

Financial Justification of Conformal Cooling

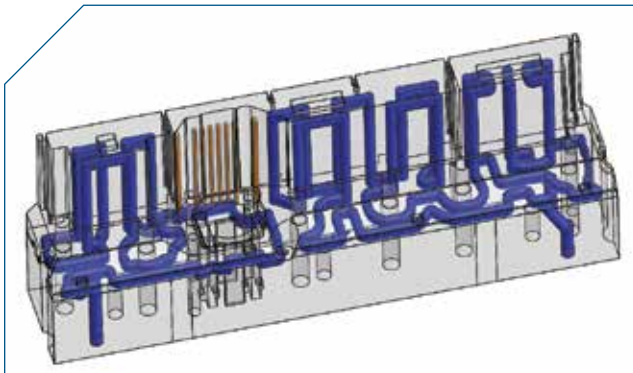
A ratio analysis helps illustrate the estimated effects of conformal cooling on profitability.

There has been a lot of talk in the plastics industry about conformal cooling. It is an industry game changer.

Simply put, conformal cooling makes use of cooling lines in an injection mold that closely follow the geometry of the part to be produced. There are a variety of methods for manufacturing a conformal-cooled mold, including laser sintering, vacuum brazing, diffusion bonding and others.

If conformal cooling is implemented with little or no engineering analysis, you can expect to get a 10-percent reduction in injection mold cycle time. However, by performing more engineering analysis (such as flow analysis, computational fluid dynamics (CFD) and finite element analysis (FEA), a better-quality mold and more cycle reduction can be achieved.

A typical cycle time reduction range for a properly engineered conformal-cooled mold is 20 to 40 percent. If little or no engineering analysis is done, you risk premature mold failure or lack of performance because of poor design elements or incorrect assumptions that were not identified and corrected before mold manufacture. Below is an example of a large complex vacuum brazed mold built by Contura MTC GmbH. Depending on the application, Contura will guarantee mold life for 1 million cycles.



Conformal cooling will decrease rejects due to the mold's uniform cooling.

Image courtesy of Contura MTC GmbH.

The income statement chart shown here, which is based on a ratio analysis (Column 1) published by Plante Moran in its 2013 *North American Plastics Industry Survey Report*, can be used to illustrate the effects of conformal cooling. I have amended the Plante Moran chart with additional columns and data. For example, since most molds are conventional molds (without the use of conformal cooling), Column 2 uses the same ratios as seen in Column 1. Columns 3, 4 and 5 show the estimated effect on profitability with a 20-, 30- and 40-percent cycle reduction from the use of conformal cooling.

To simplify the analysis, let's look at a mold that is in the press 100 percent of the time and generates \$600,000 per year in sales. A conventional mold would generate an operating income of **\$46,800**. A conformal-cooled mold would generate:

- 20% cycle reduction = **\$59,400** operating income
(27% profit improvement)
- 30% cycle reduction = **\$66,000** operating income
(41% profit improvement)
- 40% cycle reduction = **\$72,600** operating income
(55% profit improvement)

In this analysis the engineering analyses and the incremental cost to manufacture a conformal-cooled mold, over a conventional mold, would be paid for by the "Operating Income \$" increases.

Your income statement will most likely vary from the chart. You may want to add more line items for more definition. If so, make the additions. To evaluate different scenarios, change the "Sales" amount near the bottom of the chart and then multiply that amount by the "Operating Income" percentage (above in the same column) to change the "Operating Income \$". This is an analysis method that can be used to see the effect on one mold, one press or an entire plant. This analysis does not take the place of a detailed estimate or quote, however. This analysis is conservative because it only looks at "Direct Labor" and not other factors that might be improved.

The uniform cooling of the mold provided by conformal cooling will decrease rejects due to such issues as warping.

	1	2	3	4	5
	Courtesy of Plante & Moran				
	"2013 North American Plastics Industry Survey Report"	CONVENTIONAL MOLD	20% CONFORMAL REDUCTION	30% CONFORMAL REDUCTION	40% CONFORMAL REDUCTION
	>\$12.8< 20MM Sales				
SALES					
Production Sales	98.3%	98.3%	98.3%	98.3%	98.3%
Tooling Sales	7.8%	7.8%	7.8%	7.8%	7.8%
Less: Tooling COGS	-6.9%	-6.9%	-6.9%	-6.9%	-6.9%
Other Operating Revenue	0.9%	0.9%	0.9%	0.9%	0.9%
Total Sales	100.0%	100.0%	100.0%	100.0%	100.0%
COST OF SALES					
Raw Materials	33.9%	33.9%	33.9%	33.9%	33.9%
Purchased Components	5.7%	5.7%	5.7%	5.7%	5.7%
Other Direct Costs	2.4%	2.4%	2.4%	2.4%	2.4%
Direct Labor	10.7%	10.7%	8.6%	7.5%	6.4%
Overhead Costs	26.7%	26.7%	26.7%	26.7%	26.7%
Total Cost of Goods Sold	79.4%	79.4%	77.3%	76.2%	75.1%
GROSS PROFIT	20.6%	20.6%	22.7%	23.8%	24.9%
SG&A	12.8%	12.8%	12.8%	12.8%	12.8%
OPERATING INCOME	7.8%	7.8%	9.9%	11.0%	12.1%
	SALES	\$600,000	\$600,000	\$600,000	\$600,000
	OPERATING INCOME \$	\$46,800	\$59,400	\$66,000	\$72,600
	% PROFIT IMPROVEMENT		27%	41%	55%

Chart courtesy of Robert A. Beard & Associates Inc.

Ratio analysis showing the estimated effect on profitability with a 20-, 30- and 40-percent cycle reduction for one mold, one press or a whole plant.

Any reduction in reject cost will fall directly into profits. For example, the elimination of each 1 percent in reject rate would add an additional 1 percent to profits. In this analysis, the cost of the engineering analyses and the incremental cost to manufacture a conformal-cooled mold must be factored into an ROI calculation to determine the return on investment versus a conventional mold.

Conformal cooling is a tool to help decrease rejects, which reduces the risk of a costly recall. Therefore, the decision to use conformal cooling should be an easy one for automotive and medical applications, or any application with a high risk of product liability. The cost of a recall is much more than the incremental cost of a conformal-cooled mold.

Also, because conformal cooling yields uniform part cooling, molded-in stress can be reduced. This produces a stronger part, which increases part safety, mitigating part failure and recall risk.

Another consideration is the use of increased press capacity. To keep the math simple, let's examine a 10-press plant. If a 30-percent cycle reduction is achieved plant-wide, there will be three empty presses on the floor. Assuming that the presses are the same size, then there will be an increase in sales of \$600,000 per year for each of the three presses (a total of \$1.8 million),

producing an additional \$198,180 in annual profit (at 11-percent profit, according to the chart). This might also cause an over-absorption of overhead, which would produce a higher profit.

According to the chart, a 30-percent cycle reduction increases operating income by 41 percent. This gives you options. If you don't have any competition, you can keep all the profit. Or you can keep half of the increase and use the other half to lower your prices to gain more business to fill up those three empty presses. Or you can sell the three presses to free up capital.

If your competition is quoting lower prices, it may already be using conformal cooling. [MMT](#)

CONTRIBUTOR

Robert Beard, P.E., is president of Robert A. Beard & Associates Inc., an Honored Fellow of SPE and the organizer of a seminar to be held this fall titled "Conformal Cooling for Injection Molding."

FOR MORE INFORMATION:

Robert A. Beard & Associates Inc.
rabeard@Plastic-Solvers.com / Plastic-Solvers.com