MKR1163 PLASTICS DESIGN AND PROCESSING

Metal Parts Replacement and Basics of Plastics Part Design

Metals Replacement a key market strategy

- Part rationalization is another significant trend in industries such as automotive, appliances, electronics and medical, as it increases end product reliability and decreases inventories.
- This trend is expanding rapidly due to the multiple benefits provided by plastics compared to metal. All of them lead to significant productivity improvements and/or product differentiation.

Benefits of thermoplastics versus metals

- Design flexibility
- Easy to color and decoration
- In-mold decoration

- Reduce assembly
- Reduce secondary operation
- Highly complex parts
- Opportunity for part consolidation

Productivity & differentiation

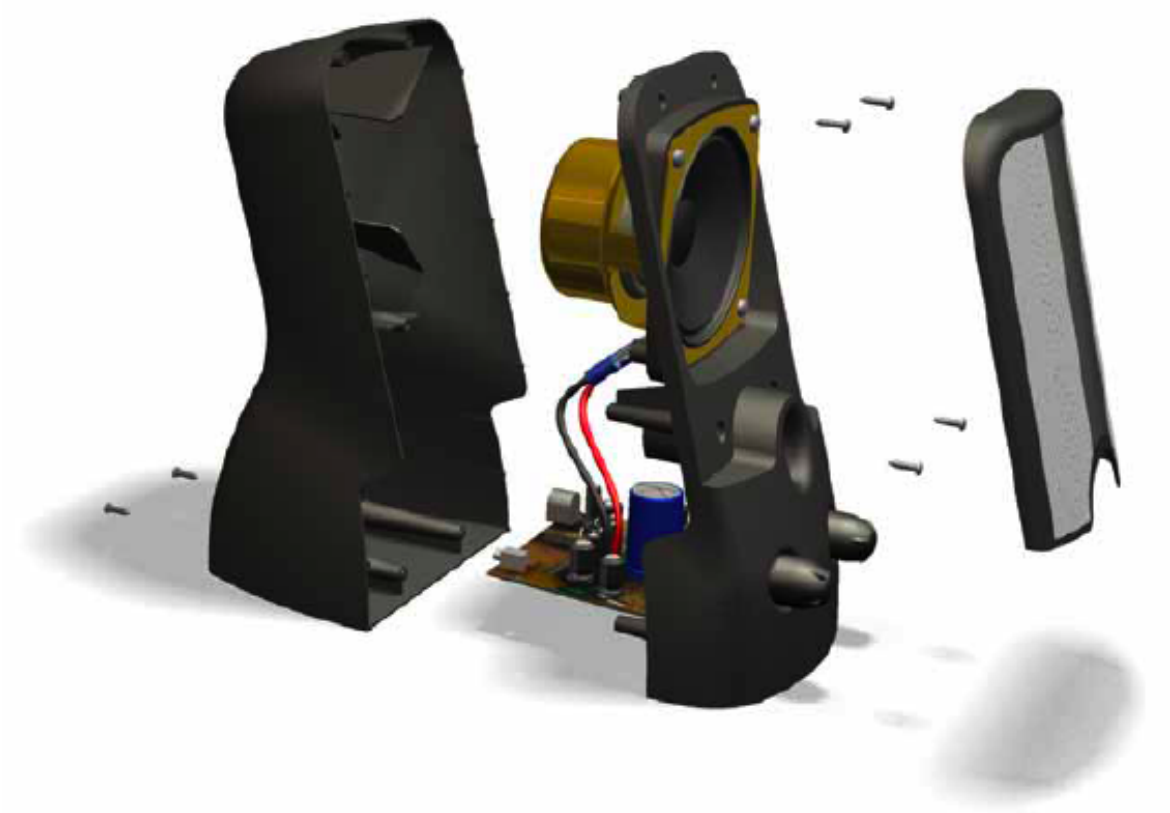
Sensorial benefits

- Noise dampening
- Surface aspect:
  Warm to the touch

Performances

- Lighter than metal
- Electrically non conductive
- Vibration dampening

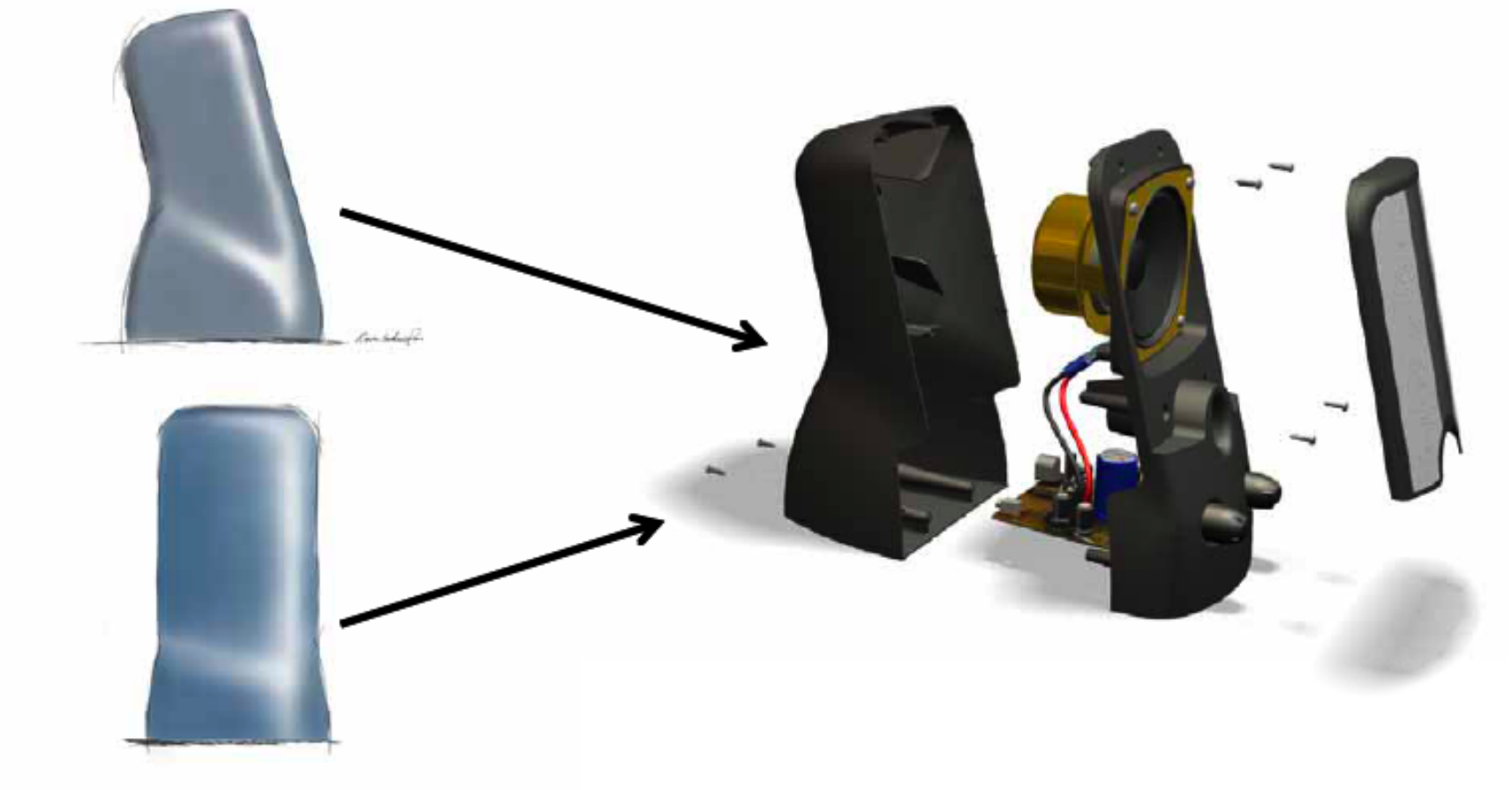
MKR1153
Basics of Plastics Part Design



Fundamentals

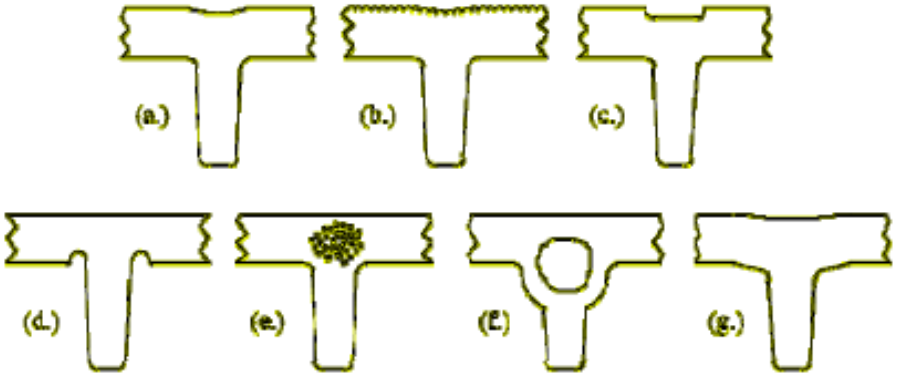
- Design Example
- Wall Thickness
- Fillets, Draft and Ribs

