

Team Meeting 3/2/20 - 1 Day to CDR

Meeting Agenda

- Inert Gas Changes
 - Purge/Inerting & Pressurization System - Helium (\$310 K-Cylinder)
 - Pneumatic Control System - Nitrogen (\$54 K-Cylinder)
- CDR Task updates

CDR Task Updates

Main Injector (est. remaining cost: \$0 - Protolabs sponsorship)

- **Progress**
 - Igniter interface redesigned to eliminate clocking issues
 - Chamber face thickness increased to increase FS
 - Drawing draft
- **To Do**
 - Redo FEA to check increased FS - **Walker - DONE**
 - ~~Update drawing/design with Greg comments~~ - **Jeff - DONE**
 - On the Main Injector, I don't see the depth of the o-ring gland specified. This should probably be 0.111".
 - The OD of the injector is 4.000 (same as chamber ID so parts won't engage).
 - CFD (fuel & ox pressure drops)
 - Can get Cd or dP info from cold flow if don't have time for CFD
 - Maybe over break?
 - Add to CDR slides
 - Design changes - **Jeff**
 - Drawing - **Jeff**
 - FoS - **Walker - DONE**

Igniter (est. remaining cost: \$300 - fittings, tooling)

- **Progress**
 - Injector interface redesigned to eliminate clocking issues
 - Drawing draft
- **To Do**
 - Check on inconel/stainless expansion question - **Walker - DONE**
 - 0.4mm difference in length under absolute worst case scenario (material temperature change of 2700 K). So we're good.
 - ~~Heat transfer~~ - **Alec**
 - FEA with 316 stainless - **Walker**

- ~~Update drawing with Greg comments~~ - **Jeff - DONE**
 - On the Igniter drawing, what are the 5/16-24 threads for? If they are for boss o-rings fittings MS 16142 (same as SAE J1926), these are typically machined using port cutters to accommodate the o-ring. Most machine shops have special cutters for MS ports and we have some of them in the lab. They cut the o-ring gland and pilot bore in one simple operation. You need to specify "for MS 16142 port" next to the thread call out (otherwise the o-ring gland will not get cut during the manufacturing).
 - The hole on the top of the igniter is not specified. If it is the same as the other 60 deg hole, you can write "2-places" below the 5/16-24 call out on the bottom hole.
- Add to CDR Slides
 - Design changes - **Jeff**
 - Drawing - **Jeff - DONE**
 - FoS - **Walker**
- Purchase priority list for initial testing - **Walker**
- Pressure transducer needs - **Walker**

Controls & electronics (est. remaining cost: \$150)

- **Progress**
 - BOM integrated into main
 - Pneumatic diagram made
- **To Do - Tom**
 - Fix BOM double counting (some prototyping parts were added near top of BOM weeks ago, are these redundant with later BOM additions?)
 - Add to CDR slides
 - Updated system diagram
 - Pneumatics PID
 - Air Compressor to N2 switch
 - Purchase priority list for initial testing

Nozzle (est. remaining cost: \$0 - quotes received & added to BOM)

- **Progress**
 - Quote received - \$600 for 3X
 - Drawing draft
- **To Do**
 - ~~Update drawing with Greg comments~~ - **Jeff - DONE**
 - On the Nozzle, can you move the o-ring aft towards the maximum thickness so that it doesn't see as much heat?
 - Also, the R=0.06 MAX call out should be a specified radius (i.e. not MAX). This corner is an interior corner on a brittle part and is vulnerable to stress concentrations.
 - Re-quote with updated drawing and prepare to purchase (how do we get them the money?) - **Bernadette**

- Add to CDR Slides
 - Drawing - **Jeff - DONE**
 - Fabrication details (shop, quote, lead time) - **Bernadette - DONE**

Combustion Chamber (est. remaining cost: \$750 (machining))

- **Progress**
 - Drawing drafts
 - Quotes?
- **To Do**
 - ~~Hydro test plug design~~ - **Jeff - DONE**
 - ~~Update drawings with Greg comments~~ - **Jeff - DONE (Note: Chamber tube switched from tube to sch 40 pipe for better dimensional control)**
 - On the Notched Retainer Bolts, show an overall length. Also, the notch width is not specified (a radius is called out but it is not clear that the width is twice the radius).
 - On the Nozzle Aft Flange, no chamfer is specified to accommodate o-rings during assembly. Also, bore ID is same as chamber OD (i.e. 4.500) so parts won't engage.
 - The OD of the phenolic liner is specified as the same (4.00) as the ID of the combustion chamber tube. The parts won't fit unless you get lucky with the tolerances. I suggest purchasing the phenolic and measuring the OD ASAP.
 - Bolt notch testing? (if possible before CDR, if not then ASAP)
 - FEA/Hand calcs for FoS at 150 psi (make sure notched bolts are weak point) - **Elida**
 - Nozzle retainer plate
 - Nozzle end flange
 - Tie rods
 - Nozzle retainer bolts
 - Chamber wall
 - Test stand flange (support plate, whatever its name is)
 - Add to CDR Slides
 - ~~Drawings~~ - **Jeff - DONE**
 - Raw material sourcing - **Bernadette - already in BOM**
 - Fabrication details (quotes, which will do in PRL, lead time) - **Wouter**
 - FoS/FEA results (verify nozzle retainer weakest) - **Elida**
 - Bolt Notch Calcs - **Rishav-Done**

Test Stand (est. remaining cost: \$300)

- **Progress**
 - Bolted joint between test stand "bed" and "flange"/support plate
 - McMaster 500lb shelf brackets
- **To Do**
 - ~~Bolted test stand bed design~~ - **Wouter**
 - ~~Drawings~~ - **Jeff - DONE**

- Parts
- Test stand Assembly
- ~~FEA/Hand calcs for FoS at 150 psi (640N thrust) - Wouter~~
- Add to CDR Slides
 - Drawings - Jeff - DONE
 - ~~Fabrication details (quotes, which will do in PRL, lead time) - Wouter~~
 - FoS - Wouter, Elida
 - Test plans (top-level test list, operations details, expected results) - Rishav
(Slides look fine to me. I will upload the detailed write-up & checklists later this week)
 - Hydro
 - Cold flow
 - Lower priority than other work, but would be good to have

Propellant Feed System (est. remaining cost: \$1500 - misc.)

● Progress

- ~~Cavitating Venturi~~
 - ~~Machinable design~~
 - ~~Drawing~~
- ~~Propellant Quotes Received~~
- Full Assembly CAD done w/tube routings

● To Do

- Update full assembly
 - ~~Pressure Transducer models (currently shown as relief valves) - Wouter/Efaine~~
 - Cryo solenoid valves - Efaine
 - ~~BVIO (closest valve to chamber on Ox igniter line) should be 1/4" ball, not solenoid valve - Wouter/Efaine~~
 - Make each feedline a subassembly
- Assembly drawings - Efaine/Jeff
 - As many/few views as needed to get BOM balloons on all parts, inc. O-rings
 - Reference (parenthesized) dimensions for overall sense of scale
 - BOM on drawing should match BOM spreadsheet, maybe even use spreadsheet BOM numbers
- ~~P&ID Part List with MAWP, source, price (partially done) - Jeff/Alec~~
 - ~~Generant relief valve quote - Efaine~~
- LOx tank support structure - Rishav/Tom
 - Support setup
 - Load cell mounting config
 - Insulation arrangement
- Add to CDR Slides
 - Assembly Drawings - Efaine/Jeff
 - ~~P&ID Part List - Jeff/Alec~~
 - LOx tank Support Structure - Rishav/Tom- Done