NORTHWEST COMPOSITES

FAA Center of Excellence
AMTAS
Advanced Materials in Transport Aircraft Structures

# Resin Infusion Process

**AMTAS Autumn 2005 Meeting**
**October 13, 2005**
**University of Washington**

**Northwest Composites Inc.**
**Marysville, WA**

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# Recent Acquisition

FAA Center of Excellence AMTAS Advanced Materials in Transport Aircraft Structures

- Mid July 2005 NWC became part of C&D Zodiac
- Individual companies have now integrated into one

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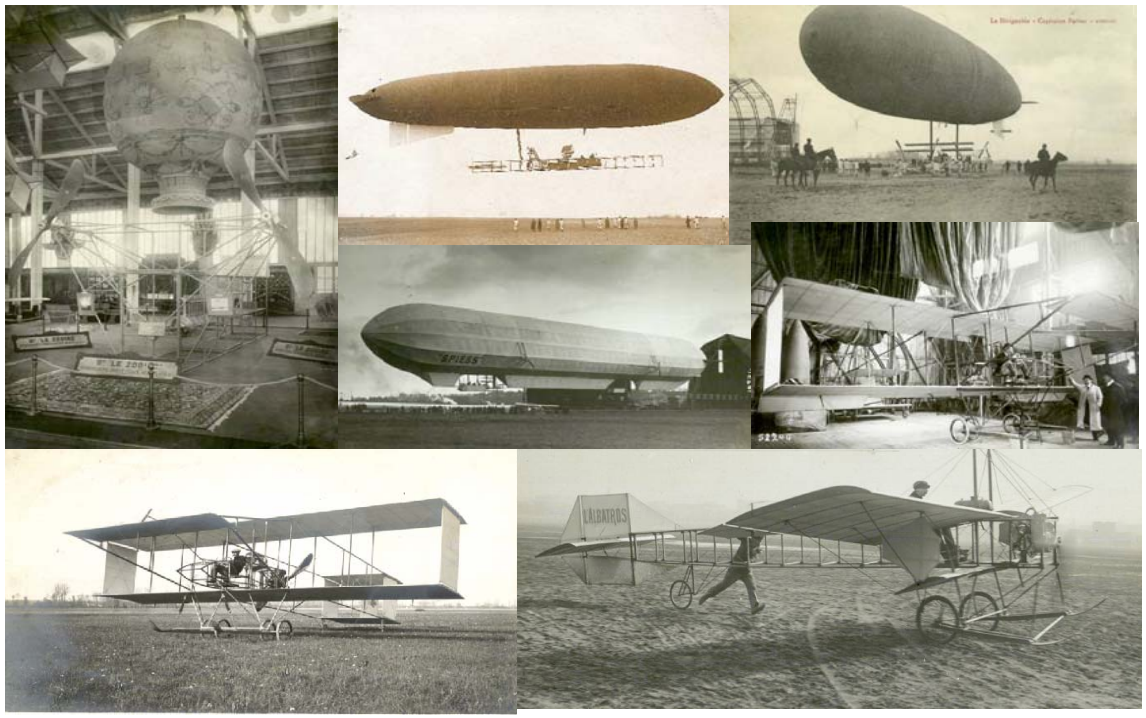
# About Zodiac

FAA Center of Excellence AMTAS Advanced Materials in Transport Aircraft Structures

