

IN RARE FORM

Switching to FDM to Build Thermoforming Molds Reduces Cost From \$1200 to \$100

“So far we have not found anything we cannot do with FDM.”

— Duane Byerley, Xerox

With sales of \$22 billion, Xerox is the world’s leading business process and document management enterprise. The company is a leader in the green packaging technology field. Last year the company won two of the 13 annual Earth Awards, including one for a solid ink package that uses 100 percent post-consumer recycled materials for the tray and lid and a 43 percent recycled content shipping box.

Many Xerox packages are made with the thermoforming process, which involves heating a plastic sheet to a pliable temperature, forming it to the final shape against a mold and trimming the sheet to create a usable product. “It’s very difficult to get the mold exactly right the first time around so we typically build and test three different designs before we are satisfied,” said Duane Byerley, senior model maker for Xerox.

In the past, Xerox produced wood molds for thermoforming on a computer numerical control (CNC) machine. This involved machining the wood to match the contours of the finished part and drilling holes so a vacuum could be drawn through the mold to pull the plastic sheet tightly against it. It cost about \$1200 and took about a week to produce each mold iteration. “The more expensive it is to produce the mold, the more apt you are to settle for less than optimal results,” Byerley said.

A New Application

Xerox originally purchased a Fused Deposition Modeling (FDM) machine primarily to produce prototype parts, but soon realized that it was also the ideal tool for fixtures and assembly tooling for use in its manufacturing processes. FDM technology is an additive manufacturing process that builds plastic parts layer by layer, using data from CAD files.

“When I was chatting with a Stratasys application engineer, he mentioned that it’s not difficult to produce an FDM part with an air gap,” Byerley said. “That gave me the idea of using a porous FDM part as a thermoforming mold. I worked with Stratasys to set up the machine correctly. It took a bit of experimentation to get just the right porosity to draw the vacuum needed to mold the part.”

How did FDM compare with traditional mold-making methods for Xerox?

Method	Cost	Time
CNC machining	\$1,200	7 days
FDM	\$100	0.5 days
SAVINGS	\$1,100 (92%)	6.5 days (93%)



Xerox experimented with various levels of porosity in its thermoforming molds, as shown in this trial fixture.



This FDM mold produces printhead covers four at a time.

Better, Faster, Less Costly

FDM eliminates the need for costly machining of the mold contour and drilling the holes required to draw the vacuum. The cost of each mold iteration is reduced to as little as \$100 and turnaround time is reduced to four hours.

Additive manufacturing also eliminates geometric restrictions that arise from the machining process, often making it possible to improve the performance and reduce the cost of the thermoformed part. FDM's lower cost and leadtime means designers can perform additional iterations that often result in further performance and cost improvements. Using a porous mold as opposed to drilling a limited number of holes provides a more uniform vacuum that improves thermoformed part quality.

Xerox has used FDM thermoforming molds to produce a wide range of packages over the past two and a half years. For example, the company makes covers for printheads with a mold that produces four covers at a time. The lower cost, reduced leadtime and improved design freedom of FDM has also enabled several new thermoforming applications. Xerox produces holders used to store drums during the manufacturing process and fixtures used to test electrical components. "So far we have not found anything we cannot do with FDM," Byerley concluded.



This FDM thermoforming mold produces drum holders for the manufacturing process.

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