Moldflow Analysis of Bike Side Mirror

Scope: Moldflow Analysis

Application: Bike Side Mirror

Moldflow software enables the analysis of plastic flow within a mold tool throughout the injection molding process. The 3D CAD data generated during the design process can be used directly to determine the manufacturability of the part. Material, tool, and molding parameters are allocated to the geometry during the analysis process. More complex analysis can show warpage, areas of distortion, fiber flow and shrinkage.

MCAD – Challenges

The client approached us with a request to analysis their design for injection molding process. The information they provided, presented a significant challenge for us to work with.

Challenges:

- To Perform flow and warp Analysis
- Material Property creation in tool
- Feed system Plan
- Creating multiple results like Fill, Pack and Warp.

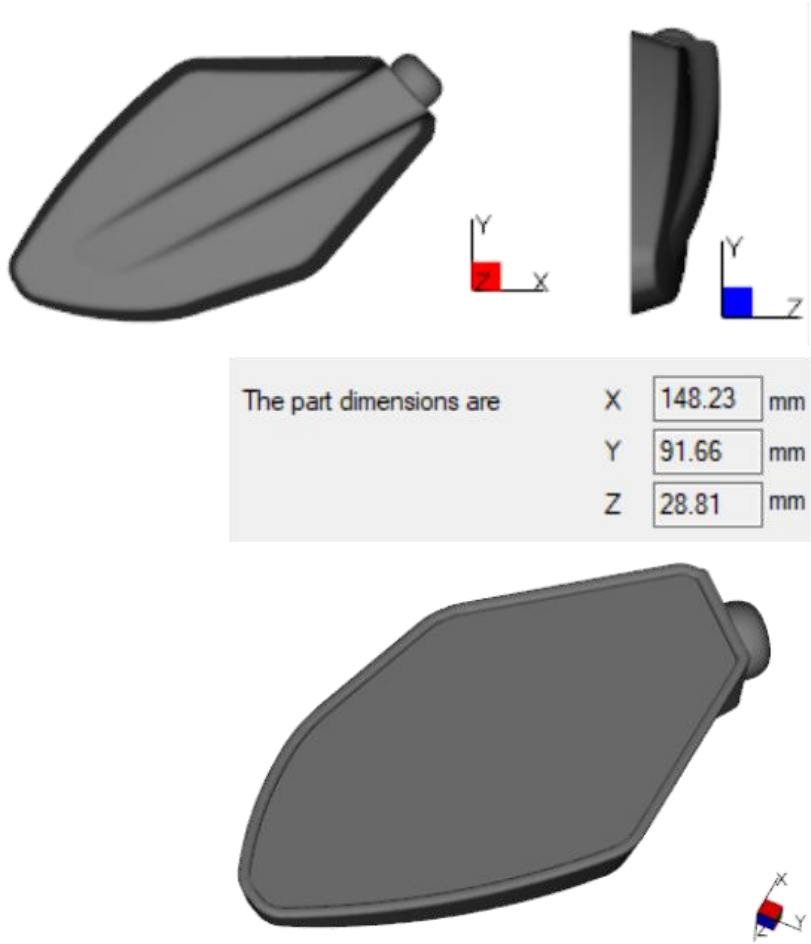
SoW:

- Input Study
- Thickness Study
- Pre Processing
- Feed Details
- Result

Input Study

Input details:

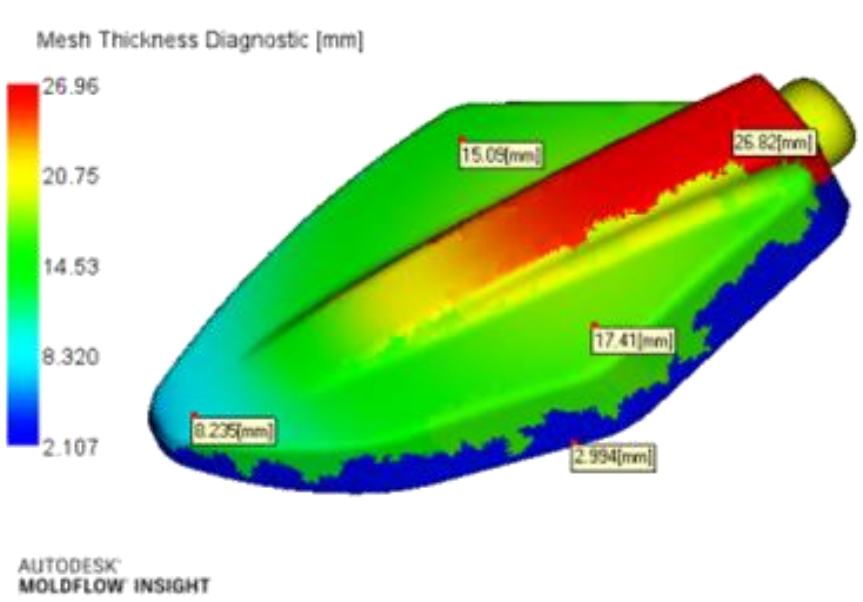
- Geometry (End-clip CAD model) study
- Part thickness plot
- Feed systems
- Material details - Ultradur B 4040 G6 (PBT+PET+30GF)
- Process input parameters
- Process sequence - Fill + Pack + Warp

