



# Aero Consultants AG

Nänikon, Switzerland

## Company Overview



# The Company ...

- More than 30 years experience
- Head office Switzerland, Zürich area
- Subsidiary in UK
- Composite applications for aerospace and other high tech sectors
- Complete packages of products, services and equipment
- Technical support
- Standard and cold storage stock
- Licensed Henkel distributor
- ISO 9001:2008 / EN 9120:2005
- ASD-EASE





# ... for Aerospace Composites



Structural Paste & Film-Adhesives,  
Core Splices, Syntactic Products,  
Primers



Lightning Strike  
Protection



Laser Manuf. Solutions  
Laser Projection  
Laser Radar (Measure)



Technical Textile  
Cutter



Thermoset  
Prepregs  
Pultruded  
Profiles



Mould Release  
Agents



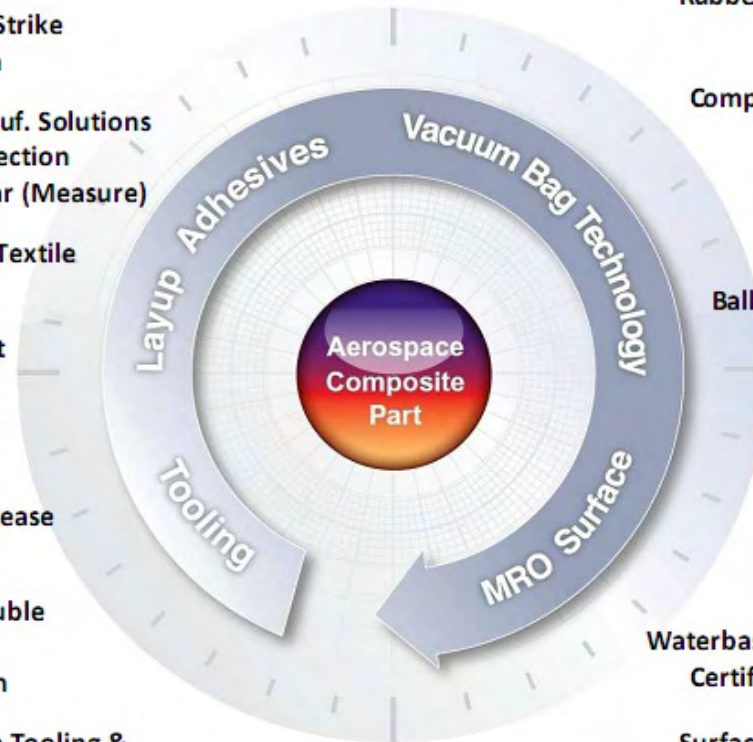
Water soluble  
mandrel  
production



Composite Tooling &  
Resin Infusion



Tooling Boards



Vacuum Bagging  
Products



Rubber Blankets &  
Bags



Composite Repair  
Systems



Precise  
Machining



Ballistic Armour  
Projects



Quintium  
Transparent  
Armour



Nylon  
Coatings



Waterbased Cleaners  
Certified Scrapers



Surface Treatment  
(Cleaners, Maskants,  
Etchants, Conversion  
Coatings, Jet Engine  
Cleaners, Coolants, Depaint)





# Aqua – Mandrel Production

- The Products
- Process Description
- Mechanical Properties
- Reasons for Mandrel Production
- Mandrel Production general
- RTM Applications
- Fastcore
- Omega Stringers
- Rapidcore



# The Products

## AQUACORE™

Unlike conventional mandrel materials, which must be laboriously removed from composite lay-ups, Aquacore™ mandrel is readily soluble in cold tap water and can easily be washed away from the finished part.



Aquacore™ saves time, labor and the wash-away feature minimizes the possibility of damaging fine details.




### Aquacore™ Benefits:

- Washes out in cold tap water in minutes.
- Environmentally friendly, no special disposal procedures required.
- Non-toxic and odorless.
- Remove mandrel from previously inaccessible hidden areas.
- Easily dried in a convection oven.
- Strong and lightweight.
- Makes complex part manufacturing simple.
- Compatible with all commercial resins and pre-preg compounds.
- Easily repaired and re-formed.
- Saves time.
- Reduces labor.
- Saves money.



### Aquacore™ Specifications:

Compressive Strength: ~700 psi  
 Density Wet: 25.1 lbs./cu. ft.  
 Density Dry: 23.1 lbs./cu. ft.  
 Coefficient of Thermal Expansion: 6 x 10<sup>-4</sup> mm./mm.<sup>2</sup> C

Aquacore™ is available in 5 and 55 gallon containers. Aquacore™ is also available in machineable, pre-formed, dried blocks in virtually any size. Call us for Aero Consultants for assistance with your specific requirements. Aero Consultants recommends Aquaseal™ to seal the tool and prevent resin migration.




## AQUACORE™ PREMIUM

Specially formulated for precision machinability, Aquacore™ Premium is ideal for manufacturing mandrels from blank billets. Aquacore™ Premium retains all of the benefits of Aquacore™, with added strength and decreased porosity to ensure tight tolerances and smooth lines during machining. No special machining equipment is required.

Aquacore™ Premium saves time, labor and the wash-away feature minimized the possibility of damaging fine details.



### Aquacore™ Premium Benefits:

- Washes out in cold tap water
- Environmentally friendly, no special disposal procedures required
- Remove mandrel from previously inaccessible hidden areas
- Low porosity
- Higher compressive strength
- Specially formulated for machining
- Compatible with all commercial resins and pre-preg compounds
- Easily repaired
- Saves time, labor and money

### Aquacore™ Premium Specifications:

Compressive Strength: ~1500 psi  
 Density Wet: 63.4 lbs./cu. ft.  
 Density Dry: 49.0 lbs./cu. ft.  
 CTE: 6x10<sup>-4</sup> mm/mm<sup>2</sup> C

Quick Machine Setup



Easy Machinability



Holds Tight Tolerances



Aquacore™ Premium is available in 5 gallon containers, and in machineable pre-formed, dried blocks.






