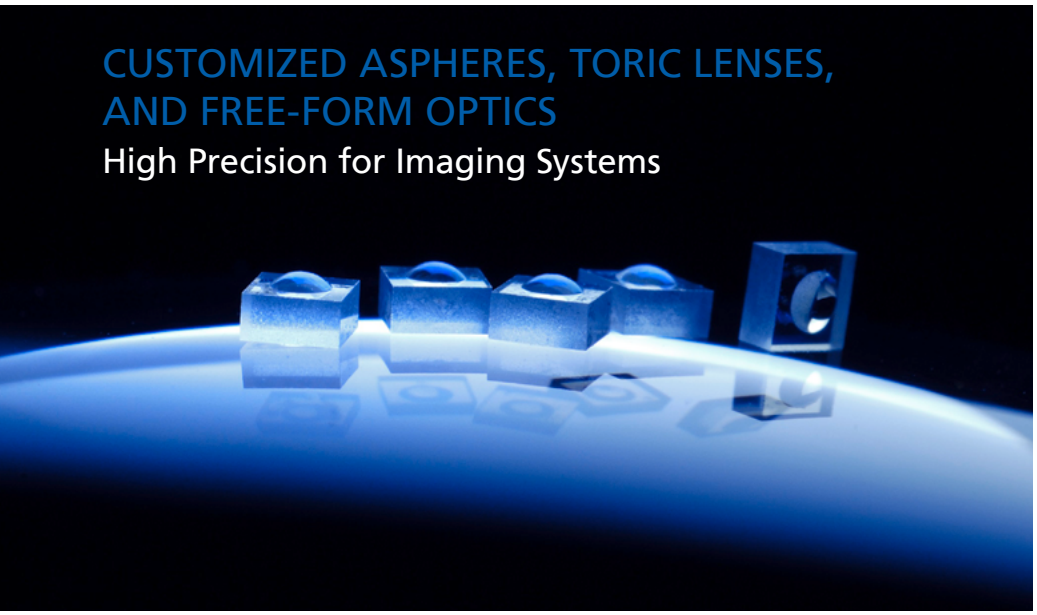
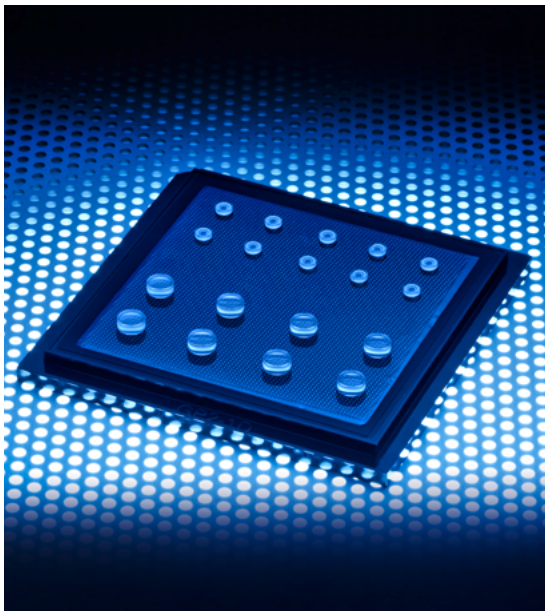
INGENERIC

CUSTOMIZED ASPHERES, TORIC LENSES, AND FREE-FORM OPTICS

High Precision for Imaging Systems





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GENERAL DESCRIPTION

Shaping light beams and generating high-resolution, distortion-free images plays a vital role in many industries. It is highly important in modern healthcare, sensor technologies, the automotive industry, and in future-oriented trend technologies such as industrial lidar and virtual reality. Achieving this standard of optimal imaging requires precision optics made of glass with high geometric complexity.

Aspheres that perfectly focus the incidental light without spherical aberration save weight and installation space in lenses. They are crucial for improving image quality and are already indispensable in many optical systems today.

INGENERIC is one of the world's leading manufacturers of micro-optics and has specialized in the manufacture of pressed, high-precision aspheres, toric lenses, and free-form optics made of glass.

ADVANTAGES

- superior image quality
- freedom of design
- free-form surfaces
- integrated alignment features
- highest level of precision and uniformity
- volume production
- highest serial reproducibility
- advantageous price-performance ratio

Overall, aspheres, toric lenses, and free-form optics offer a variety of advantages in optics, including improved image quality, more compact designs, and reduced aberration. This is why they are used in a wide range of applications, including cameras, telescopes, microscopes, and many other optical systems.

