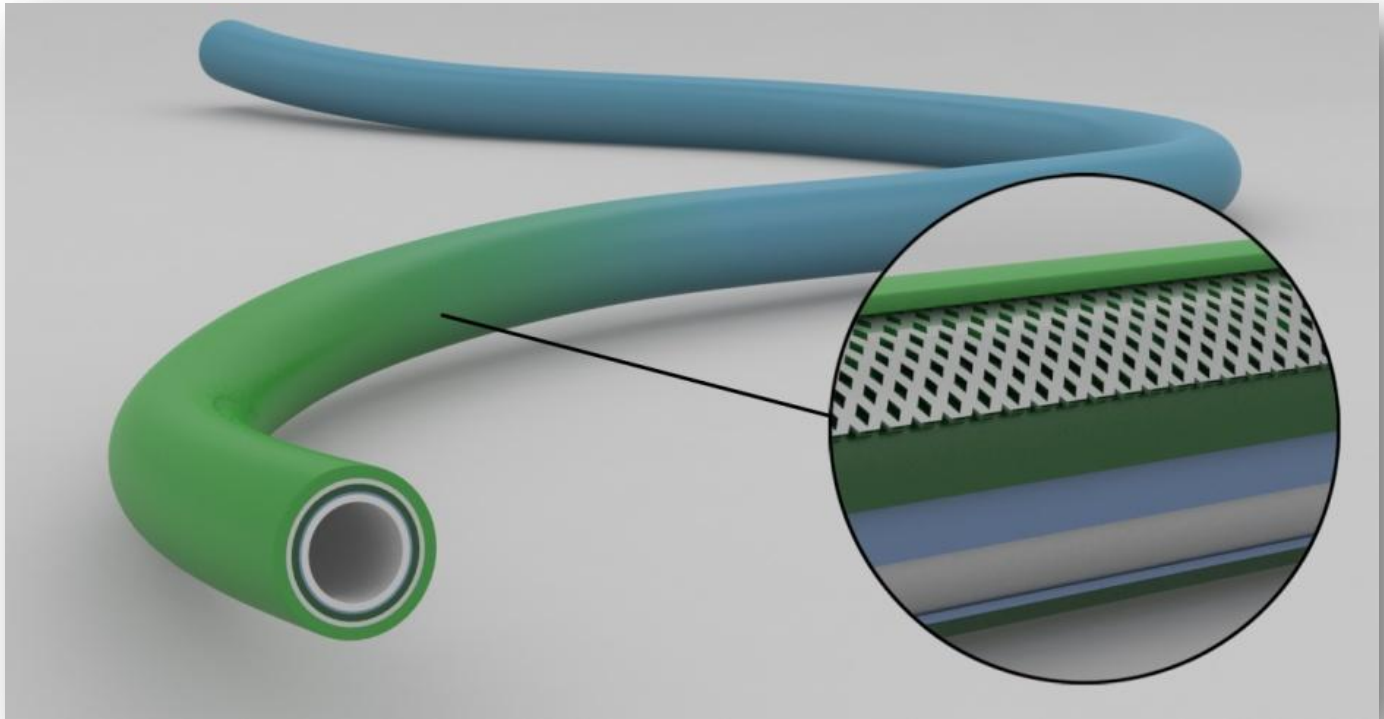


# Tri-Tie™ Continuous Extrusion Technology

*Eliminating Hand Lay-up Manufacturing of Guide Catheters*



## Benefits of Tri-Tie™ extrusion technology over the conventional approach:

### **Reliable Shaft Performance:**

*integrated bonding between outer & inner layers*

### **Reduction of Kink/Hinge Points:**

*continuous, variable durometer outer layer eliminates kinking at bonded segment interfaces*

### **Improved Quality & Validation:**

*elimination of discrete components and manual operations*

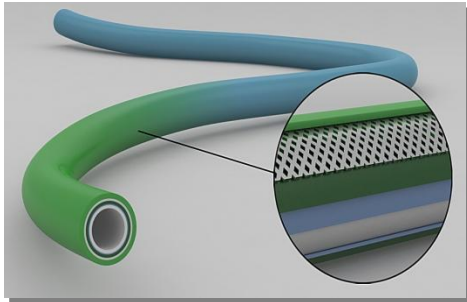
### **Cost Savings:**

*continuous manufacturing reduce cost compared to conventional methods*

Guide catheters are commonly used to access endovascular sites and deliver balloons, stents, guide wires, contrast media and other devices. These catheters are costly and challenging to manufacture due to complex shaft requirements. These include:

- a lubricious inner layer for easy passage of devices
- a braided stainless steel middle layer for torque transmission and support
- an outer layer that varies from a flexible distal end to minimize intravascular wall damage and thrombosis generation to a more rigid proximal end for pushability

Traditionally, these complex shafts have been manually assembled from discrete components and heated to create the final component. This is costly and presents challenges for validating a highly manual manufacturing process. Product performance can also vary due to poor bonding between the layers and at the interface of the discrete segments on the outer layer, where hinge points occur.



### Tri-Tie™ Technology

Putnam Plastic's Tri-Tie™ technology eliminates the traditional manual approach with a proprietary, continuous processing method to create a fully integrated composite shaft. Tri-Tie™ shafts incorporate the traditional three-layer approach with some modifications to improve performance and reliability.

The lubricious inner layer is designed with a fully bondable outer surface. This allows the outer layer of the shaft to penetrate the middle braid layer and securely bond to the

inner layer, creating an integrated structure. Discrete outer layer segments and hinge points are eliminated with Putnam's proprietary intermittent extrusion process whereby polymers of varying durometer are applied along the length of the shaft in a single extrusion.

Tri-Tie™ guide catheter shaft manufacturing rethinks the conventional approach to achieve a more integrated and reliable component, at a lower cost. While the technologies and materials used for this process have a proven track record in vascular catheter applications, the combination of these technologies in a single component is a hallmark of Putnam's innovative approach.

### About Putnam

For over two decades, Putnam Plastics has provided comprehensive extrusion technologies for medical catheters and minimally invasive devices. Technologies include thermoplastic and fluoropolymers extrusions, polyimide tubing, printing, and tipping and machining tubes. Putnam offers development through validated manufacturing services.



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