Thixomolded Magnesium Injection Molding Design Guide
Design to the benefits of Thixomolding

1. Part Design Rules and Approach similar to Injection Molded Plastic
   - More Aggressive on Walls, Reinforcements, etc.

2. Tooling Features and Capabilities similar to Plastic Mold Tooling
   - Mold runs at 400 - 500 F

3. Mechanical Properties 20X unfilled Thermoplastics

4. Designs inherently EMI Shielding - no plating or painting required

5. Parts inherently Thermally Conductive

6. Corrosion Issues:  
   a) General Corrosion better than Al & Steel
   b) Galvanic Corrosion - follow Aluminum Rules

7. Fastening/Joining:  
   Snap Fits, Thread Forming Screws, Welding all applicable

8. Variety of Cosmetic Treatments:  
   Powder Coat, Paint, Plating

9. Complete Recyclability regardless of cosmetic treatment
Areas to consider in design

Nominal Wall Thickness:
- Gradual transition: 3:1 Rule
- Core-out thick sections
- Remove sharp corners
- Thick to Thin
- Limitations

Draft Angle:
- Facilitate Part Ejection
- Suggested: 0.5° - 3.0°

Processing Concerns:
- Flow Length

Machinability vs. Other Metals

Corrosion:
- General
- Galvanic

Reinforcement Structures:
- Ribs
- Gussets
- Bosses

Assembly Methods:
- Snap-Fit
- Interference Fits
- Fasteners
- Joint Designs
Wall Thickness

• Nominal Part Thickness
  Minimum: 0.018” (0.5 mm)
  Maximum: 0.120” (3.0 mm)

• Flow length to Wall Thickness Ratio : L/D
  Thixomolded Magnesium Designs       > 150:1
  Thixomolded Magnesium Spiral Flow Tests > 400:1
  Conventional Plastic                < 100:1
Wall Thickness

**Poor Design**
Heavy Walls

**Better Design**
Shape would require slides

**Best Design**
Uniform walls No slides

**Poor Design**
Heavy section promotes internal shrinkage

**Good Design**
Coring eliminates heavy section
Nominal Wall Design

- Radius Transitions from Thin to Thick
- Core Thick Sections where Possible
Wall Transitions

Initial

Better

Best

Gradual Radiused Transitions are best
Corner Design

INITIAL

Sharp Corner

IMPROVED

R = 0.5 T

R = 1.5 T

Radius Corners / Maintain Nominal Wall
Design for uniform nominal wall: maximum stiffness with minimal shrinkage.
Draft Angle & Part Removal

1) Suggested Draft Angle 1°
   Equivalent to 0.017 in/in/deg

2) Minimum Draft Angle = 0.5°

3) No draft in some areas.
Reinforcement Design

- Ribs
- Bosses
- Gussets
Reinforcement Design Rules

Thixomolded Magnesium Rules

- $t \leq 1.2t_{\text{wall}}$
- $h \leq 5t_{\text{wall}}$
- $r \geq 0.6\text{mm}$
- $\Theta \geq 0.5^\circ$
- OD $\approx 2\text{ID}$

Plastic Rules

- $t \leq 0.6t_{\text{wall}}$
- $h \leq 4t_{\text{wall}}$
- $r \geq 0.375\text{mm}$
- $\Theta \geq 0.25^\circ$
- OD $\approx 2\text{ID}$

More Aggressive than Plastic
Rib Design Basics

$R \geq 0.015''$ (The Larger the Better)

$t < 1.25T$

$\frac{1}{4}$ to $\frac{1}{2}$ degree draft

INTERSECTIONS:

Maintain Nominal Wall at Intersections

Radius Corners
Boss Design

**Standing Features:**
- add strength
- facilitate alignment
- during assembly
- attachment

**Dimensions:**
- \( R = 0.25 \ T \)
- \( 2D \)
- \( H = 2 \text{ to } 8T \)
- \( W \leq 0.8 \ T \)
- \( t = 0.4 \text{ to } 0.6T \)
Gussets

- Points of attachment
- Support Sections
- Contact with other parts / sections
- Follow thickness and height rules for Rib Design
Assembly: Snap Fit Designs

1. Wall
2. Radius Corners
3. Insertion Angle

**Strain** \( = \frac{3\, y t}{2\, I^2} \)

**Cantilever Force** \( = \frac{y B t^3}{4\, I^3} \frac{E_s}{4\, I^3} \)

**Insertion Force** \( = \frac{F\, \mu + \tan \phi}{1 - \mu \tan \phi} \)
Assembly: Fasteners

- Self forming screw work best
  - Do not exceed the ductility limits of Magnesium.
  - Eliminate possibility of thread damage
  - Eliminate excess debris and chips
- Use Zinc or Chromate plated screws to minimize Galvanic corrosion.
V-Groove Stiffeners

Efficient stiffeners “Corrugation Effect”

Little additional material

No additional cooling time

Reduce Expansion and Compression
1. As-Molded
   - versus as-cast. Smoother, less porosity.

2. Treatments
   - Chromate
   - Phosphate

3. Hard Coats
   - Tagnite or Anomag - MgO
   - Mg Oxide (MgOAl$_2$O$_3$)

4. Finished (Final Finishes)
   - Power coating
   - Wet paint
   - Plating (Ni, Cu, Au, Ag, Chrome)