Product Family Brochure

Liner Comparison Brochure

From soft and flexible to stiff and rigid, Zeus' diverse portfolio of high-performance, thin-walled catheter liners help device engineers transform today's impossible into tomorrow's reality.

ZEUS®

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Catheter Liners? We've Got You Covered.

Liner selection remains the cornerstone of successful catheter design. Generally, the most desired features of a catheter liner are thin walls and low coefficient of friction (high lubricity). Still, for every catheter project, medical device manufacturers must match the application's requirements to the size and mechanical performance properties of the available liner options.

Lubricity -

The lubricity of a liner is an important factor when considering the inside diameter (ID) of the catheter and the need for intraluminal devices (e.g., stents, balloons, etc.) to pass through it. Increased lubricity of the catheter ID results in reduced deployment force of these devices as they are passed through the catheter's working channel, increasing the likelihood of a successful procedural outcome. PTFE largely remains the gold standard for most catheter designs thanks to having the lowest coefficient of friction of any polymer. Polyimide (PI), another popular choice, has a higher coefficient of friction than PTFE and is, therefore, not as lubricious. However, PI/PTFE composites, such as Zeus' PI Glide™, can help mitigate this difference in lubricity.

Thin Walls -

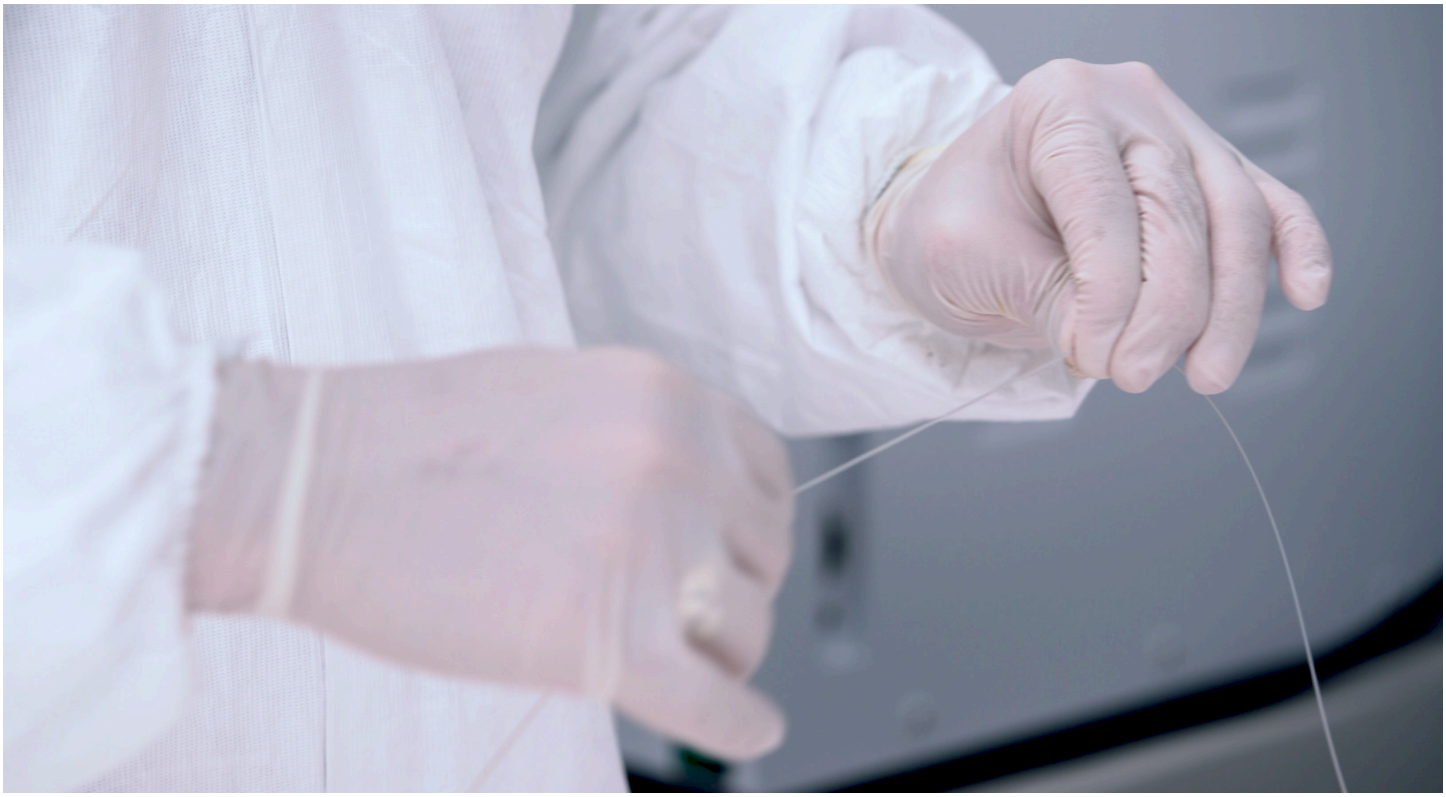
A catheter liner with thin walls is advantageous as it enables designers to maximize the catheter's working channel while keeping the device's overall profile to a minimum. Both PTFE and PI can be processed into tubing that possesses wall thicknesses well below 0.005″ (0.127 mm). Thin walls are also a contributing factor in the strength and flexibility of a catheter. For any given material, liners with thicker walls will typically be stronger, while liners with thinner walls will be more flexible.

