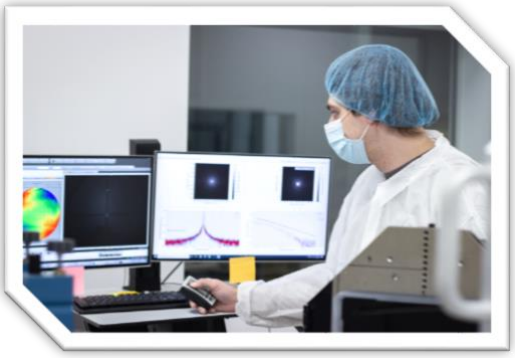
Application Note:

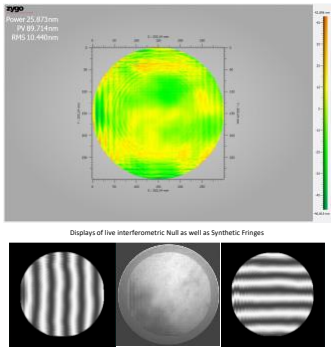
AOS Quality Grades for Aspheres



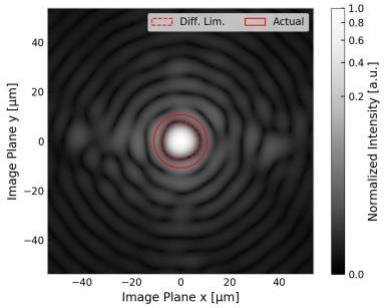
Aspheric optics differ from conventional flat mirrors and lenses in ways that can have a profound impact on imaging quality. For this reason, we've created a grading system that packages useful and compatible tolerances in three different levels of quality and allows our customers to understand the impact on cost vs. performance. AOS quality grade options are explained here.

Why not just use typical specifications? Due to the way aspheric optics are made, aspheric surfaces can demonstrate a more dominant level of high & mid-spatial content or "ripples" in the surface than conventional spheres and flats. Therefore, traditional specs of PV and RMS do not always guaranty image performance in the same way. We offer three grades to control mid-spatial frequency and introduce metrics for focus quality and an easy to apply specification for power spectral density (PSD). Our quality grades are: Standard, Precision, and High Performance.

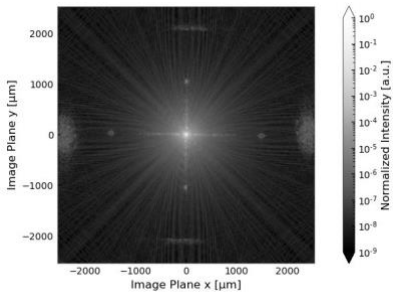
All AOS quality grades include a surface profile tolerance of 5 microns to the aspheric prescription, analysis of using high resolution interferometry and includes data such as Phase Plots, PSD Analysis, Calculation of Focus Diameter and Tolerances places on the relative intensity of diffracted features resulting from mid-spatial surface textures.



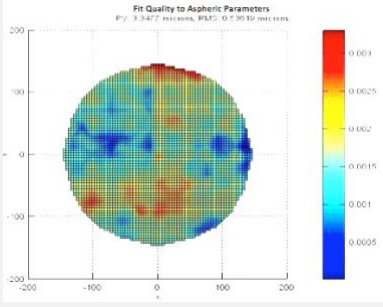
Wavefront Quality



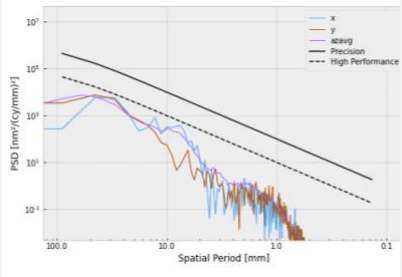
Focus Diameter vs. Diffraction Limit



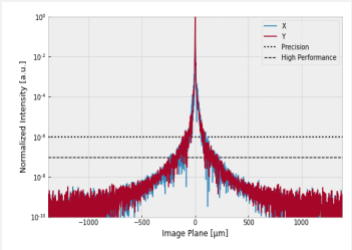
Diffraction Analysis of Focus Quality



Verification of aspheric parameters



2D Power Spectral Density



Relative Instensity of Diffracted Features

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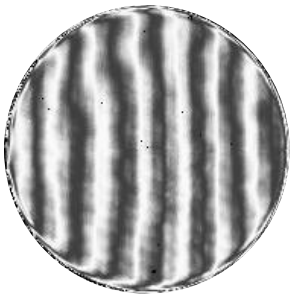
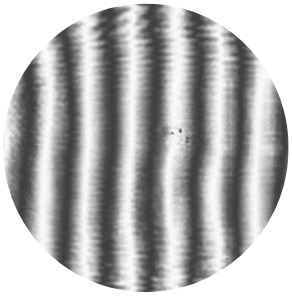
STANDARD GRADE



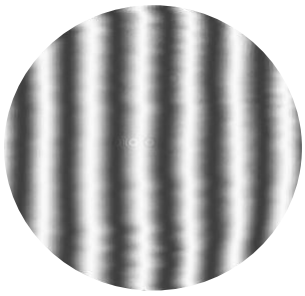
STANDARD GRADE is comparable quality to what may be found in many catalogs or manufactured by traditional technologies. AOS' "Standard Grade" is the lowest cost option and guarantees a reflected wavefront error < λ/10 RMS. Standard Grade provides good performance for many imaging applications but does not control mid and high spatial frequency amplitudes in the wavefront and does not include a PV spec. Standard Grade may include periodic features or "ripples" in the surface and wavefront resulting from residual tool path textures used in deterministic finishing. Data is provided using phase-measuring full aperture interferometry and data is characterized for spatial scale lengths > 1mm.

PRECISION GRADE



PRECISION GRADE is suitable for most applications and guarantees a reflected wavefront error < λ/20 RMS for spatial scale lengths > 1 mm. Some mid-spatial error is apparent in the interferometry, but amplitudes and frequencies are limited by tolerances in the focal spot and PSD. Precision Grade specification includes a PSD envelope tolerance and focus quality specification based on the amount of concentrated focal spot intensity vs. the diffraction limited prediction. These two metrics control mid-spatial waviness in the range of 1-10 mm, and ensures higher focused energy concentrations. Focused Spot size is guaranteed to be within 1.3x - 1.5x the theoretical diffraction limit. We place a tolerance on the maximum intensity of diffracted features in the focus. Features such as satellite foci are limited to have < 10^{-6} relative intensity to the central peak in the point-spread function.

HIGH PERFORMANCE GRADE



HIGH PERFORNCE GRADE is the current state of the art in our precision aspheres. This grade is used for only the most demanding imaging applications. AOS guarantees λ/50 RMS reflected wavefront error* for spatial scale lengths > 1 mm. Some mid-spatial and high spatial frequencies are visible, however the tolerance envelope allowed by our high performance grade is much more stringent than in Precision Grade. High Performance Grade specification includes a PSD tolerance to control mid-spatial frequencies, and enables the highest focused energy concentrations approaching the diffraction limit. This grade is the closest we can get to diffraction-limited performance with spot sizes ranging from 1.2x - 1.3x the theoretical diffraction limit. Finally, we place a tolerance on the maximum intensity of diffracted features in the focus. Features such as satellite foci are limited to < 10^{-7} of the central peak in the point-spread function.

See our downloadable technical publications to learn more

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