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## Example: The HMMWV Bulkhead



### Objectives & Requirements

- Substitution of a metal part by a composite with lower density
- Strength shall match/exceed aluminum
- Geometry must accommodate to existing attachment points
- Low costs in tooling/process (VARTM) and materials (E-Glass)
- Temperature range from -50°F to 160°F (-46°C to 71°C)
- **HIGHLY DAMAGE TOLERANT**
  - CHOICE: Polyurethane resin
  - Result: Infusion at elevated temperature

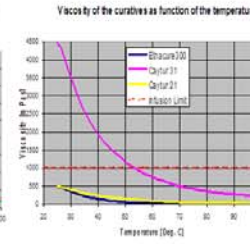
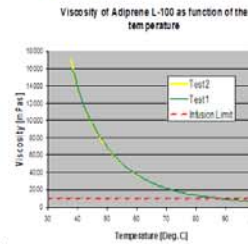
## Single Resin Components

### Resin – Adiprene L-100

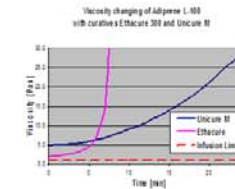
- Liquid urethane polymer; rubbery solid by reaction
- Toluene-diisocyanate (TDI) - terminated polyether based prepolymer

### Curatives

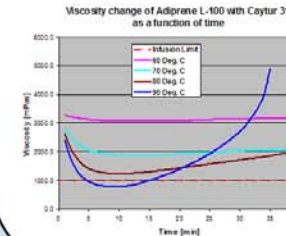
- Unicure M (MBCA), solid at RT
- Ethacure 300
- Caytar 21
- Caytar 31



## Mixed Resin Components



With viscosities over 1,000 mPas after mixing VARTM process is not applicable



Caytar 31 gives a processing window for the infusion with the VARTM process at a mixed resin temperature of 90°C.

## Elevated Temperature Station



Heatable plate and tube channel for the infusion of test panels

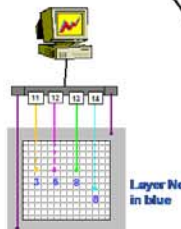
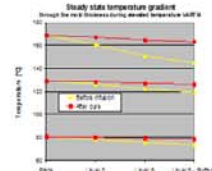


Thermocouple measurement device and heater controller



PC with LabVIEW application for monitoring and analysis

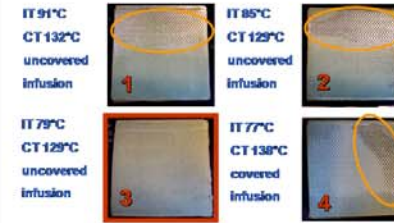
## Thermocouple Placement



### LabVIEW Application

- 1 Tube TC
- 3 Plate TCs
- 4 Mold TCs
- Setpoints for tube and plate
- Temperature programs possible

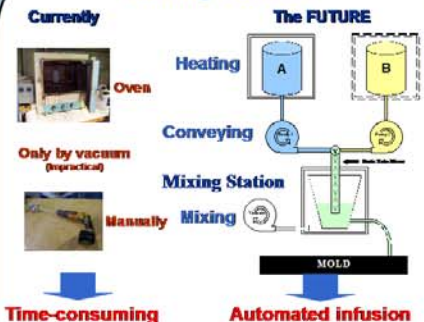
## Demonstration Parts (Tool Side)



- **Postprocessing**
- 24 oz. woven fabric E-Glass
- **Mixitz**
- Resin – Adiprene L-100 + Caytar 31



## Mixing Station



Time-consuming vs Automated infusion

### Acknowledgements

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