

Modular Coil Shim Bag Test Progress

L. Dudek

Shim Requirements

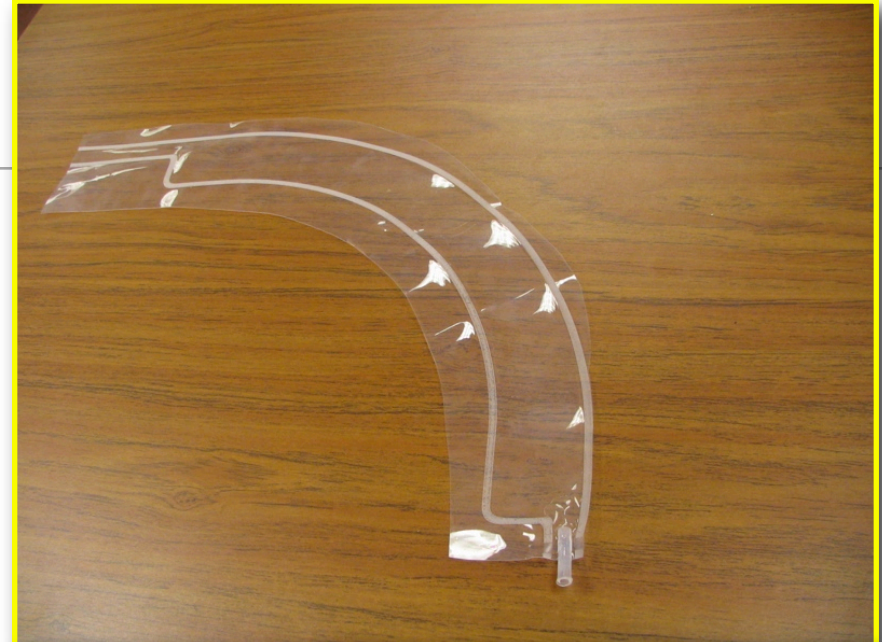
- Operating Temperature Range: -320 F to 212 F (-196 C to 100 C)
- Installation Temperature: up to 300 F (145 C)
- Max. Compressive Loads: upto 17.4 ksi (120 MPa)
- Required Compressive Strength (@ -300 F): 26 ksi (180 MPa)
- Shim must be installed after modular coils are assembled
- Minimal shrinkage for all loads to be transferred

Test Plan

- Develop the procedure and tools to inject epoxy
- Identify suitable epoxy materials for shim bag - CTD 540 or Stycast 23LV
- Identify suitable bag materials - FEP or SS Welded
- Test materials for strength at temperature
- Develop the procedure to inject the bags insitu between 2 coils

FEP Bag Sample

- Very Flexible will easily conform to pocket
- Extend lips to the edge of the casting to aid in positioning
- Extend inlet portion of bag so it meets the flange duct
- Will test upto 15 psig (supported) @ 1 minute (but will stretch)
- Used in the aircraft industry for epoxy shims to support wing potting compounds.
- Cost Estimate
 - Price \$175/bag
 - Onetime FDA GMP (Good Management Practices) charge \$1800



