

Moldflow Mondays - Round 2

Exploring Advanced Concepts, Workflows, and Best Practices

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Introduction to Mason



AUTODESK
Moldflow Insight

CERTIFIED EXPERT

Autodesk Moldflow Certification

Associate

- 60 questions
- 2 hours
- Now Online

Professional

- 110 Questions
- Mesh a part
- Create Runner
- Model Cooling/Inserts
- 144 Additional Questions
- 8-10 hours

Expert

- Professional for 1 year
- 144 Questions
- Mesh Clean Up
- Fix a Warpage Problem
- 120 Additional Questions
- 3.5 Days



Moldflow Mondays



Happy Moldflow Monday!

Part CAD vs Tool CAD - what's the difference and which one should we be using in Moldflow?

Part CAD - I would define this as the desired or designed molded part shape and size. Typically this would be the starting point for our simulation work.

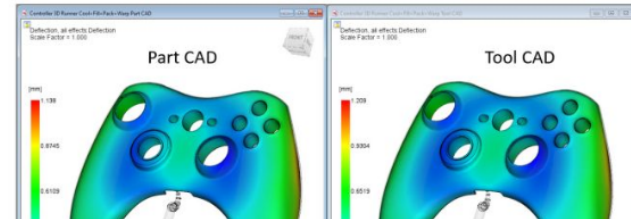
Tool CAD - I would define this model as the grown, or larger, CAD that would represent the tool negative. We would use the shrink rates to increase the size of the Part CAD to generate this model. Ultimately, the Tool CAD would be used to cut the mold cavity.

I think the best approach would be to start with Part CAD to answer early questions like gate location, runner size, and processing conditions. Once cooling is added and shrink rates have been established, your final simulation should probably be using Tool CAD.

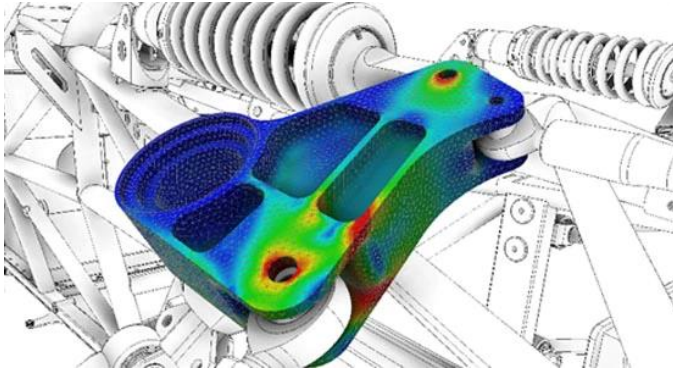
If you are trying to match deflection from actual molded samples, simulating the Tool CAD would give you the most accurate comparison.

Do you use Part CAD or Tool CAD in your Moldflow simulations?

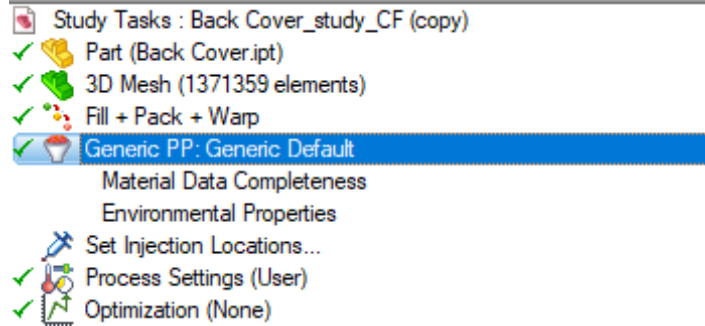
[#moldflow](#) [#autodesk](#) [#autodeskemployee](#) [#tooling](#) [#injectionmolding](#)



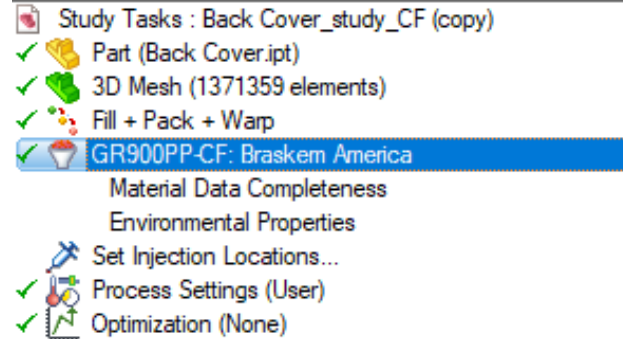
Simulation Matching Reality



Material Selection



Substitute Material



Actual Material



Juncture Loss

Juncture loss method coefficients

c1

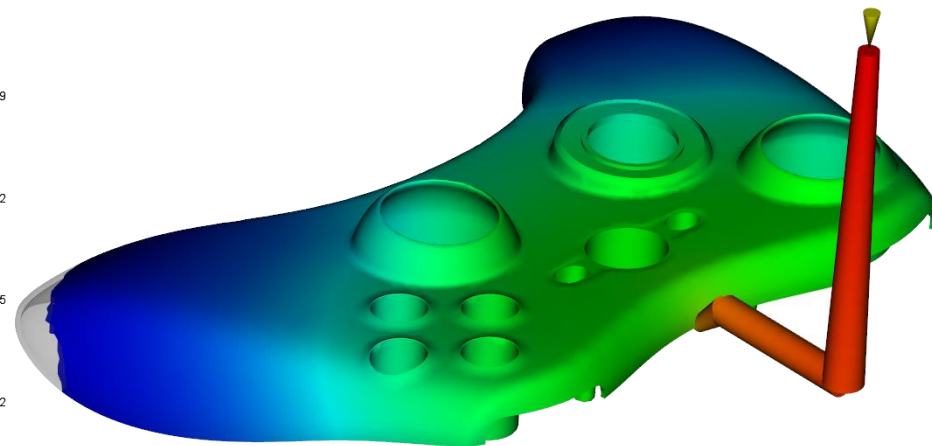
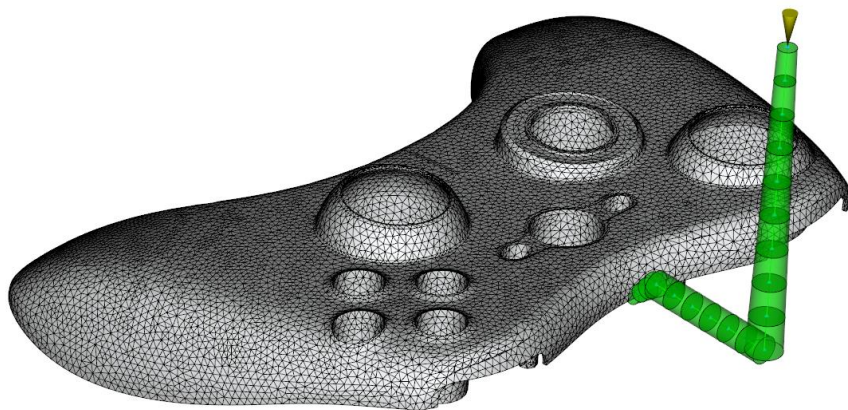
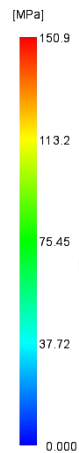
0.006

$\text{Pa}^{(1-c2)}$

c2

1.6

Pressure at V/P switchover
= 150.9[MPa]



Extensional Viscosity

☒ Extension viscosity

Edit extension viscosity model coefficients...

