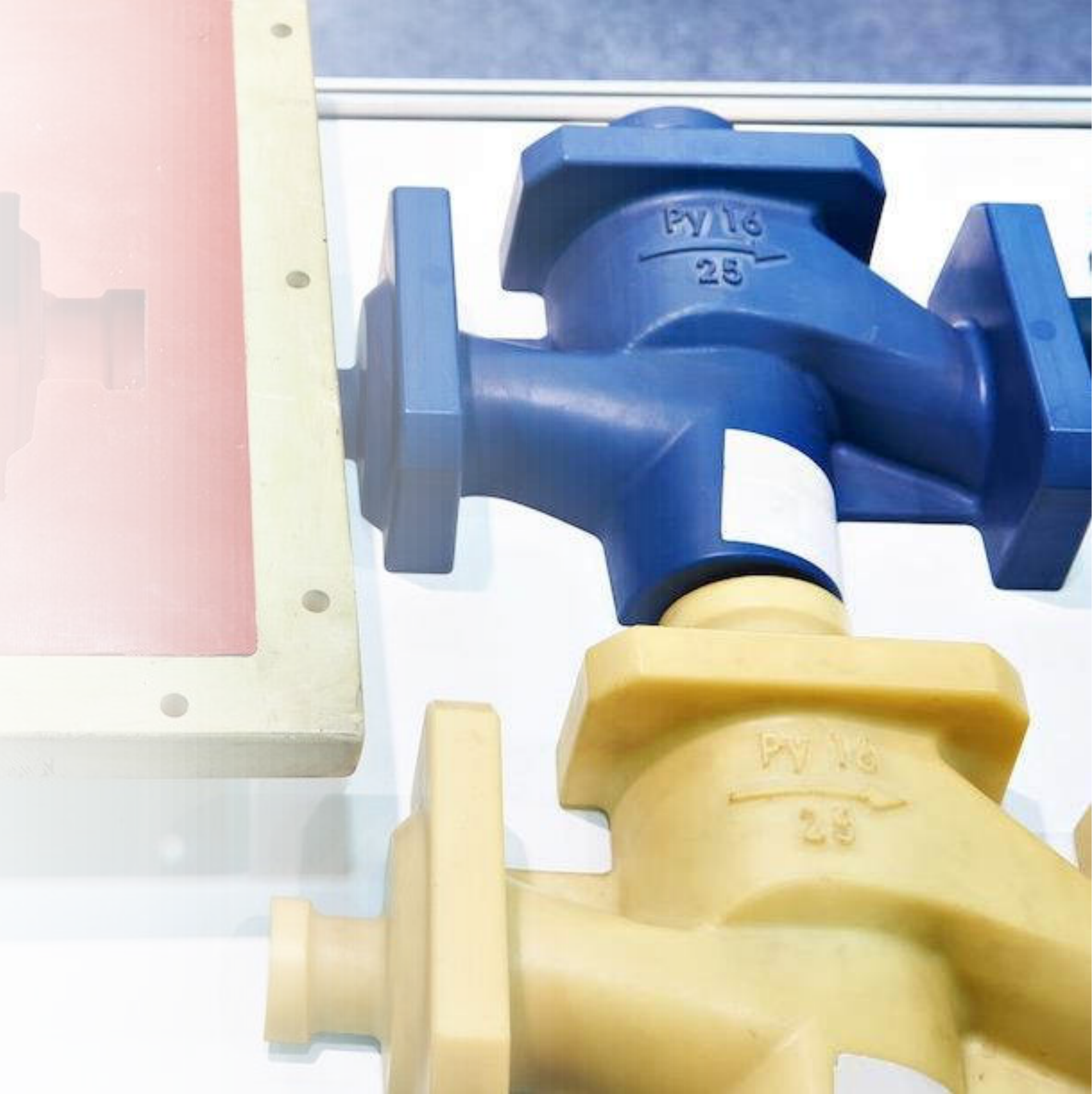
# Injection Molding & Ultrasonic Welding




Manufacturing Engineering

Professor Lima

Petros Sklavounos

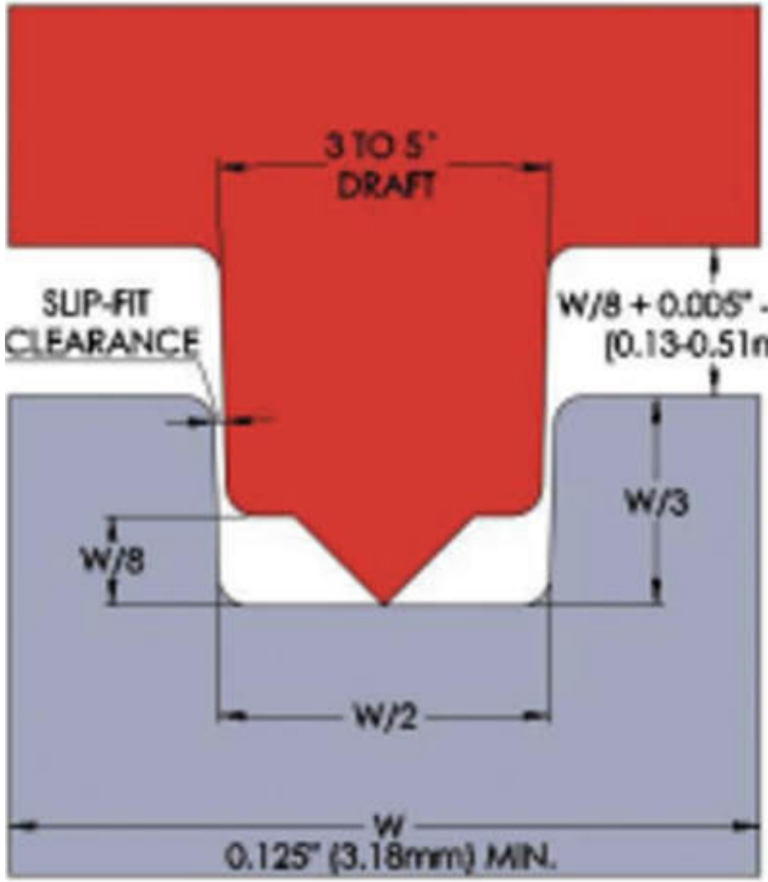
# Acetal: Plastic injection material

- “An engineered thermoplastic material that is used to manufacture parts that require increased stiffness, low friction versatility, and greater dimensional stability. Acetal resins have well-balanced properties, including a hard self-lubricated surface and excellent chemical resistance, strength , stiffness and toughness over a broad temperature range. “

Retrieved from https://springboardmfg.com/plastic-materials/delrin/

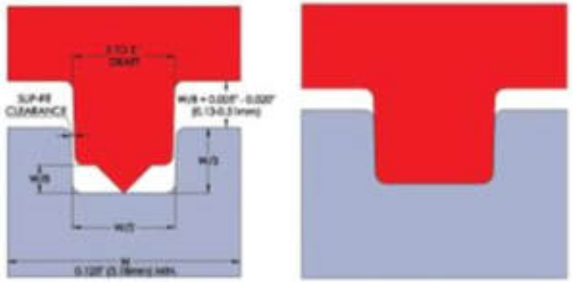
- Wall thickness Recommendation: 0.03in-0.120 in
- Actual wall thickness: 0.118in (0.003m)

# Friction Welding Calculations

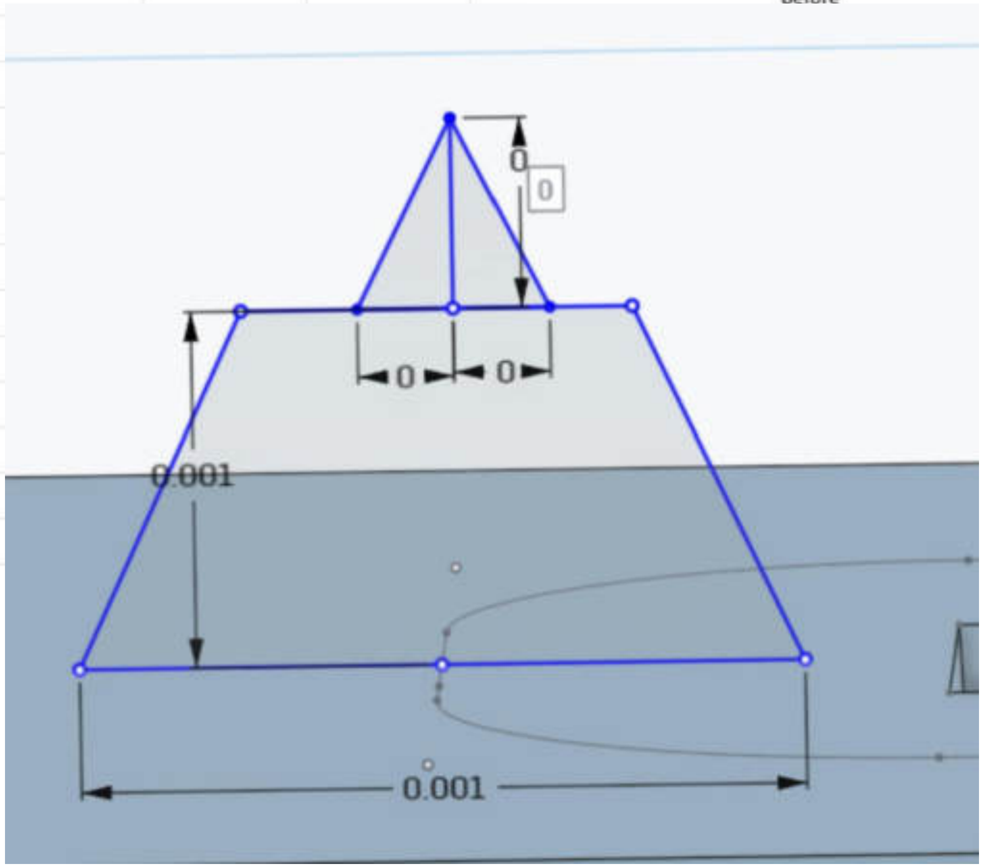



Tongue and groove Joint

| | inches | metres |
|---|---|---|
| w | 0.118 | 0.003 |
| w/8 | 0.01475 | 0.000375 |
| w/3 | 0.039333 | 0.001 |
| w/2 | 0.059 | 0.0015 |
| w/8+0.005' | 0.01975 | 0.000505 |

