Injection Molding & Ultrasonic Welding

Manufacturing Engineering

Professor Lima

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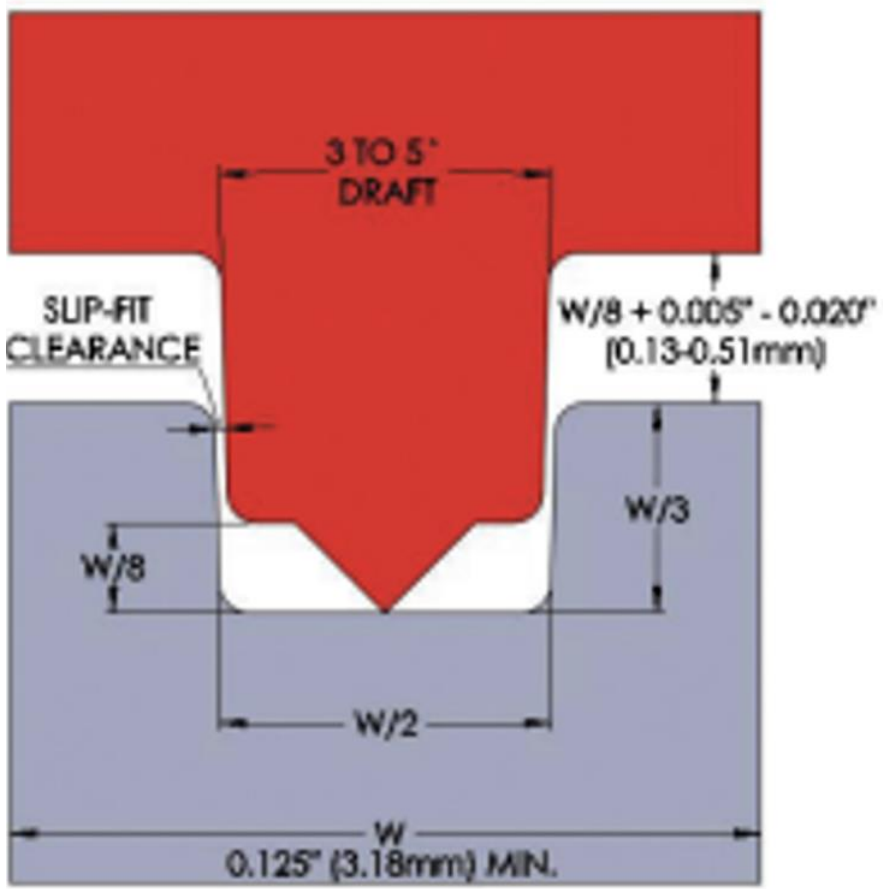
Acetal: Plastic injection material

- “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. “

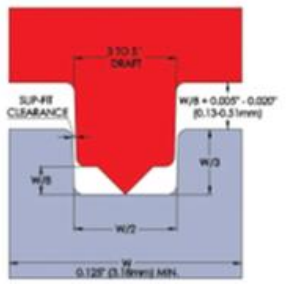
Retrieved from https://springboardmfg.com/plastic-materials/delrin/

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

Friction Welding Calculations

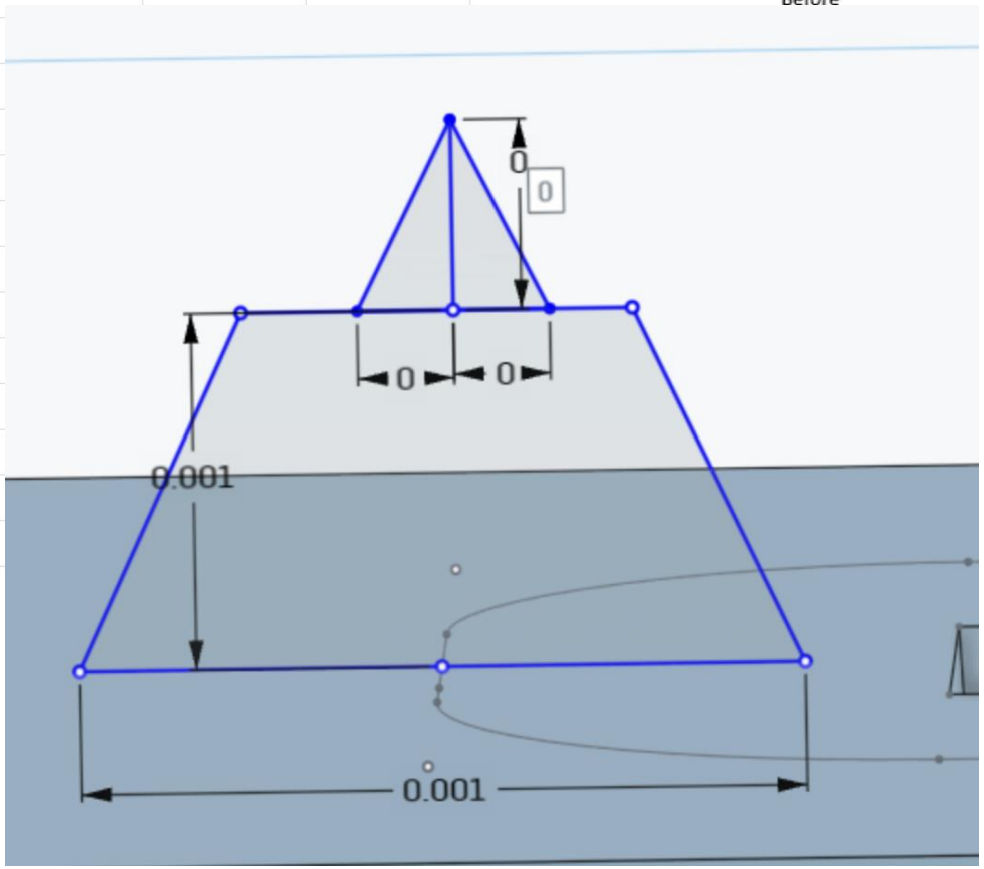


	inches	metres
w	0.118	0.003
w/8	0.01475	0.000375
w/3	0.039333	0.001
w/2	0.059	0.0015
w/8+0.005'	0.01975	0.000505



