

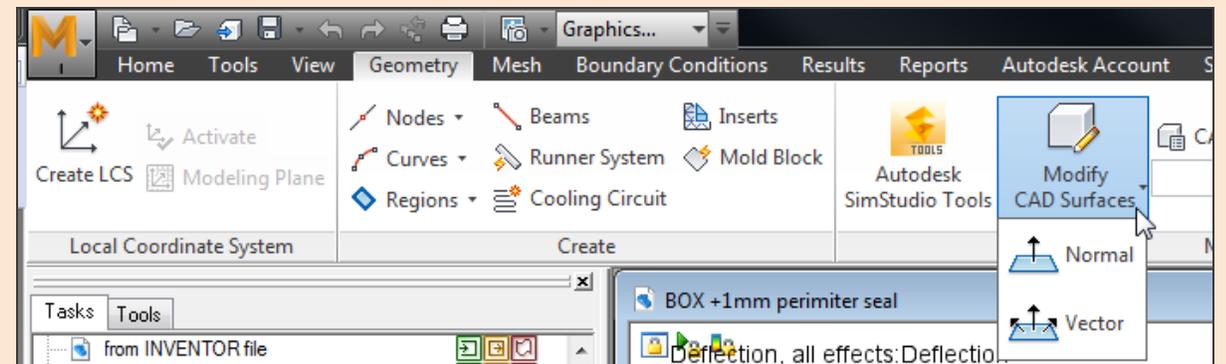
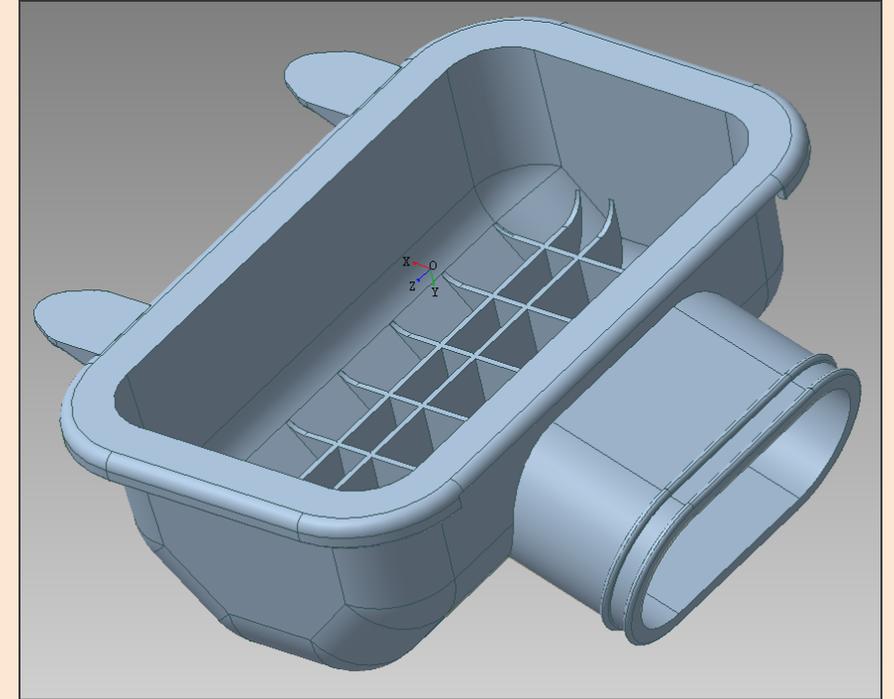
Geometric Optimization in 2017: A First Look

By:
Mike Garrett, Toledo Molding & Die
Jeff Higgins, Autodesk

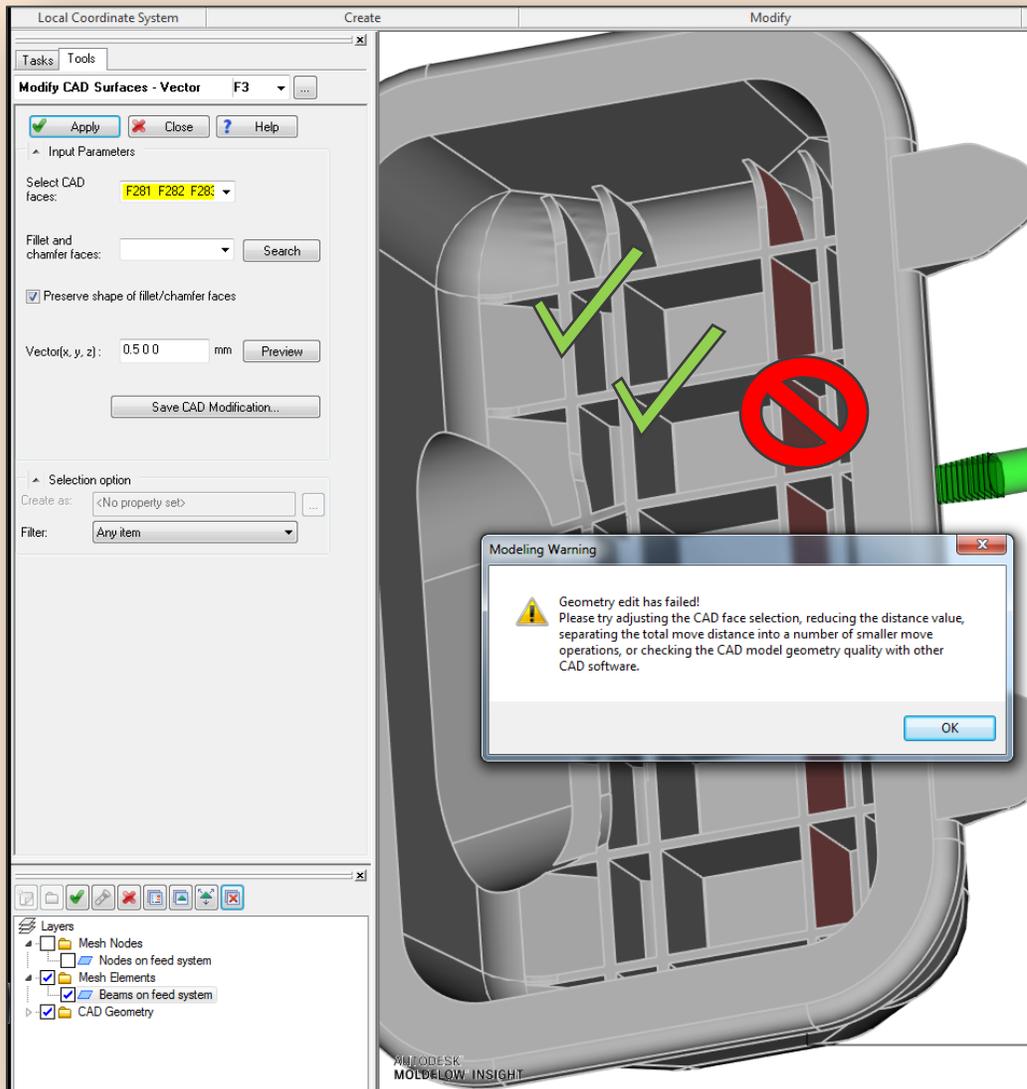
The Part, The Problem



- Half-scale Air Cleaner part made of Glass-filled PP.
- Typical Challenges:
 - Warp.
 - Sinks on A-side.
- Designed in Autodesk Inventor by everyone's favorite Moldflow celebrity.
- GOAL: Use Geometric Optimization tools to change thickness of various geometry features in order to impact warp and sink.
- Using MPI 2017 R2.



Bringing in the Inventor CAD directly into MPI



Could add 0.5mm to the first two ribs, but third rib failed (both sides).

Lets Check the file in CAD Dr...



The screenshot shows the CADdoctor interface with a 3D model of an air box cover. The 'Errors' panel on the left lists the following categories and counts:

Category	Errors	Sev...
Short curve	5	Critical
Sliver face	1	Critical
Loop with self-intersection	8	Seri...
Surface with small patches	1	Seri...
Curve with short segments	7	Seri...
Edge interference	29	Seri...
Edge direction	0	
Edge used more than twice	0	
Missing face	0	
Gap: Edge and base surface	0	
Gap: In loop	0	
Intersecting loops	0	

A red arrow points from the 'Edge interference' row in the table to a red box highlighting the error details in the software interface. The error details include:

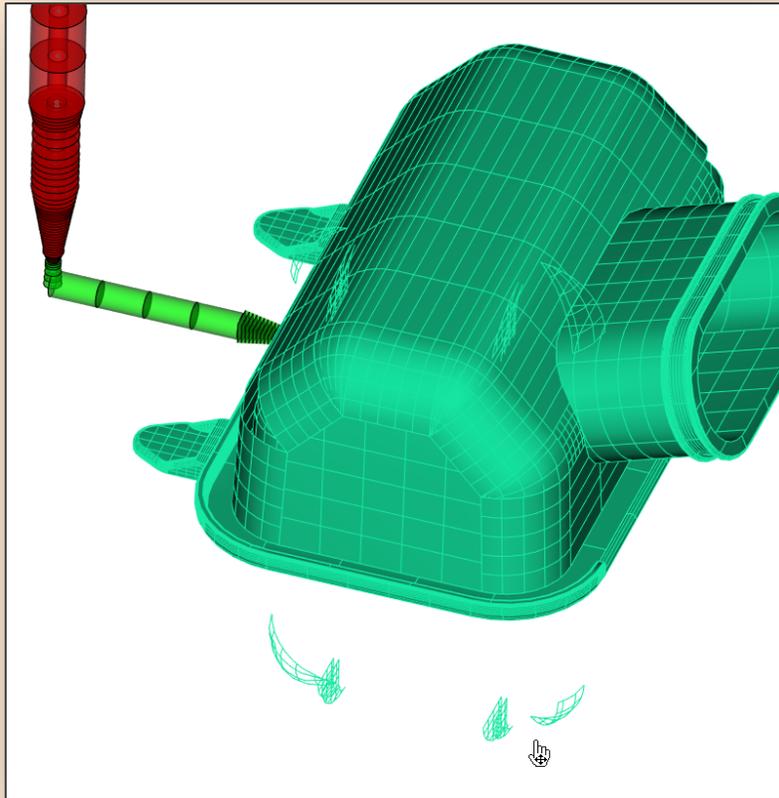
- Edge direction
- Edge used more than twice
- Missing face
- Gap: Edge and base surface
- Gap: In loop
- Intersecting loops

The 3D model shows a blue air box cover with a cylindrical inlet on the left and two smaller ports on the right. A coordinate system (X, Y, Z) is visible in the model view.