The Design



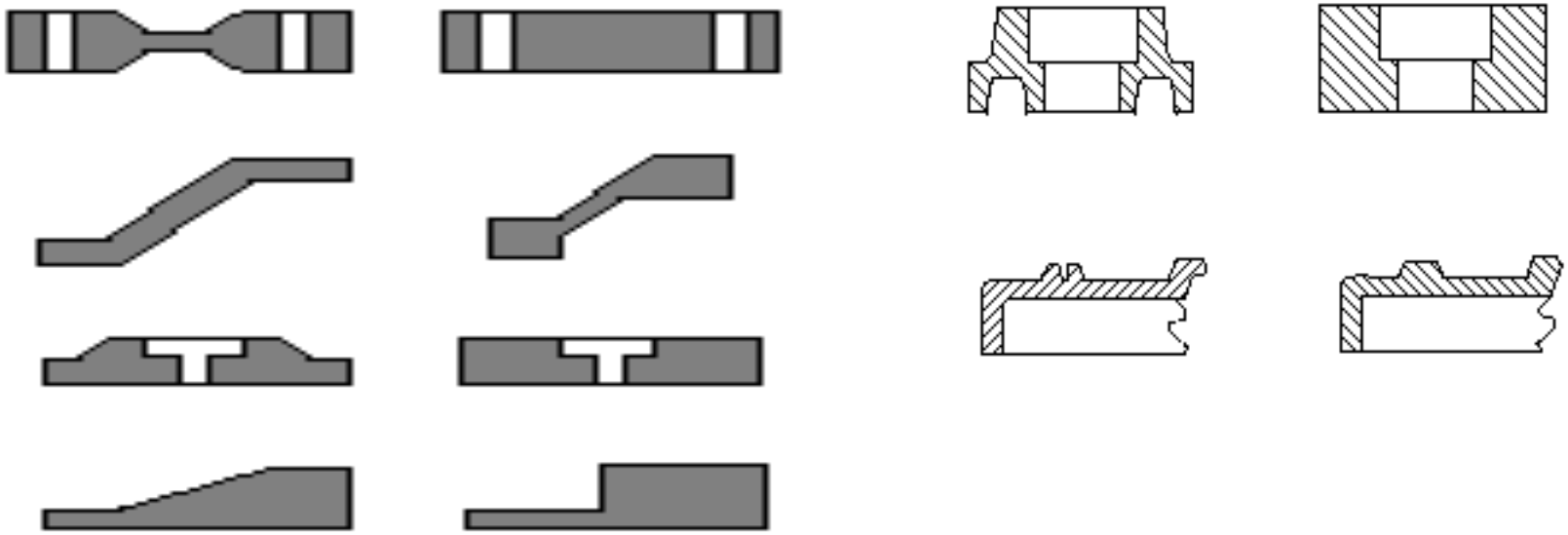
Wall Thickness

- Uniformity is critical to minimize warpage, distortion and internal stress. Uneven wall thickness presents challenges to molders
- Designing parts with uniform walls and cross section will simplify manufacturing and costing
- At wall intersection or “tees” sinking will occur
- Thick walls cool slower - greater shrinking will occur
- Thin walls cool faster - less shrinkage.
- Ways to deal with this shrinkage:

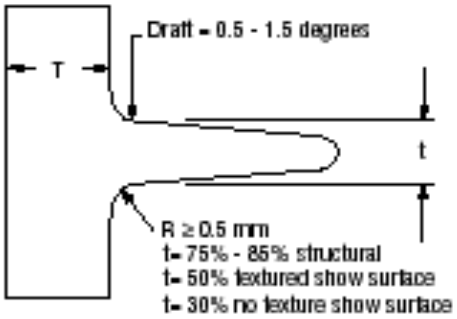


a) Unwanted sink
b) Disguise (texture)
c) Core out top
d) Core out bottom
e) Foaming agent (structfoam)
f) Gas assist molding
g) Spread sink over more area

