

**COMPOSITE ENVISIONS KNOWLEDGE CENTER
PRACTICAL AND INSIGHTFUL COMPOSITES INFORMATION**



MAKING CUTTING TEMPLATES FOR MOLDS



***COMPOSITE
ENVISIONS***



MAKING CUTTING TEMPLATES

INTRODUCTION

Ply cut templates for layups should arguably be made into a process of its own. Well before resin is ever introduced to the process of a part, whether it be infusion, wet layup, or prepreg processes. Cutting templates for ply shapes will aid the layup process in many ways. Improved cleanliness and organization throughout the layup process, helping get the most out of the resin set time / cure time, improving and standardizing material utilization, increasing the efficiency and ease of the entire layup process, layup quality, the list goes on.

When laying plies over complex or large surfaces, it is helpful that one is not fumbling around with a 3 foot long piece of carbon fiber trying to layup a part, all while keeping relative track of fiber orientation and then not causing quality issues throughout the layup. Even after doing all of this successfully, going back and trimming excess fibers from the ply may cause additional issues with dry fibers going back into the part and having to pick them out of the layup or visually ruining the beauty of the first layer going down in the tool surface.

SO, WHAT IS A PLY CUTTING TEMPLATE?

A ply cutting template is a sort of “master ply” shape. In many industrial applications, computer software can simply “flatten” complex tooling geometries and even measure “ply build up” to give an accurate cutting template file to be communicated and cut on a CNC ply cutting table. Many do not have that luxury. However, there are some crafty yet simple solutions to combat the above issues, helping the layup process go smoother.

Important Tip(s) to Remember:

- When creating tooling and ply shapes, near net shapes may yield better material utilization. (near net meaning, nearest the final trim line of the part) However, common practice is to leave at least (1”) beyond the part’s final scribe / trim line depending on how big the part is. It would not be a bad idea to incorporate (2) scribe lines to mold surfaces to get a final “layup line” and a “trim line”.
- When making ply shape templates that will not go over the entire layup area, or that may be overlapped by other plies, draw a reference line where the ply will go onto the tool surface using a pentel pen, black sharpie, or other writing utensil as needed. It may help if the line visually stands out on the tool surface. (Usually a rag soaked in IPA will remove these lines on tool surfaces when the reference lines are no longer needed.)

FOR WET LAYUPS & INFUSION PROCESSES

Dry Fabrics are usually consistent in their workability. There may be differences in weave patterns / twills / uni directional plies that may cause some differences but generally when making a ply cutting template, most any type of dry loose fabric can be used.



MAKING CUTTING TEMPLATES

For simple ply shapes over less contoured or flat molds, clear plastic or vacuum bag material may be used. Simply tape one ply edge down onto the tool, lay the film down to the mold and trace out the final ply edges with a black sharpie, take the material off the mold, and cut the ply shape to the line. As an option, the perimeter of the template ply may then be traced to cardboard, plastic, or other material for a ply cutting template. This will add rigidity and a higher degree of repeatability if making multiple parts. Cut the template out with a cutting tool as needed, staying as close to the line as possible.

Tip: Cut the template out with a saw, or other tool as needed, close to the shape and sand to the final dimensions as it would be cut for a composite laminate.

Once cut, marks can be drawn on the 0-degree fiber orientation, the 90-degree, and the 45-degree as needed. Some ply buildups incorporate 0-30-60-90 but this depends on the part needs. Once marked this will yield a way to make ply shapes in the needed orientations for a given layup schedule.

In more complex layup processes or more contoured tooling surfaces, dry fiberglass cloth such as a (2x2 twill) could be used as sacrificial fabric instead of a woven Carbon Fiber or Kevlar fabric layup, as a cost savings. Any dry fabric should conform nearly the same way when making a ply shape template.