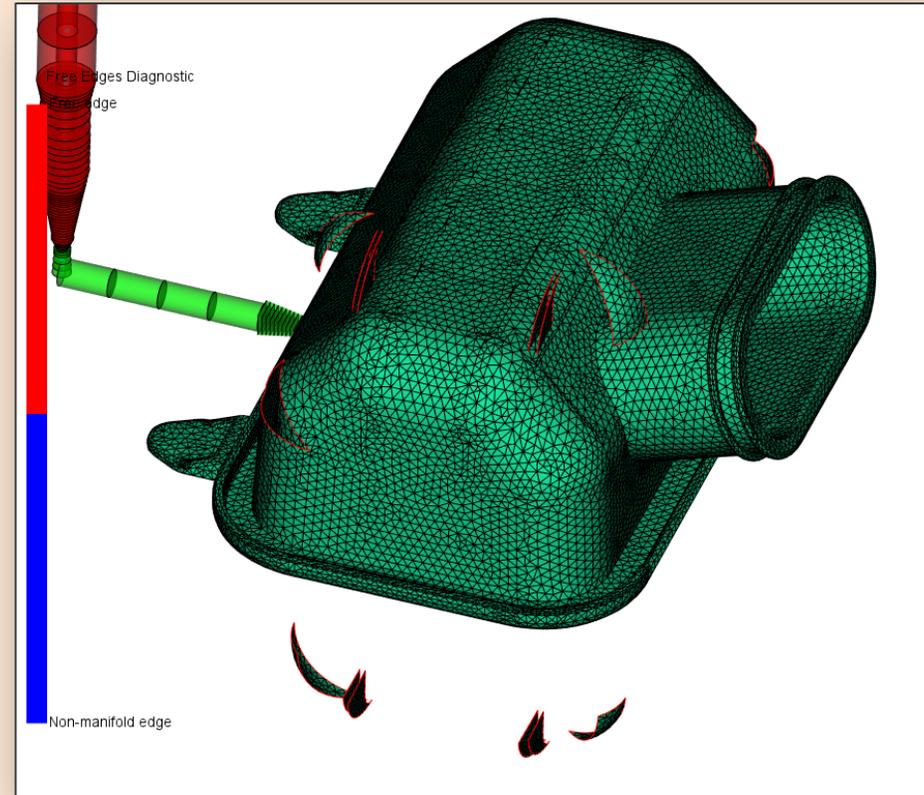
Inventor file → CAD Dr (Cleaned only) → UDM file → Moldflow



Something horrible happens....

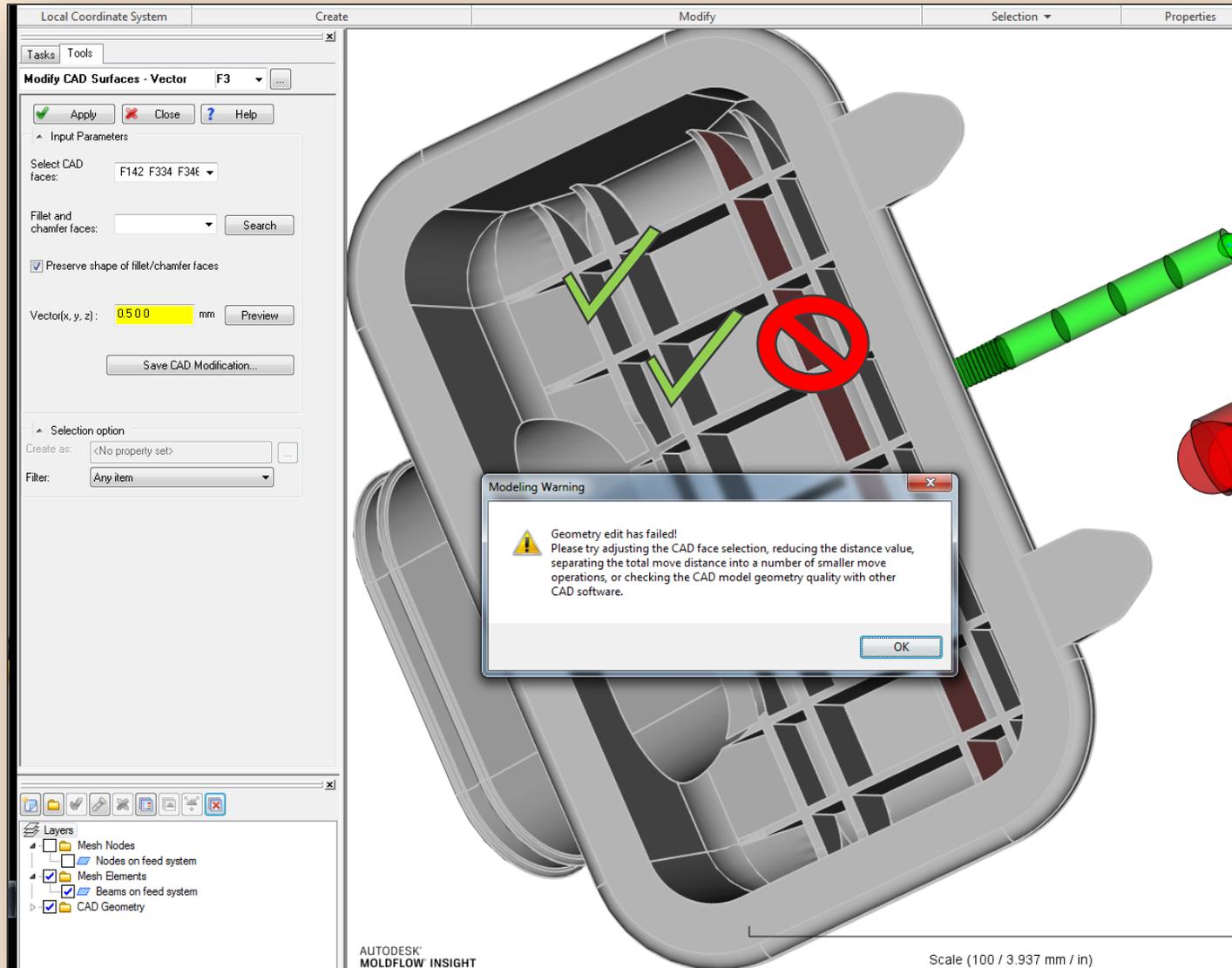


...Lets ask Autodesk and forget this one.



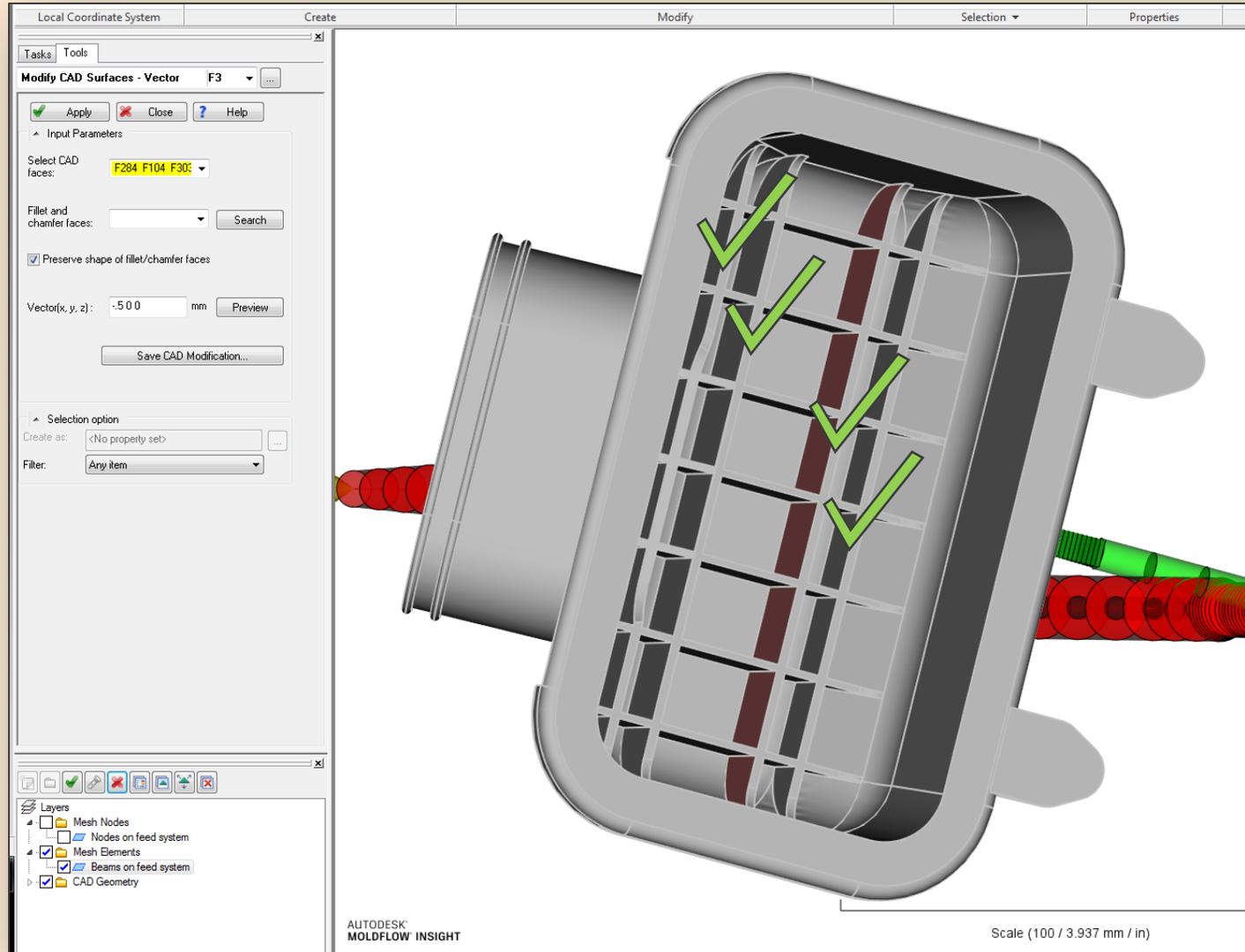
Also... "UDM is a surface file, SDY file holds the solid."

Inventor file → CAD Dr (Cleaned only) → SDY file → Moldflow



Could add 0.5mm to the first two ribs, but third rib failed (both sides).

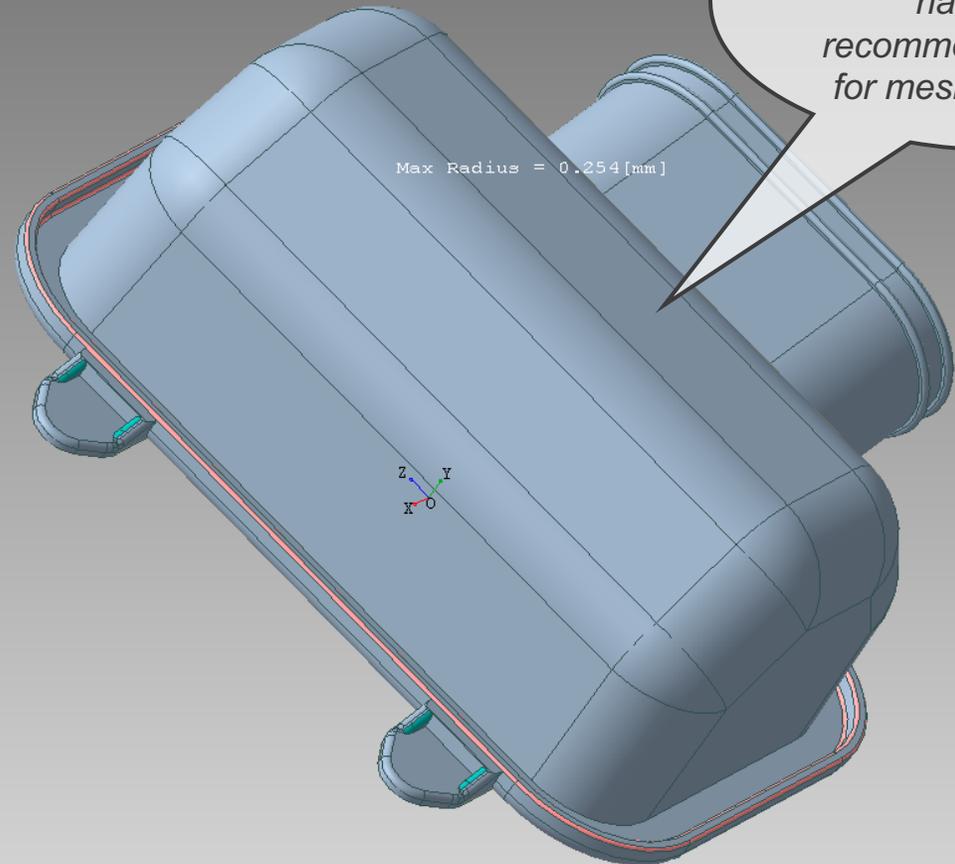
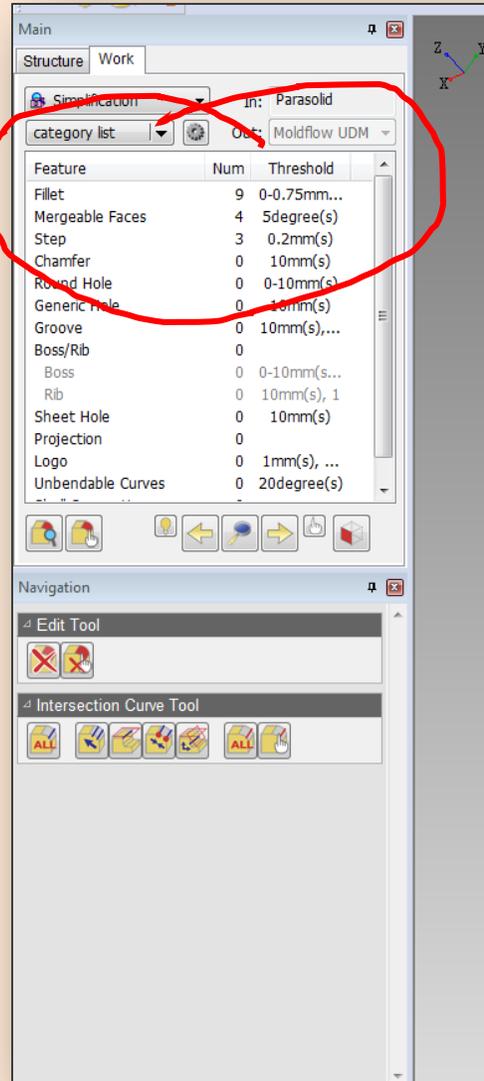
Inventor file → CAD Dr (SIMPLIFIED) → SDY file
→ Moldflow



