Intro to Solid Mechanics: SolidWorks FEA Final Project

By: Franz von Dyck

Scope

- Dimensions: 8" x 4" x 4"
  - MAX Fixed Support: 2"x 4"
  - MAX Force Area: 2" x 4"
    - 15° Counterclockwise
      - Applied on 1"

- Material: ASTM A36 Steel
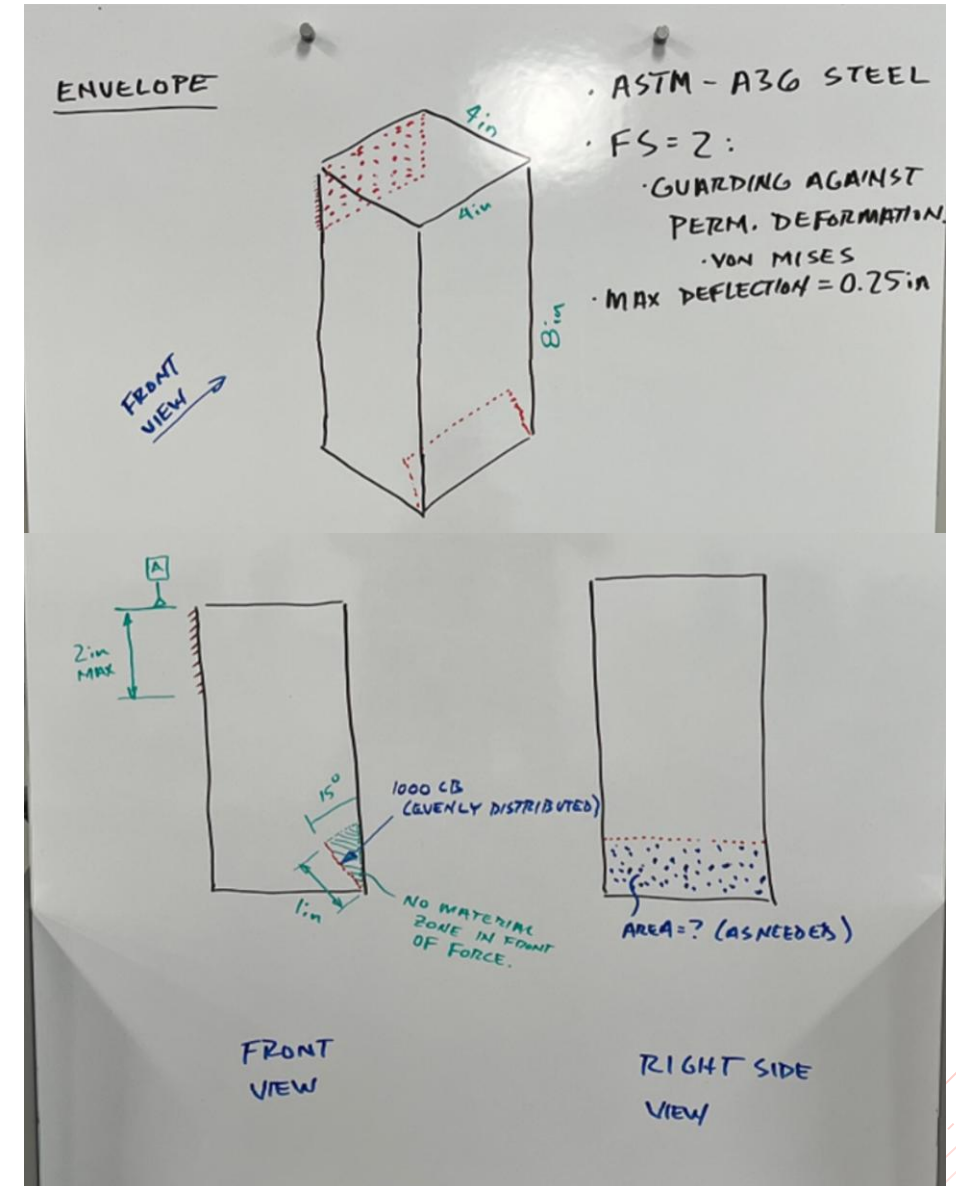 - $\sigma_y = 36259.43442\ psi$

- Factor of Safety: 2

- MAX Deflection: .25"

- Applied Force 1000LB

- MAX von mises:
  - $\sigma_{allow} = \frac{\sigma_y}{S.F} \rightarrow \frac{36259.43442\ psi}{2} = \boxed{18129.71721\ psi}$
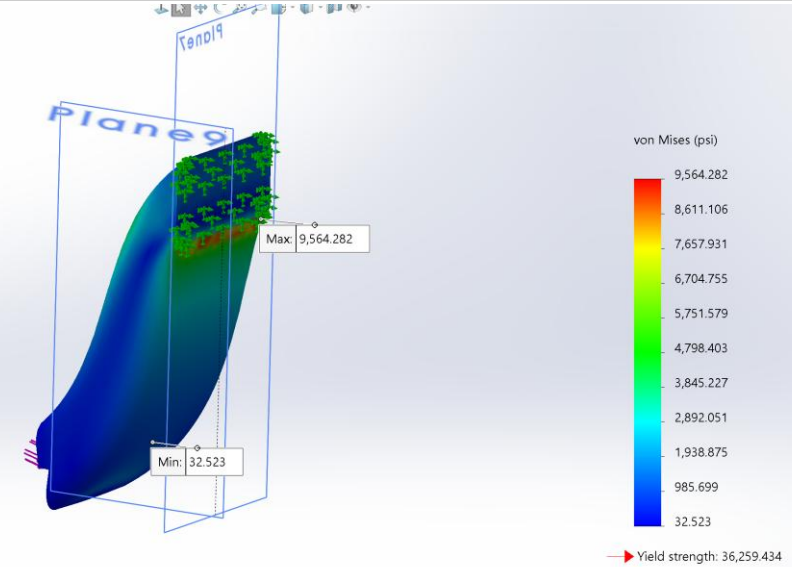
Attempt 1:

