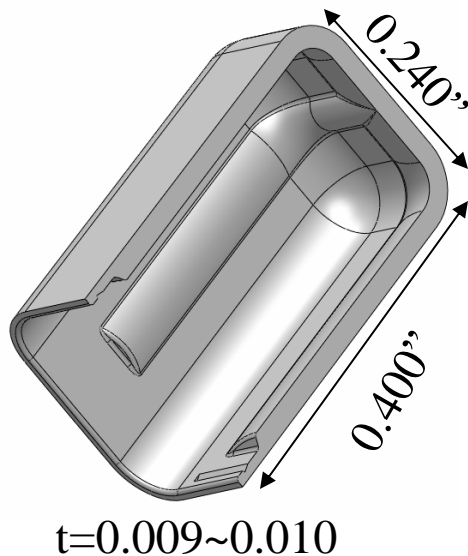


Case Study—Thin-Walled Part

MPIF 2008

Award of Distinction

Electronic Components



What is a thin-walled part?

- wall thickness $< 0.010''$
- $l/t > 100$ (Flow length-to-thickness ratio)

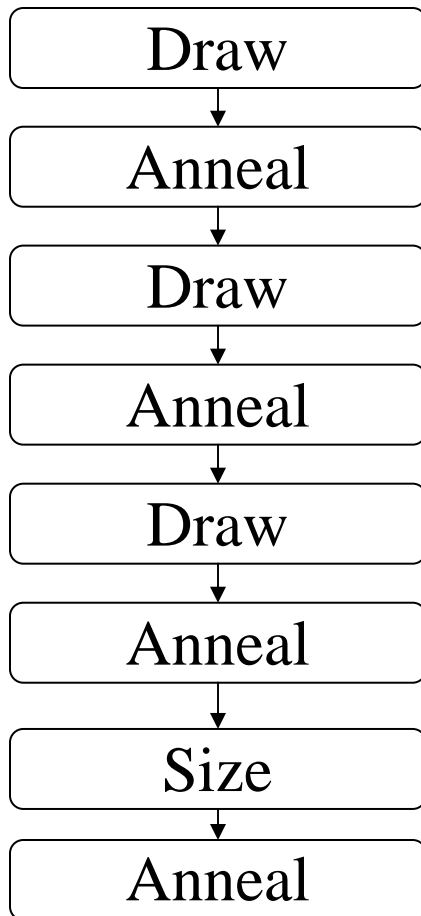
What are the challenges of a thin-walled part?

- Material Flow
 - High thermal conductivity
 - Particle size
- Part Distortion
 - Molding stress
 - Green strength
 - Debound strength
 - Sintering distortion
- Feedstock
 - Homogeneity

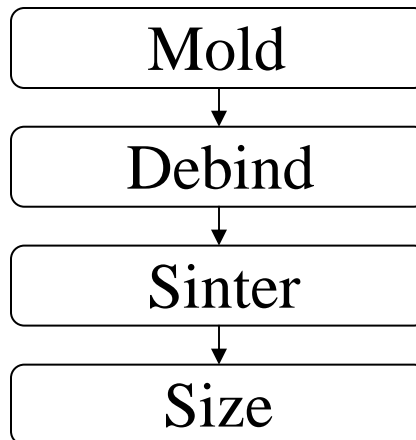
Conversion of Deep Drawing to MIM

Why MIM this part if the thin wall is difficult?

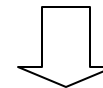
Deep Drawing



MIM



- 1) **Made with a Ni/Mo/Fe alloy with low formability → high scrap rate when deep drawing**
- 2) **Repeated high-temperature processing is expensive and causes distortion**

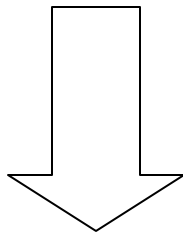


Try MIM

Thin Wall Challenges

Material Flow

- High thermal conductivity → material freezes off very fast
- Surface area = 0.84 in.²
- Volume = 0.0048 in.³



Mold at high material temperatures

- increases molding stress
- degrades binder system
- causes binder/metal separation

Mold with high die temperatures

- thin walls have no strength at high temp

Mold with high injection speeds

- shear heating helps material flow
- causes binder separation
- increases molded in stress

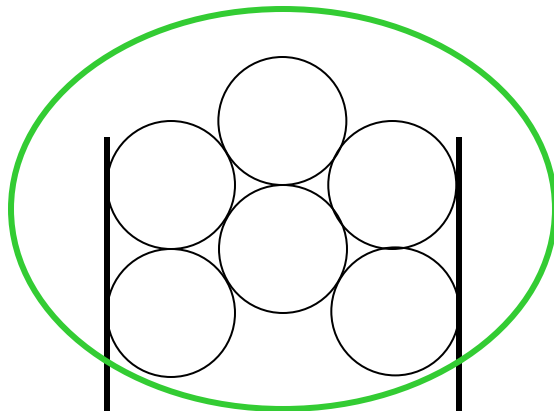


When pushing the limits of the material and process it is important to go “outside the box” when considering how to mold.