All four ribs could be thickened by +0.5mm.

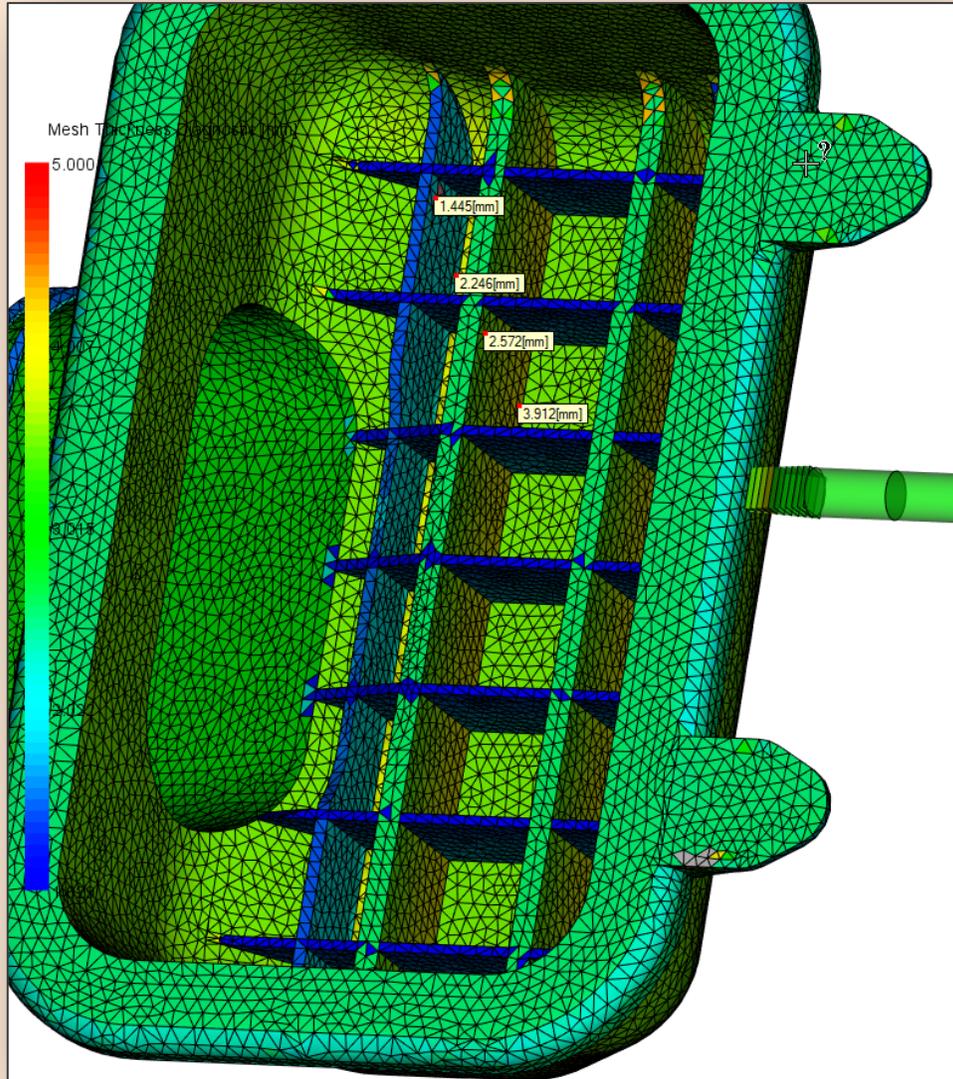
Success.

Back to CAD Dr: What was “Simplified”?



Jeff says:
“Model Simplification
has been a
recommended practice
for mesh preparation”

How thick can we go?



Outer two ribs cannot be thickened more than +0.5mm. Error result.

Inner two ribs can apparently be thickened as desired. In this case inner ribs are +2.0mm.

NOTE: Ribs could not be shifted 2.0mm all at once. Had to shift them 0.5mm at a time.

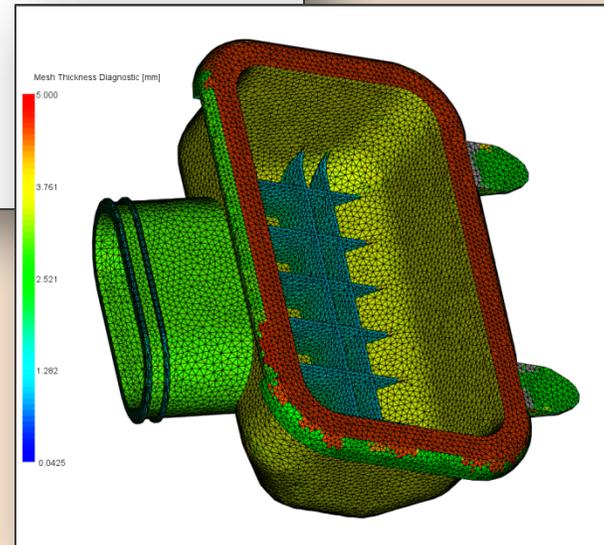
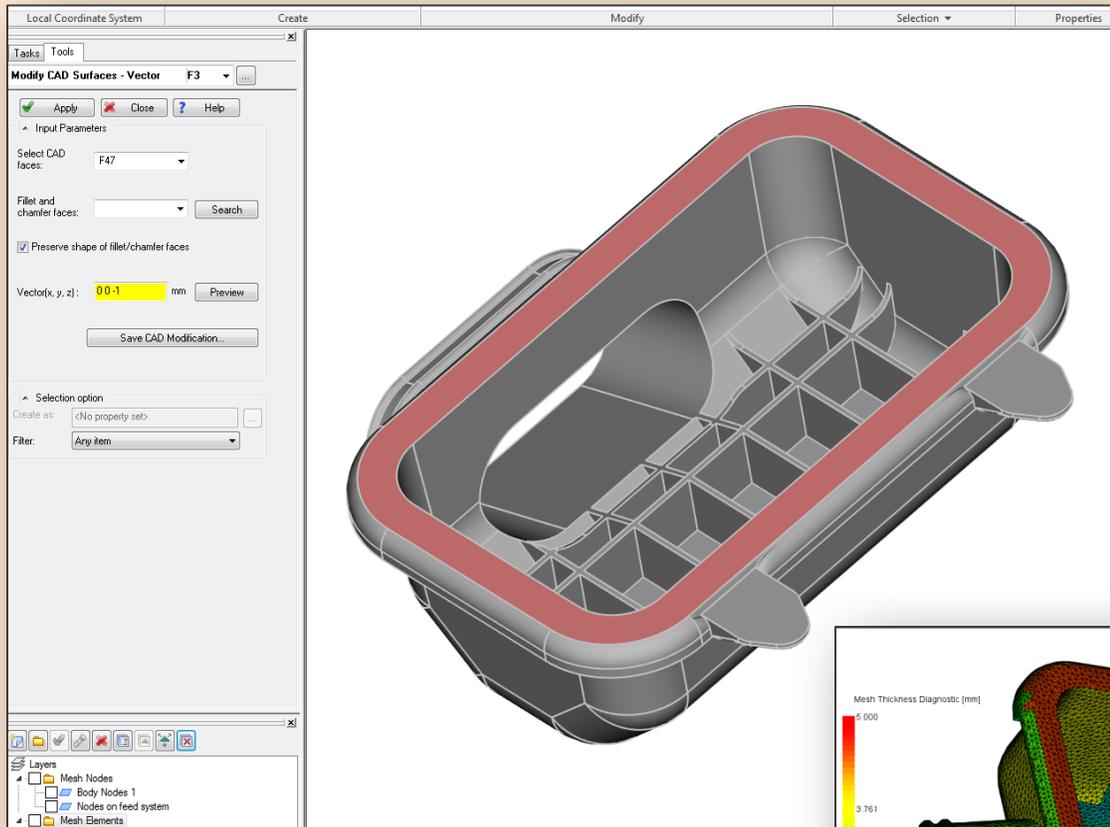
Thicken the Perimeter Flange?



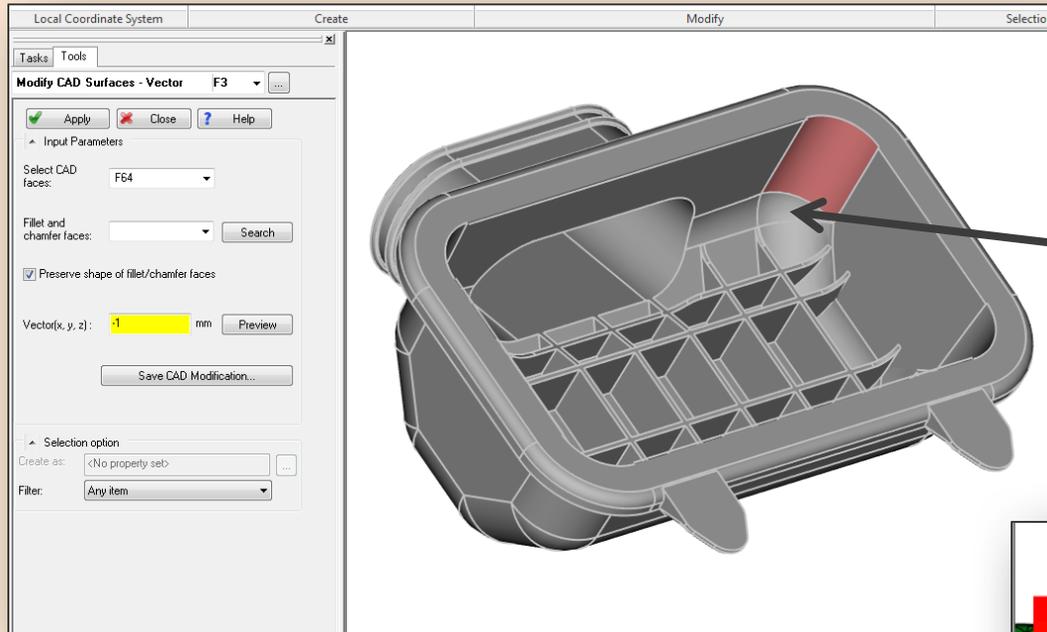
MPI was able to easily shift the selected surface shown +2.0mm.

