LyondellBasell Technical Tip

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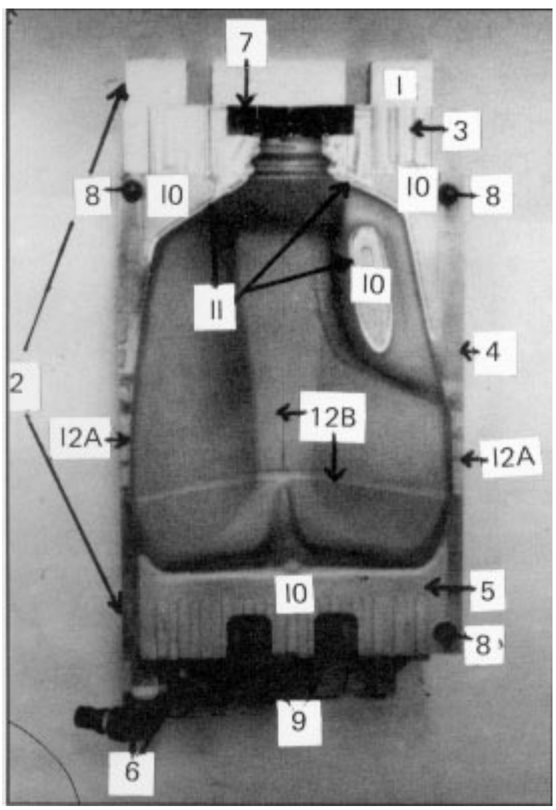
The Mold — Where the Bottle Shapes Up

The molds are the portion of the blow molding machine that shape and cool the bottle before it is released for trimming. Each mold consists of two halves called "cavities." All cavity pieces are machined from solid pieces of aluminum, except for the shear steel, locating pins and bushings. Forged alloy aluminum has high strength, light weight, good machinability, excellent thermal conductivity and low cost. The cavities are made slightly larger than the finished container to allow for shrinkage.

Each cavity consists of several parts (see Figure 1).



1. Backing plates that allow for easy mounting of cavities to movable platens. These platens incorporate slots in the top and bottom for slight adjustments vertically and horizontally.
2. The cavity, one half of the mold, consists of three major parts: neck ring, body and bottom insert.
3. The neck ring, an aluminum block mounted to the top of the mold body, is the portion of the mold that forms the threads of the finish. Within the container design, any of several styles of finish can be interchanged.
4. The mold body is the portion of the mold that forms the body of the bottle.
5. The bottom insert is an aluminum block mounted to the bottom of the mold body that forms the bottom of the bottle. The bottom insert, like the neck ring, serves two purposes: (the bottom insert includes areas that are likely to wear and can, therefore, be replaced without scrapping the entire mold and (b) the bottom insert provides an opening to the cavity that permits the mold maker to accurately match up the cavity halves at the parting line.
6. The coolant inlet and outlet are how chilled water is supplied to the molds. The inlet and outlet fittings are threaded into cooling channels machined into each cavity. These cooling channels are generally in the form of holes drilled from the top of the cavity to the bottom and are joined by cross-wise channels. These channels are drilled and plugged so cooling water can be introduced into one of the channels in the bottom. Then the water flows in a zigzag pattern throughout the cavity and exits on the other side of the cavity at the bottom.
7. The shear steel, in conjunction with the blow pin, forms the inside diameter of the finish. The sheer steel is incorporated in the form of a hardened insert that may be replaced when worn. With the pull-up system of blow molding finishing, the blow pin moves up just prior to mold opening, shearing plastic material to form an accurate, smooth and burr-free inner diameter.
8. Locating pins and bushings are located in the cavities to align the mold halves when closed. There must be at least two sets of hardened pins and bushings to accomplish this task. The pins are located in one cavity and the bushings in the other. For mold materials such as aluminum, a shoulder-type

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9. Tail-grabber slots are incorporated in the bottom insert to facilitate automatic unloading of the bottle from the mold to a conveyor system. The unloading system is comprised of fingers attached to a swinging arm. During unloading, the swing arm moves up and the fingers enter the tail-grabber slots. The fingers then close on the tail of the bottle. When the molds open, the swing arm moves down and places the bottle on a conveyor. This operation repeats for every cycle.
10. Flash pockets are reliefs milled into the mating cavity surfaces to permit displacement of excess plastic material. The depth of the relief is critical for proper molding and trimming. If the relief is too shallow, the mold does not close completely, resulting in poor pinch-offs and parting lines. If the relief is too deep, the flash does not contact the mold surface for proper cooling, resulting in trimming problems.
11. Pinch-offs are areas in the cavity where the parison is squeezed very thin and welded together. The pinch-off (a) must be structurally sound to withstand the pressure of the plastic material and repeated closing cycles of the mold, (b) must push a small amount of material into the interior of the part to slightly thicken the weld area and (c) must cut through the parison to provide a clean break point for flash removal.
12. Vents are used to allow trapped air between the outside walls of the expanding parison and the inside of the cavity to escape. Venting is accomplished by various means. Sandblasting the cavity surface provides effective venting because HDPE does not duplicate the rough mold surface at relatively cold mold temperatures and low blow pressures. Instead, the plastic lies and bridges across the high points, providing minute passageways for trapped air. The mold is further vented by relieving areas (12A) along the parting line 0.003 inches to 0.004 inches deep. For additional venting, some molds are made with split construction (12B). The bottom insert split point is incorporated in the mold for assembly convenience as well as venting. With split construction, the mold is generally split again at the center of the cavity running vertically between the bottom insert neck ring. These gaps are normally 0.003 inches to 0.004 inches wide. Vent slots, normally more expensive, are preferred over vent plugs, drilled holes or knockout pins. Large vent openings can be provided with slots without unsightly marks to spoil the surface of the bottle.

For more information about blow molding, contact your LyondellBasell sales or technical service representative.

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