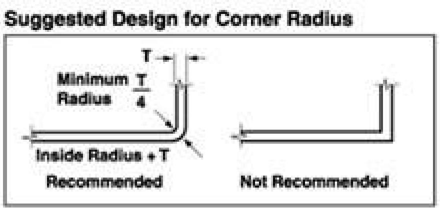
Product design terms

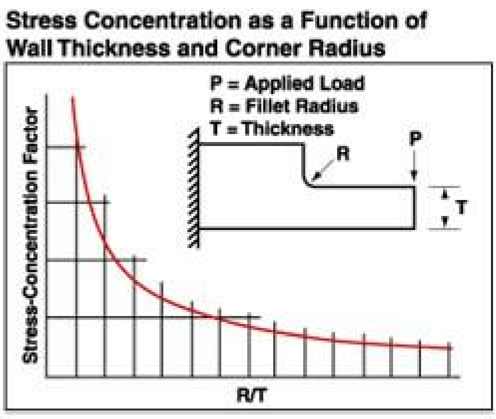
THREADS

Molded-in threads can be designed into parts made of engineering thermoplastic resins. Threads always should have radius roots and should not have feather edges — to avoid stress concentrations. The Recommended Design for Molded-in Thread illustration shows examples of good design for molded-in external and internal threads. For additional information, see molded-in threads in Fasteners. Threads also form undercuts and should be treated as such when the part is being removed from the mold i.e., by provision of unscrewing mechanisms, collapsible cores, etc. Every effort should be made to locate external threads on the parting line of the mold where economics and mold reliability are most favorable.

RADII

It is best not to design parts with sharp corners. Sharp corners act as notches, which concentrate stress and reduce the part's impact strength. A corner radius, as shown in the Suggested Design for Corner Radius illustration, will increase the strength of the corner and improve mold filling. The radius should be in the range of 25% to 75% of wall thickness; 50% is suggested. The Stress Concentration as a Function of Wall Thickness and Corner Radius illustration shows stress concentration as a function of the ratio of corner radius to wall thickness, R/T.





RIBS AND GUSSETS

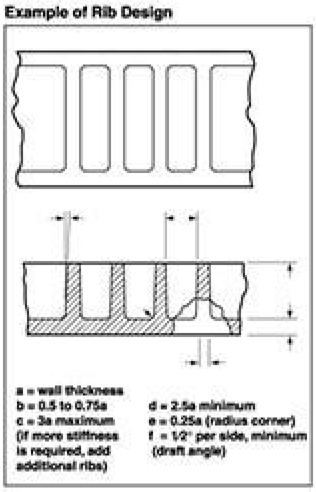
When designing ribs and gussets, it is important to follow the proportional thickness guidelines shown in the Example of Rib Design illustration and the Example of Gusset

Design illustration. If the rib or gusset is too thick in relationship to the part wall, sinks, voids, warpage, weld lines (all resulting in high amounts of molded-in stress), longer cycle times can be expected.

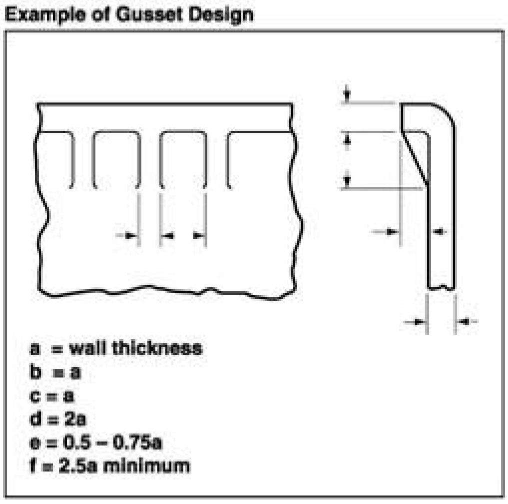
The location of ribs and gussets also can affect mold design for the part. Keep gate location in mind when designing ribs or gussets. For more information, see Gates. Ribs well-positioned in the line of flow, as well as gussets, can improve part filling by acting as internal runners. Poorly placed or ill-designed ribs and gussets can cause poor filling of the mold and can result in burn marks on the finished part. These problems generally occur in isolated ribs or gussets where entrapment of air becomes a venting problem.

