Design for Micro Molding: Guidelines, Challenges, and Pushing the Limits

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Design for Micro Molding:
Guidelines, Challenges, and Pushing the Limits

1. What is Micro Molding?
2. What makes it special?
3. Are there any guidelines?
4. What are some of the challenges?
5. What can I do with Micro Molding?
What is Micro Molding?
Is it all about the press?
Set-up for success, not just one part.
Guidelines

Understanding the Rules:

- Gates as small as 0.1mm
- Ejector pins as small as .25mm
- Aspect ratios around 6:1 (material dependent)
- Be mindful of thick-to-thin wall transitions
- Watch wall thickness uniformity
- Ribs as a % of wall thickness
- Know how shrink rates will affect the part
- Understand parting line mismatch
- Flash & Witness Marks
- Draft is still welcomed
Challenge: Prototyping: CASE STUDY

Prototyping Technologies
- Stereolithography (SLA)
- 3D Printing
- PolyJet
- Fusion Deposition Modeling (FDM)
- Selective Laser Sintering (SLS)
- Laminated Object Manufacturing (LOM)
- Cast Urethanes
- Machining/Rapid Tooling
- Rapid Injection Molding (RIM)
- Standard Hard Tooling

Ø .010” (0.254mm)
Ø .020” (0.508mm)
Artwork height .001” (0.0254mm)
250µ Ø aspheric lens
High-Polished Surface
L .015” (0.38mm) x W .006” (0.152mm)
L .005” (0.127mm) x W .0025” (0.0635mm)
L .200” (5.08mm) x W .200” (5.08mm) x H .125” (3.175mm)
Challenge: Prototyping: CASE STUDY

Results
Challenge: Prototyping: CASE STUDY

Results
**Challenge:** Material Selection & Feature Performance

**Materials**
- PEEK, Ultem®, LCP Nylon...
- TPE / TPU
- Filled materials: glass, carbon...
- Optical Grades
- Medical / Implantable Grades
- Attenuated Materials
- Specialty Materials
Challenge: Material Selection & Feature Performance: CASE STUDY

The relationship between material selection and feature performance at the micro scale.

The Resins
1. Polyethylene (PE)
2. Polypropylene (PP)
3. Polyamide (Nylon)
4. Polycarbonate (PC)
5. Polysulfone (PSU)
6. Polyoxymethylene (POM)
7. Polybutylene Terephthalate (PBT)
8. Polymethyl Methacrylate (PMMA)
9. Polyether Ether Ketone (PEEK)
10. Polyetherimide (PEI)
11. Liquid Crystal Polymer (LCP)
Picking your material:

Where Do You Turn for Expertise?

- “The wall thickness would require an increase of 5x to 10x the current .003” in order to fill.”
- “Molding the part thicker and grind it down to the desired thickness.”
- “In looking at the part, the .003” section will not fill any of the listed materials. In fact, I believe you will be hard pressed to find a thermoplastic material that would fill that .0127” long, .003” wall.”
- “I do believe you would need to be in the .015” wall thickness zone.”
- “We would suggest increasing the .003” wall thickness to at least .015” or, better yet, .030” in order to improve moldability.
- “In my opinion filling this geometry would not be possible in a production environment. I would consider trying to mold a PP at approximately .016” - .018” and an Acetal 9 melt at .025”.”
Material selection alone can have a profound effect on feature performance.
Challenge: Material Selection & Feature Performance

Ø 100µm lens w/ 125µm base radius | PEI (Ultem®)
**Challenge:** Metrology, Handling, & Packaging

**Metrology**

**Handling**

**Packaging**

24 cavity with 2 pairs of lead-strip. Each pair of lead-strip was crimped and fed thru the mold. The molded product was then fed to a testing and singulation die for packaging. The system had an annual volume of 30M parts.
Pushing the Limits: What can you do with Micro Molding?

Micro-Molding
Alignment Spacer
- 800µm x 380µm x 300µm
- Material: LCP

This part is made of LCP and is Accumold’s smallest commercial part to date. It measures 800µm x 380µm x 360µm. 144,000 parts weigh 1 oz. Part handling more of an issue with this part than the tool build and production.
2-Shot Micro-Molding
Connector Seal
• Soft TPU Ring
• Saved Labor

The hard, clear ABS part is combined with the soft, white TPU material to create a perfect bond. This process saved manufacturing resources and replaced the assembly and gluing process for the end customer.
Pushing the Limits: What can you do with Micro Molding?

This part requires delicate handling of the flex circuit during processing. Careful shut-offs on the mold were required to not damage the circuit. The two orange parts are molded simultaneously with a dual gate setup.

Overmold
Medical
- Flex-Circuit Overmolding
- Material TPE
Pushing the Limits: What can you do with Micro Molding?

This part shows an example of advanced insert molding capabilities where a delicate filter was molded into a plastic housing. This required the mold to be built in such a precise fashion so that the insert material could articulate through the mold during processing and not be destroyed in the process while keeping the tolerances tight within the part itself. The part is approximately 2mm in diameter.

Micro-Molding
Insert Molding
- Singulation Die-Integrated
- Delicate Insert Media
Pushing the Limits: What can you do with Micro Molding?

These two parts are internal chassis for hearing instruments. The very complex larger part on the bottom has 3 discrete pins that are overmolded simultaneously. The smaller part at the top has 5 discrete contacts that are overmolded as well.

Complex Micro Molding
Hand-loaded Inserts
- Unique Multi-Slide Design
- Special Packaging
Technology Highlight: MSE: Micro Structure Enhancement

Ø 400µm x 12µm tall
Ø 25µm x 1µm tall
Ø 10µm x 0.5µm tall
Technology Highlight: LDS: Laser Direct Structuring / 3D-MID

Activated additive by Laser ablation

Laser Traced

Plated Part

Molded Part

Examples:

2-Shot – Non-Laser Process

CAD Design:

Modified Polymer
Thank You!

QUESTIONS?

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