Christophorus

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"Time is money"

Porsche's experience with MCP Vacuum Casting

Porsche driving and enjoyment: exploring the Provence with a 911 Targa

Porsche production: a new factory for the Boxster

Porsche technology: joint manufacturer research for cleaner air

Time Is Money

How Weissach engineers save 90 percent in costs and 95 percent in time

By Klaus-Dieter Lehner and Roland Essig (text) and Christoph Bauer (photos)

Shorter model cycles, faster reaction to customer wishes and market requirements demand ever-shorter development periods to be internationally competitive within the automobile industry.

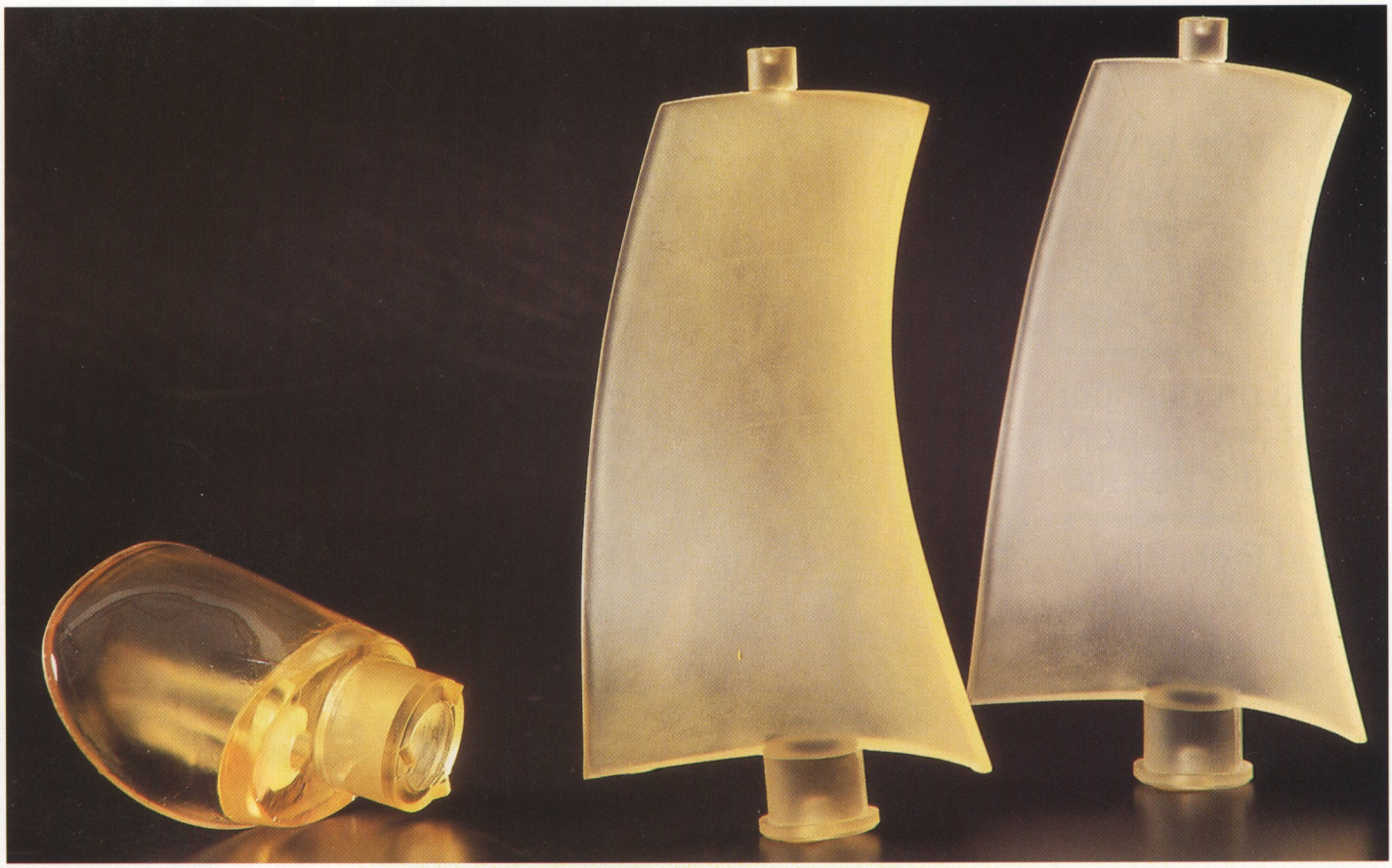
The areas of prototyping and model building in particular have made a quantum leap here during the past five years. Whereas it might take four to eight weeks between design and completion of the first prototype part in the eighties, decision-makers in development, production and marketing today can evaluate the first experimental part one working day after the model is completed, as well as eventual technical or aesthetic changes which might be needed with equal rapidity.