Extension Viscosity Model Coefficients

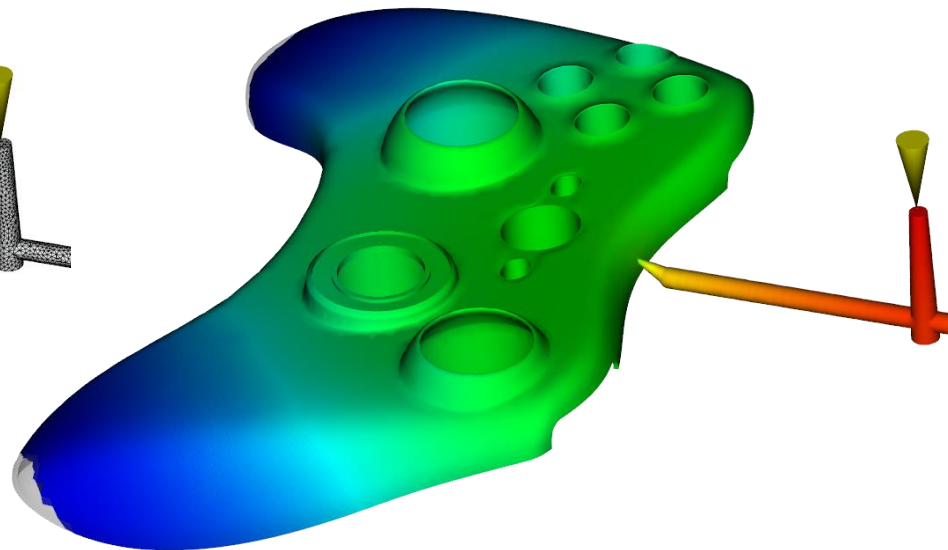
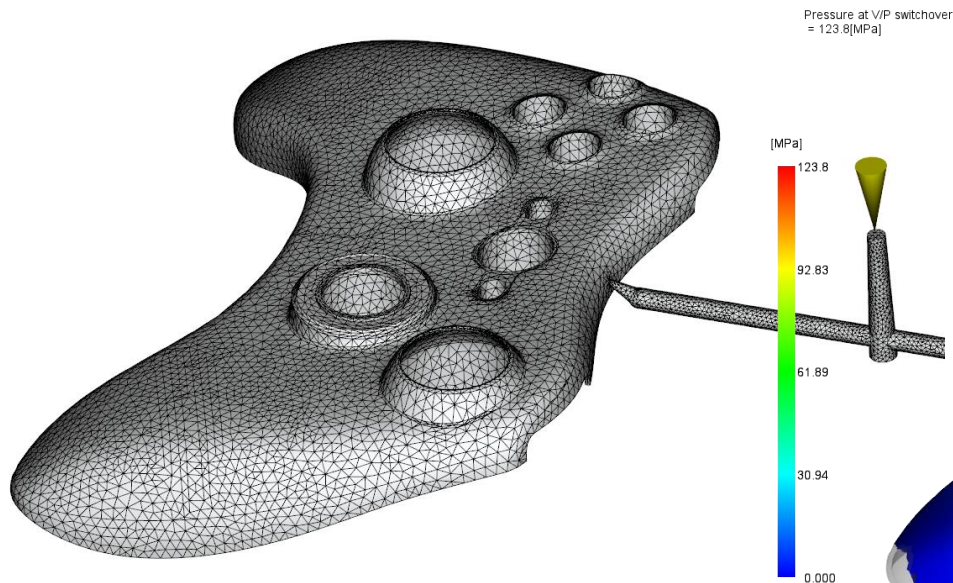
Extension viscosity model coefficients

A	9.53852	[0:1e+07]
B	26375.9	[0:1e+07]

OK

Cancel

Help



D3 Values

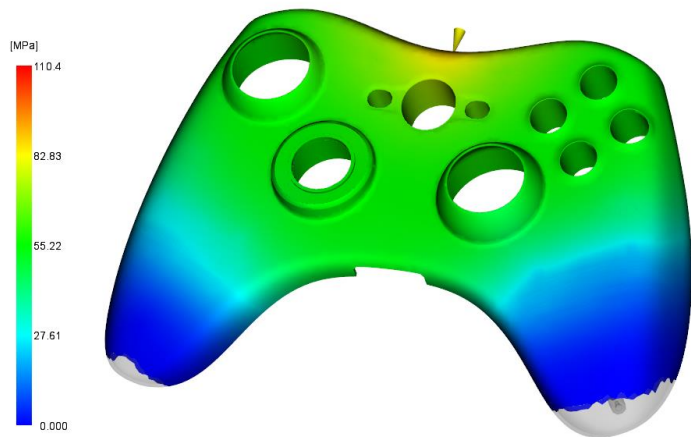
Cross WLF Viscosity Model Coefficients

Cross-WLF viscosity model

n	0.2748
Tau*	366990 Pa
D1	1.05605e+10 Pa-s
D2	417.15 K
D3	0 K/Pa
A1	24.221
A2~	51.6 K

No tested D3 value

Pressure at V/P switchover
= 110.4[MPa]



Cross WLF Viscosity Model Coefficients

Cross-WLF viscosity model

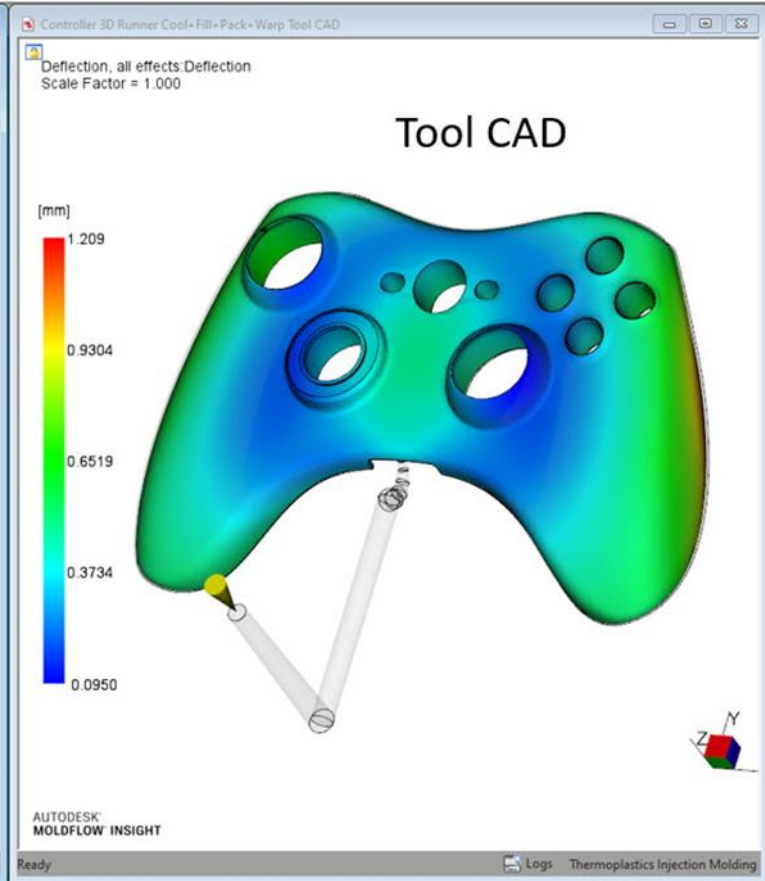
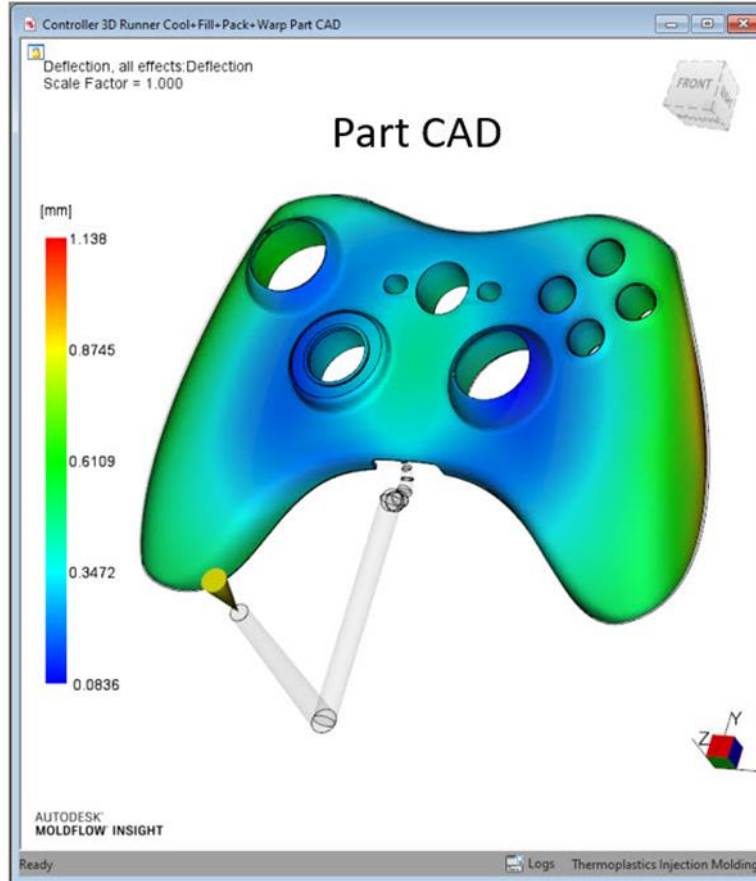
n	0.221
Tau*	658735 Pa
D1	1e+12 Pa-s
D2	427 K
D3	1.18e-07 K/Pa
A1	31.01
A2~	51.6 K