Before

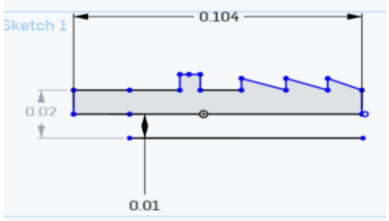
After



Tongue and groove Joint

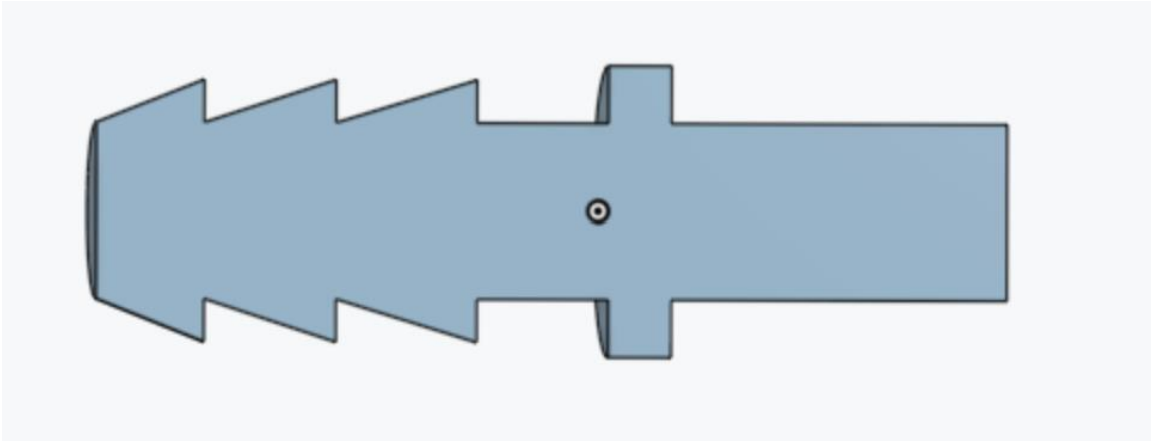
Nozzle Attachment Part: Design

Drawing Design

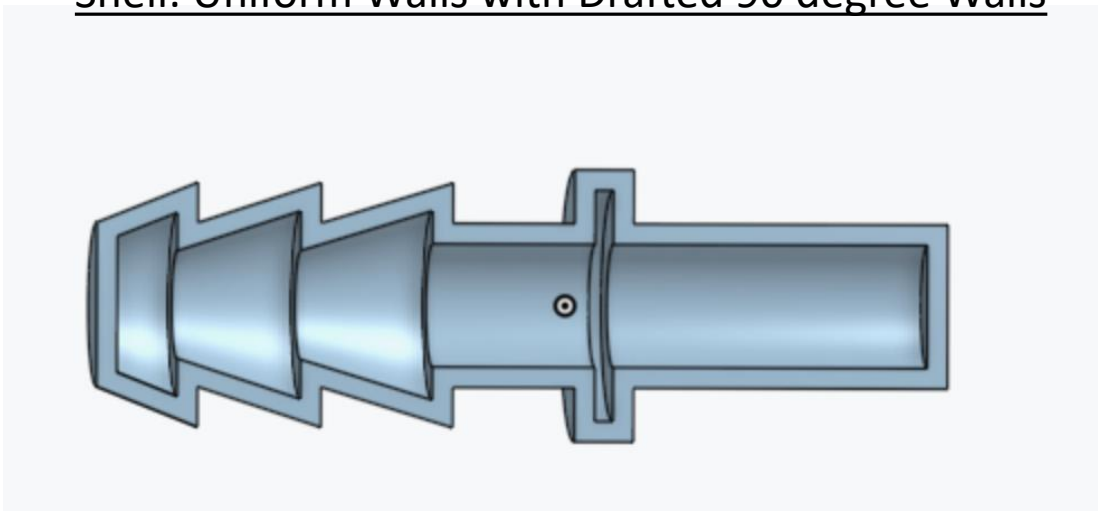


10 cm W x 4cm T

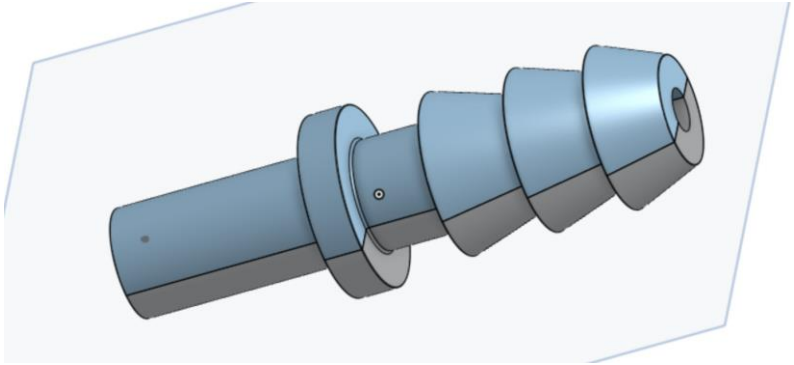
Revolving Design



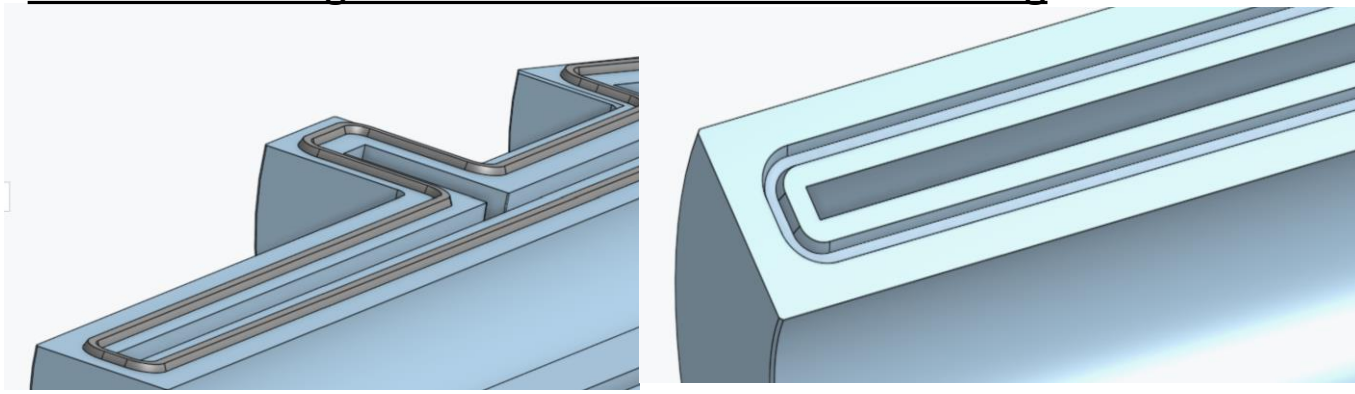
Shell: Uniform Walls with Drafted 90 degree Walls