Note: It is further recommended that the rib thickness at the intersection of the nominal wall not exceed one-half of the nominal wall in HIGHLY COSMETIC areas. For example, in the Example of Rib Design illustration, the dimension of the rib at the intersection of the nominal wall should not exceed one-half of the nominal wall. Experience shows that violation of this rule significantly increases the risk of rib read-through (localized gloss gradient difference).

Example of Rib Design



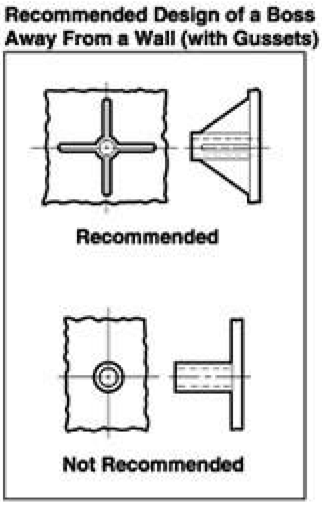
Example of Gusset Design

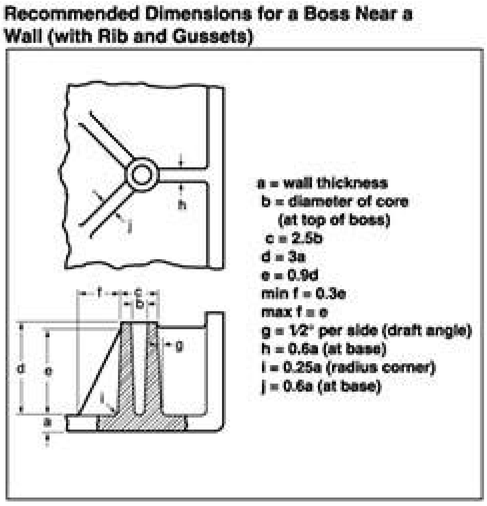


BOSSES

Bosses are used in parts that will be assembled with inserts, self-tapping screws, drive pins, expansion inserts, cut threads, and plug or force-fits. Avoid stand-alone bosses whenever possible. Instead, connect the boss to a wall or rib, with a connecting rib as shown in the Recommended Design of a Boss Near a Wall (with Ribs and Gussets) illustration. If the boss is so far away from a wall that a connecting rib is impractical, design the boss with gussets as shown in the Recommended Design of a Boss Away From a Wall (with Gussets) illustration.

The Recommended Dimensions for a Boss Near a Wall (with Rib and Gussets) illustration and the Recommended Dimensions for a Boss Away From a Wall (with Gusset) illustration give the recommended dimensional proportions for designing bosses at or away from a wall. Note that these bosses are cored all the way to the bottom of the boss.

