



Liquid Fuel Rocket Engine

Portland State Aerospace Society
Senior Capstone Project

Tamara Dib, Taylor Rice, Kristin Travis,
John Tucker, Bianca Viggiano, Cam Yun

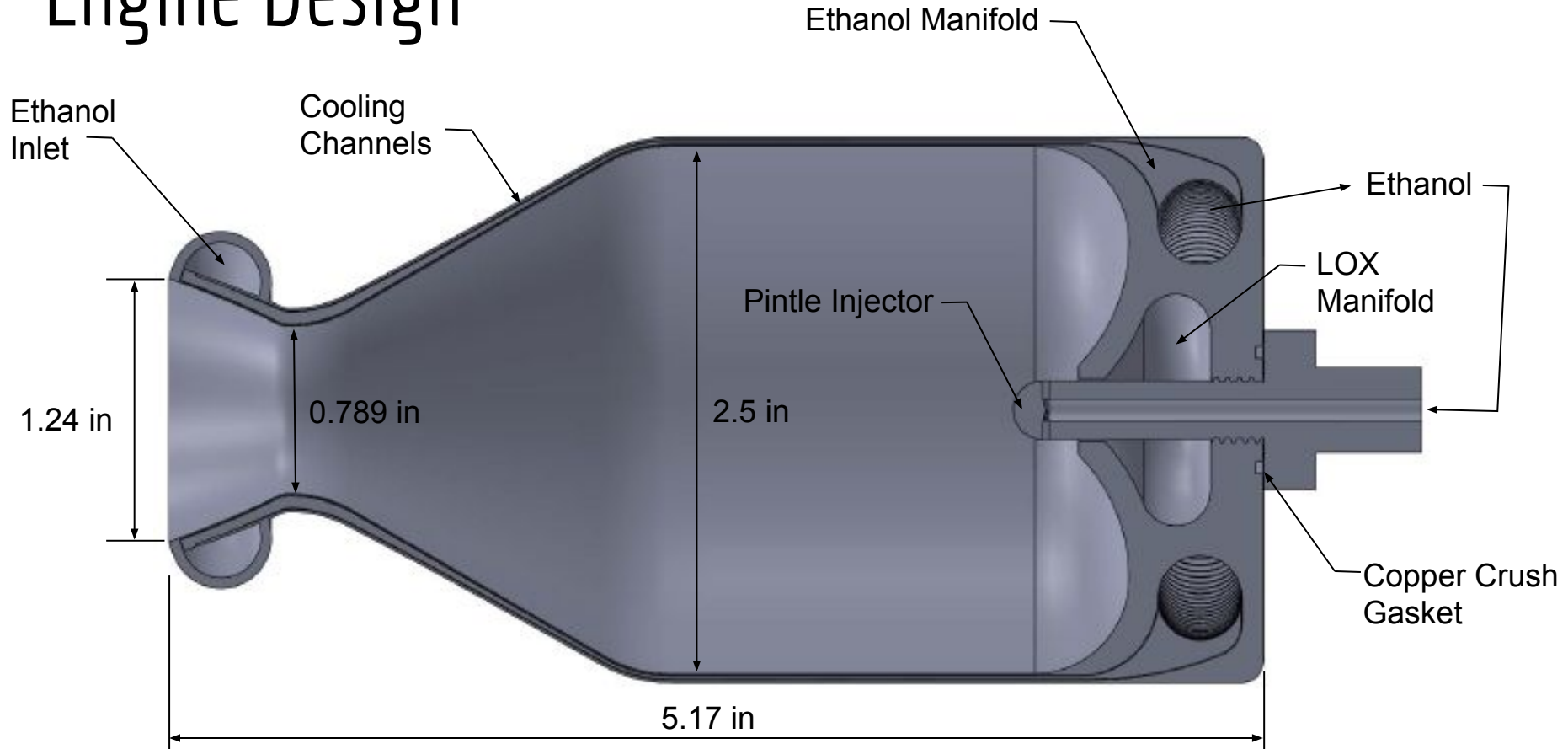


Engine Design

- 250 lb Thrust
- Static test stand engine
- 3D printed in Inconel
- Ethanol and Liquid Oxygen Propellants
- Fuel filled regenerative cooling channels
- Fuel centered stainless steel pintle injector