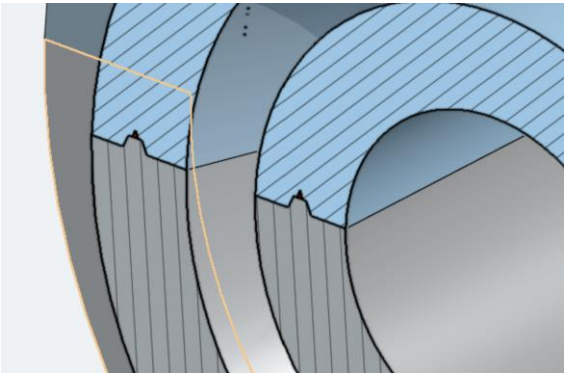


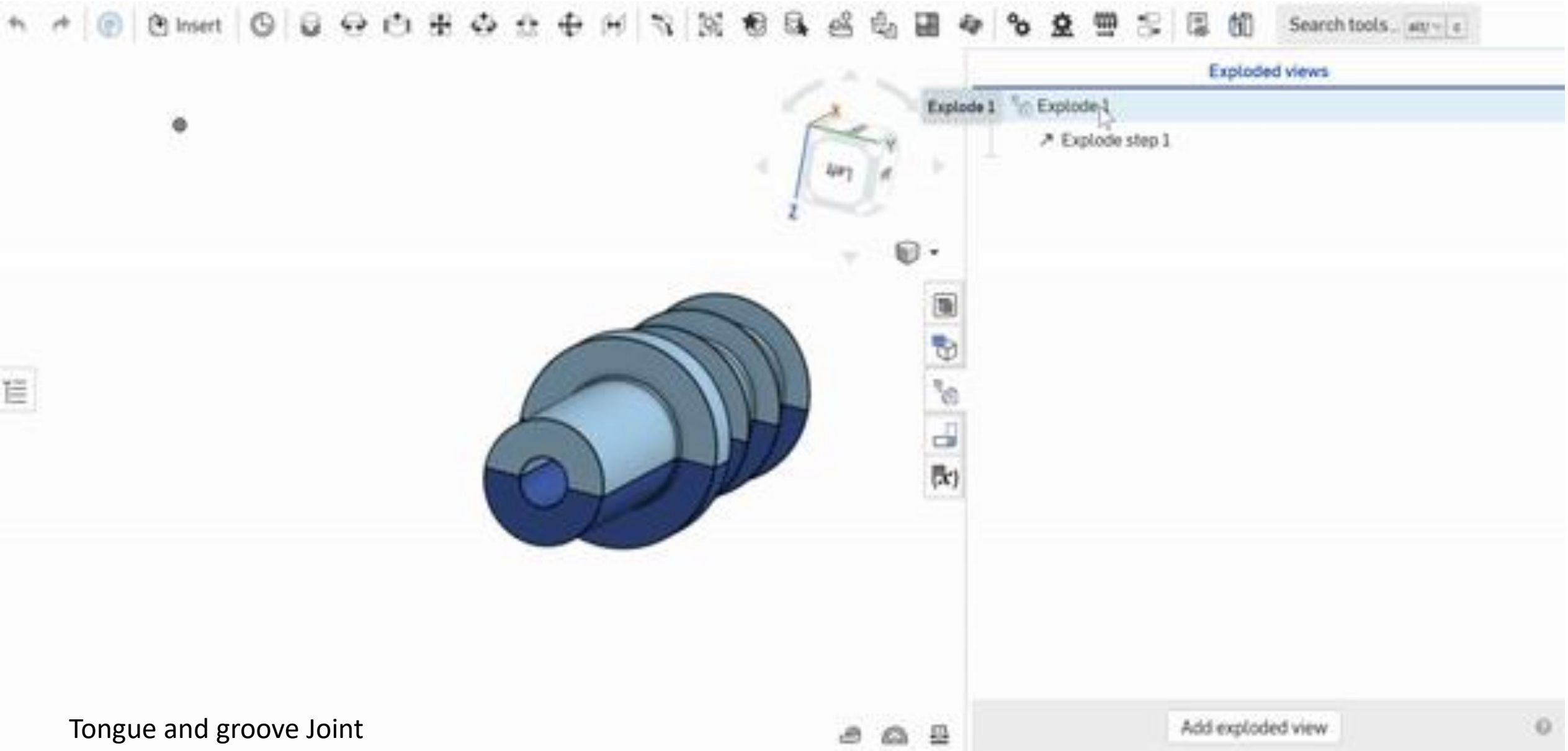
Split into two parts



Groove And Negative Groove For Ultrasonic Welding



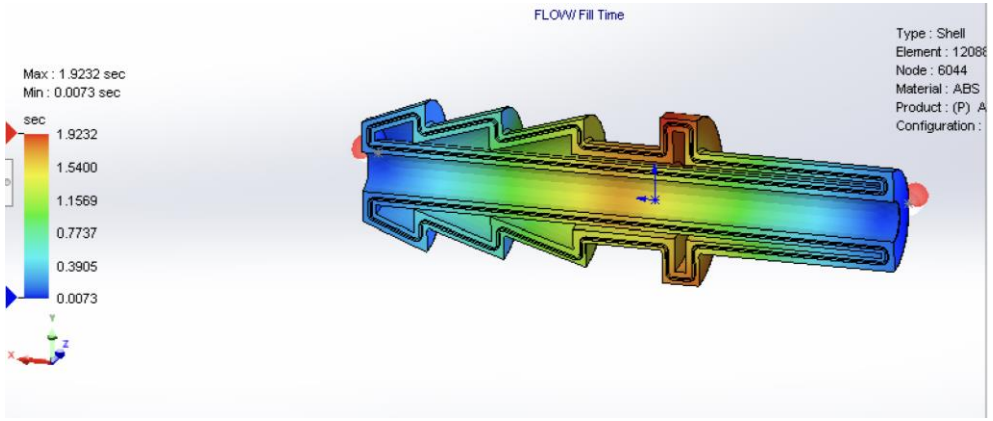




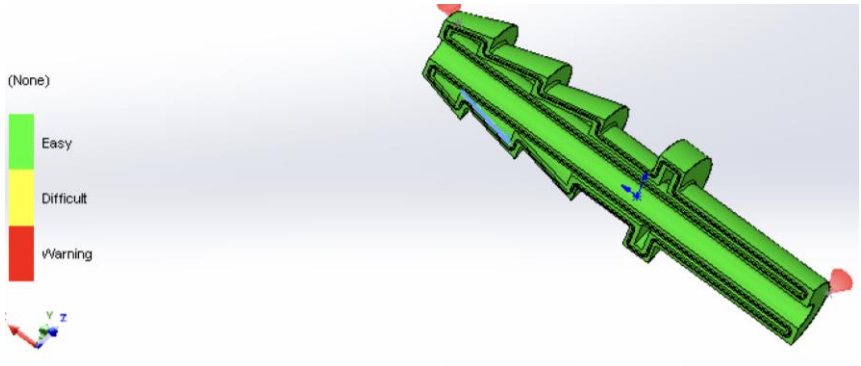
Tongue and groove Joint

Nozzle Part: Simulation

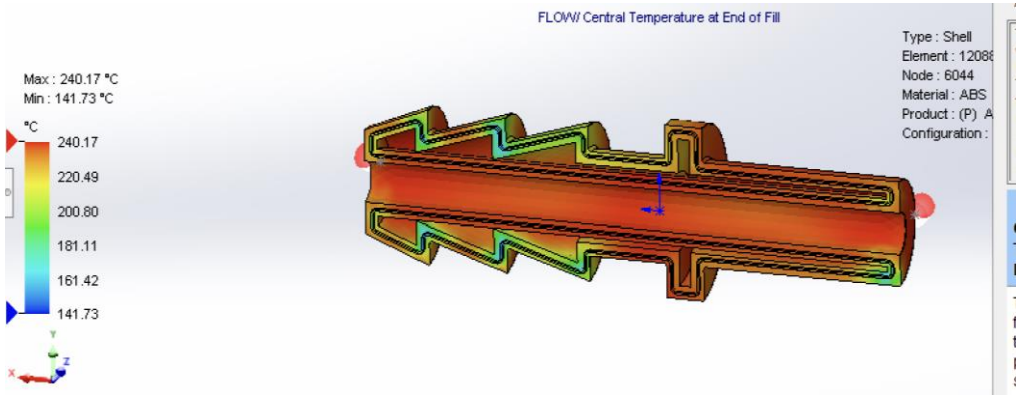
Fill Time



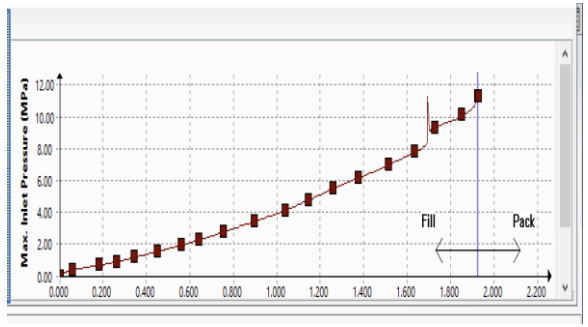
Ease of Fill



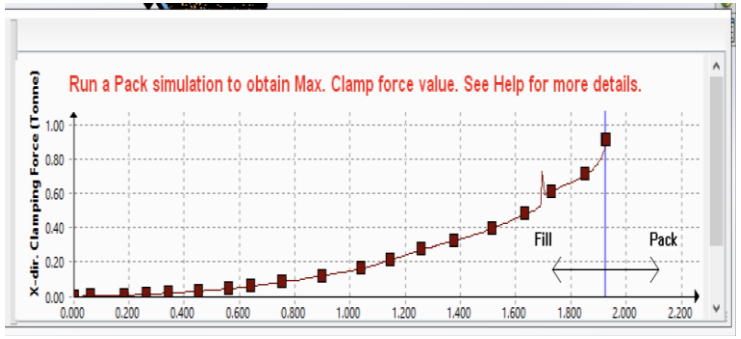
Central Temperature at End of Fill



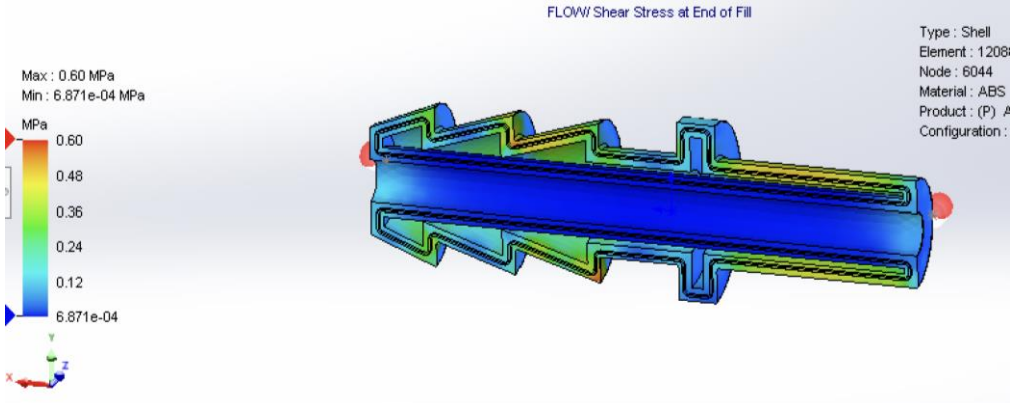
Max Inlet Pressure Vs. Time



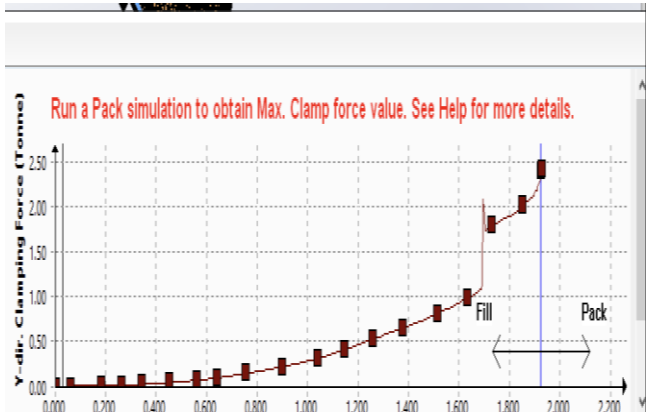
X-Dir. Clamping Force Vs. Time



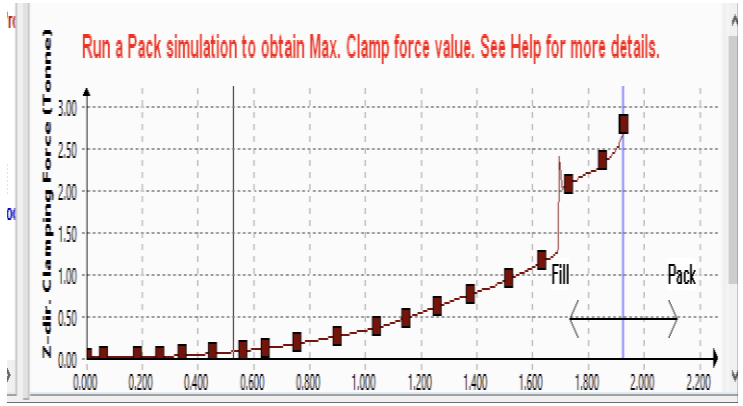
Shear Stress at End of Fill



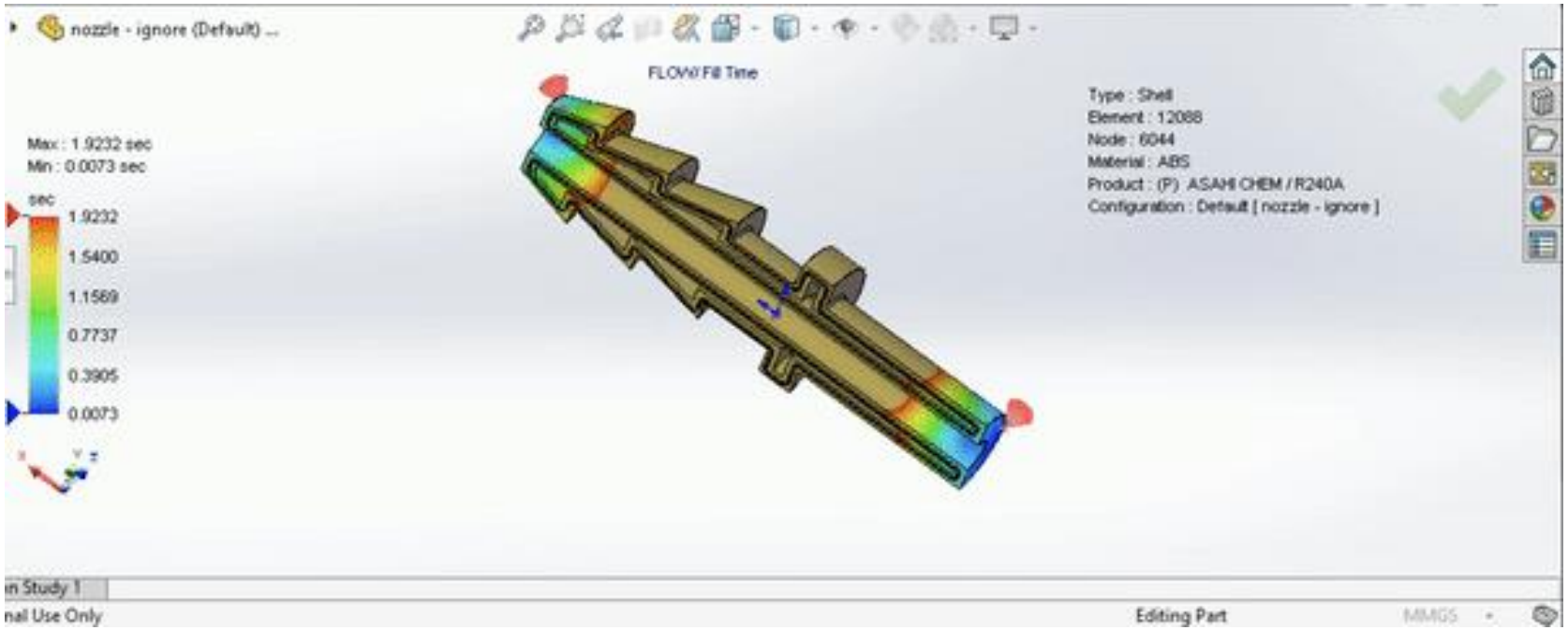