The surface shift brought the adjacent radii/fillets with the selected surface flawlessly.

Success!



Thinned Corners?



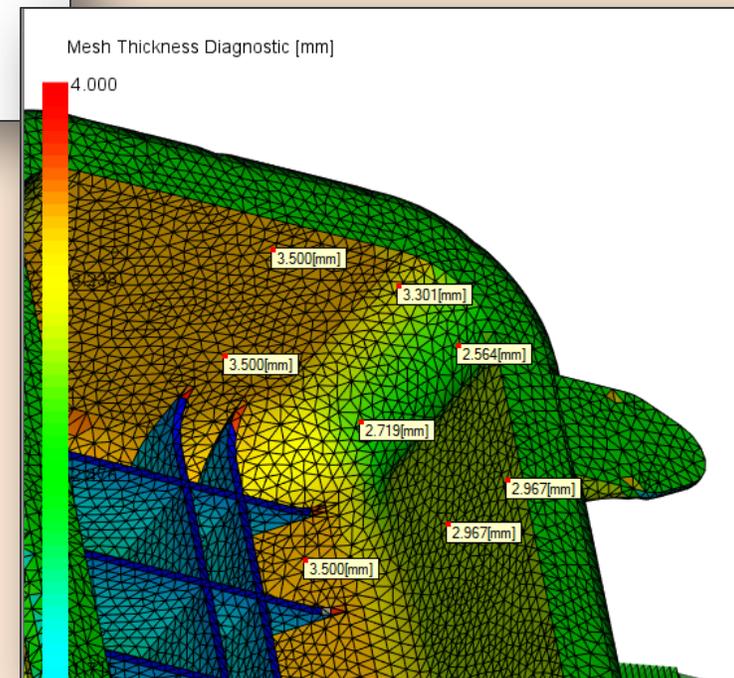
Selected all four corners of the inside of the part, assigned -1.0mm surface vector.

Must select and move each surface separately, or tool will move all surfaces to the first surface's direction vector.

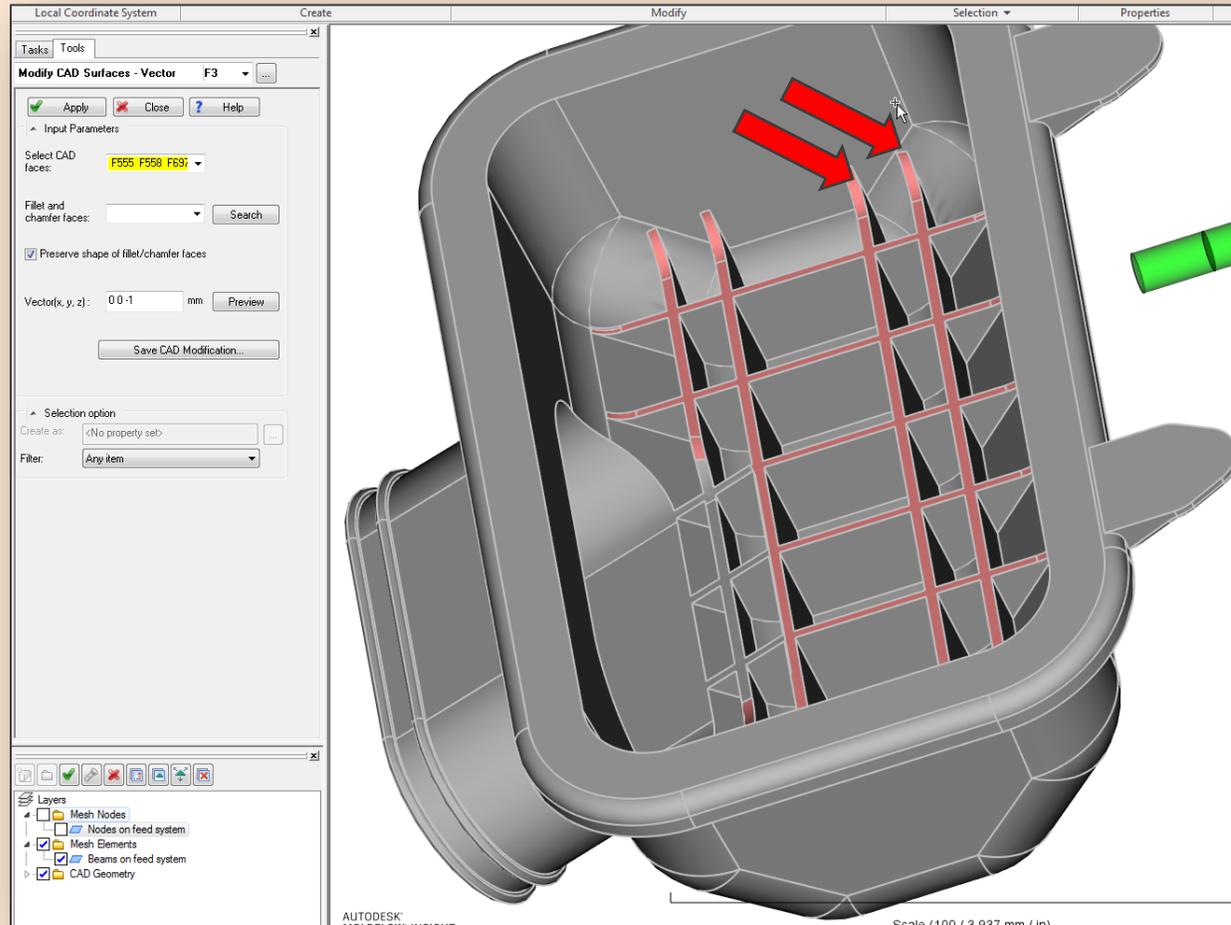
Could not shift rounded adjacent corner.

Resulting thicknesses are not exactly as intended, but they are surprisingly usable as a first “what if” investigation.

Note how it also undesirably shifted the adjacent wall -0.5mm.



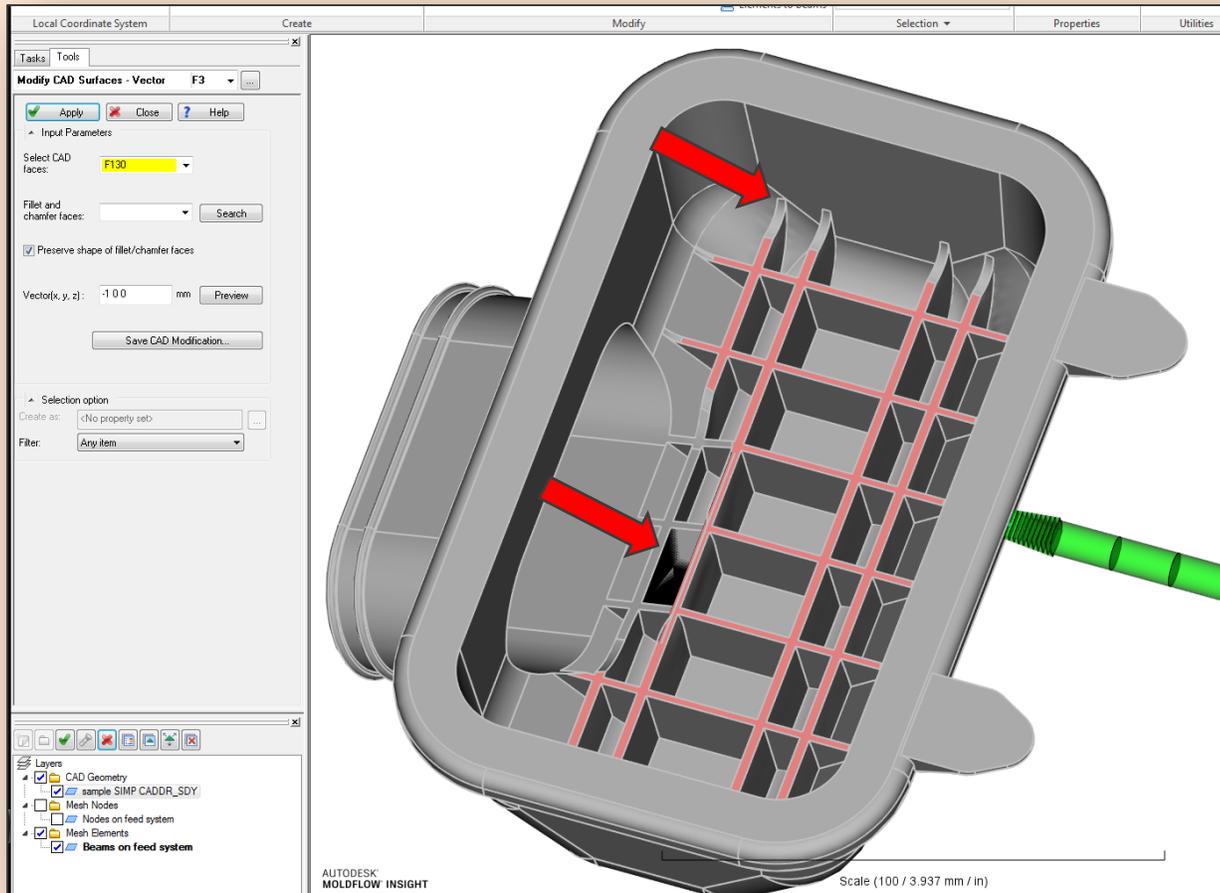
Extend the Rib Height?



MPI cannot extend all ribs as shown here. Error result.

Appears to be an issue with being able to grab the fillets at the ends of each rib and shifting them all in Z.

Extend the Rib Height?



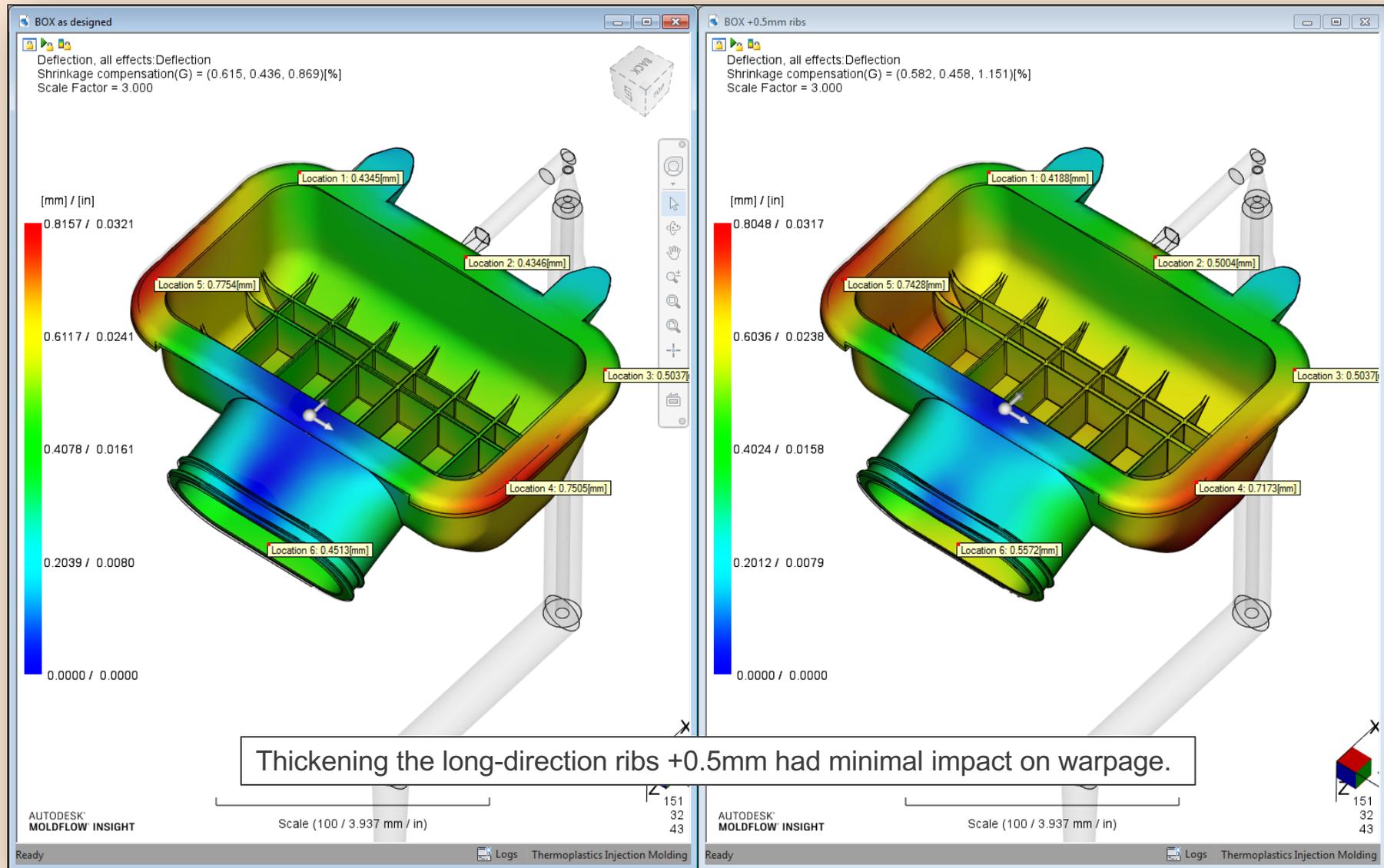
If the fillets are left out of the selection, the tool fails to extend the ribs the +5.0mm. However, it will extend the ribs +1.0mm, no further, but with obvious surface errors. Not usable.