Once the fabric choice is made use some “judgement” or some quick measuring calculations for how long or wide a piece to make for a “rough cut” of the respective ply. If ply orientation is critical in the layup, take a ruler and draw the fiber orientation line using a black sharpie (if sacrificial). This orientation line can be an easy visual reference on Fiberglass while working the ply to its needed form. This helps ensure that when the “master template” is made it will be cut to the right orientation for repeatable cuts.

Place the ply in the mold. It may be noticed that the ply slides around and isn't much good for a template as it will not stay in one place. If simply putting a piece of tape around the ply edge does not work, use of a spray adhesive may be used. It should be noted that a light mist of this spray adhesive should be used and a light version of tact in selection of the spray adhesive. However, if the tool has mold release already applied to it, it should not stick as much. Lightly place the “misted” ply onto the mold surface, not pressing firmly onto the tooling surface. Just enough to lightly stick it to the mold in order to get the shape of the ply. Draw out the needed periphery of the ply and remove it from the mold surface. Remove the ply, flatten and cut as needed using scissors. As an option, a rigid tool may be made as described above or transferred onto plastic film for making the template. The sprayed adhesive may be used as the template alone, but discretion should be used to ensure it does not adversely affect laminate properties.

Note: In thinner part's template plys usually do not have to be considered for being made slightly larger as the part thickens. However, in thicker parts with many reinforcement layers,



MAKING CUTTING TEMPLATES

the ply shape may change as the part gets thicker over contoured surfaces. Each ply may vary slightly dependent on the part's shape.

PREPREG TEMPLATES

If one has ever worked with prepreg, it is quickly noticed that the material is different than that of dry fabrics. There are a ton of prepregs to choose from that will have differing resin contents / fibers / orientations and even processes of which they were impregnated. This changes workability of plies in layup. What each prepreg does share is that it is generally easier to cut prepreg plies and consistency of the plies are higher between each ply that is laid in the same respective direction. Prepreg [generally] does not conform to complex shapes like that of dry fabrics.

One of the biggest challenges to some prepregs is that with some tighter woven fabrics will conform at a 45-degree orientation better in curvature areas vs a 0-degree orientation. 45-degree oriented plies are more likely to “stretch” to conform to mold surfaces, for better or worse. Knowing these challenges, the best way to make a ply cutting template for a prepreg layup is to start with the same prepreg material itself, making a sort of sacrificial ply that you may or may not use down the road during the layup process itself.

As stated above, use some “judgement” or some quick measuring calculations for how long or wide a piece to make for a “rough cut” of the respective ply. If ply orientation, draw the fiber orientation line. This helps ensure that when the “master template” is made it will be cut to the right orientation for repeatable cuts. A White Pentel 100WS paint pen may be used on CF to stand out visually better than a black sharpie.

As the “rough-cut” ply is laid onto the mold surface use of a heat gun (if available) may be used to help “tack” the ply to the mold surface. This is particularly useful if the prepreg is dry or has little to no tack.

Spray Adhesive could be used but will yield the ply unusable in a prepreg layup and cure process.

With an amount of patience, work the rough-cut ply into position, paying particular attention to not stretch or distort the ply orientation. Once the ply is laid down, draw out the perimeter or periphery of the final cut line of the material to the “layup line” or scribed part edge as needed. Use scissors, razorblade, or other cutting method as needed to cut the template ply to shape.

Once this is complete, remove the ply from the mold. Flatten the template ply on a flat surface as the ply allows, if the ply has not been distorted, this should be an easy process. Once flattened, it will yield the geometry needed for future ply shapes. As an option, the perimeter of the template ply may then be traced onto a more rigid ply template tool as



MAKING CUTTING TEMPLATES

described above in the Wet Layups and Infusion section and marked accordingly for fiber orientation.

Composite Envisions LLC
8450 Development Court
Wausau, WI 54401 USA
+1 715-842-0101
info@compositeenvisions.com
<https://compositeenvisions.com/>



**COMPOSITE
ENVISIONS**