Y-Dir. Clamping Force Vs. Time

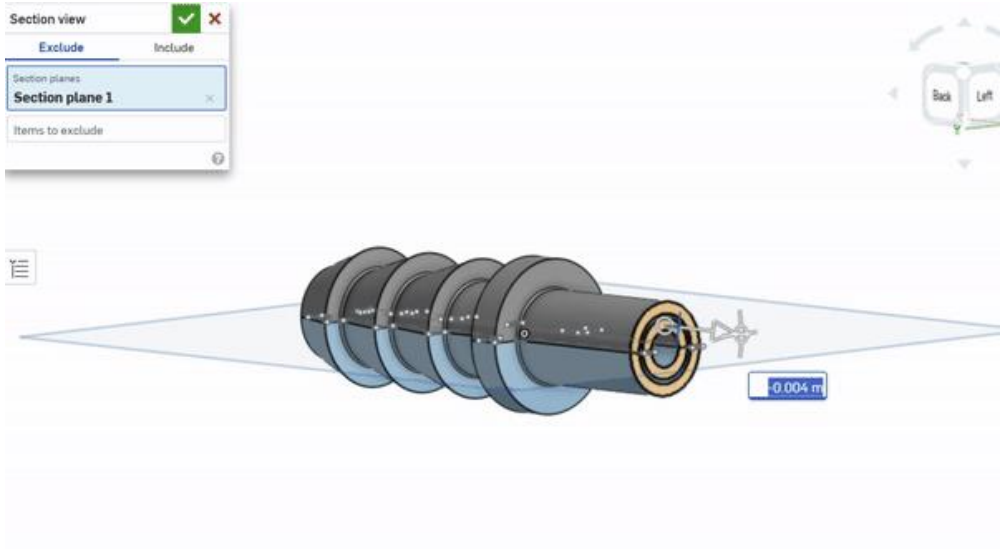


Z-Dir. Clamping Force Vs. Time



Nozzle Part: Simulation & Cross-Section Gif





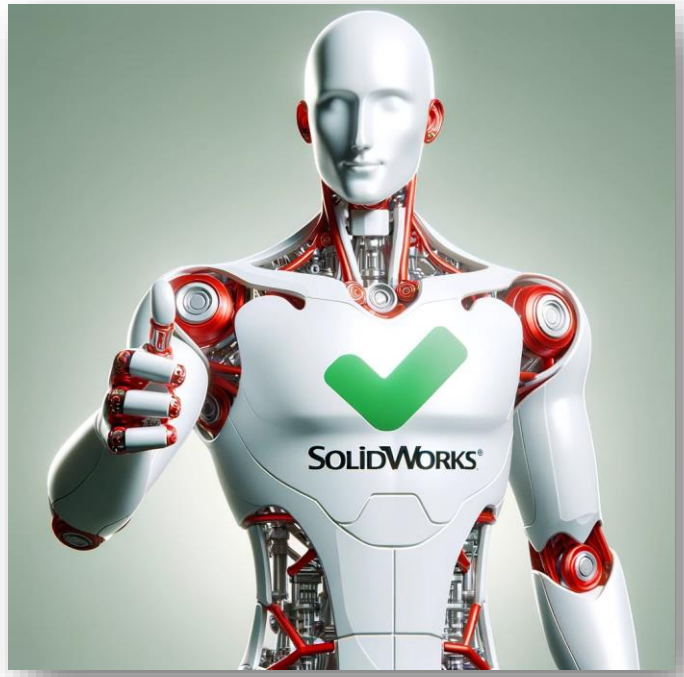
Nozzle Part: Solidworks Simulation Summary

- 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.

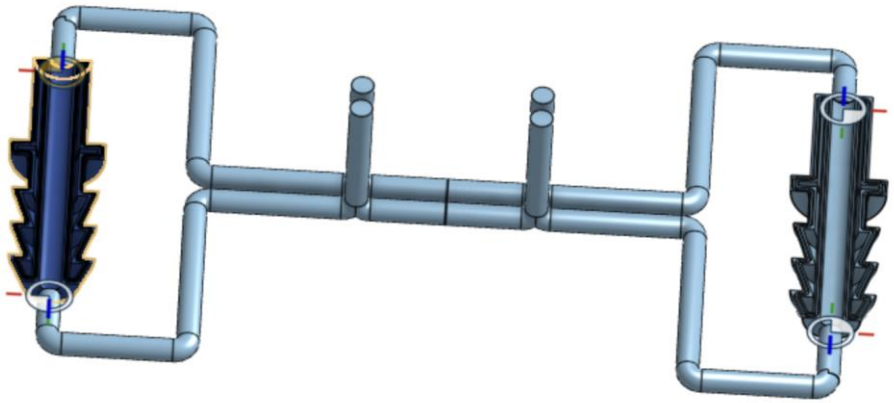
- Since the Maximum Temperature at End of Fill **has remained within 10 deg C** of the starting melt temperature, there is **little to no risk of plastics material degradation**.

- 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.**

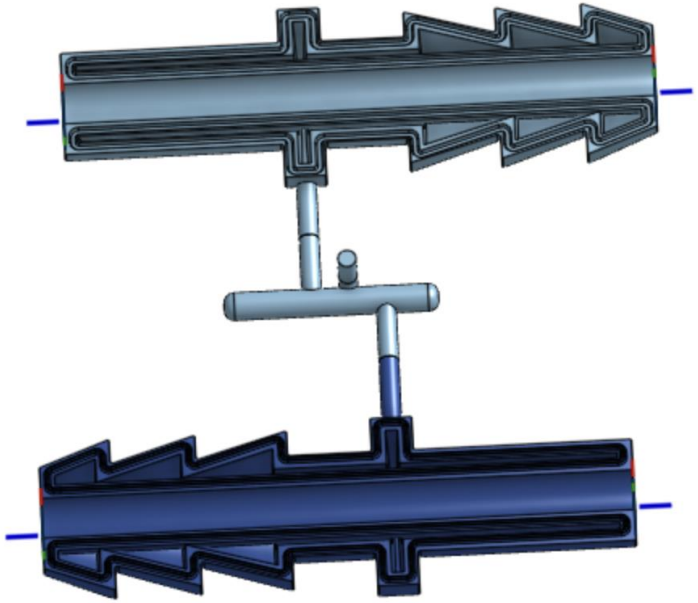


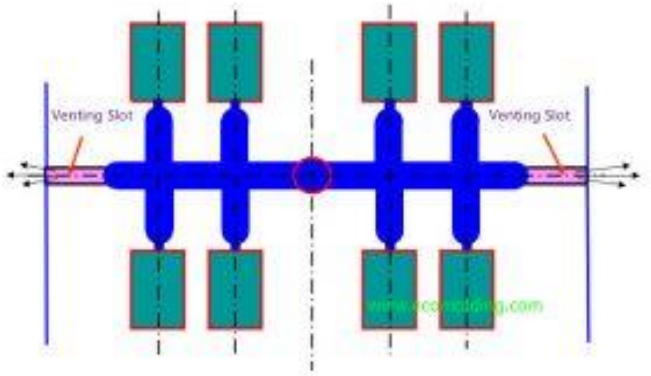
Proper Runner and Sprue System

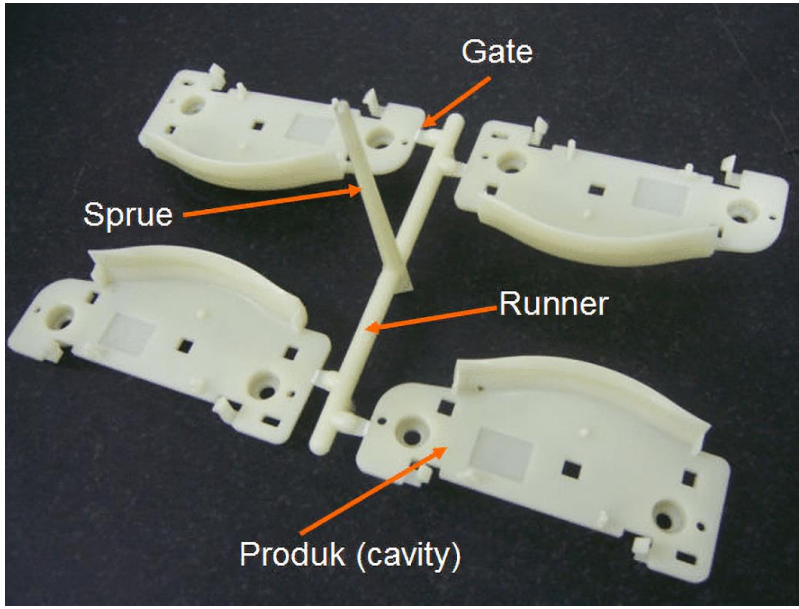
Attempt 1:



Attempt 2:



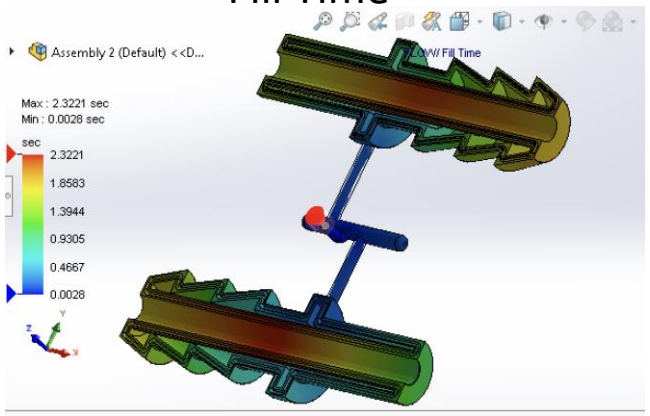




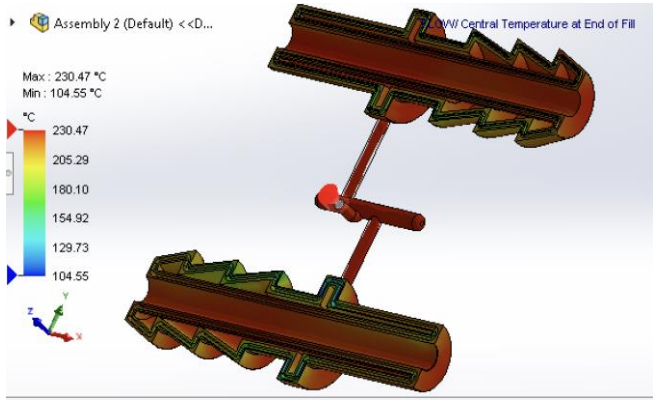
Inspiration & Research

Nozzle Part: Simulation

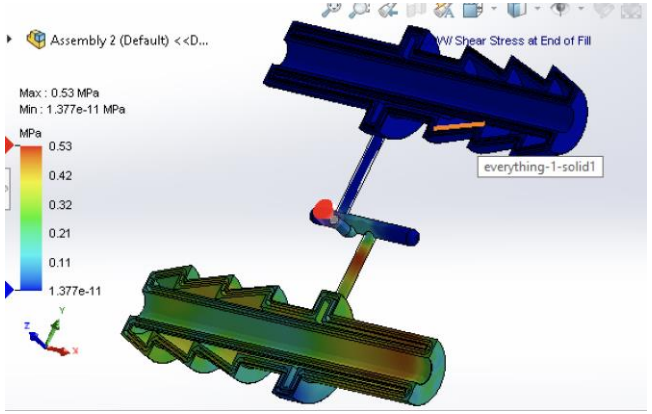
Fill Time



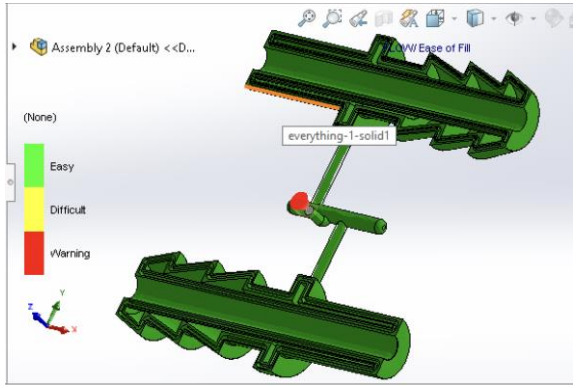
Central Temperature at End of Fill

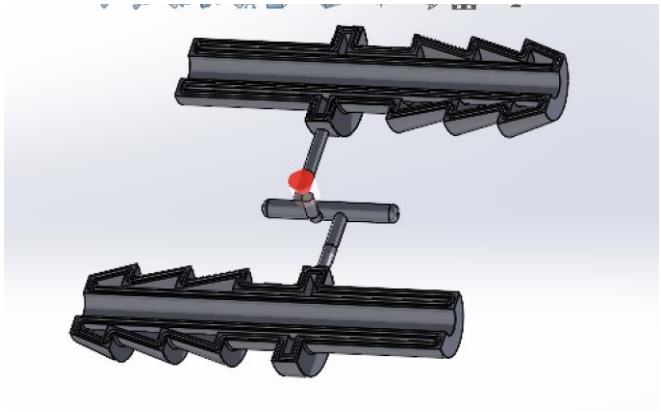


Shear Stress at End of Fill

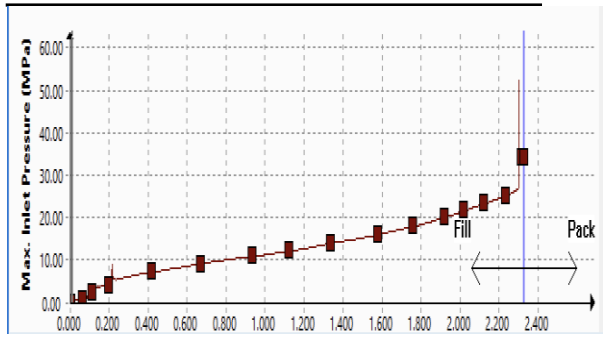


Ease of Fill

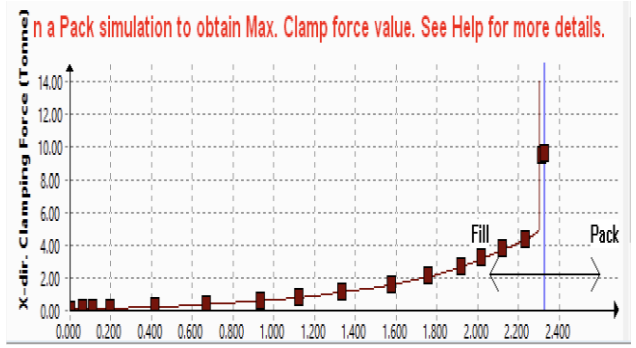




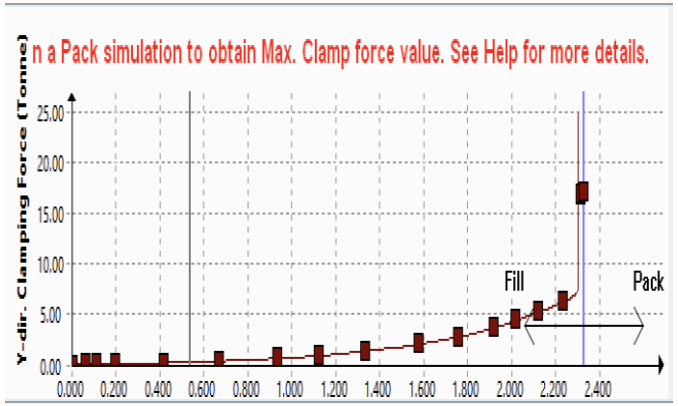
Max Inlet Pressure Vs. Time



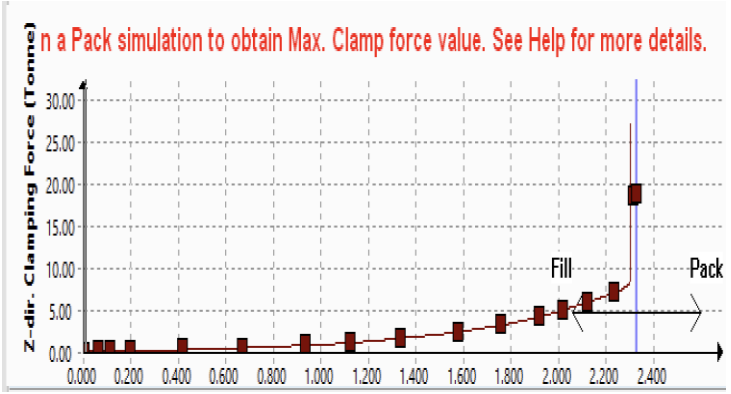
X-Dir. Clamping Force Vs. Time



Y-Dir. Clamping Force Vs. Time



Z-Dir. Clamping Force Vs. Time



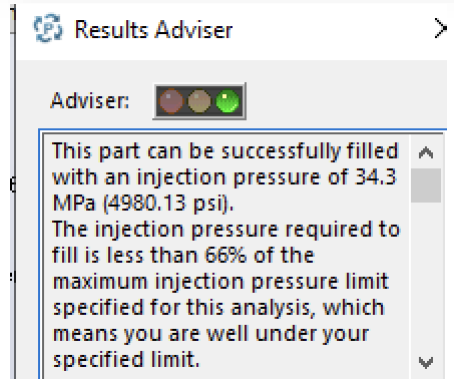
Nozzle Part: Solidworks Simulation Summary

