

Engineered blow molding : Basic concepts

Engineered blow molding offers a highly versatile process for fabricating parts. Effective designs for its blow molding take advantage of the inherent advantages of the process

- “Hollow” aspect of design
- Strength-to-weight structural integrity
- Suitability for large shapes

The designer must also work within process limitations, including

- Extent to which material can be stretched
- Degree to which complexity/detail can be reproduced
- Part length limitation by material melt strength

And the design must make economic sense compared to other processes and materials.

The design/processing relationship

Engineered blow molding forms parts by blowing a hollow parison outward to conform to the shape of the mold (figure 1). Inherent to this process is stretching of the thermoplastic resin material. That stretching thins the walls. Forcing the material to stretch too much may make it impossible control wall section thickness or even cause the parison to rupture/fracture.

How much stretching occurs in the blow molding of the parison is determined by the degree of asymmetry in the basic shape and by amount of complexity and localized detail in the part.

The designer can evaluate the suitability of a part for blow molding by examining the blow ratio conditions in the part. The term blow ratio describes a relationship between depth and width, and relates to the amount of material stretching that results.

Each case must be considered separately. The following approach is suggested

1. Examine the basic shape for blow ratio problems. The amount of sideways parison travel should be less than parison length. One way to address the problem is to make sure that the part is properly oriented in the tool.
2. Review complex sections and part details. Figure 2 shows the local area of complexity.
 - Decreasing the width W or increasing the depth D will require the material to stretch more to force through opening.
 - Filling this detail will cause gains, particularly at corners.
 - Minimize depth, and maximize width

Multiple blow ratios

A part may have dozens of blow ratio conditions if the design is a complex one. Figure 3 shows a situation where there are two separate conditions in a single area of detail. These conditions should be studied early on to determine whether various details can be reproduced in molding. Experience provides the best guide to assessing moldability and predicting local wall thickness.

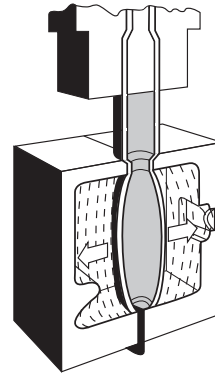


Figure 1

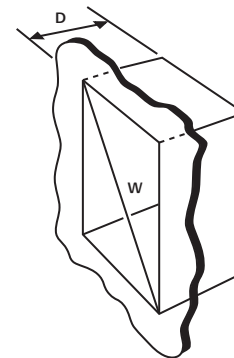


Figure 2
Review the design's blow ratio to assure moldability

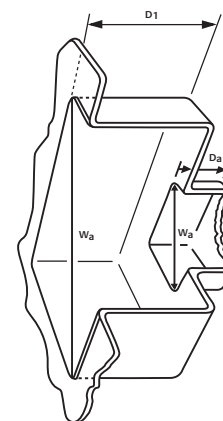


Figure 3

The situation of the part in figure 4 demonstrates what happens when three blow ratios exist

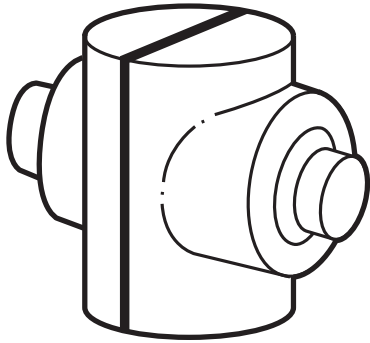
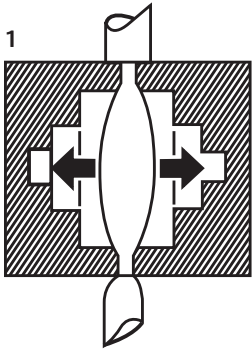
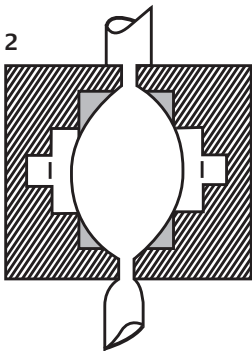


Figure 4

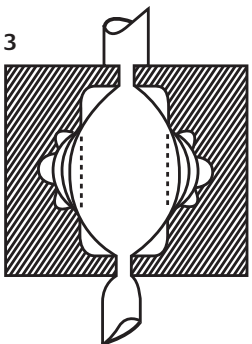
1. Mold closes; parison begins to expand