Section/Thickness Uniformity



Fillets (Radii), Drafts and Ribs

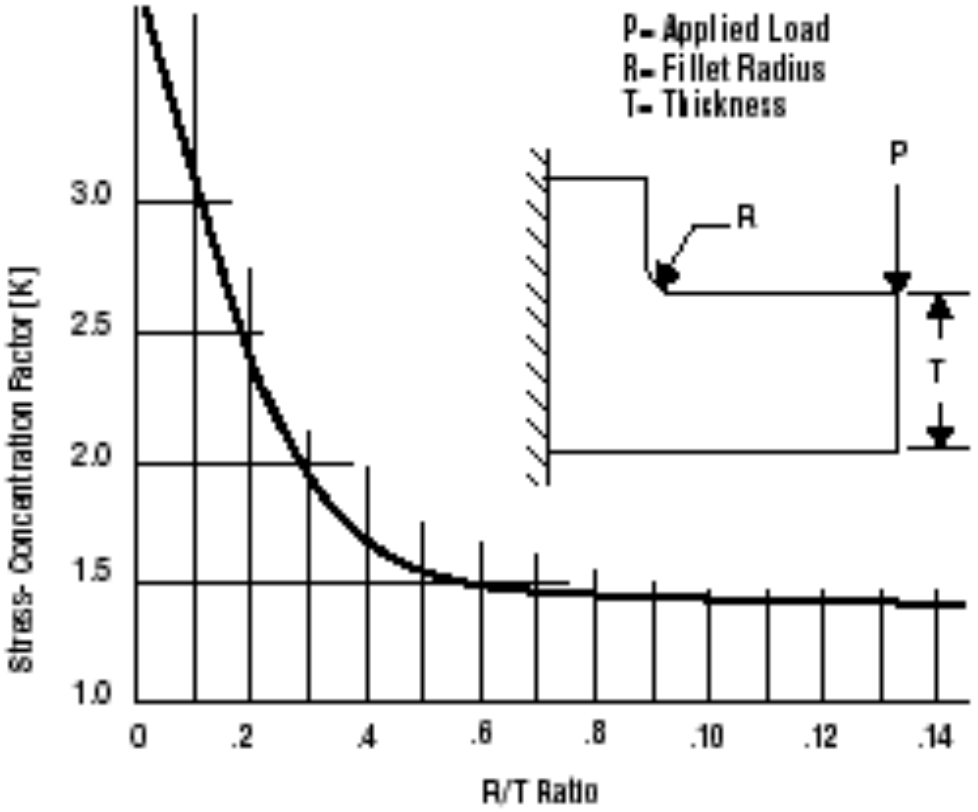


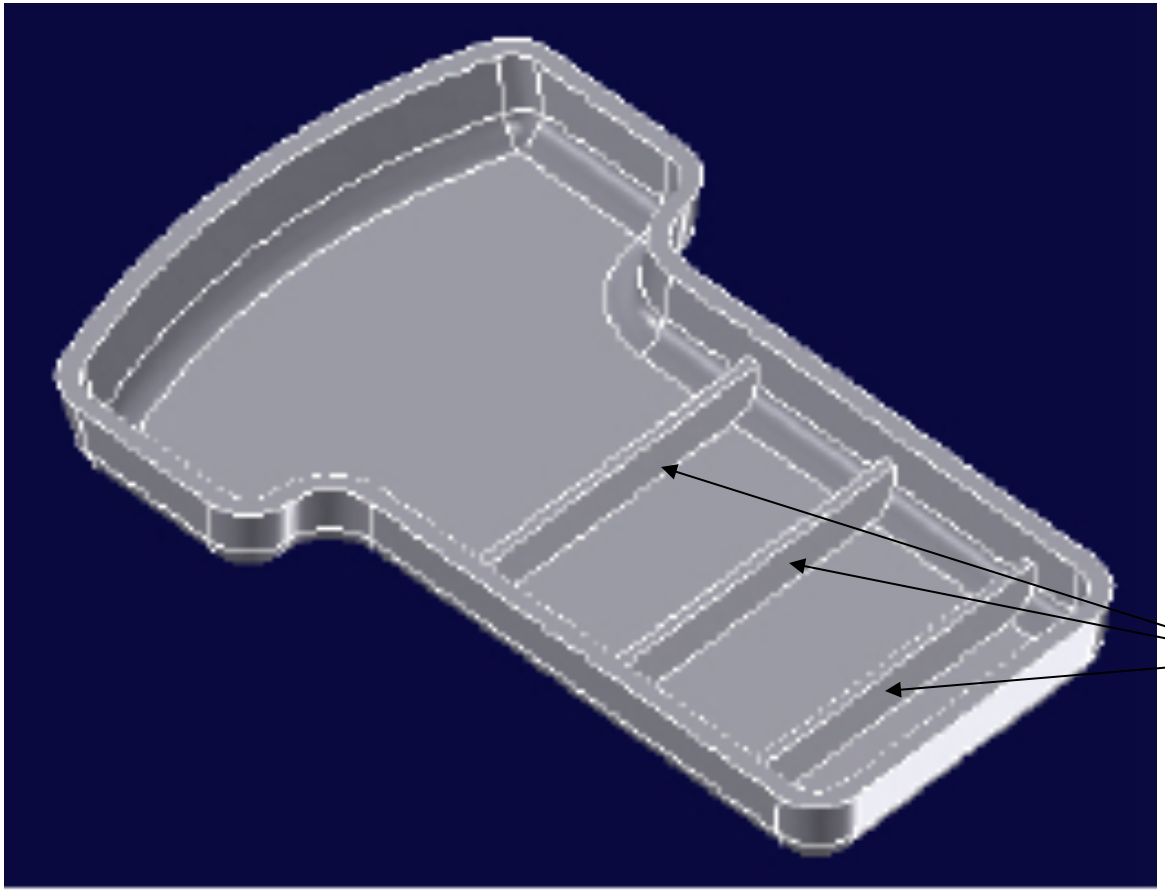
Rules of thumb…

- Fillets should be min 1/4 X Wall thickness
- High stress parts, 3/4 x Wall thickness
- Draft 0.5 - 1.5 deg. Finish affects draft. Draft facilitates part ejection.
- Ribs should be 1/2 to 2/3 of the nominal wall thickness and less than 3 times thickness in height. Ribs add strength and facilitate flow.
- Taper of 1 deg. is typical.

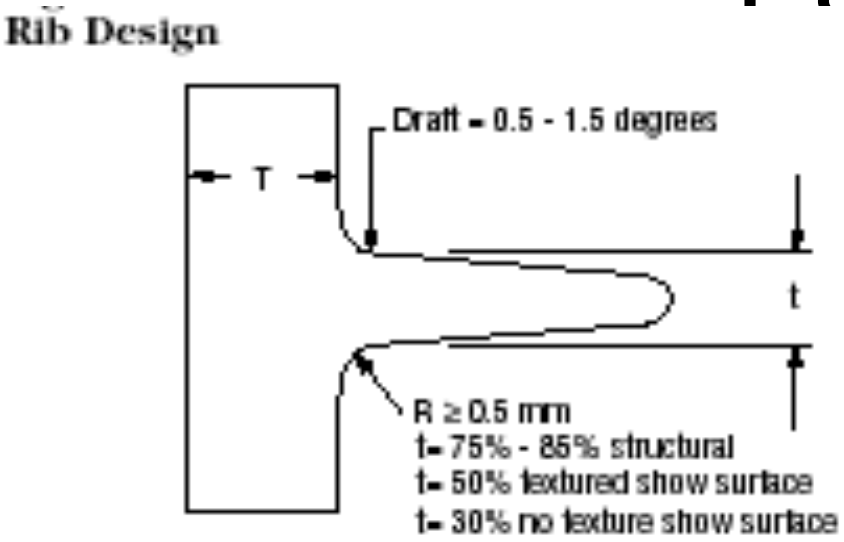
Note: excess thickness promotes shrinkage. Excess rib height combined with taper will produce thin sections requiring extra fill time at the mold

Radii - sharp corners act as stress concentrators. A minimum radius of 0.5 mm is recommended.



