensure that the products are intact and operate safely during operation or transit.

Thermal imaging camera



- Infrared image resolution 32 x 32 (1024 pixels)
- Visible image resolution : 0.3 mega pixels
- Shortest angle of view / focal distance 33 x 33 / 0.5m
- Thermal sensitivity : 0.3 ° C
- Temperature measurement range : -20 ° C to +300 ° C
- Temperature measurement accuracy : $\pm 2^{\circ} \text{C} \pm 2\%$

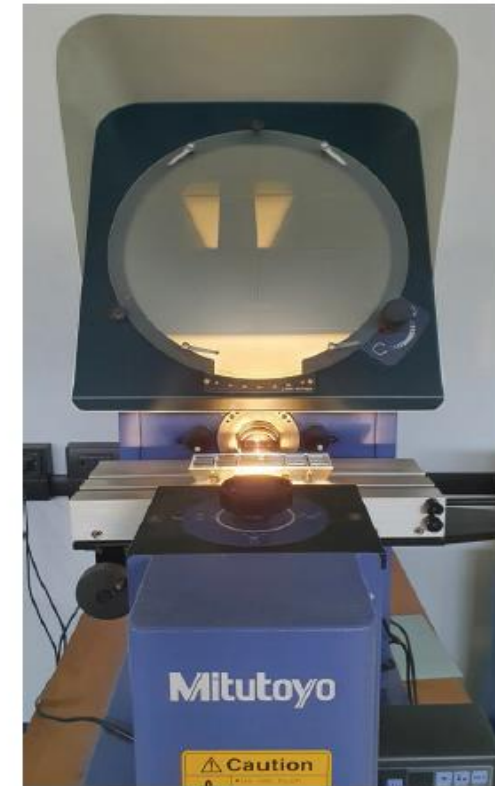


The thermal camera combines surface temperature measurement and real-time thermal imaging functions

Profile Projector



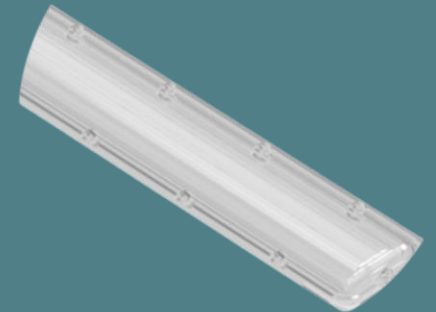
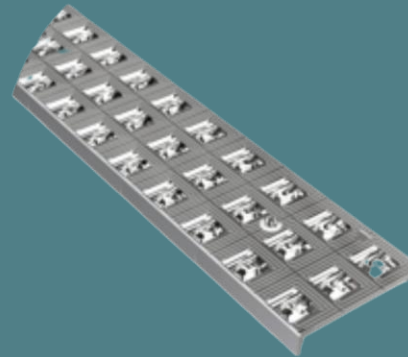
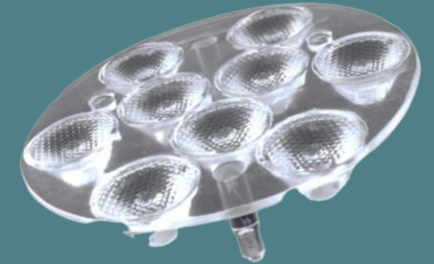
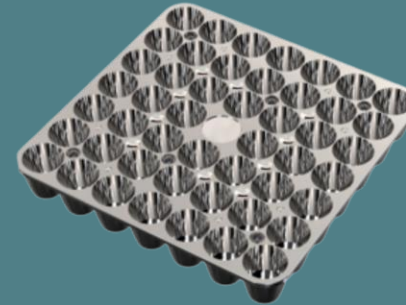
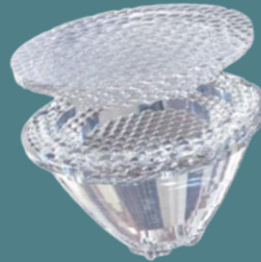
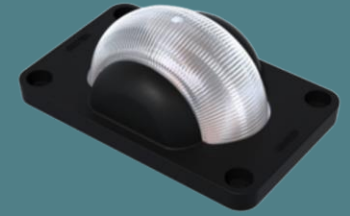
- Magnification: 10X
- You can use the projector for a wide range of applications due to its extensive 203 x 102 mm stage travel
- 5 kg allowable stage loading.
- Resolution: 0.001 mm
- Accuracy : +/- 0.01 mm



Final quality control



*One Company
Infinite Possibilities*



An aerial photograph of a large, modern industrial building with a curved, white roof. The building has a prominent entrance on the left side with the word "KHATOD" visible above it. The building is surrounded by a parking lot with several cars parked. In the foreground, there is a green lawn with a winding path. The background shows a residential area with multi-story apartment buildings and lush green trees.

THANK YOU!

Who We Are: <https://youtu.be/CKOZOgQLA-U>