THERMOFORMING MACHINERY

The Thermoformers Resource

590 Tower Boulevard
Carol Stream, IL 60188, USA
Tel: 630-665-1700 / Fax: 630-665-7799

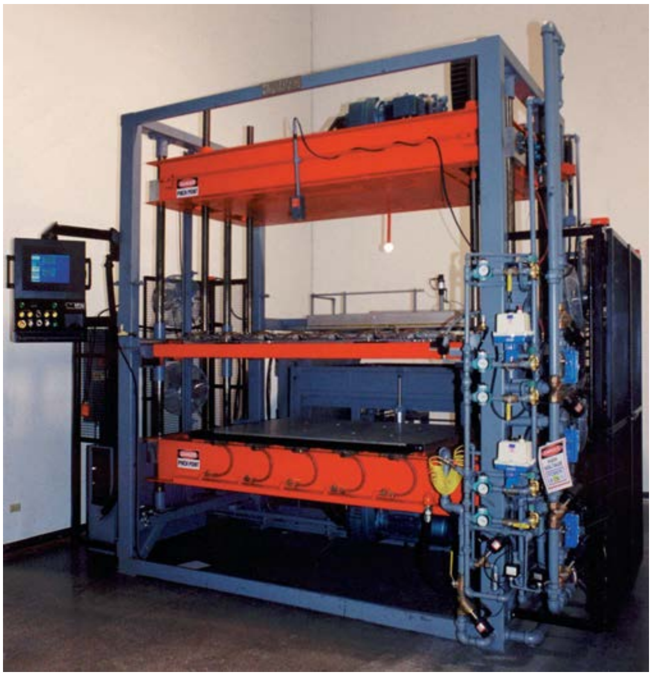
Cut Sheet Pressure Forming

A Look Into Thermoformings' High Pressure Forming

— *by Michael P. Alongi* —

Pressure Forming

Pressure forming applications have been rapidly increasing for two main reasons. First, the process can match the cosmetics of injection molded parts and get them to market quickly without high mold costs and the long lead-times associated with injection molding. Second, the process is being utilized to improve and/or upgrade parts that have been traditionally vacuum-formed. Pressure forming can achieve better detail on the mold surface of the sheet, hold closer tolerances, have better material distribution and less residual stress when compared to standard thermoforming.



Pressure forming enables designers to achieve high-end products with sharp, crisp lines, zero radii and even zero or negative draft angles. Engineers can include undercuts, flanges, ribs and louvers in their designs and still be assured that the final product's detail will be kept. Pressure forming provides aesthetic appearances, structural integrity and more design flexibility when solving part detail dilemmas.

This process of thermoforming typically uses female molds: these molds can have multiple textures, smooth areas and even company logos all on the same mold. If the final product requires definition on the inside, the mold would need to be male. For this reason, converting designs from other processes can be economically advantageous.

Process Sequence

In this process, the sheet is heated to forming temperature, the hot sheet is transferred to the forming station, the upper mold (or pressure box) and lower mold are brought together and compressed air is introduced through the pressure box pushing the material against the mold so more complex details of the mold are picked up to achieve higher part definition (Figure 1).

Process Molds

Pressure forming molds are typically more expensive than standard thermoforming molds for several reasons. Pressure forming molds require a pressure box or second mold half depending on the exact application. The mold also needs to be water cooled aluminum in order to withstand pressures and assure forming temperature of mold surface. Due to these mold features and process sequence, another advantage to pressure forming is introduced. With the additional contact pressure of the forming material with the mold surface the process allows more control over cooling of the formed part resulting in less stress and faster cooling times. Tooling deflection must also be calculated to the amount of pressure that will be applied, which can increase mold pricing. More intricate products may require molds with articulating pieces.