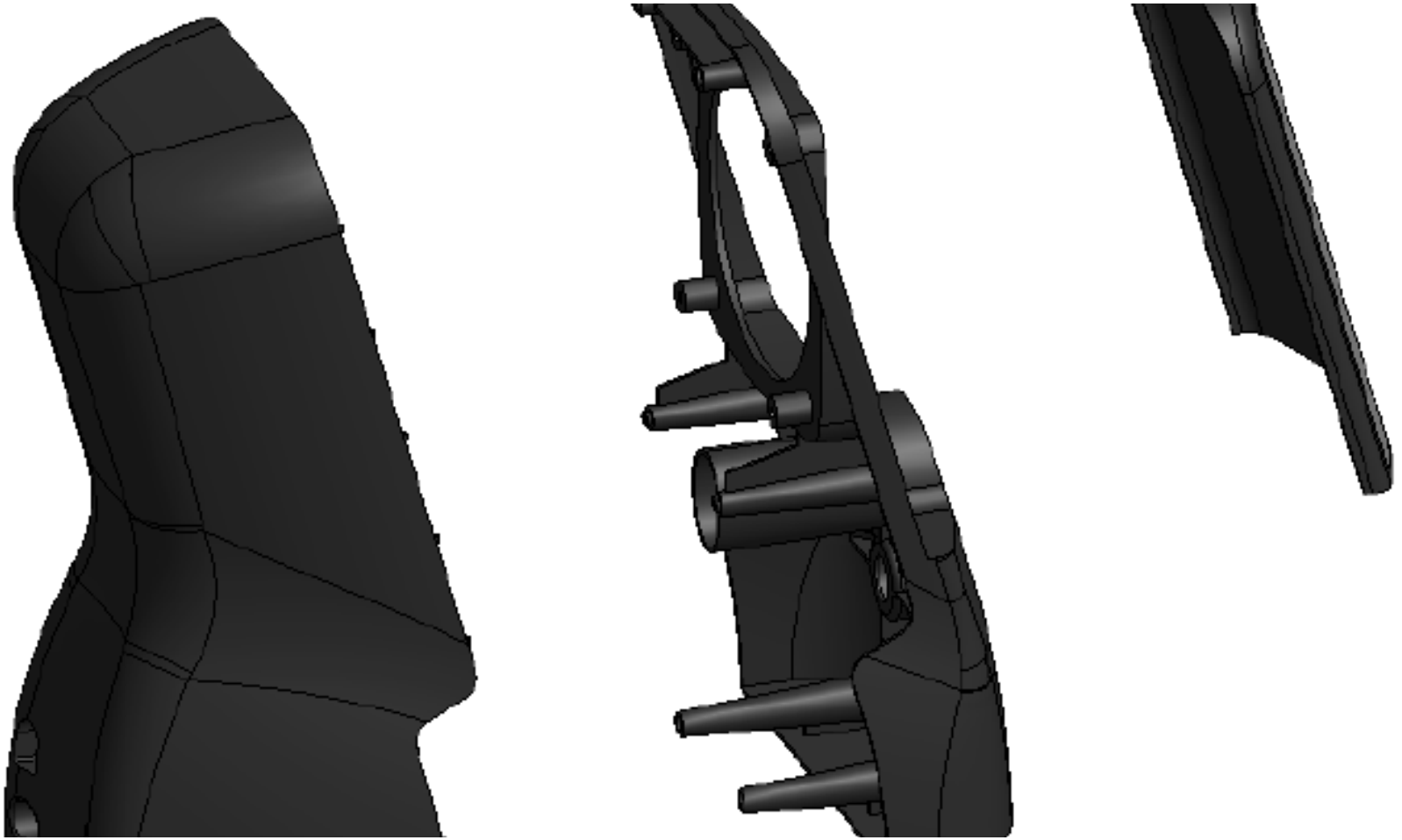

Ribs

Minimum Design Parameters

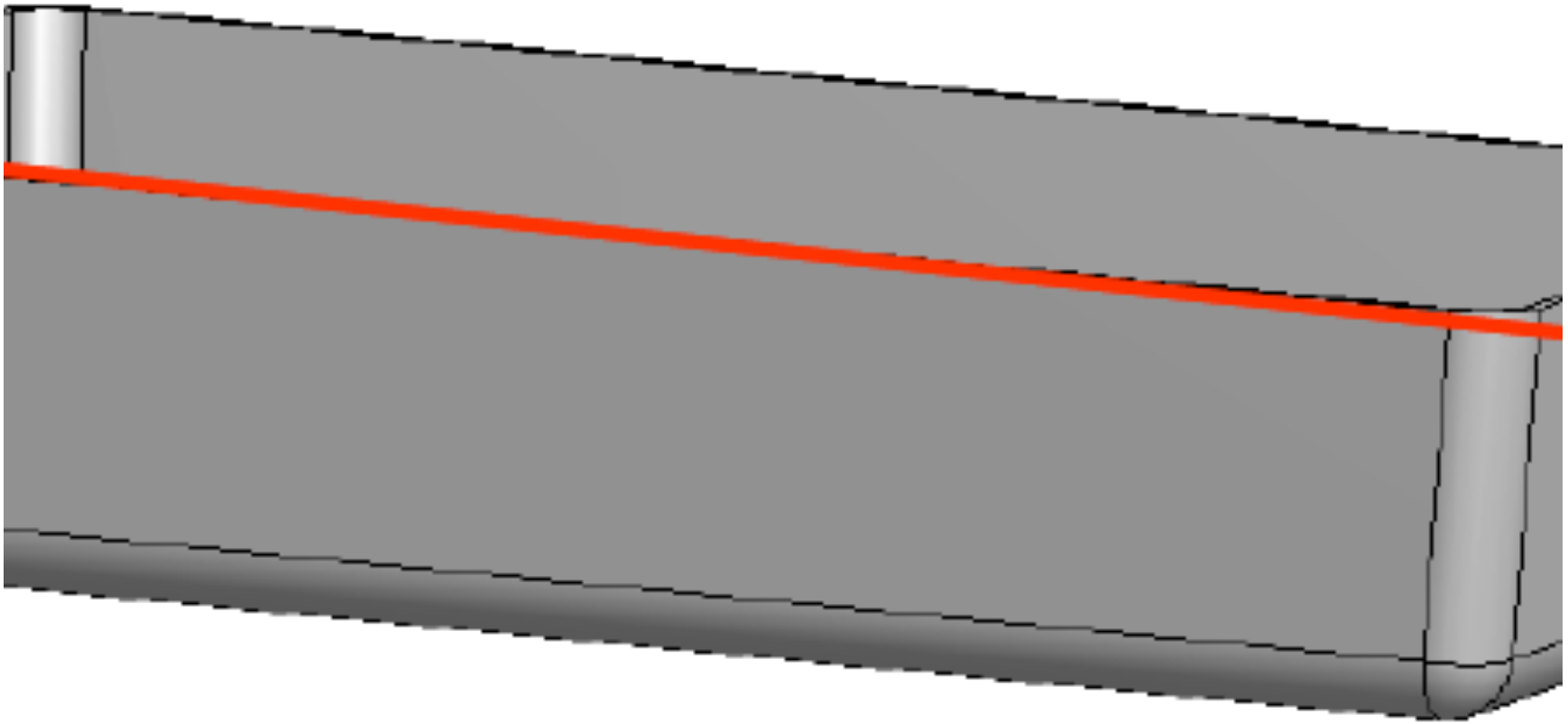


1. Wall thickness (mm) = T
2. Inside Radius (mm) = Irad = 0.75 x T (0.4 to 0.75T typical)
3. Outside Radius (mm) = Orad = Irad + T (1.5 to 1.75T)
4. Draft (degree) = 0.5 to 1.5 (typical 1 degree)
5. Rib (mm) = T x 0.6666 (1/3 to 2/3 of T)