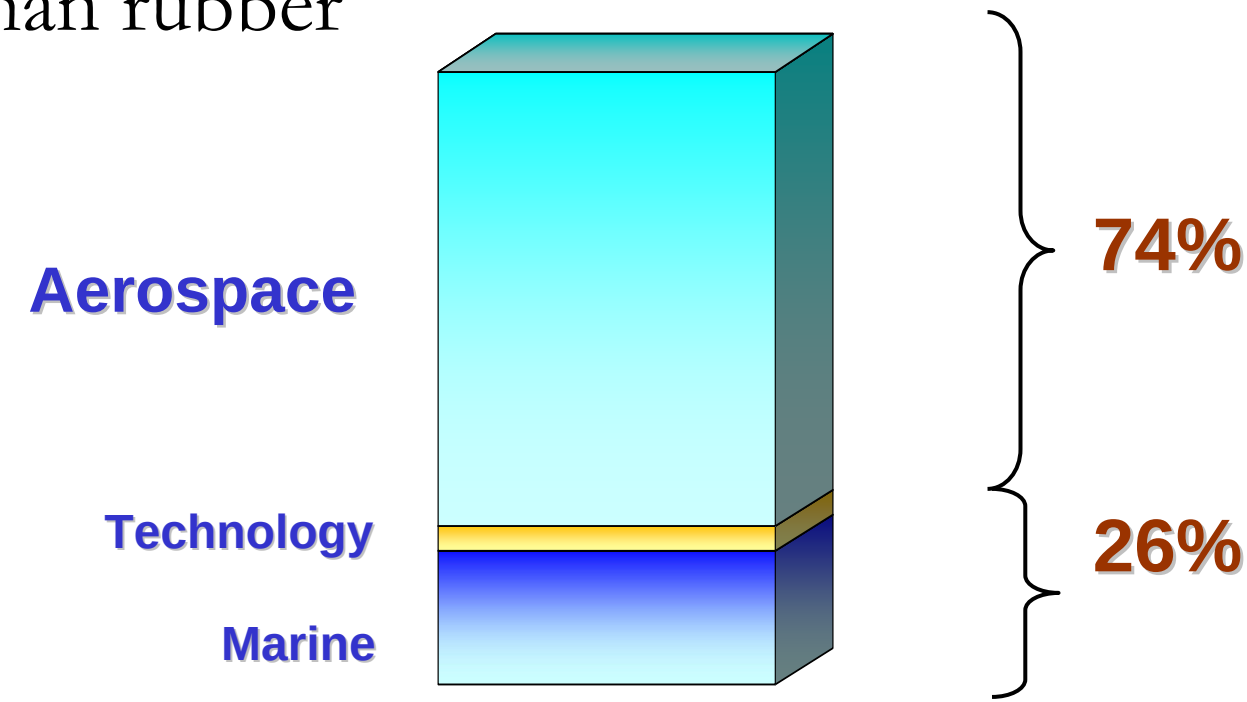
- Started in 1896
- Headquarters in Paris, France



# About Zodiac



- Much more than rubber boats




**2004/05 Sales**

*(Proforma including C&D)*

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# Research Project

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- NWC Product Development focusing on infusion process
- Infusion including VARTM process and film infusion
- Active versus Passive control of resin flow

