Preview
Oxidizer Tank

- **Material:** 6061 T6 Aluminum Alloy
- **Manufacturing:** Saw / Mill / Weld
- **Cost:** $56 / 4’

- OD: 4”
- ID: 3.75”
- Length: 24”
- Welded or Silver Solder at Both Ends to Coupler parts
- ¼” Threaded Holes in each end
- 2 Way Normally-Closed Valve in Conjunction with Ball or Needle Valves for filling/venting (Not Pictured)
Valve Configuration

- T-Junctions at both ends to accommodate filling and the actual burn
- Threaded Holes with male to male fittings
- Limited Tubing
Filling The Oxidizer Tank

- Bulk Nitrous Oxide comes from WSU
  - 60 lb tank - $110 for Testing
- Nitrous Available for Purchase at IREC
- Fill Process
  - Two Processes - Gravity Feed or Vent Feed
  - Gravity Feed involves lifting fill tank above run tank
    - Gravity forces Nitrous Into Run Tank
    - Vapor travels up fill line into fill tank which pushes more oxidizer into Run Tank
    - Major Problem: Fill Tank is heavy and might not be able to be lifted above rocket
    - Problem: No way to consistently measure amount in run tank
Filling The Oxidizer Tank

○ Vent Feed

■ With an open vent in run tank, there is a pressure difference between run tank and fill tank

■ Oxidizer flows from high pressure fill tank and atmospheric pressurized run tank

■ Vapor is vented through hole

■ When liquid reaches vent, escaping vapor thickens and whitens visibly.

■ Vent is closed, fill is stopped, and run tank is allowed to pressurize

■ Rocket is launched once pressure is reached.
2 Way Valve

PeterPaul Serial Number:
EH22G9DCCM-E DC

- Material: Stainless Steel
- Cost: About $120
- Voltage: 1.8 to 265V DC
- Nominal Power: DC — 9.5 Watts
- Response Time: 4 – 16 ms
- Weight: 1.13 lb
- Primary Orifice Size: ⅛
  (Customizable)
- Body Port Size: ¼ NPT
- Operating Pressure: 3000 psi max
- Burst Pressure: 5000 psi
Battery 4000mAh 7S 25C Lipo Pack

- Cost: $57.16
- Powers the valve
- Capacity: 4000mAh
- Voltage: 7S1P / 7 Cell / 25.9V
- Dimensions: 148x44x46mm
- Weight: 645g
- Might use lower cell Battery
- Expensive but we only need one

Injector Plate

- Material: Aluminum 6061-T6
- Manufacturing: CNC Mill
- Cost: $8

- Showerhead-style 1/4” thick copper injector plate
  - Minimal weight
  - Easily optimized flow
- 13 Hole Pattern
  - At .75” and 1.5” circles
- 0.0625” hole diameter
  - Compromise between atomization and avoidance of cavitation
Coupler

- Material: Aluminum 6061 T6 (Bar Stock milled and lathed)
- Manufacturing: CNC Mill / Lathe
- Cost: $273 / 2’

- 8X (12X if weak) .25” Thru Holes for Bolts
- Slip fit over the tube in addition to silver solder/weld to secure
O-rings

- Face Seals
- Square Cross Section
- 4 inch ID, \( \frac{1}{8} \) inch thickness
- Each vendor is fairly inexpensive (comparatively)

- Material: Viton
  - 242 V90 (4 ID X 4-1/4 OD X 1/8 W)
    - Cost: $1.44
  - 242 V75 (4 ID X 4-1/4 OD X 1/8 W)
    - Cost: $1.16
  - Fluorocarbon 75 Durometer O-Ring, Low & High Temperature (VM835-75)

- Material: Silicone
  - 242 S70 (4 ID X 4-1/4 OD X 1/8 W)
    - Cost: $0.46

- Vendors
  - hitchseals.com
  - oringsusa.com
  - anchorrubber.com
  - parker.com
Combustion Chamber

- Material: 6061-T6 Aluminum Alloy Tube
- Manufacturing Method: Saw / Mill / Welding
- Cost: $56 / 4'

- OD: 4”
- ID: 3.75”
- Length: Approx. 20 inches
- Coupler with a face seal O-Ring (Parker)
- Top End (Near Injector Plate) Silver Solder/Welded
- Bottom End (Near Nozzle) is threaded to screw on “End Cap”
Igniter

E-Match

- Material: Wire and Pyrogen
- Manufacturing Method: Buying
- Cost: ~$12 / 3 pack

- Use some from Solids Group?
- 1 or 2 in the Post Combustion Chamber
Fuel Grain

- Material: HTPB, HPTB/Paraffin Mixture, Nylon
- Manufacturing Method: Casting in Phenolic Tubes
- Cost: Varies ($40 - $70)

- OD: Slightly less than 3.75”
- ID: 1.75”
- Length: 12”
- Planned Around HTPB
- Will test HTPB, HTPB/Paraffin Mix, Nylon
- Can scale down the size once we have a better idea of how the fuel will burn
- Will cast within a sleeve that will slide into combustion chamber
Nozzle

- Material: Graphite
- Manufacturing Method: CNC Mill/Lathe from Rod Stock
- Cost: Approx. $25/Nozzle
- Conical shape for design/machining simplicity
- Losses from Conical shape not significant for our purposes
- Tenting the CNC machine
- Respirators will be required
- Throat Diameter (currently .6”) will be dialed in after testing
Body/Insulation

- Fiberglass (Or other lightweight) body
- Wrap around a 6 inch Cardboard tube to cast (or buy)
- Screws into the coupler pieces
- Should not need a lot of force to stay on
- Should be lightweight (Thin shell)
Bill Of Materials

- Total weight right now: about 60-70 lbs
- Total Cost (so far): $1318.60
- Well Under Budget so far

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<th>Description</th>
<th>Qty</th>
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**TOTAL** 1318.6
Testing

- Test Stand is Almost Finalized
  - Length of Bosch =
  - Waiting for Budget Approval from 406

- Propellant Material Purchase Order by 03/13
- Casting of Propellants after Spring Break
- Safety Test Procedure Submitted by 03/13
Additional Work

- Design Fins (Likely will attach to the outer body)
- Recovery system housing/weight
- Recovery System Attachment
- Method of Securing the Fuel Grain
- Figure out valve/vent/pressure relief placement
- Purchase ball valves and pressure relief valve
- Establishment of Burn Time
  - Get the Burn Time/Average Mass flow
  - Tweak Nozzle throat diameter to reach desired height