# The Products

## AQUAPOUR™

Aquapour™ is a powdered mandrel material, which is easily mixed with water. Aquapour™ may be poured or injected into molds to form complex mandrels for composite lay-ups.

Aquapour™ is readily soluble in cold tap water and can easily be washed away from the finished part.

Aquapour™ saves time, labor and the wash-away feature minimizes the possibility of damaging fine details. Aquapour™ is formulated to minimize air bubbles and voids.



### Aquapour™ Benefits:

Easily mixed with water.

Pourable and injectable.

Environmentally friendly, no special disposal procedures required.

Washes away in cold tap water.

Compatible with all commercial resins and pre-preg compounds.

Makes complex part manufacturing simple.

Easily dried in a convection oven.

Easily repaired and re-formed.

Reduces labor.

Saves money.

Saves time.



### Aquapour™ Specifications:

Compressive Strength: ~1500 – 2000 psi  
 Density Dry: 31.8 lbs./cu. ft.  
 Coefficient of Thermal Expansion:  $5 \times 10^{-6}$  mm/mm/°C

Aquapour™ is available in 5 and 55-gallon containers. Call or fax Aero Consultants for assistance with your specific manufacturing requirements.

Aquaseal™ is recommended to seal the tool and prevent resin migration.



## AQUAFILL™

Aquafill™ has been formulated to fill or patch the water-soluble mandrel materials Aquacore™, Aquacore™ Premium and Aquapour™. Once applied, Aquafill™ will give the surface of the mandrel a smooth porcelain-like feel.

Aquafill™ is premixed and ready to use. Once the mandrel has been formed and dried in a convection oven, Aquafill™ can be applied easily with a rubber squeegee, such as those used in auto-body applications. Aquafill™ takes slightly longer to washout, but just like the Aquacore™, Aquacore™ Premium and Aquapour™ it is environmentally friendly and requires no special procedures for disposal.

Aquafill™ is available in Quart, 1/2 Gallon and 1 Gallon containers.



## AQUASEAL™

Aquaseal™, specially formulated to seal the water-soluble mandrel materials Aquacore™, Aquacore™ Premium and Aquapour™, provides a smooth, nonporous finish on the surface of a mold or tool and inhibits the migration of resins into the porous tool during the lay up or RTM process.

Aquaseal™ is compatible with the cure temperatures of commercial resins and pre-preg compounds up to 380°F/193°C, and washes away in minutes with tap water. Aquaseal™ may be applied with an airless sprayer or a brush. Several coats can be applied. After achieving the desired finish, Aquaseal™ can be dried in a standard oven at approximately 200°F/93°C for 20 minutes. When dried, Aquaseal™ is thermally stable up to 380°F/193°C. To remove, simply wash away mandrel material and sealant with plain tap water. Aquaseal™ is environmentally friendly, no special disposal procedures are required.

Aquaseal™ is available in Quart, 1/2 Gallon and 1 Gallon containers.