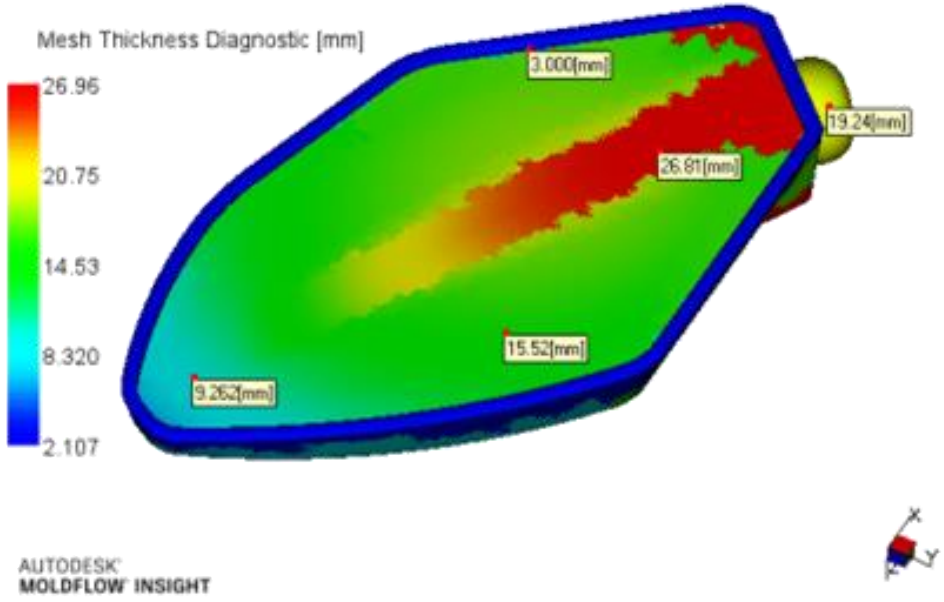


Thickness Study

The initial thickness study will show, were can we place the gate as rough at initial.

Thickness plot



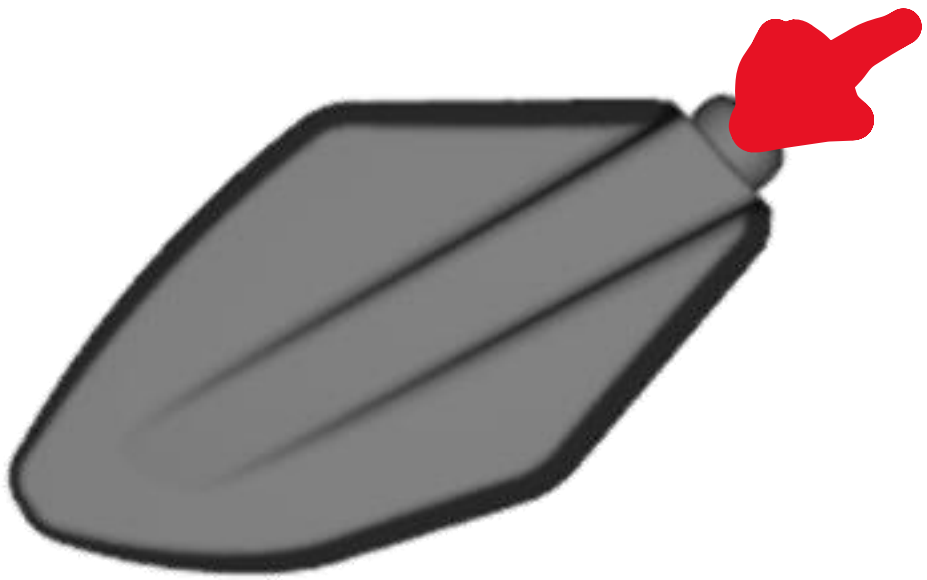


*Part Nominal thickness:**15mm***

Pre Processing

Set Injection Location

- Based on thickness study the gate location is marked at end of the mirror.



Material / Processing condition

- Material details - Ultradur B 4040 G6
- The material properties were taken from the datasheet.