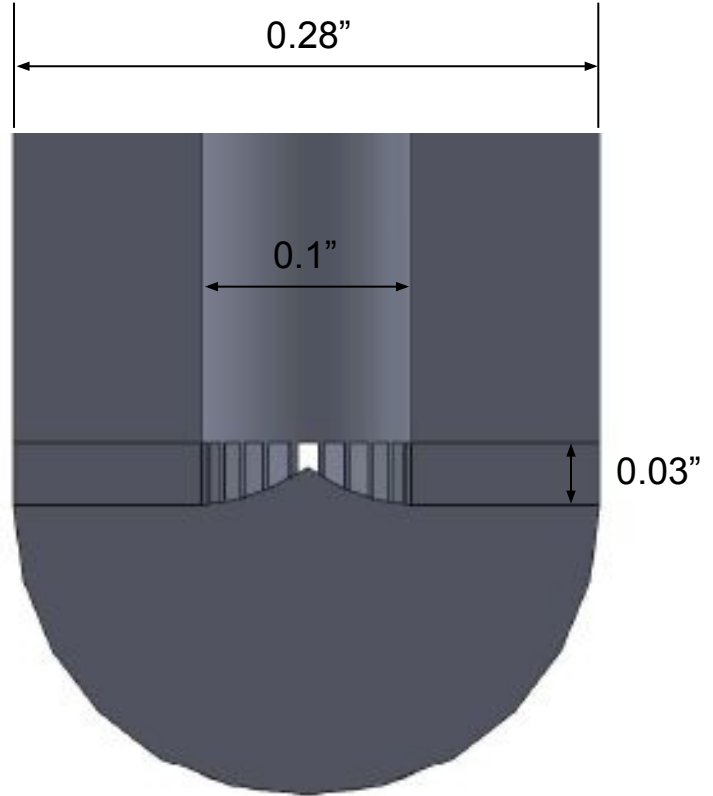
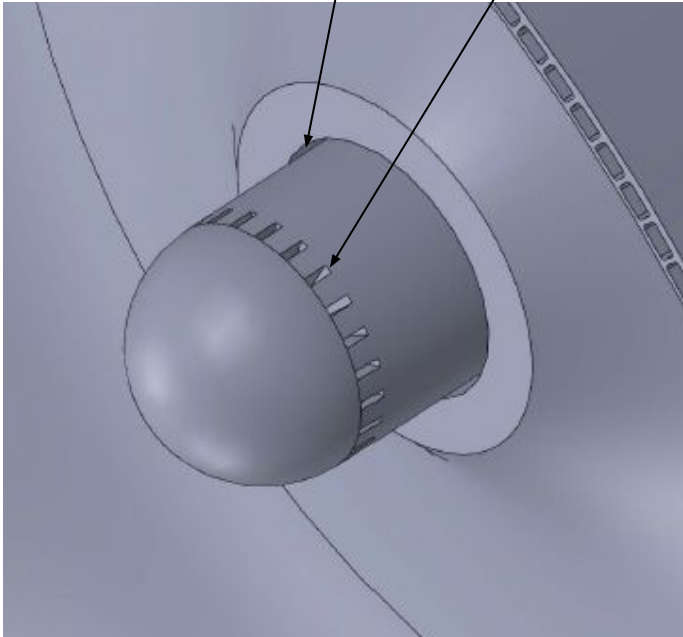
Engine Design



Pintle Design

Ethanol Holes (20 total) = 0.01" x 0.03"

LOX annulus gap = 0.008"



Injector

-Chamber pressure = 350 psi

-Mixture ratio = 1.25

-1.06 lb/s total flowrate

-0.48 lb/s ethanol

-0.58 lb/s lox

-Pressure drop across injector = 70 psi

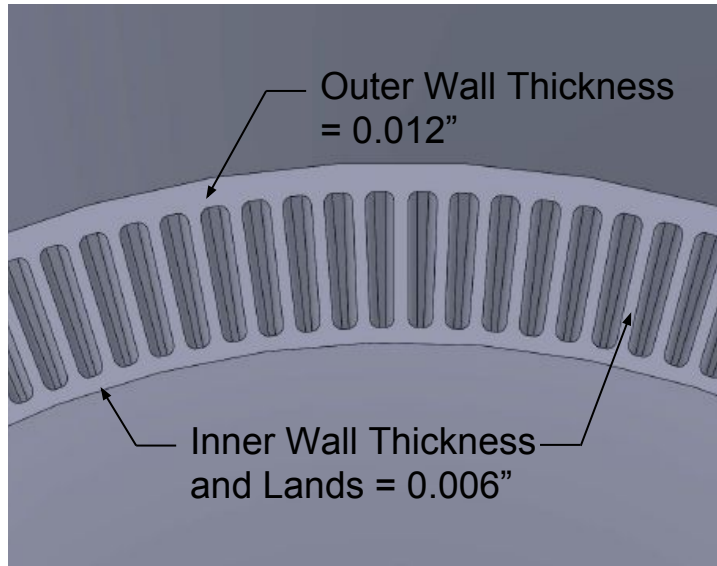
-Blockage Factor = 0.76

-Total Momentum Ratio = 0.83

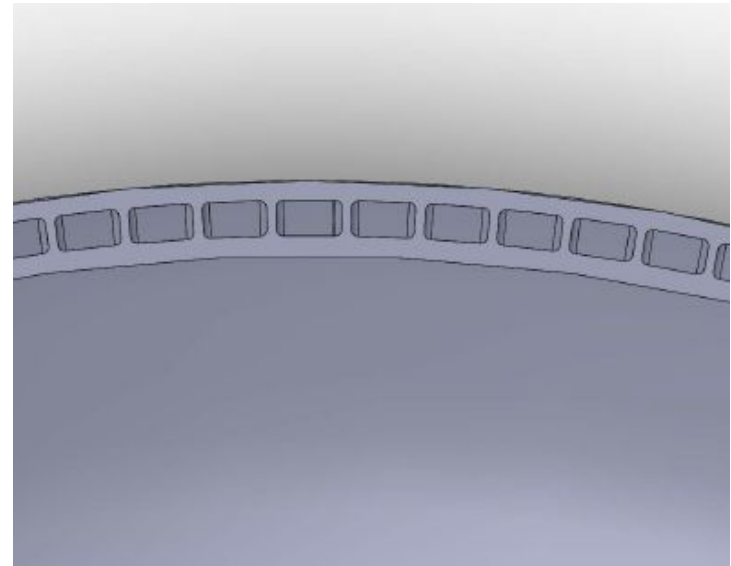
-Effective Momentum Ratio = 1.08

Cooling Channels

-Cooling channels maintain a constant cross sectional area



Cooling Channel Section at Nozzle Throat



Cooling Channel Section at Combustion Chamber

Heat Transfer and Stress Analysis

-Pr = 0.88

-Required q at the throat =
33.84 Btu/in²-s

-Wall thickness = 0.00615 in

-Combined tangential stress at nozzle
exit = 669.52 psi

-Combined tangential stress at throat
= 130473.88 psi

-Max compressive stress at coaxial
shell design = 49117.22 psi