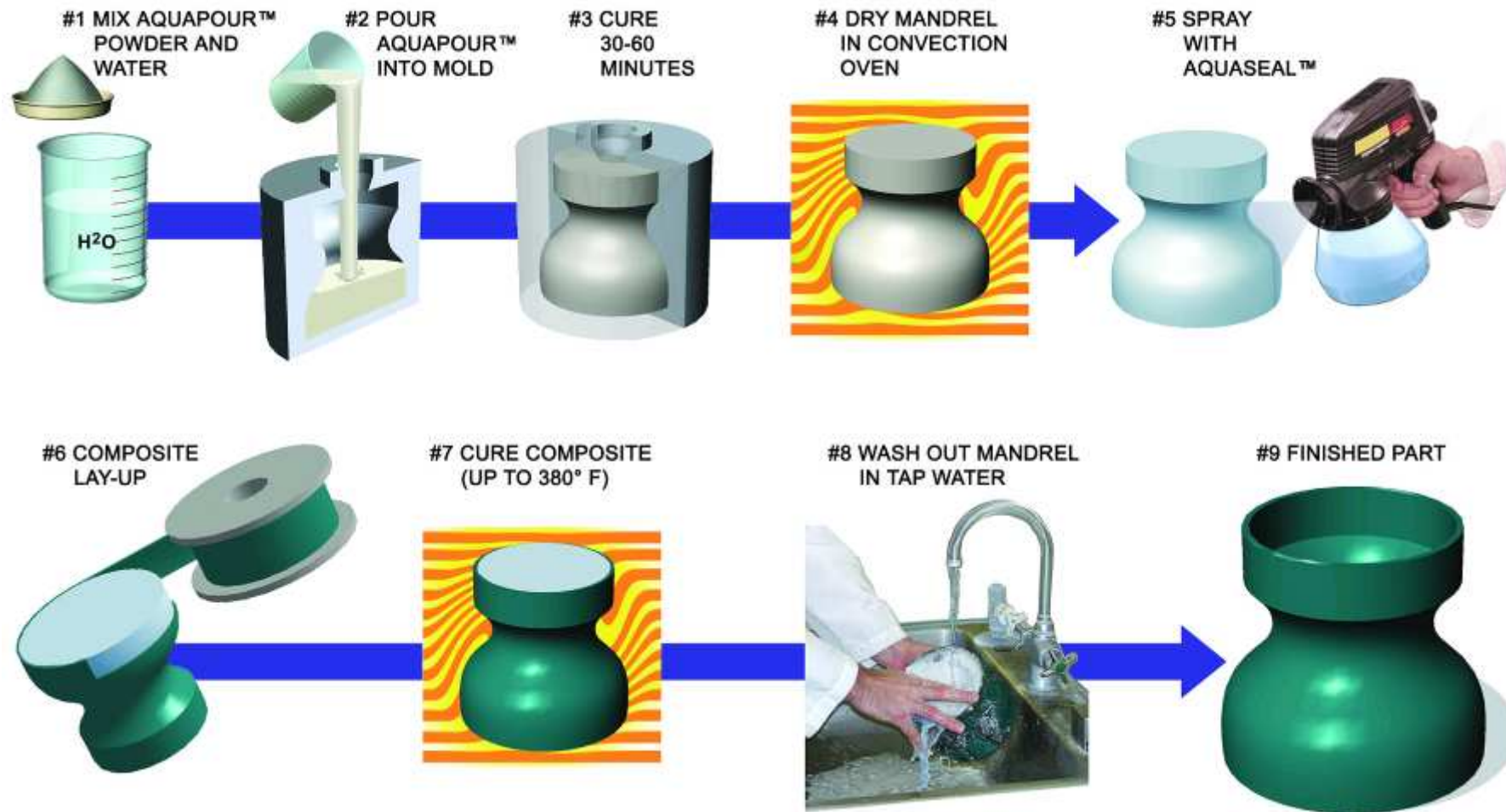


Call or fax Aero Consultants for assistance with your specific manufacturing needs.





# Mandrel Process





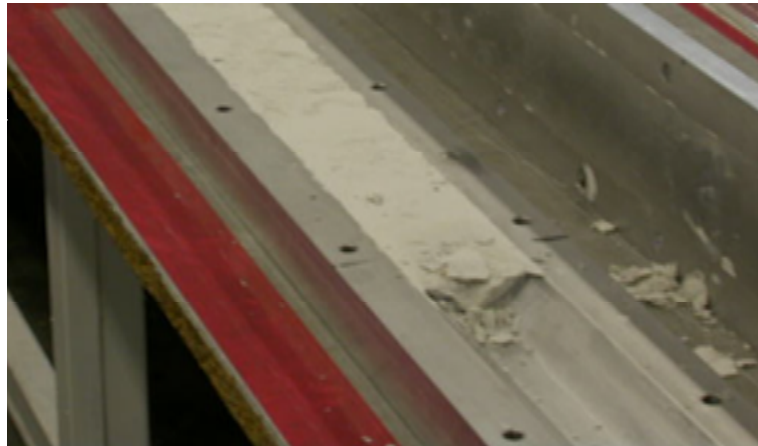
# Thermal and mechanical Properties

- **Ceramic based, high temperature, light-weight, water soluble mandrel material**
- **Properties**
  - **For autoclave 195°C, 8.5bar and RTM**
  - **Low density 0.54 g/cm<sup>3</sup>**
  - **Low CTE 4.68 x 10<sup>-6</sup> K<sup>-1</sup>**
  - **Compressive Strength 48 bar / 4.83 MPa**
  - **Flexural Strength 44 bar / 4.41 MPa**
- **Benefits**
  - **Fast and easy wash out by tap water**
  - **Easy handling and disposal**
  - **Environmentally friendly, no special disposal**
  - **Machinable**





