

## CNC PROCESSING

		Standard-Quality	Precision-Quality
<b>Dimensions [ISO 10110-1]</b>			
Diameter	mm	8 - 300	4 - 250
Tolerance	mm	± 0.10	± 0.05
Center thickness	mm	2 - 60	2 - 60
Tolerance	mm	± 0.10	± 0.05
<b>Surface form [ISO 10110-1; 12]</b>			
geometry dependent up to			
Radius of curvature – local cc	mm	15	
Clear aperture	% of Ø	95	90
Clear aperture surface slope	degree	75	50
<b>Surface form tolerances [ISO 10110-5] and Aspheric surfaces [ISO 10110-12]</b>			
3/A (B, C) RMSi < D; slope < F; slope integration length = G; spatial sampling resolution = H; see also ISO 14999-4			
Tolerance of radius of curvature	%	± 0.10	± 0.05
Sagitta deviation – A (Power)	fringe (µm)	30 -10 (7.5 - 2.5)	3 (0.75)
Irregularity – B (PV)	fringe (µm)	10 - 4 (2.5 -1)	1 (0.3)
Rotational invariant irregularity – C	fringe (µm)	4 - 1.5 (1.0 - 0.4)	0.5 (0.14)
RMS irregularity – RMS <sub>i</sub> – D	fringe (µm)	3 - 1.2 (0.75 - 0.3)	0.3 (0.09)
Slope tolerance – F / G / H	arc sec/mm/mm	180 / 1 / 0.1	40 / 1 / 0.1
<b>Centration [ISO 10110-6] 4/σ (L)</b>			
Edge thickness variation (defines tilt angle)	µm	25	15
Tilt angle of the aspheric surface to the second surface – σ	arc min	2.50	1
Lateral displacement of the aspheric to the edge of the lens – L	mm	0.02	0.01
Lateral displacement of the aspheric to the second surface – L	mm	0.03	0.02
<b>Surface imperfections [ISO 10110-7; 5/ N x A; L N “ x A“]</b>			
Dig – N x A <sup>1</sup>		2 x 0.40	2 x 0.10
Scratches – L N “ x A“ <sup>1</sup>		L2 x 0.10	L2 x 0.06
MIL – Scratch / Dig		40 – 20	20 – 10
<b>Surface texture [ISO 10110-8]</b>			
Surface roughness – Rq	nm	3.00	1.50
<b>Measurement</b>			
Full-surface interferometric measurement		optional	

## DIAMOND TURNING

Ultra-precise cutting using monocrystalline diamond is the key technology for manufacturing virtually any optical functional surface with the utmost precision. This enables the processing of non-ferrous metals, nickel-phosphorus coatings, plastics, crystals and IR lenses.

Manufacturing dimensions [ISO 10110-1]		
Achievable diameters	mm	1 - 420
Center thickness	mm	from 0.5 <sup>1</sup>
Surface shape [ISO 10110-1; 12]		up to
Irregularity – B (PV) <sup>2</sup>	nm	100
RMS irregularity – RMSi – D	nm	20
Surface roughness – Rq	nm	1

<sup>1</sup> Depends on diameter and material

<sup>2</sup> Often also called the PV - error of the measured surface. Means the total surface deviation corrected for Sagitta error (power).

Available technologies	
<ul style="list-style-type: none"> <li>= Diamond turning with 2 and 3 linear axes</li> <li>= Fly cutting</li> <li>= Slow tool servo</li> </ul>	
Processable materials	
<ul style="list-style-type: none"> <li>= Copper, aluminum, brass, nickel silver</li> <li>= Nickel-phosphorus layers</li> <li>= Polycarbonate, PMMA</li> <li>= Silicon, germanium, zinc sulfide</li> <li>= IR lenses</li> </ul>	
Achievable optical component geometries	
<ul style="list-style-type: none"> <li style="width: 50%;">= Aspheres</li> <li style="width: 50%;">= Microlenses</li> <li style="width: 50%;">= Spheres</li> <li style="width: 50%;">= Fresnel structures</li> <li style="width: 50%;">= Cylinders</li> <li style="width: 50%;">= Diffractive optical elements</li> <li style="width: 50%;">= Toroids</li> <li style="width: 50%;">= Freeforms</li> </ul>	

## HIGH-END FINISHING

Dimensions [ISO 10110-1]		
Diameter	mm	6 - 300
Tolerance	mm	± 0.03
Center thickness	mm	< 60
Tolerance	mm	± 0.01
Surface form [ISO 10110-1; 12]		geometry dependent up to
Radius of curvature - local cc	mm	15
Clear aperture	% of Ø	90
Clear aperture surface slope	degree	75
Surface form tolerances (ISO 10110-5) and Aspheric surfaces (ISO 10110-12)		
3/A (B, C) RMSi < D; slope < F; slope integration length = G; spatial sampling resolution = H; see also ISO 14999-4		
Tolerance of radius of curvature	%	± 0.02
Sagitta deviation - A (Power)	fringe (µm)	0.30 (0.08)
Irregularity - B (PV)	fringe (µm)	0.30 (0.08)
Rotational invariant irregularity - C	fringe (µm)	0.20 (0.05)
RMS irregularity - RMS <sub>i</sub> - D	fringe (µm)	0.10 (0.03)
Slope tolerance - F / G / H	arc sec/mm/mm	12/ 1 / 0.1
Centration [ISO 10110-6] 4/ σ ( L )		
Edge thickness variation (defines tilt angle)	µm	5
Tilt angle of the aspheric surface to the second surface - σ	arc min	0.35
Lateral displacement of the aspheric to the edge of the lens - L	mm	0.01
Lateral displacement of the aspheric to the second surface - L	mm	0.01
Surface imperfections [ISO 10110-7; 5/ N x A; L N " x A" <sup>4</sup> ]		
Dig - N x A <sup>1</sup>		2 x 0.04
Scratches - L N " x A" <sup>4</sup>		L2 x 0.04
MIL - Scratch / Dig		20 - 10
Surface texture [ISO 10110-8]		
Surface roughness - Rq	nm	0.50
Measurement		
Full-surface interferometric measurement		guaranteed