



Maseeh College of En
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PORTLAND STATE UNIVERSITY



PSAS Composite Cryogenic Fuel Tank

ME 492 Capstone Presentation
2017-02-14



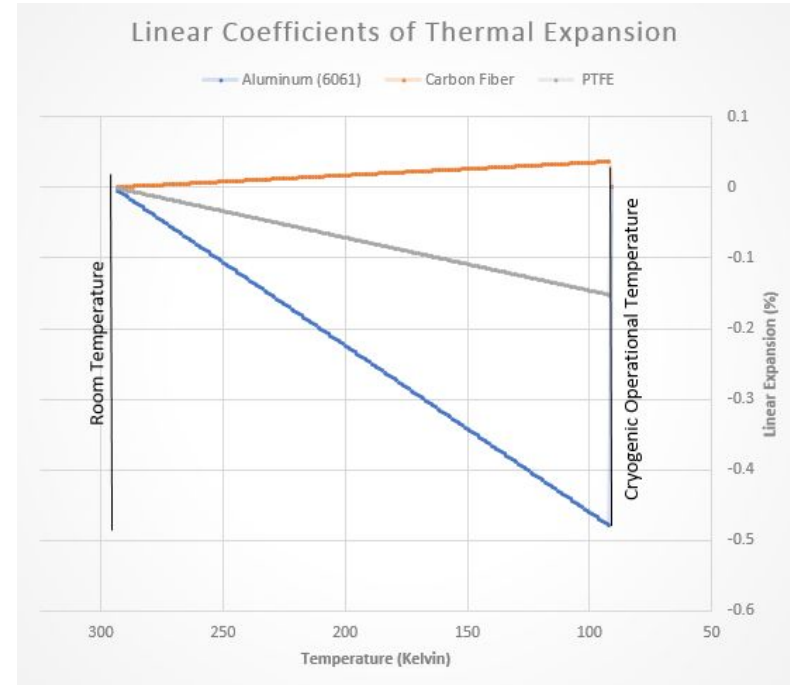
Manufacturing concerns

- How to go about layup/fabrication process?
- Carbon fiber + Nomex Sandwich Core + Al Mating Rings/End caps + PTFE Liner + Thermal insulation + Adhesive, How do we assemble all of these parts? Design must consider assembly
- Previous capstone ('16) developed process of laying up on Al rings/mandrel, how can this be applied or changed for our uses? We cannot use a mandrel without attaching the end caps after curing the CF
- Investigating option to create PTFE liner mandrel and lay up directly onto PTFE to avoid nightmarish concerns fitting a proper liner into a preformed layup. Can the PTFE hold up to the shrink tape at the curing temperature?

Thermal Contraction/Expansion Concerns:



- Current PSAS LV4 rocket airframe modules are composed of carbon-fiber composite with aluminum mating rings.
- Tank design would ideally incorporate light-weight characteristics of carbon-fiber composite frame, isolate the LOX from the tank structure via a liner material, and interface with the rest of rocket via aluminum endcaps and mating rings (minimum of 3 different materials).
- Challenges: Interfacing and nesting materials with different coefficients of thermal expansion and insulating to prevent mating ring contraction.
- Potentially exploit contraction for shrink fitting.
- Design with intent to reduce Al/CF interface.



(Internal tank operating temperature: 90°K/-183°C)



Seal Concerns and Material Compatibility

- The reaction between the epoxy and the lox requires an impervious seal or the project will fail (LOX+CF Resin=Fire)
- The differences in the thermal properties of the materials mentioned earlier make this one of the biggest design problems that we are facing. Cracking of the CF, delamination of layers, and poor sealing at the interfaces can all allow leaks that could ultimately lead to a rapid, unscheduled disassembly of the tank.
- Can we use adhesives on hand? How will they perform at 90 K? Must we use threaded fasteners? If so, will the resulting stress concentrations force a bulkier design?