Appears to be an issue with the port cut-out in the ribs.

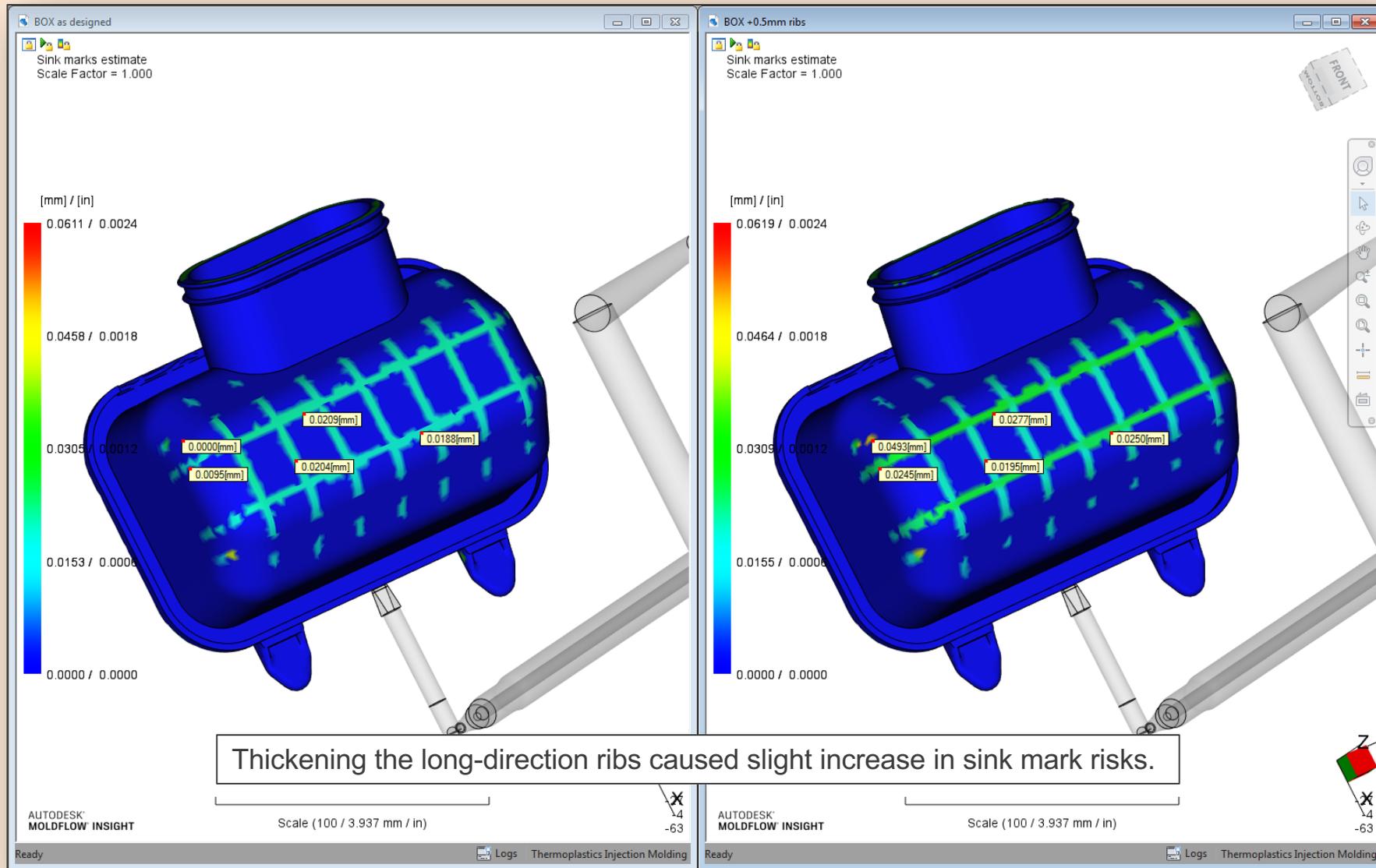
Cannot extend the ribs more than 1.0mm.

Unsuccessful.