- Original Baseline Design
  - Implemented Fillet
    - .5"
  - Boss/ Base Extrusion
- Design **meets** specs
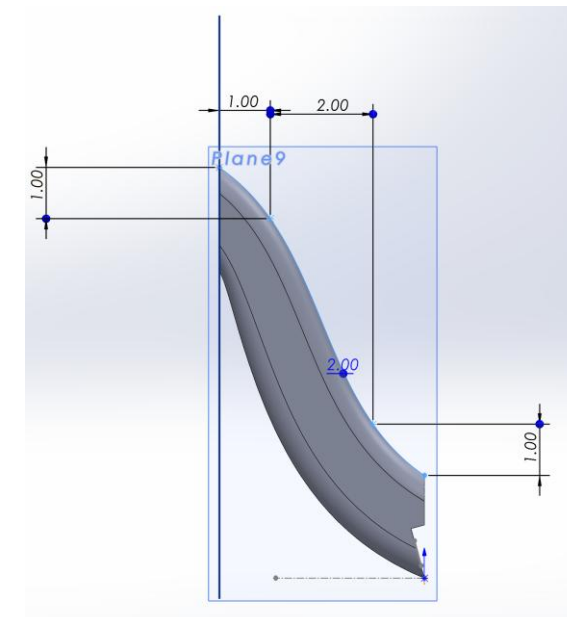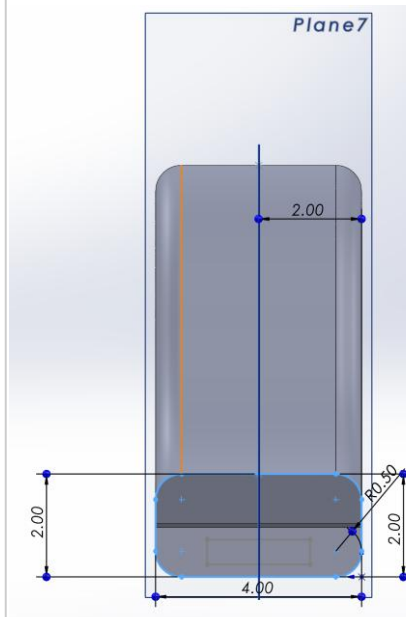
Density = 0.04 pounds per cubic inch

Mass = 1.69 pounds

Volume = 46.69 cubic inches

von Mises (psi)

9,564.282
8,611.106
7,657.931
6,704.755
5,751.579
4,798.403
3,845.227
2,892.051
1,938.875
985.699
32.523

Max: 9,564.282

Min: 32.523

Yield strength: 36,259.434

Plane7

Plane9

2.00

1.00

2.00

1.00

2.00

1.00
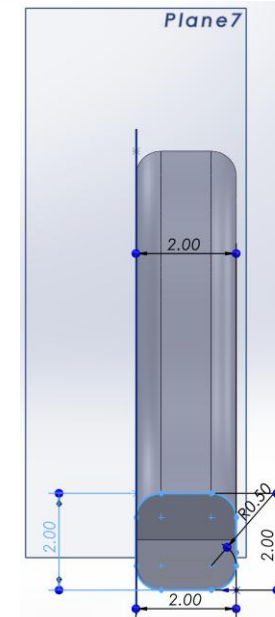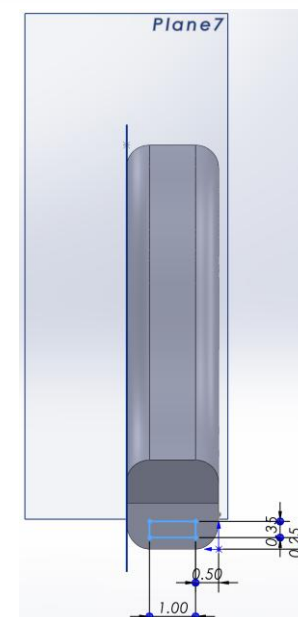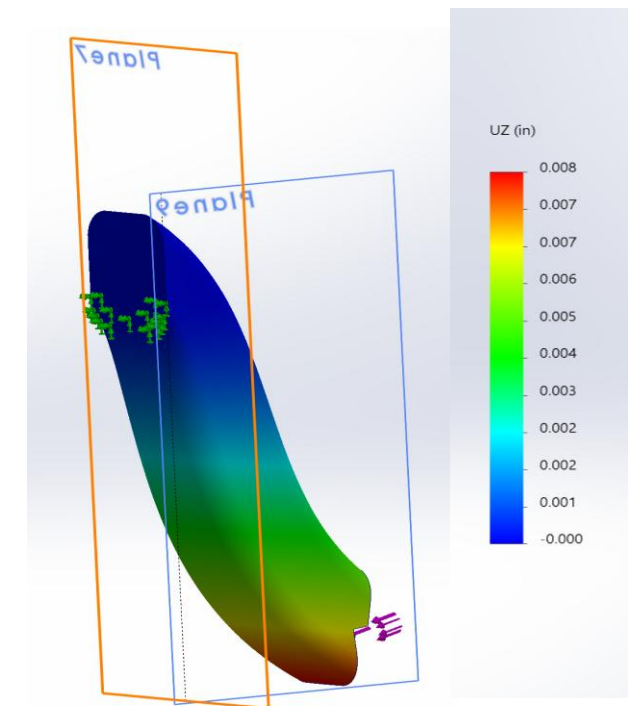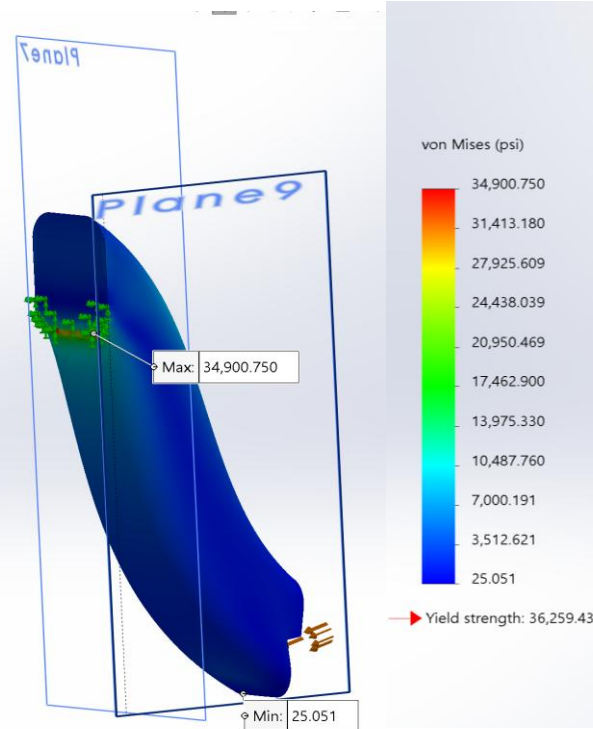
2.00