Tested D3 value

Pressure at V/P switchover
= 196.6[MPa]



Part CAD vs Tool CAD



Shrink Compensation

- Deflection, all effects – Plot Properties – Deflection Tab - Shrinkage Compensation
- Automatic, Isotropic, or Anisotropic available
- Runners and Cooling may influence these results
- Can be useful for determining our tooling shrink rates

Shrinkage compensation	
Options	Automatic
Estimated shrinkage [x%, y%, z%]	0.963, 0.633, 0.565
Reference coordinate system	Global

Injection Molding Machine

- Pick from public database
- Create your own Injection Molding Machine

Injection molding machine

Description

Injection Unit

Hydraulic Unit

Clamping Unit

Machine pressure limit

Maximum machine injection pressure

at

180

MPa [0:500]

Intensification ratio

10

(0:30)

Machine hydraulic response time

0.01

s (0:10)

Injection molding machine

Description

Injection Unit

Hydraulic Unit

Clamping Unit

Machine pressure limit

Maximum machine injection pressure

at

165.5

MPa [0:500]

Intensification ratio

10

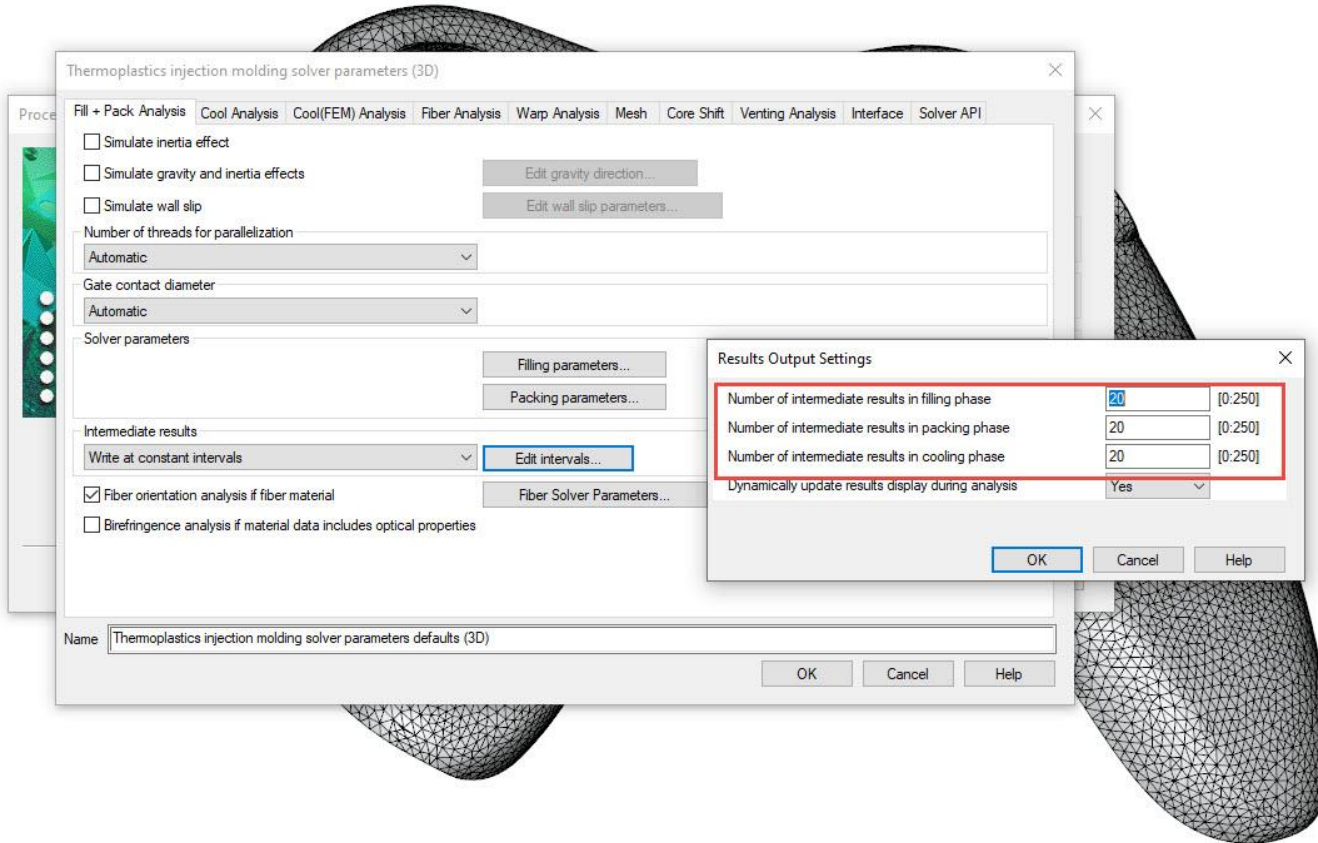
(0:30)

Machine hydraulic response time

0.2


s (0:10)

3D Intermediate Results



Process Settings

Process Settings Wizard - Fill+Pack Settings - Page 1 of 2



Mold surface temperature C

Melt temperature C

Filling control

Velocity/pressure switch-over

Pack/holding control


Cooling time

☒ Fiber orientation analysis if fiber material

☐ Birefringence analysis if material data includes optical properties

OK for Starting Point

Process Settings Wizard - Fill+Pack Settings - Page 1 of 2



Mold surface temperature C

Melt temperature C

Filling control
 of s [0:]