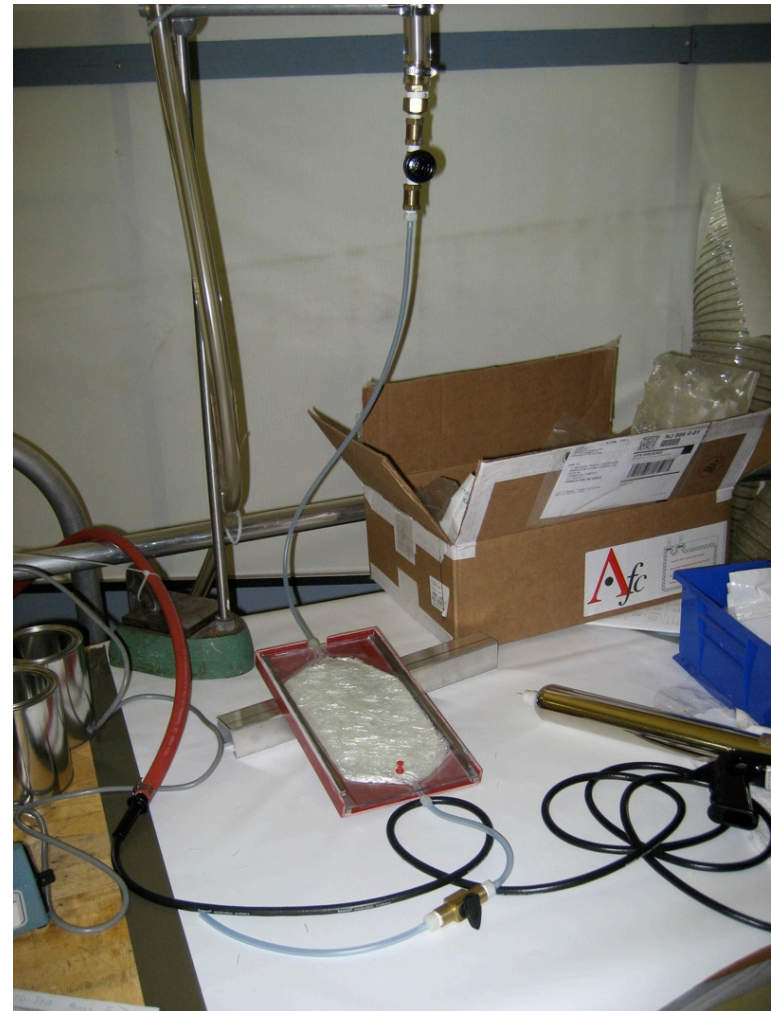
Test Samples



- Purchased 13.5 cm x 22 cm standard bags for test purposes (\$48)2F-1000
- Unsupported these bags will burst at approximately 7 psig, higher if supported.

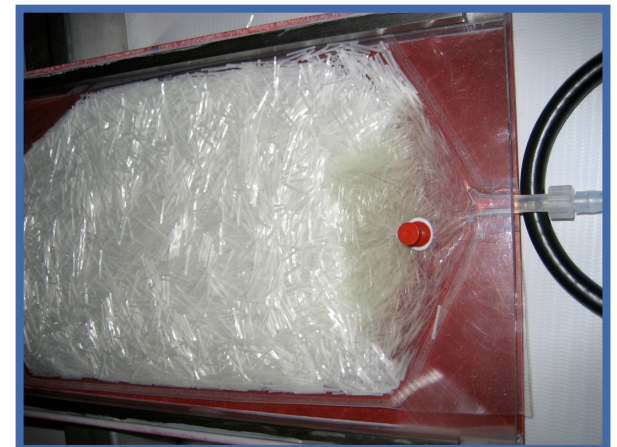
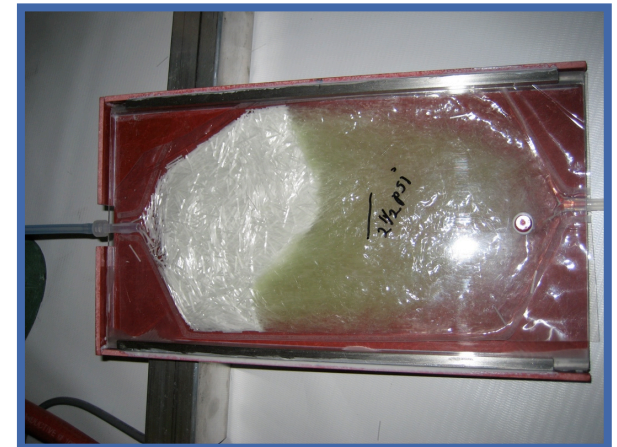
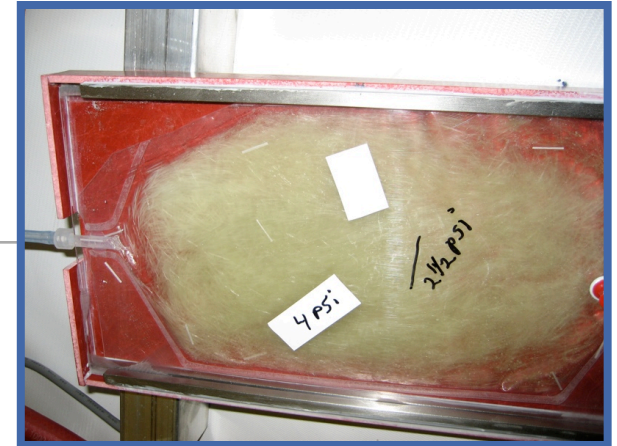
Shim Bag Trial #1

- Purpose
 - To Prove out glass stuffing and sealing of bag
 - Test use of pneumatic adhesive gun
 - Test FEP, Luer fittings and Eurathane hose materials with epoxy
 - Characterize timing of epoxy fill rate



Trial #1 Results

- Fiberglass 100 grams, 1/4" thick shim
- Fill time was approximately 1 hour
- Fill pressure 1-6 psi; in ~ 2 psi increments
- Epoxy in injection gun began to heat and gell - need to decrease fill time to approximately 30 minutes
- Additional fill ports would be useful