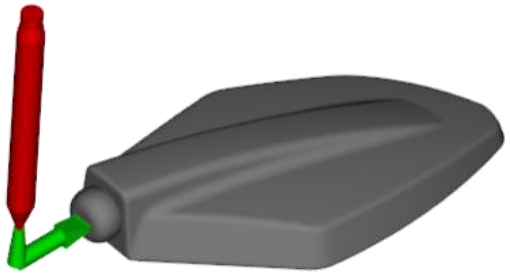
Ultradur® B 4040 G6

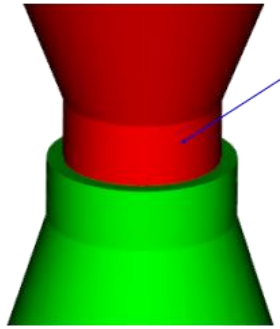
Product Information

BASF
We create chemistry

Typical values for uncoloured product at 23 °C[1]	Test method	Unit	Values[2]
Properties			
Polymer abbreviation	-	-	(PBT+PET)-GF30
Density	ISO 1183	kg/m³	1550
Viscosity number (solution 0,005 g/ml Phenole/1,2 Dichlorbenzol 1:1)	ISO 307, 1157, 1628	cm³/g	105
coloured	-	-	+
black	-	-	+
Water absorption, equilibrium in water at 23°C	similar to ISO 62	%	0.4
Moisture absorption, equilibrium 23°C/50% r.h.	similar to ISO 62	%	0.2
Processing			
Melt volume-flow rate MVR at 275 °C and 2.16 kg	ISO 1133	cm³/10min	15
Melting temperature, DSC	ISO 11357-1/-3	°C	223
Melt temperature, Injection moulding/Extrusion	-	°C	250 - 280
Mould temperature, Injection moulding	-	°C	60 - 100
Molding shrinkage (parallel)	ISO 294-4	%	0.30
Molding shrinkage (normal)	ISO 294-4	%	0.90
Melt volume-flow rate MVR at 275 °C and 2.16 kg	ISO 1133	cm³/10min	15
Flammability			
Burning Behav. at thickness d = 1.5 mm	IEC 60695-11-10	class	HB
Burning Behav. at thickness d = 0.75 mm	IEC 60695-11-10	class	HB
Automotive materials (thickness d ≥ 1mm) [3]	ISO 3795, FMVSS 302	-	+
Mechanical properties			
Tensile modulus	ISO 527-1/-2	MPa	10500
Stress at break	ISO 527-1/-2	MPa	145
Strain at break	ISO 527-1/-2	%	2.6
Charpy unnotched impact strength (23°C)	ISO 179/1eU	kJ/m²	60
Charpy unnotched impact strength (-30°C)	ISO 179/1eU	kJ/m²	55
Charpy notched impact strength (23°C)	ISO 179/1eA	kJ/m²	8
Thermal properties			
HDT A (1.80 MPa)	ISO 75-1/-2	°C	200
HDT B (0.45 MPa)	ISO 75-1/-2	°C	220
Max. service temperature (short cycle operation)	-	°C	210
Coefficient of linear thermal expansion, longitudinal (23-55)°C	ISO 11359-1/-2	E-6/K	25
Coefficient of linear thermal expansion, transverse (23-55)°C	ISO 11359-1/-2	E-6/K	110
Specific heat capacity	-	J/(kg*K)	1050
Electrical properties			
Relative permittivity (100 Hz)	IEC 62631-2-1	-	4
Relative permittivity (1 MHz)	IEC 62631-2-1	-	3.8
Dissipation factor (100 Hz)	IEC 62631-2-1	E-4	16
Dissipation factor (1 MHz)	IEC 62631-2-1	E-4	170
Volume resistivity	IEC 62631-3-1	Ohm*m	1E14
Surface resistivity	IEC 62631-3-2	Ohm	1E13
Comparative tracking index, CTI, test liquid A	IEC 60112	-	250
Electric strength K20/K20, (60*60*1 mm³)	IEC 60243-1	kV/mm	36

