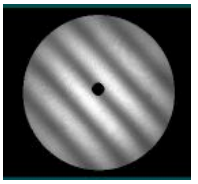
Aperture Optical Sciences

Aspheric Optics



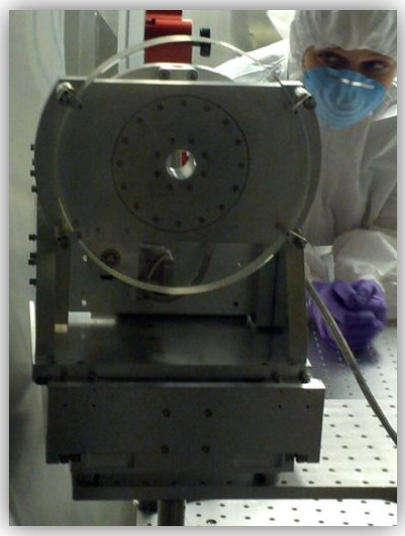
Aperture Optical Sciences Inc. provides some of the most unique custom precision optics and systems made in the world today. We develop and employ advanced technology for making aspheric mirrors and lenses, SiC optics, optics for high energy lasers and engage in developmental processes of advanced materials. AOS optics are deployed in aircraft vision systems, industrial scanners, research facilities using advanced lasers, and remote sensing applications.

Aspheric Optics

Aspheric optics are used throughout sophisticated optical systems today. Our customers use aspheres in beam expanders, collimators, airborne imaging systems, telescopes, and as focusing elements for high-energy lasers. Aspheric systems offer the advantages of compact geometry, simplification in optical design over spherical optics, and enhanced performance. AOS manufactures parabolas, hyperboloids, ellipsoids, cylinders, toroids, and higher order aspheric surfaces.

AOS Technology

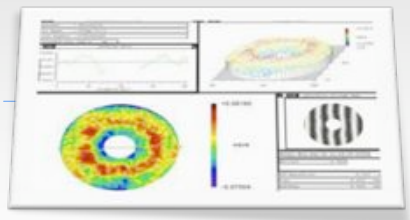
Precision contouring of aspheric surfaces is accomplished by means of fixed abrasive diamond grinding using a 7-axis robotic machine platform. AOS first models the desired mathematical description of the asphere using in-house developed software and then programs the fine grinding operation using a combination of 3D mechanical probing and robotic small tool grinding. This operation is extended into the polishing regime using interferometric surface characterization and polishing using robotic polishing. Surface Roughness is characterized using white light scanning interferometric profilometry. Finished mirrors are available in multiple configurable options. Our applications engineers can work with you to determine the specifications you need.



- *Intelligent Robotic Polishing*
- *Aspheric Finishing for Low Mid-Spatial Error*
- *High Accuracy Interferometry*
- *High Damage Threshold Coatings*
- *Actuated Multi-axis Mounts and Alignment Controls*

AOS Manufacturing Capabilities

- **Size:** 25-mm – 945-mm
- **Materials:** Fused Silica, Zerodur / Clearceram, Silicon Carbide & Single Crystal Silicon. Other materials may also be available
- **Off-Axis Angle**: 0-90 deg.
- **F/#:** f/0.65 – F/20
- Lightweighting available
- High Damage Threshold Coatings
- Design Services
- Custom Opto-Mechanical components / mounts
- Custom reflective beam expanders



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Aspheric Optics Fabrication with computer controlled polishing:

