

Technical Note #02

Lens Protection Cover Glasses for High Average Power Fiber Lasers

Introduction

Multi-kilowatt fiber lasers have been commercially available for several years and are continuing to gain market share against all other laser types. Laser cutting of steel has historically used CO₂ gas laser technology and is now changing to cutting with fiber lasers. It is widely accepted by laser and laser system manufacturers that for cutting steels up to ~ 6 mm (1/4") thick the fiber laser cuts significantly faster than other laser types at an equivalent laser power. Fiber lasers (as opposed to fiber DELIVERED lasers such as disc and direct diode systems) are a completely different technology from other laser types in that the beam is actually generated in the fiber itself and the whole optical train is also within the fiber. Fiber lasers have numerous benefits including easier cooling and less contamination of optics.

Differences between Fiber Lasers and CO₂ Laser Cutting

It has taken many years to develop the laser cutting process with CO₂ lasers to the current level of sophistication. With the advent of fiber laser based cutting systems there is a need to learn as quickly as possible the subtle differences between cutting with fiber lasers and CO₂ lasers. One of these subtle differences is that the use of cover glass lens protectors or cover slides (see Figure 1, right) and these may currently be necessary to prevent optics damage. Although these lens protectors were initially deemed necessary for CO₂ lasers, as that laser cutting process has become better understood and improvements have been implemented in details such as pierce-through at the commencement of laser cutting these are often no longer deemed necessary.



Figure 1: Selection of Cross Slides

Currently, all users of high power fiber lasers are using lens protectors, at least partly because fused silica glass components have always been readily available.

Another indirect effect of the use of the shorter wavelength is that any metallic debris on the cover slide is better absorbed which makes cover slide maintenance more important for process stability. Customer feedback has shown that not all cover glasses are made equally and product consistency is a main concern. Some suppliers have identified what is necessary to ensure excellent performance at reasonable cost to meet the needs of this rapidly developing industry sector.

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New Developments in Cover Glasses

One of the many advantages of fiber lasers is that smaller laser beam diameters and narrower kerf widths can be achieved but this places more demands on all optics and, in particular, cover glass slides. Major improvements in optical components have been incorporated as follows:

- Thermal lensing has been tackled by selecting high grade fused silica substrates for improved optical transmission at 1070-1090 nm and lower thermal expansion, both of these help to maintain the AR coating integrity. Other substrates such as BK7, Pyrex and borosilicate do not share the same superior optical quality and thermal properties.
- Sophisticated high quality multi-layer narrow band AR (Anti-Reflective) "V" coatings are used and these provide higher transmission and longer life whilst maintaining high beam quality at multi-kilowatt levels.

These issues have been solved by selecting high grade fused silica substrates to withstand multi-kilowatt laser power. Fused silica has greater optical transmission properties at 1070-1090 nm as well as offering lower thermal expansion that helps maintain the AR coating integrity. Other substrates such as BK7, Pyrex and borosilicate do not share the same superior optical quality and thermal management required in high power applications.

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Summary

Fused Silica is readily available off the shelf enables suppliers to offer a wide variety of geometries from traditional circular cover slides to square and rectangular configurations. Directed Light, Inc. (www.directedlight.com) holds a large inventory of cover slides from 20-100 mm diameters all with high grade A/R coatings.

IPG looks forward to helping our customers with their laser applications and future plans. A laser solution should evaluate all aspects of the project including feasibility, productivity, metallurgy and part fixturing before a laser type and optical configuration is selected. IPG supports well equipped and professionally staffed applications laboratories to fully explore and develop fiber laser solutions.

Contact IPG's applications facilities to arrange free sample evaluation or process development. For more information on all of IPG's products go to www.ipgphotonics.com.