R0.50

2.00

4.00

Attempt 2:

- Change of Boss/ Base extrusion
- Dimensions:
  - 2" x 2" Area
    - Fixed Support
    - Force Area
- Design **OUT** of Spec
  - Von Mises

Density = 0.04 pounds per cubic inch

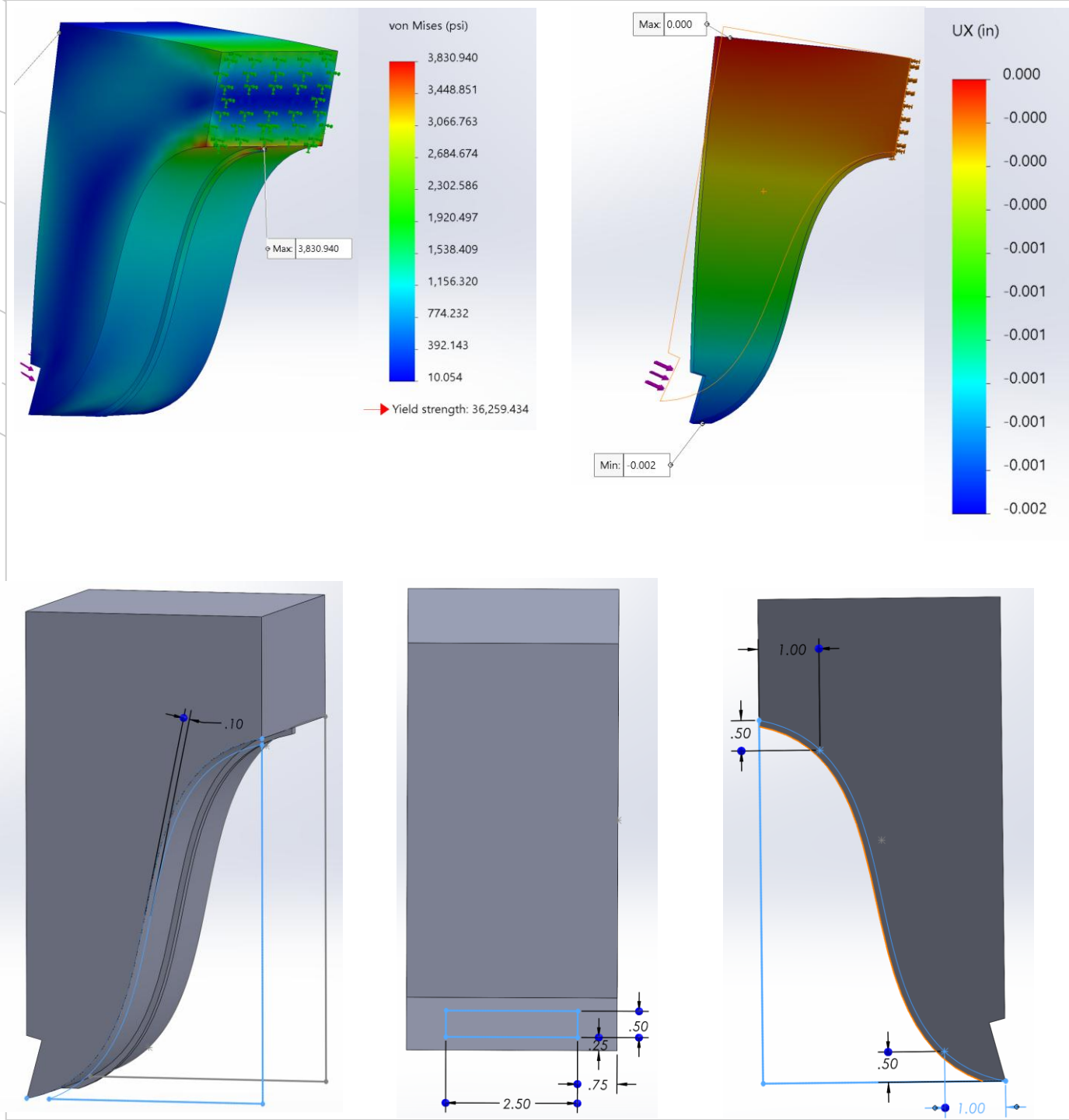Mass = 0.82 pounds