Velocity/pressure switch-over
 at % [0:100]

Pack/holding control

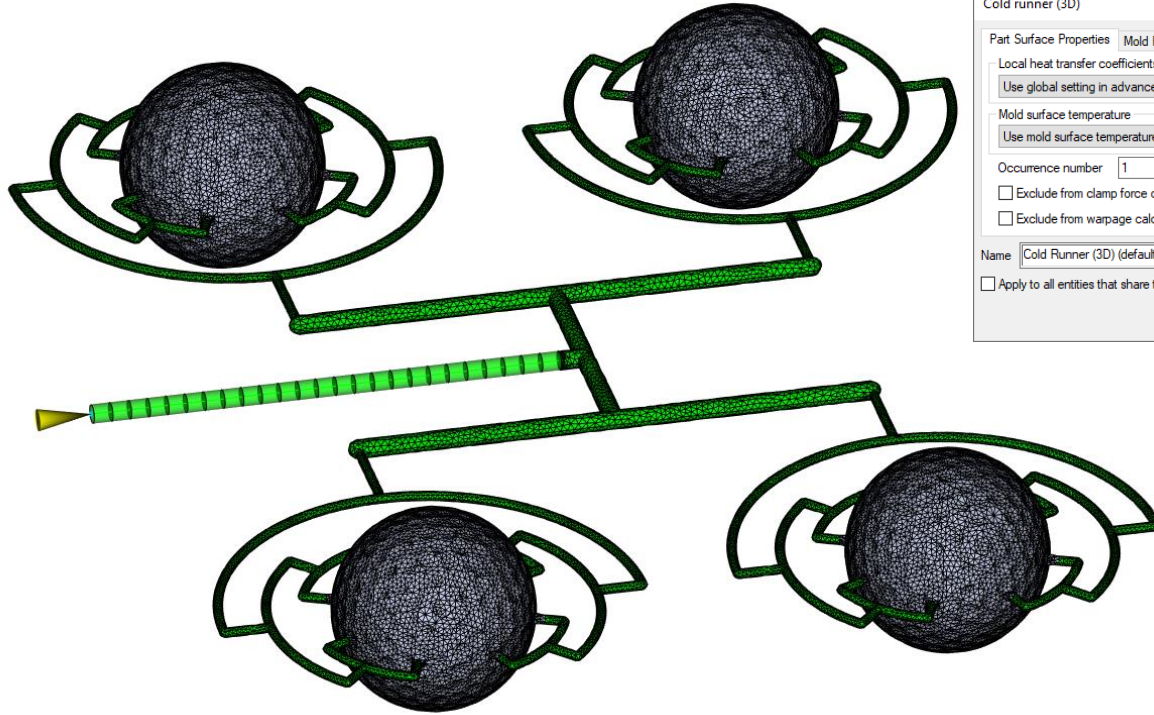
Cooling time
 of s [0:]

☒ Fiber orientation analysis if fiber material

☐ Birefringence analysis if material data includes optical properties

More Realistic Process

Runners & Runner Properties



Cold runner (3D)

Part Surface Properties | Mold Properties

Local heat transfer coefficients
Use global setting in advanced options

Mold surface temperature
Use mold surface temperature in process settings

Occurrence number 1 [1:1024]

☐ Exclude from clamp force calculation

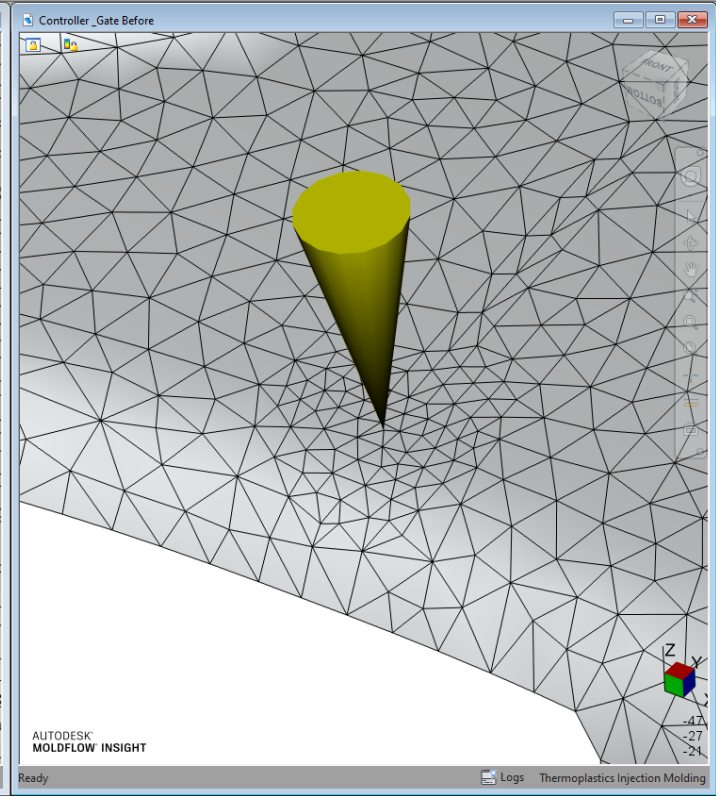
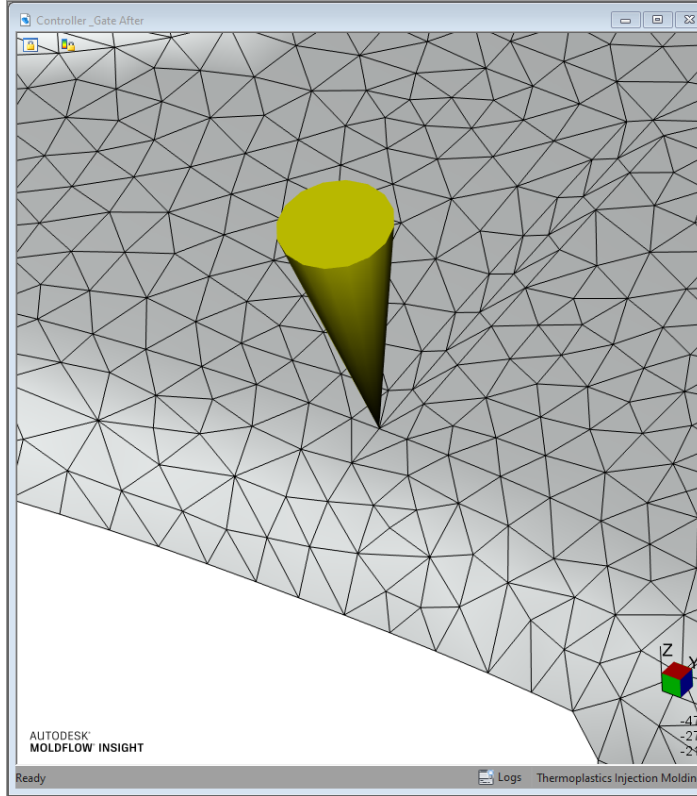
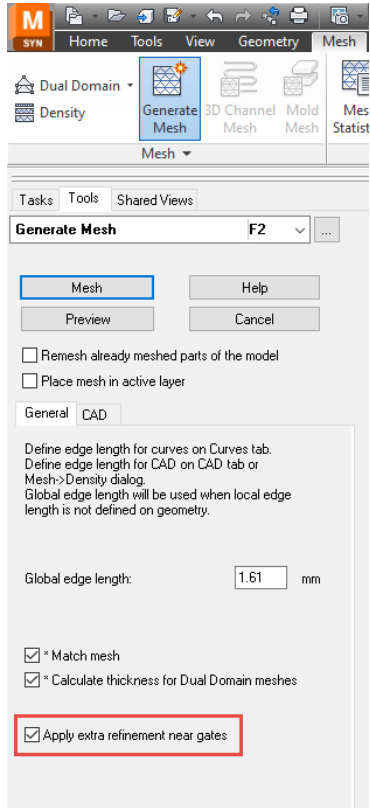
☐ Exclude from warpage calculation