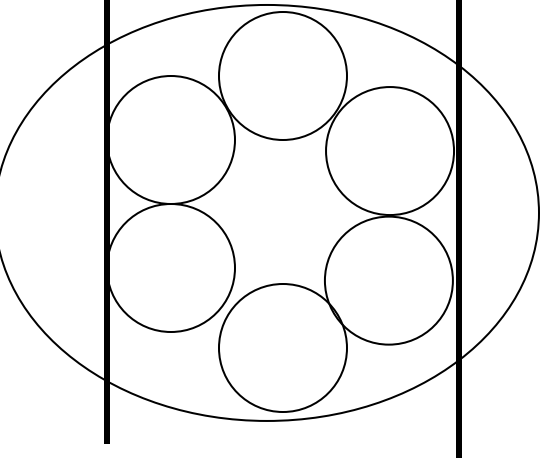
Thin-Wall Challenges

Material Flow

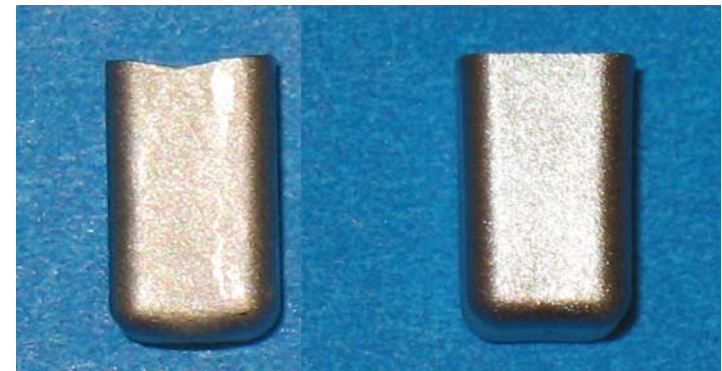
- Particles size → on small parts, particle sizes become critical
 - Typical metal particle size ~10 μm (0.0004") in diameter
 - However, D90 -22 μm (0.0009")-sized powder is typically used in MIM
 - 0.010" thick wall is 10~25 metal particles thick



If metal flowed ideally, uniform packing would occur

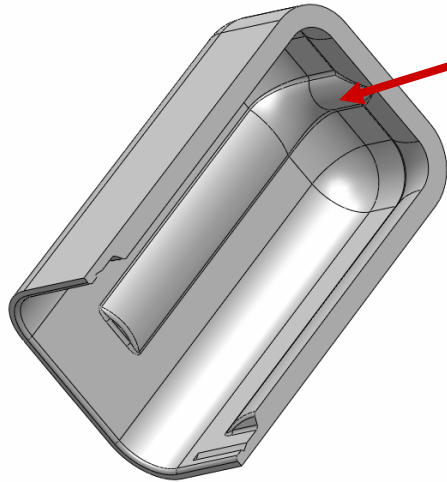


Of course that doesn't happen, which leads to flow problems (material bridging) and non-uniform packing (distortion in sintering)



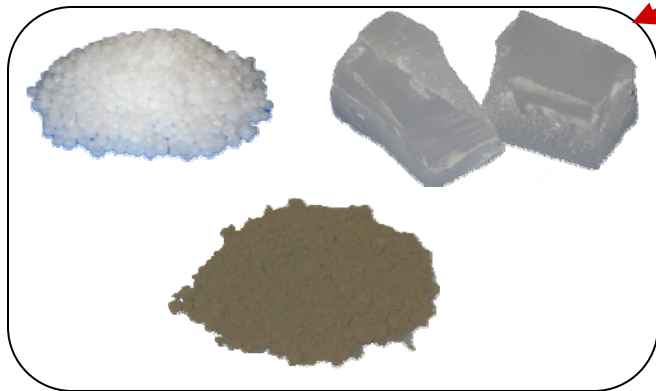
In thick walls, material doesn't bridge easily and any non-uniformity is averaged out

How To Overcome Some of the Challenges



Design in features to improve material flow

- “Flow ribs” could be added at no cost to tooling and designed to fit with the assembly
- Improved material flow
- Added structural support to prevent distortion in sintering



Change feedstock

- Modified binder system
 - Lower viscosity
 - Change melt point
- Modified powders
 - Optimize powder/binder ratio
 - Use “high-flow” powders

New applications often require optimization of design and process.