# Common Problems



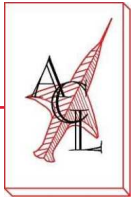
➔ Reasons for our Mandrel Production



# Common Problems



→ Reasons for our Mandrel Production



# Common Problems

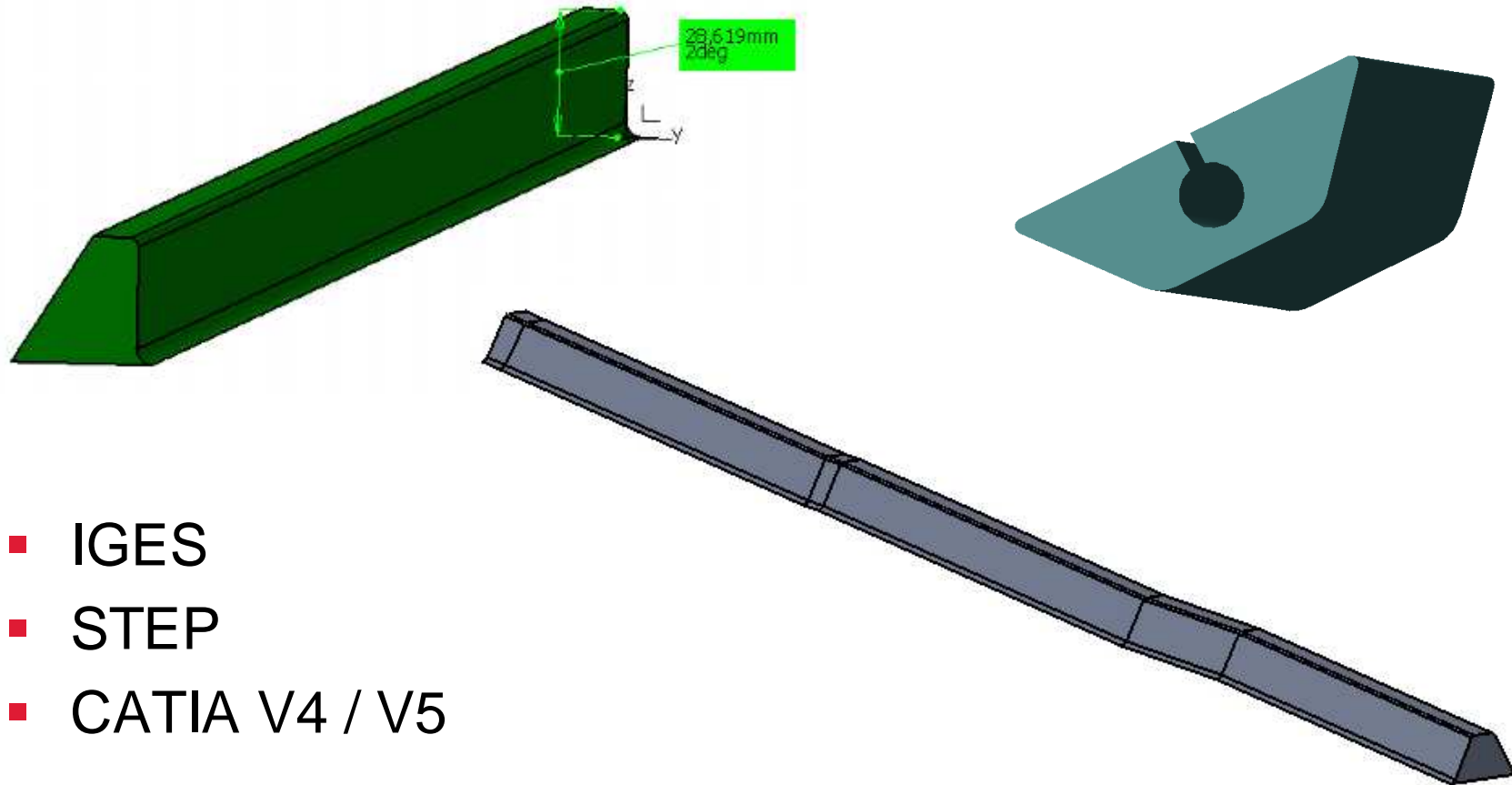


→ Reasons for our Mandrel Production





# Mandrel Production general



- IGES
- STEP
- CATIA V4 / V5



# Mandrel Production general



**Part of the Production Area**



# Mandrel Production general





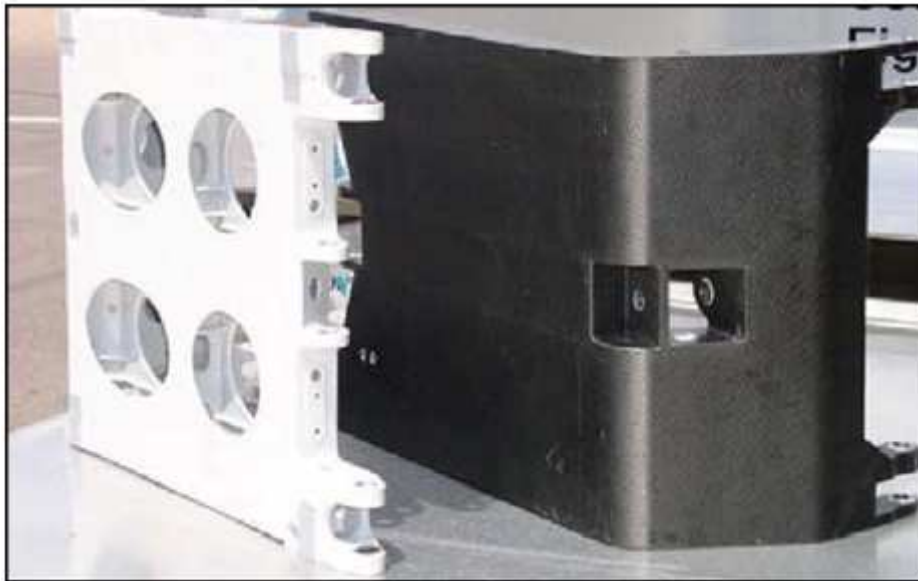
# Mandrel Production general







# RTM Door Hinge Application

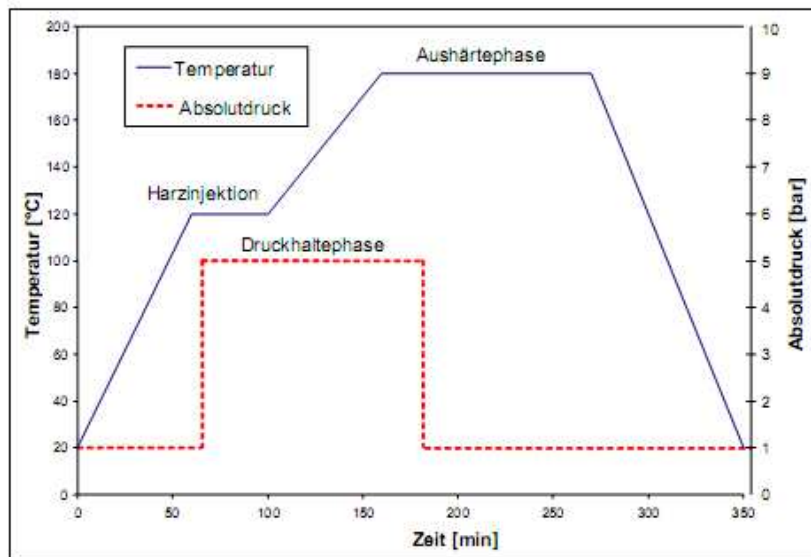


**From Aluminium Casting Construction**  
**→ To RTM Design with Foam Mandrel**  
**→ To hollow RTM Design**

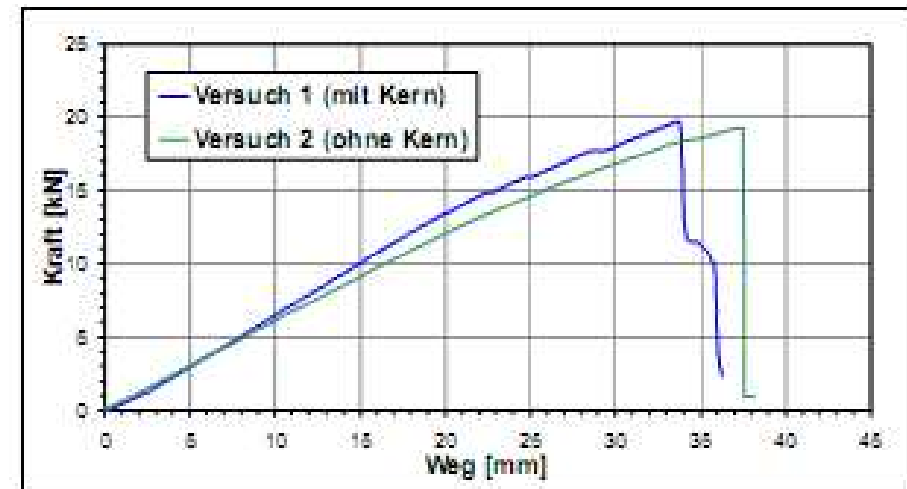




# RTM Door Hinge Application



**RTM Process**  
**180°C and 5 bar of Pressure**



**Ultimate Load Test**  
**Foam Hinge vs Coreless Hinge**



# RTM Door Hinge Application



**Steel Tools**



**Mandrel Storage**



# RTM Door Hinge Application



**Storage and Exchange Transport Box**



# RTM Door Hinge Application



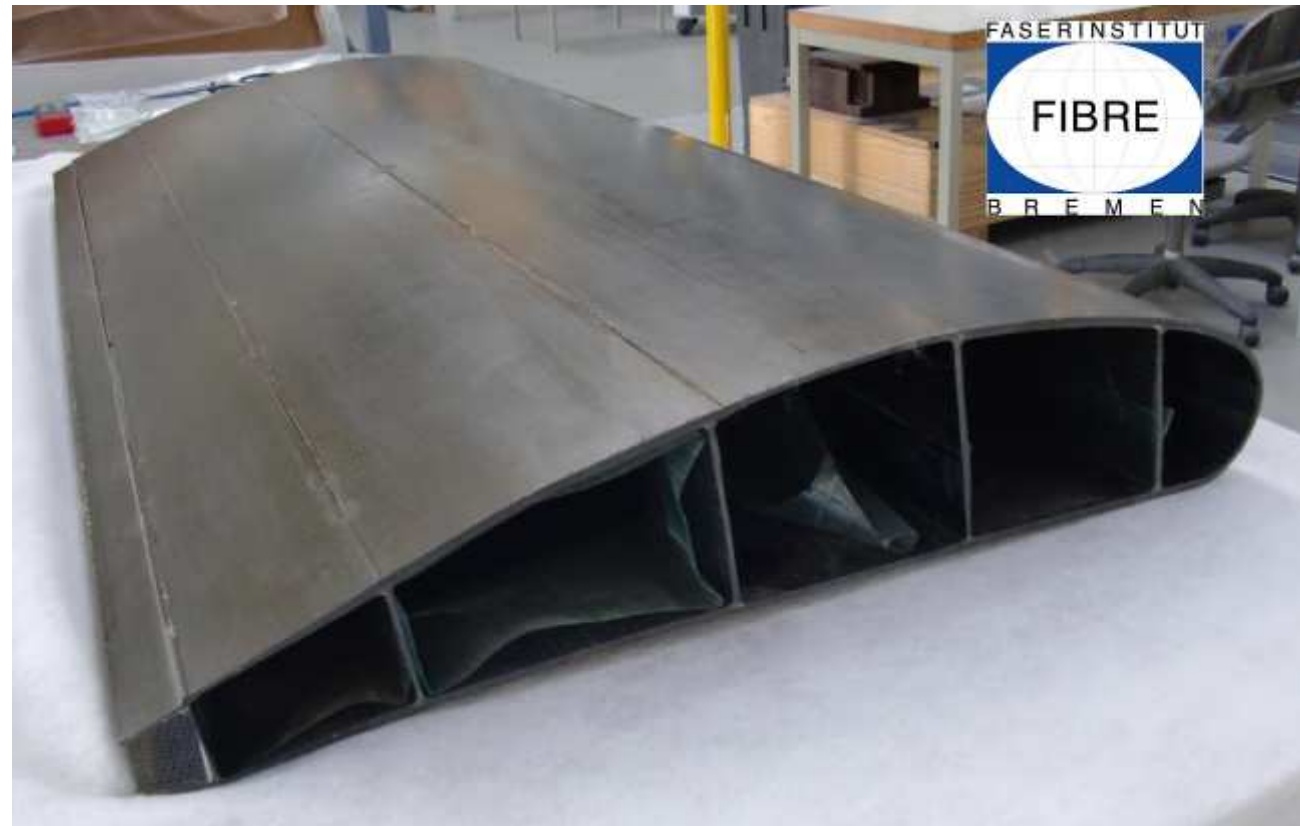
**Semi-automated Washout Station**



**Hinge Arm assembled at Aircraft Door**



# FIBRE RTM Landing Flap

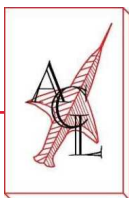


**Demonstrator Part RTM 180°C, Length 1500mm**



# Fastcore - The Next Generation

- **High Green Strength**
- **Fast turn around of molds**
- **Low labor cost**
- **Consistent Quality**
- **Holds close tolerances**
- **Lightweight**
- **For autoclave 195°C, 8.5bar and RTM**
- **Fast washout**
- **Nontoxic and odorless**
- **Environmental friendly**
- **Automated Process**

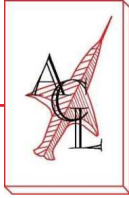


# Fastcore - The Next Generation

From CAD file to the finished part with our ready to use mandrels







# Fastcore - The Next Generation

## Mandrels to fabricate hollow, seamless, one part composite structures

Our unique water soluble mandrel tooling material is suitable for serial or mass production of several thousand mandrels per month.

Unlike conventional mandrel materials, which must be tediously removed from composite lay-ups, our mandrels are readily soluble in tap water and easily washed away from the finish part without damaging the finish composite structure.

Our mandrels can be produced in almost any shape you can imagine.

Water-soluble mandrels save customers time and labor and allow them to utilize free production space for composite part fabrication rather than mandrel fabrication.