Name Cold Runner (3D) (default) #1

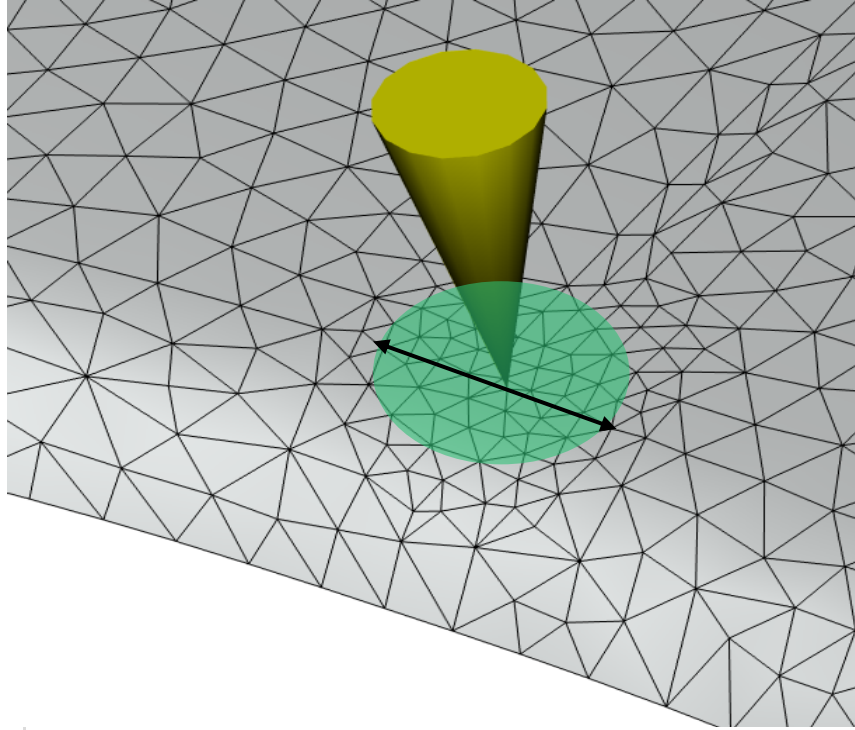
☐ Apply to all entities that share this property

OK Cancel Help

Meshing Gate Locations



Meshing Gate Locations



8 elements across gate
contact diameter

Gate contact diameter

Specified

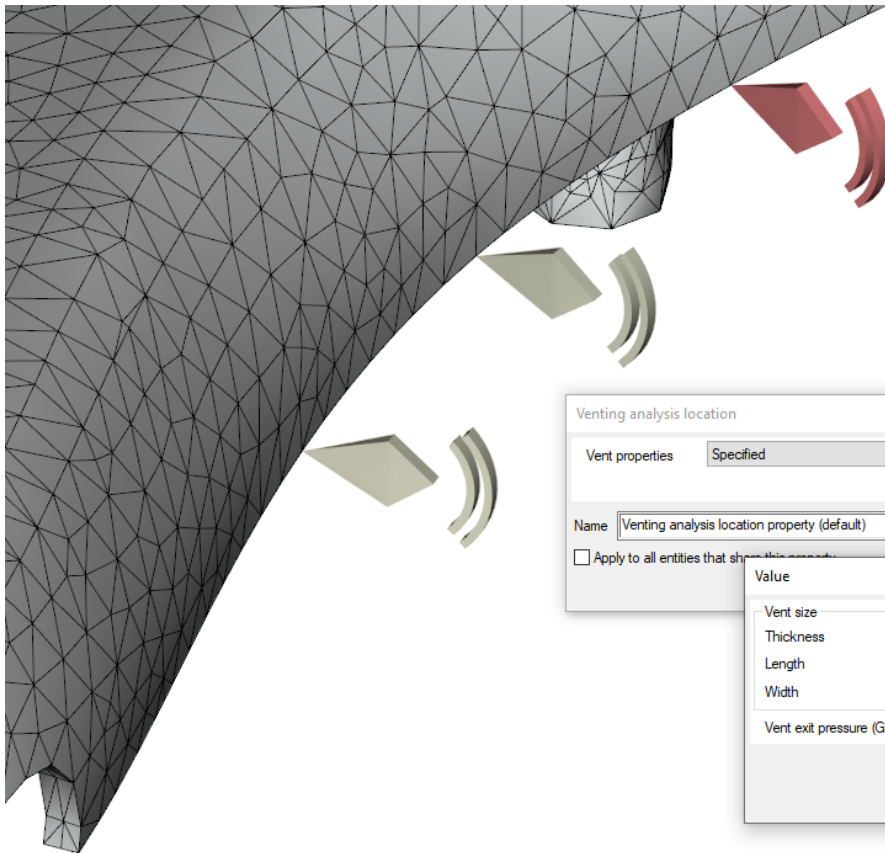


Gate diameter

2

mm

Venting



Venting analysis location

Vent properties: Specified Edit venting analysis parameters...

Name: Venting analysis location property (default)

☐ Apply to all entities that share this property

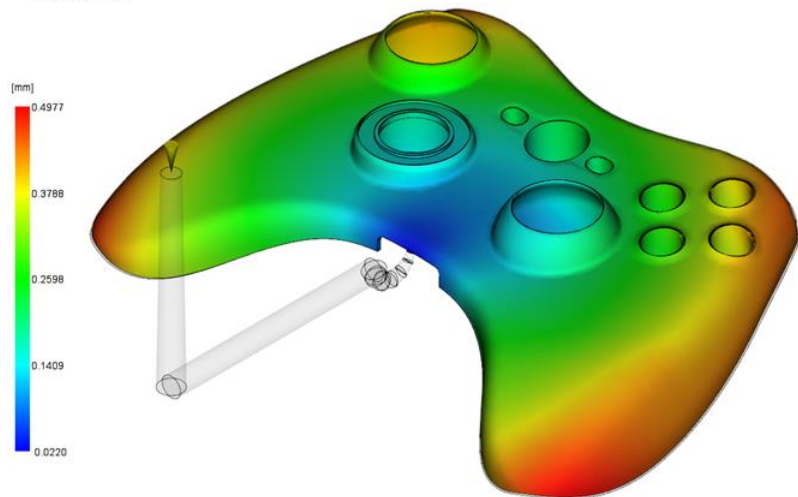
Value

Vent size		
Thickness	0.03	mm [0.001:10]
Length	3	mm (0.1:1000)
Width	3	mm (0.1:1000)
Vent exit pressure (Gauge)	0	MPa [-0.1013:100]