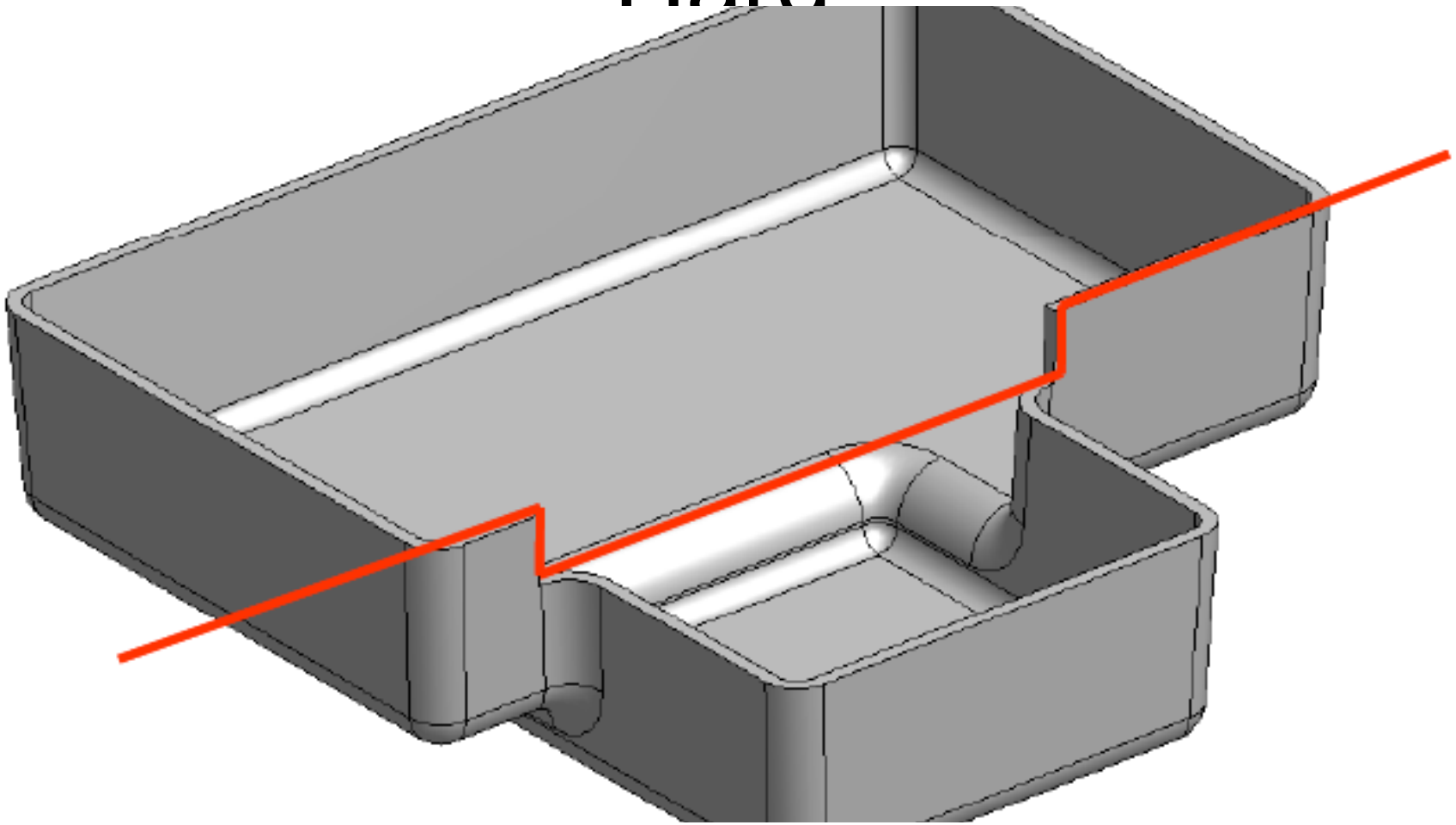
Parts Splitting and Fastening



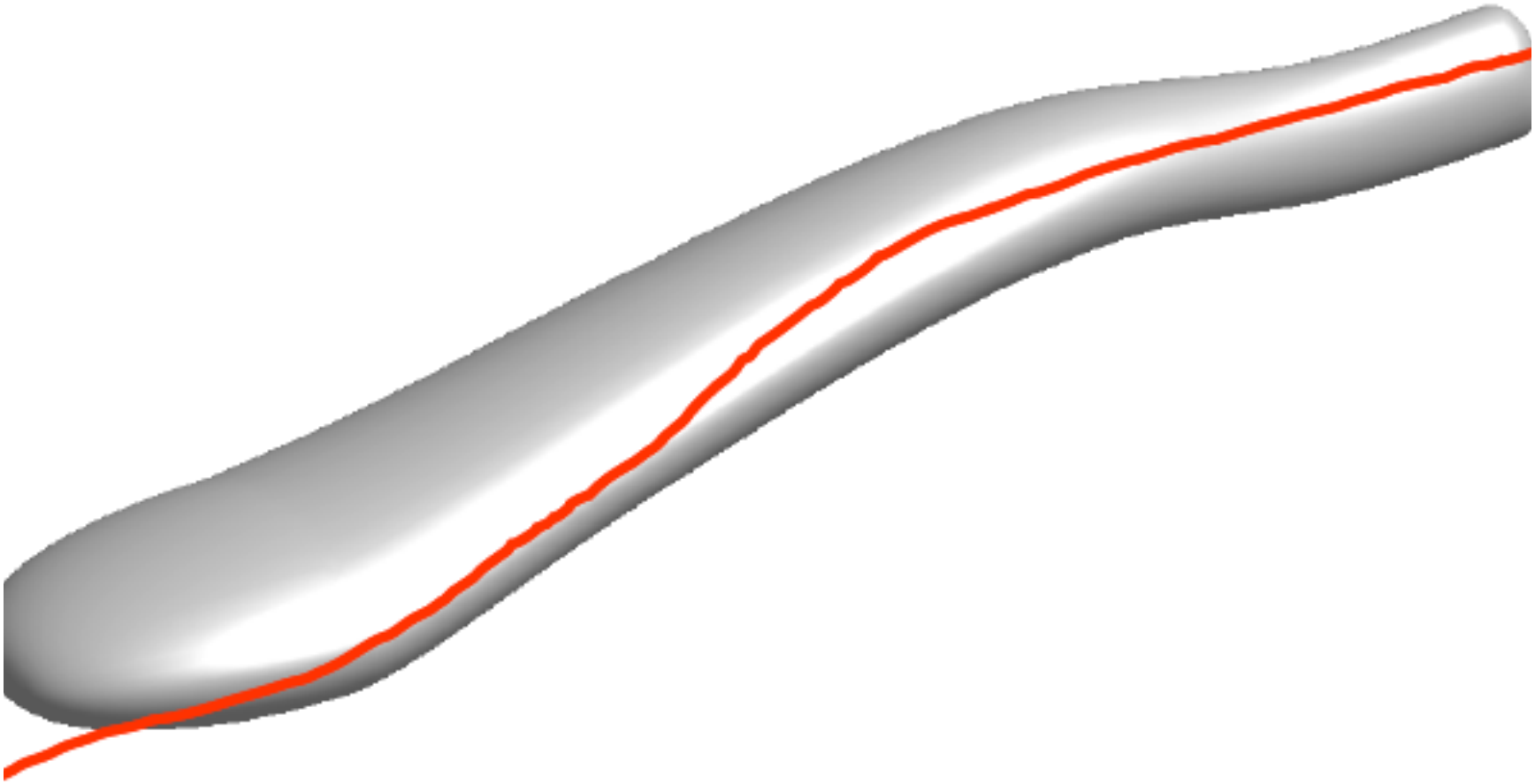
Easy

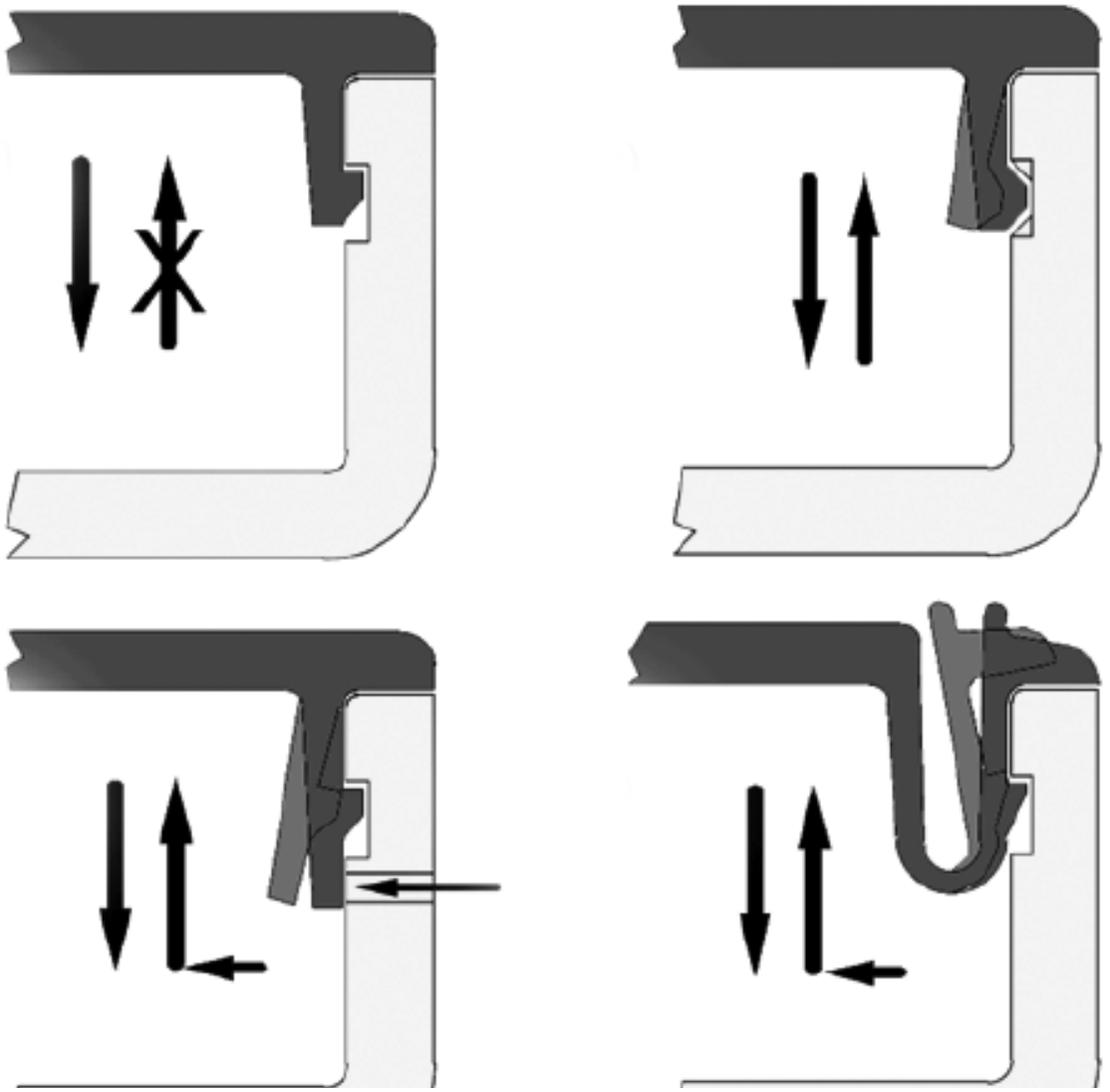


Hard

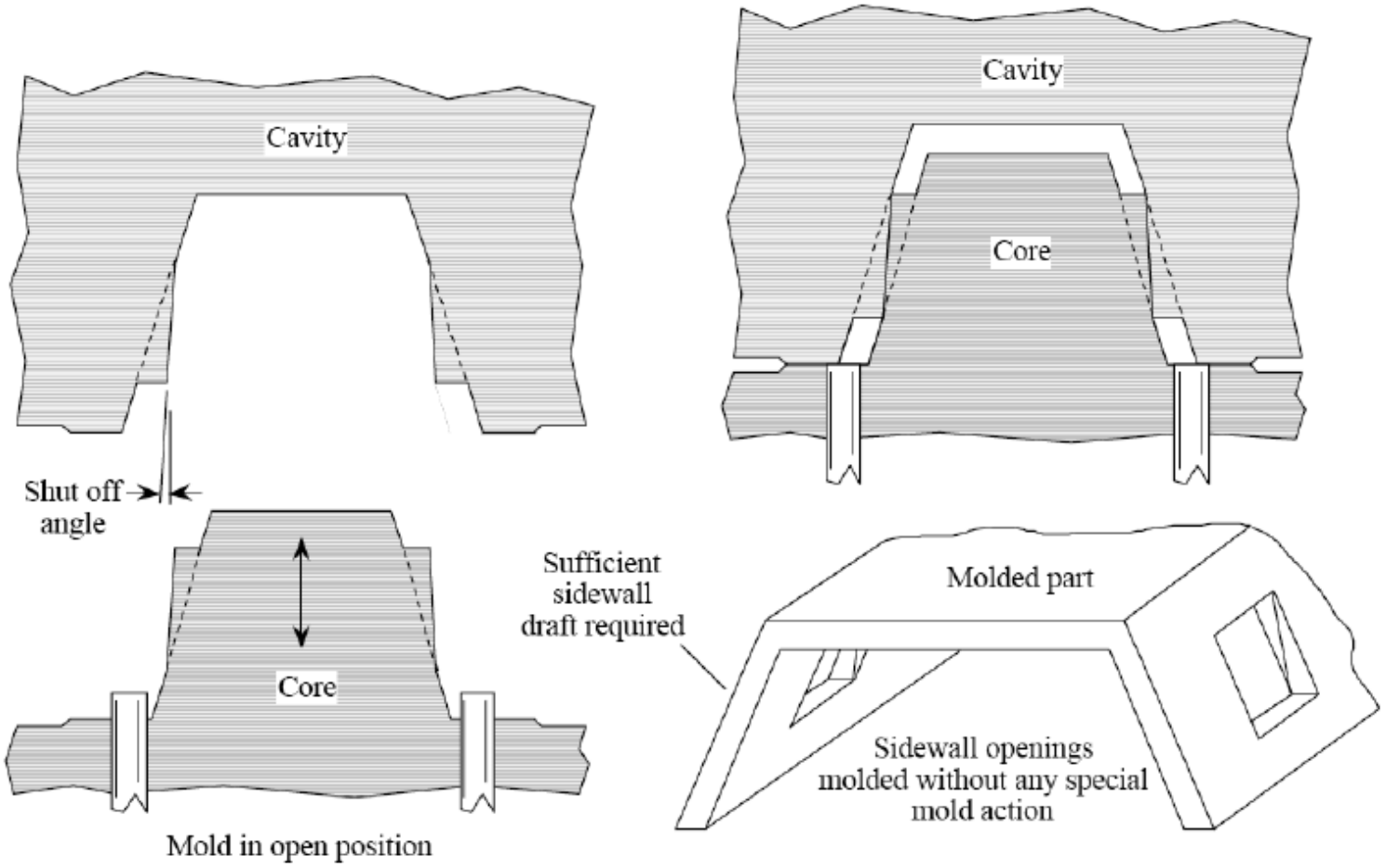


Impossible

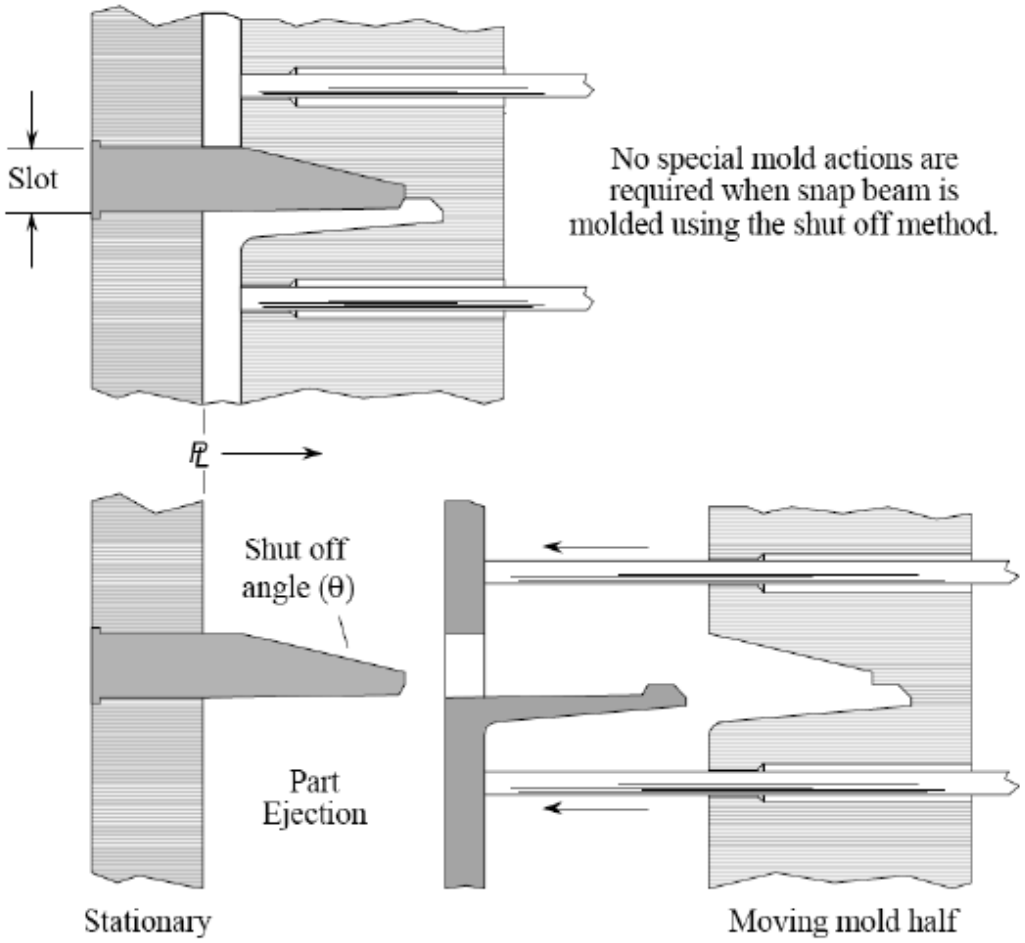




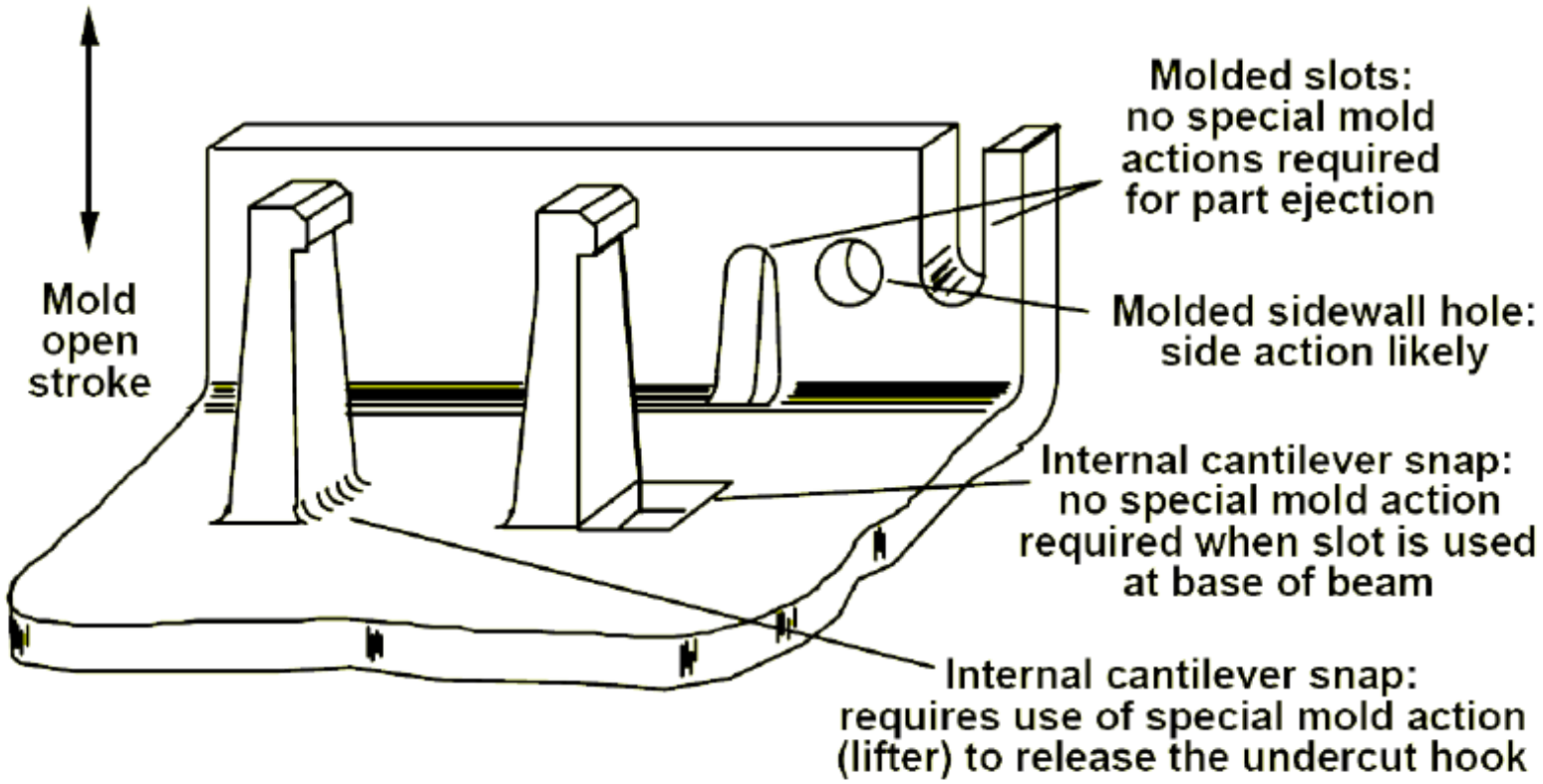
Snapping Features



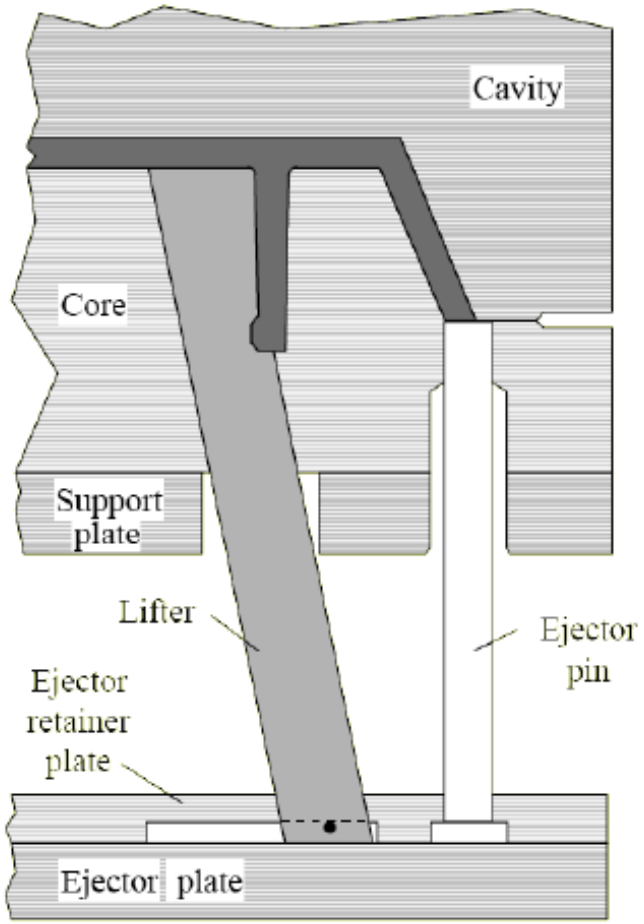
Snapping Features

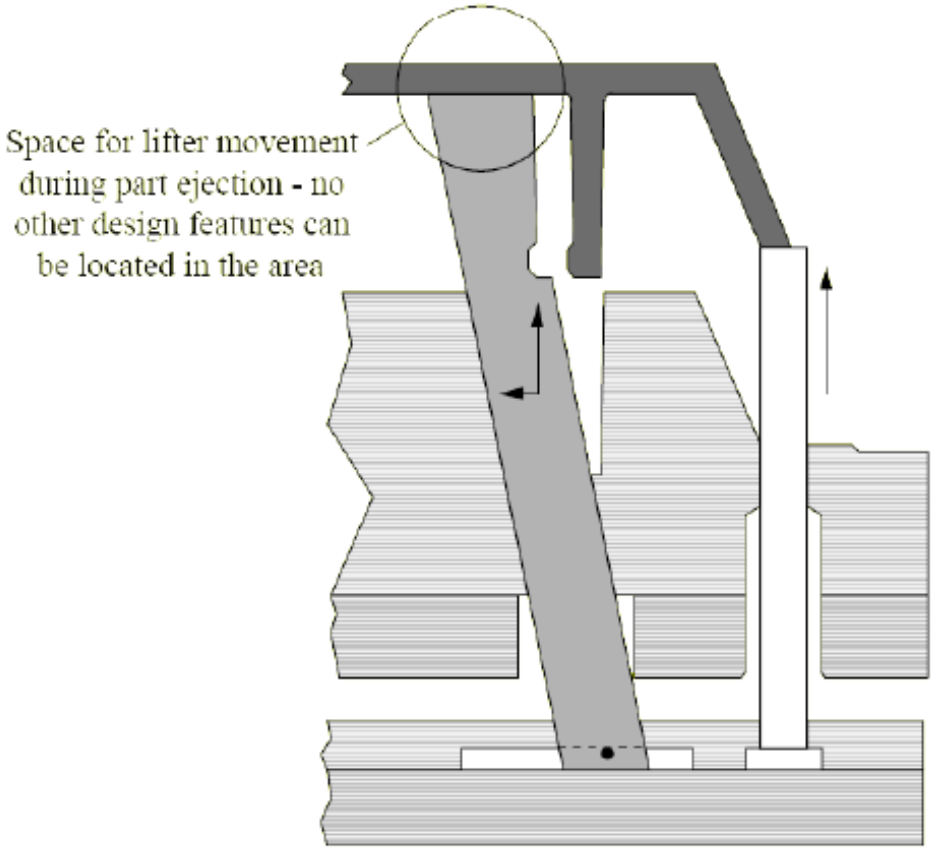


Snapping features and ejection

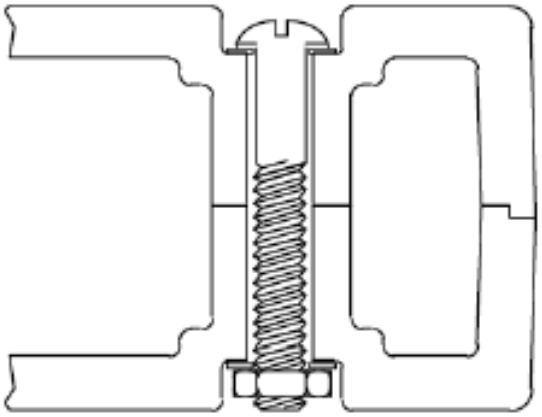


Snapping Features and ejection