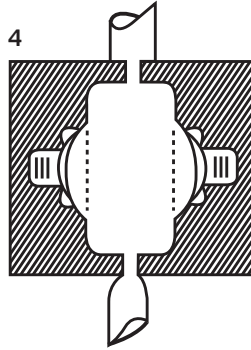
2. Contact with first blow ratio condition thinning begins



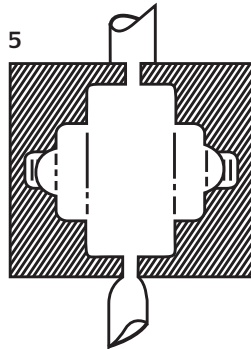
3. Parison expands into second opening



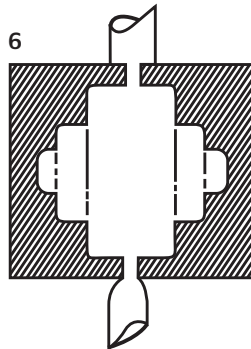
4. Second condition encountered; more thinning



5. Parison expands into third opening



6. Third condition maximum thinning occurs here



Designing for Basic Shapes

Some common blow molded shapes present standard situations.

- Part is oriented so that the longest side is parallel to direction of parison drop (figure 5).
- Parison is pinched and preblown before the mold is closed.
- Mold closing action flattens "round" parison into shape.
- Corners tend to thin the most.

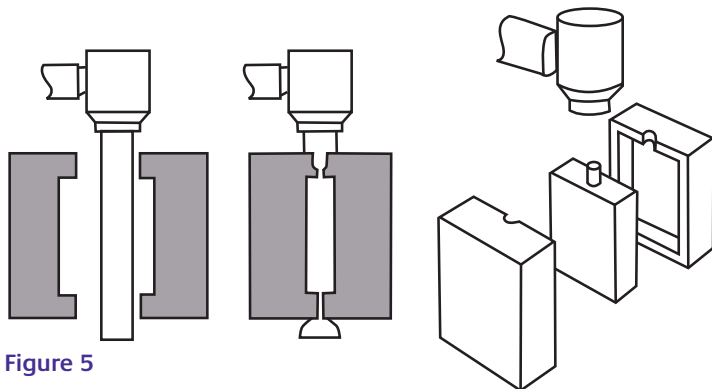


Figure 5

L-shapes

- Part is oriented at an angle to minimize the amount of stretching (figure 6).
- Closing mold pushes the parison flat into shape.
- Thinning occurs at angles and corners.
- Some L-shapes cannot be molded because they require too much stretching.

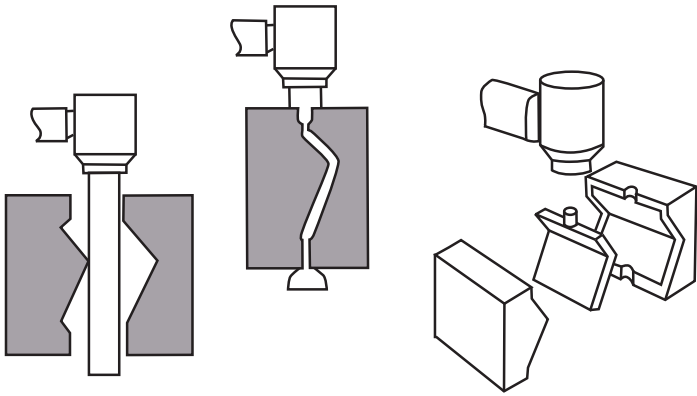


Figure 6

U-shapes

Parts that are U-shaped are of limited moldability (figure 7).

- “Legs” must be short to avoid a material distribution problem.
- Center section is oriented in the direction of the parison.
- Locate centroid and balance amount of material in each half of the tool.

