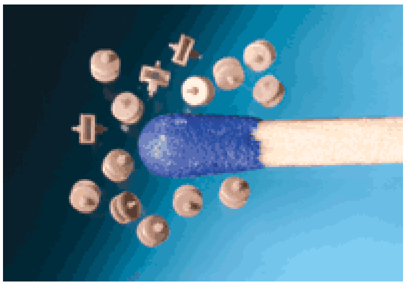
IMM Magazine Article Archive

Sweating the small stuff works here

By: Robert Neilley

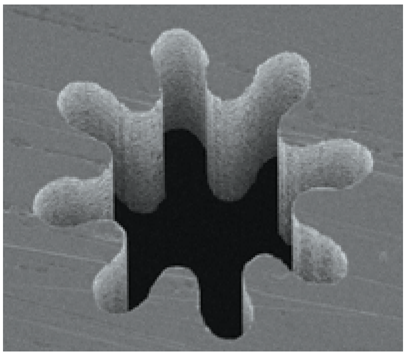
Generally, "Don't sweat the small stuff" is good advice. But micromolder Stamm AG is positively turned on by "probing the limits of what's feasible" and pushing the limits.

Besides catching up on the latest molding developments, plastics trade fairs are great for catching up with old friends. Sometimes you can do both at once, as happened when Swiss micromolding specialist Stamm AG (Hallau, Switzerland; see January 2002 IMM, immnet.com/articles?article=1800) showed us two recent projects during the Fakuma show in Germany this past October. One is a very tiny watch part; the other is a tiny two-component valve.



Stamm's watch rotor weighs .001g. The eight teeth of the gear on the axle have a draw of .04 mm.

Helpful hint: If you ask a micromolder what's new, carry a magnifying glass. The watch rotor mechanism that company general manager Andreas Stamm showed us was not only small, but it also had a deep undercut where a magnet would be inserted. The undercut looked tricky enough, but Stamm was pointing at the tiny gear on one surface. The teeth of that gear have a draw of .04 mm, small enough that it is hard to see with the naked eye that it's a gear. And small enough, says Stamm, to have brought the company to a new level of precision.

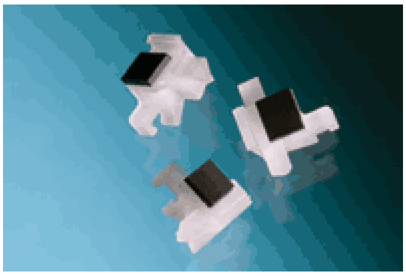


The gear mold insert was made via EDM using .03-mm wire.

Stamm AG also designs and builds the tools for the microparts it makes. Making the tool insert—the insert is smaller than a dime—for that gear "presented a challenge that was simply huge," says Stamm. Despite its extensive micro toolmaking and molding experience, the dimensions and the tolerances of this part were smaller than anything the company had done before.

The tough get going

How small? The eight-tooth gear has a diameter of .4 mm. The wall enclosing the magnet inserted downstream by Stamm's client is .14 mm, roughly double the OD of a human hair; the axles have a diameter of .18 mm. The entire part weighs .001g. Put one on your palm and you can't feel its presence.



A two-component piezoelectric valve for an automatically adjusting driver's seat has 5-6-µm tolerances.

Hairy as all that sounds, meeting the customer's economic goals (possibly the best part of this story—read on) called for a 16-cavity mold running very fast cycles. The axes mismatch tolerance between the mold halves is 5 µm or less.

The most obvious technology choice for making cavities this small would seem to be photolithographic LIGA, and Andreas Stamm agrees—but not in this case. He says the life cycle of LIGA-made inserts would have been less than what could be achieved using wire EDM and a special steel.

One reason a cavity like this is usually made with LIGA is that it's really hard to do with wire EDM. Conventional EDM wire is too thick, and most wire EDMs are not made for anything thinner.

To make the gear inserts, Stamm modified one of its existing Agie wire-cut machines to use .03-mm wire that it sourced from Japan. Wire guidance had to be ultraprecise to keep from breaking that skinny wire. Stamm says it “only” took six months until the teeth were perfect.

Stamm modified one of its Agie wire-cut machines to use .03-mm wire.

Mold assembly is done under a microscope.

Assembling this mold, which includes hot runners to the parts and tiny cold-channel distributors, can only be done under the microscope by very steady hands. The bores for the axles had to be lapped to the middle of the tolerance and the 16 slides required perfect fitting.