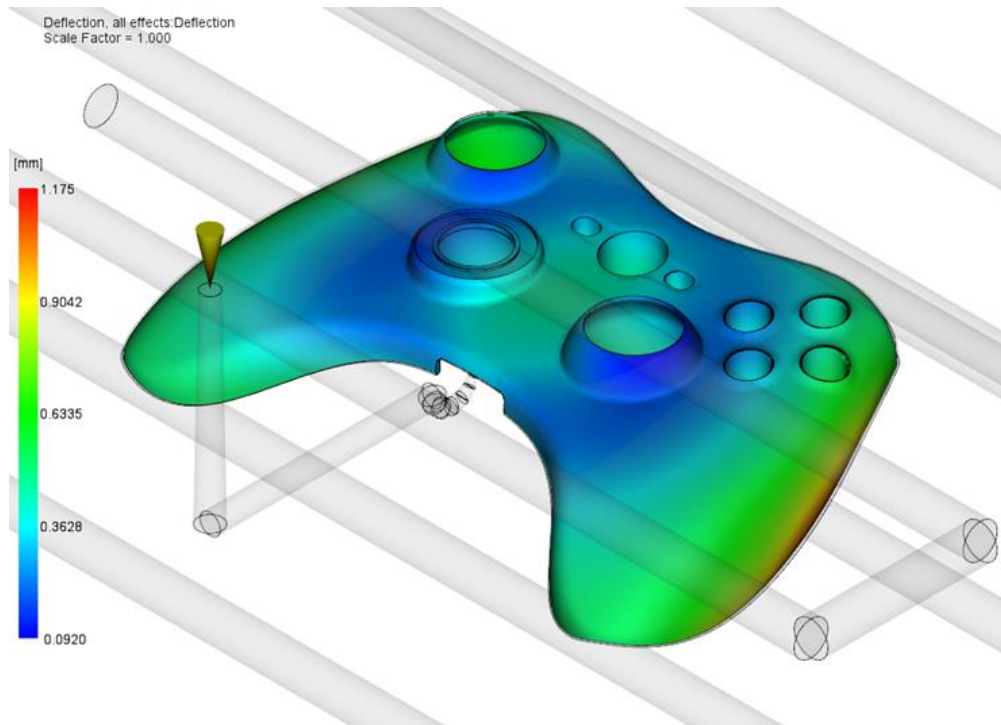
OK Cancel Help

Fill+Pack+Warp vs Cool+Fill+Pack+Warp

Deflection, all effects Deflection
Scale Factor = 1.000



Deflection, all effects Deflection
Scale Factor = 1.000

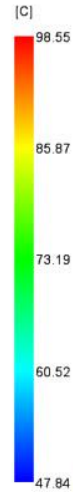


Cool vs Cool(FEM) Analyses

Temperature, mold
= 96.19[C]

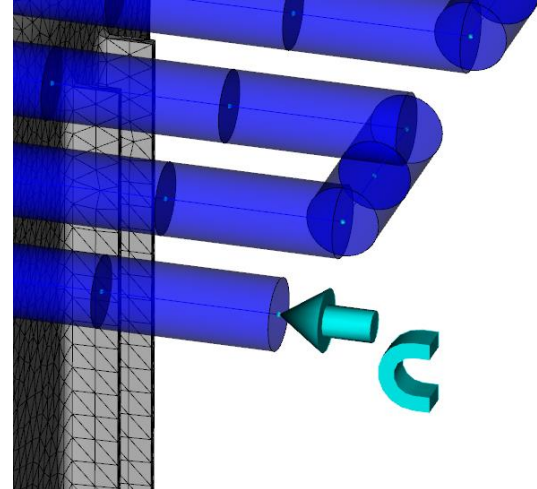


Temperature, mold (averaged)
= 98.55[C]

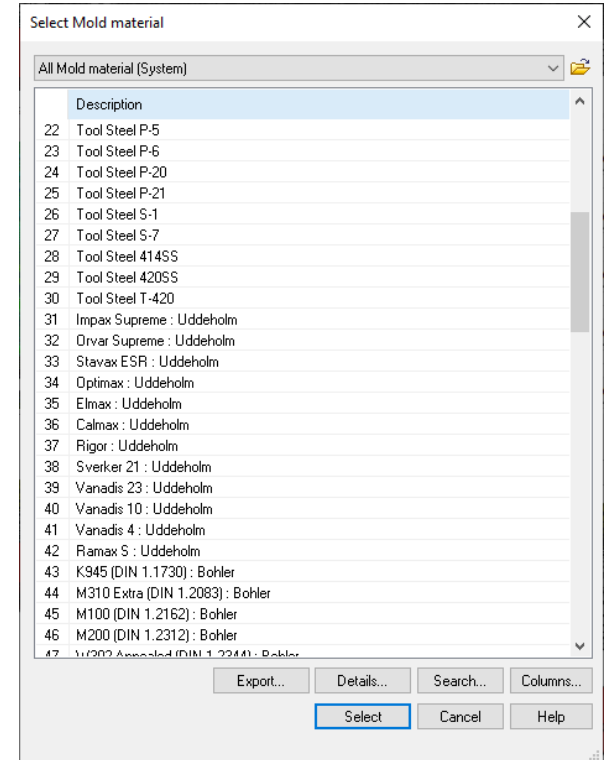
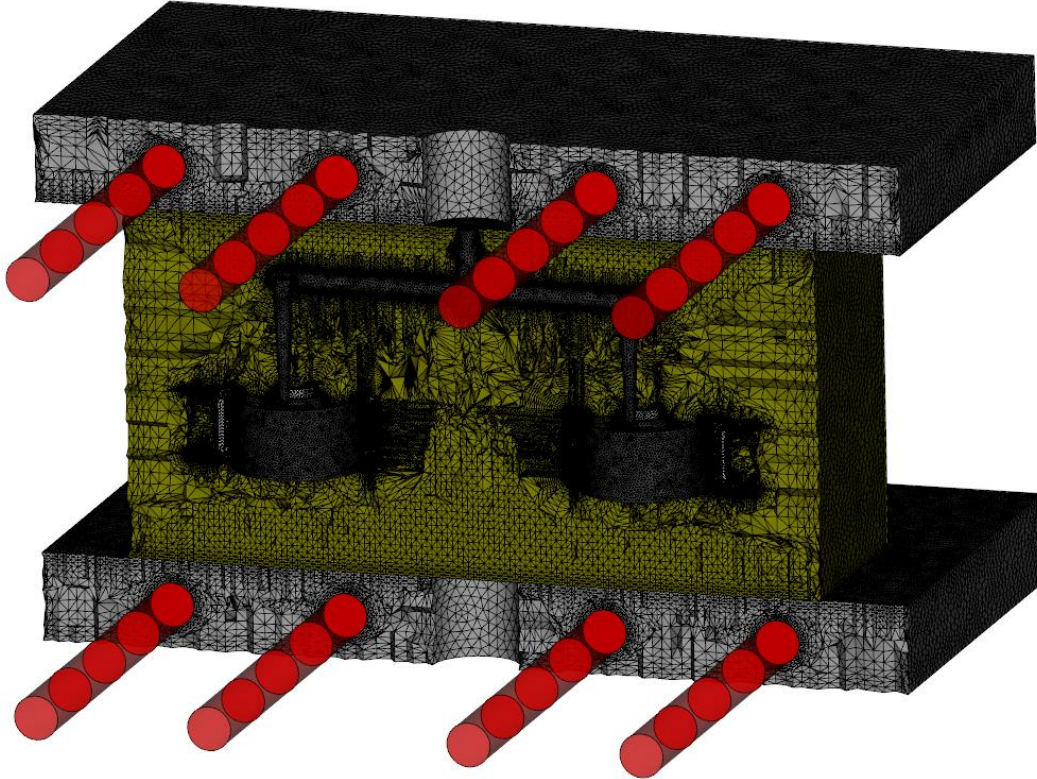