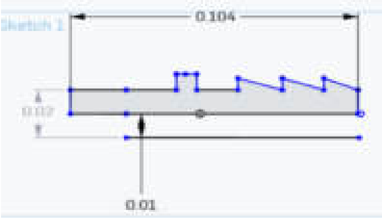


Before After



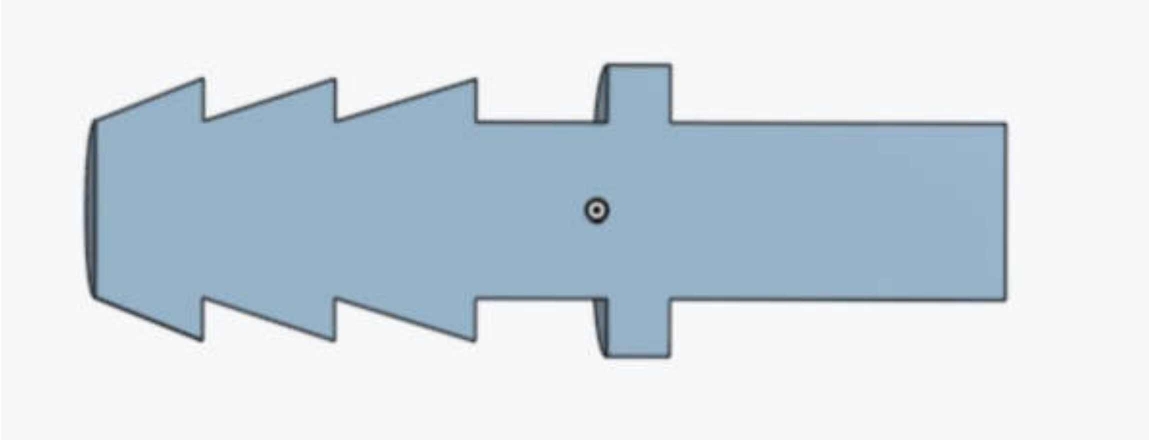
# Nozzle Attachment Part: Design

Drawing Design

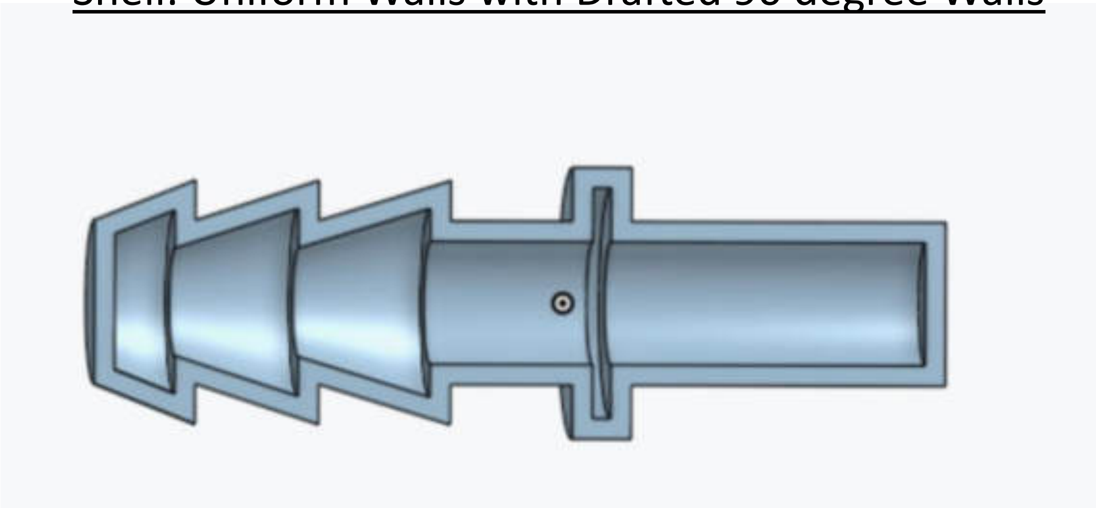



10 cm W x 4cm T

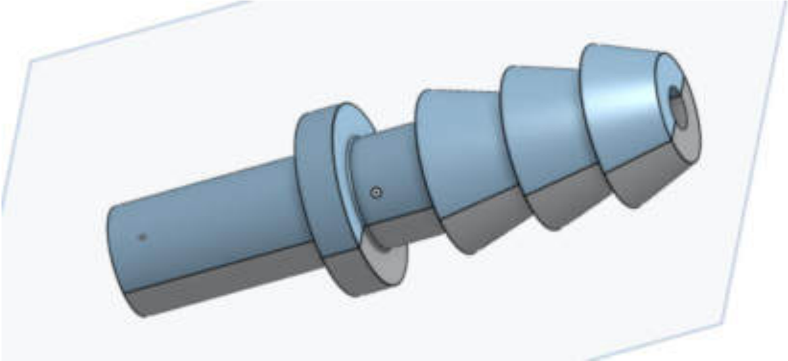
Revolving Design



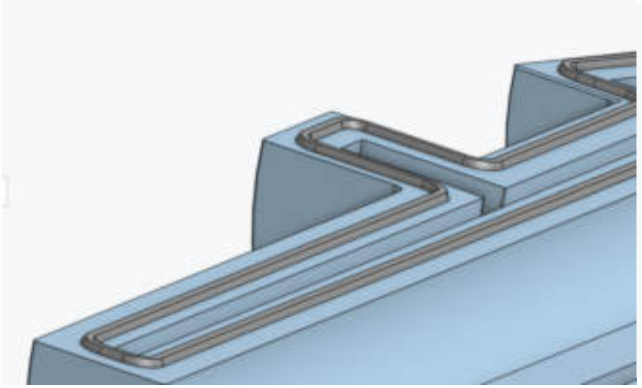
Shell: Uniform Walls with Drafted 90 degree Walls