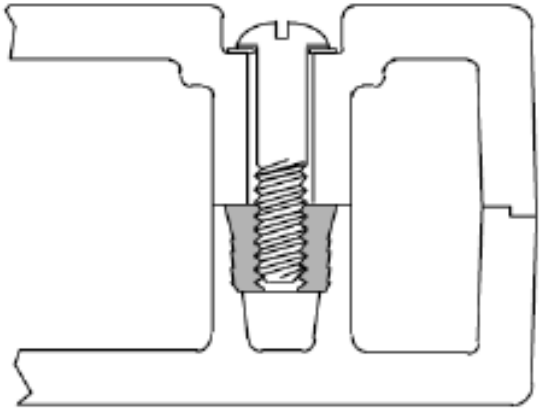
(a.)



Machine screw and nut

- Esthetic interuption on both top and bottom surfaces
- Many parts required for assembly
- Access to both top and bottom of part is required during assembly
- Need locking hardware to avoid vibration loosening
- Durable assembly

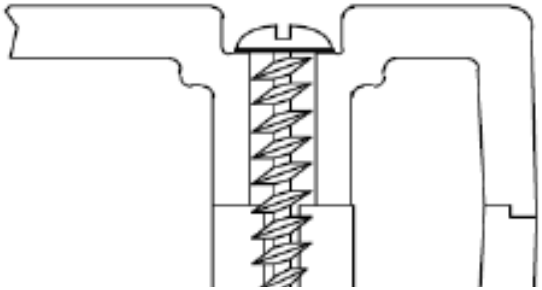
(b.)



Machine screw and insert

- One clean smooth surface obtained
- Fewer parts required for assembly
- Internally threaded insert must be inserted into boss during or after molding
