Building a Better Plastic Part

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Gas-assist techniques fit the bill for certain plastic parts that require more than standard injection-molding techniques.

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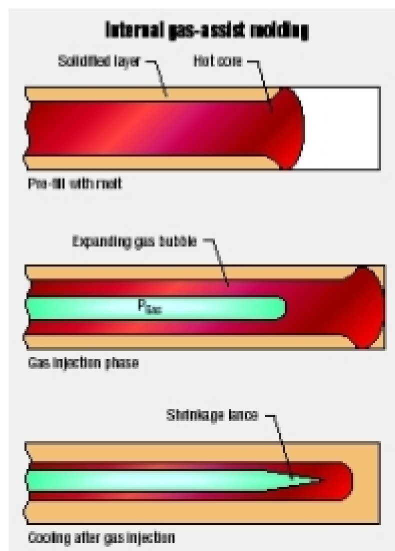
Tooling limitations and structural requirements rule out standard injectionmolding methods when making certain plastic parts. These include rod-shaped items, large, cover-shaped components, and complex parts with localized heavy sections. Also included are components with bosses, ribs, and thick sections requiring a sink-free cosmetic surface. These parts require services providing specialized gas-assist techniques. Typical medical applications include handles, panels, enclosures, and overmolded and painted parts.



As the mold fills with plastic, a shrinkage lance forms at the tip of the gas bubble and prevents the molded part from sinking inward.

Gas-assist techniques
Several different gas-assist techniques all use the same basic process. A stand-alone gas-assist unit containing nitrogen gas connected to an injection-molding machine forces gas into a mold cavity after it has been injected with molten plastic. Gas either flows into a nozzle and through the mold sprue, runners, and gates into the hot core of the melt, or it flows directly into the part through one or more gas needles.

One technique called **internal gas-assist** involves either *short-shot molding*, in which the cavity is partially filled with melt before gas is injected, or *full-shot molding*, in which the cavity fills completely before injecting gas. Variants of this, in turn, include full-shot molding with over-spill. There, the cavity fills completely, gas is injected, and then overspill cavities open. Full-shot molding with resin pushed back into the barrel is similar to overspill, but it uses the machine barrel as the overspill cavity.

The grab rails and handle on a defibrillator for ambulances were made using the overspill

Another technique, **external gas-assist,** applies nitrogen gas behind the core of the part after melt injection. Variants use lowtemperature nitrogen gas. Another uses water instead of, or in addition to, nitrogen.

Using water as the hollowing medium produces parts in shorter cycle times because it naturally removes heat from the center sections of the molded part.

Internal gas-assist
Shortly after injecting a mass of plastic, its outer layer begins to solidify. This layer increases thickness from when injection ends and gassing begins. Injected gas always takes the path of least resistance through cores of thicker or hotter portions as it flows in the direction of the melt front.

As the gas advances, it displaces molten plastic and pushes it into unfilled cavity areas.

The almost constant gas pressure guarantees an even distribution across the molded part. After a complete volumetric filling, the gas pressure acts like the holding pressure typical to conventional injection molding. A so-called shrinkage lance forms at the tip of the gas bubble. This internal pressure prevents the molded part from sinking inward. After the gassing phase, pressure is lowered either by gas recycling or releasing gas into the atmosphere. Molded parts can be ejected as soon as the internal pressure reaches ambient pressure.

process.

Cross-section of a side handle

A cross-section of a side handle shows a cutaway view of a gas channel.

Cross-section of a keyboard

A cross-section of a complex keyboard for a medical system shows gas channel and gas nozzle locations, as well as handle, tubular, and localized thick sections that were produced by an internal gas-assist technique.

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External gas-assist
External gas-assist applies nitrogen behind the non-cosmetic surface after melt injection. The gas forms a blanket on the core side, uniformly pressing the cushioned core against the cavity and gently squeezing out sink marks. The result is a solid part without gas holes, voids, or marks from gas lines on cosmetic surfaces.

Here, compensation for shrinkage comes from the core side of the part due to the applied gas pressure.

Application examples
Combining material selection with computer modeling is key to successfully meeting structural, mechanical, and regulatory requirements. Some applications allow combining techniques. Part examples include:

Handles with cross-sections of up to more than 1.5-in. width or diameter call for overspills to ensure a properly hollowed-out cosmetic and mechanically structural part.

Large covers can be designed with a number of gas-channels that create a network. This network acts as a flow leader, which encourages flow in a particular direction, and helps reduce the press tonnage typically required for larger parts. In one application, for example, gas-assist technology reduced the required tonnage for molding a cover-shaped part from an initial 3,500 tons to less than 1,500 tons.

Keyboards with handles may require coring-out the whole perimeter of the part.

Automated external defibrillators require no sink marks in areas with mass accumulations for a subsequent overmolding step.

Parts made with gas-assist technology can be metallized or powder coated in a secondary operation so they can be used for shielding, or even to make them electrically conductive.

A few benefits
Gas-assist technology simplifies part design and reduces costs. For example, compared to a structuralfoam process, paint costs can be cut, or eliminated for lighter colors. Gas-assist processes avoid undercuts because of the inherent ability to create thicker sections. Tooling is thus less complicated, less expensive, and more reliable.

In addition, the technology produces structurally stronger parts, which improves product safety. It also uses less material for a structurally sound part, thereby reducing part cost. The technology also allows creating functional channels within parts without the limitations of tooling actions. Lastly, parts tend to be much flatter than conventional injection-molded parts because pressure applied to different sections of the part is more equal and much lower than that of conventional holding pressures.

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