Active

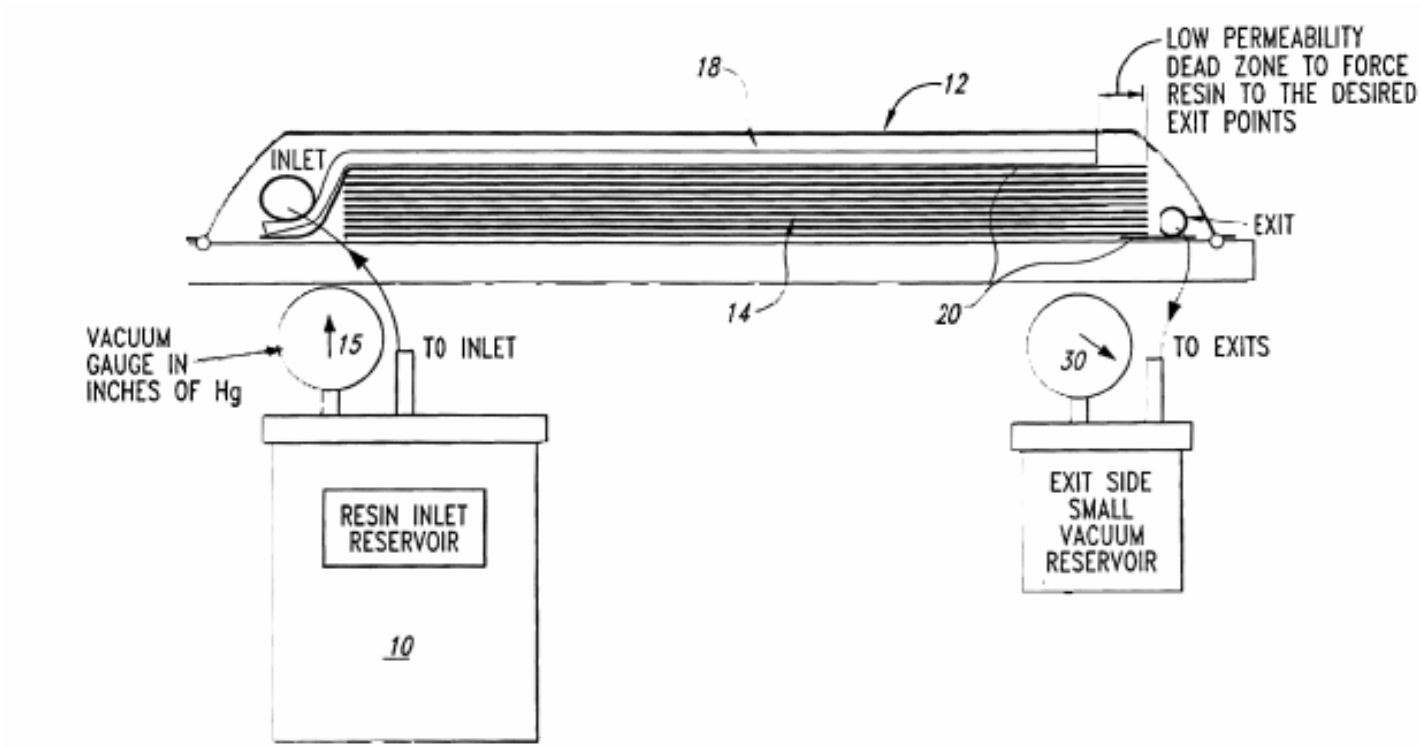
- CAPRI – Controlled Atmosphere Pressurize Resin Infusion
- RTM closed mold process
- RFI – Resin Film Infusion autoclave cure

# Research Project



Active Control of VARTM resin flow

- Boeing CAPRI system (US Patent No. 5,772,950)



