

# **Characterization of Defects in Low-Cost Resin-Infused Aeronautical Structures**

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## **ABSTRACT**

The Vacuum Assisted Resin Transfer Molding (VARTM) process is currently used for the manufacturing of low cost aeronautical composite structures. More specifically, E-glass/Vinyl Ester composites fabricated by the VARTM process have shown excellent potential in a range of applications, including kit aircraft, but have never been employed in certified aeronautical structures. Certification mechanical tests have shown that VARTM produces consistent, high quality solid laminates however, the more complex certification of sandwich structures has to be addressed. To support this certification process, an understanding of process-induced defects is critical. Therefore, the objective of this work is to characterize defects that arise during processing of sandwich structures by VARTM and to correlate these defects with the mechanical properties of the structures. The composite sandwich structures studied were made from a closed-cell PVC foam and E-glass satin cloth skins impregnated with a vinyl-ester resin. A variety of non-destructive inspection (NDI) techniques were used to establish their applicability for identifying defects and to correlate the results with visual and microscopic observations. In particular, specimens containing artificial defects were used to calibrate a thermography technique. The calibrated technique was used on typical sandwich specimens to identify and characterize classes of process-induced defects. During this work, a system of defect metrics was developed and with this system, it is now possible to define the effects of variations in key process parameters on part quality. For example, the types of intrinsic defects associated with variations in the placement of distribution media and resin flow distribution patterns in the core can be determined.