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

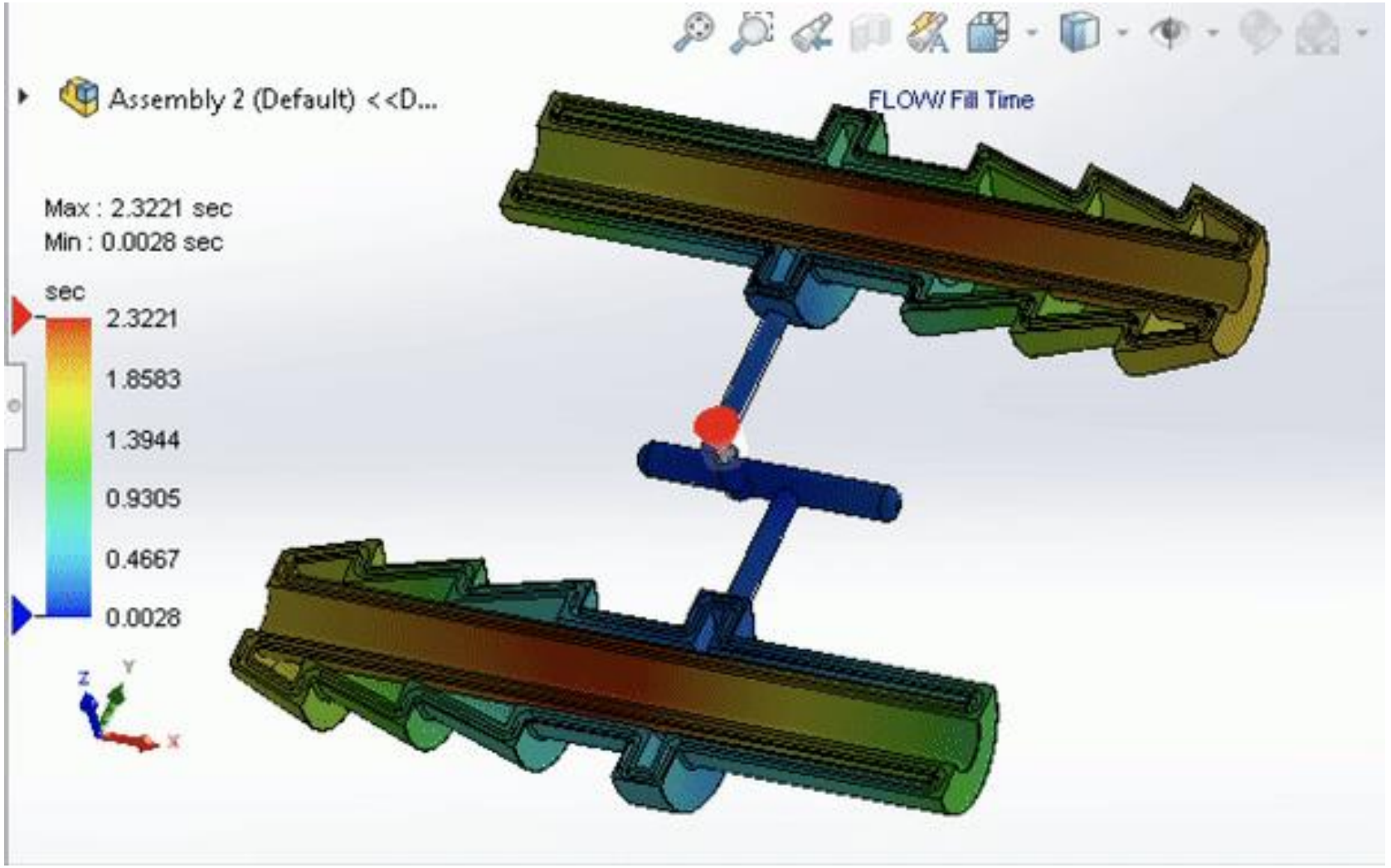
- The injection pressure required to fill is **less than 66% of the maximum injection pressure limit** specified for this analysis, which means you are well under your specified limit.

- 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**.

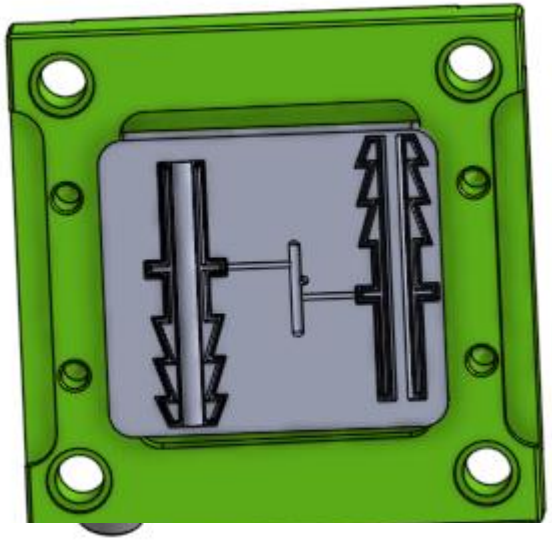
- The flow front melt temperature **is within the acceptable range of +/- 10 deg C from your starting melt temperature.** This helps promote **good mold filling and packing, minimizes injection pressure requirements, helps achieve good weld line integrity and appearance and gives you the best chance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

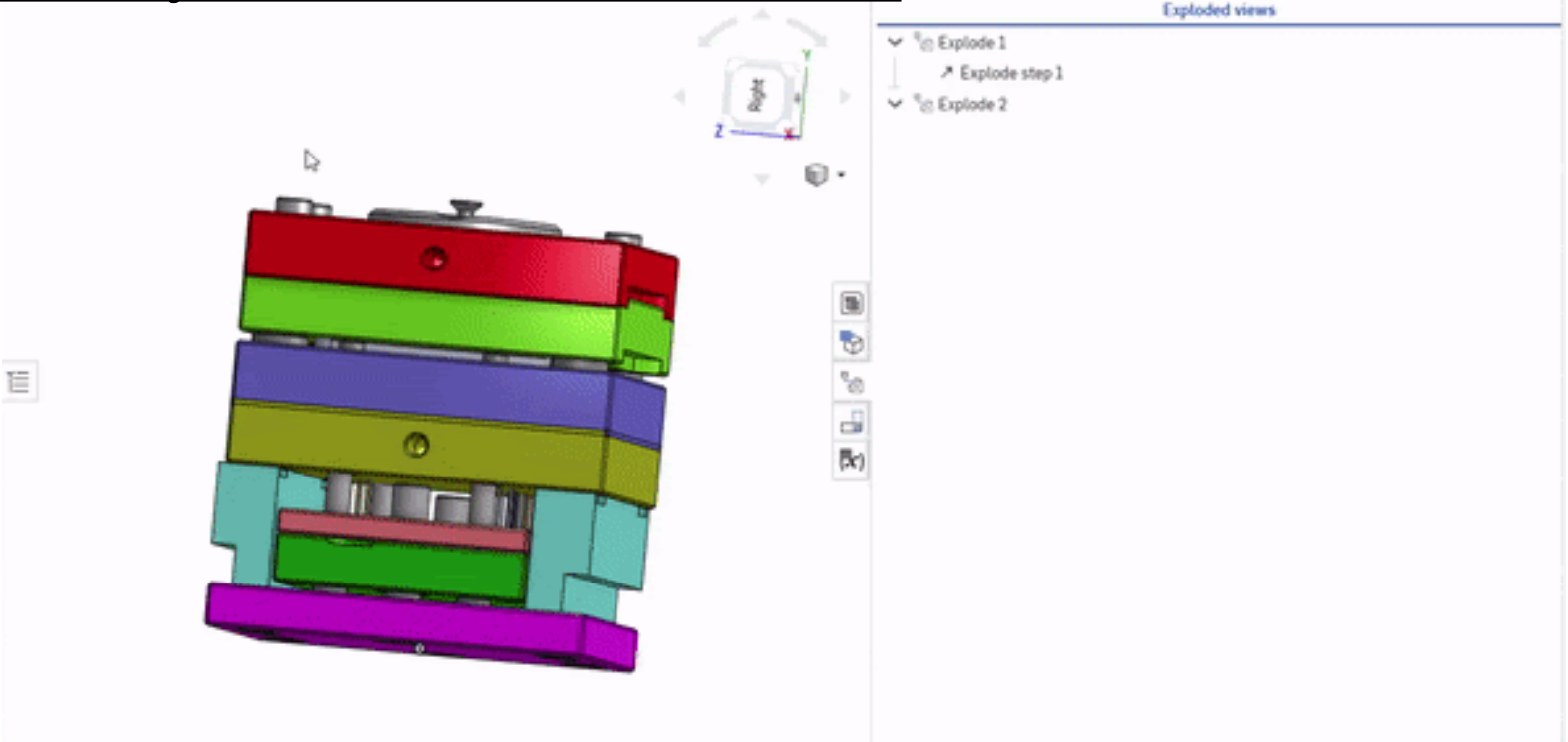


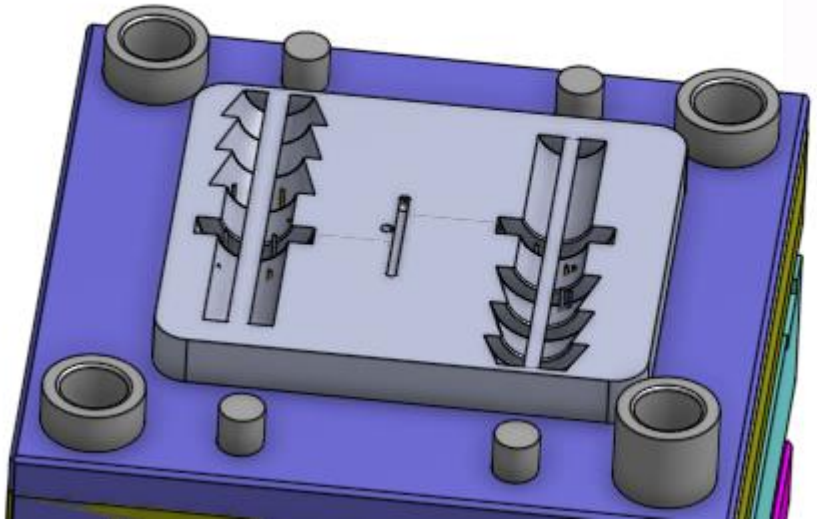
Nozzle Part With Runner System: Simulation & Cross-Section Gif