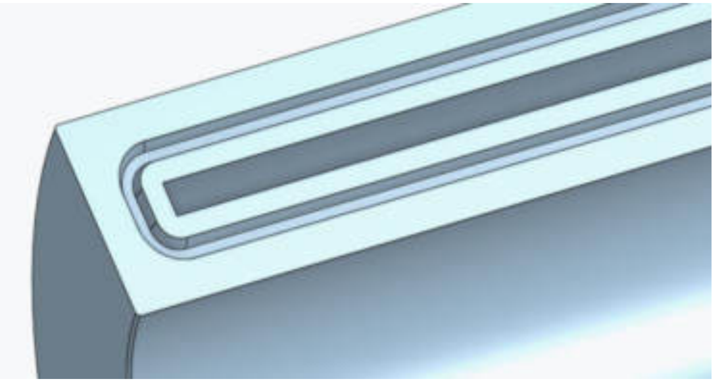


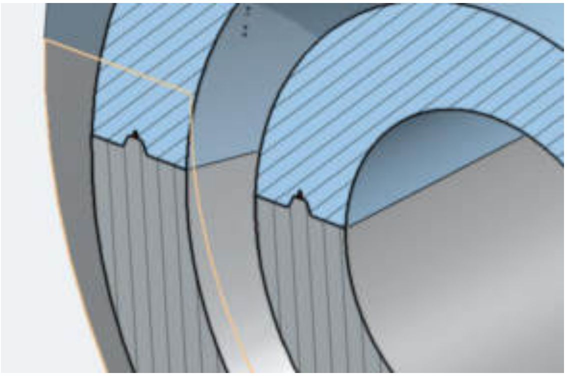
Split into two parts

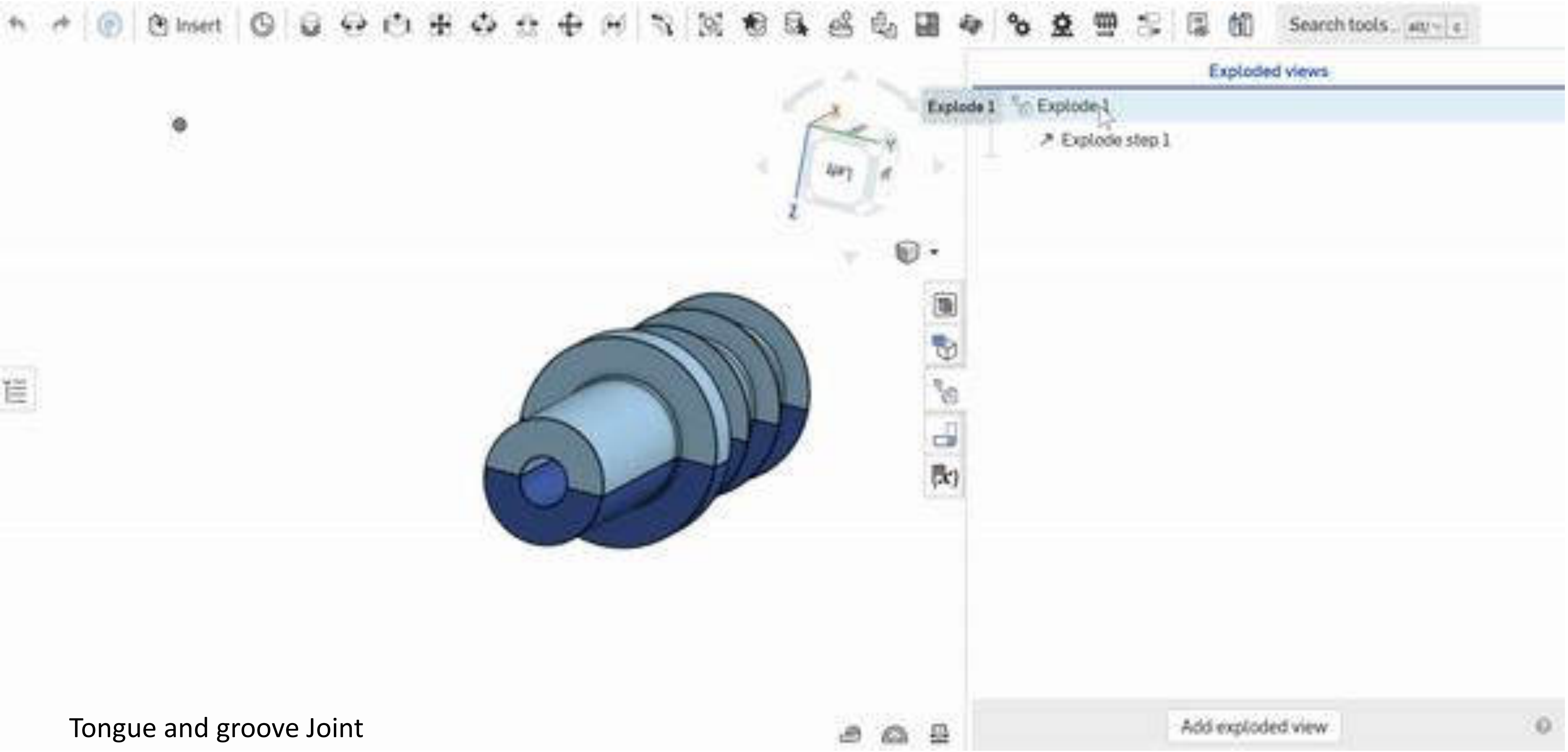


Groove And Negative Groove For Ultrasonic Welding





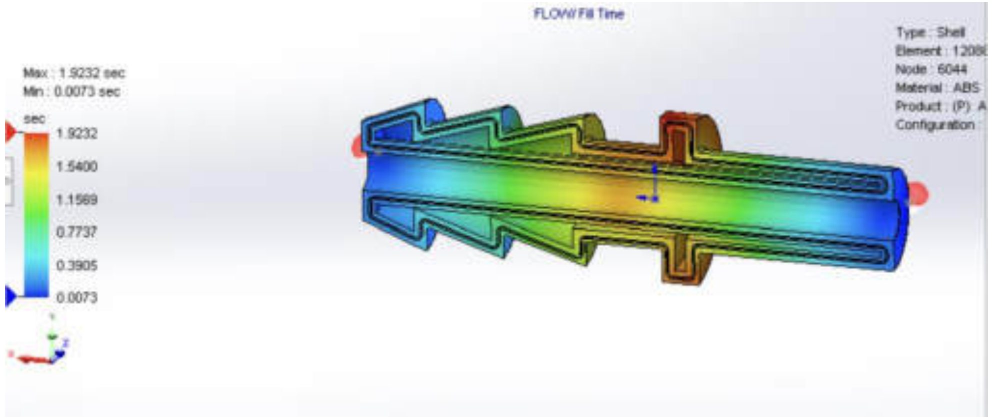




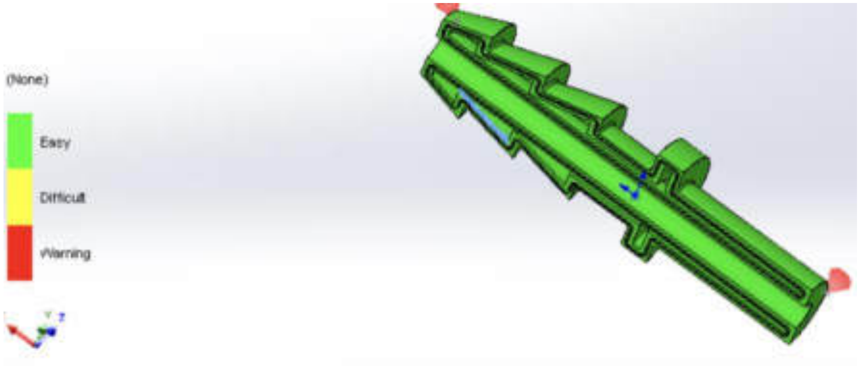

Tongue and groove Joint

# Nozzle Part: Simulation

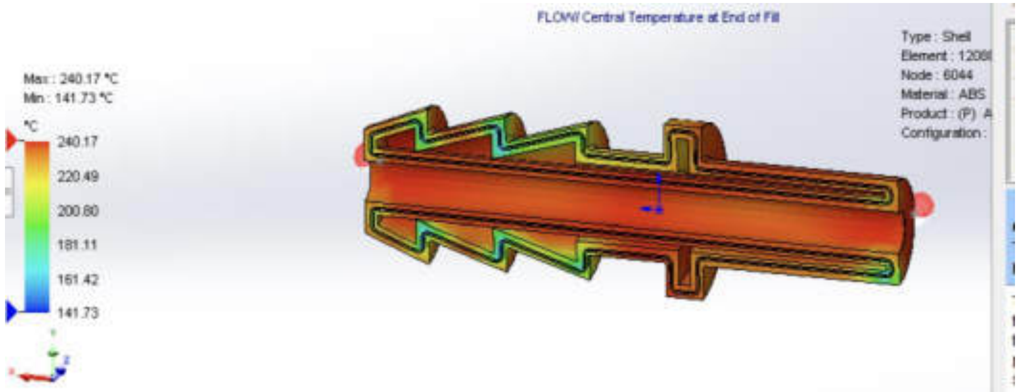
## Fill Time



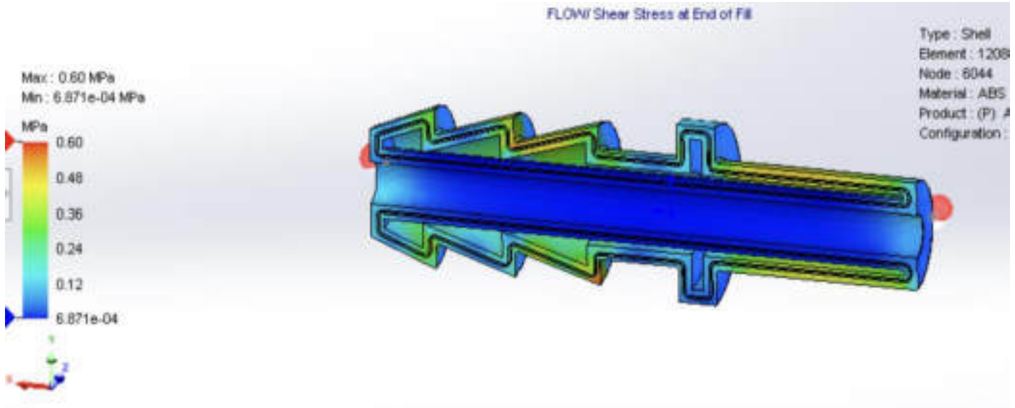

## Ease of Fill



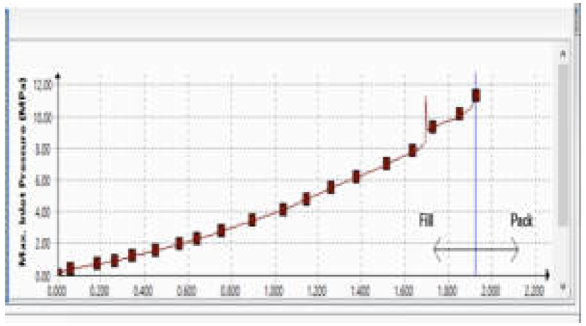

## Central Temperature at End of Fill




## Shear Stress at End of Fill

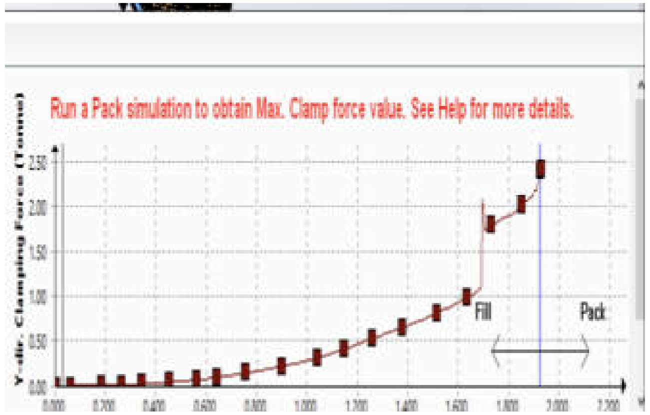



## Max Inlet Pressure Vs. Time

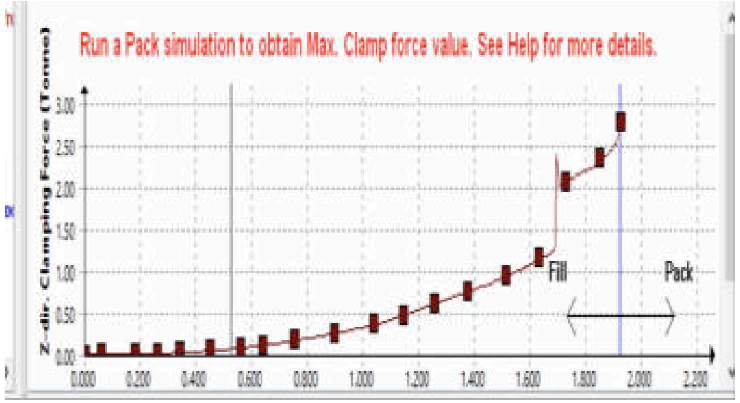



## X-Dir. Clamping Force Vs. Time

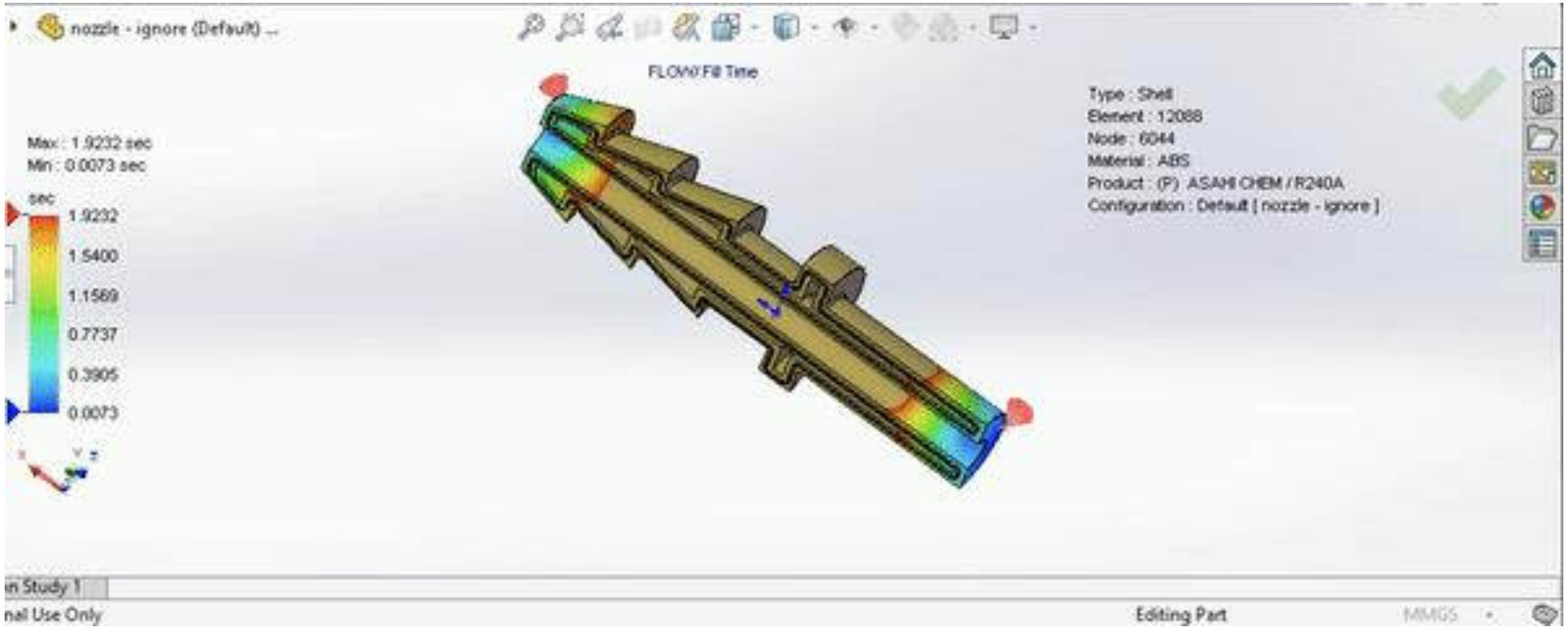

## Y-Dir. Clamping Force Vs. Time




## Z-Dir. Clamping Force Vs. Time



# Nozzle Part: Simulation & Cross-Section Gif




# Nozzle Part: Solidworks Simulation Summary

- This part can be successfully filled with an injection pressure of **11.3 MPa (1639.85 psi).**

