

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



HOW TO KEEP WEAWE STRAIGHT AND ALIGNED



***COMPOSITE
ENVISIONS***

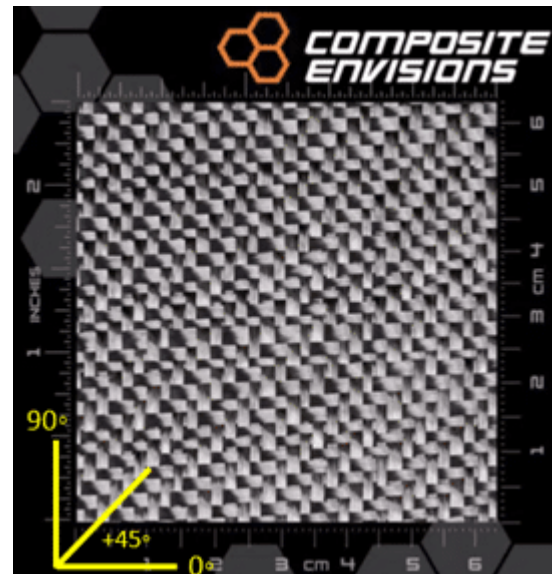
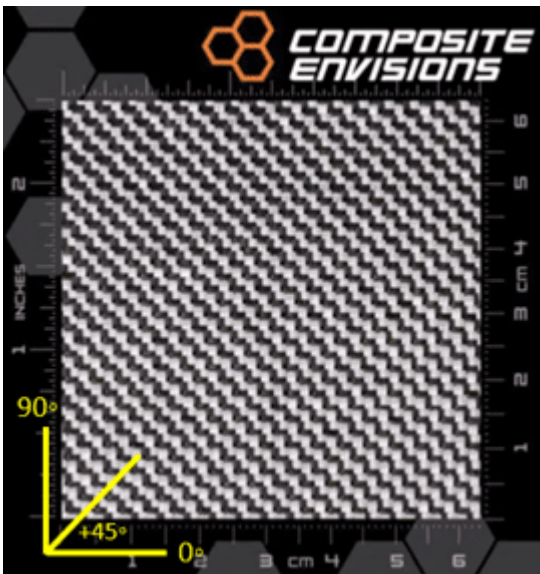


INTRODUCTION

Keeping a weave straight and aligned is critical in keeping a balanced layup accurate. In carbon parts especially, having an unbalanced layup can lead to part warpage and a loss in a designed mechanical performance. To mitigate any effect from misalignment, we have plenty of quality measures and techniques from industrial aerospace practices that can be used to ensure any project is set for keeping any weave / fabric straight and aligned. We also have some of our own tips and tricks paired with some innovative products to show along the way.

IT STARTS IN PLYCUT

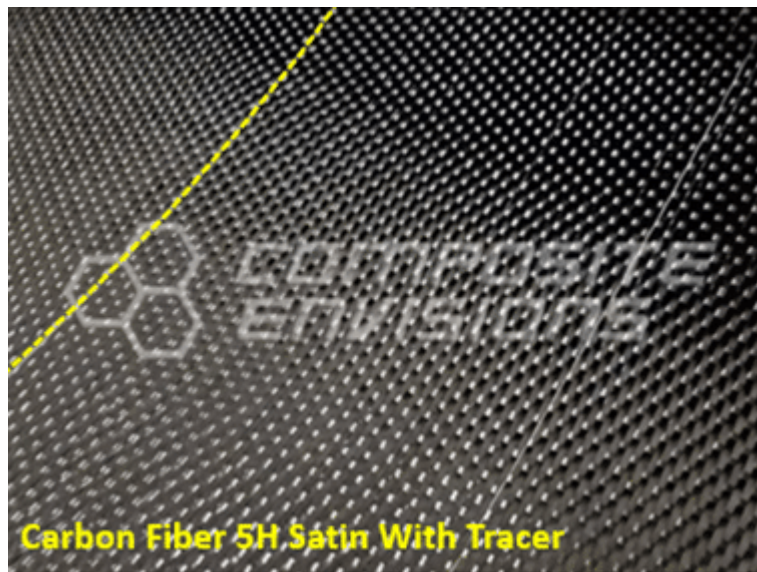
Ensuring all plies are cut in a quality fashion before layup, or ply cut verification is standard practice industry wide. It promotes cleanliness and order to layup processes and ultimately ensures quality in layup. Using a ply sheet template, check off each ply to ensure they are to the needed orientation and size. Having each ply numbered may also help this process. This is done not only to make layup process more effective but really to ensure each ply cut is correct for the needed orientation and size. That way when the layup is done, the focus is going to the orientating the layup, not the cut. A simple way to check orientation is using a triangular “speed square” to verify a plys orientation. This simple, inexpensive tool will aid in ply cut and add a quick visual indication for a ply no matter what type of fabric / weave is being used.





