Aspheres

Superior Performance for High Precision Optics

Optimax offers integrated manufacturing and measurement capabilities to produce precise, complex shapes that can replace multiple elements for lower weight and improved end-product performance.

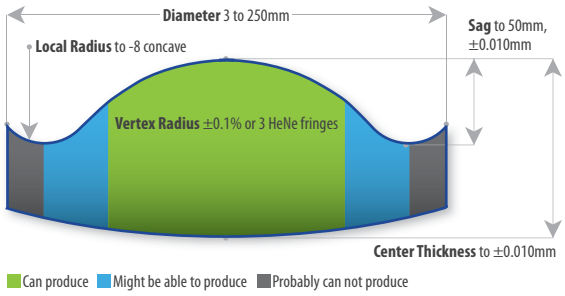
We utilize deterministic CNC machine tools for predictable removal rates and adherence to tight tolerances. Precision tools constrain the aspheric axis to conserve centration.

By investing in the most advanced technology, we can offer the widest array of manufacturing options and best quality end product.

Materials:
Glass, fused silica, crystals, ceramics

Applications:
UV, Visible and IR

Testing:
100% of optics are inspected to ensure quality. Surface profilers and interferometers verify that parts meet form error tolerances.



Optimax continues to innovate in the field of aspheres fabrication. Current research focuses on conformal and freeform optics and mid-spatial frequency, error-free surfaces. We welcome your challenges and opportunities to collaborate.

Even Aspheric Equation

$$z = \frac{cr^2}{\left(1 + \sqrt{1 - (k+1)\,c^2 r^2}\right)} + \sum_{i=1}^{10} a_{zi} \left| r^{zi} \right|$$

Forbes Q Polynomial

$$z(r) = \frac{cr^2}{1 + \sqrt{1 - c^2 r^2}} + \frac{1}{\sqrt{1 - c^2 r^2}} \left\{ u^2 (1 - u^2) \sum_{m=0}^{M} a_m Q_m (u^2) \right\}$$

Attribute	Asphere Tolerancing Limit
Irregularity - Interferometry (HeNe fringes)	0.1
Irregularity - Profilometry (µm)	± 0.5
Wedge Lens - ETD (mm)	0.002
Bevels - Face Width @ 45° (mm)	± 0.05
Scratch - Dig (MIL-PRF-13830B5)	10 - 5
Surface Roughness* (Å RMS)	10

*non-crystalline

OPTIMAX™
585.265.1020 | sales@optimaxsi.com | optimaxsi.com

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Asphere Equations

Even Asphere

$$z = \frac{cr^2}{(1+\sqrt{1-(k+1)c^2r^2})} + \sum_{i=1}^{10} a_{zi} |r^{zi}|$$

Forbes Q Polynomial

$$z(r) = \frac{cr^2}{1+\sqrt{1-c^2r^2}} + \frac{1}{\sqrt{1-c^2r^2}} \left\{ u^2(1-u^2) \sum_{m=0}^{M} a_m Q_m(u^2) \right\}$$

z = sag | c = curvature at vertex | k = conic constant | r = radial coordinate | $u = r/r_{max} = r/(CA/2)$

Asphere Metrology

Method	Cost of Test Setup[1]	Setup Time[2]	Test Time[3]	Tolerance Limit	Max. Departure	Comments
Surface Contact Measurement						
CMM	Low	Minutes	~10 min	± 5µm	mm	No required symmetry; requires datum & fixturing
Profilometry	Low	Minutes	~5 min	± 0.5µm	<25 mm	Most common method; only provides 2D data
Surface Testing in Reflection						
Spherical Wavefronts	Low	Minutes	~10 min	0.1 Fringes	<10 µm	Zernike subtraction; fringe density limited
CGH	High	Months	~20 min	0.25 Fringes	mm	No required symmetry; part specific
Spherical Null Reflection	High	Weeks	~10 min	0.1 Fringes	100 µm	Part specific
Parabola/Ellipse	Average	Hours	~30 min	0.1 Fringes	mm	$-1 \leq k > 0$
Subaperture Stitching	Average	Minutes	~30 min	0.1 Fringes	<650 µm	Absolute test
Annular Ring Stitching	Average	Minutes	~15 min	0.1 Fringes	<800 µm	Discontinuous at sagittal zero curvature
Lens Testing in Transmission						
TWE	Average	Hours	~10 min	0.1 Fringes	<50 µm	Must be well-behaved aspheric lens
CGH	High	Months	~20 min	0.25 Fringes	mm	No required symmetry; part specific
Spherical Null TWE	High	Weeks	~10 min	0.1 Fringes	~100 µm	Part specific

1. Relative cost of tooling & labor for each test
2. Includes time to obtain needed components & alignment of system
3. Includes time for alignment of unit under test, data collection & analysis