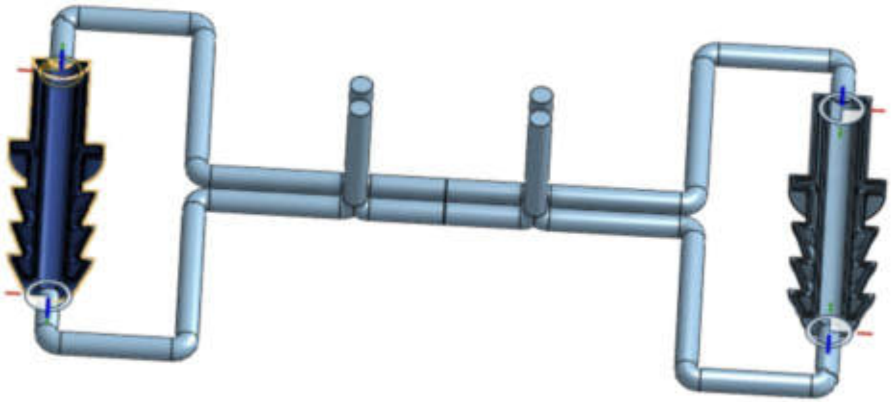
- The injection pressure required to fill is **less than 66% of the maximum injection pressure limit** specified for this analysis, which means you are well under your specified limit.

- Since the Maximum Temperature at End of Fill **has remained within 10 deg C** of the starting melt temperature, there is little to no risk of plastics material degradation.

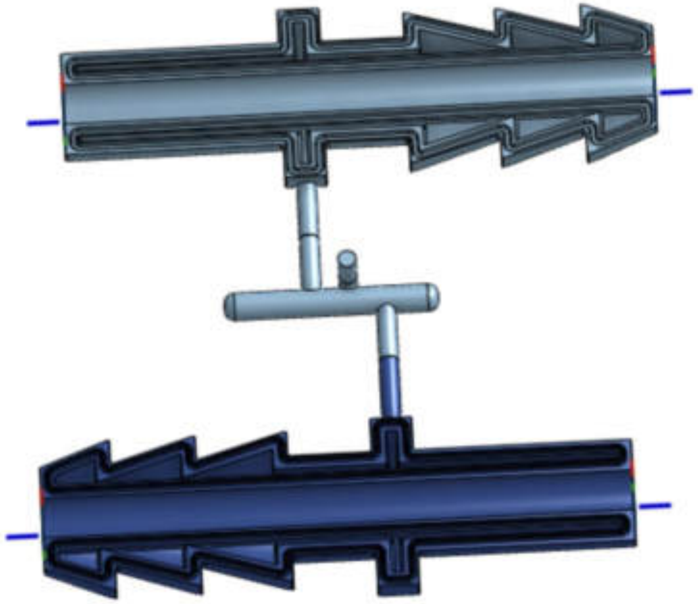
- The flow front melt temperature **is within the acceptable range of +/- 10 deg C from your starting melt temperature.** This helps promote **good mold filling and packing, minimizes injection pressure requirements, helps achieve good weld line integrity and appearance and gives you the best chance to manufacture a part with optimum properties.**