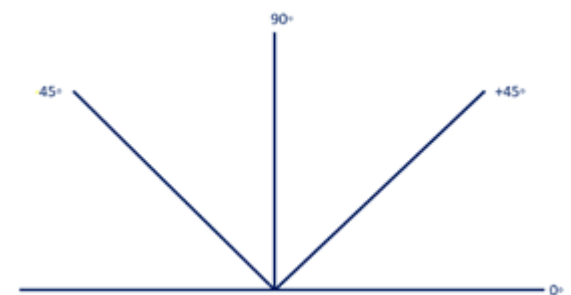
WEAVE ALIGNMENT

Certain fabrics and prepregs come equipped with orientation “tracers” for easily determining the ply orientation. These tracers are usually a color visually complimenting the plys 0° fiber orientation for quick visual reference in comparison to the layup. Tracers will cure within the part laminate. (See above right.) Tracers do not add weight or effect material properties but will be evident visually on the cured part. If a tracer is not visually appealing on a given part, it can be used for the plys inside of the first and last ply, as needed.



If material tracers are not an option and fiber orientation is not visually obvious while laying up, a given ply can be marked with a layup approved pen. A “Pentel White 100WS” will mark plys and provide a simple reference line to follow through a layup process. It should be noted to not put this on the first or last ply, as it may show on the final part. This ink will not degrade the fiber properties or the resin’s ability to bond with the fabric.

If a given fabric is not workable as needed for a part and one finds themselves in a situation where apply will just not “work”. As in the fabric is getting to the point of being destroyed, frayed, or distorted due to its inability to conform properly. There is an option to do multiple plys for a given reinforcement ply on a part. For example, splitting “PLY002” into plys “PLY002A, PLY002B, and PLY002C” respectively. Having a ply smaller may make it easier to layup and keep the needed fiber orientation for a part. This is often referred to as ply splicing and is commonly practiced in industry where material sizes limit how wide a ply can be. In some applications, it may also be used to make certain ply shapes more manageable during complex layup. Just be sure not to splice across an entire radial area or it will affect mechanical performance of a part. It is suggested with structural plys to overlap each one by at least (0.5 to 1”) inch depending on the material type and / or design requirements.





MOLD / TOOL MARKING

Tools / Molds can be marked to any given orientation by etching, taping, drawing, etc. As orientation of the plys are marked for a given ply, a tool can be marked in reference to these plys. This can be as simple as what is shown. Marking a tool with a 0-45-90 can be a great visual indicator for keeping track of orientation as a ply is laid up. This should be placed onto the tool outside of the layup area and in an area which is made easy to visualize. Placing multiple orientation markers along larger molds will help aid layup processes. Adding in a (-45°) may also aid in initially setting a ply as it will provide additional points of reference.

LASER VERIFICATION

Lasers are also used widely in the composite's industry. Its application ranges from simply marking ply orientation to complete laser projection systems that provide ply placement verification by marking a plys outline on a tool. But that's not all, its applicable ply number and orientation on the part's surface can even be displayed by reference to a tool's coordinates. Systems that do all of this can be relatively expensive. If a costly laser projection system is too much for a DIY project, we have some good news. A cost-effective solution may not be any farther away than a hardware store or quick internet search. With a little creativity, a simple laser line system can be just as effective for marking fiber orientation over a layup surface. Lasers can be purchased for under 40\$ and by using multiple lasers, all orientations can be marked as needed or designed. Just place them over the tool's surface and they can project down onto a tool.

PRODUCTS / PROCESSES FOR AIDING ALIGNMENT IN COMPLEX LAYUPS

As an option, we offer Web-Lock fabric stabilization to help ease a fabric's ability to form to complex surfaces. This fabric add on can be added to any fabric order and can be used to alleviate issues with complex ply layups. Check out the link to see the advantages and if this provided process would help in an upcoming project.

Using a spray adhesive such as 3M Spray 71 HI-Tack Composite Adhesive, Airtac 2 Improved Temporary Spray Contact Adhesive, 3M Spray 77 or equivalent is commonly used to tack plys in place for infusion processes. However, this practice is not limited to VIP processes tacking plys into place. Adding a spray tack (adhesive) to wet layups or infusions will make fibers easier to position into place along a part's surface by making them a little stiffer or resistant to fraying. Note: It only takes a light dusting to achieve the needed result. The idea is not to provide a bond at this point, just to position a ply orientation as needed.

For traditional wet layups, an option to pre-wet the fabric ply can be put into a fabricator's



WEAVE ALIGNMENT

arsenal of skills. Through using a release film, resin, and spreader, one can achieve a slight equivalent of a rather tacky prepreg, Cleanly. Place a layer of non-perforated release film under and over a fabric ply. Remove the top layer of release film over the ply and pour measured amount of resin onto the fabric. Replace the release film and spread the resin across the ply as needed. Once ready to place, remove the bottom player of the release film and apply. The release film will also sturdy the ply to a degree and aid in the layup process. It also helps mitigate the affects of overworking a ply with tools that can cause fabrics to fray or become unusable.

HOW CLOSE DOES IT NEED TO BE?

With all the importance of having a balanced layup, fiber orientations, keeping the weave straight and aligned, laser projection systems, tracers, it's a better question of how close does the fiber orientation need to be for proper alignment in a quality part? In most parts, generally about +/- 10° of play either way that will still provide a balanced part. This accounts for various contours and complexity within a layup and provides the layup operation a little wiggle room without effecting the part quality. That would be generally for most plain woven, twill and satin weaves. Unidirectional plys or tapes may need to have stricter adherence to fiber orientation.

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