Strength & Flexibility -

Beyond just the dimensions of the catheter liner, the polymer, and even the manufacturing process, can play a considerable role in dictating the overall mechanical performance of the liner. For instance, PI possesses a higher tensile strength than PTFE. As a result of this greater strength, PI liners will also be more rigid and less flexible than comparatively sized PTFE liners. Ultimately, choosing a liner material greatly depends on the intended application and requirements of the finished device, and a Zeus team member can help you select the right material for your project.

The table below provides a general overview of the differences between materials used in various Zeus liners.

	Film-Cast PTFE	PTFE OTW	Free-Extruded PTFE	Polyimide	PI Glide™
LUBRICITY	●●●●●	●●●●●	●●●●●	●●●○○	●●●●○
WALL THICKNESS	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
STRENGTH	●●●○○	●●●◐○	●●●●○	●●●●●	●●●●●
FLEXIBILITY	●●●●●	●●●●◐	●●●●○	●●●○○	●●●○○



Choosing the Right Liner for Your Next Project

PTFE Sub-Lite-Wall™ Liners

With industry-leading sizing, tight tolerances, and high-performance properties, Zeus PTFE Sub-Lite-Wall™ liners are an ideal choice for a wide variety of advanced vascular catheter designs.

- Thin and flexible
- Largest range of ID and wall sizes in the industry
  - *ID's from 0.002" – 0.500" (0.051 mm – 12.7 mm)*
  - *Nominal wall thicknesses from 0.001" - 0.005" to (0.025 mm - 0.127 mm)*
- Available in straight cut lengths
  - *Max cut length 86" (2184.4 mm)*

PTFE Sub-Lite-Wall™ StreamLiner™

Pairing max wall thicknesses of 0.001" (0.0254 mm) and below with best-in-class tensile strength, StreamLiner™ catheter liners enable advanced catheter designs with smaller profiles or larger working channels.

- Thinner and more flexible than Sub-Lite-Wall™ liners
- Nominal wall thicknesses from 0.0005" – 0.00075" (0.0127 mm – 0.01905 mm)
- More design freedom
  - *Maximize working channel or minimize device profile*

PTFE Sub-Lite-Wall™ StreamLiner™ Over-The-Wire

Blending strength and flexibility with nominal wall thicknesses as low as 0.0004″ (0.0102 mm), StreamLiner™ OTW catheter liners open new pathways for delivering lifesaving therapies.

- Blend of strength and flexibility
- Nominal wall thicknesses from 0.0004″ – 0.00075″ (0.0102 mm – 0.01905 mm)
- More design freedom
  - *o Maximize working channel or minimize device profile*

PTFE Sub-Lite-Wall™ StreamLiner™ NG

Thanks to Zeus' proprietary film-cast process, which helps reduce surface imperfections and pinholes, StreamLiner™ NG catheter liners take flexibility, mechanical performance, and reliability to the next level while still featuring the exceptional sizing and tolerances of existing StreamLiner™ offerings.

- Most flexible StreamLiner™ yet
  - *o Access to smaller, more complex vasculatures*
- Proprietary film-cast process
  - *o Reduced surface imperfections and pinholes*
- Max walls up to 0.001″ (0.025 mm)

PTFE Sub-Lite-Wall™ Multi-Lumen

As a single, process-ready extrusion, Zeus PTFE Sub-Lite-Wall™ multi-lumen tubing helps simplify steerable catheter construction, reduce manufacturing steps, and improve yields.