### Benefits

- Washes away with tap water
- No special disposal procedure
- Nontoxic and odorless
- No damage to composite part
- Less expensive in serial production than plaster or eutectic salt mandrels
- Strong and lightweight
- Stable in autoclave conditions

### Applications

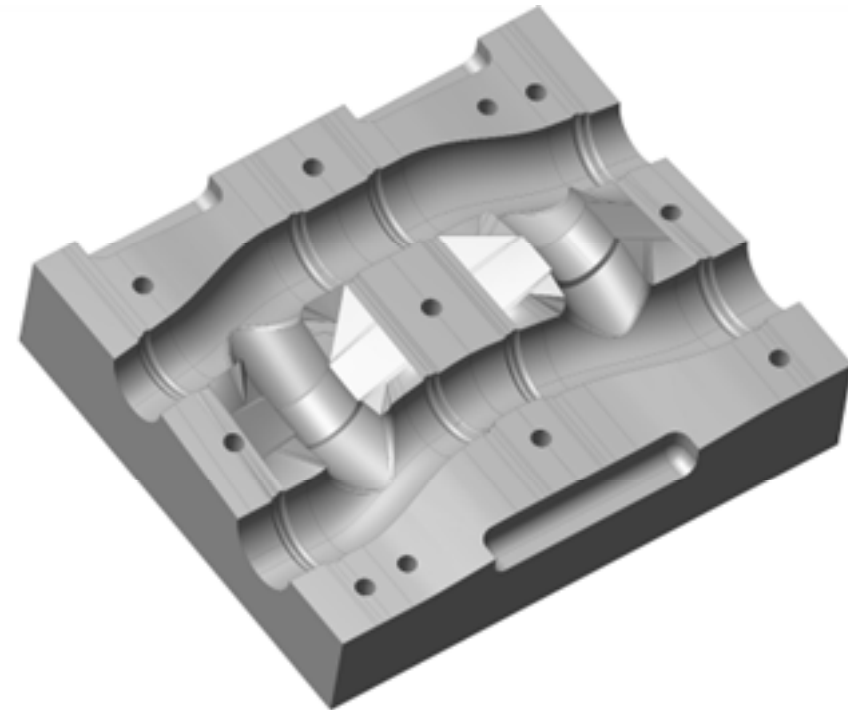
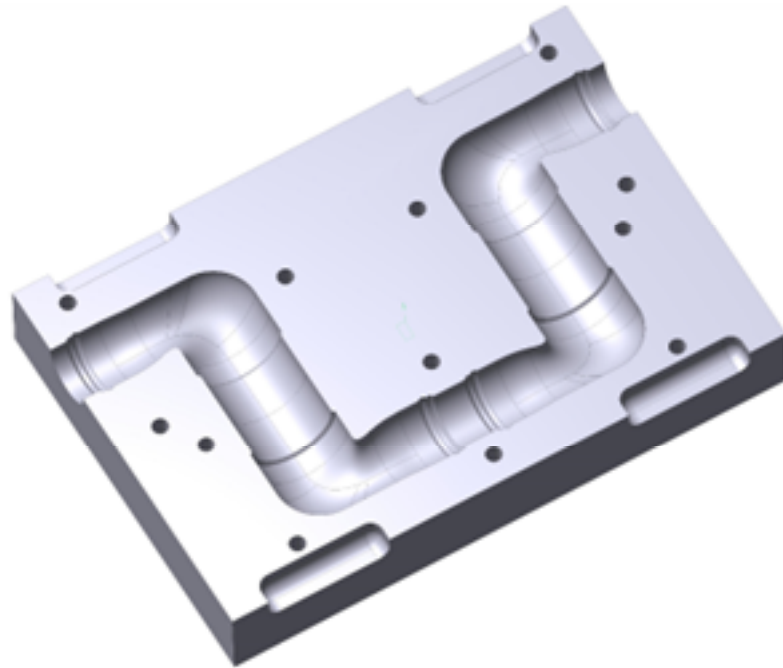
- Air- / Cable ducts for Aerospace
- High pressure tanks
- Hat stiffener sections for aircrafts
- Flap support fairing
- Manifold intakes
- Motorcycle wheels
- Automotive parts
- Honeycomb stabilization
- Any hollow structural component

### Contact for Pricing, Inquiries and Orders

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# Fastcore Mandrel Production