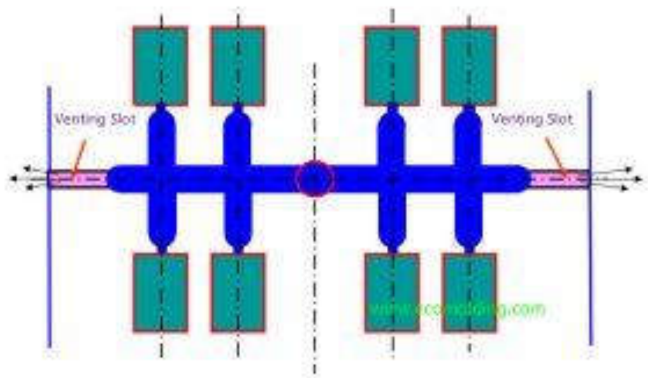
# Proper Runner and Sprue System

## Attempt 1:

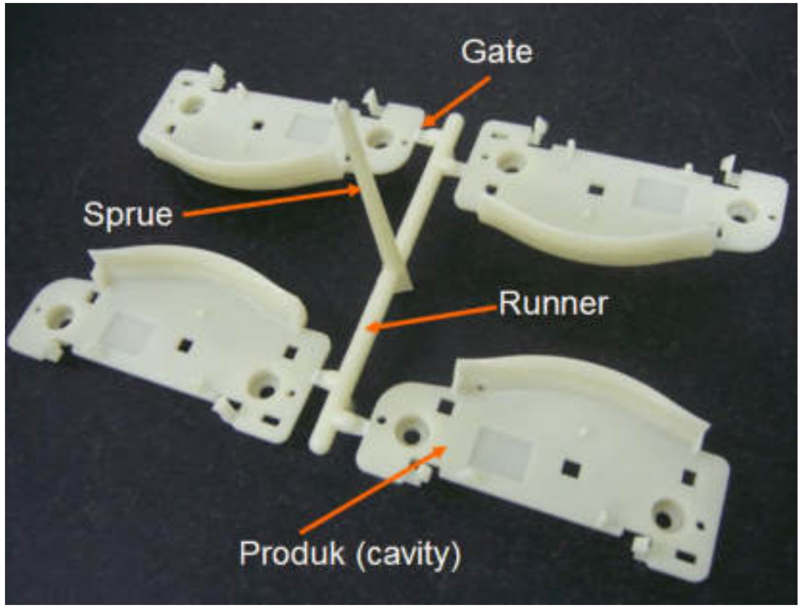


## Attempt 2:







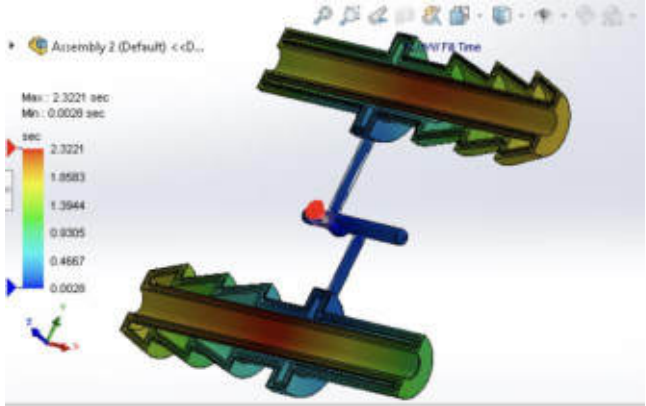




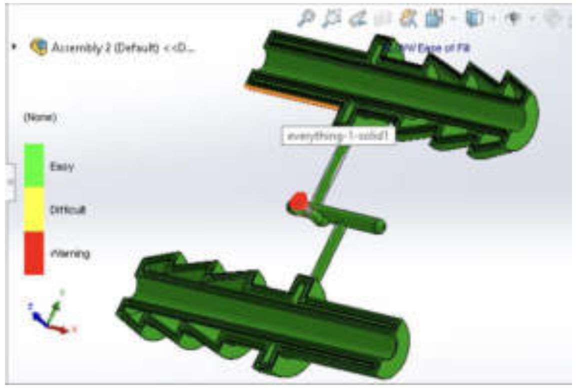
# Inspiration & Research

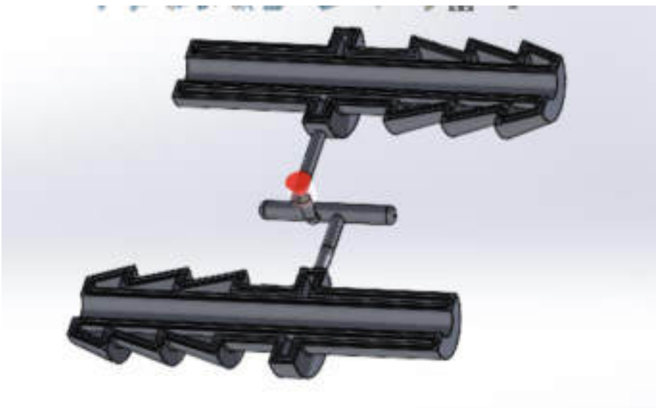
# Nozzle Part: Simulation

Fill Time

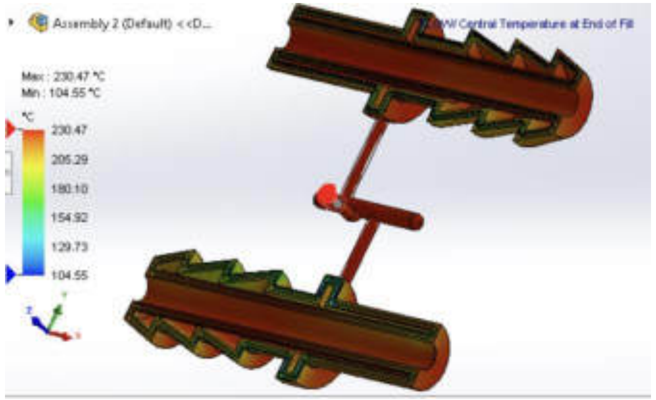



Ease of Fill

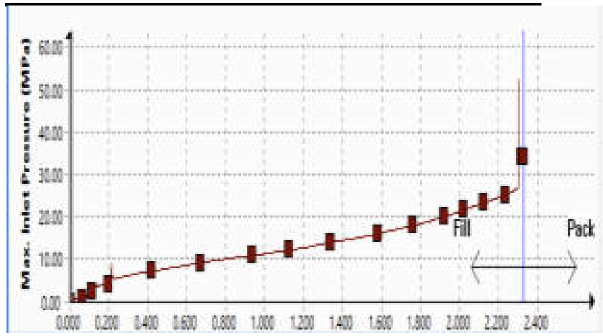


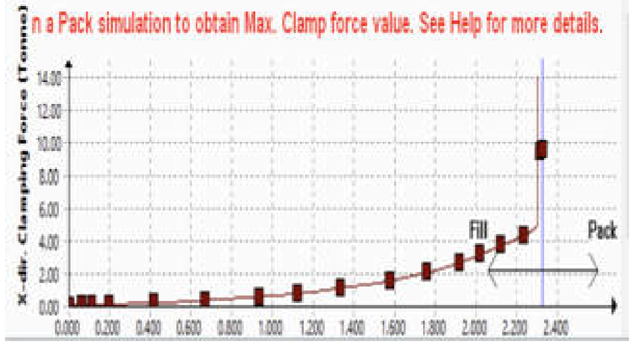
Central Temperature at End of Fill



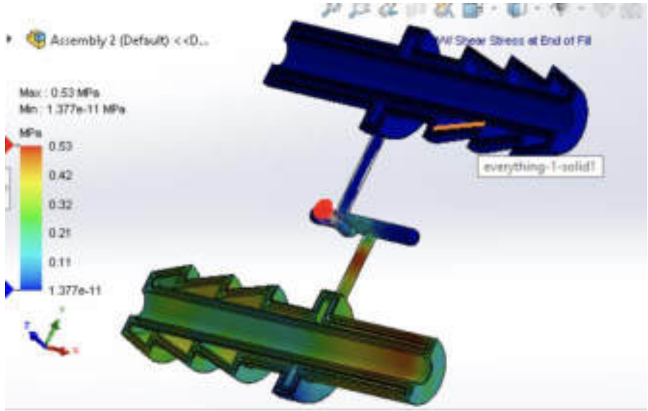

Max Inlet Pressure Vs. Time



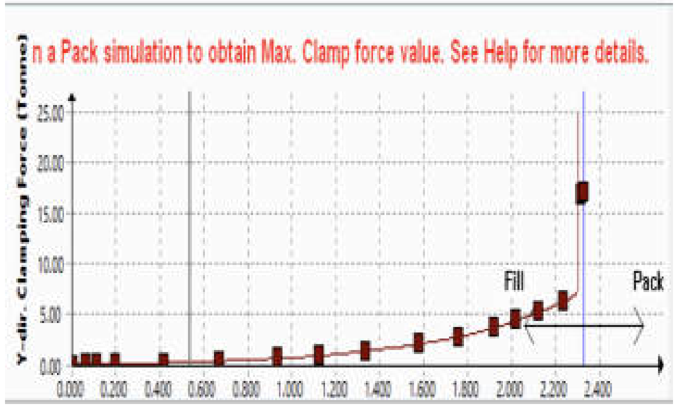

X-Dir. Clamping Force Vs. Time



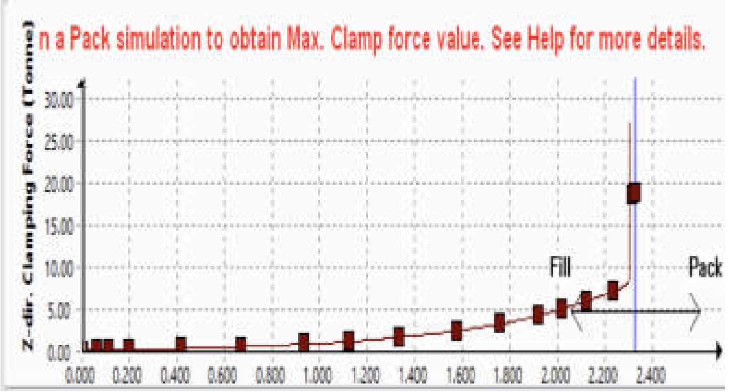

Shear Stress at End of Fill




Y-Dir. Clamping Force Vs. Time




Z-Dir. Clamping Force Vs. Time



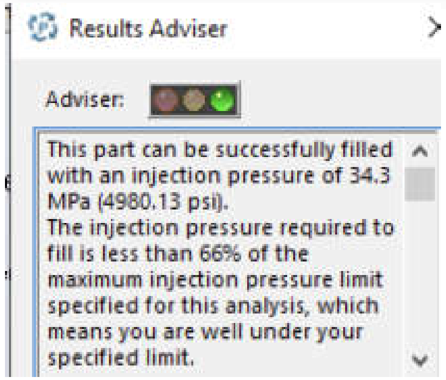
# Nozzle Part: Solidworks Simulation Summary

- This part can be **successfully** filled with an injection pressure of **of 34.3 MPa (4980.13 psi).**