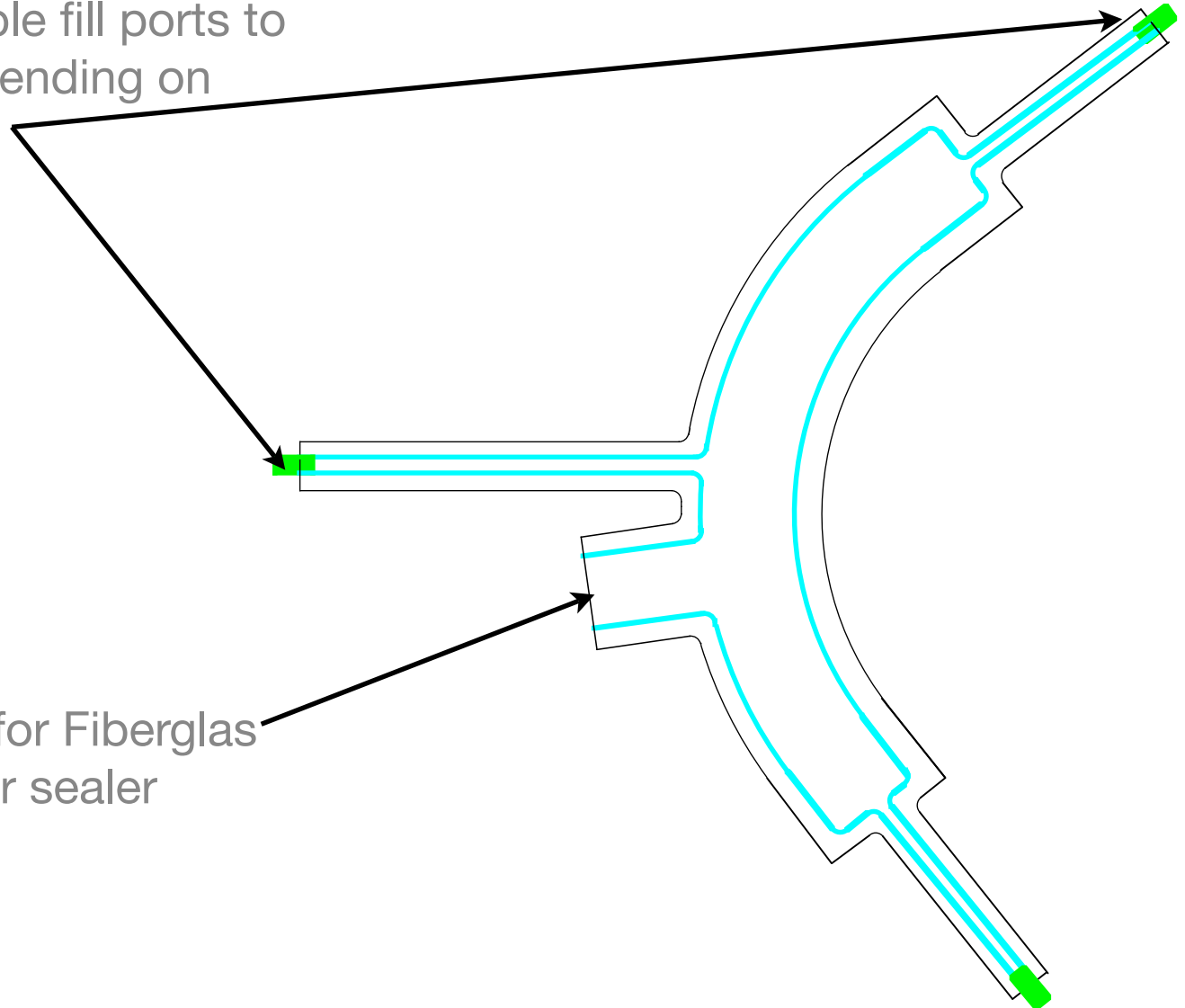
Trial #4 Stycast Epoxy with 250 grams glass

- Epoxy system: Catalyst 23LV, Resin 2850FT
- Fiberglass content 250 grams
- Used manual epoxy gun
- Bag fill time was slower ~ 50 minutes
- Approximately 20% of glass would not wet
- Too thick to work in this application



Prototype Shim Bag

- Bag may have multiple fill ports to ease installation depending on configuration



- Open port provided for Fiberglass stuffing, seal with bar sealer

Trial Summary

| Trial | Epoxy | Thickness | Fiber Content | Comments |
|-------|-----------------|-----------|---------------|------------------------|
| 1 | CTD 540 | 1/4 | 100 g | Fill too slow |
| 2 | CTD 540 | 1/4 | 150 g | Good Fill rate |
| 3 | CTD 540 | 1/2 | 250 g | Good Fill Rate |
| 4 | Stycast 23LV | 1/2 | 250 g | Slow insufficient fill |

304SS Welded Envelope Shim

- Fabricated from 0.005" thick shim stock
- TIG welded around perimeter using a 0.010" frame to aid in welding
- Inflated with a few psi of Argon pressure
- Does not bend around curved surfaces without buckling
- Needs a durable insulating layer to prevent shorting
- Can't see inside to fill completely with glass
- Cost: Approximately \$2000 / envelope (plus development costs)



Metal Shim Envelope



Remaining Tests

- Epoxy Impregnation
 - Shrinkage during curing
 - C-C Bag Installation Trial (requires prototype bag dimensions)
- Mechanical Properties
 - Compressive Strength at LN2 temp