**Air duct Tools for automated Process**



# Fastcore Mandrel Production



**Air duct Mandrels**





# Fastcore Mandrel Production



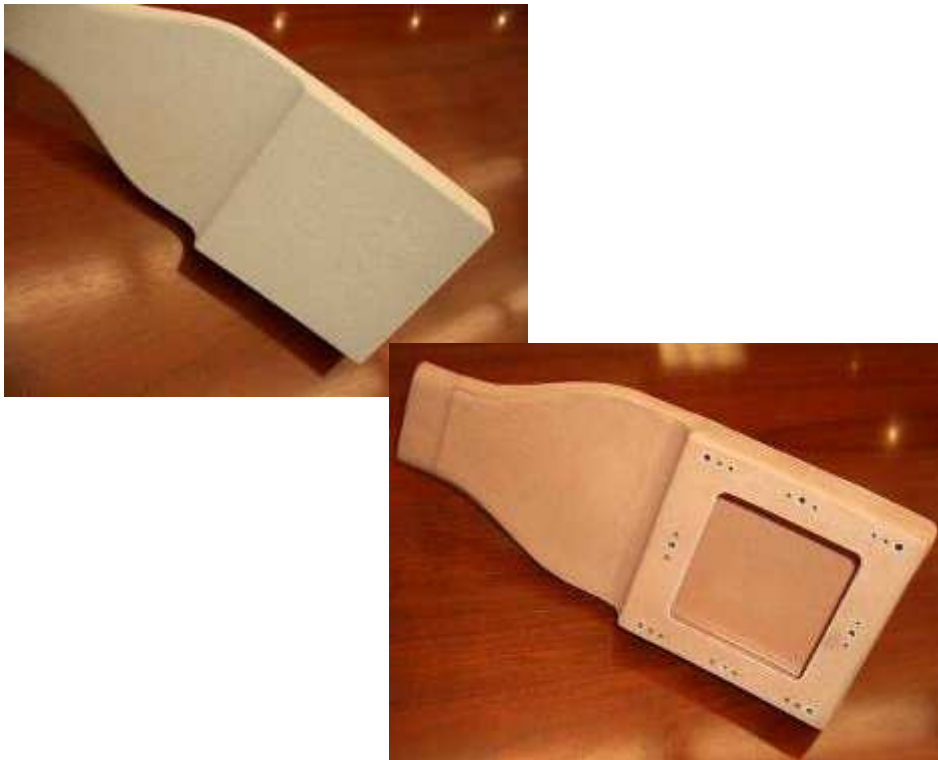
**Air duct Mandrels**





# Fastcore Mandrel Production

**ECS Airduct for Bombardier CRJ200**



**Interior Airduct Mandrels  
Boeing 787 – AIM Aviation**





# Fastcore Mandrel Production



**Airducts**





# Fastcore Mandrel Production

Different Airducts



**MBDA**  
MISSILE SYSTEMS





# Fastcore Mandrel Production



**Boeing Flap-Support-Faring**





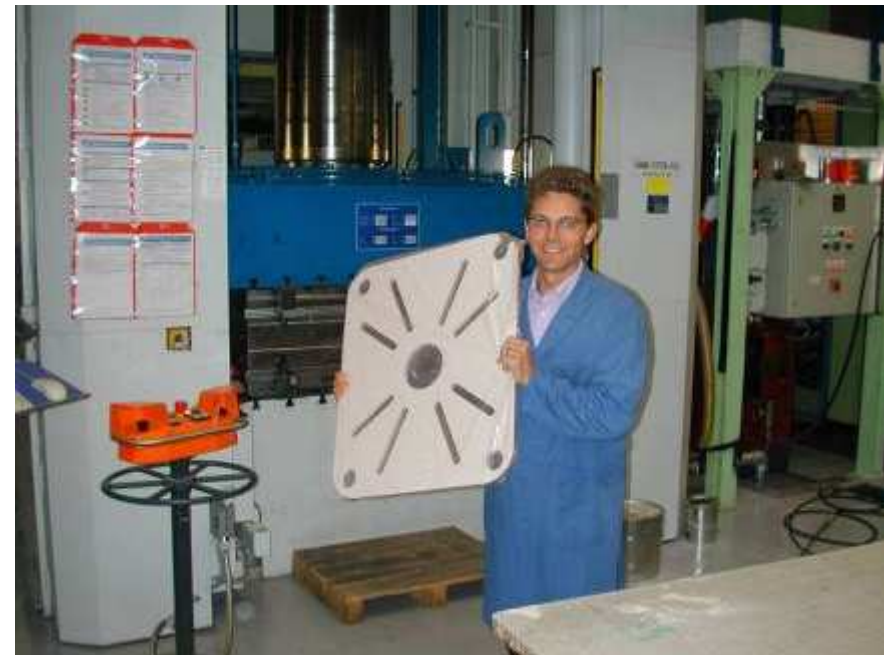


# Fastcore Mandrel Production



- **Dimension 600x690mm (24"x 27")**
- **Volume 8.0 litre**
- **OEM in Germany**

## Automotive Maintenance Door





# Fastcore Mandrel Production

## Automotive Maintenance Door

- Lay-up of the SMC material
- Temperature 140°C / 284°F
- Pressure 40bar / 580psi
- Cycle time each part 8 – 11min





# Fastcore Mandrel Production

## Automotive Maintenance Door

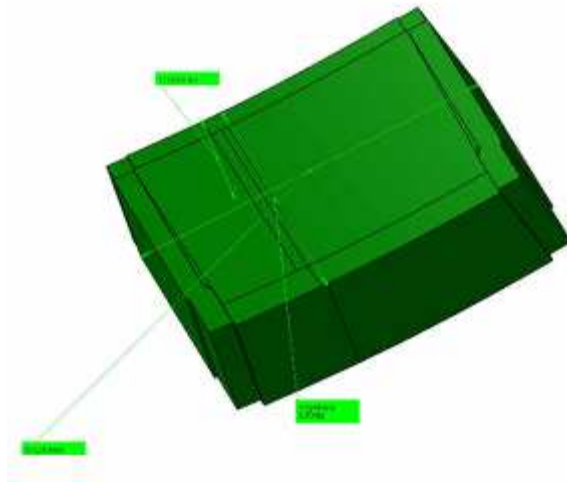
- **SMC Part**
- **Very accurate in wall thickness**
- **Weight reduction 51% (16.5kg => 8.0kg)**
- **Better acoustic insulation**





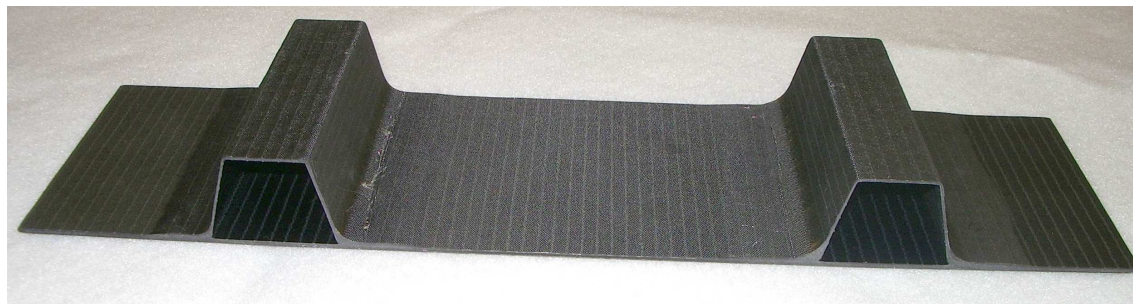
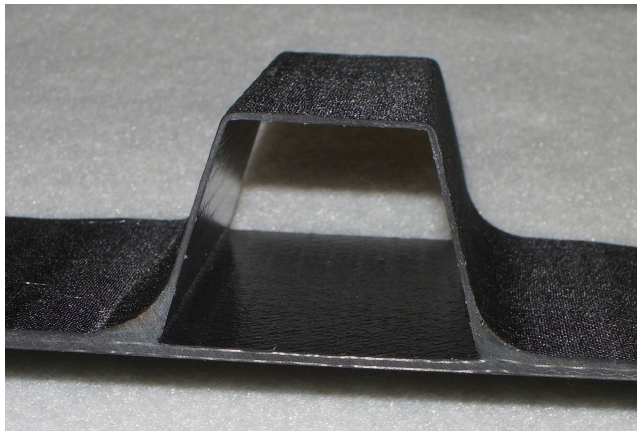
# Aerospace Aqua Projects