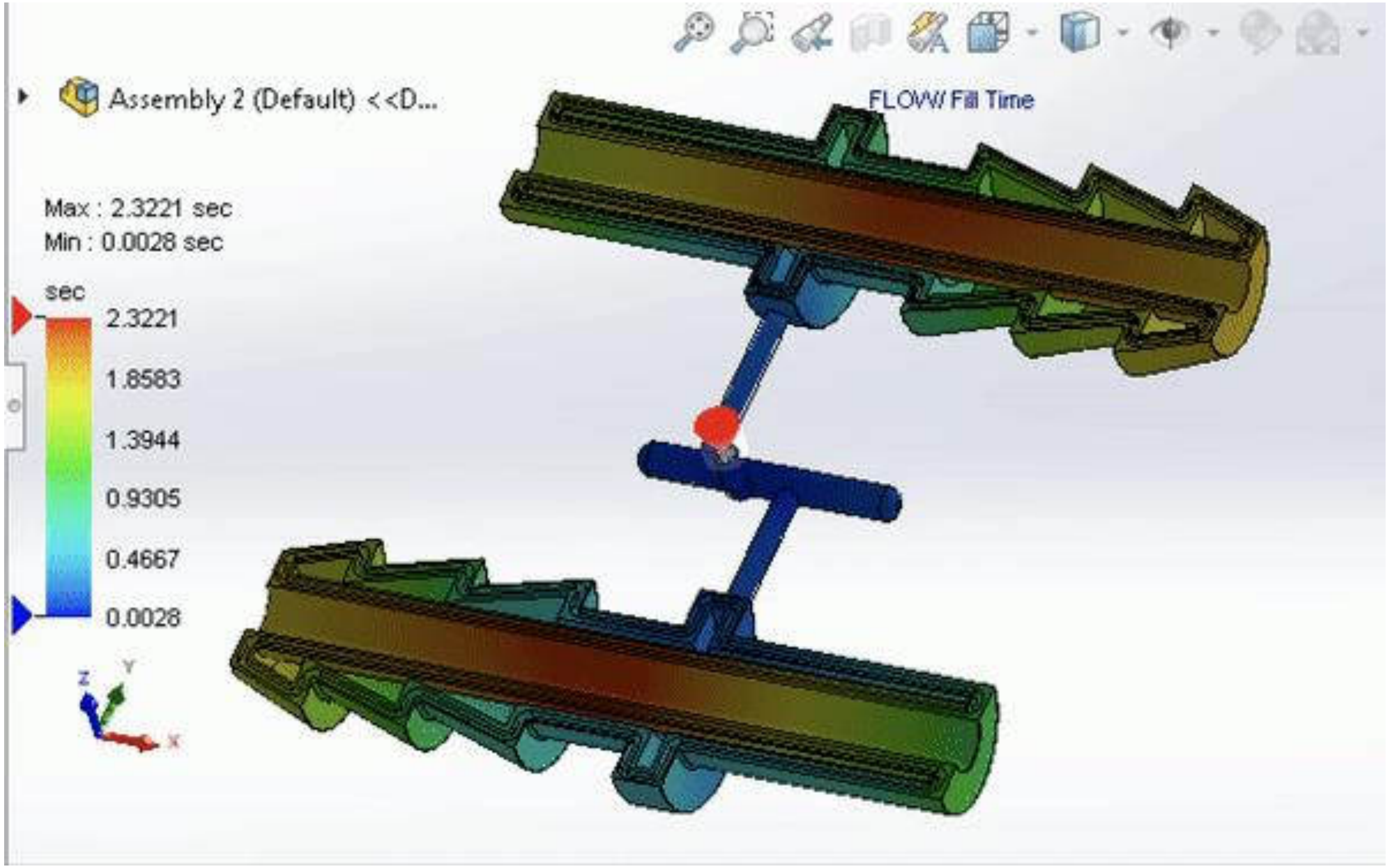
- The injection pressure required to fill is **less than 66% of the maximum injection pressure limit** specified for this analysis, which means you are well under your specified limit.

- Since the Maximum Temperature at End of Fill **has remained within 10 deg C** of the starting melt temperature, there is **little to no risk of plastics material degradation**.

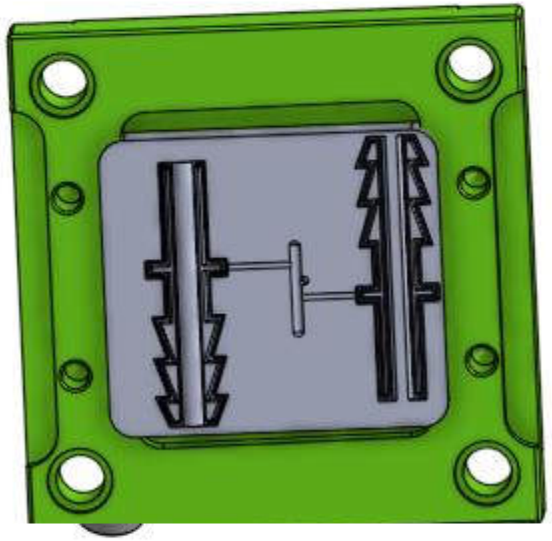
- The flow front melt temperature **is within the acceptable range of +/- 10 deg C from your starting melt temperature.** This helps promote **good mold filling and packing, minimizes injection pressure requirements, helps achieve good weld line integrity and appearance and gives you the best chance to manufacture a part with optimum properties.**

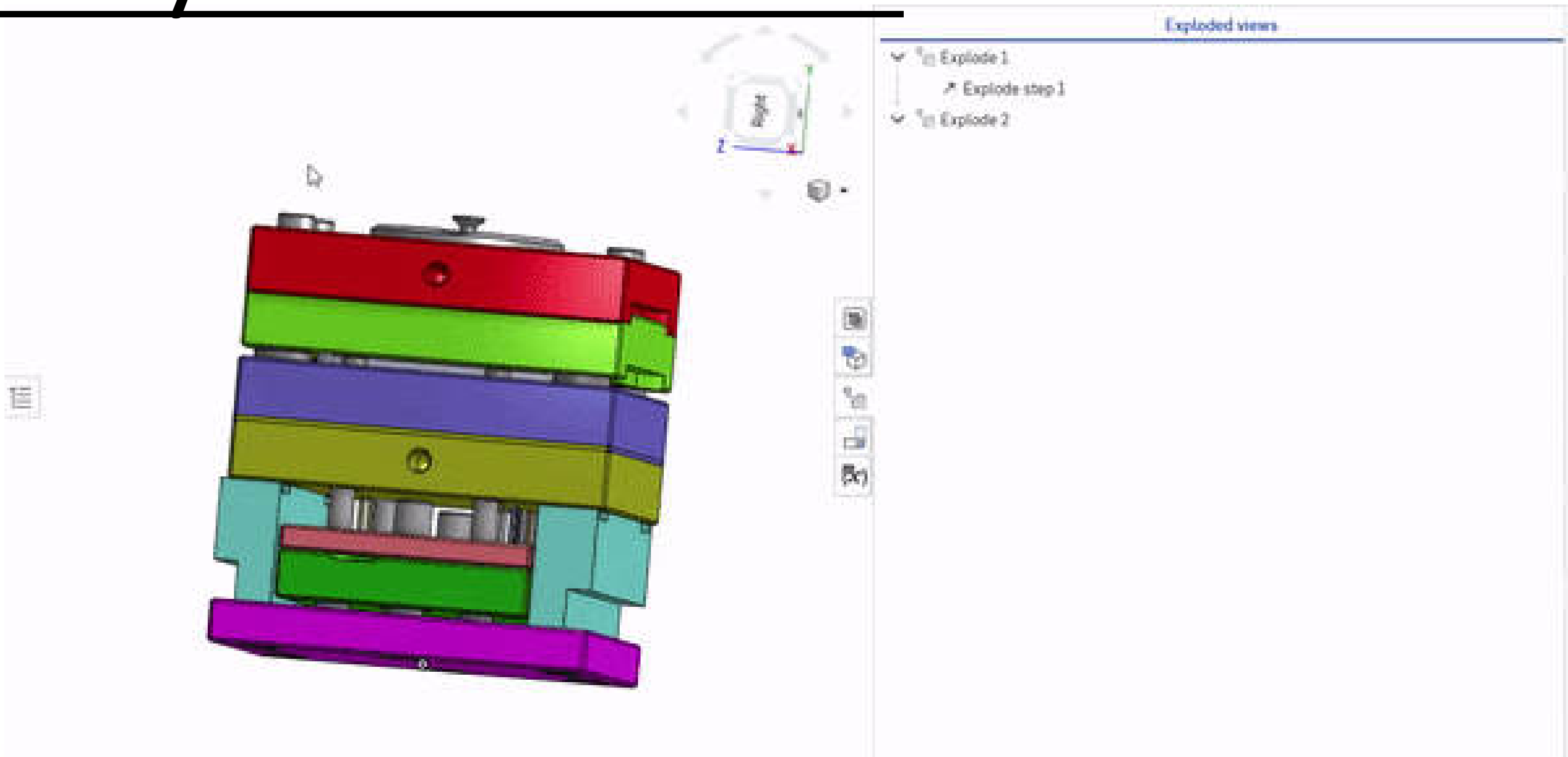



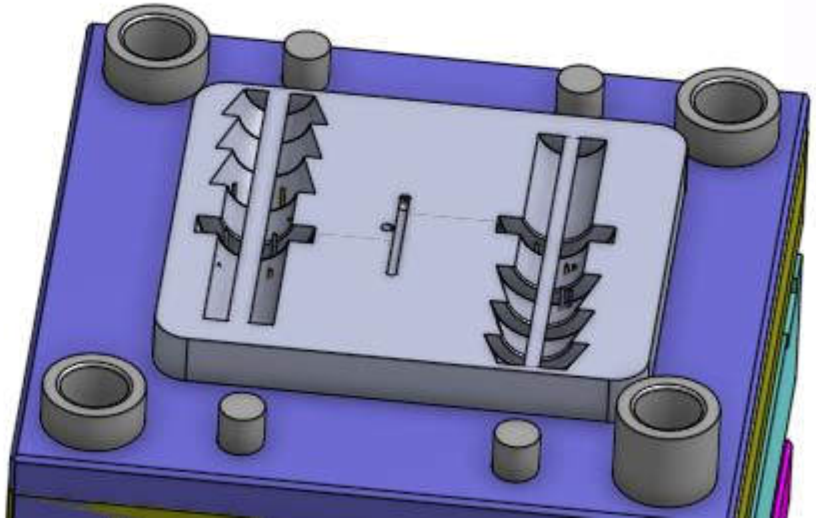
# Nozzle Part With Runner System: Simulation & Cross-Section Gif