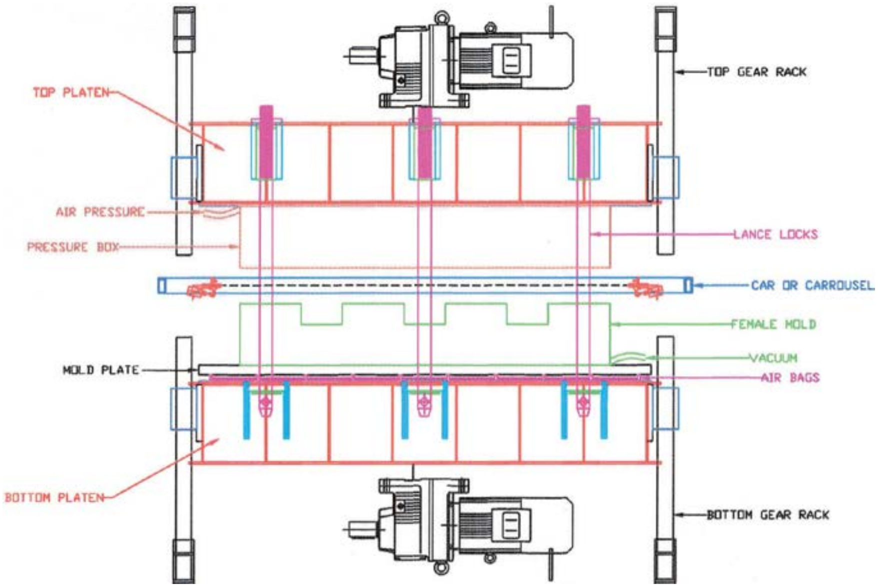


Figure 1

Typical applications include: automotive panels, computer housings and bezels, cases, medical housings, exercise equipment, instrument panels, light lenses, television backs, appliances, aircraft interiors and many more.

Process Materials

Generally speaking, all materials which can be thermoformed can be pressure formed. However, as might be expected, some are more suitable than others. Amorphous polymers such as ABS, Polystyrene and acrylic are ideal for both thermoforming and pressure forming in giving high viscosity melts over a broad temperature range. Polymers having a mixture of crystalline and amorphous characteristics such as polypropylene and polyethylene are intermediate in performance but are being molded successfully. A further consideration is that certain materials, such as polycarbonate, are highly hydroscopic and must be thoroughly dried before thermoforming. This is not necessarily a problem but it does add to the expense of processing the material.

Given the wide range of materials that can be pressure formed, normal plastic design criteria apply. The material selected must fulfill the specific requirements of the part in terms of aesthetics, fitness for purpose and compatibility with its expected environment. Last but not least, the part must also meet economic goals.

Types Of Pressure Forming:

Air-Assist Pressure Forming

Air-Assist pressure forming is referred to as pressure forming without locking the platens. Air assist pressure forming is defined as the amount of detail in a part that 30 psi will create (using 16 psi from air pressure in addition to 14 psi from vacuum {29hg}). This is typically only done on machines with hydraulic or motor driven platen drives. Without locking the platens, machines are only designed to hold the amount of pressure created by the cylinder or brake-motor before the tools separate, releasing the air pressure.

High Pressure Forming Platen Lock-Up Pressure Forming

Air cell lock up, high pressure forming is done with machinery specifically designed for this process. This technique extends both platens, locking them to each other then inflating air cells under a floating plate which can be attached to either the bottom or top platen. This method provides the force necessary to create a high pressure seal. High pressure forming is the amount of detail in a part that 60 psi will create using 50 psi from air pressure and 10 psi from vacuum. Common pressures are 35 psi to 60 psi, however in some applications utilizing large parts or highly engineered/reinforced materials, higher pressures may be required.

Compression Forming

Compression forming is the thermoforming process utilized for creating high detail on two sided parts, achieving an exact finished gauge and creating a high pressure knit between two mold surfaces (twin sheet forming). Most applications require locking platens. This is determined by sheet gauge and material type. In single sheet forming, the part will be formed by the bottom tool compressing the material against the top tool. This requires matched tools.

Pressure Forming VS Injection Molding

The pressure forming market is continually increasing from year to year and does hold several advantages over injection molding.

Tooling can be up to 80% less for upfront tooling expenses on pressure forming versus injection molding. The significant savings comes from pressure forming molds only needing to be machined aluminum or cast aluminum, rather than machined steel. Also, most pressure forming molds only require one mold half and a pressure box instead of two matched molds that are required in injection molding.

Costs are usually much less due to tool amortization, especially when comparing limited production quantities. These advantages become even more significant as the size of the parts become progressively larger. Lead times and deliveries are much faster, with lower prototyping costs, therefore allowing for more time on final design modifications. With quicker prototyping capabilities, pressure formers can ensure maximum flexibility and even visibility of the product definition before finalized. Pressure forming can also eliminate negative conditions that are common to the injection molding process; such as ejection marks, gate marks and porosity.

Written by Michael P. Alongi, Sales Director for MAAC Machinery Corp., manufacturers of a wide range of cut-sheet thermoforming machinery. For additional information, contact MAAC Machinery Corp., 590 Tower Blvd., Carol Stream, IL 60188, 630-665-1700, Fax: 630-665-7799, E-mail: sales@maacmachinery.com, Web: www.maacmachinery.com.