AREAS OF APPLICATION

There is increasing demand for high-precision aspheres, toric lenses and free-form optics in growth markets such as medical technology, sensor technology, consumer electronics, and the automotive industry.

Example applications for aspheres and complex optics from INGENERIC include:

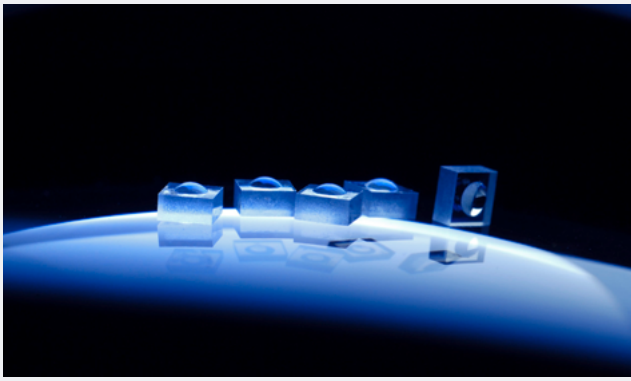
- Endoscopy lenses / surgical imaging
- Ophthalmics
- Industrial and automotive lidar
- Virtual Reality / Augmented Reality / Smart Glasses
- Defense systems
- Distance measuring devices (range finders, distance sensors)
- Fiber-optic collimation and coupling

CAPABILITIES AND TOLERANCES

Molded glass optics can be curved on one or both sides with a large degree of geometrical freedom and a customizable lateral contour. The lateral dimensions of INGENERIC aspheres range from 1.5 mm to 40.0 mm. Aspherical optical surfaces can be concave or convex, with steep angles and numerical apertures up to 0.8.

Material:	optical glass (high index)
Lens diameter (D):	1.5 mm - 40.0 mm
Diameter (D) tolerance (molded):	< 0.025 mm
Lens aperture:	round, rectangular
Center Thickness (CT):	1.0 mm - 10.0 mm
CT tolerance:	< 0.02 mm
max. Edge slope angle:	< 65°
Radius (ROC) Accuracy:	< 0,1 %
Form accuracy:	< 100 nm PV (Irregularity)
Slope Error (mid frequency error):	tbd. customer-specific
Surface Roughness:	2-5 nm rms
Cleanliness* (depends on lens size):	0.025 / 0.04 / 0.063 /… 0.4

*according to ISO 10110-7



EXAMPLE PRODUCTS FOR COLLIMATION

Lens Type	λ (nm)	D (mm)	Aperture	CT (mm)	NA	EFL (mm)	BFL (mm)	Form accuray	Material
ASPH-PL-CX-2.4	785 nm	4.2 x 4.2	rectangular	2.0	0.8	2.4	1.25 mm	< 260 nm	K-VC89
ASPH-PL-CX-6.5	1030 nm	6.325	round	2.3	0.33	6.5	5.23 mm	< 300 nm	K-VC89
ASPH-PL-CX-0.75	1100 nm	3.0 x 3.0	rectangular	0.8	0.7	0.75	0.30 mm	< 600 nm	K-VC89

EXAMPLE PRODUCTS FOR IMAGING

Lens Type	λ (nm)	D (mm)	CA (mm)	Aperture	CT (mm)	EFL (mm)	Form accuray	Material
ASPH-CX-CX-2.47	1210 nm	4.0	3.2 / 3.0 mm	round	3.0	2.47	< 300 nm	K-VC89

EXAMPLE SPECIFICATIONS IN GENERAL

Lens Type	D (mm)	Aperture	CA (mm)	CT (mm)	vertex ROC 1 (mm)	vertex ROC 2 (mm)	SAG (mm)	max slope angle (°)	Sagitta deviation (µm)	Form accuracy (irregularity)
Meniscus aspherical	2.40	round	1.8 / 1.2	0.4 +/-0.02	10.0 +/-2%	-0.75 +/-0,4%	0.20 / 0.44	22° / 62°	< 0.8 / < 2.0	< 250 nm PV
Bi-CX lens aspherical	3.75	round	3.0 / 3.0	1.7 +/-0.02	13.0 +/-1%	9.0 +/-0.7%	0.15 / 0.15	5°	< 0.9 / < 0.9	< 250 nm PV
Meniscus aspherical	24.00	round	23 / 22	7.25 +/-0.05	21.0 +/- 0.2%	-80.0 +/-0.2%	5.64 / 4.92	46° / 6°	< 8.0 / < 1.5	< 160 nm PV
Plano-CX aspherical	35.00	round	24 / 24	5.0 +/-0.1	∞	40.0 +/-0.1%	3.92	25°	< 1.4 / < 2.0	< 500 nm PV