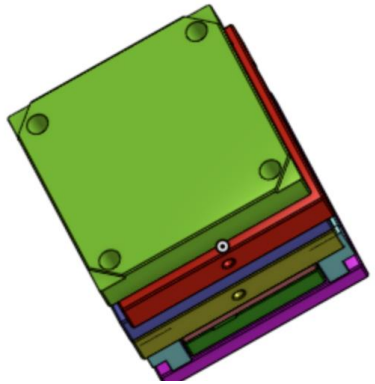


Mold Design Assembly for Nozzle Part





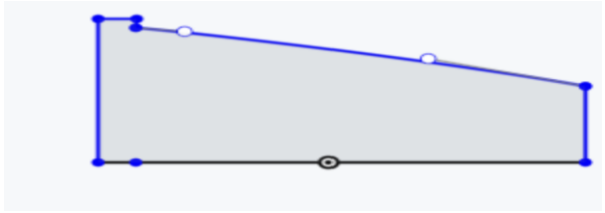




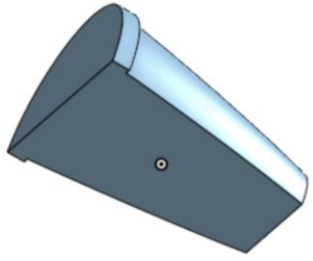
Backup Additional Slides: Simpler Plastic Cup

Simpler Cup Part: Design

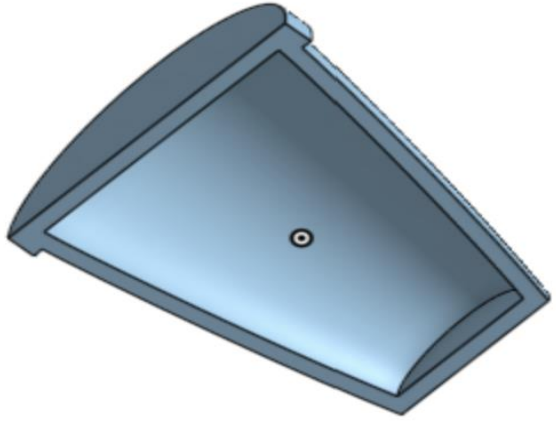
Drawing Design



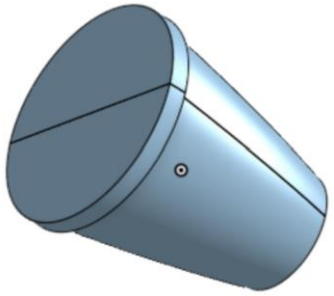
Revolving Design



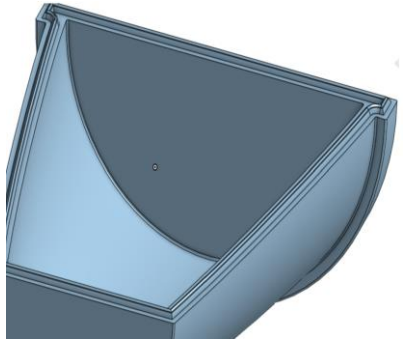
Shell: Uniform Walls with Drafted 90 degree walls

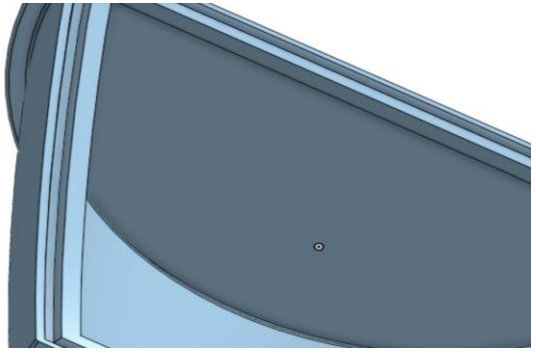


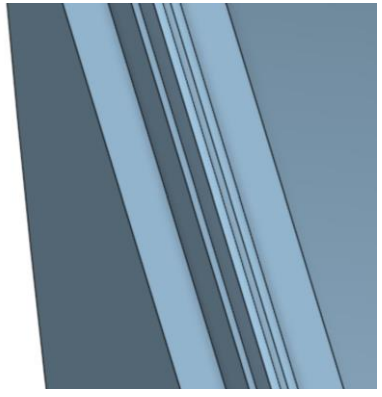
Add Second Split

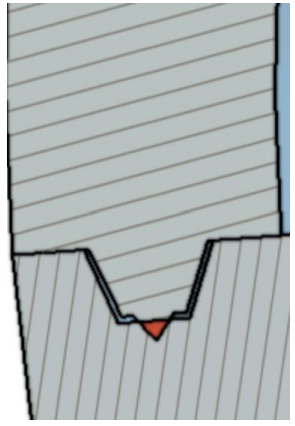


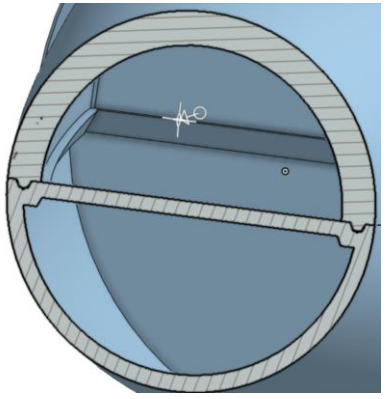
Groove And Negative Groove For Ultrasonic Welding