Volume = 22.69 cubic inches
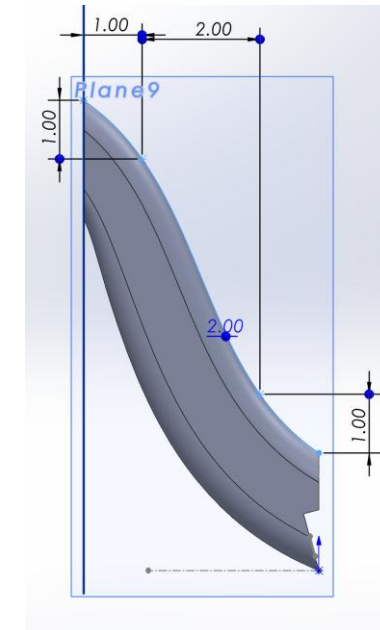
Attempt 3:

- Design Change
  - "Support Spline Rib"
- Design **meets** specs

Density = 0.04 pounds per cubic inch

Mass = 2.88 pounds

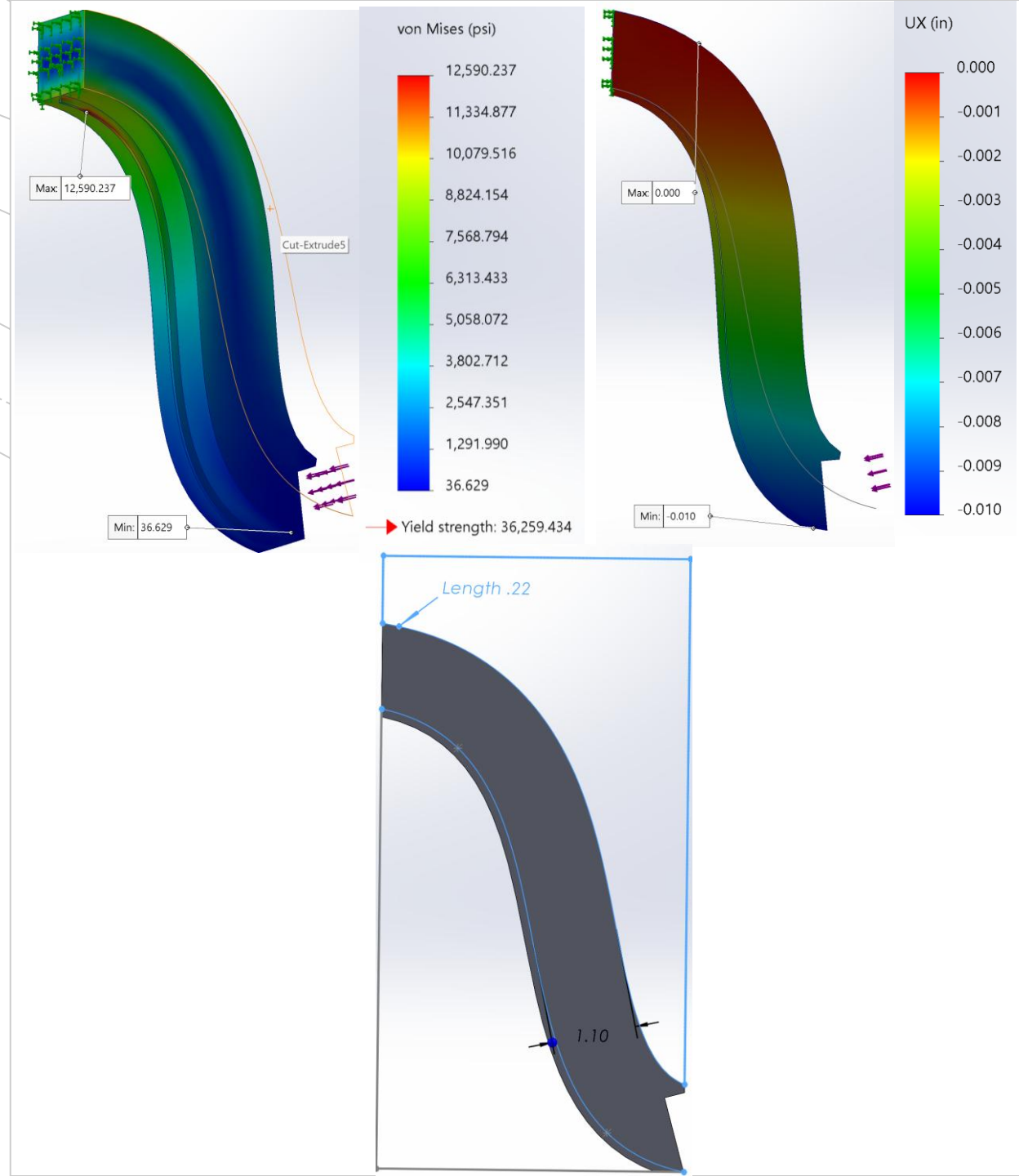Volume = 79.61 cubic inches

Attempt 4:

- Removal of Excess Material
- Design **meets** specs

Density = 0.04 pounds per cubic inch

Mass = 1.22 pounds
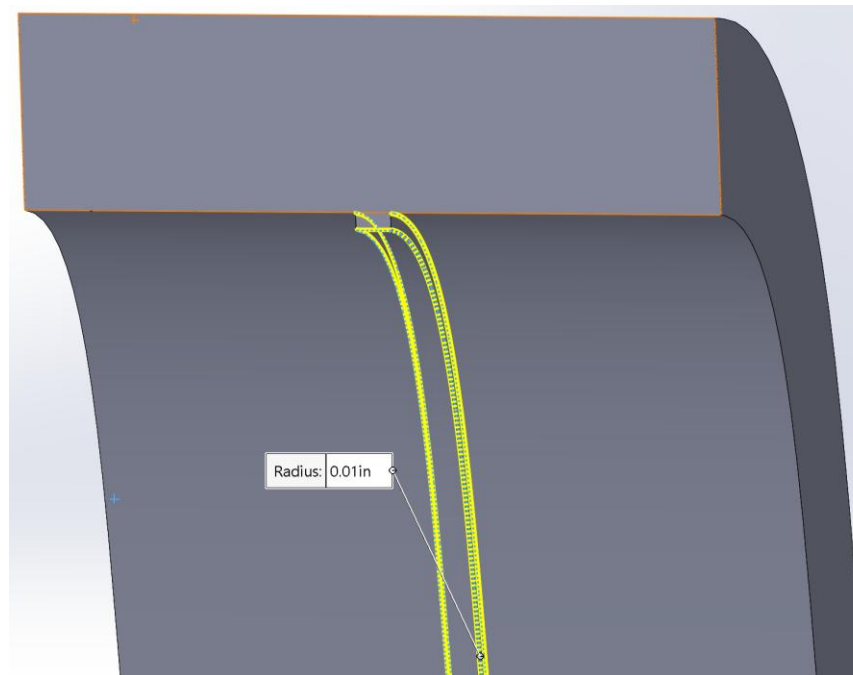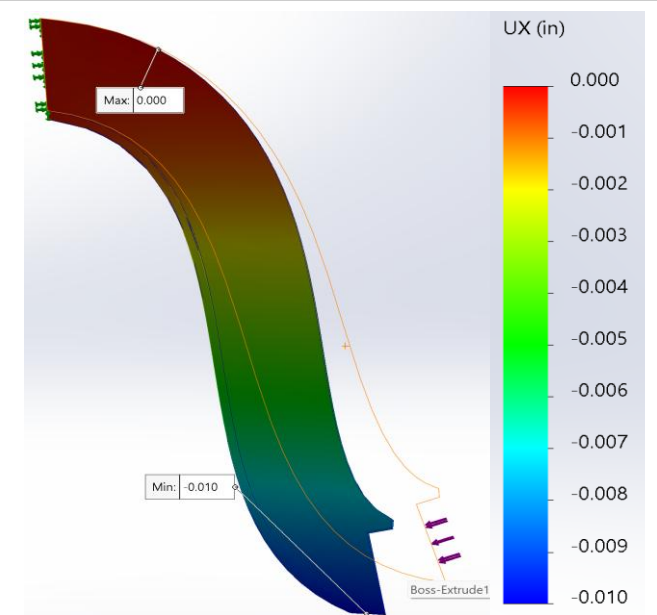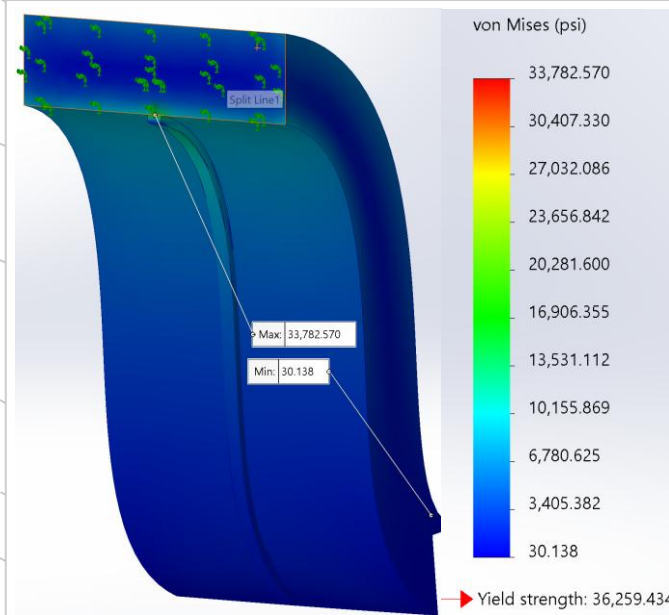
Volume = 33.65 cubic inches

Attempt 5:

- Implemented Fillet
  - "Support Spline Rib"
- Design **OUT** of Spec
  - Von Mises
- Fillet – "Friend or Foe"?

