

GPX-3000 Series

Glass Processing and Fusion Splicing Systems for Large Diameter Fibers



 **VYTRAN**



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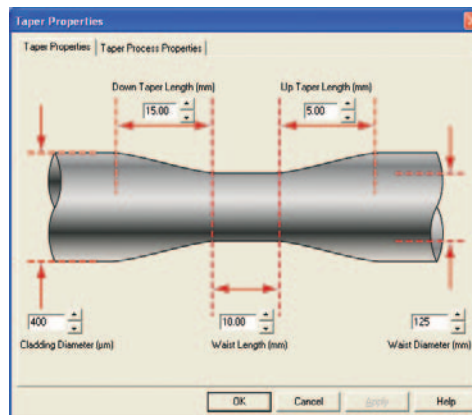
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Process Solutions for Fiber Laser

System Overview

The GPX-3000 series is a versatile glass processing platform for the fabrication of splices, tapers, couplers and combiners with optical fibers ranging from 125 microns up to 1.5 mm. All systems incorporate a filament "furnace" assembly that provides a stable high-temperature heat source for precise control of glass processing conditions. An embedded real time control system and powerful machine level macro programming language allow the user to develop unique event-driven routines for fast and flexible process development. All high level system communication is through a user-friendly PC based graphical interface that provides for easy operation and convenient data storage. This level of control combined with the consistency of filament fusion technology, makes the GPX-3000 series a multipurpose platform for the production of fiber laser and other specialty fiber applications, such as:

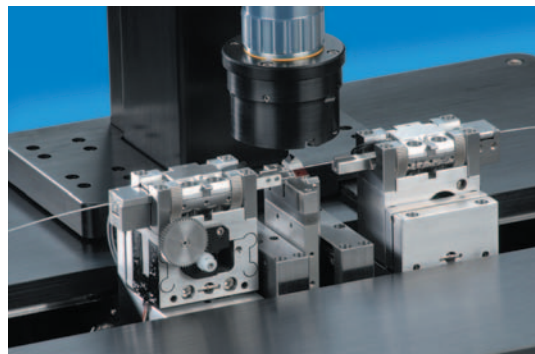
- Fusion splicing
- Fiber tapering and drawing
- Fiber lensing
- Mode adapters
- N.A. converters
- Thermal core expansion
- Pump and output combiners
- Fiber couplers
- End caps



Taper parameters are programmed through intuitive GUI

Glass Processing

All GPX-3000 configurations are capable of tapering and drawing fibers and capillaries with a processing length up to 180 mm. The physical characteristics of the desired taper are simply entered through a taper interface menu, and a low-level machine control macro is automatically generated. An optional tension monitoring and control system is also available for precise control of drawing conditions. The ability to physically taper and draw fibers is a critical capability for the assembly and fabrication of many fiber laser systems.



180 mm glass processing length with 0.25 µm resolution.

Mode Adapters and N.A. Converters

Fiber laser systems typically employ large mode area double clad gain fibers that must be coupled a wide variety of dissimilar input or output fibers. In order to optimize the signal and/or pump coupling between these fibers it is often very advantageous to physically taper the fibers to change the mode field diameter of the signal fibers (Mode Adapter) or the N.A. of the pump fibers (N.A. Converter).

Couplers and Combiners

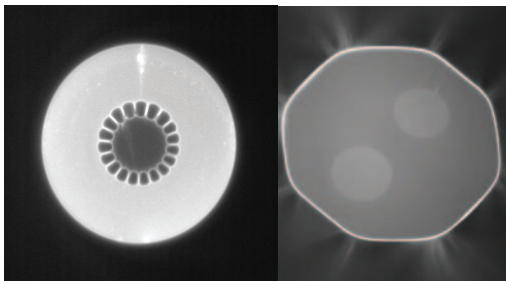
The GPX-3000 systems can also be used to fuse fibers side-by-side or into bundle configurations, which is the fundamental process for the fabrication of fused tapered couplers and pump or output combiners. Through precise control of the heating and pulling conditions, the operator has the flexibility and controls to develop application specific coupler and combiner solutions.

R&D and Production

Fusion Splicing

Vytran's unique filament fusion technology provides a consistent and reliable method of making high-strength low-loss splices. Precise control and repeatability of the fusion process is achieved by purging the splice region with an inert gas and using a resistive heating element to supply the thermal energy necessary for fiber fusion. The size, shape and power delivery of the resistive heating element can be changed to suit the application, and allows for easy scaling to very large diameter fibers. The filament furnace assembly can also be moved along the length of the fiber, which opens the possibility for many specialty processing applications, such as post-splice fire-polishing for strength enhancement.

The splicing capabilities of the various GPX-3000 configurations are summarized in the table at right and compared with Vytran's Model FFS-2000 Splicing Workstation. In general, the GPX-3100 and 3200 systems are best suited for very large diameter multi-mode fibers, while the GPX-3300 and 3400 are suitable for both single mode and multi-mode applications.