Coolant Inlet Temperatures

- Inlet temperature is determined primarily by the desired mold surface temperature
- Normally 10° to 30°C ($\sim 20^{\circ}$ to $\sim 55^{\circ}\text{F}$) lower than mold surface temperature
- Optimum temperature will depend on
 - Distance between the cooling lines and the part
 - Thermal conductivity of the mold material



Tool Steel Database



Warp Solver, Dual Domain and 3D

Thermoplastics material ✕

Optical PropertiesEnvironmental ImpactMaterial data completenessCrystallization MorphologyStress - Strain (Tension)Stress - Strain (Compression)Tiger Stripe

DescriptionRecommended ProcessingRheological PropertiesThermal PropertiespvT PropertiesMechanical PropertiesShrinkage PropertiesFiller / Fiber

Select a shrinkage model (Midplane and Dual Domain)

Corrected residual in-mold stress (CRIMS) ✕Examine CRIMS modelDefault Flow/Fiber set ✕Edit model coefficients...

Select a shrinkage model (3D)

Shrinkage test adjusted mechanical properties (STAMP) ✕

Observed nominal shrinkage

Parallel0.2638% [-100:100]

Perpendicular1.476% [-100:100]

Average nominal shrinkage0.8699% [-100:100]

Observed shrinkage

Minimum Parallel0.2064% [-100:100]

Maximum Parallel0.3469% [-100:100]

Minimum Perpendicular1.086% [-100:100]

Maximum Perpendicular1.955% [-100:100]

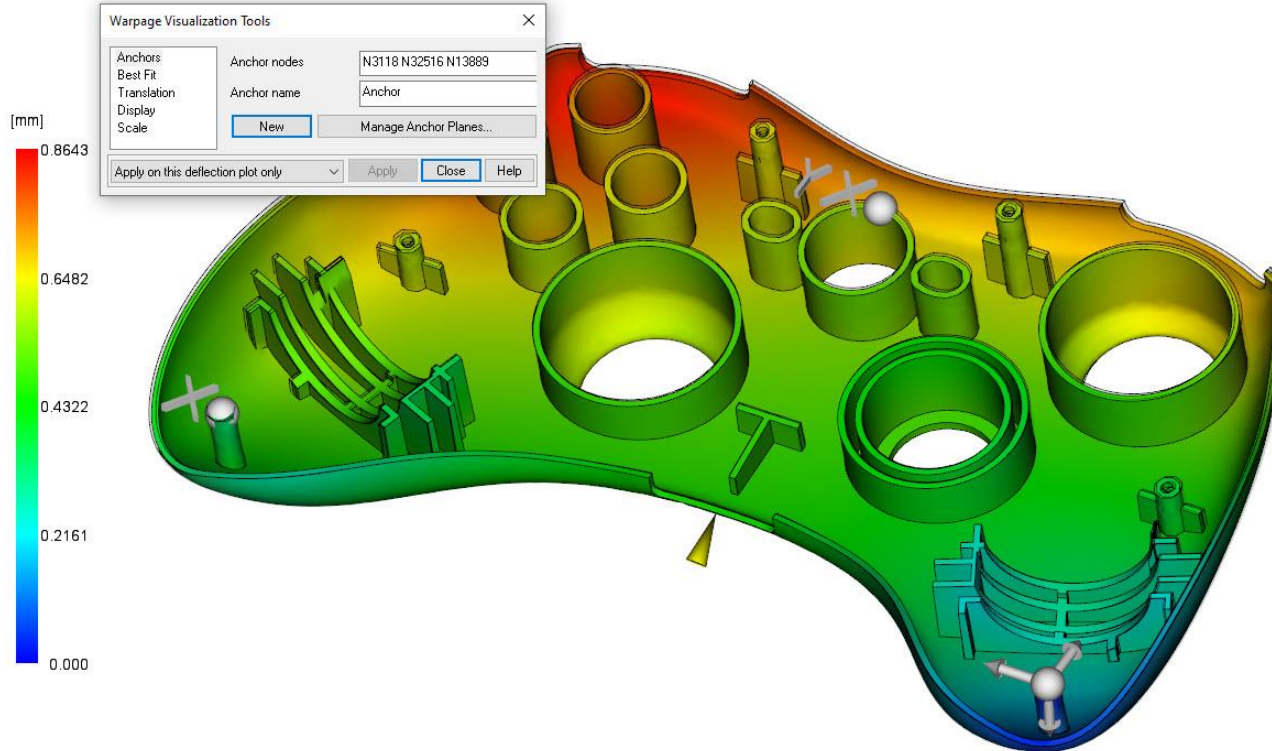
Edit observed shrinkage test information...

Shrinkage Molding Summary

	Melt Temperature C	Mold Temperature C	Flow Rate (R) cm ³ /s	Flow Rate (F) cm ³ /s	Ram Diameter mm	Ram Displacement mm	Thickness mm	Packing Pressure MPa	Packing Time s	Cooling Time s	Parallel Shrinkage %
1	300.3	117.9	19.9	19.4	35	68.6	2	28.1	15	20	0.275
2	300.8	118.7	25.3	25.3	35	70.5	2	28	15	20	0.275
3	299.9	118.4	31.7	36.1	35	71	2	28.1	15	20	0.282
4	300.8	119.1	13.2	12	35	69.6	2	28.1	15	20	0.28