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MANUFACTURING PROCESS

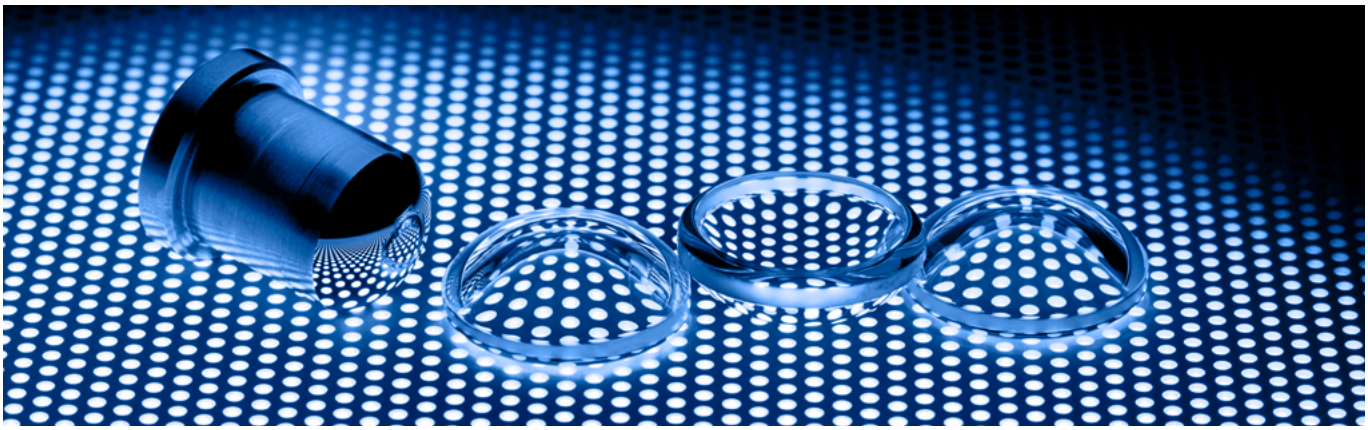
At INGENERIC, complex optics are manufactured using precision glass molding – the replication of a high-precision tool surface through the isothermal forming of glass. This technology enables precise and reproducible shaping of tailor-made optics with optimal optical performance in a single production step. Highest precision, versatile design, excellent surface quality, and efficient mass production are attributes of our manufacturing. Treatment of the optics with anti-reflective coatings or masking is also possible.

Particularly in the series production of micro-optics, precision glass molding is characterized by greater flexibility as well as greater precision and reproducibility than alternative lithographic processes. And yet the technology is also successful for small or medium production quantities. Compared to machining by grinding and polishing, the technology benefits from greater cost-effectiveness and productivity depending on the geometric complexity of the optics.

FROM RFQ TO YOUR FINAL PRODUCT

INGENERIC is excellent – especially for Design-In product developments. Close customer relationship, intensive communication and information exchange is essential for these successful collaborations.

Upon receipt of your request, the lens design or even your optical task is reviewed and potentially adapted by our engineering team to ensure a perfect fit with our production technology. This may involve selecting the best glass type, designing transition zones or determining target specifications. Our Sales team performs consistent price calculations for prototyping, small series or volume production. Our manufacturing technology is capable for all project stages, starting with process development, try-out molding tests, glass type analysis, and ending with highly productive series production.



QUALITY

INGENERIC provides substantial quality assurance throughout the manufacturing process. Every step is logged, from the incoming component inspection to the precise final control of each processed item. If required, a customized test set-up can be realized to ensure that there is no deviation from the measured characteristics when the optic is subsequently used in industrial practice.

GOOD TO KNOW

The glass type is essential for the optical performance but also influences the moldability. INGENERIC offers molded aspheres, toric lenses, and free-form optics from several glass types and different suppliers. We recommend a number of specific glass types with a well-known molding behavior and excellent optical properties. However, our technology is feasible for a large variety of glass materials right across the Abbe diagram. We have opportunities for fast glass material qualification, testing, and prototyping. Please do not hesitate to discuss this issue with our optical design team.