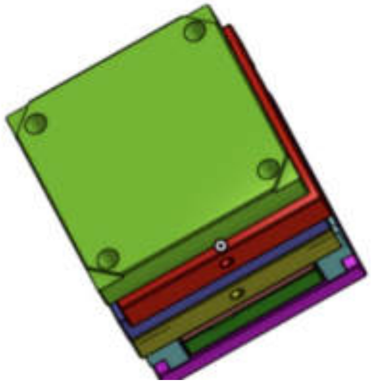


# Mold Design Assembly for Nozzle Part





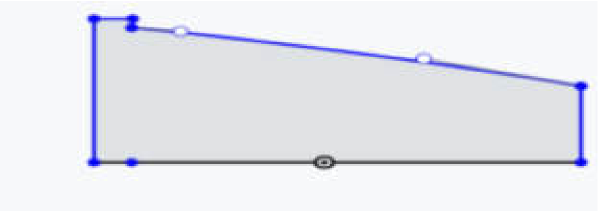





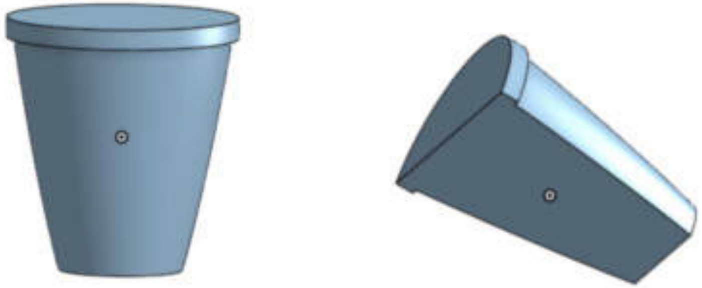
# Backup Additional Slides: Simpler Plastic Cup

# Simpler Cup Part: Design

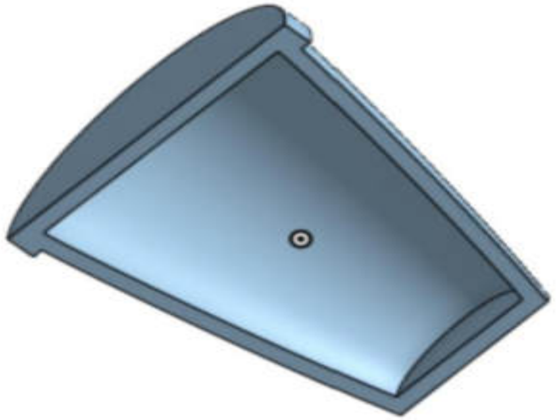
## Drawing Design



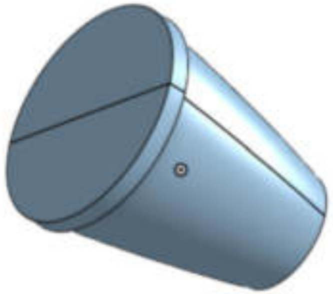
## Revolving Design



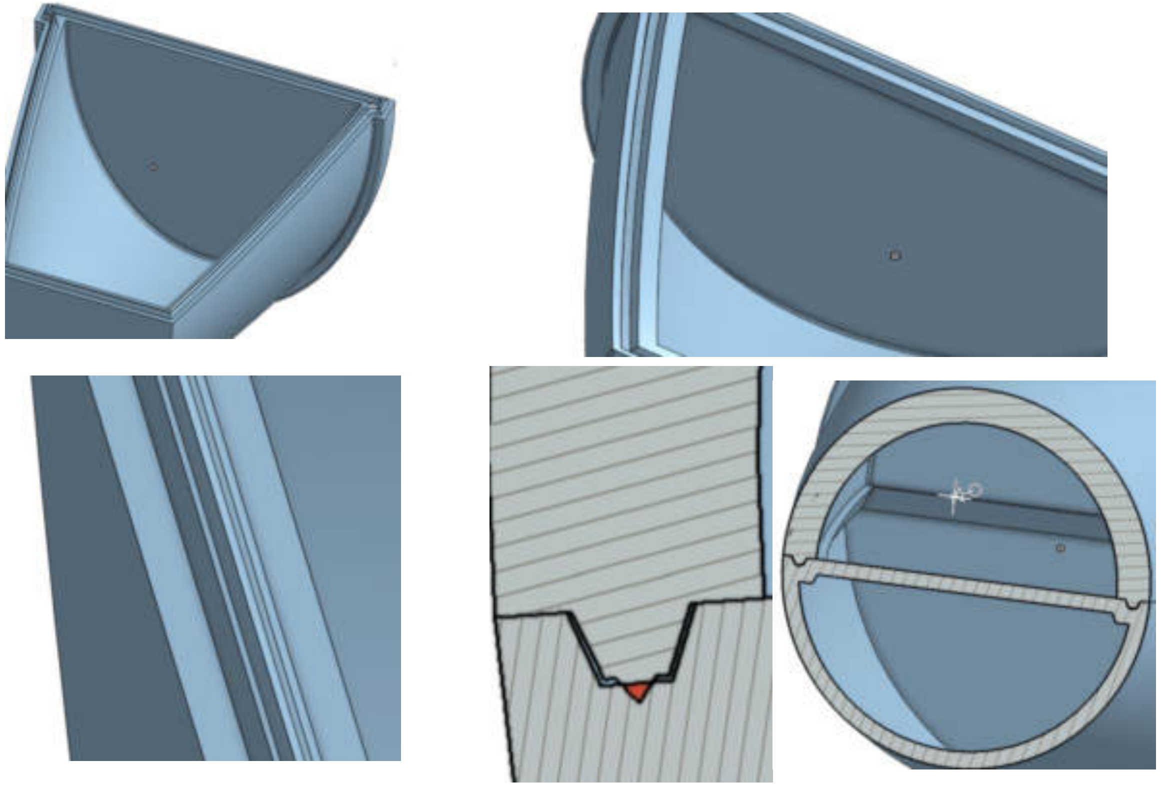
## Shell: Uniform Walls with Drafted 90 degree walls