Density = 0.04 pounds per cubic inch
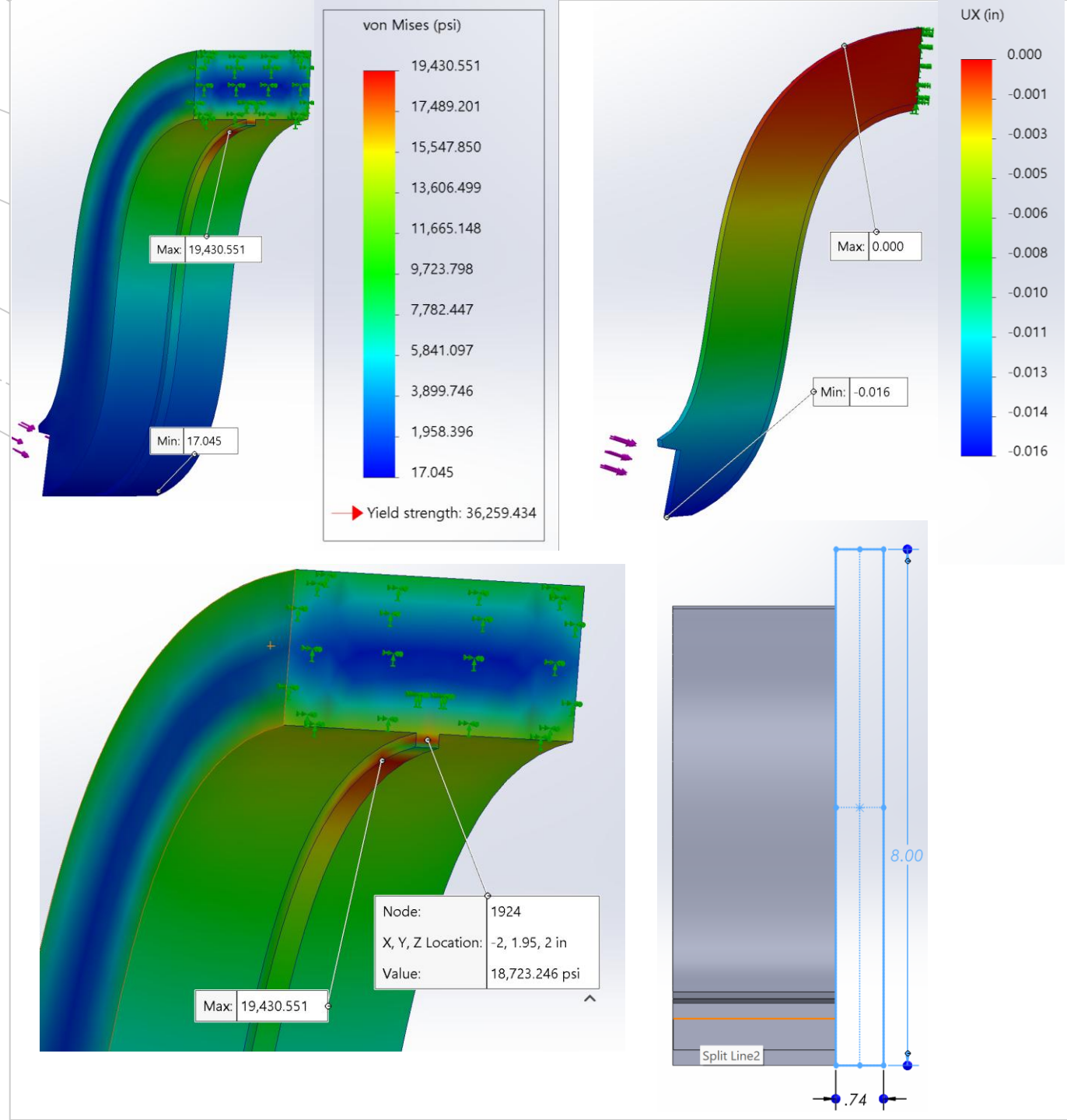
Mass = 1.22 pounds

Volume = 33.65 cubic inches

Attempt 6:

- Reverted to Design "Attempt 4"
- Force and Fixed Area
  - Removed Excess Material on Sides
- Design **OUT** of Spec
  - Von Mises

Density = 0.04 pounds per cubic inch

Mass = 0.77 pounds
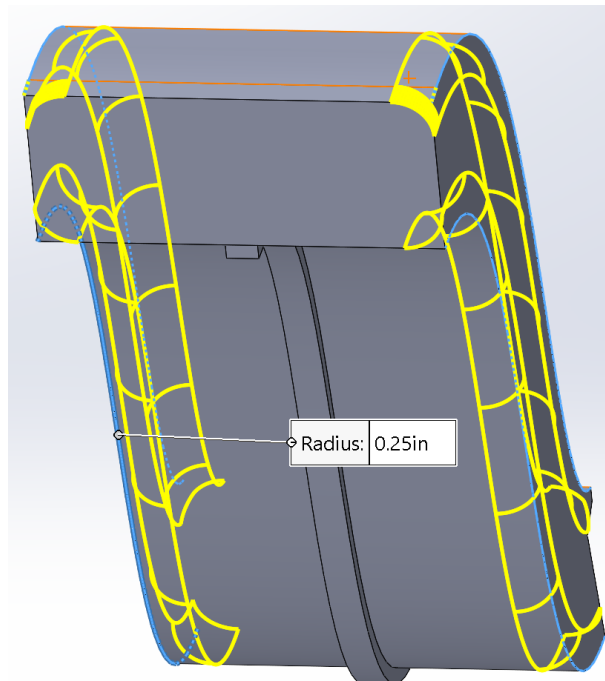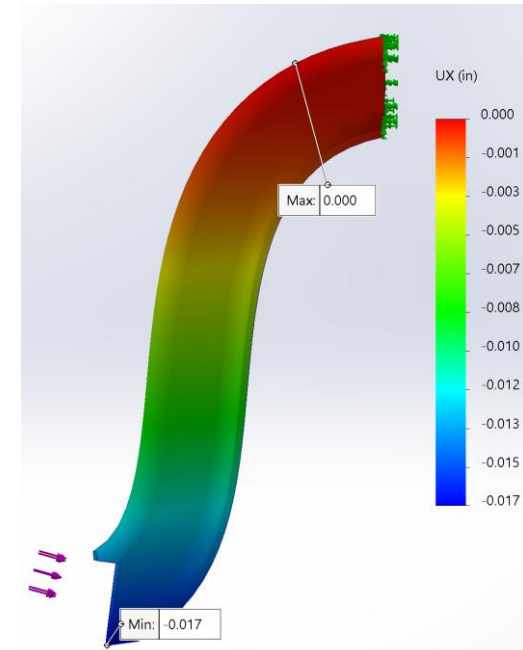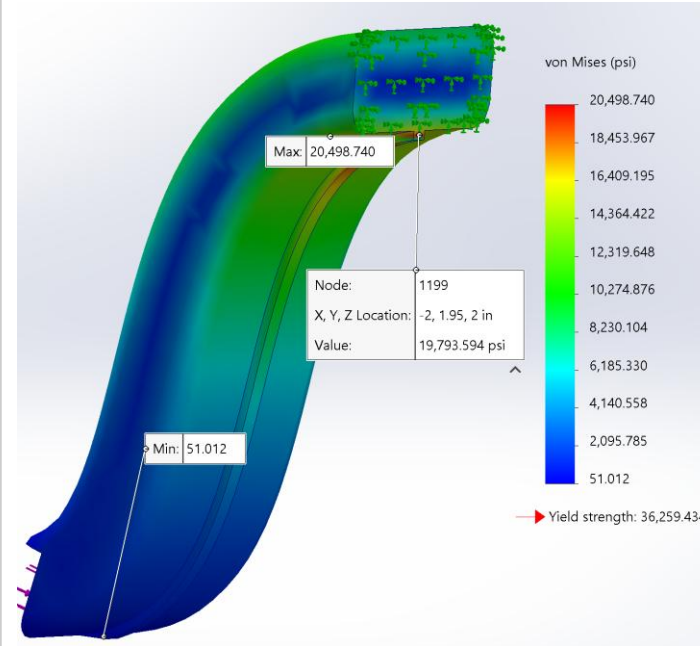
Volume = 21.26 cubic inches

