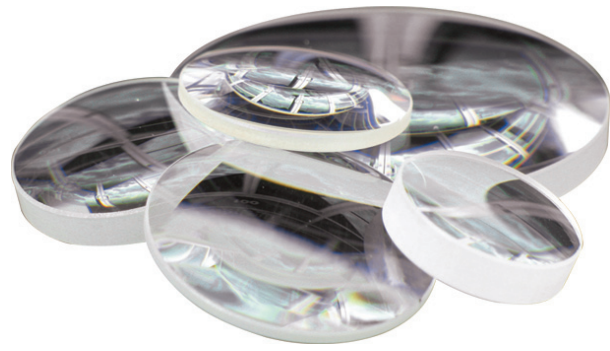


- Aspheric like performance
- Smaller focused spot size
- Low wavefront distortion
- High power handling
- Power threshold exceeds 1.3 kW/cm²*
- Single lens replacement for conventional doublets
- High performance, cost effective



In high performance optical systems, spherical aberration, chromatic aberration and astigmatism induce sweat on the brows of optical designers. These aberrations can prevent optical systems from reaching their full potential.

Avoiding these factors in optical systems is often difficult without using multiple lens elements. LightPath's® unique line of GRADIUM® optics makes correcting these aberrations with a single optical element a practical reality.

GRADIUM® lenses are made from LightPath's® proprietary axial gradient index glass. Its unique refractive qualities can be exploited to reduce spherical aberrations – resulting in performance similar to single-term aspheres.

GRADIUM® lenses have been applied as simple singlets or doublets in complex multi-element systems. They have been very well received for use in high-power industrial laser systems; many of the world's largest Nd:YAG and fiber laser manufacturers now incorporate GRADIUM® optics in their laser delivery systems.

LightPath's® DuraYAG™ assemblies provide a drop-in replacement for focusing and collimating assemblies on some of the most popular YAG laser systems. Their unique coverplate design extends the life of the assembly while the GRADIUM® lens provides a smaller focused spot size, increasing power density at the workpiece and enhancing overall system performance.

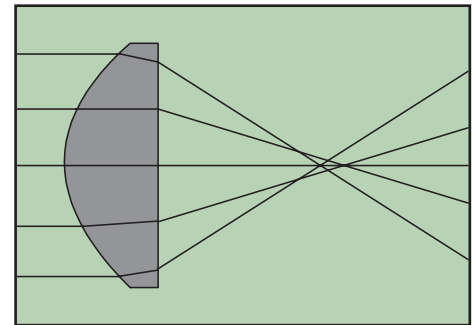
LightPath's® achromatic doublets are designed for use with collimated, polychromatic light in the visible spectrum. The GRADIUM® glass element is used to reduce the spherical aberration which is a common side effect of a cemented doublet design.

GENERAL LENS SPECIFICATIONS

Design Wavelength	546nm
Operating Temperature	-20°C to +200°C
Storage Temperature	-40°C to +300°C
Outer Diameter (OD) Tolerance	± 0.250mm
Center Thickness (CT) Tolerance	± 0.100mm
Effective Focal Length (EFL) for GAD Series	± 2%
Effective Focal Length (EFL) for GPX, GBX and GMN Series	± 1%
Working Distance (WD) for GAD Series	± 2%
Working Distance (WD) for GPX, GBX and GMN Series	± 1%
Surface Quality	40-20 Scratch-Dig
Chamfered with Safety Bevel	

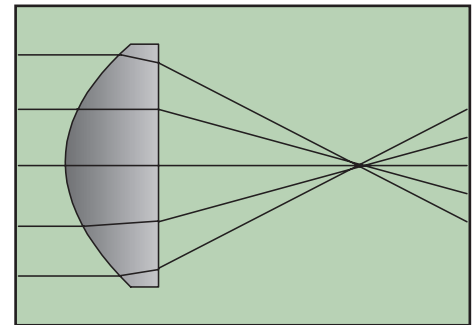
Standard Spherical Lens

Standard spherical lenses suffer from spherical aberration, which artificially limits the focused spot size.



GRADIUM® Lens

GRADIUM's® unique refractive index profile bends rays while traveling through the lens, resulting in a better focused, smaller spot.



GRADIUM® lenses provide a cost-effective solution for many high-performance applications.