Engineers at the Porsche Development Center in Weissach celebrated a major advance when time-consuming, conventional model making, largely by hand, was replaced by computer-aided

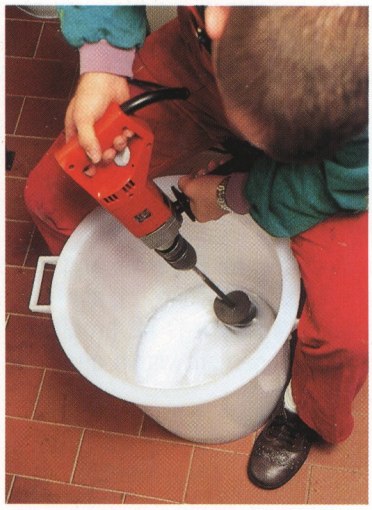
Porsche engineers report from Weissach

design and manufacturing methods (CAD, CAM) and machining on a CNC machine. The breakthrough to today's level was actually achieved in 1990, when the Weissach Development Center began to use rapid prototyping through vacuum casting of Polyol resin parts in silicone molds.

The necessary models for this can be produced by stereo-lithography methods. In this method, components designed with the aid of CAD (Computer Aided Design) are built up in layers, direct from liquid photopolymer, by means of a laser scanner. In this manner a firm, three-dimensional, basic model is made from polymers hardened by the effect of light. Once pouring and separation surface of the silicone mold have been determined, the model is set into a casting frame. Evacuated silicone rubber is then cast around the model and hardened in a heat chamber. By cutting through the separation surface, following hardening, a model is then removed from its silicone mold. Depending on the complexity of its shape,



Models produced with SLA (Stereo-Lithography)



Mixing (top) and vacuum casting of silicone rubber (center), finished silicone mold with stereo-lithographic model (above). Transparent mirror base for function studies, adjustable fan blades for flow tests (left).

From handwork to rapid prototyping via CAD-CAM/CNC

the silicone rubber form made in this manner can be reused from ten to forty times.

Actual production of prototype parts begins with dosage of the two-component material based on a Polyol resin, with color pigments added as needed. Resin components are then mixed under computer control and poured automatically into the vacuum chamber. Following hardening in the heat chamber, the molds are removed, vent fillets and cast marks cut off and the finished parts either coated or galvanized, depending on needs.

This vacuum casting method reduces the time for basic part production from the previous four to eight weeks to only eight to twelve hours, as well as cutting overall costs to only five to ten percent of the former bill. However, this technology cannot replace production tooling.

A further advantage of vacuum casting in silicone molds is the possibility of producing parts with undercuts, such as clips for instance, and removing them from their molds without problems. Depending on the material you start with, usually synthetic resin, you can also control the properties of such prototype components. Depending on resin type, hard, shock-resistant components can be made just as easily as elastic parts.

The wide material spectrum, from soft to hard, includes exceptionally varied application areas. For the Porsche Boxster which goes into production this year, for instance, parts for both first and second building stages could be made, ranging from side intake grills to various seals as well as switches and ventilation grills. An indication of the later actual surface can already be rendered on the original part

Prototype components produced with the MCP Vacuum Casting System from HEK GmbH, Lübeck-Germany

Rapid prototype component production at Porsche

as well, because parts can be made to resemble glass as easily as any desired color nuances.

Advantages of this new procedure are thus not limited to the doubtlessly enormous time and cost reductions mentioned above. They apply equally to previously almost-impossible, true-to-the-original reproduction of a model, from smallest detail to surface properties which once seemed hardly possible to realize so comprehensively – whether for automobile components or completely different technical products.

In addition, there is the advantage of equally rapid and cost-effective reproducibility of a part. Previously, for instance, if an outside contract partner insisted he must be able to take a model from Weissach to his own company, it was

Porsche engineers report from Weissach

then unavailable to Porsche engineers responsible for that contract, for some time at least. Today it is no problem to produce a replacement within one working day. □

The variety of model and prototype parts which can be produced, using this new method, is extensive (left).

Number of sample pieces, depending on potential use

Development stage	Purpose of the sample	Desired number
Planning	Planning of a new product	1
Artist's design	Examination and approval of the product (image)	1 to 4
Design	Examination and approval of the design (assembly of the model)	4 to 10
Research and development	Examination and computation of functional studies, working model	10 to 50
Building tooling	Study and approval of costs and preparation for production	50 to 5000
Development and administration	Overall examination and approval of the production process	1 to 5000

Comparison table of production methods for completion of samples, prototypes and small series

Mold production methods	Costs	Cast or spray weight	Production time	Numbers	Reusability
Steel mold (machining)	100%	unlimited	50 days	over 100,000	below 5%
Fine zinc (cast)	70%,	4 kg	40 to 50 days	10,000	90%
Nickel (galvanically coated)	23%	2 to 4 kg	60 days	5 to 10,000	–
MCP/TAFA (metal-sprayed)	15%	3 to 5 kg	within 3 days	1000 to 6000	90%
Silicone	2 to 5%	4 kg	8 to 12 hours	up to 100	–

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