Feed Details



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Total volume                                =    153.9637 cm^3
  Volume of tetrahedral elements            =    145.4410 cm^3
  Volume of sprue/runner/gate elements      =      8.5227 cm^3
  Volume of hot sprue/runner/gate elements  =      7.1463 cm^3
  Volume filled initially                   =      7.1463 cm^3
  Volume to be filled                       =    146.8173 cm^3
    Part volume to be filled                =    145.4410 cm^3
    Sprue/runner/gate volume to be filled   =      1.3763 cm^3
Parting plane normal                  (dx) =      0.0000
                                      (dy) =      0.0000
                                      (dz) =      1.0000
Total projected area                        =     94.0745 cm^2
```

Deliverables (Moldflow Results)

Fill Results:

- Fill Pattern
- Frozen layer fraction at end of fill
- V/P switchover
- Pressure at injection location
- Flow front temperature
- Shear rate
- Fiber orientation tensor
- Weld line.

Pack Results:

- Pack Pressure
- Clamping Force
- Average Volumetric Shrinkage results

Warp Results:

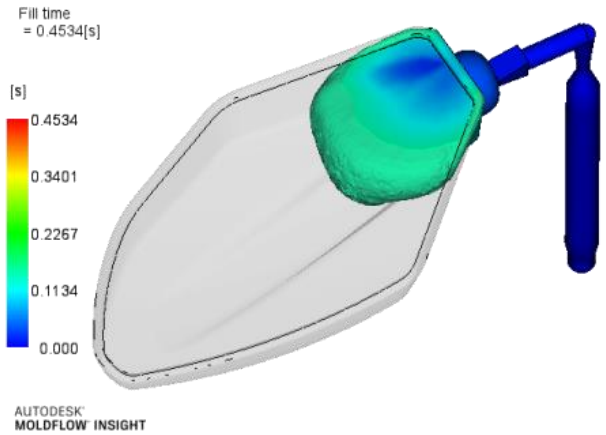
- Deflection all effects
- Shrinkage compensation
- X,Y & Z Deflection

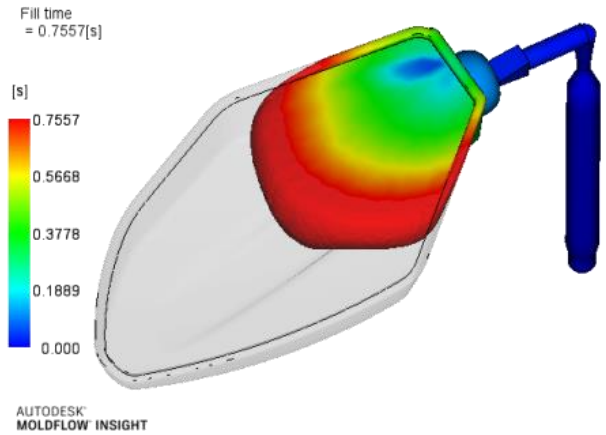
Core shift Analysis

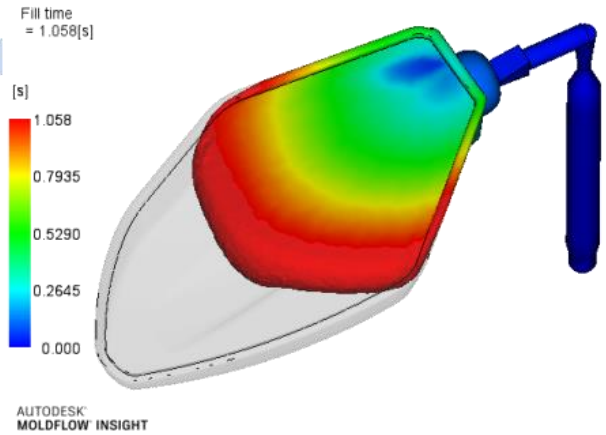
Results summary and observation

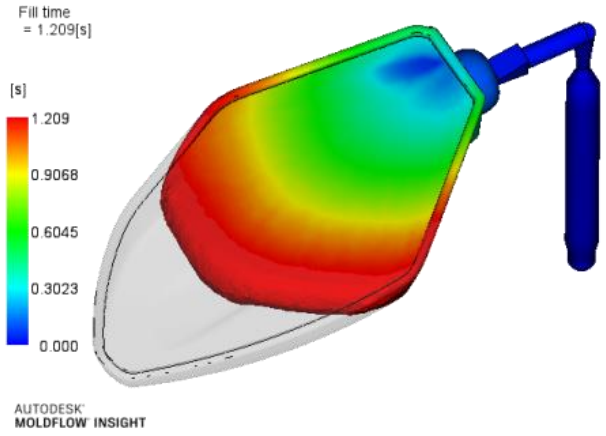
Result - Fill Pattern

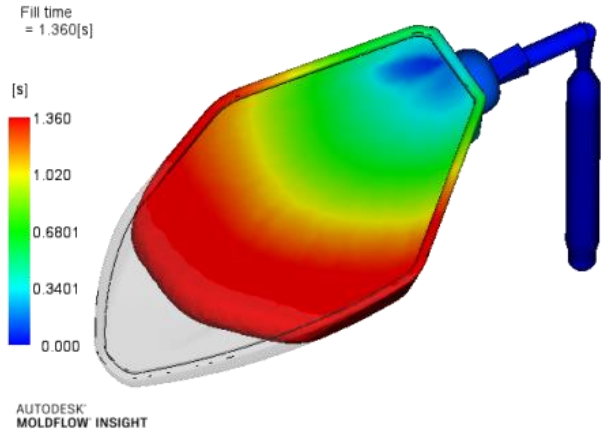
- Fill Status:Part filled
- Actual injection time:1.5sec
- Filling time:1.51sec

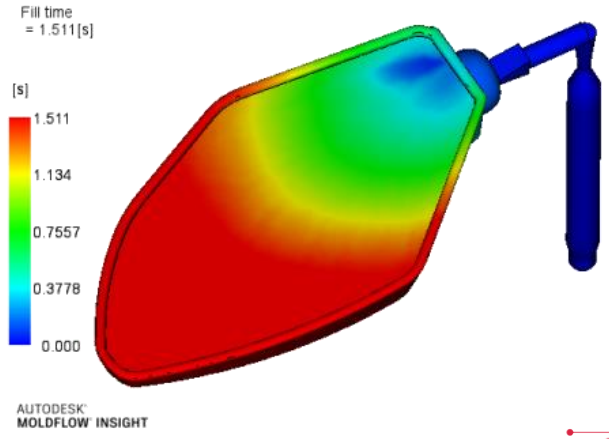








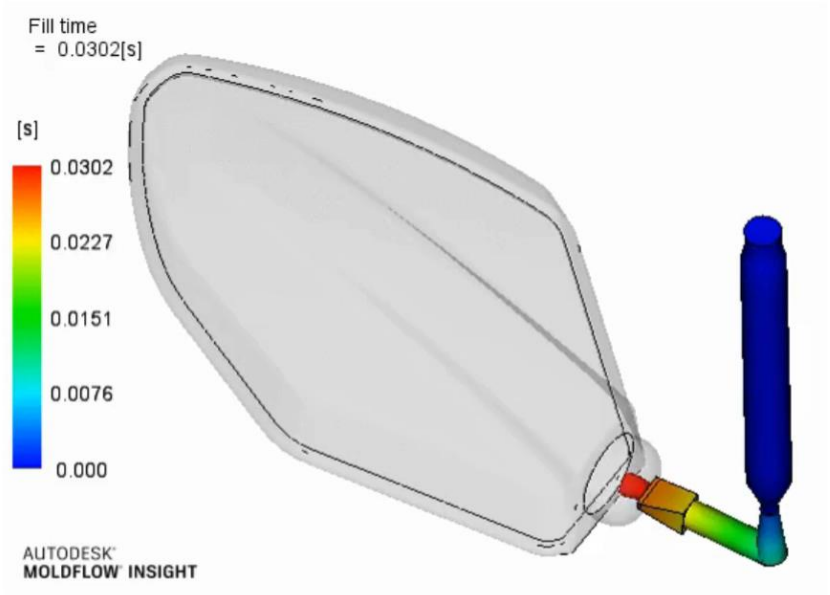




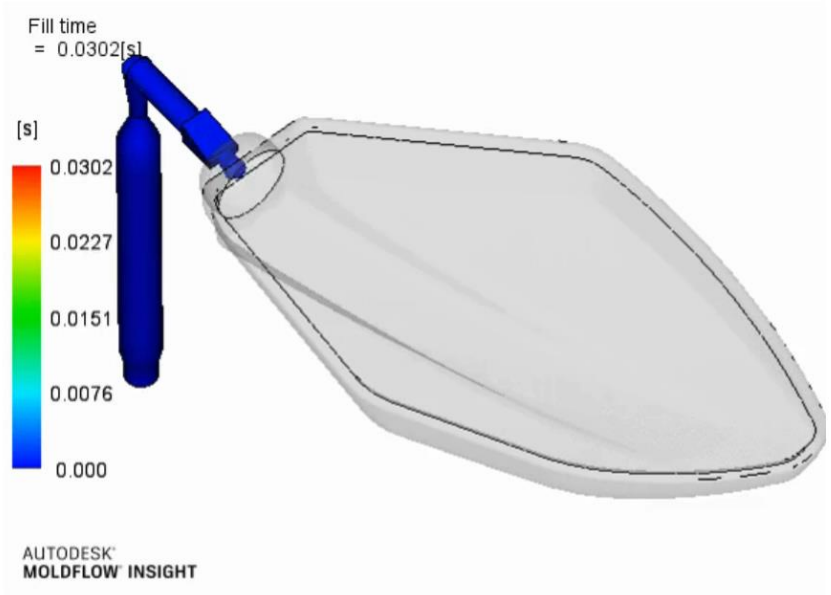
Result - Fill Animation

Fill Animation

View-1

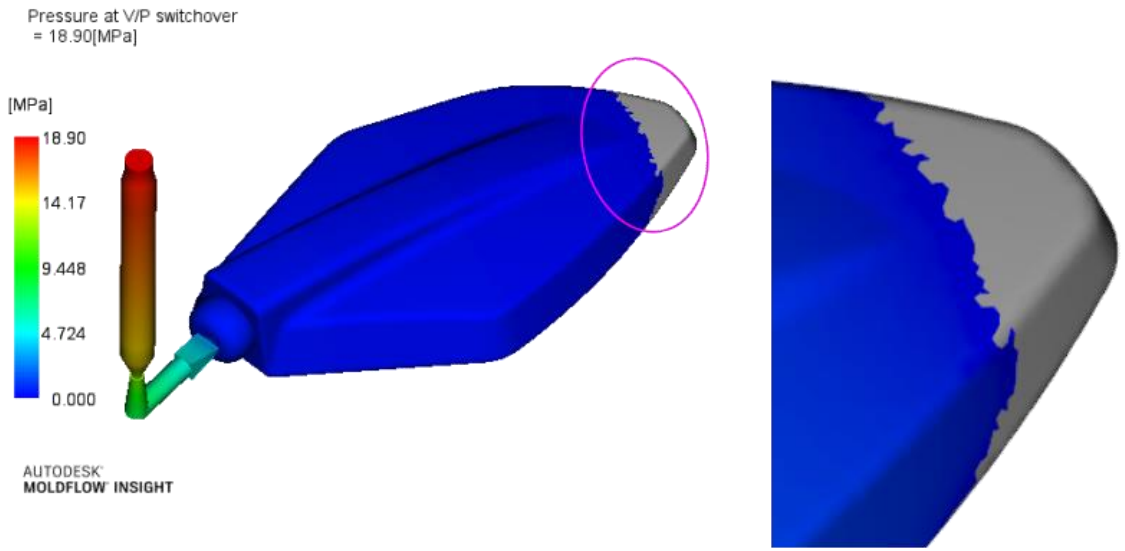