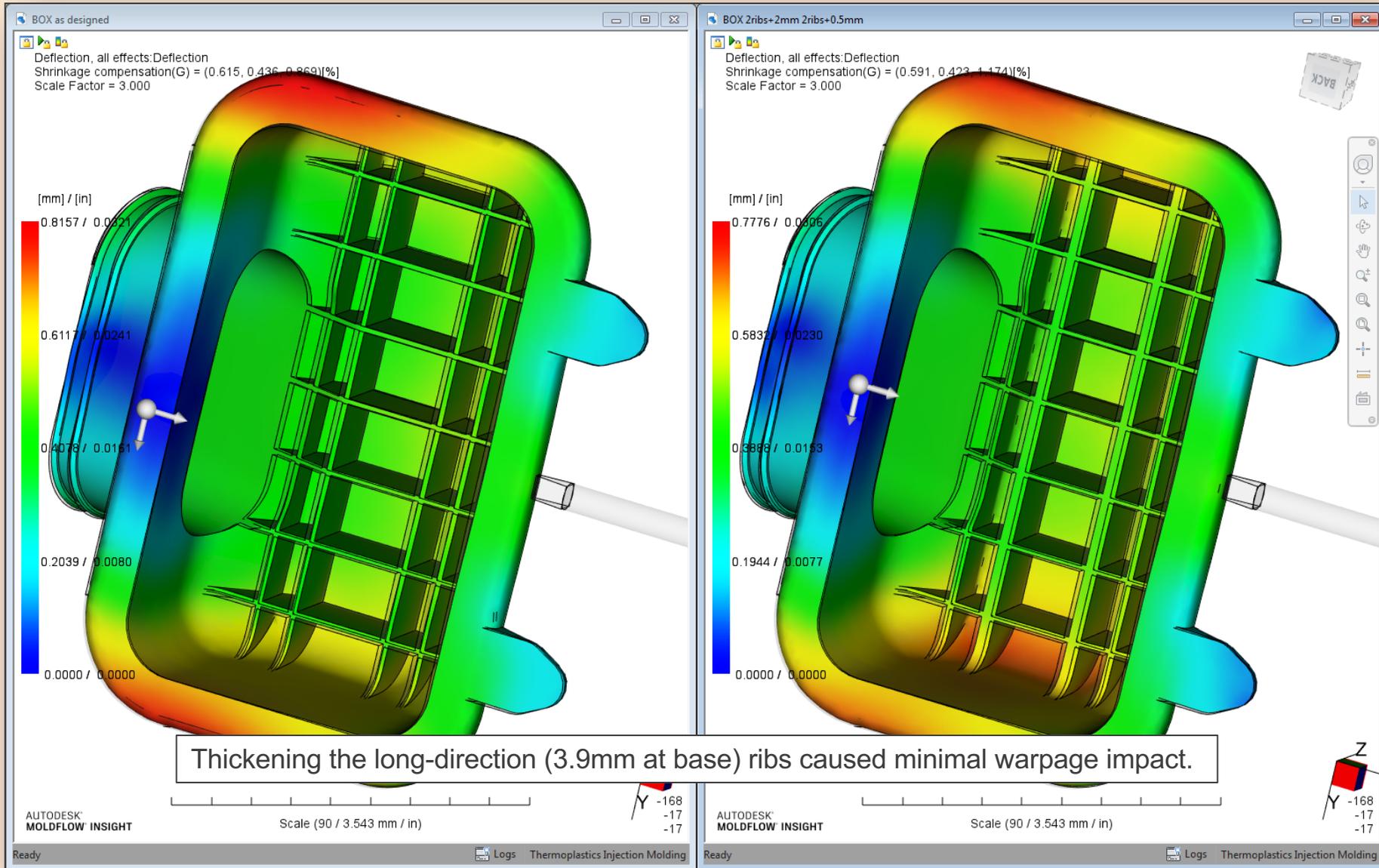
RESULTS: Longitudinal Ribs +0.5mm



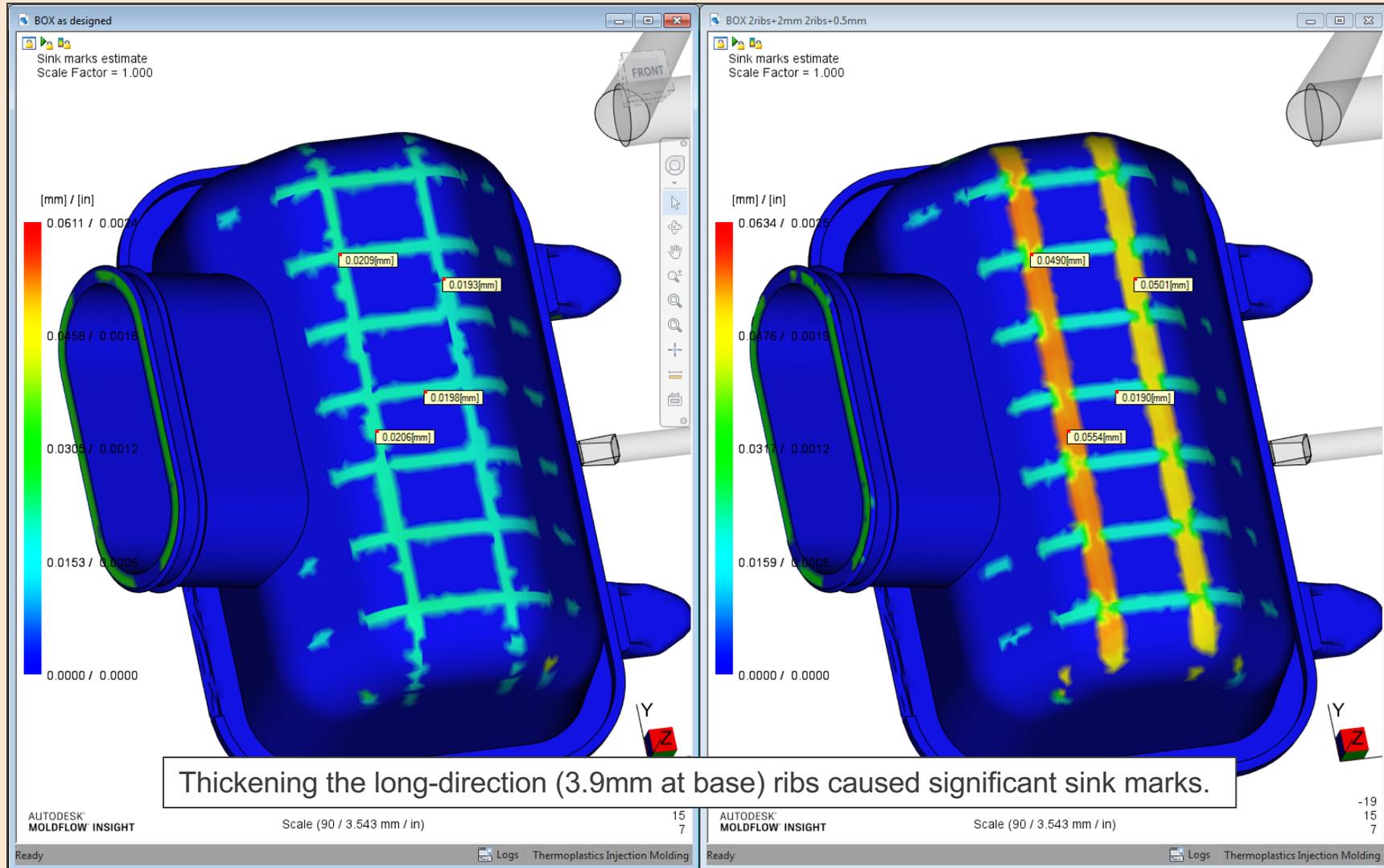
RESULTS: Longitudinal Ribs +0.5mm



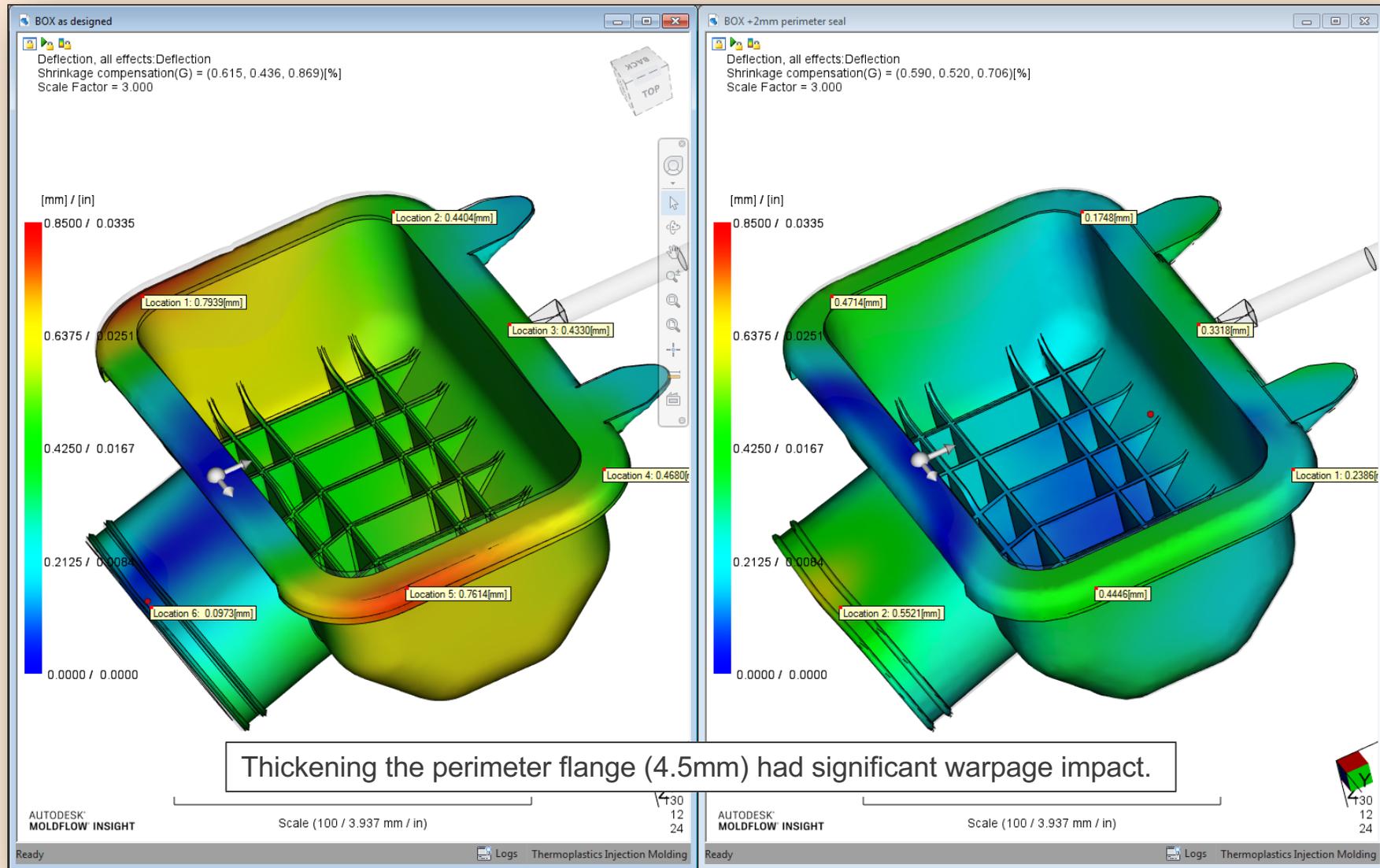
RESULTS: Longitudinal Ribs +2.0mm



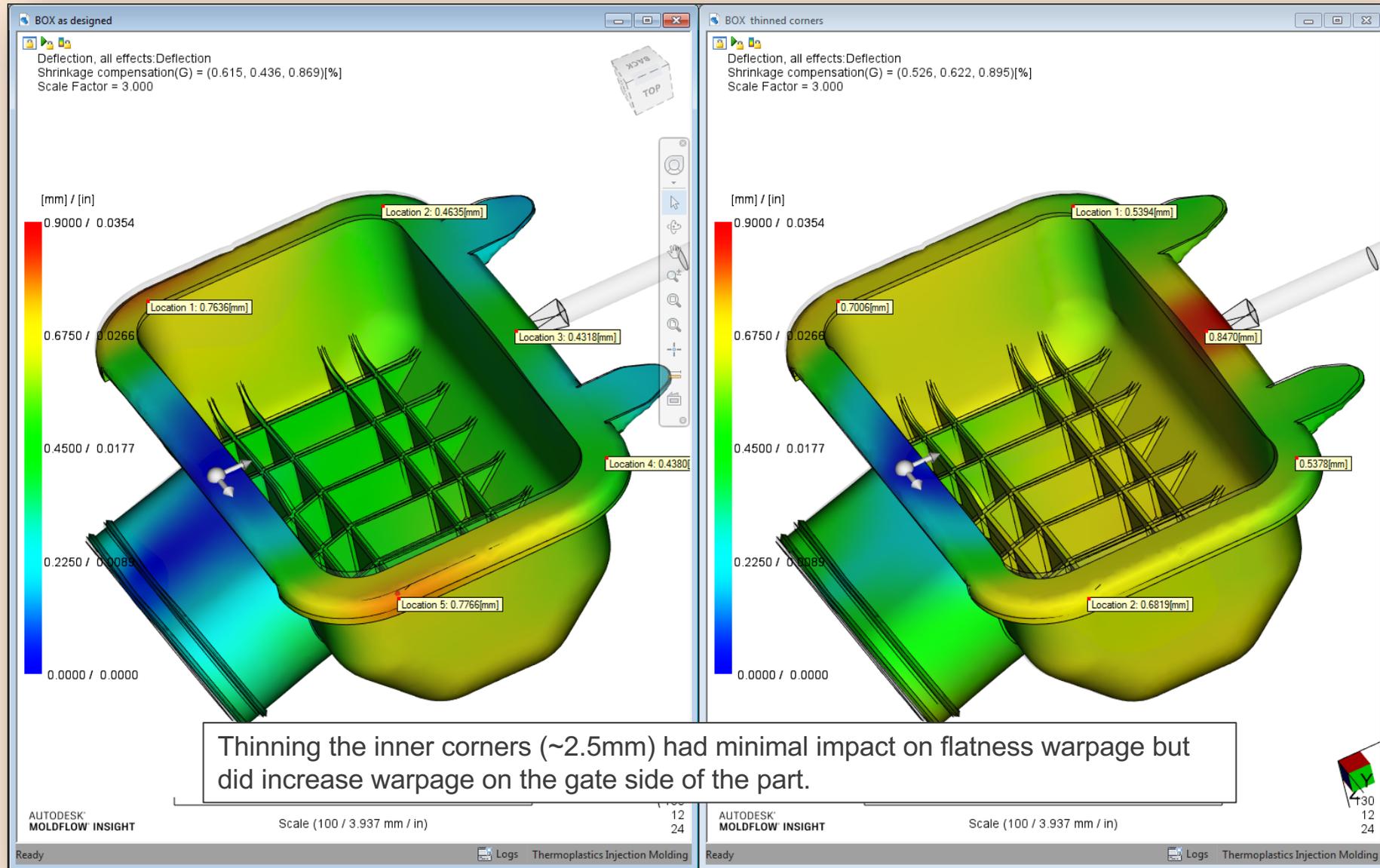
RESULTS: Longitudinal Ribs +2.0mm



RESULTS: Perimeter flange thickened +2.0mm



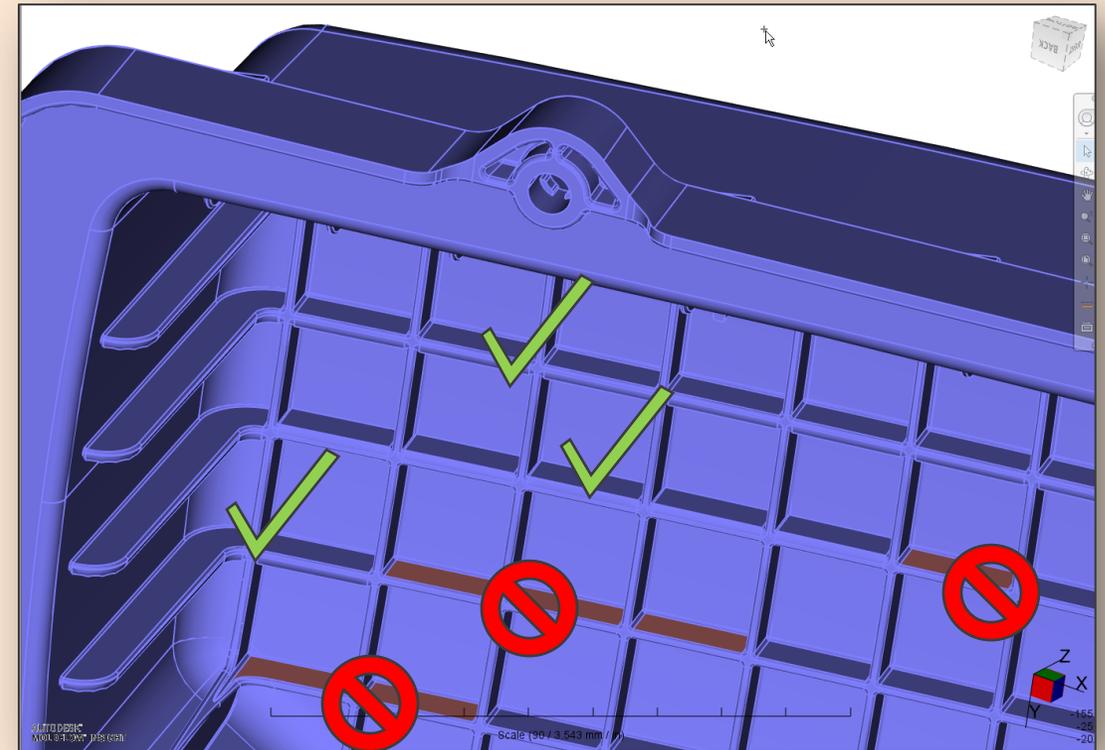
Thinned Inner Corners -1.0mm



Real Part #1



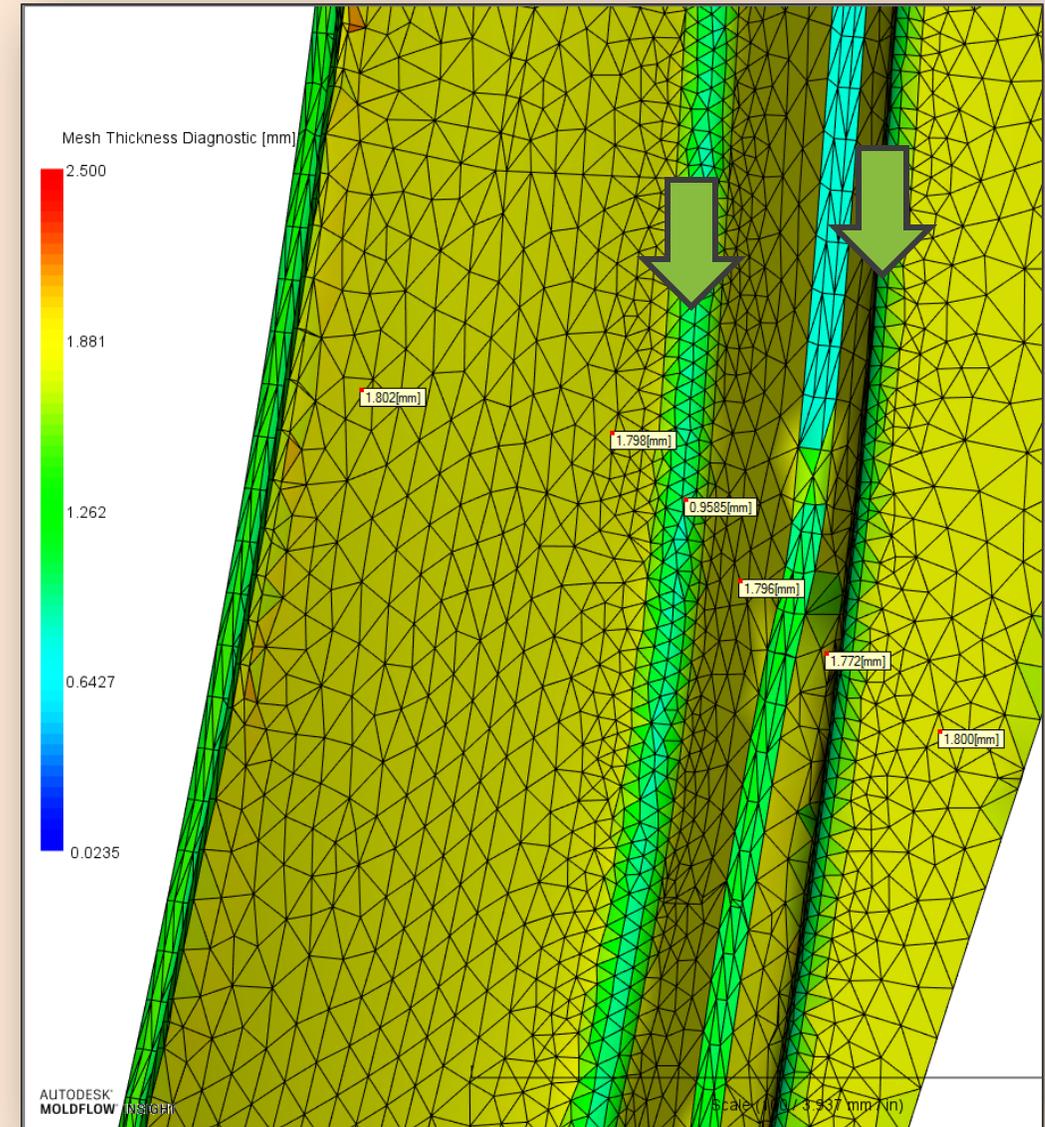
- Using a SDY file, cleaned in CAD Dr.
- Was able to thicken the first 3 horizontal ribs by 1.0mm, failed on next few rows.
- Had to select one face at a time for shifts.
- First two ribs shifted one direction, but third row had to shift other direction.
- Successful? Unsuccessful? Tedious?



Real Part #2



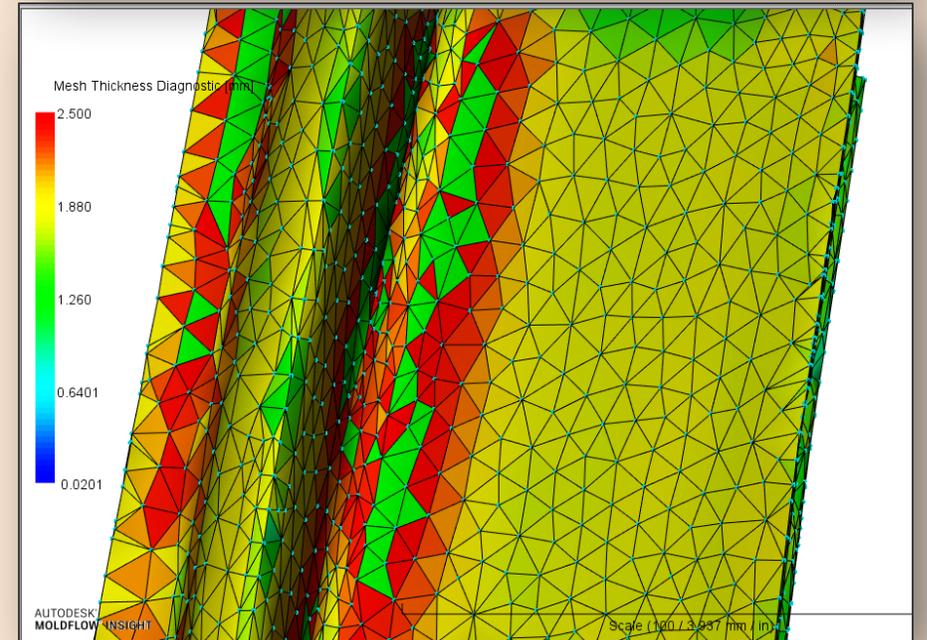