- Requires special equipment / tooling for insert
- Good overall durability
- Suitable for repeated assembly

(c.)



Self threading screw and plastic boss

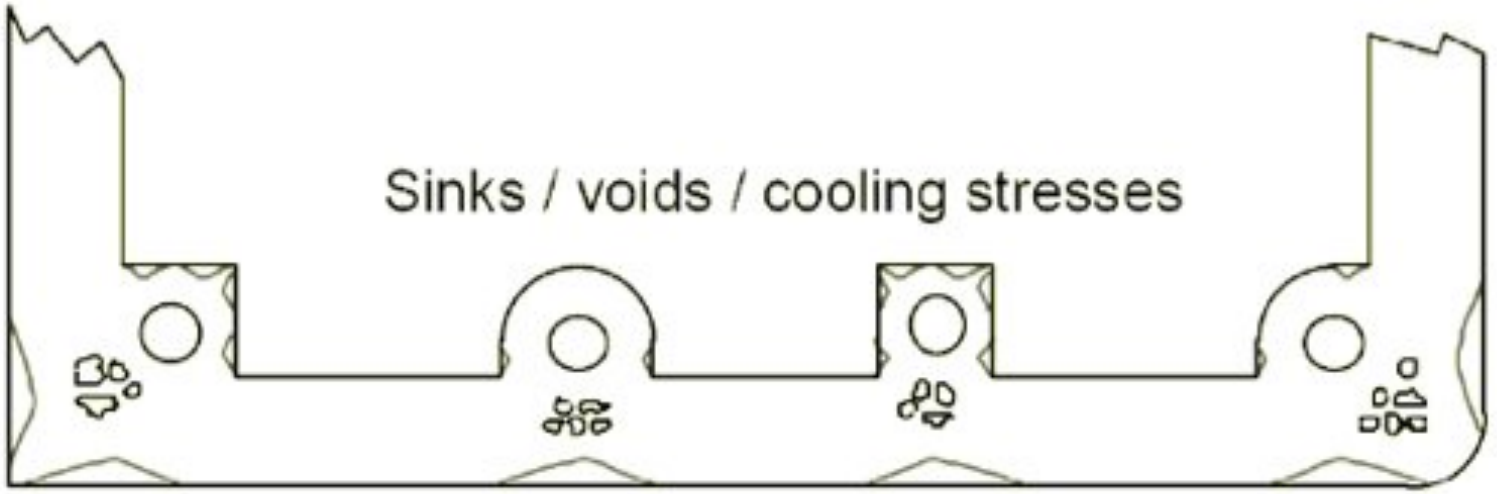
- One clean smooth surface obtained
- Minimum number of parts required for assembly
- Mating plastic threads formed during assembly

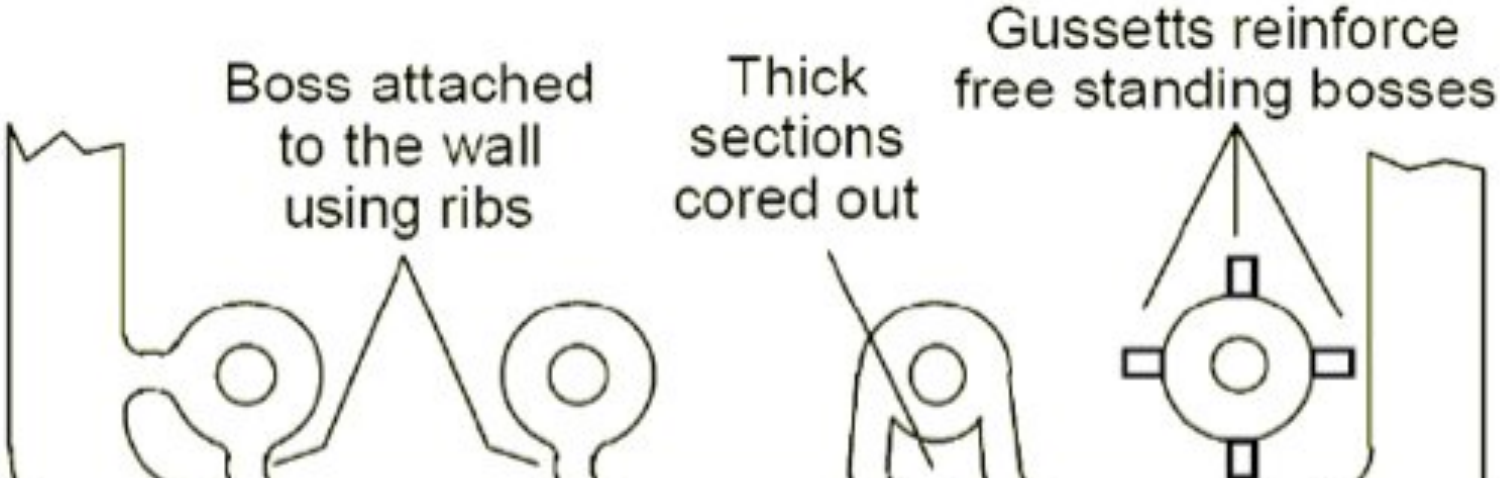
Fastener Limitations

- Mechanical fasteners are point fasteners.
- Localized regions of potentially high stress.
- Holes >>> stress concentration and weld line formation.
- Thermal expansion mismatch.
- Additional pieces / parts.
- Gasket to achieve a fluid or gas tight seal.

Fastener Advantages

- Operable (or reversible) joints or permanent assembly.
- An effective method for joining most thermoplastic & thermosetting parts (except very flexible items).
- Join parts produced in similar or dissimilar materials.
- Available in a variety of sizes and materials.
- The joining practices are very conventional.


Sinks / voids / cooling stresses


Boss attached to the wall using ribs
Thick sections cored out
Gussetts reinforce free standing bosses