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OUTSOURCING SOLUTIONS FOR PRODUCT MANUFACTURERS

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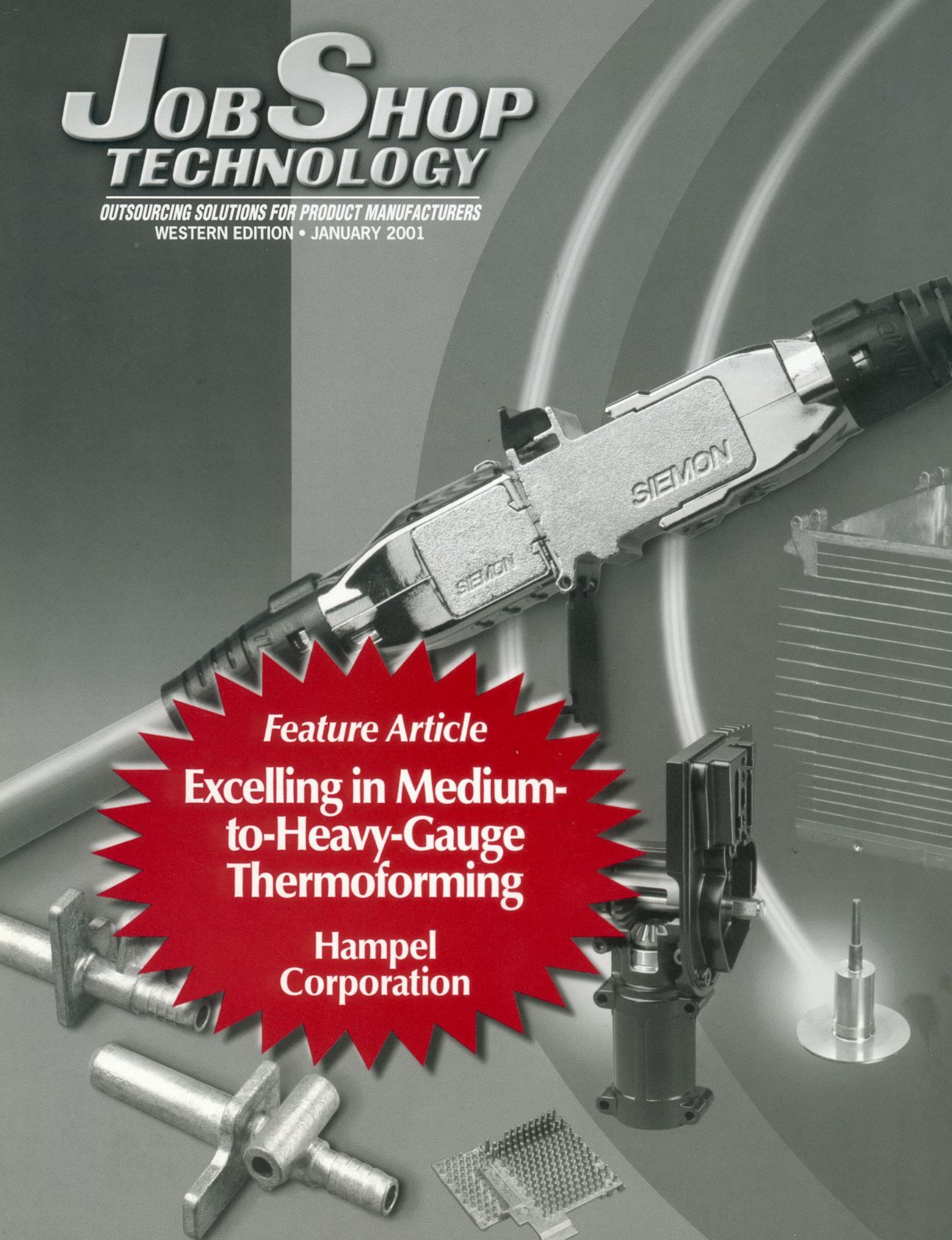


Feature Article

Excelling in Medium-to-Heavy-Gauge Thermoforming

Hampel Corporation

Excelling in Medium-to-Heavy-Gauge Thermoforming

A custom molder solves technical challenges with vacuum, pressure, and twin sheet forming

By D. Douglas Graham

Hampel Corp of Germantown, Wisconsin is a master of the art of medium-to-heavy-gauge industrial thermoforming. The firm's ambitious motto, "Known for Doing the Difficult," summarizes the company's identity as a custom molder. In all of Hampel's work, whether it involves the use of CAD-CAM, pattern making, or temperature-controlled aluminum molds, the firm uses every means at its disposal to achieve success for its customers and, by extension, itself.