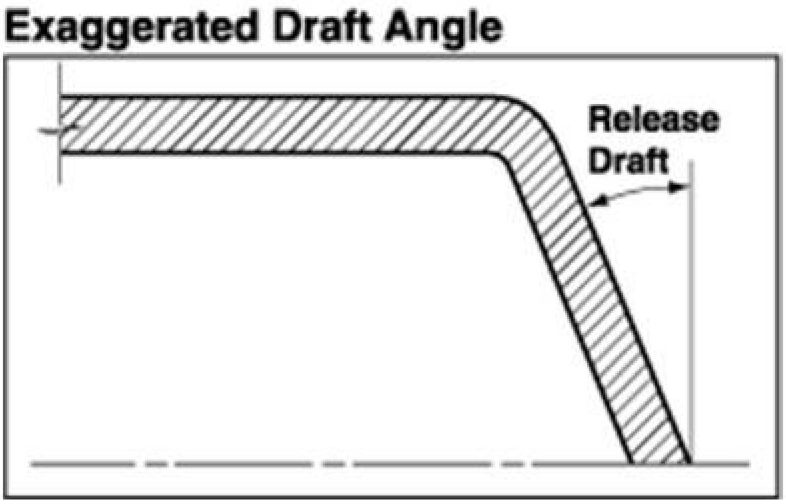




DRAFT ANGLE

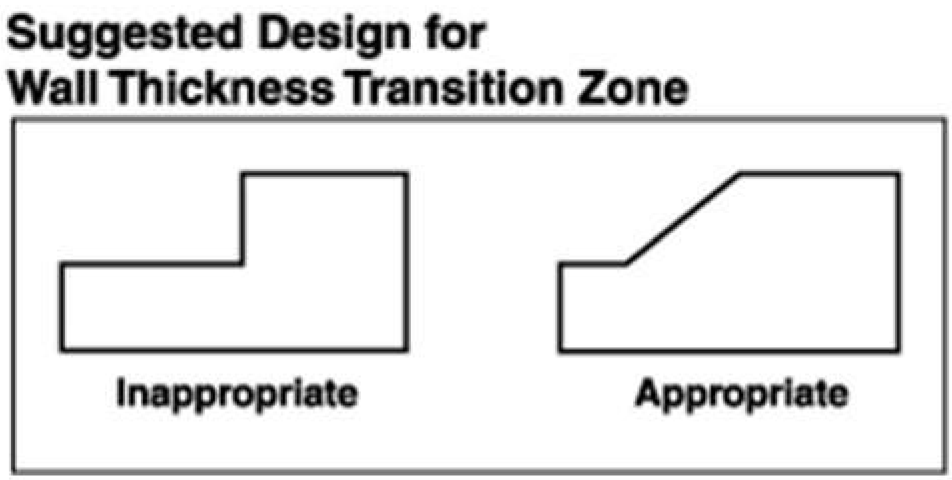
So that parts can be easily ejected from the mold, walls should be designed with a slight draft angle, as shown in the Exaggerated Draft Angle illustration. A draft angle of 1/2° draft per side is the extreme minimum to provide satisfactory results. 1° draft per side is considered standard practice. The smaller draft angles cause problems in removing completed parts from the mold. However, any draft is better than no draft at all.

Parts with a molded-in deep texture, such as leather-graining, as part of their design require additional draft. Generally, an additional 1° of draft should be provided for every 0.025 mm depth of texture.



NOMINAL WALL THICKNESS

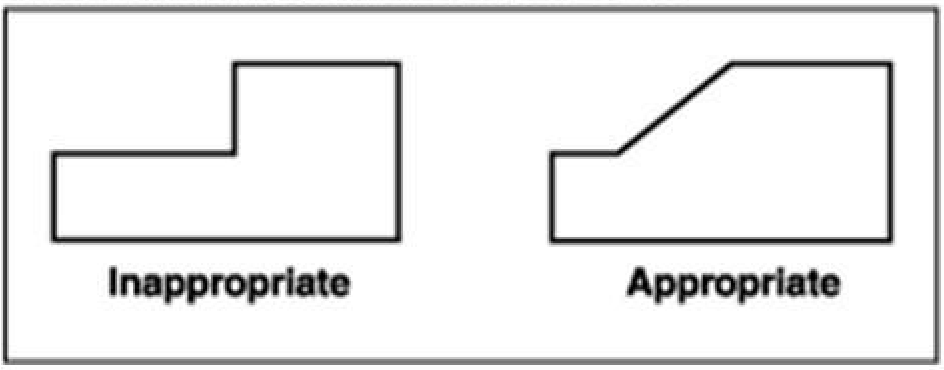
For parts made from most thermoplastics, nominal wall thickness should not exceed 4.0 mm. Walls thicker than 4.0 mm will result in increased cycle times (due to the longer time required for cooling), will increase the likelihood of voids and significantly decrease the physical properties of the part. If a design requires wall thicknesses greater than the suggested limit of 4.0 mm, structural foam resins should be considered, even though additional processing technology would be required.
In general, a uniform wall thickness should be maintained throughout the part. If variations are necessary, avoid abrupt changes in thickness by the use of transition zones, as shown in the Suggested Design for Wall Thickness Transition Zone illustration. Transition zones will eliminate stress concentrations that can significantly reduce the impact strength of the part. Also, transition zones reduce the occurrence of sinks, voids, and warping in the molded parts.
A wall thickness variation of ±25% is acceptable in a part made with a thermoplastic having a shrinkage rate of less than 0.01 mm/mm. If the shrinkage rate exceeds 0.01 mm/mm, then a thickness variation of ±15% is permissible.



UNDERCUTS

Because of the rigidity of most engineering thermoplastic resins, undercuts in a part are not recommended. However, should a design require an undercut, make certain the undercut will be relieved by a cam, core puller, or some other device when the mold is opened.

Suggested Design for Wall Thickness Transition Zone



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