Attempt 7:

- Implemented Fillet
  - .25"
- Design **OUT** of Spec
  - Von Mises

Density = 0.04 pounds per cubic inch
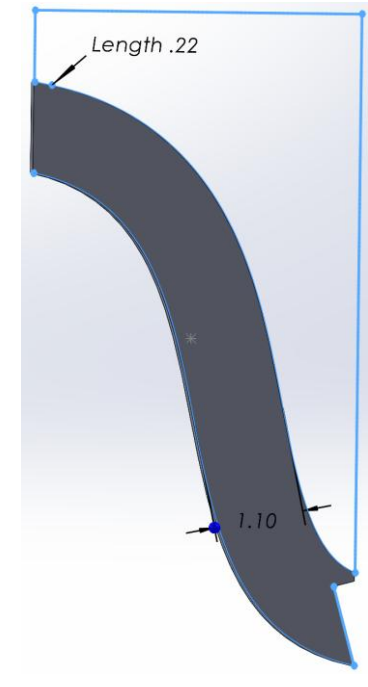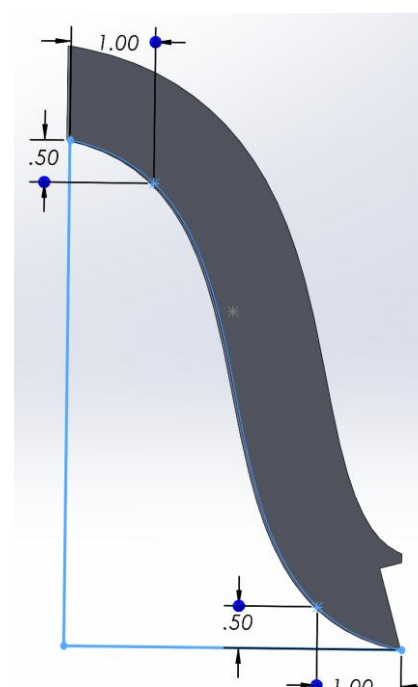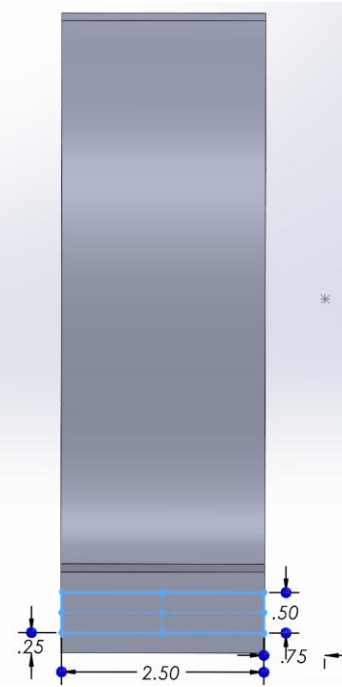
Mass = 0.75 pounds
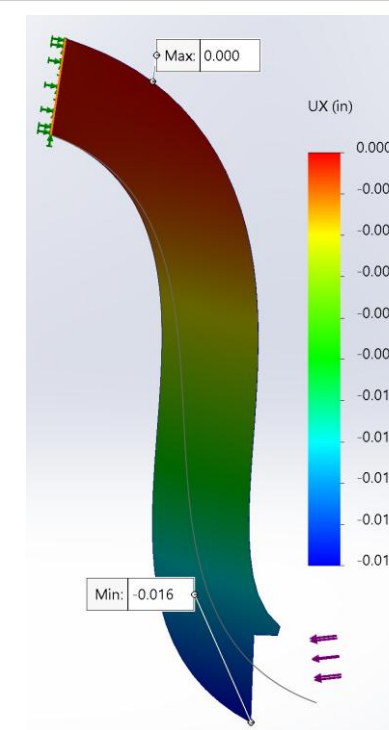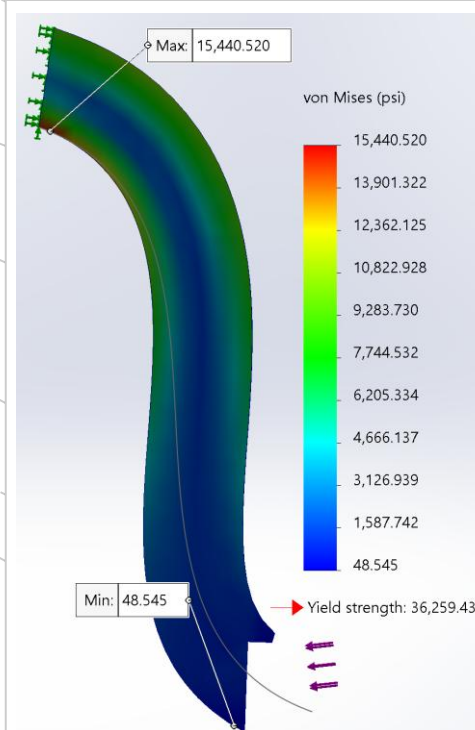
Volume = 20.85 cubic inches