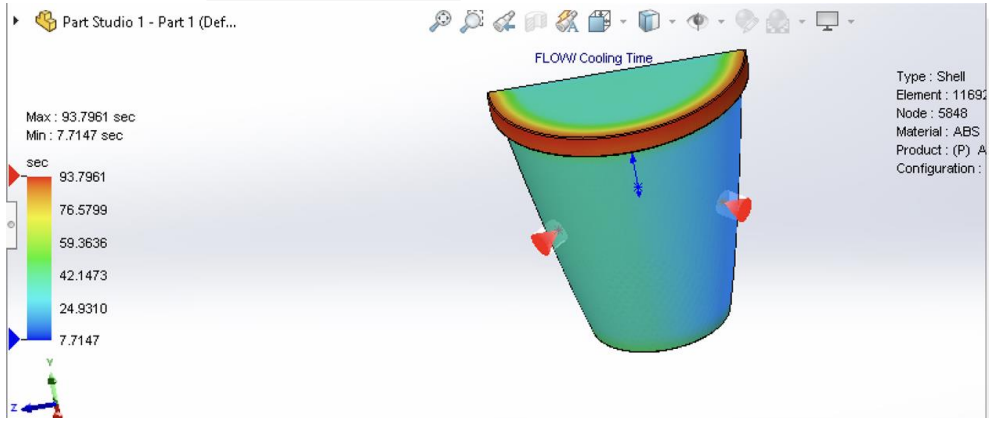




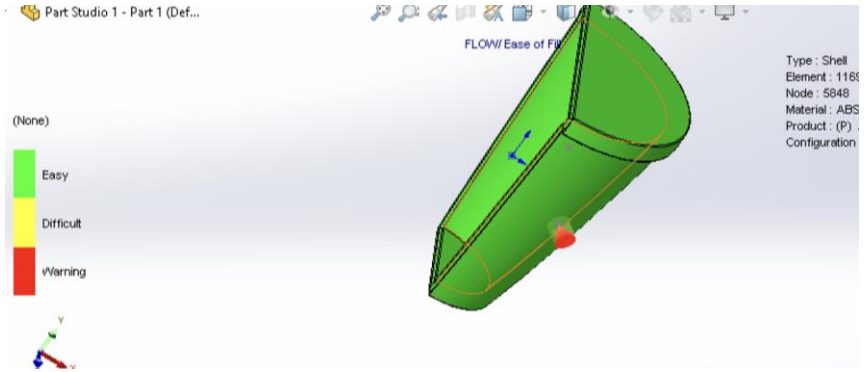


Cup Part: Simulation

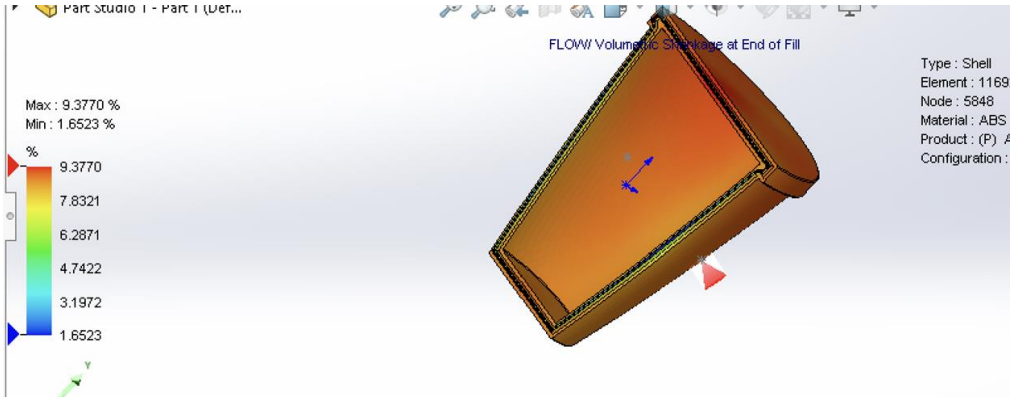
Cooling Time



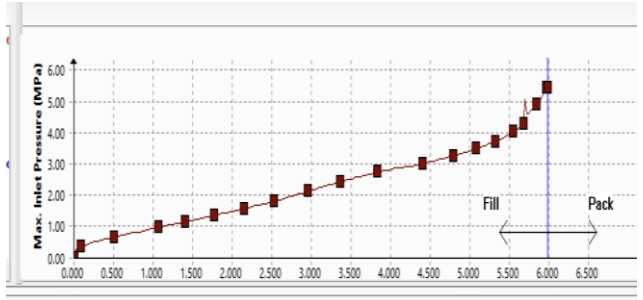
Ease of Fill



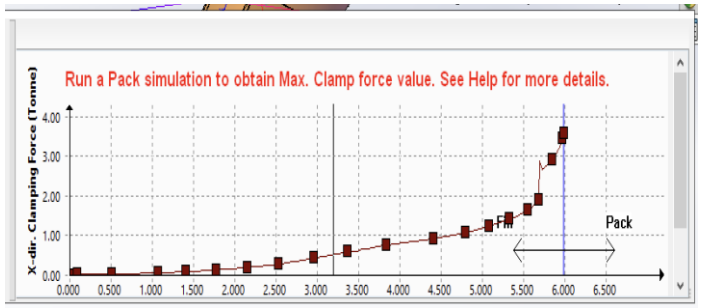
Volumetric Shrinkage at End of Fill



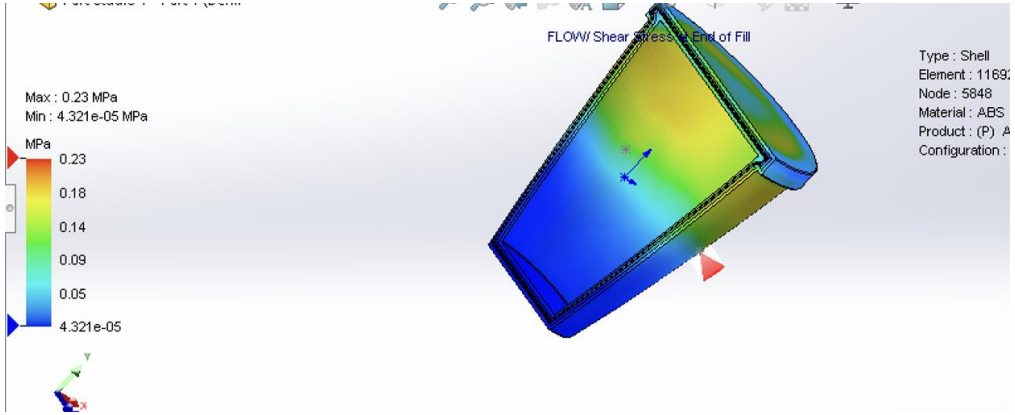
Max Inlet Pressure Vs. Time



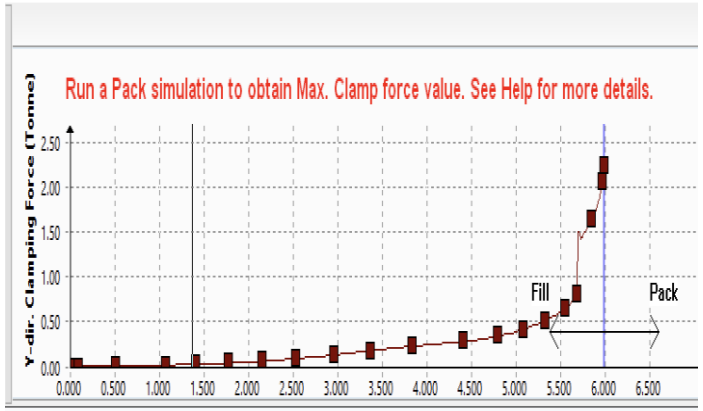
X-Dir. Clamping Force Vs. Time



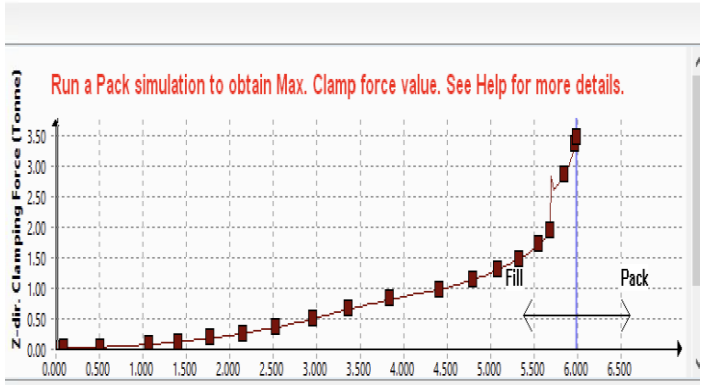
Shear Stress at End of Fill



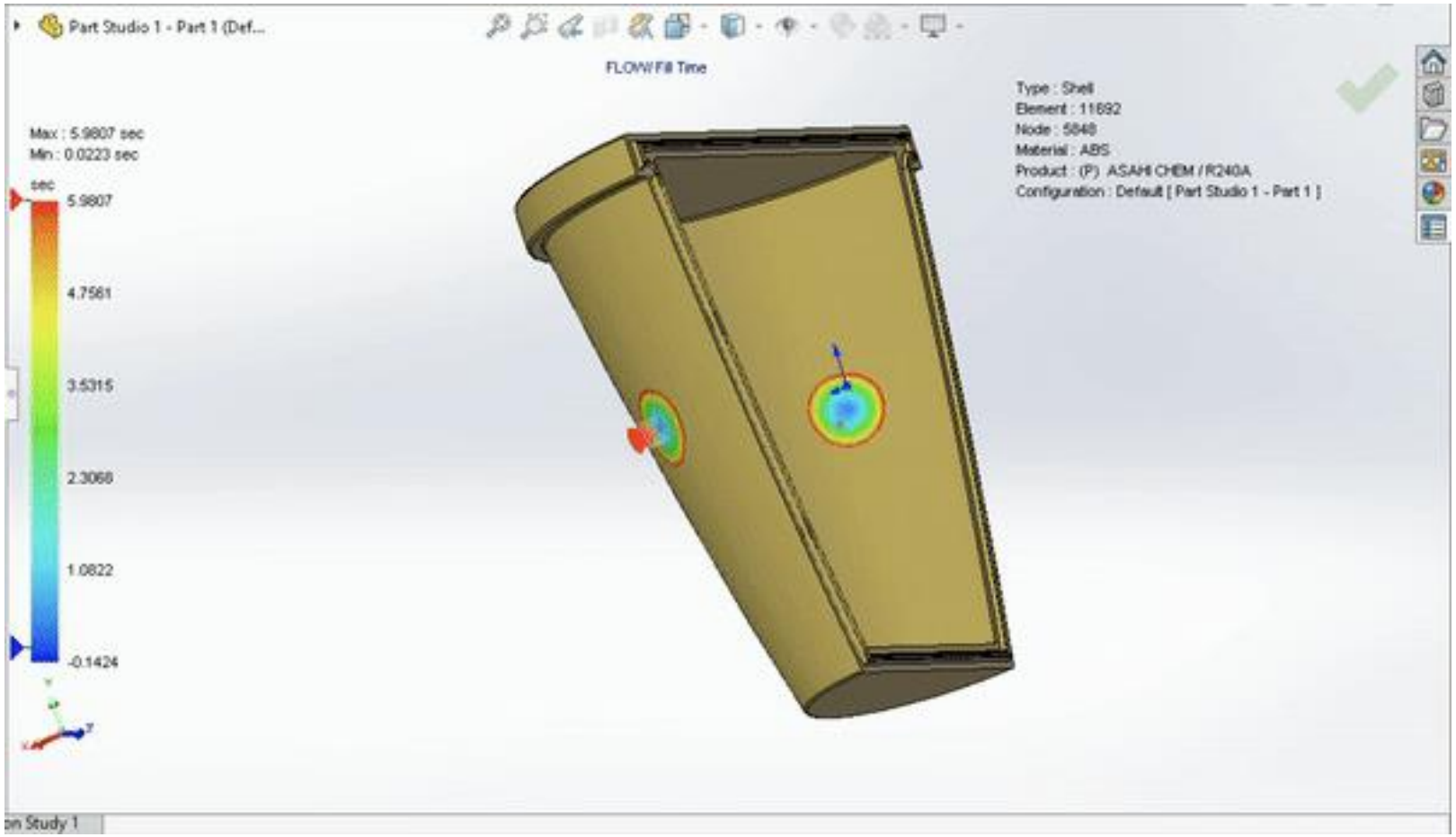
Y-Dir. Clamping Force Vs. Time



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.**