- Long, flat part that has two thinned inner radii extending down the entire length of part.
- It is believed that these thin-outs increase warpage in the part, among other potential defects.
- Can we locally thicken the radii using new 2017 tools?



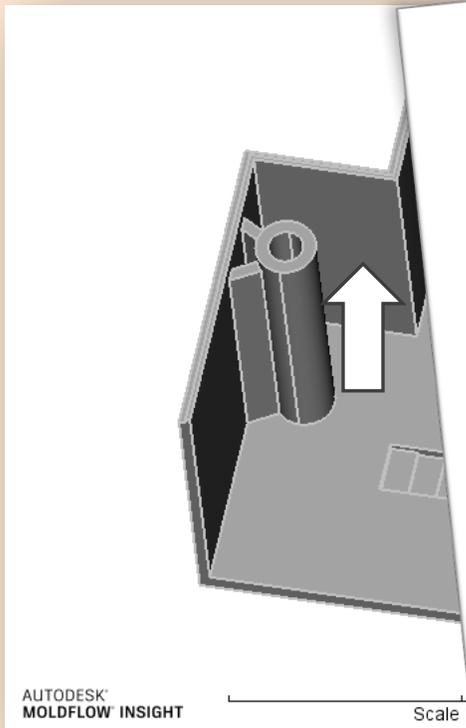
Real Part #2



- Could not modify the target radii down the entire length of the part. Some sections did thicken with apparent success, some would not.
- CAD meshing then failed due to errors caused by the manipulation of what surfaces could be shifted, so an untidy STL mesh completed.
- Appears even if it did shift all desired radii, it would also thicken and blend-out the adjacent walls (see red areas).
- It made no difference if CAD was also simplified in CAD Dr or not.
- Unsuccessful.

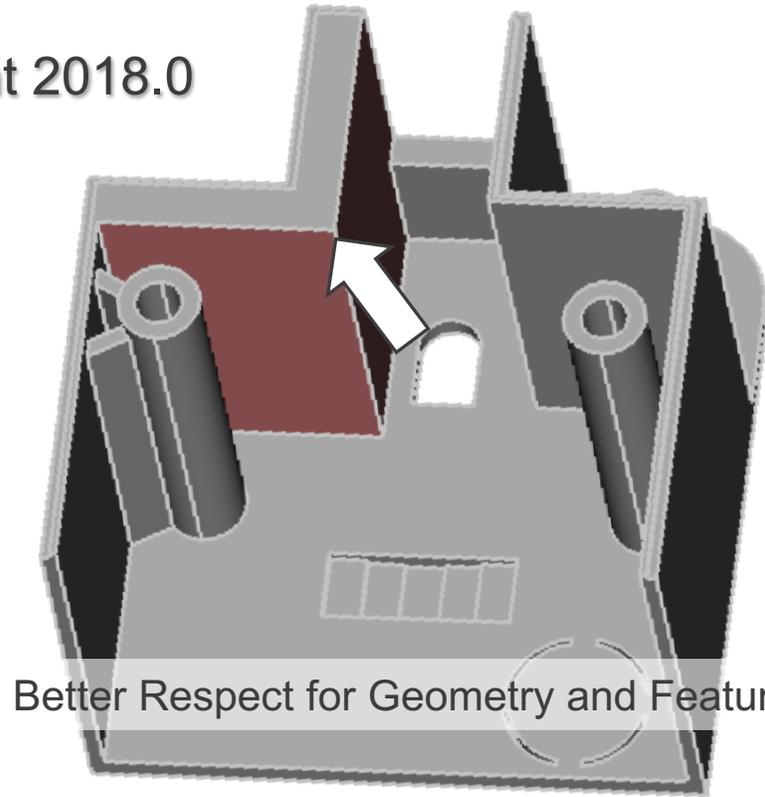


How are things in 2018?