According to company founder Lance T. Hampel, the company maintains a technological edge over its competitors and draws upon decades of combined team experience. Together, these elements have been instrumental in helping Hampel remain profitable while lowering tooling costs and permitting shorter lead times.

"There are three parts to our business," Hampel says. "First are original equipment manufacturers. We make components for Fortune 500 companies like Harley Davidson and John Deere. The second part of our business is the production of reusable packaging, such as pallets and part hugging trays for shipping parts from manufacturing sites to assembly plants. The third part, our Shelter Division, is divided into two separate components. One is dedicated to the production of a product we call the 'Calf-tel,' a housing unit for dairy calves. The other makes portable sanitation stations for use on recreation areas."

Lance Hampel founded the company in January 1976. Thirty-two years of age at the time, he had previously worked for another Wisconsin thermoformer, and then briefly worked as a manufacturer's representative. During his stint as a salesman, the former engineer became frustrated when his employers regularly turned down jobs he knew they were capable of doing. The companies were leaving money on the table, simply because the jobs did not fit in with their routine.

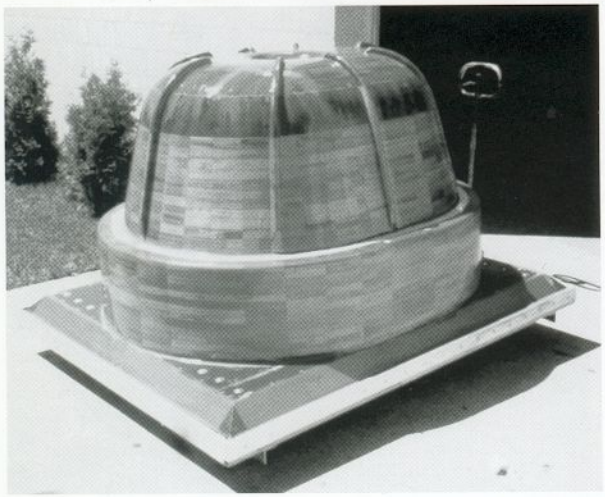
Hampel soon realized that he had discovered a vein of gold just waiting to be mined. Shortly after establishing the company, he increased his staff to two full-time employees by bringing a partner on board. The work poured in, forcing a move in 1979 to the site the firm currently occupies. The shop doubled in size with the addition of a new structure in 1982. A second addition in 1989 expanded the facility to 46,000 square feet, effectively doubling its area once again.

The current facility occupies more than 100,000 square feet and is fully equipped with state-of-the-art equipment. In brief, this manufacturing arsenal includes 6 rotary and 2 single station thermoforming machines with vacuum, pressure, and twin sheet capabilities in sizes up to 7 feet by 11 feet, 84 inches in depth, and thicknesses from 0.060 inch to 0.50 inch. Included also are five 5-axis CNC trimming machines, a 6-axis robotic CNC trimming machine, and a 4-ft by 8-ft Brown and Sharpe coordinate measuring machine (CMM).

Process Basics

Thermoforming is a process by which plastic is formed or molded after being exposed to heat. Essentially, the desired formations are created from a hot plastic sheet through the application of vacuum or air pressure. In some cases, thermoforming can offer manufacturers significant benefits—including greatly reduced tool costs and substantially shortened lead times—over closed-cavity forming methods, such as injection molding.

Hampel's thermoforming process begins with computer-aided design (CAD). Equipped with complete CAD/CAM capabilities, the company can customize a rough design provided by a customer, or invent proprietary designs of its own. The great benefit of CAD is that it makes it possible to visualize a part in progress and bring it to a state of near perfec-



Hampel Corp. recently formed a part using this 40-inch-deep male wood pattern, 58 inches in diameter.

tion long before a mold is cut. Once it's ready to move beyond this electronic blackboard, the design is relayed to the pattern shop, where a CNC machine creates a pattern. The pattern is prototyped and the parts evaluated for design and formability. This saves the customer a substantial amount of money, as it reduces to zero the possibility that a defective permanent mold will be created.

Once the wood pattern passes muster, it is forwarded to the foundry for aluminum casting. Assisting in this part of the process is Hampel's team of toolmakers, all of them skilled in the latest cooling, texturing, and construction technology. The company developed much of this technology to deal with complex construction issues, such as movable inserts or the insertion of elaborate plugs that make undercuts and complex shapes possible.