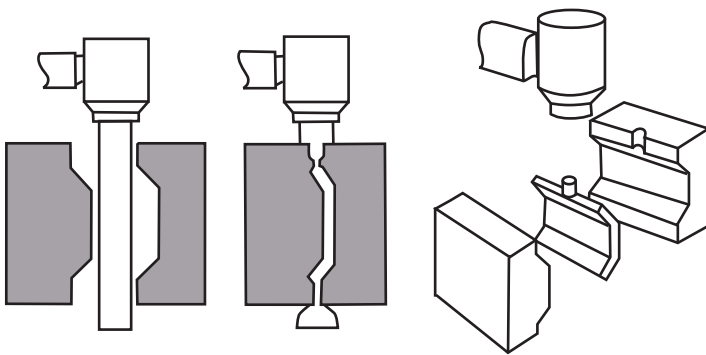


Figure 7

S-shapes

The moldability of S-shapes is also limited (figure 8).

- Orient so as to minimize the parison travel.
- Material thinning occurs at edges and corners.

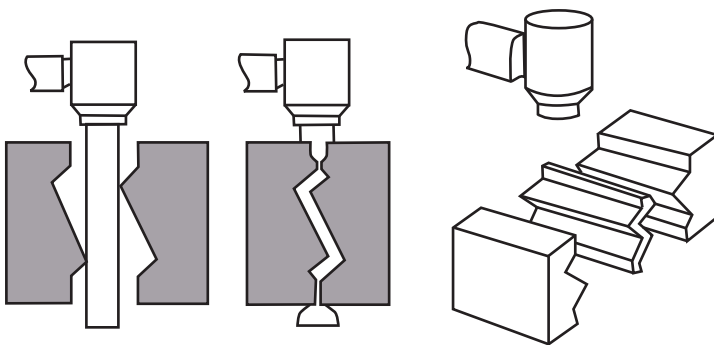


Figure 8

Hollow shapes are inherently stronger because of their structure. This existing structure can be enhanced without changing the material in three basic ways

1. Increase the nominal wall thickness of the part.
2. Balance section modulus through ribbing a single wall (figure 9).

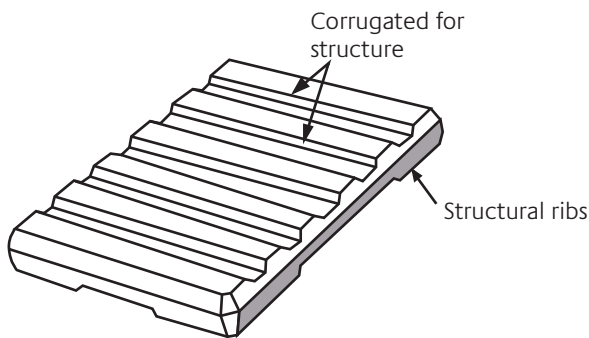


Figure 9

3. Develop compression tacking details or patterns (figure 10). Sidewalls are forced together by the closing action of the mold to form a single wall. This creates local areas with locally thick walls. It also develops localized beam sections more resistant to bending, tension and torsion. Beware of “read-through” from compression; avoid tacking in appearance areas.

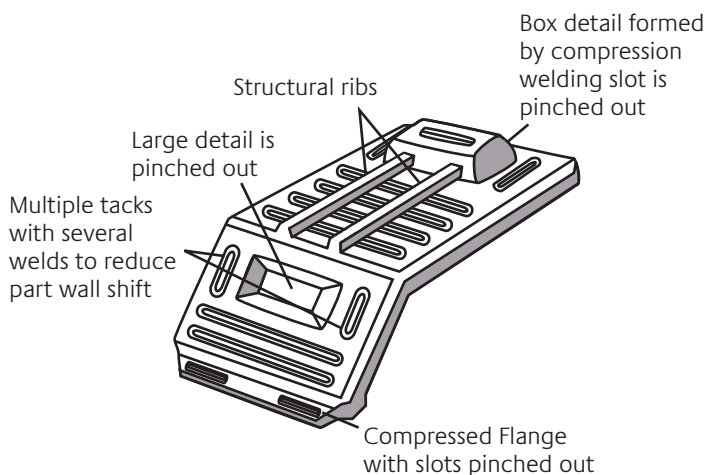


Figure 10

Summary

- Take maximum advantage of the inherent process strengths.
- Develop a basic shape that can be molded.
- Assess the moldability of details, and avoid blow ratio problems.
- Build structure into the part.
- Seek to make the design as simple as possible.
- Check economics against other process approaches .

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