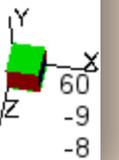
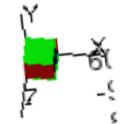
Let's start with a simple
Geometry

Moldflow Insight 2018.0

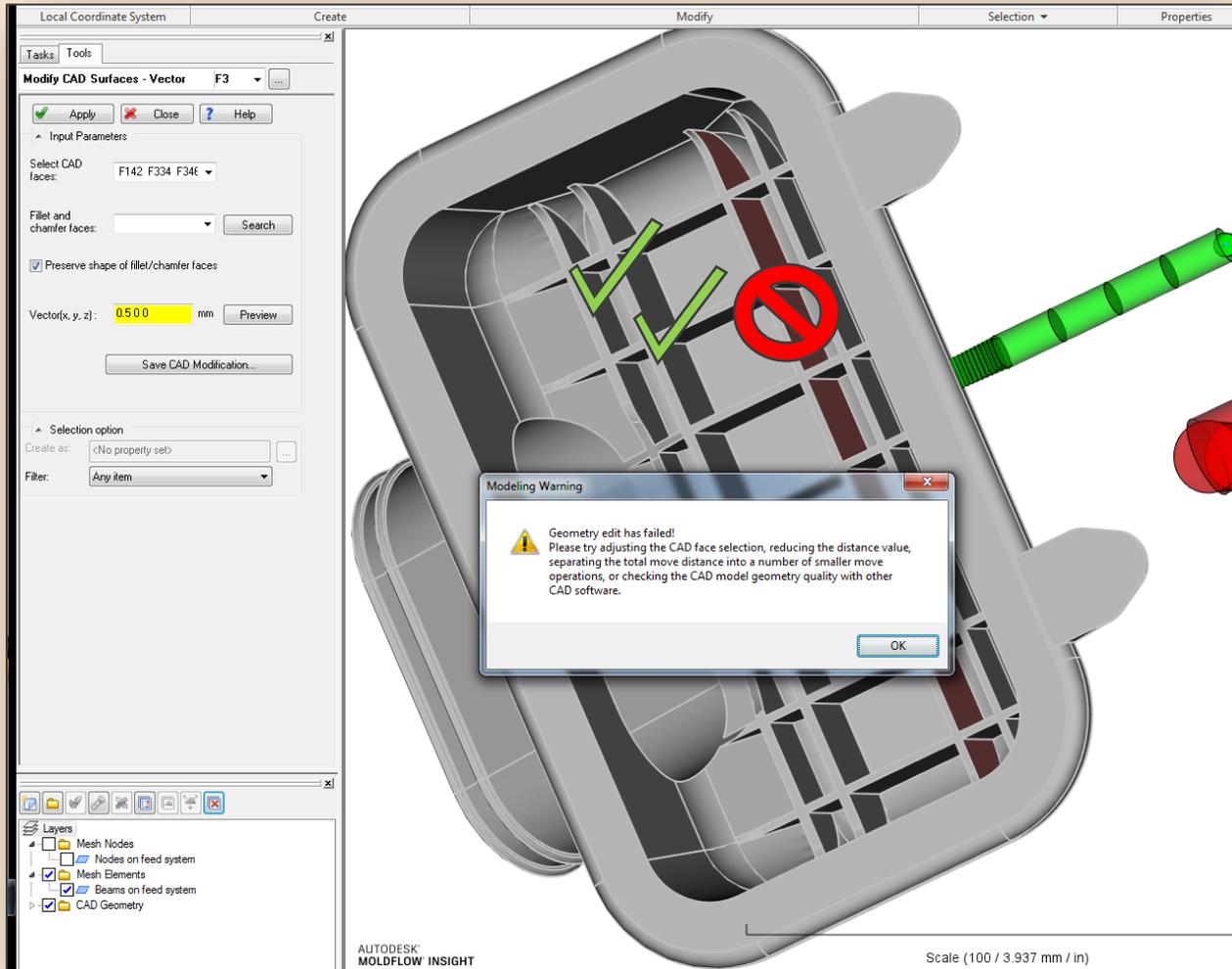


Better Respect for Geometry and Features

AUTODESK
MOLDFLOW INSIGHT

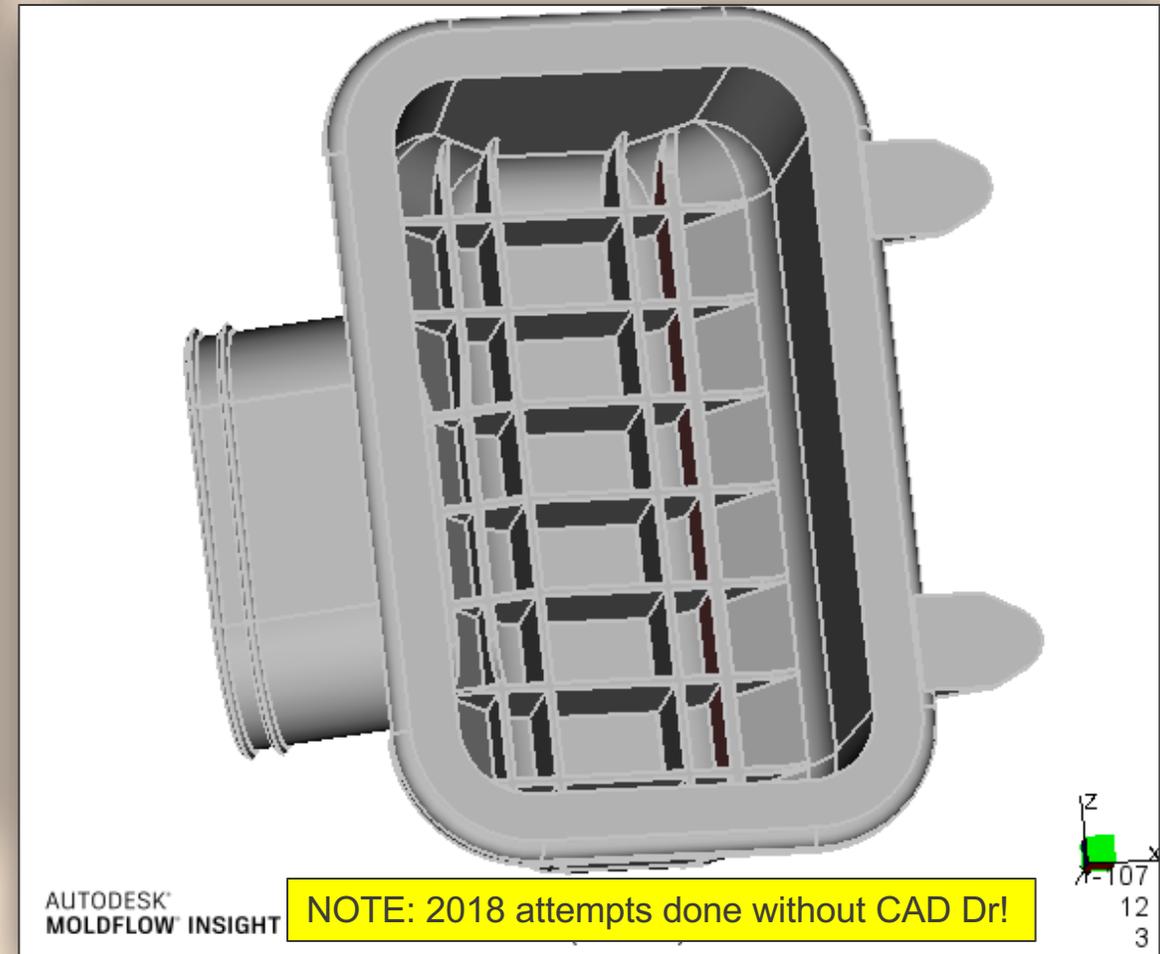


What about our Sample Air Box Cover?



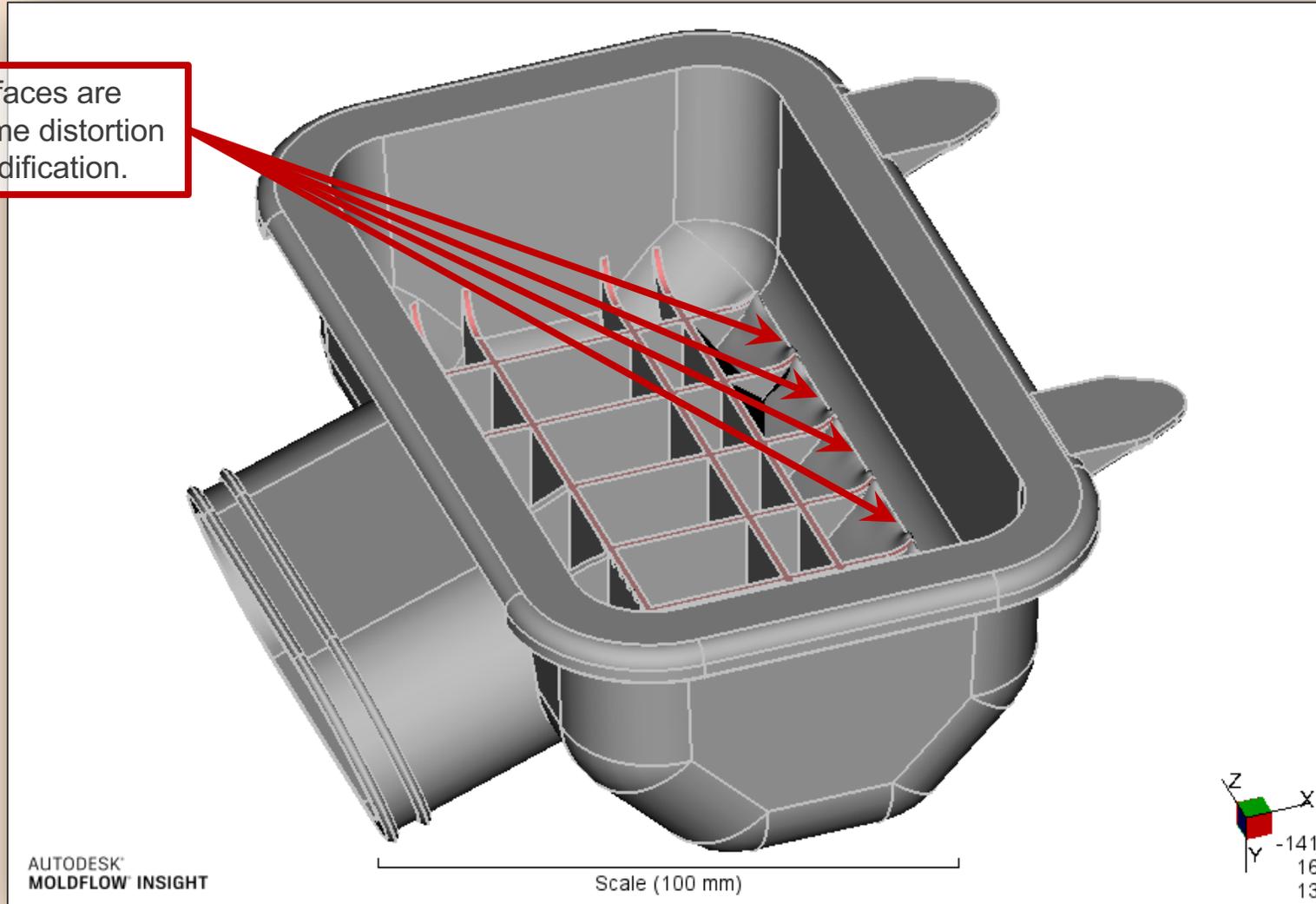
Previous Attempt to Modify 3rd Rib, Failed

2018.0 Attempt on 4th Rib at 0.5mm, SUCCESS!!!



And what about the rib height?

The angles faces are showing some distortion from the modification.



Using a setting of 1mm, the rib height is extended, let's call this mixed success

MPI 2017 Random Thoughts



- Wish: Create dual-domain mesh first, THEN shift walls with Geometric Optimization tools and elements move with it.
 - Better for 'real life' parts that require post-meshing cleanup.
 - Better for doing split screen comparisons when all nodes are same number (anchor points, examination).
 - Limits data that can be exported and shared with CAD or Design
- Material database: Resin suppliers! Put your resins in the database so they get updated with every release!

Conclusions



- Geometric Optimization tools in 2017 are intended for quick “what if” scenarios involving quick geometry changes.
- I am reminded that “Insight is not a CAD package”. The tools can be powerful, but are somewhat unpredictable. They do not always work on all features, and may not work as intended when they do move geometry features. Make sure to check what else as been unintentionally modified!
- The more ‘isolated’ the geometry or face being changed, the higher the chance of success.
- Play with the “vector” and “Normal” options, and the “preserve fillets” checkbox.
- Use a SDY file, not a UDM file.
- How have the Geometric Optimization tools improved in 2017.3? Or in 2017 v.4 (*aka 2018.0*)? Maybe!



*If you ever fall off the Sears Tower,
just go real limp because maybe you'll look like a dummy
and people will try to catch you because
hey, free dummy.*

- Jack Handy



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