When the mold is ready for action, it will be employed in one of three thermoforming processes—vacuum forming, pressure forming, or twin sheet forming. In vacuum forming, a vacuum is applied to a hot sheet of plastic, forcing it to take on the shape of the aluminum mold. There are many variations to the process, all of them aimed at achieving a specific feature such as surface finish, wall thickness, material type, and depth of part. All part properties are programmed into this computer driven process, insuring that success will be achieved time and time again.

Pressure forming is a similar procedure in all respects but one. In addition to applying a vacuum, pressure is brought against a plastic sheet on the side opposite the mold. Pressure forming makes it possible to produce a broad range of different textures on a single part, and improve it with fine detail.

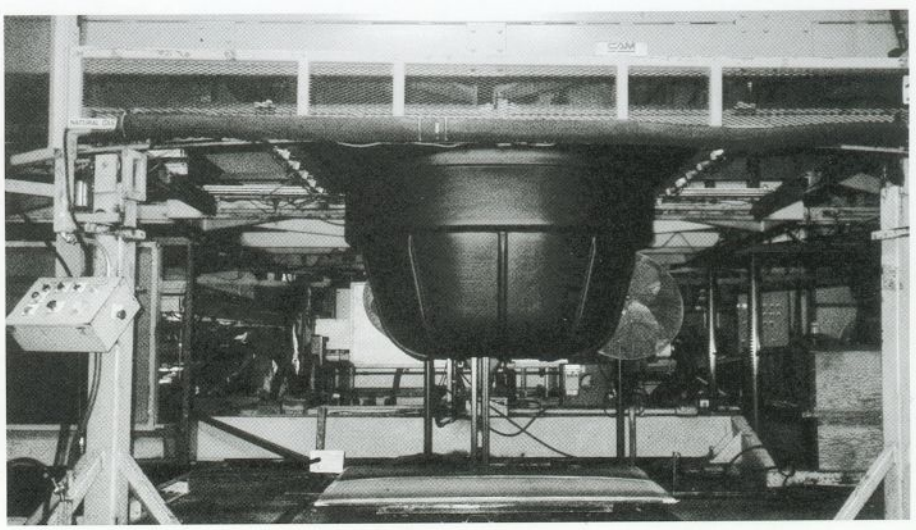
In the process of twin sheeting, two separate sheets of material in two separate tools are simultaneously fused under pressure. The intent is to create a double-wall part to address structural or cosmetic design criteria. Twin sheeting is most often used to make pallets and architectural building materials, but the technique's total possibilities are probably without limit.

Deep Draw Vacuum Forming

"One of the specialties for which we are best known is a vacuum forming method called deep draw," says Sales & Engineering Manager, Mike Diaz. "The key to deep draw is tool design. You have to design parts that enable the plastic to stretch to extreme depths. The process involves draft angles, radii, zoned temperature control, and highly specialized techniques such as pre-stretching, and plug assisting."

Although there are many deep draw methods, two of the most popular are the "snap-back" method, and a technique known as "billow/plug-assist/snap-back," Diaz continues. In snap-back, a draw box is used to prestretch a plastic sheet. The box is mounted to the platen opposite the male mold. The heated sheet is sealed against the box, after which a partial vacuum sufficient to achieve the desired amount of stretching is applied. The mold is pushed into the concave sheet, then the box is vented to the atmosphere and a vacuum is drawn on the mold. The atmospheric pressure forces the material against the mold, resulting in the shape desired.

Billow/plug-assist/snap-back forming combines several different techniques. First, the heated plastic sheet is sealed against a female mold. The mold is pressurized to stretch the sheet by blowing a bubble. A plug mounted opposite the mold is forced into the convex bubble, and controlled venting of the displaced air in the bubble causes the material to drape



A drape form prototype on the wood pattern.

over the plug. When the plug is fully extended, the mold is evacuated and the material pushed off the plug and onto the mold.