View-2



- Fill Status:Part filled
- Actual injection time:1.5sec
- Filling time:1.51sec

Result - V/P Switchover



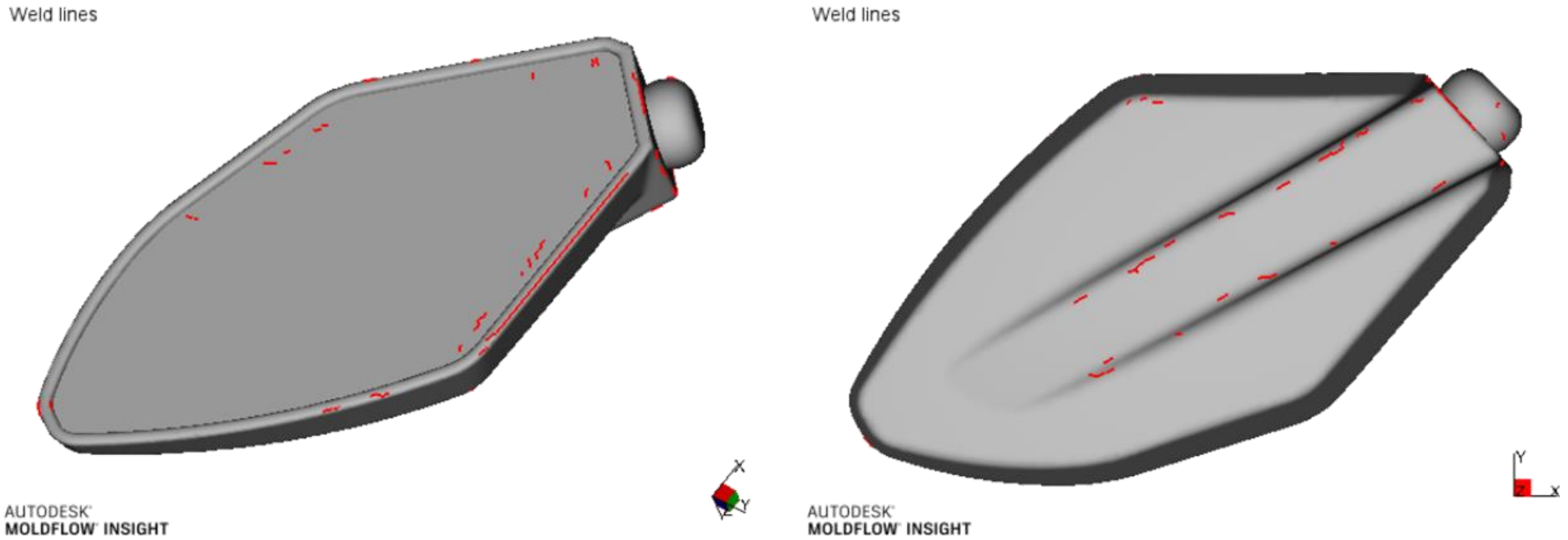
End of fill region

Ultradur S 4090 G6 (PBT+ASA with 30%GF)

This is the point - usually a percentage of the total volume - where the injection molding machine (IMM) will change the filling process from a velocity driven (fill) to a pressure driven control (pack). Here, it's at 18.9MPa.

- V/P switchover pressure:18.9MPa

Result - Weld line



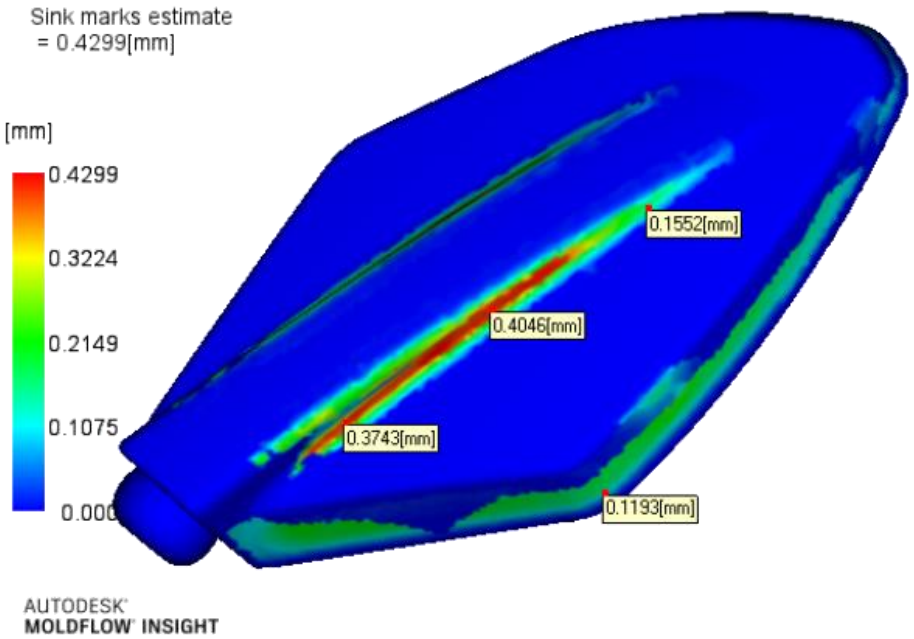
Weld line as shown by Red line

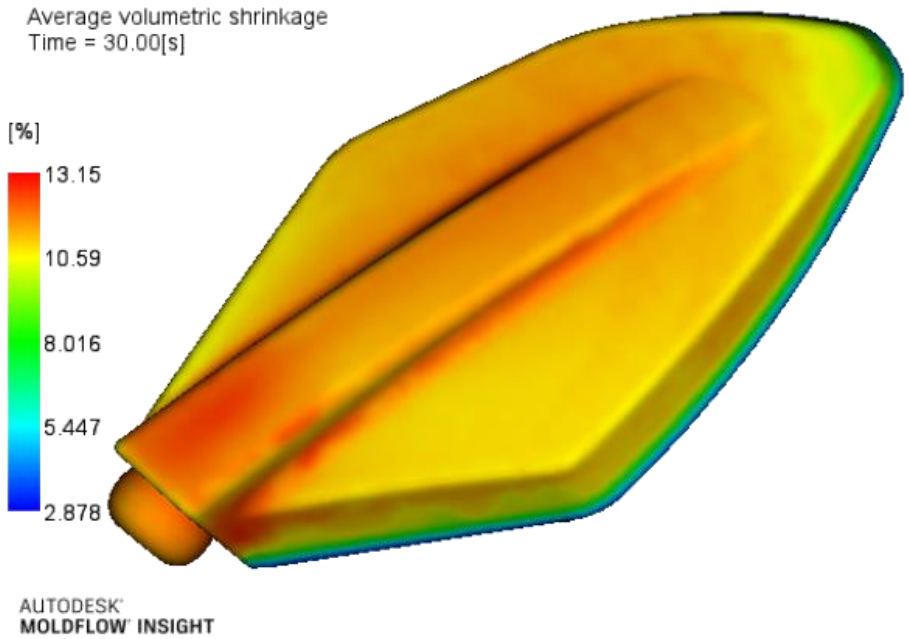
- The Weld lines to displays the angle of convergence as two flow fronts meet. The presence of weld lines may indicate a structural weakness or a surface blemish.
- Weld lines observed are mechanically strong, since the flow fronts meet at high temperatures and here temperature drop is not happened.

