



## Which P-2000 model do I need?

By Jack Belgum, Ph.D.

Here is some useful information for choosing the model of P-2000 laser puller best suited to your needs. The P-2000 was designed at the outset for use with glass capillary tubes that were 0.6 to 1.5mm in diameter. The original puller bars were the same as used on our other horizontal pullers. These puller bars are able to clamp glass as small as 0.6mm in diameter, but glass capillaries of a smaller diameter are not easily clamped in the puller bars. After the introduction of the P-2000 customers expressed an interest in using the P-2000 to draw 125 micron diameter optical fiber. The only real change required was the design of a new puller bar that could clamp glass that was much smaller than 600 microns in diameter. Eventually, it was decided to call the original version used with larger diameter glass the P-2000/G and the version equipped to clamp very small diameter glass or fiber the P-2000/F.

The P-2000/G is designed to produce even heating on glass capillaries up to 1.2mm in outside diameter. Larger diameter glasses can be used with the P-2000/G (up to 1.5mm quartz and 1.8mm conventional glasses), but the performance is better with glass that is 1.2mm diameter or less. It is possible to clamp glass that is somewhat smaller than 0.6mm in diameter, but we do not advise selecting the P-2000/G if you plan to do a significant amount of work with glass that is less than 600 microns in diameter. (Please contact Sutter for more information if you must try to use the P-2000/G with glass that is less than 0.6mm in diameter).

The P-2000/F is the correct version for use with small diameter glasses such as optical fibers, and the small diameter fused silica capillary commonly used for the manufacture of nanospray tips. Small diameter glass (outer diameter in the range of 0.125mm to 0.6mm) requires the special puller bars of the P-2000/F as well as an optical alignment optimized for the smaller diameter material. As with larger diameter glass, a wide range of tip sizes and taper geometries can be produced with the P-2000/F and small diameter glass. We have drawn optical fiber tips ranging from less than 10nm to more than 5 $\mu$ m. Please consult our technical staff for further information. The puller bars of the P-2000/F are also able to clamp larger diameter glass. In fact, each P-2000/F is adjusted with 1mm quartz glass in exactly the same fashion as the P-2000/G before readjusting the optics to center the heating on smaller diameter glass.

If you only expect to use glass that is larger than 600 microns, the P-2000/G is clearly preferred. The puller bars of the P-2000/F can be used with larger glass, but it takes extra care to ensure the glass is clamped in place accurately. In addition, the current standard puller bars for the P-2000/G clamp different diameters of glass in the same vertical position. With the P-2000/F, larger diameter glass clamps in a higher position than smaller glass. This means that the incoming laser beam and the retro mirror must be readjusted for the best results when you switch between one diameter of glass and another.