- **First all-composite aircraft doors using a single-phase polymerization process by Eurocopter Germany**





# Omega Stringer Projects



**Vacuum Infusion at 180°C**  
**Test Panel Length 3000mm**



# Omega Stringer Projects

- **Aquacore 1024  
Mandrel length 5.0m**
- **Prepreg application at  
180°C and 7bar  
of pressure**
- **For a perfect surface  
the mandrel was  
sealed with Airtech  
Teflease MG2**





# Omega Stringer Projects



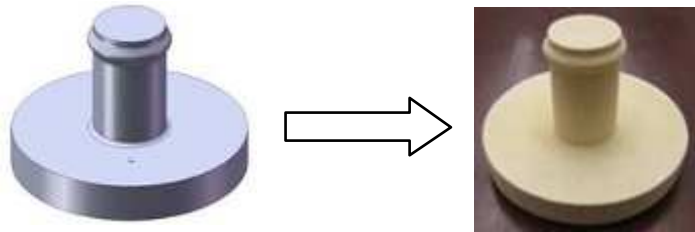
**Mandrel Length 7000mm**

**Test panel Length 2300mm**





# Rapidcore Technology



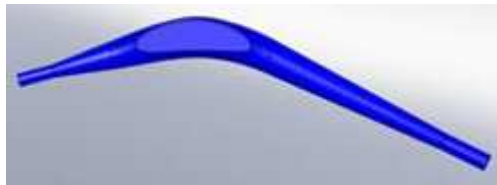
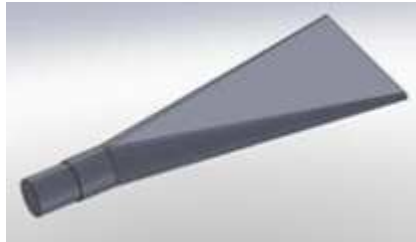
- From CAD File to the finished Mandrel
- Fast Delivery, without Tool Costs







# Rapidcore Technology



- **Ceramic based, high temperature, water soluble Rapid Prototyping material**
- **Material Properties**
  - For autoclave 180°C at 6 bar
  - Density approx 1.0 g/cm<sup>3</sup>
  - CTE 6.5 – 7.0 x 10<sup>-6</sup> K<sup>-1</sup>
  - Compressive Strength 30 bar / 3.0 MPa
  - Current Tolerance +/- 0.75 mm with sealing
- **Benefits**
  - Fast and easy wash out by tap water
  - Easy handling and disposal
  - Environmentally friendly, no special disposal
  - Fast delivery, no tool cost



# Rapidcore Technology

**Harrier ECS Duct, small Scale**



**Embraer ECS Duct, small Scale**





# Rapidcore Technology

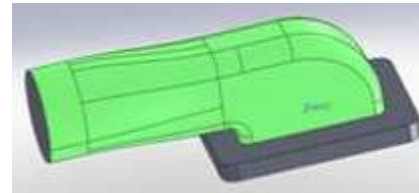
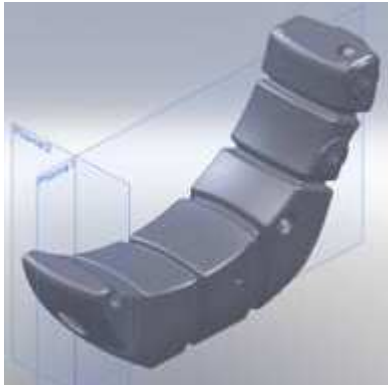
## Mandrel Samples





# Rapidcore Technology

CAD File → Mandrel → Part





# Aqua Mandrel Technology

## When – What?



### Rapidcore Mandrels – Size Limitation

- No Tools needed
- Max. Size without bonding  
600 x 500 x 400 mm
- Prototypes or small series



### Fastcore Mandrels – Tool needed

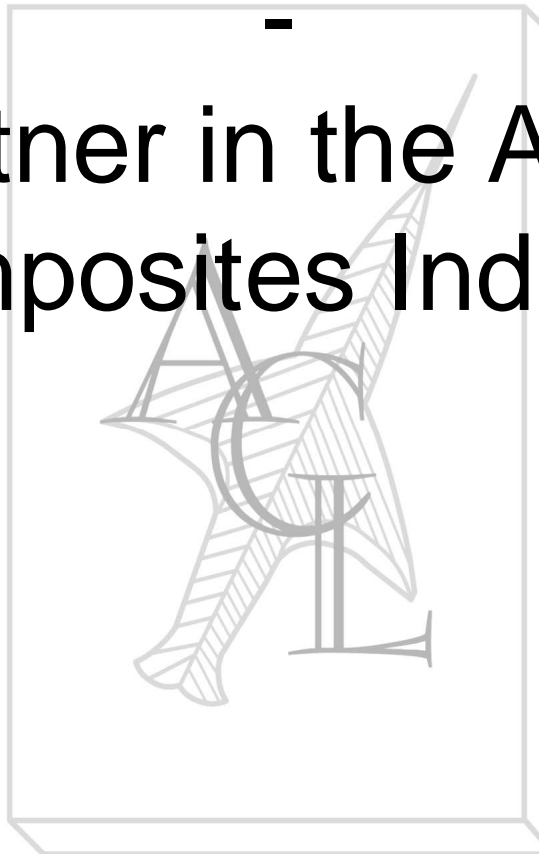
- Tools are necessary
- No size limitation at the moment
- Serial Production Material



AERO CONSULTANTS AG

# Aero Consultants

## Your Partner in the Aerospace Composites Industry



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