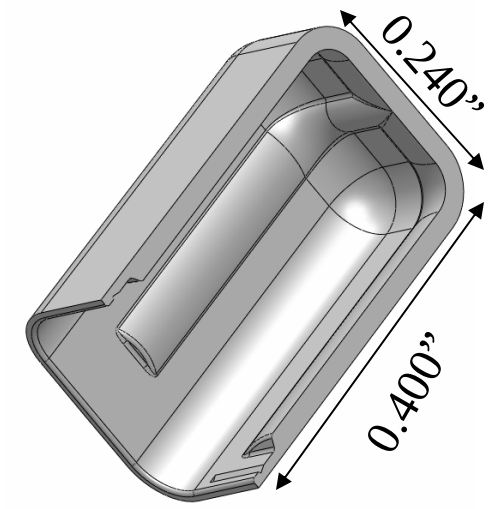
# Case Study—Thin-Walled Part

MPIF 2008
Award of Distinction
Electronic Components




t=0.009~0.010

## What is a thin-walled part?

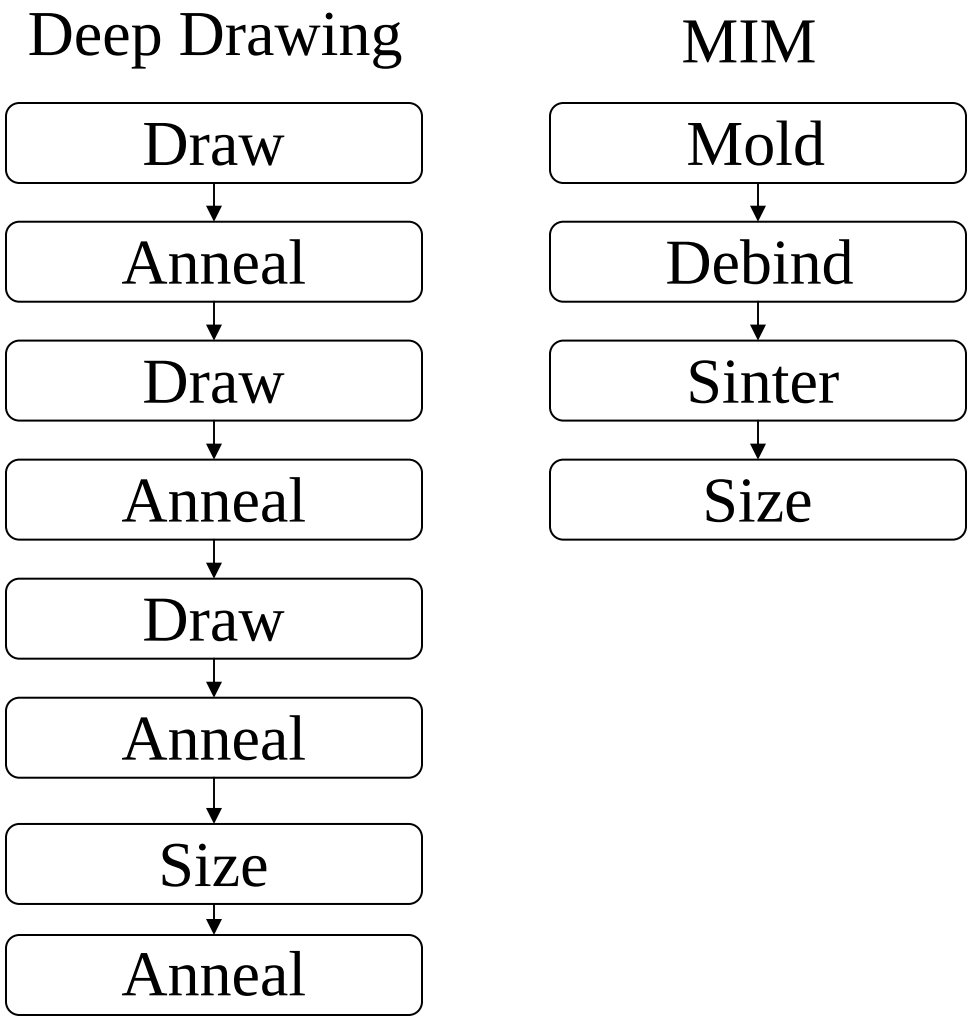
- wall thickness <0.010”
- l/t > 100 (Flow length-to-thickness ratio)

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?




