

# Overview of Solid Elastomeric Mandrels for Composite Fabrication

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### Our Vision

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GENERATION



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SYSTEMS

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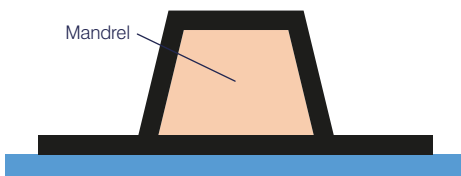
Rigid metallic mandrels have long been used for laying up cylindrical composite structures, either by hand, filament winding, or automated tape and tow placement.

Solid elastomeric mandrels are most typically used for skin-stringer applications in combination with rigid mold tooling. They have been used, experimentally or in production, with all of the common types of stringer designs.

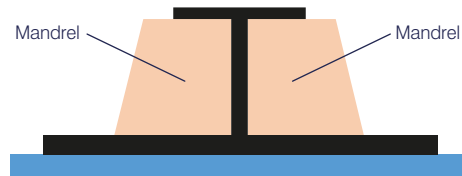
Mandrels can enable more efficient and complex designs and more integrated composite structure with reduced secondary assembly steps.

The diagrams below show the most common types of stringers and a typical way that a mandrel can be used to form them.

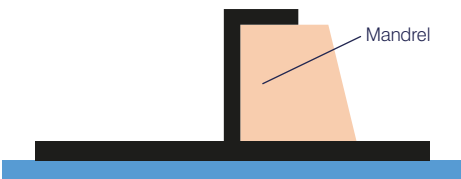
## “Hat” or “Omega” Stiffener



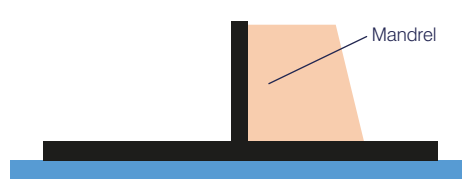
## “I-Beam” Stiffener



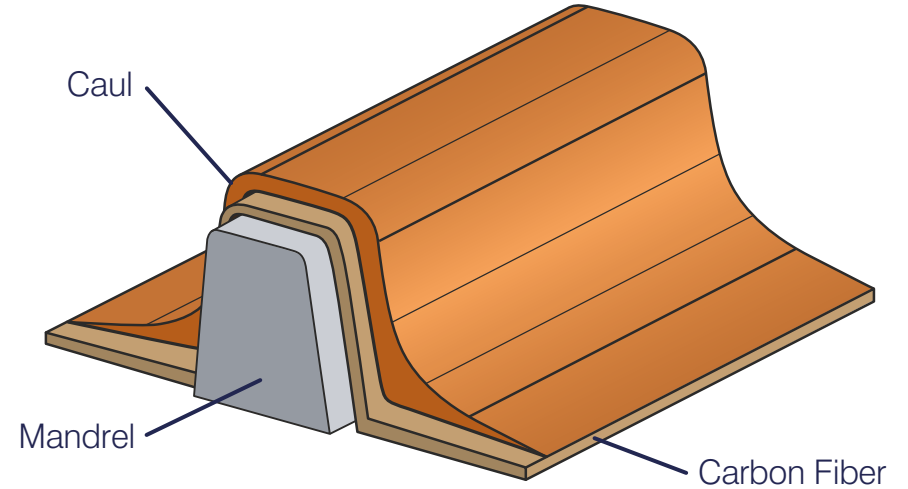
## “J” Stiffener



## “Blade” Stiffener



Common applications for elastomeric mandrels. Actual transitions may be more gradual, to avoid mark-off on the composite skin.



## Mandrel + Caul + Carbon Fiber for Elastomeric Applications

In any of these cases, it can be useful to have an elastomeric caul that goes over the exposed composite to ensure proper pressure distribution and protect both male and female corner radii. The key advantage of the rubber mandrel is that it is rigid enough to support the composite laminate, but flexible enough to conform to the contoured surface. A metallic mandrel detail can result in resin pockets or resin starved areas, if the preform layup and the mandrel do not match perfectly. Elastomeric mandrels can also conform along its length to curvature or ply drops.

Due to its relatively high coefficient of thermal expansion, the mandrel shrinks away from the composite during cool-down, and is easy to withdraw. Silicone is one of the most common mandrel materials for autoclave use due to its modest cost, good high temperature longevity, and ease of fabrication. Other materials like Viton™, butyl, and EPDM have also been used. In many cases, a surface film made from FEP is used to prevent direct contact between the rubber and composite, and to ease extraction.

Current applications for Rubbercraft elastomer mandrels are for fabricating carbon fiber skin-stringer structure including on engine nacelle, wings, vertical fin, horizontal stabilizer, rotorcraft fuselage, UAV fuselage.