- Reduce complex procurement steps and inspection times
  - *o No need to buy 3-5 individual liners*
- Reduce manufacturing steps and speed production
  - *o Eliminate complex tooling*
  - *o No need to glue/assemble/bundle individual liners together*
- Reduce costs and improve yields and efficiency
  - *o PTFE Sub-Lite-Wall™ Multi-Lumens are process-ready*

At a Glance – Zeus Liner Capabilities

	Sub-Lite-Wall™	StreamLiner™	StreamLiner™ OTW	StreamLiner™ NG	Sub-Lite-Wall™ Multi-Lumen
MATERIAL	PTFE	PTFE	PTFE	PTFE	PTFE
PROCESS	Free-Extruded	Free-Extruded	Extruded Over-The-Wire	Proprietary Film-Cast	Free-Extruded
MANDREL	None	None	Silver-plated copper, Stainless steel	Silver-plated copper, Stainless steel	None
INSIDE DIAMETER (ID)	0.002″ – 0.500″ (0.051 mm – 12.700 mm)	0.004″ – 0.120″ (0.102 mm – 3.048 mm)	0.013″ – 0.0915″ (0.330 mm – 2.3241 mm)	0.017″ – 0.0915″ (0.432 mm – 2.3241 mm)	0.010″ – 0.300″ (0.254 mm – 7.620 mm)
ID TOLERANCE	± 0.0005″ – 0.003″ (± 0.0127 mm – 0.076 mm)	± 0.0005″ – 0.001″ (± 0.0127 mm – 0.025 mm)	± 0.0005″ (± 0.0127 mm)	± 0.0005″ (± 0.0127 mm)	± 0.001″ – 0.003″ (± 0.025 mm – 0.076 mm)
NOMINAL WALL THICKNESS	0.001″ – 0.005″ (0.025 mm – 0.127 mm)	0.0005″ – 0.00075″ (0.0127 mm – 0.01905 mm)	0.0004″ – 0.00075″ (0.0102 mm – 0.01905 mm)	0.0005″ – 0.00075″ (0.0127 mm – 0.01905 mm)	0.0035″ Max Avg. (0.0899 mm Max Avg.)
WALL TOLERANCE	± 0.0005″ – 0.001″ (± 0.0127 mm – 0.025 mm)	± 0.00025″ (± 0.00635 mm)	± 0.0002″ – 0.00025″ (± 0.0051 mm – 0.00635 mm)	± 0.00025″ (± 0.00635 mm)	N/A
CUT LENGTH	86″ Max.* (2184.4 mm Max.)	86″ Max.* (2184.4 mm Max.)	86″ Max. (2184.4 mm Max.)	86″ Max.* (2184.4 mm Max.)	86″ Max.* (2184.4 mm Max.)
SURFACE TREATMENTS	Etched, Tie Layer	Etched, Tie Layer	Etched	Etched, Tie Layer	Etched, Tie Layer
STERILIZATION METHODS	Autoclave, EtO	Autoclave, EtO	Autoclave, EtO	Autoclave, EtO	Autoclave, EtO
STRENGTH	●●●●●	●●●●○	●●●◐○	●●●○○	●●●●●
FLEXIBILITY	●●●○○	●●●●○	●●●●◐	●●●●●	●●●○○

** Liners with a Tie Layer have a maximum cut length of 78″ (1981.2 mm)*

StreamLiner™ and StreamLiner™ OTW may be shipped with product labels that feature VT, XT, or UT size designations. VT represents a standard nominal wall thickness of 0.00075″ (0.01905 mm). XT represents a standard nominal wall thickness of 0.0005″ (0.0127 mm). UT represents a standard nominal wall thickness of 0.0004″ (0.0102 mm)

Polyimide and PI Glide™

With a combination of mechanical toughness, thermal stability, and radiation and chemical resistance, Zeus PI tubing is well-suited for a wide variety of medical applications. When enhanced lubricity is required, PI Glide™, a PI/PTFE composite, provides up to 25% lower coefficient of friction over standard PI.