End-View Imaging

	80µm	125µm	< 250µm	< 500µm	< 1000µm	< 1500µm	MultiMode Fiber	Singlemode Fiber	Double Clad Fiber	PM Fiber
FFS-2000	•	•	•				•	•	•	•
FFS-2000 Large CCD	•	•	•	•			•	•	•	•
GPX-3100*					•	•	•			
GPX-3200					•	•	•			
GPX-3300		•	•	•	•		•	•	•	
GPX-3400		•	•	•	•		•	•	•	•

* While the GPX-3100 system is configured for taper-only applications, it is possible to use fixed V-Groove alignment to splice large diameter multimode fibers.

Thermal Core Diffusion

In addition to the ability to physically taper a fiber to alter its mode properties, the GPX-3000 systems can also be used to thermally diffuse the core dopants of a fiber, thereby changing its waveguide characteristics. A controlled heat distribution profile along the length of a fiber can be easily programmed for the adiabatic expansion of the mode field diameter. This technique can be used to obtain extremely low-loss splices between highly dissimilar fibers.

Splice Loss Determination

The GPX-3300 and 3400 systems incorporate Vytran's True Core Imaging™ technology for precise core alignment prior to splicing. Because this technology provides a true clear view of a fiber's inner core, an accurate estimation of splice loss can be achieved based on an analysis of the completed splice. Vytran has developed a proprietary algorithm that accurately calculates loss for splicing a variety of similar or dissimilar fiber types.

End-View Imaging

The GPX-3400 features an End-View Imaging system for looking directly at the ends of the fibers prior to splicing. This is used in conjunction with high-resolution rotary positioners for the automated alignment of PM fibers through either image-based or active feedback control. The End-View Imaging is also a very powerful tool when working with fiber laser gain fibers, which may have non-circular claddings or micro-structured cores.

End-Caps

The GPX-3000 systems are ideally suited for the task of fusing silica end-caps to power beam delivery fibers. Techniques are available for the collapse of PCF fiber and the fusion of silica end caps to silica-silica fibers. When used in conjunction with Vytran's Model LDC-200 Fiber Cleaver, precise end-cap lengths can be easily fabricated.

Specifications

Overall

Size:	16.0" x 12.5" x 6.3" (410 x 320 x 160 mm).
Weight:	45 lbs (20 kg).
Power:	External power supply unit, universal input: 90-260 VAC, 47-63 Hz, single phase. GPX-3000 input 12V and 48V DC 10A. PC input: 115 or 230 VAC, 47-63 Hz. Single phase.
Gas Supply:	Argon, Zero grade at 10 PSIG.

	GPX-3100	GPX-3200	GPX-3300	GPX-3400
Fusion Method	Filament	Filament	Filament	Filament
Max. Filament Temp.	~5600° F (3100° C)	~5600° F (3100° C)	~5600° F (3100° C)	~5600° F (3100° C)
Max. Fiber Cladding Dia.	2.0mm in soft glass 1.5mm in Silica	2.0mm in soft glass 1.5mm in Silica	1.0mm	1.0mm
Furnace "Z" Movement	±90mm from home position ¹	±90mm from home position ²	±90mm from home position ²	±90mm from home position ²
Max. Fiber "Z" Movement	180mm	180mm	180mm	180mm
"Z" Movement Resolution ³	0.25µm	0.25µm	0.25µm	0.25µm
Alignment Method	Fixed Alignment ⁴	Automatic or manual ⁵	Fully automated ⁶	Fully automated ⁶
X-Y Fiber Positioning Resolution ³	N/A	1µm	0.02µm	0.02µm
Fiber Viewing	Optional	CCD zoom lens ⁷	Core Imaging ⁸	Core Imaging ⁸
Strength Enhancement	N/A	Fire polish	Fire polish	Fire polish
Loss Estimation ⁹	N/A	N/A	Yes	Yes
Rotation Alignment	N/A	N/A	N/A	Full automated ¹⁰
Rotation Drive Resolution ³	N/A	N/A	N/A	0.02°
Rotation Travel	N/A	N/A	N/A	190°
Tension Monitor and Control System	Optional	N/A	Optional	Optional
Combiner/Coupler Packaging Fixture	Optional	N/A	N/A	N/A

¹ Max travel with fiber holding blocks fully extended.

² Max travel with fiber holding blocks parked.

³ Stepper motor controlled.

⁴ Fixed V-Groove in fiber holding block for tapering, FBT coupler and combiner applications.

⁵ CCD-based imaging system.

⁶ True Core Imaging™ or external feedback.

⁷ CCD / zoom lense imaging system; 2-axis view on PC monitor.

⁸ Real time image processing system viewed directly on PC monitor.

⁹ True Core Imaging™ technology for accurate loss estimation.

¹⁰ Fully automated End-View Alignment technology for PANDA, Bow Tie, Elliptical Clad or Elliptical core fibers. External Extinction ration feedback for automatic active rotation of all PM fiber types.