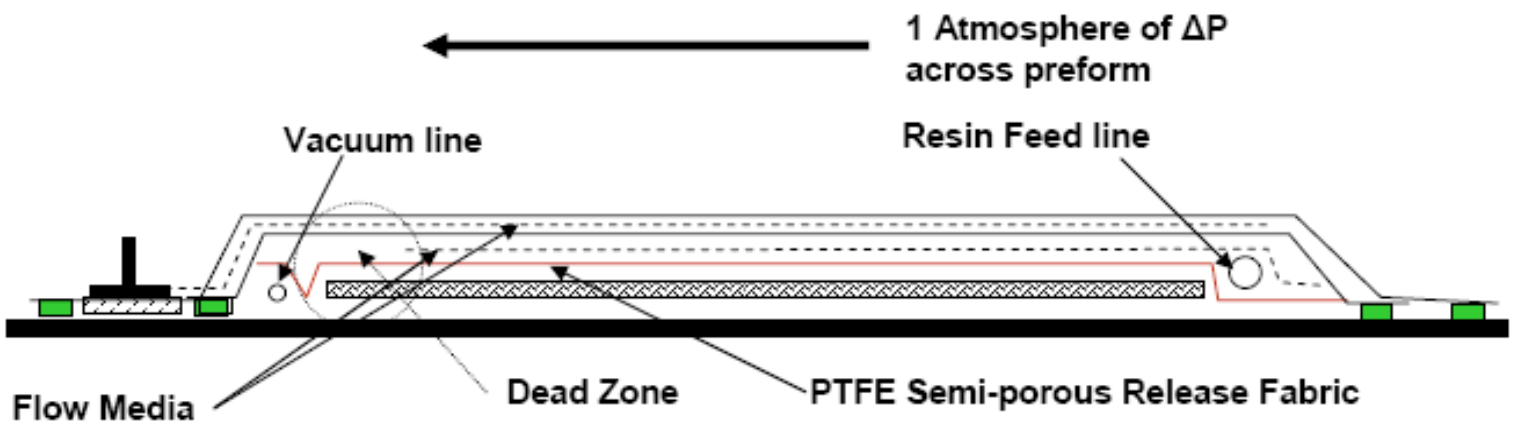
# Research Project



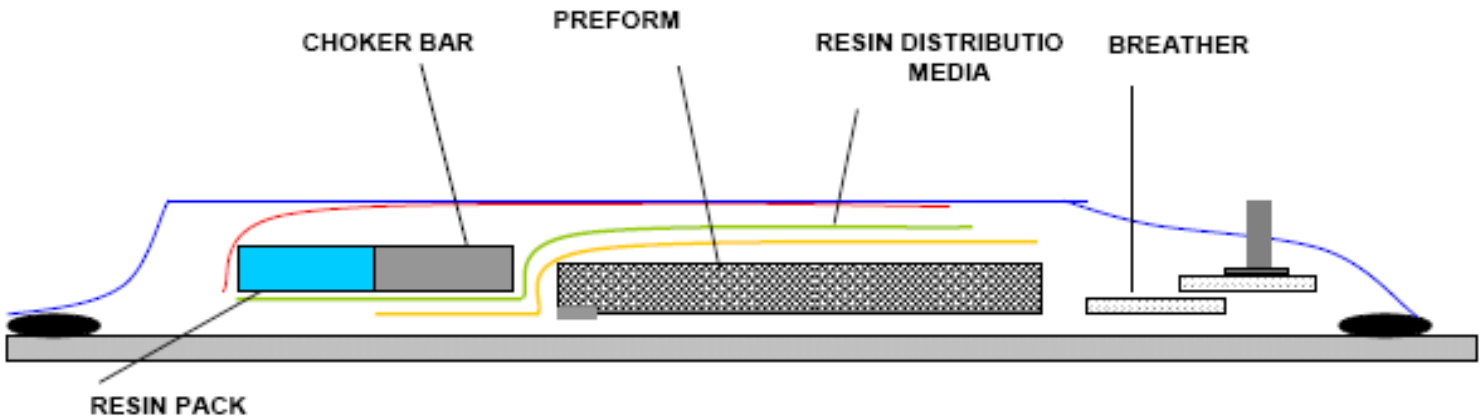
Passive control of VARTM resin flow

1. Bernoulli's Law – Δh of resin and preform
2. Permeability of materials
3. Tool geometry
4. Control features – choke bar, dead zone, etc

Typical VARTM Infusion Process



Passive control of resin flow with the choker bar




Typical Film Infusion Process

# Research Project



Computational Fluid Dynamic Modeling (CFD) of Infusion System

1. Passive infusion systems will push resin across preform using 1 ATM pressure
2. Preform may relax as resin flow front passes over preform
3. Resulting in loss of net compaction on preform and decrease fiber volume
4. May result preform displacement if large $\Delta P$ occurs
5. Resin constriction (choker bar, tooling) may be modeled

# Research Project



CFD Parameters

1. Define material permeability of materials (preform, release ply, infusion media)
2. Determine resin viscosity (temperature dependent)
3. Geometry considerations including tool design and other passive controls of resin flow

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# Research Project

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| Geometry | Preform Material | Resin | Parting Film | Distribution Media | Passive Control Mechanism |
|---|---|---|---|---|---|
| Flat Panel | Carbon Fiber Braid (0, ± 60°) | Room Temp Liquid Resin | Permeable TFP | Nylon Bi-planar | Baseline |
| C-channel Beam | Carbon Fiber Braid (0, ± 60°) | Room Temp Liquid Resin | Permeable TFP | Nylon Bi-planar | Tooling Radius |
| Flat Panel | Carbon Fiber Braid (0, ± 60°) | B-staged filmed resin | Permeable TFP | Nylon Bi-planar | Baseline (autoclave cure) |
| C-channel Beam | Carbon Fiber Braid (0, ± 60°) | B-staged filmed resin | Permeable TFP | Nylon Bi-planar | Baseline (autoclave cure) |

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# Research Project

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Experimental Measurements

1. CFD models will compare preform pressure (time dependent) and part thickness with actual data
2. Relationship will be developed between CFD preform pressure / part thickness and actual part thickness
3. Fiber volumes will be able to be predicted through part thickness correlation

Continued Studies

1. Further studies may include material variation, parting film/distribution media and cure cycle (resin viscosity) variation.