

Mandrel Extrusion for a Small ID Pressure Transducer Tube

Introduction

While small diameter tubing is commonly used in the medical market for catheters and surgical applications, Teel had the opportunity to develop a small diameter tubing product for a unique application in the medical transducer market. The transducer is part of a device that is integrated with an IV set, and the manufacturer needed a small tube to use with the device's restrictor. The part was a challenge because the ratio of the ID to the wall was so large it made maintenance of the ID specification difficult. To further complicate the development, the part needed a method ensuring that 100% of the parts had the ID present.

Achieving an Ultra-Small ID with Mandrel Extrusion

The customer requested extremely small dimensions and tight tolerances for the tube. The target dimensions were approximately 0.060" OD x 0.002" ID x 0.033" L with high Cpk values.

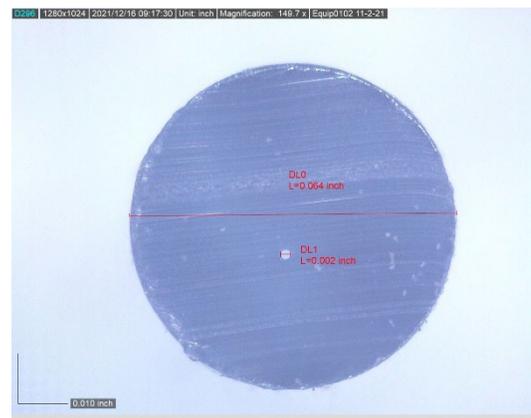
The thickness of the wall relative to the ID would be difficult to achieve with standard extrusion methods, so Teel developed a method of extruding the tubing over a wire mandrel and then extracting the wire in a separate process with automated equipment. This method would help ensure a controlled and consistent ID at the small size requested, in addition to ensuring the ID was unobstructed.

Teel first needed to determine the size of wire needed to achieve the ID, as it was uncertain how the plastic would mold itself around the wire and subsequently how exact the created ID would be relative to the size of the wire. After attempting several runs with differently sized wire, Teel found the wires created a tubing ID that almost exactly matched the dimensions of the wires themselves. The ideal mandrel for production was determined to be a 0.002" annealed stainless steel wire.

The Mandrel Extrusion Process

The extrusion setup process begins by stringing the wire through the extrusion tooling, pin, cooling tank, and then into the puller. The wire is pulled through the equipment as the extruder, situated perpendicular to the line, begins coating the wire with material using a crosshead die. The coated wire then works its way to the puller, which continues moving the composite material and wire through the system.

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Magnified image showing final ID.

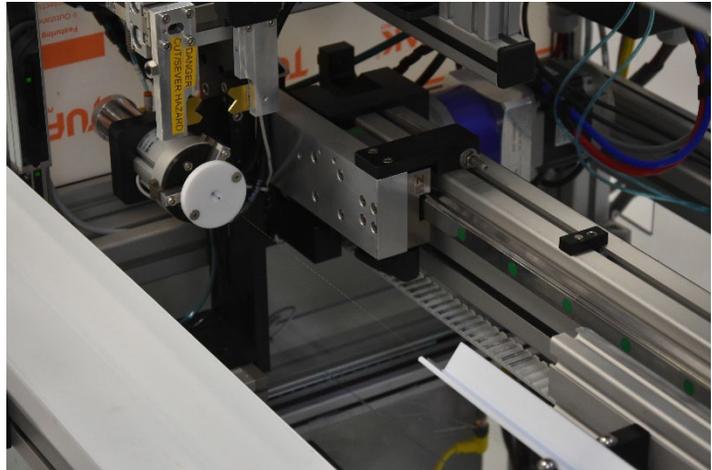


Final product size comparison.

Using a crosshead die to orient the extruder perpendicular to the wire and downstream equipment allows the wire to be pulled down the line unimpeded. During development, the crosshead tooling needed to be sized for the wire, and different extrusion speeds and temperatures were tested to achieve a precise level of coating. During extrusion, great care needs to be taken to ensure the wire is not stretched or broken. The output of the extrusion process is a master length part that is ready for automated wire extraction. The master length was carefully engineered to balance extractability of the wire with the demands of the high-speed, automated equipment used for the extraction.

The Wire Extraction Process

After extrusion, the master lengths of coated wire are taken to the custom-built wire extraction equipment. A piece is clamped on both ends, and a cutter pinches one of the ends to release the plastic from the wire. The cutter then pulls the plastic tubing off the wire using a defined speed and tension. As it is pulled off the wire, the tubing is cut to length. The process is slower than extrusion, but high-speed relative to per-unit output. As an added quality control process, the machine will fault if it believes the wire has been compromised during the process.



Wire extraction in process.

Conclusion

This project demonstrates how outside-the-box thinking can modify the standard extrusion process to achieve exceptional results and create parts others might think are not obtainable. Bring your unique medical product to market by partnering with the experienced and innovative engineering team at Teel Plastics for truly custom solutions.