Anchor Point and Anchor Planes

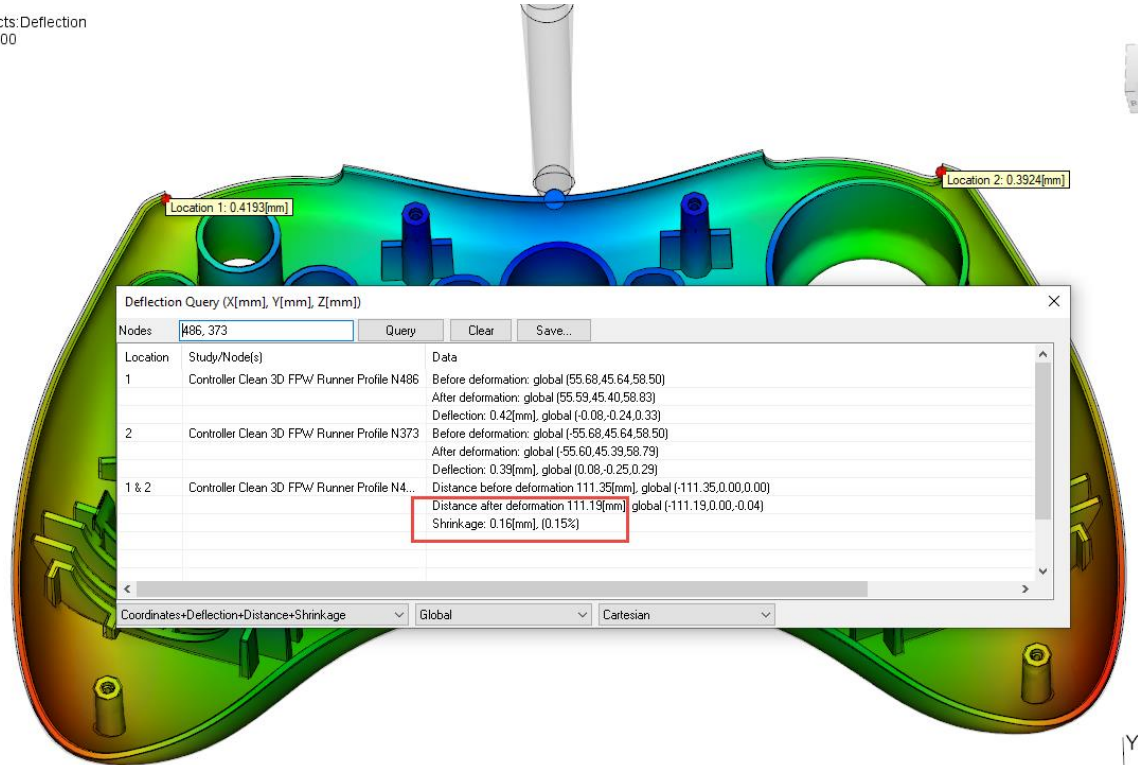
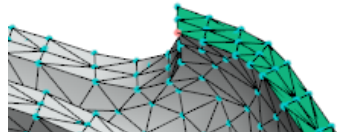
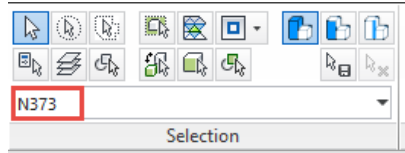
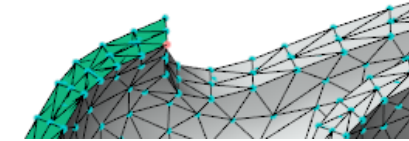
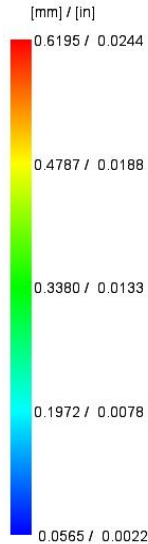
Deflection, all effects: Deflection
Scale Factor = 1.000



Measuring Linear Distances



Deflection, all effects: Deflection
Scale Factor = 1.000



Moldflow Solvers

GIVEN THE PACE OF
TECHNOLOGY, I PROPOSE
WE LEAVE MATH TO THE
MACHINES AND GO PLAY
OUTSIDE.



$$K_i = \left(\frac{\phi_i}{\phi_r}\right)^3 - \left(\frac{1-\phi_r}{1-\phi_i}\right)^2 K_r$$

$$a_{ij} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \rightarrow \begin{bmatrix} \lambda_1 & 0 & 0 \\ 0 & \lambda_2 & 0 \\ 0 & 0 & \lambda_3 \end{bmatrix}; \begin{bmatrix} e_1 & e_2 & e_3 \end{bmatrix}$$

$$P_{\max} = \frac{F}{A} 100 \times 0.8$$

$$v_n = \frac{\partial p}{\partial n} = C$$

$$\alpha = \frac{\Delta L}{L \cdot \Delta T}$$

$$\Delta P = \frac{12Q/\eta}{wt^3}$$

$$\sigma_{ij} = \int_{-\infty}^t C_{ijkl} (\xi(t) - \xi(t')) \frac{\partial \varepsilon_{kl}}{\partial t'} dt'$$

$$\varepsilon_i = \int_{T_r}^{T_0} \alpha_i(T) dT$$

$$-\int_{-\infty}^t \beta_{ij} (\xi(t) - \xi(t')) dT(t')$$

$$T_c = \frac{t^2}{\alpha \pi^2} \ln \left| \frac{4}{\pi} \left(\frac{T_m - T_w}{T_e - T_w} \right) \right|$$

$$\tau = \frac{F}{A}$$

$$\{\sigma_g\} = -[D_g]\{\varepsilon_{g0}\} + \{\sigma_{g0}\}$$

$$[D_g] = [T_g^T][D_l][T_g]$$

$$[\varepsilon_{g0}] = -[T_g^{-1}][\varepsilon_{l0}]$$

$$\phi = 1 - \frac{1}{2b} \sum_{i=1}^m \frac{n_i^{\xi} \zeta_i}{\rho_{fi}}$$

$$0 = \frac{\partial}{\partial z} \left(\eta \frac{\partial u}{\partial z} \right) - \frac{\partial p}{\partial x}$$

$$0 = \frac{\partial}{\partial z} \left(\eta \frac{\partial v}{\partial z} \right) - \frac{\partial p}{\partial y}$$

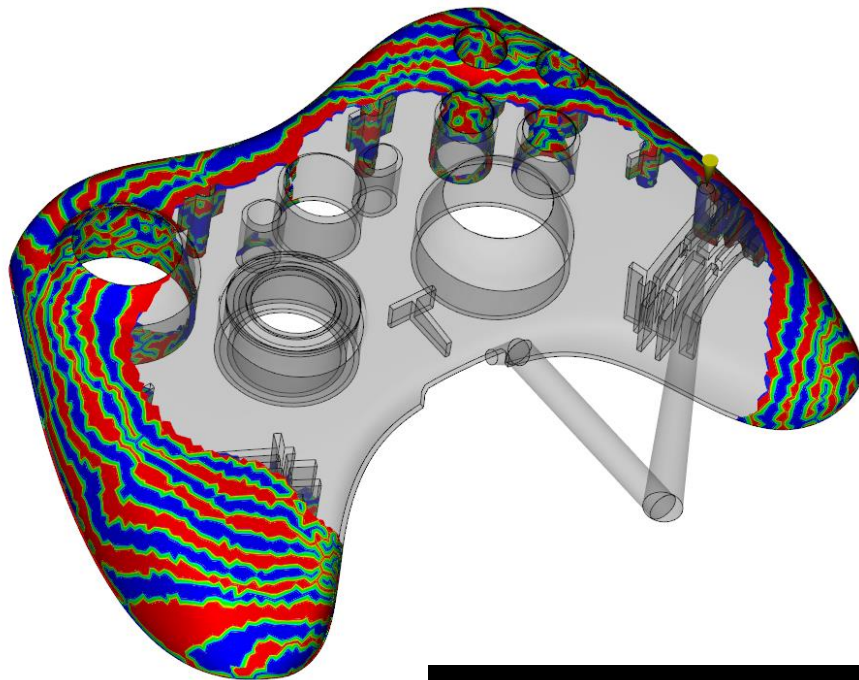
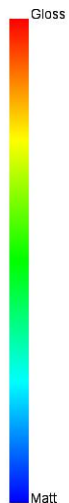
$$\Delta P = \frac{8Q/\eta}{\pi r^4}$$

$$\frac{\partial p}{\partial t} + \frac{\partial(\rho u)}{\partial x} + \frac{\partial(\rho v)}{\partial y} + \frac{\partial(\rho w)}{\partial z} = 0$$

$$\rho C_p \left(\frac{\partial T}{\partial t} + u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} + w \frac{\partial T}{\partial z} \right) = \frac{\partial}{\partial z} \left(k \frac{\partial T}{\partial z} \right) + \eta \Upsilon^2 + \frac{d\alpha}{dt} H$$

Project Scandium

Tiger stripe region
= 2.000



**Project Scandium for Moldflow Technology
Preview**

Summary

- Please connect on LinkedIn
- Let me know what topics YOU want me to cover
- Small or seemingly insignificant items can lead to larger variations in simulation vs reality





Make Anything