- Large range of ID and wall sizes
  - *ID's from 0.0045" – 0.090" (0.1143 mm – 2.286 mm)*
  - *Nominal wall thicknesses from 0.0004" – 0.005" (0.0101 mm – 0.127 mm)*
- Stronger and more rigid than comparatively sized PTFE liners
- Helps you adhere to REACH and EU MDR guidelines*

**Our thorough analytical test results indicate that no SVHC/CMR restricted substances are intentionally included in Zeus-supplied polyimide products at levels above the 0.1% threshold outlined by REACH and EU MDR*

Reinforced Polyimide

For challenging applications that require enhanced torque, flexibility, kink resistance, improved pushability, or increased strength, reinforced polyimide tubing is an ideal choice. Reinforced polyimide tubing helps medical device engineers optimize their designs and fine-tune key performance characteristics, paving the way for improved procedural outcomes and increased patient safety.

- Customizable reinforcement options
  - *Full-load and half-load braid patterns*
  - *Clockwise and counter-clockwise coiling*
  - *30 – 150 PPI/WPI*
- Total wall thicknesses from 0.002" – 0.006" (0.051 mm – 0.152 mm)
- Helps you adhere to REACH and EU MDR guidelines*

**Our thorough analytical test results indicate that no SVHC/CMR restricted substances are intentionally included in Zeus-supplied polyimide products at levels above the 0.1% threshold outlined by REACH and EU MDR*

At a Glance – Zeus Polyimide Capabilities

	Polyimide Tubing	Reinforced Polyimide Tubing
MATERIAL	Polyimide, PI Glide™	Polyimide, PI Glide™
PROCESS	Film-Cast	Film-Cast
INSIDE DIAMETER (ID)	0.0045″ – 0.090″ (0.1143 mm – 2.286 mm)	0.010″ – 0.070″ (0.254 mm – 1.778 mm)
ID TOLERANCE	± 0.0002″ – 0.001″ (± 0.0051 mm – 0.025 mm)	± 0.0002″ – 0.001″ (± 0.0051 mm – 0.025 mm)
WALL THICKNESS	0.0004″ – 0.005″ Nom. (0.0102 mm – 0.127 mm Nom.)	0.002″ – 0.006″ Total (0.051 mm – 0.152 mm Total)
WALL TOLERANCE	± 25%	± 25%
CUT LENGTH	78″ Max. (1981.2 mm Max.)	78″ Max. (1981.2 mm Max.)
SURFACE TREATMENTS	Tie Layer, Pebax®, Vestamid®	Tie Layer, Pebax®, Vestamid®
REINFORCEMENT	n/a	304V Stainless Steel, Nitinol
COLORS	Natural, Amber, Green, Red, Black	Natural, Amber, Green, Red, Black
STERILIZATION METHODS	EtO, Gamma**, e-beam**	EtO, Gamma**, e-beam**
STRENGTH	●●●●●	●●●●●
FLEXIBILITY	●●○○○	●●●○○

*** Gamma and e-beam sterilization methods are not available with PI Glide™*

Braid Capabilities				
Wire Type	**Shape**	**Sizes**	**Braid Pattern**	**PPI**
304V Stainless Steel	Flat	0.0005″ x 0.0025″ – 0.001″ x 0.005″ (0.0127 mm x 0.0635 mm – 0.025 mm x 0.127 mm)	Full Load (1 under 2, over 2) or Half Load (1 under 1, over 1)	30 – 150
	Round	0.001″ (0.025 mm)		
Nitinol	Flat	0.0005″ x 0.0025″ – 0.001″ x 0.005″ (0.0127 mm x 0.0635 mm – 0.025 mm x 0.127 mm)	Full Load (1 under 2, over 2) or Half Load (1 under 1, over 1)	30 – 150
	Round	0.001″ (0.025 mm)		

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- Refine and Optimize Manufacturing Techniques
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OUR MISSION

PROVIDE SOLUTIONS · ENABLE INNOVATION · ENHANCE LIVES

Zeus, headquartered in Orangeburg, South Carolina, is the world's leading polymer extrusion and catheter design manufacturer. With over 55 years of experience in medical, aerospace, energy, automotive, fiber optics, and other leading industries, Zeus's mission is to provide solutions, enable innovation, and enhance lives. The company employs over 2,400 people worldwide with facilities in Aiken, Columbia, Gaston, Orangeburg, and St. Matthews, South Carolina; Branchburg, New Jersey; Chattanooga, Tennessee; San Jose, California; Arden Hills, Minnesota; Guangzhou, China; and Letterkenny, Ireland. For more information, visit *www.zeusinc.com.*

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