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# Advances in Cutting and Cleaving of Fused Silica Capillary Tubing ›

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**Polyimide coated fused silica capillary tubing is frequently employed in a variety of analytical instrumentation. In this application note we revisit methods for cutting and cleaving capillary tubing with a focus on recent advances.**

Fused silica capillary tubing's unique properties have made it a key component in separation scientist's tool box. Although used in analytical techniques such as GC, CE, Capillary LC, CEC, and Cytometry, it is of increasing importance in the area of fluid metering such as in drug delivery systems. Its dimensional precision is unmatched for microfluidic interfacing and mass flow control. The ease of cutting capillary to length is a key attribute, but care must be taken to insure that the appropriate cutting or cleaving method is selected so that optimum system performance is achieved.

Previous publications have outlined and defined the four primary methods of end face preparation, with those being Standard Cleaving, Precision Cleaving, Laser Cutting, and Saw Cutting (1, 2). Subsequent work provided more detailed guidance on selecting the most optimum method (3). In this latter effort tubing attributes such as i.d., o.d. and wall thickness were considered, as were their influence on finished part length. A comparative analysis of end-face quality, perpendicularity and cleanliness of the different techniques was also made. Advances in cutting and cleaving methods have been realized and are discussed in this note.

**Table I: Guidelines for use in comparing and selecting a cutting method for capillary tubing.**

| Attributes and Impacts | Standard Cleaving | Precision Cleaving | Saw Cutting | Laser Cutting |
|---|---|---|---|---|
| Min Length (mm) | 5 | 15* | 0.5 | 7 |
| Max Length (cm) | No Limit | No limit | 12 | 200 |
| Min i.d.(µm) | No Limit | No limit | 40** | 10 |
| Min o.d.(µm) | 90 | 90 | 200 | 100 |
| Min Wall Thickness (µm) | 20-25 | 25-35 | 45 | 40 |
| End Face Quality: 1 is highest | 3 | 2 | 4 | 1 |
| End Face Angle: 1 is lowest | 4 | 1 | 3 | 2 |
| Cleanliness: 1 is cleanest | 3 | 2 | 4 | 1 |

*Based on an o.d. up to 794µm; 40mm minimum on larger sizes.
**Based on 5mm or longer part.

## Recent Advances

**Standard Cleaving** – Cleaving capillary tubing to lengths less than 20mm while maintaining a good end face had been challenging at the production level. Improvements in technique now allow standard cleaving to lengths as short as 5mm on nearly all tubing products.

**Precision Cleaving** – This increasingly popular technique has seen similar reductions in finished part length due to tooling advances. Lengths as short as 15mm are now achievable. This applies to tubing with a high glass cross sectional area such as our new 1/32" OD Capillary. Polymicro has also developed the ability to provide precision cleaved parts with up to 35mm of the polyimide removed from the cleaved end. Previously, parts with this length of polyimide removed would have required a laser cut or lower quality standard cleave.

**Saw Cutting** – The maximum part length for saw cutting has increased from 4.5cm to 12cm due to investments in state of the art sawing equipment. New cleaning techniques allow for processing of tubing with i.d. down to 40µm. As in the past, part length is limited when saw cutting small i.d. tubing. Likewise, the minimum o.d. that can be processed has been lowered. For short parts, the o.d. can be as low as 200µm.

**Laser Cutting** – Industry leading attributes previously listed for laser cutting remain unchanged. However, related advances realized include improved control of end face contour of thick wall parts. Further, developments in the associated laser based polyimide removal techniques and equipment now allow for ablation of longer lengths of polyimide, i.e. up to 40mm on most tubing products.

Table 1 summarized the current guidelines for use in selecting the most appropriate cutting and cleaving method for your application.

## Conclusion

This note reviewed recent advances in the primary techniques employed for cutting and cleaving capillary tubing. For assistance with your specific application please contact a Polymicro Technical Sales Specialist.

## References

*(1) "Cutting and Cleaving Capabilities," The Book on the Technologies of Polymicro, Polymicro Technologies Publication, p. 3-5, (2011).*
*(2) J. Macomber, R. Hintz, T. Ewing & R. Acuna, LCGC Application Notebook, June 2005 p. 81.*
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