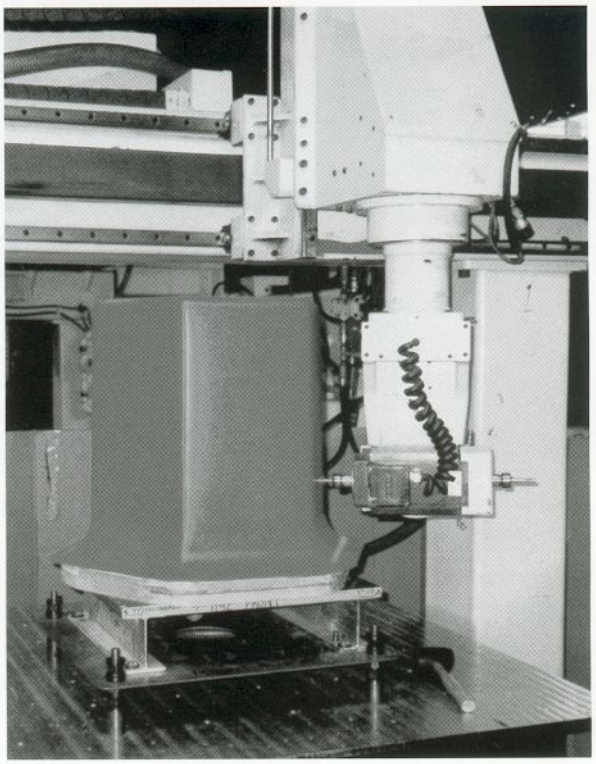
Manufacturing Solutions

Hampel's Calf-tel is a clear example of a deep draw success story. It is a single-piece construction for which other production methods would probably be inadequate or totally inappropriate. But the company can point to many other similarly successful jobs.

In one typical situation, the company was hired to create a cover for a large dehumidifier for a hotel/motel pool area. The piece was similar in size to a Calf-tel hutch (86 inches long by 48 inches wide and 52 inches high). It was a replacement for one that had been constructed of fabricated sheet metal. Using plastic as an alternative material presented many advantages, including less weight, no possibility of corrosion, and the fact that color matching could be done without painting.

"For cosmetic reasons, the part was pressure formed in a female tool," Hampel remembers. "We encapsulated the base with thirty mounted studs, and made a big cap to fit over it. We had to maintain extremely close tolerances, since any plastic part will shrink once it cools off. The big challenge was to release the part while maintaining the perpendicularity of the studs.

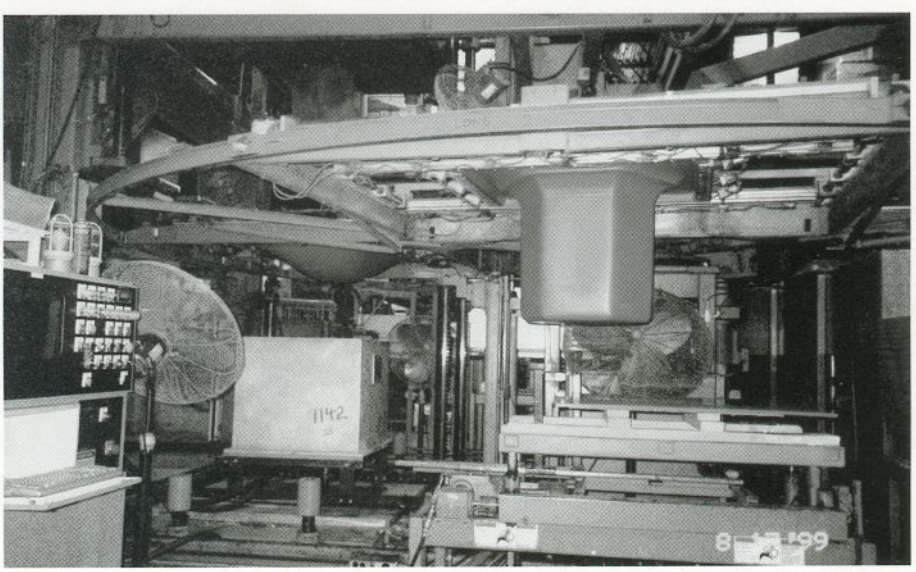
"We knew the holes would inevitably become smaller and that the spacing between the holes would retract after cooling. This would make it very difficult to de-mold while still maintaining the correct hole spacing and vertical spacing over the studs. The way we got around the problem was to put all thirty studs on moveable inserts. This allowed for movement as the plastic shrank."



Hampel uses a 5-axis router to perform CNC trimming on the part.

In another case, a customer contracted with the firm to make Christmas tree bailers. When Christmas trees are sold, the branches are enshrouded with a net in order to make them portable. The bailer is the foundation on which the netting is mounted. Until Hampel got into the act, the units had been built out of fiberglass, but increased volume had rendered that material unprofitable. Hampel made a wood pattern before going into production, and, thanks to thermoforming, was able to come up with a plastic, single-piece replacement for the costly fiberglass units.

"The bailers were created from the deep draw method, employing a process similar to the one used to make the Calf-Tel," Hampel says. "We make them in a variety of sizes, which we are also able to color code. Thanks to deep draw, the customer not only saved money, he also met his growing production requirements." JST



After forming and cooling, a thermoformed part is rotated around to the unloading station.

Hampel Corp
W194N11551 McCormick Drive
Germantown, WI 53022
262-255-4540
800-558-8558
fax: 262-255-9731