*Tested at Fraunhofer Institute, Detroit, Michigan 2003

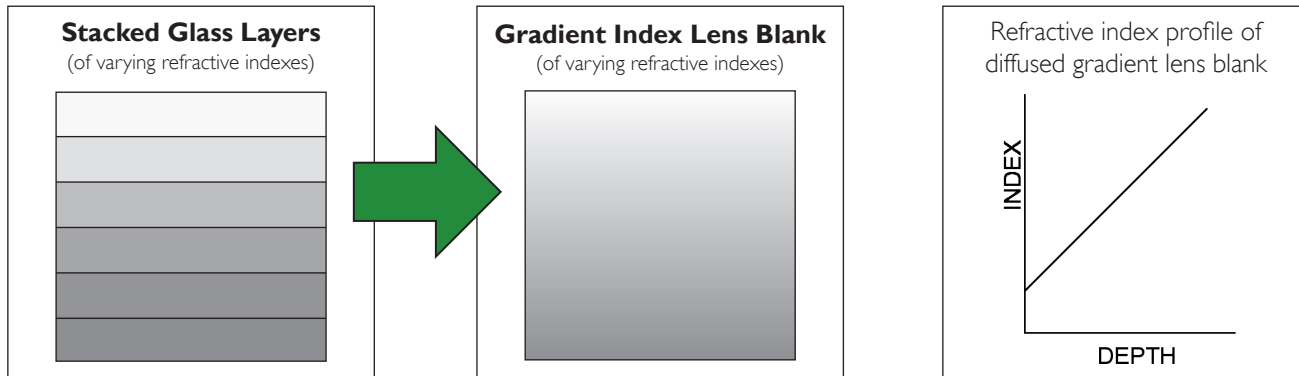
GRADIUM® lenses take advantage of recent advances in the manufacturing of axial gradient glass. Large diameter blanks are fabricated with index changes (Δn) of up to 0.15, about 100 times that available from radial GRIN (GRAdient INdex) technology. The large range in Δn available provides a substantial ability to correct aberrations, especially spherical.

The process used to produce the GRADIUM® glass turns a series of SF glass layers into a single piece of gradient material. Unlike radial GRIN lenses, this process provides large diameter optical blanks with controlled index and dispersion profiles. Proper gradient profile selection allows a simple spherical lens to act as an asphere.

GRADIUM® lenses should be used wherever small spot size, high numerical aperture (NA), increased beam energy, or excellent wavefront quality are important. A GRADIUM® singlet does not have the limited laser damage threshold of a conventional cemented doublet, so laser power can be increased, leading to increased production throughput.

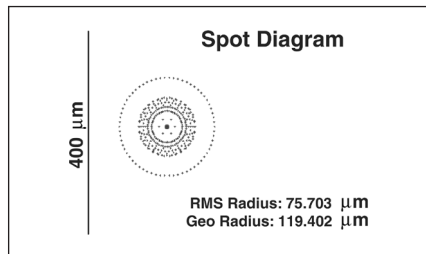
GRADIUM® glass offers the additional benefit of chromatic correction. The dispersion, as well as the optical index, varies in a controlled fashion within the lens. A finished lens can be viewed as a seamless, contiguous combination of many glass types. This continuous variation results in a transfer aberration correction not possible with homogeneous lenses. By combining GRADIUM® flint glass with a homogeneous crown glass, achromatic doublets are fabricated with superior color correction.

The GRADIUM® Process

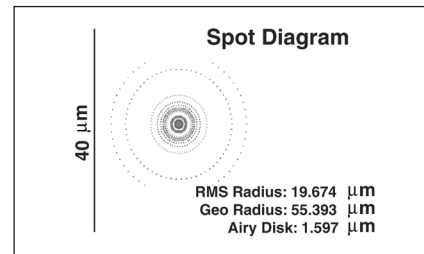


Typical Spot Diagram

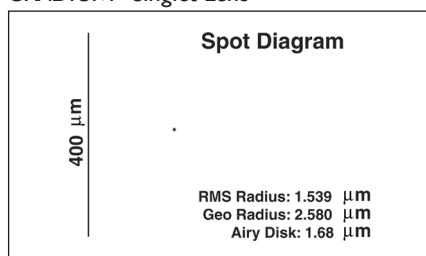
Standard BK7 Plano-Convex Lens



Standard Achromatic Doublet



GRADIUM® Singlet Lens



GRADIUM® Achromatic Doublet