Result - Sink mark estimate

- Sink marks occur when the surface of a molded product shrinks and forms slight depressions or craters.

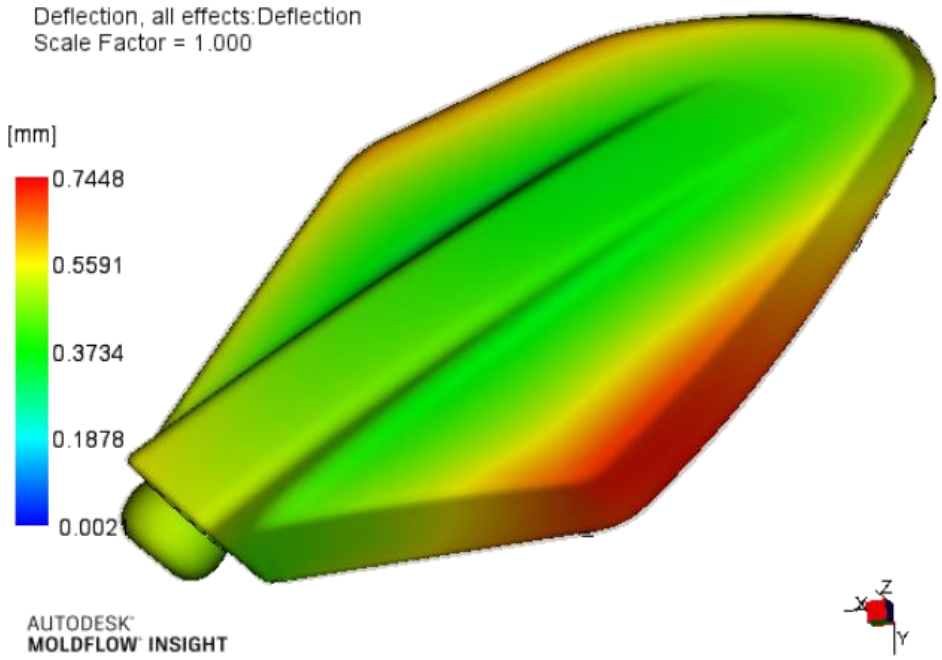
- The Sink marks estimate result displays the calculated depths of sink marks in the part, and shows a legend to detail the depth differences.

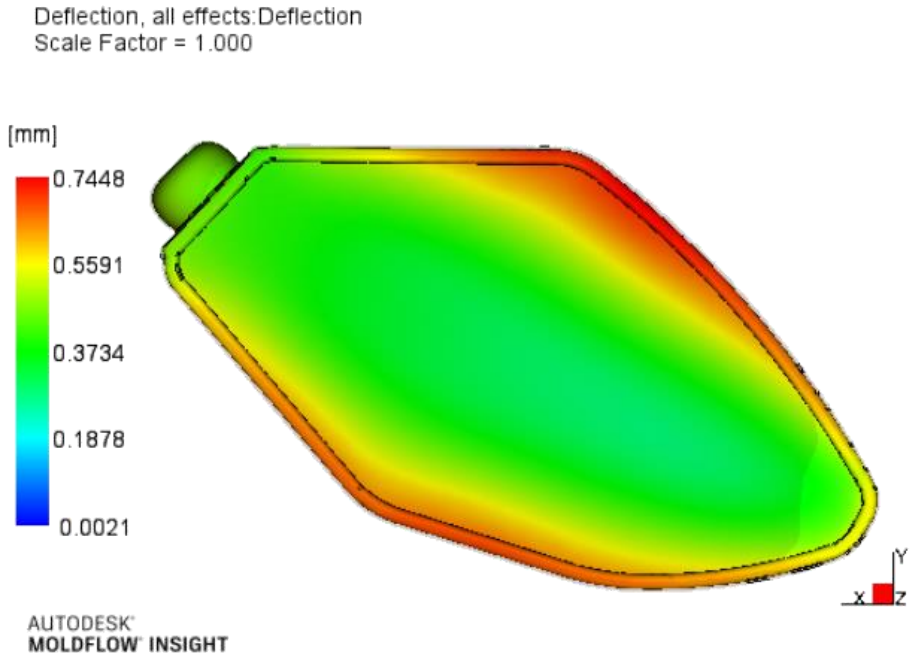




Result - Deflection results

- The Deflection, all effects result combines differential cooling, differential shrinkage and orientation effects to show the final part warpage.





Deflection all effects 0.002 to 0.75mm

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A Heartfelt Customer's Voice

"We couldn't be more pleased with the exceptional work delivered by this outstanding team. Despite facing various challenges, they skillfully completed the Moldflow Analysis of Bike Side Mirror. Thanks to their expertise and attention to detail, we were able to identify potential issues early on and implement necessary optimizations, ensuring the highest quality and performance of our bike mirror. In a surprisingly short time frame, they not only met but exceeded our expectations, marking a significant milestone in our project. This team has proven to be the go-to choice for anyone seeking a winning combination of time, cost, and quality."

Conclusion

- In summary, Despite the challenges our team successfully completed the Moldflow Analysis of Bike Side Mirror after lots of brainstorming and with our expertise in MCAD Engineering Services.
- We've provided multiple deliverables for their design, serving as a reference point to identify any flaws or areas for improvement.
- With completing this analysis in short time period, marks a significant milestone in our journey.