

# AEROSPACE MANUFACTURING TECHNOLOGY

## **Liquid Composite Moulding**

The NRC Institute for Aerospace Research (NRC Aerospace) has expertise and facilities for projects involving the use of liquid composite moulding technologies to fabricate composite aerospace parts. Studies are currently underway to develop these technologies and improve their cost-effectiveness through process simulation and modular tooling solutions.

Liquid composite moulding is an important technology for low-cost composite manufacturing in the automotive and marine transport industry. It is starting to attract the attention of aerospace companies seeking a lower-cost alternative to autoclave processing, the current method for producing high-quality parts. It has been proven that resin transfer moulding and other liquid moulding processes can be reliable in producing large composite structures with improved performance and dimensional tolerance. The technology reduces costs through part consolidation and fastener elimination, but better process control is needed in order to produce the high quality parts required by aerospace.

### **Capabilities**

NRC Aerospace researchers are conducting studies with resin transfer moulding (RTM), vacuum-assisted resin transfer moulding (VARTM), and resin film infusion (RFI) technologies to improve the reliability, quality and cost-effectiveness of the output products.

With RTM and VARTM, moulds into which pre-cut dry, fibre layers have been placed are sealed, resin is injected, and then cured. While VARTM uses a vacuum to suck the air out of the mould and pull the resin through it, RTM pushes the resin into the mould under pressure.



*Modular mould used to fabricate composite parts*

NRC Aerospace is using flow simulation software to optimize these processes through reduced tool development time, optimized injection strategies, and better location of mould injection and vent ports.

### **Current projects**

A collaborative project is currently underway with Bell Helicopter Textron Canada and Delastek, a Canadian SME, to develop resin transfer moulding as a low-cost alternative manufacturing process and use it to fabricate the rib chords for a large composite wing box structure. NRC Aerospace developed a modular mould for the component and worked out preform and processing parameters (injection), then manufactured the part and evaluated its properties. The advantage of using a modular mould is that it cuts down on machining because different parts of the mould can be used for different applications. On completion of the project, the technology will be transferred to Delastek, who will manufacture the part for Bell Helicopter.

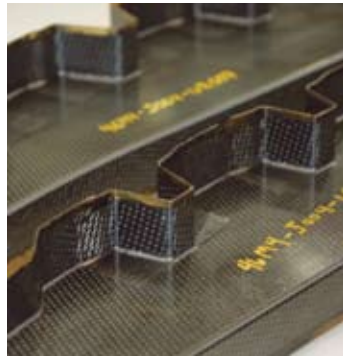
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Cutting table

### Equipment

- Eastman cutter (M9000) with digitizer for cutting prepreg and dry fibres
- Resin Injection system (Radius 5000)
  - Pressure and flow rate computer control
  - High-temperature injection up to 200°C
- Flat plate tooling for process optimization



Composite helicopter rib chord manufactured using VARTM

- Material characterization equipment including:
  - Modulated differential scanning calorimetry
  - Dynamic mechanical analyzer
  - Thermogravimetric analyzer.

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