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

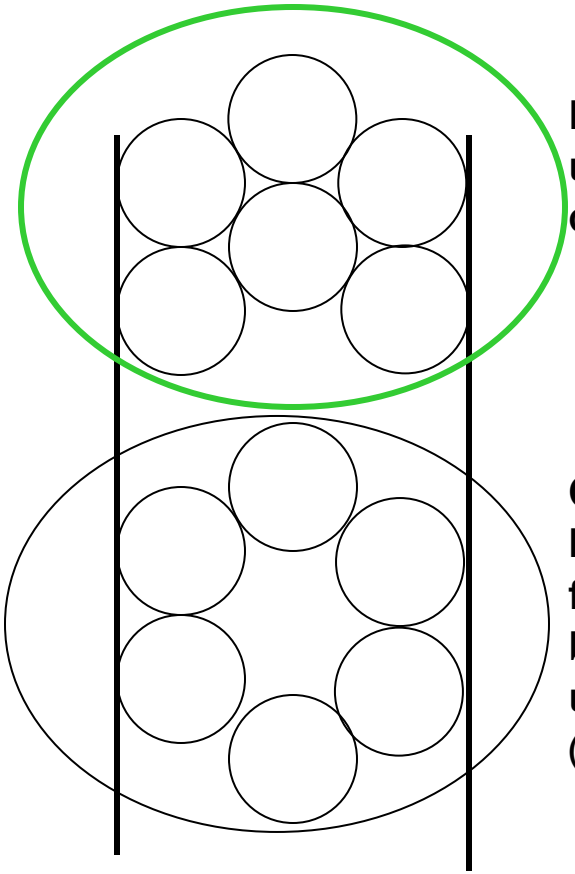
Mold with high injection speeds
- → shear heating helps material flow
  - → causes binder separation
  - → increases molded in stress

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

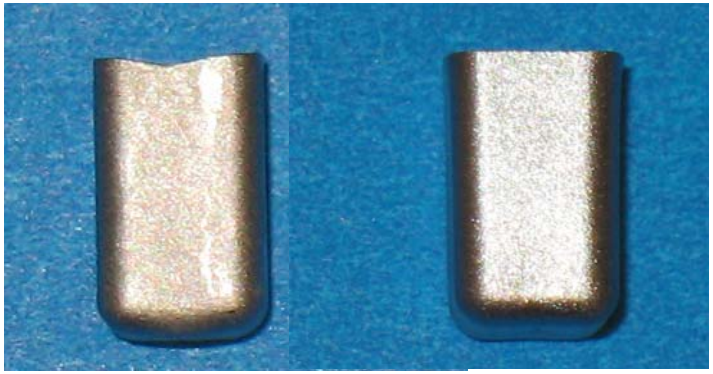
## Material Flow

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



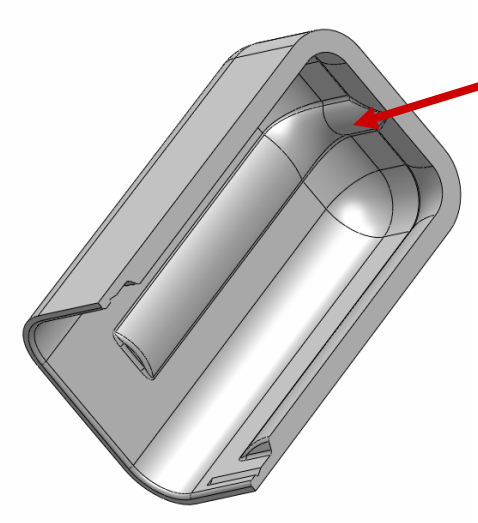
If metal flowed ideally, uniform packing would occur

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.**