Attempt 8:

- Removed "Support Spline Rib"
- Design **Meets** Spec

Density = 0.04 pounds per cubic inch

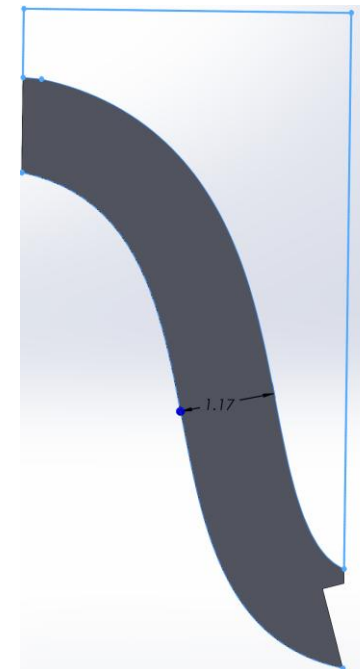Mass = 0.76 pounds
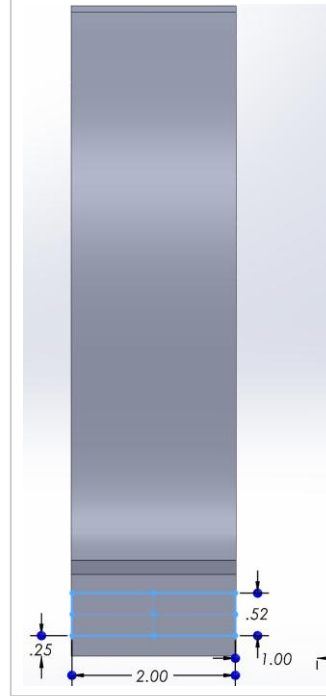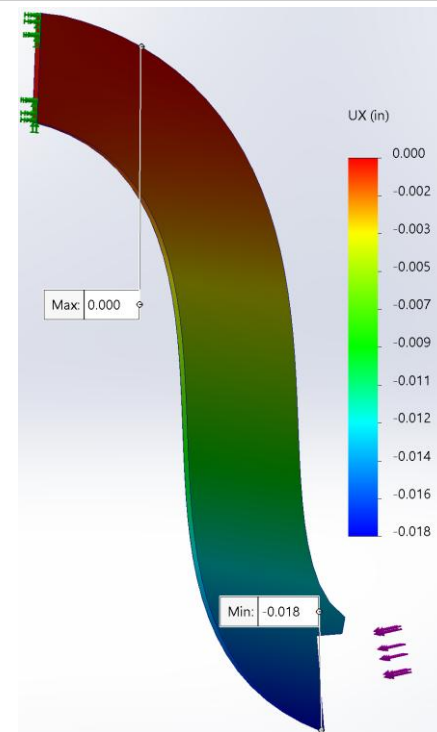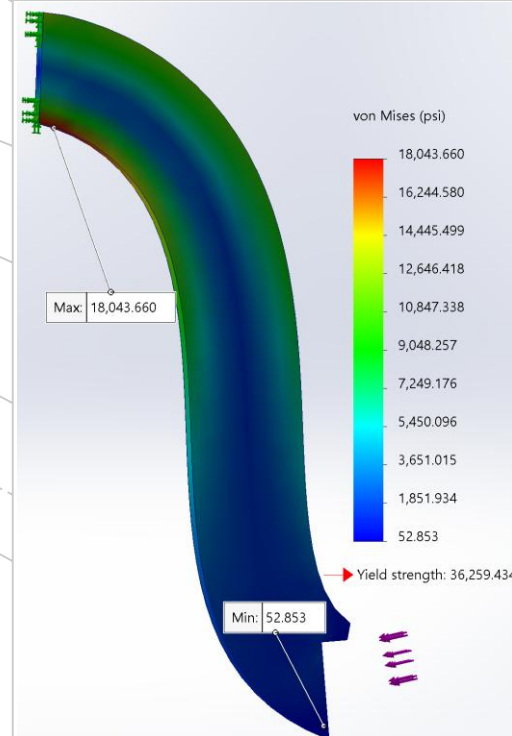
Volume = 21.11 cubic inches

Attempt 9:

- Changed Force and Fixed Area
- Design **Meets** Specs

Density = 0.04 pounds per cubic inch

Mass = 0.65 pounds

Volume = 17.93 cubic inches

Attempt 10:

- Implemented Holes
- Decreased the Width
  - Force Area
  - Fixed Area
- Design **Meets** Specs

Density = 0.036 pounds per cubic inch

Mass = 0.596 pounds

Volume = 16.507 cubic inches