Making it and making it competitive

In contrast with the special work the moldmaking involved, the molding itself is relatively standard. The injection machine is one of Stamm’s fleet of Demag systems, a 25-ton Ergotech Concept unit, modified with a 14-mm-diameter screw; the material is a standard grade of POM from Celanese, Hostaform C52021. Molded parts are removed by a Hekuma automation system that sorts them into test tubes by cavity.

Automation rules the roost of 30 Demag IMs (25-125 tons). A second multimolding system goes online early this year.

Here is an insight into how Stamm AG operates. The development for this project took about a year, using the skill and experience of designers, toolmakers, and molders. But when parts first began coming from the machine at production rates, they were as they should be. Proof? The client ordered a run of 2 million.

It takes time to fill a test tube with parts this small, but maybe not as much as you’d think. The 16-cavity tool runs 7-second cycles—another part of meeting the customer’s economic needs. Remember that we said the economic specs may be the best part of this story?

The client’s product is a complex subassembly for watches, which includes this part, with the magnet inserted, plus microelectronics on a printed circuit board. The economics are so critical because this Swiss supplier—think high-cost manufacturing location—is selling into China. Better still, the product goes into low-cost watches. And it has become the market leader. Gotta love it!

Some suspect the Swiss have watchmaking chromosomes in their DNA by now. There can be no doubt that watchmaking is a source of national pride. You can hear it in Andreas Stamm’s voice when he talks about this project’s success.

Micromultimolding

Happy to keep challenging itself, Stamm AG moved into multicomponent micromolding. It is now producing a two-component, piezoelectric microvalve for the driver’s seat in the new S-Class Mercedes. The seat uses adjustable air support to stabilize the driver as the car moves—for example, when taking a turn.

The piezo valve Stamm molds is PP 30 GF and TPE, and opens and closes to control that air pressure. The valve, which is scarcely larger than a match head, must work very precisely, despite the fact that the piezo force is weak. Tolerances throughout are 5-6 µm. Critical tolerance is .01 mm between the TPE and the PP. Surfaces need full contact.

Stamm says this micro level of multicomponent work also was new to the client, so they formed a close working partnership that made the project work. The client began with a 2D scratch file, and Stamm says the two companies’ engineers were able to use the best of each other’s experience to get a good result. FMEA was instrumental in predicting any possible weak spots, as well as considerations for tooling and production.

The decision was made to use a four-cavity hot runner mold in which a hydraulic core motion opens a space for the soft component in the second shot. Stamm says one early concern—that the .4-mm-thick soft material would not provide enough heat to fuse with the hard material—turned out to be a nonissue. The two components fused well.

However, one very real and demanding issue was the flatness of the soft component, which has to be within .02 mm. This is the most critical functional area of the part since it is what actually seals the valve. It's normal that the TPE will shrink in accordance with the PA. Extensive analysis and mold improvement has enabled production of a part with an average flatness of .008 mm.

Though prototype molds are not the norm at Stamm, in this case there were too many unknowns. A tool steel pilot mold was made and put to work. Aluminum was not used because of the difficulty in optimizing geometry and measurements within a hundredth of a millimeter.

One of the mold's first tasks was testing nearly 20 material pairs. Stamm says it also provided the basis for developing the measurement and evaluation tools for the statistical methodology that would be used in production.

The IM was a different story.

The machine

Though the company at that point had no multicomponent machine, its extensive micro experience gave it very specific ideas about what it wanted. An off-the-shelf answer would not do, so Stamm's long-term supplier, Demag Plastics Group, worked with the company's engineers to modify a Demag Ergotech 50 Multi. The work included software and hardware, including 14-mm screws in both barrels. The four-cavity mold for the two-material valve runs 20-second cycles and makes 18,000 components in a three-shift operation.

That machine was acquired specifically for this valve, but has since begun making parts for another application. Two others, a hearing aid part and a micropump system, are in development, and each is much smaller than the piezo valve.

A second multicomponent system will come on line early this year. Stamm does not expect to see a huge market for multimolded microparts, but the company intends to keep an edge. At the moment, Stamm is not aware of any other micromolder doing multimolding on such a small scale.

Contact information
Stamm AB
+41 (52) 687 00 60 | http://www.stamm.ch/

IMM - February 2006