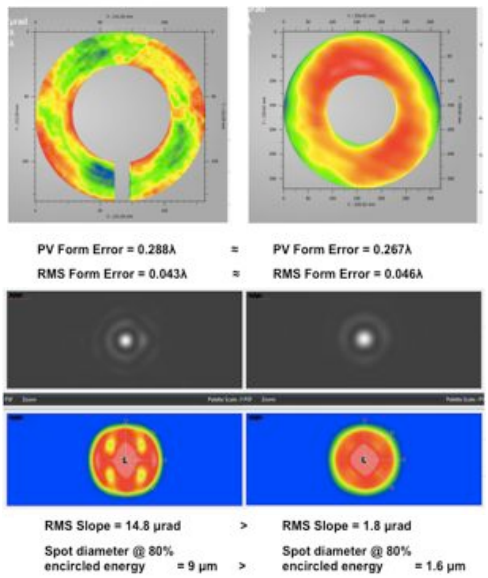
Optical Metrology: Our process design always begins with metrology. We employ a variety of techniques including computer generated holographic null correctors, plus a combination of spherical and flat reference elements. We've recently added QED's SSI-A aspheric optics stitching interferometer to our partner facility at Okamoto Optics in Japan. Tests are conducted in controlled environments. We analyze and mitigate sources of error like self-weight deflection, vibration, and misalignment. Good metrology enables corrective polishing with techniques, which can be exploited by technologies such as Magnetorheological finishing (MRF) at Okamoto Optics and Zeeko Robotic Polishing here at AOS in the United States. We augment this technology with our own proprietary software analysis and conformal polishing capability to achieve smooth, low slope error signatures.

Robotic Polishing addresses the fundamental challenge in aspheric fabrication of surfaces by controlling both the tool contact geometry and the polishing tool motion over the aspheric surface to precisely correct for errors in surface form. This process is dependent on accurate measurement of the surface prior to polishing. Interferometric maps of the surface form are translated into machine instructions, which guide the corrective polishing process. However, control of mid and high-spatial frequency amplitudes in polished surfaces requires an engineered approach to process design that optimizes material selection, chemistry, tool design, and tool path strategies.

AOS's Unique Process Design minimizes the impact of Mid-Spatial Errors

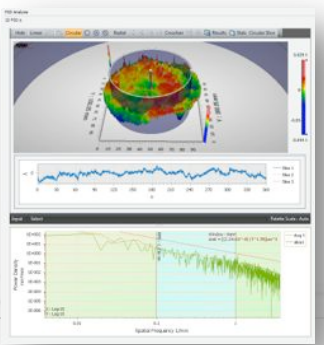
Today's most common deterministic finishing approaches such as ion-beam figuring, MRF, and other "small tool" computer controlled polishing technologies are necessary for deterministic finishing of aspheric surfaces. However, a common consequence of these approaches is the creation of periodic surface "ripples" or textures in the surface that impact can imaging performance. Additionally, traditional specifications tolerances, which describe a wavefront in Peak to Valley and RMS statistics over the full range of spatial frequencies cannot adequately predict image performance.

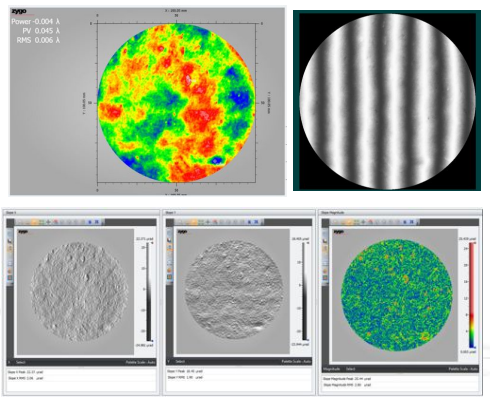
The severity and prevalence of mid-spatial periodic errors may be effectively captured by observing the RMS wavefront gradient over specific spatial frequency regions. The graphics to the right demonstrate how two optics with equivalent Peak to Valley and RMS wavefronts but with different mid-spatial gradients can produce vastly different point spread and encircled functions. AOS has developed a process and method to produce low gradient surfaces that optimize image performance. We also employ high-resolution interferometry that enables such features to be adequately measured.



AOS's aspheric manufacturing process results in low mid-spatial ripples and gradients – which mimimizes spot size and maximizes image resolution

The AOS Advantage





Aperture Optical Sciences Inc.'s mission is to provide its customers with optical components, systems and optically driven technologies that will fuel the growth of their businesses in the US, Japan, Europe and Asia. We are a privately owned US company and ITAR registered.

Our principal products are Silicon Carbide optics, Aspheric mirrors and lenses, laser optics, and opto-mechanical systems including precision beam steering systems, telescopes, and laser focusing systems. Our customers use our optics in high-energy lasers, airborne vision systems, remote sensing, optical lithography, and a variety of scientific research applications.

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