



Material Selection for GLAST Sidewall Laminate

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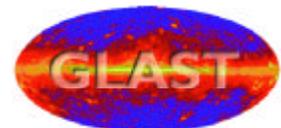
Abstract

The proposed GLAST sidewall laminate consists of a $[0/90_{\text{fabric}}, 0, +/-22.5, +45, 90, -45]_s$ lay-up. Several questions were raised about the use of 0/90 woven fabric with regular uni-tape as far as manufacturability, performance, and overall appearance of the laminate. This technical note documents the suggestions and ideas of Susan Robitaille from YLA Inc. and Tom Wong from Nippon Graphite concerning the issues of using fabric with uni-tape.

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Revision Log

Rev.	Date	Author(s)	Summary of Revisions/Comments
-	5/23/2000	Steve Ney	Initial release.

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1. Fabric versus Uni-tape plys

The use of fabric in the GLAST sidewalls was considered for structural reasons. The sidewalls for the tracker towers are only 1.5 mm thick. One of the requirements set by SLAC for the tracker instrument was accessibility to the electronics boards that are attached to the sides of the tray closeouts. Since the sidewalls are on the outside of these electronics boards, the sidewalls need to be easily removable. Presently, the attachment scheme for the sidewalls is by an array of machine screws with counter sunk heads to maintain the specified gap distance between towers, currently prescribed to be 1mm. Structural issues like fastener pullout and shear drove the design of the sidewalls to using fabric plies on the outside layers of each sidewall. Ply lay-up for the laminate is $[0/90_{\text{fabric}}, 0, +/- 22.5, + 45.0, 90, - 45.0]_s$.

Unfortunately, in talking to YLA's Susan Robitaille, she seemed to think that there might be CTE mismatch problems between fabric and uni-tape. In addition, fabrics are considered specialty items, and as a result are much more expensive than uni-tape and a lot more difficult to get in stock. Tom Wong from Nippon Graphite agreed with Susan Robitaille's point about cost and availability of fabrics, but he didn't seem to be worried about CTE mismatch problems and suggested using one of the following to go with the YS-90 uni-tape selected for the internal part of the sidewall: either YS-90, YSH-70, YSH-50, or XN-50. The fabric should be treated just as another layer in the lay-up process and it will work with other layers of uni-tape without any special processing or other considerations.

Both Tom and Susan agreed that replacing the woven fabric for uni-tape plys would be worse because the 0/90 orientation of the uni-tape plys would result in high interlaminar shear stresses. Tom also mentioned that fabrics have a distinct advantage over uni-tape when holes or machined features are added to a laminate, the edges of the machined feature chip and feather more with uni-tape than fabric.

2. Balanced Lay-up versus Orthotropic Lay-up

Concern was raised about the orthotropic properties of the ply lay-up for the selected sidewall laminate. The sidewalls need to be as flat as possible in order to minimize stresses induced in the tracker towers, due to attachment of the sidewalls. The out of plane warping or saddling of a laminate is a common concern when determining the ply layers and ply angles. Is this out of plane saddling that the laminate takes in its stress free state due to an unbalanced lay-up, or is it due to the orthotropic properties of the ply lay-up? Both Tom Wong and Susan Robitaille agree that "saddling" in a laminate is mostly due to an unbalanced lay-up. Tom also added that sometimes "saddling" will occur in laminates if more resin is bled from one side than the other. The uneven shrinkage of the resin as it dries causes the laminate to dry in the "saddle" state.

Tom Wong was also asked for any suggestions about HYTEC's ply angle selections and the order of ply layers for the sidewall laminate. Tom recommended placing the 90° uni-tape ply

in between the $+45^\circ$ and -45° plies to reduce the angle between plies thereby reducing interlaminar shear stresses.

3. References

1. Telephone conversation with Susan Robitaille, YLA Inc., 5/10/2000.
2. Telephone conversation with Tom Wong, Nippon Graphite, 5/10/2000.