## Add Second Split

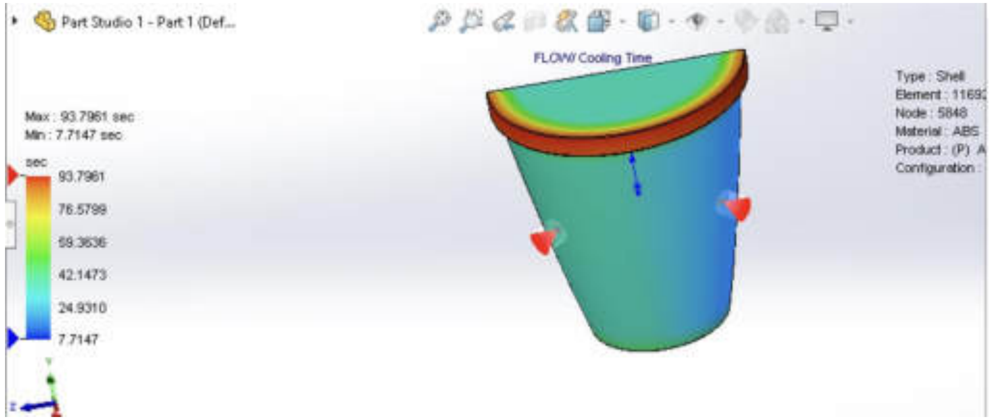


## Groove And Negative Groove For Ultrasonic Welding

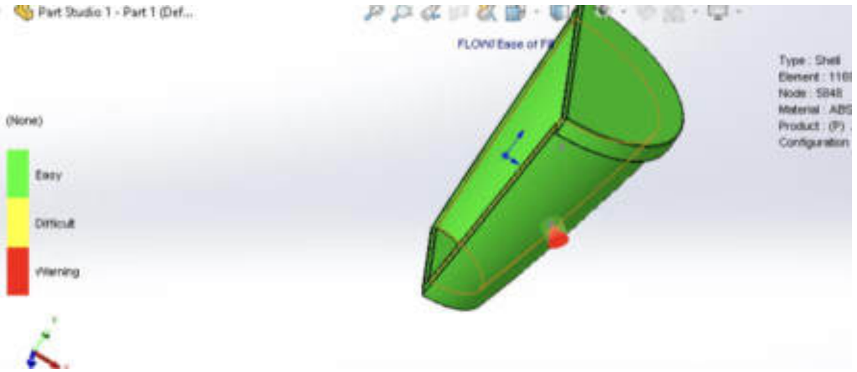


# Cup Part: Simulation

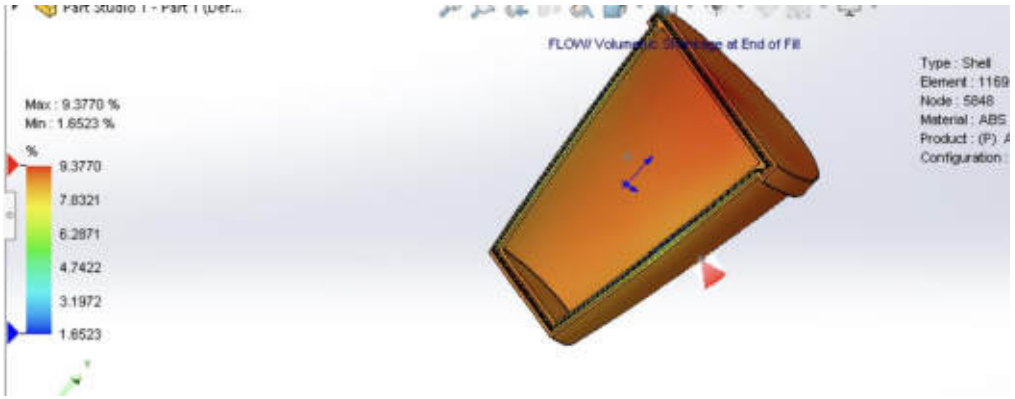
## Cooling Time



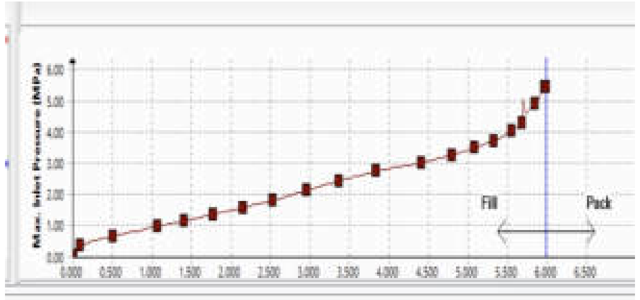

## Ease of Fill




## Volumetric Shrinkage at End of Fill

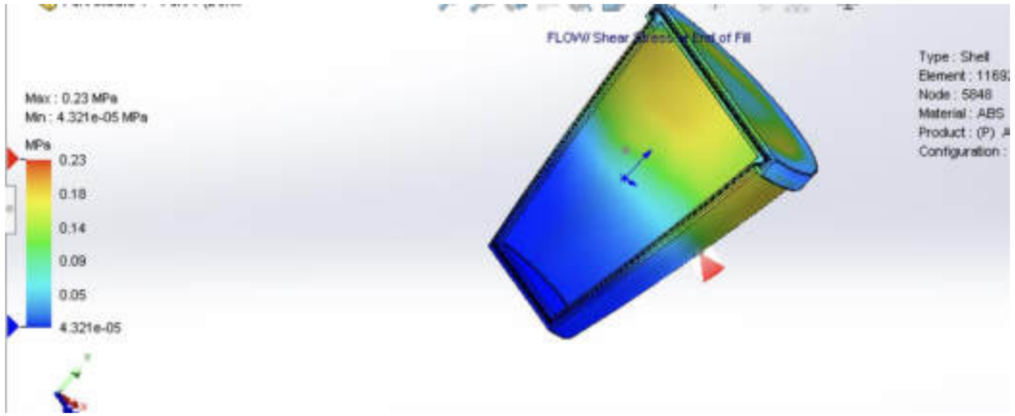



## Max Inlet Pressure Vs. Time

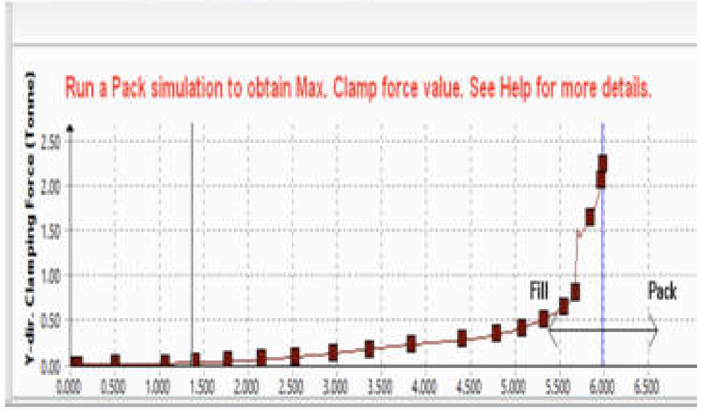



## X-Dir. Clamping Force Vs. Time

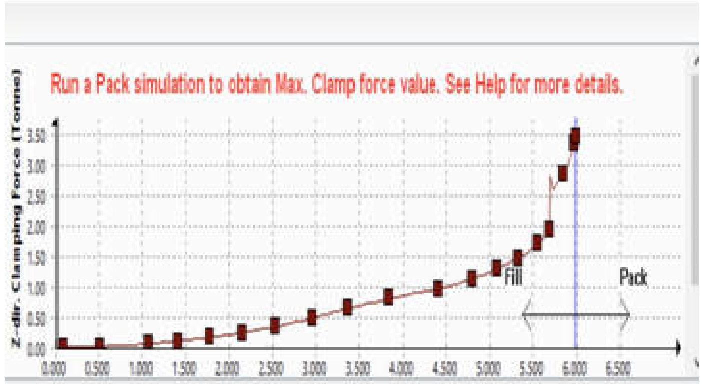

## Shear Stress at End of Fill



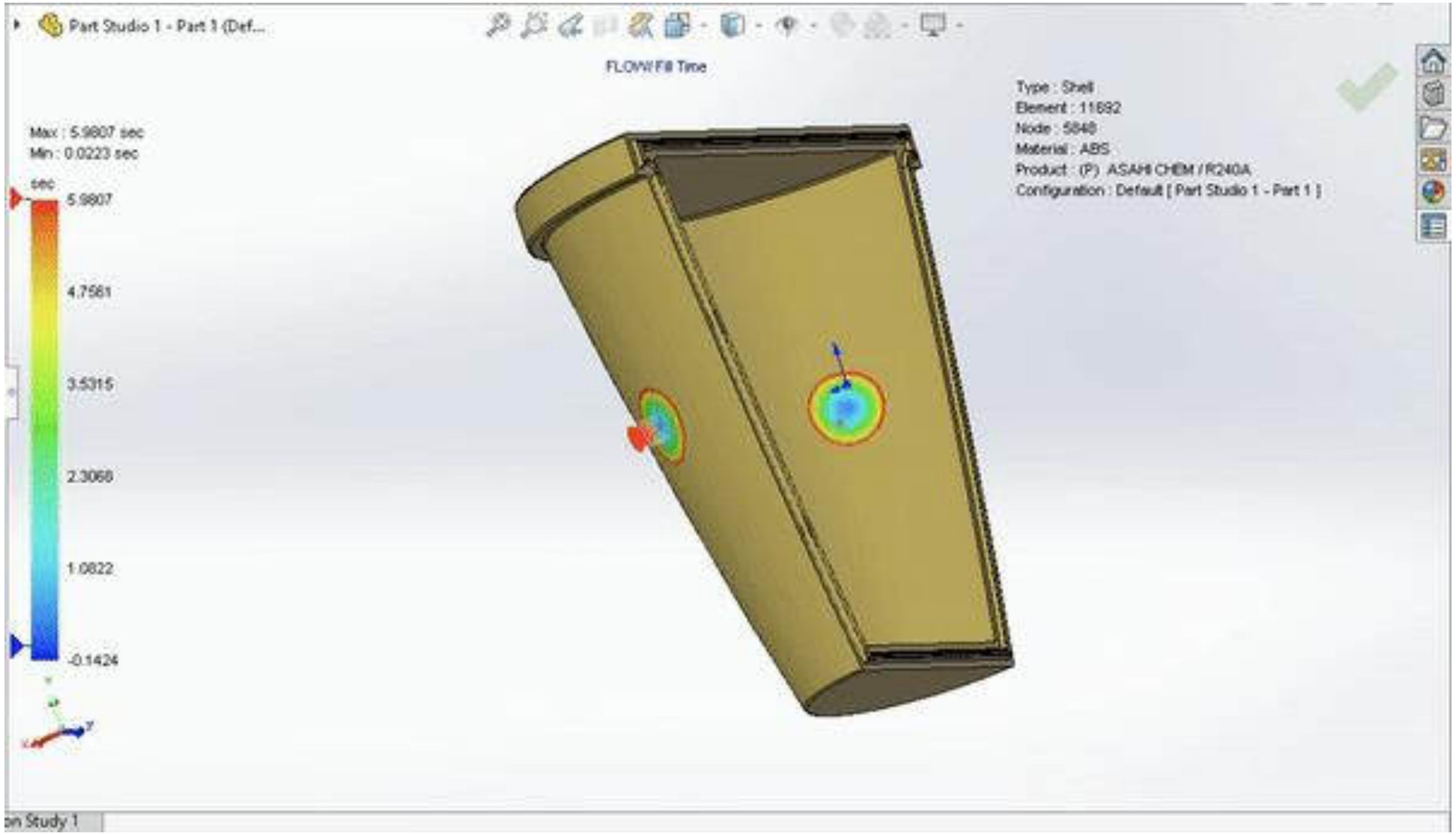

## Y-Dir. Clamping Force Vs. Time




## Z-Dir. Clamping Force Vs. Time



# Cup Part: Simulation Gif



# Nozzle Part: Solidworks Simulation Summary

- This part can be **successfully** filled with an injection pressure **of 5.9 MPa (862.40 psi).**

- The injection pressure required to fill is **less than 66% of the maximum injection pressure limit** specified for this analysis, which means you are well under your specified limit.

- Since the Maximum Temperature at End of Fill **has remained within 10 deg C** of the starting melt temperature, there is **little to no risk of plastics material degradation**.

- The flow front melt temperature **is within the acceptable range of +/- 10 deg C from your starting melt temperature**. This helps promote **good mold filling and packing, minimizes injection pressure requirements, helps achieve good weld line integrity and appearance and gives you the best chance to manufacture a part with optimum properties.**